

**INSTRUCTION MANUAL**  
**For Model 7360A/7360AM1**  
**6-DoF SENSOR**  
**IM7360A, Revision B**

## SAFETY CONSIDERATIONS



Model 7360A/7360AM1 6-DoF Sensor Is declared to fully comply with EU Council Directives:

Low Voltage Directive, 2014/35/EU - Compliant  
EMC Directive, 2014/30/EU - Compliant  
RoHS Directive, 2011/65/EU and 2015/863 (RoHS 3)- Compliant



The Product listed above is manufactured by Endevco, Inc. and is declared to comply with the noted Product Safety and Environmental Standards when installed and operated in accordance with the Manufacturer's instructions provided. The product is declared to comply by design, testing and 3<sup>rd</sup> party evaluation (when necessary). The certification program management, product safety testing, EMC testing and evaluations were provided by Endevco, Inc. or an Outsourced 3<sup>rd</sup> Party Provider. RoHS compliance declared by evaluation of product and materials used and exemptions granted to test instruments. The product is eligible to bear and display the CE mark. All safety and EMC standards listed below are the latest revision in force at the time and date tests and evaluations were conducted.

### EMC standards

EN 55011, Class A conducted and radiated RF emissions	
EN 61000-3-2 Harmonic current emissions	EN 61000-3-3 Voltage fluctuations and flicker
EN 61000-4-2 Electrostatic discharge immunity	EN 61000-4-3 Radiated electromagnetic field immunity
EN 61000-4-4 Fast transient burst immunity	EN 61000-4-6 Conducted RF immunity
EN 61000-4-11 Voltage dips, short interrupts and variations	

### Safety standard

EN/IEC 61010-1; Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1

This manual contains information and warnings that must be followed to ensure safety of personnel and the safe operation of the product.

#### Warnings:

Switch off all power to equipment before connecting or disconnecting the product. Failure to do so may cause damage to the product.

Any adjustment, maintenance or repair, other than detailed within this manual, must be carried out by trained service personnel.

If it is suspected that the correct operation of the equipment is threatened, impaired or otherwise, it must be made safe and free from further operation until the threat has been removed.

To return unwanted product for disposal, please contact your local Endevco representative.

## 1.0 Table of Contents

1.0	Table of Contents.....	3
2.0	Product Description.....	4
3.0	Materials Required.....	4
4.0	Pre-installation Check-up.....	4
5.0	Mounting.....	5
5.1.	Mounting Surface.....	5
5.2.	Screw Mount.....	5
5.3.	Adhesive Mount.....	6
5.4.	Cable.....	7
5.5.	Electrical Connection.....	7
6.0	Electrical Precautions.....	7
6.1.	Excitation Voltage.....	7
6.2.	Signal Leads.....	8
6.3.	Grounding.....	8
6.4.	Signal Conditioning.....	8
7.0	Recalibration.....	8
8.0	Questions.....	8

## 2.0 Product Description

The ENDEVCO Model 7360A is a six degrees of freedom (6-DoF) sensor that features three DC accelerometers and three angular rate sensors packaged in a compact enclosure. This 6-DoF sensor is designed specifically for vehicle development testing and other systems requiring accurate measurement of accelerations and angular velocity in harsh shock and vibration environments. The 7360A 6-DoF sensor features various acceleration ranges including  $\pm 2$ ,  $\pm 10$ ,  $\pm 50$ ,  $\pm 200$ ,  $\pm 500g$  and angular rate ranges including  $\pm 100$ ,  $\pm 500$ ,  $\pm 1500$ ,  $\pm 8000$ ,  $\pm 12000$  and  $\pm 18000$  deg/sec, and provides full scale voltage output of  $\pm 2V_{pk}$ . As is the practice with all instrumentation, certain electrical precautions should be followed with pre-installation check-up, mounting and recalibration.

The ENDEVCO Model 7360AM1 is the same as 7360A except the excitation voltage of 7360AM1 is +5Vdc ( $\pm 5\%$ ). The following sections of this instruction manual apply to both 7360A and 7360AM1 except for section 6.1.

## 3.0 Materials Required

All the materials used in the mounting of the Model 7360A 6-DoF sensor are supplied with the unit in the shipping container. These materials, as shown in Figure 1, include:

(1) 4-40 x 1 1/4 inch Socket Head Cap Screws- Endevco P/N EH866 (2pc)

(2) Size 4, Flat Washers- Endevco P/N EHW289 (2pc)

## 4.0 Pre-installation Check-up

Before installation of the 6-DoF sensor, it should be checked to insure proper operation on all three accelerometers and three angular rate sensors.

### Accelerometer check-up:

A simple Zero Measurand Output and 2 g Turnover test can be conducted on the three accelerometers with minimal test equipment. For each of the three accelerometer axes (X/Y/Z accelerometer), place the unit on table so that the accelerometer sensing direction is in parallel with the table top surface. Apply the specified excitation voltage to the accelerometer (see data sheet for proper wiring hook-up) and measure the output with a DC millivolt meter. Allow the unit to warm-up for one minute. The accelerometer should have a Zero Measurand Output (ZMO) within the specified limits in the data sheet.

To perform the 2 g Turnover Test, for each of the three accelerometer axes (X/Y/Z accelerometer), the unit is oriented with its sensing direction perpendicular to the table top (sensitive axis is vertical) and the output is measured with the DC millivolt meter. The unit is then turned over  $180^\circ$ , resulting in a change of 2 g, and the output is measured again. The sensitivity is computed by dividing the change in output by 2 g. The sensitivity in mV/g should be within the specified limits in the data sheet.

### Angular rate sensor check-up:

A simple Output Voltage test can be conducted on the three angular rate sensors with minimal test equipment.

Place the unit on the flat surface of a vibration-free table top. For each of the three angular rate axes (X/Y/Z rate), apply the specified excitation voltage to the angular rate sensor (see data sheet for proper wiring hook-up) and measure the output with a voltage meter. Allow the unit to warm-up for one minute before the output voltage measurement.

The output voltage should be measured on the three tests listed in Table 1. The voltage of +OUT and -OUT with respect to GND should fall in range of  $+2.3V \sim +2.6V$ , and the voltage of +OUT with respect to -OUT should be within  $-100mV \sim +100mV$ .

Connection	Voltage
+OUT with respect to GND	+2.3V ~ +2.6V
-OUT with respect to GND	+2.3V ~ +2.6V
+OUT with respect to -OUT	-100mV ~ +100mV

TABLE 1. Output Voltage test for three angular rate sensors check-out

If this initial check does not give a proper reading on any of the accelerometers or angular rate sensors, which indicates a possible malfunction, and the reason for the erroneous reading cannot be found, please contact [sales@endevco.com](mailto:sales@endevco.com) for troubleshooting or return.

## 5.0 Mounting

When mounting the Model 7360A 6-DoF sensor, it is best to utilize the proper techniques and tools listed to ensure optimum performance.

### 5.1. Mounting Surface

The mounting surface should be clean and free of burrs. Two #4-40 tapped holes, 0.15 inches (3.81mm) minimum depth should be spaced 1.41 inches (35.8 mm) apart. A 32 micro inch rms surface finish with flatness of 0.0001 inches is recommended for the area that will contact the 6-DoF sensor. The two mounting holes should be positioned to best suit the requirement of the acceleration and angular rate measurement in the specific application. Figure 2 shows the positive sensing directions of the three accelerometers and the three angular rate sensors in the 6-DoF sensor.

### 5.2. Screw Mount

To screw mount Model 7360A 6-DoF sensor, use an Allen wrench and the supplied mounting washers (EHW289, Steel, Black Oxide), mounting screws (EH866, 4-40 x 1 1/4", Steel, Black Oxide) as shown in Figure 1.

Remove the unit from the shipping container. Place the unit on the mounting surface and align the mounting holes.

Slide the washers over the screws. Using the wrench to tighten the screws to 6 lbf-in (0.68 Nm). This is roughly equivalent to finger tight with the wrench.

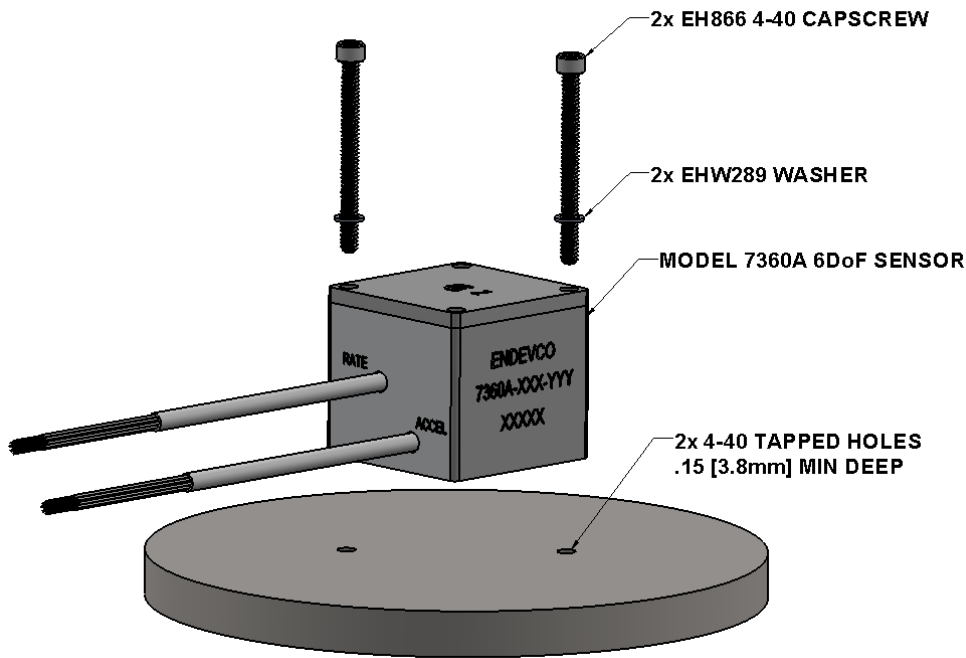


FIGURE 1. Screw Mount of Model 7360A 6-DoF Sensor

Note: Suggested distance between the two mounting holes in substrate is 1.414 in (3.59mm).

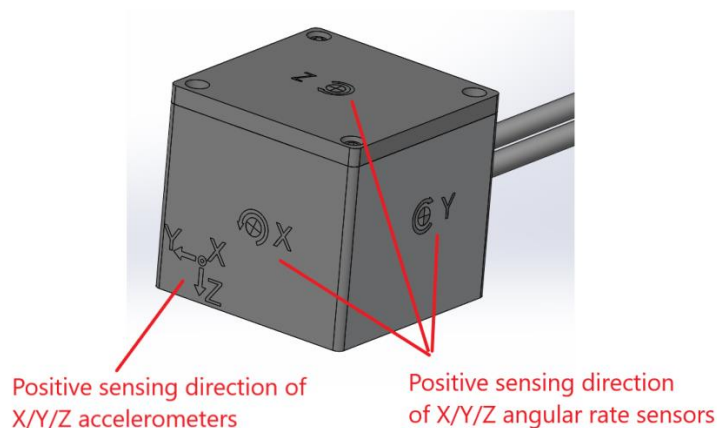


FIGURE 2. Positive sensing directions of the 6-DoF Sensor

### 5.3. Adhesive Mount

Model 7360A 6-DoF sensor can be mounted by adhesives too. Adhesion of epoxies to the hard anodized case is excellent, but thermal mismatch to the mounting surface can degrade the joint and cause an undulating surface. A compliant adhesive, such as Dow Corning 3145 RTV, is recommended. Use care to maintain flatness of the unit during curing to reduce measurement errors. To remove adhesive-mount sensor from the mounting surface, apply acetone or other dissolving agent to the adhesive layer using a cotton tip, wait for epoxy to be partly dissolved before gently removing the sensor by hand or tools. Do not apply excessive strain on the sensor body during removal of the sensor.

### 5.4. Cable

As practical, tie down the cable within 2 to 3 inches (4 to 6 cm) of the unit. Whipping of the cable during rotation, vibration and shock will strain the cable unnecessarily at the unit. The cable has 12x #32 AWG wires. The cable diameter is .118" +/- .005". The cable jacket is white matte finish polyurethane, care should be taken to avoid cutting or tearing the jacket. The cable is rated for 212°F (100°C) continuous service.

### 5.5. Electrical Connection

Connect the six axes of the 6-DoF sensor to the signal conditioner using the following lead designations (Table 2):

ACCELEROMETER CABLE				RATE SENSOR CABLE			
CONTACT	X AXIS	Y AXIS	Z AXIS	CONTACT	X AXIS	Y AXIS	Z AXIS
EXC	RED	BROWN	ORANGE	EXC	RED	BROWN	ORANGE
+OUT	GREEN	BLUE	GRAY	+OUT	GREEN	BLUE	GRAY
-OUT	WHITE	YELLOW	VIOLET	-OUT	WHITE	YELLOW	VIOLET
GND	BLACK	PINK	TAN	GND	BLACK	PINK	TAN

TABLE 2. Signal Lead Designation of the 7360A 6-DoF sensor

Two twelve-wire cables are labelled for the accelerometer and angular rate channels of the 7360A 6-DoF sensor (as shown in Figure 3 below).

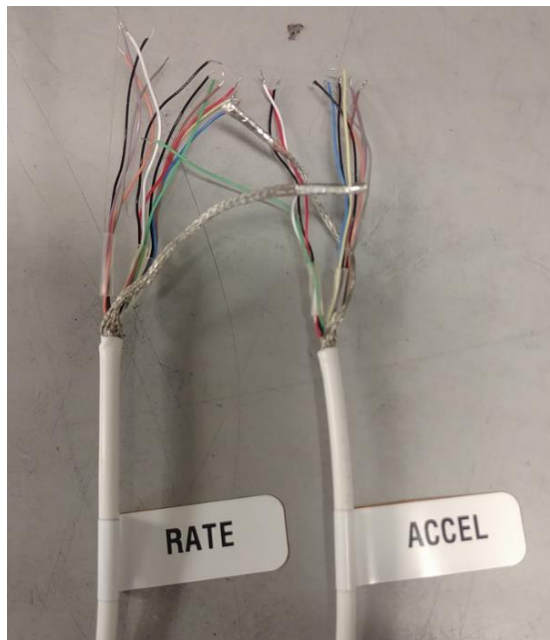


FIGURE 3. Labelled cables and grouped wires

## 6.0 Electrical Precautions

### 6.1. Excitation Voltage

The Model 7360A 6-DoF sensor features internal voltage regulators, it's required to supply excitation voltage of +7Vdc to +36Vdc to the three accelerometer axes, and +5Vdc to +16Vdc to the three angular rate axes. The model 7360AM1 requires excitation voltage of +5Vdc (±5%) to the three accelerometer axes, and +5Vdc (±5%) to the three angular rate axes. The excitation voltage is not regulated in 7360AM1, it's recommended to supply a clean and stable +5Vdc (±5%) power to ensure accurate measurement of the 6-DoF sensor.

A low noise power supply is recommended and care should be taken to minimize pickup on the cabling to the sensor. The maximum current drain over the entire operating range of 7360A and 7360AM1 is 8 mA for each accelerometer axis, and 6 mA for each angular rate axis. It's recommended to use Endevco Model 136 3-channel signal conditioner to provide power and signal processing functions to Model 7360A and 7360AM1 6-DoF sensors.

## 6.2. Signal Leads

Refer to Table 2 for signal lead designation of the 6 axes of the 7360A 6-DoF sensor.

The +OUT and -OUT signal leads are differential. The +OUT lead has a varying output, while the -OUT lead is fixed at a reference voltage of approximately +2.5 Vdc. Although the output is high level, at  $\pm 2$  Vdc, the usual precautions of using twisted pair, shielded instrumentation cable should be taken to avoid noise pickup on the signal leads.

## 6.3. Grounding

The case of the model 7360A 6-DoF sensor is not attached to circuit ground, and the cable shields of the two output cables are not attached to the case or to circuit ground. The recommended grounding scheme is to ground the cable shield at the power supply ground and to no other point to avoid ground loops.

## 6.4. Signal Conditioning

Each axis of the model 7360A 6-DoF sensor has a high level differential output of  $\pm 2$  Vdc, biased at +2.5 Volts. The zero rotation reading, or Zero Measurand Output (ZMO), is 0 volts  $\pm 50$  mV for accelerometer axes, and 0 volts  $\pm 100$  mV for angular rate axes. When either the accelerometer or the angular rate sensor is subjected to acceleration input or angular rate input greater than the full range, the output of the unit will electrically clip, with a recovery time of  $< 100$  milliseconds.

## 7.0 Recalibration

Sensitivity and Zero Measurand Output calibration should be performed at 6 to 12 month intervals, depending on usage. Ordinarily, recalibration needs to be performed only at 12 month intervals if it is known that the 6-DoF sensor has not been used beyond its rated specifications. If the unit is used under severe environments, it may be desirable to use shorter calibration intervals.

Contact Endevco for calibration information or return the 7360A unit to Endevco for recalibration. Endevco maintains an angular rate recalibration service with A2LA traceability in the United States.

If the user installs a customized connector to the 6-DoF sensor, a mating connector with pigtailed leads is recommended to be provided to Endevco with the sensor in order not to cause delay of the calibration or the removal of the customized connector from the cable.

Dirty units may be wiped clean using a damp cloth and a solvent such as acetone.

## 8.0 Questions

If you have any questions regarding the use of this or any Endevco sensors, please contact [sales@endevco.com](mailto:sales@endevco.com) or go to our website <https://endevco.com/> for information from Endevco Application Engineering in North America and your local sales representatives.