TURCK

Your Global Automation Partner

TS700…
Compact Temperature
Sensors

Instructions for Use

Contents

1 About these instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols

The following symbols are used in these instructions:

⚠	**DANGER** DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.
⚠	**WARNING** WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.
⚠	**CAUTION** CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.
❗	**NOTICE** CAUTION indicates a situation which, if not avoided, may cause damage to property.
ℹ	**NOTE** NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.
▶	**MANDATORY ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULT OF ACTION** This symbol denotes the relevant results of an action.

1.3 Other documents

Besides this document, the following material can be found on the Internet at **www.turck.com**:

- Data sheet
- Declarations of conformity
- Quick Start Guide
- Commissioning manual IO-Link devices

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to **techdoc@turck.com**.

2 Notes on the product

2.1 Product identification

These instructions apply to the following compact temperature sensors:

| TS | 7 | 0 | 0 | – | L016 | – | 30 | – | LI2UPN8 | – | H | 1 | 1 | 4 | 1 |

TS Operating principle

Operating principle
TS Temperature sensor

7 0 0 Mechanical design — **L016** Probes

Display
0 12-segment display

Mechanical design
0 Process connection via adapter

Design
7 Compact device

Probes
L016 Immersion length 16 mm
L050 Immersion length 50 mm

30 Process connection — **LI2UPN8** Electrical version — **H1 1 4 1** Electrical connection: Male connector

Process connection
16 1/2" NPT male thread
30 G1/2" male thread

Electrical version
LI2UPN8 Analog and switching outputs, voltage range 17…33 VDC
2UPN8 2 switching outputs, voltage range 17…33 VDC

Assignment
1 Standard-compliant assignment

Number of contacts
4 4 contacts

Orientation
1 Straight

Design
H1 Male connector M12 x 1

Devices with Smart Sensor Profile 4.1.1

The instructions for use apply to devices from Production date 2310 (date format YYWW) with Smart Sensor Profile 4.1.1. You can find the production date on the back of the housing.
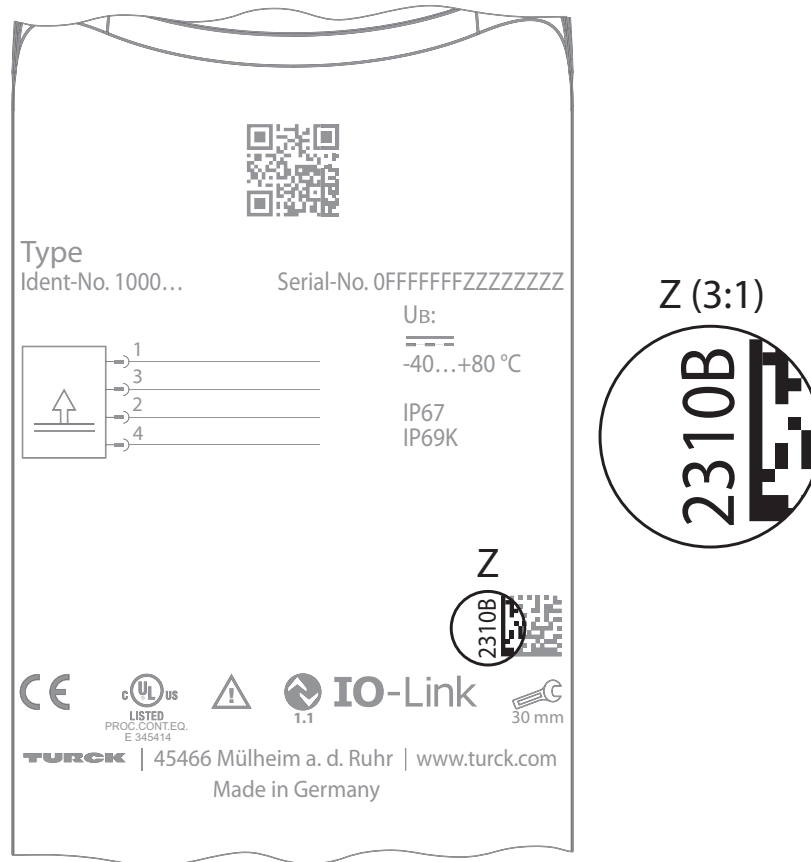
Fig. 1: Production date on the back of the housing

2.2 Scope of delivery

The delivery consists of the following:

- Compact temperature sensor
- Screw-in adapter with process connection, 1/2″ NPT or G1/2″ male thread
- TS700…-30-…: 2 AFM flat seals
- Quick Start Guide

2.3 Turck service

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database at **www.turck.com** offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

The contact data for Turck branches is provided at [▶ 47].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The compact temperature sensors of the TS700… product series are designed for measuring temperatures in machines and plants.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 Obvious misuse

- The devices are not safety components and must not be used for personal or property protection.

3.3 General safety instructions

- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- Only operate the device within the limits stated in the technical specifications.

4   Product description

> **NOTE**
> These instructions apply to compact temperature sensors in the TS700… product series from production date 2310 (date format YYWW) with Smart Sensor Profile 4.1.1. The date of production can be found on the rear of the housing. Devices prior to a production date 2310 are not compatible with the Smart Sensor Profile. The 100020589 instructions for use apply to old devices.

The compact temperature sensors in the TS+ product series feature a metal housing with an integrated temperature probe in immersion lengths of 16 mm or 50 mm. The devices are equipped with a 1/2″ NPT or G1/2″ process connection. The sensor head can also be rotated by 340° after installation. The display can be rotated 180°. The devices have a metal M12 connector (male) for connecting the sensor cable.

Devices with the following output functions are available:

- TS…LI2UPN…: 2 switching outputs (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1 or 1 switching output (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1 and 1 analog output (I/U/Auto)
- TS…2UPN…: 2 switching outputs (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1

4.1   Device overview

TS700…-16-…
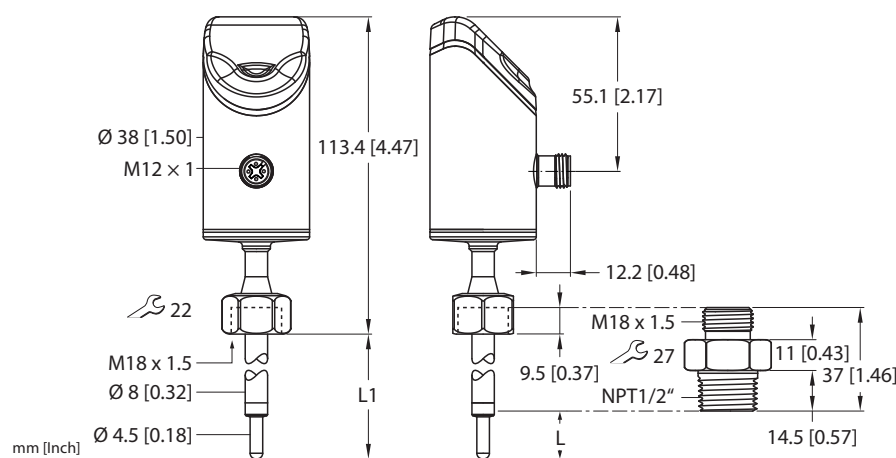
Fig. 2: Dimensions in mm [inch]

TS700…-30-…
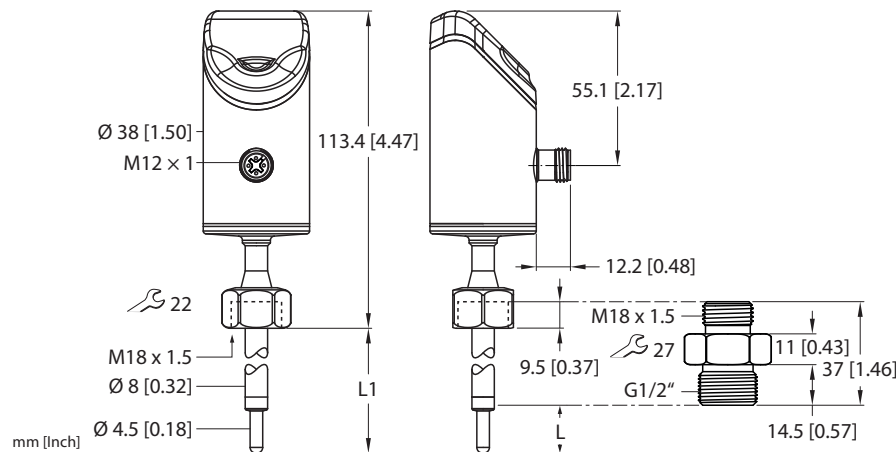
Fig. 3: Dimensions in mm [inch]

4.2 Properties and features

- Compact temperature sensor with G or NPT process connection
- 4-digit, 2-color, 12-segment display, rotatable by 180°
- Housing upper section rotatable by 340°
- Legacy Mode: Various IO-Link mapping profiles selectable

4.3 Operating and display functions

The front of the device is provided with three touchpads [ENTER], [MODE] and [SET], a 4-digit 12-segment multicolor display and status LEDs. This enables the user to set all essential functions and properties directly on the device and read the actual process values and set switching points.

4.4 Operating principle

The compact temperature sensor measures the temperature value through an integrated probe. The measured temperature value is passed on to the higher-level I/O. The device display shows the temperature value in the unit selected by the user.

4.5 Functions and operating modes

Type	Output
TS…LI2UPN…	2 switching outputs (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1 or 1 switching output (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1 and 1 analog output (I/U/Auto)
TS…2UPN…	2 switching outputs (PNP/NPN/Auto) according to Smart Sensor Profile 4.1.1

The sensors can be operated in normal operation (factory settings) or in Legacy Mode. In normal operation, a single point mode (SPM), two point mode (TPM) or window mode (WIn) can be set for the switching outputs. In single point mode, a limit value is set at which the selected switching output changes its switching state. In two point mode, a lower and an upper limit are set at which the selected switching output changes its switching state as the temperature rises or falls. In window mode, a lower and an upper window limit are set. Outside the window, the selected switching output changes its switching state.

In Legacy Mode, a window function or a hysteresis function can be defined for the switching outputs. The output range of the analog output is freely scalable to the measuring range. The measured temperature can be displayed in °C, °F or K. The device parameters can be set via IO-Link and with the touchpads.

4.5.1 Setting options

The devices have three setting options:

- Setting via IO-Link
- Setting via touchpads
- Setting via FDT/DTM

4.5.2 Normal operation — run mode

The device detects the temperature on the probe and shows the required switching or analog behavior according to the factory-set or customer-specific parameters. The display indicates the process temperature present, the selected unit and the status of the switching outputs.

4.5.3 Programming mode

When the sensor is unlocked, the display will go into programming mode after the user presses the [MODE] touch pad. In programming mode, all parameters and their corresponding values can be read out and changed. The values for a parameter are displayed by briefly pressing the [ENTER] touch pad. The [MODE] and [SET] touch pads are used to navigate within programming mode. For more information, refer to the chapter "Setting and parameterization."

4.5.4 Legacy Mode

Devices prior to production date 2310 without Smart Sensor Profile operate with their own menu guidance, which is divided into a main menu, an extended functions menu and VDMA menus.

In Legacy Mode, devices after production date 2310 with Smart Sensor Profile can be operated using the old menu guidance.

4.5.5 Output functions

The output functions in normal operation (factory setting) include a single point mode (SPM), a two point mode (TPM) or a window mode. In Legacy Mode, a window function or hysteresis function can be selected.

4.5.6 Output functions — switching output

The switching logic can be inverted via IO-Link or via the touchpad (parameter LOGI). The following examples apply to the **HIGH** (0 → 1) switching logic.

Single point mode

In single point mode, the switching behavior is defined via a SP1 limit value and a hysteresis. The output changes its switching state at limit value SP1.

The hysteresis can be set via IO-Link or via the touchpad (parameter HYST) and must be within the detection range.

If the process value increases, the switching output is inactive as long as the process value is between the start of the detection range and the SP1 limit value. If the process value increases above the SP1 limit value, the switching output becomes active.

If the process value decreases, the switching output is active as long as the process value is between the end of the detection range and the SP1 limit minus the set hysteresis (SP1-Hyst). If the process value decreases below the limit value (SP1-Hyst), the switching output becomes inactive.

Fig. 4: Single point mode

Two point mode

In two point mode, the switching behavior is defined via a switch-on point SP1 and a switch-off point SP2. This mode can also be used as a freely adjustable hysteresis.

If the process value increases, the switching output is inactive as long as the process value is between the start of the detection range and the switch-on point SP1. If the process value rises above the switch-on point SP1, the switching output becomes active.

If the process value decreases, the switching output is active as long as the process value is between the end of the detection range and the SP2 switch-off point. If the process value decreases below the switch-off point SP2, the switching output becomes inactive.
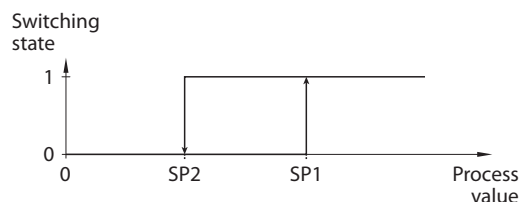
Fig. 5: Two point mode

Window mode

In window mode, an upper and lower window limit are set for the switching output. A hysteresis can be set for the window limits SP1 and SP2. The switching window must be within the detection range.

The hysteresis can be set via IO-Link or via the touchpad (parameter HYST) and must be within the detection range.

If the process value increases, the switching output is inactive as long as the process value is between the start of the detection range and the window limit SP2. The switching output remains active until the process value increases above the window limit SP1 plus the hysteresis (SP1+Hyst). If the process value increases above (SP1+Hyst), the switching output becomes inactive again.
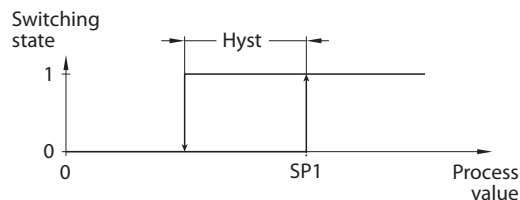
If the process value decreases, the switching output is inactive as long as the process value is between the end of the detection range and the window limit SP1. The switching output remains active until the process value decreases below the window limit SP2 minus the hysteresis (SP2-Hyst). If the process value decreases below (SP2- Hyst), the switching output becomes inactive again.
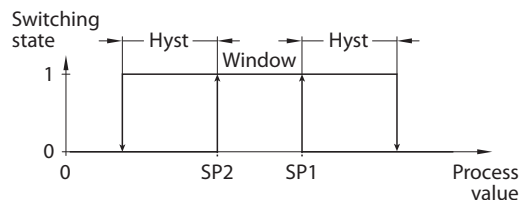
Fig. 6: Window mode

4.5.7 Output functions — switching output in Legacy Mode

A window function and a hysteresis function can be set for the switching outputs.

Window function

The window function is used to set a switching range in which the switching output takes on a defined switching state. The switching range is defined by means of an upper (FH) and lower limit (FL). The minimum distance between the switching points is 0.2 K. The release point is automatically adjusted if the switching point is changed.
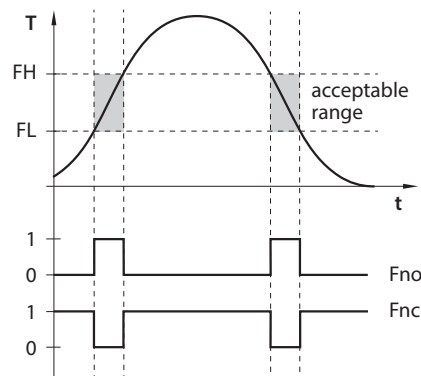
Fig. 7: Behavior of the switching output – Window function

Hysteresis function

The hysteresis function is used to set a stable switching state around a setpoint that is independent of system-related temperature fluctuations. The switching range is defined by means of a switching point (SP) and a release point (rP). The minimum hysteresis is 0.2 K. The release point is automatically adjusted if the switching point is changed.
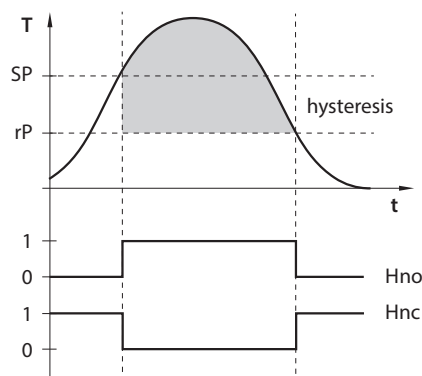
Fig. 8: Behavior of the switching output (hysteresis function)

4.5.8 Output functions — analog output

The analog output of the TS…LI2UPN8 sensors can be set as either a current or voltage output. The measuring range is freely definable.

The minimum distance between the start and end point is 0.2 K.

Current output

In the defined measuring range, the device supplies an analog current signal between ASP (analog start point) and AEP (analog end point). The following output configurations can be set:

- 4…20 mA (factory setting)
- 0…20 mA
- 20…4 mA
- 20…0 mA

Voltage output

In the defined measuring range, the device supplies an analog voltage signal between ASP (analog start point) and AEP (analog end point). The following output configurations can be set:

- 0…10 V
- 0…5 V
- 1…6 V
- 0.5…4.5 V
- 4.5…0.5 V (not in Legacy Mode)
- 10…0 V
- 5…0 V
- 6…1 V

Output behavior of the analog outputs

The following figures illustrate the behavior of the analog outputs:
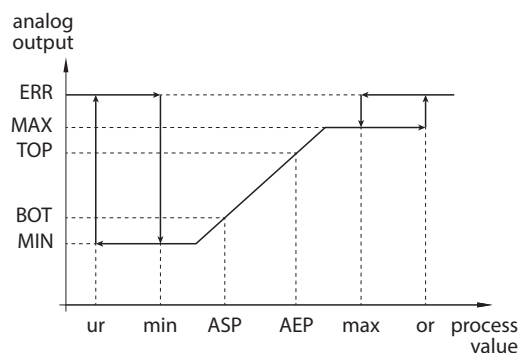
Fig. 9: Rising output characteristic
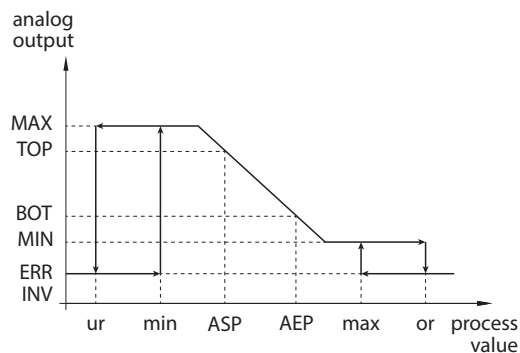
Fig. 10: Falling output characteristic, MIN ≠ 0
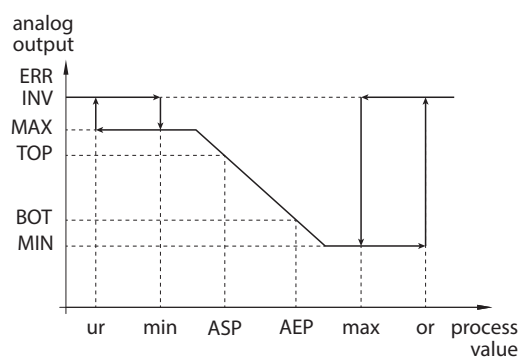
Fig. 11: Falling output characteristic, MIN = 0

Output configuration		BOT	TOP	ERR INV	MIN	MAX	ERR
4…20 mA	20…4 mA	4 mA	20 mA	3.5 mA	3.8 mA	20.5 mA	21.1 mA
0…20 mA	20…0 mA	0 mA	20 mA	21.1 mA	0 mA	20.5 mA	21.1 mA
0…10 V	10…0 V	0 V	10 V	11 V	0 V	10.5 V	11 V
0…5 V	5…0 V	0 V	5 V	6 V	0 V	5.5 V	6 V
1…6 V	6…1 V	1 V	6 V	0 V	0.5 V	6.5 V	7 V
0.5…4.5 V	4.5…0.5 V	0.5 V	4.5 V	5.5 V	0 V	5 V	5.5 V

Abbreviation	Description
ERR	Fault value
MAX	Upper value of the analog output
MIN	Lower value of the analog output
ASP	Analog start point
AEP	Analog end point
TOP	Value of the output when the AEP or ASP is reached
BOT	Value of the output when the ASP or AEP is reached
ur	Underrun/underrange
or	Overrun/overrange
max	Maximum process value
min.	Minimum process value

4.5.9   IO-Link mode

In order to operate in IO-Link mode, the device must be connected to an IO-Link master. When the port is configured in IO-Link mode, bidirectional IO-Link communication takes place between the IO-Link master and the device. To make this possible, the device is integrated via an IO-Link master at the control level. First the communication parameters are exchanged, and then the cyclic data exchange of process data (objects) starts.

4.5.10   SIO mode (standard I/O mode)

In standard I/O mode no IO-Link communication takes place between the device and the master. The device only transfers the switching state of its binary outputs and can also be run via a fieldbus device or controller with digital PNP or NPN inputs. An IO-Link master is not required for operation.

The device parameters can be set via IO-Link and then operated at the digital inputs with the appropriate settings in SIO mode. Not all functions and properties of the device can be used in SIO mode.
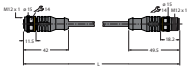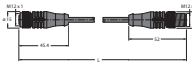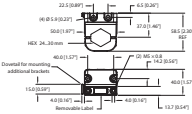
4.5.11   Auto detect function

When connected to an I/O module, the device detects the pre-defined switching output behavior (PNP/NPN) or the analog output characteristic. The auto detect function is activated by default.

4.6 Technical accessories

4.6.1 Connectivity accessories

In addition to the above connection cables, Turck also offers other cable types for specific applications with the correct terminals for the device. More information on this is available from the Turck product database at **www.turck.de/products** in the Connectivity area.

Dimension drawing	Type	ID	Description
	RKC4.4T-2-RSC4.4T/TEL	6625208	Extension cable, M12 female to male, straight, 4-pin, cable length: 2 m, jacket material: PVC, black; cULus approval
	RKC4.4T-2-RSC4.4T/TXL	6625608	Extension cable, M12 female, straight, 4-pin to M12 male, straight, 4-pin; cable length: 2 m, jacket material: PUR, black; cULus approval
	HT-WAK4-2-HT-WAS4/S2430	8038668	High-temperature-resistant extension cable, M12 female, straight, 4-pin to M12 male, straight, 4-pin; cable length: 2 m, jacket material: PTFE, white
	RKH4.4-2-RSH4.4/TFG	6933472	Food and Beverage extension cable, M12 female, straight, 4-pin to M12 male, straight, 4-pin; cable length: 2 m, jacket material: TPE, gray; approval: Ecolab, FDA
	FAM-30-PA66	100018384	Mounting of display sensors on walls and surfaces, variable wrench size 24…30 mm, removable labeling plates 20 × 9 mm

5   Installing

The compact temperature sensors may be mounted in any orientation. The display can be ro-
tated by 180°.
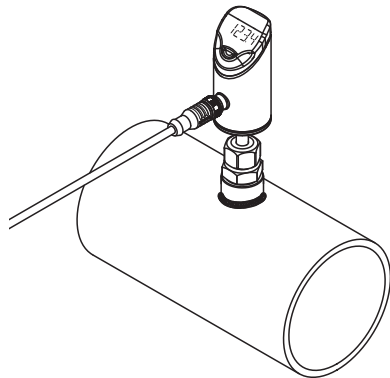
Fig. 12: Installing the TS700

▶ The compact temperature sensors in the TS700… product series can only be mounted
with screw-in adapters from the FAA-… product series or with the supplied screw-in
adapter.

▶ For TS700…-30-…: Position one of the two seals (included in the delivery) between the
screw-in adapter and the process connection (e.g. union).

▶ Screw the screw-in adapter with the seal onto the process connection (maximum torque
of 100 Nm).

▶ Guide the probe rod through the screw-in adapter and hand-tighten the sensor
(M18 × 1.5 coupling nut) with the screw-in adapter.

▶ Screw an M18 × 1.5 coupling nut onto the screw-in adapter (maximum torque of 40 Nm).

▶ Optional: Rotate the sensor head within the 340° range to align the connection to the
I/O level as well as to ensure optimum operability and readability.

▶ For TS700…-30-…: After removing and reinstalling the screw-in adapter, use a new seal
(replacement seal included in the delivery).

6   Connection

> **NOTE**
> For USA/Canada: The devices must be supplied with limited energy in accordance with UL 61010-1 3rd Edition, section 9.4 or LPS in accordance with UL 60950-1 or Class 2 in accordance with UL 1310 or UL 1585. Connect the sensor to a separated extra-low voltage (SELV) power supply.
>
> The connection cables between the temperature probe and the compact processing and display unit must have a rated operating temperature of at least 75 °C and a rated voltage of at least 300 V RMS.
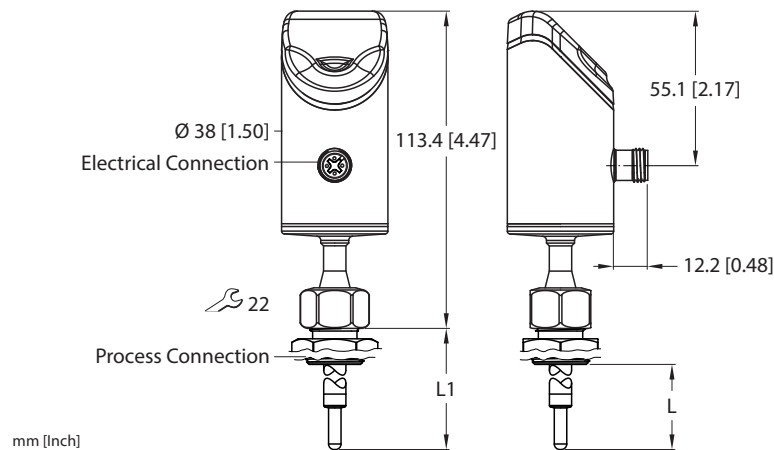
Fig. 13: Electrical connection for controller

▶ Connect the device to the controller or an I/O module according to the wiring diagram (see "Electrical connection").

6.1   Wiring diagrams
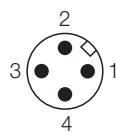
Fig. 14: Pin assignment TS…LI2UPN…
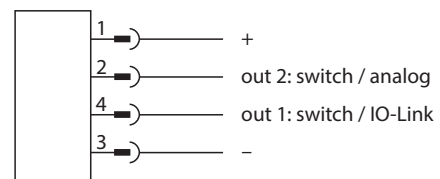
Fig. 15: Wiring diagram TS…2LIUPN…
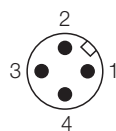
Fig. 16: Pin assignment TS…2UPN…
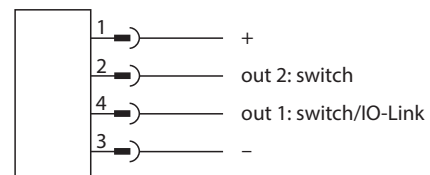
Fig. 17: Wiring diagram TS…2UPN…

7 Commissioning

The device is operational automatically once the power supply is switched on.

When connected to an I/O module, the device detects the pre-defined switching output behavior (PNP/NPN) or the analog output characteristic. The auto detect function is activated by default.

Replacing the devices

If replacing an old device (Production date 2310 (date format YYWW)) with a new device, proceed as follows:

▶ Set the Compatible Device mode in the IO-Link master so that the device changes to Legacy Mode.

▶ Alternatively, set to Legacy Mode in the Extended Functions menu.

8 Operation

> ⚠️ **WARNING**
> The enclosure can heat to over 75 °C (167 °F).
> **Risk of burns from hot enclosure surfaces!**
> ▶ Prevent the enclosure from coming into contact with flammable substances.
> ▶ Prevent the enclosure from being touched unintentionally.

8.1 LEDs — operation

LED	Display	Meaning
PWR	green	Device is operational
	Green flashing	IO-Link communication
FLT	red	Error
°C	green	Temperature in °C
°F	green	Temperature in °F
K	green	Temperature in K
LOC	yellow	Device locked
	Yellow flashing	"Lock/unlock" process active
	off	Device unlocked
I and II (switching point LEDs)	yellow	switching output ▪ NO: Switching point exceeded/within window (active output) ▪ NC: Switching point undershot/outside window (active output)
	off	switching output ▪ NO: Switching point undershot/outside window (inactive output) ▪ NC: Switching point exceeded/within window (inactive output)

8.2 Display indications

Display	Meaning
- - - -	Sensor failure
HW	Internal hardware fault
PArF	Incorrect factory parameterization
SC 1	Short circuit at output 1
SC 2	Short circuit at output 2
SC12	Short circuit at both outputs
WB 2	Wire break at current output 2
VOLT	Operating voltage outside the permissible range
LOAD	Load at the analog output outside the permissible range
Oor+	Value outside of the measuring range, temperature > 5 % of full scale above the measuring range

Display	Meaning
Oor-	Value outside of the measuring range, temperature > 5 % of full scale below the measuring range
Oor	No measurement data available
PArA	Incorrect user parameterization
TEMP	Device temperature outside the permissible range
Err	Unspecified error

9 Setting and Parameterization

The device can be assigned parameters as follows:

- Setting via touchpads
- Setting via IO-Link
- Setting via FDT/DTM

9.1 Settable functions and properties

The three front touchpads [ENTER], [MODE] and [SET] enable the user to set all the essential functions and properties directly on the device via the menu guidance. It is also possible to configure the device via the IO-Link interface (see IODDfinder).

Setting options — via touchpads and IO-Link interface

The following functions and properties can be set and used both in standard I/O mode as well as in IO-Link mode:

- Locking/unlocking the device
- Switching behavior in Smart Sensor Profile:
    - Window mode
    - Single point mode
    - Two point mode
- Switching behavior in Legacy Mode:
    - Window function
    - Hysteresis function
- Analog range
- OUT1 output configuration for SIO mode: PNP/NPN, auto detection on/off
- OUT2 output configuration for SIO mode: PNP/NPN, auto detection on/off
- Advanced settings: Reset to factory settings.
- Advanced settings: Minimum and maximum value memory
- Advanced settings: Offset adjustment
- Advanced settings: Display color and behavior

Other setting options — only via touchpads

- Advanced settings: Reset to presettings.
- Advanced settings: Set password.

Other setting options — only via IO-Link

Additional functions and properties can also be set via the IO-Link interface.

- Set display units for IO-Link mode
- Fully lock user interface (display and touchpads locked)
- Lock local parameters (user interface parameters — parameters are displayed but cannot be changed)

9.2 Setting parameter values via touchpads

Turck standard menu

▶ Unlock the device when [MODE] or [SET] is touched, a red running light appears and the LOC LED is lit.

▶ Touch [MODE] or [SET] until the required parameter is displayed.

▶ Touch [ENTER] to select a parameter.

▶ Changing the displayed value: Touch [SET] for 3 s until the display is no longer flashing. Or: Touch [MODE] to return to the parameter selection.

▶ Increase or decrease the value gradually via [MODE] or [SET]. Certain values can be continuously changed by holding down [MODE] or [SET].

▶ Touch [ENTER] to save the modified value. The saved value flashes twice.
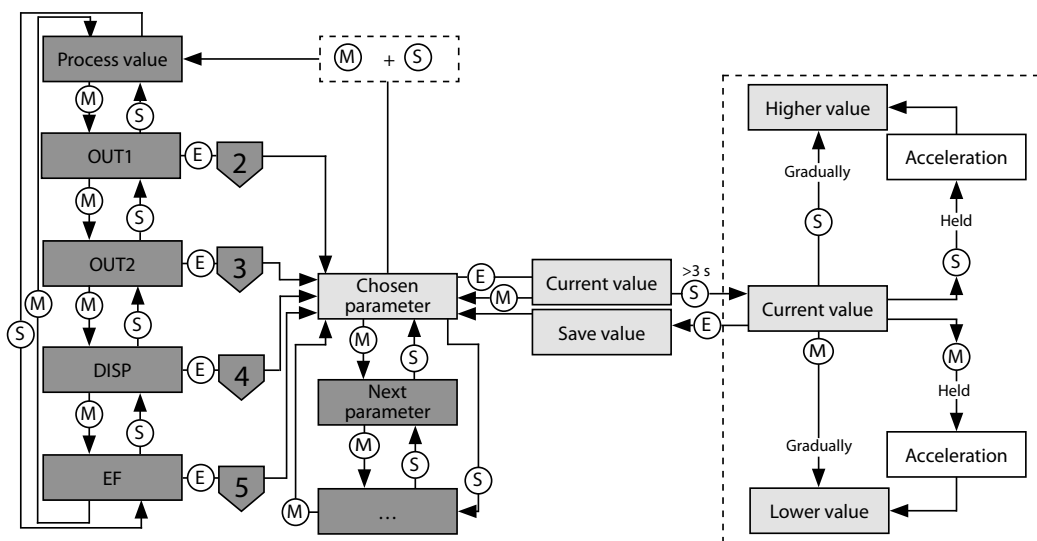
Fig. 18: Setting parameter values

9.3 Unlocking the device

▶ Touch [ENTER] for 3 s until all green bars are flashing on the display.

▶ Swipe [MODE], [ENTER], [SET] in succession: Two red flashing bars appear when each touchpad is touched. Once the two red bars have turned green, move onto the next touchpad without removing your finger from the touchscreen.

▶ Release the touchpads when six green bars are flashing on the display.

⇨ LOC LED goes off.

⇨ uLoc appears in the display and then disappears.

9.4 Locking the device

▶ Touch [MODE] and [SET] simultaneously for 3 s.

⇨ When the LOC LED flashes, Loc will appear on the display and then go out.

⇨ LOC LED is yellow.

The sensor is automatically locked if the touchpads of the device are not actuated for 1 min.

9.5 Protecting the sensor with a password

▶ Select PASS in the EF menu.

▶ Change values via [SET].

▶ Use [MODE] to navigate between the four digits of the password.

▶ Use [ENTER] to store the new password.
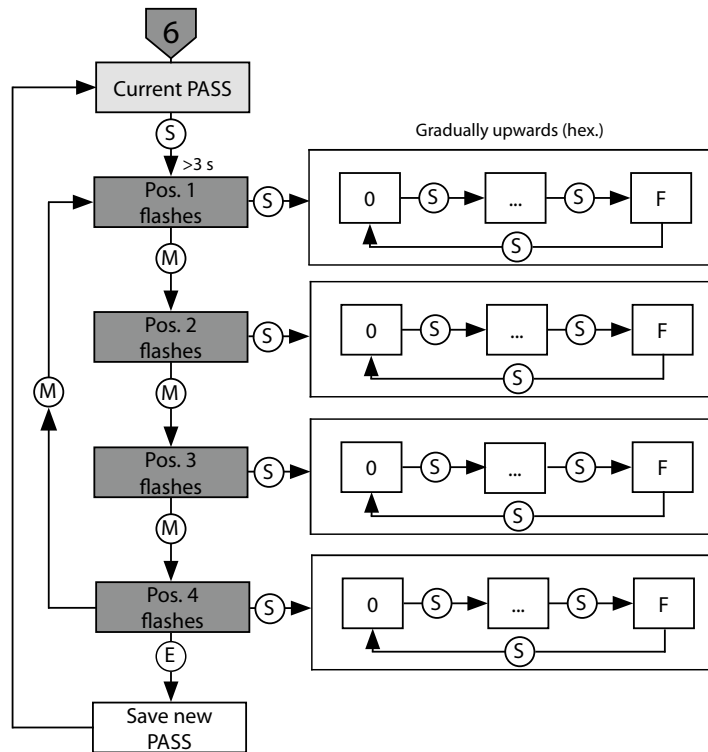
Fig. 19: Password setting

9.6   Setting via touchpads — standard menu guidance

Use the [MODE] or [SET] touchpads to navigate through the main menu, as well as the OUT1 and OUT2 submenus, the EF extended functions menu and the DISP display menu. Press [ENTER] to select the respective submenu. Touching [MODE] and [SET] at the same time will cancel the parameter assignment. The device returns to the standard display.

In the EF menu, you can select Legacy Mode with its own menu guidance.

Standard menu guidance — main menu
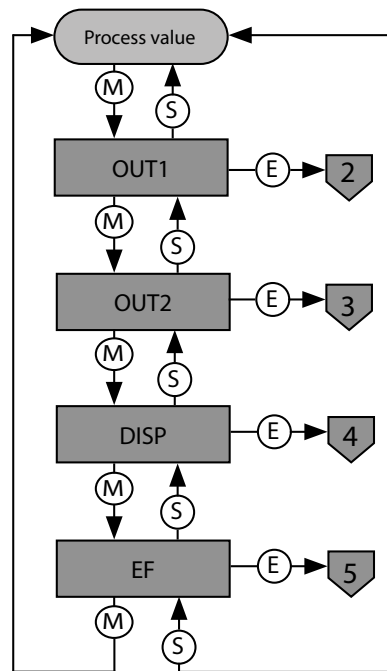
Fig. 20: Main menu

Outputs submenu (OUT…)
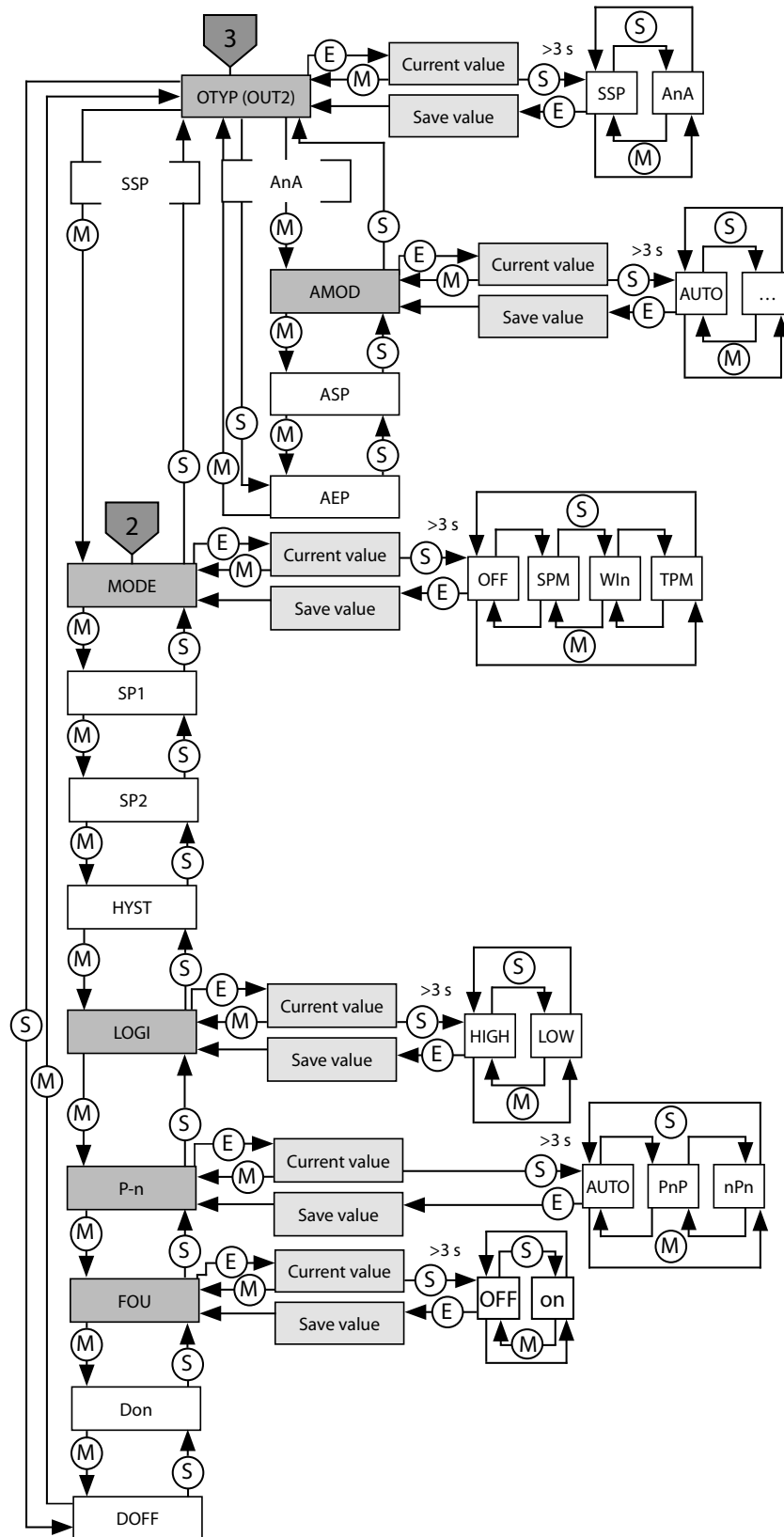
Fig. 21: Outputs submenu (OUT…)

Display submenu (DISP)
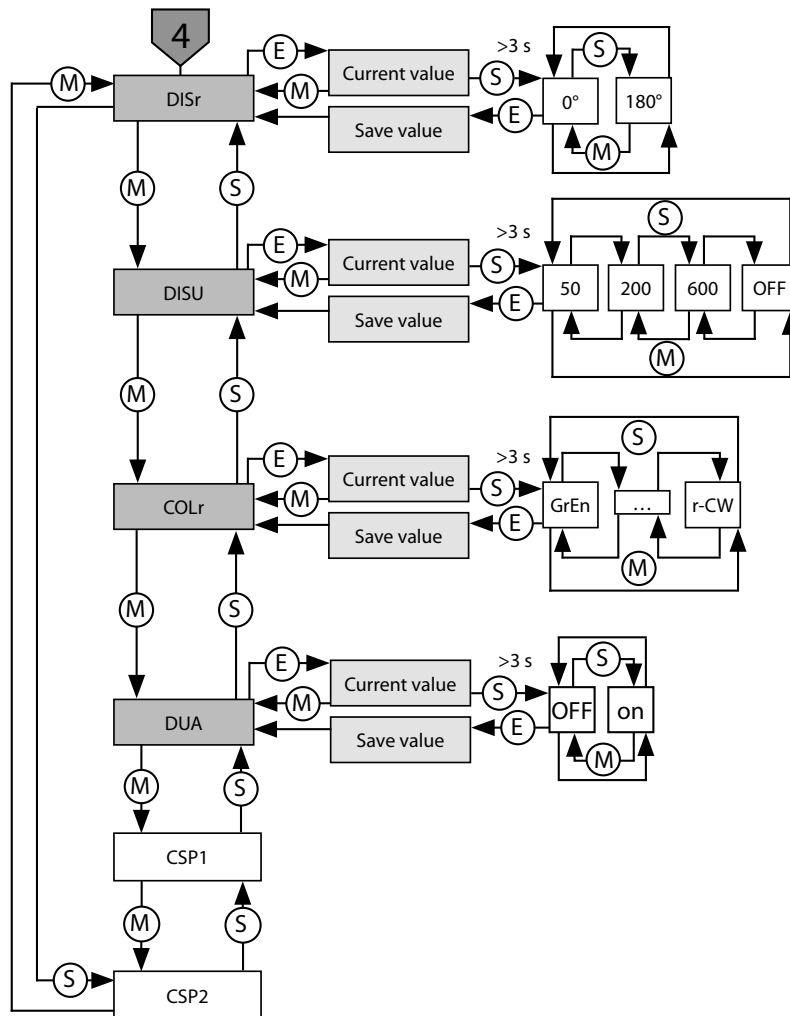
Fig. 22: Display submenu (DISP)

Extended functions submenu (EF)
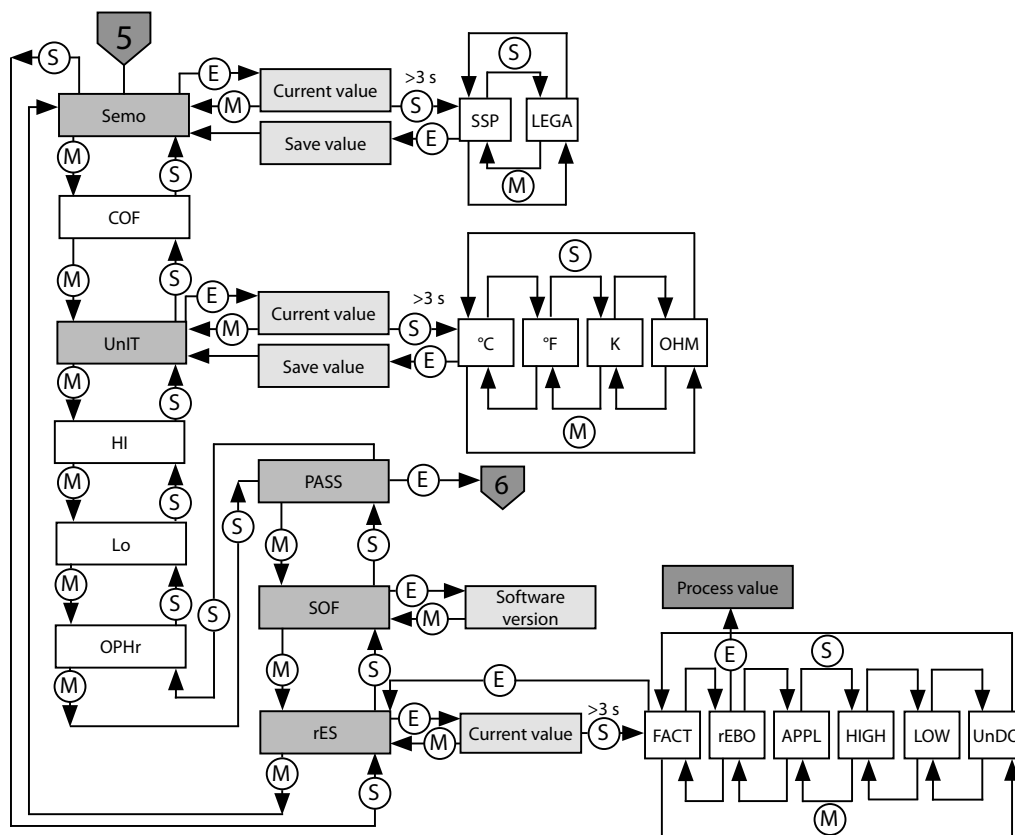
Fig. 23: Extended functions submenu (EF)

9.6.1 Parameters in the main menu

Default values are shown in **bold**.

	Explanation	Function
OUT1	Output 1 submenu	Setting options for switching output 1
OUT2	Output 2 submenu	Setting options for switching output 2 or analog output
DISP	Display submenu	Refer to the "Parameters in the DISP submenu" table for additional setting options
EF	Extended Functions submenu	For additional setting options see the "Parameters in the EF submenu" table

9.6.2 Parameters in the OUT… (outputs) submenu

	Explanation	Options	Function
OTYP	Output Type (OUT2)	SSP	Switching output Smart Sensor Profile
		AnA	Analog output
MODE		OFF	
		SPM	Single point mode
		WIn	Window mode
		TPM	Two point mode
SP1	Switching point 1		SPM: Limit value at which the switching output changes its switching state TPM: Upper limit value at which the switching output changes its switching state as the temperature rises WIn: Upper window limit at which the switching output changes its switching state **Default: 800 (80.0 °C)**
SP2	Switching point 2		SPM: Not available TPM: Lower limit value at which the switching output changes its switching state as the temperature falls WIn: Lower window limit at which the switching output changes its switching state **Default: 700 (70.0 °C)**
HYST	Hysteresis		The minimum hysteresis is 0.1 K. The maximum hysteresis comprises the complete value range of the sensor. **Default: 0.1 K**
LOGI	Invert switching logic	**HIGH**	$0 \rightarrow 1$
		LOW	$1 \rightarrow 0$
P-n	Behavior of the switching output	**AUTO**	Auto detection (NPN/PNP)
		PnP	N switching
		nPn	P switching
Don	Switch-on delay		0…60 s in increments of 0.1 s (0 = delay time not activated) **Default: 0.0 s**
DOFF	Switch-off delay		0…60 s in increments of 0.1 s (0 = delay time not activated) **Default: 0.0 s**

	Explanation	Options	Function
FOU	Behavior in the event of a fault (e.g. wire break or short circuit)	on	Switching output: The output is activated in the event of a fault Analog output: Fault value of the set function at output 2 (OUT2)
		OFF	Switching output: The output is deactivated in the event of a fault. Analog output: Fault value of the set function at output 2 (OUT2)
AMOD	Analog output (only available for OUT2)	**AUTO**	Automatic detection (4…20 mA/0…10 V)
		4–20	4…20 mA
		0–20	0…20 mA
		20–4	20…4 mA
		20–0	20…0 mA
		0–10	0…10 V
		0–5	0…5 V
		1–6	1…6 V
		10–0	10…0 V
		5–0	5…0 V
		6–1	6…1 V
		0545	0.5…4.5 V
		4505	4.5…0.5 V
ASP	Start point of the analog signal		Temperature value at which the analog output signal has its start point **Default: -49.8 °C**
AEP	End point of the analog signal		Temperature value at which the analog output signal has its end point **Default: 50.0 °C**

9.6.3 Parameters in the DISP (display) submenu

	Explanation	Options	Function
DISr	Display orientation	**0°**	Display rotated by 0°
		180°	Display rotated by 180°
DISU	Display update	50	50-ms update time
		200	200-ms update time
		600	600-ms update time
		OFF	Display update deactivated
COLr	Display color	**GrEn**	Always green
		rED	Always red
		G1oU	Green if OUT1 is switched, otherwise red
		r1oU	Red if OUT1 is switched, otherwise green
		G2ou	Green if OUT2 is switched, otherwise red
		r2ou	Red if OUT2 is switched, otherwise green
		G-CW	Green if the process value is between the virtual switching points CSP1 and CSP2
		r-CW	Red if the process value is between the virtual switching points CSP1 and CSP2

	Explanation	Options	Function
DUA	Display	**OFF**	Display of process value
		on	Alternating display of process value and unit
CSP1	Virtual upper switching point		Virtual upper switching point at which the display changes color (if display color G-CW or r-CW is selected) **Default: 80.0**
CSP2	Virtual lower switching point		Virtual lower switching point at which the display changes color (if display color G-CW or r-CW is selected) **Default: 70.0**

9.6.4 Parameters in the EF submenu (Extended Functions)

	Explanation	Options	Function
Semo	Set mode	SSP	Smart Sensor Profile
		LEGA	Legacy Mode
COF	Offset adjustment		Severe temperature changes in the environment of the sensor can cause the shifting of the zero point. As a result, the measured value zero is not displayed at 0 °C . This drift can be corrected with the offset value. Setting range: -55…+55 °C in increments of 0.1 K. **Default: 0.0 °C**
UnIT	Display unit	°C	°C
		°F	°F
		K	K
		OHM	Ohm
HI	Maximum value memory		The highest process temperature is stored and displayed.
Lo	Minimum value memory		The lowest process temperature is stored and displayed.
OPHr	Operating hours counter		Display of operating hours in years (y), days (d) and hours (h)
PASS	Password protection		Define password and activate password protection
		0000	No password
SOF	Software version		Display the firmware version
rES	Reset	FACT	Reset the parameters to factory settings
		rEBO	Restart the device (warm start)
		APPL	Reset application-specific data
		HIGH	Reset the maximum value memory: The highest process temperature is deleted.
		LOW	Reset the minimum value memory: The lowest process temperature is deleted.
		UnDO	Reset the parameters to the previous settings (last device start)

9.7 Setting via touchpads — Legacy Mode

Use the [MODE] or [SET] touchpads to navigate through the main menu, the EF extended functions menu or the VDMA menus. Press [ENTER] to select the respective submenu. Touching [MODE] and [SET] at the same time will cancel the parameter assignment. The device returns to the standard display.

In the EF menu, you can select the VDMA menu with its own menu guidance.

Legacy Mode — main menu
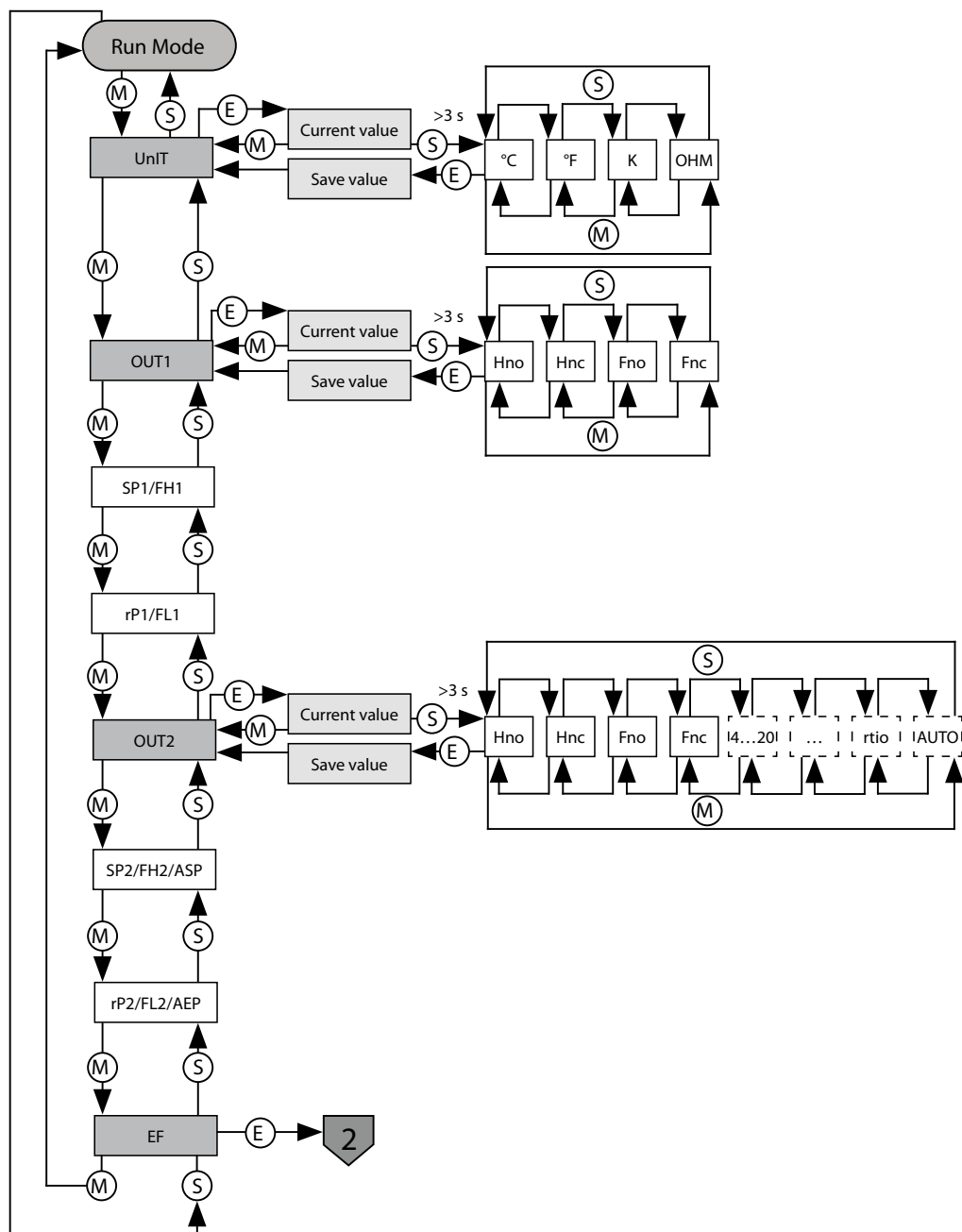
Fig. 24: Main menu TS700 in Legacy Mode

Legacy Mode — extended functions (EF) submenu
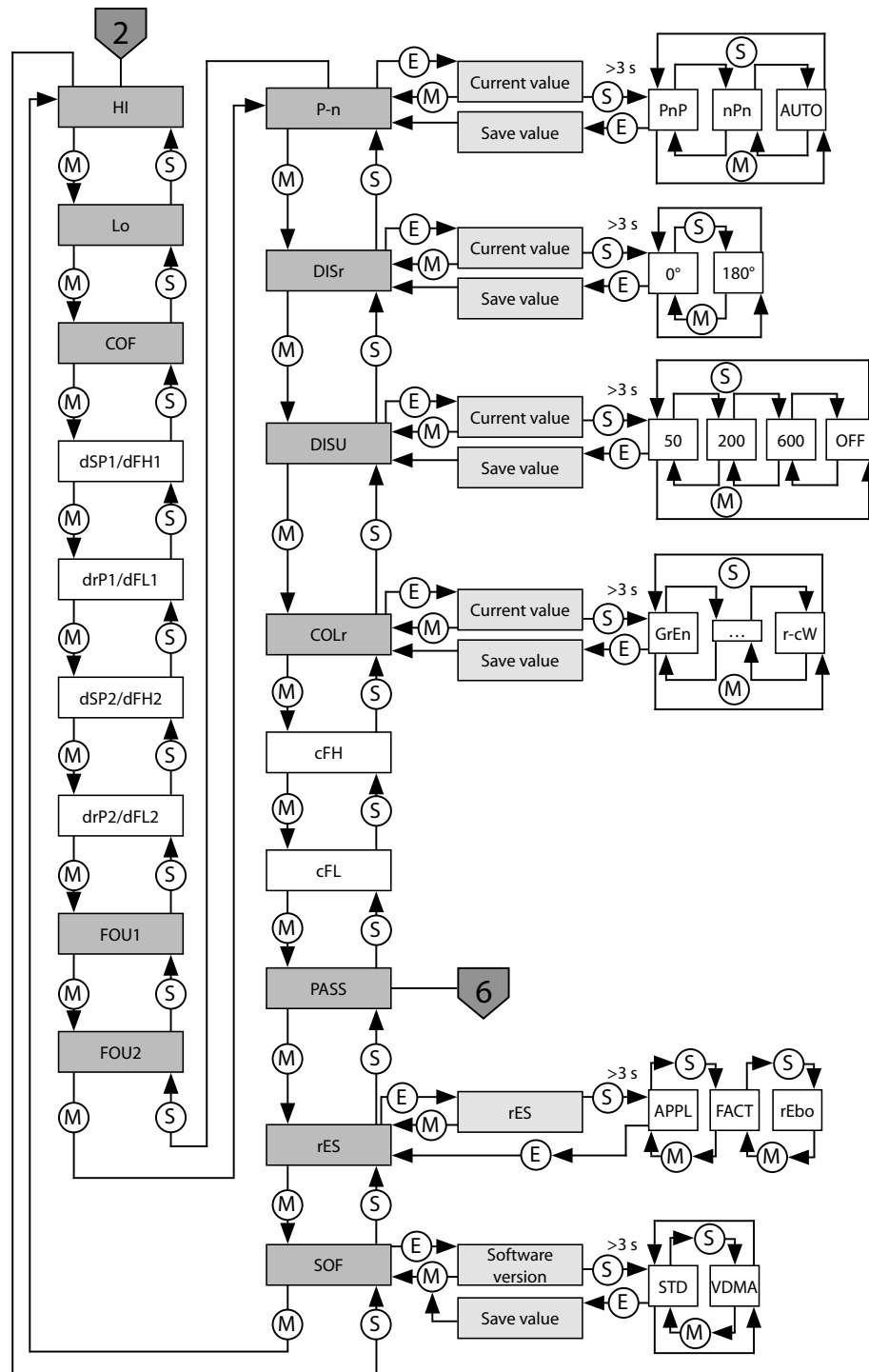
Fig. 25: Extended functions (EF) submenu in Legacy Mode

VDMA menu — main menu
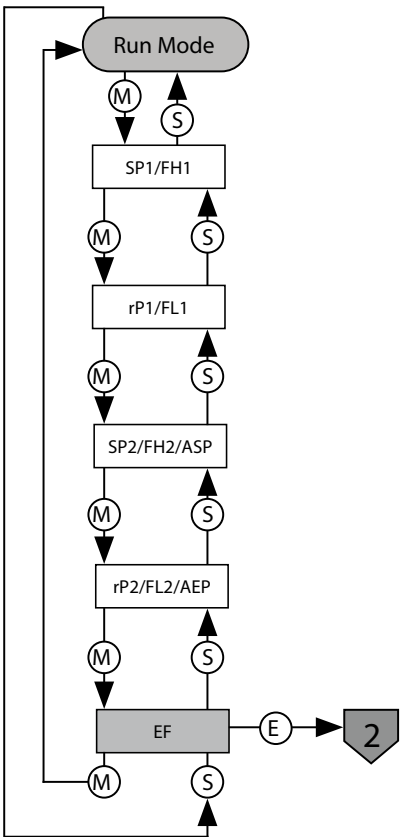
Fig. 26: Main menu in the VDMA menu guidance

VDMA menu — extended functions (EF)
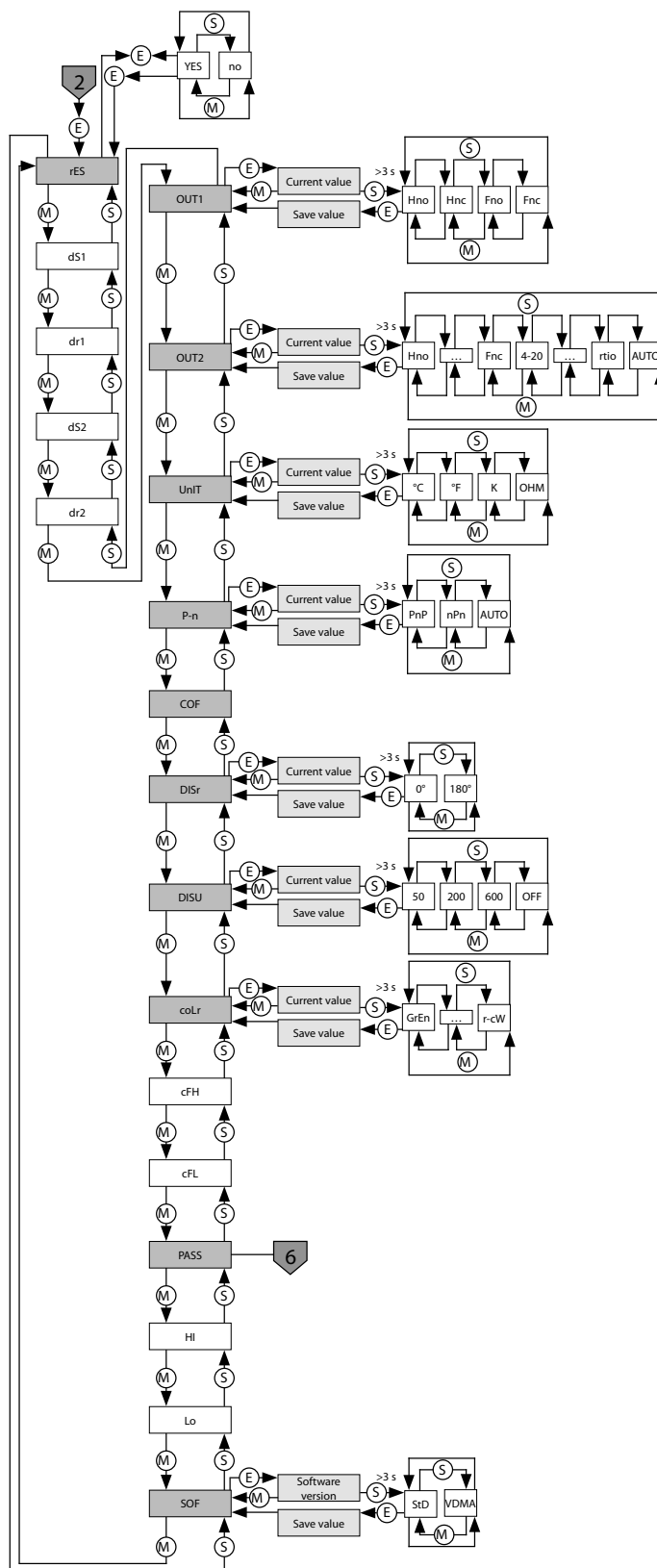
Fig. 27: Extended functions (EF) submenu in the VDMA menu guidance

9.7.1 Legacy Mode — parameters in the main menu

	Explanation	**Options**	**Function**
UnIT	Display unit	**°C**	°C
		°F	°F
		K	K
		OHM	Ohm
OUT1	Function of output 1	**Hno**	Hysteresis function (NO = NO contact)
		Hnc	Hysteresis function (NC = NC contact)
		Fno	Window function (NO = NO contact)
		Fnc	Window function (NC = NC contact)
SP1	Switching point 1 for hysteresis function OUT1: Hno/Hnc		Upper limit value at which output 1 changes its switching state as the temperature rises **Default: 80.0 °C**
rP1	Release point 1 for hysteresis function OUT1: Hno/Hnc		Lower limit value at which output 1 changes its switching state as the temperature falls **Default: 70.0 °C**
FH1	Upper switching point for window function OUT1: Fno/Fnc		Upper switching point at which output 1 changes its switching state **Default: 80.0 °C**
FL1	Lower switching point for window function OUT1: Fno/Fnc		Lower switching point at which output 1 changes its switching state **Default: 70.0 °C**
OUT2	Function of output 2	**Hno**	Hysteresis function (NO = NO contact)
		Hnc	Hysteresis function (NC = NC contact)
		Fno	Window function (NO = NO contact)
		Fnc	Window function (NC = NC contact)
	Analog output	**AUTO**	Automatic detection (4…20 mA/0…10 V)
		4-20	4…20 mA
		0-20	0…20 mA
		20-4	20…4 mA
		20-0	20…0 mA
		0-10	0…10 V
		0-5	0…5 V
		1-6	1…6 V
		10-0	10…0 V
		5-0	5…0 V
		6-1	6…1 V
		rtio	0.5…4.5 V
SP2	Switching point 2 OUT2: Hno/Hnc		Upper limit value at which output 2 changes its switching state as the temperature rises **Default: 80.0 °C**
rP2	Release point 2 OUT2: Hno/Hnc		Lower limit value at which output 2 changes its switching state as the temperature falls **Default: 70.0 °C**

	Explanation	Options	Function
FH2	Upper switching point for window function OUT2: Fno/Fnc		Upper switching point at which output 2 changes its switching state **Default: 80.0 °C**
FL2	Lower switching point for window function OUT2: Fno/Fnc		Lower switching point at which output 2 changes its switching state **Default: 70.0 °C**
ASP	Start point of the analog signal OUT2: Auto/analog values/rtio		Temperature value at which the analog output signal has its start point **Default: -49.8 °C**
AEP	End point of the analog signal OUT2: Auto/analog values/rtio		Temperature value at which the analog output signal has its end point **Default: 50.0 °C**
EF	Submenu for additional setting options		See table "Parameters in the EF submenu"

9.7.2 Legacy Mode — parameters in the EF (extended functions) submenu

	Explanation	Options	Function
HI	Maximum value memory		The highest process temperature is stored and can be displayed or deleted (press and hold [SET]).
Lo	Minimum value memory		The lowest process temperature is stored and can be displayed or deleted (press and hold [SET]).
CoF	Offset adjustment		Severe temperature changes in the environment of the sensor can cause the shifting of the zero point. As a result, the measured value zero is not displayed at 0 °C . This drift can be corrected with the offset value. Setting range: -55…+55 °C in increments of 0.1 K. **Default: 0.0 °C**
dSP1	Switching delay of SP1		0…60 s in increments of 0.1 s (0 = delay time not active) **Default: 0.0 s**
drP1	Switching delay of rP1		0…60 s in increments of 0.1 s (0 = delay time not active) **Default: 0.0 s**
dFH1	Switching delay of FH1		0…60 s in increments of 0.1 s (0 = delay time not active), only available with window mode Fno or Fnc **Default: 0.0 s**
dFL1	Switching delay of FL1		0…60 s in increments of 0.1 s (0 = delay time not active), only available with window mode Fno or Fnc **Default: 0.0 s**
dSP2	Switching delay of SP2		0…60 s in increments of 0.1 s (0 = delay time not active). **Default: 0.0 s**
drP2	Switching delay of rP2		0…60 s in increments of 0.1 s (0 = delay time not active). **Default: 0.0 s**

	Explanation	Options	Function
dFH2	Switching delay of FH2		0…60 s in increments of 0.1 s (0 = delay time not active), only available with window mode Fno or Fnc **Default: 0.0 s**
dFL2	Switching delay of FL2		0…60 s in increments of 0.1 s (0 = delay time not active), only available with window mode Fno or Fnc **Default: 0.0 s**
FOU1	Behavior of output 1 in the event of an error (not a short circuit)	ON	Switching output: The output is activated in the event of a fault
		OFF	Switching output: The output is deactivated in the event of a fault.
FOU2	Behavior of output 2 in the event of an error (not a wire break or short circuit)	ON	Switching output: The output is activated in the event of a fault Analog output: Fault value of the set function at output 2 (OUT2)
		OFF	Switching output: The output is deactivated in the event of a fault. Analog output: Fault value of the set function at output 2 (OUT2)
P-n	Behavior of the switching output	**AUTO**	Auto detection (NPN/PNP)
		nPn	N switching
		PnP	P switching
DISr	Display orientation	**0°**	Display rotated by 0°
		180°	Display rotated by 180°
DISU	Measured value display	50	50-ms update time
		200	200-ms update time
		600	600-ms update time
		OFF	The display does not show any values during operation. The status LEDs remain active. The value on the display appears when you touch the touch pads.
COLr	Display color	**GrEn**	Always green
		rEd	Always red
		G1oU	Green if ou1 is switched, otherwise red
		r1oU	Red if ou1 is switched, otherwise green
		G2oU	Green if ou2 is switched, otherwise red
		r2oU	Red if ou2 is switched, otherwise green
		G-CW	Green if the measured value is between the virtual switching points cFL and cFH
		r-CW	Red if the measured value is between the virtual switching points cFL and cFH
cFH	Virtual upper switching point		Upper switching point at which the display changes color (if display color G-CW or r-CW is selected) **Default: 80.0 °C**
cFL	Virtual lower switching point		Lower switching point at which the display changes color (if display color G-CW or r-CW is selected) **Default: 70.0 °C**

	Explanation	Options	Function
PASS	Password protection		Define password and activate password protection
		0000	No password
rES	Reset	FACT	Reset the parameters to factory settings
		UnDO	Reset the parameters to the previous settings (last device start)
		rEBO	Restart the device (warm start)
SOF	menu navigation	**STD**	Standard menu guidance in Legacy Mode
		VDMA	VDMA menu navigation

9.8 Setting via IO-Link

The device can be parameterized within the technical specifications (see data sheet) via the IO-Link communication interface – both offline, e.g. with the configuration tool as well as also on-line via the controller. An overview of the different functions and properties that can be set and used for IO-Link or SIO mode can be found in the chapter "Setting and parameterization" and via the IODDfinder. Detailed instructions on the parameterization of devices via the IO-Link interface are provided in the IO-Link commissioning manual.

All parameters can be changed in IO-Link mode via the controller, both during commissioning and during operation. In SIO mode, the device operates in accordance with the most recent setting configured in IO-Link mode.

10   Troubleshooting

If the device does not function as expected, first check whether ambient interference is present. If there is no ambient interference present, check the connections of the device for faults.

If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

11 Maintenance

The device is maintenance-free. Clean with a damp cloth if required.

12 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

12.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at
https://www.turck.de/en/return-service-6079.php
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Disposal

The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

14.1 TS700-…-LI2UPN8-H1141

Technical data	TS700-L016-16-LI2UPN8-…	TS700-L016-30-LI2UPN8-…	TS700-L050-16-LI2UPN8-…	TS700-L050-30-LI2UPN8-…
ID	100004380	100003641	100004382	100004381
Temperature range				
Measuring range	-50…+150 °C			
	-58…+302 °F			
Accuracy	± 0.15 °C + 0.002 $\cdot |t|$ (-30…300 °C)			
Measuring element	Pt-100 probe, DIN EN 60751, class A			
Response time	$t_{0.5}$ = 3.5 s/$t_{0.9}$ = 9.5 s in water at 0.2 m/s			
Immersion depth (L)	16 mm		50 mm	
Pressure resistance	300 bar			
Operating voltage	17…33 VDC			
Voltage drop at I_e	$\leq$ 2 V			
Protective measure	SELV, PELV according to DIN EN 61140			
Short-circuit/reverse polarity protection	Yes/yes			
Protection class	III			
Outputs				
Output 1	Switching output or IO-Link mode			
Output 2	Analog or switching output			
switching output				
Communication protocol	IO-Link			
Output function	NC/NO programmable, PNP/NPN			
Switching point accuracy	$\pm$ 0.2 K			
Rated operating current	0.25 A			
Switching point	-49.8…+150 °C			
Release position	-50…+149.8 °C			
Switching point distance	$\geq$ 0.2 K			
Switching cycles	$\geq$ 100 million			
Repetition accuracy	-0.1 K			
Analog output				
Current output	0…20 mA/4…20 mA, each invertible			
Voltage output	Smart Sensor Profile: 0…5/10 VDC, 1…6 VDC, 0.5…4.5 V, each invertible			
	Legacy Mode: 0…5/10 VDC, 1…6 VDC, each invertible, 0.5…4.5 V			
Accuracy (Lin. + Hys. + Rep.)	$\pm$ 0.3 K			
Repetition accuracy	0.1 K			

Technical data	TS700-L016-16-LI2UPN8-…	TS700-L016-30-LI2UPN8-…	TS700-L050-16-LI2UPN8-…	TS700-L050-30-LI2UPN8-…
IO-Link				
IO-Link specification	V 1.1			
Physical transmission layer	Complies with 3-wire technology (PHY2)			
Frame type	2.2			
Transmission rate	COM 2 (38.4 kBaud)			
Parameterization	FDT/DTM/selection of various mapping profiles			
Accuracy	± 0.1 K			
Included in the SIDI GSDML	yes			
Programming				
Programming options	Automatic switching logic recognition, switching/release point; hysteresis/window mode; NO/NC; unit; IO-Link mapping profile; Smart Sensor Profile: Single point mode, two point mode, window mode; analog output 0/4…20 mA, 0…5/10 VDC, 1…6 VDC, 0.5…4.5 VDC			
Mechanical data				
Housing material	Stainless steel/plastic, 1.4404 (AISI 316L)/Grilamid TR90 UV			
Process connection	1/2″ NPT male thread	G1/2″ male thread	1/2″ NPT male thread	G1/2″ male thread
Electrical connection	Male connector, M12 × 1			
Protection class	IP67, IP69K			
Electromagnetic compatibility (EMC)	EN 61326-2-3: 2013 minimum operating quality: +3.0 K under worst possible conditions			
Environmental data				
Ambient temperature	-40…+80 °C			
Storage temperature	-40…+85 °C			
Shock resistance	50 g (11 ms) , DIN EN 60068-2-27			
Vibration resistance	20 g (10…3000 Hz), DIN EN 60068-2-6			
Application range (UL)	Indoor application			
Tests/approvals				
Approvals	UL			
UL approval number	E516036			
Reference conditions acc. to IEC 61298-1				
Temperature	15…25 °C			
Atmospheric pressure	860…1060 hPa abs.			
Air humidity	10…95 % rel.			
Auxiliary power	24 VDC			
Display	4-digit, 2-color (green/red), 12-segment display, rotatable by 180°			
Switching state indication	2 × LEDs, yellow			
Unit display	4 x green LED (°C, °F, K, Ohm)			
Included in delivery	Screw-in adapter with process connection 1/2″ NPT male thread	Screw-in adapter with process connection G1/2″ male thread, 2 × AFM flat seal	Screw-in adapter with process connection 1/2″ NPT male thread	Screw-in adapter with process connection G1/2″ male thread, 2 × AFM flat seal

14.2   TS700-…-2UPN8-H1141

Technical data	TS700-L016-16-2UPN8-…	TS700-L016-30-2UPN8-…	TS700-L050-16-2UPN8-…	TS700-L050-30-2UPN8-…
ID	100004377	100003635	100004379	100004378
Temperature range				
Measuring range	-50…+150 °C			
	-58…+302 °F			
Accuracy	± 0.15 °C + 0.002 ·$|t|$ (-30…300 °C)			
Measuring element	Pt-100 probe, DIN EN 60751, class A			
Response time	$t_{0.5} = 3.5$ s/$t_{0.9} = 9.5$ s in water at 0.2 m/s			
Immersion depth (L)	16 mm		50 mm	
Pressure resistance	300 bar			
Operating voltage	17…33 VDC			
Voltage drop at I_e	≤ 2 V			
Protective measure	SELV, PELV according to DIN EN 61140			
Short-circuit/reverse polarity protection	Yes/yes			
Protection class	III			
Outputs				
Output 1	Switching output or IO-Link mode			
Output 2	switching output			
switching output				
Communication protocol	IO-Link			
Output function	NC/NO programmable, PNP/NPN			
Switching point accuracy	± 0.2 K			
Rated operating current	0.25 A			
Switching point	-49.8…+150 °C			
Release position	-50…+149.8 °C			
Switching point distance	≥ 0.2 K			
Switching cycles	≥ 100 million			
Repetition accuracy	0.1 K			
IO-Link				
IO-Link specification	V 1.1			
Physical transmission layer	Complies with 3-wire technology (PHY2)			
Frame type	2.2			
Transmission rate	COM 2 (38.4 kBaud)			
Parameterization	FDT/DTM/selection of various mapping profiles			
Accuracy	± 0.1 K			
Included in the SIDI GSDML	yes			
Programming				
Programming options	Automatic switching logic recognition, switching/release point; hysteresis/window mode; NO/NC; unit; IO-Link mapping profile; Smart Sensor Profile: Single point mode, two point mode, window mode			

Technical data	TS700-L016-16-2UPN8-…	TS700-L016-30-2UPN8-…	TS700-L050-16-2UPN8-…	TS700-L050-30-2UPN8-…
Mechanical data				
Housing material	Stainless steel/plastic, 1.4404 (AISI 316L)/Grilamid TR90 UV			
Process connection	1/2″ NPT male thread	G1/2″ male thread	1/2″ NPT male thread	G1/2″ male thread
Electrical connection	Male connector, M12 × 1			
Protection class	IP67, IP69K			
Electromagnetic compatibility (EMC)	EN 61326-2-3: 2013 minimum operating quality: +3.0 K under worst possible conditions			
Environmental data				
Ambient temperature	-40…+80 °C			
Storage temperature	-40…+85 °C			
Shock resistance	50 g (11 ms) , DIN EN 60068-2-27			
Vibration resistance	20 g (10…3000 Hz), DIN EN 60068-2-6			
Application range (UL)	Indoor application			
Tests/approvals				
Approvals	UL			
UL approval number	E516036			
Reference conditions acc. to IEC 61298-1				
Temperature	15…25 °C			
Atmospheric pressure	860…1060 hPa abs.			
Air humidity	10…95 % rel.			
Auxiliary power	24 VDC			
Display	4-digit, 2-color (green/red), 12-segment display, rotatable by 180°			
Switching state indication	2 × LEDs, yellow			
Unit display	4 x green LED (°C, °F, K, Ohm)			
Included in delivery	Screw-in adapter with process connection 1/2″ NPT male thread	Screw-in adapter with process connection G1/2″ male thread, 2 × AFM flat seal	Screw-in adapter with process connection 1/2″ NPT male thread	Screw-in adapter with process connection G1/2″ male thread, 2 × AFM flat seal

15 Turck branches — contact data

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