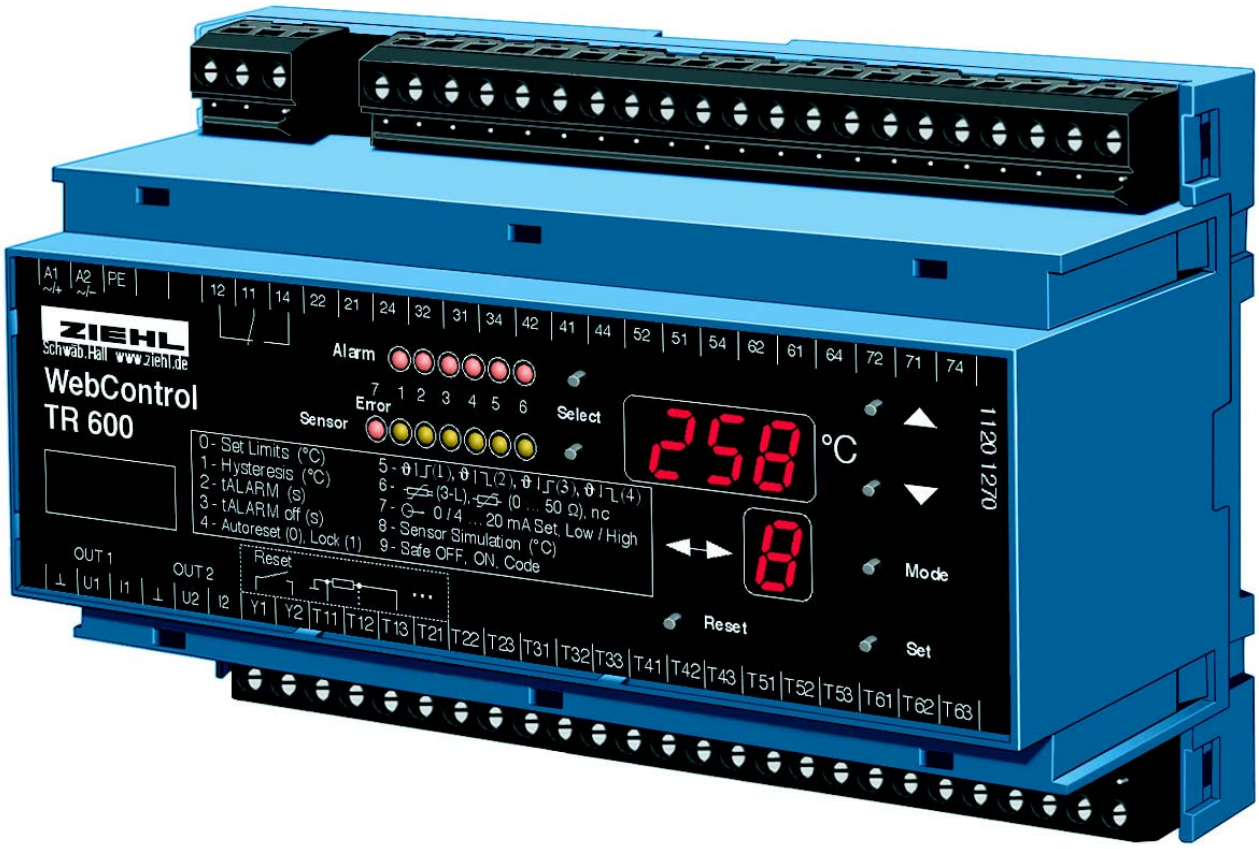
Operating manual - Archive document -

Pt 100 temperature relay TR 600 WebControl



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Contents Page

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Application and short description

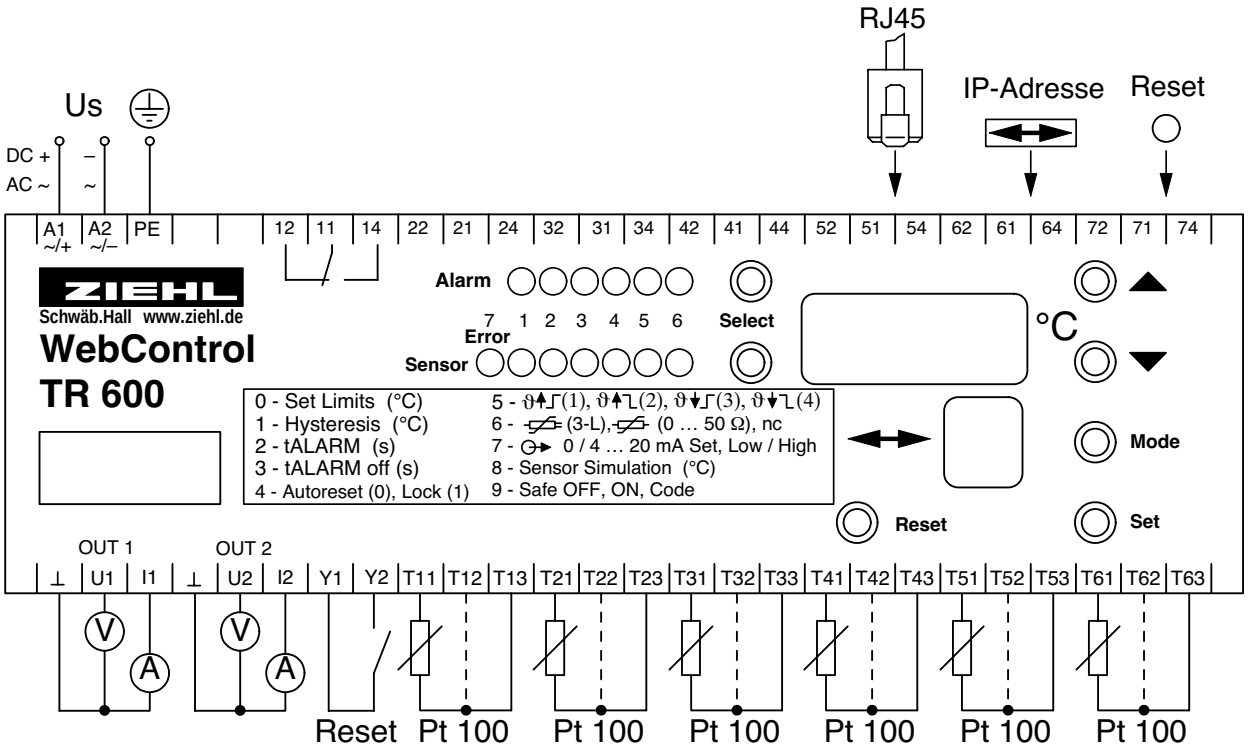
The Pt 100 thermostat TR 600 is a temperature controller and monitors up to six Pt 100 sensors at the same time. Six switching points and six relays permit almost any combination of switching action. It also can select the highest temperature of a group of three or six sensors. The temperatures of two sensors or groups of sensors can be issued to 2 analogue outputs i.e. for remote displays or further evaluation. Programming is very variable and simple. The TR 600 WebControl includes its own Web server and can be attached to existing 10BaseT - Ethernet networks (LAN) with RJ45 connector.
Due to the fact that 6 types Pt 100 sensors can be connected, the unit is especially suitable for temperature monitoring wherever up to 6 different measuring points must be monitored simultaneously:

- Motors and generators with simultaneous monitoring of bearings and coolant.
- Transformers with additional monitoring of the core temperature also.
- Power machines and plants

Overview of functions

- Measuring and monitoring range -199 ... +800 °C
- 6 sensor inputs with 2- or 3-wire connection
- 7 relay outputs with change-over contact
- Alarm 1 … 6 relay K1 (11/12/14) ... K6 (61/62/64)
- Sensor Error Relay K7 (71/72/74) monitors sensor break or sensor short circuit.
- 2 analog outputs, 0/4...20 mA and 0/2...10 V, with individual scaling.
- Universal power supply. 2 ranges AC/DC 24-60V or AC/DC 90-240 V

Connection plan:



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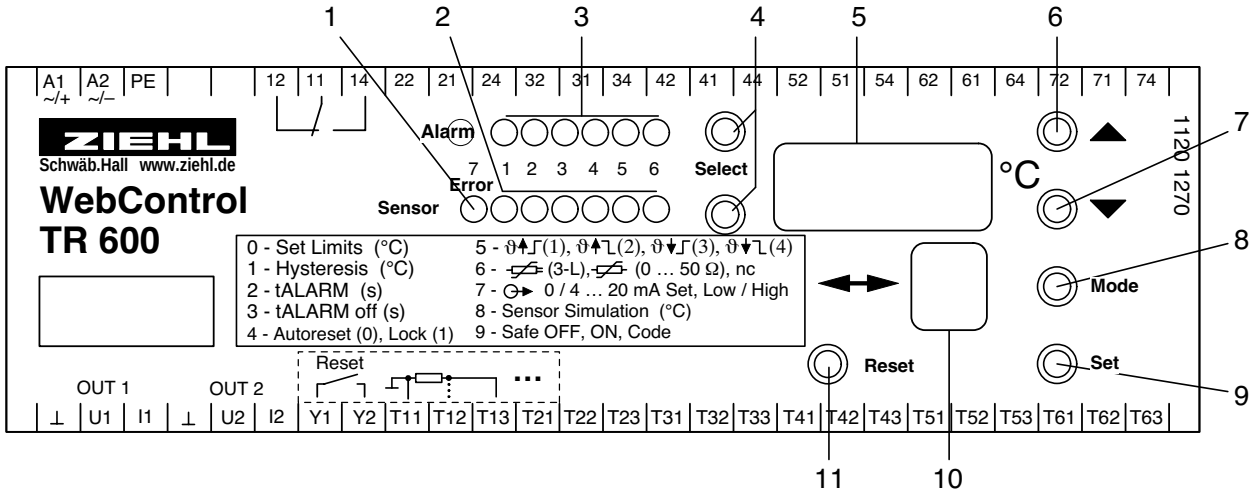
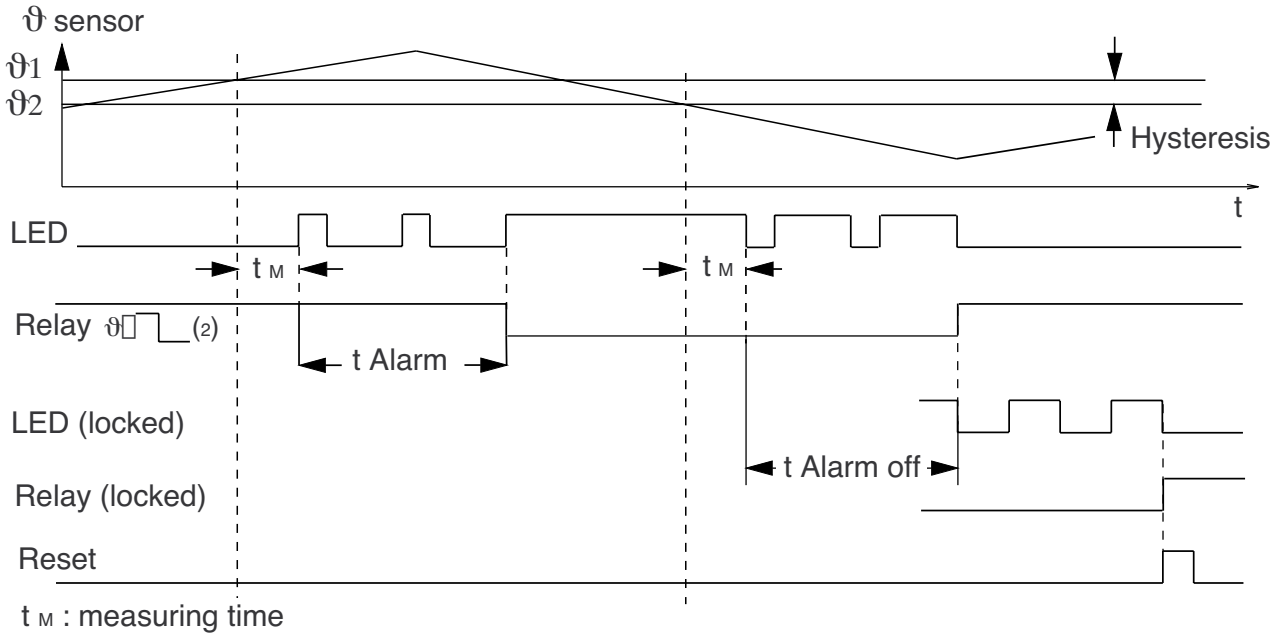
Display and operating elements



1	LED Sensor Error
2	6x LED Sensor
3	6x LED Alarm
4	Select buttons
5	Display, 3 digits
6	Up button
7	Down button
8	Mode button
9	Set button
10	Display, 1 digit (Mode)
11	Reset button

Function diagram



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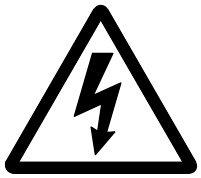
Important notes



ATTENTION

Dangerous electrical voltage!
May lead to electrical shock and burn.
Before beginning of work switch unit and equipment free of voltage.

To use the equipment flawless and safe, transport and store properly, install and start professionally and operate as directed.
Only let persons work with the equipment who are familiar with installation, start and use and who have appropriate qualification corresponding to their function. They must observe the contents of the instructions manual, the information which are written on the equipment and the relevant security instructions for the setting up and the use of electrical units.

The equipments are built according to DIN / EN and checked and leave the plant according to security in perfect condition. To keep this condition, observe the security instructions with the headline „Attention“ written in the instructions manual. Ignoring of the security instructions may lead to death, physical injury or damage of the equipment itself and of other apparatus and equipment.
If, in any case the information in the instructions manual is not sufficient, please contact our company or the responsible representative.
Instead of the industrial norms and regulations written in this instructions manual valid for Europe, you must observe out of their geographical scope the valid and relevant regulations of the corresponding country.

Observe the maximum temperature permissible when installing in switching cabinet. Make shure sufficient space to other equipment or heat sources. If the cooling becomes more difficult e.g. through close proximity of apparatus with elevated surface temperature or hindrance of the cooling air, the tolerable environmental temperature is diminishing.

ATTENTION!

Connecting temperature sensors Pt 100
Temperature sensors must be connected to the plug-in terminals T11, T12, T13 etc.
To ensure proper operation this plug-in terminals have gold-plated contacts. Do not use these plugs for other terminals.

Universal power supply
The universal power supply works within the ranges AC/DC 24-60 V or AC/DC 90-240 V. Before switching on make sure, that the operational voltage Us of the type- plate and the mains voltage are the same.

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Assembly:

- Mount on 35 mm mounting rail according to EN 60715
- Wall-mount with 3 x screws M4
- Connecting wires refer to the wiring diagram to prevent miss-operation and malfunction.
- Apply mains voltage to terminals A1 and A2 (DC A1=+, A2=-, also connect PE)

Putting into operation

Remarks

- **LEDs Alarm**
  off: temperature below switching point
  on: temperature beyond switching point
  blinking 1x on 4x off: alarm-relay delay time t_{ALARM} is running
  blinking 4x on 1x off: alarm-relay delay time t_{ALARM} off is running
  blinking 1x on 1x off: relay locked, ready for reset
  Alarm-relay can be resetted with reset-push-button or external contact closed Y1, Y2.
  A closed contact or short circuit at terminals Y1-Y2 means no auto resetfunction.

- **Operating Delay Time – Measuring Time t_M**
  The operating delay time of the relay depends on the number of connected sensors and the measuring function. With continuous change of temperature the measuring time t_M is about 1,5 s. With abrupt change of temperature the measuring time t_M is about 3 … 4 s (for example by simulation of temperature changes in mode 8). With sensor short circuit or sensor interruption the measuring time t_M increases to 6…8 s.

- **Relay locked active (Mode 4 = "1")**
  In this mode the relay can switch on when all the following parameters are full filled:
  - the temperature decreases below the switching back limit
  - the alarm relay delay-time t_{ALARM} off has overrun
  - a reset signal Y1,Y2 (reset push-button or external closed contact) is done or the mains (supply voltage) is switched off an on.
  In the ready for reset status the alarm-LED will be blinking 1x on 1x off .

- **2-wire technique line resistance compensation**
  To compensate the line resistance short-circuit the wires nearby the sensor and measure the line resistance. Setting see mode 6.
  We recommend to use 2 or better 3 wires for each sensor. With 2-wire connection and a common line for all signals, all sensor measuring currents will be added on the common line. Thus the value of the compensation line resistance RK must be calculated as follows:
  RK = (n+1) x RL/2 (RL = line resistance of two wires, n = number of sensors)

- **Sensor Simulation**
  If no button is pushed within 15 minutes the relay automatically returns in the normal function mode.

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Table of function

Function	Key	Display
Sensor temperatureSensor select 1 …6	Measuring temperature of selected sensor	
ϑ - MAX	Δ	Highest measured temperature
ϑ - MIN	∇	Lowest measured temperature
ϑ - MIN - MAX- Reset	Δ or ∇ + Reset	Measured temperature
Relay locked Reset	Reset	
Switching points	Alarm select 1 …6	Adjusted limit and sensor or sensor group

Setup

Mode	Function	Alarm select (Alarm=Relay)	Sensor select	Display	SET	Factory Adjust
0	Switching Point (°C)	Relay 1…6	Sensor 1…6 Group 1+2+3 Group 4+5 Group 4+5+6 Group 1…6	-199°…800°C	Store	100 °C Alarm 1 = Sensor 1 ... Alarm 6 = Sensor 6
1	Hysteresis (K)	Relay 1…6	-	1 …20 K	Store	3 K
2	t_{ALARM} (s)	Relay 1…6	-	0,1 … 20,0 s	Store	0,1 s
3	$t_{ALARM\ off}$ (s)	Relay 1…6	-	0 … 999 s	Store	0 s
4	Auto reset - locked	Relay 1…6	-	0 = auto reset 1 = locked	Store	0 = auto reset
5	Operating function Max-NO contact Max-NC contact Min-NO contact Min-NC contact	Relay 1…6 Sensor alarm (Relay K7)	-	1 = ϑ⇑⌐ 2 = ϑ↑¬ 3 = ϑ⇓⌐ 4 = ϑ⇓¬	Store	2 = ϑ↑¬
6	Sensor connection 3-wire not connected 2-wire (Ω)	-	Sensor 1…6	3-.L nc. 0…50,6		3-.L
7	Analog out Zero Full Scale	Out 1 = 1 Out 2 = 2 - -	Sensor 1…6 Group 1+2+3 Group 4+5 Group 4+5+6 Group 1…6 - -	0 = 0…20 mA 0 = 0…10 V 4 = 4…20 mA 4 = 2…10 V -199°…800°C -199°…800°C	Store Store Store	Out 1 = Group 1+2+3 Out 2 = Group 4+5+6 0 °C = 0 mA 100 °C = 20 mA
8	Sensor Simulation	-	Sensor 1…6	-199°…800°C	-	
9	Code safe = off Code safe = on	-	-	off = 500 on = 504	 Store	500

* return within 30 s without any button pushed

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Trouble shooting

- **LED Sensor Error**
  The LED sensor error indicates a failure at a sensor and the sensor-LED blinks. The sensor alarm relay K7 has switched. Refer to operation mode 5. Also see analogue output.

- **Display**
  EEE sensor interruption or over-range
  -EE sensor short circuit or under -range

- **Analog output 0 mA/0 V**
  Any sensor or group of sensors can be programmed to an analog output (mode 7). If sensor failure short circuit or sensor interruption is detected the output current is 0 mA and the output voltage 0 V

- **Reset to factory adjust**
  When pushing the buttons "Reset" and "Set" simultaneously > 5 s all programmed parameters will be set back to factory adjust. Code save must be off. If code save is on, see mode 9.

- **No parameter set-up possible - Code save on**
  Code save protects the relay against not allowed manipulations. With code save on no programmed parameters can be changed. The factory code is 504 and cannot be changed by the user. See set-up mode 9.

- **Failure display "E 0", Sensor error relay K7 switching**
  Operation failure. Switch off the supply voltage and restart. When the failure is still going on, the relay should be replaced and send to the factory.

- **Failure display "E 1" or "E 2", Sensor error relay K7 switching**
  EEPROM parameter failure. Check all programmed parameters and set-up new when necessary. Switch off the supply voltage and restart again. When the failure is still going on, the relay should be replaced and send to the factory.

- **Sensor Alarm Relay K7**
  Sensor alarm relay K7 with operating function 2 = NC-contact releases at any failure and also signals an interruption of power-supply.
  ATTENTION! There is a short alarm-signal of K7 when switching-on the supply-voltage.

  Sensor alarm relay K7 with operating function 1 = NO-contact picks up at any failure.
  ATTENTION: There is no alarm-signal of K7 if interruption of power supply occurs.
  See set-up mode 5.

  In case of any other malfunctions, replace device and send it in together with a description of the occurred malfunction.

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Technical data

Rated supply voltage Us:	AC/DC 24 – 60 V (see lateral type plate)
Tolerance DC-supply	DC 20 - 81 V (0,85 x 24V…1,35 x 60V)
Tolerance AC-supply	AC 20 - 66 V (0,85 x 24V…1,1 x 60V)
Rated supply voltage Us:	AC/DC 90 – 240 V (see lateral type plate)
Tolerance DC-supply	DC 81 - 297 V (0,9 x 90V…1,35 x 220V)
Tolerance AC-supply	AC 76 - 264 V (0,85 x 90V…1,1 x 240V)
Power consumption	< 8 VA
Frequency	0 / 50 / 60 Hz
Relay output:	1 change-over (CO) contact
Switching voltage	max. AC 415 V
Switching current	max. 5 A
Switching power cos φ =1	max. 1250 VA (ohmic load) max. 48 W at DC 24 V
Derating factor cos φ =0,7	0,5
UL electrical ratings:	3 A Resistive, 240 VAC D300 1A 240 VAC
Rated operational current Ie:	
	AC15 Ie = 1 A Ue = 400 V Ie = 2 A Ue = 250 V DC13 Ie = 2 A Ue = 24 V Ie = 0,2 A Ue = 125 V Ie = 0,1 A Ue = 250 V
Recommended fuse for contacts	T 3,15 A (gL)
Expected life mechanical	1 x 10^7 operations
Expected life electrical	1 x 10^5 operations with AC 250 V / 5 A 2 x 10^5 operations with AC 250 V / 3 A 6 x 10^5 operations with AC 250 V / 1 A
Test conditions:	EN 60947, EN 50178
Insulation	EN 60664
Rated impulse voltage	4000 V
Overvoltage category	III
Contamination level	3 2
Rated insulation voltage Ui	250 V 415 V
Sensor connection :	6 x Pt 100 acc. to DIN EN 60751
Measuring accuracy	±0,5 % of value ±1 Digit
Sensor current	≤ 2 mA
3-wire sensor	Pt 100 + R_L = max. 490 Ω
2-wire sensor	R_L = 0 …50,6 Ω adjustable
Measuring delay time t_M	<1,5 s (normal operation, depends on number of connected sensors)

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Switch points:	6, digital adjustable
Relay operating function	standard = closed circuit current principle (NC) option = operating current (NO)
Temperature alarm:	
Temperature range $\vartheta 1 \ldots \vartheta 6$	-199 ... +800 °C
Hysteresis	1 ... 20 K
(Release) delay time t_{ALARM}	0,1 ... 99,9 s
(Pick-up) delay time $t_{ALARM\ off}$	0 ... 999 s
Analog output:	
	Voltage output DC 0/2 V – 10 V, max. DC 10 mA Current output DC 0/4 mA – 20 mA Burden effective resistance max. 500 Ω No-load voltage max. DC 16 V Accuracy 1% of span ±1 K
Max. Ambient Temperature:	
Operating Temperature	-20 °C … +65 °C
Storage Temperature	-20 °C … +70 °C
no condensation permitted	
LAN :	10BaseT Ethernet connector RJ45
Housing:	Typ V8
Dimensions (H x W x D)	140 x 90 x 58 mm
Mounting height / Width	55 mm / 4 TE
Line connection solid wire	1 x 1,5 mm^2
Stranded wire with insulated ferrules	1 x 1,0 mm^2
Torque	0,5 Nm (3,6 lb.in)
Protection class housing	IP 31
Protection class terminals	IP 20
Fitting position	any
Mounting	Snap mounting on 35 mm standard rail EN 60715 or M4 screws
Weight	app. 350 g

Subject to technical modifications

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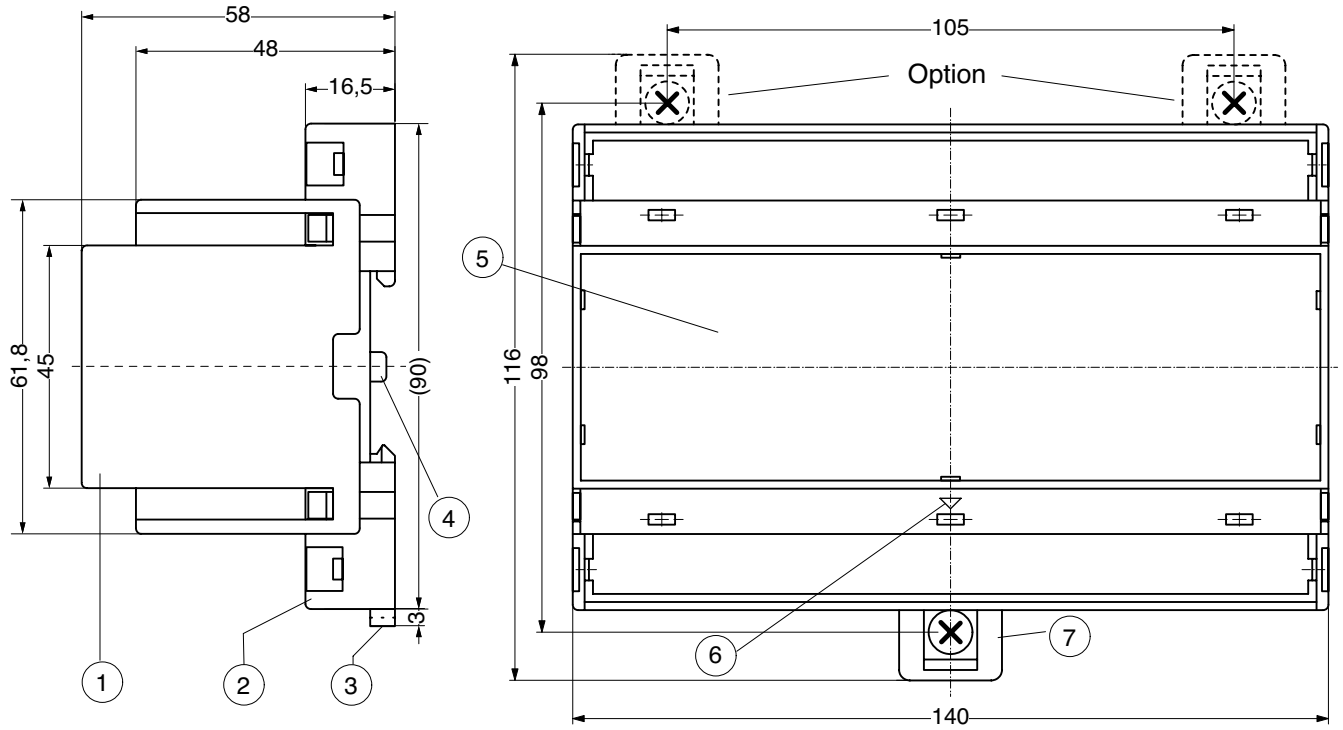
Form V8: dimensions in mm



1 Oberteil / cover
2 Unterteil / base
3 Riegel / bar for snap mounting
4 Plombenlasche / latch for sealing
5 Frontplatteneinsatz / front panel
6 Kennzeichen für unten / position downward
7 Riegel bei Wandbefestigung mit Schrauben. Riegelbohrung Ø 4,2 mm / for fixing to wall with screws, Ø 4,2 mm

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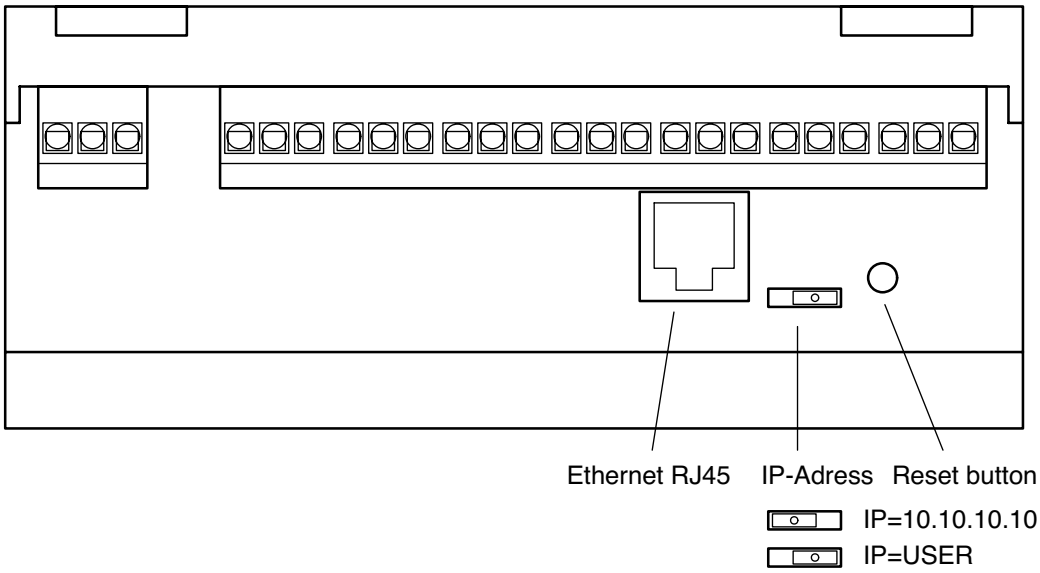
First step for putting into operation:

The following components must be installed:

- PC with Windows® operating system WIN XP
- 10BaseT Ethernet card (100BaseTX Ethernet also) and the TCP/IP protocol for this card
- Standard Web Browser (Microsoft® Internet Explorer)
- Java 1.4 or higher

The following description refers to an installation with Windows XP

Attaching to the LAN



Factory setting IP = User

Implementing and testing the LAN connection

Connect the TR 600 WebControl with a Ethernet - cable to your network. Switch supply voltage on. With PING function the network connection can be simply implemented using the TCP/IP protocol. In addition the PC must be able to address the preset IP address 10.10.10.10. If your network card has a firmly IP address (in the following example 192.168.0.1) go to the DOS-Mode and type in the following route – instruction and press Enter:

```
route add 10.10.10.10 192.168.0.1
```

If the attitude of the network card is implemented correctly, you can address the TR 600 WebControl with the PING function. Type in the following ping – instruction and press Enter:

```
ping 10.10.10.10
```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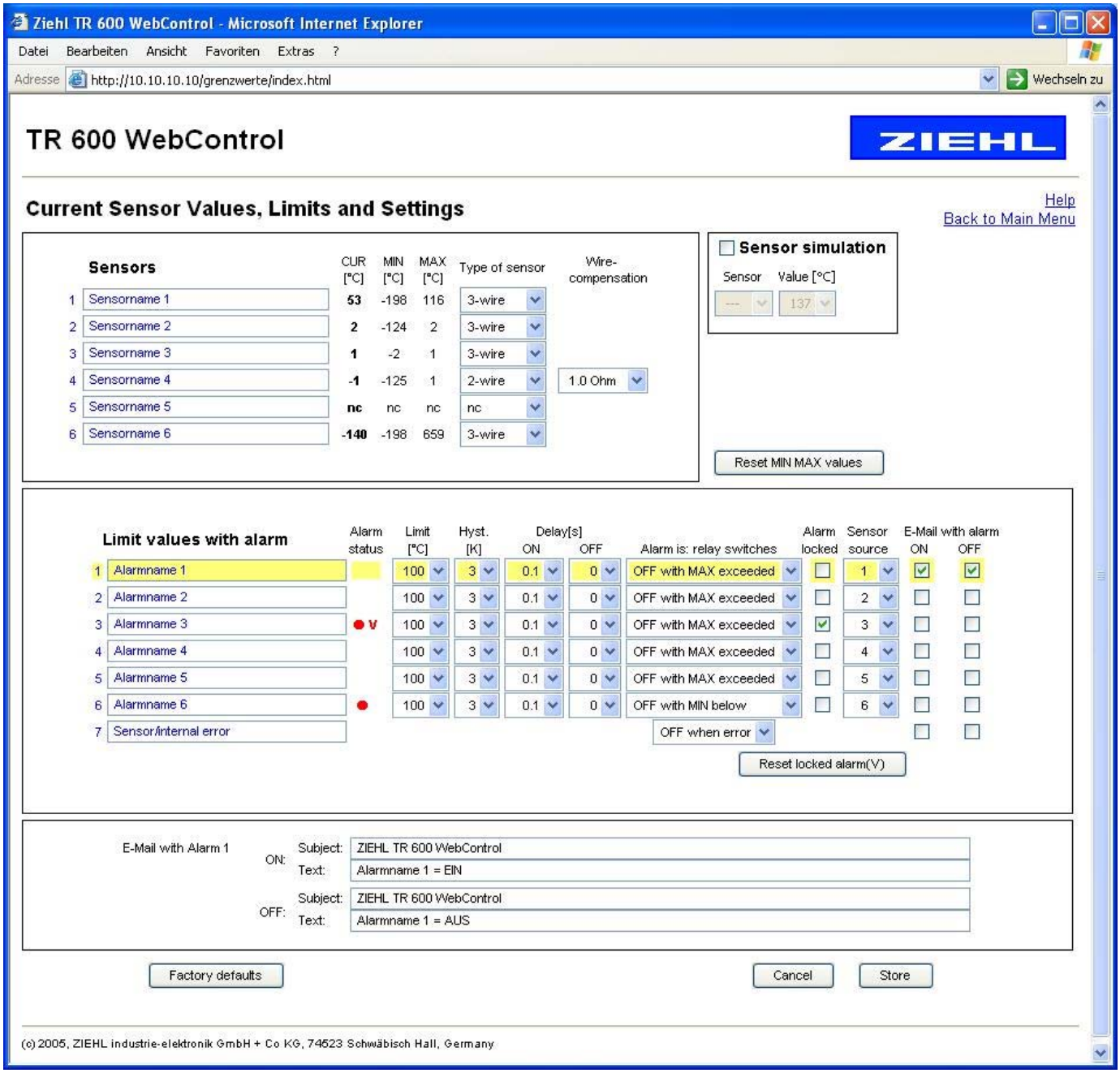
```
Ping is executed for 10.10.10.10 with 32 Bytes Daten:

Antwort von 10.10.10.10: Bytes=32 Zeit=3ms TTL=32
Antwort von 10.10.10.10: Bytes=32 Zeit=1ms TTL=32
Antwort von 10.10.10.10: Bytes=32 Zeit=2ms TTL=32
Antwort von 10.10.10.10: Bytes=32 Zeit=1ms TTL=32

Ping-Statistics for 10.10.10.10:
    Pakets: Sended = 4, Received = 4, Lost = 0 (0% loss),
App. Times in Milliseconds:
    Minimum = 1ms, Maximum =  3ms, Average =  1ms
```

The TR 600 WebControl answers automatically to this requirement with the ECHO REPLY. Subsequently, you can receive the TR 600 WebControl on TCP/IP address 10.10.10.10 in your Browser.

Calling http://10.10.10.10

Choose your language in menu „Grundeinstellungen“ (Base Properties)

Current Sensor Values, Limits and Settings



In the window "**Sensors**" you can change the settings of the sensors.
The actual values of the measured temperatures and the minimum- and maximum-values are displayed..
With „Reset MIN MAX Werte“ a Reset of the values can be made.

Selction of sensor-type:
- 2-wire: the resistance of the line can be compensated. Enter resistance (line to and back from sensor) in Ohm.
- 3-wire at sensors with 3-wire-connection (automatical compensation of line resistance)
- nc when no sensor is connected.

When no sensor is connected, the device recognizes an error.

„EEE“ = sensor-break. „-EE“ = sensor-short-circuit. Alarm 7 is activated.

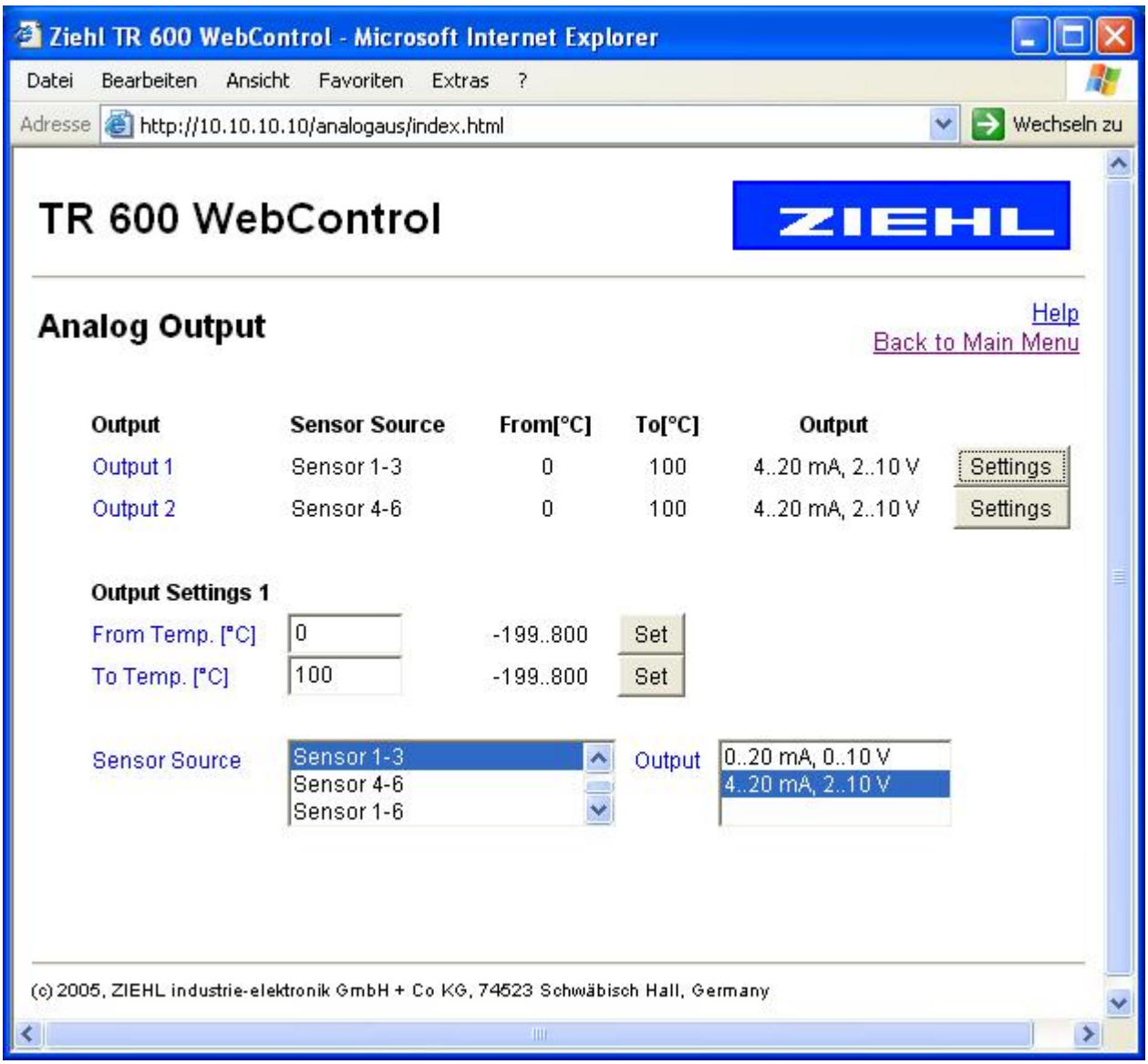
In the window "**Limit values with alarm**" limits can be set.
Display Alarmstatus (state of alarm):
„ „ no alarm active.
„• „ alarm active.
„• V „locked alarm active" A locked alarm has to be resetted manually, e.g. with "Reset locked alarm (V)".

E-Mail with alarm on: When alarm changes from OFF to ON, an e-mail is sent to the receiver (see base properties).
E-Mail with alarm off: When alarm changes from ON to OFF, an e-mail is sent to the receiver (see base properties).

In the window "**Sensor simulation**" the temperature at a sensor can be simulated. Select a sensor and enter a tempoerature.
Hint: Simulation doesn't work with "nc", sensor not connected.

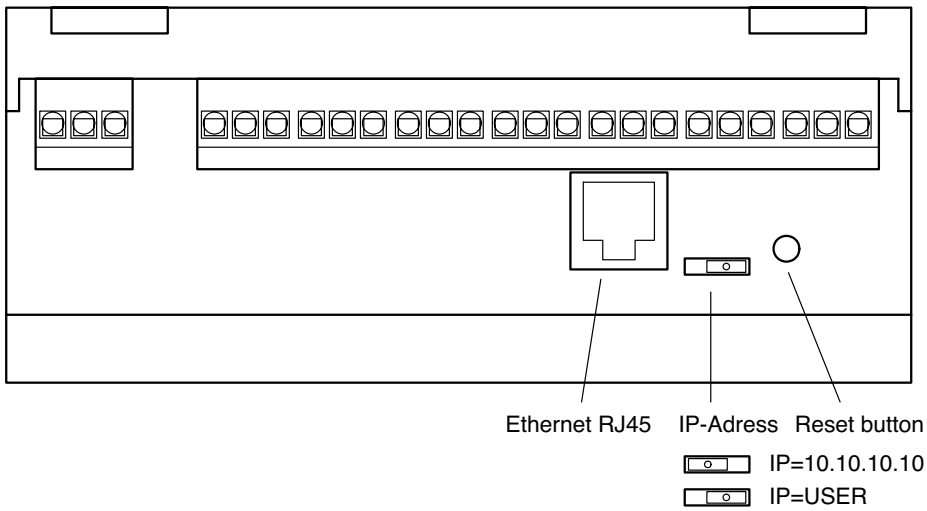
Field „Store“: the entered values are stored.
Field „Cancel“: return to old values (only if new values have not been stored).
Fiels „Factory defaults“: Values are set back to preset values from factory, but not yet stored.
Press „Store“ to store the values.

Analog Output settings



Select the sensor or group of sensors which refer to analog output. Define the temperature range of the output signal. The attitudes are immediately taken over and displayed.

Base Properties



When 10.10.10.10 is selected at the switch at the TR 600 WebControl, always the main menu answers. Reading and writing is permitted. In this configuration, the data for the authentication can be changed, if these have been lost.
Attention! Use this setting only for configuration.

IP 10.10.10.10 is applied and MAC is changed to 00-02-0A-0A-0A-0A.

When IP = USER is selected, also the main menu answers. The changed user-IP is only activated after a reset or a restart of the system.
This setting shall be used during normal operation.

The set IP-adress and the MAC-adress of the lateral type-plate of the device is active.

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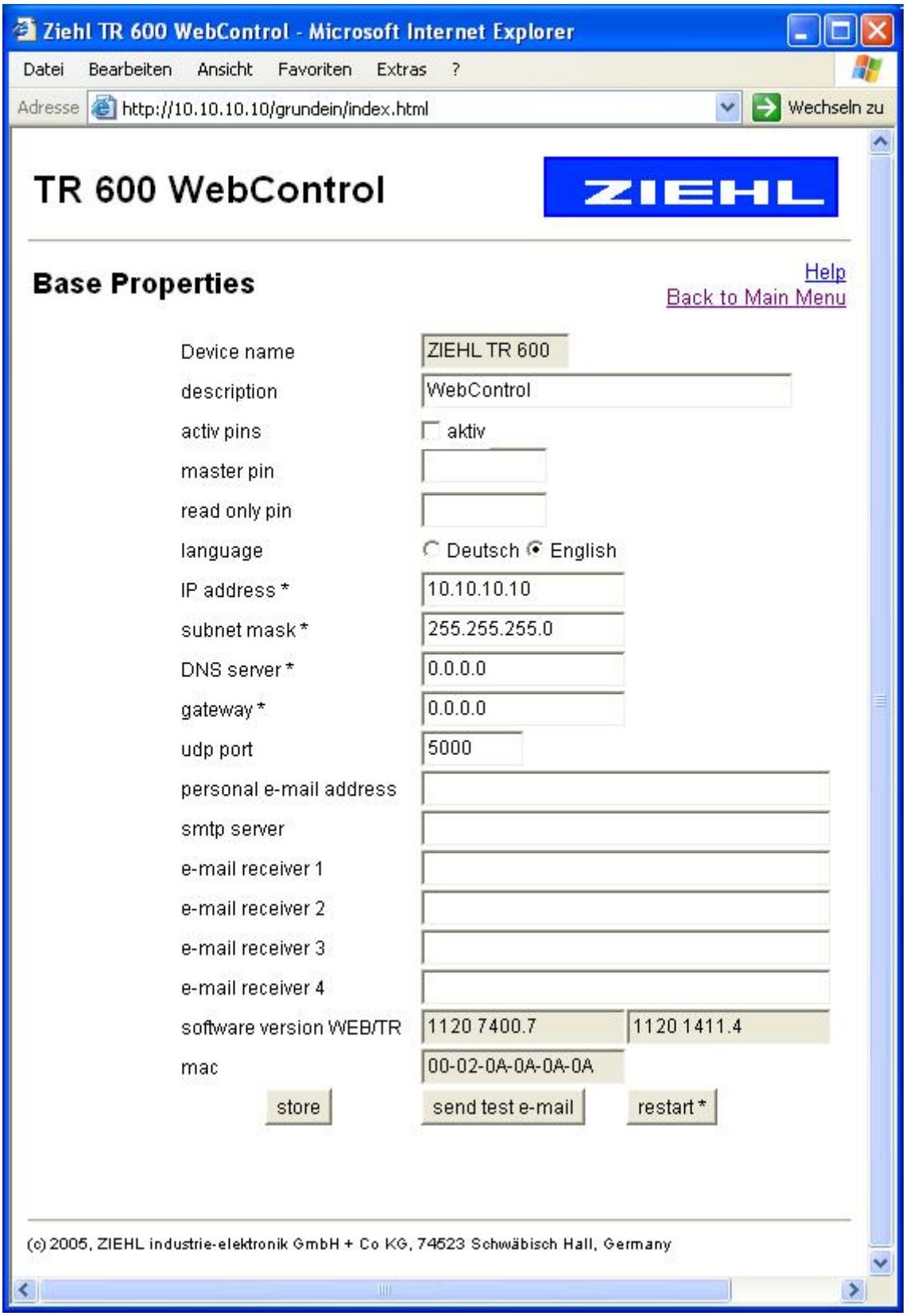
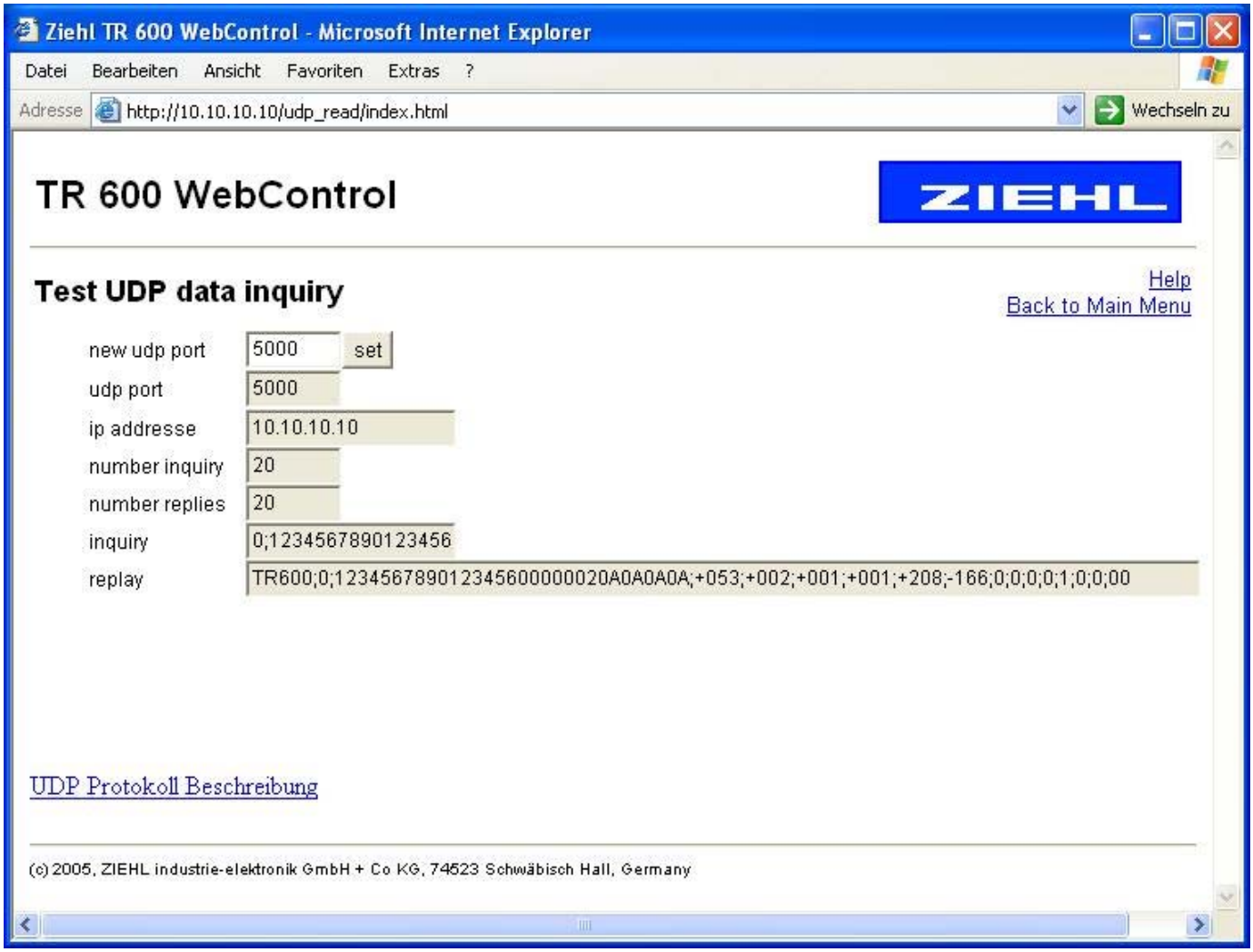


In the Menu "Base Properties" the PIN can be activated. Subsequently the authentication asks for the actual PIN. Subsequently the Main menu appears with display of authrization (read ony or read + write = master PIN). With authorization for read + write the access-data can be changed.

Test UDP data inquiry



The temperatures of the sensors and the states of the alarms/relays can be read out via UDP-protocol. The applied UDP-port can be selected in the base properties.

UDP data inquiry protocol

		Transfer-format:	ASCII/Byte	Port: selectable
1.	Master calls for data Master sends request			
	Mode		0 .. 9 (ASCII)	1 Byte (+ hyphen ";")
	Additional data in Mode 0			
	Reference of request	Any data of the master. Those are sent back in the answer (e.g. number of sequence, time-stamp).	BYTE[16]	16 Byte
				Summe: 18 Byte
2.	TR 600 sends the requested data			
	TR sends answer			
	Type of device		TR600 (ASCII)	5 Byte (+ hyphen ";")
	Mode of utility-data		0 .. 9 (ASCII)	1 Byte (+ hyphen ";")
	Utility-data for mode 0			
	Reference of request	Copied reference of request of the received telegram of request	BYTE[16]	16 Byte
	ID od device	ASCII-string for definite marking of the device. 3 leading „0“ + MAC-adress e.g. „0000012E4000014“. MAC 00-12-E4-00-00-14	ASCII[15]	15 Byte(+hyphen ";")
	actual value sensor 1		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	actual value sensor 2		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	actual value sensor 3		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	actual value sensor 4		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	actual value sensor 5		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	actual value sensor 6		-199 .. +800 (ASCII) *1	4 Byte (+hyphen ";")
	alarm 1		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 2		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 3		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 4		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 5		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 6		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	alarm 7		0 .. 1 (ASCII)	1 Byte (+hyphen ";")
	internal error	00 = no error	00 .. 99 (ASCII)	2 Byte
				sum: 86 Byte

*1 Sensor-input not connected = "+980"
Sensor-short-circuit = "-999"
Sensor-break = "+999"

Example for programming:
Data are requested from TR 600, Mode 0:
0;1234567890123456
TR 600 answers:
TR600;0;12345678901234560000012E4000014;+154;-055;+268;+999;+980;
-999;1;0;0;1;0;0;1;00

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MODBUS TCP/IP

TCP port: 502
Max. number of TCP connections (max. TCP connections): 5
Modbus function-code: 03

Register Adresse (Address)	Name	Zugriff (Access)	Kommentar (Comment)
00	Sensor 1	R	Sensor-Temperatur (Temperature) -199 … 800 °C -999 Sensor Kurzschluss (short circuit) 999 Sensor Unterbrechung (interruption) 980 Sensor = nc nicht angeschlossen (not connected)
01	Sensor 2	R	
02	Sensor 3	R	
03	Sensor 4	R	
04	Sensor 5	R	
05	Sensor 6	R	
06	Alarm	R	Bit 0 = Alarm 1 Bit 1 = Alarm 2 … Bit 6 = Alarm 7 Bit 7 = 0
7	Fehler (error)	R	0 = kein Fehler (no error) Bit 0 = Sensor 1 Bit 1 = Sensor 2 … Bit 5 = Sensor 6 Bit 6-7 = 0 Bit 8 = Sensor Fehler (error) Bit 9 = Interner Fehler (internal error) Bit 10 = Interner Kommunikationsfehler / internally communication error Bit 11 = Modbus Fehler (error) Bit 12-15 = 0
08	Sensortyp 1	R	Sensoranschluss (Sensor connection) 0-253 = 2-Leiter 0-50,6 Ohm (2-wire) 254 = 3-Leiter (3-wire) 255 = nc: nicht angeschlossen (not connected)
09	Sensortyp 2	R	
10	Sensortyp 3	R	
11	Sensortyp 4	R	
12	Sensortyp 5	R	
13	Sensortyp 6	R	

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Authentication with PIN

After entering of master-PIN the main menu apperas with:
„(Access rights: read and write)“

After entering of read-only-PIN the main menu appears with:
„(Access rights: read only)“

When a wrong PIN is entered, an error is reported.

FTP-Server

Calling ftp://10.10.10.10

The ftp server starts always automatically and is always freely accessible in the default condition (IP=10.10.10.10) as a user "anonymous" with password "@" (also over Web browser). If a IP-address is configured and used, then access is permitted only to Users, which are listed in the file ftp_accounts.txt in the path /flash. There at present the entry user name is "ziehl", registered to password "tr600". This attitude can be changed on file level or will be supplemented by further user names.

With active PIN name and password were requested. Factory setting: name = ziehl; Password = tr600. Further names and passwords must be deposited in the file ftp_accounts.txt. Program - updates: The file Project.hex must be replaced by a new version.

This and other operating manuals, as far as available also in other languages, you find on our homepage:

www.ziehl.com

More products of our programme (see **www.ziehl.de** for details):

Temperature Monitoring

PTC-(thermistor)-relays, partially with UL-approval,
ATEX-approval and multiple inputs
PTC-relais for dry-type transformers
PTC-thermistor-sensors type Minika ®
Pt 100 (RTD) temperature relays and temperature sensors
for 1 to 6 sensor-inputs and 1 to 6
alarm outputs, also connectable to Internet
Safety temperature limiter according to EN 954-1
Temperatur-relays for thermocouples

Mains Monitoring

Phase monitor-relays
Voltage monitor-relays
Current relays (current yes/no) for current recognition
Electronic current transformers
(current yes/no or as measuring transducers with analogue or frequency-output)
Current-reölays (adjustable limits)
Frequency relays
Vector-step relay

Digital Panel Meters measuring devices for installation type MINIPAN ®

3 to 4 1/2 digits for most common inputs, with up to 2 limits/alarms, displays 7 to 100 mm, displays for mounting on DIN-rail

Switching Relays and Controls

Controls for suction plants
Frequency- and Speed-relays
Level-relays for conductive liquids
Twilight switches and light-sensors
Power supply units
Watchdog time-delay relay

MeasuringTransducers

for Pt 100 with or without galvanic separation
for thermocouples
for DC-voltage and current
for frequency
for resistance
Measuring point change-over switches

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