S410

IN-PLACE
INCLINOMETERS

INCLINOMETERS
& PENDULUMS

SISGEO®

S410_EN_13_03/2024

IN-PLACE
INCLINOMETERS

S410 MEMS In-Place Inclinometer (double wheel-carriage) is specifically designed to combine the benefits of automatic monitoring and the selective installation of probes at different depths.

This configuration allows a cost effective solution in those cases where the critical depths are known. Consequently the probes may be concentrated only in some areas along the borehole profile.

IPI probes are equipped with uniaxial or biaxial MEMS inclinometers and available either in analogue 4-20mA output or digital RS485 ModBus version.

APPLICATIONS

- Landslides
- Tunneling
- Diaphragm walls
- Dams
- Deep excavations
- Unstable slopes

FEATURES

- Removable and modular system for multiple installation
- Available in both digital and 4-20mA version
- Digital model has internal termometer, humidity and power supply sensors that permit to have more information in the event of gauge malfunction

CE *Meet the essential requirements of the EMC Directive 2014/30/UE*

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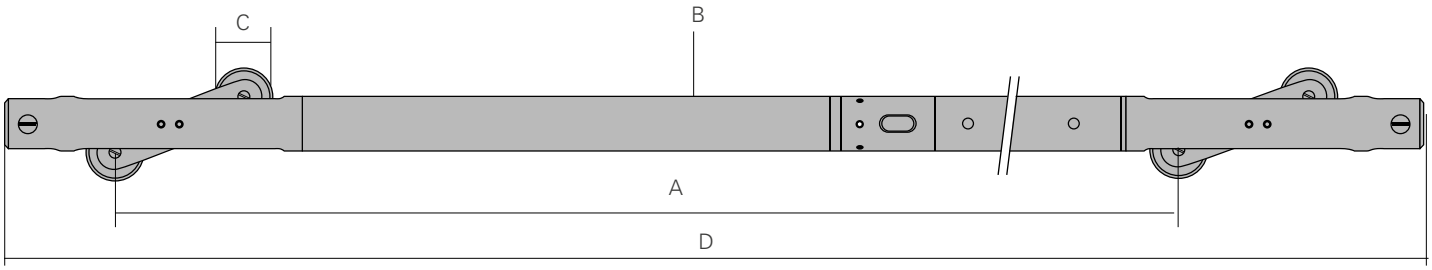
TECHNICAL SPECIFICATIONS(1)

	S411HA151S UNIAXIAL S412HA151S BIAXIAL	S411HA301S UNIAXIAL S412HA301S BIAXIAL	S412HD151S BIAXIAL	S412HD301S BIAXIAL
Model	**Analogue In-Place Inclinometers**		**Digital In-Place Inclinometers**	
Measurement principle	Uniaxial/Biaxial MEMS inclinometer	Uniaxial/Biaxial MEMS inclinometer	Biaxial MEMS inclinometer	Biaxial MEMS inclinometer
Application	vertical		vertical	
Sensor resolution	0.0001°		0.0001°	
Measuring range	±10°, ±15°	±20°, ±30°	±10°, ±15°	±20° ±30°
Sensitivity (2)	see calibration report		see calibration report	
Sensor accuracy	Lin. MPE(3) ±0.150% FS for ±10°, ±20° ±0.200% FS for ±15°, ±30° Pol. MPE(3) ±0.050% FS		MPE(4) < ±0.01% FSR	
Sensor repeatability	<0.007°		<±0.001°	
Sensor 24h stability (5)	not available		<±0.004° @24h	
Power supply	from 18 to 30 Vdc		from 8 to 28 Vdc	
Signal output	4-20 mA (current loop)		RS-485 with Modbus RTU protocol (6)	
A/D converter	-		sigma-delta 32 bit, 38-KSPS	
Average consumption (per axis)	from 4 to 20 mA		8 mA @ 12 Vdc	
Temperature operating range	-30°C to +70°C		-30°C to +70°C	
Offset temperature dependancy	±0.003° / °C		±0.002° / °C	
IP class	IP68 untill 1.0 MPa		IP68 untill 1.0 MPa	
Built-in temperature sensor -range -accuracy	thermistor from -50°C to +150°C ±0.5 °C		Temperature sensor of electronic board from -40°C to +125°C ±1 °C (-10°C + 85°C)	

PHYSICAL FEATURES

PROBE FEATURES

Gauge (A) and total (D) length	1000 mm (A), 1191 mm (D)	1000 mm (A), 1191 mm (D)
Body (B) and wheel (C)	Ø 30 mm	Ø 30 mm
Material	stainless steel	stainless steel
Casing compatibility	casing ID from 58 mm up to 88 mm (7)	casing ID from 58 mm up to 88 mm (7)



(1) Performance are granted for instruments installed in vertical casing installations where borehole inclination should be kept within ±2° of vertical, at any point along the borehole (ISO 18674-3). (2) Sensitivity is a specific paramenter different for every gauge. The sensitivity is calculated during gauge calibration test and inserted into the Calibration Report. (3) MPE is the Maximum Permitted Error on the measuring range (FSR). In the Calibration Report, the accuracies of the gauge are calculated using both linear regression (≤ Lin. MPE) and polynomial correction (≤ Pol. MPE). (4) MPE is the Maximum Permitted Error on the measuring range (FSR). In the Calibration Report, the accuracies of the gauge are calculated using the linear regression; the error reported is the maximum residual error on the FSR. (5) Stability calculated as difference after a 24 h period under repeatability conditions (ISO 18674-3). (6) RS485 not-optoisolated Modbus communication with RTU Protocol. Default output is sen α, other units available are degree, mm/m and inch/feet (to be requested at order). Sisgeo Modbus protocol manual is available for download at this page. (7) We strongly suggest to use Sisgeo ABS casing

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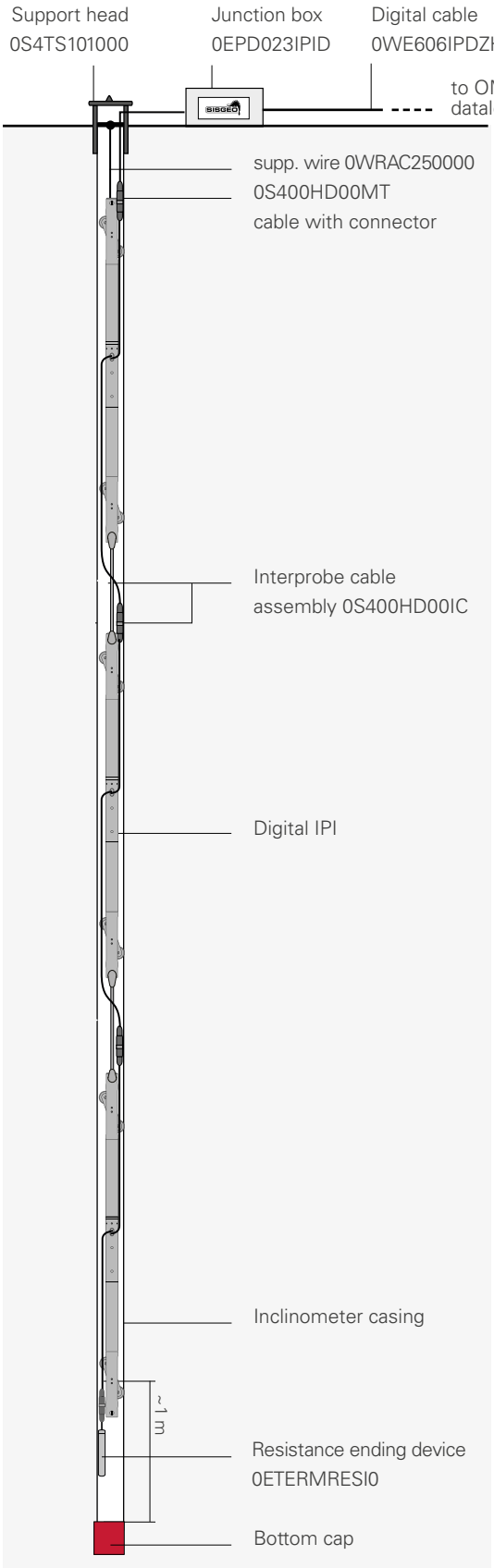
ACCESSORIES AND SPARE PARTS FOR DIGITAL MEMS IPIs



INTERPROBE CABLE ASSEMBLY 0S400HD00IC

Available in different lengths (2m, 5m, 10m, 15m), it is composed by digital signal cable and stainless steel support wire for the connection of a lower probe to the upper one.

SUPPORT STEEL WIRE 0WRAC250000

Steel wire for hanging the IPI string from the upper IPI probe to the support head. Diameter 2.5 mm.

IPI SUPPORT HEAD 0S4TS101000

It is installed at the top of inclinometer casings for hanging the in-place inclinometer string.

DIGITAL JUNCTION BOX 0EPD023IPID

Junction box for chains of digital instruments, composed by IP67 plastic box, internal electronic board for wiring and three cable glands.

UPPER CABLE WITH CONNECTOR 0S400HD00MT

Available in different lengths (2m, 5m, 10m, 15m), it is composed by a signal cable with IP68 connector to link the upper inclinometer probe to the junction box or local logger.

DIGITAL IPI CABLE 0WE606IPDZH

LSZH cable for connecting digital IPI chain to OMNIAlog datalogger.

RESISTANCE ENDING DEVICE 0ETERMRESI0

Termination resistance with connector, needed to close every digital IPI chain. The value of resistor depends on the layout of each IPI system. For more detail see the F.A.Q.#076.

RESISTANCES KIT (SPARE) 0ERESIKIT00

Kit composed by one 120 Ohm, two 240 Ohm, three 360 Ohm and four 480 Ohm resistance ending devices. Each one has an M12 5-pin connector for linking to SISGEO digital gauges. Check compatibility with old digital gauges with your Sales Representative.

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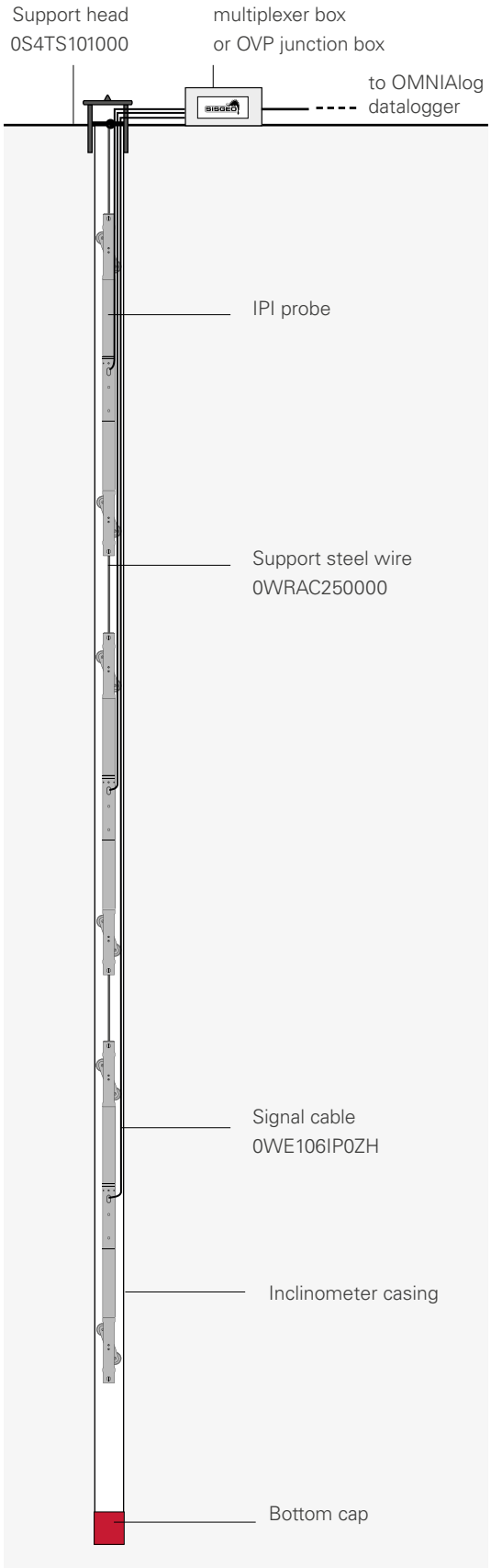
ACCESSORIES AND SPARE PARTS FOR ANALOGUE MEMS IPIs



SIGNAL CABLE 0WE106IP0ZH

24 AWG, 6 conductors cable for 4-20mA (analogue) IPI with LSZH flame-retardant external jacket. External diameter 5 mm.

SUPPORT STEEL WIRE 0WRAC250000

It is used to install the IPIs at the correct depth within the inclinometer casing. Diameter 2.5 mm.

MOUNTING KIT 0S4IPIT00L0

Mounting kit for vertical In-Place Inclinometer composed by No.20 copper clamps and plier.

IPI SUPPORT HEAD 0S4TS101000

It can be installed at the top of inclinometer casings for hanging the in-place inclinometer string.

MULTIPLEXER BOX 00MN00MUXB0

Relays multiplexer board with surge arrestors, mounted in IP67 plastic box for the connection of up to 16 biaxial IPIs or 24 uniaxial IPIs. It allows local reading with New Leonardo readout or remote connection to OMNIAlog datalogger.

MUX BOX - OMNIA CABLE 0WE610MUXZH

Cable with LSZH flame retardant jacket for the connection of multiplexer boxes to OMNIAlog datalogger.

MULTICORE CABLE 0WE1320LSZH

Multicore cable for the connection of OVP junction box to OMNIAlog. Composed by 16 twisted pair conductors and LSZH flame retardant jacket. External diameter 12.2 mm

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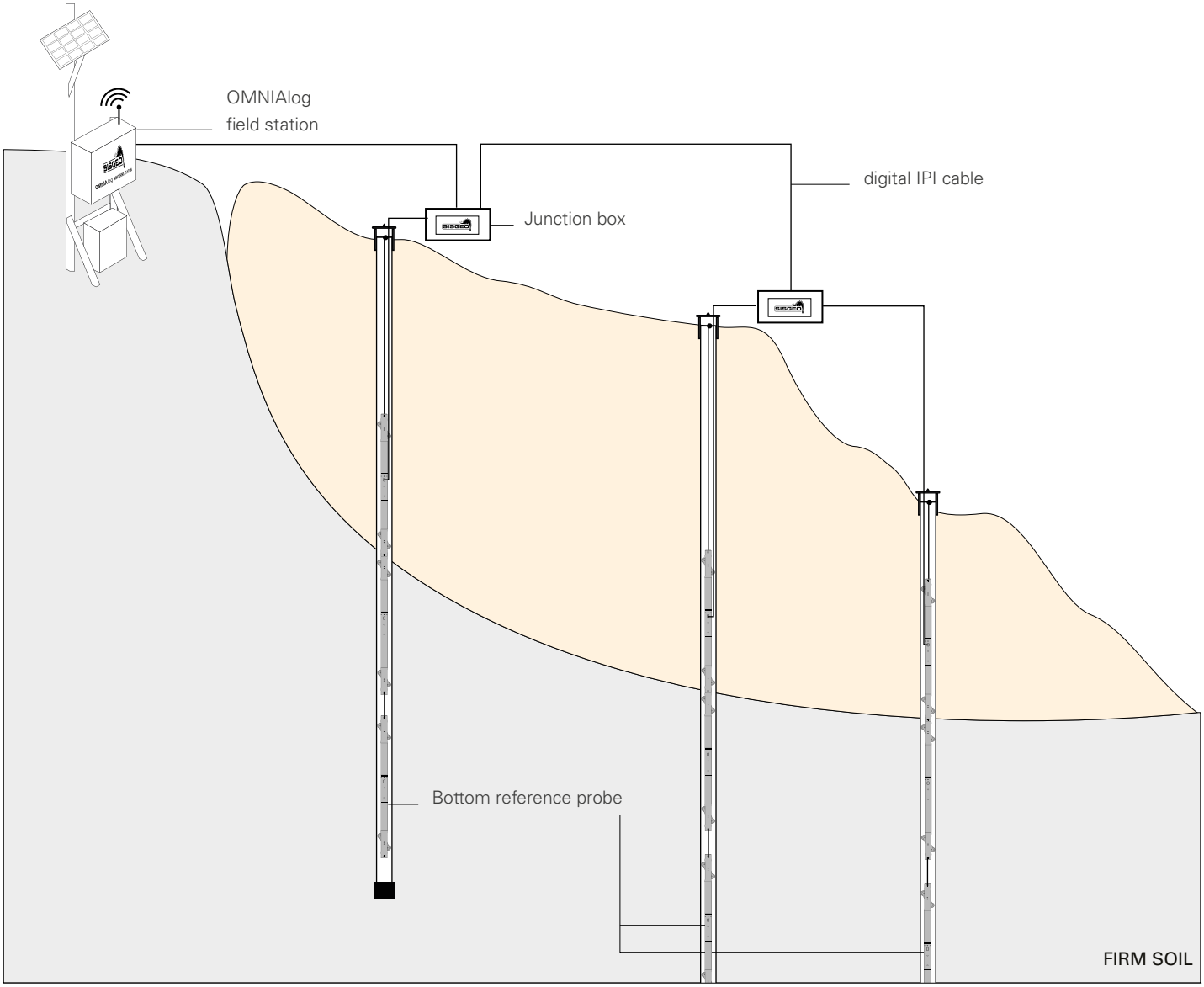
LANDSLIDE APPLICATION

After a number of manual inclinometer surveying, the sliping surface is identified. Therefore is possible to organize an automatic monitoring by installing IPIs in the vicinity of the sliping surface dept and one IPI in the bottom point of each casing as reference.



READABLE BY

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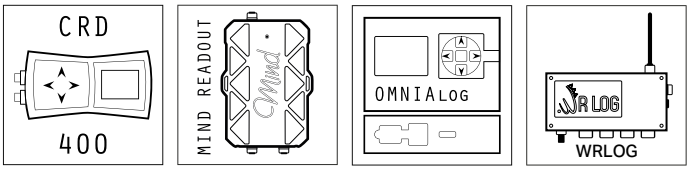

(1) Only for 4-20 mA IPIs (mod. S410HA)

For further information refer to their own datasheets

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ADDITIONAL SUPPORT

SISGEO offers customers e-mail and phone assistance to ensure proper use of instruments and readout and to maximize performance of the system.

For more information, please refer to the FAQ pages on our website or email us: **assistance@sisgeo.com**