akYtec

TRM202

2-channel controller

User guide

CE

Contents

1 Overview

This guide describes the functions, system configuration, operating instructions, programming and troubleshooting of the 2-channel controller TRM202 (hereinafter referred to as TRM202, device, or controller).

1.1 Documentation

Data sheet (PDF document to download)
Data sheet contains general information, ordering information and the technical data needed for purchase decision.

Short guide (PDF document to download / printed document in the box)
Short guide contains the most important information about installation, wiring, configuration and operation of the device.

User guide (PDF document to download)
User guide contains the complete information about the device.

Modbus access (PDF document to download / printed document in the box)
The document contains the information about the Modbus functions and the Modbus register allocation of the device.

All PDF documents can be downloaded from www.akytec.de.

1.2 Functions

The 2-channel controller TRM202 is designed for creating automatic control and regulation systems of various technological processes in different areas of industry, agriculture and utilities.

The controller provides following basic functions:

– measuring of the process value and its transformation according to the sensor type
– displaying the process values and configuration parameters on two 4-digit LED displays
– scaling and filtering of input signal
– signal correction, square root function
– calculation of the difference between two signals
– independent ON/OFF control of two process variables or three-step control of one process variable
– automatic control
– network control (RS485 interface) with akYtec, Modbus-RTU and Modbus-ASCII protocols as a Slave
– signal retransmission using analog output 4-20 mA or 0-10 V
– alarm output
– sensor / input error detection
– error indication
– configuration via the functional keys

1.3 RS485 network

The TRM202 uses the common standard RS485 for data exchange.

Serial interface RS485 enables communication via two-wired line in half-duplex mode. The device supports the Modbus RTU, Modbus ASCII and akYtec protocols with automatic protocol detection.

The network consists of a Master device and can contain up to 32 Slave devices. Maximum length is 1200 m. The number of Slave devices and network length can be increased by using RS485 interface repeater.

Devices are connected to a network according to linear (bus) topology. It means that the line goes from the first device to the second one, from the second one to the third one, etc. Star connection and spur lines are not allowed.

Line reflections always occur at each of the two ends of the bus (the first and the last node). The higher the data transmission rate, the stronger the reflections are. A terminating resistor is needed to minimize reflections. 150 ohm (0.5 W) resistor can be used as a line termination.

The TRM202 can only be used as a Slave device. PLC, computer with SCADA software or device can be used as a Master device. To connect TRM202 to PC the interface converter IC4 from akYtec can be used.

To establish the communication via Modbus see sections 7.10, 8.3.

1.4 Ordering information

The TRM202 can be ordered in different variants depending on the required housing and output type.
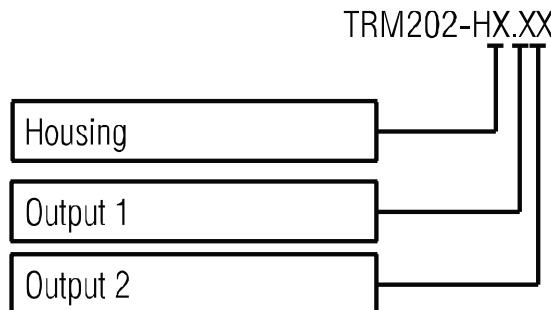
Housing:

H1 - panel mount (96 x 96 x 70 mm)

H2 - panel mount (96 x 48 x 100 mm)

H3 - wall mount (105 x 130 x 65 mm)

Outputs:

R - Relay *

T - NPN transistor *

C - TRIAC *

S - Solid state relay *

I - 4-20 mA

U - 0-10 V

For three-step control the device should be equipped with two digital outputs.

2 Specifications

Table 2.1 General Specifications

Power supply		230 (90…245) V AC, 50 (47…63) Hz		
Power consumption, max.		6 VA		
Analog inputs		2		
Input resistance	4-20 mA	external resistor R_{IN} = 100 ohm (in parallel)		
	0-1 V	≥ 100 kohm		
Optional output		2		
Sampling rate, max.		1 s		
RS485 interface	Terminals	D+, D-		
	Protocols	Modbus RTU/ASCII, akYtec		
	Baud rate	2.4…115.2 kbit/s		
	Cable	Shielded twisted pair (STP)		
Enclosure		H1	H2	H3
Dimension, mm		96 x 96 x 70	96 x 48 x 100	105 x 130 x 65
IP Code		front IP54	front IP54	IP44

Table 2.2 Linear signals

Signal type	Measurement range, %	Accuracy, %
0-1 V	0…100	
-50…+50 mV	0…100	
0-5 mA	0…100	±0.5
0-20 mA	0…100	
4-20 mA	0…100	

Table 2.3 Temperature sensors

Signal type	Measurement range, °C	Temperature coefficient, $°C^{-1}$	Accuracy, %
RTD according to IEC 60751:2008			
Pt50	-200…+750	0.00385	±0.25
Pt100	-200…+750		
RTD according to GOST 6651			
50P	-200...+750	0.00391	
50M	-190…+200	0.00428	
Cu50	-50…+200	0.00426	
100P	-200...+750	0.00391	±0.25
100M	-190…+200	0.00428	
Cu100	-50…+200	0.00426	
53M	-50…+200	0.00426	
46P	-200…+750	0.00391	
TC according to IEC 60584-1:2013			
J	-200…+1200	-	
N	-200…+1300	-	
K	-200…+1300	-	
S	0…+1750	-	
R	0…+1750	-	±0.5
A	0…+2500	-	
T	-200…+400	-	
B	+200…+1800		
TC according to GOST 8.585			
L	-200…+800	-	
A-2	0…+1800	-	±0.5
A-3	0…+1800	-	

Specifications

Table 2.4   Optional outputs

Ordering code	Output type	Loading capacity
R	Relay	8 A / 230 V AC, cos φ ≥ 0.4/ 30 V DC
T	NPN transistor	200 mA, 40 V DC
C	TRIAC	50 mA, 240 V AC (constant operation) 500 mA (f ≤ 50 Hz, pulse duration ≤ 5 ms)
S	Solid state relay	100 mA, 4…6 V DC
I	4-20 mA	10…36 V, max. 1 kohm
U	0-10 V	15…36 V, min. 2 kohm

2.1   Environmental conditions

The device is designed for natural convection cooling that should be taken into account when choosing the installation site.

The following environment conditions must be met:

– clean, dry and controlled environment, low dust level

– closed non-hazardous areas, free of corrosive or flammable gases

Table 2.5

Conditions	Permissible range
Ambient temperature	+1…+50°C
Storage temperature	-25…+55°C
Relative humidity	up to 80% (at +35°C, non-condensing)
Altitude	up to 2000 m above sea level

3   Safety

Explanation of the symbols and keywords used:

⚠ DANGER   *DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

⚠ WARNING   *WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.*

⚠ CAUTION   *CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury*

▶ NOTICE   *NOTICE indicates a potentially harmful situation which, if not avoided, may result in damage of the product itself or of adjacent objects.*

3.1   Intended use

The device has been designed and built solely for the intended use described in this guide, and may only be used accordingly. The technical specifications contained in this guide must be observed.

The device may be operated only in properly installed condition.

Improper use

Any other use is considered improper. Especially to note:

–   This device should not be used for medical devices which receive, control or other-wise affect human life or physical health.

–   The device should not be used in an explosive environment.

–   The device should not be used in an atmosphere with chemically active substance.

![akYtec logo]

4   Installation

⚠️ **CAUTION**

Improper installation
Improper installation can cause serious or minor injuries and damage the device.
Installation must be performed only by fully qualified personnel.

The device is designed in a plastic enclosure for panel or wall mounting. For the dimension drawings see Appendix A.

4.1   Requirements

– Install the device in a cabinet with clean, dry and controlled environment. For further details see 2.1.
– The device is designed for natural convection cooling that should be taken into account when choosing the installation site.
– The seal contact surface must be clean and smooth, so that the IP54 protection (for H1 and H2) can be provided.
– The device can be placed at any angle.
– Maximum panel thickness is 15 mm

4.2   Mounting

Mounting procedure for panel mount (H1 or H2 housing):

– prepare the mounting cutout for H1 (Fig. A.1) or H2 (Fig. A.2 and Fig. 4.1) housing
– make sure that the device is provided with the mounting seal
– fit the device into the cutout
– insert the 2 fastening clips into the slots on the sides of the device
– insert the screws and tighten them to fix the device

Mounting procedure for wall mount (H3):

– prepare three drilled holes according to Fig. A.3
– fix the triangle mounting bracket to the wall using three M4x20 screws (not included) (see Fig. A.3 and Fig. 4.2a)
– hook the angle bracket on the back of the device on the upper edge of the triangle bracket (Fig. 4.2b)
– fix the device to the triangle bracket with the screw supplied (Fig. 4.2c)

Fig. 4.1   Panel mount

a)	b)	c)
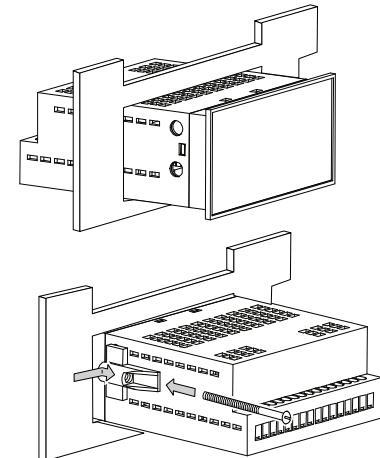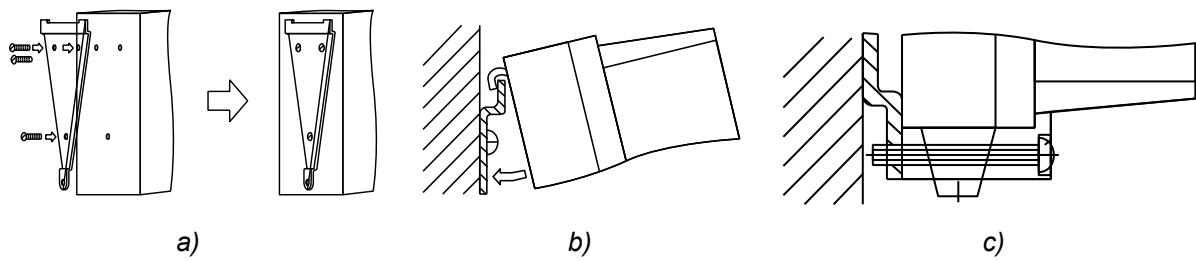
Fig. 4.2   Wall mount

5 Wiring

⚠ **DANGER**	*Dangerous voltage* *Electric shock could kill or seriously injure.* *All electrical connections must be performed by a fully qualified electrician.* *Ensure that the mains voltage matches the voltage marked on the nameplate.* *Ensure that the device is provided with its own power supply line and electric fuse.*
⚠ **WARNING**	*Switch on the power supply only after wiring of the device has been completed.*
⚠ **WARNING**	*Terminals 1…8 for connecting power supply and outputs are designed for a maximum voltage of 250 V. Don't apply voltage above 250 V to the terminals 1...8 to avoid an insulation breakdown or flashover. Different phases are not allowed.*

5.1 General

– The layout of terminal blocks is shown in Fig. 5.1 and the terminal assignments in Table 5.1

– Ensure that the device is provided with its own power supply line and electric fuse I = 0.5 A

– Connect the power supply to the terminals L / N

– The inputs should be wired in accordance with Fig. 5.2...5.3

– The outputs should be wired in accordance with Fig. 5.4...5.10

– The maximum conductor cross-section is 1.5 mm²

▶ **NOTICE**	*Signal cables should be routed separately or screened from the supply cables. Only a shielded cable may be used for signal lines.*

– Connect the RS485 lines to terminals D+ and D-.

– Twisted pair cable should be used for the connection to RS485 interface. Maximal cable length is 1200 m.
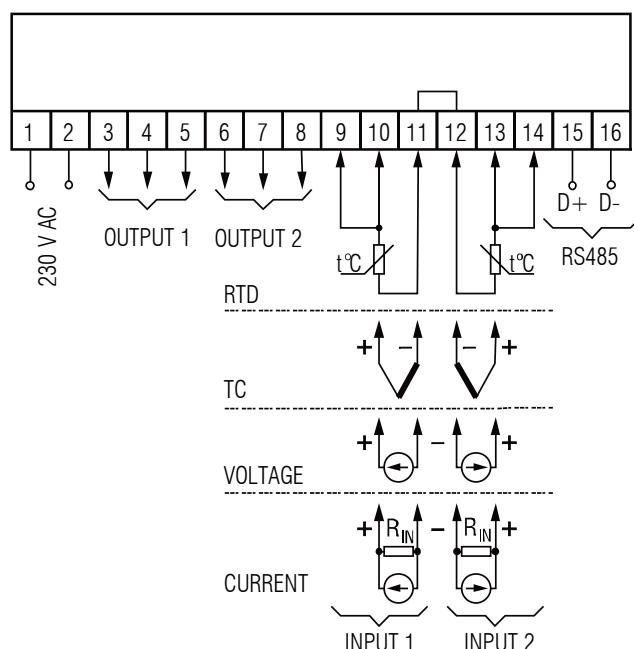
Fig. 5.1   Terminal block layout

Table 5.1   Terminal assignment

No	Designation	Description
1	N	Power supply
2	L	230 V AC
3		
4	Output 1	see 5.2
5		
6		
7	Output 2	see 5.2
8		
9		+ (three-wire RTD)
10	Input 1	+
11		-
12		-
13	Input 2	+
14		+ (three-wire RTD)
15	D+	RS485
16	D-	

5.2   Inputs

Supported signals (see Table 2.2 and 2.3):

– Thermocouple (TC)

– Resistance thermometer (RTD)

– Linear current / voltage signal

Table 5.2   Sensor cables

Sensor type	Cable length, max.	Resistance (per wire), max.	Requirement
RTD	100 m	15 ohm	Equal length and cross-section for 3-wire
TC	20 m	100 ohm	Compensation cable
Current signal	100 m	100 ohm	–
Voltage signal	100 m	5 ohm	–

– Use wires of equal length and cross section when connecting RTD

– Use a thermocouple cable when connecting TC

– Thermocouple sensing junctions of both channels must be isolated from each other and from the grounded equipment.

– Cold junction compensation (CJC) is provided.

5.2.1   Linear signals

Connect the current or voltage signal according to Fig. 5.2, 5.3. An auxiliary voltage source is needed.

▶ NOTICE

To measure a current signal a shunt resistor R_{IN} = 100 ohm (±1%) should be connected in parallel.

Voltage signal can be connected directly to the input terminals.

▶ NOTICE

The auxiliary voltage must not exceed 36 V
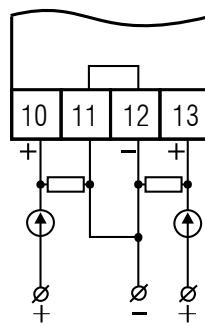
Fig. 5.2   4-20 mA sensor wiring   *Fig. 5.3   0-1 V sensor wiring*
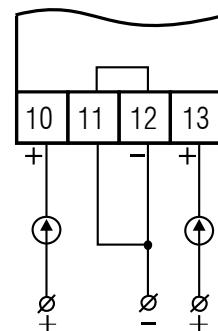
5.3   Outputs

Optional outputs (see Table 2.4):

–   Relay

–   NPN transistor

–   TRIAC

–   Solid state relay

–   Analog 4-20 mA

–   Analog 0-10 V

5.3.1   Relay output (R)
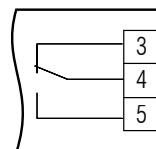
Fig. 5.4   Relay output

5.3.2   NPN transistor (T)

The NPN transistor outputs of T type are designed to control low voltage relay up to 60 V DC / 400 mA.

► **NOTICE**   *As a precaution against inadvertent current reversal on the output, a parallel diode (Imax = 1 A, Umax=100 V) is usually included in the output circuit.*
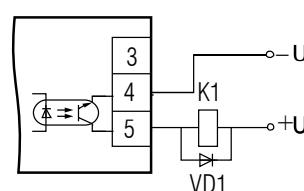
Fig. 5.5   NPN transistor outputs

5.3.3   TRIAC (C)

The resistor R1 (5…20 kohm) is used to limit the load current.

► **NOTICE**   *To protect thyristors and TRIACs from voltage surges an RC protect circuit should be connected in parallel to load: R2 (47…68 ohm) and C1 (0.1 x 630 V).*
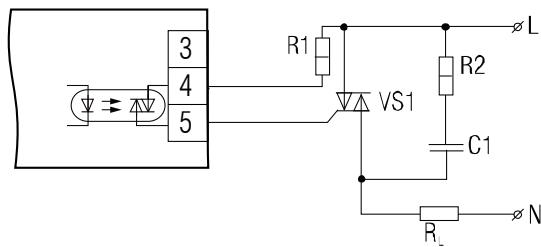
Fig. 5.6   Power TRIAC connection
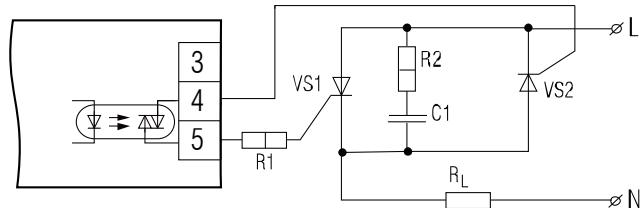
Fig. 5.7   Inverse-parallel connection of two thyristors

5.3.4   Solid state relay (S)

The logic output of S type is designed to control a solid state relay with rating voltage 4…6 V DC and current up to 100 mA.
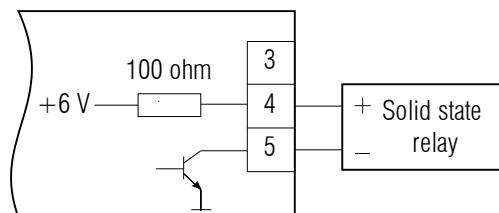
Fig. 5.8   SSR output

5.3.5   Analog 4-20 mA (I)

For the current output an external voltage source is required.

► **NOTICE**

The auxiliary voltage must not exceed 36 V
The output is designed for maximal load resistance of 1 kohm.
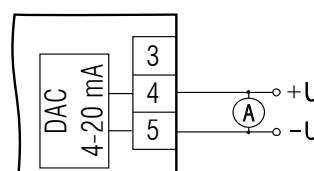
Fig. 5.9   4-20 mA output

5.3.6   Analog 0-10 V (U)

An external power supply is required for analog output 0-10 V

► **NOTICE**

The auxiliary voltage must not exceed 36 V.
The output is designed for minimal load resistance of 2 kohm.
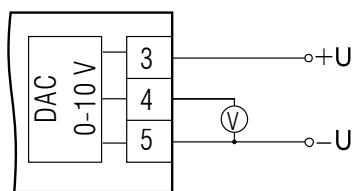
Fig. 5.10   0-10 V output

6 Operation

6.1 Control elements

The device is designed in a plastic enclosure for panel or wall mounting, depending on the model. The indicators and control elements are located on the front side of the device.
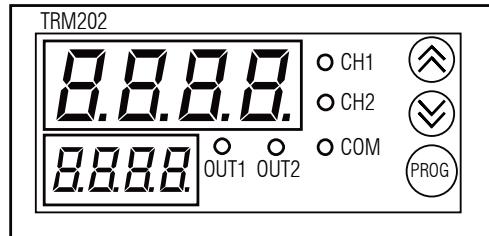
Fig. 6.1 Front view (H2 housing)

The operation of the device can be controlled with two 4-digit displays, three buttons and five LEDs on the front panel. Indicators inform the operator about the controller and output status. Displays show following information:

Table 6.1 Displays

Display	Mode	Displayed information
Upper display (red)	Operation	Process value
	Configuration	Parameter name
	Menu	"MENU"
	Error	Error name
Lower display (green)	Operation	Setpoint
	Configuration	Parameter value
	Menu	Parameter group

For display functions during the configuring see section 7 "Configuration".

Table 6.2 Indicators

LED	Indication	Description
CH1	lights	upper display shows the CH1 input value
CH2	lights	upper display shows the CH2 input value
COM	flashes for 0.1 s	on data transmission
OUT1	lights	output 1 is ON
OUT2	lights	output 2 is ON

Table 6.3 Function keys

Key	Description
⊼	Increase value or menu navigation
⊻	Decrease value or menu navigation
PROG	Press > 3 s − enter the configuration mode − exit the parameter group Press < 1 s: − enter the parameter group − save the parameter and go the next one
PROG + ⊼ + ⊻	Passcode access

Key	Description
PROG + ⋀	Modify the decimal part of parameter (Configuration)
PROG + ⋁	Go back to modify the integer part of parameter (Configuration)

6.2 Principle of operation
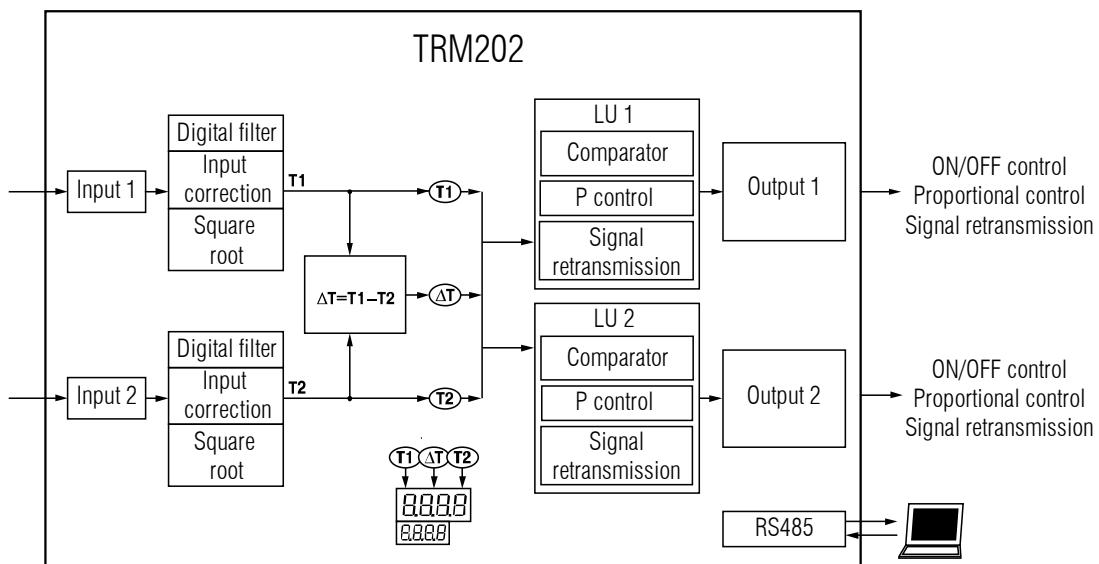
Fig. 6.2   Block diagram

The device has two control channels.

The input signals are continuously sampled and converted according to the selected sensor type (parameters **in.t1**, **in.t2**, see Table B.1) and the measured value is displayed and processed according to the channel settings.

Each of the measured values or the difference between them can be used as an input value for one of the Control Units (LU). The Control Unit analyses the input value and generates the output signal in accordance with the Control Unit settings.

Each of the outputs can be assigned to the one of the Control Units and used for control, alarm or signal retransmission.

The device can be ordered with analog or digital outputs (see 1.4 "Ordering information"). For three-step control the device should be equipped with two digital outputs.

6.3 First start up

▶ **NOTICE**

Before starting

Before switching on, make sure that the device was stored at the specified ambient temperature (+1... +50°C) for at least 30 minutes.

After the device is powered on, the self-test is carried out and all LEDs are on for 2 seconds. If the self-test is not successful, the error cause is displayed (see Table D.1). Otherwise the automatic control is activated, the Control Unit Input value **LUPv1** is shown on the upper display and the Setpoint **SP1** on the lower display. To display the **LUPv2** and **SP2** values press the key PROG.

The setpoint can be modified with the ⋀ and ⋁ keys, if no access protection for the parameter is activated (see 7.11). Press PROG key to save the setpoint and go to the

next operation parameter. Alternatively the setpoint can be modified via system menu (see 7) in the group **LvoP**.

At the first start up the device will use the default parameter set. Before integrating the device in the control system, we recommend:

– connect the device to a power source

– power up the device

– configure the parameters to suit your application (see 7)

– turn off the power

– connect the process signals and actuators to the device inputs and outputs

7 Configuration

In the system menu the parameters are divided into 5 groups: **LvoP**, **Adv, LvIn**, **LvoU** and **Comm** (Fig. 7.1).

The full list of the programmable parameters is given in Table B.1.

The parameters are saved in the memory registers according to the Table C.3.
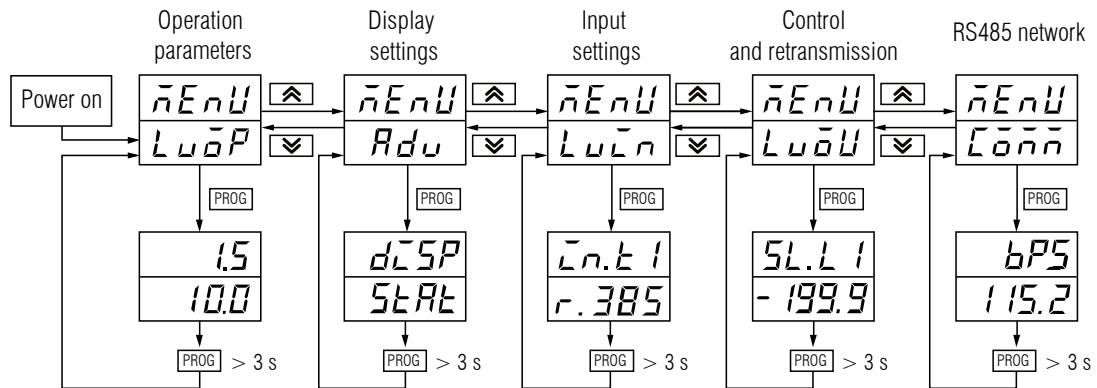
Fig. 7.1   Parameter groups

- **LvoP** (**SP1**, **SP2**) – operation parameters, displayed at the device start
- **Adv**   – display settings
- **LvIn**   – input settings
- **LvoU**   – control and retransmission settings
- **Comm**   – RS485 network settings

To use the functional keys in Configuration refer to Table 6.3.

Switching between control and configuration modes is carried out using the key PROG by default. To exit the configuration mode automatically, use the parameter **rESt** (Rest time). If no keypad activity is detected during the Rest time, the configuration mode will be ended. The parameter can be set in the range 5…99 s. By default **rESt** = OFF.

7.1 Temperature sensor

The signal from the resistance thermometer or thermocouple is converted according to the sensor curve for the selected sensor. The type of the connected sensor should be set in the parameter **in.t1**,**in.t2** for both channels.

When the RTD or TC is used, the displayed accuracy for the measured temperature can be set in the parameter **dPt1, dPt2** (Decimal point displayed). The parameter is not available in the menu for sensors with the linear output. For the thermocouples with the upper limit above 1000°C is recommended to set **dPt** =1, for other temperature sensors **dPt** =0.

When the difference ΔT as the input for a Control Unit is used and settings for **dPt1** and **dPt2** are different, the ΔT value is displayed with the accuracy **dPt1**.

When the thermocouple is used, Cold junction compensation (CJC) enables precise temperature measurement. The reference junction sensor is located near the input terminals. The function is active by default. It should be deactivated only during the calibration. Set the parameter **wXC** (Calibration parameters) to OFF to disable this function. This setting is effective for both inputs.

7.2 Linear signal

There are additional functions for linear signal processing: decimal point position, scaling and square root.

When a linear sensor is used, the accuracy can be set in the parameter **dP1**, **dP2** (Decimal point). For temperature sensors the parameter **dP** = 1 and is not available in the menu.

Note: The parameter **dP** affects other parameters (see Table B.1).

The measurement range can be defined in the parameters:

> **in.L1** (**in.L2**) – signal lower limit

> **in.H1** (**in.H2**) – signal upper limit

If **in.L** < **in.H**, then

$$Measured\ value = \boldsymbol{in.L} + \frac{(\boldsymbol{in.H} - \boldsymbol{in.L}) * (S_i - S_{min})}{S_{max} - S_{min}}$$

If **in.L** > **in.H**, then

$$Measured\ value = \boldsymbol{in.L} - \frac{(\boldsymbol{in.L} - \boldsymbol{in.H}) * (S_i - S_{min})}{S_{max} - S_{min}}$$

where

> S_{max} – max. input signal (for example, 20 for 4-20 mA signal)
> S_{min} – min. input signal (for example, 4 for 4-20 mA signal)
> S_i – current signal value

Note:

After the Signal limits are set so that **in.L1** > **in.H1** (**in.L2** > **in.H2**), the Setpoint limits **SL.L1**, **SL.L2**, **SL.H1**, **SL.H2** (see 7.6) and the Retransmission limits **An.L1**, **An.L2**, **An.H1**, **An.H2** (see 7.8.2) have to be set again.

7.2.1 Square root function

The function is provided for transmitters with output signal proportional to the square of the measured signal. To enable the function for the input, the parameter **Sqr1, Sqr2** (**Lvin** group) must be set to ON.

7.3   Correction

The sensor characteristic curve can be corrected by the user. Two correction parameters, Offset and Slope, are provided for each input:

–   Offset can be set in the parameter **SH1**, **SH2** (**Lvin** group) in measuring units in the range of -500…500 to correct the sensor initial error.
–   Slope can be set in the parameter **KU1**, **KU2** (**Lvin** group) within the range 0.5…2.0.

Set the correction parameters **SH1**, **SH2, KU1, KU2** if necessary. When the resistance thermometer in 2-wire connection is used, Offset should be set to compensate the sensor line resistance.
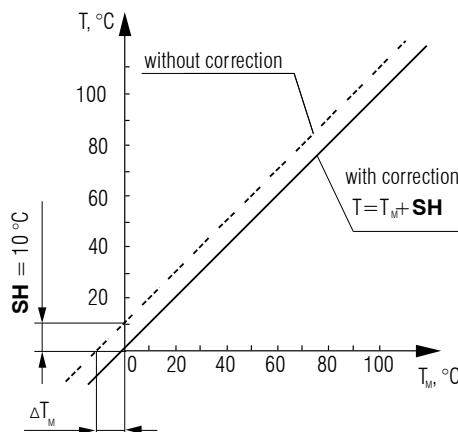
Fig. 7.2   Offset   *Fig. 7.3   Slope*
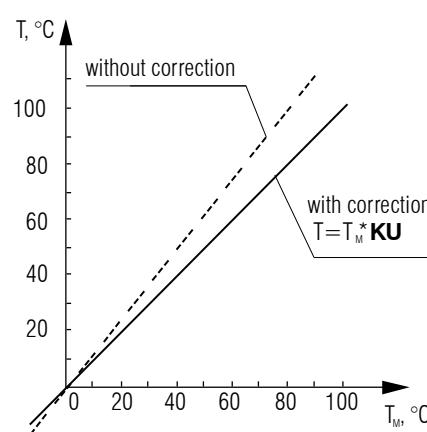
7.4   Filter

The digital filter consists of two stages.

1.   The **comparator** is used at the first stage to detect apparent "gaps" or "outliers" in the input signal. The Filter bandwidth for the comparator should be specified in the parameter **Fb** (**Fb2**) (**Lvin** group) in measuring units within the range 0…9999. The filter is disabled if the bandwidth is set to 0.

The difference between the last two measurements T_i and T_{i-1} is determined and compared with the bandwidth. If the difference exceeds the bandwidth, the last measurement T_i will be replaced with the (T_{i-1} + **Fb**) and the bandwidth will be doubled to smooth the characteristic curve. A smaller filter bandwidth slows down the response to input signal variations (Fig. 7.4).

It is recommended to increase the filter bandwidth or disable the parameter when a low level of interference or rapidly varying process.

If the process signal has high interferences, decrease the bandwidth to reduce the influence on the process.
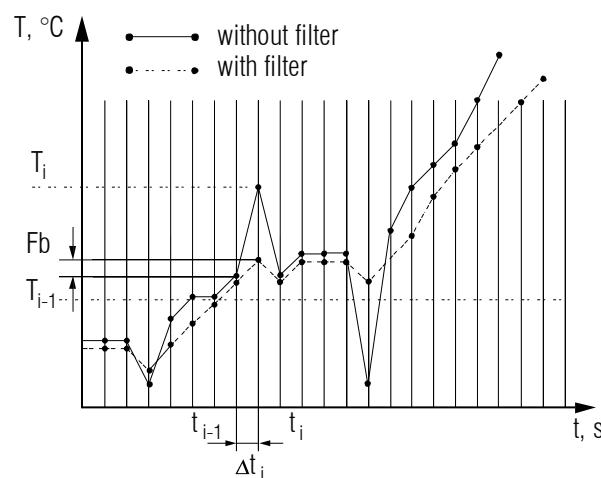
Fig. 7.4   Filter bandwidth

2.   The **Damping** with the parameters **inF1**, **inF2** is used at the second stage. The filter time constant can be set within the range 1…999 seconds. The higher the value, the higher the noise resistance and the slower the output response are. When the value is set to 0, the damping is deactivated.
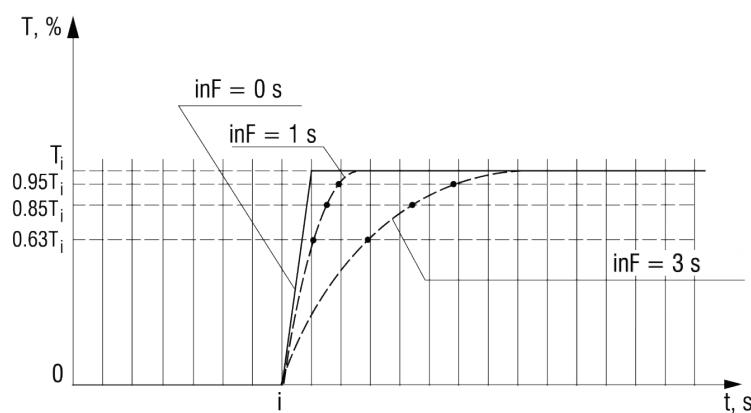
Fig. 7.5   Filter time constant

7.5 Control Unit

The combination of a Control Unit (LU) with its input parameter and the associated output defines a control channel (see Fig. 6.2).

Setpoints **SP1** and **SP2** should be set as a main control parameter. For further details see 7.6.
Following parameters should be set to define the control procedure:

– The inputs of the Control Units **iLU1**, **iLU2** (**Lvin** group): Pu1, Pu2 or dPv. If a value Pu1 or Pu2 is selected, one of the inputs is directly connected to the LU. Also the difference dPv between two input values can be selected. When calculating the difference, the input values must be measured in the same units. To use the device as a three-point controller the same signal should be used as the input for both LU.
– Each LU can work in different modes depending on the type of the connected output:
  o ON/OFF control – for digital output only
  o Proportional control – for analog output, parameter **dAC1**, **dAC2** = o
  o Signal retransmission – for analog output parameter **dAC1**, **dAC2** = Pv

7.6 Setpoint limits

The valid range for the setpoint **SP1**, **SP2** is limited by the Setpoint limits **SL.L1**, **SL.L2** and **SL.H1, SL.H2** (group **LvoU**).

The Setpoint limits are limited too. They can assume the values only within the measurement range for the selected sensor.

Note:

The parameters **SP**, **SL.L**, **SL.H**, **An.L**, **An.H** can assume the values above 1000°C for the thermocouples with the upper limit above 1000°C. In this case the value is displayed on the lower display without decimal part but with the flashing point after the last digit:

[$1000.$]. The flashing point indicates that the number has a decimal part.

To display and to modify the decimal part press the $\boxed{PROG}$ + $\boxed{\wedge}$ keys, then [- - - . 0] will be displayed. To modify the decimal part press the $\boxed{\wedge}$ or $\boxed{\vee}$ keys. To go back to the integer part press the $\boxed{PROG}$ + $\boxed{\vee}$ keys.

7.7 Digital output

Configurable parameters for LU with outputs of type R, T, C, S (see Table B.1):

– Hysteresis **HYS1, HYS2**
– Digital function **CmP1, CmP2**
– ON delay **don1**, **don2**
– OFF delay **doF1**, **doF2**
– Minimum ON-state duration **ton1**, **ton2**
– Minimum OFF-state duration **toF1**, **toF2**
– Output safe state **oEr1**, **oEr2**
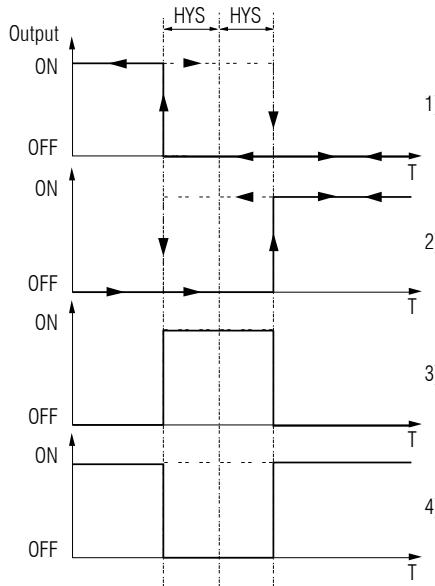
Fig. 7.6   Digital control functions

One of the following functions (parameters **CmP1**, **CmP2**) can be selected in the ON/OFF control mode (see Fig. 7.6):

1. Function "Heating" is used to control the heating process or generate an alarm signal if the process value T is below the setpoint **SP**. The output is activated when the T < (**SP** – **HYS**) and deactivated when T > (**SP** + **HYS**).

2. Function "Cooling" is used to control the cooling process or generate an alarm signal if the process value is above the setpoint **SP**. The output is activated when the T > (**SP** + **HYS**) and deactivated when T < (**SP** – **HYS**).

3. Function "Alarm within limits" is used to generate an alarm if the process value is within the preset range. The output is activated when (**SP** – **HYS**) < T < (**SP** + **HYS**).

4. Function "Alarm outside limits" is used to generate an alarm signal if the process value is outside the preset range. The output is activated when T < (**SP** – **HYS**) or T > (**SP** + **HYS**).
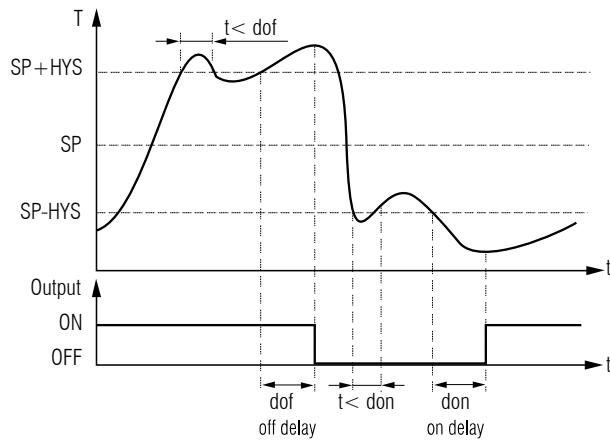
Fig. 7.7   Turn-on and Turn-off delays

The ON and OFF delays as well as the minimum ON and OFF state duration time can be set for the ON/OFF control mode.
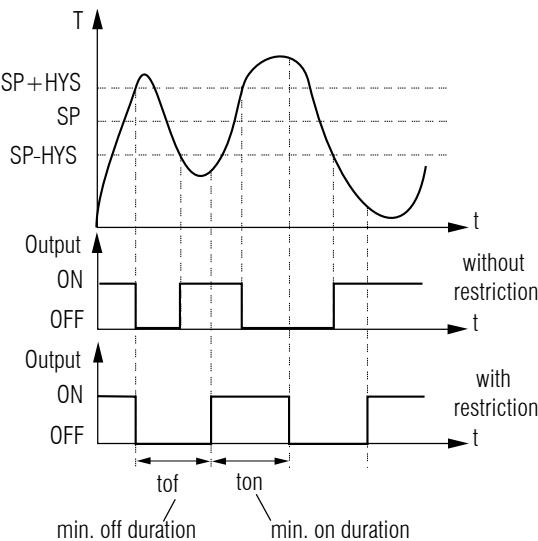
Fig. 7.8   Minimum ON/OFF-state duration

In case of an error in the channel the control will be stopped and the output value set to the Output safe state defined in the parameter **oEr1** (**oEr2**):

oEr = oFF   – OFF for digital output

oEr = oN   – ON for digital output

7.8   Analog output

The operating mode for the analog output can be selected in the parameters **dAC1**, **dAC2** (Analog mode):

dAC = o   – P control

dAC = Pv   – signal retransmission

After setting the parameters of the selected mode the output safe state can be set (see 7.8.3).

7.8.1   P control

In the proportional control mode the output signal is generated to minimize the deviation between the Control Unit Input value **LUPv** and the setpoint **SP**. The signal will be proportionally scaled within the proportional band (see Fig. 7.10).

If the P control is selected, the Analog function **CtL1**, **CtL2** must be set:

CtL = HEAt   – Heating

CtL = CooL   – Cooling

The Proportional band **XP1**, **XP2** can be set in the measuring units within the range 2…9999 to scale the output signal. The proportional band has to be reset after changing the sensor type.
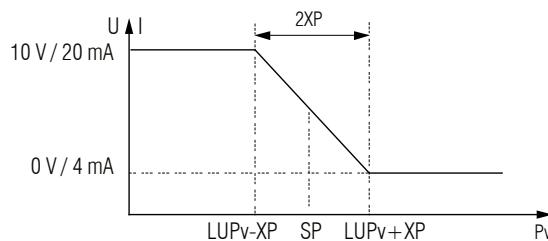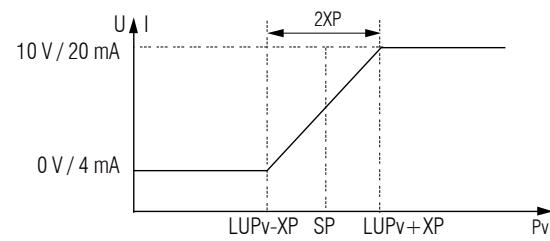
a) Heating   *b) Cooling*

Fig. 7.10   Analog function

7.8.2 Signal retransmission

In the Retransmission mode (**dAC** = Pv) the linear signal 4-20 mA or 0-10 V can be scaled and transmitted to the analog output.

Configurable parameters (only for Output of type U or I available):

An.L1, **An.L2**   – Retransmission lower limit

An.H1, **An.H2**   – Retransmission upper limit

a) An.L < An.H   b) An.L > An.H
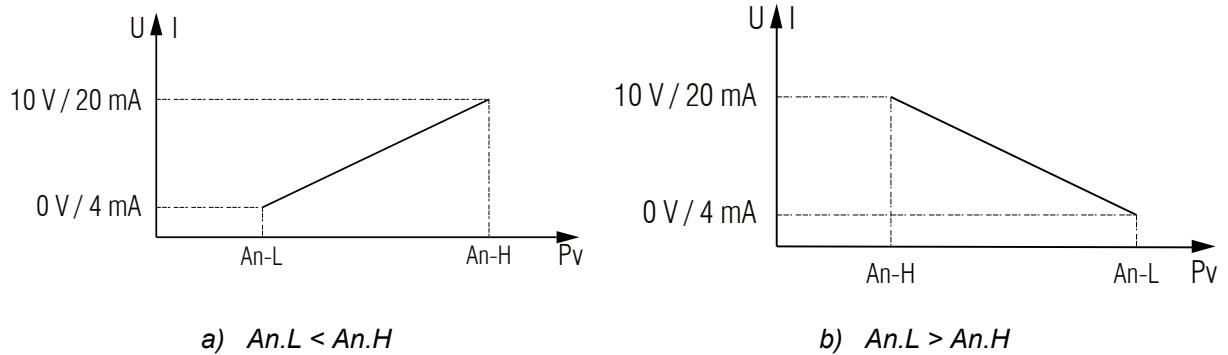
Fig. 7.11   Retransmission

7.8.3 Output safe state

In case of an error in the channel the control will be stopped and the output value set to the Output safe state defined in the parameter **oEr1** (**oEr2**):

$\quad$ **oEr** = oFF $\qquad$ – 4 mA (0 V) for analog output

$\quad$ **oEr** = oN $\qquad$ – 20 mA (10 V) for analog output

7.9 Display settings

In the control mode the measured value on the input 1 is shown in the upper display and the setpoint in the lower display by default. The display mode can be changed in the parameter **diSP** (**Adv** group).

diSP = StAt   – Static mode (default): The input signal of the Control Unit 1 is displayed in the upper display. Press the key ⌷PROG⌷ to see the input signal of the Control Unit 2

diSP = CYCL – Cyclic mode: The input signals of two channels are alternately displayed in the upper display with the period of 6 seconds. The display flashes once when channel is changed.

diSP = botH – Parallel mode: The input signal of the Control Unit 1 is displayed in the upper display and the input signal of the Control Unit 2 in the lower display. Press the key ⌷PROG⌷ to switch to the Static mode.

About using the parameter **rESt** (Rest time) see 7 "Configuration".

7.10 RS485 network settings

To establish communication via RS485 connect the RS485 lines to terminals D+ and D- (see 5.1) and set the network parameters in the menu group **Comm** (see Table C.1):

Prot   – Protocol (akYtec, Modbus RTU, Modbus ASCII)
bPS   – Baud rate (2.4…115.2 kbit/s)
ALEn   – Address bits (7, 8)
Addr   – Network address. Valid values:

$\qquad$ 0…255 for **Prot** = o‿YEn and **A.Len** = 8

$\qquad$ 0…2047 for **Prot** = o‿YEn and **A.Len** = 11

0…247 for **Prot** = ⲛⲕⲧⵀ or ⲛⲀⲋⲓ

rSdL   – Response delay (1…45 ms)

Note: The changed network parameter values come into effect only after restarting the device (power off and on again or via Network).

The following invariable network parameters are not available in the system menu (see Table 7.1).

Table 7.1   Invariable network parameters

Parameter	Name	Protocol		
		akYtec	**Modbus RTU**	**Modbus ASCII**
Stop bits	**Sbit**	1	2	2
Data bits	**LEn**	8 bit	8 bit	7 bit
Parity	**PrtY**	none	none	none

7.11   Access protection

Three security parameters are available for unauthorized access protection (**SECr** group):

- **oAPt** – read access
  - o **oAPt** = 0   – Access to all parameters
  - o **oAPt** = 1   – Access only to **SP1**, **SP2**
  - o **oAPt** = 2   – No access
- **wtPt** – write access
  - o **wtPt** = 0   – Access to all parameters
  - o **wtPt** = 1   – Access only to **SP1**, **SP2**
  - o **wtPt** = 2   – Access only to **SP1**
  - o **wtPt** = 3   – No access
- **EdPt** – individual parameter access (ON/OFF)

To access the **SECr** group enter the passcode 100 using the keys ⌃ and ⌄.

These parameters have no effect on the access via RS485 network.

Each parameter has an access attribute that can be set only via the RS485 network.

If **EdPt** = ON, all the parameters with the access attribute "Protected" become unavailable in the system menu.

If **EdPt** = OFF, all the parameters become available in the system menu.

If all the parameters within the group are protected, the group becomes unavailable.

7.12   Factory settings

To reset the device to the default settings switch it off **at least for 1 minute,** hold the ⌃ and ⌄ keys together and then switch the device on. When [– – – –] appears on the upper display, release the keys. The settings will be reset to default values.

7.13   Calibration

The device should be calibrated to restore the accuracy after a long-term operation or repair works with an effect on the measurement system. Calibration has to be carried out by the manufacturer.

Contact the Technical Support of akYtec GmbH for further details.

8 Control modes

8.1 General

Two control modes are available: automatic control and control over network.

When the device is powered on, it starts to work immediately according to the parameters values saved in its memory. The device behaviour and its performance are governed by the value of the stored parameters.

After the device is powered on, the self-test is carried out and all LEDs are on for 2 seconds. If the self-test is not successful, the error cause is displayed (see Table D.1). Otherwise the selected control mode will be activated.

The operator can control the state of the outputs with the indicators **OUT1**, **OUT2**. The indication depends on the type of output. For digital outputs:

– The indicator is on when the corresponding Control Unit with the connected output is activated.

– The indicator is off when the corresponding Control Unit with the connected output is deactivated.

In the devices with an analog output the flashing indicator shows the output signal level:

– The indicator is off when the output signal is at its lowest value (4 mA for current, 0 V for voltage).

– The indicator starts to flash once per second, when the output signal begins to grow.

– The indicator is steadily on, when the signal level reaches 20 mA or 10 V accordingly.

8.2 Automatic control

In this mode the Control Unit Input value **LUPv1** is shown on the upper display and the Setpoint **SP1** on the lower display. To display the **LUPv2** and **SP2** values press the key PROG .

The setpoint can be modified with the ⌃ and ⌄ keys, if no access protection for the parameter is activated (see 7.11). Press PROG key to save the setpoint and go to the other channel. Alternatively the setpoint can be modified via system menu (see 7) in the group **LvoP**.

The automatic control can be started or stopped in three ways:

1. Set **r-S** = rUn to start control, set **r-S** = StoP to stop it (see Table B.1, **LvoP** group).
2. Change the parameter **r-S** via RS485 network
3. Restart the device

8.3 Control over Network

If Network control is activated, the outputs are only controlled by the Master device. The controller operates only as a Slave.

The device supports control over RS485 interface with the protocols Modbus RTU / Modbus ASCII.

The supported Modbus functions are shown in the Table C.1.

The implemented Modbus Exception Codes are shown in the Table C.2.

The complete list of parameters that can be accessed via Modbus network is shown in the Table C.3 "Modbus Registers".

To select the control mode the parameters **r-L1, r-L2** (Network control) should be set:

> **r-L** = 0 – Automatic control (default)
>
> **r-L** = 1 – Network control

Network control can be activated for each Control Unit individually.

To set the desired output signal via Modbus the parameter **r.oUt1**, **r.oUt2** (Network output signal) should be specified:

> **r.oUt =** 0 or 1　– output state for digital output
>
> **r.oUt =** 0…1.0　– output level for analog output

Note:

1. The parameters **r-L** and **r.oUt** are only available via network.

2. The parameter **r-L** is initiated with 0 every time the device is switched on or restarted via RS485 network using the command **init** (see Table C.3, **Comm** group).

3. The decimal point position for the parameter **r.oUt** is permanently 3. To set **r.oUt** = 1 you should enter 1000.

4. When the parameter **r.oUt** is being set, the following error codes can be returned:

   a.　0xF0　– Memory error Er.64 (see Table D.1)

   b.　0xF1　– attempt to write a value other than 0 or 1 for digital output

8.4　Errors

The device monitors the integrity of the transmitters connected to the inputs. Sensor error (Err.S) is generated when the sensor fails or when the measured value is outside the measuring range (see Table 2.3). After the error cause is eliminated, the control is automatically resumed.

To quit any other error resume the control (see 8.2):

> set **r-S** = StoP to deactivate the alarm
>
> set **r-S** = rUn to start control

or restart the device.

In case of a thermocouple shirt-circuit the "cold end" temperature will be displayed.

The detailed descriptions and remedy actions are given in Table D.1.

▶ **NOTICE**

Switch off the device before checking the sensor and connection lines.
Use only the measuring device with the output voltage max. 4.5 V to prevent the device damage during the circuit integrity check. Disconnected the sensor in case of higher voltages.

For Output safe state in case of error see 7.7 for digital output and 7.8.3 for analog output.

9   Maintenance

The maintenance includes:

–   cleaning of the housing and terminal blocks from dust, dirt and debris

–   checking the fastening of the device

–   checking the wiring (connecting leads, fastenings, mechanical damage).

The device should be cleaned with a damp cloth only. No abrasives or solvent-containing cleaners may be used. The safety information in section 3 must be observed when carrying out maintenance.

10 Transportation and storage

Pack the device in such a way as to protect it reliably against impact for storage and transportation. The original packaging provides optimum protection.

If the device is not taken immediately after delivery into operation, it must be carefully stored at a protected location. The device should not be stored in an atmosphere with chemically active substances.

Permitted storage temperature: -25...+55 °C

▶ **NOTICE**	*Transport damage, completeness* *The device may have been damaged during transportation.* *Check the device for transport damage and completeness!* *Report the transport damage immediately to the shipper and akYtec GmbH!*

11 Scope of delivery

–	TRM202	1
–	Short guide	1
–	Mounting kit	1
–	Gasket	1

Appendix A   Dimensions

Max. panel thickness 15 mm
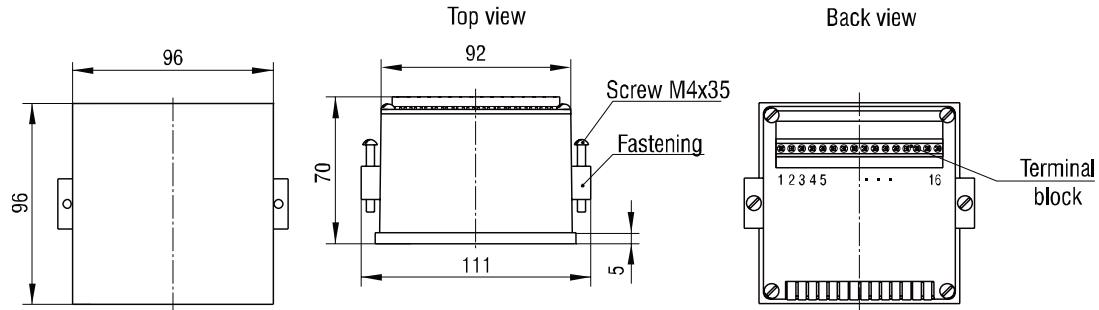
Fig. A.1   External dimensions TRM202-H1
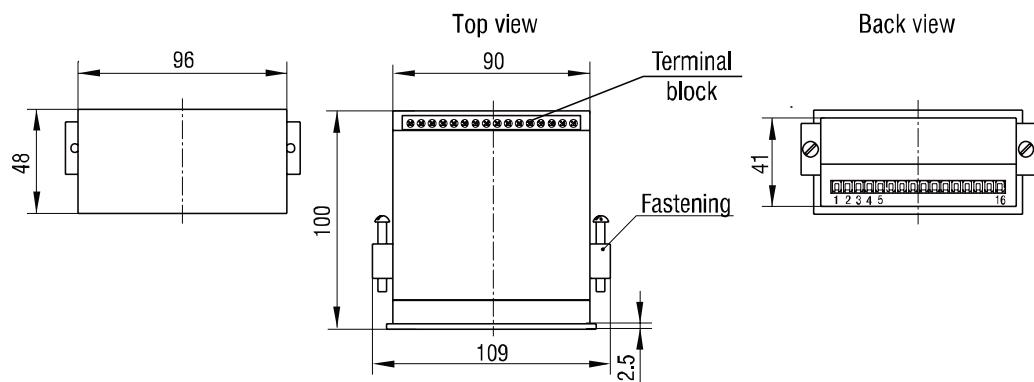
Fig. A.2   External dimensions TRM202-H2
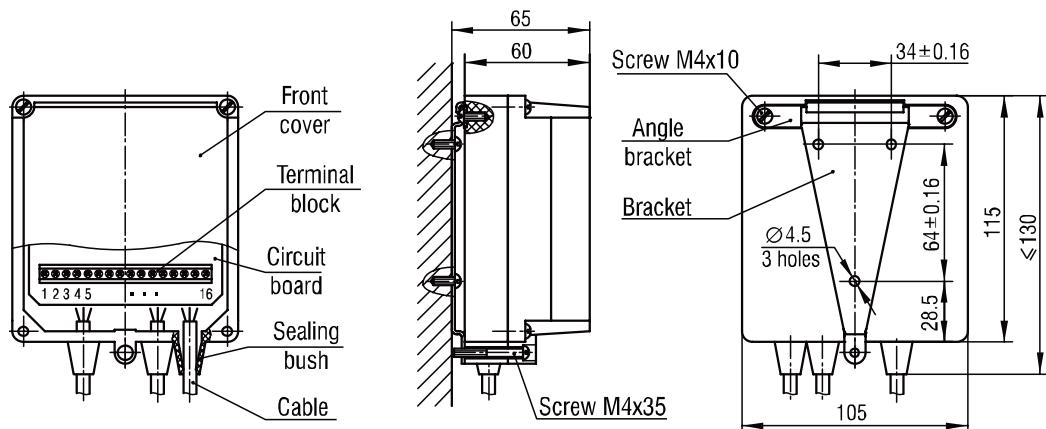
Fig. A.3   External dimensions TRM202-H3
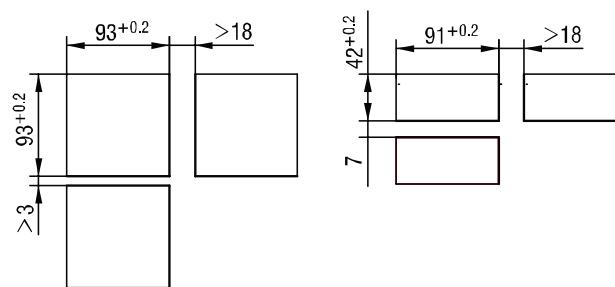
Fig. A.4   Panel mount TRM202-H1 (left) and TRM202-H2 (right)

Appendix B   Configuration parameters

Table B.1   Configuration parameters

No	Name	Display	Parameter	Valid value	Meaning	Factory
			Operation parameters (LvoP)			
1	**SP1**	5P 1	Setpoint 1	SL.L1…SL.H1	-	30.0
2	**SP2**	5P2	Setpoint 2	SL.L2…SL.H2	-	30.0
			Input settings (Lvin)			
1	**in.t1**	in.t 1	CH1 Sensor	r385	Pt50	Pt100
				r.385	Pt100	
				r39 1	50P (GOST)	
				r.39 1	100P (GOST)	
				r-2 1	46P (GOST)	
				r426	Cu100	
				r.426	Cu50	
				r-23	53M (GOST)	
				r428	50M (GOST)	
				r.428	100M (GOST)	
				E_A 1	A	
				E_A2	A-2 (GOST)	
				E_A3	A-3 (GOST)	
				E__b	B	
				E__J	J	
				E__y	K	
				E__L	L (GOST)	
				E__n	N	
				E__r	R	
				E__5	S	
				E__t	T	
				i0_5	0-5 mA	
				i0.20	0-20 mA	
				i4.20	4-20 mA	
				U-50	-50…+50 mV	
				U0_ 1	0-1 V	
2	**dPt1**	dPt 1	CH1 Decimal point displayed [1]	0	0000	1
				1	000.0	
3	**dP1**	dP 1	CH1 Decimal point [2]	0	0000	1
				1	000.0	
				2	00.00	
				3	0.000	
4	**in.L1**	in.L 1	CH1 Signal lower limit	–1999...9999	Affected by **dP1**	0.0
5	**in.H1**	in.H 1	CH1 Signal upper limit	–1999...9999	Affected by **dP1**	100.0
6	**Sqr1**	5qr 1	CH1 Square root	ON	-	OFF
				OFF		

Appendix B   Configuration parameters

No	Name	Display	Parameter	Valid value		Meaning	Factory
7	**SH1**	*SH 1*	CH1 Offset	-500…500		Affected by **dP1**	0.0
8	**KU1**	*HU 1*	CH1 Slope	0.5…2.0		-	1.000
9	**Fb1**	*Fb 1*	CH1 Filter bandwidth	0….9999		Affected by **dP1**	0.0
10	**inF1**	*inF 1*	CH1 Filter time constant	OFF		-	OFF
				1…999 s			
11	**iLU1**	*iLU 1*	LU1 Input	Pv1	Input 1 (T1)		Pv1
				Pv2	Input 2 (T2)		
				dPv	Difference T1-T2		
12	**in.t2**	*in.t2*	CH2 Sensor	See **in.t1**			Pt100
13	**dPt2**	*dPt2*	CH2 Decimal point displayed [1]	0	0000		1
				1	000.0		
14	**dP2**	*dP2*	CH2 Decimal point [2]	0	0000		1
				1	000.0		
				2	00.00		
				3	0.000		
15	**inL2**	*in.L2*	CH2 Signal lower limit	–1999...9999		Affected by **dP2**	0.0
16	**in.H2**	*in.H2*	CH2 Signal upper limit	–1999...9999		Affected by **dP2**	100.0
17	**Sqr2**	*5qr2*	CH2 Square root	ON		-	OFF
				OFF			
18	**SH2**	*SH2*	CH2 Offset	-500…500		Affected by **dP2**	0.0
19	**KU2**	*HU2*	CH2 Slope	0.5…2.0		-	1.000
20	**Fb2**	*Fb2*	CH2 Filter bandwidth	0….9999		Affected by **dP2**	0.0
21	**inF2**	*inF2*	CH2 Filter time constant	OFF		-	OFF
				1…999 s			
22	**iLU2**	*iLU2*	LU2 Input	Pv1	Input 1 (T1)		Pv2
				Pv2	Input 2 (T2)		
				dPv	Difference T1-T2		
Control and retransmission (LvoU)							
1	**SL.L1**	*SL.L 1*	LU1 Setpoint lower limit	-1999...9999		Affected by **dP1**	-199.9
2	**SL.H1**	*SL.H 1*	LU1 Setpoint upper limit	-1999...9999		Affected by **dP1**	800
3	**SL.L2**	*SL.L2*	LU2 Setpoint lower limit	-1999...9999		Affected by **dP2**	-199.9
4	**SL.H2**	*SL.H2*	LU2 Setpoint upper limit	-1999...9999		Affected by **dP2**	800
Control Unit 1 (Digital output)							
1	**CmP1**	*CmP 1*	LU1 Digital function	0	OFF		1
				1	Heating		
				2	Cooling		
				3	Alarm within limits		
				4	Alarm outside limits		
2	**HYS1**	*HY5 1*	LU1 Hysteresis	0…9999		Affected by **dP1**	1.0
3	**don1**	*don 1*	LU1 Turn-on delay	0…250 s			0
4	**doF1**	*doF 1*	LU1 Turn-off delay	0…250 s			0
5	**ton1**	*ton 1*	LU1 ON-state minimum duration	0…250 s			0
6	**toF1**	*toF 1*	LU1 OFF-state minimum duration	0…250 s			0

No	Name	Display	Parameter	Valid value	Meaning	Factory
7	oEr1	ōEr 1	LU1 Output safe state	oFF	OFF	OFF
				on	ON	
Control Unit 1 (Analog output)						
1	dAC1	dAC 1	LU1 Analog mode	o	Proportional control	Pv
				Pv	Signal retransmission	
2	CtL1	CtL 1	LU1 Analog function	HEAt	Heating	HEaT
				CooL	Cooling	
3	XP1	ūP 1	LU1 Proportional band	2...9999	Affected by **dP1**	1.0
4	An.L1	An.L 1	LU1 Retransmission lower limit	-1999...9999	Affected by **dP1**	-199.0
5	An.H1	An.H 1	LU1 Retransmission upper limit	-1999...9999	Affected by **dP1**	800.0
6	oEr1	ōEr 1	LU1 Output safe state	oFF	4 mA (0 V)	OFF
				on	20 mA (10 V)	
Control Unit 2 (Digital output)						
1	CmP2	CōP2	LU2 Digital function	0	OFF	1
				1	Heating	
				2	Cooling	
				3	Alarm within limits	
				4	Alarm outside limits	
2	HYS2	HYS2	LU2 Hysteresis	0…9999	Affected by **dP2**	1.0
3	don2	dōn2	LU2 Turn-on delay	0…250 s		0
4	doF2	dōF2	LU2 Turn-off delay	0…250 s		0
5	ton2	tōn2	LU2 ON-state minimum duration	0…250 s		0
6	toF2	tōF2	LU2 OFF-state minimum duration	0…250 s		0
7	oEr2	ōEr2	LU2 Output safe state	oFF	OFF	OFF
				on	ON	
Control Unit 2 (Analog output)						
1	dAC2	dAC2	LU2 Analog mode	o	Proportional control	Pv
				Pv	Signal retransmission	
2	CtL2	CtL2	LU2 Analog function	HEAt	Heating	HEAt
				CooL	Cooling	
3	XP2	ūP2	LU2 Proportional band	2...9999	Affected by **dP2**	1.0
4	An.L2	An.L2	LU2 Retransmission lower limit	-1999...9999	Affected by **dP2**	-199.0
5	An.H2	An.H2	LU2 Retransmission upper limit	-1999...9999	Affected by **dP2**	800.0
6	oEr2	ōEr2	LU2 Output safe state	oFF	4 mA (0 V)	OFF
				on	20 mA (10 V)	
Display settings (Adv)						
1	diSP	dīSP	Display mode	StAt	Static mode	StAt
				CYCL	Cyclic mode	
				botH	Parallel mode	

Appendix B Configuration parameters

No	Name	Display	Parameter	Valid value	Meaning	Factory
2	rESt	rESt	Rest time	5…59 s	exit configuration if no keypad activity	OFF
				OFF	function inactive	
RS485 network (Comm)						
1	Prot	Prot	Protocol	oYEn	akYtec	oYEn
				n.rtU	Modbus RTU	
				n.ASC	Modbus ASCII	
2	bPS	bPS	Baud rate	2.4…115.2 kbit/s		115.2
3	Addr	Addr	Address [3]			0
4	A.LEn	A.LEn	Address bits	8		8
				11		
5	rSdL	rSdL	Response delay	1…45 ms		20
Calibration parameters (PASS = 104)						
1	CLb1	CLb1	CH1 Input calibration	rUn	Start calibration	StoP
				Erc	Calibration factor out of range	
				StoP	Calibration completed	
2	CLb2	CLb2	CH2 Input calibration	rUn	Start calibration	StoP
				Erc	Calibration factor out of range	
				StoP	Calibration completed	
3	CLbS	CLbS	CJC sensor calibration	rUn	Start calibration	StoP
				StoP	Calibration completed	
4	wXC	wXC	Cold Junction Compensation (CJC)	on	ON	-
				oFF	OFF	
5	i1-0	i1-0	CH1 4 mA output calibration [3]	0…1023	DAC value for output current 4 mA	-
6	i1-1	i1-1	CH1 20 mA output calibration [3]	0…1023	DAC value for output current 20 mA	-
7	i2-0	i2-0	CH2 4 mA output calibration [3]	0…1023	DAC value for output current 4 mA	-
8	i2-1	i2-1	CH2 20 mA output calibration [3]	0…1023	DAC value for output current 20 mA	-
Access protection (PASS = 100)						
1	oAPt	oAPt	Read access [5]	0	Allowed to all parameters	0
				1	Access only to **SP1** and **SP2**	
				2	No access	

No	Name	Display	Parameter	Valid value	Meaning	Factory
2	**wtPt**	$\underline{u}tPt$	Write access [5]	0	Allowed to all parameters	0
				1	Access only to **SP1** and **SP2**	
				2	Access only to **SP1**	
				3	No access	
3	**EdPt**	$EdPt$	Individual parameter access	on	ON	OFF
				oFF	OFF	

[1] *Displayed for temperature sensors only*

[2] *Displayed for current and voltage signals only*

[2] *Valid values:*

– *0…255 for **Prot** = $\bar{o}^{\underline{u}}En$ and **A.LEn** = 8*

– *0…2047 for **Prot** = $\bar{o}^{\underline{u}}En$ and **A.LEn** = 11*

– *0…247 for **Prot** = $\bar{n}.rtU$ or $\bar{n}.ASC$*

[4] *Factory calibration value is displayed on the lower display*

[5] *Each parameter has an access attribute. It can be set via RS485 network. Each parameter can be read and changed via RS485 network regardless of the parameters **oAPt** and **wtPt**.*

Appendix C   Modbus access

Table C.1   Modbus Functions Supported

Function code (hex)	Description	Note
03 (0x03)	Read Holding Registers	Group request not enabled
16 (0x10)	Write Multiple Registers	Group request not enabled
08 (0x08)	Serial line diagnostic	Only sub-function 0 supported - Return Query Data

Table C.2   Modbus Exception Codes

Code	Name	Meaning
01	ILLEGAL FUNCTION	Function not supported
02	ILLEGAL DATA ADDRESS	Invalid register number (not used)
03	ILLEGAL DATA VALUE	Invalid data: - Value out of range - Response is longer than the size of communication buffer - Number of data bytes does not match the declared one
04	SLAVE DEVICE FAILURE	Command cannot be executed

Table C.3   Modbus Registers

Parameter name	Description	Address (hex)	Data format	Decimal places
Function 0x03, read only				
StAt	Status Register (see Table C.5)	0x0000	Binary	–
Pv1	CH1 Process value	0x0001	INT16	*
Pv2	CH2 Process value	0x0002	INT16	**
LUPv1	LU1 Input value	0x0003	INT16	*
LUPv2	LU2 Input value	0x0004	INT16	**
Function 0x03/0x10, read/write				
SP1	Setpoint 1	0x0005	INT16	*
SP2	Setpoint 2	0x0006	INT16	**
r-L1	CH1 Network control	0x0007	UINT16	0
r-L2	CH2 Network control	0x0008	UINT16	0
r.oUt1	CH1 Network output signal	0x0009	UINT16	3
r.oUt2	CH2 Network output signal	0x000A	UINT16	3
Function 0x03, read only				
DEv	Device name	0x1000…0x1003	Char[8]	–
vEr	Firmware version	0x1004…0x1007	Char[8]	–
StAt	Status Register (see Table C.5)	0x1008	Binary	–
Pv1	CH1 Process value	0x1009…0x100A	Float32	–
Pv2	CH2 Process value	0x100B…0x100C	Float32	–
LUPv1	LU1 Input value	0x100D…0x100E	Float32	–
LUPv2	LU2 Input value	0x100F…0x1010	Float32	–
SP1	Setpoint 1	0x1011…0x1012	Float32	–

SP2	Setpoint 2	0x1013…0x1014	Float32	–
Function 0x03/0x10, read/write				
Prot	Protocol	0x0100	UINT16	0
bPS	Baud rate	0x0101	UINT16	0
A.LEn	Address bits	0x0102	UINT16	0
Addr	Address	0x0103	UINT16	0
rSdL	Response delay	0x0104	UINT16	0
LEn	Data bits	0x0105	UINT16	0
PrtY	Parity	0x0106	UINT16	0
Sbit	Stop bits	0x0107	UINT16	0
PrtL	Apply new network protocol (command)	0x0109	UINT16	–
APLY	Apply new network settings (command)	0x010A	UINT16	–
init	Device restart (command)	0x010B	UINT16	–
in.t1	CH1 Sensor	0x0200	UINT16	0
dPt1	CH1 Decimal point displayed	0x0201	UINT16	0
dP1	CH1 Decimal point	0x0202	UINT16	0
in.L1	CH1 Signal lower limit	0x0203	INT16	*
in.H1	CH1 Signal upper limit	0x0204	INT16	*
SH1	CH1 Offset	0x0205	INT16	*
KU1	CH1 Slope	0x0206	UINT16	3
Fb1	CH1 Filter bandwidth	0x0207	UINT16	*
inF1	CH1 Filter time constant	0x0208	UINT16	0
Sqr1	CH1 Square root	0x0209	UINT16	0
iLU1	LU1 Input	0x020A	UINT16	0
in.t2	CH2 Sensor	0x020B	UINT16	0
dPt2	CH2 Decimal point displayed	0x020C	UINT16	0
dP2	CH2 Decimal point	0x020D	UINT16	0
in.L2	CH2 Signal lower limit	0x020E	INT16	**
in.H2	CH2 Signal upper limit	0x020F	INT16	**
SH2	CH2 Offset	0x0210	INT16	**
KU2	CH2 Slope	0x0211	UINT16	3
Fb2	CH2 Filter bandwidth	0x0212	UINT16	**
inF2	CH2 Filter time constant	0x0213	UINT16	0
Sqr2	CH2 Square root	0x0214	UINT16	0
iLU2	LU2 Input	0x0215	UINT16	0
rESt	Rest time	0x0300	UINT16	0
diSP	Display mode	0x0301	UINT16	0
SL.L1	LU1 Setpoint lower limit	0x0400	INT16	*
SL.H1	LU1 Setpoint upper limit	0x0401	INT16	*
CmP1	LU1 Digital function	0x0402	UINT16	0
HYS1	LU1 Hysteresis	0x0403	UINT16	*

don1	LU1 ON-state minimum duration	0x0404	UINT16	0
doF1	LU1 OFF-state minimum duration	0x0405	UINT16	0
ton1	LU1 Turn-on delay	0x0406	UINT16	0
toF1	LU1 Turn-off delay	0x0407	UINT16	0
oEr1	LU1 Output safe state	0x0408	UINT16	0
dAC1	LU1 Analog mode	0x0409	UINT16	0
An.L1	LU1 Retransmission lower limit	0x040A	INT16	*
An.H1	LU1 Retransmission upper limit	0x040B	INT16	*
CtL1	LU1 Analog function	0x040C	UINT16	0
XP1	LU1 Proportional band	0x040D	UINT16	*
SL.L2	LU2 Setpoint lower limit	0x040E	INT16	**
SL.H2	LU2 Setpoint upper limit	0x040F	INT16	**
CmP2	LU2 Digital function	0x0410	UINT16	0
HYS2	LU2 Hysteresis	0x0411	UINT16	**
don2	LU2 ON-state minimum duration	0x0412	UINT16	0
doF2	LU2 OFF-state minimum duration	0x0413	UINT16	0
ton2	LU2 Turn-on delay	0x0414	UINT16	0
toF2	LU2 Turn-off delay	0x0415	UINT16	0
oEr2	LU2 Output safe state	0x0416	UINT16	0
dAC2	LU2 Analog mode	0x0417	UINT16	0
An.L2	LU2 Retransmission lower limit	0x0418	INT16	**
An.H2	LU2 Retransmission upper limit	0x0419	INT16	**
CtL2	LU2 Analog function	0x041A	UINT16	0
XP2	LU2 Proportional band	0x041B	UINT16	**
oAPt	Read access	0x0700	UINT16	0
wtPt	Write access	0x0701	UINT16	0
EdPt	Individual parameter access	0x0702	UINT16	0

Notes:

** – see **dP1***

*** – see **dP2***

Table C.4   Data format

Data format	Description
UINT16	2-byte integer Format X*10-n is used for transmission, where X – integer value n – power of 10 (specified in the column "Decimal point" for each parameter)
INT16	2-byte signed integer Format X*10-n is used for transmission, where X – integer value n – power of 10 (specified in the column "Decimal point" for each parameter)
Float32	4-byte floating-point "Big-endian"
Char[8]	String of 8 symbols each 1 byte, direct order
Hex word	2-byte integer in hexadecimal format
Binary	2-byte numbers in binary format When transmitting, the bit numbering starts at zero for the most significant bit (MSB 0)

*Table C.5   Parameter "**StAt**" – bit assignment*

Bit No.	Assignment
0	CH1 Input error
1	CH2 Input error
2	0
3	Other error (e.g. **Er.Ad**, **Er.64**)
4	Relay 1 on
5	Relay 2 on
6	CH1 Network control (**r-L1**)
7	CH2 Network control (**r-L2**)
8 - 15	0

Appendix D   Error causes and remedies

Table D.1

Error	Potential cause	Remedy
Err.5 displayed in Control mode, sensor connected	Sensor error	Replace the sensor
	Open circuit or short circuit between the sensor and the device	Remove the cause
	Wrong sensor type	Select the correct sensor type
	Incorrect 2-wire connection	Install the jumper between terminals 9-10 for the channel 1 and terminals 13-14 for the channel 2
	Incorrect sensor connection	Check the sensor connection diagram given in Fig. 5.1
Er.64	Memory error	Contact the Technical Support of akYtec GmbH
Er.Ad	ADC conversion error	
ЭЭЭЭ displayed in Control mode	Control Unit input value exceeds 999.9 and cannot be displayed on the 4 digit display with the accuracy 0.1°C	Set **dPt1** (**dPt2**) = 0
ССCC displayed in Control mode	Control Unit input value less than -199.9 and cannot be displayed	Set **dPt1** (**dPt2**) = 0
Displayed temperature differs from the current temperature (Control mode)	Wrong sensor type	Select the correct sensor type
	Incorrect Offset or Slope settings	Set the correct values in **SH1** (**SH2**), **KU1** (**KU2**) parameters. If no correction required, set **SH** = 0 and **KU** = 1.
	2-wire connection without correction	See 7.3 "Correction"
	Electromagnetic interference	Use only shielded sensor line, ground the shield on one point
Zeros are displayed for the current input signal	Incorrect sensor connection	See 5 "Wiring"
Same values displayed for LU1 and LU2	Both Control Units connected to the same input	Set **iLU1** and **iLU2** parameters to different inputs
Output relay does not switch	Wrong Control Unit function	Set the function in parameters **CmP1** (**CmP2**) or **CtL1** (**CtL2**) (see 7.7, 7.8.1)
	Hysteresis value is too high comparing to the setpoint value. The temperature at startup is within T± **HYS** zone.	Adjust the parameter **HYS1** (**HYS2**)
	ON-delay > 0 or OFF-delay > 0	Set **don1** (**don2**) or **doF1** (**doF2**) to 0
Output is not triggered when the set	ON-duration > 0 or OFF-duration > 0	Set **ton1** (**ton2**) or **toF1** (**toF2**) to 0

Error	Potential cause	Remedy
limit is reached	ON-delay > 0 or OFF-delay > 0	Set **don1** (**don2**) or **doF1** (**doF2**) to 0
	Control Unit input is the difference ΔT	Set **iLU1** = Pu1 and **iLU2** = Pu2
Setpoint cannot be modified	Setpoint modification is disabled	Set **wtPt** to 0 (all parameters can be modified) or 1 (only Setpoints can be modified)
	Setpoint modification is limited	Change the Setpoint limits **SL.L1** (**SL.L2**) and **SL.H1** (**SL.H2**)
No parameter can be modified	Parameter modification is disabled	Set **oAPt** = 0 and **wtPt** = 0

* If the error or potential cause is not specified in the table above, contact the Technical Support of akYtec GmbH