

C12-SIPI SMART IN-PLACE INCLINOMETER (SMART IPI)

Datasheet C12-SIPI



**Description**

The Smart In-Place Inclinerometer (Smart IPI) System is used to remotely monitor lateral displacement within a vertical borehole.

The Smart IPI System has been designed to supersede traditional IPI systems; with advanced technology and new mechanical design, the Smart IPI is seen as a new product rather than just an improvement to the old.

The Smart IPI System comprises in its most basic form a Data Acquisition system, a Sensor Interface Module, one Top Support Assembly, up to 39 Smart IPI Sensors and one Terminating Sensor.

The Easy-Connect Coupling and single cable approach lead to a much easier, quicker and more efficient installation as well as an increased number of sensors per borehole.

**Features**

- **Biaxial MEMS Sensors**
- **Single cable system**
- **Sensor strings give a readily automated profile of vertical or horizontal displacements**
- **Factory allocated serial numbers**
- **Onsite allocation of sensor IDs**
- **Mechanical/electrical connection rated IP68 to 2000 kPa**
- **Accurate and precise measurements using MEMS sensors**

**Benefits**

- **Easy to automate using data acquisition system and 'Argus' software**
- **Removes the need for manual monitoring**
- **Fast onsite installation with minimal cable management**
- **Plug-and-play into Sensor Interface Module (S.I.M.)**
- **Up to 40 Smart IPI sensors per borehole**
- **Ability to add to the network as and when required**



Comprehensive information about this product and our full range is available at [www.soilinstruments.com](http://www.soilinstruments.com)  
If you would like to speak with someone directly please call +44 (0)1825 765044 or email [sales@soilinstruments.com](mailto:sales@soilinstruments.com)



Microelectromechanical Systems, or MEMS, is a technology that uses miniaturised mechanical and electromechanical elements that are made using the techniques of microfabrication. The physical dimensions of MEMS devices can vary from well below one micron all the way to several millimetres.

Our MEMS microsensors are small discrete devices that convert a measured mechanical signal, gravity (g) into a voltage signal.

### Operation

The Smart IPI System comprises a Data Acquisition system, a Sensor Interface Module (S.I.M.), one Top Connector, up to 39 Smart IPI Sensors and one Terminating Sensor.

The Top Connector is always positioned at the top of the borehole and consists of a wheel assembly and two gauge tubes.

The Smart IPI Sensor incorporates an Easy-Connect Coupling on the upper end and a wheel assembly on the lower. Connected to the wheel assembly is a gauge extension tube which connects to the next sensor; this is repeated as required, creating a daisy chain of up to 40 Smart IPI Sensors.

The sensor string must always be completed with a Terminating Sensor; this is the first sensor to be installed in the chain at the bottom of the borehole.

Contained within Smart IPI Sensor body are a PCB and two MEMS sensors. The data is transmitted up through the Smart IPI string to a Sensor Interface Module (S.I.M.). The S.I.M. handles all data and transmits it to a datalogger.

'Argus' monitoring software can be used to remotely monitor and present data, producing a near real-time profile of displacement that is constantly updated and available online via web servers, enabling a fully automated system.

### Applications

The Smart IPI System is used to measure lateral movement in the ground or in a structure, determining the depth, direction, magnitude, and rate of movement.

Typical monitoring applications include:

- Slopes and landslides
- Shear and slip zones
- Diaphragm or sheet pile walls
- Bending in piles
- Dams
- Ground movement due to tunnelling operations
- Retaining walls
- Concrete slabs and tank bases

### Associated products

For details on:	Catalogue code:
Dataloggers	D1
EC (Easy Connect) Inclinator Casing	C9
Standard Inclinator Casing	C18
Argus Monitoring Software	D4
IPI Handheld Readout	C12-7.4

View our full product range on [www.soilinstruments.com](http://www.soilinstruments.com)



### THE TECHNICAL RATING FOR THIS PRODUCT:

As the correct installation of any monitoring sensor or system is vital to maximise performance and accuracy, Soil Instruments makes the following recommendations, for the skill level of the installation contractor.

#### ADDITIONAL SUPPORT

We offer installation and monitoring services to support this system. For more information please email : [sales@soilinstruments.com](mailto:sales@soilinstruments.com) or call : **+44 (0) 1825 765044**

#### ADVANCED



#### ADVANCED



The installer is trained and experienced in the installation of this type of instrument or systems, and is ideally a specialist Instrumentation and Monitoring contractor.

#### INTERMEDIATE



The installer already has previous experience and/or training in the installation of this instrument or system.

#### BASIC



As a minimum the installer has read and fully comprehends the manual, and if possible has observed these instruments or systems being installed by others.

## Specifications

### Sensors

Calibrated range	±10°
Resolution <sup>1</sup>	0.001% full scale
Sensor accuracy	±0.05% full scale
Operating temperature	-10 to +50°C
Repeatability	±0.006% full scale
Minimum casing internal diameter	56mm
Maximum casing internal diameter	72mm
Dimensions	192mm x Ø32mm
Input voltage	11 - 16 VDC
Current consumption per sensor	23mA
Maximum number of sensors per string	40
Maximum distance from logger to borehole <sup>2</sup>	200m
Ingress protection	IP68 to 200mH <sub>2</sub> O (2000kPa)

### Gauge Sensor Assembly

Gauge length	1m	2m	3m
Material	Stainless Steel		
Dimensions	Ø34mm x L 1.040m	Ø34mm x L 2.040m	Ø34mm x L 3.040m
Weight	1.43kg	1.88kg	2.31kg

### Terminating Sensor Assembly

Material	Stainless Steel
Dimensions	Ø36mm x 310mm
Weight	0.78kg

### Top Support Assembly

Gauge length	1m	2m	3m
Total length	1.79m	2.79m	3.79m
Weight	2.9kg	3.3kg	3.7kg
Range of adjustment	900mm		
Material	Stainless Steel		

### Datalogger

Type	Campbell CR800	Campbell CR1000
Communication options	Cellular GSM/GPRS   RS485   Ethernet   USB	
Power options	110 - 240 VAC or 12V battery with Solar charging or battery pack	
Operating temperature	-20 to +50°C	
IP rating	IP65	
Number of boreholes	1 - 2	1 - 6

<sup>1</sup>Dependent on readout equipment.

<sup>2</sup>With maximum number of sensors and 2m gauge length, consult Soil Instruments for less sensors or different length gauge tubes. When using connection cable CA-2.1-4-TP.

## Ordering Information

### Smart In-Place Inclinometer Sensor and Gauge Tube Assembly

Includes  $\pm 10^\circ$  biaxial sensor, gauge tube, wheel assembly and coupling. Maximum 39 Sensors per borehole

C12-SIPI-1M	Smart IPI; 1 metre gauge length, complete with wheel assembly
C12-SIPI-2M	Smart IPI; 2 metre gauge length, complete with wheel assembly
C12-SIPI-3M	Smart IPI; 3 metre gauge length, complete with wheel assembly

### Smart In-Place Inclinometer Sensor Top Support Assembly

Includes top support fixings, gauge tube, wheel assembly and coupling. One required per borehole

C12-SIPI-TS-1M	Top support assembly; 1m gauge length, complete with wheel assembly and termination box
C12-SIPI-TS-2M	Top support assembly; 2m gauge length, complete with wheel assembly and termination box
C12-SIPI-TS-3M	Top support assembly; 3m gauge length, complete with wheel assembly and termination box

### Smart In-Place Inclinometer Terminating Sensor

Includes  $\pm 10^\circ$  biaxial sensor, wheel assembly and coupling. One required per borehole

C12-SIPI-TN	Smart IPI Terminating Sensor; complete with wheel assembly
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### Logger Connection Cable

CA-2.1-4-TP	Data Cable, 4 Core, 2 Twisted Pairs, $\varnothing 12.2$
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### Installation Tools

C12-SIPI-TK	Installation tool kit for Smart IPI System; contains Installation Support Tool, 5mm allen key, combination pliers, 7, 10 & 19 mm ring spanners, wire cutters and 150mm cable ties
C12-SIPI-HSB	Installation Support Tool for Smart IPI
C12-SIPI-RR	Stainless Steel support wire; 7 x 7 strand, 3mm, priced per metre

### Manual

MAN-233	Smart In-Place Inclinometer Manual
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