SPEC SHEET

Wireless Tiltmeters

LS-G6-TIL90-X-MON / LS-G6-TIL90-I-MON

The Trimble® Tilt90 is a 3-axis wireless tiltmeter designed to 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.

The Tilt90 wireless sensors are available with an external antenna for full range capabilities or with an internal antenna for applications as railway tracks where it's important to minimize the potential risk for external parts.

The Tilt90 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, the Tilt90 is an autonomous battery-powered device with C-size batteries that can last up to 10 years with minimal to zero maintenance required.

LS-G6-TIL90-X-MON
Tilt90 with an external antenna

LS-G6-TIL90-I-MON
Tilt90 with an internal antenna

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FEATURES

- Wireless 2-1 sensor and data logger.
- 3-axis inclination with respect to gravity's direction and a range of ± 90°.
- Standard deviation transmitted with each tilt measurement to enable noisy data filtering.
- Robust, compact design and IP68 grade weather-proof box.
- Long battery life (>17 years @1h sampling rate).
- Two versions available - external and internal antenna
- Long range communications through LoRa communications.
- User-friendly Trimble Geotech app for Android™ included.

APPLICATIONS

Structural Health

- Cant, twist and vertical alignment in rail track monitoring.
- Static deflections of piles, piers and decks of bridges and other structures.

Geotechnical Monitoring

- Slope movements in landslides, embankments.
- Ground movements in foundations and deep excavations.

ADVANTAGES

- High precision due to individual device calibration.
- 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 Android mobile application.
- Customer support from an expert team of geotechnical monitoring.
- Pioneer company in the field, long history in monitoring large-scale civil infrastructure.

TECHNICALS SPECIFICATIONS

GENERAL	
Sensor type	3-axis MEMS accelerometer
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	Android app
App advanced functionalities	Field samples and signal coverage test when connected to the app. Set the previous configuration to quickly configure tiltmeters for installation in the same project. Tiltmeter calibration parameters check using the app.

TILTMETER		
Sensor variants	LS-G6-TIL90-X	LS-G6-TIL90-I
Antenna	External	Internal
Range[1]	± 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.	

TILTMETER		
Accuracy *f*(a)		
± 2°	± 0.0025	± 0.0045°
± 4°	± 0.005	± 0.006°
± 45°	± 0.08	± 0.08°
± 80°	± 0.23	± 0.23°
± 15°	± 0.013	± 0.013°
Resolution	0.0001°	0.0001°
Repeatability	<0.0003°	<0.0015°
Offset temperature dependency	± 0.002°/ °C	± 0.005°/ °C
Stability @ 14 h	<0.003°	<0.010°
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	

MECHANICAL		
Node	LS-G6-TIL90-X-MON	LS-G6-TIL90-I-MON
Box dimensions (W x L x H):	100 x 100 x 61 mm	100 x 100 x 61 mm
Overall dimensions:	150 x 120 x 61 mm (excluding antenna)	103 x 100 x 61 mm
Operating temperature:	-40 °C to +80 °C (-40 °F to +175 °F)	
Weather protection:	IP68 (at 2 m for 2 h)	
Weight (excluding batteries)	606 g	390 g

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MECHANICAL CONT'D.		
Antenna	External: 100 mm length (including connector)	Internal
Mounting options	Clearance holes for M4 hexagon socket head cap screws in bottom. Blind holes for M5 screws on the lateral side.	
Configuration	Internal mini USB	
Box material	Aluminium alloy	Aluminium alloy
Lid material	Aluminium alloy	Polycarbonate
Batteries	from 1 up to 2	
Vibration resistance	Up to ±8 g	Up to ±80 g Test: random vibration test railroad profile according to level C.2 (on sleeper) of EN 50125-3:2003 CORR:2010 standard and methodology of EN 60068-2-64:2008 standard.
Impact resistance[2]	Drop from 1 meter onto a concrete surface (20,000 g)	

MEMORY - CIRCULAR BUFFER STRUCTURE
Maximum memory records: 140,000 readings including time and 3 axis.

RADIO SPECIFICATIONS		
Radio band	ISM sub 1 GHz	
Operating frequency bands	Adjustable	
Bdirectional communications	Remote sampling rate change / Clock synchronization	
Maximum link budget	151 dB / 157 dB	
Configuration	LoRa Star / LoRa Tree	
Radio range: [3]	External antenna (LS-G6-TIL90-X-MON)	Internal antenna (LS-G6-TIL90-I-MON)
Open sight	15 km	10 km
City street	4 km	2 km
Manhole in a city street	2 km	1 km
Tunnel	4 km	2 km

BATTERY LIFE ESTIMATIONS[4]				
Battery model		LSH14	LM26500	
Number of cells		2 cells	1 cell	2 cells
Reporting period	30 s	4.8 months	3.1 months	6.2 months
	5 min	3.6 years	2.5 years	5.1 years
	1 h	12.9 years	17.2 years	>25 years
	6 h	15.5 years	>25 years	>25 years

ACCESSORIES[5]	
LS-ACC-IN15-VP-MON	Mounting plate for vertical mounting: attachment option: anchor rods.
LS-ACC-IN15-HP-MON	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-MON	Horizontal surface mounting plate for track monitoring; attachment option: glue.
LS-ACC-IN15-DP-MON	Versatile double plate for horizontal surface mounting; 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-H-MON[6]	Kit of 3 anchor rods for injection M8, 110 mm length, Nuts and washers included.
LS-ACC-MAG[7]	Kit of 3 magnets, Ø 32 mm, strength approx. 30 kg, screws included.
WS-ACC-1BEAM	1 m Aluminum beam with specific profile to attach a LS-G6-TIL90.
WS-ACC-2BEAM	2 m Aluminum beam with specific profile to attach a LS-G6-TIL90.
WS-ACC-BEAMFIX	Fixation kit for beam accessory mounting. Includes: anchors, brackets and washer assembly.
LS-ACC-CELL-1C	Saft LSH 14 C-size spiral cell 5.8 Ah.
WS-ACC-CELL2-1C	Saft LM26500 C-size spiral cell 7.4 Ah.
LS-ACC-ANTC	Antenna cable extension RP-SMA to RP-N, 2.5 m.
LS-ACC-MUSB-C	Data logger - mobile cable. USB C to mini USB cable, 1 m. Not compatible with LS-G6-TIL90-I.

Accessories not ending with "MON" are not part of the Trimble portfolio. These can be purchased directly from Worldsensing.

1 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.
2 The tiltmeter has good impact resistance. However it should be treated carefully like any precision instrument.
3 The distances have been tested by Trimble 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.
4 Typical Europe radio configuration. Spreading factor 9, radio transmit power 14dBm. Considering laboratory conditions. Consumption varies depending on the sensor used, sampling rate and environmental and wireless network conditions.
Battery life estimations based on the lifetime mathematical model using Barcelona weather profile. Average values provided.
5 Other mounting brackets and accessories available upon request. Magnetic mounting options undergoing development
6 The kit can be used to fix the following mounting kits: LS-ACC-IN15-HP-MON, LS-ACC-IN15-VP-MON, LS-ACC-LAS-AP-MON, LS-ACC-LAS-SB-MON.
7 The kit of 3 magnets can be used to fix the LS-ACC-IN15-VP mounting plate. Only available in Europe.

Note: Specifications are subject to review and change without notice

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An inner view of the Tilt90s. The nodes are autonomous battery-powered devices with C-size batteries that can last several years with minimal to zero maintenance required.

Tilt90-x mounted on a vertical mounting plate (LS-ACC-IN15-VP-MON) for wall mounting.

The Tilt90s mounted on a versatile horizontal surface mounting plate (LS-ACC-IN15-HP-MON). The plate has three clearance holes for M8 anchor rods and an M8 threaded hole available for installing a monitoring prism or a button head screw for precise levelling.

The Tilt90-i with the LS-ACC-IN-HPTM-MON horizontal surface mounting plate for track monitoring.

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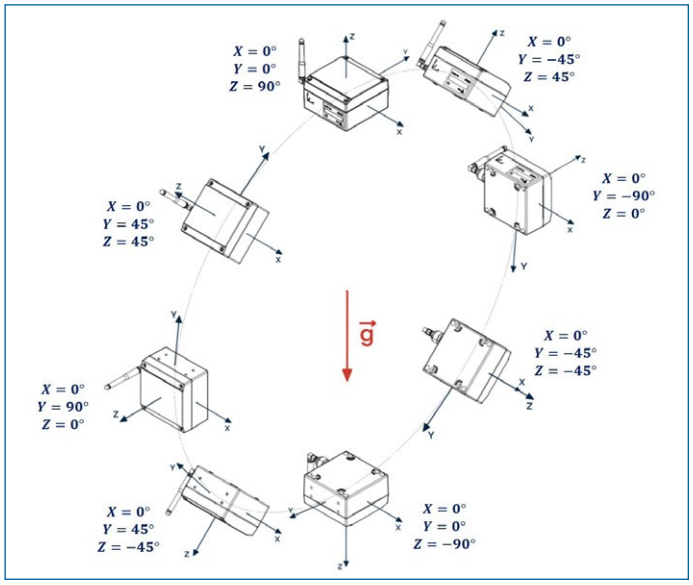
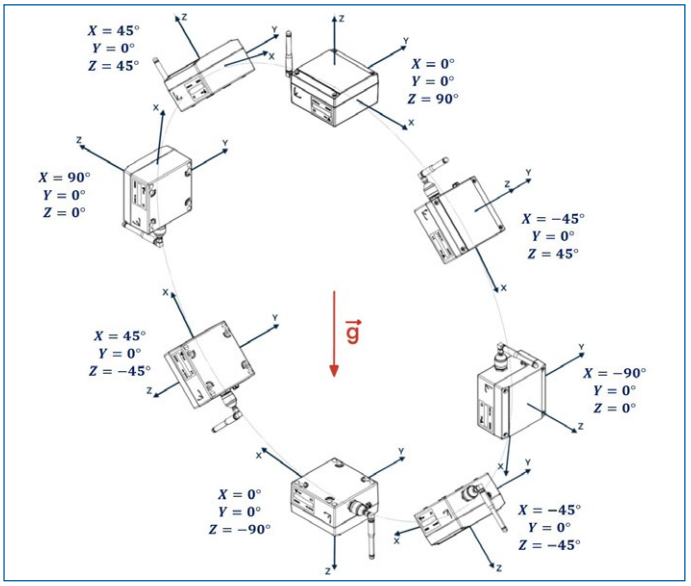
INSTALLATION ORIENTATION OPTIONS BASED ON THE X, Y AND Z AXES





The Tilt90-i mounted on a double plate for horizontal surface mounting (LS-ACC-IN15DP-MON). This is suitable for applications that need avoid opening the casing during installation. The plate includes a threaded hole available for installing a monitoring prism or a button head screw for precise levelling.

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