



**108-160045**

**Date:** 22-Nov-2023

**Revision:** A1

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# 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: \_\_\_\_\_

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## 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 <sub>Width</sub>			70.5		mm
Length <sup>1</sup>	d <sub>Length</sub>			45		mm
Height <sup>1</sup>	d <sub>Height</sub>			15		mm

<sup>1</sup> just the housing, without cable

## 4.2 Dimensions

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

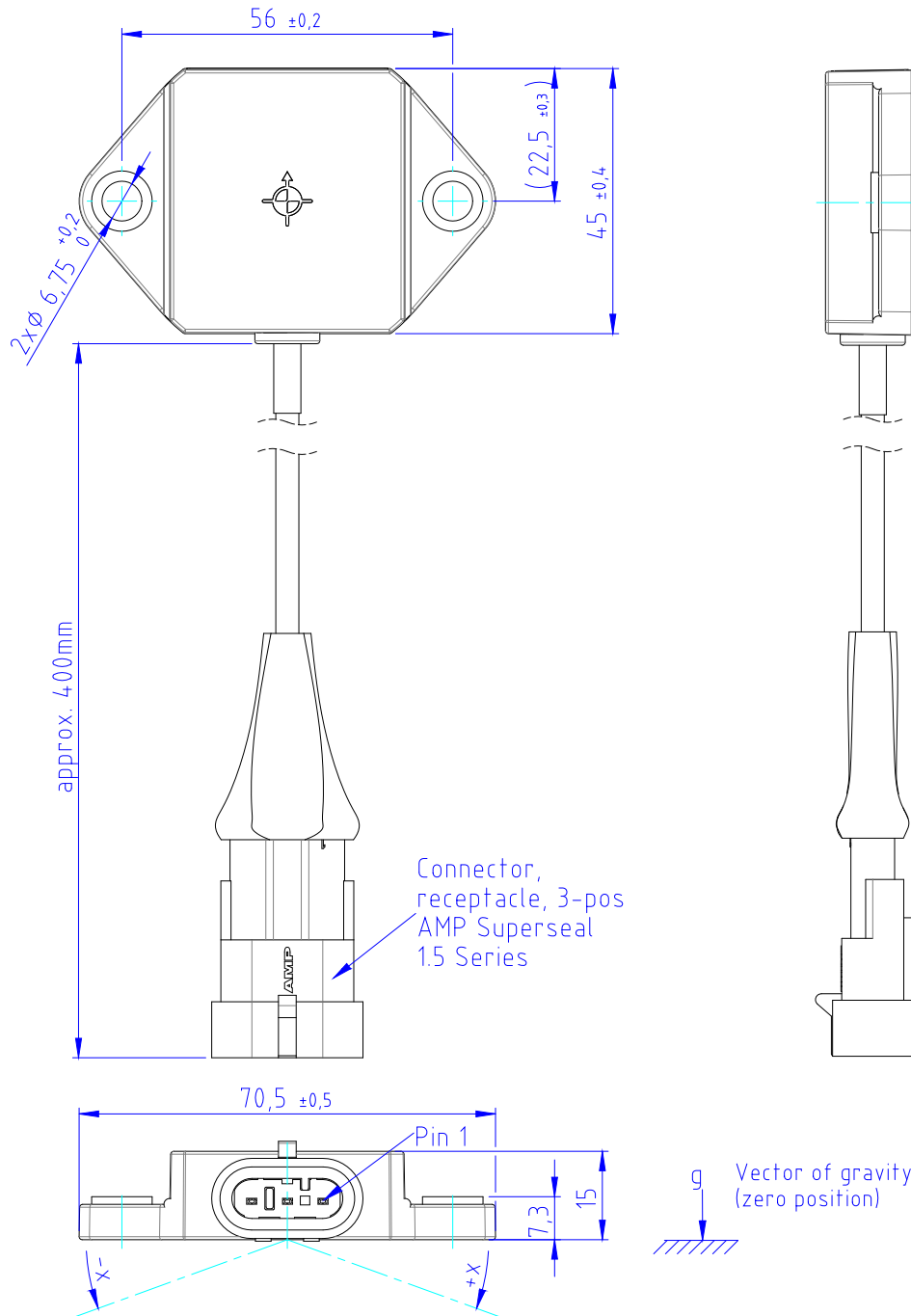


Figure 4.2.1: tilt sensor and connector, g arrow indicates acceleration of gravity in neutral/zero position

### 4.3 Mounting Orientation and Function View

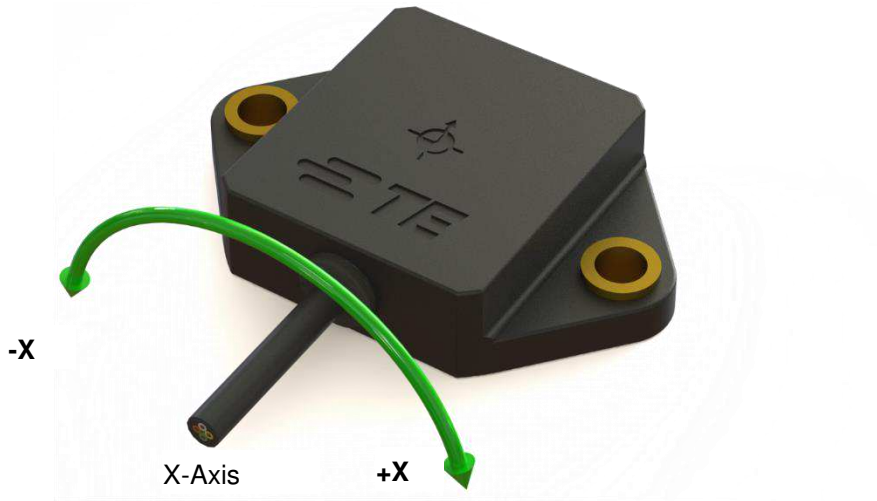


Figure 4.3.1: Mounting Orientation and Measurement Angle Indication

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 <sub>CC</sub>	reference: GND	0		33	V <sub>DC</sub>
Operating Temperature	T <sub>OP</sub>		-40		85	°C
Storage Temperature	T <sub>STO</sub>		-40		85	°C
Operating Humidity	H <sub>OP</sub>	>80 %RH less than 40% of time		≤50	90	%RH
Storage Humidity	H <sub>STO</sub>			≤40	60	%RH
Shock	a <sub>SHOCK</sub>	non-repetitive 0.5 ms, powered			5000	G
Torque	M <sub>FIX</sub>	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 <sub>OP</sub>		-40		85	°C
Operating Humidity	H <sub>OP</sub>	>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 <sup>5</sup>		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	V <sub>CC</sub>		8	12 – 24	30	V
Supply Current	I <sub>CC1</sub>			15	20	mA
Voltage Output	V <sub>Out</sub>		0.5		4.5	V



## 8 Tilt Sensor Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Startup Time	$t_s$	$V_{CC}=0\text{ V}$ to $V_{CC}=12\text{ V}$ transition			1	s
Temperature Offset Drift	$T_{off}$	$\varphi_x = \varphi_y = 0\text{ deg}$ $-40\text{ °C} \leq T \leq 85\text{ °C}$	-0.5	$-0.4 < T_{off} < 0.4$	0.5	deg
Accuracy I, <sup>1</sup>	$A_{CC,T25}$	$T=23\text{ °C}$	-0.2	$-0.1 < A_{CC,T25} < 0.1$	0.2	deg
Accuracy II, <sup>1</sup>	$A_{CC,TFULL}$	$-40\text{ °C} < T < 85\text{ °C}$	-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, <sup>3</sup>	$t_{SET}$	to 90% of final reading	0.1	0.2	2	s
Cross Sensitivity, <sup>2</sup>	CCA				0.25	deg

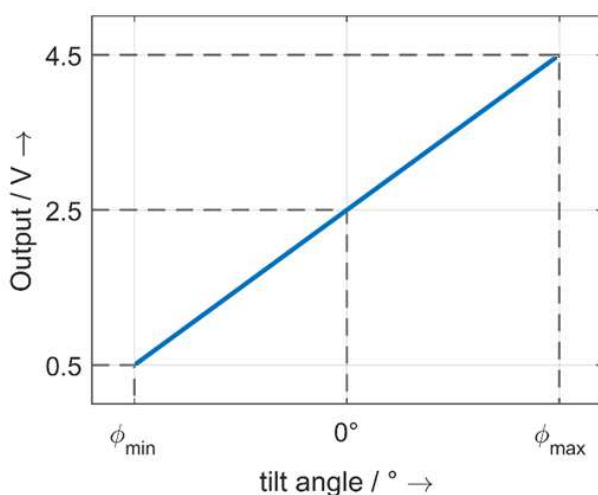
<sup>1</sup> Accuracy is verified by an end of line measurement after calibration without sensor module being removed in between. As the tilt sensor is designed to be fixed with M6 screws, there is some mechanical clearance that may lead to a small misalignment and offset. For some applications it may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

<sup>2</sup> 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.

<sup>3</sup> 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	$\phi_{min}$	$\phi_{max}$
AXISENSE-1-006	-180°	180°

Linear transfer characteristic between  $\phi_{min}$  and  $\phi_{max}$ .

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.

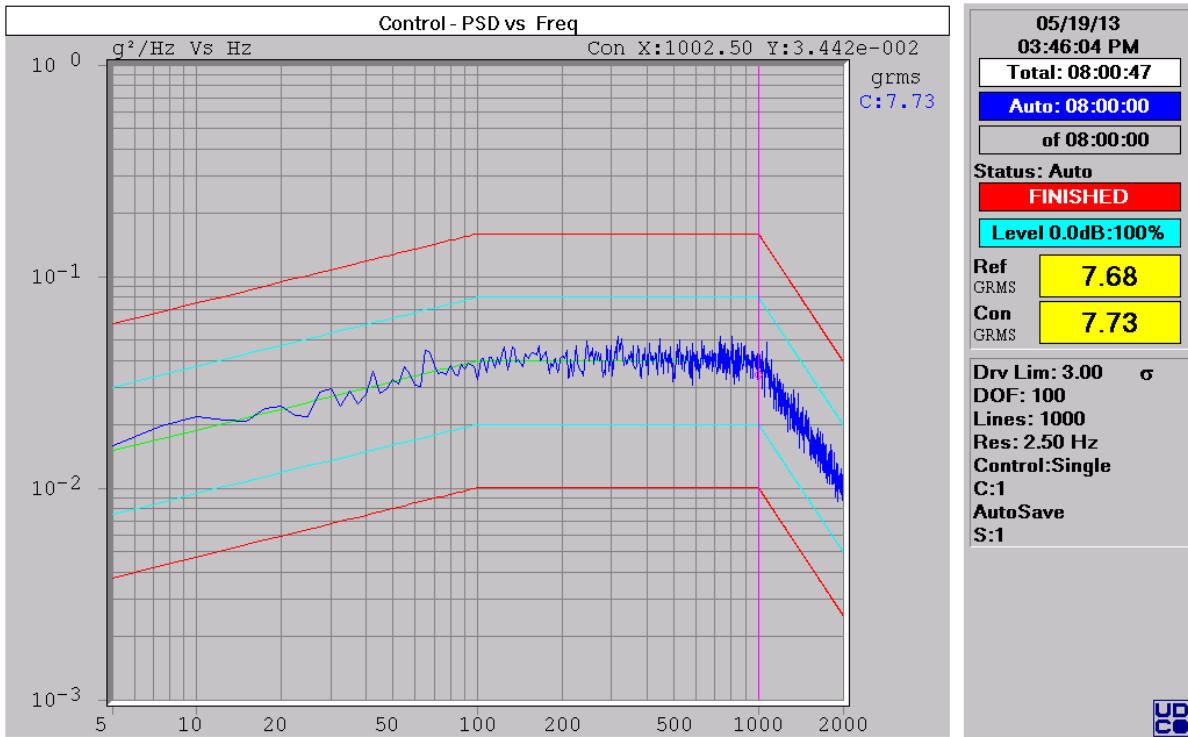


Figure 10.1.1: Random vibration profile used for testing, green trace: ideal excitation, blue trace: actual excitation during test

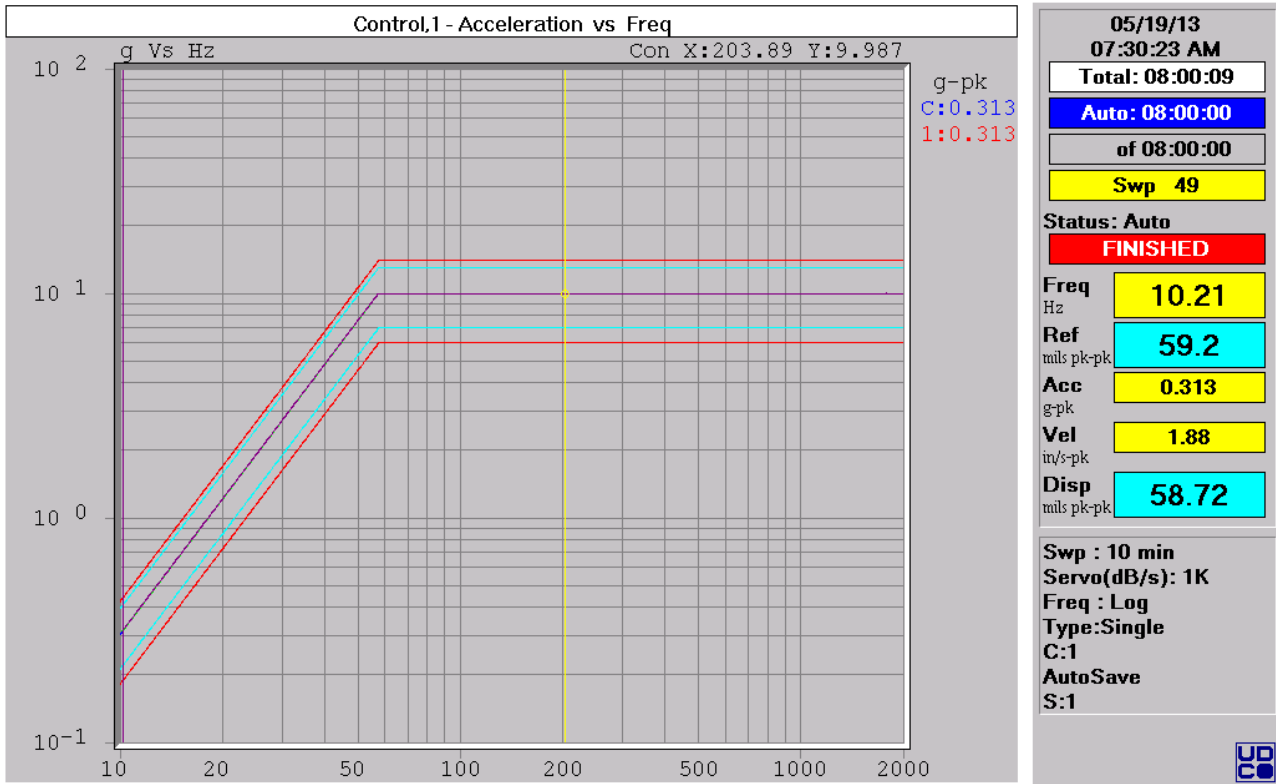


Figure 10.1.2: Sine vibration profile for testing, purple trace: ideal excitation

## 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.



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## 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](http://te.com).



## 12 Additional Information

### 12.1 Ordering Information

**PART NUMBER**

AXISENSE-1-006  
(TCPN: G-NSDOG1-006)

**SHORT DESCRIPTION**

Single axis tilt sensor, floor mount, angular range  $\pm 180^\circ$ , supply 8 to 30 VDC, output voltage 0.5 to 4.5 V

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