GEMAC

User manual

Inclination Sensors with Current and Voltage Interface

Version: 1.5

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economicLINE

IS2XP010-I-EL
IS2XP045-I-EL
IS2XP060-I-EL
IS2XP010-U-EL
IS2XP045-U-EL
IS2XP060-U-EL

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Revision History

Date	Revision	Changes
2015-03-30	0	first version
2015-08-04	1	Chapter 2.1 “Load Resistance“ added
2015-08-26	2	Designation Table 2 corrected
2017-01-25	3	MTTF values added
2017-10-27	4	housing drawings
2018-05-22	5	Updating CE conformity

Table of Contents

List of Tables

List of Figures

1 Overview

1.1 Characteristics

- Inclination sensors with measurement range: ±10° / ±45° / ±60° (X/Y)
- Sinusoidal output, good accuracy (0.15°)
- non-adjustable current or voltage interface
- Robust, impact strength, extra small plastic housing
- Suitable for industrial use:
  - Temperature range: -40 °C to +80 °C
  - Degree of protection: IP65/67

The 2-dimensional inclination sensors IS2XP0xx-I-EL and IS2XP0xx-U-EL are suitable to measure the inclination in the measurement range of ±10°, ±45° and ±60° in 2 dimensions (X/Y). To ensure a high accuracy, the sensors are calibrated at the factory.

The compact and robust design makes the sensor a suitable angle measurement device in rough surroundings for different applications in industry and vehicle technology.

1.2 Applications

- Solar thermal and photo-voltaic systems
- Agricultural and forestry machinery
- Construction machinery
- Crane and hoisting technology

2 Technical Data IS2XP0xx-I-EL

General Parameters [1]	IS2XP010-I-EL	IS2XP045-I-EL	IS2XP060-I-EL
Measurement axes	2 axes	2 axes	2 axes
Measurement range	±10°	±45°	±60°
Resolution (zero point)	0.01°	0.05°	0.06°
Accuracy	±0.15°	±0.30°	±0.50°
Temperature coefficient (zero point)	max. ±0.009 °/K (referring to T = 25 °C)		
Cut-off frequency	typ. 18 Hz		
Operating temperature	-40 °C ... +80 °C [2]		
Characteristics			
Current interface	current output: 4...20 mA		
Calculation formula Angle value [°]	$\arcsin\left[\left(\frac{I_{meas}-12\,mA}{8\,mA}\right)*\sin range value\right]$		
Electrical Parameters			
Supply voltage	11 to 30 VDC [3]		
Current consumption	15 mA .. 45 mA		
Load resistance	depends on supply voltage, see table 2 and figure 1		
Mechanical Parameters			
Connector	0.2 m PUR-cable 5 x 0.34 mm² with 5-pole M12 sensor- actor- male connector, IEC 61076-2-101, IEC 60947-2		
Degree of protection	IP65/67 min. locking torque 0.9 Nm		
Shock survival	max. 20 000 g		
Dimensions	extra small plastic housing (ABS): 65 mm x 35 mm x 20 mm		
Weight	about 55 g incl. cable		
Reliability according EN ISO 13849-1[4]			
MTTF	323 years		
MTTFd	664 years		
CE conformity			
EC Directives			
2014/30/EU	EMC directive		
2011/65/EU	RoHS directive		
Harmonized standards			
DIN EN 61326-1:2013-07	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements		
DIN EN 50581:2013-02	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances		

Table 1: Technical Data IS2XP0xx-I-EL

1 All indicated angle accuracies are valid after a running time of 10 minutes at 25 °C
2 for full temperature range up to 80 °C limited combinations of supply voltage and load resistance are permitted only, see figure 1
3 protected with 1 A time-lag fuse
4 This product is a standard product and no safety part in accordance with the machinery directive. The calculation is based on an average environment temperature of 40 °C and a usage of 8760 h/a.

2.1 Load Resistance

Power dissipation depends on supply voltage and the load resistance. To reduce power dissipation, which may cause overheating, the load resistor should be chosen according to supply voltage. Table 2 and figure 1 show the relation between supply voltage and the permitted load resistance for different temperature ranges. The green area in figure 1 shows the permitted load resistance depending on supply voltage for operating temperatures up to 80 °C. Combinations of supply voltage and load resistor within the gray colored area are permitted for a limited operating temperature range up to 65 °C in addition.

Note: As a safety function, the sensor has an overheat shutdown. Both sensor outputs will be disabled, in case of exceeding a critical temperature because of to much power dissipation. Both outputs will be re-enabled automatically after the sensor cooled down. In case the cause of increased power dissipation (incorrect combination of supply voltage and load resistor in general – see table 2 and figure 1) is not eliminated, the sensor will shut down again after a short time.

The following values of minimum and maximum load resistance are meant as total resistance as sum of resistance of the load resistor and cable resistance.

U_{dd} [V]	R_L min. [Ω] @ Ta_{max} = 65 °C	R_L min. [Ω] @ Ta_{max} = 80 °C	R_L max. [Ω]
11	0	150	290
12	0	200	330
24	600	800	930
30	900	1100	1230

Table 2: Minimum and maximum Load Resistance at different Operating Temperatures

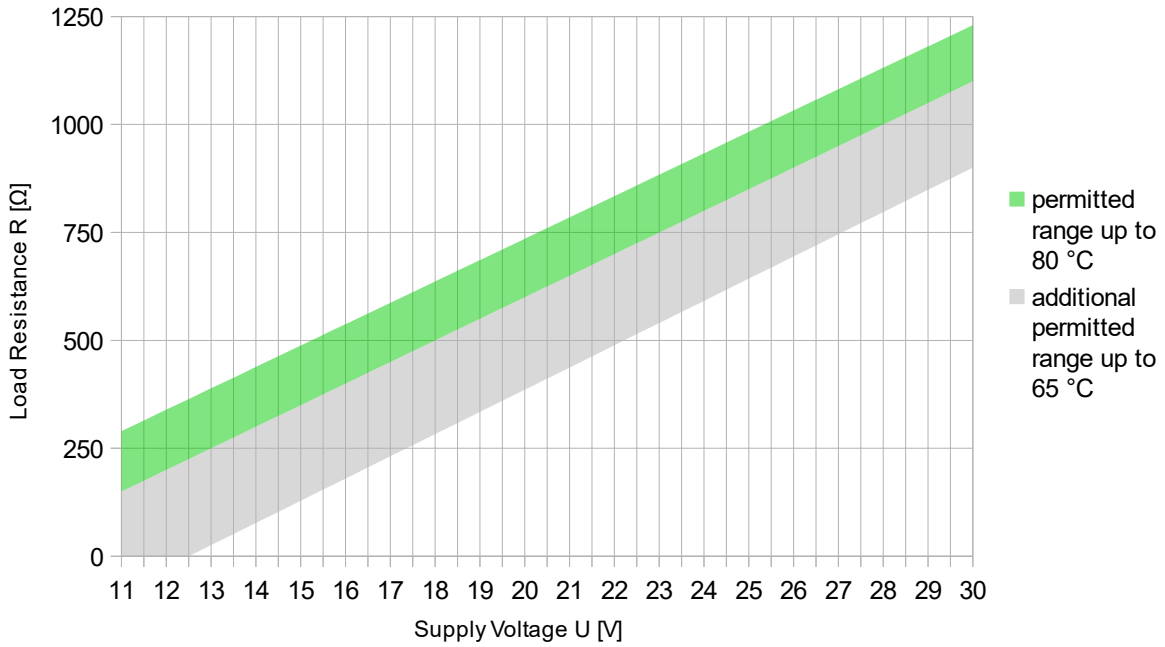


Figure 1: Permitted Load Resistance

3 Technical Data IS2XP0xx-U-EL

General Parameters[5]	IS2XP010-U-EL	IS2XP045-U-EL	IS2XP060-U-EL
Measurement axes	2 axes	2 axes	2 axes
Measurement range	±10°	±45°	±60°
Resolution (zero point)	0.01°	0.05°	0.06°
Accuracy	±0.15°	±0.30°	±0.50°
Temperature coefficient (zero point)	max. ±0.009 °/K (referring to T = 25 °C)		
Cut-off frequency	typ. 18 Hz		
Operating temperature	-40 °C ... +80 °C		
Characteristics			
Voltage interface	voltage output: 0...10 V (on request: 0.5 V ... 4.5 V)		
Calculation formula Angle value [°]	$\arcsin\left[\left(\frac{U_{meas}-5V}{5V}\right)*\text{sinrange value}\right]$		
Electrical Parameters			
Supply voltage	11 to 30 VDC [6]		
Current consumption	15 mA .. 25 mA		
Mechanical Parameters			
Connector	0.2 m PUR-cable 5 x 0.34 mm² with 5-pole M12 sensor- actor- male connector, IEC 61076-2-101, IEC 60947-2, min. locking torque 0.9 Nm		
Degree of protection	IP65/67		
Shock survival	max. 20 000 g		
Dimensions	extra small plastic housing (ABS): 65 mm x 35 mm x 20 mm		
Weight	about 55 g incl. cable		
Reliability according EN ISO 13849-1[7]			
MTTF	290 years		
MTTFd	568 years		
CE conformity			
EC Directives			
2014/30/EU	EMC directive		
2011/65/EU	RoHS directive		
Harmonized standards			
DIN EN 61326-1:2013-07	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements		
DIN EN 50581:2013-02	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances		

Table 3: Technical Data IS2XP0xx-U-EL

5 All indicated angle accuracies are valid after a running time of 10 minutes at 25 °C
6 protected with 1 A time-lag fuse
7 This product is a standard product and no safety part in accordance with the machinery directive. The calculation is based on an average environment temperature of 40 °C and a usage of 8760 h/a.

4 Mounting

4.1 Position of Drilling Holes

The four drilling holes to mount the sensor (Figure 2) are situated in the base plate of the inclination sensor.

4.2 Dimensioned drawing

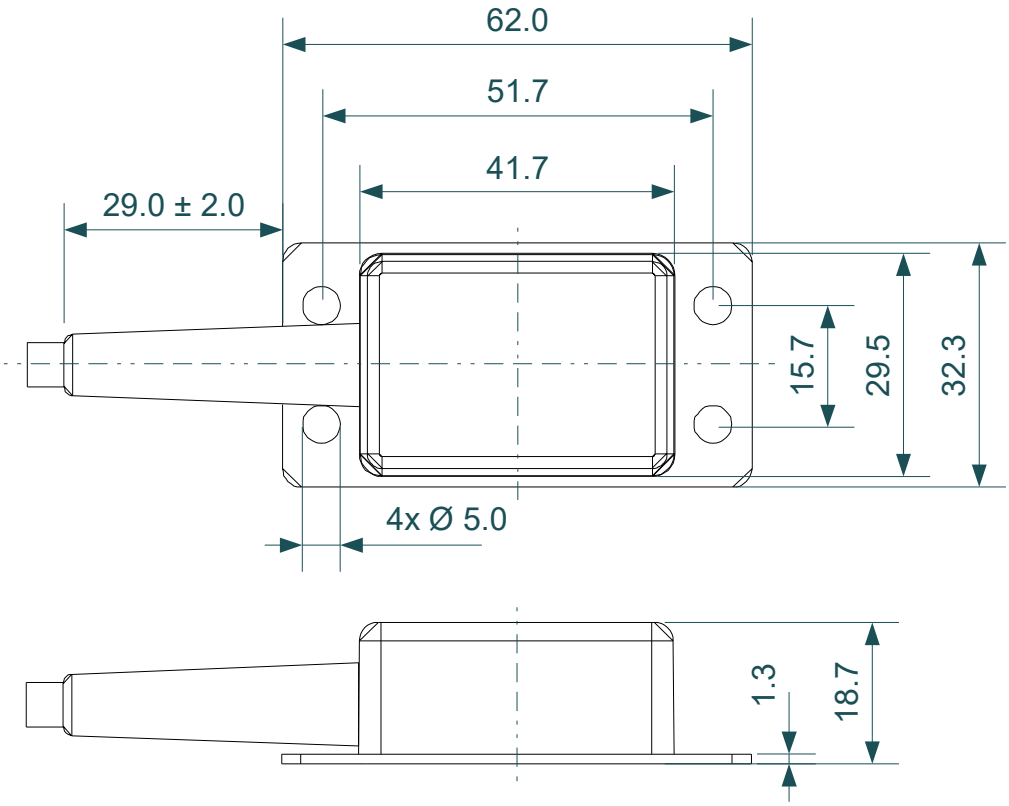


Figure 2: Dimensioned drawing (dimensions in mm)

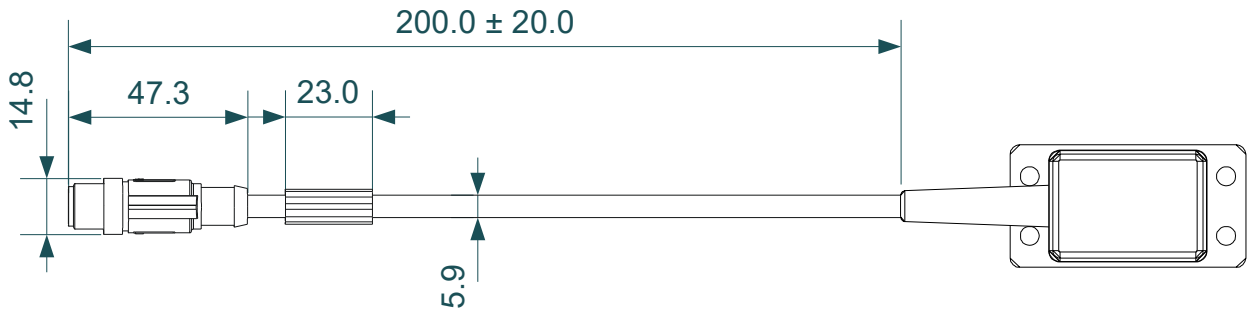


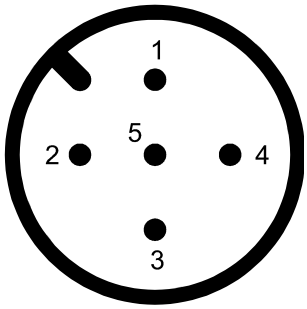
Figure 3: Dimensioned drawing connection cable (dimensions in mm)

5 Connection

5.1 Connector Pin Out

Pin	Signal	Allocation
1	brown	Supply voltage
2	white	Sensor signal Y-Axis (Y-OUT)
3	blue	GND-supply (V- / GND)
4	black	Sensor signal X-Axis (X-OUT)
5	green/yellow	Signal-GND (internal connected to GND)

Figure 4: Connector Pin Out



(View from the outside)

The inclination sensors IS2XP0xx-I-EL and IS2XP0xx-U-EL are equipped with a 20 cm cable with common 5-pole round plug M12 (A-coded).

6 Ordering Information

Product	Parameters	Connection / Cable	Article Number
Current loop interface			
IS2XP010-I-EL	2-dimension., ±10°, 4 mA .. 20 mA	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24231-00
IS2XP045-I-EL	2-dimension., ±45°, 4 mA .. 20 mA	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24232-00
IS2XP060-I-EL	2-dimension., ±60°, 4 mA .. 20 mA	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24233-00
Voltage interface			
IS2XP010-U-EL	2-dimension., ±10°, 0 V .. 10 V	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24331-00
IS2XP045-U-EL	2-dimension., ±45°, 0 V .. 10 V	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24332-00
IS2XP060-U-EL	2-dimension., ±60°, 0 V .. 10 V	0.2 m PUR-cable, 5 pole M12 sensor- actor- male connector	PR-24333-00

Table 4: Ordering Information