DS 96/48 PK   Digital indicator

Manual   42/33-90 EN   Rev. 00

ABB

DS 96/48 PK
Digital Indicator

Manual

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Contents

1 Safety Instructions

Safe and proper operation of this digital indicator requires proper transportation and storage, installation and commissioning by qualified personnel, proper use and careful maintenance

This device has been designed and tested in accordance with DIN EN 61 010 Part 1 "Safety Requirements for Electrical Measuring, Control and Laboratory Apparatus" and has been supplied in a safe condition.

The present operating instructions contain warnings and cautions marked accordingly which must be followed by the user to retain the device in a safe condition and to ensure safe operation. Ignoring the safety instructions can result in death, injuries, or damages to the equipment itself or other devices and equipment.

Instead of the German industrial standards and regulations (e. g. EN, DIN, VDI, VDE) mentioned in these operating instructions the appropriate and valid regulations of the respective country must be observed, if the device is used outside the scope of validity of the German standards and regulations.
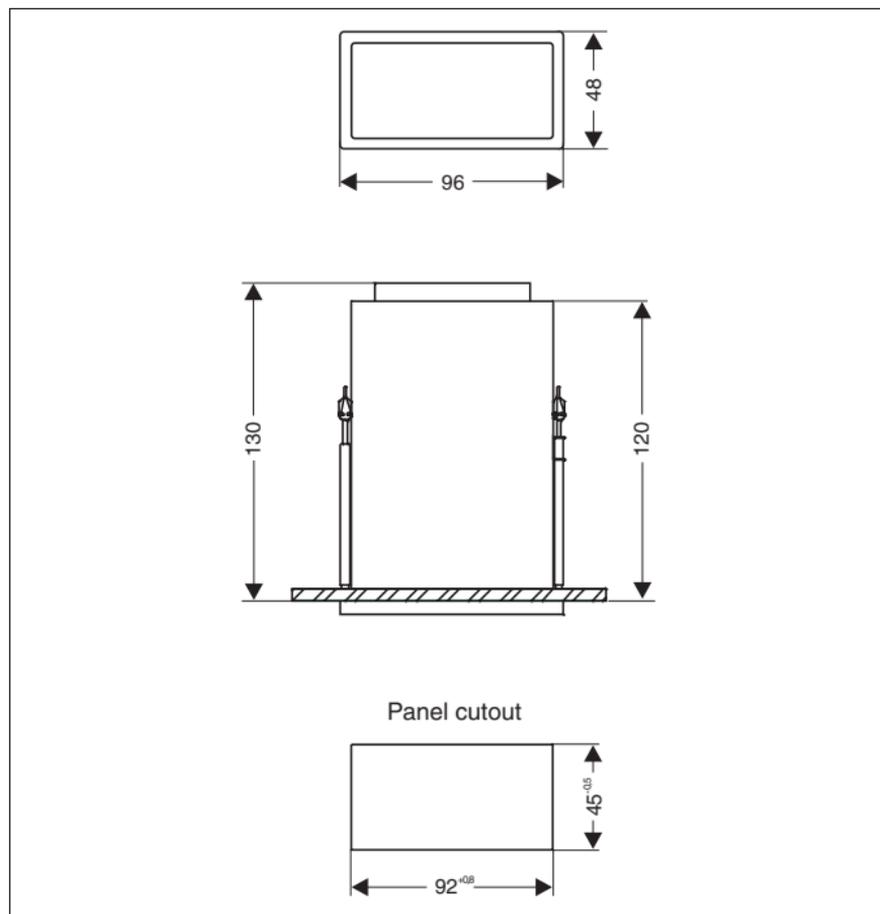
2 Installation

Figure 2-1 Dimensional drawing
Panel cutout: 92 (+0.8 -0) mm x 45 (+0 -0.5) mm
Dimensions: 96 mm x 48 mm x 120 mm
(130 mm incl. plug-in terminal block)

3 Brief Description

The device can be adopted universally to a variety of different measuring tasks.

Depending on the order the indicator is delivered in one of the three following variants:

– **Current and voltage meter**

   A current and a voltage measuring input are available. The two inputs can be toggled via the keypad and the measuring value can be freely assigned within the valid indicator value range. The only thing to be observed is that the scaling factor (max. amplification) must remain smaller that 10, see Section 10, Scaling.

– **Temperature measurement with thermocouple**

   The following thermocouple linearizations can be factory-set:

   B, E, J, K, L, N, R, S, T, U.

   It is also possible to select between degrees centigrade and Fahrenheit via the front keys (menu item d06).

– **Resistance measurement**

   For resistance measurements in 2-, 3-, or 4-wire technology one of the two selected Pt 100 or Ni 100 linearization curves is factory-loaded into the indicator.

   Switching between 2-, 3-, or 4-wire technology can later be achieved via the keypad (menu item d14). Moreover, when using 2-wire technology, the resistance compensation of the measuring leads can be calibrated via the front keys (menu items d15 and d16). The temperature units °C or °F can also be selected via the front keys (menu item d06) at a later point in time.

The programming functions of the indicator can be accessed via the four keys
"5" 🔲 , "6" 🔲 , "7" 🔲 and "8" 🔲 (see Figure 5-1, Operating elements 1 Front frame 2 optical limit value indicator Alarm 2 3 optical limit value indicator Alarm 1 4 4-digit 7-segment display 5 key   select, cancel 6 key   next digit, decrease value 7 key   increase value 8 key   acknowledge 9 Pocket for dimension label).

On the right the membrane keypad has a pocket to be accessed from the side for inserting a label, see Section 4, Dimension Label.

The "Segment test" function (all segments lit) can be controlled via rear connections. The following functions are available as options:

– "HOLD" ("Freeze" the display) or "Blanking the display".

– Two limit relays with additional front-side optical indicator. (The two LEDs A1 and A2 are installed even without the limit relay option.)

– Serial RS 232 interface for convenient configuration and reading of measuring value (in preparation).

– Transmitter supply 24 VDC, max. 25 mA unregulated.

Warning:
The ID plate lists the power supply of the device, the measuring and display range ordered, and the installed options. Prior to connecting the power supply you must make sure that the available mains voltage matches the voltage required by the device.

4 Dimension Label

On the right the membrane keypad has a pocket to be accessed from the side for inserting a label with dimensions (see Figure 5-1, Operating elements 1 Front frame 2 optical limit value indicator Alarm 2 3 optical limit value indicator Alarm 1 4 4-digit 7-segment display 5 key select, cancel 6 key next digit, decrease value 7 key increase value 8 key acknowledge 9 Pocket for dimension label).

If the label is to be changed, the clip-on front frame must be removed to the front. Then, carefully fold up the membrane keyboard and insert the label to the right into the pocket. Replace the membrane keyboard uniformly and clip the front frame onto the enclosure.

5 Operating Elements
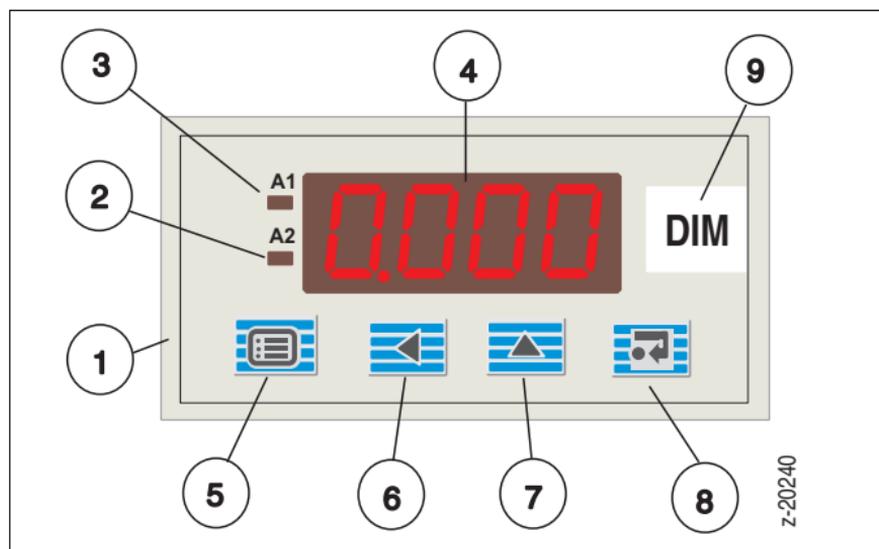
Figure 5-1 Operating elements

1	Front frame
2	optical limit value indicator Alarm 2
3	optical limit value indicator Alarm 1
4	4-digit 7-segment display
5	key ⊞ select, cancel
6	key ◀ next digit, decrease value
7	key ▲ increase value
8	key ⊡ acknowledge
9	Pocket for dimension label

6 Connections

Connect the device according to the ID plate.

Rear side of enclosure
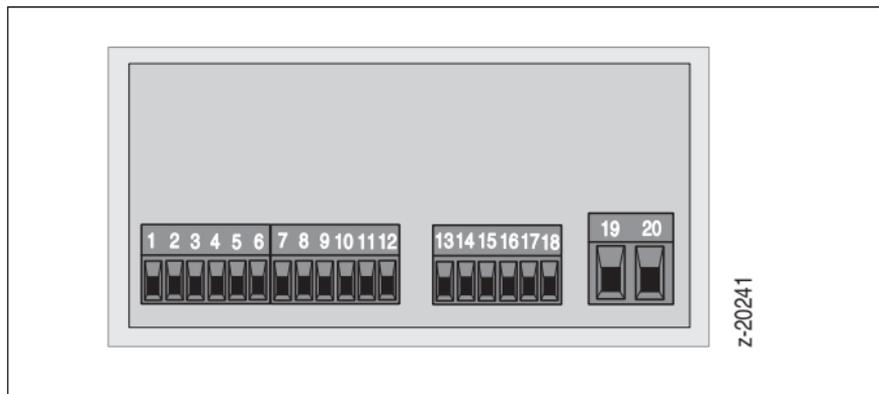
Figure 6-1 Terminals (wire cross-section max. 1.5 mm^2)

Warning:
Prior to connecting the device always make sure that the operating voltage listed on the ID plate matches the mains voltage.

Terminal assignment

1	Tx (serial interface)	11	Transmitter supply (+)
2	Rx (serial interface)	12	Transmitter supply (-)
3	Segment test	13	A1 common
4	Hold or blanking	14	A1 NC contact
5	Programming lock	15	A1 NO contact
6	Digital GND (terminals 1-5)	16	A2 common
7	Inp.: V (+), TE(+), Pt100(I-)	17	A2 NC contact
8	Inp.: V(-), I(-), TE(-), Pt100 (V-)	18	A2 NO contact
9	Input: I(+), Pt100 (V+)	19	N, DC (-)
10	Input: Pt100 (I+)	20	L1, DC (+)

Connection Diagram
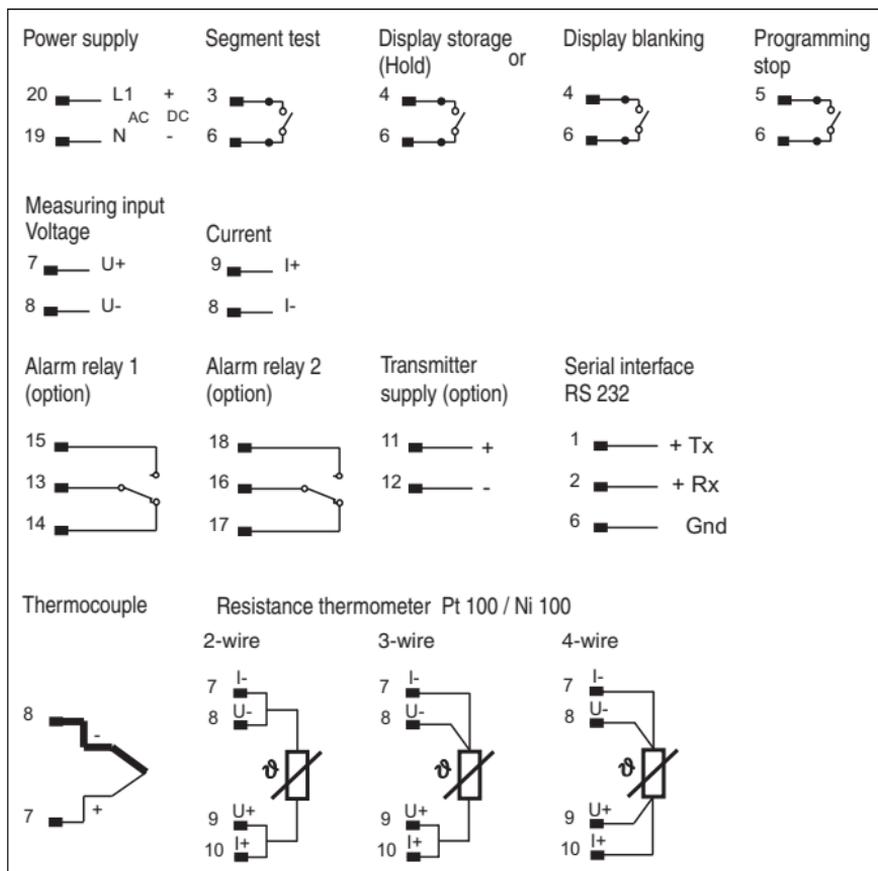
7 Measuring Mode

The device is delivered with the ordered measuring and display range, which is listed on the ID plate. After correct connection of the power supply and the measuring input the indicator is ready for operation.

8 Control Inputs

Segment test terminal 3:
Display *"8.8.8.8."* and both LEDs A1 and A2 are lit.

Programming lock terminal 5:
The programming menu of the indicator is locked. Settings cannot be changed via the keypad. Despite of an active programming lock the serial RS 232 interface can still be used to open the programming menu (in preparation).

Hold or blanking terminal 4 (option):
This control input is factory-set **either** to the hold function (the currently displayed value is "frozen", i. e. it can be read until the terminal in released), or to the blanking function of the entire display.

Caution:
If the Hold control input is activated, the indicator does not respond to any keys, the limit values will not be updated. It is also not possible to communicate with the device via the serial interface. When Hold is activated, the "frozen" measuring value flashes on the display.

These control inputs are activated by connecting them via potential-free pins to terminal 6 (GND/control signal reference).

9 Programming Menu

The Programming menu is entered by simultaneously pressing keys
▣ and ▣ . The programming mode is indicated by flashing LEDs
A1 and A2. Subsequently, the display indicates *"CON"*.

Pressing ▣ again returns to measuring mode.

Confirming with ▣ points to the first menu item "d01".

To step from menu item to menu item press key ▣ .

If a menu item is to be changed, you must first select the item and then
press key ▣ . The value that is valid for this menu item is displayed.
The displayed parameter can now be changed via the keys ▣ and
▣ .

Numeric values are changed by selecting the decimal digit via key ▣
and then incrementing the digit via the key ▣ .

Parameters allowing only two alternative values (e. g. ON/OFF) the
setting changes every time the keys ▣ or ▣ are pressed.

If the selected value is to be permanently saved, press key ▣ .
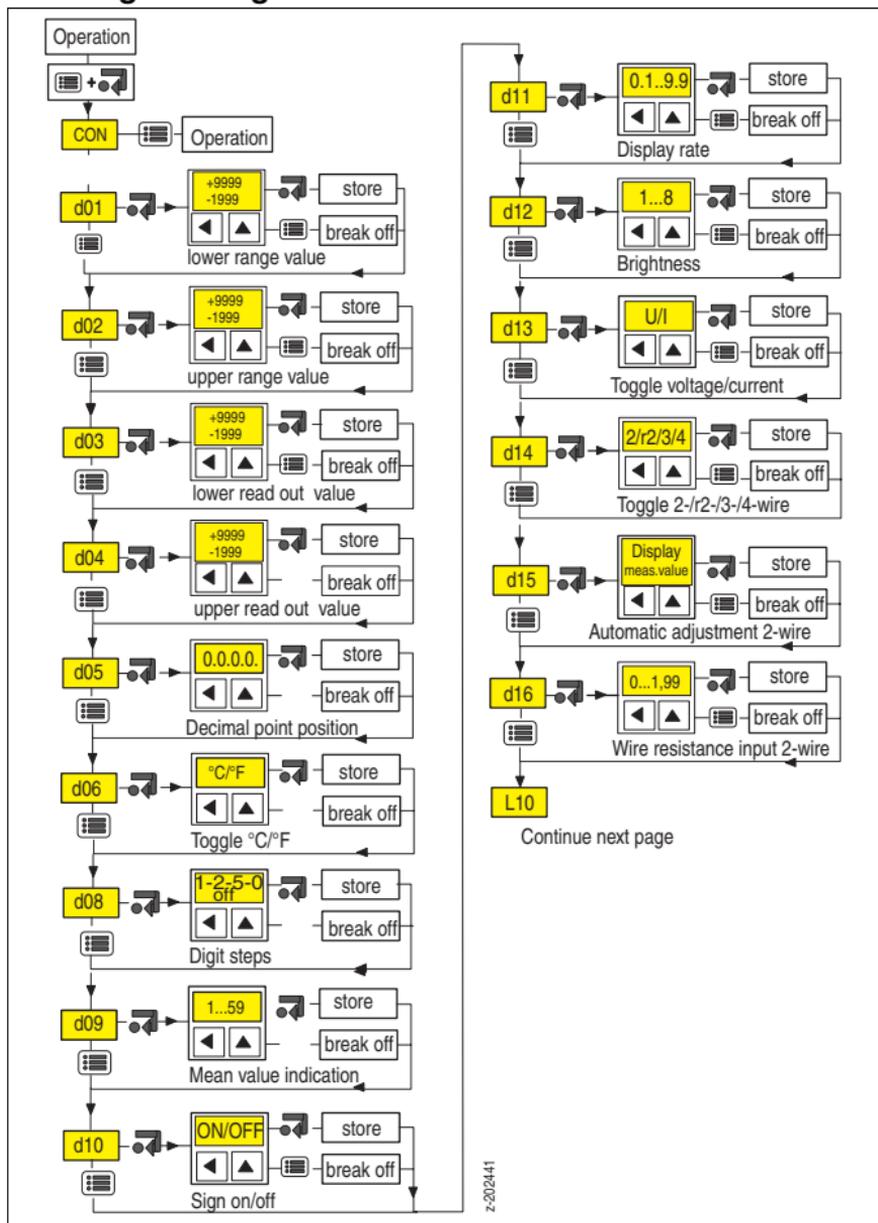If the previous value is to be preserved (e. g. when accidentally selecting
this menu item) just continue stepping the menu items via the key ▣ .
Parameters for non-installed options cannot be selected.

When the last accessible menu item is reached, the device switches
automatically back to measuring mode. If no key is pressed within
approximately two minutes, the device switches also back to measuring
mode.

Programming Menu Overview

Menu item	Operating parameter	Menu item	Operating parameter
d01	Lower range value	Limit value/relay option	
d02	Upper range value	L10	A1 setting the value
d03	Display range start	L11	A1 min/max
d04	Display range end	L12	A1 open/closed circuit current
d05	Decimal point position	L13	A1 hysteresis
d06	Toggle °C/°F	L14	A1 response delay time
d08	Digit steps	L20	A2 setting the value
d09	Mean value indication	L21	A2 min/max
d10	Sign ON/OFF	L22	A2 open/closed circuit current
d11	Display rate	L23	A2 hysteresis
d12	Display brightness	L24	A2 response delay time
d13	Toggle voltage/current		
d14	Toggle 2-/r2-/3-/4-wire		
d15	Automatic adjustment 2-wire		
d16	Wire resistance input 2-wire		

9.1 Programming Menu Overview

Programming Menu Overview, Continued

store
break off
Alarm A1

store
break off
Alarm A1 min/max

store
break off
Alarm A1 ncc/noc operation

store
break off
Alarm A1 hysteresis

store
break off
Alarm A1 delay

store
break off
Alarm A2

store
break off
Alarm A2 min/max

store
break off
Alarm A2 ncc/noc operation

store
break off
Alarm A2 hysteresis

store
break off
Alarm A2 delay

z-202441a

Operation
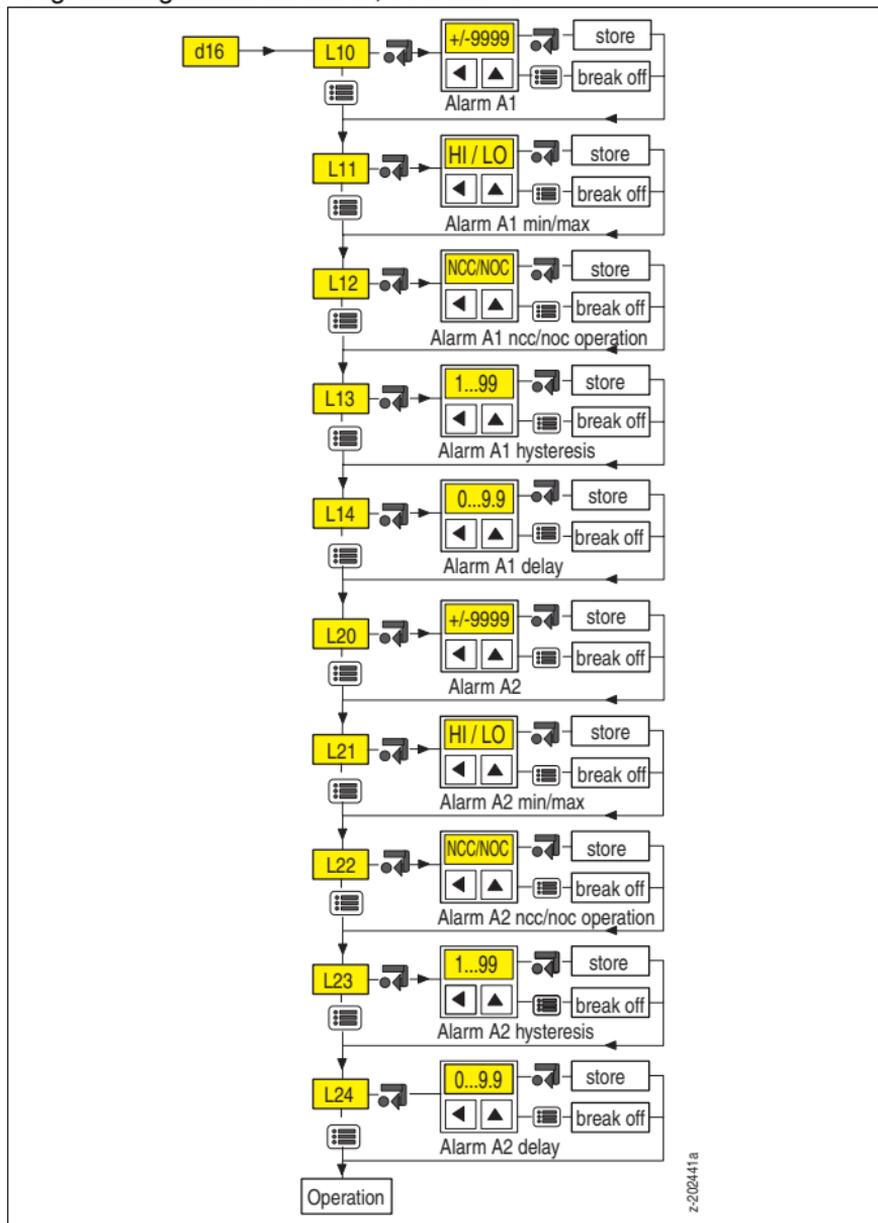
9.2 Description of Menu Items

The device with the current/voltage input has been designed for displaying the highest display value for the positive upper range value, i. e. 9999. The user can change this basic setting by desired scaling settings. The scaling can be adjusted for the measuring task across a wide range. The adjustment is made on site via the keypad.

The lower and upper range value must be entered as described below.

The positive end value must be filled with zeros so that it can just be displayed.

Thus, the measuring ranges for 1 V, 10 mA, 10 V are filled with zeros to 10000, i. e. when entered they become 9999, as 10000 cannot be displayed.

This method is described here for the following measuring ranges:

Measuring range	Value to be entered	Input f. upper range value
-40 mV...+200 mV	Meas. value in mV x 10	2000
-0.4 V.........+2 V	Meas. value in mV x 1	2000
-4 V..........+20 V	Meas. value in mV x 0.1	2000
-0.4 mA......+2 mA	Meas. value in mA x 1000	2000
-4 mA.......+20 mA	Meas. value in mA x 100 (example)	2000
-40 mA...+200 mA	Meas. value in mA x 10	2000
-2 V..........+10 V	Meas. value in V x 100	9999
- 2 mA......+10 mA	Meas. value in mA x 100	9999
-1 V............+5 V	Meas. value in V x 1000	2000

The display range is directly entered according to the desired presentation. Then, the decimal point is set to the required position. The decimal point does not affect other parameters, it is merely a visual representation.

The setting of menu items d01...d05 is explained using the following example:

A measuring transmitter supplies a current of -3 mA....+17.5 mA (within the standard measuring range of -20 mA to 20 mA, see above).

-3 mA is to result in an indication of -50.0. The end value of 17.5 mA is to correspond to an indication of +173.0.

Menu item d01, lower range value:
Set to -300.
(Only available for V/I version)

Menu item d02, upper range value:
Set to 1750.
(Only available for V/I version)

Menu item d03, display start:
Set to -500. (Only available for V/I version)
Factory setting is *"0"*.

Menu item d04, display end:
Set to 1730. (Only available for V/I version)
Factory setting is *"9999"*.

Menu item d05, decimal point position:
The decimal point can be shifted to any position on the display via keys
🔼 or 🔽 . For the example above, position *"000.0"* is selected.
For the V / I version the factory setting is 000.0. The following table lists
the factory settings for temperature measurements with respect to
measuring and display ranges as well as decimal point positions:

Pt 100:	- 199.9	…+	850.0 °C
Ni 100:	- 60.0	... +	180.0 °C
Type J:	- 210	... +	1200 °C
Type K:	- 250	... +	1372 °C
Type R:	- 50	... +	1769 °C
Type S:	- 50	... +	1769 °C
Type B:	+ 200	... +	1820 °C
Type E:	- 100.0	... +	999.9 °C
Type L:	- 100.0	... +	900.0 °C
Type T:	- 140.0	... +	400.0 °C
Type U:	- 199.9	... +	600.0 °C
Type N:	- 250	... +	1300 °C

Menu item d06, toggle °C/°F:
The display can be toggled to the desired presentation via keys 🔼 or
🔽 . (Only available for temperature version)
Factory setting is *"°C"*.

Menu item d08, digit steps of units place:
In standard operating mode, the units place is incremented/decremented by 1. The following settings can be made:

Increments of one (*"1"*)
Increments of two (*"2"*)
Increments of five (*"5"*)
Units place fixed to 0 (*"0"*)
(*"OFF"*) switches the units place off.

Factory setting is *"1"*, if the scaling factor does not yield another value, see chapter 10, example 1.

Menu item d09, calculation of mean value:
Here, the number of measuring values is set, from which the numeric mean value is calculated. The setting range is 1...59.
Factory setting is "*1*".

Menu item d10, sign ON/OFF:
The negative sign can be switched off. *"ON"* corresponds to a display with sign, *"OFF"* switches the minus bar off. Factory setting is *"ON"*.

Menu item d11, display rate:
The display refresh rate can be selected in the range from 0.1 s to 9.9 seconds in steps of 0.1 seconds. This does not affect the internal measuring rate of 10 measurements per second.
Factory setting is *"0.3"* seconds.

Menu item d12, display brightness:
You can select eight different display brightness levels. Level 1 corresponds to the highest brightness, level 8 results in the smallest luminance.
Factory setting is brightness level 4.

Menu item d13, toggle current (I)/voltage (V):
Here, the corresponding measuring input is selected. The device has two measuring inputs with a common minus connection both in the V and I version. In the V version an additional current measuring range from 0 to 20 mA is also supplied. In the I version an additional voltage measuring range from 0 to 10 V is also supplied. These additional measuring ranges must be reconfigured every time the range is toggled!

Menu item d14, switching between 2-/r2-/3-/4-wire measurement for resistance measuring:
For 2-wire measurements menu d15 is displayed next. Here, you can perform automatic 2-wire adjustment by means of an 100 ohms resistor at the end of a measuring lead. For r2-wire measurements menu d16 is displayed next. Here, you can perform a 2-wire adjustment by entering a wire resistance.
(Only available for resistance measurement.)

Menu item d15, automatic 2-wire adjustment:
When entering this menu while a 100 ohms resistor is connected at the end of the lead, the display indicates a measured value that deviates from 0, because of the measuring lead error. If you now press the key ⌨ again, this error is calculated and when switching to the operating mode, 0 degrees centigrade or the corresponding Fahrenheit value is displayed.
(Explanation: At 0° a Pt100 or Ni100 has a resistance value of 100 ohms.) (Only available for resistance measurement and 2-wire setting)

Menu item d16, 2-wire adjustment by entering the wire resistance:
Here, the wire resistance in the format "X.XX" ohms is entered. The maximum value is 1.99 ohms.
If this menu is called, the entered or displayed value must be confirmed with the key ⌨ to be effective. It is possible that a value is displayed which is not in effect.
(Only available for resistance measurement and r2-wire setting)

Menu item L10, limit value 1:
In menu item L10 the switching point for the first limit value is defined.
Setting range: -1999...9999.
Factory setting is *"9999"*.

Menu item L11, limit value 1 min./max.:
Programming the limit value 1 as maximum contact (exceeding the value) or minimum contact (falling below the value). The indication *"HI"* corresponds to the settings as maximum contact, *"LO"* represent the minimum contact.
Factory setting is *"HI"*.

Menu item L12, limit value 1: open/closed circuit current:
The open/closed circuit current setting defines whether the limit value
relay is energized or deenergized in its idle state. The setting "N.C.C."
means that the relay is energized in its idle state. The setting "N.O.C."
means that the relay is energized in its non-idle state. If an alarm
message is always to be issued when the power supply fails (limit value
relay deenergized) the setting "N.C.C." must be selected.
Factory setting is *"N.O.C."*.

Menu item L13, limit value 1, hysteresis:
After activating the limit value a hysteresis is set in opposite direction of
the switching threshold. The limit value relay can only be reset after
leaving the hysteresis, see Figure 9-1, Limit values: Min./max. relay.
The hysteresis can be set between 1...99 digits, see Figure 9-1, Limit
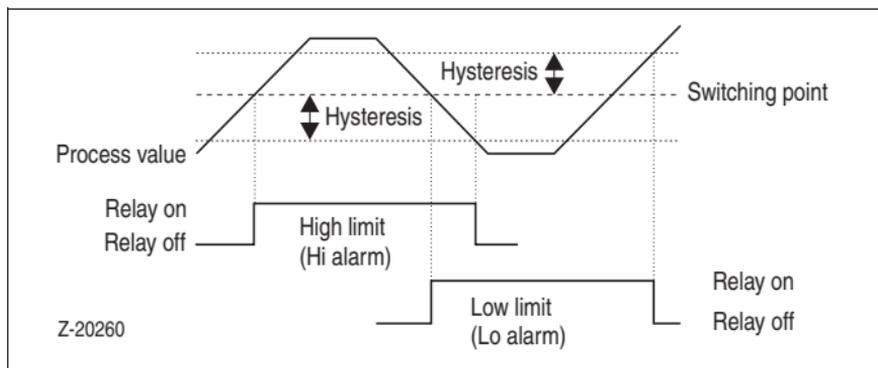values: Min./max. relay.
Factory setting is *"02"*.

Figure 9-1   Limit values: Min./max. relay

Menu item L14, limit value 1, response delay time:
In order to activate the limit value, the limit value condition must be
fulfilled for the entire response delay time, the response delay time is
restarted whenever a glitch occurs. The setting range is between 0 and
9.9 s in steps of 0.1 s, see Figure 9-2, Time hysteresis, response delay
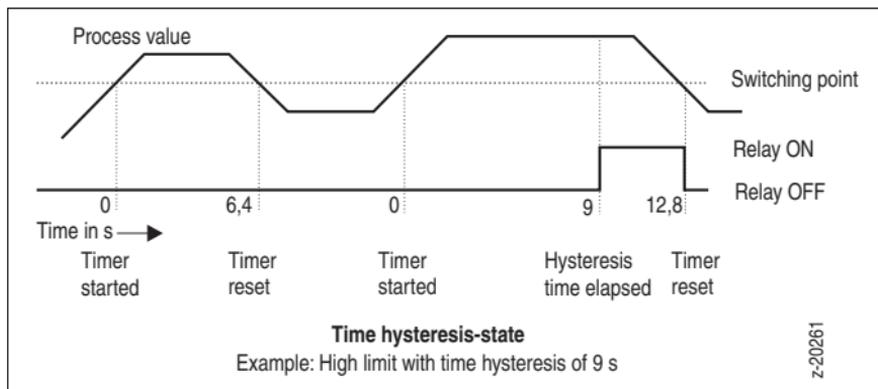time.
Factory setting is *"0.1"*.

Figure 9-2   Time hysteresis, response delay time

Menu items L20...L24:
These are identical to menu items L10...L14. However, they are used to set limit value 2.
The factory settings correspond to the ones for the first limit value L10...L14:
L20 = *"9999"*
L21 = *"HI"*
L22 = *"NOC"*
L23 = *"02"*
L24 = *"0.1"* s

Only relevant for current or voltage measurement:
If the indicator calculates a scaling factor greater than 10 through the settings in menu items d01 to d04, it will not switch to measuring mode, but reports *"Cord"*. This message means that the device should be reconfigured or the default settings should be loaded. By simultaneously pressing the keys 🖃 and 🖭 you reach the programming menu again (*"CON"*) and can correct the wrongly set values in menu items d01 to d04, see Section 10, Scaling.

10 Scaling

The scaling factor resulting from menu items d01...d04 can be checked or calculated using the formula seen below. It is important that no scaling factor may result that is >10. This is because the indicator automatically calculates the scaling factor and reports *"Cord"* for a factor >10.

Formula for calculating the scaling factor

$$V = \frac{A2 - A1}{X2 - X1}$$

V   = Scaling factor
A2 = Set display end value   (menu item d04)
A1 = Set display start value   (menu item d03)
X2 = Set upper range value   (menu item d02)
X1 = Set lower range value   (menu item d01)

Example 1
A2 = 1999, A1 = -1999, X2 = 1999, X1 = 0

$$V = \frac{1999 - (-1999)}{1999} = 2$$

If a scaling factor of 2 results like in example 1, this will principally cause "missing codes" in the display range due to the continuous resolution of the measuring range.
The display will be incremented/decremented in steps of 2.

Example 2
A measuring input from 0…20 mA DC was ordered. 4 mA are to correspond to a display of -1900 and 6 mA to a display of 1800. The values must be entered into the formula as shown below or programmed in the indicator.
A2 = 1800, A1 = -1900, X2 = 600, X1 = 400

$$V = \frac{1800 - (-1900)}{600 - 400} = 18,5$$

As the amplification factor is >10, the indicator will report *"Cord"*. The desired measuring task cannot be implemented in this way.

---

11 Indicating Memory and Limit Values

Calling the min./max. memory:

500 ms after putting into operation the indicator a memory is activated. This memory automatically stores the smallest and largest measuring value. The min. value is read by pressing the key ▦ (LED A2 flashes), the max. value by pressing ▦ (LED A1 flashes). To indicate the "non-measuring mode" one of the corresponding LEDs will be flashing during that time. Pressing a key again will switch back to measuring mode. If no key is pressed within approximately two minutes, the device switches back to measuring mode. Both memories are erased by simultaneously pressing keys ▦ and ▦ .

Checking set limit values:

To check the set limit values you must press key ▦ . Then, *"L1"* will be displayed. By pressing key ▦ you can advance to display *"L2"*. By pressing key ▦ either the first or second limit value is displayed. Pressing a key again will switch back to measuring mode. To indicate the "non-measuring mode" both LEDs A1 and A2 will be flashing during that time. If no key is pressed within approximately two minutes, the device switches back to measuring mode, see Figure 11-1, Indicating memory and limit values.
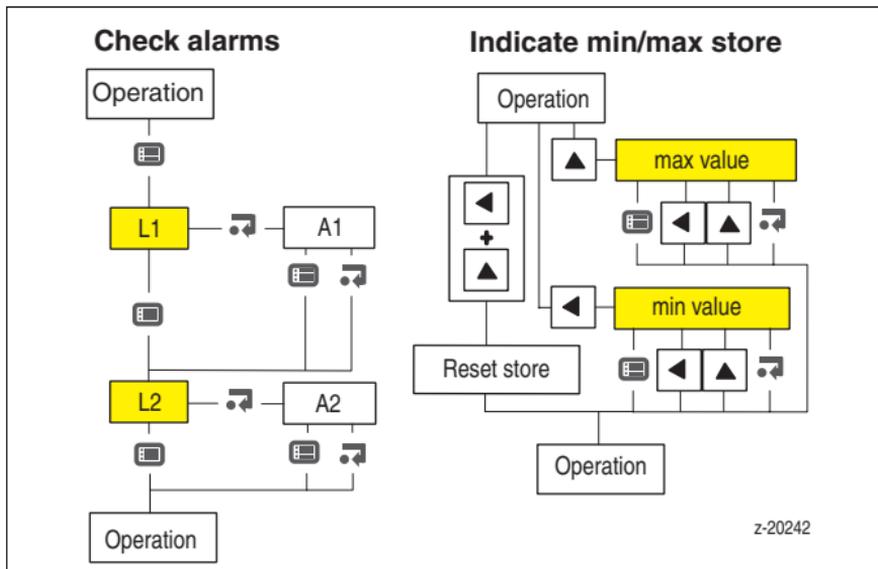
Figure 11-1 Indicating memory and limit values

12 Factory Settings (Default)

With the "Default" function the indicator can be reset to its delivery condition. All four keys ▤ , ◀ , ▲ , and ⤒ must be pressed simultaneously. If the subsequently displayed message *"def"* is confirmed by pressing key ⤒ the indicator is reset to its delivery condition. As usual, pressing key ▤ returns to measuring mode.
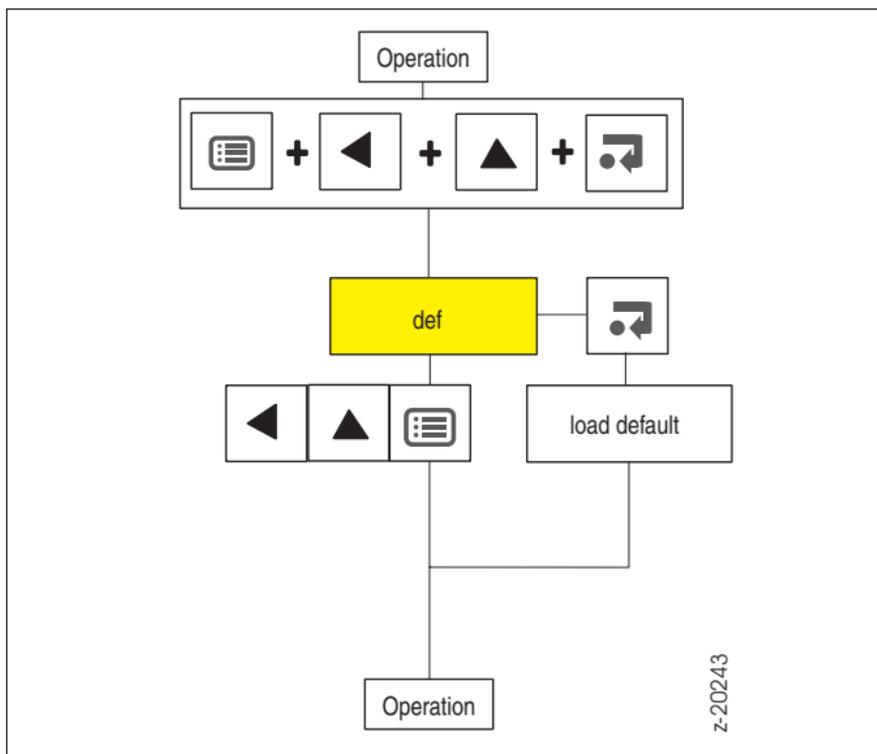

Figure 12-1 Default function

13 Status Indication

If the key combination ▦ and ▲ is pressed and released in measuring mode, the device version is displayed:

– Current/voltage version
   I = current device
   V = Voltage device

– Resistance measurement
   Pt = Pt 100 device
   Ni = Ni 100 device

– Thermocouple version
   B, E, J, K, L, N, R, S, T, U = Thermocouple type,
   then
     an I   = internal cold junction or
     a number = temperature of external cold junction
   At the far right digit
     a dot   = display in degrees Fahrenheit.

By pressing ▦ (or after approx. 2 min.) you return to measuring mode.
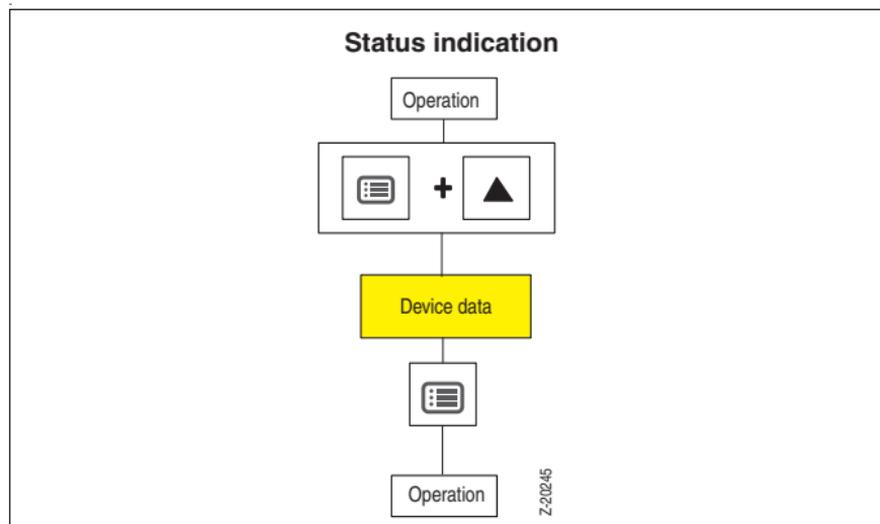

Figure 13-1 Status indication

14 Transmitter supply (option)

For the power supply of a measurement transmitter or active sensor an electrically isolated power supply (24 V unregulated, max. 25 mA) is available at terminals 11 (+) and 12 (-).

15 Serial RS 232 Interface
(in preparation)

For fast configuration and reading the measuring value a serial interface is available at terminals 1 (TXD) and 2 (RXD).

16 Technical Data

Display

Display	red LEDs, digit height 13 mm
Max. range	- 1999...+9999 digit
Overflow indication	"OFL"
Outside measuring range	"Err"
Scaling factor >10	"Cord"
Decimal point	switchable (on/off), variable position
Measuring cycle	6/s (167 ms)
Display refresh	adjustable from 0.1 s to 9.9 s
Deviation	app. 0.1% of meas. value, ± 1 at 23 °C for current/voltage measurement
Temperature coefficient	app. 0.05 % of meas. value/10 °C, ± 1 for temperature measurement
Common mode rejection	> 100 dB (0/50 Hz)
Limit values	$2 \times$ red LEDs, A1 and A2

Display control

Last digit of display	steps of 1, steps of 2, steps of 5, fixed 0, last digit blank
Complete display	either Hold or blanked, segment test

Input

Current	± 2 mA...200 mA DC,
Voltage	± 0.2 V...50 VDC
Input resistance	100 Ω at 20 mA, > 400 kΩ at 2 V
Thermocouple	Type B +200 ...+1820 °C
	Type E -100.0 ...+ 999.9 °C
	Type J -210 ...+1200 °C
	Type K -250 ...+1372 °C
	Type L -100.0 ...+ 900.0 °C
	Type N -250 ...+1300 °C
	Type R - 50 ...+1769 °C
	Type S - 50 ...+1769 °C

	Type T	-140.0 ...+400.0°C
	Type U	-199.9 ...+600.0°C

All elements can be adjusted for internal or external cold junction. The external cold junction temperature can be adjusted between 0 and 50 °C, in steps of one degree. The internal cold junction operates at a terminal temperature of 0 to 50 °C.

Resistance	Pt100	-199.9...+850.0 °C
	Ni100	- 60.0...+180.0 °C
	2-, 3-, and 4-wire mode can be set	
	Wire resistance	
	4-wire	max. 50 ohms/wire
	3-wire	max. 10 ohms/wire
	2-wire	max. 2 ohms/wire
	Sensor current	approx. 1 mA

Power supply
DC	18...32 V approx. 1.8 W
AC	24/115/230 VAC
	50...60 Hz, approx. 3 VA

Environmental conditions
Ambient temperature	0...+50 °C
Storage temperature	- 25...+65 °C
Relative humidity	$\leq$ 75% annual average, non-condensing

Housing
Dimensions (W x H x D)	96 mm $\times$ 48 mm $\times$ 120 mm (130 mm incl. terminals)
Panel cutout	92 (+0.8) mm x 45 (-0.5) mm
Material	ABS plastic
Protection class	housing IP 52, terminals IP 20
Weight	approx. 0.4 kg
Connection type	plug-in screw terminals for 1.5 mm^2

Standards
EMC, Safety technology	EN 55011-B, EN 61010-1, EN 50082-1

Options

Transmitter supply	24 VDC, max. 25 mA unregulated
2 limit values	Relay output 4 A, 250 V; Min. or max., open/closed circuit current Switching hysteresis and response delay can be adjusted

In preparation

Serial interface	RS 232 Configuration, reading measuring values and parameters

Subject to technical changes.

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