

# Safety Temperature Limiter STL 50Ex

**Certified to DIN EN 14597 (replaces DIN 3440)**

**SIL2**

## Features

- For use as:
  - STB** Protection - temperature limiter
  - ASTB** Exhaust gas - protection - temperature limiter
  - STW** Protection - temperature monitor
- Certified according to EN 61508 SIL2
- Input intrinsically safe acc. to  
 ATEX II (1) G [Ex ia] IIC/IIB or ATEX II (1) D [Ex iaD]  
 Certificate No. TÜV 07 ATEX 554295  
 Pt100, 3-wire circuit or double thermocouple J, K, N, S
- Temperature limit value and switching hysteresis programmable
- Basic accuracy < 0.5%, ±2 digits
- Reaction time ≤ 0.5 sec
- Alarm output 1 relay, SPDT
- Memory function for error report
- Operation-lock feature (password protection)
- Case for TS35 DIN rail mounting



## General

The STL50Ex safety temperature limiter is used where ever thermal processes must be monitored and the system must be transferred into a safe operational state in case of fault. If the permissible temperature limit value is reached, or if a fault occurs within the permissible temperature range on the monitoring equipment (sensor open, sensor short-circuit, failure of a component part in the device, fault in the software, failure or inadmissible value of the supply voltage etc.), the STL50Ex switches off without delay.

The alarm contact is activated, the LED ALARM on the front panel and the back-lighting of the display light up, and the error cause is indicated as plain text on the display.

In addition, there is a 24 V DC signal present on the terminals 17-18 for an external alarm signal.

## Brief description

Programming	The device is programmed using the front-sided buttons, in connection with the graphics display.
Operating modes	The device can be used as: <b>STB</b> → Maximum or minimum monitoring with lock Reset following removal of the fault through actuation of the front-sided button or externally connected pushbutton <b>ASTB</b> → As before, however for the monitoring of the exhaust gas temperature <b>STW</b> → Maximum or minimum monitoring without lock Reset automatically on return into the permissible range
Switching hysteresis	Always acts in the direction of safe range.
Error log memory	The last fault is stored as plain text and can be called up in the working level and deleted.
Temperature probe	⚠ The device may be operate only with temperature probes which are certified according to DIN EN 14597!

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## General notes!

Please read this manual attentive and take care to the country specific standards, safety requirements and accident prevention regulations. This document is part of the device and must stay at site at a easy accessible location for each user.

### 1 Mounting, starting up and operation

Mounting, starting up, operating and maintenance of the safety temperatur-limiter must effected from qualified personnel.

This device works without service. Opening is not permitted.

The valid standards and directives have to be strictly observed.

The EMV-directives must be fulfilled for the whole unit.


The technical datas (see page 3) are maximum values.


### 2 Interference resistance

This device fullfills the european standards with the EMC protection requirements for the industry. The indicated interference resistance is valid for the correct connection of this device according to the manual datas.

### 4 Warnings!

Warning notices are identified as following:

 Risk warning

 Important information

### 5 Reshipment

Following points have to pay attention to

- clean device
- operation description
- error description
- operating time if available
- address and contact person

### 6 Disposal

Material separation and utilisation is to be respected at disposal. The valid legal regulations and directives at this time, have to be considered.

## Technical data

### Power supply

Supply voltage : 230 V AC  $\pm 10\%$ , 115 V AC  $\pm 10\%$ , or 24 V DC  $\pm 15\%$

Power consumption : < 4 VA

Rated voltage : 250 V AC according to EN 60664-1,, between input/relay output/supply voltage, degree of pollution 2, overvoltage category III

Test voltage : 4 kV DC between input/relay output/supply voltage

CE-conformity : EN55022, EN60555, IEC61000-4-2/3/4/5/6/11/13

continue page 3

### Ambient conditions

Operating temperature : -10 ... 55 °C  
 Storage temperature : -30 ... 60 °C  
 Rel. humidity : < 95 %  
 Condensation : not permitted

⚠ Operation only in vibration less ambient

### Approvals

EN 14597:2005 : Title  
 : Temperature control devices and temperature limiters for heat-generating systems  
 EN 61508:2001 SIL2 : Functional security safety-related electrical/electronic/programmable electronic systems

The EC-Type Examination Certificate is posted @ internet: [www.martens-elektronik.de](http://www.martens-elektronik.de)

### Inputs

Explosion protection : ⚠ II (1) G [Ex ia] IIC/IIB or II (1) D [Ex iaD]  
 Certificate : TÜV 07 ATEX 554295  
**Pt100** : -100,0 ... 600,0 °C/-100 ... 600 °C, 3-wire, max. line resistance 4 Ω each line, sensor current <1 mA (non self heating)

### Data in case of an error

max. voltage (no load)  $U_0$  : 1.4 V  
 max. short circuit current  $I_0$  : 6 mA  
 max. power consumption  $P_0$  : 7 mW  
 min. internal resistance R : 1.6 kΩ (characteristic curve trapezoidal)

	Ex	ia/IIB	ia/IIC
max. external capacity	:	110 μF	28 μF
max. external inductivity	:	100 mH	20 mH
internal capacity	:	negligible	
internal inductivity	:	negligible	

### Thermocouple

Type J : Fe-CuNi in the range -100.0 ... 800.0 °C/-100 ... 800 °C  
 Type K : NiCr-Ni in the range -150 ... 1200 °C  
 Type N : NiCrSi-NiSi in the range -150 ... 1200 °C  
 Type S : Pt10Rh-Pt in the range 0 ... 1600 °C  
 cold junction compensation integrated

### Data in case of an error

max. voltage (no load)  $U_0$  : 0.7 V  
 max. short circuit current  $I_0$  : 2 mA  
 max. power consumption  $P_0$  : 1.5 mW  
 min internal resistance R : 5 kΩ (characteristic curve trapezoidal)

	Ex	ia/IIB	ia/IIC
max. external capacity	:	240 μF	54 μF
max. external inductivity	:	100 mH	50 mH
internal capacity	:	negligible	
internal inductivity	:	negligible	
Basic accuracy	:	< 0.5 %, ±2 digit	
Temperature coefficient	:	0.01 %/K	

**Display** : Graphic LCD display with 128 x 64 pixels, with white back lighting

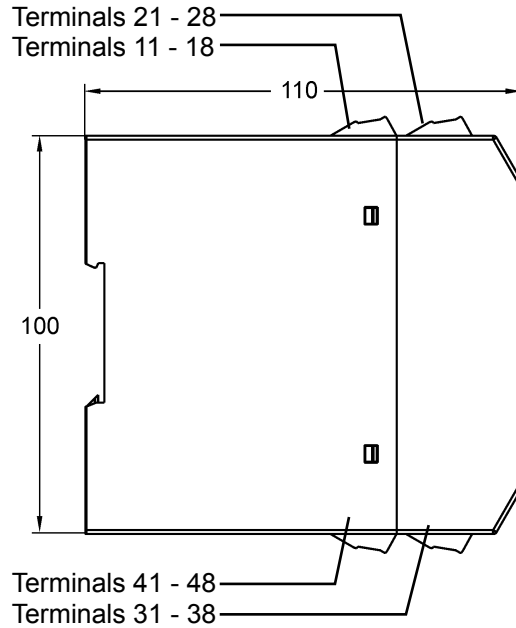
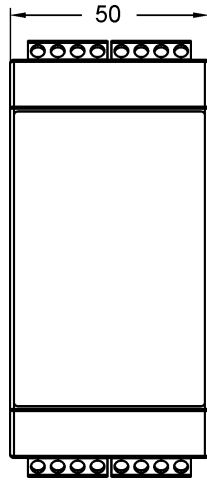
### Output

Relay : SPDT < 250 V AC < 200 VA < 2 A  $\cos \varphi \geq 0.7$ ; < 250 V DC < 80 W < 2 A  
 Protected internally with secondary fuse 2 A, delayed

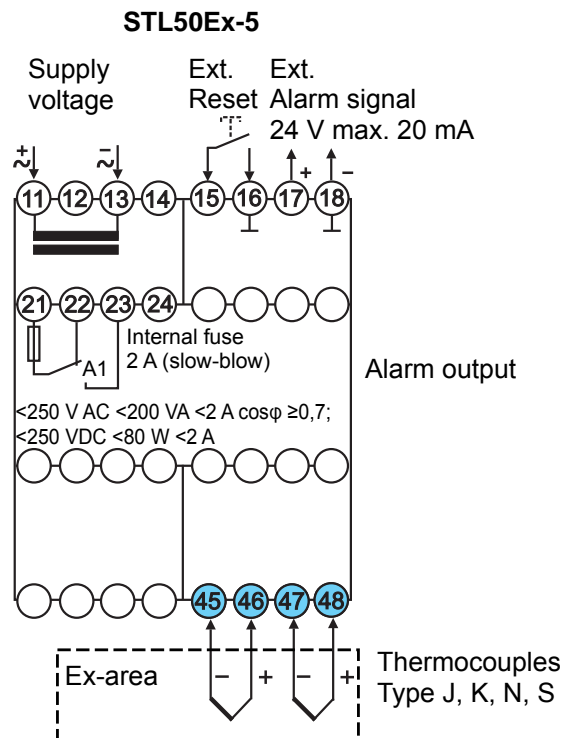
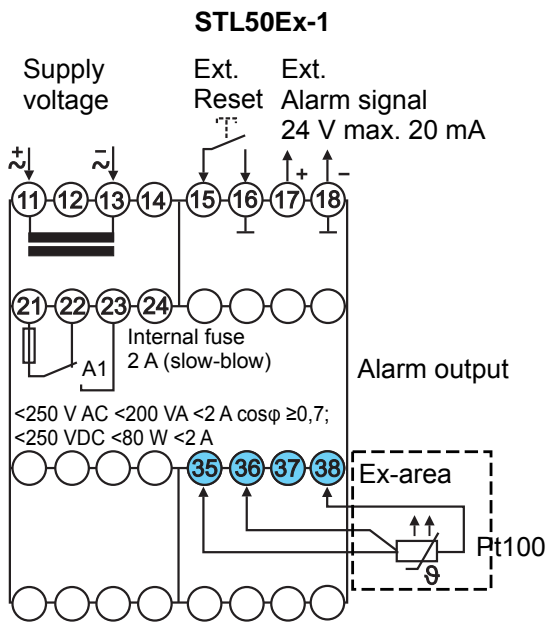
**Case** : Polyamide (PA) 6.6, UL94V-0  
 DIN rail mounting TS 35 acc. to DIN EN 50022

Weight : Approx. 450 g  
 Connection : Screwed terminals 0.14 ... 2.5 mm<sup>2</sup> (AWG 26 .. 14)  
 Protection type : IP20, DIN EN 60529, German BGV A3

## Dimensions



## Connection diagram



### ⚠ Input Pt100:

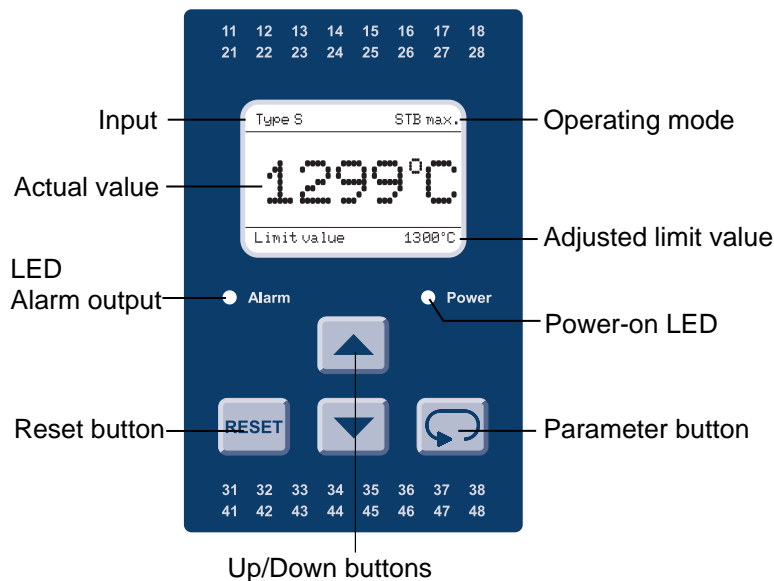
The maximum line resistance may not exceed 4 Ω each line. The corresponding line length for copper is stated in the table.

For other cable materials and cross sections, the values must be new calculated.

Max. cable length for copper cable


Cross section	max. length
0.14 mm <sup>2</sup>	32 m
0.25 mm <sup>2</sup>	58 m
0.5 mm <sup>2</sup>	116 m
0.75 mm <sup>2</sup>	174 m
1 mm <sup>2</sup>	232 m
1.5 mm <sup>2</sup>	348 m



## Operating and display elements



### Description

The operation of the device is implemented in 2 levels.

The required parameter is called up with the button .

The selection within a parameter and the setting-adjustment of a value is implemented with the buttons  and .


Button combinations (press buttons simultaneously):





1 parameter back



Parameter is set to "0" or minimum value.

After switching on the supply voltage, the device initializes itself. In the display the message indicating device type and software version is shown. After the initialization, the device is running in the working level and the current temperature, as well as all safety-relevant adjustments, are displayed. The peak value storage is called up by short activation of the button .

The configuration level is called up by activation of the button  for 2 seconds. In this case, all parameters which determine the properties of the device are programmed. In order to reach the security area of the configuration level, a password must be entered. If an incorrect password is entered, this appears as an error report in the display. After this signal, or even if no password has been entered, the skip-back into the working level is implemented. After entering an incorrect password three times, a security time of 60 minutes will elapse. The remaining security time is indicated in the display. With input of the correct password, the security area becomes accessible. Here adjustments can be carried out which must be protected against unauthorized change. After the last menu item, or if no button is pressed for longer than 2 minutes, a skip-back into the working level is implemented automatically and the current measured value is indicated in the display. The configuration level can be exited at any time by holding down button  for 2 seconds.

### Error reports

In case of occurring faults, the messages are shown on the display in plain text. This simplifies the location of the error.

### Operational startup reference!

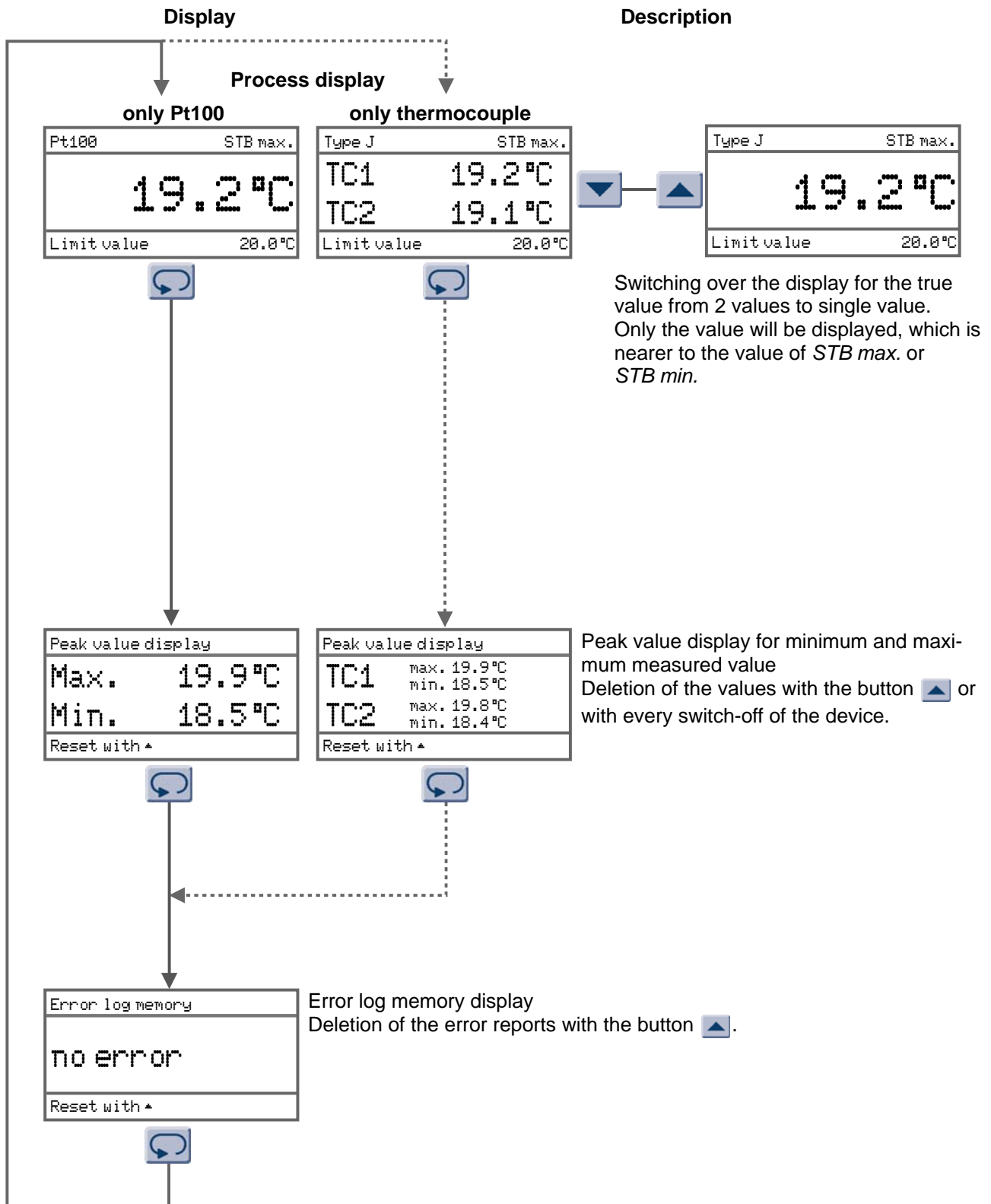
The device is preset with an ex-works default setting. Therefore it must be adapted to each special application. See Page 7.

### Requirements

- It is necessary to keep the conditions of the ATEX EC-Type Examination Certificate.
- The device must be installed in dry and good monitored rooms.
- If the intrinsic safety input is connected to the dust and dangerous area of zone 20 or 21, it has to be ensured that the corresponding devices in this circuit have the requirements of category 1D or 2D.
- Repairing and design modifications are only allowed at works.

## Working level

ⓘ Note: In the working level only the resetting of the peak value storage is possible



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### Note on the representation

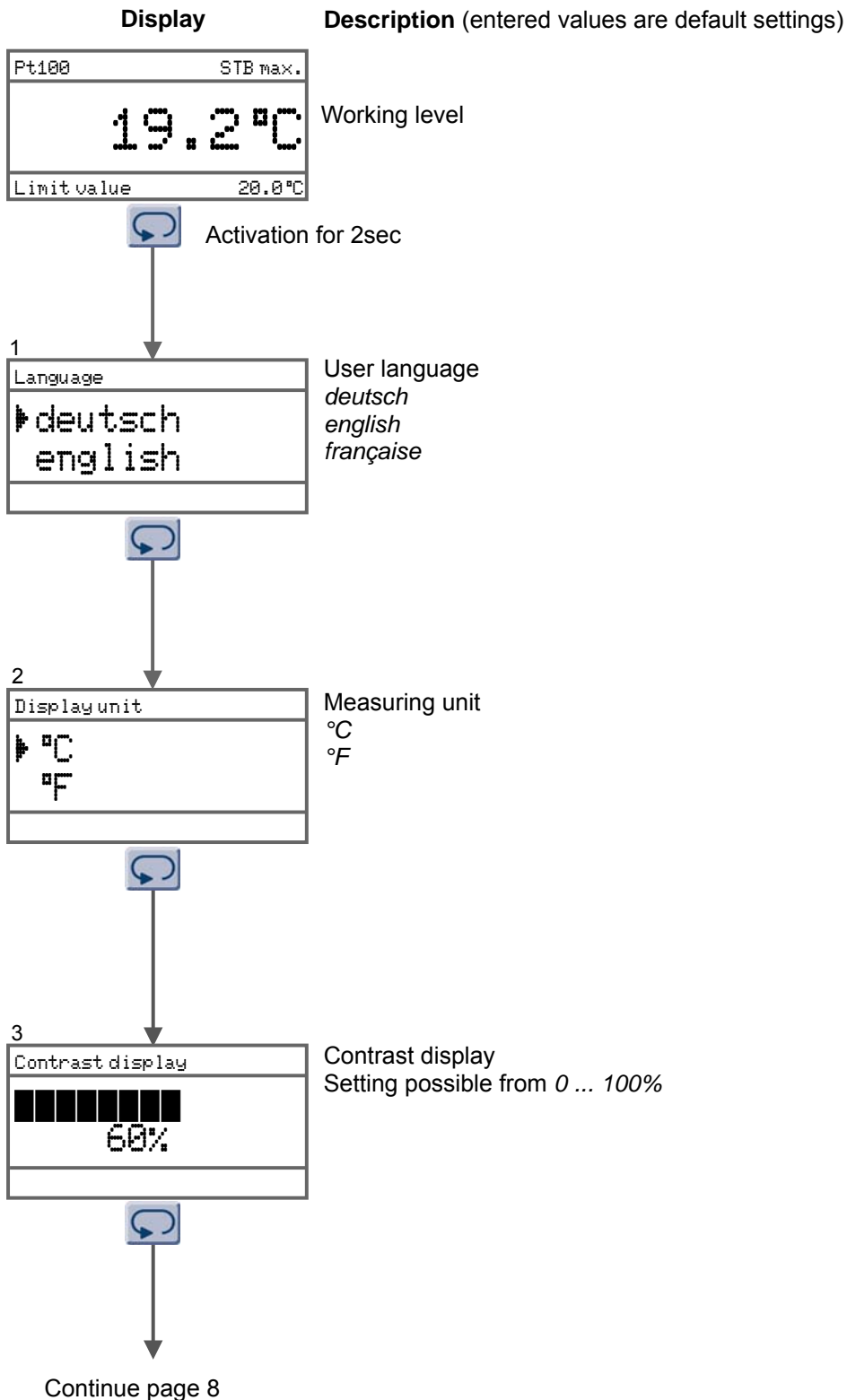


Parameter appears only with corresponding configuration



Parameter appears only with corresponding equipment version

### Configuration level



### Display

4

Enter password

0010

for safety area

Input of the password for the security levels  
 (in the delivery condition 0010)

⚠ Following three inputs of an incorrect password, a security time of 60 minutes will elapse. On entering 0000 and active password protection, a skip-back into the working level is implemented.

### Safety area

5

Change password

! 0010 !

Please note

Change password  
 Setting possible from 0000 ... 9999

⚠ **Caution:**  
 Note password. Resetting to 0010 can take place at works only!

6

Input

Type J

Type K

Thermocouple 2x type J

Input	
Type J	Double thermocouple Fe-CuNi
Type K	Double thermocouple NiCr-Ni
Type N	Double thermocouple NiCrSi-NiSi
Type S	Double thermocouple Pt10Rh-Pt

7

Display

without

with

Decimal place

Decimal point (only in case of input Pt100 and thermocouple Type J)

<i>without</i>	No decimal point
<i>with</i>	One decimal point

8

Sensor correction

0.0 °C

Measure value correction  
 Setting possible from  
 -10°C (-10.0°C) ... 10°C (10.0°C)

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## Display

## Description (entered values are default settings)

9

Operating mode
STB max. STB min.
Safety temp. limiter

**Reference:** Select the STB operating mode for ASTB

Display	Operating mode	Alarm function
STB max.	Safety-temperature limiter;	max
STB min.	Safety-temperature monitor;	min



Description:

**max:**

Relay is deactivated in case of *Overshooting* of the set-adjusted limit value

**min:**

Relay is deactivated in case of *Undershooting* of the set-adjusted limit value

10

Limit value
20.0 °C
Alarm output

Limit value (set point ) alarm output  
Setting possible in the corresponding measuring range



11

Hysteresis
2.0 °C
Alarm output

Hysteresis alarm output  
Setting possible from 1 °C (0.1 °C) ... 100 °C (100.0 °C)



12

Max. Temp.-difference of the thermocouples
40.0 °C

Measuring value difference of the thermocouples  
Setting possible from 1 °C (1.0 °C) ... 5% up to the end value of the programmed thermocouple.



13

Backlight
AUTO ON
Display

Display backlight

**AUTO** The backlight turns off after 2 min. **only** without button action. At error and switching off the relays the backlight turns on and remains in place.

**ON** The backlight is permanent active.



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**Display**

**Description** (entered values are default settings)

14

Function reset button
OFF
▶ ON
front side

Function reset button front side  
 OFF button blocked  
 ON button active



15

Parameter lock
▶ OFF
ON
Configuration level

Parameter lock for configuration level.  
 OFF no parameter locked  
 ON parameter locked



Pt100	STB max.
19.2°C	
Limit value	20.0°C

Return to the working level

## Error reports

Display	Description			
<table border="1"> <tr><td>Caution!</td></tr> <tr><td>Suppl. voltage too low!</td></tr> <tr><td>Please check</td></tr> </table>	Caution!	Suppl. voltage too low!	Please check	The supply voltage does not reach the value which is required for secure function of the STL50.
Caution!				
Suppl. voltage too low!				
Please check				
<table border="1"> <tr><td>Caution!</td></tr> <tr><td>Parameter locked</td></tr> </table>	Caution!	Parameter locked	The parameter cannot be changed, because the parameter lock for the configuration level is switched on.	
Caution!				
Parameter locked				
<table border="1"> <tr><td>Caution!</td></tr> <tr><td>Incorrect password</td></tr> <tr><td>1. unsuccessful attempt</td></tr> </table>	Caution!	Incorrect password	1. unsuccessful attempt	An incorrect password was entered for the security area. After 3 seconds a skip-back to the password input is implemented.
Caution!				
Incorrect password				
1. unsuccessful attempt				
<table border="1"> <tr><td>Sequence</td></tr> <tr><td>49min 30s</td></tr> <tr><td>Safetay time</td></tr> </table>	Sequence	49min 30s	Safetay time	Following three incorrect entries, a security time of 60 minutes will elapse.
Sequence				
49min 30s				
Safetay time				
<table border="1"> <tr><td>Thermocouples</td></tr> <tr><td>Broken line</td></tr> <tr><td>Please check</td></tr> </table>	Thermocouples	Broken line	Please check	A broken line was detected at the connecting terminals to the thermocouples. Check connection of the thermocouples.
Thermocouples				
Broken line				
Please check				
<table border="1"> <tr><td>Thermocouples</td></tr> <tr><td>Measured val. &gt; XXX °C</td></tr> <tr><td>Please check</td></tr> </table>	Thermocouples	Measured val. > XXX °C	Please check	The measured value exceeds the maximum temperature for the selected thermocouple.
Thermocouples				
Measured val. > XXX °C				
Please check				
<table border="1"> <tr><td>Thermocouples</td></tr> <tr><td>Measured val. &lt; XXX °C</td></tr> <tr><td>Please check</td></tr> </table>	Thermocouples	Measured val. < XXX °C	Please check	The measured value falls below the minimum temperature for the thermocouple.
Thermocouples				
Measured val. < XXX °C				
Please check				
<table border="1"> <tr><td>Pt100</td></tr> <tr><td>Short circuit</td></tr> <tr><td>Please check</td></tr> </table>	Pt100	Short circuit	Please check	A short circuit was detected at the terminals of the Pt100. Check connection lines and Pt100 sensor.
Pt100				
Short circuit				
Please check				

Continue page 9

## Error reports

Display	Description			
<table border="1"> <tr><td>Pt100</td></tr> <tr><td>Broken line</td></tr> <tr><td>Please check</td></tr> </table>	Pt100	Broken line	Please check	A broken line was detected at the terminals of Pt100. Check connection lines and Pt100 sensor.
Pt100				
Broken line				
Please check				
<table border="1"> <tr><td>Pt100</td></tr> <tr><td>Measured val. &gt; 650 °C</td></tr> <tr><td>Please check</td></tr> </table>	Pt100	Measured val. > 650 °C	Please check	The measured value exceeds the maximum temperature for Pt100 sensor.
Pt100				
Measured val. > 650 °C				
Please check				
<table border="1"> <tr><td>Pt100</td></tr> <tr><td>Measured val. &gt; -120 °C</td></tr> <tr><td>Please check</td></tr> </table>	Pt100	Measured val. > -120 °C	Please check	The measured value falls below the minimum temperature for Pt100 sensor.
Pt100				
Measured val. > -120 °C				
Please check				
<table border="1"> <tr><td>Interner Fehler</td></tr> <tr><td>Device temperature</td></tr> <tr><td>Please check</td></tr> </table>	Interner Fehler	Device temperature	Please check	The internal temperature of the device has determined an inadmissibly high or low value. Check installation requirements and ambient temperature of the device.
Interner Fehler				
Device temperature				
Please check				
<table border="1"> <tr><td>Fatal error</td></tr> <tr><td>Memory error</td></tr> <tr><td>Replace device</td></tr> </table>	Fatal error	Memory error	Replace device	The monitoring of the program and main memory has resulted in a fault. The device must be checked in the works.
Fatal error				
Memory error				
Replace device				
<table border="1"> <tr><td>Fatal error</td></tr> <tr><td>Hardware error</td></tr> <tr><td>Replace device</td></tr> </table>	Fatal error	Hardware error	Replace device	An abnormality has been detected during internal voltage. The device must be checked in the works.
Fatal error				
Hardware error				
Replace device				
<table border="1"> <tr><td>Fatal error</td></tr> <tr><td>Relay fault</td></tr> <tr><td>Replace device</td></tr> </table>	Fatal error	Relay fault	Replace device	A fault position of the relay contacts has been determined. The device must be checked in the works.
Fatal error				
Relay fault				
Replace device				

## Functional safety

The STL50Ex safety temperature limiter was developed according to the specifications of IEC 61508. This standard describes the functional safety of safety-related programmable electrical and electronic systems.

The device corresponds to a subsystem of Class B, with the requirement Level SIL2 (single-channel). The safety function of the device refers to the recording and evaluation of the temperature, and the contact position of the built-in relay automatically resulting from that.

### Safe status

The safe status of the device is given only in the initial position of the relay (closed-circuit current mode). If the internal diagnostics system identifies a fault, the relay assumes the initial position. The make-contact is therefore to be employed for linking the relay change-over switch into the monitoring equipment.

### Temperature detector

Connected temperature probes are monitored for circuit break or short circuit. In case of thermocouples, this is only possible with double thermocouples due to physical conditions. It is not permitted to employ single thermocouples and to switch the inputs in parallel through jumpers. If separate sensor fittings are employed, these must be mounted directly next to each other, so that they both record the same temperature.

### Malfunction and fault case

If a fault case results in the system, the cause must be eliminated immediately. If the safety temperature limiter STL50Ex is taken out of operation for this purpose, the process is to be assured in another manner. If there is a device error, we request that you return it to the works with a brief error description.

<b>Safety-technical key indicators of the Functional Safety STL 50Ex</b>			
Safety-related output signal		Relay output	
Test standard		IEC 61508	
Testing authority		TÜV NORD CERT GmbH	
SIL		2	
System		Type B	
		Input	
		Pt100	Thermo couple
$\lambda_{SD}$	(Rate of detected harmless failures)	1740 FIT	1740 FIT
$\lambda_{SU}$	(Rate of non-detected harmless failures)	601 FIT	542 FIT
$\lambda_{DD}$	(Rate of detected dangerous failures)	741 FIT	742 FIT
$\lambda_{DU}$	(Rate of non-detected dangerous failures)	127 FIT	109 FIT
		(1 FIT = 1 failure / 10 <sup>9</sup> h)	
Content of harmless failures (SFF)		96 %	97 %
Average probability of a failure (PFDavg)		$3.76 \times 10^{-3}$	$2.95 \times 10^{-3}$
Probability of one failure per hour (PFH)		$1.27 \times 10^{-7}$	$1.09 \times 10^{-7}$
Effective service life of the safety function		10 years	

## Functional test

During operation of a device with a high requirement rate, i.e. in case of process-conditional frequent addressing of the device, additional function tests can be dispensed with, in accordance with IEC 61508. This also applies for an operation with a low requirement rate, i.e. in case of process-conditional infrequent addressing of the device. The probability of a failure is very small for 10 years of service life according to SIL2 (see table Page 13).

For a function test, the temperature probe is simulated with a simulator.  
In case of thermocouples, the inputs may be switched in parallel.

The test begins with the verification of the temperature monitoring. The relay must be active in the approved range.

The following are then tested:

- Agreement of the temperature indicated on the STL50ExEx display with that of the simulator for every test stage
- The alarm function in case of leaving the approved temperature range
- The alarm function in case of sensor open (every line disconnected) and sensor short-circuit.

A correct alarm function of the STL50Ex exists in the following cases:

- The relay is deactivated and the contact occupies the initial position of rest
- The respective fault is indicated correctly as plain text in the display
- The LED alarm on the front panel of the STL50Ex lights up
- A voltage of 24 V DC for an external alarm is present on Terminals 17 and 18.

After the temperature has been changed with the simulator into the approved range again, a correct function of the STL50Ex exists when the following occur in the operating mode safety temperature limiter.

- the relay is again activated only after the front-sided RESET button or
- an external RESET button has been activated,
- after that, the display indicates the normal operating data,
- the LED alarm on the device front of the STL50Ex lights up and
- there is no further voltage on Terminals 17 and 18.

if, in the safety temperature monitor operating mode, the following are implemented

- the relay is activated without the front-sided RESET button or an external RESET button being activated,
- the display indicates the normal operating data,
- the LED alarm on the device front of the STL50Ex get lightless and
- there is no further voltage on Terminals 17 and 18.

### **Caution!**

- If the relay is not deactivated during the test stages, or the temperature and/or error cause are not indicated correctly in the display, the STL50Ex must be returned to the works for verification.
- In the meantime, the system must be maintained in a secure status by other means.

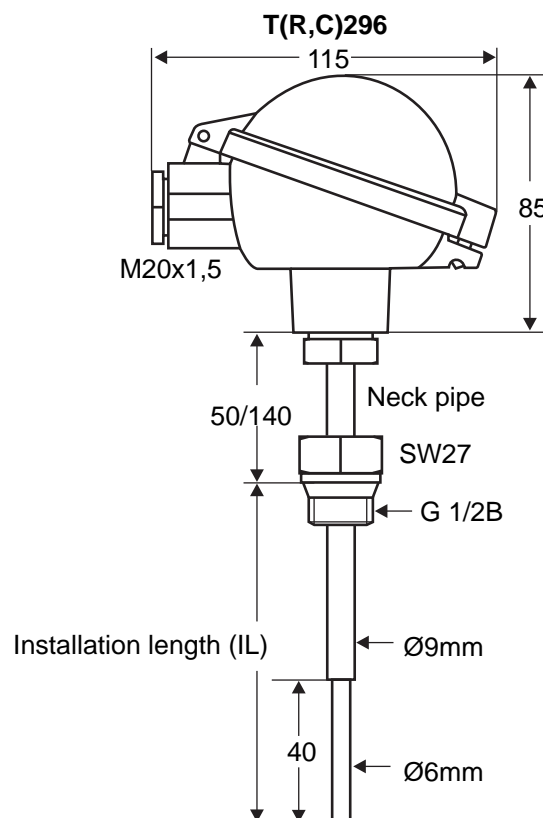
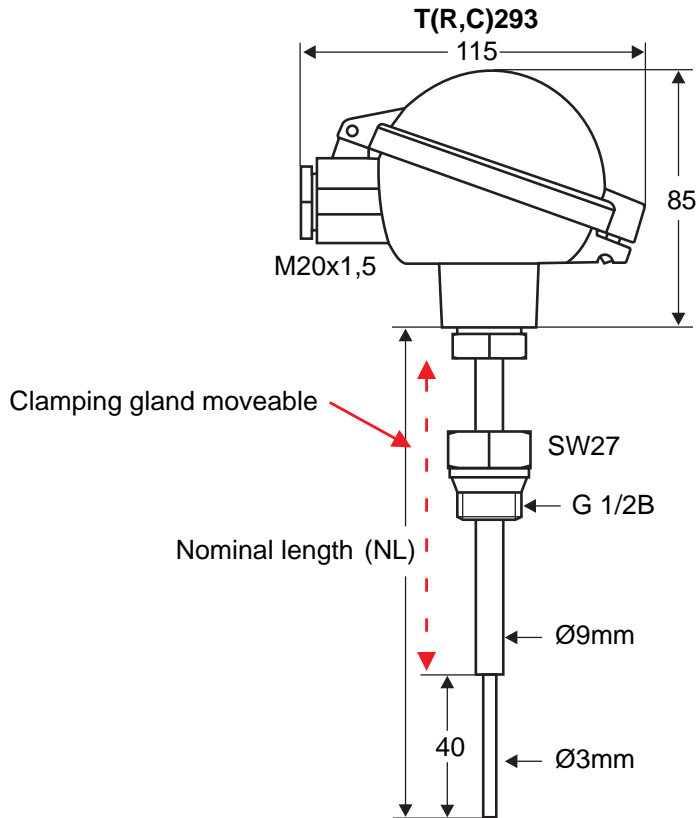
### **Special information!**

- The STL50Ex safety temperature limiter must be installed in a switchgear cabinet with protection type IP40 at least.
- Tension relief of the connecting line(s) from the temperature probe is to be provided.
- To assure the internal device protection of the STL50Ex, protection of the monitoring circuit with an external fuse (a maximum of 1.6 A semi-time-lag) is recommended. In case of triggering the internal fuse, the device must be returned to the works for repair!

## Certified probes

Pt100  
Thermocouples

Safety-temperature probes TR293; TR296  
Safety-temperature probes TC293; TC296



## Ordering code:

STL50Ex -  1. -  2. -  3. -  4.

### 1. Input

1	Pt100, 3-wire connection	-100.0 ... 600.0 °C/-100 ... 600 °C
5	Thermo couples	
	J (Fe-CuNi)	-100.0 ... 800.0 °C/-100 ... 800 °C
	K (NiCr-Ni)	-150 ... 1200 °C
	N (NiCrSi-NiSi)	-150 ... 1200 °C
	S (Pt10Rh-Pt)	0 ... 1600 °C

### 2. Output

1R	1 Alarm output relay
----	----------------------

### 3. Supply voltage

0	230 V AC	±10 %	50-60 Hz
1	115 V AC	±10 %	50-60 Hz
5	24V DC	±15 %	

### 4. Option

00	without option
----	----------------