

## MEMS Tiltmeter



### Applications

The MEMS tiltmeter is a compact, waterproof tiltmeter with a range of  $\pm 10^\circ$  from vertical. It is used to monitor changes in the inclination of a structure. Applications for the tiltmeter include:

- Monitoring rotation of retaining walls, piers, and piles.
- Providing early warning of potential structural damage.
- Documenting any effects of nearby deep excavations.

The deepwater MEMS tiltmeter is made of a brass enclosure so that it can be installed in saline environments. Applications for the deepwater MEMS tiltmeter include:

- Monitoring the behavior of the concrete face of rockfill dams
- Monitoring rotation of marine structures

### Operation

The MEMS tiltmeter measures tilt over a range of  $\pm 10^\circ$  from vertical and is available in uniaxial and biaxial versions. Signal conditioning makes the tiltmeter compatible with most data loggers.

The tiltmeter is fixed to the structure via an angle bracket that can be welded to steel or bolted to an anchor set into concrete or rock. Because the tiltmeter has a relatively wide range, careful zeroing of the sensor is not required.

Readings are obtained with a data logger or a portable readout. The initial reading is used as a baseline. Changes in the inclination of the structure are found by comparing current readings to the initial.

### Advantages

**Mounts Anywhere:** The tiltmeter is supplied with a bracket that can be welded to steel or bolted to anchors.

**Wide Range:** The tiltmeter has a range of  $\pm 10^\circ$ , so it can be installed without careful zeroing.

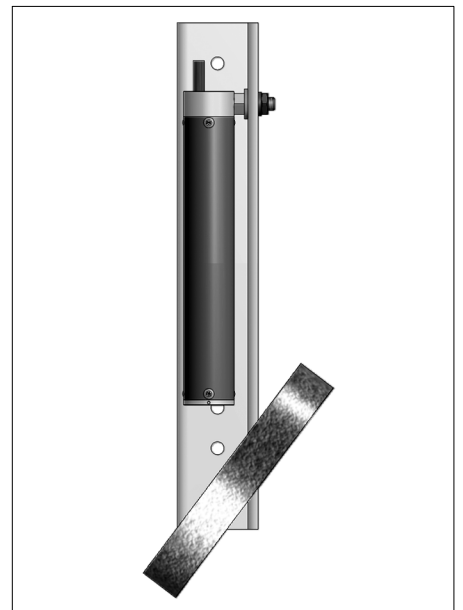
**Uniaxial or Biaxial:** The tiltmeter is available in uniaxial and biaxial versions.

**Waterproof:** The tiltmeter can tolerate submersion.

**Suitable for Automatic Readings:** The tiltmeter outputs a voltage signal that can be read by most data loggers. It can also be read manually with the EL/MEMS Data Recorder.



The tiltmeter can be fixed to most structures via the included angle bracket. The bracket can be anchored to rock or concrete and welded to steel.



An optional embedding mounting bracket provides a way to stand tiltmeters on sloping surfaces, such as the concrete face of a rock-fill dam.

**TILTMETER SPECIFICATIONS**

- MEMS Tiltmeter ±10°, Uniaxial. 57803101
- MEMS Tiltmeter ±10°, Biaxial . . 57803102
- MEMS Tiltmeter ±20°, Uniaxial. 57803201
- MEMS Tiltmeter ±20°, Biaxial . . 57803202
- MEMS Deepwater Tiltmeter, ±10°, Uniaxial 57803301
- MEMS Deepwater Tiltmeter, ±10°, Biaxial . 57803302

Tiltmeter includes angle bracket, 5 m of signal cable, calibration record, an user manual. Anchor is not included. Please note that the Deepwater Tiltmeter does not include an angle bracket.

**Sensor Type:** MEMS (Micro Electro-Mechanical Systems) sensor for tilt readings and a 3K ohm thermistor for temperature readings.

**Range:** ± 10 degrees or ±20 degrees.

**Resolution:** 9 arc seconds, using a 13 bit readout device such as the CR1000 datalogger.

**Repeatability:** ±22 arc seconds.

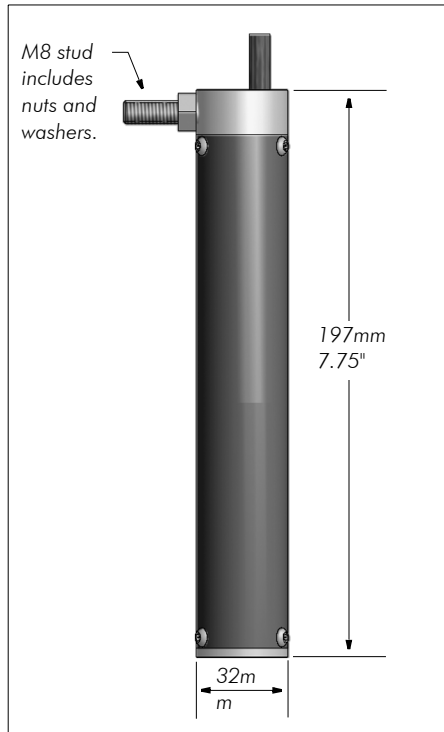
**Calibration:** 11-point calibration taken at three temperatures from -8 to 40 °C.

**Input Power:** 8 to 15 Vdc.

**Output Signal:** ±2.5 Vdc.

**Body:** Stainless steel. Waterproof to 20m.

**Dimensions:** 32 x 190 mm (1.25 x 7.5"). Mounting stud is M8.



**SIGNAL CABLE**

Signal Cable . . . . .50613527  
Cable has seven 22-gauge tinned-copper conductors, shield, and polyurethane jacket. The standard product includes 5 m of cable. Custom lengths of cable can be special ordered.

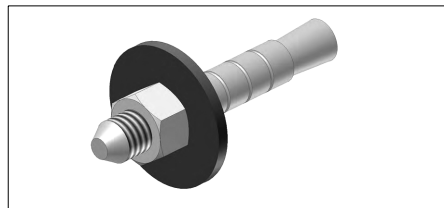
**MOUNTING BRACKETS**

**Angle Bracket. . . included with std tiltmeter**  
The angle bracket included with the tiltmeter is suitable for most applications. It can be welded to steel or bolted to an anchor. The bracket does not include an anchor.

**Embedment Mounting Bracket . . 97803115**  
This special-order bracket provides a way to stand the tiltmeter on sloping surfaces, such as the concrete face of a rock-fill dam. The bracket is grouted into a drill hole.

**ANCHORS**

Anchors are used in concrete or rock. Order one anchor per tiltmeter.



**Expansion Anchor. . . . .57803128**  
Includes anchor, bolt, and washer. Install in 9.5 x 64 mm (3/8 x 2.5") drill hole.



**Groutable Anchor with Bolt . . . .57803130**  
Includes anchor, bolt, and washer. Install in 13 x 90mm (0.5 x 3.5") drill hole. Requires epoxy grout below.

**Epoxy Grout Kit . . . . .57803133**  
Includes plastic dispenser and cartridge of quick-set epoxy grout. Sufficient for 15 anchors.

**PORTABLE READOUT**

- EL/MEMS Data Recorder . . . . . 56813500
- Terminal Box for 12 Sensors . . . 57711600
- Jumper Cable . . . . . 56813557

The EL/MEMS Data Recorder is a portable readout that displays and stores tilt readings in volts and temperature readings in degrees C. Includes software for transferring stored readings to a Windows PC.

Terminal box allows connection of up to 12 tiltmeters. Sensors are selected by a rotary switch. Fiberglass box measures 290 x 345 x 135mm (11.5 x 13.5 x 5.25").

Jumper cable is required to connect the Data Recorder to the terminal box.



**DATA LOGGERS**

**M-Logger . . . . . 58810100**

The M-Logger, shown above, is a simple data logger dedicated to MEMS sensors. It reads one tiltmeter connected directly or up to 16 sensors connected via a multiplexer. See separate datasheet.

**Campbell Scientific Loggers**

The Campbell Scientific CR1000 data logger allows direct connection of two biaxial sensors or three uniaxial sensors. Adding a multiplexer increases the capacity to 16 uniaxial or biaxial sensors. Up to five multiplexers can be added to the CR1000 data logger. See separate datasheet.