

WiSenMeshWAN® 4-Channel Wheatstone Bridge Interface Node User Manual

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Wuxi Wisen Innovation Co., Ltd.

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Revision History and Clarification

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Document Definition:

It defines the specifications (i.e., introduction, technical features, deployment and maintenance methods) of the WiSenMeshWAN® 4-Channel Wheatstone Bridge Interface Node, which is one of the key components in WiSenMeshWAN® Low Power, Intelligent, Wireless Sensor Network (WSN) system. It is responsible to:

- Sample data from up to 4 strain gauges in Wheatstone bridge arrangement (4 or 6 wires);
- Form a time-synchronised Wireless Sensor Network with other nodes in the system;
- Transmit the data packet to a gateway.

Scope:

Customer Site Project Managers and Engineers, Wisen Service Engineers, etc.

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1. Product Introduction



The WiSenMeshWAN® 4-Channel Wheatstone Bridge Interface Node is one of the key products in our patented WiSenMeshWAN® geotechnical safety monitoring system. Working together with the WiSenMeshWAN® gateway product and external strain gauge sensors, it intelligently delivers real-time strain, load, or pressure data from up to 4 channels to the information centre.

The WiSenMeshWAN® 4-Channel Wheatstone Bridge Interface Node operates using our core technology, i.e., the WiSenMeshWAN® Low Power, Intelligent, Wireless Sensor Network protocol, together with its internal high precision analogue sample module and power unit. This product satisfies the three fundamental identities of the system:

- A. Network Life Span: to maximise battery life across the mesh network as a whole;
- B. Network Data Arrival Rate: to minimise data packet loss;
- C. Single Node Environmental Coverage: to maximise radio coverage.

Our product has IP68 and is designed to work in a tough environment. It is small in size, reliable in performance, easy for maintenance, has high precision during sampling, and has strong immunity to radio-interference. The node supports 4-wire or 6-wire Wheatstone bridge sensors.



Figure 1. 4-Channel Wheatstone Bridge Interface Node – Overview.

2. System Structure Layout

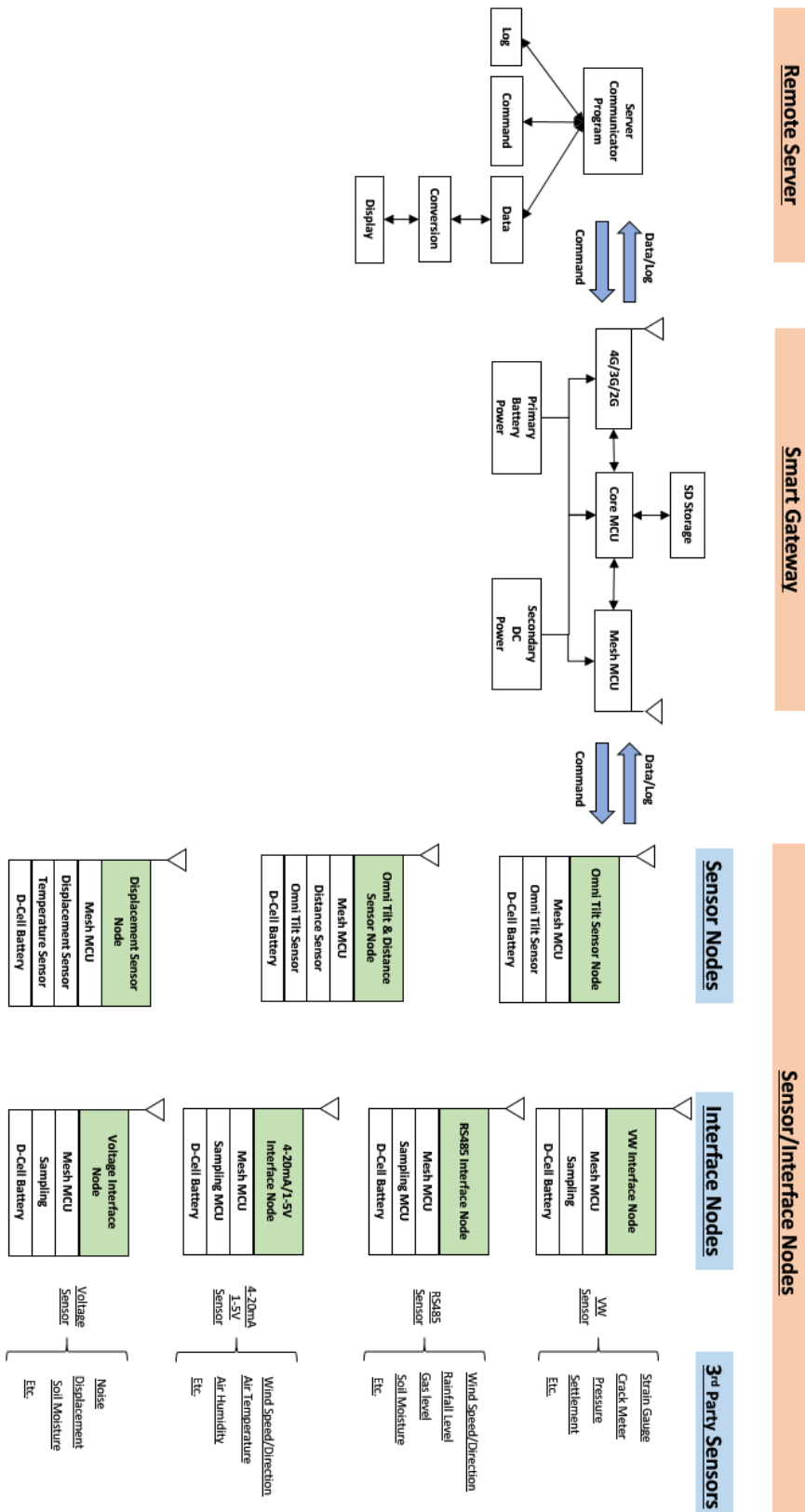


Figure 2. System Structure Layout.

3. Node & Radio Features

Node Features:

Basics	
Battery Power	Qty. x 4 (3.6V Lithium primary D-Cell ER34615)
Mesh Stop Voltage	2.1VDC
Battery Connection	Standard Aluminium Battery Holder
Local Storage	Min. 1500 Messages at Mesh3.0 Protocol
Dimension (L x W x H)	180 x 140 x 60mm
Node Weight	1.45kg
Cable Gland	Qty. 4 x EMC-CMA14 for external sensor connections (through cable diameter, 4-8mm)
Wire Connection	Spring type wiring terminal
Primary Sensor	
Sensor Type	Strain gauges in Wheatstone Bridge, 4 or 6 wires
No. of Inputs	4 Channel
Excitation Voltage	10.0V (Default Setting), 5.0V or 2.5V via rotary switch (per channel)
Excitation Current	Max. 100 mA per channel
Range	± 4.8 mV/V @ 10.0V; ± 9.5 mV/V @ 5.0V; ± 19.0 mV/V @ 2.5V
Accuracy	Better than 0.02%FS
Sensitivity	0.1 μ V/V
Standard System Parameter	
Temperature	Range: -40 to 125°C; Accuracy: $\pm 0.1^\circ\text{C}$
Humidity	Range: 0-100%RH; Accuracy: $\pm 1.5\%$ RH
Voltage	Accuracy: $\pm 0.1\text{V}$

Basics	
WSN Interface	
Mesh Wireless Interface	WiSenMeshWAN® / WiSenMeshNET® Protocol Mesh 3.0 ONLY
Industrial Standard	
Casing & Painting Materials	Aluminium-Alloy Die Castings 12 (Epoxy Polyester Powder Coating)
IP Rating	≥ IP68
Operating Temperature	-40 to 85°C
Fire Proof	Approved

Radio Features:

	FCC 915MHz System	CE 868MHz System
Radio Band	902-928MHz	865-868MHz
Central Frequency (Default)	905 /910/915/920/925/922/923MHz	865.75/866.25/866.75/ 867.25 MHz
Default Transmit Power	12dBm	14dBm
Transmit Power Range	5-12dBm	
Receive Sensitivity	-112dBm	
Bandwidth	500kHz	
Transmission Speed	19.2kb/s	
No. of Mesh Hop* Supported	6 Hops	
Sampling Interval	1-60mins	

* E.g., the radio link from a gateway to the 1st layer node is called the 1st hop.

4. Terminologies

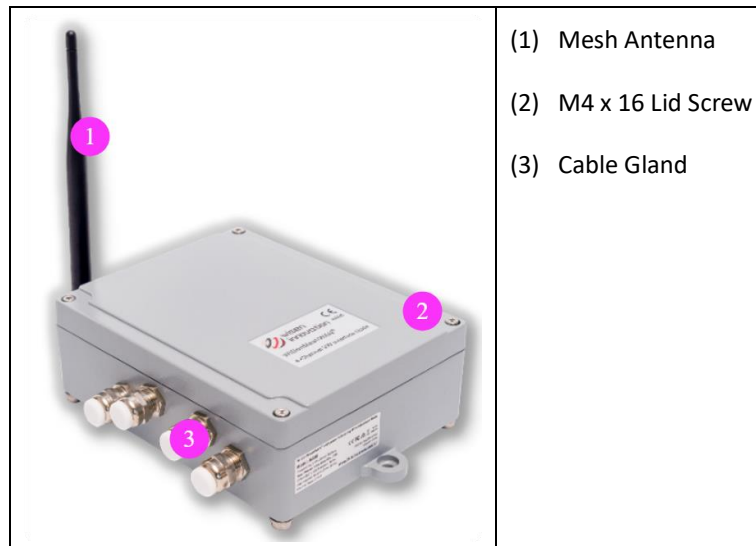


Figure 3. 4-Channel Wheatstone Bridge Interface Node Terminologies.

5. Operation Procedures



5.1. System Deployment Notifications

- 1) Location: The deployment location of a Wheatstone Bridge Interface Node is usually determined by the required monitoring or inspection location;
- 2) All the Serial Numbers of a Unit must be recorded against their site references;
- 3) Before any node is switched on, two tasks will need to be carried out:
 - A. The Wheatstone Bridge sensors chosen by the customer must be connected to the node;
 - B. The connections between a customer chosen sensor and the node must strictly follow the rules stated in this document;
 - C. A gateway must be deployed, powered on and proven to be working properly. Otherwise, the nodes will need to be switched off, then switched on again after a gateway is switched on. So simply speaking, the rules to follow to correctly deploy a WiSenMeshWAN® system are:

Gateway first, then nearby nodes, then further nodes.

- 4) During deployment, the Serial Number (SN) of a node and the orientation of the sensors deployed against their

site references must be recorded;

- 5) All the node should have its antenna point upwards.

5.2. Deployment Procedures

- 1) Open the box: Take the node out of the package and open its lid;
- 2) Insert Battery: By default, a node does not contain batteries. Therefore the Qty. 4 x D-Cell batteries need to be inserted. Notice : +ve and –ve orientation must be correct, otherwise, the internal circuit may be damaged.
- 3) Antenna Installation: screw the antenna tightly onto the node;
- 4) Sensor Connection at each channel:
 - A. For 4-wire sensor: use terminals Exc+, Exc-, Sigl+, Sigl-;
 - B. For 6-wire sensor: use terminals Sens+, Sens-, Exc+, Exc-, Sigl+, Sigl-;
 - C. Shield connection required if external noise is large.
- 5) Set Excitation Voltage via rotary switch (10V default).
- 6) Sensor connections to Node:
 - A. Untighten the cable gland cover, insert the cable through the cable gland, then connect the wires to the corresponding spring terminals according to the table below.
 - B. Once the wires are connected, please tighten the cable gland cover firmly to ensure its IP rating on that channel.

Notice  1: The cable gland diameter of the Wheatstone Bridge Interface Node is 4-8mm.

Notice  2: All required wires must be connected to minimise electrical interference and possible loss of precision.

Notice  3: Within any electrically noisy environment, nodes with sensors must be $\geq 0.3\text{m}$ away from the source of the noise.

- 7) Power On: once the external sensor is connected, turn the switch on. You should see 3 LEDs flashing 3 times, which means the node is on. Then switch off the node to save power if the gateway is off;
- 8) Tighten the 4 Cap-Hex-Head screws of the lid to secure the enclosure IP rating;
- 9) To validate the sensor data, please visit Wisen Visualisation Platform for further details.

5.3. Mounting Options

The Wheatstone Bridge Interface Node can be deployed with various methods. However, the principle is to make sure it is firmly attached to the installation surface.

6. General Maintenance and Notification



- 1) Once the Wheatstone Bridge Interface Node is installed in the field, please minimise any man-made disturbance so that data quality can be maintained;
- 2) Radio communication will be impaired if the antenna is covered by metal or very moist soil material;
- 3) Due to the discharge characteristics of the recommended battery, a battery replacement should be carried out when a node reported voltage reaches 2.7V, at which point you have approximately 3 weeks to change the battery;
- 4) Our product will use all the possible capacity in a battery down to its stop (minimum) voltage, which has been specified in the Features table. When this occurs, our WiSenMeshWAN® protocol will send you a warning, then it will enter a deep sleep mode until a new battery is installed;
- 5) If the data from nodes are showing unexpected results or are not being sent back to the Wisen gateway, then please carry out investigation using the following two stage procedure:
 - A. Remote Inspection of historical data, to identify the following:
 - a) Whether the heart-beat message has been sent back successfully at each time interval;
 - b) Whether the battery voltage is too low, if yes, please change the battery unit;
 - c) Whether the signal strength has become significantly weaker than before. If yes, please check the antenna has been screwed on firmly.
 - B. On-site Inspection: If all the above are good, please arrange an on-site inspection to check:
 - a) Whether a Node has visible external damage;
 - b) Check the box lid to see if it is firmly tightened;
 - c) Whether the antenna is bent or damaged and that the node is not blocked by new construction, e.g., hoardings;
 - d) When possible, check that the signal strength is normal by using a spectrum analyser;
 - e) Open the lid, to see whether the battery is firmly attached to its holder;
 - f) Use a multi-meter to measure the battery voltage. If it is below the stop (minimum) voltage, replace the battery.
 - g) Make sure the 4 or 6 wires are connected properly. If necessary, please disconnect the wires to inspect.

Notices :

- i. Case One: If any change has been made from the list above, please inspect the data at the remote server;

- ii. Case Two: If all the actions from the list above have not cured the problem, please contact Wisen. We will be happy to help.

7. Package and Accessories



Standard:

No.	Items	Dimension (mm)	Qty.
1	WiSenMeshWAN® 4-Channel Wheatstone Bridge Interface Node	180x140x60	1
2	Mesh Antenna	200	1
3	Cap-Hex-Head Screw	M6x14	4
4	User Manual*	Downloadable from Wisen Visualisation Platform.	
5	Inspection Report*		

8. Safety and Warning



Warning: Please read the following instructions carefully.

1) Operation Safety

- Before taking any action, please read all the information provided carefully, and keep the guidance documents safe;
- Ensure that any procedures and installations are correctly carried out. The communication cable and the case must be grounded;
- This product has been designed to meet a certain water-proof level. However, it becomes water vulnerable when the lid is open or if the cable gland has not been sealed properly.

2) Electric Safety

- To install the battery into a holder, please follow the “+” (positive) and “-” (negative) signs in any Wisen product.

Wrong orientation of a battery could potentially cause unit damage.

Notice : The orientation of battery can vary among products;

- When disconnecting the battery, please take special care not to apply excessive force, otherwise the battery holder and the nearby circuitry may be damaged.

3) Warning

- The battery in the product has a relatively high capacity, so please take special care during storage and usage;
- This product must not be disassembled under any circumstances, to do so will void the warranty and may leave the product in a dangerous state;
- If all the above are not followed, the manufacturer cannot be responsible for any damage and injury caused to the users.

4) Caution

- Danger of explosion if battery is incorrectly replaced. Replace only with the type recommended by the manufacturer;
- When disposing of the batteries, please contact your local authorities or dealer and ask for the correct method of disposal.

9. Contact

- Wuxi Wisen Innovation Co., Ltd.: www.wisencn.com
- Email: support@wisencn.com

FCC Warning

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.

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

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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

End of User Manual
