MANUAL

Ultrasonic Sensors with IO-Link

UC***-30GM-IUEP-IO-V15
UC***-30GM-2EP-IO-V15

⊘ **IO**-Link

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Symbols Used

Note on a hazard or immediate danger.
Ignoring this symbol can lead to property damage, serious injury, or even fatal injuries.

This symbol warns the user of a potential device failure. Ignoring this warning can lead to a complete failure of the device or other connected devices.

Recommendation for the user
Observing this note makes commissioning and handling of this product easier.

Safety information

This product must not be used in applications in which the safety of persons depends on the function of the device.
This product is not a safety component as specified in the EU Machinery Directive.

Note

The guarantee provided by Pepperl+Fuchs for this product ceases to be valid if the product is not operated or used as specified by Pepperl+Fuchs.

Modifications to devices or components and the use of defective and incomplete devices or components are not permitted. Repairs to devices or components may be performed only by authorized workshops or Pepperl+Fuchs. These workshops are responsible for obtaining the latest technical information about the devices and components from Pepperl+Fuchs. Pepperl+Fuchs has no influence on repairs made to the product that were not carried out by Pepperl+Fuchs. Our liability is therefore restricted to the repair work performed by Pepperl+Fuchs.

The above does not modify the information relating to warranties and liability in the Pepperl+Fuchs terms of sale and supply.

Observe the general notes on the information in the Pepperl+Fuchs product catalogs at http://www.pepperl-fuchs.com.

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1 Introduction

1.1 Congratulations

You have decided to purchase a device from Pepperl+Fuchs.

Pepperl+Fuchs develops, produces, and markets electronic sensors and interface modules worldwide for the automation technology market.

Before you install this device and put it into operation, please read the operating instructions thoroughly. The instructions and notes contained in this operating manual will guide you step-by-step through the installation and commissioning procedures to ensure trouble-free use of this product. By doing so, you:

- guarantee safe operation of the device
- can utilize the entire range of device functions
- avoid faulty operation and associated errors
- reduce costs from downtimes and incidental repairs
- increase the effectiveness and operating efficiency of your plant.

Store these instructions somewhere safe in order to have them available for future work on the device.

Directly after opening the packaging, please ensure that the device is intact and that the package is complete.

1.2 Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

Pepperl+Fuchs GmbH

Lilienthalstraße 200

68307 Mannheim, Germany

Tel.: +49 (0) 621 776-1111

Fax: +49 (0) 621 776-27-1111

E-mail:fa-info@de.pepperl-fuchs.com

1.3 Declaration of Conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Note!

A Declaration of Conformity may be requested from the manufacturer.

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The product manufacturer, Pepperl+Fuchs GmbH, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.

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ISO**9001**

1.4 Purpose of this Documentation

These operating instructions contain information necessary for the commissioning and use of the UC***-30GM-**EP-IO-V15 ultrasonic sensors. The documentation is targeted at persons performing the commissioning who connect the device and programmers who write a PLC program.

1.5 Range of Validity of this Documentation

This documentation is valid for UC***-30GM-**EP-IO-V15 ultrasonic sensors and describes the delivery status from 11/2011.

1.6 Recycling and Disposal

UC***-30GM-**EP-IO-V15 ultrasonic sensors can be recycled. To recycle and dispose of your old device in an environmentally friendly way, contact a disposal company accredited in the disposal of electronic waste.

1.7 Intended Use

The ultrasonic sensors from the UC….-30GM Series detect objects using ultrasonic pulses. Ultrasound is emitted by the sensor and reflected on the object. The resulting runtime determines the distance of the object. (pulse-echo principle). Objects in the following forms can be detected: solid, granular, powder, or liquid. Gases cannot be detected. The color and surface structure of the objects are irrelevant.

Not a safety component
UC***-30GM-**EP-IO-V15 ultrasonic sensors are not safety components in the sense of the EU Machinery Directive 2006/42/EC.
UC***-30GM-**EP-IO-V15 ultrasonic sensors must not be used to avert risks to persons or body parts.

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Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and plant is guaranteed only if the device is operated in accordance with its intended use.

Use the recommended original accessories only.

The responsibility for compliance with locally valid safety regulations is borne by the operator.

Installation and commissioning of all devices must be performed only by personnel specially trained for that purpose.

If you open or modify the device yourself, not only are you endangering yourself and others but you will void any warranty and absolve the manufacturer from any liability. If serious faults occur on the device, switch the device off. Make sure that the device cannot be switched back on accidentally. If the device needs to be repaired, return it to Pepperl+Fuchs.

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2 Product Description

2.1 Function

UC***-30GM-**EP-IO-V15 ultrasonic sensors detect objects using ultrasonic pulses. Ultrasound is emitted by the sensor and reflected on the object. The resulting runtime determines the distance of the object. (pulse-echo principle). Objects in the following forms can be detected: solid, granular, powder, or liquid. Gases cannot be detected. The color and surface structure of the objects are irrelevant.

2.2 Indicators and Controls
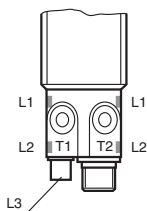
The sensor has LEDs for signaling operating statuses, two buttons for adjusting the outputs, and an M12 connector plug.

L1, yellow LED Status display for output A1 (pin 4)
L2, yellow LED Status display for output A2 (pin 2)
T1   Button for adjusting output A1
T2   Button for adjusting output A2
L3   Indicates ready for operation (green) or fault (red)

2.3 Delivery Scope and Accessories

The following are delivered:

- 1 sensor
- 2 mounting nuts
- Brief description (product insert)

Accessories for mounting, connecting, or parameterizing must be purchased separately.

You can find suitable accessories on our website **http://www.pepperl-fuchs.com**.

> *Tip*
> *In the product search, simply enter the type designation for your sensor. The product page contains a list of the related products.*

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3 Installation

3.1 Mounting

The sensors are mounted with the nuts supplied. Mounting sets for mounting M30 sensors can be used (optional), e.g., BF 30, BF 30-F, or BF 5-30.

3.2 Commissioning

For commissioning, a voltage in the permitted range is applied to the corresponding plug connections. The green LED indicates that the device is ready for operation and the sensor works with the values set previously. For initial commissioning, all internal parameters are set to the factory settings.

3.3 Electrical Installation

The ultrasonic sensor is supplied with power via the M12 plug. A voltage in the range 10 VDC ... 30 VDC (15 V ... 30 V if the voltage output is used) must be applied between pin 1 (+U_b) and 3 (-U_b, 0 V).

If the IO-Link interface is used, pin 4 **(IO-Link, C/Q)** is used for communication.
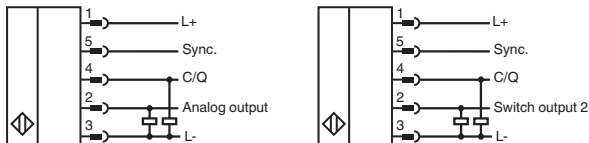
The following plug assignments apply for both available versions of the UC***-30GM-**EP-IO-V15:

3.3.1 UC***-30GM-2EP-IO-V15 (Two Switching Outputs)

Connection pin	Assignment	Wire color [*)]
1	L+	Brown (BN)
2	Switching output A2	White (WH)
3	L- (0 V)	Blue (BU)
4	Switching output A1 (IO-Link, C/Q)	Black (BK)
5	Synchronization	Gray (GY)

[*)] with use of a female single-ended cordset as per EN 60947-5-6

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3.3.2 UC***-30GM-IUEP-IO-V15 (Switching Output + Analog Output)

Connection pin	Assignment	Wire color [*)]
1	L+	Brown (BN)
2	Switching output A2	White (WH)
3	L- (0 V)	Blue (BU)
4	Switching output A1 (IO-Link, C/Q)	Black (BK)
5	Synchronization	Gray (GY)

[*)] with use of a female single-ended cordset as per EN 60947-5-6

The analog output can be configured as a voltage output or current output.

3.3.3 Synchronization of Multiple Sensors

The sensors are fitted with a synchronization input that suppresses mutual interference from external ultrasonic signals. If this input is not connected, the sensors operate with internally generated cycle pulses. They can be synchronized by creating external rectangular pulses and by setting the appropriate parameters via the IO-Link interface.

Each falling pulse edge sends an individual ultrasonic pulse.

If the signal at the synchronization input is low for ≥1 second, the sensor reverts to the normal, unsynchronized operating mode. This also occurs if the synchronization input is disconnected from external signals.

If a high signal is applied to the synchronization input for > 1 second, the sensor switches to standby. This is indicated by the green LED. In this operating mode, the last recorded output statuses are retained.

If the option of synchronizing is not used, the synchronization input must be connected to ground (0 V) permanently or the sensor must be operated with a 4-pin connection cable.

The option of synchronization is not available during the programming process. During synchronization, the sensor can switch to programming via the IO-link interface. This interrupts the synchronization process and the sensor is no longer synchronized.

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The following synchronization modes are available:

- Multiplex mode

  Up to 10 sensors can be synchronized by simply connecting their synchronization inputs. In this case, the sensors synchronize themselves in succession in multiplex mode. Only one sensor sends signals at any one time.

- Master/slave synchronization

  Multiple sensors (max. 10) can be synchronized by simply connecting their synchronization inputs. The sensor interface can be used to parameterize the sensors so that one functions as a master and the others function as slaves. In this case, the sensors in master/slave mode work synchronously, i.e., in synchronization, whereby the master sensor plays the role of an intelligent external impulse generator.

- External, synchronous operation

  Several sensors can be controlled collectively by an external signal. In this case, the sensors are triggered in parallel and operate synchronously, i.e., at the same time. All sensors must be parameterized via the sensor interface so that they are set to external.

- External, multiplex mode

  Several sensors are controlled with a time delay by an external signal. In this case, only one sensor is externally synchronized at any one time. All sensors must be parameterized via the sensor interface so that they are set to external.

- Standby

  A high signal ($+U_B$) or a low signal ($-U_B$) at the synchronization input switches the sensor to standby in the case of external parameterization.

4 Settings on the Device

4.1 General

The devices have two outputs: **A1** and **A2**. There are two different device models:

- UC***-30GM-2EP-IO-V15   2 switching outputs (A1 and A2);
- UC***-30GM-IUEP-IO-V15   1 switching output (A1)
                                           1 analog output (A2)

A button **(T1, T2)** and two yellow LEDs **(L1 and L2)** are assigned to each output.

Two distances **(SP1 and SP2)** can be taught in for each output. They influence the switching characteristics or the characteristics of the analog output.

The buttons allow the following sensor settings:

Switching output

- Teaching in of the distances SP1 and SP2 for each output
- Output function switching output
  (switching point, window, hysteresis, barrier)
- Output type (NO contact, NC contact)
- Sound cone width (narrow, medium, wide)
- Reset to the factory settings

Analog output

- Teaching in of the distances SP1 and SP2 for each output.
- Output function analog output
  (rising characteristic, falling characteristic, zero point line)
- Output type (current, voltage, high impedance)
- Sound cone width (narrow, medium, wide)
- Reset to the factory settings

Note that you can only change the settings via buttons within the first 5 minutes after switching the device on (time lock).

You can deactivate this "time lock" (see 5.6.17).

4.2 Resetting to the Factory Settings (Reset)

You can reset the sensor to its initial values by resetting it to the factory settings.

Note that this deletes any settings you may have entered.

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Procedure:

1. Switch off the power supply on the device
2. Press T1 or T2
3. Switch on the power supply on the device
   ➟ The yellow and red LEDs flash for 5 seconds (warning)
   ➟ After 5 seconds, the yellow and green LEDs flash
4. Release the button
   ➟ Reset is executed
   ➟ The sensor is reset to its factory settings

   If you continue to press the button (> 10 s), the sensor is NOT reset (=command cancellation).

4.3   Sensors with Two Switching Outputs (UC***-30GM-2EP-IO-V15)

4.3.1   Adjusting the Switching Points of the Switching Output (Output A1 and A2)

   Note that you can only change the settings via buttons within the first 5 minutes after switching the device on.

You can use the **T1** and **T2** keys to Teach-in two distances **SP1** and **SP2** for each output. One or two switching points are defined. You are free to choose the setting for SP1 and SP2. The sensor ensures internally that no invalid input can occur (e.g., through transposition of taught-in values).

Procedure:

1. Switch on the power supply on the device.

   ➟ The Teach-in process can be triggered within 5 minutes.

   T1 teaches in the switching points for **output A1**; **T2** teaches in the switching points for **output A2**.

2. Press T (> 2 s)
   ➟ The related yellow LED flashes (red LED flashes if no object is detected).
3. Align the object
4. Press the button briefly
   ➟ SP1 setting
5. Press and hold the button (approx. 2 s)
   ➟ SP2 setting

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➡ Green LED flashes 3x ➡ Setting completed

➡ Red LED flashes 3x ➡ Fault; repeat setting

The device always saves the distances internally such that the "Long range" and the "Close range" are set correctly - irrespective of the order of the teaching in.
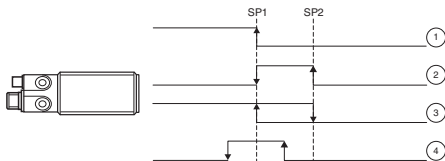
Image 4.1: Definition of the switching points dependent on the output function

(1)   Output function **<switching point>** (only **SP1** is considered.)

(2)   Output function **<window>**

(3)   Output function **<hysteresis>**

(4)   Output function **<reflex mode>** (only **SP1** is considered.)

4.3.2   Output Function of the Switching Output (Output A1 and A2)

You can use the buttons to set three different output functions:

- **<Switching point>**

  When an object approaches, the output switches ON at the set distance **SP1** (set: NO contact). Any set distance **SP2** is ignored.

- **<Window>**

  When an object approaches, the output switches ON at the set distance **SP2** and OFF again at **SP1**. (set: NO contact)

- **<Hysteresis>**

  When an object approaches, the output switches ON at the set distance **SP1**. If the object moves away again, the output switches OFF again at **SP2**. (set: NO contact)

- **<Reflex mode>**

  When an object approaches, the output switches ON at the set distance **SP1** + offset and OFF again at the distance **SP1** - offset. If no object is detected, the output switches ON. (Set: NO contact) Any set distance **SP2** is ignored.

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Procedure:

1. Switch on the power supply on the device.
   ➡ The Teach-in process can be triggered within 5 minutes.
   T1 teaches in the output function for output A1; T2 teaches in the output function for output A2.

2. Press and hold the T button (approx. 5 seconds)
   ➡ Green LED flashes
   1 x short flash = **Switching point mode**
   2 x short flashes = **Window mode**
   3 x short flashes = **Hysteresis mode**
   4 x short flashes = **Reflex mode**

3. Press the T button briefly
   ➡ The output function is advanced. The flashing of the green LED shows the output function selected.

4. Continue to press the T button until the required output function is selected.

5. To save the selected output function, press the button for longer than 2 seconds and then release.
   ➡ The sensor now switches to the setting for the output type (see 4.3.3).

> *To exit the setting of the output function without making any changes, press the button for longer than 10 seconds. The sensor switches to normal mode.*

4.3.3 Output Type of the Switching Output (Output A1 and A2)

<NO contacts> or <NC contacts> can be set.

Procedure:

1. Switch on the power supply on the device.
   ➡ The Teach-in process can be triggered within 5 minutes.
   T1 teaches in the output type for output **A1**; T2 teaches in the output type for output **A2**.

2. Press and hold the T button (approx. 5 seconds)
   ➡ Green LED flashes, display of output type set

3. Press the T button (approx. 2 seconds)
   ➡ Yellow LED flashes
   1 x short flash = **NO contact**
   2 x short flashes = **NC contact**

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4. Press the T button briefly
➟ The output type is advanced. The flashing of the yellow LED shows the output type selected.

5. Continue to press the T button until the required output type is selected.

6. To save the selected output type, press the button for longer than 2 seconds and then release.
➟ The sensor now switches to the setting for the sound cone width. (See 4.3.4)

To exit the setting of the output type without making any changes, press the button for longer than 10 seconds. The sensor switches to normal mode.

4.3.4 Sound Cone Width

The operating characteristics of the sensor can be set to three levels. This allows the device to be adapted to different applications. The detection ranges are not reduced.

The selection options available are:

• **Narrow sound cone**
• **Medium sound cone**
• **Wide sound cone**.
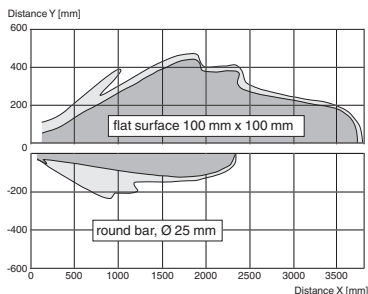
Image 4.2: Wide and narrow sound cone using the example of UC2000-30GM-...

Procedure:

1. Switch on the power supply on the device.
➟ The Teach-in process can be triggered within 5 minutes.
T1 or T2 set the sound cone width of the sensor.

2. Press and hold the T button (approx. 5 seconds)
➟ Green LED flashes (display of the output function set)

3. Press the T button (approx. 2 seconds)
   ➡ Yellow LED flashes (display of output type set)

4. Press the T button (approx. 2 seconds)
   ➡ Red LED flashes (display of the sound cone width set)
   1 x short flash = narrow sound cone
   2 x short flashes = medium sound cone
   3 x short flashes = wide sound cone

5. Press the T button briefly
   ➡ The sound cone width is advanced. The flashing of the red LED shows the sound cone width selected.

6. Continue to press the T button until the required sound cone width is selected.

7. To save the selected sound cone width, press the button for longer than 2 seconds and then release.
   ➡ The sensor now switches to normal mode.

> *To exit the setting of the output type without making any changes, press the button for longer than 10 seconds. The sensor switches to normal mode.*

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4.3.5   Summary of the Button Operation (UC***-30GM-2EP-IO-V15)

Setting the assured operating distances
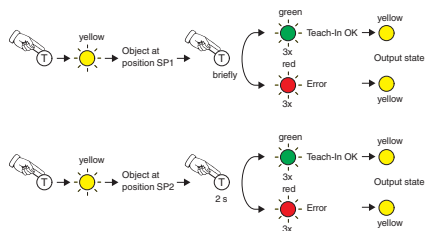
Extended configuration
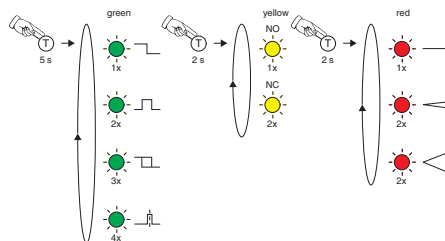
Default settings
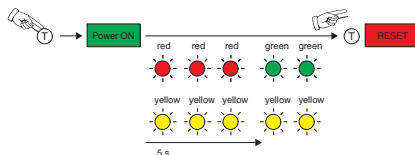
If the button is pressed for longer than 10 s, the command is canceled and the settings are retained.

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4.4 Sensors with 1 Switching Output + 1 Analog Output (UC***-30GM-IUEP-IO-V15)

4.4.1 Setting the Switching Output Switching Points (Output A1)

See 4.3.1; "Adjusting the Switching Points of the Switching Output (Output A1 and A2)" on page 12. You perform the setting with the T1 button.

4.4.2 Setting the Limits of the Analog Output (Output A2, Button T2)

Note that you can only change the settings via buttons within the first 5 minutes after switching the device on.

Using the T2 button, you can Teach-in a maximum of two distances **SP1** and **SP2**. This is the key data of the characteristics of the analog output. The "Close range" and "Long range" can be set as required. The sensor ensures internally that no invalid input can occur (e.g., through transposition of taught-in values).

Procedure:

1. Switch on the power supply on the device.
   ➡ The Teach-in process can be triggered within 5 minutes.
   T2 sets the limits for analog output A2.

2. Press T2 (> 2 s)
   ➡ Yellow LED L1 or L2 flashes

3. Align the object
   Press the **T2** button briefly ➡ SP1 setting
   Press and hold **T2** (approx. 2 s) ➡ SP2 setting
   ➡ Green LED flashes 3x ➡ Setting completed
   ➡ Red LED flashes 3x ➡ Fault; repeat setting

The device always saves the distances internally such that the "Long range" and the "Close range" are set correctly - irrespective of the order of the teaching in.
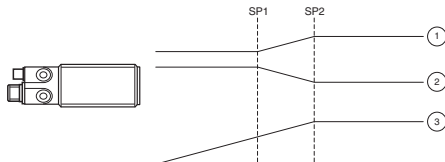
Image 4.3:   Definition of the limits of the analog output

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4.4.3 Output Function of the Switching Output (Output A1)

See 4.3.2; "Output Function of the Switching Output (Output A1 and A2)" on page 13.

4.4.4 Output Function of the Analog Output (Output A2)

You can use the T2 button to set three different output characteristics:

- **Rising characteristic**

  The analog value rises with the increasing distance between **SP1** and **SP2**. Below **SP1** and above **SP2**, the values remain constant.

- **Falling characteristic**

  The analog value falls with the increasing distance between **SP1** and **SP2**. Below **SP1** and above **SP2**, the values remain constant.

- **Zero point line**

  The analog value rises with increasing distance. The zero point of the straight line is at distance 0 mm. (Surface of the sensor) Any value set for **SP1** is ignored.
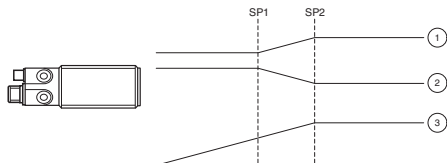
Image 4.4: Output functions of the analog output

(1) Rising characteristic between **SP1** and **SP2**

(2) Falling characteristic between **SP1** and **SP2**

(3) Zero point line; any value set for **SP1** is ignored.

Invalid values can occur in the blind zone!

Procedure:

1. Switch on the power supply on the device.
   ➠ The Teach-in process can be triggered within 5 minutes.
   T2 sets the characteristics for output A2.

2. Press and hold T2 (approx. 5 seconds)
   ➠ Green LED flashes (display of the output function selected)
   1 x short flash = Rising characteristic
   2 x short flashes = Falling characteristic
   3 x short flashes = Zero point line

3. Press the T2 button briefly
   ➠ The characteristic is advanced (the flashing of the green LED shows
   the characteristic selected).

4. Continue to press the T button until the required output characteristic is
   selected.

5. To save the selected output characteristic, press the button for longer
   than 2 seconds and then release.
   ➠ The sensor now switches to the setting for the output type (see 4.4.6).

> *To exit the setting of the output type without making any changes,*
> *press the button for longer than 10 seconds. The sensor switches*
> *to normal mode.*

4.4.5 Output Type of the Switching Output (Output A1)

See 4.3.3; "Output Type of the Switching Output (Output A1 and A2)" on
page 14. You perform the setting with the T1 button.

4.4.6 Output Type of the Analog Output (Output A2)

You can use the T2 button to set three different output types:

- **Current output**
  The difference is converted into current values in the range 4 mA ... 20 mA
  and output at output A2.

- **Voltage output**
  The difference is converted into voltage values in the range 0 V ... 10 V and
  output at output A2.

- **High impedance/not active**
  Analog output A2 is brought into a high impedance state (analog output
  deactivated).

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Procedure:

1. Switch on the power supply on the device.
   ➠ The Teach-in process can be triggered within 5 minutes.
   T2 sets the output type for output 2.

2. Press and hold T2 (approx. 5 seconds)
   ➠ Green LED flashes (display of the output characteristic set)

3. Press T2 (approx. 2 seconds)
   ➠ Yellow LED flashes (display of output type set)
   1 x short flash = **Current [mA]**
   2 x short flashes = **Voltage [V]**
   3 x short flashes = **High impedance/not active**

4. Press the T2 button briefly
   ➠ The output type is advanced (display of output type set)

5. Continue to press the T button until the required output type is selected.

6. To save the selected output type, press the button for longer than 2 seconds and then release.
   ➠ The sensor now switches to the setting for the sound cone width. (See 4.3.4).

> *To exit the setting of the output type without making any changes, press the button for longer than 10 seconds. The sensor switches to normal mode.*

4.4.7 Sound Cone Width

See 4.3.4; "Sound Cone Width" on page 15.

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4.4.8 Summary of the Button Operation (UC***-30GM-IUEP-IO-V15)

Setting the assured operating distances/analog limit values
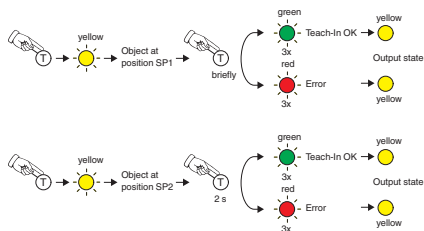
Extended configuration for switching output A1 (button T1)
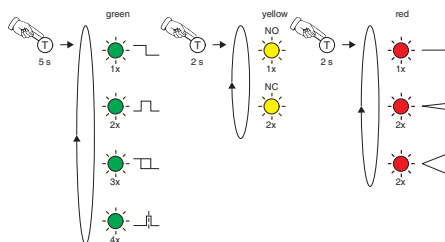
Extended configuration for analog output A2 (button T2)
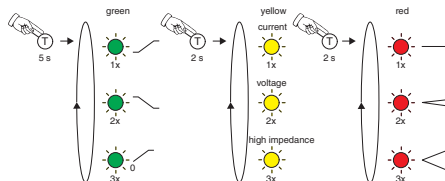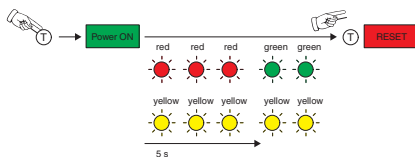
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Default settings

If the button is pressed for longer than 10 s, the command is canceled and the settings are retained.

5 IO-Link

The sensors correspond to the "Smart Sensor Profile".

5.1 Process Data

Process data is transferred as a 16-bit word.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AD13	AD12	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0	BD2	BD1
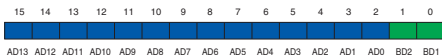
BD1:   Switching signal output **A1**   bool   \<true\> = output active
                                                                  \<false\>= output not active

BD2:   Switching signal output **A2**   bool   \<true\> = output active
                                                                  \<false\>= output not active

AD0...AD13:   Offset to object in [mm]   14-bit integer

Three forms of display (for the setting, see 5.6.11):

1.   \<MinDist\> - \<MaxDist\>   Distance from object, absolute [mm]
2.   0 ... 16000   Distance from object; normalized to end of detection range
3.   0 – 16000   Normalized between SP1 and SP2 of the analog output (see 5.6.6)

Fault values: 16383 (-1)   No echo;
                                                      object outside detection range

5.2 Summary of Commands

The following is a summary of the most important parameters of the UC….-30GM sensors. For a precise description, see Section 5.6. "Adjustable Parameters" on page 37. There you will also find the description of all possible parameters.

5.2.1 UC….-30GM-2EP-IO-V15; Two Switching Outputs

5.2.1.1   Setting the Assured Operating Distances

Output A1 (switching output 1)

Input of values in [mm]

BD1 - SET Point Value	**Index 0x3C hex**	
Switching point 1	BD1.SP1 (set point 1)	Subindex 0x01
Switching point 2	BD1.SP2 (set point 2)	Subindex 0x02

Output A2 (switching output 2)

Input of values in [mm]

BD2 - SET Point Value	**Index 0x3E hex**	
Switching point 1	BD2.SP1 (set point 1)	Subindex 0x01
Switching point 2	BD2.SP2 (set point 2)	Subindex 0x02

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5.2.1.2 Setting the Output Function

Output A1 (switching output 1)

BD1 - Switch Point Configuration	**Index 0x3D hex**	
Output function	BD1.SPC (switch point mode)	Subindex 0x02
	01 = Switching point	
	02 = Window mode	
	03 = Hysteresis mode	
	04 = Reflex mode	

Output A2 (switching output 2)

BD2 - Switch Point Configuration	**Index 0x3F hex**	
Output function	BD2.SPC (switch point mode)	Subindex 0x02
	01 = Switching point	
	02 = Window mode	
	03 = Hysteresis mode	
	04 = Reflex mode	

5.2.1.3 Setting the Output Type

Output A1 (switching output 1)

BD1 - Switch Point Configuration	**Index 0x3D hex**	
Switching type	BD1.SPC (switch point logic)	Subindex 0x01
	00 = NO contact / not inverted	
	01 = NC contact / inverted	

Output A2 (switching output 2)

BD2 - Switch Point Configuration	**Index 0x3F hex**	
Switching type	BD2.SPC (switch point logic)	Subindex 0x01
	00 = NO contact / not inverted	
	01 = NC contact / inverted	

5.2.2 UC...-30GM-IUEP-IO-V15; Switching Output + Analog Output

5.2.2.4 Setting the Assured Operating Distances/Analog Limit Values

Output A1 (switching output 1)

Input of values in [mm]

BD1 - Switch Point Value	**Index 0x3C hex**	
Switching point 1	BD1.SP1 (set point 1)	Subindex 0x01
Switching point 2	BD1.SP2 (set point 2)	Subindex 0x02

Output A2 (analog output)

Input of values in [mm]

AD - Analog Signal Set Point Value	**Index 0x42 hex**	
Analog value 1	AD.SP1 (set point 1)	Subindex 0x01
Analog value 2	AD.SP2 (set point 2)	Subindex 0x02

5.2.2.5   Setting the Output Functions

Output A1 (switching output)

BD1 - Switch Point Configuration	**Index 0x3D hex**	
Output function	BD1.SPC (switch point mode)	Subindex 0x02
	01 = Switching point	
	02 = Window mode	
	03 = Hysteresis mode	
	04 = Reflex mode	

Output A2 (analog output)

AD - Analog Signal Configuration	**Index 0x43 hex**	
Output function	Analog output signal mode	Subindex 0x02
	00 = Rising characteristic	
	01 = Falling characteristic	
	02 = Zero point line	

5.2.2.6   Setting the Output Type

Output A1 (switching output)

BD1 - Switch Point Configuration	**Index 0x3D hex**	
Switching type	BD1.SPC (switch point logic)	Subindex 0x01
	00 = NO contact / not inverted	
	01 = NC contact / inverted	

Output A2 (analog output)

Output Configuration (OCF)	**Index 0x70 hex**	
Analog type	Analog output type UI	Subindex 0x03
	00 = Current output [mA]	
	01 = Voltage output [V]	
	02 = High impedance / not active	

5.2.3   General Settings

5.2.3.7   Ultrasonic Sensor Window Width

Input of the values in [%] of set value A1 or A2; 1 % …. 50 %.

If output A2 is an analog output, a setting in subindex 0x02 influences only the process image.

Barrier Offset Configuration	**Index 0x40 hex**	
For output A1	Barrier offset channel 1	Subindex 0x01
For output A2	Barrier offset channel 2	Subindex 0x02

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5.2.3.8 Switching Output Time Functions

Input of the values in [number of function cycles] from 0 cycles … 255 cycles

If output A2 is an analog output, a setting in subindexes 0x03 and 0x04 influences only the process image.

Barrier Offset Configuration	**Index 0x41 hex**	
Output A1 ON delay	Switching signal 1 ON delay	Subindex 0x01
Output A1 OFF delay	Switching signal 1 OFF delay	Subindex 0x02
Output A2 ON delay	Switching signal 2 ON delay	Subindex 0x03
Output A2 OFF delay	Switching signal 2 OFF delay	Subindex 0x04

5.2.3.9 Output Configuration

Definition of the physical configuration of the outputs.

Depending on the device model, only the configuration of the second switching output or the analog output is considered.

Output Configuration (OCF)	**Index 0x70 hex**	
Configuration of A1 (switching output)	Output type Q1 00 = Push - pull output Other values are not allowed.	Subindex 0x01
Configuration of A2 (switching output)	Output type Q2 00 = Push - pull output 01 = Negative switching (NPN) 02 = Positive switching (PNP) 03 = High impedance / not active	Subindex 0x02
Configuration of A2 (analog output)	Analog output type UI 00 = Current output 01 = Voltage output 02 = High impedance / not active	Subindex 0x03

5.2.3.10 Sound Cone Width

The sound cone characteristic of the sensor is set. This characteristic applies for both outputs. This does not influence the detection range.

Measurement	**Index 0x61 hex**	
Sound cone	Beam width 00 = Narrow sound cone 01 = Medium sound cone 02 = Wide sound cone	Subindex 0x01

5.2.3.11 Synchronization

Multiple sensors can be switched via pin 5. This avoids mutual interference.

Synchronization	**Index 0x65 hex**	
Setting	Synchronization mode	Subindex 0x01
	00 = Switched off	
	01 = Immediate synchronization; no delay	
	02 = Synchronization starts with 1 s delay	
	03 = External synchronization	
	04 = Device is master; controls the synchronization	
	05 = Device is slave; is controlled	
Number of devices	Number of devices	Subindex 0x02
	2 devices … 10 devices are possible	

5.2.3.12 Temperature Compensation

The temperature compensation of the devices can be switched on or off.

Temperature	**Index 0x64 hex**	
Switch on/off	Temperature compensation	Subindex 0x01
	00 = Off	
	01 = On	

5.3 Index Assignment

5.3.1 Direct Parameters

Page 0:

	Address hex	Address dec	Name	Type	Data type	Value
Communication Parameters	0x00	0	Master Command	R/W	uint8	
	0x01	1	Master Cycle Time	R/W	uint8	
	0x02	2	Min. Cycle Time	R	uint8	UC500: 0x51 (13.2 ms) UC2000: 0x81 (33.6 ms) UC4000: 0x91 (59.2 ms) UC6000: 0x99 (72.0 ms)
	0x03	3	Frame Capability	R	uint8	0x01
	0x04	4	IO-Link Version ID	R	uint8	0x10
	0x05	5	Process Data In	R	uint8	0x50 (16 bit, SIO)
	0x06	6	Process Data Out	R	uint8	0x00
Validation Parameters	0x07	7	IO-Link Vendor ID 1 (MSB)	R	uint8	0x00
	0x08	8	IO-Link Vendor ID 2 (MSB)	R	uint8	0x01
	0x09	9	Device ID 1 (MSB)	R	uint8	0x30
	0x0A	10	Device ID 2 (MSB)	R	uint8	0x01
	0x0B	11	Device ID 3 (MSB)	R	uint8	UC500: 0x01 UC2000: 0x02 UC4000: 0x03 UC6000: 0x04
	0x0C	12	Function ID 1 (MSB)	R/W	uint8	0x00
	0x0D	13	Function ID 2 (LSB)	R/W	uint8	0x00

Page 1: Addresses 16 - 31 (0x10 - 0x1F hex)
Not supported

5.3.2 Device-Specific Indexes

Standard parameters

Index hex	Index dec	Name	Type	Data type	Data type
0x02	2	System command	W	uint8	See Table 0x02
0x0D	13	Profile ID	R	record	See Table 0x0D
0x0E	14	PD Input Descriptor	R	record	See Table 0x0E
0x10	16	Vendor Name	R	char[18]	Pepperl+Fuchs GmbH
0x11	17	Vendor Text	R	char[max. 32]	www.pepperl-fuchs.com/io-link
0x12	18	Product Name	R	char[max. 32]	<P+F standard> (32 characters)
0x13	19	Product ID	R	char[11]	<P+F standard> (11 characters)
0x14	20	Product Text	R	char[max. 32]	Ultrasonic Distance Sensor
0x15	21	Serial number	R	char[14]	<P+F standard> (14 characters)
0x16	22	Hardware Revision	R	char[7]	HWxx.xx<Release Code>
0x17	23	Firmware Revision	R	char[7]	FWxx.xx<Release Code>
0x18	24	Application-Specific Name	R/W	char[max. 32]	default: UC-30GM Series
0x20	32	Error Count	R	uint16	Not implemented
0x21	33	Last Event	R	octet string[3]	<last event qualifier and event code>
0x24	36	Device status	R	uint8	Not implemented <IOL-spec V1.1>
0x28	40	Process data input	R	uint16	<actual PD input value>
0x29	41	Process Data Output	R/W		<actual PD output value>

Table 0x02: System Command

Value hex	Value dec	Function
0x82	130	Restore factory settings

Table 0x0D: Profile ID

Subindex	Value	Function
1	0x0001	Smart Sensor Profile supported
2	0x8000	Device identification
3	0x8001	Binary data channel
4	0x8002	Process data variable

Table 0x0E: PD input descriptor

Subindex	Value	Function
1	SetofBool.2.0	Binary
2	SetofBool.2.0	Analog

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5.3.3 Device-Specific Parameters

Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0x3C		**BD1 - Set Point Value (BD1.SPV)**		record			
	0x01	BD1.SP1 (set point 1)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 10000	50 100 240 400	mm
	0x02	BD1.SP2 (set point 2)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 10000	500 2000 4000 6000	mm
0x3D		**BD1 - Switch Point Configuration (BD1.SPC)**		record			
	0x01	Switch point logic	R/W	uint8	0x00 - Non inverted 0x01 - Inverted	0x00	
	0x02	Switch point mode	R/W	uint8	0x01 - Single point mode 0x02 - Window mode 0x03 - Two point mode 0x80 - Barrier mode	0x01	
	0x03	Switch point hysteresis	R/W	uint16	0 … 50	1	%
0x3E		**BD2 - Set Point Value (BD2.SPV)**		record			
	0x01	SP1 (set point 1)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 10000	100 100 500 500	mm
	0x02	SP2 (set point 2)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 10000	250 1000 2000 3000	mm
0x3F		**BD2 - Switch Point Configuration (BD2.SPC)**		record			
	0x01	Switch point logic	R/W	uint8	0x00 - Non inverted 0x01 - Inverted	0x00	
	0x02	Switch point mode	R/W	uint8	0x01 - Single-point mode 0x02 - Window mode 0x03 - Two-point mode 0x80 - Barrier mode	0x01	
	0x03	Switch point hysteresis	R/W	uint16	0 … 50	1	%

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Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0x40		**Barrier Offset Configuration**		record			
	0x01	Barrier offset channel 1	R/W	uint8	1 …50	10	%
	0x02	Barrier offset channel 2	R/W	uint8	1 …50	10	%
0x41		**Switching Delay Configuration**		record			
	0x01	Switching signal 1 ON delay	R/W	uint8	0 ... 255	0	cycles
	0x02	Switching signal 1 OFF delay	R/W	uint8	0 ... 255	0	cycles
	0x03	Switching signal 2 ON delay	R/W	uint8	0 ... 255	0	cycles
	0x04	Switching signal 2 OFF delay	R/W	uint8	0 ... 255	0	cycles
0x42		**AD - Analog Signal Set Point Value**		record			
	0x01	SP1 (set point 1)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 10000	100 100 500 500	mm
	0x02	SP2 (set point 1)	R/W	uint16	35 to 1000 80 to 4000 200 to 8000 350 to 1000	250 1000 2000 3000	mm
0x43		**AD - Analog Signal Configuration**		record			
	0x01	Analog output signal mode	R/W	uint8	0x00 - Rising ramp 0x01 - Falling ramp 0x02 - Zero point ramp	0x00	
0x5F		**Measurement Data Collection**		record			
	0x01	Absolute distance evaluated	R	uint16	<value>		mm
	0x02	Echo amplitude (signal quality)	R	uint8	0 - 255		
	0x03	Switching signals	R	uint8	0x00: 1 inactive/2 inactive 0x01: 1 active/2 inactive 0x02: 1 inactive/2 active 0x03: 1 active/2 active		

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Operation mode/state

Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0x61		Measurement		record			
	0x01	Beam Width	R/W	uint8	0x00 - Small 0x01 - Medium 0x02 - Wide	0x02	
	0x02	Burst Time	R/W	uint8	0x00 - Automatic 0x01 - Short 0x02 - Long 0x03 - Dirac	0x00	
	0x03	Sensor Cycle Time	R/W	uint16	0, 7 - 65535 0, 15 - 65535 0, 30 - 65535 0, 45 - 65535	0	ms
	0x04	Measurement Mode	R/W	uint8	0x00 - Echo threshold detection 0x01 - Echo peak detection	0x00	
	0x05	Blind Range	R/W	uint16	0 to 980 0 to 3950 0 to 7900 0 to 9800	0	mm
	0x06	Range Reduction	R/W	uint16	0, 70 - 1000 0, 150 - 4000 0, 340 - 8000 0, 600 - 10000	0	mm
0x62		Evaluation		record			
	0x01	Evaluation method	R/W	uint8	0x00 - Direct 0x01 - Arithmetic average 0x02 - Low pass 0x03 - Adaptive filter	0x01	
	0x02	Arithmetic averaging: measurements & skip count	R/W	uint8	0x20 - M=2 N=0 0x30 - M=3 N=0 0x31 - M=3 N=1 0x40 - M=4 N=0 0x41 - M=4 N=1 0x50 - M=5 N=0 0x51 - M=5 N=1 0x52 - M=5 N=2 0x60 - M=6 N=0 0x61 - M=6 N=1 0x62 - M=6 N=2 0x70 - M=7 N=0 0x71 - M=7 N=1 0x72 - M=7 N=2 0x73 - M=7 N=3 0x80 - M=8 N=0 0x81 - M=8 N=1 0x82 - M=8 N=2 0x83 - M=8 N=3	0x52	

Index hex	Sub	Name	Type	Data type	Value	Default	Unit
	0x03	Low pass: weight	R/W	uint16	1 … 1000	100	
	0x04	Low pass: deviation	R/W	uint8	0 … 15	0	
	0x05	Low pass: skip count	R/W	uint8	0 … 15	0	
	0x06	Adaptive filter: first or max echo	R/W	uint8	0x00 - First echo 0x01 - Max. echo	0x01	
	0x07	Adaptive filter: width of acceptance window	R/W	uint8	0x00 - Narrow 0x01 - Normal 0x02 - Wide	0x01	
	0x08	No echo behavior	R/W	uint8	0x00 - Ignore 0x01 - Accept with delay 0x02 - Error with delay	0x00	
	0x09	No Echo On Delay	R/W	uint8	0 … 255	2	cycles
	0x0A	No Echo Off Delay	R/W	uint8	0 … 255	2	cycles
0x63		**PDControl - Distance Mode**		uint8	0x00 - Absolute distance 0x01 - Zero point ramp normalized 0x02 - Rising ramp normalized	0x00	
0x64		**Temperature**		record			
	0x01	Temperature compensation	R/W	uint8	0x00 - Disabled 0x01 - Enabled	0x01	
	0x02	Enabled: Temperature offset	R/W	uint8	-50 … 50	29 (IUEP) 20 (2EP)	°C
	0x03	Disabled: Fixed operating temperature for disabled temperature compensation	R/W	uint8	-25 … 70	25	°C
0x65		**Synchronization**		record			
	0x01	Synchronization Mode	R/W	uint8	0x00 - Disabled 0x01 - Cyclic quick start 0x02 - Cyclic standard 0x03 - External 0x04 - Master 0x05 - Slave	0x01	
	0x02	Number of Devices (for cyclic synchronization only)	R/W	uint8	2 … 10	5	

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Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0x66		**Error Handling**		record			
	0x01	Reaction Mode	R/W	uint8	0x00 - Ignore 0x01 - Warn 0x02 - Error 0x03 - Alarm	0x01	
	0x04	Output 1 Error State	R/W	uint8	0x00 - Freeze 0x01 - Closed 0x02 - Open	0x00	
	0x05	Output 2 Error State	R/W	uint8	0x00 - Freeze 0x01 - Closed 0x02 - Open	0x00	
	0x06	Analog Output Error State	R/W	uint8	0x00 - Freeze 0x01 - Current/voltage low 0x02 - Current/voltage high	0x00	
	0x07	Open Loop Detection	R/W	uint8	0x00 - Disabled 0x01 - Enabled (red LED is flashing)	0x00	
0x67		**Access Control**	R/W	uint8	0x00 - Local controls disabled in COM mode 0x01 - Local controls enabled in COM mode	0x00	

Standard operation control

Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0x70		**Output Configuration (OCF)**	R/W	record			
	0x01	Output Type Q1	R/W	uint8	0x00 - Push-pull 0x01 - 0xFF - not allowed	0x00	
	0x02	Output Type Q2	R/W	uint8	0x00 - Push-pull 0x01 - Low side 0x02 - High side 0x03 - Hi-Z/n.a.	0x00	
	0x03	Analog output type UI	R/W	uint8	0x00 - I output 0x01 - U output 0x02 - Hi-Z/n.a.	0x00	
0x71		**Local Controls (LOC)**	R/W	uint8	0x00 - Unlocked (locked in COM) 0x01 - Locked 0x02 - Time locked (locked in COM)	0x02	
0x7F		**Locator Indication Control (LIC)**	R/W	uint8	0x00 - Normal indication 0x01 - Locator indication	0x00	
0xC0		**User Tag 1 (UT1)**	R/W	uint32	0x00000000 ... 0xFFFFFFFF	0	
0xC1		**User Tag 2 (UT2)**	R/W	uint16	0x0000 ... 0xFFFF	0	

Special function

Index hex	Sub	Name	Type	Data type	Value	Default	Unit
0xE0		**System Time**	R	uint32	0 s … 4294967295 s		
0xE1		**Operating Temperature**	R	uint8			°C
0xE8		**Device characteristics**					
	0x01	Position range min	R	uint16	35 80 200 350		mm
	0x02	Position range max	R	uint16	500 2000 4000 8000		mm

5.4 "Direct Parameters" Page

This page describes the parameters that are generally valid for the use of ultrasonic sensors. For the precise description of all parameters, see the current IO-Link specification.

Address 0x02 Min. Cycle Time
Minimum cycle time in which the sensors can communicate.
This parameter is dependent on the detection range and cannot be changed.

Address 0x04 IO-Link Version ID
Version of the current IO-Link specification

Address 0x07 IO-Link Vendor ID1

Address 0x08 IO-Link Vendor ID2
Sensor manufacturer; ID 0001 = Pepperl+Fuchs

Address 0x09 Device ID 1 (MSB)

Address 0x0A Device ID 2

Address 0x0B Device ID 3 (LSB)

Sensor type;   00 00 01 : UC500
                    00 00 02 : UC2000
                    00 00 03 : UC4000
                    00 00 04 : UC6000

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5.5 Device-Specific Indexes

This section describes only those parameters that are generally valid for the use of ultrasonic sensors. For the precise description of all parameters, see the current IO-Link specification.

Index 0x0D	**Profile ID**	
	Subindex 1:	Smart Sensor Profile supported
		The ultrasonic sensor supports the "Smart Sensor Profile"
Index 0x10	**Vendor Name "Pepperl+Fuchs GmbH"**	
Index 0x11	**Vendor Text "www.pepperl-fuchs.com/io-link"**	
	These texts are fixed and cannot be changed.	
Index 0x12	**Product Name**	Model number of the ultrasonic sensor
Index 0x13	**Product ID**	Order number
Index 0x14	**Product Text "Ultrasonic Distance Sensor"**	
Index 0x15	**Serial number**	
	Sequential serial number of the sensor. The number is unique and identifies the sensor.	
Index 0x18	**Application Specific Name** default: **"UCxxxx-30GM-xxEP-IO-V15"**	
	This parameter describes the sensor more precisely.	
	This enables the sensor to be assigned to an application.	
	The text (max. 32 characters) can be changed by the user.	

5.6 Adjustable Parameters

The following describes the individual parameters in detail. The order corresponds to the index of the IO-Link IODD.

5.6.1 Assured Operating Distances for Output A1 or A2 (BD1 or BD2)

Here, the switching thresholds for output A1 or output A2 are set. The function of the output depends on how it is configured (see 5.6.2).

If the sensor has an analog output, output A2 is not available as a switching output. In this case, any settings undertaken for output A2 are visible only in the process image.

Index:
0x3C (60 dec) BD1 - Set Point Value (BD1.SPV)Output A1

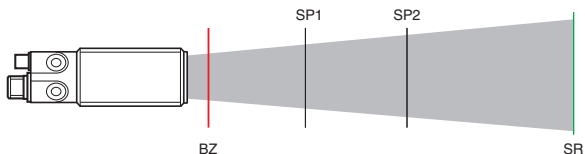| Subindex 0x01:	BD1.SPV (set point 1):	SP1
Subindex 0x02:	BD1.SPV (set point 2):	SP2

Index:
0x3E (62 dec) BD2 - Set Point Value (BD2.SPV)Output A2

Subindex 0x01:	BD1.SPV (set point 1):	SP1
Subindex 0x02	BD1.SPV (set point 2):	SP2

BZ = Blind zone according to data sheet/catalog

SR = End of the detection range according to data sheet

5.6.2 Switching Signal Configuration Output A1 or A2 (DB1 or DB2)

Here, various functions for output 1 or output 2 are set.

Index: 0x3D (61 dec)	BD1 - Set Point Configuration (BD1.SPC) Output A1		
Subindex 0x01:	BD1.SPC (switch point logic)	0x00	Not inverted (factory setting)
		0x01	Inverted
Subindex 0x02:	BD1.SPC (mode)	0x01	Single point mode (factory setting)
		0x02	Windows mode
		0x03	Two point mode
		0x80	Reflex mode (barrier mode)
Subindex 0x03:	BD1.SPC (hysteresis)	0 to 50	
Index: 0x3F (63 dec)	BD2 - Set Point Configuration (BD2.SPC) Output A2		
Subindex 0x01:	BD2.SPC (switch point logic)	0x00	Not inverted (factory setting)
		0x01	Inverted
Subindex 0x02:	BD2.SPC (mode)	0x01	Single point mode (factory setting)
		0x02	Windows mode
		0x03	Two point mode
		0x80	Reflex mode (barrier mode)
Subindex 0x03:	BD2.SPC (hysteresis)	0 to 50	

5.6.3 Switching Type Output A1 or A2 (Subindex 0x01 - SPC (Switch Point Logic))

For sensors with an analog output, any value set for output 2 is ignored. In this case, the status of the second switching output can be accessed logically only via the process data.

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A choice of two types is available:

Not inverted (NO contact function)

The BD1 or BD2 bit in the process data is set to <true> if an object is within the assured operating distances set by SP1 and SP2. In all other cases, the BD1 or BD2 bit = <false>.

Inverted (NC contact function)

The BD1 or BD2 bit in the process data is set to <false> if an object is within the assured operating distances set by SP1 and SP2. In all other cases, the BD1 or BD2 bit = <true>.

5.6.3.13 Output Function Output A1 or A2 (Subindex 0x02 - SPC (mode))

For sensors with an analog output, any value set for output A2 is considered in the process image.

A choice of four functions is available:

Single point mode (switching point mode)
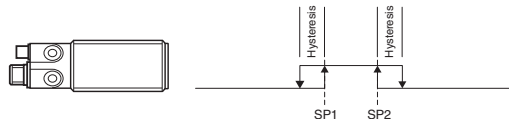
The output switches when an object is closer to the sensor than SP1. Any value set in SP2 is ignored.

Windows mode

The output switches when an object is between SP1 and SP2.

Two point mode (hysteresis mode)

The output switches when an object is closer to the sensor than SP1 and switches back again once the object has moved farther away from the sensor than SP2.

Reflex mode (barrier mode)

The output switches when an object is within a range around SP1 defined by SP1 and the "barrier offset" (corresponds to window mode with a defined window width).
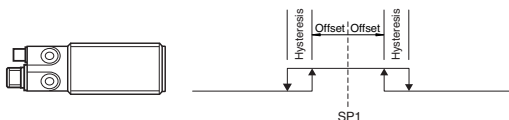
5.6.3.14 Hysteresis Output A1 (Subindex 0x03 - SPC (Hysteresis))

The value of the output hysteresis is specified in % of the switching point set. The range is 0 % ... 50 % of the set value of the switching point.

5.6.4 Parameters for the Reflex Mode (Barrier Offset)

Index: 0x40 (64 dec)	Barrier Offset Configuration		
Subindex 0x01:	Window width A1	Value: 1 % … 50 %	Output A1
Subindex 0x02:	Window width A2	Value: 1 % … 50 %	Output A2

This value can be used to set the width of the detection window in reflex mode for each switching output. The value is specified in [%] of the set offset value.

For sensors with an analog output, any value set for output A2 (barrier offset channel 2) is ignored.

5.6.5 Timer Function for the Switching Outputs of Output A1 or A2

For sensors with an analog output, any value set for output 2 is ignored.

Index: 0x41 (65 dec)	Switching Delay Configuration		
Subindex 0x01:	ON delay A1	Value: 0 cycles … 255 cycles	Output A1
Subindex 0x02:	OFF delay A1	Value: 0 cycles … 255 cycles	Output A1
Subindex 0x03:	ON delay A2	Value: 0 cycles … 255 cycles	Output A2
Subindex 0x04:	OFF delay A2	Value: 0 cycles … 255 cycles	Output A2

Here, an ON delay or an OFF delay can be set for switching outputs A1 or A2. The times are specified as multiples of the cycle time of the sensor. The corresponding cycle times can be read at **Address 0x02 of the "Direct Parameters"**.

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5.6.6 Analog Output Limit Values

In addition to the switching output (output A1), the devices in the UC…-30GM-IUEP-IO-V15 series have an analog output (output A2).

Index: 0x42 (66 dec)	AD - Analog Signal Set Point Value
Subindex 0x01:	SP1 (set point 1) [mm]
Subindex 0x02:	SP2 (set point 2) [mm]

The values are specified in [mm] and can be within the detection range. The values depend on the device used and can be queried via the "Device Characteristics" parameters.

Index: 0xE8 (232 dec)	Device characteristics
Subindex 0x01:	Blind zone
Subindex 0x02:	End of the detection range

Here the values are displayed according to the data sheet.

5.6.7 Characteristics of the Analog Output

The analog output can be operated in different characteristics. The value influences the voltage or current value output at output A2. The value transferred in the process image is influenced by **Index 0x63 "PDControl Distance Mode"** (see 5.6.11).

Index: 0x43 (67 dec)		AD - Analog Signal Configuration
Subindex 0x01	0x00	Rising characteristic
	0x01	Falling characteristic
	0x02	Zero point line

0x00 Rising characteristic

The voltage or current value at output A2 rises with the increasing distance. The minimal analog value is reached at SP1 (set point 1), and the maximum analog value at SP2 (set point 2).

The distance does not affect the output value.

0x01 Falling characteristic

The voltage or current value at output A2 falls with the increasing distance. The maximum analog value is reached at SP1 (set point 1), and the minimum analog value at SP2 (set point 2).

The distance does not affect the output value.

0x02 Zero point line

The voltage or current value at output A2 rises with the increasing distance. Here, the minimum analog value is based on the transducer surface (0 mm). The maximum analog value is reached at SP2 (set point 2). Any value set for SP1 (set point 1) is ignored.

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5.6.8 Summary of the Output Data

Index: 0x5F (95 dec)	**Measurement Data Collection**
Subindex 0x01	Measured distance in [mm]
Subindex 0x02	Echo amplitude between 0 … 255
Subindex 0x03	Status of outputs A1 and A2

The values specified here indicate the internal state. They are always present - regardless of the hardware configuration of the actual device.

Subindex 0x01 Measured Distance

Current distance in [mm]

Subindex 0x02 Echo Amplitude

Echo amplitude of the current signal measured. The amplitude is scaled to a value range from 0 … 255.

Subindex 0x03 Status of the Outputs

The logical status of the outputs can be read:

0x00	A1 not active	A2 not active
0x01	A1 active	A2 not active
0x02	A1 not active	A2 active
0x03	A1 active	A2 active

5.6.9 Measurement Parameters

Index: 0x61 (97 dec)	**Measurement**	
Subindex 0x01	Beam Width	Sound Cone Width
Subindex 0x02	Burst Time	Type and duration of the send signal
Subindex 0x03	Sensor Cycle Time	Sensor cycle time
Subindex 0x04	Measurement Mode	Type of evaluation
Subindex 0x05	Blind Range	Blind zone amplification
Subindex 0x06	Range Reduction	Reduction in the detection range

Subindex 0x01 Sound Cone Width

The sensor characteristic is set here. By adapting internal values, the sensitivity of the sensor can be changed for lateral approach. This creates the impression that the width of the sound cone changes.

0x00	Narrow sound cone
0x01	Medium sound cone
0x02	Wide sound cone (factory setting)

This characteristic can be set via the buttons using Teach-in, see 4.3.4.

Subindex 0x02 Type and Duration of the Send Signal

A change in this parameter enables the sensor to change its specified guaranteed detection ranges. This means that list specifications may no longer be met.

0x00	Automatic adjustment of the send signal (recommended, factory setting)
0x01	Short send signal (reduction in the detection range possible)
0x02	Long send signal
0x03	Very short send signal ("Dirac"; reduction in the detection range possible)

Subindex 0x03 Cycle Time of the Sensor

This parameter can be used to change the measuring cycle of the sensor. The measuring cycle can be extended to a maximum of 65535 ms, in which case a measurement is performed only every 65.5 s.

Attention:

A reduction in the cycle time can lead to sensor malfunctions.

Subindex 0x04 Type of Runtime Evaluation

Two types of runtime evaluation of the echo are possible:

0x00	Threshold detection The echo signal is compared with an internally generated threshold and the runtime is determined when this threshold is exceeded.
0x01	Peak value detection The echo signal is differentiated and the runtime above the peak value of the echo is determined.

Subindex 0x05 Blind Zone Amplification

The blind zone (prohibited area directly in front of the sensor) specified in the list can be amplified. This enables smaller, interfering objects in front of the sensor to be hidden.

When the desired object enters this area, it is no longer detected!

Subindex 0x06 Reduction in the Detection Range

The detection range specified in the list can be reduced. This enables interfering objects that are farther away than the desired object to be hidden. When the desired object enters this area, it is no longer detected!

5.6.10 Evaluation

Index: 0x62 (98 dec)   Evaluation

Subindex 0x01	Type of Evaluation
Subindex 0x02	Parameters for Formation of Mean Values
Subindex 0x03	Low-Pass Filtering: Weighting Factor
Subindex 0x04	Low-Pass Filtering: Acceptance Window
Subindex 0x05	Low-Pass Filtering: Suppressed Measuring Cycles
Subindex 0x06	Adaptive Filter Evaluation Method
Subindex 0x07	Adaptive Filter Width
Subindex 0x08	Reaction to "No Echo"
Subindex 0x09	ON Delay for "No Echo"
Subindex 0x0A	OFF Delay for "No Echo"

Subindex 0x01 Type of Evaluation

Four different evaluation methods are available. Depending on the method, they improve the detection of the desired objects and can prevent faults reliably.

Index: 0x62 (98 dec)   Evaluation

0x00	Direct evaluation with no filters applied	
0x01	Arithmetic mean value filter	Arithmetic mean value filter
0x02	Low-pass filter	Setting via subindex 0x03, 0x04, and 0x05
0x03	Adaptive filter	Setting via subindex 0x06 and 0x07

Subindex 0x02 Parameters for Arithmetic Mean Value

An initial mean value is calculated from the **M** last measured values.

From these **M** measured values, the number of **N** measured values with the greatest deviation are removed and from the remaining **M-N** measured values, the mean value is transferred as the measured result.

The following values pairs are possible:

0x20	M=2	N=0						
0x30	M=3	N=0	0x31	M=3	N=1			
0x40	M=4	N=0	0x41	M=4	N=1			
0x50	M=5	N=0	0x51	M=5	N=1	0x52	M=5	N=2
0x60	M=6	N=0	0x61	M=6	N=1	0x62	M=6	N=2
0x70	M=7	N=0	0x71	M=7	N=1	0x72	M=7	N=2
0x73	M=7	N=3						
0x80	M=8	N=0	0x81	M=8	N=1	0x82	M=8	N=2
0x83	M=8	N=3						

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Subindex 0x03	Parameters for Low-Pass Filtering: Weighting Factor (W)	Range 1 ... 1000
Subindex 0x04	Parameters for Low-Pass Filtering: Acceptance Window (D)	Range 0 ... 15
Subindex 0x05	Parameters for Low-Pass Filtering: Suppressed Measuring Cycles (S)	Range 0 ... 15

The low-pass filter calculates the measurement result from the previous measurement result and the current measured value according to the following formula:

Measurement result_new = (measurement result_old * W + measured value * 10) / (W + 10)

An acceptance window (D) can be used as an option. Measured values that are outside the acceptance window (D) around the current measurement result are suppressed for a certain number (S) of measuring cycles before they are included in the evaluation calculation.

Weighting factor	W	Range 1 ... 1000
Acceptance window	D	Range 0 ... 15 [%]
Number of measuring cycles to be suppressed	S	Range 0 ... 15

Subindex 0x06	**Adaptive Filter Evaluation Method**	
0x00	First echo	
0x01	Largest echo (echo amplitude)	

Subindex 0x07	**Adaptive Filter Width**	
0x00	Narrow filter	Offset ± 0.8 %
0x01	Standard width of the filter	Offset ± 1.6 %
0x02	Wide filter	Offset ± 3.2 %

The **adaptive filter** always selects the three strongest echoes of a measurement and checks whether they have occurred in the past four measuring cycles of a certain acceptance window. If this is the case, the related echo amplitudes are added up and at the end of the evaluation, the strongest or first echo is selected. In the "Evaluation Method" parameter, you can select whether the sensor responds to the "first echo" or the "largest echo." If an echo does not appear for one or more cycles, its historic measurements are still considered and the related amplitudes are added up and included in the further evaluation.

Example:

"Wide Filter" setting for an object offset of 3000 mm.
The acceptance window is thus approx. ± 96 mm, meaning that only echoes in the range from 2904 mm to 3096 mm are accepted.
Other echoes are hidden.

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Subindex 0x08 Reaction to "No Echo"

This parameter allows you to configure how the sensor behaves if it does not detect any echo signal, since under certain circumstances, the loss of the echo represents an error condition.

0x00	Ignore
	The sensor ignores an echo loss. The evaluation continues.
0x01	Accept with delay
	An echo loss is delayed by a given number of measuring cycles and only subsequently included in the evaluation. This enables individual signal losses to be suppressed.
0x02	Error with delay
	An echo loss is delayed by a given number of measuring cycles and then triggers a fault (red LED lights up).
	If the sensor is in communication mode, an IO-Link event is generated
	(see 5.6.24).

Subindex 0x09 ON Delay for "No Echo" Range 0 ... 255

Number of measuring cycles by which the signal loss is delayed or suppressed.

Subindex 0x0A OFF Delay for "No Echo" Range 0 ... 255

Number of measuring cycles in which the signal loss must be at least delayed.

5.6.11 Format of the Process Data; Distance Values

Index: 0x63 (99dec) PDControl Distance Mode

This parameter enables the presentation of the process data to change.

Possible settings for the distance value output:

0x00	Distance as absolute value in [mm] (factory setting)
	The measured distance is always given in mm. If no echo is detected, the corresponding fault value is displayed (see 5.1).
0x01	Zero point line; normalized
	The measured distance to the object normalized to the value range 0 ... 16000, whereby the maximum value corresponds to the end of the detection range (e.g., 500 mm for UC500).
0x02	Rising characteristic; normalized
	If the rising characteristic is selected, the object offset in the area between SP1 and SP2 of the analog output under 5.6.6 (also for version 2EP) is normalized to the value range 0 ... 16000.
	This means that the output of the process data can be mapped to a user-defined area.

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5.6.12 Temperature Compensation

Index: 0x64 (100 dec)	Temperature
Subindex 0x01	Temperature compensation ON/OFF
Subindex 0x02	ON: Temperature offset for the compensation
Subindex 0x03	OFF: Specification of a fixed temperature

Subindex 0x01	Temperature compensation
Subindex 0x00	Switched off; no automatic temperature compensation
Subindex 0x01	Switched on (factory setting)

This setting can be used to activate or deactivate the temperature compensation.

If the temperature compensation is active, the Temperature Offset parameter describes the internal temperature increase of the device, enabling the sensor to derive the current ambient temperature. This calculated ambient temperature can be queried as described under 5.6.21.

If the ambient temperature is constant, a fixed ambient temperature can be specified (see below).

Subindex 0x02 Temperature Offset for the Compensation Range -50 [°C] ... +50 [°C]

This parameter specifies the temperature offset for the calculation of the ambient temperature.

This temperature describes the actual internal temperature increase in the sensor and is used to calculate the current ambient temperature.

Subindex 0x03 Specification of a Fixed Temperature Range -25 [°C] ... +70 [°C]

If the temperature compensation is deactivated, the temperature set on this index is used to correct the sound runtime. This means that the temperature can be fixed, increasing the measurement accuracy of the runtime measurement at constant ambient temperature.

5.6.13 Synchronization

Index: 0x65 (101 dec)	Synchronization	
Subindex 0x01	Synchronization mode	Type of synchronization
Subindex 0x02	Number of devices	Number of devices

Subindex 0x01	Type of synchronization
0x00	Synchronization switched off
0x01	Multiplex mode; fast (factory setting)
0x02	Multiplex mode; standard
0x03	External synchronization
0x04	Sensor is master
0x05	Sensor is slave

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- **Multiplex mode**

Multiple sensors (max. 10) can be synchronized by simply connecting their synchronization inputs. In this case, the sensors synchronize themselves one after the other in multiplex mode. Only one sensor sends signals at any one time.

- **External synchronization**

Several sensors can be controlled collectively by an external signal. In this case, the sensors are triggered in parallel and operate synchronously, i.e., at the same time. All sensors must be parameterized via the sensor interface so that they are set to external.

- **Master/slave operation**

Multiple sensors (max. 10) can be synchronized by simply connecting their synchronization inputs. The sensor interface can be used to parameterize the sensors so that one functions as a master and the others function as slaves. In this case, the sensors in master/slave mode work synchronously, i.e., in synchronization, whereby the master sensor plays the role of an intelligent external impulse generator.

Subindex 0x02 Number of Devices Range 2 ... 10

The number of devices connected is specified here.

5.6.14 Troubleshooting

Index: 0x66 (102 dec) Troubleshooting

The behavior of the sensor on detection of an error condition can be defined under this index.

Subindex 0x01 Type of Reaction to Fault

There are four different reaction modes that can be set:

0x00	Ignore	Any fault that occurs is ignored and displayed neither via LED nor via the command interface. The sensor continues to work in normal mode.
0x01	Warn	If a fault occurs, the red LED lights up. An event is also set via IO-Link (5.6.24) and the outputs maintain their current state.
0x02	Error	If a fault or error occurs, the red LED lights up and an event is generated via IO-Link. The outputs take on the "Error state" configured below.
0x03	alarm	The behavior corresponds to that for the "Error" setting. In addition, IO-Link is informed that the sensor process data is invalid. If this setting is used, the plant behavior on receipt of invalid process data must be clarified in advance.

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Subindex 0x02 Behavior of Output A1

This parameter defines the behavior of output A1 in the event of a fault (for the Error and Alarm settings only).

0x00	Remain	The output retains the last valid state.
0x01	Closed	The output switches on (setting: NO contact)
0x02	Open	The output switches off (setting: NO contact)

Subindex 0x03 Behavior of Output A2

This parameter defines the behavior of output A2 in the event of a fault (for the Error and Alarm settings only).

0x00	Remain	The output retains the last valid state.
0x01	Closed	The output switches on (setting: NO contact)
0x02	Open	The output switches off (setting: NO contact)

Subindex 0x04 Behavior of Analog Output A2

This parameter defines the behavior of the analog output when a fault is detected (for the Error and Alarm settings only).

0x00	Remain	The analog output retains the last valid value.
0x01	Current/voltage low	Depending on the output configuration, the analog output outputs the maximum voltage or the maximum current.
0x02	Current/voltage high	Depending on the output configuration, the analog output outputs the minimum voltage or the minimum current.

Subindex 0x05 Lead Breakage Detection

This parameter can be used to activate the lead breakage detection when the current output is used. If a lead breakage is detected, the red LED flashes.

0x00	Inactive	Lead breakage detection is deactivated.
0x01	Active	Lead breakage detection is activated.

5.6.15 Releasing Controls during Communication

Index: 0x67 (103 dec) Access Control

This setting enables temporary access to the sensor controls during communication. The standard setting is that no operation with buttons is possible during communication.

If a parameter is changed by operation, the sensor triggers an IO-Link event (see 5.6.24).

Since this parameter is not saved, once the supply voltage has been switched off, the factory setting is active (controls locked).

0x00	Controls on the sensor are locked during communication (factory setting)
0x01	Controls are released during communication.

5.6.16 Physical Output Configuration

Index: 0x70 (112 dec) Access Control

Subindex 0x01	Output Configuration Output A1
Subindex 0x02	Output Configuration Output A2
Subindex 0x03	Output Configuration Analog Output A2

Subindex 0x01 Output Configuration Output A1

0x00	"Push-pull"; the output switches both positively and negatively (pnp/npn) (factory setting)

All other values are not allowed.

Subindex 0x02 Output Configuration Output A2

0x00	"Push-pull"; the output switches both positively and negatively (pnp/npn) (factory setting)
0x01	Negative switching output (npn)
0x02	Positive switching output (pnp)
0x03	High impedance output (no function)

Subindex 0x03 Output Configuration Analog Output A2

0x00	Current output 4 mA ... 20 mA (factory setting)
0x01	Voltage output 0 V ... 10 V
0x02	High impedance output (no function)

5.6.17 Operating Controls

Index: 0x71 (113 dec) Local Controls (LOC)

0x00	Operation released on sensor; Teach-in buttons active
0x01	Operation locked on sensor; local setting not possible
0x02	Time lock active (factory setting)

If "Time lock active" is set, settings can be entered with the buttons only within the first five minutes after switching the device on. The buttons are then locked. The time is extended each time a button is pressed, i.e., the buttons are locked five minutes after the last press of a button.

The controls are generally locked during the IO-Link communication. They can be activated temporarily (see 5.6.15).

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5.6.18 Locator Function

Index: 0x7F (127 dec) Locator Indication Control (LIC)

0x00	Normal LED function; corresponding to the sensor function (factory setting)
0x01	LEDs are used as "locators."

This function makes it possible to find and identify a sensor in a large plant. After activation of the "locator function," all yellow and green LEDs flash in a characteristic pattern.
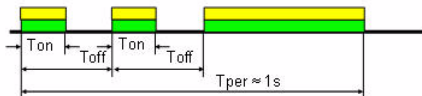
5.6.19 User-Specific Identifiers

Index: 0xC0 (192 dec)User Tag 1 (UT1) max. 32 bits
Index: 0xC1 (193 def)User Tag 2 (UT2) max. 16 bits

Here the user can define data for identifying the sensor within his project.

5.6.20 System Time

Index: 0xE0 (224 dec) System Time

Sensor runtime since Power-On [s]

5.6.21 Sensor Temperature

Index: 0xE1 (225 dec) Operating Temperature

Current ambient temperature used internally for compensation

5.6.22 Sensor Detection Range

Index: 0xE8 (232 dec) Device Characteristics

0x01	Blind zone
0x02	End of the sensing range

5.6.23 Analog Output Present

Index: 0xEF (239 dec) Feature Flag

Indicates whether an analog output is present on output A2. This bit is set for types UC….-30GM-IUEP-IO-V15.

5.6.24 Event Codes via IO-Link

Depending on the parameterization, the sensor sets some events via IO-Link. These are available only in communicative operation. The following events are possible:

Standard Application Events:	Type	Mode	Event Qualifier	Event Code	Details
Parameter changed	Message	Single shot	0x54	0x6350	A parameter was changed via the controls
Pepperl+Fuchs defined Application Events:					
Hardware Error	Error	Appear	0xF4	0x5010	A device fault has occurred
Hardware Error	Error	Disappear	0xB4	0x5010	The device fault no longer exists
No Echo Error	Warning	Appear	0xF4	0x8CA4	The sensor has lost the echo signal
No Echo Error	Warning	Disappear	0xB4	0x8CA4	The sensor is receiving an echo again

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