HORIZONTAL IN-PLACE INCLINOMETER SYSTEM

GEOKON®

MODEL 6185

Model 6185 Biaxial MEMS Tilt Sensors.

APPLICATIONS

The remote, continuous, and automatic monitoring of:

- The stability of structures, underground openings, and foundations
- The stability of tank foundations and subway tunnels
- Ground movements and differential settlements in, around and above tunnels and underground openings

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 an inclinometer casing installed under the structure being studied.

The Model 6185 Horizontal In-Place Inclinometer System consists of a string of Biaxial MEMS Tilt Sensors, installed in sections of stainless steel tubing, which are manufactured to customer-selected lengths (see table on next page).

Spring-loaded wheel assemblies, located between each segment, allow the inclinometer to positively engage the vertically oriented grooves of the inclinometer casing[1] in which it is installed. The entire string is normally affixed to the end of the casing by a mounting bracket.

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 outermost sensor connects the string to the chosen readout (PC, datalogger, 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 other 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.

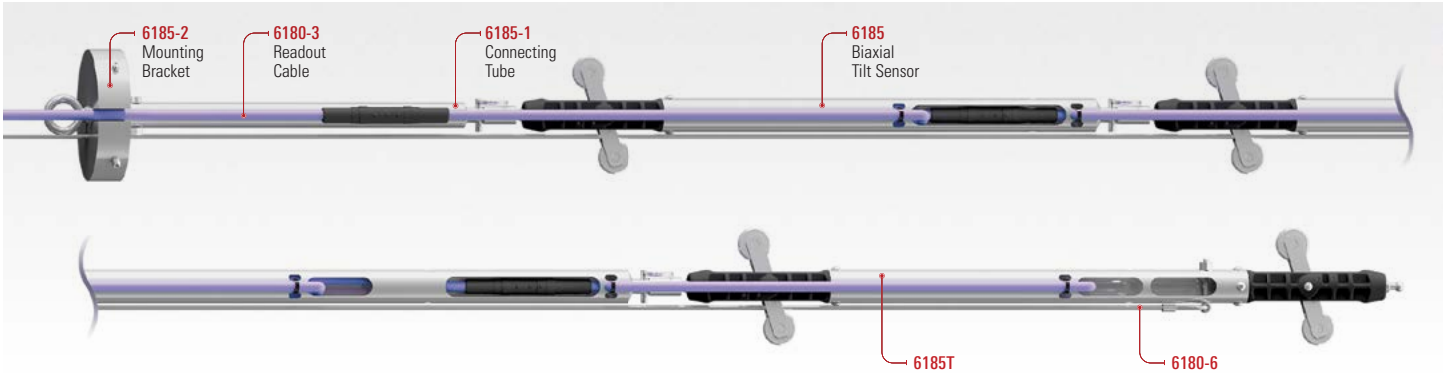
Other advantages of automated In-Place Inclinometer readings include the ability for increased frequency of readings, which can be critical for online (real-time) monitoring applications.

Addressable In-Place Inclinometer systems also allow the user to optimize the spatial resolution by allowing a combination of different gauge lengths in the same string.

DATA ACQUISITION

The Model 6185 Horizontal In-Place Inclinometer System uses industry standard Modbus® Remote Terminal Unit (RTU) protocol to communicate, in particular. 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 Loggers, the Model 8020-38 Addressable Bus Converter, Model 8600 Series Dataloggers, Campbell Scientific Dataloggers, or any other device capable of operating as a Modbus RTU client and having an RS-485 port.



Model 6185 Horizontal In-Place Inclinometer.

TECHNICAL SPECIFICATIONS

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

[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

6185-0.5M: MEMS Digital In-Place Addressable Inclinometer, Horizontal, Biaxial, sensor for 0.5 m spacing
6185-1M: as above, 1 m spacing
6185-2M: as above, 2 m spacing
6185-3M: as above, 3 m spacing
6185-2FT: as above, 2 ft. spacing
6185-5FT: as above, 5 ft. spacing
6185-10FT: as above, 10 ft. spacing
6185T-0.5M: MEMS Digital In-Place Addressable Inclinometer, Horizontal, Biaxial, terminal sensor for 0.5 m spacing
6185T-1M: as above, 1 m spacing
6185T-2M: as above, 2 m spacing
6185T-3M: as above, 3 m spacing
6185T-2FT: as above, 2 ft. spacing
6185T-5FT: as above, 5 ft. spacing
6185T-10FT: as above, 10 ft. spacing
6185-1-1: Connecting Tube, lengths <1.5 m (5 ft.)
6185-1-2: Connecting Tube, 1.6 to 3 m (5 to 10 ft.)
6185-2: Mounting Bracket
6180-3-1: Readout Cable, lengths <15 m (50 ft.), bare leads
6180-3-2: Readout Cable, 16 to 30 m (50 to 100 ft.)
6180-3V: as above, lengths >30 m (100 ft.)
6180-1: Pulley Cable Assembly, used with dead end pulley assembly for IPI installation, specify required length
6180-6: Retrieval Cable Assembly, facilitates string removal in installations where only one end of the casing is open, specify required length
6550-1-#: Dead End Pulley Assembly, specify casing and return pipe sizes

**Each string is comprised of a customer-specified number of 6185 sensors, and one of each of the following: 6185T, 6185-1, 6185-2, 6180-3*

LEGACY VERSIONS

Limited legacy versions are available allowing for the repair and/or expansion of retired, previously available GEOKON In-Place Inclinometer models. Please contact GEOKON for more information.

COMPATIBLE READOUTS AND DATALOGGERS

8600 Series: Multi-Channel Dataloggers
8800 and 8900 Series: GeoNet Wireless Data Acquisition System
8920, 8930, 8950 Series: GeoNet Cellular, Wi-Fi, and Satellite Network Loggers
8940: GeoNet Dataloggers
8020-38: Addressable Bus converter

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