JCT Analysentechnik GmbH

# Installation and Operating Instructions
# Compact controller series HT40
# HT41 / HT42 / HT43 / HT44 / HT45 …

## Contents





JCT Analysentechnik GmbH

Werner Heisenberg - Str. 4 / A-2700 Wr. Neustadt / Tel +43 (0)2622 87 201 / Fax +43 (0)2622 87 2011
sales@jct.at / Firmenbuchgericht: Kreisgericht Wr. Neustadt FN 119682 d / UID - Nummer ATU 20559900

## 1. Safety

This chapter provides important information about the safe operation of your HT40 and the use of these instructions.

### 1.1 Intended Usage

The HT40 series regulator is a microprocessor-based temperature regulator for industrial applications which has its own surface-mount housing. The configurable regulator is used to impose control, according to the parameters set, on manufacturer-approved heating elements (resistive loads) with defined sensors.

### 1.2 Non-intended usage

All usage outside the scope of those described in Point 1.1 are non-intended usage and may be hazardous and/or lead to consequential damage.

### 1.3 Operator

Installation, electrical connection, commissioning, operating and maintenance of the HT40 may only be performed by trained professionals who have been authorised or instructed for these activities by the operating authority.

### 1.4 Safety-relevant notices

Safety notices in this guide are marked by symbols. These notices are placed immediately before the procedure step to which they apply and must be followed precisely in order to avoid hazardous situations for persons and property damage to objects.

The following pictograms are used to call attention to notices:

**Attention !** is used to call attention to potential health hazards or lethal situations.

**Note !** is used for notices which, if disregarded, could result in failures during operational processes.

**Tip !** is used to provide advice or additional information.

### 1.5 Liability exclusion

We herewith expressly serve notice that Hillesheim is not liable for any damage resulting from incorrect or negligent operation, maintenance or non-intended usage. This also applies to device modifications, attachments and conversions which could be detrimental to safety. In these cases the manufacturer's warranty is voided.

## 2. General

### 2.1 Unpacking and inspecting

The product must be inspected for possible shipping damage when it is unpacked. If damage is found then the freight carrier, railway company or postal authority is to be notified so that a damage report can be initiated.

### 2.2 Standards and regulations

This product complies with the following national and European regulations:

The "Electromagnetic compatibility" directive (89/336/EEC and 93/68/EEC)

The "Low voltage equipment" directive (73/23/EEC und 93/68/EEC)

## 3. Important reference before start up procedure

According to the EMV instructions 89/336/EWG this controller is only a part of a complete unit. After connecting a heating system this EMV-instruction insists a new EMV-test. We call your attention to the fact, that the start up person is obligated to meet these instructions.

This controller was suppressed after practice measurements, therefore during operation with resistive components / heatings there should be no EMV-fails.

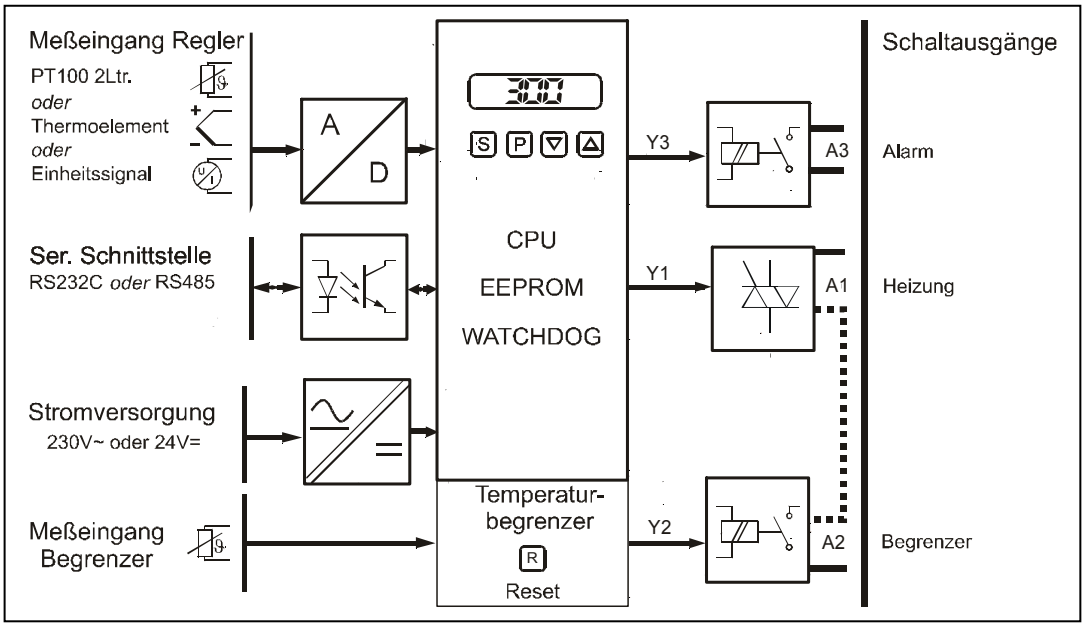
In case of using an electrical heating or a heating in uncontrolled operation, we call your attention to the VDE-instructions (safety in electro-heat-units DIN EN 60619-2 [VDE 0721 part 411]) and the instructions from professional association, which demand a thermal supervision (or a thermal clipper) in this case or an own-safe architecture. Please ask company Hillesheim in these cases.

## 4. Introduction

The self-optimised controller is an universal controller for machine-, unit- and apparatus construction because of its free configuration, its serial interface and the special compact construction.

This operating manual should support you with start up and operation of the controller. If you start up a controller of the compact controller series for the first time, please read next chapter start up.

**block diagram**



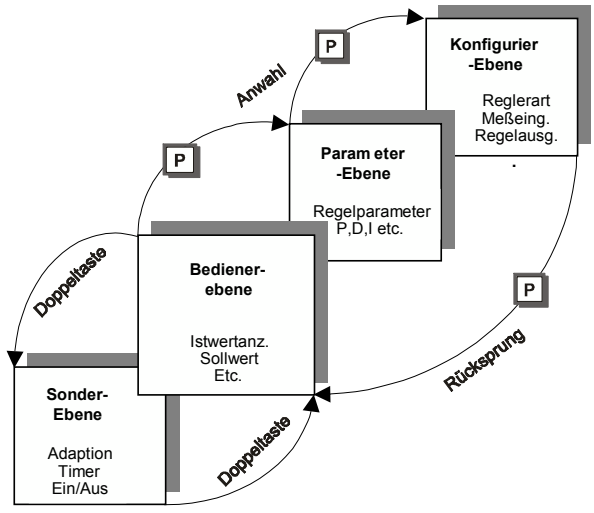

All controller functions are comprehended in four levels for a more easy and clear handling.

**Operating level:** standard mode, if controller is active. Here, e.g. the set point can be set or the regulation ratio can be displayed.

**parameter level:** can be called up by p-key; here, e.g. the parameter records for P, I and D are stored to modify the controller for process.

**Configuration level:** can be called up by p-key together with a code word to set the basic logic function of the controller, e.g. controller mode, mode of action of the inputs and outputs.

**Special level:** can be called up by pressing two keys together to program or activate e.g. the program or the timer.




## 5. Start up

Check power supply on type plate!

What to do:

1. Check position of jumper clip for measure input (right cover side page 4
2. Assembly and electrical terminal, set up power supply page 4
3. Select configuration level, fixing of controller configuration, measure inputs and controller outputs (not necessary if configured by manufactorer) ..... page 6ff

More writing options, please see list of contents


1 Connecting serial interface (option)

2 Measure input configuration

thermocouple or resistance thermometer Pt100

standard signal 0(4) …20mA

after switch clipper alarm function

3 Alter switch clipper alarm function

temperature clipper (relay Y2: clipper-function)

alarm function relay Y2

Assembly surface ca. 160,0mm x 100,0mm

### 5.1 Assembly

Please make sure that during assembly and following configuration of the controller the load-circuit is switched off. The controller should be assembled in such a way to protect it from inadmissible moisture and strong soiling. The admissible ambient temperature of 0…50°C may not passed over, even under worst conditions.

**1.** Compare power supply on type plate with supply voltage.

**2.** Check position of the jumper clip for measure input, and only set it at standard signal to the left or right position.

**3.** The mounting occurs by the four drillings (Ø 4,2mm) at the edges of the cooling plate. The cover must not be opened. Use screw with a 4mm diameter, e.g. M4

A spatial separation between controller and any inductive user / circuit breaker has to be guaranteed.

### 5.2 Electrical terminal

Voltage-, actuators- and test probe terminals have to be effected according to the terminal diagram (page 5, contact load HT41 and 43 see p.22).

The electrical wires have to be installed according to the customary instructions, resp. the legal instructions (in Germany e.g. VDE 0100) The controller is built in protection class II acc. DIN 57411/ VDE 0411. A terminal of a grounding conductor is not necessary. There is an internal connection between the grounding conductor and the user.

The controller has to be used at a separate voltage-supply, at the connecting terminal there may not be installed any other control current circles (circuit breaker, fan, etc) directly; they have to be wired separately.

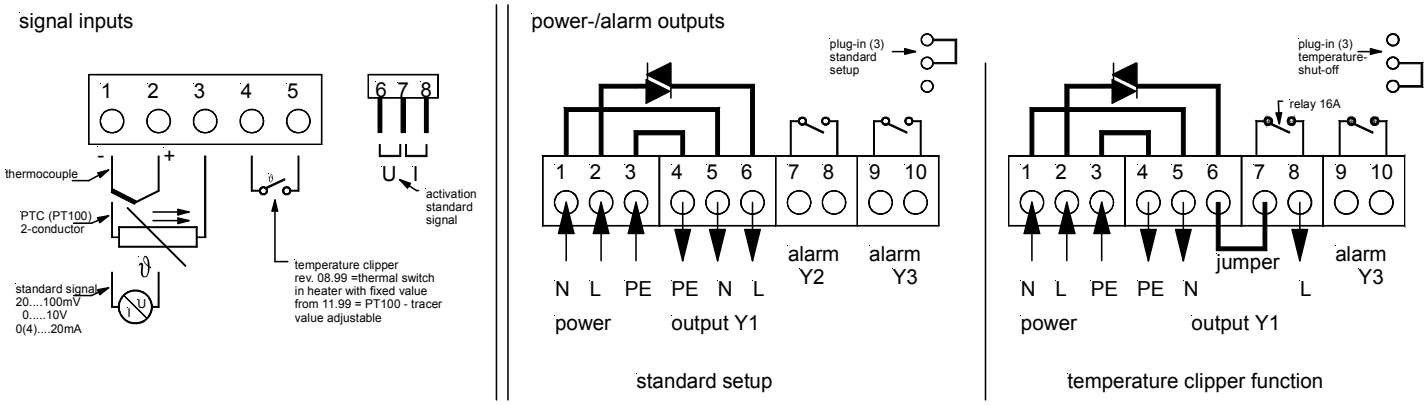
Use shielded wires and ground them one-sided.

To avoid noise crash on wires/control lines, the circuit breakers and magnet ventils have to be suppressed with adjusted RC-links.

The function of the signal terminals depends to the specific configuration. By activating the clipper function, the load circuit (L) is leaded over output A2 (relay 16A). There is also signal output A3 available.

| **Configuration of the outputs HT40.....** | | | |
|---|---|---|---|
| Configuration | triac output A1 | relay output A2 | relay output A3 |
| C 0201 | Y1: heating | Y2: alarm | Y3: alarm |
| C 0202 | Y1:no function | Y2: heating | Y3: alarm |
| C 0203 | Y1: heating | Y2: clipper function | Y3: alarm |

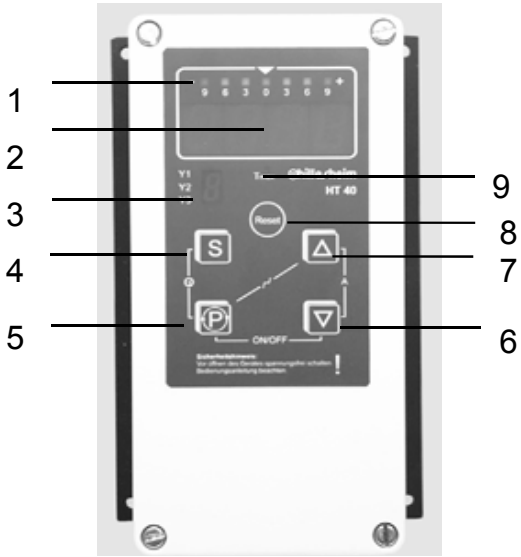
### 5.3 Terminal diagram




| | | |
|---|---|---|
| HT41 | controller | wired completely with temp. clipper function, but free configuration* |
| HT42 | controller | clamp controller standard set-up, free configuration* |
| HT43/44/45 | controller | wired completely in standard set-up, setted (tracer type, array) |

* carriage restore sensor type PT100, array 0…200°C, alarm output limit comparator +/- 10K

### 5.4 Operating elements and displays




**Displays**

1 deviation display (W-X)
2 digital display for actual-value / set point and datas
3 switch mode display of the controller outputs
9 temperature clipper attention display

**Key functions**

4 set point key [S]
5 parameter selection key [P]
6, 7 value smaller / bigger
8 reset key temp. clipper

**Double key functions**

[S] [P] timer (Option) on / off pressing longer the programming function will be called up

[P] [△] program on / off if pressing longer the programming function will be calldes up

[△] [▽] adaption on / off

[P] [▽] on / off function of controller outputs

**Typography**

9999 digital display of the set

**.** dummy for any display

[P] k brief key stroke (ca. 0,5 s)

[P] long key stroke (ca. 4 s)

[P] very long key stroke (ca. 7 s)

[P] keep key pressed

[S] [▽] keys, pressed together

2x [P] keys, to be pressed twice

radix piont blinking in segment display

**Please make sure that during configuration of the controller the load-circuit is switched off!**

## 6. Unit configuration

In the configuration level the controller will be modified to the control task and prepared for operation. The manufacturer configuration should be checked before the first start up and maybe changed.
The whole controller configuration is stored in a four-digit alpha-numeric code. The two most significant digits show the carriage restore. For each carriage restore a possible variant can be chosen (e.g. C00.** =carriage restore "controller type", where the ** stand for variants .02 =two-state-controller, .03 = three-state-controller etc.) or a value can be set (e.g. C 15.-- = actual-value-correction).

The basic procedure of a code selection / change is as follows:

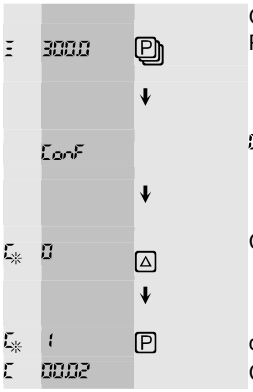
1. select the code to be changed with △or ▽ (leaf)
2. release the selected code with P (radix point is blinking in P-display)
3. select variant or set value with △ or ▽
4. confirm the change / selection with P (radix point is not blinking anymore)

Mentioned below there is an example for a change of configuration described:

1. selection of the configuration level
2. change of a function / value
3. quit the configuration level

The configuration level is protected with a code word, which has to be typed if selected. From the manufacturer the code word is 1. If the code word is set wrong, the controller reverses into operation level (change of code word see page 18).

Selection of the configuration level:




Operation level / control mode:
Press P longer than 5 s

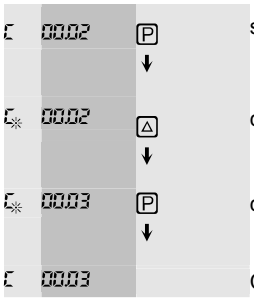
ConF is shown briefly

Change code word from 0 to 1: press △

confirm code word: press P

Configuration level

Change of a function:
(Example: change code 00.** from 00.02 to 00.03)



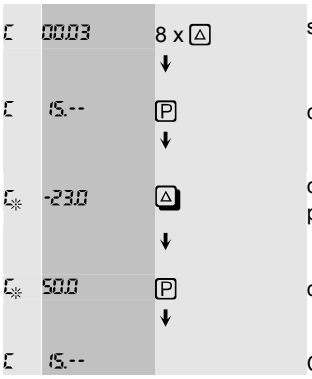

select code : press P

change function: press △

confirm function: press P

Configuration level

change of a value:
(Example: change code 15.-- from -23.0 to 50.0)




select code : press △ 8x

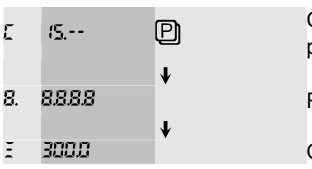
choose code: press P

change value: press and keep pressed △ until value=50.0

confirm value: press P

Configuration level

Quit configuration level:




Configuration level:
press P longer than 3 s

Reset of controller

Operation level / control mode

### 6.1 Configuration tablet

Mentioned below there are all configuration codes shown in a tablet. For more information's for functions please see the corresponding references. In the last column (✓) there are shown the manufacturer settings.

| Function | | Code | Variant / Range | | |
|---|---|---|---|---|---|
| **Controller selection** | | | | | **reference p.9** |
| Controller type | C | 0002 | Two-state controller | | ✓ |
| | | 03 | Three-state controller * | | |
| *= option | | 04 | Three-state stepper controller * | | |
| Configuration | C | 0201 | Regulation ratio Y1 triac<br>→ output A1 heating<br>Y2 and 3 alarm | | ✓ |
| Configuration | C | 0202 | Regulation ratio Y2 relay<br>→ output A2 heating<br>Y3 alarm | | |
| Configuration | C | 0203 | Regulation ratio Y1 triac<br>→ output A1/A2<br>Clipper function<br>Y3 alarm | | |
| Start function | C | 0300 | Direct start up | | ✓ |
| | | 01 | Start up with ramp | | |
| Characteristic | C | 0501 | Falling (typ. Heating) | | ✓ |
| | | 02 | Rising (typ. Cooling) | | |
| **Measuring input** | | | | | **reference p.9** |
| Input signal | C | 1001 | Thermocouple / Resistance-thermometer | | ✓ |
| | | 02 | -20 ... 100mV | | |
| | | 03 | 0 ... 10 V | | |
| | | 04 | 0 ... 20 mA | | |
| | | 05 | 4 ... 20 mA | | |
| **Function** | | **Code** | **Variant / Range** | | |
| Unit | C | 1101 | °C | | ✓ |
| | | 02 | °F | | |
| | | 03 | % | | |
| | | 04 | User-defined | | |
| Linearization | C | 1200 | without | -1999...9999°C | |
| | | 01 | Pt 100 | 0...200°C | ✓ |
| | | Array | Pt 100 | -200...800°C | |
| | | 02 | Ni 100 | -60...180°C | |
| | | .10 | Fe-CuNi, L | -200...800°C | |
| | | .11 | Fe-CuNi, J | -200...1100°C | |
| | | .12 | NiCr-Ni, K | -200...1300°C | |
| | | .13 | PtRh-Pt, S | 0...1760°C | |
| | | .14 | PtRh-Pt, R | 0...1760°C | |
| | | .15 | PtRh-Pt, B | 0...1820°C | |
| | | .16 | Cu-CuNi, T | -200...400°C | |
| | | .17 | Cu-CuNi, U | -200...600°C | |
| Referencejunction - compensation | C | 1400 | off | | |
| | | 01 | on | | ✓ |
| Actual-value correction | C | 15.-- | -500...500 | | 0 |
| Scale standardsignal | C | 18.-- 19.- | -1999...9999 | down | -200 |
| | | - | -1999...9999 | up | 800 |
| **Function** | | **Code** | **Variant / Range** | | |
| **Set points** | | | | | **reference p.10** |
| Set point clipper | C | 32.-- | -1999...9999 | down | -200 |
| | | 33.-- | -1999...9999 | up | 800 |
| Set point | C | 34.-- | -1999...9999 | | 0 |
| **Three-state controller (option)** | | | | | |

| | | | | |
|---|---|---|---|---|
| Motor minimum cyclic duration factor | C | 41.01 | 50msec | ✓ |
| | | .02 | 100msec | |
| | | .03 | 200msec | |
| | | .04 | 300msec | |
| | | .05 | 400msec | |
| | | .06 | 500msec | |
| | | .07 | 700msec | |
| | | .08 | 900msec | |
| Motor run duration | C | 42.-- | 10 ... 250 s | 60 |
| **display settings** | | | | **reference p.10** |
| Fractional digits | C | 81.00 | 0 Fractional digits | ✓ |
| | | .01 | 1 Fractional digits | |
| (standard-signal) | | .02 | 2 Fractional digits | |
| | | .03 | 3 Fractional digits | |
| **Function** | | **Code** | **Variant / Range** | |
| User guide | C | 89.01 | German | ✓ |
| | | .02 | English | |
| **Alarm output Y2 (clipper function)** | | | | **reference p. 10** |
| Start up-alarm Suppression | C | c0.00 | off | ✓ |
| | | .01 | on | |
| Function | C | c1.00 | without | |
| | | .01 | Signal contact | |
| | | .02 | Limit comparator | |
| | | .03 | Boundary contact | ✓ |
| | | .04 | Signal contact (invers) | |
| | | .05 | Limit comparator (invers) | |
| | | .06 | Boundary contact (invers) | |
| Hysteresis | C | c2.01 | 0,1 % | ✓ |
| | | .02 | 0,3 % | |
| | | .03 | 1,0 % | |
| | | .04 | 3,0 % | |
| **Alarm output Y3** | | | | **reference p. 10** |
| Start up-alarm Suppression | C | d0.00 | off | ✓ |
| | | .01 | on | |
| Function | C | d1.00 | without | |
| | | .01 | Signal contact | |
| | | .02 | Limit comparator | ✓ |
| | | .03 | Boundary contact | |
| | | .04 | Signal contact (invers) | |
| | | .05 | Limit comparator (invers) | |
| | | .06 | Boundary contact (invers) | |
| | | .07 | Segment-end-contact | |
| | | .08 | Program-end-contact | |
| **Function** | | **Code** | **Variant / Range** | |
| Hysteresis | C | d2.01 | 0,1 % | ✓ |
| | | .02 | 0,3 % | |
| | | .03 | 1,0 % | |
| | | .04 | 3,0 % | |
| Lag | C | d3.-- | 0 ... 500 s | 0 |
| Locking | C | d4.00 | off | ✓ |
| | | .01 | on | |
| Reset code | C | d5.-- | 1 ... 255 | 111 |
| **Protection against unauthorised operation reference p. 10** | | | | |
| Code word | C | P0.-- | 1 ... 255 | |
| Set point | C | P1.00 | disabled | |
| | | .01 | enabled | ✓ |
| Alarm values | C | P2.00 | disabled | |
| | | .01 | enabled | ✓ |
| Control parameters | C | P3.00 | disabled | |
| | | .01 | enabled | ✓ |

| | | | | |
|---|---|---|---|---|
| Manual operation | C | P400 | disabled | |
| | | 01 | enabled | ✓ |
| Program | C | P500 | disabled | |
| | | 01 | enabled | ✓ |
| Serial interface | C | P600 | disabled | |
| | | 01 | enabled | ✓ |
| **Function** | | **Code** | **Variant / Range** | |
| **Serial interface** | | | | **reference p. 12** |
| Baud rate | C | b101 | 300 Baud | |
| | | 02 | 1200 Baud | |
| | | 03 | 2400 Baud | |
| | | 04 | 4800 Baud | |
| | | 05 | 9600 Baud | ✓ |
| | | 06 | 19200 Baud | |
| Set address | C | Adr.-- | 0 ... 253 | 0 |

### 6.2 Controller selection

**Configuration code** **C00.** to C05.****

The controller can be configured as two-state-, three-state- or three-state-step-controller (C00.**).
The regulation ratio output of the controller can be rerouted via change-function from output A1 (relay) to output A3 (logic) to trigger e.g. semiconductor-relays directly.
The **start-function** (C03.**) decides if the set point or the program should be started after switch on or reset the controller (see chapter 6.3, p.33).
The **characteristics** (C05.**) describes the behaviour of the controller after changing the actual-value. If the actual-value is below set point, then a falling characteristics means a rising of the regulation ratio Y1 (typ. heating). But a rising characteristics means a decrement of the regulation ratio Y1 (typ. cooling).

Two-state controller
Two-state-controller with triac output and two signal relays (Code C0201) or as
Two-state-controller with relay output and one signal relay (Code C0202) ore as
Two-state-controller with triac output / clipper function and one alarm relay (Code C0203).

### 6.3 Inputs

**Configuration code** **C10.** and C19.--**

At the measuring input there can be aligned different sensors or test probes (see p.5 terminal diagram). With the parameter code “input signal” (C10.**) the type of the emitter can be fixed. For the different thermometers there are linearization-tablets(C12.**) in the controller. These proceed the translation of the dates to the real temperature. If such a sensor (C12.**) is chosen, the additional scale (C18.--,C19.--) is not active.

The measure signal (=actual-value) can be corrected / scaled in different ways.

- **Without correction:**
  The reference junction compensation (C1400) ) is switched off, the actual-value-correction (C15.--) .--) is set to 0 and the scales (C18.--,C19.--) .--) are adjusted to the range limits of the emitter.

- **Reference junction compensation** (only active at thermocouple):
  The reference junction compensation (C1401) is switched on, the actual-value-correction (C15.--) is set to 0 and the scales (C18.--,C19.--) are adjusted to the range limits of the emitter.

- **AI-value-correction:** (15.**)
  The actual-value display of the controller can be corrected in range ± 500 (sensor alignment) (reference: at Pt100-dual-conductor-mode the actual-value will be shown too high without correction, if the lines are longer).

- **Scale with standard signals:**
  With the parameters scale standard signal down and up(C18.--,C19.--) any modification of the actual-value display to the date is possible. If there e.g. is a norm signal emitter 0..10V connected, which shows a date from 250°C (=0V) to 550°C (=10V), then the display can be modified setting the lower scale value (C18.--) to 250 and the upper (C19.--) to 550.

If the unit of the actual-value (C11.**) is set to °F, each values will be converted from °C to °F.

### 6.4 Outputs

Control output Y1 / A1
The switch output Y1 / A1 is always used as a two-state output of the regulation ratio. For switch element there is an electronic switch (triac) used. You have to make sure always to switch a phase (L1, L2, L3) over this contact.

Control- / alarm output Y2 / A2
Configuration code Cc1.** to Cc2.**
Depending on the configuration the switch output Y2 / A2 is used as an alarm output or, if thermal clipper coded, as permanent switch off.

Alarm output Y3 / A3
Configuration code Cd1.** to Cd4.**
The switch output Y3 / A3 is always an alarm output and can be configured additionally with an alarm lag (Cd3.--) and a locking (Cd4.--) If a locking was activated it has to be reset with a code word (cd5.--) in the user level (Cd5.--) in the user level.

**6.5 Set points**
Internal set points Configuration code C32.** to C34.--
For the set point a value can be set in the configuration level (C34.--). By changing the set point with keyboard it will be stored. A clipping of the set point input is possible (C32.-- and C33.--).

**6.6 Adjustments of the display**
Radix point and user interface Configuration code C91.** and C99.**
The radix point (C91.**) can be chosen free depending on the used sensor or test probe. If a special thermometer is chosen, only a display without or with one fractional digit is possible. The user interface can be read in german (C99.01) or in english (C99.02).

**6.7 Protection against trespassed operation** Configuration code CP0.-- to CP6.**
Some operation functions can be protected against trespassed operation (CP1.**, CP6.**), the configuration level is protected with a code word (CP0.--) as well.

**6.8 Serial interface (Option)** Configuration code CU1.** und CU2.--
If there is a serial interface RS232 used, the baud rate (CU1.**) and the set address (CU2.--) has to be adjusted.

## 7. Parameter level

For adjustment of the controller to the current controlled system, in the parameter level the values for P, I, D, cycle time etc. are stored.

The manufacturer adjustments have to be checked and maybe changed.

If you don't know the motion control you should determinate the parameters with self-optimisation (page 16) and reset the control-action results according to behaviour with optimisation references (page 14).

The basically procedure of the parameter input is as follows:
1.choose the parameter level with [P] in the operation level (standard operation) (PArA will be shown for control)
2.change parameters with [▽] or [△] or
3.choose, change, etc. the next parameter with [P] and
[P][P] return to operation level (bEdn)with [P]

According to the configuration in the parameter level only relevant parameters will be shown! (bEdn) is shown.

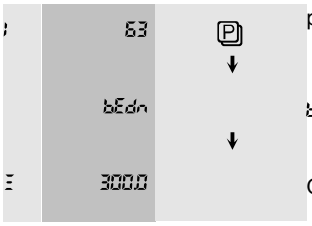
Selection of the parameter level:

| | | | |
|---|---|---|---|
| E | 3000 | [P] ↓ | Operation level / closed-loop press [P] longer than 3s |
| | PArA | ↓ | PArA is shown. Display changes after approx. 2s |
| P | 5.0 | | parameter level: 1st parameter (P-share) is shown. |

Change of a value:
(expl: change parameter p-share from 5.0 to 6.0)

| | | | |
|---|---|---|---|
| P | 5.0 | [▽] ↓ | change value: press [▽] until value = 6.0 |
| P | 6.0 | [P] ↓ | confirm value: press [P] short |
| I | 63 | | parameter level: next parameter is shown |

Quit the parameter level:




parameter level: press P longer than 3s

bEdn is shown. Display changes after approx. 2s

Operation level / closed.loop control

The set switches automatically to the operation level if there is no key pressed within 25s

**Parameter tablet**

Following all parameters are shown in a tablet. For more information about functions please see according references. According to the controller configuration in the display only relevant parameters will be shown. Cooling parameters are signed through a radix point.In the last column of the tablet the (✓) manufactorer settings are shown.

| Parameter | | Value range | |
|---|---|---|---|
| **Two -state/heating** | | | |
| P-share $X_p$ | P | 0.0 ... 500 % | 0.5 |
| I-share $T_n$ | I | AUS, 1 ... 4000 sec. | 50 |
| D-share $T_v$ | d | AUS, 1 ... 1000 sec. | 11 |
| Switch hysteresis $h_y$ | h | 0.1%; 0.3%, 1.0%, 3.0% | 1.0 |
| Switch cycle time T | c | 1.0 ... 100 sec. | 1.0 |
| Cyclic duration factor Clipper min. | - | 0, 5, 10 ... 50 % | 0 |
| Cyclic duration factor Clipper max. | - | 50, 55, 60 ... 100 % | 100 |
| **Others** | | | |
| Detector breaking | F | bei Zweipunkt-Regler<br>Auto,0 ... 100 %<br>bei Dreipunkt-Regler<br>-100...-1,Auto,0... 100 % | 0 |
| Switchpoint lag | - | 0 ... 125 (Dreipunkt)<br>0 ... 125 (3P-Schritt) | 0 |
| **Parameter** | | **Value range** | |
| **Alarm values** | | | |
| Alarm values 1 | * | value range of Sensor | 0 |
| Alarm values 2 | * | value range of Sensor | 0 |

*= symbol depends on configured

**Reference to parameters**

p-share ($X_p$ ): is adjustable from 0,1…500% and accords to the current measuring range, i.e. with Pt100 (-200…+800°C) 1% $X_p$ corresponds to a value:

$$\frac{1\% \cdot 1000^\circ C}{100\%} = 10^\circ C$$

but with NiCr-Ni (-200...+1300°C):

$$\frac{1\% \cdot 1500^\circ C}{100\%} = 15^\circ C$$

So the $X_p$ should be reduced to 0,7% with NiCr-Ni-sensors to get the same control-action result. (Also important at $X_p$ - takeover from external brands!)

At a $X_p$ –adjustment of 0.0 the structure is switched to an on/off behaviour, i. e. the control output Y1 can be used e.g. as MIN-contact.

I-share ($T_n$ ): the range is adjustable from 1…4000 sec. The parameter adjustment AUS is used for structure shift.

D-share ($T_v$ ): the range is adjustable from 1…1000 sec. The adjustment AUS is used for structure shift.

Switch hysteresis ($h_y$ ): has an effect on control output Y1 only by on/off structure.

Cyclic duration factor limitations: specifies at which regulation ratio a regulation ratio output occur. All regulation ratios below the minimum cyclic duration factor limitation will not be given to the current control output (Expl.: short turn on of a cooling compressor can be avoided.). All regulation ratios above the maximum cyclic duration factor limitation will be limited to this value.

sensor breakage behaviour: states, which regulation ratio will be shown at the control output if sensor breakage occurs. Manufactorers adjustment: 0%. This parameter can be set to Auto at the two-state- and three-state-controller. This possibility make the controller work on with the last regulation ratio if sensor breakage occurs.

Switching point distance: works as a “dead zone” between control outputs Y1 and Y2, so that both outputs can´t be switched at the same time. In this “dead zone” none of both outputs Y1 and Y2 are switched on.

**Structure shift**

The controller has a structure shiftable control algorithm. The control behaviour on/off, P, PI, PD or PID is selected according to the following tablet, and not relevant parameters will be set to AUS .

| Controller structure | Proportional range Xp | Reset time TN (I) | Rate time Tv (D) | Switch-histeresis hy | Switch cyclic time T |
|---|---|---|---|---|---|
| **on/off** | 0.0 | --- | --- | 0.1-5 | --- |
| **P** | 0.1-500 | AUS | AUS | --- | 10 - 100 |
| **PI** | 0.1-500 | 1-4000 | AUS | --- | 10 - 100 |
| **PD** | 0.1-500 | AUS | 1- 1000 | --- | 10 - 100 |
| **PID** | 0.1-500 | 1-4000 | 1- 1000 | --- | 10 - 100 |

**Alarm values**

The alarm values are limit values, at which the controller set the alarm, i.e. set the according switch output. The type of the alarm contact and its hysteresis depends on the configuration. In the parameter level the limit value (alarm value) is set. The display, which alarm is set, is shown in the parameter- resp. switch-mode-display.

| Function | | Comment |
|---|---|---|
| Signal contact | S | |
| Limit comparator | L | |
| Limit contact | G | |
| Signal contact (invers) | S. | |
| Limit comparator (invers) | L. | |
| Limit contact (invers) | G. | |
| Locking | C | only Y3 code word for locking (0 ... 255) |

In succession with the alarm function the according control port Y2/Y3 is blinking in the switch mode display!

If an alarm function is switched off, the according alarm value is not shown!

Y2 can only be used as an alarm contact at the two-state controllers (standard adjustment clipper function switched off)!

If the locker of Y3-alarm is activated (symbolised by blinking in the switch mode display), the locker can be reset with a code word. In the parameter display a C will be shown instead of the alarm function (cf. tablet 4.3). The reset code can be adjusted with ▽- and △- keys and confirmed with P--key. It is adjusted to 111 from the manufacturer.

**References to the alarm functions**

Signal contacts are used to supervise the positive and negative control deviation. The alarm value will be set as distance to set point and is linked to its dissimulation. The switch output is closed (positive), if the actual-value is below the adjusted value, above switch threshold it will be opened (high resistance). This behaviour can be inverted (invers).

Limit comparators enable the supervision of a symmetric good range around the set point. The limit comparator switch point is linked to the set point analogue to the signal contact, and will be set as distance to it. Inside the good range the switch output is closed (positive), outside it will be opened (high resistance). This behaviour can be inverted (invers).

Limit contacts will be adjusted to a fixed value inside a measuring range, independent from the set point. If the actual-value is below the adjusted value, the switch output is closed (positive), if the actual-value rises above this value, the contact opens (high resistance). This behaviour can also be inverted (invers).

If the start-up-alarm-suppression is switched on, an alarm is suppressed while start-up the stage until the actual-value for the first time moved into the alarm-good range. The alarm-good range corresponds to the alarm mode at actual-value = set point. After that the behaviour corresponds to the configured alarm function.

The program-end-alarmcontact Y3 will be confirmed by pressing [P]--key.

**Adjustment effects of the parameters**

| Two-state/three-state controller | | | |
|---|---|---|---|
| **Characteristic value** | **Adjustment** | **control proceedings and compensation of malfunctions** | **start-up proceeding** |
| **P** ($X_p$) | larger | more subdued, slower compensation of malfunctions | slower reset of regulation ratio Y, perhaps overshoot |
| | smaller | less subdued, faster compensation of malfunctions; at oscillating control size: enlarge P | faster reset of regulation ratio Y; at oscillating initial run to the set point:: enlarge P |
| **I** ($T_n$) | larger | more subdued, slower compensation of malfunctions | slower change of regulation ratio Y |
| | smaller | less subdued, faster compensation of malfunctions; if stability too small: enlarge Xp | faster change of regulation ratio Y |
| **D** ($T_v$) | larger | less subdued, more reaction to malfunctions | earlier switch off before set point, perhaps creep to the Set point |
| | smaller | more subdued, less reaction to malfunctions | later switch off before set point, perhaps overshoot |

## 8. Controller handling

! In the closed-loop control the set is in the operation level. A change into the operation level is shown with a short display bEdn. In the operation level you can move with the [P]--key through the different operation functions. The according values can be changed with [▽]- and [△]-key.

The set point will be shown by pressing the [S]-key and can be changed by keeping the [S]-key pressed and pressing the [▽] or [△]keys (a change from actual-value- to set point-display will be confirmed with a short reverse clipping of the actual-value).

Some operation functions can be protected against trespassed operation!

During display of actual-value, set point, regulation ratio or deviation, there are shown the modes of the three switch outputs in the parameter display.

If there are 3 dots (…) in combination with blinking timer display, Hnd or a ⌐-symbol shown in the actual-value/set point display, then there is a special function active.

Display of the operation level

| P | P alternated | Display | Function |
|---|---|---|---|
| ⁝ | | 300.0* | Set point and set point dissimulation |
| ⁝ | | 300.0* | Normal position Actual-value display |
| ⁝ | | y 80* | Regulation ratio display/ manual operation 0(-100)...100% |
| | | bEdn | Change into normal position (display approx. 2s) |

* The display always shows the actual value

### 8.1 Actual-value-display

The actual-value-display is the standard setting of the operation level. It is shown every time after display bEdn, when a change into the operation level was effected. The deviation to the set point is shown on a bar display within range –9…0…+9. If deviations are larger than ± 12°C, the according LED is blinking.

Change into the actual-value display:

| | | | |
|---|---|---|---|
| | | n x [P] | Operation level: press [P] several times until bEdn is shown. |
| | | ↓ | |
| | bEdn | | bEdn is shown. Display changes after approx. 2s |
| | | ↓ | |
| ⁝ | 300.0 | | Actual-value-display (standard setting) |

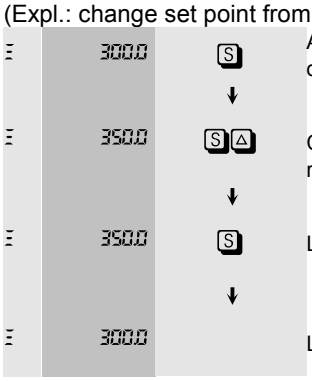
If there is F⁻⁻⁻,F___ or FPoL shown in the actual-value-/set point-display, then a sensor breakage or an overflow of the sensor occurred (cf. chapter 6.3)

If the actual-value-/set point-display is blinking, then a range overflow of the measuring signal occurred!

**8.2 Set point setting**

In the operation level the set point can be set with key [S] and [▽] or [△] together within the configured set point limits (cf. chapter 3.5, p.18). The controller is working with the new value after a set point reset and stores it in an EEprom, so that it will be kept after a power disconnection.
Only internal set points can be adjusted by keyboard!

Change of the set point:
(Expl.: change set point from 300.0 to 350.0)




Actual-value-display: keep [S] pressed – set point-display

Change set point: press [S] and [△] until new value reached

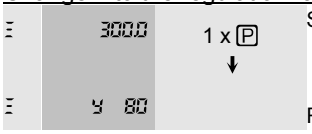
Let go [△] : new set point is shown

Leave [S] : back to actual-value-display

**8.3 Regulation ratio display / manual operation**

In the display there is a Y placed in front of the regulation ratio. During manual operation the y will be replaced by a H. The value range of the regulation ratio depends on the type of controller. It extends from max. -100% resp. 0% ..... 100%.

Change into the regulation ratio display:



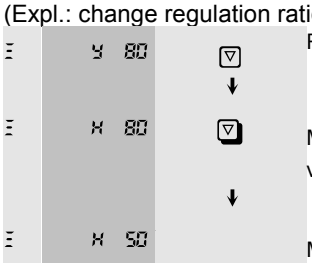

Set point display (standard setting): press [P] 1x

Regulation ratio is shown

If you want to change into manual operation, i.e. set a regulation ratio manual, you can use the [▽] or [△]-keys in the regulation ratio display. The controller changes from closed-loop control to manual operation. During manual operation there is no controlling. The chosen regulation ratio will be put out directly on the switching output!

A cyclic duration factor limitation of the regulation ratio has no influence on the manual operation!

Change of the regulation ratio (manual operation):
(Expl.: change regulation ratio from 80% to 50%)




Regulation ratio display: press [▽]

Manual operation: press and keep pressed [▽] until value reached

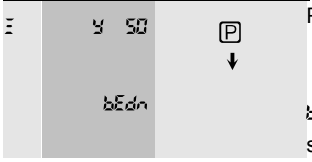
Manual operation: new regulation ratio

Back to regulation ratio display:


Manual operation: press [P]

Regulation ratio will be displayed.

Back to actual-value display:




Press [P]

bEdn will be displayed. Display changes after approx. 2 s to actual-value display.

## 9. Special functions

The units of compact controller series are equipped with a number of special functions. These are self-optimisation, timer function and program controller. Basically they can be reached by pressing two keys in the operation level. On the front foil of the controller there are the symbols for these functions at the corresponding key-combinations.

### 9.1 Self-optimisation

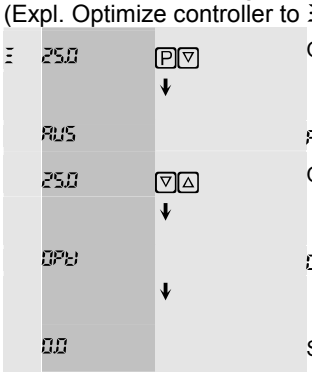
As standard the controller is equipped with a self-optimisation-algorithm and is able to calculate the control parameter either during start up the controlled system or on demand.

As base for optimization procedure there are modified adjustment rules by “Ziegler und Nichols”. At the calculation method the controller will be optimized to the response to setpoint changes and the procedure is practicable for controlled systems with equalization and not dominated dead time (Tu : tg <= 0.2).

During the self –optimisation the controller calculates the parameters P ($X_p$ ), I ($T_n$ ), D ($T_v$ ) and the cycle time for both the two-state-controller and three-state-controller.

The self-optimisation only starts at a stable actual-value! The program controller and the timer have to be switched off.

Self-optimization during start up of the controlled system
(Expl. Optimize controller to 3000) switch off controlling (switch outputs):




Operation level: press [P] and [▽] together

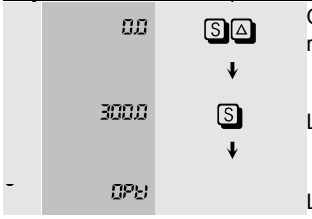
RUS will be displayed

Operation level: press [△] and [▽] together

OPt will be displayed

Set point will be displayed for approx. 2 s

Adjust the aimed set point within these 2 s:



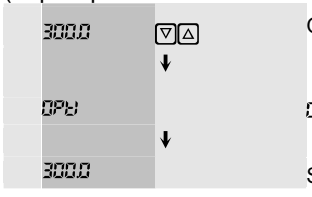

Change set point: press [S] and [△] until new value reached

Leave [△]: new set point will be displayed

Leave [S]: after 5 s OPt will be displayed.

5 s after last key stroke the controller starts the self-optimisation. For control, the OPt is blinking in exchange with actual-value in the display until the optimisation is finished or interrupted.

Self-optimisation during controlling
(Expl. Optimise controller to 3500)




Operation level: press [▽] and [△] together

OPt will be displayed briefly

Set point is displayed for approx. 2 s

Adjust the aimed set point within these 2 s:

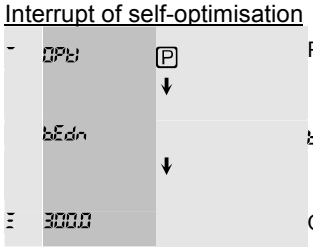

Change set point: press [S] and [△] until new value reached

Leave [△]: new set point will be displayed

Leave [S]: after 5 s OPt will be displayed.

5 s after last key stroke the controller starts the self-optimisation. Therefore the controller reduces the actual-value independently to a determined value. For control, the OPt is blinking in exchange with actual-value in the display until the optimisation is finished or interrupted.

Interrupt of self-optimisation




Press any key

bEdn will be displayed briefly

Operation level: actual-value will be displayed

After finished optimisation the determined parameters will be stored in the parameter level. The controller automatically works with these values. The control parameter can be shown in the parameter level and eventually modified manual (cf. chapter 7)

After 2 h not finding any control parameters, the controller interrupts the optimisation with an error message F-2!

**9.2 Timer**

The timer enables a time-controlled switch On and Off of the controller.

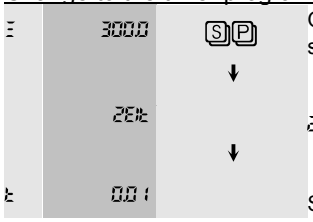
Timer programming

The timer can be programmed with a switch time and a switch function (cf. tablet 6.1). The switch time specifies the period from starting the timer until execution of switch function.

| Display | Function |
|---|---|
| 00:1 .... 99.60 | Switch time 1 min to 100h |
| AUS | Switch function OFF: controlling is switched off (Standby) |
| E n | Switch function ON: controlling is switched on |

If the controlling is switched off (standby) during timer operation, this will be symbolised with 3 dots (…) in the display. The clock symbol at the front is blinking. The standby mode will be interrupted by pressing any key!

Change to the timer programming:



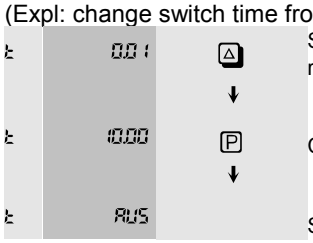

Operation level: press S and P together longer than 3 s

2Et. Will be displayed briefly

Switch time will be displayed

Adjust switch time:

(Expl: change switch time from 1 min to 10 h)



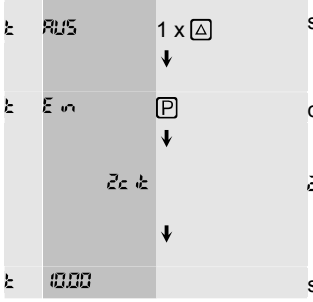

Switch time: press and hold △ until new value will be reached

Confirm new switch time: press P

Switch function is displayed

Just switch function:

(Expl.: change switch function from AUS to E n)



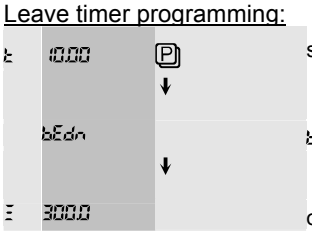

switch function: press △ -key once

confirm new switch function: press P

2c t will be displayed briefly

switch time will be displayed

Leave timer programming:



switch time: press P longer than 3 s

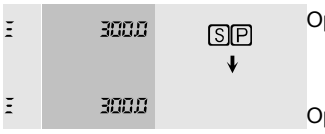
bEdn will be displayed briefly

operation level: actual-value will be displayed

Start and Stop of the timer

The timer will be started / stopped from the operation level. If it is active, the clock symbol at the front is blinking. The timer can't be started while self-optimisation, program controller- and manual operation.

If the controlling is switched off during timer operation (Standby), this will be symbolised with3 dots (…) in the display. The standby mode will be stopped by pressing any key.

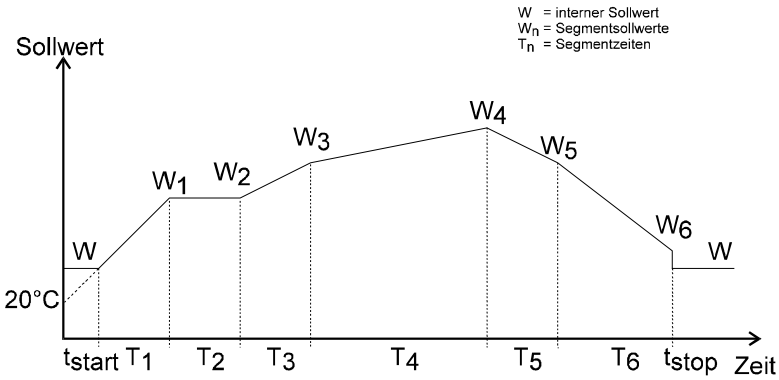


Operation level: press S and P together

Operation level: set point or standby will be displayed

**9.3 Program controller**

The program controller enables a program-controlled start of the set point for a fixed time. The program has 6 segments with 6 set points and 6 segment times. The program can be started and stopped with the keyboard. Also, a stepping of the program segments is possible with the keyboard. The figure 6.1 shows a possible curve of the program:




A segment- resp. program stop can be marked at alarm output Y3!

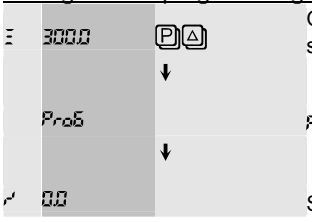
$T_1$ will get shorter, if the actual-value is bigger than the reference temperature of 20°C at the program start.

Programming function

Each of the 6 program segments can be related one set point and one segment time. Which segment is active, can be displayed with the symbol and the exchange blinking segment number ( to ). First the set point and then the time of the segment will be displayed resp. changed.

The segment time is adjustable from 1 min to 100 h. If it is set to EndE, the program runs until before the corresponding segment.

Change to the programming function:

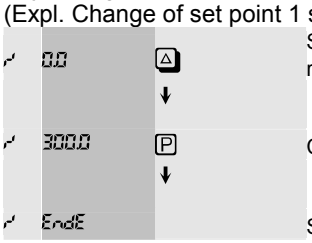


Operation level: press A and P together longer than 3 s

ProG will be displayed briefly.

Set point of the first segment will be displayed

Adjust segment set point:
(Expl. Change of set point 1 segment from 0.0 to 300.0)

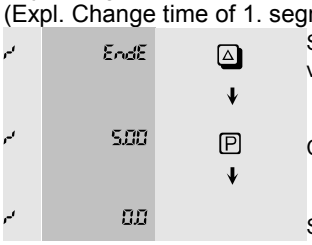



Set point 1: press and keep pressed △ until new value reached

Confirm new set point: press P

Segment time will be displayed

Adjust segment time:
(Expl. Change time of 1. segment from EndE to 5h)




Segment time: press and keep pressed △ until new value reached

Confirm new time: press P

Set point of the next segment will be displayed

All following segments have to be adjusted in the same way!

Quit programming function:

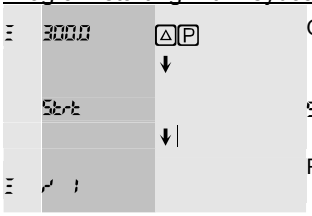

Segment set point: press P longer than 3 s

bEdn will be displayed briefly

Operation level: actual-value will be displayed

Start and stop of the program
The program can be started and stopped from the operation level. If the program is active, the actual program segment and the actual-value will be displayed in the actual-value-display in exchange.

Program starting with keyboard:



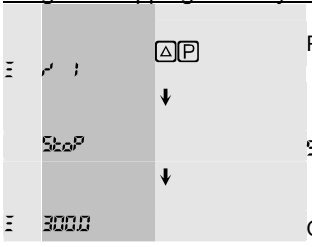

Operation level: press △ and P briefly

Strt will be displayed briefly

Program: actual segment will be displayed

If the self-optimisation or the timer are active, the program can't be started.

Program stopping with keyboard:




Program: press △ and P together

StoP will be displayed briefly

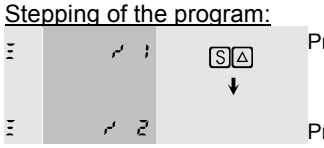
Operation level: actual-value will be displayed.

If the segment time of the 1. segment is set to EndE, the program can´t be started. There will be an error message E-3 (cf. chapter 10)! If the actual-value is bigger than the first program set point, the program can´t be started.

The program-end-alarm contact can be confirmed by pressing P.

Stepping – program segments
If the program is active, you can step from the actual program segment to the next segment with the keyboard. If you step from the last program segment, the controller stop the program execution.

Stepping of the program:




Program: press S and △ together

Program: next segment number will be displayed.

**9.4 on/off function**

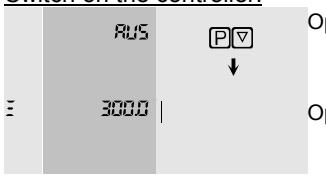
The units of the compact controller series can be switched on and off with the double key function of P and ▽ . If the controller is switched off, there is the symbol AUS in exchange with actual-value. In this mode all outputs and the controlling are switched off. Only the actual-value will be determinated and displayed.

Switch off the controller:


Operation level: press P and ▽ together

AUS will be displayed

Switch on the controller:




Operation level: press P and . ▽ together

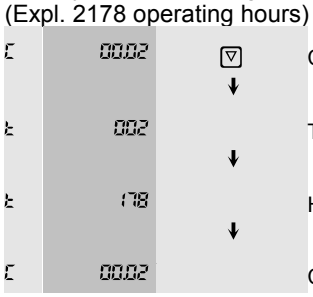
Operation level: actual-value will be displayed

The on/off mode will be stored during a power interrupt and ensuing it will be active again!

**9.5 Operating hours and firmware version**

The controller is equipped with a meter panel which will be actualised hourly and be stored in the non-volatile store (EEprom). If you are in the configuration level, you can have a look at the meter panel. Also, there you can readout the firmware version of the controller. By having any technical demands you have to state this version number.

Display of the operating hours:
(Expl. 2178 operating hours) Chose configuration level (see chapter 6)!




Configuration level: press ▽

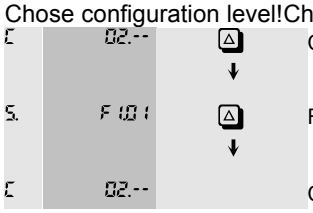
Thousands-hours will be displayed (approx. 3 s)

Hours will be displayed (approx. 3 s)

Configuration level

Display of the firmware-version:
(Expl. Version number F1.01)

Chose configuration level!Chose configuration code 02.--




Configuration level: press and hold △

Firmware version will be displayed

Configuration level

## 10. Error message

Error messages will be displayed in the display of the controller with a F and following number or with a corresponding symbol. The error messages with error numbers can be erased by briefly pressing P (except error –1).

**F--- or F---**

Description:
At the measuring input or at the external set point input there is a sensor breakage, a sensor short circuit or an overflow of the test probe.
What to do:
If this error is shown instead of the actual-value, check the connected sensor to sensor breakage and check the electrical connection. Check the configuration of the measuring input.

FPoL
Description:
At the measuring input there is a polarity of sensor of the connected thermocouple.
What to do:
If this error is shown instead of the actual-value, check the connected sensor to polarity of sensor. Check the configuration of the measuring input.

F -3
Description:
Time of 1. segment is adjusted to EndE. The program doesn´t start.
What to do:
Confirm error with key [P]. check set point and times of start-up ramp.

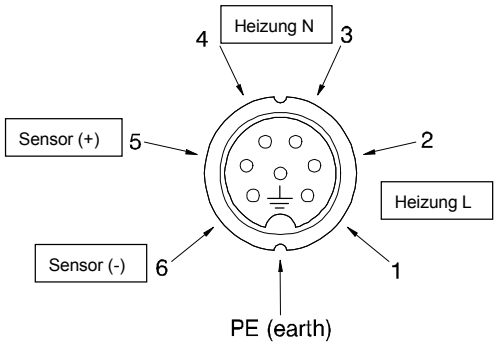
F -2
Description:
During the self-optimisation there is a time overflow. No control parameters could be found.
What to do:
Confirm this error with key [P]. check the sensor connection and the connection of the actuator, pay attention to the unit configuration. Check the actual-value and the set point and make sure, that before starting the optimisation the actual-value was below the aimed set point and was stable.
If all described errors are excluded there is a manual adjustment of the parameters necessary.

F -1
Description:
An error happened in the non-volatile store (EEprom).
What to do:
This error can´t be removed by the user. Please send the unit to your distributor.

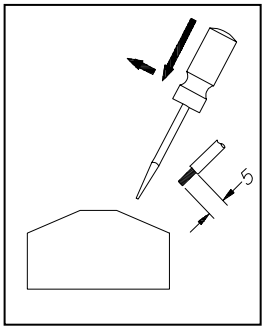
## 11. Contact load

Flange box 6+PE, max. 10A (binder series 693 …)

**HT43**

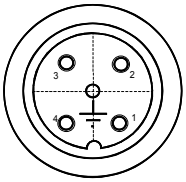



**HT42**




Clamp connection see the connection diagram on page 5. Cable run only through the planned PG-screwings, 2x PG9 for power / heating, 2x PG7 for sensors and signals.
For connecting the self-holding clamps a screwdriver has to be set into the square opening of the clamp and this opens the clamp by slight levering. After removing the screwdriver blade this connection is closed. This clamp type is only to be used at one wire!

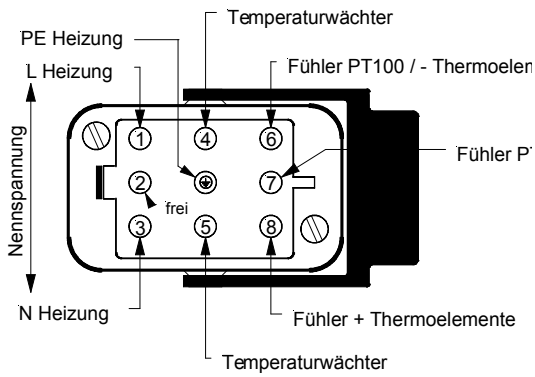
**HT45** Flange box 4+PE, max. 20A (binder series 694 ...)




Ansicht auf die Lötanschlussenden der Steckereinsätze
View on termination side of male inserts

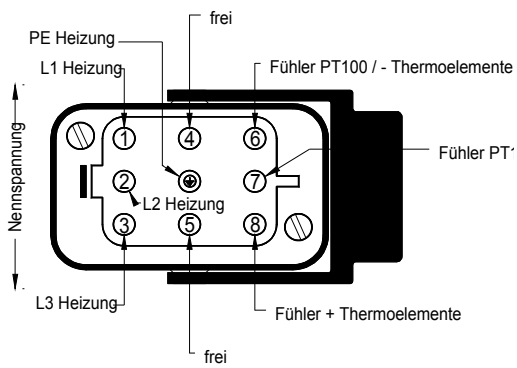
| Kontakte/contact Stecker/plug - 6+PE | PT100 2-Leiter | Fe-CuNi (J) | NiCr-Ni (K) |
|---|---|---|---|
| 1 Phase phase | braun brown | braun brown | braun brown |
| 2 Nulleiter neutral wire | blau blue | blau blue | blau blue |
| 3 Temperaturfühler temperature feeler | rot (schwarz) red (black) | + schwarz black | + grün green |
| 4 Temperaturfühler temperature feeler | weiss (schwarz) white (black) | — weiss white | — weiss white |
| ⏚ Schutzleiter protection earth wire | grün/gelb green/yellow | grün/gelb green/yellow | grün/gelb green/yellow |

**HT41**



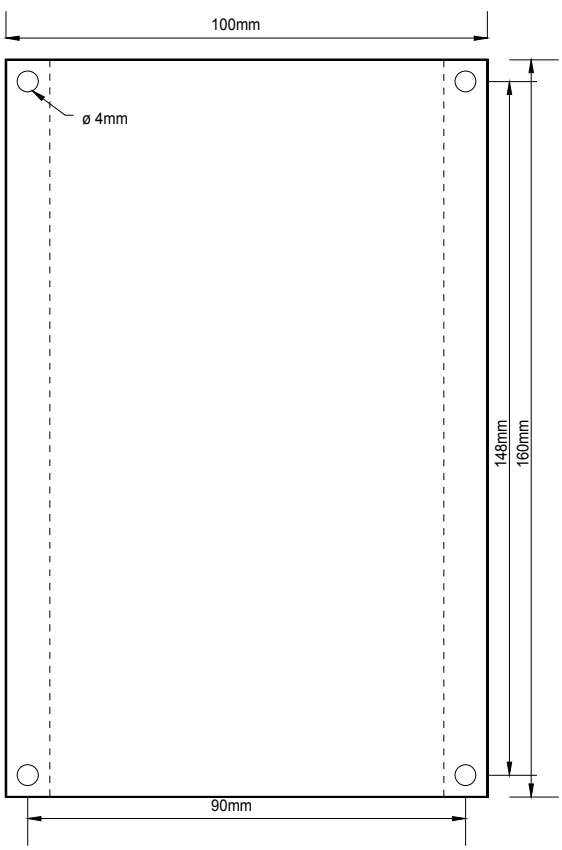

**HT44**

HT44 --> 230/400V AC 3 x 10A




Flange box 8+PE. max. 16A (HANQ8)

## 12. Mounting plate / Fastening




**Special devices:**

Three-channel regulator, HTM41 and 42 (3xHT42)
**Mains connection terminals 230/400 V AC**
5 pole terminal block (L1/L2/L3/N/PE)
**Load connection terminals, 16 A maximum**
9 pole terminal block

| | | |
|---|---|---|
| H1(2/3) | = | heater phase legs |
| N | = | neutral conductor, heater |
| PE | = | protective earth, heater |
| G | = | ground (thermal element/PT100 -) |
| + | = | thermal element + |
| PT | = | PT100 (between G and PT) |
| W | = | PT100 monitor |
| W | = | PT100 monitor |

Functions as described for HT42 regulator with limit function.

**HT44 and HT55**

Mounting plate 180mm otherwise as sketch

## 13. Disposal

**Packaging**
Materials used to package the device for transport are to be disposed of in an environmentally-friendly manner by giving them to the appropriate local disposal facilities.

**Device components**
Defective components are to be collected and disposed according to applicable regulations. The same applies to the device itself.