TOPS INSTRUMENTS

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LaserTilt90

EDGE DEVICES - WIRELESS SENSORS

LS-G6-LAS-TIL90

The LaserTilt90 wireless sensor is a 2-in-1 laser distance meter and tiltmeter. The laser measures the relative distance between pairs of reference points. One of the two points can be a natural surface or target foils while the node can be placed at the other end point. Meanwhile, the tiltmeter provides measurements of changes from the vertical level, either on the ground or in structures and is used to monitor inclinations, movements and differential settlements of slopes or infrastructures.

Network Management

The LaserTilt90 is capable of transmitting data via long-range radio to a gateway connected to the Internet. One gateway can support hundreds of Loadsensing edge devices in the same network that are also measuring other sensors installed in the monitoring sections (borehole extensometers, pressure cells, load cells, strain gauges etc.). It can be easily configured and connected with a USB cable and an Android phone. The device network can also be easily managed through the Connectivity Management Tool.

Work without disruptions

Measurement of tunnel convergence is one of the most important controls of the NATM (New Austrian Tunneling Method) construction. Portable devices like tape extensometers, levels and temporarily installed total stations allow sporadic measurements. On the other hand, one of the most commonly used methods, the measuring tape, disrupts construction activities due to the use of aerial work platforms.

The LaserTilt 90 may be easily relocated along the convergence cross sections up to the excavation front or until the measured relative displacements are stabilized when the required frequency of measurements is reduced. It can also be used when permanent monitoring is required. The wireless sensor can also measure deformations in underground excavations and mining without causing work disruptions and delays.

FEATURES

Wireless sensor. An integrated unit (2-in-1 sensor + data logger).
Accurate distance measurement through a visible Laser Class II laser with 655 nm.
3-axis inclination measurement with respect to gravity's direction and a range of ± 90°
Long battery life (up to 8.5 years @6h sampling rate).
Long-range communications (up to 15 km / 9 miles).
High repeatability.
Robust, small and weather-proof box.
Easy configuration.

APPLICATIONS

Tunnel and mining convergence monitoring.
Deformations in underground excavations.
Remote monitoring of slope movements.
Fracture and faults surveillance.
Bearing and expansion joint movements.
Monitoring displacement in structures and buildings.
Bridge and structural health monitoring.
Measurement of settlement at a single point.

Main specifications

GENERAL

Sampling rates	Battery life estimates in years[1]					
	Distance = 20m			Distance = 65m		
	Singapore	Barcelona	Moscow	Singapore	Barcelona	Moscow
5 min	1.5	1.6	1.8	0.5	0.5	0.5
1 h	7.9	9.1	10.9	4.6	4.2	5.3
6 h	10.5	12.9	16.2	10.8	9.1	13.1

Battery type	2 x 3.6V C-Size user-replaceable batteries (recommended Saft LSH 14).
Sampling rate	30 seconds to 1 day.

Internal temperature collected and transmitted at each reading (Accuracy: ±1 °C).

Configuration software: Android App.

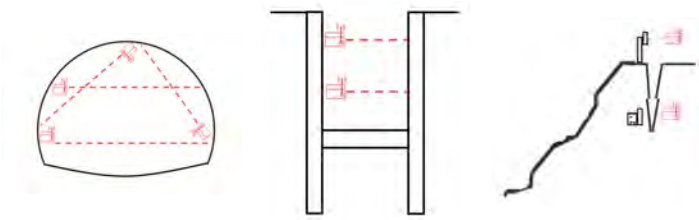
App features: Laser pointing mode. Tiltmeter calibration parameters check using the app. Radio signal coverage tests for easy installation.

LASER DISTANCE METER

Measuring range at favorable conditions	0.05 to 150 m
Typical measuring accuracy	±1 mm
Resolution	0.1 mm
Repeatability (1 sigma)	0.15 mm
Laser type (light source)	Visible Laser Class II laser with 655 nm.
Laser power	0.75 to 0.95 mW
Time required for a reading	Up to 4 seconds, depending on distance.
Signal strength	Signal strength and gain are transmitted with each laser measurement. It can be used for maintenance purposes.

Accuracy	**in favorable conditions[1]**	**in unfavorable conditions[2]**
@ 1 m	±1 mm	±2 mm
@ 10 m	±1 mm	±2 mm
@ 20 m	±1.5 mm	±3 mm
@ 50 m	±4 mm	±7 mm
@ 100 m	±9 mm	±15 mm
@ 150 m	±16 mm	not applicable

[1] Lifetime estimations based on the mathematical model from Saft, for typical Europe radio configuration (Spreading factor 9 and radio transmit power 14 dBm), obtained for 20 m and 65 m considering three different temperature profiles. Consumption varies depending on sampling rate and environmental and wireless network conditions.
[2] On natural objects (white wall, low target illumination <3K lx, moderate temperatures).
[3] On natural objects (white wall, high target illumination with 30K lx, full specified operating temperature range).



TILTMETER

Type	Tilt angle calculated from a triaxial MEMS Accelerometer.
Range[4]	± 90º
Axes	3-axis inclination measurement with respect to gravity's direction. Reports the two axes of rotation from the horizontal plane in any orientation.
Accuracy within ± 2º	± 0.0025°
Accuracy within ± 4º	± 0.005°
Accuracy within ± 15º	± 0.013°
Accuracy within ± 45º	± 0.038°
Accuracy within ± 86º	± 0.06°
Resolution	0.0001°
Repeatability	<0.0003°
Offset Temperature dependency	± 0.002°/°C
Stability @ 14 hours	<0.003°
Time required for a reading	9.6 seconds.
Measure of dispersion	Standard deviation of the set of measurements collected during the reading transmitted with each tilt measurement. It can be used to filter noisy data.
Temperature sensor resolution	0.1 °C

CONNECTIVITY

Works with the new Worldsensing Android app. To download, paste this link in your browser https://info.worldsensing.com/mobileapp.

Pointing mode for an easy installation.

Web browser software
CMT Edge - from version 2.5 onwards
CMT Cloud - from version 1.6.0 onwards

Standard CSV download, FTP push, Modbus TCP, MQTT[5] and API access.

[4] The recommended measuring range is ±85°. Outside of this range, the margin of error increases. However, when one of the axes is close to 90°, the other axis will be close to 0° and measuring the same inclination.
[5] MQTT available upon request.

Main specifications

MEMORY - Circular buffer structure	
Memory records	Up to 100 000 readings including time, distance and 3-axis tilt measurement.
MECHANICAL	
Box dimensions (WxLxH)	100x100x61 mm.
Overall dimensions	150x120x61 mm (excluding antenna).
Operating temperature	-10ºC to +50ºC
Storage temperature	-25ºC to + 70ºC
Weather protection	IP68 (at 2 m for 2 hours).
Weight (excluding batteries)	841 g
External Antenna	100 mm length (including connector).
Mounting options	Clearance holes for M4 hexagon socket head cap screws in bottom. Blind holes for M5 screws on the lateral side.
External Port	Mini USB port for configuration and data access; can also be used to power the node.
Box material	Aluminium alloy.
Batteries	1 to 2.
Vibration resistance	Laser modules comply with standard ISO 9022-3, Method 36, Severity 05 (0.15mm, 10Hz..55Hz)
RADIO - ISM sub 1 GHz operating frequency bands adjustable	
Range open field[6]	15 km
Range city street[6]	4 km
Range manhole in a city street[6]	2 km
Tunnel[6]	4 km
Bidirectional communications	Remote sampling rate change / Clock synchronization.
Maximum link budget	151 dB / 157 dB
Configuration	Star (no repeaters needed).

[6] The distances have been tested by Worldsensing and have been accomplished in actual projects using the standard antenna. However, radio range depends on the environment so these distances are only indicative. Consult with us for your application.

ACCESSORIES	
Other mounting brackets and accessories available upon request.	
LS-ACC-CELL-1C	Saft LSH 14 C-size spiral cell (5.8Ah).
LS-ACC-IN15-VP[6]	Mounting plate for vertical mounting; attachment option: anchor rods.
LS-ACC-IN15-HP[6]	Versatile plate for horizontal surface mounting; attachment option: anchor rods or glue; includes a threaded hole available for installing a monitoring prism or a button head screw for precise levelling.
LS-ACC-LAS-AP	Adjustable mounting plate for vertical surface; attachment option: anchor rods. This support allows limited rotation in two axis with respect to the reference surface. This support is proper for fine aiming of the laser beam.
LS-ACC-LAS-SB[7]	Swivel mounting bracket; attachment option: pole fixing 50 mm U-bolts, anchor rods or on a convergence bolt with 3/8" male thread. The swivel mounting bracket allows swivelling around the vertical axis (+/- 90°) and a minor rotation of the enclosure on the plate (+/- 3°).
LS-ACC-ANC[8]	Kit of 3 anchor rods and 3 chemical capsules for injection. M8, 110 mm Length, nuts and washers included.
LS-ACC-MAG[9]	Kit of 3 magnets, Ø 32 mm, strength approx. 30 kg, screws included.

[6] The laser beam cannot be aimed using this mounting plate because the node is fixed.
[7] The swivel mounting bracket allows swivelling and rotation but these degrees of freedom, even if the bracket is fixed in place with screws or fasteners, can aversely affect the inclination measurement specifications of the whole system.
[8] The kit of 3 anchors and 3 chemical capsules can be used to fix the following mounting kits: LS-ACC-IN15-HP, LS-ACC-IN15-VP, LS-ACC-IN15-DP.
[9]The kit of 3 magnets can be used to fix the LS-ACC-IN15-VP mounting plate.

SERVICES	
WS-S-TILT-CAL	Wireless Tiltmeter Recalibration Service. Includes the replacement of the screws and the verification of the different mechanical elements. Shipment to and from Worldsensing warehouse excluded.

Installation orientation options and the associated x, y and z axes tilt measurements