Product Specification
AXISENSE-1 V-OUT-180 FLOOR MT

±180 deg Tilt Sensor with Analog Voltage Output

Revision A1

Customer Acceptance

Company: _____

Address: _____

Date: _____

Name: _____

Function: _____

Signature: _____

TE Connectivity Smart Grid GmbH
Hauert 13, D-44227 Dortmund, Germany

Contents

1 History

Ver.	Date	Purpose / Description of changes	Author
A	16-Feb-2020	Initial Release	M. Kalinowski
A1	20-Nov-2023	- Update of Chapter 3, 5, 6, 11 and 12.1 for more clarity. No change in content. - Update of Output Voltage Characteristic	M. Kalinowski

2 Applicable Documents

#	Document title	Originator	Description
1	114-160013	TE	Mounting Recommendations for Sensor Modules of AXISENSE-Series
2			
3			
4			
5			
6			
7			
8			
9			

3 Description of the AXISENSE Tilt Sensor

The tilt sensor is based on a micro machined accelerometer (MEMS). This sensor includes 3 acceleration sensing axes that form a nearly orthogonal 3D coordinate system. A microcontroller reads the sensor information as voltage signal. The amplified signal is digitized with a 12-bit ADC using oversampling to increase resolution. Roll data is calculated from sensor signals after digital temperature compensation is applied. Misalignment error is minimized by application of a full 3D corrective algorithm.

This tilt sensor offers a voltage output.

TE Part Number	Related Drawing	Description
AXISENSE-1-006 (TCPN: G-NSDOG1-006)	220SM100_0002	Tilt Sensor, single axis, floor mount, AXISENSE-1-Series

4 Mechanics and Connections

4.1 Mechanical Data

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Weight	m			60		g
Width	d_{Width}			70.5		mm
Length[1]	d_{Length}			45		mm
Height[1]	d_{Height}			15		mm

[1] just the housing, without cable

4.2 Dimensions

The dimensions of the tilt sensor are depicted by Figure 4.2.1.

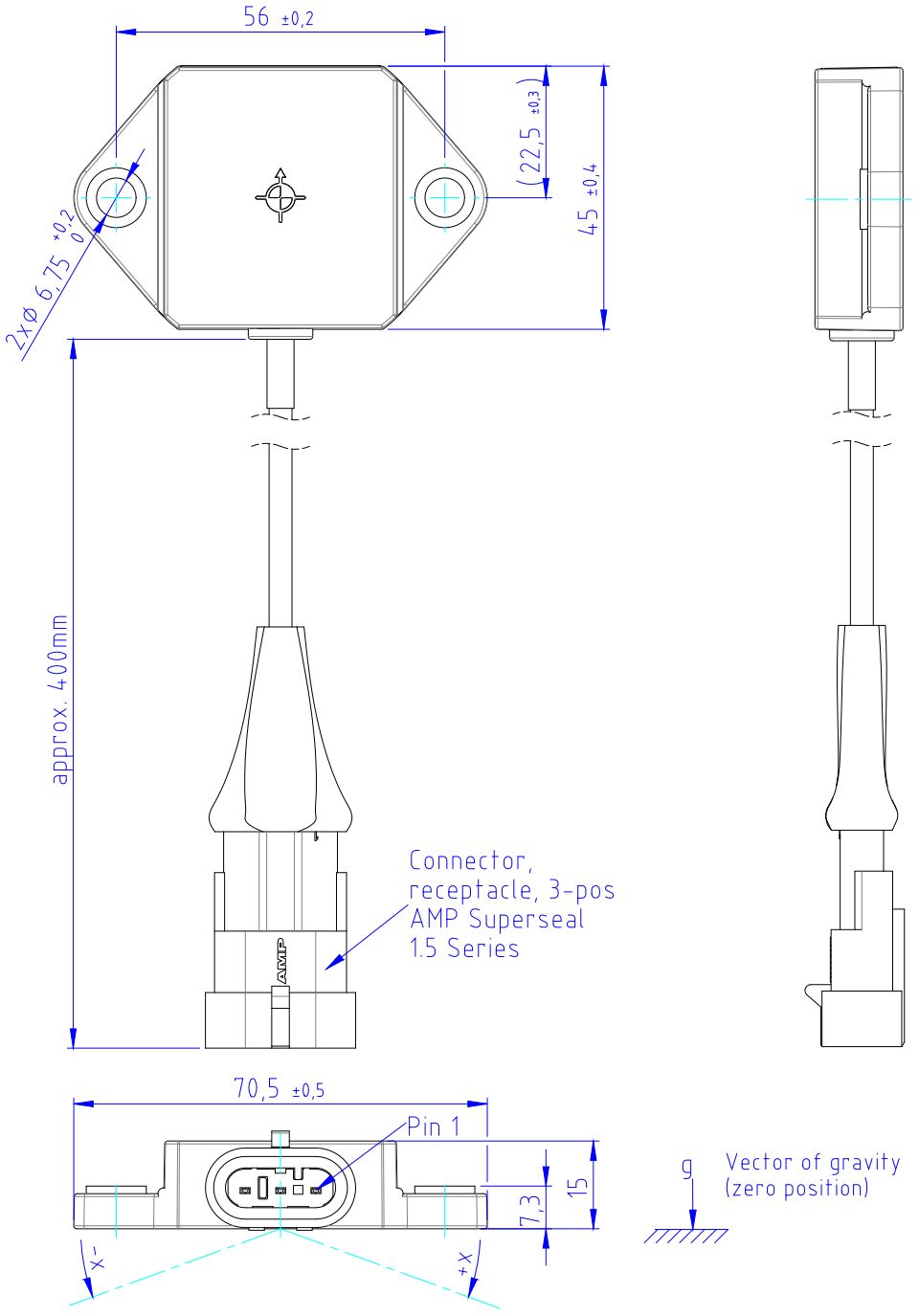


Figure 4.2.1: tilt sensor and connector, g arrow indicates acceleration of gravity in neutral/zero position

4.3 Mounting Orientation and Function View

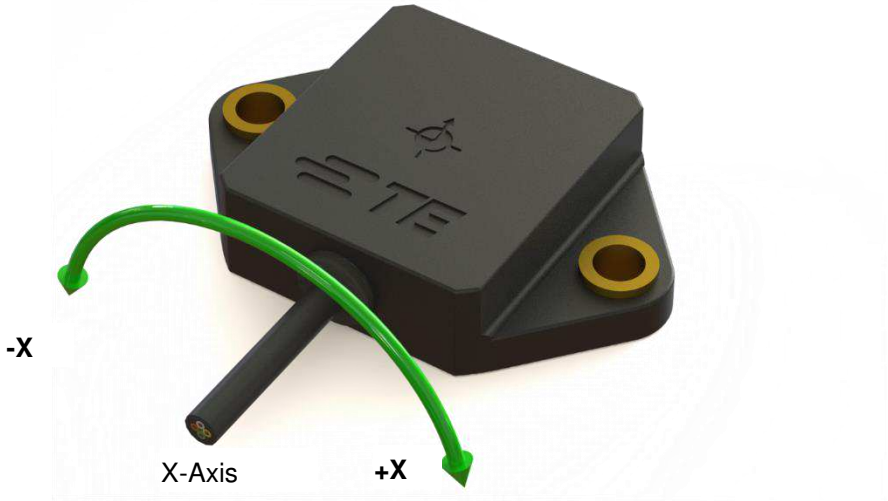


Figure 4.3.1: Mounting Orientation and Measurement Angle Indication

All tilt sensors referenced to in this document are designed for applications where they are used in floor mounting orientation.

4.4 Connector

The tilt sensor has an AMP Superseal 1.5 series connector with 3 terminals. It mates with TE Connectivity part number 282087-1.
The pin assignment is described below.

Pin	Function	Description	Direction
1	Supply Voltage	8 – 30 V	in
2	Ground, GND	0 V, ref. voltage	in
3	Output X	0.5 – 4.5 V, X axis output	out

5 Absolute Maximum Ratings

5.1 Definition of Terms

Absolute maximum values are limit values for permissible operation and should never be exceeded, even under the worst conditions. If exceeded by even the smallest amount, instantaneous catastrophic failure can occur. Even if the device continues to operate satisfactorily, its life may be considerably shortened. Operation at an absolute maximum rating is permitted (although not desirable-even a short test is believed by some to cause incipient failure). Operation at two or more limits (i.e., output current and ambient temperature) almost always means that some other limit has been exceeded (in this instance, probably package power dissipation). In certain ICs that include an internal thermal shutdown, fault conditions could generate higher than permitted (steady state) temperatures and activate device thermal shutdown circuitry. These fault conditions can be tolerated for short periods of time, but they will affect life expectancy and should be avoided.

5.2 Absolute Maximum Ratings

CAUTION: Exceeding these values may permanently damage the device. Exceeding nominal operation parameters may have negative impact on performance, depending on application time and actual condition.

Parameter	Symbol	Conditions	Min	Type	Max	Unit
Supply Voltage	V_{CC}	reference: GND	0		33	V_{DC}
Operating Temperature	T_{OP}		-40		85	°C
Storage Temperature	T_{STO}		-40		85	°C
Operating Humidity	H_{OP}	>80 %RH less than 40% of time		≤50	90	%RH
Storage Humidity	H_{STO}			≤40	60	%RH
Shock	a_{SHOCK}	non-repetitive 0.5 ms, powered			5000	G
Torque	M_{FIX}	mounting, M6 screws (also depends on strength category of screw)		10	15	Nm

TE is not responsible for identifying all limits of environmental impacts on reliability and sensor performance in the application.

6 Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating Temperature	T_{OP}		-40		85	°C
Operating Humidity	H_{OP}	>80 %RH less than 40% of time		≤50	90	%RH
Ingress Protection Class		applies if proper mating connector is attached to form sealing		IP67		
Angular Range		Single axis sensor; other axis must be kept at 0° to reach full scale	-180		180	deg
MTBF		calculated with Telcordia 2 for ground mobile at 50 °C permanent op. temperature		>4*10^5		h

7 Electrical Characteristics

If not otherwise noted, 12 VDC supply voltage applied at an ambient temperature of 25 °C.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	Vcc		8	12 – 24	30	V
Supply Current	I_{CC1}			15	20	mA
Voltage Output	V_{Out}		0.5		4.5	V

8 Tilt Sensor Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Startup Time	t_s	V_{CC}=0 V to V_{CC}=12 V transition			1	s
Temperature Offset Drift	T_{off}	$\varphi_x = \varphi_y$ = 0 deg -40 °C ≤ T ≤ 85 °C	-0.5	-0.4 < T_{off} < 0.4	0.5	deg
Accuracy I, [1]	$A_{CC,T25}$	T=23 °C	-0.2	-0.1< $A_{CC,T25}$<0.1	0.2	deg
Accuracy II, [1]	$A_{CC,TFULL}$	-40 °C < T < 85 °C	-0.6	-0.3< $A_{CC,TFULL}$ <0.3	0.6	deg
Resolution	Res			12		bit
Update Rate	f_u	independent of op. condition		100		Hz
Settling Time, [3]	t_{SET}	to 90% of final reading	0.1	0.2	2	s
Cross Sensitivity, [2]	CCA				0.25	deg

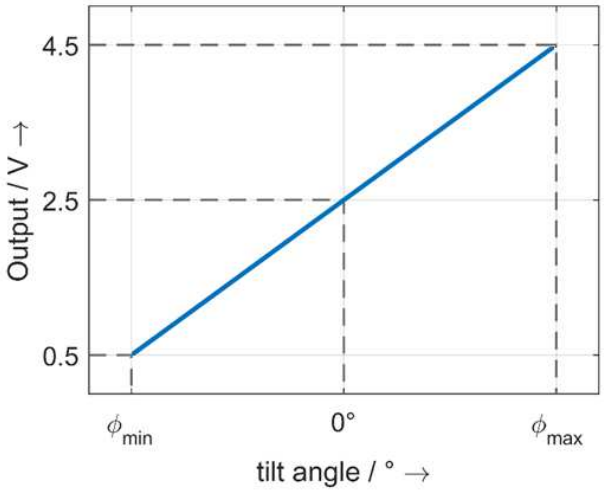
[1] Accuracy is verified by an end of line measurement after calibration without sensor module being removed in between. As the tilt sensor is designed to be fixed with M6 screws, there is some mechanical clearance that may lead to a small misalignment and offset. For some applications it may be reasonable to implement an in-application offset or/and span correction to attain best overall accuracy.

[2] CCA is defined as maximum difference between actual and expected angle on passive axis for whole angular range of active axis and full temperature range.

[3] Depends on filter setting; for default configuration response time is 0.2 s

9 Voltage Output

The tilt sensor has a voltage output. Details are described below.



Part Number	Φ_{min}	Φ_{max}
AXISENSE-1-006	-180°	180°

Linear transfer characteristic between Φ_{min} and Φ_{max}.

Figure 9.1 Graphical visualization of the voltage output

10 Qualification and Test

10.1 Vibration

The AXISENSE-1 tilt sensor survives exposure to vibration according to Figure 10.1.1 and Figure 10.1.2. Duration of the test has been 8 hours each Cartesian axis.

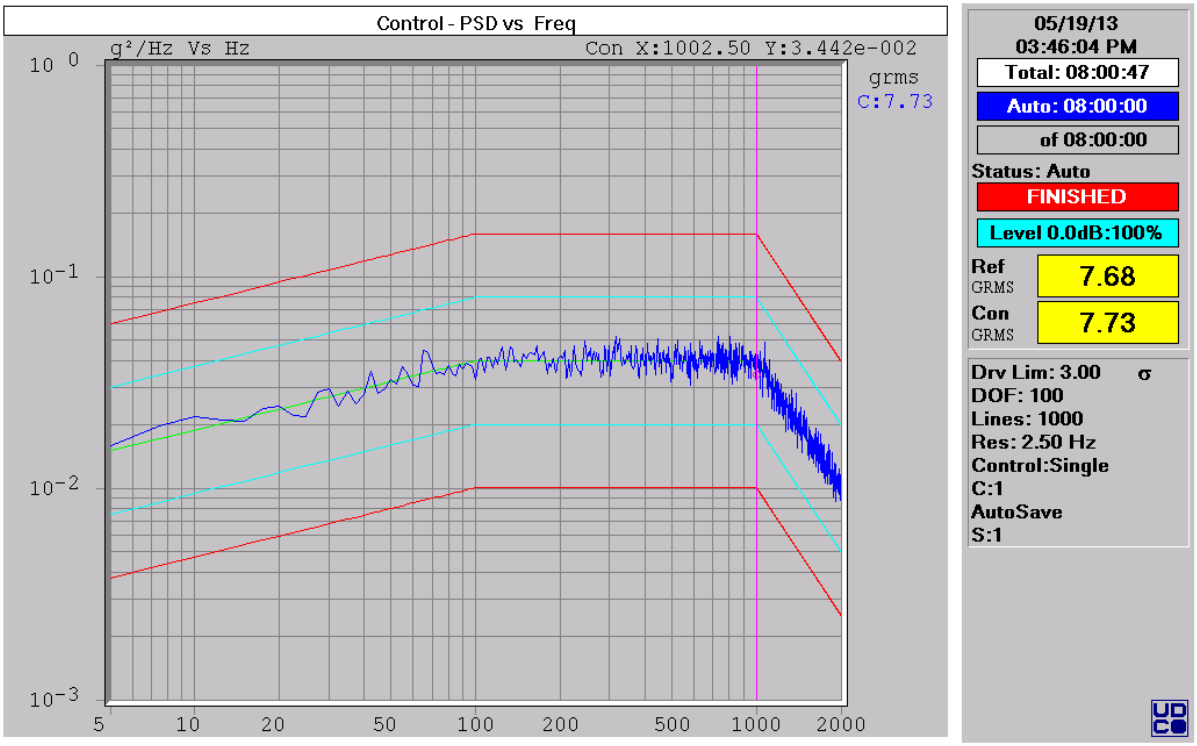


Figure 10.1.1: Random vibration profile used for testing, green trace: ideal excitation, blue trace: actual excitation during test

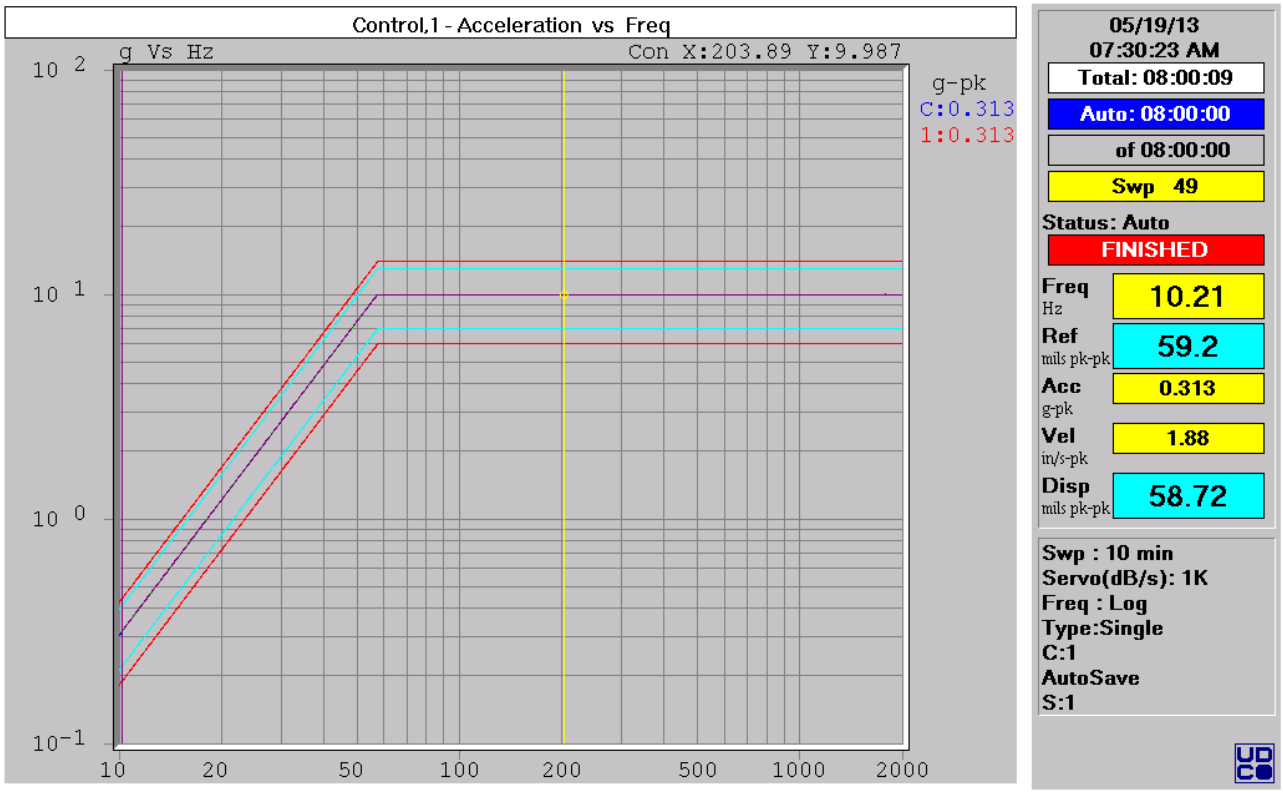


Figure 10.1.2: Sine vibration profile for testing, purple trace: ideal excitation

10.2 Drop

The unit withstands a drop of height 1 m onto a concrete surface.

10.3 End of Line Test

Each unit is end of line tested. After calibration, each tilt sensor is tested at different angles at 23 °C (±5 °C).

10.4 Statistical Test

On customer demand, a statistical temperature test can be offered.

10.5 Material Testing

All materials used in the process are released by checking the corresponding supplier certificates if available. A regular material analysis from an independent laboratory will not be scheduled.

10.6 Electromagnetic Compatibility

Sensor complies with:

EN 55011 :2009+A1 :2010, Group1, Class B including:
CISPR 11:2009, modified + A1:2010, Group 1, Class B

EN 61326-1:2006 including:
IEC 61000-4-2:2008
IEC 61000-4-3:2006 + A1:2007 + A2:2010
IEC 61000-4-4:2004 + Cor.1:2006 + Cor.2:2007 + A1:2010
IEC 61000-4-5:2005
IEC 61000-4-6:2008
Performance Criteria EN 61326-1:2006, Table 3

11 RoHS and REACH

For latest compliance status check the Statement of Compliance on te.com.

12 Additional Information

12.1 Ordering Information

PART NUMBER	SHORT DESCRIPTION
AXISENSE-1-006 (TCPN: G-NSDOG1-006)	Single axis tilt sensor, floor mount, angular range ±180°, supply 8 to 30 VDC, output voltage 0.5 to 4.5 V

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