User Guide

Version 4.8

July 2013

LOADSENSING. Trademark by WORLDSENSING
+34 934 180 585 · support@worldsensing.com · info@loadsensing.com · www.loadsensing.com

INDEX

1. ABOUT THIS DOCUMENT

This user guide is about the basic configuration procedure for data acquisition with the Loadsensing (LS) wireless system from Worldsensing (WS).

2. INITIAL STEPS

2.1.1. Equipment

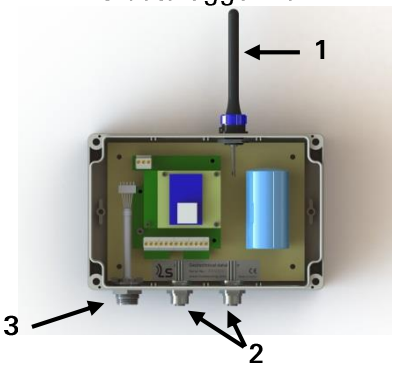
- LS datalogger (node/device) & accessories:
  - radio antenna
  - sensor connector (code 43-00102)

- LS gateway (GW) & accessories:
  - Ethernet lid (to secure IP protection)
  - 2.4GHz radio antenna
  - UMTS antenna (red base)
  - 2.4GHz WiFi antenna
  - power connector (code 43-00092)

NOT INCLUDED: power cable.
NOT INCLUDED: SIM card for GW UMTS connectivity.

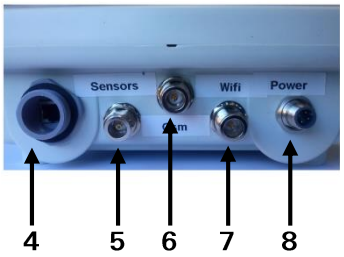
2.1.2. Interfaces

LS datalogger 2ch



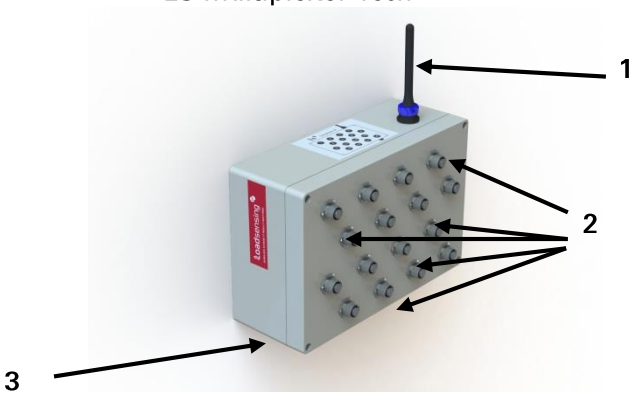
1. Datalogger radio antenna
2. Sensor connector
3. USB

LS gateway



4. Ethernet lid/connection
5. GW radio antenna (2.4GHz)
6. UMTS antenna (red base)
7. WiFi antenna (2.4GHz)
8. Power connector

LS multiplexer 16ch



1. Datalogger radio antenna
2. Sensor connector
3. USB

2.1.3. Connectors

2.1.3.1. Sensor connector

Manufacturer: CONEC
Manufacturer reference number: 43-00102
Web datasheet: http://www.conec.com/catalogs/c2/sal/catalog/product/view/id/2765

1. Each connector is supplied with mounting instructions. If these instructions are not followed the cable or the connector may be damaged, resulting in a faulty connection. WS is not liable for incorrect connector mounting.

2. The connector is supplied with two sealings, for the adjustment to different cable diameters.

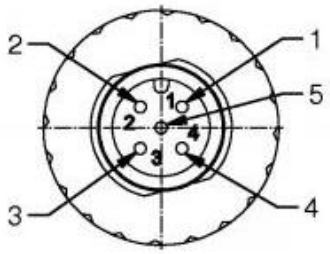
3. The cable to be connected must be stripped according to the instructions.

4. Cables must be connected in accordance to these tables:

- Instructions for load cell connections

Connector position 1	+ power (5V)
Connector position 2	- power (Ground)
Connector position 3	+ signal
Connector position 4	- signal
Connector position 5	mesh

- Instructions for vibrating wire connections



Connector position 1	vibrating wire
Connector position 2	vibrating wire
Connector position 3	thermistor
Connector position 4	thermistor
Connector position 5	mesh

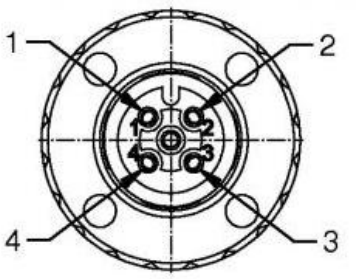
5. After each connector is mounted, WS recommends taking a sensor reading in order to ensure that the connector has been correctly installed. This reading should be compared with the reading of the sensor on installation, before connecting to the LS datalogger.

2.1.3.2. GW power connector

Manufacturer: CONEC
Manufacturer reference number: 43-00092
Web datasheet: http://www.conec.com/catalogs/c2/sal/catalog/product/view/id/2771

- Connection instructions

Connector position 1	phase
Connector position 2	earth
Connector position 3	neutral
Connector position 4	not connected



3. INSTALLATION

3.1. General

The maximum range at which nodes can communicate with each other and with the GW is 150m on LOS (line-of-sight). In NLOS (non-line-of-sight) conditions, this range may vary. In order to have an optimized communication within the LS network, all equipment should be installed as far as possible from metallic and concrete structures, and high voltage electricity lines.

3.2. Gateway (GW)

1. If possible, the GW should be located near the middle of the distribution of nodes, to reduce latency and node power.

2. GW must always be installed with connectors facing downwards in order to secure IP water protection. Wi-Fi and radio (sensors) antenna are both 2.4GHz, and are different from the UMTS antenna (which is shorter and with a red base).

3. Before plugging the GW in, open it and insert the SIM card to get 3G connectivity (not necessary if accessed locally, via Wi-Fi or Ethernet).

4. Plug the GW to the main power: 100-240V AC direct connection, or 12V by PoE (Power over Ethernet).

5. Wait 5 minutes for Wi-Fi or Ethernet, and 10 minutes (or more, depending on the network) for UMTS connectivity.

6. Check access to the GW using the LS software (page 8) before installing the nodes.

7. Reboot. If required, the GW can be rebooted through the software menu (page 12). If the GW is not connected to the Internet, it reboots automatically every 12 hours.

NOTE: Demo Kits are supplied with nodes already registered in the sensor network. If the GW and nodes are connected for the first time, it takes 30 minutes to get the nodes registered in the "sensor network" (page 11). Until this happens, the system sends an "error code 202".

3.3. Nodes

General deployment strategies

- Nodes should be installed at least 75cm above the ground.
- Time required to create a one-hop communication is at least 10 minutes.
- Draw circles of 50m radiuses around the GW to determine the number of nodes at each hop.
- Each device, including the GW, should be within the range of 3 other devices.
- The network should be no more than 8 hops. Deeper networks are possible and should work, but they are harder to model.
- Use as many one-hop nodes as possible. Consumption in any hop ring is inversely proportional to the number of nodes in that hop ring.

In general, when devices or paths are found not to behave like the others, it is necessary to determine whether the source of the problem is the location of the device, or the device itself.To check if the device is faulty it should be swapped with a known working device. If the faulty behavior follows the device, the device is not working well. If the faulty behavior stays at the location, the location is the problem, and should be fixed by moving the device if possible, or adding another device (repeater) nearby.

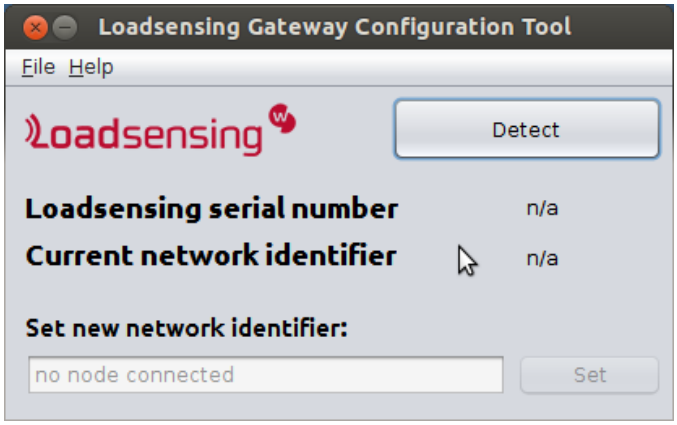
3.3.1. Loadsensing Gateway configuration tool

This tool is to be used when more than one gateway is deployed in an installation. This tool sets a network identifier to a node, in order to register this node to a specific gateway (according to the gateway's network identifier), or to change the node registration from one gateway to another.

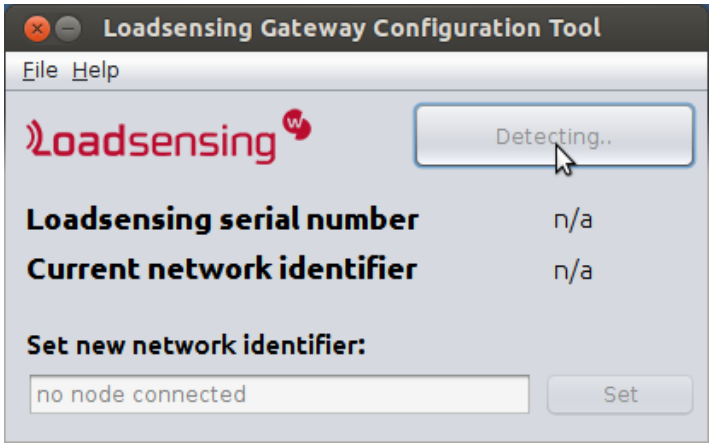
NOTE: when a node is changed from one gateway to another, this node will still appear in the "original" gateway, in order to be able to access to the historical data of the node in the original gateway.

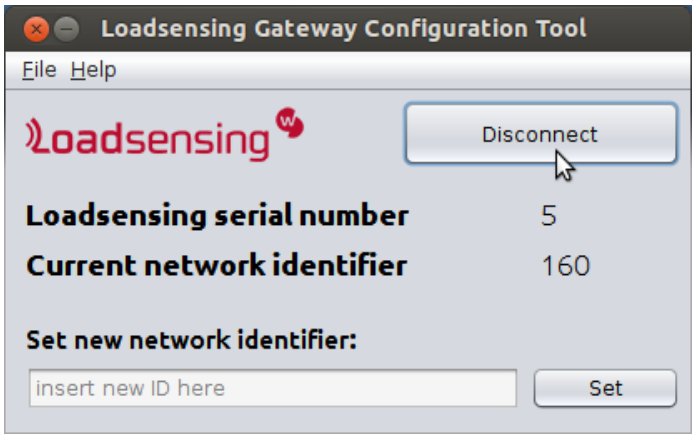
To set/change a network identifier to a node, please follow the next steps:

1. Connect your computer to the node via USB.
2. Download the software "Loadsensing Gateway Configuration Tool" from http://loadsensing.com/downloads/LS_CFG_USB.zip (in the "usb_driver" folder choose between x64 or x86 option, according to your computer).
3. Run the "Loadsensing Gateway Configuration Tool" software.

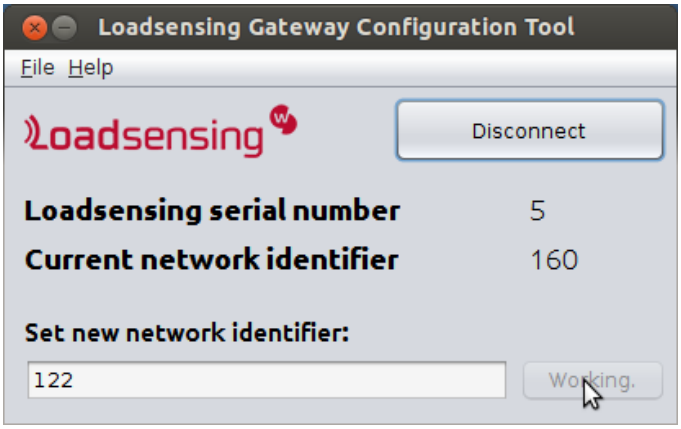


4. Click "Detect": the software will connect to the node and display the node information.

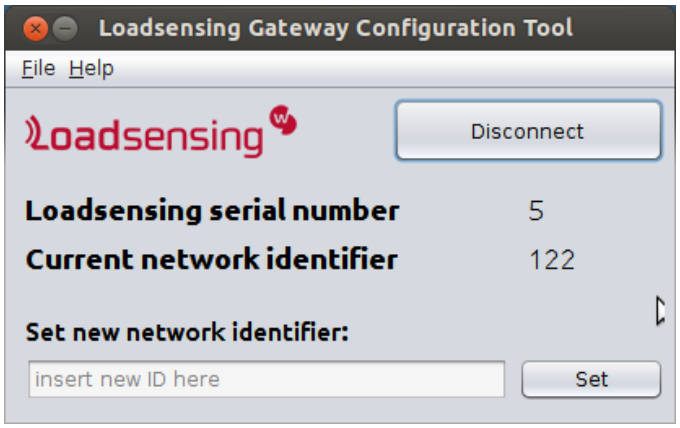




5. To set a new network identifier, enter the gateway identifier in the "Set new network identifier" field and click "Set'.



6. Now the network identifier is changed for the selected identifier.



7. To end the process, click "Disconnect" and the software will automatically disconnect from the node.
8. Repeat this process for each node you want to register to a new network identifier.

3.3.2. Install and check

1. Installation and test of “one-hop” nodes:
    a. Install all nodes that according to range should be able to communicate directly with the GW with one hop.
    b. Once these nodes are installed, wait 10 minutes until this “one-hop” network is created.
    c. Using the LS software, check that data from these nodes is received by the GW.
    d. If one node is not detected, the location of this node may be conflictive to direct communication with the GW. Install this node as a “second-hop” node.

2. Installation of “two-hop” nodes:
    a. Install all nodes that according to range should be able to communicate directly with the “one-hop” nodes.
    b. Once these nodes are installed, wait 10 minutes until this “two-hop” network is created.
    c. Using the LS software, check that data from these nodes is received by the GW.
    d. If one node is not detected, the location of this node may be conflictive to direct communication with any of the “first-hop” nodes. Install this node as a “three-hop” node.

3. Repeat this process for as many nodes/hops as required.

IMPORTANT: each node acts simultaneously as a datalogger and repeater.

3.4. Battery lifespan

The following table gives indicative battery lifespans for the single channel nodes. User should take into account that consumption varies depending on the sensor used, the sampling rate and the environmental conditions.

Sensor	Sampling rate		
	60 minutes	30 minutes	10 minutes
350Ω full bridge	*5.5 years*	*4.5 years*	*2.5 years*
Vibrating wire	*5 years*	*4 years*	*2 years*
20mA@24V	*5 years*	*4 years*	*2 years*

3.5. Scenarios

The following table gives indicative radio ranges between nodes for different scenarios. This radio ranges may vary depending on environmental conditions and scenario topology.

Scenario	Recommended distance (m)	Max distance (m)
1. Open field	260	305
2. City street	70	85
3. Industrial street	185	220
4a. Anchored retaining wall (node at 2m above ground)	90	110
4b. Anchored retaining wall (node on the ground)	45	55
5. Tunnel	190	220
6a. Manhole – plastic cover	30	35
6a. Manhole – metallic cover	13	16

1. Open field: free LoS, no buildings or any other structure. Nodes at 1.5m above ground, not attached to any structure.
2. Narrow street in the city: many buildings and other structures, cars. Nodes attached to the building on same side of the street.
3. Wide street in an industrial area: low buildings, few cars.
4. Nodes attached to the same anchored retaining wall. The range in this scenario can be improved if the nodes and gw are installed 30cm away from the wall.
5. The range depends on the curvature of the tunnel, which determines the LoS. The range between node and GW was as long as the LoS inside the tested tunnel (220m).
6. Nodes tih antenna inside a manhole. Nodes can be installed with external antenna to achieve longer ranges.

NOTE: all these can be significantly increase by using a directional antenna in the gateway. For example, 550m achieved in a tunnel without LoS.

4. DATA/network MANAGEMENT & CONFIGURATION

The following section provides information about Websensing, the free Loadsensing software for data/network management and configuration. Data can be downloaded in a CSV file (page 11) for management with other softwares.

4.1. Web browsers

Websensing is supported by the following web browsers:

- Chrome 22.0 or higher (recommended)
- Explorer 9.0 or higher
- Safari 5.1.7 or higher

4.2. Gateway Information Sheet (GIS)

Each gateway has an assigned GIS (provided by WS at notification of receipt of DK). The GIS includes specific access information about the user's GW:

- GW ID
- Password of the GW WiFi network
- Password of the direct connection to the GW
- Name of the remote access
- One or more user names/passwords for remote access

4.3. Access

The different access routes to the software are:

1. Direct connection. Through the GW's IP from the network connected to the Ethernet port:
   - User: *admin*
   - Password: web password (see GIS)

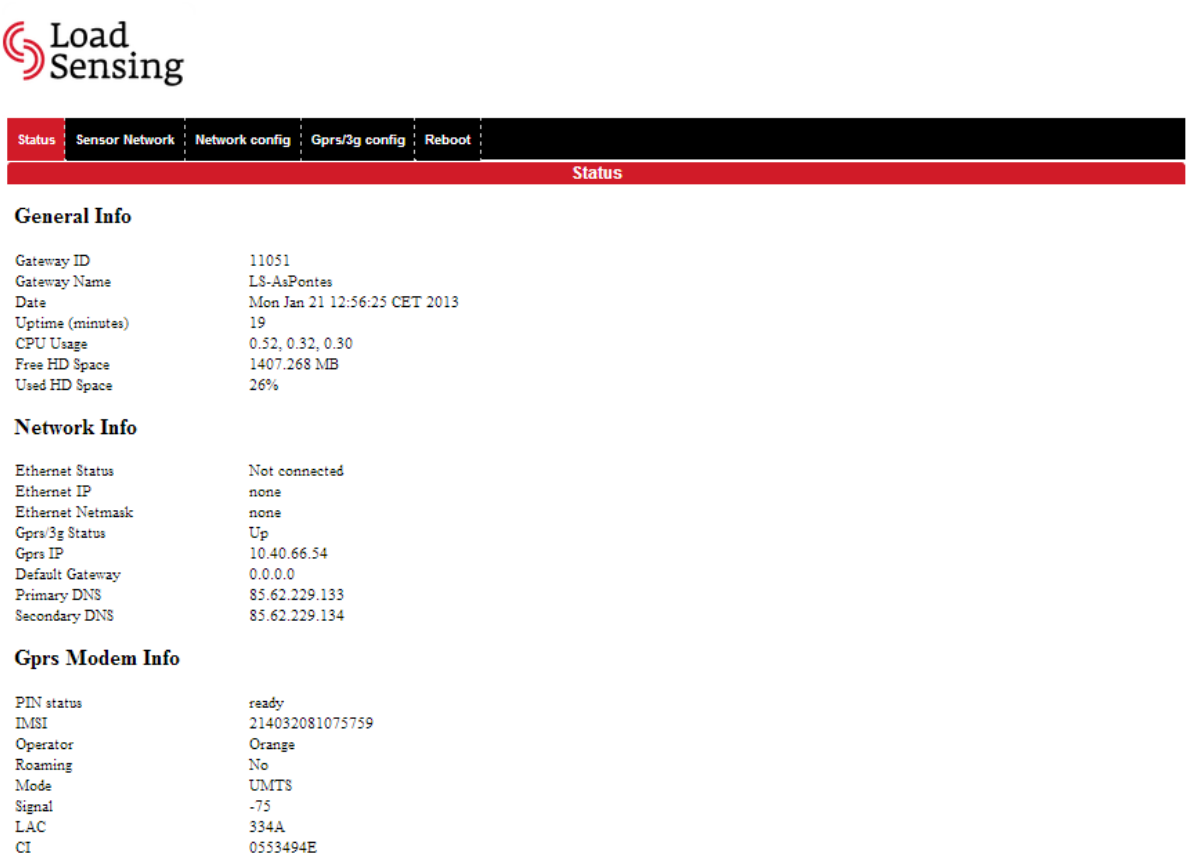
2. WiFi. Connection to the GW WiFi and IP:
   - The GW creates a WiFi network with the name "ws_gw_XXXXX" where XXXXX is gateway's ID (see GIS).
   - Password: WiFi password (see GIS).
   - Once connected to WiFi, type http://10.1.10.1 in the location bar of the browser.
   - User: *admin*
   - Password: WiFi WPA password (see GIS).

3. Remote access through Worldsensing's server:
   - Access from any computer connected to the Internet.
   - Type into the location bar of the web browser: "https://loadsensing.wocs3.com/<installation name>/" (see GIS).
   - User and Password: remote access (see GIS).

4.4. Configuration and data view

4.4.1. Status

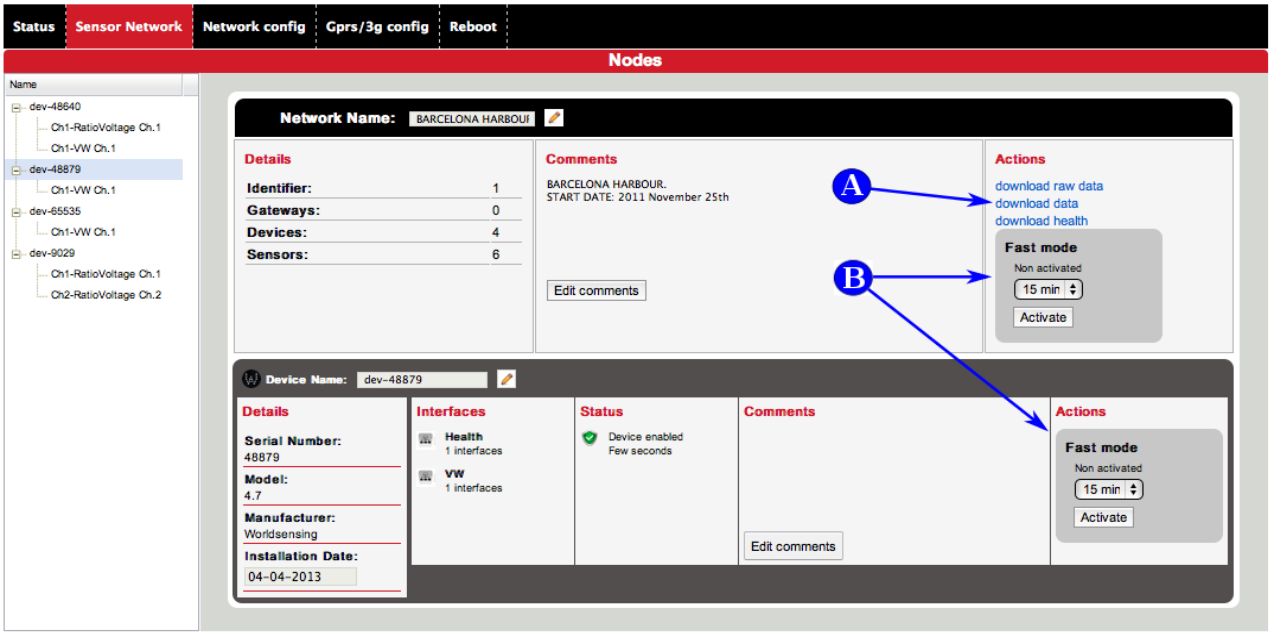
Information about gateway, network, and GPRS modem status.



4.4.2. Sensor network and data download

This screen displays the entire network: the devices (dataloggers) and all sensors connected to each node. On selecting a sensor, the node containing it is also shown.

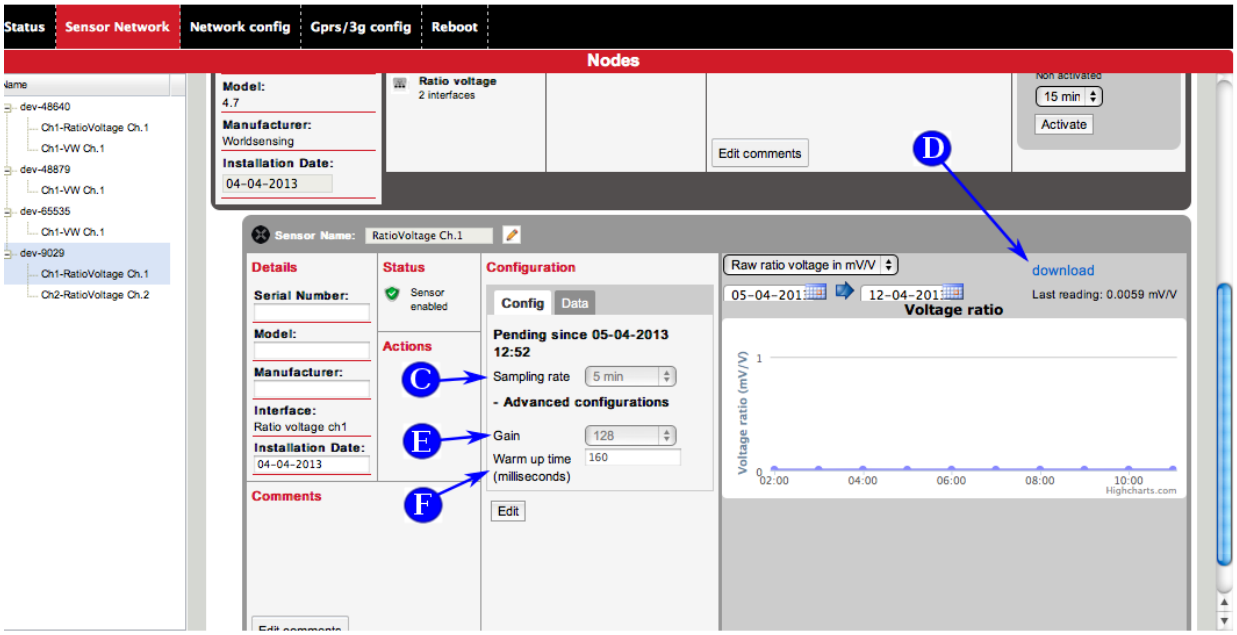
Network and Device level:



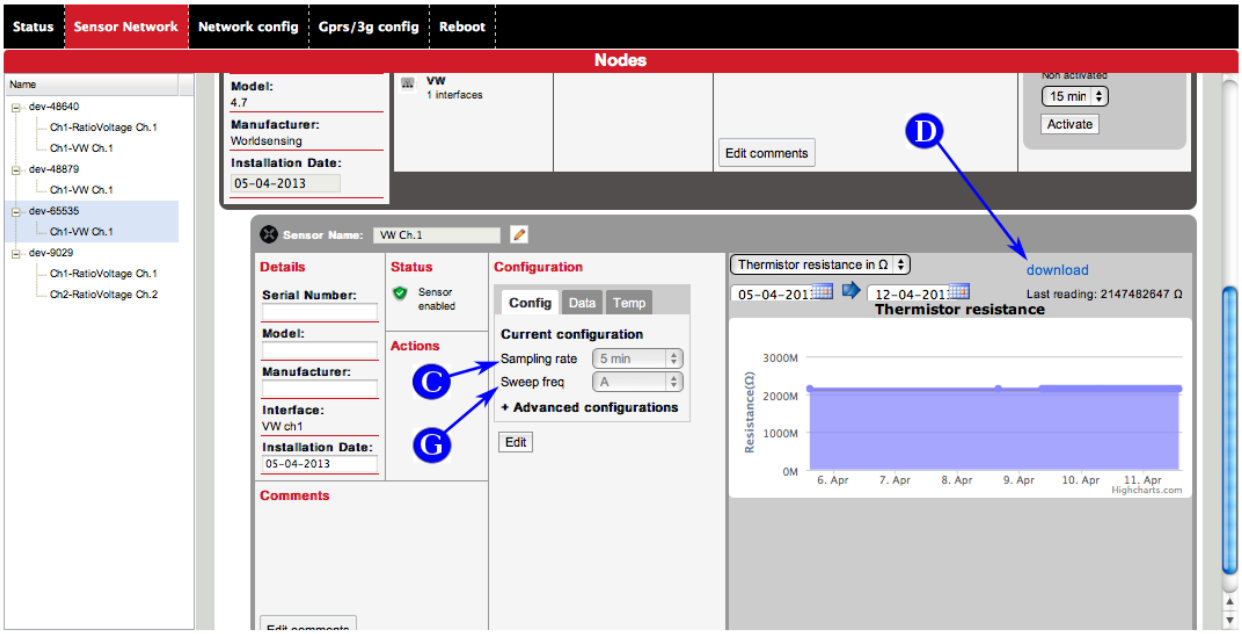
A- Data Download. Here you can download the data and health, as well as the raw data, for the entire network, in CSV format. Times are in UTC.

B- Fast Mode. Activate the Fast Mode: 5 seconds sampling rate for deployment/checking purposes, either for the entire network or just specific devices. Please bear in mind that the Fast Mode is very battery intensive.

Sensor level, Voltage Ratio:



Sensor level, Vibrating Wire:



A- Sampling Rate. Set the sampling rate of the sensor. The value range is from 5min to 24h.

B- Data Download. Download the sensor data for the selected timeframe in CSV format. Times are in UTC. Graphics: data visualization for the selected period. Data is shown summarized giving the highest value per hour, except for the last two hours where all data is shown. To zoom into a part of the graphic, just select it with the cursor. The graphic shows data in the local time of the web browser; important: the times in the CSV file of the downloaded data are in UTC.

A- Gain. Set a gain factor if required. The value range is from 1 to 128.

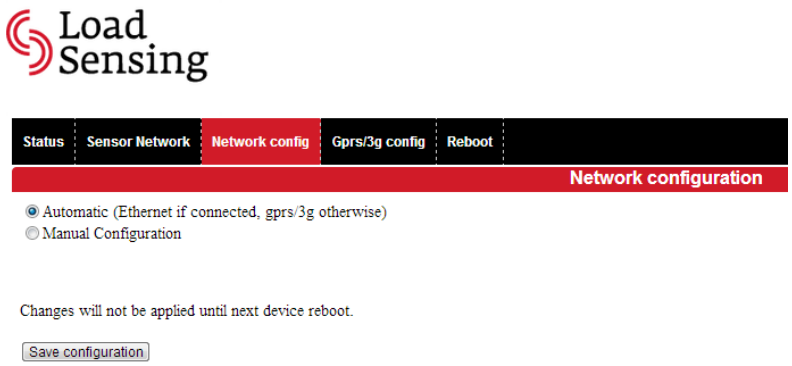
B- Warm-up Time. Set the warm-up time for the sensor.

C- Sweep Frequency. Set the sweep frequency, with one of the following values:

	Starting Frequency (Hz)	Ending Frequency (Hz)
Sweep A	450	1125
Sweep B	800	2000
Sweep C	1400	3500
Sweep D	2300	6000

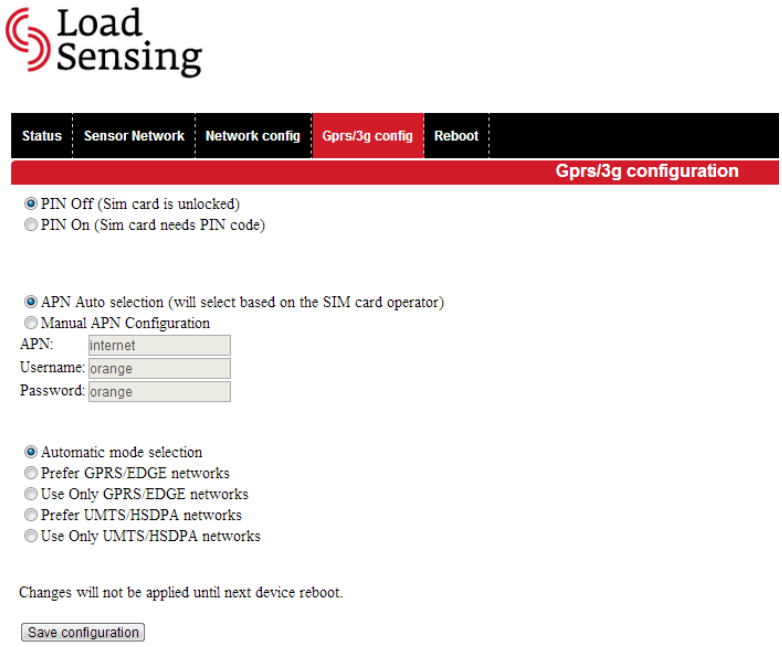
4.5. Network configuration

Configuration of the network (automatic by Ethernet/GPRS, unless indicated). The changes will be applied after a GW reboot.



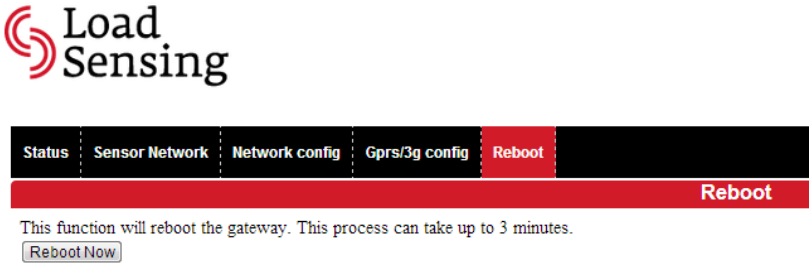
4.6. GPRS/3G configuration

Access/configuration to the GPRS/3G network (automatic detection of SIM card without PIN). The changes will be applied after a GW reboot.



4.7. Reboot

Gateway reboot. If the GW is not connected to Internet, it reboots automatically every 12 hours.



5. MAINTENANCE

Proper maintenance of Loadsensing components is essential to obtain accurate data. Equipment must be in good operating condition, which requires a program of regular inspection and maintenance. The person in charge of the logging system can accomplish routine and simple maintenance. More difficult maintenance such as datalogger calibration, datalogger performance testing, and datalogger component replacement, generally requires a skilled technician, or that the instrument is send to Worldsensing SL.

A station log should be maintained for each monitoring site that includes serial numbers, dates of site inspections, and maintenance that was performed.

These guidelines apply to most Loadsensing logger unit's deployment. Deployment site selection can also affect the accuracy of the data. They should be located at stable places, above 60cm from the ground and if possible protected from harsh weather conditions and direct sunlight exposition.

5.1. General Maintenance

- Check sensor leads and cables for cracking, deterioration, proper routing, and strain relief. Replace sensor cables if required.
- Check that the box junction and cable gland are dry and completely tightened. Check that the screws are correctly locked and the enclosure lid in perfect conditions.
- An occasional cleaning of the glass on the solar panel on the GW will improve its efficiency, if applicable.
- Check battery life periodically. Replace when less than 20% remaining.
- Check node coverage. An indicator of the last package received might be found in the GW.

5.2. Periodical maintenance

1 Month

1. Monitor data values collected by the units periodically. Abnormal or out of range sensor values may indicate problems with the unit.
2. Monthly visual inspection of the station to observe any apparent problems.
3. Do a visual inspection of the sensors and boxes position.
4. Check node coverage. An indicator of the last package received might be found in the GW or software client.

6 Months

1. Inspect the enclosure seal.

12 Months

1. An occasional cleaning of the glass on the solar panel of the GW will improve its efficiency, if applicable.
2. Check battery life periodically. Replace when less than 20% remaining.

2-3 years

1. Battery replacement. The lifetime of the battery depends on the use of each node, number of channels, sensors, etc.

5.3. Return material authorization

Products may not be returned to WS without prior authorization. To obtain a Return Material Authorization (RMA), please contact WS technical support. After an engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. The following contact information is for international customers residing in countries served by Worldsensing S.L. directly. Worldsensing's shipping address is:

WORLDSENSING, S.L.
Aragó 383
08013 Barcelona
(Spain)

RMA#_____

NOTE: Worldsensing reserves the right to refuse service on products that:

- were exposed to contaminants that may cause health or safety risks.
- were opened or manipulated without WS written authorization.
- were used for purposes other than instrumentation readings.

6. FAQs

6.1. Powering the Gateway

1. Can the normal LAN cable be used between PoE port 240V adapter and the Gateway Power Connector?

The PoE implemented by our gateway is a passive PoE schema, it is NOT 802.3AF compliant. It works by connecting 12V power to the unused pairs of the Ethernet connector.

12V+ needs to be supplied to pins 4 and 5 of the ethernet connector (blue and blue-white wires, according to T-568a/b)

12V GND needs to be supplied to pins 7 and 8 of the ethernet connector (brown and brown-white wires, according to T-568a/b)

Pins 1,2,3 and 6 are used for the ethernet connection, and can be left unconnected if you are only using the connector to supply power.

This is exactly what the supplied PoE adapter does. It supplies 12V to the corresponding wires, and bridges the ethernet ones to the LAN connector.

Therefore, any 8-cable ethernet cable with RJ-45 connectors on both ends can be used to connect the Gateway to the PoE adapter. If the gateway is to be placed outdoors, remember to mount the weatherproof seal as well.

2. Can DC Jack be used for supplying 12 v CD?

If it is preferred to supply power directly in the gateway box, it is also possible to do so. Power needs to be supplied to both boards, just like the original power supply does.

6.2. Data

1. How can the time stamping be configured as local time?

The data and times are registered in UTC. If you connect with the gateway through the web, you will see in the charts the local time (according to your computer time) but if you download the .csv file, you will see the UTC time.

2. If GPRS option is chosen for downloading, how can the data be transported back to a dedicated FTP server?

Other alternatives are being developed for downloading the data. Up to now, it can only be downloaded through the web or alternatively HTTP calls can also be used.

Attached you will find a document with the specific API calls.

6.3. Instrument Type

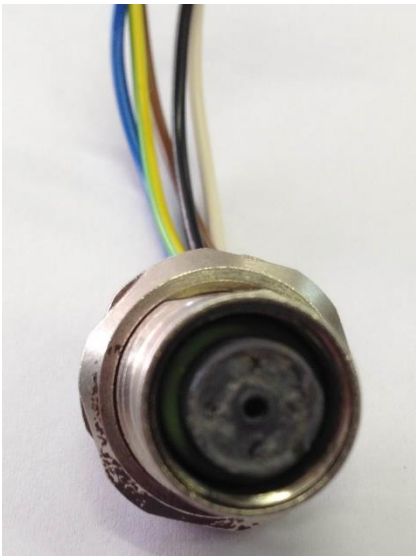
1. Can the nodes only be used for Vibrating Wired Instruments with thermistor?

WOS have nodes suitable for reading FSG sensors, VW sensors, potentiometers, voltage output sensors (like MEMS inclinometers) and also we could read pulses and some digital sensors (SDI-12 output).

6.4. Sensors connection

1. When trying to connect a sensor to a cannel with the wrong connector. What could happen?

Sensor connector 1



Node connector 1

All the pins of the sensor connector will be smashed as well as the slot of the node connector.

Replace the connectors:

- Sensor connector 1: CONEC Male connector M12x1,field attachable, axial, screw connection ref: 43-00102
- Node connector 1: Conec-TC 5 poles female cir with Cable(80mm) + pin ref: WORLD006

7. ABBREVIATIONS

The abbreviations used in this guide include:

CP	Commercial product
GIS	Gateway information sheet
GW	Gateway
LS	Loadsensing
RMA	Return material authorization
WS	Worldsensing

8. CONTACT WS

Phone: +34 93 418 05 85 (08.30h - 16.30h UTC) 

Technical support: support@worldsensing.com 

General information: info@worldsensing.com 

Worldsensing sl
Aragó 383
08013 Barcelona
(Spain)