Temperature

Thermostats · Temperature transmitters · Hygrostats

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Electronic thermostats

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Smart Temp

Electronic Thermostats

Smart Temp

Applications

Smart Temp electronic thermostats are used wherever it is necessary to carry out special monitoring tasks combined with switching functions. They are the optimum solution for replacing thermometers with limit contacts. The device is ideal for two-stage temperature control. Smart Temp is therefore highly suitable for temperature control in mechanical and plant engineering, fluidics, process engineering and pneumatics, and for monitoring and control of heating systems, climatic cabinets, ovens, and cooking systems. Thanks to its open-ended sensor technology, the range of applications is growing all the time. In the **TST…-R** version, potential-free switching signals are output via a relay contact. A convenient and configurable analogue output transmits critical process temperatures to measurement and control systems. With an **overall accuracy of 0.5%** of full scale, these electronic thermostats are also suitable for monitoring measurements in laboratory applications. Models with built-on sensors for a temperature range of **-50°C....+200°C** and models with external Pt 1000 sensors for a temperature range of **-50°C....+400°C** are available.

Please let us know if you have special sensor requirements.

Technical data

Measuring ranges	-50°C…+400°C	
Ambient temperature	-20°C…+60°C	
Storage temperature	-35°C…+80°C	
Relative air humidity	0…95% non-condensing	
Overall accuracy	0.5% of full scale	
Weight	Depends on model	
Parts in contact with medium	Built-on sensors: 1.4571, external sensors: depends on model	
Process connections	Standard built-on sensor	G 1/2" external thread
	External sensor	M8 plug according to DIN IEC 60947-5-2
Electrical connections	TS and TST versions	5-prong M12 plug, as per DIN IEC 60947-5-2 (available as accessory)
	TST…-R versions	Additional 3-prong M12 plug, as perDIN EN 50044 (available as accessory)
Sensor element	PT 1000 Class A	
Protection class	II as per EN 60335-1	
Protection type	IP65 as per EN 60529	
Climate class	C as per DIN EN 60654	
Power supply	14…36 VDC	
Outputs	2 open-collector outputs	250 mA at 16…36 VDC
		Configurable as high-side/low-side or push-pull switches
	Switching differential	(SP and RP) selectable via software
Relay outputs (TST...-R)	Permissible resistive load	250 VAC, 5 A
	Permissible inductive load	250 VAC, 0.8 A (200 VA)
	Contact type	1 changeover contact (1 x UM)
	Maximum service life	100,000 switching cycles
Warning output	Output configuration	Warning output on plug 2 max. 20 mA, 16...36 VDC
Transmitter output	Voltage/current	0 -10 V and 4…20 mA, configurable in expert mode
Housing and cover	Polybutylene terephthalate (PBT-GF30), resistant to chemicals and stress cracking	
Display screen cover	Polycarbonate (PC)	

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Functions

The 2 switch outputs can be configured as:
· Minimum thermostat, maximum thermostat or temperature window monitor
· Normally closed or normally open, high-side or low-side switching or as a push/pull output
· Relay output assigned to channel 1 or 2 or to the warning output (in the case of TST…-R)

Configuration of the analogue output:
· 0 - 10 V, 4 - 20 mA or 10 - 0 V and 20 - 4 mA
· Analogue measuring range can be limited to 20% of the total measuring range
· Choice of temperature units (°C or °F)

Smart Temp display functions:
· 4-digit digital display with bar graph for temperature, settings and set parameters
· 2 three-colour LEDs showing the switching state of the outputs, implausible settings and as warning
  status indicator

Electrical connection:
· 2 five-prong M12 plug connections for power supply, switch outputs and analogue output
· 1 three-prong M12 plug connection for relay output
· Sensor connection: 1 three-prong M8 plug connection for Pt 1000 Class A sensors
  (for all TST... EPT series)

Plus:
· Switch on/off delay of 0-3600 sec.
· Temperature simulation mode, two-stage locking code, restore function
· Warning function for implausible switching points, cable break, overload and overheating of the
  device
· Demo mode

Ordering data
Electronic thermostats

Temperature range	Sensor immersion depth mm	Max. pressure "at sensor" in bar	Sensor design	Type, switch and transmitter	Type, switch, transmitter and relay
-50°C…+50°C	100	100	Built-on	TST050G12100	TST050G12100-R
-50°C…+50°C	250	100	Built-on	TST050G12250	TST050G12250-R
-50°C…+200°C	100	100	Built-on neck-tube	TST200G12100	TST200G12100-R
-50°C…+200°C	250	100	Built-on neck-tube	TST200G12250	TST200G12250R
-50°C…+200°C	n.a.	n.a.	External Pt 1000	TST200EPT1K	TST200EPT1K-R
-50°C…+400°C	n.a.	n.a.	External Pt 1000	TST400EPT1K	TST400EPT1K-R

External sensors Pt 1000 Class A

Temperature range	Sensor immersion depth mm	Max. pressure "at sensor" in bar	Sensor design	Type
-50°C…+400°C	100	100	External sensor	P2-TVS12-400100
-50°C…+400°C	250	100	External sensor	P2-TVS12-400250

TST…EPT… Supplied **inclusive of wall mounting kit AST1**.

· Seal to DIN 7603
· Screw-in connector
  to DIN 3852-2 Form A

Installation guide
Screw-in connectors to DIN 3852-2, Form A are sealed with seals to DIN 7603.

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D e f i n i t i o n s

Maximum temperature monitoring

If an output is configured as a maximum thermostat, the electronic thermostat monitors a programmed upper temperature limit. A switching process is triggered as soon as the temperature exceeds this limit.

Minimum temperature monitoring

If an output is configured as a minimum thermostat, the electronic thermostat monitors a programmed lower temperature limit. A switching process is triggered as soon as the temperature falls below this limit.

Temperature window monitoring

If an output is configured for temperature window monitoring, the electronic pressure switch monitors a programmed temperature window, i.e. the range between a defined lower limit and a defined upper limit. A switching process is triggered as soon as the temperature exceeds or falls below the limit.

Electronic thermostat

In contrast to mechanical thermostats where the temperature acts on a microswitch via an expansion system, an electronic thermostat evaluates the change in resistance of a Pt 1000 sensor. Whereas a mechanical thermostat can only perform simple switching functions, a Smart Temp electronic thermostat can be operated on one channel or several channels and even generate an analogue signal from the sensor evaluation.

Switch displacement

Illegal settings are automatically detected by the software. If the electronic thermostat is configured as a maximum thermostat, the switching point must lie above the reset point. If the user tries to set the reset point above the switching point, this is signalled by 2 red LEDs on the front of the housing. For an electronic thermostat configured as a minimum thermostat, the opposite applies.

Time Out function

"Time Out" refers to the time window in which values can be entered without the display automatically reverting to temperature display mode. For all settings at user level the setting window is 1 minute. This means that if the user does not enter anything for one minute during the setting process, the unit automatically reverts to display mode and shows the current temperature in the display, disregarding any values that have been entered but not saved. However, when the unit is in setting mode at expert level, this "Time Out" function is turned off. In other words, the display (and thus the unit) remain in setting mode until the settings are saved in expert mode.

Escape function

After entering a valid 4-digit code, the user is able to parameterise and configure the unit at user or expert level. However, the unit automatically reverts to the locked state if no adjustment activity takes place within 60 seconds. Any manipulation of the rotary/push button extends the setting time by a further 60 seconds. On returning to the locked state, the word "CODE" (instead of "EXP") appears in the corresponding screen. Once the correct code has been entered, the settings can be changed both in user mode and in expert mode. In expert mode it is also possible to change the code. While the unit is in expert mode, if values or settings are changed but not saved (with "SAVE"), the unit will remain in expert mode until a defined state is chosen with "SAVE" or "REST" (restore data). If the code is set to "0000" in expert mode and this state is saved (with "SAVE"), the unit remains in the unlocked condition. In this case the "Escape" function is disabled.

Switch on/off delay

In user mode, an on/off delay of 0 - 3600 seconds can be programmed. Unless a temperature variation lasts longer than the preset delay time, the device does not switch. This largely filters out brief and irrelevant temperature fluctuations, thereby making the control behaviour more stable.

Analogue output

All devices have a programmable analogue output. A 0-10 V- or 4-20 mA signal can be output over the whole nominal temperature range, or the range display can be limited to 20% of the nominal range. In this way temperature ranges can be observed "more closely".

Open Collector outputs

The "OUT1" and "OUT2" outputs are connected as configurable Open Collector outputs. The switching current range is limited to a maximum of 250 mA (short-circuit-proof). Overload is indicated as a warning signal in the display and signalled at the warning output.

Push/pull outputs

In expert mode, the "OUT1" and "OUT2" outputs can alternatively be configured as push/pull outputs. In this case the output behaves like a relay changeover contact. In other words, a defined potential is always present at the output — either a minus potential or a plus potential. In this situation there is no open contact, as with "Open Collector" outputs.
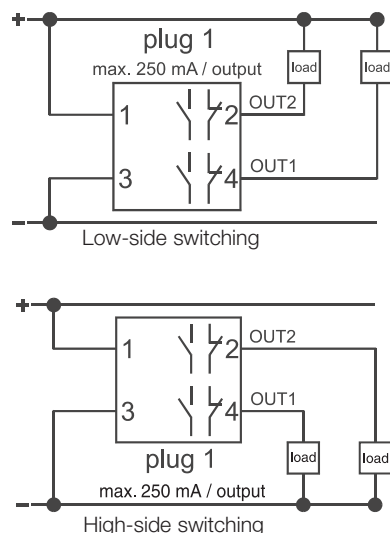
Demo mode

In Demo mode 1 it is possible to run through the whole nominal temperature range with a handwheel. In the process, switching and reset points can be checked and the system's reaction to switching signals can be tested with a "dry run". Demo mode 2 allows cyclical switching of outputs with a variable frequency. In this way you can test the system's ability to react.

Key to abbreviations:	
SP	Setpoint
RP	Resetpoint
DIG	Digital Incremental Switch
Aout	Analogue output
FSO	Full Scale Output
RSET	Reset
WIN	Window supervision
FCT1	Function channel 1
FCT2	Function channel 2
NO	Normally open
NC	Normally closed
FCTA	Function Output 420 mA
FCTV	Function Output 010 V
REL	Relay assignment
OC	Open Collector
UNIT	Pressure/Temperature unit
LED+	Display constant illuminated
LED-	Display Timeout 1 min
REST	Restore
INV	Inversion Analogue output
EXPL	Expert "Lock"
EXPN	Expert "Non-Lock"
ATT	Attenuation
NAVL	Not available

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Switch outputs

plug 1
max. 250 mA / output

OUT2
OUT1

Low-side switching

OUT2
OUT1

plug 1
max. 250 mA / output

High-side switching

Switch output OUT1 and OUT2

The switch outputs can be configured via the software (at expert level) both as normally closed / normally open, and as high-side and low-side switching.

In **normally closed configuration**, the selected voltage potential (earth or supply voltage) occurs at the output in the **unswitched** state.

In **normally open configuration**, the selected voltage potential (earth or supply voltage) occurs at the output in the **switched** state.

In the **low-side switching configuration**, the outputs switch the voltage potential 0V (earth) with respect to a consumer connected to OUT1 or OUT2.

In the **high-side switching configuration**, the outputs switch the supply voltage potential (minus approx. 2V) with respect to a consumer connected to OUT1 or OUT2.
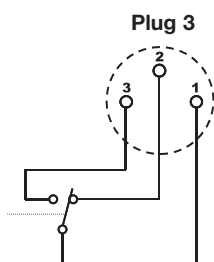
If the power supplies of the pressure switch and connected load are independent of one another, the following must be taken into account: The potential difference between OC output and earth and OC output and supply voltage must not exceed 36 VDC. If the configuration is "low-side switching", the external power supply must have the same earth reference as the device itself. If the device is defined as "high-side switching", the external power supply must be connected to the positive power supply of the device. It is important to note that the voltage drop in the through-connected state can be as much as 2 V. The maximum permitted current at the OC is 250 mA per switch output (OUT1, OUT2). A maximum switching current of 250 mA may flow through each channel.

The switching channels are short-circuit-proof and they are monitored for current and temperature. Where current limiting is used and on overheating, both LEDs light up red (WARN function).
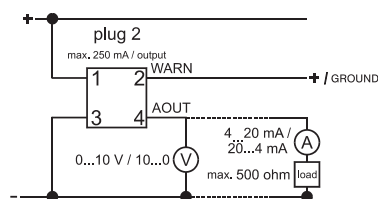
Relay output REL

The relay output is realised in version **TST…-R**. In expert mode the analogue output can be coupled via the software with output 1 (OUT1) and output 2 (OUT2), and with the WARN function. This means that the user can choose a potential-free output for these 3 important functions. The changeover contact of the relay is designed for a maximum resistive load of 4A and an inductive load of 200VA. At the lower end the 5µ gold-plated silver contacts are designed for a minimum load of 50 mW (5 V at 10 mA).

It should always be remembered that, after a one-off maximum load on the switching current side, the gold plating of the contacts is stripped so they can no longer be used for low-current and low-voltage applications.

Plug 3

Analogue output

plug 2
max. 250 mA / output
WARN
AOUT
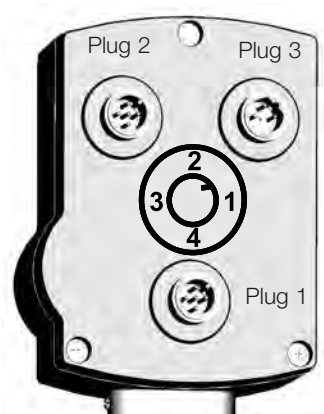/ GROUND
4...20 mA /
20...4 mA
0...10 V / 10...0 V
max. 500 ohm

Analogue output

The analogue output (AOUT) is available in versions TST and TST…-R. In expert mode it is configurable both as a 010 V/100 V, and as a 420 mA/204 mA output. The unit is supplied with the output configured for 0-10 V.

The input impedance of the connected consumer **must not exceed 500 ohms**.

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Electrical connection

Electrical connection and contact assignment
Electrical connection is via M12 plugs on the back of the unit.
Depending on the version, either 2 (TST) or 3 (TST…-R) M12 connector plugs are available
(not supplied with the unit).

Contact assignment on plug 1
Pin 1:   Supply voltage 14…36 VDC
Pin 2:   OUT 2 (output 2) open collector output
Pin 3:   0 volt (earth)
Pin 4:   OUT 1 (output 1) open collector output
Pin 5:   Serial interface (locked for calibration)

Special characteristic of open collector outputs
Depending on the design, the output voltage at open collector outputs can be up to 2.5 V lower than
the applied supply voltage.
Example: Supply voltage 14 V… Output voltage OUT 1 approx. 11.5 V.

Contact assignment on plug 2
All versions of series TST and TST…-R are also equipped with an A-coded M 12 plug.
Pin 1:   Supply voltage 14…36 VDC
Pin 2:   WARN (warning output max. 20 mA)
Pin 3:   0 V (earth)
Pin 4:   Analogue output AOUT
Pin 5:   Serial interface (locked for calibration)

Units of the TST series can be powered both via plug 1 and via plug 2. If the TST is used purely as a
transmitter, only one connection via plug 2 is needed, because the supply voltage can be connected
here too (see "Contact assignment on plug 1").

Contact assignment on plug 3
All versions of series TST…R are also equipped with a B-coded M 12 plug.
Pin 1:   Common contact
Pin 2:   Normally closed contact
Pin 3:   Normally open contact

Settings at user level

OUT1 SP   30.0
FSO   °C

Switch output OUT 1 and OUT 2
At user level, the switching point (SP) and reset point (RP) can be set across the entire nominal pressure range.
When the DIG (digital incremental sensor) is turned by one notch in the clockwise direction, the symbol "OUT 1" and "SP" appears. When the DIG is pressed, the "EDIT" symbol appears.
After that, any switching point can be selected by turning the DIG clockwise or anticlockwise. When you press the DIG again, "SAVE" is displayed. Press the DIG again to confirm. The chosen switching point is now permanently saved.
Turn it clockwise again to display the reset point (RP) symbol. The reset point (RP) is set in the same way as the switching point (SP).

Switch on/off delay
In user mode, an on/off delay of 0 - 3600 seconds can be programmed. If a temperature change lasts longer than the preset delay time, the device switches. If a temperature change lasts for a shorter time than the preset switch delay time, the device does not switch. This largely filters out brief and irrelevant temperature fluctuations, thereby making the control behaviour more stable.

Analogue output (AOUT)
Turning the DIG clockwise again opens the analogue output (AOUT) window. The screen displays the lower pressure value set (AOUT ZERO). Press the DIG to enter "EDIT" mode and then "SAVE" to save the lower reference value permanently.
Turn the DIG again to set "AOUT" "FSO". Here you can alter the upper reference value. The pressure value can be changed in the way described above.

Electronic slave pointer
Turn the DIG again to enter the display mode of the electronic slave pointer. The dotted arrow pointing to the left of the display and the shown temperature indicate the lowest temperature measured since the last reset, or since the device was switched on. Press the DIG again to go into edit mode and turn the knob one step clockwise to see how much time has passed since the lowest temperature was measured. Turning the knob again takes you to the reset (RSET) window. Press the knob to return the "clock" to zero.
Turning the DIG clockwise again takes you to the maximum temperature display screen. The dotted arrow pointing to the right of the display and the shown temperature indicate the highest temperature measured since the last reset, or since the device was switched on. Press the DIG again to go into edit mode and turn the knob one step clockwise to see how much time has passed since the highest temperature was measured. Turning the knob again takes you to the reset (RSET) window. Press the knob to return the "clock" to zero.

DEMO mode
In Demo mode 1 it is possible to run through the whole nominal temperature range by turning the handwheel. In the process, switching and reset points can be checked and the system's reaction to switching signals can be tested with a "dry run". Demo mode 2 allows cyclical switching of outputs with a variable frequency. In this way you can test the system's ability to react.

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Settings at expert level

Configuration of OUT 1 and OUT 2
The last menu item in user mode (EXP) allows you to enter expert mode (after entering a code if necessary). The screen shows the configuration of OUT 1 (e.g. as WIN monitor for temperature window monitoring). Press the DIG to enter edit mode (EDIT).
Output 1 can be configured as a minimum detector (left arrow), maximum detector (right arrow) or for pressure window monitoring (WIN). Press to confirm your selection and open the function screen (FCT1) of output OUT1. Press to enter edit mode (EDIT) and configure output 1 as normally open (NO), normally closed (NC), high-side or low-side switching or as a push/pull output. OUT 2 is configured in the same sequence, but note than output 2 can also be configured as a WARN output.

Configuration of analogue output (AOUT)
Turn the DIG clockwise again to open the configuration menu (AOUT). The screen shows either FCTA (current output) or FCTV (voltage output). In EDIT mode the analogue output can be configured as current or voltage output, or inverted.

Allocation of relay contact (on TST…-R versions only)
Turn the DIG clockwise again to enter the relay output configuration mode (REL). Press to switch to EDIT mode. Turn to apply the relay function to OUT1, OUT2 or the WARN output. The push/pull outputs are not affected by this. That is to say, the relay function should always be regarded as parallel to the corresponding output.

Setting temperature units to °C or °F
Turn the DIG clockwise again to enter the "UNIT" menu. Press and turn to select and confirm the desired temperature unit.

Setting a four-digit locking code
Turn the DIG clockwise again to enter the "CODE" menu. Press to enter EDIT mode, where you can enter and confirm a four-digit code between 0001 and 9999. **0000 is not a code.**

Factory calibration
Press the DIG to display the measured temperature. If a deviation from the actual temperature is apparent (e.g. temperature distorted due to difficulty of placing sensor), the factory calibration can be altered. The direction is indicated by arrows in the trend display. Both arrows visible at the same time means factory calibration status. The calibration can be altered in any temperature situation. However, you are strongly recommended to use a higher quality and more accurate method of measurement for the comparison.

Display lighting
In this input window you can change the display lighting from permanently lit (LED+) to lit only during input (LED-). In "LED-" mode the lighting stays on for a maximum of one minute, as long as the DIG is not moved. This lighting time starts again from the beginning every time the DIG is moved.

DEMO mode (see page 12 below)

Exiting expert level
Turn the DIG clockwise again to enter the "EXIT" menu. Press to go directly to display mode or to the SAVE menu (if any value has been modified). Here you can either confirm the new state with SAVE, or go back to the previous state (which existed before the modification) with REST (Restore).

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Overview of possible configurations and parameter settings

Activity / Situation	Indications in LCD display		Parameters modifiable in	
	Symbols	**Digital values/text**	**User mode**	**Expert mode**
Current temperature is displayed*				
Current temperature	▊▊▊▊▊▊▊▊▊▊▊▊▊ , relevant unit	relevant digital value		–
Output OUT 1 active	OUT 1			–
Output OUT 2 active	OUT 2			–
AOUT (temperature between ZERO and FSO)	AOUT			–
Rising temperature	▶			–
Falling temperature	◀			–
Alarm	WARN	digital value	No	No
Parameterisation of outputs OUT 1 (and OUT 2)*				
SP	▌, OUT1 (OUT2), SP	digital value	Yes	No
RP	▌, OUT1 (OUT2), RP	digital value	Yes	No
1. Window (WIN) setting	▌, OUT1 (OUT2), SP	digital value	Yes	No
2. Window (WIN) setting	▌, OUT1 (OUT2), RP	digital value	Yes	No
Configuration of outputs OUT 1 (and OUT 2)				
Maximum temperature monitor (SP>RP)	EXPERT, SP, RP, ▌▌▌▶	OUT1 (OUT2)	No	Yes
Minimum temperature monitor (SP<RP)	EXPERT, SP, RP, ◀▌▌▌	OUT1 (OUT2)	No	Yes
Temperature window monitoring (WIN)	EXPERT, WIN	OUT1 (OUT2)	No	Yes
Output 2 as "WARN" output	EXPERT, WARN	OUT2	No	Yes
Normally closed, low-side OUT 1 (2)	EXPERT, ⎯⎯⌐ , ZERO	FCT1 (FCT2)	No	Yes
Normally open, low-side OUT 1 (2)	EXPERT, ⎯⎯⌐ , ZERO	FCT1 (FCT2)	No	Yes
Normally closed, high-side OUT 1 (2)	EXPERT, ⎯⎯⌐ , FSO	FCT1 (FCT2)	No	Yes
Normally open, high-side OUT 1 (2)	EXPERT, ⎯⎯⌐ , FSO	FCT1 (FCT2)	No	Yes
OUT 1 (2) as "Push-Pull"	EXPERT, ⎯⎯⌐ , ZERO, FSO	FCT1 (FCT2)	No	Yes
OUT 1 (2) as inverted "Push-Pull"	EXPERT, ⎯⎯⌐ , ZERO, FSO	FCT1 (FCT2)	No	Yes
Parameterisation of analogue output*				
Starting point (ZERO)	▌, AOUT, ZERO	relevant digital value	Yes	No
Full-scale output (FSO)	▌, AOUT, FSO	relevant digital value	Yes	No
Configuration of the analogue output				
0…10 V voltage output	EXPERT, AOUT	FCTV	No	Yes
10…0 V voltage output	EXPERT, AOUT, INVΔ	FCTV	No	Yes
4…20 mA current output	EXPERT, AOUT	FCTA	No	Yes
20…4 mA current output	EXPERT, AOUT, INVΔ	FCTA	No	Yes
Configuration of the relay output				
Relay coupled with OUT1	EXPERT, OUT1	REL	No	Yes
Relay coupled with OUT2	EXPERT, OUT2	REL	No	Yes
Relay with alarm output	EXPERT, WARN	REL	No	Yes
Configuration units				
Unit	EXPERT,°C,°F	UNIT	No	Yes
Parameterisation of switching delay				
Type of switching delay	OUT1 (2), SP/RP, ATT	⌐⌐ or ⌐⌐ or ⌐⌐	Yes	No
Duration of switching delay	Bar graph, OUT1(2), ATT, s	digital value or OFF	Yes	No
Locking/unlocking the unit with a code (user and expert level)				
Unlocked (code = 0000)	–	EXP	Yes	No
Locked (code ≠ 0000)	–	CODE, digital value	Yes	No

* The same symbols that appear in expert mode are visible in user mode and show the current output configuration. Exceptions: if output is configured as max./min. detector, in user mode instead of ▌▌▌▶ or ◀▌▌▌, only ▶ or ◀ is displayed.

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Activity / Situation	Indications in LCD display		Parameters modifiable in	
	Symbols	Digital values/text	User mode	Expert mode
Changing a code				
Unit is locked	EXPERT	LOCK	No	Yes
Unit is unlocked	EXPERT	CODE	No	Yes
Locking of expert level separately (shortly after switching the unit on, press DIG until "V…" appears)				
Lock expert mode	EXPERT, EDIT	EXPL	No	Yes
Unlock expert mode	EXPERT, EDIT	EXPN	No	Yes
Switching display lighting				
Display permanently lit	EXPERT	LED+	No	Yes
Lighting turned off	EXPERT	LED-	No	Yes
Electronic slave pointer				
Temperature overrun value	▐▐▐▶, temperature unit (°C/°F)	digital value	Yes	No
Temperature overrun time	▐▐▐▶, EDIT, h	digital value or NAVL	Yes	No
Temperature overrun value	◀▐▐▐, temperature unit (°C/°F)	digital value	Yes	No
Temperature overrun time	◀▐▐▐, EDIT, h	digital value or NAVL	Yes	No
Reset memory	◀▐▐▐ (▐▐▐▶), EDIT	RSET	Yes	No
Simulation mode				
Configure simulation mode	EXPERT, EDIT	SIM-/SIM1/SIM2	No	Yes
Carry out temperature simulation SIM1	▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐▐, EDIT	digital value, SIM1	Yes	No
Carry out switching simulation SIM2	▐, %	digital value, SIM2	Yes	No

Dimensioned drawings

SW27
G 1/2"
100, 250 mm
6 mm
100 mm:
TST050G12100[-R]
250 mm:
TST050G12250[-R]

SW27
50 mm
SW27
G 1/2"
100, 250 mm
6 mm
100 mm:
TST200G12100[-R]
250 mm:
TST200G12250[-R]

SW27
ST8-3
SW27
G 1/2"
100, 250 mm
6 mm
SENSOR:
100 mm: P2-TVS12-400100
250 mm: P2-TVS12-400250

70
98
SW27

43.5
13
30.3
3.7
50.9

-50…200 °C:
TST200EPT1K[-R]
-50…400 °C:
TST400EPT1K[-R]

FEMA
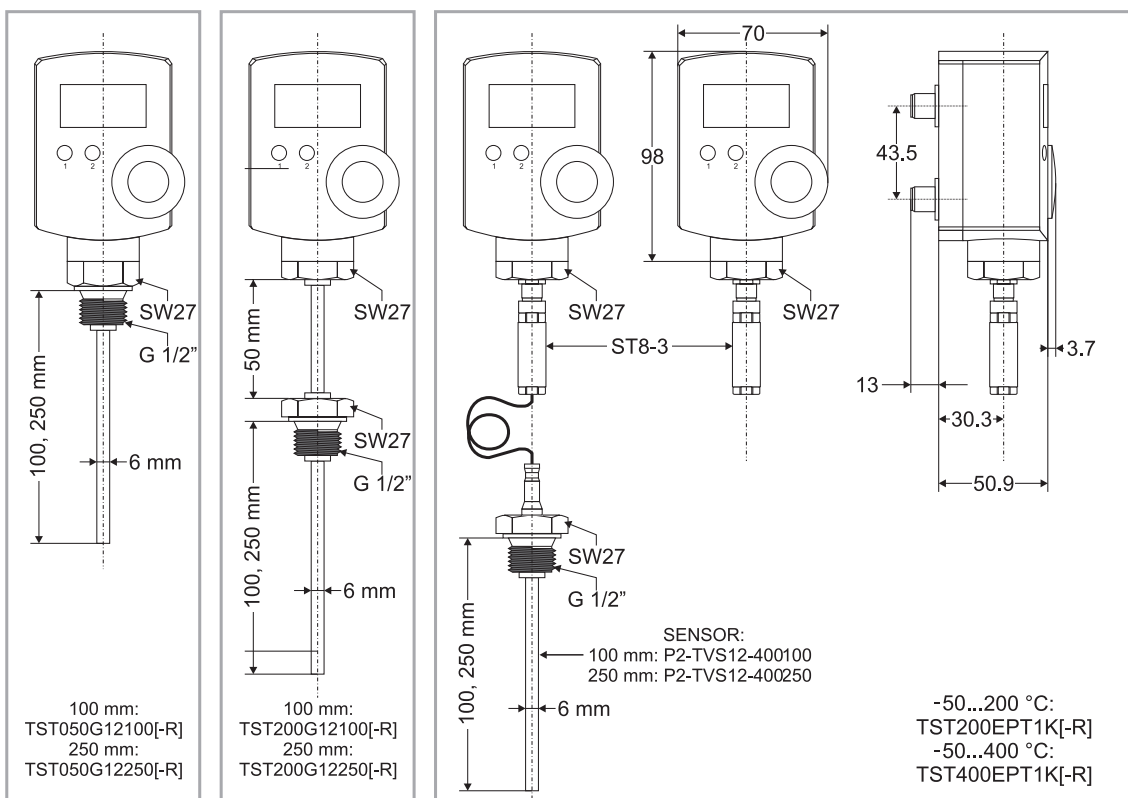
Accessories ordering data

Accessories (please order separately)
Cable socket

Type		
For plugs 1 + 2		
ST12-5-G	5-prong	Straight version
ST12-5-A	5-prong	Right-angle version
For plug 3 (relay output)		
ST12-4-G	3-prong	Straight version
ST12-4-A *	3-prong	Right-angle version
ST12-4-GK	3-prong	Straight version with 2 m cable
ST12-4-AK *	3-prong	Right-angle version with 2 m cable
Sensor connection		
ST8-3	3-prong	Sensor plug
AST1		Wall mounting kit for evaluation unit

*Caution:
Due to lack of space when wall-mounting with kit AST1, use only right-angle plugs.

Thermowells for Smart Temp

Type	Immersed length mm	max. perm. pressure at thermowell in bar	Material	Type	Comment
Thermowell G1/2" **G1/2 A**	100	100	1.4571/316L	G12-100	Cyl. ext. thread
Thermowell G1/2" **G1/2 A**	250	100	1.4571/316L	G12-250	Cyl. ext. thread
Thermowell G1/2" **R1/2"**	100	100	1.4571/316L	R12-100	Con. ext. thread
Thermowell G1/2" **R1/2"**	250	100	1.4571/316L	R12-250	Con. ext. thread
Thermowell G1/2" **N1/2"**	100	100	1.4571/316L	N12-100	Con. ext. NPT thread
Thermowell G1/2" **N1/2"**	250	100	1.4571/316L	N12-250	Con. ext. NPT thread

Mounting dimensions for Smart Temp thermowells
· Wrench size: SW 27
· Internal thread for insertion sensor: G1/2"
· Immersion tube diameter: 8 x 0.7 mm

Type	A	B	C	D	E	F	Thread
G12-100	105	36	19	14	15	83	G1/2" (cylindrical)
G12-250	255	36	19	14	15	233	G1/2" (cylindrical)
R12-100	105	36	19	14	15	83	G1/2" (conical)
R12-250	255	36	19	14	15	233	G1/2" (conical)
N12-100	105	36	19	14	15	83	N1/2" (conical NPT)
N12-250	255	36	19	14	15	233	N1/2" (conical NPT)

SW27 G1/2" thread 8 x 0.7 mm

FEMA
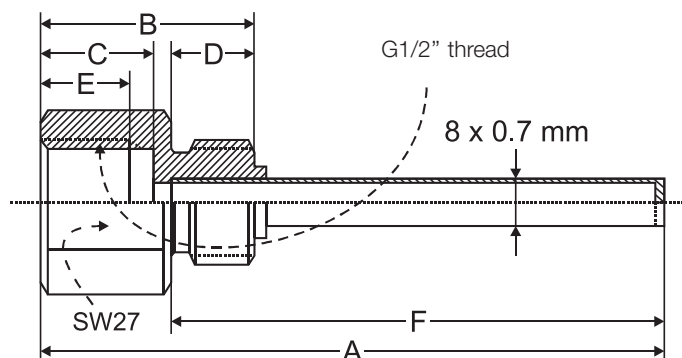
Mechanical thermostats

Mechanical thermostats

Principal technical data
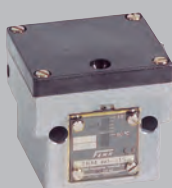
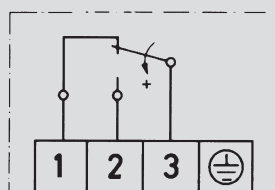| Standard version ...200	Terminal connection ...300	⟨Ex⟩-version ...700
Switch housing	Diecast aluminlum GDAlSi 12	Diecast aluminlum GDAlSi 12
Switching function and connection drawing (applies only to version with microswitch)	Floating change-over contact With rising pressure switching single-pole from 3–1 to 3–2	Floating changeover contact. With rising pressure switching single-pole from 3–1 to 3–2
Switching capacity (applies only to version with microswitch)	8 A at 250 VAC 5 A at 250 VAC inductive 8 A at 24 VDC 0.3 A at 250 VDC min. 10 mA, 12 VDC	3 A at 250 VAC 2 A at 250 VAC inductive 3 A at 24 VDC 0.03 A at 250 VDC min. 2 mA, 24 VDC
Mounting position	vertical or horizontal preferably vertical	vertical
Degree of protection (in vertical position)	IP 54 (terminal connection IP 65)	IP 65
Explosion protection **Code** **EC Type Examination Certificate Number**	– – –	EEx de IIC T6 ⟨Ex⟩ II 2 G D EEx de IIC T6 IP65 T80° C PTB 02 ATEX 1121
Electrical connection	Plug connection to DIN 43650/ Terminal connection	Terminal connection
Cable entry	PG 11 / for terminal connection M 16 x 1.5	M 16 x 1.5
Ambient temperature	-15 to +70 °C	-15 to +60 °C
Switching point	Adjustable with spindle.	Adjustable with spindle after the terminal box lid is removed.
Switching differential	Adjustable or not adjustable (see Product Summary)	Not adjustable
Medium temperature	Max. 70 °C, briefly 85 °C	Max. 60 °C
Vibration strength	No significant deviations up to 4 g. At higher accelerations the switching differential is reduced slightly. Use over 25 g is not permitted.	
Isolation values	Overvoltage category III, contamination class 3, reference surge voltage 4000 V. Conformity to DIN VDE 0110 (01.89) is confirmed.	

Sensor systems
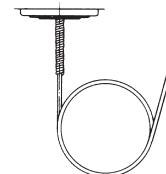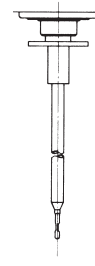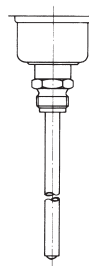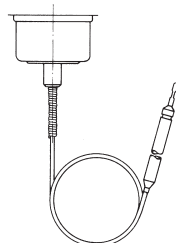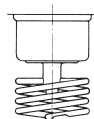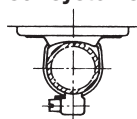
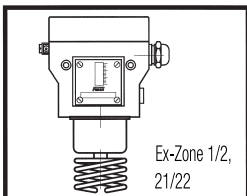| Strap-on sensor TKM	Room sensor TRM	Capillary tube sensor TAM	Rod sensor TX + R 1	Air duct sensor TX + R 6	Frost protection sensor FT

T e m p e r a t u r e   m o n i t o r i n g
in explosion-endangered areas

Temperature switches with special equipment can also be used in explosion risk area ≥ Zone 1 (21).

The following alternatives are possible:

**1. Thermostats with pressure-proof encapsulated switching device,
degree of protection ⟨Ex⟩ II 2 G/D EEx de IIC T6 IP65 T 80°C**
The thermostat in pressure-proof encapsulation can be used directly in explosion risk areas ≥ Zone 1 (21). The maximum switching voltage, switching capacity and ambient temperature must be taken into account and the rules for installation in the explosion risk area must be observed.
All thermostats may be equipped with explosion-proof switching devices. However, special circuits and designs with an adjustable switching differential are not permitted.

Ex-Zone 1/2, 21/22
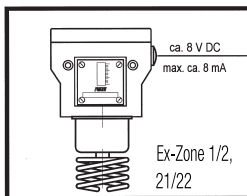
2. Thermostats in EExi version
All thermostats in the standard version can be used in explosion risk areas ≥ Zone 1, if they are incorporated into an "intrinsically safe circuit". Intrinsic safety is based on the principle that the control current circuit in the explosion risk area carries only a small quantity of energy which is not capable of generating an ignitable spark.
Isolating amplifiers, e.g. type Ex 011, must be tested by the Physikalisch-Technische Bundesanstalt (PTB) pursuant to ATEX 100 and approved for use in explosion risk areas. Isolating amplifiers must in any event be installed outside the explosion risk area.
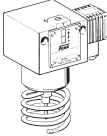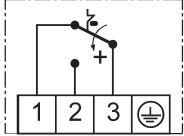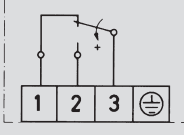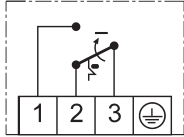Thermostats which are intended for EEx-ia installations are equipped with blue terminals and cable entries. In view of the low voltages and currents carried via the contacts of the microswitches, gold-plated contacts are used in the EX-i version (additional function ZFT 513).
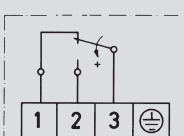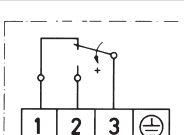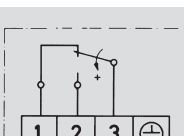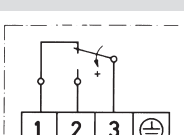
ca. 8 V DC
max. ca. 8 mA
Ex 011
Ex-Zone 1/2, 21/22

Temperature monitoring in Zone 1 (21) and 2 (22)

Pressure-proof encapsulated Ex-de …	Intrinsically safe D …-513 +Ex 011
Explosion protection: ⟨Ex⟩ II 2 G/D EEx de IIC T6 IP 65 T80° C	Explosion protection: EEx-ia
ATEX approval for the complete switching device	ATEX approval for isolating amplifier Ex 011
Thermostats with silver contact	Thermostats with gold-plated contacts, blue terminals and blue cable entries.
Switching capacity: max. 3 A, 250 VAC min. 2 mA, 24 VDC	Switching capacity: max. 100 mA, 24 VDC min. 2 mA, 5 VDC
	Information for devices with additional function ZF 513, ZF 574, ZF 576 to EN 50020: U_i = 10 VDC I_i = 20 mA L_i = 0 µH C_i = 0 pF
The thermostat can be installed within the Ex-Zone.	The isolating amplifier must be installed outside the Ex-Zone.

FEMA

Thermostats
Additional functions

| Plug connection, 200 series	Description	Connection scheme
	Standard version Microswitch, single pole switching	
ZFT 205	**Maximum limiter** with reclosing lockout. Locking with rising temperature	
ZFT 206	**Minimum limiter** with reclosing lockout. Locking with falling temperature	
ZFT 213	**Gold-plated contacts** with low contact resistance (e.g. for low voltage) Not available with adjustable switching differential	
ZFT 301	**Terminal connection housing (IP 65)**	
ZFT 351	**Degree of protection IP 65 and switch housing with surface protection** (terminal connection housing)	
ZFT 513	**EExi version** Housing 300, cable entry and terminals blue Gold-plated contacts, degree of protection IP 65	

* The additional prices should be added to the prices of the standard equipment.
  For devices which differ from the standard equipment, the code of the switching
  device is part of the type designation.
** Switching point adjustment: Please specify switching point and direction of action
  (rising or falling temperature).

Example for ordering:

TX, 150-513,
└─ Code of additional function
└─ Code for temperature range
└─ Type
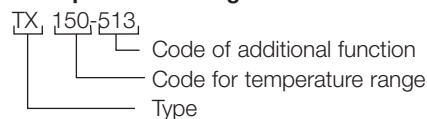
Service functions

In future, devices with service functions will be produced individually according to the customer's specifications.
The system requires that these product combinations be identified in such a way as to prevent any possibility of confusion. These combinations
are characterised by a product code with the suffix "-S" on the packaging label as well as separate labels with barcodes for each service function.

Service functions

ZFT 5970	**Setting of switching point according to customer's instructions**
ZFT 5971	**Setting of switching point according to customer's instructions with lead sealing**
ZF 1978	**Labelling of units** according to customer's instructions with sticker

|	**Test certificates according to EN 10 204**
WZ 2.2	Factory certificate 2.2 based on non-specific specimen test
AZ 3.1	Acceptance test certificate 3.1 based on specific test

 *Switching point adjustment: Please specify **switching point and direction of action** (rising or falling pressure).
Service functions are available for the following type series (including Ex-versions):
Thermostats: TAM, TX, TRM, FT

General technical information
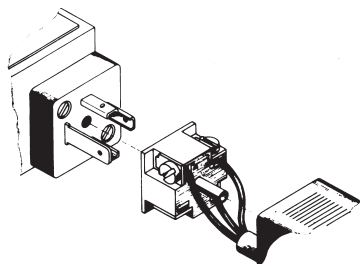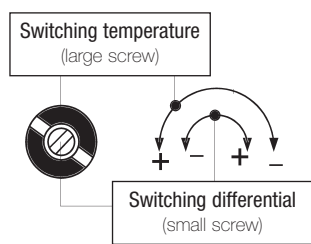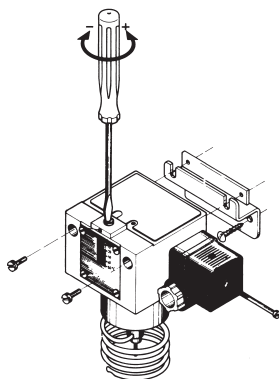
Adjustment of thermostats at lower switching point

Setpoint x_s corresponds to the lower switching point (with falling temperature), the upper switching point x_o (with rising temperature) is higher by the amount of the switching differential x_d.

Setting the switching temperature (setpoint adjustment)

Prior to adjustment, the setscrew above the scale must be loosened by approx. 2 turns and retightened after setting.

The switching temperature is set via the spindle. The set switching temperature is shown by the scale. In view of tolerances and variations in the characteristics of sensors and springs, and due to friction in the switching kinematics, slight discrepancies between the setting value and the switching point are unavoidable. The thermostats are usually calibrated in such a way that the setpoint adjustment and the actual switching temperature correspond as closely as possible in the middle of the range. Possible deviations spread to both sides equally.

Clockwise: low switching temperature
Anticlockwise: high switching temperature

Switching temperature
(large screw)

Switching differential
(small screw)

Changing the switching differential (only for switching device TRMV…)

The switching differential is changed by turning the setscrew within the spindle. The lower switching point is not changed by the differential adjustment; only the upper switching point is shifted by the differential. One turn of the differential screw changes the switching differential by about of the total differential range.

When adjusting please note:

Switching temperature: Clockwise for lower switching point.
Anticlockwise for higher switching point.
Switching differential: Clockwise for larger differential. Anticlockwise for smaller differential.

Electrical connection

Plug connection to DIN 43650. Cable entry Pg 11, max. cable diameter 10 mm. Cable outlet possible in 4 directions spaced 90° apart.

Temperature limiter with reclosing lockout

Additional function ZFT 205 and ZFT 206: All thermostats can be equipped with a mechanical interlock. On reaching the value set on the scale, the microswitch trips over and remains in this position. The lock can be released by pressing the unlocking button (identified by a red dot on the scale side of the switching device). The interlock can take effect with rising or falling temperature, depending on the version.

Mounting position

A vertical mounting position is preferable if at all possible. IP 54 protection according to the requirements of DIN 40050 is guaranteed with a vertical mounting position. A different mounting position may alter the degree of protection, but the operation of the thermostat is not affected.

Outdoor installation of thermostats

FEMA thermostats can be installed out of doors provided they are mounted vertically and suitably protected against the direct effects of weather. At ambient temperatures below 0°C, ensure that condensation cannot occur in the sensor or in the switching device.

FEMA

TRM 150

Room thermostats type series TRM

for industrial premises

FEMA room thermostats are suitable for industrial plants, greenhouses, livestock buildings and warehouses, and also for monitoring the maximum temperature in switchgear cabinets and relay stations. Room thermostats are supplied complete with wall bracket H1.

Technical data
(not applicable to Ex versions)

Body	Diecast aluminium GD Al Si 12 according to DIN 1725. Resistant to ammoniacal vapours and seawater
Mounting position	Any, preferably vertical
Max. ambient temperature	70°C 60°C for Ex versions
Max. temperature at sensor	70°C
Contact arrangement	Single-pole changeover switch
Switching capacity	8 (5) A 250 VAC
Degree of protection	IP 54 according to DIN 40050 (with vertical installation)
Mounting	With wall bracket H 1 or directly on the wall with 2 screws (Ø 4)
Calibration	Scale value corresponds to the lower switching point (with falling temperature), the upper switching point is higher by the amount of the switching differential
Plug connection	Via angled plug to DIN 43650 (3-prong + earth contact), cable entry Pg 11, max. cable diameter 10 mm, cable outlet possible in 4 directions spaced 90° apart.
Switching temperature	Adjustable from outside with screwdriver
Switching differential	Not adjustable on TRM series, adjustable on TRMV series For values see Product Summary

Product Summary

Type	Setting range	Switching differential (mean values)
Switching differential not adjustable		
TRM 022	-20 to +20°C	1.0 K
TRM 40	0 to +40°C	1.0 K
TRM 150	+10 to +50°C	1.0 K
Switching differential adjustable		
TRMV 40	0 to +40°C	3–10 K
TRMV 150	+10 to +50°C	3–10 K

⟨Ex⟩-version · Degree of protection ⟨Ex⟩II 2 G/D EEx de IIC T6 IP65 T 80°C
(Technical data see page 18)

Type	Setting range	Switching differential (mean value)
Switching differential not adjustable		
Ex-TRM 022	-20 to +20°C	1.0 K
Ex-TRM 40	0 to +40°C	1.0 K
Ex-TRM 150	+10 to +50°C	1.0 K

Specification
Room thermostats for industrial premises, type TRM, setting range from … to …°C.
Switching differential not adjustable / adjustable.
Diecast aluminium with plug connection to DIN 43 650.

Dimensions

CE ⟨Ex⟩

**Degree of protection:
IP 54/65**
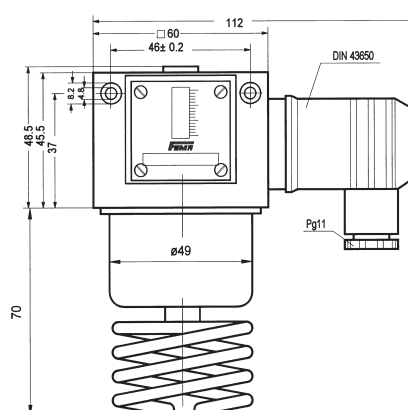
T6120B1003

Room thermostats
Type series T6120A, B

Single and dual stage

· Liquid-filled copper and stainless steel sensors
· Robust design:
  Degree of protection IP 54 or IP 65
· Easy installation and wiring

· Dustproof encapsulated microswitch with
  changeover contact for heating and cooling

Applications

T6120A and B single and dual stage room thermostats are suitable for measuring, monitoring and controlling temperatures in heating and cooling systems.
These devices are used for the following applications:
· Commercial buildings
· Storage premises
· Garages
· Machine rooms
· Factories
· Greenhouses
· Livestock buildings

Dimensions
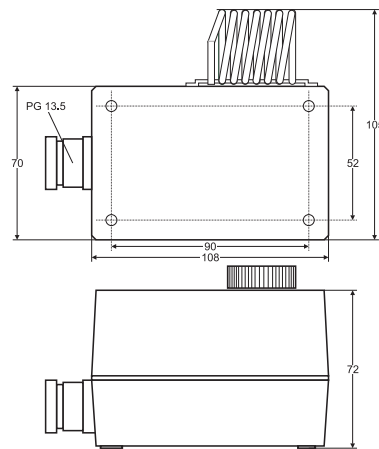
T6120A1005 (in mm)
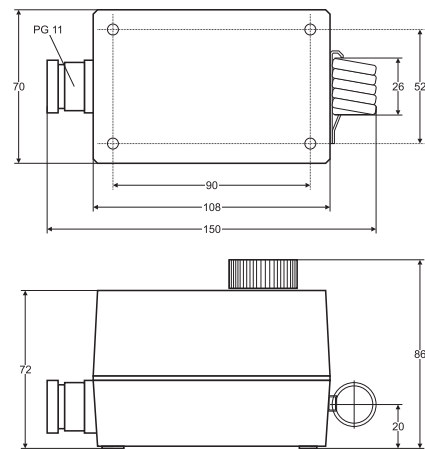
T6120A1013/A1021/A1039 and
T6120B1003 (in mm)

	T6120A1005	T6120A1013	T6120A1021	T6120A1039	T6120B1003
Number of stages			1		2
Contact type			1 changeover contact		2 changeover contacts
Switching interval per stage	1 K (fixed)	2…15 K (adjustable)		1 K (fixed)	1 K (fixed)
Switching interval between stages			not applicable		2…10 K (adjustable)
Setting range		0…60°C		-30…+30°C	
Working temperature	-10…+65°C		-35…+65°C		
Storage temperature			-20…+70°C		
Permissible switching current	10 (1.5) A		15 (8) A		
Permissible switching voltage	250 VAC		24…250 VAC		
Housing material			ABS, glass fibre reinforced		
Sensor material	1.4301		Copper		
Weight	360 g		530 g		
Degree of protection	IP 54		IP 65		
Dimensions (W x H x L in mm)			108 x 70 x 72		

CE

FEMA

Figure 1: T6120A1005
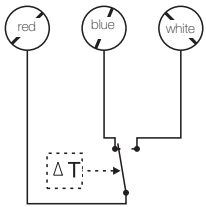
Figure 2: T6120A1013/A1021/A1039

Stage 1   **Stage 2**

Figure 3: T6120B1003

Function and wiring T6120A1005
To control a heating unit, connect terminals 2 and 3 of the thermostat to the heating unit. When the temperature rises, the contact will open (see Figure 1). To control a cooling unit, connect terminals 1 and 2 of the thermostat to the cooling unit. When the temperature drops, the contact will open (see Figure 1).
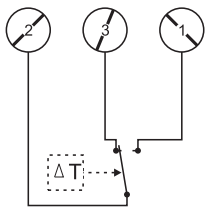
Function and wiring T6120A1013/A1021/A1039
To control a heating unit, connect the red terminal (Common) and the blue terminal (Norm open) of the thermostat to the heating unit. When the temperature rises, the contact will open (see Figure 2).
To control a cooling unit, connect the red terminal (Common) and the white terminal (Norm closed) of the thermostat to the heating unit. When the temperature drops, the contact will open (see Figure 2).

Function and wiring T6120B1003
To control a heating unit, connect the red terminal and the blue terminal of both stages of the thermostat to the corresponding terminals of the heating unit. When the temperature rises, first the contact of stage 1 opens. If the temperature continues to rise by an amount corresponding to the set switching interval, the contact of stage 2 opens. To control a cooling unit, connect the red terminal and white terminal of both stages of the thermostat to the corresponding terminals of the cooling unit. When the temperature falls, first the contact of stage 1 opens. If the temperature continues to fall by an amount corresponding to the set switching interval, the contact of stage 2 opens (see Figure 3). See also the explanation given below: "Adjusting the switching interval between 2 stages on the T6120B1003".
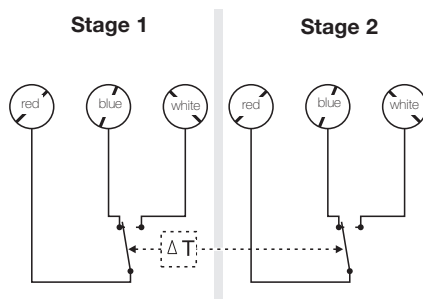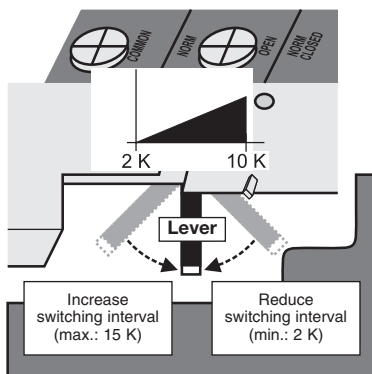

Adjusting the switching interval between 2 stages on the T6120B1003
The switching interval between the two stages can be adjusted between 2 K (factory setting) and 10 K. To do this, pull off the adjustment knob, undo the two fastening screws, and remove the housing cover. An adjustment lever with scale is now visible on the side. Move this lever to the right to increase the switching interval. Move it to the left to reduce the switching interval.
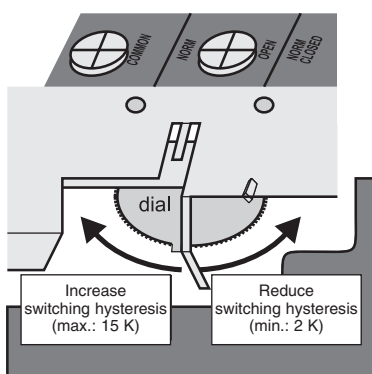
Adjusting the hysteresis on single stage thermostats T6120A1013 / A1021
In the case of T6120A1013 and T6120A1021 single-stage thermostats, it is possible to adjust the hysteresis to a value between 2 K and 15 K. To do this, pull off the adjustment knob, undo the fastening screws, and remove the housing cover. An adjustment dial with scale is now visible on the side of the switching device. The hysteresis between the switching point and the reset point can be adjusted by turning this dial.

TX 490

Rod thermostats type series TX

Rod thermostats can be used as immersion thermostats for pressure-tight installation in pipelines and containers and for monitoring temperature in air ducts.
The correct immersion tube must be chosen for the application and ordered as a separate item.

Technical data
(not applicable to Ex versions)

Housing	Diecast aluminium GD Al Si 12 according to DIN 1725.
Mounting position	Any, preferably vertical
Max. ambient temperature at switching device	+70°C +60°C for Ex versions
Max. perm. temperature at sensor	See Product Summary
Contact arrangement	Single pole change-over switch
Switching capacity	8 (5) A 250 VAC
Degree of protection	IP 54 according to DIN 40050 (with vertical installation)
Calibration	Scale value corresponds to the lower switching point (with falling temperature), the upper switching point is higher by the amount of the switching differential
Plug connection	Via angled plug to DIN 43650 (3-prong + earth contact), cable entry Pg 11, max. cable diameter 10 mm, cable outlet possible in 4 directions spaced 90° apart. Supplied with plug.
Switching temperature	Adjustable from outside with screwdriver
Switching differential	Not adjustable, for values see Product Summary
Immersion tubes	See page 32.

Product Summary

Type	Setting range	Switching differential (mean value)	Max. perm. temperature at sensor
Immersion depth 135 mm			
TX 023	-20 to + 30°C	1.5 K	110°C
TX 150	+10 to + 50°C	1.5 K	110°C
TX 490	+40 to + 90°C	2.5 K	125°C
TX 813	+80 to +130°C	4.0 K	150°C
Immersion depth 220 mm			
TXB 023	-20 to + 30°C	1.5 K	110°C
TXB 150	+10 to + 50°C	1.5 K	110°C
TXB 490	+40 to + 90°C	2.5 K	125°C
TXB 813	+80 to +130°C	4.0 K	150°C

〈Ex〉-version · Degree of protection 〈Ex〉 II 2 G/D EEx de IIC T6 IP65 T80°C
(Technical data see page 18)

|			
Immersion depth 135 mm			
Ex-TX 023	–20 to + 30°C	1.5 K	110°C
Ex-TX150	+10 to + 50°C	1.5 K	110°C
Ex-TX 490	+40 to + 90°C	2.5 K	125°C
Immersion depth 220 mm			
Ex-TXB 023	–20 to + 30°C	1.5 K	110°C
Ex-TXB 150	+10 to + 50°C	1.5 K	110°C
Ex-TXB 490	+40 to + 90°C	2.5 K	125°C

Specification
Rod thermometer type TX …,
range of adjustment from … to …°C.
Immersion depth 135 mm / 220 mm,
diecast aluminium housing with
plug connector to DIN 43 650.

✚ Accessories
Immersion tube type R10/MS, R20/MS, R10/NST, R20/NST.
Immersion tubes for NPT thread on request.

Dimensions

Degree of protection:
IP 54/65
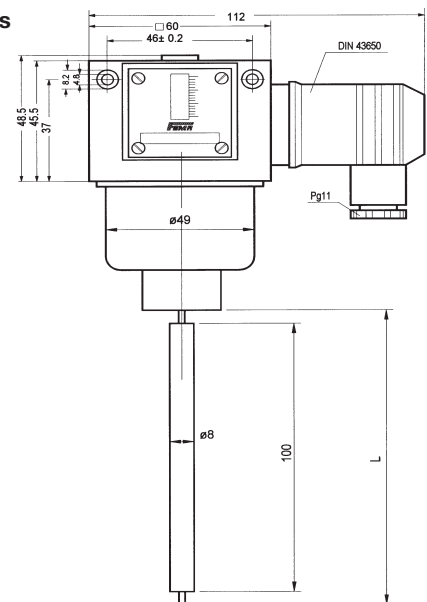
TAM 813

Capillary tube thermostats
Type series TAM

with 1.5 m capillary tube

The sensor cartridge at the end of the capillary tube is the actual active (temperature-sensitive) part of the sensor. Changes in temperature on the capillary tube have no effect on the switching point. Pressure-tight installation of the sensor in pressure vessels of all kinds is possible with the aid of immersion tubes.

Technical data
(not applicable to Ex versions)

Body	Diecast aluminium GD Al Si 12 according to DIN 1725.
Mounting position	Any, preferably vertical
Max. ambient temperature at switching device	+70°C +60°C for Ex versions
Capillary tube	Cu capillary tube, 1.5 m long Other capillary tube lengths are not possible
Sensor cartridge	8 mm Ø, 100 mm long, material: Cu
Contact arrangement	Single pole changeover switch
Switching capacity	8 (5) A 250 VAC
Degree of protection	IP 54 according to DIN 40050 (with vertical installation)
Mounting	Temperature sensor with or without immersion tube in containers, air ducts etc. Switching device with 2 screws (Ø 4) directly on a flat wall surface
Calibration	Scale value corresponds to the lower switching point (with falling temperature), the upper switching point is higher by the amount of the switching differential
Plug connection	Via angled plug to DIN 43650
Switching temperature	Adjustable via the setting spindle with a screwdriver
Switching differential	Not adjustable
Immersion tubes	see page 32.

Product Summary

Type	Setting range	Switching differential (mean value)	Max. perm. temperature at sensor
TAM 022	-20 to + 20°C	1.5 K	110°C
TAM 150	+10 to + 50°C	1.5 K	110°C
TAM 490	+40 to + 90°C	2.0 K	125°C
TAM 813	+80 to +130°C	2.0 K	150°C

⟨Ex⟩-version · Degree of protection ⟨Ex⟩ II 2 G/D EEx de IIC T6 IP65 T80°C
(Technical data see page 18)

Type	Setting range	Switching differential (mean value)	Max. perm. temperature at sensor
Ex-TAM 022	-20 to + 20°C	1.5 K	110°C
Ex-TAM 150	+10 to + 50°C	1.5 K	110°C
Ex-TAM 490	+40 to + 90°C	2.0 K	125°C
Ex-TAM 813	+80 to +130°C	2.0 K	150°C

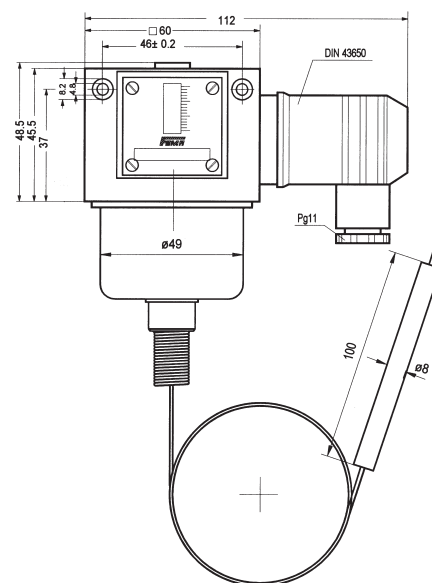## Specification
Capillary tube thermostat type TAM …
Range of adjustment from … to …°C.
Capillary tube length 1.5 m, diecast aluminium with plug connection to DIN 43650.

✚ Accessories
Immersion tube type … R 1, R 2, R3, RN 1, RN 2.

Dimensions:

FEMA

CE ⟨Ex⟩

Strap-on thermostats Type series TKM

self-monitoring

An outstanding feature of FEMA strap-on thermostats is the fast-reacting sensor system, which is also self-monitoring. If the sensor is broken or damaged, the FEMA strap-on thermostat behaves as though the temperature had exceeded the set value and switches off to the safe side (e.g. circulating pump off).

TKM 70-315

Technical data

Body	Diecast aluminium GD Al Si 12 according to DIN 1725. Terminal box cover made from glass fibre reinforced plastic
Mounting position	Any
Mounting	With tension band directly on the pipe. Suitable for nominal pipe diameters from 1/2" to 2"
Max. ambient temperature	+70°C
Max. temperature at sensor	+90°C
Switching temperature	Adjustable with spindle after the terminal box cover is removed. For ranges see Product Summary.
Switching differential	Not adjustable. For values see Product Summary.
Contact arrangement	Single pole changeover switch.
Switching capacity	10 (5) A 250 V
Degree of protection	IP 54 according to DIN 40 050 (with vertical installation)
Connection	3-pole terminal strip and earth conductor connection. Accessible after removal of the terminal box cover. Cable entry M16 x 1.5 max. cable diameter 10 mm.
Calibration	The specified setting values relate to the upper switching point (with rising temperature). The lower switching point (with falling temperature) is lower by the amount of the switching differential.

The comparatively high sensitivity of FEMA strap-on thermostats can be further improved by using a heat conducting compound between the pipe and the contact face of the sensor. Heat conducting compound is included with each unit.
It is important that the surface of the pipe is carefully cleaned and free from dirt, scale and paint before fitting the sensor. The tension band included with every thermostat allows the strap-on thermostats to be attached to pipes with nominal diameters from 1/2" to 2".

Product Summary

Type	Setting range	Factory set at	Switching differential	Max permissible medium temperature
TKM 50-315	+45…+50°C	+50°C	6 K	+90°C
TKM 60-315	+55…+60°C	+60°C	6 K	+90°C
TKM 70-315	+65…+70°C	+70°C	6 K	+90°C

All strap-on thermostats are equipped with 300 series switching devices (terminal connection).

FEMA

CE

FT015

Frost protection thermostats Type series FT

for air heating and conditioning systems

With FT frost protection thermostats, it is necessary to ensure that the ambient temperature at the switching device does not fall below the defined switching point. Also, parts of the capillary tube outside the air heater must not be laid in zones whose temperature may fall below the defined switching point. Either situation would cause the device to cut out prematurely.

Technical data
(not applicable to Ex versions)

Body	Diecast aluminium GD Al Si 12 according to DIN 1725.
Sensor	Cu capillary tube
Max. ambient temperature at switching device	+70°C +60°C for Ex versions
Contact arrangement	Single-pole changeover switch
Switching capacity	8 (5) A 250 VAC
Degree of protection	IP 54 according to DIN 40050 (with vertical installation)
Switching differential	approx. 4 K, preset in factory
Calibration	Scale value corresponds to the lower switching point (with falling temperature), the upper switching point is higher by the amount of the switching differential
Plug connection	Angled plug, 3-prong + earth contact, to DIN 43650. Cable entry Pg 11. Max. cable diameter 10 mm, cable outlet possible in 4 directions spaced 90° apart. Supplied with plug.
Terminal connection	M16 x 1.5 for Ex devices

Dimensions
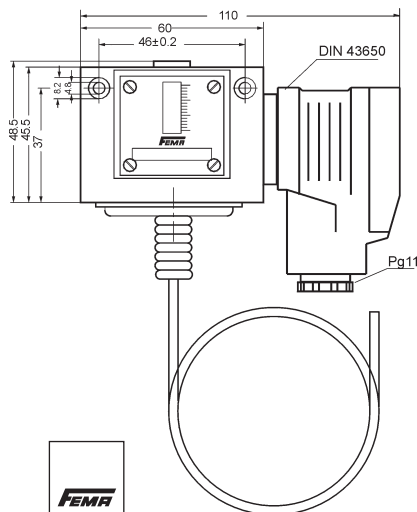
FEMA frost protection thermostats reliably monitor the temperature in hot-water-heated air heaters. If the temperature falls below the set value, the thermostat switches off. A visual or audible "frost hazard" alarm can be switched on at the same time. A fixed stop on the setting spindle at 3°C prevents the thermostat from being set below the freezing point due to inexpert adjustment.
If the capillary tube is damaged or broken, FEMA frost protection thermostats reliably switch off towards the safe side (e.g. fan off) irrespective of the temperature at the sensor.

i Operating method

FT frost protection thermostats with 3 m or 6 m capillary tube detect the temperature over the whole length of the capillary tube and are therefore able to monitor the surface of the whole air heater. If the capillary tube becomes too cold at any point, the thermostat switches off.
Frost protection thermostats with reclosing lockout (switching unit 206) break the circuit at the set value when the temperature falls. The adopted switching state is mechanically latched against automatically switching on again.
The latch can only be released by pressing the unlocking button after the temperature has risen again by approx. 8°C.

Product Summary

Type	with reclosing lockout	Setting range	Max. temperature at sensor	Version
FT 015	FT 015-206	+4 to +15°C	+200°C	6 m capillary tube
FTB 015	FTB 015-206	+4 to +15°C	+200°C	3 m capillary tube

Two-phase frost protection control with output signal 0–10 V and limit switch.
See separate data sheet, FTS, page 42.

⟨Ex⟩-version · Degree of protection ⟨Ex⟩ II 2 G/D EEx de IIC T6 IP65 T 80°C

Type	Setting range	Max. temperature at sensor	Version
Ex-FT 015	+4 to +15°C	+130°C	6 m capillary tube
Ex-FTB 015	+4 to +15°C	+130°C	3 m capillary tube

Specification

Frost protection thermostat type … with 3 m / 6 m capillary tube for monitoring the surface of the air heater. Range of adjustment 4 to 15°C with/without internal mechanical interlock. Diecast aluminium casing with plug connection to DIN 43650.

CE ⟨Ex⟩

Degree of protection: IP 54/65

T69

Frost protection thermostats Series T6950/51/60/61

for air heating and conditioning systems

T69… series frost protection thermostats are ideal for monitoring heat exchangers and water heating coils to prevent freezing in neutral, non-aggressive environments. The devices are intrinsically safe and have a lead-sealable set-point adjustment spindle. In case of damage, the thermostats switch off to the safe side.

Technical data

Body	Galvanised steel, ABS cover (for IP 65 version, housing made of macrolon)
Max. ambient temperature	-15 to +55°C
Max. sensor temperature	+200°C (max. 60 min.)
Range of adjustment	-10 to +12°C / 14°F to 50°F
Storage temperature	-10 to +70°C
Relative humidity	0–95%
Sensor design	Copper pipe active over whole length
Switch	Dustproof encapsulated microswitch, 1 changeover contact
Switching capacity	15 (8) A, 250 VAC
Switching differential	1 Kelvin
Protection class	I according to EN 60335-1
Degree of protection	IP 54 according to EN 60529 (IP 65 with seal). With vertical installation – connection wire pointing downwards.
Cable entry and electrical connection	PG 11, screw terminals for wires and leads with cross-section up to 1.5 mm². Permitted cable-diameter 6–9 mm.

ℹ️ T6950/51/60/61 frost protection thermostats with 1.8 m, 3.0 m and 6 m capillary tube detect the temperature over the whole length of the capillary tube. When installing out of doors it is important to remember that the boiler at the switching device is also temperature-sensitive and so is part of the active measuring system. If the capillary tube becomes too cold at any point, the thermostat switches off. The undercooled section of the capillary tube must be at least 30 cm long. Care must be taken to ensure that the whole length of the capillary tube is laid inside the air duct. Versions with manual reset: To return T6950 and T6960 frost protection thermostats to the working position manually by pressing the reset button on the front of the housing, the temperature must be at least 1 K higher than the switch-off value that has been set.

Product Summary

Type	Capillary length	Reset	IP
T6950A1000	1.8 m	manual	54
T6950A1018	3.0 m	manual	54
T6950A1026	6.0 m	manual	54
T6951A1009	1.8 m	automatic	54
T6951A1017	3.0 m	automatic	54
T6951A1025	6.0 m	automatic	54
T6960A1008	1.8 m	manual	65
T6960A1016	3.0 m	manual	65
T6960A1024	6.0 m	manual	65
T6961A1007	1.8 m	automatic	65
T6961A1015	3.0 m	automatic	65
T6961A1023	6.0 m	automatic	65

✚ **Supplied accessories:**
For 3 m and 6 m versions:
6 support brackets included.

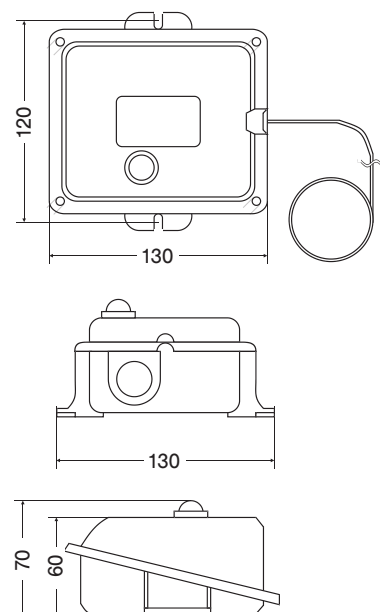For 1.8 m versions:
3 support brackets included.

✚ **Optional accessories:**

VFH-TF   Cu/brass thermowell for sensor length 1.8 m version

VFN-TF   Cu/brass thermowell for sensor length 1.8 m version

H3   Additional support brackets if needed

Dimensioned drawing

CE

Degree of protection: IP 54/65

STB

STB+TW

STB series temperature monitors and limiters

Tested according to DIN 3440

The temperature monitors and temperature limiters meet the requirements of DIN 3440 and can thus be used for heating systems according to DIN 4751, steam and hot water systems and district heating systems. The devices with safety function (STW, STB) are self-monitoring, i.e. in the event of breakage or leaks in the measuring system the circuit is opened and the system is switched off to the safe side.

Technical data

Body	Diecast aluminium with plastic cover.
Immersion tube	Brass G 1/2", included with product Stainless steel G 1/2", order separately. Type T4NSTF or T5NSTF, see Product Summary
Max. ambient temperature	+80°C at the switching head
Switching point accuracy	(in upper third of scale) for TW, STW, STB: ± 5 % for TR: ± 1.5 % (in % of scale range)
Switching differential	(in % of scale range) for TR, TW: 3–4 % for STW, STB: 4–6%
Lead seal	The cover of the switching device can be lead sealed so that the internal settings of the limiter switching points are no longer accessible after sealing.
Switching capacity	10 (2) A, 250 VAC
Degree of protection	IP 54

Connection schemes:

In devices with a dual function there are 2 switching elements. Pay attention to the function of the relevant switch when connecting.
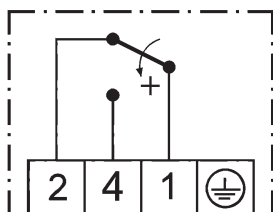
TW, STW, TR
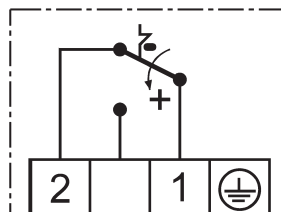
STB

Type	STW 1F	STW + TRF	STB + TWF	STB + TRF	STB 1F	TWP 1F
Function	Safety temperature monitor	Safety temperature monitor and controller	Safety temperature limiter and monitor	Safety temperature limiter and controller	Safety temperature limiter	Temperature monitor
Setting range	20 to 150° C	20 to 150° C	30 to 110° C	30 to 110° C	60 to 130° C	20 to 150°C
TÜV test certificate	STW (STB) 89401S	TR/STW (STB) 89901S	TW / STB 90401	TR / STB 90001	STB 89501	TW 89201
Setting	internal	STW internal TR external	STB internal TW internal	STB internal TR external	internal	internal
Controls accessible from outside	none	Setting wheel for TR	Reclosing button	Reclosing button and setting wheel for TR	Reclosing button	none
Contact	Changeover	2 x changeover	NC (STB) and changeover (TW)	NC (STB) and changeover (TR)	NC	Changeover
Reclosing lockout (internal)	no	no	yes	yes	yes	no
Max. temperature at sensor	175°C	175°C	130°C	130°C	150°C	175°C
Immersion depth	150 mm	150 mm	150 mm	150 mm	150 mm	100 mm
Permitted pressure, brass immersion tube	40 bar	25 bar	25 bar	25 bar	40 bar	40 bar
Permitted pressure, stainless steel immersion tube	80 bar T4NSTF	40 bar T5NSTF	40 bar T5NSTF	40 bar T5NSTF	80 bar T4NSTF	80 bar T4NSTF

FEMA

CE · TÜV tested · DIN geprüft

Degree of protection: IP 54

Room and duct hygrostats
Type series H6045/H6120

Single-stage

The H6045A1002 single-stage duct hygrostat and the H6120A1000 single-stage room hygrostat are designed for monitoring relative humidity in air conditioning systems and climatic chambers and for controlling air humidifiers and dehumidifiers in indoor swimming pool buildings.

Further applications include air humidity regulation in food storage premises, the textile and paper industries, printing works, the optical and chemical industries, greenhouses, hospitals and wherever relative air humidity levels need to be measured, controlled and monitored.

H6120A1000

Technical data

H6045A1002 duct hygrostat

Range **Relative humidity**	35…100 % r.h.
Switching capacity	15 (8) A, 24…250 VAC
Switch	Single-pole changeover
Working temperature	-10 to +65°C
Max. air-flow speed	8 m/s
Degree of protection	IP 65
Protection class	I
Tolerance	max. 4 % r.h.
Switching hysteresis	5 % r.h.
Housing material	ABS glass fibre reinforced
Weight	480 g

H6120A1000 Room hygrostat

Range **Relative humidity**	35…100% r.h.
Switching capacity	5 (0.2) A, 230 VAC
Switch	Single-pole changeover
Working temperature	0 to +60°C
Max. air-flow speed	15 m/s
Degree of protection	IP 30
Protection class	I
Tolerance	max. 3 % r.h.
Switching hysteresis	4 % r.h.
Housing material	ABS (white)
Weight	125 g

Switching point adjustment

The switching point can be adjusted using the knob located on the top of the device. The clearly marked scale and the pointer on the housing make it very easy to adjust the humidity level.

Both devices have a dustproof encapsulated microswitch with high switching capacity. Thanks to their simple and robust construction, they offer a low-cost solution for heating, ventilation and air-conditioning systems.

ℹ Mounting
H6045A1002
The duct hygrostat H6045A1002 can be installed directly in air ducts using the included mounting bracket.
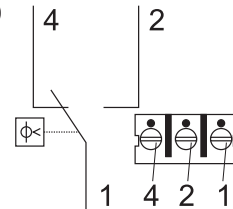**H6120A1000**
The room hygrostat H6120A1000 must be installed far enough away from heat sources and out of direct sunlight. Care must be taken to ensure that air can flow freely past the sensor. The ideal installation position on the wall is at a height of approx. 1.5 m from the floor.
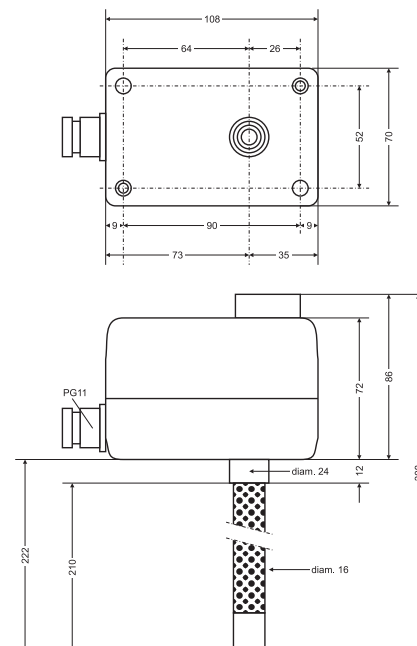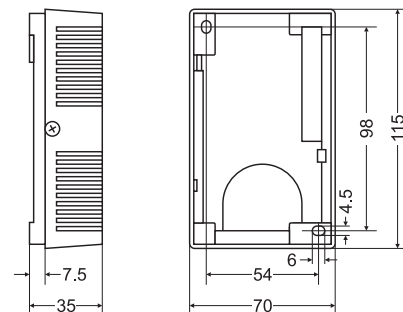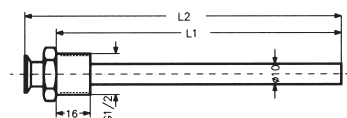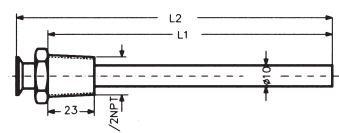
Electrical connection
H6045A1002
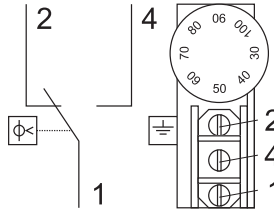
H6120A1000

Dimensions
H6045A1002

H6120A1000

CE

Degree of protection:
IP 65/30

Immersion tubes / Accessories

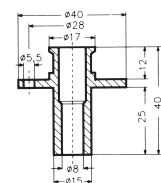### for thermostats and temperature transmitters

**Immersion tubes G 1/2,
Internal Ø 8 mm**
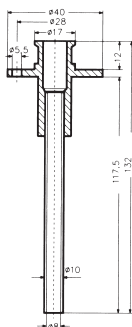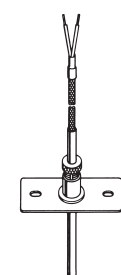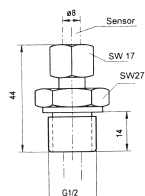
**Immersion tubes 1/2 NPT,
Internal Ø 8 mm**
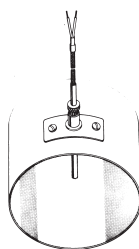
FF 135

Type	Immersion depth L₁ (mm)	Overall length L₂ (mm)	Suitable for
Nickel-plated brass, G 1/2, max. permitted pressure: 25 bar			
R 1 / brass	135	151	
R 2 / brass	220	236	TAM…
R 3 / brass	500	516	
R 10 / brass	135	–	TX… / TP
R 20 / brass	220	–	
Stainless steel (1.4571 + 1.4401), G 1/2, max. permitted pressure: 63 bar			
R 1 / steel	135	151	
R 2 / steel	220	236	TAM…
R 10 / steel	135	–	TX… / TP
R 20 / steel	220	–	
Nickel-plated brass, 1/2 NPT, max. permitted pressure: 25 bar			
RN 1 / brass	135	151	
RN 2 / brass	220	236	TAM…
RN10 / brass	135	151	TX… / TP
RN20 / brass	220	236	
Stainless steel (1.4571 + 1.4401), 1/2 NPT, max. permitted pressure: 63 bar			
RN 1 / steel	135	151	
RN 2 / steel	220	236	TAM…
RN 10 / steel	135	151	TX… / TP
RN 20 / steel	220	236	

Retaining spring
(required if TP… temperature transmitters or PF/PS sensors are to be mounted in R 10 or RN 10 immersion tubes). The retaining spring ensures rapid heat conduction between the immersion tube and the temperature sensor. Type **FF 135**

R 6   R 7

Immersion tubes with fixing flange for air ducts
Material: Chromated steel

R 6	Immersion depth 135 mm	TX…
R 7	Immersion depth 220 mm	

Mounting flange for Pt 100/Pt 1000 sensor, Ø = 5 mm
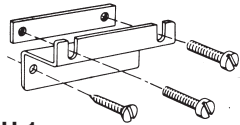R 8   TP, PF, PS

R 8   R 8 (mounting example)

Immersion tube applications

|	For pressure-tight installation (up to 100 bar)					For air ducts		For exhaust pipes		
	R 1 RN 1	R 2 RN 2	R 3	R 10 RN 10	R 20 RN 20	R 6	R 7	R 8	R 15	R 18
TAM…	●	●	●							
TX…				●		●				
TXB…					●		●			
Temperature Transmitter TP…					only together with retaining spring FF 135			●	●	
Transmitter PZ 17 Sensors P 17										●

**R 18
(R 15)**

FEMA

Accessories

for thermostats and pressure monitors

H 1

Wall bracket type H 1
including fixing screws and plugs (6 mm Ø) Included as standard with TRM type thermostats. Suitable for all switching devices of product group K.
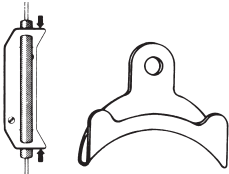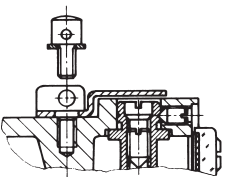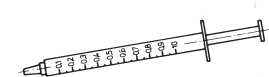
H 2   **H3**

Wall bracket type H 2
for fixing sensor cartridges of capillary tube thermostats.
Suitable for all TAM type capillary tube thermostats.

Capillary tube holder type H 3
for attaching the capillary tube of frost protection thermostats to the frame of the air heater (5 off packed in bag). Suitable for FT frost protection thermostats and FTS frost protector.

P 2

Sealing type P 2
consisting of cover plate and capstan screw for covering and sealing the adjusting screws. Only suitable for switching device 200 (plug connection).
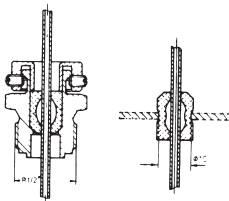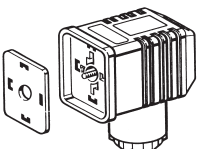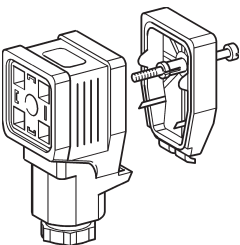
WLP1

Heat conducting compound type WLP 1
to improve the transfer of heat, e.g. for strap-on thermostats.
Approx. 0.5 cm^3 in handy dispenser.
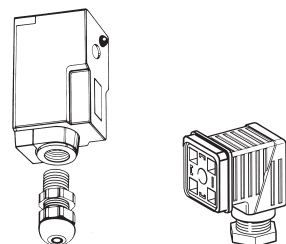
R4   **R 5**

Capillary tube bushing type R 4
for 3 mm capillary tube (not pressure-tight). G1/2" thread. Suitable for all TAM, FT and FTS devices.

Capillary tube bushing type R 5
Rubber plug for 3 mm capillary tube. Bore diameter 10 mm. Not pressure-tight.
Suitable for all TAM, FT and FTS devices.

ST 5

Replacement plug ST 5 to DIN 43650
for 200 series housing, with seal and fastening screw, 3-prong + earth contact.

ST 3

ST 218 plug connector with position indication via LEDs
Operating voltage: 12240 VAC/DC
Operating current: max. 2 A
LED current consumption: max. 10 mA
LED indication: green if voltage present at contact pin 1
                            red   if voltage present at contact pin 2
Plug rotatable 270°C engaging at increments of 45°
Connection cables: 1.5 mm^2 (finely stranded)
Degree of protection: IP 65
Ambient temperature: 0 to 60°C
Suitable for 200 series pressure and temperature switches (plug connection)
which are equipped with a microswitch (standard version).

ST 218   **ST 7**

Replacement plug ST 7 can be opened (0–10 V).
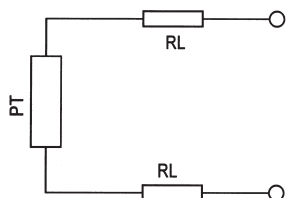Only suitable for transmitters (low voltage), 3-prong.

FEMA

General notes on temperature measurement
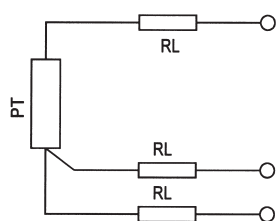## with resistance sensors Pt 100 and Pt 1000

**Connection possibilities
for Pt... sensors**

Two-wire connection

PT

RL

RL

Advantage: Only 2 wires
Disadvantage: The line resistance RL distorts the measurement result

Three wire connection

PT

RL

RL

RL

Advantage: The line resistances are taken into account by the electronic analyser. The measurement result is not distorted.
Disadvantage: 3 wires are needed. All 3 wires must have the same resistance.

Four-wire connection

Power supply +

PT

RL

RL

RL

RL

–
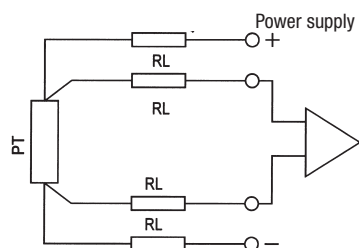
Advantage: The line resistances do not play any role due to the electronic analyser (current feed and high-ohmic voltage sensing). The measurement result is not distorted. The lines can have different resistances.
Disadvantage: 4 wires are needed.

Connection wires with the same colours are electrically connected to one another.

Platinum temperature sensors Pt 100 or Pt 1000 make use of the constant change in resistance of materials at changing temperatures. A platinum-rhodium alloy specially suited to this purpose is normally used because of its good stability and high reproducibility.
The resistance of the sensor increases as the temperature rises.

The resistance values are stipulated in DIN IEC 751 as follows:
Pt 100 = 100 ohms at 0°C
Pt 1000 = 1000 ohms at 0°C

The resistance values for all temperatures are quoted in the above-mentioned standard.
The resistance sensors are divided into accuracy classes according to their limiting error.

For FEMA Pt 100/1000 sensors, Class A applies: 0.15 K + 0.002 x t*
*t is the numerical value of the temperature in °C (disregarding the sign)

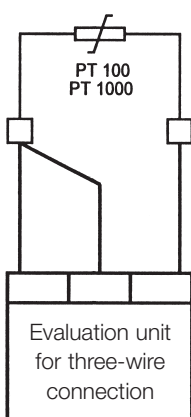**Resistance values of Pt 100 sensors (excerpt from DIN 43 760, IEC 751)**

Tem- perature °C	Basic values of Pt 100											Tem- perature °C
	0	1	2	3	4	5	6	7	8	9	10	
– 50	80,31	79,91	79,51	79,11	78,72	78,32	77,92	77,52	77,13	76,73	76,33	– 50
– 40	84,27	83,88	83,48	83,08	82,69	82,29	81,89	81,50	81,10	80,70	80,31	– 40
– 30	88,22	87,83	87,43	87,04	86,64	86,25	85,85	85,46	85,06	84,67	84,27	– 30
– 20	92,16	91,77	91,37	90,98	90,59	90,19	89,80	89,40	89,01	88,62	88,22	– 20
– 10	96,09	95,69	95,30	94,91	94,52	94,12	93,73	93,34	92,95	92,55	92,16	– 10
0	100,00	99,61	99,22	98,83	98,44	98,04	97,65	97,26	96,87	96,48	96,09	0
0	100,00	100,39	100,78	101,17	101,56	101,95	102,34	102,73	103,12	103,51	103,90	0
10	103,90	104,29	104,68	105,07	105,46	105,85	106,24	106,63	107,02	107,40	107,79	10
20	107,79	108,18	108,57	108,96	109,35	109,73	110,12	110,51	110,90	111,28	111,67	20
30	111,67	112,06	112,45	112,83	113,22	113,61	113,99	114,38	114,77	115,15	115,54	30
40	115,54	115,93	116,31	116,70	117,08	117,47	117,85	118,24	118,62	119,01	119,40	40
50	119,40	119,78	120,16	120,55	120,93	121,32	121,70	122,09	122,47	122,86	123,24	50
60	123,24	123,62	124,01	124,39	124,77	125,16	125,54	125,92	126,31	126,69	127,07	60
70	127,07	127,45	127,84	128,22	128,60	128,98	129,37	129,75	130,13	130,51	130,89	70
80	130,89	131,27	131,66	132,04	132,42	132,80	133,18	133,56	133,94	134,32	134,70	80
90	134,70	135,08	135,46	135,84	136,22	136,60	136,98	137,36	137,74	138,12	138,50	90
100	138,50	138,88	139,26	139,64	140,02	140,39	140,77	141,15	141,53	141,91	142,29	100
110	142,29	142,66	143,04	143,42	143,80	144,17	144,55	144,93	145,31	145,68	146,06	110
120	146,06	146,44	146,81	147,19	147,57	147,94	148,32	148,70	149,07	149,45	149,82	120
130	149,82	150,20	150,57	150,95	151,33	151,70	152,08	152,45	152,83	153,20	153,58	130
140	153,58	153,95	154,32	154,70	155,07	155,45	155,82	156,19	156,57	156,94	157,31	140
150	157,31	157,69	158,06	158,43	158,81	159,18	159,55	159,93	160,30	160,67	161,04	150
160	161,04	161,42	161,79	162,16	162,53	162,90	163,27	163,65	164,02	164,39	164,76	160
170	164,76	165,13	165,50	165,87	166,24	166,61	166,98	167,35	167,72	168,09	168,46	170
180	168,46	168,83	169,20	169,57	169,94	170,31	170,68	171,05	171,42	171,79	172,16	180
190	172,16	172,53	172,90	173,26	173,63	174,00	174,37	174,74	175,10	175,47	175,84	190
200	175,84	176,21	176,57	176,94	177,31	177,68	178,04	178,41	178,78	179,14	179,51	200

The resistance values of Pt 1000 are higher by a factor of ten.
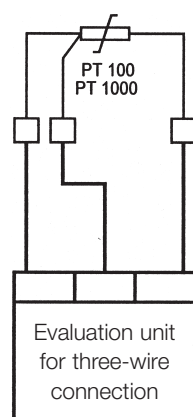
When Pt sensors are connected, the line resistances between the measuring point and evaluation unit (e.g. transmitter) must be taken into account (see left column).
All FEMA evaluation units (transmitters and temperature switches) have an inputcircuit for 3-wire connection. The sensors must be connected as shown in the following diagrams. All three wires must be of equal length and have the same conductor cross-section to compensate for the line resistances.
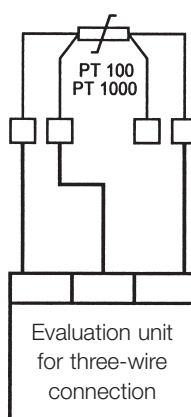
Two-wire sensor

PT 100
PT 1000

Evaluation unit for three-wire connection

Three-wire sensor

PT 100
PT 1000

Evaluation unit for three-wire connection

Four-wire sensor

PT 100
PT 1000

Evaluation unit for three-wire connection

FEMA

Fast temperature sensors Type series STF21/31

## Accurate Pt 100 / Pt 1000 Class A sensors in stainless steel

· Low-cost and accurate
· Parts in contact with medium made of stainless steel

· Insertion depth easily adjustable
· Easy to install
· STF31… ideal for use with TST

STF 21/31

Technical data

Sensor
STF21 (Pt 100)	100 Ω at 0°C STF31
(Pt 1000)	1000 Ω at 0°C

Accuracy
STF21/31	IEC751 Class A
	0.15 K + 0.2 % • [t]
	(t in °C)

Sensitivity
STF21 (Pt 100)	≈ 0.385 Ω / K
STF31(Pt 1000)	≈ 3.85 Ω / K

Response time
Nominal	t0.5 = 2.5 seconds

Pressure rating
STF21 / STF31	PN16 (nominal)

Electrical connection
Cable	3-wire (Teflon sheath)

Maximum permitted velocity of medium
75 mm length	20 m/s
220 mm length	10 m/s

Materials
Sensor screw fitting	Stainless steel 1.4571 (AISI 316Ti)
Sensor tube	Stainless steel 1.4571 (AISI 316Ti)
Connection cable	PTFE (Teflon)

Dimensions and tightening torque
|	
Sensor length	75 mm and 220 mm
Sensor diameter	4 mm
Screw-in thread	R1/2"
Tightening torque	10 +/-2 Nm at 20°C

STF dimensions
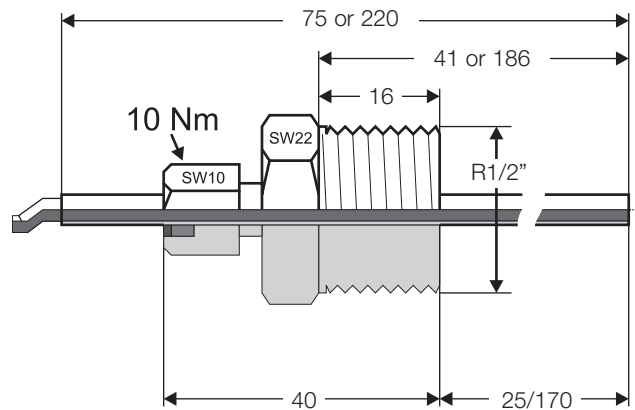
Medium:
Mineral and synthetic oil, glycol-water mixtures, cooling and lubricating emulsions, coolant liquids, service water, swimming pool water, air, non-aggressive gases and media which have no effect on material 1.4571 (AISI 316Ti).

Sensor length	Measuring range	Sensor type	Type
75 mm	-20°C…+300°C	PT 100	**STF21-75**
220 mm	-20°C…+300°C	PT 100	**STF21-220**
75 mm	-20°C…+300°C	PT 1000	**STF31-75***
220 mm	-20°C…+300°C	PT 1000	**STF31-220***

*) For attachment to TST200EPT1K or TST400EPT1K, the sensor plug ST8-3 must be ordered separately.

CE

Degree of protection: IP 65

FEMA
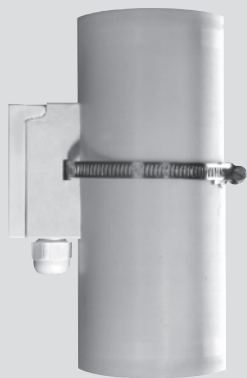
Strap-on sensor ALF21/31

High-quality sensors for HVAC and industrial applications ALF..., TF..., KF..., RF21/31

Accurate Pt 100 / Pt 1000 Class A sensors with IP 65 plastic terminal box

The highly accurate and reliable sensors of the ALF, TF, KF and RF series are designed for demanding HVAC applications. They are also suitable for industrial applications, where 3-wire technology is standard and IP 65 protection is considered necessary for the terminal box. A very low-cost yet highly accurate solution thanks to the use of Pt 100/1000 Class A sensors.

Technical data

Sensor accuracy
Sensor technology — IEC751 Class A
0.15 K + 0.2 % • [t]
(t in °C)

Sensitivity
Pt 100 — ≈ 0.385 Ω / K
Pt 1000 — ≈ 3.85 Ω / K

Electrical connection
Cable connection — PG11 and screw
terminals 3 x1.5 mm²

Electrical data
Measuring current — 1 mA
Insulation resistance — > = 100 MOhm
at 20 °C (500VDC)
Sensor connection — 3-wire
Degree of protection — IP 65

The ALF series strap-on sensors have a spring-loaded sensor ensuring good heat transfer at all times. In view of the 3-wire design, these sensors (Pt 1000A version) are recommended as an economical alternative for use together with TST…EPT1K.

Types, applications and materials

| Type	Description	Max. permissible pressure immersion tube	Temperature range	Sensor	Protective tube material
ALF21	Strap-on sensor	n.a.	-30 to +110°C	Pt 100	n.a.
ALF31	Strap-on sensor	n.a.	-30 to +110°C	Pt 1000	n.a.
TF21*	Immersion sensor	40 bar	-30 to +150°C	Pt 100	1.4301
TF31*	Immersion sensor	40 bar	-30 to +150°C	Pt 1000	1.4301
KF21**	Air duct sensor	n.a.	-30 to +150°C	Pt 100	1.4301
KF31**	Air duct sensor	n.a.	-30 to +150°C	Pt 1000	1.4301
RF21	Room sensor	n.a.	-50 to +90°C	Pt 100	1.4571
RF31	Room sensor	n.a.	-50 to +90°C	Pt 1000	1.4571

*   A thermowell made from 1.4571 stainless steel is included.
**   A PVC mounting flange is included.
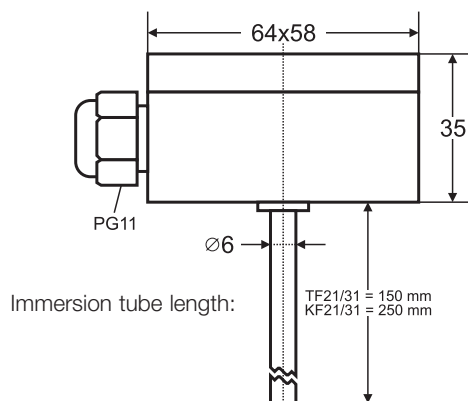
Terminal box made from PA6 (polyamide)

Air duct sensor KF21/31

Room temperature sensor RF21/31

CE

Dimensions

ALF21/31
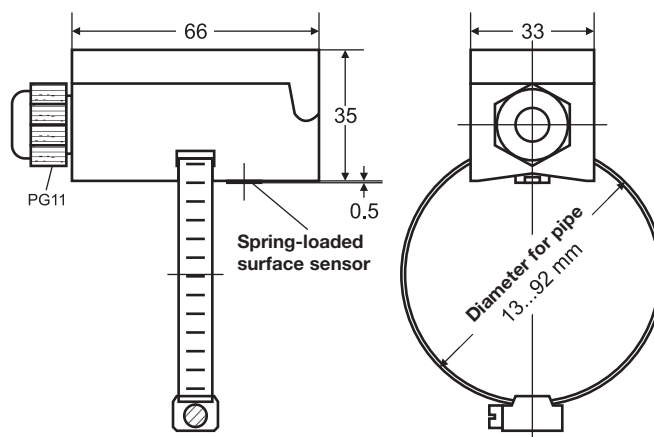
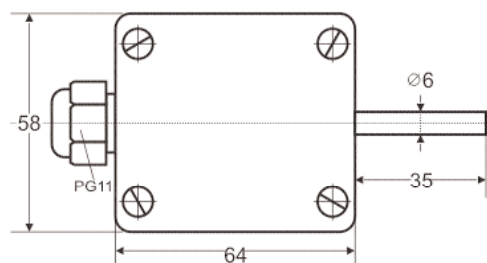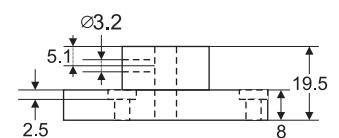Tension band for pipe diameters 13 to 92 mm included.

TF/KF21/31

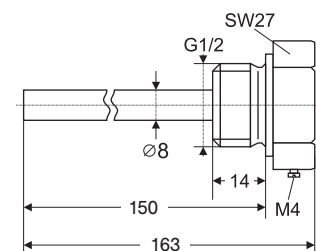Immersion tube length:

TF21/31 = 150 mm
KF21/31 = 250 mm

RF21/31

Included accessory TF/KF21/31

Mounting flange for KF21/31

Thermowell for TF21/31

Type series P 17

made from stainless steel

The temperature sensors are made from stainless steel.
Protective tube material: 1.4571, terminal box: 1.4301. Sensor element: Pt sensor. Accuracy class A according to DIN IEC 751.
Three-wire connection, cable entry PG11, degree of protection IP65. Protective tube diameter 8 mm.
Protective tube immersion depth, see table.
Max. temperature at the connection head 150°C.
Suitable connection cables must be used.

P171-150

P177-250

Immersion sensor with G 1/2" thread
Temperature range -50…400°C

Immersion depth L (mm)	Max. permissible pressure (bar)	Type Pt 1000	Type Pt 100
100	40	P 271-100	P 171-100
150	40	P 271-150	P 171-150
200	35	P 271-200	P 171-200
250	35	P 271-250	P 171-250

The "Max. permissible pressure (bar)" indicated in the table is valid up to a temperature of 250°C. Above that temperature, the maximum permissible pressure is reduced by 50%.
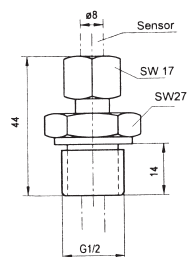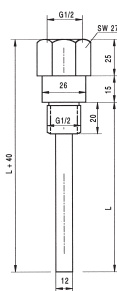
Air duct sensor
Temperature range -50…220°C

Immersion depth L (mm)	Type Pt 1000	Type Pt 100
100	P 277-100	P 177-100
150	P 277-150	P 177-150
200	P 277-200	P 177-200
250	P 277-250	P 177-250

Compression fittings G 1/2

Sensor Ø	Type
8 mm	R 18
5 mm	R 15

Immersion tubes G 1/2, (only suitable for P 171…, P 271… and PZ 171…)

Immersion depth L (mm)	Type
100	R 185-100
150	R 185-150
200	R 185-200
250	R 185-250

R 18   R 185

Honeywell
FEMA

203

Temperature transmitters

FEMA

PZ171-100/50

2-wire temperature transmitters made from stainless steel, type series PZ17

Output signal 420 mA, sensor Pt 100

The temperature transmitters are made entirely from stainless steel. The transmitter module is accommodated in the housing head for ease of access and can be replaced if required.

Technical data

Sensor element	Pt 100, Class B according to DIN IEC 751

Temperature ranges

Range	No.
-50 to + 50°C	55
-50 to + 100°C	51
0 to 50°C	50
0 to 100°C	100
0 to 200°C	200

The no. identifying the temperature range must be added to the type designation. Example: PZ 171-200/100

Direction of action	Rising temperature produces a rising output signal.
Mounting position	Any
Degree of protection	IP 65
Electrical connection	Cable entry Pg 11
Operating voltage	12–36 VDC
Output signal	4–20 mA
Impedance	500 ohms at 24 VDC
Response time in liquids	(63 % temperature change) 15 seconds
Linearity error	max. ± 0.1 % FS
Temperature drift	0.01 % FS/°C
Temperature at transmitter head	-10 to 70°C
Materials	Sensor: 1.4571 Housing: 1.4301
Accessories	Compression fitting R 18
Immersion tubes	for type 171 see page 38

Product Summary

Immersion depth L (mm)	Max. permissible pressure	Screw-in thread G 1/2
100	40	PZ 171-100/…
150	40	PZ 171-150/…
200	35	PZ 171-200/…
250	35	PZ 171-250/…
Special lengths up to 1500 mm	14	PZ 171-…/…

Immersion depth L (mm)	Air duct sensor*	
100	PZ 177-100/…	
150	PZ 177-150/…	
200	PZ 177-200/…	
250	PZ 177-250/…	
Special lengths up to 1500 mm	PZ 177-…/…	

* For temperature ranges see table with reference number

Specification

Temperature transmitter made entirely from stainless steel with G 1/2 thread / G 1/2 union nut / immersion sensor / air duct sensor immersion depth … mm, temperature range from … to …°C. Supply voltage 1236 VDC, output signal 420 mA.

Dimensions

ø65
51
38
ø14
Pg 11
51
SW 27
ø26
G1/2
L
ø8

Connection scheme

4….20 mA
11 - 36 V DC
A
+   –
1   2   3

CE
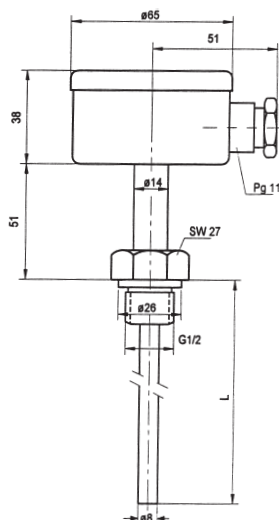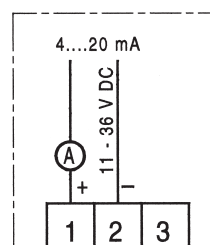
Degree of protection: IP 65

2-wire temperature transmitter in plastic housing TP

Output signals 4-20 mA, sensor Pt 100

TP series temperature transmitters consist of a fast responding Pt 100 sensor built into a 5 mm stainless steel tube with an immersion depth of 140 mm.
Suitable stainless steel and brass immersion tubes are available.

The electronic analyser is mounted directly on the sensor. The supply voltage and outputsignal are connected to a plug satisfying DIN 43650. The electronic analyser is well protected (IP 65) inside a macrolon housing.

T21-55

Technical data

Sensor element	Pt 100 with tolerance class A according to DIN IEC 751
Temperature ranges	See Product Summary
Direction of action	Rising temperature produces a rising output signal.
Mounting position	Any
Degree of protection	IP65
Electrical connection	Plug connection (3-prong) according to DIN 43650
Response time	in liquids (63% temperature change) ·15 sec. without immersion tube ·25 sec. with immersion tube R 10/brass ·33 sec. with immersion tube R 10/steel
Operating voltage	11-36 VDC
Output signal	4-20 mA
Load impedance	$Rs_{max} = \dfrac{Ub-11V}{0.02\,A}$ Under operating condition Ub = 24 V and Rs =500 ohms, the following values apply: $Rs_{max} = \dfrac{24\,V - 11V}{0.02\,A}$ = 650 ohms
Linearity	max. ± 0.05% FS
Temperature drift	(-10 ... 50°C) Lower range limit max. ± 0.05% FS/K Measurement range max. ± 0.01% FS/K
Ambient temperature for analysis module	-40…60°C

Product Summary

Type	Temperature range °C	Max. permitted temperature °C	Output signal	Operating voltage
TP21-55	-50… +50°C	150°C	4 - 20 mA	11 - 36 VDC
TP21-150	-50… +150°C	180°C	4 - 20 mA	11 - 36 VDC

✚ Accessories
Immersion tubes and compression fittings, see page 32.

Specification
Temperature transmitter with Pt 100 sensor to DIN IEC 751, tolerance class A.
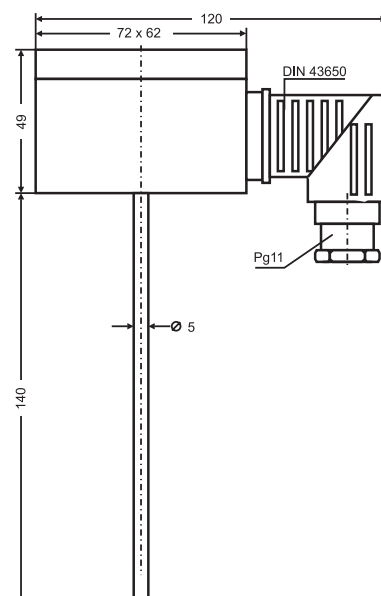Rod sensor 5 mm Ø, 140 mm long.
Electronic analyser with plug connection to DIN 43650, degree of protection IP 65.
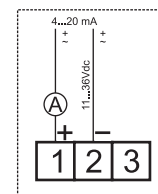Output signal 4-20 mA.
Type TP…
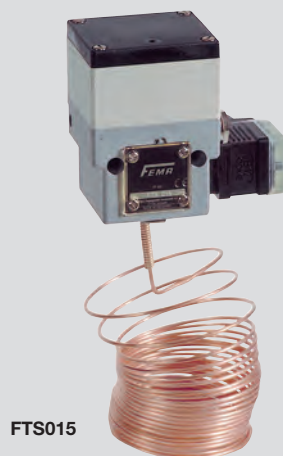Optional immersion tube R 10/brass or R 10/steel G1/2, 135 mm immersion depth and retaining spring FF 135.

Dimensions

Connection scheme

TP 21…

Two-phase frost protector Type series FTS

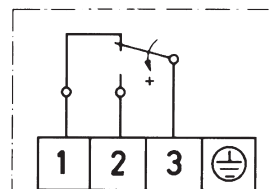## with limiter contact and integrated priority selection

With falling temperature the frost protector generates a rising output signal from 0–10 V.

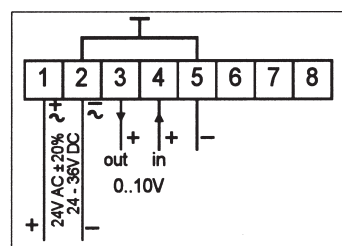If the temperature continues to fall, a limiter contact (single-pole changeover contact) is actuated.

FTS015

Technical data

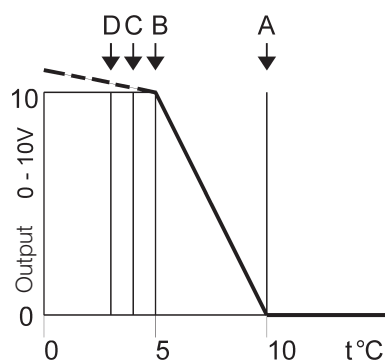|	
Supply voltage	24 VAC ± 20 % or 24–36 VDC
Output signal	0–10 V ± 1 mA (with falling temperature) + floating limiter contact
Power consumption	max. 1 W
Cable entry	M16 x 1.5 for output signal 0–10 V Plug connection to DIN 43650 for limit value switch
Degree of protection	IP 65
Mounting	With 2 x 4 mm screws directly on the duct wall. 5 capillary tube holders type H 3 are included
Ambient temperature	12 to 50°C Please note: at ambient temperatures below 10°C the unit responds and signals "risk of frost"
Switching capacity	8 A, 250 VAC

If the output signal of the controller (Y signal) is looped through the frost protector, a maximum selection of the two signals takes place. If the Y signal from the controller is greater than the output signal of the frost protector, the controller determines the position of the heating valve (normal operation). If the output signal of the frost protector is greater than the Y signal of the controller (risk of frost), then the frost protector determines the position of the heating valve, as long as "risk of frost" is signalled by the sensor. When there is no longer any risk of frost, the controller automatically resumes control of the heating valve.

External priority selection is therefore not required. The sensor acting over the entire length is self-monitoring, i.e. in the event of breakage or damage to the capillary tube, "risk of frost" is signalled. If the signal of the controller is not looped through, the FTS outputs the signal of the frost protector.
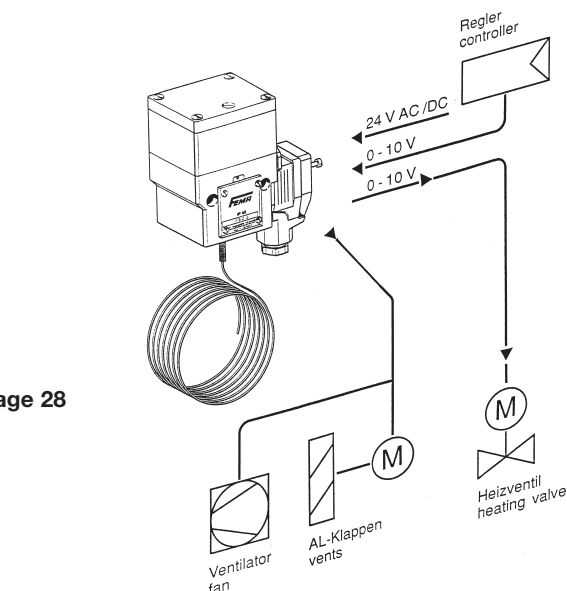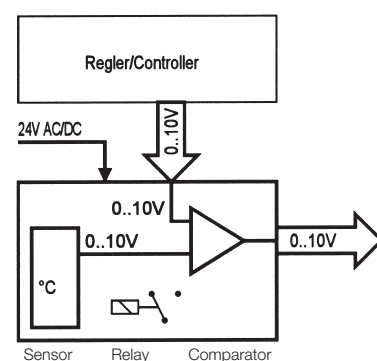
Product Summary

Type	Range of action	Capillary tube
FTS 015	+10 to +3°C	6 m
FTSB 015	+10 to +3°C	3 m

Characteristics

For frost protection thermostats, see page 28

Connection scheme (plug connection)

Connection scheme (terminal connection)

Schematic diagram

Specification

Two-phase frost protector with limiter contact and integrated maximum selection for monitoring the surface of the air heater, input signal: 0–10 V, output signal: 0–10 V ± 1 mA + single-pole changeover switch. Capillary tube length 3/6 m.

CE