Users guide for PU5 units
Panel Meter with multi-functional measuring input

V1.17
Stand 03/2007

1. Brief description

A wide variety of different sensors can be connected directly to the **PU 5 panel meter**. The 5-digit display shows the measurements or the scaled value of the measurement. During programming, the display is used to indicate the set values and the user prompts. A maximum of 4 relays are available to monitor threshold values. Via the serial interface, data can be communicated from and to the device.

2. Safety instructions

Please read the users guide before installation and keep it for future reference.

2.1. Proper use

The **PU5** is designed for the evaluation and display of sensor signals. With the setpoints, it is possible to perform simple control tasks.

Danger! Careless use or improper operation can result in personal injury and/or damage to the equipment.

2.2. Control of the device

The panel meters are checked before dispatch and sent out in perfect condition. Should there be any visible damage, we recommend close examination of the packaging. Please inform the supplier immediately of any damage.

2.3. Installation

The **PU5** must be installed by a suitably **qualified specialist** (e.g. with a qualification in industrial electronics).

2.4. Notes on installation

- There must be no magnetic or electric fields in the vicinity of the device, e.g. due to transformers, mobile phones or electrostatic discharge. [1]
- The **fuse rating** of the supply voltage should not exceed a value of **6A N.B. fuse**.
- Do not install **inductive consumers** (relays, solenoid valves etc.) near the device and **suppress** any interference with the aid of RC spark extinguishing combinations or free-wheeling diodes.
- Keep input, output and supply lines separate from one another and do not lay them parallel with each other. Position “go” and “return lines” next to one another. Where possible use twisted pair.
- Screen off and twist sensor lines. Do not lay current-carrying lines in the vicinity[1]. Connect the **screening on one side** on a suitable potential equaliser.
- The device is not suitable for installation in areas where there is a risk of explosion.
- Any electrical connection deviating from the connection diagram can endanger human life and/or can destroy the equipment.
- Do not install several devices immediately above one another (ambient temperature)[1]

[1] see technical data

3. Assembly

The **PU5** is intended for **installation** in a **control panel**. Before assembly, a cut-out must be made to accommodate the device. The sizes and tolerances are given in the technical data.
On **front** of the **PU5** are the **operating** and **display elements**.
On the **sides** are the fixing elements to mount the device in the panel.
On the **back** are the terminals for all the **electrical connections**.
A sealing strip is inserted between the contact surface of the front collar and the control panel.

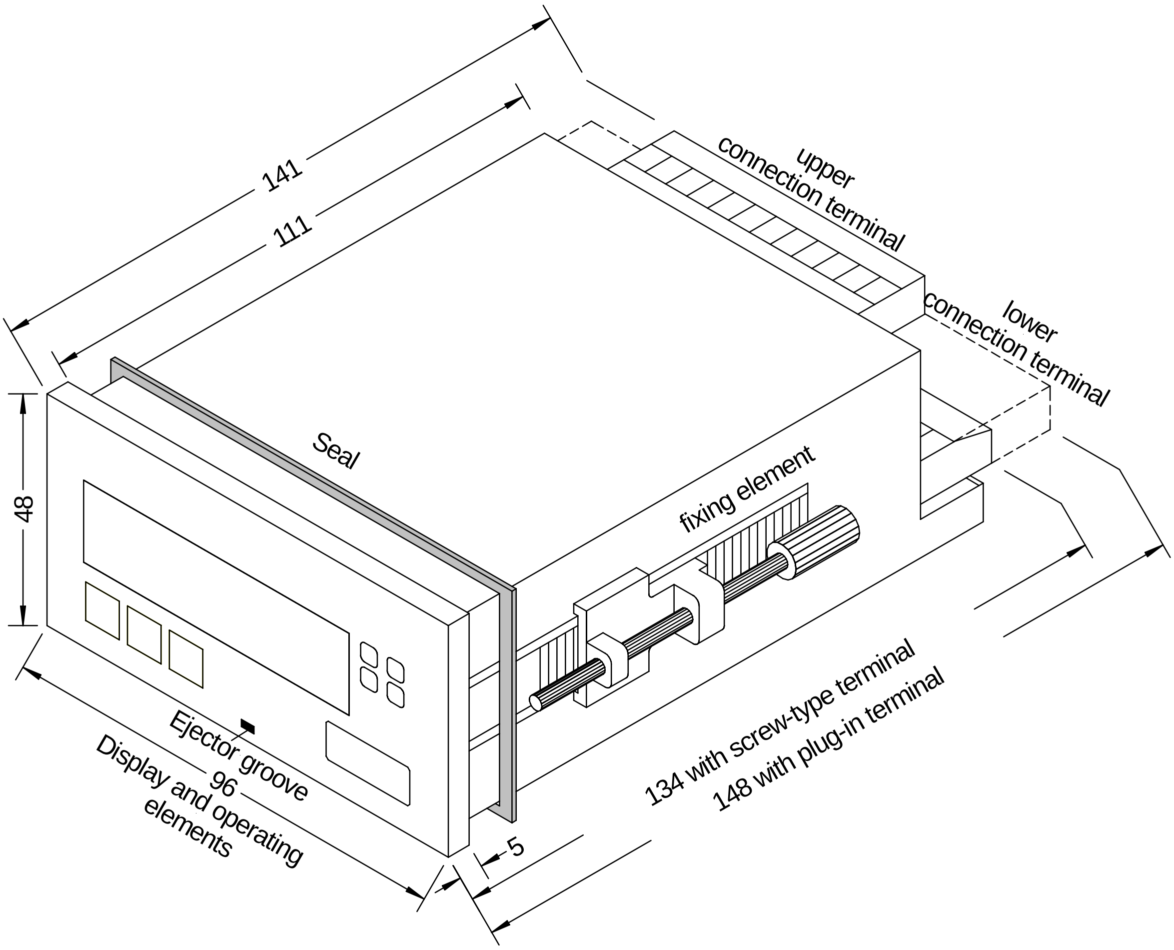
3.1. Insertion in the panel cut-out

I. Before inserting the unit, the **side fixing elements** must be pulled from the rail. To do this, slightly raise the screw head of the fixing element and pull the fixing element backwards at the same time.

II. Lay the sealing strip around the unit and push it up against the front collar. Then push the unit from the front **through the cut-out**.

III. Then place the fixing elements into the guide rails from the rear. While doing this, hold the unit from the front secure in the cut-out. Then, using a slotted screw driver, push the fixing elements as far as possible towards the front panel from the rear. Check that the sealing strip is properly positioned between the front collar and the control panel and correct it if necessary.

IV. Finally secure the device by tightening the screws on the fixing elements until they turn freely. The fixing elements have a slip coupling to prevent any over tightening of the thread; they hold the unit tight with the optimum amount of force.



View of the **PU5**

3.2. Dismantling

To remove the unit, follow the same steps as described for **Assembly** in reverse order.

For the version featuring the protective system IP65, a **new sealing** strip must be used **when** the unit is **replaced**.

3.3. Dimension strip

A strip with a physical unit can be inserted in the dimension window, see ***Chapter 5.1.3*****.**
To do this, take the following steps:

I. Insert a slotted screw driver (size 0 blade) in the ejection slot at the bottom of the front panel and lever out the front.
II. On the back of the front panel, towards the outer edge is a slit in to accommodate the appropriate strip.
III. Insert a suitable dimension strip.
IV. Insert the front panel into the front collar of the unit and press slightly against the upper and lower edges so that it snaps back into the housing.
V. Check that the plastic elements on the front have not bent the LED towards the back. This is the case if the digits are not sharp. If this does happen, remove the front panel again and replace it carefully.

4. Electrical connection

All the necessary signals for operation are connected to the rear terminals.

4.1.1. Upper connecting terminals

The set points are tapped on the 12-pole connector strip. Depending on the version, there are between zero and four changeover contacts (**N**ormally-**C**lose, **COM**mon, **N**ormally-**O**pen).

Relay 1			Relay 2			Relay 3			Relay 4		
21	22	23	24	25	26	27	28	29	30	31	32
NC	NO	COM	NC	NO	COM	NO	NC	COM	NO	NC	COM

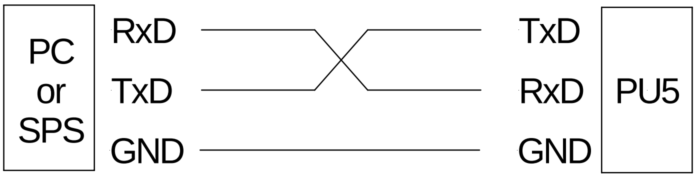
Via the 3-pole connector strip, a serial interface is connected. If neither of the two options are implemented in the unit, the respective connecting terminals will be missing.

RS232		
41	42	43
GND (RS)	TxD	RxD

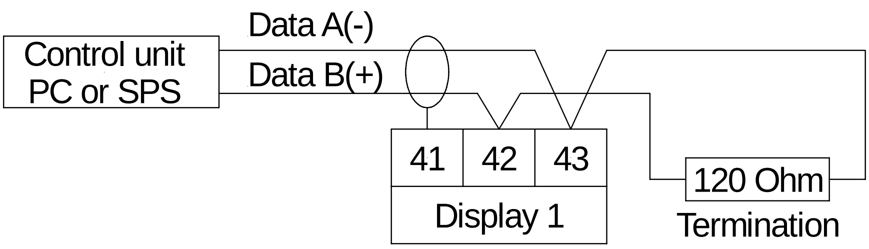
or

RS485		
41	42	43
GND (RS)	Data B (+)	Data A (–)

The lines for the **RS232 interface** must be connected **1:1** so that TxD is connected to TxD and RxD to RxD.
Connection pattern PC or SPS ⇔ PU5



The **RS485 interface** is connected via a shielded data line with a twisted pair.
At each end of the bus, a termination of the bus lines must be connected. This is necessary to guarantee reliable data transmission on the bus. For this, a resistance of 120 Ohm is inserted between the lines Data B (+) and Data A (–).



Caution! The potential reference can lead to a compensating current (interface ⇔ measuring input) with a non-galvanic insulated interface and can thus affect the measuring signals.

4.1.2. Lower connecting terminals

Input signal, analogue output, sensor supply and supply voltage are connected to the lower connecting terminal.

Terminal 1–7 Input signals

The input signal is connected to these terminals. The **PU5** features a universal measuring input to which most conventional sensors can be directly connected.
One sensor can be connected to the input of the **PU5**.

Sensor	1	2	3	4	5	6	7
–1...10 V –1...5 V					+ U		– U
-0,5...2,5 V -0,5...1,25 V – 500...600 mV ± 300 mV ± 150 mV ± 75 mV ± 35 mV ± 18 mV			+ U	– U			
0/4...20 mA 0...5 mA 0...2 mA						+ I	– I
Ptxxx 2-wire	+ Force bridged to term3	– Force bridged to term4	+ Sense	– Sense			
Ptxxx 3-wire	+ Force bridged to term3	– Force	+ Sense	– Sense			
Ptxxx 4-wire	+ Force	– Force	+ Sense	– Sense			
Thermocouples			+ Signal	– Signal			
Resistance 2-wire	+ Force bridged to term3	– Force bridged to term4	+ Sense	– Sense			
Resistance 3-wire	+ Force bridged to term3	– Force	+ Sense	– Sense			
Resistance 4-wire	+ Force	– Force	+ Sense	– Sense			

Examples of the connections for various sensors can be found in section ***4.2 Connecting examples***.

Terminals 8–9 Analogue output
The signal for the analogue output is provided on these terminals. Depending on the capabilities of the unit, a current or voltage signal can be tapped.

8	9
Analogue output +	Analogue output –

Terminals 10–11 Sensor supply
The sensor supply is provided on these connectors. The sensor supply is galvanic insulated from the measuring input. The voltage of the sensor supply varies according to the capabilities of the unit.

10	11
Sensor supply +	Sensor supply –

Terminals 13–14 Supply voltage
The supply voltage for the unit is connected to these terminals. The supply voltage is galvanic insulated from the measuring input.

13	14	Supply voltage
L+	L–	24 VDC voltage
L	N	115 or 230 VAC, depending on version

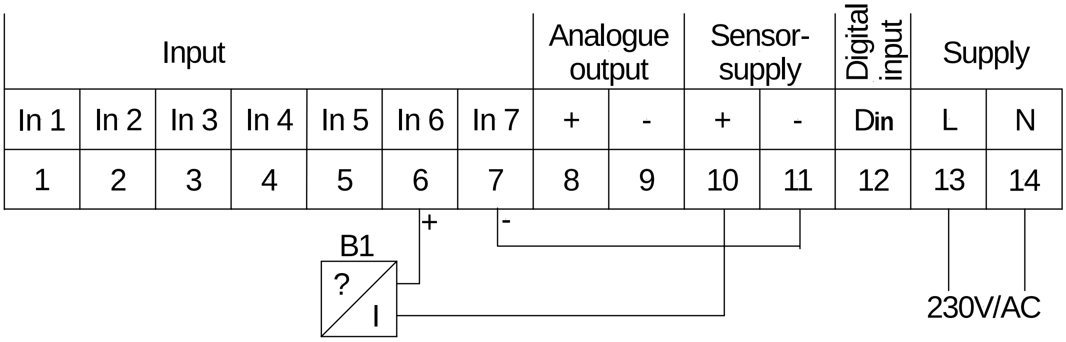
Terminal 12 Digital input
With the implemented option "Digital input", a potential-free contact can be connected to this terminal for controlling specific functions in the unit such as reset, taring, hold etc. For this function, it is necessary to also implement the same sensor supply as is used for supply and to which this connection electrically relates.

12
Digital input

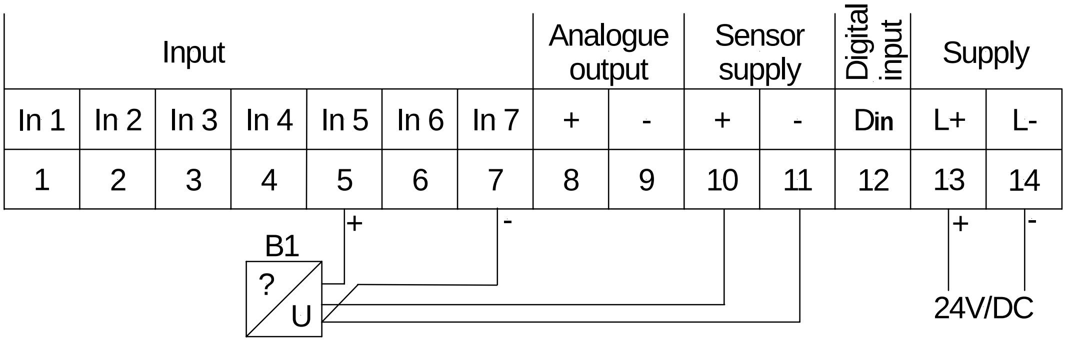
4.2. Connecting examples

This section gives a few examples of practical connections. Other connection options can be combined from the various examples.

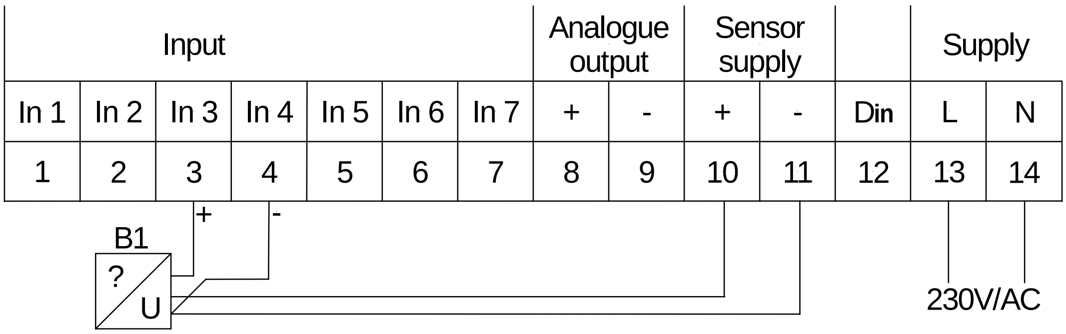
Measuring a current signal from a 2-line transmitter using the sensor supply; supply voltage 230 VAC



Measurement of a voltage signal (5 V or 10 V) from a 3-wire transmitter using the sensor supply; supply voltage 24 VDC

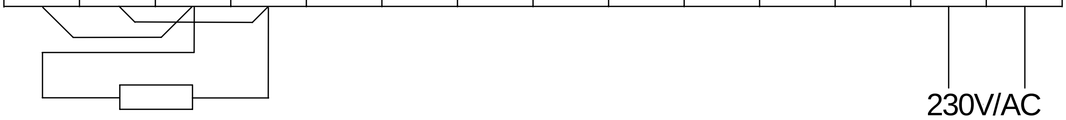


Measurement of a voltage signal (≤ 2.5 V) from a 3-wire transmitter using the sensor supply; supply voltage 230 VAC



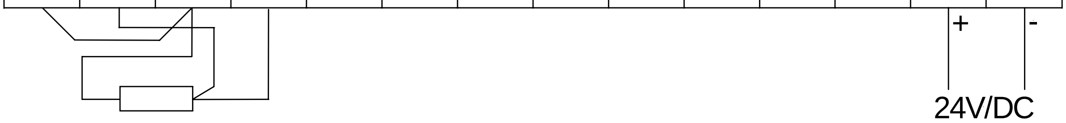
Measurement of a resistance thermometer (e.g. PT100) or resistance in the 2-wire technology; supply voltage 230 VAC

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



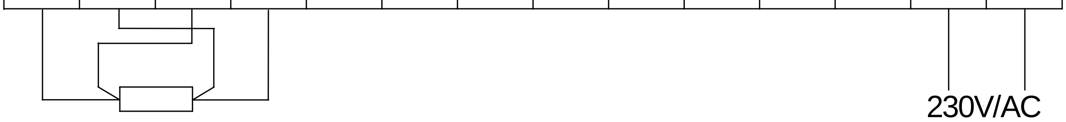
Measurement of a resistance thermometer (e.g. PT100) or resistance in the 3-wire; supply voltage 24 VAC

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L+	L-
1	2	3	4	5	6	7	8	9	10	11	12	13	14



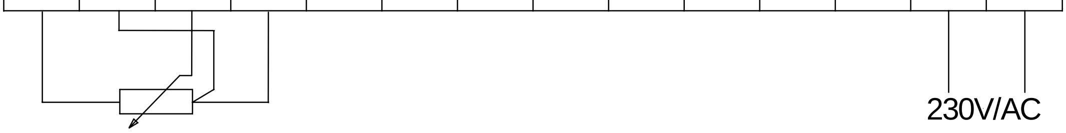
Measurement of a resistance thermometer (e.g. PT100) or resistance in the 4-wire technology; supply voltage 24 VAC

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



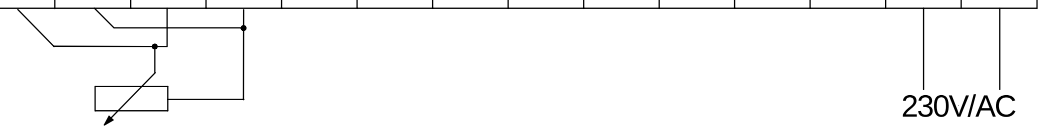
Measurement of a potentiometer in the 4-wire technology

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



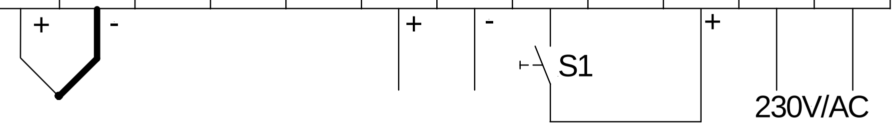
Measurement of a potentio-meter in the 2-wire technology.

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



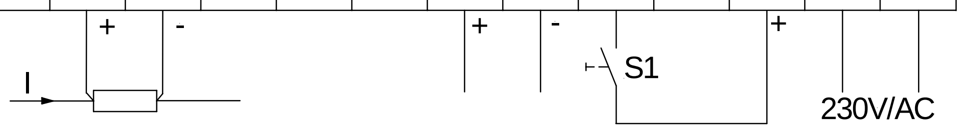
Measurement of a thermocouple; connection of the analogue output; connection of the digital input to the sensor supply; supply voltage 230 VAC.

Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



Measurement of the shunt resistance; connection to the analogue output; connection of the digital input to the sensor supply; supply voltage 230 VAC.

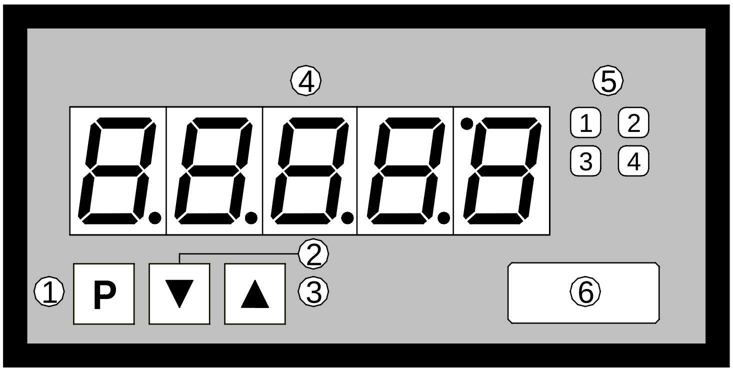
Input							Analogue output		Sensor supply		Digital input	Supply	
In 1	In 2	In 3	In 4	In 5	In 6	In 7	+	-	+	-	Din	L	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14



5. Operation

The unit is operated via the [P], [UP] and [DOWN] keys.

5.1. Operating and display elements



1 Program key [P]
2 Minus key [DOWN]
3 Plus key [UP]
4 Seven-segment display
5 Setpoint display 1-4
6 Dimension window

5.1.1. Keys

The **PU5** has three keys with which you can parameterise and call up various functions during operation.

1	Program key [P]	With the program key, you can call up the programming mode or perform various functions in the programming mode.
2	Minus key [DOWN]	With the minus key, you can call up the MIN memory or alter parameters in the programming mode.
3	Plus key [UP]	With the plus key, you can call up the MAX memory or alter parameters in the programming mode.

5.1.2. Displays

The **PU5** has a **5-digit**, 7-segment display and 4 LED.

4	7-segment display	The 7-segment display displays measurements or, during programming, the program numbers or parameters.
5	Set point display	The set point display indicates the state of the relays. If a relay is switched, the LED lights up. If relays are not implemented, these displays can be used for the optical feedback of threshold values.

5.1.3. Dimension window

6	Dimension window	The dimension window shows the factory-set **physical unit** for the measurement. The dimension can also be changed by the user as described in ***Chapter 3.3***

5.2. Switching on

Before switching on you have to check all the electrical connections to make sure they are correct. On completion of the installation, the device can be switched on by applying the supply voltage.

5.3. Starting sequence

During the switching-on process, a segment test is performed for approx. 1 second, whereby all LED on the front (including setpoint LED) are triggered. After this, the type of software is indicated for approx. 1 second and then, also for 1 second, the software version. After the starting procedure, the unit changes to operation/display mode.

5.4. MIN/MAX memory

The measured minimum and maximum values are saved in a volatile memory in the unit and get lost when the unit is switched off.
You can call up the contents of the memory by pushing (less than 1 second) the [UP] or [DOWN] key. The relevant value is indicated for approx. 7 seconds. By briefly pressing the same key again, you will return immediately to the display mode.

[UP] $\Rightarrow$ Display of the MAX value
[DOWN] $\Rightarrow$ Display of the MIN value

You can erase the value shown in the display by simultaneously operating the [UP] & [DOWN] keys. The erasure is acknowledged by horizontal bars.

5.5. Overflow/Underflow

An **overflow** of the display is indicated by horizontal bars at the top of the 7-segment display.

An **underflow** of the display is indicated by horizontal bars at the bottom of the 7-segment display.

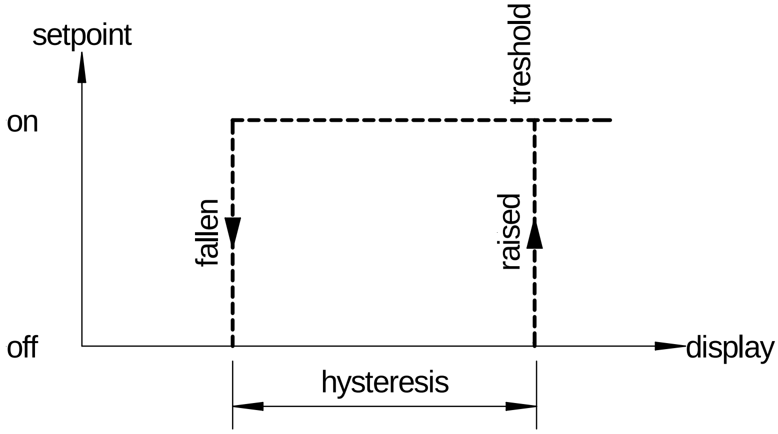
5.6. Relays

With the aid of the LED next to the 7-segment display, you can view the switching state of the relays. An active relay is indicated by the relevant LED lighting up.

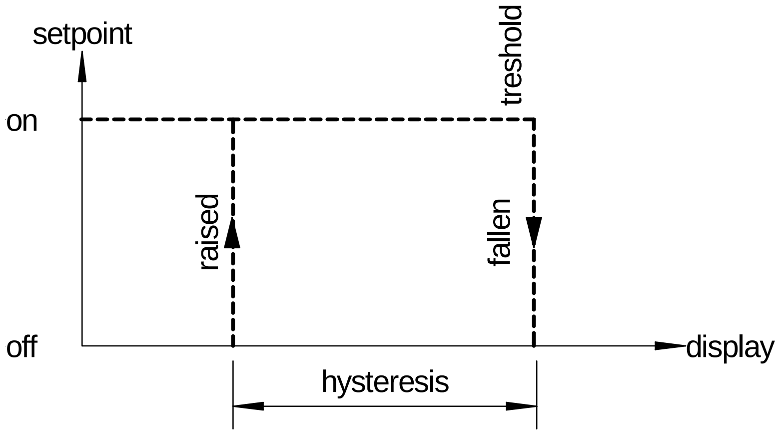
The relays have the following properties with regard to their switching characteristics:

Setpoint x	Deactivated, activated
Threshold	Threshold value for switchover
Hysteresis	Width of the window between the switch thresholds
Operating principle	active above SP value / active below SP value
Switch-on delay	Time between reaching the threshold and the resultant switching on of the relay
Switch-off delay	Time between reaching the threshold and the resultant switching off of the relay

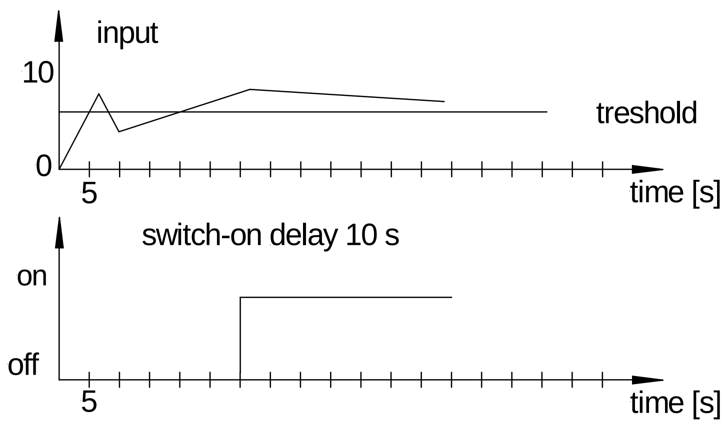
Active above SP value
The set point is off below the threshold and on on reaching the threshold.



Active below SP value
The set point is on below the threshold and switched off on reaching the threshold.



Switch-on delay
The relay is on 10 seconds after reaching the threshold; briefly exceeding the threshold does not lead to the relay being switched on. The switch-off delay functions in a similar manner, in other words it keeps the set point switched on until the parameterised time has elapsed.



5.6.1. Optical response, flashing display

The switching on of one or more set points can also be set to trigger a flashing of the display to enhance the optical response.

Example:
Let us assume the threshold for flashing of the display is set at set point 2.
If set point 1 is exceeded and set point 2 is not, the set point **LED 1** lights up permanently.
If set point 2 exceeds the threshold, the 7-segment display will start to flash, set point 1 will light up permanently and set point LED 2 will flash.
The flashing enhances the optical response and the operator sees immediately that an important threshold has been exceeded with this unit.

5.7. Analogue output

The **analogue output** is used to rescale the determined values. The analogue output is parameterised via the two program numbers, "Offset" and "Full scale". With "Offset", the value is set at which the analogue output transmits the minimal value, and with "Full scale", the value at which the output transmits its maximum.

5.8. Digital input

The digital input can be used to trigger certain specific functions in the unit, but will not be dealt with in more detail here.

6. Interface

This section describes the interface.

Pressing the ENTER or <CR> key is always denoted by ↲.

6.1. Operating modes PN34

The interface can be operated in various modes that can be parameterised via the PN34.

PN34=0
Standard mode in which the unit only replies if called on to do so. This mode is used only for configuration.

PN34=1
Transmission mode in which the measurements are transmitted via the serial interface cyclically with the set measuring time.

The transmission mode is interrupted on receipt of “> ↲“ and the unit changes to standard mode. To change back to transmission mode, the display must be restarted, either by entering the command **S** ↲ or by switching the device off and on.

With the transmission mode, the display value is transmitted via the interface in ASCII format. Minus signs and decimal points are also transmitted so that the output can be displayed directly on a terminal or processed by a SPS. Zeros at the front are suppressed during transmission. With an over or underflow, the display transmits horizontal bars (hyphens) "- - - - - ↲".

Examples: "0.00 ↲ " ; "-9.99 ↲ " ; "999.99 ↲ " ; "-123.45" ; " - - - - - ↲"

With the aid of this simple protocol structure, the display data can be transferred very easily to a PC etc. and further processed there. In the simplest case, a terminal program from the operating system is sufficient to store the received data in a file.

6.2. RS232 / RS485

All **PU5** units can be programmed or configurated via an interface. The units do not have any interface as standard.

For configuration, a terminal program or special programming software can be used.

The communication is a straight point-to-point connection. The baud rate is set to 9600 baud, with 8 databits, without parity and one stopbit.

Configuration is performed by transmitting **ASCII symbols**.

The structure of a command: *Program number / Command / Value/* ↲

Program number	see program number table
Command	**=** describe a parameter with a decimal value **B** describe a parameter with a binary value
Value	A value from the range of values given in the program number table
↲	ENTER or <CR>, conclusion of any command

Below, for example, the value for the program number 61 is parameterised with a value of 5000.

"61=5000↲"

All values are written directly into the **EEPROM** of the unit and are valid after changing into operating mode. In contrast, the communication parameters of the interface only become effective after restarting the display.

To simplify the input, there is no need for "." (dots) and "," (commas).

In the basic setting, a message is not acknowledged, which enables the parallel programming of several displays. To check the overall configuration, a checksum can be called up on the LED display.

Successful programming is indicated by a "PROG“ in the LED display.

If you want to call up the content of a program number (e.g. 61), you can do so with the command

"61↲"

The display sends the corresponding value back in ASCII format.

e.g. "5000↲"

Should a program number also contain subsidiary parameters – like the corresponding binary value in the case of a calibration point – it can be called up via the extension "B".

e.g. *"1B3433↲"*

If the scaled value needs to be changed, the extension "=" is used.

e.g. *"1=12000↲"*

Any entry that cannot be interpreted is acknowledged with an "**Err**" in the display.

If a non-existent program number or an unknown command is sent, the display will acknowledge this with an "**?**" via the interface.

In the normal condition, the display does not send an acknowledgement back. Only when the value is called up or the acknowledgement mode is activated by the “>“ command does the display send a response from then on. This mode is exited after restarting the unit or 15 s after receiving the last command.

6.2.1. Serial special commands

In addition to the program number control, special commands are also possible. In the following table we have dispensed with giving the ↲ at the and of the command.

Command	**Acknowledgement**	**Function**
S ↲		Restart the display
Q ↲		Change display mode
A ↲	Display value	Call up display value via the interface
B ↲	Binary value	Call up binary value by the interface
U ↲		Load default configuration
P ↲		Call up test total
> ↲	>	Activate interface acknowledgement

6.2.2. Treatment of calibration points

To parameterise calibration points, the binary measurement and the scaled value must be preset. Before this, the measuring input to be dealt with must be activated via PN15.

Accordingly, a calibration is made as follows:

I. Calibration with sensor
For the calibration, the binary value must be called up from the unit with the command "B↲". The unit sends the binary value of the A/D converter back via the interface.
After this, the value can be transferred to the preset program number 2 with the command e.g. "*2B8388608*↲".
The respective scaled measurement is then indicated without a decimal point by e.g. "2=10↲".

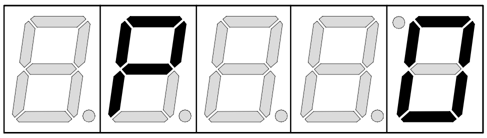
II. Rescaling
With a straight rescaling, only the scaled calibration point value has to be overwritten. With this command, the value for PN2 is programmed to 100.
"2=100↲"
The binary value is retained.

III. Binary value preset (extension "B")
Only the binary measurement of the calibration point is changed (e.g. "*2B8388608*"). The respective scaled value is retained.

IV. Takeover of calibration
Existing calibrations can be taken over from one unit to another with the aid of PC software. A PC program must call up the factory calibration of the source unit and the target unit, match the linearisation and write the calculated binary values and scale values to the target unit.

7. Programming

In the display, the program numbers (PN) are shown, right-justified, as a 3-digit number with a **P** in front of them.



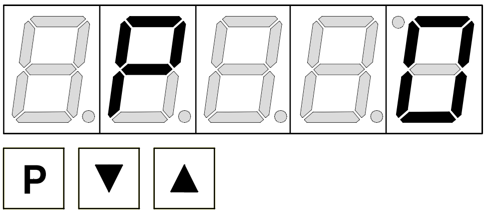
Display of e.g. program number 0

7.1. Programming procedure

The entire programming of the **PU5** is done by the steps described below.

Change to programming mode

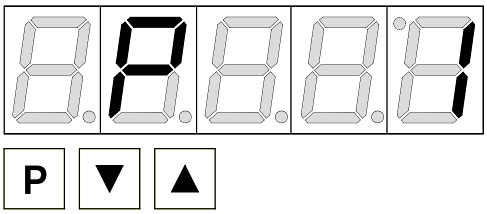
Push the [P] key to change into programming mode. The unit goes to the lowest available program number. If the programming lock is activated, the key must be pushed for at least 1 second.



Example:
Change to programming mode by pushing key [P]. The first released program number (PN) appears, in this case PN0.

Change to other program numbers

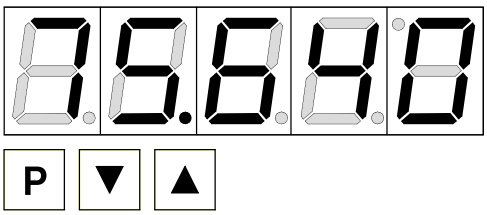
To change between individual program numbers, hold the **[P] key down** and push the **[UP]** key for changing to a higher program number or the **[DOWN]** key for changing to a lower number. By keeping the keys pushed, e.g. [P] & [UP], the display will begin, after approx. 1 second, to automatically run through the program numbers.



Example:
A **3** is parameterised under PN1.
Keep key [P] pushed and push the [UP] key several times. PN1 appears in the display. Under this parameter the full scale of the input 2 can be changed.

Change to the parameter

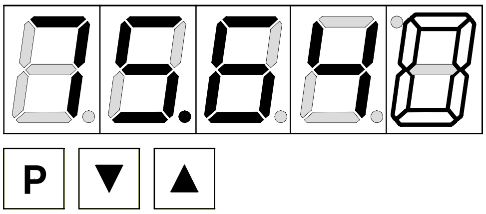
Once the program number appears in the display, you can push the **[DOWN] or [UP] key** to get to the parameters set for this program number. The currently stored parameters are displayed.



Example:
By pushing the [DOWN] or [UP] key, the currently stored value for PN1 appears in the display. In this case, it is 75,640.

Changing a parameter

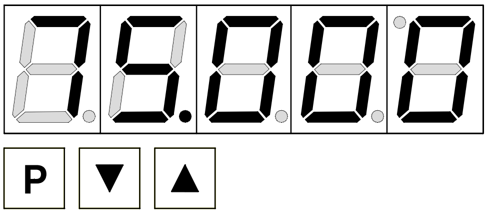
After changing to the parameter, the lowest digit of the respective parameter flashes on the display. The value can be changed with the [UP] or [DOWN] key. To move to the next digit, the **[P] key** must be briefly pushed. Once the highest digit has been set and confirmed with [P], the lowest digit will begin to flash again.



Example:
The 0 is flashing this is the lowest digit and asks if you want to change it. Let us assume the figure is to be changed from 75,640 to 75,000.
Briefly push the **[P]** key to move to the next digit. The 4 begins to flash. Change the figure by pushing [UP] or [DOWN] to change the digit from 4 to 0. Briefly push the [P] key to move on to the next digit. The 6 begins to flash. Change the digit by pushing [UP] or [DOWN] to move the 6 to a 0. Briefly push the [P] key to move to the next digit. The 5 and 7 do not need to be changed.

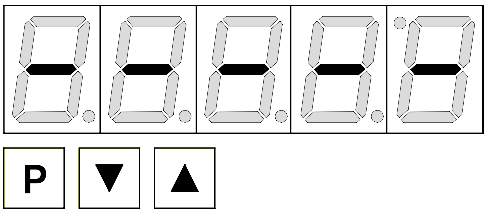
Saving parameters

All parameters must be acknowledged by the user by pushing the **[P] key** for one second. The changed parameters are then taken over as the current operating parameters and saved in the EEPROM.
This is confirmed by horizontal bars lighting up in the display.



Example:
Save the parameters by pushing [P] for 1 second.

All the **newly entered data are confirmed** by the unit. If no confirmation is received, the relevant parameters have not been saved.



Example:
You receive confirmation from the unit that the changes have been saved through the appearance of horizontal bars in the middle segments.

7.1.1. Changing from programming to operating mode

If no key is pushed in the programming mode for about 7 seconds, the unit will return automatically to operating mode.

7.2. Universal measuring input

The **PU5** is equipped with a universal measuring input that enables the signals from all kinds of different sensors to be measured direct. So that the unit can work according to the signal generated by the sensor, the input must be configured. The basic parameter is always set under **PN0**.

Caution! For the unit to function correctly, it is absolutely essential that the right sensor is parameterised under **program number 0**. If a wrong sensor is parameterised there, the operating behaviour may be impaired.

7.2.1. Calibration modes

The unit offers various possibilities with which the **PU5** can be parameterised to the measured values.

Factory calibration
All the units are calibrated in the factory, whereby offset and full scale were saved for the various measuring ranges.

Factory calibration PN0 = 1...12
For these parameters, new scaled display values can be allocated which are used for scaling the measurement on the display. For the offset, an input signal of 0 is assumed and for full scale, the specific full scale of the parameterised measuring range.

For parameterisation, no sensor signal has to be applied because stored values are used. Because of the differing input signals, the corresponding input configuration must be parameterised via PN0.

For the sensor signal with 4...20 mA, for example, PN0 = 2 has to be parameterised.

Factory calibration PN0 = 13...29
For the temperature measurement, the scaling cannot be changed by the user.

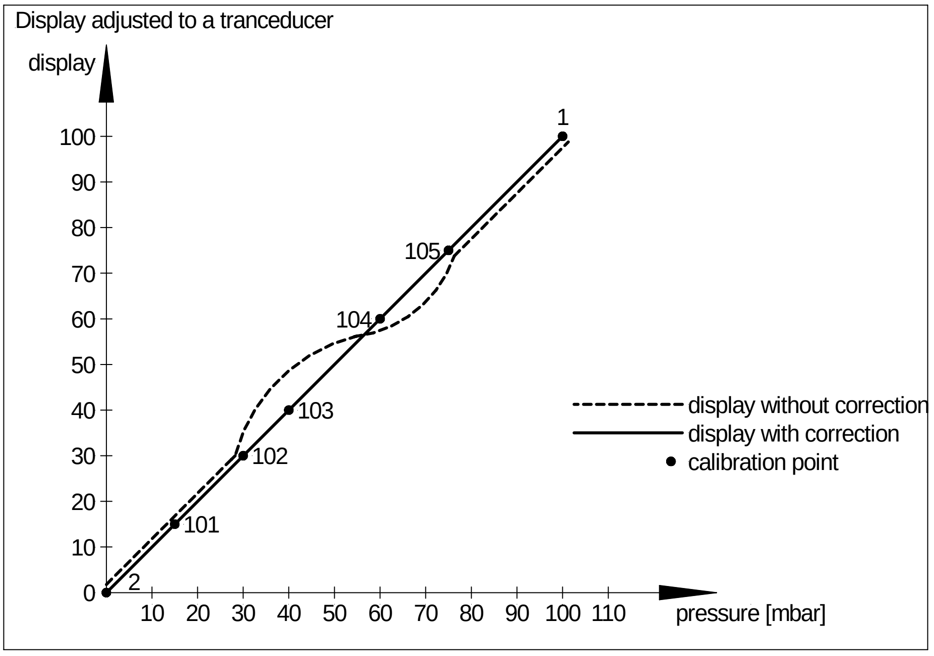
Sensor calibration PN0 ≥ 30
With the sensor calibration, the unit can be calibrated directly via the sensor signal or via a calibrator. For this, the measuring signal must be connected to the input of the unit. The respective display value must then be programmed under the program number PN1 (full scale) and PN2 (offset).
Through this process with two calibration points, the unit is matched up with the measuring section.
For more far-reaching adjustments to the characteristic line of the sensor, a linearisation can be activated.

Linearisation PN0 ≥ 30
With the linearisation, the PU5 offers the possibility for linearising non-linear sensors for displaying the measurements and for their further processing (analogue output).
In addition to the 2-point calibration, a maximum of 30 calibration points can be programmed.

Example:
To program e.g. 5 additional calibration points, 5 must be entered under PN100.
Subsequently, for each of the calibration points, the voltage/current must be applied to the unit and the respective display value programmed under the following program numbers PN101 – PN105.
The sensor signal must be consistently parameterised. A gap of at least +1 digit to the previous display value must be adhered to, otherwise the input will be refused and no confirmation of the saving will be given – see ***Saving parameters***.
Linearisation of a pressure transducer for 0...100 mbar with an output of 0...20 mA.
The display value before correction can be either calculated from the known characteristic line of the transducer or be determined empirically.

The non-linear range between 0...75 mbar. For calibration point 101, this means:
A pressure of 15 mbar, the transducer delivers 3.3 mbar instead of the ideal value of 3.0 mbar. Since 20 mA in the display corresponds to 100.0 mbar, 3.3 mA in the display corresponds to 16.5 mA before the correction.

Calibration point (PN)	Pressure [mbar]	Output Transducer [mA]	Display before correction (IN)	Desired display (OUT)
2	0	0.5	2.5	0.0
101	15	3.3	16.5	15.0
102	30	6.2	31.0	30.0
103	40	9.2	46.0	40.0
104	60	11.4	57.0	60.0
105	75	14.7	73.5	75.0
1	100	20.0	100.0	100.0



7.2.2. Measuring input PN0

For the basic configuration of the unit, you must parameterise the right measuring input for your application under this program number.
There is a choice of various inputs with a factory calibration, PN0 = 1...29.
In the case of the inputs with PN0 $\geq$ 30, a sensor calibration is necessary.

7.2.3. Scaling PN1 and PN2

The two program numbers 1 and 2 serve to scale the display; with these two parameters, the offset and full scale are parameterised.

7.2.4. Decimal point PN3

By changing this parameter, the position of the decimal point in the display is changed. With temperature measurements, the physical unit can also be added.

7.2.5. Offset shift PN5

With this parameter it is possible to carry out a parallel shift of the parameterised characteristic line. This may be necessary if, for example, a pressure sensor ages over the course of time and a shift in the zero point occurs. With the parallel shift, the sensor can be adjusted back to the zero point. Another application would be to parameterise a certain tank level to zero and have any deviation from this level displayed.
With the offset it does not matter whether the original characteristic line has been programmed by the user with PN1, PN2 or PN101...130 or whether it is the characteristic line of a temperature sensor. The value parameterised under PN5 is added to the original display value. If, for example, a temperature sensor shows approx. 3 °C instead of 0 °C, you can compensate for this deviation by changing the value under program number 5 from zero to -3.

7.2.6. Thermocouple reference junction PN6

The thermocouple reference junction is only available for thermocouples and can be activated or deactivated with this parameter. Deactivation may be useful where the interchange point is kept at a very constant level or the temperature constitutes the direct relationship to the process.

7.2.7. Display time PN13

The display time is the interval at which the display is updated. The longer the time between two display cycles, the calmer the display. The eye perceives a display time of 1 second as very pleasant.

7.2.8. Measuring time PN14

The **PU5** performs an averaging process by calculating an average from several measurements taken during the measuring time (1 / measuring time = Samples /s). For most applications, a measuring time of 50 to 10 % of the display time is suitable. You should under no circumstances parameterise a measuring time greater than the set display time.

Caution: The updating of other functional components (analogue outlet and relay) is carried out cyclically with the set measuring time. If the measuring time is set very short, it is possible that there will be jumps in the analogue output in the case of a noisy signal or a brief switching of the relay. When selecting the measuring time, it should be borne in mind that the MIN /MAX memory receives its values on the basis of the set measuring time. Should the peaks of a turbulent signal be recorded, it may certainly be worthwhile to choose a very short measuring time.

7.2.9. Zero point suppression PN18

The zero point suppression facility offers the possibility of masking an area around zero for displaying a value of zero. In the program number the amount is parameterised which is then effective in both the positive and the negative directions. This may be necessary if, for example, a number of revolutions is being measured by an analogue sensor and has a drift around zero. If the signal changes slightly when the motor comes to a standstill, a speed of zero is still indicated. In addition, slightly negative rpms are suppressed.

7.2.10. Analogue output PN20 and PN21

The parameters of the analogue output refer to the scaling of the display and are cyclically updated with the measuring time.

7.2.11. Security setting, user level PN50 to PN52

With the parameters in the security settings, access to the program numbers is regulated through the setting of various user levels. The user levels divide the access into various levels. The user is only given access to the settings authorised by the system operator, such as the setting of thresholds. The lower the figure for the user level given under PN52, the lower the level of security of the unit parameters against user intervention.

User level (PN52 =)		0	1	2	3	4	5	6	7	8
Access to:	**PN**									
Display brightness	19	X	X	X	X	X	X	X	X	X
Programming lock	50	X	X	X	X	X	X	X	X	X
Serial number	200	X	X	X	X	X	X	X	X	X
Set point parameters	59...95	X	X	X	X	X	X	X		
Interface parameters (option)	32...34	X	X	X	X	X				
Analogue output parameters (option)	20...22	X	X	X	X	X				
Measuring input parameters	0...18	X	X	X						
Linearisation parameters for measuring input	100...130	X	X	X						
Authorisation codes / User level	51, 52	X								

User levels 1, 3, 5 and 7 are reserved user levels for which the authorization is in each case the same as the next lower level.

The parameterised user level PN52 is active as long as the authorisation code PN51 and programming lock PN50 are different. On delivery both parameters are set to 0000, so that the programming lock is deactivated.

To activate the set user level, you must enter a four-digit number under PN51 as a "locking code" and confirm it by pressing the [P] key for approx. 1 second.
On changing to programming mode, the unit jumps to the first authorised program number. If user level PN52 = 3, then, for example, the parameters of the set points can be changed, but changing the parameter of the measuring input (PN0) is not possible at this user level.
In order to obtain access to all program numbers later (equivalent to user level 0), you have to enter under PN50 the same code you used before under PN51. You must then acknowledge this by pressing the [P] key for approx. 1 second. After this you have access to all program numbers.

Caution! If the authorisation code becomes lost, the unit can be set to the default value 0000 at the manufacturer's without any data loss.

7.2.12. Set points

You can influence the behaviour of the set points with various program numbers. The figures refer to the scaled measurement and are updated with the set measuring time. A description of the various parameters is given in the section on relays.

7.2.13. Linearisation PN100 to PN130

Through the linearisation, the user has the possibility to linearise a non-linear sensor signal. A detailed description can be found in the chapter on calibration modes.

7.2.14. Serial number PN200

Under the serial number, you can call up the serial number that allows allocation to the production process and the manufacturing procedure. This parameter can only be viewed.

8. Program table

The program table lists all the program numbers (PN) with their function, range of values, default values and user level.

PN	Function	Range of values	Default	User level
	Channel 1			
0	Measuring input Parameters 1 to 29 make use of the factory calibration. The parameters ≥ 30 need sensor calibration.	**Current, voltage** 1 = 0...20 mA 2 = 4...20 mA 3 = 0...10V 4 = 0....5V 5 = 0...2500 mV 6 = 0...1250 mV 7 = 0...600 mV 8 = 0...300 mV 9 = 0...150 mV 10 = 0...75 mV 11 = 0...35 mV 12 = 0...18 mV **Temperature measurement** 13 = PT100 (4/2 wire) 14 = PT100 (3 wire) 15 = PT200 (4/2 wire) 16 = PT200 (3 wire) 17 = PT500 (4/2 wire) 18 = PT500 (3 wire) 19 = PT1000 (4/2 wire) 20 = PT1000 (3 wire) 21 = L 22 = J 23 = K 24 = B 25 = S 26 = N 27 = E 28 = T 29 = R **Resistance / Potentiometer** 30 = ≤ 100 Ω (4/2 wire) 31 = ≤ 1 kΩ (4/2 wire) 32 = ≤ 10 kΩ (4/2 wire) **Sensor calibration** 33 = 0/4...20 mA 34 = – 1...10 V 35 = – 1...5 V 36 = – 500...2500 mV	3	2

PN	Function	Range of values	Default	User level
0	Measuring input (continued)	37 = – 500...1250 mV 38 = – 500...600 mV 39 = ± 300 mV 40 = ± 150 mV 41 = ± 75 mV 42 = ± 35 mV 43 = ± 18 mV 44 = 0...5 mA 45 = 0...2 mA		
1	Full scale PN0 ≤ 12 or PN0 ≥ 29	-9999...99999	10000	2
2	Offset PN0 ≤ 12 and PN0 ≥ 29	-9999...99999	0	2
3	Decimal point **Voltage, current** With PN0 ≤ 12 and PN0 ≥ 26	00000...0,0000	none	2
	Ptxxx resistance thermometer Physical unit and number after the decimal point; with PN0 = 13 to 20 0 or 1: the physical unit is not shown in the display 2 to 5: the unit is shown after the figure	0 = 8888.8 [°C] 1 = 8888.8 [°F] 2 = 8888'C [°C] 3 = 8888'F [°F] 4 = 888.8'C [°C] (-99.9...850.0) 5 = 888.8'C [°F] (-99.9...999.9)	2	2
	Thermocouple Physical unit and number after the decimal point; PN0 = 21 to 29 0 or 1: the physical unit is not shown in the display 2 or 3: the unit is given after the figure	0 = 8888.8 [°C] 1 = 8888.8 [°F] 2 = 8888'C [°C] 3 = 8888'F [°F]	0	2
5	Offset shift At analogue or resistance measurements and sensor calibration PN0 = 1 to 12 or 30 to 45;	-9999...99999	0	2
	With temperature sensors, PN0 = 13 to 29	Measuring range	0.0 / 0.00	2
6	With PN0 = 21 to 29 thermocouple reference junction (can only be parameterised with thermocouples)	0 = deactive 1 = active	1	2
	General settings			
13	Display time	0.1 ... 10.0	1.0	2
14	Measuring time (in 0.02 seconds-steps) Voltage, Current PN0 = 1...12; 33...45 PTxxxx 2/4 wire PTxxxx 3-wire	 0.02...10.00 0.04...10.00 0.06...10.00	 1.00 1.00 1.00	 2 2 2

PN	Function	Range of values	Default	User level
	Temperature measurement Thermocouple	0.04...10.00	1.00	2
	Resistance 2/4-wire Resistance 3-wire	0.04...10.00 0.06...10.00	1.00 1.00	2 2
18	Zero point suppression	0...99999	0	2
19	Display brightness	0...9 (0=bright / 9=dark)	3	8
	Analogue output			
20	Full scale	-9999...99999	10000	4
21	Offset	-9999...99999	0	4
	Interface			
34	Interface behaviour	0 = standard operation 1 = transmission operation	0	4
	Security settings			
50	Programming lock	0000...9999	0000	8
51	Authorisation code	0000...9999	0000	8
52	User level	0...8	0	0
	Flashing of the LED display			
59	Display flashing (approx. 0.5 seconds) no flashing Flashing at set point 1 Flashing at set point 2 Flashing at set point 3 Flashing at set point 4 Flashing at set point 1 and 2 Flashing at set point 3 and 4 Flashing at set point 1, 2, 3 and 4	 0 no flashing 1 flashes with 1st 2 flashes with 2nd 3 flashes with 3rd 4 flashes with 4th 5 flashes with 1st and 2nd 6 flashes with 3rd and 4th 7 flashes with 1st, 2nd, 3rd and 4th	0	6
	Set point 1			
60	Set point 1	0 = deactivated 1 = activated	1	6
61	Threshold	-9999...99999	1000	6
62	Hysteresis	1...99999	1	6
63	Active above / below SP value	0 = active below SP 1 = active above SP	1	6
64	Switch delay	0.0...10.0 seconds	0.0	6
65	Delay type	0 none 1 switch-on delay 2 switch-off delay 3 switch-on/off delay	1	6
	Set point 2			
70	Set point 2	0 = deactivated 1 = activated	1	6
71	Threshold	-9999...99999	1000	6
72	Hysteresis	1...99999	1	6
73	Active above / below SP value	0 = active below SP 1 = active above SP	1	6
74	Switch delay	0.0...10.0 seconds	0,0	6

PN	Function	Range of values	Default	User level
75	Delay type	0 none 1 switch-on delay 2 switch-off delay 3 switch-on/off delay	1	6
	Set point 3			
80	Set point 3	0 = deactivated 1 = activated	1	6
81	Threshold	-9999...99999	1000	6
82	Hysteresis	1...99999	1	6
83	Active above / below SP value	0 = active below SP 1 = active above SP	1	6
84	Switch delay	0.0...10.0 seconds	0.0	6
85	Delay type	0 none 1 switch-on delay 2 switch-off delay 3 switch-on/off delay	1	6
	Set point 4			
90	Set point 4	0 = deactivated 1 = activated	1	6
91	Threshold	-9999...99999	1000	6
92	Hysteresis	1...99999	1	6
93	Active above / below SP value	0 = active below SP 1 = active above SP	1	6
94	Switch delay	0.0...10.0 seconds	0,0	6
95	Delay type	0 none 1 switch-on delay 2 switch-off delay 3 switch-on/off delay	1	6
	Linearisation			
100	Number of additional calibration points	0...30	0	2
101 ... 130	Calibration points 1...30	-9999...99999		2
	Information			
200	Serial number	0...99999	0	8

9. Technical data

Housing

Dimensions	96 x 48 x 134 mm (WxHxD) including screw terminal 96 x 48 x 148 mm (WxHxD) including plug-in terminal
Assembly cut-out	$92.0^{+0.8}$ x $45.0^{+0.6}$ mm
Wall thickness	0...50 mm
Fixing	snap-in screw element
Material	PC/ABS-plastics blend, black, UL94V-0
Protective system	standard IP54 (front), IP00 (back)
Weight	approx. 450 g
Connection	Screw/plug-in terminal; line cross section up to 2.5 mm^2
Mounting grid	horizontal 120 mm / vertical 96 mm (recommended)

Display

Digit height	14 mm
Segment colour	red
Display range	-9999...99999
Set points	one LED per set point
Overflow	horizontal bars at top
Underflow	horizontal bars at the bottom
Display time	0.1...10.0 seconds

Input	Measuring range	R_I ca.	Error T_U= 20...40°C [%] MB	Digit
Measuring range /	–1...10 V	150 kΩ	0.01	± 1
Input resistance /	–1...5 V	150 kΩ	0.02	± 1
Measuring error	0/4...20 mA	50 Ω	0.02	± 1
at measuring time = 1 s	0...5 mA	50 Ω	0.02	± 1
	0...2 mA	50 Ω	0.02	± 1
	–500...2500 mV	1 MΩ	0.03	± 1
	–500...1250 mV	1 MΩ	0.03	± 1
	– 500...600 mV	1 MΩ	0.03	± 1
	± 300 mV	1 MΩ	0.03	± 1
	± 150 mV	1 MΩ	0.03	± 1
	± 75 mV	1 MΩ	0.04	± 1
	± 35 mV	1 MΩ	0.06	± 1
	± 15 mV	1 MΩ	0.06	± 1
	PTxxxx 2/3/4-wire -200.0-850.0°C	1 MΩ	0.04	± 1
	Thermocouple			
	Type L –200...900°C	1 MΩ	0.06 ± 1K	
	Type J –210...1200°C	1 MΩ	0.05 ± 1K	
	Type K –250...1271°C	1 MΩ	0.05 ± 1K	
	Type B 100...1810°C	1 MΩ	0.10 ± 1K	

	Measurement range	R_I	Error T_U= 20...40°C [%] MB	Digit
	Type S 0...1767°C	1 MΩ	0.06 ± 1K	
	Type N –250...1300°C	1 MΩ	0.06 ± 1K	
	Type E –260...1000°C	1 MΩ	0.06 ± 1K	
	Type R 0...1767°C	1 MΩ	0.07 ± 1K	
	Type T –240...400°C	1 MΩ	0.07 ± 1K	
	Resistance 100Ω 2/3/4-wire	1 MΩ	0.04	± 1
	Resistance 1kΩ 2/3/4-wire	1 MΩ	0.04	± 1
	Resistance 10kΩ 2/3/4-wire	1 MΩ	0.04	± 1
Temperature drift at T_U < 20°C or > 40°C	all measuring inputs	50 ppm/K		

Measuring time	Current, voltage	0.02...10.00 seconds
	PTxxxx 2/4-wire	0.04...10.00 seconds
	PTxxxx 3-wire	0.06...10.00 seconds
	Thermocouple	0.04...10.00 seconds
	Resistance 2/4-wire	0.04...10.00 seconds
	Resistance 3-wire	0.06...10.00 seconds
Measuring principle	Sigma/Delta	
Resolution	24 bit	

Output

Relay	Switch-over contact 230 VAC / 5A or 30 VDC / 2A with ohm resistive burden
Switching cycles	$0.5 * 10^5$ at max contact rating $5 * 10^6$ mechanically Separation as per DIN EN 50178 Characteristic data as per DIN EN 60255
Analogue output (galvanic insulated)	0...10 V (12-bit) load ≥ 100 kΩ 0...20 mA (12-bit) load ≤500 Ω 4...20 mA (12-bit) load ≤500 Ω
Error	0.1 % in the range T_U= 20...40°C, beyond 50 ppm/K
Internal resistance	100 Ω
Sensor supply (galvanic insulated)	10 VDC 20 mA 24 VDC 50 mA

Interface	
Protocol	Manufacturer-specific ASCII
RS232	9600 Baud, no parity, 8 databits, 1 stopbit
(optional galv. insulated)	
Lead length	max. 3 m
RS485	9600 Baud, no parity, 8 databits, 1 stopbit
(optional galv. insulated)	
Lead length	max. 1000 m
Power supply	
Supply voltage	230 VAC / 50/60 Hz / ±10 %
(galvanic insulated)	115 VAC / 50/60 Hz / ±10 %
	24 VDC / ±10 %
Power consumption	**max. 15 VA**
Memory	Parameter memory EEPROM
Data life	>100 years
Ambient conditions	
Working temperature	0...60 °C
Storage temperature	-20...80 °C
Climatic resistance	rel. humidity ≤75 % on year average without dew
EMV	DIN 61326
CE-Sign	Conformity to 89/336/EEC
Safety standard	DIN 61010

10. Error elimination

The following list gives the recommended procedure for dealing with faults and locating their possible cause.

10.1. Questions and answers

I. The unit permanently indicates overflow. „¯ ¯ ¯ ¯ ¯“

- ➢ The input has a very high measurement, check the measuring circuit.
- ➢ With a selected input with a low voltage signal, it is only connected on one side or the input is open.

II. The unit permanently shows underflow. „ _ _ _ _ _ “

- ➢ The input has a very low measurement, check the measuring circuit.
- ➢ With a selected input with a low voltage signal, it is only connected on one side or the input is open.

III. The word "HELP" lights up in the 7-segment display.

- ➢ The unit has found an error in the configuration memory. Perform a reset on the default values and reconfigure the unit according to your application, see 10.2 Reset to default values.

IV. Program numbers for parameterising the input are not accessible.

- ➢ The programming lock is set at a user level that does not allow access.
- ➢ Under PN1, a different sensor type was parameterised so that the desired program number cannot be parameterised.

V. "Err1" lights up in the 7-segment display.

- ➢ This error can only be eliminated by the manufacturer.

10.2. Reset to default values

To return the unit to a defined basic state, a reset can be carried out to the default values.

The following procedure should be used:

- ✔ Switch off the power supply.
- ✔ Press button [P]
- ✔ Switch on the power supply and press [P] for further approx. 2 seconds.

With reset, the default values of the program table are loaded and used for subsequent operation. This puts the unit back to the state in which it was supplied.

Caution! This is only possible when the programming lock PN50 allows access to all PNs or "HELP" is shown in the display.

Caution! All application-related data are lost.