EDGE DEVICES – WIRELESS SENSORS

Laser Tilt90

LS-G6-LAS-TIL90

Worldsensing LaserTilt90 is a 2-in-1laser distance meter and tiltmeter. The laser measures the relative distance to a reference point that can be either natural surfaces or target foils. Meanwhile, the tiltmeter provides measurements of changes from the vertical level, either on the ground or in structures. This 2-in-1 wireless sensor is designed to provide robust data when monitoring inclinations, movements and differential settlements of slopes or infrastructures.

The LaserTilt90 can be easily located 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.

LONG-RANGE AND LOW-POWER

The LaserTilt90 is capable of transmitting data via long-range radio to a gateway connected to the Internet up to 9 miles/ 15 km away. One gateway can also support dozens of data loggers in the same network, depending on the reporting period, through a star or tree network topology.

In terms of energy consumption, Worldsensing LaserTilt90 is an autonomous battery-powered device with C-size batteries that can last up to 10 years with minimal to zero maintenance required. It is IP68 certified and operating temperature from −20 °C to 60 °C.

FEATURES
2-in-1 Laser Meter+ tiltmeter
3-axis inclination with respect to gravity's direction and a range of±90°
Accurate distance measurement through a visible Laser Class II with 655 N-m.
Internal temperature (accuracy: ±1°c), signal strength and gain collected and transmitted at each reading.
Robust, compact design and IP68 grade weather-proof box.
Long battery life (>10 years @1 h sampling rate).
Long range communications through LoRa communications.

SOFTWARE
User-friendly Android configuration app included.
Web browser software for network, device and data management.
Single-gateway network setup with CMT Edge software (data server and radio server hosted in the gateway and data access through standard CSV downloads, FTP push, Modbus TCP, API REST and MQTT1).
Customizable Laser Measurement Scheduling in CMT Cloud. Disable laser measurements during predefined time intervals, such as weekdays, weekends, or custom settings. Control is maintained through the integrated tiltmeter, eliminating visible red dots and laser beams, ensuring seamless and uninterrupted operation.
Multi-gateway network setup with CMT Cloud software and advanced features with data access via standard CSV downloads, FTP push, API REST and MQTT push1.

[1] MQTT available upon request.

APPLICATIONS
STRUCTURAL HEALTH
Convergence monitoring for tunnels, shafts and galleries.
Static deflections of piles, piers and decks of bridges and other structures
GEOTECHNICAL MONITORING
Slope movements in landslides, embankments
Ground movements in underground excavations

ADVANTAGES
Suitable for unattended, large scale projects
Very low maintenance equipment due to its robustness and low-power consumption.
Provides complementary data for existing geospatial monitoring when high precision and robustness is needed.
Easy configuration through the Worldsensing mobile application
Customer support from a expert team of geotechnical monitoring
Pioneer company in the field, long history in monitoring large-scale civil infrastructure

TECHNICAL SPECIFICATIONS

GENERAL

Sensor type	2-in-1 Laser Distance Meter+ Tiltmeter Selectable from:
Reporting Period	Selectable from: 30 s 1, 2, 5, 10, 15, 30 min 1, 2, 4, 6, 12, 24 h
Time synchronization discipline by radio	Better than ±30 seconds
Battery type	2 x 3.6 V C-size user-replaceable, high energy density batteries
Interfaces	Internal mini USB
Device configuration	Worldsensing App
App advanced functionalities	• Laser pointing mode. • Tiltmeter calibration parameters check using the app. • Radio signal coverage tests for easy installation.

LASER DISTANCE METER

Sensor	Visible Laser Class II with 655 N-m.
Laser power	0.75 to 0.95 mW
Resolution	0.1 mm
Repeatability (±∂)[4]	0.15 mm
Measuring range at favorable conditions	0.05to 150 m
Typical measuring accuracy	±1 mm
Time required for a reading	Up to 4 seconds, depending on distance.

Accuracy $f(\alpha)$

Distance (d)	Under favorable conditions[2]	Under unfavorable conditions[2]
1 m 10 m 20 m 50 m 100 m 150 m	±1 mm ±1 mm ±1.5 mm ±4 mm ±9 mm ±16 mm	±2 mm ±2 mm ±3 mm ±7 mm ±15 mm Not applicable
Signal strength	Signal strength and gain are transmitted with each laser measurement. It can be used for maintenance purposes.	

[2] On natural objects. Low target illumination (<3 K lx), moderate temperatures.

[3] On natural objects. High target illumination (3 K lx), full specified operating temperature range.

TILTMETER

Sensor	3-axis MEMS accelerometer
Range[4]	±90°
Axes	3-axis inclination measurement with respect to gravity's direction. Reports the two axes of rotation from the horizontal plane in any orientation
Resolution	0.0001°
Repeatability	<0.0003°
Time required for a reading	Up to 4 seconds, depending on distance.

Accuracy $f(\alpha)$

Angle (α)	Accuracy
±2° ±4° ±15° ±45° ±85°	±0.0025° ±0.005° ±0.013° ±0.08° ±0.23°
Offset temperature dependency	±0.002°/°C
Stability@ 14 h	<0.003°
Time required for a reading	9.6 s
Measure of dispersion	Standard deviation of the set of measurements collected during the reading and transmitted with each tilt measurement. It can be used to filter noisy data.
Temperature sensor resolution	0.1 °C

[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 too• and measuring the same inclination.

MECHANICAL

Box dimensions (WxLxH)	100 x 100 x 61 mm.
Overall dimensions	150 x 120 x 61 mm (excluding antenna).
Operating temperature[5]	−20°c to 60 °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	Aluminum alloy
Batteries	1 to 2
Vibration resistance	ISO 9022-3 compliant. Method 36, Severity 05 (0.15 mm, 10 Hz..55 Hz)

MEMORY

Memory Structure	Circular Buffer
Maximum Memory Records	100 000 readings including time, distance and 3 axis tiltmeter measurements.

RADIO SPECIFICATIONS

Radio band	ISM sub 1GHz
Operating frequency bands	Adjustable
Bidirectional communications	Remote sampling rate change / Clock synchronization
Maximum link budget	151 dB / 157 dB
Configuration	LoRa Star/ LoRa Tree

RADIO RANGE[6]

Range open field	15 km
Range manhole in a city street	2 km
Range city street	4 km
Tunnel	4 km

BATTERY LIFE ESTIMATIONS[7]

Distance		20 m	65 m
Reporting Period	5 min	1.8 years	0.5 years
	1 h	10.2 years	5.1 years
	6 h	14.3 years	12 years

[5] Temperature range applicable to devices with serial numbers greater than 109401. Otherwise, the operating temperature range is −10 °C to 50 °C.

[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.

[7] Typical Europe radio configuration. Spreading factor 9, radio transmit power 14 dBm. Considering laboratory conditions. Consumption varies depending on the sensor used, sampling rate and environmental and wireless network conditions.

Battery life estimations using recommended Saft batteries LSH14, based on the lifetime mathematical model using Barcelona weather profile. Average values provided.
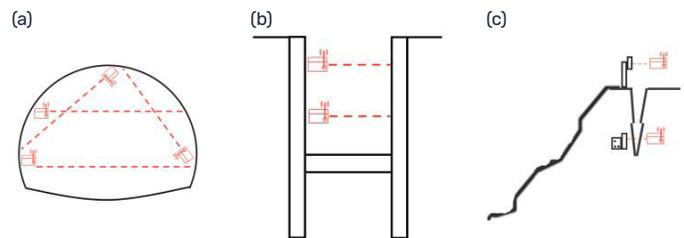

(a) (b) (c)

Fig. 1: Different applications for the LaserTil90. (a) convergence monitoring in tunnels and galleries, (b) convergence monitoring in construction shaft, (c) crack monitoring in open pit mines and rock slopes.

ACCESSORIES

LS-ACC-CELL-1C	Saft LSH 14 C-size spiral cell (5.8 Ah).
LS-ACC-IN15-VP[8]	Mounting plate for vertical mounting; attachment option: anchor rods.
LS-ACC-IN15-HP[8]	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 leveling.
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.
WS-ACC-LAS-NSB[9]	Swivel mounting bracket. Attachment options: pole fixing 50 mm using WS-ACC U50 U-bolts, anchor rods LS-ACC-ANC-H or on a convergence bolt using the WS-ACC LAS-NSB-ADAP adapter.
LS-ACC-ANC-H[10]	Kit of 3 anchor rods for injection. M8, 110 mm Length, nuts and washers included.
WS-ACC-U50	U-bolts and nuts for a pole diameter less than 50 mm. To use with WS-ACC-POLE-PL8.
WS-ACC-LAS-NSB-ADAP	Adapter to mount the WS-ACC-LAS-NSB on a convergence bolt with a G 3/8" male thread. Convergence bolt not included.
LS-ACC-MAG[11]	Kit of 3 magnets, 0 32 mm, strength approx. 30 kg, screws included.
WS-ACC-LAS-TG	Laser target rotatable and swivelable 360" compatible with convergence bolt G 3/8" male thread, M8 anchor rods and MS magnets.

[8] The laser beam cannot be aimed using this mounting plate because the node is fixed.

[9] The swivel mounting bracket allows swiveling 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.

[10] The kit can be used to fix the following mounting kits: LS-ACC-IN15-HP. LS-ACC-IN15- VP, LS-ACC-LAS-AP, LS-ACC-LAS-SB.

[11] The kit of 3 magnets can be used to fix the LS-ACC-IN15-VP mounting plate.

Fig. 3: LaserTilt90 mounted on a swivel mounting bracket WS-ACC LAS-NSB on a vertical surface.

Fig. 4: LaserTilt90 mounted on a swivel mounting bracket WS-ACC LAS-NSB on a horizontal surface.

Fig. 5: LaserTilt90 on a swivel mounting bracket LS-ACC-LAS-SB attached to a WS-ACC-LAS-NSB ADAP to be installed with a convergence bolt G3/8" male thread.

Fig. 2: Inside view of the LaserTilt90.

Fig. 6: Laser target WS-ACC-LAS-TG. Recommended to increase laser readings accuracy when beam points the surface in an oblique angle.

FOR MORE INFORMATION
Scan to access the user guide for this device.

GENERAL DISCLAIMER:

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