ENCARDIO RITE
METASENSING FOR MEGA STRUCTURES

USERS MANUAL

NEXAWAVE VIBRALINK

(Solo/Quint/Hex/Deca)

Model EWN-01V VibraLink Solo
Model EWN-10V VibraLink Deca
Model EWN-06V VibraLink Hex
Model EWN-05V VibraLink Quint

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TUNNELS | HYDROELECTRIC | CONSTRUCTION | STRUCTURAL | METRO & RAIL | BRIDGES | MINING

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1 INTRODUCTION

1.1 NexaWave VibraLink overview

NexaWave vibraLink series of wireless vibrating wire nodes are designed to expand the data collection possibilities from vibrating wire geotechnical sensors via a wireless RF LoRa network, eliminating the need for running lengthy cables. It is a reliable integrated system capable of exciting and sampling vibrating wire sensors and reporting measurements through a wireless communications network to the Gateway.

One of the significant advantages of vibrating wire wireless nodes is their ability to provide accurate and reliable measurements in remote or inaccessible locations. By eliminating the need for physical wiring connections, these nodes can be deployed in challenging environments where traditional wired sensors would be impractical or impossible to install. With their wireless connectivity, these nodes offer convenience, scalability, and cost-effectiveness, empowering industries to gather real-time critical data and make informed decisions based on accurate measurements.

1.2 Wireless network

Wireless sensors are vital in monitoring construction sites, large structures, and landslide areas. They are extensively used in applications where geotechnical and other sensors are used for data collection and transfer to a central server for access by multiple users. Encardio Rite offers an innovative network solution that allows real-time monitoring of wireless vibrating wire sensors and other geotechnical and structural sensors in challenging conditions with reliable data transfer without any delay.

In an end-to-end wireless monitoring system from Encardio-rite, the vibrating wire nodes are interfaced with the long-range, low-power radio frequency network to Gateway. The vibrating wire nodes send recorded data to the Gateway through the RF network with utmost reliability. The Gateway then uploads the collected data from nodes to the central/cloud server.

The system operates on ISM sub 1 GHz operating frequency bands adjustable to the requirement of each territory. The system can be adjusted to different frequency bands; for example:

India	865 – 867 MHz
Europe	868 MHz
USA	903- 927 MHz

A detailed reference for frequency bands allowed in different Countries is available at:

https://www.thethingsnetwork.org/docs/lorawan/frequencies-by-country.html

The Gateway also has a provision to set the frequency band, depending on the Country.

1.3 Conventions used in this manual

WARNING! Warning messages call attention to a procedure or practice that could cause personal injury if not correctly followed.

CAUTION: Caution messages call attention to a procedure or practice, which, if not correctly followed, may result in data loss or equipment damage.

NOTE: Note contains essential information from the regular text to draw the user's attention.

1.4 How to use this manual

This users' manual is intended to provide sufficient information for optimum use of vibrating wire nodes in your applications.

To make the manual more useful, we invite valuable comments and suggestions regarding any additions or enhancements. We also request you, please let us know of any errors that are found while going through the manual.

NOTE: Installation personnel must have a background of good installation practices and knowledge of fundamentals of geotechnics. Novices may find it very difficult to carry on installation work. The intricacies involved in installation are such that even if a single essential but minor requirement is ignored or overlooked, the most reliable instruments will be rendered useless.

A lot of effort has been made in preparing this instruction manual. However, best instruction manuals cannot provide for every condition in a field that may affect the sensor's performance. Also, blindly following the instruction manual will not guarantee success. Sometimes, depending upon field conditions, installation personnel will have to consciously depart from written text and use their knowledge and common sense to find solution to a particular problem.

NOTE: The sensor is normally used to monitor site conditions and will record even a minor change that may affect behaviour of structure being monitored. Some of these factors amongst others, are, seasonal weather changes, temperature, rain, barometric pressure, nearby landslides, earthquakes, traffic, construction activity around site including blasting, tides near sea coasts, fill levels, excavation, sequence of construction and changes in personnel etc. These factors must always be observed and recorded as they help in correlating data later on and also may give an early warning of potential danger or problems.

2 GENERAL DESCRIPTION

2.1 NexaWave VibraLink

NexaWave VibraLink VW nodes consist of a compact, self-contained unit equipped with a sensor module that excites the vibrating wire sensor and reads the resonance frequencies. The unit also includes a radio transceiver with an antenna, a processor that controls both modules and a power source.

The VW node collects and transmits the sensor data wirelessly to the Gateway. The unit is housed in a compact, weatherproof enclosure, ensuring durability in various environmental conditions. Data transmission occurs through the long-range (LoRa), low-power radio frequency network, ensuring no signal degradation.

The NexaWave VibraLink series is available in the following variants, each with an inbuilt thermistor:

VibraLink Solo: 1 channel

VibraLink Quint: 5 channels

VibraLink Hex: 6 channels

VibraLink Deca: 10 channels

The NexaWave VibraLink series has also introduced the **VibraLink Hex**, specially designed for tunnel segments, accommodating up to six sensors in a monitoring array.

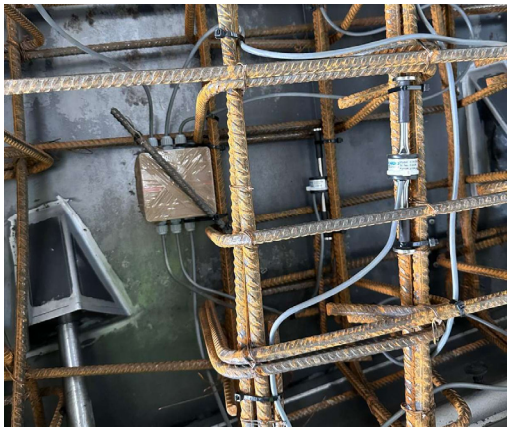

Figure 2-1 VibraLink Hex installed in tunnel segment monitoring array

The complete range of vibrating wire sensors that can be connected to a wireless Node includes:

- Piezometers and water level sensors
- Strain gauges
- Pressure cells
- Temperature meters
- Displacement sensors, extensometers, crack meters, joint meters
- Settlement monitoring sensors

Depending on site requirements, the nodes can be configured to scan and transmit data at intervals ranging from 2 minutes to 2 hours. The system automatically mitigates common wireless issues such as signal blockages and interference, ensuring reliable data transmission to the Gateway. Each radio transmission within the system is secured using AES-128 encryption, maximizing the security of the sensor data gathered.

2.2 Nexawave Hub

NexaWave Hub (wireless gateway) is the main networking hardware, which uploads data gathered from all the VW nodes (connected to vw geotechnical sensors) to the Encardio Rite cloud server or a third-party server. In addition, it passes control messages through the network to ensure seamless operation.

The Gateway is ideally installed at a location with the cellular network, in line of sight of the installed nodes. It serves as an exit point/central hub for wireless data obtained from the sensors as the readings pass through or communicate with the Gateway before being routed to an FTP or cloud server.

2.3 System components

Provided by Encardio Rite

- VibraLink node with antenna
- NexaWave Hub (wireless gateway)with antenna
- Gateway and Node mounting accessories
- USB to RS-232 FTDI cable
- Application software for Android Smartphones
- Application software for Windows

To be arranged by the Client for Gateway and Nodes

- Android Smartphone
- Activated data SIM card
- D-Cell Li-SOCl2 3.6 V 14.5 Ah batteries nominal Voltage - 2 no.
- External Power supply unit 9-30 V, 1 A for Gateway (12 V, 1 A power supply readily available can be used) and 8-20Vdc for the Quint and Deca and 9Vdc for the EWN-01V. In the EWN-06VC external power will not used.

3 TECHNICAL SPECIFICATION

Basic			
Internal Battery	**EWN-01V:** 2X3.6V Li-Ion Battery (D-cell ER34615M) **EWN-05V:** Group 1- 7.2V (2X3.6V Li-Ion Battery (D-cell ER34615M) Group 2- 7.2V (2X3.6V Li-Ion Battery (D-cell ER34615M) **EWN-06VC:** 1X3.6V Li-Ion Battery (D-cell ER34615M) **EWN-10V:** Group 1- 7.2V (2X3.6V Li-Ion Battery (D-cell ER34615M) Group 2- 7.2V (2X3.6V Li-Ion Battery (D-cell ER34615M)		
External Power	**EWN-01V:** 9V Standard DC supply **EWN-05V:** 08-20V Standard DC supply **EWN-06VC:** Not available **EWN-10V:** 08-20V Standard DC supply		
Operating Current	25 mA (max)		
Dimension	120X100X81.5(LXWXH) without antenna 159X100X187(LXWXH) with antenna		
Weight	0.807 Kg (Without Battery) 1.0045 Kg(With Battery)		
Storage	3 Million data points		
Primary Sensor			
Sensor Type	Vibrating Wire Sensor		
No. of VW Channel	01, 05, 06, 10		
Accuracy	± 0.1% FS		
Sensor Excitation Freq	400-6000 Hz		
Excitation Voltage	5V		
Temperature Sensor			
Sensor Type	3K thermistor		
Accuracy	0.1°C		
Range	-20°C to +70°C		
Enclosure			
Material	Aluminium-Alloy Die casting 12(Epoxy Polyester Powder Coating)		
Fire Proof	Approved		
Protocol			
ER Protocol	Proprietary Encardio Protocol		
Radio			
LoRa Chipset	SX1276 Global Sat		
Frequency	EU	US	ROA
	863-870 MHz	903-927 MHz	920-928 MHz
Transmit Power	863-870 MHz (EU)	903-927 MHz(US)	920-928 MHz(ROA)
	14 dBm	Up to 16 dBm	20 dBm

Atenna Gain	4.44 dBi
Antenna Type	Detachable Stub atnenna
Baud Rate	9600 bps(Max)
Receiver Sensitivity	-132 dBm
Transmission Distance	(1 ~ 15 KM)*

* 800 meter in urban areas

4 PRE-INSTALLATION PREPARATIONS

4.1 Pre-installation checks

- Before installation, please check the VW node and Gateway for any physical damage.
- Open the Node and gateway box to check if the internal wirings are intact.

4.2 Setting up the Gateway and vibrating wire nodes location

Selecting the correct locations for the Gateway and Node is essential, especially if more than one Node is installed at the site and connected to a single gateway.

The initial task involves placing the Gateway in a position where it has a clear line of sight to all installed Nodes or, at the very least, to most of the Nodes. The optimal placement should be decided on-site. It is advisable to ensure a robust connection between the Gateway and the Node to achieve optimal performance, ideally with a signal strength exceeding -100 dBm. It's important to emphasize that stronger signal strength will yield superior results.

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4.3 Setting up the Gateway & Node

It is recommended that nodes and Gateway be set up and configured before mounting them at respective installation locations.

The gateway configuration needs to be done before nodes are configured. Also when the Node is being configured, it must be ensured that the Gateway is in switched "ON" position.

For setting up and configuring the Gateway, refer to User's Manual # WI6002.117 on Gateway.

The configuration of vibrating nodes is discussed in Section 5 of this manual.

For convenience, a "Quick Start Guide" is included in Section 1 to give a brief and quick idea.

4.4 Sampling Interval for Vibrating Wire Node

When configuring the Encardio Rite wireless system, it is crucial to select appropriate sampling intervals to ensure the network operates smoothly without any data loss.

The table below provides guidance on sampling interval selection for vw nodes based on the network size:

Number of Nodes	Minimum Sampling interval(Minutes)
1	4
10	6
50	16
100	28

150	41
200	53

The General formula to calculate the Sampling interval for the vibrating wire node is:

*Sampling Interval (Seconds) = (15*No. VW Node) + 180*

5 CONFIGURING VW NODE

We have explained the configuration using NexaWave VibrLink Solo as a reference. For VIbralink Quint, Hexa and Deca similar procedure will be followed.

5.1 Setting up the VW node

- Open the top cover with a screwdriver. A description of each part of the Node is given in the Figure 5-2

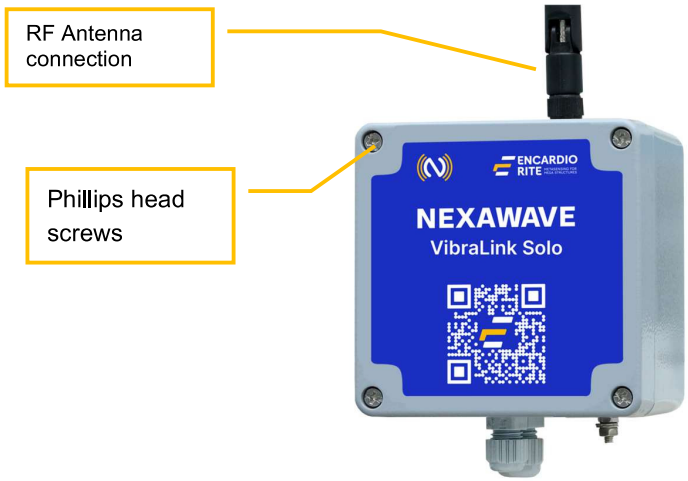

Figure 5-1 VW node

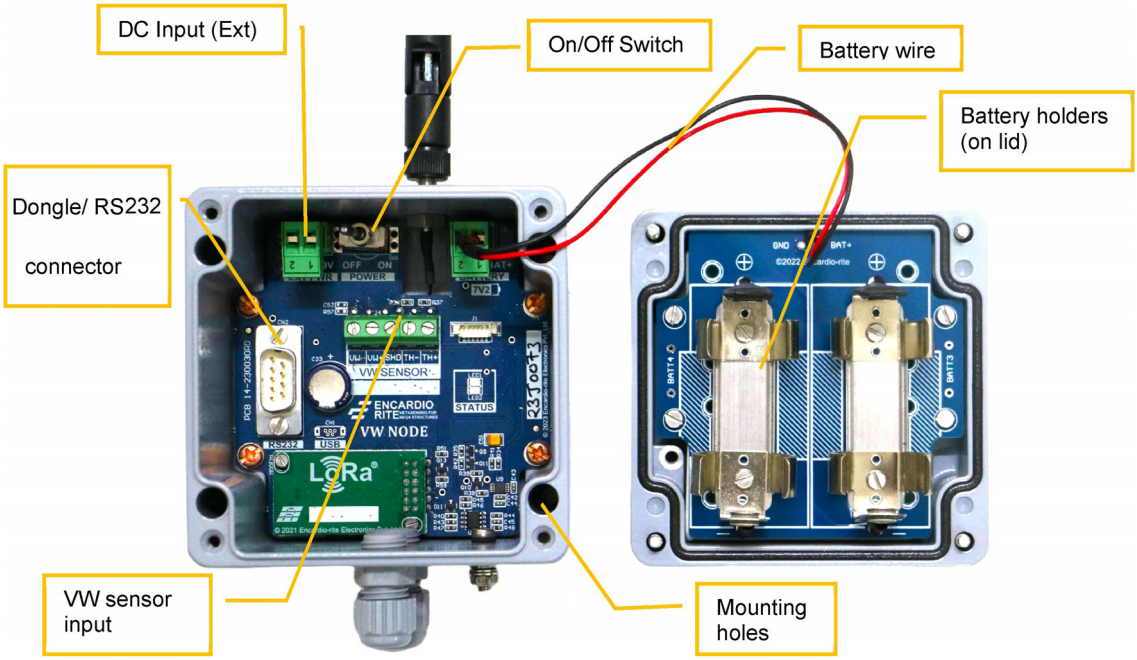

Figure 5-2 Node details

- Connect the RF antenna (provided with supply) to the Node properly.
- Connect the vibrating wire sensor cable to the designated Connector in Node as shown in Figure 5-3: VW+, VW-, SHD, T+, T-

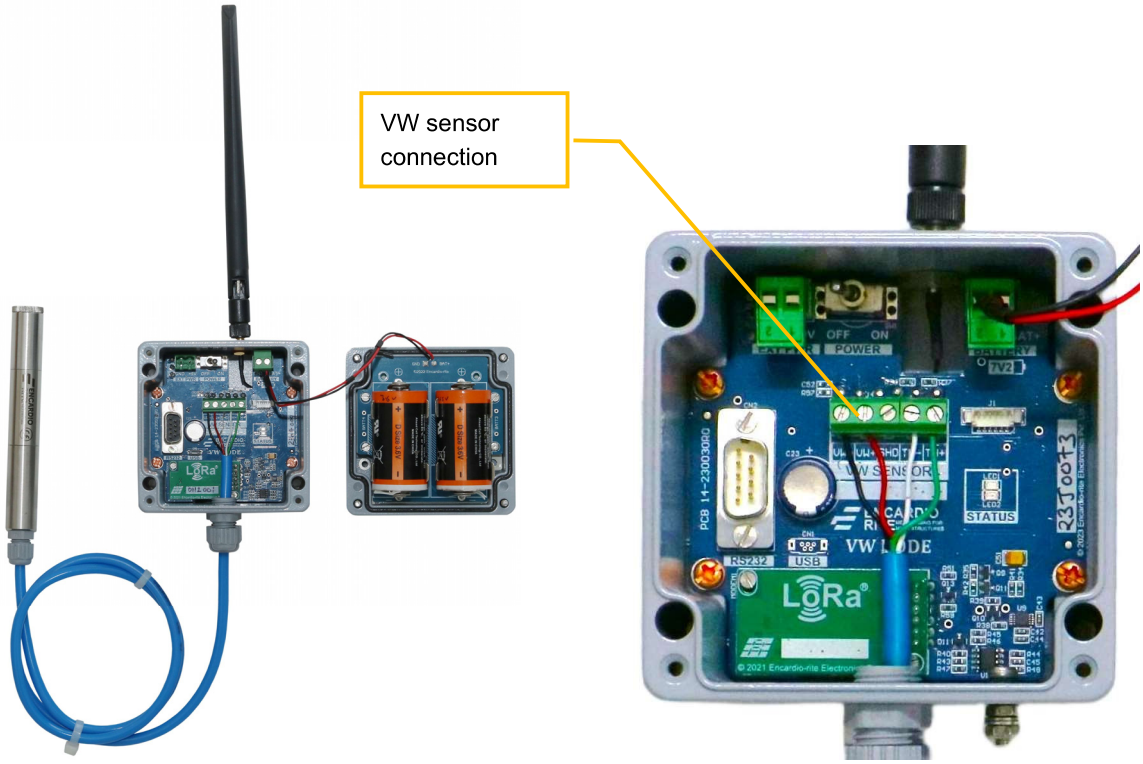

Figure 5-3 VW sensor connection to single channel VW node (Solo)

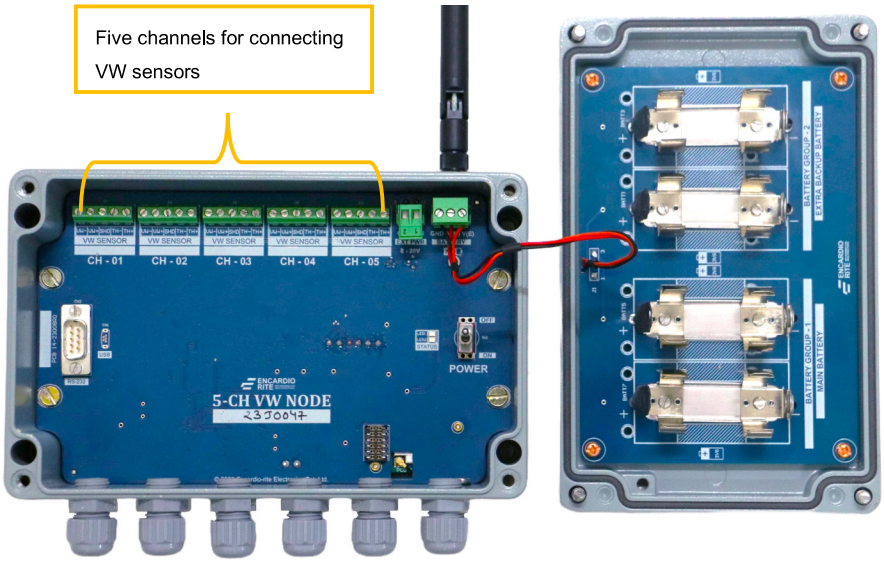

Figure 5-4 Five channel VW node (Quint)

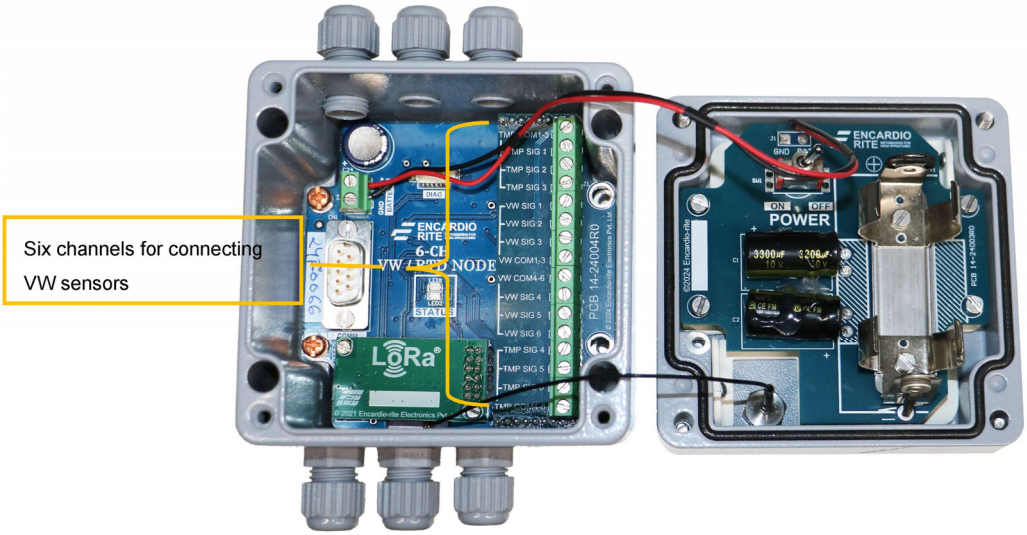

Figure 5-5 Six channel VW node (Hex)

5.2 Battery Installation

- Open the device by unscrewing the four Phillips head screws on the front of the enclosure.

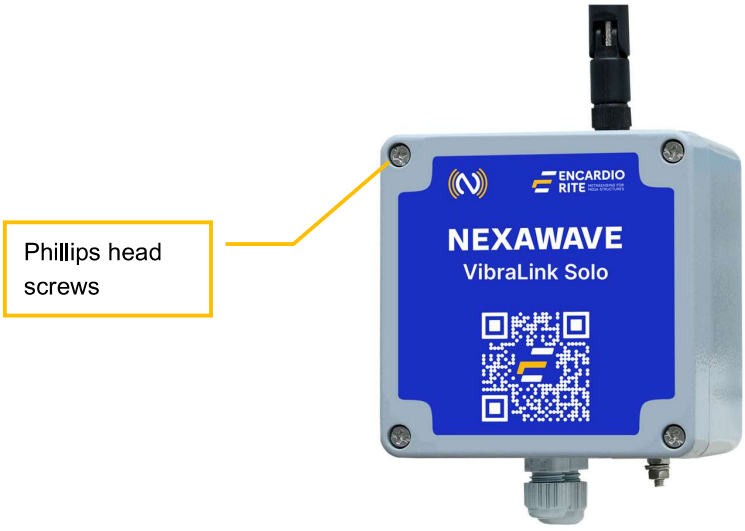

Figure 5-6

- Check for any looseness in the positive and negative clip terminals of the holder. If they are loose, press them down to ensure proper contact with the battery.