Operating Instructions

R2400

Electronic controller

14130
4/3.01

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Meaning of symbols on the controller

EC conformity mark

Double or reinforced all-insulation

Warning of danger
Attention: refer to documentation

Instrument approval

CSA approval mark

Safety features and safety precautions

The R2400 controller is constructed and tested according to IEC 1010-1 / DIN EN 61010-1 / VDE 0411-1.
If properly used the safety of both the user and the controller is assured.

Read the operating instructions carefully and completely before you use the controller and follow them in all respects.
Please make the operating instructions available to all users.

Please note the following safety precautions:

- The controller must only be installed to a system that corresponds to the nominal range of use (see wiring diagram and nameplate) and which is fused for a max. nominal current of 16 A.
- A switch or power switch must be provided as isolating facility within the installation.

The controller must not be used:

- with obvious external damages
- if it does not work properly any longer
- after prolonged storage under adverse conditions (e.g. moisture, dust, temperature)

In those cases the controller must be taken out of service and secured against accidental use.

Maintenance

Case
Special maintenance of the case is not required. Ensure a clean surface. Use a slightly moist cloth for cleaning. Do not use detergents and scouring agents.

Repair and replacement of parts
Repair or replacement of parts with the controller open and live may only be performed by persons familiar with the dangers involved.

Repair and replacement parts service

When you need service, please contact:

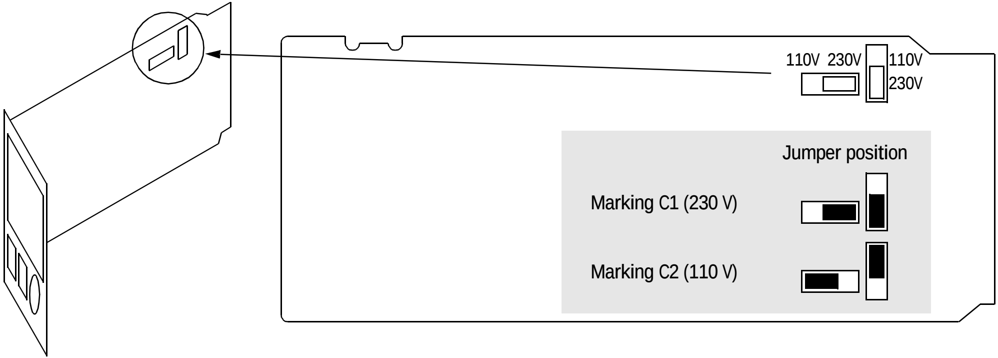
GOSSEN-METRAWATT GMBH
Service Center
Thomas-Mann-Strasse 20
90471 Nürnberg, Germany
Phone: +49 911 86 02 - 410 / 256
Fax: +49 911 86 02 - 253
e-mail: fr1.info@gmc-instruments.com

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

Identifying the controller

Description	Marking
Electronic controller, front dimensions 48 x 48 mm with self-optimization, limit relay, second set point	R2400
Controller version	
Two-state controller with heating current monitor — with relay output and transistorized output	A1
Three-state controller with heating current monitor / step controller — with 2 relay outputs and 2 transistorized outputs	A2
Continuous controller / three-state contr. with heating curr. monitor / step controller — with continuous output and 2 relay outputs	A3
Step controller with position reedback / three-state controller — with 2 relay outputs and 2 transistorized outputs	A4
Measuring ranges	
Thermocouple, configurable — Type J, L: –18 ... 850 °C / 0 ... 1562 °F Type K: –18 ... 1200 °C / 0 ... 2192 °F Type S, R: –18 ... 1770 °C / 0 ... 3218 °F Type B: 0 ... 1820 °C / 32 ... 3308 °F (Precision spec. from 600 °C) Type N: –18 ... 1300 °C / 0 ... 2372 °F Resistance thermometer Pt 100: – 100 ... 500 °C / –148 ... 932 °F	B1
Standard signal, configurable 0 / 2 ... 10 V or 0 / 4 ... 20 mA	B2
Auxiliary voltage	
AC 230 V } C1 → C2, and/or C2 → C1 internal plug change possible	C1
AC 110 V }	C2
AC 24 V	C3
DC 24 V	C4

Operating Instructions	German / English	D0
	French / Italian	D1
	None	D2
Presetting		
Standard setting		K0
Configured to customer's specifications		K9
Customer-specific front film on request		



⚠ Changing the auxiliary voltage you must mark the correct voltage on the nameplate (module) and connection diagram (case)!

Bild 1, Changing the auxiliary voltage C1 ↔ C2

Mechanical installation / Preparation ⚠

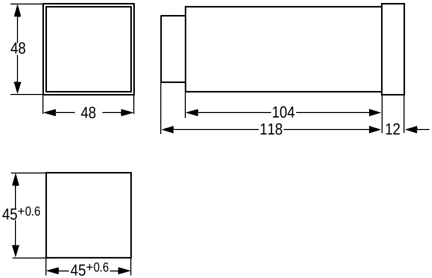
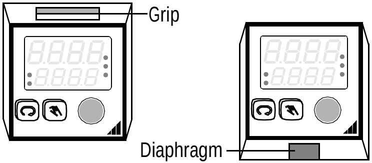


Bild 2, Case dimensions and panel cutout



The controller R2400 is meant for panel installation. The mounting site should not vibrate. Aggressive vapors reduce the service life of the controller. Note the VDE 0100 specifications. Work on the controller must only be performed by a person who is familiar with the danger involved.

From the front, slide the case into the panel cutout and at the rear tighten it at the top and bottom with 2 screw clamps. The moment of screw tension is typically 10 Ncm and should not exceed 20 Ncm.
Several controllers can be installed side-by-side without intermediate bars. In this case the gaskets supplied for meeting the protection class IP 54 cannot be used. The protection class IP 54 is only ensured with a depressed rotary knob.

Unobstructed air-flow is to be provided in general when installing one or more controllers. Below the controllers the ambient temperature must not exceed 50 °C.

Withdraw the controller module (e.g. for setting of the DIP switch):
- At the front, hold the module between thumb and forefinger at the grip and the diaphragm (pressure on the diaphragm unlocks the module)
- Pull firmly

Locking of the two screw clamps
(top and bottom of case):

– Shift in direction 1 up to the stop
– Shift in direction 2 up to the stop

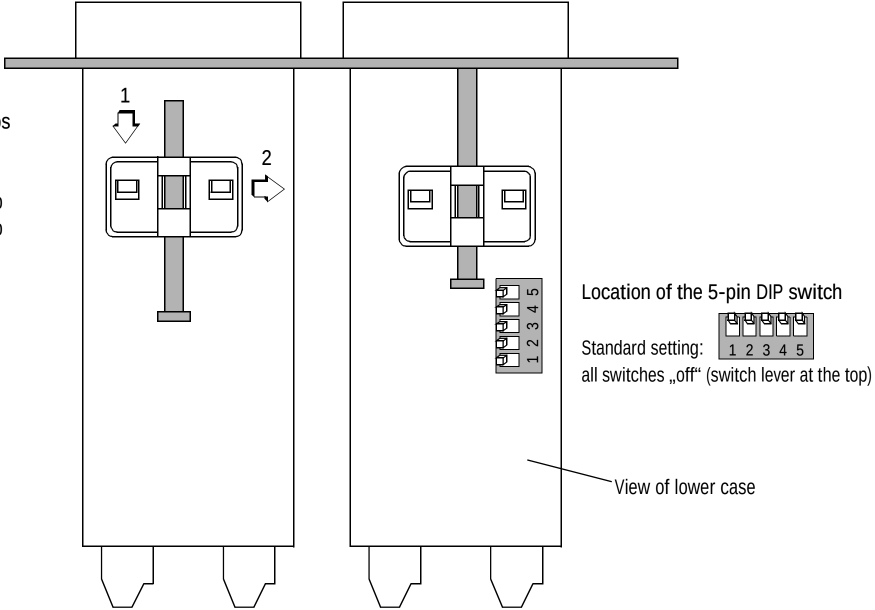
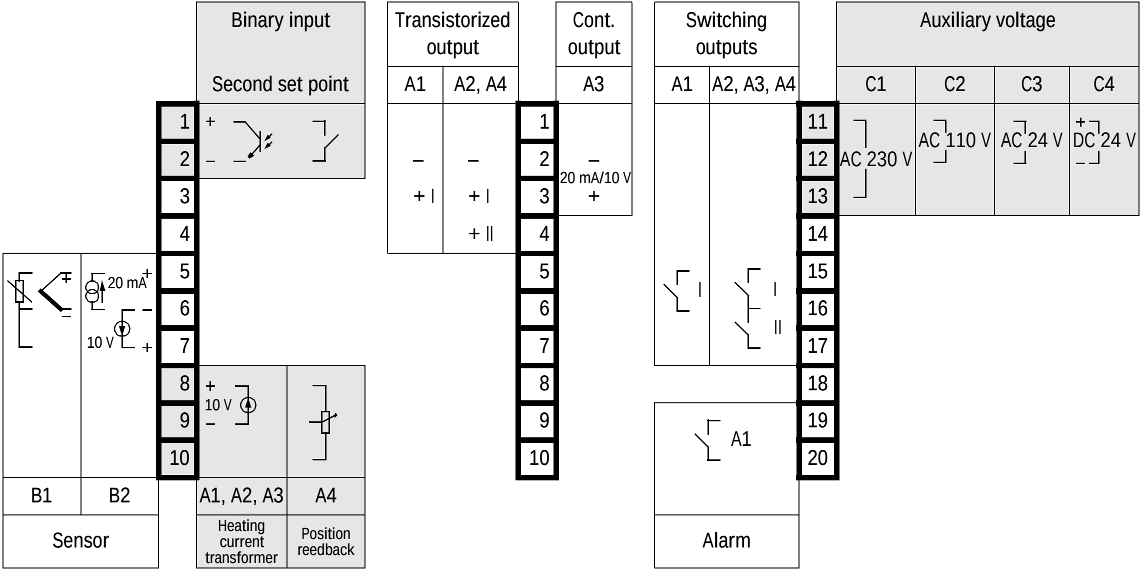


Bild 3, Case fasteners and location of the DIP switch

Electrical connection



Connection elements: Screw terminals suitable for standard wire 1.5 mm^2 and/or twin-wire multi-core cable ends for 2×0.75 mm^2

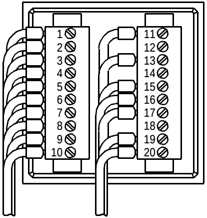
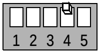


Bild 4, Location of the connection contacts

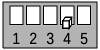
Configuration of switching outputs I and II

(not with marking A3)

Switching output I

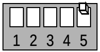


Relay

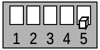


Transist. output

Switching output II



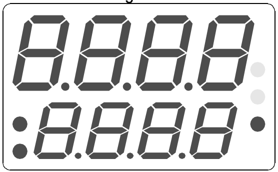
Relay



Transist. output

Behavior with switching the auxiliary voltage on

LED segment test



approx. 2 s

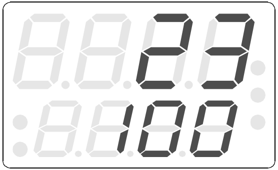
Dimension

Software version

Actual configuration

approx. 1.5 s

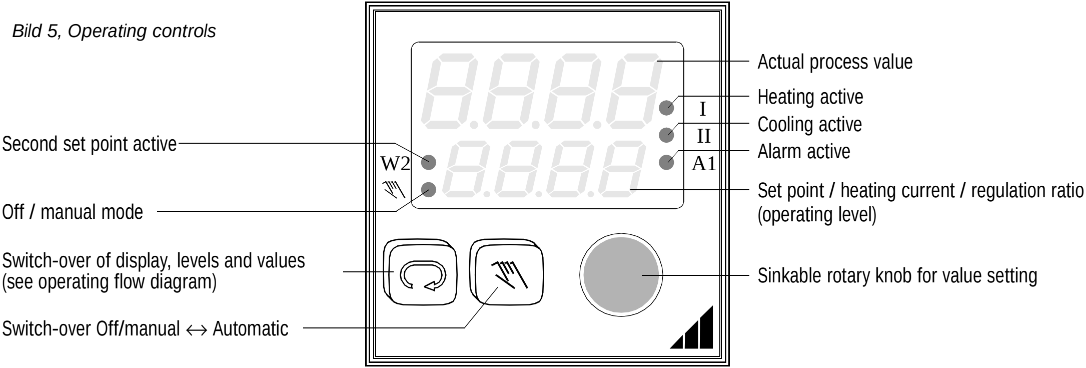
Actual value



Actual value or oFF

Operation

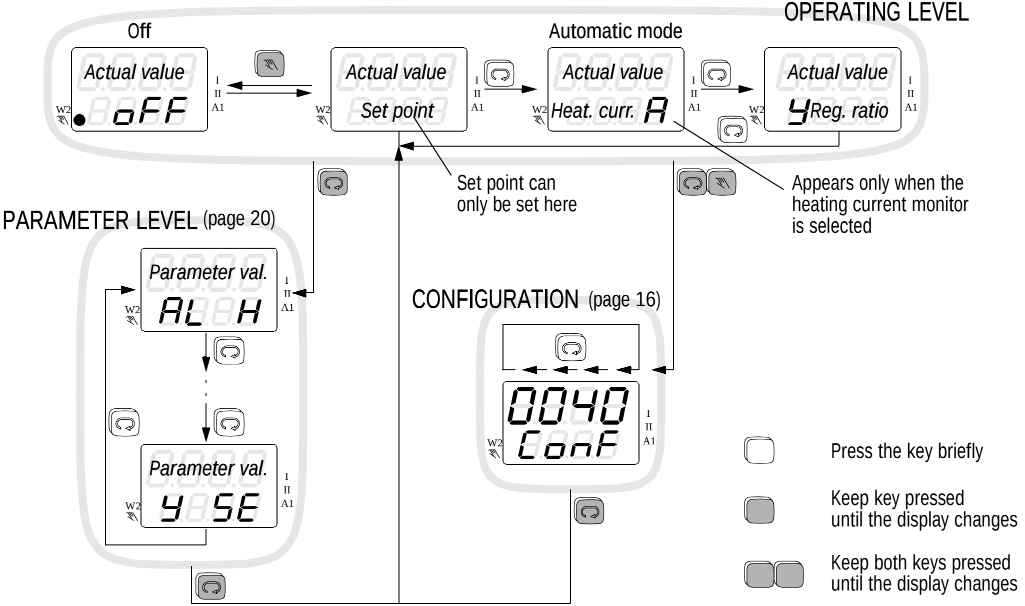
Bild 5, Operating controls



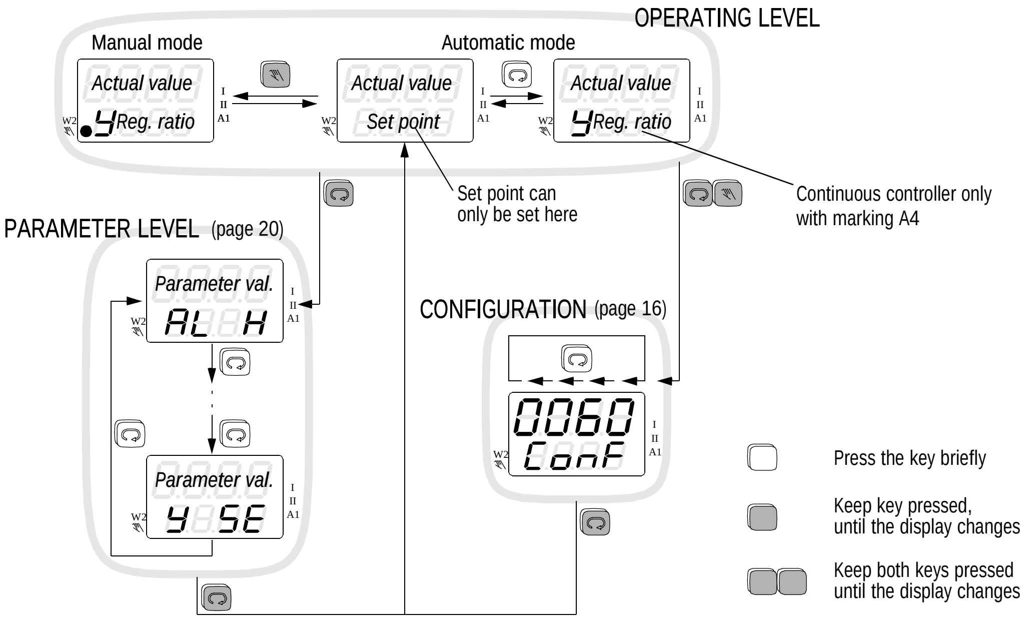
Value setting with rotary knob

- Slightly turning the knob does not change the set value in order to prevent accidental adjustment.
- The rate of change of the setting value is determined by moving the knob further to the right or left against the integral spring tension.
- When released, the rotary knob returns to the center position.
- Small changes to the setting can be made by turning the knob within the middle (vernier) range.
- After 2.5 s or after pressing a key the value is stored and active. A short blanking of the display signals this condition.

Operating flow diagram „switching controller“



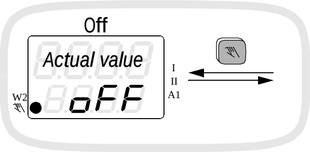
Operating flow diagram „continuous and step controller“



Off / Manual mode

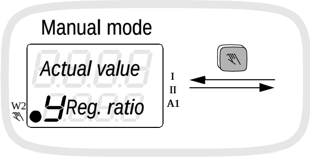
OPERATING LEVEL SWITCHING CONTROLLER

- No alarm function
- No error signalling



- The positioning outputs are inactive when the rotary knob is not operated
- The switching output I („Heat") / II („Cool") is directly controlled when turning the knob to the right / left

OPERATING LEVEL CONTINUOUS AND STEP CONTROLLER

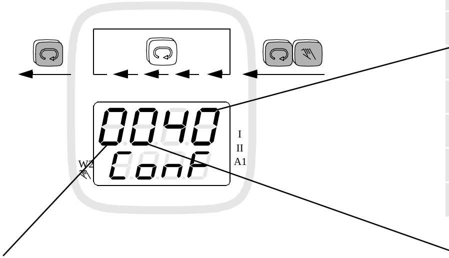


- Alarm function and error signalling same as automatic.
- The position outputs are not controlled by the control function, but with the rotary knob.
- Manual / automatic switch-over is bumpless in both directions.
- Continuous controller: The regulation ratio is displayed in %. Changes in values are slowly made in the spring ranges of the rotary knob and are immediately passed to the controller outputs.
- Step controller: By turning the knob to the right/left in the spring range the switching output I (more) / II (less) is directly controlled. With the reedback available (marking A4) the measured position is displayed in %; for marking A2, A3 lines are displayed.

Configuration

	Controller version	
Code		Condition
0	Limit monitor	
1	Positioner	
2	Two-state controller heating *)	
3	Two-state controller cooling *)	
4	Three-state controller *)	not with marking A1
5	Three-state controller water cooling	
6	Step controller	

*) See p. 20 for cont. controller settings



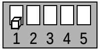
	Alarms			
Code		Start-up suppression	Contact	Heating curr. monitor
0	relative	inactive	NOC	inactive
1	absolute			
2	relative	active		
3	absolute			
4	relative	inactive	NCC	
5	absolute			
6	relative	active		
7	absolute			
8	relative	inactive	NOC	active
9	absolute			
A	relative	active		
b	absolute			
C	relative	inactive	NCC	
d	absolute			
E	relative	active		
F	absolute			

	Dimension 1) of the sensor / continuous output 2)		
Code	Dimension 1)	Output range 2)	Output quantity 2)
0	°C	0 ... 20 mA 0 ... 10 V	Actual value (switching controller)
1	°F		
2	°C	4 ... 20 mA 2 ... 10 V	
3	°F		
4	°C	0 ... 20 mA 0 ... 10 V	Regulation ratio (continuous controller)
5	°F		
6	°C	4 ... 20 mA 2 ... 10 V	
7	°F		
8 ... C	(no function)		
d E F	⚠ Storage and uploading of device settings see page 18		

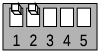
1) Switching form °C to °F only active with code B1
2) Only active with code 3

	Sensor type		
Code	Type	Version	Condition
0	J	Thermo-couple	with marking B1
1	L		
2	K		
3	B		
4	S		
5	R		
6	N		
7		Pt 100	
0	0 ... 20 mA / 0 ... 10 V	Stand. signal	with marking B2
1	4 ... 20 mA / 2 ... 10 V		

Configuration disabled with DIP switch setting



and during self-optimization,
enabled with DIP switch setting



Backed: standard setting K0

Storage and Uploading of Device Settings

Code	Function	Note
d	The current setting [1] is stored as a user defined default setting.	Configuration according to customer specifications (K9) is stored in this location and is thus overwritten.
E	The user defined default setting is uploaded [1]. If a setting has never previously been stored with *d*, the factory default setting, or the configuration in accordance with customer specifications (K9), is uploaded.	All entries are overwritten, including the results of self-optimization and calibration.
F	The factory default setting [1] is uploaded.	

1) Configuration digits and all parameters except for the interface address *Addr*.

Controller types

See page 22 for *Parameters*

Code	Controller type	Remarks
0	Limit monitor	Switching output I is active, if act. value < actual set point, switching output II is active, if actual value > actual set point + *dbnd*. The switching hysteresis is ± 0.25 % of the measuring range span. A change of the switching state can be made every *tc*.
1	Positioner	Output of a constant positioning signal to switching output I, if *Y ST* > 0, to switching output II, if *Y ST* < 0. The positioning cycle is *tc*. No alarm functions.
2	2-state controller „Heat“	A PDPI control algorithm without overshoot controls the switching output I in order to increment / decrement the actual value. The positioning cycle is at least *tc*.
3	2-state controller „Cool“	
4	Three-state controller	A PDPI control algorithm without overshoot controls the switching output I in order to increment the actual value and/or the switching output II to decrement the actual value. The positioning cycle is at least *tc*. The deadband *dbnd* suppresses a change between "Heat" and "Cool", without offset.
5	Three-state controller Water cooling	The regulation ratio of the switching output II is matched to the non-linear behavior of a water cooler. The positioning cycle is *tc*.
6	Step controller	A PDPI control algorithm without overshoot controls the switching output I and/or II in order to increment/decrement the actual value. The positioning pulse width is *tc*. The deadband *dbnd* is symmetric to the set point.

Configuration of the controller with continuous output (marking A3)

Continuous output = regulation ratio (configuration digit „sensor dimension / continuous output“ = 4 ... 7)
The different continuous controller types result of the configuration digit „controller type“.

Code	Controller type	Remarks
0	Limit monitor	Output of a regulation ratio adjustable with parameters *Y H* when actual value < set point value
1	Positioner	Output of a regulation ratio adjustable with the parameter *Y St*
2	Continuous controller with falling characteristic	An oscillation-free PDPI control algorithm controls the continuous output every 0.5 s. An output filter provides for as smooth as possible the positioning signal. With *tc* the time constant of an additional actual value is set.
3	Continuous controller with rising characteristic	
4	Split-range controller	Continuous controller with falling characteristic for positive regulation ratios (increase actual value) Negative regulation ratios are output with switching output II (decrease actual value). The positioning cycle for switching output II is at least *tc*. The deadband *dbnd* suppresses a quick change between continuous output and switching output II without offset.
5 6		No praxis-oriented function

Continuous output = actual value (configuration digit „Sensor dimension / continuous output“ = 0 ... 3)
The controller types for marking A2 and marking A3 are identical.

Calibrations

Thermocouple correction (parameter *CAL*)

The setting of the corrected value is in °C / °F. The displayed correction value is added to the measuring temperature value.

Lead balancing with Pt 100 2-wire connection (parameter *CAL*)

Balancing can be defined automatically in „Off / Man“:

– Short sensor at the site of application
– Set *CAL* value to *Auto*

The measured lead resistance is converted into a temperature charge and entered as *CAL* value.
With a known sensor temperature balancing can also be made manually: *CAL* = known sensor temp. – displayed temp.

Scaling of the heating current monitor (parameter *A H*)

The standard setting for GTZ 4121 is 42.7 A. If the current transformer is not used for acquisition of the heating current, the value at which the transformer GTZ 4121 is used provides 10 V DC is to be set.

Calibration of the display of the positive position reedback (parameter *Y100*, *Y 0*)

Calibration is made in manual mode in the parameter level when configured as step controller (configuration digit „controller type“ = 6):

1. Select parameter *Y 100*. At first the stored value appears: a standardized value between 0 and 255
   The rotary knob held at the right stop increases the switching output I and the display gives the actual measured position of the controller element.
   Keep the rotary knob at the right stop until the correct display is obtained. The displayed value is stored.
2. Select parameter *Y 0*.
   Proceed same as for parameter *Y 100*. In this case keep the rotary knob at the left stop. It serves to decrease the switching output II.

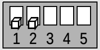
Y 100 must be higher than *Y 0*!

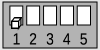
In automatic mode the parameters *Y 100* and *Y 0* are only displayed.

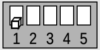
Parameter settings

X1 = Lower range limit
X2 = Upper range limit

* MBU = range span = X2 – X1

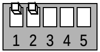
Parameters	Display	Range	Standard	Comments	
High limit	AL H	oFF, 1 ... MBU * X1 ... X2	oFF X1	relative (= standard config.) absolute	Parameter disabled with DIP switch setting 
Upper limit	AL L	oFF, 1 ... MBU * X1 ... X2	oFF X1	relative (= standard config.) absolute	
Second set point	SP 2	*SP L ... SP H*	X1		
Ramp for increasing set points	S uP	oFF, 1 ... MBU * per min	oFF		
Ramp for decreasing set points	S dn	oFF, 1 ... MBU * per min	oFF		
Set point of heat. curr. (s. calibrat.)	AMPS	Auto, oFF, 0.1 ... *A H*	oFF	not for step controller 1)	

Parameters	Display	Range	Standard	Comments	
Proportional band heating	Pb I	0.1 ... 999.9 %	10.0		Parameter disabled with DIP switch setting  and during self-optimization
Proportional band cooling	Pb II	0.1 ... 999.9 %	10.0	only with 3-state contr. 2)	
Dead zone	dbnd	0 ... MBU *	oFF	not with 2-state contr. 3)	
Delay time of the controlled system	tu	0 ... 9999 s	100		
Output cycle time	tc	0.5 ... 600.0 s	10.0	4)	
Motor running time	ty	5 ... 5000 s	60	only with step controller 5)	

Max. set point	SP H	*SP L* ... X2	X2		Parameter disabled with DIP switch setting  and during self-optimization
Min. set point	SP L	X1 ... *SP H*	X1		
Max. regulation ratio	y H	–100 ... 100 %	100	0 ... 100 with marking A1	
Calibration actual value (s. calibrat.)	CAL	–MBU * / 4 ... +MBU * / 4 Auto, –MBU */4...+MBU */4	0	only when B1, thermocple only when B1, Pt100	
Position decimal point	dPnt	9999, 999•9, 99•99, 9•999	9999	only with marking B2	
Upper range limit stand. signal	rn H	*r n L* ... 9999	100		
Lower range limit stand. signal	rn L	–1500 ... *r n H*	0		
Upper ran. lim. heat. curr. (s. calib.)	A H	1.0 ... 99.9 A	42,7	not for step controller 1)	
Calibration position reedback	y100 y 0	see calibrations		only for step controller with position reedback 6)	
Reg. ratio for positioner	y St	–100 ... 100 %	0	0 ... 100 with marking A1	
Reg. ratio for sensor error	y SE	–100 ... 100 %	0	0 ... 100 with marking A1	

1) only for: marking ≠ A4 and configuration digit „controller type“ ≠ 6
2) only for: marking ≠ A1 and configuration digit „controller type“ = 4 or 5
3) only for: marking ≠ A1 and configuration digit „controller type“ = 0, 4, 5 or 6
4) Additional actual value filter for continuous action controller (controller type = 2.3). ***tc*** = time constant
5) only for: marking ≠ A1 and configuration digit „controller type“ = 6
6) only for: marking = A4 and configuration digit „controller type“ = 6

All parameters free for DIP switch setting



Manual optimization

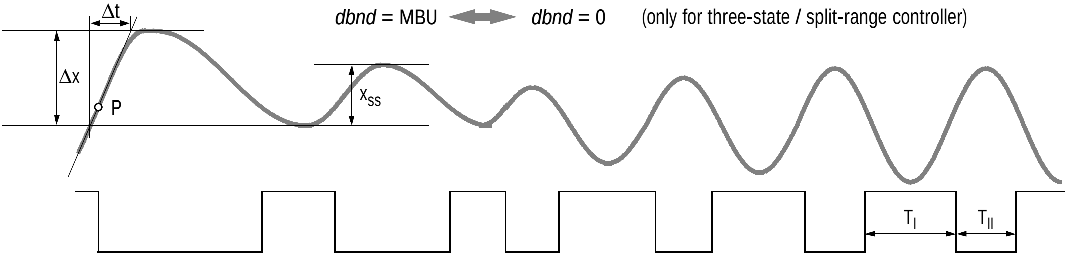
With manual optimization the parameters *Pb I*, *Pb II*, *tu* and *tc* are determined to obtain optimum control dynamics. For this purpose a start-up or oscillation test is performed.

Preparation

- Complete configuration (page 16) and Parameter setting (page 22) must be made before the controller is put in operation.
- The control elements should be deactivated by Off / Manual mode (page 15).
- A recorder must be connected to the sensor and set in line with the dynamics of the control system and the set point.
- The on and off time of the switching output I and/or the continuous output of three-state and/or split-range controllers must be recorded (e.g. with a further recorder channel or with a timer).
- Configure limit monitor (controller type code = 0).
- Set the output cycle time to minimum: *tc* = 0.5.
- If possible disconnect the limitation of regulation ratio: *Y H* = 100.
- Decrease the set point (and/or increase) so that the over- and undershoot will not take impermissible values.

Start-up trial

- Set *dbnd* = MBU on three-state and/or split-range controller (switching output II must not respond).
  Set *dbnd* = 0 on step controller (switching output II must respond)
- Start recorder
- Activate the control elements with automatic mode.
- Record 2 overshoots and 2 undershoots. *Start-up trial is finished for two-state controller, continuous and step controller.*
  Proceed as follows for three-state controller and/or split-range controller:
- Set *dbnd* = 0 to cause further oscillations by active switching output II, wait for two over- and undershoots.
- Record the on time T_I and off time T_{II} of the switching output I and/or the continuous output of the last oscillations.



Valuation of the start-up trial

– Apply the tangent to the intersection P of the actual value with the set point and/or the switch-off point of the output.
– Measure the time **Δt**.
– Measure the oscillation width x_{SS}, on step controller overshoot Δx.

	Parameter values				
tu	1.5 • Δt				Δt – (*tY* / 4)
tc	*tu* / 12				*tY* / 100
Pb I	(x_{SS} / MBU) • 100 %		(x_{SS} / MBU) • 200 %		(Δx / MBU) • 50 %
Pb II	–	*Pb I* • (T_I / T_{II})	–	*Pb I* • (T_I / T_{II})	–
Parameter	Two-state controller	Three-state contr.	Continuous contr.	Splitrange controller	Step controller

Correct the proportional band if a limitation of the regulation ratio was set.

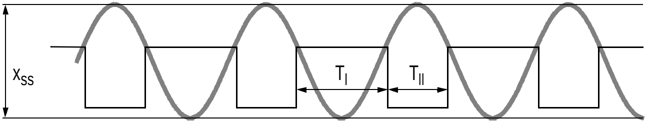
Y H positive: Multiply *Pb I* by 100 % / *Y H*

Y H negative: Multiply *Pb II* by –100 % / *Y H*

Perform an oscillation test

If a start-up trial is not possible, e.g. if adjacent control loops excessively influence the actual value or if the active switching output II is required to maintain the actual value (working point cool), or if it is required to optimize to the set point for special reasons, the control parameters can be determined from continuous oscillations. The calculated value for *tu* is, however, eventually not exact.

- Preparation as above. The test can be made without recorder when the actual value can be checked on the display and the times via a timer.
- Set *dbnd* = 0 on three-state controller, split-range and step controller.
- Activate the control elements in automatic mode, eventually start recorder. Record several oscillations until they are of like magnitude.
- Measure oscillation width x_{SS}.
- Record the on time T_I and off time T_{II} of the switching output I and/or of the continuous output of the oscillations.



Valuation of the oscillation test

	Parameter values				
tu [1]	$0.3 \bullet (T_I + T_{II})$				$0.2 \bullet (T_I + T_{II} - 2tY)$
tc	*tu* / 12				*tY* / 100
Pb I	$\frac{x_{SS} \bullet 100\ \%}{MBU}$	$\frac{x_{SS} \bullet T_{II} \bullet 100\ \%}{MBU\ (T_I + T_{II})}$	$\frac{x_{SS} \bullet 200\ \%}{MBU}$	$\frac{x_{SS} \bullet T_{II} \bullet 200\ \%}{MBU\ (T_I + T_{II})}$	$\frac{x_{SS} \bullet 50\ \%}{MBU}$
Pb II	–	*Pb I* $\bullet (T_I / T_{II})$	–	*Pb I* $\bullet (T_I / T_{II})$	–
Parameter	Two-state controller	Three-state contr.	Continuous contr.	Splitrange controller	Step controller

1) With one of the times T_I or T_{II} extremely higher than the other one too high a value for *tu* will result.

Correction with limitation of reg. ratio *Y H* positive: Multiply *Pb I* by 100 % / *Y H*
Y H negative: Multiply *Pb II* by –100 % / *Y H*

Correction for step controller if one of the times T_I or T_{II} is smaller than *tY*:

Multiply *Pb I* by $\frac{tY \bullet tY}{T_I \bullet T_I}$, if T_I is smallest and by $\frac{tY \bullet tY}{T_{II} \bullet T_{II}}$, if T_{II} is smallest.

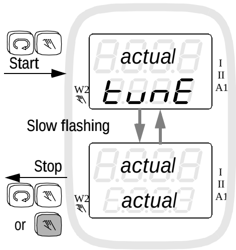
The value for ***tu*** is not exact in this case. It should be re-optimized in control mode.

Control mode

After optimizing control mode is active:

- Configure the desired control algorithm in control mode.
- Set the set point to the required value.
- On three-state controller, split-range and step controller the deadband can be increased from ***dbnd*** = 0 if control of the switching outputs I (and/or continuous output) and II changes rapidly e.g. due to an unstable actual value.

Self-optimization



The self-optimization serves to determine an optimal control dynamic that is the parameters *Pb I*, *Pb II*, *tu* and *tc* are determined.

Preparation

– Prior to starting the self-optimization the complete configuration must be made
– Set the set point to the value required after optimization.

Start

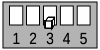
– Simultaneous pressing of the two keys in the operating level (automatic or manual / off) initiates self-optimization. It cannot be started in the „positioner“ or „limit monitor“ mode
– The display of *tunE* flashes on all levels during the optimization run
– The controller returns to automatic mode after successful optimization.
– With the three-state controller (controller type = 4 and 5) cooling is activated when the high limit responds to avoid overheating. Self-optimization then conducts an oscillation test in proximity to the set point.

Procedure

– The actual set point at the start remains valid; it cannot be changed
– Activation / deactivation of the second set point is disabled
– Adjusted set point ramps are not considered
– When starting in the working point (actual value about set point) overshoot cannot be prevented.

Stop

– Optimization can be stopped at any time with  (→ automatic mode) and/or by switching over to man /off with 
– If an error occurs during optimization the controller does not issue a positioning signal. Optimization must be stopped. More information on request.

When supplied (standard setting K0) self-optimization is enabled. Disabling via DIP switch: 

Set point ramps

Function	The parameters *SPuP* / *SPdn* cause a gradual change in temperature (rising / falling) in degrees per minute. Activated when: – Switching on the auxiliary voltage – Changing the actual set point and activating the second set point – Changing from manual to automatic mode
Set point display	The target set point, not the actual one is displayed.
Limit values	Relative limit values make reference not the ramp, not the target value. For this reason no alarm is triggered as a rule.

Heating current monitor

Function	The acquisition of the heating current is made with the external transformer (e.g. GTZ 4121). An alarm message shows if the measured current falls more than 20 % below the expected current (set point AMPS) when the heater is switched on, or when current is still flowing with the heater switched off. The alarm is cleared only when, with active output, the heating current is high enough and no current flows with an inactive output I. Monitoring is inactive, when the controller is switched OFF and when continuous and step controller.
Curr. set point AMPS	For this parameter enter the nominal current of the heater. For automatic setting set AMPS to Auto with the heater switched on. The actually measured current is stored.

Heating circuit monitor

Function

– Active / inactive configurable with configuration digit „alarm“ (see configuration)

–Without external transformer, without additional parameters

–Under the condition set correct optimization of the controller parameters *tu* and *Pb I* !

i.e. before self-optimization is started, heating circuit monitoring must be activated.

The lower limit for the *tu* parameter must be maintained for manual optimization or subsequent adjustment of the control parameters:

$$\text{minimum } tu = \frac{Pb\ I}{50\%} \bullet \frac{\text{MBU}}{\Delta\vartheta / \Delta t}$$

$\Delta\vartheta / \Delta t$ = maximum temperature rise during start-up

–The error message *LE* appears, when the heater is switched on 100 % and the measured increase in temperature is too low.

–Monitoring is not active,

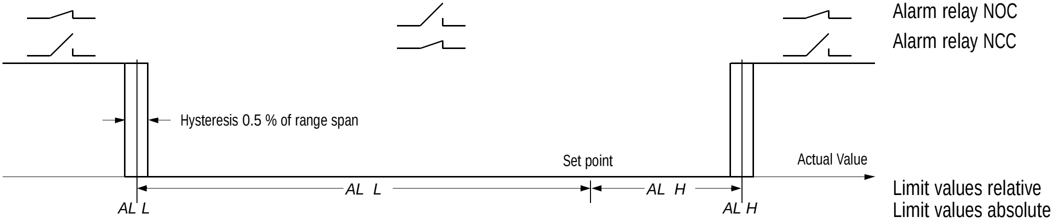
when the controller type = limit monitor, positioner or continuous controller

during self-optimization

when standard signal input (marking B2)

if the limitation of regulation ratio *Y H* < 20 %

Limit monitoring



Start-up suppression: Alarm suppression is active as start-up (configuration digit „alarms“) until the temperature exceeds the low limit for the first time. When cooling the suppression is active until the high limit is fallen below for the first time. It is active when switching on the auxiliary voltage, changing the actual set point and activating the second set point as well as when changing from Off → Automatic.

Alarms

Display (only in operating level)	Error source	Reaction
Heating current flashes	Heating current monitor	Alarm output A1 active (open circuit and closed circuit contact defined in the configuration digit „Alarms“, see configuration on page 16) and LED A1 flashes on all levels
Actual value flashes	Limit monitor	

During parameter setting or configuration the operation level is entered 30 s after the value setting was terminated.

Error messages

Reactions in case of error:

1. the alarm output A1 is activated; the configuration digit „alarm“ defines its behavior (see configuration on page 16)
2. the LED A1 flashes on all levels, add. information (flashing display) is only given on the operating level (upper display flashes))
3. during parameter setting or configuration the operation level is entered 30 s after the value setting was terminated.
4. see the following table for exceptions and further information.

<table>
<tr><th>Display</th><th></th><th>Error source</th><th>Reaction</th><th>Procedure</th></tr>
<tr><td>SE H</td><td>sensor error high</td><td>Sensor breakage or
actual value > upper range limit</td><td rowspan="2">
<table>
<tr><th>Contr. type</th><th colspan="2">Output regulation ratio</th></tr>
<tr><td rowspan="2">2-, 3-state</td><td>YSE = –100/0/100%</td><td>YSE ≠ –100/0/100%</td></tr>
<tr><td>–100/0/100%</td><td>If controller in stable state:
last „plausible“ reg. ratio,
if not: YSE</td></tr>
<tr><td>Step</td><td colspan="2">Controller outputs I and II inactive</td></tr>
<tr><td>Limit signal</td><td colspan="2">YSE</td></tr>
<tr><td>Positioner</td><td colspan="2">No error reaction</td></tr>
</table>
</td><td rowspan="2">1</td></tr>
<tr><td>SE L</td><td>sensor error low</td><td>Wrong polarity of sensor or
actual value < lower range limit</td></tr>
<tr><td>CE
Heating curr.</td><td>current error</td><td>Wrong polarity of current transformer, unsuited or unserviceable</td><td>Same as alarm of heating current monitor
Cont.</td><td>2</td></tr>
<tr><td>YE
Adj. level</td><td>y error</td><td>Position reedback beyond calibration;
$Y100 \le Y\,0$</td><td><u>No</u> error reaction</td><td>3</td></tr>
<tr><td>no t</td><td>no tune</td><td>Self-optimization cannot be started (controller type „positioner“ or „limit monitor“)</td><td>No error reaction
Error message remains until the key is pressed</td><td>–</td></tr>
</table>

tE 2	tune error 2	Disturbance of an optimization run in step 1 ... 9 (here step 2)	Controller outputs I and II inactive Self-optimization must be stopped	4
LE	loop error	Measured temperature too low with the heater switched on 100 %	Controller outputs I and II inactive Error message remains until the key is pressed	5
PE	parameter error	Outside permitted limits	Controller outputs I and II inactive The parameter level is disabled	6
dE	digital error	Error recognized by monitoring of the digital unit monitor	Controller outputs I and II inactive	7
AE	analog error	Error recognized by monitoring of the analog unit monitor	Controller outputs I and II inactive	7

Procedures

1. Eliminate sensor error
2. Check current transformer
3. Potentiometer for position reedback: check connection, re-calibrate
4. Correct faults that impair the optimization run such as e.g. sensor error
5. Closing the control loop: check the sensor function, control elements and the heater.
   Check correlation between sensor and heater (wiring).
   Correct optimization of the controller parameters *tu* and *Pb I*.
6. Run default configuration and default parameters, and then re-configure and reset parameters, or upload user defined default setting.
7. Repair by the corresponding service center.

Technical data

Climatic suitability in reference to VDI/VDE 3540	3z / 0 / 50
Annual average of rel. humidity, no condensation	75 %
Ambient temperature Nominal range of use Operational range Storage range	 0 °C ... + 50 °C 0 °C ... + 50 °C –25 °C ... + 70 °C

Aux. voltage	Nominal range of use		Power consumption
Nom. value	Voltage	Frequency	
AC 110 V AC 230 V AC 24 V	AC 95 V ... 121 V AC 196 V ... 253 V AC 21 V ... 26 V	48 Hz ... 62 Hz	max. 7 VA typically 4.5 W
DC 24 V	DC 20 V ... 30 V	–	

Relay output	Potential-free working contact (NOC), phase commun to switching output I and II
Switching capacity	AC/DC 250 V, 2 A, 500 VA / 50 W
Life span	> $2 \bullet 10^5$ duty cycles under nominal load
Interference	Provide ext. RC element (100 Ω - 47 nF) on the contactor

Transistorized output suited for commercially available solid state relays (SSR)		
Switching condition	No load voltage	Output current
Active (load ≤ 800 Ω)	< DC 17 V	10 ... 15 mA
Inactive	< DC 17 V	< 0.02 mA
Overload limit	Short-circuit, continuous interruption	

Electrical safety	
Protection class	II, panel controller acc. to DIN EN 61010-1 point 6.5.4
Pollution degree	2, acc. to DIN EN 61010-1 point 3.7.3.1 and/or IEC 664
Overvoltage category	II, acc. to DIN EN 61010 appendix J and/or IEC 664
Operating voltage	300 V acc. to DIN EN 61010
EMC emission	DIN EN 50081-2
EMC immunity	DIN EN 50082-2

See data sheet with ordering number 14451

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