



PID controller

Order number: 900310.030

As of: 11.01.2022 V2.17



Wiring diagram



Product description

This microprocessor-based controller is used for temperature control with high measuring accuracy and can be supplied with a voltage of 100 ... 240V AC and. In addition to resistance sensors and thermocouples, the multi-sensor input can also process 0...10V or 4...20mA. PID control and/or thermostat control can be activated via the parameterisation. Four relay contacts and one analogue output are available as outputs.

The controller is networked by means of an ST-Bus interface. The setpoints and parameters are set via a membrane keypad with five keys.

Sensor:	Multi-resistant
Range:	dependent on type of sensor
Front size:	84mm x 42mm
Panel cut-out:	67.5mm x 31.5mm
Tightness:	Front IP65
Connection:	plug and socket



Operating keys



- Initiate defrost (after 3 sec.)
- Increasing the setpoint
- In the menu: Selection of the next parameter level (*L*⁻⁻, *b*⁻⁻, etc.) or the next parameter name (*L* 1, *L*2, ...)
- In the menu: Increase of the parameter value



- Switching off the buzzer function (**LbH**)
- · Reducing the setpoint
- In the menu: Selection of the previous parameter level (b--, L--, etc.) or the previous parameter name (L2, L1, ...)
- In the menu: Reduction of the parameter value



Standard setting: Setpoint changeover (parameterised according to H32)

- · Switching the control on or off
- Setpoint changeover
- Autotuning start of the PID control loop (heating circuit only)
- · Coupling to an output relay



- · Displaying the current setpoint
- In the menu: Confirmation of the selected parameter level or parameter name.
- Together with the 'UP' and 'DOWN' keys, a parameter value or the setpoint (if parameter $R_{5}^{C} = 0$) can be changed.

If the setpoint is specified by the 0-20mA / 0-10V input (F50 > 0), the setpoint cannot be changed via the keys. The measured setpoint from the voltage or current input is displayed.



Standard setting: Standby (parameterised according to H3 ()

- Switching the control on or off
- · Setpoint switching
- Autotuning start of the PID control loop (heating circuit only)
- Coupling to an output relay

Control levels:

Parametrisation of the setpoint

The control setpoint $\begin{bmatrix} I \\ I \end{bmatrix}$ is accessible directly with SET key.

Pressing also the UP or DOWN key it can be adjusted.

The activation of the second setpoint of circuit 1 [2] is indicated on the display with a flashing point to the right. It can either be activated via switching entrance or with a function key (depending on parameter).

Menu levels

By pressing the 'UP' and 'DOWN' keys simultaneously for at least 4 seconds, the controller changes to the menu level. This consists of several submenus, which are marked by the respective initial letter followed by 2 dashes (e.g. C– for the C-level).

	Menu	Function
۲	Controller level	Application parame- ters
Ь	Between level	Linking parameters
H	Hardware level	Hardware parameters
d	Defrost level	Defrosting parameters
R	Analogue level	Parameter for ana- logue in- and outputs



The submenu is selected by pressing the 'UP' or 'DOWN' key. If you press the 'SET' key, the password for the respective level is requested. This must be set accordingly by additionally pressing the 'UP' or 'DOWN' key.

(Default value: 0 = deactivated).

The last parameter of the respective submenu (e.g. **[39**, **b99**, ...) corresponds to the current password of this level and can be changed there.

After releasing the 'SET' key, if the password is entered correctly, the display jumps to the submenu and shows the first parameter of the list there. If you press the 'SET' key, the value of the selected parameter is displayed. It can be adjusted by pressing the 'UP' or the 'DOWN' key. After releasing all keys, the new value is permanently stored.

If the 'UP' and 'DOWN' keys are pressed again simultaneously for at least 4 seconds, the display changes back to the menu level. If you press the 'UP' and 'DOWN' keys again for at least 4 seconds or if no key is pressed for more than 60 seconds, the display returns to the basic status.

Software version

The software version number can be called up by pressing the 'SET' + 'UP' + 'DOWN' key simultaneously.







The C-level (controller)

This level contains the application parameters.

Thermostat 1

Para- meter	Function	Adjustment range	Standard value	Custom value
E I	Setpoint control circuit 1	E 10E ()	0.0 °C	
53	Setpoint control circuit 1 (*)	E 10E ()	0.0 °C	
63	Offset for C1/C2	-99.0 99.0°K	0.0 K	
EH	Switching sense control circuit 1	0: heating function 1: cooling function	0	
65	Hysteresis control circuit 1	0.1 99.9°K	1.0 K	
6	Hysteresis mode control circuit 1	0: symmetrical 1: one-sided	0	
٢٦	Minimum action time control circuit 1 "ON"	0 400 sec.	0 sec.	
68	Minimum action time control circuit 1 "OFF"	0 400 sec.	0 sec.	
69	Function control circuit 1 at sensor error	0: relay off 1: relay on	0	
C 10	Max. control range limitation, setpoint 1	-99.0°C E 11	-99.0 °C	
E I I	Min. control range limitation, setpoint 1	Г ID 999.0°С	999 °C	

* The activation of the second setpoint [2] is indicated on the display with a flashing point to the right. It can be activated either via the switching input or via function key 1 or 2. (depending on parameter H3 I or H32). See also the chapter Notes on setpoint changeover.

Thermostat 2

Para- meter	Function	Adjustment range	Standard value	Custom value
1.53	Setpoint control circuit 2 (b =0)	C30C3 (0.0 °C	
653	Offset for C1/C21 (b =1)	-99.0 99.0°K	0.0 K	
624	Switching sense control circuit 2	0: heating function 1: cooling function	1	
C25	Hysteresis control circuit 2	0.1 99.9°K	1.0 K	
626	Hysteresis mode control circuit 2	0: symmetrical 1: one-sided	0	
C27	Minimum action time control circuit 2 "ON"	0 400 sec.	0 sec.	
853	Minimum action time control circuit 2 "OFF"	0 400 sec.	0 sec.	
653	Function control circuit 2 at sensor error	0: relay off 1: relay on	0	
C 30	Max. control range limitation, setpoint 2	-99.0°C [] (-99.0 °C	
163	Min. control range limitation, setpoint 2	E 3D 999.0°C	999 °C	
Thermo	ostat 3		-	
EHT	Setpoint control circuit 3 (b2=0)	CSOCS (0.0 °C	
СЧЭ	Offset for C1/C41 (b2=1)	-99.0 99.0°K	0.0 K	
[44	Switching sense control circuit 3	0: heating function 1: cooling function	1	
645	Hysteresis control circuit 3	0.1 99.9°K	1.0 K	
646	Hysteresis mode control circuit 3	0: symmetrical 1: one-sided	0	
647	Minimum action time control circuit 3 "ON"	0 400 sec.	0 sec.	
648	Minimum action time control circuit 3 "OFF"	0 400 sec.	0 sec.	
649	Function control circuit 3 at sensor error	0: relay off 1: relay on	0	
C 50	Max. control range limitation, setpoint 3	-99.0°C E5 /	-99.0 °C	

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Para- meter	Function	Adjustment range	Standard value	Custom value
ES (Min. control range limitation, setpoint 3	ESD 999.0°C	999 °C	
Bounda	ary or range alarm			
66 (Lower alarm value	-99.0 СБЗ °С	-10.0 °C	
662	Upper alarm value	LE I 999.0 °C	10.0 °C	
663	Alarm functions	 0: Boundary alarm, relative boundaries 1: Boundary alarm, absolute boundaries 2: Range alarm, relative boundaries 3: Range alarm, absolute boundaries 4: Boundary alarm, relative boundaries, alarm inverse 5: Boundary alarm, absolute boundaries, alarm inverse 6: Range alarm, relative boundaries, alarm inverse 7: Range alarm, absolute boundaries, alarm inverse 	0	
664	Special function at boundary alarm	0: not active 1: flashing display 2: buzzer 3: buzzer + flashing display 4: like 3, buzzer can be cancelled 5: like 4, restarts after 10 min. 6: like 4, restarts after 30 min	4	
665	Hysteresis alarm circuit	0.1 99.9 K	1 K	
PID cor	ntroller			
682	Proportional area at PID control	0.1 999.0°K	10 K	
683	Reset time at PID control (I-portion)	0999 sec., 0: inactive	600 s	
684	Lead time at PID control (D-portion)	0999 sec., 0: inactive	0 s	
685	Cycle time at PID control	2100 sec.	8 s	
686	Control variable dead volume	0.0 100.0%	0,0 %	
687	Function PID control circuit at sensor error	-100.0% 0 100.0%	0,0 %	
688	PID-mode	0: PID 1: DiffPID (2 relays - heating, cooling) 2: PID with dead volume at analogue exit	0	
689	Cycle time motor valve (Differential PID)	2100 sec.	8 s	
C90	Anti-Windup, lower limit for P+I portion	-100 100 %	-100	
ES (Anti-Windup, upper limit for P+I portion	-100 100 %	100	
Passwo	ord			
699	Password C level	-99999	0	

b-level (between) This level contains the parameters for different combinations.

Para- meter	Function	Adjustment range	Standard value	Custom value
ы	Activation setpoint combination for thermostat 1 and 2 $([23] = deltaW2)$	0: no combination 1: Setpoint thermostat 2 = [1/[2 + [2]	0	
65	Activation setpoint combination for thermostat 1 and 3 $(L^{+}3 = deltaW3)$	0: no combination 1: setpoint thermostat 3 = [1/[2 + [33]	0	
БП	Delay control circuit 1, 2, 3 after "Power-On"	0400 sec.	0 sec.	
ь (2	Mutual delay control circuit 1, 2, 3	0400 sec.	0 sec.	
ь (З	Alarm suppression after "Power-On", "setpoint"	060 min.	20 min.	
Р5 (Linking analogue exit	0: actuating variable 1: actual value 2: setpoint	0	
699	Password b-level	-99 999	0	

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Para-

meter

H level (Hardware)

Function

This level contains the hardware parameters.

н	Key-lock	0: no key-lock 1: key-lock	0	
ни	Indication mode display 1	0: integrals 1: decimals in 0.5°K 2: decimals in 0.1°K 3: decimals in 0.01°K	2	
н 15	Display mode	1: actual value 2: setpoint 3: PID control variable	1	
H IS	Temperature scale	0: Celsius 1: Fahrenheit	0	
н (Б	Indication standby	0: no display (point to the right) 1: RUS 2: OFF	1	
нп	Mode following "Power-On" "	0: Off 1: On 2: Auto	1	
H3 (Assigning function key 1	0: no function 1: Controller on/off (standby) 2: Setpoint 1 / Setpoint 2 3: Start autotuning 4: Relay (HY 1 HYY = 7), off on Standby 5: Relay (HY 1 HYY = 7), independent of Standby	1	
732 7	Assigning function key 2	0: no function 1: Controller on/off (standby) 2: Setpoint 1 / Setpoint 2 3: Start autotuning 4: Relay (HY 1 HYY = 8), off on Standby 5: Relay (HY 1 HYY = 8), independent of Standby	2	
H33	Assigning switching input E1	0: no function 1: Controller on/off (standby) 2: Setpoint 1 / Setpoint 2 3: Start autotuning 4: Relay (HY 1 HYY = 9), off on Standby 5: Relay (HY 1 HYY = 9), independent of Standby	2	
H35	Activation of key acknowledgement	0: no key acknowledgement 1: key acknowledgement with buzzer	0	
нч і	Function output K1	0: no connection 1: thermostat 1 2: thermostat 2 3: thermostat 3 4: alarm function 5: PID heating 6: PID cooling 7: Function key 1 (H3 I >= 4) 8: Function key 2 (H32 >= 4) 9: Function switching input (H33 >=3)	5	
H45	Function output K2	see HY I	0	
нчз	Function output K3	see HY I	0	
нчч	Function output K4	see HY I	0	
HS (Mains frequency	0: 50Hz 1: 60Hz	0	
LO	ST-Bus address	1 250	5	
H99	Password H level	-99999	0	

Adjustment range



Standard

value

Custom

value





d-level (defrosting functions)

This level contains the parameters for defrosting.

NOTE: Defrosting parameter only affects control circuit 1

Para- meter	Function	Adjustment range	Standard value	Custom value
40	Defrosting interval TH1	1 99h 0: no defrosting	0	
42	Defrosting temperature TH1	-99.0 999.0 °C	10,0 °C	
43	Defrosting time limit TH1	1 99 min. 0: no time limit	30 min	
49	Manual defrosting TH1	01	0	
d99	Password d-level	-99999	0	

Die A-level (analogue values)

This level contains the parameters for analogue inputs and outputs

Para- meter	Function	Adjustment range	Standard value	Custom value
R (Actual value	-		
82	Actual value correction thermocouple/temperature sensor (does not apply to current/voltage input)	-99.0 99.9 °K	0 K	
83	Weighing factor	0.50 1.50	1.00	
ЯЧ	Sensor type	1: Thermocouple type J 2: Thermocouple type K 11: Pt100 two-wire 12: Pt100 three-wire 13: Pt1000 three-wire 21: KTY81-121 two-wire 21: KTY81-121 two-wire 31: Voltage input 0 10 V 32: Voltage input 2 10 V 41: Current input 0 20 mA (sink) 42: Current input 4 20 mA (source) 44: Current input 4 20 mA (source) 50: Quantity counting	12	
RS	Display value for lower value of U/I analogue input	-99.0 999	0.0	
RE	Display value for upper value of U/I analogue input	-99.0 999	100.0	
87	Quantity counting scaling	1 9999 pulses/unit of measure	1000	
88	Display type of the quantity counting	0: Pulses / sec. (= frequency) 1: Quantity / sec. 2: Quantity / min.	0	
RS	Units for measured values, setpoints and parameters	0: without unit 1: counter 2: °C 3: bar 4: Pa 5: %rH 6: % 7: I/min 8: I/h	2	
R40	Time constant of the software filter X = 160 ms (50 Hz, H51 = 0) X = 400 ms (60 Hz, H51 = 1)	0: not active, otherwise average value over 1: 2 measured values (approx. 2*X s) 2: 4 measured values (approx. 4*X s) 3: 8 measured values (approx. 8*X s) 4: 16 measured values (approx. 16*X s) 5: 32 measured values (approx. 32*X s) 6: 64 measured values (approx. 64*X s)	2	

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Para- meter	Function	Adjustment range	Standard value	Custom value
RSO	Display of the PID control variable	-		
R5 (Display value for lower value at analogue output (0V/0mA)	-99,0 (R52 - 0,5) 0 at sensor error (b2 ! = 1)	0.0	
R52	Display value for upper value at analogue output (10V/20mA)	(R5 i + 0,5) 999	100	
RS3	Output value full cooling power (-100.00%)	0 10.0 (10 corresponds to 10 V or 20 mA)	0.0	
RSH	Output value "0" power	0 10.0 (10 corresponds to 10 V or 20 mA)	0.0	
RSS	Output value full heating power (0100.0%)	0 10.0 (10 corresponds to 10 V or 20 mA)	10.0	
R60	Type of setpoint sensor	 0: Fixed value from parameter memory (C1) 31: Voltage input 0 10 V 32: Voltage input 2 10 V 41: Current input 0 20 mA (sink) 42: Current input 4 20 mA (sink) 43: Current input 0 20 mA (source) 44: Current input 4 20 mA (source) 	0	
899	Password A-level	-99 999	0	



Notes on setpoint changeover

Shortcut for setpoint setting via the voltage / current input = "analogue".

Switching between the two setpoints [1, 1] (REC = 0) or setpoint setting via the analogue input (REC > 0) and C2 can be done via the switching input E1 as well as via the function keys **F1** or **F2**.

The following rules apply:

• A setpoint [1/analogue to [2] switchedby a function key can be switched back (<math>[1/analogue) by pressing another function key. The function keys must be configured for setpoint switching by the parameters H3 ! = 2 (F1) or H32 = 2 (F2).

• The switching input can also switch between the setpoints by closing and opening the switching contact.

• By opening the contact, the switching input E1 is able to switch back a setpoint ($\begin{bmatrix} 1/\\ analogue to \end{bmatrix}$) that has been switched by a function key. It acts like an additional function key.

• Conversely, this can also be done by a function key. A setpoint switched by the switching input can be switched back again by **F1** or **F2**.

Important:

In the event of a power failure and standby operation, the last set status is saved.

C-level:

C : Setpoint control circuit 1

This value corresponds with the setpoint set at the first control level.

Important: For [f to be used, parameter R50] must be = 0. Otherwise, the applied voltage (pins 4/5) or current (pins 4/5 or 5/7) is used as the setpoint.

C?: Setpoint control circuit 1 at closed switching input

Setpoint **C2** can only be called up via the 'SET' key if input E1 is closed or one of the function keys **F1** or **F2** has been pressed (see also the chapter Notes on setpoint switching).

If the quantity counting function (50) was set via the sensor selection (parameter FH), then the switchover via input E1 is deactivated.

[]: Offset for **[**/**[**]

This adjusted value will build the difference to the setpoint for control circuit 1, i.e. there is no regulation according to the pre-set value, but according to the sum of desired value and the value of \Box **3**.

L Switching sense control circuit 1

The switching sense for the relays, i.e. cooling or heating function, can be programmed independently. Heating function means that the contact falls as soon as the pre-set setpoint is reached, thus power interruption. At cooling function, the contact only tightens, if the actual value is above the required setpoint.

5: Hysteresis control circuit 1

The hysteresis can be set symmetrically or one-sided at the desired value (see [5]). At one-sided setting, the hysteresis works downward with heating contact and upward with cooling contact. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point.







Cooling controller, one-sided hysteresis

[b: Hysteresis mode control circuit 1

These parameters allow selection as to whether the hysteresis values which are adjustable with **C5**, are set symmetrically or one-sided at the respective switching point. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point. The one-sided hysteresis works downward with heating contact and upward with cooling contact.

C7/**C**8: Minimum action time control circuit 1 "On"/"Off"

These parameters permit a delay in switching on/off the relay in order to reduce the switching frequency. The adjusted time sets the entire minimum time period for a switching-on or switching-off phase



5: Function circuit 1 at sensor error

At sensor error the selected relay (see H4 f ... H44) falls back into the condition pre-set here.

Setpoint limit (min) setpoint 1 Setpoint limit (max) setpoint 1

The adjustment range of the setpoint can be limited in both directions. This is to prevent the end user of a unit from setting inadmissible or dangerous setpoints.

C2 : Setpoint control circuit 2 (thermostat) (b =0)

If **b** =1, this value is ineffective.

[23: Value deltaW2 (b =1)

If **b** i=1, the setpoints for control circuit 1 and 2 are linked with one another via switching difference deltaW2 (operation with deltaW). The following applies: Setpoint thermostat 2 = setpoint control circuit 1 ([1/[2]) + deltaW2.

This difference can take positive or negative values. Thus, a leading or following contact can be realised.

C24: Switching sense control circuit 2

The switching sense for the relays, i.e. cooling or heating function, can be programmed independently at works. Heating function means that the contact falls as soon as the pre-set setpoint is reached, thus power interruption. At cooling function, the contact only tightens, when the actual value is above the required setpoint.

C25: Hysteresis control circuit 2

The hysteresis can be set symmetrically or one-sided at the setpoint (see **E25**). At one-sided setting, the hysteresis works downward with heating contact and upward with cooling contact. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point.

[25: Hysteresis mode control circuit 2

These parameters allow selection as to whether the hysteresis values which are adjustable with [25, are set symmetrically or one-sided at the respective switching point. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point. The one-sided hysteresis works downward with heating contact and upward with cooling contact.

C27: Minimum action time control circuit 2 "On"

C28: Minimum action time control circuit 2 "Off"

These parameters permit a delay in switching on/off the relay, in order to reduce the switching frequency. The adjusted time sets the entire minimum time period for a switching-on or switching-off phase.



[29: Function control circuit 2 at sensor error

At sensor error the selected relay (see H4 I, H42) falls back into the condition pre-set here.

Image: Setpoint limit (min) setpoint 2Image: Setpoint limit (max) setpoint 2

The adjustment range of the setpoint can be limited in both directions. This is to prevent the end user of a unit from setting inadmissible or dangerous setpoints.

[4]: Setpoint thermostat 3 ($b^2=0$)

If **b2**=1, this value is ineffective.

[4]: Value deltaW3 (b2=1)

If b2=1, the setpoints for control circuit 1 and 2 are linked with one another via switching difference deltaW3 (operation with deltaW). The following applies: Setpoint thermostat 3 = setpoint control circuit 1 ($\begin{bmatrix} 1/\lfloor 2 \end{pmatrix}$) + deltaW3.

This difference can take positive or negative values. Thus, a leading or following contact can be realised.

CHH: Switching sense control circuit 3

The switching sense for the relays, i.e. cooling or heating function, can be programmed independently at works. Heating function means that the contact falls as soon as the pre-set setpoint is reached, thus power interruption. At cooling function, the contact only tightens, when the actual value is above the required setpoint.

CH5: Hysteresis control circuit 3

The hysteresis can be set symmetrically or one-sided at the setpoint (see E + 5). At one-sided setting, the hysteresis works downward with heating contact and upward with cooling contact. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point.

CH5: Hysteresis mode control circuit 3

These parameters allow selection as to whether the hysteresis values which are adjustable with [45], are set symmetrically or one-sided at the respective switching point. At symmetrical hysteresis, half of the hysteresis' value is effective below and half of the value above the switching point. The one-sided hysteresis works downward with heating contact and upward with cooling contact.

[식기: Minimum action time control circuit 2 "On"

L 48: Minimum action time control circuit 2 "Off"

These parameters permit a delay in switching on/off the relay, in order to reduce the switching frequency. The adjusted time sets the entire minimum time period for a switching-on or switching-off phase.

49: Function control circuit 3 at sensor error

At sensor error the selected relay (see HY I, HY2) falls back into the condition pre-set here.

50: Setpoint limit (min) setpoint 3 54: Setpoint limit (max) setpoint 3

The adjustment range of the setpoint can be limited in both directions. This is to prevent the end user of a unit from setting inadmissible or dangerous setpoints.

L6 : Lower alarm value **L62**: Upper alarm value

The exit alarm is a boundary alarm or a range alarm with one-sided hysteresis (see parameter [55]). Both at the boundary alarm and the range alarm, limit values can be relative, i.e. going along with the setpoint [1/2], or absolute, i.e. independent of the setpoint [1/2]. At boundary alarm the hysteresis works one-sided inwardly, and at range alarm outwardly (see pictures).

[63: Function exit alarm

The exit alarm evaluates an upper and a lower limit value (see parameters **[6]** and **[62**), whereas a selection is possible as to whether the alarm is active if the temperature lies within these two limits, or whether the alarm is released if the temperature lies beyond them. In the case of sensor error, the alarm is activated independently of this adjustment. The exit can also be inverted, so that it functions like a release (see pictures).



Boundary alarm, alarm contact normal:



Range alarm, alarm contact normal:



Boundary alarm, alarm contact inverse:



Range alarm, alarm contact inverse:



[54: Special function at alarm

Here can be selected whether, in the case of emergency, the indication to flash and/or the buzzer is to start. Sensor alarm (display F1L or F1H) is indicated independently thereof by flashing display and the buzzer runs off.

A sensor alarm (display F IL, F IH or F5L, F5H) is indicated independently by a flashing display and the buzzer sounds. The buzzer can be switched off at any time by pressing the 'DOWN' key. The buzzer is switched on again after 10 minutes if the error is still present.

[65: Hysteresis alarm circuit

Hysteresis is set one-sided at the adjusted limit value. It becomes effective depending on alarm definition.





PID - control

CB2: Proportional band at PID regulation

The proportional band works in such a way that with approximation of the actual value to the setpoint the variable is reduced linearly from +-100% to 0%.

LB3: Reset time at PID regulation (I-portion) LB4: Lead time at PID regulation

(D-portion)

The proportional controller as such has a remaining deviation of the actual value from the setpoint. The integral portion provides for a complete compensation of this offset.

The reset time is a measure for the period of time needed to adjust a remaining temperature deviation of the size of the proportional range.

If a small reset time is set, a fast post-adjustment will take place. At a too small reset time, however, the system may tend to vibrate.

The differential portion dampens temperature changes.

If lead time is set for long, damping is strong. At too long lead time, however, the system may tend to vibrate. At setting 0 the values are ineffective. It is therefore possible to realise a pure PI or PD regulation.

[B5: Cycle time at PID regulation

During the cycle time the control exit runs through one switching period, i.e. once switched out and once switched on. The smaller the cycle time, the faster the regulation. By consequence, however, there is also an increased switching frequency of the output, which can lead to rapid wear of relay contacts. For very fast control ways with the respective high switching frequency a voltage output is therefore of advantage.

CB5: Control variable dead volume



With parameter [Bb], the size of the dead volume can be set in % of the PID control value. This function is usually used with clocked PID controllers (relays) to achieve a minimum switch-on time. With [BB] = 1 (differential PID), a pseudo hysteresis can be realised. This leads to a reduction in the switching frequency, provided the actual value is approximately equal to the setpoint. For [BB] = 2, the dead volume is also made available at the analogue output.

EB : Function PID control circuit at sensor error

In the case a sensor error, the PID variable automatically goes to the condition set here.

[88: PID-Mode

[C88 = 0] PID standard

[C88 = 1] PID differential (see below) [C88 = 2] PID standard with dead volume at

analogue exit

PID differential: The differential mode is particularly suitable for the use of control valves (e.g. K1=OPEN, K2=CLOSED). As long as the value computed by the PID circuit remains constant, both exits remain inactive, i.e. the valve stops at the current position.

	PID Standard (C88 = $0/2$)				
	PID	K1: Heating	K2: Cooling		
1	20 %	20 %	0 %		
2	25 %	25 %	0 %		
3	25 %	25 %	0 %		
4	10 %	10 %	0 %		
5	-20 %	0 %	20 %		

	PID Differential (C88 = 1)			
	PID K1: Heating		K2: Cooling	
1	+20 %	20 %	0 %	
2	+5 %	5 %	0 %	
3	±0 %	0 %	0 %	
4	-15 %	0 %	15 %	
5	-30 %	0 %	30 %	

Thus, control valves almost show the same controlling results as analogue valves. The table shows the different behaviour of both modes within the same control system.

EB9: Cycle time control valve (DiffPID)

This parameter sets the time the control valve needs to go from 0% to 100%.

If **[BB**=1, the PID variable is converted to this interval. The PID cycle time (**[B5**) remains unaffected by this. When this time is defined, indication with a rounded up value in seconds is recommended.

Furthermore [85] should be > = [89].

At \pm 100% the respective exit remains durably active (synchronisation).

[99: Password

This parameter is to set the password for the [--] level.

b-level

b : Activation setpoint combination for thermostat 1 and thermostat 2 (deltaW2)

This parameter determines whether the setpoints for thermostat 1 and 2 independently adjustable (parameter $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$) or whether they are tied with one another via a switching offset deltaW2 (parameter $\begin{bmatrix} 2 \\ -2 \end{bmatrix}$).

b2: Activation setpoint combination for thermostat 1 and thermostat 3 (deltaW3)

This parameter determines whether the setpoints for thermostat 1 and 3 independently adjustable (parameter [4]) or whether they are tied with one another via a switching offset deltaW2 (parameter [4]).

b { : Delay control circuit 1, 2, 3 after "Power-On"

This parameter allows a switching-on delay of relays after switching-on the mains voltage. This delay corresponds with the time set here.

b [[]*C*²: Mutual delay control circuit 1, 2, 3

This parameter makes a mutual switching-on delay of relays possible, depending on whichever contact is switched first.

b [3: Alarm suppression after "Power-On", "setpoint"

This parameter allows a switching-on delay of the alarm contact after switching on the mains voltage. This delay corresponds with the time set here.

b99: Password

This parameter is to set the password for the b-level.

Autotuning of PID heating circuit:

Autotuning is intended to adapt and optimise the control behaviour to the controlled system. The following must be observed:

• Autotuning can be initiated via function key **F1** or **F2**. To do this, set parameters **H3** f or **H32** to 3.

• Autotuning only affects one heating circuit. Before the tuning process, at least one output relay (K1 ... K4) must be set to heating (= 5) via parameters H4 I ... H44.

•The setpoint must be at least 20 K higher than the actual value. Otherwise "---" is displayed (for 2 sec.) and autotuning is not started.

•After initiating the tuning process until its end, the display alternates between the normal display value (e.g. actual value) and 'Ruto' (can take 1 hour or more). Afterwards, the measured value display returns to normal.

•The tuning process changes parameters **CB2** ... **CB5**.

• After a power failure or switching to standby mode before the end of tuning makes it necessary to restart the tuning process. The above parameters have been changed by its start.

• Changing the setpoint also requires a restart of the tuning process.

• It may be necessary to readjust the above parameters **[B2** ... **[B5** by hand even after an auto-tuning has been carried out.

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H-level

H : Key-lock

The key-lock allows blocking of the control keys. In locked condition parameter adjustments with keys is not possible. At the attempt to adjust the parameters despite key-lock the message "---" appears in the display.

H I I: Indication mode display

If the range is exceeded, the system automatically switches to the next lower resolution level (e.g. 99.99 °C -> 100.0 °C or -99.9 °C -> -100 °C).

Parameter settings and setpoints are always displayed with a resolution of 0.1 $^\circ\text{C}.$

H C: Display mode

If the setpoint or the PID control value is selected instead of the actual value, the current actual value can only be displayed via parameter R 1. Conversely, if the actual value is displayed, the PID control value can only be called up via R 2.

H (5: Temperature scale

The display can be switched between Fahrenheit and Celsius. This is only a different type of display. Within the controller, the calculation is still done in $^{\circ}$ C.

(Example: 100 °C is displayed as 212 °F). ATTENTION: Display limits for °F can be smaller than the actual measuring range!

H 5: Indication standby

In standby mode the here set value appears in the display.

H []: Mode following "Power-On"

0: OFF, the controller is immediately switched to standby mode.

1: ON, the controller is switched on normally. 2: AUTO, depending on the operating state before disconnection from the mains, the controller is moved to the last set state.

HE I/HE: Assigning function key 1/2

0: The key is deactivated

1: Standby button. The controller can be switched on or off.

2: Switching between setpoint 1 ([1, 1]) and setpoint 2 ([1, 2]), see also the chapter Notes on setpoint changeover.

3: Initiate PID autotuning to optimise the PID control behaviour.

See also the chapter Autotuning of the PID heating circuit.

4: Assignment of a relay HY I...HYY

After mains interruption, the relay is off.

5: Assignment of a relay HY I...HYY

After mains interruption, the state remains stored.

Exceptions:

- Autotuning must be restarted

- A possibly switched on relay must be switched again.

H33: Function switching input E1

0: E1 deactivated

1: Standby, controller can be switched on or off.

2: Toggle setpoint 1 (£ !) and 2 (£2).
3: Assignment of a relay (HY !...HYH = 9).
After mains interruption, the relay is off.
4: Assignment of a relay (HY !...HYH = 9)

After mains interruption, the state remains stored.

H35: Key acknowledgement

This parameter permits to switch the internal buzzer on/off by key confirmation.

H닉 I ... H닉닉: Function output K1 ... K4

H5 : Mains frequency

This parameter is to select the mains frequency.

LC: Bus adress

Setting the ST-Bus address for connection to higher-level control instances.

H99: Password

This parameter is to adjust the password for the H-level

d-level:

d: Defrosting interval

The "defrosting interval" defines the time, after which a defrosting process is started. After each defrosting start, this time is reset and runs the next interval.

Manual defrosting:

Pressing the key UP for at least 3 sec. the defrosting interval is activated earlier. Alternatively, parameter d can be applied for this function, too. The next automatic defrosting process takes place again after the time d (defrosting synchronisation).

d2: Defrosting temperature

This permits to terminate defrosting when the adjusted desired temperature value is reached. The defrosting time set with " $d\exists$ " nevertheless runs at the same time, i.e. it functions as safety net to terminate the defrosting process in case the defrosting temperature is not reached.

d∃: Defrosting time limit

After the here set time the defrosting process is terminated.

dg: Manual defrosting

At change of 0 - > 1 the defrosting process is started and the defrosting interval is re-set (defrosting synchronisation).

d99: Password

This parameter is to set the password for the d-level.

A-level:

R !: Indication of actual value sensor F ! The here indicted temperature value is the sum of the actual measured value of sensor F1 and the actual value correction according to parameter **R2**.

R2: Actual value correction sensor F {

With this parameter it is possible to correct actual value deviations caused by sensor tolerances or extremely long sensor lines for example. The control measuring value is increased or decreased by the here set value.

R3: Weighing factor sensor F

With this parameter the actual value can be submitted to weighing. The measured value is multiplied by it and both indicated in the display and applied for regulation.

RH: Sensor type F |

This parameter allows the selection of the sensor type or the type of analogue input as long as the hardware requirements are met.

Note:

There are two types of current inputs

• Sink (41, 42): The power supply for a current source is integrated in the controller (11-pin terminal: + pin 4, - pin 5) (max. 22 mA). The current to be measured is given by a connected load.

• Source (43, 44): The current to be measured must be supplied from outside (11-pin terminal: + pin 5, - pin 7).

The quantity is counted via the switching input E1. In this case, the setpoint switching function via this input is omitted (see also R^{-1} and R^{-1}).

Important:

The parameter corresponds to parameter **R50**, i.e. a selected setpoint sensor type by **R50** cannot be additionally set by **R4**. Please note that sensor types between 31 (= voltage input 0...10V) and 44 (= current input 4...20mA (source)) require the same hardware.

It is therefore only possible to select a sensor type from this group once - either as an actual value sensor or as a setpoint sensor. Other sensor types are not affected by this.

Conversely, this rule also applies to parameter R60. A current input (R4) selected as actual value cannot additionally be selected by R60. In such a case, only the value 0 (i.e. parameter [1] is available for R60.

R5/R5: Display value for lower/upper value linear analogue input

These parameters are used to scale the linear analogue input. The value to be displayed for the lower and upper value of the input defines the range that is displayed by the controller.





R7: Scaling of the quantity count

Only affects display type = 1 (quantity / sec.) or = 2 (quantity / min.) (see A8). The actual measured value (pulses / sec. = frequency) is converted to a unit of quantity. The measurable frequency covers the range 2.50 Hz ... 2 kHz (max. resolution 0.01 Hz) If $\mathbf{R} = 1$: quantity = frequency / A7 (corresponds to the quantity per second) If $\mathbf{R} = 2$: quantity = (frequency * 60) / A7 (corresponds to the quantity per minute)

RB: Display type of quantity counting

RB = 0 pulses / second
(= frequency) in the range 2.50 Hz ... 2 kHz
(max. resolution 0.01 Hz)
RB = 1 quantity / second
(max. resolution 0.01 quantity units)
RB = 2 quantity / minute
(max. resolution 0.01 quantity units)

Important:

The quantity count is always based on the measurement of pulses / sec.

R9: Actual value, setpoint and parameter unit

Depending on the selected sensor, the physical units can be defined via this parameter. units can be defined via this parameter. These are supplied via the ST-Bus in addition to the values.

The following conventions apply:

•If a temperature sensor is selected, $^{\circ}$ C (abs.) or K (rel.) is always output (independent of R9).

• If quantity measurement is selected, RB is used to define the units.

(0: Hz, 1: L/sec, 2: L/min)

 \bullet If the sensor uses the current or voltage input, RS is used to define the units.

Important: The following measured values, setpoints and parameters are affected by the above convention:

Measured values:

A1, C1/C2 (if formed by sensor input) Setpoints, parameters:

C1/C2, C3, C5, C10, C11, C21, C23, C25, C30, C31, C41, C43, C45, C50, C51, C61, C62, C65, C82, A2

RHO: Software filter

Averaging over several measured values can be carried out.

If a sensor is used that reacts very quickly to external influences, averaging ensures a smooth signal curve.

R50: Display of the PID control value

Output of the internally calculated PID control value from -100%...100%.

R5 (/R52: Display value for lower/upper value at analogue output (0V / 0mA).

When the actual value is output (see b^2 !), the following range adjustment is performed: When the display value reaches the value set in R5 !, 0 V or 0 mA is output. When the display value reaches the value set in R52, 10V or 20mA are output.

R53: Output value full cooling power (-100.0..0%)

R54: Output value "0" power R55: Output value full heating power

(0..100,0%)

When the control value is output (see **b2 !**), the following range adjustment is carried out:

If cooling is to take place with 100% cooling power, the voltage set in R53 is output. If neither heating nor cooling is to take place,

the voltage set in RSH is output.

If heating is to be carried out with 100 % heating power, the voltage set in R55 is output.

R50 Setpoint sensor type (analogue input)

With this parameter it is possible to specify the setpoint either as a fixed value from the parameter memory ($\begin{bmatrix} 1 \\ 1 \end{bmatrix}$) or variably as an analogue value. The presetting as analogue signal is limited to the voltage (pins 4/5) or current input (pins 4/5 or 5/7). (see also description $\mathbf{F}^{\mathbf{H}}$).

Important:

Scaling is carried out as with the selection as actual value sensor via A5 and A6.

R99 Password

This parameter is to set the password for the A-level.



Status messages



Message	Cause	Error elimination
F IH F IL	Sensor error at actual value sensor (H: open-circuit or L: short-circuit at sensor F1)	Check sensor
F2H F2L	Sensor error (H: open-circuit or L: short-circuit at 3-wire correction)	Check sensor
FSH FSL	Sensor error at setpoint sensor (H: open-circuit or L: short-circuit at sensor F1)	Check sensor
EPO EP (0: Error program memory 1: Error parameter memory	Repair controller
	=> ALL EXITS WILL BE SWITCHED OFF	
	Display overrun or key-lock	
Flashing display	Temperature alarm at too high or too low temperature (if activated)	

If an error is detected in the parameter memory (display EP) and therefore the stored settings cannot be used, the control contacts are switched to the de-energised state.

A sensor alarm (display F IL/F2L or F IH/F2H or F5L or F5H) is indicated independently by a flashing display and the buzzer sounds. The buzzer can be switched off at any time by pressing the 'DOWN' key. The buzzer is switched on again after 10 minutes if the error is still present.



Technical data

Inputs	E1: external potential-free contact	
Measuring inputs	F1: Temperature sensur, selection from the following types: Measuring ranges: Type J: -99°C+1200°C (zero compensation 25.0°C) Type K: -99°C+1370°C (zero compensation 25.0°C) Pt100-2: -99°C+690°C Pt100-3: -99°C+550°C (max. 2x 20R lead resistance) Pt100-2: -99°C+550°C (max. 2x 20R lead resistance) Pt100-3: -99°C+450°C (max. 2x 20R lead resistance) PTC: -50°C+450°C (max. 2x 20R lead resistance) PTC: -50°C+150°C U(0-10V): -0.1V10.1V U (2-10V): I(0-20mA): -0.1mA20.1mA I (4-20mA): 3.5mA20.1mA	
Outputs	 (1: Relay, normally-open contact, 8(1.5)A 250V[~], function defined by parameter U1 (2: Relay, normally-open contact, 8(1.5)A 250V[~], function defined by parameter U2 (3: Relay, normally-open contact, 8(1.5)A 250V[~], function defined by parameter U3 (4: Relay, change-over contact, 8(1.5)A 250V[~], function defined by parameter U4 voltage output 0 10V, internal resistance approx. 100 Ohm, short-circuit proof Additional built-in buzzer, 85dB 	
Display	1 4-digit LED display, height 13mm, colour red, temperature display. 3 LEDs, diameter 3mm, colour red, for status display	
Interface	ST-Bus communication interface Interface driver: RS485, galvanically not separated The network has to be installed in lines topology and terminated with a 120 Ohm resistance on each side. In case of networking always connect port "A" with port "A" and port "B" with port "B". Crossing over is not permissible!	
Power supply	100 240V AC +/-10% (50/60Hz)	
Connectors	icrew/plug-in terminals ierminal A: 12-pole, grid 5.0mm, for cables up to 2.5 mm ² ierminal B: 11-pole, grid 3.5mm, for cable up to 1.5 mm ² Storage temperature: -20+70°C	
Amplent conditions	Operating temperature: 0+55°C Relative humidity: max. 75% without dew	
Weight	ca 150 g, without sensor	
Enclosure	Front IP65, IP00 from back	
Installation data	Unit is to be installed in an instrument panel. Front size: 84 × 42 mm Panel cut-out: 67.5 × 31.5 mm Installation depth: ca. 90 mm, mounting by fixing strap	