

# GeoFlex



## System Overview

The GeoFlex system is a string of closely spaced MEMS sensors ideal for geotechnical monitoring applications including:

- Monitoring deformation of the diaphragm walls that support deep excavations.
- Monitoring ground movements induced by tunnel construction.
- Monitoring deformations of embankments and retaining walls.
- Monitoring landslide areas above dams, highways, and railroads to provide early warning of slope failure.

## Operation

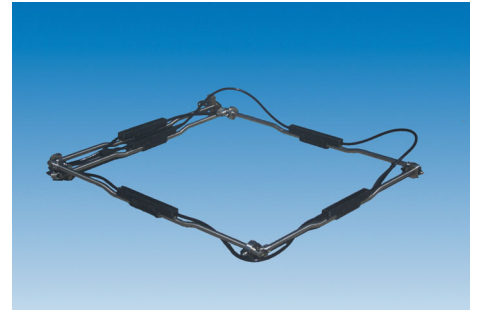
The system contains a number of sensor nodes in a vertical string installed in either 1.5-inch (38mm) diameter Schedule 40 PVC or in 2.75-inch (70mm) inclinometer casing.

The pipe or casing provides access for subsurface measurements. The joints between each sensor are robust, allowing the system to maintain a consistent orientation of all the nodes, regardless of whether it is installed in PVC pipe or ABS inclinometer casing.

The pipe or casing is typically installed in a vertical borehole that passes through a suspected zone of movement. The nodes are spaced at either 0.6 meters or 2 feet and provide a reading resolution similar to a traversing probe. The system spans the zone of movement and when the ground moves, the pipe/casing moves with it, changing the inclination of the nodes inside.

Inclination measurements from the nodes are processed to provide graphs of the casing profile and changes in the profile. Changes indicate displacement (movement).

The GeoFlex system is connected to a data acquisition system, and readings are transmitted to processing



A single GeoFlex segment folded for shipment

software that can trigger alarms based on displacements or rate of change.

## Advantages

**Real Time Monitoring:** The GeoFlex system is ideal for continuous, unattended monitoring and can deliver readings in near-real time.

**Single-Cable Installation:** Each sensor connects to the sensor above, effectively reducing the number of signal cables to one. This eases installation and simplifies connection to the data logger.

**Convenient Shipping and Transport:** GeoFlex systems have joints capable of bending to 90°, allowing for a compact shipping option. Five segments, each 3 meters (10 feet) long, can be shipped in a carton measuring approximately 64 x 64 x 64 cm (26 x 26 x 26 in) and which weighs less than 22 kilograms (50 pounds). This allows for the system to be shipped via common overnight carrier as well as fit in most standard vehicles.

The GeoFlex system can also be installed with sensorless nodes at the top of the system, allowing the designer to economize by only monitoring the zone of interest and bypassing the upper layers.

**Durable Components:** Nodes, cables, connectors and gage rods are exceptionally durable, making it practical to remove the systems at

the end of the project and redeploy them on other projects.

**Data Reduction:** The GeoFlex system outputs the displacement as engineering units, requiring less computing power and a lighter load on your data acquisition system. The nodes are preloaded with the calibration information, allowing the segments to be installed in any order.

**Complete Solutions:** DGSi offers complete monitoring solutions that include data loggers and Atlas web-based monitoring software. Atlas can check for alarm conditions in near-real time and can present plotted data immediately after the readings are obtained.

**GEOFLEX SYSTEM CONFIGURATION**

A Standard GeoFlex system requires casing, GeoFlex segments, a suspension kit, a bottom plug and a jumper cable. The Standard System is made up of 3 m (10 ft) segments and can be installed in any order.

**Casing:** Choose 70 mm (2.75 in) diameter inclinometer casing or 38 mm (1.5 in) diameter Schedule 40 PVC pipe.

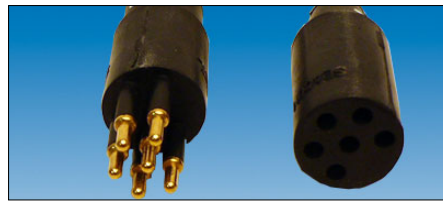
**GeoFlex Segments:** Choose a number of 3m (10 ft) long GeoFlex segments. When ordering, indicate the type of casing being used so that the proper centralizers will be installed on the system.

**Suspension Kit:** Order one suspension kit for each installation. The kit includes the suspension gate and hardware for securing the system.

**Signal Cable:** GeoFlex segments consist of 5 interconnected nodes with a connector at the top and bottom of the segment. A bottom plug is required for the bottom of the system. A jumper cable connects the top of the system to the data logger.

**Data Logger:** A number of Campbell Scientific data loggers are compatible with the GeoFlex system. Two GeoFlex systems can be connected to each CR6 or CR1000X. With an MD485 module per GeoFlex system, the CR1000 can read five systems, the CR800 three systems and the CR300 one system.

**Data Reduction Software:** Readings retrieved from the logger can be processed manually by spreadsheet or automatically by the Atlas web-based monitoring system.



Standard GeoFlex segments incorporate heavy-duty waterproof connectors.

**STANDARD GEOFLEX SYSTEM**

- GeoFlex Segment, 10 ft, Casing . . . 57801500
- GeoFlex Segment, 10 ft, PVC pipe 57801600
- GeoFlex Segment, 2 ft, Casing . . . 57801502
- GeoFlex Segment, 4 ft, Casing . . . 57801504
- GeoFlex Segment, 6 ft, Casing . . . 57801506
- GeoFlex Segment, 8 ft, Casing . . . 57801508
- GeoFlex Segment, 2 ft, PVC . . . . . 57801602
- GeoFlex Segment, 4 ft, PVC . . . . . 57801604
- GeoFlex Segment, 6 ft, PVC . . . . . 57801606
- GeoFlex Segment, 8 ft, PV . . . . . 57801608
- Dummy Segment, 5 ft, PVC . . . . . 57801530
- Dummy Segment, 5 ft, casing . . . 57801535
- Dummy Segment, 2 ft, PVC . . . . . 57801630
- Dummy Segment, 2 ft, casing . . . 57801635
- Suspension Kit  
for 70 mm (2.75 in) Casing . . . . . 57801755
- for 38 mm (1.5 in) Sch 40 PVC . . . 57801750
- Bottom Plug . . . . . 57801210
- Jumper Cable, 25 m . . . . . 57801225
- Jumper Cable, 50 m . . . . . 57801250

**REPLACEMENT ITEMS**

**Centralizers**

- for 70 mm (2.75 in) Casing . . . . . 57801725
- for 38 mm (1.5 in) Sch 40 PVC . . . 57801720

**GEOFLEX NODE SPECIFICATIONS**

**Sensor Type:** MEMS (Micro Electro-Mechanical Systems) tilt sensor for inclination readings.

**Requirements:** Minimum supply voltage of 10 Vdc. Maximum supply voltage of 30 Vdc. Digital RS485 signal requires Campbell Scientific data logger.



**Weight:** 0.54 kg per 0.6m (1.2 lb per 2 feet) gauge length.

**Calibrated Range:** ±30 degrees from vertical over a temperature range of -10°C to +40°C.

**Resolution:** 9 arc seconds or 0.04 mm/m using the CR1000 data logger.

**Repeatability:** ±82 arc seconds or ±0.4 mm/m.

**Required Casing:** Fits 70 mm (2.75") diameter inclinometer casing or 38 mm (1.5") diameter Schedule 40 PVC pipe.

**Waterproof:** Waterproof to 2 MPa (300 psi).

**Signal Cable:** Jumper Cable for connecting the system to the datalogger. Connectors are rated to 70 MPa (10,000 psi).

**Sensors per Chain:** The tables below show nominal limits for chains of nodes.

Number of Nodes	Jumper Length, m (12V Supply)	Jumper Length, m (24V Supply)
10	320	-
25	122	-
50	52	215
75	24	139
100	5	97
125	-	69
150	-	47
175	-	28
200	-	12

**DATA LOGGERS**

Campbell data loggers are required to read the GeoFlex system. The CR300, CR800 and CR1000 data loggers require use of an MD485 module, while the CR1000X and CR6 allow direct connection of the system.

- CR300 Data Logger . . . . . 56700300
- CR800 Data Logger . . . . . 56700800
- CR1000 Data Logger . . . . . 56701000
- MD485 RS-485 Interface . . . . . 56704850
- CR1000X Data Logger . . . . . 56700000
- CR6 Data Logger . . . . . 56700006