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 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
A number of Campbell Scientific Data Logger:  cable connects the top of the system to the data required for the bottom of the system. A jumper top and bottom of the segment. A bottom plug is interconnected nodes with a connector at the Signal Cable:  GeoFlex segments consist of 5 tem.

pension gate and hardware for securing the sys-

kit for each installation. The kit includes the sus-

for chains of nodes.

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.

<table>
<thead>
<tr>
<th>Number of Nodes</th>
<th>Jumper Length, m (12V Supply)</th>
<th>Jumper Length, m (24V Supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>320</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>122</td>
<td>-</td>
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</tr>
<tr>
<td>200</td>
<td>-</td>
<td>12</td>
</tr>
</tbody>
</table>

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 CR1000 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

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

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 . . 57801520
GeoFlex Segment, 4 ft, Casing . . 57801540
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, PVC . . 57801608
Dummy Segment, 2 ft, casing . . . 57801530
Dummy Segment, 5 ft, casing . . . 57801535
Dummy Segment, 2 ft, PVC . . 57801630
Dummy Segment, 5 ft, PVC . . 57801635
Suspension Kit
for 70 mm (2.75”) Casing . . 57801755
for 38 mm (1.5”) 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”) Casing . . 57801725
for 38 mm (1.5”) Sch 40 PVC . . 57801720

GEOFLEX SEGMENTS
Choose a number of 3m (10 ft) 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.

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.

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