Baumer
Passion for Sensors

Operating Manual

LBFS-2

Point Level Sensor

EN-US

V1 | 4/30/2025

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1 About this document

1.1 Purpose and scope of application

This document enables safe and efficient sensor parameterization using various interfaces. The manual describes the available functions to support installation and software use via the interfaces.

The illustrations are examples only. Deviations are at the discretion of Baumer at all times. This manual is a supplement to the existing product documentation.

1.2 Applicable documents

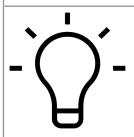
- Available for download at www.baumer.com:
  - Data sheet
  - EU Declaration of Conformity
- Attached to product:
  - Quickstart
  - General information sheet (11042373)

1.3 Labels in this manual

Identifier	Usage	Example
Dialog element	Indicates dialog elements.	Click ***OK***.
Unique name	Indicates the names of products, files, etc.	*Internet Explorer* is not supported in any version.
`Code`	Indicates entries.	Enter the following IP address: `192.168.0.250`

1.4 Warnings in this manual

Warnings draw attention to potential personal injury or material damage. The warnings in this manual indicate different hazard levels:

Symbol	Warning term	Explanation
	**DANGER**	Indicates an imminent potential danger with high risk of death or serious personal injury if not being avoided.
	WARNING	Indicates potential danger with medium risk of death or (serious) personal injury if not being avoided.
	CAUTION	Indicates a danger with low risk, which could lead to light or medium injury if not avoided.
	NOTE	Indicates a warning of material damage.
	**INFO**	Indicates practical information and tips that enable optimal use of the devices.

2 Safety instructions

2.1 Installation according to UL approval

The appliance is only certified for indoor use. UL does not evaluate IP protection classes.

Device power supply must be provided by external circuits in accordance with Class III as well as low voltage in accordance with CI requirements 9.4 of UL/CSA 61010-1 3rd ed. or Class 2 of UL1310.

Mandatory to use UL-approved CYJV/7 or PVVA/7 cables with voltage, current and temperature ratings suitable for the application, but minimum 90°C.

If the device is used otherwise than specified by the manufacturer, the device-specific protection ratings may be impaired.

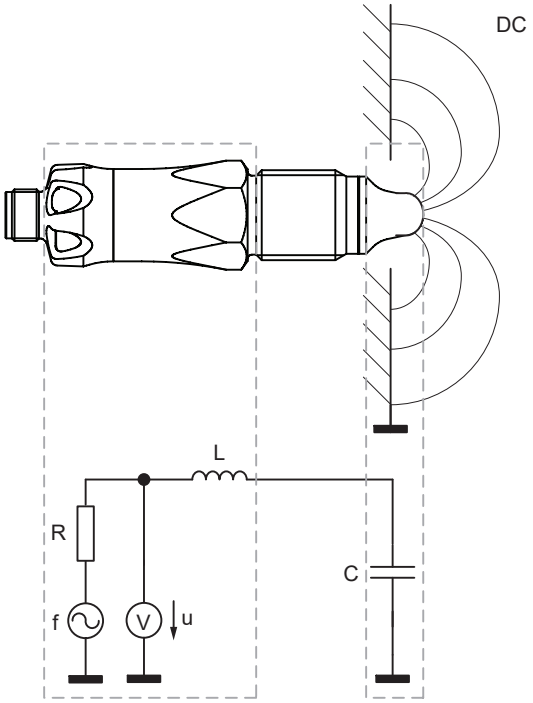
3 Structure and working principle

The CleverLevel® point level sensor with frequency sweep technology enables level monitoring in any media - whether solid, liquid or adhesive in tanks or containers.

Measurement principle

The sensor features coil L and electrode in the sensor tip. Sensor tip in combination with ambience acts as a capacitor. The medium's dielectric constant (DC value) defines the capacitance value C of the capacitor. In doing so, coil and capacitor build a resonant circuit.

The sensor's switching signal would trigger according to the measured resonance frequency and the programmed threshold.



Ill. 1: Measuring principle: Frequency sweep technology

4 Installation

⚠ DANGER

Risk of injury from dangerous media

a) Wear protective gear when working with hazardous media (e.g. acids, lye).

b) Empty pipes prior to the installation.

c) Use device only as specified by the manufacturer.

4.1 Installation site and environment

Recommended installation sites

Preferred sensor installation is in closed, metallic containers or piping systems. Ensure electrical contact between sensor and metallic process connection.

Sensor installation sensor in plastic containers may cause impairments by, electromagnetic interference.

Function check

Prior to commissioning, check proper sensor function in an application test. If electromagnetic interference is present, take appropriate counteractions like shielding or earthing.

Original Baumer accessories

Only together with original Baumer accessories the safe and reliable installation, flawless function and tight connection is ensured.

Where using process connections from other manufacturers ensure mechanical compatibility. Baumer will not accept any responsibility in terms of tightness, hygienic safety or proper function of the product in the event of:

- lack of compatibility
- improper installation.

4.2 Temperature dependency for adjustable connection

The permitted operating temperature of the electronics depends on various factors:

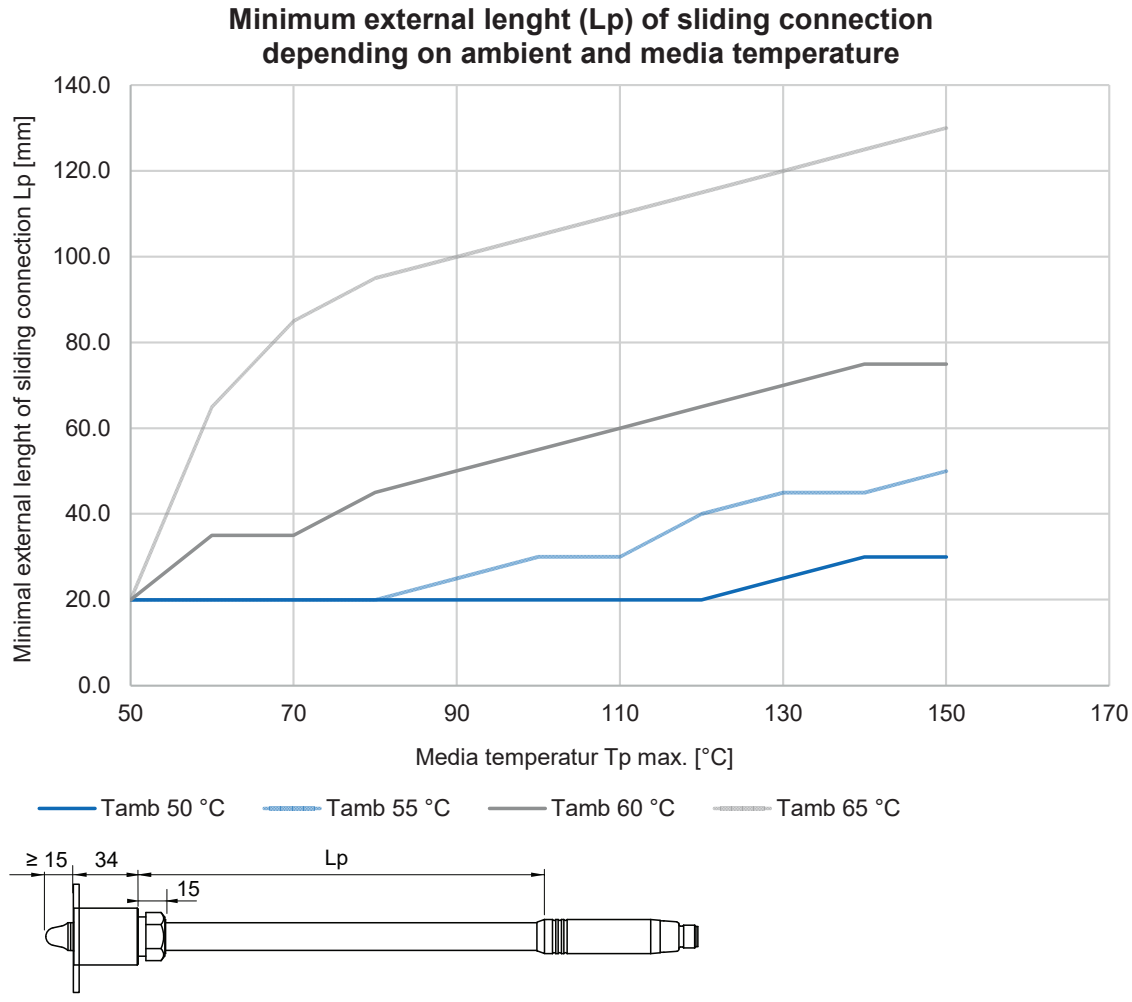
- medium temperature,
- ambient temperature,
- sensor immersion depth.

Exceeding the specified limit values may entail thermal overload, which ultimately can result in destruction of the electronics.

Consider variables of influence

To ensure safe sensor functions, take into account the variables of influence present in the application.

The following graph shows the dependencies between immersion depth and maximum permitted medium temperature as a function of ambient temperature.



Ill. 2: External Length (Lp) shown at sensor

5 Explosive atmosphere certification

All certifications for explosive atmospheres require using a connector with minimum IP67 rating.

LBFS-2.3xxxx.x: IECEx / CCC / ATEX II 3G Ex ec IIC T4 Gc

LBFS-2.4xxxx.x: IECEx / CCC / ATEX II 1G - Ex ia IIC T4 Ga + IECEx / CCC / ATEX II 1D - Ex ta IIIC T135 °C Da

NOTICE: If LBFS-2.4xxxx.x is used without a barrier (for Ex t or non-ex use) the Ex i protection is invalidated and it may not subsequently be used as an Ex i device. The user must mark the device to reflect this. Eg. by removing or striking the Ex ia code line.

5.1 Explosive gas atmosphere zone 0 and 1

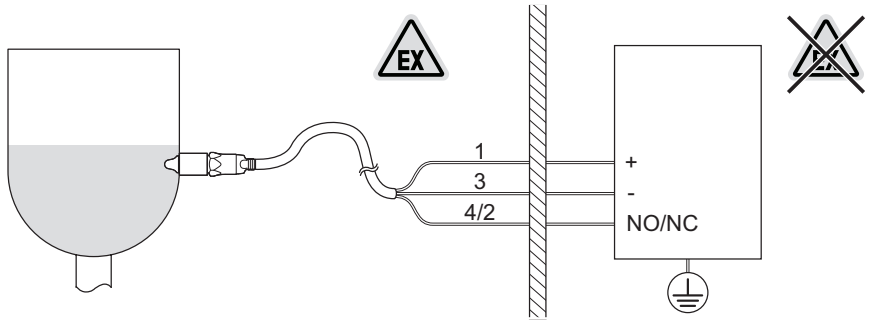
The LBFS can be used with an Ex-approved barrier in potentially explosive areas of zone 0 or zone 1.

LBFS-2.4xxxx.x

All LBFS in zone 0 and zone 1

Observe the temperatures, connection values and circuit diagram below:

IECEx / CCC / ATEX II 1G - Ex ia IIC T4 Ga	
Maximum value for selecting the barrier:	Ui: 30 VDC Ii: 100 mA Pi: 0.66 W
Internal capacity:	For LBFS-2.x2xxx.x: Ci = 56 nF + 0.17 nF/m For LBFS-2.xx52x.x: Ci = 56 nF + 0.20 nF/m
Internal inductivity:	For LBFS-2.x2xxx.x: Li: 46 µH + 0.27 µH/meter For LBFS-2.xx52x.x: Li: 46 µH + 1.13 µH/meter
Temperature class	
- Standard version:	T4: -40 < T_{amb} < 85 °C
- Cable version:	T4: -25 < T_{amb} < 70 °C



5.2 Explosive dust atmosphere zones 20-22

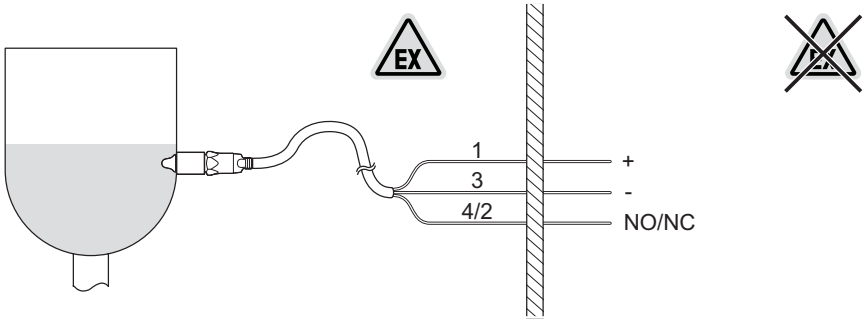
LBFS can be used in hazardous areas of zone 20, 21 or 22.

LBFS-2.4xxxx.x

All LBFS in zones 20, 21 and 22

Observe the temperatures, connection values and circuit diagram below:

IECEx / CCC / ATEX II 1D - Ex ta IIIC T135 °C Da	
Supply range:	Un: 30 VDC max. In: 10 mA + max. 20 mA output load
Temperature class	T135 °C:
- Standard version:	-40 < T_{amb} < 85 °C
- Cable version:	-25 < T_{amb} < 70 °C



5.3 Explosive gas atmosphere zone 2

The LBFS can be used in potentially explosive areas of zone 2.

LBFS-2.3xxxx.x

All LBFS in zone 2

Observe the temperatures, connection values and circuit diagram below:

IECEx / CCC / ATEX II 3G - Ex ec IIC T4 Gc	
Supply range:	Un: 30 VDC max. In: 100 mA max.
Temperature class	
- Standard version:	T4: -40 < T_{amb} < 85 °C
- Cable version:	T4: -25 < T_{amb} < 70 °C

6 Interfaces

This chapter describes the sensor's communication interfaces

6.1 FlexProgram

The *FlexProgrammer 9701* is the dedicated configuring tool for a wide range of *Baumer* products. The *FlexProgrammer 9701* is based on *FDT container technology.. FDT* is a software interface specification. This software interface defines the data exchange between application and field device software components.

User access to field devices is via *FlexProgram* for configuration of the associated Baumer sensors using the related *DTMs (Device Type Manager)*.

In standard operation, *FlexProgrammer 9701* is operated and powered via the computer's USB port. Baumer products allow for monitoring and parameterization independent of a computer (stand-alone feature). If the PC-based software *FlexProgram* supports a Baumer product, the associated configuration data is stored directly in the *FlexProgrammer 9701*. In this case, *FlexProgrammer 9701* is powered by the internal battery to enable remote configuration.

Via the LC display users can monitor parameterization of the product.

6.1.1 Installation

For installation of the PC-based software *FlexProgram* proceed as follows:

Instruction:

a) Download both the PC software *FlexProgram* and the firmware for your sensor at the Baumer homepage www.baumer.com.

b) Unzip and save the file in any directory, e.g. on your desktop.

✓ If a firmware update the file is available.

◆ Open the PC software *FlexProgram* and follow the user menu navigation.

6.1.2 User interface

The following chapter describes the user interface structure of FlexProgram.

Language selection

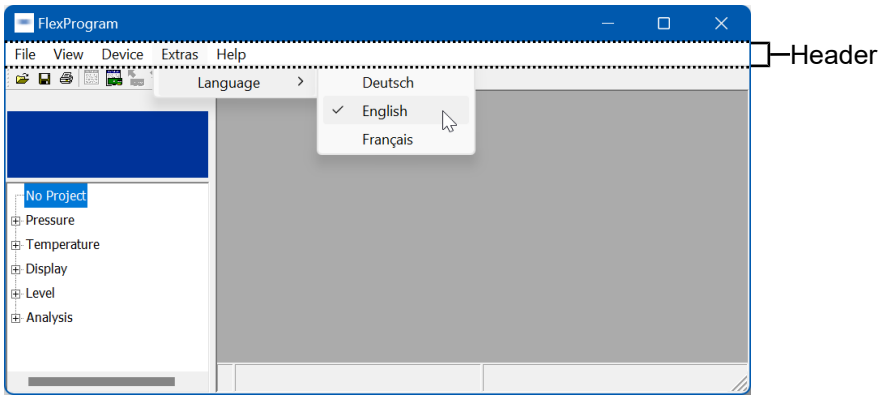
Instruction:

a) Navigate in header: ***Extras*** > ***Language***

b) Select your preferred language: German, English or French.

Result:

✓ System language selected.



Ill. 3: Select system language

Select sensor

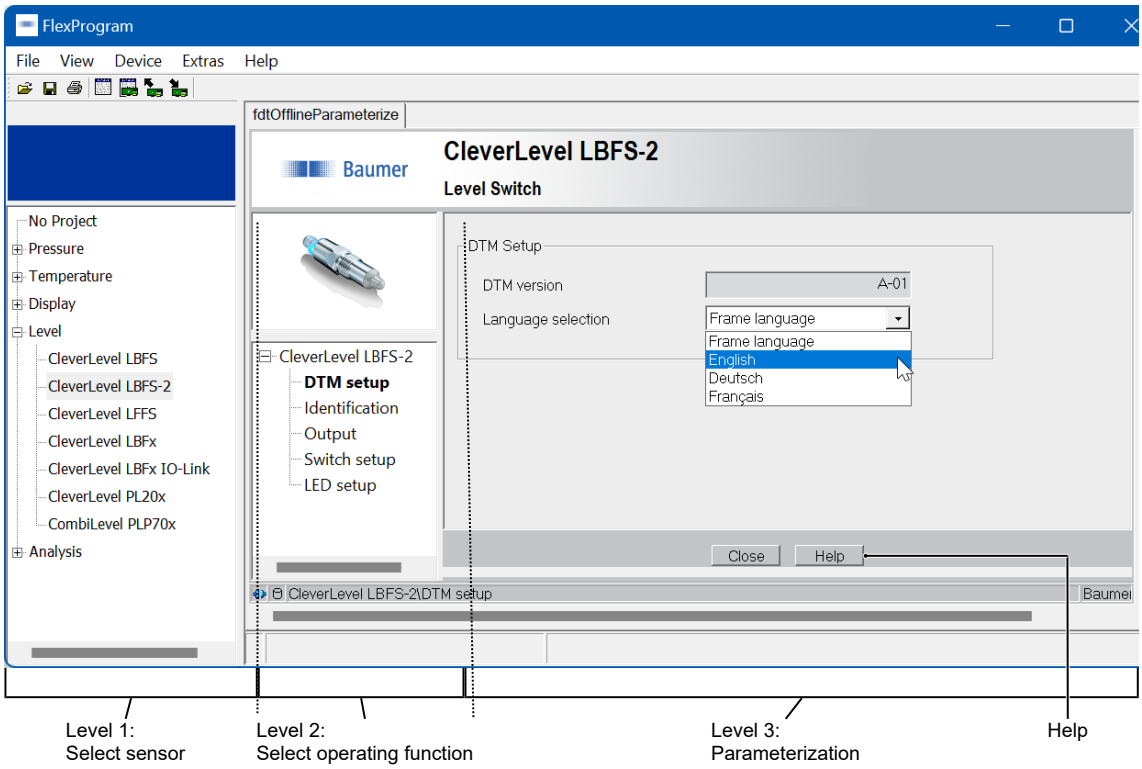
FlexProgram provides three levels.

- Navigate as follows: ***FlexProgram | Level | CleverLevel LBFS-2***

Result:

✓ Level 2 and level 3 open.

✓ You can access the sensor parameterization.



Ill. 4: User interface FlexProgram

INFO

More information or support available at *FlexProgram* itself:

FlexProgram | Level | CleverLevel LBFS-2 | Help

7 Operating functions

7.1 Basic functions

7.1.1 Select language

Select the language of preference for *FlexProgram*.

Static parameters:

- ***DTM version***

Editable parameters:

- ***Language selection***: English, German, French

FlexProgram access: *Language selection*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *DTM setup* | *Language selection***

7.1.2 Identification

To identify the sensor, there is factory-set information about the sensor that cannot be changed. Further you may name the sensor for better identification. You may also enter a customer-specific date for example date of last check.

Static parameters:

- **Serial number of the sensor**
- **Product name**
- **Type number**
- **Production date**

Editable parameters:

- **Tag**: max. 30 characters
- **User date**: YYYY MM DD

FlexProgram access: *Identification*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Identification***

7.2 Output

7.2.1 Output circuit

The parameter specifies the switching function of ***Output Circuit*** for both switching outputs. The function is available both for SW1 and for SW2. The parameters are read-only and cannot be edited.

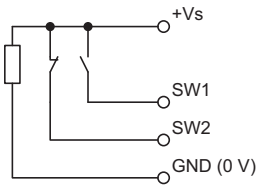
Static parameters:

- PNP
- NPN

Explanation

With **PNP sensors** the load is connected to both switching output and GND; with GND being the new reference point. In the event of signal change at the sensor, the transistor will switch through. Current flow is from +Vs to GND via transistor load which will close the circuit.

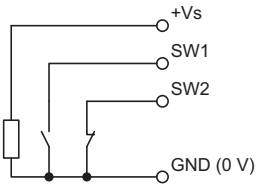
The output being inactive will have the control voltage virtually applied to +Vs blocking the transistor and this way eliminating current flow.



Ill. 5: Circuit diagram of PNP switching output

With **NPN sensors** the load is connected to switching output and +Vs; with +Vs being the reference point. Changing signals at the sensor will make the transistor switch through, current flow is from +Vs via transistor load to GND which will close the circuit.

The output being inactive will have the control voltage virtually applied to GND (0 V) blocking the transistor and this way eliminating current flow.



Ill. 6: Circuit diagram of NPN switching output

FlexProgram access: *Output Circuit*

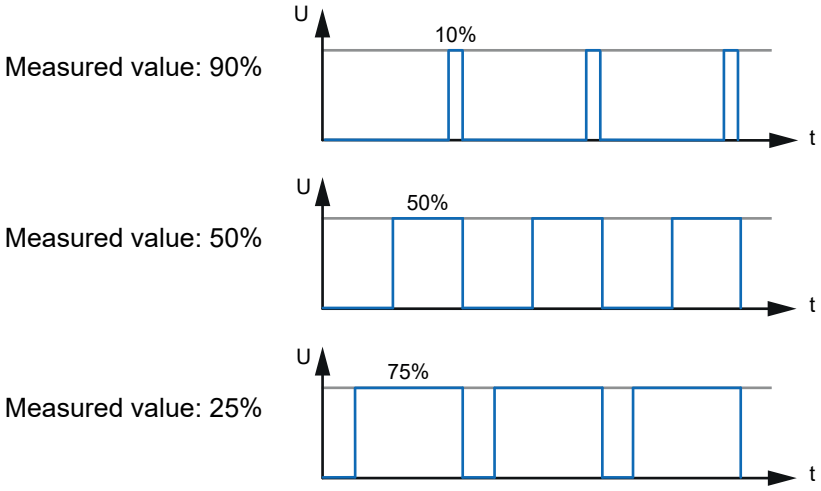
- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Output* | *Output Circuit***

7.2.2 Output function

The sensor provides two different output functions: ***State*** and ***PWM***. The switching signal channel SSC is reserved for media detection. Parameterization is done in two independent switching windows, ***SSC1*** and ***SSC2***, as well as their ***Logic*** (see *Switching logic for output function State [▶ 18]*).

State-Mode: The function acts as a switch, for related settings please see the following chapter *Switch configuration for output function State [▶ 17]*.

PWM-Mode: Pulse width modulation (PWM) is a digital technology for signal control by repeated switching between "high" and "low" in a regular pattern. The sampling rate of pulse width corresponds to the measured value.



Ill. 7: Example: Different pulse length

The defined digital pulse width is utilized by output ***PWM*** to modulate the sensor's output signal. The sampling rate of width duty depends on the measured value. The pulse width is within the sensor's measuring range and can be configured.

Signal ***PWM*** includes two key parameters: Frequency and sampling rate (see *Switch configuration for PWM output function [▶ 22]*)

Editable parameters:

***SW1 Output Settings*:**	***SW2 Output Settings*:**	**Description:**
***Output Function*:**	***Output Function*:**	
▪ ***SSC1 State*** (default)	▪ ***SSC2 State*** (default)	Sensor outputs "High" or "Low".
▪ ***SSC1 PWM***	▪ ***SSC2 PWM***	Sensor outputs the measured value via pulse width modulation.

FlexProgram access: *Output Function*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Output* | *Output Function***

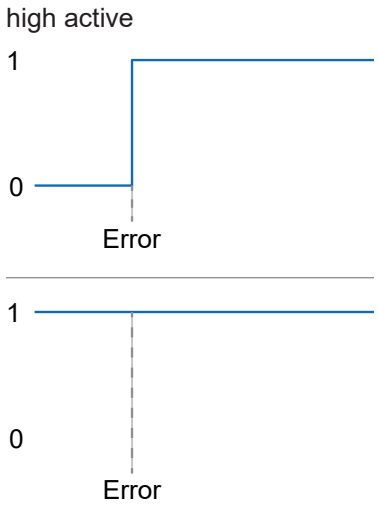
7.2.3 Alarm behavior

Function ***Overlay Function*** is used to overlay/override the switching output in the event of error. Triggered alarm behavior will override the switching output function.

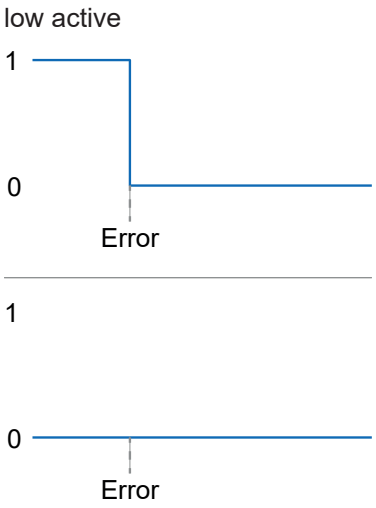
Editable parameters:

- ***No overlay function***: off
- ***High Output***: In the event of error, the output sensor signal is on high
- ***Low output***: In the event of error, the output sensor signal is on low
- ***Floating output (High impedance)*** in the event of error, the output is on high-impedance and does not output an active signal. The external pull-down resistor ensures the signal remaining on low (0 V), while an external pull-up resistor will remain the signal on high. The combination of pull-up and pull-down resistors is ideal since the alarm signal is in intermediate state between high and low. As a result, the alarm status is clearly differentiated from others. Prerequisite is a receiver capable of detecting a medium signal.

Examples of ***High-active*** and ***Low-active***:



Switching signal is set to ***High-active***.



Switching signal is set to ***Low-active***.

FlexProgram access: *Output Function*

- ***FlexProgram*** | ***Level*** | ***CleverLevel LBFS-2*** | ***Output*** | ***Overlay Function***

7.3 Switch configuration for output function State

Switch setup parameters depend on the selected ***Output Function***: ***State*** or ***PWM*** (see *Output function [▶ 15]*).

This chapter describes the ***Switch setup*** parameters for ***Output Function***: ***State***.

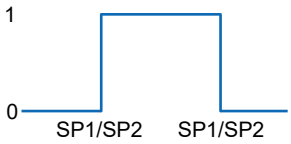
7.3.1 Setting the switching points

This parameter would change the sensor's switching point. Sensor would switch at the set percentage (Teach-by-Value-Funktion).

Default settings are the same for both output ***SSC1*** and ***SSC2***. Switching points ***SP1*** and ***SP2*** can be freely programmed for each output.

Editable parameters:

- Minimum switching point: ***SP1*** = 0.0 % (default)
- Maximum switching point: ***SP2*** = 75.3 % (default)



Ill. 8: Sensor would perform switching operations within the range SP1 to SP2

NOTICE

If ***Mode*** for ***Single point*** = active, ***SP2*** is disabled and only ***SP1*** would have an effect on the measurement results, see *Switch point mode [▶ 19]*.

FlexProgram access: switching points

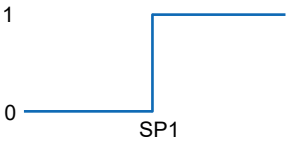
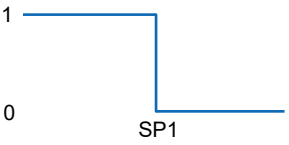
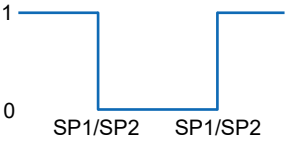
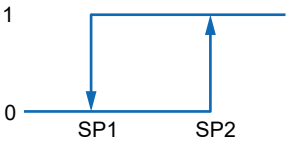
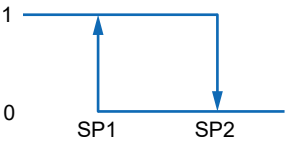
- ***FlexProgram*** | ***Level*** | ***CleverLevel LBFS-2*** | ***Switch setup*** | ***Setpoints***

7.3.2 Switching logic for output function State

Parameter *switching logic* would set the switching signal to ***High-active*** or ***Low-active***. This results into inverted switching signal behavior.

Editable parameters:

- ***High-active***: (default ***Output SSC1***) If the measured value is within the switching window, the output signal is on high.
- ***Low-active***: (default ***Output SSC2***) If the measured value is within the switching window, the output signal is on low.

Mode	***High-active***	***Low-active***
Single point	 Output signal is on "low" if object is being detected.	 Output signal is on "high" if object is being detected.
Window	 Output signal is on "high" if the object is being detected within the defined switching window.	 Output signal is on "low" if the object is being detected within the defined switching window.
Two point	 Output signal is on "low" if object is being detected.	 Output signal is on "high" if object is being detected.

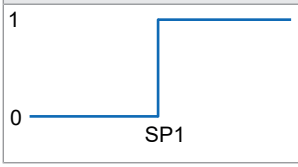
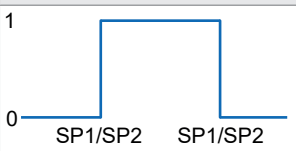
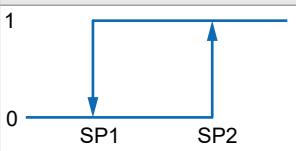
FlexProgram access: *Logic*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Switch setup* | *Logic***

7.3.3 Switch point mode

Editable parameters:

- ***Deactivated***: switching output is disabled.
- ***Single point***: sensor is switching when reaching the specified setpoint (SP1) in %. In single-point mode, air detection is output as a "high" signal (Note: inverted in window mode).
- ***Window***: (default) Sensor is switching within the defined window between switching points SP1 and SP2 in %.
- ***Two point***: sensor for manual setting of hysteresis by specifying a second setpoint (SP2). In two-point mode, air detection is output with a "high" signal.

Single point	*Window*	*Two point*
		

NOTICE

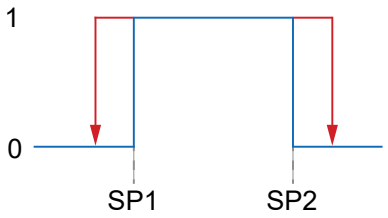
Both the parameters of functions ***Setpoints*** and ***LED setup*** can be edited, see *Setting the switching points [▶ 17]* and *LED indicator [▶ 23]*.

FlexProgram access: *Mode*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Switch setup* | *Mode***

7.3.4 Hysteresis

Function *hysteresis* prevents unwanted switching operations by the switching output. The parameterized value of the hysteresis is the difference in distance between the points at which the switching output is activated and deactivated. Baumer recommends always setting the hysteresis not equal to 0.



Ill. 9: Hysteresis in window mode

Editable parameters:

- ***Hysteresis***:`[0 ... 100]`

Example

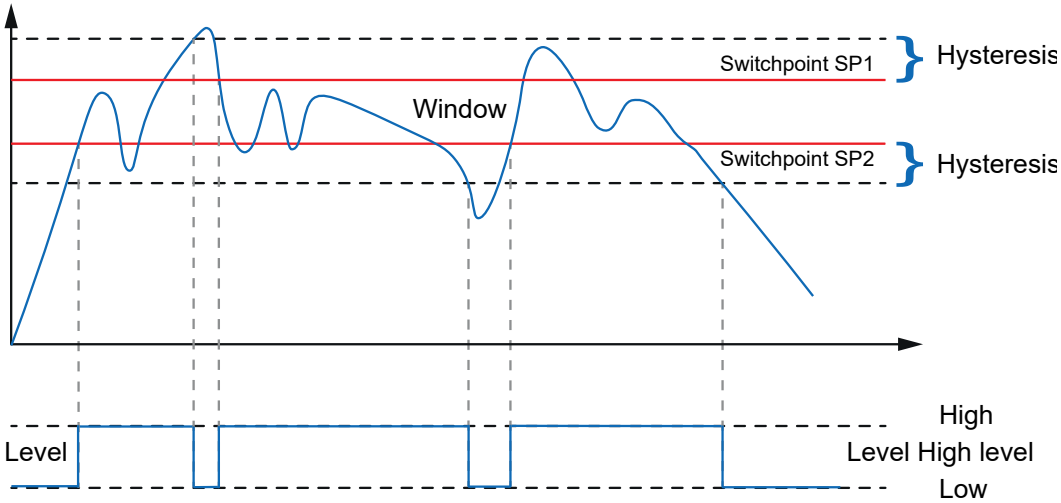
- *Minimum switching point* (SP1): 30 %
- *Maximum switching point* (SP2): 60 %
- *Hysteresis*: 2 %

The switching output is active at measured levels between 30 % and 60 %. If the fill level drops from 30 % to 29 %, the switching output is still enabled because of hysteresis. However, as soon as the measured fill level falls below 28 % or rises above 62 %, the switching output will be disabled.

For further fill level change, the output will not be re-enabled until level is between 30 % and 60 % (parameterized switching point).

Switching output behavior

Hysteresis:



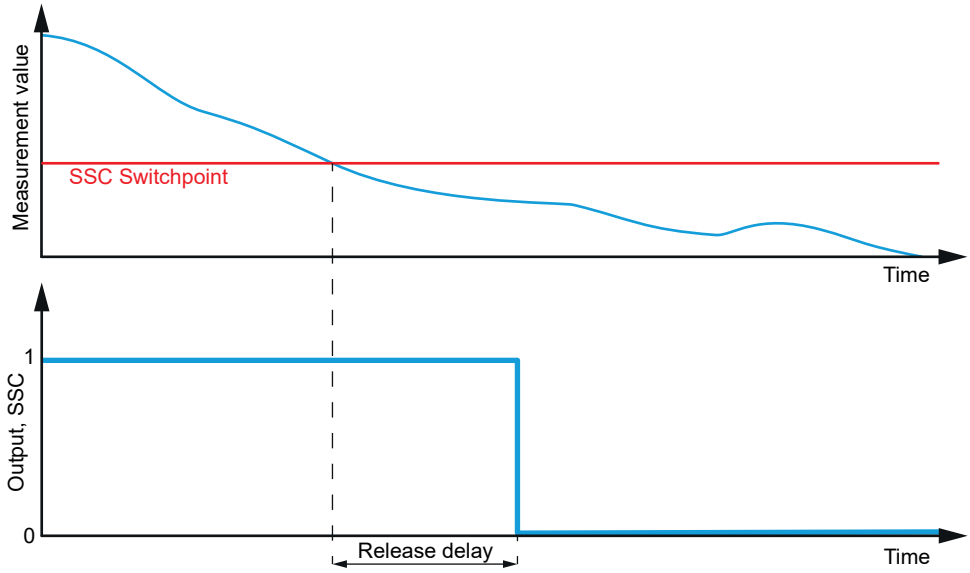
Ill. 10: Behaviour of the switching output in window mode

FlexProgram access: *Hysteresis*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Switch setup* | *Hysteresis***

7.3.5 Damping

Damping specifies the time during which measured values may be inferior (***Mode*** = ***Single point***) or outside (***Mode*** = ***Window***) the switching points of the related SSC until status changes from "low" to "high" or vice versa.



Measuring signal damping

Editable parameters:

- ***Damping***:`[0 ... 60]s`

Examples

- Suppress short-time signal loss caused by known interference such as air bubbles.
- Avoid frequent flickering.
- Ensure optimally harmonized damping time for downstream devices that will respond to the sensor's output signal.
- Recognize the size of unwanted gaps in continuous product flow.

NOTICE

Both ***Mode*** and inversion ***High-active***/***Low-active*** can be adapted, see *Switch point mode [▶ 19]* and *Switching logic for output function State [▶ 18]*.

FlexProgram access: Damping

- ***FlexProgram*** | ***Level*** | ***CleverLevel LBFS-2*** | ***Switch setup*** | ***Damping***

7.4 Switch configuration for PWM output function

Switch setup parameters depend on the selected ***Output Function***: ***State*** or ***PWM*** (see *Output function [▶ 15]*).

This chapter describes the ***Switch setup*** parameters for ***Output Function***: ***PWM***.

7.4.1 Period time

The period time defines the length of a single period.

Editable parameters:

- ***Period time***: `[0.01 ... 60]s`

FlexProgram access: *Period time*

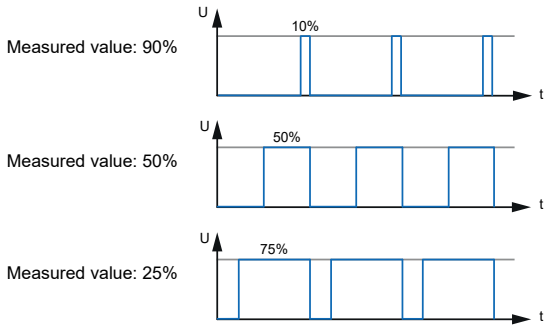
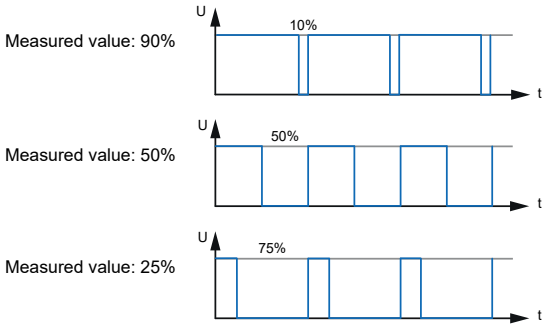
- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Switch setup* | *Period time***

7.4.2 Switching logic for PWM output function

Parameter *switching logic* would set the switching signal to ***High-active*** or ***Low-active***. This results into inverted switching signal behavior.

Editable parameters:

- ***High-active***: (default ***Output SSC1***) If the measured value is within the switching window, the output signal is on high.
- ***Low-active***: (default ***Output SSC2***) If the measured value is within the switching window, the output signal is on low.

High-active	***Low-active***
	
Output signal is on "high" if object is being detected.	The output signal is on "low" if object is being detected.

FlexProgram access: *Logic*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *Switch setup* | *Logic***

7.5 LED indicator

There are two LEDs one in green and the other in blue. You can configure both LEDs individually.

Editable parameters:

- ***Enable error indicator***: enabled/disabled.
  The error alarm enabled:
  - In the event of error, both LEDs are flashing simultaneously.
  - In the event of short circuit, both LEDs are flashing alternately.

Green LED:

- ***SSC1 inactive*** (default)
- ***SSC1 active***
- ***SSC2 inactive***
- ***SSC2 active***
- ***ON***
- ***OFF***

Blue LED:

- ***SSC1 inactive***
- ***SSC1 active*** (default)
- ***SSC2 inactive***
- ***SSC2 active***
- ***ON***
- ***OFF***

FlexProgram access: *LED setup*

- ***FlexProgram* | *Level* | *CleverLevel LBFS-2* | *LED setup* | *LED setup***

7.6 Real-time measurement

Use function ***Measuring (Online)*** to visualize the values in real time. The diagram shows graph of measured values curve together with the set parameters. Use function ***Measuring (Online)*** for parameterization and consequently optimization of the various *SSCs*.

NOTICE

When changing the output function from ***State*** to ***PWM***, close and reopen ***Measuring (Online)*** to access the parameters in ***PWM*** mode.

FlexProgram access: Real-time measurement

Click icon ***Measuring (Online)*** in the header.

8 Maintenance

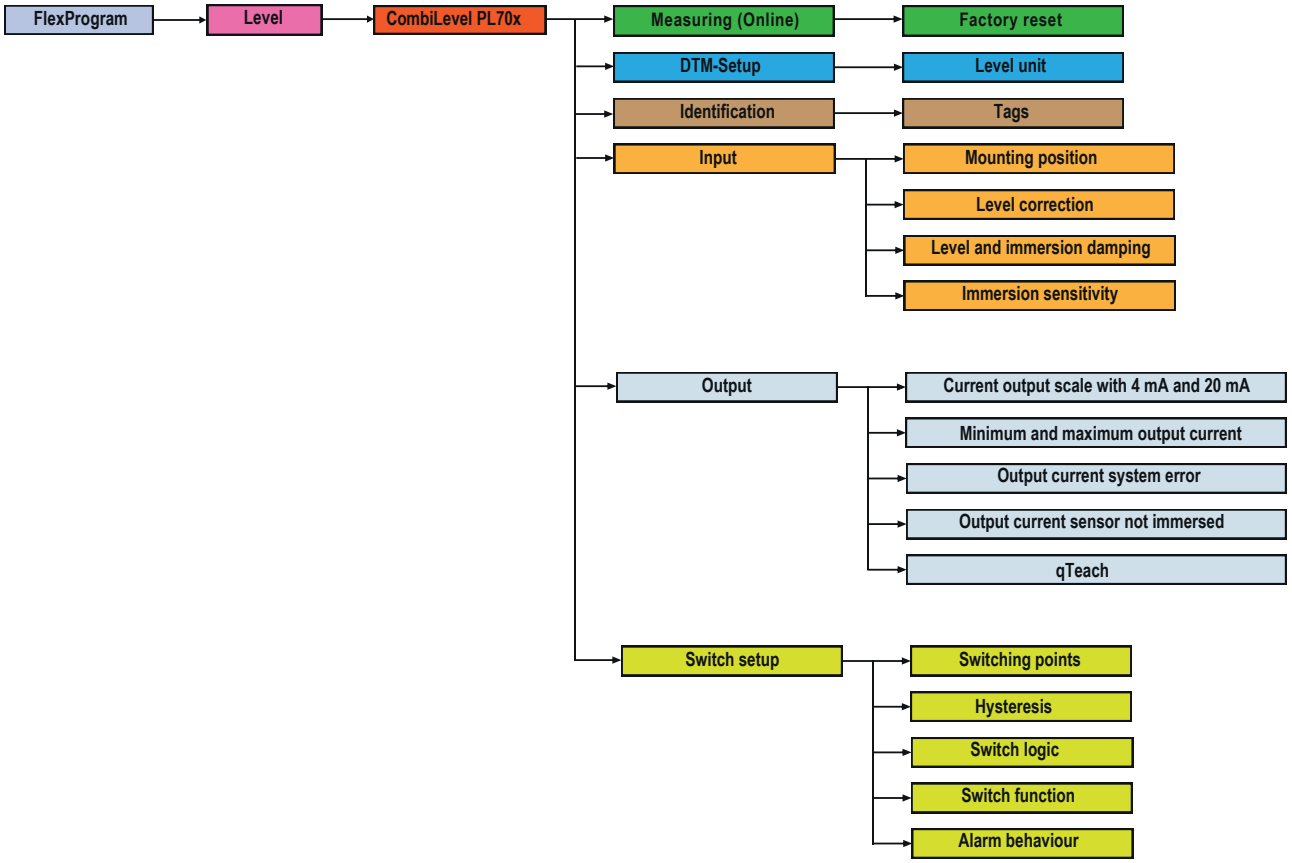
The sensor is maintenance-free. No particular preventive maintenance required.

Cleaning & inspection: Regular cleaning and visual inspection of the plug connections are recommended.

Repair: Do not repair the sensor yourself. Return a damaged sensor to Baumer.

9 Annex

9.1 FlexProgram



Ill. 11: FlexProgram: menu structure plan

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