

## USERS MANUAL



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TUNNELS



HYDROELECTRIC



CONSTRUCTION



STRUCTURAL



METRO & RAIL



BRIDGES



MINING

Encardio-Rite Group - India | Bhutan | Bahrain | Qatar | Saudi Arabia | UAE | Peru | Greece | Spain | UK | USA

Encardio-Rite Electronics Pvt. Ltd. A-7, Industrial Estate, Talkatora Road, Lucknow, UP-226011, India | geotech@encardio.com | www.encardio.com

## 1 INTRODUCTION

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### 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

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### 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:

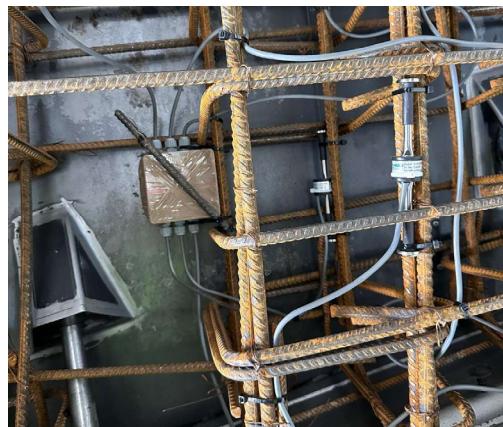
**VibraLink Solo:** 1 channel

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

<b>Atenna Gain</b>	4.44 dBi
<b>Antenna Type</b>	Detachable Stub atnenna
<b>Baud Rate</b>	9600 bps(Max)
<b>Receiver Sensitivity</b>	-132 dBm
<b>Transmission Distance</b>	(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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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. For best results, the link between the gateway and the Node should be strong, preferably better than -100 dBm. Please note, the stronger the link, the better the results. **When mounting the gateway's antenna, it's crucial to position it at least 6 feet (1.8 meters) away from any surface, including roofs, hills, or walls. This clearance helps ensure optimal signal propagation and minimizes interference.** 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.

### 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:

$$\text{Sampling Interval (Seconds)} = (15 \times \text{No. VW Node}) + 180$$

## 5 CONFIGURING VW NODE

We have explained the configuration using NexaWave VibraLink 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

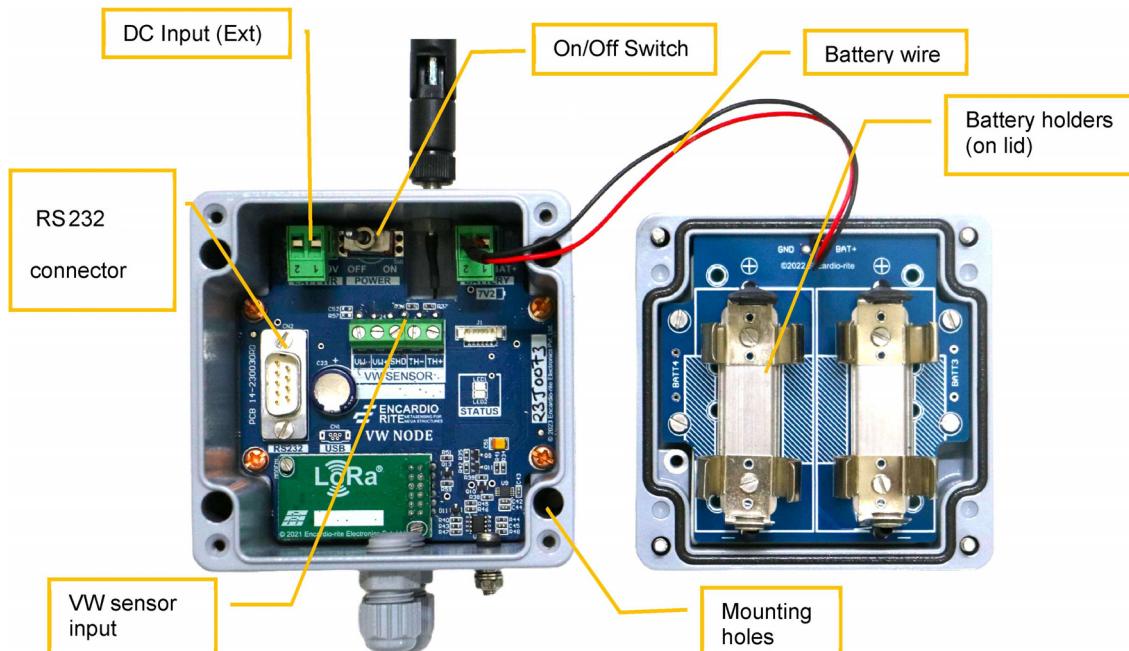


Figure 5-2 Node details

- 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-

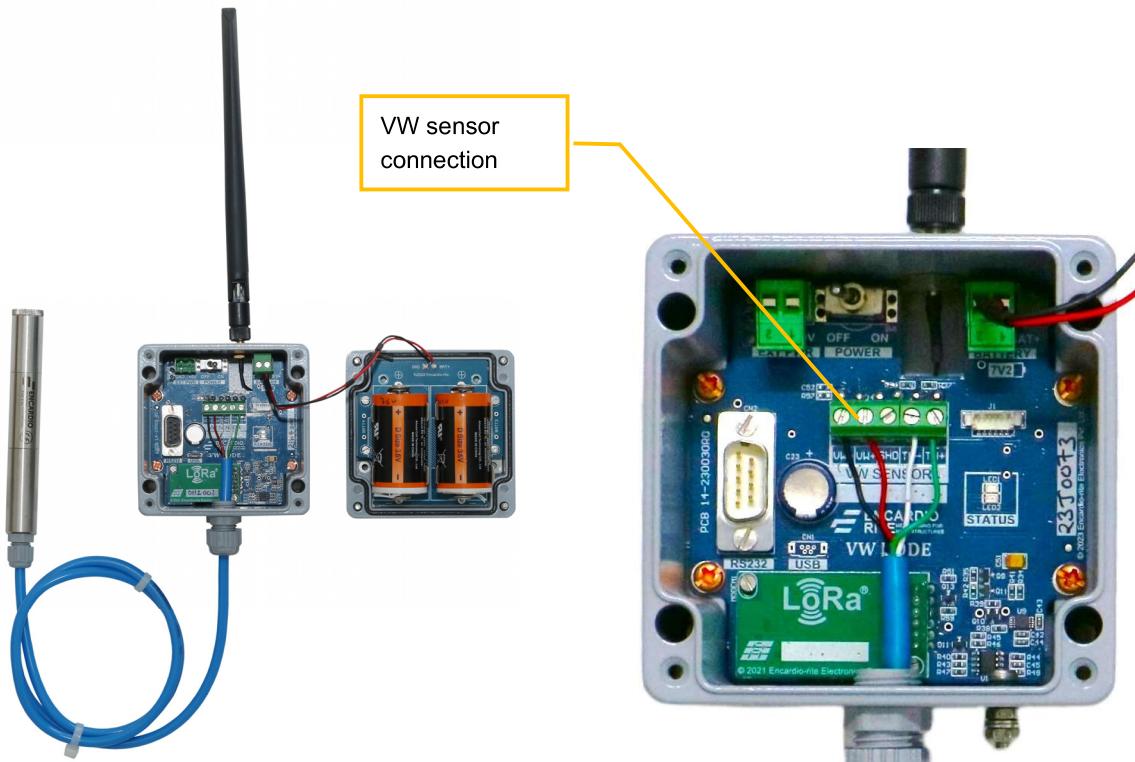


Figure 5-3 VW sensor connection to single channel VW node (Solo)

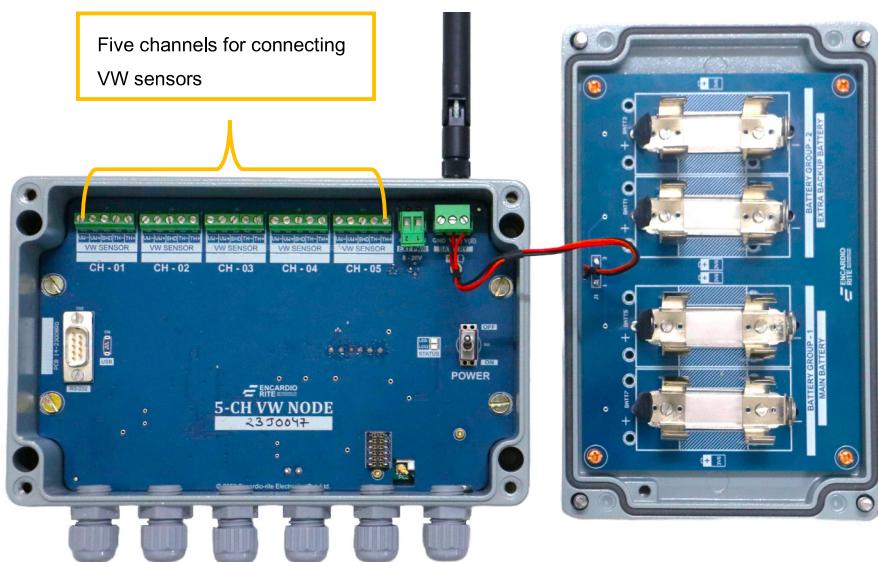


Figure 5-4 Five channel VW node (Quint)

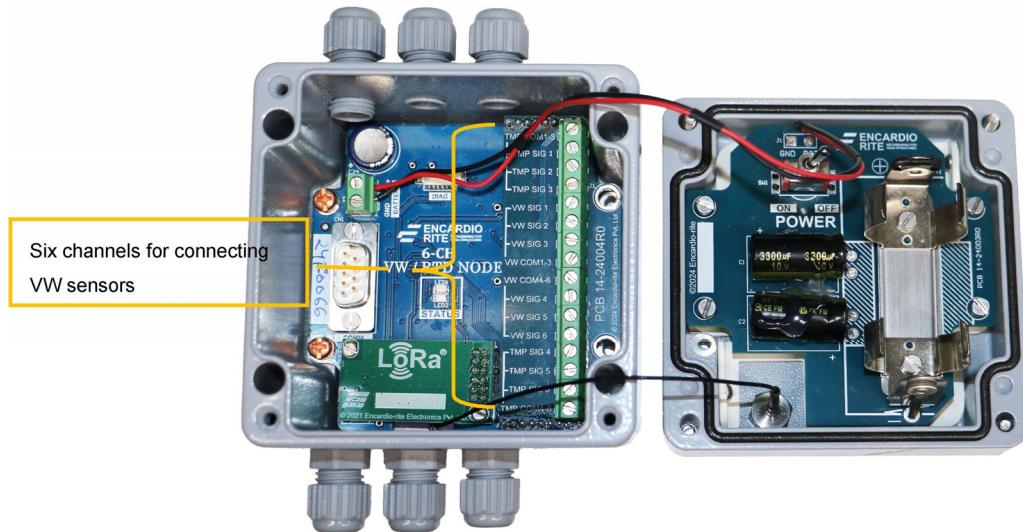


Figure 5-5 Six channel VW node (Hex)

## 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.

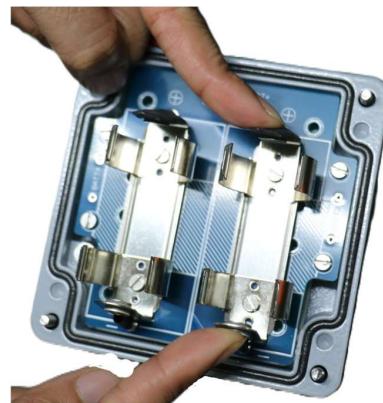


Figure 5-7

- Align the positive (+) side of the batteries with the + indicator in the battery holder.

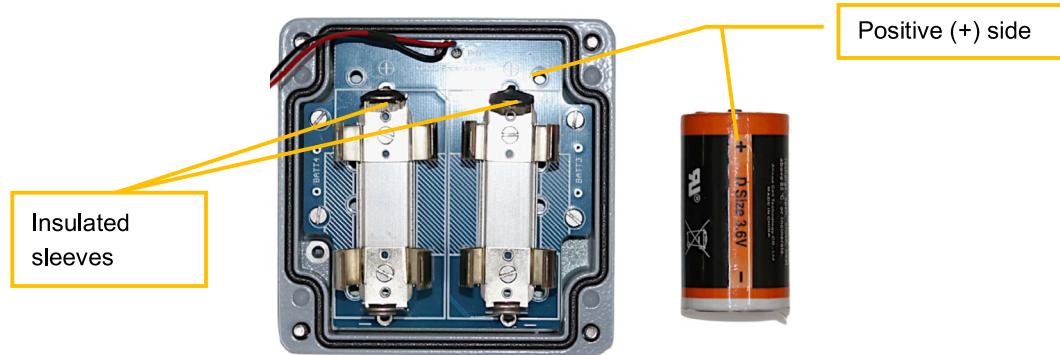


Figure 5-8

- Slide the positive end of the battery inside the compartment first. Installing the positive end first allows the battery to slide into the compartment more easily. Just push the positive end of the battery into the lever, flattening it down into the holder. Apply a bit more pressure, if necessary, to snap the negative end of the battery securely into place.



Figure 5-9

- In case fast scanning is required, connect any standard DC power adaptor (9 V, 1 A) to "DC Input".
- Or, Encardio rite make solar battery charger can also be used (available against order).
- After power up, wait for 30 seconds as during this time tilt meter performs internal operations.

### 5.3 Connection VW Node to phone

Install the apk file (provided with the supply) for the "EWA-01" app on the phone. App shortcuts will be available in the list of application software. Open the application and allow all the permissions required for proper functioning.

#### 5.3.1 Connection through OTG

- Switch on the Node and connect it to the Smartphone using the FTDI to OTG adaptor provided with the supply, as shown in Figure 5-11-1 below.



Figure 5-11-1 EWN-01V VW node connected to Android phone with FTDI cable via OTG adaptor

### 5.4 VibraLink Node configuration

The VibraLink node is configured using the EWA-01 Android application. Ensure the Hub (Gateway) is configured and powered on before configuring the VibraLink nodes. Configuration can be done via USB OTG. The following subsections detail the configuration process.

- Open the "EWA-01" apk installed on an Android phone. It will show the list of paired Nodes. Select the Node that you paired earlier from the list. It will take you to the home screen of the Node.

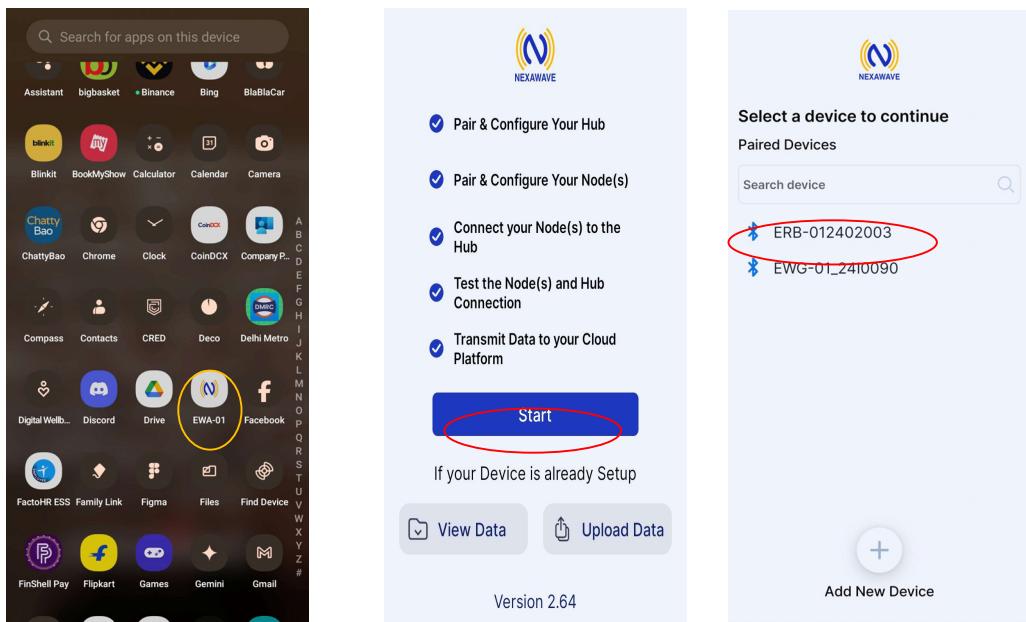


Figure 5-10

- It will take you to the home screen of the VibraLink, as shown in Figure 5-13.1(a). Clicking on the 'i' button (Figure 5-13.1(b)) will open the information window. Within this window, you can scroll to view information about the VibraLink, sensor, sampling, and battery and the phone (Figure 5-13.1(c)).

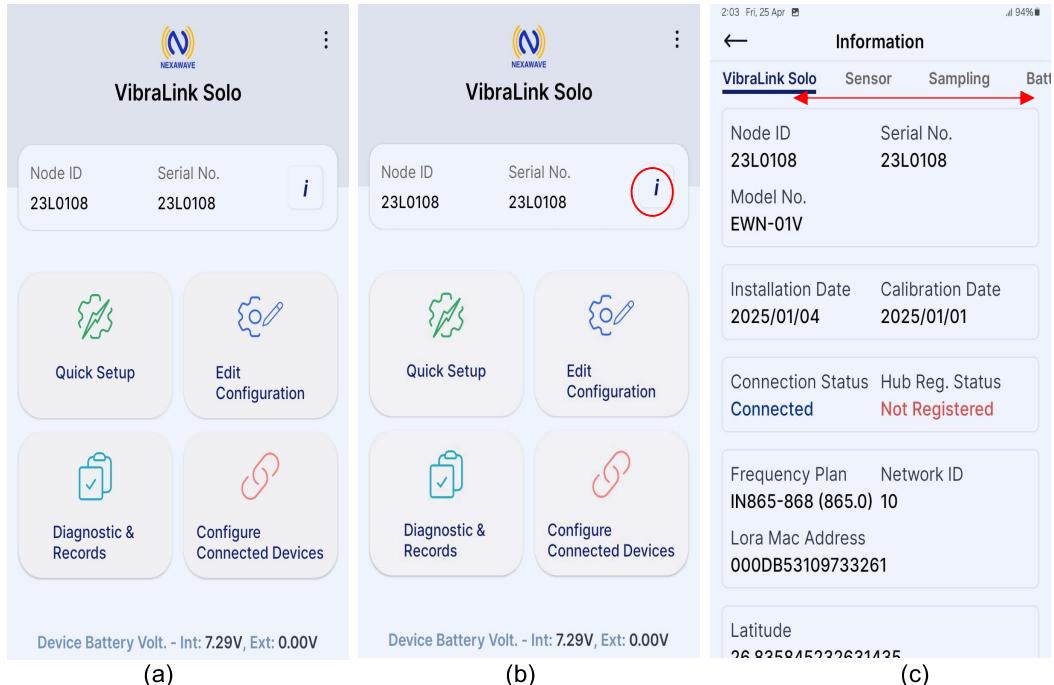


Figure 5-13.1

- **Resetting Your Vibralink Node: Factory Default and Memory Erase Procedures**

To access the reset options, navigate to the Advanced Settings menu. This is achieved by clicking the three dots located in the top left corner of the screen.

#### Factory Default

The Factory Default reset restores the VibraLink node to its original factory configuration, erasing all user-defined settings and data.

**Important:** While user-configured data will be lost, any settings configured at the factory will be retained. This reset is useful for troubleshooting, preparing the device for a new user, or if other configuration changes have led to unexpected behavior.

**Caution:** All user-generated data will be permanently erased. It is strongly recommended to back up any critical data before performing a factory reset. Data lost through this process cannot be recovered.

To reset the Node, click on the "Rest VibraLink to Factory Default" tab from the advance setting. A prompt window asking for a reset password will appear.

Enter the password "**4TfZ9q7X**" and click on the "OK" button to reset the Node.

#### Erase Node Memory

The "Erase Node Memory" function clears all previously stored logs on the VibraLink node. This is often performed to clear old logs, free up storage space, or as part of a security or privacy protocol.

**Caution:** Erasing the node memory is irreversible. **Ensure you have archived any necessary logs before proceeding**, as they cannot be recovered after deletion.

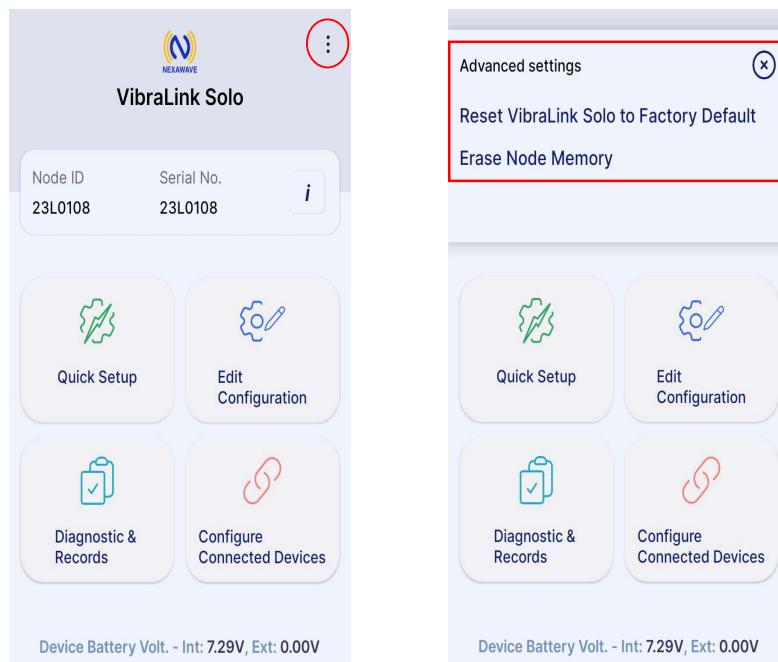


Figure 5-11

On the home screen, click on "QUICK SETUP" to configure the VibraLink. This simple five-step process guides you through the setup. A brief, step-by-step guide is provided below:

### 5.4.1 Quick Setup

#### Step 1: Set the Configuration

- **VibraLink ID:** Input "VibraLink ID" of their choice. Try to input some meaningful ID so that it becomes convenient for other users also.
- **Installation Date:** Click on the "Calendar Icon" to enter the installation date of the gateway.
- **Relay Hopes:** Select the relay hopes from drop-down menu which is closer the node.
- **Frequency Plan:** Select the "Frequency Plan" from the drop down. This depends on the installation location, to comply with the local regulations. User can select the region and associated frequency by tapping on the search icon.
- **Network ID:** User can select any of the Network ID from the "Network ID" drop-down menu. It is important to remember that the network ID should remain consistent throughout the entire network, including all nodes and the gateway. Note down the configured Gateway Network ID as it will be necessary for node configuration.
- **Location:** For setting Latitude and Longitude of respective installation location:
- If user knows the installation location coordinates, enter the Latitude and Longitude information manually.
- If user does not know the installation location coordinates, select the button "Select on map" for automatic location setup. This needs to be done at the installation site location only. Ensure that the internet connectivity is there in the phone during this process.
- **Device Date & Time:** To set the RTC (date and time) of VibraLink, click on the "Calendar" and "Clock" icons given in line with "VibraLink date" and "VibraLink time". Click on the "Update Date/Time" tab to save it. To synchronize the VibraLink RTC with phone's RTC, click on the "Sync with phone" tab. Make sure that the phone's RTC is up to date and correct.
- Click on the Save & Next button to move step-2.

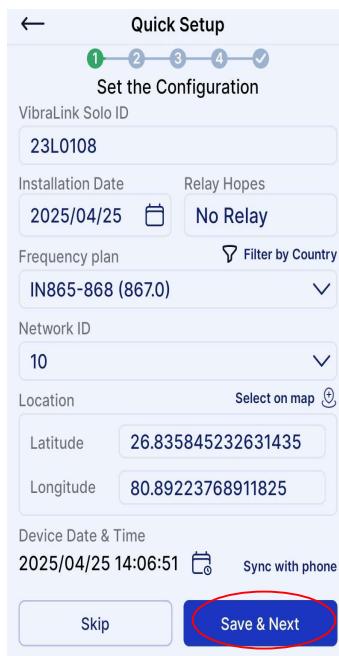


Figure 5-12