OPERATING INSTRUCTIONS

CFP CUBIC

Level sensor

SICK
Sensor Intelligence.

en

Product described

CFP Cubic

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

Legal notes

Original document

This document is an original document published by SICK AG.

Content

1 About this document

1.1 Information on the operating instructions

These operating instructions provide important information on how to use sensors from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied.
- Compliance with local work safety regulations and general safety regulations for sensor applications.

The operating instructions are intended to be used by qualified personnel and electrical specialists.

Note:

Read these operating instructions carefully before starting any work on the device, in order to familiarize yourself with the device and its functions.

The instructions constitute an integral part of the product and are to be stored in the immediate vicinity of the device so they remain accessible to staff at all times. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on operating the machine in which the sensor is integrated. For information about this, refer to the operating instructions of the specific machine.

1.2 Scope

These operating instructions explain how to incorporate a sensor into a customer system. Instructions are given in stages for all actions required.

These instructions apply to all available device variants of the sensor. For more detailed information on identifying your device type, see “3.1.2 Type code”.

Available device variants are listed on the online product page:

▶ **www.sick.com/CFP_Cubic**

A number of device variants are used as examples for commissioning, based on the default parameter settings for the relevant device.

1.3 Explanation of symbols

Warnings and important information in this document are labeled with symbols. The warnings are introduced by signal words that indicate the extent of the danger. These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

HAZARD

... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION

... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

IMPORTANT

... indicates a potentially harmful situation, which may lead to material damage if not prevented.

HINT

... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

1.4 Further information

HINT

All the documentation available for the sensor can be found on the online product page at:

www.sick.com

The following information is available for download from this page:

- Model-specific online data sheets for device variants, containing technical data, dimensional drawings, and diagrams
- EU declaration of conformity for the product family
- Dimensional drawings and 3D CAD dimension models in various electronic formats
- These operating instructions, available in English and German, and in other languages if necessary
- Other publications related to the sensors described here (e.g., IO-Link)
- Publications dealing with accessories

1.5 Customer service

If you require any technical information, our customer service department will be happy to help. To find your agency, see the final page of this document.

HINT

Before calling, make a note of all sensor data such as type code, serial number, etc., to ensure faster processing.

2 Safety information

2.1 Intended use

The CFP Cubic is a level sensor based on a capacitive measurement principle. The level is determined and the limit values are assessed by evaluating the capacitive fields.

The sensor is designed for both continuous level measurement and discontinuous level measurement in nearly all liquids. Depending on the variant, temperature values can also be processed continuously or as limit values.

The sensor fulfills the requirements of EN 61326-2-3 for industrial environments.

2.2 Improper use

Any use outside of the stated areas, in particular use outside of the technical specifications and the requirements for intended use, will be deemed to be incorrect use.

If the sensor is to be used under other conditions or in different environments, the manufacturer's service department may issue an operating license in consultation with the customer and in exceptional cases.

2.3 Limitation of liability

Applicable standards and regulations, the latest technological developments, and our many years of knowledge and experience have all been taken into account when assembling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Failing to observe the operating instructions
- Improper use
- Use by untrained personnel
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

2.4 Modifications and conversions

IMPORTANT

Modifications and conversions to the sensor and/or the installation may result in unforeseeable dangers.

Interfering with or modifying the sensor or SICK software will invalidate any warranty claims against SICK AG. This applies in particular to opening the housing, even as part of mounting and electrical installation work.

Before making technical modifications to or expanding the sensor, the prior written approval of the manufacturer must be obtained.

2.5 Requirements for skilled persons and operating personnel

WARNING

Risk of injury due to insufficient training.

Improper handling of the sensor may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

The operating instructions state the following qualification requirements for the various areas of work:

- **Instructed personnel** have been briefed by the operating entity about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks assigned to them and to detect and avoid any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions to be able to carry out work on electrical systems and to detect and avoid any potential dangers independently. In Germany, electricians must meet the specifications of the BGV A3 Work Safety Regulations (e.g., Master Electrician). Other relevant regulations applicable in other countries must be observed.

The following qualifications are required for various activities:

Tasks	Qualification
Mounting, maintenance	• Basic practical technical training • Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	• Practical electrical training • Knowledge of current electrical safety regulations • Knowledge of device control and operation in the specific application concerned (e.g., conveying line)
Commissioning, configuration	• Basic knowledge of the control system used • Basic knowledge of the design and setup of the described connections and interfaces • Basic knowledge of data transmission
Operation of the device for the specific application	• Knowledge of device control and operation in the particular application concerned (e.g., bottling plant) • Knowledge of the software and hardware environment for the particular application concerned (e.g., bottling plant)

2.6 Operational safety and specific hazards

Please observe the safety notes and the warnings listed here and in other chapters of these operating instructions to reduce the possibility of risks to health and avoid dangerous situations.

2.7 General safety notes

- Read the operating instructions prior to commissioning.
- These operating instructions are valid for devices from firmware version 2.00.
- The CFP Cubic is not a safety component under the EU Machinery Directive.
- Observe national safety and work safety regulations.
- Wiring work and the opening and closing of electrical connections may only be carried out when the power is switched off.
- The radiated power is far lower than that from telecommunication equipment. According to current scientific research, the operation of this device can be classified as safe and non-hazardous.

2.8 Repairs

Repair work on the sensor may only be performed by qualified and authorized personnel from SICK AG. Interference with or modifications to the sensor on the part of the customer will invalidate any warranty claims against SICK AG.

3 Product description

3.1 Product identification

3.1.1 Information on the housing

Information for identification of the sensor and its electrical connection are printed on the housing.

3.1.2 Type code

CFP Cubic	0100	–	X	P	Q	N	N	C	T
1	2		3	4	5	6	7	8	9

Position	Description
1	**Product group** CFP Cubic: Capacitive level sensor CFP Cubic
2	**Probe length in mm** 0100: 100 mm ... ascending in increments of 100 mm 1,000: 1,000 mm
3	**Certification** X: Without certification
4	**Probe design** P: PP rod probe
5	**Process connection** X: Without process connection A: G 3/4" A; PBT B: 3/4" NPT; PBT
6	**Application type** N: Oil and water applications
7	**Housing** N: Plastic housing with display
8	**Electrical outputs** A: 2 digital outputs B: 2 digital outputs + 1 analog output C: 4 digital outputs + 2 analog outputs
9	**Additional options** T: With temperature sensor X: No additional options

Not all variants of the type code can be combined!

3.2 Product characteristics

3.2.1 Device view

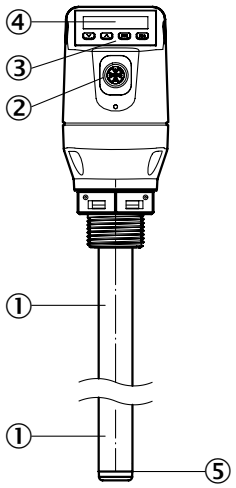


Fig. 1: CFP Cubic

① Probe

② Electrical connection

③ Operating buttons

④ Display

⑤ Temperature sensor (optional)

3.2.2 Operating buttons

The sensor is operated using the display and the operating buttons.

For a detailed description of the pushbuttons and their functions, see “8.1 Display and pushbuttons”.

3.3 Product features and functions

3.3.1 Principle of operation

The CFP Cubic works according to the capacitive measurement principle. This means that electrodes are integrated in the probe to span and measure a capacitive field. The medium touching the probe influences the measured capacitance. Linear to the level, this change in capacitance is then evaluated in the sensor and output as a corresponding level.

The sensor can output this level as a continuous measured value (analog output) and can also derive two or four freely positionable switching points from it (switching outputs). IO-Link communication is also available for the switching output Q1, see “8.1.3 IO-Link”.

3.3.2 Fields of application

The MCiM technology developed by SICK enables convenient and reliable level measurement irrespective of the container material.

The CFP Cubic is suitable for both continuous level measurement and discontinuous level measurement in nearly all liquids. Furthermore, temperature values can also be processed continuously or as a limit value depending on the variant.

4 Transport and storage

4.1 Transport

For your own safety, please read and observe the following notes:

IMPORTANT

Damage to the sensor due to improper transport.

- The device must be packaged for transport with protection against shock and damp.
- Recommendation: Use the original packaging as it provides the best protection.
- Transport should be performed by specialist staff only.
- The utmost care and attention is required at all times during unloading and transportation on company premises.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before starting installation work.

4.2 Transport inspection

Immediately upon receipt in Goods-in, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

Note:

Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.3 Storage

Store the device under the following conditions:

- Recommendation: Use the original packaging.
- Do not store outdoors.
- Store in a dry area that is protected from dust.
- Do not store in an airtight container: this is so that any residual moisture present can escape.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see “14 Technical data”.
- Relative humidity: see “14 Technical data”.
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

5 Mounting

5.1 Installation conditions

The CFP Cubic level sensor is mounted vertically from above into the container.
The sensor features a G 3/4 A, 3/4" NPT threaded connection or Easy Clamp bracket (clamping bracket for infinite adjustment of the required length).

A minimum connecting piece diameter in accordance with the following graphic must be observed. The CFP Cubic is to be installed in such a way that, after it has been mounted, there is a sufficient distance between it and other tank components (e.g., supply pipes, other measuring devices) as well as the sides and bottom of the container.

These minimum distances are also specified in the following graphic. Observe a minimum distance of 30 mm to the container sides and to the tank components.

When operating the sensor, ensure that the ambient temperature is not above or below the limits. Insulating the sensor housing is not permitted for tanks with hot media.

When positioning the device, ensure that the sensor is not directly exposed to the filling flow and that at least 10 mm of the probe is covered by the medium to be measured on all sides.

The sensor housing can be rotated 360°, allowing for the cable outlet to be positioned freely. If the process temperature drops below 0 °C during operation, the probe must not be subjected to transverse loads.

5.2 Installation in a container

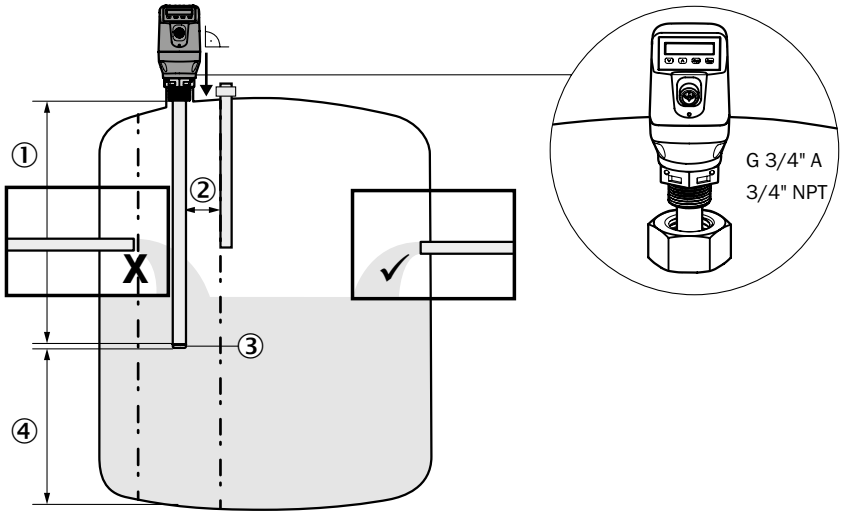


Fig. 2: CFP Cubic in the container

① *100 ... 1,000 mm measuring range*
② *min. 30 mm*
③ *10 mm inactive area at probe end*
④ *min. 10 mm*

6 Electrical installation

6.1 Safety

6.1.1 Notes on the electrical installation

IMPORTANT

Equipment damage due to incorrect supply voltage!

An incorrect supply voltage may result in damage to the equipment.

- Only operate the device using a protected low voltage and safe electrical insulation as per protection class III.

IMPORTANT

Equipment damage or unpredictable operation due to working with live parts.

Working with live parts may result in unpredictable operation.

- Only carry out wiring work when the power is off.
- Only connect and disconnect electrical connections when the power is off.

- **The electrical installation must only be performed by electrically qualified personnel.**
- **Standard safety requirements must be met when working on electrical systems.**
- Only switch on the supply voltage for the device when the connection tasks have been completed and the wiring has been thoroughly checked.
- When using extension cables with open ends, ensure that bare wire ends do not come into contact with each other (risk of short-circuit when supply voltage is switched on!). Wires must be appropriately insulated from each other.
- Wire cross-sections in the supply cable from the user's power system must be designed in accordance with the applicable standards. In Germany, observe the following standards:
  DIN VDE 0100 (Part 430) and DIN VDE 0298 (Part 4) or DIN VDE 0891 (Part 1).
- Circuits connected to the device must be designed as SELV circuits
  (SELV = Safety Extra Low Voltage).
- Protect the device with a separate fuse at the start of the supply circuit.

Notes on layout of data cables:

- To avoid interference, e.g., from switching power supplies, motors, clocked drives, and contactors, always use suitable EMC cables and layouts.
- Do not lay cables over long distances in parallel with voltage supply cables and motor cables in cable channels.

The IP 67 enclosure rating for the device is only achieved under the following conditions:

- The cable on the M12 connection has been screwed on.

If this is not done, the device does not fulfill any specified IP enclosure rating!

6.2 Electrical connection

6.2.1 Overview of the electrical connections

The sensor is connected using a pre-assembled female cable connector with 1 x M12 plug connector (5-pin or 8-pin). With the power switched off, plug the female cable connector into the sensor and screw it tight.

Connect the cable according to its function. After the supply voltage has been applied, the sensor carries out a self-test. Once installed, the sensor is ready for operation on completion of the self-test (< 5 s) and the display shows the current measured value.

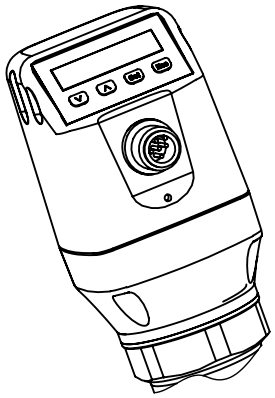


Fig. 3: CFP Cubic device view

6.2.2 Pin assignment, M12 plug connector, 5-pin (depending on the variant)

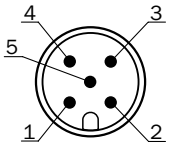


Fig. 4: M12 x 1 plug connector, 5-pin

Pin	Identification	Description
1	L+	Supply voltage
2	Q_A	Current output 4 ... 20 mA Or Voltage output 0 ... 10 V Variant-dependent
3	M	Ground, reference potential for current/voltage output
4	C/Q_1	Switching output 1, PNP / NPN / DRV (push-pull) / IO-Link
5	Q_2	Switching output 2, PNP / NPN / DRV (push-pull)

6.2.3 Pin assignment, M12 plug connector, 8-pin

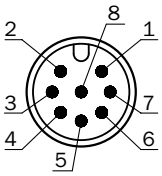


Fig. 5: M12 x 1 plug connector, 8-pin

Pin	Identification	Description
1	L+	Supply voltage
2	Q_2	Switching output 2, PNP / NPN / DRV (push-pull)
3	M	Ground, reference potential for current / voltage output
4	C/ Q_1	Switching output 1, PNP / NPN / DRV (push-pull) / IO-Link
5	Q_3	Switching output 3, PNP / NPN / DRV (push-pull)
6	Q_4	Switching output 4, PNP / NPN / DRV (push-pull)
7	Q_A	Analog current / voltage output
8	Q_B	Analog current / voltage output

The wire colors for 8-pin cables are not uniform. Always note the pin assignment of the sensor.

7 Commissioning

General requirements

- Installation according to reference conditions (safety distances, etc.)
- Installation using G3/4" A or 3/4" NPT process connection
- Installation using Easy Clamp**Commissioning**

1. Mount the sensor as appropriate to the installation conditions, see “5 Mounting”.
2. The level must be at least 10 mm below the end of the probe.
3. Perform empty adjustment.
   This menu can be accessed via EXPRT and USER.
   - Perform the adjustment using CALEMP.
   - The successful empty adjustment is confirmed with !CALOK.
4. Adapt the level in the container until approx. 50% of the probe is covered with the measuring medium.
5. Automatically adjust the medium.
   - Adjust using AUTCAL.
   - The successful AUTCAL function is confirmed with !CALOK.
6. Analyze the signal quality, see “8.5.10 Evaluating signal quality”.
   Perform the following steps if the signal quality is not sufficient:
   - Reduce the value in the MEAS / TRSHLD menu.
7. Configure the filter, see “8.5.8 Filtering measured values”.
8. Configure outputs, see “8.3 Configuring the switching outputs”.

Note:

If the AUTCAL function was confirmed with !FAILD, relaunch commissioning.

Note:

The following parameters are automatically adjusted while executing the AUTCAL function:

- The EXPRT / MEAS / TRSHLD parameter is adjusted.
- The EXPRT / MEAS / ADAPT = 60 s parameter is adjusted.

Note:

If the CalEmp function was confirmed with !FAILD, relaunch commissioning.

Note:

If a quick adjustment to a new medium is required, the EXPRT / MEAS / ADAPT parameter has to be reduced.

In the event of problems during commissioning, see “11 Troubleshooting”.

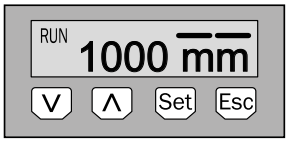
8 Operation

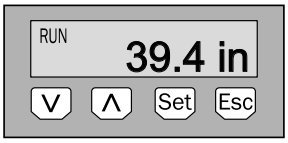
8.1 Display and pushbuttons

All lengths specified in the menu refer to the end of the probe and/or with a configured offset (see “8.5.11 Setting the offset”) to the tank bottom.

8.1.1 Variants with two switching outputs

Q1 Q2





Arrow pushbuttons: *For navigating in the menu and changing values*

Set pushbutton: *For saving and confirming*

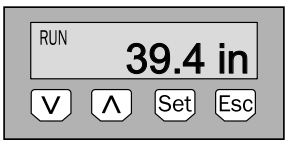
Esc pushbutton: *To exit the operating menu one step at a time*

Note:

The status of the switching outputs is indicated in millimeters by the bars above the mm unit symbol. This display is not available when inches are selected as the unit.

8.1.2 Variants with four switching outputs

Q1/2/3/4



Arrow pushbuttons: *For navigating in the menu and changing values*

Set pushbutton: *For saving and confirming*

Esc pushbutton: *To exit the operating menu one step at a time*

8.1.3 IO-Link

For operation via IO-Link 1.1 with data storage, the following files can be downloaded from www.sick.com:

- IODD file
- Description of the available telegram parameters

8.2 User and Exprt mode

The two menu structures User mode and Exprt mode are available for users. The Exprt mode contains additional functions for advanced settings.

You can access the menu by pressing the Set pushbutton for at least three seconds.

8.2.1 User mode

The User mode makes it easy to commission many standard applications. The number of parameters that can be set on the display is reduced.

8.2.2 Exprt mode

The Exprt mode offers the full functionality of the display.

Advanced functions are available for:

- Switching outputs
  - Output: Process variable, hysteresis/window, polarity, simulation, electrical property (NPN / PNP / DRV (push-pull))
  - Using the switching output as input for initiating actions (minLvl, maxLvl, etc.)
- Analog outputs
  - Switching the process variable, 4–20 mA/0–10 V, error signal, simulation
- Configuration
  - Display, units, offset, lock
- Measurement
  - Detailed signal quality, filter, TrsHld

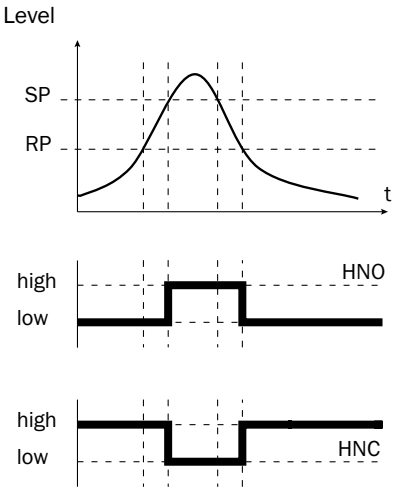
Note:

Exprt mode is automatically activated when IO-Link is used.

8.3 Configuring the switching outputs

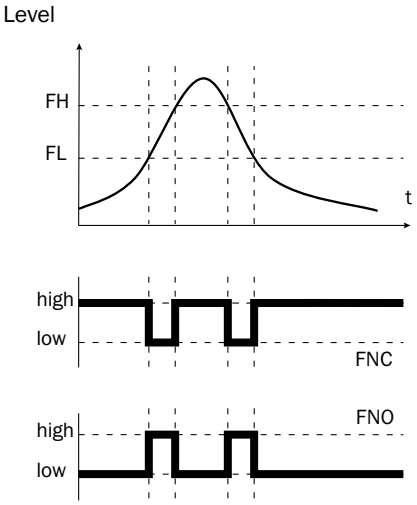
8.3.1 Switching hysteresis and window function

2 or 4 outputs depending on variant



If the level is fluctuating around the set value (e.g., ripple movement during filling), the hysteresis keeps the switching status of the outputs stable. When the level is increasing, the output switches when the respective switching point (SP) is reached; if the level sinks again, the output switches back only after the reset switching point (RP) has been reached.

2 or 4 outputs depending on variant



The window function enables monitoring of a defined range. If the level is between window high (FH) and window low (FL), the output will be active (normally open) or inactive (normally closed).

The error status of the measuring device reflects the cable break monitoring. During an error status, the measuring device switches to a safe state; i.e. the switching outputs become inactive. As far as the downstream signal evaluation is concerned, this corresponds to a cable break.

8.3.2 Normally open with configurable hysteresis

Applications

- Dry run protection
- Empty signal

Configuration

Configure the Qx switching output as normally open (using Q1 as an example).

Note:

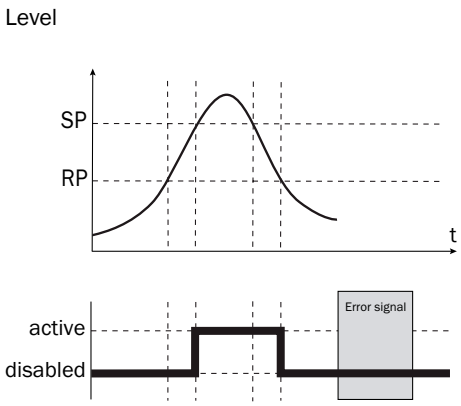
The switching output designation (Q1 in the example here) changes according to the selected process variable to be output.

The following configuration is only possible if the value is set to LEVEL or TEMPER under PROC1.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Configure the switching output as output in the Q1-### / MODE1 / OUTPUT menu.
3. Configure the process variable to be output.
   - Set the value to LEVEL or TEMPER in the Q1-### / PROC1 menu.
4. Set the Hysteresis mode in the Q1-### / OUT1 / HYST. menu.
   - Set the parameter to NO in the Q1-### / POL1 menu.
5. Set the switching point.
   - Set the value in the Q1-### / SP1 menu to level in mm (e.g., 500 mm).
6. Set the reset point.
   - Set the value in the Q1-### / RP1 menu to level in mm (e.g., 450 mm).
7. Select the electrical property (NPN/PNP/DRV [push/pull]).
   Select the parameter in the Q1-### / TYP1 menu.
   The following rules apply:

- PNP = Switching output in PNP circuit
- NPN = Switching output in NPN circuit
- DRV = Switching output in push/pull function

Switching output behavior



Switching output		PNP	NPN	DRV	Error status
Normally open/HNO	active	U_v	0 V	U_v (PNP switched)	disabled
	disabled	0 V [1]	U_v [2]	0 V (NPN switched)	

[1] Pulldown only

[2] Pullup only

8.3.3 Normally closed with configurable hysteresis

Applications

- Overfill protection
- Full signal

Configuration

Configure the Qx switching output as normally closed (using Q1 as an example).

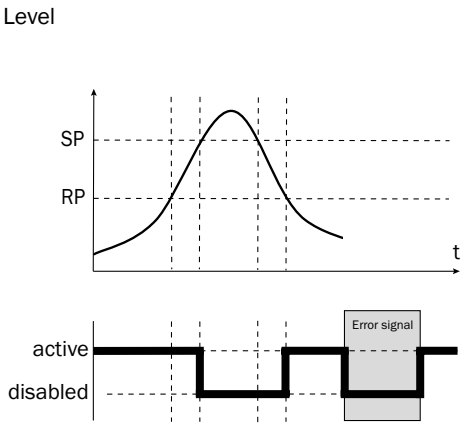
Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the Output mode in the Q1-### / MODE1 / OUTPUT menu.
3. Configure the process variable to be output.
   - Set the parameter to the required value in the Q1-### / PROC1 menu.
4. Set the Hysteresis mode in the Q1-### / OUT1 / HYST. menu.
5. Configure the switching output.
   - Set the parameter to NC in the Q1-### / POL1 menu.

6. Set the switching point.
   - Set the value in the Q1-### / SP1 menu to level in mm (e.g., 500 mm).
7. Set the reset point.
   - Set the value in the Q1-### / RP1 menu to level in mm (e.g., 450 mm).
8. Select the electrical property (NPN/PNP/DRV [push/pull]).
   Select the parameter in theQ1-LVL / TYP1 menu.
   The following rules apply:
   - PNP = Switching output in PNP circuit
   - NPN = Switching output in NPN circuit
   - DRV = Switching output in push/pull function

Switching output behavior



Switching output		PNP	NPN	DRV	Error status
Normally closed/ HNC	active	U_v	0 V	U_v (PNP switched)	disabled
	disabled	0 V[1)]	U_v[2)]	0 V (NPN switched)	

[1)] Pulldown only

[2)] Pullup only

8.3.4 Normally open with window function

Application

Thecritical filling level for the application is within the FHx and FLx window thresholds.

Configuration

Configure the Qx switching output as normally open (using Q1 as an example).

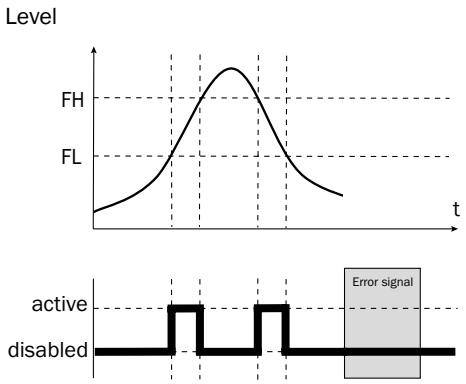
Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.

2. Set the Output mode in the Q1-### / MODE1 / OUTPUT menu.
3. Configure the process variable to be output.
   - Set the parameter to the required value in the Q1-### / PROC1 menu.
4. Set the Window mode in the Q1-### / OUT1 / WINDOW menu.
5. Configure the switching output as normally open.
   - Set the parameter to NO in the Q1-### / POL1 menu.
6. Set the switching point.
   - Set the value in the Q1-### / FH1 menu to level in mm (e.g., 500 mm).
7. Set the reset point.
   - Set the value in the Q1-### / FL1 menu to level in mm (e.g., 400 mm).
8. Select the electrical property (NPN/PNP/DRV [push/pull]).
   Select the parameter in the Q1-### / TYP1 menu.
   The following rules apply:
   - PNP = Switching output in PNP circuit
   - NPN = Switching output in NPN circuit
   - DRV = Switching output in push/pull function

Switching output behavior



Switching output		PNP	NPN	DRV	Error status
Normally open/FNO	active	U_v	0 V	U_v (PNP switched)	disabled
	disabled	0 V [1]	U_v [2]	0 V (NPN switched)	

[1] Pulldown only

[2] Pullup only

8.3.5 Normally closed with window function

Application

The critical filling level for the application is outside the FHx and FLx window thresholds.

Configuration

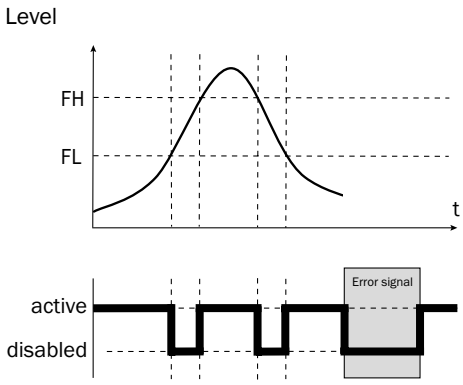
Configure the Qx switching output as normally closed (using Q1 as an example).

Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the Output mode in the Q1-### / MODE1 / OUTPUT menu.
3. Configure the process variable to be output.
   - Set the parameter to the required value in the Q1-### / PROC1 menu.
4. Set the Window mode in the Q1-### / OUT1 / WINDOW menu.
5. Configure the Q1 switching output as normally closed.
   - Set the parameter to NC in the Q1-### / POL1 menu.
6. Set the switching point.
   - Set the value in the Q1-### / FH1 menu to level in mm (e.g., 500 mm).
7. Set the reset point.
   - Set the value in the Q1-### / FL1 menu to level in mm (e.g., 400 mm).
8. Select the electrical property (NPN/PNP/DRV [push/pull]).
   Select the parameter in the Q1-### / TYP1 menu.
   The following rules apply:
   - PNP = Switching output in PNP circuit
   - NPN = Switching output in NPN circuit
   - Drv = Switching output in push/pull function

Switching output behavior



Switching output		PNP	NPN	DRV	Error status
Normally closed/FNC	active	U_v	0 V	U_v (PNP switched)	disabled
	disabled	0 V [1]	U_v [2]	0 V (NPN switched)	

[1] Pulldown only

[2] Pullup only

8.3.6 Normally open with error signal

Application

If there is an error message on the CFP Cubic, this can be output using a switching output.

Configuration

Configure the Qx switching output as normally open for error signals (using Q1 as an example).

Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output: Q1-LVL or Q1-TEMP is now Q1-STA.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Configure Q1 as output.
   - Set the parameter to OUTPUT in the Q1-### / MODE1 menu.
3. Configure the process variable to be output.
   - Set the parameter to STATUS in the Q1-### / PROC1 menu.
4. Set the status to be output in the Q1-STA / STAT1 menu.
   - Set the parameter to FAILURE in the Q1-STA / STAT1 menu.
5. Configure the Q1 switching output as normally open.
   - Set the parameter to NO (normally open) in the Q1-STA / POL1 menu.
6. Select the electrical property (NPN/PNP/DRV [push/pull]).
   Select the parameter in the Q1-TYP1 menu.
   The following rules apply:
   - PNP = Switching output in PNP circuit
   - NPN = Switching output in NPN circuit
   - DRV = Switching output in push/pull function

8.3.7 Switching output as input for processing external signals

Application

Switching outputs can also be used as inputs for the CFP Cubic. This enables you to integrate external signals (e.g., from a tuning fork). In this way, the CFP Cubic can be used as a mini PLC and reduces the number of cables to the PLC.

Configuration

Configure the Qx switching output as input (using Q1 as a redundant overfill protection example).

Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output: Q1-LVL or Q1-TEMP is now Q1-INP.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Configure Q1 as input.
   - Set the parameter to INPUT in the Q1-### / MODE1 menu.
3. Configure the action to be performed when the signal is present.
   - Set the parameter to MAXLVL in the Q1-INP / ACTIO1 menu (if the external signal is present, the CFP Cubic outputs the MAXLVL status).
4. Configure the form of the external signal.
   - Set the parameter to NO (normally open) in the Q1-INP / POL1 menu.

8.4 Configuration of analog outputs

8.4.1 Automatic signal detection

The CFP Cubic can automatically detect if a 4–20 mA or 0–10 V signal is required using the connected output load.

The following rules apply:

- 4 mA to 20 mA if load < 500 ohms at U_V > 15 V
- 4 mA to 20 mA if load < 350 ohms at U_V > 12 V
- 0 V to 10 V if load > 750 ohms at U_V ≥ 14 V

Configuration

Note:

The analog output designation (QA in the example here) changes according to the selected process variable to be output.

1. Perform automatic signal detection.
   - Set the parameter to AUTO in the QA-### menu.

Note:

Automatic signal detection is only active when the device is switched on for the first time. After this, the function can be activated again with AUTO in the QA-### menu.

8.4.2 Current output 4 to 20 mA

Configuration

Note:

The analog output designation (QA in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Define the output as temperature or level (temperature sensor depends on variant).
   - Set the parameter to TEMPER or LEVELin the QA-### / QAPROC menu.
3. Set the upper limit value for the level or temperature at which 20 mA is output.
   - Set the parameter in the QA-### / QAHIGH menu to level in mm or temperature in °C (e.g., 500 mm).
4. Set the lower limit value for the level or temperature at which 4 mA is output.
   - Set the parameter in the QA-### / QALOW menu to level in mm or temperature in °C (e.g., 10 mm).
5. Invert the signal.
   The analog signal can be inverted in the QAPOL menu.
   Set the parameter to INVERT in the QA-### / QAPOL menu.
   - Normal = Analog output signal as configured
   - Invert = Analog output signal is inverted; QaHigh 4 mA and QaLow 20 mA
6. Select electrical signal.
   - Set the parameter in the QA-### / QATYP menu to 4 to 20 mA.

8.4.3 Voltage output 0-10 V

Configuration

Note:

The analog output designation (QA in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Define the output as temperature or level (temperature sensor depends on variant).
3. Set upper limit value (10 V).
   - Set the parameter in the QA-### / QAHIGH menu to level in mm or temperature in °C (e.g., 500 mm).
4. Set lower limit value (0 V).
   - Set the parameter in the QA-### / QALOW menu to level in mm or temperature in °C (e.g., 10 mm).
5. Invert the signal.
   The analog signal can be inverted in the QAPOL menu.
   Set the parameter to INVERT in the QA-### / QAPOL menu.
   - Normal = Analog output signal as configured

- Invert = Analog output signal is inverted; QaHigh 0 V and QaLow 10 V

6. Select electrical signal.
   Set the parameter in the QA-### / QATYP menu to 0–10 V.

8.4.4 Behavior of outputs in the event of an error

Configuration

Note:

The analog output designation (QA in the example here) changes according to the selected process variable to be output.

This function is only available if 4 to 20 mA is selected under QA-TYP.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Select electrical signal.
   - Select the parameter in the QA-### / QA-TYP menu and set the value to 4 to 20 mA.
3. Define the signal in the event of an error.
   - Select the parameter in the QA-### / QA-FAIL menu and set to the required value.

8.5 Advanced functions

8.5.1 Selecting display unit

The following units can be selected for the measured values:

– UnitLv: mm, inch

– UnitTm: °C, °F

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the unit for level.
   - Set the unit in the CONFIG / UNITLV menu (mm/inch).

Or

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the unit for temperature.
   - Set the unit in the CONFIG / UNITTM menu (°C/°F).

8.5.2 Setting an alternating display of measurands (DispA and DispB)

Up to two measured values can be displayed alternately.

Function	Description
Level	Level in mm/inch
Level %	Level in %
Temp[1)]	Temperature in °C/°F
QaSign[1)]	Qa analog output signal in mA/mV

Function	Description
QbSign[1)]	Qb analog output signal in mA/mV
QxSign	Qx switching output status

[1)] *variant-dependent*

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the unit in the CONFIG / DISPA or DISPB menu.

8.5.3 Autocalibration

Autocalibration automatically determines the ideal setting for the TRSHLD (EXPRT / MEAS / TRSHLD) and ADAPT (EXPRT / MEAS / ADAPT) parameters. The container must be filled to 50% during calibration.

Autocalibration should always be performed in the following situations:

- Commissioning has been carried out
- There has been a change in medium
- The sensor's measurement performance is declining

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Perform autocalibration using AUTCAL.
   - Confirm LEVEL AT 50%? using Set.
   - The successful AUTCAL function is confirmed with !CALOK.

8.5.4 Performing empty adjustment

An empty calibration must always be performed after installation or conversion.

An empty adjustment is also performed during advanced commissioning, see “7 Commissioning”

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Perform the adjustment using MEAS / CALEMP.
   - The successful empty adjustment is confirmed with !CALOK.

8.5.5 Locking the display without a password

Local operation on the sensor is immediately locked when the Local User Interface Lock is activated via IO-Link. The Local User Interface Lock can only be activated via IO-Link.

The !LOCKD message is displayed if you try to open the menu.

The display lock can be unlocked with the following steps:

- Via IO-Link by resetting the Local User Interface Lock
- Via the display by pressing the Set pushbutton for at least 10 seconds

8.5.6 Locking the display with a password

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.

2. Activate or deactivate the display lock using CONFIG / LOCK.

If the display lock is activated:

– The display is locked after a timeout of 5 minutes has elapsed

– The display is unlocked temporarily by entering the password 000237

Note:

When the display is locked, only the configured measured value display can be seen.

8.5.7 Setting the medium adjustment

This setting is used to configure the speed of the medium adjustment. The medium adjustment allows the sensor to adapt to changing measuring media. The slower this adjustment occurs, the more stable the measurement.

Note:

The value is automatically set to 60 s when AUTCAL is performed.

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the parameter in the MEAS / ADAPT menu.
   The possible values are 60 s, 30 s, 10 s, 5 s, 1 s.

If the medium remains the same, a value of 60 s is recommended.

8.5.8 Filtering measured values

Activating filtering

The filter supports the smoothing of the measured value; e.g., in the case of ripples on level surfaces. For fast level changes, the average of the measured values over x seconds is indicated.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the parameter in the MEAS / FILTER menu.
   The possible values are Off, 500 ms, 1 s, 2 s, 5 s, 10 s.

8.5.9 Testing the configuration

Testing outputs

Switching and analog outputs can be simulated. This allows for the wiring and signal values on the connected systems, such as a PLC, to be checked.

Configuration

Activating the Qx switching output

Note:

The switching output designation (Q1 in the example here) changes according to the selected process variable to be output.

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Activate the Q1 switching output

- Set the parameter to ON in the Q1-### / SIMQ1 menu.

Further options:

– Off = switching output off

– Norm = switching output in measuring operation

– On = switching output is active

Note:

The simulation is automatically deactivated if the supply voltage is interrupted.

Activate the QA analog output

The sensor's analog outputs can be activated for simulation; for example, to check the settings of a PLC.

Note:

The analog output designation (QA in the example here) changes according to the selected process variable to be output.

Configuration (using current output for level as an example)

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Define the level setting.
   - Set the parameter to LEVEL in the QA-### / QAPROC menu.
3. Define the current output.
   - Set the parameter in the QA-### / QATYP menu to 4 to 20 mA.
4. Activate the simulation.
   - Set the parameter in the QA-### / SIMQA menu to a value between 3.5 mA and 21.5 mA.

Simulating the level

A simulated level can be set to test the completed configuration in the sensor.
All parameters and outputs are then set according to the simulated level.

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Set the parameter to the desired fill level as a % in the CONFIG / SIMLEV menu.
3. Activate the simulation.
   - Set the parameter to the required value in the QA-### / SIMQA menu.

Note:

The level simulation refers to the probe length and/or container level (probe length + offset) if an offset is configured.

The simulation is only active when there are no error messages. The simulation is automatically deactivated if the supply voltage is interrupted.

If Simulation mode is active during Run mode, !SIMUL is displayed alternately with the simulated values.

Parameter selection

- SimOff: Off
- Fill level 0%
- Fill level 25%
- Fill level 50%
- Fill level 75%
- Fill level 100%

8.5.10 Evaluating signal quality

The parameters describe the quality of the measuring signal and can be accessed under EXPRT / INFO.

SigQu1

Characteristic for the robustness of the EXPRT / MEAS / TRSHLD setting.

- Value range: 0 to 100%
- Good signal: > 40%

Measures in the event of a poor signal: Reduce the value in the EXPRT / MEAS / TRSHLD menu to increase SigQu1.

The EXPRT / MEAS / TRSHLD value must be set as high as possible so that no defective level is detected in the empty state.

SigQu2

Characteristic for the robustness of the medium detection in the event of interferences (deposits/tank components).

- Value range: 0 to 100%
- Good signal: > 50%

A high characteristic describes a stable detection of the measuring medium. A low characteristic indicates an unstable detection. In this case, a possible interference can cause a stronger signal than the actual level and lead to faulty measurements.

Measures in the event of a poor signal:

- Check the installation conditions, see “5.1 Installation conditions”
- Free the probe from deposits
- Perform empty adjustment, see “8.5.4 Performing empty adjustment”

SigQu3

Characteristic for signal noise and electromagnetic interference, see “11 Trouble-shooting”.

- Value range: 0 to 100%
- Good signal: > 75%
- Poor signal: < 50%

Check this value if the level value emits a signal noise or is unstable.

Measures in the event of a poor signal:

- Activate the filter, see “8.5.8 Filtering measured values”
- Improve filtering
- Remove possible EMC interferences

SigQu4

Characteristic for the quality of the probe in the empty state.

- Value range: 0 to 100%
- Good signal: > 50%

Measures in the event of a poor signal:

- Check the installation conditions, see “5.1 Installation conditions”
- Free the probe from deposits
- Perform empty adjustment, see “8.5.4 Performing empty adjustment”

SigQua

Summarizes the evaluation of SigQu1 – SigQu4 and indicates the measurement quality. This characteristic is only visible via the User role.

8.5.11 Setting the offset

This setting makes it possible to indicate the level value on the display in relation to the tank bottom instead of the end of the probe. The actual container level is then indicated on the display.

Configuration

1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Enter the required value in the CONFIG / OFFSET menu and confirm with Set. Possible values are 0 to 3,000 mm.

Note:

All parameters related to the level (e.g., SP/RP) are adapted according to the offset setting.

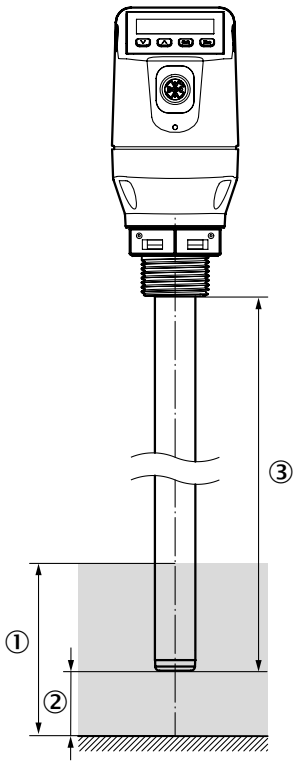


Fig. 6: CFP Cubic measuring range

① *Level*
② *Offset*
③ *Measuring range*

Note:

If the offset parameter is changed, the SPx/RPx/FLx/FHx/QaLow/QaHigh parameters are automatically adjusted.

8.5.12 Resetting the calibration

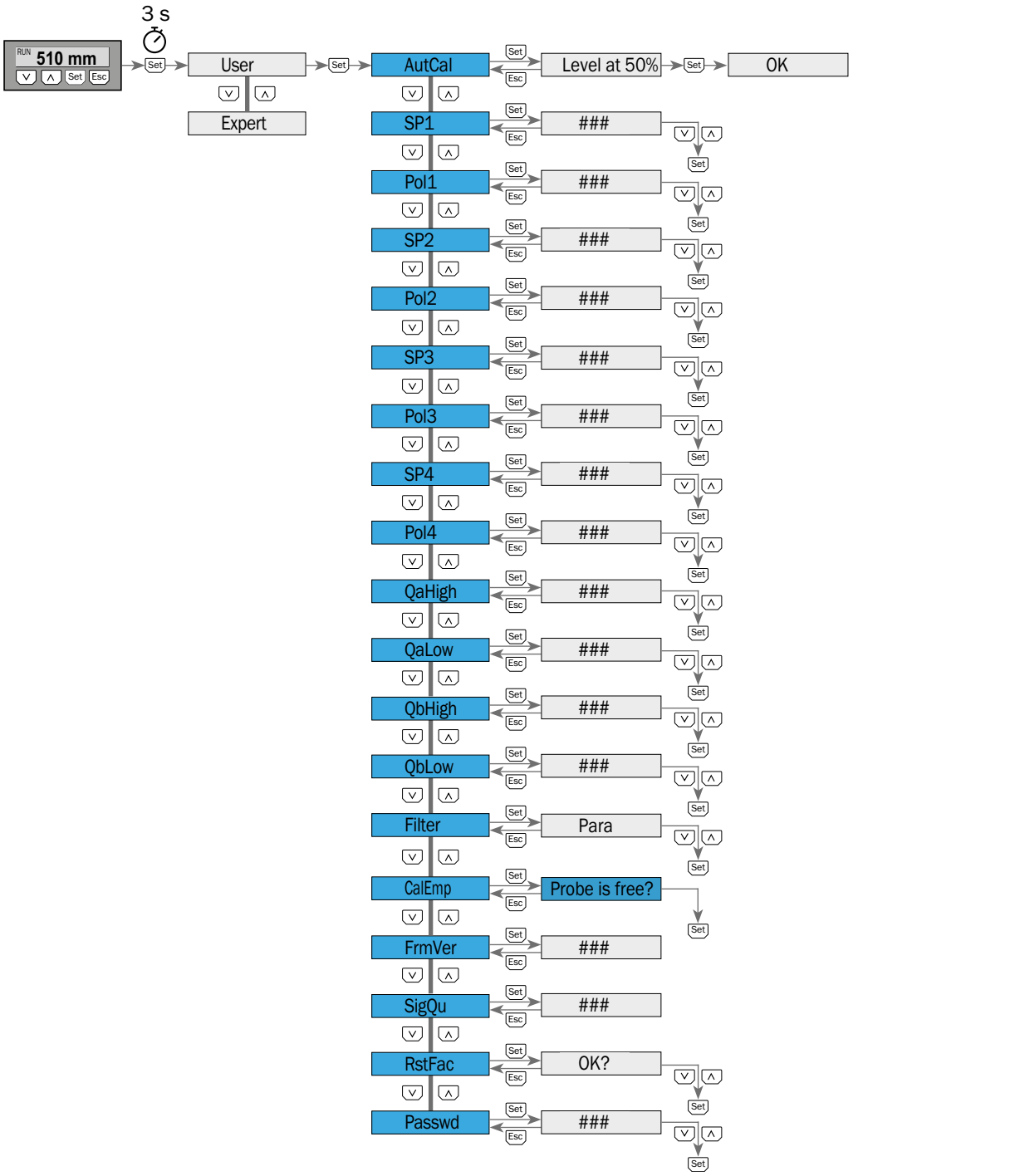
Executing this function resets the empty adjustment that was carried out by the customer, and the threshold value (EXPRT / MEAS / TRSHLD) and the filter time of the medium adjustment (EXPRT / MEAS / ADAPT) are reset to the default value.

Configuration

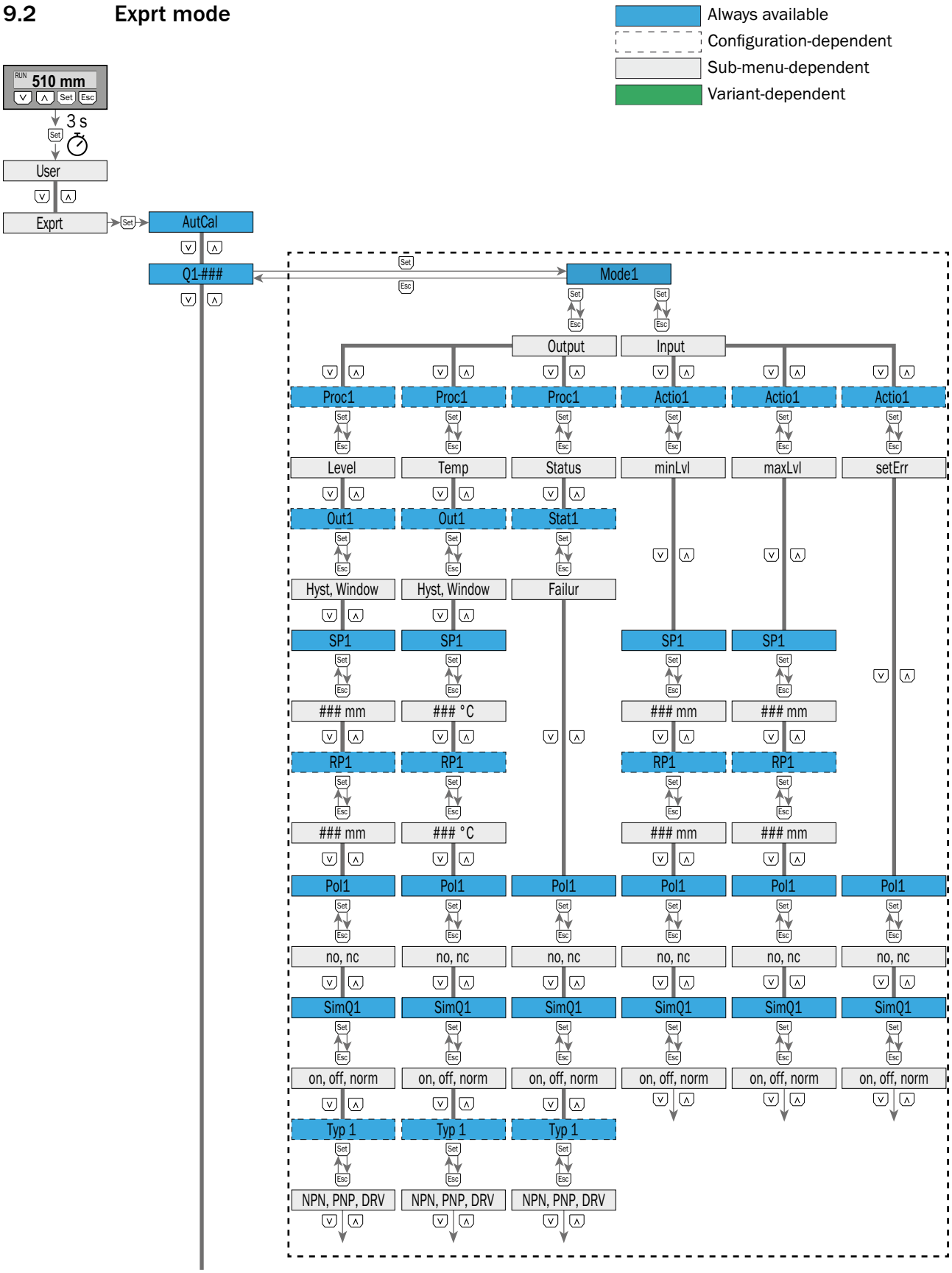
1. Log in to Exprt mode, see “8.2.2 Exprt mode”.
2. Select MEAS / RESET and confirm using Set.
3. Confirm the RESET? safety prompt using Set.

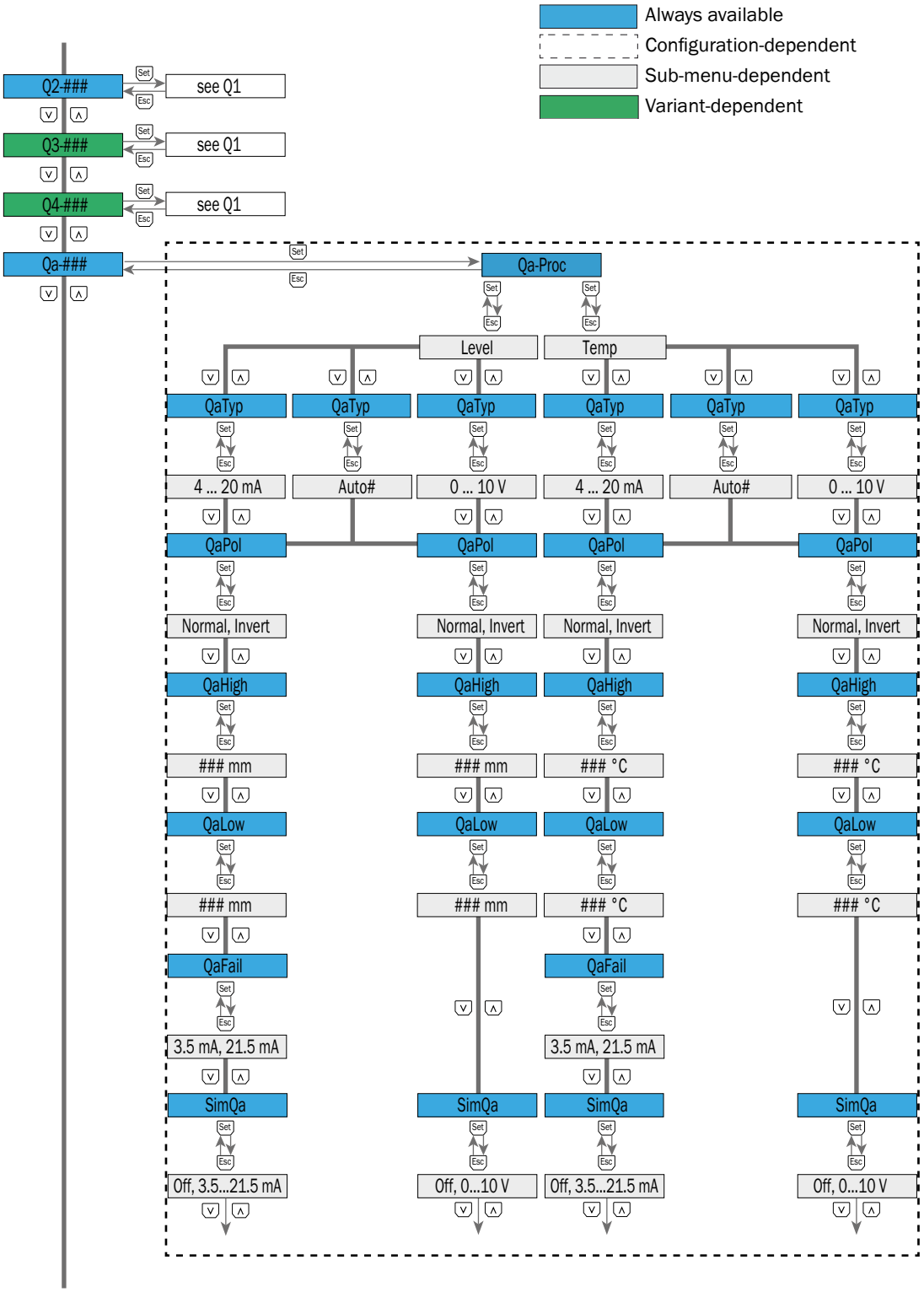
9 Menu overview

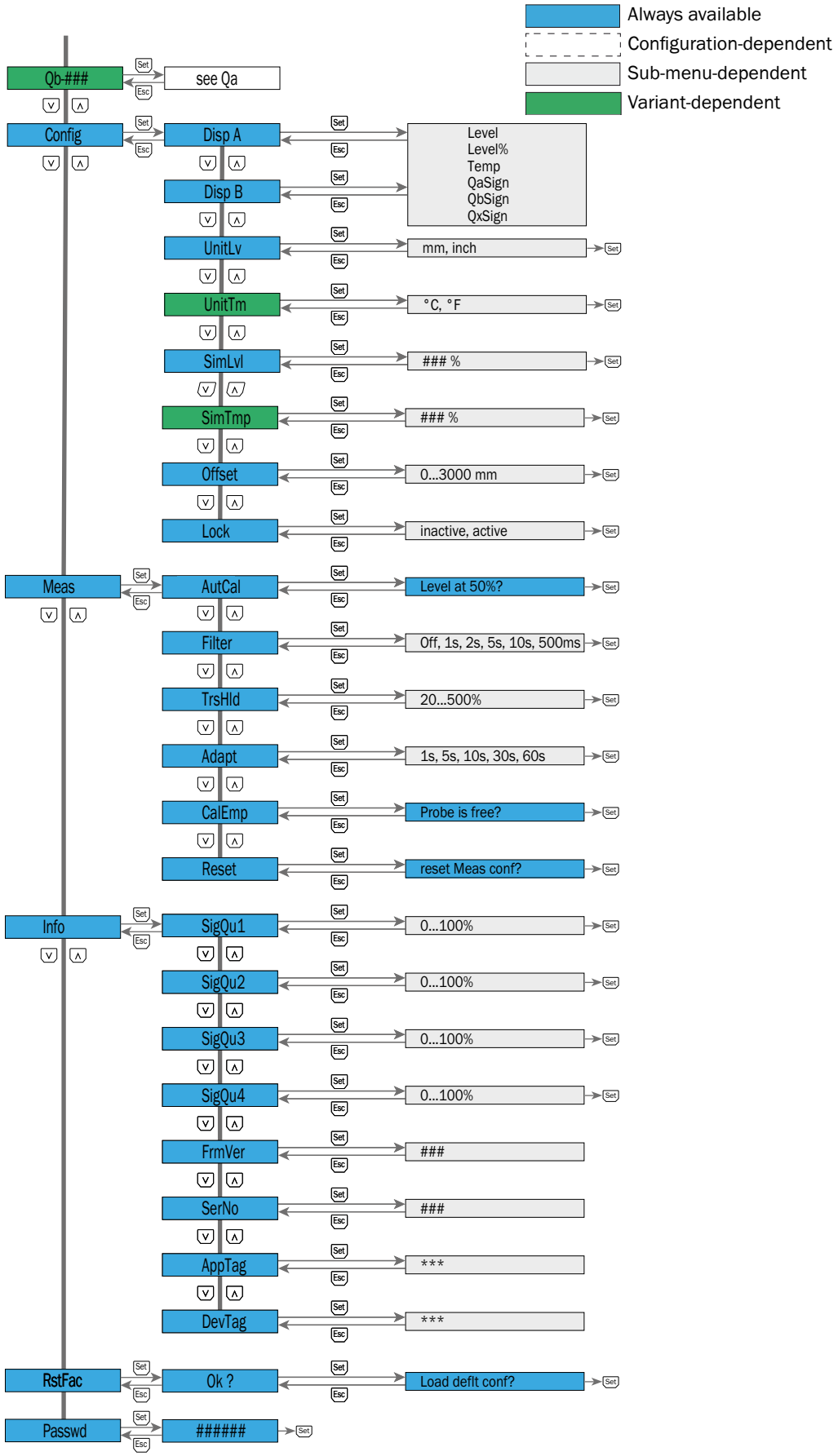
9.1 User mode



9.2 Exprt mode




Always available
Configuration-dependent
Sub-menu-dependent
Variant-dependent
Q2-###
Q3-###
Q4-###
Qa-###
see Q1
see Q1
see Q1
Qa-Proc
Level
Temp
QaTyp
4 ... 20 mA
Auto#
0 ... 10 V
QaPol
Normal, Invert
QaHigh
mm
°C
QaLow
QaFail
3.5 mA, 21.5 mA
SimQa
Off, 3.5...21.5 mA
Off, 0...10 V
Set
Esc


Always available
Configuration-dependent
Sub-menu-dependent
Variant-dependent
Qb-###
see Qa
Config
Disp A
Disp B
Level
Level%
Temp
QaSign
QbSign
QxSign
UnitLv
mm, inch
UnitTm
°C, °F
SimLvl
%
SimTmp
%
Offset
0...3000 mm
Lock
inactive, active
Meas
AutCal
Level at 50%?
Filter
Off, 1s, 2s, 5s, 10s, 500ms
TrsHld
20...500%
Adapt
1s, 5s, 10s, 30s, 60s
CalEmp
Probe is free?
Reset
reset Meas conf?
Info
SigQu1
0...100%
SigQu2
0...100%
SigQu3
0...100%
SigQu4
0...100%
FrmVer
###
SerNo
###
AppTag
***
DevTag
***
RstFac
Ok ?
Load defIt conf?
Passwd
######
Set
Esc

10 Overview of parameters

Parameter	Description
Menu for switching outputs **Based on example: Q1-Lvl**	See "8.2 User and Exprt mode". **Note:** The switching output designation changes according to the selected process variable to be output – in this case: Lvl (Level).
Mode1	Switching point output mode. **Output:** The switching output is used as output. **Input:** The switching output is used as input for an external signal.
Proc1 **Note:** Can only be selected for Mode1 / Output	Switching output process parameters: Level, temperature, or status The corresponding switching point is marked with a reference to the selected parameter. Example: Q1-Lvl.
Out1	Switching function, switching output.
SP1 RP1	Switching point, switching output (SPx > RPx). Reset switching point, switching output Note: Not displayed if the switching output is used to output the status (Proc1/Status) or if window is selected as the output function.
FH1 FL1	Upper threshold (high) window function, switching output (FHx > FLx) Lower threshold (low) window function, switching output **Note:** Not displayed if the switching output is used to output the status (Proc1/Status) or if hysteresis is selected as the output function.
Pol1	Switching output property: Normally open – no Normally closed – nc
SimQ1	See "8.5.9 Testing the configuration".
Typ1	Switching output execution: PNP = Switching output in PNP circuit NPN = Switching output in NPN circuit Q1-Drv = Switching output executed in push/pull function
Menu for analog outputs **Based on example: Qa-Lvl**	See "8.4 Configuration of analog outputs".
QaProc	Analog output process parameters: Level, temperature.
QaTyp	Analog output output signal: 4 to 20 mA, 0 to 10 V or automated.

Parameter	Description
QaPol	The analog output signal can be inverted. Normal = Analog output signal as configured. Example: QaLow 4 mA/0 V and QAHigh 20 mA/10 V. Invert = Analog output signal is inverted. Example: QaLow 20 mA/10 V and QAHigh 4 mA/0 V.
QaHigh	Input of the fill level in mm/°C for 20 mA / 10 V signal (QaHigh > QaLow).
QaLow	Input of the fill level in mm (inch)/°C (F) for 4 mA / 0 V signal.
QaFail	Output behavior as per NE43 in the event of a fault (function only available when current output has been selected under QaTyp). 3.5 mA = Analog current output is set to 3.5 mA in the event of a fault. 21.5 mA = Analog current output is set to 21.5 mA in the event of a fault.
SimQa	See “8.5.9 Testing the configuration”.
Disp A/B	Display settings. See: “8.5.2 Setting an alternating display of measurands (DispA and DispB)”.
UnitLv	Level display unit mm/inch.
UnitTm	Temperature display unit °C/°F.
SimLvl	See “8.5.9 Testing the configuration”. Setting the level to be simulated.
SimTmp	See “8.5.9 Testing the configuration”. Setting the temperature to be simulated.
Offset	See “8.5.11 Setting the offset”.
Lock	See “8.5.6 Locking the display with a password”.
AutoCal	See “7 Commissioning”.
Filter	See “8.5.8 Filtering measured values”.
TrsHld	The factor which determines how strong a signal has to be in order to be recognized by the device. The value range lies between 20% and 500%. The default is 100%. Only shown if password entered. 20% = high sensitivity 100% = standard 500% = low sensitivity
Adapt	See “8.5.7 Setting the medium adjustment”.
CalEmp	Empty calibration. See “7 Commissioning”.
Reset	Resetting the calibration for: empty adjustment, threshold, and filter settings.
SigQa1	See “8.5.10 Evaluating signal quality”.
SigQa2	See “8.5.10 Evaluating signal quality”.

Parameter	Description
SigQa3	See “8.5.10 Evaluating signal quality”.
SigQa4	See “8.5.10 Evaluating signal quality”.
FrmVer	Shows the firmware version.
SerNo	Shows the serial number.
AppTag	Measuring point name, can only be written via IO-Link.
DevTag	Device name, can only be written via IO-Link.
RstFac	Reset the set parameters to the factory settings.
Passwd	Currently no function.

11 Troubleshooting

11.1 Error message on the display

Error	Cause	Solution
!SC-Q{1,2,3,4} !SC-Q{a,b}	Short-circuit at Q{1,2,3,4} Q{a,b}	Remove short-circuit.
	Load resistance at the output is too low	Increase load resistance.
!InErr	Error signal at switching output that is configured as input. Sensor is in a safe state	
!OLQ{1,2,3,4}	Overload at Q{1,2,3,4}	Reduce the load. Reduce the ambient temperature.
!MFail	Memory error	The device is faulty and needs to be replaced.
!QxOff	Supply voltage too low for switching outputs	Increase supply voltage to achieve the desired functionality.
!QaOff	Supply voltage too low for analog output	Increase supply voltage to achieve the desired functionality.
!IOLOf	Supply voltage too low for IO-Link	Increase supply voltage to achieve the desired functionality.
!Ovolt	Supply voltage too high	Reduce the supply voltage.
!HTmpH !HTmpL	Sensor housing temperature too low/high	Adapt the ambient conditions.
!PTmpH !PTmpL	Process temperature outside the specification	Adapt the process conditions.
!Temp	Process temperature measurement not possible	Contact service.
!Q{a,b}Ovl	The ohmic load at the analog current output Qa is too high	Reduce the load at Qa.
	The analog current output Qa is not wired	Connect the load to Qa.
!Simul	At least one simulation (SimQ{1,2,3,4,a,b}, SimLvl, SimTmp) is active	Deactivate the simulation.
!Signl	Signal quality 2 or 4 is too low (sensitivity to interference or quality of empty state); for example, due to deposits or temperature drift	Probe must be cleaned, tank components are too close to the probe or CalEmp must be performed, see “8.5.4 Performing empty adjustment”.
!Trshl	Signal quality 1 is too low (sensitivity to threshold)	The threshold is set too high for the current medium, the medium permittivity is too low.
!Attnt	Other parameters have been adapted automatically. E.g.: - SPx changed, RPx corrected - RPx changed, SPx corrected - Offset changed, SPx/RPx/... corrected	
!lockd	IOLink Local User Interface Access Locks activated	Reset the Access Locks via IO-Link.
		Press and hold the Set pushbutton for at least 10 seconds.
!Err{xx}	Internal error has occurred	Contact service.

11.2 Operating the display

Error	Cause	Solution
Expert mode is activated	IO-Link communication active	
Menu does not open	IO-Link Device Access Locks active	See “8.5.5 Locking the display without a password”.
The display only shows Passwd	Display lock activated with password entry	See “8.5.6 Locking the display with a password”.

11.3 Outputs

Error	Cause	Solution
Switching output does not behave as expected	Configuration incorrect	Check the configuration of the switching output (see “8.3 Configuring the switching outputs”).
	Error signal at switching output that is configured as input. Sensor is in a safe state	If a switching output is configured as an input, check the signal and the system if required.
	Cable break	Check the cable.
Analog output does not behave as expected	Configuration incorrect	Configure the analog output (see “8.4 Configuration of analog outputs”).
	Error signal at switching output that is configured as input. Sensor is in a safe state	If a switching output is configured as an input, check the signal and the system if required.
	Cable break	Check the cable.
IO-Link communication not possible	Input is set under Q1Mode	Set output under Q1Mode.

11.4 Error behavior

Error	Cause	Solution
Level display does not change	Insufficient signal quality	Perform empty adjustment, see “8.5.4 Performing empty adjustment”.
	Probe is contaminated	Clean the probe.
	Easy Clamp used	Perform empty adjustment, see “8.5.4 Performing empty adjustment”.
The displayed level value is greater than SPx/RPx/FHx/FLx/QxLow/QxHigh	An offset was configured for the level value	Adjust offset, see “8.5.11 Setting the offset”.
Level is fluctuating	Media surface unsettled	Activate filtering, see “8.5.8 Filtering measured values”.
	Strong EMC interferences	Activate filtering, see “8.5.8 Filtering measured values”.
Level is not detected, sensor (at times) indicates too low a level (< 50 mm), although a high level is present.	Threshold is set too high	Check SigQu1 and reduce the threshold until a good signal is emitted.
	The empty state of the probe has changed significantly due to altered ambient conditions or aging	Check SigQu4, perform empty adjustment if required, see “8.5.4 Performing empty adjustment”.

Error	Cause	Solution
Sensor shows high level even though the tank is empty.	The empty state of the probe has changed significantly due to altered ambient conditions or aging	Increase the threshold so that faults are below the threshold. Check SigQu4, re-teach capacitance values in empty state, see “8.5.4 Performing empty adjustment”.
	Deposit is detected as level	Remove deposit. If the level is detected at the deposit, check SigQu1 and increase the threshold until the level is no longer detected.
	Strong temperature fluctuations are interfering with the probe	Increase the threshold, reduce the rate of temperature change.

12 Repair

12.1 Maintenance

The CFP Cubic is maintenance-free. We recommend that you perform the following measures at regular intervals:

- Check the probe for contamination
- Check the screw connections and plug connectors

12.2 Returns

Rinse off and/or clean removed devices before returning them in order to protect our employees and the environment from dangers posed by residue from measured materials. Faulty devices can only be examined when accompanied by a completed return form. This form includes information about all materials which have come into contact with the device, including those which were used for testing purposes, operation, or cleaning. The return form is available from our website (www.sick.com).

13 Disposal

Dispose of device components and packaging materials in compliance with applicable country-specific waste treatment and disposal regulations for the region of use.

14 Technical data

14.1 Note for critical applications

Critical application	Restrictions	Solution
Inhomogeneous temperature in the tank	Increased measurement inaccuracy	Ensure uniform temperature distribution in the tank.
Changing the medium	When the tank is filled for the first time, increased measurement inaccuracy at the end of the probe within 100 mm	Fill the tank up to a level over 100 mm.
Deposits	Deposits can be wrongly detected as the level Increased measurement inaccuracy around the deposit	Clean the probe, remove the deposit.
Full tank and temperature changes at the same time	Increased inaccuracy within the upper 100 mm when emptying the tank	Adapt the application so that the level does not need to be accurately controlled in the upper 100 mm. Or avoid big temperature changes if the tank is full.
Empty tank (probe is not in contact with medium) and temperature changes at the same time	A low level (up to 50 mm) is measured in an empty tank if the tank is heated but the probe is not in contact with the medium	Only heat the medium if the probe is in contact with it. Do not perform any critical control operations based on the sensor's empty signal.
Emulsions (mixture of water and oil-based media)	Conductive residues on the probe can falsify the measurement result	Clean the probe, remove all deposits.

14.2 Features

Medium	Water and oil-based liquids
Detection type	Switch, continuous
Probe length	100 mm ... 1,000 mm (mono-rod probe)
Adjustable measuring range	0 mm ... 1,000 mm
Adjustable measuring range (temperature)	–20 °C ... +80 °C
Process pressure	–0.5 bar ... +3 bar
Process temperature	–20 °C[1] ... +80 °C
GOST certificate	✓
RoHS certificate	✓
IO-Link	✓ Version 1.1 with data storage
UL certificate	✓

[1] *For applications below 0 °C, the probe must not be subjected to transverse loads.*

14.3 Performance

Accuracy (level)[1]	± 15 mm
Accuracy (temperature)	± 2 °C
Reproducibility (level)[1]	< 5 mm
Resolution (level)	< 2 mm
Resolution (temperature)	≤ 0.1 °C
Response time[2]	< 300 ms
Response time t90 (temperature)	120 s
Dielectric constant	≥ 5
Conductivity	No limitation

Inactive area at end of probe[1)]	7 mm ... 15 mm (depending on the length of the probe)

[1)] With water or oil under reference conditions.

14.4 Mechanics/materials

Materials in contact with the media	Outer tube: polypropylene (PP-H) G 3/4": PPSU 3/4" NPT: PPSU Easy Clamp Bracket: PP O-ring/seal: FKM
Process connection	G 3/4" A 3/4" NPT without process connection
Housing material	PBT and PC
Max. probe load	≤ 4 Nm
Enclosure rating	IP 65 / IP 67: EN 60529
Weight	max. 500 g

14.5 Reference conditions

Air humidity	65% (± 20%)
Temperature	20 °C (± 5 °C)
Print	Water (DC = 80)
Medium	Distance to built-in components: 60 mm
Centered installation of sensor	Distance to bottom of the tank: 10 mm
Container parameterization carried out	CalEmp completed

14.6 Ambient conditions

Ambient temperature, operation [1)]	–20 °C ... +60 °C
Ambient temperature, storage	–40 °C ... +80 °C

[1)] According to UL listing: degree of contamination 3 (UL61010-1: 2012-05); air humidity: 80% at temperatures up to 31 °C; installation height: max. 3,000 m above sea level; only for indoor applications.

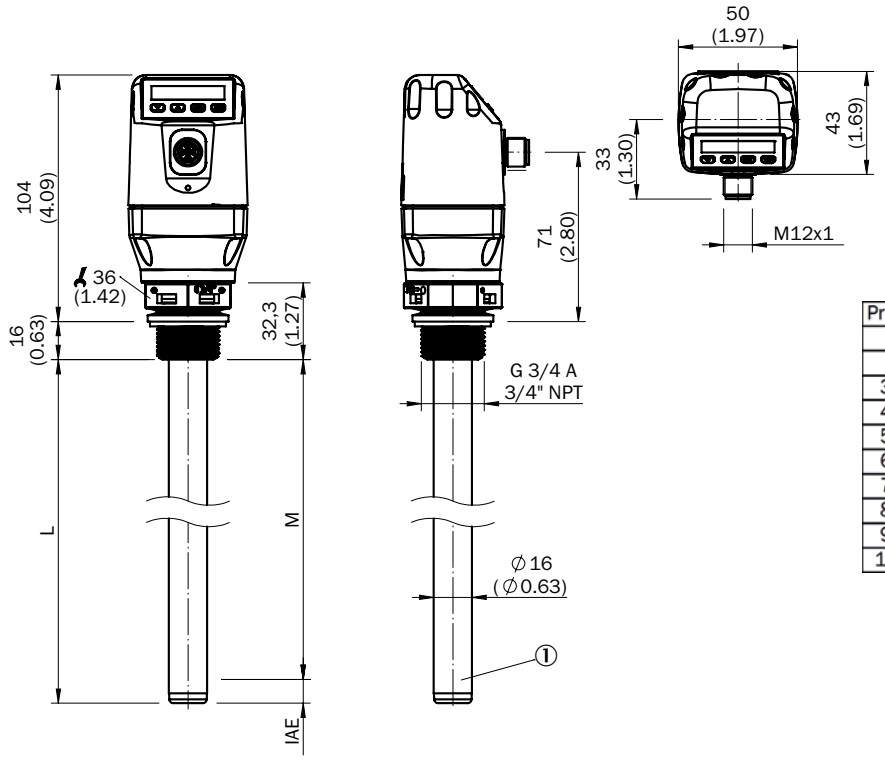
14.7 Electrical connections

Supply voltage[1)]	DC 10 V ... 30 V
Current consumption	≤ 100 mA at 24 V without output load
Initialization time	≤ 5 s
Protection class	III
Connection type	M12 x 1 (5-pin) M12 x 1 (8-pin)
Hysteresis	Min. 3 mm, min. 2 °C, freely configurable
Output signal [2)]	• 2 switching outputs PNP/NPN/DRV • 2 switching outputs PNP/NPN/DRV and 1 analog output 4 mA to 20 mA / 0 V to 10 V automatically switchable depending on output load • 4 switching outputs PNP/NPN/DRV and 2 analog outputs 4 mA to 20 mA / 0 V to 10 V automatically switchable depending on output load
Signal voltage HIGH	Uv –3 V
Signal voltage LOW	≤ 3 V
Output current	< 100 mA per output
Inductive load	< 1 H
Capacitive load	100 nF
Temperature drift	< 0.1 mm/K
Output load	4 mA to 20 mA < 500 ohms at U_v > 15 V 4 mA to 20 mA < 350 ohms at U_v > 2 V 0 V to 10 V > 750 ohms at $U_v \geq$ 14 V
Lower signal level	3.8 mA to 4 mA
Upper signal level	20 mA to 20.5 mA
EMC	EN 61326-2-3, 2014/30/EU

[1)] *Use an energy-limited circuit for voltage supply as per UL61010-1 3rd Ed., Section 9.3.*

[2)] *All connections are reverse polarity protected. All outputs are overload and short-circuit protected.*

15 Dimensional drawings



Probe length L	Inactive area IAE
100 (3.94)	<10 (0.39)
200 (7.87)	<10 (0.39)
300 (11.81)	<10 (0.39)
400 (15.75)	<10 (0.39)
500 (19.69)	<15 (0.59)
600 (23.62)	<15 (0.59)
700 (27.56)	<15 (0.59)
800 (31.50)	<15 (0.59)
900 (35.43)	<15 (0.59)
1000 (39.37)	<15 (0.59)

Rod probe

M Measuring range
L Probe length
IAE Inactive area at probe end 10 mm
① *Temperature sensor (option)*

16 Factory setting

Parameter	Factory setting
SP1	80% of probe length measured from end of probe
RP1	5 mm below SP1
OUT1	Q1_Hno
SP2	For 5-pin versions: 20% of the probe length measured from the end of the probe For 8-pin versions: 60% of the probe length measured from the end of the probe
RP2	5 mm below SP2
OUT2	Q2_Hno
TYP2	Q2_PNP
SP3	40% of probe length measured from end of probe
RP3	5 mm below SP3
OUT3	Q3_Hno
SP4	20% of probe length measured from end of probe
RP4	5 mm below SP4
OU4	Q4_Hno
TYP3	Q3_PNP
TYP4	Q4_PNP
QAHigh	50 mm below start of probe
QALOW	10 mm above end of probe
QAPOL	QA_Nrm
QATYP	Auto
QAFAIL	3.5 mA
SimCur	SimOff
SimVol	SimOff
DspVal	Distan
Filter	Off
SimLev	SimOff
TrsHld	100
MaskZn	0 mm
MaskTr	50%
Mode	Pulse
CalSta	noCal
Probe/Type	Depending on probe type: Rod/Rope
MaxCol	Depending on measuring mode: HiSped = AnySped, HiAcc = 10 cm/s
MeasMd	HiSpd
CalRng	6,005 mm
FomSta	Inactive
Limit	90
Offset	0 mm
Unit	mm
Lock	Inactive

17 Accessories

- Accessories can be found online at: www.sick.com

8021989/10Y1/2019-12-02 · COMAT (2019-12) · A4 4c int49

Australia
Phone +61 (3) 9457 0600
1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 234 719 500
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 010
E-Mail info@sick.de

Greece
Phone +30 210 6825100
E-Mail office@sick.com.gr

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972 97110 11
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mexico@sick.com

Netherlands
Phone +31 (0) 30 229 25 44
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Russia
Phone +7 495 283 09 90
E-Mail info@sick.ru

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 10 060 0550
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321/4
E-Mail infokorea@sick.com

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail contact@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Detailed addresses and further locations at **www.sick.com**

SICK
Sensor Intelligence.