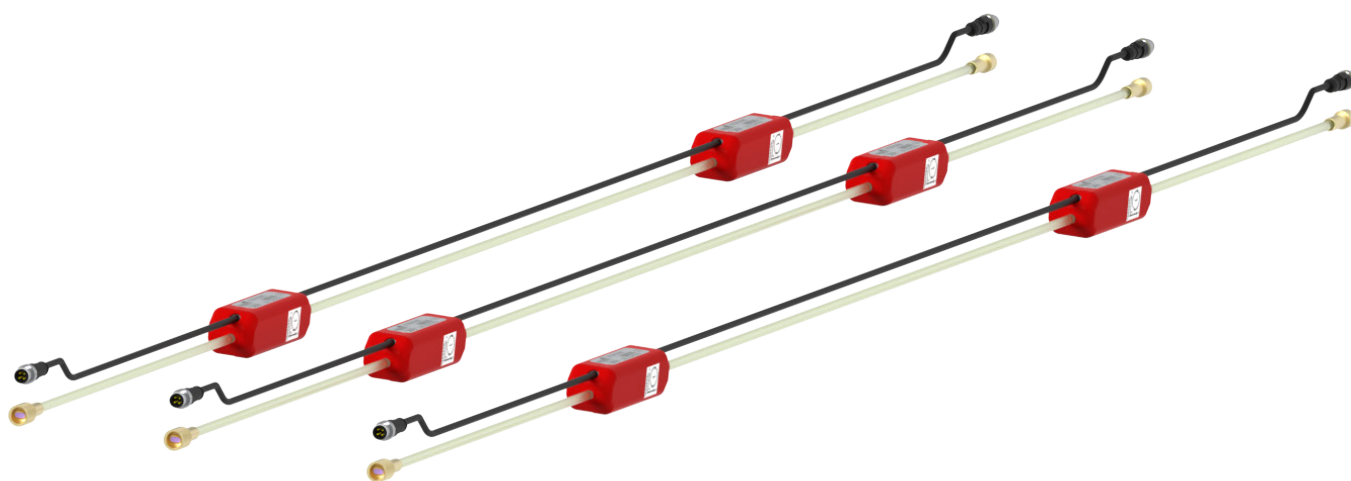




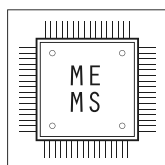
LTIN

— LT-INCLIBUS 360

INCLINOMETERS
& PENDULUMS



LT-INCLIBUS 360



The LT-Inclibus monitors local tilting along a line while maintaining the alignment, spacing and measuring-axis orientation between the gauges. The standard segment consists of a 2 m fibreglass rod with two waterproof gauges spaced at 1 m intervals.

Versions with one or four gauges on the 2 m rod are also available on request.

The LT-Inclibus chain can be installed inside a borehole, laid in a trench, embedded in concrete, or mounted on the surface of a structure.

The rods are connected by mechanical joints, while the gauges are connected in an RS485 chain.

The innovative 360° technology allows each gauge to be calibrated over the full 360° range on three axes. This allows the LT-Inclibus to be installed in any spatial orientation without affecting measurement quality, thus simplifying installation.

Customers can use any electronic device compatible with RS485 and Modbus RTU protocol as a data logger. The LT-Inclibus provides a complete and transparent set of data directly in engineering units.

MAIN APPLICATIONS

- Embankments
- Unstable slopes
- Settlements
- LNG tanks
- Deep excavations
- Tunneling
- Dam slope stability
- Bridge deck deformation

FEATURES

- Lightweight and flexible array
- Simple and quick to install
- Customizable number of measuring points
- Each measuring point is individually calibrated according to high-level metrological procedures over the full 360° range



Meets the essential requirements of the EMC Directive 2014/30/EU

WORKING PRINCIPLE

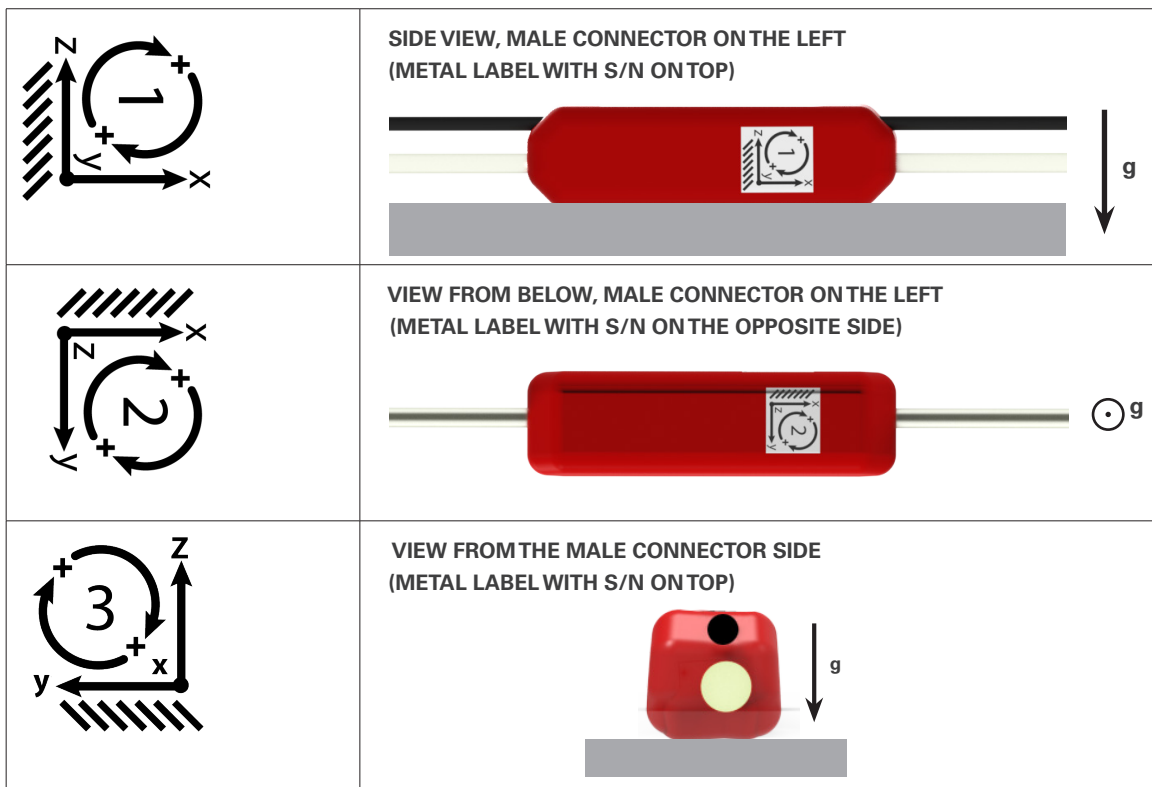
The sensor used in the 360° LT-Inclibus is a triaxial MEMS accelerometer. The three axes x, y and z of the MEMS sensor define three planes ZY, XZ and YX, generated by the pairs of axes zy, xz and yx.

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

In the three pictures below, 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 rotation 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 labels on the gauges, the label "3" is not applied due to clearance limitations).

So, with LT-Inclibus installed on a horizontal surface like in the pictures below, 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°. This ensures the stated accuracy performance.



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 checking gauge alignment on a circumferential arc. For more information, please refer to the instrument's user manual.

The 360° LT-Inclibus also provides the values of internal temperature and voltage supply on channels 13 and 15, and the calibrated components of gravity acceleration 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 fibreglass rod, one gauge)
0LTIB203602 (2m fibreglass rod, two gauges)
0LTIB403602 (2m fibreglass 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 individual Calibration Report
MPE Accuracy ⁽²⁾	<±0.02° (<±0.0055% FSR at 360°)
Offset temperature dependency	±0.002° / °C
Power supply	8 to 28 Vdc
Signal output and protocol	RS485, Modbus RTU protocol ⁽³⁾
Average consumption ⁽⁴⁾	3 mA @ 24 Vdc, 6 mA @ 12 Vdc
Temperature operating range	-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 over the temperature range -10°C to +85°C (resolution 0.01 °C)
On-board supply voltage monitor ⁽⁵⁾	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), fibreglass (rod), stainless steel joint ends
Weight	0.2 kg per gauge, 0.2 kg (2m FG rod and joints)
Max. cable length to logger	1000 m (for more information, see FAQ #077) ⁽⁶⁾

(1) Sensitivity is a specific parameter and is different for each gauge. Sensitivity is determined during the gauge calibration test and reported in the Calibration Report.

(2) MPE is the Maximum Permitted Error over the full scale range (FSR). In the Calibration Report, the gauge accuracies are calculated using linear regression; the reported error is the maximum residual error over the FSR on the three axes.

(3) RS485 non-opto-isolated Modbus communication with RTU protocol. Default output unit is degrees. The Sisgeo Modbus protocol manual is available for download from the Sisgeo website.

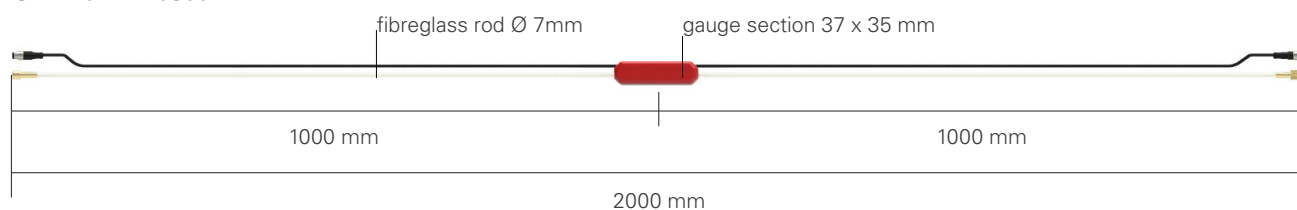
(4) Average consumption values apply to instruments starting from S/N S25 0002. Previous serial numbers may have different consumption values.

(5) These sensors are installed on the internal electronic board to provide diagnostic information in the event of gauge malfunction.

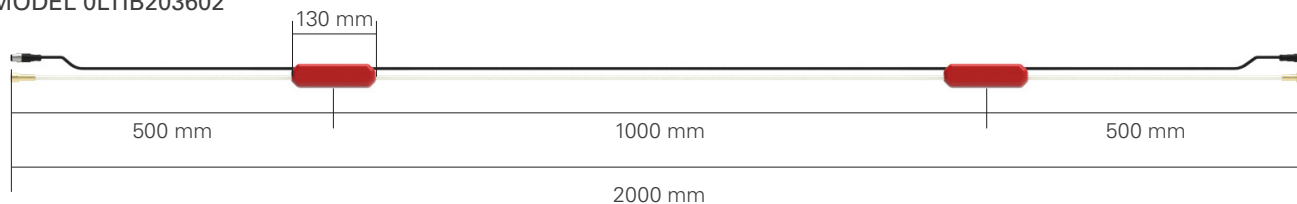
(6) Refer to FAQ section on Sisgeo website: www.sisgeo.com/faq

PHYSICAL FEATURES

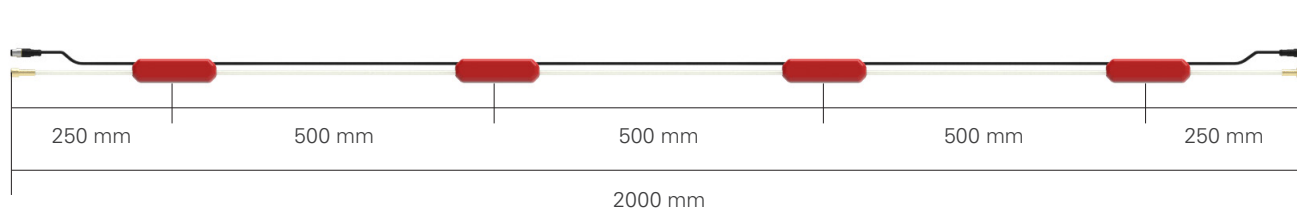
MODEL 0LTIB103602



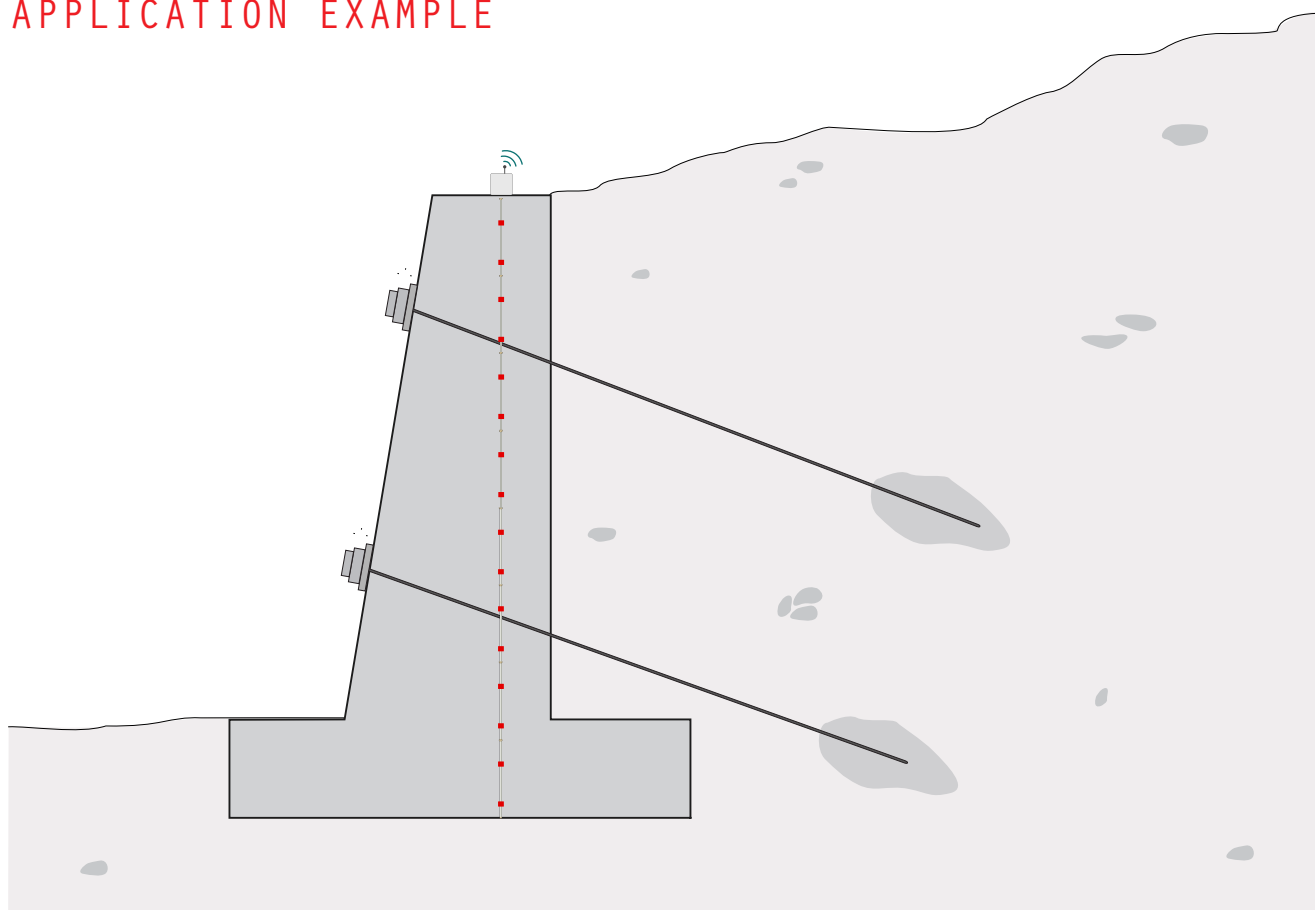
MODEL 0LTIB203602



MODEL 0LTIB403602



APPLICATION EXAMPLE



ACCESSORIES AND SPARE PARTS

CABLE WITH CONNECTOR OS400HDO0MT

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

DIGITAL CABLE OWE606IPDZH

LSZH cable for connecting digital gauge chains to the OMNIAlog datalogger.

TERMINATION RESISTANCE OETERMESIO

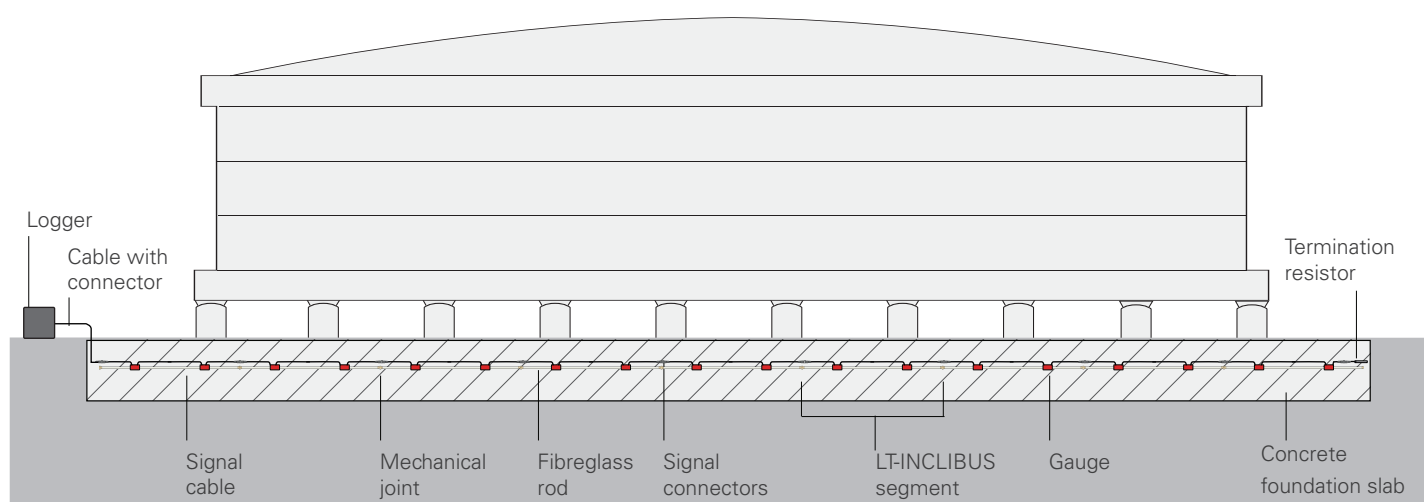
Termination resistor with connector, required to terminate each digital LT-INCLIBUS chain. For more details, please see the [FAQ#076](#).

2M FG ELONGATION ROD OLTIBROD020

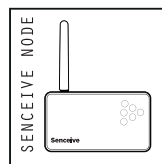
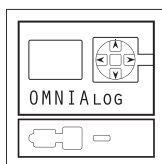
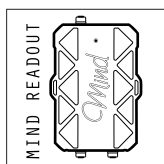
Fibreglass rod for chain extension, 2m length, including mechanical joints and signal cable with connectors assembled at the factory.

RESISTANCES KIT (SPARE) OERESIKIT00

Kit composed of one 120 Ohm, two 240 Ohm, three 360 Ohm and four 480 Ohm termination resistors. Each resistor has an M12 5-pin connector for connecting to SISGEO digital gauges. Check compatibility with older digital gauges by consulting your Sales Representative.



READABLE BY



For further information, refer to the relevant readout datasheets.

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TECHNICAL ASSISTANCE

SISGEO offers e-mail technical support to ensure correct installation and use and to maximize system performance. For full installation and maintenance procedures, refer to the Installation & User Manual. For further information, contact: assistance@sisgeo.com