

Manual

Inclination sensor GIM500R with analog interface

Firmware version 1.00 and up

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At any time we should be pleased receiving your comments or proposals for further improvement of the present manual.

Created by:

Baumer IVO GmbH & Co. KG

Villingen-Schwenningen, Germany

1 Introduction

1.1 Scope of delivery

Please check the delivery upon completeness prior to commissioning.

Depending on sensor version and purchase order, the delivery may include:

- Sensor
- manual (also available for download at www.baumer.com)

2 Safety and operating instructions

Intended use

- The inclination sensor is a precision measuring device to determine angular positions and to supply the downstream device with measured values in the form of electronic output signals. The inclination sensor must not be used for any other purpose.
- Make sure the appropriate safety measures are present to prevent damage to persons, the system or operating facilities in case of sensor error or failure.

Personnel qualification

- The inclination sensor must only be installed by a qualified electronics and precision mechanics.
- Observe the user manual of the machine manufacturer.

Maintenance

- The inclination sensor is maintenance-free and must not be opened or modified in its electronics or mechanical design. Opening the sensor can lead to personal injury.

Disposal

- The inclination sensor contains electronic components. At its disposal, local environmental guidelines must be followed.

Installation

- Avoid mechanical impacts or shocks on the housing.

Electrical commissioning

- Do not perform any electrical modifications at the inclination sensor.
- Do not carry out any wiring work when the inclination sensor is live.
- Do not dock or undock the electrical connection while the inclination sensor is live.
- Ensure that the entire equipment is installed in line with EMC requirements. Ambient conditions and wiring affect the electromagnetic compatibility of the inclination sensor. Install sensor and supply cables separately or far away from lines with high interference emissions (frequency converters, contactors, etc.).
- Provide separate power supply for the inclination sensor where working with consumers that have high interference emissions.
- Completely shield the inclination sensor housing and connecting cables.
- Connect the sensor to protective earth (PE) using shielded cables. The braided shield must be connected to the cable gland or connector. Ideally, aim at a bilateral connection to protective earth (PE), the housing via the mechanical assembly and the cable shield via the downstream devices. In case of earth loop problems, earth on one side only as a minimum requirement.

Supplementary information

- This manual is intended as a supplement to already existing documentation (i.e. catalogue, product information and mounting instruction).

3 Analog interface communication

3.1 Analog interface properties

- Supply voltage 8...36 VDC
- Sensor is protected against reverse polarity and short circuiting.
- Initialization time after power on ≤ 0.5 s
- Operating current with no load is inferior to 40 mA, at 24 VDC
- Several analog signal outputs 4...20 mA / 0.5...4.5 V / 0...5 V / 0...10 V
- Load resistance ≥ 1 k Ω / voltage output resp. ≤ 800 Ω / current output
- Different sensing ranges, 1 and 2 dimensional
- Resolution 12 bit
- Temperature coefficient 0.008 °/K
- Precision: (+25 °C) typical $\pm 0.1^\circ$
- Scanning frequency 1600 Hz
- Limit frequency 0.1...25 Hz, 2nd order / deep-pass filter (default: 5 Hz)
- Programmable parameters: preset and offset value resp. filter
- Diagnostic function to identify parameterization errors

3.2 Installation position

The mounting position is of critical importance for the measured signal values. Depending on the mounting position of the inclination sensor and the movement in the application, the analog signal values will increase or decrease.

3.2.1 Installation position 1-dimensional

When installing the 1-dimensional inclination sensor, observe the rotation axis shown below is directed in perpendicular position towards gravity. The maximum misalignment of $\pm 3^\circ$ must not be exceeded. The sensor default position is 0° as shown in the illustration below but may be configured at will in a 2-point teaching or zeroing operation.



Default 0°



Measured value 90°



Measured value 180°



Measured value 270°

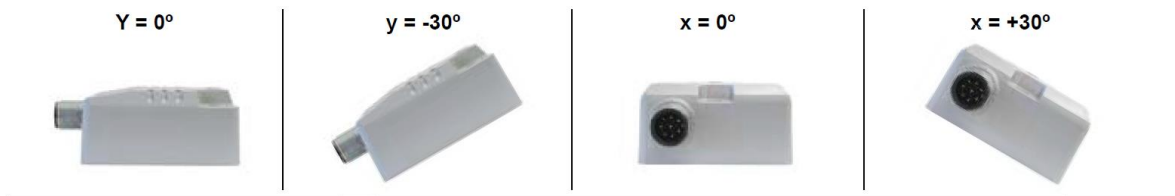


3.2.2 Installation position: 2-dimensional

Inclination sensor GIM500R can be installed both in horizontal and vertical position (according to the default settings).

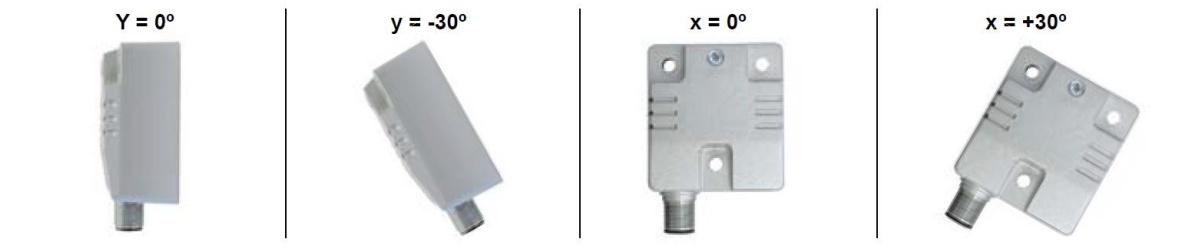
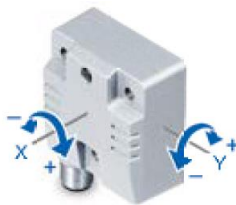
Horizontal installation

The 2-dimensional inclination sensor (housing in horizontal position) must be installed with the base plate aligned parallel to the horizontal line. The sensor can be inclined both towards the X and Y direction at the same time. By default, the sensor measures within the configured range, e.g. $\pm 30^\circ$ in both directions. Zero crossing is exactly the horizontal line.



Vertical installation

The 2-dimensional inclination sensor (housing in vertical position) must be installed with the base plate vertically aligned. The sensor can be inclined both towards the X and Y direction at the same time, for each a separate measured value is supplied. By default, the sensor measures within the configured range, e.g. $\pm 30^\circ$ in both directions. Zero crossing is exactly in the vertical line.

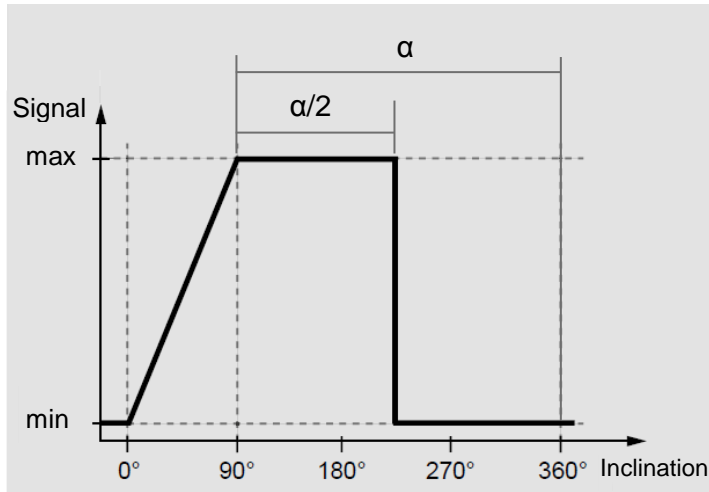


3.3 Output signals

3.3.1 Analog output signals

Within the sensing range, the output signals come as analog values from minimum to maximum. According to the product variant, the analog signal is current or voltage dependent.

Outside the sensing range, the output value jumps from the maximum to the minimum signal value at half the rotation angle (α) (see diagram below). When the sensor is inclined in the opposite direction the value jumps from the minimum to the maximum signal value.

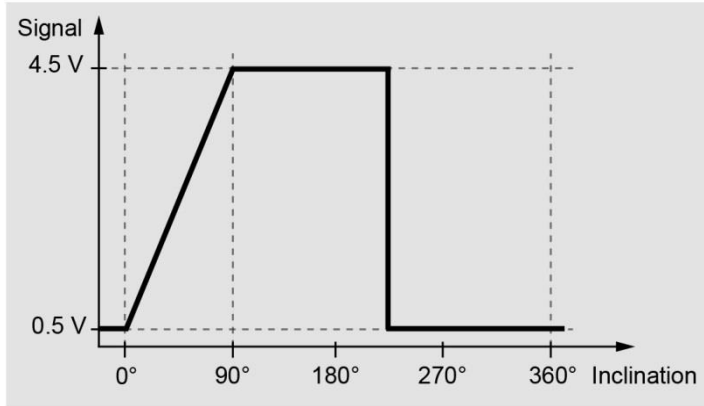


Overview of output signals

Analog Interface	Output Underrange	Output Overage
0...5 V	0 V	5 V
0...10 V	0 V	10 V
4...20 mA	4 mA	20 mA
0...20 mA	0 mA	20 mA
0...24 mA	0 mA	24 mA
0.5...4.5 V	0.5 V	5.5 V

3.3.2 Analog output signals 1-dimensional

Measuring range 0...90° / 0.5...4.5 V



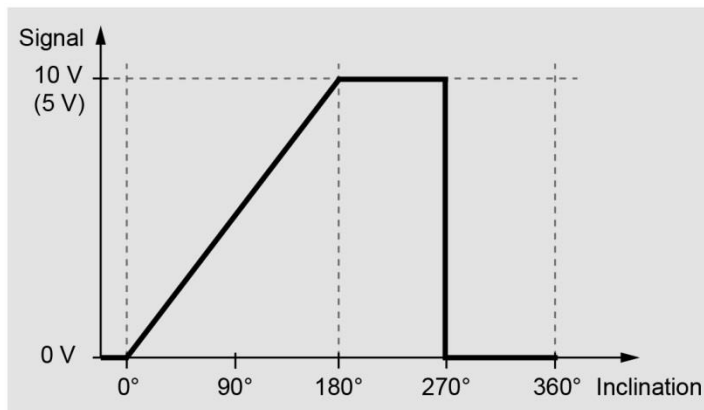
Inclination 0°



Inclination 90°



Measuring range 0...180° / 0...10 V (0...5 V)



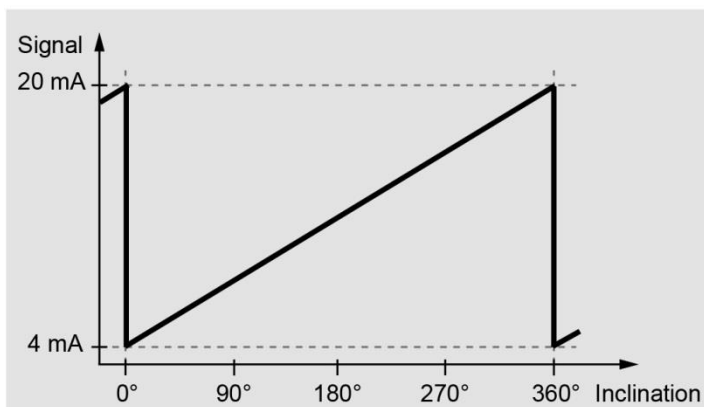
Inclination 0°



Inclination 180°



Measuring range 0...360°



Inclination 0°

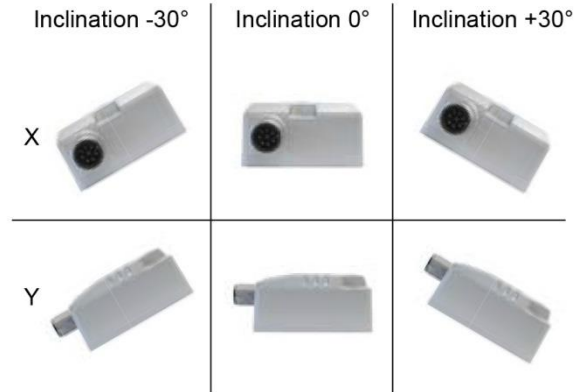
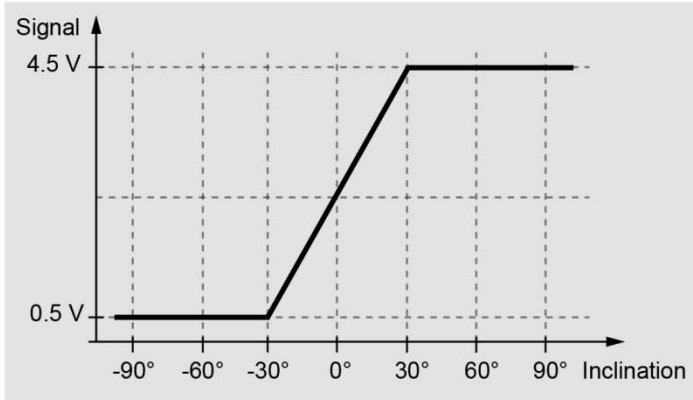


Inclination 360°

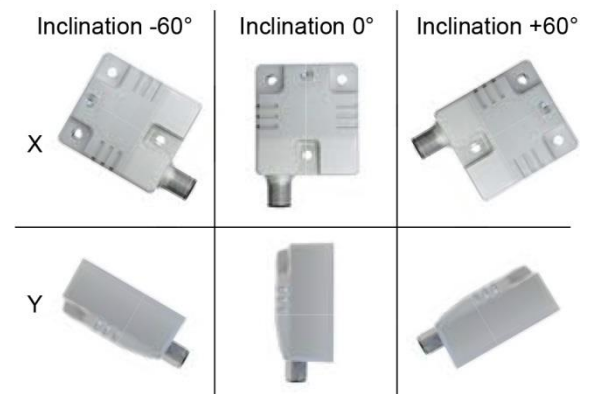
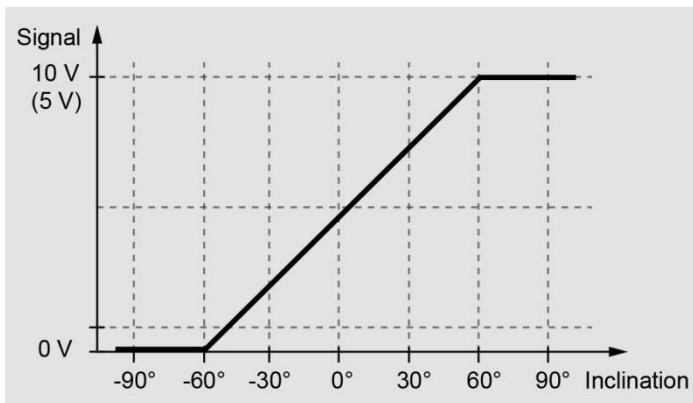


3.3.3 Analog output signals 2-dimensional

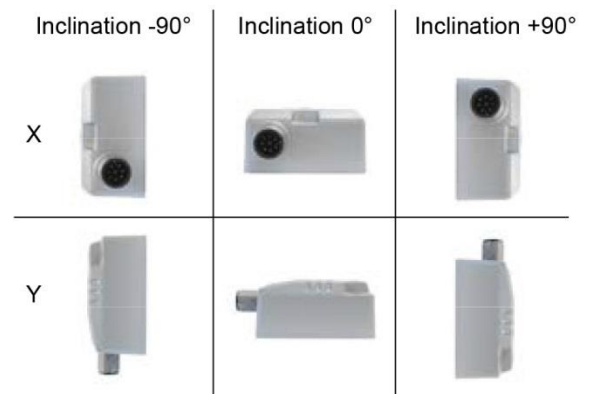
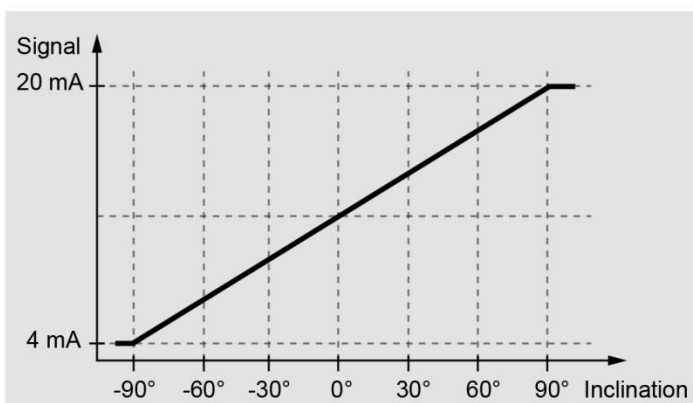
Measuring range $\pm 30^\circ$ / horizontal installation



Measuring range $\pm 60^\circ$ / vertical installation



Measuring range $\pm 90^\circ$ / horizontal installation



3.3.4 Analog output with sensing range monitoring (Option: /4822)

Sensor behavior with option /4822 sensing range monitoring is as follows: the output value jumps to a higher respectively lower value compared to nominal voltage or nominal current.

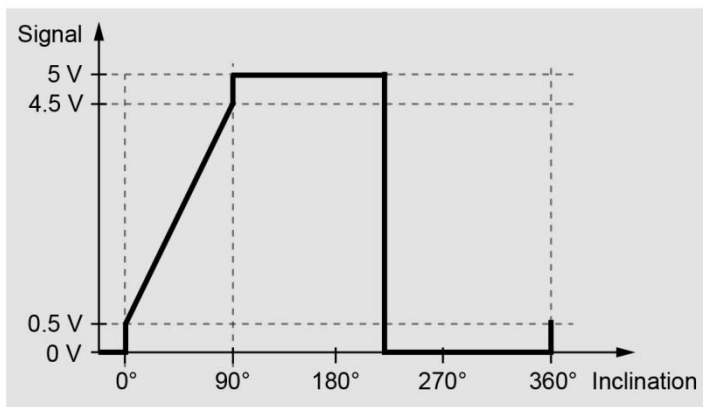
Outside the sensing range, the output value jumps from the maximum to the minimum signal value at half the rotation angle (see 3.3.1 Analog output signals) When the sensor is inclined towards the opposite direction the value jumps from the minimum to the maximum signal value.

Overview output signals

Analog Interface	Output Underrange	Output Overage	Out of Range Diagnostic
0...5 V	0 V	5.5 V	Overrange
0...10 V	0 V	11 V	Overrange
4...20 mA	2 mA	22 mA	Underrange, Overage
0...20 mA	0 mA	22 mA	Overrange
0...24 mA	0 mA	24 mA	None
0.5...4.5 V	0 V	5 V	Underrange, Overage

Analog output with sensing range monitoring 1-dimensional

Measuring range 0...90° / 0.5...4.5V



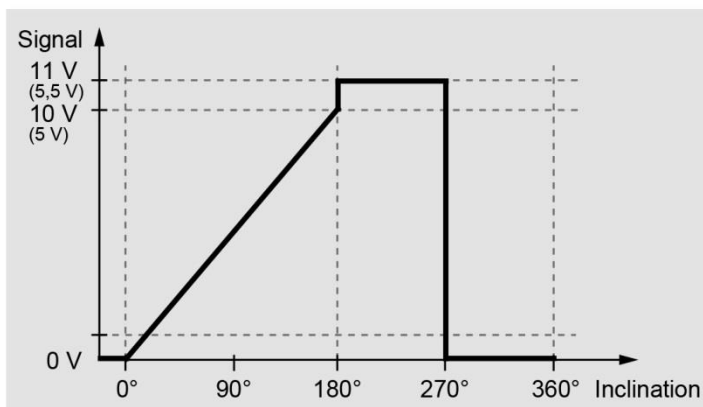
Inclination 0°



Inclination 90°



Measuring range 0...180° / 0...10 V (0...5 V)



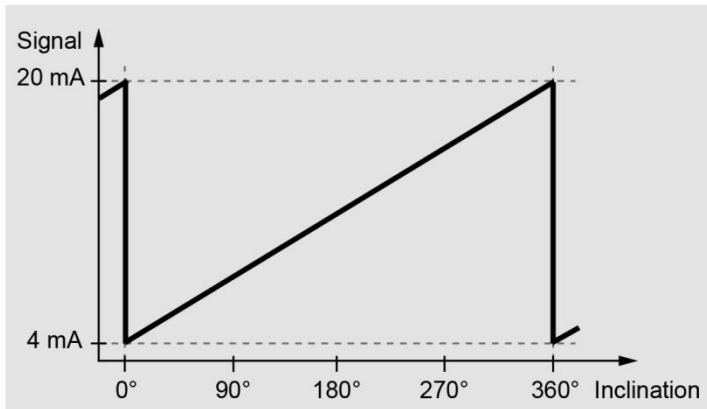
Inclination 0°



Inclination 180°



Measuring range 0...360° / 4...20 mA

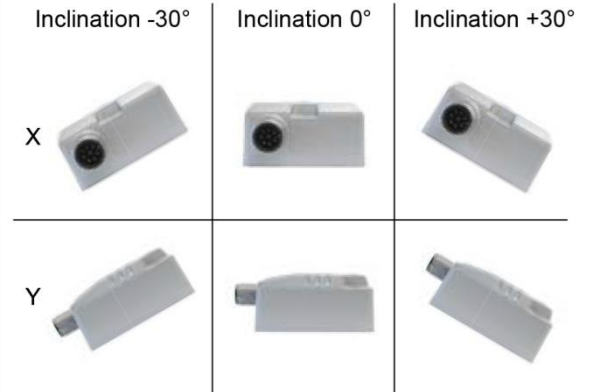
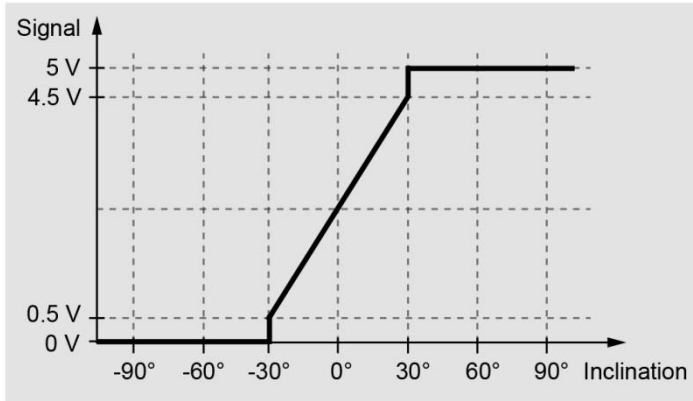
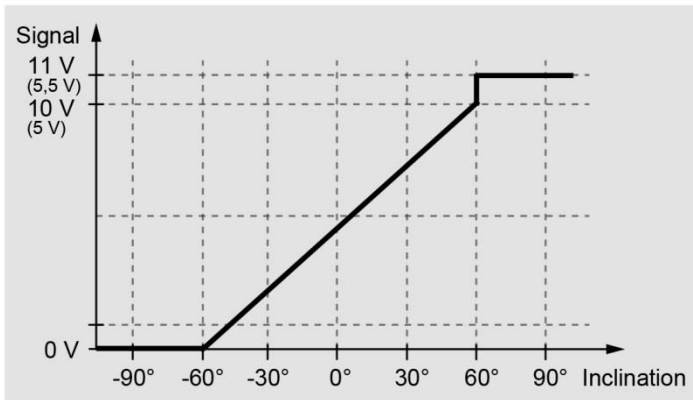
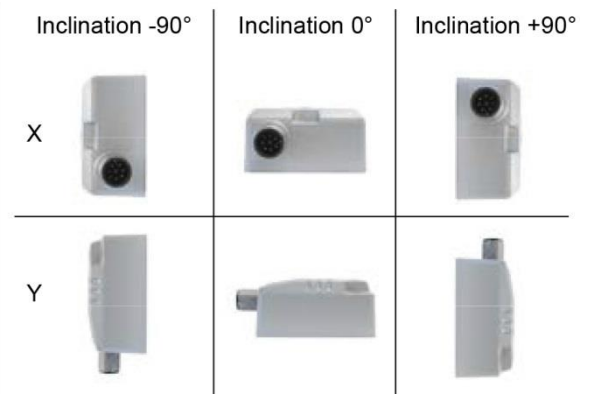
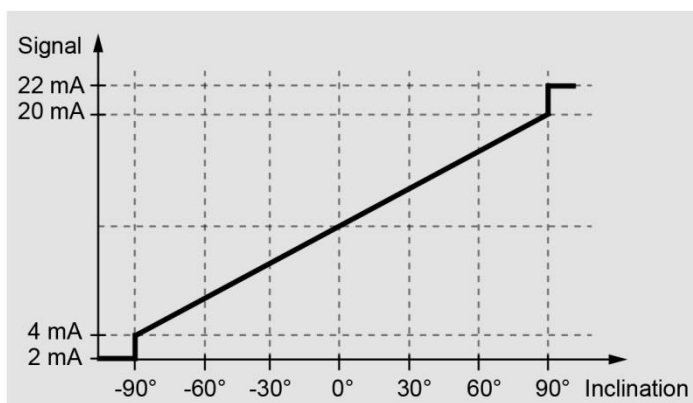


Inclination 0°



Inclination 360°



Analog output with sensing range monitoring 2-dimensional
Measuring range $\pm 30^\circ$ / horizontal installation / 0.5...4.5V

Measuring range $\pm 60^\circ$ / vertical installation / 0...10 V (0...5 V)

Measuring range $\pm 90^\circ$ / horizontal installation / 4...20 mA



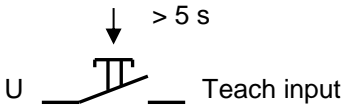




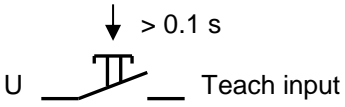



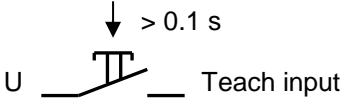


3.4 2-point teaching operation



The 2-point teaching operation is only supported by 1-dimensional inclination sensors with measuring range 0... 360°.

2-point teaching means the measuring range is defined manually by teaching the minimum and maximum values. Within the sensing range, the output signals come as analog values. Outside the sensing range, the output value jumps from the maximum to the minimum signal value at half the rotation angle (see 3.3.1 Analog output signals). When the sensor is inclined in the opposite direction the value jumps from the minimum to the maximum signal value.

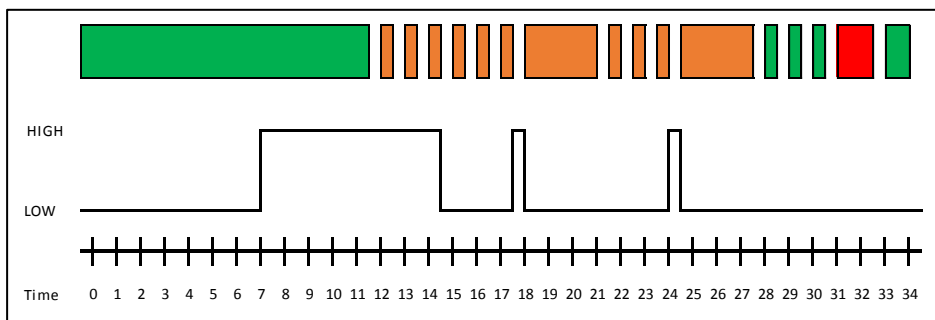
To activate the teaching function, apply a HIGH signal ($\geq 0.7 \cdot V_s$) at pin 5 of the teach input (see 4.1 Electrical connection). The two limits must not be too close to each other but provide a minimum angular difference of $> 5^\circ$. (see 4.1 Electrical connection).

3.4.1 The teaching operation

Action	LED	Description
Initial situation		DUO-LED is green continuous
Activate 	 	Start the teaching operation within 5 minutes after power on. Set teach input on HIGH for >5 seconds ($\geq 0.7 \cdot V_s$). DUO-LED: flashing amber after 5 seconds
Get sensor to position 1 		Get inclination sensor into the position intended for min. voltage output / current output
Confirm position 1 		Set teach input on HIGH for >0.1 sec. DUO-LED: Amber continuous for 3 seconds, then flashing
Get sensor to position 2 		Get sensor to the position for maximum voltage/current output. Make sure there is a difference of $>5^\circ$ between the two positions. Sens of rotation in the teaching operation is the same as in the later application.
Confirm position 2 	 	Set teach input on HIGH for >0.1 sec. DUO-LED: amber continuous for 3 seconds, followed by 3x flashing green.

Standard operation		Inside the sensing range DUO-LED: green continuous. Outside the sensing range DUO-LED: red continuous.
Teaching error		When exceeding the measuring range or the limits are too close to each other ($>5^\circ$ difference), the teaching operation was not successful and must be repeated. DUO-LED: 3 x flashing red.

3.4.2 Time pattern 2-point teaching operation



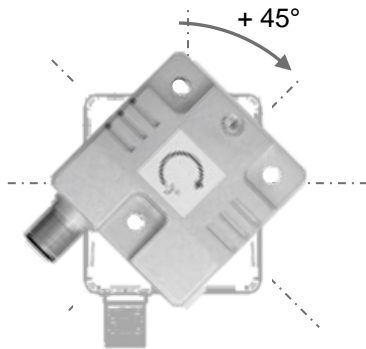
3.5 Sensor zeroing

The inclination sensors with the measuring ranges 0...90°, 0...120°, 0...180° and 0...270° have the function zero setting. By zeroing the output value at the defined position corresponds to an inclination of 0°.

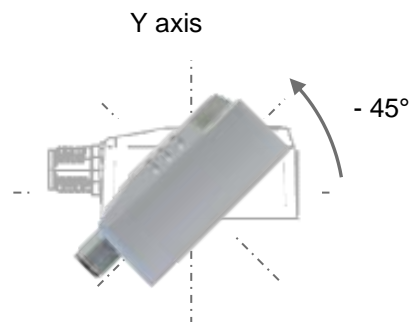
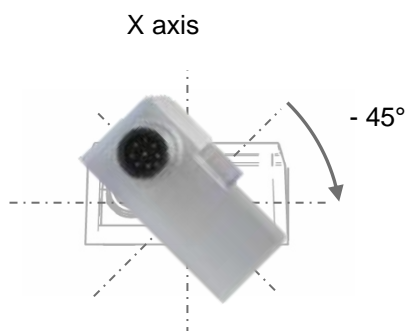
To execute zeroing, apply a HIGH signal ($\geq 0.7 \cdot V_s$) pin 5 (teach input) for >250 ms (see 4.1 Electrical connection)

2-dimensional sensors apply the zeroing operation to both directions X/Y).

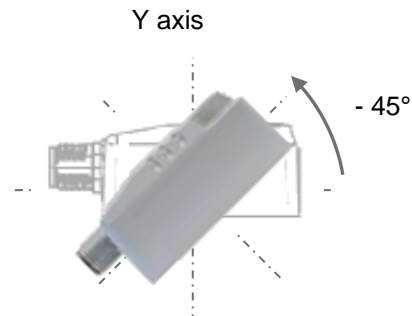
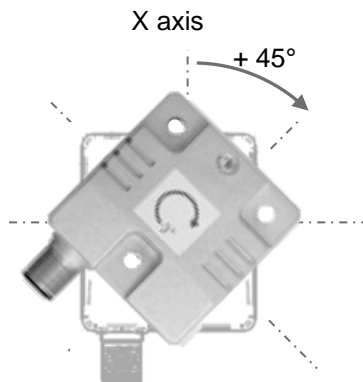
1-dimensional:




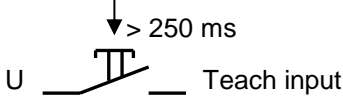
2-dimensional - horizontal installation:



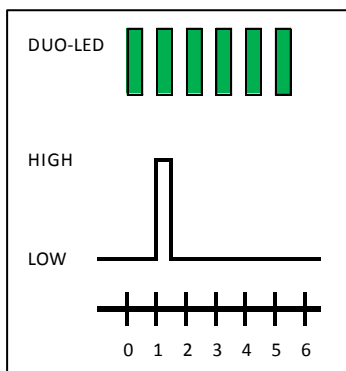
2-dimensional - vertical installation:



3.5.1 Zeroing operation


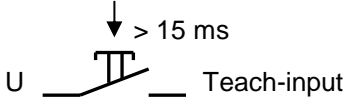




Action	LED status	Description
Initial situation		LED is green continuous
Activate 		Set teach input on HIGH for >250 ms ($\geq 0.7 \cdot +Vs$). Sensor inclination = 0°

3.5.2 Time pattern zeroing operation

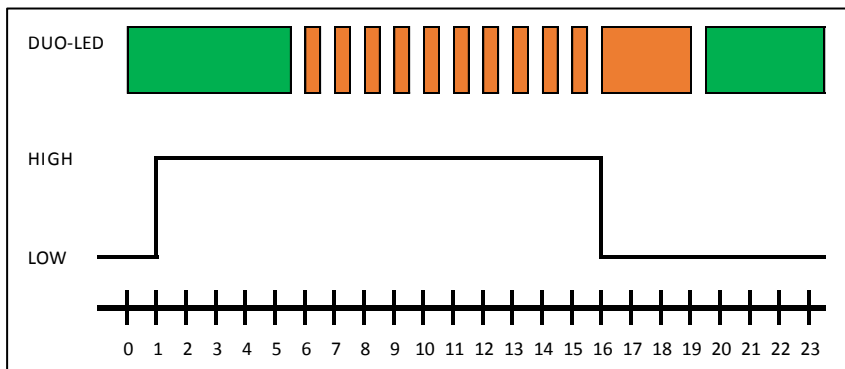


3.6 Restore Factory Settings

3.6.1 How to Restore Factory Settings

Action	LED indication	Description
Initial situation		LED is green continuous
Activate 		Set teach input on HIGH for >15 seconds. DUO-LED: amber flashing after 5 seconds
End operation		Set teach input to LOW. DUO-LED: Amber continuous for 3 seconds
Operational mode	 	DUO-LED: indicates the present status, operational/ non-operational

3.6.2 Time pattern of Restore Factory Settings

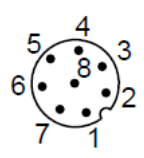


4 Terminal assignment and commissioning

4.1 Electrical connection

4.1.1 Terminal assignment 1-dimensional

M12 flange connector, 8-pin

Pin	Assignment	Description	M12 connector, A-coded, male contacts
1	+Vs	Voltage supply	
2	GND	Ground connection relating to +Vs	
3	OUT	output	
4	d.u.	Do not use	
5	Teach	Teach input	
6	d.u.	Do not use	
7	d.u.	Do not use	
8	A_GND	Ground connection related to analog	

Terminals with the same designation are internally hardwired and identical in their functions. Maximum load applied on Vs-Vs / GND-GND is 1 A each.

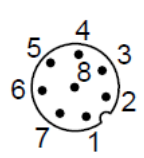
Cable wires

Wire	Assignment	Description
white	+Vs	Voltage supply
brown	GND	Ground connection relating to +Vs
green	OUT	Output
yellow	d.u.	Do not use
grey	Teach	Teach input
pink	d.u.	Do not use
blue	d.u.	Do not use
red	A_GND	Ground connection related to analog

Wires with the same designation are internally hardwired and identical in their functions. Maximum load applied on Vs-Vs / GND-GND is 1 A each.

4.1.2 Terminal assignment 2-dimensional

M12 flange connector, 8-pin

Pin	Assignment	Description	M12 connector, A-coded, male contacts
1	+Vs	Voltage supply	
2	GND	Ground connection relating to +Vs	
3	OUT_X	Output	
4	OUT_Y	Output	
5	Teach	Teach input	
6	d.u.	Do not use	
7	d.u.	Do not use	
8	A_GND	Ground connection related to analog	

Terminals with the same designation are internally hardwired and identical in their functions. Maximum load applied on Vs-Vs / GND-GND is 1 A each.

Cable wires

Wire	Assignment	Description
white	+Vs	Voltage supply
brown	GND	Ground connection relating to +Vs
green	OUT_X	Output
yellow	OUT_Y	Output
grey	Teach	Teach input
pink	d.u.	Do not use
blue	d.u.	Do not use
red	A_GND	Ground connection related to analog

Wires with the same designation are internally hardwired and identical in their functions. Maximum load applied on Vs-Vs / GND-GND is 1 A each.

4.2 LED activity indicator

Integrated in the sensor housing

4.2.1 LED green

LED activity indicator	Activity	Description
Flashing	Teaching operation	See teaching operation
on	Standard operation	Sensor position within the sensing range
off	Power off	

4.2.2 LED red

LED activity indicator	Activity	Description
Slowly flashing	Teaching operation	See teaching operation
on	Outside the sensing range	Inclination sensor position outside the sensing range
off	No error	

4.2.3 LED amber

LED activity indicator	Activity	Description
Slowly flashing	In teach mode	Inclination sensor is ready for the teaching operation.
on	Teaching operation successful	Value was adopted by the inclination sensor
off	teach mode off	Inclination sensor is in operational mode

4.2.4 DUO-LED in standard operation

Example for DUO-LED indications in a 2-point teaching operation, min. limit 315°, max. limit 90°.

