# **C12 IN-PLACE INCLINOMETER**





#### Description

The In-Place Inclinometer (IPI) is used to measure lateral displacement within a borehole.

Most commonly, the IPI is used in a system where multiple IPIs are installed at varying depths. In this manner the profile of the displacement can be monitored.

The IPI itself consists of one or two (uniaxial or biaxial) MEMS tilt sensors mounted in a Stainless Steel housing.

# Features

- Sensor strings give a readily automated profile of vertical or horizontal displacements
- Accurate and precise measurements using MEMS sensors
- Available in uniaxial and biaxial versions
- Inbuilt temperature compensation
- Stainless Steel construction, waterproof to 2000kPa

Each sensor incorporates an on-board microprocessor which performs an automatic temperature compensation of the tilt (g) data.

The sensor itself is a small discrete device which measures in g (gravity). The sensors are powered and read by a datalogger.

'Argus' software can produce a near real time profile of displacement that is constantly updated.

# Benefits

- Easy to automate using data acquisition systems and 'Argus' software
- Removes the need for manual monitoring
- **Recoverable and reusable**
- Suitable for safety critical applications
- Low power consumption



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

# PRECISELY MEASURED

# MICROELECTROMECHANICAL SYSTEMS (MEMS)



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 microsensor is a small discrete device that converts a measured mechanical signal, gravity (g) into a voltage signal.

#### Operation

IPIs are installed in inclinometer casing within a borehole; a sprung wheel assembly on the IPI engages into the keyways of the inclinometer casing to ensure alignment.

Multiple IPIs are installed at varying depths and secured using gauge rods connected to the next and previous IPI.

borehole using a top support assembly. Each IPI is connected to a datalogger which powers

The final gauge rod is secured at the top of the

the sensors, initiates readings and retrieves the data. 'Argus' monitoring software can also be used to

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**Applications** 

IPI systems measure lateral movement in the ground or in a structure. They are useful for determining the depth, direction, magnitude, and also rate of movement.

They can be used to ascertain the stability of retaining walls by measuring bending and rotation. They can also reveal ground movement that could affect other buildings. Inclinometer systems can also be used to detect movement in the downstream and upstream side of dams and to define shear zones in the foundations of concrete faced dams.

The measurements of recorded movement can be utilised to check that the deflections are within the design assumptions. Monitoring should be continued to establish any long-term effects after works have finished.

Typical applications include:

display and monitor the data.

- Detecting slopes and landslides
- Determining shear and slip zones
- Monitoring diaphragm or sheet pile walls
- Monitoring bending in piles
- Verifying design assumptions and finite element analysis
- Long-term monitoring purposes
- Monitoring of dams
- Detecting and recording ground movement due to tunnelling operations
- Monitoring retaining walls
- Horizontal IPI systems to measure settlement and deformation of concrete slabs and tank bases

# Associated products

contractor.

ADDITIONAL SUPPORT

For details on:	Catalogue code:
Dataloggers	D1
EC (Easy Connect) Inclinometer Casing	С9
Standard Inclinometer Casing	C18
Quick Drive Inclinometer Casing	C9-4
Argus Monitoring Software	D4
IPI Handheld Readout	C12-7.4

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#### ADVANCED THE TECHNICAL RATING FOR THIS PRODUCT: As the correct installation of any monitoring sensor The installer is trained and experienced in the installation ADVANCED or system is vital to maximise performance and of this type of instrument or systems, and is ideally a accuracy, Soil Instruments makes the following specialist Instrumentation and Monitoring contractor. recommendations, for the skill level of the installation The installer already has previous experience and/or **INTERMEDIATE** training in the installation of this instrument or system. We offer installation and monitoring services to support this system. For more information As a minimum the installer has read and fully BASIC please email : sales@soilinstruments.com comprehends the manual, and if possible has observed or call : +44 (0) 1825 765044 these instruments or systems being installed by others.

# Specifications

#### Sensors

C 11	
Calibrated Range	$\pm 3^{\circ}$   $\pm 5^{\circ}$   $\pm 10^{\circ}$   $\pm 15^{\circ}$
Resolution <sup>1</sup>	0.008% full scale
Sensor accuracy	±0.05% full scale
Operating temperature	-20 to +80°C
Repeatability	±0.01% full scale
Minimum casing internal diameter	56mm
Maximum casing internal diameter	72mm
Weight (without cable)	540g
Dimensions	192mm x Ø32mm
Input voltage	10-16VDC
Signal output at full range	±2.5VDC differential
Current consumption	9mA (uniaxial) / 17mA (biaxial)
Ingress protection	IP68 to 200mH <sub>2</sub> O (2000kPa)
Housing material	Stainless Steel

#### Wheel Assembly

Material	Stainless Steel
Dimensions	100mm x 85mm x 12mm
Weight	90g

## Top/End Support Assembly

Gauge length	1m	2m	3m
Total length	1.9m	2.9m	3.9m
Weight	3.1kg	3.4kg	3.7kg
Range of adjustment	940mm		
Material	Stainless Steel/PVC		

# Gauge Extension Tubes

Gauge length	1m	2m	3m
Length	0.76m	1.76m	2.76m
Weight	370g	766g	1130g
Diameter		19mm	
Material		Stainless Steel	

#### Cables

Туре	Uniaxial	Biaxial
Construction	4 conductor screened polyurethane outer sheath	6 conductor screened polyurethane outer sheath
Weight	26g	33g
Cable diameter	5mm	6mm

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

# **Ordering Information**

#### In-Place Inclinometer Sensor (uniaxial)

Includes sensor in 32mm diameter Stainless Steel housing	
C12-1.6	Vertical uniaxial ±52.3mm/metre (±3 arc degrees)
C12-1.1	Vertical uniaxial ±87.2mm/metre (±5 arc degrees)
C12-1.2	Vertical uniaxial ±173.6mm/metre (±10 arc degrees)
C12-1.7	Vertical uniaxial ±258.8mm/metre (±15 arc degrees)
C12-1.5	Horizontal uniaxial ±87.2mm/metre (±5 arc degrees)
C12-3.1	Wheel assembly; one per sensor, for 70mm OD casing
CA-3.1-4-IC	Instrument cable 4 core, 7/0.20; screened, priced per metre, polyurethane jacket, for use with uniaxial sensors

#### In-Place Inclinometer Sensor (biaxial)

Includes sensor in 32mm d	iameter Stainless Steel housing
C12-1.8	Vertical biaxial ±52.3mm/metre (±3 arc degrees)
C12-1.3	Vertical biaxial ±87.2mm/metre (±5 arc degrees)
C12-1.4	Vertical biaxial ±173.6mm/metre (±10 arc degrees)
C12-1.9	Vertical biaxial ±258.8mm/metre (±15 arc degrees)
C12-3.1	Wheel assembly; one per sensor, for 70mm OD casing
CA-3.1-6-IC	Instrument cable, 6 core, 7/0.20; screened, priced per metre, polyurethane jacket, for use with biaxial sensors

#### In-Place Inclinometer Extension Tubes

	one per sensor, minus one per hole	
C12-2.1	1 metre gauge length	
C12-2.2	2 metre gauge length	
C12-2.3	3 metre gauge length	

#### In-Place Inclinometer Top Support and Termination Wheel Assembly

	iole support; support rod; non-articulated wheel assembly; final gauge tube & fixings. For 70mm outer diameter casing
C12-4.1	1 metre gauge tube
C12-4.2	2 metre gauge tube
C12-4.3	3 metre gauge tube
C12-7.1	Installation tool kit for standard IPI system; tool box includes: metric Allen keys, pliers, screwdriver, wire cutters, M6 nut spinner, knife, cable ties, spare nuts, hammer and bolts

#### In-Place Inclinometer Top Support and Termination Wheel Assembly For GRP Rod Suspension

One per borehole. Includes: top of borehole support; support rod; non-articulated wheel assembly; final gauge tube & fixings. For 70mm outer diameter casing

C12-6.1	1 metre gauge tube
C12-6.2	2 metre gauge tube
C12-6.3	3 metre gauge tube
C12-7.3	Fibreglass rod for suspension; priced per metre, not recommended for use over 30 metres
C12-7.2	Installation tool kit for GRP rod IPI system; tool box as C12-7.2 including adhesive, hand drill and 2.5mm diameter drill

### In-Place Inclinometer Discontinuous Extension Tubes For GRP Rod Suspension

	fixings, one per sensor, minus one per hole	
C12-6.4	1 metre gauge length	
C12-6.5	2 metre gauge length	
C12-6.6	3 metre gauge length	
Installation Tools		
C12-7.4	Manual IPI readout	
Manual		
MAN-186	In-Place Inclinometer Manual	





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