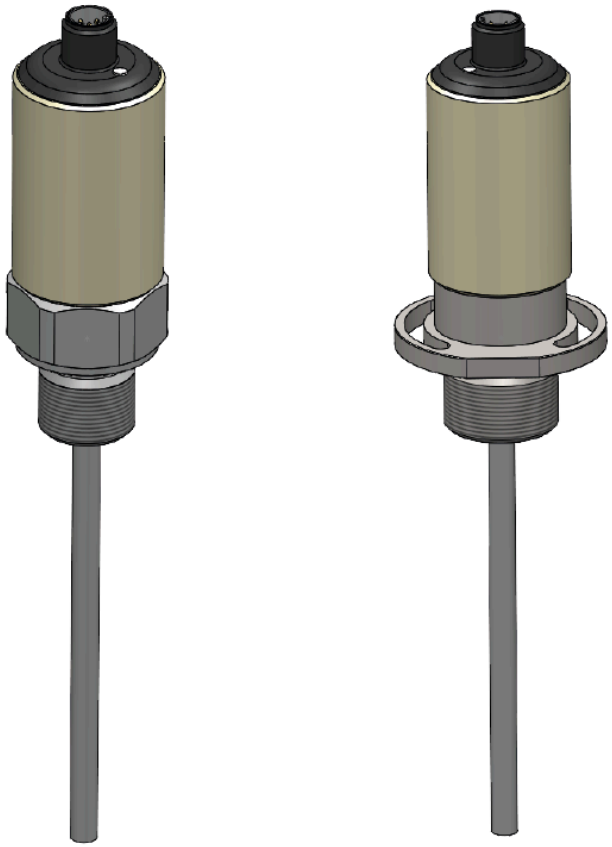
Fill level sensor ORCA HT
Operating instructions



CLP-_HTN2-____

Table of Contents

1 Foreword

These operating instructions were written for fitters and operators, and they contain all information necessary for handling the product safely. The operating instructions shall be retained for subsequent use.

2 Safety

2.1 Symbols and references used

Warning information relating to personal injury and material damage is set out based on the “SAFE” principle, and it contains details about type and source of the danger, its potential consequences, and how to avoid and avert it.

The following hazard classifications apply to the warning information:

⚠ DANGER

Danger designates a hazardous situation, which, if ignored, will lead to death or serious injury. The symbol in front of the warning information graphically indicates the type and source of the danger.

⚠ WARNING

Warning designates a hazardous situation, which, if ignored, can lead to death or serious injury. The symbol in front of the warning information graphically indicates the type and source of the danger.

⚠ CAUTION

Caution designates a hazardous situation, which, if ignored, can lead to injuries. The symbol in front of the warning information graphically indicates the type and source of the danger.

NOTICE

Notice designates a situation, which, if ignored, can lead to material damage and impair the functioning of the product.

TIP

Tip provides additional useful information about the handling of the product.

Symbol/Typeface	Meaning
‣	Avoiding and adverting the danger in the warning information
▶	Instruction All handling instructions in a sequence of instructions are always listed in chronological order.
▪	List
✔	Result

Symbol/Typeface	Meaning
`Software Button`	Fields, tabs, system commands and buttons in the software are represented in this typeface.

2.2 Intended use

The capacitive sensor continuously measures the fill level of non-conductive materials in metallic containers.

► Use the fill level sensor as per the values listed in Chapter 7, "Technical specifications" and only with aSELV or PELV system (Safety/Protective Extra Low Voltage).

2.3 Reasonably foreseeable misuse

Any use deviating from or going beyond the use specified in Chapter 2.2, "Intended use" is deemed to be improper use.

Do not use the fill level sensor:

- With a connection cable longer than 20 m (66 feet)
- With gaseous media
- In the electroplating industry
- In environments with particular hygiene requirements
- In explosion-risk areas

2.4 Personnel qualifications

Only a specialized electrician may work on electrical equipment or operating materials. The safety of the system with integrated fill level sensor is the responsibility of the operator.

A specialized electrician is a person who, thanks to his specialist training, experience, and knowledge of the applicable regulations, is able to assess risks and recognize potential dangers which arise during his own work.

3 Installation of the fill level sensor

⚠ WARNING

Risk of injury through the escape of dangerous and hot media from the container
If the container is overfilled, dangerous and hot media can escape, e.g. fluids, bulk materials, pastes, adhesives, chemicals.

- Seal the process connection against escaping media.
- It is essential to calibrate the fill level sensor (see Chapter 4.7.3.2).
- Wear protective gloves for thermal protection against hot containers.
- Install an external limit value transmitter.

⚠ WARNING

Improperly performed work on electrical equipment:

An electric shock can be life-threatening or even fatal for humans.

- Before working on electrical equipment, make it voltage-free and secure it against being switched on again.
- Allow tasks on electrical equipment to be performed only by qualified personnel, in compliance with local and national electrical regulations and provisions.

TIP

A flat seal is recommended. The material of the flat seal should be selected to suit the medium to be measured in the container.

► Make the system free of voltage, and secure it against being switched on again.

► Screw the fill level sensor into the intended thread of the container.

NOTICE

When screwing the sensor in, apply the force to the gap of the wrench. Do not use the thermal insulation body made from PEEK for screwing in.

► Connect the fill level sensor electrically as per the wiring diagram.

► After installation, check the container for leaks.

✓ Fill level sensor has been installed.

4 Operation

Connect the fill level sensor:

- For manual configuration using an IO-Link master and computer
- For automated configuration using an IO-Link master and a PLC

4.1 Manual operation

The fill level sensor is controlled using an IO-Link master on the computer; the IO-link interface of the fill level sensor and the device-specific IO device description (IODD) are used.

The following actions are possible:

- Identify the fill level sensor
- Read out current process data
- Read out diagnostics data
- Configure the fill level sensor
- Calibrate the fill level sensor

4.2 Operation using PLC

Alternative to manual operation of the fill level sensor, it is possible to automate this from the PLC, using an IO-Link master. The Technical Reference Manual (TRM) contains the necessary information about the cyclical process data, the acyclical service data (ISDUs) and the events with the corresponding indices, their meaning and ranges.

4.3 Configuring the fill level sensor

The fill level sensor has been given a standard configuration ex-works.

Unless required for the specific application, it is unnecessary to modify the configuration.

Standard configuration:

- All pins are implemented as digital PNP outputs, normally open, with switching point 50 % and 10 % hysteresis
- Low fill level corresponds to 0 % (9pF)
- High fill level corresponds to 100 % (90pF)
- The LED is controlled by the device, and it uses color changes to display the fill level

4.4 Operating the fill level sensor with IO-Link master

► Connect the device to an IO-Link master to read out sensor data, modify parameters, or calibrate. For more information on connecting to the IO-Link master, see the IO-Link master documentation.

► Download device-specific IODD from the IODD Finder website.

Operate the fill level sensor using the following tabs:

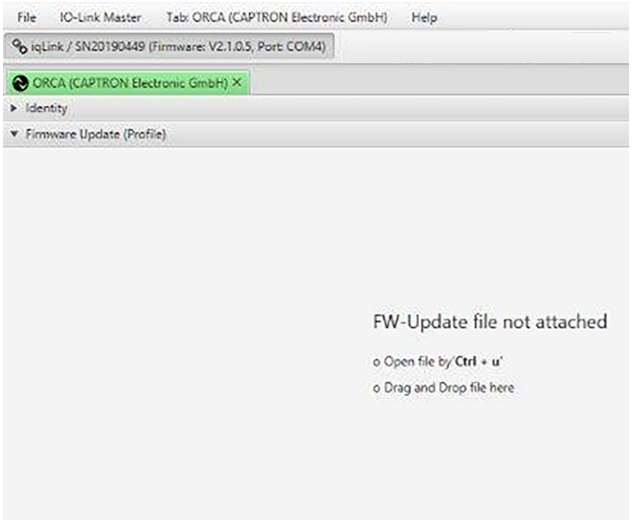
- `Identity`: The “Identity” tab provides information on the manufacturer and product, including IDs
- `Firmware Update`: Using the “Firmware Update” tab, new device firmware can be installed
- `Specialist`: The “Specialist” tab provides information on current process data, device characteristics and diagnostics, as well as execution of configuration and sensor calibration
- `Events`: The “Events” tab provides information on events such as errors and warnings

4.5 “Identity” tab

The `Identity` tab lists the basic data for the manufacturer and product, including pin assignment.

4.6 “Firmware Update” tab

If new firmware is required, the software is stored here and saved to the fill level sensor. CAPTRON makes the firmware available.

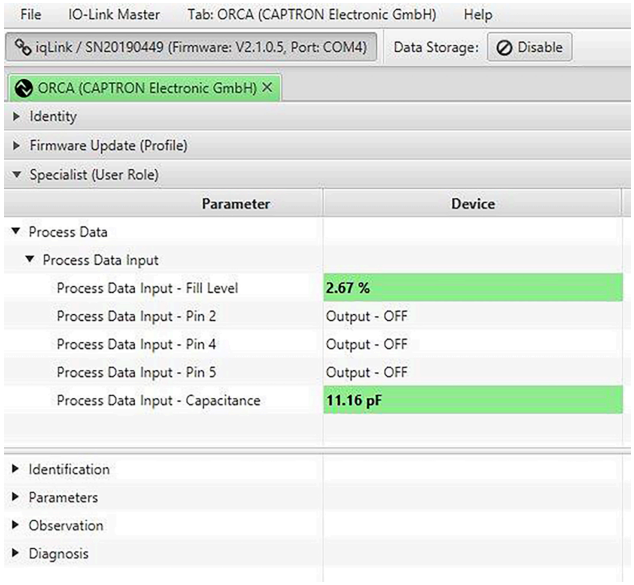


4.7 “Specialist” tab

The `Specialist` tab is used mainly for configuring and calibrating the fill level sensor.

The `Specialist` tab is subdivided into the following five sub-tabs:

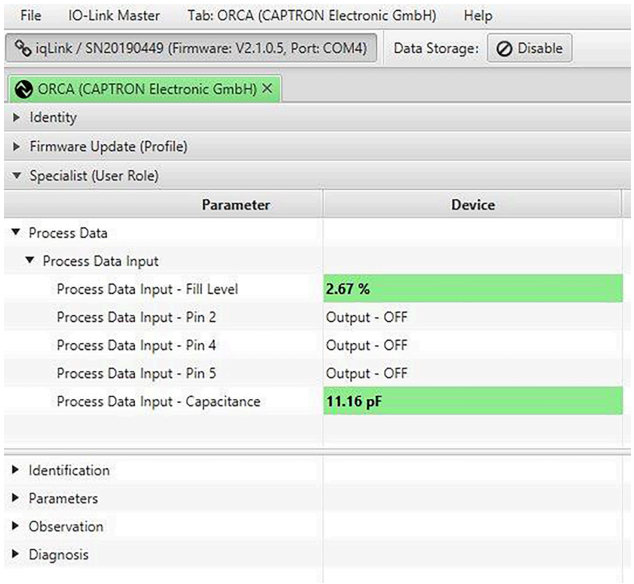
- `Process data`
- `Identification`
- `Parameters`
- `Observation`
- `Diagnosis`



4.7.1 “Process data” sub-tab

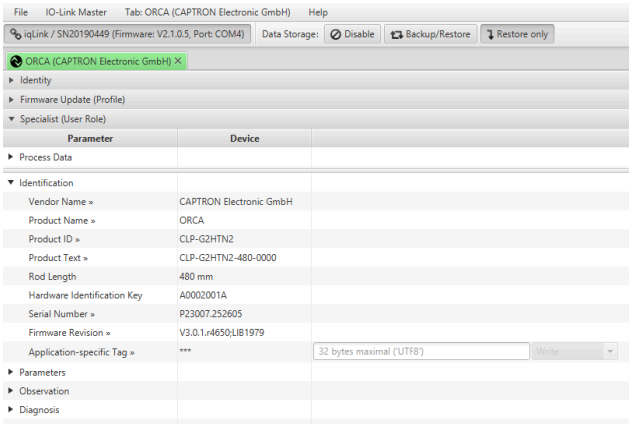
In the `Process data` sub-tab the measured capacity, the status of the outputs, and the calculated fill level in percent (%) are displayed.

If, after calibration, the resulting values for 100 % and 0 % are within the measurement range of the fill level sensor, both negative values and values greater than 100 % can be displayed.



4.7.2 “Identification” sub-tab

In addition to the information in the "Identity tab" further information is contained, such as details of the probe length, serial number and firmware version of the fill level sensor.



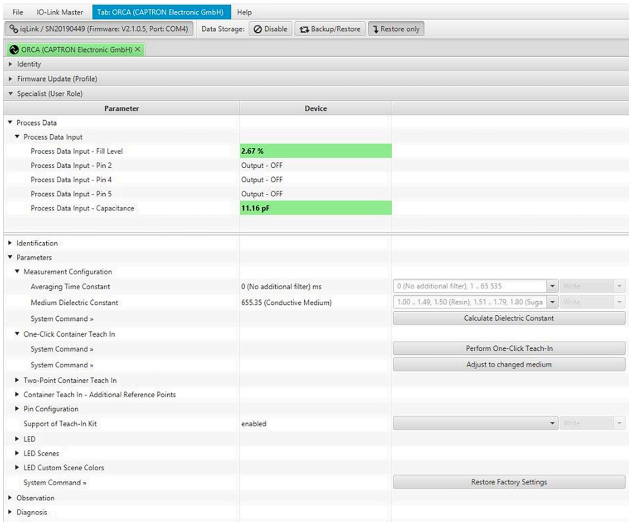
TIP

If multiple sensors are in use, the operator can assign a designation, e.g. machine name, as an application-specific identity.

4.7.3 “Parameters” sub-tab

The sub-tab `Parameters` has the following sub-sections:

- `Measurement Configuration`
- `One-Click Container Teach-in`
- `Two-Point Container Teach-in`
- `Container Teach-in - Additional Reference Points`
- `Pin Configuration`
- `LED`
- `LED Scenes`



TIP

Save every modified value using the `Write` button.

If multiple values are to be modified, press the `Write All` button.

4.7.3.1 “Measurement Configuration” sub-section

“Averaging Time Constant”

► In order to balance the accuracy and inertia of the application, use the `Averaging Time Constant` to set the averaging of the measured value within the time range of 0 and 65635 ms. Ex-works, the default value is 0 ms.

“Medium Dielectric Constant”

► Enter the dielectric constant (DK value) of the medium to be measured.

The input range is between 0 and 655.35. In the Drilldown area it is possible to select values for a number of recorded materials. Further values for media are listed on the DK values website.

TIP

For the use of `One-Click Container Teach-in`, it is necessary to input dielectric constant. For other calibration methods, this value has no effect on the measurement result.

4.7.3.2 Calibration of the fill level sensor

► Calibrate the fill level sensor to the container and the medium.

► After changing the container or the medium, recalibrate the fill level sensor.

If the fill level sensor is changed to a new sensor, saved configurations, including calibration values, can be transferred. In consultation with CAPTRON, the fill level sensor can be delivered loaded with pre-configured configurations.

► Calibrate using the following methods.

The methods are listed in increasing order of accuracy.

- `One-Click Container Teach-in`: Simplest method
- `Two-Point Container Teach-in`: Sensor is calibrated using two fill levels
- `Container Teach-in - Additional Reference Points`: Method for containers whose fill level does not increase linearly with height. Up to six calibration points in total are possible

4.7.3.3 Sub-section “One-Click Container Teach-in”

Prerequisites:

- Fill level sensor is installed correctly
- Container is empty
- IO-Link master is connected, and the device-specific IODD is loaded

► Enter the dielectric constant (DK value) of the medium to be measured, see ""Measurement Configuration" sub-section", page 10.

► Calibrate container, press `Perform One-Click Teach-in`.

✓ Button turns green and is marked `Done`.

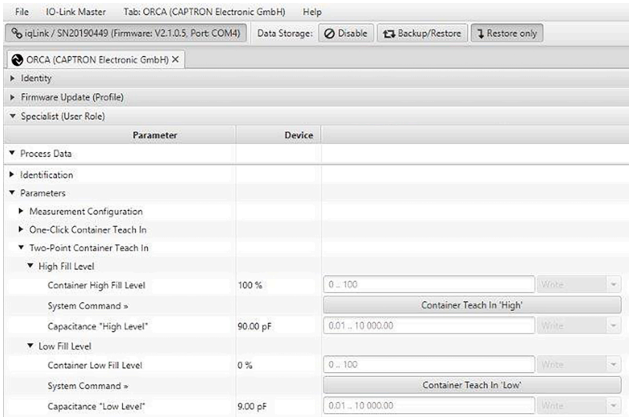
✓ Fill level sensor is calibrated and ready for use.

4.7.3.4 Sub-section “Two-Point Container Teach-in”

In this method, two fill levels (“Low” and “High”) are calibrated.

TIP

For an accurate measurement result, choose a large interval between the percentage values for “Low” and “High”. As a rule, calibration points between 20 % and 80 % deliver the best results over the whole measurement range.



Prerequisites:

- Fill level sensor is correctly installed.
- IO-Link master is connected, and the device-specific IODD is loaded.

► Fill the container between 0 % and 25 % of the desired measurement range.

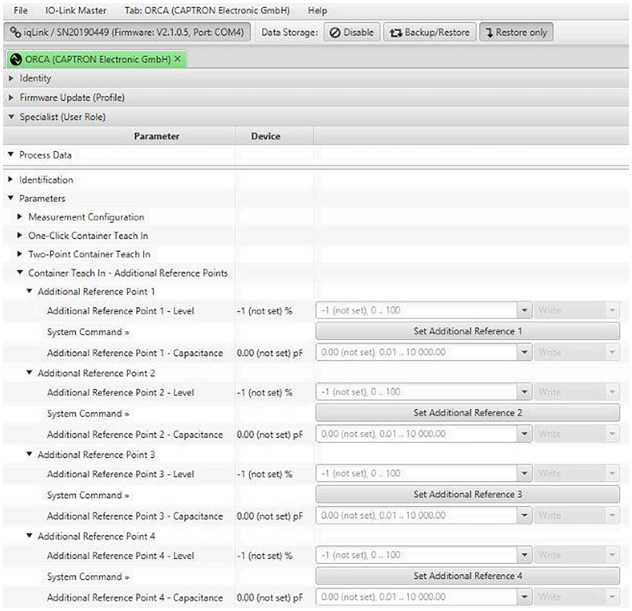
► Enter the corresponding value in `Container Low Fill Level`.

- ▶ Confirm the value with `Write`.
- ▶ Press `Container Teach-in 'Low'`.
- ✔ Button turns green and is marked `Done`.
- ✔ “Low” is calibrated.
- ▶ Fill the container between 25 % and 100 % of the desired measurement range.
- ▶ Enter desired value in `Container High Fill Level`.
- ▶ Confirm the value with `Write`.
- ▶ Press `Container Teach-in 'High'`.
- ✔ Button turns green and is marked `Done`.
- ✔ “High” is calibrated.
- ✔ Fill level sensor is ready for use.

The measured capacities for both reference points are displayed.

4.7.3.5 Sub-section “Container Teach-in - Additional Reference Points”

Particularly for inhomogeneous containers, the measurement accuracy is improved by the use of further reference points. In addition to the two reference points of the `Two-Point Container Teach-in` up to four further reference points can be used. Calibration is performed analogous to the two reference points of the "Two-Point Container Teach-in". The sequence of the calibration points is freely selectable.



4.7.3.6 Sub-section “Pin Configuration”

Pins 2, 4 and 5 can be configured as switching points. The following table lists the possible configurations.

Pin	Signal	Description
2	Switching output or analog output	PNP/NPN or Push-Pull; NO/NC 4...20 mA/0...10 V
4	Switching output IO-Link communication	PNP/NPN or Push-Pull; NO/NC
5	Switching output	PNP/NPN or Push-Pull; NO/NC

TIP

In order to modify the parameters, connect the device to the IO-Link master. For more information on connecting to the IO-Link master, see the IO-Link master documentation.

Here, as an example, Pin 2 is being configured; Pin 4 and Pin 5 are configured analogously.

Prerequisites:

- IO-Link master is connected and the device-specific IODD is loaded.

► Define the function using the dropdown list `Pin 2 Function`.

► Define the output using the dropdown list `Output Function`.

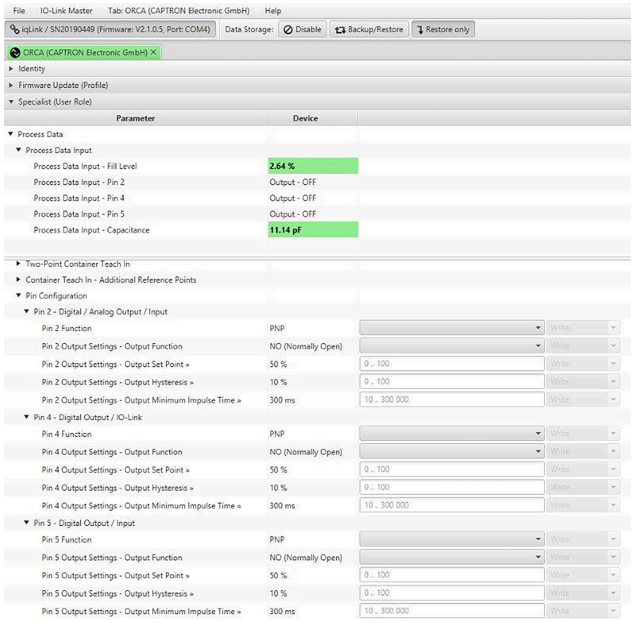
► Enter switching point as a percentage value in field `Output Set Point`.

► Enter the reset value of the switching point in field `Output Hysteresis` as a percentage value.

► Enter the minimum length of the output impulse in field `Output Minimum Impulse Time`. Guideline 300 ms.

► Confirm all values using `Write`.

✔ Switching point is configured.



The switching point (fill level in %) and the hysteresis (difference below the switching point in %) and the minimum impulse time of the output can be specified and transferred.

► If the output is to be closed when a defined fill level is undershot, then specify the output as “Normally Closed”, and set the defined fill level at Set Point minus hysteresis.

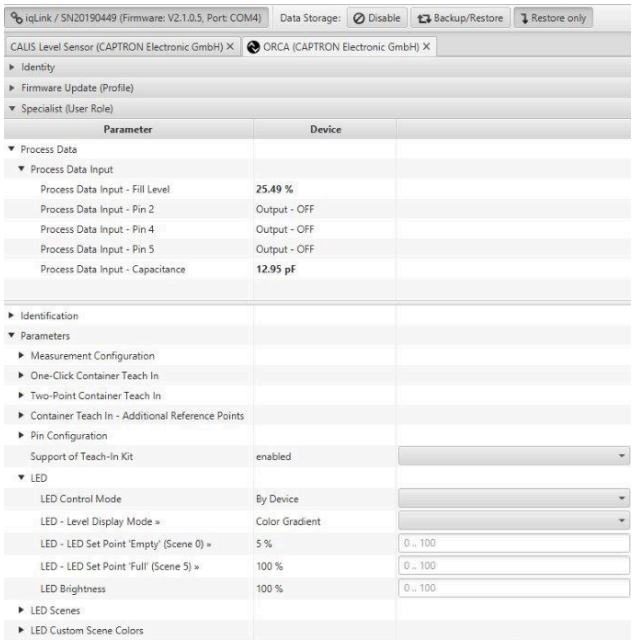
✔ The Set Point is above the defined fill level to the same extent that the hysteresis level is above the switching point.

4.7.3.7 Sub-section “LED”

► Set LED according to color and mode.

LED modes:

- static
- pulsed
- flashing



“LED Control Mode”

Activation can be selected via the fill level sensor “By Device”, or for IO-Link communication via the process data “By IO-Link Process Data”. For IO-Link communication the procedure is described in the TRM.

“LED Level Display Mode”

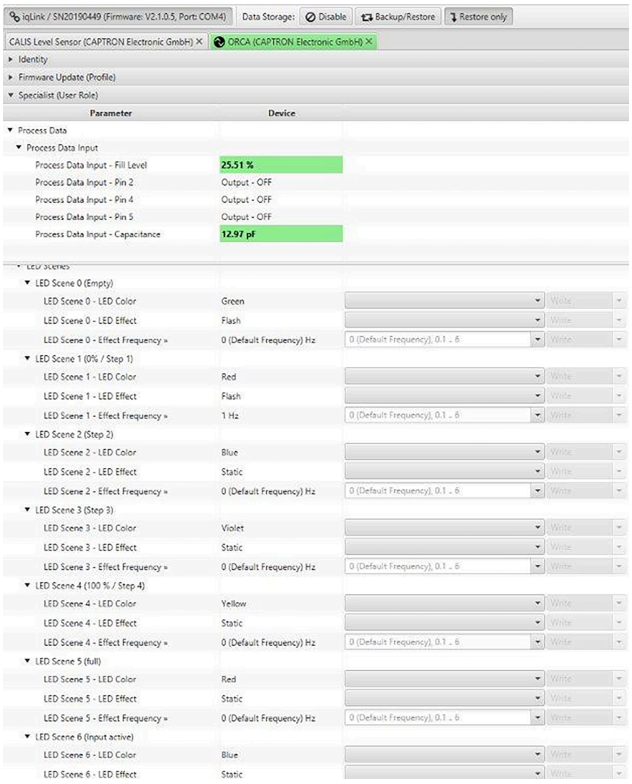
- ► Display the fill level in two ways using LED.
  - Color Gradient: The color changes continuously according to the fill level.
  - Output Switch Points: The LED changes color in four steps defined by the specified Set Points of the digital outputs (Pins 2, 4 and 5). For this representation mode, the definition of Set Points and hysteresis for Pins 2 and 5 is important, even when they were defined as inputs.
- ► Define and display “LED Set Point Empty” and “LED Set Point Full”.

  Define and display statuses ‘empty’ `LED Set Point 'Empty'` and ‘full’ `LED Set Point 'Full'` here, regardless of the defined Set Points for Pins.
- ► Adjust “LED Brightness”:

  Adjust brightness of the LED via `LED Brightness`.

4.7.3.8 Sub-section “LED Scenes”

Up to six “Scenes” can be defined.



According to the selection of the “Level Display Mode”, the overview of the characteristics of the LED Scenes is shown in the following table.

Scene Number	Color Gradient Mode	Output Switch Points Mode	Example
0	Fill level lower than „LED Set Point Empty“		Red, flashing
1	Reference color 0 %	Fill level lower than all output set points	Red
2		Fill level lower than one output set point	Orange
3		Fill level lower than two output set points	Yellow
4	Reference color 100 %	Fill level greater than all output set points	Green
5	Fill level greater than „LED Set Point Full“		Green, flashing
6	High signal on any input pin		Blue, flashing

► Select the color and light effect of the LED for every Scene, via drop-boxes.

4.7.4 System command

► Use the system command to reset the fill level sensor to the factory setting. Not only is the configuration reset to the factory setting, but the calibration values are also deleted.

⚠ WARNING

Risk of injury through the escape of dangerous and hot media from the container
If the container is overfilled, dangerous and hot media can escape, e.g. fluids, bulk materials, pastes, adhesives, chemicals.

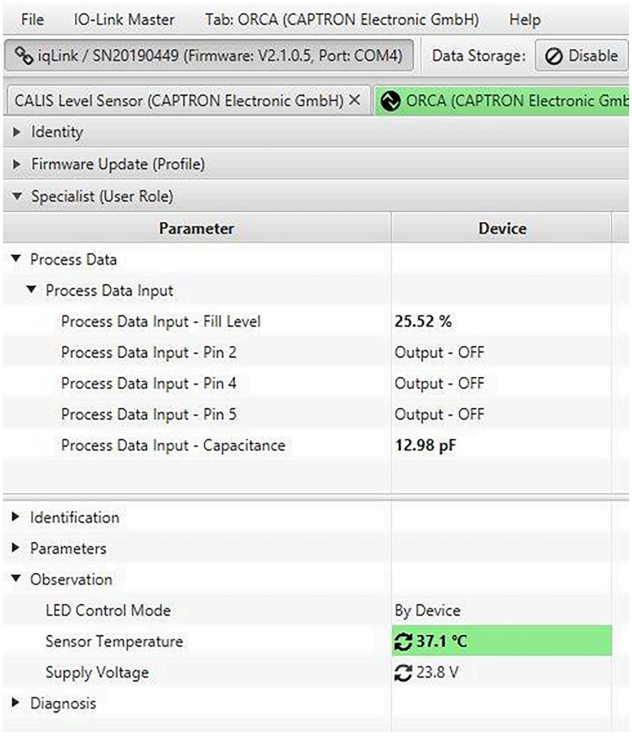
‣ It is essential to calibrate the fill level sensor (see Chapter 4.7.3.2).

4.7.5 Sub-tab “Observation”

This section displays information and status for the following items:

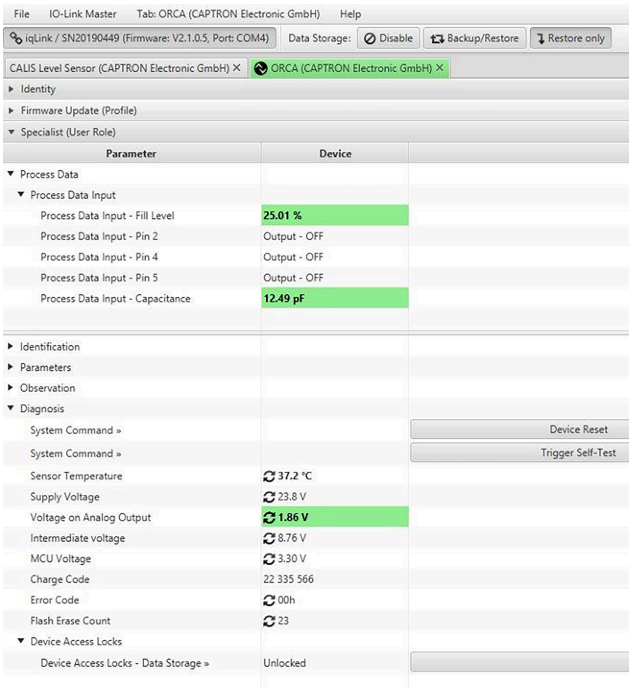
- The current configuration of the `LED Control Mode`
- The current sensor temperature

  The current sensor temperature (electronics in the fill level sensor head) is displayed. It is not the temperature of the medium.
- The current supply voltage



4.7.6 “Diagnosis” sub-tab

Compared with the information in section "Sub-tab “Observation”" this section provides a broader range of data of data, as well as the option to use system commands to restart the fill level sensor, initiate a self-test, and perform a device lock.



The system command `Device Reset` performs a warm start of the fill level sensor. In contrast to the system command “Reset to factory settings”, the device’s configuration and calibration values are retained.

The system command `Trigger Self-Test` tests the electrical functioning of the LED.

In addition, the sensor temperature (electronics in the fill level sensor head), the fill level sensor's supply voltage, the voltage at the analog output, and internal voltage values (Intermediate and MCU) are monitored, and their values are displayed.

If the sensor temperature exceeds 90 °C (194 °F) this is recorded as an error, and `Error Code` is displayed.

The internal voltage values and the lot number and `Flash Erase Count` are details which can be important to the CAPTRON service team in the event of a malfunction.

The following list contains an overview of the error codes.

Blink code	IO-Link Error Code	Description
1	0x0001	Internal error
2	0x0002	Error with intermediate voltage
4	0x0008	Supply voltage overrun/underrun
8	0x0080	Parameter memory error
9	0x0100	Parameter error
12	0x0800	LED error
13	0x1000	Overload on digital output
-	0x2000	Overload on analog output
15	0x4000	Temperature overrun

4.8 "Events" tab

The `Events` tab provides a logbook. This logbook documents the errors and warnings which have been generated, and timestamps them. The timestamp documents the occurrence and disappearance of the message.

Events which may be displayed are listed below.

Event Code	Type	Definition and recommended maintenance action
6144	Error	Output Overload – Output current too high – maximal 200 mA
6145	Error	Voltage Output Overload – Current on analog voltage output too high
6146	Warning	Current Output Overload – Resistance on current output too high
16912	Warning	Device temperature overrun – Clear source of heat
16928	Warning	Device temperature underrun – Insulate device
20496	Error	Component malfunction – Repair or exchange
20752	Warning	Primary supply voltage overrun – Check tolerance
20753	Warning	Primary supply voltage underrun – Check tolerance

Event Code	Type	Definition and recommended maintenance action
25376	Error	Parameter error – Check data sheet and values

5 Removal of the fill level sensor

⚠ WARNING

Risk of injury through the escape of dangerous and hot media from the container
If the container is overfilled, dangerous and hot media can escape, e.g. fluids, bulk materials, pastes, adhesives, chemicals.

- If necessary correct overpressure in the container.
- Wear protective gloves for thermal protection against hot containers.

⚠ WARNING

Improperly performed work on electrical equipment:

An electric shock can be life-threatening or even fatal for humans.

- Before working on electrical equipment, make it voltage-free and secure it against being switched on again.
- Allow tasks on electrical equipment to be performed only by qualified personnel, in compliance with local and national electrical regulations and provisions.

► Make the system free of voltage, and secure it against being switched on again.
► Depressurize the equipment if necessary.
► Disconnect the electrical connection from the fill level sensor.
► Remove the fill level sensor.

6 Disposal

► Different types of electrical and electronic components must be recycled according to their type.
► All applicable statutory, state and local laws and regulations must be observed without restriction.

7 Technical specifications

Technical data at 24 V and 20 °C	
Connection	Plug M12, 5-pin
Protection class	III
Operating voltage	⎓ DC 24 V (16.8 to 30.0 V)
Current consumption	typically 29 mA
Short-circuit resistance	yes
Reverse polarity protection	yes
Analog output	4 to 20 mA (< 300 Ω)/0 to 10 V (> 10 kΩ)
Switching output	NPN/PNP/Push-Pull, NO/NC selectable
Switching point position	adjustable
Load current	typically 50 mA, max. 200 mA
Output load, switching output	300 Ω
Inductive load, switching output	500 mJ
Capacitative load, switching output	30 µF
Measurement principle	Capacitive
Medium	Fluid, non-conductive
DK medium	Medium > 1.8 (dielectric constant ε_r)
Measurement accuracy	±2 % of the measurement range end value
Repeatability	±1 % of the measurement range end value
Temperature drift	< 0.1 %/K
Resolution	1 mm
Measurement range	see model code; L as per dimensional drawing
Initialization time	< 2 s
Reaction time	< 1 s
Operating temperature of probe head	0 to +60 °C (32 to 140 °F)
Process temperature of medium	0 °C to +230 °C (32 to 446 °F)
IP degree of protection	IP67
Pressure resistance	10 bar

Technical data at 24 V and 20 °C	
Communication interface	IO-Link, COM 1.1
Process connection	See model code, material V4A
Probe rod	Diameter 6 mm, material V4A

Model code
CLP-XXHTN2-xxxx-abcd

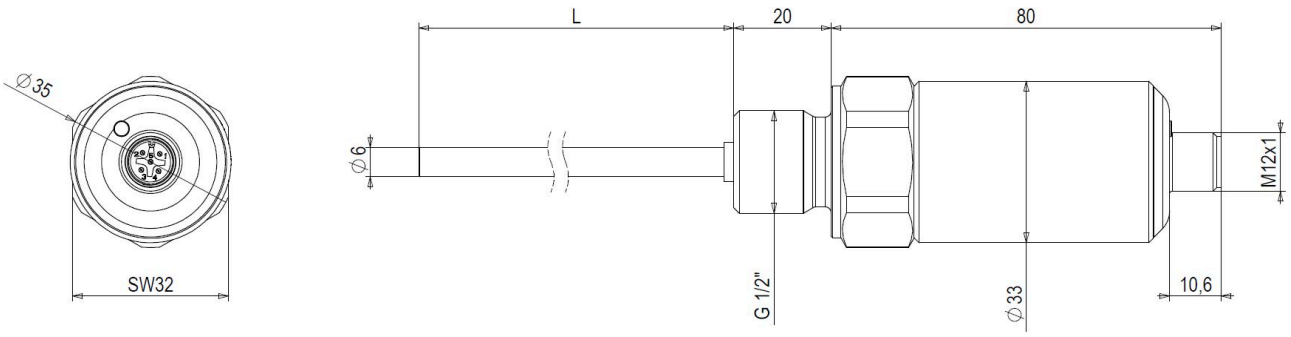
XX	Process connection G2 = G 1/2" LH = slot and G4 = G 3/4"
xxxx	Probe length L in mm; matches the measurement range
abcd	Configuration of the sensor

7.1 Dimensional drawing

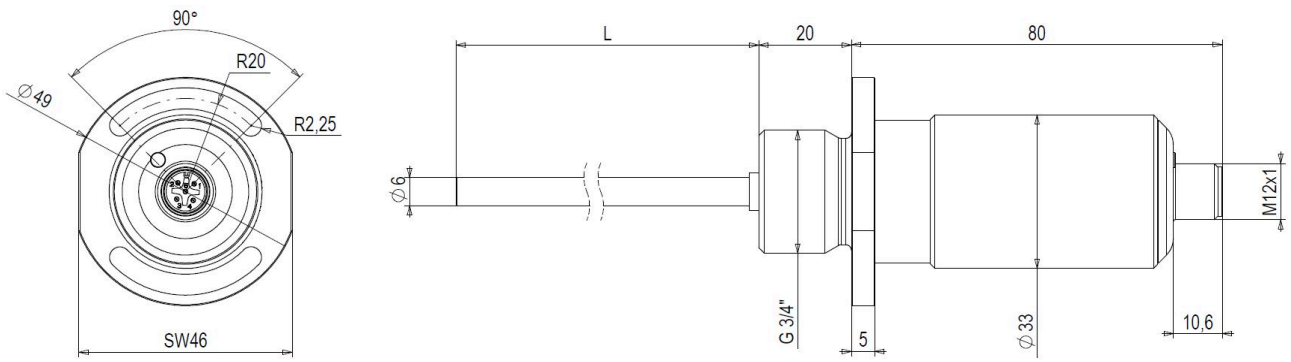
TIP

Metric and imperial measurements are used in drawings. Imperial measurements are marked with [ ].

CLP-G2HTN2-_

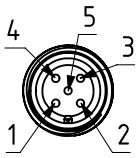


CLP-LHHTN2-_



7.2 Connection option

Plug M12, 5-pin



Pin	Signal	Description
1	U_V	+24 V DC supply voltage
2	Switching output or analog output	PNP/NPN or Push-Pull; NO/NC 4...20 mA/0...10 V
3	GND	0 V
4	Switching output IO-Link communication	PNP/NPN or Push-Pull; NO/NC
5	Switching output	PNP/NPN or Push-Pull; NO/NC

8 Updating the instructions

CAPTRON reserves the right to make changes to the contents of this manual as needed. The most current version can be found on our website at www.captron.com.

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