

Operating Manual

TEC06-24P, TEC06-24N

TEC18-24, TEC18-32

Your contact:



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[Warranty](#)

head electronic warrants that these products will be available for a period of three (3) years from delivery are free from material and labor defects. Should a product prove defective within this warranty period, head electronic will either repair or replace the product under the terms set out in the full warranty.

To request maintenance service, contact head electronic.

EXCEPT AS SET FORTH IN THIS SUMMARY OR THE FULL WARRANTY, HEAD ELECTRONIC MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL HEAD ELECTRONIC BE LIABLE FOR ANY INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES.

Safety instructions

Peltier elements can generate temperatures that can lead to serious injuries when they come into contact with the skin. Therefore, use a thermometer to check the temperatures and not your hand!

We are happy to support you with advice, please call our technical service on Tel. +49 8051 6404512. Our TEC controllers are designed for research and industrial applications. Handling requires technical expertise and responsible action.

Scope of delivery

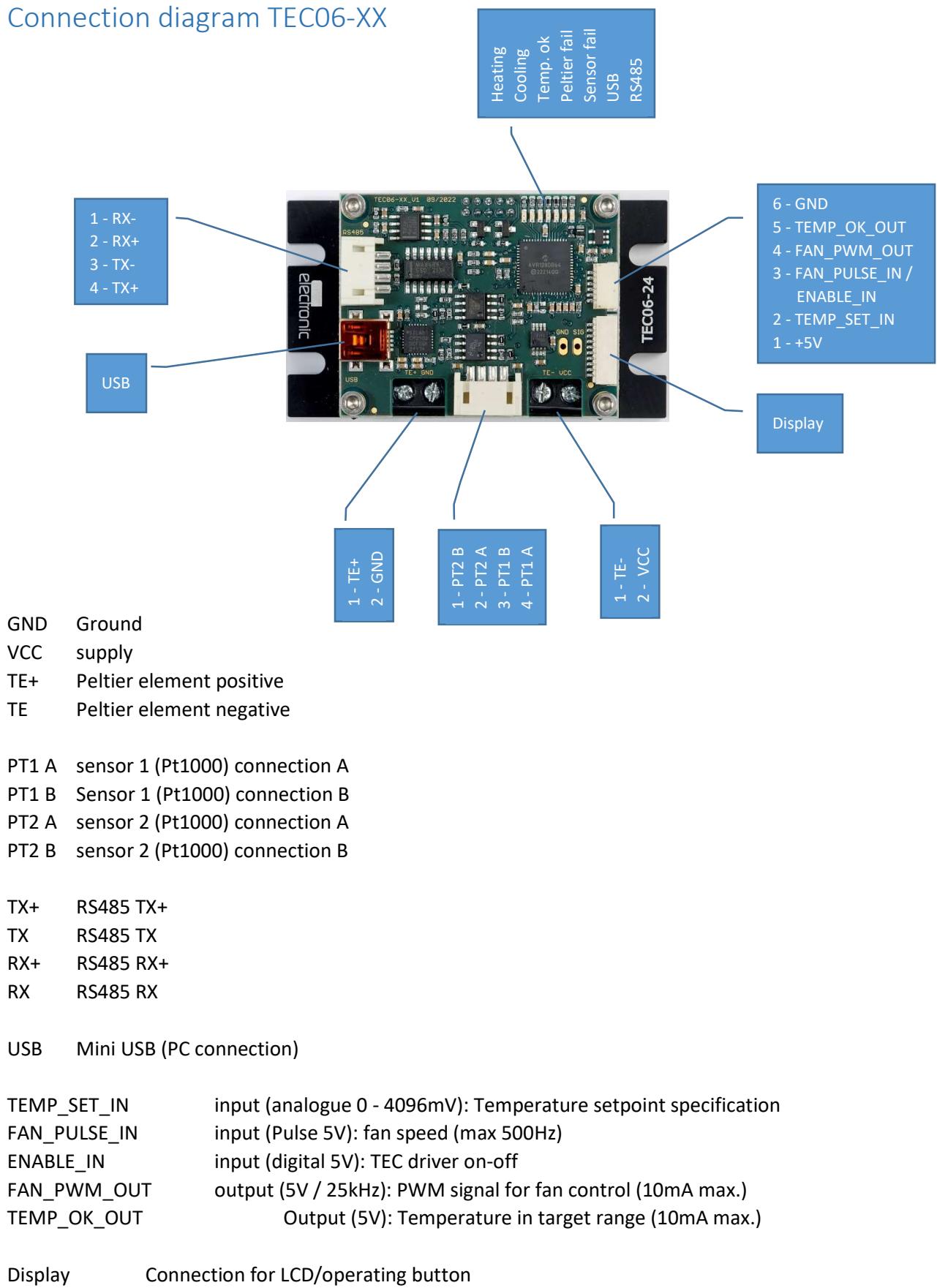
TEC06-XX

- 1x TEC06-XX
- 2x temperature sensors Pt1000 (monitoring cold side and hot side) for TEC06-XXP
- 2x temperature sensors NTC10K (monitoring cold side and hot side) for TEC06-XXN
- 1x temperature sensor cable 4-wire
- 2x power supply connection cables (red and black)
- 2x connecting cables Peltier element (grey and blue)
- 1x USB connection cable
- 1x RS485 connection cable

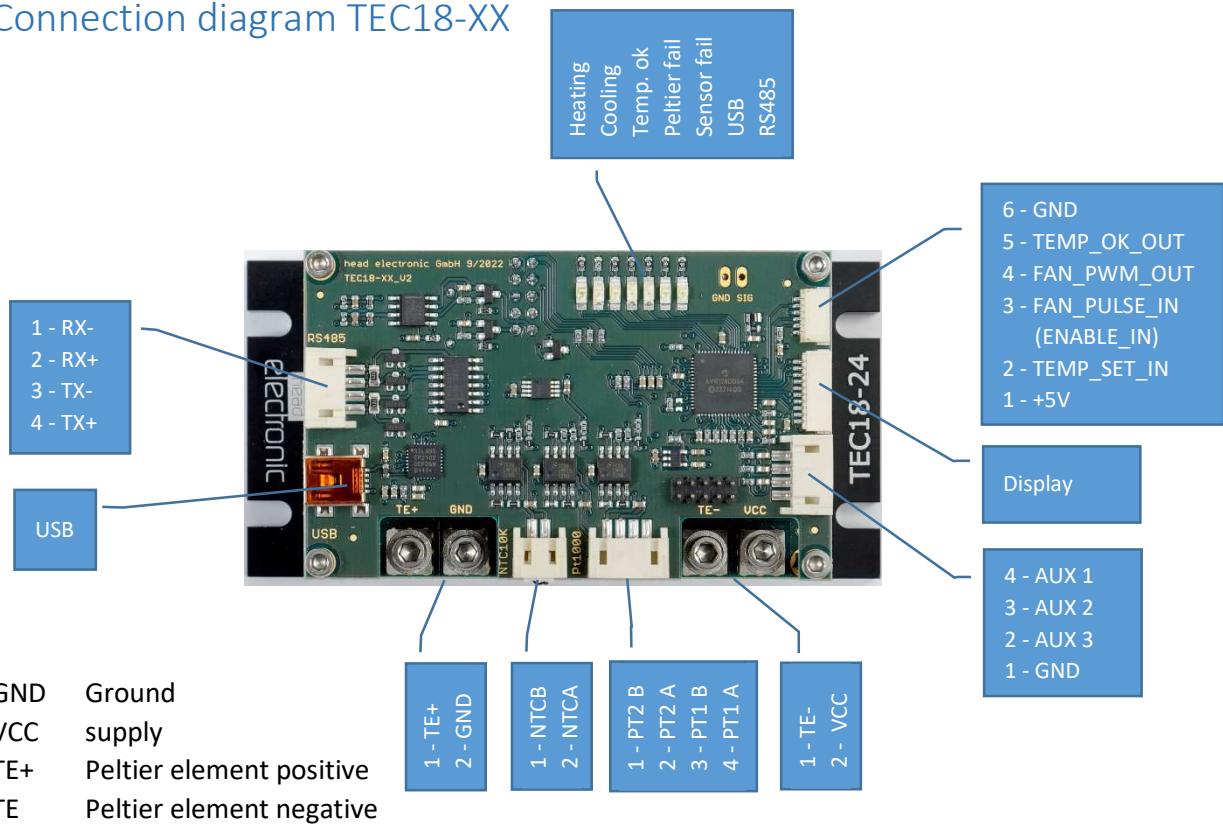
TEC18-XX

- 1x TEC18-XX
- 2x temperature sensors Pt1000 (monitoring cold side and hot side)
- 1x temperature sensor cable 4-wire
- 2x power supply connection cables (red and black)
- 2x connecting cables Peltier element (grey and blue)
- 1x USB connection cable
- 1x RS485 connection cable

Connection diagram TEC06-XX



Connection diagram TEC18-XX



Data interfaces

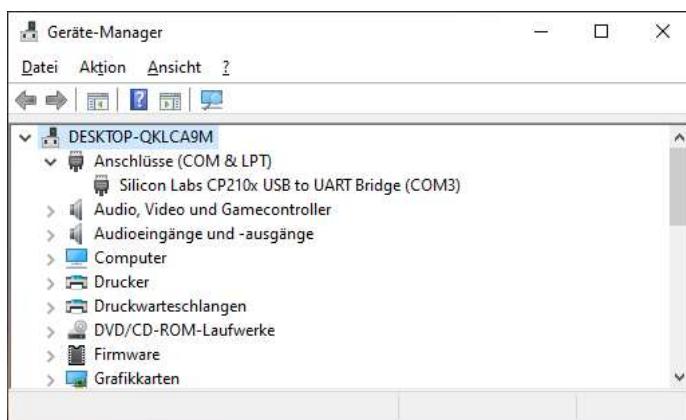
The TEC controller has a USB and an RS485 interface. This can be used to configure and control the TEC controller. The associated communication protocol is described in detail in Appendix I.

USB driver software

The TEC controller is equipped with the USB chip **CP2102**. When you connect the TEC controller to your PC for the first time, the driver installation will start automatically. Depending on your operating system, you may have to specify the location of the driver files and the appropriate driver will be installed automatically. The associated driver files can be found at:

<https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads>

The connected TEC controller generates a virtual COM port (eg COM3) in your PC.



RS485

The RS485 interface corresponds to the EIA-485 standard and has 4 wires (full duplex). The levels at all four connections must be between GND and +5V. Since some RS485 interfaces are inverted, it may be necessary to swap the + and - signals.

TX+ > TX- => logical 1 = bus idle state

TX+ < TX- => logical 0

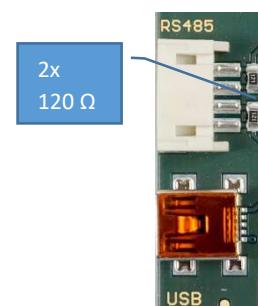
If required, the sending wire pair can be connected to the receiving wire pair in order to connect the TEC driver to a 2-wire remote station:

D+ (B) = TX+ / RX+

D-(A) = TX- / RX

C = GND

120Ω terminating resistors are fitted on the TEC controller near the RS485 connection. If you connect more than 2 TEC controllers in series, these resistors must be removed from all TEC controllers in the series so that only the beginning and end are terminated.

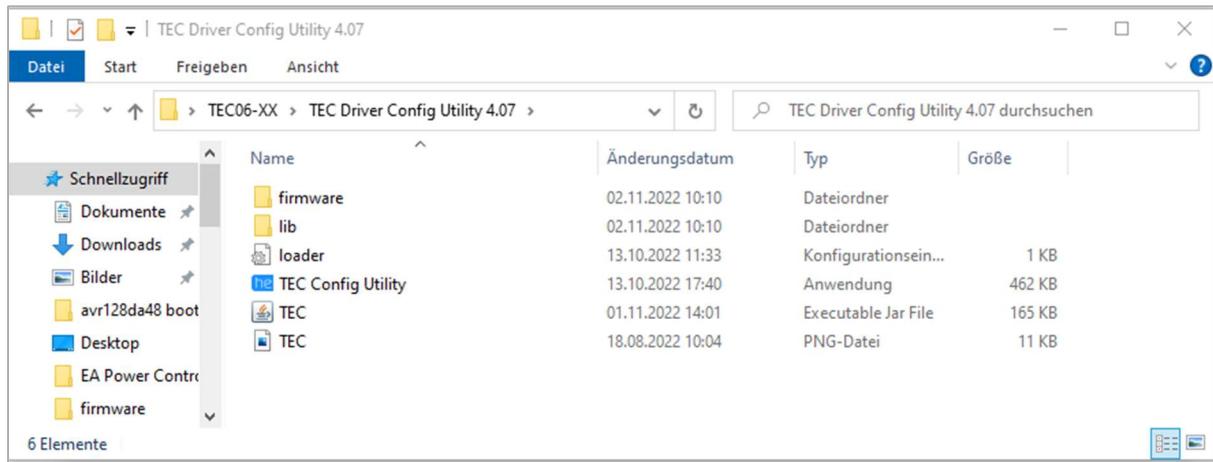


TEC Config Utility

The Java-based application "TEC Config Utility" is available for convenient operation of the TEC controller. You will receive the current version by email on request. The TEC Config Utility requires a Java Runtime Environment, the latest version of which can be downloaded from <https://www.java.com>.

Start

Start the TEC Config Utility:



connection

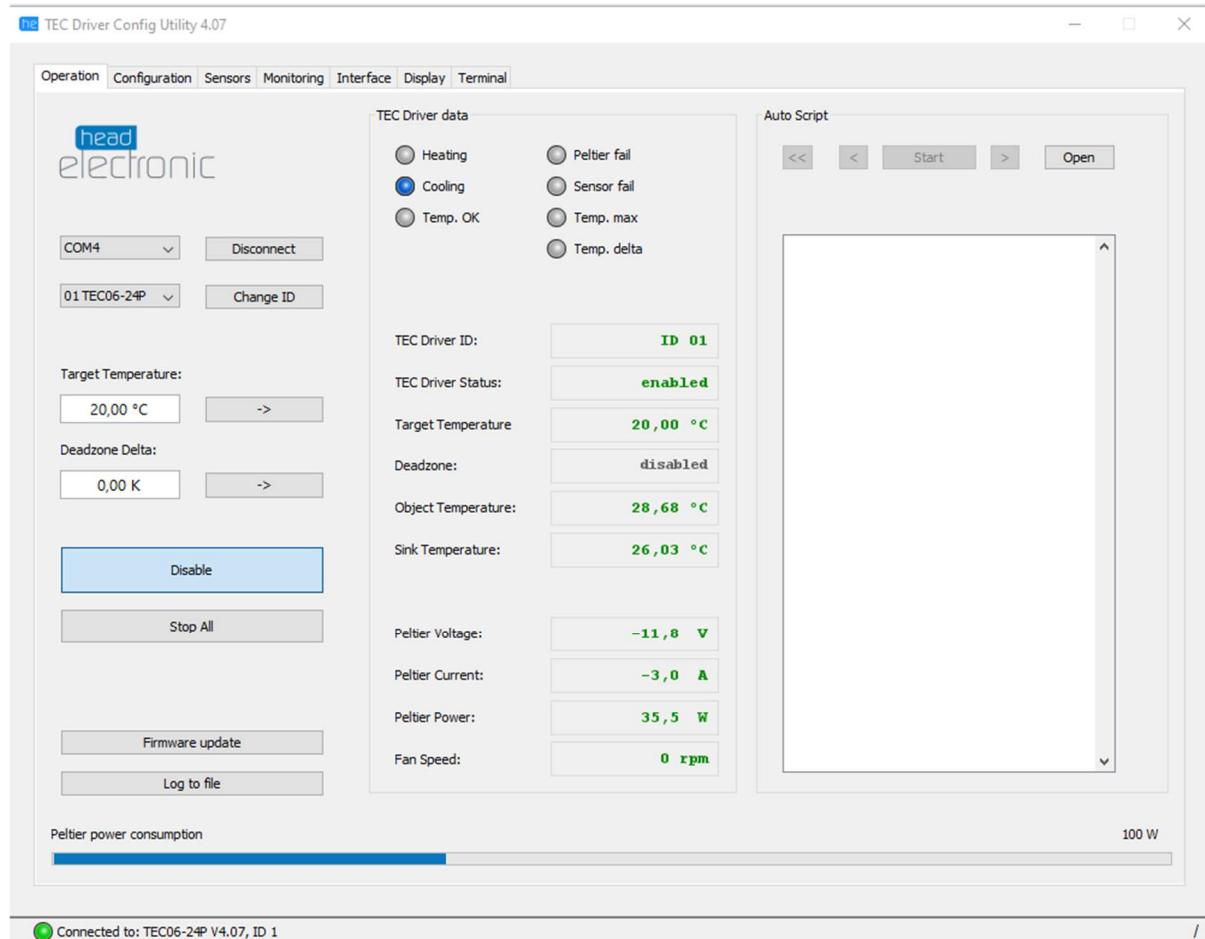
Select the COM port that was generated by your TEC controller and now start the connection setup with the "Connect" button. After a successful connection establishment, the connected TEC controller and its firmware version are displayed in the status bar.

If the corresponding COM port is not listed, check whether the TEC controller and PC are connected with the USB connection cable.

Operation

The current measured values of the TEC controller are displayed on the "Operation" page. The TEC controller is switched on or off with the "Enable" button.

The measurement data can be saved in a CSV file if required. Start and end the recording with the "Log to file" button. A separate file is created in the main directory of the software for each recording.



Keys/Field Name	description
Connect/Disconnect	Establish and disconnect the connection to the TEC controller.
Change ID	Changing the RS485 ID of the TEC controller
Target temperature	temperature setpoint
Dead Zone Delta	Permissible temperature difference to the setpoint that should not be corrected. If the actual temperature is within the dead zone, the TEC controller remains inactive.
Enable/Disable	TEC controller on/off
Stop all	Common switching off of all TEC controllers connected via RS485
Alarm on/off	Alarm buzzer on/off (TEC16-24 only)
Firmware update	Updating the TEC Controller Firmware (See Appendix I)

Log to file	Log measurement data to a CSV file
AutoScript	Automatic control of the TEC controller via script (see "AutoScript")

AutoScript function

With the AutoScript function, a rule process can be programmed using a script. To do this, create a text file in which you enter a command in each line.

In addition to the known TEC controller commands, the following instructions are possible:

PAUSE	pause execution of the script.
BEEP	output notification tone on the PC.
WAIT n	Wait specified time in seconds.
CHECK TEMP	'Temp OK', if not satisfied stop the script and turn off the TEC controller.
JUMP n	Continue script at specified line .
JUMP TEMP n	Check 'Temp OK', if not satisfied continue the script at the given line.
MESSAGE msg	Outputs the message 'msg' and waits for confirmation.
INPUT cmd msg	Opens an input box and sends the command 'cmd' followed by the input

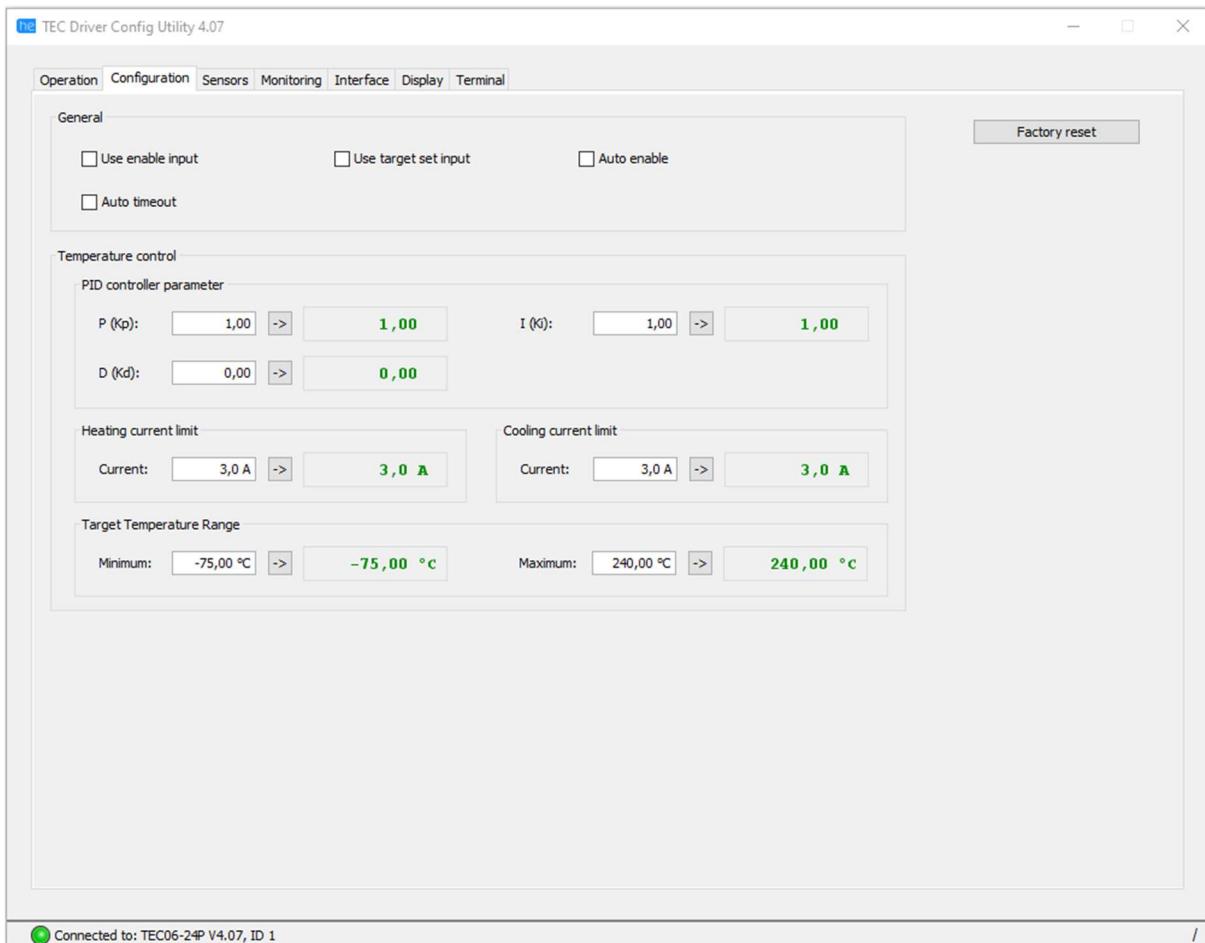
Example:

```

STV 6000          // Temperature setpoint 60°C
SEN               // TEC controller turn on
WAIT 10           // wait 10s
JUMP TEMP 3       // If not reaching setpoint, go to line 3
BEEP              // Output a notification tone on the PC
INPUT STV Please enter temperature // Enter temperature setpoint
WAIT 300          // wait 5 minutes
SDI               // Turn off TEC controller
BEEP              // Output a notification tone on the PC
WAIT 1             // wait 1s
BEEP              // Output a notification tone on the PC
MESSAGE Please change test object // Display message
JUMP 2            // Continue to line 2

```

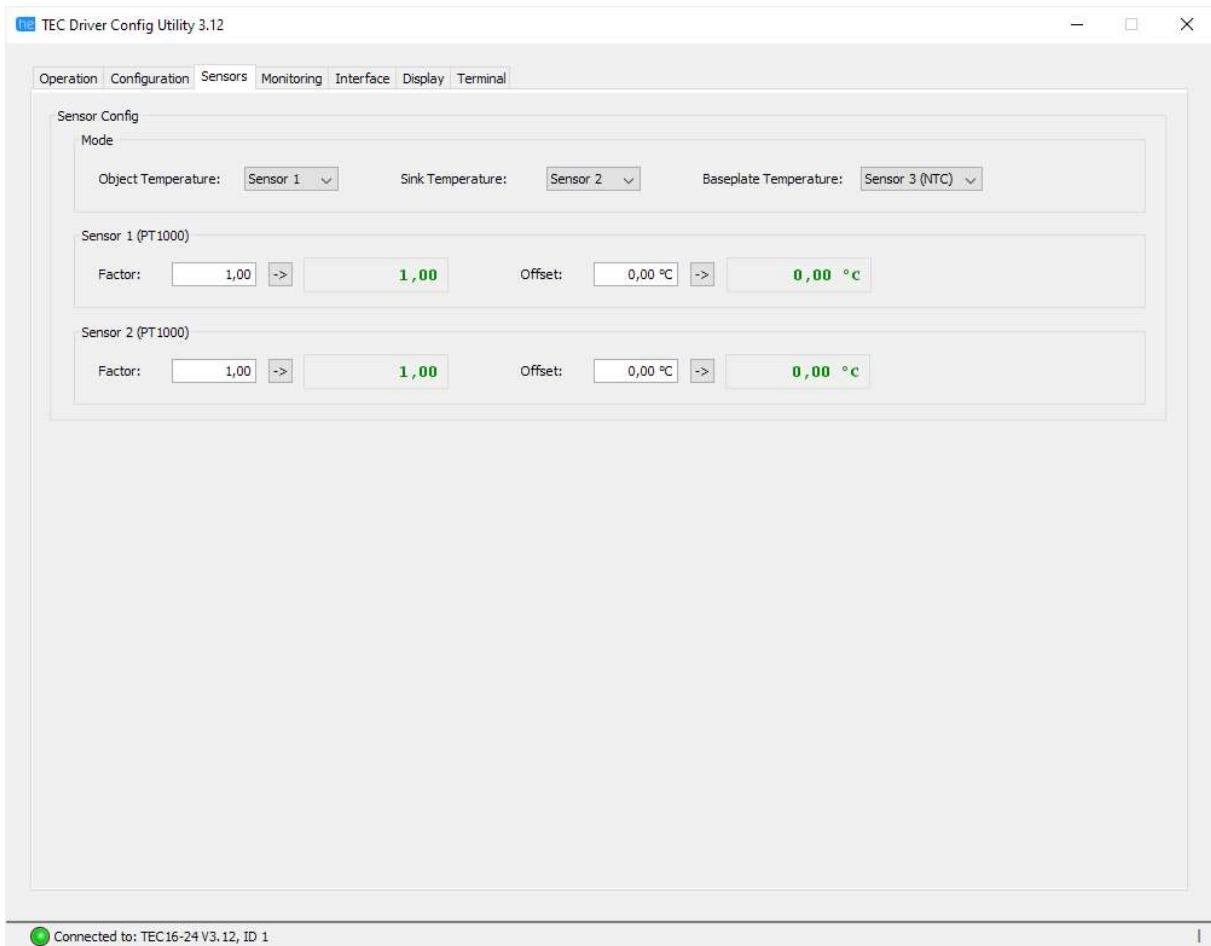
Configuration



field name	description
Use enable input	Digital input for switching the TEC controller on/off
Use target set input	Use analog input for temperature setpoint specification
Auto enable	Automatic switching on of the TEC controller after applying the supply voltage and regulating to the current setpoint.
Auto timeout	If activated, the TEC controller switches off after 3 seconds if communication is interrupted.
Alarm peltier fail	TEC error warning tone (TEC18-XX only)
Alarm sensor fail	Warning sound for sensor errors (TEC18-XX only)
P (Kp)	Proportional part of the temperature controller $P_{out} = \Delta_{temp} (K) * Kp * 10\%$
I (Ki)	Integral part of the temperature controller $I_{out} = \Delta_{temp} (K) * Ki * 0.1\% * 1s$
D (Kd)	Differential part of the temperature controller $D_{out} = \Delta_{temp} (K) * Kd * 10\% / 1s$

Heating current limit	Current limitation positive ("heating")
Cooling current limit	Negative current limitation ("cooling")
Target temperature range	Limitation of the temperature setpoint
Factory reset	Reset TEC controller to factory settings

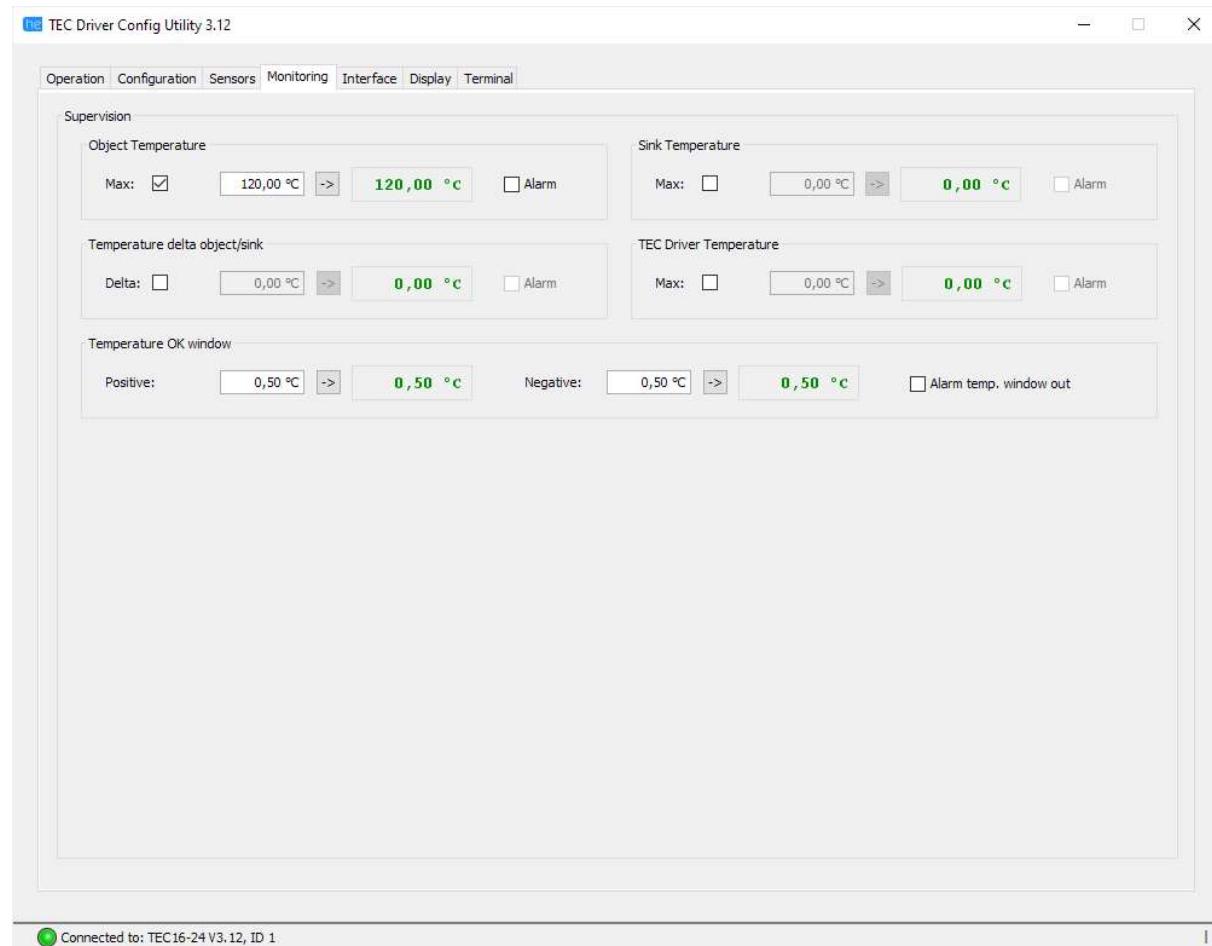
Temperature sensors



field name	description
Object Temperature	Temperature to which is regulated (cold side)
Sink temperature	Temperature of the heatsink (hot side)
Base plate temperature	Bottom plate temperature (TEC18-XX only)
Factor	Factor for calculating the temperature from the temperature sensor signal
Offset	Zero shift of the temperature sensor

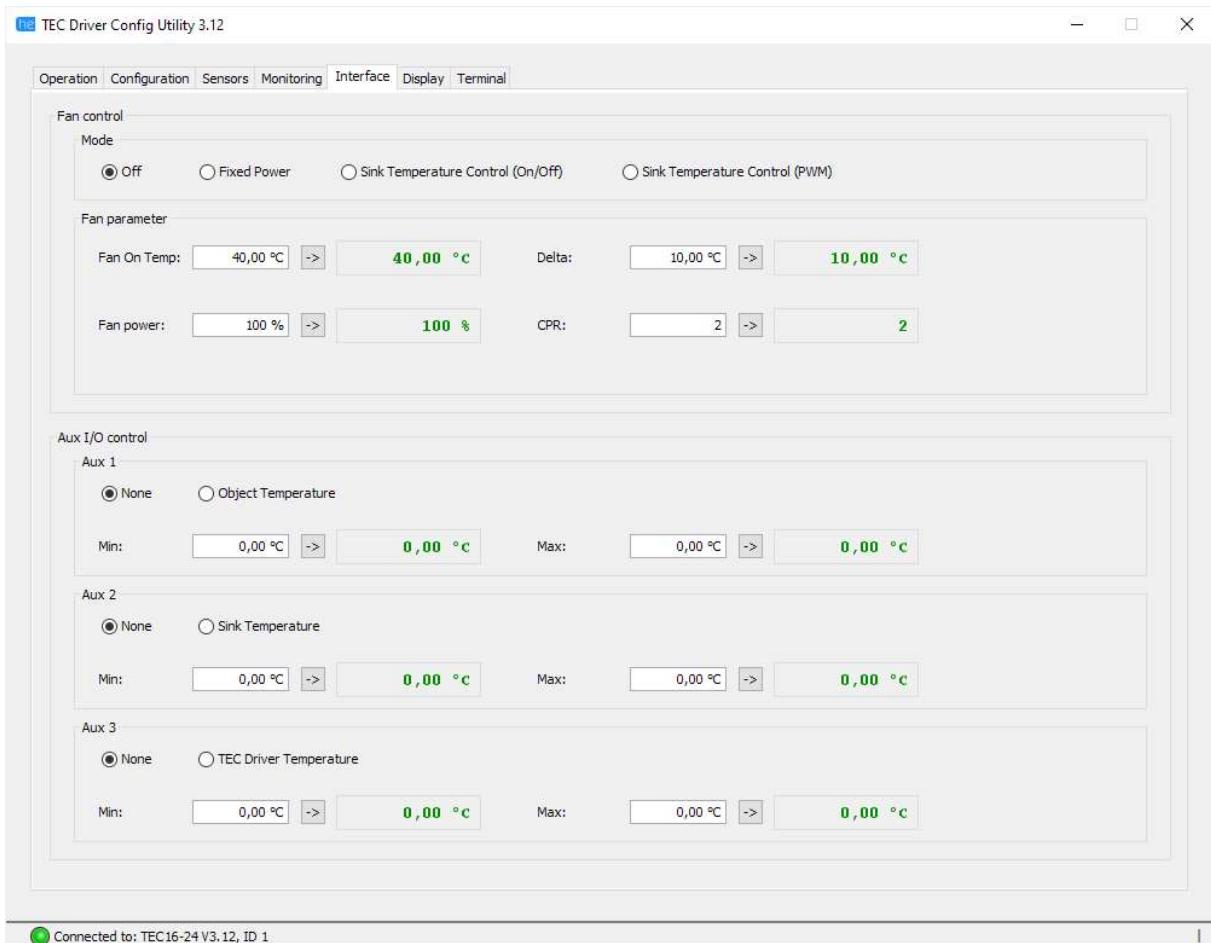
Monitoring

A limit value can be set for each temperature to protect against damage. If this is exceeded, the TEC controller is switched off. To protect against a "thermal breakdown" of the Peltier element, the temperature difference can also be limited.



field name	description
Object Temperature	Limit object temperature for safety shutdown.
Sink temperature	Limit sink temperature for safety shutdown.
TEC driver temperature	TEC controller temperature limit for safety shutdown (TEC18-XX only).
Temperature delta	Temperature difference between object and sink for safety shutdown.
Alarm	Warning tone (TEC18-XX only).
Temperature OK Window	Permitted positive/negative deviation of the object temperature from the temperature setpoint for control LED and output.
Alarm temp. window out	Warning sound when exiting the 'Temp Ok' window (TEC18-XX only)

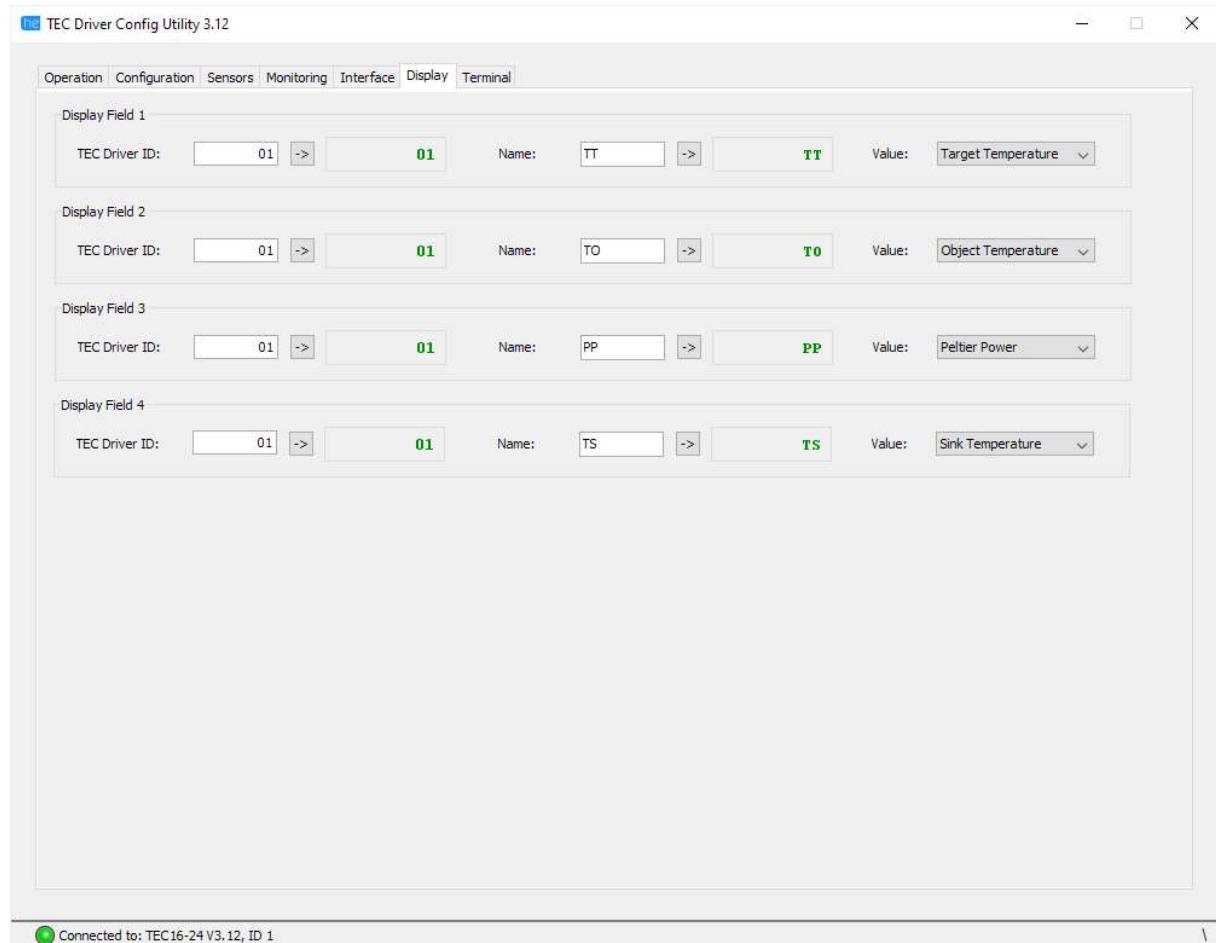
Connections (Interface)



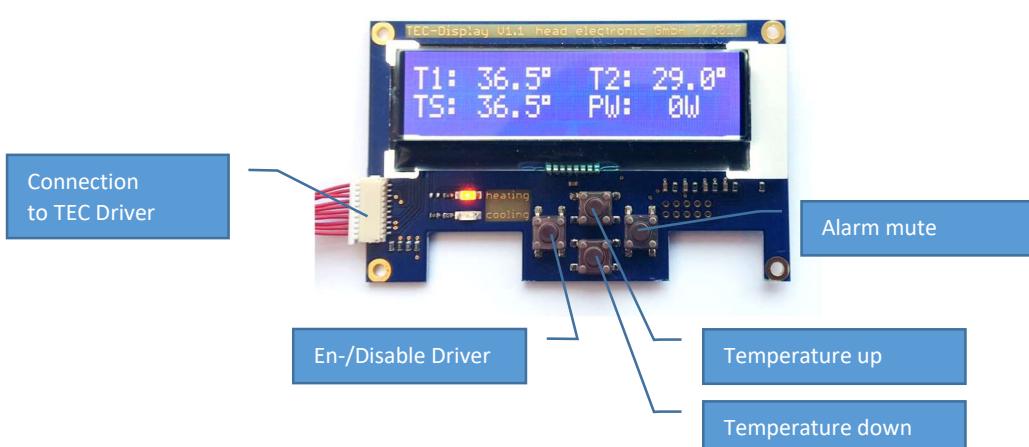
field name	description
Fixed power	Fixed fan speed (PWM).
Sink Temperature Control (On/Off)	The fan is switched on when the fan-on temperature is exceeded and switched off again when the fan-on temperature minus the set delta is undershot.
Sink Temperature Control (PWM)	The fan speed is increased linearly within the set delta up to the fan-on temperature (fan-on temperature = max. speed).
Fan On Temp	At this temperature, the fan switches on (On/Off) or has reached its maximum speed (PWM).
Delta	Hysteresis (On/Off) or control range (PWM)
Fan power	Fixed fan speed when selecting "Fixed Power" or temperature control mode (On/Off), maximum fan speed in temperature control mode (PWM).
CPR	Number of pulses per revolution of the fan speed signal.
Min	Lowest temperature at analog output (0% PWM) (TEC18-XX only).
Max	Highest temperature at analog output (100% PWM) (TEC18-XX only).

Display

A display with control buttons can be connected to the TEC controller as an independent input and output option.

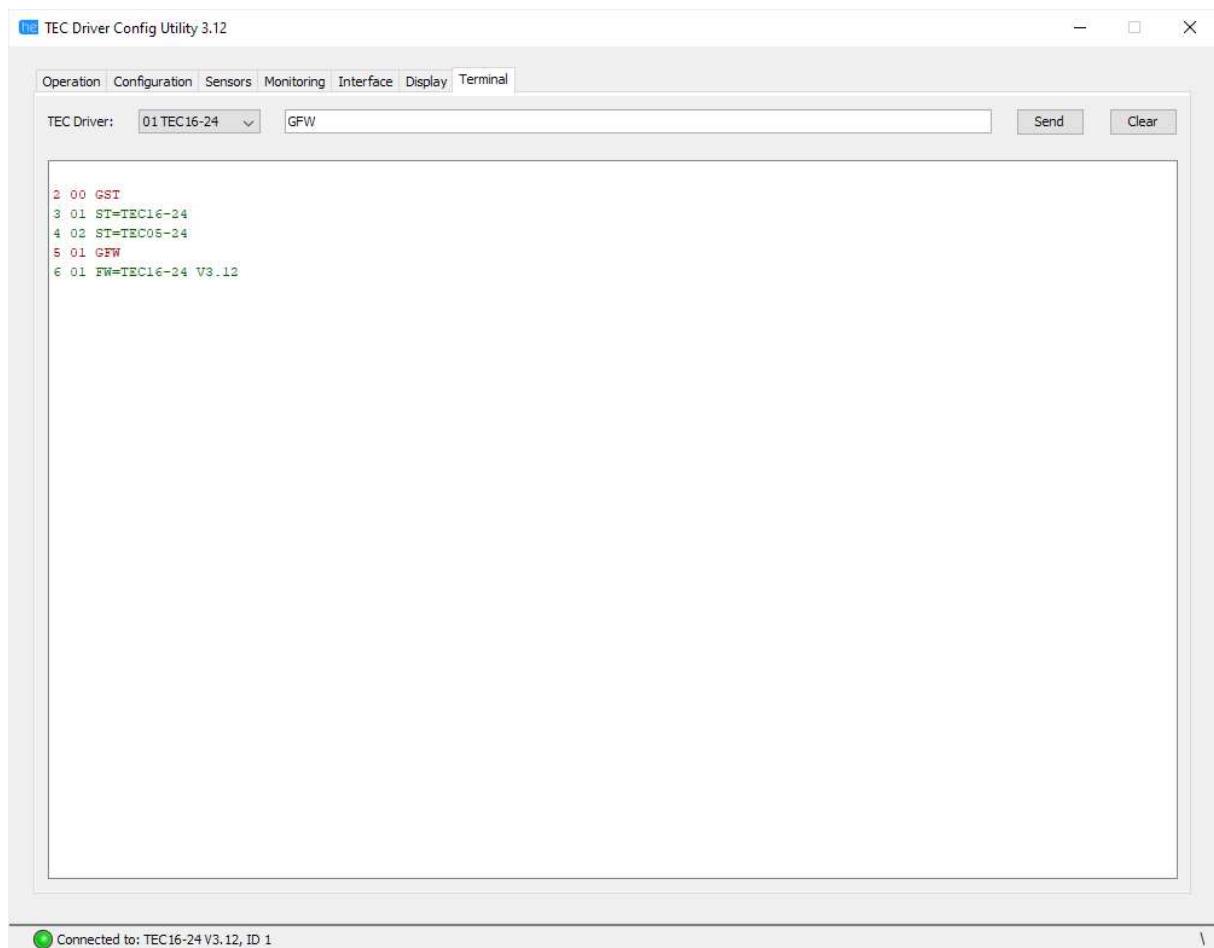


field name	description
TEC Driver ID	ID of the TEC controller whose measured value is to be displayed. (0-> Show own value, regardless of ID)
Name	Two-digit designation.
Value	Value to display



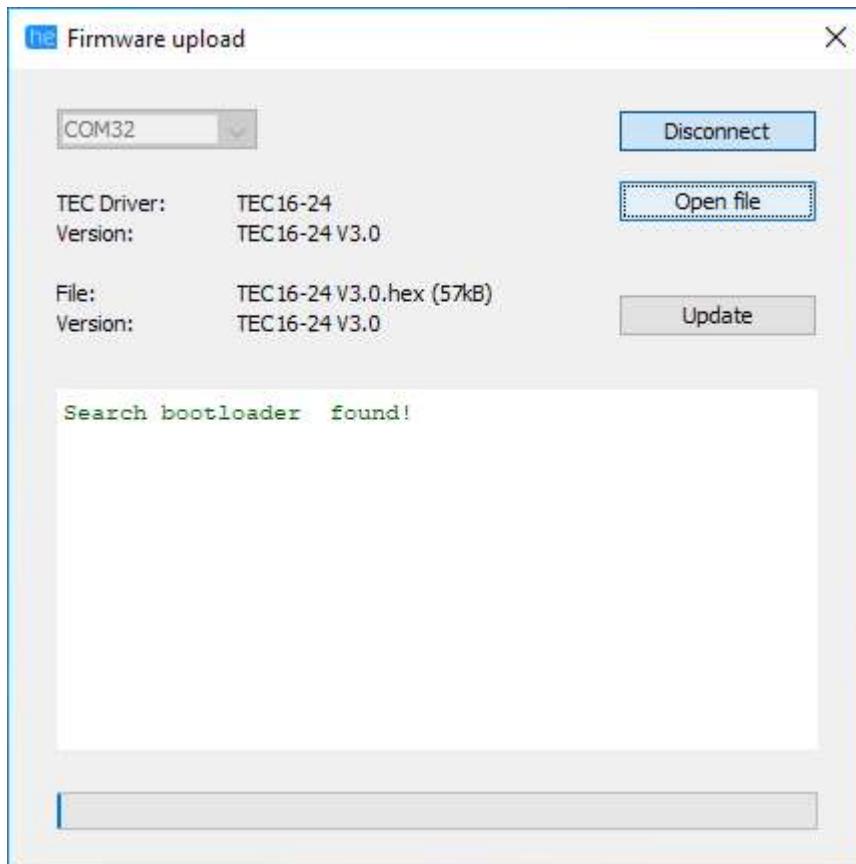
Terminal

The terminal is used for manual operation of the TEC controller using general ASCII commands (see Appendix II).



Appendix I, Software Update

The software update is started via the "Firmware update" button on the "Operation" page. Note that the TEC controller must be in ASCII data mode and will be disabled during the update process.



Appendix II, Data Interfaces

parameter

USB chip: Silicon Labs CP2106

RS485: 2-wire or 4-wire

Baud rate USB/RS485: 9600, 14400, 19200, 28800, 38400, 57600, 115200

Fashion: 8N1

On the RS485 bus, the commands must be preceded by the two-digit ID followed by a space ('\s').

If all TEC controllers on the RS485 bus are to be addressed, use collective address 00. In this case, all TEC controllers respond with an additional delay according to their ID: (ID – 1) * 128 symbols + 1ms.

TEC controller ASCII command set

Set commands

command, followed by a space and the parameter if necessary, and a newline character (\n), e.g.:

01 SEN\n

01 STV 2000\n

If the command is incorrectly composed, the response is: "COMMAND ERR".

If the parameters are incorrect, the response is: "FORMAT ERR".

If the values are outside the permissible range, the answer is: "NUMBER ERR".

The answers are prefixed with the two-digit ID.

command	parameter	description	answer
RST		Controller reset	reboot
RST	1	Controller reset (load factory settings)	factory reset
SA1	MIN + 100 .. 24000	Upper limit temperature Aux 1 (x 10m°C) (TEC18-XX only)	TEMP_OUT_1_MAX=x.xx C
SA2	MIN + 100 .. 24000	Upper limit temperature Aux 2 (x 10m°C) (TEC18-XX only)	TEMP_OUT_2_MAX=x.xx C
SA3	MIN + 100 .. 10000	Upper limit temperature Aux 3 (x 10m°C) (TEC18-XX only)	TEMP_OUT_3_MAX=x.xx C
SAE	0;1	Enable auto power on	AUTOENAB=x
SAT	0;1	Enable auto power off when there is no communication	AUTO_TIMEOUT=x
SBE	0;1	Activate buzzer (TEC18-XX only)	BUZZER_ENABLE=x
SBR	96.. 1152	Baud rate for RS485(x 0.1 kBd)	BAUDRATE=xx kBd
SBT	0;1 .. 4	Output tone/tone sequence (TEC18-XX only)	BUZZER=x
SC0	0;1	Monitor sensor 1	CHECK_SENS_1=x
SC1	0 .. 1000	Coefficient sensor 1 (Object) (x 0.01)	TEMP_1_COEFF=x.xx
SC2	0 .. 1000	Coefficient sensor 2 (Sink) (x 0.01)	TEMP_2_COEFF=x.xx
SCC	0 .. 500 (1600)	Current limitation "Cooling" (x 10mA)	COOL_C_LIMIT=x.x A
SCL	1	Reset the Hi/Low temperature memory	OK

SCU	COOL_C_LIMIT .. HEAT_C_LIMIT	Operation as current source (x 10mA)	CU=xx
SDF	0 .. 1000	Factor of the derivative part	D_FACTOR=x.xx
SDI	-	Switch off the TEC controller	STATUS=0
SDZ	0 .. 10000	Dead zone delta (permissible temperature difference without regulation) (x 10m°C)	DEADZONE=x.xx C
SEI	0;1	Switching the TEC controller on and off via the input	ENABLE_INPUT=x
SEN	-	Switch on the TEC controller	STATUS=x
SFC	1 .. 8	Fan speed signal pulses per revolution	FAN_CPR=x
SFD	0 .. 10000	Fan hysteresis (On/Off) or control range (PWM) (x 10m°C)	FAN_DELTA =x.xx C
SFP	0 .. 100	Maximum value fan (%)	FAN_POWER=x %
SFS	0;1;2;3;4	Ventilation control mode (0=fan inactive; 1=fixed speed; 2=temperature control (temp sink, hysteresis); 3=temperature control (temp sink, PWM); 4=fixed speed	FAN_SENS=x
SFT	-7500 .. 24000	Fan switch-on temperature (x 10m°C)	FAN_TEMP=x.xx C
SHC	0 .. 500 (1600)	Current limitation "Heating" (x 10mA)	HEAT_C_LIMIT=x.x A
SI1	-7500 .. MAX-100	Lower limit temperature Aux 1 (x 10m°C) (TEC18-XX only)	TEMP_OUT_1_MIN=x.xx C
SI2	-7500 .. MAX-100	Lower limit temperature Aux 2 (x 10m°C) (TEC18-XX only)	TEMP_OUT_2_MIN=x.xx C
SI3	1000 .. MAX 100	Lower limit temperature Aux 3 (x 10m°C) (TEC18-XX only)	TEMP_OUT_3_MIN=x.xx C
SID	01 .. 32	Set TEC controller ID	ID=xx
SIF	0 .. 1000	Factor of the integral term	I_FACTOR=x.xx
SIM	0;1	Interface mode (0=ASCII; 1=Binary)	IF_MODE=x
SMA	MIN + 100 .. 24000	Maximum temperature MAX (set value) (x 10m°C)	TEMP_MAX=x.xx C
SMI	-7500 .. MAX - 100	Minimum temperature MIN (set value) (x 10m°C)	TEMP_MIN=x.xx C
SM1	0;1 .. 24000	Switch-off temperature object sensor (x 10m°C) (0=inactive)	TEMP_1_MAX=x.xx C
SM2	0;1 .. 24000	Switch-off temperature sink sensor (x 10m°C) (0=inactive)	TEMP_2_MAX=x.xx C
SM3	0;1 .. 10000	Switch-off temperature driver sensor (x 10m°C) (0=inactive) (TEC18-XX only)	TEMP_3_MAX=x.xx C
SN1	ascii [2]	Designation LCD field 1	SN1=xx
SN2	ascii [2]	Designation LCD field 2	SN2=xx
SN3	ascii [2]	Designation LCD field 3	SN3=xx
SN4	ascii [2]	Designation LCD field 4	SN4=xx
SNT	0 .. 10000	Negative limit "Temperature OK" (x 10m°C)	TEMP_OK_NEG=x.xx C

SO1	-10000 .. 10000	Zero shift sensor 1 (x 10m°C)	TEMP_1_OFFSET=x.xx C
SO2	-10000 .. 10000	Zero shift sensor 2 (x 10m°C)	TEMP_2_OFFSET=x.xx C
SPF	0 .. 1000	Factor of proportional part	P_FACTOR=x.xx
SPT	0 .. 10000	Positive limit "Temperature OK" (x 10m°C)	TEMP_OK_POS=x.xx C
SPW	0; -4095 .. 4095	Specify TEC voltage manually (0=inactive, normal control mode) (4095=100%) !Only for test purposes, no current limitation etc.	POWER=x
SRR	0;1	Set USB-RS485 relay on	SSR=x
SS1	0 .. 99	LCD Field 1 TEC Controller ID (0=self)	SS1=x
SS2	0 .. 99	LCD field 2 TEC controller ID (0=self)	SS2=x
SS3	0 .. 99	LCD panel 3 TEC Controller ID (0=self)	SS3=x
SS4	0 .. 99	LCD panel 4 TEC Controller ID (0=self)	SS4=x
SSD	1;2;3	Temperature sensor for TEC driver temperature (TEC18-XX only)	SENSOR_DRIVER=x
SSN	Number	serial no. (8 numbers)	SN=x
SSO	1;2;3	Temperature sensor for control (object temperature)	SENSOR_OBJECT=x
SSS	1;2;3	Heat sink temperature sensor	SENSOR_SINK=x
STI	0;1	Use setpoint temperature input	TEMP_INPUT=x
STD	0;1 .. 24000	Maximum temperature delta sensor 1 and 2 (x 10m°C) (0=inactive)	TEMP_DELTA=x.xx C
STO	0;1 .. 1000	Timeout in seconds After the time has elapsed, the TEC controller switches off (0=inactive)	TO=xs
STS	0;1 .. 1000	Temperature slope (x 10m°C/s) (0=inactive)	TEMP_SLOPE=x.xx C/s
STV	MIN .. MAX	Target temperature (x 10m°C)	TEMP_SET=x.xx C
SUR	96.. 1152	Baud rate for USB (x0.1 kBd)	USB_BAUDRATE=x
SUT	text	User text field (20 characters)	UT=x
SV1	0 .. 5	LCD value 1 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)	SV1=x
SV2	0 .. 5	LCD value 2 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)	SV2=x
SV3	0 .. 5	LCD value 3 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)	SV3=x
SV4	0 .. 5	LCD value 4 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)	SV4=x
SX1	0;1;2	Set Aux I/O 1 (0=Inactive; 1=0V; 2=5V; 3=Temp 1) (TEC18-XX only)	AUX_1=x
SX2	0;1;2	Set Aux I/O 2 (0=Inactive; 1=0V; 2=5V; 3=Temp 2) (TEC18-XX only)	AUX_2=x
SX3	0;1;2	Set Aux I/O 3 (0=Inactive; 1=0V; 2=5V; 3=Temp 3) (TEC18-XX only)	AUX_3=x

Get commands

Command followed by a newline character ('\n'), e.g.:

```
01 GST\n
01 GTP\n
```

If the command composition is incorrect, the response is "COMMAND ERR"

The responses are prefixed with the controller ID

command	description	answer	range of values
GBR	Baud rate for RS485(x 0.1 kBd)	BAUDRATE=xx kBd	9.6 .. 115.2
GBE	Buzzer activated (TEC18-XX only)	BUZZER_ENABLE=x	0;1
GC1	Coefficient sensor 1	TEMP_1_COEFF=x.xx	0.00 .. 10.00
GC2	Coefficient sensor 2	TEMP_2_COEFF=x.xx	0.00 .. 10.00
GCS	Status switching regulator	CONV=x	0=idle; 1=heat; 2=cool
GCU	Peltier current	CURRENT=x.x A	-99.9 .. 99.9
GDZ	Dead Zone Delta	DEADZONE=x.xx C	0.00 .. 100.00
GEI	Switching the TEC controller on and off via the input	ENABLE_INPUT=x	0;1
GEN	Controller operating state	STATUS=x	0;1
GFC	Fan speed input pulses per revolution	FAN_CPR=x	1 .. 8
GFV	Fan speed	FAN_SPEED=xrpm	0 .. 15000
GFW	Firmware version	FW=x	text
GID	Controller ID	ID=xx	01 .. 32
GLC	Display configuration	LCD_SET=x	text
GMA	Maximum temperature (setpoint)	TEMP_MAX=x.xx C	-75.00 .. 240.00
GMI	Minimum temperature (set value)	TEMP_MIN=x.xx C	-75.00 .. 240.00
GM1	Switch-off temperature object sensor	TEMP_1_MAX=x.xx C	0;0.01 .. 240.00
GM2	Switch-off temperature sink sensor	TEMP_2_MAX=x.xx C	0;0.01 .. 240.00
GM3	Switch-off temperature baseplate sensor (TEC18-XX only)	TEMP_3_MAX=x.xx C	0;0.01 .. 100.00
GO1	Offset sensor 1	TEMP_1_OFFSET=x.xx C	-100.00 .. 100.00

GO2	Offset sensor 2	TEMP_2_OFFSET=x.xx C	-100.00 .. 100.00
GOK	Temperature inside ok window	TEMP_OK=x	0;1
GPA	Main parameter list	PARAMS=x	text
GPW	TEC power	POWER=x W	0 .. 999
GR1	Raw value sensor 1	TR1=x	0 .. 8191
GR2	Raw value sensor 2	TR2=x	0 .. 8191
GR3	Raw value sensor 3 (TEC18-XX only)	TR3=x	0 .. 8191
GS1	Sensor 1 error status	SENSOR_1_ERR=x	0=ok; 1=low; 2=high; 3=faulty; 4=Limit exceeded
GS2	Sensor 2 error status	SENSOR_2_ERR=x	0=ok; 1=low; 2=high; 3=faulty; 4=Limit exceeded
GS3	Sensor 3 error status (TEC18-XX only)	SENSOR_3_ERR=x	0=ok; 1=low; 2=high; 3=faulty; 4=Limit exceeded
GSD	Driver sensor (TEC18-XX only)	SENSOR_DRIVER=x	1;2;3
GSN	Serial no. (8 numbers)	SN=x	Number
GSO	Object sensor	SENSOR_OBJECT=x	1;2;3
GSS	Sink sensor	SENSOR_SINK=x	1;2;3
GST	Controller type	ST=x	text
GSV	Current values (operating status)	ALL=x	text
GT1	Temperature value object sensor	TEMP1=x.xx C	-99.99 .. 999.99
GT2	Temperature value sink sensor	TEMP2=x.xx C	-99.99 .. 999.99
GT3	Driver sensor temperature value (TEC18-XX only)	TEMP3=x.xx C	-99.99 .. 999.99
GTD	Maximum temperature delta sensors 1 and 2	TEMP_DELTA=x.xx C	0;0.01 .. 240.00
GTI	Raw value setpoint temperature input	GTI=x	0 .. 1023
GTS	Temperature slope (x 10m°C/s) (0=inactive)	TEMP_SLOPE=x.xx C/s	0;0.01 .. 10.00
GTV	Target temperature (x 10m°C)	TEMP_SET=x.xx C	MIN..MAX
GTE	Peltier element error	TEC_ERR=x	0;1
GUR	Get USB baudrate	BAUDRATE=xx kBd	9.6 .. 115.2
GUT	User text field (20 characters)	UT=x	text
GV1	Output voltage TEC+	U_HEAT=x.x V	0.00 .. 99.99
GV2	Output voltage TEC-	U_COOL=x.x V	0.00 .. 99.99

List of values collective commands

GPA
Target temperature
100
100
Limit current positive "heating"
Current limitation negative "Cooling"
Factor of proportional part
Factor of the integral term
Positive limit "Temperature OK"
Negative limit "Temperature OK"
Minimum temperature
Maximum temperature
Automatic switch-on active
Use setpoint temperature input
Switch-off temperature object
Maximum temperature delta object / heatsink
Temperature sensor for regulation (object)
Switch-off temperature heatsink
Switch-off temperature TEC driver base plate
Fan control sensor
Temperature delta fan control
Ambient temperature fan control
Maximum fan control
Coefficient sensor 1
Offset sensor 1
Coefficient sensor 2
Offset sensor 2
Auxiliary I/O 1
Auxiliary I/O 2

Auxiliary I/O 3
Lower limit temperature Aux 1
Upper limit temperature Aux 1
Lower limit temperature Aux 2
Upper limit temperature Aux 2
Lower limit temperature Aux 3
Upper limit temperature Aux 3
Switching the TEC controller on and off via the input
Buzzer Active
Fan speed input Pulses per revolution
Alarm when the permissible object temperature is exceeded
Alarm when the permissible heatsink temperature is exceeded
Alarm when the permissible TEC driver temperature is exceeded
Alarm when the permissible object/heatsink temperature delta is exceeded
Alarm when the target temperature is reached
Alarm when leaving the target temperature
Object sensor error alarm
Alarm on TEC error
Factor of the derivative part
Automatic shutdown if there is no communication
Dead Zone Delta
Heat sink temperature sensor
Temperature sensor of the TEC driver base plate (TEC18-XX only)

GLC
Field 1 designation
Field 1 Slave ID
Field 1 display value
Field 2 designation

Field 2 Slave ID
Field 2 display value
Field 3 designation
Field 3 Slave ID
Field 3 display value
Field 4 designation
Field 4 Slave ID
Field 4 Display value

GSV
Converter status
Target temperature
Object sensor error status
Object temperature
Heatsink sensor error status
Heatsink temperature
TEC driver sensor error status
TEC driver temperature
Current
Voltage output B
Voltage output A
LED "Heat"
LED "cool"
LED "temp_ok"
LED "tec_fail"
LED "sensor_fail"
Absolute limit temperature sensor object/heatsink/TEC driver exceeded
Maximum temperature delta sensor object/heatsink exceeded
Fan speed
Temperature slope

TEC controller binary instruction set

Data telegrams

Telegrams are only processed if they correspond to the following specification. There is always a response in the form of a repeated command or an error message. Once the feedback has been received, another telegram can be transmitted.

The telegrams are structured as follows:

Frame start	recipient address	Sender address	telegram length	function/error (big endian)	data (big endian)	CRC16 Lbytes	CRC16 Hbyte	frame end
1 byte	1 byte	1 byte	1 byte	2 bytes	0 - 247 bytes	1 byte	1 byte	1 byte

Frame start

Character: 0x7E

Escape: 0x7D + XOR 0x20 (0x7E -> 0x7D + 0x5E)

recipient address

Address range: 1 - 32

Broadcast: 0

Sender address

Address range: 1 - 32

telegram length

Number of bytes without frame start/frame end

CRC16

Start value: 0xFFFF

Polynomial: 0xA001

Wildcard: 0xAAAA (Can be used instead of CRC16 if CRC is not desired)

frame end

Sign: Start of frame

Not applicable for directly consecutive telegrams

Commands (functions)

The following commands are implemented. The newly set value follows as a response to a valid command including valid data.
If a command is sent without data, the set value is sent as a response.

function	bytes	range of values	L	S	description
0x1000	1	0;1;2	X		Status switching controller (0=idle; 1=heat; 2=cool)
0x1001	1	0;1;2	X	X	Switch on control (0=off; 1=on; 2=on + error reset)
0x1002	2	MIN..MAX	X	X	Target temperature (x 10m°C)
0x1003	1	1		X	Reset the Hi/Low temperature memory
0x1004	1	0;1	X	X	Enable auto power on
0x1005	2	96.. 1152	X	X	Baud rate (x 0.1 kBd)
0x1006	1	0;1	X	X	Interface mode (0=ASCII; 1=Binary)
0x1007	1	0;1	X	X	Switching the TEC controller on and off via the input
0x1008	2	0;1 .. 10000	X	X	Timeout in sec./10 After the time has elapsed, the TEC controller switches off (0=inactive)
0x2001	2	0 .. 1000	X	X	Coefficient sensor 1 (x 0.01)
0x2002	2	0 .. 1000	X	X	Coefficient sensor 2 (x 0.01)
0x2004	2	-10000 .. 10000	X	X	Zero shift sensor 1 (x 10m°C)
0x2005	2	-10000 .. 10000	X	X	Zero shift sensor 2 (x 10m°C)
0x2007	2	MIN + 100 .. 24000	X	X	Maximum temperature (x 10m°C)
0x2008	2	-7500 .. MAX - 100	X	X	Minimum temperature (x 10m°C)
0x2009	2	0 .. 10000	X	X	Positive limit "Temperature OK" (x 10m°C)
0x2010	2	0 .. 10000	X	X	Negative limit "Temperature OK" (x 10m°C)
0x2011	1	0;1	X	X	Use setpoint temperature input
0x2012	2	0;1 .. 24000	X	X	Maximum temperature delta sensor 1 and 2 (x 10m°C) (0=inactive)
0x2013	2	0.1 .. 24000	X	X	Switch-off temperature sensor 1 (x 10m°C) (0=inactive)
0x2014	1	1;2;3	X	X	Temperature sensor for regulation
0x2015	2	0 .. 1000	X	X	Factor of proportional part
0x2016	2	0 .. 1000	X	X	Factor of the integral term
0x2017	2	0;1 .. 24000	X	X	Switch-off temperature sensor 2 (x 10m°C) (0=inactive)
0x2018	2	0;1 .. 10000	X	X	Switch-off temperature sensor 3 (x 10m°C) (0=inactive) (TEC18-XX only)

function	bytes	range of values	L	S	description
0x2020	2	-9999 .. 9999	X		Temperature value sensor 1
0x2021	2	-9999 .. 9999	X		Temperature value sensor 2
0x2022	2	-9999 .. 9999	X		Temperature value sensor 3 (TEC18-XX only)
0x2023	1	0;1;2;3	X		Sensor 1 error status (0=ok; 1=low; 2=high; 3=faulty; 4=limit exceeded)
0x2024	1	0;1;2;3	X		Sensor 2 error status (0=ok; 1=low; 2=high; 3=faulty; 4=limit exceeded)
0x2025	1	0;1;2;3	X		Sensor 3 error status (0=ok; 1=low; 2=high; 3=faulty; 4=limit exceeded)
0x2026	1	0;1	X		Temperature okay
0x2028	2	0 .. 4095	X		Raw value sensor 1
0x2029	2	0 .. 4095	X		Raw value sensor 2
0x2030	2	0 .. 1023	X		Raw value sensor 3 (TEC18-XX only)
0x2031	2	0 .. 1023	X		Raw value setpoint temperature input
0x2032	2	0 .. 15000	X		Fan speed (rpm)
0x2101	2	0 .. 1600	X	X	Current limitation positive "heating" (x 10mA)
0x2102	2	0 .. 1600	X	X	Current limitation negative "cooling" (x 10mA)
0x2103	2	-9999 .. 9999	X		Actual current (x 10mA)
0x2104	1	0 .. 9999	X		Actual value voltage output A (x 10mV)
0x2105	1	0 .. 9999	X		Actual value voltage output B (x 10mV)
0x2106	1	0;1	X		TEC module error status
0x2201	1	0;1;2;3	X	X	Ventilation control mode (0=fan inactive; 1=fixed speed; 2=temperature control (hysteresis); 3=temperature control (PWM))
0x2202	2	-7500 .. 24000	X	X	Switch-on temperature fan control (x 10m°C)
0x2203	2	0;1 .. 10000	X	X	Temperature delta fan control (x 10m°C)
0x2204	1	0 .. 100	X	X	Maximum value fan control (%)
0x2205	1	0;1;2;3	X	X	Set Aux I/O 1 (0=Inactive; 1=0V; 2=5V; 3=Temp 1) (TEC18-XX only)
0x2206	1	0;1;2;3	X	X	Set Aux I/O 2 (0=Inactive; 1=0V; 2=5V; 3=Temp 2) (TEC18-XX only)
0x2207	1	0;1;2;3	X	X	Set Aux I/O 3 (0=Inactive; 1=0V; 2=5V; 3=Temp 3) (TEC18-XX only)
0x2208	2	MIN + 100 .. 24000	X	X	Upper limit temperature Aux 1 (x 10m°C) (TEC18-XX only)
0x2209	2	MIN + 100 .. 24000	X	X	Upper limit temperature Aux 2 (x 10m°C) (TEC18-XX only)
0x2210	2	MIN + 100 .. 10000	X	X	Upper limit temperature Aux 3 (x 10m°C) (TEC18-XX only)

function	bytes	range of values	L	S	description
0x2211	2	-7500 .. MAX - 100	X	X	Lower limit temperature Aux 1 (x 10m°C) (TEC18-XX only)
0x2212	2	-7500 .. MAX - 100	X	X	Lower limit temperature Aux 2 (x 10m°C) (TEC18-XX only)
0x2213	2	0 .. MAX - 100	X	X	Lower limit temperature Aux 3 (x 10m°C) (TEC18-XX only)
0x2220	2	ASCII	X	X	Designation LCD field 1
0x2221	2	ASCII	X	X	Designation LCD field 2
0x2222	2	ASCII	X	X	Designation LCD field 3
0x2223	2	ASCII	X	X	Designation LCD field 4
0x2224	1	0 .. 32	X	X	LCD Field 1 TEC Controller ID (0=self)
0x2225	1	0 .. 32	X	X	LCD field 2 TEC controller ID (0=self)
0x2226	1	0 .. 32	X	X	LCD panel 3 TEC Controller ID (0=self)
0x2227	1	0 .. 32	X	X	LCD panel 4 TEC Controller ID (0=self)
0x2228	1	0 .. 5	X	X	LCD value 1 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)
0x2229	1	0 .. 5	X	X	LCD value 2 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)
0x2230	1	0 .. 5	X	X	LCD value 3 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)
0x2231	1	0 .. 5	X	X	LCD value 4 (0=blank; 1=temp 1; 2=temp 2; 3=temp 3; 4=temp set; 5=TEC power)
0x9001	2	0x0 .. 0xFFFF	X		Firmware version (code)
0x9002	<=32	ASCII	X		Firmware version (text)
0x9003	<=32	ASCII	X		Controller type
0xAA01	1	1 .. 32	X	X	Set address (controller ID)
0xAA02	2	0; -4095 .. 4095	X	X	Specify TEC voltage manually (0=inactive, normal control mode) !Only for test purposes, no current limitation etc.
0xAFF	1	0;1		X	Controller reset (0=restart; 1=load factory settings)

Error messages

The following error messages are implemented.

error code	bytes	range of values	description
0xFFA1	0		Function not available

0xFFA2	0		Data not in value range
0xFFA3	2	CRC	CRC error (is only output up to the first correctly transmitted CRC)
0xFFA4	2		Transferred length not equal to the number of bytes received

Release Notes

V4.10

- New command: SRR, set USB - RS485 relay on
- New command: SUR, set USB baud rate
- New command: GUR, get USB baud rate
- Receiver ID limited to 32
- Bugfix: Binary communication protocol

V4.09

- Display: Automatic reactivation after loss of communication removed

V4.08

- Bugfix: RS485 buffer increased to 255 characters

V4.07

- Bugfix: fan calculation error

V4.06

- Bugfix: RS485 fail function

V4.05

- Support for new device TEC06-24N
- Bugfix: sensor error check
- Bugfix: GR1, GR2 calculation error

V4.04

- Support for new device TEC06-24P
- Bugfix: LCD names couldn't be changed

V4.03

- Support for new device TEC18-24

V4.00

- New devices with AVR128DB microcontroller

V3.12

- RS485: Fixed protocol error at ID 00 (broadcast).

V3.11

- New command: "SSN", serial no. put
- New command: "GSN", serial no. read
- New command: "SUT", set free text field
- New command: "GUT", read free text field

V 3.1

- Internal resolution I component increased
- Resolution PT1000 increased to 0.01°C

V3.0

- PID control
- Adjustable permissible temperature difference without regulation
- Advanced fan control
- Automatic timeout can be activated
- New command: "SCU" (operate as a current source)
- Changed command: "SO1", new unit 0.1°C
- Changed command: "SO2", new unit 0.1°C
- Changed command: "GO1", new unit 0.1°C
- Changed command: "GO2", new unit 0.1°C
- New temperature range from -75°C – 240°C