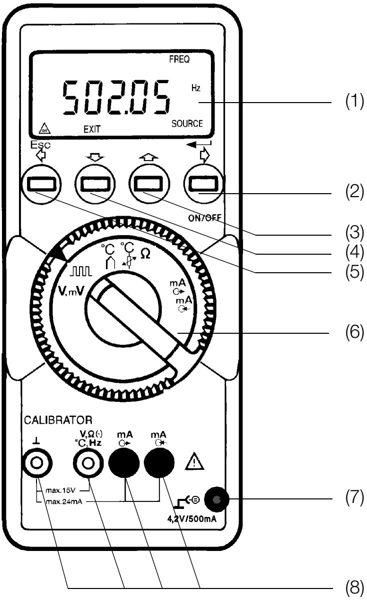
Operating Instructions

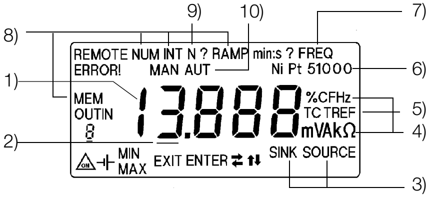
GOSSEN METRAWATT CAMILLE BAUER

METRA *Hit*® 18C

Calibrator

3-348-715-15
5/1.02


FREQ
502.05
Hz
SOURCE
EXIT
Esc
ON/OFF
V,mV
mA
CALIBRATOR
max.15V
max.24mA
4,2V/500mA
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)


REMOTE NUM INT N ? RAMP min:s ? FREQ
ERROR! MAN AUT
Ni Pt 51000
MEM
OUTIN
%CFHz
TC TREF
mVAkΩ
MIN
MAX
EXIT ENTER
SINK SOURCE
1)
2)
3)
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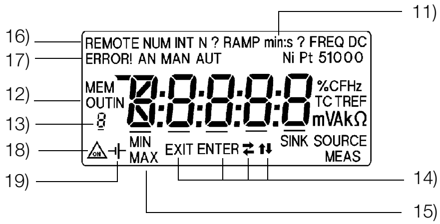
10)


REMOTE NUM INT N ? RAMP min:s ? FREQ DC
ERROR! AN MAN AUT
Ni Pt 51000
MEM
OUTIN
%CFHz
TC TREF
mVAkΩ
MIN
MAX
EXIT ENTER
SINK SOURCE
MEAS
11)
12)
13)
14)
15)
16)
17)
18)
19)

Operating Instructions

(1) LC display
(2) ON/OFF key, cursor right ENTER
(3) Key for digit increment, increasing step
(4) Key for digit decrement, decreasing step
(5) Key for cursor left, EXIT
(6) Functions selector for basic functions
V, mV = V, mV-source
⎍⎍⎍ = frequency, pulse
°C ⌒ = thermocouple (TC) simulation
°C = RTD sensor simulation
Ω = resistance simulation
mA ○→ = mA-SOURCE
mA ○← = mA MEAS, mA SINK
(7) Jack for plug type mains unit
(8) Jacks with automatic interlocking

LC Display

1) 5-digit numeric display, 1st digit indicates type of thermocouple
2) Cursor field
3) Menu guidance symbols for basic functions
SOURCE = source, i.e. simulation of signals
SINK = sink, i.e. for simulating a 2-terminal transmitter
4) Measurement units for measured values
5) Menu guidance symbols
TC = basic function "**°C** ⌒ ", for thermocouple simulation
TREF = setting the reference temperature
6) Type of simulated RTD sensor, e.g. Pt100 in the basic function "**°C** "
7) **FREQ** = pointing to the basic function " ⎍⎍⎍ " = frequency or pulse output
8) Menu guidance symbols for types of signal output
NUM = numerical entry for the output signal
INT = intervals, output in N steps
RAMP = ramp output
MEM = memory, output from the non-volatile memory
9) **N?** = request for entry of the number of steps in output type INT
10) Menu guidance symbols for output method MEM using
MAN = number of steps by manual key action
AUT = number of automatic steps with selectable time per step
11) **min:s** = flashing menu guidance symbol for time entries
12) Menu guidance symbols for output method MEM using
OUT = output from memory
IN = input to memory
13) Number of the memory value or number of the procedure
14) Menu guidance symbols for permissible key operations
EXIT = key (5) for EXIT function (Esc)
ENTER = key (2) for ENTER function
⇄ = keys (2) and (5) moving the cursor to the right (2) or to the left (5)
⇅ = keys (3) and (4) for menu selection on the same level modifying digits or step function
15) **MIN** and **MAX** simultaneously
pointing out the ranges with selectable lower and upper range limits
MIN or **MAX** flashing
Menu guidance symbol when entering the lower range limit **(MIN)** or the upper range limit **(MAX)** for output types INT and RAMP
MAX flashing
Upon entering the upper range limit during current measurement
16) Menu guidance symbol for **REMOTE** operation via the serial interface
17) **ERROR !** = warning symbol for error states
18) ⚠ = pointing out the inhibited automatic cut-out
19) ⊣⊢ = indication of "battery low" or for battery voltage indication

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1 Safety Features and Precautions

This chosen instrument will provide a high degree of safety.

The calibrator is designed and tested in accordance with the safety regulations IEC 61010-1 / DIN VDE 0411.
When used in accordance with the regulations, it will ensure the safety of the operating personnel and protection of the instrument. However, safety is not ensured when the instrument is operated improperly or treated carelessly.

To maintain a proper state of safety, and to ensure a hazard-free use, the operating instructions must be read carefully and completely prior to the use of the instrument, and all points in the operating instructions must be complied with.

For the purpose of personal safety, and for the protection of the instrument, the calibrator is provided with automatic jack interlocking.
This is coupled with the functions selector, and makes only those jacks accessible that are required for the selected function. Furthermore, it inhibits switching into wrong basic functions when the measurement leads are plugged in. Hence, only the correct polarity of the connection as marked at the jacks need be verified.

Please observe the following safety precautions:

Attention!
The meter has been designed for safe use when not connected to circuits which conduct hazardous contact voltages of greater than 42 V to earth.

- *Never* mistake the calibrator for the similarly housed *multimeters*.
  The calibrator is distinguished from the multimeter by its *YELLOW* jack sleeves and leads; the multimeter has red jack sleeves and red and black leads.
- When intending to connect the instrument with a circuit, the absence of hazardous touch voltages must be verified first, if necessary with a multi-meter.
- Please observe the *maximum* permissible voltages for the protection of the instrument stated at the jacks.
  Except during operation for resistance simulation and mA-SINK, the connected signal circuits should *not feed currents or voltages* back into the calibrator.
  In order to prevent major damages to the instrument when extraneous voltages (within the permissible limits) are applied, the measuring circuit for mA-SINK and mA-SOURCE is provided with a PTC resistor overload protection that turns these measuring circuits into high resistance ones during the overload period when higher currents occur during a fault.

Warning!
The instrument shall not be used in explosion endangered zones or inserted in self-protected circuits.

Repairs, Exchange of Parts, and Calibration

Voltage-carrying parts can be found exposed when the instrument is opened. The instrument must be disconnected from measuring circuits before any repair, exchange of parts or calibration. When repair or calibration work under voltage and with an opened instrument is unavoidable, then this shall only be carried out by a skilled person aware of the dangers that may arise.

Faults and Extraordinary Loading

When a continued hazard-free use of the instrument is doubtful, it must be made inoperable and protected against inadvertent use.

A hazard-free use is no longer ensured when

- the instrument shows visible damage,
- the instrument no longer operates,
- the instrument has been kept in storage under adverse conditions,
- the instrument has been subjected to severe transport conditions,
- measurement leads or probe tips are damaged.

2 Putting into Operation

Inserting Batteries

3 alkaline cells size IEC LR6, 1.5 V / 2.2 Ah are supplied inserted in the instrument. It is ready for operation.

Please note Section 7.1 Maintenance – Battery" prior to operating the instrument.

In there, the additional statement is made that externally rechargeable batteries may be used.

One of the accessories is a plug type mains power supply that permits driving the instrument with power from the mains.

The internal batteries will be disconnected from the circuit when the plug is inserted into the instrument. Thus, they cannot draw power from the mains power supply.

Only this plug type power supply that is matched to the instrument in respect of voltage and power, may be used.

Switching the Instrument On

➩ Press the "ON/OFF" key (2).

The switched-on state is acknowledged by a signalling tone.

Pressing the "ON/OFF" key (2) for a *short period* will cause the firmware version stored in the EPROM and, subsequently, the battery or power supply voltage to be briefly displayed during switching on process, before the instrument becomes operational in the operational mode selected with the functions selector (6).

Pressing the "ON/OFF" key (2) for a longer period will cause all segments of the LC display (1) shown in Section 3.3 to be displayed.

The instrument becomes operational when the key is released.

⚠ **Attention!**

The following can occur when the charge state of the batteries is low: the internal battery voltage supervision causes the instrument

- not to switch on
- to switch off immediately afterwards
- to switch off when the output is loaded or
  the internal change-over selects a higher auxiliary voltage
  (e.g. 10/15 V range, 20 mA / 750 Ω).
  See also Section 5.2 and Section 7.1.
  In this case, the batteries should be replaced
  in accordance with Section 7.1 or
  the plug type mains unit may be used, if possible.

When the instrument is operational, the *last menu position* will be saved in the non-volatile memory (NVRAM) before the instrument is switched off.

Provided the position of the functions selector has not been changed during the switched-off period, the instrument will, immediately after switching on, revert to the menu position used prior to switching off.

Jumping to the *highest* menu level is achieved in the simplest way by turning the functions selector into an adjacent position and back.

This switching process is also recommended after wrong menu operations or uncertainties in respect of the actual menu setting.

☞ **Note!**

Electrical discharge and RF interference may cause incorrect readings and disrupt the measuring sequence.
Then the instrument should be switched off and switched on in a different position of the functions selector; this will reset the operation of the instrument.
Should this attempt fail, then the batteries should be disconnected from the circuit for a short period. This can be done by plugging in the power supply without opening the instrument.
Prior to opening the instrument, the latter must be disconnected from the circuit to be measured, and Section 7 "Maintenance" must be observed!

Automatic Switching Off

The instrument is switched off automatically, if none of the keys or the function selector have been activated for a period of approx. 10 min.

Inhibiting the Automatic Switching Off

The instrument can be set to "PERMANENTLY ON".

➩ When switching ON, the "ON/OFF" key (2) and the yellow "ESC" key (5) must be pressed simultaneously.

Note:
The function "PERMANENTLY ON" is indicated by the symbol ⚠ON on the LC display (1).

Automatic switching off is inhibited also when the instrument is set to REMOTE operation via the serial interface in accordance with Section 6.

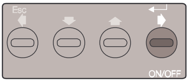
Switching the Instrument Off

Press the ON/OFF key (2) for at least 1 second.

3 General Advice for Operation

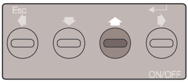
3.1 Key Panel

The control operations required for the comprehensive facilities for signal outputs are executed by using only the four keys (2) to (5) after the basic function has been selected by means of the functions selector. Their effect depends on the actual setting of the menu position, but follows a general control principle described in Section 3.2.



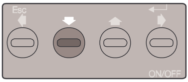
(1)

ON/OFF
- Switching ON/OFF
  ENTER-function,e.g.
- Entering a sub-menu
- Loadng an entered number digit
- Moving the cursor to the right when entering digits



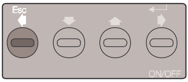
(2)

- Incrementing a digit
- Stepping to an adjacent menu on the same menu level
- Starting ramps and interval steps upwards and stopping them
- Jumping back to the preceding program step (RECORD) under the basic function PROCEDURES in accordance with Section 4.6



(3)

- Decrementing a digit
- Stepping to an adjacent menu on the same menu level
- Starting ramps and interval steps downwards and stopping them
- Jumping forward to the next program step (RECORD) under the basic function PROCEDURES in accordance with Section 4.6



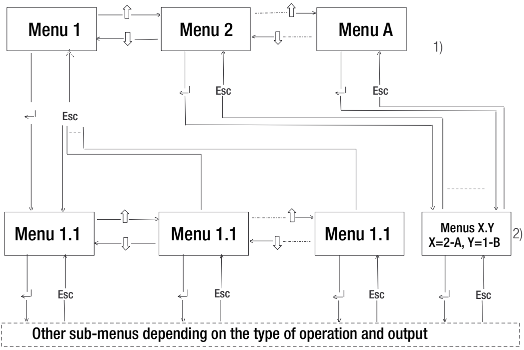
(4)

Esc EXIT-function, i.e.
- Back to the higher menu level
- Terminating ramps, automatic interval stepping, frequency and back to the higher menu level
- Moving the cursor left when entering digits

3.2 Menu Structure and Key Operations

The menu structure is designed on a uniform concept for nearly all basic functions.

The highest menu level comprises the basic functions that can be selected with the functions selector (6). All other operations are executed by using the 4 keys in accordance with a structure shown in Figure 1.



1) 1. Key panel menu level of the selected type of operation (ranges or type of sensor)

2) 2. Key panel menu level, method of output for the selected range or type of sensor

Figure 1 Concept of the Menu Structure

The basic function " ⎍⎍ " and the "mA MEAS" function are excepted from this menu structure.

Furthermore, the following is carried out between the 1st and 2nd menu levels in the basic functions:

"°C ⌒ " selection of the internal and external reference temperature and its entry, as well as

"°C ⌁ " entering the lead resistance

The following functions are associated with the various menu levels:

1st Menu Level	2nd Menu Level	Other Menu Levels
Selection of the signal ranges or of the types of sensor depending on the basic function selected with the functions selector	Selection of the method of signal output:	
	NUM = numerical	Manual numerical input of the output value
	INT- ⌐⌐ = subdivision of a specified range into a number of similar steps. The sequence can be manual (MAN) or automatic (AUTO) with an adjustable time per step	Input of the lower and upper range limits (these are already defined for the standard ranges 0 ... 10 V, 0/4 ... 20 mA) as well as entering the number of steps. Under AUTO: entering the time per step, starting and stopping steps
	RAMP /\/ = output as an ascending or descending ramp with a dwell time at the upper and lower range limits	Entering the lower and upper range limits as well as ramp duration (_/‾_) and dwell time (_/‾_) Starting and stopping the ramps
	MEM = output of 10 signal values per range or type of sensor that have been saved earlier in the non-volatile memory (NVRAM)	Entering signal values into the non-volatile memory (NVRAM) and output from the NVRAM

The menu structure with the functions on the menu levels is printed in an summarizing format (Figure 2) on the underside of the housing.

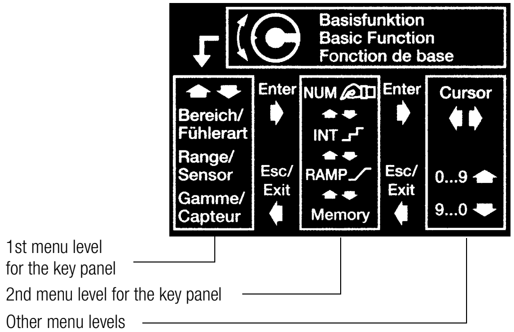


Figure 2 Illustration of the Menu Structure Printed on the Underside of the Housing

3.3 LC display

The LC display is an important element in the user guidance in which, in addition to numerical displays, various symbols show the actual menu position and give advice on actions to be taken.

Figure 3 shows the LC display with all its symbols that are displayed during a segment test mentioned in Section 2.

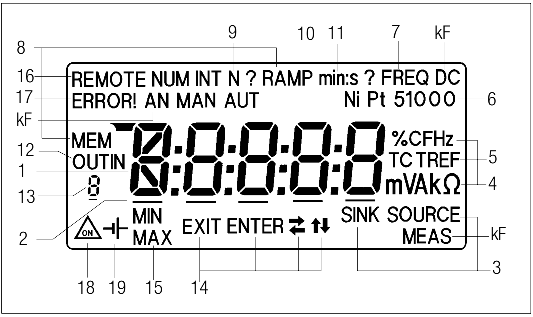


Figure 3 LC Display

The symbols have the following significance:

1) 5-digit number display,
1st digit for an additional indication of the type of thermocouple

2) Cursor field

3) Menu guidance symbols for basic functions
SOURCE = source, i.e. simulation of signals
SINK = sink, i.e. for simulating a 4-terminal transmitter
MEAS = measuring the current signal 0 ... 24 mA DC

4) Measurement units for measured values

5) Menu guidance symbols
TC = basic function "**°C** ⋂ ", for thermocouple simulation
TREF = setting the reference temperature, (internal or external cold junction)

6) Type of simulated RTD sensor, e.g. Pt100 in the basic function "**°C** ⏚ "

7) **FREQ** = pointing to the basic function " ⎍⎍⎍ " = frequency or pulse output

8) Menu guidance symbols for methods of signal output
NUM = numerical entry for the output signal
INT = intervals, output in N steps
RAMP = ramp output
MEM = memory, output from the non-volatile memory

9) **N?** = flashing menu guidance symbol when entering the number of steps in output method INT

10) Menu guidance symbols for output method MEM
MAN = number of steps using manual key operation
AUT = number of automatic steps with selectable time per step

11) **min:s** = flashing menu guidance symbol for time entries for method output INT, AUT and RAMP

12) Menu guidance symbols for method output MEM
OUT = output from memory
IN = entry for memory

13) 7-segment digit indicating the number of the memory value output method MEM or the procedure No. under the basic function PROCEDURE

14) Menu guidance symbols for permissible key operations
EXIT = key (5) for EXIT function (Esc)
ENTER = key (2) for ENTER function
⇄ = keys (2) and (5) moving the cursor to the right (2) or to the left (5)
⇅ = keys (3) and (4) for menu selection on the same level, changing digits or step function

15) Menu guidance symbols
MIN and **MAX** simultaneously
pointing out the ranges with selectable lower and upper range limits on the 1st menu level of the basic functions "**V**, **mV**, **mA**"
MIN or **MAX** flashing
menu guidance symbol when entering the lower range limit (**MIN**) or the upper range limit (**MAX**) for output method INT and RAMP
MAX flashing
upon entering the upper range limit during current measurement

16) Menu guidance symbol for **REMOTE** operation via the serial interface

17) **ERROR !** = warning symbol for error states

18)  = symbol for "PERMANENTLY ON".

19)  = indication of "battery low" or for battery voltage indication after switching on

kF) = no function, symbols are not used.

3.4 Operating Assistance by the LC Display

Symbols are displayed on the LC display as a function of the selected menu to support the user of the instrument during the control operation as follows:

- Where am I ?
  i.e. confirmation of the basic function and the data functions selected with keys, e.g. output method and type of quantities to be entered
- Keys for further processing ?
  Key operations required for continuing a process are indicated by the menu guidance symbols (14) in accordance with Section 3.1 Inadmissible key operations are pointed out by a single tone pulse.
- Special events, e.g.
  ⊣⊢ = low battery voltage,
  ERROR ! = wrong operational states, pointed out in more detail by assisting text.

3.5 Entering Digits

Manual entering of numerical values is carried out in the following manner

⇨ = moving the cursor to the right (2).
When the cursor is already positioned beneath the last digit, then this key has the function ENTER for saving the entered value.

⇧ = incrementing a digit (3).
Pressing this key briefly will **increment** the value of the digit by 1.
Keeping this key pressed will increase the indicated value by 1 every 0.4 sec. from the cursor position to the left after a short tone pulse.

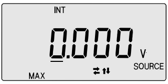
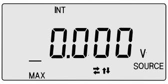
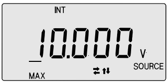
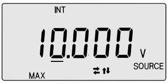
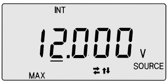
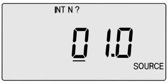
⇩ = Decrementing a digit (4).
Pressing this key briefly will **decrement** the value of the digit by –1.
Keeping this key pressed will decrease the indicated value by 1 every 0.4 sec. from the cursor position to the left after a short tone pulse.

⇦ = moving the cursor to the left (5).
When the cursor is already positioned beneath the **first** digit, then this key has the **function EXIT**, i.e. the next pressing causes a jump to the next higher menu level.

- When a digit is incremented from 9 to 0, the next digit to the left is increased by +1. When decrementing a digit from 0 to 9, the next digit to the left is decreased by –1 (counting function).
- Each digit entry is limited within a maximum and a minimum in accordance with the technical data. A change of a digit that would lead to a violation of these limits, is signalled by a short tone. In this case, the numerical value will be set to the range limit.

Example of Entries

Entering the upper interval limit (MAX) = 12 V in the basic function, "V, mV SOURCE" in the range 0...15 V under the output method "Intervals" (INT).
See also Section 4.2.

Key Operation	Display	Notes
Various key operations see Section 4.2		Ready for entering the MAX value; Cursor and MAX are flashing
⇦		Cursor to the left; Further movement to the left causes a jump back to entering the MIN value
⇧		Further incrementing would set the value to the upper range limit of 15 V after a short tone
⇨		Moving the cursor to the right
2x ⇧		MAX set to 12 V
3x ⇨		Key (2) now has the function of ENTER. Pressing key ⇩ would set the value to 11.999 V
↵		Ready for entering the number N of intervals "N?" flashes

3.6 Non-Volatile Saving of Menu Positions and Configurations

The METRA*Hit* 18Cis fitted with a non-volatile memory (NVRAM) in which current menu positions (LAST MENU) and configurations remain saved after switching off.

When switched off, the NVRAM is supplied with power from 3 small batteries. During a battery replacement in accordance with Section 7.1, a special supporting capacitor acts in a bridging function for 3 minutes.

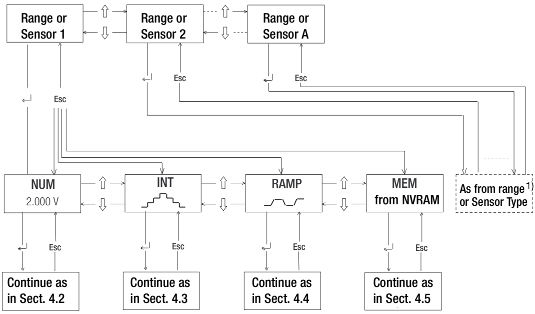
As mentioned in Section 2, the instrument will, when switched on again, resume exactly the last menu position prior to switching off, provided the functions selector position has remained unchanged. This saves time-consuming key operations for entering complex menus. *Furthermore when used on site, this will reduce the load on the batteries, when the instrument is switched off whenever it is not in active use.*

In all basic functions, the configurations once set for a range or type of sensor, will be saved in the non-volatile memory when the instrument is switched off, e.g. MIN/MAX values in INT, RAMP, RAMP timing.

4 Types of Output Signals

4.1 Menu Structure

The methods of outputting signals described in Section 4.2 to Section 4.5 apply to all basic functions that can be selected with the functions selector (6), except the basic function "⎍⎍⎍ ". Figure 4 shows their menu structure.



1) Additional entries in accordance with Sect. 5.3 and 5.4 are made between the two menu levels in the operational modes „°C" and „°C"

Figure 4 Menu Structure

4.2 Numerical or Manual Entries for the Output Signal (NUM)

The most simple method for outputting signals is by a numerical or manual entry of the output signal value.

After the range or type of sensor and possible additional entries for "**°C**" have been selected, the key " ↵ " (2) must be pressed again when the symbol NUM appears.

The value 0 or the lowest possible signal value will appear on the number field (1), and the cursor flashes for further digit settings.

The signal value can be modified within limits in accordance with Section 3.5, and the displayed value will immediately be present at the jacks (8).

Holding the key ⇧ (3) or ⇩ (4) pressed will cause a change of the signal value regularly by 1 every 0.4 seconds left of the cursor position in small to large steps up or down depending on the cursor position.

4.3 Intervals, Output in N Steps (INT)

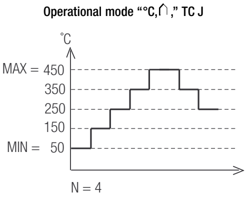
This output method permits subdividing a range into N intervals. This is particularly useful for controlling items under test with digitally or linearly divided analog displays.

The range limits of standard signals 0 ... 10 V and 0/4 ... 20 mA are fixed. In other ranges, they can be entered within the whole range.

The number of steps can be set from 1 ... 99.9 (steps), i.e. non-integer steps can be set. This useful in the particular case when analog displays or recorders with non-standard full-scale values are connected.

The steps can be triggered manually (MAN) using the keys ⇧ (3) and ⇩ (4), or automatically (AUT) with a dwell time per step that can be selected.

Figs. 5 and 6 show 2 examples of such range divisions.



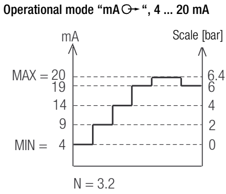


Figure 5 Range Divisions N = 4

Figure 6 Range Divisions N = 3.2

The MIN/MAX limits in Figure 5 have been entered to cover the whole range from –200 to + 1200 °C. The range divisions into 3.2 intervals for connection of an item under test with a scale of 0 ... 6.4 bar, corresponding to a range of 4 ... 20 mA with fixed range limits, is shown in Figure 6. Figure 7 shows the general menu struct. starting with the menu pos. in accordance with Figure 4 in which the output method 'Intervals' (INT) is ready for a selection.

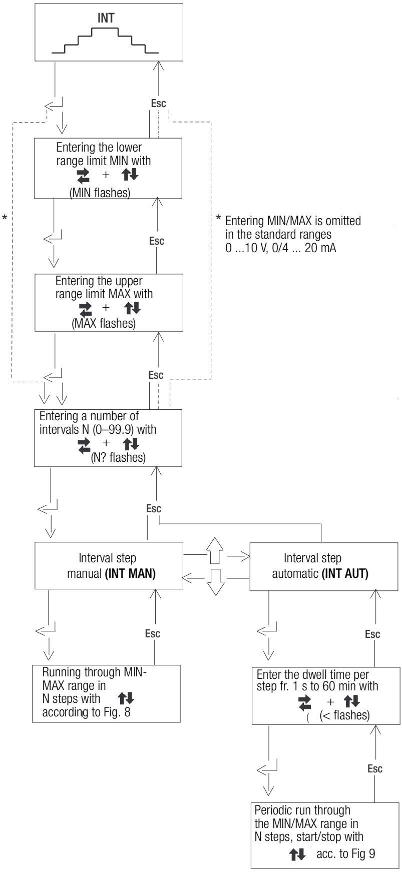


Figure 7 General Operator Control Structure in the Output Method 'Intervals' (INT)

Manual Run through the MIN/MAX Range in N Steps (INT, MAN)
The steps can be triggered with the keys ⇧ (3) and ⇩ (4) after all parameters in accordance with the menu structure in Figure 7 for the output method INT, MAN have been entered.

The relationship between the output signal and the key operations can be derived from the two examples shown in Figure 8 and Figure 9.

Example: Basic function „V, mV“ range 0-15 V, MIN = 2 V, MAX = 10 V, N = 3

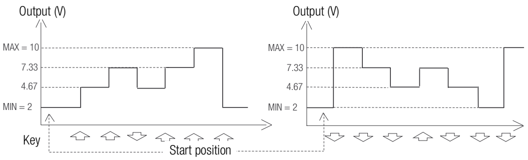


Figure 8 *Figure 9*

Automatic Run through the MIN/MAX Range in N Steps (INT, AUT)
The automatic run through a programmed range is particularly useful in all cases in which the feed for a signal circuit and reading on the periphery equipment to be tested are spatially separated.

The interval time per step over the range from 1 second to 60 minutes can be entered after the menu "INT AUT" has been selected, and the step sequence can be stopped by means of the keys ⇧ (3) and ⇩ (4) in accordance with Figure 10.

Example: Basic function „V, mV“, range 0-15 V, MIN = 2 V, MAX = 10 V, N = 3
time per step = 5 s

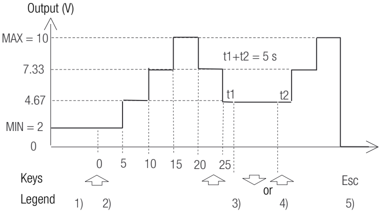


Figure 10 Example of a Step Function Sequence

Legend:

1) Starting position after the time per step = 5 s has been entered.
The output signal is 2 V.

2) Start of the steps with ” ⇧ “from 2 V at the bottom upwards.
When using ” ⇩ “, the starting point is 10 V at the top downwards.

3) Stop with ” ⇧ “ or ” ⇩ “,
The time t1 elapsed since the last step remains saved.

4) Continue upwards with ” ⇧ “ after t2 = 5 s – t1

5) Abort the step function with "Esc" and jump back to the entry of a new interval dwell time. The output signal is approx. 0 V.

The following information on the current status is available during the run through the step function:

- Flashing segment or in the first digit from the left.
  signifies the next step **upwards**,
  signifies the next step **downwards**

This auxiliary indication is not possible when the first position is already claimed by a figure > 0, e.g 10.000 V.

- Using the key ” ↵ “ (2) causes the residual time to the next step to appear instead of the current numeric output value.
  This residual time is switched off by pressing the key ” ↵ “ (2) again.

4.4 Output as Periodic Ramp (RAMP)

Ramp-shaped signals permit checking the time-dynamic behavior of items under test or of whole measured circuits. One example is the behavior of a control circuit when the nom. value is entered via the analog nom. value input of the controller. The instrument can, in this output method, replace expensive hardware and software solutions for long duration test assemblies with cyclic sequences.

The input parameters for the periodic ramp shown in Figure 11 are:

- Lower (MIN) and upper (MAX) range limits that are fixed for the standard range. 0 ... 10 V and 0/4 ... 20 mA, but are otherwise selectable within the whole range
- Rise and decay time t1 that can be selected between 1 second and 60 minutes
- Dwell time t2 at the upper and lower range limit, and selectable between 0 and 60 minutes

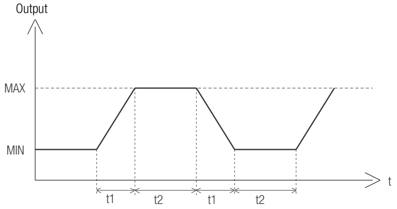


Figure 11 Example of a Periodic Ramp

Figure 12 shows the menu structure for entering ramp parameters after the method of output RAMP (see Figure 4) has been selected.

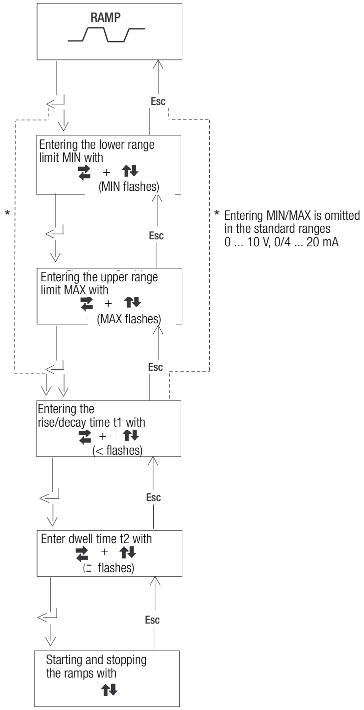


Figure 12 Menu Structure for Entering Ramp Parameters

When all ramp parameters have been entered in accordance with the menu structure in Figure 12, the ramp is started and stopped with the keys ⇧ (3) and ⇩ (4).

Note!
Interruptions of periodic ramp cycles caused by pressing the ⇧ or the ⇩ key should be avoided.
Uncontrolled sudden changes may otherwise result.

Press "**Esc**" to jump back to entering a dwell time t2.
The output signal is approx. 0 V.

The following information relating to the current status will be available during the run along the ramp:

- Flashing segments , , or signify:

  or , ramp running up or down

  or , dwelling at the upper (MAX) or lower (MIN) limit.

  This auxiliary indication is not possible when the first position is already claimed by a digit > 0, e.g. 20.000 mA.

- Key " ↵ " (2) causes the residual time to the end of the ramp or the residual dwell time to the start of the next ramp to be displayed instead of the current numerical output value. This display of the residual time can be switched off with the key " ↵ ".

Attention!
For reasons of a critical timing, the internal supervisory facilities described in Section 5.1 (e.g. output load too high) are inactive during the ramp sequence with t1 = 10 s. Hence, error conditions will in such cases be displayed with a delay until after the end of the ramp has been reached.

4.5 Output from the Non-Volatile Memory (MEM)

This output method permits entering manually up to 10 signal values or sensor types, and calling up the values stored in the non-volatile memory. This provides the possibility of storing measurement series having non-linear intervals. This can be very helpful when simulating sensors or transducers for various physical and chemical quantities.

The menu structure shown in Figure 13 from the selection of the type of output MEM onwards is split into one type of output in which the value is only called up, and a second type of output in which the value is called up and can be modified.

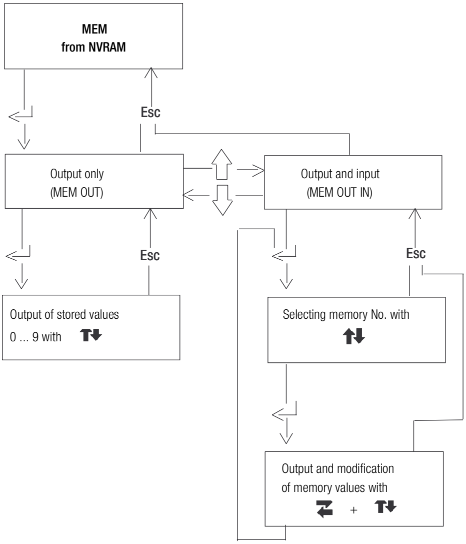


Figure 13 Menu Structure from the Method of Output (MEM) Onwards

The detailed key operations can be copied from the following examples of entering operations.

Example: Basic Function „V, mV“, Range 0...10 V.

Key Operation	Display	Notes
1x ↵, 3x ⇧ (Esc)	MEM 0 - 10 V ENTER ⇅ SOURCE	Ready for output method MEM
↵	MEM OUT 0 - 10 V ENTER ⇅ SOURCE	MEM, OUT, only outputting possible
↵	MEM OUT 0 5.000 V ENTER ⇅ SOURCE	Memory No. 0 (small segment digit left) comprises the value 5 V, available immediately at the jacks. Memory No. and ⇅ are flashing.
3x ⇧	MEM OUT 3 2.500 V ENTER ⇅ SOURCE	Keys ⇧ and ⇩ can be used to call up other mem. numbers in steps, and their values are immediately available at the jacks
Esc	MEM OUT 0 - 10 V ENTER ⇅ SOURCE	Back to menu selection MEM OUT for the purpose of changing to MEM OUT IN, outputting and entering (values can be modified)
⇧ (Esc)	MEM OUTIN 0 - 10 V ENTER ⇅ SOURCE	Ready for output MEM OUT IN
↵	MEM OUTIN 3 0 - 10 V ENTER ⇅ SOURCE	⇅ can be used to select the memory No. that is to be output or modified.
↵	MEM OUTIN 3 2.500 V ⇄ ⇅ SOURCE	The value 2.5 V in memory No. 3 is available at the jacks and can be modified.
⇧, 3x ⇨	MEM OUTIN 3 3.500 V ENTER ⇄ ⇅ SOURCE	The value in memory No. 3 has been modified to 3.5 V and is saved with (↵)
↵	MEM OUTIN 4 0 - 10 V ENTER ⇅ SOURCE	⇅ can be used to select a new memory No. for outputting and modification.

4.6 Output by Procedures Saved in the Non-Volatile Memory

This output method permits saving in the non-volatile memory repetitive sequences during a simulation of process signals such as those occurring e.g. during periodic checking or during the validation of systems. 10 procedures with up to 99 program steps each (records) are available for saving such sequences. The program steps within a procedure can be selected freely via basic functions, ranges and output methods.

The PC software „METRAwin 90“ is offered as an ancillary program with an interface adapter for transferring a procedure from the PC to the instrument, so that procedures can be created.

Working with procedures is explained by way of examples in the following sequences.

Keys, Functions selector (6)	Display	Notes
⇧ **and** ⇩ simultaneously for **at least** 1 second	REMOTE MAN Pr.nr._1 ENTER ⇅	Change to "Procedures" from any menu position. Ready for selecting procedure No. 1.
3x ⇧	REMOTE MAN noPr 4 ⇅	No procedure stored under No. 4.
2x ⇧	REMOTE MAN Pr.nr.2 ENTER ⇅	Selecting procedure No. 2 with 10 records.
↵ Functions selector (6) is already in position "V, mV"	REMOTE MAN 2 .2500 V EXIT ⇅ SOURCE	1 record in procedure No. 2 = output of 2.5 V DC. Small digit on the left (13) = procedure No.
⇩	REMOTE MAN 2 REC.02 V EXIT ⇅ SOURCE	Briefly displaying the next record No. Subsequently
	REMOTE MAN 2 - - - - - °C TC EXIT ⇅ SOURCE	New basic function „°C ⋂ „ is displayed flashing when this does not comply with the position of the functions selector
Function selector (6) in basic function „°C ⋂ „	REMOTE MAN 0 2 K:1200 °C TC EXIT ⇅ SOURCE	Record No. 2 = output thermocouple type K, 1200 C with the internal reference temperature ("0" top right). Key ⇧ leads back to record No. 1
9x ⇩	REMOTE MAN 2 End 11 EXIT ⇅	End" is signalled shortly after the last record No. 10. Subsequently
	REMOTE MAN Pr.nr.3 ENTER ⇅	Ready for entering procedure No. 3 or selection of a different procedure No.
⇧ **and** ⇩ simultaneously	J. °C TC ENTER ⇅ SOURCE	Switching the output off via procedures, and jump to the highest menu level of the set basic function.

> ☞ **Note!**
> When switching off, output method "Procedures" remains saved in the non-volatile memory , i.e. the last menu position is set when the instrument is again switched on. This results in a battery-saving operation during location changes on sites.
> Consequently, switching this basic function off is possible only like switching on via the keys “ ⇧ “ (3) and “ ⇩ “ (4) pressed simultaneously for at least 1 second.
> The display of "REMOTE MAN" is an acknowledgement that the output method "Procedures" is set.

4.7 Output via the Serial Interface (REMOTE)

The calibrator in its standard version is fitted with infrared diodes permitting communicating with a PC via a DC-decoupled connection with an interface adapter. This adapter in conjunction with an efficient "Windows" communication software „METRAwin 90“, covering many valuable applications, is offered as a cost efficient ancillary item.

Switching the Interface On

➪ When pressing the keys "ON/OFF" (2) and ” ⇧ “ (3) simultaneously, operation via the interface will be acknowledged with the symbol "REMOTE" (16). At the same time, an automatic switching off of the equipment will be inhibited, and this is indicated by the symbol ” ⚠ON “ (18).

For this reason, the plug type mains supply should be used for long operational periods. This avoids an automatic switching off by the battery supervisory circuit.

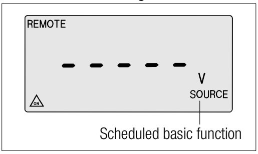
Operating Controls in REMOTE Operation

The instrument will not respond to any key operation when set to REMOTE operation. One exception is given by switching off the equipment with the ”ON/OFF“ key (2). Only by switching the instrument on with this key will cause it to resume local control operation.

LC Display in REMOTE Operation

The instructions sent by the PC during direct operation will be executed by the instrument directly, provided the basic function set by the message complies with that set on the functions selector (6). The LC display will acknowledge the programmed signal value and the output method after each message.

Wrong settings of the functions selector are signalled by a flashing display of the scheduled basic function. The new instruction will be executed immediately when the functions selector (6) has been set to the scheduled basic function.



Message Read-Out during Current Measurements ⊸ in the LOCAL Operating Mode

In this operating mode a message with the measurement value in ASCII format is transmitted via the serial interface with a frequency of approximately 6 measurements per second. The format corresponds to the LCD, e.g. „17.35 mA“.
If overload occurs, the message is expanded via “overrange” to include the content: “24.00mA”.

Interface parameters are as follows:

Format: 8 data bits, no parity, 1 stop bit
Baud rate: 9600 baud

Signal LED on the Interface Adapter
One green and one red signal diode on the interface adapter indicate the following information and warning:

- **Green** LED:
  This will be lit briefly when instructions are transferred from the PC to the instrument.

- **Red** LED:
  This will be lit during the transfer of messages from the instrument to the PC. This occurs after each switching on and when a message received from the PC is acknowledged. This response, as well as a signalling tone, give a confirmation indicating a correct physical communication between PC and instrument.

5 Basic Functions

5.1 General Notes

The 7 basic functions that can be set manually with the functions selector (6), form the highest menu level in the instrument. However, a signal output within the set basic function occurs only after the signal range or the sensor type, and the output method have been selected, and further key operat. have been executed.

In all menu positions in which the output signal is not defined, e.g. parameter entries, the output signal will be set to the following symbols:

- approx. 0 V in"V, mV", " ⎍⎍ ", "°C ⌒ ", "mA ○→ " and "mA ○← ", as well as
- approx. 100 Ω in "°C ⌇ " and "Ω".

Similar values will also be present at the jacks when a jump back into a higher menu position is executed by using the "Esc" key (5). The jacks are open-circuited in all intermediate positions of the functions selector, i.e. they are not connected internally with the circuit.

➩ The lowest possible range for the output signals to be simulated on the uppermost menu level should always be selected in the basic functions "V, mV", "mA ○→ " and "mA ○← ". This produces the best possible accuracy, and the
battery drain will be lower.

5.2 Supervisory Circuits

Various internal measurement and supervisory circuits are continuously testing the external and internal conditions of the instrument under which the selected output signal available at the jacks is within the technical specifications.

These are:

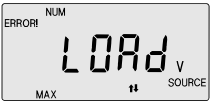
- **Measurement of the Battery Voltage**

  This leads to an LC display with the symbol "⊣⊢ " (19) when the voltage has dropped below approx. 3.4 V, and switches the instrument off when the voltage drops further below approx. 3.2 V.
  The battery voltage measurement has the additional purpose of compensating the effect from the battery voltage on the accuracy of the instrument.

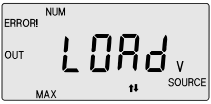
☞ **Note!**
The load is heavier when the load current and voltage is high as well as in the voltage range 0 ... 10 V or 0 ... 15 V respectively. This can lead to an immediate internal cut-out when the batteries are weak or used at the end of their useful life.

- **Measurement of the Output Load in the Basic Functions „V, mV" and „TC, ⌒ "**

  The illustrated flashing warning display "**ERROR MAX LOAD**" will appear above a current drain of approx. 15 mA



  Above approx. 18 mA, the flashing display of "**ERROR OUT MAX LOAD**" indicates that the stabilization in the instrument is no longer ensured.



  This error message will also appear during a short-circuit on the jacks with the following exception:
  The current state makes a detection of a short-circuit impossible with a nominal output voltage of approx. 4 mV and within approx. 0.7 to 2.5 V.

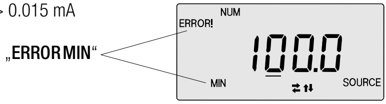
- **Measurement of the Sensor Current in the Basic Functions „°C “ and „Ω“**

  A correct electronic resistance simulation depends on the magnitude of the sensor current (from the item under test) and its polarity.

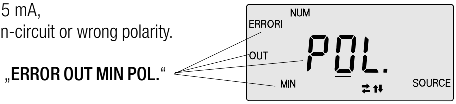
  The operating range for current is Is = 0.05 ... <u>0.1 ... 1</u> ... 1.4 mA
  The specified tolerance applies to Is = 0.1 ... 1 mA
  Twice the tolerance applies to Is = 0.05 ... 0.1 mA and 1 ... 1.4 mA

  Sensor current *outside* the permissible range is indicated by the following error messages:

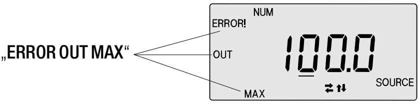
  Is < 0.05 mA, but > 0.015 mA



  Is < 0.015 mA,
  Input open-circuit or wrong polarity.



  Is > 1.4 mA



  When these described warning messages appear, the resistance simulation will continue to function, but without reliable accuracy.
  In such cases, additional means should be employed (e.g. selected precision resistors) to ensure an operational usefulness in principle, and an accuracy required for practical applications

- **Supervision of the Current Regulation and the Actual Current in the Basic Function “ ○► “**

  The regulating circuit for the internal current source is supervised.
  A deviation of nominal/actual values due to too high an output load will trigger the display of an error. This supervision of the regulating circuit is also used for a switching action from a low auxiliary voltage, normally used for reducing the battery drain, to a higher voltage as a function of the external load.

  The current source normally works with an internal auxiliary voltage that allows a voltage drop of 4 V max. across the external load. Exceeding this voltage drop will

  – either cause a change to a higher auxiliary voltage for a voltage drop up to 15 V (20 mA x 750 Ω) when the external load drops below approx. 5 kΩ .
  – or trigger the display of an error message without switching the auxiliary voltage, when the external load is above approx. 5 kΩ or when the circuit is broken.

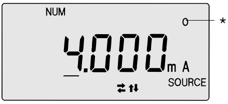
  The internally switched auxiliary voltage is indicated at the top edge of the LC display (* in the example illustrations) by a "0" for a low auxiliary voltage, or a "1" for a high auxiliary voltage.

  The following examples of sequences show the various LC displays as a function of the external load.

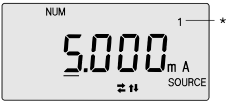
1st Example: Range 4 ... 20 mA, external ´load = 1 kΩ

Process **Display**

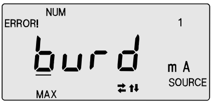
Nominal value 4 mA,
Ua = 4 mA x 1 kΩ = 4 V
⋆ = **0** = low auxiliary voltage



Increase to 5 mA, i.e. Ua > 4 V
With a brief display of
"**ERROR MAX burd**" a change to
a higher auxiliary voltage is made
⋆ = **1**



Increase to 20 mA, i.e. Ua > 15 V
The nominal/actual value deviation
triggers the error display
"**burd**" = load too heavy

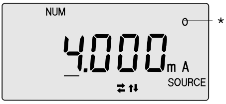


Note: When switching from a higher auxiliary voltage back to a lower one, the signal output must be aborted to go to a higher menu level using "Esc" (5) or a change at the functions selector is necessary, even when Ua ≤ 4 V.

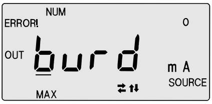
2nd Example: Range 4 ... 20 mA, external load = 0 Ω

Process **Display**

Nominal value 4 mA,
Ua = 0 V
⋆ = **0** = low auxiliary voltage



The circuit will be broken.
The measurement of the actual value
finds Ra > approx. 5 kΩ .
Hence "**ERROR OUT MAX burd**".
The auxiliary voltage is not increased,
because a fault has been detected in
the output circuit.



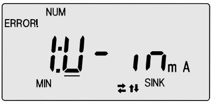
The error message disappears when the circuit is closed.

- **Supervision of the Current Regulation in the Basic Function „ “**

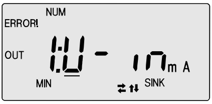
A nominal/actual deviation in the basic function " “ can occur when the external signal circuit does either not exhibit the programmed nominal current or when the voltage on the jacks is too low.

These fault conditions are pointed out by the following displays:

The actual current is less than the
value set on the instrument, but higher
than approx 1 mA.
Reason: Current limiting in the ext.
circuit or the voltage is too low.



The actual current is less than the
value set on the instrument, but lower
than approx 1 mA.
Reason: Current limiting in the ext.
circuit or the voltage is too low.



5.3 [V, mV], Voltage Source

- ➭ Set the functions selector (6) to "V, mV"
- ➭ Connect the item under test in accordance with Figure 14 using test leads.

Once the instrument is switched on, the 4 signal ranges 0-10 / 15 / 1.5 V / 150 mV on the uppermost menu leve will be available for selection, and the wanted signals can be simulated in the 4 output methods NUM, INT, RAMP, and MEM.

The first range 0-10 V applies as a standard signal in process techniques.

In this range, MIN/MAX entries are not required under output methods INT and RAMP. These are fixed at MIN = 0 V and MAX = 10 V. The output of the instrument is protected against short-circuits, and loads with more than approx. 15 mA or approx. 18mA respectively are detected and displayed by the internal supervision in accordance with Section 5.2. The short-circuit current is approx. 23 mA.

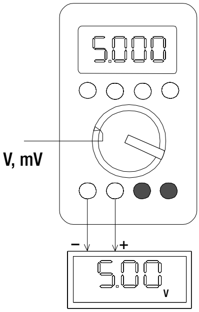


Figure 14 Connections for Use as a Voltage Source

5.4 ⎍⎍⎍ , Pulse Generator

Description of the Function, Applications

This basic function is designed for typical requirements in processing techniques, such as e.g. simulation of initiators, pulses from flow counters, rev-counters, energy or frequency control and event counters in the low frequency region. The maximum pulse amplitude of 15 V is usually adequate, even for inputting pulses into control circuits (SPS) using 24 V logic inputs.

The instrument produces positive square waves with a pulse duty factor of 1:1 (duty cycle 50 %). The output can be selected as continuous or as a time-limited number of pulses.

Menu Structure

Figure 15 on the following page shows the menu structure which deviates from the basic scheme of the other basic functions.

The input parameters are: amplitude, frequency, and a selected number of positive (LO-HI) or negative (HI-LO) pulses.

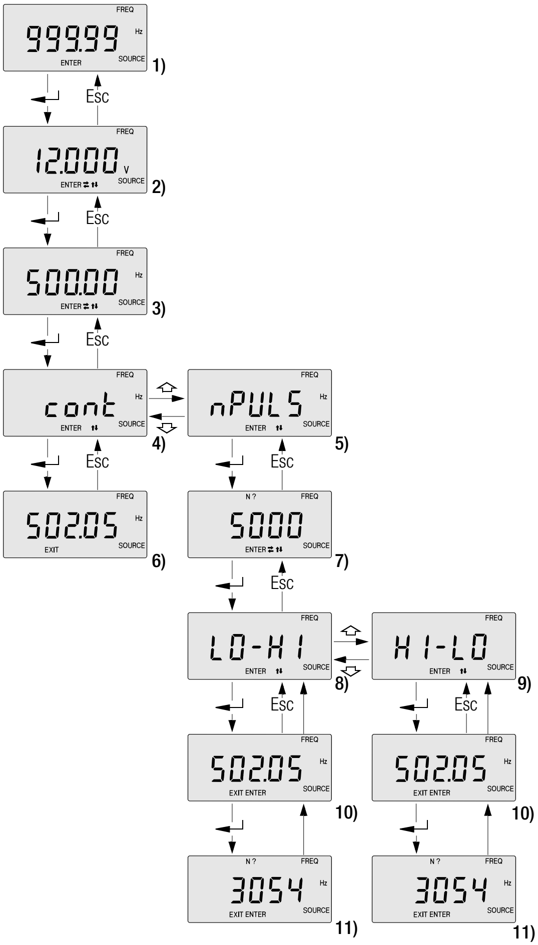


Figure 15   Menu Structure for the Pulse Generator

Legend for the individual menu positions in Figure 15

1) Selection of the basic function " ⎍⎍⎍ " makes the frequency range of 0.01 ... 999.99 Hz available

2) Entering an amplitude of 0 ... 15 V

3) Entering a frequency of 0.01 ... 999.99 Hz

4) Selecting continuous pulse output

5) Selecting an output of N pulses at a prescribe pulse frequency

6) Continuous pulse output with 502.05 Hz
Stopping the pulse output with " ↵ "
Note:
The nearest possible frequency for nominal value entry is calculated from the limited timer resolution of the microprocessor.

7) Entering the number of pulses

8) The pulse output starts with a low level in accordance with the upper timing diagram in Figure 16.

9) The pulse output starts with a high level in accordance with the lower timing diagram in Figure 16.

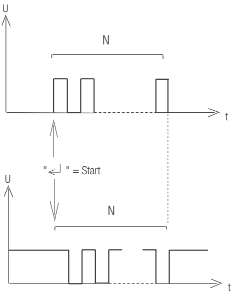


Figure 16 Timing Diagram

10) Output of the pulse series with the selected parameters and the nearest possible frequency in accordance with menu position **6)**.
After the output of the pulses, the instrument is ready for a new start from menu positions **8)** or **9)**.

11) Pressing the " ↵ " key (2) will cause the display for approx. 1 second of the number of pulses remaining at the time of pressing that key, instead of the frequency.

☞ **Note!**
This change-over will lead to a short duration break in the pulse output at the jacks (only noticeable at higher frequencies).

Operator Control

➪ Set the functions selector (6) to „ ⎍⎍⎍ ".

➪ Connect the item under test by means of test leads as shown in Figure 17.

➪ Continue with further settings in accordance with the menu structure described above.

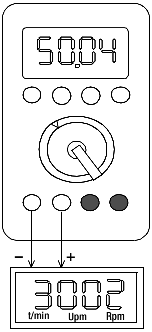


Figure 17 Connection of the Test Leads

⚠ **Attention!**
For reasons of a critical timing, the automatic cut-out and supervision of the battery voltage as well as of the loading are switched off during the output of pulses. However, the output is protected against short-circuits, and the output current is limited to approx. 25 mA.

5.5 "°C ∩ ", Thermocouple Simulation

Description of the Function, Applications

10 types of thermocouple are available for selection and can be simulated over the full temperature range specified by IEC/DIN.

The internally measured reference temperature can be used or the temperature of an external reference for –50 to +100 °C can be entered.

Important Advice relating to the Reference Temperature

The internal reference temperature is continuously measured by using a built-in temperature sensor coupled with the jack " ⊥ " (8).

The reference temperature for Items under test having a thermocouple measurement input terminal is usually measured at the terminals for the thermocouple.

The two measurements may differ from each other, and the difference fully enters the simulation as an error. The following methods will help to reduce this error:

- The connections from the item under test to the jacks of the instrument are made with a compensating lead for the thermocouple to be simulated (Figure 18).
- The temperature is measured with a precision temperature measuring instrument at the thermocouple terminals of the item under test, and this value is entered into the instrument as an external reference temperature (Figure 19). The connection between the calibrator and the measuring instrument is made by using copper leads.

Entering the external reference temperature is also used in all cases in which the temperature measurement in the item under test is carried out via a reference point with a stabilized temperature (end of the compensating lead for the thermocouple).

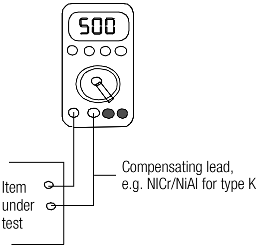


Figure 18 Temp. measurement via comp. lead

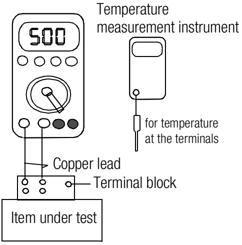


Figure 19 Entering the reference temperature

Operator Control

➪ Set the functions selector (6) to „°C ∩ "

➪ Select the wanted thermocouple type using the keys " ⇧ " (3) or" ⇩ " (4) . For an accurate designation and ranges see Section 6.

➪ The internal reference temperature will be displayed after entering this with the " ↵ " key (2). The choice between internal or external reference is explained further down by an application example.

➪ Connect the item under test to the jacks in accordance with Figure 20, and note the advice given above for the reference temperature in respect of the connecting leads.

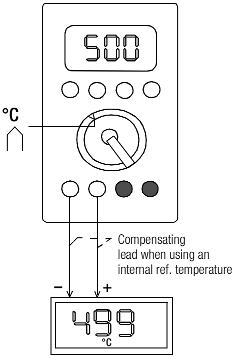
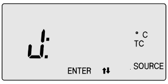
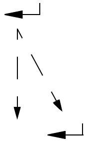
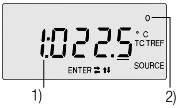
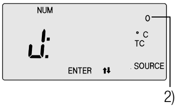
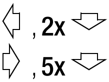
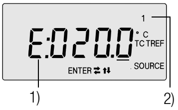
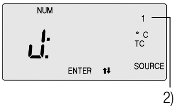


Figure 20 Connections of the measurement Leads

Example for Inputting a Specified Reference Temperature

Key Operation	Display	Notes
After switching ON or adding the connection using the functions selector (6)		Ready for selecting the type of thermocouple
		Display of the *internally* measured reference temperature 1) **I** = internal ref. temperature 2) **0** = pointing out the int. ref. temp. in other menu positions
		Selecting the *internal* reference temperature for the following simulations
		Numerical change of the value = entering an *external* ref. temp. 1) **E** = external ref. temperature 2) **1** = pointing out the ext. ref. temp. in other menu positions
		Selecting the external reference temperature 20°C for the following simulations.

Notes!

- A change from °C to °F may be made by keeping the keys ” ⇩ “ (4) and ” ↵ “ (2) pressed simultaneously when switching on the instrument.
- The output load is supervised, and an output current of approx. 15 mA is signalled by a flashing display of ”**ERROR MAX LOAd**“ or in the case of approx. 18 mA it is signalled by ”**ERROR OUT MAX LOAd**“.
  The output is protected against short-circuits. The short-circuit current is approx. 23 mA.
- In the case of low-impedance items under test, e.g. moving coil meters or recorders, a signal distortion by the output resistance R_a of the equipment (0.2 Ω max.) can lead to significant errors.
  (Error $\Delta U = I_{out} \times R_a$, e.g. 1 mV with I_{out} = 5 mA, R_a = 0.2)

5.6 “[°C] ”, RTD Sensor Simulation

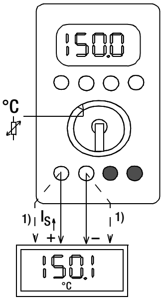
Function and Applications

The electronic resistance simulation is, in principle, a measurement of the sensor current Is, that is fed by the item under test into the instrument, and a voltage U_a depending the programmed resistance R_p is applied to the jacks, the following applies to the voltage: $U_a = R_p \times I_s$

This simulation operates within limited ranges for sensor current and resistance that are aimed at a simulation of commonly used RTD temperature sensors. However for this range of application, the electronic simulation realized in the instrument, offers a flexibility of the signal output that is far superior to conventional resistance sources.

Operator Controls

- ⇨ Set the Functions selector (6) to ”°C “
- ⇨ Set the wanted type of RTD sensor using the keys ” “ (3) or ” “ (4). Their temperature ranges are stated in Section 6.
- ⇨ The lead resistance ROFFS (Roffset) is displayed after entering the above with the ” “ key (2). Entering between –9.99 and +99.99 Ω is possible. This resistance is added to the later programmed resistance value in accordance with the sensor characteristic. The value can be modified or a jump to the type of output can be made by twice pressing key (2) (” “ and ” “).
- ⇨ Connect the item under test with the jacks in accordance with Figure 21 and observe the following notes relating to sensor current supervision which is additionally described in detail in Section 5.2.



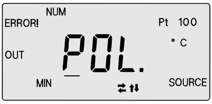
1) Sensor cables for 4-wire connection

Figure 21 Connection of the Measurement Leads

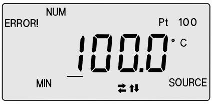
Note Relating to Sensor Current Supervision

When items under test with unknown sensor current are connected and/or the polarity of the sensor current is not marked at the point of connection, error messages can be generated at the output that can be interpreted in the following manner:

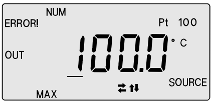
„ERROR OUT MIN POL.“
The item under test does not supply a sensor current (<10 µA) or the sensor is connected with the wrong polarity. The polarity must be reversed and the item under test must be measured separately when this is unsuccessful.



„ERROR MIN“
The sensor current is too low (<50 µA). Resistance simulation will operate, but compliance with the specified limit is not ensured.



„ERROR OUT MAX“
The sensor current is too high (>1.4 mA). Resistance simulation will operate up to approx. 2 mA, but compliance with the specified limit is not ensured.



Note the tolerance figures in Section 5.2 that are dependent on the sensor current !

5.7 "Ω", Resistance Simulation

This basic function differs from "°C ⊄ " only in the fact that a resistance value within the range 30.0 Ω to 2000.0 Ω is entered directly and can be simulated. Hence:

➪ Set the functions selector (6) to "Ω".

➪ Take further information for operator control from Section 5.6 relating to the basic function " C ⊄ ", simulation of RTD sensors.

☞ **Note!**

Simulation will also work below 30 Ω to 0 Ω . However, the data in respect of inherent deviation of the instrument are not ensured.

5.8 " ○► ", Current Source

➪ Set the function selector to " ○► "

➪ Connect the item under test by means of the measurements accordance with Figure 22.

3 signal ranges 4-20 / 0-20 / 0-24 mA are available for selection after the instrument has been switched on, and signals in the 4 methods of output NUM, INT, RAMP and MEM can be simulated in these ranges.

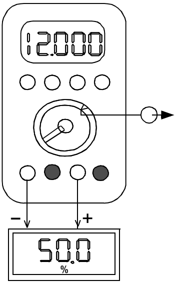


Figure 22Connection of the Measurement Leads

The first two ranges apply as standard signals to process techniques. No entries of the MIN/MAX limits are required for the output methods INT and RAMP, because these are fixed to MIN = 4 or 0 mA respectively and MAX = 20 mA.

A supervision of a correct current regulation and a two-stage matching of the internal auxiliary voltage to the load by the external circuit is carried out during the output of current.

For this reason, please read the detailed description of this supervision in Section 5.2 , and check the external circuit when error messages described there are displayed.

Note:

The little figure 6) at the top left on the LC display signifies:

0 Low battery drain reducing auxiliary voltage for external loads up to 200 Ω at 20 mA

1 Higher auxiliary voltage for external loads up to 750 Ω at 20 mA

The switching from a low to a high auxiliary voltage is carried out when the voltage at the jacks exceeds approx. 4 V.

5.9 Current Measurement [mA]

Functions Description

Two basic functions are possible in the “mA “ selector switch position:

- Current measurement (basic function: MEAS)
- Active current control (basic function: SINK, see Section 5.10).

The measurement input for the MEAS function is unipolar and encompasses a current measuring range of 0 ... 24 mA DC.

Operation

⇨ Set the function selector switch (6) to “ “.

⇨ Complete the circuit with correct polarity (+ to “ “).

⇨ Activate the “ “ key (2); input current is displayed at the instrument.

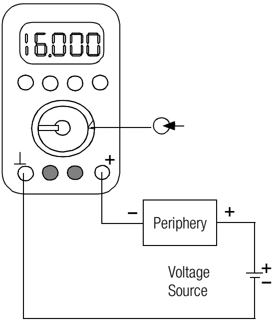


Figure 23 Measurement Cable Connection

Note!
Current measurement includes unipolar display only. “0” appears at the display if polarity is reversed, and the power circuit is disabled by a diode.

Attention!
Input currents of greater than 24 mA are limited by the instrument to 24.00 mA by means of a semiconductor; entry into the upper limit range is indicated by blinking characters at the display and the MAX menu guidance symbol.
The voltage drop from the external circuit caused at the jacks in the event of an overload may not exceed 27 V DC.

5.10 “ “, Current Drain, Simulation of a Transmitter with two Leads

Description of the Function, Applications

In this basic function, the current selected between 0 and 24 mA flows into the instrument, independent from the DC voltage (4 ... 27 V) present at the jacks. The most important application of this function as a current drain is the simulation of 4-terminal transmitters.

4-terminal transmitters are measurement transducers for measuring quantities in process techniques. In an operation as a drain, they accept a constant current between 4 - 20 mA depending on the measured quantity and independent from the applied voltage (Figure 24). The measuring circuit is fed from the signal of 4 - 20 mA. 4-terminal transmitters are particularly useful in systems with long distances between the components, e.g. on board of ships, in chemical industry plants or refineries, because additional lines for auxiliary voltages can be omitted in this case.

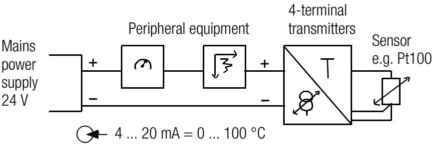


Figure 24 Example of a Meas. Circuit for 4-Terminal Transmitters

Tests on peripheral equipment by means of simulation of a 4-terminal transmitter in a measuring circuit are described in the following paragraphs of these operating instructions.

Operator controls

- ➩ Switch on the instrument.
  After the instrument is switched on the basic function „ “ MEAS. is active.
- ➩ Change with the key (3) to the basic function „ “ SINK.
  3 signal ranges 4 - 20 mA, 0 - 20 mA or 0 - 24 mA are available for the selection in the same menu level.

After selection of the range the signal can be simulated in the following 4 output methods:
NUM, INT, RAMP and MEM.

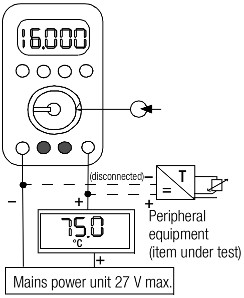


Figure 25Connections with Measurement Leads

The first two ranges apply as standard signals to process techniques. No entries of the MIN/MAX limits are required for the output methods INT and RAMP, because these are fixed to MIN = 4 or 0 mA respectively and MAX = 20 mA.

Supervision of correct current regulation is carried out in the instrument. For this reason, please read the detailed description of this supervision in Section 5.2, and check the connected circuit for the presence and polarity of the specified voltage when error messages described there are displayed.

Notes:

- Verify that the applied voltage does not exceed 27 V. Otherwise, the instrument will be thermally overloaded.
- The instrument is protected against wrong polarity.
  Wrong polarity or missing voltage is indicated by the flashing error message "**ERROR OUT MIN I:U-in**".

Warning!
The instrument shall not be used in explosion endangered zones or inserted in self-protected circuits.

6 Technical Data

Basic Functions

I Source

Fixed Ranges

Standard signal	4 ... 20 mA, 0 ... 20 mA	Resolution 1 µA
Variable range	0 ... 24 mA	Resolution 1 µA
	Ranges are entered into a non-volatile memory by means of keys.	
Maximum Load	200/750 Ω with automatic change-over (heavier battery drain at 750 Ω)	
Overload	limited by an internal self recovering PTC resistor for protection	

U Source

Fixed range

(Standard signal)	0 V ...10 V	Resolution 1 mV
Variable ranges	0 V ... 15 V	Resolution 1 mV
	0 V ... 1.5000 V	Resolution 0.1 mV
	0 mV ... 150.00 mV	Resolution 0.01mV
	Range entry by keys	
Load	≥ 1 kΩ (max. 15 mA at 15 V)	
Output resistance	0.2 Ω	

RTD source

Sensor Pt 100	Range –180 ... + 850 °C	Resolut. 0.1 °C/°F
Pt 1000	Range –180 ... + 250 °C	Resolut. 0.1 °C/°F
Ni 100, Ni 1000	Range –60 ... + 180 °C	Resolut. 0.1 °C/°F
Operating conditions	Sensor current 0.05 ... 0.1 ... 1 ... 1.4 mA	
Setting	°C or °F	
Entry of signal offset	range –9.99 ... +99.99 Ω (e.g. for power cable resistance)	

R Source

Range covered	30 ... 2000.0 Ω	Resolution 0.1 Ω
Operating conditions	Sensor current 0.05 ... 0.1 ... 1 ... 1.4 mA	

Thermocouples (according to DIN/IEC584)

Thermocouples	Type	Range	Resolution
Fe-CuNi	Type J	– 200 ... + 1200°C – 328 ... + 2192°F	1 °C/°F
Fe-CuNi	Type L	– 200 ... + 900°C – 328 ... + 1652°F	1 °C/°F
Cu-CuNi	Type T	– 250 ... + 400°C – 418 ... + 752°F	1 °C/°F
Cu-CuNi	Type U	– 200 ... + 600°C – 328 ... + 1112°F	1 °C/°F
NiCr-NiAl	Type K	– 250 ... + 1350°C – 418 ... + 2462°F	1 °C/°F
NiCr-CuNi	Type E	– 250 ... + 1000°C – 418 ... + 1832°F	1 °C/°F
Pt10Rh-Pt	Type S	– 50 ... + 1750°C – 58 ... + 3182°F	1 °C/°F
Pt13Rh-Pt	Type R	– 50 ... + 1750°C – 58 ... + 3182°F	1 °C/°F
Pt30Rh-Pt6Rh	Type B	+ 50 ... + 1800° + 122 ... + 3272°F	1 °C/°F
Nicrosil-Nisil	Type N	– 240 ... + 1300°C – 400 ... + 2372°F	1 °C/°F

D/A-resolution	3 µV
Setting	°C or °F
Reference- temperature	internal via a temperature sensor at the terminals external, entry – 50 ... + 100 °C

I Measurement

Measuring Range	0 ... 24 mA unipolar, resolution 0.05 mA
Voltage Drop	approx. 0.5 V DC + I (mA) x 125 Ω
Sampling Rate	approx. 6 measurements/sec.
Overload Capacity	Input current is limited to 24 mA. Entry into the upper range limit is signalled.
Max. Input Voltage	±27 V DC

I-Drain (Simulation of 4-Terminal Transmitters)

Fixed ranges		
Standard signal	4 ... 20 mA, 0 ... 20 mA	Resolution 1 μA
Variable range	0 ... 24 mA	Resolution 1 μA
	Ranges are entered by means of operator keys.	
Input voltage/ Input power	4 ... 27 V, max 0.6 VA	
Overload	internal self-recovering PTC resistor	

Frequency (Squarewave Pulses)

Frequency range	0.01 ... 999.99 Hz	Resolution 0.01 Hz
Pulse amplitude	selectable 0 ... 15 V	
Resolution	1 mV	
Duty cycle	50 %	

Pulse Series (as for frequency, but the number of pulses are selected)

Number of pulses	1 ... 99999
Start	selected for start from a high or a low level

Output Methods for Source and Drain Functions

Numerical	by means of keys
Interval	subdivision of a fixed (standard signal) or a variable range into N intervals
Interval step	switched manually or automatically
Dwell time per step	programmable over 1 s ... 60 min
Ramp	periodic, positive or negative going ramp time and dwell time each programmable over 1 s ... 60 min
Memory (10 for each range and type of sensor)	individual values stored in a non-volatile memory can be output in steps

Error limits	(for Tu = 23 ± 3°C)
I Measurement	0.25% of the value ±0.05 mA
I source/drain	0.05 % of the value + 2μA
V source (15 V)	0.05 % of the value + 2 Digit
Thermocouples	
ext. ref. temp.	0.1 % of the value [1] + 15 μV
int. ref temp.	0.1 % of the value [1] + 15 μV + 2 °C
Pt 100, Ni 100, Pt 1000, Ni 1000	0.1 % of the value + 0,25 °C [2]
R source (500 Ω)	0.1 % of the value + 0,1 Ω [2]
Frequency	
Frequency stability:	30 ppm
Frequency accuracy	0.05 % of the indicated actual frequency resolution of the timer frequency, approx. 16 μs, results in a difference between the nominal and nearest possible actual frequency

1) relative to the thermocouple voltage [mV];
The errors in [°C] as a function of thermocouple and temperature are listed in a table shown in the Appendix to these operating instructions
2) for a sensor current 0.1 ... 1 mA

Display	5-digit LCD 12 mm high with additional text and symbols for user guidance

Operator Controls	Setting of the basic functions by means of a rotary switch for menu selection (range, output) and numerical entries via 4 menu keys

Auxiliary Energy

Battery operation	from 3 small alkaline-manganese cells 1.5 V / 2.2 Ah type IEC LR6
Useful time (with 2.2 Ah per cell)	approx. 15 h without current drain for $V_{out} \leq 1.5$ V approx. 10 h without current drain for $V_{out} > 1.5$ V approx. 12 h with I source 20 mA/≤ 200 Ω approx. 6 h with I source 20 mA/> 200 to 750 Ω
Switching off	after 10 min by means of an internal timer when no key or switch is operated
Supervisory circuit	Display of low battery voltage and subsequent switching off
Mains operation	Separate plug type mains unit. The inserted battery will be switched off automatically.
Rechargeable cells	The instrument can also be operated with rechargeable NiCd or NiMH cells charged by a separate charger.

Ambient Conditions

Operational Temperature	– 10 ... + 50°C
Storage Temperature	– 25 ... + 70°C
Temperature error	max 0.05 % of the value per 10°K, additional offset 2 digits/10°K
Relative humidity	max. 75%, no condensation
Climatic class	2z /0/50/70/75% derived from VDI/VDE 3540
Height over NN	up to 2000 m

Electrical Safety	(for plug type mains unit) protection class II to IEC 1010-1/DIN VDE 0411

Mechanical Design

Type of protection	IP 50 to VDE 0470 / EN 60529 IP 20 at the jacks for connection an main supply
Dimensions	84 x 185 x 35 mm
Weight	approx. 400 gr. including batteries

7 Maintenance

7.1 Batteries

The calibrator is an instrument that, in comparison with a merely indicating hand-held multimeter, requires in principle more auxiliary energy and has a correspondingly shorter operational time of the batteries.

In the METRA*Hit* 18C, this has been taken into consideration in several ways:

- By automatically switching off after 10 minutes of operation without action by means of keys or function selector.
- By enabling, after switching on, a continuation with the function set by the function selector, provided the latter has not been changed since switching off.
- By the plug type mains unit as a standard accessory that, when used, disconnects the inserted batteries.
- This disconnection and the permissible operational range of the battery voltage of 3.3 to 4.6 V permits using small primary cells (IEC LR6) or 3 rechargeable NiMH-cells of 1.2 V each. The latter must be charged externally by a separate plug type charger offered as an accessory.

Before switching the instrument on, as well as during battery replacement or after storage of the instrument, the user should make sure that the batteries in the instrument have not leaked.

When batteries have leaked, the user must remove the battery electrolyte completely and insert new batteries, before using the instrument again.

Prior to a long storage of the instrument for more than approx. 2 months, the batteries should be removed to protect the instrument against damage by battery leakage. This also avoids discharging the batteries by the current flowing for the non-volatile in the switched off state (current typically 0.1 mA).

The batteries should be replaced as soon as possible when the symbol " ⊣⊢ " (18) appears on the display.
The internally measured and supervised battery voltage depends on the magnitude of the load, i.e. an increased load on the output will cause this symbol to appear earlier, and may even lead to a cut-out by the internal low voltage supervision.

Replacement of Batteries

- Place the instrument face down on a surface, release the two screws on the back, and lift the lower housing part carefully off by beginning at the bottom end while holding the twin battery holder so that it can be drawn out from the compartment in the lower housing part.
  The upper and lower part of the housing are engaged at the top end by securing hooks.
- Remove the twin battery holder from the compartment in the upper housing part without applying mechanical force on the red/black connecting litz wires.
- Remove all 3 inserted batteries from the two battery containers.
- Insert 3 new batteries or recharged accumulators, and observe the polarity engraved on the battery holders. When the user does not want to loose the configurations and procedures saved in the non-volatile memory, the instrument may be left without batteries for a maximum of 3 minutes.
- Re-insert the twin battery holder into the compartment of the upper housing part in accordance with Figure 26, and make sure that the connecting litz wires are not resting on the housing edge or on the screw with the tapped hole.

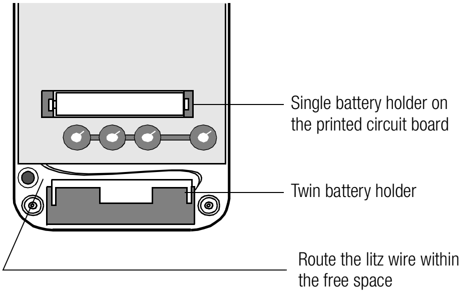


Figure 26 Battery Holders

- Replace the lower housing part by starting at the upper face, and make sure that the securing hooks at this point are correctly engaging. Make also sure that the connecting litz wires are not resting on the edge of the housing or on the screw.
- Secure the lower housing part with the two screws.
- Please dispose of used batteries as hazardous waste !

7.2 Housing

Special maintenance work on the housing is not required. Please ensure that the surface is kept clean.

8 Appendix

8.1 Errors in [°C] in Thermocouple Simulation

The error for thermocouples is specified in the technical data as a ΔU-error of the thermocouple voltage. The ΔT-error is dependent on the slope of the thermocouple characteristic.

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

The maximum of this ratio is determined within each partial range.

dU/dT is calculated from the difference in voltage for ΔT = 10 °C.

Examples

1. For a thermocouple type R, the maximum of the ratio in the range 200 - 300 °C is at 200 °C:
   ΔT [°C] = (1.468 + 15) ÷ (1557 - 1468)/10 = (16.468 / 8.9) = 1.85 °C
2. For a thermocouple type K, the maximum of the ratio in the range 400 - 500 °C is at 500 °C:
   ΔT [°C] = (20.640 + 15) ÷ (20640 - 20214)/10 = (35.640 / 42.6) = 0.84 °C

As a result of the linearity of the thermocouple characteristic, that also applies to its slope (1st derivative dT/dU), the calculated ΔT-error is listed in the following Table for partial ranges of 100 °C covering all types of thermocouple.
The listed values represent the possible maximum error in the respective partial range.

Thermocouple Type	T-Error in °C at the Reference Temperature 0 °C for the Following Types of Thermocouple									
Partial Range °C	**J**	**L**	**T**	**U**	**K**	**E**	**S**	**R**	**B**	**N**
– 200 ... 100	1.00	0.80	1.26	1.09	1.30	0.91	–	–	–	1.79
– 100 ... 0	0.47	0.47	0.64	0.63	0.60	0.44	≥ -50°C 3.63	≥ -50°C 4.01	–	0.81
0 ... 100	0.37	0.37	0.41	0.43	0.46	0.37	2.73	2.78	–	0.60
100 ... 200	0.47	0.46	0.46	0.46	0.58	0.39	2.11	2.06	15.03	0.64
200 ... 300	0.56	0.56	0.52	0.50	0.66	0.46	1.93	1.85	7.23	0.69
300 ... 400	0.67	0.66	0.58	0.58	0.75	0.55	1.90	1.78	4.98	0.76
400 ... 500	0.76	0.75	–	0.64	0.84	0.64	1.94	1.79	3.85	0.83
500 ... 600	0.83	0.82	–	0.70	0.94	0.74	1.98	1.81	3.18	0.92
600 ... 700	0.87	0.87	–	–	1.05	0.85	2.01	1.83	2.79	1.01
700 ... 800	0.94	0.91	–	–	1.17	0.97	2.05	1.87	2.53	1.11
800 ... 900	1.07	1.02	–	–	1.31	1.09	2.09	1.91	2.36	1.21
900 ... 1000	1.23	–	–	–	1.44	1.22	2.14	1.92	2.26	1.33
1000 ... 1100	1.36	–	–	–	1.59	–	2.18	1.96	2.18	1.45
1100 ... 1200	1.47	–	–	–	1.74	–	2.25	2.03	2.12	1.58
1200 ... 1300	–	–	–	–	1.93	–	2.35	2.10	2.09	1.73
1300 ... 1400	–	–	–	–	2.02	–	2.43	2.20	2.11	–
1400 ... 1500	–	–	–	–	–	–	2.53	2.30	2.18	–
1500 ... 1600	–	–	–	–	–	–	2.63	2.42	2.26	–
1600 ... 1700	–	–	–	–	–	–	2.82	2.61	2.34	–
1700 ... 1800	–	–	–	–	–	–	3.10	2.76	2.44	–

All errors are greater by 2 °C for the **internal** reference temperature.

At an **external** reference temperature ≠ 0 °C, the Table applies when the partial ranges are shifted by the reference temperature.
Example: External Ref. Temp. = 50 °C: the partial range 100 - 200 °C becomes 150 -250 °C.

In case of an **°F display,** the values in °F are increased by a factor of 1.8.

The partial ranges in **°F** are calculated as follows: °F = 32 + °C · 1.8.

9 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 20
90471 Nürnberg, Germany
Phone +49 911 86 02 - 410 / 256
Fax +49 911 86 02 - 2 53
e-mail service@gmc-instruments.com

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

10 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 vmp.info@gmc-instruments.com

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