User Guide
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AMS Wireless Vibration Monitor

User Guide

EMERSON

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Patents

The product(s) described in this manual are covered under existing and pending patents.

Where to get help

AMS Machinery Manager Help

Launch AMS Machinery Manager and select **Help** from the main menu. The Help is also available on the Guardian website.

AMS Machinery Manager Manuals DVD

Your AMS Machinery Manager package includes a disc with user manuals in PDF format.

Software Registration

Phone:	Toll free 888.367.3774, option 2 (U.S. and Canada) +63.2.702.1111 (Rest of world)
Email:	wwcs.custserv@emerson.com
Web:	http://www.emerson.com/machineryhealthreg

Product Support

Emerson provides a variety of ways to reach your Product Support team to get the answers you need when you need them:

Phone	Toll free 800.833.8314 (U.S. and Canada) +1.512.832.3774 (Latin America) +63.2 702.1111 (Asia Pacific, Europe, and Middle East)
Email	Guardian.GSC@Emerson.com
Web	http://www.emerson.com/en-us/contact-us

To search for documentation, visit http://www.emerson.com.

To view toll free numbers for specific countries, visit http://www.emerson.com/technicalsupport.

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1 Introduction

1.1 Safety messages

Instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations.

The AMS Wireless Vibration Monitor complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

This device may not cause harmful interference, this device must accept any interference received, including interference that may cause undesired operation.

This device must be installed to ensure a minimum separation of 20 cm from all persons.

Refer to the following safety messages before performing an operation preceded by the warning symbol:

⚠ WARNING

Failure to follow these installation guidelines can result in death or serious injury. Only qualified personnel should install the AMS Wireless Vibration Monitor.

Explosions could result in death or serious injury:

- Before connecting a Field Communicator in an explosive environment, make sure the instruments are installed in accordance with applicable field wiring practices.
- Verify that the operating environment of the AMS Wireless Vibration Monitor is consistent with the appropriate hazardous locations certifications.

1.2 Symbols

Note
This symbol marks passages that contain important information.

⚠ CAUTION

This symbol marks operations that can lead to malfunctions or faulty measurements, but will not damage the device.

⚠ DANGER

This symbol indicates actions that can lead to property damage or personal injury.

The symbols on the device signify compliance to the following:

	Ukraine Restriction of Hazardous Substances (RoHS)

	Regulatory Compliance Mark Australia
	China Restriction of Hazardous Substances (RoHS)
	Lithium-ion cell recyclable
	The documentation must be completely read and understood before installing and commissioning the device. Observe all safety-related instructions in this document.
	Waste Electronic and Electrical Equipment Directive

1.3 Considerations

General

Electrical vibration sensors, such as accelerometers, produce low-level signals proportional to their sensed vibration. With simple HART configuration, the monitor converts the low-level sensor signal to a wireless-enabled signal.

Commissioning

The monitor can be commissioned before or after installation. You can commission it on the bench before installation to ensure proper operation and to be familiar with its functions.

Make sure the instruments are installed in accordance with applicable field wiring practices.

The AMS Wireless Vibration Monitor is powered whenever the battery is installed.

Installation

When choosing an installation location and position, provide ample access to the monitor. The device should be mounted vertically, perpendicular to the shaft and on the bearing case. Horizontal mounting is also an option. For more information, see Installation.

Battery

The AMS Wireless Vibration Monitor uses an off-the-shelf Tadiran TL-4920/VE battery.

The battery comes with the device but it is not connected when the device is shipped. You need to connect the battery before configuring and installing the device.

Environmental

The monitor operates within specifications for ambient temperatures between –40°F and 185°F (–40°C and 85°C).

Verify that the operating environment of the monitor is consistent with the appropriate hazardous location certifications.

1.4 Return of materials

You may need to ship the device to an Emerson Product Service Center for return or replacement in case of warranty issues. Before shipping, contact Emerson Product Support to obtain a Return Materials Authorization (RMA) number and receive additional instructions.

Emerson Product Support contact information:

Phone	Toll free 800.833.8314 (U.S. and Canada) +1.512.832.3774 (Latin America) +63.2 702.1111 (Asia Pacific, Europe, and Middle East)
Email	Guardian.GSC@Emerson.com
Web	http://www.emerson.com/en-us/contact-us

Note
If the monitor has been exposed to hazardous substances, a Material Safety Data Sheet (MSDS) must be included with the returned materials. An MSDS is required by law to be available to people exposed to specific hazardous substances.

Shipping considerations for wireless products (Lithium Batteries)

- The unit was shipped to you with the battery inside but disconnected. Connect the battery for proper operation.
- Primary lithium batteries are regulated in transportation by the U.S. Department of Transportation, and are also covered by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization), and ADR (European Ground Transportation of Dangerous Goods).
- It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Please consult current regulations and requirements before shipping.

1.5 Overview

The manual

This User Guide applies to the AMS Wireless Vibration Monitor, a triaxial vibration measurement device designed for use on a WirelessHART network.

Use this manual to install, operate, and maintain the device.

The monitor

The AMS Wireless Vibration Monitor is an installation-ready solution that monitors vibration and temperature in rotating equipment in hard-to-reach locations.

The AMS Wireless Vibration Monitor also provides a variety of monitor and sensor configurations. It has built-in radio and four integral sensors:

- X and Y MEMS
- Z MEMS High Sensitivity, High Bandwidth (Vibration & PeakVue)
- Temperature sensor

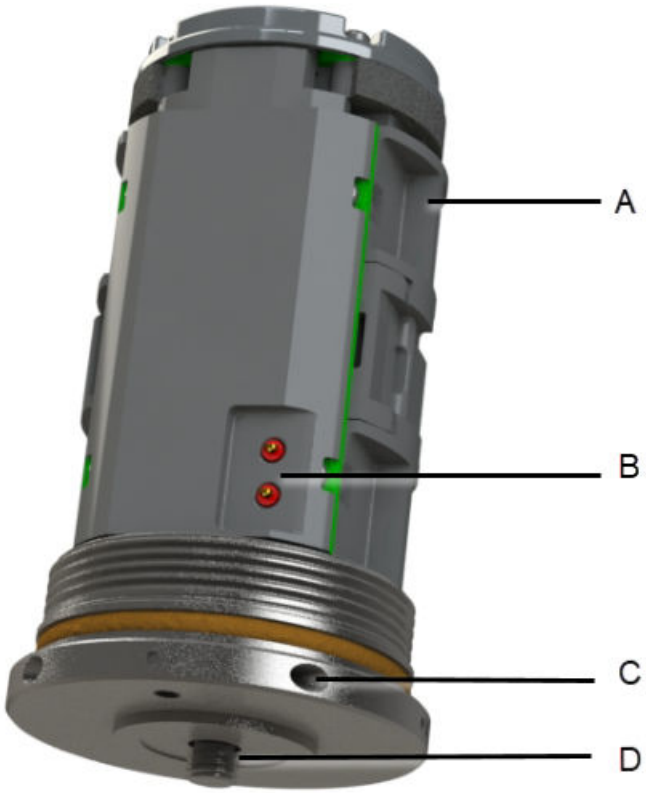
The Z accelerometer has the highest bandwidth and is considered the primary sensor. The temperature sensor is designed to measure the temperature near the mounting point (that is, the machine surface).

Other features include:

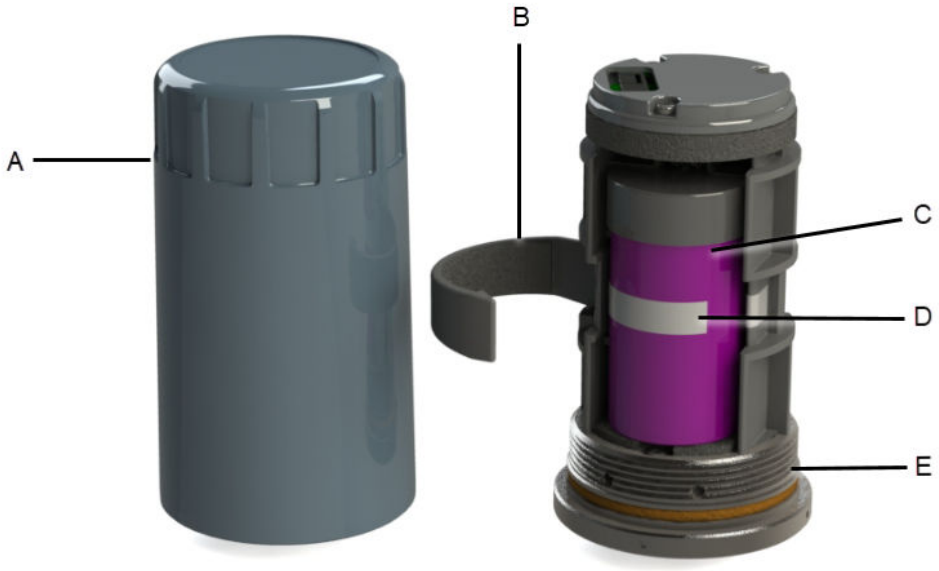
- Support for up to 13 device variables with up to three user-configurable alerts for each process variable. Any device variable can be configured as any process variable (PV, SV, TV, QV).
- Support for storage of Waveform/Spectrum directly in AMS Machine Works
- Wireless output with >99% data reliability, delivering rich HART data, protected by industry leading security (when operated as part of a well-formed network)

The device uses an off-the-shelf battery contained in the device which is easily removable for device installation and replacement.

Parts of the monitor



A. Chassis
B. HART Terminals
C. Orientation hole
D. Mounting screw



A. Cover
B. Battery clamp
C. Battery
D. Battery pull tab
E. Base O-ring

Device revision information

Revision	Current level	Description
Universal	7	This is the HART version the monitor supports.
Field device[1]	1	This is the major revision of the monitor and corresponds with a major interface release. When using AMS Device Manager, this revision can be found on the screen title.
Software	56	This is the current software version. The software may be occasionally modified to refine functionality. When major functionality is added, the device revision increases.
Hardware	2	This is the hardware revision.
DD	1	This is the Device Descriptor (DD) revision. The device descriptor is primarily used for configuring devices in the field.

1 *If you have an older device revision, a factory upgrade may be possible in some cases. Contact Product Support for more information.*

You can also view the revision information in AMS Device Manager and Trex Communicator.

Figure 1-1: Revision numbers in AMS Device Manager

1.6 Device variables

The device supports the following measurements.

Device variable index	Device variables
0	Z-Velocity
1	Z-Peakvue
2	Machine Temperature
3	Supply Voltage
4	X-Velocity (Triax Mode license required)
5	Y-Velocity (Triax Mode license required)
6	IB1 (Velocity) (Advanced Diagnostics license required)
7	IB2 (Velocity) (Advanced Diagnostics license required)
8	IB3 (Acceleration) (Advanced Diagnostics license required)
9	IB4 (Accleration) (Advanced Diagnostics license required)
10	Speed Estimate (Advanced Diagnostics license and valid speed required)
11	Mechanical Condition (Advanced Diagnostics license and valid speed required
12	Lubrication Condition (Advanced Diagnostics license and valid speed required

1.7 Variable mappings

Any of the device variables can be configured as a process variable.

The process variables and their default values are as follows.

Table 1-1: Process Variables

Process Variable	Default
PV	Z-axis Overall
SV	X-axis Overall
TV	Y-axis Overall
QV	Z-axis PeakVue

Table 1-2: Device Variables

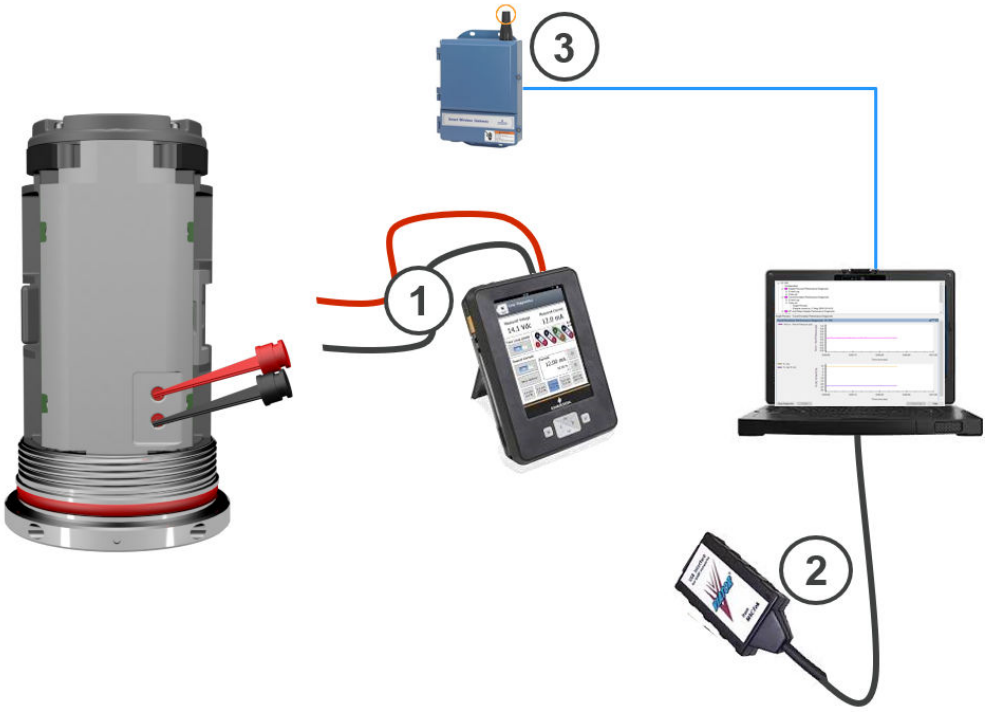
Device Variables		Process Variables
X-axis Overall	Any of the 13 Device Variables can be configured as a Process Variable	PV
Y-axis Overall		SV
Z-axis Overall		TV
Z-axis PeakVue		QV
Velocity Parameter 1		
Velocity Parameter 2		
Acceleration Parameter 1		
Acceleration Parameter 2		
Bearing/Mechanical Severity		
Lubrication Severity		
Calculated Speed		
Skin Temperature		
Supply Voltage		

2 Configuration

2.1 Setup overview

Unless the AMS Wireless Vibration Monitor is purchased pre-configured from the factory, it needs to be configured prior to installation at the facility or measurement location.

There are three possible setups to configure the device:



1. Connect the device to a field communicator, and then configure the device using the field communicator.

   Note
   This setup is recommended if you are in a hazardous area.

2. Connect the device to a computer through a HART modem, and then configure the device using AMS Device Manager.

   Note
   The HART modem is purchased separately.

3. Connect the device to a computer through a wireless gateway and then configure the device using AMS Device Manager.

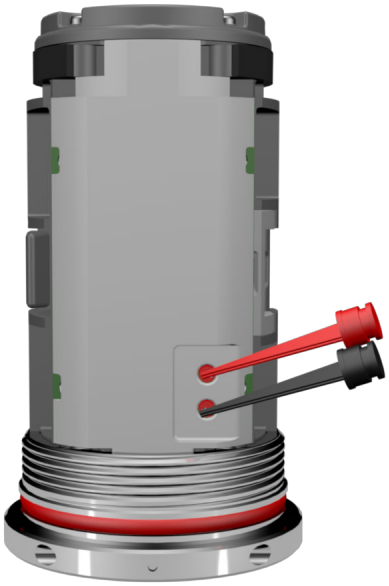
Note
This setup is recommended for standard device configuration.

2.2 Pre-configuration

The AMS Wireless Vibration Monitor is shipped with the battery disconnected from the device to comply with safety requirements. You need to connect the battery before you can configure the device. Remove the battery after configuration to avoid depleting it.

Procedure

1. Use your hands to unscrew and remove the blue cover.
   This exposes the HART ports.

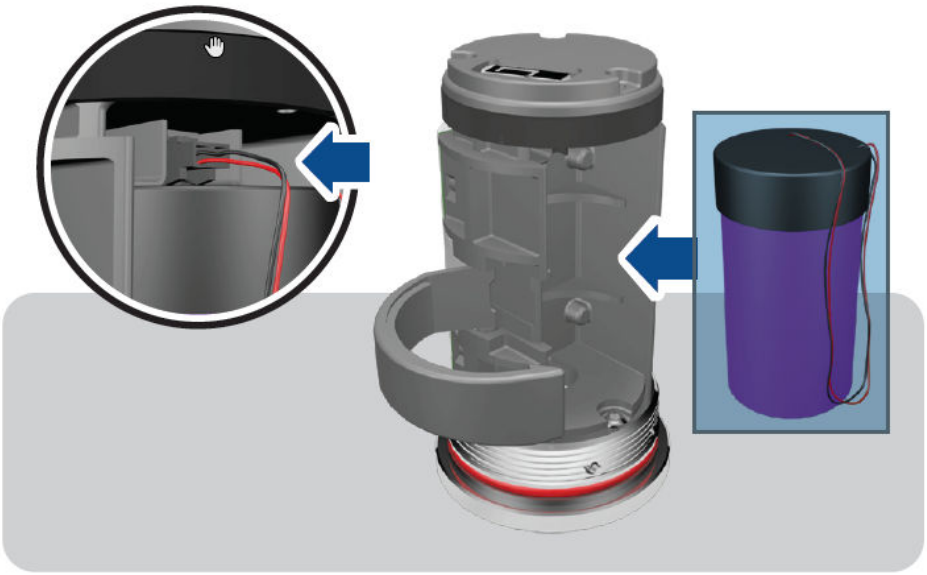


   Use an Allen wrench or a small screwdriver and put it through the Orientation hole to use as leverage while loosening the cover.

⚠ CAUTION

Exercise caution when using your bare hands to remove the cover.

2. Remove the battery with the pull tab.
3. Locate the battery connector and plug it into the socket on the device as shown.



4. Replace the battery. Tuck the wires against the battery and lock them into place.
5. Mount the cover and then tighten it.

Note
To avoid depleting the battery, disconnect it when the device is not in use. If you have configured the device and network but are not ready to commission it, remove the battery to extend its operating life. Reconnect the battery when you are ready to install the device.

2.3 Configuration overview

Configure the device to control the following operations:

- How measurement results are reported and how often are they reported
- How and when alerts are generated
- Set the upper and lower limits of the alerts
- Set the units of measurement for the parameters
- Set the primary variable, secondary variable, tertiary variable, and quarternary variable

You can change these configurations from AMS Device Manager or from a field communicator such as Trex Communicator.

To view the default values, see Configuration defaults.

Note
The specific user interface for performing the configuration varies depending on the host used.

Procedure

1. **Connect to a computer or field communicator.**

   You need to connect to a wired connection to set the wireless credentials.

   For more information, see Connect to a wired HART interface.

2. **Set the wireless network credentials (Network ID and Join Key) using wired connection.**

   The monitor has a default Network ID and Join Key. You can change the network credentials in the gateway that you used for configuration. All devices should join the network once the battery is connected.

   For more information, see Set the wireless network configuration.

   After the device has joined the network, you can complete the rest of the configuration steps over a wireless connection.

3. ***(Optional)* Name the device (Tag and Device Description).**

   By default, the tag is VXAABBCC, where AABBCC: is the unique device ID. The device joins the network and operates correctly even if no changes are made, but it is recommended to name the device something meaningful for the specific application.

4. **Specify the units (English or metric) that will be used for each parameter.**

   By default, units are set to English.

5. **Specify which measurements (velocity, temperature, etc.) correspond to the process variables PV, SV, TV, and QV. Specify the units (English or metric) for each parameter.**

   By default, PV corresponds to Z-axis overall, SV is X-axis overall, TV is Y-axis overall, and QV is Z-axis PeakVue.

6. **Specify alert levels.**

   Determine the thresholds at which measurement alerts will display and determine the behavior of device alerts. See the alert limits in Device variable alert limits.

7. **Specify the update rate.**

   The default update rate is once every 60 minutes. A faster update rate is not recommended as it significantly reduces battery life.

8. **Configure trending of parameters.**

   You can trend parameters in multiple locations such as in a plant historian, in AMS Machine Works, and in a DCS control system.

2.3.1 Connect to a wired HART interface

You need to initially connect the device to a wired HART interface to define the credentials that allow it to communicate on a wireless network. You can also define other device configurations such as sensor type and alert thresholds at this time.

Notes

Use the wired HART interface only for configuration. Dynamic variables (such as measured vibration parameters) are not updated when communicating on the wired interface.

Procedure

1. Locate the terminals for the communication port on the opposite side of the device.
2. Connect a configuration device to the terminals such as a computer running AMS Device Manager with a HART™ modem or an AMS Trex Communicator.
3. Configure the device.
   - To configure the device using AMS Device Manager, see Configuration with AMS Device Manager.

   - To configure the device using AMS Trex Communicator, see Configure with Trex Communicator.

Press **Send** to send configuration changes to the monitor.

2.3.2 Set the wireless network configuration

This enables the monitor to communicate with the Emerson Wireless Gateway and with other systems. This is the wireless equivalent of connecting wires from a transmitter to a control system input.

Procedure

1. From the Emerson Wireless Gateway, click **System Settings** → **Network** → **Network Settings** to obtain the Network ID and Join Key.

2. Using a field communicator or AMS Device Manager with a wired modem, enter the Network ID and Join Key so that they match the Network ID and Join Key from the Emerson Wireless Gateway.

Note
If the Network ID and Join Key are not identical to the gateway settings, the AMS Wireless Vibration Monitor will not communicate with the network.

2.4 Configuration with AMS Device Manager

2.4.1 Configure wireless network credentials

Prerequisites

Before performing operations in AMS Device Manager, first scan the AMS Wireless Vibration Monitor with a wired HART modem. Right-click the HART Modem icon in Device Explorer and select **Scan All Devices**.

Note
Configuring the wireless network is only applicable using a wired HART modem and cannot be done using WirelessHART devices.

Procedure

1. In AMS Device Manager, right-click AMS Wireless Vibration Monitor and then select **Methods → Join Network**.
2. Enter the network ID for the wireless network in the Join Device to Network screen and click **Next**.

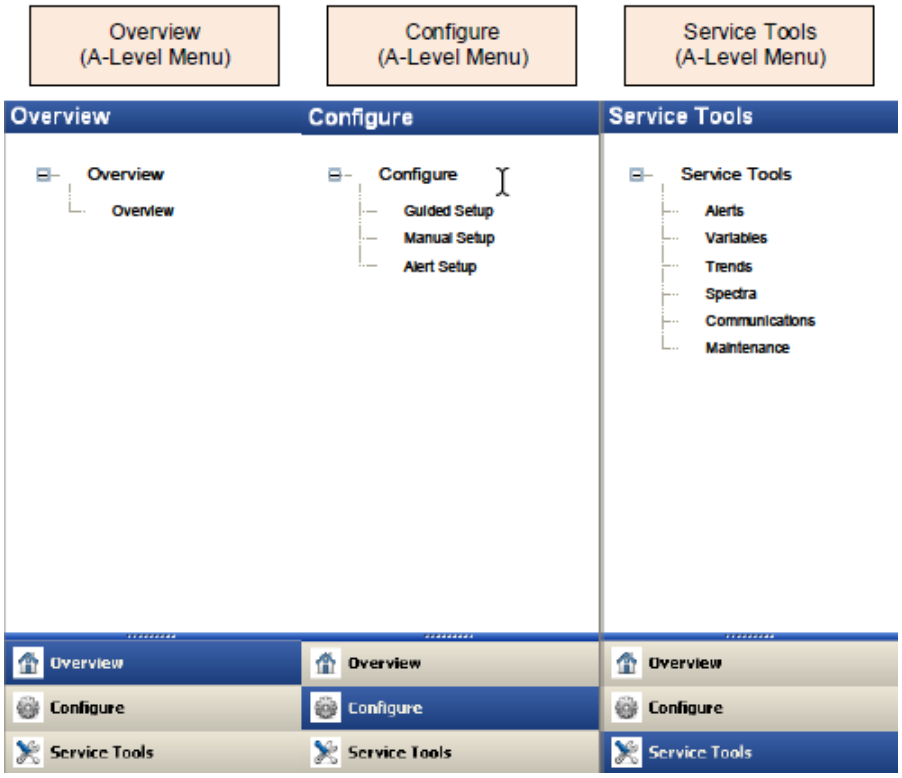
   You can obtain the network ID from the Emerson Wireless Gateway web server. Click **Setup → Network → Settings**.
3. Enter the Join Key in the screens that follow, and click **Next**.
4. Select the **Accept new join key** option, and click **Next**.
5. Click **Finish** when done.

2.4.2 Main navigation

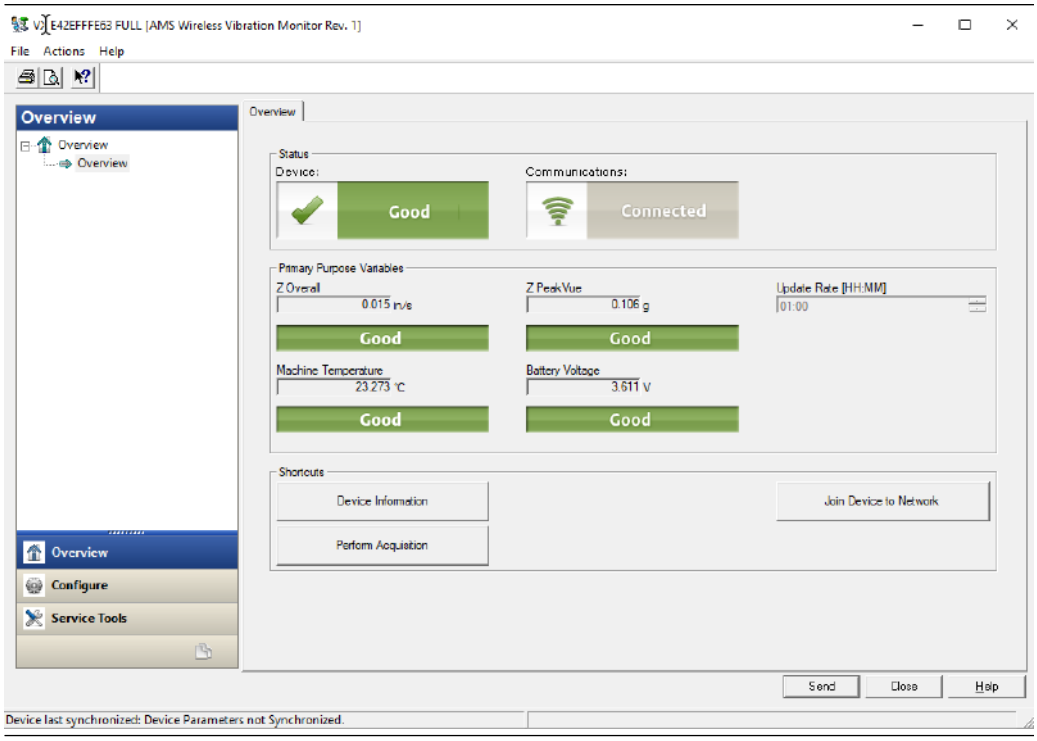
The main navigation page provides quick links to the Overview, Configure, and Service Tools menus, as well as to other context menus available for the device.

In the Device Explorer view, select the wireless network where the transmitter is connected and right-click the transmitter to display the context menus.

Figure 2-1: AMS Wireless Vibration Monitor Main Navigation



2.4.3 Overview menu



The Overview menu provides a glimpse of the status of the AMS Wireless Vibration Monitor, including the status of the connection to the wireless network, and a summary of the primary variables, machine temperature, battery voltage, and update rate.

From this menu, you can access the Configure menu and the Service Tools.

You can also access these shortcuts:

- Device Information
- Perform Acquisition
- Join Device to Network

2.4.4 Configure menu

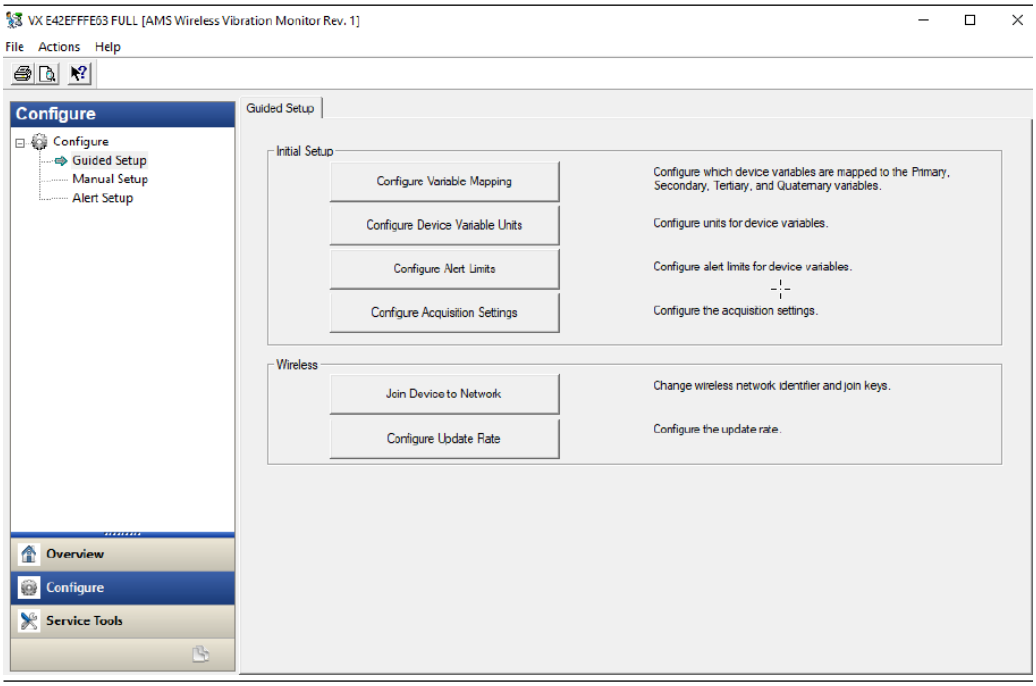
Use this menu to configure sensors, variable mappings, units and alert limits.

There are two options to configure the device. It is advisable to use Guided Setup.

Important
To be able to edit configuration settings, select **Current** in the Time drop-down menu at the bottom of the screen.

Guided setup

This option lets you configure device settings in a guided step-by-step process. Click each of the buttons under Initial Setup to complete the guided setup.



Click **Configure Variable Mapping** to display or specify which measurements are reported as the Primary, Secondary, Tertiary, and Quaternary variables.

Click **Configure Device Variable Units** to configure the units for device variables.

Click **Configure Alert Limits** to define the lower range and upper range values and alert limits for Advisory, Maintenance, and Failure for each of the process variables. You can also configure alert reporting from here.

Click **Configure Acquisition Settings** to set the acquisiton settings.

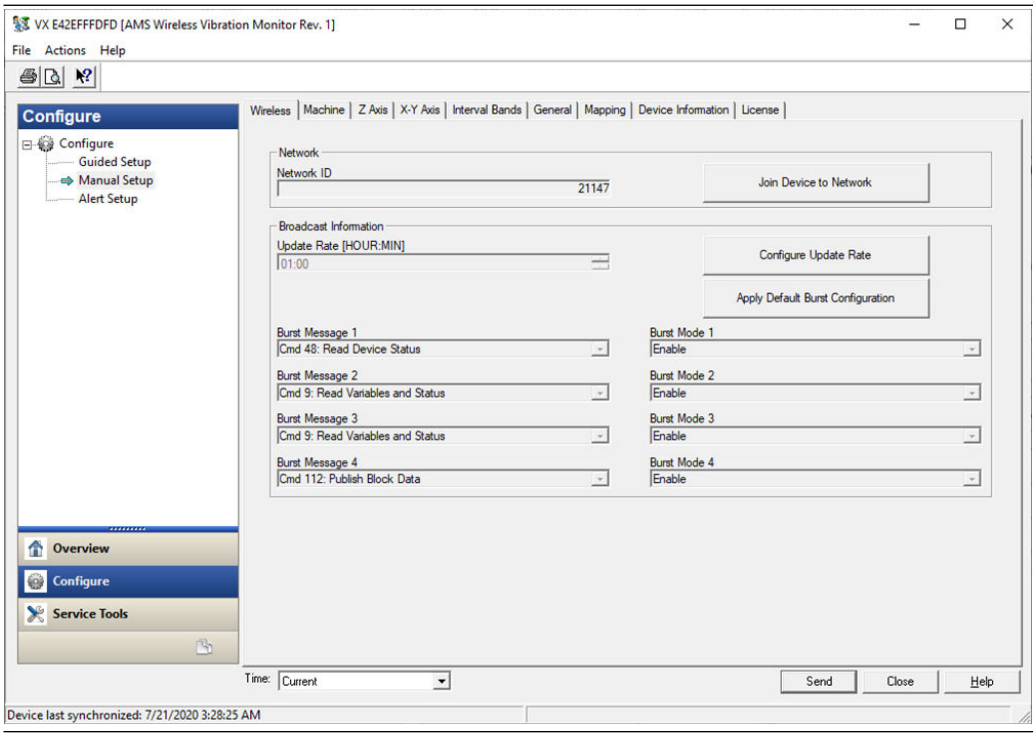
Click **Join Device to Network** to enter network identifiers and join keys that will enable the device to join a wireless network.

Click **Configure Update Rate** to set how often the device acquires and reports new measurements (update rate) and to specify the number of times the transmitter skips data acquisitions between updates to the gateway.

Manual setup

In this option, you have to define the settings in several tabs as shown below.

Wireless tab



Click **Join Device to Network** to enter network identifiers and join keys that will enable the monitor to join a wireless network.

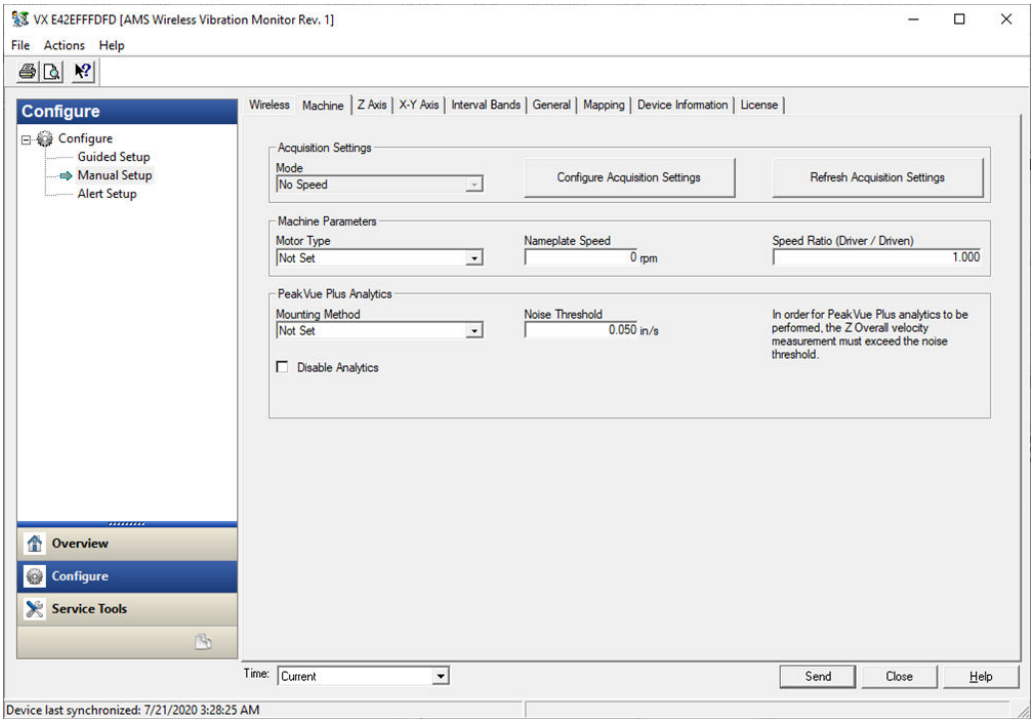
Click **Configure Update Rate** to set how often the device acquires and reports new measurements (update rate) and to specify the number of times the monitor skips data acquisitions between updates to the gateway.

Click **Apply Default Burst Configuration** to reset the burst configuration to default values.

Note

The burst messages are not individually controllable via the DD.

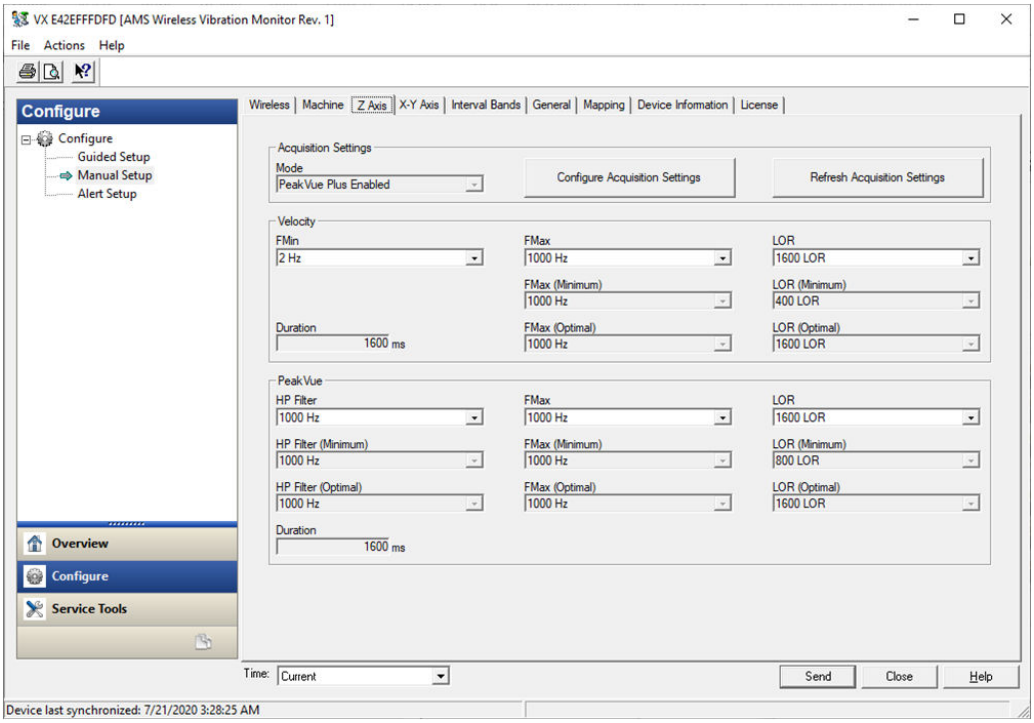
Machine tab



Click **Configure Acquisiton Settings** to configure the parameters for the specific sensor.

Click **Refresh Acquisition Time** to reset the parameters to default values.

Z Axis tab

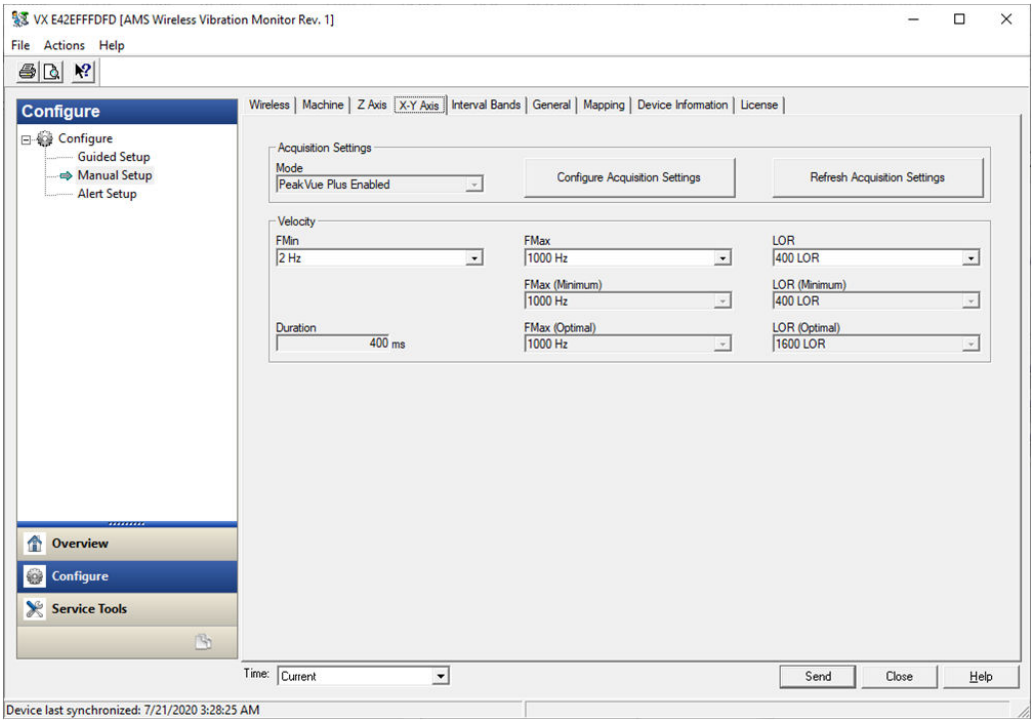


Click **Configure Acquisiton Settings** to configure the parameters for the specific sensor.

Click **Refresh Acquisition Time** to reset the parameters to default values.

When configured with speed (which requires the Advanced Diagnostics License), the optimal and minimum values are displayed.

X-Y Axis tab



Click **Configure Acquisiton Settings** to configure the parameters for the specific sensor.

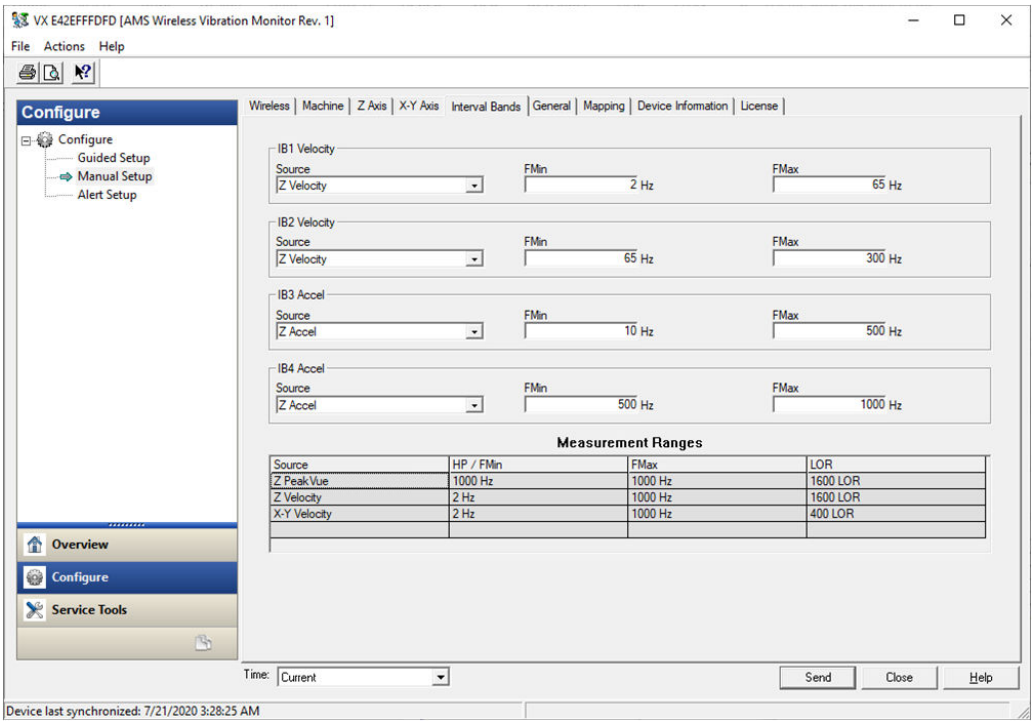
Click **Refresh Acquisition Time** to reset the parameters to default values.

When configured with speed (which requires the Advanced Diagnostics License), the optimal and minimum values are displayed.

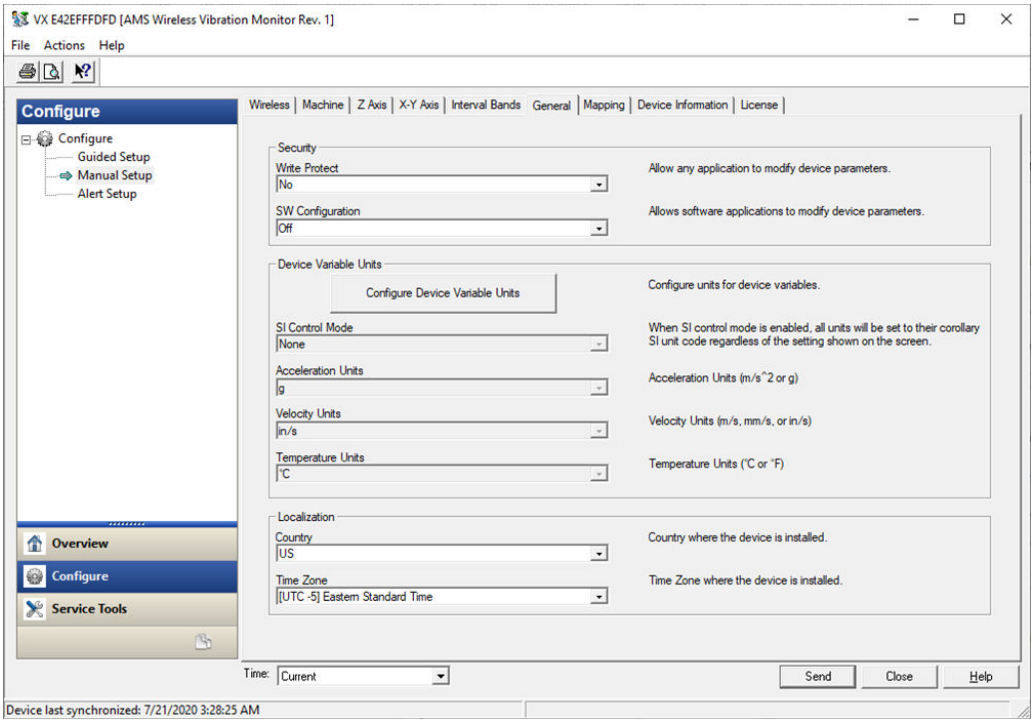
Interval Bands tab

This tab shows the measurement ranges for the Z PeakVue, Z Velocity, and X-Y Velocity and effectively bound FMin and FMax for the selected source.

The device enforces these ranges and forces them to the bounded values. This was designed to never allow bad configuration.



General tab



Write Protect—Allow or block an application from modifying the device parameters.

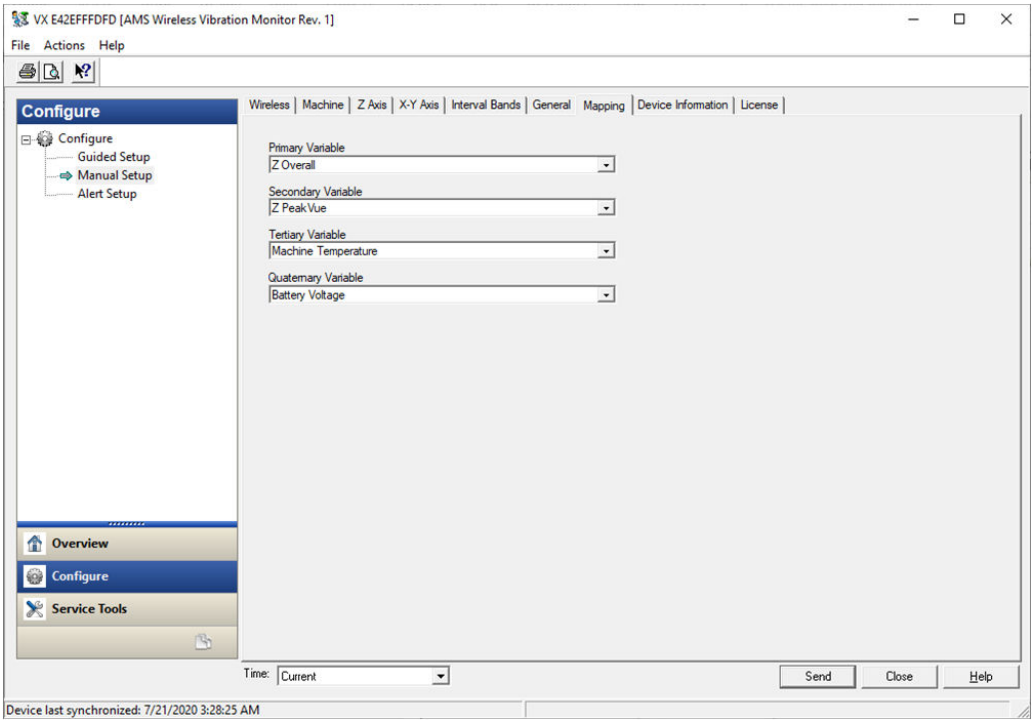
SW Configuration—Allow or block software applications to modify the device parameters.

Configure Device Variable Units—Specify the units of measurement for acceleration, velocity, and temperature.

Localization—Set the country and timezone where the device is located.

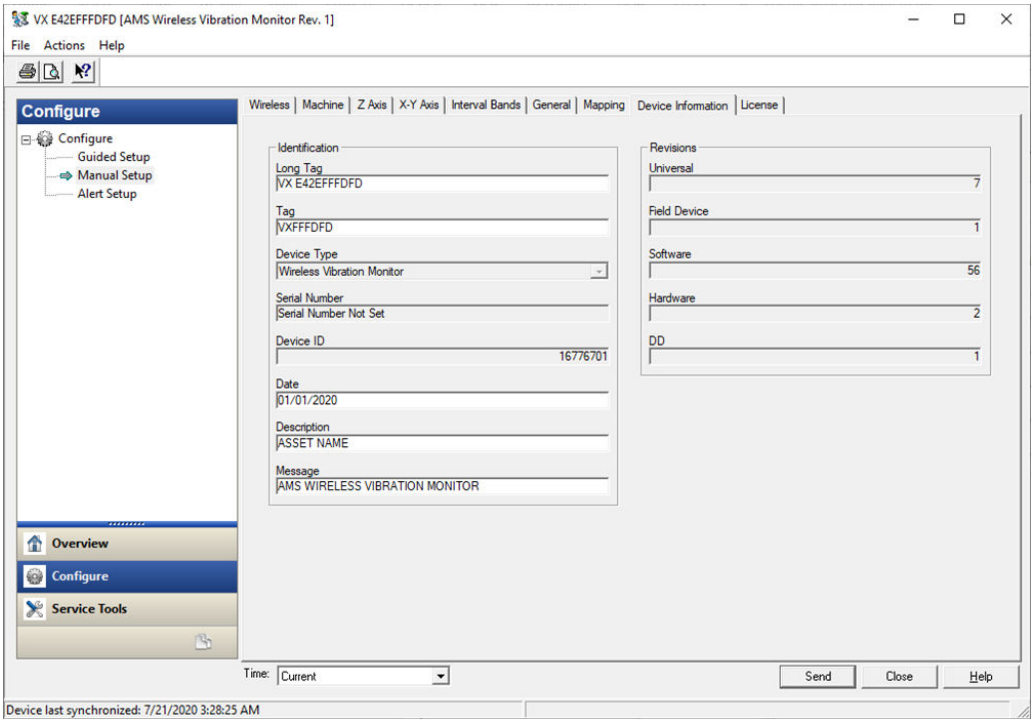
Mapping tab

Use this menu to set the PV, SV, TV, and QV.



Device Information tab

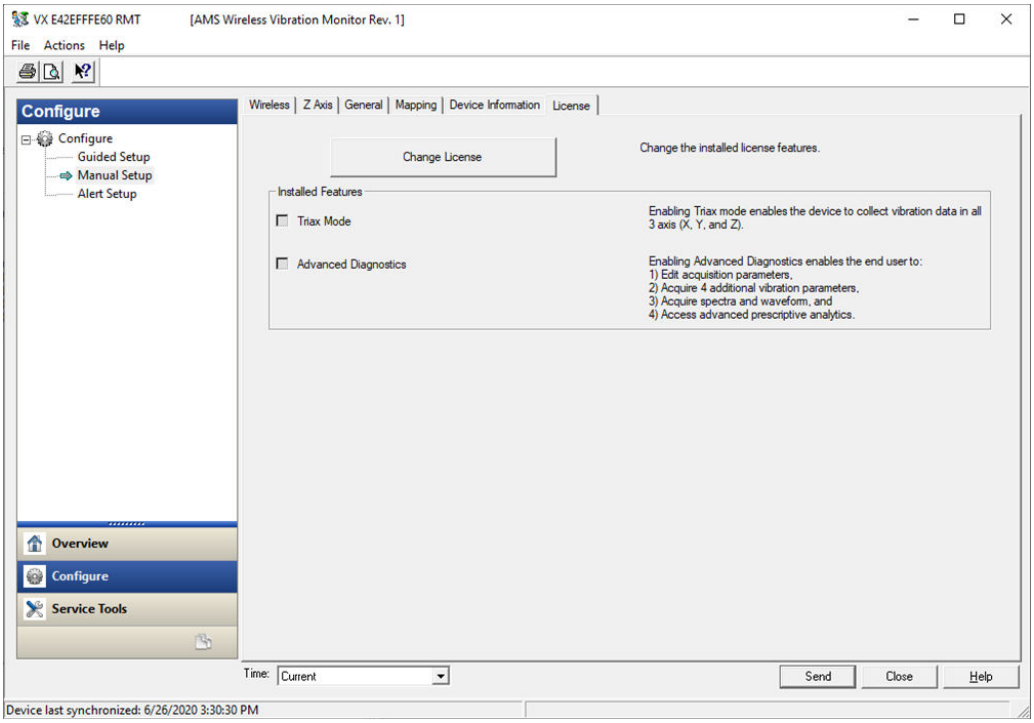
This window shows relevant device information such as the serial number, device identifier, and revision numbers.



Identification—displays the device tag, long tag, device type, serial number, device identifier, date, and device description.

Revision Numbers—displays the universal, field device, software, hardware, and DD revision numbers.

License tab



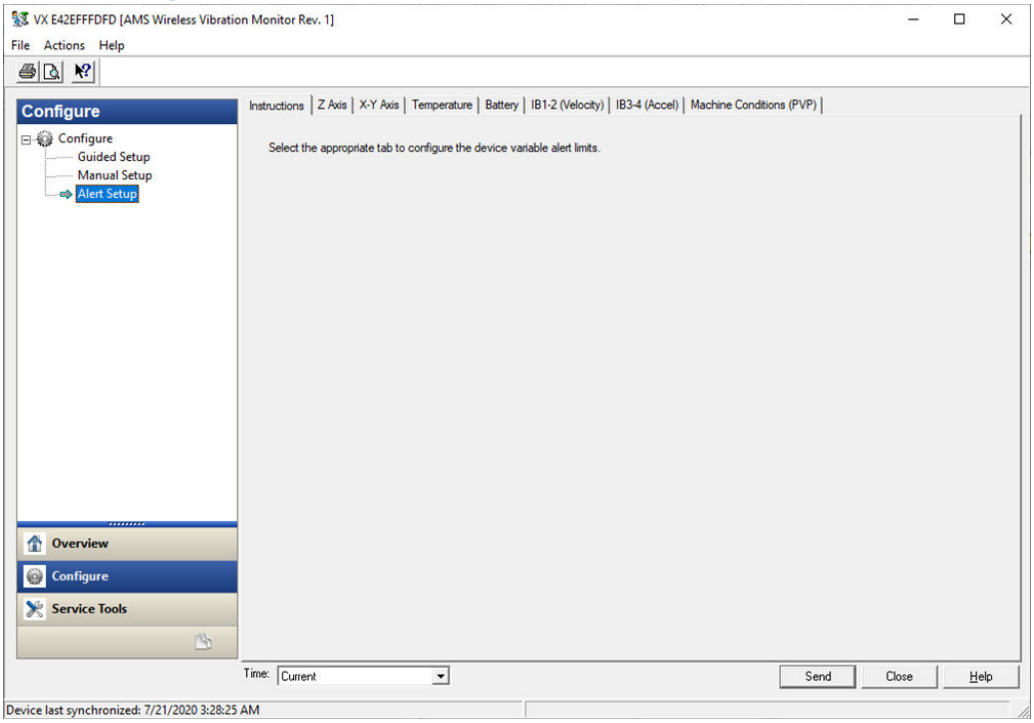
Change License—This option lets you upgrade the device license. Downgrading is not allowed. When the device is fully licensed, this option is not visible to the user.

Installed Features

The device has 2 license options:

- **Triax Mode**—Enabling this mode allows the device to collect vibration data in all axis (X, Y, and Z).
- **Advanced Diagnostic**—Enabling this mode lets you edit acquisition parameters, acquire four additional vibration parameters, acquire spectra and waveform, access advanced prescriptive analytics.

Alert setup

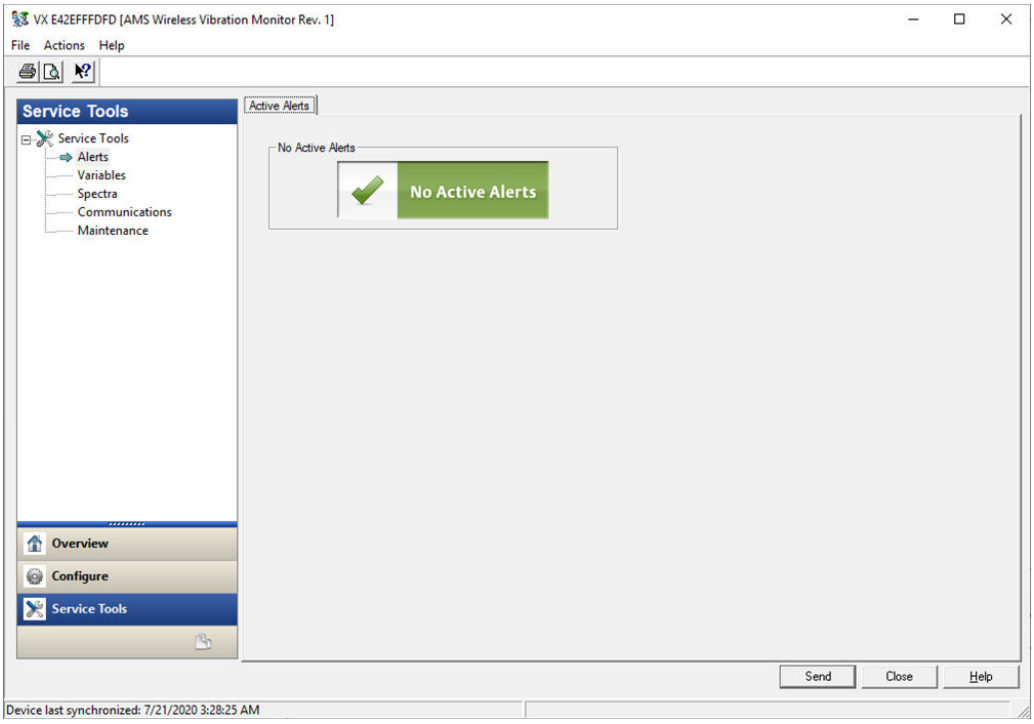


Use this menu to configure the alert limits of the device variables. Each tab lets you configure the units of each variable or set it back to the default values. All alerts are configured from highest value to lowest value. Depending on the alert type, this may mean the fail or the advise follows the range upper.

2.4.5 Service Tools

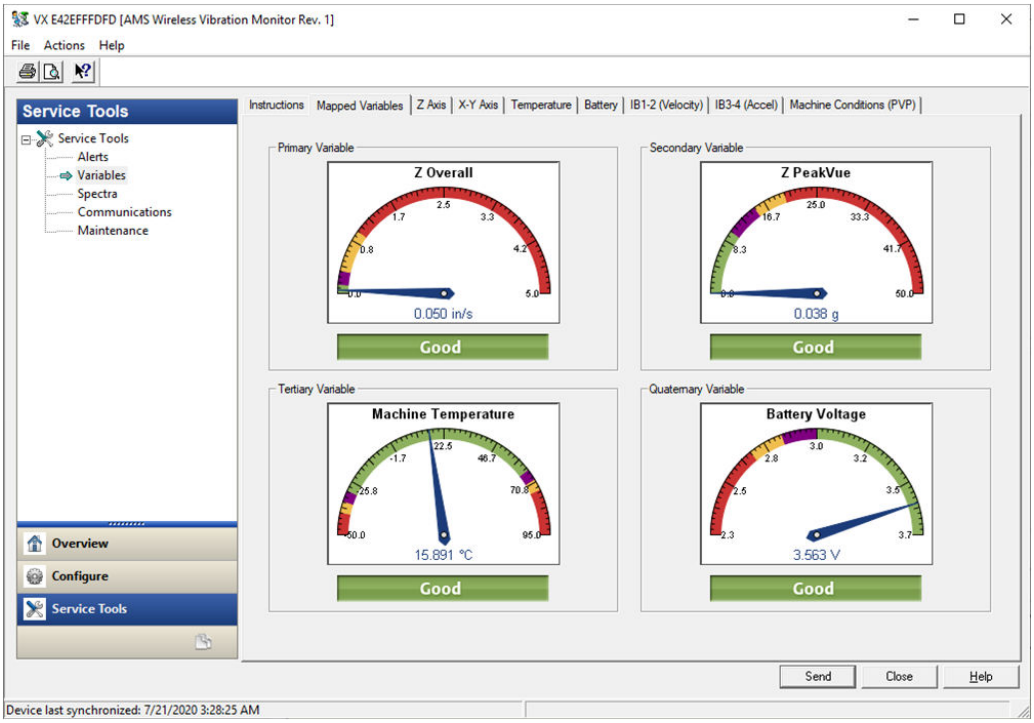
Alerts

This menu displays alert conditions. These include hardware and software malfunctions or parameters with values beyond specifications. Only active alerts are visible.



Variables

This tab lets you see the graphical gauge for each device variable.

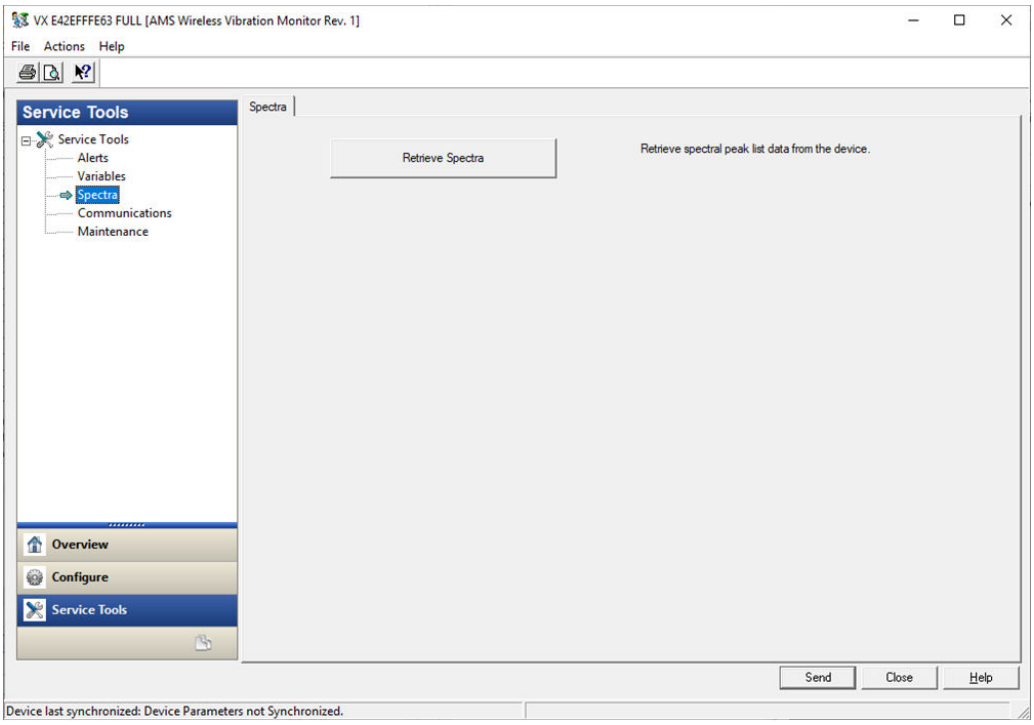


Click **Mapped Variables** to display graphical gauges of the PV, SV, TV, and QV.

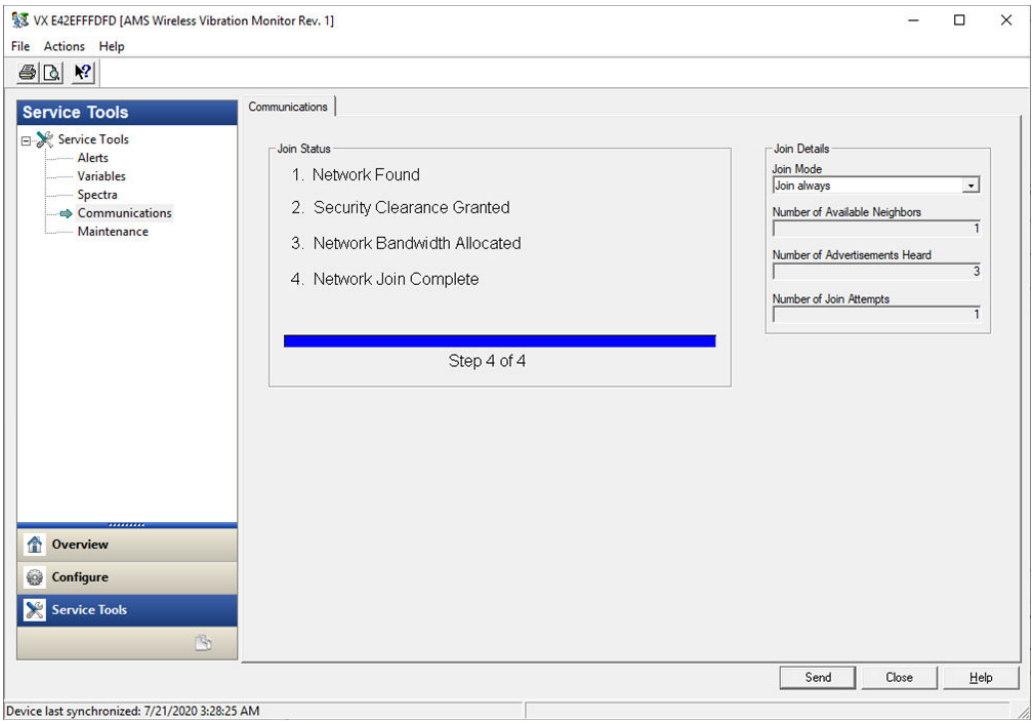
Click the tabs for each parameter to view graphical gauges for each of the parameters.

Spectra

This tab allows you to retrieve spectral data from the device. It is only visible if the Advanced Diagnostics license is enabled



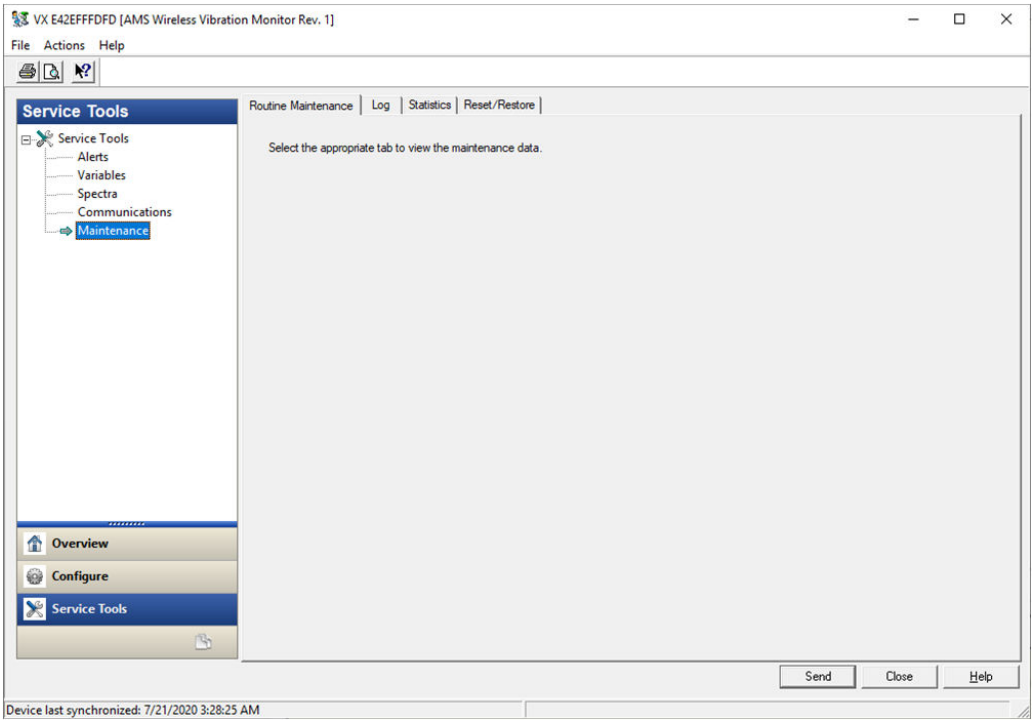
Communications tab



This tab shows the status and details of the device joining a network.

Maintenance tab

Use this tab to manage the device maintenance and log settings.



Click **Routine Maintenance** to view device statistics and restore the device to default settings.

Log to display events such as measurements, HART transmissions, and wake actions.

Click **Log Configuration** to configure event logging options. Data from event logs are useful during a debug process.

Click **Device Statistics** to display statistics related to radio transmission operation such as communication interval between data requests.

Click **Reset/Restore** to reset the device or to restore factory default settings.

2.5 Configure with Trex Communicator

You can configure the monitor using a field communicator such as the AMS Trex Communicator. For instructions on using the AMS Trex, refer to the AMS Trex Device Communicator User Guide.

A Rev 1 DD is required when using a field communicator to configure the AMS Wireless Vibration Monitor. Refer to the Field Communicator User's Manual for more details on DDs or go to https://www.emerson.com/en-us/catalog/ams-trex-device-communicator for instructions on adding a DD for AMS Wireless Vibration Monitor.

2.6 Configuration options

2.6.1 Measurement parameter units

The table below shows the measurement parameters and units that can be configured for each parameter.

Table 2-1: Measurement parameter units

Parameter	Units
Acceleration	m/s
Velocity	m/s mm/s in/s
Temperature	°C °F
Speed	rpm
Supply Voltage	V

2.6.2 Configuration defaults

Table 2-2: Configuration Values

Configuration option	Default value
Network ID	1234
Join Key	12340000 00000000 00000000 00000000
Message	WIRELESS VIBRATION TRANSMITTER
Description	ASSET NAME
Default Long Tag Format	VX WWYYTTTTTT
Default Short Tag Format	VXAABBCC
Update Rate	60 minutes
Mounting Method	Not Set
Motor Type	Not Set
Line Frequency	Not Set
VFD	Not Set
Machine Noise Threshold	0.05 in/sec
Nameplate Speed RPM	0 rpm
Driver/Driven Ratio	1
X_YLOR	1600 lines
X_YFMIN	2 Hz

Table 2-2: Configuration Values *(continued)*

Configuration option	Default value
X_YFMAX	1000 Hz
Z LOR	1600 lines
Z FMIN	1000 Hz
Z FMAX	1000 Hz
Z Peakvue LOR	Z velocity spectrum
Z Peakvue HP Filter	2
Z Peakvue FMAX	65
Velocity Band 1 Source	Z velocity spectrum
Velocity Band 1 Start	2
Velocity Band 1 Stop	65
Velocity Band 2 Source	Z velocity spectrum
Velocity Band 2 Start	65
Velocity Band 2 Stop	300
Acceleration Band 1 Source	Z acceleration spectrum
Acceleration Band 1 Start	10
Acceleration Band 1 Stop	500
Acceleration Band 2 Source	Z acceleration spectrum
Acceleration Band 2 Start	500
Acceleration Band 2 Stop	1000

2.6.3 Publish mode

The device publishes all device variables and status in three bursts. In cases where a third party host or other control system configures the burst configuration in a custom mode, the DD allows the user to reset the burst configuration to the default burst mode.

However, it is strongly recommended that the device bursting not be manipulated as it has been optimized to provide all device variables and status bytes, hence allowing any potential data from the device to be cached in the gateway, minimizing opportunity for errant communication from a 3rd party host or other control system to wake the device due to burst misconfiguration.

2.6.4 Update rate

The default update rate is 60 minutes. This is the maximum (fastest) recommended update rate. You can change this at commissioning or at any time through AMS Device Manager, the AMS Trex Communicator, or the Smart Wireless gateway web server.

The update rate can be set from 1 minute to 60 minutes (with 1-second resolution) and from 1 hour to 24 hours (with 1-hour resolution, always rounding to the next hour).

When the update rate is greater than 1 hour, the device will publish the last measurement every hour (meeting the HART requirement to at least publish data once / hour) and will publish the new data set on the update rate.

Reducing the update rate minimizes power consumption and extends the life of the battery.

Note
If the device is configured to publish at the fastest allowable update rate (once per minute), the battery is expected to last only about 2-3 months.

2.6.5 Alert levels

The AMS Wireless Vibration Monitor sets HART status bits to indicate when measured values exceed the configured thresholds. Measured values have six levels: Saturated, Sensor, Range, Advisory, Maintenance, and Failed.

The level at which these thresholds should be set depends on the type of equipment being monitored and on your specific process.

Check the alert thresholds in Device variable alert limits.

One rule of thumb for vibration is to examine the current level at which the equipment is operating. Assuming the equipment is in good working condition, set the Advisory level at 2x the current value (or at a minimum of 0.05 in/s RMS, whichever is greater), set the Maintenance level at 4x the current value, and set the Failed level at 8x the current value. For example, if the current value for Overall Velocity is 0.1 in/s, set the Advisory threshold at 0.2 in/s, the Maintenance threshold at 0.4 in/s and the Failed threshold at 0.8 in/s. While this type of vibration program is not recommended, it can provide a starting point when no other information is available.

A good rule of thumb for establishing the PeakVue alert levels is to use the rule of 10's. This applies for most rolling element bearing equipment with a turning speed between 900 and 4000 CPM. Using this approach, the Advisory alert would be set at 10 g's, the Maintenance alert at 20 g's, and the Failed alert at 40 g's. In general, PeakVue alert levels can then be interpreted as follows:

10 g's	Indication of Abnormal Situation
20 g's	Serious Abnormal Situation - Maintenance Plan Required
40 g's	Critical Abnormal Situation - Implement Maintenance Plan

For more information on PeakVue, see PeakVue.

Notes
When any measured process parameter (Velocity, PeakVue, or Temperature) exceeds the configured Advisory, Maintenance, or Failed threshold, this causes an alert indication that you can view from AMS Device Manager (or in another graphical host). This indicator itself does not set a status bit.

2.6.6 Trend parameters

You can trend parameters in multiple locations such as in a plant historian or in AMS Machine Works. The method for configuring this functionality is contained in the

associated software and the details of all the possibilities are beyond the scope of this manual. This manual only indicates some of the general capabilities and version requirements.

You can trend values in essentially any host that accepts Modbus or OPC inputs. Configure OPC tags and Modbus registers for wireless devices in the Smart Wireless Gateway web interface. Refer to the Smart Wireless Gateway User Manual for additional information. The settings in the gateway and the host must be consistent and entered in both locations (for example, Modbus register definitions).

Also, with AMS Machine Works and AMS Wireless Vibration Monitor devices (that are licensed for the Advanced Diagnostics application), you can trend Energy Band parameters and collect spectrum and waveform information.

3 Installation

3.1 Device handling

Before beginning the installation process:

Install the Emerson Wireless Gateway and ensure it functions properly before you activate the AMS Wireless Vibration Monitor or any other wireless devices. Power up wireless devices in order of proximity from the Emerson Wireless Gateway, beginning with the closest. This will result in a simpler and faster network installation.

Note
The device requires a standard 1/4–28-inch mounting location.

⚠ CAUTION

Do not drop, hammer, or impact the device housing before, during, or after installation.

⚠ CAUTION

When installing the device in hazardous locations, ensure that the device is grounded to the machine case.

⚠ CAUTION

If the equipment is used in a manner not specified by the manufacturer or contrary to the instructions in this manual, the protection provided by the equipment may be impaired.

3.2 Mounting tools and supplies

Mounting tools

- Drill
- Spot face or end mill tool

The spot face tool attaches to a standard electric drill and provides a machined surface that is at least 1.1 times greater than the diameter of the sensor. The spot face tool also drills a pilot hole that can then be tapped for a stud mounted sensor.

You can purchase the spot face tool from Emerson (MHM P/N 88101), or you can substitute a spot face tool with similar characteristics as required. Contact your local sales representative for assistance.

Figure 3-1: Spot face or end mill tool

Attachment tools and supplies

- 1/4-28" taps and tap handle
- 9/16" open-end wrench
- 1/8" hex Allen key
- 3/16" ball-end hex wrench
- Wire brush
- Plant-approved cleaner/degreaser
- Plant-approved semi-permanent thread locker (e.g. Loctite)

For epoxy mount, you also need the following:

- 2-part epoxy
- A212 Mounting Pads

Figure 3-2: A212 mounting pad

- (Optional) Grinder – to create a sufficiently flat mounting surface

For motor fin mount, you also need the following:

- Motor Fin Mount Probe
- Epoxy

3.3 Mounting mechanisms

The device may be mounted using any of the mechanisms listed below. Stud mounting is preferred. The mounts are listed according to our recommendation. Temporary mounting should be a last resort.

- Stud mounting (preferred)

- Epoxy mounting (alternative)
- Triaxial quick connection
- Motor fin mounting
- Temporary mounting

3.3.1 Stud mounting (preferred)

Prerequisites

The mounting location must provide a flat surface of at least 1.1 in (27.94mm) in diameter and a case thickness exceeding 0.4 in. (10.2 mm). If this is not possible, use the epoxy mount method instead.

Stud mount provides increased reliability, improved frequency response, and increased signal sensitivity.

⚠ CAUTION

Do not exceed the specified torque when tightening a stud-mounted device. Over-tightening the device will damage the sensing element and void the manufacturer's warranty.

Procedure

1. Prepare the spot face or end mill tool by setting the drill bit depth to a minimum of 0.325 in. (8.255 mm).
2. Using a wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Keeping the spot face and end mill tool perpendicular to the machine surface, drill into the mounting location until the surface is smooth to the touch with no noticeable irregularities. This may require the spot face tool to remove as much as 0.04 in. (1.016 mm) or more from the surface.

   Note
   If the spot face is not uniform on all sides, it indicates that the spot face tool is not perpendicular to the mounting surface, and the resulting surface will not allow the sensor to be mounted properly.

4. Using 1/4-28 in. tap set, tap a pilot hole to a minimum depth of 0.25 in. (6.35 mm).

3.3.2 Epoxy mounting (alternative)

If it is not practical to drill into the machine casing, then the epoxy mount method is acceptable.

⚠ CAUTION

When installing in a hazardous location, all efforts must be made to ensure that the device is grounded to the machine case.

Procedure

1. If the equipment surface has a radius of curvature that is less than 4 in. (100 mm), grind a flat surface approximately 0.5 in. (12.7 mm) in diameter.
2. Using a wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Using a two-part epoxy (such as Emerson P/N A92106)), spray the activator onto the mounting surface. Place a light coat of epoxy on the surface of the mounting pad and hold firmly against the machine spot face surface for one minute.

   Note
   If the adhesive does not set within 1 minute, it indicates that too much epoxy is applied or that the mounting surface is not prepared properly. Repeat steps 2–3.

4. Ensure that the mounting pad / base of the device is grounded to the machine case. Use a two-part conductive epoxy (such as Loctite Ablestik 2902) and make a bead that bridges the mounting pad to the machine case.
5. Use a multimeter to check conductivity between the mounting pad and machine surface.

3.3.3 Triaxial quick connection

Use this mount in scenarios where there is a need to remove the monitor from the machine but you also need a more permanent type of installation. This mounting mechanism has two components: the receptacle that attaches to the device and the base that attaches to the machine. The base itself comes in two options: epoxy mounted, or stud mounted.

Procedure

1. Find the right location for the base. Make sure that the base notch is oriented with either the X or the Y axis of the device.
2. Install the device on the receptacle and orientate the whole assembly together.
3. Install the base on the machine using either Stud mounting (preferred) or Epoxy mounting (alternative).
4. Align the notch on the receptacle with the notch on the base and give it a ¼ turn. It will lock in the same place every single time.

3.3.4 Motor fin mounting

Procedure

1. Prepare cooling fins on motor for mounting by scraping or grinding any paint or debris between cooling fins.
2. Clean mounting area with a spray degreaser that will not leave a thin fil lubricating residue.
3. Mix adhesive.
4. Apply adhesive to the sides and the bottom of the probe portion of the motor fin mount probe/pad (the area is roughened to enhance the bonding area).

5. Place the motor fin mount probe/pad between the motor fins at the location desired.
   - Correct motor fin mount selection is important. The probe must fit in between the motor fins, and the bottom of the probe must contact the motor casing.
   - For motors that have a space greater than ½" between each fin, motor fin mount probe pads with a thickness of ½" are available and will reduce the amount of adhesive needed.
6. Firmly press the motor fin mount probe/pad into place, ensuring the bottom of the motor fin mount probe/pad is touching the motor casing (this contact area is where the vibration is transferred from the motor to the sensor).
   - The tip of the motor fin mount probe/pad should be as flat against the motor casing as possible.
   - The motor fin mount probe/pad should not be resting on the top of the fins – if it does, then the bottom of the probe may not be in direct contact with the motor casing.
7. Use a spatula to redirect any epoxy that has been displaced from the mounting area when pushing the fin mount probe/pad into place.
8. Fill in any remaining voids with the adhesive to ensure the motor fin mount will be fixed in place.
9. Allow full cure for the adhesive prior to installing sensor.

3.3.5 Temporary mounting

Temporary mounting may be required to perform field testing. This allows for testing the location and orientation of each sensor to get the best possible coverage. A magnetic mount is the best solution in this case. Once the optimum location is determined, the device shall be permanently mounted using one of the methods outlined above.

⚠ CAUTION

The recommended magnets have a pull force of 40lb-60lb and are very strong. Handle with care when working with multiple units or near metal structures.

Procedure

1. Prepare the surface. Use a rag or wire brush to remove any loose debris, grease, dirt, or rust.
2. Attach the device on the magnetic base with a ¼"-28 threaded hole.
3. Position the magnetic base on a ferrous surface, making sure that the device is properly oriented.
4. Check to see that the device is properly and firmly attached. Wriggle the device with your hand. It should not wobble or rotate.

3.4 Mount the device

Prerequisites

Prepare the surface according to your mounting method. The mounting location is the machine surface when using stud mount and the mounting pad when using epoxy mount. The mounting location should be prepared according to best practices.

Procedure

1. To stud mount the device (recommended), prepare the machine surface using a spot face tool. Then drill and tap a ¼-28" hole 0.25" (6.35mm) deep. Alternately, a mounting pad with ¼-28" thread can be glued in place using epoxy.
2. With the cover still on the device, use your hand to loosely screw the device into the threaded hole. Do not tighten.
3. Using your hand, loosely screw device into the mounting location.
4. Remove the cover and battery.
5. Set the device in the proper orientation. Insert a small screwdriver through the guide hole in the base of the unit (shown below) and use this to hold the device in the desired orientation.

Make sure that your planes are in the right direction. The Z plane should be vertical. The orientation of the X and Y axis depends on how you configured your device.

To make sure that your X and Y axis stay where they are, use an allen wrench or a small screwdriver while you torque down the device to make sure that everything stays in the correct position. You can also hold the device while you torque it down.

6. While maintaining the device orientation, use a 3/16" ball driver to tighten the captive screw in the center of the base (shown above) to 2-5 ft-lb.

   The mounting screw must be tightened firmly but carefully to prevent stripping out the mounting thread, typically 1/8 turn past finger tight for steel and slightly less for aluminum or brass. For high-frequency applications above 7kHz and all PeakVue

measurements, a good quality silicon grease (Dow #4) should be used as a coupling agent on the mounting ring on the bottom of the device. Only a small amount is needed.

7. Insert and connect the battery.
8. Mount the cover and then tighten it. Tighten the cover all the way down until the bottom of the cover touches the base.

   Ensure that the base does not turn while tightening the cover. Turning of the base causes misalignment of the measuring directions.

   Always ensure a proper seal when screwing the cover. The cover should be tightened all the way down to the base to keep the device watertight and free from the elements.

3.5 Change the battery

The battery that comes with the device is replaceable. The battery may last without need of replacement or recharge for a minimum of 3 years up to 5 years, if used at room temperature while collecting and reporting with default collection parameters.

Note
While the device is approved for battery replacement in hazardous locations, always check with your local Safety Officer before replacing the battery in a hazardous location.

Procedure

1. Using an allen wrench, hold the metal base.
2. Unscrew the device cover and then remove it.
3. Release the holding latch, and then carefully pull the battery tab to take the battery out of the compartment.
4. Use your finger to release the bottom latch on the battery connect by lifting the tab and then gently pull it until the connector is released.
5. Plug the battery wire into the connector and position the wire so that it is held by the battery clamp.
6. Place the battery into the compartment.
7. Snap the battery clamp back into place to secure the battery and wire.
8. Mount the cover and then tighten it. Tighten the cover all the way down until the bottom of the cover touches the base.

   Ensure that the base does not turn while tightening the cover. Turning of the base causes misalignment of the measuring directions.

   Always ensure a proper seal when screwing the cover. The cover should be tightened all the way down to the base to keep the device watertight and free from the elements.

4 Operation

4.1 Verify the device is operational

You can verify the device operates properly using the following methods:

- Field Communicator
- Emerson Wireless Gateway web interface

4.2 Verify operation with Emerson Wireless Gateway

If the device is configured with the Network ID and Join Key, and sufficient time for network polling has passed, the monitor will be connected to the network.

Note
The time to join a new device to the network is dependent upon the number of devices being joined and the number of devices in the current network. For one device joining an existing network with multiple devices, it may take up to five minutes. It may take up to 60 minutes for multiple new devices to join the existing network.

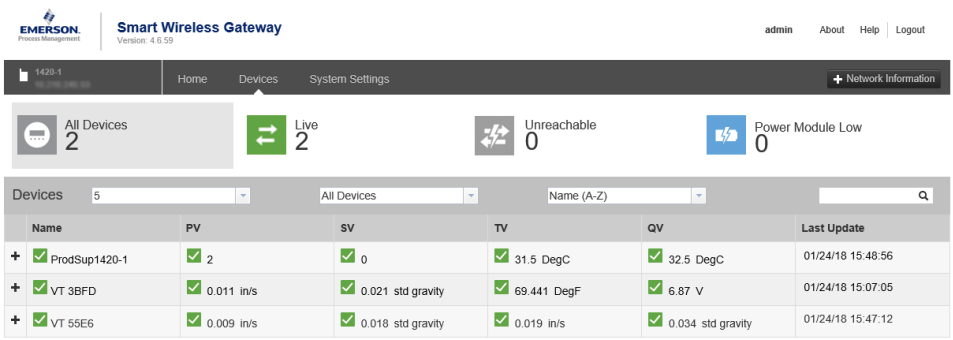
Procedure

1. From the Emerson Wireless Gateway Home page, navigate to the Devices page.

   The Devices page shows if the device has joined the network and if it is communicating properly. It also displays the transmitter tag name, PV, SV, TV, QV, time of last update. A checkmark in a green box means that the device is working properly. A red indicator means there is a problem with either the device or its communication path.

Note
It is normal for the AMS Wireless Vibration Monitor to have a red “X”, on the screen until the sensor is installed and configured.

Figure 4-1: Emerson Wireless Gateway Devices page



2. On the Devices page, click + beside a tag name to display more information about the device.
3. Verify the Network ID and Join Key in the device match those found on the Emerson Wireless Gateway:
    a. From the Emerson Wireless Gateway, click **System Settings** → **Network** → **Network Settings**.
    b. Verify **Show join key** has a check mark.

Note
The most common cause of incorrect operation is that the Network ID or Join Key are not set correctly in the device.

4.3 Verify operation with AMS Trex Communicator

You can verify the status of the AMS Wireless Vibration Monitor and configure it using an AMS Trex Communicator. For instructions on using the AMS Trex unit, see the User Guide.

Note
HART Wireless transmitter communication requires a AMS Wireless Vibration Monitor Device Descriptor file (DD). Refer to the Field Communicator User's Manual for more details on DDs or go to http://www2.emersonprocess.com/en-US/brands/Field-Communicator/Pages/SysSoftDDs.aspxhttps://www.emerson.com/en-us/catalog/ams-trex-device-communicator for instructions on adding a DD for AMS Wireless Vibration Monitor.

Table 4-1: Field Communicator menu

Menu	Submenu
Guided Setup	Configure Variable Mapping Configure Device Variable Units Configure Alert Limits Configure Acquisition Settings Join Device to Network Configure Update Rate
Manual Setup	Wireless Machine Z Axis X-Y Axis Interval Bands General Mapping Device Information License

Table 4-1: Field Communicator menu *(continued)*

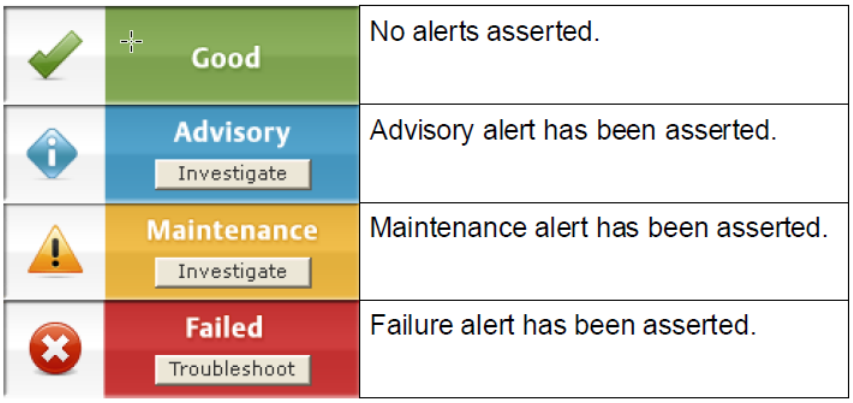
Menu	Submenu
Alert Setup	Z Axis X-Y Axis Temperature Battery IB1-2 (Velocity) IB3-4 (Accel) Machine Conditions (PVP)

Note
Disconnect the leads when you are finished configuring or troubleshooting. The AMS Wireless Vibration Monitor does not publish any new vibration data to the gateway while connected to an AMS Trex Device Communicator or HART modem. It can take up to three minutes for the leads connection to time out; after which, the AMS Wireless Vibration Monitor resumes reporting new readings to the gateway.

4.4 Check device status

You can check the device status from the AMS Device Manager or the AMS Trex Communicator.

The images below show the status of the device and what it means.



The device status is dependent upon individual device variable evaluation, system activity, and operating parameters.

The out-of-the box overall status should always be Good.

The highest level severity is always be asserted, even if there are underlying lower level alerts.

4.5 Device variable ranges

The device variables have the following ranges:

1. **Saturated** – Indicates the saturation point of the transducer. In this device, this level is not settable by the end user. When this range is violated, the device variable status is Bad. This is referred to as “Upper Saturated” and “Lower Saturated”.
2. **Sensor** – Indicates the sensor point of the transducer. In this device, this level is not settable by the end user. When this range is violated, the device variable status is Degraded. This is referred to as “Upper Sensor” and “Lower Sensor”.
3. **Range** – Indicates the user-defined process range. This is referred to as “Upper Range” and “Lower Range”.
4. **Fail** – The user-defined fail level(s)
5. **Maint** – The user-defined maintenance levels.
6. **Advise** – The user-defined fail levels.

4.6 Device operating limits

Table 4-2: Operational ranges

Sensor	Range	Frequency Response
Vibration Overall X	16 g's	1 KHz
Vibration Overall Y	16 g's	1 KHz
Vibration Overall Z	80 g's	20 KHz
PeakVue Z	80 g's	20 KHz
Temperature	-40ºC to 85ºC	N/A

4.7 Clean the device

Use a soft towel or paper towel to wipe any excess grime.

If necessary, use a cloth dampened with a mixture of water and mild detergent (similar to cleaning household dishes).

Do not use solvents to clean the device.

5 Overall Velocity, PeakVue, and temperature

5.1 Overall Velocity

The Overall Velocity measurement provides a summation of the low-frequency vibration energy, which indicates fault conditions such as imbalance, misalignment, looseness, and late-stage bearing problems.

The AMS Wireless Vibration Monitor uses (lower-frequency) Overall Velocity in conjunction with (higher-frequency) PeakVue to provide a holistic solution across all frequencies while optimizing the usage of the limited power and bandwidth available in a wireless device. The majority of developing fault conditions manifest in one or both of these key parameters.

The difference between the standard vibration waveform and the associated PeakVue waveform is shown in Figure 5-1 and Figure 5-2. Overall Vibration indicates energy from shaft rotation, expressed in units of RMS velocity per the ISO 10816 standard. PeakVue, on the other hand, filters out the rotational energy to focus on impacting. Impacting is expressed in units of Peak acceleration. This indicates key mechanical problems such as rolling element bearing faults, gear defects, and under-lubrication.

Figure 5-1: Velocity waveform

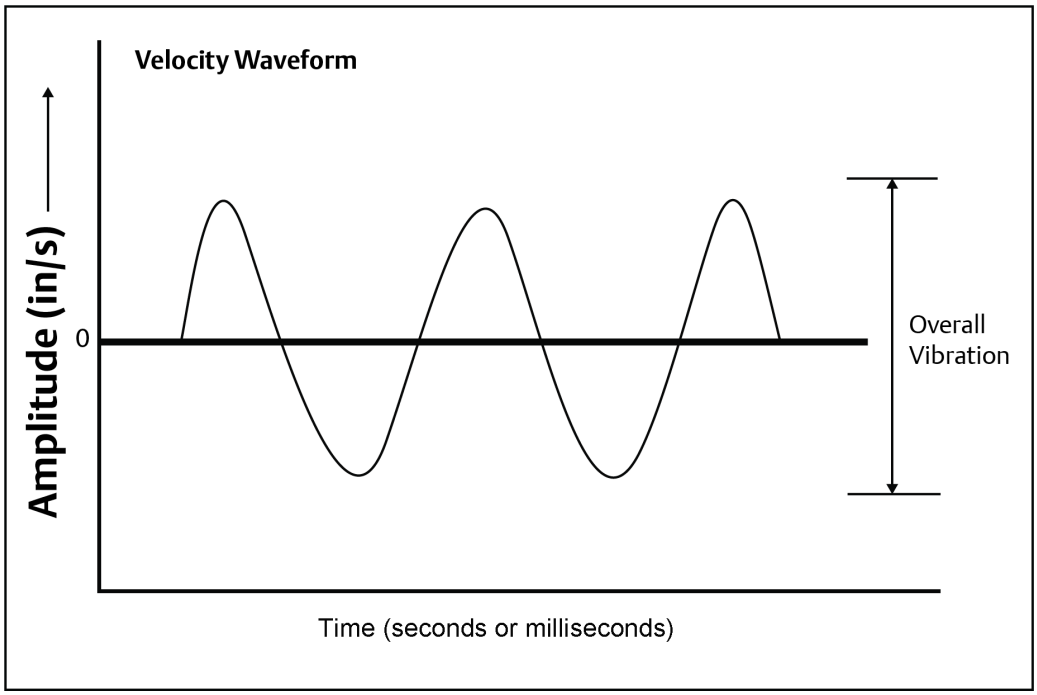
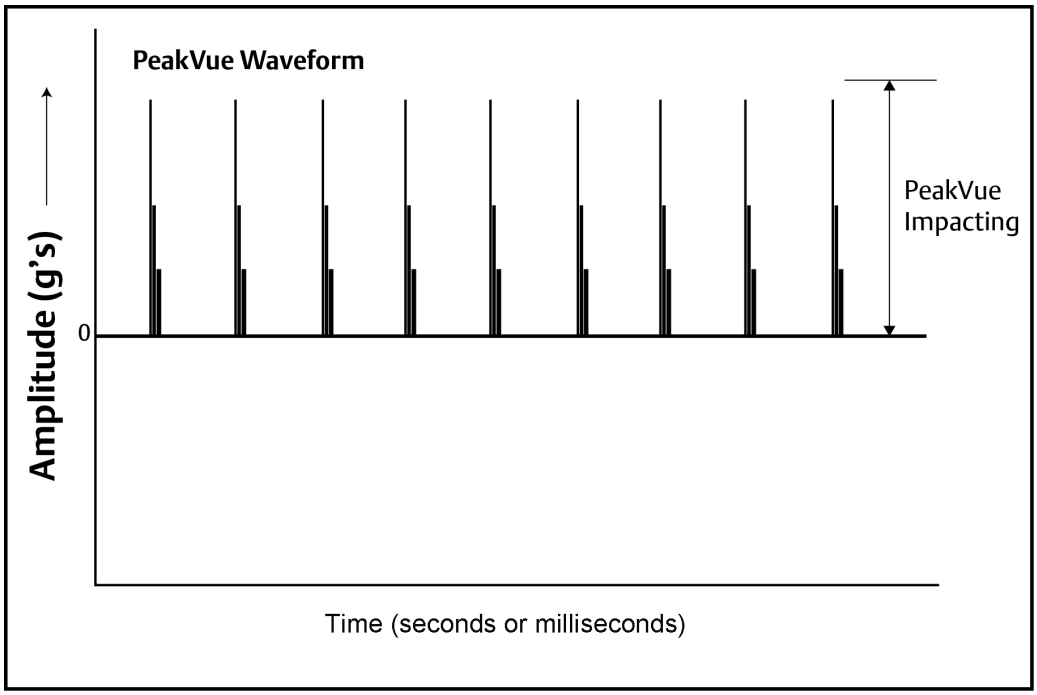


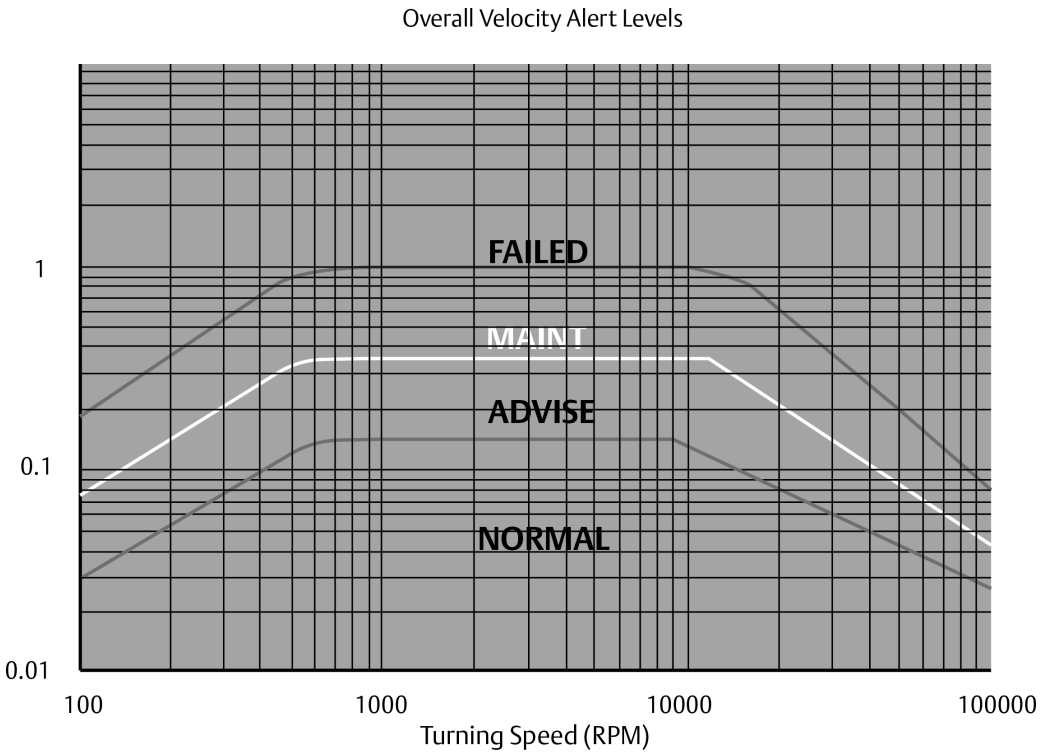
Figure 5-2: PeakVue waveform



While PeakVue is very useful for providing an early indication of impact-related faults in rolling-element bearings, there are many general applications where a lower-frequency measurement is more appropriate. Also, virtually all vibration analysts are very familiar with the Overall Velocity measurement and use it as part of their existing vibration programs. While it may not be possible to obtain a measurement result comparable to the PeakVue value reported by the AMS Wireless Vibration Monitor with a non-Emerson unit, the Overall Velocity measurement is common throughout the industry and should be easy to correlate with results from handheld instruments.

There are, however, a number of different methods for measuring and reporting Overall Velocity, so ensure that the measurement conditions are similar when trying to duplicate the value reported by the AMS Wireless Vibration Monitor with a handheld. The AMS Wireless Vibration Monitor uses ISO 10816, which defines a measurement bandwidth of 2 Hz to 1 kHz. The ISO 10816 general fault levels at various turning speeds are shown in Figure 5-3.

Figure 5-3: General fault levels



Depending on the type of machine being monitored, the values shown in this graph should be multiplied by the service factors given in Table 5-1.

Table 5-1: Service factor multiplier

Machinery type	Service factor
Single-stage Centrifugal Pump, Electric Motors, Fans	1.0
Non-critical Chemical Processing Equipment	1.0
Turbine, Turbine Generator, Centrifugal Compressor	1.6
Miscellaneous Equipment	2.0

Figure 5-3 shows the Overall Velocity thresholds for root-mean-square (RMS) velocity in units of inches per second. Particularly, in digital acquisition systems, it is customary to measure and calculate with RMS quantities. While it is accepted practice in the industry to convert between RMS and peak values using the 1.4142 conversion factor, it is not technically correct to do so except for a pure sinusoidal waveform. For this reason, the AMS Wireless Vibration Monitor measures, calculates, and reports Overall Velocity in RMS, and it is necessary to multiply by 1.4142 to get the corresponding peak levels if this is the preferred format.

Table 5-2: Default velocity levels in AMS Wireless Vibration Monitor

Alert level	Velocity (in RMS)
Advise	0.14 in/s

Table 5-2: Default velocity levels in AMS Wireless Vibration Monitor *(continued)*

Alert level	Velocity (in RMS)
Maintenance	0.35 in/s
Failed	1.0 in/s

5.2 PeakVue

PeakVue™ is a patented Emerson technology that is very useful for isolating high-frequency phenomena associated with developing faults, especially in rolling-element bearings.

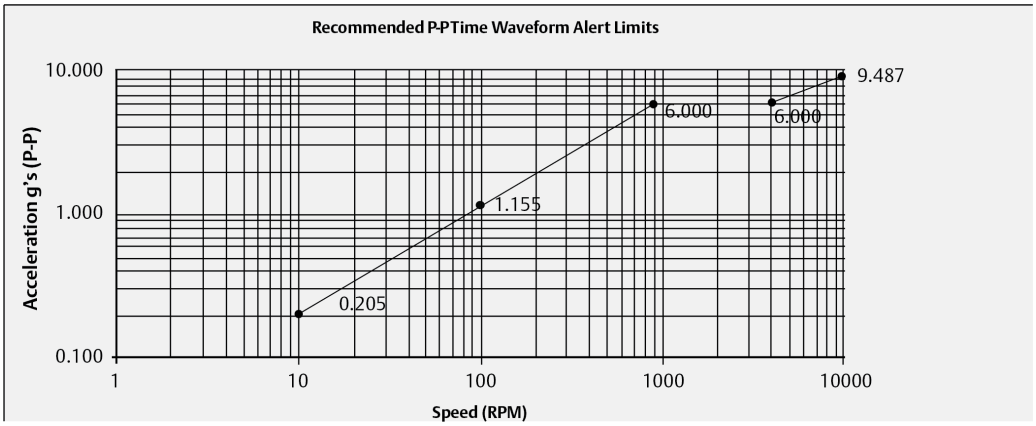
The premise for PeakVue is that the high-frequency components are not readily detected with more conventional measurements such as Overall Velocity, low-frequency energy (LFE), or digital overall. This is because the low-frequency measurements either average the energy or provide an energy summation over a relatively large frequency band, and the relative amount of energy that is typically contributed by the high-frequency components is quite small. As a result, even large "spikes" are difficult to detect with classic techniques.

The difference in the vibration waveform and the associated measurement for overall vibration versus PeakVue is shown in Figure 5-5 and Figure 5-6. The overall vibration is well below the established advisory and maintenance alert levels indicating that the machine is running well. In contrast, the PeakVue graph shows that the values have increased from zero, and that they are already crossing the advisory alert level and approaching the maintenance alert level. This early warning about impending defects is key to maintaining good machine health.

The PeakVue algorithm isolates the peak energy of interest to provide early indications of developing bearing faults such as inner and outer race defects, ball defects, and lubrication problems. Any type of "impacting" fault, where metal is contacting metal, is readily visible with PeakVue long before there is any significant increase in Overall Vibration. PeakVue is especially useful for monitoring rolling-element bearings.

Figure 5-4 shows an example of a typical formula for calculating the advisory alert level for PeakVue.

Figure 5-4: PeakVue advisory levels



These are the equations that govern this curve:

$$g's = \left(\frac{RPM}{900}\right)^{0.75} \times 6 \text{ for } RPM < 900$$

$$g's = 6, \quad \text{for } 900 < RPM \leq 4000,$$

$$g's = \left(\frac{RPM}{4000}\right)^{0.5} \times 6 \text{ for } 4000 < RPM \leq 10000,$$

$$g's = 10, \quad \text{for } RPM > 10000,$$

These, however, are generic limits. They are provided as a starting point and these values (for a 3600 RPM machine) are used as the default alert thresholds by the vibration transmitter.

These levels were devised for periodic data collection with a portable vibration analyzer and are set relatively low. For frequent automated monitoring, such as that offered by the AMS Wireless Vibration Monitor, the levels can be increased for most balance of plant equipment running between 900 and 4000 RPM. You can use the "rule of tens" as a simple but effective approach to monitoring PeakVue on most rolling element bearing machines. Using this guideline, we can assume the following:

Level	Interpretation
0	Machine is in good condition
10	Some problem is developing on the machine
20	The problem has become serious
40	Problem is critical

Note
The appropriate alerts for a given machine will be a function of its design, service, and turning speed.

Utilizing the embedded PeakVue technology, the AMS Wireless Vibration Monitor identified developing problems at a couple of test sites during early field trials. In both cases, the problem was not visible with conventional low-frequency analysis. The following examples provide sample data from one of the sites. Notice in the example that the velocity measurement is indicating less than 0.1 in/s. The PeakVue trend, however, indicates high-frequency vibration that is regularly in excess of 6 g's.

Figure 5-5: Example 1: 4600 HP fan motor - OH (Overall)

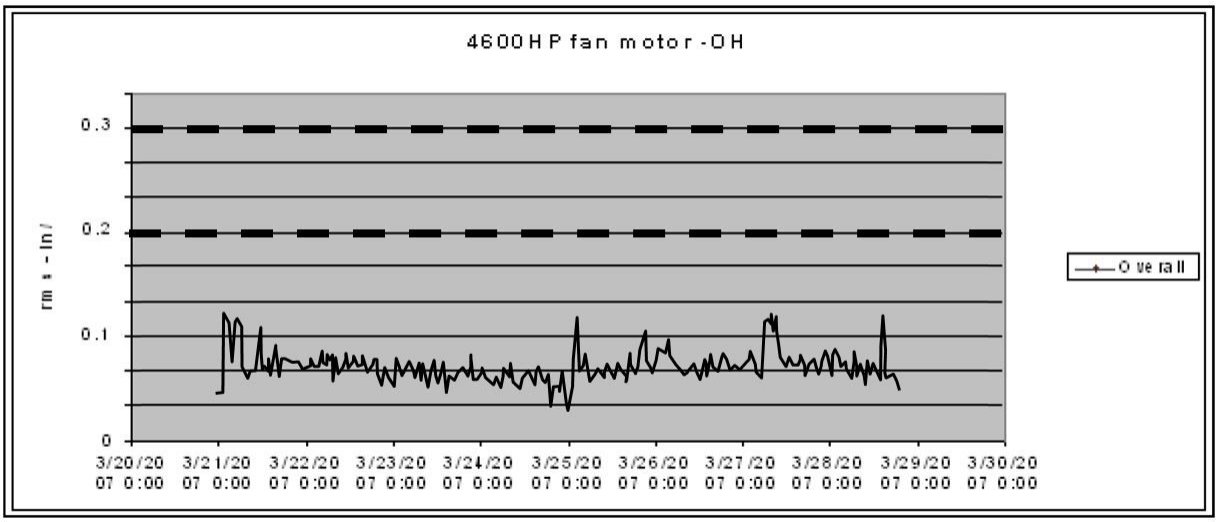
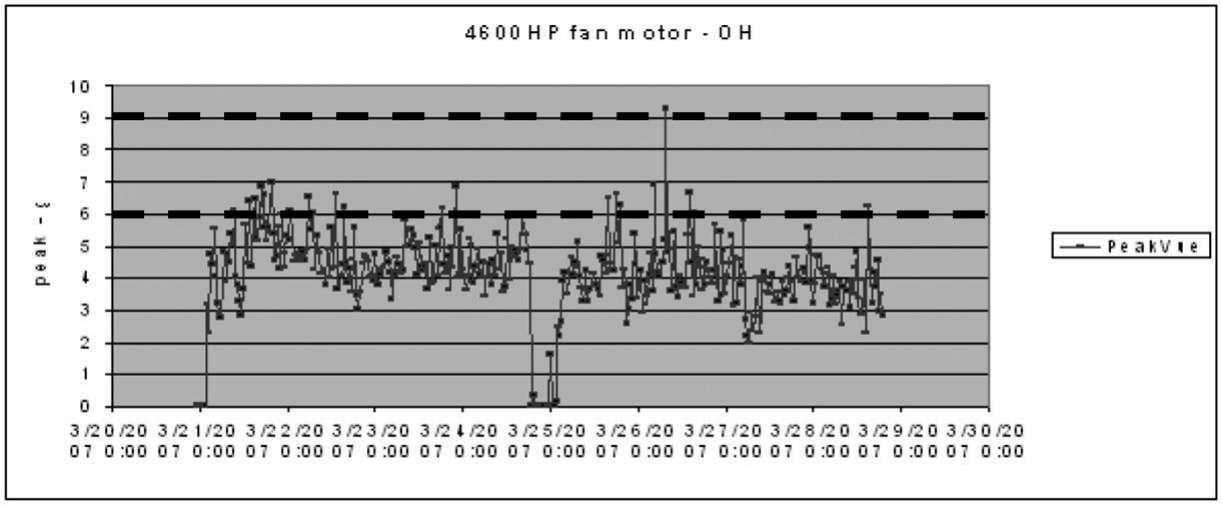


Figure 5-6: Example 2: 4600 fan motor - OH (PeakVue)



The defective bearing was removed and Figure 5-7 shows the developing problem that was the source of the impacting. After replacing the bearing, the PeakVue vibration is significantly reduced, as shown in Figure 5-8, indicating that the problem has been resolved.

Figure 5-7: Defective bearing

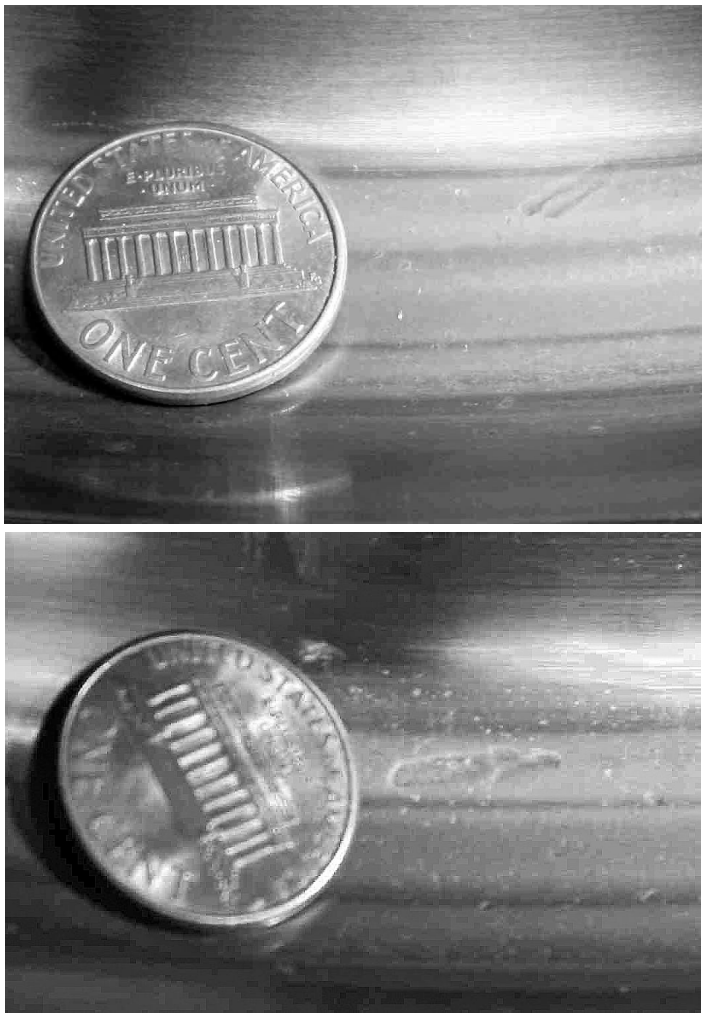
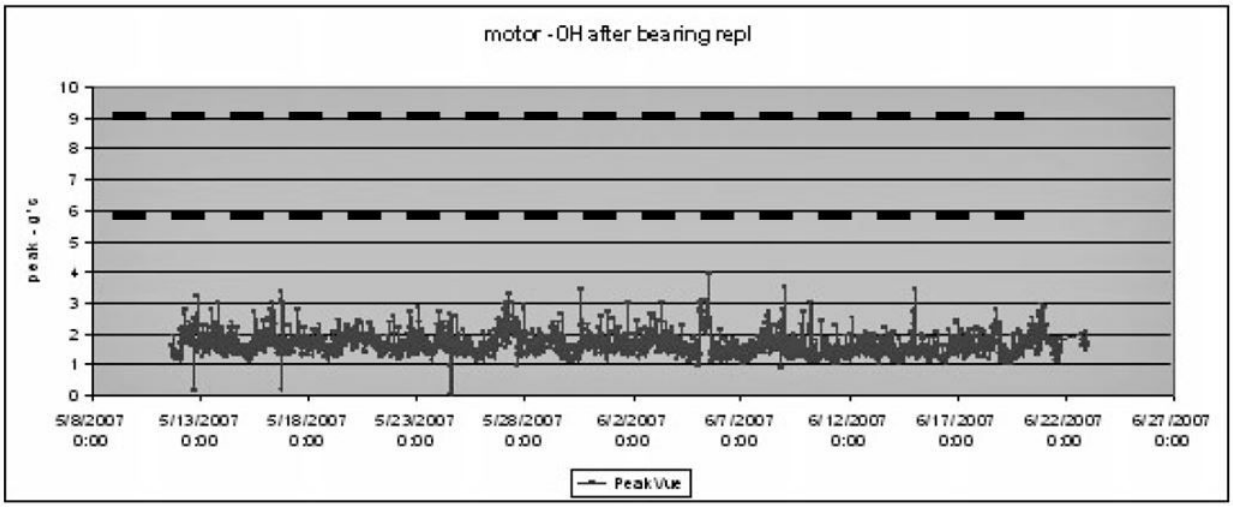


Figure 5-8: Motor - OH after the bearing is replaced (PeakVue)



5.3 Temperature

The levels at which to set temperature alerts depend on a number of factors including the specific process, the operating environment, and the characteristics of the equipment being monitored. This section provides some generic guidelines, given some knowledge of the variables involved, for setting the thresholds for your specific AMS Wireless Vibration Monitor installation. However, the generic methodologies described here are no substitute for first-hand knowledge of your plant. If, for example, you know that you have problems when a temperature exceeds a particular value, then set your thresholds accordingly rather than following these generic guidelines.

In general, the best way to detect a developing fault related to temperature is to look for an increase in temperature, relative to ambient, over time. This implies that, for reliable alerting, the thresholds should change as ambient temperature changes. In practice, this can be difficult to do because it requires the operator to constantly monitor the ambient temperature and adjust the alert levels accordingly. It is customary, therefore, to pick an "average" ambient temperature (that is generally seasonal for outdoor installations) and choose fixed thresholds based on this average. Also, there are issues with this methodology (such that it does not work well) in areas with large variations in ambient temperature.

You can select thresholds based on some absolute temperature limit. In practice, this is much easier to maintain but is not as effective at detecting early failures as relative monitoring.

5.3.1 Relative temperature monitoring

The recommended generic guidelines for setting the thresholds based on the relative change are:

T_{Advise} = 10°C increase

$T_{Maintenance}$ = 15°C increase

T_{Failed} = 20°C increase

Assuming that the ambient temperature is 25°C, when operating at steady-state, you have determined that the normal temperature at this point on your equipment is 55°C. Your "baseline" relative difference is 30°C. Using these guidelines, you should choose the Advise, Maintenance, and Failed levels for a difference of 40°C, 45°C, and 50°C, respectively. Assuming the ambient temperature is constant at 25°C, this means the thresholds become 65°C, 70°C, and 75°C for Advise, Maintenance, and Failed, respectively. Then, as the ambient temperature changes, the thresholds should be changed accordingly (e.g., a 5°C increase in ambient temperature raises the alert thresholds by 5°C).

5.3.2 Absolute temperature monitoring

For monitoring a driven component (such as a pump or fan), there are no generic rules to determine the default levels without some prior knowledge of the steady-state baseline (good) value. In general, the Advise level should be set about 10°C to 20°C above this baseline, with the Maintenance level about 10°C above Advise and the Failed level about 10°C above Maintenance.

There are equations that define the suggested generic thresholds for monitoring motor (driver) temperature. These are based on characteristics of the motor as well as knowledge of the ambient temperature.

The first step is to determine the estimated winding temperature, which is dependent on the following variables:

- Insulation type
- Motor type
- Ambient temperature
- Altitude

The estimated winding temperature, T_W, is the rise in temperature, T_{rise}, for the appropriate type of motor adjusted for high ambient temperature (T_a) effects.

T_{rise}=

- 65°C + serv_fact_temp; for class A insulation
- 85°C + serv_fact_temp; for class B insulation
- 110°C + serv_fact_temp; for class F insulation
- 130°C + serv_fact_temp; for class H insulation
- 150°C + serv_fact_temp; for class N insulation

where serv_fact_temp =

- 5 for service factor of 1.15 or greater
- -5 for either open or totally enclosed fan cooled (TEFC) motors, and service factor of 1.0
- 0 for either totally enclosed non-ventilated (TENV) motors or motors with encapsulated windings, and service factor of 1.0

If elevation > 3300 ft (1000m), then:

$T_{rise} = T_{rise}$ {1-[(altitude (units of ft) - 3300)/33,000]}

If T_a is less than or equal to 40°C (or unknown), then:

$T_w = T_{rise} + 40°C$

If T_a > 40°C, then:

$T_w = T_{rise} + 40°C - (Ta - 40°C)$

If T_a is unavailable, assume that T_a is less than 40°C.

Next, calculate the generic alert thresholds based on the estimated winding temperature, T_W.

T_{f_fault} = Fault level alarm temperature (°C) of the motor skin (frame)

$T_{f_maintenance}$ = Maintenance level alarm temperature (°C) of the motor skin

$T_{f_advisory}$ = Advisory level alarm temperature (°C) of the motor skin

Alarm levels

For open drip proof (ODP) motors:

$T_{f_fault} = 35.5366 * Ln(T_w) - 91.1571$

For totally enclosed motors:

$T_{f_fault} = 37.2028 * Ln(T_w) - 102.8868$

For all motors:

$T_{f_maintenance} = T_{f_fault} - 10°C$

$T_{f_advisory} = T_{f_fault} - 20°C$

Error indication and steady-state determination

- Do not use any data readings collected within 30 seconds of motor start up.
- Steady-state is said to have been reached when, over any 5-minute time interval, the maximum variation in temperature is less than 2°F.

A Specifications and reference data

A.1 Functional specifications

Input

Three internal MEMS accelometers oriented in the X-Y-Z direction. The Z accelometer has the greatest bandwidth and is considered the primary sensor. The device also has a temperature sensor designed to read the temperature near the mounting point.

Output

Wireless-enabled, linear with temperature or input.

Humidity limits

0–95% relative humidity

Transmit rate

User-selectable, 60 seconds to 24 hours.

Measurement

Measurement Parameters

The device is capable of measuring and reporting machine health measurement parameters and generating alerts based on overall vibration in each axis as well as peak impact measurements in the primary axis and temperature readings.

Measurement precision

Measurement precision refers to the variability of the same measurement in a fixed operating environment under steady-state conditions. For vibration, this value is obtained with statistical measurements with 1 g-peak (9.81 m/s^2) input excitation at a frequency of 100 Hz. For temperature, this value is obtained with statistical measurements at room temperature.

- Vibration: 0.2 dB
- Temperature: +/- 2°C

Amplitude Range

Primary axis: +/- 80 g's

Secondary axis: +/- 16g's

Measurement Accuracy

+/- 3 dB from 2 Hz to 10 kHz primary axis, +/- 3 dB from 2 Hz to 1 kHz secondary axis

Dynamic signal range

Target: 80dB

A.2 Physical specifications

Battery

Table A-1: Tadiran Lithium Batteries Model TL-4920/VE

Nominal capacity @ 3 mA, to 2 V	8.5 Ah
Rated voltage	3.6 V
Maximum recommended continuous current	75 mA
Maximum 1 sec. pulse capability	200 mA
Weight	49.5 g (1.746 oz)
Volume	26 cc
Operating temperature range	-55 ºC to +85 ºC
U.L. Component Recognition, MH 12193	

Field Communicator connections

- HART ports
- Clips attached to the HART ports

Mounting

Mounting tools and supplies depend on the mounting mechanism. For more information, see Mounting tools and supplies.

Mounting screw thread is 1/4 - 28

Weight

0.697 lb (315 g)

Enclosure ratings

Housing is NEMA 4X and IP66

A.3 Performance specifications

Temperature Limits

The device is rated for operation in the range from -40 to +85C.

Table A-2: Temperature limits

Device	Operating limit	Storage limit
AMS Wireless Vibration Monitor	-40 to +85C	-55 to +85C **Note** Prolonged storage above +75 C degrades battery life

A.4 Radio specifications

Parameter	Value
Frequency Band	2.4GHz - 2.4835GHz
Output Power	+8dBm
Receiver Sensitivity	-93dBm
Range	100m (outdoor +25 C, 50% RH)

A.5 Device variable alert limits

This table shows the alert limits of the device variables.

Table A-3: X Overall

Axis	Severity	Upper Limit	Lower limit	Unit	Notes
X Overall	Saturated	70	0	in/s	Read-only
X Overall	Sensor	70	0	in/s	Read-only
X Overall	Range	5	0	in/s	Can be set by the user up to the sensor range
X Overall	Fail	1	Not Applicable	in/s	
X Overall	Maint	0.35	Not Applicable	in/s	
X Overall	Advise	0.14	Not Applicable	in/s	

Table A-4: Y Overall

Axis	Severity	Upper Limit	Lower Limit	Unit	Notes
Y Overall	Saturated	70	0	in/s	Read-only
Y Overall	Sensor	70	0	in/s	Read-only
Y Overall	Range	5	0	in/s	Can be set by the user up to the sensor range
Y Overall	Fail	1	0	in/s	
Y Overall	Maint	0.35	0	in/s	
Y Overall	Advise	0.14	0	in/s	

Table A-5: Z Overall

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Z Overall	Saturated	70	0	in/s	Read-only

Table A-5: Z Overall *(continued)*

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Z Overall	Sensor	70	0	in/s	Read-only
Z Overall	Range	5	0	in/s	Can be set by the user up to the sensor range
Z Overall	Fail	1	0	in/s	
Z Overall	Maint	0.35	0	in/s	
Z Overall	Advise	0.14	0	in/s	

Table A-6: Z Peakvue

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Z Peakvue	Error	Not Applicable	Not Applicable	250	Read-only
Z Peakvue	Unused	Not Applicable	Not Applicable	250	Read-only
Z Peakvue	Saturated	100	0	g	Can be set by the user up to the sensor range
Z Peakvue	Sensor	100	0	g	
Z Peakvue	Range	100	0	g	
Z Peakvue	Fail	40	0	g	
Z Peakvue	Maint	20	0	g	
Z Peakvue	Advise	10	0	g	

Table A-7: IB1 Velocity

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
IB1 Velocity	Unused	Not Applicable	Not Applicable	250	Read-only
IB1 Velocity	Saturated	70	0	in/s	Read-only
IB1 Velocity	Sensor	70	0	in/s	Can be set by the user up to the sensor range
IB1 Velocity	Range	5	0	in/s	
IB1 Velocity	Fail	0.6	0	in/s	
IB1 Velocity	Maint	0.21	0	in/s	
IB1 Velocity	Advise	0.084	0	in/s	

Table A-8: IB2 Velocity

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
IB2 Velocity	Saturated	70	0	in/s	Read-only
IB2 Velocity	Sensor	70	0	in/s	Read-only
IB2 Velocity	Range	5	0	in/s	Can be set by the user up to the sensor range
IB2 Velocity	Fail	0.3	0	in/s	
IB2 Velocity	Maint	0.105	0	in/s	
IB2 Velocity	Advise	0.042	0	in/s	

Table A-9: IB3 Accel

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
IB3 Accel	Saturated	100	0	g	Read-only
IB3 Accel	Sensor	100	0	g	Read-only
IB3 Accel	Range	50	0	g	Can be set by the user up to the sensor range
IB3 Accel	Fail	10	0	g	
IB3 Accel	Maint	7	0	g	
IB3 Accel	4	0	g		

Table A-10: IB4 Accel

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
IB4 Accel	Saturated	100	0	g	Read-only
IB4 Accel	Sensor	100	0	g	Read-only
IB4 Accel	Range	50	0	g	Can be set by the user up to the sensor range
IB4 Accel	Fail	15	0	g	
IB4 Accel	Maint	10	0	g	
IB4 Accel	Advise	6	0	g	

Table A-11: Machine Temperature

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Machine Temperature	Saturated	95	-50	°C	Read-only

Table A-11: Machine Temperature *(continued)*

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Machine Temperature	Sensor	95	-50	°C	Read-only
Machine Temperature	Range	95	-50	°C	Can be set by the user up to the sensor range
Machine Temp	Fail	75	-40	°C	
Machine Temperature	Maint	70	-35	°C	
Machine Temperature	Advise	65	-30	°C	

Table A-12: Supply Voltage

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Supply Voltage	Saturated	3.75	0	V	Read-only
Supply Voltage	Sensor	3.75	0	V	Read-only
Supply Voltage	Range	3.7	2.3	V	Read-only
Supply Voltage	Fail	Not Applicable	2.7	V	Read-only
Supply Voltage	Maint	Not Applicable	2.85	V	
Supply Voltage	Advise	Not Applicable	3	V	

Table A-13: Speed

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Speed	Saturated	10000	0	rpm	Limits calculated by device and not user settable.
Speed	Sensor	10000	0	rpm	Limits calculated by device and not user settable.
Speed	Range	3000	0	rpm	Limits calculated by device and not user settable.

Table A-13: Speed *(continued)*

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Speed	Fail	Not Applicable	Not Applicable	rpm	Limits calculated by device and not user settable.
Speed	Maint	Not Applicable	Not Applicable	rpm	Limits calculated by device and not user settable.
Speed	Advise	2000	1600	rpm	Limits calculated by device and not user settable.
Mechanical Condition	Saturated	1000	0	None	Limits calculated by device and not user settable.

Table A-14: Mechanical Condition

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Mechanical Condition	Sensor	1000	0	None	Limits constant in the device and not user-settable.
Mechanical Condition	Range	100	0	None	Limits constant in the device and not user-settable.
Mechanical Condition	Fail	70	0	None	Limits constant in the device and not user-settable.
Mechanical Condition	Maint	40	0	None	Limits constant in the device and not user-settable.
Mechanical Condition	Advise	10	0	None	Limits constant in the device and not user-settable.

Table A-15: Lubrication Condition

Axis	Severity	Upper Limit	Lower Limit	Units	Notes
Lubrication Condition	Saturated	1000	0	None	Limits constant in the device and not user-settable.
Lubrication Condition	Sensor	1000	0	None	Limits constant in the device and not user-settable.
Lubrication Condition	Range	100	0	None	Limits constant in the device and not user-settable.
Lubrication Condition	Fail	70	0	None	Limits constant in the device and not user-settable.
Lubrication Condition	Maint	40	0	None	Limits constant in the device and not user-settable.
Lubrication Condition	Advise	10	0	None	Limits constant in the device and not user-settable.

B Product certifications

Note
For specific device certifications, always refer to the product nameplate and markings on the device.

B.1 Approved manufacturing locations

Emerson
835 Innovation Drive
Knoxville, TN 37932 USA
T: +1 865-675-2400

Benchmark Electronics (Thailand) Plc.
109 moo.4, Chaimongkol, Muang, Nakorn Ratchasima
Thailand 30000
T: +66 44-233-800

B.2 Wireless certifications

Telecommunications compliance

All wireless devices require certification to ensure that they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. Emerson works with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage.

Radio Equipment Directive (2014/53/EU)

Emerson complies with the Radio and Equipment Directive.

FCC approvals

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 a 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 device must be installed to ensure a minimum antenna separation distance of 20cm from all persons.

⚠ CAUTION

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

ISED approvals

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs / récepteurs exemptés de licence qui sont conformes aux RSS exempts de licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas provoquer d'interférences.
2. Cet appareil doit accepter toute interférence, y compris les interférences pouvant entraîner un fonctionnement indésirable de l'appareil.

Radio approvals

Table B-1: Radio Approvals

Brazil	ANATEL	16244-20-13480
Canada		IC: 3434A-A9530M1
Equatorial Guinea	ORTEL	608-2910712020
Hong Kong	通訊事務管理局 COMMUNICATIONS AUTHORITY	Certified for use in Hong Kong 經認證可在香港使用 Certificate Numbers: 證書編號 A9530V1: HK0022000126 A9530V3: HK0022000125
Jamaica		This product contains a Type Approved Module by Jamaica: SMA – A9530XX
Mexico	NOM–ANCE	RCPAMA921-0109

Table B-1: Radio Approvals *(continued)*

Philippines		Type Accepted No: ESD-RCE-2023390 Type Accepted No: ESD-RCE-2023391
Serbia	И 005 20	P1620103200
Singapore		Complies with IMDA Standards DA100927
South Africa		TA-2020/7576
Thailand		This telecommunication equipment conforms to NTC technical requirements.
US		NL5-A9530M1 Model: A9530V1, A9530V3

Note
The table above does not include all countries for which certificates have been issued. For a complete list, please contact you local Emerson Sales Representative.

B.3 Ordinary location certification (CSA)

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by CSA, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Electromagnetic Compatibility (EMC) (2014/30/EU)

All Models: EN 61326-1

Canadian Standards Association (CSA)

CAN/CSA-C22.2 No. 61010-1-04 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements

ISA S82.02.01 2nd (IEC 61010-1 Mod) - Safety Standards for Electrical and Electronic Test, Measuring, Controlling and Related Equipment - General Requirements

UL 61010-1 2nd - Safety Requirements for Electrical Equipment for Measurements, Control, and Laboratory Use, Part 1: General Requirements

B.4 CE mark

The device has been tested and complies with all relevant directives required for CE marking.

CE

Country	Restriction
Bulgaria	General authorization required for outdoor use and public service.
Italy	If used outside of own premises, general authorization is required.
Norway	May be restricted in the geographical area within a radius of 10 km from the center of Ny-Alesund.
Romania	Use on a secondary basis. Individual license is required.

B.5 Hazardous locations certifications

Model No:: A9530

Product Name: Wireless Vibration Monitor

The AMS Wireless Vibration Monitor carries certificates for operation in hazardous locations.

Table B-2: Hazardous locations certifications

CSA C/US Certificate CSA20CA80026524	Class I Division 1 Groups A, B, C, D T4 Class II, Div. 1 Groups E, F & G Class I Zone 0 AEx / Ex ia IIC T4 Ga Zone 20, AEx/ Ex ia IIIC T135 °C Da; -40ºC ≤ Ta ≤ +85ºC Type 4X and IP66 Enclosure
IECEx Certificate IECEx CSA 20.0002X	Ex ia IIC T4 Ga Ex ia IIIC T135°C Da Ta: -40ºC to +85ºC
ATEX Certificate CSANe 20ATEX2042X	CE Ex **II 1 G** Ex ia IIC T4 Ga -40ºC ≤ Ta ≤ +85ºC II 1 D Ex ia IIIC T135°C Da IP66

Other approvals

For a complete list of approvals, see the product page at https://www.emerson.com/en-us/catalog/ams-wirelessvibrationmonitor.

Conditions for Safe Use

1. Shall be powered only by C-sized lithium primary cell type TL-4920/VE manufactured by Tadiran or Emerson Part Number A0702PPU.
2. HART Terminal Entity Parameters:
   Uo = 5.84V, Io = 116mA, Po =169mW, Co = 0.1μF, Lo = 5mH;
   Ui = 5.27V, Ii = 5mA, Pi = 6.6mW, Ci = 13 μF, Li = 0.022mH
3. The device may be configured using the HART terminals only by 375, 475, or TREX field communicators.
4. Under certain extreme circumstances, the non-metallic parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic discharge. Therefore, the equipment shall not be installed in a location where the external conditions are conductive to the build-up of electrostatic charge on such surfaces. In addition, the equipment shall only be cleaned with a damp cloth.
5. The device shall be installed on an earthed metal frame.

Note
Battery may be replaced in hazardous locations. Only replace battery with Tadiran Part Number TL-4920/VE or Emerson Part Number A0702PPU.

Note
The markings that appear on the monitor housing determine whether a device is suitable for operation in a specific hazardous location. This further requires that the monitor is operated in accordance with the installation drawings provided with the unit.

Conditions d'utilisation sûre:

1. Ne doit être alimenté que par une cellule primaire au lithium de taille C de type TL-4920/VE fabriquée par Tadiran ou Emerson Part Number A0702PPU.
2. Paramètres d'entité de terminal HART:
   Uo = 5.84 V, Io = 116 mA, Po = 169 mW, Co = 0.1 µF, Lo = 5 mH;
   Ui = 5.27 V, Ii = 5 mA, Pi = 6.6 mW, Ci = 13 µF, Li = 0.022 mH
3. L'appareil ne peut être configuré à l'aide des terminaux HART que par des communicateurs de terrain 375, 475 ou TREX.
4. Dans certaines circonstances extrêmes, les pièces non métalliques incorporées dans le boîtier de cet équipement peuvent générer un niveau de décharge électrostatique capable d'allumage. Par conséquent, l'équipement ne doit pas être installé dans un endroit où les conditions externes conduisent à l'accumulation de charges électrostatiques sur de telles surfaces. De plus, l'équipement ne doit être nettoyé qu'avec un chiffon humide.
5. L'appareil doit être installé sur un cadre métallique mis à la terre.

Warnings:

1. Care should be taken to protect this device from impact or abrasion if located in a zone 0 environment.
2. Substitution of components may impair intrinsic safety.
3. The battery may present a potential electrostatic ignition hazard. Use Caution when replacing the battery.

Avertissements:

1. Des précautions doivent être prises pour le protéger des chocs ou de l'abrasion s'il est situé dans un environnement de zone 0.
2. La substitution de composants peut compromettre la sécurité intrinsèque.
3. La batterie peut présenter un risque potentiel d'allumage électrostatique. Soyez prudent lors du remplacement de la batterie.

List of Standards:

IEC:

IEC 60079-0 7th Edition, December 2017

IEC 60079-11 6th Edition, June 2011

ATEX:

EN IEC 60079-0:2018

EN 60079-11:2012

North America:

CAN/CSA C22.2 No. 61010-1-12

UL Std. No. 61010-1 3rd Ed.

CAN/CSA C22.2 No. 60079-0 7th Ed.: 2019

UL 60079-0 7th Ed.: 2019

CAN/CSA C22.2 No. 60079-11 6th Ed.: 2014

UL 60079-11: 6th Ed.: 2013

CAN/CSA-C22.2 No. 60529 Ed. 2.2: 2016

ANSI/IEC 60529-2004 (R2011)

CAN/CSA-C22.2 No. 94.2-2007 (R2012)

UL 50E 2015

B.6 Waste Electrical and Electronic Equipment

Marking for the Waste of Electrical and Electronic Equipment in accordance with Article II (2) of Directive 2012/19/EU (WEEE). The European Directive 2012/19/EU requires marking:

- That applies to electrical and electronic equipment falling under Annex 1 Category 9 of Directive 2012/19/EU.
- That serves to clearly identify the producer of the equipment and that the equipment has been put on the market after 13 August 2005.
- That the crossed out wheeled bin alerts the end-user to dispose this equipment via the special recycling procedure for electrical and electronic equipment that is applicable in the country of use.
- The shown marking is attached to the product and identifies the product to fall within the scope of this directive.

C Third-party licenses

C.1 Dust SmartMeshSDK C Library

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