

**Inclinometer**

CANopen®, 1 Deutsch IPD DT15-4P Connector

P/N: AX06045X

**Features:**

- 1 or 2 axis inclination or slope sensors
- 2 axis (-80°...80°), functional up to  $\pm 90^\circ$
- 1 axis, vertically positioned (-180° ... 180° or 0...360°)
- High resolution and accuracy
- CANopen® (SAE J1939 models also available)
- 12V, 24VDC nominal
- Aluminum enclosure, 1 DT15-4P connector, gasket, encapsulation
- IP67 protection
- .EDS provided to interface to standard CANopen® tools for user programmability

**Applications:**

- Industrial Automation, Cranes, Hoists, Utility Vehicles, Off-highway, Ag, and Forestry Equipment

**Ordering Part Numbers:****Inclinometers:****AX060450** – Inclinometer, CANopen®, 1 Deutsch IPD DT15-4P Connector*(For a model with 2 5-pin M12 Connectors, refer to TDAX06025X.)***AX060451** – Inclinometer, CANopen®, Internal CAN Termination, 1 DT15-4P Connector**Accessories:****PL-DT06-4S** - A mating plug kit, Axiomatic P/N: PL-DT06-4S is available.  
Mating cables are not supplied.**Documentation:**

EDS File

User Manual UMAX06025X-45X

SAE J1939 models with the DT15-4P connector are also available. Refer to TDAX06040X.

**AX060400** – Inclinometer, SAE J1939, 1 Deutsch IPD DT15-4P Connector**AX060401** – Inclinometer, SAE J1939, Internal CAN Termination, 1 DT15-4P Connector

**Description:** The inclinometer is designed to accurately measure inclination angles in two directions X and Y in the range of  $\pm 80^\circ$ . The CANopen® device profile for inclinometers [DS-410], defines the X-axis as the longitudinal measurement, and the Y-axis as the lateral measurement. For both axes, the range of measurement is up to  $\pm 90^\circ$ . If vertically installed, the sensor can also measure an inclination angle in one sensing direction in the  $\pm 180^\circ$  (0-360°) range.

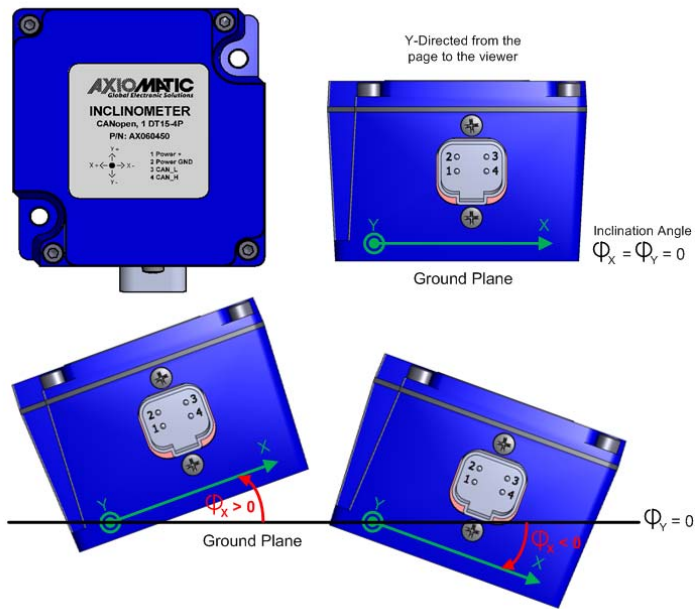
The angles are measured by a two-axis MEMS sensor, which senses acceleration caused by the gravity force in two orthogonal directions. The sensor provides two output signals corresponding to each sensing direction. The output signals from the MEMS sensor are normalized and processed by a powerful microcontroller to receive inclination angles. The resolved angles can be then sent to the CAN bus.

The inclinometer is designed to not only comply with the CANopen® profile, but to also support a variety of extra features that makes it a more versatile sensor. Several of the optional Communication objects outlined in DS-301 are supported by the Inclinometer beyond those referenced in the device profile DS-410. The unit has user programmable functionality using SDO object access, per CiA DS-301. An .EDS file is provided to interface to standard CANopen® tools.

The inclinometer is IP67 rated and is packaged in a cast Aluminum housing with 1 Deutsch IPD p/n DT15-4P connector.

Note: CANopen® is a registered community trade mark of CAN in Automation e.V.

## Standard Functionality - Longitudinal (X) Axis Measuring



The inclinometer measures angles between the sensing directions and the ground plane (relative to gravity). Normally, the sensor is mounted horizontally, with the sensing direction vectors being in parallel with the ground plane.

This initial sensor position corresponds to the zero degree inclination on both axes. The zeroed value may be set after the sensor has been mounted by writing to object 6012h for the X-axis (longitudinal) or 6022h for the Y-axis (lateral).

When a sensing direction vector points up, out of the ground plane, the inclination angle is considered to be positive, and when the sensing direction vector points down, into the ground plane, it is negative, as shown in Figures 1 and 2.

Figure 1 – AX06045X X-Axis Mounting

## Standard Functionality – Lateral (Y) Axis Measuring

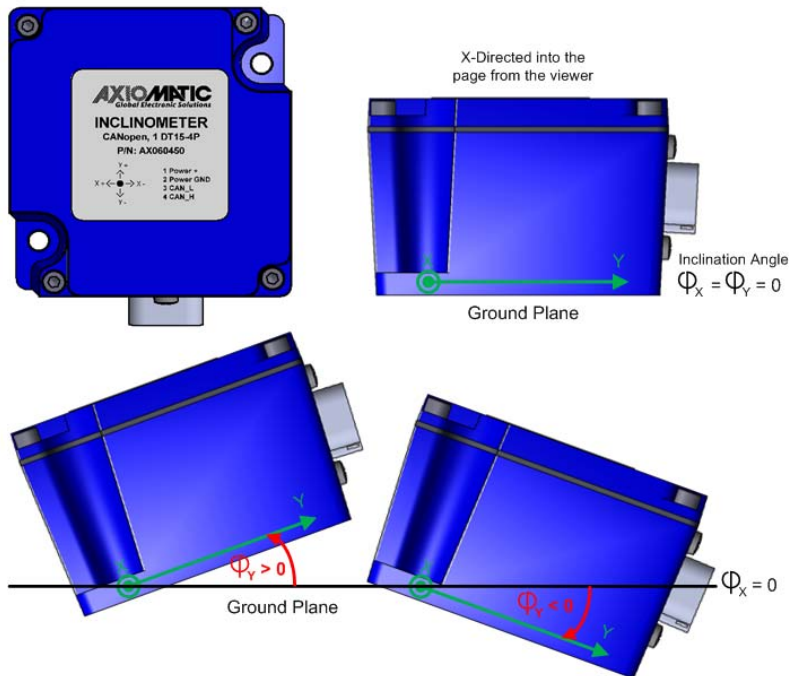
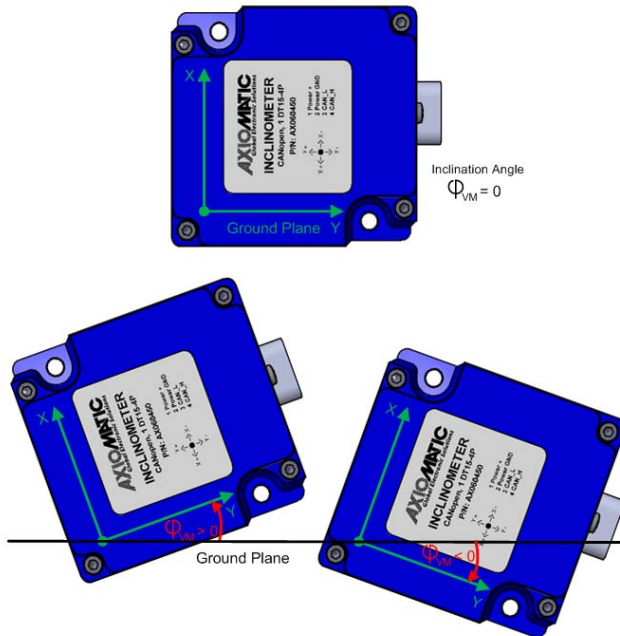


Figure 2 – AX06045X Y-Axis Mounting

## Standard Functionality – Vertical Mount (360°) Measuring

This functional block is used only when the inclinometer is mounted vertically, i.e. orthogonally (at 90°) to the ground plane. In this position, if kept vertical, the inclinometer can measure an inclination angle in one direction in the whole  $\pm 180^\circ$  (0-360°) degree range.



The sensing direction of the vertically mounted sensor is the same as the Y sensing direction of the regularly (horizontally) mounted sensor. When the X sensing direction points up and the Y sensing direction points to the right, and is in parallel with the ground plane, the inclination angle is zero.

The counterclockwise rotation of the sensor produces positive angles and the clockwise, correspondingly, negative, as shown in Figure 3.

Figure 3 – AX06045X Vertical Mounting

## Other Functionality

The standard functionality is to use CAN to output angles. Using commercially-available CANopen® tools, the inclinometer can be reprogrammed for another function. The unit could be reprogrammed to act as a tilt sensor where an out-of-range state (signal) would be transmitted over CAN.

## Technical Specifications:

### Input

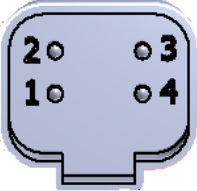
Power Supply Input	12V, 24V nominal (9...43 VDC power supply range)
Supply Current	40 mA at 12 V Typical; 22 mA at 24 V Typical
Protection	Reverse polarity and transient protection is provided.

### Outputs

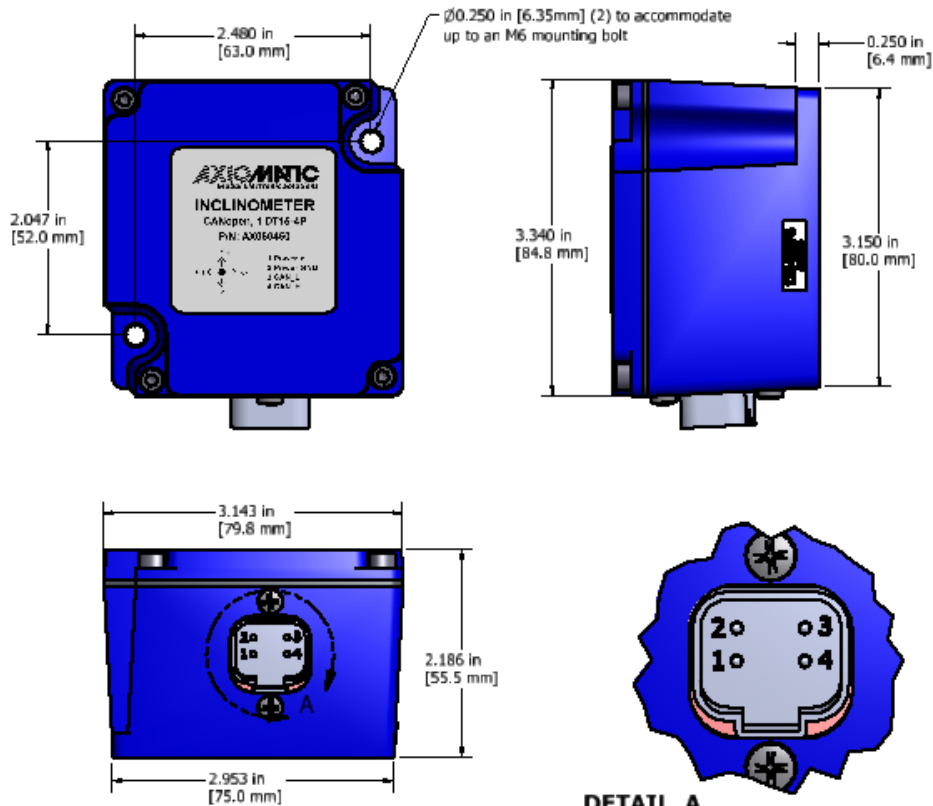
Operation Modes	Dual Axis or Single Axis
Single Axis – Angle Range	Single Axis: $-180^\circ \dots 180^\circ$ ( $0 \dots 360^\circ$ ) Vertical position of the inclinometer should be maintained within the maximum displacement angle
Resolution	$\pm 0.05^\circ$ Maximum
Initial Accuracy	$\pm 0.25^\circ$ Maximum at 25°C
Repeatability	$\pm 0.05^\circ$ Maximum
Nonlinearity	$\pm 0.1^\circ$ Typical

Dual Axis – Angle Range	Dual Axis: -80°...80° Functional up to ±90°	
Dual Axis Measurement Range	Low-angle range -30°...30°	High-angle range -80°...-30° 30°...80°
Resolution	±0.05° Maximum	±0.2° Maximum
Initial Accuracy	±0.25° Maximum at 25°C	±0.5° Maximum, at 25°C
Repeatability	±0.05° Maximum	±0.2° Maximum
Temperature Drift	±0.0015°/°C Typical, at 0° over the full temperature range -40...85°C	-
Nonlinearity	±0.1° Typical	±0.25° Maximum
Cross-Axis Sensitivity	0.5% Typical	
Cut-off frequency, Fc	5 Hz (default) 1...20 Hz (User configurable)	
Settling Time	0.3 sec. Typical at Fc ≥ 5Hz from 0 to 95% of the static output value	
CAN	1 CAN port, CANopen® By default, the inclinometer transmits longitudinal and lateral angles (objects 6010h and 6020h) on TPDO1 to the CAN network, according to CiA Standard DS-410.	
Protection	Short circuit to ground Connection to the power supply (24V maximum)	

### General Specifications

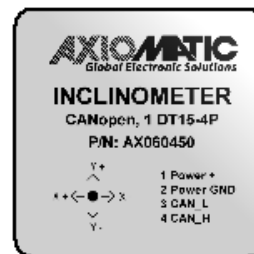
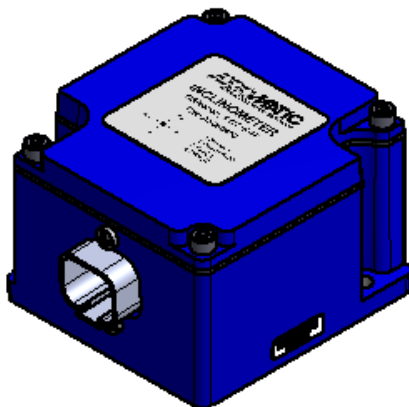
Microprocessor	32-bit, 128 KByte flash program memory
Sensor	Dual axis MEMS acceleration sensor
Control Logic	User programmable functionality using SDO object access, per CiA DS-301 Refer to UMAX06025X-45X for details.
User Interface	.EDS provided to interface to standard CANopen® tools
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Packaging and Dimensions	Cast Aluminum enclosure with gasket, Encapsulated 1 Deutsch IPD p/n DT15-4P connector 3.34 x 3.14 x 2.18 inches 84.8 x 79.8 x 55.5 mm (L x W x H) (Refer to Figure 4.)
Protection	IP67
Weight	1.25 lbs, 0.58 kg
Vibration	MIL-STD-202G, Test 204D and 214A (Sine and Random) 10 g peak (Sine) 7.86 Grms peak (Random)
Shock	MIL-STD-202G, Test 213B 50g
Approvals	CE marking
Electrical Connections Model AX060450	1 Deutsch IPD p/n DT15-4P connector   Pin out 1 Power + 2 Power GND 3 CAN_L 4 CAN_H A mating plug kit, Axiomatic P/N: PL-DT06-4S is available.
Electrical Connections Model AX060451	This model includes internal CAN termination. 1 Deutsch IPD p/n DT15-4P connector The pinout is the same as for the model AX060450. A mating plug kit, Axiomatic P/N: PL-DT06-4S is available.
Installation	Mounting holes accept #10 or M6 screws. The thickness of the mounting flange is 0.25 inch or 6.35 mm.  The CAN wiring is considered intrinsically safe. All field wiring should be suitable for the operating temperature range of the module. CAN wiring may be shielded using a shielded twisted conductor pair. Since there is no CAN shield pin available on the

	DT15-4P connector, the shield must be grounded on the other end. All chassis grounding should go to a single ground point designated for the machine and all related equipment.
Network Termination	<p>The CAN port is electrically isolated from all other circuits. Refer to the CAN 2.0B specification for more information. No more than two network terminators should be used on any one single network.</p> <p>For the AX060450, it is necessary to terminate the network using an external CAN termination. A terminator is a 121Ω, 0.25 W, 1% metal film resistor placed between CAN_H and CAN_L terminals at the end two nodes on a network.</p> <p>In the AX060451, an integrated 120Ω, 1%, 1W resistor is built into the unit. It is meant for use at the end of a CAN network.</p>



**DETAIL A  
SCALE 2 : 1**

DT15-4P receptacle mating plug is Deutsch IPD P/N: DT06-4S with two wedgelocks (W4S) and 4 contacts (0462-201-16141). All field wiring should be suitable for the operating temperature range.



**Label detail scale 2:1**

Figure 4 – AX06045X Dimensions and Pin out

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. Users should satisfy themselves that the product is suitable for use in the intended application. All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Approvals/Limitations and Return Materials Process as described on [www.axiomatic.com/service.html](http://www.axiomatic.com/service.html).

Form: TDAX06045X-08/21/15