CANEO series10 – Firmware V10.x

Revision A | 2024-02-13

Overview

CANEO series10 SENSORswitches can be used in IO-Link and in non-IO-Link environments.

For non-IO-Link usage, the sensor features one standard Digital Output and up to two standard Digital Inputs (E1, E2), which can be used to control the sensor's LED.

The related parameters can be configured before/during deployment via IO-Link:

- Function of the Digital Output – PNP/NPN/PushPull, Normally Open/Closed
- Function of the up to two Digital Inputs (E1, E2)
  - LED control
  - Locking/release of Digital Output
- LED behavior for various states

IO-Link Communication

If the sensor detects IO-Link communication, it automatically switches to the IO-Link communication mode. The IO-Link standard offers different communication mechanisms:

- **Acyclic Data** (Indexed Service Data Units): Used to set the sensor configuration during commissioning.
- **Cyclic Process Data**: Used to receive the sensor's state and influence its behavior during runtime.
- **Events**: The sensor will report events in case of error.

In IO-Link applications the sensor always provides the same information (like actuation state) in its Process Data (PDin), but depending on the configured LED Control Mode, different kind of Process Data to the sensor (PDout) can be used:

- **Automatic Scene Selection** – Use this mode if you don't want to use IO-Link to control the sensor's LED.
- **Scene controlled by IO-Link Process Data** – This control mode is used to control the LED scenes through IO-Link. It covers most applications which use IO-Link, but is limited to eight LED scenes. A LED scene describes the behavior of the LED with a couple of parameters (e.g., color and effect).
- **Advanced Control by IO-Link Process Data** – If you use IO-Link, but the eight LED scenes are not sufficient for your application, it is recommended to use this LED control mode. The advanced control mode lets you control the LED with R-G-B data.

> **INFO**
>
> Process Data, ISDUs and events of the sensor, their respective numeric indices, offsets, and values, are described in the IODD file of the sensor. It is highly recommended to use this file when integrating the sensor in an application.

Device Variants

Product ID	Name	Description
CS10H-MODU	CANEO series10 Hygienic	SENSORswitch hygienic with stainless steel housing and milligrid connector
CS10H-MSDT	CANEO series10 Hygienic	SENSORswitch hygienic with stainless steel housing and M12 connector
CS10K-MLDT	CANEO series10 Standard	SENSORswitch with connector M12
CS10K-MMDU	CANEO series10 Standard	SENSORswitch with milligrid connector
CS10S-MNDU	CANEO series10 Stainless Steel	SENSORswitch with stainless steel housing and milligrid connector
CS10S-MTDT	CANEO series10 Stainless Steel	SENSORswitch with stainless steel housing and M12 connector

LED Control

series10 supports four modes for controlling its LED:

- Automatic Scene Selection
- Scene controlled by IO-Link-Process Data *
- Advanced Control by IO-Link Process Data *
- Classic Two LED Mode

* If the SENSORswitch is not used with IO-Link, it will behave like with "Automatic Scene selection" mode.

The control mode can be selected via IO-Link parameter **LED Control Mode** (see ISDU Indices).

Automatic Scene Selection

Number of applicable scenes depends on parameter **Active Inputs**:

Active Inputs	Scenes Used
None (3 pin mode)	0, 1
Pin2 (E1) (4 pin mode)	0 ... 3
Pin2 (E1) and Pin5 (E2) (5 pin mode)	0 ... 7

Scene n is selected depending on the state of touch (sensor actuation) and the state of the input pins E1 and E2:

LED Scene	Touch	E1	E2	None	Pin 2 (E1)	Pin 2 (E1), Pin 5 (E2)
0	0	0	0	✓	✓	✓
1	1	0	0	✓	✓	✓
2	0	1	0		✓	✓
3	1	1	0		✓	✓
4	0	0	1			✓
5	1	0	1			✓
6	0	1	1			✓
7	1	1	1			✓

Scene Controlled by IO-Link Process Data

The active Scene is set according to the **LED Scene** value in IO-Link process data.

Advanced Control by IO-Link Process Data

The LED color, brightness, effect, and effect frequency is controlled by IO-Link process data.

Classic Two LED Mode

"Idle" and "Touch" parameters of "Classic LED Control" section are used.

The **Active Inputs** parameter controls whether the input pins affect the selection of "Idle" or "Touch" configuration:

Active Inputs = None (3 pin mode)

Touch	E1	E2	LED Configuration
0	Not relevant	Not relevant	Idle
1	Not relevant	Not relevant	Touch

Active Inputs = Pin2 (E1) (4 pin mode)

Touch	E1	E2	LED Configuration
0	0	Not relevant	off
0	1	Not relevant	Idle
1	Not relevant	Not relevant	Touch

Active Inputs = Pin2 (E1) and Pin5 (E2) (5 pin mode)

Touch	E1	E2	LED Configuration
Not relevant	0	0	off
Not relevant	1	0	Idle
Not relevant	0	1	Touch
Not relevant	1	1	Idle & Touch colors mixed

Output Features

Output Locking

This feature was designed for applications without IO-Link.

When enabled, inputs E1/E2 can lock the sensor from giving an output signal on actuation. To use this function:

- **LED Control Mode** must be set to "Automatic Scene selection"
- Inputs E1 or E1E2 need to be activated by **Active Inputs** parameter

With "Output Locking" enabled, the **Pin 4** output signal is locked, but there is no impact on the **Actuation Flag**.

The "Output Locking" has no influence on the scene or scene change. This means touching and inputs on E1/E2 will change the scene as described in the LED Control section: The state of Scene 1, for example, is: "Sensor is touched, but output is locked".

Output locking can also be used to interrupt an infinite timer or to terminate an output signal.

Output Snap-In

This feature relates to **Sensor Mode** "Static".

When actuated, the sensor works at first in Static mode. If the sensor is actuated longer than set in **Output Snap Time**, the output 'snaps' (latches), i.e. it works like in "Toggle" mode.

The Timer feature can be used to signal the Static and Snapped Phase:

1. Set **LED Control Mode** to "Automatic Scene selection"
2. Set **LED Scene 1** according to your needs — it holds the LED settings for the Snapped Phase
3. Set **LED Effect** and **LED Color** for the Timer — it holds the LED settings for the Static phase
4. Set **Trigger Timer** to "when entering Scene 1" (1)
5. Set **Timer Timeout** to same time (s) as **Output Snap Time** (ms)

If **Output Snap Time** is set to 0 ms, this feature is disabled.

Output with Soft Start

This feature was designed for motor control applications.

Since the SENSORswitch can provide an output current of max. 200 mA only, the motor is typically controlled via a driver circuit.

- **Output Mode** must be configured to "PushPull"
- The **Output Soft Start Time** defines the time during which a PWM of 5 kHz with constantly increasing duty cycle is output when the output switches on

- A time of 0 ms means the default way of output operation: immediate "hard" change from Pull to Push when the output switches on

Timer

The timer functionality is designed for applications without IO-Link.

The **LED Control Mode** needs to be set to "Automatic Scene Selection", so the timer can be started by activation of the switch or the inputs E1/E2.

> **NOTE**
>
> Timer overwrites the **LED Effect** of the scene; LED Effects with prefix "Timer" are synchronized with the timer.

Example Use Case 1

The output signal shall come in the beginning of the Timer period.

1. Set **Sensor Mode** to "Static" or "Dynamic"
2. Set **Timer Function** to "1 - enabled"
3. Set **Trigger Timer** to "0 - when entering Scene 0"
4. Set **Timer timeout** to e.g. "10" s
5. Set **Output Minimum Impulse Time**
6. Set **LED Effect** for Timer

> **NOTE**
>
> **Sensor Mode** needs to be "Static" or "Dynamic". If the sensor is in "Toggle" mode, the timer will start when the sensor is touched for a second time since it will be in "Scene 1" after the first touch and goes back to "Scene 0" after the second.

Example Use Case 2

The output signal shall come at the end of the Timer period.

1. Set **Sensor Mode** to "Static" or "Dynamic"
2. Set **Timer Function** to "1 - enabled"
3. Set **Trigger Timer** to "1 - when entering Scene 1"
4. Set **Timer timeout** to e.g. "10" s
5. Set **Output Minimum Impulse Time** to e.g. "300" ms
6. Set **Output Activation Delay** to e.g. "9700" ms
7. Set **LED Effect** for Timer

> **NOTE**
>
> **Sensor Mode** needs to be "Static" or "Dynamic".
>
> **Output Activation Delay** = **Timer timeout** - **Output Minimum Impulse Time**.

IO-Link Interface

IO-Link Specification: V1.1.2 (July 2013)

Property	Value
Device Family	Capacitive Sensors
Device Name	CANEO series10
Device ID	258
IODD	IODDfinder

Communication Interface

Property	Value
IO-Link Version	V1.1
Bitrate	COM2
Minimum Cycle Time	14800 µs
Process Data Input Bits	80
Process Data Output Bits	64
SIO Supported	Yes
ISDU Supported	Yes
Data Storage	Yes
Block Parameter	No

Process Data

> **NOTE**
>
> IO-Link bit offset counts from the last byte of the data array.

Process Data Input

80 bit / 10 bytes

Byte	0	1	2	3	4	5	6	7	8	9
Bit Offset		64	56		48	32	24	16	8	0
Data	unused	Surrounding Brightness	Actuation Strength		Actuation Count		Actuation Flag	Pin 5	Pin 4	Pin 2

Field Reference

Bit Offset	Name	Datatype	Values	Info
0	Pin 2	8-bit UIntegerT	4 - Input OFF, 5 - Input ON, 8 - Pin unused	E1 input pin state
8	Pin 4	8-bit UIntegerT	0 - Output OFF, 1 - Output ON	OUT pin state
16	Pin 5	8-bit UIntegerT	4 - Input OFF, 5 - Input ON, 8 - Pin unused	E2 input pin state
24	Actuation Flag	8-bit UIntegerT	0 - Idle, 1 - Actuated	Sensor actuation state
32	Actuation Count	16-bit UIntegerT	0 ... 65535	Number of actuation cycles since sensor has been turned on. Counter resets when sensor restarts and after count of 65535.
48	Actuation Strength	8-bit UIntegerT	0 ... 100 [%]	Damping of sensor in percent.
56	Surrounding Brightness	8-bit UIntegerT	0 ... 100 [%]	Ambient brightness in percent.
64	unused	16-bit UIntegerT	0 ... 65535	

Process Data Output

64 bit / 8 bytes

LED Control Modes "Automatic Scene Selection" (0) / "Classic Two LED Mode" (3)

Process Data Output is **unused**.

LED Control Mode "Scene controlled by IO-Link Process Data" (1)

Byte	0	1	2	3	4	5	6	7
Data	unused							LED Scene

Bit Offset	Name	Datatype	Values	Info
0	LED Scene	8-bit UIntegerT	0...7, 255 - Automatic	Switch between LED scenes "0" to "7". For control by activation and input pins set value to "255".

LED Control Mode "Advanced control by IO-Link Process Data" (2)

Byte	0	1	2	3	4	5	6	7
Bit Offset	56	48	40	32	24	16		0
Data	Effect Frequency	LED Effect	LED Color B	LED Color G	LED Color R	LED Brightness		Active LEDs

Bit Offset	Name	Datatype	Values	Info
0	Active LEDs	16-bit UIntegerT	0...1	Bitmask, defining which LEDs are active.
16	LED Brightness	8-bit UIntegerT	0...100, 255 - Automatic Control [%]	Brightness of LED ring in percent. Value of 255 means automatic brightness control by sensor.
24	LED Color R	8-bit UIntegerT	0 ... 255	Red component of LED color.
32	LED Color G	8-bit UIntegerT	0 ... 255	Green component of LED color.
40	LED Color B	8-bit UIntegerT	0 ... 255	Blue component of LED color.
48	LED Effect	8-bit UIntegerT	0 - Static Ring, 1 - Flash Ring, 2 - Pulse Ring	
56	Effect Frequency	8-bit UIntegerT	1...60, 0 - Default Frequency [0.1 Hz]	Frequency of LED effect in 1/10 Hz, range: 0.1 ... 6 Hz.

Events & Commands

Events

Event Code	Type	Definition and recommended maintenance action
6144	Error	Output Overload – Output current too high – max. 200 mA
16912	Warning	Device temperature over-run – Clear source of heat
16928	Warning	Device temperature under-run – Insulate device
20496	Error	Component malfunction – Repair or exchange
20752	Warning	Primary supply voltage over-run – Check tolerance
20753	Warning	Primary supply voltage under-run – Check tolerance

Commands

ISDU Index 2 – System Command

Value	Name	Description
128	Device Reset	Restart the device
130	Restore Factory Settings	Restore Factory Settings
160	Trigger Self-Test	Tests sensor and LED. Any error will be reported in Error Code variable

ISDU Indices

Access Rights: **ro** – Read Only, **rw** – Read/Write, **wo** – Write Only

System Command

Name	Index	Bytes	Access	Values	Description
System Command	2	1	wo	see Events & Commands	

Identification

Name	Index	Bytes	Access	Values	Description
Vendor Name	16	23	ro	CAPTRON Electronic GmbH	
Product Name	18	31	ro	CANEO series10 ...	Standard, Stainless Steel, Hygienic
Product ID	19	10	ro	CS10X-xxxx	
Product Text	20	19	ro	CS10X-xxxx-xxx-xxxx	
Symbol	276	3	ro		
Hardware Identification Key	17342	9	ro	A000010012	
Serial Number	21	13	ro		
Firmware Version	23	4	ro	V10.x	

Activation Parameters

Name	Index	Bytes	Access	Values	Description
Sensor Mode	261	1	rw	1 - Toggle, 2 - Dynamic, 3 - Static	**Toggle** : Touch to switch on, touch again to switch off. Can only be set back after "Output Minimum Impulse Time" is over. **Dynamic** : Output is on as long as "Output Minimum Impulse Time" is set; even though the user continues touching, the output will switch off. **Static** : Output is on until the user is no longer touching the sensor (but is at least on for the "Output Minimum Impulse Time").
Touch Sensitivity	260	1	rw	0 - High, 1 - Middle, 2 - Low	**High** : required "Actuation Strength" > 4%. **Middle** : required "Actuation Strength" > 14%. **Low** : required "Actuation Strength" > 24%.
Water Resistance	262	1	rw	0 - Basic, 1 - Enhanced, 2 - Ultimate	**Basic** : Activation by e.g. light rain/dripping water unlikely. **Enhanced** : Activation by water jet/high-pressure cleaner unlikely. No limitation in operability, but activation by water possible in low light conditions. **Ultimate** : Strongly reduced probability of activation by e.g. water jet/high-pressure cleaner. Possible limitation in operability in low light condition.
Minimum Actuation Time	263	2	rw	0 ... 65535 [ms]	Time the sensor must be activated before output on Pin 4 switches, "Actuation Flag" is set to "Actuated" and "Actuation Count" goes up.
Minimum Actuation Time (Toggle OFF)	283	2	rw	0 ... 65535 [ms]	Time the sensor must be touched in "Toggle" mode before output on Pin 4 turns OFF and "Actuation Flag" is set to "Idle".
Output Snap Time (Static Mode)	339	2	rw	0 ... 65535 [ms]	Time after which the output snaps in (toggles); a value of 0 means no snap-in. For Static Sensor Mode only.
Output Activation Delay	324	2	rw	0 ... 65535 [ms]	Time the switching of the output is delayed when the sensor has been actuated.

I/O Parameters

Name	Index	Bytes	Access	Values	Description
Active Inputs	271	1	rw	3 - None (3 pin mode), 4 - Pin 2 (E1) (4 pin mode), 5 - Pin 2 (E1) and Pin 5 (E2) (5 pin mode)	Controls which input pins are monitored.
E1/E2 Mode	272	1	rw	0 - Active Low, 1 - Active High, 2 - Active Low/High	**Active Low** : Accepts a low signal as input to turn on. **Active High** : Accepts a high signal as input to turn on.
Output Locking	337	1	rw	0 - No locking, 1 - Release by E1, 2 - Release by E2, 3 - Release by E1 and E2	Controls whether inputs E1/E2 must be active for the output signal on Pin4 to be ON when the sensor is touched.
Output Mode	273	1	rw	0 - NPN, 1 - PNP, 2 - PushPull	**NPN** : Output signal is pulled down to 0V when output is on. **PNP** : Output signal is pushed up to +VDC when output is on. **PushPull** : Output signal is pushed up to +VDC when output is on and is pulled down to 0V when it is off.
Output NO/NC	274	1	rw	0 - NO (Normally Open), 1 - NC (Normally Closed)	
Output Minimum Impulse Time	275	4	rw	10 ... 86400000 [ms]	The minimal time (ms) of the output signal when the sensor is activated. The output signal cannot be interrupted. In toggle mode the sensor can only be deactivated after the minimal output signal length is over.
Output Soft Start Time (PushPull Mode)	338	2	rw	0 ... 65535 [ms]	Soft Start means that the output signal ramps up with a PWM for the given time. A value of 0 means "hard" switching without PWM. Available for PushPull Output Mode only.

LED Parameters

Name	Index	Bytes	Access	Values	Description
LED Control Mode	293	1	rw	0 - Automatic Scene selection, 1 - Scene controlled by IO-Link Process Data, 2 - Advanced control by IO-Link Process Data, 3 - Classic Two LED Mode	See LED Control for details on each mode.
Adaptive LED Brightness	270	1	rw	0 - Off, 1 - On	If turned "On" the sensor automatically adjusts the LED Brightness depending on the "Surrounding Brightness".
Brightness of the LED	285	1	rw	0 ... 100 [%]	Serves as minimum value with automatic brightness control.

Classic LED Control (LED Control Mode = 3)

Name	Index	Bytes	Access	Values	Description
LED Color Idle	264	1	rw	0 - CANEO, 1 - Red, 2 - Green, 3 - Blue, 4 - Yellow, 5 - Magenta, 6 - Cyan, 10 - Orange, 11 • Violet, 13 - Off, 14 - Clean Blue, 254 - Manual	Color of LED when sensor is not touched / E1 is on.
LED Color Touch	265	1	rw	0 - CANEO, 1 - Red, 2 - Green, 3 - Blue, 4 - Yellow, 5 - Magenta, 6 - Cyan, 10 - Orange, 11 • Violet, 13 - Off, 14 - Clean Blue, 254 - Manual	Color of LED when sensor is touched / E2 is on.
LED Mode Idle	266	1	rw	0 - Static Ring, 1 - Flash Ring, 2 - Pulse Ring	Behavior of LED when sensor is not touched / E1 is on.
LED Mode Touch	267	1	rw	0 - Static Ring, 1 - Flash Ring, 2 - Pulse Ring	Behavior of LED when sensor is touched / E2 is on.

LED Manual Color Idle

Name	Index - Subindex	Bytes	Access	Values	Description
R	268 - 1	1	rw	0 ... 255	Red component of color
G	268 - 2	1	rw	0 ... 255	Green component of color
B	268 - 3	1	rw	0 ... 255	Blue component of color

LED Manual Color Touch

Name	Index - Subindex	Bytes	Access	Values	Description
R	269 - 1	1	rw	0 ... 255	Red component of color
G	269 - 2	1	rw	0 ... 255	Green component of color
B	269 - 3	1	rw	0 ... 255	Blue component of color

Observation & Diagnosis

Name	Index	Bytes	Access	Values	Description
Sensor Temperature	257	2	ro	-32768 ... 32767 [0.1 °C]	
Supply Voltage	256	2	ro	0 ... 65535 [0.001 V]	
Input E1 voltage	277	2	ro	0 ... 65535 [0.001 V]	
Input E2 voltage	278	2	ro	0 ... 65535 [0.001 V]	
MCU Voltage	279	2	ro	0 ... 65535 [0.001 V]	
Charge Code	280	4	ro	0 ... 4294967295	
Error Code	282	2	ro	0 ... 65535	
Flash Erase Count	259	2	ro	0 ... 65535	
Device Access Locks	12		rw		

LED Scenes

LED scenes are available for **LED Control Mode 0** (Automatic Scene Selection) and **LED Control Mode 1** (Scene controlled by IO-Link Process Data).

Each scene is configured with three parameters:

- **LED Color** – The color of the LED
- **LED Effect** – The behavior (Static Ring, Flash Ring, Pulse Ring)
- **Effect Frequency** – Frequency of animated effects in 1/10 Hz (range: 0.1 ... 6 Hz)

Available LED Colors

Value	Color
0	CANEO
1	Red
2	Green
3	Blue
4	Yellow
5	Magenta
10	Orange
11	Violet
13	Off
14	Clean Blue
128	Custom Color 1
129	Custom Color 2

Scene ISDU Indices

Scene	Condition	LED Color Index	LED Effect Index	Effect Frequency Index
Scene 0	no Touch, E1 off, E2 off	295 - 1	295 - 2	295 - 3
Scene 1	Touch, E1 off, E2 off	296 - 1	296 - 2	296 - 3
Scene 2	no Touch, E1 on, E2 off	297 - 1	297 - 2	297 - 3
Scene 3	Touch, E1 on, E2 off	298 - 1	298 - 2	298 - 3
Scene 4	no Touch, E1 off, E2 on	299 - 1	299 - 2	299 - 3
Scene 5	Touch, E1 off, E2 on	300 - 1	300 - 2	300 - 3
Scene 6	no Touch, E1 on, E2 on	301 - 1	301 - 2	301 - 3
Scene 7	Touch, E1 on, E2 on	302 - 1	302 - 2	302 - 3

Custom Scene Colors

Custom colors allow you to define arbitrary RGB values for use in scenes.

Custom Color 1 (Index 306)

Subindex	Component	Values
1	R	0 ... 255
2	G	0 ... 255
3	B	0 ... 255

Custom Color 2 (Index 307)

Subindex	Component	Values
1	R	0 ... 255
2	G	0 ... 255
3	B	0 ... 255

Timer LED Settings

When the timer is active, it can override the LED scene with its own settings:

Name	Index - Subindex	Bytes	Access	Values	Description
Timer Function	322 - 1	1	rw	0 - disabled, 1 - enabled	Enable/disable timer
Trigger Timer	322 - 2	1	rw	0...7 - when entering Scene n	Trigger to start timer
Timer Timeout	322 - 3	2	rw	0 ... 9999 [s]	Time after which the timer stops
LED Color	323 - 1	1	rw	0 - CANEO, 1 - Red, 2 - Green, 3 - Blue, 4 - Yellow, 5 - Magenta, 10 - Orange, 11 - Violet, 13 - Off, 14 - Clean Blue, 128 - Custom Color 1, 129 - Custom Color 2	LED color during timer
LED Effect	323 - 2	1	rw	0 - Static Ring, 1 - Flash Ring, 2 - Pulse Ring	LED behavior during timer
Effect Frequency	323 - 3	1	rw	1...60, 0 - Default Frequency [0.1 Hz]	Frequency of LED effect

Self-Diagnosis and Error Codes

The SENSORswitch includes the following diagnosis features:

- **Self-Test**: When triggered by the respective IO-Link System Command:
  - The capacitive measurement circuit is checked (duration: 200 ms)
  - The RGB LED is checked electrically
- **Monitoring** of Supply Voltage and MCU Temperature
- **Output Overload Detection**

Detected errors are indicated via IO-Link Events and/or in the **Error Code** IO-Link Parameter, as well as by blinking patterns of the LED.

Error Codes

Blink Code	IO-Link Error Code	Description
1	0x0001	Internal error
5	0x0010	Sensor error (self-test)
8	0x0080	Memory error
12	0x0800	LED error (self-test)
13	0x1000	Overload error on digital output

Revision History

Rev. A – 2024-02-13

- Based on Technical Reference Manual CANEO series10 – Firmware V9.x, revision B
- Added tables to illustrate order of Process Data
- Added parameter size in bytes to IO-Link ISDU table
- Changed description of self-test