



loadsensing^w

WORLDSENSING

WIRELESS MONITORING SYSTEM

GATEWAY

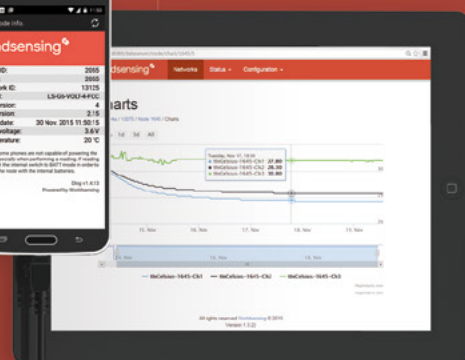
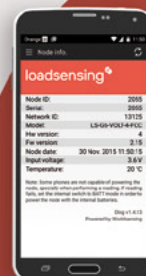


WIRELESS
DATA UNIT



WIRELESS TILTMETER

SOFTWARE SUITE





WORLDSENSING

THE CONNECTED INFRASTRUCTURE SOLUTION

MONITORING HOW STRUCTURES EVOLVE

Loadsensing is a data acquisition and monitoring system which combines state-of-the-art wireless monitoring and advanced software tools. It is widely recognized as the leading solution for connecting and monitoring infrastructures in remote locations.

Loadsensing devices are battery-powered and equipped with long-range, low-power wide area network (LPWA) radio communications and are compatible with a wide range of geotechnical sensors. The software suite is web-based and facilitates real-time data capture and analytics. It is also possible to set automatic alarms to make operations safer.

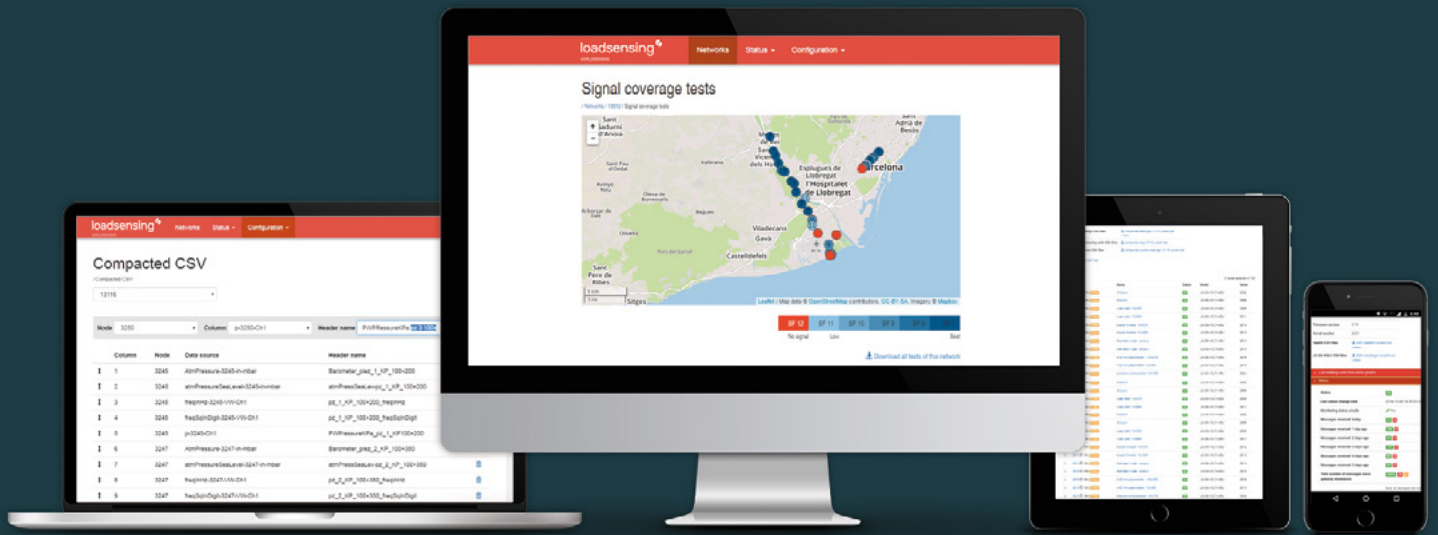
Mining and construction companies and operators of bridges, tunnels, dams, railways and many other inaccessible assets can now work with reliable data. Having access to this information and real-time insights enables operators to anticipate needs, manage their workforce, diminish risks, and even prevent disasters.

FEATURES

- Long-range communication of over 9 miles / 15km
- Truly low-power, 10 years of unattended runtime
- Wireless LPWA communication
- Supports most structural and geotechnical sensors (vibrating wire, digital, analog)
- Wireless tiltmeter
- Integrated alarm system
- User-friendly web software

BENEFITS

- Leverage already formatted data to optimize operations
- Remotely monitor hard-to-access infrastructures
- Cover a wide area with geotechnical sensors
- Easily add sensors to extend measurement range
- Save resources through fast implementation
- Decrease costs through easy maintenance
- Diminish risks and make operations safer



SOFTWARE SUITE

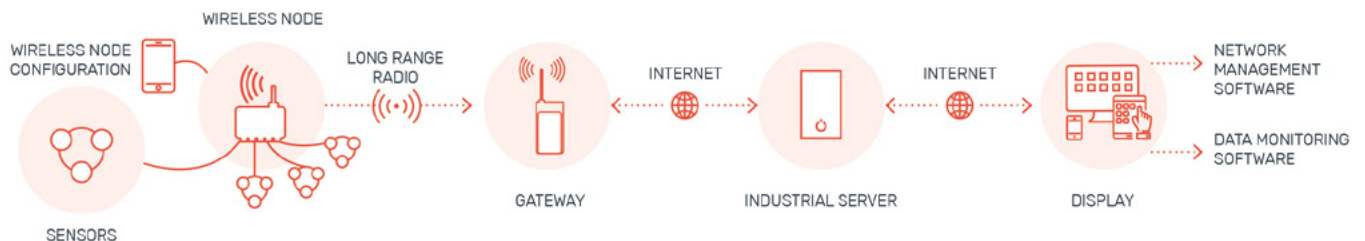
NETWORK AND ASSET MANAGEMENT SOFTWARE

- Network communications configuration and control
- Wireless data unit and sensor attributes display
- Wireless data unit configuration
- Sensor data in near real time
- Conversion of raw sensor data in engineering units
- Manual and automatic data download in .csv
- Data transmitted in a secure manner
- Remote change of sensor's sampling rate
- Data accessible through Modbus TCP
- Able to push data on user FTP

DATA MANAGEMENT SOFTWARE

- Sensor data visualization and download (tables and graphs)
- Topological view
- Creation of virtual variables
- Configuration of alarm thresholds
- Alarms sent to stakeholders by email
- Automatically generated reports (tables, graphs and notes)

HOW IT WORKS



Operational Intelligence
for Mines and Industrial Companies

Worldsensing is not only among the best in the world at connecting distributed infrastructures with smart devices, we also know how to extract intelligence from collected data to transform operations. Our software solutions combine location intelligence with infrastructure monitoring.



NODE: LS-G6-INC15

BOX DIMENSIONS (WxLxH): 100x100x61 mm
 OVERALL DIMENSIONS: 150x120x61 mm (excluding antenna)
 EXTERNAL ANTENNA: 100 mm length (including connector)
 HOUSING MATERIAL: Aluminium alloy
 Internal C-size 3.6 V High power batteries, from 1 up to 2 batteries

NODE: LS-G6-VW-1P (POLYCARBONATE)

BOX DIMENSIONS (WxLxH): 151x80x60 mm
 OVERALL DIMENSIONS: 160x85x60 mm
 INTERNAL ANTENNA
 RADIO COVERAGE: 60 % of the achieved with the external antenna
 WITHOUT GROUNDING
 HOUSING MATERIAL: Polycarbonate
 Internal C-size 3.6 V High power batteries, 1 battery



WIRELESS TILTMETER

LS-G6-INC15

APPLICATIONS

Remote tilt monitoring from retaining and building walls

Landslide monitoring

Bridge pier monitoring

Structural load monitoring

Ground subsidence

SPECIFICATIONS

Type:	MEMS (Micro-Electro-Mechanical) Inclinometer
Range:	$\pm 15^\circ$
Accuracy ($\pm 5^\circ$):	0.03% FS / 0.004°
Accuracy full range:	0.17% FS / 0.025°
Resolution:	0.001°
Repeatability:	0.005°
Axes:	Two (biaxial)

Temperature sensor resolution: 0.1 °C

Temperature sensor accuracy: ± 0.5 °C

BATTERY LIFE ESTIMATION Wireless tiltmeter

SAMPLING RATE	Barcelona temperature profile *	Singapore temperature profile*
5 min	1.2 years	1.1 years
1 h	5.8 years	4.7 years
6 h	8.3 years	6.4 years

* Estimations for 2 x saft LSH 14 batteries

VIBRATING WIRE 1ch and 5ch NODES

LS-G6-VW-1P, LS-G6-VW-1M, LS-G6-VW-5

VIBRATING WIRE NODE 1ch and 5ch

VIBRATING WIRE

Measurement method: Embedded algorithms increasing immunity to noise

Excitation wave: ± 5 V

Measurement range: 300 to 7,000 Hz

Resolution (-40 to $+85^\circ\text{C}$): 0.12 Hz

Accuracy (-40 to $+85^\circ\text{C}$): 0.018 % FS

THERMISTOR

Measurement range: 0 ohm to 4 Mohm

Resolution: 1 ohm

Accuracy (20°C): 0.05°C (0.04 % FS)

BAROMETER

Pressure Range: 300 to 1,100 hPa

Relative Accuracy (950 to 1,050 hPa at 25°C): ± 0.12 hPa

BATTERY LIFE ESTIMATION Vibrating wire nodes

CHANNELS & SAMPLING	BATTERIES*	BATTERY LIFE ESTIMATION*
1 CH 5 min	1 cell	3 years
1 CH 30 min	1 cell	7 years
5 CH 5 min	1 cell	1.5 years
5 CH 5 min	4 cell	5 years
5 CH 30 min	1 cell	4 years
5 CH 30 min	4 cell	>10 years

* Nominal capacity of each battery: 5,8 Ah.
 Considering laboratory conditions



Node: LS-G6-VW-1M (ALUMINIUM)

BOX DIMENSIONS (WxLxH): 100x100x61 mm
OVERALL DIMENSIONS: 140x120x61 mm (excluding antenna)
EXTERNAL ANTENNA: 114 mm length (including connector)
HOUSING MATERIAL: Aluminium alloy
Internal C-size 3.6 V High power batteries, 1 battery

Nodes: LS-G6-ANALOG-4, LS-G6-DIG-2 and LS-G6-VW 5 ch

BOX DIMENSIONS (WxLxH): 100x200x61 mm
OVERALL DIMENSIONS: 140x220x61 mm (excluding antenna)
EXTERNAL ANTENNA: 114 mm length (including connector)
HOUSING MATERIAL: Aluminium alloy
Internal C-size 3.6 V High power batteries, from 1 up to 4 batteries



ANALOG NODE

LS-G6-ANALOG-4

ANALOG NODE 4ch

Each channel is individually configured by the user

Power supply: 5 V DC / 12 V DC / 24 V DC up to 60 mA selectable for each channel

VOLTAGE

Measuring ranges [V DC]: +/-10 ; +/-1.25 (8x)

Accuracy (-40 to +85°C): +/- 0.05 % FS

CURRENT LOOP (2-3 wires)

Measuring range: 4-20 mA

Accuracy (0 to +50°C): 0.05 % FS

POTENTIOMETER (POT)

Accuracy (0 to +50°C): +/- 0.02 % FS

FULL WHEATSTONE BRIDGE (FWB)

Accuracy (0 to -50°C): +/- 0.1 % FS

THERMISTOR

Accuracy (0 to +50°C): +/- 0.2°C

PT 100

Accuracy (20°C): +/- 0.8°C

BATTERY LIFE ESTIMATION **

Channels & Sampling	Current @12V@24mA	Current @24V@24mA	Voltage @12V@24mA	FWB@5V@0.7 kΩ	Pot@5V@1.5 kΩ
Warm up time	1 second	1 second	1 second		
1 CH 5 min	6 months	4 months	5 months	1.5 years	1.5 years
1 CH 6 hours	>10 years	>10 years	>10 years	8.5 years	>10 years
4 CH 5 min	1.5 months	39 days	2 months	1.5 months	7 months
4 CH 6 hours	8 years	6.5 years	>10 years	8.5 years	>10 years

DIGITAL NODE

LS-G6-DIG-2

DIGITAL NODE

One RS485 channel and two SDI-12 channels

Power supply: 12 V DC up to 120 mA

RS485 full or half duplex supported

Suitable for a chain of in-place inclinometers

Modbus RTU RS485

Supported sensors: RTS, Sisgeo and Geosense digital inclinometers

BATTERY LIFE ESTIMATION **

RST and Sisgeo chains of Inclinometers

Number of sensor	Sampling rate		
	6 hours	30 minutes	3 minutes
10 (RST)	>10 years	2.5 years	4 months
30 (RST)	5.2 years	4 months	26 days
10 (SISGEO)	4 years	5 months	30 days

SHARED SPECIFICATIONS

INTERNAL DATA STORAGE

Up to 72,500 readings including time and 5 sensors

Up to 200,000 readings including time and 1 sensor

Sampling rate: 30 seconds to 1 day

Time synchronization by radio: Time discipline better than ± 10 seconds

Operating temperature: -40°C to 80°C (-40°F to 175°F)

Weather protection: IP67

ACCESSORIES

ACCESSORIES

Soft LSH 14 C-size spiral cell

Node-mobile cable

External mounting brackets for wall mounting

Plate for pole mounting

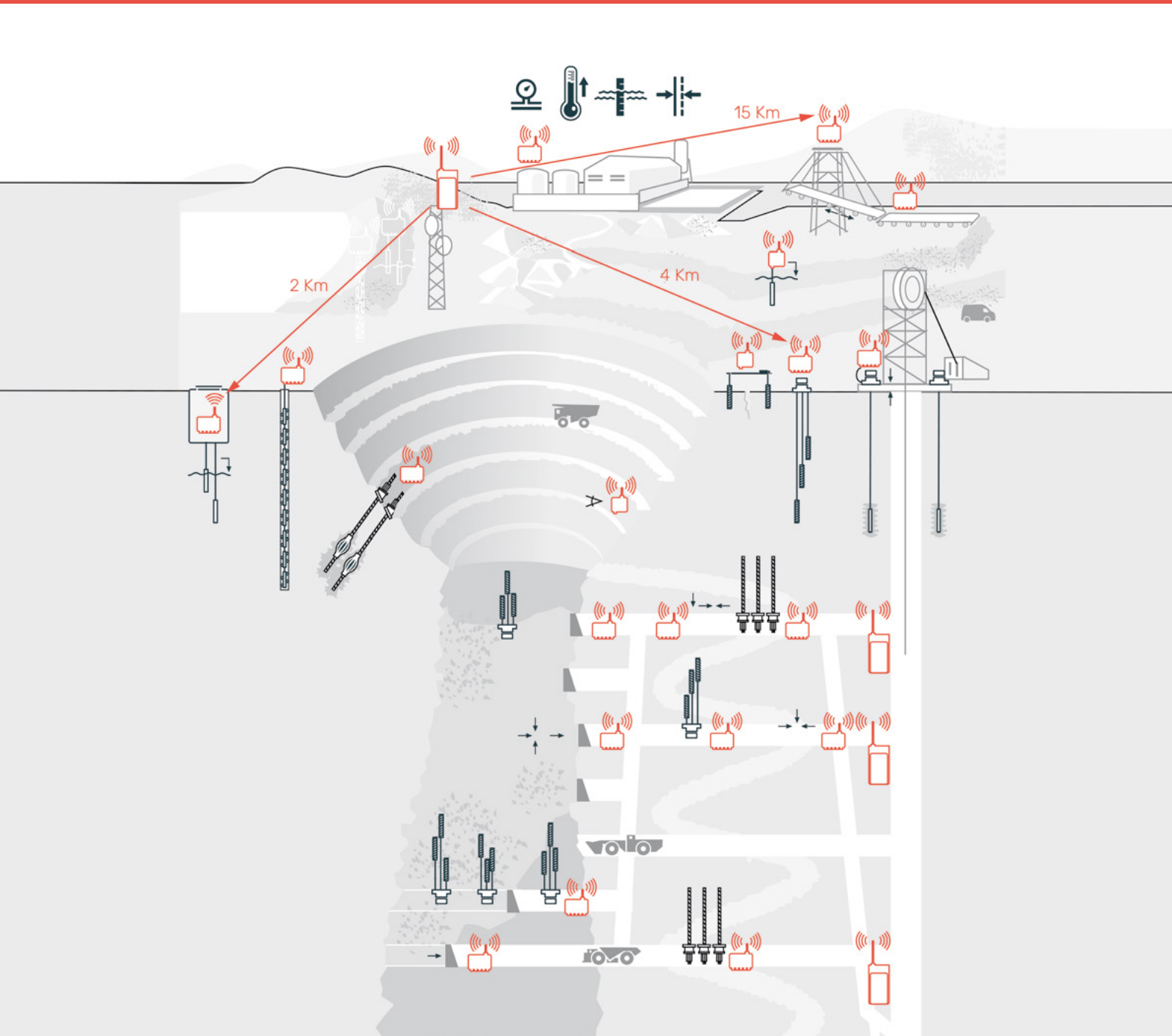
Tiltmeter horizontal mounting plate

Tiltmeter vertical mounting bracket

** Estimations for 4 x saft LSH 14 batteries.
Considering laboratory conditions



HOW IT WORKS IN MINES





CONFIGURATION APP

DLOG APP

Simple and fast connection to wireless node

Runs on Android devices

Easy sensor configuration: ID, sampling rate, frequency sweep, interface type, etc.

Checks radio signal coverage

Records coordinates (GPS)

Downloads data from wireless node and sends by e-mail or saves it on the Android device

Takes current reading

Updates wireless node firmware



GATEWAY

BASE STATION

ISM Sub 1 GHz band, sensitivity: down to -137 dBm

Detachable omnidirectional ½ dipole

Integrated GPS antenna

GNSS High Sensitivity GPS module

POWER

Power supply: 48 V DC PoE

Nominal: 3 Watts

DC power supply (ex.: solar panel use): 11 to 30 Volts

MECHANICAL

Size: 210 x 310 x 170 mm, including mounting kit

Weight: 2 kg including mounting kit

IP67 rating

Operating range: -20 to + 60 °C

NETWORK INTERFACES

10/100 Ethernet WAN (RJ45 PoE)

Integrated 3G Modem & Antenna (HSDPA, EDGE, GPRS) quad band

LS gateways:

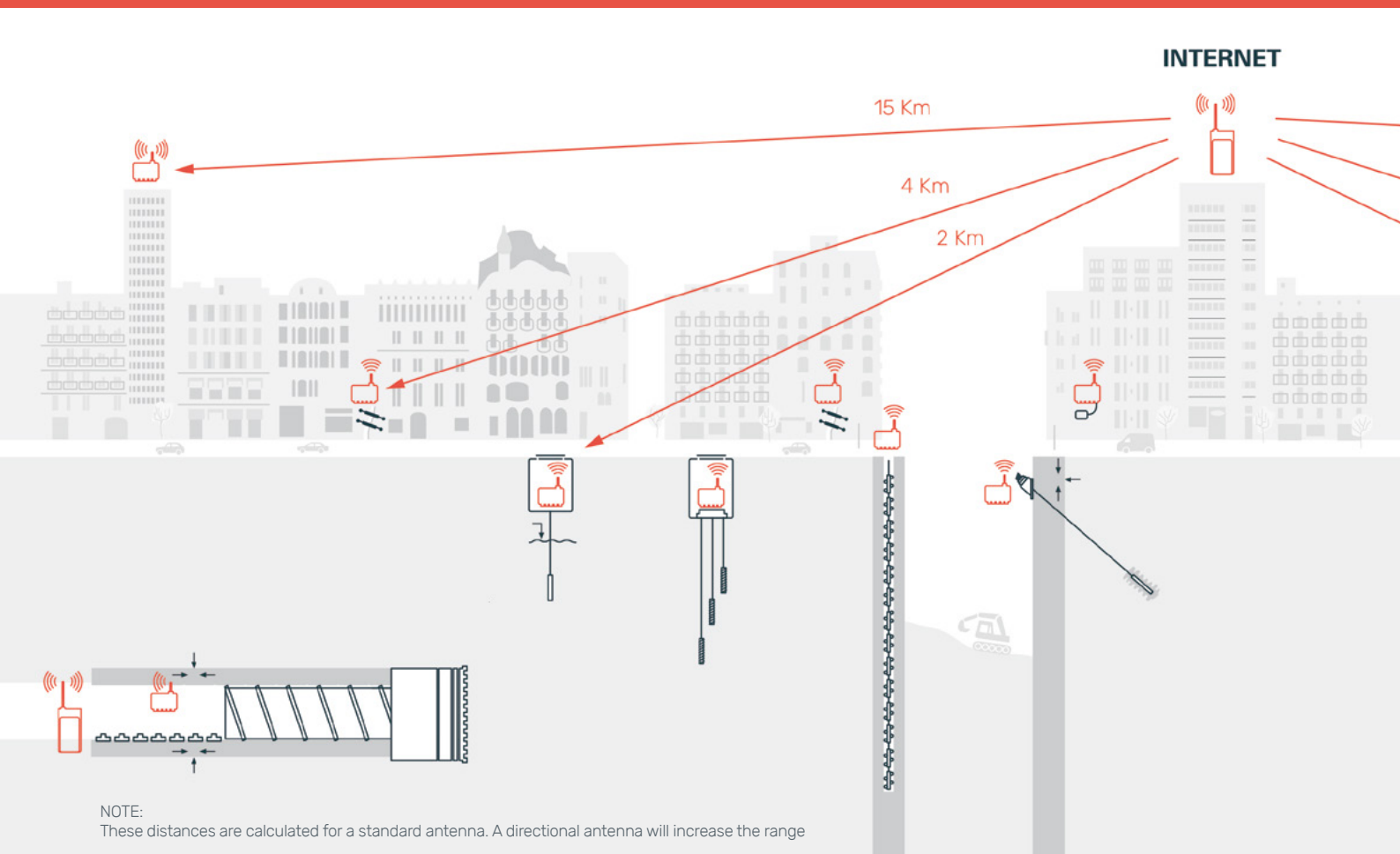
868 MHz ISM band

915 MHz FCC ISM band

915-928 MHz ISM band



HOW IT WORKS IN CITIES



RADIO & APPLICATIONS

LONG RANGE RADIO

OPEN FIELD:	15 km
CITY STREET:	4 km
MANHOLE IN A CITY STREET:	2 km
TUNNEL:	4 km

RADIO SPECS

ISM sub 1 GHz operating frequency bands adjustable to each territory requirements

No repeaters needed

High sensitivity: down to -137 dBm

Transmission: +14 dBm high efficiency / +20 dBm

Maximum link budget: 151 dB / 157 dB

Remote sampling rate change

Bidirectional communications capabilities



Wireless Tiltmeter

For long-range, remote readings in geotechnical monitoring

Measuring inclinations with tiltmeters is essential for the success of many projects: from controlling building response during a tunneling project, over analyzing settlements, to tracking changes in the inclination of structures such as bridge piers or historical monuments and dams, to monitoring landslides including berms in open pits.

The Loadsensing Tiltmeter is a low-power long-range wireless datalogger and inclinometer in a single, compact box. It measures tilt in two (biaxial) perpendicular axes in the plane of the base. It combines a highly precise MEMS sensor plus the radio transmission network by Loadsensing, Worldsensing's leading connected infrastructure solution. One gateway can support several nodes in the same network.

Its ability to provide accurate measures with long-range wireless communication and extended battery life sets this inclinometer apart from other comparable products in the market.

The tiltmeter can also be used as a standalone logger for manual monitoring and can be easily configured and connected with a USB cable and an Android phone.

APPLICATIONS

Remote tilt monitoring from retaining and building walls

Landslide monitoring

Bridge pier monitoring

Structural load monitoring

Ground subsidence

FEATURES

HARDWARE

Datalogging and tilt monitoring in a compact box

High accuracy and repeatability

Long battery life (> 5 years @ 1h sampling rate)

-40°C to 80°C (-40°F to 175°F) operating range

Reduced size (140 x 120 x 61 mm)

SOFTWARE

User-friendly Android configuration app at no extra cost

Web browser software

Standard CSV download, FTP push and API access

ADVANTAGES

Highly accurate and reliable biaxial tilt sensor

Long-range communications (up to 15km/9miles)

Low-power, long battery life (over 5 years)

Robust, small and weather proof box for harsh environments

Easy configuration



The wireless tiltmeter features a range of up to 15km/9miles and over 5 years battery life in line with the rest of Loadsensing datalogger family.



/ Specifications

SPECIFICATIONS		
GENERAL		
Battery life – sampling rate 5 min	> 1 years	Life time estimations based on a model considering Barcelona temperature profile
Battery life – sampling rate 1 h	> 5 years	
Battery life – sampling rate 6 h	> 8 years	
Battery type	2 x 3.6V C-Size (recommended Saft LSH 14)	
Sampling rate	30 seconds to 1 day	
Configuration software	Android App	
SENSOR		
Type	MEMS (Micro-Electro-Mechanical) Inclinator	
Range	± 15°	
Accuracy (± 5°)	0.03% FS / 0.004°	
Accuracy full range	0.17% FS / 0.025°	
Resolution	0.001°	
Repeatability	0.005°	
Axes	Two (biaxial)	
Temperature sensor resolution	0.1 °C	
Temperature sensor accuracy	±0.5 °C	
MEMORY		
Reading capacity	200,000 readings	
MECHANICAL		
Box dimensions (WxLxH)	100x100x61 mm	
Overall dimensions	150x120x61 mm (excluding antenna)	
Operating temperature	-40°C to 80°C (-40°F to 175°F)	
Weather protection	IP67	
External antenna	100 mm length (including connector)	
Box material	Aluminium alloy	
RADIO		
Range open sight	15km	
Range with obstacles	> 1km	
Maximum link budget	151 dB	
Configuration	Star (no repeaters needed)	



Regulatory Information Canada

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler l'autorisation de l'utilisateur d'utiliser l'équipement.

This device complies with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR de l'ISDE applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF exposure safety

This device is a radio transmitter and receiver.

It is designed not to exceed the emission limits for exposure to radio frequency (RF) energy set by the ISED.

The antenna must be installed and operated with minimum distance of 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le modèle est un émetteur et un récepteur radio.

Il est conçu pour ne pas dépasser les limites d'émission pour l'exposition à l'énergie radiofréquence (RF) établie par l'ISDE.

L'antenne doit être installée de façon à garder une distance minimale de 20 cm entre la source de rayonnements et votre corps.

L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

Permitted Antenna

This radio transmitter model, IC: 21260-LSG6INC15 has been approved by the ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Type	Max Gain
External antenna: Wellshow AR017 GSM Quad Band Antenna	+2 dBi

Le présent émetteur radio modèle, IC: 21260-LSG6VW1M a été approuvé par ISDE pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal.

Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Type	Max Gain
External antenna: Wellshow AR017 GSM Quad Band Antenna	+2 dBi

CAN ICES-3 (B)/NMB-3(B)

This Class B digital apparatus complies with Canadian ICES-003

Cet appareil numérique de classe B est conforme à la norme Canadienne ICES-003

Regulatory Information USA

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Class B device notice

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF exposure safety

This device is a radio transmitter and receiver.

It is designed not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission.

The antenna must be installed and operated with minimum distance of 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Permitted Antenna

This radio transmitter model, FCC ID: 24HN4-LS-G6-INC5 has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.





Type	Max Gain
External antenna: Wellshow AR017 GSM Quad Band Antenna	+2 dBi








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



Avertissements généraux





- Attention ! Risque d'explosion si la batterie est remplacée par un type de batterie inapproprié. Jetez les batteries usagées conformément aux instructions.
- Les batteries et le matériel conçus pour se connecter par l'intermédiaire du port de données doivent être en conformité avec le chapitre 2.5 de la Norme EN 60950-1.
- Cet équipement doit être installé dans des zones d'accès restreint.





Symboles

Symbole	Description
	Attention ! N'utilisez pas cet équipement avant d'avoir parfaitement compris les instructions et vérifié que toutes les conditions requises étaient réunies.
	Veuillez lire attentivement les instructions d'utilisation avant d'utiliser cet équipement.
	Attention ! Surface chaude.
	Les déchets doivent être collectés séparément.

Símbolos	
Símbolo	Descripción
	• Precavición. Riesgo de explosión en caso de sustitución de la batería por una de tipo incorrecto. Deshágase de las baterías usadas de acuerdo con las instrucciones.
	• Las baterías y los equipos destinados a conectarse mediante el puerto de datos deben cumplir con el capítulo 2.5 de la Norma EN 60950-1.
	• Equipo destinado a instalarse en zonas de acceso restringido.
	• Precavición. No continúe hasta que las instrucciones se hayan comprendido con claridad y se cumplan todas las condiciones requeridas.
	• Lea atentamente las Instrucciones de uso antes de utilizarlo.
	• Precavición, superficie caliente.
	• Los residuos deben ser recolectados en forma diferenciada.

General warnings	
<ul style="list-style-type: none"> Caution. Risk of explosion if the battery is replaced with an incorrect type. Dispose of used batteries according to the manufacturer's instructions. Batteries and equipment to be connected via the data port must comply with clause 2.5 of the EN 60950-1 standard. Equipment to be installed in restricted access areas. 	
Symbol	
Description	Caution. Do not proceed until the instructions are clearly understood and all required conditions are met.
	
	Read the instructions for use carefully before using.
	Caution, hot surface.
	
	Waste should be collected separately.
	

<p>Allgemeine Warnhinweise</p> <ul style="list-style-type: none"> Vorsicht! Explosionsgefahr, wenn die Batterie durch eine andere Batterie des falschen Typs ausgetauscht wird. Entsorgen Sie leere Batterien entsprechend den Anweisungen. Die Batterien und Betriebsmittel, die über den Datenanschluss verbunden werden, müssen die Bestimmungen aus Abschnitt 2.5 der Norm EN 60950-1 erfüllen. Betriebsmittel, die in zugangsbeschränkten Bereichen installiert werden. 	
Symbol	Beschreibung
	Vorsicht! Fahren Sie nicht fort, bevor Sie die Anweisungen vollständig verstanden haben und alle erforderlichen Voraussetzungen erfüllt sind.
	Lesen Sie vor der Benutzung aufmerksam die Gebrauchsanweisung.
	Vorsicht: Heiße Oberfläche!
	Die Abfallprodukte müssen getrennt entsorgt werden.





	Avfall skal innsamles separat.
	Forsiktig, varm overflate.
	Les bruksanvisningen nøye før bruk.
	Forsiktig. Gå ikke videre før du har forstått instruksjonene og alle obligatoriske krav er oppfylt.
Symbol	Beskrivelse





Symboler

- Utskyr som skal installeres i områder med begrenset overhøyde (klausul 2.5 i EN 60950-1-standarden).
- Batterier og utstyr som skal kobles til via dataporten må henhold til produsentens instruksjoner.
- Forsiktig. Fare for eksplosjon hvis batteriet trykkes ut med feil type batteri. Brukte batterier skal avhendes i

Generelle advarsler

ON

<p>PL</p>	<p>Opis</p>	<p>• Ostrzeżenie. Zagrożenie wybuchem w przypadku wmiary na baterię niewłaściwego typu. Zużytych baterii należy pozbywać się zgodnie z instrukcjami producenta.</p> <p>• Baterie i sprzęt podłączany za pośrednictwem portu danych muszą być zgodne z paragrafem 2.5 normy EN 60950-1.</p> <p>• Sprzęt przeznaczony do instalowania w miejscach o ograniczonym dostępie.</p>
<p>Symbol</p>	<p></p>	<p>Ostrzeżenie. Należy kontynuować bez dokładnego zapoznania się z instrukcjami! spełnienia wszystkich wymaganych warunków.</p>
<p>Symbol</p>	<p></p>	<p>Przed użyciem należy dokładnie przeczytać instrukcję użytkownika.</p>
<p>Symbol</p>	<p></p>	<p>Ostrzeżenie, gorąca powierzchnia.</p>
<p>Symbol</p>	<p></p>	<p>Opady należy wyrzucać do oddzielnych pojemników.</p>

<p>Avvertenze generali</p>	
<ul style="list-style-type: none"> • Attenzione: Rischio di esplosione in caso di sostituzione della batteria con una di tipo non conforme. Smaibare le batterie usate secondo le istruzioni. • Le batterie e i dispositivi progettati per il collegamento tramite la porta dati devono essere conformi alla sezione 2.5 della norma EN 60950-1. • Dispositivo destinato all'installazione in zone ad accesso limitato. 	<p>Simboli</p>
<p>Simbolo</p>	<p>Descrizione</p>
	<p>Attenzione: Non procedere finché non sono comprese chiaramente le istruzioni e non sono state soddisfatte tutte le condizioni richieste.</p>
	<p>Leggere attentamente le istruzioni per l'uso prima di utilizzare il dispositivo.</p>
	<p>Attenzione, superficie calda.</p>
	<p>I rifiuti devono essere raccolti in modo differenziato.</p>