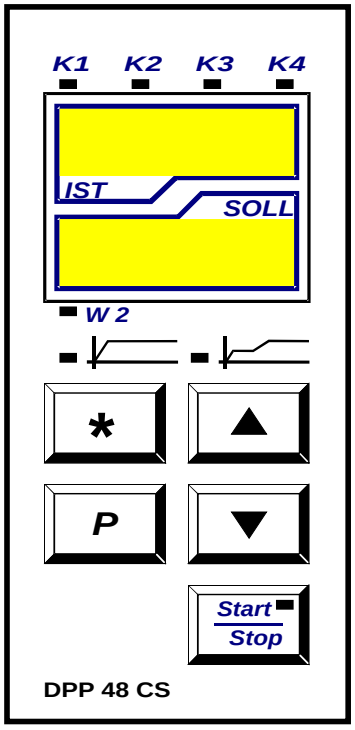
/D/O/L/D/

Operation of the unit (short version)

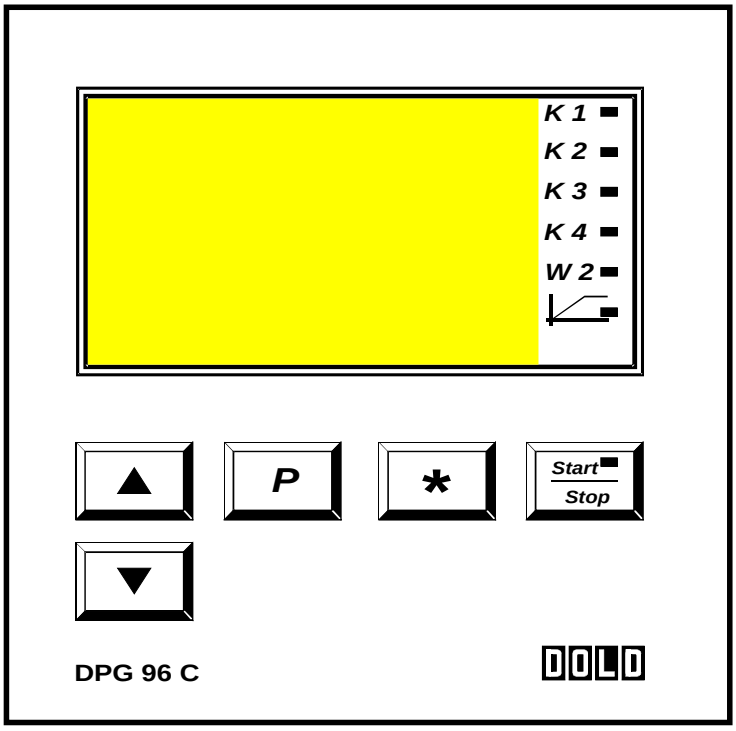
Processor controller (free configuration)

Version 22.9

DPG 48 CS
DPP 48 CS



DPG 96 C
DPP 96 C



Subject to technical and functional change

Before connecting the controller it is essential to read this manual carefully and follow its instructions.

Index

1. Installation:

Important: These directions for the installation of DOLD devices have to be adhered to:

If these directions are not adhered to the device may not work accurately, be destroyed or it may result in data being lost.

Read all directions carefully before connecting the device.

Connection to be carried out only by experts.

This device is not a safety device. Safety devices have to be installed according to the relevant directions for use.

Check if the power-supply voltage corresponds to rated voltage indicated on the identification plate before connecting and putting the device into operation. Fluctuations in the main voltage are only admissible within the indicated limits (specifications/identification plate).

The described device is designated for the installation of switchboards.

Electrical connections are to be carried out according to the connecting plan and the directions of the local electric supply company or the relevant regulations of the VDE respectively.

Other consumers must not be connected to the mains terminals.

In the event of mains interruptions, which lead to a malfunctioning of the device, relevant measures must be taken to avoid interruptions or interruptions must be filtered out by an external hum eliminator. The device is equipped with an internal hum eliminator.

On installation the sensor lines have to be shielded. The screen must be single-ended. With regard to thermocouple pick-ups the compensating lead has to be laid as far as the control terminals. The device and inductive consumers as well as sensor lines/signal lines and high tension lines have to be placed in such a way that any mutual interference is excluded (placed separately; not parallely laid). go-and-return lines should be laid parallely and, if possible, twisted.

Non-insulated sensors of a two-channel control have to be adjusted to the same potential (max. potential difference: $\pm$3.5 V eff.). Otherwise insulated sensors must be used (Warning: Ceramics insulations (Al-Oxide) can be conducting $\geq$ 400 °C).

Post-connected contactors have to be equipped with RC protective allocations according to the manufacturer's instructions. If an internal protective allocation is mentioned in the connection plan of the device this has to be taken into account in the event of external allocation. If external allocation is missing short-term voltage peaks may result which lead to faster contact wear and may cause interference.

The preadjustment of all parameters has to be checked during operation and adjusted to the local conditions (installation)! Wrongly adjusted parameters may cause serious malfunctions!

Not all controlled systems can be controlled by parameters measured by means of self-optimising; therefore, on principle, control response is to be checked for stability.

The load circuits of the relays have to be protected against excessive currents in order to avoid the relay contacts becoming welded together.

The device must not be installed in an ex-area.

If used for purposes other than originally intended the device may be damaged and cause damage to connected installations.

The life time of the relays is limited to 10^6 switching cycles at a load of 500 VA. Thus it is to a high degree dependent on the frequency of switching cycles.

Time per switching cycle	**Time after which 10^6 switching cycles are reached (operation: 8 hours/day at a load of 500 VA)**
2 minutes	about 11.4 years
60 s	about 5.7 years
30 s	about 2.8 years
This table is invalid for Solid-State-Relay (SSR).	

At low loads life time increases with regard to the values indicated in the table.

The device is to be protected against moisture (especially condensing moisture) and excessive contamination. If this is not assured the device is liable to malfunctions.

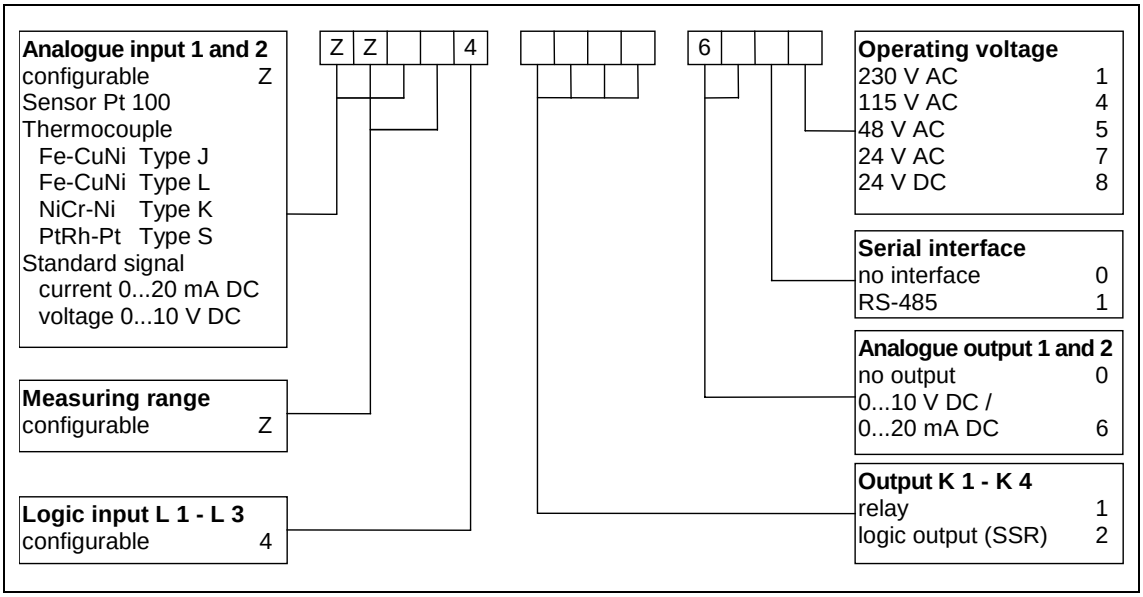
Unplug connecting plugs only longitudinally to plug direction. Under no circumstances must the connecting plugs be plugged in or out obliquely!

Furthermore care must be taken that the surrounding temperature corresponds to the values shown in the specifications. Sufficient air circulation must be provided.

These operating instructions do not contain all directions to regulations, standards etc. which become effective when using this device in connection with other installations. These regulations, standards etc. must be ascertained and abided to by the purchaser.

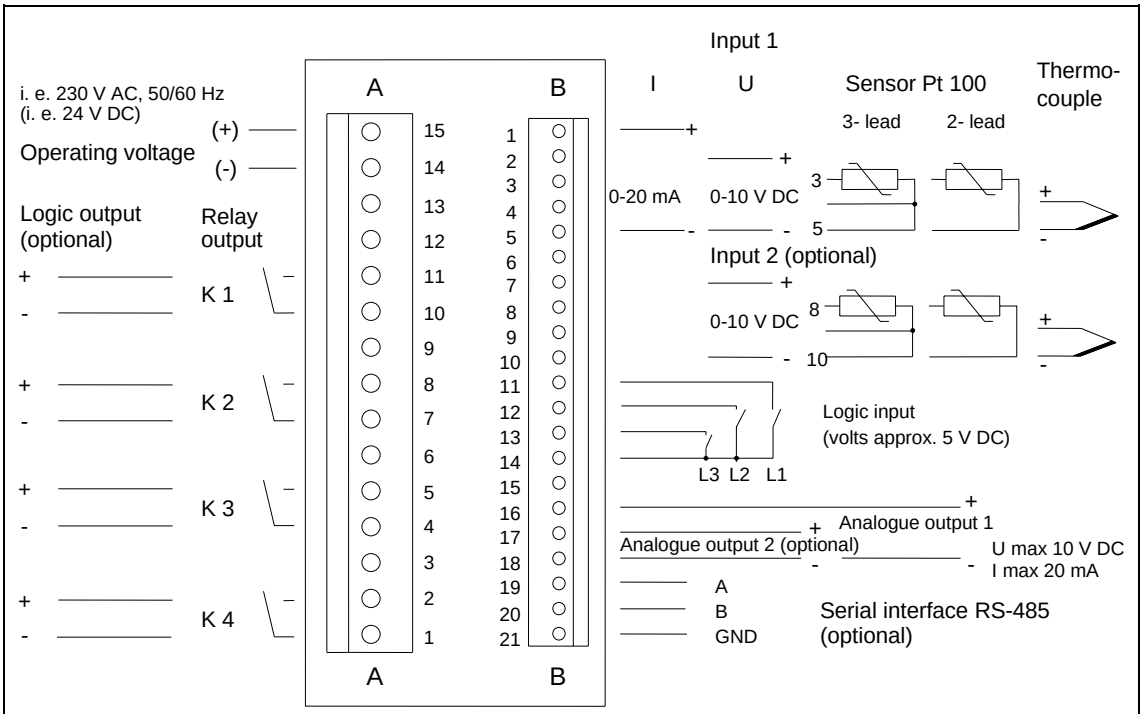
Further informations please take from the detailed operating instructions of the unit.

1.1 Order code (identification of the unit)



1.2 Terminal connection diagram DPG 48 CS / DPP 48 CS (in dependence on version)

The connection diagram shows maximum terminal assignment for the controller when all connection possibilities are used. The appropriate terminal assignment (depending of the type of controller used) can be found in the accompanying connection diagram and order code.



Outputs K 1 - K 4 (dependent on version):
the function of the outputs is determined through the configuration

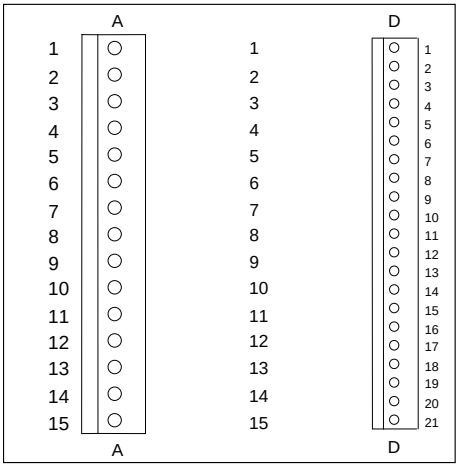
Relay output:
with protective circuit (Suppression capacitor 4,7 nF / 250 V AC)

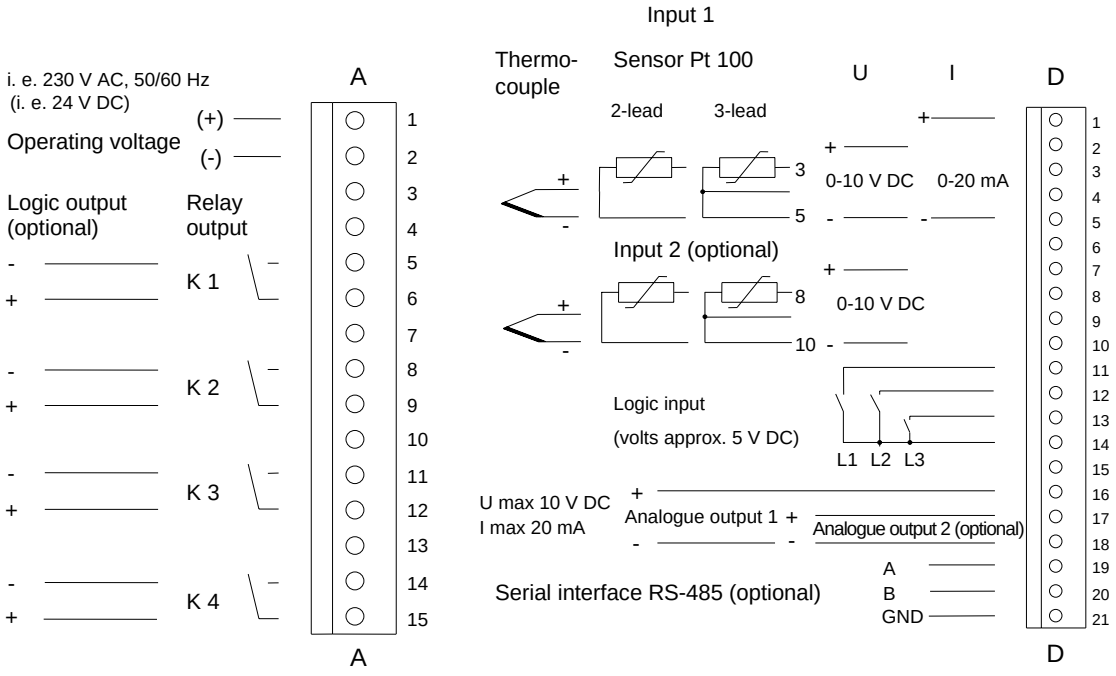
Logic output (SSR):
type 0/10 V DC, max. 10 mA

Caution: Terminals + and terminals - do not have the same potential !

1.3 Terminal connection diagram DPG 96 C / DPP 96 C (depending on version)

The connection diagram shows maximum terminal assignment for the controller when all connection possibilities are used. The appropriate terminal assignment (depending on the type of controller) can be found in the connection diagram and order code.





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Logic output (SSR):
type 0/10 V DC, max. 10 mA

Caution: Terminals + and terminals - do not have the same potential !

2. Inputs:

2.1 Analogue inputs (**configurable**)

Input 1:	Pt 100 two-wire lead:	range:	-150...600°C
	Pt 100 three-wire lead:	range:	-150...600°C
		(wire resistance < 50 Ω per wire)	
	thermocouple:	Fe-CuNi (type J):	0...871°C
	thermocouple:	Fe-CuNi (type L):	0...856°C
	thermocouple:	NiCr-Ni (type K):	0...1233°C
	thermocouple:	PtRh-Pt (type S):	0...1700°C
	voltage:	0...10 V DC:	-999...9999
	current:	0...20 mA DC:	-999...9999

Input 2: Selection as channel 1 (excepted current)

The second input can take over four configurable functions:
as actual value input in connection with limit contacts,
as external setpoint value
as actual value for difference controller (see page 23)
as regulation ratio limiting.

The input range can be limited as required by two parameters within the above maximum ranges. The PID-parameters are based on the limited temperature range (input 1 and input 2).

The input temperature during thermocouple operation is calculated by the built-in comparative temperature compensation circuit.

2.2 Digital inputs

Logic input 1 to 3 configurable (see configuration level page 16).

1. **Start/Stop - function:**
   At every alternation of the corresponding logic input from opened to closed the function is alternated between Start and Stop - operation.

2. **Start/Stop - function:** contact open: controller is stopped
   contact closed: controller is started

   If the unit has started over once of the logic inputs with this adjustment, it can only be stopped shortly with the Start/Stop - key, through the external logic input it will be started immediately again.

3. **Pause function:**
   At active pause all relays are further activated. The internal timing during the pause is stopped and the setpoint value of a possibly running ramp will not become further in/decremented. This function is not active at running optimization. During the pause the Start/Stop-LED flashes. The Start/Stop-LED flashes also, when the pause was triggered by the Start/Stop - key. The pause function only has an effect in the program mode or during the ramp function.

4. **Switchover from internal to external setpoint value.**
   An active logic input with this adjustment will switchover only to the external setpoint value, when this was discontinued in the configuration level. If the second input is discontinued in its function as external setpoint value, but none of the logic inputs is configurated for switchover from internal to external setpoint value, it works fundamentally with the input 2 as external setpoint value.

5. **Switchover between internal setpoint value 1 / setpoint value 2.**
   The switchover between setpoint value 1 / setpoint value 2 is not active in connection with the program function (unit DPP) or with the external setpoint value. The adjustment of the setpoint value 2 is only possible, if switchover was done by logic input.

6. **Limiting the regulation ratio.**
   To jump into a code level is possible only with closed logic input (see page 15).

2.3 Handling input errors

If the input signal deviates from the preset temperature more than 20%, the error will be recognized and evaluated. The regulation process will be interrupted and the outputs set or cleared according to the configuration (see page 16). The unit remains also still in the bolted condition, when the error was removed. The error can be acknowledged and deleted by switching the unit off/on or by entering code 110.

3. Outputs:

3.1 Potential free relay contacts, normally open

Contact loading: ≤ 250 V AC, ≤ 8 A resistive load at 500 VA typically 10^6 switching operations

K 1 Function freely configurable: limit contact or controller contact
K 2 Function freely configurable: limit contact or controller contact
K 3 Function freely configurable: limit contact or controller contact
K 4 Function freely configurable: limit contact or controller contact

Caution! The relays are subject to wear, dependant on switching frequency and load.

3.2 Logic outputs (optional)

Logic outputs for activating solid-state relays, (in place of relay outputs K 1 or K 2):
Open collector, not galvanically separated, short-circuit-proof,
typically: 0/10 V DC, maximum: 10 mA.

3.3 Analogue outputs

The function of analogue output 1 and analogue output 2 is configurable (see page 16):

- control output (heating, cooling or splitrange)
- actual value input 1
- setpoint value
- actual value input 2
- permanent 0 V / 0 mA
- permanent 10 V / 20 mA
- permanent signal "A1_"
- permanent signal "A2_"
- permanent signal "$\overline{A1}$"
- permanent signal "$\overline{A2}$"

3.4 Output reaction to error

The reaction of the relay outputs, analogue output 1 and analogue output 2 to the incidence of error can be configured (see configuration level on page 16).

If an error is detected for longer than 10 seconds, the controller will switch off and display the error number alternately with the actual/preset figures. If the error has been corrected in the meantime, the error display can be cancelled by entering the code 110. After this the controller can be restarted. Alternatively, the controller can be reset by switching the mains supply on and off.

4. Display:

4.1 Upper 7-segment display

shows the:

- actual temperature
- parameter designation in the input mode

4.2 Lower 7-segment display

shows the:

- preset value
- parameter value in input mode
- alternating flashing: setpoint value/"oPti" in tuning mode
- remaining time with flashing decimal point in program mode
- actual temperature input 2 (dependend of configuration)

4.3 LED's:

LED	K1	yellow	lights up when output K1 is active
LED	K2	yellow	lights up when output K2 is active
LED	K3	yellow	lights up when output K3 is active
LED	K4	yellow	lights up when output K4 is active
LED	W2	yellow	dark when setpoint value SP.1 is activated lights up when setpoint value SP.2 is activated flashes when external setpoint value is activated
LED		yellow	lights up when ramp function is activated
LED		yellow	lights up when program function is activated
LED	"start button"	red	lights up when controller is activated flashes when controller and pause function is activated

5. Operation:

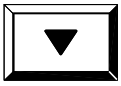
General:

Switching on: When operating voltage is applied, the code "doLd" appears on the upper 7-segment display, the current program number appears on the lower 7-segment display.

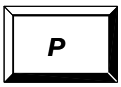
This is followed by the controller switching to operating mode. Depending upon the parameters "Auto" and "nos.", the controller will either start automatically or will remain in the no-start condition.

Setting the parameters in the operating, parameter, and configuration levels:

current value: +1
after 3 s: +10
after 6 s: +100



current value: -1
after 3 s: -10
after 6 s: -100

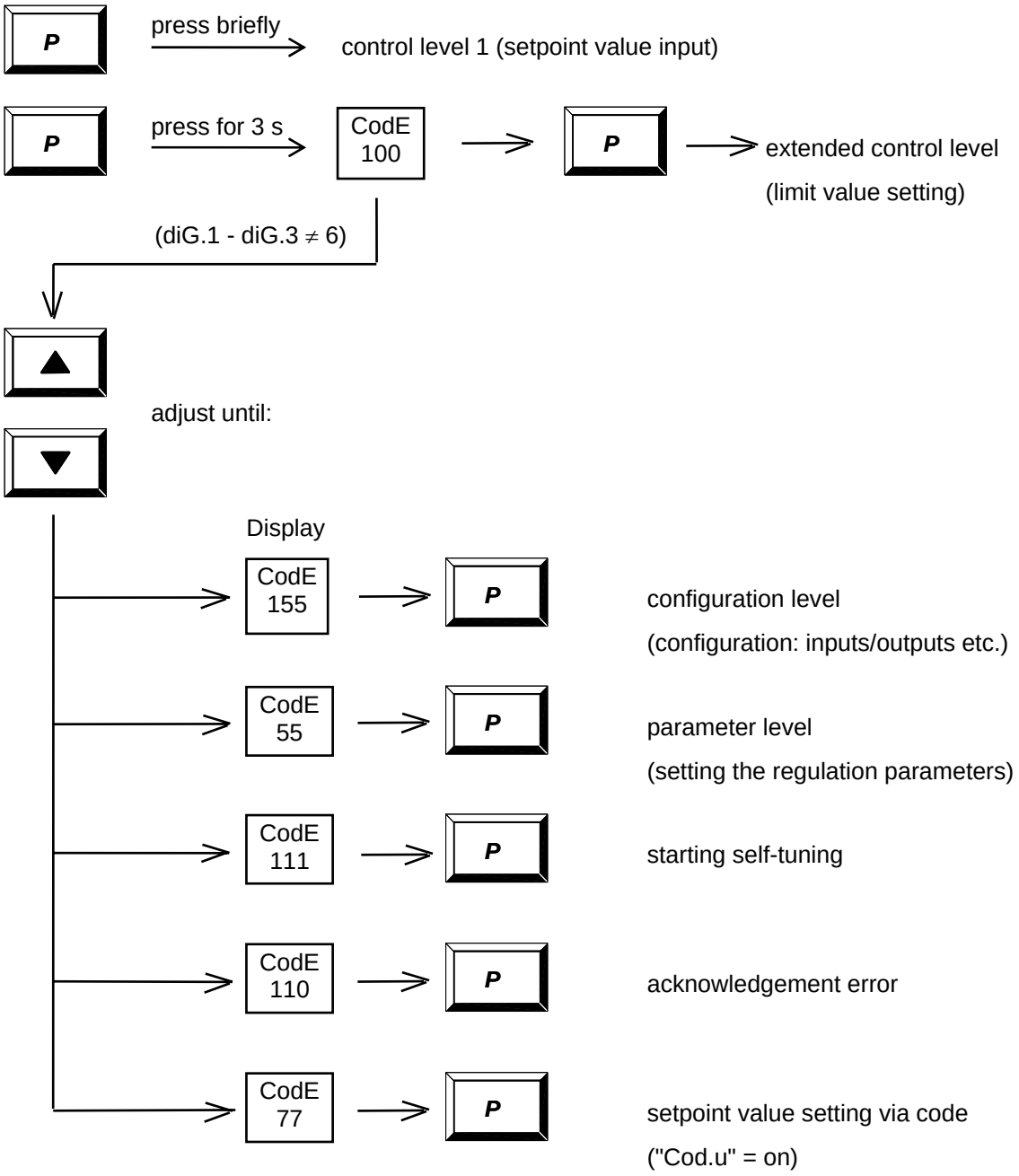


displayed value is accepted

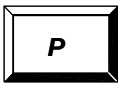
After confirming the last parameter, the system returns to the standard operating mode.

If no key is pressed within 30 seconds, the system automatically returns to the standard operating mode. The system can be configured whether to accept or not to accept the displayed and any modified value or not.

5.1 The various levels:



5.2 Setpoint value setting (control level 1)



jump to control level 1.

With set parameter "Cod.u" = on at the configuration level, setting the nominal value is only possible by entering code 77.

5.3 Parameters of control level 1 (unit DPG)

Unit DPG and option: ramp function,
Unit DPP with deactivated program function

Display	Parameter	Range
"Sp.1" "Sp.2"	setpoint value 1 setpoint value 2 (depending on logic input)	rA_ ... rA‾
"rA.co"	ramp function 0 ramp via gradient 1 ramp via time only when rump function is activated	0 ... 1
"GrAd"	gradient only when rump function is activated	-10,0 ... +10,0 °C
"hour"	setting hours hours and minutes are on display, hours are flashing	0 ... 99 h
"ti_2"	setting minutes hours and minutes are on display, minutes are flashing	0 ... 59 min

5.4 Parameters of control level 1 (unit DPP)

If the unit is in stop-mode and the program mode is activated (see page 24), all setpoint values (temperature and times) of the steps 0 - 9 can be shown and changed in this level. In start mode the setpoint values are accessible in this level.

Unit DPP and activated program mode:
Unit not started: setpoint values of steps 1 to 10 (saved in the EEPROM and protected against power failure)

Display	Parameter	Range
"Sp_1"	setpoint value 1	rA_ ... rA‾
"con.1"	configuration ramp function 0 ramp via gradient 1 ramp via time 2 time step only when rump function is activated	0 ... 2
"GrA.1"	gradient only when parameter "con.1" = 0 is set	-10,0 ... +10,0 °C
"Ho_1"	process time: hours hours and minutes are on display, hours are flashing	0 ... 99 h
"nn_1"	process time: minutes hours and minutes are on display, minutes are flashing	0 ... 59 min

Display	Parameter	Range
"1-4.LX"	limit contact	display and range see page 15
"SP_2"	setpoint value 2	rA_ ... rA‾
"con.2"	configuration ramp function 0 ramp via gradient 1 ramp via time 2 time step only when rump function is activated	0 ... 2
"GrA.2"	gradient only when parameter "con.2" = 0 is set	-10,0 ... +10,0 °C
"Ho_2"	process time: hours hours and minutes are on display, hours are flashing	0 ... 99 h
"nn_2"	process time: minutes hours and minutes are on display, minutes are flashing	0 ... 59 min
"1-4.LX"	limit contact	display and range see page 15
"	"	"
"	"	"
"Sp.10"	setpoint value 10	rA_ ... rA‾
"co.10"	configuration ramp function 0 ramp via gradient 1 ramp via time 2 time step only when rump function is activated	0 ... 2
"Gr.10"	gradient only when parameter "co.10" = 0 is set	-10,0 ... +10,0 °C
"Ho.10"	process time: hours hours and minutes are on display, hours are flashing	0 ... 99 h
"nn.10"	process time: minutes hours and minutes are on display, minutes are flashing	0 ... 59 min
"1-4.LX"	limit contact	display and range see page 15

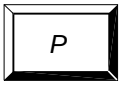
Unit DPP and activated program mode:
Unit started: setpoint values of the actual step (only in the RAM)

The setpoint values of the actual step can be changed during the regulation. Thereby the set values in the EEPROM are not transferred. The change is valid only during the current processing of the step. The remaining time of a step is calculated only once per minute, so that the display indicates possibly first after one minute after setting the setpoint value of time shows the new remaining time.

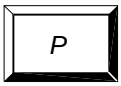
Display	Parameter	Range
"_Sp_"	setpoint value of the actual step	rA_ ... rA‾
"_co_"	configuration ramp function 0 ramp via gradient 1 ramp via time 2 time step only when rump function is activated	0 ... 1
"_Gr_"	gradient only when rump function is activated	-10,0 ... +10,0 °C

Display	Parameter	Range
"_Ho_"	process time: hours hours and minutes are on display, hours are flashing	0 ... 99 h
"_nn_"	process time: minutes hours and minutes are on display, minutes are flashing	0 ... 59 min
"1-4.LX"	limit contact	display and range see page 15

5.5 Limit value setting (extended control level)



press for approx. 3 s → display: " CodE: 100 "

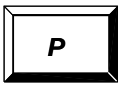


release and press again briefly

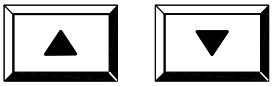
Configuration of the limit value function in the configuration level.

Display	Parameter	Range
"1.L X"	limit value 1	
"2.L X"	limit value 2	
"3.L X"	limit value 3	
"4.L X"	limit value 4	
X = depending upon configuration		U = 0,2(rA‾ - rA_)
"L – " absolute limit normally open		rA_ - U ... rA‾ + U
"L –| " absolute limit normally closed		rA_ - U ... rA‾ + U
"L = " limit following downwards normally open		0 ... rA‾ + U
"L =| " limit following downwards normally closed		0 ... rA‾ + U
"L = " limit following upwards normally open		0 ... rA‾ + U
"L =| " limit following upwards normally closed		0 ... rA‾ + U
"L = " limit comparator normally open		0 ... rA‾ + U
"L =| " limit comparator normally closed		0 ... rA‾ + U
"HYS.X" X = 1 ... 4	hysteresis 1 - 4	0,1 ... temperature range of input 1
The limit can only be input as long as no regulating function has been applied to the output in question (see configuration level).		
Important! After adjusting any of the following parameters (configuration level) the limits must be rechecked and if necessary re-entered rA_, rA‾, Ein, tE_, tE‾, tyP, Au.H, Au.C, rE.1 ... 4		

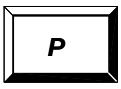
5.6 The configuration level:



press for 3 s display: " CodE: 100"



code-input: 155



jump to configuration level

Display	Parameter	Range	The appearance of the parameter in the configuration level will depend upon the following parameters
ti.Fi	low pass filter	1 ... 20 s 1 each value is evaluated directly after the setting number of seconds the actual input value is accepted to 70%	
Ein.1	input 1 selection	1 ... 8 1 Pt 100: -150...600°C 2-wire lead 2 Pt 100: -150...600°C 3-wire lead 3 Fe-CuNi (Type J): 0...871°C 4 Fe-CuNi (Type L): 0...856°C 5 NiCr-Ni (Type K): 0...1233°C 6 PtRh-Pt (Type S): 0...1700°C 7 voltage: 0...10 V DC 8 current: 0...20 mA	
dAu.1	display-comma input 1 only on current or voltage input	0 ... 3 0 no display-comma 1 comma after 1st digit from left 2 comma after 2nd digit from left 3 comma after 3rd digit from left	Ein.1
1.tE_	input 1 temperature range lower value	depending upon input selected	Ein.1
1.tE¯	input 1 temperature range upper value	temperature range lower value to max. input value	Ein.1
1.Ei_	input 1 lower value (current/voltage input)	depending upon input selected	Ein.1
1.Ei¯	input 1 upper value (current/voltage input)	input lower value to point depending upon input selected	Ein.1
Lin.1	Line balancing input 1	- 9.9.9.9 to 9.9.9.9	Ein.1
Ei.1C	Correction of the gradient for input 1 (actual value 1 = input 1 x correction "Ei.1C")	0,500...2,000	
Ein.2	input 2 selection	1 ... 7 1 Pt 100: -150...600°C 2-wire lead 2 Pt 100: -150...600°C 3-wire lead 3 Fe-CuNi (Type J): 0...871°C 4 Fe-CuNi (Type L): 0...856°C 5 NiCr-Ni (Type K): 0...1233°C 6 PtRh-Pt (Type S): 0...1700°C 7 voltage: 0...10 V DC	

Display	**Parameter**	**Range**	The appearance of the parameter in the configuration level will depend upon the following parameters
Ei2.u	use of input 2	0 ... 3 0 2nd input for limit contacts 1 2nd input for external setpoint value 2 2nd input for difference controller as reference input 3 regulation ratio limiting	
nA.Gr	succeeded limit	temperature range input 1	Ein.1
Ei2.A	display input 2	0 ... 3 function see page 23	
dAu.2	display-comma input 2 only on current or voltage input	0 ... 3 0 no display-comma 1 comma after 1st digit from left 2 comma after 2nd digit from left 3 comma after 3rd digit from left	Ein.2
Ei2.S	setpoint value to select the position of the temperature band	0 to 9.9.9.9 comma depending upon input selected	Ei2.u
Ei2.d	delta to select the wide of the temperature band	- 9.9.9 to 9.9.9.9 comma depending upon input selected	Ei2.u
2.tE_	input 2 temperature range lower value	Depending upon input selected (see parameter "Ein.2")	Ein.2
2.tE¯	input 2 temperature range upper value	temperature range lower value to max. input value	Ein.2
2.Ei_	input 2 lower value (current/voltage input)	Depending upon input selected (see parameter "Ein.2")	Ein.2
2.Ei¯	input 2 upper value (current/voltage input)	input lower value to point depending upon input selected	Ein.2
Lin.2	Line balancing input 2	- 9.9.9 to 9.9.9.9	Ein.2
rA_	setpoint value range lower value	setpoint value range up to temperature range low	
rA¯	setpoint value range upper value	setpoint value range down to temperature range up	
tyP	type of regulation	0 - 6 0 two-point heating 1 two-point cooling 2 three-point 3 two-point -PID heating 4 two-point -PID cooling 5 three-point -PID 6 three-point stepping controller	
Hand	manual function at three-point stepping controller	0 - 2 0 no manual function (controller function) 1 heating or cooling only active when Up- or Down-key is pressed 2 analogue output: heating or cooling level-continuous signal is always active. Display in % of correcting signal	
rA.Fu	ramp function unit DPG: ramp function optional unit DPP: ramp function include	0 ... 1 0 ramp function disabled 1 ramp function enabled	(optional) HAnd
rA.L_	ramp limit lower	0 to - temperature range/5	rA.Fu

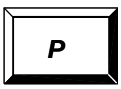
Display	**Parameter**	**Range**	The appearance of the parameter in the configuration level will depend upon the following parameters
rA.L	ramp limit upper	0 to + temperature range/5	rA.Fu
Li.BE	in case of limit	0 ... 1 0 relay limits in case of the ramp end value 1 relay limits in case of the actual ramp setpoint value	rA.Fu
Gr.Au	gradient automatic	0 ... 1 0 setting sign is valid 1 the sign will be determined automatically, so the ramp of the current value runs to the setpoint value	rA.Fu
rA.ES	ramp function at external setpoint value	0,1 ... 999,9 if the external setpoint value alters greatly more than the discontinued value during running ramp, so the ramp is starting anew	rA.Fu
Pro	program function (only for unit DPP)	0 ... 1 0 program function disabled 1 program function enabled	Option, HAnd
rEPE	repeat function	0 ... 1 0 the controller is stopped after the last step or by breaking off step 1 the program is starting again after the last step or by breaking off step	Pro
Pr.An	lower display during program operation	0 ... 1 0 setpoint value display on lower display 1 remaining time on lower display if possible (in steps with gradient ____)	An.LA
tu.di	tuning difference	0.0 - 30.0°C exception: input current/voltage 0 ... +(tE-tE_)/5	tyP
Au.H	output heating	0 - 6 0 regulation variable refers to no output 1 relay 1 2 relay 2 3 relay 3 4 relay 4 5 analogue output 1 6 analogue output 2 (optional)	tyP
Au.C	output cooling	0 - 6 0 regulation variable refers to no output 1 relay 1 2 relay 2 3 relay 3 4 relay 4 5 analogue output 1 6 analogue output 2 (optional)	tyP, Au.H

Display	**Parameter**	**Range**	The appearance of the parameter in the configuration level will depend upon the following parameters
	at configuration Au.H and Au.C = 5 or 6: analogue output 1 is interpreted as splitrange output, that means: no controlled signal: output in the middle of the range 100% heating: output on upper range 100% cooling: output on lower range		
StEL	regulation ratio function inactive with setting Ei2.u = 3	1,0 ... 100 %	Ei2.u
rE.1 ... 4	configuration relay 1 to relay 4	0 ... 12: freely configurable 0 ... 32: only with 2nd input	Au.H, Au.C
	0 no function 1 absolute limit, n/o based on rising temperature 2 limit following for downward temp. violation, n/o based on rising temperature 3 limit following for upward temp. violation, n/o based on rising temperature 4 limit comparator closed in good zone 5 no function 6 no function 7 relay always inactive 8 relay always active 9 absolute limit, n/c based on rising temperature 10 limit following for downward temp. violation, n/c based on rising temperature 11 limit following for upward temp. violation, n/c based on rising temperature 12 limit comparator open in good zone 20 ... 32 function as 0 ... 12: the output refers to input 2 A relay can only be set as a limit if that relay has not been configured as a regulating output.		
An.1	configuration analogue output 1	0 ... 6 0 no function (0 V DC / 0 mA) 1 value input 1 2 setpoint value 3 10 V DC / 20 mA (permanent) 4 A1_ (permanent) 5 A1¯ (permanent) 6 value input 2	Au.H, Au.C
A1.c	configuration: voltage / current output	0 ... 1 0 voltage 1 current parameter A1.c must agree with the hardware of the analogue output (see wiring diagram or name plate)	An.1, Au.H, Au.C
A1._	analogue output 1 low	voltage: 0.0 - 10.0 V DC current: 0.0 - 20.0 mA	An.1, Au.H, Au.C
A1.¯	analogue output 1 high	voltage: 0.0 - 10.0 V DC current: 0.0 - 20.0 mA	An.1, Au.H, Au.C
notes: configuration A1._ > A1.¯ for inverted output signal			

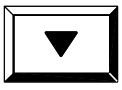
Display	**Parameter**	**Range**	The appearance of the parameter in the configuration level will depend upon the following parameters
An.2	configuration analogue output 2	0 ... 6 0 no function (0 V DC / 0 mA) 1 value input 1 2 setpoint value 3 10 V DC / 20 mA (permanent) 4 A2_ (permanent) 5 A2¯ (permanent) 6 value input 2	Au.H, Au.C
A2.c	configuration: voltage / current output	0 ... 1 0 voltage 1 current parameter A2.c must agree with the hardware of the analogue output (see wiring diagram or name plate)	An.2, Au.H, Au.C
A2._	analogue output 2 low	voltage: 0.0 - 10.0 V DC current: 0.0 - 20.0 mA	An.2, Au.H, Au.C
A2.¯	analogue output 2 high	voltage: 0.0 - 10.0 V DC current: 0.0 - 20.0 mA	An.2, Au.H, Au.C
notes: configuration A2._ > A2.¯ for inverted output signal			
Auto	automatic start	0 ... 1 0 no automatic start 1 automatic start when main is switched on	
St.Fu	start key function	0 ... 2 0 Start/Stop-function possible 1 start key has no function 2 in addition to the Start/Stop-function a pause can be set with the start/stop key: press briefly: starting press briefly: activating pause press for 3-s: stopping	
diSP	display resolution	0 ... 1 0 without 1/10 1 with 1/10	Ein
bAUd	baud rate	0 ... 96 0: interface disabled 24: 2400 baud 48: 4800 baud 96: 9600 baud	
Adr	device address	1 ... 32	
PAri	parity / data-bits	0 ... 5 data / parity / stop-bits 0 = 8 No 1 1 = 8 Odd 1 2 = 8 Even 1 3 = 7 No 2 4 = 7 Even 2 5 = 7 Odd 1	
r1.F ... r4.F	error allocation output 1 to output 4	0 ... 1 0 output inactive 1 output active	

Display	Parameter	Range	The appearance of the parameter in the configuration level will depend upon the following parameters
A1.F	error allocation analogue output 1	0 ... 3 0 output value: A1._ 1 output value: A1.¯ 2 output value: (A1.¯ + A1._)/2 3 output value refers to A1.FS	
A1.FS	regulation ratio with error allocation analogue output 1	0...100% 0% A1._ 100% A1.¯	
A2.F	error allocation analogue output 2	0 ... 3 0 output value: A2._ 1 output value: A2.¯ 2 output value: (A2.¯+ A2._)/2 3 output value refers to A2.FS	
A2.FS	regulation ratio with error allocation analogue output 2	0...100% 0% A2._ 100% A2.¯	
diG.1 - diG.3	logic input 1 to 3	0 ... 6 0 logic input X deactivated 1 Start/Stop; slope controlled 2 Start/Stop; level controlled 3 pause function 4 switching setpoint value / external setpoint value 5 switching setpoint value 1 / setpoint value 2 6 programming blocked contact closed: programming function in all code-levels released contact open: programming function blocked	
cod.u	setpoint value setting	0 ... 1 0 setpoint value setting via P-key 1 setpoint value setting via code 77	
Important!	After adjusting any parameters of the following parameters must be rechecked and if necessary re-entered		

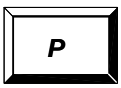
5.7 The parametrication level



press for approx. 3 s display: " CodE: 100"



code-input: 55



jump to parametrication level

The appearance of individual parameters in this level and their individual meaning depends upon the type of regulation configured.

Important! After adjusting any of the following parameters in the configuration level, all the current parameters in the parameter level must be rechecked: Ein, tE_, tE-, tyP,

Regulation type = 0, two-point heating:

Display	Parameter	Range
di.H	hysteresis heating	0.1 ... temperature range input 1

Regulation type = 1, two-point cooling:

Display	Parameter	Range
di.C	hysteresis cooling	0.1 ... temperature range input 1

Regulation type = 2, three-point:

Display	Parameter	Range
di.H	hysteresis heating	0.1 ... temperature range input 1
di.C	hysteresis cooling	0.1 ... temperature range input 1

Regulation type = 3, two-point-PID heating:

Display	Parameter	Range
Pb.H	proportional band heating	0.1 ... 200.0 % of total temperature range
td.H	time derivative heating setting 0 = zero fraction	0 ... 2000 s
ti.H	time integral heating setting 0 = zero fraction	0 ... 2000 s
Cy.H	cycle time heating	1 ... 99 s

Regulation type = 4, two-point-PID cooling:

Display	Parameter	Range
Pb.C	proportional band cooling	0.1 ... 200.0% of total temperature range
td.C	time derivative cooling setting 0 = zero fraction	0 ... 2000 s
ti.C	time integral cooling setting 0 = zero fraction	0 ... 2000 s
Cy.C	cycle time cooling	1 ... 99 s

Regulation type = 5, three-point-PID:

Display	Parameter	Range
di.H	difference band heating during regulation in the cooling range, the set point must be exceeded by this value so that the regulation switches over to heating	0.1 ... temperature range input 1
Pb.H	proportional band heating	0.1 ... 200.0 % of total temperature range
td.H	time derivative heating setting 0 = zero fraction	0 ... 2000 s
ti.H	time integral heating setting 0 = zero fraction	0 ... 2000 s
Cy.H	cycle time heating	1 ... 99 s
di.C	difference band cooling	0.1 ... temperature range input 1

Display	Parameter	Range
	during regulation in the heating range, the set point must be exceeded by this value so that the regulation switches over to cooling.	
Pb.C	proportional band cooling	0.1 ... 200.0% of total temperature range
td.C	time derivative cooling setting 0 = zero fraction	0 ... 2000 s
ti.C	time integral cooling setting 0 = zero fraction	0 ... 2000 s
Cy.C	cycle time cooling	1 ... 99 s

Regulation type = 6, three-point stepping controller:

Display	Parameter	Range
db	dead zone	0.0 ... 20.0°C
Pb.H	proportional band	0.1 ... 200.0 % of total temperature range
td.H	time derivative	6 - 600 s
ti.H	time integral	30 - 4800 s
Cy.H	cycle time	1 - 99 s
t.ru	motor running time	6 - 600 s

6. Special functions

6.1 The second input

The second input is a pure measurement input. It can take over three configurable functions (parameter Ei2.u in the configuration level):

1) as measurement input in connection with the limit contacts
2) as external setpoint value
3) as measurement input for difference controller (see page: 26)
4) as regulation ratio limiting.
   With parameters ”Ei2.S” and ”Ei2.d” you can define a temperature band. Parameter ”Ei2.S” is selecting the position, parameter ”Ei2” the wide of the temperature band. If the actual value of input 2 goes into this temperature band, the regulation ration will be limited linear. If the actual value is on the edge of the band at ”Ei2.S” - ”Ei2.d”, the regulation ratio will be maximally 100%. In the middle of the band the actual value of the regulation ratio will be maximally 50%. If the actual value is on the edge of the band at ”Ei2.S”, the actual value of the regulation ratio will be limited to 0%.

6.1.1 The display by using the second input

"Ei.2u" using the 2nd input	"Ei.2A" display setting	upper display	lower display
limit contacts	0	actual value input 1	setpoint value
limit contacts	1	actual value input 2	setpoint value
limit contacts	2, 3	actual value input 1	actual value input 2
external setpoint value	0, 1, 2, 3	actual value input 1	actual value input 2 (external setpoint value)
difference controller	0	actual value input 1	setpoint value
difference controller	1	actual value input 2	setpoint value

"Ei.2u" using the 2nd input	"Ei.2A" display setting	upper display	lower display
difference controller	2	actual value difference (actual value input 1 - actual value input 2)	setpoint value
difference controller	3	actual value input 1	actual value input 2
regulation ratio limiting	0, 1, 2, 3	actual value input 1	setpoint value

6.2 The program function (unit DPP)

The unit can process by a program different setpoint values over adjustable times one after another. Available are 10 steps, which are associated a temperature setpoint value and a time between 0 ... 99h 59 minutes.

The program with the setting steps can be processed only completely. When the unit is started it is beginning fundamentally at step one. After stopping the unit is standing on step one again.

If one of the logic input is configured for start/stop - function (level controlled), the unit remains started and repeats a program endlessly.

Particularities: If the time 0 is entered at a step, so the pertinent setpoint value is held on unlimited duration. The following steps will not be processed. The lower display shows in this case ≡≡≡≡. Requirement is, that the setpoint value of this step is unequal 0.

If the lowest practicable value is set for the setpoint value and the times 0, the unit will be stopped by reaching this step. The display shows the setpoint values of the first step after stopping. Alternatively the program can be started automatically by setting the parameter "rEPE" = 1 again (repeat function).

6.2.1 The program function in connection with the ramp function

The program function offers together with the ramp function three different kinds of steps. The selection results by parameter "con.X" in the control level 1.

Configuration 0: Setting a setpoint value and the gradient. With this gradient the setpoint value will be reached.
Reference: If setting for the gradient = "0", means, that the pertinent setpoint value is started with maximum rise.

Configuration 1: Setting a setpoint value and time (hh.mm), within the setpoint value is started.
If the actual value is out of the ramp band about the ramp setpoint value, the ramp will be stopped until the actual value is in the band again.
At the re-entry into the ramp band the gradient is calculated newly, so that the ramp is finished in the given time. If the given time has run down already at the re-entry, the step is finished.

Configuration 2: Setting a setpoint value and a time (hh.mm), while this time the controller regulate to this setpoint. After end of the time it will be switched over to the next step.
If the lowest practicable value is set for the setpoint value and the times 0, the unit will be stopped. Alternatively the program can be started automatically by setting the parameter "rEPE" = 1 again (repeat function).
If setting only the time = 0, the pertinent setpoint value will be held indefinitely.

6.2.2 The program setpoint values

During the program is the possibility, to change the current values (setpoint value, configuration, times, gradient, limit values) temporarily, without changing the values in the EE-Prom.

When changing the time it can occur, that the new time is considered first up to a minute later.

The changed time is considered as total time (if ramp function is out of order) of the step. If the step has run down up to the point in time of the change already longer, as the time, which was entered newly, the step is interrupted at the latest one minute later and to the next step switched over.

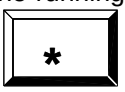
6.2.3 The program function in connection with the external setpoint value

There is a particularity at the combination of the program function with the external setpoint value. Although the parameters SP.1 to SP.10 has no validity as setpoint values, because the setpoint values of the 2nd measurement input is recorded, these parameters appear furthermore in the control level 1.

The automatic stop- and repeat function of the program is dependent furthermore by the adjustable setpoint value, so that the setpoint values must be set still reasonably, to guarantee the switchover to the program mode or to produce a stop- and switch off condition.

6.2.4 The display during the program processing

During the processing of an entered program in the upper display is shown the current actual value. In the lower display, according to the configuration of the parameter "Pr.At", either the setpoint value or the remaining time of the current step.

During the running of a program it is additional possible to show at the upper display by pressing the 

key the current step number and at the lower display complementary to the configuration of the parameter "Pr.At" either the remaining time or the setpoint value of the current step. The additional display extinguishes after 10 seconds.

6.3 The ramp function (optional)

The ramp function (optional) can be activated in the configuration level. The gradient of the ramp will be set (configurable) either by gradient [°C/min] or by time [hh.mm]. At time setting the unit calculates the gradient themselves.

In addition it can be configured, that the sign of the rise of the ramp is determined automatically. If the starting temperature is over the setpoint value, the gradient will furnish with a negative sign. If the starting temperature lies under the setpoint value, the gradient will furnish with a positive sign.

If the automatic fixing of the sign is not activated, the entered sign is set. If the ramp is started with a positive gradient, although the actual value is over the setpoint value, this is recognized and the ramp immediately as finished interrupted.

If during the processing of a ramp, who was set their rise over times, one of these times was shifted, the new time will be shown at the latest after 1 minute on the display. The newly entered time becomes as new remaining time evaluated.

6.3.1 Start of the ramp

If the ramp function is activated (configuration level), the ramp will automatically started when the regulation is starting. If during the regulation parameters are shifted, which affect the ramp, the ramp is started again. Already run down times do not evaluate at a new start.

The new start of the ramp is also accomplished, if parameters are changed by the interface, which have influence on the ramp.

Changing the external setpoint value in a higher value (parameter rA.ES) than the preset value, the ramp will be started again.

If gradient or time is set at 0, the regulation will start without ramp.

6.3.2 The limit band around the current ramp setpoint value

In addition to the gradient a positive and a negative deviation of the current ramp setpoint value must be entered in the configuration level. If the actual value leaves this band about the set point value, the current setpoint value is frozen, until the actual value runs into this band again.

If the rise of the ramp was entered via a gradient, the ramp moves on after the re-entry into the limit band with the entered gradient.

By setting the rise of the ramp via time this time is considered primarily. After this re-entry into the limit band the controller calculates a new gradient to finish the ramp in the alleged time. If the alleged time has run down to the point in time of the re-entry already the ramp is interrupted and started to the end of the setpoint value directly.

6.3.3 Closing of the ramp

If the actual value has reached the setpoint value, the ramp is switched off. After this the controller will regulate without ramp function on the discontinued setpoint value.

If the rise of the ramp was entered via time and this time is over, the ramp will be finished, independently of it, whether the end of the setpoint value was reached or not. Then the controller will regulate without ramp function on the discontinued setpoint value.

If the program function is activated at the end of the ramp, the unit switches to the next step.

6.3.4 The ramp by using the external setpoint value

The combination between ramp and external setpoint value is possible if the 2nd input is available. The parameter "rA.ES" is therefore, that a change of the external setpoint value for the ramp is considered, but also each swaying of the external setpoint value does not trigger the ramp newly. First, if the external setpoint value changes at least around this amount, the ramp is started new.

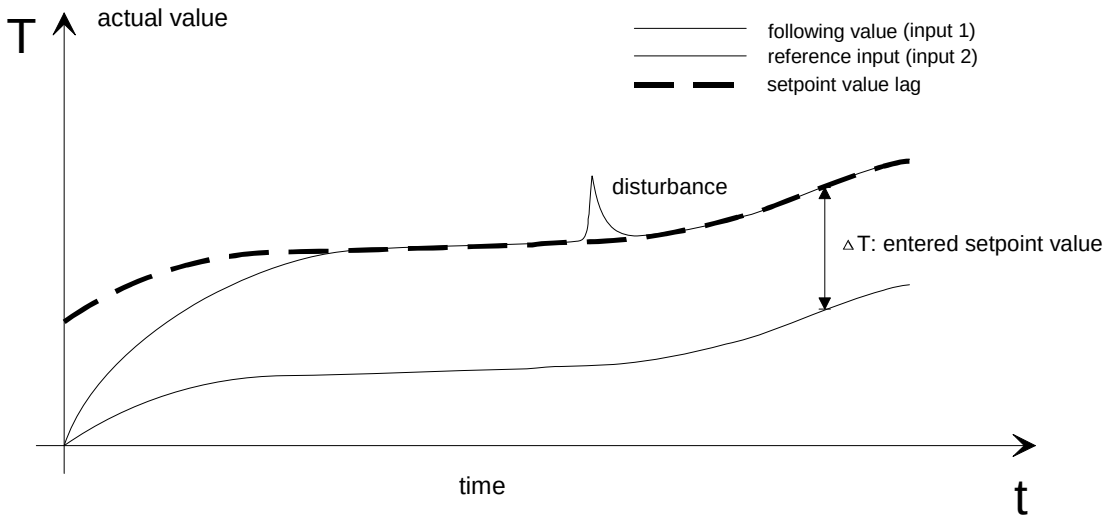
6.4 The difference controller

If the unit disposes of a 2nd input (optional), it can configured as reference input for a difference controller.

In this mode the unit furthermore regulates to the actual value of input 1, the setpoint value consists of the addition of the entered setpoint value (SP.1, SP.2 or a program setpoint value) and the actual value of input 2, so that the following value (input 1) observes the entered difference (setpoint value) to the reference input (input 2).

Setpoint value = reference input (input 2) + entered setpoint value (SP.1, SP.2) formula (1)

The difference controller do not work in combination with ramp function.



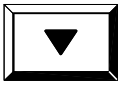
6.4.1 The range of the following value

So that the reference input and the following value (input 1) cannot get into dangerous temperature ranges (if the reference input drifts), the absolute temperature (setpoint value of following value), to which is regulated, is limited in their absolute size. At a heating controller or a three-point controller the maximum setpoint value, which the unit calculates (see formula (1)), cannot be higher than the parameter "nA.Gr". At a cooling controller the minimal setpoint value cannot be lower than the parameter "nA.Gr".

For units with PID - characteristic and self-tuning is valid: Not all processes can be mastered with the parameters determined in the self-tuning; the quality of control is to be examined fundamentally on stability, if necessary the parameters have to be corrected.

6.5 The manual operation of the stepping controller

If the controller type is activated for stepping controller, the parameter "hand" in the configuration level can switched over of controlled or manual operation.

Alternatively the heating/cooling signal is active only during pressing key  (heating),  (cooling) or as constant signal. In this case the correcting variable is indicated in percent. Combinations of relay output and analogue output as control signal are possible.

6.6 The self-tuning

The unit is equipped with a self-tuning facility for the automatic adaptation of the controller to the regulated section.

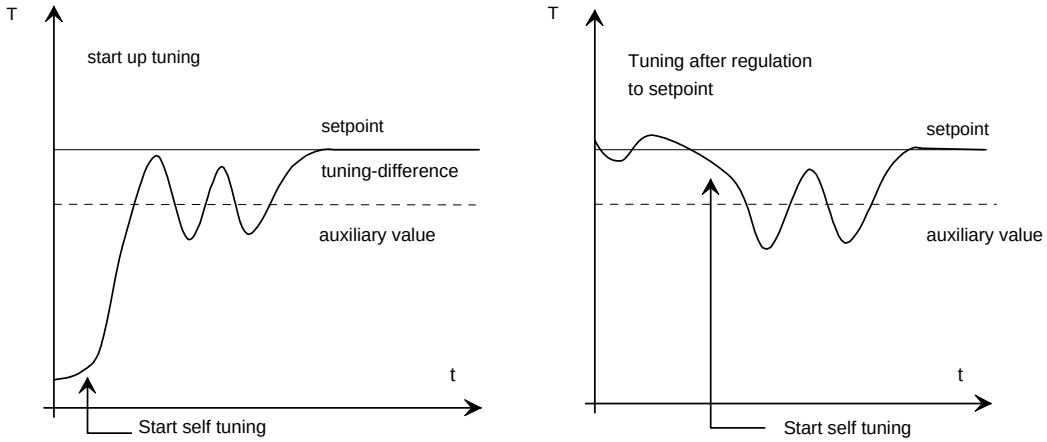
The tuning algorithm is based on modified Ziegler-Nichols-rules according to which the nominal data of a section are established following an oscillation test in a closed regulating circuit.

These nominal data (in particular cycle and amplitude of the oscillation) are the basis for calculating the relevant parameters.

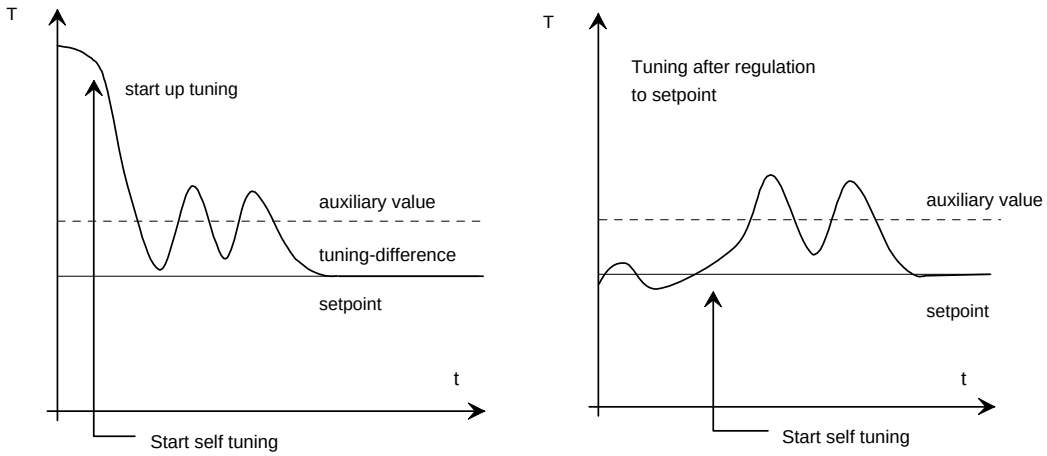
The tuning function find out by a tuning run the regulation parameters of the heating and of the cooling side. If tuning is started with the controller in the heating mode, heating parameters are determined. Similarly, cooling parameters are determined if tuning is started during cooling operation.

Important: The return parameters of proportional band heating and proportional band cooling refer to the total temperature range (tE- ... tE_). If the temperature range is altered, the above mentioned parameters must be changed manually or adapted to the new temperature range by a repeated self-tuning operation.

Tuning example heating:



Tuning example cooling:



Starting tuning

The optimization can be activated any time by entering of code 111. The optimization optimizes either on heating or on cooling, depending on which is active. If a logic input is configured to the Start/Stop - function (level controlled) and this logic input is not closed, so the self-tuning can not be started.

The setpoint value, which is used during the optimization, is determined at the beginning of the optimization and can be changed after that no more. In the normal mode of the unit the current setpoint value is determined as optimization-setpoint. In the program mode the setpoint value of step 1 (unit DPP) is fundamentally used as optimization-setpoint.

By configuration as difference controller the current setpoint value is used at the beginning of the optimization as optimization-setpoint. Because this is not an absolute value, it depends on the reference input (input 2), the starting in difference controller mode only allowed at the working process.

For tuning, the algorithm employs an auxiliary preset which diverges from the preset value by the amount set in the parametrication level. This auxiliary preset serves to prevent any temperature spikes which exceed the preset from interfering with the regulation during tuning. The tuning difference must be adjusted to the application in question.

Self-tuning for heating: auxiliary value = preset - "tu.d"

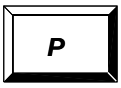
Self-tuning for cooling: auxiliary value = preset + "tu.d".

During the tuning process, the unit works with P - regulating characteristic (Pb.X = 0.1%) and, as a visual check, preset and "OPti" are shown on the lower display alternately.

The unit requires two oscillations in order to calculate the parameters and then applies the regulating factor to the preset.

Of the tuning process is completed, only the current preset will be shown on the lower display. The calculated parameters are saved in the EE-Prom and protected against power failure. They can be called up any time and be changed manually.

Aborting tuning

Tuning can be aborted at any time by holding the 

key down for three seconds. The unit acknowledges the abort by dimming the lower display.

6.7 The pause function

The unit disposes of a pause function, which can be switched on/off via the Start/Stop - key or via a configurated logic input.

During this pause the relays are steered for their according configuration. The running down process time and the in/decrement of the ramp setpoint value is exposed during the pause function.

In process mode, where neither a program is processed nor the ramp is activated, the pause function has no effect.

The logic input as well as the Start/Stop - key can trigger a pause. The active pause is indicated through the flashing Start/Stop-LED.

The pause is deleted, as soon as the logic input is restored and the pause is triggered through the key by a new keystroke.

6.8 List of possible error messages (display):

Error-messages:	Reason:	Explanation / Fault clearance:
1	writing error I²C-bus	switch unit off/on
10	sensor error input 1 or exceeding range	check sensor, set code 110 or switch unit off/on (see page: 12)
11	sensor error input 2 or exceeding range	check sensor, set code 110 or switch unit off/on (see page: 12)
12	reference point compensation for thermocouple faulty	return unit for calibration
30	reading error EE-Prom	switch unit off/on
31	controller not calibrated	return unit
32	calibration faulty	return unit

6.9 Encountering an error:

Appeared error can be cleared by entering code 110 and the block will be released. To regulate it is necessary to start the unit again.

If the Start/Stop-key function is activated (configuration level), the unit remains after acknowledgement of the error into the switched off condition. The unit must be started manual again. If

the Start/Stop-key function is deactivated, the unit switches automatically after acknowledgement of the error to the started condition.

If a serious error is encountered, the unit will stop. The outputs will be set according to the error configuration. The controller displays the error number and remains blocked even after the error has been corrected.

7. Software version

7.1 Checking the software version

When operating voltage is applied, the code "doLd" appears on the upper 7-segment display, the current program number of software (XX.X) appears on the lower 7-segment display.

8. List of parameters

Type of unit:	
Number of version:	

Display (Symbol)	Works setting	Your setting
"Sp 1"	0	
"Sp 2"	0	
"rA.co"	0	
"GrAd"	1	
"hour"	0	
"ti_2"	0	
ti.Fi	3	
Ein.1	1	
dAu.1	3	
1.tE_	-150	
1.tE¯	600	
1.Ei_	0	
1.Ei¯	10	
Lin.1	0	
Ei.1C	1,000	
Ein.2	1	
Ei2.u	0	
nA.Gr	600	
Ei2.A	0	
dAu.2	3	
Ei2.S	0	
Ei2.d	1	
2.tE_	-150	
2.tE¯	600	
2.Ei_	0	
2.Ei¯	10	
Lin.2	0	
rA._	0	
rA.¯	600	
tyP	3	
Hand	0	
rA.Fu	0	
rA.L_	-10,0	
rA.L¯	10,0	
"Li.BE"	1	
Gr.Au	0	
Pro	0	
rEPE	0	
Pr.An	0	
tu.di	0	
Au.H	1	

Display (Symbol)	Works setting	Your setting
Au.C	0	
StEL	100,0	
rE.1	0	
rE.2	0	
rE.3	0	
rE.4	0	
An.1	0	
A1.c	0	
A1._	0	
A1.¯	10	
An.2	0	
A2.c	0	
A2._	0	
A2.¯	10	
Auto	0	
St.FU	0	
diSP	0	
conF	0	
ti.UE	0	
r1.F	0	
r2.F	0	
r3.F	0	
r4.F	0	
A1.F	0	
A1.FS	0	
A2.F	0	
A2.FS	0	
di.H	2,0	
Pb.H	5,0	
td.H	50	
ti.H	250	
Cy.H	30	
di.C	2,0	
Pb.C	5,0	
td.C	50	
ti.C	250	
Cy.C	30	
db	2,0	
t.ru	6	
"SP_1"	0	
"con.1"	1	
"GrA.1"	0	

Display (Symbol)	Works setting	Your setting
"Ho_1"	0	
"nn_1"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_2"	0	
"con.2"	0	
"GrA.2"	0	
"Ho_2"	0	
"nn_2"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_3"	0	
"con.3"	0	
"GrA.3"	0	
"Ho_3"	0	
"nn_3"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_4"	0	
"con.4"	0	
"GrA.4"	0	
"Ho_4"	0	
"nn_4"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_5"	0	
"con.5"	0	
"GrA.5"	0	
"Ho_5"	0	
"nn_5"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_6"	0	
"con.6"	0	
"GrA.6"	0	
"Ho_6"	0	
"nn_6"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_7"	0	
"con.7"	0	
"GrA.7"	0	
"Ho_7"	0	

Display (Symbol)	Works setting	Your setting
"nn_7"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_8"	0	
"con.8"	0	
"GrA.8"	0	
"Ho_8"	0	
"nn_8"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP_9"	0	
"con.9"	0	
"GrA.9"	0	
"Ho_9"	0	
"nn_9"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
"SP10"	0	
"co10"	0	
"Gr10"	0	
"Ho10"	0	
"nn10"	0	
"1.LX"	0	
"2.LX"	0	
"3.LX"	0	
"4.LX"	0	
rA.ES	5,0	
diG.1	5	
diG.2	0	
diG.3	0	
cod.u	0	