## JUMO dTRON 304/308/316

## Compact Controller with program function



## B 70.3041 .0

Operating Manual

Please read this operating manual before commissioning the instrument. Keep the manual in a place which is accessible to all users at all times.
Your comments are appreciated and may help us in improving this manual.
All necessary settings are described in this operating manual. Manipulations not described in the manual or expressly forbidden will jeopardize your warranty rights. Please contact the nearest subsidiary or the head office, should you encounter problems.
This manual is valid from instrument software version 192.02.05.
It appears by simultaneously pressing the $-\underset{\square}{ }$ and keys.

When accessing the inner parts of the unit and returning modules, assemblies or components, please observe the regulations accordings to EN 61340-5-1 and EN 61340-5-2 „Protection of electrostatic sensitive devices". Only use ESD packaging for transport.

Please note that we cannot accept any liability for damage caused by ESD.
ESD=Electro Static Discharge

## Contents

1 Introduction ..... 7
1.1 Description ..... 7
1.2 Typographical conventions ..... 8
2 Identifying the instrument version ..... 9
2.1 Type designation ..... 9
2.2 Scope of delivery ..... 10
2.3 Accessories ..... 10
3 Mounting ..... 11
3.1 Mounting site and climatic conditions ..... 11
3.2 Dimensions ..... 11
3.2.1 Type 703044 ..... 11
3.2.2 Type 703042/43 ..... 12
3.2.3 Type 703041 ..... 12
3.3 Side-by-side mounting ..... 13
3.4 Fitting in position ..... 13
3.5 Removing the controller module ..... 14
4 Electrical connection ..... 15
4.1 Installation notes ..... 15
4.2 Electrical isolation ..... 16
4.3 Connection diagrams ..... 17
4.3.1 Type 703041 ..... 17
4.3.2 Type 703042/43/44 ..... 20
4.3.3 Termination resistor for the RS422/485 serial interface ..... 24
4.3.4 Connection of the PROFIBUS-DP connector ..... 24

## Contents

5 Operation ..... 25
5.1 Displays and controls ..... 25
5.2 Level concept ..... 26
5.3 Level inhibit ..... 27
5.4 Entries and operator prompting ..... 28
5.5 Fixed-setpoint controller (ex-factory) ..... 29
5.6 Program controller ..... 30
5.6.1 Entering programs ..... 30
5.6.2 Operation ..... 32
5.6.3 Shifting the program profile ..... 33
6 Operator level ..... 35
7 Parameter level ..... 37
8 Configuration ..... 39
8.1 Analog inputs "InP" ..... 41
8.1.1 Customized fine tuning ..... 43
8.2 Controller "Cntr" ..... 45
8.3 Generator "Pro" ..... 47
8.4 Limit comparators "LC" ..... 50
8.5 Outputs "OutP" ..... 54
8.6 Binary functions "binF" ..... 56
8.7 Display "diSP" ..... 59
8.8 Timer "tFct" ..... 61
8.9 Interfaces "IntF" ..... 62
9 Tuning (optimization) ..... 63
9.1 Autotuning (self-optimization) ..... 63
9.2 Check of the tuning ..... 66

## Contents

10 Extra codes ..... 67
10.1 Math and logic module ..... 67
10.2 Difference, humidity or ratio controller ..... 67
11 Retrofitting of modules ..... 69
12 Appendix ..... 71
12.1 Technical data ..... 71
12.2 Alarm messages ..... 74
13 Index ..... 75

Contents

## 1 Introduction

### 1.1 Description

The controller series consists of four freely programmable instruments in different DIN formats for controlling temperature, pressure and other process variables.
As a temperature controller TR ${ }^{1}$ according to EN 14597 the devices are used in heatgenerating plants to control the temperature of liquids or gases (mode of action: 1B).
The high-contrast, multicolor LCD display for process value, setpoint and operator prompting contains two four-digit 7 -segment displays, two single-character 16segment displays, display of the active setpoints, six status indicators, and displays for the unit, ramp function and manual operation.
Just four keys on the front panel are needed for operation, parameterization and configuration. The instruments can be used as 2 -state, 3 -state, modulating or continuous controllers. The controller software includes a program or ramp function, parameter set changeover, two autotuning (self-optimization) procedures, a math and logic module, as well as 4 limit comparators.
Linearizations for the usual transducers are stored, and a customer-specific linearization table can be programmed.
A setup program is available for user-friendly configuration from a PC.
An RS422/485 or a Profibus-DP interface can be used to integrate the instrument into a data network.
The electrical connection is made at the back of the instrument, via screw terminals.


1. For more detailed explanation, see EN 14597

## 1 Introduction

### 1.2 Typographical conventions

## Warning signs



Danger


Caution

Note signs

Representation


Note

instruction described.

Menu items Texts from the setup program are shown in italics, for example: edit program.

## Blinking display

Reference This symbol refers to further information in other operating instructions, chapters or sections.

* Action This symbol indicates that an action to be performed is

The individual steps are marked by this asterisk, e.g.

* Press Exit

This symbol is used when your special attention is drawn to a remark.
This symbol is used when there may be danger to personnel if the instructions are ignored or not followed correctly!

This symbol is used when there may be damage to equipment or data if the instructions are ignored or not followed correctly!

This symbol is used where special care is required when handling components liable to damage through electrostatic discharge.
*

## 2 Identifying the instrument version

### 2.1 Type designation

|  | Basic type |
| :--- | :--- |
| 703041 | JUMO dTRON 316, format 48mm $\times 48 \mathrm{~mm}$ <br> incl. 1 analog input, 2 relay outputs and 2 binary inputs or 2 logic outputs |
| 703042 | JUMO dTRON 308, format 48mm $\times 96 \mathrm{~mm}$ (portrait format) <br> incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs |
| 703043 | JUMO dTRON 308, format $96 \mathrm{~mm} \times 48 \mathrm{~mm}$ (landscape format) <br> incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs |
| 703044 | JUMO dTRON 304, format $96 \mathrm{~mm} \times 96 \mathrm{~mm}$ <br> incl. 1 analog and 2 binary inputs, 2 relays and 2 logic outputs |



## 2 Identifying the instrument version

### 2.2 Scope of delivery

- 1 controller
- 1 seal
- mounting brackets
- Operating Manual B70.3041.0 in DIN A6 format

1 CD with demo software and PDF documents in DIN A4 format (operating manual and further documentation) can be ordered separately.
The individual documents and programs are available for dowload from www.jumo.net (the software can be enabled for a charge.)

### 2.3 Accessories

| PC interface | PC interface with TTL/RS232 converter and adapter (socket connector) for setup program <br> Sales No. 70/00350260 |
| :---: | :---: |
| USB interface | PC interface with USB/TTL converter, adapter (socket conector) and adapter (pins) Sales No. 70/00456352 |
| Setup program | Setup program with program editor and Startup Sales No. 70/00445443 <br> Hardware requirements: <br> - PC Pentium 100 or compatible <br> - 128 MB RAM, 30 MB free fixed disc memory <br> - CD ROM drive <br> - free serial or USB interface <br> Software requirements: <br> Microsoft ${ }^{1}$ Windows 98/NT4.0/ME/2000/XP |



[^0]
## 3 Mounting

### 3.1 Mounting site and climatic conditions

The conditions on the mounting site must meet the requirements specified in the technical data. The ambient temperature on the mounting site can be from 0 to $55^{\circ} \mathrm{C}$, with a relative humidity of not more than $90 \%$.

### 3.2 Dimensions

### 3.2.1 Type 703044



Panel cut-out


## 3 Mounting

### 3.2.2 Type 703042/43




Panel cut-out

3.2.3 Type 703041


Panel cut-out


### 3.3 Side-by-side mounting

| Minimum spacing of panel cut-outs |  |  |
| :---: | :---: | :---: |
| Type | horizontal | vertical |
| without setup plug: |  |  |
| 703041 (48mm x 48mm) | 11 mm | 30 mm |
| 703042 (portrait format: $48 \mathrm{~mm} \times 96 \mathrm{~mm}$ )) | 11 mm | 30 mm |
| 703043 (landscape format: $96 \mathrm{~mm} \times 48 \mathrm{~mm}$ ) | 30 mm | 11 mm |
| 703044 ( $96 \mathrm{~mm} \times 96 \mathrm{~mm}$ ) | 11 mm | 30 mm |
| with setup plug (see arrow): |  |  |
| 703041 (48mm x 48mm) | 11 mm | 65 mm |
| 703042 (portrait format: $48 \mathrm{~mm} \times 96 \mathrm{~mm}$ ) | 11 mm | 65 mm |
| 703043 (landscape format: $96 \mathrm{~mm} \times 48 \mathrm{~mm}$ ) | 65 mm | 11 mm |
| 703044 ( $96 \mathrm{~mm} \times 96 \mathrm{~mm}$ ) | 11 mm | 65 mm |

### 3.4 Fitting in position

* Fit the seal that is supplied onto the instrument body.
* Insert the controller from the front into the panel cut-out.
* From behind the panel, slide the mounting brackets into the guides on the sides of the housing. The flat faces of the mounting brackets must lie against the housing.
* Push the mounting brackets up to the back of the panel, and tighten them evenly with a screwdriver.


Type 703041

* Fit the seal that is supplied onto the instrument body.
* Insert the controller from the front into the panel cut-out.
* From the back of the panel, push the mounting frame onto the instrument body and press it against the back of the panel, compressing the springs, until the latches snap into the notches provided and it is firmly fixed in position.


Care of the front panel

The front panel can be cleaned with normal commercial washing, rinsing and cleaning agents. It has a limited resistance to organic solvents (e.g. methylated spirits, white spirit, P1, xylol etc.). Do not use high-pressure cleaning equipment.

## 3 Mounting

### 3.5 Removing the controller module

The controller module can be removed from its housing for servicing.

* Press together the knurled areas (top and bottom, or left and right for landscape format) and pull out the controller module.


When inserting the controller module, make sure that the latches (below the
knurled areas) snap into place.

## 4 Electrical connection

### 4.1 Installation notes

- The choice of cable, the installation and the electrical connection must conform to the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with Nominal Voltages below 1000 V" or the appropriate local regulations.
- The electrical connection must only be carried out by qualified personnel.
- The instrument shall be operated by mains protected with a branch circuitry overcurrent protection device not more than 20 Amps.
For servicing/repairing a Disconnecting Device shall be provided to disconnect all conductors.
- The load circuit must be fused for the maximum relay current, in order to prevent the output relay contacts becoming welded in the event of a short circuit.
- Electromagnetic compatibility conforms to the standards and regulations cited in the technical data.
- Run input, output and supply cables separately and not parallel to one another.
- Sensor and interface cables should be shielded cables with twisted conductors. Do not run them close to current-carrying components or cables. Ground the shielding on one side.
- Do not connect any additional loads to the supply terminals of the instrument.
- The instrument is not suitable for use in areas with an explosion hazard (Ex areas).
- In addition to faulty installation, incorrect settings on the controller (setpoint, data of the parameter and configuration levels, internal alterations) can also interfere with the correct operation of dependent processes, or even cause damage. Safety devices should always be provided that are independent of the controller (such as overpressure valves or temperature limiters/monitors) and only capable of adjustment by specialist personnel. Please observe the relevant safety regulations for such matters. Since adaptation (self-optimization) can not be expected to handle all possible control loops, an unstable parameterization is theoretically possible. The stability of the actual value that is produced should therefore be checked.


The electrical connection must only be carried out by specialist personnel.

The instrument version can be identified by the type code.

Conductor cross-sections and core-end ferrules for installation

|  | Minimum <br> cross-section | Maximum <br> cross-section | Min. length of <br> core-end ferrule |
| :--- | :--- | :--- | :--- |
| Without core-end ferrule | $0.34 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 10 mm <br> (stripped) |
| Core-end ferrule, no lip | $0.25 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 10 mm |
| Core-end ferrule, lip up to $1.5 \mathrm{~mm}^{2}$ | $0.25 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | 10 mm |
| Core-end ferrule, lip above $1.5 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 12 mm |
| Twin ferrule with lip | $0.25 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | 12 mm |

## 4 Electrical connection

### 4.2 Electrical isolation



### 4.3 Connection diagrams

### 4.3.1 Type 703041


Type 703041 continued

| PROFIBUS | RS422 | RS485 |
| :---: | :---: | :---: |
| $\mathrm{VP}(+5 \mathrm{~V})$ | - RxD + |  |
| RxD/TxD-P (B) | - RxD - |  |
| D/TxD-N (A) | - TxD + | - RxD/TxD + |
| - DGND | - TxD - | - |
| - VP (+5 V) | - RxD + |  |
| D/TxD-P (B) | - RxD - |  |
| /TxD-N (A) | - TxD + | - |
| - DGND | - TxD - | - RxD/TxD |


| Type 703041 continued |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Outputs and interfaces - terminal strip 1 (option board) |  |  |  |  |  |
|  |  | Analog output | Relay (changeover) | 2 relays (n.o. make) | Solid-state relay |
| ---흠O | 1 |  |  | -- -o- Out5 | ----------- |
|  | 3 |  |  | -o- Out8 | ¢ |
|  | 4 | Analog output 5 (Out5) | Binary output 5 (Out5) | Binary output 5+8 (Out5+Out8) | Binary output 5 (Out5) |
| $\begin{aligned} & \text { N } \\ & \text { 을 } \\ & \text { O} \end{aligned}$ | 5 |  |  |  |  |
|  | 6 |  | (not possible!) | (not possible!) | 2 |
|  | 7 |  |  |  |  |
|  | 8 | Analog output 6 (Out6) |  |  | Binary output 6 (Out6) |

[^1]$\Rightarrow$ Chapter 8.5 "Outputs "OutP""
Type 703041 continued
Analog input 1 and binary inputs 1+2-terminal strip 2

|  |  | Resistance thermometer | Resistance thermometer | Resistance thermometer | Resistance transmitter | Thermocouple | Current | Voltage $0(2)-10 \mathrm{~V}$ | Voltage $0-1 V$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { - } \\ & \frac{0}{0} \\ & \frac{0}{0} \\ & \hline \frac{1}{4} \end{aligned}$ | 1 <br> 2 <br> 3 <br> 4 |  |  |  |  |  | $\mathrm{I}_{\mathrm{x}}-/ \mathrm{I}_{\mathrm{x}} \approx$ | ${\overline{U_{\mathrm{x}}}}^{+}$ | $\overline{U_{x}}+$ |
| $\begin{aligned} & 0 \\ & \hline 0 \\ & \hline \end{aligned}$ | 6 <br> 7 <br> 8 |  | Binary input <br> Binary input |  | As an alte (configura | tive to bi )! | outputs | and 4 |  |



## 4 Electrical connection

### 4.3.2 Type 703042/43/44


Type 703042/43/44 continued
RS485
— RxD/TxD +
— RxD/TxD -
— RxD/TxD + — RxD/TxD -



(a) $d-a \times \perp / \square \times y-$

 | 0 |
| :--- |
| 0 |
| 0 |
| 0 |
| 1 |



| Solid-state relay |
| :---: |
|  |


|  |  |
| :---: | :---: |
|  |  |

H Binary output 7
(Out7)

Note numbering of outputs.
$\Rightarrow$ Chapter 8.5 "Outputs "OutP""

$$
\begin{aligned}
& \text { RS422 } \\
& -\mathrm{RxD}+ \\
& -\mathrm{RxD} \text { - } \\
& -\mathrm{TxD}+ \\
& -\mathrm{TxD}-
\end{aligned}
$$



## 4 Electrical connection

Type 703042/43/44 continued
Voltage
O-1V
isi

$+\quad 1$
$\left|\begin{array}{c}\prime \prime \\ \times \\ \times \\ \vdots \\ \times\end{array}\right|$
Current
couple

Resistance



Binary input 1
Binary input 2

Type 703042/43/44 continued

|  | Resistance thermometer | Resistance thermometer | Resistance thermometer | Resistance transmitter | Thermocouple | Current | Voltage $0(2)-10 \mathrm{~V}$ | $\begin{aligned} & \text { Voltage } \\ & 0-1 \mathrm{~V} \end{aligned}$ | 2 binary inputs |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\nrightarrow$ |  |  |  |  | $\overline{I_{x}-1 I_{x}} \approx$ | ${\overline{\mathrm{U}_{\mathrm{x}}}}^{+}$ | $\overline{U_{x}}+$ |  |
|  |  | $\overbrace{9}$ |  |  |  | $\overline{I_{x}-/ I_{x}} \approx$ | $\overline{\mathrm{U}_{\mathrm{x}}}+$ | $\underline{\underline{u x}^{+}}$ | Binary input 5+6 |
| $\begin{array}{l\|l} - & 9 \\ \stackrel{y}{c} & 9 \\ \stackrel{\circ}{10} \\ \text { 흥 } & 11 \\ \hline 12 \end{array}$ |  | $5$ |  |  |  | $\mathrm{I}_{\mathrm{x}-/ / I_{\mathrm{x}}}$ | ${\overline{U_{x}}}^{+}$ | ${\overline{U_{x}}}^{+}$ | Binary input 7+8 |

## 4 Electrical connection

### 4.3.3 Termination resistor for the RS422/485 serial interface

For fault-free operation of several devices in a line structure, their internal termination resistors must be activated at the start and end.

* Pull plug-in module out towards the front by pressing on the knurled areas
* Using a ballpoint pen, press all the white switches into the same direction

| Bus termination <br> resistor active: | $*$ Push all 5 switches down |  |
| :--- | :--- | :--- |
|  |  | P Push all 5 switches up |
| No bus termination |  |  |
| (ex-factory) |  |  |

* Re-insert the module back into the housing


## Check

* Press the PGM $+\Delta$ keys

To the right of the green "VErS" display, "ON" is shown for active and "OFF" for inactive termination resistors.

### 4.3.4 Connection of the PROFIBUS-DP connector

Mounting the adapter

* Identify option slot with the PROFIBUS-DP interface by means of the type code (in the case of pre-configured devices)

In this example, the PROFIBUS-DP interface is in option slot 1

To fit the D-SUB adapter, open the housing of the adapter; otherwise the terminal screws are hided by the adapter.


Assignment of the 9-pole D-SUB socket

| Pin: Signal | Designation |
| :--- | :--- |
| 1: VP | Supply voltage positive |
| 2: RxD/TxD-P | Receive/Transmit data positive |
| 3: RxD/TxD-N | Receive/Transmit data negative |
| 4: DGND | Ground |

## 5 Operation

### 5.1 Displays and controls


(1) 7-segment display (factory setting: process value) four-digit, red, decimal place is configurable (automatic adjustment on display overflow)
(2) Active setpoint (factory setting: SP1) SP1, SP2, SP3, SP4 (SP=setpoint); green;
(3) 7-segment display (factory setting: setpoint)
four-digit, green; decimal place is configurable; also used for operator prompting (display of parameter and level symbols)
(4) Keys
(5) Indication
yellow, for

- switch status of binary outputs $1-6$ (display lights up $=$ on)
- ramp/program function is active
- manual operation is active
(6) 16-segment display for the unit ${ }^{\circ} \mathrm{C} /{ }^{\circ} \mathrm{F}$ and text
two-digit, green; configurable; symbols for h, min, \%
In addition, the current segment number (program), the parameter set or any two-place letter/number combination can be displayed through the setup program.
The displays are configurable.
$\Rightarrow$ Chapter 8.7 "Display "diSP""


## 5 Operation

### 5.2 Level concept

The parameters for making the settings on the instrument are arranged at different levels.


## Time-out

If no key is pressed for 180 sec , the instrument returns to normal display.
$\Rightarrow$ Chapter 6 "Operator level"
$\Rightarrow$ Chapter 7 "Parameter level"
$\Rightarrow$ Chapter 8 "Configuration"
$\Rightarrow$ Setup/Display - Operation/Time-out

## User data "USEr"

The setup program can be used to display and edit up to 8 freely chosen parameters at this level.

## $\Rightarrow$ Setup/Configuration level/Display - Operation/User data

The user can assign a symbol for the representation of each parameter. Otherwise the default symbol will be used. Permissible symbols are the letters and numbers that can be presented by a 7 -segment display.

## 5 Operation

### 5.3 Level inhibit

The access to the individual levels can be prevented.

| Code | Operator level, <br> user level, <br> program editor | Parameter level | Configuration level |
| :--- | :--- | :--- | :--- |
| 0 | enabled | enabled | enabled |
| 1 | enabled | enabled | inhibited |
| 2 | enabled | inhibited | inhibited |
| 3 | inhibited | inhibited | inhibited |

* Go to code entry with PGM and $\boldsymbol{\nabla}$ (simultaneously for $>5 \mathrm{sec}$ ).
* Alter code with PGM (display blinks!)
* Enter code with $\boldsymbol{\Delta}$ and $\boldsymbol{\nabla}$. Ex-factory: all levels enabled.
* Return to normal display with Exit or automatically after approx. 180 sec

The parameter and configuration levels can also be inhibited via the binary function.
$\Rightarrow$ Chapter 8.6 "Binary functions "binF""

## 5 Operation

### 5.4 Entries and operator prompting

## Entering values

When entries are made within the levels, the parameter symbol is shown in the lower display.


* Select parameter with $\boldsymbol{\Delta}$ or $\boldsymbol{\nabla}$
* Change to entry mode with PGM (lower display blinks!)
* Alter value with $\Delta$ and $\nabla$

The value alters dynamically with the duration of the key stroke.

* Accept the setting with PGM or automatically after 2 sec
or
* Cancel entry with Exit

The value is not accepted.

## Entering times

When entering times (e.g. timer time), the time unit is shown in addition.


The highest time unit of the display is shown for the unit.
If, for instance, " $h$ " is shown for the hour, then the time format for the value is hh:mm.

* Select parameter with $\Delta$ or $\nabla$
* Change over to the entry mode using PGM (lower display blinks!)
* Alter value with $\Delta$ and $\nabla$

The value alters dynamically with the duration of the key stroke.

* Accept the setting with PGM or automatically after 2 sec
or
* Cancel entry with EXIT

The value is not accepted.

## 5 Operation

### 5.5 Fixed-setpoint controller (ex-factory)



## Altering the setpoint

## Manual mode

In normal display:

* Alter the present setpoint with $\boldsymbol{\Delta}$ and $\boldsymbol{\nabla}$ (the value is accepted automatically)

In manual mode, the controller output can be altered by hand.

* Change to manual mode with EXIT (> 2 sec )

The output appears in the lower display. The hand symbol and the unit "\%" light up in addition.

* Alter the output with $\boldsymbol{\Delta}$ and $\boldsymbol{\nabla}$

In the case of a modulating controller, the actuator is opened or closed using the keys. The various levels can be accessed from the manual mode.

* Finish manual mode with ExiT (>2 sec)

The output entry on a changeover is configurable. The manual mode can be inhibited.
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""
Additional operating options for the fixed-setpoint controller can be implemented via the binary functions.
$\Rightarrow$ Chapter 8.6 "Binary functions "binF""
On overrange/underrange and probe break, the controller automatically changes over to manual mode.

## 5 Operation

### 5.6 Program controller

## Condition as delivered

The instrument must be configured as a program controller/generator. Furthermore, a program must be entered beforehand, to operate the instrument as a program controller/generator.

### 5.6.1 Entering programs

## Function

## Entry on the instrument



The instrument must be configured as a program controller/generator.
$\Rightarrow$ Chapter 8.3 "Generator "Pro"" (Function)
Configurable time base: mm:ss, hh:mm und dd:hh (s=seconds, m=minutes, h=hours, d=days).
$\Rightarrow$ Chapter 8.3 "Generator "Pro"" (unit)
The settings for segment setpoints (SPP1 - SPP8) and segment times (tP1 - tP8) are made in the program editor.


## 5 Operation

The program segments (up to eight) are defined by the segment setpoint and the segment time.


Entry through setup program

Additional functions via the setup program

The setup program (accessory) features a user-friendly program editor, with a graphical presentation of the program profile.

- Start at the process value
- Response to over/underrange
- Repeat program
- Setpoint input (ramp/step)
- Process is controlled to the most recent setpoint
- Delay time
- Program editor/management with graphical preview
- Up to four control contacts can be programmed segment by segment
- Parameter sets can be assigned segment by segment


## 5 Operation

### 5.6.2 Operation



The program is canceled in the event of a power failure.
Additional program control functions via binary functions.
$\Rightarrow$ Chapter 8.6 "Binary functions "binF""

## 5 Operation

### 5.6.3 Shifting the program profile

The function "External setpoint with correction" can be used to shift the program profile upwards or downwards (configurable through the setup program only).


The external setpoint is defined via an analog signal.
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""

## 5 Operation

## 6 Operator level

## Access



The four setpoints are displayed and edited here, and additional process variables are shown in accordance with the configuration.

| Symbol | Meaning |
| :---: | :---: |
| 5P | Setpoint 1 (editable) |
| $5 P$ 2 | Setpoint 2 (editable) |
| $5 P 3$ | Setpoint 3 (editable) |
| $5 P 4$ | Setpoint 4 (editable) |
| 5 Pr | Ramp setpoint (only if configured) |
| inP 1 | Measurement of analog input 1 |
| inpl | Measurement of analog input 2 (only if available) |
| F 1 | Calculated result of math formula 1 (and for difference, ratio and humidity controller) |
| F? | Calculated result of math formula 2 (only if available) |
| 4 | Controller output |
| trun | Program run time (only with program controller/generator) |
| trES | Residual program time (only with program controller/generator) |
| t 1 | Timer run time 1 (only if configured) |
| t? | Timer run time 2 (only if configured) |

## 6 Operator level

## Definition of the program times



## 7 Parameter level

## General

Two parameter sets (PAr1 and PAr2) can be stored.

## Access

Applications

Example

- Parameter set switching via binary function
$\Rightarrow$ Chapter 8.6 "Binary functions "binF""
- Allocating parameter sets to program segments (only through the setup program)
$\Rightarrow$ Program editor/Program

Setting a 2-state controller with PI action:
$\mathrm{Pb} 1=12^{\circ} \mathrm{C}$ (proportional band)
rt=160sec (reset time; I component)
$\mathrm{dt}=0 \mathrm{sec}$ (derivative time, D component)

## 7 Parameter level

| Proportional band | PRrR $\rightarrow$ PRr ${ }^{\text {( }}$ PRre2) |  |  | Description |
| :---: | :---: | :---: | :---: | :---: |
|  | Display | Value range | Factory setting |  |
|  | Pb : | 0...9999 | 0 | Size of the proportional band <br> The gain of the controller decreases with increasing proportional band. <br> With $\mathrm{Pb} 1,2=0$ the controller structure is ineffective (limit comparator response). <br> Continuous controllers: $\mathrm{Pb} 1,2$ must be $>0$. |
|  | Pb? | 0...9999 | 0 |  |
| Derivative time | $d t$ | 0...9999 s | 80 s | Influences the differential component of the controller output signal. <br> The effect of the D component increases with increasing derivative time. |
| Reset time | rt | 0...9999 s | 350 s | Influences the integral component of the controller output signal. <br> The effect of the I component decreases with increasing reset time. |
| Cycle time | [】1 | 0.0...999.9s | 20 s | With a switched output, the cycle time should be chosen so that a) the pulsed energy flow to the process does not cause any impermissible PV fluctuations and b) the switching elements are not overloaded. |
|  | [บ2 | 0.0...999.9 s | 20 s |  |
| Contact spacing (dead band) | db | 0.0...999.9 | 0 | The spacing between the two control contacts for 3 -state or modulating controllers. |
| Switching differential | H45 | 0.0...999.9 | 1 | Hysteresis for switching controllers with $\mathrm{Pb} 1,2=0$. |
|  | Hப5? | 0.0...999.9 | 1 |  |
| Actuator time | tt | 5...3000 s | 60 s | Actuator time range used by the control valve for modulating controllers. |
| Working point | 40 | -100...+100\% | 0\% | Output for P and PD controllers ( $w$ hen $\mathrm{x}=\mathrm{w}$ then $\mathrm{y}=\mathrm{YO}$ ). |
| Output limiting | リ1 | 0..100\% | 100\% | Maximum output limiting. Minimum output limiting. (only effective with $\mathrm{PB}>0$ !) |
|  | 42 | -100...+100 \% | -100\% |  |

The parameters $\mathrm{Pb} 2, \mathrm{Cy} 2$, HyS2 refer to the second controller output for a 3 -state controller.
The decimal place of some parameters depends on the decimal place setting in the displays.

The parameter display on the instrument depends on the controller type selected.
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""

## 8 Configuration

## General

The following applies to the representation of parameters and functions at the configuration level:
The parameter is not displayed or can not be selected if

- the equipment level does not permit the function assigned to the parameter.

Example: Analog output 2 can not be configured if
analog output 2 is not implemented in the instrument.
Some parameters can only be programmed through the setup program. These are marked in the symbol column with "(setup)".
The symbol (appears in the display) that corresponds to the menu item is shown in the chapter headings (e.g. 8.1 Analog inputs "InP").

## Access



龱 Levels can be inhibited.
$\Rightarrow$ Chapter 5.3 "Level inhibit"

## 8 Configuration

## Analog selector

With some parameters, you can choose from a series of analog values. To provide you with an overview, this selection is listed below.

0 no function
1 analog input 1
2 analog input 2
3 process value
4 present setpoint
5 ramp end value
6 program setpoint
7 math 1
8 math 2
9 setpoint 1
10 setpoint 2
13 controller output level
14 controller output 1
15 controller output 2

21 program run time in sec
22 residual program time in sec
23 segment run time in sec
24 residual segment time in sec
25 timer run time for timer 1 in sec
26 timer run time for timer 2 in sec
27 residual run time for timer 1 in sec
28 residual run time for timer 2 in sec
29 present segment end value
30 analog marker (Profibus)
31 reserved
32 reserved
33 reserved

## Definition of the program times


(1) Program run time
(3) Segment run time
(2) Residual program time
(4) Residual segment time

## 8 Configuration

### 8.1 Analog inputs "InP"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

Sensor type

## Linearization

InP: Analog input
Depending on the instrument version, up to two analog inputs are available.

なThe approval according to DIN EN 14597 requires the usage of probes, also approved to DIN EN 14597, in the specified temperature ranges.
$\Rightarrow$ see data sheets T90.1006 and T90.2006

Analog input 1 inP $\mid \rightarrow$
Analog input 2 inP己 $\rightarrow$

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| 5En5 | 0 1 2 3 4 5 6 7 8 9 10 11 | no function <br> Resistance thermometer in 3-wire circuit <br> Resistance thermometer in 2-wire circuit <br> Resistance thermometer in 4-wire circuit <br> Thermocouple <br> Resistance transmitter <br> Heater current $0-50 \mathrm{~mA} \mathrm{AC}$ (analog input 2 only) $0-20 \mathrm{~mA}$ <br> $4-20 \mathrm{~mA}$ <br> $0-10 \mathrm{~V}$ <br> $2-10 V$ <br> $0-1 \mathrm{~V}$ <br> factory-set on analog input 2: no function |
| LIM | 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 | Linear <br> Pt100 <br> Pt500 <br> Pt1000 <br> KTY11-6 <br> W5Re_W26Re C <br> W3Re_W25Re D <br> NiCr-Con E <br> Cu-Con T <br> Fe-Con J <br> Cu-Con U <br> Fe-Con L <br> $\mathrm{NiCr}-\mathrm{Ni} \mathrm{K}$ <br> Pt10Rh-Pt S <br> Pt13Rh-Pt R <br> Pt30Rh-Pt6Rh B <br> NiCrSi-NiSi N <br> W3Re_W26Re <br> customized linearization <br> For customized linearization, a maximum of 10 knee-points can be implemented, or a 5th order polynomial function programmed (only through the setup program). <br> For the linearization "KTY11-6", the resistance is $2 \mathrm{k} \Omega$ at $25^{\circ} \mathrm{C}$ (only through the setup program). |

Factory settings are shown bold.

## 8 Configuration

| Measurement offset | Analog input 1 inP $\rightarrow$ Analog input 2 inP己 $\rightarrow$ |  |  |
| :---: | :---: | :---: | :---: |
|  | Symbol | Value/selection | Description |
|  | OFFS | -1999...0.. +9999 | The measurement offset is used to correct a measured value by a certain amount upwards or downwards. <br> The controller uses the corrected value (= displayed value) for its calculation. This value is not the same as the actually measured value. If incorrectly applied, this can result in impermissible values of the control variable. <br> Special case: 2-wire circuit If the input is connected to a resistance thermometer in 2-wire circuit, then the lead resistance is set in ohms here. |
| Display start | 551 | -1999...0...+9999 | On transducers with standard signal and on potentiometers, a display value is assigned to the physical signal. |
| Display end | 5 CH | -1999... 100...+9999 | Example: $0-20 \mathrm{~mA} \xlongequal{ } \wedge-1500^{\circ} \mathrm{C}$. <br> The range of the physical signal can be $20 \%$ wider or narrower without generating an out-of-range signal. |
| Filter time constant | $d F$ | 0...0.6... 100 s | To adjust the digital input filter (Osec = filter off). <br> $63 \%$ of the alterations are acquired after $2 x$ filter time constant at a signal step change. <br> When the filter time constant is large: <br> - high damping of disturbance signals <br> - slow reaction of the process value display to process value changes <br> - low limit-frequency (2nd order low-pass filter) |
| Fine tuning start value | FE5 ${ }^{1}$ | -1999... 0... 9999 | $\Rightarrow$ See "Customized fine tuning" on Page 43. <br> If these values are altered by mistake, then this setting has to be canceled, using the procedure described under "Customized fine tuning". <br> These values can not be accepted by another instrument. |
| Fine tuning end value | FLE ${ }^{1}$ | -1999...1...+9999 |  |
| Heater current monitoring (output) | HERE | $\begin{array}{r} 0 \\ 1 \ldots . .10 \end{array}$ | No function <br> Binary output 1-10 (controller output) <br> The heater current is measured via a current transformer with standard signal output and can be monitored by linking analog output 2 to limit comparator 1. <br> The input signal range is $0-50 \mathrm{~mA} \mathrm{AC}$ (see probe type: "Heater current") and must be scaled correspondingly (display start/end). <br> The heater current is measured when the heating contact is closed. For this purpose, the binary output which controls the heating contact (not the binary output for the alarm) has to be selected here. |
| KTY correction value at $25^{\circ} \mathrm{C}$ | (setup) | 0...2000...4000 $\Omega$ | Resistance at $25^{\circ} \mathrm{C} / 77^{\circ} \mathrm{F}$ for linearization "KTY 11-6" |

Factory settings are shown bold.

1. Both parameters can be activated/deactivated with setup program.

## 8 Configuration

| Analog inputs (general) in ${ }^{12} \rightarrow$ |  |  |  |
| :---: | :---: | :---: | :---: |
|  | Symbol | Value/selection | Description |
| Temperature unit | Üпl | 0 | deg. Celsius deg. Fahrenheit <br> Unit for temperature values |
| Sampling cycle time | EHat | 0 <br> 1 <br> 2 <br> 3 | 50 msec 90 msec 150 msec 250 msec |
| Supply frequency | (setup) | $\begin{aligned} & 50 \mathrm{~Hz} \\ & 60 \mathrm{~Hz} \end{aligned}$ | Adaptation of the conversion time of the input circuitry to the supply frequency |

Factory settings are shown bold.

### 8.1.1 Customized fine tuning

## Activate FtS and FtE with setup program

Ex-factory, both parameters are not visible at the device and have to be activated first.

* Connect the device to the PC and start the setup program
* Establisch a connection to the device
* Make a double click on Undocumented parameters

* Click on check box at Parameter 17 (a tick shall appear)
* Save the setup file and execute Data transfer to device

Now the parameters FtS and FtE are visible in the Configuration level.

## Principle

The customised fine tuning (= fine adjustment) is used to correct the values displayed by the device. This may be necessary, for example, after a system validation, if the displayed values no longer coincide with the actual values at the point where the measurement is taken.

Using a reference measuring instrument, two measured values are determined which should be as far apart as possible (start value, end value). Ensure that the measuring conditions are stable. Enter the reference value found as the start value (FtS) or end value (FtE) on the device to be adjusted.

## 8 Configuration



## Example

## Procedure

Characteristic curve

## Caution:

If start value and/or end value deviate from the factory-set values (FtS=0 and FtE=1), a fine adjustment has already been done before. In this case the fine adjustment has to be reset (see below).
Repeating fine adjustment without doing a reset before means that an already adjusted characteristic curve is used. This leads to wrong values.

The temperature inside an oven is measured with a resistance thermometer and displayed on a device. The reading on the device deviates from the actual temperature as a result of the sensor temperature drifting. At $20^{\circ} \mathrm{C}$ the device reads $15^{\circ} \mathrm{C}$, at $80^{\circ} \mathrm{C}$ it shows $70^{\circ} \mathrm{C}$ (exaggerated example for better understanding).


* Determine lower measurement value (as low as possible and constant) with a reference measuring instrument;
Example: Oven temperature $20^{\circ} \mathrm{C}$ (= room temperature)
* Set start value at the device to this lower measurement value;

Example: Set start value (FtS) to 20

* Increase temperature and determine higher measurement value (as high as posible and constant) with reference measuring instrument;
Example: Increase oven temperature to $80^{\circ} \mathrm{C}$
* Set end value at the device to this higher measurement value;

Example: Set end value (FtE) to 80

The following diagram shows the changes in the characteristic curve caused by the fine adjustment (point of intersection with the x axis as well as ascent)


Special case: Offset
If the deviation between measured value and displayed value at the low and high measuring point is identical, an offset correction is sufficient (ascent remains unchanged). In this case, fine adjustment is not required.
$\Rightarrow$ Chapter 8.1 "Analog inputs "InP"" Parameter OFFS

## Reset <br> fine adjustment

In order to reset fine adjustment, the same value hast to be given to start value (FtS) and end value (FtE) (e. g. set both parameters to 0). This automatically sets the start value to 0 and the end value to 1 (factory setting).

## 8 Configuration

### 8.2 Controller "Cntr"

## Configuration

Analog inputs

## Controller

Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

| Controller type | Symbol | Value/selection | Description |
| :---: | :---: | :---: | :---: |
|  | Configuration |  |  |
|  | ELபP | 0 1 2 3 4 | no function 2-state controller 3-state controller Modulating controller Continuous controller |
| Control action | ERat | 0 | Direct <br> Inverse <br> inverse: <br> The controller output Y is $>0$ when the process value is smaller than the setpoint (e. g. heating). <br> The controller output Y is $>0$ when the process value is larger than the setpoint (e. g. cooling). |
| Inhibit manual mode | InHA | 0 | enabled <br> inhibited <br> If the manual mode is inhibited, changing over to "manual" is not possible from the keys or via the binary input. |
| Manual output | HRand | -100... 101 | Defines the controller output level after changing over to manual mode. <br> 101 = last output <br> For modulating controller: <br> 101 = actuator is stationary; <br> $0=$ actuator closes; $100=$ actuator opens |
| Range output | -Rut | -100...0... 101 | Output on over/underrange. <br> 101 = last output <br> For modulating controller: <br> 101 = actuator is stationary; <br> $0=$ actuator closes; $100=$ actuator opens |
| Setpoint low | 5PL | -1999...+9999 | Setpoint limiting prevents the input of values outside the defined range. |
| Setpoint high | 5PH | -1999 ...+9999 | The setpoint limits are not effective with setpoint input via the interface. <br> The correction value is limited for external setpoint with correction. |

Factory settings are shown bold.

## 8 Configuration



Factory settings are shown bold.

## Analog selector

| 0 | no function | 21 program run time in sec |
| :--- | :--- | :--- |
| 1 | analog input 1 | 22 residual program time in sec |
| 2 | analog input 2 | 23 segment run time in sec |
| 3 process value | 24 residual segment time in sec |  |
| 4 present setpoint | 25 timer run time for timer 1 in sec |  |
| 5 ramp end value | 26 timer run time for timer 2 in sec |  |
| 6 program setpoint | 27 residual run time for timer 1 in sec |  |
| 7 math 1 | 28 residual run time for timer 2 in sec |  |
| 8 math 2 | 29 present segment end value |  |
| 9 setpoint 1 | 30 analog marker (Profibus) |  |
| 10 setpoint 2 | 31 reserved |  |
| 11 setpoint 3 | 32 reserved |  |
| 12 setpoint 4 | 33 reserved |  |
| 13 controller output level |  |  |
| 14 controller output 1 |  |  |
| 15 controller output 2 |  |  |

## 8 Configuration

### 8.3 Generator "Pro"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

## Pro: (Program) Generator

The basic function of the instrument is defined here. The instrument can be operated as a fixed-setpoint controller with or without a ramp function, or warm-up ramp for hot-channel equipment, program controller or program generator.

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| General |  |  |
| Frat | 0 1 2 3 4 | Fixed-setpoint controller <br> Ramp function <br> Program controller <br> Program generator <br> Hot-channel controller <br> Ramp function: <br> A rising or a falling ramp function can be implemented. The ramp end value is determined by the setpoint input and can be altered from the $\boldsymbol{\Delta}$ and $\boldsymbol{\nabla}$ keys, just as for a fixed-setpoint controller. <br> The ramp function can be paused or canceled via the binary functions. <br> $\Rightarrow$ Chapter 8.6 "Binary functions "binF"" <br> The ramp function is interrupted on a probe break, or for manual mode. The outputs react as for overrange/ underrange (configurable). <br> Program generator: <br> Is used, for instance, to output the setpoint profile via a continuous output without a control function. <br> Settings for the program generator are not evaluated with regard to the process value (e. g. start at process value, continue, tolerance band). |

Factory settings are shown bold.

## 8 Configuration

| Unit of slope | Unו | 0 |  |
| :---: | :---: | :---: | :---: |
| Ramp slope | －R5L | 0．．． 9999 | Value of slope for ramp function |
| Tolerance band | toip | 0．．． 999 | 0＝off <br> For a program controller／generator and ramp function，the process value can be monitored by applying a tolerance band around the setpoint profile． <br> If the upper or lower limit is infringed，a tolerance limit signal is generated，which is internally processed or produced via an output． <br> Example： <br> Signal is produced when process value is $20^{\circ} \mathrm{C}$ larger or smaller than setpoint． toLP＝40 <br> Processing the tolerance limit signal，see： <br> $\Rightarrow$ Chapter 8.5 ＂Outputs＂OutP＂＂ <br> $\Rightarrow$ Chapter 8.6 ＂Binary functions＂binF＂＂ |
|  | Progr |  |  |
| Program start | （setup） | Program start start at the process value | Defines whether the program starts with the first program setpoint or whether the present process value is accepted as the first program setpoint． |
| Range response | （setup） | Continue pause program | Defines the response to over／underrange |
| Response to power－on | （setup） | No start automatic start | Defines whether the program starts on connecting the supply voltage． |
| Program repeat | （setup） | none cyclic | The＂Cyclic＂setting has the effect of continuously repeating the program． |
| Setpoint input | （setup） | Ramp Step |  |
| Control to the most recent setpoint | （setup） | inactive active | If active，the process is controlled to the most recent program setpoint after the program has ended． |
| Delay time | （setup） | 0．．． 9999 min | Delays the program start by an adjustable time． <br> ＂Sヒール＂is shown in the lower display． |
|  | Basic s | tus |  |
| Control contacts | （setup） | $\begin{aligned} & \hline \text { SK1 } \\ & \text { SK2 } \\ & \text { SK3 } \\ & \text { SK4 } \end{aligned}$ | The four control contacts can be activated in the basic status （when the program is not running）． |

Factory settings are shown bold．

## 8 Configuration

## Hot-channel controller

The warm-up ramp for hot-channel equipment is used, for example, for the gentle operation of ceramic heater elements. Damage can be avoided by allowing moisture to evaporate slowly from the hygroscopic heater elements during the warm-up phase $\left(t_{0}-t_{2}\right)$.


The present setpoint is accepted as the start value for the ramp at time $t_{0}$. Within the time period $t_{0}-t_{1}$, the programmed ramp slope rASL is used to approach the hold setpoint SPP2. Within this period, the ramp setpoint is increased linearly. This is followed by the programmable dwell time tP2 $\left(t_{1}-t_{2}\right)$, after which the process is controlled to the present setpoint (factory setting: setpoint 1 (SP1)).

The hot-channel function, with the settings for the ramp function and the program, is implemented through the setup program.

## Relevant settings:

## Setup/Generator/General

- Ramp slope rASL with time unit
- Tolerance band (optional)


## Setup/Generator/Program

- Configure program start to "Start at process value"
- Define response after power-on; the warm-up ramp either starts automatically when switching on the supply voltage, or by pressing the $\Delta$ key.


## Setup/Parameter level/Controller parameters

- Output limiting for parameter sets 1 and 2 (optional)


## Setup/Program editor/Program

- Set parameter set 2 for segment 1 (segment setpoint and time are not taken into account)
- Configure segment 2 with segment setpoint (= hold setpoint SPP2), segment time (= dwell time tP2) and parameter set 2


## Setup/Display - Operation/ User data

- Relevant parameters can optionally be placed in the user data (operator level)


## 8 Configuration

### 8.4 Limit comparators "LC"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

## Limit comparator

 functions (lk)LC: Limit comparator
Limit comparators (threshold monitors, limit contacts) can be used to monitor an input variable (process value for the limit comparator) against a fixed limit or another variable (the setpoint for the limit comparator). When a limit is exceeded, a signal can be output or an internal controller function initiated.
4 limit comparators are available.

Limit comparators can have different switching functions.
The hysteresis functions "asymmetrical, left" and "asymmetrical, right" can only be set through the setup program. The "symmetrical" hysteresis function is used as standard.

|  | asymmetrical, left | Hysteresis function symmetrical | asymmetrical, right |
| :---: | :---: | :---: | :---: |
| Ik1 |  |  |  |
| Ik2 |  |  |  |
| Ik3 |  |  |  |
| Ik4 |  |  |  |
| Ik5 |  |  |  |
| Ik6 |  |  |  |

## 8 Configuration

In the case of the limit comparator functions Ik7 and Ik8, the measurement that is set is monitored with respect to a fixed value AL.


|  | Limit comparator 1 L : $\rightarrow$ <br> Limit comparator 2 L[르 $\rightarrow$ <br> Limit comparator 3 L[3 $\rightarrow$ <br> Limit comparator 4 L[4 $\rightarrow$ |  |  |
| :---: | :---: | :---: | :---: |
|  | Symbol | Value/selection | Description |
| Function | Fnat | 0 <br> 1 <br> 2 <br> 3 <br> 4 <br> 5 <br> 6 <br> 7 <br> 8 | no function lk1 lk2 lk3 lk4 lk5 lk6 lk7 lk8 |
| Limit value | Ri | -1999...0...+9999 | Limit value to be monitored Limit range for lk1 and lk2: 0-9999 |
| Switching differential | Hபらt | 0...1... 9999 | Switching differential |

Factory settings are shown bold.

## 8 Configuration

Action/
range response

Switch-on delay

Switch-off delay

Limit comparator 1 L[ $\rightarrow$
Limit comparator 2 L[己 $\rightarrow$
Limit comparator 3 L $3 \rightarrow$
Limit comparator 4 LU $\rightarrow$

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| Para | 0 1 2 3 | absolute/off relative/off absolute/on relative/on <br> Defines the switching action of the limit comparators and the switch status for an overrange or underrange. <br> Action: <br> Defines the switching action of the limit comparators on a setpoint change or power-on. <br> absolute: <br> At the time of alteration, the limit comparator acts according to its function. <br> relative: <br> The limit comparator is in the OFF status. <br> An alteration of the limit value or the (limit comparator) setpoint could cause the limit comparator to switch ON. Such a reaction will be suppressed, and this condition is maintained until the (limit comparator) process value has moved out of the switch-on region (gray area). <br> Example: <br> Monitoring the (controller) process value x with function Ik4 Setpoint alteration $\mathrm{w}_{1} \rightarrow \mathrm{w}_{2}$ <br> a) Initial condition <br> b) Condition at the time of the alteration <br> The limit comparator remains OFF, although the process value is within the switch-on region. <br> c) Stabilized condition <br> The limit comparator again operates in accordance with its function. <br> This function also prevents a limit comparator from being triggered during the approach phase. |
| tOn | 0... 9999 | Delays the switch-on edge by a definable time period |
| EDFF | 0...9999s | Delays the switch-off edge by a definable time period |

Factory settings are shown bold.

## 8 Configuration

|  | Limit comparator 1 L[ $\rightarrow$ <br> Limit comparator 2 L[己 $\rightarrow$ <br> Limit comparator 3 L[ق $\rightarrow$ <br> Limit comparator 4 L[U $\rightarrow$ |  |  |
| :---: | :---: | :---: | :---: |
|  | Symbol | Value/selection | Description |
| Acknowledgement | Premil | 0 | no acknowledgement <br> acknowledgement; only with inactive limit comparator acknowledgement; always possible <br> For settings with acknowledgement, the limit comparator is latching, which means it remains ON, even when the switchon condition is no longer present. <br> The limit comparator must be reset via the $\boldsymbol{\nabla}+$ ExiT keys or binary signal. |
| Pulse time | LPut | 0...9999s | The limit comparator is automatically reset after an adjustable time period. |
| Limit comparator PV | LEPr | (analog selector) process value | see circuit diagrams |
| Limit comparator SP | 1-5P | (analog selector) present setpoint | see circuit diagrams (only with lk1 - lk6) |
| Hysteresis function | (setup) | symmetrical asymmetrical, left asymmetrical, right | see circuit diagrams <br> $\Rightarrow$ Chapter 12.2 "Alarm messages" |

Factory settings are shown bold.

Analog selector

| 0 no function | 21 program run time in sec |
| :--- | :--- |
| 1 analog input 1 | 22 residual program time in sec |
| 2 analog input 2 | 23 segment run time in sec |
| 3 process value | 24 residual segment time in sec |
| 4 present setpoint | 25 timer run time for timer 1 in sec |
| 5 ramp end value | 26 timer run time for timer 2 in sec |
| 6 program setpoint | 27 residual run time for timer 1 in sec |
| 7 math 1 | 28 residual run time for timer 2 in sec |
| 8 math 2 | 29 present segment end value |
| 9 setpoint 1 | 30 analog marker (Profibus) |
| 10 setpoint 2 | 31 reserved |
| 11 setpoint 3 | 32 reserved |
| 12 setpoint 4 | 33 reserved |
| 13 controller output level |  |
| 14 controller output 1 |  |
| 15 controller output 2 |  |

## 8 Configuration

### 8.5 Outputs "OutP"

## Configuration

Analog inputs
Controller
Generator
Limit comparators

## Outputs

Binary functions
Display
Timer
Interfaces

## Numbering of the outputs

OutP: Outputs
Configuration of the instrument outputs are subdivided into analog outputs (OutA; max. 2) and binary outputs (OutL; max. 9). Binary outputs are relay, solid-state relay and logic outputs. Display and numbering of the outputs depends on the assignment of the option slots.
The switching states of the binary outputs $1-6$ are shown in the display.

> Standard for all instrument versions:
> (Binary) output 1 (Out1) = relay
> (Binary) output 2 (Out2) $=$ relay
> (Binary) output 3 (Out3) $=$ logic output
> (Binary) output 4 (Out4) $=$ logic output

Extended numbering for the option slots:

| Slot | Plug-in board with <br> 1 analog output | Plug-in board with <br> 1 binary output <br> (relay or solid-state <br> relay) | Plug-in board with <br> 2 binary outputs <br> (2 relays) |
| :--- | :--- | :--- | :--- |
| Option 1 | Output 5 (Out5) | Output 5 (Out5) | Output 5+8 (Out5/Out8) |
| Option 2 | Output 6 (Out6) | Output 6 (Out6) | Output 6+9 (Out6/Out9) |
| Option 3 | Output 7 (Out7) | Output 7 (Out7) | Output 7+10 (Out7/Out0) |

Binary outputs ButL

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| Mat | 0 | no function |
|  | 1 | Controller output 1 (ex-factory with Out1) |
|  | 2 | Controller output 2 |
| ... | 5 | Binary input 1 |
| CぃしT | 6 | Binary input 2 |
|  | 7 | Binary input 3 |
|  | 8 | Binary input 4 |
|  | 9 | Binary input 5 |
|  | 10 | Binary input 6 |
|  | 11 | Binary input 7 |
|  | 12 | Binary input 8 |
|  | 13 | Limit comparator 1 |
|  | 14 | Limit comparator 2 |
|  | 15 | Limit comparator 3 |
|  | 16 | Limit comparator 4 |
|  | 17 | Control contact 1 |
|  | 18 | Control contact 2 |
|  | 19 | Control contact 3 |
|  | 20 | Control contact 4 |
|  | 21 | Logic formula 1 |
|  | 22 | Logic formula 2 |
|  | 23 | Timer 1 active |
|  | 24 | Timer 2 active |
|  | 25 | Program active |
|  | 26 | Program end signal |
|  | 27 | Tolerance limit signal |
|  | 28 | Manual mode on/off |
|  | 29 | Binary marker |
|  | 30 | Any binary value from storage address (only through setup) |
|  | 31 | always active |

Factory settings are shown bold.

## 8 Configuration

Function
Type of signal

Zero point
End value

Offset
Analog outputs ButA $\rightarrow$ Output 5 But5 $\rightarrow$

Range output


| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| Fnat | (analog selector) switched off | Function of the output |
| 5, 50 | 0  <br> 1  <br> 2  <br> 3  | Physical output signal $\begin{aligned} & 0-10 \mathrm{~V} \\ & 2=10 \mathrm{~V} \\ & 0-20 \mathrm{~mA} \\ & 4-20 \mathrm{~mA} \end{aligned}$ |
| rout | 0...101\% | Signal on going above/below range <br> 101 = last output signal <br> If the output is a controller output, the controller switches over to manual mode and produces the output level defined in chapter "Controller Cntr" under rOut. <br> Chapter 8.2 "Controller "Cntr"" |
| OPnt | -1999...0...+9999 | A physical output signal is assigned to the value range of an output variable. |
| End | -1999...100...+9999 | Ex-factory, the setting corresponds to an output level of $0-100 \%$ for controller outputs. <br> No changes of the ex-factory setting are required for continous controllers with only one output. <br> Setting for controller outputs for cooling With 3 -state controllers, the following settings must be predefined: <br> zero: 0 / end value: -100 <br> Example (function as a transducer): <br> An analog output ( $0-20 \mathrm{~mA}$ ) is to be used to put out the process value (value range 150 to $500^{\circ} \mathrm{C}$ ), that means: <br> 150 to $500^{\circ} \mathrm{C} \xlongequal[\wedge]{\wedge}-20 \mathrm{~mA}$; Zero point: 150 / End value: 500 |
| (setup) | -1999...0... 9999 | The offset is used to correct the output signal by a certain amount upwards or downwards. |

Factory settings are shown bold.

| 0 no function | 21 program run time in sec |
| :--- | :--- | :--- |
| 1 analog input 1 | 22 residual program time in sec |
| 2 analog input 2 | 23 segment run time in sec |
| 3 process value | 24 residual segment time in sec |
| 4 present setpoint | 25 timer run time for timer 1 in sec |
| 5 ramp end value | 26 timer run time for timer 2 in sec |
| 6 program setpoint | 27 residual run time for timer 1 in sec |
| 7 math 1 | 28 residual run time for timer 2 in sec |
| 8 math 2 | 29 present segment end value |
| 9 setpoint 1 | 30 analog marker (Profibus) |
| 10 setpoint 2 | 31 reserved |
| 11 setpoint 3 | 32 reserved |
| 12 setpoint 4 | 33 reserved |
| 13 controller output level |  |
| 14 controller output 1 |  |
| 15 controller output 2 |  |

## 8 Configuration

### 8.6 Binary functions "binF"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

## Switching action

## Edge-triggered functions

State-triggered functions
binF: Binary functions
Functions are assigned here to the binary signals of the binary inputs and limit comparators.
In addition, the functions for control contacts, tolerance limit signal and program end signal are defined for program controllers/generators.
In the case of a fixed-setpoint controller, functions can be assigned to the ramp end signals.


The functions are arranged in two groups:

The binary function reacts to switch-on edges.
The following functions are edge-triggered:

- Start/stop of autotuning
- Acknowledge limit comparators
- Program start/cancel
- Start timer
- Segment change

The binary function reacts to switch-on or switch-off states.

- All remaining functions


## 8 Configuration

| Binary input 1 | Symbol | Value／selection | Description |
| :---: | :---: | :---: | :---: |
|  | b，п I | 0 | no function |
|  |  | 1 | Start autotuning |
| ．．． |  | ， | Cancel autotuning |
| Binary input 8 | b，$\square^{\text {a }}$ | 4 | Change to manual mode Controller off（controller outputs are switched off） |
|  | 口1ma | 5 | Inhibit manual mode |
| Limit comparator 1 | LE 1 | 6 | Hold ramp |
|  |  | 7 | Cancel ramp |
| ．．． |  | 8 | Setpoint changeover |
| Limit comparator 4 | 15 | 19 | Parameter set switching |
|  | －1－4 | 11 | Level inhibit |
| Timer 1 | LF | 12 | Display＂off＂with key inhibit |
| Timer 2 | LF？ | 13 | Acknowledge limit comparators |
|  |  | 15 | Start program |
| Logic 1 | Loi | 16 | Pause program |
| Logic 2 | Lロコ | 18 | Cancel program |
|  |  | 19 | Start timer 1 |
| Control contact 1 | ［E1 | 20 | Start timer 2 |
|  |  | 21 | Cancel timer 1 |
| ．．． |  | 22 | Cancel timer 2 |
| Control contact 4 | ［－4 |  | Level inhibit： |
|  |  |  | The parameter and configuration levels are inhibited． |
| Tolerance limit signal | Lols |  | In addition，the start of autotuning is inhibited． |
| Program end signal | PrES |  | Program end signal： <br> The signal is active after approx． 1 second（pulse）．For longer signals，the program end signal can be used to start a timer． |
|  |  |  | Text display： <br> If the binary function is active，a configurable text is shown in the lower display．The text can be uniquely defined（only through the setup program）． |
|  |  |  | Type 703041： <br> The settings for the binary inputs $1+2$ have priority over those for the logic outputs． |

Factory settings are shown bold．

## Setpoint and parameter set switching

A binary function can be used to switch between setpoint 1 and setpoint 2 or parameter set 1 and parameter set 2.

| Setpoint switching | Parameter set switching | Binary signal |
| :--- | :--- | :--- |
| Setpoint 1 active | Parameter set 1 active | $0 /$ contact open |
| Setpoint 2 active | Parameter set 2 active | $1 /$ contact closed |

In order to switch between the four possible setpoints，two binary functions must be configured to＂setpoint switching＂．The states of the two binary functions are designated Z1 and Z2 and switch the setpoints over as shown in the table below：

| Setpoint | $\mathbf{Z 2}$ | $\mathbf{Z 1}$ |
| :--- | :--- | :--- |
| Setpoint 1 | 0 | 0 |
| Setpoint 2 | 0 | 1 |
| Setpoint 3 | 1 | 0 |
| Setpoint 4 | 1 | 1 |

0 ＝contact open／OFF 1 ＝contact closed／ON

## 8 Configuration

The states Z 1 and Z 2 are assigned to the binary functions in descending order (see list on the right), i. e. the first binary function selected in the list is Z 1 .

## Example:

The setpoint is to be selected via a binary input and the state of one limit comparator.
This results in the following assignment:
Z1 - binary input 1
Z2 - limit comparator 1
The binary function for the binary input 1 and limit comparator 1 have to be configured to "setpoint switching"
Depending on the further configuration, the following diagram applies:


Setpoint switching (active setpoint)
 external setpoint with correction


Setpoint 4

* An exception to this is the configuration for a program controller with external setpoint input, with or without correction. Setpoint 2 is the program setpoint in this case.

Additional functions via the setup program

Several binary functions can be combined through the setup program. In addition, the binary function "Text display" can be implemented. This is used to show a letter combination in the lower display.

## 8 Configuration

### 8.7 Display "diSP"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

| Upper display | Symbol | Value/selection | Description |
| :---: | :---: | :---: | :---: |
|  | General |  |  |
|  | d, 5u | (analog selector) process value | Displayed value for the upper display |
| Lower display | d, 5i | (analog selector) present setpoint | Displayed value for the lower display |
| Decimal point | dEcP | $\begin{aligned} & 0 \\ & 1 \\ & 2 \end{aligned}$ | no decimal place one decimal place two decimal places <br> If the value that is be displayed can no longer be represented with the programmed decimal point, then the number of decimal places will be automatically reduced. If, subsequently, the measured value decreases, the number increases to the programmed value of the decimal point. |
| 16-segment display | d, 5t | 0 1 2 3 4 | ```Displayed value for the two-digit 16-segment display switched off Unit ( \({ }^{\circ} \mathrm{C}\) or \({ }^{\circ} \mathrm{F}\) ) current segment current parameter set text (only setup program)``` |
| Brightness <br> Time-out | (setup) | 0... 5 | (bright) 0-5 (dark) |
|  | (setup) | 0...180...255s | Time period, after which the instrument automatically returns to normal display if no key is pressed. |
| Level inhibit | (setup) | none <br> configuration level parameter/ configuration level operator/ parameter/ configuration level | The access to the individual levels can be inhibited. <br> The setting is independent of the binary function "level inhibit". <br> Inhibiting the parameter level will, at the same time, also inhibit the start of autotuning. |
|  | User data (setup program) |  |  |
|  | Up to eight parameters from different levels can be shown under User data (operator level) on the instrument and edited. The symbols for these parameters (shown in the lower display) must be assigned by the user himself. |  |  |

Factory settings are shown bold.

## 8 Configuration

Analog selector

| 0 no function | 21 program run time in sec |
| :--- | :--- |
| 1 analog input 1 | 22 residual program time in sec |
| 2 analog input 2 | 23 segment run time in sec |
| 3 process value | 24 residual segment time in sec |
| 4 present setpoint | 25 timer run time for timer 1 in sec |
| 5 ramp end value | 26 timer run time for timer 2 in sec |
| 6 program setpoint | 27 residual run time for timer 1 in sec |
| 7 math 1 | 28 residual run time for timer 2 in sec |
| 8 math 2 | 29 present segment end value |
| 9 setpoint 1 | 30 analog marker (Profibus) |
| 10 setpoint 2 | 31 reserved |
| 11 setpoint 3 | 32 reserved |
| 12 setpoint 4 | 33 reserved |
| 13 controller output level |  |
| 14 controller output 1 |  |
| 15 controller output 2 |  |

## 8 Configuration

### 8.8 Timer "tFct"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces
tFct: Timer function
Time-dependent control actions can be carried out with the help of the timer. The timer signal (timer $1+2$ ) shows whether the timer is active. It can be output via the binary outputs or processed internally.
The timers are started or canceled via the binary functions.
$\Rightarrow$ Chapter 8.6 "Binary functions "binF""
The current timer run times can be viewed at the operator level (process data).

Function

Timer setting
Tolerance limit

Timer 1 LF $\rightarrow$
Timer 2 LFZ $\rightarrow$

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| Frat | 0 1 2 3 4 5 | no function <br> with timer running: timer signal=1 (signal is active) / unit of time: hh:mm <br> with timer running: timer signal=0 (signal is inactive) / unit of time: hh:mm tolerance band / unit of time: hh:mm <br> with timer running: timer signal $=1$ (signal is active) / unit of time: mm:ss with timer running: timer signal=0 (signal is inactive) / unit of time: mm:ss tolerance band / unit of time: mm:ss <br> Signal inactive <br> Function: "Tolerance band" <br> The time runs when the process value has reached a tolerance band around the setpoint. <br> Timer signal = 1 (signal is active) from the start of the function until the time has expired. |
| $t$ | 0...99:59 | Time input (unit of time, see "Function") |
| toit | 0... 999 | 0=off |

Factory settings are shown bold.

## 8 Configuration

### 8.9 Interfaces "IntF"

## Configuration

Analog inputs
Controller
Generator
Limit comparators
Outputs
Binary functions
Display
Timer
Interfaces

Protocol

Baud rate

Data format

## Device address

Min. response time

| Protocol | PROFIBUS-DP PrDF $\rightarrow$ |  |  |
| :---: | :---: | :---: | :---: |
|  | Symbol | Value/selection | Description |
|  | Prot | 0 | Intel Motorola Intel integer |
| Device address | Rdr | 0... $125 \ldots . .255$ | Address in data network |
| Analog marker | AnRP | -1999...0...+9999 | Analog value |
| Binary marker | b | 0 ... 255 | Binary value |

Factory settings are shown bold.

## IntF: Interfaces

The interface parameters for the RS422/485 or PROFIBUS-DP interface have to be configured in order to communicate with PCs, bus systems and peripheral devices.

PROFIBUS-DP Pr-IF $\rightarrow$

Modbus r4ここ $\rightarrow$

| Symbol | Value/selection | Description |
| :---: | :---: | :---: |
| Prot | 0 | Modbus Modbus integer |
| bdirt | 0 1 2 | 9600 bps 19200 bps 38400 bps |
| dFt | 0 1 2 3 | 8 data bits, 1 stop bit, no parity 8 data bits, 1 stop bit, odd parity 8 data bits, 1 stop bit, even parity 8 data bits, 2 stop bits, no parity |
| Rdr | 0... $1 . . .255$ | Address in data network |
| (setup) | 0...500ms | Minimum time that elapses between the request of a device in the data network and the response of the controller. |

Factory settings are shown bold.

Interface descriptions:

- B70.3041.2.0 (Modbus)
- B70.3041.2.3 (PROFIBUS-DP)


## 9 Tuning (optimization)

### 9.1 Autotuning (self-optimization)

## Oscillation method

Step response method

Autotuning (self-optimization, SO) establishes the optimum controller parameters for a PID or PI controller.

Depending on the controller type, the following controller parameters can be defined: Reset time (rt), derivative time (dt), proportional band (Pb), cycle time (Cy), filter time constant (dF)
The controller selects one of two procedures (a or b), depending on the size of the control deviation:


This type of optimization involves determining the control parameters through an output step that is applied to the process. First a standby output is produced until the process value is "steady" (constant). Afterwards, an output step (step size), which can be defined by the user, is automatically applied to the process. The resulting response of the process value is used to calculate the control parameters.
Autotuning establishes the optimum control parameters for a PID or PI controller, according to the selected control structure.
Depending on the controller type, the following control parameters can be determined: Reset time (rt), derivative time (dt), proportional band (Pb), cycle time (Cy), filter time constant ( dF )

Autotuning can be started from any system status, and can be repeated as often as is required.
The controller outputs (continuous, relay, solid-state), the controller standby output and the step size (min. 10\%) have to be defined.

## Principal applications of the step response method

- Autotuning instantly after "power on", during the approach phase Considerable time savings, setting: controller standby output = $0 \%$.
- The process does not readily permit oscillations (e.g. highly insulated furnaces with small losses, long oscillation period)
- Process value must not exceed setpoint

If the output (with stabilized setpoint) is known, overshoot can be avoided through the following adjustment:
standby output + step size <= output in stabilized condition

## 9 Tuning (optimization)

With output type "solid-state", the cycle time during autotuning is reduced to $8 x$ the sampling cycle time.
With the "relay" output type, care has to be taken that the process value is not influenced by the cycle time, since otherwise autotuning can not be completed successfully.
Solution: Reduce the cycle time Cy, until the process value is no longer influenced. (Manual mode can be used for the adjustment!)

Start of autotuning after power-on and during the approach phase


## 9 Tuning (optimization)

Start of autotuning during operation


## Starting autotuning

* Start with $\Delta$ and $\nabla$ (simultaneously $>2$ sec "tUnE" is shown, blinking, in the lower display

Autotuning is ended when the display automatically changes over to normal display.
The duration of autotuning depends on the control process.


శ్ర్ర心 The type of controller outputs has to be defined for autotuning.
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""
For a device configured as program controller, the autotuning can only be started if no program is running (normal display).
In case of problems, you may find further information at www.jumo.net (Support/FAQ).

## Canceling autotuning

* Cancel with $\Delta$ and $\boldsymbol{\nabla}$ (simultaneously)


## 9 Tuning (optimization)

### 9.2 Check of the tuning

The optimum adaptation of the controller to the process can be checked by recording the approach phase (e.g. with Startup) with the control loop closed. The diagrams below indicate possible maladjustments and how these can be corrected.

The control response of a third-order control loop for a PID controller is shown as an example. However, the procedure for adjusting the controller parameters can also be applied to other control loops.


## 10 Extra codes

### 10.1 Math and logic module

The setup program can be used to implement two mathematical calculations or logical combinations of various signals and process variables from the controller in a formula.

With math formulae, the calculated result is presented through the two signals "Math 1" and "Math 2" of the analog selector. With logic formulae, the result of the logical combination is available through the signals "Logic 1" and "Logic 2" of the binary selector and when configuring the binary functions.

Chapter 8.6 "Binary functions "binF""

## Entering formulae

- The string of signs in the formula consists of ASCII characters, and can have a maximum length of 60 characters.
- The formula can only be entered in the setup program.
- Formulae can be freely entered according to normal mathematical rules.
- Spaces can be inserted at will into the formula character string. But spaces are not permitted within function labels, variable names and constants.


### 10.2 Difference, humidity or ratio controller

The controller is preset either as a difference/humidity or ratio controller (extra code) or must be configured via the setup program. Analog input 2 must be available.
$\Rightarrow$ Setup/Only setup/Math/Logic/Math 1
The process variables for the two analog inputs have a fixed definition.

Difference control

The difference between the measurements from analog input 1 and 2 is formed and made available via "Math 1 ". Input 1 is affected by the controller. Input 2 is the reference value.
Difference: E1-E2


E1 = analog input 1
E2 = analog input 2
w = setpoint
$x$ = process value

For the controller to function as a difference controller, further settings have to be made:

- controller process value: math 1
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""
If the difference is to be displayed, then one display must be configured to "Math 1".
$\Rightarrow$ Chapter 8.7 "Display "diSP""


## 10 Extra codes

## Humidity control

A psychrometric humidity sensor is used to determine relative humidity, through the mathematical combination of wet bulb and dry bulb temperatures.
relative humidity: (E1, E2)


E1 = analog input 1
(dry bulb temperature)
E2 = analog input 2
(wet bulb temperature)
$\mathrm{w}=$ setpoint
$x$ = process value

For the controller to function as a humidity controller, further settings have to be made:

- controller process value: math 1
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""
If the value for relative humidity needs to be displayed, then one display must be configured to "Math 1".
$\Rightarrow$ Chapter 8.7 "Display "diSP""

The control is always based on analog input 1 (E1).
The math module forms the ratio of the measurements from E1 and E2, and produces the setpoint for the controller. The ratio of the measurements can be called up through the function "Math 1" and displayed.
The required ratio E1/E2 is programmed as the setpoint (ratio setpoint) in the setpoint definition.

Ratio: E1/E2


E1 = analog input 1
E2 = analog input 2
w = setpoint
$w v=$ ratio setpoint
$x$ = process value

For the controller to function as a ratio controller, further settings have to be made:

- controller process value: analog input 1
- external setpoint: ramp end value
$\Rightarrow$ Chapter 8.2 "Controller "Cntr""
If the ratio needs to be displayed, then one display must be configured to "Math 1 ".
$\Rightarrow$ Chapter 8.7 "Display "diSP""


## 11 Retrofitting of modules

## Safety notes

Retrofitting of modules must only be carried out by qualified professional persons.
$\Delta$
The modules can be damaged by electrostatic discharge. So avoid electrostatic charge during fitting and removal. Carry out retrofitting on a workbench that is earthed.

Identifying the module

* Identify the module by the Sales. No. glued onto the packaging

| Module | Code | Sales no. | View of boards |
| :---: | :---: | :---: | :---: |
| Analog input 2 | 1 | 70/00442785 |  |
| 1 relay (changeover, SPDT) | 2 | 70/00442786 |  |
| 2 relays (make, SPST-NO) | 3 | 70/00442787 | (10m |
| 1 analog output | 4 | 70/00442788 |  |
| 2 binary inputs | 5 | 70/00442789 |  |
| 1 solid-state relay $230 \mathrm{~V} / 1 \mathrm{~A}$ | 6 | 70/00442790 |  |
| RS422/485 interface | 7 | 70/00442782 |  |
| PROFIBUS-DP | 8 | 70/00442791 |  |

## 11 Retrofitting of modules

Removing the controller module

* Press together the knurled surfaces on the front panel (top and bottom, or left and right for landscape format) and pull out the controller module.


Retrofitting of modules

Select the slot for the option (Observe the restrictions for Type 703041! (see connection diagram))

Type 703041


雨
On Type 703041, relays can only be retrofitted in option slot 1!

Type 703042/43/44


* Push the module into the slot until the plug connector snaps into place

* Push the module into the housing until the lugs snap into their slots
12.1 Technical data

Thermocouple input

| Designation |  | Measuring range | Measuring accuracy | Ambient temperature error |
| :---: | :---: | :---: | :---: | :---: |
| Fe-Con L |  | -200 to $+900^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Fe-Con J | EN 60584 | -200 to $+1200^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Cu-Con U |  | -200 to $+600^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Cu-Con T | EN 60584 | -200 to $+400^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| NiCr-Ni K | EN 60584 | -200 to $+1372{ }^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| NiCr-Con E | EN 60584 | -200 to $+1000^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| NiCrSi-NiSi N | EN 60584 | -100 to $+1300^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Pt10Rh-Pt S | EN 60584 | 0 to $1768{ }^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Pt13Rh-Pt R | EN 60584 | 0 to $1768^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Pt30Rh-Pt6Rh B | EN 60584 | 0 to $1820^{\circ} \mathrm{C}$ | $\leq 0.25 \%{ }^{\text {a }}$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| W5Re-W26Re C |  | 0 to $2320{ }^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| W3Re-W25Re D |  | 0 to $2495{ }^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| W3Re-W26Re |  | Oto $2400{ }^{\circ} \mathrm{C}$ | $\leq 0.25 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Cold junction |  | Pt100, internal |  |  |

a. in the range 300 to $1820^{\circ} \mathrm{C}$

## Input for resistance thermometer

| Designation | Connection | Measuring range | Measuring accuracy |  | Ambient temperature error |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 3-/4-wire | 2-wire |  |
| Pt100 EN 60751 <br> (factory setting)  | 2-wire / 3-wire / 4-wire | -200 to $+850^{\circ} \mathrm{C}$ | $\leq 0.05 \%$ | $\leq 0.4 \%$ | $50 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Pt500 EN 60751 | 2-wire / 3-wire / 4-wire | -200 to $+850^{\circ} \mathrm{C}$ | $\leq 0.2 \%$ | $\leq 0.4 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Pt1000 EN 60751 | 2-wire / 3-wire / 4-wire | -200 to $+850^{\circ} \mathrm{C}$ | $\leq 0.1 \%$ | $\leq 0.2 \%$ | $50 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| KTY11-6 | 2-wire | -50 to $+150^{\circ} \mathrm{C}$ | - | $\leq 2.0 \%$ | $50 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Sensor lead resistance | max. $30 \Omega$ per lead for 3-wire or 4-wire circuit |  |  |  |  |
| Measuring current | approx. $250 \mu \mathrm{~A}$ |  |  |  |  |
| Lead compensation | Not required for 3-wire or 4 -wire circuit. With a 2-wire circuit, the lead resistance can be compensated in software by a correction of the process value. |  |  |  |  |

## Input for standard signals

| Designation | Measuring range | Measuring <br> accuracy | Ambient <br> temperature error |
| :--- | :--- | :--- | :--- |
| Voltage | $\mathrm{O}(2)-10 \mathrm{~V}$ <br> $0-1 \mathrm{~V}$ <br> input resistance $\mathrm{R}_{\mathrm{IN}}>100 \mathrm{k} \Omega$ | $\leq 0.05 \%$ <br> $\leq 0.05 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ <br> $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Current | $0(4)-20 \mathrm{~mA}$, voltage drop $\leq 1.5 \mathrm{~V}$ | $\leq 0.05 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Heating current | $0-50 \mathrm{~mA} \mathrm{AC}$ | $\leq 1 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |
| Resistance transmitter | $\min .100 \Omega, \max .4 \mathrm{k} \Omega$ | $\leq 0.5 \%$ | $100 \mathrm{ppm} /{ }^{\circ} \mathrm{C}$ |

## Binary inputs

[^2]
## 12 Appendix

## Measuring circuit monitoring

In the event of a fault, the outputs move to a defined (configurable) status.

| Sensor | Overrange / <br> underrange | Probe or lead short-circuit | Probe or lead break |
| :--- | :---: | :---: | :---: |
| Thermocouple | $\bullet$ | - | $\bullet$ |
| Resistance thermometer | $\bullet$ | $\bullet$ | $\bullet$ |
| Voltage $2-10 \mathrm{~V}$ | $\bullet$ | $\bullet$ | $\bullet$ |
|  | $0-10 \mathrm{~V}$ | $\bullet$ | - |
| Current | $4-20 \mathrm{~mA}$ | $\bullet$ | - |
|  |  |  |  |
|  | $0-20 \mathrm{~mA}$ | $\bullet$ | $\bullet$ |
| Resistance transmitter | $\bullet$ | - | $\bullet$ |

$\bullet=$ recognized $\quad-=$ not recognized

## Outputs

| Relay (changeover) for Type 703042/43/44 contact rating contact life | 5 A at 230VAC resistive load ${ }^{\text {a }}$ 350,000 operations at rated load / 750,000 operations at 1A |
| :---: | :---: |
| Relay (changeover) (option) contact rating contact life | 8 A at 230 VAC resistive load ${ }^{\text {a }}$ 100,000 operations at rated load / 350,000 operations at 3A |
| Relay (n.o. make) for Type 703041 contact rating contact life | $3 A$ at 230VAC resistive load 150,000 operations at rated load / 350,000 at 1A |
| Relay (n.o. make) (option) contact rating contact life | 3 A at 230VAC resistive load 350,000 operations at rated load / 900,000 operations at 1A |
| Logic output | $0 / 12 \mathrm{~V} / 30 \mathrm{~mA}$ max. (sum of all output currents) or $0 / 18 \mathrm{~V} / 25 \mathrm{~mA}$ max. (sum of all output currents) |
| Solid-state relay (option) contact rating protection circuitry | The holding current of the triac is at least 50 mA . 1 A at 230 V varistor |
| Voltage (option) output signals load resistance accuracy | $\begin{gathered} 0-10 \mathrm{~V} / 2-10 \mathrm{~V} \\ \mathrm{R}_{\text {load }} \geq 500 \Omega \\ \leq 0.5 \% \end{gathered}$ |
| Current (option) output signals load resistance accuracy | $\begin{gathered} 0-20 \mathrm{~mA} / 4-20 \mathrm{~mA} \\ \mathrm{R}_{\text {load }} \leq 500 \Omega \\ \leq 0.5 \% \\ \hline \end{gathered}$ |
| Supply voltage for 2-wire transmitter for Type 703042/43/44 voltage | electrically isolated, not stabilized <br> 17 V at 20 mA load, 25 V DC with no load |

a. 3 A with devices certified to DIN EN 14597

## Controller

| Controller type | 2-state controller (factory setting), |
| :--- | :---: |
| Controller structures | 3-state controller, modulating controller, continuous controller |$|$| P/PD/PI/PID |
| :--- |
| A/D converter |
| Sampling cycle time |

Electrical data

| Supply voltage (switchmode PSU) | $\begin{gathered} 110-240 \mathrm{~V} \text { AC }-15 /+10 \%, 48-63 \mathrm{~Hz} \\ 20-30 \mathrm{~V} \text { AC/DC, } 48-63 \mathrm{~Hz} \end{gathered}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Electrical safety | Type 703041: to EN 61010, Part 1 <br> Type 703042/43/44: to EN 60730 <br> Overvoltage category III, pollution degree 2 |  |  |  |
| Power consumption | Type 703041: 8VA max. Type 703042/43/44: 13VA max. |  |  |  |
| Data backup | EEPROM |  |  |  |
| Electrical connection | at the back, via screw terminals, conductor cross-section up to $2.5 \mathrm{~mm}^{2}$ with core ferrules (length: 10 mm ) <br> Conductor cross-sections and core-end ferrules for installation |  |  |  |
|  |  | Minimum crosssection | Maximum crosssection | Min. length of core-end ferrule |
|  | Without core-end ferrule | $0.34 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 10 mm (stripped) |
|  | Core-end ferrule, no lip | $0.25 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 10 mm |
|  | Core-end ferrule, lip up to $1.5 \mathrm{~mm}^{2}$ | $0.25 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | 10 mm |
|  | Core-end ferrule, lip above $1.5 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | $2.5 \mathrm{~mm}^{2}$ | 12 mm |
|  | Twin ferrule with lip | $0.25 \mathrm{~mm}^{2}$ | $1.5 \mathrm{~mm}^{2}$ | 12 mm |
| Electromagnetic compatibility interference emission interference immunity | EN 61326-1Class Bto industrial requirements |  |  |  |

## Housing

| Housing type | plastic housing for panel mounting to IEC 61554 |
| :--- | :---: |
| Depth behind panel | 90 mm |
| Ambient/storage temperature range | 0 to $55^{\circ} \mathrm{C} /-30$ to $+70^{\circ} \mathrm{C}$ |
| Climatic conditions | rel. humidity $\leq 90 \%$ annual mean, no condensation |
| Operating position | horizontal |
| Enclosure protection | to EN 60529, front IP65 / back IP20 |
| Weight (fully fitted) | Type 703041: approx. 220 g |
|  | Type $703042 / 43:$ approx. 380 g |
|  | Type 703044: approx. 490 g |

## Interface

Modbus

| Interface type | RS422/485 |  |  |
| :--- | :---: | :---: | :---: |
| Protocol | Modbus, Modbus Integer |  |  |
| Baud rate | $9600,19200,38400$ |  |  |
| Device address | $0-255$ |  |  |
| Max. number of nodes | 32 |  |  |
| PROFIBUS-DP | $0-255$ |  |  |
| Device address |  |  | 0 |

Approvals/marks of conformity

| Mark of <br> conformity | Testing laboratory | Certificates/certification <br> numbers | Test basis | valid for |
| :--- | :--- | :--- | :--- | :--- |
| DIN | DIN CERTCO | Register No. TR1187 | DIN EN 14597 | all types |
| GL - Hardware <br> GL - Software | Germanischer Lloyd | Type Approval Certificate <br> No. 45 059-07 HH | GL-Approval <br> Category C, EMC1 | $703044 / 191-320-23 /$ <br> 214,062 |
| c UL us | Underwriters Laboratories | E 201387 | UL 61010-1 <br> CAN/CSA-C22.2 No. 61010-1 | all types |

### 12.2 Alarm messages

| Display | Cause | Fault removal test/repair/replace |
| :---: | :---: | :---: |
| $-1999$ <br> (blinking!) | Underrange for the value being displayed. | - Check that the connected probe complies with the configured sensor type and linearization <br> - Check the probe connection and the terminals <br> - Check the cable <br> - Check probe for short-circuit and probe break <br> - In case of standard signal: Is the signal within the permissible range (e.g. 4-20mA)? |
| $\begin{aligned} & 9999 \\ & \text { (blinking!) } \end{aligned}$ | Overrange for the value being displayed. |  |
| $\begin{aligned} & 9999 \\ & \text { (lower display) } \end{aligned}$ | Error in output feedback of modulating controller | Check the source signal for output feedback |
| (blinking!) | Source signal for controller process value is switched off | Select a source signal in configuration level |
| all displays on; lower 7 -segment display is blinking | Watchdog or power-on trigger initialization (reset). | Replace the controller if the initialization continues for more than 5 sec |
| Praf | PROFIBUS error | Can be suppressed by setting the PROFIBUS address to " 0 " (if PROFIBUS interface is not used). |
| OPL | Hardware configuration error | Check which option boards are installed in the slots |

Overrange / underrange covers the following events:

- Probe break or short-circuit
- Measurement is outside the controllable range for the probe that is connected
- Display overflow


## A

Access code 39
Accessories 10
Acknowledgement 53
Analog input 41
Analog marker 62
Analog selector 40
Autotuning (self-optimization) 46, 63

## B

Baud rate 62
Binary functions 56
Binary marker 62
Binary output 54
Brightness 59

## C

Connection diagrams 17
Control action 45, 61-62
Control contacts 48
Controller 45
Controller module, removing 14
Controller standby output 46
Controller type 45, 54, 57, 61

## D

Data format 62
Decimal point 59
Delay time 48
Device address 62
Difference control 67
Dimensions 11
Display 59
Display end 42
Displays 25

## E

Electrical isolation 16
End value 55
Entering formulae 67
Entering programs 30
Entering times 28
Entering values 28

## F

Filter time constant 42
Fine tuning 42
Fitting 13
Front panel, care of 13

## H

Heater current monitoring 42
Hot-channel controller 49
Humidity control 68

Installation notes 15 Interface 62

## L

Level concept 26
Level inhibit 27, 59
Limit comparator 50
Limit comparator functions 50
Limit value 51
Linearization 41

## M

Manual mode 55
Manual mode, inhibiting 45
Manual output 45
Measurement offset 42
Module
identification 69
retrofitting 69
Mounting site 11

## 0

Outputs 54
numbering 54

## P

Parameter level 37
Parameter set switching 57
Password 39
PC interface 10
Program profile, shifting 33
Program start 48
Protocol 62
Pulse time 53

## R

Ramp slope 48
Range output 45
Ratio control 68

## S

Safety notes 69
Sampling cycle time 43

## 13 Index

Scope of delivery 10
Sensor type 41
Setpoint 35
external 46
Setpoint limits 45
Setpoint switching 57
Setup program 10
Side-by-side mounting 13
Signal type 55
Step response method 63
Step size 46
Supply frequency 43
Switching action 56
Switching differential 51
Switch-on delay 52

## T

Text display 57
Time-out 59
Timer 61
Tolerance band 48, 61
Tuning (optimization) 66
Type designation 9

## U

Unit 43, 48

## Z

Zero point 55

## Overview of the configuration level



JUMO GmbH \& Co. KG
Street address:
Moritz-Juchheim-Straße 1 36039 Fulda, Germany Delivery address:
Mackenrodtstraße 14
36039 Fulda, Germany Postal address:
36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway Harlow, Essex CM20 2DY, UK
Phone: +44 1279635533
Fax: $\quad+441279635262$
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
8 Technology Boulevard
Canastota, NY 13032, USA
Phone: 315-697-JUMO
1-800-554-JUMO
Fax: 315-697-5867
E-mail: info@jumo.us
Internet: www.jumo.us


[^0]:    1. Microsoft is a registered trademark of Microsoft Corporation
[^1]:    Note numbering of outputs.

[^2]:    Floating contacts

