Your Global Automation Partner

TURCK

FS100...L-2LI-...
Flow Sensors

Instructions for Use

Contents

1 About these instructions

These instructions for use describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use 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 used

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.
	**WARNING** WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided.
	**CAUTION** CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.
	**NOTICE** NOTICE indicates a situation which may lead to property damage if not avoided.
	**NOTE** NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.
▶	**CALL TO ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULTS OF ACTION** This symbol denotes relevant results of actions.

1.3 Other documents

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

- Data sheet

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 flow sensors:

Type designations	Application area
FS100-…L-…2LI-…	Liquid media

2.2 Scope of delivery

The scope of delivery includes:

- Compact flow sensor
- Thread adapter for process connection (not with FS10…-00-…)
- Two seals (not on devices with NPT and R threads)
- Quick Start Guide

2.3 Turck service

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database under www.turck.com contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats.

The contact details of Turck subsidiaries worldwide can be found on p. [▷ 24].

3 For your safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Intended use

The compact flow sensors in the FS100 product series are used to monitor flow speeds. Typical applications include monitoring cooling circuits (e.g. in welding applications) and protecting pumps from running dry. Based on the calorimetric principle, the devices can also be used to measure the media temperature.

The devices may 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 notes

- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for industrial areas. When used in residential areas, take measures to avoid radio interference.

4 Product description

The compact flow sensors in the FS100-…-…-2LI product series have two analog outputs of 4…20 mA. The FS100-…L-…-2LI device variant is designed for liquid media. The sensor and the evaluation electronics are completely encapsulated in a single housing. A corresponding screw-in adapter for the process connection selected by the user (see type designation) is included in the scope of delivery. Screw-in adapters for process connections with other thread sizes are available as optional accessories.

4.1 Device overview

The overview shows example dimension drawings of the compact flow sensors.

Plug-in devices

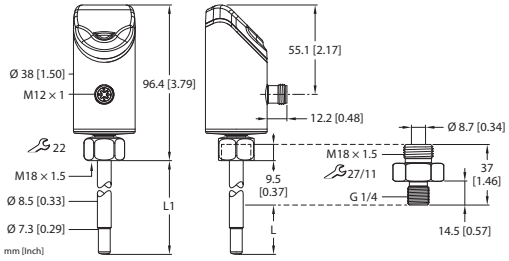


fig. 1: Dimensions — sensor with G1/4″ screw-in adapter

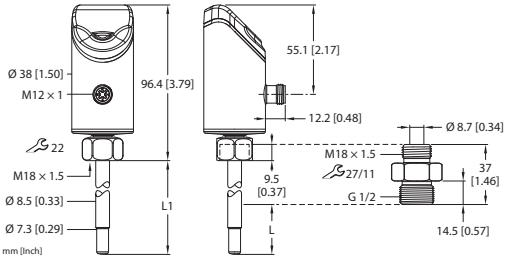


fig. 2: Dimensions — sensor with G1/2″ screw-in adapter

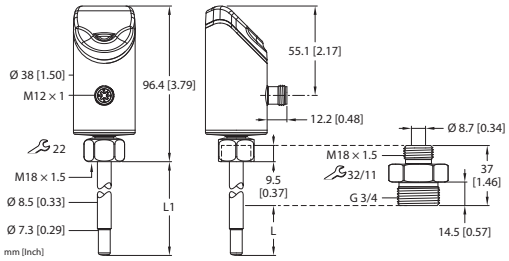


fig. 3: Dimensions — sensor with G3/4″ screw-in adapter

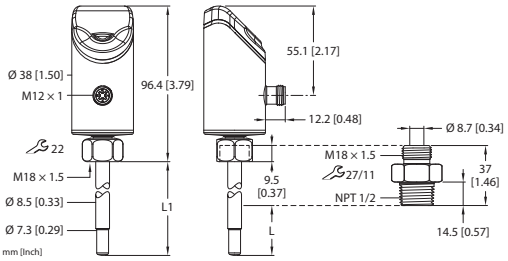


fig. 4: Dimensions — sensor with NPT 1/2″ screw-in adapter

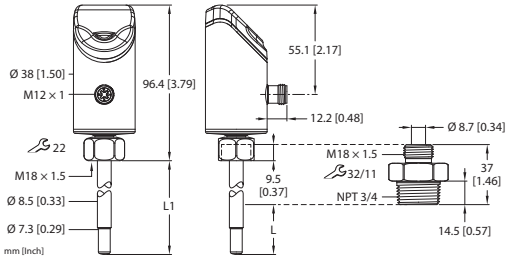


fig. 5: Dimensions — sensor with NPT 3/4″ screw-in adapter

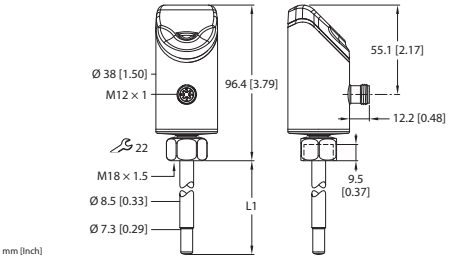


fig. 6: Dimensions — sensor without screw-in adapter

4.1.1 Display and control elements

The device is equipped with three touch pads, an LED bar and status LEDs on the front. This enables the user to set all essential functions and properties directly on the device and read the actual process values.

4.2 Properties and features

- Flow monitoring for liquid media
- Sensor housing material 1.4404 (316L)
- Material in contact with medium 1.4571 (316Ti)
- Protection classes IP66, IP67, IP69K
- Process value display via LED bar
- Analog output 4…20 mA
- Teach-in function for configuring the display range for flow monitoring

4.3 Operating and display functions

The user can configure and operate the device via three touch pads ([ENTER], [MODE] and [SET]) on the front. An 11-digit LED bar aids parameterization and displays the current flow or temperature values (as selected) in operating mode. Five LEDs indicate the output status and device status.

4.4 Operating principle

The flow sensors operate calorimetrically. The function is based on the thermo-dynamic principle. When the medium is flowing, thermal energy is dissipated at the sensor. The resulting temperature on the sensor is measured and compared to the medium temperature. The flow status can be derived directly from the determined temperature difference: The greater the energy dissipation, the higher the flow speed or flow rate.

4.5 Functions and operating modes

The FS100…-2LI compact flow sensors monitor the flow speed of liquid media (type FS1…-…L-). In addition, the sensors also measure the media temperature. The devices show the recorded flow and temperature values on the front via status LEDs and an LED bar. The current and temperature values are converted into analog signals of 4…20 mA and output at one of the two outputs.

4.5.1 Flow monitoring

The flow speed is detected by a calorimetric sensor in the flow channel and evaluated by the integrated evaluation electronics. The current flow value is displayed via the LED bar. The flow values are converted into analog signals of 4…20 mA and output at analog output Out 1 (Flow).

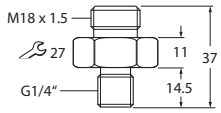
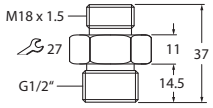
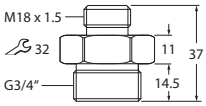
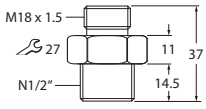
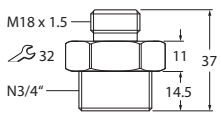
4.5.2 Temperature monitoring

The calorimetric measurement method used by the sensors not only monitors the flow speed, but also measures the approximate temperature of the media. Both process variables are recorded and evaluated independently of each other. The current temperature is displayed via an LED bar when the [SET] touchpad is pressed and held in display mode.

The temperature values are converted into analog signals of 4…20 mA and output at analog output Out 2 (Temp).

4.6 Technical accessories

The screw-in adapters are available for different threads. This allows the device to be flexibly adapted to different process connections. Additional adapters can be ordered separately as accessories.

Dimension drawing	Type	ID	Description
	FAA-04-1.4571	100001989	Screw-in adapter for immersion sensors from the FS…, FP… product series; material: stainless steel 1.4571 (316Ti); process connection: G1/4"
	FAA-80-1.4571	100001988	Screw-in adapter for immersion sensors from the FS…, FP… product series; material: stainless steel 1.4571 (316Ti); process connection: G1/2"
	FAA-81-1.4571	100001991	Screw-in adapter for immersion sensors from the FS…, FP… product series; material: stainless steel 1.4571 (316Ti); process connection: G3/4"
	FAA-A1-1.4571	100001987	Screw-in adapter for immersion sensors from the FS…, FP… product series; material: stainless steel 1.4571 (316Ti); process connection: N1/2"
	FAA-34-1.4571	100001990	Screw-in adapter for immersion sensors from the FS…, FP… product series; material: stainless steel 1.4571 (316Ti); process connection: N3/4"

5 Installing

5.1 General installation instructions

- For optimal monitoring, mount the sensor such that the probe rod is fully immersed in the medium.
- If the medium flows in a horizontal direction and may contain deposits or trapped gas (e.g. air bubbles): Mount the sensor e.g. laterally.

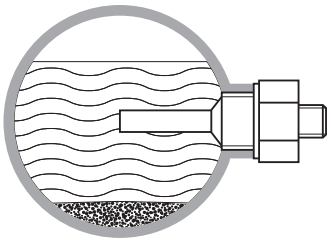


fig. 7: Lateral mounting

- If the medium flows in a horizontal direction and the flow channel is not completely filled with the medium: Mount the sensor e.g. below the flow.

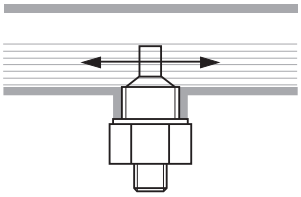


fig. 8: Mounting below the flow

- If the medium flows in a vertical direction: Mount the sensor only in risers.
- A minimum distance from potential interference variables (pumps, valves, flow rectifiers, pipe bends, changes in the cross section) must be maintained.

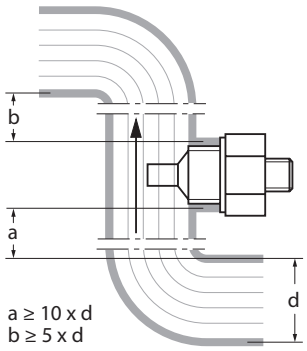


fig. 9: Minimum distances to interference variables

- Prevent the tip of the probe rod coming into contact with the opposite side of the flow channel inner wall.

5.2 Special installation instructions

- Only mount Turck sensors from the FS product series using screw-in adapters from the FAA-… product series.
- For devices with a G…" process connection: 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 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.
- For a standard flow range (3…300 cm/s): The probe rod can be installed in the medium independent of the flow direction (range of 360°).
- For an extended flow range (1…300 cm/s): Mount the probe rod directed so that the medium flows toward the prick punch mark, tolerance range of ± 45°.

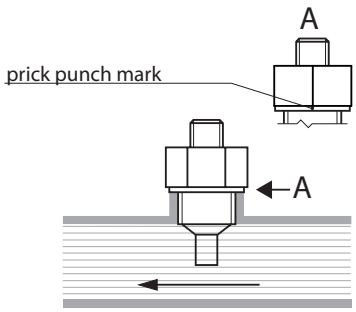


fig. 10: Mount the probe rod directed correctly

- Screw an M18 × 1.5 coupling nut onto the screw-in adapter (maximum torque of 40 Nm).
- Optional: For optimum operation and readability, adjust the sensor head within a range of 340°.
- For devices with a G…" process connection: After removing and reinstalling the screw-in adapter, use a new seal (replacement seal included in the delivery).
- Teach in the teach-in values again if the sensor has been removed and re-installed or the process connection has been disconnected.

6 Connecting

6.1 Connecting plug-in devices

- Connect the connection cable coupling to the sensor connector.
- Connect the connection cable to the power source as shown in the wiring diagram.

6.1.1 Wiring diagram

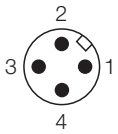


fig. 11: Pin assignment

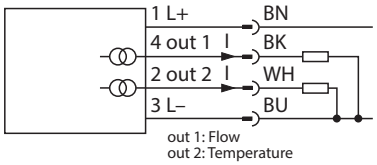


fig. 12: FS…-2LI-H1141 wiring diagram

7 Commissioning

After switching on the operating voltage, the DeltaFlow function monitors the warm-up phase of the sensor. During this phase, the LED indicator bar flashes yellow and the two output LEDs FLOW and TEMP are switched off.

The warm-up phase is deemed to be complete:

- If the period of 30 seconds that is allotted for the warm-up phase has elapsed.
- If the system is in a stable condition, i.e. the change in flow rate is sufficiently small.

After the warm-up phase, the device is ready for use and automatically switches to display mode for the flow speed.

8 Operation

WARNING
The housing can heat up to over 75 °C (167 °F) in the area of the probe
Risk of burning due to hot housing surfaces!
- ▶ Protect the housing from contact with flammable material.
- ▶ Protect the housing from accidental contact.

8.1 LED status indicators — operation

The LEDs indicate readiness for operation, the status of the outputs and pending diagnostic messages. An additional LED indicates that the device has been locked.

LED	Indication	Meaning
PWR	Green	Device is operational
FLOW	Yellow	See "Settings/LEDs — diagnostic messages"
	Yellow flashing	
	Off	
TEMP	Yellow	See "Settings/LEDs — diagnostic messages"
	Yellow flashing	
	Off	
LOC	Yellow	Device locked
	Yellow flashing	"Lock/unlock" process active
	Off	Device unlocked
FLT	Red	Error, see "LED Indicators — diagnostic messages"

8.2 LED indicator bar — flow monitoring

The current flow speed is displayed in the LED bar by 1…11 green LEDs proportional to the previously set indicated range.

Flow monitoring	LED indicator bar
Green LEDs: Indicate the flow speed proportional to the set indicated range (0…11 LEDs: 0…100 %).	

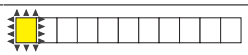
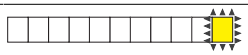
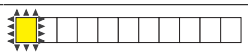
8.3 LED indicator bar — temperature monitoring

- ▶ To display the temperature: Press and hold [SET] in display mode.

The current media temperature is displayed in the LED bar by 0…11 yellow LEDs proportional to a fixed indicated range (0…11 LEDs: -40 °C…+180 °C/-40 °F…+356 °F).

Temperature monitoring	LED indicator bar
Yellow LEDs: Indicate the media temperature proportional to the indicated range (0…11 LEDs: -40 °C…+180 °C/-40 °F…+356 °F).	

8.4 LEDs — diagnostic messages

LEDs — diagnostic messages			LED indicator bar	Error
FLOW	**TEMP**	**FLT**		
Yellow flashing	–	–		Flow speed above the indicated range
Yellow flashing	–	–		Flow speed below the indicated range
–	Yellow flashing	–		Media temperature above the indicated range
–	Yellow flashing	–		Media temperature below the indicated range
–	–	Red		General error (shut down all outputs, manual reset required)

9 Setting

9.1 Settable functions and properties

The three front touchpads (ENTER, MODE, SET) enable the user to set all the essential functions and properties directly on the device via the menu guidance.

Setting options — via touchpads

The following functions and properties can be set:

- Locking/unlocking touchpads
- Indicated range: MAX/MIN teach-in
- Advanced settings: Reset to the previous settings (Pre-Settings)
- Advanced settings: Reset to factory settings

Factory settings

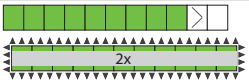
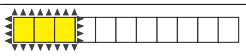
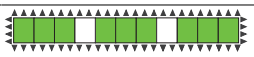
- Medium: water
- MAX value: maximum
- MIN value: minimum

9.2 Setting via touchpads

9.2.1 Locking and unlocking the device

To prevent accidental entries, the touch pads are automatically locked after switching on and after 5 minutes without being pressed (after 30 minutes in setting mode). If the key lock is activated, teach-in procedures cannot be initiated and parameters cannot be changed.

Locking the device (LOC)
▶ Press and hold [MODE] and [SET] for 3 s.
⇨ The LOC LED first flashes and then turns a constant yellow.

Unlocking the device (uLOC)	**LED indicator bar**
▶ Press and hold [ENTER] until all the LEDs in the LED bar turn green and the LED bar briefly flashes green twice.	
▶ Swipe across each the touchpads with your finger — in the order [MODE], [ENTER], [SET] until all the LEDs (3 × 3) in the LED bar are flashing green.	
▶ Release the touchpads. ⇨ The LOC LED flashes first and then goes out.	

9.2.2 Setting options

The user can set the main device functions directly on the device via the touchpads [ENTER], [MODE] and [SET]:

Setting options — devices with analog output for flow monitoring		
①	Indicated range: MAX/ MIN teach-in	MAX/MIN teach-in: Teach in the upper and lower limit values for the flow monitoring indicated range
②	Advanced settings	Reset to last setting
		Reset to factory setting

Flow chart — setting the device via touchpads

The following overview shows the various setting options and operating steps:

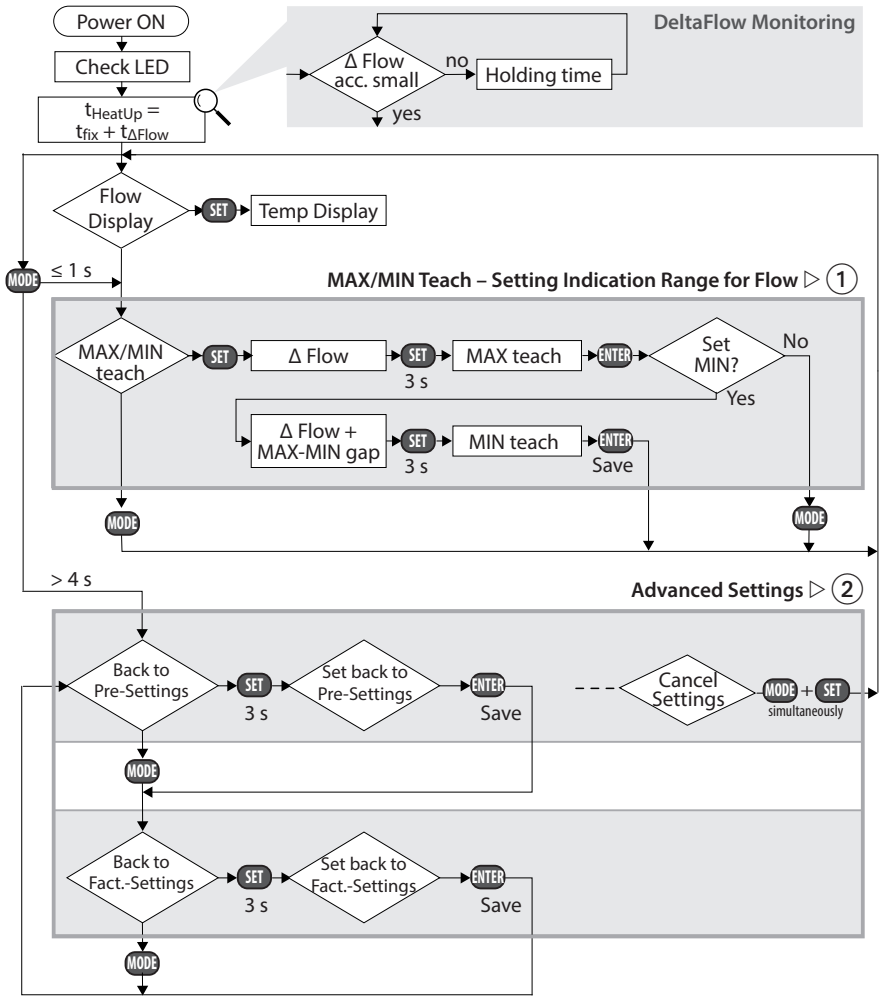
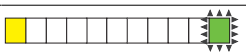
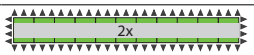
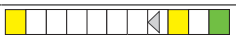
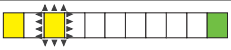
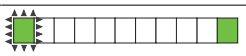
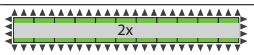


fig. 13: Setting via touchpads — flow chart

9.2.3 MAX/MIN teach-in — setting the indicated range for flow

The MAX/MIN teach-in function for teaching in the indicated range is marked in the flow chart with ①.

▶ To open from display mode: Press [MODE] once.

Menu		LED indicator bar
Setting the indicated range for the flow		
1	Set the upper limit value:	
	▶ Operate the flow speed in the application at the upper limit value and press [SET] once. ⇨ DeltaFlow active: LED 11 in the LED bar flashes yellow, system not yet stabilized. ▶ Wait until the LED is flashing green.	
	▶ Once the LED bar is flashing green, the system has stabilized: Press [SET] for 3 s until only LED 11 is a constant green.	
	▶ Store the upper limit value: Press [ENTER]. ⇨ LED bar briefly flashes green twice.	
2	Set the lower limit value:	
	▶ Operate the flow speed in the application at the lower limit value. ⇨ The system checks the MAX/MIN offset	
	▶ LED moves to position 1 and flashes yellow: MAX/MIN offset OK DeltaFlow active: System has not yet stabilized: Wait until LED 1 flashes green	
	▶ LED does not move to position 1 and flashes yellow: MAX/MIN offset too small: Reduce the flow speed	
	▶ Once LED 1 in the LED bar is flashing green, the system has stabilized: Press [SET] for 3 s until LED 1 in the LED bar is a constant green.	
	▶ Store the lower limit value: Press [ENTER]. ⇨ LED bar briefly flashes green twice. The next menu appears.	

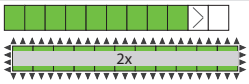
9.2.4 Advanced settings

The following functions and properties can be set and used as advanced settings.

- Advanced settings: Reset to the previous settings (Pre-Settings)
- Advanced settings: Reset to factory settings

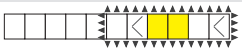
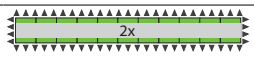
The advanced settings are marked in the flowchart with ②.

Starting or exiting the "advanced settings" menu sequence

Starting/exiting the "advanced settings" menu sequence	LED indicator bar
To start **advanced settings**: ▶ Press [MODE] for at least 4 s until all LEDs in the LED bar turn green and the LED bar briefly flashes green twice.	
To exit **advanced settings**: ▶ Automatically: Do not press the touchpads for at least 30 s. ▶ Manually: Press [MODE] + [SET] simultaneously once.	

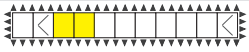
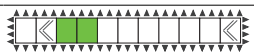
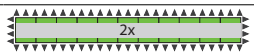
Reset to the previous settings (Pre-Settings)

The device includes a function that allows you to reset the current settings to the previous device settings: "Back to Pre-Settings."

Menu	LED indicator bar
Resetting to the previous settings: LEDs 11…6 will flash yellow one after the other.	
Reset to last saved setting:	
▶ Press [SET] for at least 3 s until LEDs 11…6 quickly flash green one after the other.	
▶ Save settings: Press [ENTER]. ⇨ LED bar briefly flashes green twice. The next menu appears.	

Reset to factory settings

The device includes a feature that allows you to reset the current settings to the factory settings: "Back to Factory-Settings".

Menu	LED indicator bar
Reset to factory settings: LEDs 11…1 will flash yellow one after the other.	
Reset to factory settings:	
▶ Press [SET] for at least 3 s until LEDs 11…1 quickly flash green one after the other.	
▶ Save settings: Press [ENTER]. ⇨ LED bar briefly flashes green twice. The next menu appears.	

10 Troubleshooting

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

If no faults are identified, this indicates that the device is faulty. In this case, decommission the device and replace it with a new device of the same type.

11 Maintenance

The maintenance requirements of the particular system apply to the devices.
No other device-specific maintenance measures are required.

12 Repair

The device must not be repaired 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

Returns to Turck can only be accepted if the device has been equipped with a Decontamination declaration enclosed. The decontamination declaration can be downloaded from
https://www.turck.de/en/retoure-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

Technical data	
Application area	
Mounting conditions	Immersion sensor
Application area	FS100-…L: liquid media
Ambient temperature	-25…+85 °C
Temperature of medium	-25…+85 °C
Storage temperature	-40…+100 °C
Pressure resistance	300 bar
Electrical data	
Operating voltage	17…33 VDC
Output function	4…20 mA, analog
Output 1	Flow: analog
Output 2	Temperature: analog
Power consumption	≤ 1.5 W
Overload protection	Yes
Load resistance, current output	≤ 0.5 kΩ
Reverse polarity protection	Yes
Standby delay time (min)	18 s
Standard/Directive conformity	
Vibration test	Acc. to EN 60068-2-27
Shock testing	Acc. to EN 60068-2-27
EMC (electromagnetic compatibility)	Acc. to EN 55011, EN 60947-5-9
Approvals	CE, cULus
Mechanical data	
Housing material	Stainless steel, 1.4404 (316L)
Material (in direct contact with media)	Stainless steel, 1.4571 (316Ti), FKM O-ring, AFM flat seal (only for devices with a G…" process connection)
Electrical connection	Connector device: Male connector, M12 × 1, 4-pin
Type of protection	IP66, IP67, IP69K
MTF	120 years acc. to SN 29500 (Ed. 99) 40 °C
Display functions	LEDs indicate the status of the power supply, outputs and teach-in processes, display of the process values via LED bar

15 Turck subsidiaries — contact information

Germany	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr **www.turck.de**
Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria **www.turck.com.au**
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Mexico	Turck Comercial, S. de RL de CV Blvd. Campestre No. 100, Parque Industrial SERVER, C.P. 25350 Arteaga, Coahuila **www.turck.com.mx**
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