WIRELESS TILTMETER

LS-G6-INC15

LS-G6-INC15
Wireless tiltmeter
with an external antenna

LS-G6-INC15-I
Wireless tiltmeter
with an internal antenna

Tiltmeters for monitoring applications provide measurements of changes from the vertical level, either on the ground or in structures. This makes them key sensors to monitor inclinations, movements and differential settlements of slopes or infrastructures.

For example they can be applied to vertical structures as columns, piers, pylons, facades or retaining walls to track the changes in inclinations and detect differential settlement; or they can be installed to verify over time the geometry and stability of tunnels, railway tracks (cant, twist and vertical alignment) or bridges decks.

Tiltmeters have been as well extensively used in landslides, embankments and mines monitoring to control the stability of the slopes.

The Loadsensing wireless tiltmeter combines an extremely accurate dual axis sensor with the Loadsensing long-range radio wireless monitoring system which ensures connectivity up to 15 kms / 9 miles with line-of-sight.

The data collected are stored on board the tiltmeter and shared wirelessly to the closest Loadsensing Gateway. A single gateway can support hundreds of tiltmeters.

The tiltmeters, as all Loadsensing products, can be programmed via an Android based app, in a few simple steps.

The Loadsensing tiltmeter is extremely low power and can operate for several years unattended relying solely on the replaceable internal batteries.

The unit is now available with external antenna for full range capabilities or with internal antenna for applications as railway tracks where it's important to minimise the potential risk for external parts.

FEATURES
Wireless sensor
High accuracy and repeatability
Long battery life (> 5 years @ 1h sampling rate)
Reduced size (103x100x61 mm, internal antenna version)
Two versions available - external and internal antenna
Durable and versatile
SOFTWARE
User-friendly Android configuration app included
Web browser software
Single-gateway network setup with the dataserver and radio server hosted in the gateway and data access through standard CSV downloads, FTP push, Modbus TCP and API REST
Multi-gateway network setup with a network management software and advanced features with data access via standard CSV downloads, FTP push, API REST and MQTT push*

* MQTT available upon request

APPLICATIONS
Railway track monitoring
Building response to tunneling and excavation-induced ground movements
Foundations and deep excavations
Landslides and slope stability
Bridge and structural health monitoring
Embankments
ADVANTAGES
Highly accurate and reliable biaxial tilt sensor
Long-range communications (up to 15km)
Low-power, long battery life (over 5 years)
Robust, small and weather-proof box
Easy configuration
Proven track record

Main specifications

GENERAL

Battery life estimation**	Barcelona temperature profile	Singapore temperature profile	Estimations for Saft LSH 14 batteries based on the life time mathematical model
sampling rate 5 min	1.2 years	1.1 years	
sampling rate 1 h	5.8 years	4.7 years	
sampling rate 6 h	8.3 years	6.4 years	

Battery type	2 x 3.6V C-Size user replaceable high energy density batteries (recommended Saft LSH 14)
Sampling rate	30 seconds to 1 day
Configuration software	Android App
App features: Calibration parameters can be checked using the app. Radio signal coverage tests for an easy installation	

SENSOR

Type	MEMS (Micro-Electro-Mechanical) Inclinometer with internal offset compensation
Range	± 15°
Axes	Two (biaxial)
Accuracy within ± 5°	± 0.003°
Accuracy full range (± 15°)	± 0.010°
Resolution	0.001°
Repeatability	<0.0002°
Offset Temperature dependency	± 0.002°/°C
Stability @ 6 hours	<0.002°
Sensitivity	See calibration report specific and provided for each tiltmeter
Time required for a reading	8.3 seconds
Mechanical bandwidth	18Hz
Temperature sensor resolution	0.1 °C
Temperature sensor accuracy	±0.5 °C
A/D converter	24-bit sigma-delta

** Typical Europe radio configuration. Spreading factor 9, radio transmit power 14dBm; considering Barcelona and Singapore temperature profiles; consumption varies depending on sampling rate and environmental and wireless network conditions

MEMORY - CIRCULAR BUFFER STRUCTURE

Memory records: Up to 200 000 readings including time and 1 sensor

MECHANICAL

Node	LS-G6-INC15	LS-G6-INC15R
Box dimensions (WxLxH):	100x100x61 mm	100x100x61 mm
Overall dimensions:	150x120x61 mm (excluding antenna)	103x100x61 mm
Operating temperature:	-40°C to 80°C (-40°F to 175°F)	
Weather protection:	IP68 (at 1 m for 1 week)	IP68 (at 2 m for 2 hours)
Weight (excluding batteries):	841 g	624 g
Antenna:	External: 100 mm length (including connector)	Internal
Mounting options:	Clearance holes for M4 hexagon socket head cap screws in bottom. Blind holes for M4 screws on the lateral side.	
USB (configuration/ext. power):	Internal Mini USB	
Box material:	Aluminium alloy	Aluminium alloy
Lid material	Aluminium alloy	Polycarbonate
Batteries:	from 1 up to 2	
Vibration resistance	Test: Random vibration test railroad profile according to level C.2 (on sleeper) of standard EN 50125-3:2003	
Impact resistance***	Drop from 1 meter onto a concrete surface (20 000g)	

*** The tiltmeter has good impact resistance. However it should be treated carefully like any precision instrument.

An external view of a Loadsensing wireless tiltmeter with external antenna. The blind holes for M4 screws on the lateral side are visible.

Note: Specifications are subject to review and change without notice.

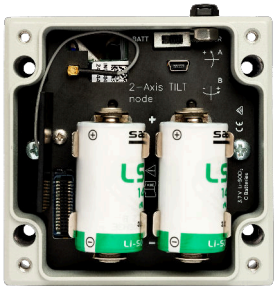
www.worldsensing.com
connect@worldsensing.com

Geomotion
AUSTRALIA

SYDNEY
9/31-33 Chaplin Drive
Lane Cove West, NSW, 2066
+61 (2) 9693 5493
salesnsw@geomotion.com.au

MELBOURNE
22/15 Earsdon Street
Yarrville, VIC, 3013
+61 (3) 8060 7969
salesvic@geomotion.com.au

PERTH
2/34 Millrose Drive
Malaga, WA, 6090
+61 (8) 9284 0244
sales@geomotion.com.au



An inner view of a Loadsensing wireless tiltmeter.
The nodes are autonomous battery-powered devices with C-size batteries that can last several years with minimal to zero maintenance required.

Wireless tiltmeter mounted on a vertical mounting plate (LS-ACC-IN15-VP) for wall mounting. Anchor rods (LS-ACC-ANC) for injection are positioned.

Wireless tiltmeter mounted on a versatile horizontal surface mounting plate (LS-ACC-IN15-HP). The plate has three clearance holes for M8 anchor rods and a M8 threaded hole allowing a combined use with surveying.

RADIO - ISM sub 1 GHz operating frequency bands adjustable

	External antenna (LS-G6-INC15)	Internal antenna (LS-G6-INC15R)
Range open sight	15 km	10 km
Range city street	4 km	2 km
Range manhole in a city street	2 km	1 km
Tunnel	4 km	2 km

Notes: 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.

Bidirectional communications: Remote sampling rate change / Clock synchronization

Maximum link budget: 151 dB / 157 dB

Configuration: Star (no repeaters needed)

ACCESSORIES

Other mounting brackets and accessories available upon request. Contact us if you are interested in magnetic mounting kits or in tilt beams.

LS-ACC-IN15-VP	Mounting plate for vertical mounting; attachment option: anchor rods
LS-ACC-IN15-HP	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-IN-HPTM	Horizontal surface mounting plate for track monitoring; attachment option: glue
LS-ACC-IN15DP	Versatile double plate for horizontal surface mountingl; suitable for applications that need to eliminate the need to open the casing during installation; 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-ANC	Kit of 3 anchor rods for injection. M8, 110 mm Length, nuts and washers included

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