

# Wireless Laser + Tiltmeter



LS-G6-LAS-TIL90-MON

2-IN-1 WIRELESS LASER DISTANCE METER AND TILTMETER

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.





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### FEATURES

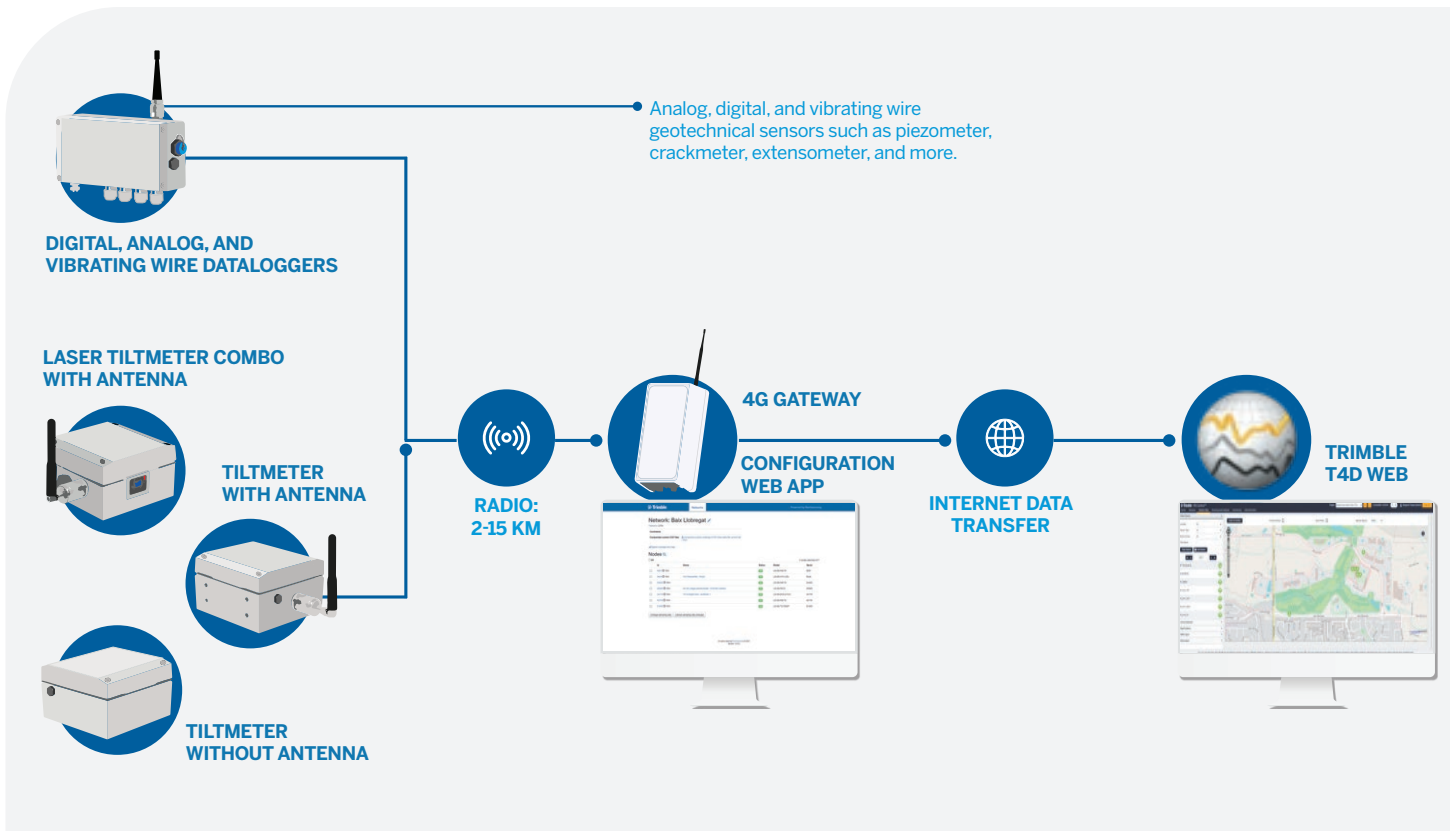
- ▶ Wireless sensor. An integrated unit (2-in-1 sensor + data logger).
- ▶ Accurate distance measurement through a visible Laser Class II laser with 655 nm.
- ▶ 3-axis inclination with respect to gravity's direction and a range of  $\pm 90^\circ$
- ▶ Long battery life (up to 8.5 years @6 h sampling rate).
- ▶ 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.

# IoT-based Geotechnical Monitoring

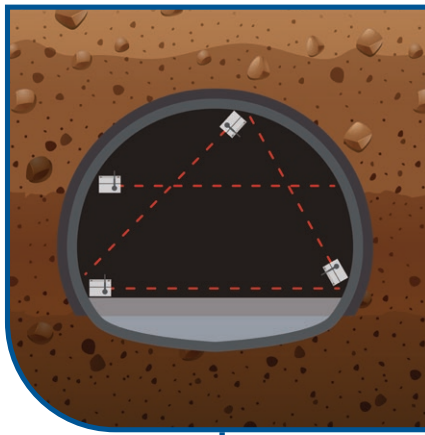
## SYSTEM INSTALLATION



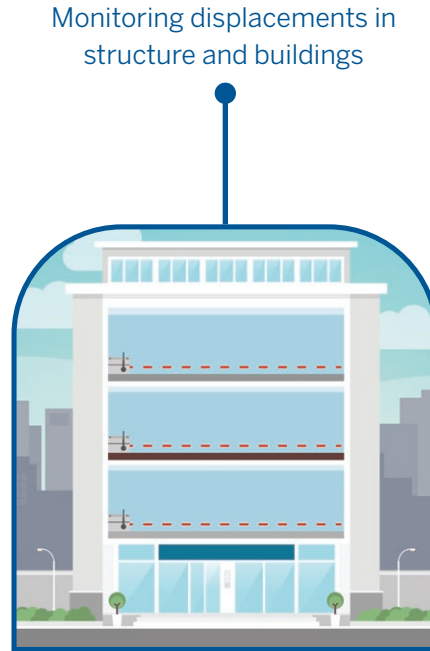


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Tunnel and underground convergence monitoring



Monitoring displacements in structure and buildings



Remote monitoring of slope stability

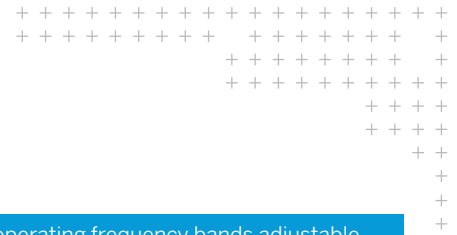
## SPECIFICATIONS

GENERAL		
<b>Battery life</b>		
- sampling rate 5 min	1.5 years	Estimations for Saft LSH 14 batteries based on the life time mathematical model considering Barcelona temperature profile.
- sampling rate 1 h	6.4 years	
- sampling rate 6 h	8.5 years	
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: $\pm 1^\circ\text{C}$ ).		
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	$\pm 1$ 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.

LASER DISTANCE METER		
Accuracy	in favorable conditions <sup>1</sup>	in unfavorable conditions <sup>2</sup>
@ 1 m	$\pm 1$ mm	$\pm 2$ mm
@ 10 m	$\pm 1$ mm	$\pm 2$ mm
@ 20 m	$\pm 1.5$ mm	$\pm 3$ mm
@ 50 m	$\pm 4$ mm	$\pm 7$ mm
@ 100 m	$\pm 9$ mm	$\pm 15$ mm
@ 150 m	$\pm 16$ mm	not applicable

TILTMETER	
Type	Tilt angle calculated from 3-Axis MEMS Accelerometer.
Range	$\pm 90^\circ$
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 $\pm 4^\circ$	$\pm 0.005^\circ$
Accuracy within $\pm 15^\circ$	$\pm 0.013^\circ$
Accuracy within $\pm 45^\circ$	$\pm 0.038^\circ$
Accuracy within $\pm 86^\circ$	$\pm 0.06^\circ$
Resolution	0.001°
Repeatability	$< 0.0003^\circ$
Offset Temperature dependency	$\pm 0.002^\circ/\text{c}$
Stability @ 14 hours	$< 0.003^\circ$
Time required for a reading	9.6 seconds



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### TILTMETER

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
Temperature sensor accuracy	± 0.5 °C

### CONNECTIVITY

User-friendly Android configuration app included.	
Pointing mode for an easy installation .	
Web browser software	CMT Edge - from version 2.5 onwards CMT Cloud - from version 1.4.0 onward
Standard CSV download, FTP push, Modbus TCP, MOTT <sup>3</sup> and API access	

### MEMORY - Circular buffer structure

Memory records	Up to 100 000 readings including time, distance and 3-axis tilt measurement.
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### MECHANICAL

Box dimensions (WxLxH)	100 x 100 x 61 mm.
Overall dimensions	150 x 120 x 61 mm (excluding antenna).
Operating temperature	-10 °C to +50 °C
Storage temperature	-25 °C to +70 °C
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 (0.15 mm, 10 Hz..55 Hz).

### RADIO - ISM sub 1 GHz operating frequency bands adjustable

Range open field <sup>4</sup>	15 km
Range city street <sup>4</sup>	4 km
Range manhole in a city street <sup>4</sup>	2 km
Tunnel <sup>4</sup>	4 km
Bidirectional communications	Remote sampling rate change / Clock synchronization.

### RADIO - ISM sub 1 GHz operating frequency bands adjustable

Maximum link budget	151 dB / 157 dB
Configuration	Star (no repeaters needed).

### ACCESSORIES

Other mounting brackets and accessories available upon request. Magnetic mounting kits are undergoing development.

LS-ACC-CELL-1C	Soft LSH 14 C-size spiral cell (5.8Ah).
LS-ACC-IN15-VP <sup>5</sup>	Mounting plate for vertical mounting; attachment option: anchor rods.
LS-ACC-IN15-HP <sup>5</sup>	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	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 <sup>6</sup>	Kit of 3 anchor rods for injection. M8, 110 mm Length, nuts and washers included.

Other mounting brackets and accessories available on request.

### 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.
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- 1 On natural objects (white wall, low target illumination <3K lx, moderate temperatures).
- 2 On natural objects (white wall, high target illumination with 30K lx, full specified operating temperature range).
- 3 MQTT available upon request.
- 4 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.
- 5 The laser beam cannot be aimed using this mounting plate because the laser node is fixed.
- 6 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.

Contact your local Authorized Trimble Distribution Partner for more information

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