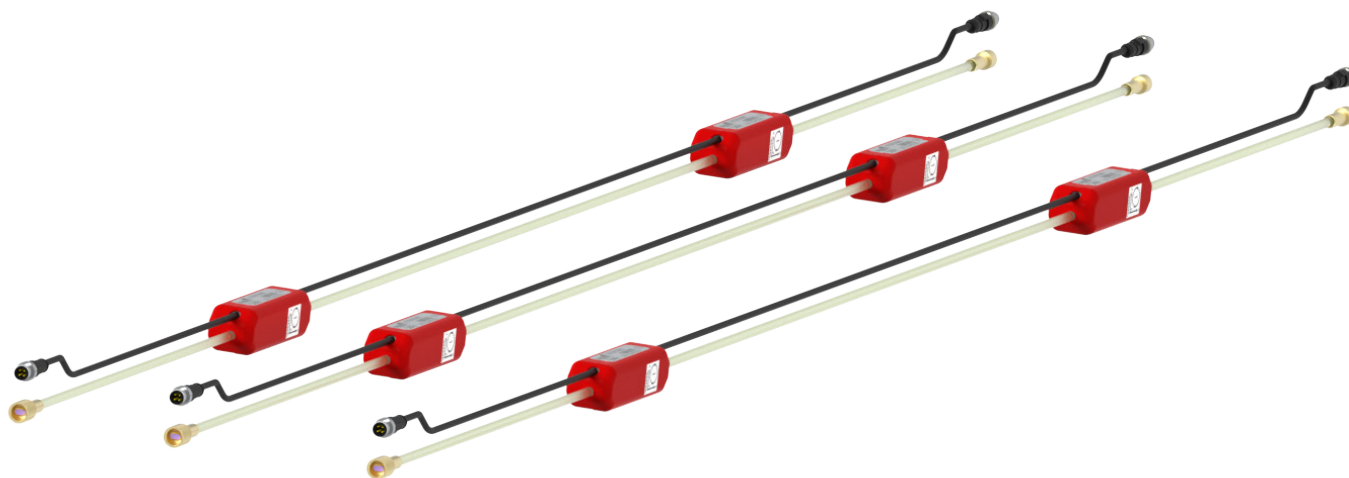


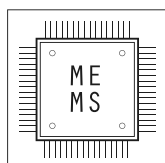
LTIN

— LT-INCLIBUS 360

INCLINOMETERS
& PENDULUMS



LT-INCLIBUS 360



The LT-Inclibus is able to monitor local tilting along a line, assuring the alignment, distance and measuring axis orientation between the gauges. The standard segment is composed by a 2m fibre glass rod with two waterproof gauges, 1m spaced.

It is possible to have one or four gauges on the 2m rod upon request. The chain of LT-Inclibus can be installed within a borehole, laid along a trench, buried in a concrete mass or mounted to a surface of a structure.

The rods are connected through mechanical joints, while the gauges are connected in a RS485 chain.

Innovative 360° technology, allows each gauge to be calibrated over the full 360° range on three axes. This permits the LT-Inclibus to be installed in any orientation in space with no effect on measurement quality, simplifying installation operations.

Customers can use any electronic device compatible with RS485 and Modbus RTU protocol as a logger. The LT-Inclibus gives a complete and transparent array of data in engineering unit, as a result.

MAIN APPLICATIONS

- Embankments
- Unstable slopes
- Settlements
- LNG tanks
- Deep excavations
- Tunneling
- Dam slope stability
- Deck bridges deformation

FEATURES

- Light and flexible array
- Simple and fast to install
- Number of measuring points customizable
- Each measuring point is individually calibrated according to high-level metrological procedures over the entire range of 360°

WORKING PRINCIPLE

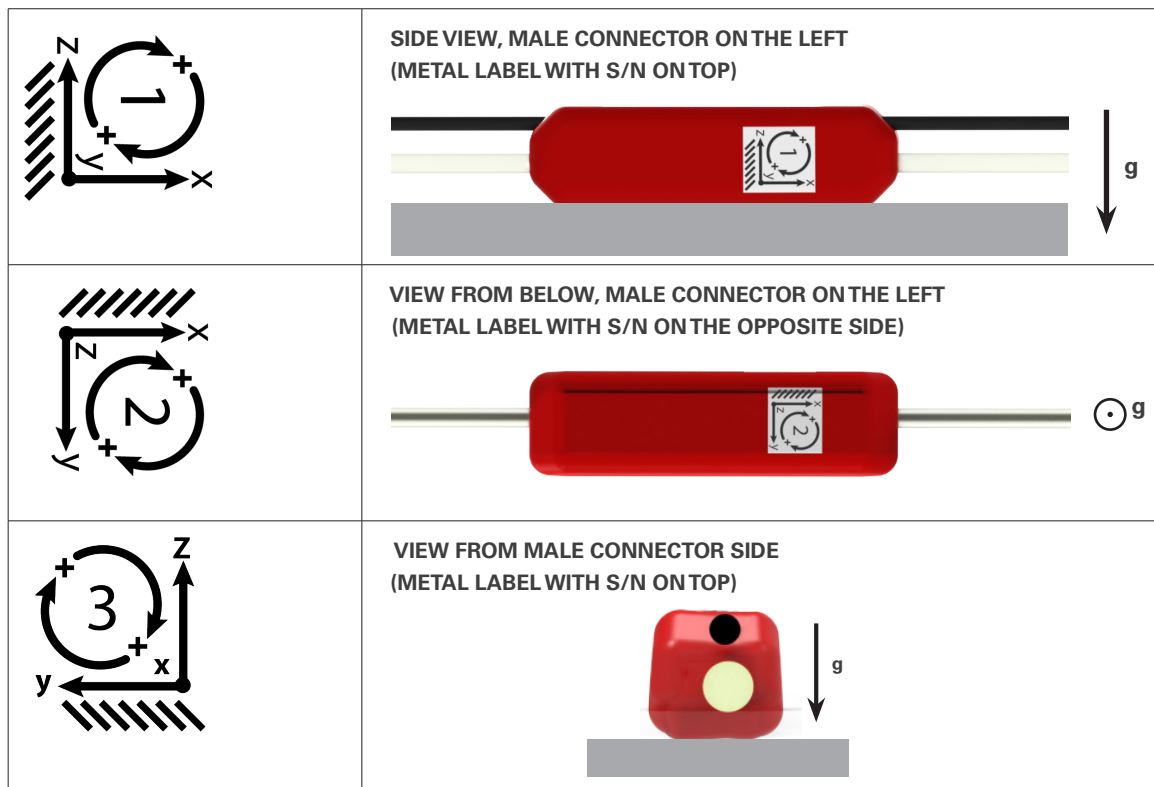
The sensor utilized in 360 LT-Inclibus is a triaxial MEMS accelerometer. The three axes x, y and z of the MEMS sensor define three planes ZY, XZ and YX generated by the pairs of axes zy, xz and yx.

MEMS sensors are capable of measuring inclinations with respect to the acceleration of gravity "g."

In the three next pictures, the LT-Inclibus is installed on a **horizontal surface** so that the z axis is vertical and parallel to g. In this position, the MEMS sensor will be able to measure the rotations of the XZ and ZY planes, while it will NOT be able to measure the rotations of the YX plane (perpendicular to the acceleration of gravity "g").

The rotations of the three planes XZ, YX and ZY are defined by the numbers 1, 2 and 3 corresponding to channels 1, 2 and 3 of the instrument output (refer to the labeling on the gauges, the label "3" is not applied due to clearance).

So, with LT-Inclibus installed on a horizontal surface like in the below pictures, channels 1 and 3 of the gauge will give the rotation of the XZ and ZY planes, while channel 2 will return no data (channel automatically disabled). Channel 2 will remain disabled if the inclination of the YX plane relative to the horizontal is less than 40° or greater than 140°. In this way, the stated accuracy performance can be guaranteed.



If the gauge is installed e.g. in a **vertical borehole** such that the x-axis is vertical and parallel to g, the data returned by the gauge will be on channel 1 (XZ plane rotation) and channel 2 (YX plane rotation), while channel 3 will return no data (channel automatically disabled as described before for the horizontal application).

With this configuration, by simply reading channels 1 and 3, or 1 and 2, an LT-Inclibus string can cover most of the required installation types (vertical or sub-vertical borehole, and horizontal or sub-horizontal surfaces). In addition, due to calibration over the entire 360° range on all axes, there is no need for careful positioning of the instrument.

The 360° LT-Inclibus, in parallel to the rotations of the main planes on channels 1, 2 and 3, also outputs the inclinations of the XZ, YX and ZY planes with respect to gravity acceleration g on channels 4, 5 and 6. These data can be used in the case of complex monitoring, such as for gauges alignments on a circumferential arc. For more information, please refer to the instrument's user manual.

The 360 LT-Inclibus gives also the values of internal temperature and voltage tension on channels 13 and 15, and the calibrated components of gravity accelerations g_x , g_y and g_z on channels 7, 8 and 9. This is in keeping with Sisgeo's view of complete data transparency.

TECHNICAL SPECIFICATIONS

PRODUCT CODES	0LTIB103602 (2m fiberglass rod, one gauge) 0LTIB203602 (2m fiberglass rod, two gauges) 0LTIB403602 (2m fiberglass rod, four gauges)
Measurement principle	Triaxial MEMS accelerometer
Measuring range	360° (±180°) on all three axes (see WORKING PRINCIPLE)
Repeatability	<± 0.001°
Resolution	0.0001°
Sensor mechanical bandwidth	Hz
Stability @ 24 hours	<± 0.004°
Sensitivity ⁽¹⁾	see Calibration Report
MPE Accuracy ⁽²⁾	<±0.02° (<±0.0055% FSR @360°)
Offset temperature dependency	±0.002° / °C
Power supply	from 8 to 28 Vdc
Signal output and protocol	RS485, Modbus RTU ⁽³⁾
Average consumption	3.7 mA @ 24 Vdc, 7.0 mA @ 12 Vdc
Temperature operating range	from -30°C to +70°C
Internal temperature sensor	Embedded on electronic board (output channel 13)
- measuring range	- 40°C to +125°C
- accuracy (resolution)	±1°C with temperature range -10°C to +85°C (res. 0.01 °C)
On-board supply voltage monitor ⁽⁴⁾	Embedded on electronic board (output channel 15)
- measuring range	0 to 36 V
- accuracy (resolution)	±5% FS (res. 0.01 V)
IP Protection class	IP68 up to 1.0 MPa (2.0 MPa on request)
Materials	polycarbonate (gauge enclosure), fibre-glass (rod), stainless steel joint tips
Weight	0.2 kg each gauge, 0.2 kg (2m FG rod and joints)
Max. cable length to logger	1000 m (for more information see FAQ #077) ⁽⁷⁾

(1) Sensitivity is a specific parameter different for every gauge. The sensitivity is calculated during gauge calibration test and inserted into the Calibration Report.

(2) 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 on the three axis

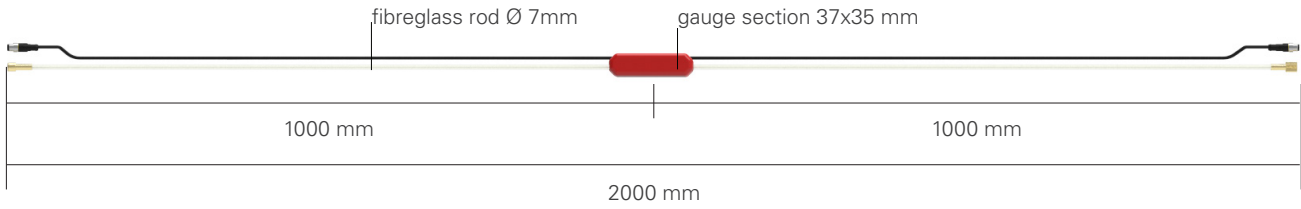
(3) RS485 not-optoisolated Modbus communication with RTU Protocol Default output is degree. Other units available are mm/m or inch/feet (to be requested at order). Sisgeo Modbus protocol manual is available for download on Sisgeo web site.

(4) These sensors are installed on the internal electronic board to give information in the event of probe malfunction.

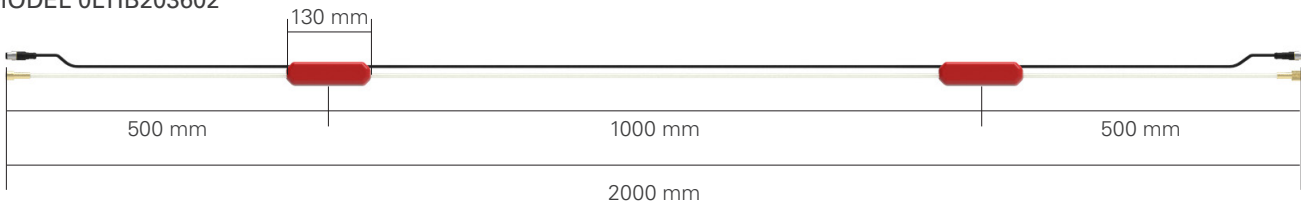
(7) Refer to FAQ section on Sisgeo website: www.sisgeo.com/faq

PHYSICAL FEATURES

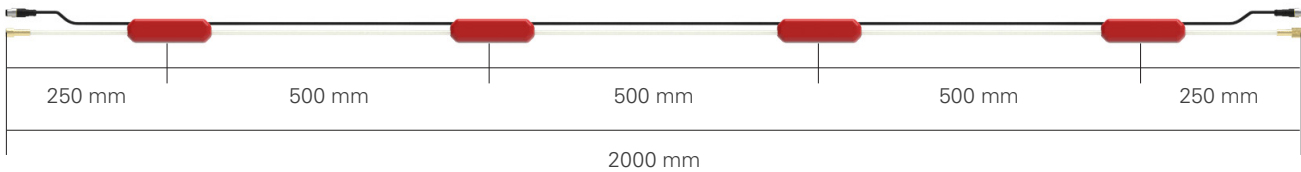
MODEL 0LTIB103602



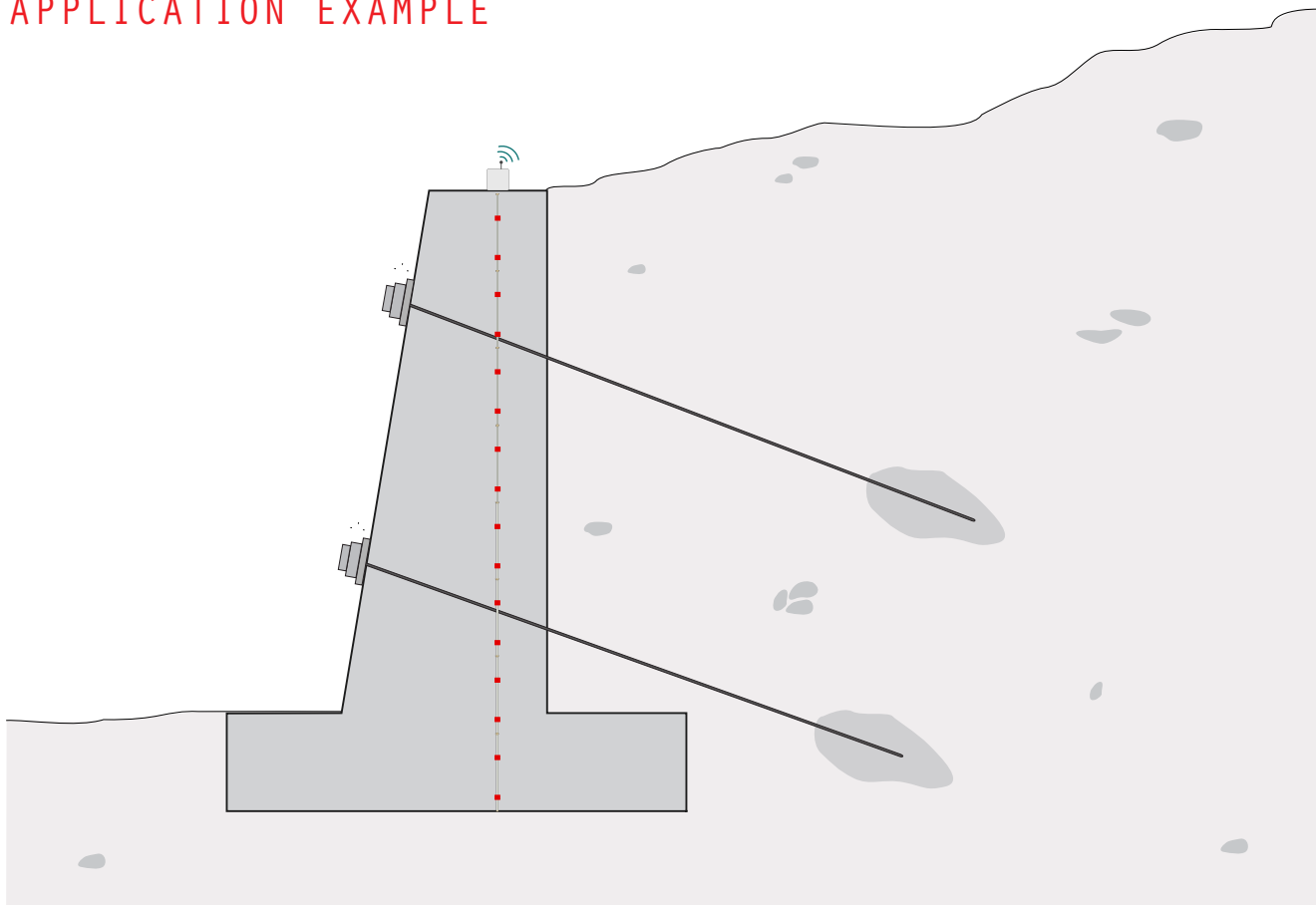
MODEL 0LTIB203602



MODEL 0LTIB403602



APPLICATION EXAMPLE



ACCESSORIES AND SPARE PARTS

CABLE WITH CONNECTOR OS400HD00MT

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

TERMINATION RESISTANCE OETERMRESIO

Resistance ending device with connector, needed to close every digital IPI chain. The value of resistor depends on the layout of the system. For more details, please see the [FAQ#076](#).

2M FG ELONGATION ROD OLTIBROD020

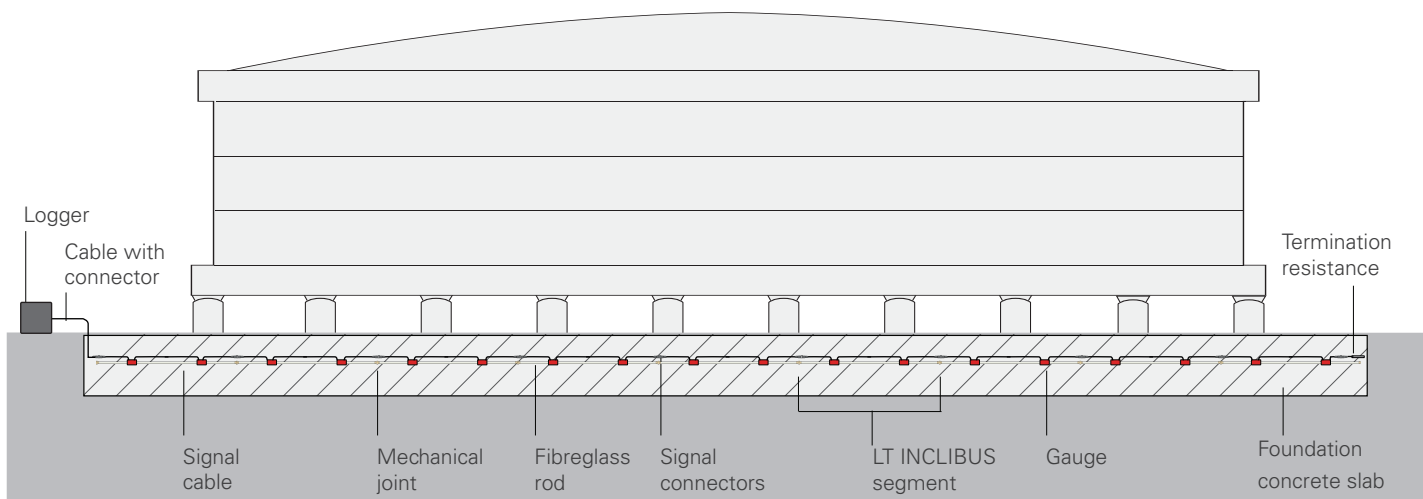
Fibre glass rod for chain elongation, 2m length, including mechanical joints and signal cable with connectors assembled at factory.

DIGITAL CABLE OWE606IPDZH

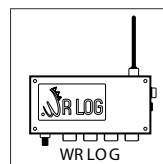
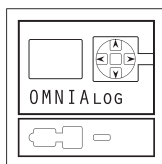
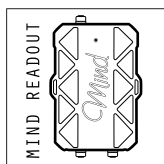
LSZH cable for connecting digital gauge chains to OMNIAlog datalogger.

RESISTANCES KIT (SPARE) OERESIKIT00

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



READABLE BY



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ADDITIONAL SUPPORT

SISGEO offers on-line assistance service to the Customers in order to maximize the performance of the system and training on the correct use of the instrument/readout.

For more information contact mail: assistance@sisgeo.com