BEAMER Tilt Beam Sensor

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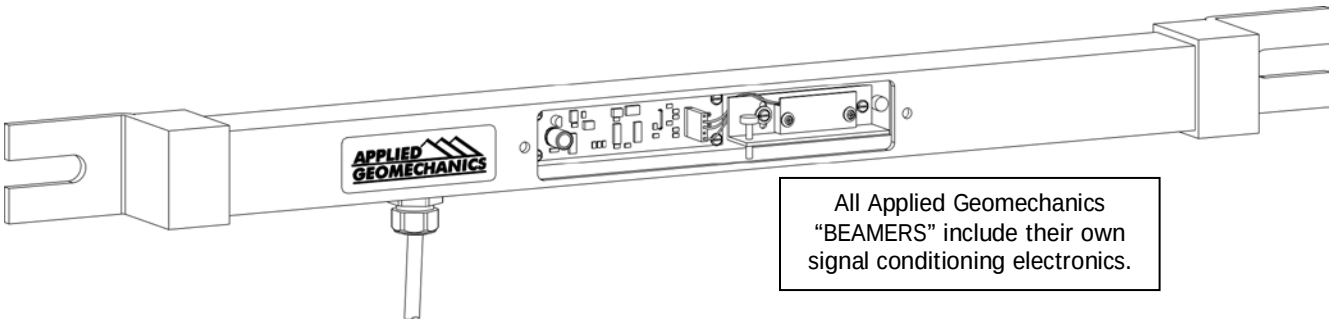
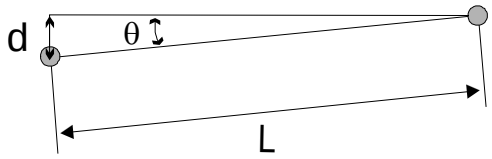
***CAUTION**: Never measure the sensor inside your Beamer with an ohmmeter. Doing so will cause permanent damage that is not covered by the warranty.*



All Applied Geomechanics "BEAMERS" include their own signal conditioning electronics.

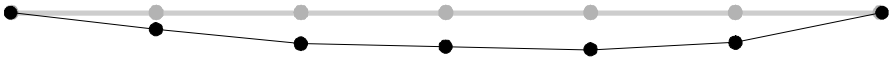
General Description

Beam sensors detect rotation between two fixed points. A tilt sensor is mounted on a rigid beam, typically one to three meters in length, anchored at each end to the structure being measured. In this manner changes in tilt can be easily converted to displacements since the measured rotation occurs over a defined length.



Displacement (d) = L sin θ

Beam sensors can be connected end-to-end to determine cumulative displacement along a horizontal or vertical profile.



Cumulative displacements along a horizontal profile

ADVANTAGES	***APPLICATIONS***
High Resolution Tilt beam sensors can detect tilt change as small as one arc second (0.005 mm/m). **Long Cable Length** Electrical signal can be transmitted over distances >500 meters without problems. **Easy Installation** Tilt beam sensors are made with two fork-shaped ends for use with groutable anchors.	♦ Monitor the effect of excavation and tunneling on existing structures. ♦ Monitor the movement of tunnel walls. ♦ Monitor the performance of bridges and structures under load. ♦ Monitor settlement in dams, retaining walls, pipelines and over tunnels.

The Model 805 ***BEAMER*** consists of a uniaxial tiltmeter mounted on a rigid 38 x 38mm square aluminum beam. Beams can be mounted horizontally or vertically. The beam is fixed to the structure using two anchors, one at each end, so that very accurate movement profiles can be generated over long distances. ***BEAMERS*** can be read using a manual readout or with an automated data acquisition system at a remote location.

The tilt sensor for the horizontal beam is mounted inside the beam. For the vertical beam, the sensor is supplied in a waterproof enclosure attached to the outside of the beam. An adjustment screw in horizontal ***BEAMERS*** allows initial zeroing and range adjustment without moving the beam.

Specifications

TILT OUTPUT	± 2.5 VDC (referenced to signal ground)
MEASUREMENT RANGE	±1 degrees (greater ranges available)
ADJUSTMENT RANGE	±5 degrees (horizontal Beamers only)
SCALE FACTOR	0.4 degree/Volt
RESOLUTION	0.0003 degree (1 arc second)
REPEATABILITY	0.001 degree at constant temperature
LINEARITY	1% of full span typical
TEMPERATURE OUTPUT	0.1°C/mV (single-ended), -40° to +100°C, ±0.75°C accuracy, 0°C = 0 mV
POWER REQUIREMENTS	+8 to +24 VDC @ 8 mA, 250 mV peak-to-peak ripple max., reverse polarity protected
RESPONSE TIME	150 milliseconds
TEMPERATURE COEFFICIENT	K_Z = ±1 arc sec / °C typical; K_S = +0.04% / °C typical
MATERIALS	Square aluminum tube, 38 x 38mm; cable: PVC jacket, polypropylene insulation
WEIGHT	1m Beamer: 1.8 kg (4lb); 2m Beamer: 2.8kg (6lb)

Ordering Information

Order No.	Description
98805-02	1-meter Beamer, horizontal*
98805-03	2-meter Beamer, horizontal*
98806-02	1-meter Beamer, vertical*
98806-03	2-meter Beamer, vertical*
89028	Stainless steel mounting stud and hardware set, 1 per end
70369	Hook-up cable

*Other lengths available at higher cost

Useful Accessories

Part No.	Description
98001	ADVisor Readout and Hand-held Datalogger
98002	Model 870 Readout Module and Digital Multimeter for manual readings
62204	6-pin male receptacle (connector) for Beamer cable; required for use with ADVisor or Model 870
798-A	Handi-Logger for continuous data acquisition

Conversion Factors: 1mm/meter = 0.0573 degree = 206.3 arc seconds = 0.0120 inch/ft

Installation

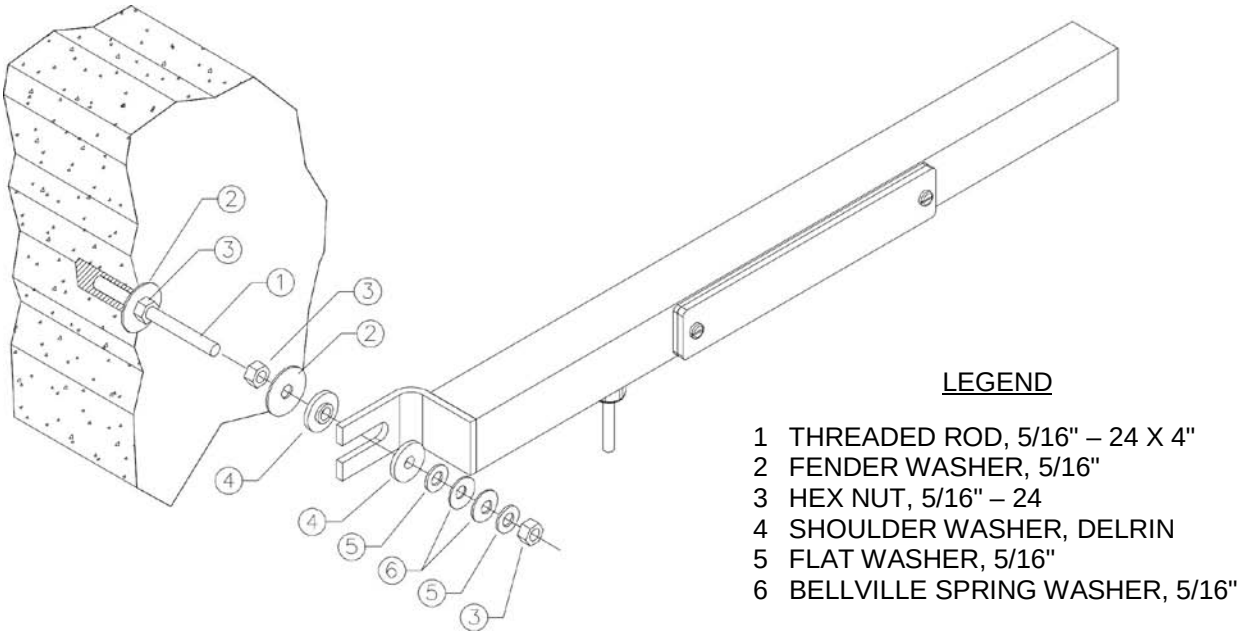


Figure 1 – ***BEAMER*** mounting

Installing the BEAMER

1. Hold the ***BEAMER*** in place and level, then mark the location of the two anchor holes—one at each end of the beam. The correct hole location is halfway along the anchor slot in the end-cap. Put ***BEAMER*** aside. Do not use the ***BEAMER*** itself as a drilling guide.

2. Drill 5/16 or 3/8 inch (8-9mm) mounting holes so that at least 1 inch of the mounting stud will remain outside the hole. Hole depth may vary if the ***BEAMER*** is installed around obstacles.

3. Blow or swab the drill cuttings out of the holes. Fill each hole ½ full of mounting epoxy and insert the mounting stud (threaded rod). Be careful to avoid getting epoxy on the exposed threads of the mounting stud.

4. Hold the studs in place to insure correct positioning as the epoxy hardens. Allow time for complete hardening to take place before attaching the ***BEAMER*** to the mounting studs. Wipe away epoxy drips as necessary.

5. When epoxy has hardened completely, attach the ***BEAMER*** to the studs (see Figure 1). The ***BEAMER*** end fork is designed to slide laterally on the Delrin shoulder washers as the beam expands and contracts with temperature changes. It is therefore important not

to over-tighten the final hex nut; it should be snug but not tight. The spring washers will provide the proper tension.

6. After the ***BEAMER*** has been fastened down, it is usually a good idea to adjust the sensor inside the beam so that the ***BEAMER*** is reading as close to zero (0) Volts as possible. See the instructions below for details.

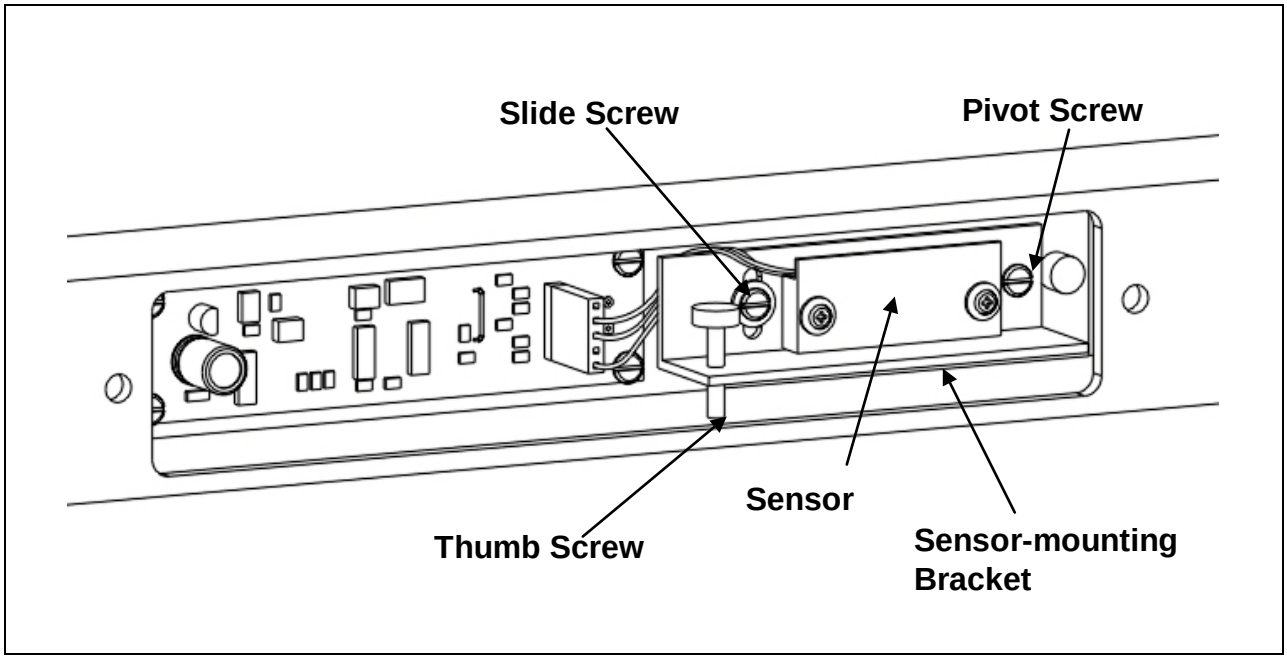


Figure 2 – Sensor leveling parts

Leveling the Sensor Inside Your Beamer

With the cover off the front of your horizontal ***BEAMER***, adjust (level) the internal tilt sensor so that the output of the ***BEAMER*** is as close to zero (0) Volts as possible. The sensor has its best linearity and lowest temperature coefficient when the ***BEAMER*** output is 0 Volts. Follow the procedure below while referring to Figure 2:

1. Loosen the slide screw and the pivot screw just enough so that the sensor-mounting bracket can rotate up and down about the pivot screw without binding.

2. While reading the ***BEAMER*** output with a voltmeter (see below), turn the thumb screw to adjust the angle of the sensor-mounting bracket. Keep adjusting until the output is as close to zero (0) Volts as possible.

3. Tighten the slide screw and the pivot screw, while keeping the output at approximately zero (0) Volts.

4. Replace the cover and tighten down the cover screws. If your horizontal ***BEAMER*** will be used outdoors, seal the edges of the cover with silicone rubber caulking compound (Figure 3).

5. *WARNING: Never measure the tilt sensor using an ohmmeter. Using an ohmmeter or applying DC current to the sensor will cause permanent damage that is not covered by the warranty!*

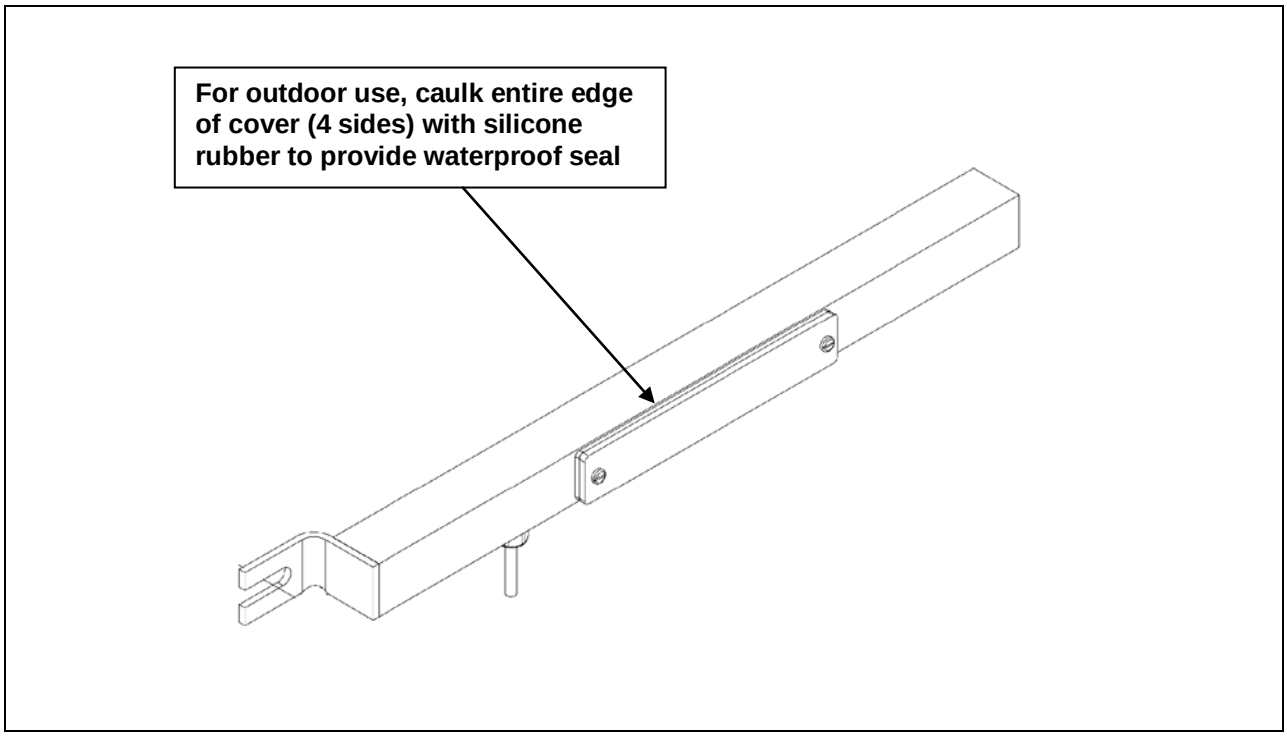


Figure 3 – Caulking of cover for outdoor operation

Measurements

Figure 4 shows the wiring convention used with the ***BEAMER***. Measurements can be taken using a datalogger, an ADVisor hand-held logger, a Model 870 Readout Module, or simply with a voltmeter.

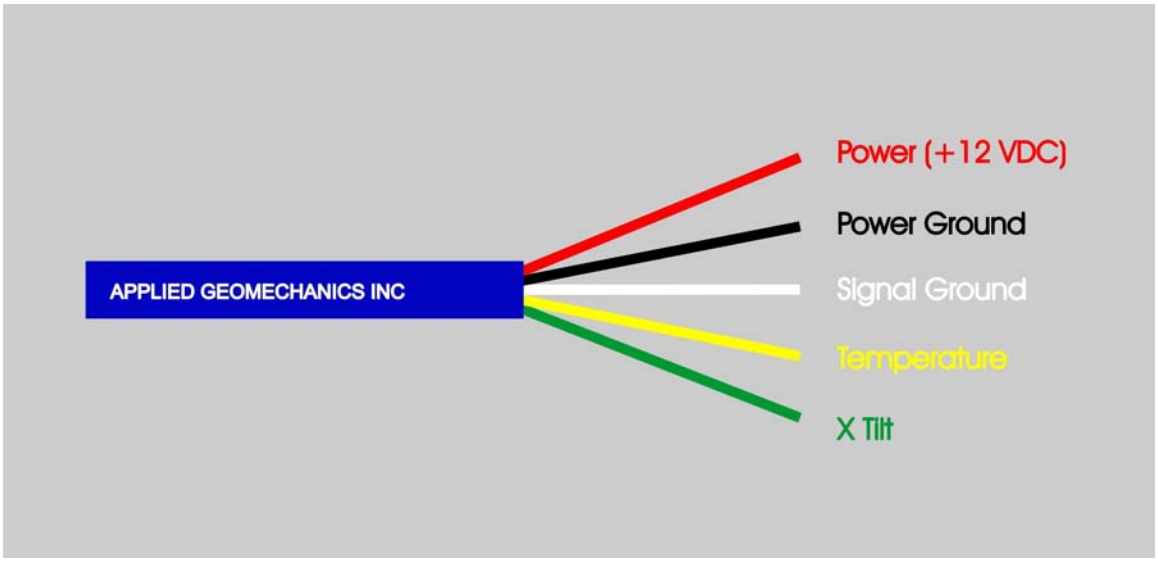


Figure 4 - ***BEAMER*** Wiring Pin-Out

Once power is supplied to the instrument, the X-Tilt signal channel (Figure 5) will put out a DC voltage proportional to the tilt angle. The conversion from DC voltage to tilt angle is performed using the scale factor shown on the Calibration Certificate at the back of this manual. The scale factor is unique to a particular instrument, which is identified by its serial number.

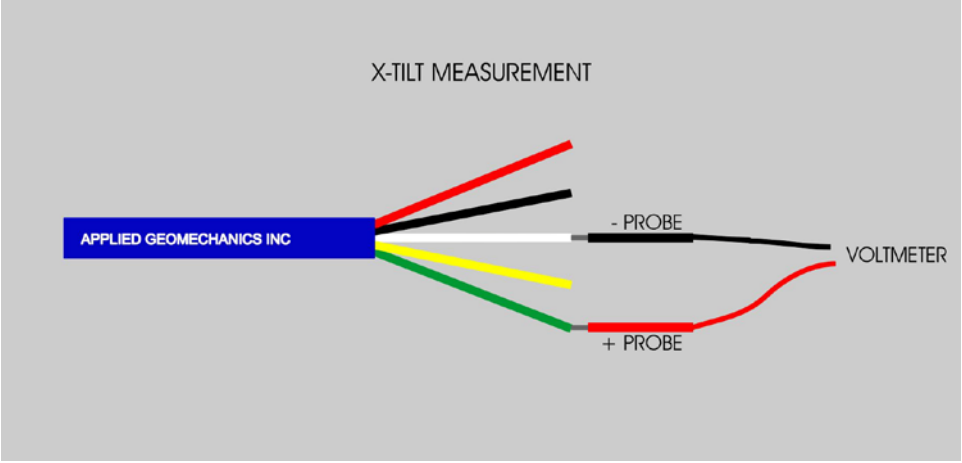


Figure 5 – Measuring the X-Tilt signal with a voltmeter

The temperature signal channel (Figure 6) puts out a DC voltage proportional to the temperature inside the ***BEAMER***. The conversion from DC volts to temperature in degrees Celsius is accomplished by multiplying the number of volts by 100. For example, if the voltage output is 0.239 VDC, the corresponding temperature is 23.9 degrees Celsius.

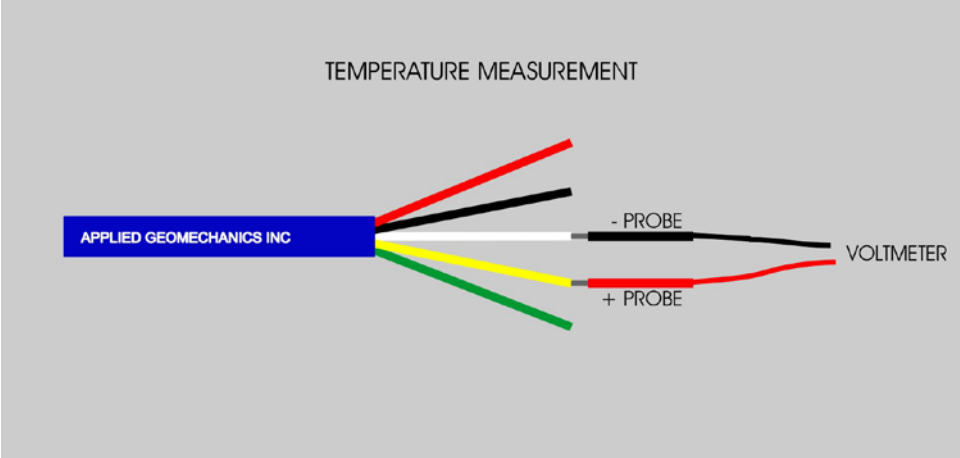


Figure 6 - Measuring the temperature signal with a voltmeter

Wire Connections to a Datalogger

As shown in Figures 5 and 6, the X-Tilt and Temperature signals are referenced to Signal Ground. Whenever possible, the signals should be recorded in *differential* mode for best data quality. When using a CR10X datalogger to measure both X-Tilt and Temperature simultaneously, it is necessary to install a jumper as shown in Figure 7. Logger channel 2 is not being used in the example in Figure 7, and its H and L inputs are therefore shorted.

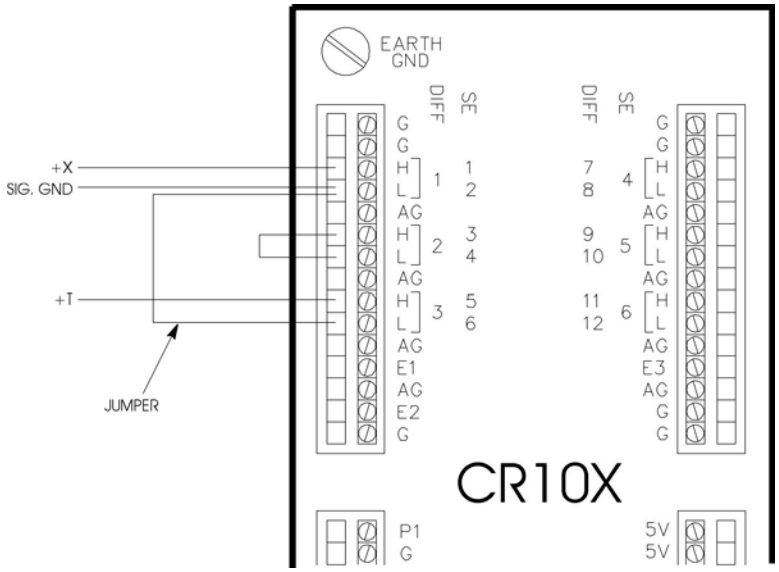


Figure 7 – Connecting signal wires to the CR10X module inside the Model 798 ***HANDI-LOGGER***

For technical support contact:

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