

PVH01 Manual & User Guide v2.0beta



Manual and User Guide

PVH01 Vibration Meter

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**CORRESPONDING FIRMWARE**

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Page 1 of 40

## Table of Contents

1 Introduction .....	6	3.6 Display Backlight .....	11
2 Overview .....	6	4 Vibration Measurement .....	11
2.1 Operation .....	7	4.1 Base measurements.....	11
2.2 Navigating the User Interface.....	7	4.2 Metrics Option.....	12
2.3 Real-Time Clock.....	8	4.3 High Resolution Option.....	12
3 Getting Started .....	8	4.4 Wave Record Option .....	12
3.1 Power Supply .....	8	5 Wifi Interface setup.....	12
3.2 Data Storage.....	9	5.1 Wifi Access Point mode - configuration .....	12
3.3 Connecting the InstraLabs AKF391 vibration sensor .....	9	5.1.1 Enable AP mode .....	13
3.4 Switching the PVH01 On and Off.....	9	5.1.2 Configure settings using AP mode .....	13
3.5 Select Measurement characteristics .....	10	5.1.3 Unlock Options with AP mode.....	14
3.5.1 Filter.....	10	5.1.4 Update Firmware with AP mode .....	15
3.5.2 Measurement Interval .....	10	5.1.5 Download files from the uSD card with AP mode .....	16
3.5.3 Measurement Timing.....	10	5.2 Wifi Client mode – MQTT Data publication ....	16

5.3 Wifi Mesh mode – Multi-hop Wifi connection .....	18	8 Extended Options.....	24
6 System Settings .....	20	8.1 Metrics Option.....	24
6.1 Real-time Clock .....	20	8.2 High Resolution Option.....	24
6.1.1 Setting the timezone.....	20	8.3 Wave Record Option .....	25
6.1.2 Setting the current time.....	21	8.4 Legacy Serial Option .....	25
6.2 Input Filter .....	21	8.5 Mesh Wifi Option.....	25
6.3 Record options .....	21	9 Specifications .....	25
6.4 Default Location .....	22	9.1 JSON data format .....	26
6.5 Watchdogs .....	22	9.1.1 Description .....	26
6.6 Wifi and network Settings.....	22	9.1.2 Example .....	27
7 Data Management.....	23	9.2 CSV data format .....	28
7.1 uSD card .....	23	9.2.1 Description .....	28
7.2 MQTT data publication.....	23	9.2.2 Example .....	29

## 1 Introduction

The PVH01 is a 3 axis vibration meter designed for measuring vibration levels of objects. It uses an accelerometer to measure the movement of the object to which the accelerometer is mounted.

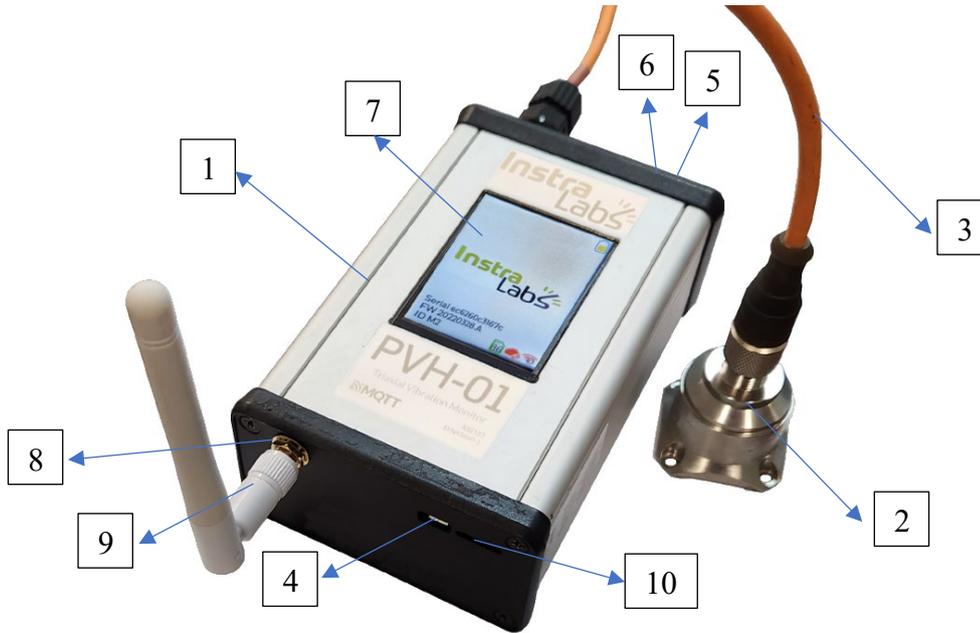
The device is designed to allow handheld operation for ad-hoc measurements, with results displayed on the graphic interface.

The PVH01 contains an internal battery to allow handheld operation for a period of time without an external power connection.

As an Internet of Things (IoT) device, it is also capable of publishing the vibration results to online services, allowing remote and long term monitoring. It may be operated permanently connected to an external power connection.

Suitable applications include structure monitoring (eg. bridges) and blasting monitoring (eg. around quarries).

Basic metrics are provided on all PVH01 meters, providing measurement of velocity at 15 minute intervals. Extended capabilities may be unlocked through the purchase of several options. These options are unlocked through the provision of a unique 'unlock code' which unlocks the capability for the selected unit.



## 2 Overview

1. InstraLabs PVH01 Vibration Monitor body (PVH01)
2. InstraLabs AKF391 Triaxial Vibration sensor (Sensor)
3. Sensor Cable
4. USB-C Charge port
5. Power button
6. Reset button
7. Graphic display with touch interface
8. Wifi antenna connector
9. Wifi antenna
10. uSD card socket (maybe show the power and reset buttons?)

### 2.1 Operation

The Sensor is the transducer which must be securely and rigidly mounted to the object being measured. It must be connected to the PVH01 body using the sensor cable.

The charge port allows powering the PVH01 and recharging its internal battery.

The power button turns the PVH01 on and off, and illuminates the graphic display if it has entered a power saving mode.

The reset button allows the user to initiate a hard reset if the unit has entered an unrecoverable software state.

The uSD card socket allows long term storage of large quantities of data to user accessible memory.

The graphic display allows the user to control many aspects of the unit's operation, and view live vibration levels.

The wifi interface allows reporting of measurements to internet services (if connected and configured). It also

allows the user to control and configure advanced device options.

To power on the unit, ensure the sensor is connected to the PVH01 using the sensor cable, and press the power button on the PVH01. The graphic display will illuminate, and indicate the device status.

## 2.2 Navigating the User Interface

The graphic display and touchscreen provides the primary user interface for the PVH01.

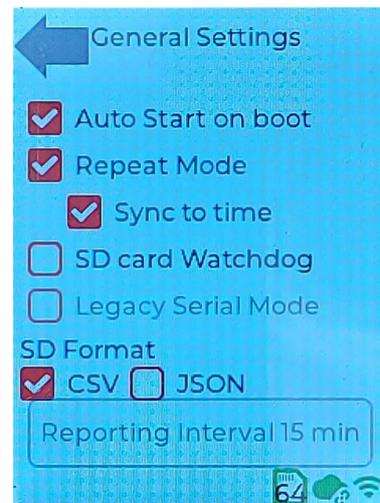
The user interface is comprised of many 'pages', which the user may navigate between.

When there has been no user activity on the graphic display for more than 30s (default, adjustable) the graphic display illumination will be disabled until the graphic display or power button is pressed again. The PVH01 remains turned on.

In general, pressing the 'Back' icon in the top left of the display will take the user to the previous page. Pressing this repeatedly will typically take the user back to the main page.

Pressing a button may initiate an action, or navigate the user to a related page.

When the unit is powered up it takes the user to the main page, which displays the vibration levels, wifi status, measurement filename and current time.



To view or modify the unit configuration, press the 'settings' button in the top left corner of the main page.

The status of the SD card, Wifi and MQTT is displayed using icons in the bottom right corner of the display.

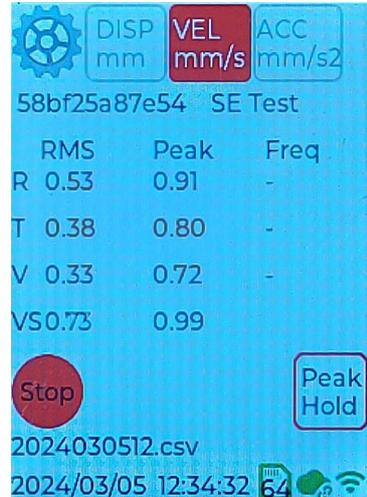
- The SD status icon is the left-most icon
  - It is red if the SD card is not detected
  - It is green if it is detected and operating.
  - The percentage free space remaining on the SD card is overlaid on the icon.
- The MQTT status icon is the middle icon, which looks like a cloud
  - It is green if the MQTT connection to the MQTT broker is connected.
  - It is red if the unit is not connected to the MQTT broker.
- The Wifi status icon is the right-most icon

◦ It is not displayed if Wifi is turned off.

◦ It is yellow if the unit is in AP mode.(AP mode allows users to connect remotely to PVH01 and is mainly used to update FW and to change other setting remotely)

◦ It is red if the unit is configured to connect to a wifi network and it has not successfully connected to the network.

◦ It is green if the unit is connected to a wifi network.



## 2.3 Real-Time Clock

How it keeps track of time and under what conditions it loses time

When the PVH01 is connected to a wifi network with internet, it automatically connects to an internet time server and synchronises it's internal clock. It will continue to use the internet time server to synchronise its time.

*On the original/legacy Matrix PVH01:*

When the PVH01 is powered off, the timekeeping accuracy is reduced. The internal clock may drift by dozens of minutes every day that it is powered off. While it is powered on, the timekeeping accuracy is much better.

If the internal battery becomes flat, due to a sufficiently long period of use or storage, the internal clock will be reset.

If a hard reset is triggered, the internal clock will also be reset. The time will reset to 1-Feb-2020 until adjusted by the user or updated from an internet time server.

*On the (proposed) revised PVH01:*

The revised PVH01 has an internal GPS which provides high accuracy timekeeping to the PVH01. Once the GPS has obtained a fix, the time is accurate and remains so, including over device resets, periods powered off, and for an extended duration after the battery is fully discharged.

If the battery becomes discharged and remains discharged for a long (do we need to define how long?) period of time, the time will be reset.

## 3 Getting Started

### 3.1 Power Supply

The PVH01 contains a Lithium Polymer battery which is capable of operating the unit for a period of up to 3 days from a full charge.

The unit is charged by USB-C. The maximum charge rate is 15W, but any USB charger may be used to power and charge the unit at a reduced rate.

With a high power USB charger, the unit will charge to full charge in 24 hours or less

Internal battery	20Ah, 3.7V
USB-C Charge maximum	5V @ 3A
Compatible USB chargers	Any
Time to full charge (with 15W supply)	24 hours
Battery operating time from full charge	48 - 72 hours

## 3.2 Data Storage

The unit requires a uSD card be installed for storing vibration data. It is recommended to use a quality card from a well known manufacturer and reliable supply chain. Any capacity of card may be used. It is the users responsibility to install a card which has sufficient capacity for the intended application and duration.

SanDisk cards are suggested. uSD cards must be formatted as either FAT32 or exFAT. They will come from the manufacturer formatted appropriately.

The vibration data is stored to the SD card in CSV format.

To insert a uSD card, simply push it into the uSD card socket with the contacts facing down until a click, then release.

To remove the uSD card, push the uSD card until a click, then release it and allow it to pop out. Gently withdraw the card.

## 3.3 Connecting the InstraLabs AKF391 vibration sensor

The InstraLabs AKF391 vibration sensor must be connected to the PVH01 before the PVH01 is powered on for successful operation.

The maximum cable length is 5 metres. The cable is terminated at both ends with a 5-pin M12 connector.

To connect the cable to the PVH01 and the vibration sensor, align the keyway on the connectors and press the two halves together. When the two halves are pressed firmly together, turn the locking collar on the plug to screw onto the socket. Do up firmly until the locking collar is snug and ratchet bumps are felt.

## 3.4 Switching the PVH01 On and Off

To turn the PVH01 on, briefly press the power button once. If it is off, it will turn on. If it is already on, the graphic display will illuminate. If unsuccessful, ensure the PVH01 is charged or powered.

To turn the PVH01 off, press and hold the power button until the graphic display illumination is deactivated. Alternatively, navigate to the 'Settings' page of the graphic display and press the power button in the top right of the screen.

## 3.5 Select Measurement characteristics

The characteristics of the measurement being made may be adjusted using the following settings

### 3.5.1 Filter

The vibration filter may be set to one of the following:

- AS2187 (2Hz to 250Hz)
- Linear (0.315Hz to 500Hz)

To adjust the vibration filter, power on the PVH01 and navigate to the 'Settings' > 'General Settings' page. The selected option will be checked. Press the preferred filter checkbox to select it.

### 3.5.2 Measurement Interval

The measurement interval may be set between 1 second and 1 hour. The default option allows only 15 minute intervals.

To adjust the measurement interval (if available), power on the PVH01 and navigate to the 'Settings' > 'General Settings' > 'Measurement Interval' page. The selected option will be indicated at the top of the screen. Scroll through the list and select the preferred option from the list.

### 3.5.3 Measurement Timing

The measurement timing may be adjusted with the 'Repeat Mode', 'Sync to Time' and 'Auto Start on boot' options. To adjust these options, power on the PVH01 and navigate to the 'Settings' > 'General Settings' page.

- 'Repeat Mode' will, if enabled, stop each measurement once the measurement interval is completed, and immediately begin a new measurement. If not enabled, the

measurement will continue indefinitely until stopped.

- ‘Sync to Time’ will, if enabled, align the end of each measurement interval so that it aligns with the start of the hour (eg. 15 min intervals started at 6:07 will begin at 6:07, 6:15, 6:30, 6:45, ...). If not enabled, the measurement will begin at whatever time it is initiated, and a new measurement will begin every subsequent interval (eg. 15 min intervals started at 6:07 will begin at 6:07, 6:22, 6:37, 6:52, ...)
- ‘Auto Start on boot’ will, if enabled, begin a measurement immediately after the unit powers up. This ensures that if the unit restarts for any reason, it will automatically continue measurements. It is critical that this setting be enabled for any remote or long term logging scenario.

### 3.6 Display Backlight

To save power when deployed in a logging system, the PHV01 will turn off the backlight of the graphic display after 30 seconds (default) of no user activity. When the backlight is disabled, if the user touches the graphic display, the backlight is illuminated and the 30s timer is reset. If the user briefly presses the power button, the backlight will also be illuminated and reset the 30s timer.

When the backlight is disabled, the graphic display is still active and



the user may still press buttons, so they should take care not to stop a measurement when reactivating the display.

The user may adjust the display inactivity timeout or stop it altogether. To adjust the backlight inactivity timeout, power on the PVH01 and navigate to the 'Settings' page. Select the 'Backlight Auto Off' slider and drag it to the desired timeout. To disable the timeout, drag the slider fully to the left and observe the indication 'Always ON'.

The Backlight timeout option will reset to 30s after the unit is power cycled.

## 4 Vibration Measurement

Describes the measurements which are recorded by the PVH01

### 4.1 Base measurements

The base measurements taken by the PVH01 (without purchasing extended options) are as follows:

- Measurements are taken over a 15 minute measurement interval (or manually triggered measurements of arbitrary length)
- The reported metrics over the measurement interval are:
  - Peak Velocity (3-axis + vector sum)
  - RMS Velocity (3-axis + vector sum)
  - Dominant frequency (3-axis)

The measurements are displayed on the 'Main' page as follows:

- The current 1s peak and 1s RMS values are displayed at all times (whether a recording is active or not) and are updated every 1 second
- The 3 axes (R, T, V) and vector sum (VS) are displayed in columns
- The 1s RMS value is displayed in the leftmost column, headed 'RMS'

- The 1s peak value is displayed in the middle column, headed 'Peak'
- The measurements are displayed in mm/s
- The 1s dominant frequency is displayed in the right-most column, headed 'Freq'. If there is no identifiable dominant frequency in the presently displayed second, a dash '-' is displayed.

These measurements will all be recorded to the uSD card in CSV format

## 4.2 Metrics Option

The 'Metrics' option is an extended capability which may be purchased for the PVH01 vibration meter. This option adds Acceleration and Displacement as measurements which will be reported by the unit.

On the 'Main' page of the graphic display, these additional measurements may be viewed instead of velocity by selecting 'DISP' or 'ACC' at the top of the page. The currently selected measurement will be

indicated by highlighting the corresponding button at the top of the page in red.

## 4.3 High Resolution Option

The 'High Resolution' option is an extended capability which allows the user to select measurement intervals other than 15 minutes for periodic measurements.

The available measurement intervals with this option are those intervals which divide evenly into 1 hour, ranging from 1 second to 1 hour.

## 4.4 Wave Record Option

The 'Wave Record' option is an extended capability which allows the user to record the velocity waveform on all 3 axes in response to the velocity exceeding a specified threshold. This waveform is saved to the uSD card in CSV format, and may optionally be published to the remote internet service.

The velocity wave recording begins 1 second before the high level event occurred, ensuring a full picture of the peak event. The recording runs for 10 seconds.

## 5 Wifi Interface setup

Describes the purposes of the Wifi interfaces and how to use them

### 5.1 Wifi Access Point mode - configuration

The first and most important mode in which the Wifi interface may be operated is Access Point (AP) mode. When AP mode is enabled, the PVH01 creates a Wifi hotspot to which the user may connect a computer system such as a phone or laptop, and provides a webpage allowing viewing and editing of PVH01 settings, including advanced and complex settings which may not be accessible through the graphic display interface. It also allows download of files stored to the uSD card. This interface is hereafter referred to as the web config interface.

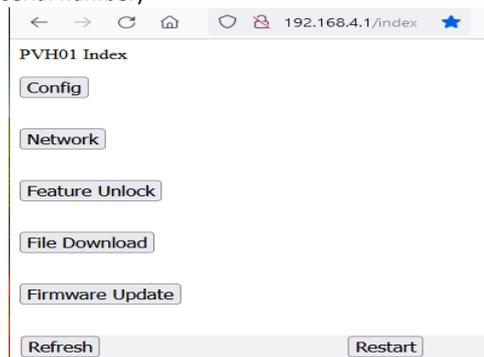
The settings which are likely to be most frequently modified are available on the graphic display for convenience, however some settings which would be

difficult to modify on the small display are only accessible through the AP mode web config pages.

#### 5.1.1 Enable AP mode

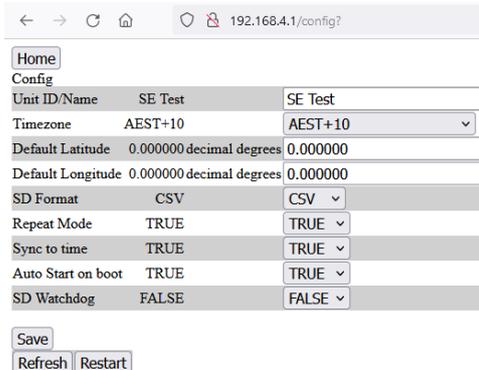
1. Power on the PVH01 and navigate to the 'Settings' > 'Wifi Settings' page.
2. Ensure that the 'On' checkbox and the 'AP' checkbox are checked
3. Power the unit off and back on
4. A wifi network corresponding to the unit serial number will appear
5. Connect your computer system to the newly created wifi network. The wifi password is

the same as the network name (the unit serial number)



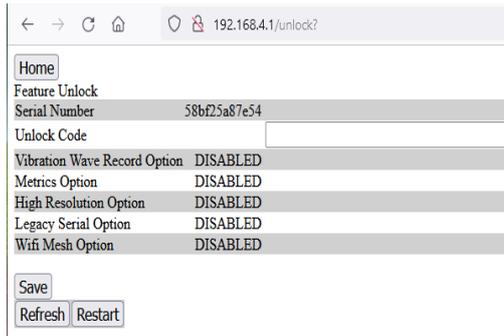
6. Open a web browser and navigate to the configuration webpage at <http://192.168.1.4>. You should be taken to a web page similar to the below.

## 5.1.2 Configure settings using AP mode



1. Having successfully navigated to the configuration webpage, click the menu which contains the desired configuration options (eg. Config).  
**Note:** Authentication may be required. The username/password combination is: config/config

2. Modify the configuration values in accordance with your requirements. When the options are set, click the 'Save' button at the bottom of the page.
3. Repeat for other configuration pages as required until the settings are set as required.



### 5.1.3 Unlock Options with AP mode

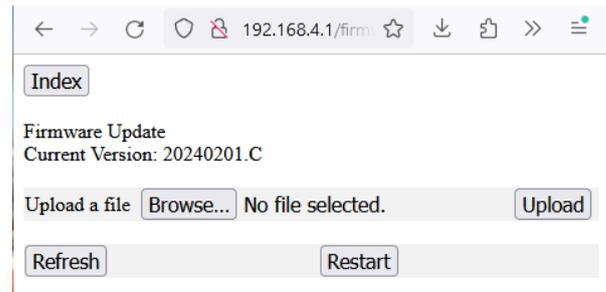
1. Purchase the desired option(s) for your unit serial number, and receive the unlock code
2. Put the unit into AP mode and connect to it (as above)
3. From the 'Index' page, navigate to the 'Feature Unlock' page
4. Observe the available options and their status.
5. Copy the unlock code you received into the 'Unlock Code' field and click 'Save'  
**Note:** some characters look very similar and may be confused with one another, eg. O and 0, 1, l and I. To avoid mistakes and confusion, it is advised to copy the unlock code instead of typing it in.
6. If the unlock code was valid for your serial number and was correctly entered, observe the newly available option(s) indicating 'ENABLED' instead of 'DISABLED'

7. Power off the PVH01 and power it back on. Enjoy your newly available options!

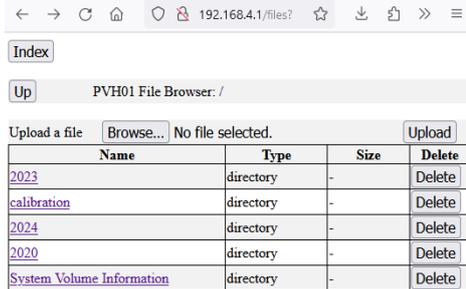
### 5.1.4 Update Firmware with AP mode

1. Download the firmware file to your computer
2. Put the unit into AP mode and connect to it (as above)
3. From the 'Index' page, navigate to the 'Firmware' page  
**Note:** Authentication may be required. The username/password combination is: firmware/firmware
4. Click 'Browse' and select the firmware file from the location in which you downloaded it (or drag it from an explorer window onto the 'Browse' button)

5. Observe the 'No file selected' indication change to display the filename of the selected file
6. Click 'Upload' and wait for the upload to complete.  
**Note:** This may take a while, wait for the webpage to indicate completion.
7. The PVH01 will reboot when the update has completed.
8. Check that the firmware version running on the PVH01 matches the version you



## PVH01 Manual & User Guide v2.0beta



uploaded (View at the bottom of the 'Settings' page on the graphic display)

### 5.1.5 Download files from the uSD card with AP mode

1. Put the unit into AP mode and connect to it (as above)
2. From the 'Index' page, navigate to the 'File Download' page
3. Browse the files and directories on the uSD card

- To open a directory, click on its name
- To download a file, click on its name
- To delete a file, click 'Delete' beside its name
- To delete a directory, first delete all the files it contains, then delete the directory.
- To upload a file, click 'Browse', navigate to the file on your computer, then click 'Upload' to upload it to the currently opened directory of the PVH01 uSD card

### 5.2 Wifi Client mode – MQTT Data publication

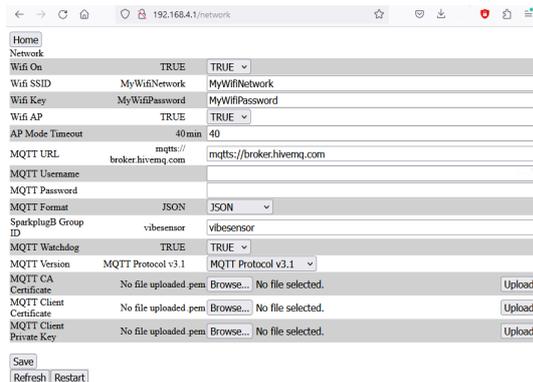
How to set up the Wifi Client mode and settings to publish MQTT data to a private MQTT broker

1. Set up an MQTT broker (or use an existing one) which you will use in your internet data storage system. It is advised to use certificate

## PVH01 Manual & User Guide v2.0beta

authentication to prevent unauthorised access.

2. If using certificate authentication, generate and download the certificate and key files for your unit.
3. Create a Wifi network with internet access (or access to your private MQTT broker if not connected to the internet)
4. Enable AP mode in the PVH01 and connect to the web config interface (See 16 Wifi Access Point mode - configuration for details)
5. Navigate to the 'Network' page



The screenshot shows the 'Network' configuration page in a web browser. The address bar shows '192.168.4.1/network'. The page contains several configuration fields:

Home		
Network		
Wifi On	TRUE	TRUE ▾
Wifi SSID	MyWifiNetwork	MyWifiNetwork
Wifi Key	MyWifiPassword	MyWifiPassword
Wifi AP	TRUE	TRUE ▾
AP Mode Timeout	40 min	40
MQTT URL	mqtt:// broker.hivemq.com	mqtt://broker.hivemq.com
MQTT Username		
MQTT Password		
MQTT Format	JSON	JSON ▾
SparkplugB Group ID	vibesensor	vibesensor
MQTT Watchdog	TRUE	TRUE ▾
MQTT Version	MQTT Protocol v3.1	MQTT Protocol v3.1 ▾
MQTT CA Certificate	No file uploaded .pem	Browse... No file selected. Upload
MQTT Client Certificate	No file uploaded .pem	Browse... No file selected. Upload
MQTT Client Private Key	No file uploaded .pem	Browse... No file selected. Upload
Save		
Refresh	Restart	

6. Set the settings as follows:

Wifi On	TRUE
Wifi SSID	The SSID of the wifi network the PVH01 will connect to
Wifi Key	The password of the wifi network the PVH01 will connect to
MQTT URL	The URL of the MQTT broker you set up in step 1
MQTT Username	If using username/password authentication, this is the username. If using Certificates or No authentication, leave blank
MQTT Password	If using username/password authentication, this is the password. If using Certificates or No authentication, leave blank
MQTT Format	Select JSON
MQTT Version	Set this to the MQTT protocol version your server requires. Most typically v3.1

7. Click 'Save'

8. If using certificate authentication, upload the certificates as follows:

MQTT CA Certificate	Leave blank
MQTT Client Certificate	Upload the certificate (in .pem format) you generated above. Leave blank if not using certificate authentication.
MQTT Client Private Key	Upload the private key (in .pem format) you generated above. Leave blank if not using certificate authentication.

9. Disable AP mode and reboot. The PVH01 will try to connect to the specified network, and will publish it's data to the specified MQTT server. It is the user's responsibility to set up a system to catch the published MQTT data and store and present it.
- Note:** Matrix Hub is an all in one subscription service which receives, stores and presents data from PVH01 sensors with dashboards for interacting with the measurement data.

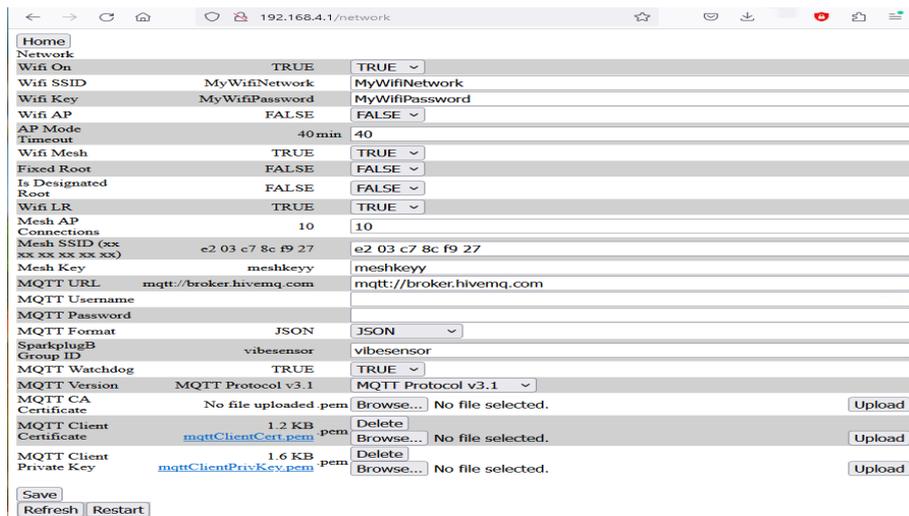
### 5.3 Wifi Mesh mode – Multi-hop Wifi connection

The Wifi Mesh mode (if option purchased) allows multiple PVH01 units to form a wifi mesh network. In this mesh network, units may connect to the main wifi network via other units, allowing a unit which may be out of range from the base wifi station to have its communication relayed to the base station by another unit which is in range of both.

To set up a Wifi Mesh network:

PVH01 Manual & User Guide v2.0beta

1. Set up an MQTT broker and wifi network as for Wifi Client Mode
2. Configure the PVH01 as for Wifi Client Mode (See 20 Wifi Client mode – MQTT Data publication for details)
3. Navigate to the 'Network' page of the web config interface (See 16 Wifi Access Point mode - configuration for details). Note the extra options available when the Mesh Wifi feature is unlocked.



4. the Mesh settings as follows:

Wifi Mesh	TRUE	Set this TRUE to enable Wifi Mesh
Fixed Root	FALSE	Only set this true if you need to designate a specific PVH01 unit as the gateway for all the other PVH01 units. By default, they negotiate this automatically.
Is Designated Root	FALSE	Only set this true if Fixed Root is true AND this is the unit you wish to designate as the gateway for all the other PVH01 units.
Wifi LR	FALSE	Setting this option true MAY help to increase the range of the wifi between PVH01 units, at the cost of reduced throughput. It will NOT increase the range to the wifi base station.
Mesh AP Connections	10	This setting sets the limit of how many other PVH01 units may connect directly to this one. Recommend 10.
Mesh SSID	e2 03 c7 8c f9 27	This is the name of the mesh network the PVH01 units use to communicate to each other. It is 12 hexadecimal characters. It is suggested you generate this randomly. It MUST be the same for ALL units in the same mesh network.
Mesh Key	meshkeyy	This is the password of the mesh network the PVH01 units use to communicate to each other. It is 8-31 characters. It is suggested you generate this randomly. It MUST be the same for ALL units in the same mesh network.

5. Click 'Save'
6. Repeat for all units you wish to connect as part of the same mesh network.

## 6 System Settings

How and where to access and change the various system settings

- Many settings may be viewed and modified using the graphic display
- All settings may be viewed and modified using the Wifi AP mode web config interface. See 16 Wifi Access Point mode - configuration for details on using the web config interface

### 6.1 Real-time Clock

The Real Time Clock in the PVH01 supports all Australian timezones, and uses internet time servers (and GPS in the Mk2) to synchronise to the current time.

#### 6.1.1 Setting the timezone

The timezone may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the 'Settings' > 'Set Time' > 'Set Time Zone' page and select the desired Australian timezone from the list.
- To set using the web config interface, navigate to the 'Config' page and select the desired Australian Timezone from the options listed at 'Timezone'

#### 6.1.2 Setting the current time

The current time is normally automatically detected from an internet time server. However if the unit is not connected to the internet, it may be necessary to manually set the time.

- To set the current time: Navigate to the 'Settings' > 'Set Time' page on the graphic

display and press the +/- buttons to modify the Year, Month, Day, Hour, Minute and Second until the time displayed at the top of the page is accurate.

- Press 'Back' to set the modified time.
- Note that without an accessible time server, the timestamp in the (Mk1) PVH01 will drift

## 6.2 Input Filter

The input filter may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the 'Settings' > 'Vibration Settings' page and select the desired filter from the options.
- To set using the web config interface, navigate to the 'Config' page and select the desired filter from the options listed at 'Vibration Filter'

## 6.3 Record options

See 12 Select Measurement characteristics for details on the operation of these settings.

The Measurement timing settings may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the 'Settings' > 'General Settings' page and set the value of the desired options.
- To set the measurement interval using the graphic display: Navigate to the 'Settings' > 'General Settings' > 'Reporting Interval' page and select the desired reporting interval from the list.
- To set using the web config interface, navigate to the 'Config' page and set the 'Reporting Interval', 'Repeat Mode', 'Sync to time' and 'Auto Start on boot' options to the desired values.

## 6.4 Default Location

The default location is used if there is not a valid GPS position fix or if there is no GPS module installed. The default location may be set from the web config interface.

- To set using the web config interface, navigate to the 'Config' page and enter the desired latitude and longitude in the 'Default Latitude' and 'Default Longitude' fields.
- To view the default location on the graphic display: Navigate to the 'Settings' > 'Info' page and view the value of 'Lat' and 'Long'

## 6.5 Watchdogs

The PVH01 contains watchdog timers to monitor device status and trigger a system restart if there are persistent faults. The watchdog timers on the MQTT interface and on the uSD card interface may be enabled or disabled by the user.

The MQTT watchdog timer will, if enabled, trigger a system restart if MQTT connectivity is unavailable for a period of 60 minutes. It will trigger if the Wifi network has been unavailable for 60 minutes as without a working Wifi connection the MQTT connection will be unavailable. This is recommended to be enabled in a long-term logging situation.

The SD watchdog timer will, if enabled, trigger a system restart if the uSD card is unable to be opened for a period of 60 minutes. This is recommended to be enabled in a long-term logging situation.

Both watchdogs may be configured using the graphic display or the web config interface.

- To set the SD watchdog using the graphic display: Navigate to the 'Settings' > 'General Settings' page and enable 'SD card watchdog'.
- To set the SD watchdog using the web config interface, navigate to the 'Config' page and set the 'SD card watchdog' option to 'TRUE' and click 'Save'

## 6.6 Wifi and network Settings

The wifi settings may predominantly be configured and viewed using the web config interface, however some settings may also be configured using the graphic display. This is partly to prevent making privileged information (such as passwords) accessible easily through the graphic display, and also due to the impracticality of entering complex text data and authentication certificates on the small display.

- To view and set the available wifi and network settings using the graphic display: Navigate to the 'Settings' > 'Wifi Settings' page and view/set the value of the available options.
- To set the wifi and network settings using the web config interface, navigate to the 'Network' page and set the options to the desired values. See 20 Wifi Client mode – MQTT Data publication for an example of setting these options.

## 7 Data Management

There are two main channels through which the collected data may be accessed – the files saved onto the uSD card, and the IoT Wifi MQTT publication.

### 7.1 uSD card

Files are placed in directories on the SD card organised by date.

- In the root directory, there is a folder for the year (eg. 2020)
- In the year directory, there is a folder for the month (eg. 05)
- In the month directory, there is a folder for the day (eg. 18)
- Files are saved in the corresponding day directory
  - Manual measurements (eg. not periodic) are named according to the

date-time the recording started to the second. eg. 20200518-150832.csv

- Periodic measurements are split into a file for each hour, and are named according to the date-time they started to the hour. eg. 2020051815.csv
- Wave recordings are named according to the date-time **the wave** recording started to the millisecond. eg. 20200518-150850-394.csv

The units in which values are saved to the files are SI units. Thus:

- Acceleration is reported in  $m/s^2$
- Velocity is reported in  $m/s$
- Displacement is reported in  $m$

For the file format, see 32 Specifications

## 7.2 MQTT data publication

If the unit is configured to connect to a wifi network and a valid MQTT broker, data is published to the MQTT broker.

- Data is published at the end of the measurement interval
  - For a manually triggered recording, when the recording is stopped, the measurement results are published.
  - For a periodic measurement, the data is published at the end of every measurement interval.
- The published data may be formatted as either JSON (recommended) or CSV.

For the data format, see 32 Specifications

## 8 Extended Options

The PVH01 has several optional capabilities which may be purchased. After purchasing the desired option(s),

an unlock code will be delivered. This unlock code must be entered into the PVH01 to unlock the purchased features. Unlock codes are unique to the specific unit serial number they were purchased for.

- To enter the unlock code using the web config interface (preferred), see 18 Unlock Options with AP mode
- To enter the unlock code using the graphic display: Navigate to 'Settings' > 'Info' > 'Options' and type in the unlock code using the on screen keyboard.
  - To cancel the code entry and return to the Info screen, press the 'Cross' key
  - To apply the code, press the 'Tick' key.
    - If the code is valid and entered correctly, the user will be returned to the 'Info' screen, and the newly unlocked options will be black (instead of greyed out). Restart the unit to fully apply the changes.

- If the code is not not valid or not entered correctly, 'INVALID unlock code' will be indicated at the top of the screen. Check and correct the code and try again. In particular, check for where 1, I and l may have been interchanged, and likewise 0 and O.

## 8.1 Metrics Option

Adds Acceleration and Displacement metrics to the displayed, recorded and published data. See 15 Metrics Option

## 8.2 High Resolution Option

Adds time resolution options other than 15 minutes (1 second to 1 hour). See 15 High Resolution Option

### 8.3 Wave Record Option

Add ability to record and publish the velocity wave in all 3 axes upon the vibration level exceeding a preset threshold. See 15 Wave Record Option

unit to another to reach the primary wifi access point over a range greater than the unit may be able to reach independently.

See 23 Wifi Mesh mode – Multi-hop Wifi connection

### 8.4 Legacy Serial Option

Publish periodic vibration data on the USB-C serial UART interface in a format matching the AWA6258 vibration meter communications. The serial configuration is: 115200 baud, 8 data bits, No parity, 1 Stop bit (15200 8N1)

### 8.5 Mesh Wifi Option

Add Mesh Wifi communication option. This option allows units to forward wifi communications from one

## 9 Specifications

Channels	4 (R, T, V, VS)
Measured parameters	Peak (the peak instantaneous filtered value in the measurement period)

	RMS (the RMS of the vibration level over the measurement period)
	Acceleration ( $m/s^2$ )
	Velocity (m/s)
	Displacement (m)
Filters	Linear (0.315Hz - 500Hz)
	AS2187 (2.0Hz - 250Hz)
Noise floor (velocity)	0.1mm/s RMS
	0.25mm/s Peak
Noise floor (acceleration)	13.5mm/s <sup>2</sup> RMS
	50mm/s <sup>2</sup> Peak
Noise floor (displacement)	0.007mm RMS
	0.015mm Peak

## 9.1 JSON data format

The JSON format is primarily intended to be published over the MQTT interface and automatically processed by an internet service. It is however a text based

format which can be read by any computer system or determined user.

JSON is a format which uses key-value pairs, in a hierarchical structure.

### 9.1.1 Description

- The root level keys are as follows:

key	Format	Meaning
utc	Quoted string	Timestamp formatted as YYYY-MM-DD HH:mm:ss
utc_us	Number	Microseconds value of timestamp
localtime_offset	Number	Minutes difference between local time and utc
serial	Quoted string	Unit serial number
sensor	Quoted string	Sensor name (PVH01)
id	Quoted string	Sensor ID
lat	Decimal number	Latitude in decimal degrees
long	Decimal number	Longitude in decimal degrees
measurement_duration_s	Number	Duration of measurement in seconds
sd_percentage_free	Number	Percentage of SD card space remaining (0-99)
measurement	Array of JSON objects	Contains values from measurement

- The keys of the first element of the measurement array correspond to the values of the record and are as follows:

key	Format	Meaning
X	Array of JSON objects	Contains values for the X axis
Y	Array of JSON objects	Contains values for the Y axis
Z	Array of JSON objects	Contains values for the Z axis
VS	Array of JSON objects	Contains values for the VS axis

- The keys of the elements of the X, Y and Z objects are as follows:

key	Format	Meaning
accel	Array of JSON objects	Contains values for the X axis
vel	Array of JSON objects	Contains values for the Y axis
disp	Array of JSON objects	Contains values for the Z axis
freq	Number	Contains the dominant frequency for the axis

- The keys of the elements of the VS object is as follows:

key	Format	Meaning
accel	Array of JSON objects	Contains acceleration values for the parent axis
vel	Array of JSON objects	Contains velocity values for the parent axis
disp	Array of JSON objects	Contains displacement values for the parent axis

- The keys of the elements of the accel, vel and disp objects are as follows:

key	Format	Meaning
pk	Number	Contains the peak value for the parent axis and property.
rms	Number	Contains the rms value for the parent axis and property.

### 9.1.2 Example

```
[{ "utc":"2024-01-09 05:05:10",
  "utc_us":751, "localtime_offset":600,
  "serial":"58bf25a87e54", "id":"SE
  Test", "sensor":"PVH01",
```

```
"lat":0.000000, "long":0.000000,
  "measurement_duration_s":10,
  "filter":"FILTER_NONE",
  "measurement": {
  "X": {"accel": {"pk":835.636,
```



PVH01 Manual & User Guide v2.0beta

- Row 1 contains Serial number and ID
- Row 2 contains headings and labels.
- Rows 3 and onwards contain a periodic record of peak and rms vibration data.
- Column A Contains the timestamp of the start of the reading
- Column B-I contains the Acceleration values
  - Column B contains the X Acceleration Peak
  - Column C contains the Y Acceleration Peak
  - Column D contains the Z Acceleration Peak
  - Column E contains the VS Acceleration Peak
  - Column F contains the X Acceleration RMS
  - Column G contains the Y Acceleration RMS
  - Column H contains the Z Acceleration RMS
  - Column I contains the VS Acceleration RMS
- Column J-Q contains the Velocity values
  - Column J contains the X Velocity Peak
  - Column K contains the Y Velocity Peak
  - Column L contains the Z Velocity Peak
  - Column M contains the VS Velocity Peak
  - Column N contains the X Velocity RMS
  - Column O contains the Y Velocity RMS
  - Column P contains the Z Velocity RMS
  - Column Q contains the VS Velocity RMS

- Column R-Y contains the Displacement values.
  - Column R contains the X Displacement Peak
  - Column S contains the Y Displacement Peak
  - Column T contains the Z Displacement Peak
  - Column U contains the VS Displacement Peak
  - Column V contains the X Displacement RMS
  - Column W contains the Y Displacement RMS
  - Column X contains the Z Displacement RMS
  - Column Y contains the VS Displacement RMS

- Column Z-AB contains the dominant frequency values.
  - Column Z contains the X axis dominant frequency
  - Column AA contains the Y axis dominant frequency
  - Column AB contains the Z axis dominant frequency

## 9.2.2 Example

58bf25a87e54,SE Test

Timestamp,X\_Acc\_Pk,Y\_Acc\_Pk,Z\_Acc\_Pk,  
VS\_Acc\_Pk,X\_Acc\_RMS,Y\_Acc\_RMS,Z\_Acc\_R  
MS,VS\_Acc\_RMS,X\_Vel\_Pk,Y\_Vel\_Pk,Z\_Vel  
\_Pk,VS\_Vel\_Pk,X\_Vel\_RMS,Y\_Vel\_RMS,Z\_V  
el\_RMS,VS\_Vel\_RMS,X\_Disp\_Pk,Y\_Disp\_Pk  
,Z\_Disp\_Pk,VS\_Disp\_Pk,X\_Disp\_RMS,Y\_Di  
sp\_RMS,Z\_Disp\_RMS,VS\_Disp\_RMS,X\_Dom\_F  
req,Y\_Dom\_Freq,Z\_Dom\_Freq

PVH01 Manual & User Guide v2.0beta

'2024-01-09

07:00:00.000746',0.050011,0.053068,0.040869,0.057827,0.013252,0.012787,0.010930,0.021414,0.000375,0.000369,0.000288,0.000409,0.000110,0.000098,0.000085,0.000169,0.000026,0.000022,0.000023,0.000028,0.000008,0.000007,0.000006,0.000013,0.0,0.0,0.0

10695,0.021432,0.000340,0.000290,0.000276,0.000390,0.000106,0.000088,0.000080,0.000159,0.000021,0.000018,0.000022,0.000024,0.000009,0.000006,0.000007,0.000013,0.0,0.0,0.0

'2024-01-09

07:00:10.000736',0.058696,0.052286,0.038412,0.060640,0.013628,0.012747,0.010769,0.021546,0.000321,0.000303,0.000289,0.000396,0.000102,0.000094,0.000082,0.000161,0.000023,0.000020,0.000014,0.000026,0.000006,0.000007,0.000006,0.000011,0.0,0.0,0.0

'2024-01-09

07:00:20.000695',0.050504,0.050893,0.040315,0.052661,0.013461,0.012797,0.0