DRANETZ BMI

DranTech ISO

TRMS Multimeter with Insulation Measurement

Standard Equipment

1 Multimeter for isolation measurement
1 protective rubber cover
1 condensed operating instructions, English/German
1 operating instructions in English and German (CD ROM or printed)
1 DKD calibration certificate with calibration report
2 batteries, 1.5 V, type AA, installed

Function	DranTech ISO
V AC+DC TRMS (Ri = 1 MΩ)	•
V AC / Hz TRMS (Ri ≥ 9 MΩ)	• 1kHz Filter
V AC+DC TRMS (Ri ≥ 9 MΩ)	•
V DC (Ri ≥ 9 MΩ)	•
Hz (V AC)	... 300 kHz
Bandwidth V AC	15 Hz ... 10 kHz
A AC / Hz TRMS	300 µA 3/30/300 mA 3 A / 10 A
A AC+DC TRMS	
A DC	
Fuse	10 A/1000 V
Transformation factor ⋊C	mV/A, mA/A
Hz (A AC)	... 30 kHz
Insulation Resistance $M_{\Omega ISO}$	adjustable test voltage
Resistance Ω	•
Continuity	•
Diode ... 5.1 V	•
Temperature TC (K)	•
Temperature RTD	•
Capacitance	•
MIN/MAX / data hold	•
540kb memory [1)]	•
IR Interface	•
Power pack adapter socket	•
Protection	IP54
Measuring category	1000 V CAT II, 600 V CAT III

[1)] For 15,400 measured values, sampling rate adjustable from 0.1 second to 9 hours

Accessories (sensors, plug inserts, adapters, consumable materials)

The accessories available for your instrument are checked for compliance with currently valid safety regulations at regular intervals, and are amended as required for new applications.
Currently up-to-date accessories which are suitable for your measuring instrument are listed at the following web address along with photo, order number, description and, depending upon the scope of the respective accessory, data sheet and operating instructions:
www.dranetz-bmi.com

See also chapter 10 on page 68.

Product Support

Technical Queries
(use, operation, software registration)

If required please contact:

Dranetz-BMI
1000 New Durham Road
Edison, NJ 08818-4019 USA
Phone: 1-800-372-6832 or 732-287-3680
Fax: 732-248-1834
www.dranetz-bmi.com

DranWin 10 Software Enabling for DranTech ISO

Dranetz-BMI
1000 New Durham Road
Edison, NJ 08818-4019 USA
Phone: 1-800-372-6832 or 732-287-3680
Fax: 732-248-1834
www.dranetz-bmi.com

Training

On-site training at customer facilities (scheduling, prices, registration, travel, accommodation)

If required please contact:

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1000 New Durham Road
Edison, NJ 08818-4019 USA
Phone: 1-800-372-6832 or 732-287-3680
Fax: 732-248-1834
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Recalibration Service

We **calibrate** and **recalibrate** all instruments supplied by Dranetz-BMI, as well as other manufacturers, at our service center, for example after one year within the framework of your test equipment monitoring
program, as well as prior to use etc. and offer you test equipment management free of charge.

Repair and Replacement Parts Service
DKD Calibration Laboratory* and Rental Instrument Service

If required please contact:

Dranetz-BMI
1000 New Durham Road
Edison, NJ 08818-4019 USA
Phone: 1-800-372-6832 or 732-287-3680
Fax: 732-248-1834
www.dranetz-bmi.com

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

* **DKD** Calibration Laboratory for Measured Electrical Quantities
DKD – K – 19701 accredited per DIN EN ISO/IEC 17025:2005

Accredited quantities: direct voltage, direct current value, direct current resistance, alternating voltage, alternating current value, AC active power, AC apparent power, DC power, capacitance, frequency, temperature

Competent Partner

GMC-I Messtechnik GmbH is certified in accordance with DIN EN ISO 9001:2000.

Our DKD calibration lab is accredited by the Deutscher Kalibrierdienst (German Calibration Service) in accordance with DIN EN ISO/IEC 17025:2005 under registration number DKD–K–19701.

We offer a complete range of expertise in the field of metrology: from **test reports** and **factory calibration certificates**, right on up to **DKD calibration certificates**.

Our spectrum of offerings is rounded out with free **test equipment management**.

As a full service calibration lab, we can calibrate instruments from other manufacturers as well.

1 Safety Features and Precautions

You have selected an instrument which provides you with a high level of safety.

This instrument fulfills the requirements of applicable European and national EC directives. This is confirmed by means of the CE mark. A corresponding declaration of conformity can be requested from Dranetz-BMI.

The TRMS digital multimeter has been manufactured and tested in
accordance with the following safety regulations:
IEC 61010–1:2001 / DIN EN 61010–1/VDE 0411–1:2002. When used for its intended purpose (see page 10), safety of the operator, as well as that of the instrument, is assured. Their safety is however not guaranteed, if the instrument is used improperly or handled carelessly.

In order to maintain flawless technical safety conditions, and to assure safe use, it is imperative that you read the operating instructions thoroughly and carefully before placing your instrument into service, and that you follow all instructions contained therein.

The multimeter is equipped with an automatic socket blocking mechanism for your safety, and in order to safeguard your instrument. This mechanism is linked to the rotary switch and only allows access to those jacks which are actually required for the selected function. It also prevents the user from turning the rotary switch to impermissible functions after the measurement cables have already been plugged in.

Measuring Categories and their Significance per IEC 61010-1

CAT	Definition
I	Measurements in electrical circuits which are not directly connected to the mains: *e.g. electrical systems in motor vehicles and aircraft, batteries etc.*
II	Measurements in electrical circuits which are electrically connected to the low-voltage mains: *via plug, e.g. in household, office and laboratory applications*
III	Measurements in building installations: stationary consumers, distributor terminals, devices connected permanently to the distributor

The measuring category and the maximum rated voltage which are printed on the device apply to your measuring instrument, e.g. 600 V CAT III or 1000 V CAT II.

Observe the following safety precautions:

- The multimeter may not be used in **potentially explosive atmospheres**.
- The multimeter may only be operated by persons who are capable of recognizing **contact hazards** and taking the appropriate safety precautions. Contact hazards according to the standards exist anywhere, where voltages of greater than 33 V RMS or 70 V DC may occur. Avoid working alone when taking measurements which involve contact hazards. Be certain that a
  second person is present.
- **Maximum allowable voltage** between the voltage measuring sockets or all connector sockets and ground is 1000 V for measuring category II, and 600 V for measuring category III.
- Be prepared for the occurrence of unexpected voltages at devices under test (e.g. defective devices). For example, capacitors may be dangerously charged.

- Make certain that the measurement cables are in flawless condition, e.g. no damage to insulation, no interruptions in cables or plugs etc.
- No measurements may be made with this instrument in electrical circuits with corona discharge (high-voltage).
- Special care is required when measurements are made in HF electrical circuits. Dangerous pulsating voltages may be present.
- Measurements under moist ambient conditions are not permitted.
- Be absolutely certain that the measuring ranges are not overloaded beyond their allowable capacities. Limit values are included in chapter 8; “Technical Data” in the table entitled “Measuring Functions and Measuring Ranges” in the “Overload Capacity” column.
- **The multimeter may only be operated with installed batteries or rechargeable batteries. Dangerous currents and voltages are otherwise not indicated, and the instrument may be damaged.**
- The instrument may not be operated if the fuse cover or the battery compartment lid has been removed, or if its housing is open.
- The input for the current measuring range is equipped with a fuse link.
  Maximum permissible voltage for the measuring circuit (= rated voltage of the fuse) is 1000 V AC/DC.
  Use specified fuses only (see page 61)! The fuse must have a **breaking capacity of at least 30 kA**.

Repair and Parts Replacement

When the instrument is opened, voltage conducting parts may be exposed. The instrument must be disconnected from the measuring circuit before the performance of repairs or the replacement of parts. If repair of a live open instrument is required, it may only be carried out by trained personnel who are familiar with the dangers involved.

Defects and Extraordinary Strains

If it may be assumed that the instrument can no longer be operated safely, it must be removed from service and secured against unintentional use.
Safe operation can no longer be relied upon:

- If the device demonstrates visible damage,
- If the instrument no longer functions, or if malfunctioning occurs,
- After long periods of storage under unfavorable conditions, e.g. humidity, dust or extreme temperature (see “Ambient Conditions” on page 60).

1.1 Use for Intended Purpose

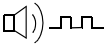
- The respective multimeter is a portable device which can be held in the hand during the performance of measurements.
- Only those types of measurements described in chapter 5 may be performed with the measuring instrument.
- The measuring instrument, including measurement cables and plug-on test probes, may only be utilized within the specified measuring category (see page 61 and the table on page 8 regarding significance).
- Overload limits may not be exceeded. See technical data on page 56 for overload values and overload limits.
- Measurements may only be performed under the specified ambient conditions. See page 60 regarding operating temperature range and relative humidity.
- The measuring instrument may only be used in accordance with the specified degree of protection (IP code) (see page 62).

1.2 Meanings of Danger Symbols

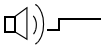
Warning concerning a point of danger
(attention: observe documentation!)

Warning concerning dangerous voltage at the measurement input: U > 15 V AC or U > 25 V DC

1.3 Meanings of Acoustic Warning Signals



Voltage warning: > 1000 V (intermittent acoustic signal)



Current warning: > 11 A (continuous acoustic signal)

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2 Operating Overview – Connections, Keys, Rotary Switch, Symbols

1 Display (LCD) (see page 13 for significance of symbols)

2 **MAN / AUTO** shift key for manual/automatic measuring range selection
△ Increase parameter values
"Operating Mode" menu: Selection of individual menu entries against the direction of flow

3 **ON / OFF | LIGHT** key for switching device and display illumination on and off

4 **FUNC | ENTER** multifunction key
"Operating Mode" menu: Acknowledge entry (ENTER)
UISO ON / OFF Insulation resistance measurement
Key for switching insulation resistance measurement on and off

5 ▷ Increase measuring range or move decimal point to the right (MAN function)

6 **Rotary switch** for measuring functions (see page 14 for significance of symbols)

7 DKD calibration mark (back of unit)

8 Connector socket for ground / connected to ground

9 Connector socket for current measurement with automatic blocking

10 Connector socket for voltage, resistance, temperature, diode and capacitance measurement with automatic blocking

11 **DATA / MIN / MAX**
Key for freezing, comparing, deleting the measured value, and for Min/Max function
▽ Decrease values
"Operating Mode" menu: Select individual menu entries in flow direction

12 **MEASURE | SETUP** Key for switching between measuring and menu functions

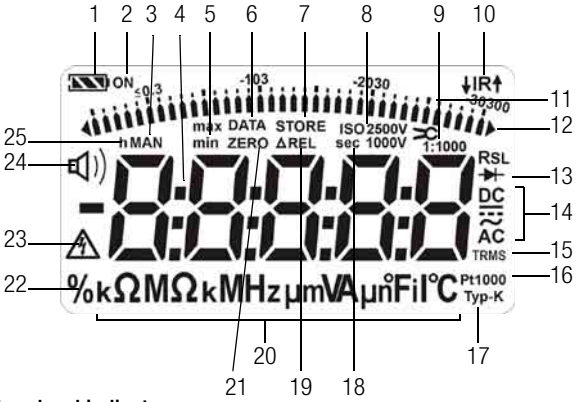
13 **ZERO | ESC**
Key for zero balancing
"Operating Mode" menu: Exit menu level and return to a higher level, exit parameters entry function without saving

14 ◁ Decrease measuring range or move decimal point to the left (MAN function)

15 Power pack connector jack

16 Infrared interface

Symbols used in the Digital Display



Battery level indicator

Battery full

Battery OK

Battery weak

Battery (almost) dead, U < 1.8 V

Interface indicator

↓IR↑ Data transmission ↓ to / ↑ from the multimeter is active

IR IR interface in standby mode
(ready to receive starting commands)

1 Battery level indicator
2 ON: continuous operation (automatic shutdown deactivated)
3 MAN: manual measuring range selection active
4 Digital display with decimal point and polarity display
5 max/min: Min/Max value storage
6 DATA: display memory, “freeze measured value”
7 STORE: memory mode active
8 ISO: insulation resistance measurement active / selected test voltage
9 1: x current clip factor (transformation ratio)
10 IR: infrared interface display
11 Scale for analog display
12 Pointer for analog display (bar graph – pointer)
triangle appears: indicates overranging
13 Diode measurement selected
14 Selected type of current
15 TRMS measurement
16 Pt100(0): selected platinum resistance thermometer with automatic recognition of Pt100/Pt1000
17 Type K: temperature measurement with type K (NiCr-Ni) thermocouple
18 sec (seconds): unit of time
19 ΔREL: relative measurement with reference to offset
20 Unit of measure
21 ZERO: zero balancing active
22 Duty Cycle %
(this function only available with customer-specific variant)
23 Warning regarding dangerous voltage: U > 15 V AC or U > 25 V DC
24 Continuity test with acoustic signal active
25 h (hours): unit of time

Symbols used for Rotary Switch positions

Switch	FUNC	Display	Measuring Function	Additional Function clip-on (by menu SET ⇨ CLIP 1:1/10/100/1000)
V≂$_{1M\Omega}$	0/2	V DC AC TRMS	Pulsating voltage, TRMS DC + AC, full bandwidth	
MΩ_{ISO}@UISO	1	UISO / kΩ / MΩ	Insulation resistance measurement	
V~	0/5	V~ AC TRMS	Alternating voltage, AC TRMS, full bandwidth	⊃ Clip-on AC (V): clip-on current sensor
Hz (V)	1	Hz ~ AC	Voltage frequency, full bandwidth	⊃ Clip-on Hz (V): clip-on current sensor
%	2	%	Duty Cycle (customer-specific variant)	
V~ $\overline{1kHz\backslash}$	3	V Fil ~ AC TRMS	Voltage frequency, with low pass filter (1 kHz)	
Hz (V) $\overline{1kHz\backslash}$	4	Hz Fil ~ AC	Voltage frequency, with low pass filter (1 kHz)	
V⎓	0/2	V⎓ DC	Direct voltage	⊃ Clip-on DC (V): clip-on current sensor
V≂	1	V≂ DC AC TRMS	Pulsating voltage, TRMS ($V_{ACDC} = \sqrt{V_{AC}^2 + V_{DC}^2}$)	⊃ Clip-on DC + AC (V): clip-on current sensor
Ω	0	Ω	(DC) resistance	
🔊	0/2	🔊 Ω	Continuity test with acoustic signal	
⊣▶⊢	1	⊣▶⊢ V⎓ DC	Diode voltage where I is constant	
Temp RTD	0	°C Pt 100/1000	Temperature with Pt 100 / Pt 1000 resistance thermometer	
Temp TC	1	°C Typ-K	Temperature with thermoelement type K	
⊣‖⊢	0	nF, µF	Capacitance	
A⎓	0/2	A⎓ DC	Direct current value	
A≂	1	A≂ DC AC TRMS	Pulsating current amperage, AC DC TRMS	
A~	0/2	A~ AC TRMS	Alternating current amperage, AC TRMS	⊃ Clip-on AC (A): clip-on current transformer
Hz (A)	1	Hz ~ AC	Current frequency	⊃ Clip-on Hz (A): clip-on current transformer

User Interface Symbols in the Following Chapters

▷ ... ▷ Scroll through main menu

▽ ... ▽ Scroll through submenu

◁ ▷ Select decimal point

△▽ Increase/decrease value

SubME Submenu/parameter (7-segment font)

InFo Main menu (7-segment font, boldface)

Symbols on the Device

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

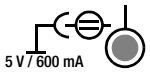
Ground

CAT II / III Measuring category II or III device, see also “Measuring Categories and their Significance per IEC 61010-1” on page 8.

Continuous, doubled or reinforced insulation

Indicates EC conformity

▲ IR ▼ Position of the infrared interface, window on the top of the instrument

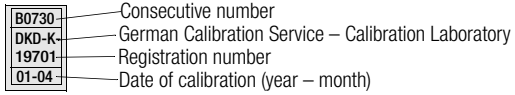


Position of the power pack adapter socket, see also chapter 3.1.

Fuse for current measuring ranges (see chapter 9.3)

The device may not be disposed of with the trash. Further information regarding the WEEE mark can be accessed on the Internet at www.dranetz-bmi.com under the search term WEEE (see also chapter 9.5).

Calibration seal (red seal):



See also “Recalibration Service” on page 66.

3 Initial Start-Up

3.1 Batteries

Be certain to refer to chapter 9.2 regarding correct battery installation!

Momentary battery voltage can be queried in the “Info” menu (see chapter 6.3).

Attention!
Disconnect the instrument from the measuring circuit before opening the battery compartment lid in order to replace the batteries.

Operation with Power Pack (not included, see chapter)

Installed batteries are disconnected electronically if the NA power pack is used, and need not be removed from the instrument. If rechargeable batteries are used, they must be recharged externally.
If the external power supply is switched off, the device is switched to battery operation without interruption.

3.2 Activation

Switching the Instrument On Manually

- Press the **ON / OFF | LIGHT** key until the display appears. Power-up is acknowledged with a brief acoustic signal. As long as the key is held depressed, all of the segments at the liquid crystal display (LCD) are illuminated.
  The LCD is depicted on page 13.
  The instrument is ready for use as soon as the key is released.

Display Illumination

After the instrument has been switched on, background illumination can be activated by briefly pressing the **ON / OFF | LIGHT** key. Illumination is switched back off by once again pressing the same key, or automatically after approximately 1 minute.

Switching the Instrument On with a PC

The multimeter is switched on after transmission of a data block from the PC, assuming the “ı rStb” parameter has been set to “ı r on” (see chapter 6.4).
However, we recommend using the power saving mode: “ı roFF”.

Note
Electrical discharge and high frequency interference may cause incorrect displays to appear, and may disable the measuring sequence.
Disconnect the device from the measuring circuit. Switch the instrument off and back on again in order to reset. If the problem persists, briefly dislodge the battery from the connector contacts (see also chapter 9.2).

3.3 Setting the Operating Parameters

Setting Time and Date

See “t ı ME” and “dAtE” parameters in chapter 6.4.

Display Modes for the Digital Display

Selection can be made from two different display modes (see “0.d ı SP” parameter in chapter 6.4).

3.4 Switching the Instrument Off

Switching the Instrument Off Manually

➪ Press the **ON / OFF | LIGHT** key until *OFF* appears at the display.

Shutdown is acknowledged with a brief acoustic signal.

Automatic Shutdown

The instrument is switched off automatically if the measured value remains unchanged for a long period of time (maximum measured value fluctuation of approximately 0.8% of the measuring range per minute or 1° C or 1° F per minute), and if none of the keys or the rotary switch have been activated before a selected period of time in minutes has elapsed (see "*APoFF*" parameter on page 49). Shutdown is acknowledged with a brief acoustic signal.
Exceptions include:
Transmission and memory mode operation, continuous operation and whenever a dangerous voltage is applied to the input (U > 15 V AC or U > 25 V DC).

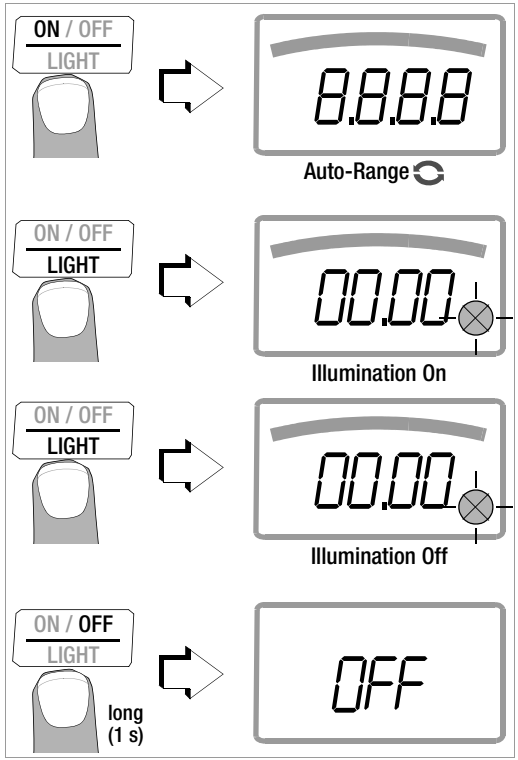
Disabling Automatic Shutdown

The instrument can be set to continuous operation.

➪ Simultaneously press the

ON / OFF / LIGHT and FUNC / ENTER keys to this end.

The "Continuous On" function is indicated at by means of the ON display to the right of the battery symbol.
**The "Continuous On (oN)" setting can be cancelled by changing the respective parameter or by switching the instrument off manually.
In this case the parameter will be reset to 10 min (see "*APoFF*" on page 52).**



4 Control Functions

4.1 Selecting Measuring Functions and Measuring Ranges

4.1.1 Automatic Range Selection

The multimeter is equipped with auto-ranging for all measuring functions, except for temperature measurement, and diode and continuity testing. Auto-ranging is active as soon as the instrument is switched on. The instrument automatically selects the measuring range which allows for highest possible resolution of the applied quantity. When the instrument is switched to frequency measurement, the previously selected voltage measuring range remains active.

AUTO-Range Function

The multimeter is switched automatically to the next higher range at ±(3099 d + 1 d → 03 10 d), and to the next lower range at ±(280 d - 1 d → 2799 d).

With high resolution the multimeter is switched automatically to the next higher range at ±(30999 d + 1 d → 03 100 d), and to the next lower range at ±(2800 d - 1 d → 27999 d).

4.1.2 Manual Measuring Range Selection

Auto-ranging can be deactivated and measuring ranges can be selected manually in accordance with the following table by pressing the **MAN / AUTO** button.

The desired measuring range can then be selected with the ◁ or ▷ key.

The instrument is automatically returned to range selection when the **MAN / AUTO** key is pressed, the rotary switch is activated or the instrument is switched off and back on again.

Overview: Auto-Ranging and Manual Range Selection

	Function	Display
MAN / AUTO	Manual mode active: utilized measuring range is fixed	MAN
◁ or ▷	Range switching sequence for: **V:** 300 mV* ↔ 3 V ↔ 30 V ↔ 300 V ↔ 1000 V **Hz:** 300 Hz ↔ 3 kHz ↔ 30 kHz ↔ 300 kHz (Hz(U)) Ω: 300 Ω ↔ 3 kΩ ↔ 30 kΩ ↔ 300 kΩ ↔ 3 MΩ ↔ 30 MΩ **A:** 300 µA ↔ 3 mA ↔ 30 mA ↔ 300 mA ↔ 3 A ↔ 10 A A : See chapter 5.8.3 und chapter 5.8.4 **F:** 30 nF ↔ 300 nF ↔ 3 µF ↔ 30 µF ↔ 300 µF $M\Omega_{@ISO}$:300 kΩ ↔ 3 MΩ ↔ 30 MΩ ↔ 300 MΩ ↔ 3000 MΩ	MAN
MAN / AUTO	Return to automatic measuring range selection	—

* Via manual measuring range selection only

The multimeter is held in the selected measuring range. If the range limit is exceeded, OL appears at the display. You should then switch to the next higher measuring range with the help of the ▷ key.

4.1.3 Quick Measurements

Measurements performed using a suitable fixed measuring range are executed more quickly than those which utilize automatic range selection. Quick measurement is made possible with the following two functions:

- **Manual measuring range selection**, i.e. selection of the measuring range with the best resolution (see chapter 4.1.2)

or

- With the **DATA function** (see chapter 4.4). In this way, the appropriate measuring range is selected automatically after the first measurement and the second measurement is executed more quickly.

The selected measuring range remains active for the subsequent series of measurements with these two functions.

4.2 Zero Offset / Relative Measurements

Zero balancing or a reference value for relative measurements can be stored to memory depending upon deviation from the zero point:

Deviation from zero – with short-circuited measurement cables for V, Ω, A – with open input for capacitance unit of measure: F	Display
0 to 200 digits	ZERO ΔREL
> 200 to 1500 digits	ΔREL

The relevant reference or correction value is deducted individually for the respective measuring function as an offset from all future measurements and remains in memory until deleted, or until the multimeter is switched off.

Zero balancing and reference value adjustment can be used for auto-ranging, as well as for manual measuring range selection.

Zero Balancing

➪ Plug the measuring cables into the instrument and connect the free ends to each other, except for capacitance measurement in which case the ends of the cables are not connected to each other.

➪ Briefly press the **ZERO | ESC** key.
The instrument acknowledges zero balancing with an acoustic signal, and the “ZERO ΔREL” symbol appears at the LCD. The value measured at the moment the key is pressed serves as a reference value.

➪ Zero balancing can be cleared by once again pressing the **ZERO | ESC** key.

Note
As a result of TRMS measurement, the multimeter displays a residual value of 1 to 10/35 digits with short-circuited measurement cables as the zero point for V AC / I AC or V(AC+DC) / I (AC+DC) measurements (non-linearity of the TRMS converter). This has no influence on specified accuracy above 1% of the measuring range (or 3% in the mV, V(AC+DC) ranges).

Setting the Reference Value

➪ Plug the measuring cables into the instrument and measure a reference value (max. 1500 digits).

➪ Briefly press the **ZERO | ESC** key.
The instrument acknowledges storage of the reference value with an acoustic signal, and the "ZERO ΔREL" or the "ΔREL" symbol appears at the LCD. The value measured at the moment the key is pressed serves as a reference value.

➪ The reference value can be cleared by once again pressing the **ZERO | ESC** key.

Notes Regarding Relative Measurement

- Relative measurement effects the digital display only. The analog display continues to read out the original measured value.
- In the case of relative measurement, Ω F or AC quantities may also appear as negative values.

4.3 Display (LCD)

4.3.1 Digital Display

Measured Value, Unit of Measure, Type of Current, Polarity

The measured value with decimal and plus or minus sign appears at the digital display. The selected unit of measure and current type are displayed as well. A minus sign appears to the left of the value during the measurement of zero-frequency quantities, if the plus pole of the measured quantity is applied to the "⊥" input.
The "*D.d ı SP*" parameter can be used to determine whether leading zeros will be appear or be suppressed at the measured value display (see chapter 6.4).

Overranging

If the upper range limit of 3100 digits is exceeded "*OL*" (overload) appears at the display.
Exceptions: "*OL*" appears at the display as of 1000.0 V in the case of voltage measurement in the 1000 V range, as of 5.100 V for diode testing, and as of 11.00 A in the 10 A range.

4.3.2 Analog Display

Measured Value, Polarity

The analog display demonstrates the dynamic performance of a moving-coil mechanism. This display is especially advantageous for observing measured value fluctuation, and for balancing procedures.

Display mode Pointer: the current measured value is tracked in real-time.

The analog scale displays a negative range of 5 scale divisions for the measurement of zero-frequency quantities, allowing for precise observation of measured value fluctuation around zero. If the measured value exceeds the negative range of 5 scale divisions, polarity is reversed at the analog display.

Scaling of the analog scale is automatic. This is very helpful for manual measuring range selection.

Overranging

Overranging in the positive range is displayed by means of the right triangle symbol.

Refresh Rate

In the bar graph and pointer modes, the analog display is refreshed 40 times per second.

4.4 Measured Value Storage: DATA (auto-hold / compare)

An individual measured value can be automatically “frozen” with the DATA function (auto-hold). This is useful, for example, when contacting the measuring points with the test probes requires your full attention. After the measuring signal has been applied and the

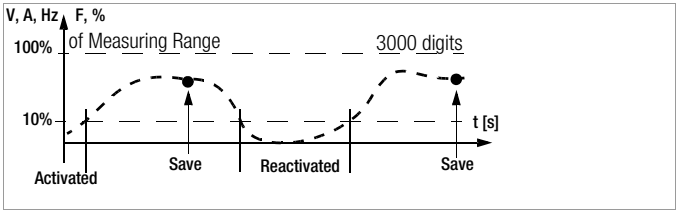
measured value has settled in in accordance with the “condition” listed in the table below, the measured value is frozen at the digital display and an acoustic signal is generated. The test probes can now be removed from the measuring points, and the measured value can be read from the digital display. If the measuring signal falls below the value specified in the table, the function is reactivated for storage of the next value.

Measured Value Comparison (DATA Compare)

If the currently frozen value deviates from the first saved value by less than 100 digits, the acoustic signal is generated twice. If deviation is greater than 100 digits, only one brief acoustic signal is generated.

> **Note**
> The DATA function has no effect on the analog display, at which the current measured value continues to appear. However, when the digital display is “frozen”, the decimal point is fixed as well (fixed measuring range, symbol: MAN). The selected measuring range should not be manually changed as long as the DATA function is active.

The DATA function is deactivated by pressing and holding the **DATA/MIN/MAX** key (approx. 1 second), when the measuring function is changed or when the instrument is switched off and back on again.



DATA Function	Press DATA / Min/ Max	Condition		Response from Instrument		
		Measuring Function	Measuring Signal	Display MV Digital	Display DATA	Acou-stic
Activate	Brief				Blinks	Once
Save (stabilized measured value)		V, A, F, Hz, %	> 10% of R	Is dis-played	Static	Once Twice [2]
		Ω 🔊 ⊣▶⊢	≠0L			
Reactivate [1]		V, A, F, Hz, %	< 10% of R	Stored MV	Blinks	
		Ω 🔊 ⊣▶⊢	= 0L			
Change to Min/Max	brief	See table in chapter 4.4.1				
Exit	long			Is cleared	Is cleared	Twice

[1] Reactivation results from falling short of specified measured value limits.

[2] Two acoustic signals are generated the first time a measured value is saved as a reference value. For subsequent data hold, two acoustic signals are only generated if the currently frozen value deviates from the **first** saved value by less than 100 digits.

Key: MV = measured value, R = measuring range

Example

The voltage measuring range is set manually to 30 V.
The first measured value is 5 V and is stored to memory because it is greater than 10% of the measuring range (= 3 V), and is thus reliable above the background noise level. As soon as the measured values drops to less than 10% of the measuring range, i.e. amounts to less than 3 V which corresponds to removal of the test probes from the measuring point, the instrument is ready to store a new value.

4.4.1 Saving Minimum and Maximum Values – MIN/MAX Function

Minimum and maximum measured values applied to the measuring instrument's input after the Min/Max function has been activated can be "frozen" at the display. The most important use of this function is the determination of minimum and maximum values during long-term measured value observation.

The Min/Max function can be activated in all measuring functions.

The Min/Max function has no effect on the analog display, at which the current measured value continues to appear.

Apply the measured quantity to the instrument and set the measuring range with the **MAN / AUTO** key before activating the Min/Max function.

The Min/Max function is deactivated by pressing and holding the **DATA/MIN/MAX** key (approx. 1 second), when the measuring function is changed or when the instrument is switched off and back on again.

Note
As opposed to the DATA function, the Min/Max function can also be used for temperature measurement.

Function Min/Max	Press DATA / Min/Max	Min. and Max. Measured Values	Response from Instrument		
			Display		Acoustic Signal
			Measured Value Digital	Max. Min.	
1 Activate and save	2 x brief	Are saved	Current measured value	Max and min	Twice
2 Save and display	Brief	Storage continues in background, new min. and max. values are displayed.	Saved min. value	Min.	Once
	Brief		Saved max. value	Max.	Once
3 Return to 1	Brief	Same as 1, stored values are not deleted	Same as 1	Same as 1	Once
Stop	Long	Are deleted	Current measured value	Is deleted	Twice

4.5 Measurement Data Recording

The multimeter is capable of recording measurement data using an adjustable sampling rate for long periods of time in the form of measurement series. Data are stored to a battery-backed memory module, and are retained even after the multimeter is switched off. The system acquires measured values relative to real-time.

Stored measured values can subsequently be read out with the help of DranWin 10 software. The only prerequisite is a PC which is connected by means of an interface cable to the USB bidirectional interface adapter, which is plugged onto a multimeter. See also chapter 7, “Interface Operation”.

Memory Parameters Overview

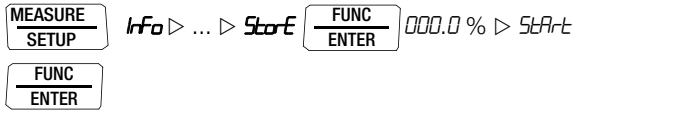
Parameter	Page: Header
CLEAr	24: Clear Memory
EMPtY	24: Clear Memory – appears after CLEAr
OCCuP	24: Querying Memory Occupancy
rAtE	51: rAtE – set the sampling rate
StArt	23: Starting Recording via Menu Functions
StoP	24: Ending Recording

The STORE Menu Function

- First set the **sampling rate** for memory mode operation (see chapter 6.4 the rAtE parameter) , and then start memory mode operation.
- First select the desired measuring function and an appropriate measuring range.
- Check the battery charge level before starting long-term measurement recordings (see chapter 6.3).
  Connect the NA power pack if required.

Starting Recording via Menu Functions

- Switch to the “SEtuP” mode by pressing **MEASURE | SETUP**, and select the “Store” menu.



- Memory mode operation is started by activating **FUNC | ENTER**. STORE appears underneath the analog display and indicates that the memory mode has been activated. “StoP” appears at the digital
  display.
- Press **MEASURE | SETUP** in order to return to the measuring function.

During Recording

STORE is displayed underneath the analog display during memory mode operation, and **memory occupancy** can be monitored:

StoP ▷ 000.3%

The following message appears as soon as memory is full: " 100.0%".

In order to be able to **observe measured values during recording**, switch to the measuring function by pressing **MEASURE | SETUP**. The display is returned to the memory menu after once again pressing **MEASURE | SETUP**.

A new memory block is created when another measuring function is selected with the rotary switch or the **FUNC | ENTER** key. Data storage then continues automatically.

Ending Recording

➪ "StoP" appears at the display after pressing **MEASURE | SETUP**.

StoP [FUNC / ENTER] StArt

➪ Acknowledge the "StoP" display by pressing **FUNC | ENTER**. **STORE** is cleared from the display indicating that recording has been ended.

➪ Press **MEASURE | SETUP** in order to return to the measuring function.

➪ Memory mode operation can also be exited by switching the multimeter off.

Querying Memory Occupancy

Memory occupancy can be queried during recording with the help of the " InFo" menu (see also chapter 6.3).

Memory occupancy range: 000. 1% to 099.9%.

[MEASURE / SETUP] InFo [FUNC / ENTER] bAtt: ▽ ... ▽ OCCuP %: 0 17.4 %

Memory occupancy can be queried before recording is started via the "StorE" menu.

[MEASURE / SETUP] InFo ▷ ... ▷ StorE [FUNC / ENTER] 0 17.4 % ▷ StArt

Clear Memory

This function deletes all measured values from memory!

This function cannot be executed during memory mode operation.

[MEASURE / SETUP] InFo ▷ ... ▷ StorE [FUNC / ENTER] 0 17.4 % ▷ StArt

▷ CLEAr [FUNC / ENTER] EMPtY

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5 Measurements

5.1 Voltage Measurement

Notes Regarding Voltage Measurement

- **The multimeter may only be operated with installed batteries. Dangerous voltages are otherwise not indicated, and the instrument may be damaged.**
- The multimeter may only be operated by persons who are capable of recognizing **contact hazards** and taking the appropriate safety precautions. Contact hazards exist anywhere, where voltages of greater than 33 V RMS may occur.
  The test probes may only be only gripped up to the finger guard. Do not touch the metallic test probes under any circumstances.
- Avoid working alone when taking measurements which involve **contact hazards**. Be certain that a second person is present.
- **Maximum allowable voltage** between terminals 9 or 10 and ground (8) is 1000 V for measuring category II, and 600 V for measuring category III.
- Be prepared for the occurrence of unexpected voltages at devices under test (e.g. defective devices). For example, capacitors may be dangerously charged.
- No measurements may be made with this instrument in electrical circuits with corona discharge (high-voltage).
- Special care is required when measurements are made in HF electrical circuits. Dangerous pulsating voltages may be present.
- **Be aware of the fact that dangerous voltage spikes are not displayed during measurement with the low-pass filter. We recommend measuring voltage without the low-pass filter first, in order to be able to detect any dangerous voltages.**
- Be absolutely certain that the measuring ranges are not overloaded beyond their allowable capacities. Limit values are included in chapter 8, “Technical Data”, in the table entitled “Measuring Functions and Measuring Ranges” in the “Overload Capacity” column.

Note
Rotary selector switch position “ **V 1**MΩ / **MΩ@UISO**” is available for the detection of interference voltage during insulation resistance measurement.
Us switch position V~ , V⎓ or V⎓ in order to perform precise voltage measurements.

5.1.1 Direct and Pulsating Voltage Measurement, V DC and V (DC+AC)

➪ Set the *CL, P* parameter to ***OFF*** in the current clip setup menu. Otherwise all measured values are displayed in amperes, corrected by the amount resulting from the selected transformation ratio for an interconnected clip-on current sensor.

MEASURE SETUP *InFo* ▷ ... ▷ *SEt* FUNC ENTER *rAtE* ▽ ... ▽ *CL, P*

FUNC ENTER *1/ 10/ 100/ 1000 / OFF* △▽ FUNC ENTER

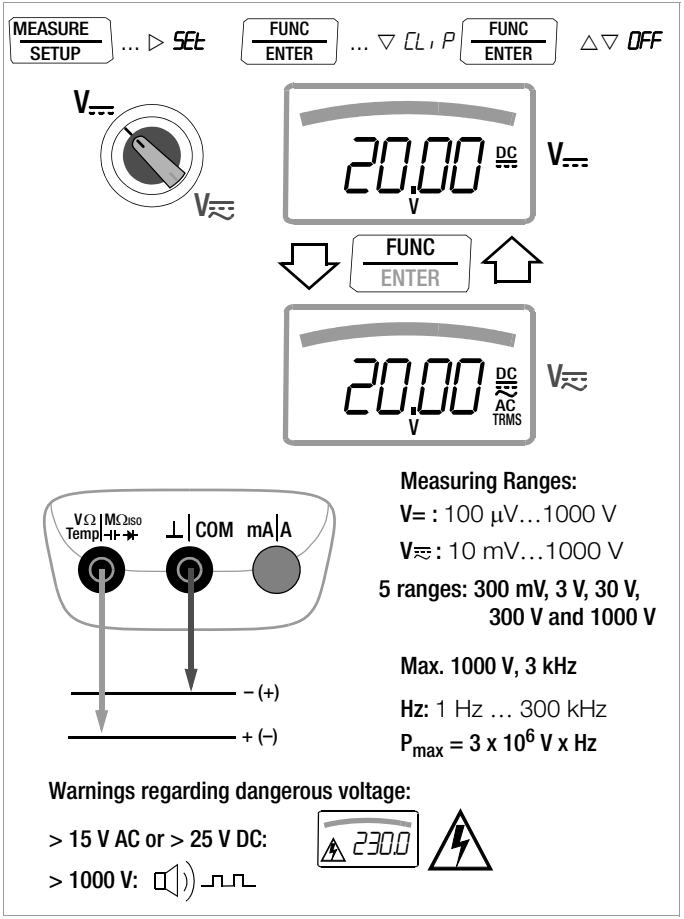
➪ In accordance with the voltage to be measured, turn the rotary switch to V ⎓ or V ≂.

➪ Connect the measurement cables as shown.
The "⊥" connector jack should be grounded.

Note
An intermittent acoustic signal warns the operator if the measured value exceeds the upper range limit in the 1000 V range.

Make sure that a current measuring range ("A") has **not** been activated when the multimeter is connected for voltage measurement! If the fuse's blowing limits are exceeded as a result of operator error, both the operator and the instrument are in danger!

With the rotary switch in the V position, the multimeter is always in the 1 V measuring range immediately after it is switched on. As soon a the **MAN / AUTO** key is pressed, and assuming the measured value is less than 280 mV, the multimeter is switched to the mV measuring range.



5.1.2 Alternating Voltage and Frequency Measurement V AC and Hz with Selectable Low-Pass Filter

➪ Set the *CL.P* parameter to *OFF* in the current clip setup menu. Otherwise all measured values are displayed in amperes, corrected by the amount resulting from the selected transformation ratio for an interconnected clip-on current sensor.

MEASURE / SETUP *InFo* ▷ ... ▷ *SEt* FUNC / ENTER *rAtE* ▽ ... ▽ *CL.P*

FUNC / ENTER *1/ 10/ 100/ 1000 / OFF* △▽ FUNC / ENTER

➪ In accordance with the voltage or frequency to be measured, turn the rotary switch to V~ or Hz/%.

➪ Connect the measurement cables as shown. The "⊥" connector jack should be grounded.

Voltage Measurement

Note
An intermittent acoustic signal warns the operator if the measured value exceeds the upper range limit in the 1000 V range.

Make sure that a current measuring range ("A") has not been activated, when the multimeter is connected for voltage measurement! If the fuse's blowing limits are exceeded as a result of operator error, both the operator and the instrument are in danger!

➪ You can switch back and forth between voltage measurement with and without low-pass filter.

➪ Repeatedly press the FUNC | ENTER multifunction key, until the V or V/Fil unit of measure appears at the display.

Frequency Measurement

➪ Connect the measured quantity in the same way as for voltage measurement.

➪ Manually select the measuring range for the voltage amplitude. When the instrument is switched to frequency measurement, the previously selected voltage measuring range remains active.

➪ You can switch back and forth between frequency measurement with and without low-pass filter. Repeatedly press the FUNC | ENTER multifunction key, until the Hz or Hz/Fil unit of measure appears at the display. Lowest measurable frequencies and maximum allowable voltages are included in chapter 8, "Technical Data".

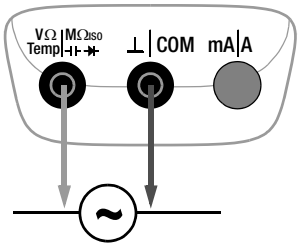
Measurement with Low-Pass Filter

Attention!
Be aware of the fact that dangerous voltage spikes are not displayed during this type of measurement (see also "Voltage Comparator"). We recommend measuring voltage without the low-pass filter first, in order to be able to detect any dangerous voltages.

A 1 kHz/-3 dB low-pass filter can be activated if required, in order to filter out capacitively induced high frequency pulses of greater than 1 kHz, for example when performing measurements at cables, i.e. undesired voltages of greater than 1 kHz can be suppressed.

"Fil" appears at the display in order to indicate the respectively activated low-pass filter. The multimeter is automatically switched to manual measuring range selection.

Specified measuring accuracy is not reached with signals of greater than 500 Hz when the filter is active.



Measuring Ranges:
V~: 10 mV … 1000 V
5 ranges: 300 mV, 3 V, 30 V, 300 V and 1000 V

Max. 1000 V, 3 kHz
Hz: 1 Hz … 300 kHz
P_{max} = 3 x 10^6 V x Hz

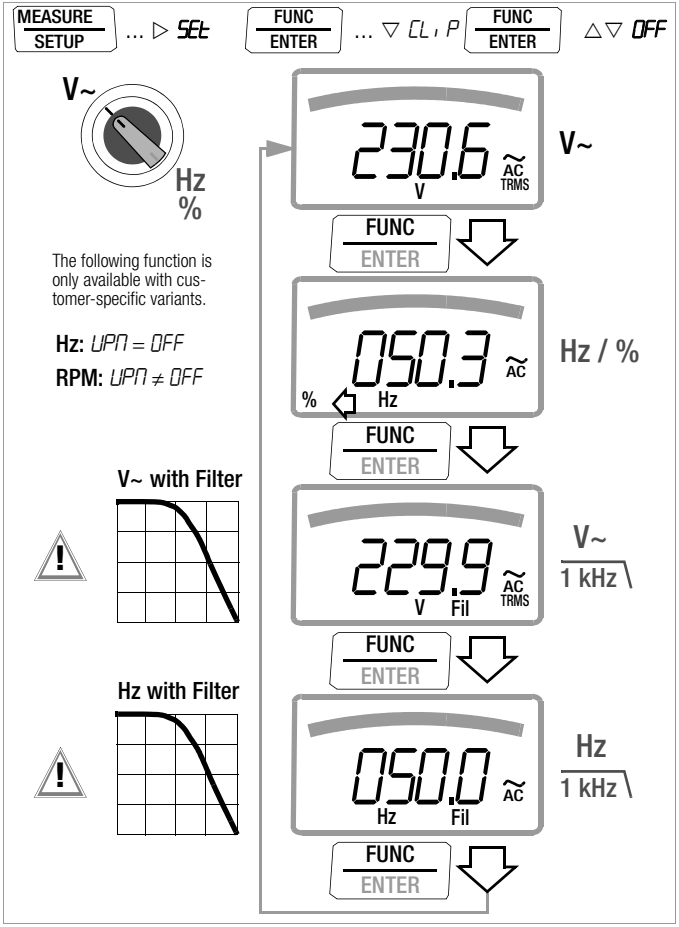
Warnings regarding dangerous voltage:

> 15 V AC or > 25 V DC:

> 1000 V: ◁)) ⊓⊔⊓

Voltage Comparator for Displaying Dangerous Voltage

The input signal or measuring signal is checked by a voltage comparator for dangerous spikes, because these do not appear at the display when the low-pass filter is used.
At voltages of greater than 15 V AC or 25 V DC, a danger symbol appears at the display: ⚠ .



Duty Cycle Measurement
(this function only available with customer-specific variant)

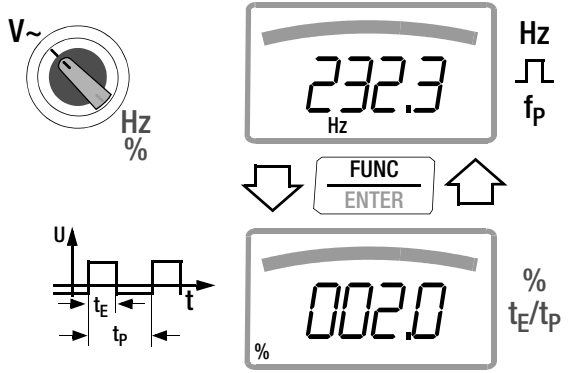
- ➪ Set the rotary switch to V~.
- ➪ Repeatedly press the FUNC | ENTER multifunction key until % appears at the display.
- ➪ Connect the measurement cables as shown.

Make sure that a current measuring range (“A”) has not been activated, when the multimeter is connected for frequency or duty cycle measurement!

The ratio of pulse duration to pulse period is measured with periodic square-wave signals and displayed as a percentage.

$$\text{Duty cycle (\%)} = \frac{\text{Pulse duration } (t_E)}{\text{Pulse period } (t_P)} \bullet 100$$

Note
The applied frequency must remain constant during duty cycle measurement.

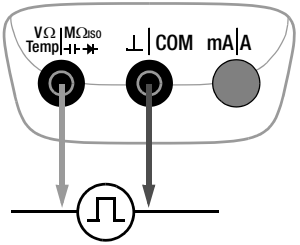


Pulse Time Quantities

f_P	pulse frequency = $1/t_P$
t_E	pulse duration
t_P	pulse period
$t_P - t_E$	interpulse period
t_E/t_P	pulse or duty cycle

Measuring Ranges:

Hz	t_E/t_P
15 Hz ... 1 kHz	5 ... 95%
1 kHz ... 4 kHz	10 ... 90%



RPM Measurement (function only available with customer-specific variant)

Revolutions per minute (also known as rotational frequency) are measured by acquiring pulses. As a prerequisite for this measurement, the number of measurable pulses per revolution must first be set in the RPM setup menu (*UPn* ≠ *OFF*, see below).

- ➪ Set the rotary switch to V~.
- ➪ Repeatedly press the FUNC | ENTER multifunction key until RPM is briefly displayed. The measured value then appears in RPM, for example “244.3 r”.

$$\text{RPM} = \left(\frac{\text{Revolutions}}{\text{min}} \S \frac{\text{Pulses}}{\text{Revolution}}\right) x \frac{60\text{s}}{\text{s}}$$

Measured value RPM = revolutions per minute.

Parameter *UPn* = pulses per revolution.

Pulses per Revolution Setup Menu

MEASURE SETUP *InFo* ▷ ... ▷ *SEt* FUNC ENTER *rAtE* ▽ ... ▽ *UPn*

FUNC ENTER *OFF/ 1*: *1* ... *1000* ◁ ▷ △ ▽ FUNC ENTER

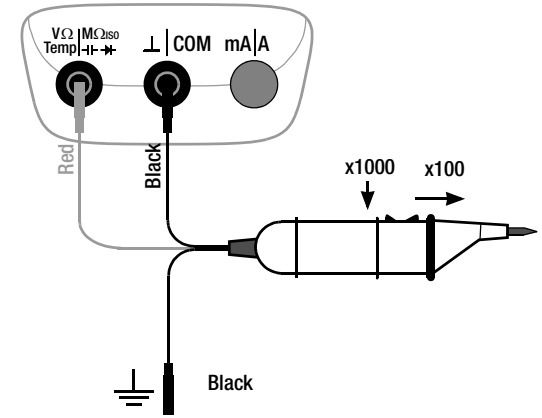
5.1.3 Transient Overvoltages

The multimeters are protected against transient overvoltages of up to 6 kV with wave-front durations of 1.2 ms and halftimes of 50 µs in the voltage measuring range. If longer pulse durations are expected, e.g. when conducting measurements at transformers or motors, use of our KS30 measuring adapter is recommended. It provides protection against transient overvoltages of up to 6 kV with wave-front durations of 10, and halftimes of 1000 µs. Continuous load capacity is 1200 V_{RMS}. Additional influence error caused by the KS30 measuring adapter amounts to approximately –2%.

5.1.4 Voltage Measurements at Above 1000 V

Voltages of greater than 1000 V can be measured with a high-voltage probe, e.g. the HV3[1] or the HV30[2] from Dranetz-BMI. It is absolutely essential to earth the ground terminal in this case. Observe all applicable safety precautions!

Voltage Measurements at Above 1000 V with the HV3 High-Voltage Probe



[1] HV3: 3 kV

[2] HV30: 30 kV, for ⎓ (DC) voltages only

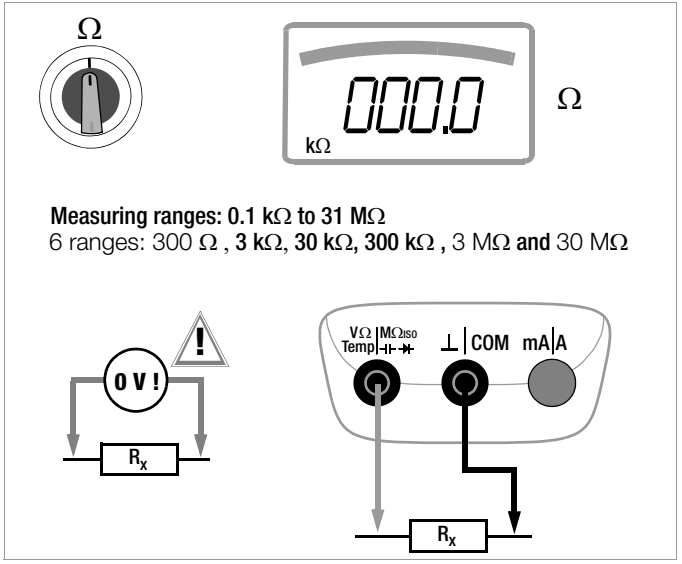
5.2 Resistance Measurement, Ω

- Disconnect supply power from the electrical circuit of the device to be measured, and discharge all high-voltage capacitors.
- Make sure that the device under test is voltage-free. Interference voltages distort measurement results! Refer to section 5.1.1 regarding testing for the absence of voltage with the help of the direct voltage measurement.
- Set the rotary switch to "Ω".
- Connect the device under test as shown.

Note
Use short or shielded measurement cables in the case of high-impedance resistance.

Improving Accuracy by means of Zero Balancing

Cable resistance and contact resistance can be eliminated in all measuring ranges by means of zero balancing (see section 4.2).



5.3 Temperature Measurement: Temp RTD and Temp TC

Temperature measurement is performed with a Pt100 or Pt1000 resistance thermometer, or a type K thermocouple (accessory, not included), which is connected to the voltage input.

Selecting the Unit of Measure for Temperature

MEASURE SETUP → *InFo* ▷ ... ▷ *tEMP* → FUNC ENTER → **°C** / °F △▽ → FUNC ENTER

(**°C** = default setting)

5.3.1 Measurement with Resistance Thermometers

➪ Set the rotary switch to "$Temp_{RTD}$".

Press the FUNC | ENTER key in order to change to the other measuring function if required.

The sensor type, i.e. Pt100 or Pt1000, is detected automatically and displayed.

There are two different ways to compensate for cable resistance:

Automatic Compensation

➪ Acknowledge by pressing the ZERO | ESC key.
"Short leads" appears at the display.

If you prefer to enter cable resistance directly, you can skip the following entry prompt.

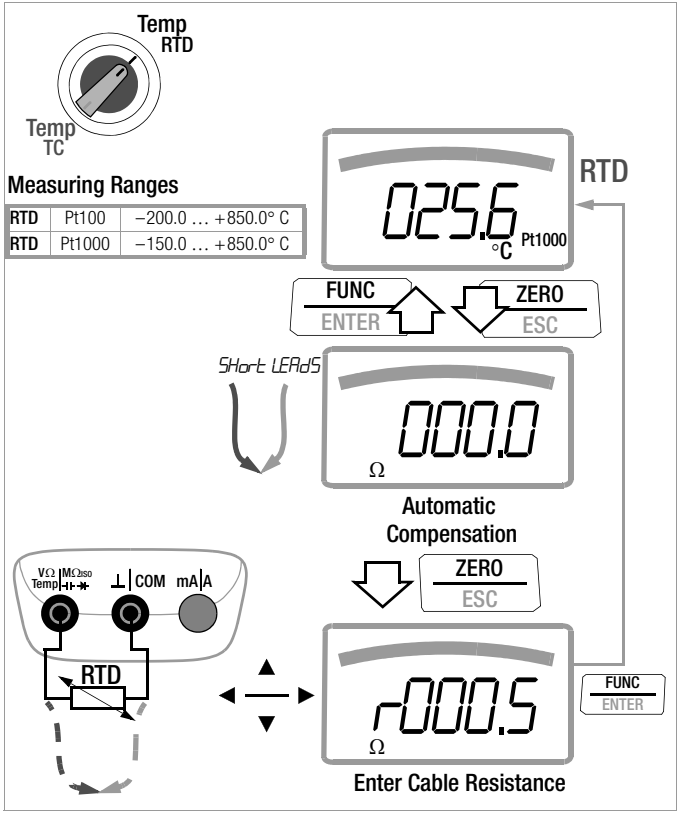
➪ Short circuit the measuring instrument's connector cables. "*000.0*" appears at the display. After pressing the FUNC | ENTER key, automatic compensation of cable resistance is activated for all subsequent measurements. The short-circuit can now be
eliminated, and the device is ready for use.

Enter Cable Resistance

➪ Press the ZERO | ESC key once again in the automatic compensation menu.

➪ Enter the known resistance of the connector cables with the scroll keys:
Select the digit to be changed with the ◁ ▷ keys, and change the respectively selected digit with the ▽△ keys. The default value is 0.43 Ω. Values can be selected within a range of 0 to 50 Ω.

➪ Upon pressing the FUNC | ENTER key, the selected value is activated and the display is returned to the measuring function. Cable resistance remains in memory even after the instrument has been switched off.


Temp
RTD
Temp
TC
Measuring Ranges
RTD Pt100 −200.0 … +850.0° C
RTD Pt1000 −150.0 … +850.0° C
025.6
°C
Pt1000
RTD
FUNC
ENTER
ZERO
ESC
SHort LEAdS
000.0
Ω
Automatic
Compensation
ZERO
ESC
VΩ MΩISO
Temp
COM
mA
A
RTD
r000.5
Ω
FUNC
ENTER
Enter Cable Resistance

5.3.2 Measurement with Thermocouples, Temp TC

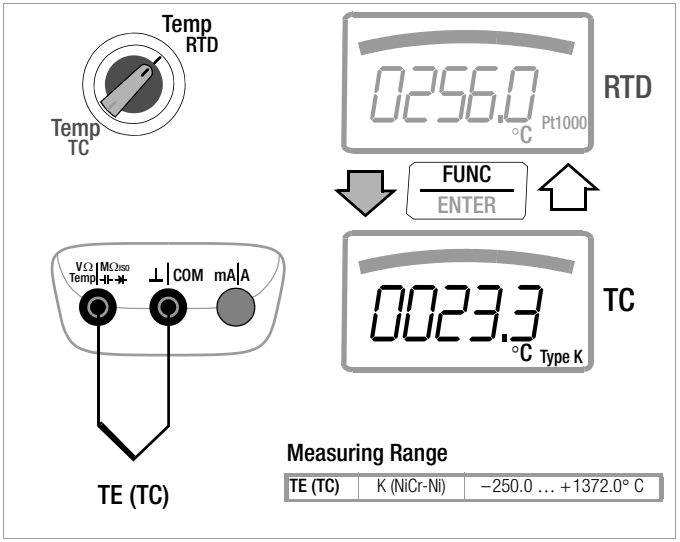
➪ Set the rotary switch to "Temp$_{RTD}$".

Note
The last selected temperature measurement or the last selected temperature sensor, i.e. type K or Pt100/Pt1000, remains in memory and is accordingly displayed. Press the FUNC | ENTER key in order to change to the other measuring function if required.

➪ The reference temperature is measured at the internal reference junction (see parameter " *ıŁEΠP*" in page 50 regarding querying).

Note
The internal reference temperature (temperature of the internal reference junction) is measured by a temperature sensor inside of the instrument. This may be somewhat above room temperature as a result of internal heat-up, or moving from warmer to colder surroundings or vice versa.

➪ Connect the sensor to the two accessible jacks. The instrument displays the measured temperature using the selected unit of measure.



5.4 Continuity Test 🔊

- Disconnect supply power from the electrical circuit of the device to be measured, and discharge all high-voltage capacitors.
- Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- Set the rotary switch to "🔊".
- A loudspeaker symbol appears at the display.
- Connect the conductor path under test as shown.

Depending upon the selected limit value, the multimeter generates a continuous acoustic signal in the case of continuity or short-circuiting, i.e. at a value of less than the selected limit value.

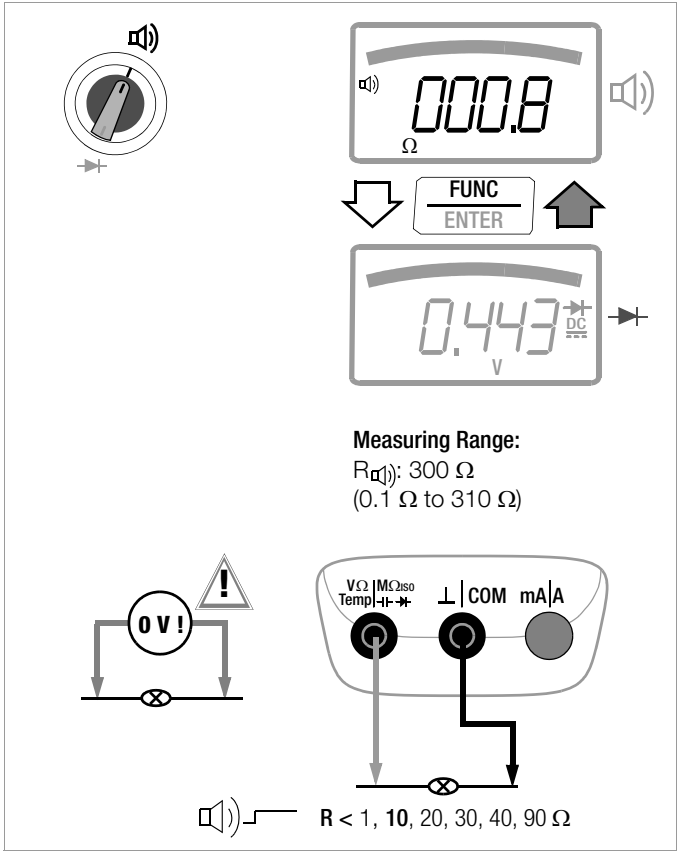
"OL" appears at the display in the case of an open connection.

The limit value can be adjusted in the "SEt" menu (see also section 6.4):

MEASURE SETUP → InFo ▷ ... ▷ SEt → FUNC ENTER → rAtE ▽ ... ▽ bEEP

FUNC ENTER → 1, 10, 20, 30, 40, 90 Ω △▽ → FUNC ENTER

(10 = default setting)



5.5 Diode Testing ⊣▶⊢ with Constant Current of 1 mA

- Disconnect supply power from the electrical circuit of the device to be measured, and discharge all high-voltage capacitors.
- Make sure that the device under test is voltage-free. Interference voltages distort measurement results! Refer to section 5.1.1 regarding testing for the absence of voltage with the help of the direct voltage measurement.
- Set the rotary switch to "🔊".
- Press the FUNC | ENTER key and the diode symbol appears at the display.
- Connect the device under test as shown.

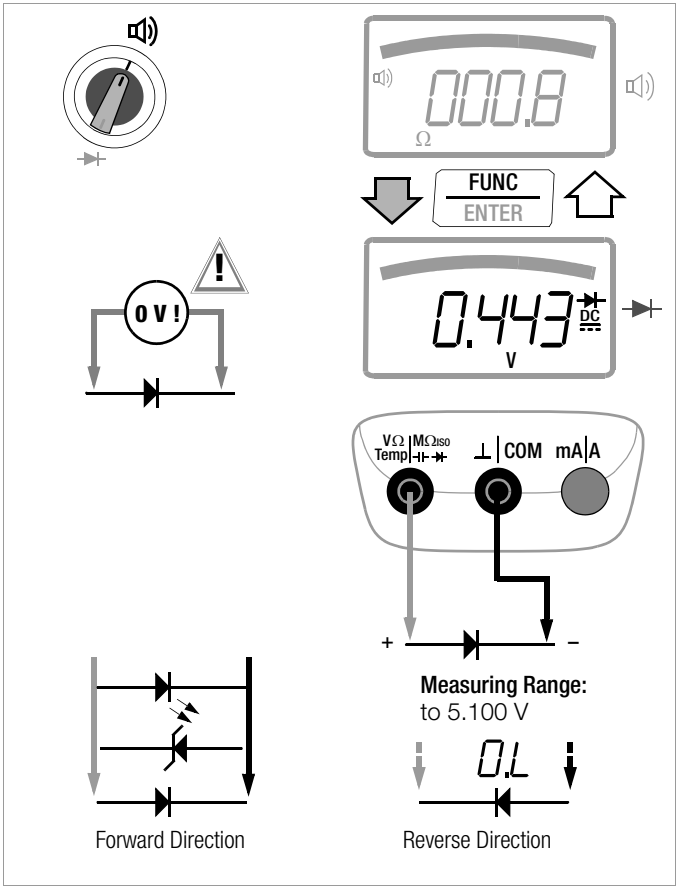
Conducting Direction and Short-Circuit

The instrument displays forward voltage in volts (display: 4 places). As long as voltage drop does not exceed the maximum display value of 5.1 V, several series connected components or reference diodes with small reference voltages, as well as Z-diodes and LEDs, can be tested.

Reverse Direction and Interruption

The measuring instrument indicates overload OL

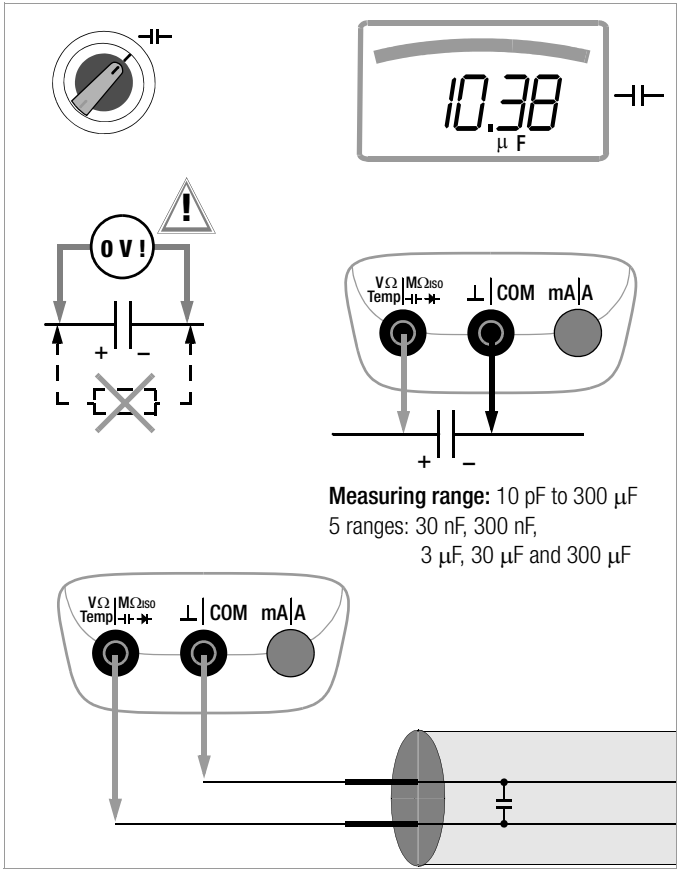
> **Note**
> Resistors and semiconductor paths connected in parallel to the diode distort measurement results!



5.6 Capacitance Measurement ⊣⊢

- Disconnect supply power from the electrical circuit of the device to be measured, and discharge all high-voltage capacitors.
- Make sure that the device under test is voltage-free.
  Capacitors must always be discharged before measurement is performed.
  Interference voltages distort measurement results!
  Refer to section 5.1.1 regarding testing for the absence of voltage with the help of the direct voltage measurement.
- Set the rotary switch to "⊣⊢".
- Connect the (discharged!) device under test to the sockets with the measurement cables as shown.

Note
The "–" pole of polarized capacitors must be connected to the "⊥" jack.
Resistors and semiconductor paths connected in parallel to the capacitor distort measurement results!

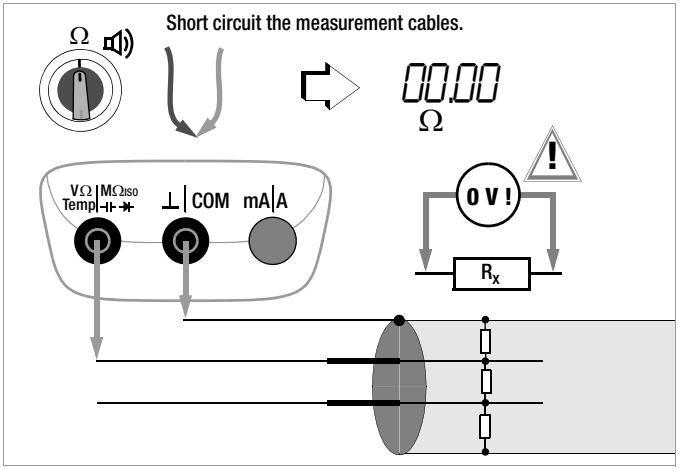


Measuring range: 10 pF to 300 µF
5 ranges: 30 nF, 300 nF,
3 µF, 30 µF and 300 µF

5.7 Insulation Resistance Measurement – MΩ@UISO

5.7.1 Preparing for Measurement

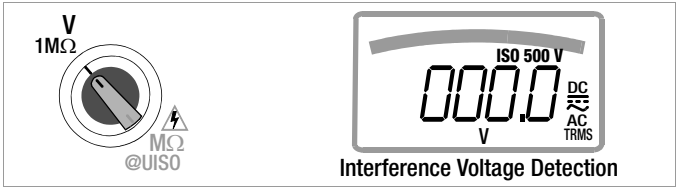
Note
Testing the Measurement Cables
The test probes at the ends of the measurement cables should be short circuited before performing insulation resistance
measurements with the selector switch in the Ω or the 🔊 position, in order to make sure that a value close to 0 Ω is displayed at the instrument. Incorrect connection or a broken measurement cable can be detected in this way.



Note
Insulation resistance may only be measured at voltage-free devices. The measurement cables may not come into contact with one another during high-resistance insulation measurements.

- Set the rotary switch to "MΩ@UISO".
- Connect the measurement cables to the two accessible jacks.
- Interference voltage measurement (V AC+DC TRMS) is conducted in this switch position.

The FUNC | ENTER key for UISO ON / OFF may only be pressed in order to start the insulation resistance measurement if the device under test is voltage-free.



Interference Voltage Detection

Note
The MΩ@UISO switch position may only be used for insulation resistance measurement. However, if interference voltage is inadvertently applied with the switch in this position, it appears at the display.
If an interference voltage of > 50 V is present, insulation resistance measurement is disabled. The LCD continues to display the interference voltage value. If a voltage of greater than 1000 V is present, an acoustic signal is generated as well.

Caution: High-Voltage!
Do not touch the conductive ends of the test probes when the instrument has been activated for the measurement of insulation resistance.
You may otherwise be exposed to a current of 2.5 mA (limited in the measuring instrument), and although this is not life endangering, the resulting electrical shock is quite discernible.
If, on the other hand, measurement is being performed on a capacitive device under test, for example a cable, it may be charged with up to approximately ±1200 V.
Touching the device under test after measurement has been performed is life endangering in this case!

Selecting the Test Voltage (U_{ISO} = 50 to 1000 V)

The desired test voltage can be selected in the "SEt" menu (see also section 6.4):

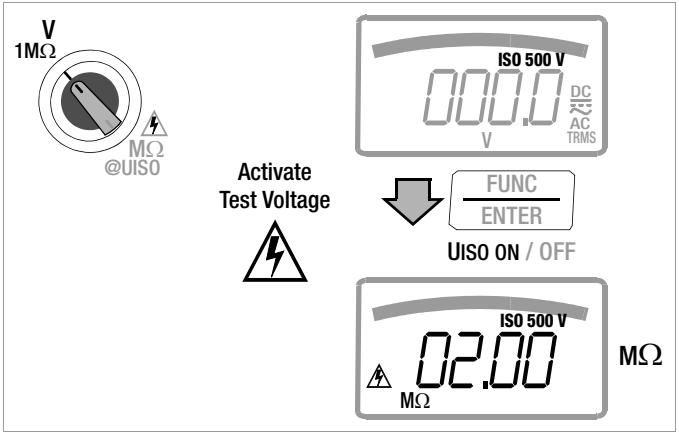
MEASURE/SETUP InFo ▷ ... ▷ SEt FUNC/ENTER rAtE ▽ ... ▽ U ISo
FUNC/ENTER ... 500, 1000 V* △▽ FUNC/ENTER

* Selectable test voltages and the default value depend upon the respective device variant.

The selected test voltage appears at the display during testing.

5.7.2 Performing the Insulation Measurement

➪ **Starting the insulation resistance measurement**:
Press and hold the UISO ON / OFF key until the display settles in, in order to measure insulation resistance.
Insulation resistance measurement is ended by releasing the key.



Auto-ranging is active during insulation resistance measurement.

Automatic Recognition of Interference Voltage during Insulation Resistance Measurement

If the instrument detects interference voltage of greater than **15 V AC or > 25 V DC** during insulation testing (condition: $U_{interference} \neq U_{ISO}$, e.g. Riq < 100 kΩ at 100 V, see Seite 58, footnote 1), ***ERROR*** is briefly displayed at the LCD. The instrument is then automatically switched to voltage measurement, and the currently measured voltage value is displayed.

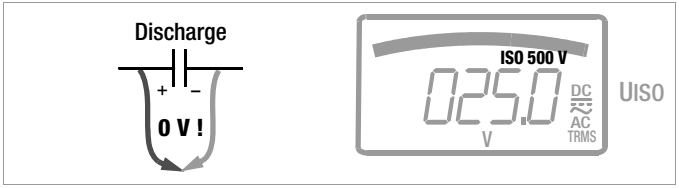
Note
A dead zone results in erroneous measurements for automatic interference voltage detection during insulation resistance measurement. The dead zone lies within a range of 80% to 120% of the selected test voltage
(in the case of an interference voltage whose value is equal to that of measuring voltage, the two voltages neutralize each other).

Manual switching to insulation resistance measurement is disabled for as long as voltage is applied to the test terminals.

If interference voltage is no longer present, the MΩ@ISO measurement can be started by once again pressing the UISO ON / OFF key.

Attention!
If ERROR appears at the display, the cable (the device under test) is most likely capacitively charged to a significant extent.
Remedy:
Short circuit the cable (the device under test). Repeat the measurement.

5.7.3 Ending the Measurement and Discharging



➪ Briefly press the UISO ON / OFF key.

After measurement has been completed, any remaining residual voltage is displayed which may result from cable capacitance. The
instrument's internal 100 MΩ resistor causes rapid discharging. However, contact to the device under test must be maintained. The falling voltage value can be observed directly at the LCD.
Do not disconnect the device under test until the voltage value has dropped to < 25 V!

Note
The instrument's batteries are rapidly depleted during insulation resistance measurement. Deactivate insulation resistance measurement between measurements for this reason. Use only alkaline manganese batteries in accordance with IEC 6 LR61.

Note
Rotary selector switch position " **V 1**MΩ / **MΩ@UISO**" is available for the detection of interference voltage during insulation resistance measurement.
Us switch position V ∼ , V ⎓ or V ≂ in order to perform precise voltage measurements.

5.8 Current Measurement

Notes Regarding Current Measurement

- **The multimeter may only be operated with installed batteries or rechargeable batteries. Dangerous currents are otherwise not indicated, and the instrument may be damaged.**
- Set up the measuring circuit in a mechanically secure fashion, and secure it against inadvertent breaks. Select conductor cross-sections and lay out connections such that they do not overheat.
- An continuous acoustic signal warns of current greater than 11 A.
- The input for the current measuring range is equipped with a fuse link. Maximum permissible voltage for the measuring circuit (= rated voltage of the fuse) is 1000 V AC/DC.
  Use specified fuses only! The fuse must have a **breaking capacity of at least 30 kA**.
- If the fuse for the active current measuring range blows, "FUSE" appears at the digital display, and an acoustic signal is generated at the same time.
- If a fuse should blow, eliminate the cause of overload before placing the instrument back into service!
- Fuse replacement is described in section 9.3.
- Be absolutely certain that the measuring ranges are not overloaded beyond their allowable capacities. Limit values are included in chapter 8, "Technical Data" in the table entitled "Measuring Functions and Measuring Ranges" in the "Overload Capacity" column.

Direct Current Measurement – CLIP Parameter = OFF

➪ Set the *CLIP* parameter to *OFF* in the current clip setup menu. Otherwise all displayed measured values are corrected by the amount resulting from the selected transformation ratio for an interconnected clip-on current sensor.

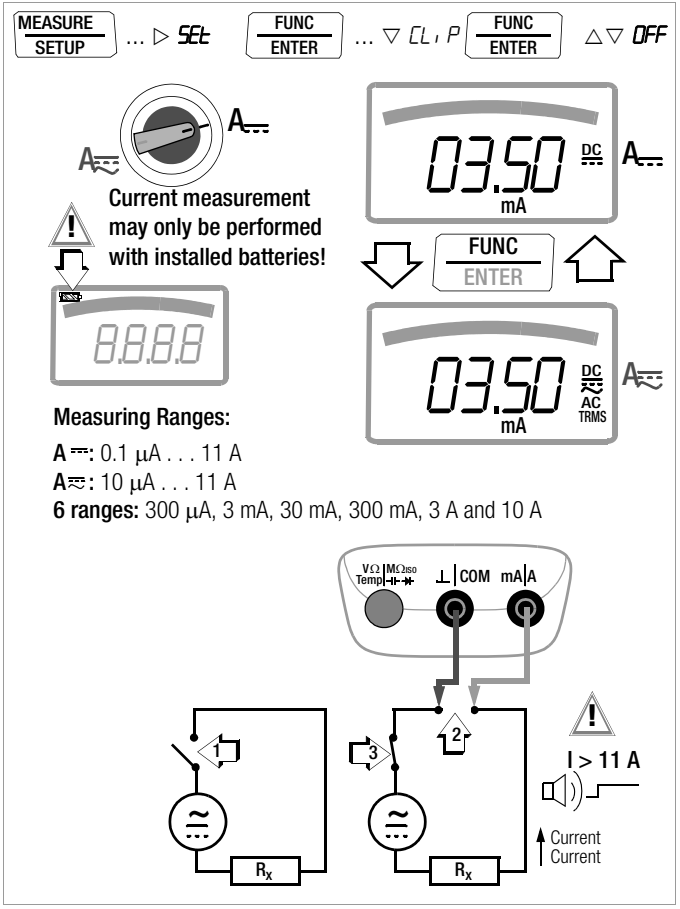
MEASURE SETUP *InFo* ▷ ... ▷ *SEt* FUNC ENTER *rAtE* ▽ ... ▽ *CLIP*

FUNC ENTER *1/ 10/ 100/ 1000 / OFF* △▽ FUNC ENTER

Switch	FUNC	Display	Additional clip function (via SET menu) CLIP 1:1/10/100/1000
A⎓	0/2	A⎓ DC	
A⎓~	1	A⎓~ DC AC TRMS	
A~	0/2	A~ AC TRMS	⋗C AC (A) clip: clip-on current transformer
Hz (A)	1	Hz ~ AC	⋗C Hz (A) clip: clip-on current transformer

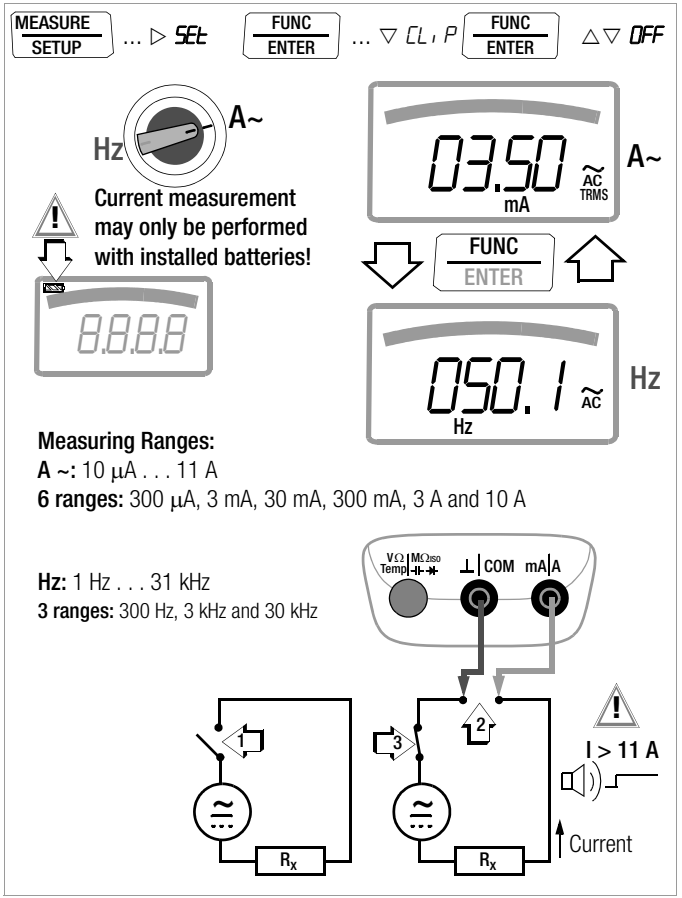
5.8.1 Direct and Pulsating Current Measurement, Direct Connection, A DC and A (DC+AC)

- ➪ First disconnect supply power from the measuring circuit or the power consumer (1), and discharge any capacitors.
- ➪ In accordance with the current to be measured, set the rotary switch to A ⎓ or A ≂.
- ➪ Select the type of current appropriate for the measured quantity by briefly pressing the FUNC | ENTER multifunction key. Each time the key is pressed, the instrument is switched back and forth between A DC and A $(DC + AC)_{TRMS}$, which is indicated by means of an acoustic signal. The current type is indicated at the LCD by means of the DC or the $(DC+AC)_{TRMS}$ symbol.
- ➪ Safely connect the measuring instrument (without contact resistance) in series to the power consumer (2) as shown.
- ➪ Switch supply power to the measuring circuit back on (3).
- ➪ Read the display. Make a note of the measured value if the instrument is not being operated in the memory mode or the transmission mode.
- ➪ Disconnect supply power from the measuring circuit or the power consumer (1) once again, and discharge any capacitors.
- ➪ Remove the test probes from the measuring point and return the measuring circuit to its normal condition.



5.8.2 Alternating Current and Frequency Measurement, Direct Connection, A AC and Hz

- ⇨ First disconnect supply power from the measuring circuit or the power consumer (1), and discharge any capacitors.
- ⇨ In accordance with the current or frequency to be measured, turn the rotary switch to A~ or Hz.
- ⇨ Select the desired measured quantity by briefly pressing the FUNC | ENTER multifunction key. Each time the key is pressed, AC_{TRMS} and Hz are alternately selected, and switching is acknowledged with an acoustic signal.
- ⇨ Safely connect the measuring instrument (without contact resistance) in series to the power consumer as shown.
- ⇨ Switch supply power to the measuring circuit back on (3).
- ⇨ Read the display. Make a note of the measured value if the instrument is not being operated in the memory mode or the transmission mode.
- ⇨ Disconnect supply power from the measuring circuit or the power consumer (1) once again, and discharge any capacitors.
- ⇨ Remove the test probes from the measuring point and return the measuring circuit to its normal condition.



5.8.3 Direct and Pulsating Current Measurement with Clip-On Current Sensor A DC and A (DC+AC)

Transformer Output, Voltage/Current

When a clip-on current sensor is connected to the multimeter (V input), all current displays appear with the correct value in accordance with the selected transformation ratio. The only prerequisite is that the current sensor is equipped with at least one of the below listed transformation ratios, and that the ratio has been previously selected in the following menu (CL i P ≠ OFF).

Current Clip Setup Menu

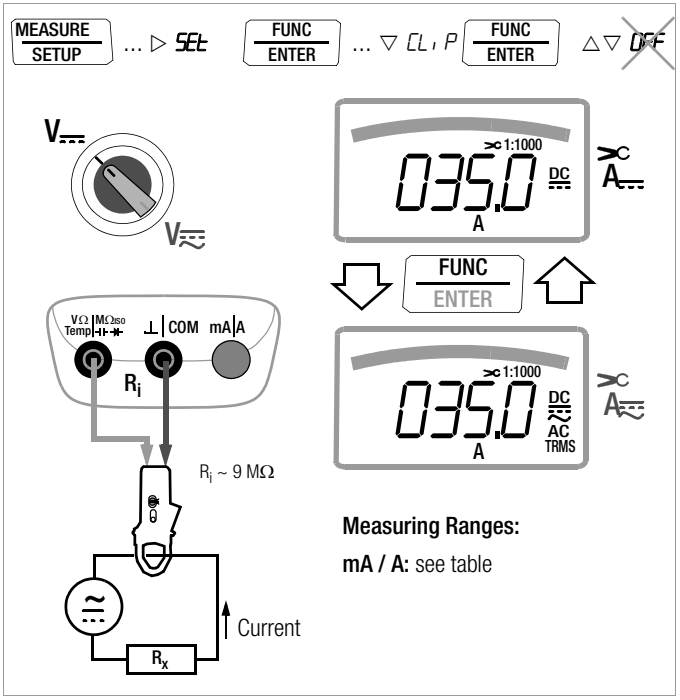
MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ CL i P

FUNC ENTER OFF/ 1/ 10/ 100/ 1000 △▽ FUNC ENTER

Transf. Ratio CL i P	Measuring Ranges 300 mV	3 V	30 V	Clip Type
1:1 1 mV / 1 mA	300.0 mA	3.000 A	30.00 A	WZ12C
1:10 1m V / 10 mA	3.000 A	30.00 A	300.0 A	WZ12B, Z201A
1:100 1m V / 100 mA	30.00 A	300.0 A	3,000 kA	Z202A
1:1000 1 mV/1 A	300.0 A	3,000 kA	30.00 kA	Z202A, Z203A, WZ12C

Maximum allowable operating voltage is equal to the current transformer's nominal voltage. When reading the measured value, additional error resulting from the clip-on current sensor must also be taken into consideration.

(default value: CL i P = OFF = voltage display)



5.8.4 Alternating Current Measurement with Clip-On Current Sensor, A AC and Hz

Transformer Output, Voltage/Current

When a clip-on current sensor is connected to the multimeter (V input), all current displays appear with the correct value in accordance with the selected transformation ratio. The only prerequisite is that the current sensor is equipped with at least one of the below listed transformation ratios, and that the ratio has been
previously selected in the following menu (CL, P ≠ OFF).

Current Clip Setup Menu

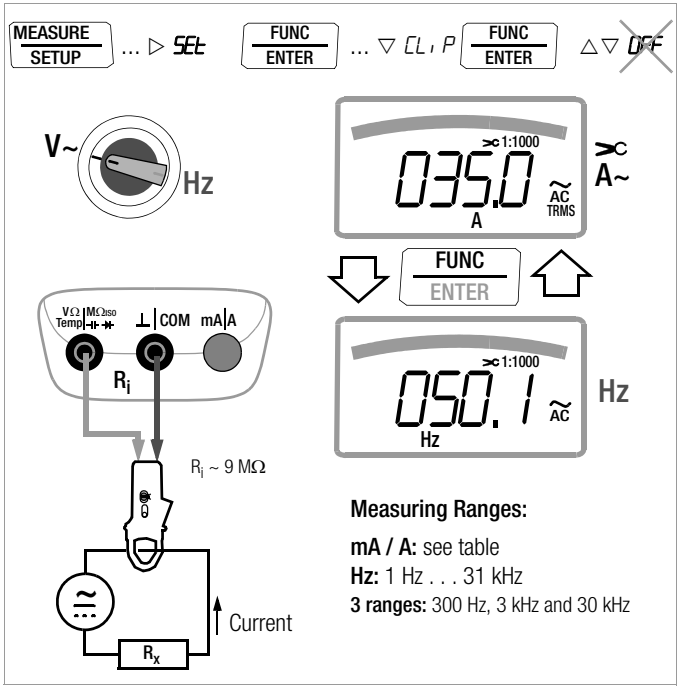
MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ CL, P

FUNC ENTER OFF/ 1/ 10/ 100/ 1000 △▽ FUNC ENTER

Transf. Ratio CL, P	Measuring Ranges 300 mV	3 V	30 V	Clip Type
1:1 1 mV / 1 mA	300.0 mA	3.000 A	30.00 A	WZ12C
1:10 1m V / 10 mA	3.000 A	30.00 A	300.0 A	WZ12B, Z201A
1:100 1m V / 100 mA	30.00 A	300.0 A	3,000 kA	Z202A
1:1000 1 mV/1 A	300.0 A	3,000 kA	30.00 kA	Z202A, Z203A, WZ12C

Maximum allowable operating voltage is equal to the current transformer's nominal voltage. When reading the measured value, additional error resulting from the clip-on current sensor must also be taken into consideration.

(default value: CL, P = OFF = voltage display)



5.8.5 Alternating Current Measurement with A AC and Hz Clip-On Current Transformer

Current/Current Transformer Output

When a clip-on current transformer is connected to the multimeter (mA/A input), all current displays appear with the correct value in accordance with the selected transformation ratio.

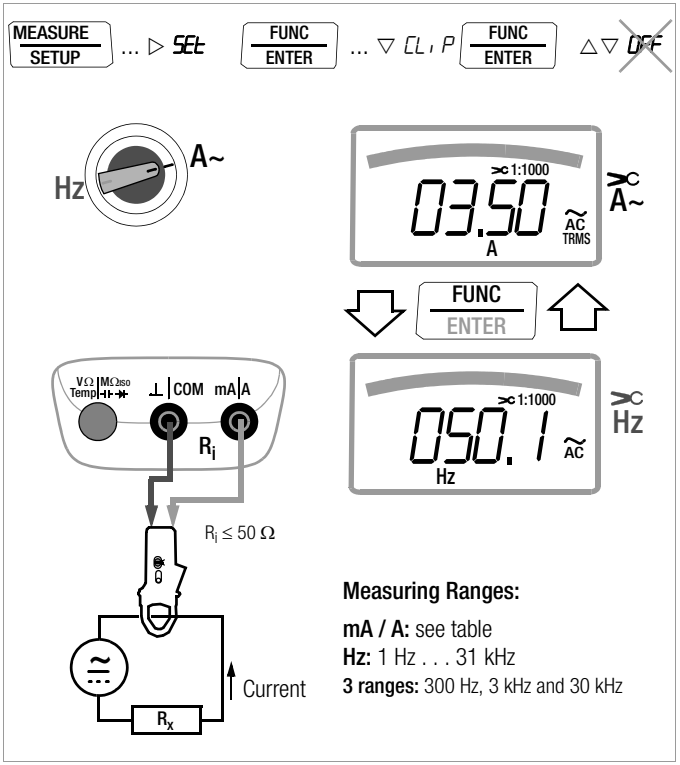
The only prerequisite is that the current transformer is equipped with at least one of the below listed transformation ratios, and that the ratio has been previously selected in the following menu (*CL.P* ≠ *OFF*).

Current Clip Setup Menu

MEASURE SETUP *InFo* ▷ ... ▷ *SEt* FUNC ENTER *rAtE* ▽ ... ▽ *CL.P*

FUNC ENTER *1/ 10/ 100/ 1000 / OFF* △▽ FUNC ENTER

Transf. Ratios *CL.P*	DMM Measuring Ranges			Clip Types
	30 mA	300 mA	3 A	
1:1 1mA / 1 mA	30.00 mA	300.0 mA	3.000 A	
1:10 1 mA / 10 mA	300 mA	3.000 A	30.00 A	
1:100 1 mA / 100 mA	3.000 A	30.00 A	300.0 A	
1:1000 1 mA / 1 A	30.00 A	300.0 A	3000.0 A	WZ12A, WZ12D, WZ11A, Z3511, Z3512, Z3514



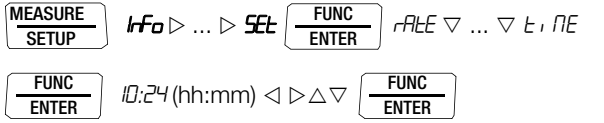
6 Device and Measuring Parameters

The instrument's "SEtuP" mode (menu mode) makes it possible to set operating and measuring parameters, query information and activate the interface.

- The menu mode is accessed by pressing the **MEASURE | SETUP** key, assuming that the instrument is switched on and set to "Measure" (measuring mode operation). " InFo" appears at the display.
- The main menus, i.e. the "SEt" and "tEMP" menus, as well as the "SEnd" and "StorE" menus, are accessed, and the display is returned to "ı nFo", by repeatedly activating the ◁ ▷△▽ keys (in any direction).
- After selecting the desired main menu, sub-menus are accessed by pressing the **FUNC | ENTER** key.
- The desired parameter is selected by repeatedly pressing the △▽ keys.
- In order to check or change a parameter, acknowledge it with the **FUNC | ENTER** key.
- The ◁ ▷ keys can be used to position the cursor at the entry position.
  The desired value is selected with the help of the △▽ keys.
- Changes can only be accepted with the **FUNC | ENTER** key.
- You can return to the sub-menu without making any changes by pressing the **ZERO | ESC** key, and to the main menu by pressing the **ZERO | ESC** key once again etc.
- You can switch to the measuring mode from any menu level by pressing the **FUNC | ENTER** key.

After repeatedly pressing the **MEASURE | SETUP** key (without first turning the multimeter off), you can return to the last selected menu or parameter from the measuring mode.

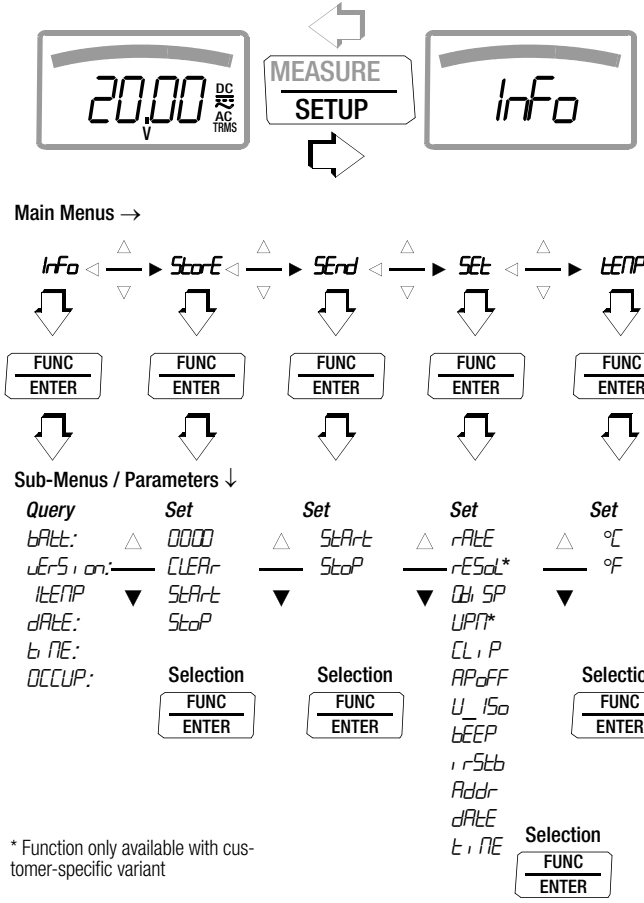
Example: Setting Time



Setting hours and minutes:

◁ ▷	Advance to desired entry position.
△▽	Change the setting, the entry position blinks. Press and hold the key to change the setting rapidly.
FUNC / ENTER	The new time setting is activated after acknowledgement.

6.1 Paths to the Various Parameters



6.2 List of All Parameters

Parameter	Page: Header
0.diSP	51: 0.diSP – show/hide leading zeros
Addr	55: Configuring Interface Parameters
APoFF	52: APoFF – specified time for automatic shutdown and continuous ON
bAtt	50: bAtt – query battery voltage
bEEP	52: bEEP – set limit value for continuity testing
CLEAr	23: Measurement Data Recording
CLiP	45: Direct and Pulsating Current Measurement with Clip-On Current Sensor A DC and A (DC+AC) 46: Alternating Current Measurement with Clip-On Current Sensor, A AC and Hz
dAtE	50: dAtE – query date, 53: dAtE – enter date
EMPty	23: Measurement Data Recording
InFo	50: Querying Parameters – InFo Menu (as moving letters)
rStb	55: Configuring Interface Parameters
ItEMP	50: ItEMP – query reference temperature
OCCUP	23: Measurement Data Recording
rAtE	51: rAtE – set the sampling rate
rESoL	51: rESoL – high resolution for V DC and W (customer-specific function)
SEnd	54: Activating the Interface
SEt	51: Entering Parameters – SETUP Menu
StArt	23: Measurement Data Recording
StoP	
Store	
tEMP	33: Temperature Measurement: Temp RTD and Temp TC
tiME	50: tiME – query time, 53: tiME – set time
U ISo	52: U_ISo – select test voltage
UPM	52: RPM – revolutions per minute (customer-specific function)
vErSion	50: vErSion – query firmware version

6.3 Querying Parameters – InFo Menu (as moving letters)

bAtt – query battery voltage

MEASURE SETUP InFo FUNC ENTER bAtt: 2.75 V.

vErSion – query firmware version

MEASURE SETUP InFo FUNC ENTER bAtt: ▽ vErSion: 1.00

ItEMP – query reference temperature

The temperature of the internal reference junction is measured with a temperature sensor in close proximity to the input sockets.

MEASURE SETUP InFo FUNC ENTER bAtt: ▽ ... ▽ ItEMP: 24 °C

dAtE – query date

MEASURE SETUP InFo FUNC ENTER bAtt: ▽ ... ▽ dAtE: 31. 12.05 (DD.MM.YY)

D = day, M = month, Y = year

Date and time must be reentered after replacing the batteries.

tiME – query time

MEASURE SETUP InFo FUNC ENTER bAtt: ▽ ... ▽ tiME: 13:46:56 (hh:mm:ss)

h = hours, m = minutes, s = seconds

Date and time must be reentered after replacing the batteries.

OCCUP – query memory occupancy

MEASURE SETUP InFo FUNC ENTER bAtt: ▽ ... ▽ OCCUP: 000.0%

6.4 Entering Parameters – SETUP Menu

rAtE – set the sampling rate

The sampling rate specifies the time interval after which the respective measured value is transmitted to the interface, or to measured value memory.

Any one of the following sampling rates can be selected:
[mm:ss.t]: 00:00,1, 00:00,2, **00:00.5**, 00:01,0, 00:02,0, 00:05.0
[h:mm:ss.t] (h=hours, m=minutes, s=seconds, z=tenths of a sec.):
0:00:10, 0:00:20, 0:00:30, 0:00:40, 0:00:50, 0:01:00, 0:02:00, 0:05:00, 0:10:00, 0:20:00, 0:30:00, 0:40:00, 0:50:00, 1:00:00, 2:00:00, 3:00:00, 4:00:00, 5:00:00, 6:00:00, 7:00:00, 8:00:00, 9:00:00

Setting the Sampling Rate

MEASURE / SETUP InFo ▷ ... ▷ SEt FUNC / ENTER rAtE FUNC / ENTER

00:00. 1 ... **00:00.5** ... 9:00:00 △▽ FUNC / ENTER

(00:00.5 = 0.5 s = default value)

rESoL – high resolution for V DC and Ω (customer-specific function)

Switching back and forth between 3¾ and 4¾ places is possible for
direct voltage and resistance measurement.

MEASURE / SETUP InFo ▷ ... ▷ SEt FUNC / ENTER rAtE ▽ ... ▽ rESoL

FUNC / ENTER 3000. / 30000 △▽ FUNC / ENTER

(3000 = default setting)

0.diSP – show/hide leading zeros

This parameter determines whether or not leading zeros will appear in the measured value display.

MEASURE / SETUP InFo ▷ ... ▷ SEt FUNC / ENTER rAtE ▽ ... ▽ 0.di SP FUNC / ENTER

0000.0 : with leading zeros (default value)
0.0 : leading zeros suppressed

△▽ FUNC / ENTER

CLIP – set current clip factor

See chapter 5.8.3, chapter 5.8.4 and chapter 5.8.5.

APoFF – specified time for automatic shutdown and continuous ON

The instrument is switched off automatically if the measured value remains unchanged for a long period of time and if none of the keys or the rotary switch have been activated before the specified time "APoFF" (entered in minutes) has elapsed.

If the on setting is selected, the multimeter is set for long-term measurement and **ON** appears in the display to the right of the battery symbol. In this case, the multimeter can only be switched off manually. The "on" setting can only be cancelled by changing the
respective parameter, and not by switching the instrument off.

MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ APoFF

FUNC ENTER 10 ... 59 min on △▽ FUNC ENTER

(10 minutes = default setting)

U_ISo – select test voltage

The desired test voltage for insulation resistance measurement can be selected here:

MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ U ISo

FUNC ENTER ... 500, 1000 V* △▽ FUNC ENTER

* Selectable test voltages and the default setting depend upon the respective customer-specific variant.

RPM – revolutions per minute (customer-specific function)

See section 5.1.2 regarding settings.

bEEP – set limit value for continuity testing

MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ bEEP

FUNC ENTER 1, 10, 20, 30, 40, 90 Ω △▽ FUNC ENTER

(10 Ω = default setting)

irStb – status of the infrared receiver in the stand-by mode

See chapter 7.2 on page 55 regarding settings.

Addr – set device address

See chapter 7.2 on page 55.

dAtE – enter date

Entering the current date makes it possible to acquire measured values in real-time.

MEASURE / SETUP InFo ▷ ... ▷ SEt FUNC / ENTER rAtE ▽ ... ▽ dAtE

FUNC / ENTER 31.12 (DD: day . MM: month) ◁ ▷△▽ FUNC / ENTER

2005 (YYYY: year) ◁ ▷△▽ FUNC / ENTER

Date and time must be reentered after replacing the batteries.

tiME – set time

Entering the correct time makes it possible to acquire measured values in real-time.

MEASURE / SETUP InFo ▷ ... ▷ SEt FUNC / ENTER rAtE ▽ ... ▽ tiME

FUNC / ENTER 10:24 (hh:mm) ◁ ▷△▽ FUNC / ENTER

Date and time must be reentered after replacing the batteries.

6.5 Default Settings

Previously entered changes can be undone, and the default settings can be reactivated. This may be advisable under the following circumstances:

- after the occurrence of software or hardware errors,
- if you are under the impression that the multimeter does not work correctly.

➪ **Disconnect the device from the measuring circuit.**

➪ Remove the batteries temporarily (see also chapter 9.2).

➪ Simultaneously press and hold the ZERO / ESC and ON / OFF / LIGHT keys, and connect the battery at the same time.

A sequence of acoustic signals consisting of two immediately consecutive tones acknowledges successful resetting.

7 Interface Operation

The multimeter is equipped with an infrared interface for the transmission of measurement data to a PC. Measured data are optically transferred through the instrument housing by means of infrared light to an interface adapter (accessory), which is attached to the multimeter. The adapter's USB interface allows for the establishment of a connection to the PC via an interface cable. Beyond this, commands and parameters can be transmitted from the PC to the multimeter as well. The following functions can be executed:

- Configuration and read-out of measuring parameters,
- Measuring function and measuring range selection,
- Start measurement,
- Read out stored measured values.

7.1 Activating the Interface

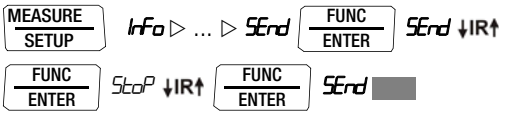
The interface is automatically activated for receiving operation (multimeter receives data from the PC) as soon as the interface is addressed by the PC, assuming that the "i rStb" parameter has been set to "i ron" (see chapter 7.2), or the instrument is already switched on (the first command wakes up the multimeter, but does not yet execute any further commands).

The "continuous transmission" operating mode is selected manually as described below. In this operating mode, the instrument continuously transmits measurement data to the PC via the interface adapter, which can then be displayed with the help of a terminal program.

Starting Continuous Transmission Operation with Menu Functions

The IR symbol blinks at the display in order to indicate interface operation.

Stopping Continuous Transmission Operation with Menu Functions



The IR symbol is cleared from the display.

Automatic Activation and Deactivation of Transmission Mode Operation

If the sampling rate is 10 seconds or longer, the display is switched off automatically between samples in order to prolong battery service life. The only exception is when the multimeter is set to continuous operation.

As soon as an event occurs, the display is automatically switched back on.

7.2 Configuring Interface Parameters

ı rStb – status of the infrared receiver in the stand-by mode

There are two possible switching statuses for the infrared interface when the multimeter is switched off:

ı r on: IR appears at the display and the infrared interface is active, i.e. signals such as making commands can be received, and power is consumed even though the multimeter is switched off.

ı roFF: IR does not appear at the display and the infrared interface is switched off, signals cannot be received.

MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ ı rStb

FUNC ENTER ı r on / ı roFF △▽ FUNC ENTER

(ı rStb = ı roFF = default setting)

Addr – Address

If several multimeters are connected to the PC via an interface adapter, a separate address can be assigned to each instrument. Address number 1 should be selected for the first instrument, 2 should be assigned to the second and so forth.

MEASURE SETUP InFo ▷ ... ▷ SEt FUNC ENTER rAtE ▽ ... ▽ Addr

FUNC ENTER 00 ... 01 ... 15 △▽ FUNC ENTER

(15 = default setting)

8 Technical Data

Meas. Function (input)	Measuring Range	Resolution at Upper Range Limit		Input Impedance		Intrinsic Uncertainty under Reference Conditions ±(... % rdg. + ... d)				Overload Capacity [2]	
		30000	3000	⎓	~ / ≂	30000 ⎓	3000 ⎓	3000 ~ [1] [11]	3000 ≂ [1] [11]	Value	Time
V	300.0 mV	10 µV	100 µV	9 MΩ	9 MΩ // < 50 pF	0.15 + 15 [10]	0.2 + 3 [10]	1 + 3 (> 100 D)	1.5 + 5 (> 100 D)	1000 V DC AC RMS Sine [6]	Cont.
	3.000 V	100 µV	1 mV	9 MΩ	9 MΩ // < 50 pF	0.15 + 15	0.15 + 2	1 + 3 (> 30 D)	1.5 + 5 (> 100 D)		
	30.00 V	1 mV	10 mV	9 MΩ	9 MΩ // < 50 pF	0.15 + 15	0.15 + 2				
	300.0 V	10 mV	100 mV	9 MΩ	9 MΩ // < 50 pF	0.15 + 15	0.15 + 2				
	1000 V	100 mV	1 V	9 MΩ	9 MΩ // < 50 pF	0.15 + 15	0.2 + 2				
				Voltage drop at approx. range limit			⎓	~ [1] [11]	≂ [1] [11]		
A	300.0 µA		100 nA	18 mV	18 mV		0.5 + 5	1.5 + 5 (> 100 D)	1.5 + 5 (> 100 D)	0.3 A	Cont.
	3.000 mA		1 µA	160 mV	160 mV		0.2 + 3	1.5 + 5 (> 30 D)	1.5 + 5 (> 100 D)		
	30.00 mA		10 µA	32 mV	32 mV		0.5 + 3				
	300.0 mA		100 µA	200 mV	200 mV		0.2 + 3				
	3.000 A		1 mA	120 mV	120 mV		1 + 5			10 A	5 min [12]
	10.00 A		10 mA	400 mV	400 mV		1 + 5				
	Factor 1:1/10/100/1000		Input	Input impedance			⎓	~ [1] [11]	≂ [1] [11]		
A ⋋ C @ A	0.03/0.3/3/30 A		30 mA	Current measurement input (jack A~)			—	1.5 + 5 (> 100 D)	—	0.3 A	Cont.
	0.3/3/30/300 A		300 mA								
	3/30/300/3k A		3 A				Plus clip-on current transformer error			3 A	5 min
A ⋋ C @ V	0.3/3/30/300 A		300 mV	Voltage measurement input approx. 9 MΩ (V socket)			0.5 + 3	1.5 + 3 (> 300 D)	1.5 + 5 (> 300 D)	Meas. input [6]: 1000 V RMS	max. 10 s
	3/30/300/3k A		3 V					1.5 + 3 (> 30 D)	1.5 + 5 (> 100 D)		
	30/300/3k/30k A		30 V				Plus clip-on current sensor error				
				Open-circuit voltage	Meas. current at range limit	±(... % rdg. + ... d) 30000	3000				
Ω	300.0 Ω	10 mΩ	100 mΩ	< 1.4 V	Approx. 300 µA	0.5 + 3 with ZERO active	0.5 + 3 with ZERO active			1000 V DC AC RMS Sine	max. 10 s
	3.000 kΩ	100 mΩ	1 Ω	< 1.4 V	Approx. 200 µA	0.5 + 15	0.5 + 2				
	30.00 kΩ	1 Ω	10 Ω	< 1.4 V	Approx. 30 µA	0.5 + 15	0.5 + 2				
	300.0 kΩ	10 Ω	100 Ω	< 1.4 V	Approx. 3 µA	0.5 + 15	0.5 + 2				
	3.000 MΩ	100 Ω	1 kΩ	< 1.4 V	Approx. 0.3 µA	0.5 + 15	0.5 + 2				
	30.00 MΩ	1 kΩ	10 kΩ	< 1.4 V	Approx. 33 nA	2.0 + 20	2.0 + 5				
🔊	300.0 Ω		100 mΩ	ca. 10 V	Approx. 1 mA const.	3 + 5					
⏚	5.1 V [3]		1 mV	ca. 10 V		2 + 5					

Meas. Function (input)	Measuring Range		Resolution at Upper Range Limit	3000			Intrinsic Uncertainty under Reference Conditions		Overload Capacity [2] Value	Time
					Discharge resist.	$U_{0\ max}$	±(... % rdg. + ... d)			
F	30.00	nF		10 pF	10 MΩ	0.7 V	1 + 6 [4] with ZERO function active		1000 V DC AC RMS Sine	max. 10 s
	300.0	nF		100 pF	1 MΩ	0.7 V	1 + 6 [4]			
	3.000	µF		1 nF	100 kΩ	0.7 V	1 + 6 [4]			
	30.00	µF		10 nF	12 kΩ	0.7 V	1 + 6 [4]			
	300.0	µF		100 nF	3 kΩ	0.7 V	5 + 6 [4]			
						f_{min} [5]	±(... % rdg. + ... d)			
Hz (V)/ Hz (A)	300.0	Hz		0.1 Hz		1 Hz	0.1 + 2 [8]		Hz (V) [6]: Hz(A⌇) [6]: 1000 V Hz (A): [7]	max. 10 s
	3.000	kHz		1 Hz						
Hz (A⌇)	30.00	kHz		10 Hz		10 Hz				
Hz (V)	300.0	kHz		100 Hz		100 Hz				
							±(... % rdg. + ... d) [9]			
°C	Pt 100	– 200.0 ... +850.0 °C		0.1 °C			0.5 %+ 15		1000 V DC/AC RMS Sine	max. 10 s
	Pt 1000	– 150.0 ... +850.0 °C					0.5 %+ 15			
	K (NiCr-Ni)	– 250.0 ... +1372.0 °C					1% + 5 K			

[1] 15 ... 45 ... 65 Hz ... 10 (5) kHz sine. See following page for influences.
[2] At 0 ° ... + 40 °C
[3] Display of up to max. 5.1 V, “OL” in excess of 5.1 V.
[4] Applies to measurements at film capacitors
[5] Lowest measurable freq. for sinusoidal meas. signals symmetrical to zero point
[6] Overload capacity of the voltage measurement input: power limiting: frequency x max. voltage 3 x 10^6 V x Hz @ U > 100 V
[7] Overload capacity of the current measurement input: See current measuring ranges for maximum current values.
[8] Input sensitivity, sinusoidal signal, 10% to 100% of the voltage or current measuring range; limitation: up to 30% of the range at up to 100 kHz in the mV measuring range, 30% of the range in the 3 A measuring range. The voltage measuring ranges with max. 30 kHz apply in the A⌇ measuring range.
[9] Plus sensor deviation
[10] With ZERO function active
[11] Residual value of 1 to 10 d with short circuited terminal tips, exception: mV / µA range of 1 to 35 d at zero point due to the TRMS converter

Key: R = meas. range, d = digit(s), rdg. = measured value (reading)

Insulation Resistance Measurement [1]

Measuring Range	Resolution	Test voltage U_{ISO}	Digital Display Intrinsic Uncertainty under Reference Conditions
0,3 V ... 1000 V ≂ [2]		Ri=1MΩ	3 + 30 > 100 Digit
5 ... 310.0 kΩ	0,1 kΩ	50/100/250/500 V	3 + 5
0.280 ... 3.100 MΩ	1 kΩ	50/100/250/500/1000 V	3 + 5
02.80 ... 31.00 MΩ	10 kΩ	50/100/250/500/1000 V	5 + 5
028.0 ... 310.0 MΩ	100 kΩ	50/100/250/500/1000 V	5 + 5
0280 ... 3100 MΩ	1 MΩ	500/1000 V	5 + 5

1) During insulation measurement ($M\Omega_{@UISO}$): If ERROR is displayed >> limits: $U_{interference}$ > 10....20 V and $U_{interference} \neq U_{ISO}$, Ri < 50 kΩ @ Uiso 50 V, Ri < 100 kΩ @ Uiso 100 V, Ri < 250 kΩ @ Uiso 250 V, Ri < 500 kΩ @ Uiso 500 V, Ri < 1000 kΩ @ Uiso 1000 V

2) Interference voltage measurement TRMS (V AC + DC) with 1 MΩ input resistance, Bandwidth 15 Hz ... 500 Hz, measuring error 3% + 30 Digit

Measuring Function	Nom. Voltage U_N	Open-Circuit Voltage U_o	Nom. Current I_N	Short-Circuit Current I_k	Acoustic Signal for	Overload Capacity Value	Overload Capacity Time
$U_{interference}$/ $M\Omega_{@UISO}$	—	—	—	—	U>1000V	1000 V≂	Cont.
$M\Omega_{@UISO}$	50, 100, 250, 500 V	max. 1.1x U_{ISO}	1.0 mA	< 1.2 mA	U>1000V	1000 V≂	10 s
$M\Omega_{@UISO}$	1000 V	max. 1.1x U_{ISO}	0.5 mA	< 1.2 mA	U>1000V	1000 V≂	10 s

Internal Clock

Time format	TT.MM.JJJJ hh:mm:ss
Resolution	0.1 s
Accuracy	±1 minute per month
Temperature influence	50 ppm/K

Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range [1]	Influence Error (...% rdg. + ... d) / 10 K
Temperature	0 °C ... +21 °C and +25 °C ... +40 °C	V ⎓	0.2 + 5
		V ∼	0.4 + 5
		300 Ω ... 3 MΩ	0.5 + 5
		30 MΩ	1 + 5
		mA/A ⎓	0.5 + 5
		mA/A ≂	0.8 + 5
		30 nF ... 300 µF	1 + 5
		Hz	0.2 + 5
		°C/°F (Pt100/Pt1000)	0.5 + 5

1) With zero balancing

Influencing Quantity	Measured Quantity / Measuring Range		Sphere of Influence	Intrinsic Uncertainty [3] ±(... % rdg. + ... d)
Frequency	V_{AC} [2]	300 mV ... 300 V	> 15 Hz ... 45 Hz	2 + 5 > 300 Digit
			> 65 Hz ... 2 kHz	2 + 5 > 300 Digit
			> 2 kHz ... 10 kHz	3 + 5 > 300 Digit
		1000 V	> 65 Hz ... 5 kHz	3 + 5 > 60 Digit
	A_{AC}	300 µA ... 10 A	> 15 Hz ... 45 Hz	3 + 10 > 300 Digit
			> 65 Hz ... 10 kHz	
	A_{AC+DC}	300 µA ... 10 A	> 15 Hz ... 45 Hz	3 + 30 > 300 Digit
			> 65 Hz ... 10 kHz	
	A_{AC} ⩙	300 mV / 3 V / 30 V [2]	>65 Hz ... 10 kHz	3 + 5 > 300 Digit
	A_{AC} ⩙	30 mA...3 A	>65 Hz ... 10 kHz	3 + 30 > 300 Digit

2) Power limiting: frequency x voltage, max. 3×10^6 V x Hz

3) The accuracy specification is valid as of a display value of 10% and up to 100% of the measuring range for both measuring modes with the TRMS converter in the A AC and A (AC+DC) ranges.

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range	Influence Error [5]
Crest Factor CF	1 ... 3	V ∼, A ∼	± 1% rdg.
	> 3 ... 5		± 3% rdg.

[5] Except for sinusoidal waveshape

Influencing Quantity	Sphere of Influence	Measured Quantity	Influence Error
Relative Humidity	75%, 3 days, instrument off	V, A, Ω, F, Hz, °C	1 x intrinsic uncertainty
Battery voltage	1.8 to 3.6 V	ditto	Included in intrinsic uncertainty

Influencing Quantity	Sphere of Influence	Measured Qty. / Measuring Range	Damping
Common Mode Interference Voltage	Interference quantity max. 1000 V ∼	V ⎓	> 120 dB
	Interference quantity max. 1000 V ∼ 50 Hz ... 60 Hz, sine	3 V ∼, 30 V ∼	> 80 dB
		300 V ∼	> 70 dB
		1000 V ∼	> 60 dB
Series Mode Interference Voltage	Interference quantity: V ∼ , respective nominal value of the measuring range, max. 1000 V ∼ , 50 Hz ... 60 Hz sine	V ⎓	> 50 dB
	Interference quantity max. 1000 V ⎓	V ∼	> 110 dB

Response Time (after manual range selection)

Measured Quantity / Measuring Range	Response Time Digital Display	Measured Quantity Jump Function
V ⎓ , V ∼ A ⎓ , A ∼	1.5 s	From 0 to 80% of upper range limit value
300 Ω ... 3 MΩ	2 s	From ∞ to 50% of upper range limit value
30 MΩ, $M\Omega_{@UISO}$	Max. 5 s	
Continuity	< 50 ms	
°C (Pt 100)	Max. 3 s	
⭲⭰	1.5 s	
30 nF ... 300 µF	Max. 5 s	From 0 to 50% of upper range limit value
>10 Hz	1.5 s	

Reference Conditions

Ambient temperature	+23° C ±2 K
Relative humidity	40% to 75%
Meas. Qty. Freq.	45 Hz … 65 Hz
Meas. Qty. Waveshape	Sine
Battery voltage	3 V ±0.1 V

Ambient Conditions

Accuracy range	0° C ... +40° C
Operating temp. range	–10° C ... +50° C
Storage temp. range	–25° C ... +70° C (without batteries)
Relative humidity	40 to 75%, no condensation allowed
Elevation	to 2000 m
Deployment	Indoors and Outdoors

Display

LCD panel (65 mm x 36 mm) with analog and digital display including unit of measure, type of current and various special functions

Background illumination

Background illumination is switched off approximately 1 minute after it has been activated.

Analog

Display	LCD scale with pointer
Scaling	Linear: ∓ 5 ... 0 ... ±30 with 35 scale divisions for ⎓ , 0 ... 30 with 30 scale divisions in all other ranges
Polarity display	With automatic switching
Overflow display	With the ▶ symbol
Measuring rate	40 measurements per second and display refresh

Digital

Display/Char. Height	7-segment characters / 15 mm
Number of places	3¾ places, ≙ 3100 steps 4¾ places in measuring function V DC and Ω
Overflow display	"OL" is displayed for ≥3100 digits
Polarity display	"–" (minus sign) is displayed if plus pole is connected to "⊥"
Measuring rate	10 and 40 measurements per second with the Min/Max function except for the capacitance, frequency and keying ratio measuring functions
Refresh Rate	2 times per sec., every 500 ms

Power Supply

Battery	2 ea. 1.5 V alkaline manganese batteries (2 ea. size AA), alkaline manganese per IEC LR6
Service life	With alkaline manganese batteries: approx. 200 hours (without $M\Omega_{@UISO}$ measurement)
Battery test	Battery capacity display with battery symbol in 4 segments:  . Querying of momentary battery voltage via menu function.
Power OFF function	The multimeter is switched off automatically: – If battery voltage drops to below approx. 1.8 V – If none of the keys or the rotary switch are activated for an adjustable duration of 10 to 59 minutes, and the multimeter is not in the continuous operation mode
Power pack socket	If the power pack has been plugged into the instrument, the installed batteries are disconnected automatically. Rechargeable batteries can only be recharged externally.

Measuring Function	Nominal Voltage U_N	Resistance of the DUT	Service life in Hours	Number of Possible Measurements with Nominal Current per VDE 0413
V ⎓			200 [1]	
V ∼			150 [1]	
MΩ	100 V	1 MΩ	50	
	100 V	100 kΩ		3000
	500 V	500 kΩ		600
	1000 V	2 MΩ		200

[1] Times 0.7 for interface operation

Electrical Safety

Safety class	II per EN 61010-1:2001/VDE 0411-1:2002	
Measuring category	CAT II	CAT III
Nominal voltage	1000 V	600 V
Fouling factor	2	
Test voltage	5.2 kV~ per EN 61010-1:2001/VDE 0411-1:2002	

Fuses

Fuse link	FF 10 A/1000 V AC/DC; 10 mm x 38 mm; switching capacity: 30 kA at 1000 V AC/DC; protects the current measurement input in the 300 µA through 10 A ranges

Electromagnetic Compatibility (EMC)

Interference emission	EN 61326-1:2006, class B
Interference immunity	EN 61326-1:2006 EN 61326-2-1:2006

Data Interface

Type	Optical via infrared light through the housing
Data transmission	Serial, bidirectional (not IrDa compatible)
Protocol	Device specific
Baud Rate	38,400 baud
Functions	– Select/query measuring functions and parameters – Query momentary measurement data

The USB plug-in interface adapter (see accessories) is used for adaptation to the PC's USB port.

Internal Measured Value Storage

Memory capacity	540 kB for approx. 15,000 measured values with indication of date and time

Mechanical Design

Housing	Impact resistant plastic (ABS)
Dimensions	200 x 87 x 45 mm (without protective rubber cover)
Weight	Approx. 0.35 kg with batteries
Protection	Housing: IP 65 (pressure equalization by means of the housing)

Table Excerpt Regarding Significance of the IP Code

IP XY (1st digit X)	Protection against foreign object entry	IP XY (2nd digit Y)	Protection against the penetration of water
4	≥ 1.0 mm dia.	4	splashing water
5	dust protected	5	water jets

9 Maintenance and Calibration

Attention!
Disconnect the instrument from the measuring circuit before opening the battery compartment lid or fuse cover when replacing batteries or fuses!

9.1 Displays – Error Messages

Message	Function	Meaning
FuSE	Current measurement	Blown fuse
[ ]	In all operating modes	Battery voltage has fallen below 1.8 V
OL	Measurement	Indicates overflow
ur	$M\Omega_{ISO}$ measurement	Measured value of less than 10% of the measuring range
Error	$M\Omega_{ISO}$ measurement	Interference voltage detected

9.2 Batteries

Note
Removing the Batteries During Periods of Non-Use
The integrated quartz movement draws power from the batteries even when the instrument is switched off. It is advisable to remove the batteries during long periods of non-use for this reason (e.g. vacation). This prevents excessive depletion of the battery, which may result in damage under unfavorable conditions.

Note
Battery Replacement
Stored measurement data are lost when the batteries are replaced. In order to prevent data loss, it is advisable to backup your data to a PC with the help of **DranWin 10** software before replacing the batteries.
The selected operating parameters remain in memory, although date and time must be reentered.

Battery

The current battery charge level can be queried in the " InFo" menu:

MEASURE / SETUP InFo FUNC / ENTER bAtt: 2.75 V.

Make sure that no battery leakage has occurred before initial start-up, as well as after long periods of storage. Continue to inspect the batteries for leakage at short, regular intervals.

If battery leakage has occurred, carefully and completely clean the electrolyte from the instrument with a damp cloth, and replace the battery before using the instrument.

If the "[ ]" symbol appears at the display, the batteries should be replaced as soon as possible. You can continue working with the instrument, but reduced measuring accuracy may result.

The instrument requires two 1.5 V batteries in accordance with IEC LR 6, or two equivalent rechargeable NiCd batteries.

Replacing the Batteries

Attention!
Disconnect the instrument from the measuring circuit before opening the battery compartment lid in order to replace the batteries.

- Set the instrument face down onto the working surface.
- Turn the slotted screw on the lid with the battery symbols counterclockwise.
- Lift off the lid and remove the batteries from the battery compartment.
- Insert two new 1.5 V alkaline manganese batteries into the battery compartment, making sure that the plus and minus poles match up with the provided polarity symbols.
- When replacing the battery compartment lid, insert the side with the guide hooks first.
  Tighten the screw by turning it clockwise.
- Please dispose of depleted batteries in accordance with environmental protection regulations!

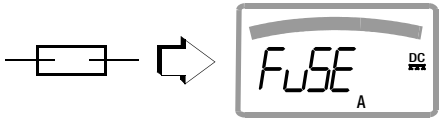
9.3 Fuses

Testing the Fuse

The fuse is tested automatically:

- When the instrument is switched on with the rotary switch in the A position
- When the instrument is already on and the rotary switch is turned to the A position
- In the active current measuring range when voltage is applied

If the fuse is blown or has not been inserted, “FuSE” appears at the digital display. The fuse interrupts the current measuring ranges. All other measuring ranges remain functional.



Blown Fuse

Replacing the Fuse

If a fuse should blow, eliminate the cause of overload before placing the instrument back into service!

Attention!
Disconnect the instrument from the measuring circuit before opening the fuse cover in order to replace the fuse!

- Set the instrument face down onto the working surface.
- Turn the slotted screw on the cover with the fuse symbol counterclockwise.
- Lift off the cover and pry the fuse out using the flat side of the fuse cover.
- Insert a new fuse. Make sure that the fuse is centered, i.e. between the tabs at the sides.
- When replacing the fuse cover, insert the side with the guide hooks first. Tighten the screw by turning it clockwise.
- Dispose of the blown fuse with the trash.

Attention!
Use specified fuses only!
If fuses with other blowing characteristics, other current ratings or other breaking capacities are used, the operator is placed in danger, and protective diodes, resistors and other components may be damaged.
The use of repaired fuses or short-circuiting the fuse holder is prohibited.

Note
Testing the Fuse with the Instrument Switched On
After inserting the fuse with the instrument switched on, the instrument must be switched off briefly and then switched back on, or briefly switched to a non current measuring range and then back to the A measuring range.
If contact is poor or the fuse is blown, FUSE appears at the display.

9.4 Housing Maintenance

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

9.5 Return and Environmentally Sound Disposal

The instrument is a category 9 product (monitoring and control instrument) in accordance with ElektroG (German electrical and electronic device law). This device is not subject to the RoHS directive.

We identify our electrical and electronic devices (as of August 2005) in accordance with WEEE 2002/96/EC and ElektroG with the symbol shown at the right per DIN EN 50419.

These devices may not be disposed of with the trash.

Please contact our service department regarding the return of old devices (see page 4).

9.6 Recalibration Service

We **calibrate** and **recalibrate** all instruments supplied by Dranetz-BMI, as well as other manufacturers, at our service center, for example after one year within the framework of your test equipment monitoring program, as well as prior to use etc. (see address on page 4).

9.7 Manufacturer's Guarantee

The multimeter is guaranteed for a period of 3 years after shipment. The manufacturer's guarantee covers materials and workmanship. Damages resulting from use for any other than the intended purpose, as well as any and all consequential damages, are excluded.

Calibration is guaranteed for a period of 12 months.

10 Accessories

10.1 General

The extensive accessories available for our measuring instruments are checked for compliance with currently valid safety regulations at regular intervals, and are expanded as required for new applications. Currently up-to-date accessories which are suitable for your measuring instrument are listed at the following web address along with photo, order number, description and, depending upon the scope of the respective accessory, data sheet and operating instructions: www.dranetz-bmi.com
(→ Products → Measuring Technology – Portable → Digital Multimeters → DranTech ... → Accessories).

10.2 Technical Data for Measurement Cables

Electrical Safety

Maximum rated voltage Measuring category	1000 V CAT III, 600 V CAT IV
Maximum rated current	16 A

Ambient Conditions (EN 61010-031)

Temperature	–20 °C ... + 50 °C
Relative humidity	50 to 80%
Pollution degree	2

10.3 Power Pack NA (not included)

Use only power packs from Dranetz-BMI only in combination with your instrument. This assures operator safety by means of an extremely well insulated cable, and safe electrical isolation (nominal secondary ratings: 5 V / 600 mA).
Installed batteries are disconnected electronically if the power pack is used, and need not be removed from the instrument.

10.4 Interface Accessories (not included)

USB Bidirectional Interface Adapter

This adapter makes it possible to connect cable multimeters, as well as **DranTech ISO** multimeters which are equipped with a serial IR interface, to the USB port at a PC. The adapter allows for data transmission between the multimeter and the PC.

DranWin 10 **PC Analysis Software**

DranWin 10 PC software is a multilingual, measurement data logging program for recording, visualizing, evaluating and documenting measured values from DranTech multimeters.

The following conditions must be fulfilled in order to allow for use of DranWin 10:

Hardware

- IBM compatible Windows PC, 200 MHz Pentium processor or faster with at least 64 MB RAM
- SVGA monitor with at least 1024 x 768 pixels
- Hard disk with at least 40 MB available memory capacity
- CD ROM drive
- Microsoft compatible mouse
- Windows supported printer
- 1 USB port for the use of USB

Software

- MS Windows 98, ME, NT4.0, 2000 or XP or VISTA

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