



CARLO GAVAZZI



IO-Link capacitive sensors

CA18CB, CA30CB

User manual

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1. Introduction

This manual is a reference guide for Carlo Gavazzi IO-Link capacitive proximity sensors CA18CB...IO and CA30CB...IO. It describes how to install, setup and use the product for its intended use.

1.1. Description

Carlo Gavazzi capacitive sensors are devices designed and manufactured in accordance with IEC international standards and are subject to the Low Voltage (2014/35/EU) and Electromagnetic Compatibility (2014/30/EU) EC directives.

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Please do not hesitate to make any suggestions for improving this document.

1.2. Validity of documentation

This manual is valid only for CA18CB and CA30CB capacitive sensors with IO-Link and until new documentation is published.

This instruction manual describes the function, operation and installation of the product for its intended use.

1.3. Who should use this documentation

This manual contains important information regarding installation and must be read and completely understood by specialized personnel dealing with photoelectric sensor installation.

Save the manual for future use.

1.4. Intended use of the product

Capacitive proximity sensors are non-contact devices capable of measuring the position and/or change of position of any conductive target. They are also capable of measuring thickness or density of non-conductive materials. Capacitive proximity sensors are used in a wide variety of applications including plastic moulding processing, feeding systems for chicken or pigs, assembly line testing, filling or emptying processes of solid or liquid objects.

The CA18CB... and CA30CB... sensors are equipped with IO-Link communication. By using an IO-Link master it is possible to operate and configure these devices.

1.5. Safety precautions

This sensor must not be used in applications where personal safety depends on the function of the sensor (The sensor is not designed according to the EU Machinery Directive).

Installation and use must be carried out by trained technical personnel with basic electrical installation knowledge.

The installer is responsible for correct installation according to local safety regulations and must ensure that a defective sensor will not result in any hazard to people or equipment. If the sensor is defective, it must be replaced and secured against unauthorised use.

1.6. Other documents

It is possible to find the datasheet, the IODD file and the IO-Link parameter manual on the Internet at <http://gavazziautomation.com>

1.7. Acronyms

PLC	Programmable Logic Controller
IEC	International Electrotechnical Commission
NO	Normally Open contact
NC	Normally Closed contact
NPN	Pull load to ground
PNP	Pull load to V+
Push-Pull	Pull load to ground or V+

2. Product

2.1. Main features

New IO-Link Carlo Gavazzi 4-wire DC 4th Generation Tripleshield sensors, built to the highest quality standards, are available in two different housing sizes.

- CA18CB.. PBT M18-cylindrical threaded barrel housing for flush or non-flush installation with 4-pole M12 connector or 2 metre PVC cable.
- CA30CB.. PBT M30-cylindrical threaded barrel housing for flush or non-flush installation with 4-pole M12 connector or 2 metre PVC cable.

They can operate in standard I/O mode (SIO), which is the default operation mode. When connected to an IO-Link master, they automatically switch to IO-Link mode and can be operated and easily configured remotely.

Thanks to their IO-Link interface, these devices are much more intelligent and feature many additional configuration options, such as the settable sensing distance and hysteresis, also timer functions of the output. Advanced functionalities such as the Logic function block and the possibility to convert one output into an external input makes the sensor highly flexible in solving decentralized sensing tasks.

2.2. Identification number

Code	Option	Description
C	-	Sensing principle: Capacitive Sensor
A	-	Cylindrical housing with threaded barrel
<input type="checkbox"/>	18	M18 housing
	30	M30 housing
C	-	Plastic housing - PBT
B	-	Bar graph
<input type="checkbox"/>	F	Flush installation
	N	Non-flush installation
<input type="checkbox"/>	08	8 mm sensing distance (for CA18CBF...)
	12	12 mm sensing distance (for CA18CBN...)
	16	16 mm sensing distance (for CA30CBF...)
	25	25 mm sensing distance (for CA30CBN...)
B	-	Selectable functions: NPN, PNP, Push-Pull, External Input (only pin 2), External teach input (only pin 2)
P	-	Selectable: NO or NC
<input type="checkbox"/>	A2	2 metre PVC cable
	M1	M12, 4-pole connector
IO	-	IO-Link version

Additional characters can be used for customized versions.

2.3. Operating mode

IO-Link capacitive sensors are provided with two switching outputs (SO) and can operate in two different modes: SIO mode (standard I/O mode) or IO-Link mode.

2.3.1. SIO mode

When the sensor operates in SIO mode (default), an IO-Link master is not required. The device works as a standard capacitive sensor, and it can be operated via a fieldbus device or a controller (e.g. a PLC) when connected to its PNP, NPN or push-pull digital inputs (standard I/O port). One of the greatest benefits of these capacitive sensors is the possibility to configure them via an IO-Link master and then, once disconnected, they will keep the last parameter and configuration settings. In this way it is possible, for example, to configure the outputs of the sensor individually as a PNP, NPN or push-pull, or to add timer functions such as T-on and T-off delays or logic functions and thereby satisfy several application requirements with the same sensor.

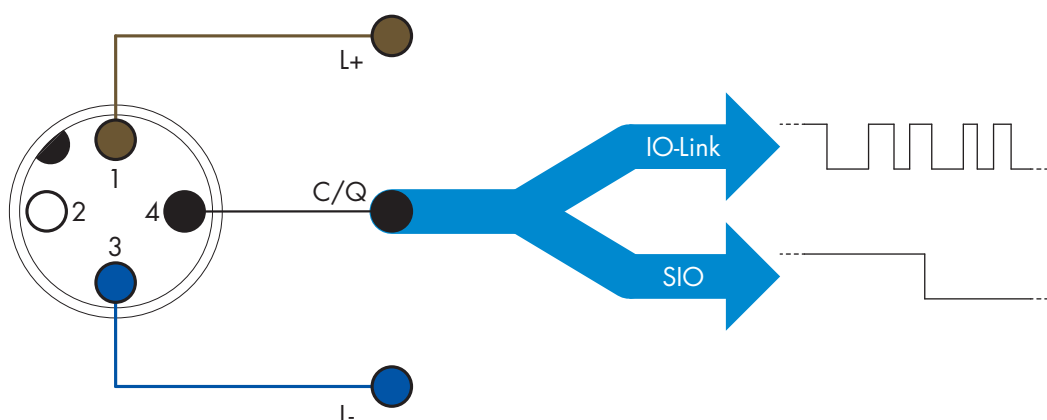
2.3.2. IO-Link mode

IO-Link is a standardized IO technology that is recognized worldwide as an international standard (IEC 61131-9).

It is today considered to be the "USB interface" for sensors and actuators in the industrial automation environment.

When the sensor is connected to one IO-Link port, the IO-Link master sends a wakeup request (wake up pulse) to the sensor, which automatically switches to IO-Link mode: point-to-point bidirectional communication then starts automatically between the master and the sensor.

IO-Link communication requires only standard 3-wire unshielded cable with a maximum length of 20 m.



IO-Link communication takes place with a 24 V pulse modulation, standard UART protocol via the switching and communication cable (combined switching status and data channel C/Q) PIN 4 or black wire.

For instance, an M12 4-pin male connector has:

- Positive power supply: pin 1, brown
- Negative power supply: pin 3, blue
- Digital output 1: pin 4, black
- Digital output 2: pin 2, white

The transmission rate of CA18CB...IO or CA30CB...IO, sensors is 38.4 kBaud (COM2).

Once connected to the IO-Link port, the master has remote access to all the parameters of the sensor and to advanced functionalities, allowing the settings and configuration to be changed during operation, and enabling diagnostic functions, such as temperature warnings, temperature alarms and process data.

Thanks to IO-Link it is possible to see the manufacturer information and part number (Service Data) of the device connected, starting from V1.1. Thanks to the data storage feature it is possible to replace the device and automatically have all the information stored in the old device transferred into the replacement unit.

Access to internal parameters allows the user to see how the sensor is performing, for example by reading the internal temperature.

Event Data allows the user to get diagnostic information such as an error, an alarm, a warning or a communication problem.

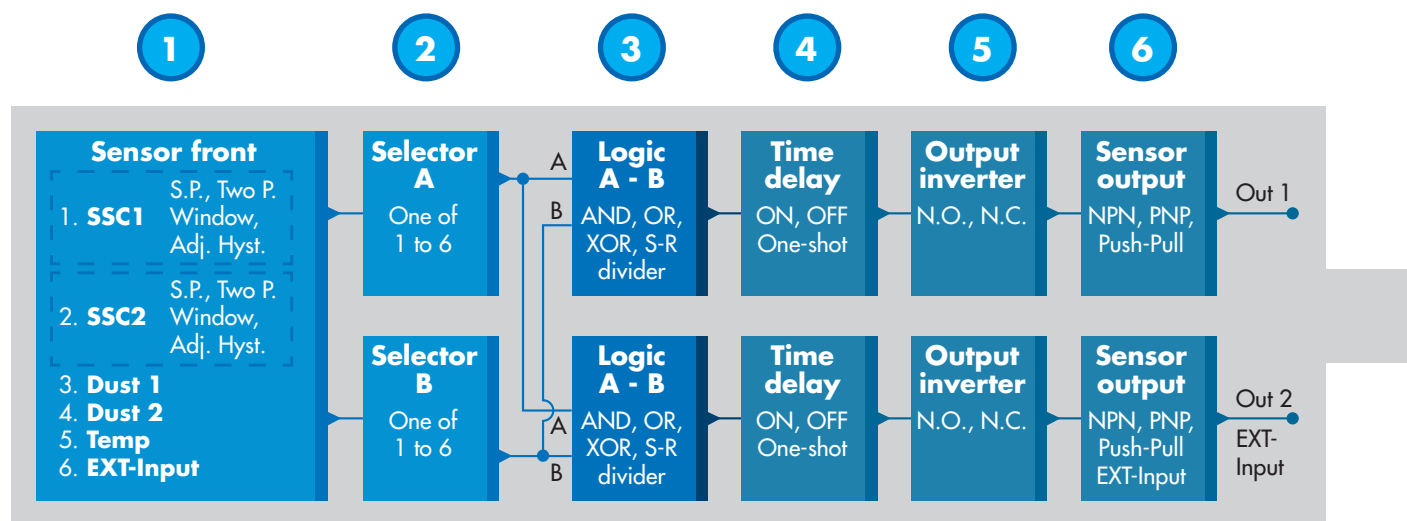
There are two different communication types between the sensor and the master and they are independent of each other:

- Cyclical for process data and value status – this data is exchanged cyclically.
- Acyclical for parameter configuration, identification data, diagnostic information and events (e.g. error messages or warnings) – this data can be exchanged on request.

2.4. Output parameters

The sensor measures five different physical values. These values can be independently adjusted and used as source for the Switching Output 1 or 2; in addition to those an external input can be selected for SO2. After selecting one of these sources, it is possible to configure the output of the sensor with an IO-Link master, following the six steps shown in the Switching Output setup below.

Once the sensor has been disconnected from the master, it will switch to the SIO mode and keep the last configuration setting.



1

2.4.1. Sensor front

When an object, solid or liquid, approaches the face of the sensor, the capacitance of the detecting circuit is influenced and the sensor output changes its status.

2.4.1.1. SSC (Switching Signal Channel)

For presence (or absence of presence) detection of an object in front of the face of the sensor, the following settings are available: SSC1 or SSC2.

The setpoints can be set from 0 to 10.000 units which represent the change of capacitance of the detecting circuit. The higher the value, the closer the target appears to the sensing face of the sensor, also a higher dielectric value of the target will increase the value. E.g. a metal target has a higher dielectric value than a plastic target.

2.4.1.2. Switchpoint mode

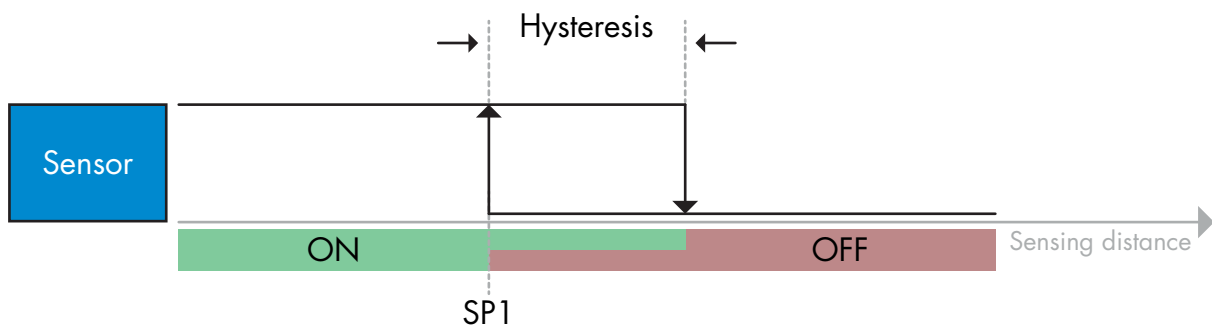
The Switchpoint mode setting can be used to create more advanced output behaviour. The following switchpoint modes can be selected for the switching behaviour of SSC1 and SSC2

Disabled

SSC1 or SSC2 can be disabled individually, but this will also disable the output if it is selected in the input selector (the logic value will always be "0").

Single point mode

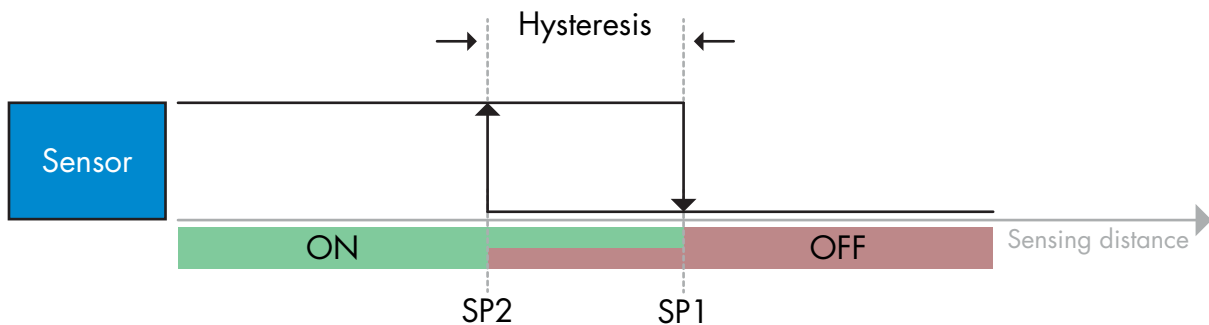
The switching information changes, when the measurement value passes the threshold defined in setpoint SP1, with rising or falling measurement values, taking into consideration the hysteresis.



Example of presence detection - with non-inverted logic

Two point mode

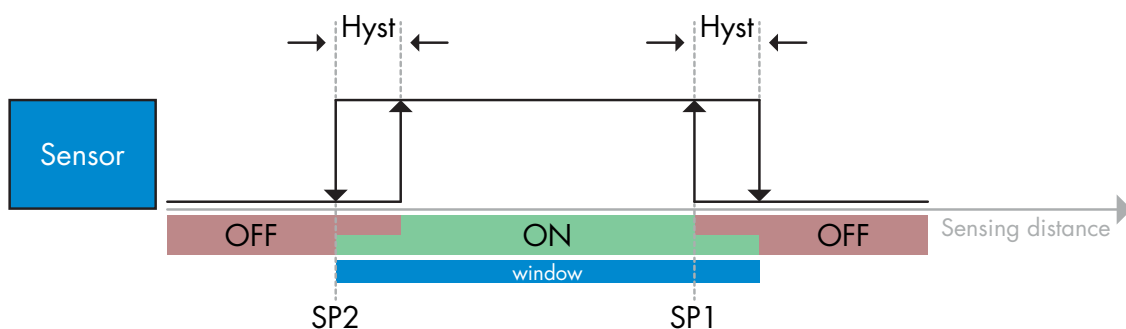
The switching information changes when the measurement value passes the threshold defined in setpoint SP1. This change occurs only with rising measurement values. The switching information also changes when the measurement value passes the threshold defined in setpoint SP2. This change occurs only with falling measurement values. Hysteresis is not considered in this case.



Example of presence detection - with non-inverted logic

Window mode

The switching information changes, when the measurement value passes the thresholds defined in setpoint SP1 and setpoint SP2, with rising or falling measurement values, taking into consideration the hysteresis.



Example of presence detection - with non-inverted logic

2.4.1.3. Hysteresis Settings

In SSC1 and SSC2 - single point mode and in windows mode the hysteresis can be set between 1 and 100 % of the actual switching value. Standard settings depend on the sensing type:

CA18CBF...4%

CA18CBN...15%

CA30CBF...5%

CA30CBN...10%

(SP2 + Hysteresis < SP1) & (SP1 + hysteresis < Sensing range upper limit).

Information

An extended hysteresis is generally used to solve vibration or EMC issues in the application.

2.4.1.4. Dust alarm 1 and Dust alarm 2

The safe limit between when the sensing output is switching and the value at which the sensor can detect safely even with a slightly build up of dust, can be set.

See 2.6.5 Safe limits.

2.4.1.5. Temperature alarm (TA)

The sensor constantly monitors the internal temperature in the front part of the sensor. Using the temperature alarm setting it is possible to get an alarm from the sensor if temperature thresholds are exceeded. See §2.6.4

The temperature alarm has two separate values, one for setting maximum temperature and one for setting minimum temperature.

It is possible to read the temperature of the sensor via the acyclic IO-Link parameter data.

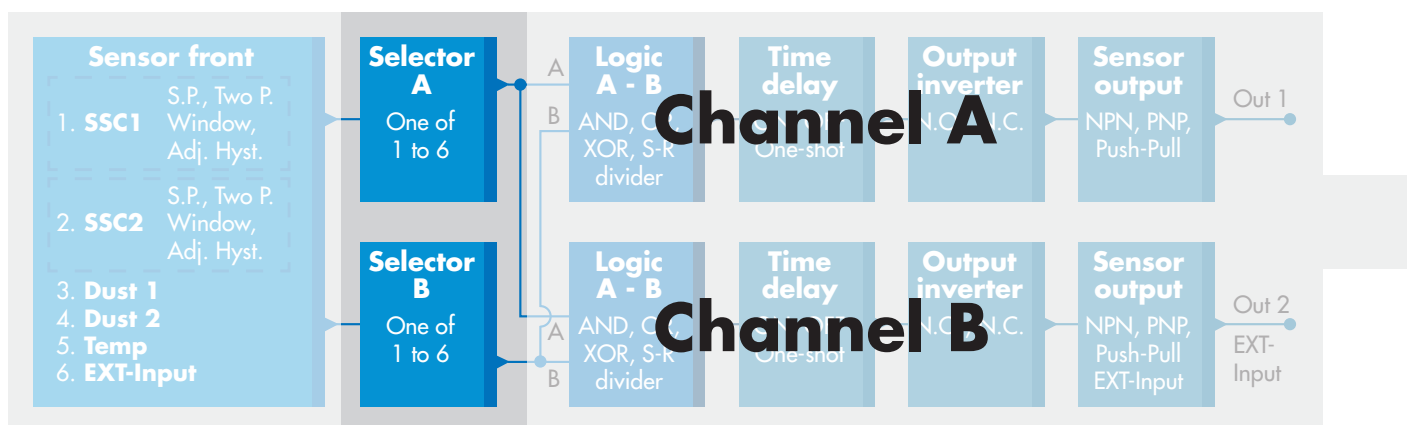
NOTE!

The temperature measured by the sensor will always be higher than the ambient temperature, due to internal heating.

The difference between ambient temperature and internal temperature is influenced by how the sensor is installed in the application. If the sensor is installed in a metal bracket the difference will be lower than if the sensor is mounted in a plastic one.

2.4.1.6. External input

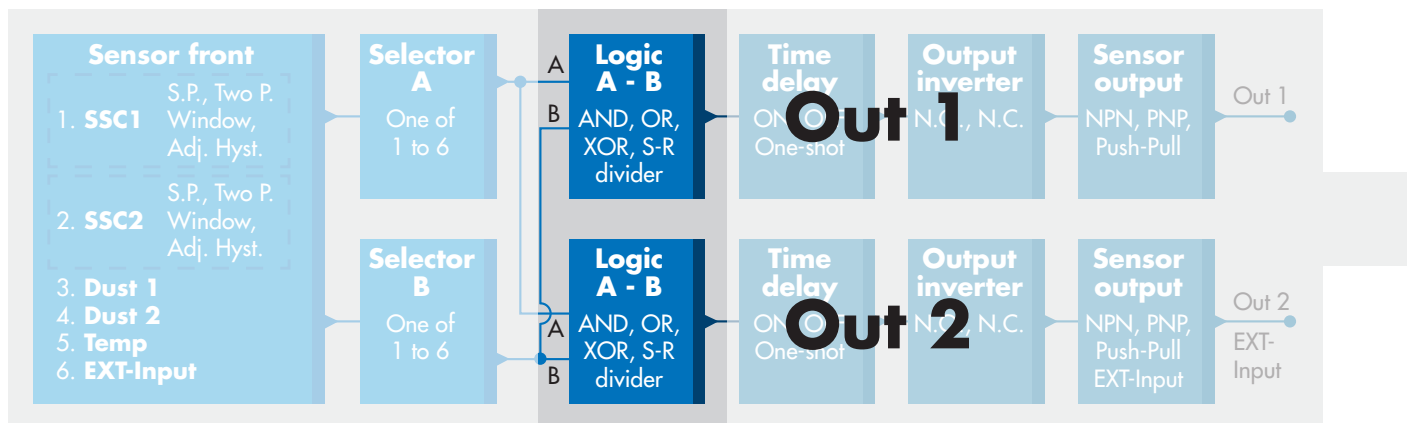
The output 2 (SO2) can be configured as an external input allowing external signals to be fed into the sensor, this can be from a second sensor or from a PLC or directly from machine output



2.4.2. Input selector

This function block allows the user to select any of the signals from the “sensor front” to the Channel A or B.

Channels A and B: can select from SSC1, SSC2, Dust1, Dust2, Temperature alarm and external input.

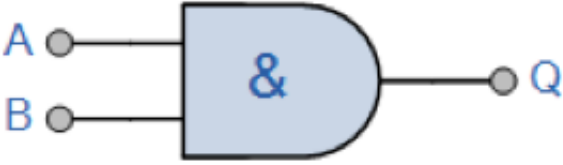


2.4.3. Logic function block

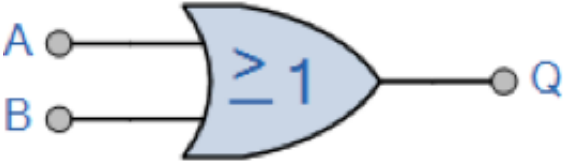
In the logic function block a logic function can be added directly to the selected signals from the input selector without using a PLC – making decentralised decisions possible.

The logic functions available are: AND, OR, XOR, SR-FF.

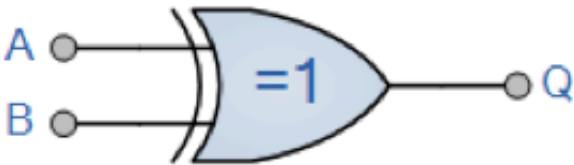
AND function

Symbol	Truth table		
 <p>2-input AND Gate</p>	A	B	Q
	0	0	0
	0	1	0
	1	0	0
	1	1	1
Boolean Expression Q = A.B	Read as A AND B gives Q		

OR function

Symbol	Truth table		
 <p>2-input OR Gate</p>	A	B	Q
	0	0	0
	0	1	1
	1	0	1
	1	1	1
Boolean Expression Q = A + B	Read as A OR B gives Q		

XOR function

Symbol	Truth table		
 <p>2-input XOR Gate</p>	A	B	Q
	0	0	0
	0	1	1
	1	0	1
	1	1	0
Boolean Expression Q = A ⊕ B	A OR B but NOT BOTH gives Q		

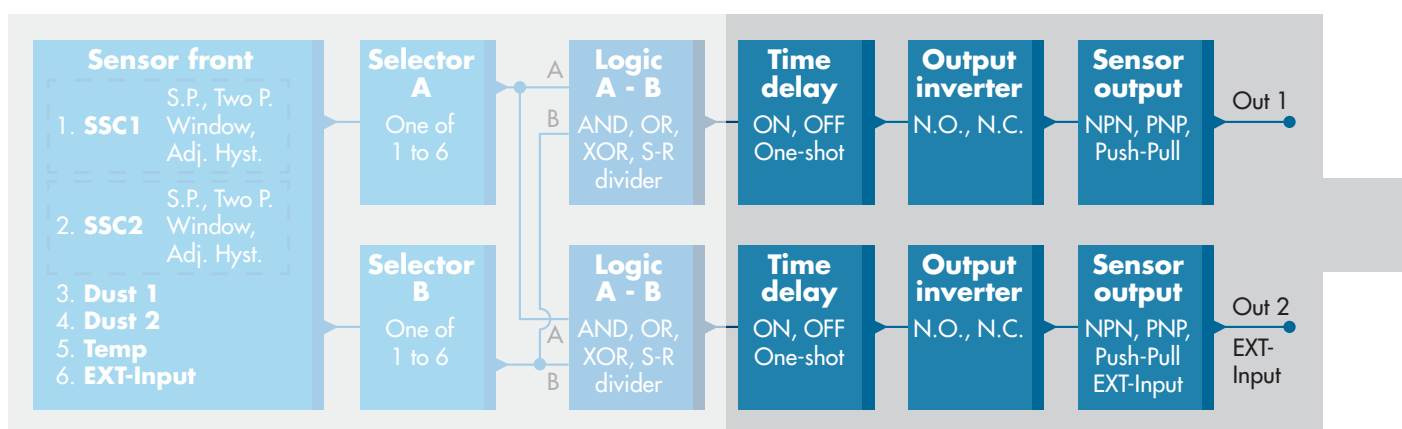
"Gated SR-FF" function

The function is designed (to: e.g. function) as a filling or emptying function using only two interconnected sensors

Symbol	Truth table		
	A	B	Q
	0	0	0
	0	1	X
	1	0	X
	1	1	1

X – no changes to the output.

4



2.4.4. Timer (Can be set individually for Out1 and Out2)

The Timer allows the user to introduce different timer functions by editing the 3 timer parameters:

- Timer mode
- Timer scale
- Timer value

2.4.4.1. Timer mode

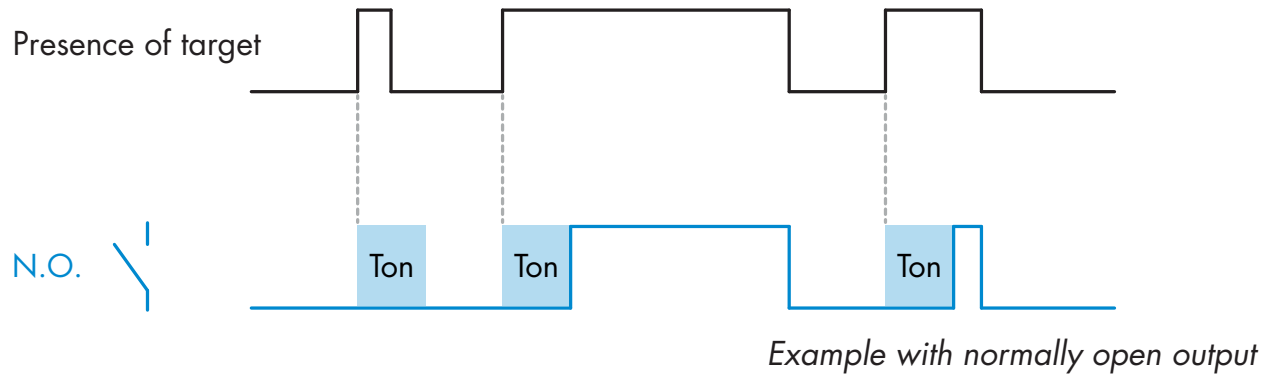
This selects which type of timer function is introduced on the Switching Output. Any one of the following is possible:

2.4.4.1.1. Disabled

This option disables the timer function no matter how the timer scale and timer delay is set up.

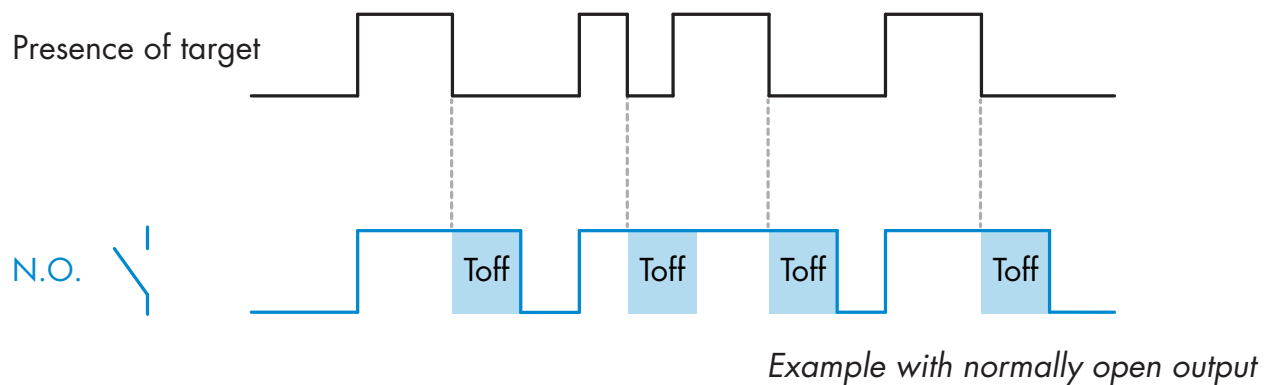
2.4.4.1.2. Turn On delay (T-on)

The activation of the switching output is generated after the actual sensor actuation as shown in the figure below.



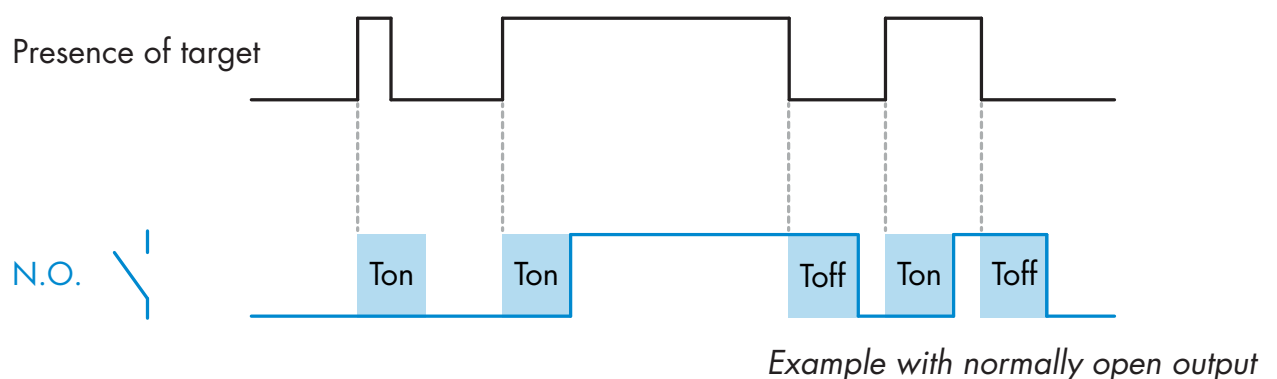
2.4.4.1.3. Turn Off delay (T-off)

The deactivation of the switching output is delayed until after to the time of removal of the target in the front of the sensor, as like shown in the figure below.



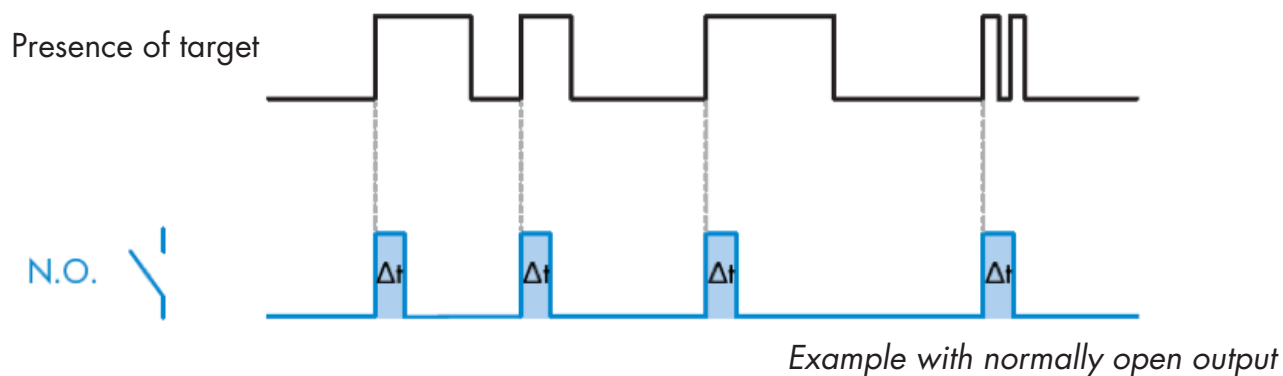
2.4.4.1.4. Turn ON and Turn Off delay (T-on and T-off)

When selected, both the T-on and the T-off delays are applied to the generation of the switching output.



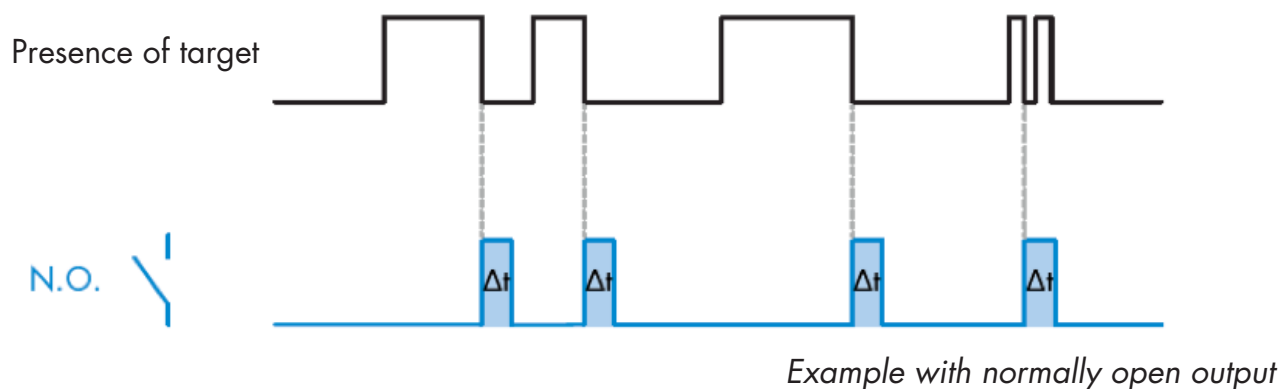
2.4.4.1.5. One shot leading edge

Each time a target is detected in front of the sensor the switching output generates a pulse of constant length on the leading edge of the detection. See figure below.



2.4.4.1.6. One shot trailing edge

Similar in function to the one shot leading edge mode, but in this mode the switching output is changed on the trailing edge of the activation as shown in the figure below.



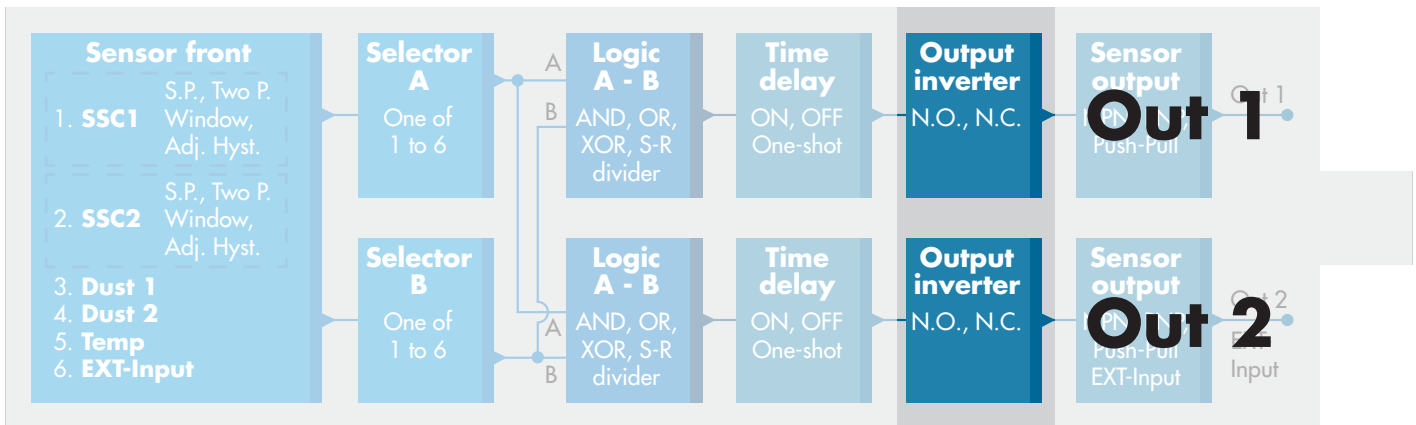
2.4.4.1.7. Timer scale

The parameter defines if the delay specified in the Timer delay should be in milliseconds, seconds or minutes

2.4.4.1.8. Timer Value

The parameter defines the actual duration of the delay. The delay can be set to any integer value between 1 and 32 767

5



2.4.5. Output Inverter

This function allows the user to invert the operation of the switching output between Normally Open and Normally Closed.

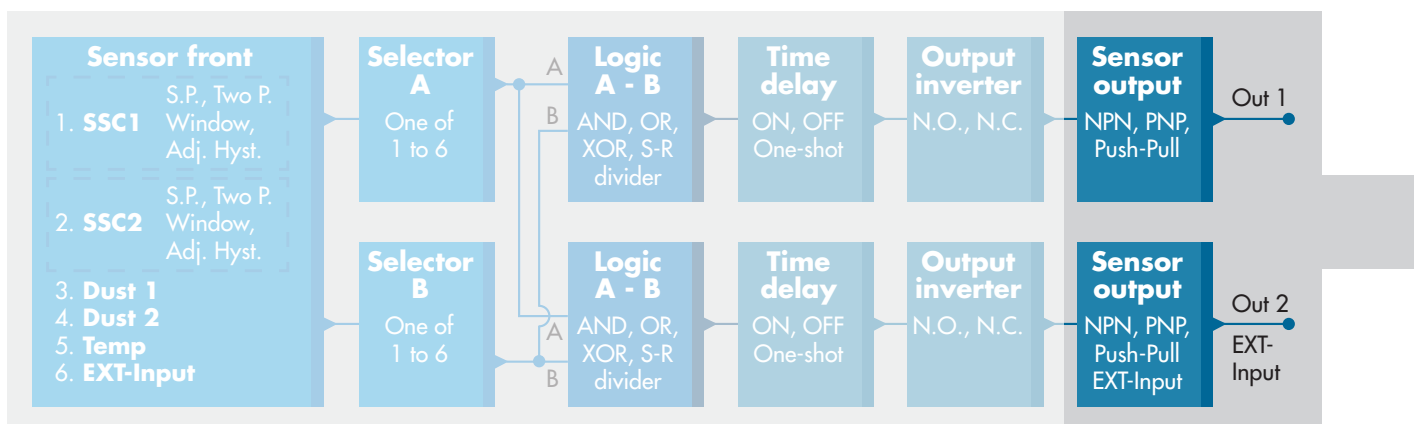
RECOMMENDED FUNCTION

The recommended function is found in the parameters under 64 (0x40) sub index 8 (0x08) for SO1 and 65 (0x41) sub index 8 (0x08) for SO2. It has no negative influence on the Logic functions or the timer functions of the sensor as it is added after those functions.

CAUTION!

The Switching logic function found under 61 (0x3D) sub index 1 (0x01) for SSC1 and 63 (0x3F) sub index 1 (0x01) for SSC2 are not recommended for use as they will have a negative influence on the logic or timer functions. Using this function will turn an ON delay into an Off delay if it is added for the SSC1 and SSC2. It is only for the SO1 and SO2.

6



2.4.6. Output stage mode

In this function block the user can select if the switching outputs should operate as:

SO1: Disabled, NPN, PNP or Push-Pull configuration.

SO2: Disabled, NPN, PNP, Push-Pull, External input (Active high/Pull-down), External input (Active low/pull up) or External Teach input.

2.5. Teach procedure

2.5.1. External Teach (Teach-by-wire)

NB! This function works in single point mode and only for SP1 in SSC1.

The Teach-by-wire must be set up first using an IO-link master:

- Select: "2=Teach by wire" in the Selection of local/remote adjustment parameters 68 (0x44).
- Select: "1=Single Point Mode", to verify that it is selected in "SSC1 Configuration" 61(0x3D), "Mode 1" 2(0x02), (this value should already be set as default).
- Select: "6=Teach-In" (Active High) in Channel 2 (SO2) 65 (0x41) sub index 1 (0x01).

Teach-by-wire procedure.

- Place the target in front of the sensor and connect the teach-by-wire input (pin 2 white wire) to V+ (pin 1 brown wire). The yellow LED will Flash with 1Hz (ON 100ms and OFF 900 ms).
- Within 3-6 seconds the wire must be disconnected, and the yellow led will be flashing with 1Hz (ON 900 ms and OFF 100 ms).
- After a successful Teach the yellow LED will flash with 2 Hz (ON 250 ms and OFF 250 ms).

NB! If the Teach procedure is to be cancelled do not remove the wire after 3 to 6 seconds but keep the connection for 12 secs until the yellow LED is flashing with 10 Hz (On 50 ms and off 50 ms).

2.5.2. Teach from IO-Link Master

- To enable Teach from the IO-Link master first disable the trimmer input:
Select: "0=Disabled" in the Selection of local/remote adjustment parameters 68 (0x44).
- The individual teach commands can be written to index 2.

2.5.2.1. Single point mode procedure

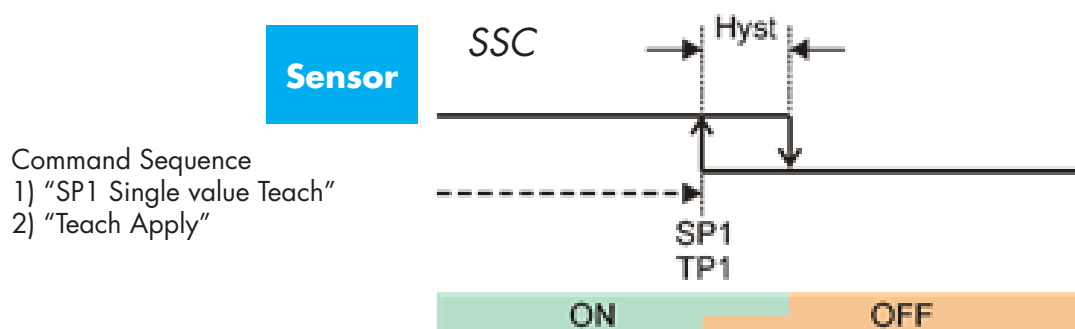
Select the Switching channel to be taught

- Select: 1=SSC1 or 2=SSC2 in the "Teach-in Select" 58(0x3A) or 255 = All SSC.
- Change the Hysteresis if requested for SSC1 or SSC2.
 - "SSC1 configuration" 61(0x3D) "Hysteresis" 3(0x03).
 - "SSC2 configuration" 62(0x3E) "Hysteresis" 3(0x03).

NB! It is not recommended to change the hysteresis below the values stated in the SSC parameter list.

1) Single value teach command sequence:

- #65"SP1 Single value teach"
- #64"Teach Apply" (optional command)

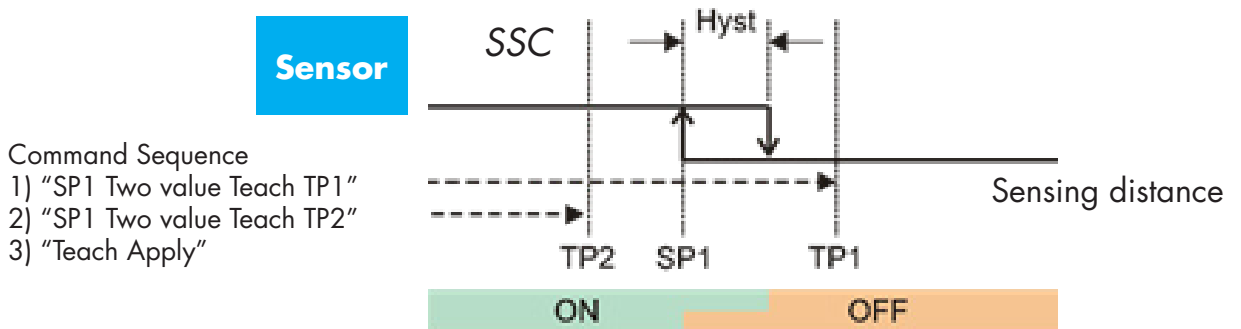


2) Dynamic teach command sequence

- #71 "SP1 dynamic teach start"
- #72 "SP1 dynamic teach stop"
- #64 "Teach apply" (optional command)

3) Two value teach command sequence

- #67 "SP1 two value teach TP1"
- #68 "SP1 two value teach TP2"
- #64 "Teach apply" (optional command)

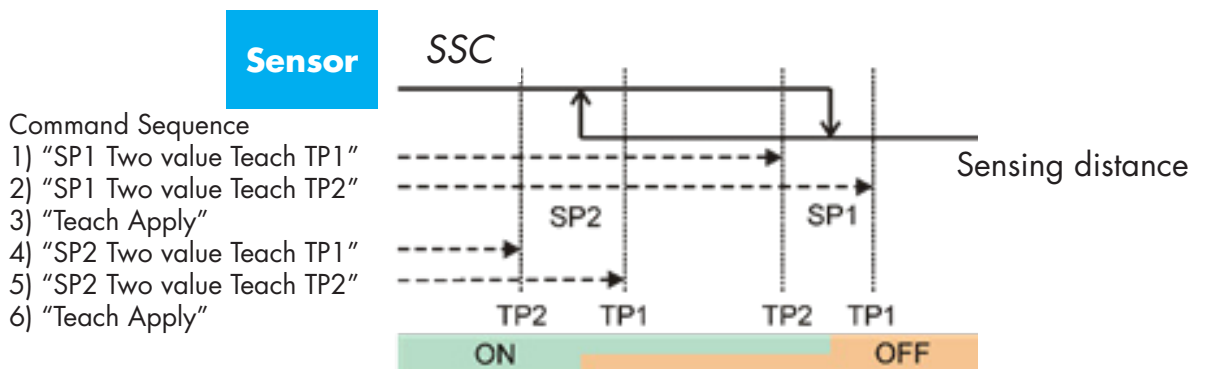


2.5.2.2. Two point mode procedure

1) Two value teach command sequence:

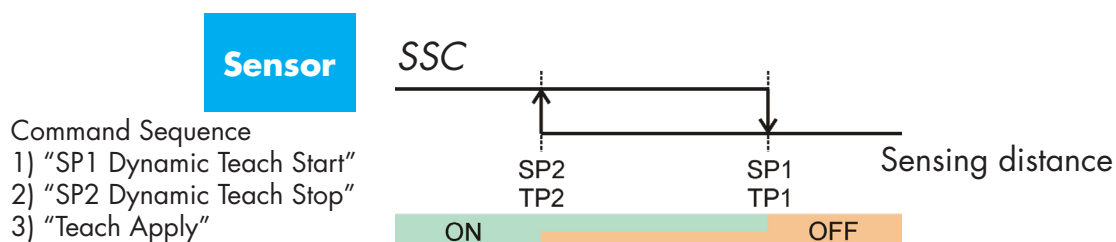
- #67 "SP1 two value teach TP1"
- #68 "SP1 two value teach TP2"
- #64 "Teach apply" (optional command)

- #69 "SP2 two value teach TP1"
- #70 "SP2 two value teach TP2"
- #64 "Teach apply" (optional command)



2) Dynamic teach command sequence:

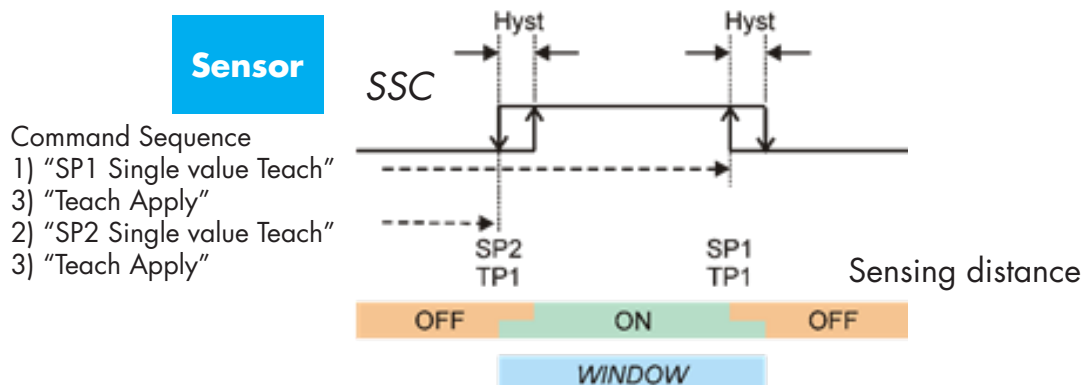
- #71 "SP1 dynamic teach start"
- #72 "SP1 dynamic teach stop"
- #73 "SP2 dynamic teach start"
- #74 "SP2 dynamic teach stop"
- #64 "Teach apply" (optional command)



2.5.2.3. Windows mode procedure

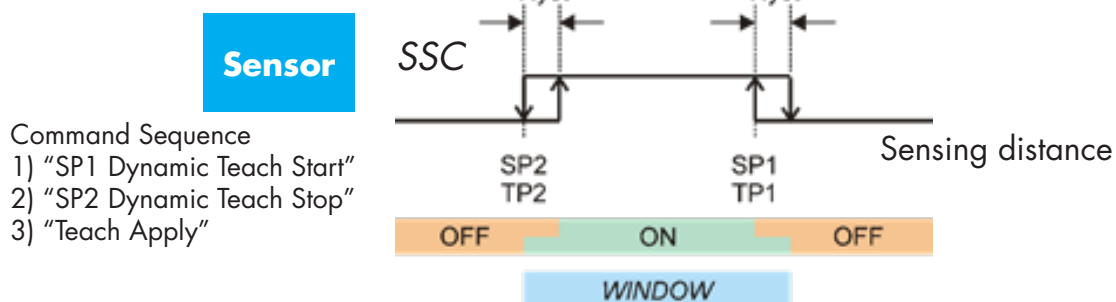
1) Single value teach command sequence:

- #65 "SP1 Single value teach"
- #66 "SP2 Single value teach"
- #64 "Teach apply" (optional command)



2) Dynamic teach command sequence:

- #71 "SP1 dynamic teach start"
- #72 "SP1 dynamic teach stop"
- #73 "SP2 dynamic teach start"
- #74 "SP2 dynamic teach stop"
- #64 "Teach apply" (optional command)



2.6. Sensor Specific adjustable parameters

Besides the parameters directly related to output configuration, the sensor also have various internal parameters useful for setup and diagnostics.

2.6.1. Selection of local or remote adjustment

It is possible to select how to set the sensing distance by either selecting the Trimmer or Teach-by-wire using the external input of the sensor, or to disable the potentiometer to make the sensor tamperproof.

2.6.2. Process data and variables

When the sensor is operated in IO-Link mode, the user has access to the cyclic Process Data Variable. By default the process data shows the following parameters as active: 16 bit Analogue value, Switching Output1 (SO1) and Switching Output 2 (SO2).

The following parameters are set as Inactive: SSC1, SSC2, DA1, DA2, TA, SC.

However by changing the Process Data Configuration parameter, the user can decide to also enable the status of the inactive parameters. This way several states can be observed in the sensor at the same time.

Byte 0	31	30	29	28	27	26	25	24
	MSB							
Byte 1	23	22	21	20	19	18	17	16
								LSB
Byte 2	15	14	13	12	11	10	9	8
Byte 3	7	6	5	4	3	2	1	0
	SC	TA1	DA2	DA1	SO2	SO1	SSC.2	SSC.1

4 Bytes

Analogue value 16 ... 31 (16 BIT)

Scale 8 ... 15 (8 BIT)

2.6.3. Sensor application setting

The sensor has 3 pre-settings depending on the application:

- Full scale range, the setpoints of the sensor can be adjusted at full scale and the sensing speed is set to maximum.
- Liquid level: this is to be used for slow moving objects with a high dielectric value such as in the detection of water-based liquids. When this function is selected the teach and potentiometer settings are optimized to high range scaling.
In this mode the "Filter Scaler" is set to 100
- Plastic Pellets: this is to be used for slow moving objects with a low dielectric value such as in the detection of plastic pellets. When this function is selected the teach and potentiometer settings are optimized to low range scaling.
In this mode the "Filter Scaler" is set to 100.

2.6.4. Temperature alarm threshold

The temperature at which the temperature alarm will activate can be changed for the maximum and minimum temperature. This means that the sensor will give an alarm if the maximum or minimum temperature is exceeded. The temperatures can be set between -50 °C to +150 °C. The default factory settings are, Low threshold -30 °C and high threshold +120 °C.

2.6.5. Safe limits

The sensor has a built-in safety margin that helps to adjust the sensing up to the set points with an additional safety margin. The factory settings are twice the standard hysteresis of the sensor e.g. for a CA18CB/CA30CB... sensor with a hysteresis of 15% the safety margin is set to 30%. This value can be set individually from 0% to 100% for SSC1 or SSC2.

2.6.6. Event configuration

Temperature events transmitted over the IO-Link interface are turned off by default in the sensor. If the user wants to get information about critical temperatures detected in the sensor application, this parameter allows the following 3 events to be enabled or disabled:

- Temperature fault event: the sensor detects temperature outside the specified operating range.
- Temperature over-run: the sensor detects temperatures higher than those set in the Temperature Alarm threshold.
- Temperature under-run: the sensor detects temperatures lower than those set in the Temperature Alarm threshold.
- Short-circuit: the sensor detects if the sensor output is short-circuited.
- Maintenance: the sensor detects if maintenance is needed, e.g. the sensor needs cleaning.

2.6.7. Quality of run QoR

The quality of run value informs the user about the actual sensing performance compared to the set-points of the sensor: the higher the value the better quality of detection.

The value for QoR can vary from 0 ... 255 %.

The QoR value is updated for every detection cycle.

Examples of QoR is listed in the table below.

Quality of run values	Definitions
> 150%	Excellent sensing conditions, the sensor is not expected to have any maintenance issues.
100%	Good sensing conditions, the sensor performs as well as when the set-points were taught or set-up manually with a safety margin of twice the standard hysteresis. <ul style="list-style-type: none"> • Long term reliability is expected for all environmental conditions. • Maintenance is not expected to be required.
50%	Average sensing conditions <ul style="list-style-type: none"> • Short-term reliability and maintenance is expected due to environmental conditions • Reliable detection can be expected with restricted environmental influence.
0%	Poor to unreliable working sensing conditions are expected.

2.6.8. Quality of Teach QoT

The quality of Teach value lets the user know how well the actually the teach procedure was carried out, in terms of the margin between the actual setpoints and the environmental influences on the sensor. The value for QoT can vary from 0 ... 255 %.

The QoT value is updated after every Teach procedure.

Examples of QoT are listed in the table below.

Quality of teach value	Definitions
> 150%	Excellent teach conditions, the sensor is not expected to have any maintenance issues.
100%	Good teach conditions, the sensor has been taught with a safety margin of twice the standard hysteresis. <ul style="list-style-type: none"> • Long term reliability is expected for all environmental conditions. • Maintenance is not expected to be required.
50%	Average teach conditions. <ul style="list-style-type: none"> • Short-term reliability and maintenance is expected due to environmental conditions. • Reliable detection can be expected with restricted environmental influence.
0%	Poor teach result. <ul style="list-style-type: none"> • Unreliable sensing conditions are expected. (e.g. too small measuring margin between the target and the surroundings).

2.6.9. Filter Scaler

This function can increase the immunity towards unstable targets and electromagnetic disturbances: Its value can be set from 1 to 255, the default factory setting is 1.










A filter setting of 1 gives the maximum sensing frequency and a setting of 255 gives the minimum sensing frequency.

2.6.10. LED indication

This parameter allows the user to select which LED indication function works best for the application.

The LED bar graph provides a visual confirmation that the switch point is set with a sufficient safety margin to ensure proper activation and deactivation as required by the application.

The central, yellow LED shows the ON/OFF state of the sensor, while the green LEDs show the stability of the ON/OFF state. The farther the lit green LED is from the yellow LED, the more stable the signal state is. Ideally the OFF state and the ON state should be equally stable, shown by a symmetrical pattern of lit green LEDs.

LED indication inactive	Disables all LEDs for situations where the LED light might disturb the application 
LED indication, centered LED bar graph	A row of green LEDs light up to indicate the stability of the state starting from the central, yellow LED moving outward. The number of lights indicate level of stability. This is the default setting. Very stable ON state:  Very stable OFF state:  Barely stable OFF state: 
LED indication, single LED bar graph	One green LED will light up at a time. The farther from the yellow LED the green LED lights up, the more stable the state is. Very stable ON state:  Very stable OFF state: 
LED indication, full LED bar graph	1-2 LEDs to the far left means very stable off state. Very unstable OFF state is shown by all 5 green LEDs on the left being lit. A slightly unstable ON state has 2 green LEDs just to the right of the yellow LED as well as all the LEDs on the left. Very stable ON state:  Very stable OFF state: 
LED indication, find my sensor	The entire LED bar flashes: 
IO-Link connection	When the sensor is in IO-Link mode, LED to the far right will flash. The flash pattern depends on the base state of the rightmost LED: On or Off Stable ON + IO-Link: LED flashes 90% on, 10% off Stable OFF + IO-Link: LED flashes 10% on, 90% off

2.7. Diagnostic parameters

2.7.1. Operating hours

The sensor has a built-in counter that logs every hour in which the sensor has been operational. The maximum hours that can be recorded are 2 147 483 647 hours: this value can be read from an IO-Link master.

2.7.2. Number of power cycles [cycles]

The sensor has a built-in counter that logs every time the sensor has been powered-up. The value is saved every hour. The maximum numbers of power cycles that can be recorded is 2 147 483 647. This value can be read from an IO-Link master.

2.7.3. Maximum temperature – all time high [°C]

The sensor has a built-in function that logs the highest temperature that the sensor has been exposed to during its full operational lifetime. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.4. Minimum temperature – all time low [°C]

The sensor has a built-in function that logs the lowest temperature that the sensor has been exposed to during its full operational lifetime. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.5. Maximum temperature since last power-up [°C]

From this parameter the user can get information about what the maximum registered temperature has been since start-up. This value is not saved in the sensor.

2.7.6. Minimum temperature since last power-up [°C]

From this parameter the user can get information about what the minimum registered temperature has been since start-up. This value is not saved in the sensor.

2.7.7. Current temperature [°C]

From this parameter the user can get information about the current temperature of the sensor.

2.7.8. Detection counter [cycles]

The sensor logs every time the SSC1 changes state. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.9. Minutes above maximum temperature [min]

The sensor logs how many minutes the sensor has been operational above the maximum temperature. The maximum number of minutes to be recorded is 2 147 483 647. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.10. Minutes below minimum temperature [min]

The sensor logs how many minutes the sensor has been operational below the minimum temperature. The maximum number of minutes to be recorded is 2 147 483 647. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.11. Maintenance event counter

The sensor logs how many times the event counter has asked for maintenance. The maximum number of events to be recorded is 2 147 483 647. This parameter is updated once per hour and can be read from an IO-Link master.

2.7.12. Download counter

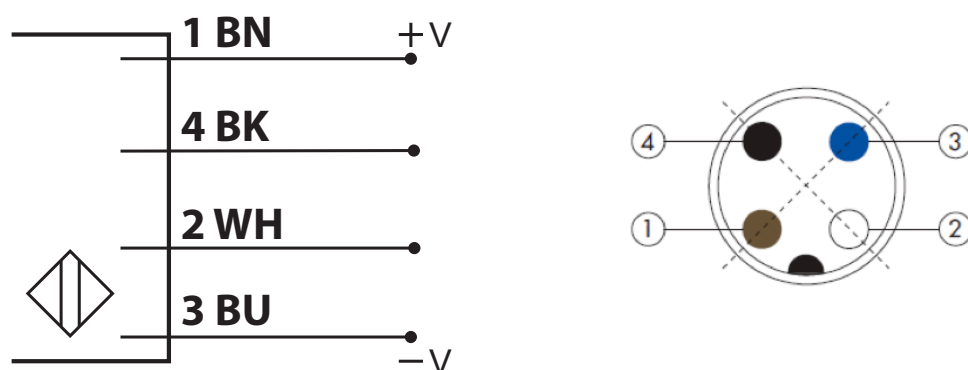
The sensor logs how many times its parameters have been changed. The maximum number of changes to be recorded is 65 536. This parameter is updated once per hour and can be read from an IO-Link master.

NOTE!

The temperature measured by the sensor will always be higher than the ambient temperature, due to internal heating.

The difference between ambient temperature and internal temperature is influenced by how the sensor is installed in the application. If the sensor is installed in a metal bracket the difference will be lower than if the sensor is mounted in a plastic one.

3. Wiring diagrams



PIN	Color	Signal	Description
1	Brown	10 to 40 VDC	Sensor Supply
2	White	Load	Output 2 / SIO mode / External input / External Teach
3	Blue	GND	Ground
4	Black	Load	IO-Link /Output 1 /SIO mode

4. Commissioning

50 ms after the power supply is switched on, the sensor will be operational.

If it is connected to an IO-link master, no additional setting is needed and the IO-Link communication will start automatically after the IO-Link master sends a wake-up request to the sensor.

5. Operation

5.1. User interface of CA18CB...IO and CA30CB... IO

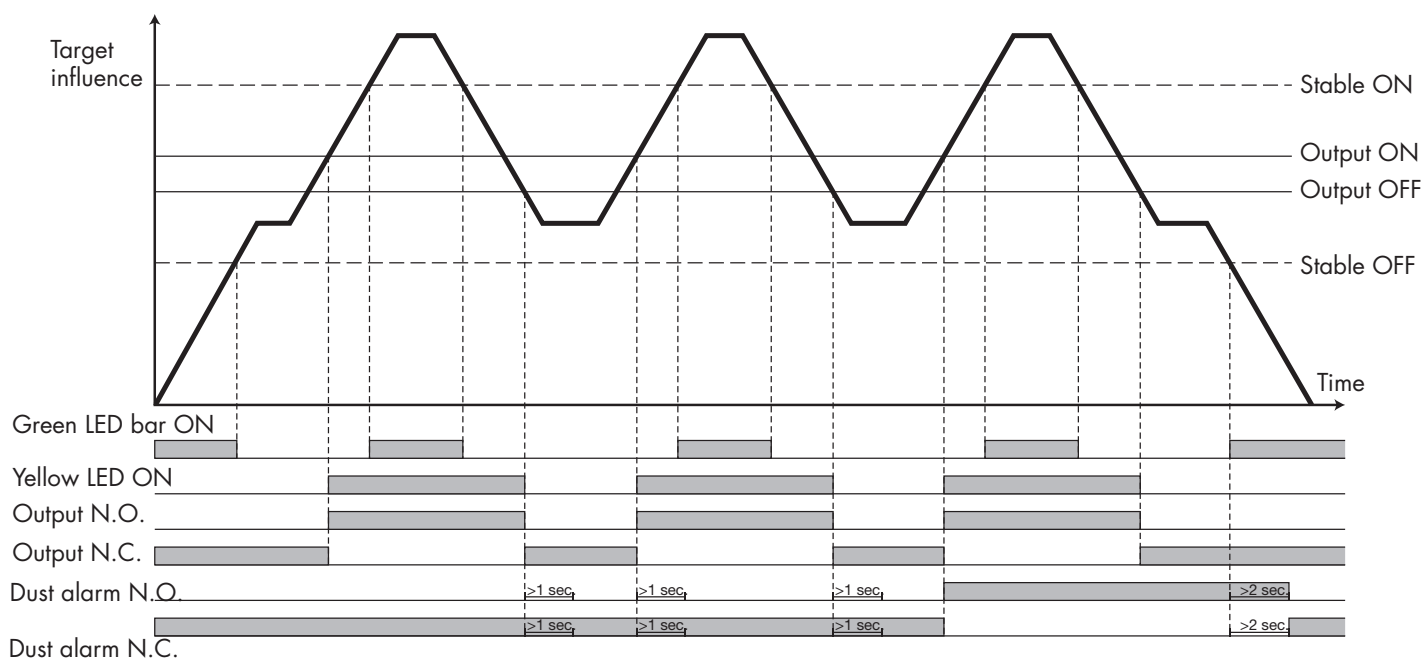
CA18CB...IO and CA30CB...IO sensors are equipped with a yellow LED and a green LED bar. Please also refer to section 2.6.10.

SIO and IO-Link mode			
Yellow LED	Detection	LED bar*	IO-Link setting**
ON	ON (Stable)		LED indication full LEDs
			LED indication centered LEDs
			LED indication single LED
OFF	OFF (Stable)		LED indication full LEDs
			LED indication centered LEDs
			LED indication single LED
ON	ON (Barely stable)		LED indication full LEDs
			LED indication centered LEDs
			LED indication single LED
OFF	OFF (Barely stable)		LED indication full LEDs
			LED indication centered LEDs
			LED indication single LED
Flashing 10 Hz 50% dutycycle	-		Output shortcircuit
Flashing (0,5 ... 20 Hz)	-		Timer indication
SIO mode only			
Flashing 1 Hz ON 100 ms OFF 900 ms	-		Teach activated (single point only)
Flashing 1 Hz ON 900 ms OFF 100 ms	-		Teach window (3-6 sec)
Flashing 10 Hz ON 50 ms Off 50 ms	-		Teach Time out (12 sec)
Flashing 2 Hz ON 250 ms Off 250 ms	-		Teach Successful
IO-Link mode only			
-	Flashing 1 Hz ON 900 ms, OFF 100 ms		Sensor is in IO-Link mode and stable ON
-	Flashing 1 Hz ON 100 ms, OFF 900 ms		Sensor is in IO-Link mode and stable OFF

* LED bar options selectable via IO-Link

** Option that disables all LEDs also available

5.2. Operation diagram

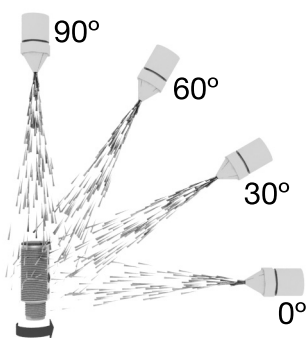


Operation of a sensor with default factory settings

Power supply	ON	
Target (Object)	Present	
Break output (N.C.)	ON	
Make output (N.O.)	ON	

5.3. Environmental testing

The sensor has undergone the IP69K test according to DIN 40050-9 for high-pressure, high-temperature wash-down applications. The sensor must not only be dust tight (IP6X), but also able to withstand high-pressure and steam cleaning. The sensor is exposed to high pressure water from a spray nozzle that is fed with 80°C water at 8 000– 10 000 kPa (80–100bar) and a flow rate of 14–16L/min. The nozzle is held 100 –150 mm from the sensor at angles of 0°, 30°, 60° and 90° for 30s each. The tested device sits on a turntable that rotates with a speed of 5 times per minute. The sensor must not suffer any damaging effects in appearance or function from the high pressure wash-down.



6. IO-Link file and factory setting

6.1. IO-Link file of an IO-Link device

All features, device parameters and setting values of the sensor are collected in a file called I/O Device Description (IODD file). The IODD file is needed in order to establish communication between the IO-Link master and the sensor. Every supplier of an IO-Link device has to supply this file and make it available for download on their web site. The file is compressed, so it is important to de-compress it. The IODD file includes:

- Process and diagnostic data
- Parameters description with the name, the allowed range, type of data and address (index and sub-index)
- Communication properties, including the minimum cycle time of the device
- Device identity, article number, picture of the device and logo of the manufacturer

An IODD file is available on IODD Finder as well as the Carlo Gavazzi Website:
<http://gavazziautomation.com>

6.2. Factory settings

The Default factory settings are listed in appendix 7 under default values.

7. Appendix

7.1. Acronyms

DA	Dust Alarm
IntegerT	Signed Integer
OctetStringT	Array of Octets
PDV	Process Data Variable
R/W	Read and Write
RO	Read Only
SO	Switching Output
SP	Set point
SSC	Switching Signal Channel
StringT	String of ASCII characters
TA	Temperature Alarm
UIntegerT	Unsigned Integer
WO	Write Only

7.2. IO-Link Device Parameters for CA18CB.. and CA30CB..

7.2.1. Device parameters

Parameter Name	Index Dec (Hex)	Access	Default value	Data range	Data Type	Length
Vendor Name	16 (0x10)	RO	Carlo Gavazzi	-	StringT	20 Byte
Vendor Text	17 (0x11)	RO	www.gavazziautomation.com	-	StringT	26 Byte
Product Name	18 (0x12)	RO	(Sensor name) e.g. CA30CBN258PA2IO	-	StringT	20 Byte
Product ID	19 (0x13)	RO	(EAN code of product) e.g. 5709870394046	-	StringT	13 Byte
Product Text	20 (0x14)	RO	Capacitive Proximity Sensor	-	StringT	30 Byte
Serial Number	21 (0x15)	RO	(Unique serial number) e.g. LR24101830834	-	StringT	13 Byte
Hardware Revision	22 (0x16)	RO	(Hardware revision) e.g. v01.00	-	StringT	6 Byte
Firmware Revision	23 (0x17)	RO	(Software revision) e.g. v01.00	-	StringT	6 Byte
Application Specific Tag	24 (0x18)	RW	***	Any string up to 32 characters	StringT	max 32 Byte
Function Tag	25 (0x19)	RW	***	Any string up to 32 characters	StringT	max 32 Byte
Location Tag	26 (0x1A)	RW	***	Any string up to 32 characters	StringT	max 32 Byte
Error Count	32 (0x20)	RO	0	0..65 535	IntegerT	16 Bit
Device Status	36 (0x24)	RO	0 = Device is operating properly	0 = Device is operating properly 1 = Maintenance required 2 = Out-of-specification 3 = Functional-Check 4 = Failure	UIntegerT	8 Bit
Detailed Device Status	37 (0x25)		-	-		3 Byte
Temperature fault	-	RO	-	-	OctetStringT	3 Byte
Temperature over-run	-	RO	-	-	OctetStringT	3 Byte
Temperature under-run	-	RO	-	-	OctetStringT	3 Byte
Short-circuit	-	RO	-	-	OctetStringT	3 Byte
Maintenance Required	-	RO	-	-	OctetStringT	3 Byte
Process-DataInput	40 (0x28)	RO	-	-	IntegerT	32 bit

7.2.2. SSC parameters

Parameter Name	Index Dec (Hex)	Access	Default value	Data range	Data Type	Length
Teach-In Select	58 (0x3A)	RW	1 = Switching Signal Channel 1	0 = Default channel 1 = Switching Signal Channel 1 2 = Switching Signal Channel 2 255 = All SSC	UIntegerT	8 bit
Teach-In Result	59 (0x3B)	-	-	-	RecordT	8 bit
Teach-in State	1 (0x01)	RO	0 = Idle	0 = Idle 1 = Success 4 = Wait for command 5 = Busy 7 = Error	-	-
Flag SP1 TP1 TeachPoint 1 of Set point 1	2 (0x02)	RO	0 = Not OK	0 = Not OK 1 = OK	-	-
Flag SP1 TP2 TeachPoint 2 of Set point 1	3 (0x03)	RO	0 = Not OK	0 = Not OK 1 = OK	-	-
Flag SP2 TP1 TeachPoint 1 of Set point 2	4 (0x04)	RO	0 = Not OK	0 = Not OK 1 = OK	-	-
Flag SP2 TP2 TeachPoint 2 of Set point 2	5 (0x05)	RO	0 = Not OK	0 = Not OK 1 = OK	-	-
SSC1 Parameter (Switching Signal Channel)	60 (0x3C)		-	-	-	-
Set point 1 (SP1)	1 (0x01)	R/W	1 000	0 ... 10 000	IntegerT	16 bit
Set point 2 (SP2)	2 (0x02)	R/W	10 000	0 ... 10 000	IntegerT	16 bit
SSC1 Configuration (Switching Signal Channel)	61 (0x3D)	-	-	-	-	-
Switching Logic 1	1 (0x01)	R/W	0 = High active	0 = High active 1 = Low active	UIntegerT	8 bit
Mode 1	2 (0x02)	R/W	1 = Single Point Mode	0 = Deactivated 1 = Single Point Mode 2 = Window Mode 3 = Two Point Mode	UIntegerT	8 bit
Hysteresis 1	3 (0x03)	R/W	CA18CBF 4% CA18CBN 15% CA30CBF 5% CA30CBN 10%	1 ... 100	UIntegerT	16 bit
SSC2 Parameter	62 (0x3E)		-	-	-	-
Set point 1 (SP1)	1 (0x01)	R/W	1 000	0 ... 10 000	IntegerT	16 bit
Set point 2 (SP2)	2 (0x02)	R/W	10 000	0 ... 10 000	IntegerT	16 bit
SSC2 Configuration	63 (0x3F)				UIntegerT	8 bit
Switching Logic 2	1 (0x01)	R/W	0 = High active	0 = High active 1 = Low active	UIntegerT	8 bit
Mode 2	2 (0x02)	R/W	1 = Single Point Mode	0 = Deactivated 1 = Single Point Mode 2 = Window Mode 3 = Two Point Mode	UIntegerT	8 bit
Hysteresis 2	3 (0x03)	R/W	CA18CBF 4% CA18CBN 15% CA30CBF 5% CA30CBN 10%	1 ... 100	UIntegerT	16 bit

7.2.3. Output Parameters

Parameter Name	Index Dec (Hex)	Access	Default value	Data range	Data Type	Length
Channel 1 (S01)	64 (0x40)					
Stage Mode 1	1 (0x01)	R/W	1 = PNP output	0 = Disabled output 1 = PNP output 2 = NPN output 3 = Push-pull output	UIntegerT	8 bit
Input selector 1	2 (0x02)	R/W	1 = SSC 1	0 = Deactivated 1 = SSC 1 2 = SSC 2 3 = Dust Alarm 1 (DA1) 4 = Dust Alarm 2 (DA2) 5 = Temperature Alarm (TA) 6 = External logic input	UIntegerT	8 bit
Timer 1 - Mode	3 (0x03)	R/W	0 = Disabled timer	0 = Disabled timer 1 = T-on delay 2 = T-off delay 3 = T-on/T-off delay 4 = One-shot leading edge 5 = One-shot trailing edge	UIntegerT	8 bit
Timer 1 - Scale	4 (0x04)	R/W	0 = Milliseconds	0 = Milliseconds 1 = Seconds 2 = Minutes	UIntegerT	8 bit
Timer 1 – Value	5 (0x05)	R/W	0	0 to 32'767	IntegerT	16 bit
Logic function 1	7 (0x07)	R/W	0 = Direct	0 = Direct 1 = AND 2 = OR 3 = XOR 4 = Gated SR-FF	UIntegerT	8 bit
Output Inverter 1	8 (0x08)	R/W	0 = Not inverted (N.O.)	0 = Not inverted (Normal Open) 1 = Inverted (Normal Closed)	UIntegerT	8 bit
Channel 2 (S02)	65 (0x41)					
Stage Mode 2	1 (0x01)	R/W	1 = PNP output	0 = Disabled output 1 = PNP output 2 = NPN output 3 = Push-Pull output 4 = Digital logic input (Active high/ Pull-down) 5 = Digital logic input (Active low/ Pull-up) 6 = Teach-in (Active high)	UIntegerT	8 bit
Input selector 2	2 (0x02)	R/W	1 = SSC 1	0 = Deactivated 1 = SSC 1 2 = SSC 2 3 = Dust Alarm 1 (DA1) 4 = Dust Alarm 2 (DA2) 5 = Temperature Alarm (TA) 6 = External logic input	UIntegerT	8 bit
Timer 2 – Mode	3 (0x03)	R/W	0 = Disabled timer	0 = Disabled timer 1 = T-on delay 2 = T-off delay 3 = T-on/T-off delay 4 = One-shot leading edge 5 = One-shot trailing edge	UIntegerT	8 bit
Timer 2 – Scale	4 (0x04)	R/W	0 = Milliseconds	0 = Milliseconds 1 = Seconds 2 = Minutes	UIntegerT	8 bit
Timer 2 – Value	5 (0x05)	R/W	0	0 to 32'767	IntegerT	16 bit
Logic function 2	7 (0x07)	R/W	0 = Direct	0 = Direct 1 = AND 2 = OR 3 = XOR 4 = Gated SR-FF	UIntegerT	8 bit
Output Inverter 2	8 (0x08)	R/W	1 = Inverted (Normally Closed)	0 = Not inverted (Normally Open) 1 = Inverted (Normally Closed)	UIntegerT	8 bit

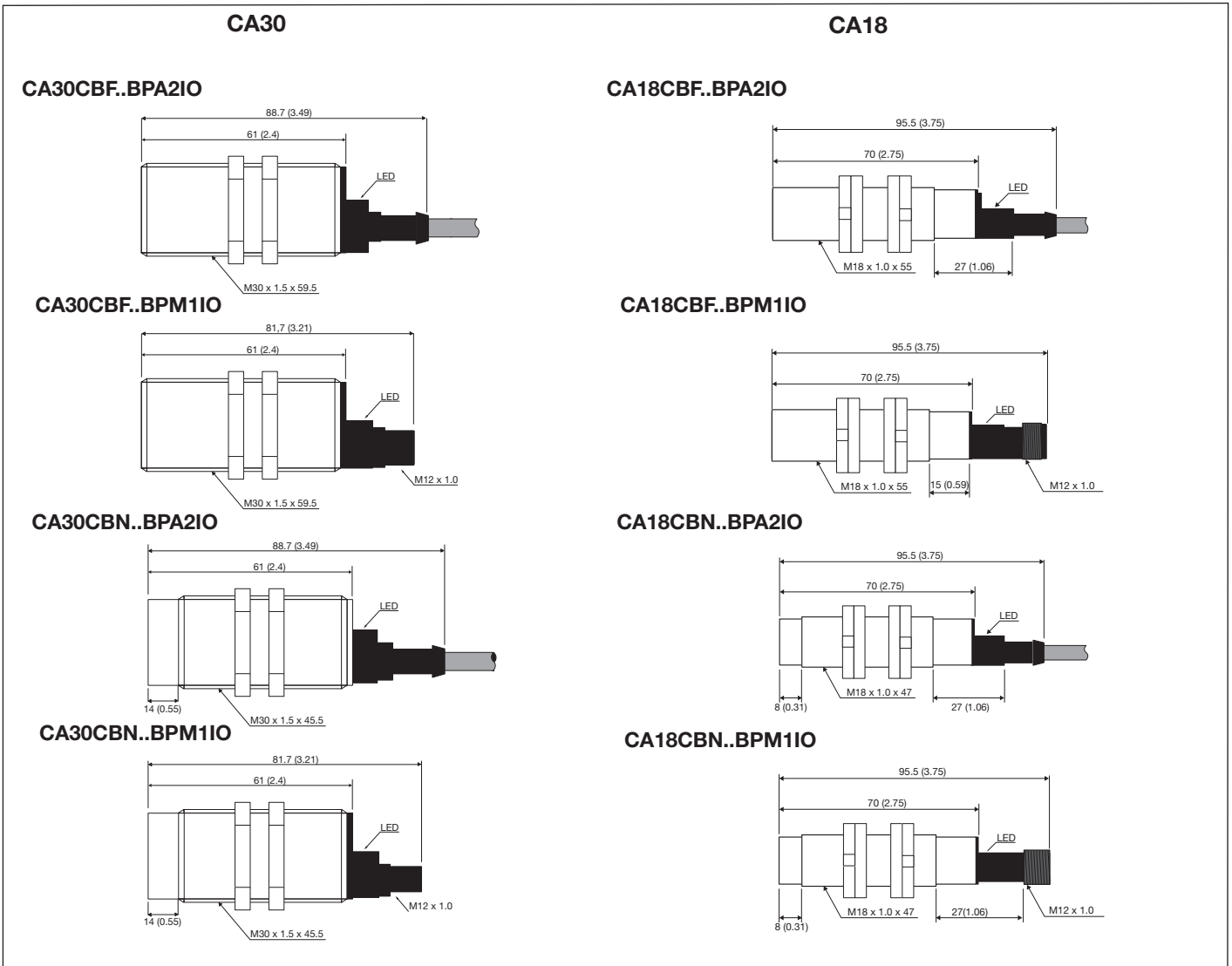
7.2.4. Sensor specific adjustable parameters

Parameter Name	Index Dec (Hex)	Access	Default value	Data range	Data Type	Length
Selection of local/remote adjustment	68 (0x44)	RW	1 = Trimmer input	0 = Disabled 1 = Trimmer input 2 = Teach-by-wire	UIntegerT	8 bit
Trimmer value	69 (0x45)	RO		10 ... 10 000		
Process data configuration	70 (0x46)	RW			RecordT	16 bit
Analogue value	1 (0x01)	RW	1 = Analogue value Active	0 = Analogue value Inactive 1 = Analogue value Active		
Switching Output 1	2(0x02)	RW	1 = Switching Output 1 Active	0 = Switching Output 1 Inactive 1 = Switching Output 1 Active		
Switching Output 2	3 (0x03)	RW	1 = Switching Output 2 Active	0 = Switching Output 2 Inactive 1 = Switching Output 2 Active		
Switching Signal Channel 1	4 (0x04)	RW	0 = SSC1 Inactive	0 = SSC1 Inactive 1 = SSC1 Active		
Switching Signal Channel 2	5 (0x05)	RW	0 = SSC2 Inactive	0 = SSC2 Inactive 1 = SSC2 Active		
Dust alarm 1	6 (0x06)	RW	0 = DA1 Inactive	0 = DA1 Inactive 1 = DA1 Active		
Dust alarm 2	7 (0x07)	RW	0 = DA2 Inactive	0 = DA2 Inactive 1 = DA2 Active		
Temperature alarm	8 (0x08)	RW	0 = TA Inactive	0 = TA Inactive 1 = TA Active		
Short-circuit	9 (0x09)	RW	0 = SC Inactive	0 = SC Inactive 1 = SC Active		
Sensor Application pre-set	71 (0x47)	R/W	0 = Full scale range	0 = Full scale range 1 = Liquid level 2 = Plastic pellets	UIntegerT	8 bit
Temperature Alarm Threshold	72 (0x48)	R/W			RecordT	30 bit
High Threshold	1 (0x01)	R/W	120	-50 to 150 [°C]	IntegerT	16 bit
Low Threshold	2 (0x02)	R/W	- 30	-50 to 150 [°C]	IntegerT	16 bit
Safe ON/OFF Limits	73 (0x49)	R/W			RecordT	16 bit
SSC 1 - Safe limit	1 (0x01)	R/W	2 x standard hysteresis	0 ... 100	UIntegerT	8 bit
SSC 2 - Safe limit	2(0x02)	R/W	2 x standard hysteresis	0 ... 100	UIntegerT	8 bit
Event Configuration	74 (0x4A)	R/W			RecordT	16 bit
Maintenance (0x8C30)	1 (0x01)	R/W	0 = Maintenance Notification - Inactive	0 = Maintenance notification Inactive 1 = Maintenance notification Active		
Temperature fault event (0x4000)	2 (0x02)	R/W	0 = Temperature fault Error event - Inactive	0 = Error event Inactive 1 = Error event Active		
Temperature over-run (0x4210)	3 (0x03)	R/W	0 = Temperature over-run Warning event - Inactive	0 = Warning event Inactive 1 = Warning event Active		
Temperature under-run (0x4220)	4 (0x04)	R/W	0 = Temperature under-run Warning event - Inactive	0 = Warning event Inactive 1 = Warning event Active		
Short circuit (0x7710)	5 (0x05)	R/W	0 = Short circuit Error event - Inactive	0 = Error event Inactive 1 = Error event Active		
Quality of Teach	75 (0x4B)	RO	-	0 ... 255	UIntegerT	8 bit
Quality of Run	76 (0x4C)	RO	-	0 ... 255	UIntegerT	8 bit
Filter scaler	77 (0x4D)	R/W	1	1 ... 255	UIntegerT	8 bit
LED indication	78 (0x4E)	R/W	2 = LED indication Centered LED	0 = LED indication Inactive 1 = LED indication Single LED 2 = LED indication Centered LEDs 3 = LED indication Full LEDs 4 = LED indication Find my sensor	UIntegerT	8 bit

7.2.5. Diagnostic parameters

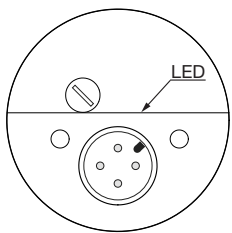
Parameter Name	Index Dec (Hex)	Access	Default value	Data range	Data Type	Length
Operating Hours	201 (0xC9)	RO	0	0 ... 2 147 483 647 [h]	IntegerT	32 bit
Number of Power Cycles	202 (0xCA)	RO	0	0 ... 2 147 483 647	IntegerT	32 bit
Maximum temperature – All time high	203 (0xCB)	RO	0	-50 to 150 [°C]	IntegerT	16 bit
Minimum temperature - All time low	204 (0xCC)	RO	0	-50 to 150 [°C]	IntegerT	16 bit
Maximum temperature since power-up	205 (0xCD)	RO	-	-50 to 150 [°C]	IntegerT	16 bit
Minimum temperature since power-up	206 (0xCE)	RO	-	-50 to 150 [°C]	IntegerT	16 bit
Current temperature	207 (0xCF)	RO	-	-50 to 150 [°C]	IntegerT	16 bit
Detection counter SSC1	210 (0xD2)	RO	-	0 ... 2 147 483 647	IntegerT	32 bit
Minutes above Maximum Temperature	211 (0xD3)	RO	-	0 ... 2 147 483 647 [min]	IntegerT	32 bit
Minutes below Minimum Temperature	212 (0xD4)	RO	-	0 ... 2 147 483 647 [min]	IntegerT	32 bit
Maintenance event counter	213 (0xD5)	RO	0	0 ... 2 147 483 647	IntegerT	32 bit
Download counter	214 (0xD6)	RO	0	0 ... 65 536	UIntegerT	16 bit

Dimensions

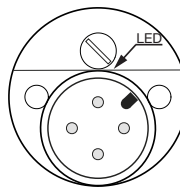


Back part

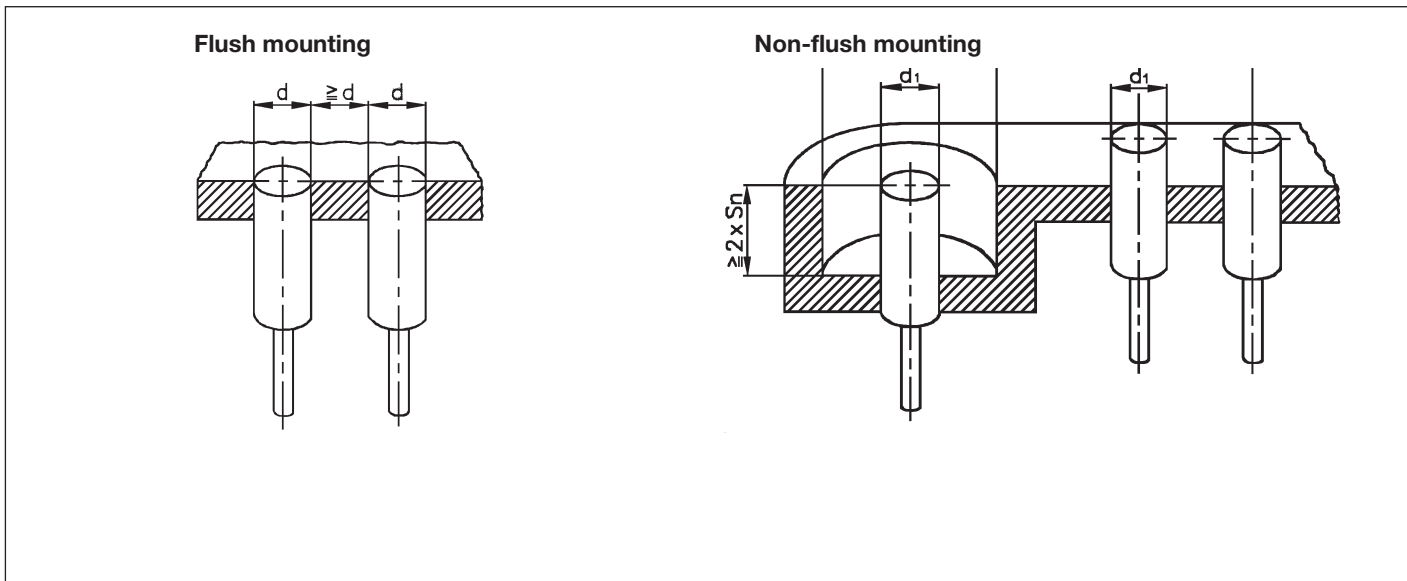
CA30



CA18



Mounting



Installation Hints

<p>To avoid interference from inductive voltage/ current peaks, separate the prox. switch power cables from any other power cables, e.g. motor, contactor or solenoid cables</p>	<p>Relief of cable strain The cable should not be pulled</p>	<p>Protection of the sensing face A proximity switch should not serve as mechanical stop</p>	<p>Switch mounted on mobile carrier Any repetitive flexing of the cable should be avoided</p>

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