Guided Wave Radar

SITRANS LG240

4 ... 20 mA/HART - two-wire

PFA coated rod and cable probe

With SIL qualification

Operating Instructions • 09/2017

SITRANS

SIEMENS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: Cardboard shipping package provides limited humidity and moisture protection. This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.
This product is intended for use in industrial areas. Operation of this equipment in a residential area may cause interference to several frequency based communications.

Note: Always use product in accordance with specifications.

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Technical Publications
Siemens Canada Limited
PD PA PI LW
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Peterborough, Ontario, Canada, K9J 7B1
Email: **techpubs.smpi@siemens.com**

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Safety instructions for Ex areas

Take note of the Ex specific safety instructions for Ex applications. These instructions are attached as documents to each instrument with Ex approval and are part of the operating instructions manual.

Editing status: 2017-09-14

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1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance, fault rectification, the exchange of parts and the safety of the user. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

1.3 Symbols used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

Battery disposal
This symbol indicates special information about the disposal of batteries and accumulators.

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

SITRANS LG240 is a sensor for continuous level measurement.

You can find detailed information about the area of application in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of this product can give rise to application-specific hazards, e.g. vessel overfill through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the protective characteristics of the instrument can be impaired.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.

To avoid any danger, the safety approval markings and safety tips on the device must also be observed and their meaning looked up in this operating instructions manual.

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2.5 EU conformity

The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.

Electromagnetic compatibility
Instruments in four-wire or Ex-d-ia version are designed for use in an industrial environment. Nevertheless, electromagnetic interference from electrical conductors and radiated emissions must be taken into account, as is usual with class A instruments according to EN 61326-1. If the instrument is used in a different environment, the electromagnetic compatibility to other instruments must be ensured by suitable measures.

2.6 SIL qualification according to IEC 61508

The Safety Integrity Level (SIL) of an electronic system is used to assess the reliability of integrated safety functions.

For detailed specification of the safety requirements, multiple SIL levels are specified according to safety standard IEC 61508. You can find detailed information in chapter "*Functional safety (SIL)*" of the operating instructions.

The instrument meets the specifications of IEC 61508: 2010 (Edition 2). It is qualified for single-channel operation up to SIL2. The instrument can be used homogeneously redundant up to SIL3 in multi-channel architecture with HFT 1.

2.7 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfils the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for fault information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components
- NE 107 - Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.8 Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the following text is only available in the English language.

Installations in the US shall comply with the relevant requirements of the National Electrical Code (ANSI/NFPA 70).

Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code

A Class 2 power supply unit has to be used for the installation in the USA and Canada.

3 Product description

3.1 Configuration

Type label

The type label contains the most important data for identification and use of the instrument:

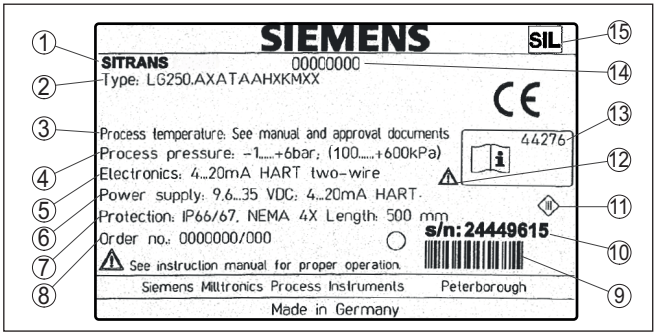

Fig. 1: Layout of the type label (example)

1 Instrument type
2 Product code
3 Approvals
4 Power supply and signal output, electronics
5 Protection rating
6 Probe length
7 Process and ambient temperature, process pressure
8 Material wetted parts
9 Hardware and software version
10 Order number
11 Serial number of the instrument
12 Symbol of the device protection class
13 ID numbers, instrument documentation
14 Reminder to observe the instrument documentation
15 Notified authority for CE marking
16 Approval directives
17 Marking of the safety function in SIS

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.0
- Software from 1.2.0
- DTM from version 1.67.2

Versions

The instrument and the electronics version can be determined via the product code on the type label as well as on the electronics.

- Standard electronics: Type FX80H.-SIL

Scope of delivery

The scope of delivery encompasses:

- Sensor
- Optional accessory
- Documentation

- Operating instructions SITRANS LG240
- Safety Manual (SIL)
- Instructions for optional instrument features
- Ex-specific "*Safety instructions*" (with Ex versions)
- If necessary, further certificates

Information:
In this operating instructions manual, the optional instrument features are described. The respective scope of delivery results from the order specification.

3.2 Principle of operation

Application area

The SITRANS LG240 is a level sensor with coated cable or rod probe for continuous level or interface measurement, particularly suitable for applications in the chemical industry.

SIL

Due to the qualification up to SIL2 or homogeneous redundant up to SIL3 (IEC 61508) the SITRANS LG240 is suitable for the use in safety-instrumented systems (SIS).

The safety function (SIF) can be a monitoring of the max. or min. level or a combination of both.

Functional principle - level measurement

High frequency microwave pulses are guided along a steel cable or a rod. Upon reaching the product surface, the microwave pulses are reflected. The running time is evaluated by the instrument and outputted as level.

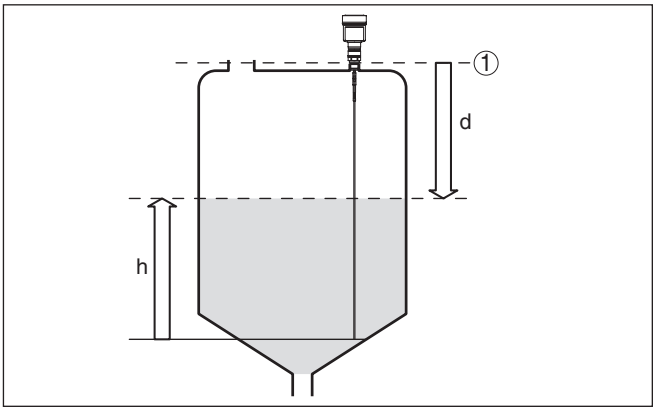

Fig. 2: Level measurement

1 Sensor reference plane (seal surface of the process fitting)
d Distance to the level
h Height - Level

Functional principle - interface measurement

High frequency microwave impulses are guided along a steel cable or rod. Upon reaching the product surface, a part of the microwave impulses is reflected. The other part passes through the upper product

and is reflected by the interface. The running times to the two product layers are processed by the instrument.

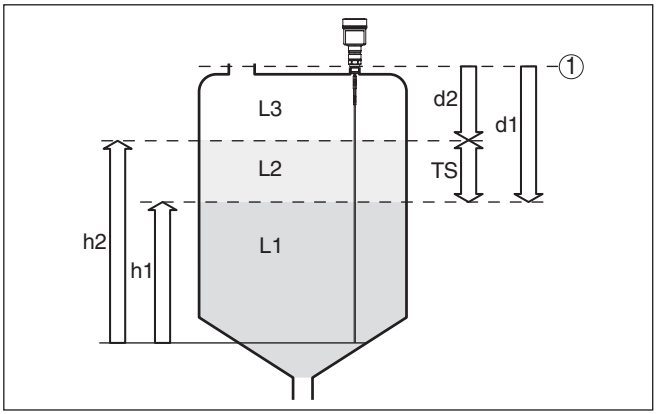

Fig. 3: Interface measurement

1 Sensor reference plane (seal surface of the process fitting)
d1 Distance to the interface
d2 Distance to the level
TS Thickness of the upper medium (d1 - d2)
h1 Height - Interface
h2 Height - Level
L1 Lower medium
L2 Upper medium
L3 Gas phase

Prerequisites for interface measurement

Upper medium (L2)

- The upper medium must not be conductive
- The dielectric constant of the upper medium or the actual distance to the interface must be known (input required). Min. dielectric constant: 1.6. You can find a list of dielectric constants on our home page: www.siemens.com/sitranslg.
- The composition of the upper medium must be stable, no varying products or mixtures
- The upper medium must be homogeneous, no stratifications within the medium
- Min. thickness of the upper medium 50 mm (1.97 in)
- Clear separation from the lower medium, emulsion phase or detritus layer max. 50 mm (1.97 in)
- If possible, no foam on the surface

Lower medium (L1)

- The dielectric constant must be 10 higher than the dielectric constant of the upper medium, preferably electrically conductive. Example: upper medium dielectric constant 2, lower medium at least dielectric constant 12.

Gas phase (L3)

- Air or gas mixture

- Gas phase - dependent on the application, gas phase does not always exist (d2 = 0)

Output signal

The instrument is always preset to the application "*Level measurement*".

For the interface measurement, you can select the requested output signal with the setup.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

Lifting and carrying

With an instrument weight of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

3.4 Accessories and replacement parts

Display and adjustment module

The display and adjustment module LG Local Display Interface is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor and removed at any time.

You can find additional information in the operating instructions manual "*LG Local Display Interface*" (Document-ID 43838).

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External display and adjustment unit

The LG Remote Interface is an external display and adjustment unit for sensors with single chamber housing and Ex-d double chamber housing.

It is suitable for measured value indication and adjustment of sensors and is connected to the sensor with a four-wire standard cable up to 50 m (164 ft) long.

You can find additional information in the operating instructions manual "*LG Remote Interface*".

Flanges

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, ASME B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*" (Document-ID 47574).

Electronics module

The electronics module SITRANS series LG is a replacement part for TDR sensors of SITRANS series LG. There is a different version available for each type of signal output.

You can find further information in the operating instructions manual "*Electronics module SITRANS series LG*".

Centering

If you mount the SITRANS LG240 in a bypass tube or standpipe, you have to avoid contact to the bypass tube by using a spacer at the probe end.

You can find additional information in the operating instructions manual "*Centering*".

4 Mounting

4.1 General instructions

Protection against moisture

Protect your instrument against moisture ingress through the following measures:

- Use a suitable connection cable (see chapter "*Connecting to power supply*")
- Tighten the cable gland
- When mounting horizontally, turn the housing so that the cable gland points downward
- Loop the connection cable downward in front of the cable gland

This applies mainly to outdoor installations, in areas where high humidity is expected (e.g. through cleaning processes) and on cooled or heated vessels.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

Make sure that the degree of contamination specified in chapter "*Technical data*" meets the existing ambient conditions.

Cable glands

Metric threads
In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

You have to remove these plugs before electrical connection.

NPT thread
In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection. The dust protection caps do not provide sufficient protection against moisture.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

Suitability for the process conditions

Make sure before mounting that all parts of the instrument exposed to the process are suitable for the existing process conditions.

These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions in particular are:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

You can find detailed information on the process conditions in chapter "*Technical data*" as well as on the type label.

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Suitability for the ambient conditions

The instrument is suitable for standard and extended ambient conditions acc. to DIN/EN/IEC/ANSI/ISA/UL/CSA 61010-1.

4.2 Mounting instructions

Installation position

Mount SITRANS LG240 in such a way that the distance to vessel installations or to the vessel wall is at least 300 mm (12 in). In non-metallic vessels, the distance to the vessel wall should be at least 500 mm (19.7 in).

During operation, the probe must not touch any installations or the vessel wall. If necessary, fasten the probe end.

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible nearly down to the lowest point of the bottom. Keep in mind that measurement all the way down to the tip of the probe may not be possible. The exact value of the min. distance (lower dead band) is stated in chapter "*Technical data*" of the operating instructions.

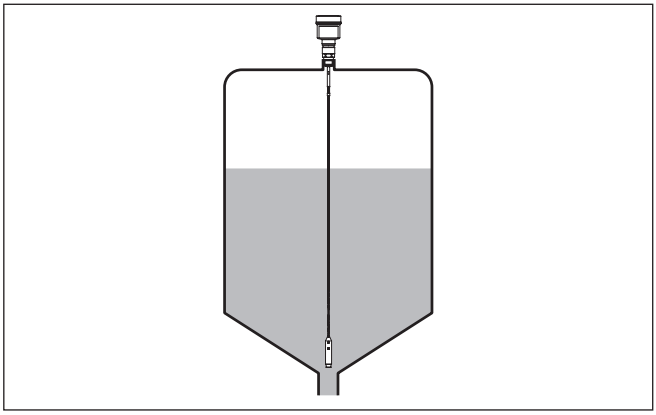


Fig. 4: Vessel with conical bottom

Type of vessel

Plastic vessel/Glass vessel

The guided microwave principle requires a metallic surface on the process fitting. Therefore, in plastic vessels, etc., use an instrument version with flange (from DN 50) or place a metal sheet (ø > 200 mm/8 in) beneath the process fitting when screwing it in.

Make sure that the plate has direct contact with the process fitting.

When mounting rod or cable probes in vessels without metal walls, e.g. in plastic vessels, the measured value can be influenced by strong electromagnetic fields (emitted interference according to EN 61326: class A). In this case, use a probe with coaxial version.

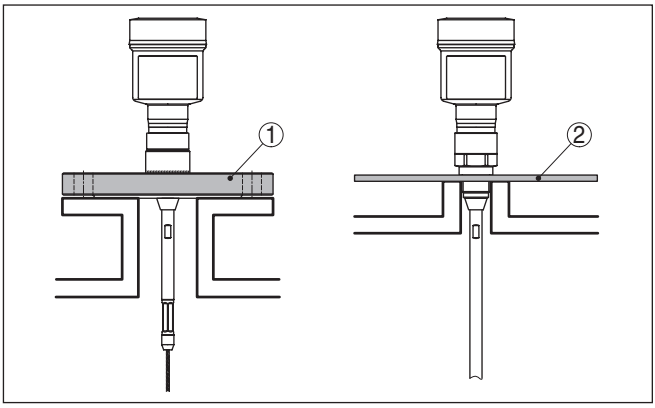


Fig. 5: Mounting in non-metallic vessel

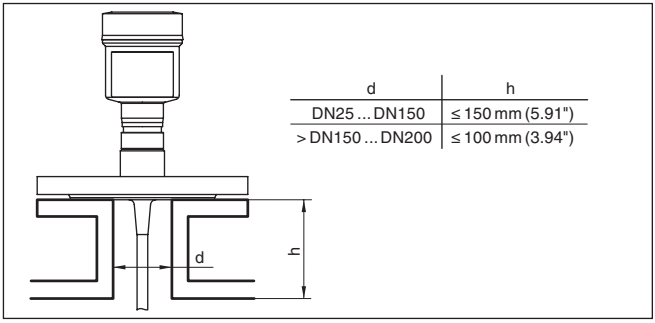
1 Flange
2 Metal sheet

Mounting socket

If possible, avoid sockets. Mount the sensor flush with the vessel top. If this is not possible, use short sockets with small diameter.

Higher sockets or sockets with a bigger diameter can generally be used. They can, however, increase the upper blocking distance (dead band). Check if this is relevant for your measurement.

In such cases, always carry out a false signal suppression after mounting. You can find further information under "*Setup procedure*".



d	h
DN25 ... DN150	≤ 150 mm (5.91")
> DN150 ... DN200	≤ 100 mm (3.94")

Fig. 6: Mounting socket

When welding the socket, make sure that the socket is flush with the vessel top.

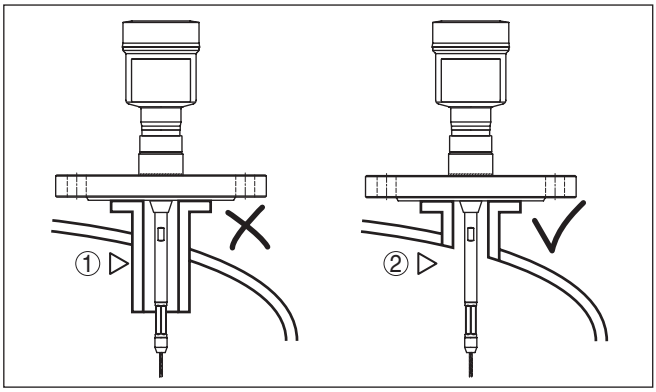


Fig. 7: Socket must be installed flush

1 Unfavourable mounting
2 Socket flush - optimum mounting

Welding work

Before beginning the welding work, remove the electronics module from the sensor. By doing this, you avoid damage to the electronics through inductive coupling.

Inflowing medium

Do not mount the instruments in or above the filling stream. Make sure that you detect the product surface, not the inflowing product.

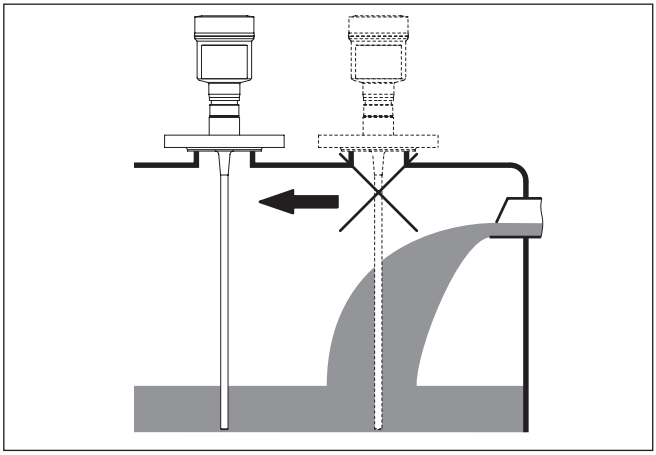


Fig. 8: Mounting of the sensor with inflowing medium

Measuring range

The reference plane for the measuring range of the sensors is the sealing surface of the thread or flange.

Keep in mind that a min. distance must be maintained below the reference plane and possibly also at the end of the probe - measurement in these areas is not possible (dead band). The length of the cable can be used all the way to the end only when measuring conductive

products. These blocking distances for different mediums are listed in chapter "*Technical data*". Keep in mind for the adjustment that the default setting for the measuring range refers to water.

Pressure

The process fitting must be sealed if there is gauge or low pressure in the vessel. Before use, check if the seal material is resistant against the measured product and the process temperature.

The max. permissible pressure is specified in chapter "*Technical data*" or on the type label of the sensor.

Lateral installation

In case of difficult installation conditions, the probe can also be mounted laterally. For this, adapt the rod with rod extensions or angled segments.

To compensate for the resulting changes in signal runtime, let the instrument determine the probe length automatically.

The determined probe length can deviate from the actual probe length when using curved or angled segments.

If internal installations such as struts, ladders, etc. are present on the vessel wall, the measuring probe should be mounted at least 300 mm (11.81 in) away from the vessel wall.

You can find further information in the supplementary instructions of the rod extension.

Fasten

If there is a risk of the rod probe touching the vessel wall during operation due to product movements or agitators, etc., the measuring probe should be securely fixed at the extreme lower end.

For this, use an additional plastic sleeve (PTFE, PPS, PEEK etc.), to protect the probe against damages.

Keep in mind that measurement is not possible below the fastening point.

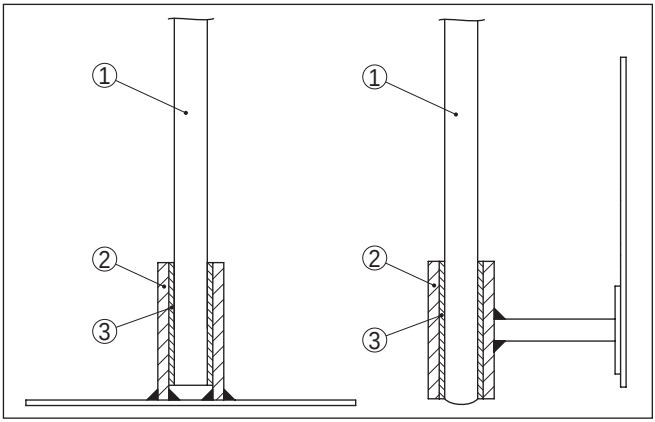


Fig. 9: Fasten the probe

1 Measuring probe
2 Retaining sleeve
3 Plastic sleeve (PTFE, PPS, PEEK etc.)

Rod extension

In case of difficult installation conditions, for example in a socket, the probe can be suitably adapted with a rod extension.

To compensate for the resulting changes in signal runtime, let the instrument determine the probe length automatically.

You can find further information in the supplementary instructions of the rod and cable components.

Torque with PTFE plated flanges

The PTFE washer of the antenna encapsulation serves also as process seal.

To compensate the normal prestress loss due to the seal materials, you have to use also disc springs in addition to the flange screws for fastening PTFE plated flanges.

We recommend flexible retaining washers (e.g. Schnorr VS or S) or detent edged rings (e.g. Gross VS KD).

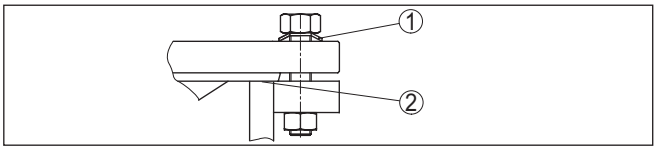


Fig. 10: Use of disc springs

1 Single disc spring
2 Laminated disc spring

The flange screws of SITRANS LG240 must be tightened with a torque of approx. 60 Nm (44 lbf ft) so that the PTFE washer seals reliably.

Note:
We recommend, retightening the screws in regular intervals depending on process pressure and temperature

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

Warning:
Connect only in the complete absence of line voltage.

- The electrical connection must only be carried out by trained personnel authorised by the plant operator.
- If overvoltage surges are expected, overvoltage arresters should be installed.

Voltage supply

Power supply and current signal are carried on the same two-wire cable. The operating voltage can differ depending on the instrument version.

The data for power supply are specified in chapter "*Technical data*".

Keep in mind the following additional factors that influence the operating voltage:

- Lower output voltage of the power supply unit under nominal load (e.g. with a sensor current of 20.5 mA or 22 mA in case of fault)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Connection cable

The instrument is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326-1 for industrial areas, screened cable should be used.

Make sure that the cable used has the required temperature resistance and fire safety for max. occurring ambient temperature

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

Cable glands

Metric threads
In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

You have to remove these plugs before electrical connection.

NPT thread
In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

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On plastic housings, the NPT cable gland or the Conduit steel tube must be screwed into the threaded insert without grease.

Max. torque for all housings, see chapter "*Technical data*".

Cable screening and grounding

If screened cable is required, we recommend connecting the cable screen on both ends to ground potential. In the sensor, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the ground potential (low impedance).

In Ex systems, the grounding is carried out according to the installation regulations.

In electroplating plants as well as plants for cathodic corrosion protection it must be taken into account that significant potential differences exist. This can lead to unacceptably high currents in the cable screen if it is grounded at both ends.

Information:
The metallic parts of the instrument (process fitting, sensor, concentric tube, etc.) are connected with the internal and external ground terminal on the housing. This connection exists either directly via the conductive metallic parts or, in case of instruments with external electronics, via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter "*Technical data*".

5.2 Connecting

Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Information:
The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When reinserting the terminal block, you should hear it snap in.

Connection procedure

Proceed as follows:

1. Unscrew the housing lid
2. If a display and adjustment module is installed, remove it by turning it slightly to the left
3. Loosen compression nut of the cable gland and remove blind plug
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry

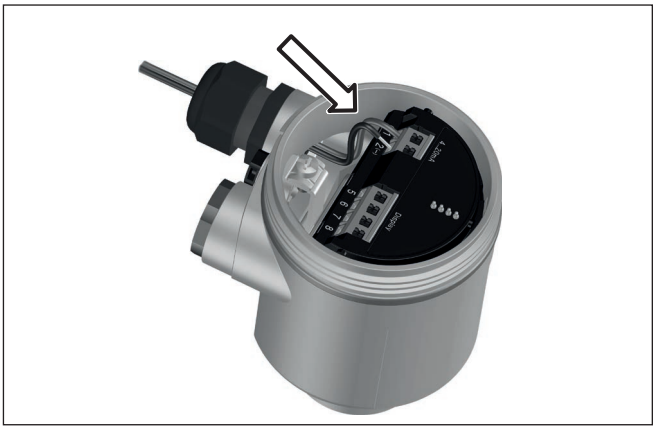

Fig. 11: Connection steps 5 and 6 - Single chamber housing

Fig. 12: Connection steps 5 and 6 - Double chamber housing

6. Insert the wire ends into the terminals according to the wiring plan

Information:
Solid cores as well as flexible cores with wire end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the terminal opening is then free. When the screwdriver is released, the terminal closes again.

You can find further information on the max. wire cross-section under "*Technical data - Electromechanical data*".

7. Check the hold of the wires in the terminals by lightly pulling on them

8. Connect the screen to the internal ground terminal, connect the external ground terminal to potential equalisation
9. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
10. Reinsert the display and adjustment module, if one was installed
11. Screw the housing lid back on

The electrical connection is finished.

5.3 Wiring plan, single chamber housing

The following illustration applies to the non-Ex, Ex-ia and Ex-d-ia version.

Electronics and terminal compartment

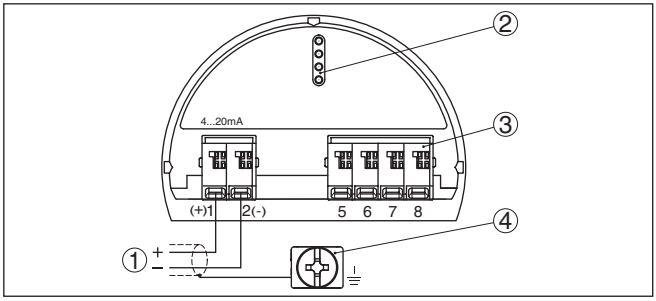

Fig. 13: Electronics and terminal compartment - single chamber housing

1 Voltage supply, signal output
2 For display and adjustment module or interface adapter
3 For external display and adjustment unit
4 Ground terminal for connection of the cable screen

5.4 Wiring plan, double chamber housing

The following illustrations apply to the non-Ex as well as to the Ex-ia version.

Electronics compartment

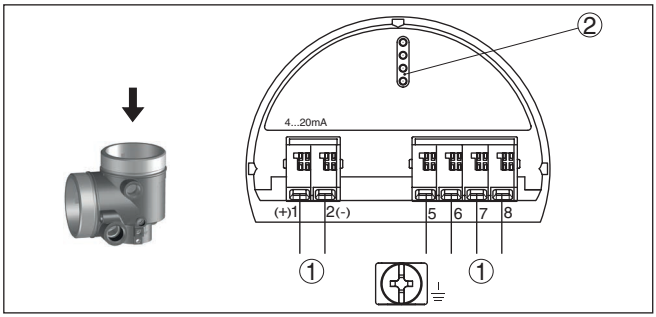

Fig. 14: Electronics compartment - double chamber housing

1 Internal connection to the terminal compartment
2 For display and adjustment module or interface adapter

Terminal compartment

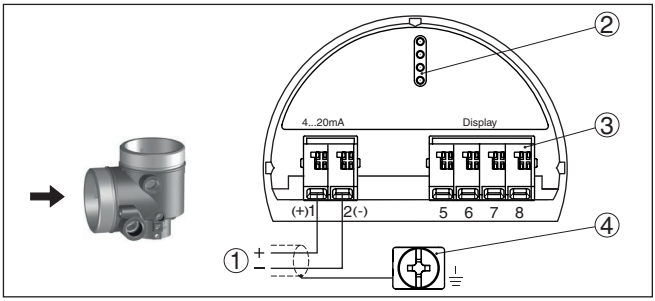

Fig. 15: Terminal compartment - double chamber housing

1 Voltage supply, signal output
2 For display and adjustment module or interface adapter
3 For external display and adjustment unit
4 Ground terminal for connection of the cable screen

5.5 Wiring plan, Ex-d-ia double chamber housing

Electronics compartment

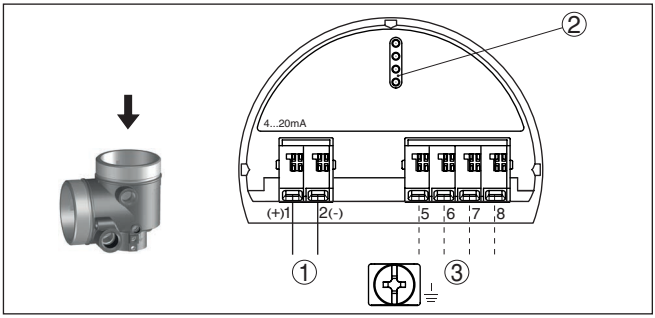

Fig. 16: Electronics compartment - double chamber housing

1 Internal connection to the terminal compartment
2 For display and adjustment module or interface adapter
3 Internal connection to the plug connector for external display and adjustment unit (optional)

Terminal compartment

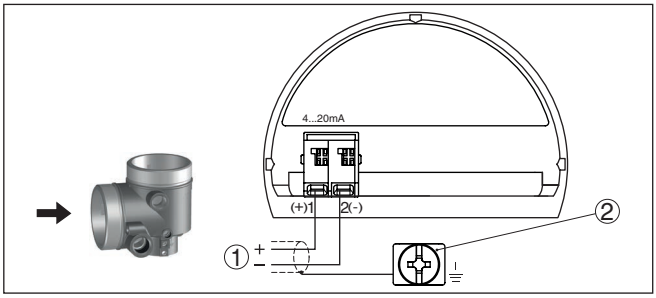

Fig. 17: Connection compartment - Ex-d-ia double chamber housing

1 Voltage supply, signal output
2 Ground terminal for connection of the cable screen

5.6 Supplementary electronics

Supplementary electronics - Additional current output

To make a second measured value available for use, you can use the supplementary electronics - additional current output.

Both current outputs are passive and need a power supply.

SIL

The additional current output (II) cannot be used in safety-instrumented systems according to SIL.

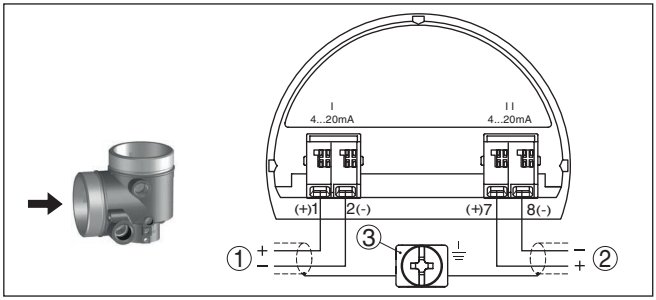

Fig. 18: Terminal compartment, double chamber housing, supplementary electronics - additional current output

1 Current output (I) - Voltage supply of the sensor and signal output (with HART)
2 Additional current output (II) - Voltage supply and signal output (without HART)
3 Ground terminal for connection of the cable screen

5.7 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 s:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC

- Indication of the status message "*F 105 Determine measured value*" on the display or PC
- The output signal jumps to the set fault current

As soon as a plausible measured value is found, the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

6 Functional safety (SIL)

6.1 Objective

SIL

In case of dangerous failures, processing facilities and machines can cause risks for persons, environment and property. The risk of such failures must be judged by the plant operator. Dependent thereon are measures for risk reduction through error prevention, error detection and fault control.

The part of plant safety depending on the correct functioning of safety-related components for risk reduction is called functional safety. Components used in such safety-instrumented systems (SIS) must therefore execute their intended function (safety function) with a defined high probability.

The safety requirements for such components are described in the international standards IEC 61508 and 61511, which set the standard for uniform and comparable judgement of instrument and plant (or machine) safety and hence contribute to worldwide legal certainty. We distinguish between four safety levels, from SIL1 for low risk to SIL4 for very high risk (SIL = Safety Integrity Level), depending on the required degree of risk reduction.

6.2 SIL qualification

Additional characteristics and requirements

When developing instruments that can be used in safety-instrumented systems, the focus is on avoiding systematical errors as well as determining and controlling random errors.

Here are the most important characteristics and requirements from the perspective of functional safety according to IEC 61508 (Edition 2):

- Internal monitoring of safety-relevant circuit parts
- Extended standardization of the software development
- In case of failure, switching of the safety-relevant outputs to a defined safe state
- Determination of the failure probability of the defined safety function
- Reliable parameterization with non-safe user environment
- Proof test

The SIL qualification of components is specified in a manual on functional safety (Safety Manual). Here, you can find all safety-relevant characteristics and information the user and the planner need for planning and operating the safety-instrumented system. This document is attached to each instrument with SIL rating and can be also found on our homepage via the instrument search.

6.3 Application area

The instrument can be used for point level detection or level measurement of liquids and bulk solids in safety-instrumented systems (SIS) according to IEC 61508 and IEC 61511. Take note of the specifications in the Safety Manual.

The following inputs/outputs are permitted:

- 4 … 20 mA current output

6.4 Safety concept of the parameterization

Tool for operation and parameterization

The following tools are permitted for parameterization of the safety function:

- The integrated display and adjustment unit for on-site adjustment
- The DTM suitable for the signal conditioning instrument in conjunction with an adjustment software according to the FDT/DTM standard, e. g. PACTware

Note:
To operate SITRANS LG240, the DTM Collection version 1.67.2 or higher is required. The modification of safety-relevant parameters is only possible with active connection to the instrument (online mode).

Safe parameterization

To avoid possible errors during parameterisation in a non-safe operating environment, a verification procedure is used that enables reliable detection of parameter adjustment errors. The safety-relevant parameters have to be verified after they are saved in the instrument. In normal operating condition, the instrument is also protected (locked) against inadvertent or unauthorized parameter changes. This concept applies to adjustment directly on the instrument as well as adjustment with PACTware and DTM.

Safety-relevant parameters

To prevent unintentional or unauthorized adjustment, the set parameters must be protected from unauthorized access. For this reason the instrument is shipped in locked condition. The PIN in delivery status is "0000".

When shipped with a specific parameter adjustment, the instruments are accompanied by a list with the values deviating from the basic setting.

All safety-relevant parameters must be verified after a change.

The parameter settings of the measurement loop must be documented. You can find a list of all safety-relevant parameters in the delivery status in chapter "*Setup with the display and adjustment module*" under "*Additional adjustments - Reset*". In addition, a list of the safety-relevant parameters can be stored and printed via PACTware/DTM.

Unlock adjustment

For each parameter change, the instrument must be unlocked via a PIN (see chapter "*Setup steps - Lock adjustment*"). The device status is indicated by the symbol of an unlocked or locked padlock.

In delivery status, the PIN is **0000**.

Unsafe device status

Warning:
If adjustment is enabled, the safety function must be considered as unreliable. This applies until the parameterisation is terminated correctly. If necessary, other measures must be taken to maintain the safety function.

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Change parameters

All parameters changed by the operator are automatically stored temporarily so that they can be verified in the next step.

Verify parameters/Lock adjustment

After setup, the modified parameters must be verified (confirm the correctness of the parameters). To do this, you first have to enter the PIN. Here the adjustment is locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.

Then you confirm that the serial number of your instrument has been carried over correctly. This is used to check device communication.

Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.

Incomplete process

Warning:
If the described process was not carried out completely or correctly (e.g. due to interruption or voltage loss), the instrument remains in an unlocked, and thus unsafe, status.

Instrument reset

Warning:
In case of a reset to basic settings, all safety-relevant parameters will also be reset to default. Therefore all safety-relevant parameters must be checked or readjusted.

6.5 Setup process

Operating sequence
A parameter change with SIL qualified instruments must always be carried out as follows.

- Unlock adjustment
- Change parameters
- Lock adjustment and verify modified parameters

Start: Safe operating state

The setup must be carried out according to an exactly specified pattern.

Generally the instrument is in safe operating state before the adjustment is released.

Unlock adjustment

Each parameter change requires the release of the instrument through a PIN (see chapter "*Setup steps - Lock adjustment*").

In delivery status, the PIN is **0000**.

Change parameters

Set up the SITRANS LG240 according to the specification in this operating instructions and the Safety Manual.

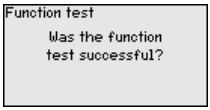
Setup - Function test

When locking the adjustment, the instrument checks the data of the measurement loop and decides on the basis of the evaluation results if a function test is required.

Function test not required
If the parameter check was successful, the adjustment is locked automatically and the instrument is again in safe operating state.

Setup is then finished.

Function test required
Should a function test be necessary, the following message is displayed on the display and adjustment module. The adjustment software also signals that a function test is required.



If a function test is required, the switching point or the range must be controlled with the original medium. For this purpose, you have to decide for your application which condition is potentially critical.

Function test

During a function test, you have to test the safety function of the instrument in the vessel with the original medium.

For this purpose, you should know the filling height of the vessel as well as the min. and max. levels respectively for 4 and 20 mA. You then can calculate the respective output current.

Measure the output current of SITRANS LG240 with a suitable multimeter and compare the measured output current with the calculated output current.

SIL If you have to interrupt the function, you can leave the SITRANS LG240 in the respective situation.

As long as SITRANS LG240 is powered, the display and adjustment module remains in the currently set adjustment menu.

To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

If you click to "*Complete*", the adjustment of the instrument is locked, but not yet verified. After conclusion of the function test, you have to restart the adjustment.

If a function test is necessary, please proceed as follows:

Mode overfill protection/dry run protection
Select the respective safety function (overfill protection/dry run protection) for your application.

1. Raise the level to directly below the switching point

   Keep a holding time of 1 minute for each level before you compare the measured value.
2. Lower the level to directly above the switching point

   Keep a holding time of 1 minute for each level before you compare the measured value.

Result

In both cases the output current must correspond to the respective level.

Measure the current output and compare the value with the calculated current value.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

Mode "Range monitoring"
If both levels are important for the safety function, you have to proceed according to the mode "Range monitoring".

1. Move the level to at least three points within the range limits.

   Keep a holding time of 1 minute for each level before you compare the measured value.

2. Move the level to a point directly above and directly below the range limits.

   Keep a holding time of 1 minute for each level before you compare the measured value.

Result

In all cases the output current must correspond to the respective level.

For this purpose, you have to measure for all levels the current output and compare the values with the calculated current values.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

Verify parameters/Lock adjustment

After setup, the modified parameters must be verified. To do this, you first have to enter the current PIN. The adjustment is then locked automatically. Then you carry out a comparison of two character strings. You must confirm that the character strings are identical. This is used to check the character presentation.

Then you confirm that the serial number of your instrument has been carried over correctly. This is used to check device communication.

Then, all modified parameters that have to be confirmed are listed. After this process is terminated, the safety function is again ensured.

7 Set up with the display and adjustment module

7.1 Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. You can choose any one of four different positions - each displaced by 90°. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing lid
2. Place the display and adjustment module on the electronics in the desired position and turn it to the right until it snaps in.
3. Screw housing lid with inspection window tightly back on

Disassembly is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

Fig. 19: Insertion of the display and adjustment module with single chamber housing

Note:
If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher lid with an inspection glass is required.

7.2 Adjustment system

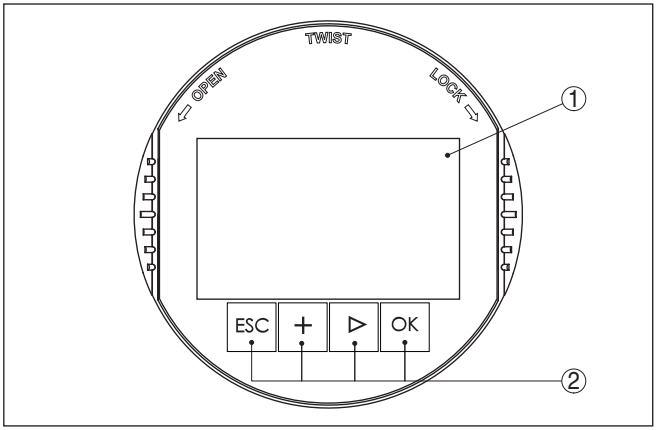


Fig. 20: Display and adjustment elements

1 LC display
2 Adjustment keys

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- ***[->]*** key:
  - Change measured value presentation
  - Select list entry
  - Select editing position
- ***[+]*** key:
  - Change value of the parameter
- ***[ESC]*** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

The sensor is operated via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the function of the individual keys in the previous illustration.

When the ***[+]*** and ***[->]*** keys are pressed quickly, the edited value, or the cursor, changes one value or position at a time. If the key is pressed longer than 1 s, the value or position changes continuously.

When the ***[OK]*** and ***[ESC]*** keys are pressed simultaneously for more than 5 s, the display returns to the main menu. The menu language is then switched over to "*English*".

Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

Switch-on phase

After switching on, the SITRANS LG240 carries out a short self-test where the device software is checked.

The output signal transmits a fault signal during the switch-on phase.

The following information is displayed on the display and adjustment module during the startup procedure:

- Instrument type
- Device name
- Software version (SW-Ver)
- Hardware version (HW-Ver)

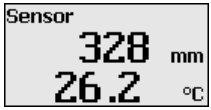
Measured value indication

With the ***[->]*** key you can move between three different indication modes.

In the first view, the selected measured value is displayed in large digits.

In the second view, the selected measured value and a corresponding bar graph presentation are displayed.

In the third view, the selected measured value as well as a second selectable value, e.g. the temperature, are displayed.

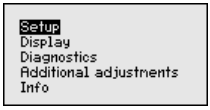


7.3 Parameter adjustment - Extended adjustment

For technically demanding measuring points, you can carry out extended settings in "*Extended adjustment*".

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, e.g. measurement loop name, medium, vessel, adjustment, signal output, device unit, false signal suppression, linearization curve

Display: Settings, e.g., for language, measured value display, lighting

Diagnosis: Information, e.g. on instrument status, pointer, measurement certainty, simulation, echo curve

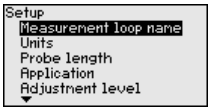
Additional adjustments: Reset, date/time, reset, copy function

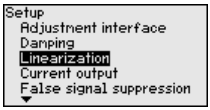
Info: Instrument name, hardware and software version, date of manufacture, instrument features

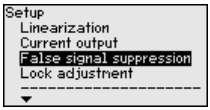
Note:
For optimum adjustment of the measuring point, the individual submenu items in the main menu item "*Setup*" should be selected one after the other and provided with the correct parameters. If possible, go through the items in the given sequence.

The procedure is described below.

The following submenu points are available:







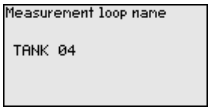
The submenu points are described below.

Setup - Measurement loop name

Here you can assign a suitable measurement loop name. Push the "***OK***" key to start the editing. With the "**+**" key you change the sign and with the "**->**" key you jump to the next position.

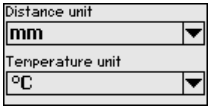
You can enter names with max. 19 characters. The character set comprises:

- Capital letters from A … Z
- Numbers from 0 … 9
- Special characters + - / _ blanks



Setup - Units

In this menu item you select the distance unit and the temperature unit.

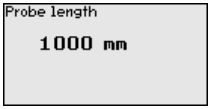


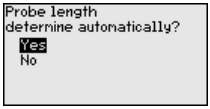
For the distance units you can choose between m, mm and ft and for the temperature units °C, °F and K.

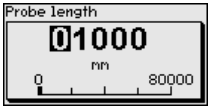
Setup - Probe length

In this menu item you can enter the probe length or have the length determined automatically by the sensor system.

When choosing "*Yes*", then the probe length will be determined automatically. When choosing "*No*", you can enter the probe length manually.

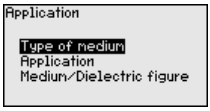


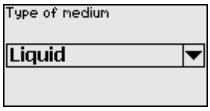


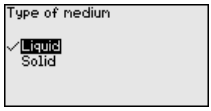


Setup - Application - Type of medium

In this menu item you can select which type of medium you want to measure. You can choose between liquid or bulk solid.







Setup - Application

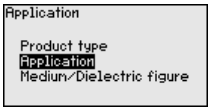
In this menu item, you can select the application. You can choose between level measurement and interface measurement. You can also choose between measurement in a vessel or in a bypass or standpipe.

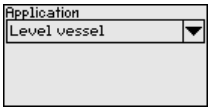
Note:
The selection of the application has a considerable influence on all other menu items. Keep in mind that as you continue with the parameter adjustment, individual menu items are only optionally available.

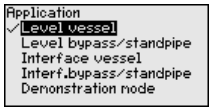
You have the option of choosing the demonstration mode. In this mode, the sensor ignores the parameters of the application and reacts immediately to any change.

SIL This mode is only suitable for test and demonstration purposes and must not be used in a safety-instrumented application (SIL).

You have to enter the tube inner diameter when measuring in a bypass or standpipe.



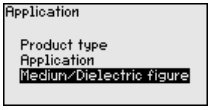


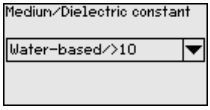


Setup - Application - Medium, dielectric constant

In this menu item, you can define the type of medium (product).

This menu item is only available if you have selected level measurement under the menu item "*Application*".





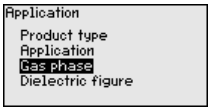
You can choose between the following medium types:

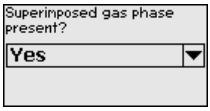
Dielectric constant	Type of medium	Examples
> 10	Water-based liquids	Acids, alcalis, water
3 … 10	Chemical mixtures	Chlorobenzene, nitro lacquer, aniline, isocyanate, chloroform
< 3	Hydrocarbons	Solvents, oils, liquid gas

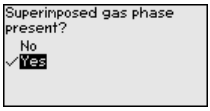
Setup - Application - Gas phase

This menu item is only available, if you have chosen interface measurement under the menu item "*Application*". In this menu item you can enter if there is a superimposed gas phase in your application.

Only set the function to "*Yes*", if the gas phase is permanently present.

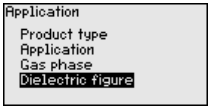


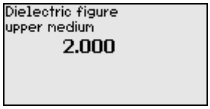


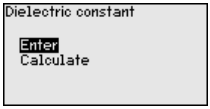


Setup - Application - Dielectric constant

This menu item is only available if you have selected interface measurement under the menu item "*Application*". In this menu item you can enter the dielectric constant of the upper medium.

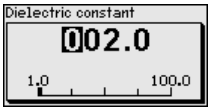


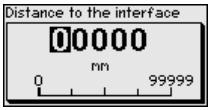




You can directly enter the dielectric constant of the upper medium or have the value determined by the instrument.

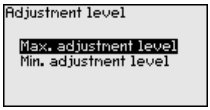
If you want the dielectric constant to be determined by the instrument, you have to enter the measured or known distance to the interface.

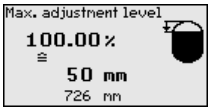




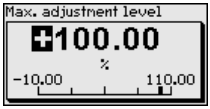
Setup - Max. adjustment Level

In this menu item you can enter the max. adjustment for the level. With interface measurement this is the maximum total level.

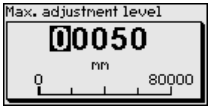




Adjust the requested percentage value with ***[+]*** and store with ***[OK]***.

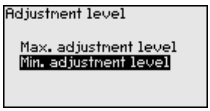


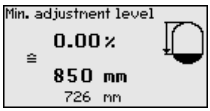
Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. The distance refers to the sensor reference plane (seal surface of the process fitting). Keep in mind that the max. level must lie below the dead band.



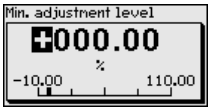
Setup - Min. adjustment Level

In this menu item you can enter the min. adjustment for the level. With interface measurement this is the minimum total level.

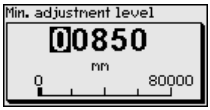




Adjust the requested percentage value with ***[+]*** and store with ***[OK]***.

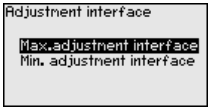


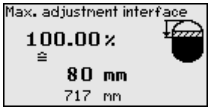
Enter the suitable distance value in m for the empty vessel (e.g. distance from the flange to the probe end) corresponding to the percentage value. The distance refers tot he sensor reference plane (seal surface of the process fitting).



Setup - Max. adjustment - Interface

This menu item is only available if you have selected interface measurement under the menu item "*Application*".

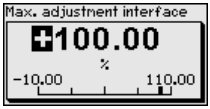


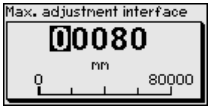


Enter the requested percentage value for the max. adjustment.

As an alternative, you have the possibility taking over the adjustment of the level measurement also for the interface.

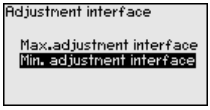
Enter the respective distance value in m for the surface of the upper medium corresponding to the percentage value.

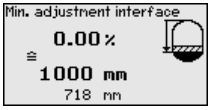




Setup - Min. adjustment - Interface

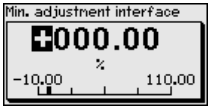
This menu item is only available if you have selected interface measurement under the menu item "*Application*".

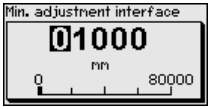




Enter the requested percentage value for the min. adjustment (interface).

Enter the respective distance value in m for the interface corresponding to the percentage value of the interface.

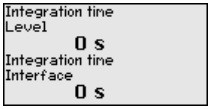


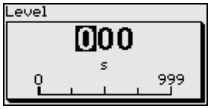


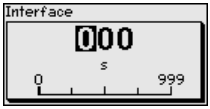
Setup - Damping

To damp process-dependent measured value fluctuations, set an integration time of 0 … 999 s in this menu item.

If you have selected interface measurement under the menu item "*Application*", you can adjust the damping for the level and the interface separately.





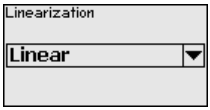


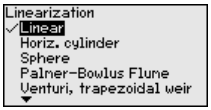
The default setting is a damping of 0 s.

Setup - Linearisation

A linearisation is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. a horizontal cylindrical or spherical tank, when the indication or output of the volume is required. Corresponding linearisation curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume.

The linearisation applies to the measured value indication and the current output. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".





Warning:
If a linearisation curve is selected, the measuring signal is no longer necessarily linear to the filling height. This must be considered by the user especially when setting the switching point on the limit signal transmitter.

In the following, you have to enter the values for your vessel, for example the vessel height and the socket correction.

For non-linear vessel forms, enter the vessel height and the socket correction.

For the vessel height, you have to enter the total height of the vessel.

For the socket correction you have to enter the height of the socket above the upper edge of the vessel. If the socket is lower than the upper edge of the vessel, this value can also be negative.

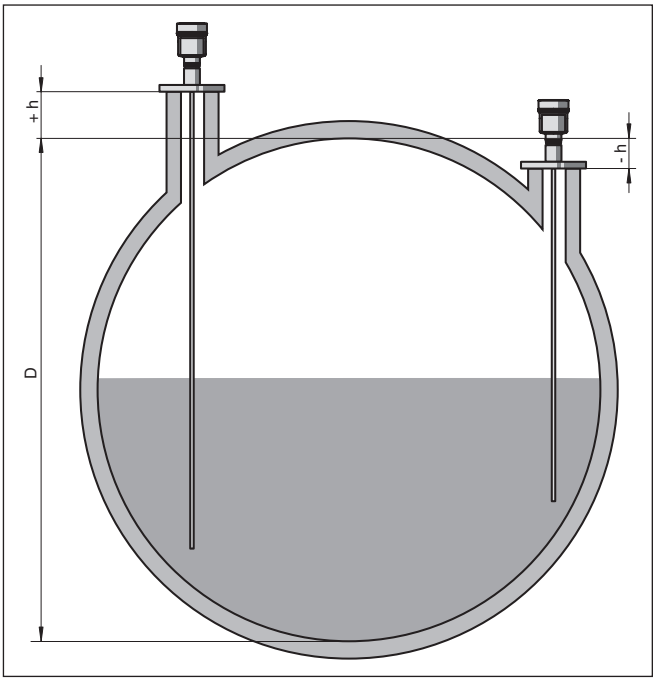
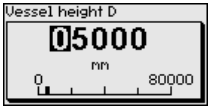
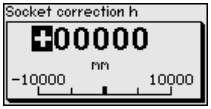
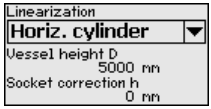


Fig. 21: Vessel height and socket correction value

D Vessel height
+h Positive socket correction value
-h Negative socket correction value

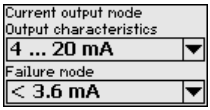


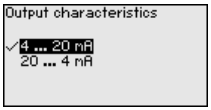


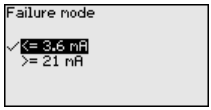


Setup - Current output, mode

In the menu item "*Current output mode*" you determine the output characteristics and reaction of the current output in case of fault.



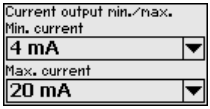


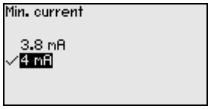


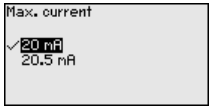
The default setting is output characteristics 4 … 20 mA, fault mode < 3.6 mA.

Setup - Current output Min./Max.

In the menu item "*Current output Min./Max.*", you determine the reaction of the current output during operation.







The default setting is min. current 3.8 mA and max. current 20.5 mA.

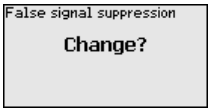
Setup - False signal suppression

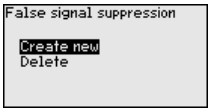
The following circumstances cause interfering reflections and can influence the measurement:

- High mounting sockets
- Vessel internals such as struts

Note:
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for the level and interface measurement. We generally recommend carrying out a false signal suppression to achieve the best possible accuracy. This should be done with the lowest possible level so that all potential interfering reflections can be detected.

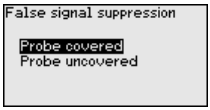
Proceed as follows:

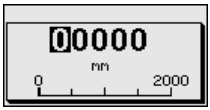




Select first if the probe is covered or uncovered.

If the probe is covered, enter the actual distance from the sensor to the product surface.



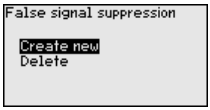


All interfering signals in this section are detected by the sensor and stored.

Keep in mind that with covered probe only false signals in the uncovered area of the probe are detected.

Note:
Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as a false signal. The level would then no longer be detectable in this area.

If a false signal suppression has already been created in the sensor, the following menu window appears when selecting "*False signal suppression*":



The instrument carries out an automatic false signal suppression as soon as the probe is uncovered. The false signal suppression is always updated.

The menu item "*Delete*" is used to completely delete an already created false signal suppression. This is useful if the saved false signal suppression no longer matches the metrological conditions in the vessel.

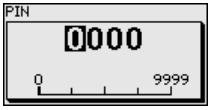
Unlock setup - adjustment

With this menu item you safeguard the sensor parameters against unauthorized or unintentional modifications.

To avoid possible errors during parameterization in a non-safe user environment, a verification procedure is used that makes it possible to detect parameterization errors reliably. For this, safety-relevant parameters must be verified before they are stored in the device. In normal operating condition, the instrument is also locked against parameter changes through unauthorized access.

For this reason, the instrument is shipped in locked conditon. The PIN in the delivery status is **0000**.

Call our service department if you have modified and forgotten the PIN.

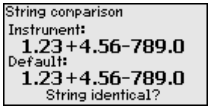


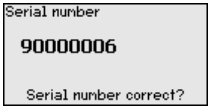
Character string comparison and serial number

You first have to carry out the character string comparison. This is used to check the character respresentation.

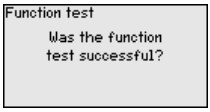
Confirm if the two character strings are identical. The verification texts are provided in German and in the case of all other menu languages, in English.

Afterwards you confirm that the serial number of your instrument was carried over correctly. This is used to check device communication.





In the next step, the instrument checks the data of the measurement and decides by means of the evaluation results if a functions test is required. If a function test is necessary, the following message is displayed.



In this case, you have to carry out a function test.

Function test

During a function test, you have to test the safety function of the instrument in the vessel with the original medium.

SIL You can find the detailed sequence of the function test in chapter "*Functional safety (SIL)*"

For this purpose, you should know the filling height of the vessel as well as the min. and max. levels respectively for 4 and 20 mA. You then can calculate the respective output current.

Measure the output current of SITRANS LG240 with a suitable multimeter and compare the measured output current with the calculated output current.

You have to determine the permissible deviation of the values yourself. This deviation depends on the the accuracy requirements of your measurement loop. Determine the permissible tolerance for the deviation.

SIL If you have to interrupt the function, you can leave the SITRANS LG240 in the respective situation.

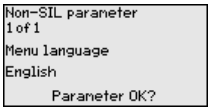
As long as SITRANS LG240 is powered, the display and adjustment module remains in the currently set adjustment menu.

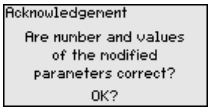
To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

Verify parameter

All safety-relevant parameters must be verified after a change. After the function test, all modified, safety-relevant parameters will be listed. Confirm the modified values one after the other.





If the described process of parameter adjustment was run through completely and correctly, the instrument will be locked and hence ready for operation.

Otherwise the instrument remains in the released and hence unsafe condition.

SIL If you have to interrupt the function test, you can leave the display and adjustment module of SITRANS LG240 in its current state.

As long as SITRANS LG240 is powered, the display and adjustment module remains in the currently set adjustment menu.

To interrupt the function test, you have to push the button "*ESC*".

If you carry out the function test by means of the "*PACTware*" software, you can store the previously performed tests and continue from there later on.

Setup - Current output 2

If a supplementary electronics with an additional current output is installed in the instrument, you can adjust the additional current output separately.

In menu item"*Current output 2*" you specify which measured value the additional current output refers to.

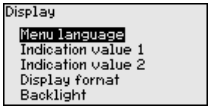
SIL The additional current output cannot be used as an output in the sense of a safety-instrumented application (SIL).

The procedure corresponds to the previous settings of the standard current output. See "*Setup - Current output*".

Display

In the main menu point "*Display*", the individual submenu points should be selected one after the other and provided with the correct parameters to ensure optimum adjustment of the display options. The procedure is described in the following.

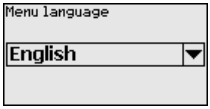
The following submenu points are available:

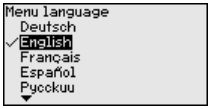


The submenu points are described below.

Display - Menu language

This menu item enables the setting of the requested national language.

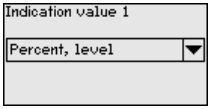


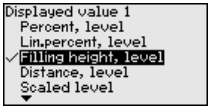


In delivery status, the sensor is set to English.

Display - Displayed value 1

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 1.

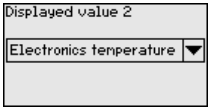


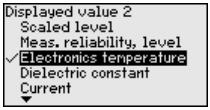


The default setting for the displayed value 1 is "*Filling height Level*".

Display - Displayed value 2

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 2.



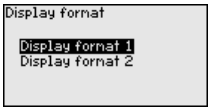


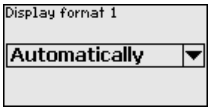
The default setting for the displayed value 2 is the electronics temperature.

Display - Display format

In this menu item, you define the display format of the measured value on the display. You can define different display formats for the two measured values.

You can thus define the number of decimal positions the measured value is displayed with.





The default setting for the display format is "*Automatic*".

Display - Backlight

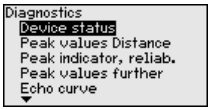
The integrated background lighting can be switched off via the adjustment menu. The function depends on the strength of the supply voltage, see "*Technical data*".

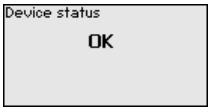
In delivery status, the lighting is switched on.

Diagnostics - Device status

In this menu item, the device status is displayed.

When the instrument displays a failure message, you can here get detailed information on the failure reason.

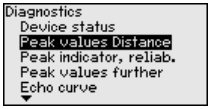


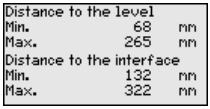


Diagnostics - Peak values, Distance

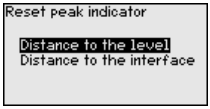
The respective min. and max. measured value is saved in the sensor. The two values are displayed in the menu item "*Peak values, distance*".

If you have selected interface measurement under the menu item "*Setup - Application*", the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





In another window you can carry out a reset of the two peak values separately.

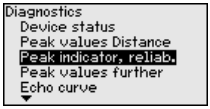


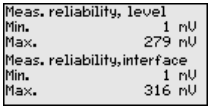
Diagnostics - Peak values Measurement certainty

The respective min. and max. measured values are saved in the sensor. The two values are displayed in the menu item "*Peak values, measurement certainty*".

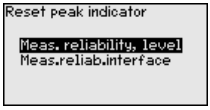
The measurement can be influenced by the process conditions. In this menu item, the measurement certainty of the level measurement is displayed in mV. The higher the value, the more reliable the measurement.

If you have selected interface measurement under the menu item "*Setup - Application*", the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





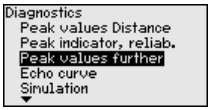
In another window you can carry out a reset of the two peak values separately.

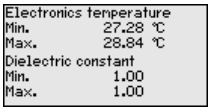


Diagnostics - Peak values, Additional

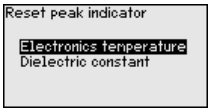
The respective min. and max. measured values are saved in the sensor. The values are displayed in the menu item "*Peak values Additional*".

This menu item displays the peak values of the electronics temperature as well as the dielectric constant.





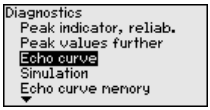
In another window you can carry out a reset of the two peak values separately.

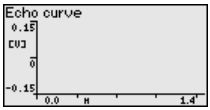


Information:
If one of the display values flashes, there is actually no valid value available.

Diagnostics - Echo curve

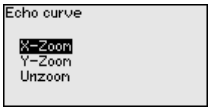
The menu item "*Echo curve*" shows the signal strength of the echoes over the measuring range in V. The signal strength enables an evaluation of the quality of the measurement.

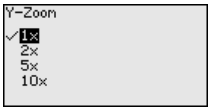




With the following functions you can zoom part sections of the echo curve.

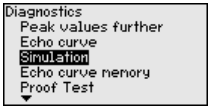
- "X-Zoom": Zoom function for the meas. distance
- "Y-Zoom": 1, 2, 5 and 10x signal magnification in "*V*"
- "Unzoom": Reset the presentation to the nominal measuring range without magnification

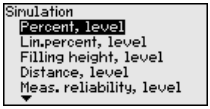




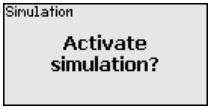
Diagnosis - Simulation

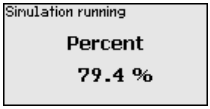
In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. through downstream indicating instruments or the input card of the control system.

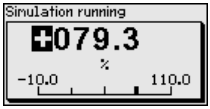




Select the requested simulation variable and set the requested value.







Caution:
During simulation, the simulated value is outputted as 4 … 20 mA current value and digital HART signal.

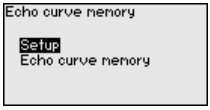
Push the ***[ESC]*** key to deactivate the simulation.

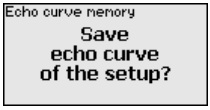
Information:
The simulation is terminated automatically 60 minutes after the activation of the simulation.

Diagnostics - Echo curve memory

With the menu item "*Setup*" the echo curve it is possible to save at the time of setup. This is generally recommended; for using the Asset Management functions it is necessary. If possible, the curve should be saved with a low level in the vessel.

With this, you can detect signal changes over the operating time. With the adjustment software PACTware and the PC, the high-resolution echo curve can be displayed and used to compare the echo curve of the setup with the actual echo curve.



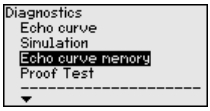


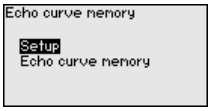
The function "*Echo curve memory*" enables storing echo curves of the measurement.

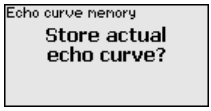
Under the sub-menu item "*Echo curve memory*" you can store the current echo curve.

Parameter settings for recording the echo curve and the settings of the echo curve itself can be carried out in the adjustment software PACTware.

With the adjustment software PACTware and the PC the high-resolution echo curve can be displayed and used later on to assess the quality of the measurement.

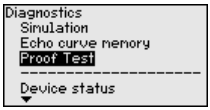


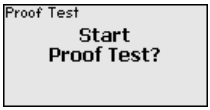


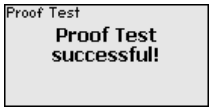


Diagnosis - Proof test

With the function "*Proof test*", the function of the instrument can be checked on a recurring basis.







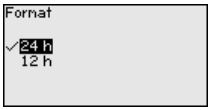
SIL

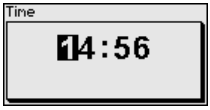
During the function test, the safety function must be treated as unsafe. Keep in mind that the function test influences downstream connected devices.

You can find detailed information on the proof test in the Safety Manual (SIL).

Additional settings - Date/ Time

In this menu item, the internal clock of the sensor is set.





Additional settings - Reset

After a reset, certain parameter adjustments made by the user are reset.

Note:
After this menu window, the reset process is carried out. No further safety inquiry follows.

The following reset functions are available:

Delivery status: Restores the parameter settings at the time of shipment from the factory, incl. order-specific settings. Any stored false signal suppression or user-programmed linearisation curve, as well as the measured value memory, are deleted.

Basic settings: Resetting of the parameter settings incl. special parameters to the default values (presettings) of the respective instrument. Any created false signal suppression or user-programmable linearization curve as well as the measured value memory are deleted.

The following tables show the default values of the instrument. Depending on the instrument version or application, all menu items may not be available or some may be differently assigned.

The menu items in bold are safety-relevant in terms of the functional safety according to IEC 61508 (Edition 2) SIL.

Menu - Setup

Menu	Menu item	Default value
Setup	**Lock adjustment**	Locked
	Measurement loop name	Sensor
	Units	Distance unit: order-specific Temperature unit: order-specific
	Probe length	Länge der Messsonde factory setting
	Type of medium	Liquid
	Application	Level, vessel
	Medium, dielectric constant	Water-based, > 10
	Superimposed gas phase	Yes
	Dielectric constant, upper medium (TS)	1.5
	Tube inner diameter	200 mm
Setup	**Max. adjustment - Level**	100 %
	Max. adjustment - Level	Distance: 0.000 m(d) - note blocking distances
	Min. adjustment - Level	0 %
	Min. adjustment - Level	Distance: Probe length - take dead band into account
	Accept adjustment of the level measurement?	No
	Max. adjustment - Interface	100 %
	Max. adjustment - Interface	Distance: 0.000 m(d) - note blocking distances
	Min. adjustment - Interface	0 %
	Min. adjustment - Interface	Distance: Probe length - take dead band into account
Setup	**Integration time - Level**	0.0 s
	Integration time - Interface	0.0 s
Setup	**Linearization type**	Linear
	Linearization - Socket correction	0 mm
	Linearization - Vessel height	Probe length

Menu	Menu item	Default value
Setup	Scaling variable - Level	Volume in l
	Scaling unit - Level	Litres
	Scaling format - Level	Without decimal positions
	Scaling level - 100 % corresponds to	100
	Scaling level - 0 % corresponds to	0
	Accept scaling of the level measurement	Yes
	Scaling variable - Interface	Volume
	Scaling unit - Interface	Litres
	Scaling format - Interface	Without decimal positions
	Scaling interface - 100 % corresponds to	100
	Scaling interface - 0 % corresponds to	0
Setup	**Current output, output variable** First HART variable (PV)	Lin. percent - Level
	Current output - Output characteristics	0 … 100 % correspond to 4 … 20 mA
	Current output - Reaction in case of failure	≤ 3.6 mA
	Current output - Min.	3.8 mA
	Current output - Max.	20.5 mA
	Current output 2 - Output variable Second HART variable (SV)	Distance - Level
	Current output 2 - Output characteristics	0 … 100 % correspond to 4 … 20 mA
	Current output 2 - Reaction in case of fault	≤ 3.6 mA
	Current output - Min.	3.8 mA
	Current output - Max.	20.5 mA
	Third HART variable (TV)	Measurement certainty, level
	Fourth HART variable (QV)	Electronics temperature

Menu - Display

Menu	Menu item	Default value
Display	Language	Selected language
	Displayed value 1	Filling height Level
	Displayed value 2	Electronics temperature
	Backlight	Switched on

Menu - Diagnosis

Menu	Menu item	Default value
Diagnostics	Status signals - Function control	Switched on
	Status signals - Out of specification	Switched off
	Status signals - Maintenance	Switched on
Diagnostics	Device memory - Echo curve memory	Stopped
	Device memory - Measured value memory	Started
	Device memory - Measured value memory - Measured values	Distance level, percentage value level, reliability level, electronics temperature
	Device memory - Measured value memory - Recording in time interval	3 min.
	Device memory - Measured value memory - Recording with measured value difference	15 %
	Device memory - Measured value memory - Start with measured value	Not active
	Device memory - Measured value memory - Stop with measured value	Not active
	Device memory - Measured value memory - Stop recording when memory is full	Not active

Menu - Additional adjustments

Menu	Menu item	Default value
Additional adjustments	PIN	0000
	Date	Actual date
	Time	Actual time
	Time - Format	24 hours
	Probe type	Device-specific
	HART mode	Analogue current output

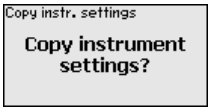
Additional settings - Copy instrument settings

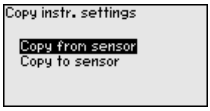
The instrument settings are copied with this function. The following functions are available:

- Read from sensor: Read data from sensor and save in the display and adjustment module
- Write to sensor: Save data from the display and adjustment module back into the sensor

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Reset, Date/Time*"
- Special parameters





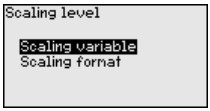
The copied data are permanently saved in an EEPROM memory in the display and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.

Note:
Before the data are stored in the sensor, a check is carried out to determine if the data fit the sensor. If the data do not fit, a fault signal is triggered or the function is blocked. When data are being written into the sensor, the display shows which instrument type the data originate from and which TAG-no. this sensor had.

Tip:
We recommend to save the instrument adjustments. In case of an electronics exchange the saved parameter adjustment data relieve this process.

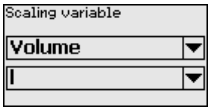
Additional settings - Scaling level

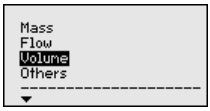
Since scaling is very extensive, scaling of the level value was divided into two menu items.



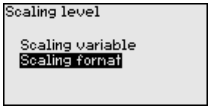
Additional settings - Scaling level - Scaling variable

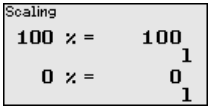
In menu item "*Scaling variable*" you define the scaling variable and the scaling unit for the level value on the display, e.g. volume in l.



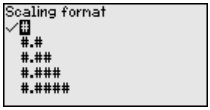


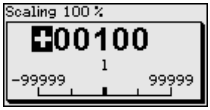
Additional settings - Scaling level - Scaling format

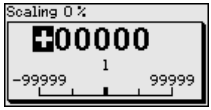




In menu item "*Scaling format*" you define the scaling format on the display and the scaling of the measured level value for 0 % and 100 %.

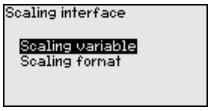






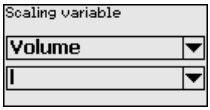
Additional settings - Scaling interface

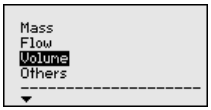
Since scaling is very extensive, scaling of the interface value was divided into two menu items.



Additional settings - Scaling interface - Scaling variable

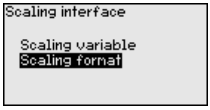
In menu item "*Scaling variable*" you define the scaling variable and the scaling unit for the interface value on the display, e.g. volume in l.

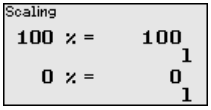


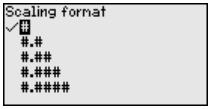


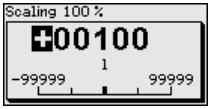
Additional settings - Scaling interface - Scaling format

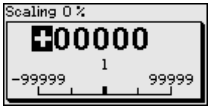
In menu item "*Scaling format*" you define the scaling format on the display and the scaling of the measured interface value for 0 % and 100 %.





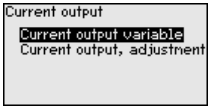






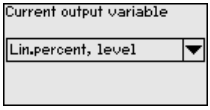
Additional settings - Current output

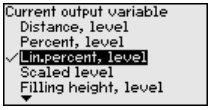
Since scaling is very extensive, scaling of the level value was divided into two menu items.



Additional settings - Current output - Current output, meas. variable

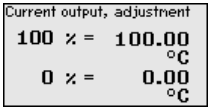
In menu item "*Current output, variable*" you specify which measured variable the current output refers to.

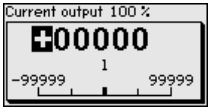


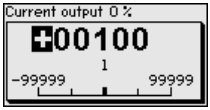


Additional settings - Current output - Current output, adjustment

In menu item "*Current output, adjustment*" you can assign a respective measured value to the current output.

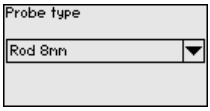


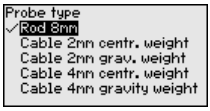




Additional settings - Probe type

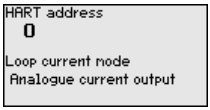
In this menu item you can select the type and size of your probe from a list of all possible probes. This is necessary to adapt the electronics optimally to the probe.

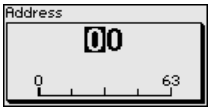




Additional adjustments - HART mode

The sensor is permanently set to the HART mode "*Analogue current output*". This parameter cannot be modified.





The default setting is "*Analogue current output*" and the address 00.

Additional settings - Special parameters

In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

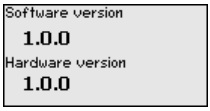
Change the settings of the special parameters only after having contacted our service staff.

Info - Instrument name

In this menu, you read out the instrument name and the instrument serial number.

Info - Instrument version

In this menu item, the hardware and software version of the sensor is displayed.

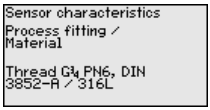


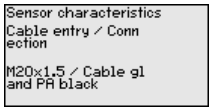
Info - Factory calibration date

In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the display and adjustment module or via the PC.

Info - Sensor characteristics

In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.





Example for displayed sensor features.

7.4 Saving the parameterisation data

Backup on paper

We recommended writing down the adjustment data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

Backup in the display and adjustment module

If the instrument is equipped with a display and adjustment module, the data in the sensor can be saved in the display and adjustment module. The procedure is described in menu item "*Copy device settings*" in the menu "*Additional settings*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the display and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- The items "*Sensor-specific units, temperature unit and linearisation*" in the menu "*Additional settings*".
- The values of the user-programmable linearisation curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the display and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item "*Copy device settings*".

8 Setup with PACTware

8.1 Connect the PC

Via the interface adapter directly on the sensor

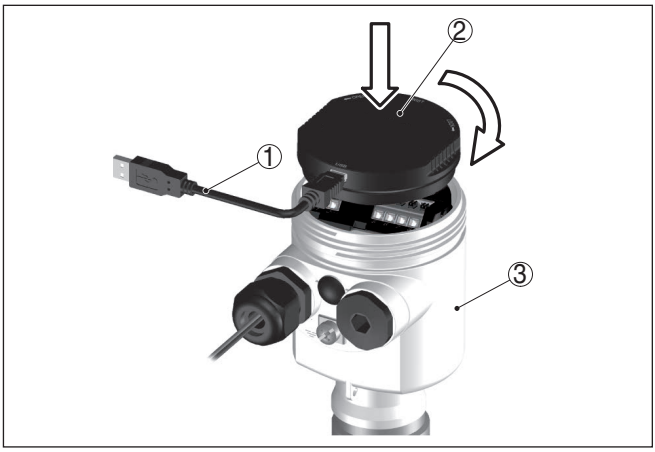


Fig. 22: Connection of the PC directly to the sensor via the interface adapter

1 USB cable to the PC
2 Interface adapter
3 Sensor

Connection via HART

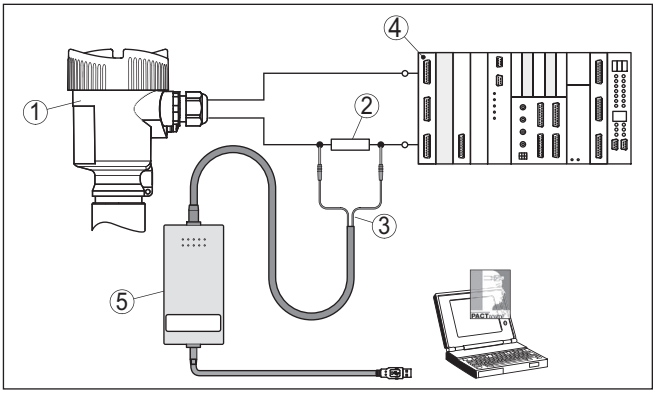


Fig. 23: Connecting the PC via HART to the signal cable

1 Sensor
2 HART resistance 250 Ω (optional depending on evaluation)
3 Adapter cable for HART modem
4 Processing system/PLC/Voltage supply
5 HART modem

8.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The available DTMs are compiled on a DVD. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:
To ensure that all instrument functions are supported, you should always use the latest DTM. Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

The further setup steps are described in the online help of PACTware and the DTMs.

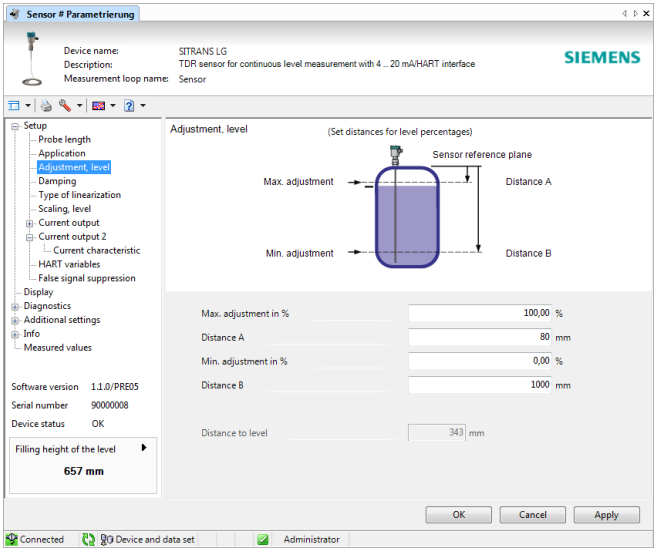


Fig. 24: Example of a DTM view

Device DTMs

The device DTM includes an assistant for simple project configuration simplifying the adjustment considerably. You can save and print your project documentation as well as import and export projects.

You can also save measured value and echo curves in the DTM. Furthermore a tank calculation program as well as a multiviewer for indication and analysis of the saved measured value and echo curves are available.

The supplied DVD includes the respective device DTM. However, you can also download the DTM from our homepage www.siemens.com/sitranslg.

8.3 Saving the parameterisation data

We recommend documenting or saving the parameterisation data via PACTware. That way the data are available for multiple use or service purposes.

9 Set up with other systems

9.1 DD adjustment programs

Device descriptions as Enhanced Device Description (EDD) are available for DD adjustment programs such as, for example, AMS™ and PDM.

9.2 Field Communicator 375, 475

Device descriptions for the instrument are available as EDD for parameterisation with Field Communicator 375 or 475.

Integrating the EDD into the Field Communicator 375 or 475 requires the "Easy Upgrade Utility" software, which is available from the manufacturer. This software is updated via the Internet and new EDDs are automatically accepted into the device catalogue of this software after they are released by the manufacturer. They can then be transferred to a Field Communicator.

10 Diagnostics and servicing

10.1 Maintenance

If the instrument is used correctly, no maintenance is required in normal operation.

When used in safety-instrumented systems (SIS), the safety function must be carried out on the instrument in regular time intervals by means of a proof test.

Hence possible undetected, dangerous failure can be identified.

The operator's responsibility to select the kind of test. The time intervals depend on the used PFD_{AVG}.

SIL

During the function test, the safety function must be treated as unsafe. Keep in mind that the function test influences downstream connected devices.

If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures.

You can find detailed information on the proof test in the Safety Manual (SIL).

10.2 Diagnosis memory

The instrument has several memories available for diagnostic purposes. The data remain there even in case of voltage interruption.

Measured value memory

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value. Storable values are for example:

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- Meas. certainty
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement certainty and electronics temperature every 3 minutes.

In "Extended adjustment" you can select the respective measured values.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

Event memory

Up to 500 events are automatically stored with a time stamp in the sensor (non-deletable). Each entry contains date/time, event type, event description and value. Event types are for example:

- Modification of a parameter
- Switch-on and switch-off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

The data are read out via a PC with PACTware/DTM or the control system with EDD.

Echo curve memory

The echo curves are stored with date and time and the corresponding echo data. The memory is divided into two sections:

Echo curve of the setup: This is used as reference echo curve for the measurement conditions during setup. Changes in the measurement conditions during operation or buildup on the sensor can thus be recognized. The echo curve of the setup is stored via:

- PC with PACTware/DTM
- Control system with EDD
- Display and adjustment module

Further echo curves: Up to 10 echo curves can be stored in a ring buffer in this memory section. Additional echo curves are stored via:

- PC with PACTware/DTM
- Control system with EDD
- Display and adjustment module

10.3 Status messages

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables, detailed error messages are available under menu item "*Diagnostics*" via the display and adjustment module, PACTware/DTM and EDD.

Status messages

The status messages are divided into the following categories:

- Failure
- Function check
- Out of specification
- Maintenance requirement

and explained by pictographs:

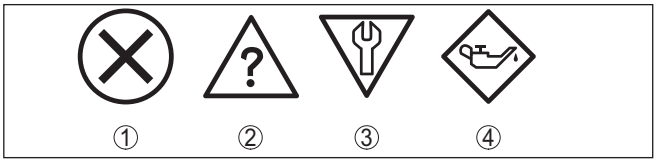


Fig. 25: Pictographs of the status messages

1 Failure - red
2 Out of specification - yellow
3 Function check - orange
4 Maintenance - blue

Failure: Due to a malfunction in the instrument, a fault message is outputted.

This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is being worked on, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Out of specification: The measured value is unreliable because an instrument specification was exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Maintenance: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Failure

The following table shows the error codes in the status message "*Failure*" and gives information on the reason and rectification. Keep in mind that some information is only valid for four-wire instruments.

Code **Text message**	**Cause**	**Rectification**	**DevSpec State in CMD 48**
F013 no measured value available	● Sensor does not detect an echo during operation ● Process component or probe contaminated or defective	● Check for correct mounting and/or parameter settings ● Clean or exchange process component or probe	Bit 0 of Byte 0 … 5
F017 Adjustment span too small	● Adjustment not within specification	● Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)	Bit 1 of Byte 0 … 5
F025 Error in the linearization table	● Index markers are not continuously rising, for example illogical value pairs	● Check values of the linearization table ● Delete/create a new linearization table	Bit 2 of Byte 0 … 5
F036 No operable software	● Failed or interrupted software update	● Repeat software update ● Check electronics version ● Exchanging the electronics ● Send instrument for repair	Bit 3 of Byte 0 … 5
F040 Error in the electronics	● Hardware defect	● Exchanging the electronics ● Send instrument for repair	Bit 4 of Byte 0 … 5
F041 Probe loss	● Cable probe broken or rod probe defective	● Check probe and exchange, if necessary	Bit 13 of Byte 0 … 5
F080 General software error	● General software error	● Disconnect operating voltage briefly	Bit 5 of Byte 0 … 5

Code Text message	Cause	Rectification	DevSpec State in CMD 48
F105 Measured value is determined	● The instrument is still in the start phase, the measured value could not yet be determined	● Wait for the end of the switch-on phase ● Duration depending on the version and parameter adjustment max. 5 min.	Bit 6 of Byte 0 … 5
F113 Communication error	● EMC interference ● Transmission error during external communication with 4-wire power supply unit	● Remove EMC influences ● Exchange 4-wire power supply unit or electronics	Bit 12 of Byte 0 … 5
F125 Impermissible electronics temperature	● Temperature of the electronics in the non-specified range	● Check ambient temperature ● Insulate electronics ● Use instrument with higher temperature range	Bit 7 of Byte 0 … 5
F260 Error in the calibration	● Error in the calibration carried out in the factory ● Error in the EEPROM	● Exchanging the electronics ● Send instrument for repair	Bit 8 of Byte 0 … 5
F261 Error in the instrument settings	● Error during setup ● Error when carrying out a reset ● False signal suppression faulty	● Carry out a reset ● Repeat setup	Bit 9 of Byte 0 … 5
F264 Installation/Set-up error	● Error during setup	● Check for correct mounting and/or parameter settings ● Check probe length	Bit 10 of Byte 0 … 5
F265 Measurement function disturbed	● Sensor no longer carries out a measurement	● Carry out a reset ● Disconnect operating voltage briefly	Bit 11 of Byte 0 … 5
F266 Impermissible operating voltage	● Operating voltage below specified range	● Check electrical connection ● If necessary, increase operating voltage	Bit 14 of Byte 0 … 5
F267 No executable sensor software	● Sensor cannot start	● Exchanging the electronics ● Send instrument for repair	No communication possible

Function check

The following table shows the error codes and text messages in the status message "*Function check*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification	DevSpec State in CMD 48
C700 Simulation active	● A simulation is active	● Finish simulation ● Wait for the automatic end after 60 mins.	"Simulation Active" in "Standardized Status 0"
C701 Parameter verification	● Parameter verification was interrupted	● Finish parameter verification	Bit 12 of Byte 14 … 24

Out of specification

The following table shows the error codes and text messages in the status message "*Out of specification*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification	DevSpec State in CMD 48
S601 Overfilling	● Level echo in the close range not available	● Reduce level ● 100 % adjustment: Increase value ● Check mounting socket ● Remove possible interfering signals in the close range ● Use coaxial probe	Bit 9 of Byte 14 … 24

Maintenance

The following table shows the error codes and text messages in the status message "*Maintenance*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification	DevSpec State in CMD 48
M500 Error in the delivery status	● The data could not be restored during the reset to delivery status	● Repeat reset ● Load XML file with sensor data into the sensor	Bit 0 of Byte 14 … 24
M501 Error in the non-active linearisation table	● Index markers are not continuously rising, for example illogical value pairs	● Check linearisation table ● Delete table/Create new	Bit 1 of Byte 14 … 24
M504 Error at a device interface	● Hardware defect	● Exchanging the electronics ● Send instrument for repair	Bit 4 of Byte 14 … 24
M506 Installation/Set-up error	● Error during setup	● Check and correct mounting and/or parameter adjustment ● Check probe length	Bit 6 of Byte 14 … 24
M507 Error in the instrument settings	● Error during setup ● Error when carrying out a reset ● False signal suppression faulty	● Carry out reset and repeat setup	Bit 7 of Byte 14 … 24

10.4 Rectify faults

Reaction when malfunction occurs

The operator of the system is responsible for taking suitable measures to rectify faults.

Procedure for fault rectification

The first measures are:

- Evaluation of fault messages via the adjustment device
- Checking the output signal
- Treatment of measurement errors

Further comprehensive diagnostics options are available with a PC with PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults rectified.

Check the 4 … 20 mA signal

Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to eliminate them:

Error	Cause	Rectification
4 … 20 mA signal not stable	● Fluctuations of the measured variable	● Set damping appropriate to the instrument via the display and adjustment module or PACTware/DTM
4 … 20 mA signal missing	● Electrical connection faulty	● Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"
	● Voltage supply missing	● Check cables for breaks; repair if necessary
	● Operating voltage too low or load resistance too high	● Check, adapt if necessary
Current signal greater than 22 mA or less than 3.6 mA	● Electronics module in the sensor defective	● Exchange the instrument or send it in for repair

Treatment of measurement errors

The below tables show typical examples for application-relevant measurement errors. There are two measurement errors:

- Constant level
- Filling
- Emptying

The images in column "*Error pattern*" show the real level as a broken line and the level displayed by the sensor as a continuous line.

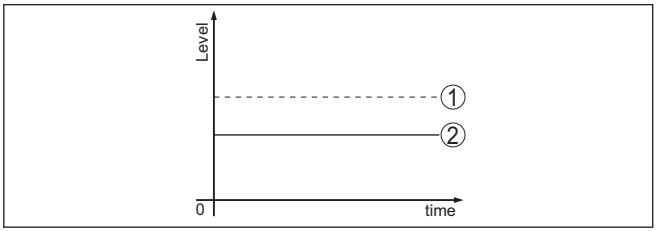
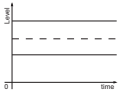
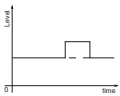


Fig. 26: The broken line 1 shows the real level, the continuous line 2 shows the level displayed by the sensor

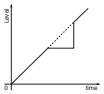
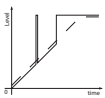
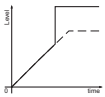
Note:

- Wherever the sensor displays a constant value, the reason could also be the fault setting of the current output to "*Hold value*"
- If the level indication is too low, the reason could be a line resistance that is too high

Measurement error with constant level

Fault description	Error pattern	Cause	Rectification
1. Measured value shows a too low or too high level		● Min./max. adjustment not correct	● Adapt min./max. adjustment
		● Incorrect linearisation curve	● Adapt linearisation curve
		● Running time error (small measurement error close to 100 %/ serious error close to 0 %)	● Repeat setup
2. Measured value jumps towards 100 %		● Due to the process, the amplitude of the product echo decreases ● A false signal suppression was not carried out	● Carry out a false signal suppression
		● Amplitude or position of a false signal has changed (e.g. buildup); false signal suppression no longer matches	● Determine the reason for the changed false signals, carry out false signal suppression, e.g. with buildup

Measurement error during filling

Fault description	Error pattern	Cause	Rectification
3. Measured value remains in the area of the bottom during filling		● Echo from the probe end larger than the product echo, for example, with products with $\varepsilon_r < 2.5$ oil-based, solvents, etc.	● Check parameter "Medium" and "Vessel height", adapt if necessary
4. Measured value remains momentarily unchanged during filling and then jumps to the correct level		● Turbulence on the product surface, quick filling	● Check parameters, change if necessary, e.g. in dosing vessel, reactor
5. Measured value jumps sporadically to 100 % during filling		● Changing condensation or contamination on the probe	● Carry out a false signal suppression
6. Measured value jumps to ≥ 100 % or 0 m distance		● Level echo is no longer detected in the close range due to false signals in the close range. The sensor goes into overfill protection mode. The max. level (0 m distance) as well as the status message "Overfill protection" are outputted.	● Eliminate false signals in the close range ● Check installation conditions ● If possible, switch off the function "Overfill protection"

Measurement error during emptying

Fault description	Error pattern	Cause	Rectification
7. Measured value remains unchanged in the close range during emptying		● False signal larger than the level echo ● Level echo too small	● Eliminate false signals in the close range ● Remove contamination on the probe. After having removed the source of the false signals, the false signal suppression must be deleted. ● Carry out a new false signal suppression
8. Measured value remains reproducible in one position during emptying		● Stored false signals in this position are larger than the level echo	● Delete false signal suppression ● Carry out a new false signal suppression

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Setup*" must be carried out again or must be checked for plausibility and completeness.

10.5 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

With SIL qualified instrument, only a respective electronics module with SIL qualification must be used.

The electronics modules are adapted to the respective sensor. Hence the new electronics module must be loaded with the default settings of the sensor. These are the possibilities:

- In the factory
- Or on site by the user

In the factory

Order the replacement electronics module from the agency serving you.

When ordering the replacement electronics module, please state the serial number of the sensor.

The serial numbers are stated on the type label of the instrument, inside the housing as well as on the delivery note.

The replacement electronics module is provided with the serial number of the affected sensor. Before mounting, check if the serial number on the replacement electronics module and the serial number of the sensor correspond.

Then all application-specific settings must be entered again. Carry out a fresh setup after exchanging the electronics or load the stored data of the setup.

Or on site by the user

SIL First you have to transfer the device-specific sensor data to the new electronics module.

You can download these individual, device-specific data of your sensor from our homepage.

Under "Instrument search (serial number)" you can download the specific sensor data as XML file with the sensor serial number directly to the sensor.

After the transfer of the sensor data, you have to verify the correct transmission by means of a check sum. Only then, the instrument will be ready for operation, again.

You can find the detailed process of the electronics exchange in the supplementary instructions "*Electronics module*".

Then all application-specific settings must be entered again. Carry out a fresh setup after exchanging the electronics or load the stored data of the setup.

If you saved the parameter settings during the first setup of the sensor, you can transfer them to the replacement electronics module. Also in this case a verification of the instrument is necessary.

10.6 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- HART modem
- PC with PACTware
- Current sensor software as file

You can find the actual sensor software as well as detailed information of the procedure in the download area on our homepage: www.siemens.com/sitranslg.

You can find information about the installation in the download file.

SIL Make sure that you are using the correct software with SIL qualification.

Instruments with SIL qualification can only be updated with a respective software. An accidental update with a wrong software version is impossible.

⚠ **Caution:**
Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval is still effective after a software update is carried out.

You can find detailed information in the download area on our homepage: www.siemens.com/sitranslg.

10.7 How to proceed if a repair is necessary

If it is necessary to repair the instrument, please contact Siemens Milltronics Process Instruments. You find the locations on "www.siemens.com/sitranslg".

11 Dismount

11.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

11.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

WEEE directive 2012/19/EU
This instrument is not subject to the WEEE directive 2012/19/EU and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

12 Supplement

12.1 Technical data

General data

316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Process fitting	PTFE-TFM 1600
– Process seal	PTFE-TFM 1600
– Rod: ø 10 mm (0.394 in)	316L, PFA coated
– Cable: ø 4 mm (0.157 in)	316 (1.4401), PFA coated
– Gravity weight	PFA coated
Materials, non-wetted parts	
– Plastic housing	Plastic PBT (Polyester)
– Aluminium die-cast housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing (precision casting)	316L
– Stainless steel housing (electropolished)	316L
– Seal between housing and housing lid	Silicone SI 850 R
– Inspection window in housing cover (optional)	Polycarbonate (with Ex d version: glass)
– Ground terminal	316L
– Cable gland	PA, stainless steel, brass
– Sealing, cable gland	NBR
– Blind plug, cable gland	PA
Process fittings	
– Clamp	from 2"
– Slotted nut	from DN 32 PN 40
– Flanges	DIN from DN 25, ASME from 2"
Weight	
– Instrument weight (depending on process fitting)	approx. 0.8 … 8 kg (0.176 … 17.64 lbs)
– Rod: ø 10 mm (0.394 in) - PFA coated	approx. 330 g/m (3.55 oz/ft)
– Cable: ø 4 mm (0.157 in) - PFA coated	approx. 41 g/m (0.44 oz/ft)
– Gravity weight (long) for cable ø 4 mm (0.157 in)	325 g (11.5 oz)
Probe length L (from seal surface)	
– Rod: ø 10 mm (0.394 in) - PFA coated	up to 4 m (13.12 ft)
– Trimming accuracy - rod	±(1 mm + 0.05 % of the rod length)
– Cable: ø 4 mm (0.157 in) - PFA coated	up to 32 m (105 ft)
– Trimming accuracy - cable	±(2 mm + 0.05 % of the cable length)

Lateral load with rod: ø 10 mm (0.394 in) - PFA coated	4 Nm (3 lbf ft)
Max. tensile load with cable: ø 4 mm (0.157 in) - PFA coated	2 KN (450 lbf)
Torque for NPT cable glands and Conduit tubes	
– Plastic housing	max. 10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	max. 50 Nm (36.88 lbf ft)

Input variable	
Measured variable	Level of liquids
Min. dielectric constant of the medium	
– Cable probes	$\varepsilon_r \geq 1.6$
– Rod probes	$\varepsilon_r \geq 1.6$

Output variable	
Output signal	4 … 20 mA/HART
Range of the output signal	3.8 … 20.5 mA/HART (default setting)
Fulfilled HART specification	7
Signal resolution	0.3 µA
Fault signal, current output (adjustable)	≥ 21 mA, ≤ 3.6 mA
Max. output current	21.5 mA
Starting current	≤ 10 mA for 5 ms after switching on, ≤ 3.6 mA
Load	see load diagram under Power supply
Damping (63 % of the input variable), adjustable	0 … 999 s
HART output values according to HART 7 (default setting)[1]	
– First HART value (PV)	Linearised percentage value, level
– Second HART value (SV)	Distance to the level
– Third HART value (TV)	Measurement certainty, level
– Fourth HART value (QV)	Electronics temperature
Indication value - Display and adjustment module[2]	
– Displayed value 1	Filling height Level
– Displayed value 2	Electronics temperature
Resolution, digital	< 1 mm (0.039 in)

Output variable - Additional current output	
For details on the operating voltage see chapter "Voltage supply"	
Output signal	4 … 20 mA (passive)
Range of the output signal	3.8 … 20.5 mA (default setting)
Signal resolution	0.3 µA

[1] The output values can be assigned individually.
[2] The indication values can be assigned individually.

Fault signal, current output (adjustable)	Last valid measured value, ≥ 21 mA, ≤ 3.6 mA
Max. output current	21.5 mA
Starting current	≤ 10 mA for 20 ms after switching on, ≤ 3.6 mA
Load	Load resistor, see chapter "Voltage supply"
Damping (63 % of the input variable), adjustable	0 … 999 s
Indication value - Display and adjustment module[3]	
– Displayed value 1	Filling height Level
– Displayed value 2	Electronics temperature
Resolution, digital	< 1 mm (0.039 in)

Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1	
– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %
– Air pressure	+860 … +1060 mbar/+86 … +106 kPa (+12.5 … +15.4 psig)
Mounting, reference conditions	
– Min. distance to internal installations	> 500 mm (19.69 in)
– Vessel	metallic, ø 1 m (3.281 ft), centric mounting, process fitting flush with the vessel ceiling
– Medium	Water/Oil (dielectric constant ~2.0)[4]
– Mounting	Probe end does not touch the vessel bottom
Sensor parameter adjustment	No gating out of false signals carried out

[3] The indication values can be assigned individually.
[4] With interface measurement = 2.0

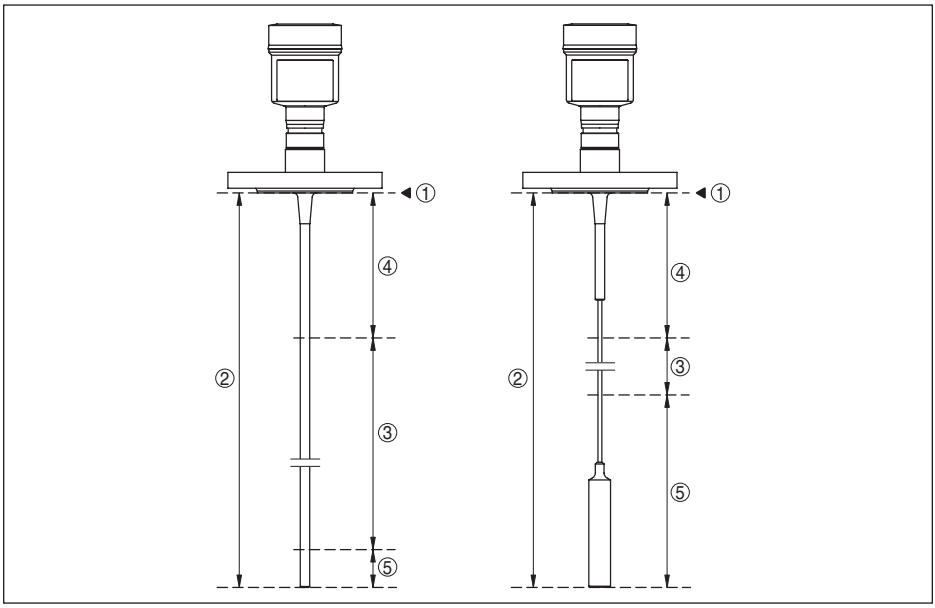


Fig. 35: Measuring ranges - SITRANS LG240

1 Reference plane
2 Probe length L
3 Measuring range (default setting refers to the measuring range in water)
4 Upper dead band (see following diagrams - grey section)
5 Lower dead band (see following diagrams - grey section)

Typical deviation - Interface measurement	± 5 mm (0.197 in)
Typical deviation - Total level interface measurement	See following diagrams
Typical deviation - Level measurement[5)6)]	See following diagrams

[5)] Depending on the mounting conditions, deviations can occur which can be rectified by adapting the adjustment or changing the measured value offset in the DTM service mode.
[6)] The dead bands can be optimized via a false signal suppression.

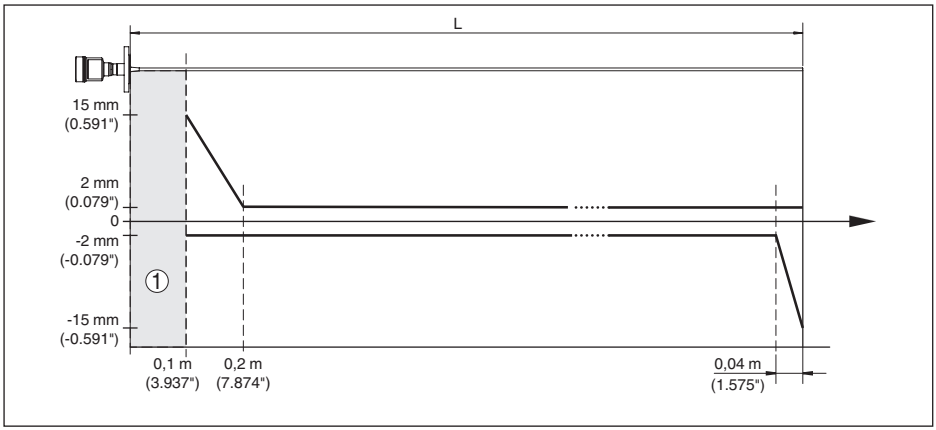


Fig. 36: Deviation SITRANS LG240 in rod version (coated) in water

1 Dead band (no measurement possible in this area)
L Probe length

Deviation - level measurement from 6 m 0.5 % of the probe length
probe length

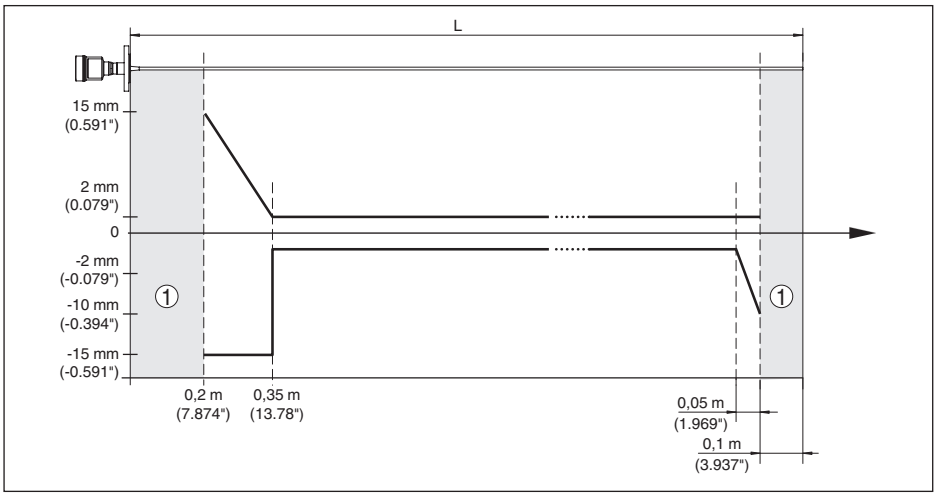


Fig. 37: Deviation SITRANS LG240 in rod version (coated) in oil

1 Dead band (no measurement possible in this area)
L Probe length

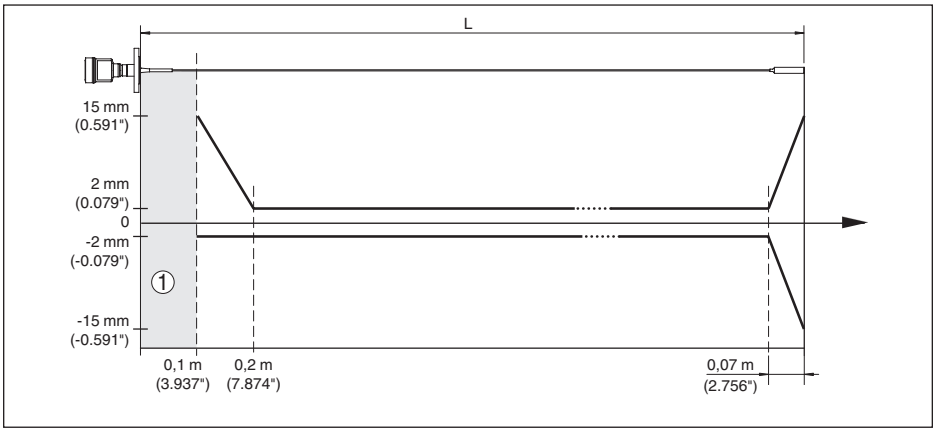


Fig. 38: Deviation SITRANS LG240 in cable version (coated) in water

1 Dead band (no measurement possible in this area)
L Probe length

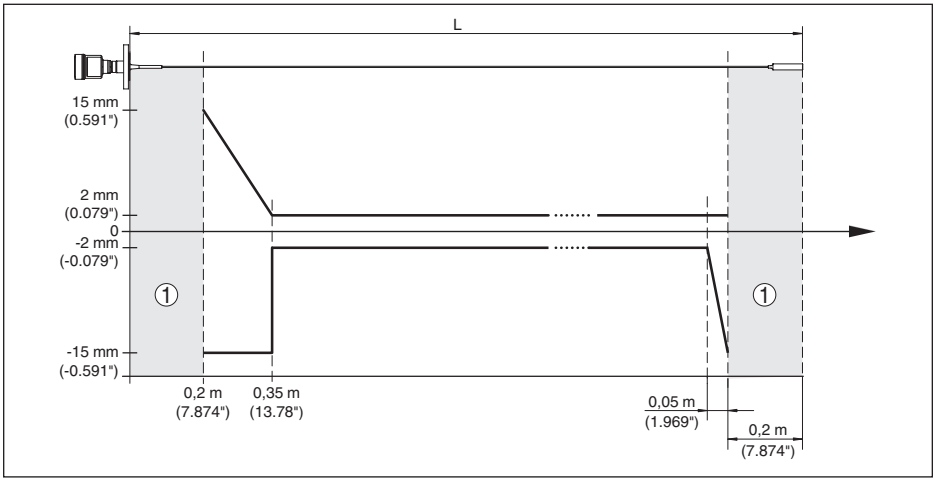


Fig. 39: Deviation SITRANS LG240 in cable version (coated) in oil

1 Dead band (no measurement possible in this area)
L Probe length

Repeatability	≤ ±1 mm
Specifications of the safety tolerance (SIL)	See "*Safety Manual*"

Variables influencing measurement accuracy

Specifications for the digital measured value

Temperature drift - Digital output	±3 mm/10 K relating to the max. measuring range or max. 10 mm (0.394 in)

Additional deviation through electromagnetic interference acc. to EN 61326	< ±10 mm (< ±0.394 in)

Specifications apply also to the current output[7)]

Temperature drift - Current output	±0.03 %/10 K relating to the 16 mA span max. ±0.3 %
Deviation in the current output due to digital/analogue conversion	
– Non-Ex and Ex-ia version	< ±15 µA
– Ex-d-ia version	< ±40 µA
Additional deviation through electromagnetic interference acc. to EN 61326	< ±150 µA

Influence of the superimposed gas and pressure on measurement accuracy

The propagation speed of the radar impulses in gas or vapour above the medium is reduced by high pressure. This effect depends on the superimposed gas or vapours.

The following table shows the resulting deviation for some typical gases and vapours. The specified values refer to the distance. Positive values mean that the measured distance is too large, negative values that the measured distance is too small.

Gas phase	Temperature	Pressure		
		1 bar (14.5 psig)	10 bar (145 psig)	50 bar (725 psig)
Air	20 °C (68 °F)	0 %	0.22 %	1.2 %
	200 °C (392 °F)	-0.01 %	0.13 %	0.74 %
	400 °C (752 °F)	-0.02 %	0.08 %	0.52 %
Hydrogen	20 °C (68 °F)	-0.01 %	0.1 %	0.61 %
	200 °C (392 °F)	-0.02 %	0.05 %	0.37 %
	400 °C (752 °F)	-0.02 %	0.03 %	0.25 %
Steam (saturated steam)	100 °C (212 °F)	0.26 %	-	-
	180 °C (356 °F)	0.17 %	2.1 %	-
	264 °C (507 °F)	0.12 %	1.44 %	9.2 %
	366 °C (691 °F)	0.07 %	1.01 %	5.7 %

Characteristics and performance data

Measuring cycle time	< 500 ms
Step response time[8)]	≤ 3 s
Max. filling/emptying speed	1 m/min Products with high dielectric constant (>10) up to 5 m/min.

Ambient conditions

Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

[7)] Also for the additional current output (optional).

[8)] Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

Process conditions

For the process conditions, please also note the specifications on the type label. The lowest value always applies.

The measurement error through the process conditions in the specified pressure and temperature range is < 1 %.

Process pressure

– Clamp, flange version ≤ 2"/DN 50	-0.5 … +16 bar/-50 … +1600 kPa (-7.3 … +232 psig), depending on the process fitting
– Clamp, flange version > 2"/DN 50	-0.2 … +16 bar/-20 … +1600 kPa (-2.9 … +232 psig), depending on the process fitting
Vessel pressure relating to the flange nominal pressure stage	see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"

Process temperature (thread or flange temperature)

– FKM (SHS FPM 70C3 GLT)	-40 … +150 °C (-40 … +302 °F)
– EPDM (A+P 75.5/KW75F)	-40 … +150 °C (-40 … +302 °F)

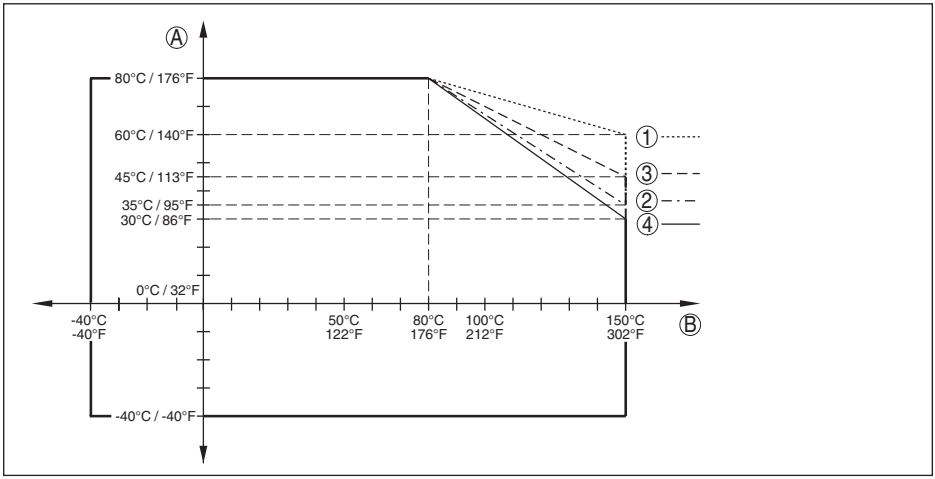


Fig. 40: Ambient temperature - process temperature, standard version

A Ambient temperature
B Process temperature (depending on the seal material)
1 Aluminium housing
2 Plastic housing
3 Stainless steel housing, precision casting
4 Stainless steel housing, electropolished

Mechanical stress

Vibration resistance

– Rod probe	1 g with 5 … 200 Hz according EN 60068-2-6 (vibration at resonance) with rod length 50 cm (19.69 in)

Shock resistance

– Rod probe	25 g, 6 ms according to EN 60068-2-27 (mechanical shock) with rod length 50 cm (19.69 in)

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar	
Cable entry	
– M20 x 1.5	1 x cable gland M20 x 1.5 (cable: ø 6 … 12 mm), 1 x blind plug M20 x 1.5
– ½ NPT	1 x blind plug NPT, 1 x closing cap (red) ½ NPT
Wire cross-section (spring-loaded terminals)	
– Massive wire, stranded wire	0.2 … 2.5 mm^2 (AWG 24 … 14)
– Stranded wire with end sleeve	0.2 … 1.5 mm^2 (AWG 24 … 16)

Display and adjustment module	
Display element	Display with backlight
Measured value indication	
– Number of digits	5
– Size of digits	W x H = 7 x 13 mm
Adjustment elements	
– 4 keys	***[OK]***, ***[->]***, ***[+]***, ***[ESC]***
– Switch	Bluetooth On/Off
Protection rating	
– unassembled	IP 20
– mounted in the housing without lid	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil
Functional safety	SIL non-reactive

Integrated clock	
Date format	Day.Month.Year
Time format	12 h/24 h
Time zone, factory setting	CET
Max. rate deviation	10.5 min/year

Additional output parameter - Electronics temperature	
Output of the values	
– Indication	Via the display and adjustment module
– Analogue	Via the current output
– Digital	Via the digital output signal (depending on the electronics version)
Range	-40 … +85 °C (-40 … +185 °F)
Resolution	< 0.1 K
Accuracy	±3 K

Voltage supply

Operating voltage U_B

- Non-Ex instrument, Ex-d instrument 9.6 … 35 V DC
- Ex ia instrument 9.6 … 30 V DC
- Ex-d-ia instrument 15 … 35 V DC
- Ex-d-ia instrument with ship approval 15 … 35 V DC

Operating voltage U_B - illuminated display and adjustment module

- Non-Ex instrument, Ex-d instrument 16 … 35 V DC
- Ex ia instrument 16 … 30 V DC
- Ex-d-ia instrument No lighting (integrated ia barrier)

Reverse voltage protection Integrated

Permissible residual ripple - Non-Ex, Ex-ia instrument

- for 9.6 V< U_B < 14 V ≤ 0.7 V_{eff} (16 … 400 Hz)
- for 18 V< U_B < 36 V ≤ 1.0 V_{eff} (16 … 400 Hz)

Permissible residual ripple - Ex-d-ia instrument

- for 18 V< U_B < 36 V ≤ 1 V_{eff} (16 … 400 Hz)

Load resistor

- Calculation (U_B - U_{min})/0.022 A
- Example - Non-Ex instrument with U_B= 24 V DC (24 V - 9.6 V)/0.022 A = 655 Ω

Potential connections and electrical separating measures in the instrument

Electronics Not non-floating

Ground terminal Galvanically connected with the metal process fitting

Galvanic separation between electronics and metal housing parts

- Reference voltage 500 V AC

Electrical protective measures

Protection rating

Housing material	Version	Protection acc. to IEC 60529	Protection acc. to NEMA
Plastic	Single chamber	IP 66/IP 67	Type 4X
	Double chamber	IP 66/IP 67	Type 4X
Aluminium	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar)	Type 4X Type 6P
Stainless steel, electro-polished	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P
Stainless steel, precision casting	Single chamber	IP 66/IP 68 (0.2 bar)	Type 6P
	Double chamber	IP 66/IP 67 IP 66/IP 68 (0.2 bar)	Type 4X Type 6P

Connection of the feeding power supply unit	Networks of overvoltage category III
Altitude above sea level	
– by default	up to 2000 m (6562 ft)
– with connected overvoltage protection	up to 5000 m (16404 ft)
Pollution degree[9]	4
Protection class	III[10]

Approvals

Instruments with approvals can have deviating technical data (depending on the version). For such instruments, the corresponding approval documents must be noted.

12.2 Dimensions

Plastic housing

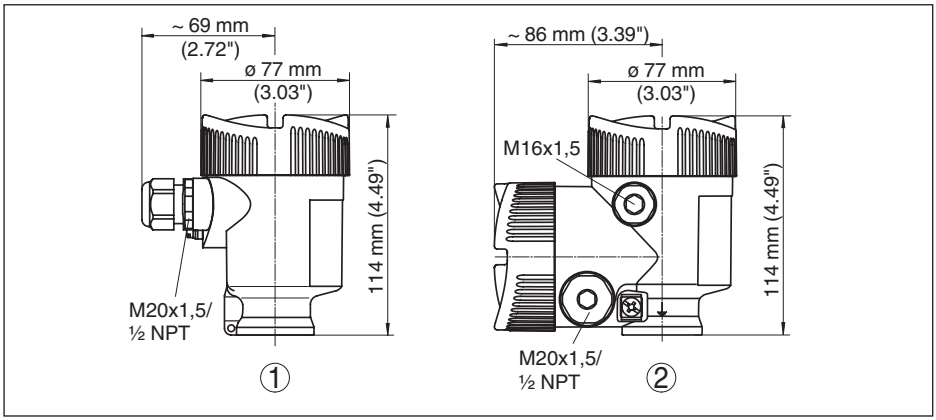


Fig. 41: Housing versions with protection rating IP 66/IP 67 - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Plastic single chamber
2 Plastic double chamber

[9] When used with fulfilled housing protection
[10] IEC 61010-1

Aluminium housing

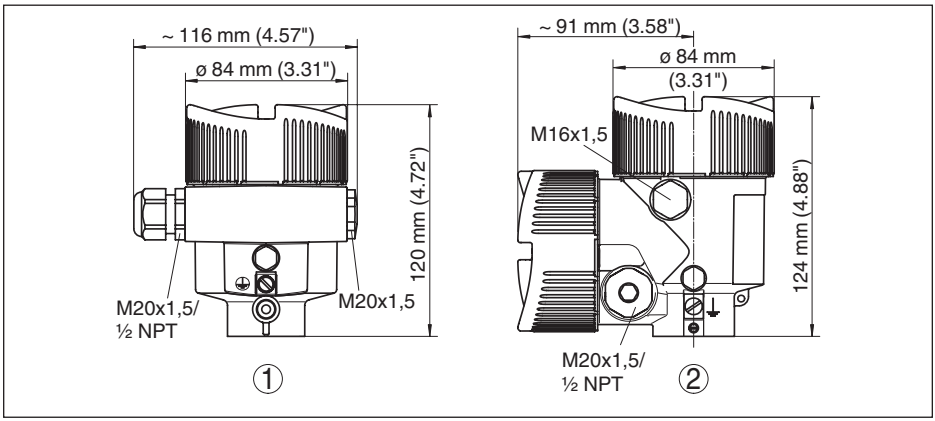


Fig. 42: Housing versions with protection rating IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Aluminium - single chamber
2 Aluminium - double chamber

Stainless steel housing

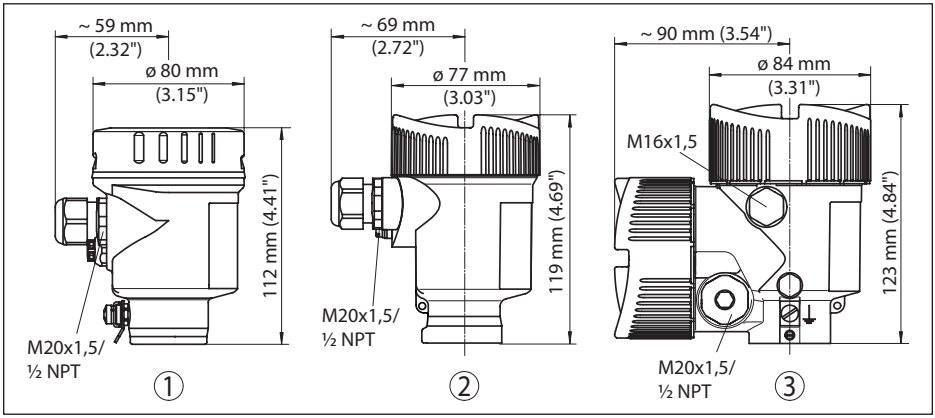


Fig. 43: Housing versions with protection rating IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Stainless steel single chamber (electropolished)
2 Stainless steel single chamber (precision casting)
3 Stainless steel double chamber housing (precision casting)

SITRANS LG240, cable version ø 4 mm (0.157 in) - PFA coated

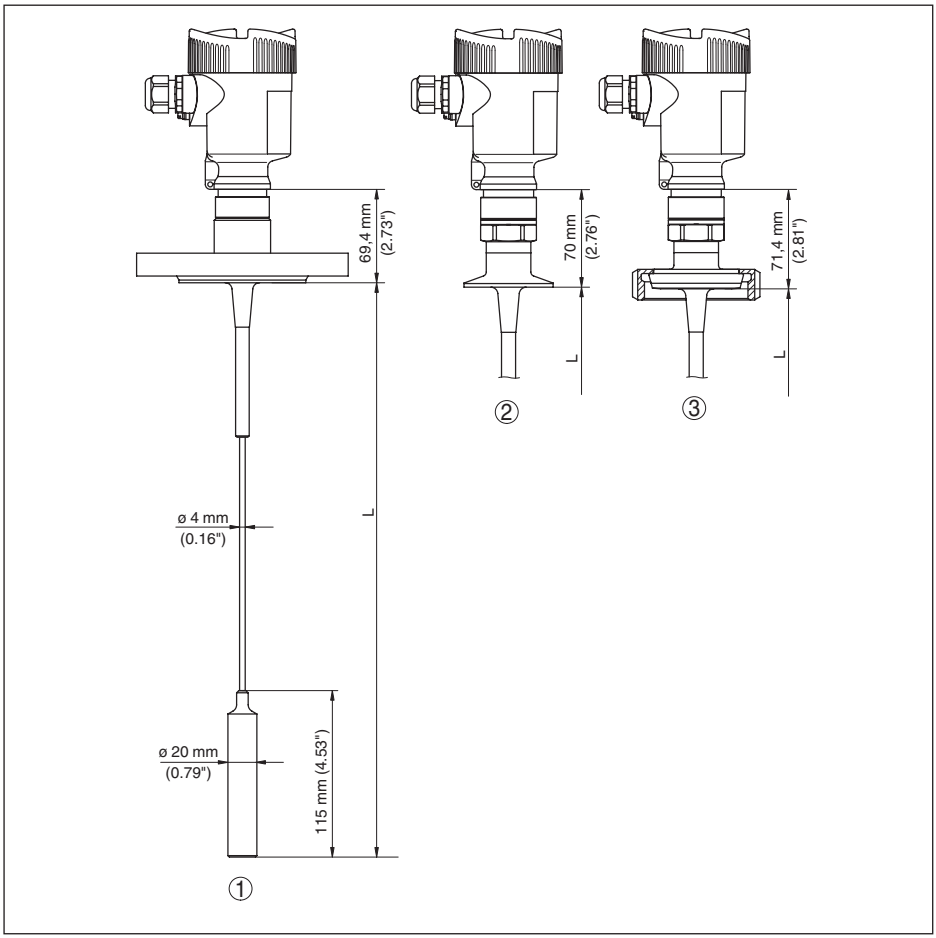


Fig. 44: SITRANS LG240, cable version with gravity weight

L Sensor length, see chapter "Technical data"
1 Cable version, ø 4 mm (0.157 in) with flange
2 Cable version with Clamp
3 Cable version with slotted nut

SITRANS LG240, rod version ø 10 mm (0.394 in) - PFA coated

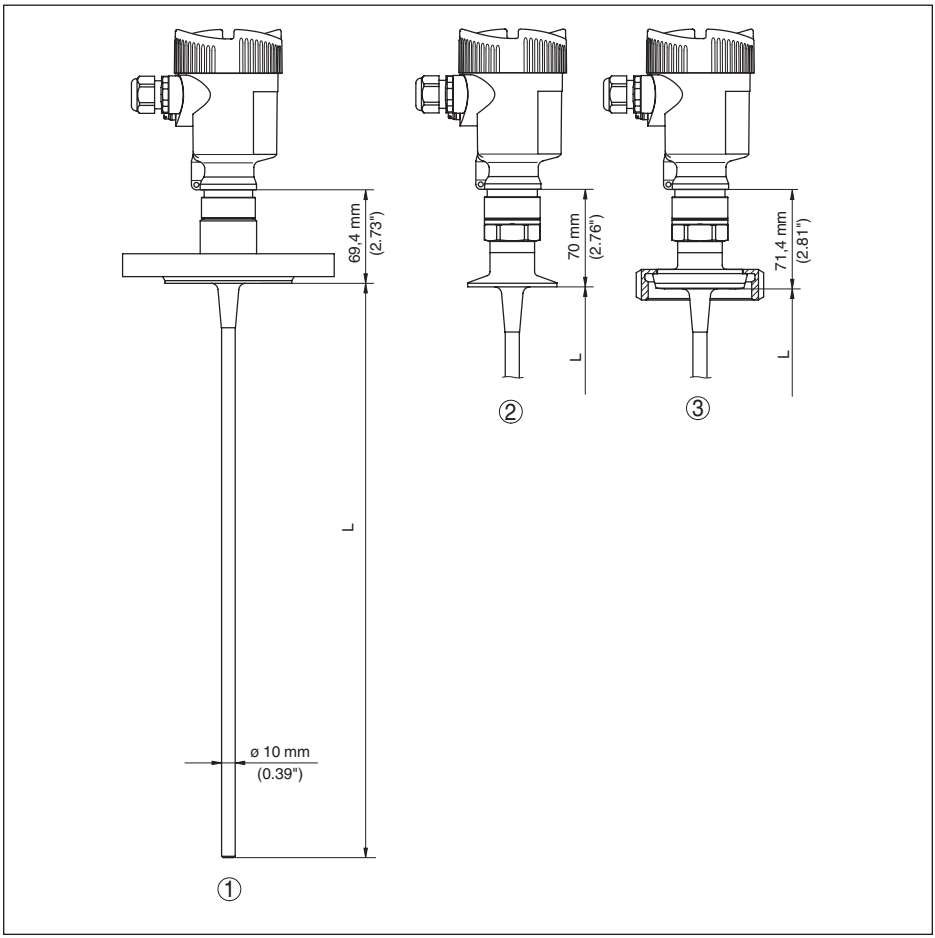


Fig. 45: SITRANS LG240, rod version

L Sensor length, see chapter "Technical data"
1 Rod version, ø 10 mm (0.394 in) with flange
2 Rod version with Clamp
3 Rod version with slotted nut

12.3 Trademark

All the brands as well as trade and company names used are property of their lawful proprietor/ originator.

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Siemens Canada Limited
PD PA PI LW
1954 Technology Drive
P.O. Box 4225
Peterborough, ON
K9J 7B1, Canada

email: techpubs.smpi@siemens.com

www.siemens.com/processautomation

Subject to change without prior notice
PBD-51041385 Rev. 5.0

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PBD-51041385

Printed in Canada