

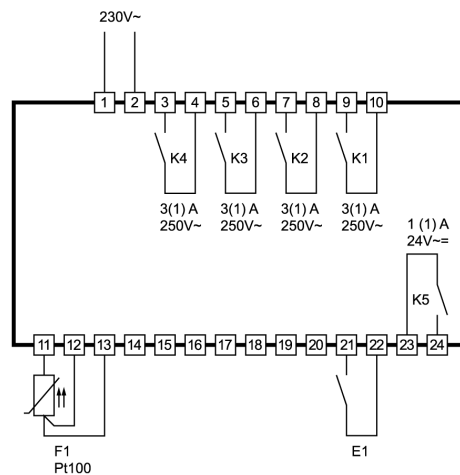
ST96-35.16

Four-stage controller

Order number 900090.002



Wiring diagram



Product description

The four-stage controller with 4-digit setpoint and actual value display, 3 keys and 4 relays was developed for the control of compressor groups of up to 4 machines. The switching exits can be programmed as thermostat controllers with additional protection times for the compressor. The switching input E1 allows change-over of the setpoint. The general functions which can be freely parametered open the way for a broad application area.

Sensor: Pt100

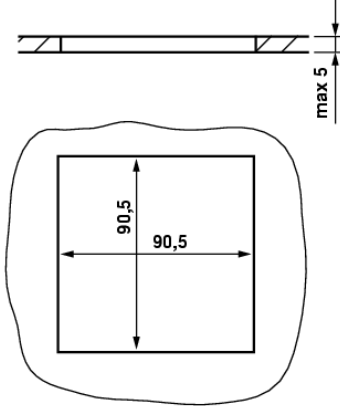
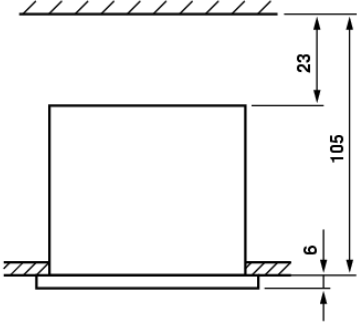
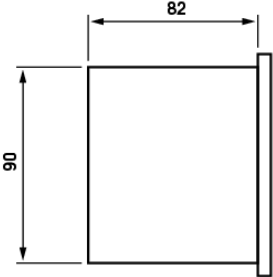
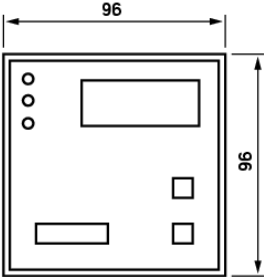
Range: -99...300°C

Front size: 96mm x 96mm

Panel cut-out: 90.5mm x 90.5mm

Connector: plug and socket

ST 96...



SOFTWARE .16

Adjustment options



Key UP

Pressing this key you can increase the parameter or parameter value or scroll the parameter list.



Key DOWN

Pressing this key you can decrease the parameter or parameter value or scroll the parameter list. At alarm the buzzer function can be switched off with this key.



Key SET

While SET key is pressed, the setpoint is indicated.
In addition, the SET key is used for setting parameters.

First control level:

Parameter setting of the main setpoint

If none of the keys is pressed, the display indicates the actual value of the temperature. Pressing the SET key, the setpoint shows on the display.

If the setpoint is to be changed, the SET key is to be kept pressed while adjusting the setpoint with the keys UP and DOWN.

Please note that the setpoint can only be changed within the set setpoint limits

Para- meter	Function description	Adjustment range	Standard setting	Custom setting
S1	Setpoint	P12...P13	0.0°C	

Second control level (P parameters):

Setting of control parameters

Simultaneously pressing the UP and DOWN key for at least 4 seconds opens a parameter list containing control parameters.

With the UP and DOWN keys the list can be scrolled in both directions.

Pressing the SET key will give you the value of the respective parameter. Pressing also the UP or DOWN key at the same time the value can be adjusted.

Return to the initial position takes place automatically, if no key is pressed for 60 seconds

Parameter	Function description	Adjustment range	Standard setting	Custom setting
P1	Delta W1	-99 ... 99.0 K	10.0 K	
P2*	Delta W2	-99 ... 99.0 K	20.0 K	
P3*	Delta W3	-99 ... 99.0 K	30.0 K	
P6**	Hysteresis K1	0.1 ... 99.0 K	1.0 K	
P7**	Hysteresis K2	0.1 ... 99.0 K	1.0 K	
P8**	Hysteresis K3	0.1 ... 99.0 K	1.0 K	
P9**	Hysteresis K4	0.1 ... 99.0 K	1.0 K	
P12	Control range limitation – minimum setpoint	-99 ... 999 °C	-99 °C	
P13	Control range limitation – maximum setpoint	-99 ... 999 °C	999 °C	
P19	Key-lock	0: no key-lock 1: key-lock	0	
P20	Indication actual value 1	N/A		
P21	Actual value correction	-10...+10 K	0.0 K	
P30	Lower alarm value	-99...999 °C	-99 °C	
P31	Upper alarm value	-99...999 °C	999 °C	
P32**	Alarm hysteresis	0.1...99.0 K	1.0 K	
P33***	Total operating time contact K1 in years	0 ... 25 years	0	
P34***	Total operating time contact K1 in days	0 ... 364 days	0	
P35***	Total operating time contact K2 in years	0 ... 25 years	0	
P36***	Total operating time contact K2 in days	0 ... 364 days	0	
P37*/***	Total operating time contact K3 in years	0 ... 25 years	0	
P38*/***	Total operating time contact K3 in days	0 ... 364 days	0	
P39*/***	Total operating time contact K4 in years	0 ... 25 years	0	
P40*/***	Total operating time contact K4 in days	0 ... 364 days	0	

* Some parameters are only effective if the corresponding outputs exist.

** The Hysteresis is set symmetrically on the switching points.

*** To delete or change the operating times P33-P34 parameter A42 must be set to "0".

Parameter description:

P1-P3: Delta W1-W3

Main contact K1 and secondary contact K2 (K3, K4) are linked with one another via switching difference Delta W1 (W2, W3). This difference can take positive or negative values. Thus, a leading or following contact can be realised. In this configuration the controller can be also used as three-point controller.

Note: Parameters P2 and P3 are only effective if the corresponding output exists and is included with parameter A44.

P6-P9: Hysterese K1-K4

The hysteresis can be adjusted separately for all contacts and is set symmetrically at the setpoints, i.e. half of the hysteresis' value is effective below and half of the value above the switching point. Note that a small hysteresis permits a more exact regulation, however also leads to more frequent switching frequency decreasing the lifetime of the relay.

Under critical conditions the controller can be equipped with a semiconductor relay.

Note: Parameters P8 and P9 are only effective if the corresponding output exists and is included with parameter A44.

P12: Control range limitation – minimum setpoint

P13: Control range limitation – maximum setpoint

The adjustment range of the setpoint 1 can be limited in both directions. This is to prevent the end user of a unit from setting inadmissible or dangerous setpoints.

P20: Actual value

The here indicated temperature presents the actual measured value.

P21: Actual value correction

This parameter allows the correction of actual value deviations caused for example by sensor tolerances or extremely long sensor lines. The regulation measure value is increased or decreased by the here adjusted value.

P30: Lower alarm value

P31: Upper alarm value

The exit alarm is a boundary alarm or a range alarm with adjustable hysteresis (see parameter P32). The required output contact is set with the operation mode selected with parameter A44. If boundary alarm is selected and only one switching point is required, you have to set the second switching point to a value above or below the operating range of the controller.

Boundary alarm function (see fig. 1):

The alarm contact is closed if the process temperature is above the upper or below the lower boundary value.

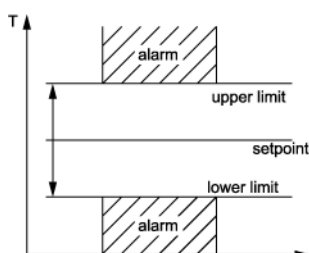


Fig. 1: Boundary alarm, rel. boundaries

Range alarm function (see fig. 2):

Opposite switching behaviour to the boundary value alarm. The alarm contact is closed if the actual value remains between the boundary values.

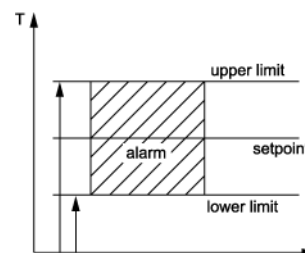


Fig. 2: Range alarm, abs. boundaries

P32: Alarm hysteresis

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

The operating time recorded by parameters P33-P44 is mainly used in the field of refrigeration technology to register the operating time of the connected compressors.

P33: Total operating time contact K1 in years

P35: Total operating time contact K2 in years

P37: Total operating time contact K3 in years

P39: Total operating time contact K4 in years

These parameters indicate the total operating times in years elapsed with the respective contact switched on.

P34: Total operating time contact K1 in days

P36: Total operating time contact K2 in days

P38: Total operating time contact K3 in days

P40: Total operating time contact K4 in days

These parameters indicate the remaining total operating times in days elapsed with the respective contact switched on.

Note: Time is recorded in minute cycles. Periods shorter than one minute are ignored. Storage in the non-volatile memory takes place daily, so that an inaccuracy of max. 24 hours may result if a power failure occurs.

Caution: Parameters P37-P40 are only effective when the pertinent output is available and activated by parameter A44.

To avoid statistical errors, it is essential that the operating mode set in parameter 44 corresponds to the number of external loads (e.g. compressors) that are connected.

Failure to do this will result in incorrect operating times being recorded by parameter P33-P44.

Operating times can be updated after replacement of components only if parameters P19 and A19 are unlocked together with parameter A42. Otherwise data can be irretrievable lost.

Third control level, (A parameters):

Setting of control parameters

Access to the third control level is granted when selecting the last P-parameter on the second control level. Continue to press the UP key for approximately 10 seconds until "PA" appears. Continue to press the UP key and additionally press the DOWN key for about 4 seconds and the first A-parameter of the third control level is indicated.

With the keys UP and DOWN you can scroll the list in both directions. Pressing the SET key will give you the value of the respective parameter. By pressing the UP or DOWN key at the same time the value can be adjusted.

Return to the initial position takes place automatically, if no key is pressed for 60 seconds, or by simultaneously pressing the UP and DOWN key for approx. 4 seconds.

Parameter	Function description	Adjustment range	Standard setting	Custom setting
A1	Switch mode K1	0: heating contact 1: cooling contact	1	
A2	Switch mode K2	0: heating contact 1: cooling contact	1	
A3	Switch mode K3	0: heating contact 1: cooling contact	1	
A4	Switch mode K4	0: heating contact 1: cooling contact	1	
A5	Function of contact K1 at sensor error	0: relay off 1: relay on	0	
A6	Function of contact K2 at sensor error	0: relay off 1: relay on	0	
A7	Function of contact K3 at sensor error	0: relay off 1: relay on	0	
A8	Function of contact K4 at sensor error	0: relay off 1: relay on	0	
A10	Temperature scale	0: Celsius 1: Fahrenheit 2: Kelvin	0	
A11	Display mode	0: without decimal point, without leading zeros 1: with decimal point, without leading zeros 2: without decimal point, with leading zeros 3: with decimal point, with leading zeros	1	
A12	Alarm mode	0: Boundary alarm 1: Range alarm	0	
A13	Activation of alarm output	0: not active 1: active, no flashing display 2: active, flashing display	1	
A19	Parameter lock	0: no lock 1: A-parameter locked 2: A- and P-parameter locked	0	
A20	Minimum action time K1 'ON'	0...999 sec.	0	
A21	Minimum action time K2 'ON'	0...999 sec.	0	
A22	Minimum action time K3 'ON'	0...999 sec.	0	
A23	Minimum action time K4 'ON'	0...999 sec.	0	

Parameter	Function description	Adjustment range	Standard setting	Custom setting
A24	Minimum action time K1 'OFF'	0...999 sec.	0	
A25	Minimum action time K2 'OFF'	0...999 sec.	0	
A26*	Minimum action time K3 'OFF'	0...999 sec.	0	
A27*	Minimum action time K4 'OFF'	0...999 sec.	0	
A30	Mutual delay of contacts	0...999 sec.	0	
A31	Delay after "Power-on"	0...999 sec.	0	
A32	Alarm suppression after "Power-On"	0...999 sec.	0	
A33	Operating time before time depending load replacement	0...999 sec. or min.	240	
A34	Time scale for parameter A33	0: seconds 1: minutes	1	
A40	Time depending load replacement of the compressors	0: no load replacement 1: load replacement	1	
A41	Sequential operation mode	0: not activated 1: activated	1	
A42	Interlocking of total operating times	0: not locked 1: locked	1	
A43*	Function of switching input E1	0: no function 1: S1' activated relative to setpoint S1 2: S1' activated absolute (freely adjustable)	0	
A44	Operating mode	0: 2 compressors K1, K2 alarm at K3 1: 3 compressors K1, K2, K3 alarm at K4 2: 4 compressors K1, K2, K3, K4 alarm at K5	2	

* If parameter A43 is set to "0" the display will indicate an alarm message in case of closed switching input E1. Outputs K1...K4 will behave like set in parameters A5...A8. An alarm output defined with parameter A44 is not affected.

Parameter description:

The following values can change the equipment characteristics and are therefore to be set with utmost care.

A1: Switch mode K1

A2: Switch mode K2

A3: Switch mode K3

A4: Switch mode K4

The switch mode for the relays, i.e. cooling or heating function, can be programmed independently at works. Heating function means that the contact opens as soon as the setpoint is reached, thus power interruption. At cooling function the contact closes, if the actual value is above the required setpoint.

A5: Function of contact K1 at sensor error

A6: Function of contact K2 at sensor error

A7: Function of contact K3 at sensor error

A8: Function of contact K4 at sensor error

At sensor error the display indicates "F1-" (flashing) and the selected relay falls back into the condition pre-set here.

A80: Temperature scale

Indication can be switched between Fahrenheit, Celsius and Kelvin. At conversion, the parameters and setpoints maintain their numerical value and adjustment range. (Example: A controller with the desired value of 0°C is switched to Fahrenheit. The new desired value is then interpreted as 0°F, which corresponds to a temperature of -18°C).

NOTE: Indication limits with °F can be smaller than the actual measuring range!

A11: Display mode

The value can be indicated with or without decimal point and with or without leading zeros.

A12: Alarm mode

The alarm exit evaluates an upper and a lower limit value, whereas a selection is possible as to whether the alarm is a boundary or a range alarm. In case of sensor error the following applies: at boundary alarm the relay is on and at range alarm the relay is off.

A13: Activation of the alarm

The alarm can be deactivated. If activated a flashing display can be set.

A19: Parameter lock

This parameter enables locking of each parameter level. If third level is locked, only parameter A19 may be changed.

A20: Minimum action time contact K1 "On"

A21: Minimum action time contact K2 "On"

A22: Minimum action time contact K3 "On"

A23: Minimum action time contact K4 "On"

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

Note: all delays are even effective after switching mains on, after an external error message or after the elimination of sensor errors.

If available the Call-LED "C" flashes during the period where the output contacts are suppressed by the adjusted minimum action time.

A24: Minimum action time contact K1 "Off"**A25: Minimum action time contact K2 "Off "****A26: Minimum action time contact K3 "Off "****A27: Minimum action time contact K4 "Off "**

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

Caution: Parameters A3, A4, A7, A8, A22, A23, A26 und A27 are only effective if the corresponding output exists and is activated with A44.

A30: Mutual delay of contacts

This parameter makes a mutual switching-on delay of relays possible, depending on whichever contact is switched first. It ensures that two output contacts do not switch simultaneously. The mutual delay affects no free contacts that are not involved in the load replacement. With A44=0 the delay is always effective.

A31: Delay after "Power-on"

This parameter allows a switching-on delay of relays after switching-on the mains voltage. This delay corresponds with the time set here. A mutual delay set by parameter A30 becomes effective as soon as the first contact is switched on.

A32: Alarm suppression after "Power-On"

This parameter allows a switching-on delay of the alarm contact after switching on the mains voltage. This delay corresponds with the time set here. This suppression does not apply to sensor error alarm or, if activated, external alarms.

A33: Operating time before time depending load replacement

Load replacement depending on time is mainly used in the field of refrigeration technology to balance the use of the connected compressors. If only some of the outputs are continuously active, outputs that have not yet been activated will be used.

This parameter determines the time to elapse before outputs are changed for the first time. If available the Replace-LED "R" lights up as soon as the first replacement occurs and signals the continuous operation of some of the outputs in power stages below 100%. The LED goes out if power stage 0% or 100% is reached and no more load replacement is possible.

A34: Operating time range

If operating mode with time-dependent load replacement is activated these time ranges are available for parameter A33.

A40: Activation of time-dependent load replacement

This parameter either activates or deactivates time-dependent load replacement to balance the use of the connected compressors. The replacement takes place after the operating time set with parameter A33.

A41: Sequential operation mode

This parameter either activates or deactivates the sequential operation mode. If this mode is activated different compressors will be activated or deactivated (if possible) at each change of output stage to ensure an even load of the compressors.

Concerning the switching of the compressors the following applies:

If several compressors are activated the first started unit will be deactivated first.

If several units are deactivated the first stopped unit will be activated first.

Note: The time-dependent load replacement and the sequential operation mode only make sense if there is a control circuit with several components of the same power.

A42: Interlocking of total operating times

This parameter releases the locking of the total operating times in parameters P33-P40. The adjustment of time values resulting from time registration is only necessary for updating purposes when plant components are replaced.

A43: Adjustment of setpoint S1' (not available on all types of controllers)

By closing switching input E1, setpoint S1 can be switched to a setpoint S1'. Setpoint S1' can be either relative to setpoint S1 or an independent, freely adjustable, control setting. The setpoint S1' can only be accessed if input E1 is closed.

If setpoint S1' is deactivated and the switching input is closed, the display indicates "FEH" or "FEHL" and the output relays fall back in the condition set with parameters A5-A8. This setting does not effect an alarm output.

A44: Operation mode

The control program is intended for a maximum of four regulating output contacts plus one alarm contact. In this case 5 power stages with 0%, 25%, 50%, 75% and 100% are available. If less output contacts are available the operation mode can be adjusted with this parameter, namely for four power stages with 0%, 33%, 66% and 100% or for three power stages with 0%, 50% and 100% (with additional alarm contact each).

A change of the operation mode may also be considered if the system has to be operated with a different number of controlling components. The contact following the last controlling output is always the alarm contact.

Status messages

Message	Cause	Error elimination
F1H	Sensor error, open circuit	Check sensor
F1L	Sensor error, short circuit	Check sensor
FEHL	Closed switching input while setpoint S1' is deactivated	
---	Key lock	see parameter P19 and/or A19
Flashing display	Temperature alarm	
EP	Data loss at parameter memory	If error cannot be eliminated by switching on/off, the controller must be repaired
LED "C"	flashes during a minimum action time, if a switching request is executed. Example: A20=20, K1 is switched on, LED "C" flashes for 20 seconds..	
LED "R"	flashes as soon as the first compressor is replaced in sequential operation mode. As a compressor replacement occurs only in partial load operation (25%-75%) the LED don't flash in power stage 0% and 100%.	
LED "S"	lights up if the switching input is closed. Depending on parameter A43 it has different functions: A43=0: alarm function A43=1 or A43=2: if switching input is closed, a new main setpoint is effective that can be adjusted by the SET key. The LED lights up if the switching input is closed and also enabled with parameter A43=1 or 2.	

Technical data of ST96-35.16

Input

E1: External potential-free switching contact

Measuring input

F1: Resistance thermometer Pt100-3L

Measuring range: -99°C...300°C

Measuring accuracy: 0.5K +/- 0.5 % of scale range, without sensor

Outputs

K1: Relay, normally-open contact, 3(1)A 250V

K2: Relay, normally-open contact, 3(1)A 250V

K3: Relay, normally-open contact, 3(1)A 250V

K4: Relay, normally-open contact, 3(1)A 250V

K5: Relay, normally-open contact, 1A 24V

Display

One 3-digit LED-Display, height 13mm, for temperature display, colour red

One 4-digit LED-Display, height 10 mm, colour red

7 LEDs, diameter 3mm, for status display

Power supply

230V 50/60Hz

Ambient conditions:

Storage temperature: -20...+70°C

Operating temperature: 0...+55°C

Relative humidity: max. 75% without dew

Weight

ca. 200g, without sensor

Connectors

Plug and socket for cable up to 1.5 mm²

Enclosure

IP63

Installation data

Unit is to be installed in an instrument panel.

Front size: 96 x 96 mm

Panel cut-out: 90.5 x 90.5 mm

Installation depth: ca. 105 mm with connector