VERTICAL IN-PLACE INCLINOMETER SYSTEM

GEOKON®

MODEL 6180



Model 6180 Biaxial MEMS Tilt Sensors.

APPLICATIONS

The remote, continuous, and automatic monitoring of:

- Lateral deformation in dams and tailings
- The stability of natural slopes, landslides, embankments, and subsea marine sediments
- The stability of slurry walls, sheet piling and tieback walls
- Lateral movements in, around and above tunnels and underground openings



GeoNet Addressable Data Logger.

OPERATING PRINCIPLE

The basic principle of operation is the utilization of MEMS (Micro-Electro-Mechanical Systems) tilt sensors to make accurate measurements of inclination over segments of a borehole drilled into the structure being studied.

The Model 6180 Vertical In-Place Inclinometer System consists of a string of Biaxial MEMS Tilt Sensors, installed in sections of stainless tubing, which are manufactured to customer-selected lengths. Spring-loaded wheel assemblies, located between each segment, allow the string to positively engage the grooves of the conventional inclinometer casing[1] in which it is installed. The entire string is normally supported from the top of the casing by a suspension bracket, although installations where the string sits on the bottom of the casing are also possible.

Each segment in the inclinometer string is mechanically connected with quick-connect ball joints and electrically connected by means of waterproof connectors on a four-wire bus cable. The cable from the uppermost sensor connects the string to the chosen readout (PC, data logger, SCADA system, etc.).

The output from each string consists of calibrated tilt readings and temperatures for each sensor, which can be easily imported into MS Excel, or any inclinometer visualization software, without the need to convert raw data into engineering units.

[1] Fits any standard casing with groove diameter from 58 mm to 90 mm.

ADVANTAGES

MEMS tilt sensors operate over a wide angular range, with high sensitivity, and excellent long-term stability. In addition, their low profile and low mass makes them very resistant to shock loads.

Digital inclinometer systems offer greater noise immunity than analog types and are capable of signal transmission over cable lengths up to 1200 m, depending on the number of sensors in the string.

Other advantages of automated In-Place Inclinometer readings include the ability for increased frequency of readings, which can be critical for online (real-time) monitoring applications.

Addressable In-Place Inclinometer systems also allow the user to optimize the spatial resolution within the borehole by allowing for different gauge lengths in the same string.

Inclinometers can be customized to meet your needs. Our staff will work with you throughout the process Common customizations include sensor length, sensor spacing, materials, etc.

DATA ACQUISITION

The Model 6180 Vertical In-Place Inclinometer System uses industry standard Modbus® Remote Terminal Unit (RTU) protocol to communicate. It employs an RS-485 (half duplex) electrical interface, recognized for its prevalence, simplicity, and success as a robust, industrial physical layer.

Monitoring can be accomplished using GeoNet Addressable Data Loggers, the Model 8020-38 Addressable Bus Converter, Model 8600 Series Data Loggers, Campbell Scientific data loggers, or any other device capable of operating as a Modbus RTU client and having an RS-485 port.

TECHNICAL SPECIFICATIONS

Range[1]	±90°	Standard Sensor Length[6]	0.5 m, 1 m, 2 m, 3 m, 2 ft., 5 ft., 10 ft.
Resolution[2]	0.00025° (0.004 mm/m)	Minimum Sensor Spacing	0.5 m
Precision[3]	±0.0075° (±0.13 mm/m)	Materials	316 Stainless Steel, Engineered Polymer
Nonlinearity	±0.005° across ±30° range (±0.09 mm/m)	Electrical Cable	Four Conductor, Foil shield, Polyurethane jacket, nominal OD = 7.9 mm
Temperature Dependent Uncertainty	±0.001° across ±5° angular range (±0.016 mm/m) ±0.0016° across ±15° angular range (±0.026 mm/m) ±0.0026° across ±30° angular range (±0.042 mm/m)	Sensor Weight	0.5M: 0.55 kg (1.22 lb.), 1M: 0.97 kg (2.14 lb.), 2M: 1.80 kg (3.98 lb.), 3M: 2.64 kg (5.82 lb.), 2FT: 0.64 kg (1.42 lb.), 5FT: 1.40 kg (3.10 lb.), 10FT: 2.67 kg (5.90 lb.).
Operating Temperature	–40 °C to 65 °C (–40 °F to 149 °F)	Interface	RS-485
Power Supply Voltage	12 VDC ±20%	Protocol	MODBUS
Operating Current [4]	12 mA ±1 mA	Baud Rate	115,200 bps
Standby Current[4]	2 mA ±0.1 mA	Temperature Accuracy	±0.5 °C
Maximum Supply Current[5]	500 mA	Ingress Protection	IP68 to 3 MPa (300 m head water)
Sensor Diameter	25.4 mm (1")	Maximum Allowable String Weight	272 kgf (600 lbf)

[1] Calibrated Range: ±30°
[2] 99% confidence interval (i.e. 99 out of 100 individual readings fall within this tolerance).
[3] Includes random walk (changes between consecutive readings that have no discernible cause) and seismic noise during testing.
[4] Operating and standby current are for each individual sensor in a string.
[5] Per entire string.
[6] Custom spacing available upon request.

ORDERING INFORMATION

6180-0.5M: MEMS Digital In-Place Addressable Inclinometer, Vertical, Biaxial, sensor for 0.5 m spacing
6180-1M: as above, 1 m spacing
6180-2M: as above, 2 m spacing
6180-3M: as above, 3 m spacing
6180-2FT: as above, 2 ft. spacing
6180-5FT: as above, 5 ft. spacing
6180-10FT: as above, 10 ft. spacing
6180T-0.5M: MEMS Digital In-Place Addressable Inclinometer, Vertical, Biaxial, terminal sensor 0.5 m spacing
6180T-1M: as above, 1 m spacing
6180T-2M: as above, 2 m spacing
6180T-3M: as above, 3 m spacing
6180T-2FT: as above, 2 ft. spacing
6180T-5FT: as above, 5 ft. spacing
6180T-10FT: as above, 10 ft. spacing
6180-1: Suspension Cable Assembly, connects suspension bracket to top sensor, specify required length
6180-2: Suspension Bracket, sits atop casing
6180-3-1: Readout Cable, lengths <15 m (50 ft.), bare leads
6180-3-2: as above, 16 to 30 m (50 to 100 ft.)
6180-3V: as above, lengths >30 m (100 ft.)
6180-6: Safety Cable Assembly, secures bottom sensor to stable point above ground, specify required length

**Each string comprises a customer-specified number of 6180 sensors (including one 6180T sensor), and one of each of the following: 6180-1, 6180-2, 6180-3, 6180-6.*

COMPATIBLE READOUTS AND DATA LOGGERS

8800 and 8900 Series: GeoNet Wireless Mesh Data Acquisition System
8910 Series: GeoNet Wireless LoRa® Data Acquisition System
8920 and 8921 Series: GeoNet Cellular Data Loggers
8930 Series: GeoNet Wi-Fi Data Loggers
8940 Series: GeoNet Local Data Loggers
8600 Series: Data Loggers



Model 6180 Vertical In-Place Inclinometer.

GEOKON | TRUSTED MEASUREMENTS

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