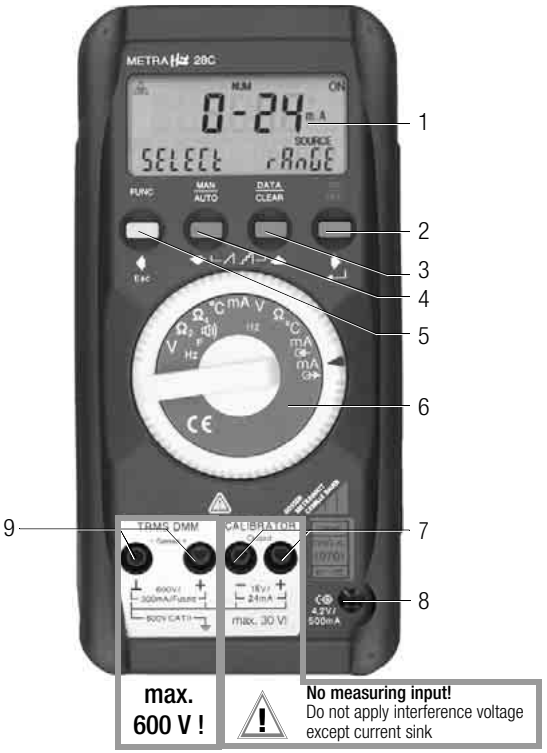
Operating Instructions

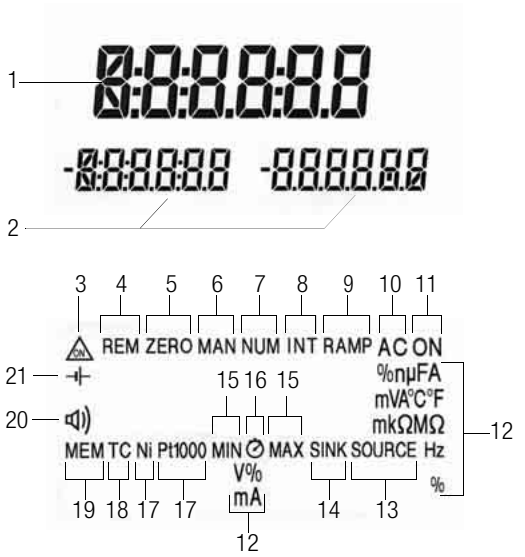
GOSSEN METRAWATT

METRAHit® 28C

Multimeter, Milliohmmeter and Calibrator

3-349-099-15
3/3.03





1 Display (LCD)

2 ON/OFF key, menu functions
Operating mode menu: Changeover to sub-menus / acknowledgement of entries

3 DATA/CLEAR key for following functions: save measured value, delete and MIN/MAX
Operating mode menu: Selection of individual menu items against direction of flow, increase values

4 MAN/AUTO key for manual measuring range selection
Operating mode menu: Selection of individual menu items in direction of flow, decrease values

5 FUNC/ESC key for selecting ranges or functions
Operating mode menu: Exit menu level and return to a higher level, exit parameters configuration without saving data

6 Rotary switch for measuring and simulation functions

7 Connector jacks for calibrator output

8 Power pack connector jack

9 Connector jacks for measuring and sensing inputs

Symbols used in the Digital Display

1 Main display with decimal point and polarity display

2 Auxiliary display with decimal point and polarity display

3 ⚠: Multimeter in continuous operation, ON blinks at sampling frequency in transmission mode

4 REM: Memory mode operation, disappears after interface communication is ended by means of key or switch operation

5 ZERO: Zero balancing

6 MAN: Manual measuring range selection

7 NUM: Numeric entry of output signal

8 INT: Interval sequence active

9 RAMP: Ramp function active

10 AC: Alternating current / voltage

11 ON: Calibrator output is active

12 Unit of measure (if blinking, refer to chapter 23 on page 39)

13 SOURCE: Current source is active

14 SINK: Current sink is active

15 MIN/MAX: Display of smallest/largest recorded values

16 Time data for MIN/MAX function

17 Ni/Pt1000: Selected temperature sensor

18 TC: Thermocouple

19 MEM: Memory mode is active

20 🔊: Acoustic signal enabled, beeper is activated for corresponding function

21 ⊣⊢: Low battery voltage (< 3.5 V), replace batteries

Table of Contents

1 Safety Features and Precautions

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

The process calibrator is manufactured and tested in accordance with safety regulations IEC 61010–1 / DIN EN 61010–1 / VDE 0411–1. When used for its intended purpose, safety of the operator, as well as that of the instrument, is assured. However, their safety is 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.

Observe the following safety precautions:

- The instrument 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 30 V RMS may occur.
- Avoid working alone when taking measurements which involve contact hazards. Be certain that a second person is present.

Attention!
Maximum allowable voltage between any given connector jack (9) and earth is equal to 600 V, category II.

Attention!
The calibrator has been designed for safe connection to signal circuits.
Maximum allowable voltage between connector jacks (7) amongst themselves, between (7) and (9), and between (7) and earth is 15 V.

- 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 can be found in the “Measuring Ranges” table in chapter 21.2, “Multimeter”.
- The mA current measuring ranges are protected with a fuse. Maximum allowable voltage for the measuring current circuit is 600 V AC/DC.
- **The instrument may only be used in power installations if the electrical circuit is protected with a fuse or circuit breaker with a maximum rating of 20 A, and the nominal voltage of the installation does not exceed 600 V.**
- For this reason, never confuse the *calibrator* with the *multimeter*.
  The color *“yellow”* used for the jack cover at the *calibrator* differentiates it from the *multimeter* which has a *white* jack cover. Accordingly, simulator cables are yellow/black and measuring cables are red/black.
- When necessary, use a multimeter to make sure that no dangerous contact voltages are present in the signal circuits to which the instrument is to be connected.
- In order to prevent damage to the instrument, observe the *maximum* allowable voltage and current values indicated at the jacks.
  With the exception of the resistance simulation and mA SINK operating modes, the connected signal circuits should *not feed any voltage or current* back to the calibrator.
  In order to avoid damage to the instrument when interference voltages are applied (within allowable limit values), the mA SINK and mA SOURCE measuring circuit is equipped with a 250 mA/250 V fuse, which makes this measuring circuit highly resistive if excessive current should occur in the event of a fault for the duration of overloading.

Warning!

The instrument may not be operated in explosive atmospheres, or connected to intrinsically safe electrical circuits.

Meanings of symbols on the instrument

Warning concerning a source of danger (Attention: observe documentation!)

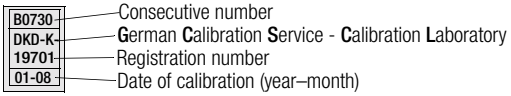
Earth

Continuous, doubled or reinforced insulation

CAT II Overvoltage category II device

Indicates EC conformity

DKD calibration certificate (red seal):



Repair, Parts Replacement and Balancing

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, the replacement of parts or balancing. If balancing, maintenance or repair of a live open instrument is required, this 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 instrument or the test probes are damaged
- If the instrument no longer functions
- After long periods of storage under unfavorable conditions
- After extraordinary stressing due to transport

2 Initial Start-Up

Battery

Be certain to refer to chapter 22.1 regarding correct battery installation.

Attention!
As a result of internal battery voltage monitoring, the instrument may respond as follows if the battery charge level is low:
– Cannot be switched on
– Shuts back down immediately
– Shuts back down in the event of loading at the output, or internal switching to higher auxiliary voltage (e.g. 10/15 V range, 20 mA 750 Ω).
If this is the case, replace the batteries in accordance with chapter 22.1, or continue work with the power pack if possible.

Switching the Instrument On Manually

➪ Press the ON/OFF key.
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 shown in the diagram on page 3.
The instrument is ready for use as soon as the key is released.

Switching the Instrument On with a PC

After transmission of a data frame from the PC, the multimeter is switched on. See also chapter 19.4.

Switching the Instrument On Automatically

The multimeter is switched on automatically in the transmission and memory modes.

Note!
Electrical discharge and high frequency interference may cause incorrect displays to appear, and may disable the measuring sequence. In such cases, switch the instrument off and back on again in order to reset. If the problem persists, briefly dislodge the battery from the connector contacts.

Setting Time and Date

See chapter 19 on page 26.

Switching the Instrument Off Manually

➪ Press and hold the ON/OFF key until OFF appears at the display.

Shutdown is acknowledged with two, brief acoustic signals.

Automatic Shutdown of the Multimeter and the Simulator – "SLEEP MODE"

The instrument is switched off automatically if none of the keys or the rotary switch are activated for approximately 10 minutes. Shutdown is acknowledged with a brief acoustic signal.

Memory or transmission mode: In this case, checking is first performed to determine whether or not the sampling rate has been set to a value of greater than 10 s. The instrument is switched off after 10 minutes, and is reactivated 10 s before data is to be saved to memory (for multimeter as well as simulator). The instrument is then switched back off again.

The instrument can be manually activated with the **ON**/OFF key in the memory or the transmission mode. After activation of this type, the instrument returns to the "SLEEP MODE".

If the instrument is to be fully shut down, it must first be activated and then switched off with the **ON**/OFF key. This ends the memory mode, as well as the transmission mode.

We recommend setting the instrument to continuous operation for **the transmission mode**.

The continuous operation mode is not effected by automatic shutdown.

Automatic Shutdown of the Calibrator

The simulator deactivates the output quantity after 5 minutes of inactivity. 5 minutes later, the instrument is switched off (see "SLEEP MODE").

Disabling Automatic Shutdown

The instrument can be set to continuous operation.

➪ Press and hold the FUNC key and then switch the instrument on by pressing the **ON**/OFF key. Continuous operation is indicated at the display with the ⚠ symbol.

3 Selecting Measuring Functions and Measuring Ranges

3.1 Automatic Measuring Range Selection

The multimeter is equipped with auto-ranging for all measuring ranges, except for temperature measurement, and diode and continuity testing. Auto-ranging is operative as soon as the multimeter is switched on. The instrument automatically selects the measuring range which allows for highest possible resolution for the applied quantity.

When the instrument is switched to frequency measurement, the previously selected voltage measuring range remains active.

The instrument automatically switches to the next highest or next lowest measuring range for the following measured quantities:

Measuring Ranges	Resolution	Switching to next highest range at ±(... d +1 d)	Switching to next lowest range at ±(... d –1 d)
V ⎓, mA ⎓, Ω_2	5 ¾	310 000	28 000
V~, mA~, Hz [1]	4 ¾	31 000	2 800
Ω_4, 3 nF ... 30 µF	3 ¾	3 100	280

[1] 280 digits apply when switching from 300 kHz to 3 kHz.

3.2 Manual Measuring Range Selection

Auto-ranging can be deactivated and measuring ranges can be selected manually in accordance with the following table.

The manual mode is deactivated by pressing and holding the MAN/AUTO key (approx. 1 s), by activating the rotary switch or by switching the instrument off and then back on again.

⇓ MAN/AUTO	Function	Acknowledgement	
		Display	Acoust. Signal
short	Manual mode active: utilized measuring range is fixed	MAN	1 x
short	Range switching sequence for: V: 300 mV → 3 V → 30 V → 300 V → 600 V → 300 mV ... Hz: 300 Hz → 3 kHz → 300 kHz → 300 Hz →... mA: 3 mA → 30 mA → 300 mA → 3 mA →... Ω_2: 30 MΩ → 300 Ω → 3 kΩ → 30 kΩ → 300kΩ → 3 MΩ → 30 MΩ ... F: 3 nF → 30 nF → 300 nF → 3 µF → 30 µF → 3 nF →... ⭲ 3 V → 15 V → 3 V → ... Ω_4: 30 mΩ → 300 mΩ → 3 Ω → 30 Ω → 30 mΩ →...	MAN	1 x
long	Return to automatic range selection.	—	2 x

Automatic range selection is disabled as long as the MIN/MAX function is active.

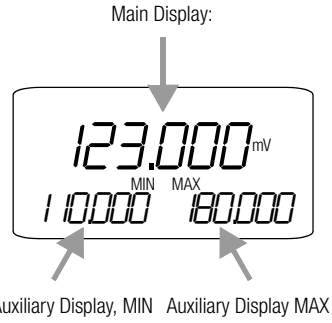
4 Triple Digital Display

The three digital displays (1 main display and 2 auxiliary displays) show the measured value with decimal and plus or minus sign. 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.

"OL" (overload) appears if the measuring range upper limit is exceeded for the following measured quantities:

V DC, I DC, Ω_2:	309999
V (AC), I (AC), ⇥⇤, Hz:	30999
3 nF … 30 µF, Ω_4, 🔊 short:	3099

The digital display is refreshed at different frequencies for the various measured quantities.



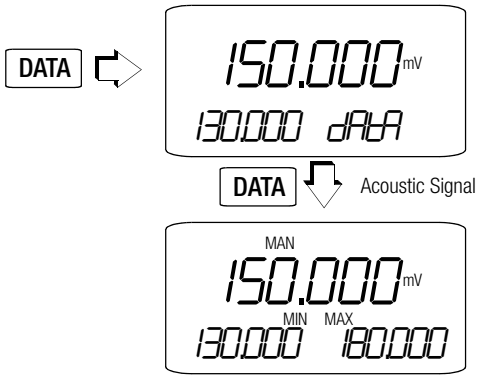
The main display appears immediately after the multimeter is switched on, but the auxiliary display have to be activated by pressing the DATA/CLEAR key. This assures that an undefined existing condition which prevailed when measurement was started is not continuously displayed as a maximum value, e.g. no-load operation.

In the following flow charts the output display is framed with a thicker line.

5 Measured Value Storage, "DATA" Hold and Compare

Measured values can be automatically "frozen" with the DATA hold function. This is useful when, for example, contacting the measuring points with the test probes requires your full attention.

After the measured value has been applied and the corresponding "condition" from the table below has been fulfilled, the measured value appears at the left-hand auxiliary display and 2 acoustic signals are generated. At the same time, "MAN" appears, indicating that the measuring range can now be manually adjusted. The test probes can now be removed from the measuring points, and the measured value can be read from the auxiliary display. If the measured value is less than the value specified in the table, the instrument is reactivated for storage of the next value and "*dAtA*" blinks at the display.



If the next stored message deviates from the first by less than 0.33% of the measuring range, two acoustic signals are generated (DATA Compare).

Function DATA	⇓ DATA	Condition: Measuring Ranges	Condition: Measured Value Limits (digits)	Response from Instrument: Auxiliary Display MV	Response from Instrument: Auxiliary Display *dAtA*	Response from Instrument: Acoust. Signal
Start	short				is displayed	short
Save		V, mA Ω [2], ⇥⇤ [2] F, Hz	> 10% of R OL [4] > 10% [4] of R	is displayed		short 2x [3]
Reactivate [1]		V, mA Ω [2], ⇥⇤ [2] F, Hz	<10% of R OL [4] < 10% [4] of R	saved MV	blinks	
Stop	short			is deleted		short
Turn back on	long short					

1) Reactivation results from falling short of specified measured value limits.
2) Valid for continuity testing as well
3) Two acoustic signals are generated the first time a measured vale is saved. For subsequent data hold, two acoustic signals are only generated if the currently frozen value deviates from the fist saved value by less than 0.33% of the measuring range, depending upon resolution.
4) Exception: 10% at 300 Ω or 3 nF

Key

R = measuring range, MV = measured value

The DATA function is deactivated by pressing the DATA key once again, by turning the rotary switch or by switching the instrument off and back on again.

6 Saving Minimum and Maximum Values "MIN/MAX" with Time Stamp

Minimum and maximum values can be displayed at the auxiliary displays for long-term observation of measured quantities.

➪ Press the DATA key twice: Current MIN and MAX values appear at the auxiliary displays.

Automatic range selection is disabled as long as the MIN/MAX function is active.

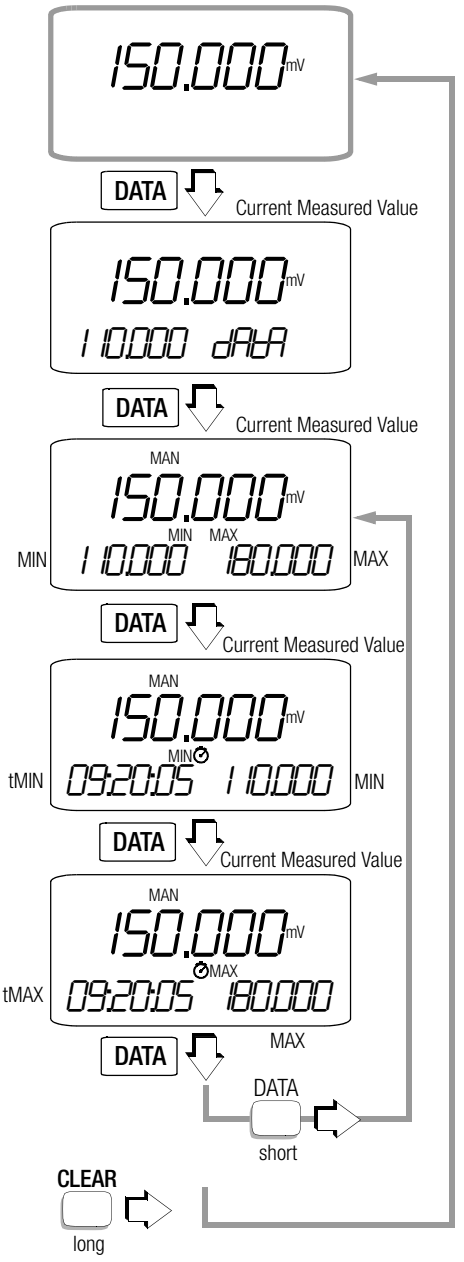
➪ Press the DATA key once more for a display of the minimum value and the time of its occurrence.

➪ Press the DATA key once more for a display of the maximum value and the time of its occurrence.

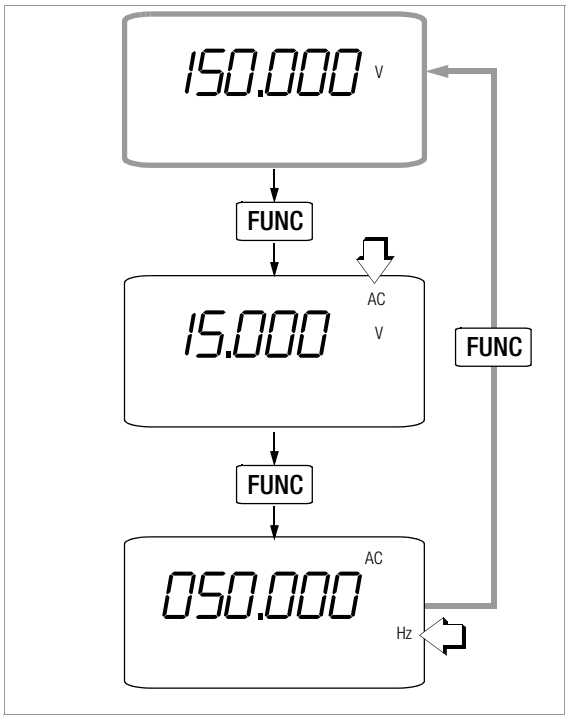
The MIN and MAX values are deleted by pressing and holding the CLEAR key (approx. 1 s), by turning the rotary switch or by switching the instrument off and back on again.

Function MIN/MAX	⇓ DATA	MIN and MAX Measured Values / Time of Measurement	Response from Instrument		
			Display		Acoustic Signal
			Main display	Aux. Display	
1. Save	2 x short ↓↓	are saved	current measured value	MIN and MAX	1 x
2. Save and Display	short ↓	are saved		t and MIN	1 x
	short ↓			t and MAX	1 x
3. Return to 1	short ↓	are saved	same as 1	same as 1	1 x
Stop	long ↓	are deleted	is deleted	is deleted	2 x

☞ **Note!**
No new MIN/MAX values are calculated for a period of 2 … 4 s after the measuring range has been changed (depending upon measuring function), in order to allow measured values to settle in.



7 Voltage and Frequency Measurement



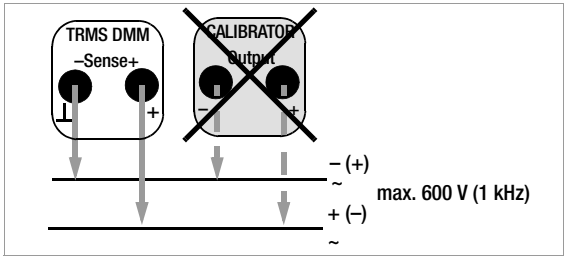
7.1 Voltage Measurement

Attention!
During voltage measurement the measurement cables must not be connected to the calibrator output, otherwise your instrument will be damaged.
This operating error and the consequences (repair work) are not covered by warranty!

- Select the V/Hz measuring function with the rotary switch.
- Connect the measurement cables as shown. The "Sense –" connector jack should be grounded.
- Select the current type appropriate for the measured quantity by briefly pressing the FUNC key. Each time the key is pressed, DC, AC and Hz are alternately selected, and switching is acknowledged with an acoustic signal. If the FUNC is pressed and held, the display is returned to the start menu. The respective measured quantity is displayed at the LCD. DC voltage measurement is always active immediately after selecting the measuring function with the rotary switch.

Note!
An intermittent acoustic signal warns the operator if the measured value exceeds the upper range limit in the 600 V range.

Attention!
M*ake sure that a current measuring function* ("mA") *has not been activated*, when the multimeter is connected for voltage measurement! If fuse trip limits are exceeded as a result of operator error, both the operator and the instrument are in danger!



Zero Balancing in the 300 mV/3 V DC Measuring Range

- Select the 300 mV/3 V DC measuring range.
- Plug the measuring cables into the instrument and connect the free ends to each other.
- Press the FUNC and MAN/AUTO keys simultaneously.

The instrument acknowledges zero balancing with an acoustic signal, and "000.000" (±1 digit) and the "ZERO" symbol appear at the display. The voltage displayed at the moment the keys are pressed serves as a reference value (max. ±30000 digits). It is automatically subtracted from all subsequent measured values.
If the measuring range is changed (MAN key), the ZERO function remains active (at the display and in memory).
Zero balancing can be deleted:

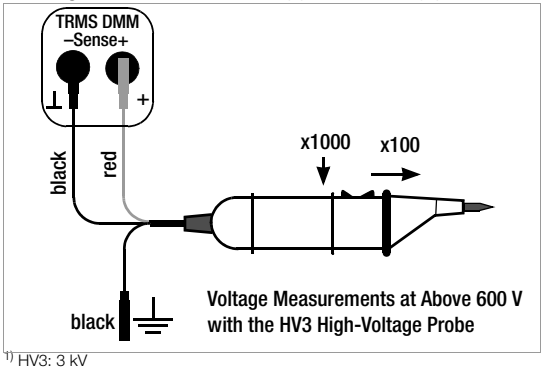
– By once again simultaneously pressing and holding the FUNC and MAN/AUTO keys, which is acknowledged with two acoustic signals
– By selecting a new function with the FUNC key or the rotary switch
– By switching the instrument off

7.1.1 Transient Overvoltages

The multimeter is protected against transient overvoltages of up to 6 kV with rise times of 1.2, and halftimes of 50 µs. For measurements at transformers or motors with long pulse durations etc., we recommend the use of our KS30 measuring adapter. It provides protection against transient overvoltages of up to 6 kV with rise times of 10, and halftimes of 1000 µs. It has a continuous load capacity of 1200 V_{eff}. Additional influence error caused by the KS30 measuring adapter amounts to approx. –2%.

7.1.2 Voltage Measurements at Above 600 V

Voltages of greater than 600 V can be measured with a high-voltage probe, e.g. the HV3[1)] or the HV30[2)] from GOSSEN METRAWATT GMBH. It is absolutely essential to ground the bonding terminal. Observe all applicable safety precautions!



[1)] HV3: 3 kV
[2)] HV30: 30 kV, for direct voltage only

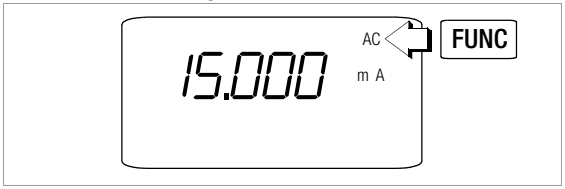
7.2 Frequency Measurement

- ➪ Select the V/Hz measuring function with the rotary switch.
- ➪ Apply the measured quantity as described under voltage measurement.
- ➪ Press the FUNC key briefly for alternating voltage measurement. Select the measuring range for the voltage amplitude.
- ➪ Press the FUNC key briefly once again for frequency measurement.
  The frequency values appears at the main display.
  The frequency measuring range can be selected subsequently by pressing MAN/AUTO.
  The lowest measurable frequencies and maximum allowable voltages are included in chapter 21.2, “Multimeter”.
- ➪ The instrument can be switched from frequency measurement back to alternating voltage measurement by pressing the FUNC key twice. This selection is acknowledged with an acoustic signal. The previously selected voltage measuring range remains active.

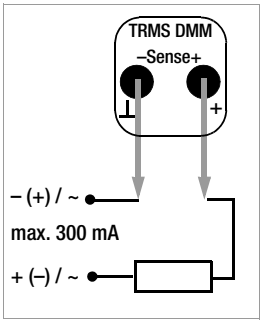
☞ **Note!**
Frequency measurement is only possible if the measuring signal passes through zero (AC coupling).

8 Current Measurement

- ➪ First disconnect supply power from the measuring circuit or the consuming device, and discharge any included capacitors.
- ➪ Select the mA range with the rotary switch.



- ➪ Select the voltage type appropriate for the measured quantity by briefly pressing the FUNC key. Each time the key is pressed, DC and AC are alternately selected, and switching is acknowledged with an acoustic signal. AC is displayed in order to indicate that AC current has been selected. DC current is always active immediately after range selection with the rotary switch.

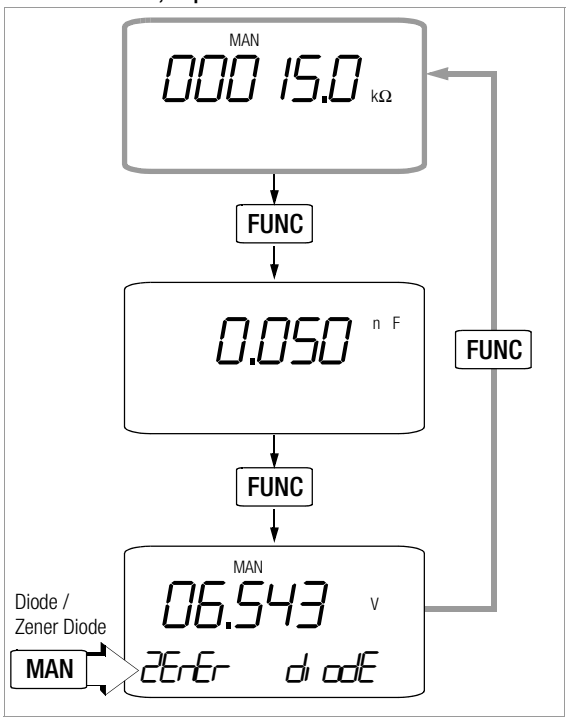


- ➪ Securely connect the measuring instrument to the consuming device in series as shown (without transfer resistor).

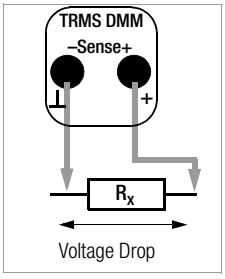
Notes Regarding Current Measurement:

- The instrument may only be used in *power installations* if the electrical circuit is protected with a *fuse* or *circuit breaker* with a maximum rating of *20 A*, and the *nominal voltage* of the installation does not exceed *600 V*.
- The measuring circuit must be mechanically stable, and must be secured against accidental interruption. Select conductor cross-sections and connectors such that no overheating occurs.
- An intermittent acoustic signal warns the operator if the measured value exceeds upper range limit in the 300 mA measuring range.
- Measuring ranges up to 300 mA are protected against short-circuit current of up to 25 A with an FF (UR) 1.6 A/ 1000 V fuse link in combination with power diodes. The fuse has a breaking capacity of 10 kA at a nominal voltage of 600 V AC/DC and ohmic load.
- If the fuse blows, eliminate the cause of overload before placing the instrument back into service!
- Refer to chapter 22.3 on page 39 regarding fuse replacement.

9 Resistance, Capacitance and Diode Measurements



9.1 Resistance Measurement



- ➪ Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- ➪ Set the rotary switch to "Ω_2/F".
- ➪ Connect the device under test as shown.

Zero Balancing in the 300 Ω and 3 kΩ Measuring Ranges

Cable and contact resistances can be eliminated for the measurement of small resistance values in the 300 Ω and 3 kΩ ranges by means of zero balancing:

- ➪ Plug the measuring cables into the instrument and connect the free ends to each other.
- ➪ Press the FUNC and MAN/AUTO keys simultaneously.

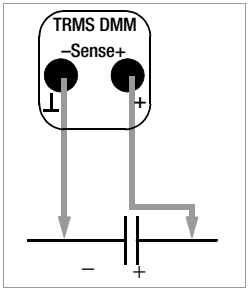
The instrument acknowledges zero balancing with an acoustic signal, and "*000.000* Ω" and the "ZERO" symbol appear at the display. The resistance value measured at the moment the keys are pressed serves as a reference value (max. 20000 digits). It is automatically subtracted from all subsequent measured values. If the measuring range is changed (MAN key), the ZERO function remains active (at the display and in memory).

- ➪ Zero balancing can be deleted:

– By once again simultaneously pressing and holding the FUNC and MAN/AUTO keys, which is acknowledged with two acoustic signals
– By selecting a new function with the FUNC key or the rotary switch
– By switching the instrument off

See chapter 10.1 regarding continuity testing.

9.2 Capacitance Measurement



- ➪ Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- ➪ Set rotary switch to "Ω_2/F".
- ➪ Press the FUNC briefly for capacitance measurement. Unit of measure "F" appears.
- ➪ Connect the (discharged!) device under test to the "⊥" and "F" jacks with the measurement cables.

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

Zero Balancing in the 3 nF and 30 nF Measuring Ranges

Measuring instrument and cable capacitances can be eliminated for the measurement of low value capacitance in the 3 nF and 30 nF ranges by means of zero balancing:

- ➪ Connect the measurement cables to the instrument without a device under test.
- ➪ Press the FUNC and MAN/AUTO keys simultaneously.

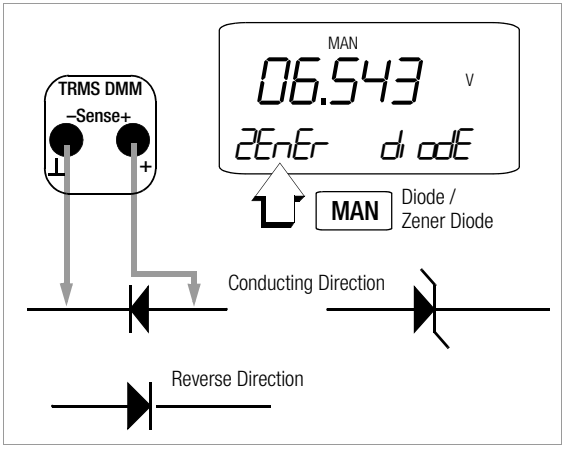
The instrument acknowledges zero balancing with an acoustic signal, and "*0.000*" and the "ZERO" symbol appear at the display. The capacitance value measured at the moment the keys are pressed serves as a reference value (max. 200 digits). It is automatically subtracted from all subsequent measured values.
If the measuring range is changed (MAN key), the ZERO function remains active (at the display and in memory).

- ➪ Zero balancing can be deleted:

– By once again simultaneously pressing and holding the FUNC and MAN/AUTO keys, which is acknowledged with two acoustic signals
– By selecting a new function with the FUNC key or the rotary switch
– By switching the instrument off

9.3 Diode Measurements

- Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- Set the rotary switch to "Ω_2/F".
- Briefly press the FUNC key twice for diode measurement. Unit of measure "V" and "*di odE*" are then displayed.
- The MAN/AUTO key is used to select either diode or Zener diode measurement (voltage drops of up to 15 V and "*2EnEr*" are displayed).
- Connect the device under test as shown.



Conducting Direction and Short-Circuit

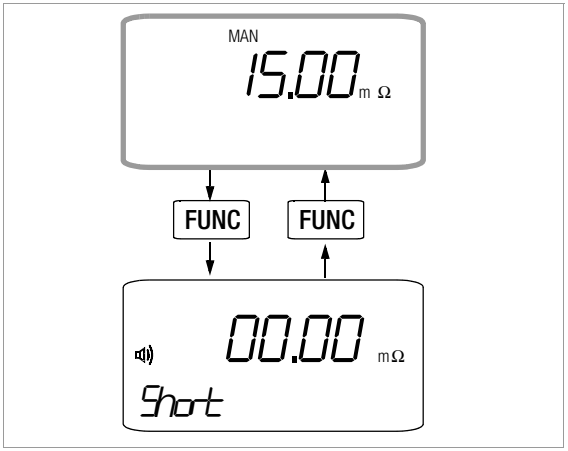
The instrument displays conducting-state voltage in volts. As long as voltage drop does not exceed the maximum display value of 3 V or 15 V, several series connected components or reference diodes can be tested.

Reverse Direction or Interruption

The measuring instrument indicates overflow: "*.OL*" for diode measurements and "*0.L*" for Zener diode measurements where Ud > 3.1 V or U_Z > 15 V. Measuring current is always a constant current of approximately 1 mA.

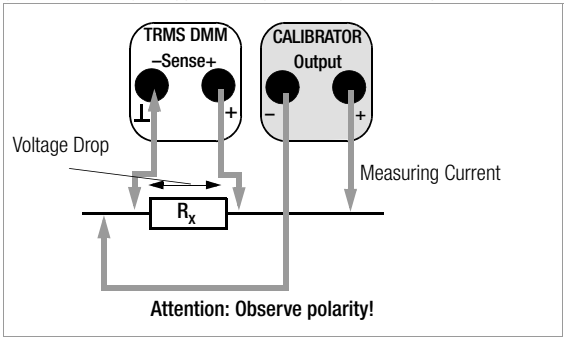
Note!
Resistors and semiconductors which are connected in parallel to the diode distort measurement results!

10 Milliohm Measurement – 4-Wire Connection



- Make sure that the device under test is voltage-free. Interference voltages distort measurement results!
- Set the rotary switch to "Ω_4/🔊".
- Connect the device under test as shown.

Connecting DUTs is simplified through the use of type KC2 (standard wire) or type KC3 (fine wire) Kelvin clips.



10.1 Continuity Test during Resistance Measurement

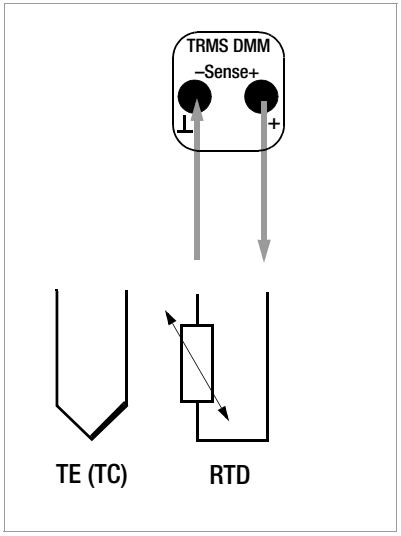
If the "acoustic signal 🔊" function is activated and the 0 ... 310 Ω measuring range is selected (display: 3¾ places), a continuous acoustic signal is generated by the instrument within a range of 0 to approx. 10 Ω.
Overflow "*OL*" is displayed where Rd > 310 Ω.

Activating and Deactivating Continuity Testing (acoustic signal)

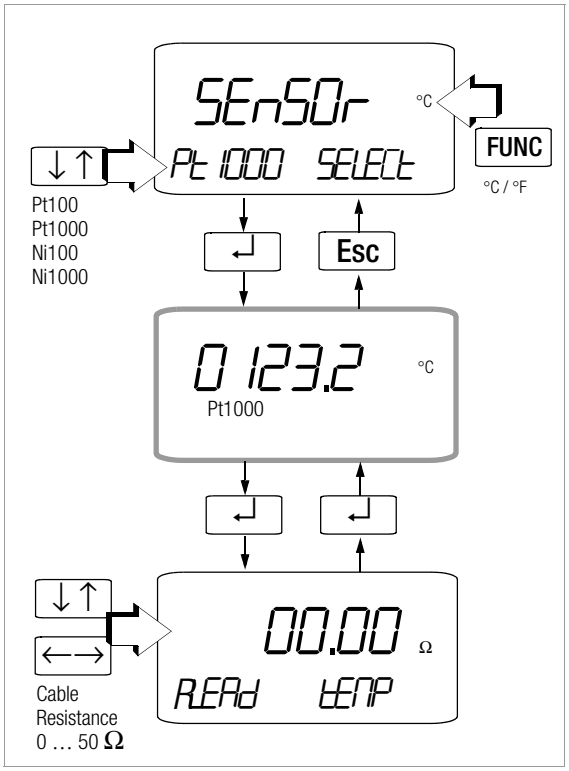
- Set the rotary switch to "Ω_4/🔊".
- Briefly press the FUNC key. Activation is acknowledged with an acoustic signal. The 🔊 symbol and "*Short*" appear simultaneously at the display.
- Connect the measurement cables to the DUT.
- Continuity testing is deactivated by pressing the FUNC key once again.

11 Temperature Measurement

- Set the rotary switch to "°C". Press Esc to access the selection menu for temperature unit of measure and sensor type. *SEnSOr* and *SELECt* are displayed.
- Press the FUNC key to select temperature unit of measure °C or °F.
- Select the sensor type (RTD or TC) with the ↓↑ keys. If a thermocouple is selected, TC is displayed as well.
- Connect the sensor to the two jacks (see diagram).

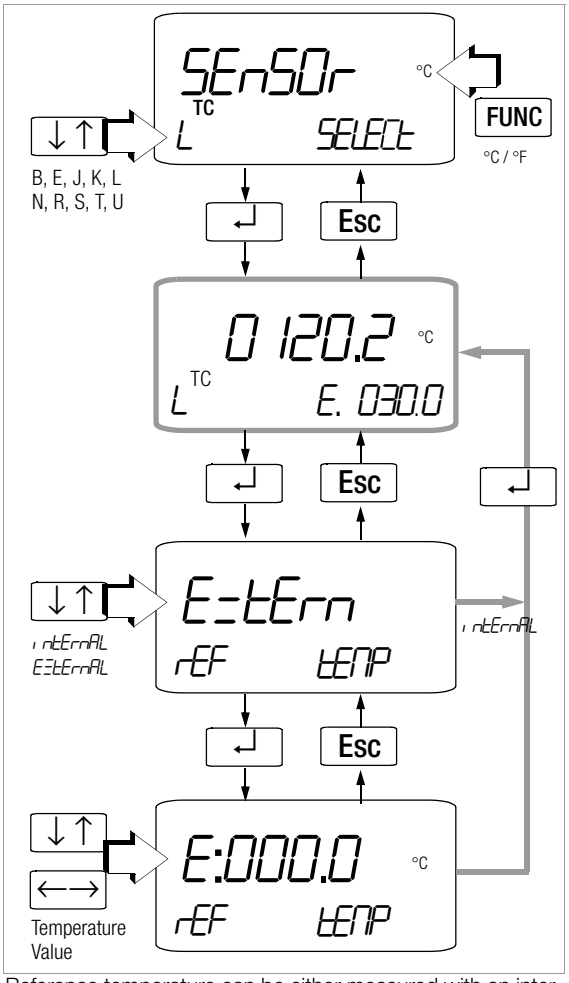


11.1 Temperature Measurement with Pt100, Pt1000, Ni100 or Ni1000



- After selecting a resistance thermometer, the measurement display is accessed by pressing the ↵ key.
- The menu for cable resistance adjustment is opened by pressing the ↵ key once again. *RLEAd* and *tEMP* are displayed.
- The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.
- The menu is exited after cable resistance entry is complete, or by pressing the ↵ key, and the measuring display returns. The cable resistance value remains in memory. The default value is 0.1 Ω. Entry is limited to a range of 0 to 50 Ω.

11.2 Temperature Measurement with Thermocouple and Reference Junction



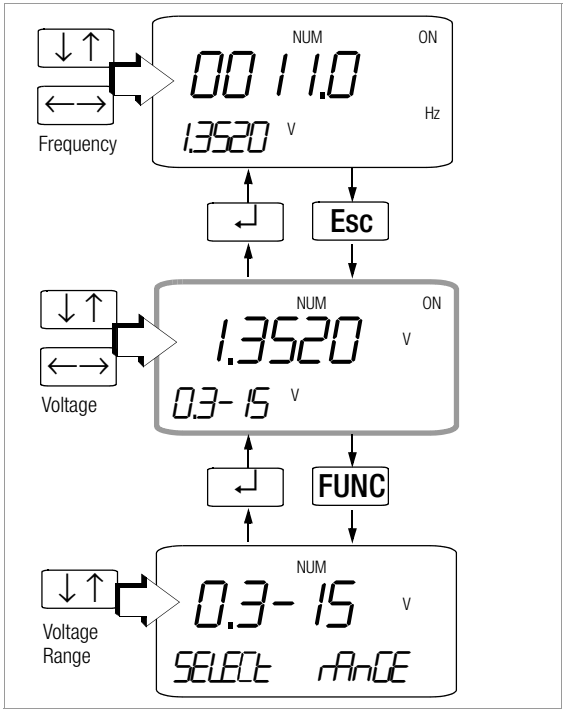
Reference temperature can be either measured with an internal reference junction, or specified with an external reference junction.

- ➪ After selecting a thermocouple (*SEnSor SELECt* menu, MAN key) the measuring display is accessed with the ↵ key. I is displayed for internal or E is displayed for external reference junction in the bottom right-hand field, along with the corresponding temperature.
- ➪ The selection menu for internal or external reference junction is accessed here with the ↵ key. External (*E-tErn*) or internal (*, ntErn*) is selected in the following menu with the ↓ ↑ keys.
- ➪ The menu is exited and the instrument is returned to the measuring display after saving the current selection with the ↵ key, or without saving the selection by briefly pressing the Esc key.
- ➪ As long as the external menu is open, the menu for setting the external reference temperature can be accessed by pressing the ↵ key. *E-tErn* and *tEMP* are displayed. The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.
- ➪ The menu is exited after reference temperature entry is complete, or by pressing the ↵ key, and the measuring display returns.

☞ **Note!**
The internal reference temperature (internal reference junction temperature) is measured with a temperature sensor in close proximity to the input jacks. It is somewhat higher than room temperature due to internal warming.

12 Voltage Simulator, Pulse and Frequency Generator

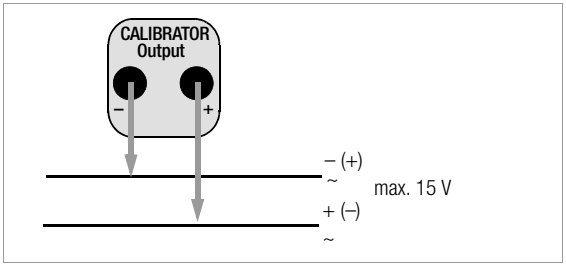
The instrument includes the following simulator functions: Direct voltage V DC, frequency f, resistance Ω, temperature °C (for resistance thermometers or thermocouples) and current mA DC.



12.1 Voltage Simulator

Voltages can be simulated within the following ranges: 0 … ±300 mV, 0 … 3 V, 0 … 10 V and 0 … 15 V.
The resistance of the interconnected circuit should not be any less than 1 kΩ.

- ➪ Connect the DUT with the measurement cables as shown.



- ➪ Select the V/Hz calibration function with the rotary switch.
- ➪ Press the FUNC key if you want to change the selected voltage simulation range. Set the selected digit with the ↓ ↑ keys.
- ➪ Setting the simulation value:
  The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.

12.2 Pulse and Frequency Generator (positive square-wave pulse)

Voltage and frequency can be generated independent of one another with the frequency generator.
The output signal is a square wave. The resistance of the interconnected circuit should not be any less than 1 kΩ.

- ➪ Select the V/Hz calibration function with the rotary switch.
- ➪ Setting voltage amplitude (0 … 15 V):
  Press the Esc key in order to access the menu for setting voltage amplitude.
  The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.
- ➪ In order to access the frequency generator menu, press the ↵ key repeatedly until the Hz unit of measure is displayed.
- ➪ Setting the frequency value (1 … 1000 Hz):
  The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.

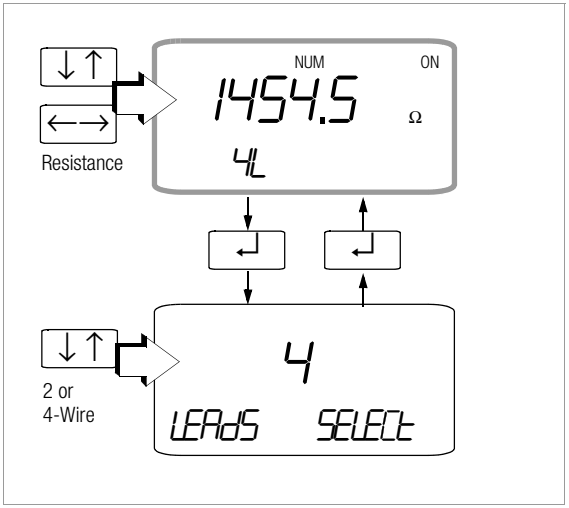
Frequency settings of 29 Hz and greater can only be selected in a limited fashion.

Note!
The following error messages may appear:
"Hi Curr" (high current – current at overload limit) where $I_{max.}$ = 18 mA,
"out oL" and 3 acoustic signals (out of limits – limit value violation) where I > 40 mA. The simulator is switched off.

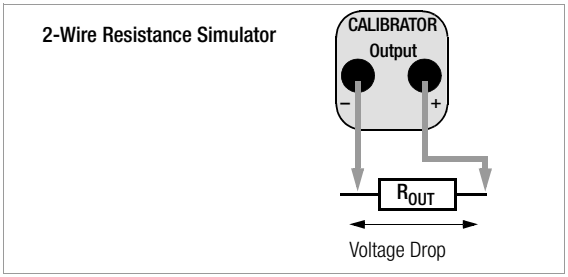
Attention!
Interference voltages must not be applied to the calibrator jacks.
Interference voltages may destroy the instrument and jeopardize the user by causing short-circuits.

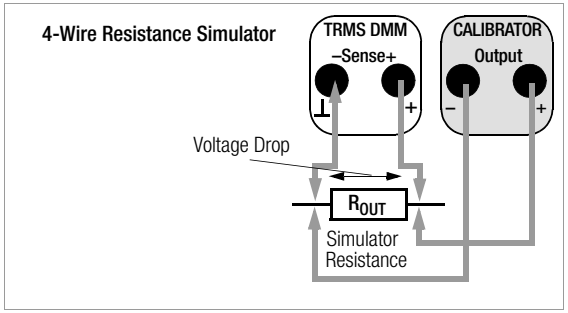
13 Resistance Simulation [Ω]

Resistance can be simulated by means of 2 or 4-wire connection within the following ranges:
2-wire: 5 … 2000 Ω
4-wire: 0 … 2000 Ω.



➪ Connect the DUT with the measurement cables as shown.





➪ Select the Ω calibration function with the rotary switch.

➪ Setting the simulation value:
The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.

➪ 2-wire connection is specified as a default value. Access the selection menu for 2 or 4-wire connection by pressing the ↵ key, and then select the desired type of connection with the ↓ ↑ keys.

➪ The menu is exited and the instrument is returned to the measuring display after saving the current selection with the ↵ key, or without saving the selection by briefly pressing the Esc key.

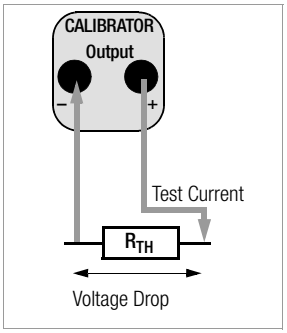
Note!
The following error messages may appear:
"Hi Curr" (high current – current too high) where I > 6 mA and
"LoCurr" (low current – current too low) where I < 40 µA (i.e. open jack sockets).

Attention!
Interference voltages must not be applied to the calibrator jacks.
Interference voltages may destroy the instrument and jeopardize the user by causing short-circuits.

14 Temperature Simulation [°C]

Thermocouples (TC) with specified external reference junction temperature and resistance temperature detectors (RTD) can be simulated.

- ➪ Select the °C calibration function with the rotary switch.
- ➪ Connect the DUT with the measurement cables as shown.
- ➪ unit of measure °C or °F can be selected with the FUNC key.

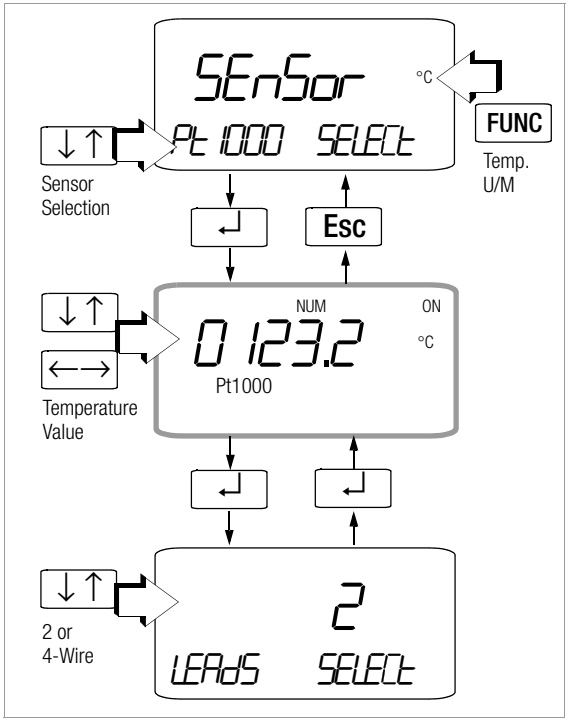


14.1 Temperature Simulation for Resistance Temperature Detectors (2 or 4-wire connection)

Resistance temperature detectors are simulated by means of resistance values.

- ➪ Select either type Pt100, Pt1000, Ni100 or Ni1000 with the ↓ ↑ keys for the simulation of an RTD.

.



14.2 Temperature Simulation for Thermocouples

Thermocouples are simulated by means of voltage. Internal or external temperature compensation is possible.

- ➪ Select either type B, E, J, K, L, N, R, S, T or U with the ↓ ↑ keys for the simulation of a thermocouple.
- ➪ External reference temperature entry is accessed with the ↵ key. The entry position at the far left blinks. Numerals are entered with the ↓ ↑ keys. Each selection is acknowledged with the ↵ key and the cursor is then advanced one place to the right.
- ➪ The display is returned to the start menu by acknowledging the selection at the far right with the ↵ key, or by activating the FUNC key.

Function Description and Applications

10 different types of thermocouples can be selected, and can be simulated within the temperature ranges specified by IEC/DIN.

Selection can be made between an internally measured reference junction temperature, or numeric entry of an external reference junction temperature within a range of –30 to +40 °C.

Important Notes Regarding the Reference Temperature

The internal reference temperature is measured continuously with the help of an integrated temperature sensor, which is thermally coupled to the " ⊥ " jack.

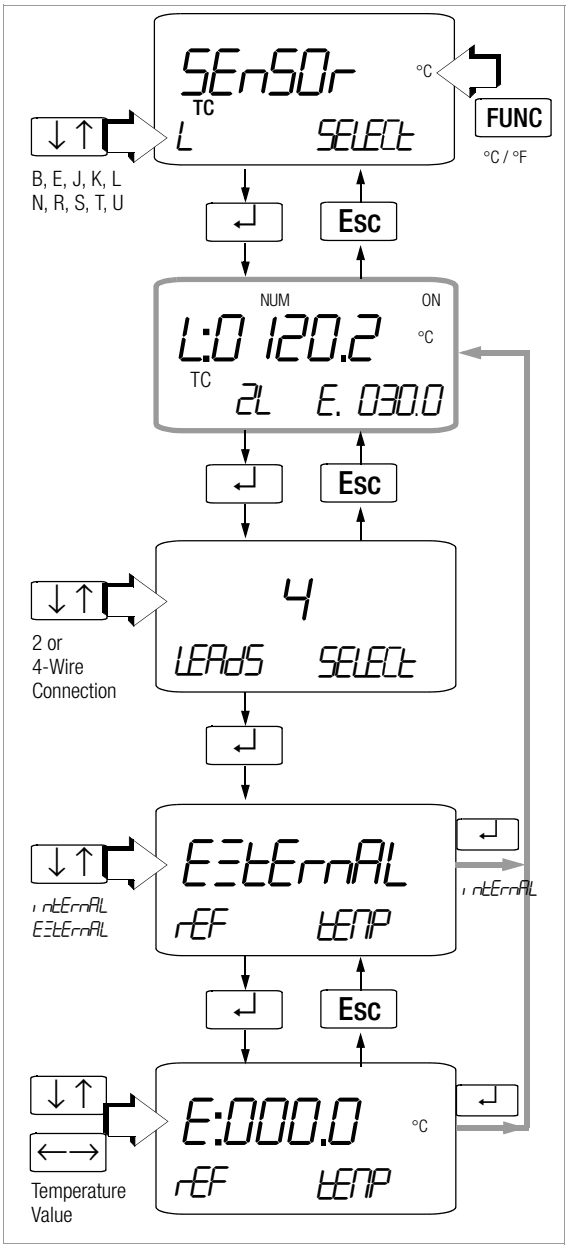
The reference temperature is generally measured at the thermocouple connector jack for devices under test with a thermocouple measuring input.

The two measurements may yield different results, and differences are registered as errors during thermocouple simulation. The following methods help to reduce this error:

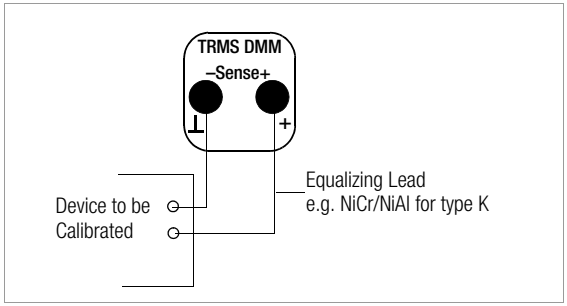
- The device under test is connected to the jacks at the calibrator with equalizing leads for the thermocouple to be simulated.
- The temperature of the thermocouple connector jack at the device under test is measured with a precision temperature measuring instrument, and the resulting value is entered to the calibrator as a reference temperature. The calibrator and the device under test are connected with copper wire.

Otherwise, the external reference temperature is entered in all cases where temperature measurement at the device under test is accomplished by means of a thermostatic reference junction (end of the thermocouple equalizing lead).

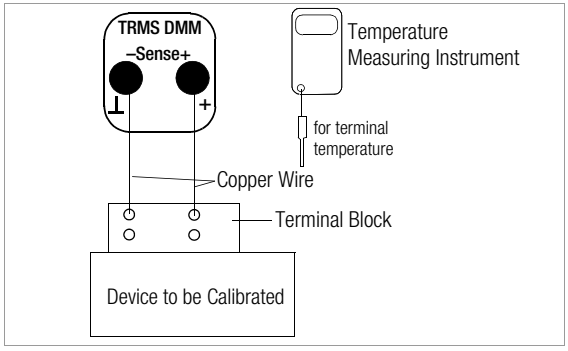
Attention!
Interference voltages must not be applied to the calibrator jacks.
Interference voltages may destroy the instrument and jeopardize the user by causing short-circuits.



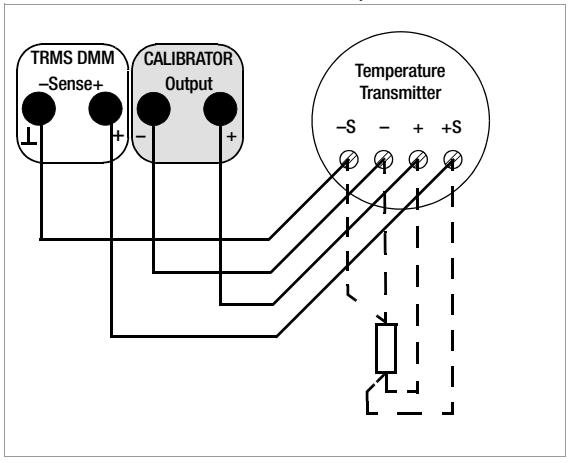
Temperature Simulation with Equalizing Lead (internal reference temperature)



Entering the External Reference Temperature



Connection and Simulation of a 4-Wire Temperature Sensor

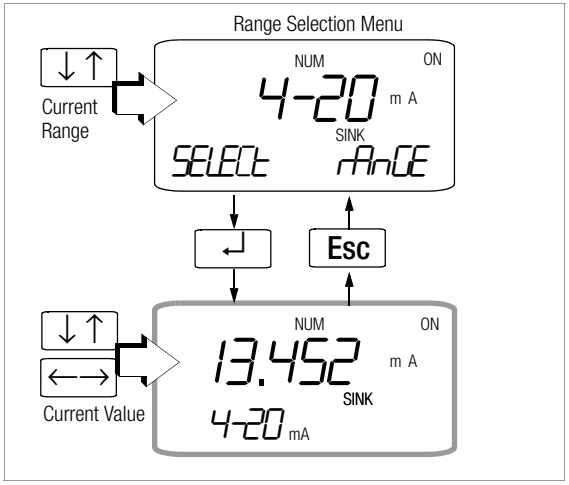


15 Current Source and Current Sink

- Connect the device under test with the measurement cables.
- Select the mA current sink ⊖← calibration function or mA current source ⊖→ with the rotary switch.
- Press Esc until you enter the range selection menu.
- Select the desired range:,
  0 … 20 mA, 4 … 20 mA or 0 … 24 mA,
  with the ↓ ↑ keys.
- Press the ↵ key to enter the output menu.
- Setting the simulation value:
  The decade (i.e. the position of the digit to be changed) is selected with the ← → keys, and the respective digit is set with the ↓ ↑ keys.
  ON indicates that the current source is active.

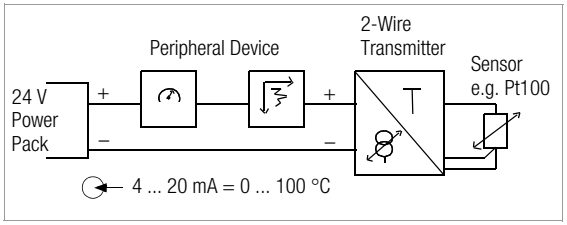
15.1 Current Sink – Simulation of a 2-Wire Transmitter ⊖←

A current sink (0 … 24 mA) or current loop load can be simulated with this function. The calibrator regulates the current, which flows via the calibrator jacks from an external power supply, independent of direct voltage applied to the jacks (4 … 27 V). The caliibrator varies the internal resistance such that the adjusted current value flows.



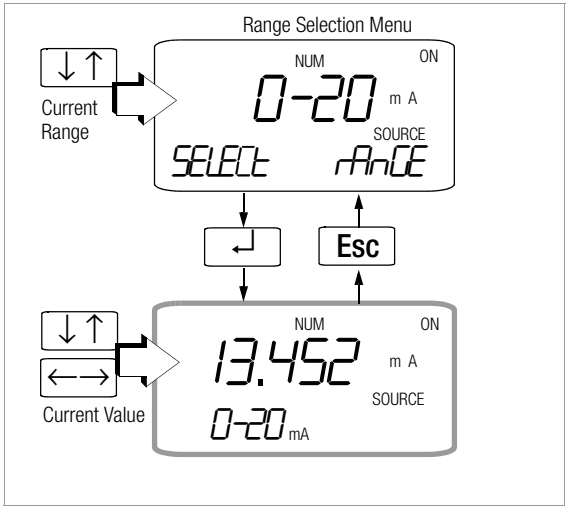
☞ **Note!**
The latest adjusted simulator range is stored to memory.
Voltage at the calibrator jacks may not exceed 27 V in the current sink operating mode, because thermal overload would otherwise occur and the fuse would blow.
LoUbLt appears at the display where U < 3 V.

Example of a 2-Wire Transmitter Measuring Circuit



15.2 Current Source ⊖→

Internal supply power is used for the simulation of a current source.



☞ **Note!**
Hi burd (high burd – i.e. excessive burden) appears at the display where R_{ext} > 700 Ω.

⚠ **Attention!**
Interference voltages must not be applied to the calibrator jacks.
Interference voltages may destroy the instrument and jeopardize the user by causing short-circuits.

16 Dual Mode (Simultaneous Calibration and Measuring)

All simulator functions can be activated and the corresponding output quantity (U or I) can be measured simultaneously in the dual mode.

Attention!
The device under test and the simulator must be electrically isolated.
The soldered-in fuse for the calibrator protects the calibrator from excessive current, but it must be replaced by our Repair and Replacement Parts department if it blows, and the calibrator must subsequently be balanced.

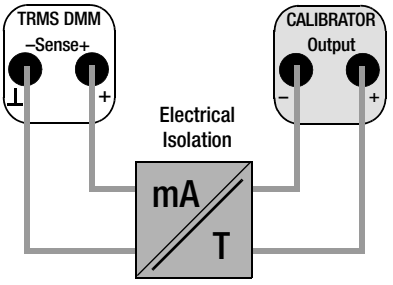
Exception where electrical isolation is concerned: simulation and measurement of voltage without an external circuit. For example, if voltage output needs to be tested, you only need to connect the Calibrator+ and Sense+ sockets to each other, because the Calibrator– and Sense– jacks are connected internally.

Activating the Dual Mode

- Select a measuring function: V or mA.
- Press and hold the FUNC key and select the simulator function with the rotary switch.
- Set the simulation value with the ⌃ and ⌄ keys in the main display.

The respective measured values appear in the left-hand auxiliary display.

- Exit the “Dual Mode” by pressing the FUNC key, or by turning the rotary switch.



17 Measuring and Simulation in Percentages

In addition to the display of absolute measured values, measurement in percentages is also possible for the most commonly used measuring ranges (30 V DC or 30 mA DC). The desired measuring range is defined by means of lower and upper range limits to this end.

Read-out as a percentage is possible as well.

Measuring in Percentages (current and voltage measurement)

- Set the measuring function and the measuring range to 30 V DC or 30 mA DC with the rotary switch and the MAN/AUTO key.
- Press the FUNC and MAN keys simultaneously.
- Select a value for 0% (lower range limit) with the ⌃ and ⌄ keys and acknowledge with the ON/OFF key.
- Select a value for 100% (upper range limit) with the ⌃ and ⌄ keys and acknowledge with the ON/OFF key.
- The measuring range now includes a span of 0 to 100%, and the unit of measure (V or mA) is displayed along with a percentage value.
- Exit the “percentage measuring” function by pressing the FUNC key, or by turning the rotary switch.

Simulation in Percentages (current source only except in dual mode)

- Select the simulation function and the output range (Isink/Isource = 4 … 20 mA) with the rotary switch and the MAN/AUTO key.
- Press the FUNC and MAN keys simultaneously.
- Select a value for 0% (lower range limit) with the ⌃ and ⌄ keys and acknowledge with the ON/OFF key.
- Select a value for 100% (upper range limit) with the ⌃ and ⌄ keys and acknowledge with the ON/OFF key.
- The output range now includes a span of 0 to 100%, and the unit of measure (V or mA) is displayed along with a percentage value.
- Exit the “percentage simulation” function by pressing the FUNC key, or by turning the rotary switch.

Measuring and Simulation in Percentages in the Dual Mode

The following combinations are possible for the measuring functions (U and I) and all simulation functions:

- Absolute measurement – simulation in percentages
- Measurement in percentages – absolute simulation
- Measurement in percentages – simulation in percentages

Measuring and output ranges for measuring and simulation in percentages are selected as described above.
The measuring function must be configured before the simulation function.

18 Interval Functions, Ramp Functions and Procedures

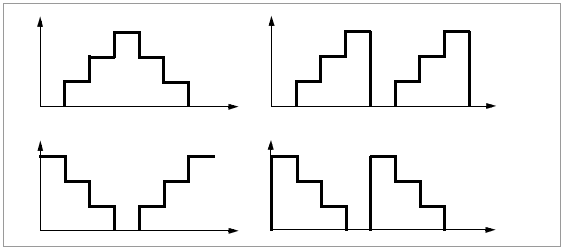
Two types of setpoint sequences can be generated in order to simulate sensor conditions at the inputs of transducers, transmitters and buffer amplifiers:
Interval sequences (see chapter 18.1)
Ramp sequences (see chapter 18.2)
With the help of METRAwin®90 software as an accessory, procedures with up to 99 steps can be generated at the PC in addition to the above mentioned sequences.
The following parameters must be specified to this end: measuring function, measuring range, tolerance limits, absolute limit values, setpoints and expected values. Up to 10 procedures can be uploaded to the calibrator. The procedures are then selected by name and started on-site. Measured values saved to the procedures can be subsequently read out with a PC.

18.1 Interval Sequences – INT Function

Output ranges are divided into rising or falling interval steps with this function, and the number of interval steps, as well as their duration, can be specified. Above all, this function is suited for the calibration of analog indicators and recorders during single-handed operation.
Input parameters for interval sequences include:

- All simulator functions except for Hz can be adjusted as output quantities.
- A lower (*StArt*) and an upper (*End*) range limit can be selected for each output quantity from within the overall range.
- The number of steps can be set within a range of 1 … 99.9. The number of steps can be entered as a whole number as well, which is especially practical for analog indicators and recorders with non-standardized scale divisions.
- The interval duration per step (t1) can be selected from within a range of 1 second to 60 minutes.
- The sequences can be run manually or automatically.
- Step jumps can be selected manually (*Auto* = no) with the ⇧ and ⇩ keys, or automatically (*Aut* = yes) with selectable time per step.

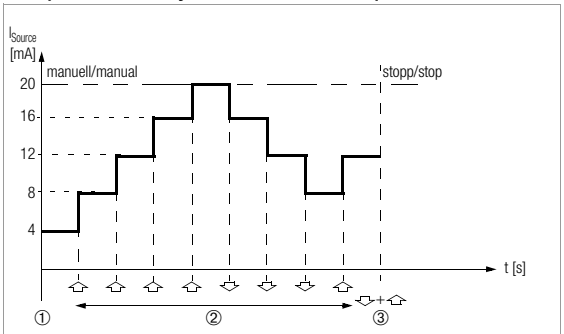
Examples of Interval Sequences:



Manual Interval Sequence

After configuring all parameters in accordance with the menu flowchart on page 23 for manual interval sequence read-out (*Int*, *Auto* = *no*), the individual steps can be triggered with the ⇧ and ⇩ keys.
The relationship between the output signal and each of the key operations is depicted with the help of the following example.

Example of a Manually Controlled Interval Sequence



The time intervals are only identical during automatic operation.

Key

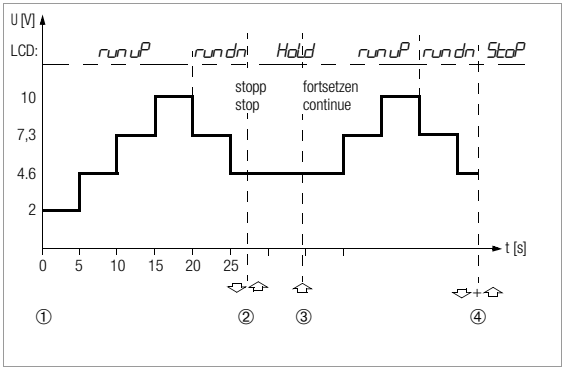
1 The sequence is started by pressing the ↵ key when *Int StArt* is displayed (see Menu Flowchart on page 22).
2 The sequence is stopped by pressing the ⇧ **or** the ⇩ key, and is started again in the corresponding direction when the same key is pressed once again.
3 Stop the interval sequence by simultaneously pressing and holding the ⇧ **and** ⇩ key (2 audible acoustic signals must be generated).

Automatic Interval Sequence

Automatic execution of a programmed sequence range is above all advisable if feeding to a signal circuit, and scanning of the peripheral device under test are physically separated.

After configuring all parameters in accordance with the menu flowchart on page 23 for the “automatic interval sequence” (*Int*, *Auto* = *YES*), the sequence can be started, and stopped or continued at any desired time.

Example of an Automatic Interval Sequence



Interval parameters: Output quantity: U (0 … 15 V range), *StArt* = 2 V, *End* = 10 V, number of interval steps = 3, t1 = 5 s, auto = Yes (yes for automatic sequence)

Key:

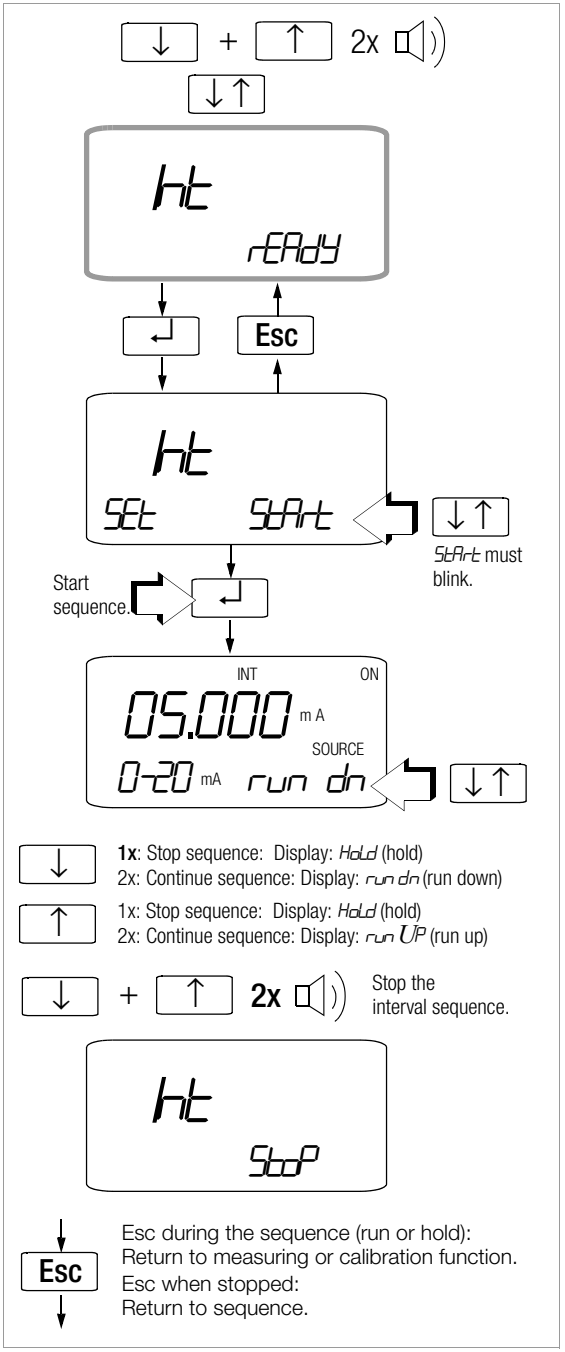
1 The sequence is started by pressing the ↵ key when *Int StArt* is displayed (see Menu Flowchart on page 22).

2 The sequence is stopped by pressing the ⇧ **or** the ⇩ key. Interval time elapsed thus far is saved as t_x.

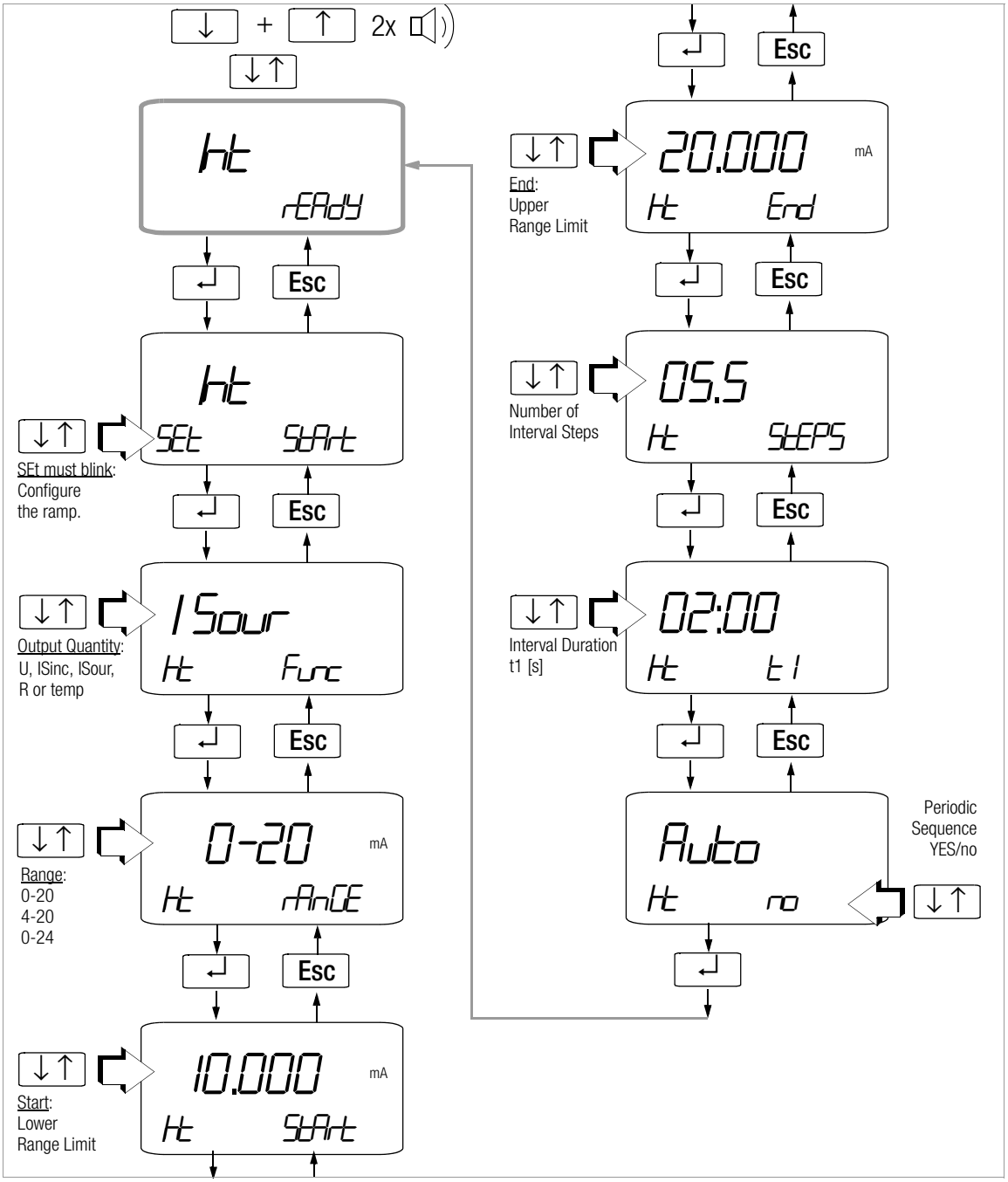
3 The sequence is resumed by pressing the ⇧ key, and remaining sequence duration t_y is equal to t1 – t_x.

4 Stop the interval sequence by simultaneously pressing and holding the ⇧ **and** ⇩ key (2 audible acoustic signals must be generated).

Menu Flowchart: Starting and Stopping the Interval Sequence



Menu Flowchart: Interval Parameters Configuration



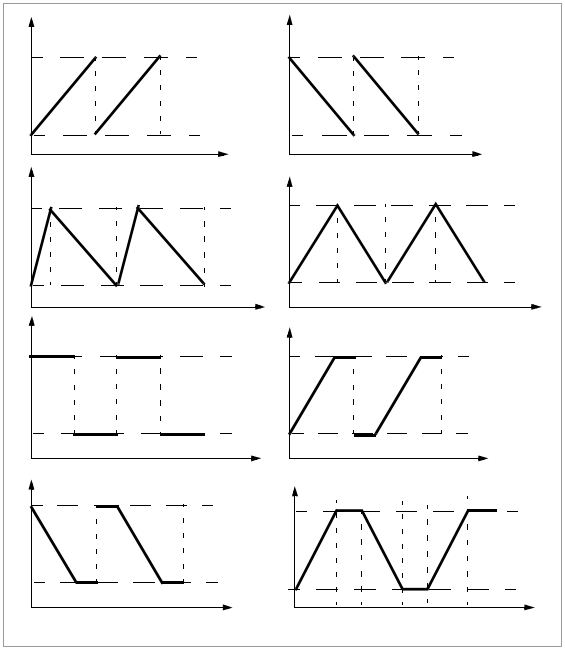
18.2 Read-Out a Periodic Ramp – RAMP Function

Ramp-type signals can be used to test dynamic performance of devices under test, or entire measuring circuits. An example would be control loop performance with a setpoint specified via the analog setpoint input at the controller. The instrument can be used to replace costly hardware and software for the set-up of long-term test bays with cyclical time sequences.

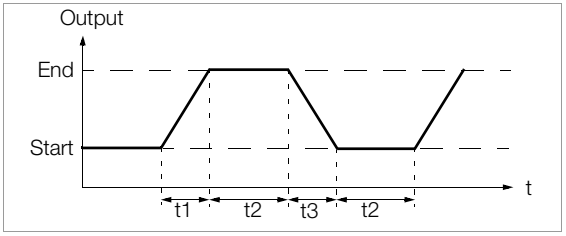
Parameters for the ramps depicted below include:

- The following functions can be adjusted as output quantities:
  voltage U, current sink I Sink, current source I Source, resistance R or temperature temp.
- A lower (*StArt*) and an upper (*End*) range limit can be selected for each output quantity. For standard signals these are always 0 … 10 V and 0/4 … 20 mA, and are otherwise values from within the entire range.
- Rise time t1 and decay time t3 are adjustable from 0 seconds … 60 minutes.
- Dwell time t2 at the upper and lower range limits is adjustable from 0 seconds … 60 minutes.
- There are 2 ramp sequences:
  – Once only: t1, t2, t3
  – Repetitive: t1, t2, t3, t2, t1, t2, t3, …

Examples of Ramp Sequences:



Example of a Periodic Ramp Sequence

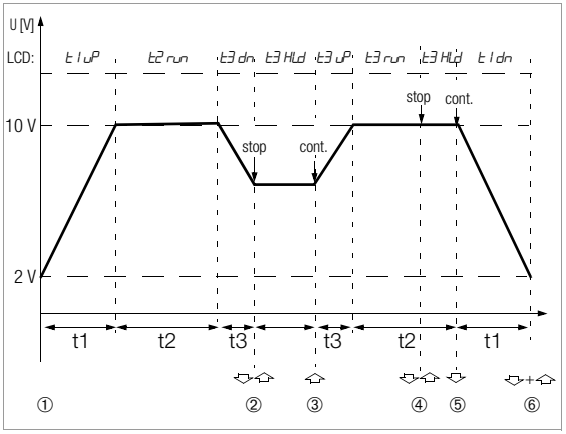


Manually Controlled Ramp Sequences

After configuring all parameters in accordance with the menu flowchart on page 25, rising or decaying ramps can be triggered with the ⇧ **and** ⇩ keys.

The relationship between the output signal and each of the key operations is depicted with the help of the following example.

Example of a Manually Controlled Ramp Sequence

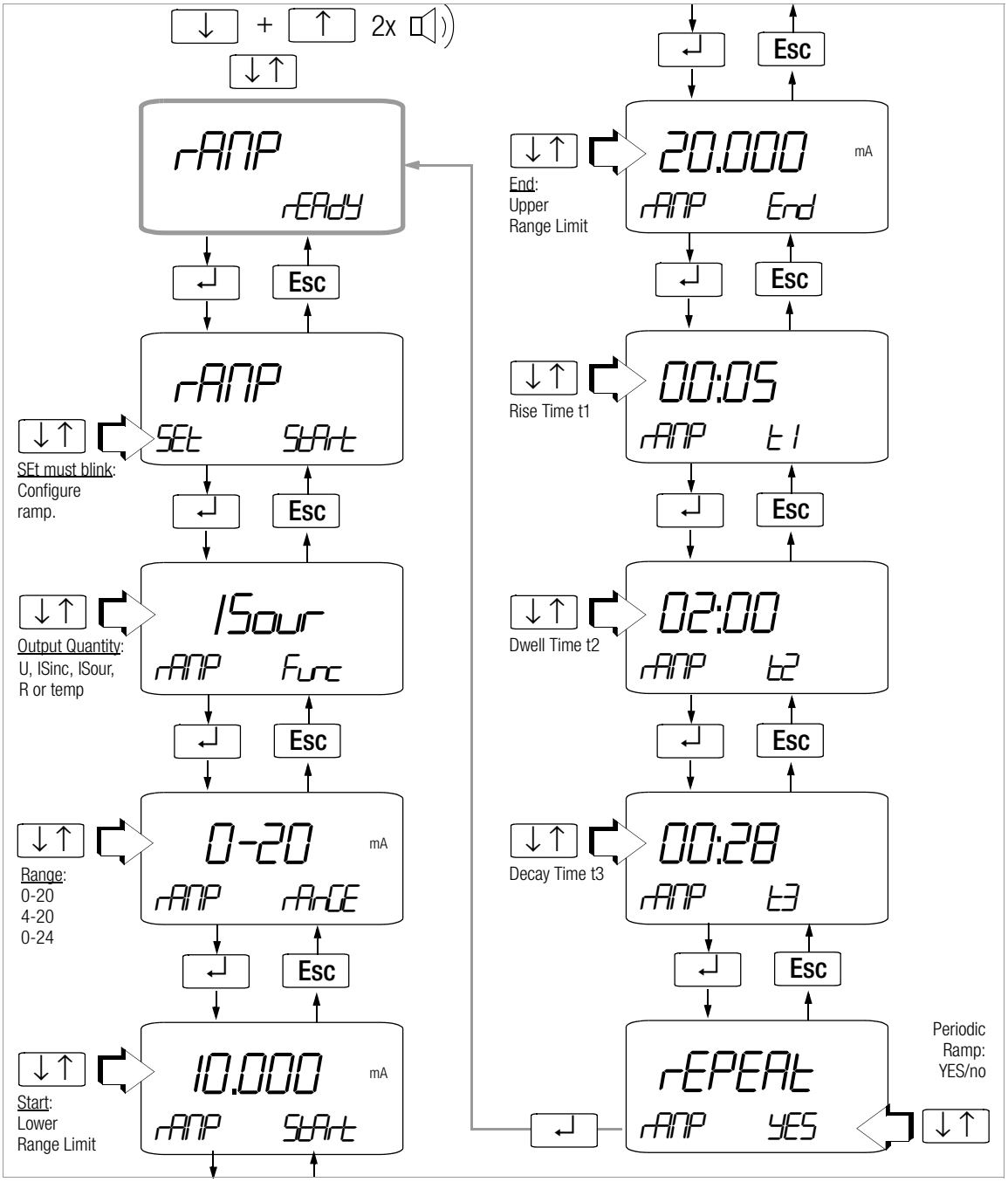


Ramp parameters: Output quantity: U (0 … 15 V range), *StArt* = 2 V, *End* = 10 V, t1 = 5 s, t2 = 8 s, t3 = 5 s, repeat = Yes (yes for periodic ramp)

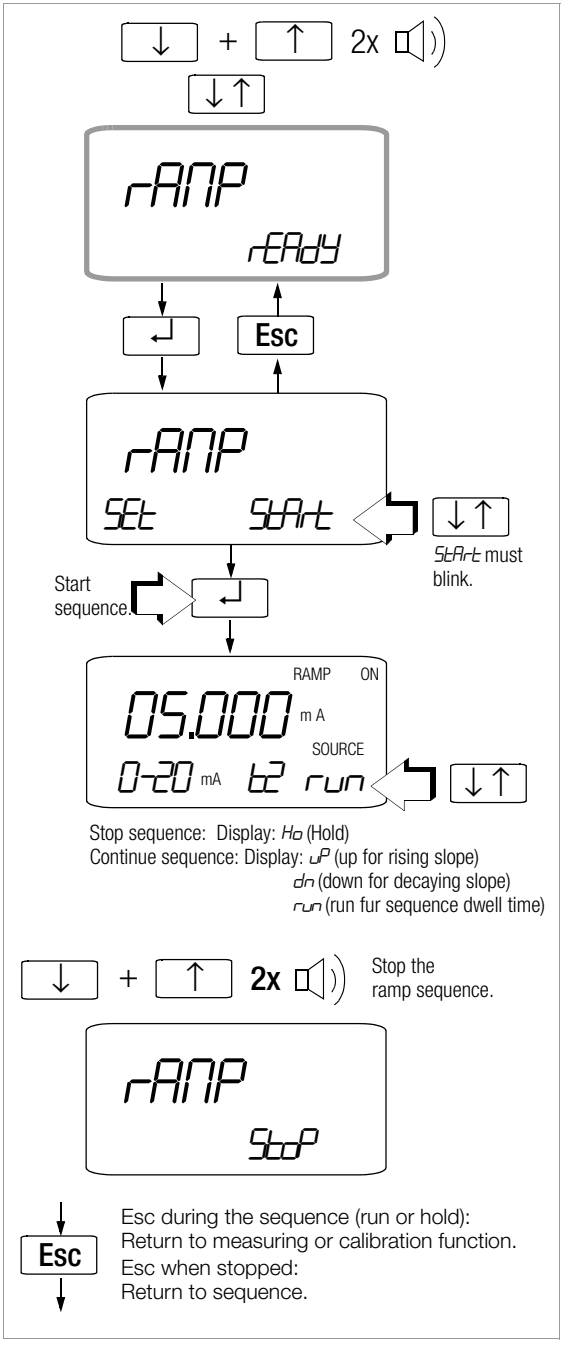
Key

1 The sequence is started by pressing the ↵ key when *rAMP StArt* is displayed (see Menu Flowchart on page 26).
2 Stop the decaying ramp within decay time t3 with the ⇧ **or** the ⇩ key.
3 Start a rising ramp within remaining decay time t3 with the ⇧ key.
4 Stop the ramp sequence with the ⇧ or the ⇩ key.
5 Start a decaying ramp with the ⇩ key, remaining dwell time t2 is deleted.
6 Stop the ramp sequence by simultaneously pressing and holding the ⇧ **and** the ⇩ keys (2 audible acoustic signals must be generated).

Menu Flowchart: Ramp Parameters Configuration



Menu Flowchart: Starting and Stopping the Ramp Sequence

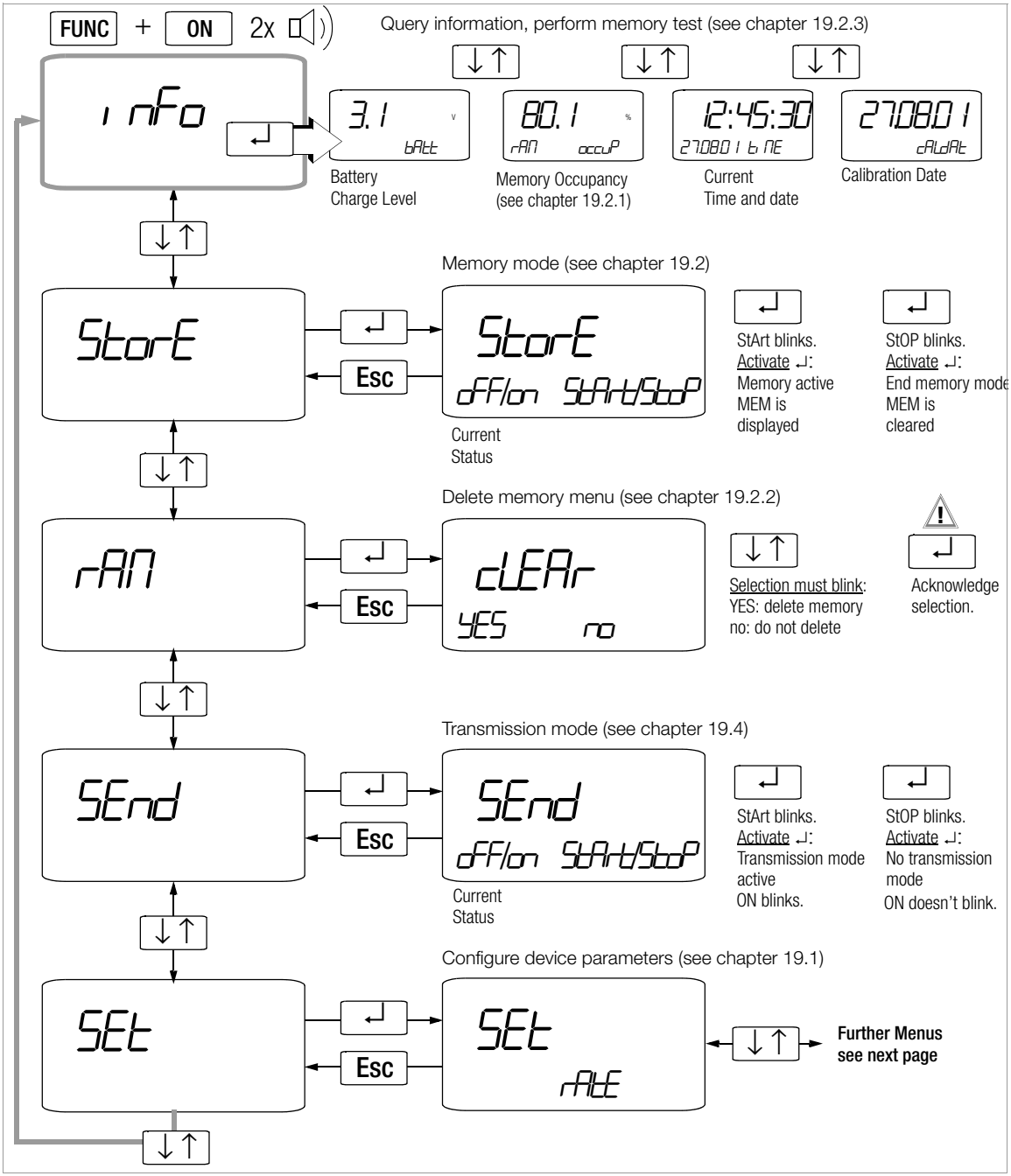


19 Using the Menus – from the Initial InFO Menu to Operating and Measuring Parameters

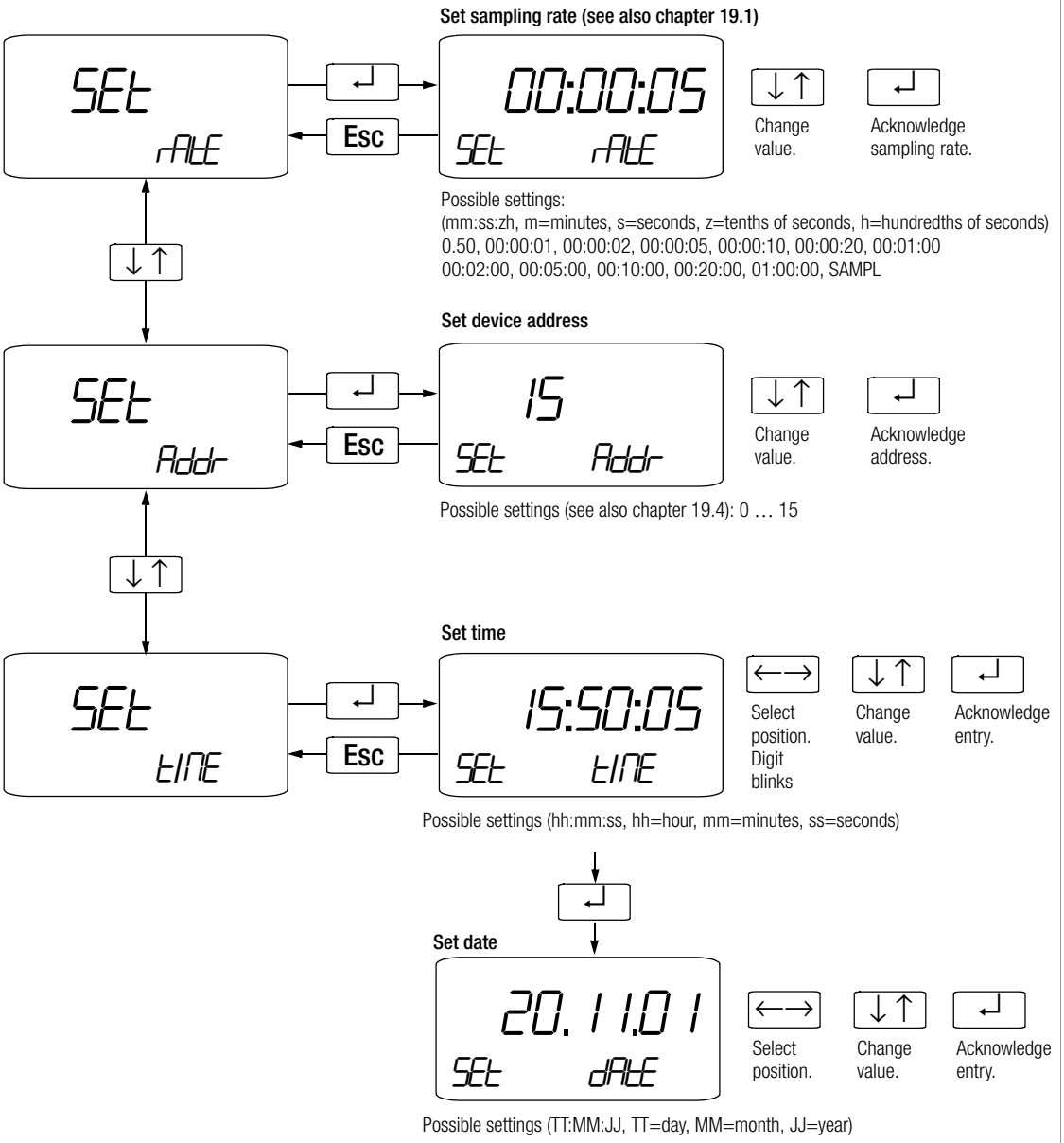
Menu-driven operation via the initial ı nFo menu allows the user to query online help, activate the memory and query memory occupancy, activate the interface and configure device parameters.

- The initial ı nFo menu is accessed by simultaneously pressing and holding the FUNC and ON keys with the instrument switched on until "ı nFo" appears at the display.
- The display can be switched from the main "ı nFo" menu to the other main menus including "StorE", "rAn", "SEnd" and "SEt", and back to the "ı nFo" menu by repeatedly pressing the ↓↑ keys.
- After accessing the desired main menu, the associated sub-menus are opened by activating the ↵ key.
- The desired parameter is selected by repeatedly pressing the ↓↑ keys.
- Acknowledge with the ↵ key in order to change the corresponding parameter or parameters.
- After the desired digit has been selected with the ←→ keys and the value has been adjusted with the ↓↑ keys, the next digit is accessed with the ↵ key, or the display is returned to the start menu or switched to the next submenu.
- The measuring mode is started by repeatedly pressing the ESC key until the measuring display appears.
- The multimeter is switched off by pressing and holding the ON/OFF key until the display goes blank.

The following pages include an overview of the menu structure.


FUNC + ON 2x
Query information, perform memory test (see chapter 19.2.3)
inFo
3.1 V
bAtt
Battery Charge Level
80.1 %
rAN occuP
Memory Occupancy (see chapter 19.2.1)
12:45:30
27.08.01 t i ME
Current Time and date
27.08.01
cALdAt
Calibration Date
Memory mode (see chapter 19.2)
StorE
Esc
StorE
oFF/on StArt/StoP
Current Status
StArt blinks. Activate ↵: Memory active MEM is displayed
StOP blinks. Activate ↵: End memory mode MEM is cleared
Delete memory menu (see chapter 19.2.2)
rAN
Esc
cLEAr
YES no
Selection must blink: YES: delete memory no: do not delete
Acknowledge selection.
Transmission mode (see chapter 19.4)
SEnd
Esc
SEnd
oFF/on StArt/StoP
Current Status
StArt blinks. Activate ↵: Transmission mode active ON blinks.
StOP blinks. Activate ↵: No transmission mode ON doesn't blink.
Configure device parameters (see chapter 19.1)
SEt
Esc
SEt
rAtE
Further Menus see next page

Continuation of page 27 (bottom)



19.1 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.

Certain sampling rate limit values apply to various measured quantities, and these may not be exceeded (see table below).

Measured Quantity	Sampling Rate
V ⎓, A ⎓,	0.5 s
V ~, A ~, →||← 🔊	0.5 s
Ω, Ω 🔊, °C (Pt100, Pt1000)	0.5 s
Hz	1 s
°C (J, K)	2 s
F	0.5 ... 5 s

SAMPLE

If the sampling rate ("*rAtE*" menu) is set to "*SAMPL*" (event), one measured value is saved each time the FUNC and DATA keys are simultaneously pressed, after the memory mode has been activated.

The contents of the memory can only be queried with the help of METRAwin®90 software.

19.2 Saving Measured Values to Memory

The instrument is equipped with a measured value memory (128 kB) which is synchronized with a quartz movement, and has an average capacity of 3,000 measured values. Minimum capacity is 2,000 measured values and maximum capacity is 4,000 values.

Data are stored to intermediate memory, or are uploaded to a PC. The system acquires measured values relative to real-time.

Measured values are stored in so-called blocks. Measured values resulting from the same measuring function are saved to the same block.

Only absolute values and absolute time stamps can be saved, i.e. not relative or Δ values, and no relative time stamps.

Memory content can only be read out with the help of a PC, an IR adapter (BD232) and METRAwin®10 or METRAwin®90 analysis software.

Preparing for 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 22.1 on page 38). Connect the power pack if applicable.

☞ **Note!**
First set the sampling rate, and then start memory mode operation. The sampling rate cannot be changed during memory or transmission mode operation.

Starting Memory Mode Operation

- ➪ Open the "*, nFo*" menu (see chapter 19 on page 26).
- ➪ Select the *StorE* menu with the ↓↑ keys.
- ➪ *StArt* blinks after acknowledging with ↵.
- ➪ After acknowledging once again with ↵, a menu appears which allows for the entry of a file name with up to 6 alphanumeric characters. Select the desired characters with the ↓↑ keys. The cursor is moved to the next place to the right with the ↵ key.
- ➪ After acknowledging the sixth character with the ↵ key, the file name is saved, memory mode operation is started and MEM appears at the display.
- ➪ Switch the display to the measuring function by pressing the ESC key.

The SAMPLE Mode

If the sampling rate is set to "*SAMPL*" (see chapter 19.1), individual measured values can be saved manually within the selected measuring function by simultaneously pressing the FUNC and DATA keys

☞ **Note!**
The selection of another measuring function with the rotary switch or the **FUNC** key does not effect memory mode operation.
If the sampling rate is 20 s or longer, the display is deactivated to prolong battery service life.

Ending Memory Mode Operation

- ➪ Open the "*, nFo*" menu (see chapter 19 on page 26).
- ➪ Select the *StorE* menu with the ↓↑ keys.
- ➪ *StoP* blinks after acknowledging with ↵.
- ➪ Press the ↵ key. Memory mode operation is ended. MEM is cleared from the display.
- ➪ The display is returned to the measuring function by pressing the ESC key.
- ➪ The memory mode can also be exited by switching the instrument off.

19.2.1 rAM OCCUP – Querying Memory Occupancy

Memory occupancy can be queried from the "*inFo*" menu. The main display shows current occupancy as a percentage between 001% and 100%.

19.2.2 rAM_{CLEAr} – Clearing the Memory

Attention!
This function deletes all measured values from memory.

19.2.3 $tESt_{rAM}$ – RAM Test Function

Attention!
This function deletes all measured values from memory. Do not perform the RAM test during memory mode operation.

No other functions can be activated during the RAM test – the following message is displayed: "*buSY*". The test has a duration of 1 minute. Two test samples are written to memory, and are subsequently read out. "*Good*" appears at the display if the test is completed successfully.

Significance of possible messages:

buSY	RAM test in progress
Good	RAM test passed
Error	RAM test failed

If the error message appears, a hardware problem may be the cause. Send the instrument to our Repair and Replacement Parts department in such cases (see chapter 24).

19.3 Activating the Default Values

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 calibrator does not work correctly

➪ Simultaneously press and hold the FUNC, MAN and DATA keys, and switch the instrument on with the ON key.

19.4 Transmission Mode Operation with RS 232 Interface

The calibrator is equipped with a bidirectional infrared interface for the transmission of measurement and calibration data to a PC. The data are optically transferred through the instrument housing by means of infrared light to an interface adapter (accessory), which is attached to the instrument. The adapter's RS 232 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 instrument as well. The following functions can be executed:

- Configuration and read-out of measuring and calibration parameters
- Measuring function and measuring range selection
- Start measurements/calibration
- Read out measured values
- Programming of user-specific procedures

Activating the Interface

The interface is switched on manually as described below for transmission mode operation. The instrument continuously transmits measurement data to the PC via the interface adapter in this operating mode.
The interface is activated automatically by the PC for receiving operation (i.e. instrument receives data from the PC).

Starting Transmission with Menu Functions

InFO ↓ SEnd ↵ StArt ↵

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

Automatic Activation and Deactivation of Transmission Mode Operation

If the sampling rate is 20 s or longer, the display is switched off automatically between samples in order to prolong battery service life.
Exception: continuous operation
As soon as an event occurs, the display is automatically switched back on.

Configuring Interface Parameters

Addr – Address

If several instruments are connected to the PC via interface adapters, an unique address must be assigned to each device. Address 1 should be used for the first device address, 2 for the second etc. If only one multimeter is used, an address between 1 and 14 should be selected. Address 15 is not used for addressing, i.e. the device with address 15 always responds, regardless of the actual address.

20 Accessories

BD232 interface adapters (without memory) allow for remote control of the instrument, as well as transmission of measurement data from up to six multimeters to the PC (this applies to METRAwin®10 in online mode).

METRAwin®10 Software

METRAwin®10 software is used to process and display measurement data at a PC. Sampling can be triggered manually with an adjustable sampling interval, or in a signal-dependent fashion. Storage of data in ASCII format can be controlled with two trigger thresholds per measuring channel, as well as by means of system time.

Software METRAwin®90

This software allows for paperless documentation and management of calibration results, the creation of calibration procedures and remote control of the calibrator. METRA*Hit*®28C sequence controls can be implemented online, or off-line after downloading complete calibration procedures.

The following conditions must be fulfilled in order to allow for use of METRAwin®10 or METRAwin®90 :

Hardware Requirements

- IBM compatible WINDOWS PC, Pentium-CPU with at least 64 MB RAM
- VGA monitor
- Hard disk with at least 40 MB available memory
- 3½" floppy disk drive for 1.4 MB floppies
- MICROSOFT compatible mouse
- If print-outs are required: a WINDOWS supported printer
- 1 serial interface COM1 or COM2

Software Requirements

⇨ WINDOWS 95, 98, ME, NT, 2000 or XP

21 Characteristic Values

21.1 Calibrator

Calibration Function	Simulator Range	Resolution 30000 Digits (4¾ places)	Max. Load Impedance	Intrinsic Error	Overload
Direct Voltage Simulator				±(% rdg. + mV)	Imax
V	0…±300 mV	0.01 mV	700 Ω	0.05 + 0.02	18 mA
	0 … 3 V	0.1 mV	1000 Ω	0.05 + 0.2	
	0 … 10 V	1 mV	1000 Ω	0.05 + 2	
	0 … 15 V	1 mV	1000 Ω	0.05 + 2	
Output Impedance: 3.5 Ω					
Pulse / Frequency Generator Keying ratio (mark-to-space ratio): 50%, amplitude: 10 mV … 15 V				±(% rdg. + Hz)	Imax
Hz	1 Hz …1 kHz	0,1 …8 Hz[1]	1000 Ω	0,05 + 0,2	18 mA
Current Source				±(% rdg. + µA)	Umax
mA	4 … 20 mA	1 µA	700 Ω	0.05 + 2	18 V
	0 … 20 mA				
	0 … 24 mA				
Current Sink				±(% rdg. + µA)	Umax
mA	4 … 20 mA	1 µA		0.05 + 2	30 V
	0 … 20 mA				
	0 … 24 mA				
V_{in}: 4 … 27 V, I_{in}: 0 … 24 mA, $P_{in} = V_{in} \times I_{in} < 0.6$ W					
Resistance-Type Sensor Ω_2 & Ω_4			Sensor Current [mA]	±(% rdg. + Ω)	Umax/ Imax
Ω	5…2000 Ω_2	0.1 Ω	0.05...0.1..5...6	0.05 + 0.2	18 V / 18 mA
	0…2000 Ω_4				
Maximum Short-Circuit Current: 6 mA					

[1] Frequencies of over 29 Hz can only be selected at limited intervals.

Note!
Observe maximum allowable voltage for connection from external sources to the calibrator output in the event of a current sink: U_{ext} 0 … 30 V.

Simulator for Temperature Sensors (Resolution: 0.1 K)

	Sensor Type	Simulator Range in °C	Simulator Range in °F	Intrinsic Error *	Overload
°C / °F	**Resistance Thermometer per IEC 751**			±(% of s.+K)	U_{max}/ I_{max}
	Pt100	–180…+850	–292…+1562	0.1 + 0.5	18 V / 18 mA
	Pt1000	–180 …+300	–292 …+572	0.1 + 0.2	
	Resistance Thermometer per DIN 43760			±(% of s.+K)	U_{max}/ I_{max}
	Ni100	–60…+180	–76…+356	0.1 + 0.5	18 V / 18 mA
	Ni1000	–60…+180	–76 …+356	0.1 + 0.2	
	RTD Sensor Current: 0.05 ... 0.1 ... 5 ... 6 mA				
	Thermocouples per DIN and IEC 584-1			±(% of s.+K) **	I_{max}
	K (NiCr/Ni)	–250…+1250	–418…+2282	0.1 + 0.5	18 mA
	J (Fe/CuNi)	–200…+1200	–328…+2192		
	T (Cu/CuNi)	–250…+400	–418…+ 752		
	B (Pt30Rh/Pt6Rh)	+500...+1800	+122…+3272		
	E (NiCr/CuNi)	–250…+1000	–418…+1832		
	R (Pt13Rh/Pt)	–50…+1750	–58…+3182		
	N (CU/Cu10)	–240…+1300	–400…+2372		
	S (Pt10Rh/Pt)	–50…+1750	–58…+3182		
	J (Fe/CuNi)	–200…+900	–328…+1652		
	U (Cu/CuNi)	–200…+600	–328…+1112		

* Without internal reference junction

** Relative to fixed reference temperature in °C and thermovoltage of the thermocouple
Reference junction, internal: 2 K intrinsic error
Reference junction, external: entry of –30 … 40 °C

Key

rdg. = reading (measured value)
s. = setting
d = digit

Thermocouple Simulation Error in [°C]

Thermocouple error is specified in the technical data as thermovoltage error: ΔU. ΔT error is dependent upon characteristic thermocouple slope.

$\Delta T\ [°C] = (0.001 \times U_{(T)} + 15\ \mu V) \div dU/dT\ [\mu V/°C]$

A maximum value is calculated for this quotient within each sub-range.

dU/dT is calculated based upon voltage difference for ΔT = 10 °C.

Examples

1 For a type R thermocouple within a range of 200 … 300 °C, the maximum value for this quotient at 200 °C is:
ΔT [°C] = (1.468 + 15) ÷ (1557 - 1468)/10 = (16.468/8.9) = 1.85 °C

2 For a type K thermocouple within a range of 400 to 500°C, the maximum value for this quotient at 500 °C is:
ΔT [°C] = (20.640 + 15) ÷ (20640 - 20214)/10 = (35.640/42.6) = 0.84 °C

In consideration of characteristic thermocouple linearity, which also applies to slope (1st dT/dU derivation), mathematically calculated ΔT error is shown in the following table for all thermocouple types in the 100 °C sub-range. The values shown in the table represent maximum possible error for the respective sub-range.

All specified error values are increased by 2 °C if an internal reference temperature is used.

If an external reference temperature other than 0 °C is used, the table values are adjusted by the amount of the reference temperature.

Example

Ref. temp. external = 50 °C
Sub-range 100 … 200 °C becomes 150 … 250 °C
For display in °**F**: numeric values in °F are increased by a factor of 1.8.
The °**F sub-ranges** are calculated as follows:
°F = 32 + °C x 1.8

Additional Error for Thermocouple Simulation

Thermocouple Type	T Error in °C for Thermocouple Types at Ref. Temp. 0°C									
Sub-Range °C	J	L	T	U	K	E	S	R	B	N
– 200 ... – 100	1.17	0.83	1.52	1.2	1.59	1.03				2.38
– 100 ... 0	0.55	0.56	0.78	0.77	0.73	0.51	≥-50° 4.79	≥-50° 5.29		1.03
0 ... 100	0.42	0.41	0.52	0.51	0.53	0.35	3.77	3.92		0.77
100 ... 200	0.46	0.45	0.47	0.49	0.6	0.36	2.78	2.75		0.73
200 ... 300	0.51	0.51	0.47	0.46	0.63	0.39	2.47	2.36		0.7
300 ... 400	0.56	0.56	0.49	0.49	0.67	0.43	2.31	2.19		0.71
400 ... 500	0.6	0.6		0.51	0.71	0.48	2.28	2.09		0.74
500 ... 600	0.63	0.62			0.76	0.53	2.24	2.06	4.12	0.78
600 ... 700	0.64	0.63			0.82	0.58	2.23	2.02	3.54	0.82
700 ... 800	0.66	0.64			0.89	0.64	2.21	1.99	3.12	0.87
800 ... 900	0.73	0.66			0.96	0.71	2.18	1.95	2.84	0.93
900 ... 1000	0.83				1.04	0.77	2.16	1.93	2.62	0.99
1000 ... 1100	0.9				1.12		2.16	1.91	2.46	1.05
1100 ... 1200	0.96				1.22		2.17	1.92	2.34	1.13
1200 ... 1300					1.32		2.2	1.94	2.27	1.21
1300 ... 1400					≤ 1370 °C: 1.39		2.24	1.99	2.22	
1400 ... 1500							2.31	2.04	2.19	
1500 ... 1600							2.39	2.12	2.2	
1600 ... 1700							2.52	2.23	2.24	
1700 ... 1800							≤ 1760 °C: 2.76	≤ 1760 °C: 2.42	2.33	

21.2 Multimeter

Measuring Function	Measuring Range		Resolution at Upper Range Limit		Input Impedance		Intrinsic Error at Max. Resolution under Reference Conditions		Overload Capacity [3]	
							±(...% rdg. + ... d)	±(...% rdg. + ... d)		
			300000 [1]	30000 [1] 3000 [1]	DC	AC_{TRMS} [6]	DC	AC_{TRMS} [6]	Value	Duration
V	300	mV	1	µV	10 µV	> 20 MΩ	11 MΩ // < 50 pF	0.05 + 15	0.5 + 30 (>500d)	600 V DC AC eff sine	cont.
	3	V	10	µV	100 µV	11 MΩ	11 MΩ // < 50 pF	0.05 + 15	0.2 + 30 (>100d)		
	30	V	100	µV	1 mV	10 MΩ	10 MΩ // < 50 pF	0.05 + 15	0.2 + 30 (>100d)		
	300	V	1	mV	10 mV	10 MΩ	10 MΩ // < 50 pF	0.05 + 15	0.2 + 30 (>100d)		
	600	V	10	mV	100 mV	10 MΩ	10 MΩ // < 50 pF	0.05 + 15	0.2 + 30 (>100d)		
					Voltage drop at approx. upper range limit					
					DC	AC_{TRMS} [6]	DC	AC_{TRMS} [6]		
A	3	mA	10	nA	100 nA	160 mV	160 mV	0.05 + 15	0.5 + 30 (>100d)	0.36 A	cont.
	30	mA	100	nA	1 µA	200 mV	200 mV	0.05 + 15	0.5 + 30 (>100d)		
	300	mA	1	µA	10 µA	300 mV	300 mV	0.05 + 15	0.5 + 30 (>100d)		
					Open-circuit voltage	Meas. current at upper range limit	±(...% rdg. + ... d)			
Ω_4	30	mΩ			0.01mΩ	0.6 V	100 mA	0.5 + 5		±0.6 V	cont.
	300	mΩ			0.1 mΩ	0.6 V	100 mA	0.5 + 5			
	3	Ω			1 mΩ	0.6 V	10 mA	0.5 + 5			
	30	Ω			1 mΩ	0.6 V	10 mA	0.5 + 5			
Ω_2	300	Ω	1	mΩ		0.6 V	250 µA	0.07 + 20 [4]		600 V DC AC eff sine	5 min.
	3	kΩ	10	mΩ		0.6 V	45 µA	0.07 + 15 [4]			
	30	kΩ	100	mΩ		0.6 V	4.5 µA	0.07 + 15			
	300	kΩ	1	Ω		0.6 V	1.5 µA	0.07 + 15			
	3	MΩ	10	Ω		0.6 V	150 nA	0.07 + 15			
	30	MΩ	100	Ω		0.6 V	15 nA	1.5 + 15			
Ω 🔊	300	Ω			0.1 Ω	3 V	1 mA	0.5 + 5		Umax	5 min.
→|←	3	V			0.1 mV	6 V	1 mA	0.5 + 5			
Zener→|←	15	V			1 mV	22 V	1 mA	1 + 5 (> 10 d)			
					Discharge resistance	$U_{0\,max}$	±(...% rdg. + ... d)			
F	3	nF			1 pF	10 MΩ	3 V	1 + 5 [4]		600 V DC AC eff sine	5 min.
	30	nF			10 pF	10 MΩ	3 V	1 + 5 [4]			
	300	nF			100 pF	1 MΩ	3 V	1 + 5			
	3	µF			1 nF	100 kΩ	3 V	1 + 5			
	30	µF			10 nF	11 kΩ	3 V	1 + 5			
					f_{min} [2]		±(...% rdg. + ... d)			
Hz	300	Hz			0.01 Hz	1 Hz		0.05 + 5 [5]		600 V	cont.
	3	kHz			0.1 Hz					600 V	
	100 kHz	< 30 kHz			10 Hz					100 V	
		> 30 kHz								30 V	

[1] Display: 5¾ places for DC and 4¾ places for AC, a different resolution and sampling rate can be selected in the rAtE menu for saving and transmitting measured values.

[2] Lowest measurable frequency for sinusoidal measuring signals symmetrical to the zero point

[3] at 0 ° ... + 40 °C

[4] ZERO is displayed for “zero balancing” function.

[5] Range
300 mV~: U_E = 100 $mV_{eff/rms}$ . . . 300 $mV_{eff/rms}$
3 V~: U_E = 0.3 $V_{eff/rms}$ . . . 3 $V_{eff/rms}$
30 V~: U_E = 3 $V_{eff/rms}$ . . . 30 $V_{eff/rms}$
300 V~: U_E = 30 $V_{eff/rms}$ . . . 300 $V_{eff/rms}$
600 V~: U_E = 300 $V_{eff/rms}$ . . . 600 $V_{eff/rms}$
For voltages > 100 V: Power limiting of $3 \cdot 10^6$ V · Hz

[6] 20 … 45 … 65 Hz … 1 kHz Sinus, for influences see page 35.

Key

rdg. = reading (measured value)
d = digit

Measuring Function	Temperature Sensor	Measuring Range	Resolution	Intrinsic Error for Max. Resolution under Reference Conditions ±(...% rdg. + ... d) [1]	Overload Capacity [3] Value	Overload Capacity [3] Duration
°C / °F	Pt 100 [4]	−200.0 … −100.0 °C	0.1 K	1 K	600 V DC eff sine	5 min.
		−100.0 … +100.0 °C		0.8 K		
		+100.0 … +850.0 °C		0.5 + 3		
	Pt 1000	−200.0 … +100.0 °C		0.8 K		
		+100.0 … +850.0 °C		0.5 + 3		
	Ni 100	−60.0 … +180.0 °C		0.5 + 3		
	Ni 1000	−60.0 … +180.0 °C		0.5 + 3		
	K (NiCr-Ni)	−270.0… +1372.0 °C		0.7 + 3 [2]		
	J (Fe-CuNi)	−210.0… +1200.0 °C		0.8 + 3 [2]		
	T (Cu-CuNi)	−270.0… +400.0 °C		0.2 + 3 [2]		
	B (Pt30Rh/ Pt6Rh)	−0… +1820.0 °C		0.5 + 3 [2]		
	E (NiCr/CuNi)	−270.0… +1000.0 °C		0.5 + 3 [2]		
	R (Pt13Rh/Pt)	−50.0… +1768.0 °C		0.5 + 3 [2]		
	N (CU/Cu10)	−270.0… +1300.0 °C		0.5 + 3 [2]		
	S (Pt10Rh/Pt)	−50.0… +1768.0 °C		0.5 + 3 [2]		
	J (Fe/CuNi)	−200.0… +900.0 °C		0.5 + 3 [2]		
	U (Cu/CuNi)	−200.0… +600.0 °C		0.5 + 3 [2]		

1) Plus sensor deviation
2) Thermocouples: The temperature value is determined on the basis of the value specified in EN 60584-1 with deactivated internal reference junction; additional error with internal reference junction: ±2 K
3) at 0 ° ... + 40 °C
4) The temperature value is determined on the basis of the value specified in EN 60751

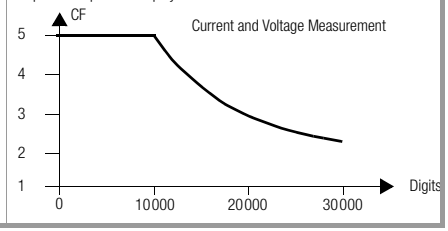
Influencing Quantities and Influence Error

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range [1]	Influence Error ± (... % rdg. + d) /10 K
Temperature	0 … +21 °C and +25 … +40 °C	V DC, °C (TC)	0.1 + 10
		V AC	0.5 + 10
		3/30 mA DC	0.1 + 10
		3/30 mA AC	0.5 + 10
		300 mA DC, AC	0.5 + 10
		300Ω/3/30/300 kΩ 2L	0.2 + 10
		3 MΩ 2L	0.5 + 10
		30 MΩ 2L	1 + 10
		Ω 4L	1 + 10
		3/30/300 nF/3/30 µF	0.5 + 10
		Hz	0.1 + 10
		°C (RTD)	0.2 + 10
		Source quantity [1]	
		mV/V, °C (TC)	0.1 + 10
		Ω, °C (RTD)	0.2 + 10
		mA source	0.1 + 10
		mA sink	0.1 + 10

Influencing Quantity	Frequency	Measured Quantity / Measuring Range	Influence Error [2] ± (... % rdg. + d)
Frequency V_{AC}	> 20 Hz ... 45 Hz	300.00 mV … 600.0 V	2 + 30
	> 65 Hz ... 1 kHz		

Influencing Quantity	Frequency	Measured Quantity / Measuring Range	Influence Error ±(...% rdg. + ... d)
Frequency I_{AC}	> 20 Hz ... 45 Hz	3 mA 30 mA 300 mA	1 + 30
	> 65 Hz ... 1 kHz		

1) With zero balancing
2) Specified error valid as of display values of 10% of the measuring range

Influencing Quantity	Sphere of Influence		Measured Quantity / Measuring Range [1]	Influence Error [2]
Measured Quantity Waveshape	Crest Factor CF	1 … 2	V AC, A AC	±1 % rdg.
		2 … 4		±5 % rdg.
		4 … 5		±7 % rdg.
	Allowable crest factor CF of the periodic quantity to be measured is dependent upon the displayed value: 			

Influencing Quantity	Sphere of Influence	Measured Quantity / Measuring Range [1]	Influence Error
Relative Humidity	75 % 3 days instrument off	V, A, Ω F, Hz °C	1 x intrinsic error

Influencing Quantity	Sphere of Influence	Measuring Range	Damping ±dB
Common Mode Interference Voltage	Interference quantity max. 1000 V AC	V DC	> 90 dB
	Interference quantity max. 1000 V AC 50 Hz, 60 Hz sine	300 mV ... 30 V AC	> 80 dB
		300 V AC	> 70 dB
		1000 V AC	> 60 dB
Series Mode Interference Voltage	Interference quantity: V AC, respective nominal value of the measuring range, max. 1000 V AC , 50 Hz, 60 Hz sine	V DC	> 60 dB
	Interference quantity max. 1000 V DC	V AC	> 60 dB

Real-Time Clock

Accuracy	±1 minute per month
Temperature Influence	50 ppm/K

Reference Conditions

Ambient Temperature	+23 °C ±2 K
Relative Humidity	40 ... 60%
Measured Quantity Frequency	45 ... 65 Hz
Measured Quantity Waveshape	sine, deviation between RMS and rectified value < 0.1%
Battery Voltage	4.5 V ±0.1 V

Response Time (multimeter functions)

Response Time (after manual range selection)

Measured Quantity / Measuring Range	Response Time for Digital Display	Measured Quantity Jump Function
V DC, V AC A DC, A AC	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	5 s	
Continuity	< 50 ms	
→|←	1.5 s	
°C Pt100	max. 3 s	
3 nF ... 30 µF	max. 2 s	from 0 to 50% of upper range limit value
>10 Hz	max. 1.5 s	

Display

LCD panel (65 mm x 30 mm) with display of up to 3 measured values, unit of measure, type of current and various special functions.

Display / Char. Height	7-segment characters Main display: 12 mm Auxiliary displays: 7 mm
Places	5¾ places ≙ 309999 steps
Overflow Display	"**OL**" appears
Polarity Display	"–" sign is displayed if plus pole is connected to "⊥"
LCD Test	All display segments available during operation of the 28C are activated after the instrument is switched on.

Power Supply

Batteries: 3 ea. 1.5 V mignon cell alkaline manganese per IEC LR6 or equivalent rechargeable batteries

Service Life: With alkaline manganese (2200 mAh)

Measuring Function	Current	Service Life
V, Hz, mA, Ω_2, F, °C	25 mA	70 h
Standby (MEM + clock)	350 µA	approx. 1 year
Calibration Function		**Service Life**
mV, thermocouple	48 mA	40 h
15 V	85 mA	20 h
Ω, RTD	95 mA	18 h
Sink, 20 mA	175 mA	10 h
Source, 20 mA	140 mA	12 h

If voltage drops below 2.7 V, the instrument is switched off automatically.

Battery Test: " ⊣⊢ " is displayed automatically if battery voltage drops to below approx. 3.5 V.

Mains Power: With NA4/500 power pack

Fuses

Fusible links for all mA measuring ranges: FF (UR) 1.6 A/1000 V AC/DC, 6.3 mm x 32 mm, 10 kA switching capacity at 1000 V AC/DC and ohmic load

Indication of over-ranging: 300 mA range: Intermittent acoustic signal for displayed value > 310 mA (250 ms on, 250 ms off)

Multimeter Electrical Safety

Safety Class: II per IEC 1010-1:1990, IEC 1010-1/A2:1995 EN 61010-1:1993, EN 61010-1/A2:1995

Overvoltage Category: II

Operating Voltage: 600 V

Fouling Factor: 2

Test Voltage: 3.7 kV~ per IEC 61010-1/EN 61010-1/VDE 0411-1

Electromagnetic Compatibility (EMC)

Interference emission: EN 61326: 2002 class B

Interference immunity: EN 61326: 2002
IEC 61000-4-2: 1995/A1: 1998
Feature A:
8 kV atmospheric discharge
4 kV contact discharge
IEC 61000-4-3: 1995/A1: 1998
Feature B:
3 V/m

Data Interface

Data Transmission: optical via infrared light through the housing

with interface adapter as accessory

Type: RS 232C, serial, per DIN 19241

Bidirectional baud rate (read and write) (MM ↔ PC)
SI232-II: all baud rates
BD232: 9600 baud

Ambient Conditions

Accuracy Range: 0 °C ... +40 °C

Operating Temperature: –10 °C ... +50 °C

Storage Temperature: –25 °C ... +70 °C (without batteries)

Relative Humidity: 45% ... 75%, no condensation allowed

Elevation: to 2000 m

Deployment: indoors, outdoors: only in the specified ambient conditions

Mechanical Design

Protection: Housing: IP 50, Connector sockets: IP 20

Dimensions: 84 mm x 195 mm x 35 mm

Weight: approx. 420 gr. with batteries

22 Maintenance

Attention!
Disconnect the instrument from the measuring circuit before opening to replace batteries or fuses!

22.1 Battery

Note!
Removing the Battery During Periods of Non-Use
The integrated quartz movement for the calibrator draws power from the battery, even when the instrument is switched off. It is advisable to remove the battery 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.

The current battery charge level can be queried in the "Info" menu: Func + 0n ↓↑ inFo ↵ X.X V (bAtt).

Make sure that no battery leakage has occurred before initial start-up, and 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 batteries 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 three 1.5 V batteries in accordance with IEC R 6 or IEC LR 6, or equivalent rechargeable batteries.

Replacing the Batteries

- ➪ Set the instrument face down onto a flat working surface, loosen the two screws at the back and lift off the housing base, starting at the bottom. The housing top and housing bottom are held together with the help of snap hooks at the top front.
- ➪ Remove the batteries from the battery compartment.
- ➪ Insert three 1.5 V mignon cells into the battery compartment, making sure that the plus and minus poles match up with the provided polarity symbols.
- ➪ Important for reassembly: First set the housing base onto the housing top and align accurately (see photo below). Then press the two housing halves together, first at the bottom front (a), and then at the top front (b).

- ➪ Secure the housing base with the two screws.
- ➪ Please dispose of depleted batteries in accordance with environmental protection regulations!

22.2 4.5 V Power Pack

Use only the NA4/500 power pack from GOSSEN METRAWATT GMBH in combination with your instrument. This assures operator safety by means of an extremely well insulated cable, and safe electrical isolation (nominal secondary ratings: 4.5 V / 600 mA). Installed batteries are disconnected electronically if the power pack is used, and need not be removed from the instrument.

Country	Type / Article Number
Germany	Z218A
North America	Z218C
Great Britain	Z218D

22.3 Fuses

If the **fuse for the measuring ranges** up to 300 mA blows, all other measuring functions remain active. If a fuse should blow, eliminate the cause of overload before placing the instrument back into service!

If the **soldered-in fuse for the simulator blows**, the multimeter continues to function normally. The instrument must be sent to our Repair and Replacement Parts department to replace the soldered-in fuse, and to perform required balancing if this fuse blows (see chapter 24).

Replacing the Multimeter Fuse

- ➪ Open the instrument as described under Replacing the Batteries.
- ➪ Remove the blown fuse with the help of an abject such as a test probe, and replace it with a new fuse.

Table of Allowable Fuses

Type	Dimensions	Article Number
For current measuring ranges up to 300 mA		
FF (UR) 1.6 A/1000 V AC/DC (10 kA)	6.3 mm x 32 mm	Z109C *

* These fuses are available in packages of ten from our sales offices and distributors.

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 battery holder is prohibited.

22.4 Housing

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 and solvents.

23 Calibrator / Multimeter Messages

The following messages appear at the main or the auxiliary displays as required. See “Symbols used in the Digital Display” on page 2 for messages displayed via fixed display segments.

Message	Function	Significance
busy	Memory test	See chapter 19.2.3
CAnnot	Memory or transmission mode	Following functions cannot be executed: set time/date, clear ram, ram test
Error	Memory test	See chapter 19.2.3
oL	Measuring	Indicates overflow
Good	Memory test	See chapter 19.2.3
Hi Curr	Calibrator mode Resistance simulation	High current = current too high (I > 15 mA)
LoCurr	Calibrator mode Resistance simulation	Low current = current too low (I < 40 µA) Indicates that connector jacks are open, e.g. with Pt and Ni sensors
OutOL	Calibrator mode Voltage simulator Pulse and frequency generator	Out of limit = limit value violated (I > 40 mA), 3 acoustic signals are generated at the same time and the simulator jacks are deactivated. The output can be reactivated with the ON/OFF key.
LoVolt	Calibrator mode Current Sink	U < 3 V (insufficient loop impedance)
Hi burd	Calibrator mode Current source	High burd = high burden, applied resistance is too high (Rext > 700 Ω)

Blinking Unit of Measure

All measuring and calibration functions are balanced in accordance with technical specifications at the factory for each series METRA*Hit*®28C calibrator. If a unit of measure blinks, this indicates that the balancing constant which has been established and saved to the calibrator or the multimeter is no longer available for the respective function. If this is the case, measurement results may deviate from the specification. We recommend sending the instrument to our Repair and Replacement Parts department for rebalancing (see chapter 24).

24 Repair and Replacement Parts Service DKD Calibration Lab * and Rental Instrument Service

When you need service, please contact:

GOSSEN METRAWATT GMBH
Service Center
Thomas-Mann-Strasse 16-20
90471 Nürnberg • Germany
Phone +49-(0)-911 8602-0
Fax +49-(0)-911 8602-253
E-mail service@gmc-instruments.com

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

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

Accredited measured quantities: direct voltage, direct current values, DC resistance, alternating voltage, alternating current values, AC active power, AC apparent power, DC power, capacitance and frequency

Competent Partner

GOSSEN METRAWATT GMBH is certified in accordance with DIN EN ISO 9001:2000.
Our DKD calibration laboratory is accredited by the Physikalisch Technische Bundesanstalt *(German Federal Institute of Physics and Metrology)* and the Deutscher Kalibrierdienst *(German Calibration Service)* in accordance with DIN EN ISO/IEC 17025 by under registration number DKD–K–19701.
We offer a complete range of expertise in the field of metrology: from **test reports** and **proprietary calibration certificates** right on up to **DKD calibration certificates**.
Our spectrum of offerings is rounded out with free **test equipment management**.
An on-site **DKD calibration station** is an integral part of our service department. If errors are discovered during calibration, our specialized personnel are capable of completing repairs using original replacement parts.
As a full service calibration laboratory, we can calibrate instruments from other manufacturers as well.

DKD Calibration Certificate Reprints

If you order a DKD calibration certificate reprint for your instrument, please provide us with the reference numbers indicated in the upper and lower most fields of the calibration seal. We do not need the instrument's serial number.

25 Warranty

The warranty period for all measuring and calibration instruments of the METRA*Hit*® series is 3 years from delivery.
A warranty period of 12 months is granted for calibration.
Warranty covers defective material and workmanship, not including any damage caused by inappropriate use or operating errors as well as any follow-up costs.

26 Product Support

When you need support, please contact:

GOSSEN METRAWATT GMBH
Product Support Hotline
Phone +49 911 86 02 - 112
Fax +49 911 86 02 - 709
E-Mail support@gmc-instruments.com

Printed in Germany • Subject to change without notice

GOSSEN METRAWATT GMBH
Thomas-Mann-Str. 16-20
90471 Nürnberg • Germany
Member of GMC Instruments Group
Phone +49-(0)-911-8602-0
Fax +49-(0)-911-8602-669
E-Mail info@gmc-instruments.com
www.gmc-instruments.com

GOSSEN METRAWATT