



PRODUCT CATEGORY:
INCLINOMETERS + TILT SENSORS

MEMS Digital In-Place Inclinometer System

MEMS Digital In-Place Inclinometer Systems (IPI) are designed to measure lateral movement when remote and continuous monitoring is required.

Each IPI employs MEMS accelerometer sensors housed inside a 28.1 mm (1.125 in) diameter, water-tight, stainless steel enclosure. The sensor body is rigidly connected to a 25.4 mm (1.0 in) diameter bay rod which establishes the length of the IPI. Multiple IPIs are assembled with pivots allowing sensing of displacement over discreet, configurable intervals. Wheel assemblies centralize the pivot point and establish the azimuth of each IPI. They are available in sizes to fit 70 mm (2.75 in) or 85 mm (3.34 in) OD inclinometer casing.

The sensors are read through a connectorized signal cable chains together multiple sensors. A data logger is used to monitor the deflection of each sensor on the digital bus. If necessary, an alarm can be triggered when movement reaches a threshold rate or magnitude.



> WHY IT IS IMPORTANT

Provides constant remote monitoring; early warning of movements is essential for protecting life and equipment.

> APPLICATIONS

Ideal for monitoring of:

Stability adjacent to excavations or underground workings	Deflection of piles, piers, abutments and retaining walls
Dams and embankments	Landslides

> FEATURES

Up to 70% reduction in installation time compared to RST's previous generation of IPIs - dependent on borehole configuration

IP68 (2 MPa), stainless steel enclosure	Wet-mate submersible connector
Precision locking & tools free bay rod connections	Reconfigurable bay lengths
Industry-leading system weight	Industry-leading low power consumption designed for battery powered datalogging

> BENEFITS

✓ Increase safety	✓ Cost effective per sensor point
✓ High accuracy	✓ Custom options

A close-up shows the signal cable which connects each sensor along the entire chain of inclinometer sensors forming a "digital bus"



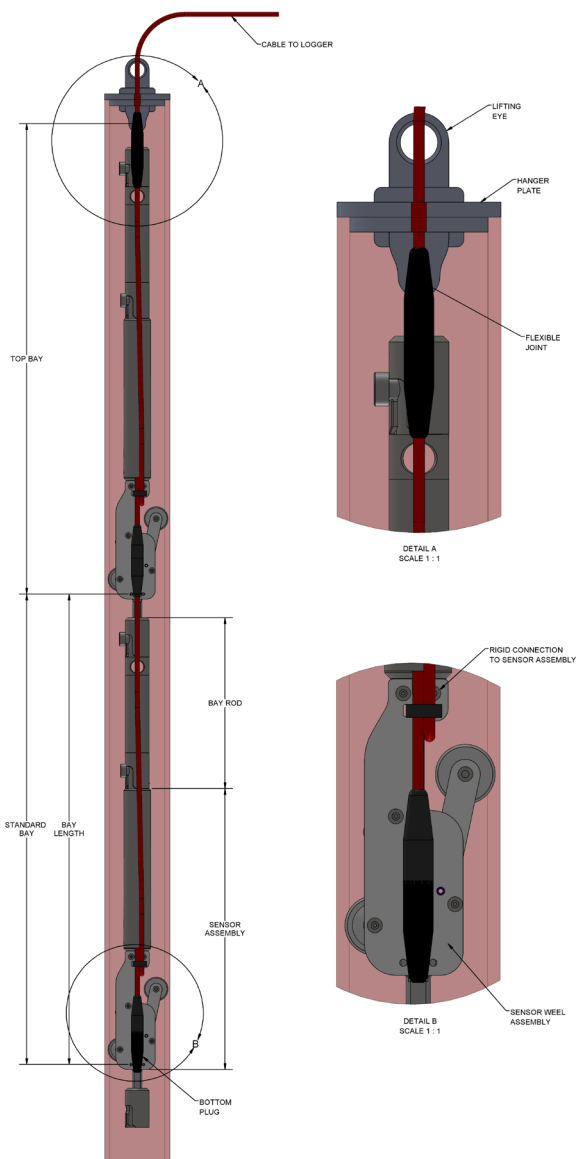
MEMS Digital In-Place Inclinator System System Configurations



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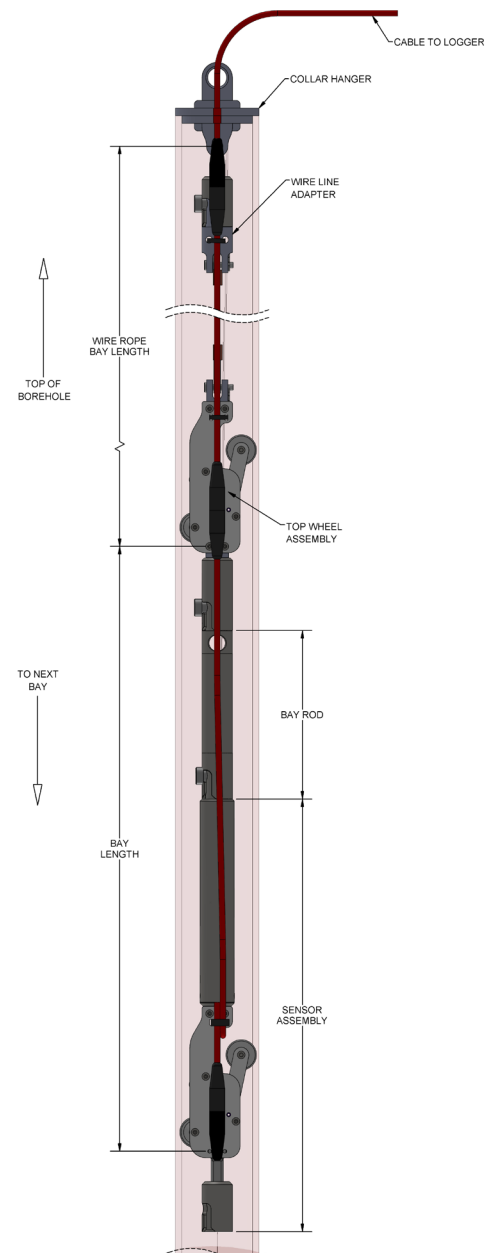
1. Standard

A standard configuration has sensors employed throughout the measured span of the inclinometer. The topmost bay is terminated by a collar hanger.



2. Wire Rope

Wire rope bays of configurable length can be inserted into the borehole configuration to omit measurement or place IPI sensors across a specific elevation.

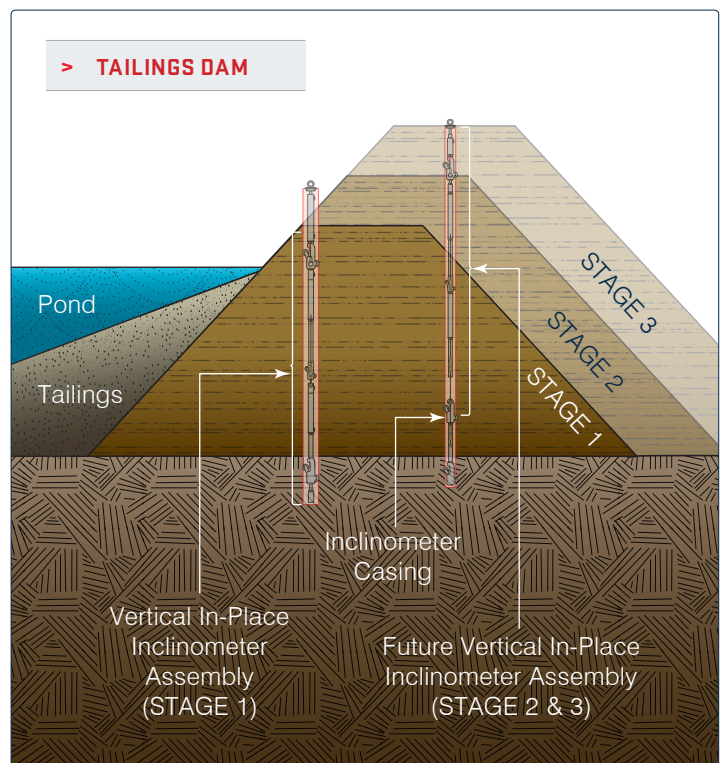
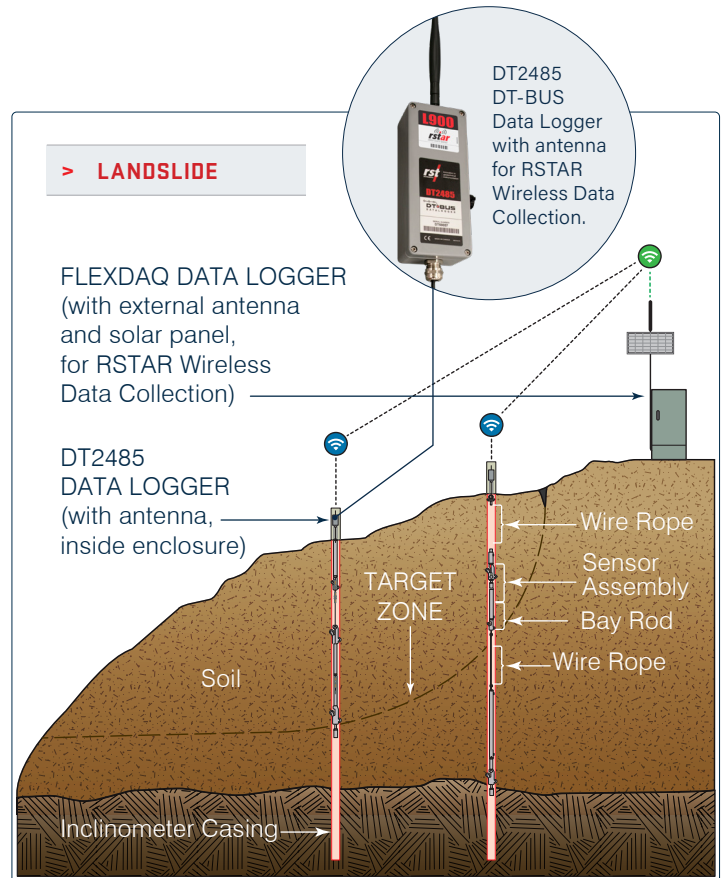
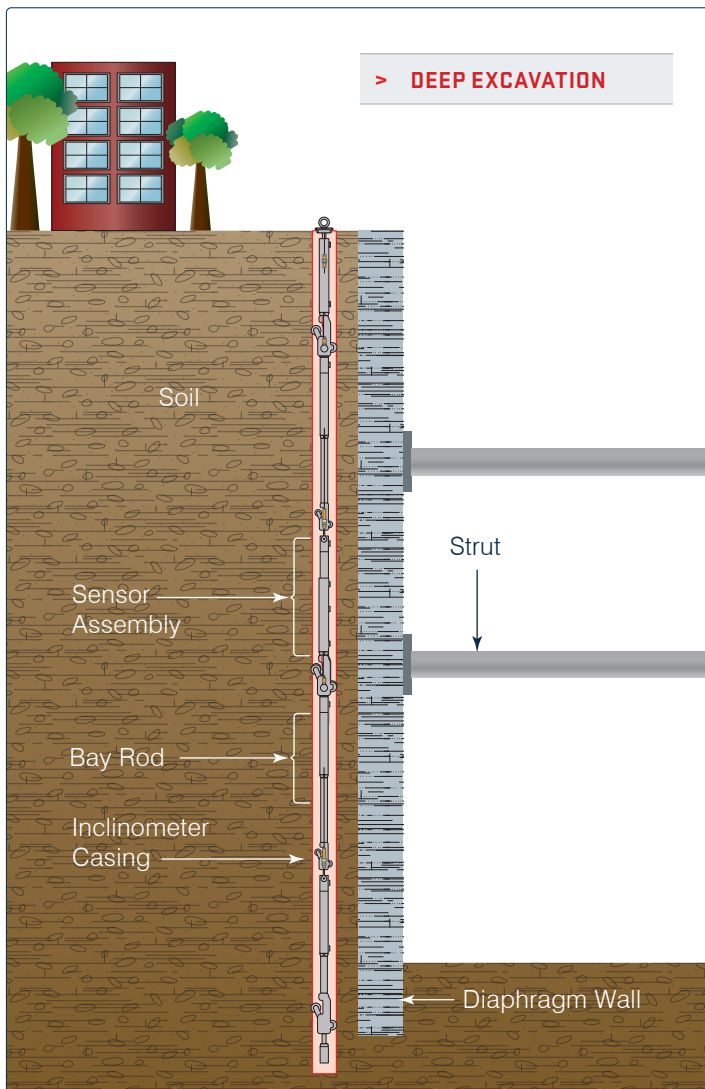


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Installation Scenarios

The two main system setup types can all be installed interchangeably across all applications where lateral movement or deflection of structures can occur. The selection of the system setup type depends on site conditions and engineering requirements. As shown in the installation scenarios, the MEMS Digital In-Place Inclinator System is ideal for long term installation in trenches, landslide areas, dams, and embankments.

Automated data collection methods can be made with the use of the RST DT2485 DT-BUS Data Logger or a FlexDAQ Data Logger System. For incorporating wireless data collection, the DT2485 is RSTAR and DT Link compatible.



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SPECIFICATIONS + ORDERING

SPECIFICATIONS		
SENSOR		
Range	± 30°	
Resolution	0.0002° (0.004 mm/m)	
Sensor Accuracy	± 0.002° (0.03 mm/m) ¹	
Sensor Precision	± 0.0013° (0.02 mm/m) ¹ ± 0.0005° (0.01 mm/m) ²	
Sensor 24 h Stability	± 0.03 mm/m ¹ ± 0.01 mm/m ²	
System Precision	± 0.5 mm for 30 m IPI (15 sensors @ 2 m, 6 months, repeatability conditions in borehole)	
Sensor	MEMS (Micro-Electro-Mechanical Systems) Accelerometer	
Temperature Dependent Uncertainty	± 0.016 mm/m/°C (±0.001°/°C) , for ± 5° from vertical ± 0.033 mm/m/°C (±0.002°/°C) , for ± 15° from vertical	
Temperature Accuracy	± 0.5 °C (0°C to 60°C) ± 1.0 °C (-40°C to 60°C)	
Temperature Resolution	0.06°C	
ELECTRICAL		
Supply Voltage	5 to 15V DC	
Operating Current	490 uA (Reading Average, per sensor)	
Standby Current	<20uA (per sensor)	
Signal Output	RS485 Digital Bus (MODBUS RTU Protocol)	
Operating Temp.	-40 to 60°C (-40 to 140°F)	
MECHANICAL		
Ingress Protection	IP68 (2 MPa)	
Gauge Length	0.5 to 3 m	
Sensor Diameter	28.6 mm (1.125 in)	
Bay Rod Diameter	25.4 mm (1.0 in)	
Wheel Assembly	70 mm (2.75 in) 85 mm (3.34 in)	
System Maximum Weight	180 kgf	
Sensor & Bay Rod Assembly Weight (dry, submerged H2O)	0.5m: 1.25, 1.00 kgf 1.0m: 1.63, 1.12 kgf 1.5m: 2.00, 1.24 kgf	2.0m: 2.37, 1.36 kgf 3.0m: 3.11, 1.60 kgf

¹: 99% Confidence Interval, ²: 68% Confidence Interval

OPTIONS >> CONTACT RST FOR DETAILS
Imperial lengths available upon request
Custom casing diameter wheel assemblies
Custom bay lengths available
DT2485: DT-BUS Data Logger
FlexDAQ Data Logger System

ORDERING: GENERAL INFO REQUIRED			
Part number		Bay length	
Number of boreholes		Wheel assembly size (70 or 85 mm casing)	
Number of sensors per borehole		Optional wire rope bays and cables	
ORDERING: BAY RODS		ORDERING: SENSORS	
ITEM	PART #	ITEM	PART #
0.5 m Bay Rod	IC8011	Vertical 70 mm IPI	IPI27050-U-70mm
1.0 m Bay Rod	IC8012	Vertical 85 mm IPI	IPI27050-U-85mm
1.5 m Bay Rod	IC8013	Horizontal 70 mm IPI	IPI27050-D-70mm
2.0 m Bay Rod	IC8014	Horizontal 85 mm IPI	IPI27050-D-85mm
3.0 m Bay Rod Bay Rod	IC8015	Contact RST if a custom sensor is required.	
Custom Metric Length Bay Rod	IC8010		
3.0 ft Bay Rod	IC8021	ORDERING: COLLAR HANGERS	
5.0 ft Bay Rod	IC8022		
10.0 ft Bay Rod	IC8023	ITEM	PART #
Custom Imperial Length Bay Rod	IC8020	70 mm Hanger	IC8030
ORDERING: BOREHOLE ACCESSORY KITS		85 mm Hanger	IC8031
ITEM	PART #	ORDERING: SAFETY LINE	
70 mm Borehole Accessory Kit (70 mm Collar Hanger, Bottom Plug, Safety Cable Attachment Kit, Extra Screws)	IC8000	ITEM	PART #
85 mm Borehole Accessory Kit (85 mm Collar Hanger, Bottom Plug, Safety Cable Attachment Kit, Extra Screws)	IC8001	Safety Line (sold in meters)	IC8040
ORDERING: WIRE ROPE AND RELATED WIRE ROPE PRODUCTS		Safety Line Attachment Kit	IC8045
ITEM	PART #	ORDERING: CABLES AND PLUGS	
Wire Rope (sold in meters)	IC8065	ITEM	PART #
70 mm Wire Rope Accessory Kit (Wheel Assembly, Adapter)	IC8070	5 m Top Cable	IC8051
85 mm Wire Rope Accessory Kit (Wheel Assembly, Adapter)	IC8071	10 m Top Cable	IC8052
70 mm Wire Rope Wheel Assembly	IC8075	20 m Top Cable	IC8053
85 mm Wire Rope Wheel Assembly	IC8076	Custom Length Top Cable	IC8050
Male Adapter for Wire Rope	IC8080	Bottom Cable Male Plug	IC8060
IPI KIT & WIRE ROPE COMMUNICATION CABLE EXTENSION			
		ITEM	PART #
		5 m	IC8085
		10 m	IC8085-10M
		15 m	IC8085-15M
		20 m	IC8085-20M