

CSI 9420 Wireless Vibration Transmitter

This Reference Manual applies to the 2.4 GHz WirelessHART version (Rev 3 and Rev 4) of the CSI 9420 for use with Smart-Power Module unless otherwise specified.

CSI 9420 2.4 GHz Hardware Revisions
HART Device Revisions

3, 4
Dev v2, DD v1
Dev v3, DD v6

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure to thoroughly understand the contents before installing, using, or maintaining this product.

The United States has two toll-free assistance numbers and one international number.

Inside US/Canada

1-800-833-8314

International

1-512-832-3774

E-mail

mhm.custserv@emerson.com

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Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

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⚠ WARNING**Explosions could result in death or serious injury:**

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of the CSI 9420 reference manual for any restrictions associated with a safe installation.

- Before connecting a Field Communicator in an explosive atmosphere, ensure the instruments are installed in accordance with applicable field wiring practices.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.
-

NOTICE

The CSI 9420 and all other wireless devices should be installed only after the Smart Wireless Gateway has been installed and is functioning properly. Wireless devices should also be powered up in order of proximity from the Smart Wireless Gateway, beginning with the closest. This will result in a simpler and faster network installation.

NOTICE**Shipping considerations for wireless products (Lithium Batteries):**

The unit was shipped to you without the power module installed. Please remove the power module pack from the unit prior to shipping.

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 ARD (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.

The power module pack with the wireless unit contains two “C” size primary lithium/thionyl chloride batteries. Each power module contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack. Under normal conditions, the power module materials are self-contained and are not reactive as long as the batteries and the pack integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.

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3. Enclose a note that describes the reason(s) you are returning the item(s).
4. Insure your package for return shipment. Shipping costs and any losses during shipment are your responsibility. COD packages cannot be accepted and will be returned unopened.

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Section 1: Overview

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

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

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Overview

Manual

This manual is designed to assist in the installation, operation, and maintenance of the CSI 9420.

Section 1: Overview

Section 2: Configuration

Section 3: Installation

Section 4: Commissioning

Section 5: Operation and Maintenance

Appendix A: Specifications and Reference Data

Appendix B: Product Certifications

Appendix C: Velocity, PeakVue, and Temperature

Appendix D: Accelerometer Installation for EMI/RFI Consideration

Transmitter

Features of the CSI 9420 include:

- An installation-ready solution that provides a variety of transmitter and sensor configurations
- Up to 4 process variables
- 3 user configurable alerts for each process variable
- Waveform/Spectrum stored directly to AMS Machinery Manager
- Flexibility to meet your most demanding applications
- Wireless output with >99% data reliability delivers rich HART data, protected by industry leading security
- The integral LCD conveniently displays the measured values and diagnostics of the transmitter
- Simple and easy installation practices already used today for robust installations

Considerations

General

Electrical vibration sensors such as accelerometers produce low-level signals proportional to their sensed vibration. With simple HART configuration, the CSI 9420 converts the low-level sensor signal to a wireless-enabled signal.

Commissioning

The transmitter can be commissioned before or after installation. It may be useful to commission it on the bench, before installation, to ensure proper operation and to become familiar with its functionality. When applicable, make sure the instruments are installed in accordance with applicable field wiring practices. The device will be powered whenever the power module is installed. To avoid depleting the power module, make sure it is removed when the device is not in use.

Mechanical

Location

When choosing an installation location and position, take into account the need for access to the transmitter. For best performance, the antenna should be vertical with some space between objects in a parallel metal plane such as a pipe or metal framework, as the pipes or framework may adversely affect the performance of the antenna.

Electrical

Smart Power Module

The power module for the CSI 9420 Wireless Vibration Transmitter contains two “C” size primary lithium/thionyl chloride batteries. Each power module contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack. Under normal conditions, the power module materials are self-contained and are not reactive as long as the batteries and the power module pack are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.



Use caution when handling the power module pack. The power module pack may be damaged if dropped from heights in excess of 20 feet.

External DC Line Power

NOTICE

The CSI 9420 may not carry the same hazardous area ratings when operated with external DC line power.

Certain versions of the CSI 9420 are optionally available for connecting external 10-28 VDC power. This is used in place of the power module.

Sensor

Make sensor connections through the cable entry in the side of the connection head. Be sure to provide adequate clearance for cover removal.

Environmental

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

The transmitter will operate within specifications for ambient temperatures between –40 and 185 °F (–40 and 85 °C).

Table 1-1. Temperature Limits

	Operating Limit	Storage Limit
With LCD Display	–4 to 175 °F –20 to 80 °C	–40 to 185 °F –40 to 85 °C
Without LCD Display	–40 to 185 °F –40 to 85 °C	–40 to 185 °F –40 to 85 °C

Return of Materials

To expedite the return process in the Americas and Canada, call the Product Service Center at +1 800 833 8314 to obtain a Return Materials Authorization (RMA) number and the address of the appropriate Product Service.



For other locations, please contact an Emerson Process Management sales representative for further instructions. Or, in Europe and the Middle East, dial +63 2 702 1111. In the Asia Pacific region, dial +65 6770 8711.

NOTICE

If the device has been exposed to a hazardous substance, 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)

Battery powered units are shipped without the power module installed. Please remove the power module pack prior to shipping the unit. 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 ARD (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.

Section 2: Configuration

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

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

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

This device 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 antenna separation distance of 20 cm from all persons.

Configuration Overview

CSI 9420 configuration can be completed either prior to installation or after the device has been installed at the measurement location. It is not necessary to have the sensor physically installed or connected to the device to complete configuration. The device will, however, report an alert until the sensor is connected; this is the expected behavior.

The basic steps for configuring the CSI 9420 are as follows. The specific user interface (UI) available for performing the configuration varies depending on the host that is used.

1. Set the wireless network credentials (Network ID and Join Key) using a wired connection – This step must be completed for the device to join the wireless network. Once this is done and the device has joined, the rest of the steps can be completed over the wireless link, if desired.
2. Name the device (Tag and Device Descriptor), if desired – By default, the tag is VT xxxx where xxxx is the unique radio ID on the wireless network. The device will join the network and operate correctly even if no changes are made, but it is usually preferable to name the device something meaningful for the specific application.

3. Specify the type of sensor installed (e.g., 1 accelerometer, 1 accelerometer w/ temperature, or 2 accelerometers) and also name the sensor. The factory default configuration is one accelerometer named SENSOR 1. Complete this step for different configurations and to name the sensor something meaningful for the specific application.
4. Enter sensor sensitivity – By default, the sensitivity is the nominal 25 mV/g (2.55 m/s²).
5. Specify the units (English, metric, or SI) that will be used for each parameter – By default, the units are set to English, unless the device was shipped to Japan.
6. Specify which measurements (e.g., velocity, temperature, etc.) are to be reported as the process variables PV, SV, TV, and QV – By default, PV is the Overall Velocity on sensor 1, SV is the PeakVue measurement on sensor 1, TV is the sensor 1 bias voltage, and QV is the supply voltage.
7. Specify alert levels - Determine the thresholds at which measurement alerts will be annunciated and determine behavior of device alerts.
8. Specify how the parameters will be published (i.e., optimized or generic burst mode) – By default, the device is configured to use optimized burst mode.
9. Specify how often the parameters will be published – This is the update rate. The factory default is once every 30 minutes. At this update rate, with the LCD disabled, and at nominal temperatures (~ 25 °C), the power module is expected to last about 4 years. Unless the device is powered with an external DC power source, a faster publish rate is not recommended because it will significantly reduce the life of the power module.
10. Optimize for power consumption - If using a power module, there are additional settings available to reduce power consumption.
11. Configure trending of parameters - Parameters may be trended in a plant historian, AMS Machinery Manager, or both.
12. For CSI 9420 revision 3 or later, if the device configuration will not be managed by a HART DCS (e.g., DeltaV), specify whether AMS Machinery Manager can make configuration changes. By default, the device is set for the configuration to be managed by a DCS and changes from AMS Machinery Manager are not permitted.
13. For CSI 9420 revision 3 or later, if the device is licensed for advanced diagnostics (spectral data retrieval), configure storage of energy bands, spectra, and waveforms in the AMS Machinery Manager database. Data can be collected “on demand” or the software can be configured to collect data automatically at periodic intervals.

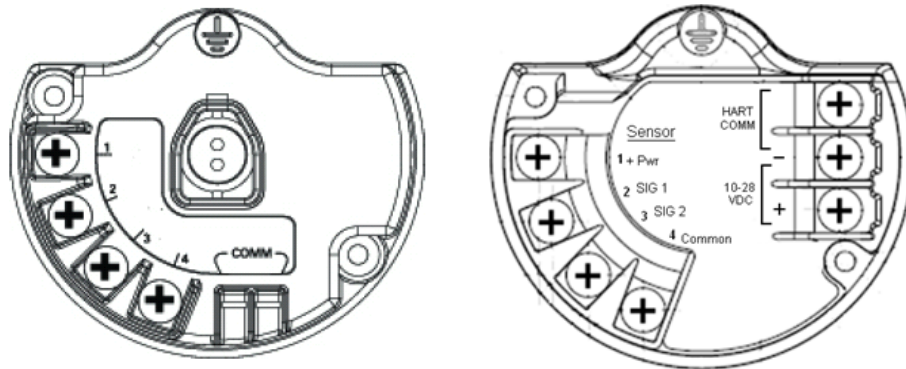
Connection to the Wired HART Interface

Unless the CSI 9420 was purchased pre-configured from the factory, it is necessary to connect to the wired HART interface to define the credentials for the device to communicate on your wireless network. If desired, other device configurations such as sensor type and alert thresholds may also be defined at this time.

The following should be taken into consideration when using a HART Interface:

- Power must be supplied to enable the wired HART interface, either by installing the power module, if applicable, or connecting external DC power.
- The wired HART interface is intended only for configuration. Dynamic variables (i.e., measured vibration parameters, etc.) are not updated when communicating on the wired interface.
- The CSI 9420 does not communicate simultaneously on both the wired and wireless HART interfaces. As a result, wireless connectivity is lost when you connect to the wired HART interface for configuration. Configuration changes are not reflected in a wireless host until connection has been re-established. To avoid loss of synchronization, hosts relying on the wireless link must be disconnected when communicating with the device on the wired interface. For example, if you are viewing a configuration screen in AMS Device Manager through a Wireless link, and you leave this screen open while making changes with a Field Communicator, you will have to exit AMS Device Manager and then re-open it (or rescan the device) after the wireless connection has been restored in order to see the changes.
- When configuration is completed over the wired HART interface, you must disconnect the device from the communication wires to re-establish WirelessHART communication. This may take several minutes.

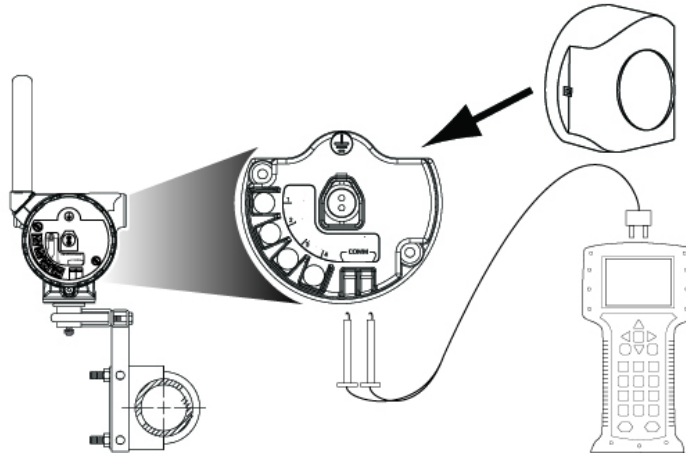
Figure 2-1. CSI 9420 Terminal Block



The wired HART connection is located on the terminal block in the rear chamber of the device, as shown in Figure 2-1. It is a two-wire, polarity-independent connection. With the power module version, it is the bottom two terminals, labeled “COMM”. In the externally powered version, it is the top two screws on the right, labeled “HART COMM.”

Begin by removing the rear housing cover. This will expose the terminal block and HART communication terminals. Connect the power module, or external 24 VDC, to supply power for configuration. This process is illustrated in Figure 2-2 (for the battery powered version).

Figure 2-2. Field Communicator Connections



For configuration, the CSI 9420 will receive any HART communications from a Field Communicator, AMS Device Manager, or other HART-enabled host. When using a Field Communicator, any configuration changes must be sent to the transmitter by using the **Send** key (F2). AMS Device Manager configuration changes are implemented when the **Apply** button is clicked.

NOTICE

The CSI 9420 enters “HART Listen” mode for communication on the wired interface. When doing so, “HART Listen” is displayed on the optional LCD, if installed. A finite amount of time is required to enter this mode and the device is unable to do so during its boot sequence or while performing its real-time vibration measurement. For this reason, it may be necessary to “retry” the initial wired HART handshaking sequence. If repeated attempts to establish wired communication fail, you can force the device into HART Listen mode by removing the front cover and pressing the “CONFIG” button once. Pressing the CONFIG button a second time causes the device to exit HART Listen mode. Once the device has entered HART Listen mode, it will remain in this mode until the CONFIG button is pushed, power is cycled, or no activity is seen on the wired interface for three (3) minutes.

Device Network Configuration

In order to communicate with the Smart Wireless Gateway, and ultimately other systems, the transmitter must be configured to communicate with the wireless network. This step is the wireless equivalent of connecting wires from a transmitter to a control system input.

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 of the gateway and other devices in the network. If the Network ID and Join Key are not identical to the gateway settings, the CSI 9420 will not communicate with the network. The Network ID and Join Key may be obtained from the gateway web server on the **Setup > Network > Settings** page.

Device Configuration Options

The CSI 9420 has a number of configuration options that affect how the device operates. These settings control such things as how often measurement results are reported, how these results are reported, the number and type of sensor installed, and how and when alerts are generated. The default configuration and process variable mappings are shown in Table 2-1.

Table 2-1. Default configuration (if not purchased pre-configured).

Sensor 1:	Accelerometer, 25 mV/g
Sensor 2:	Not installed
PV:	Overall Velocity, Accelerometer 1, units: in/s RMS
SV:	PeakVue, Accelerometer 1, units: gs
TV:	Bias, Accelerometer 1, units: Volts
QV:	Supply Voltage, units: Volts
Update Rate:	30 minutes
LCD:	Enabled
MHM Config:	Disabled
Power:	Battery Power Module
Power Save Publish:	Disabled

Sensor Configuration

The possible sensor configurations and variable mappings are shown in Table 2-2:

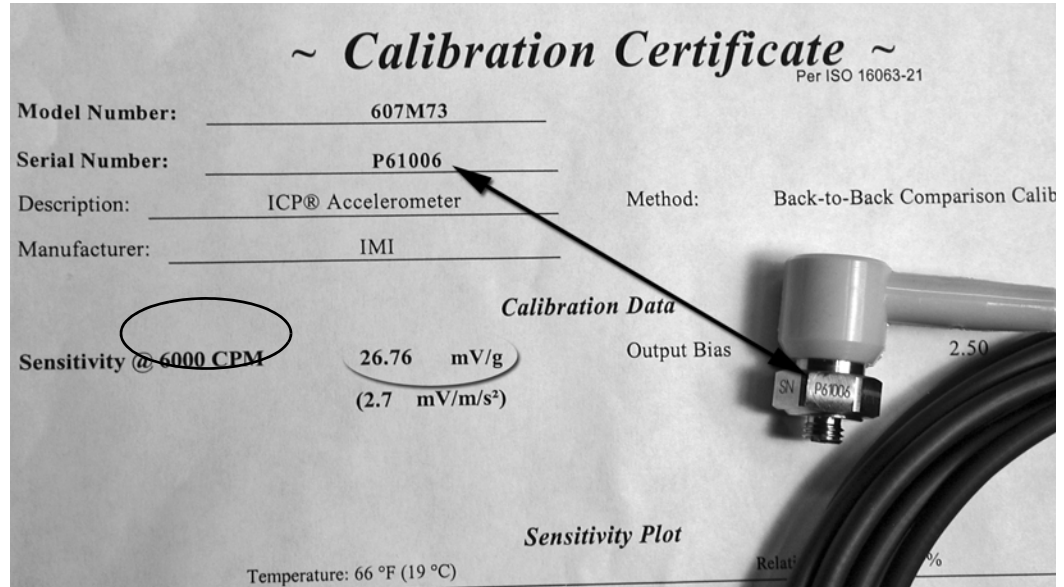
Table 2-2. Possible sensor configurations and variable mappings

Sensor1	Sensor 2	PV	SV	TV	QV
Accelerometer	Not Installed	Overall 1	PeakVue 1	Bias 1	Supply Voltage
	Accelerometer	Overall 1 PeakVue 1	PeakVue 1 Overall 2 Bias 1 PeakVue 2	Bias 1, Bias 2 Overall 2, PeakVue 2	Bias 2, Overall 2, PeakVue 2 Supply Voltage
Accelerometer with embedded temperature	Not installed	Overall 1 PeakVue 1 Temperature 1	Overall 1 Peakvue 1 Temperature 1	Temperature 1 PeakVue 1 Bias 1	Temperature 1 Supply Voltage

The CSI 9420 can be installed with two accelerometers, or one accelerometer with an embedded temperature sensor.

Each sensor is characterized at the factory to determine the precise sensitivity. This information is included with the sensor, in the form of a certificate, and may be cross-referenced with the serial number as shown in Figure 2-3.

Figure 2-3. Sensor Sensitivity



For improved accuracy, the nominal value of 25 mV/g should be replaced with the value corresponding to your specific sensor.

Units

The units for the various measurement parameters are as follows:

Table 2-3. Units

Parameter	Units
Velocity (Overall 1, Overall 2)	in/s RMS, mm/s RMS
PeakVue maximum value (PeakVue 1, PeakVue 2)	g's, m/s ²
Temperature (Temperature 1, Ambient)	° F, °C
Sensor Bias (Bias 1, Bias 2)	V
Supply Voltage	V

Alert Levels

The CSI 9420 sets HART status bits to indicate when measured values exceed the configured thresholds. Each measured value has three (3) levels: Advisory, Maintenance, and Failed that may be set independently. These thresholds are pre-configured at the factory to reasonable

generic values for single-stage, electric motor-driver equipment trains operating at 1200~3600 RPM. The default alert levels for vibration are shown in Table 2-4.

Table 2-4. Default Alert Thresholds for Vibration

Parameter	Advisory		Maintenance		Failed	
	Level	Enabled	Level	Enabled	Level	Enabled
Overall Velocity, Accel 1 (PV)	0.14 in/s (3.56 mm/s)	Yes	0.35 in/s (8.89 mm/s)	Yes	1.0 in/s (25.4 mm/s)	Yes
PeakVue, Accel1 (SV)	6 g (58.86 m/s ²)	Yes	10 g (98.1 m/s ²)	Yes	15 g (147.15 m/s ²)	Yes

The level at which these thresholds should be set obviously depends on the type of equipment being monitored and on your specific process. For more information on how to set the thresholds refer to Appendix C: Velocity, PeakVue, and Temperature, or consult with a vibration specialist.

One “rule of thumb” for vibration is to examine the current level at which the equipment is operating. Then, assuming the equipment is in good working order, 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 Emerson does not condone this type of vibration program, it can provide a starting point when no other information is available.

The default alert thresholds for temperature correspond closely to a generic open drip-proof (ODP) motor with class F insulation and a service factor of 1.15, operating at an ambient temperature at or below 40 °C and at an altitude at or below 1000 meters. These values are also reasonable thresholds to use when there is no knowledge of the process, the type of machinery, or the operating environment. Refer to Appendix C: Velocity, PeakVue, and Temperature for more information. The default temperature levels are shown in Table 2-5.

Table 2-5. Temperature Levels

Parameter	Advisory		Maintenance		Failed	
	Level	Enabled	Level	Enabled	Level	Enabled
Temperature	149 °F (65 °C)	Yes	167 °F (75 °C)	Yes	185 °F (85 °C)	Yes

The configurable device alerts include accelerometer bias and supply voltage. The default settings for these alerts are shown in Table 2-6.

NOTICE

The supply voltage measurement is made under load conditions. Therefore, the supply voltage may read differently with the CSI 9420 versus other Emerson transmitters or multi-meters.

NOTICE

When any measured process parameter (Velocity, PeakVue, or Temperature) exceeds the configured Advise, Maintenance, or Failed threshold, this causes an “Advisory” indication on a screen that is viewed from AMS Device Manager (or other graphical host). This indicator itself does not set a status bit.

Table 2-6. Configurable Device Alerts

Parameter	Advisory		Maintenance		Failed	
	Level	Enabled	Level	Enabled	Level	Enabled
Accelerometer Bias	N/A	N/A	N/A	N/A	Below 2 V or Above 3 V	Yes
Supply Voltage	Below 6.5 V	Yes	Below 6.2 V	Yes	Below 5.3 V	Yes

NOTICE

Prior to sensor connection, it is normal to see alerts related to bias failure. These alerts will go away once the sensor is installed correctly.

Burst Mode

The CSI 9420 can publish in either of two modes: Optimized Burst Mode or Generic Burst Mode.

Optimized burst mode uses less power because it combines a large amount of information into a single command. In this mode, only the 4 standard process variables (PV, SV, TV, and QV) are published at the specified update interval and cached in the Smart Wireless gateway. When values are cached in the gateway, it is not necessary to “wake up” the device for the host system to read the variables. The other variables are still available, but any request to read one of them wakes the device and consumes power.

Generic burst mode publishes all process variables the device can produce. This mode requires three publish messages to do so, which requires a little more power (<5%). If you are only trending measurements mapped to PV, SV, TV, and QV you should use optimized burst mode. If you are trending additional variables, you should use generic burst mode.

Update Rate

The default update rate is 30 minutes. This may be changed at commissioning or at any time via AMS Device Manager, the Field Communicator, or the gateway web server.

The Update Rate can be set from 1 minute to 1 hour. The maximum (fastest) recommended update rate is 30 minutes, unless using an external DC power source.

⚠ WARNING

If the device uses a power module, and it is configured to publish at the maximum allowable update rate (once per minute), the power module is expected to last only about 2-3 months. For faster update rates, if your application allows it, use the external DC power option.

Optimize for Power Consumption

The primary mechanism for minimizing power consumption is to reduce the publish rate. There are also other settings and operational considerations related to power.

Two configuration settings that effect power are:

- LCD (Liquid Crystal Display)
- Power Save Mode

LCD

If the LCD is installed, verify it is enabled. When the LCD is enabled, the CSI 9420 displays information about its network state and its measurements. This is very helpful for configuration, installation, and commissioning. It also provides a visual indication (at the device) that the device is operating, and shows its current measurements.

To display information in a meaningful way, the CSI 9420 must stay “awake” longer than otherwise necessary, to allow a human enough time to read the display. This longer wake time consumes additional power.

If the LCD is not required during normal operation, it should be disabled after installation is complete. Physically removing the LCD is neither necessary nor sufficient, it must be disabled via the configuration to realize a power savings.

NOTICE

Disabling the LCD (i.e., not removing it, just disabling it via the configuration) provides a significant power savings of about 20%.

Leaving the LCD installed even if it is disabled can still provide benefits. The LCD can still be viewed in the field by removing the front cover and pressing the DIAG button. This causes the device to wake and display current information, even if the LCD is disabled in the configuration. This can be very beneficial for taking a quick reading at the machine and also for assistance in troubleshooting.

NOTICE

Moving one LCD around to multiple devices, on an “as needed” basis, is NOT recommended. This can cause reliability problems over time because the connector pins on the LCD are not designed for repeated connect/disconnect.

Power Save Mode

The largest value that can be entered for the burst rate in the CSI 9420 is once per hour. The “Power Save” mode was added starting in Rev. 3 devices for cases where less frequent updates are acceptable. This makes it possible to extend operating life by limiting how often the CSI 9420 executes a new measurement. Instead, to save power it will re-publish a previous measurement. Since well over half of the power consumption in a normal measurement cycle is consumed by the actual measurement, this represents a significant opportunity for power savings and can be used in certain configurations to extend the operating life out to 10 years or longer on a single Smart Power Module.

While the setting for the Power Save mode is visible in the DD, it can only be activated in the AMS Machinery Manager software. Therefore, Access Control (see Fig 2-25) must first be enabled. The field in AMS Machinery Manager software where the PowerSave mode is set is referred to as “Update Rate Skip” (reference Fig 2-4 below). Power Save can be configured to skip from 0 to 23 acquisitions. When this feature is turned “Off”, the CSI 9420 will collect readings as usual. When combining the setting of “Every other 1” with a 60 minute burst rate, then a new acquisition will only occur every two hours. Similarly, when combining the maximum value of “Next 23” with a 60 minute, then a new acquisition occurs only once every 24 hours.

Figure 2-4. Sensor Sensitivity

Configure Other

Noise Threshold 0.15 in/sec RMS

Update Rate 60 (minutes) 0 (seconds)

Update Rate Skip Off

Allow configuration

- Every other 1
- Next 2
- Next 3
- Next 4
- Next 5
- Next 6
- Next 7
- Next 8
- Next 9
- Next 10
- Next 11
- Next 12
- Next 13
- Next 14
- Next 15
- Next 16
- Next 17
- Next 18
- Next 19
- Next 20
- Next 21
- Next 22
- Next 23

Trending Parameters

Parameters can be trended either in a plant historian, in AMS Machinery Manager, or in both locations simultaneously. 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 indicates some of the general capabilities and version requirements.

Values can be trended in essentially any host that accepts Modbus or OPC inputs. Configuration of OPC tags and Modbus registers for wireless devices is done 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 it is necessary to enter the information (e.g., Modbus register definitions) in both locations.

DeltaV 10.3 or later integrates the Smart Wireless Gateway as a native I/O device on the control network. In this case the wireless devices can be managed as native HART devices and the variables trended accordingly. This type of installation also allows richer alerting and diagnostics because the full HART capabilities are available.

Ovation 3.3 or later also integrates the Smart Wireless Gateway with all the associated benefits of HART.

AMS Machinery Manager 5.4 or later, supports HART functionality to read configuration and alert information as well as the dynamic parameters from the CSI 9420. This allows Machinery Manager to “auto-discover” all of the devices on the wireless mesh as well as the specific sensor configurations, units settings, and variable mappings for the CSI 9420 devices.

Also, with AMS Machinery Manager 5.4 or later, and CSI 9420 revision 3 or later devices (that are licensed for waveform/spectra), it is possible to trend Energy Band parameters. Refer to the discussion on advanced diagnostic option and storage below for additional information.

DeltaV versions prior to 10.3 and Ovation versions prior to 3.3, though not integrated via HART, do accept Modbus values from the wireless devices. DeltaV can also accept OPC values.

Remove Power Module

After the sensor and network have been configured, disconnect the communication leads, remove the power module (if the device is not already installed), and replace the transmitter cover. The power module should be inserted only when the device is ready to be commissioned.

Configuration with the Field Communicator

The Field Communicator configuration menu trees for the CSI 9420 are shown on the following pages.

The menu trees for the 2.4 GHz version are shown from Figure 2-5 to Figure 2-10.

Options listed in bold type indicate that a selection provides other options. For ease of operation, some common tasks may be accessed in several locations of the menu structure.

Figure 2-5. Field Communicator Menu Tree for CSI 9420, One Accelerometer: 1 of 2

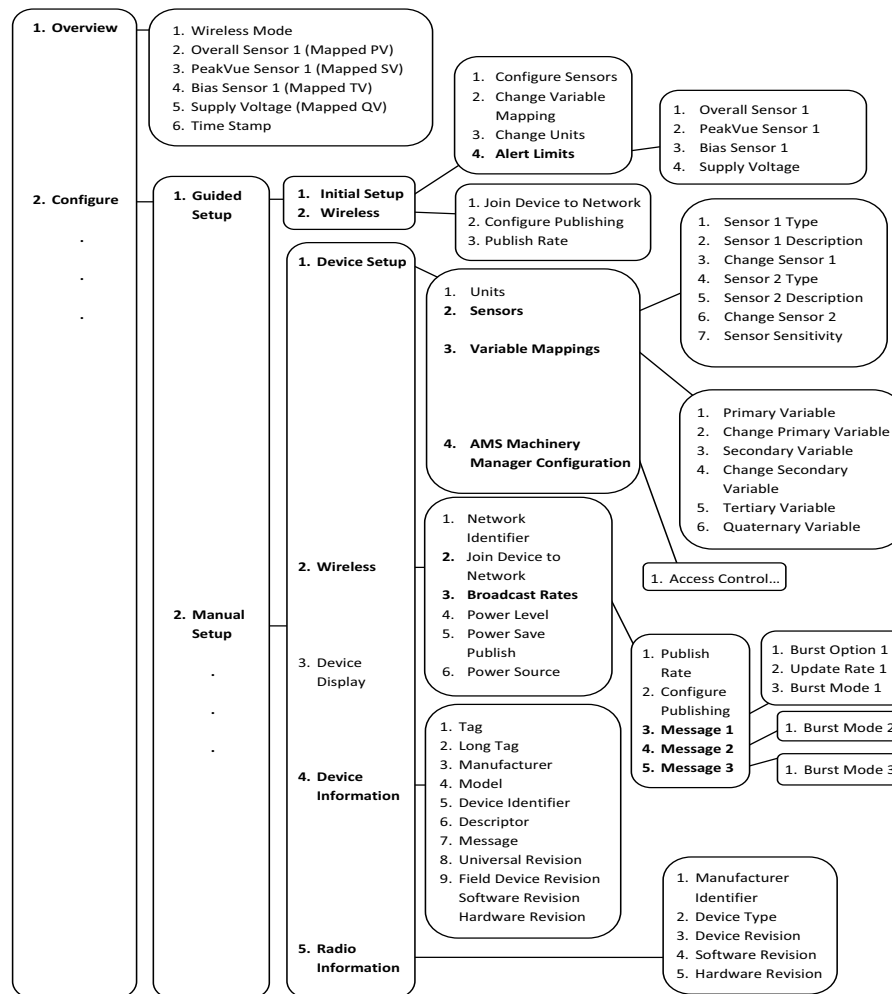


Figure 2-6. Field Communicator Menu Tree for CSI 9420, One Accelerometer: 2 of 2

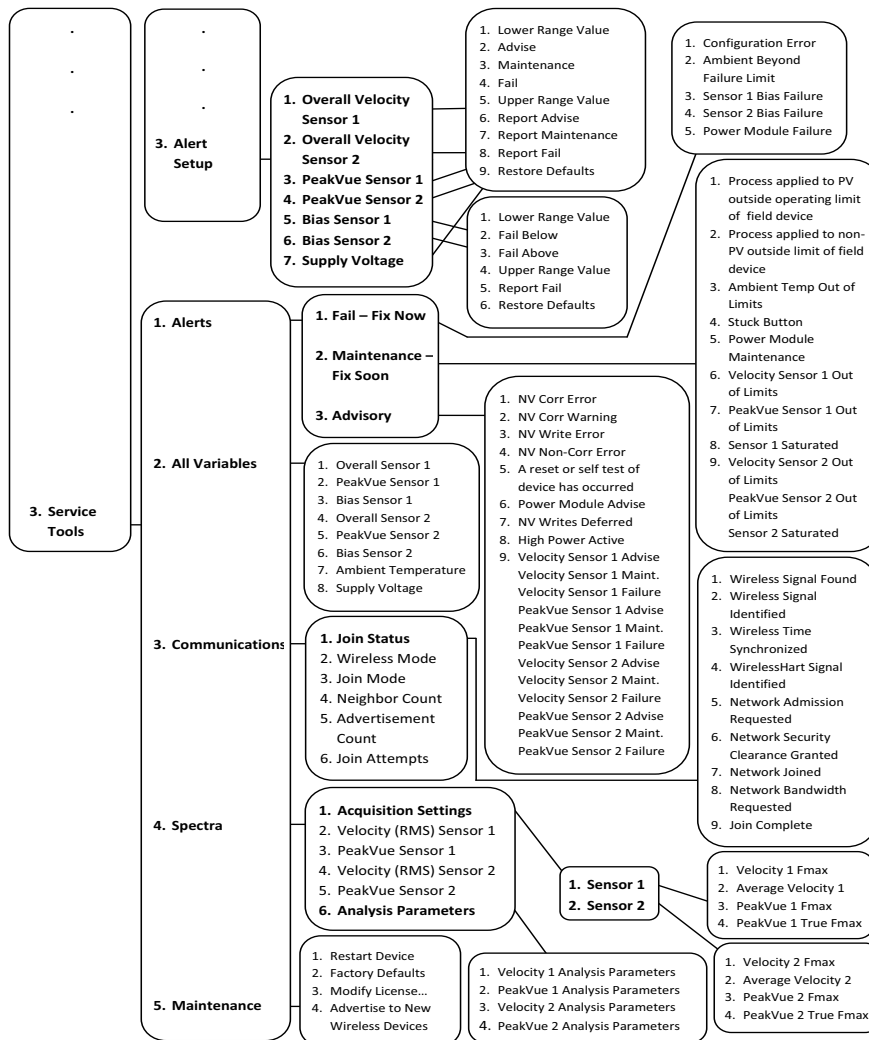


Figure 2-7. Field Communicator Menu Tree for CSI 9420, Accelerometer with embedded Temperature: 1 of 2

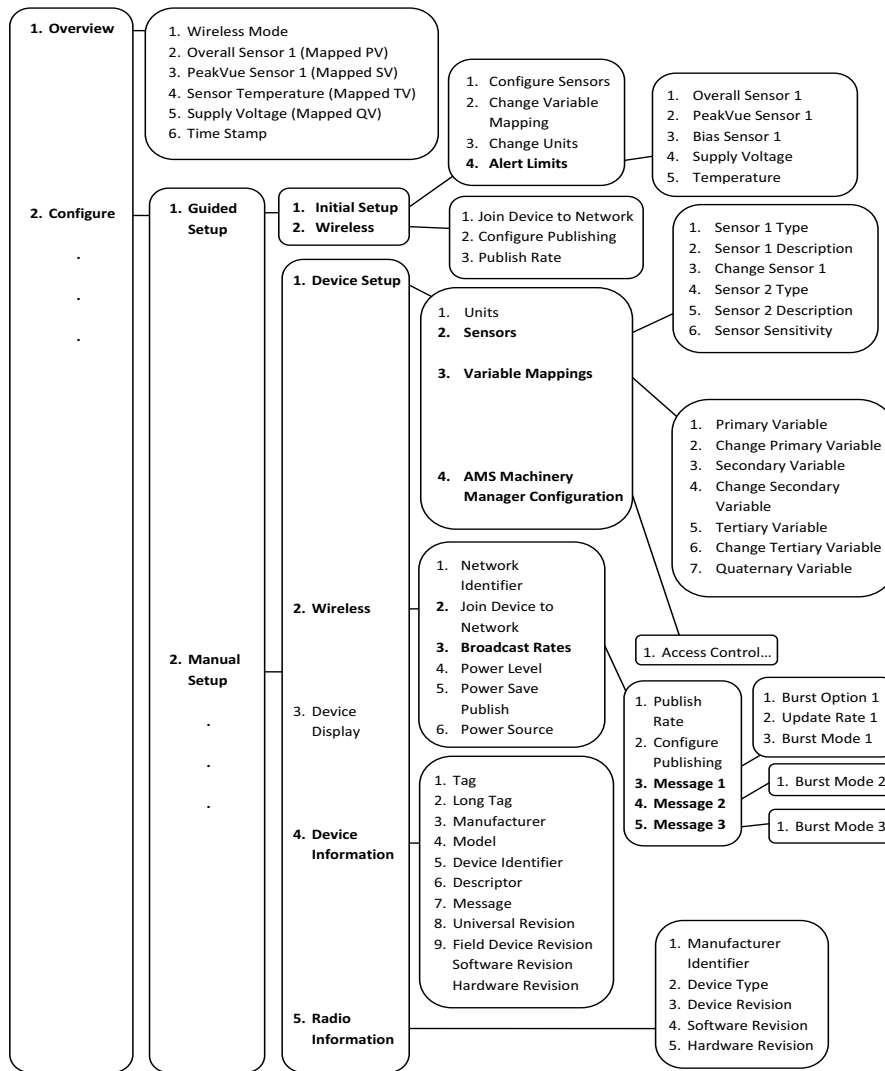


Figure 2-8. Field Communicator Menu Tree for CSI 9420, Accelerometer with embedded Temperature: 2 of 2

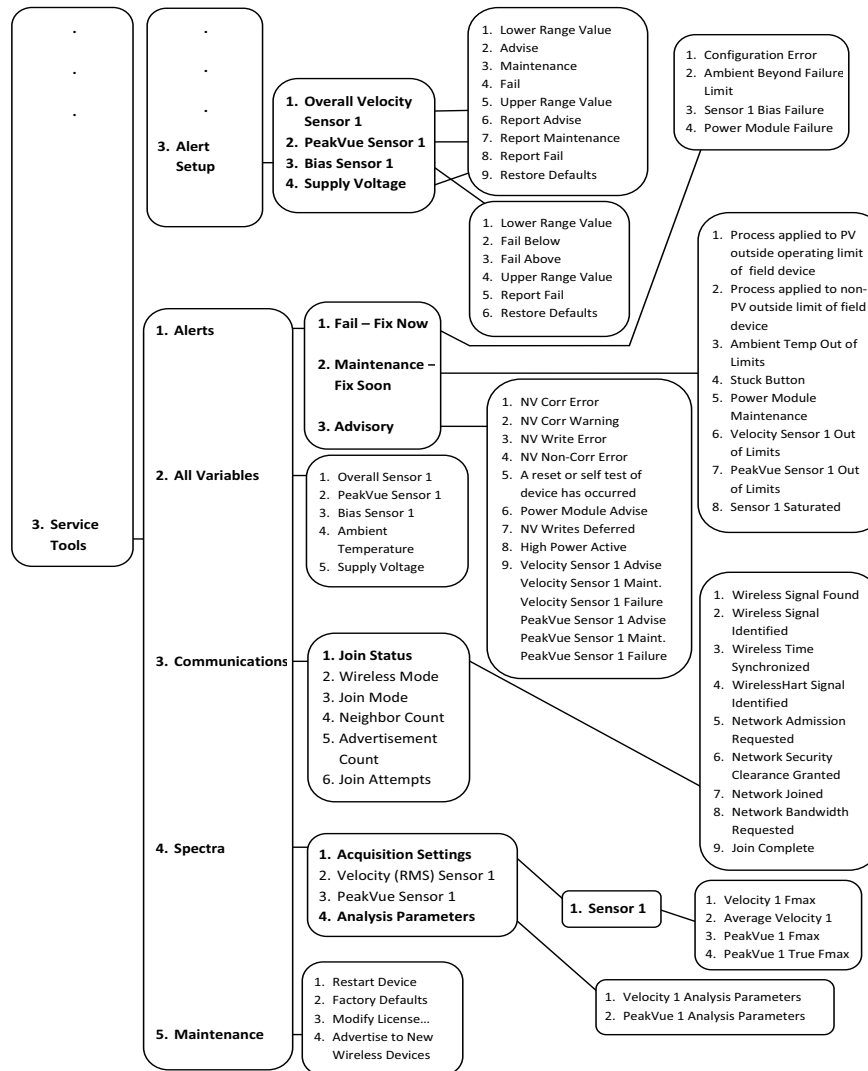


Figure 2-9. Field Communicator Menu Tree for CSI 9420, Two Accelerometers: 1 of 2

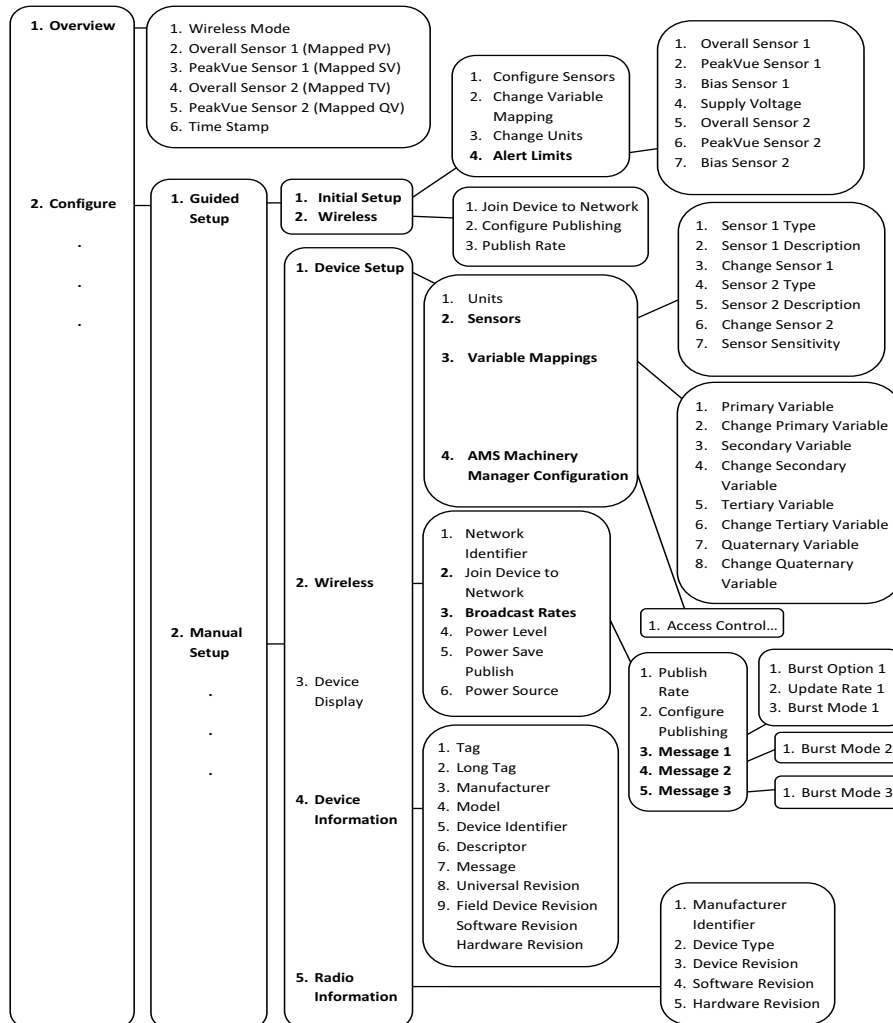
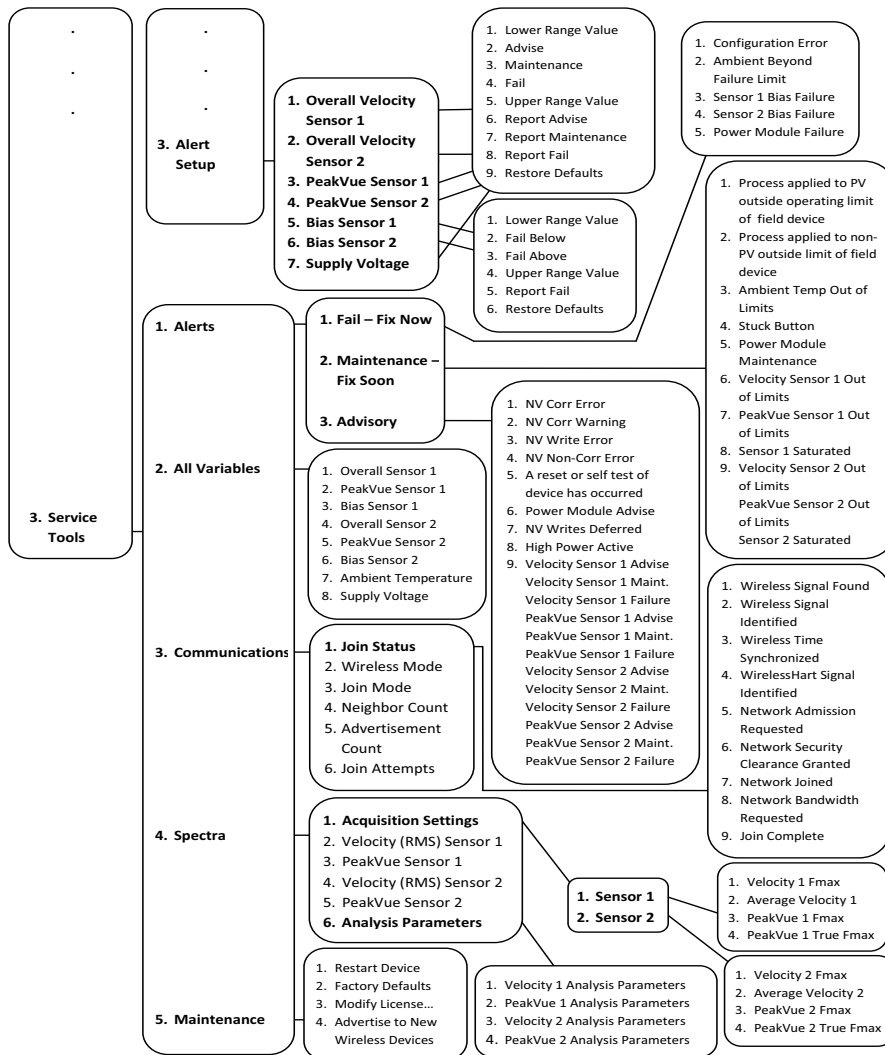


Figure 2-10. Field Communicator Menu Tree for CSI 9420, Two Accelerometers: 2 of 2



Fast Key Sequences

NOTICE

For the 2.4 GHz CSI 9420, the fast key sequences assume that Dev v3, DD v3 is being used.

To use the Field Communicator with the rev 3 or 4 CSI 9420, a rev 3 DD (Device Description file) is required. The DD for the CSI 9420 is located on the CD that is shipped with the CSI 9420.

Field Communicator System Software version 3.2 or later is also required.

NOTICE

Refer to the Field Communicator Users' Manual for details on DDs or go to <http://www2.emersonprocess.com/en-us/brands/Field-Communicator/Pages/SysSoftDDs.aspx> for instructions on adding a DD for the CSI 9420 or other new devices.

To access the Network Settings using a Field Communicator, refer to the following tables:

Table 2-7. CSI 9420 Network Configuration

Function	Key Sequence	Menu Items
Wireless	2, 2, 2 (Manual Setup)	Network Identifier, Join Device to Network, Broadcast Rates, Power Level, Power Save Publish, Power Source
Wireless	2, 1, 2 (Guided Setup)	Join Device to Network, Configure Publishing, Publish Rate

The following tables list other common fast key sequences:

Table 2-8. CSI 9420 Fast Key Sequence

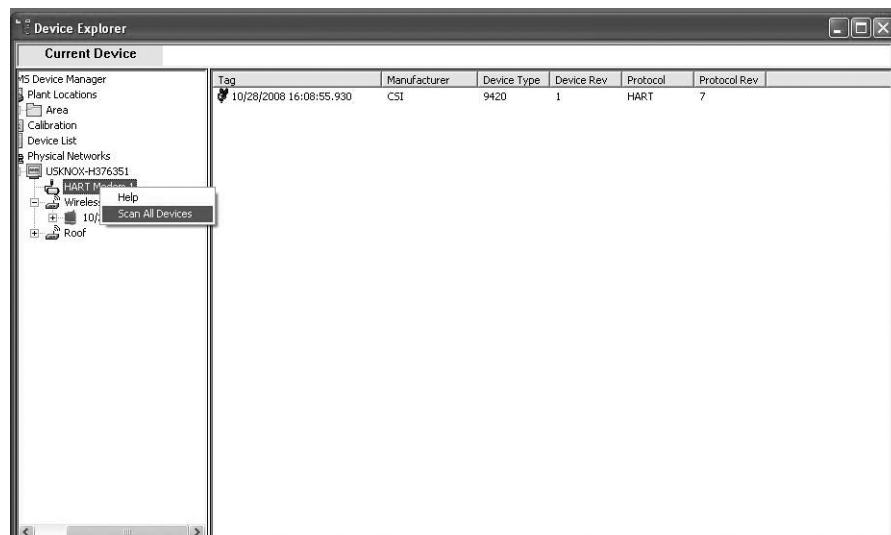
Function	Key Sequence	Menu Items
Initial Setup	2, 1, 1 (Guided Setup)	Configure Sensors, Change Variable Mapping, Change Units, Alert Limits
Device Setup	2, 2, 1 (Manual Setup)	Units, Sensors, Variable Mappings
Alert Setup	2, 1, 1, 4 (Guided Setup)	
Alert Setup	2, 3 (Manual Setup)	Dependent on sensor configuration
Update Rate / Burst mode	2,1,2 (Guided Setup)	Configure Publishing, Publish Rate
Update Rate / Burst mode	2,2,2,3 (Manual Setup)	Configure Publishing, Message 1, Message 2, Message 3
Power Options	2,2,2 (Manual Setup)	Power Level, Power Save Publish
AMS Machinery Manager Config.	2,2,1,4 (Manual Setup)	Access Control

After entering the fast key sequence, select the variable you wish to configure. For alarm levels, enter the new values for Advise, Maint, or Fail thresholds. If you want to suppress the alarm that is reported when a variable exceeds a particular limit you may un-check the associated check box. Select the “Send” button to save the changes to the device.

Configuration with AMS Device Manager

Before performing operations in AMS Device Manager, first scan the device with a wired HART modem. Right-click the HART Modem in Device Explorer and select Scan All Devices. This example shows one device connected with a HART modem.

Figure 2-11. Device Explorer screen in AMS Device Manager



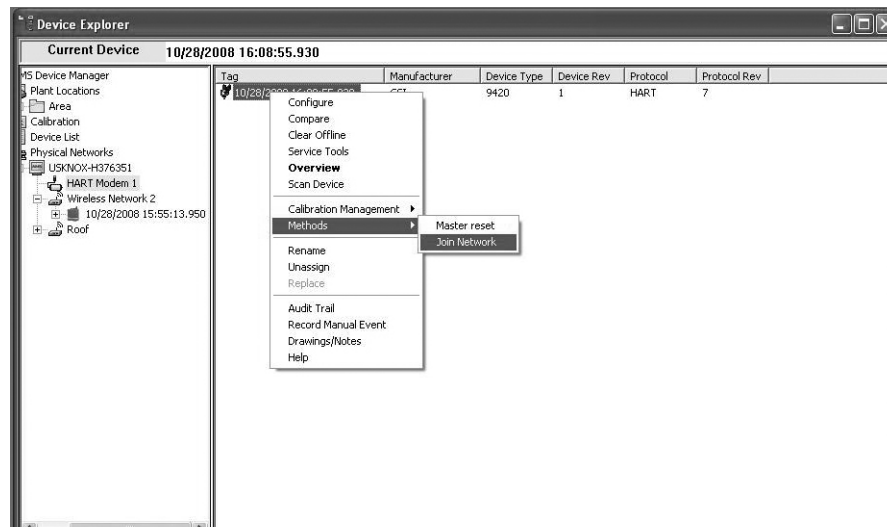
The following screen will appear during the Scan.

Figure 2-12. Scan Manager screen



To configure the wireless network settings, right-click the CSI 9420 device and select Methods, then Join Network.

Figure 2-13. The CSI 9420 device selected



Enter the Network ID for the wireless network. This can be obtained using the Smart Wireless Gateway Web Server, as shown below.

Figure 2-14. Wireless Gateway screen

The screenshot shows the 'Smart Wireless Gateway' web interface in Microsoft Internet Explorer. The browser address bar shows 'https://192.168.2.10/ser-netconf'. The page title is 'Smart Wireless Gateway'. The left sidebar contains a navigation menu with options: Diagnostics, Monitor, Explorer, Setup, Network (selected), Security, User Accounts, Certificates, Access List, Protocols, Time, System Backup, Page Options, Restart Apps, HART, Modbus, OPC, and Trends. The main content area is titled 'Network Settings' and contains the following fields and options:

- Network name: myNet
- Network ID: 12002
- Security mode: ☒ Common join key ☐ Access control list
- Join key: 21936630 00000000 00000000 00000000
- Show join key: ☒ Yes ☐ No
- Generate random join key: Generate
- Rotate network key?: ☒ Yes ☐ No
- Key rotation period (days): 2
- Change network key now?: ☐ Yes ☒ No
- Optimize for network size: ☐ 1..50 devices ☒ 51..100 devices
- Submit button

The footer of the page includes 'Emerson, 2008', 'Feedback', 'Terms Of Use', and 'SW Rev: 3.7.1'.

Figure 2-15. Join Device to Network screen: Network ID

The screenshot shows a dialog box titled 'Join Device To Network - 10/28/2008 16:08:55.930'. The text inside the dialog says: 'Enter the WirelessHART Network ID that this device should join to:'. Below this text is a text input field containing the value '12002'. At the bottom of the dialog are three buttons: 'Next >', 'Cancel', and 'Help'.

Figure 2-16. Join Device to Network screen: Join Key 1



Figure 2-17. Join Device to Network screen: Join Key 2

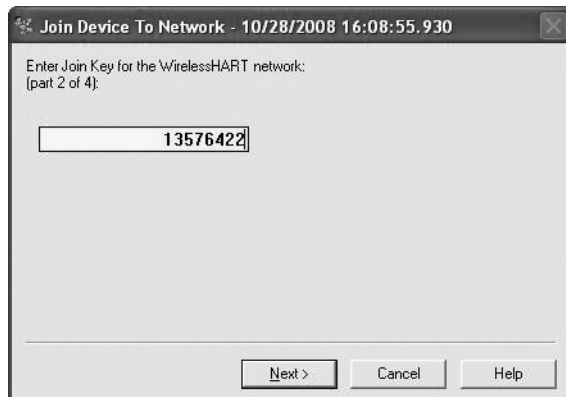
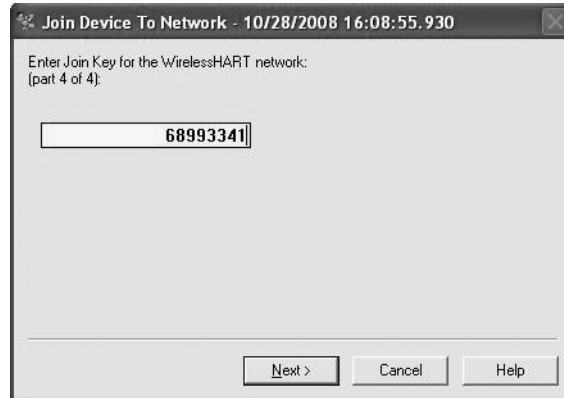


Figure 2-18. Join Device to Network screen: Join Key 3

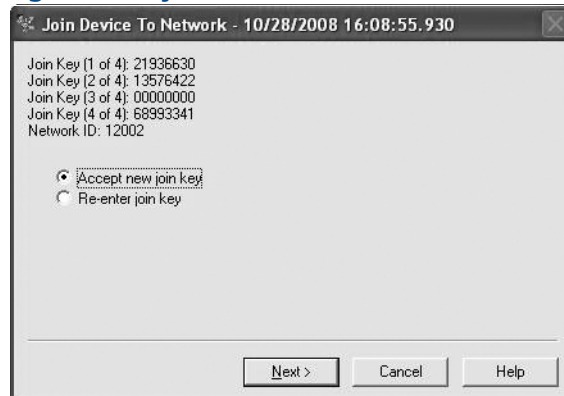


Figure 2-19. Join Device to Network screen: Join Key 4



Next, select Accept new join key.

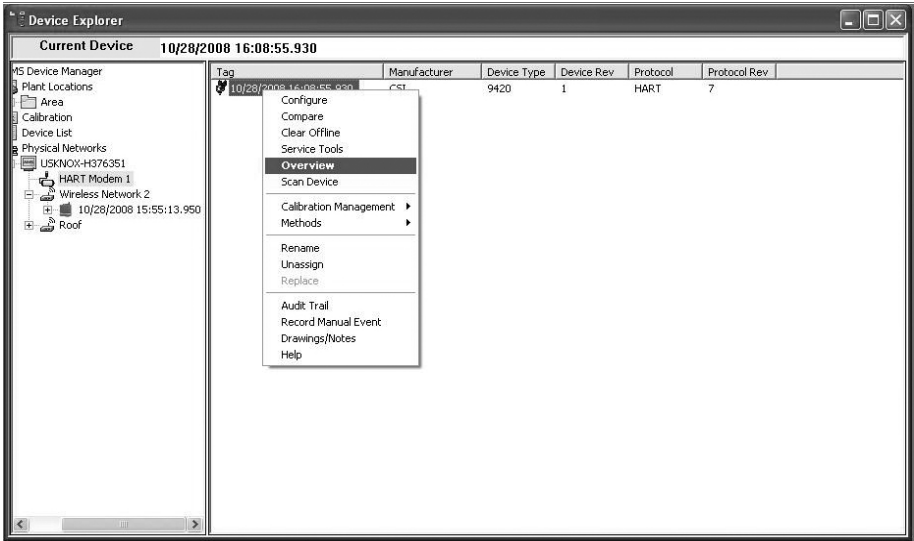
Figure 2-20. Join Device to Network screen: Accept new join key



Right-click Menu

The right-click menu of the CSI 9420 device provides a quick link to the Overview, Configure, and Service Tools window. Once this window is open, you can switch between these functions by clicking the buttons on the left side of the screen.

Figure 2-21. Right-click menu

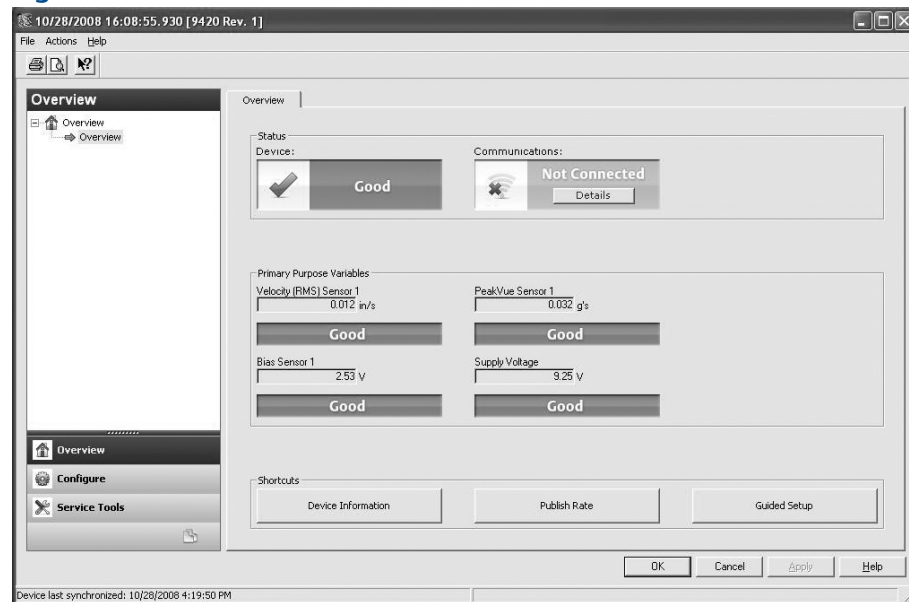


Overview

The Overview screen is shown in Figure 2-22. In this example the device is communicating via the wired HART interface. Therefore, the Status of the wireless Communications indicates “Not Connected.”

The four data variables are displayed along with their status.

Figure 2-22. Overview of the Device

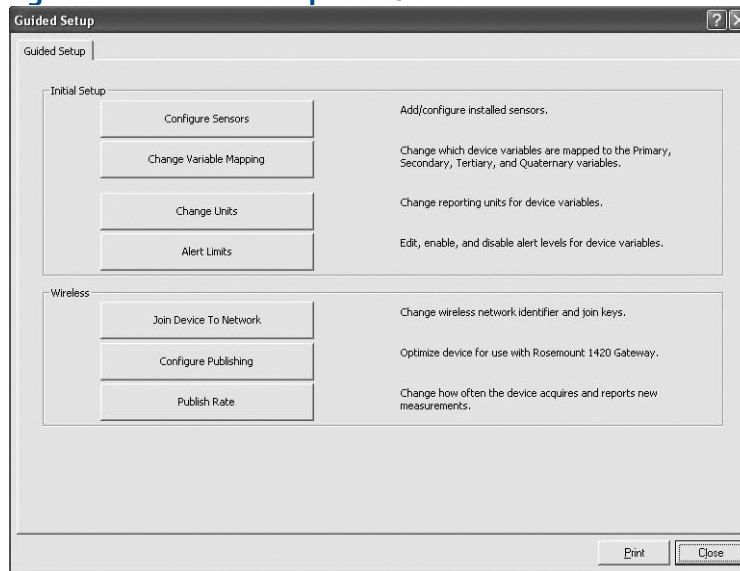


The Device Information shortcut button will display general information about the transmitter, including tag name.

The Publish Rate shortcut button allows configuration of how often the transmitter publishes data.

To configure the device, click the Guided Setup shortcut button from the Overview screen. The following window will appear. From this window, you can configure the sensor types, publish rate, unit types, alert levels, etc. in a step-by-step guided process.

Figure 2-23. Guided Setup window



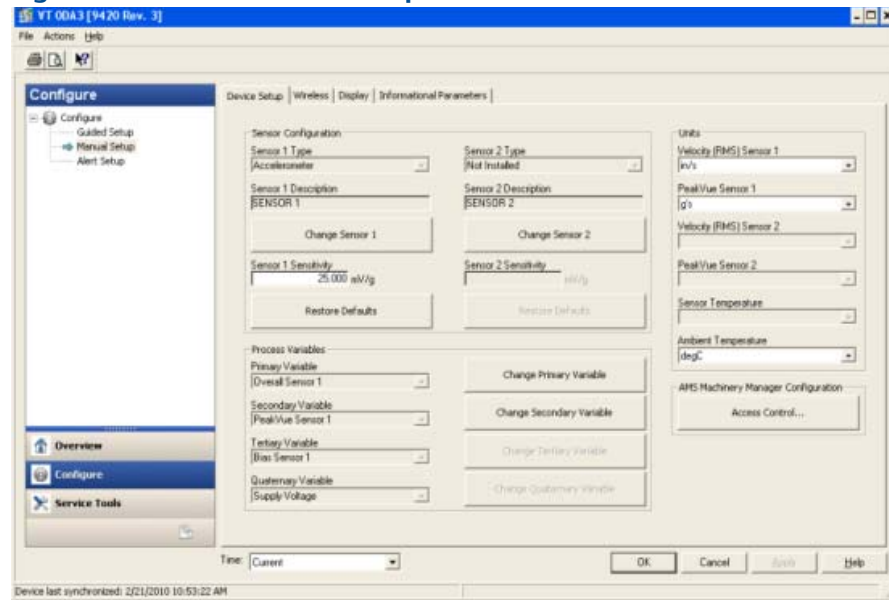
Configure

The guided setup function can also be accessed by clicking the Configure button on the left side of the screen, and then selecting the Guided Setup branch of the Configure tree.

To configure the device settings manually, select the Manual Setup branch of the Configure tree, seen in Figure 2-24. This screen can display either the current configuration settings, or a historical record of previous settings.

To edit the configuration settings, first select "Current" from the Time selection list at the bottom of the screen.

Figure 2-24. Manual Device Setup tab

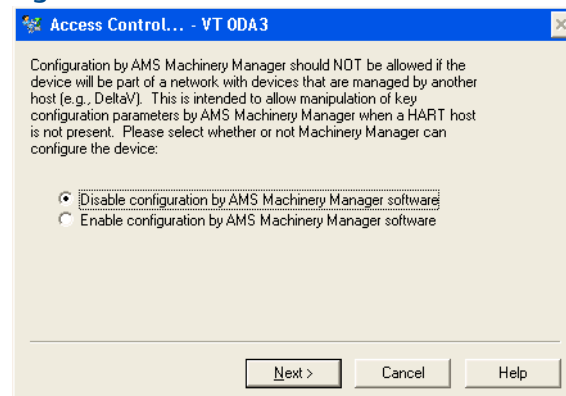


On the Device Setup tab, you can configure the sensor types and units types. You can also assign which values you want to be reported for the Primary, Secondary, Tertiary, and Quaternary variables.

When only one accelerometer is selected, only the PV and SV can be changed; When one accelerometer with a temperature sensor is selected, only the PV, SV, and TV can be configured. When two accelerometers are selected, all variables (PV, SV, TV, and QV) can be changed.

The “Access Control...” button is used to enable AMS Machinery Manager to make changes to the CSI 9420 configuration (e.g., alarm limits, PeakVue filter).

Figure 2-25. Access Control



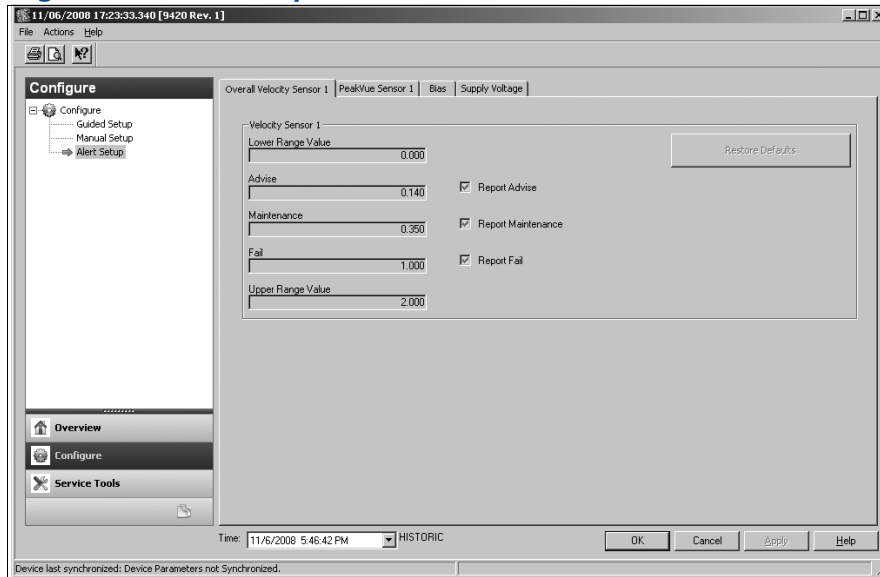
NOTICE

If the device will be commissioned in a HART DCS host (e.g., DeltaV or Ovation), then AMS Machinery Manager should not be enabled to make changes to the configuration.

Alert Setup

To configure alarm limits for the various measurement variables, select the “Alert Setup” branch of the Configure tree. These tabs display all the user configurable alarm parameters, based on the sensor configuration of the device.

Figure 2-26. Alert Setup



Select the tab of the variable you wish to configure. Enter the new values for Advise, Maint, or Fail thresholds. If you want to suppress the alarm that is reported when a variable exceeds a particular limit you may un-check the associated check box. Select the "Apply" button to save the changes to the device.

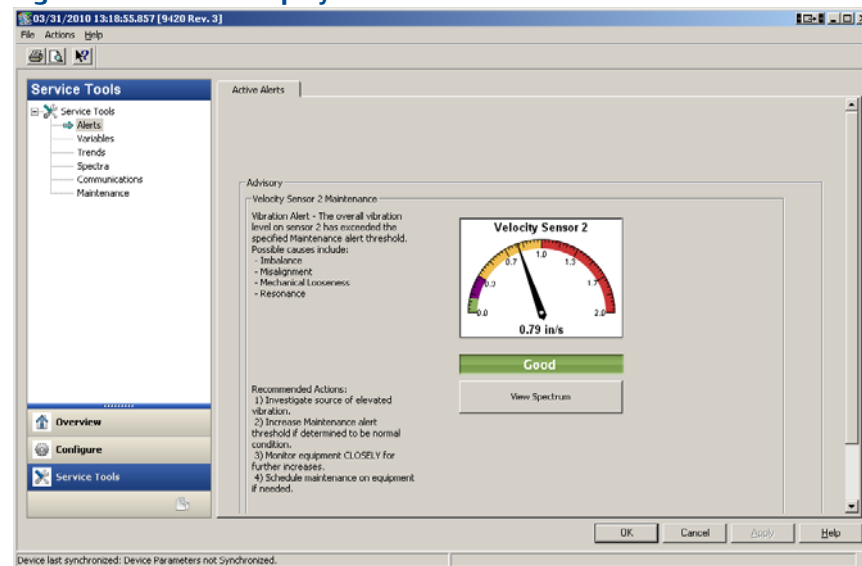
NOTICE

You may reset the alarm limits to default values by selecting the "Restore Defaults" button.

Service Tools

After clicking the Service Tools button on the left side of the screen, the Alerts branch of the Service Tools tree displays any alert information.

Figure 2-27. Alerts display



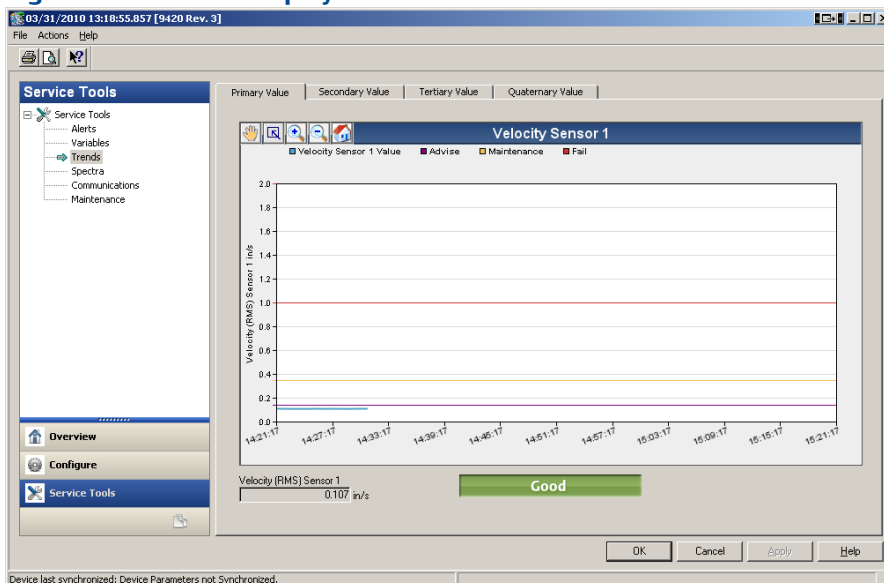
The Variables branch of the Service Tools tree displays graphical gauges of the various measurements. The Variables tab shows the sensor values. The Device Variables tab shows the supply voltage and ambient temperature values.

Figure 2-28. Variables display



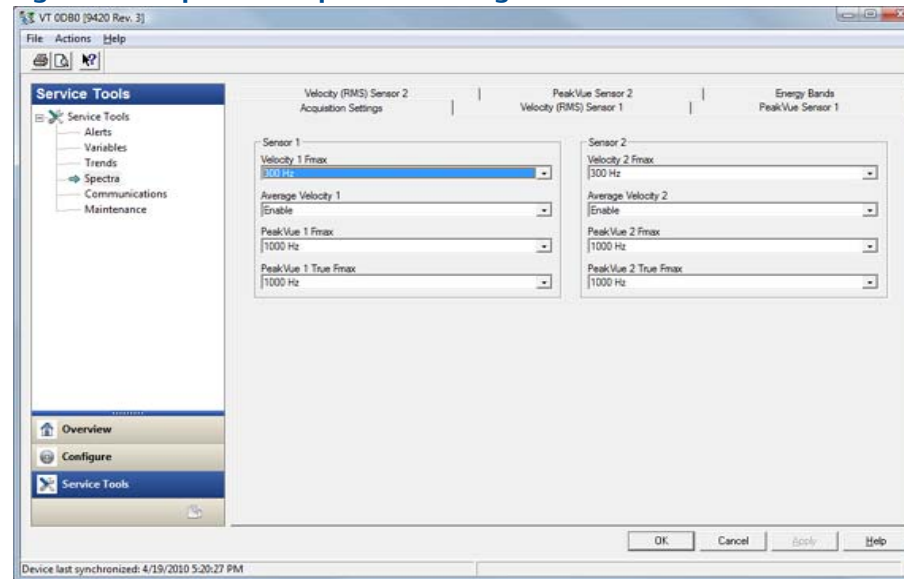
The Trends branch of the Service Tools tree displays an hour-long trend of each of the four measurement variables (PV, SV, TV, QV displayed on four separate tabs). The trend plots begin when the Trends branch of the tree is selected, and continue to build as long as this branch remains selected.

Figure 2-29. Trends display



The Spectra branch of the Service Tools tree displays spectral and analysis parameter data. This branch also has tabs for configuration of spectral data acquisition settings. Spectral data can then be imported into AMS Machinery Manager for further analysis.

Figure 2-30. Spectra - Acquisition Settings tab



On the Acquisition Settings tab, the Fmax settings define the default frequency range of the thumbnail spectra for Velocity and PeakVue.

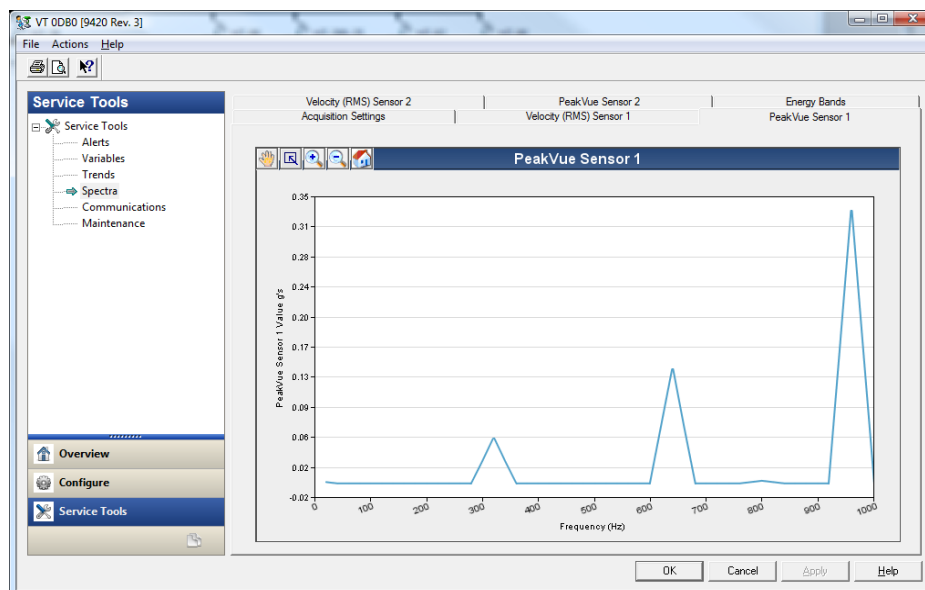
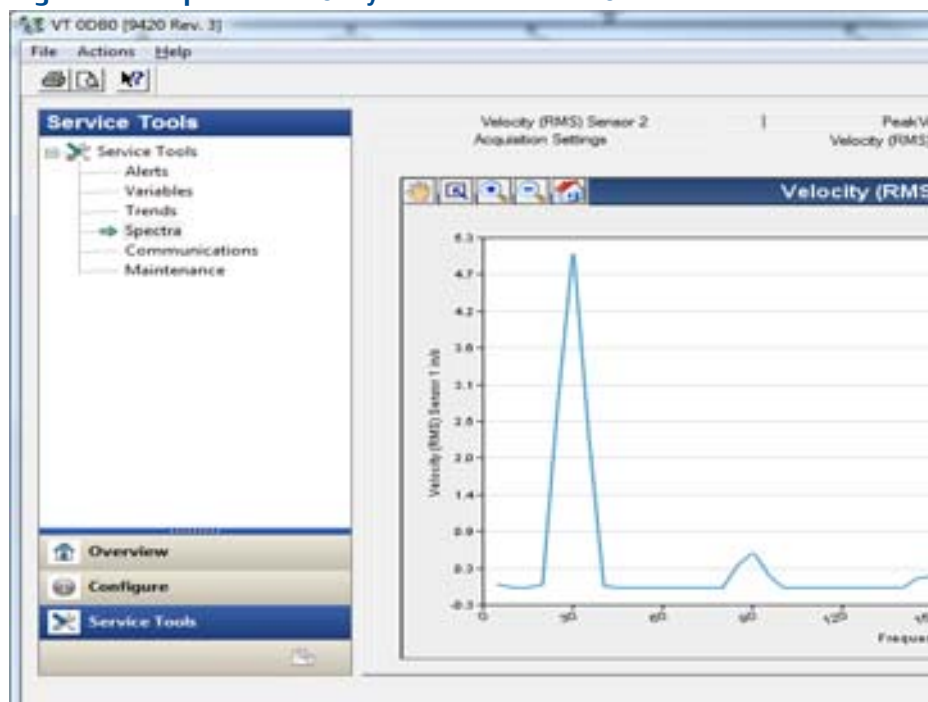
If the Average Velocity option is enabled, the high resolution Velocity Analytical spectrum will be calculated at 800 lines of resolution, with four averages. If this parameter is disabled, the spectrum will be calculated at 1600 lines of resolution, with no averaging.

When vibration data is acquired, a PeakVue waveform is sampled for 3.2 seconds. If the PeakVue True Fmax is set to 1000 Hz, the first 1.6 seconds of the PeakVue waveform is used for the analytical spectrum. If the Fmax is set to 500 Hz the entire 3.2 second PeakVue waveform is used to calculate the analytical spectrum. Regardless of the choice in Fmax, the overall PeakVue trend parameter is calculated over the entire 3.2 second waveform.

The AMS Machinery Manager Data Import help file has more information on these acquisition settings. The "Advanced Diagnostic Option and Storage in AMS Machinery Manager" section later in this manual also has additional information on this setting.

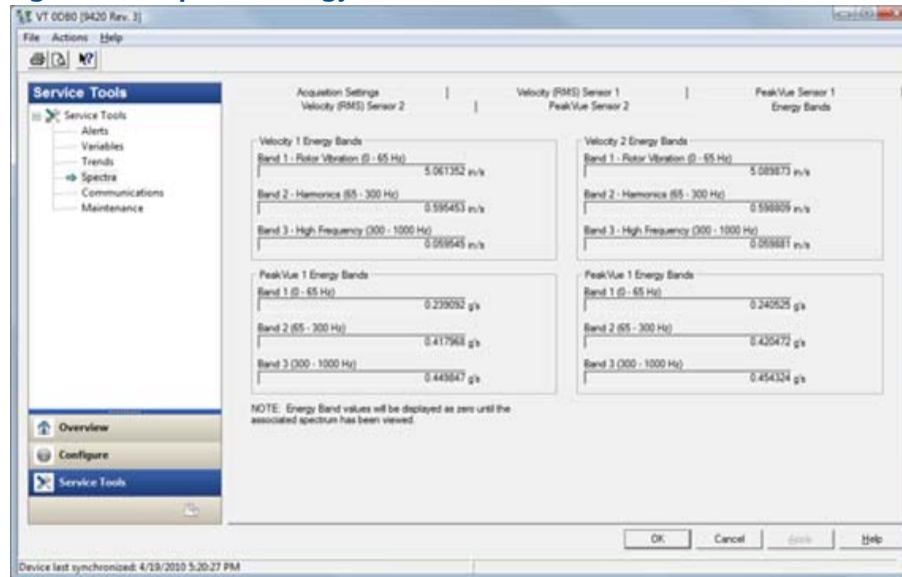
The Spectra - Velocity and PeakVue Sensor tabs display spectral plots of the last acquired data.

Figure 2-31. Spectra - Velocity and PeakVue Sensor tabs



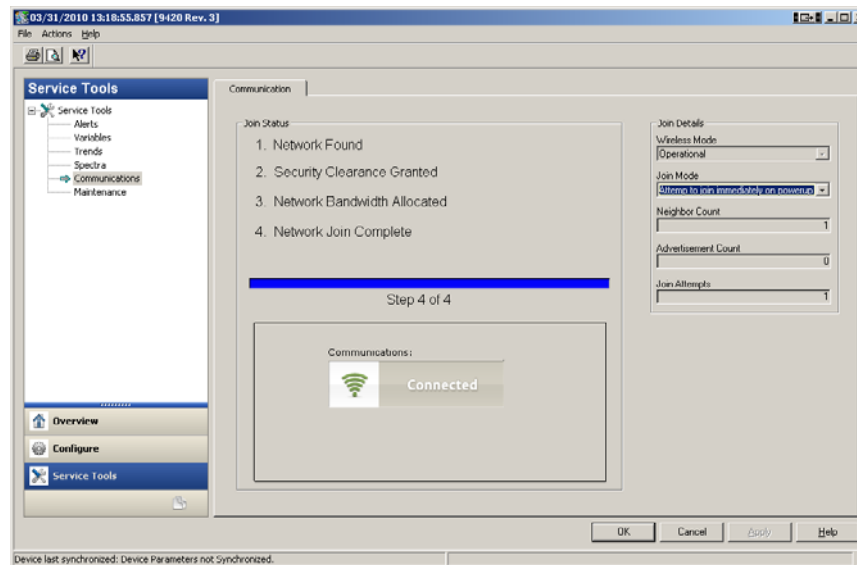
The Spectra - Energy Bands tab displays the calculated Energy Band amplitudes.

Figure 2-32. Spectra-Energy Bands tab



The Communications branch of the Service Tools tree displays network status information.

Figure 2-33. Communications display



The Maintenance branch of the Service Tools tree provides commands to reboot the transmitter, reload factory default configurations, enable licensed features, and temporarily enable active advertising. (Advertising tells the gateway to search for new wireless devices on the network. This helps the new devices join the network faster.)

AMS Machinery Manager Configuration

AMS Machinery Manager can make changes to the data acquisition settings for CSI 9420 devices that are revision 3 or later. If the device is not going to be commissioned in a DCS host (e.g., DeltaV or Ovation), then AMS Machinery Manager can be allowed to configure settings to provide easier access for the vibration analyst.

If the device will be commissioned in a HART DCS host, then the configuration should be managed completely within the DCS. Otherwise, the DCS will generate an alert if the configuration is changed externally.

For details on how to make configuration changes from within AMS Machinery Manager, refer to the Data Import section of the AMS Machinery Manager user manual.

Even if the device configuration is managed by the DCS, independent alerts can be set in Machinery Manager to allow the vibration analyst to get a notification without a notification going to the DCS operator (i.e., the analyst can set an alert at a lower threshold within AMS Machinery Manager).

If the primary HART host is AMS Device Manager, then all alert configuration as well as device update rates can be managed from within AMS Machinery Manager by the vibration analyst. The independent alert levels are still possible (i.e., a different alert level in Machinery Manager than Device Manager). In this scenario, the vibration analyst has direct access to both settings. The HART alerts are stored in the device, and will show up in Device Manager and Alert Monitor. The AMS Machinery Manager alerts will only show up for the analysts using the AMS Machinery Manager software. This type of configuration is also fine if the DCS or PCS host is using Modbus or OPC and not HART.

NOTICE

if the CSI 9420 devices are commissioned and installed on a HART DCS or PCS, which is managing and archiving device configuration information, AMS Machinery Manager should NOT be used to make configuration changes. This will cause an alert in the DCS because of the mismatch and the configuration may even be overwritten by the DCS, which can be confusing to the analyst.

Advanced Diagnostic Option and Storage in AMS Machinery Manager

This is a licensed feature available only in CSI 9420 device revision 3 or later. With this feature enabled, a compressed “thumbnail” spectrum can be viewed from within a HART host, such as DeltaV or AMS Device Manager. The primary application anticipated, however, is for integration with AMS Machinery Manager.

This feature allows compressed “thumbnail” spectra, high-resolution spectra, and analytical waveforms to be retrieved from the CSI 9420 and archived in the AMS Machinery Manager database. This “energy band” provides additional insight to the vibration analyst, over and above the trended scalar values. This information provides a better indication of whether or not

there is a real problem and, if so, how severe the problem is. Specifically, using the energy band, the analyst can determine whether or not the vibration energy is periodic and at what frequency(ies) it is occurring.

NOTICE

it is not necessary to transmit both a waveform and a spectrum from the CSI 9420. If only the spectrum is needed, this is about half as much data to transmit as a waveform. If, on the other hand, the waveform is needed, the spectrum doesn't have to be transmitted because the software calculates a spectrum from the stored waveform.

Other configurable parameters for energy band include:

- **Effective Fmax for the thumbnail spectrum** – For the velocity thumbnail spectrum, 300 Hz is the default Fmax used by AMS Machinery Manager. This includes up to 10 orders of turning speed for an 1800 RPM machine. This is where the vibration energy will be concentrated for a large number of common faults such as looseness, misalignment, or imbalance. Increasing the Fmax allows visibility of higher frequency fault types. Lowering the Fmax allows greater resolution at lower frequencies. The 1000 Hz Fmax thumbnail has a frequency resolution of 20 Hz/line. The 300 Hz Fmax thumbnail has a frequency resolution of 5 Hz/line. Other effective Fmax values for thumbnail spectra are also available. Note that all high-resolution spectra use an Fmax of 1000 Hz.
- **True Fmax for PeakVue** – This allows monitoring a slower machine with PeakVue. Choosing 1000 Hz Fmax uses about 1.6 seconds of data to produce a 1000 Hz analytical spectrum. Choosing 500 Hz Fmax uses about 3.2 seconds of data to produce a 500 Hz analytical spectrum. The 1000 Hz Fmax is better for 1800~3600 RPM machines. The 500 Hz Fmax is better for slower machines. By default, the 1000 Hz true Fmax is used.
- **Averaging for the high-resolution velocity spectrum** – Averaging the velocity spectrum reduces the effect of transients in the data. If averaging is used, the frequency resolution of the high-resolution spectrum is 1.25 Hz / bin (800 lines). If averaging is not used, the frequency resolution is 0.625 Hz/ bin. Again, the Fmax for all high-resolution spectra is 1000 Hz. By default, averaging is enabled.

Data retrieval can be either “on-demand” or “time-based”. Configuring the device for time-based data collection does not preclude on-demand data collection.

On-demand data retrieval is initiated by a direct user request from the AMS Machinery Manager Data Import application interface. One application for this is when an analyst (or an operator) sees an alert because a configured parameter measurement (e.g., velocity) value has been exceeded. The analyst then requests a spectrum (usually a thumbnail) to get a quick look at the vibration energy in the frequency domain. If more frequency resolution is needed, then a high-resolution spectrum or a waveform can be requested. The data may be optionally stored in the AMS Machinery Manager database if the point is mapped. For details on using this feature, refer to the Data Import portion of the AMS Machinery Manager help file.

Time-based data retrieval is configured once and then happens automatically thereafter. The analyst can define the type of data to be collected (compressed spectrum, high-resolution spectrum, or waveform) and how often it will be collected and stored to the database from within the AMS Machinery Manager Data Import Configuration program. All data collected on a time-basis is stored to the Machinery Manager database automatically for future viewing and analysis. For details on configuring this functionality, refer to the Data Import portion of the AMS Machinery Manager help file.

⚠ CAUTION

Unless using external DC power, take care when configuring time-based retrieval of energy band (particularly high-resolution spectrum or waveform) because this can have a significant negative impact on the life of the power module.

When using a power module, the maximum recommended time-based collection rates are:

- Thumbnail spectrum – Once per day
- High-resolution spectrum – Once every two weeks
- Waveform – Once per month

On-demand data collection is not anticipated to have a significant impact on power module life, because the average usage is not expected to exceed the limits suggested for time-based collection above. If using a power module, though, keep in mind that even on-demand advanced diagnostic option can have an adverse effect on power module life if data, especially high-resolution data, is requested too frequently.

Waveform or Spectrum Time

The amount of time required to get a waveform or spectrum varies significantly depending on a number of factors including network size, network topology, and other installed applications competing for wireless bandwidth. Demand-based acquisitions use a special high-bandwidth mechanism that can transfer a 4096-point waveform in less than 5 minutes in optimum conditions, although it can take as much as an hour in fully loaded networks. Time-based acquisitions run at a lower bandwidth and typically take at least 30 minutes to acquire the same waveform.

The software actually imposes some gross limits on energy band collection rates to ensure the network is not overloaded and the individual CSI 9420 devices remain responsive for non-energy band operation, such as a change to configuration. These limits are applied only to time-based collection (i.e., automatic periodic collection that happens under software control). At the time of this writing, the absolute limits imposed by the software are:

- One (1) waveform per measurement per device per day, based on a 2-accelerometer device; i.e., the maximum number of waveforms from a single device allowed in a 24-hour period is four – e.g., Velocity 1, PeakVue 1, Velocity 2, and PeakVue 2

- Sixteen (16) total waveforms (or 32 spectra) per gateway per day; i.e., the maximum number of waveforms from all devices, total, on a network in a 24-hour period is 16

These limits are set in the AMS Machinery Manager software and are subject to change in future releases.

In the above limits, note that two (2) high-resolution spectra can be substituted for one waveform, such that the software will allow up to eight high-resolution spectra from a single device or 32 high-resolution spectra from all devices on a gateway within a 24-hour period.

Combinations are also permitted, as long as the maximum is not exceeded. For example it is valid to have two waveforms and four spectra from a single device in a day. It is not valid to have four waveforms and eight spectra in a day.

Again, demand-based collections, those explicitly initiated by a direct user request, are not constrained by the limits above. Direct user requests are always permitted.

There are no absolute restrictions on the total number of time-based thumbnail spectra that can be collected within a 24-hour period.

The actual throughput that can be achieved for time-based collection is extremely application-specific; depending on the same factors already cited. The software, therefore, has only very loose restrictions on configuration of time-based collection. It is possible to configure collections such that the network cannot “keep up” with the requests. It is also possible to configure collections that violate the absolute limits described above.

The software will allow you to configure any measurement as quickly as once per minute. What this really means is the interval between collections, since some items such as a waveform take much longer than a minute to collect.

For example, if you set up to collect a waveform with a 1-minute interval, a waveform is collected, which may take up to an hour running in the background, and then another collection is requested 1 minute after the previous one completes. Obviously, this type of operation is not recommended, but the software will allow it to be configured anyway. The software, however, will not allow data to be collected beyond the absolute limits described above. Staying with the once per minute waveform example, this collection request would only be sent to the device four times in any 24-hour period. These four pieces of data would be acquired in rapid succession (each new acquisition 1 minute after transmission of the previous result is completed) and then not again for 24 hours.

Energy Band Trend Parameters

The transmitted thumbnail spectra, regardless of effective F_{max} , also include Energy Band parameters which cover the entire frequency range. The Energy Bands are:

- 0 – 65 Hz
- 65 – 300 Hz
- 300 – 1000 Hz

The Energy Band parameters can only be trended in AMS Machinery Manager, and they are trended in the same way as the other scalar parameters. Keep in mind, though, that these values are not “published” by the device – a request for these wakes the device just like any other special data request.

The maximum (fastest) recommended storage rate for the Energy Band parameters is once per shift (i.e., every 8 hours), unless using an external DC power source.

Standard Installation of the Advanced Diagnostic Option

The Advanced Diagnostic Option is a licensed feature. A CSI 9420 device that is revision 3 or later is capable of having this feature enabled. Contact your Emerson Sales Representative or Product Support for additional details.

The upgrade of an installed CSI 9420 that is already part of a wireless mesh network can be done remotely using either AMS Wireless Configurator or AMS Device Manager software. There is no need to walk out to the device or remove it from the field. The steps to perform the upgrade are listed below.

NOTICE

If you purchased an Emerson Smart Wireless Gateway, an installation disk for AMS Wireless Configurator should have been included in your shipment. Otherwise, contact your nearest Emerson office to learn how to obtain a copy of AMS Device Manager.

NOTICE

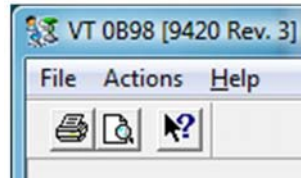
If your CSI 9420 has not yet been installed in the field, skip to the next section for instructions on how to perform the upgrade using a HART modem or a 375 or 475 Field Communicator.

1. Locate the icon for the Wireless Network icon (shown below).



2. Expand the Wireless Network until you have located the CSI 9420 that is to be upgraded and select the icon for the CSI 9420.

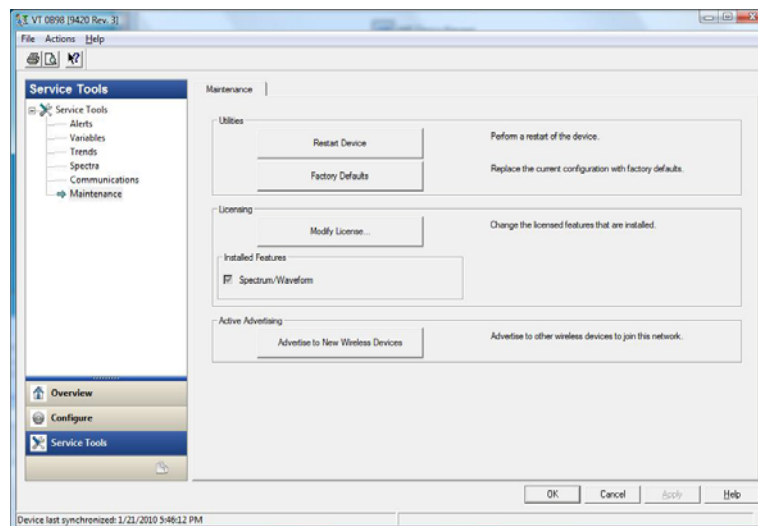
3. Verify in the upper left corner of the screen that the device is identified by the string in parentheses as Revision 3 or higher (e.g., "[9420 Rev. 3]" stands for "Revision 3").



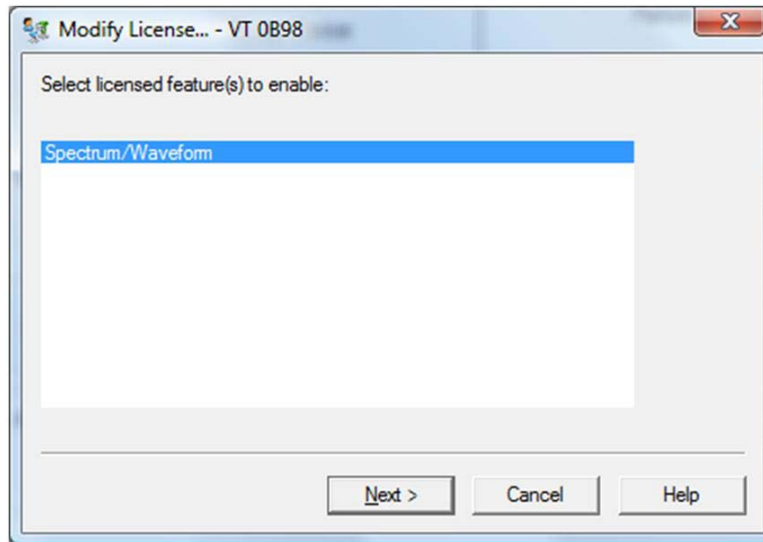
NOTICE

If your CSI 9420 is not Revision 3 or higher, then it will need to be returned to the factory for upgrade. Please contact customer support to obtain an RMA number

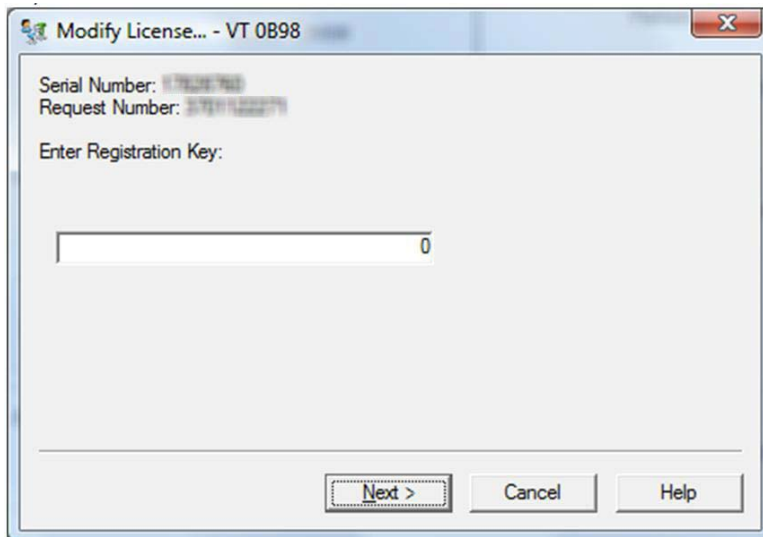
4. Click the "Service Tools" option in the left tool bar.
5. On the Service Tools screen, click "Maintenance" to display the screen below.
6. On the Maintenance screen, click "Modify License".



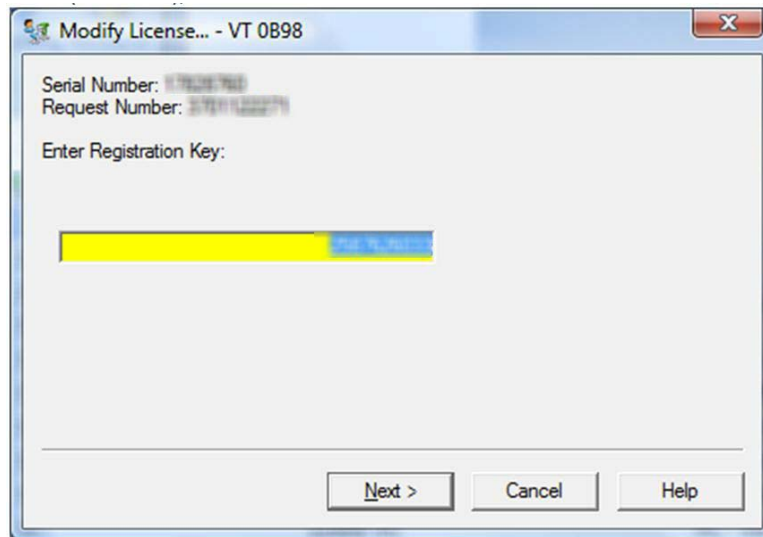
7. A screen with license options will appear. Select "Spectrum/Waveform". Click "Next".



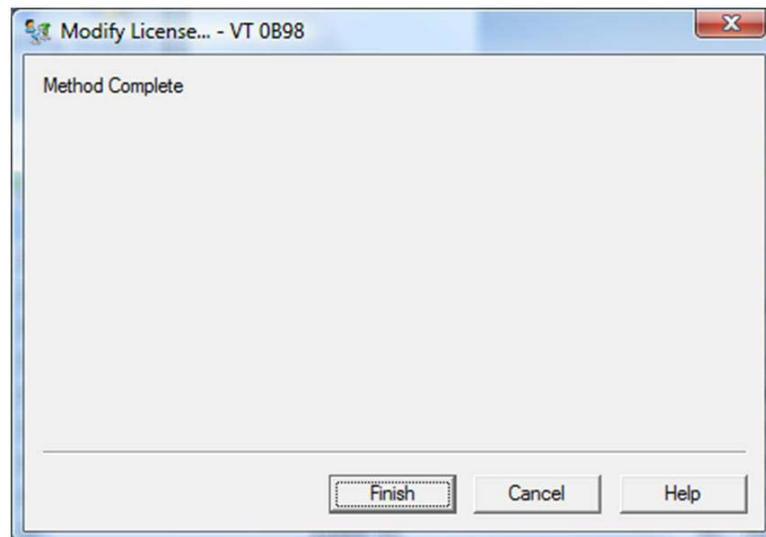
8. The next screen will show a serial number and a request number. Call or e-mail Customer Support, provide this information, and they will issue a registration key. (Note: If requesting the response code via e-mail, record the serial number information and close the software. Once you have received the response code, simply repeat steps 1 through 7 to return to this point in the process.)



9. Enter the registration key, and click "Next".



10. The following screen should appear indicating that the process is complete. Click "Finish".



Optional Installation

If your CSI 9420 is not installed on a wireless network, it is possible to perform the upgrade using either a HART modem or a 375 or 475 Field Communicator.

⚠ WARNING

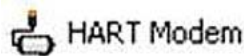
The hazardous area rating available with the CSI 9420 does not permit either of the following operations to be performed in a hazardous area. Do NOT open the device and connect to the wired HART terminals in a hazardous area without taking the appropriate safety precautions required by local, national or international regulations.

NOTICE

Connecting directly to the wired HART terminals on the CSI 9420 will temporarily take the device off of the wireless network. If in range, it will automatically rejoin the wireless network after the wired connection is removed.

Alternate Method 1:

To use a wired HART modem, launch either AMS Wireless Configurator or AMS Device Manager. Then connect the CSI 9420 to the software directly using a HART modem. Locate the CSI 9420 under the Wired HART icon in the software (shown below).

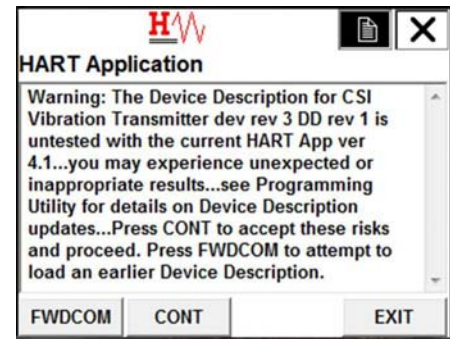


Click the icon for the CSI 9420 that is to be upgraded. Then follow steps 3 through 10 under the standard procedure listed above.

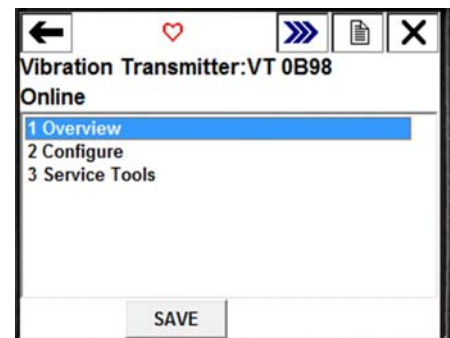
Alternate Method 2:

It is also possible to install the upgrade using either a 375 or 475 Field Communicator. In this case, use the lead set to connect the Field Communicator to the CSI 9420 terminal block.

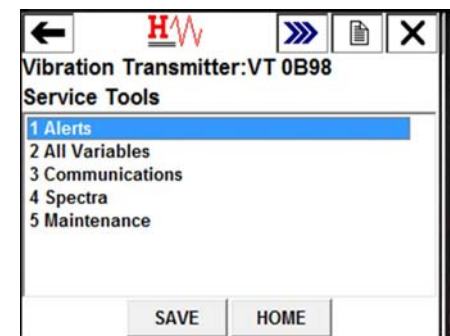
Step 1: Switch on the Field Communicator, and select HART Application from the main menu. Depending on the code version in your CSI 9420, you may get a warning message such as the one shown to the right. If so, click "CONT" to proceed to the main menu.



Step 2: Click "Service Tools" (or press 3 on the keypad).



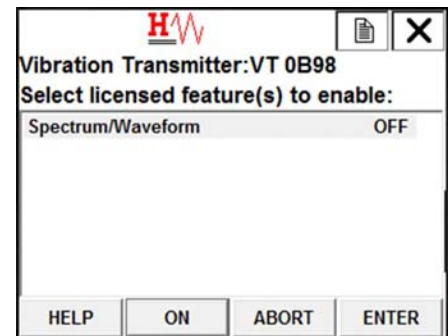
Step 3: Click "Maintenance" (or press 5 on the keypad).



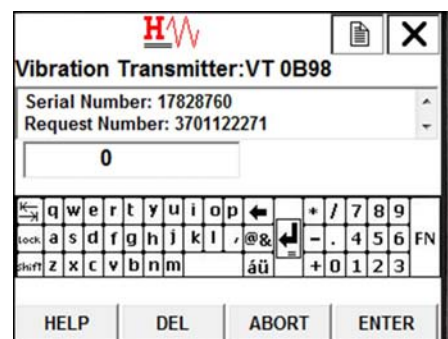
Step 4: Click "Modify License" (or press 3 on the keypad).



Step 5: This shows you the current setting. If you just wanted to know what the current setting is, press "ABORT". Otherwise, press "ON", and then press "ENTER".



Step 6: As with AMS Device Manager, the screen now displays a Serial Number and Request Code. Call or e-mail Customer Support, provide this information, and they will issue a response code. (Note: If requesting the response code via e-mail, record the serial number information. Once you have received the response code, simply repeat the steps to return to this point in the process.)

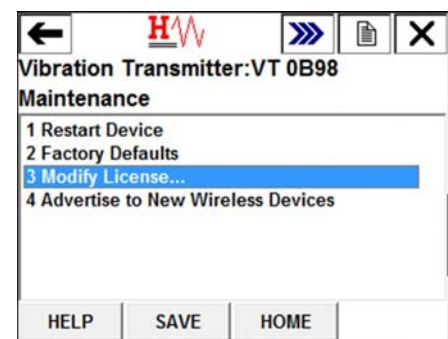


Step 7: Enter the registration key provided, and press "ENTER".



The screenshot shows a handheld device screen for a "Vibration Transmitter: VT 0B98". It displays the "Serial Number: 17828760" and "Request Number: 3701122271". Below these is a text input field containing the registration key "2587626033". A full QWERTY keyboard is visible on the screen. At the bottom, there are four buttons: "HELP", "DEL", "ABORT", and "ENTER".

Step 8: The display should return to the Maintenance menu (as shown).



The screenshot shows the "Maintenance" menu for the "Vibration Transmitter: VT 0B98". The menu options are: "1 Restart Device", "2 Factory Defaults", "3 Modify License..." (which is highlighted with a blue bar), and "4 Advertise to New Wireless Devices". At the bottom, there are three buttons: "HELP", "SAVE", and "HOME".

Section 3: Installation

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

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

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Powering the CSI 9420

The CSI 9420 and all other wireless devices should be installed only after the Smart Wireless Gateway has been installed and is functioning properly.

1. Remove the rear cover of the device to access the power connections. For the battery powered version, simply plug in the power module. For the externally powered version, connect a 10...28V DC (24V nominal) power supply to the bottom two screw terminals on the right.

2. Pull the wiring through the threaded conduit entry. When selecting the power supply, note that each CSI 9420 has a peak current draw of 40 mA when awake and powering sensors.

NOTICE

The wire used must fit snugly in the grommet feed-through to prevent ingress of water and other contaminants. If using one of the grommets for the standard low-power accelerometers, the range of cable diameter that can be used and maintain a good seal is 0.125 - 0.250 in. (3.175 - 6.35 mm). If a good seal is not possible with the wire selected, an alternative grommet that provides a good seal must be used.

Additional recommendations for power wiring include:

- Run wiring through conduit (at minimum, ensure grommet fits wire properly and does not leak)
- Install a Ferrite EMI filter inline with the wire to block electrical noise (included with package), refer to Appendix D for more information
- Use 22 gauge or larger wiring (keep current requirements in mind when connecting multiple units in-line)

NOTICE

Wireless devices should be powered up in order of proximity to the Smart Wireless Gateway, beginning with the closest device to the gateway. This will result in a simpler and faster network installation.

Sensors

Introduction

To maintain mechanical isolation of the sensor a Remote Mount configuration is required. For Remote Mount, the sensor is mounted separately from the CSI 9420 housing, then connected to the CSI 9420. Although not required for all installations, it is common to run the cable from the sensor to the housing through conduit.

To reduce power consumption and increase power module life, the CSI 9420 uses a special low-power sensor. This sensor is available with or without embedded temperature. Refer to Appendix A: Specifications and Reference Data for a complete list of available sensor options.

Please contact your local sales representative for detailed ordering information.

Operating Limits

Each of the CSI 9420 signal inputs uses accelerometers to make vibration measurements. Alternately, an accelerometer with embedded temperature may be used.

NOTICE

The word “sensor” refers to both an accelerometer and an accelerometer with embedded temperature. The word “accelerometer” refers to a sensor that measures only acceleration.

The operational ranges for the sensors are shown in Table 3-1.

Table 3-1. Sensor ranges

Channel	DC Bias Range	DC Input Range	AC Input Range
Accelerometer 1	2 - 3 Vdc	0 - 5 Vdc	0 - 5 V (+/-100 gs peak)
Accelerometer 2	2 - 3 Vdc	0 - 5 Vdc	0 - 5 V (+/-100 gs peak)
Temperature 1	N/A	-40 to +125 °C	N/A

The accelerometers require a DC bias. The CSI 9420 device provides the necessary bias and measures it to verify correct sensor operation. The nominal bias voltage is 2.5 volts. If the bias voltage is outside of the 2 - 3 volt range, the device generates a FAILED alert for the associated sensor. The DC input range represents the operational DC range of the signal input. The AC input range represents the operational AC range of the signal input.

General Sensor Handling Instructions

Each sensor requires a standard 1/4-in. - 28 mounting location. Detailed mounting instructions are provided in subsequent sections of this manual.

⚠ CAUTION

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

⚠ CAUTION

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

Although the integral cable has built-in strain relief, do not use excessive force when pulling cable. No more than 5-lb of force should be exerted directly on the sensor connection during installation. Secure the cable to the machine near the point of sensor installation if possible.

⚠ CAUTION

Do not exert more than 5-lb pull force directly on sensor/cable connection during wire pulls.

For sensors that have been mounted before pulling the cable through the conduit or raceway to the junction box, leave the cable bundled and secured to the machine. Permanent signal degradation takes place when cables are damaged. Do not step on, kink, twist or pinch cables. Also take note of the placement of the cable bundle. Do not place bundles in a manner causing strain at the sensor/cable connection.

Mounting

Preferred Method: Drill and Tap (Stud Mount)

The preferred method of mounting sensors to a machine is the drill and tap (stud mount) method. Drill and tap mounting is preferred because it provides increased reliability, improved frequency response, and increased signal sensitivity.

This method of mounting to a machine is:

1. Drill into the machinery.
2. Tap the hole.
3. Insert the mounting stud.
4. Directly mount the sensor to the surface of the machine.

Alternative Method: Epoxy Mounting

If the machinery cannot have a hole drilled into it, the epoxy mounting method is acceptable, though it is less reliable and the sensor performance is degraded at high frequencies. The epoxy mounting method is:

1. Glue a mounting pad to the machinery.
2. Insert the mounting stud.
3. Attach the sensor to the pad.

Tools and Supplies

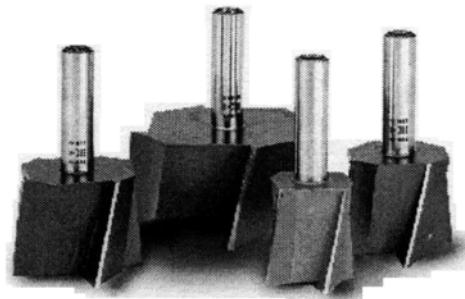
Below is a list of required tools and parts necessary to install the sensors.

- Drill
- Spot Face and End Mill Tool

The spot face tool may be purchased from Emerson's Machinery Health Management business. Please contact your local sales representative for assistance.

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

Figure 3-1. Spot face or end mill tool



Accelerometer Attachment Tools and Supplies

1. 40-200 in.-lb torque wrench with 1/8-in. hex bit
Suggested Vendor: Grainger Part # 4JW57
 - Description: 3/8-in. drive in.-lb torque wrench. Any torque wrench with a range of 40 to 70 in.-lb and less than 5 in.-lb increments can be substituted.
2. 1/4 in. 28 taps & tap handle
3. 9/16 in. open-end wrench
4. 1/8 in. hex Allen key
5. Wire brush
6. Plant-approved cleaner/degreaser
7. Loctite semi-permanent thread locker

Conditions

The mounting location must provide a flat surface 1/2 in. diameter and a case thickness exceeding 0.4 in. (400 mils). If this is not possible, then an alternative mounting procedure must be used.

For Epoxy Mounting, add

8. A92106 Loctite Depend mounting pad epoxy (or comparable 2-part epoxy)
9. A212 Mounting Pads
10. (Optional) a grinder to create a sufficiently flat mounting surface.

Preparing Sensor Mounting Locations

Stud Mount

1. Prepare the spot face and end milling tool by setting the drill bit depth to a minimum of 0.325 in. (325 mils).
2. Using the wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Keeping the spot face and end milling tool perpendicular to the machine surface, drill into mounting location until face has a minimum finish of 63 micro in. (.063 mils). This will require the spot facing tool to remove approximately 0.04 in. (40 mils) from the face. The surface should be smooth to the touch with no noticeable irregularities. The process is illustrated in Figure 3-2.

If the spot face is not uniform on all sides, this is an indication that the spot face tool was not perpendicular to the mounting surface (Figure 3-2) and the resulting surface will not allow the sensor to be mounted properly.

Technical drawing of a mechanical assembly showing a cross-section of a part with a threaded hole. The drawing includes dimensions for diameters (e.g., 0.38, 0.218, 0.100), lengths (e.g., 3.2, 1.47), and thread specifications (e.g., 8-32 UNC-2A, 1/4-28 UNF-2B). It also includes callouts for material and manufacturing notes.

8-32 UNC-2A
SOCKET HEAD
SET SCREW
(2 SUPPLIED)

0.38(09.6)

3.2(81)

1.47(37.3)

"A"

0.218(05.54)

0.100(025.4)

0.040(1.02) MAX

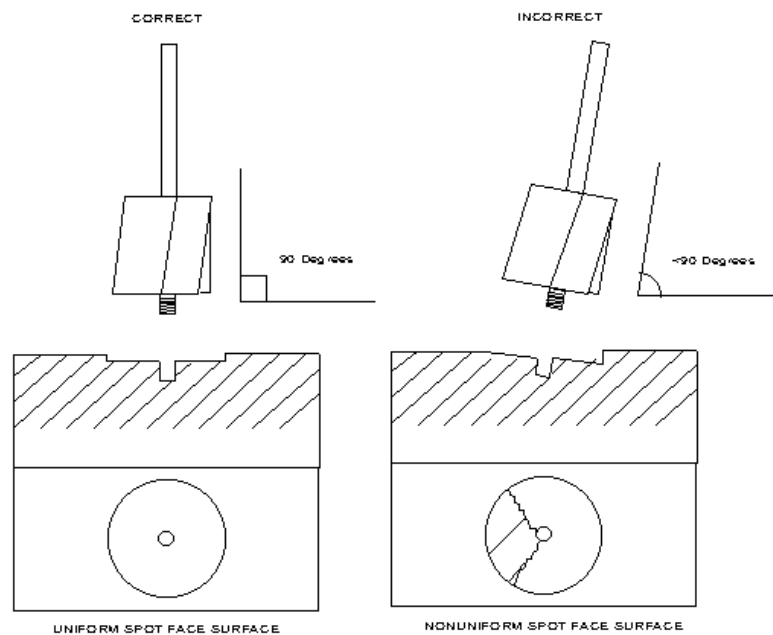
1/4-28 UNF-2B

FOR HARD STEEL DIM "A" = .145 (3.68), FOR CASTINGS = .255 (6.48)

FOR HARD STEEL DIM "A" = .215(5.46), FOR CASTINGS DIM "A" = .325(8.26)

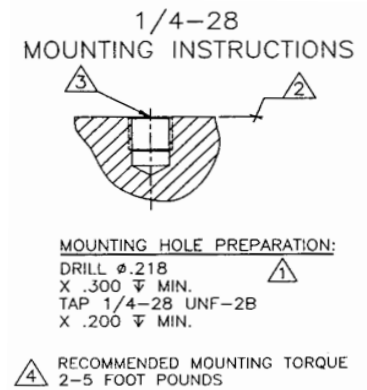
1.) USE VARIABLE SPEED 1/2" DRILL @ 200 RPM.

Figure 3-3. Diagram of correct (left) and incorrect (right) milling processes. Spot faced surface should be uniform on all sides



4. Using 1/4 in.-28 tap set, tap a pilot hole to a minimum depth of 0.25 in. (250 mils) as illustrated in Figure 3-4.

Figure 3-4. Diagram showing a tapped pilot hole



Epoxy Mount

1. If the equipment surface has a radius of curvature less than 4 in., it will be necessary to grind a flat surface approximately 1/2 in. diameter. If the curvature radius is greater than 4 in., proceed to step 2.
2. Using the wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Using A92016 2-part epoxy, spray activator onto mounting surface. Place a light coat of epoxy on surface of A212 mounting pad and hold firmly against machine spot face surface for 1 minute.
4. If adhesive does not set up within 1 minute, this is an indication that too much epoxy was applied or that the mounting surface was not prepared properly. Repeat installation steps 2 - 5.

Figure 3-5. A212 mounting pad



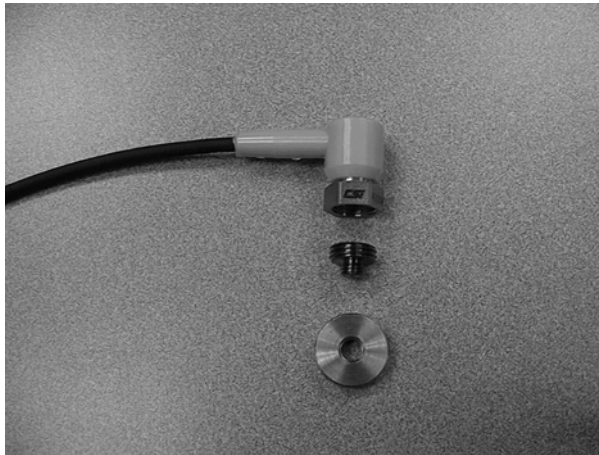
Attaching the Sensor(s)

NOTICE

Where possible, mounting sensors to the machine should be done in conjunction with pulling cables. If a sensor has to be mounted at another time, then the bundled cable must be secured to the machine and protected from damage.

1. Using a plant-approved cleaner/degreaser, remove any lubricating fluid used during the tapping process.
2. If necessary, clean mounting stud threads using plant approved degreaser/cleaner.
3. Using plant-approved Loctite™, rub a small amount of Loctite onto spot face.

Figure 3-6. Accelerometer, A0322 mounting stud (included with the accelerometer), and optional A212 mounting pad (epoxy mount only)

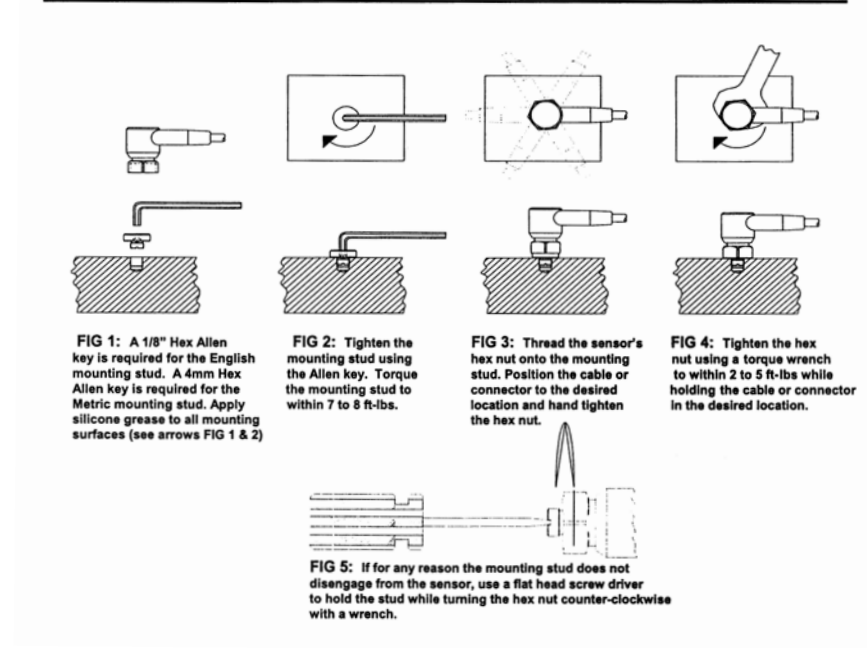


4. Using 1/8 in. Allen wrench loosely screw mounting stud into mounting location.
5. Using torque wrench with 1/8 in. hex bit, torque to 7-8 ft-lb Stud Mount only. If after correct torquing, the A0322 mounting stud is not seated against spot face this is an indication that the tap was not deep enough. It will be necessary remove the mounting stud and tap the hole deeper.
6. Apply a thin coating of Loctite semi-permanent thread locker to threads on sensor housing.

7. Place sensor onto A0322 mounting stud and hold in desired position to create the least amount of cable strain and cable exposure. Holding sensor, hand-tighten 9/16 in. captive nut and use a torque wrench with 9/16 in. open end to finish tightening to 50-60 in.-lb (see Figure 3-7).

Figure 3-7. Mounting illustrations for right angle Quick Connect sensors

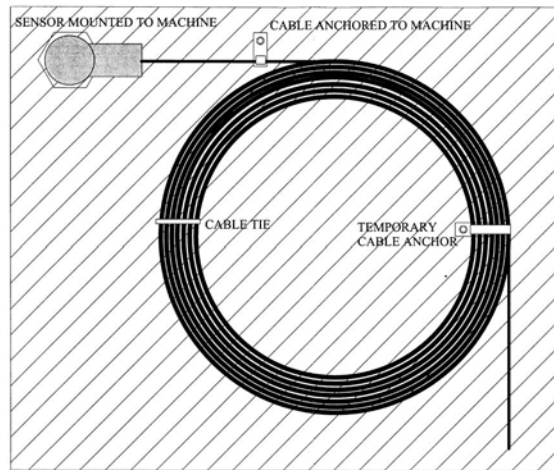
Industrial Swivel Mount Sensor Installation Instructions



Secure Cabling

1. Secure the sensor cable to the machine approximately 4 to 5 in. from the mounting location using an appropriate size cable clamp. Do not curl into a bending radius of less than 2.8 in. Refer to Figure 3-8 for an illustration.
2. If pulling cable is not currently scheduled, it will be necessary to secure the bundled sensor cables in such a manner that no strain is placed on the integral sensor/cable connectors. Do not allow bundled cable to hang from the sensors. Prevent damage to exposed cable such as on plant floors, maintenance access areas, footholds and the like.

Figure 3-8. Illustration of a secure cable with a temporary cable anchor.



Cabling

Introduction

This section covers conduit installation guidelines, power line specifications, and (if applicable) pulling the instrumentation cabling.

⚠ WARNING

All wiring should be installed by a trained and qualified electrician. Wiring must conform to all applicable local codes and regulations. Local codes and regulations regarding wire type, wire size, color codes, insulation voltage ratings, and any other standards must be followed.

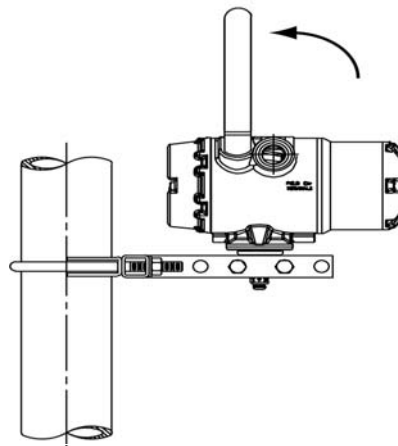
Conduit Installation Guidelines

NOTICE

If conduit is used, all conduit must be bonded to earth ground and adhere to IEEE 1100 specifications for grounding.

1. The conduit must be sized so that it does not exceed a 40 percent fill.
2. Effort should be made to route conduit away from power trays using the following guidelines:
 - 6 in. ... 110 VAC
 - 12 in. ... 220 VAC
 - 2 ft ... 440 VAC
3. Conduit attaches to CSI 9420 from the side of the enclosure as shown in Figure 3-9.

Figure 3-9. Conduit attaches to threaded holes in the side of CSI 9420.



Sensor Leads



If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

Use the following steps to wire the sensor and supply power to the transmitter:

1. Remove the transmitter enclosure cover.
2. Attach the sensor leads according to the wiring diagrams, as shown in Table 3-2, Table 3-3, or Table 3-4.
3. Connect the power module or external DC power.
4. Verify the connection by observing the LCD.
5. Reattach and tighten the cover.

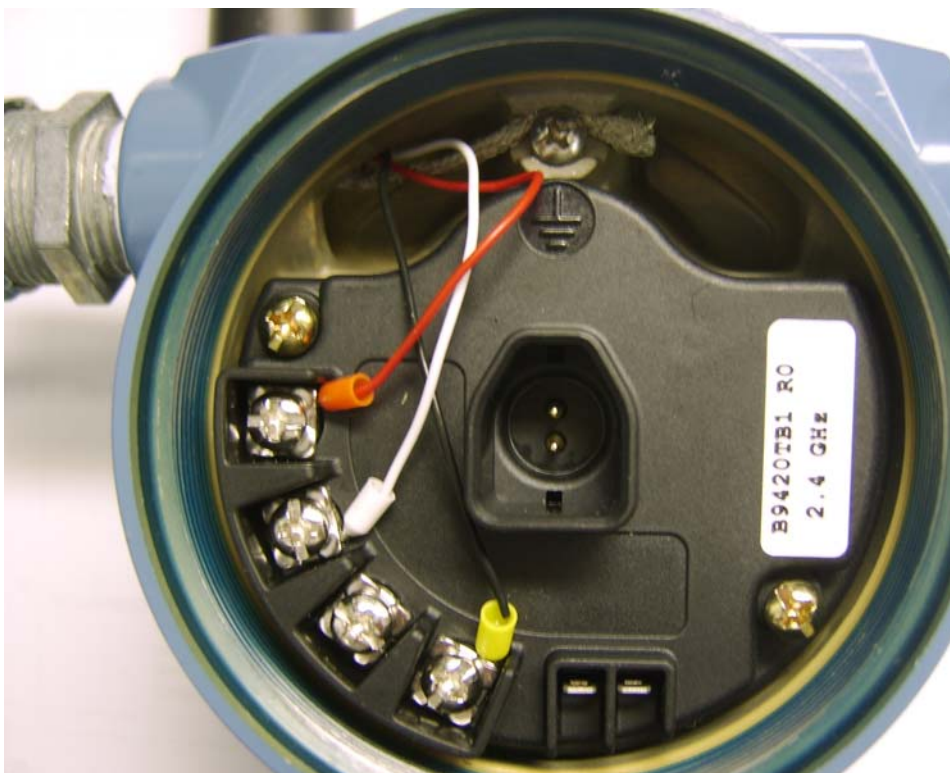
NOTICE

Crimp-on ferrules or lugs may be used to improve long-term reliability of sensor wiring.

Connecting Sensors

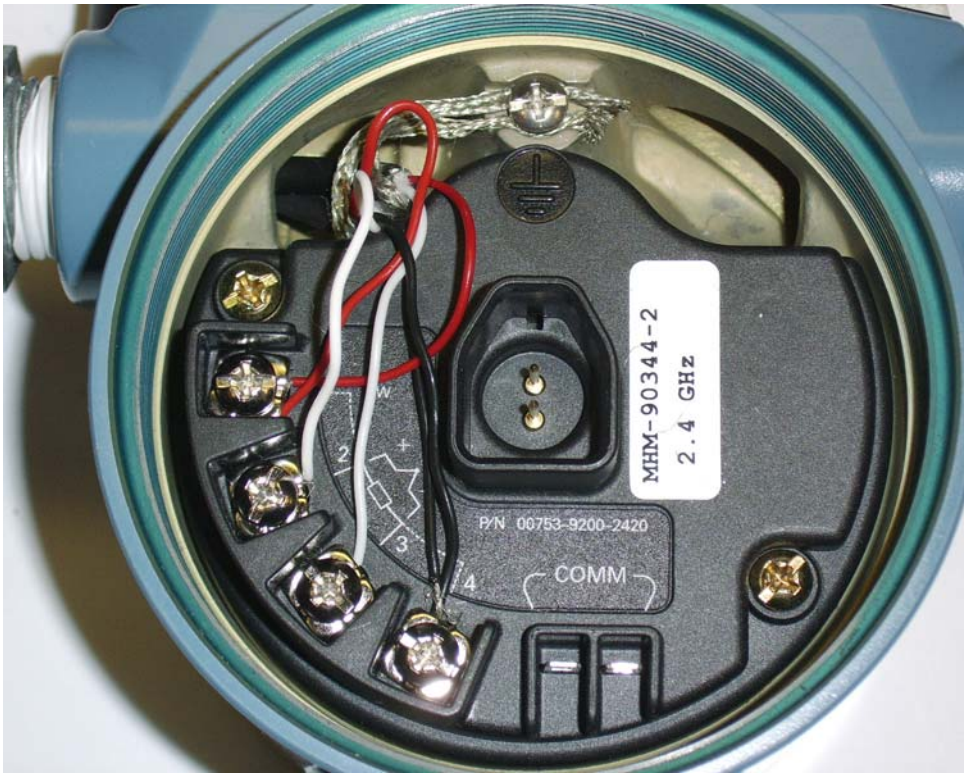
One or two accelerometers can be connected to the CSI 9420. Only one accelerometer plus temperature sensor can be connected to the CSI 9420.

Figure 3-10. Connecting One Accelerometer to the CSI 9420



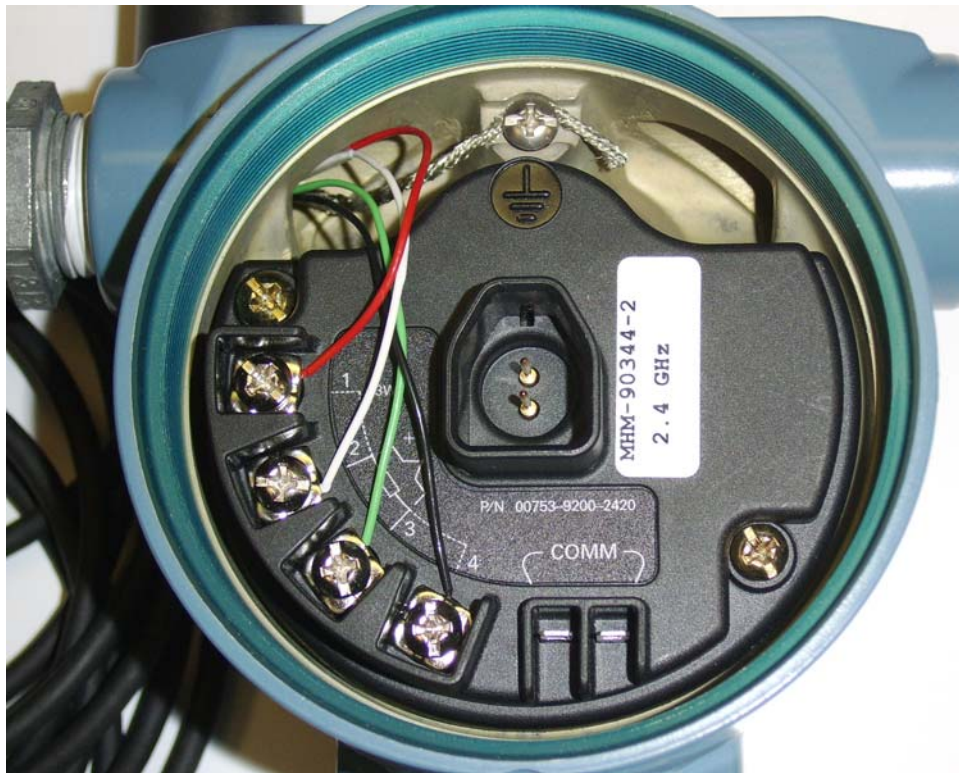
Connecting One Sensor / accelerometer			
Connector labeled 1 - Red wire	Connector labeled 2 - White wire	Connector labeled 3 - Blank	Connector labeled 4 - Black wire

Figure 3-11. Connecting Two Accelerometers to the CSI 9420



Connecting Two Sensors / accelerometers			
Connector labeled 1 - Two red wires (one from each accelerometer)	Connector labeled 2 - White wire from one accelerometer	Connector labeled 3 - White wire from other accelerometer	Connector labeled 4 - Two black wires (one from each sensor)

Figure 3-12. Connecting One Sensor with temperature



Connecting One Sensor (accelerometer with temperature)			
Connector labeled 1 - Red wire	Connector labeled 2 - White wire	Connector labeled 3 - Temperature wire (green wire)	Connector labeled 4 - Black wire

Check or change sensor configuration using a Field Communicator, enter the following Fast Key Sequence: 2, 2, 1, 2.

Liquid Crystal Display (LCD)

Transmitters ordered with the LCD will be shipped with the display installed.

The optional LCD can be rotated in 90-degree increments by squeezing the two tabs, pulling out, rotating and snapping back into place.

⚠ WARNING

CSI 9420 devices which are certified for hazardous locations MUST have LCD modules installed by an Emerson Product Service center. Failure to do so may void the hazardous location certification.

If LCD pins are inadvertently removed from the interface board, carefully re-insert the pins before snapping the LCD back into place.

Use the following procedure and Figure 3-13 to install the LCD:

1. Remove the LCD cover. Do not remove the instrument covers in explosive environments when the circuit is live.
2. Put the four-pin connector into the interface board, rotate the LCD to the desired position, and snap into place.

Note the following LCD temperature limits:

Operating: -4 to 175 °F (-20 to 80 °C)

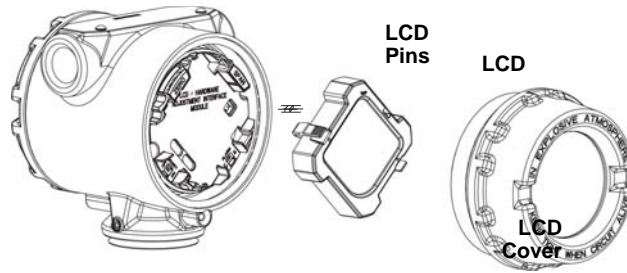
Storage: -40 to 185 °F (-40 to 85 °C)

3. Replace the transmitter cover.

NOTICE

Only use Rosemount Wireless LCD Part Number: 00753-9004-0002.

Figure 3-13. Optional LCD.



NOTICE

To maximize power module life, we recommend you disable the LCD when not in use. The LCD consumes very little power. Displaying information on the LCD and leaving it active for a sufficient amount of time for a human being to read it, however, requires the CSI 9420 to remain “awake” almost twice as long. Depending on the update rate, disabling the LCD can increase the life of the power module by as much as 40 percent.

NOTICE

Moving one LCD around to multiple devices, on an “as needed” basis, is NOT recommended. This can cause reliability problems over time because the connector pins on the LCD are not designed for repeated connect/disconnect.

If your CSI 9420 was purchased without the optional LCD, and you wish to add this later, an upgrade kit is available, MHM part number A9400LCD. Contact your Emerson sales representative for more information.

Ground the Transmitter

The transmitter will operate with the housing either floating or grounded. However, the extra noise in floating systems affects many types of readout devices. If the signal appears noisy or erratic, grounding the transmitter at a single point may solve the problem.

The electronics enclosure should be grounded in accordance with local, national, and international installation codes. This can be accomplished via the base connection, via the internal case grounding terminal, or via the external grounding terminal.

Section 4: Commissioning

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

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

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

NOTICE

The CSI 9420 and all other wireless devices should be installed only after the Smart Wireless Gateway has been installed and is functioning properly. Wireless devices should also be powered up in order of proximity from the Smart Wireless Gateway, beginning with the closest device to the gateway. This will result in a simpler and faster network installation.

Verify Operation

Operation can be verified in three locations, at the device via the Local Display, using the Field Communicator, or at the Gateway via the Smart Wireless Gateway's integrated web server.

Local Display

If the LCD is installed and enabled, the LCD should display the measured values at the configured update rate during normal operation. Every time the device (CSI 9420) wakes up to make a measurement it displays these screens and then takes a measurement. Press the **Diagnostic**

(DIAG) button to display the **TAG, Device ID, Network ID, Network Join Status** and **Device Status** screens and make a measurement.

NOTICE

To access the DIAG button, remove the front cover of the CSI 9420.

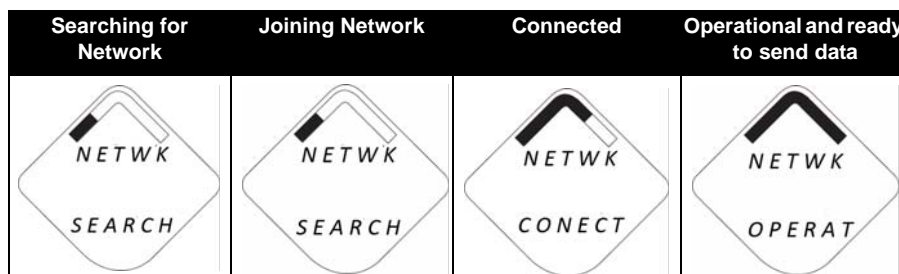
WARNING

CSI 9420 devices which are certified for hazardous locations **MUST** have LCD modules installed by an Emerson Product Service center. Failure to do so may void the hazardous location certification.

CSI 9420

For information on LCD screen messages, see LCD Screen Messages on page 5-1.

Figure 4-1. CSI 9420 Network Status Screens



Field Communicator

For HART Wireless transmitter communication, a CSI 9420 DD is required. The DD is included on the CD that was shipped with the device. Refer to the Field Communicator Users' Manual for details on DDs or go to <http://www2.emersonprocess.com/en-US/brands/Field-Communicator/Pages/SysSoftDDs.aspx> for instructions on adding a DD for the CSI 9420 or other new devices.

Table 4-1. CSI 9420 2.4 GHz

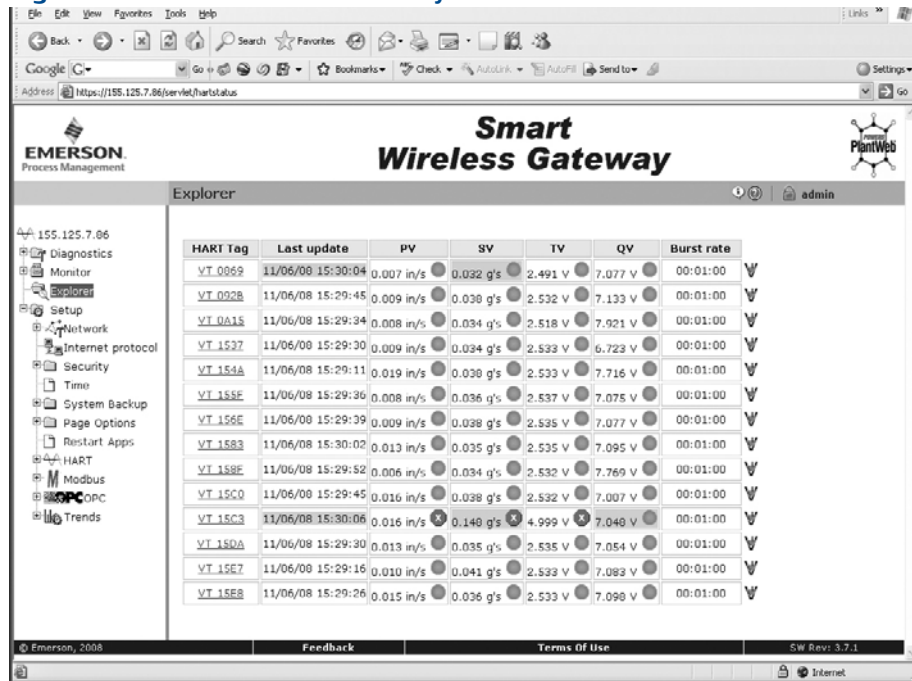
Function	Key Sequence	Menu Items
Wireless	2, 2, 2, 2 (Manual Setup)	Network ID, Join Key
Wireless	2, 1, 2, 1 (Guided Setup)	Network ID, Join Key

Smart Wireless Gateway

To verify device operation using the Smart Wireless Gateway's integrated web server, navigate to the **Explorer** page. This page will show whether the device has joined the network and if it is communicating properly.

If the CSI 9420 was configured with the Network ID and Join Key and sufficient time for network polling has passed, the transmitter will be connected to the network. To verify connectivity, open the Smart Wireless Gateway's integral web interface and navigate to the **Explorer** page.

Figure 4-2. Smart Wireless Gateway interface



This page will display the transmitter's tag, PV, SV, TV, QV, time of Last Update, and Update Rate (Burst Rate). A green status indicator means that the device is working properly. A red indicator means that there is a problem with either the device or its communication path.

NOTICE

It is normal for the CSI 9420 to have a red "X" on this screen until the sensor is installed.

For more detail on a specific device, click the tag name.

Troubleshooting

The most common cause of incorrect operation is that the Network ID or Join Key are not set correctly in the device. The Network ID and Join Key in the device must match that of the Smart Wireless Gateway exactly. The Network ID and Join Key may be obtained from the Smart Wireless Gateway on the **Setup > Network > Settings** page on the web server.

Figure 4-3. Network Settings

The screenshot shows the 'Smart Wireless Gateway' web interface for network configuration. The browser window title is '155.125.7.86 Network Settings - Microsoft Internet Explorer'. The address bar shows 'https://155.125.7.86/servlet/netconfig'. The page features the Emerson Process Management logo and a 'PlantWeb' icon. A left-hand navigation menu lists various system functions: Diagnostics, Monitor, Explorer, Setup (selected), Network, Speed, Internet protocol, Security, Time, System Backup, Page Options, Restart Apps, HART, Modbus, OPC, and Trends. The 'Network Settings' section is active, displaying several configuration fields: 'Network name' (2_5_GHz_Net), 'Network ID' (1986), 'Security mode' (radio buttons for 'Common join key' and 'Access control list'), 'Join key' (a field with masked characters), 'Show join key' (radio buttons for 'Yes' and 'No'), 'Generate random join key' (a 'Generate' button), 'Rotate network key?' (radio buttons for 'Yes' and 'No'), 'Key rotation period (days)' (a text field with '0'), 'Change network key now?' (radio buttons for 'Yes' and 'No'), and 'Optimize for network size' (radio buttons for '1..50 devices' and '51..100 devices'). A 'Submit' button is located at the bottom of the form. The footer of the page includes '© Emerson, 2008', 'Feedback', 'Terms Of Use', and 'SW Rev: 3.7.1'.

155.125.7.86 Network Settings - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Google

Address <https://155.125.7.86/servlet/netconfig>

EMERSON Process Management

Smart Wireless Gateway

PlantWeb

Network Settings

admin

155.125.7.86

- Diagnostics
- Monitor
- Explorer
- Setup
 - Network
 - Speed
 - Internet protocol
 - Security
 - Time
 - System Backup
 - Page Options
 - Restart Apps
 - HART
 - Modbus
 - OPC
 - Trends

Network name: 2_5_GHz_Net

Network ID: 1986

Security mode: ☒ Common join key ☐ Access control list

Join key: [masked]

Show join key: ☐ Yes ☒ No

Generate random join key: [Generate]

Rotate network key?: ☐ Yes ☒ No

Key rotation period (days): 0

Change network key now?: ☐ Yes ☒ No

Optimize for network size: ☒ 1..50 devices ☐ 51..100 devices

[Submit]

© Emerson, 2008 Feedback Terms Of Use SW Rev: 3.7.1

Internet

Section 5: Operation and Maintenance

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

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

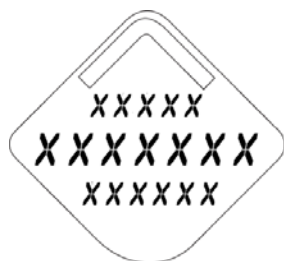
Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

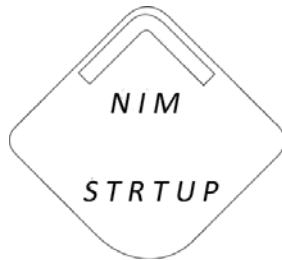
LCD Screen Messages

Startup Screen Sequence

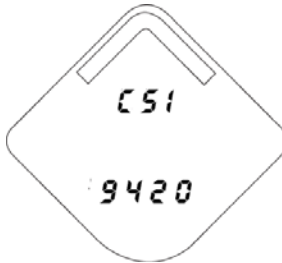
The following screens will display when the power module is first connected to the CSI 9420.



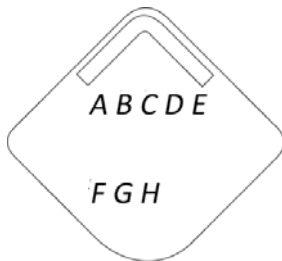
All Segments On: Used to visually determine if there are any bad segments on the LCD.



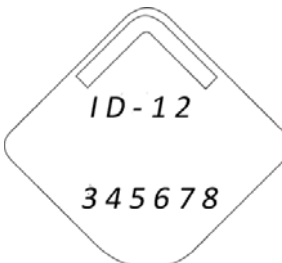
NIM Startup: The device is waiting for the radio to initialize. This takes approximately 15 seconds.



Device Name: Used to determine Device Name.



Device Information - Tag: User entered tag which is 8 characters long - will not display if all characters are blank.



Device Identification: The device's identifier that is used to make up the HART long address -- the Smart Wireless Gateway may use this to help identify devices if no unique user tag is available.



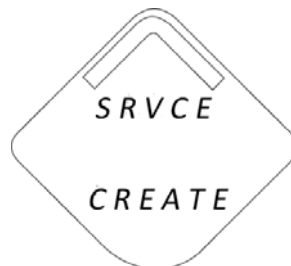
Network Identification: Assuming the device has the correct join key, this ID tells the user with what network the device can connect.



Version Code: Lists the version of the firmware in the device.

Joining and Provisioning

The following screens will display when the CSI 9420 is in the process of joining the network.



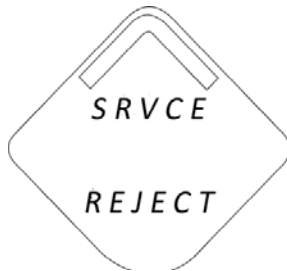
Service Created: A request for network services has been granted to the device. Services must be obtained before the device can transfer data via the network.



Service Delayed: A request for network services is pending.



Set Service: A request for network services has been issued by the device.



Service Rejected: A request for network services has been rejected by the network manager. Sufficient bandwidth may not be currently available.

Normal Operating Sequence Screens

The following screens will display during normal operation.



Data Publish: The device has started gathering new data and will publish it to the gateway when complete.



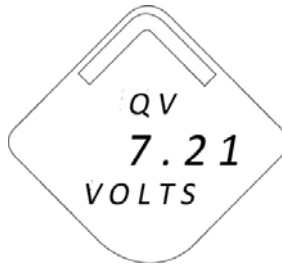
PV screen: Overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.



SV screen: Overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.



TV screen: Overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.



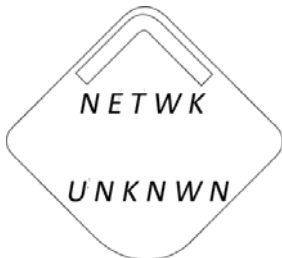
QV screen: Overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.



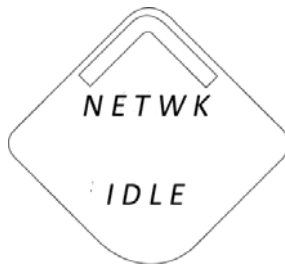
Sleep: Shows how long the device will be “asleep” between times it wakes up, gathers data, and publishes it.

Network Status Screens

These screens display the network status of the device. Only one will be shown during the startup sequence or normal operating sequence.



Network Unknown: The device has yet to retrieve the information from the Smart Wireless Gateway and is still in the process of being activated.



Network Idle: The device is in a low power idle state. The device is not connected to the network.



Network Search: The device is actively searching for a network.



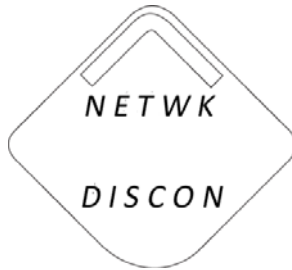
Network Negotiation: The device has deleted a network and is attempting to establish connection.



Network Connect: The device has joined the network and established communication with the network manager.



Network Operational: The device has links to both the network manager and gateway, and is ready to send data.



Network Disconnected: The device is disconnected from the network.

Device Information Screens

The following screens will show the device diagnostics depending on the state of the device.



Device Information: Failure: There is a critical error which may prevent the device from operating correctly. Check additional screens for more information.



Alert Present: At least one alert is present. This screen will not display if no alerts are present.



Low Supply Voltage: The terminal voltage is below the recommended operating range - if this is a power module operated device, the power module should be replaced - for line powered devices, the supply voltage should be increased.



Supply Failure: The terminal voltage has reached a critical level. If the device uses a power module, the module should be replaced. If the device is line powered, the supply voltage should be increased.

Power Module Replacement

Expected power module life is four (4) years at reference conditions.¹

When power module replacement is required, remove the power module cover and remove the power module pack. Replace the pack (part number MHM-89002 or Rosemount P/N 00753-9220-XXXX) and replace the cover. Tighten to specification and verify operation.

Handling Considerations

The power module pack with the wireless unit contains two “C” size primary lithium/thionyl chloride batteries. Each power module contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack. Under normal conditions, the power module materials are self-contained and are not reactive as long as the batteries and the power module pack integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.

Use caution when handling the power module pack. The power module pack may be damaged if dropped from heights in excess of 20 feet.



Power module hazards remain when cells are discharged.

Environmental Considerations

As with any battery, local, national, and international environmental rules and regulations should be consulted for proper management of spent batteries. If no specific requirements exist, recycling through a qualified recycler is encouraged. Consult the materials safety data sheet for power module specific information.

Shipping Considerations

The unit is shipped to you without the power module installed. Unless specifically instructed to do otherwise, remove the power module pack from the unit prior to shipping.

Primary lithium batteries are regulated in transportation by the U.S. Department of Transportation, and are also covered by International Air Transport Association (IATA), International Civil Aviation Organization (ICAO), and European Ground Transportation of Dangerous Goods (ARD). 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. Reference conditions are 70 °F (21 °C), two accelerometers transmit rate of once every 30 minutes, and routing data for three additional network devices, LCD disabled.

Appendix A: Specifications and Reference Data

Specifications

Functional Specifications

Input

Supports 1 or 2 accelerometers, or 1 accelerometer with embedded temperature. See Low-Power Sensor Options on page 1-5 for sensor options.

Output

Wireless enabled, linear with temperature or input.

Local Display

The optional five-digit integral LCD can display engineering units g, in/s, mm/s, °F, and °C. Display updates at transmit rate up to once per minute.

Humidity Limits

0–95% relative humidity

Transmit Rate

User selectable, 60 s to 1 hour for the 2.4 GHz CSI 9420.

Vibration

Range:

RMS velocity (frequency dependent): 0.008 in/s to >4.35 in/s (0.20 mm/s to >110.5 mm/s)

PeakVue: 0.02 g to 100 g (0.2 m/s² to 981 m/s²)

PeakVue details: 51.2 kHz sampling rate, 4096 samples/block, 1000 Hz high pass filter

Accuracy:

Measurement accuracy is the absolute accuracy of the end-to-end measurement relative to a known, calibrated excitation.

Parameter	Typical ¹	Worst Case ²
RMS Velocity	0.5 dB (corresponds to +/-4%)	5.0 dB
PeakVue	1.0 dB (corresponds to +/-7%)	11.0 dB
Temperature	+/- 2.0 °C	N/A

1

Typical measurement accuracy represents the expected end-to-end performance operating under steady-state conditions (constant temperature at 20 °C with no external interference) for a mid-band excitation (nominally 1 g (9.81 m/s² at 100 Hz). This variation includes the frequency response of the electronics and the sensor.

2

Worst case measurement accuracy represents the worst-case performance over the entire temperature range, across all frequencies and amplitudes, and in the presence of high-intensity transient EMI. This result is an RSS combination of all independent error sources.

Frequency response variability:

RMS velocity:

- 1.0 dB from 10 Hz to 800 Hz
- 4.0 dB from 2 Hz to 1000 Hz

PeakVue:

- 1.0 dB from 2000 Hz to 10 kHz
- 5.0 dB from 1000 Hz to 25 kHz

Temperature:

- +/- 5 °C

Sensor variability (vibration):

- Temperature coefficient: 0.1% per °F; 0.18% per °C

(2 dB, worst case)

• EMI/transient susceptibility (2.4 GHz only): +/- 15% (1.2 dB) under worst-case interference conditions (per EN 61326)

- 3 dB up to 10 kHz; 10 dB up to 25 kHz

Sensor variability (temperature):

EMI/transient susceptibility of the temperature measurement is unspecified, since this is not the primary purpose of the device. Testing has demonstrated that high intensity RF fields have the potential to render the temperature measurement meaningless.

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 was obtained with statistical measurements with 1 g-peak (9.81 m/s²) input excitation at a frequency of 100 Hz. For temperature, this value was obtained with statistical measurements at room temperature.

- Vibration: 0.2 dB over 24 months
- Temperature: +/- 2 °C over 24 months

Physical Specifications

Electrical Connections / power module

SmartWireless Power Module

- Replaceable, non-rechargeable, Intrinsically Safe Lithium-Thionyl Chloride power module pack with PBT enclosure.
- Four-year power module life at reference conditions.¹
- 4 Screw Terminals for sensor connection.

1. Reference conditions are 70 °F (21 °C), two accelerometers transmit rate of once every 30 minutes, and routing data for three additional network devices, LCD disabled, no time-based collection of energy band.

External DC Power

- 10...28 VDC, @ 40 mA, 80 mA peak
- 22 gauge wire minimum

Field Communicator Connections**Communication Terminals**

Clips permanently fixed to terminal block

Materials of Construction**Enclosure****Housing ⁽²⁾**

- Low-copper aluminum

Paint ⁽²⁾

- Polyurethane

Cover O-ring

- Buna-N

Terminal Block and power module Pack

- PBT

Antenna

- PBT/PC integrated omnidirectional antenna

2. The housing is also available in a non-polished stainless steel. The stainless steel housing is not painted. Contact your Emerson sales representative for more information.

Mounting

Mounting brackets are needed for remote mounting. See “Dimensional Drawings” on page A-6.

Weight

CSI 9420 without LCD - 4.6 lb (2 kg)

CSI 9420 with M5 LCD - 4.7 lb (2.1 kg)

Enclosure Ratings (CSI 9420)

Housing option code D is NEMA 4X, and IP66.

Performance Specifications

EMC (ElectroMagnetic Compatibility)

The 2.4 GHz CSI 9420 meets all requirements listed under IEC 61326:2006.

Radio Specifications (2.4 GHz WirelessHART)

Table A-1. Radio Specifications (2.4 GHz WirelessHART)

Parameters	Min	Typical	Max	Units	Comments
Operating frequency	2.4000		2.4835	GHz	
Number of channels		15			
Channel separation		5		MHz	
Occupied channel bandwidth		2.7		MHz	At -20 dBc
Frequency Accuracy	-50		+50	kHz	
Modulation					IEEE 802.15.4 DSSS
Raw data rate		250		kps	
Receiver operating maximum input level		0		dBm	
Receiver sensitivity		-92.5		dBm	At 50% PER $V_{DD} = V$, 25 °C
		-90		dBm	At 1% PER, $V_{DD} = 3 V$, 25 °C, (inferred from 50% PER measurement)
Output power, conducted		+8		dBm	$V_{DD} = 3 V$, 25 °C Long Range Antenna
		+12.5		dBm	$V_{DD} = 3 V$, 25 °C Extended Range Antenna

Low-Power Sensor Options

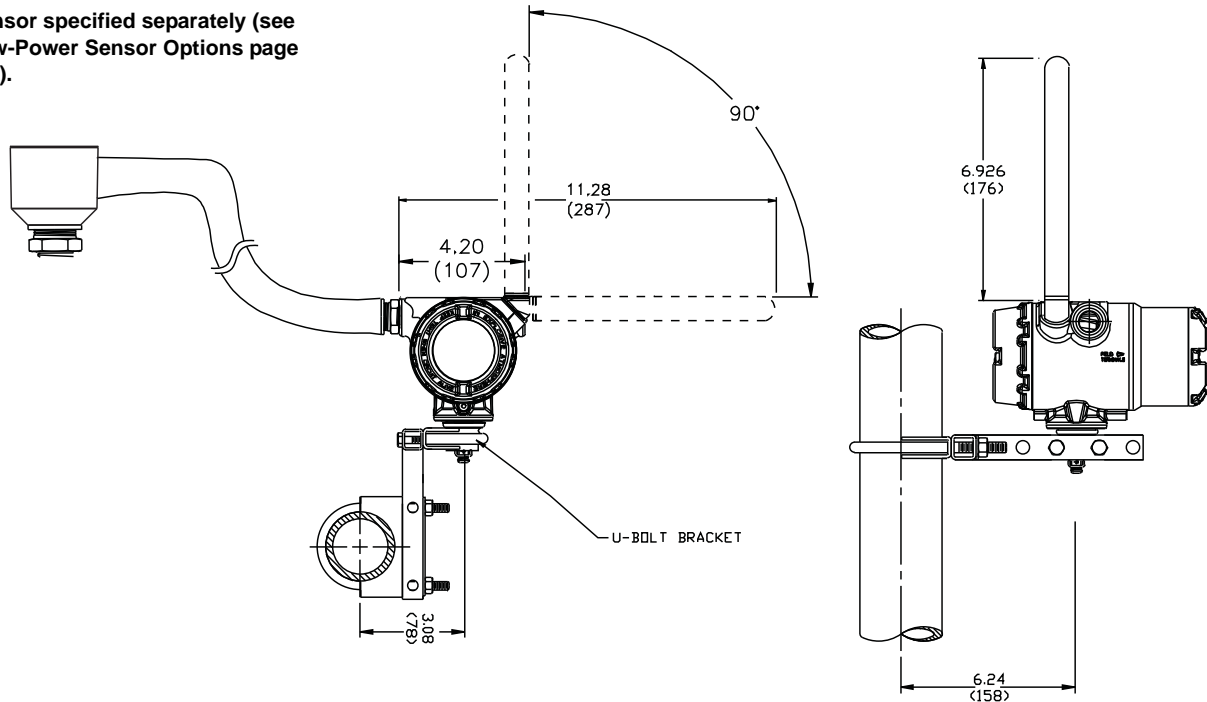
Table A-2. CSI 9420 Low-Power Sensor Options

Part number	Color Coding	Cable Length (ft)	Cable Type	Sensor Range
Accelerometer				
A0394RI	Green	10	Polyurethane	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RI-1	Green	30	Polyurethane	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RI-2	Green	50	Polyurethane	
A0394RI-3	Green	75	Polyurethane	
A0394RI-4	Green	100	Polyurethane	
A0394RA	Green	10	Armor	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RA-1	Green	30	Armor	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RA-2	Green	50	Armor	
A0394RA-3	Green	75	Armor	
A0394RA-4	Green	100	Armor	
A0394RAC	Green	10	Armor w/Teflon coating	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RAC-1	Green	30	Armor w/Teflon coating	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz
A0394RAC-2	Green	50	Armor w/Teflon coating	
A0394RAC-3	Green	75	Armor w/Teflon coating	
A0394RAC-4	Green	100	Armor w/Teflon coating	
			Armor w/Teflon coating	
Accelerometer and Temperature				
A0394DI	Blue	10	Polyurethane	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DI-1	Blue	30	Polyurethane	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DI-2	Blue	50	Polyurethane	
A0394DI-3	Blue	75	Polyurethane	
A0394DI-4	Blue	100	Polyurethane	
A0394DA	Blue	10	Armor	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DA-1	Blue	30	Armor	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DA-2	Blue	50	Armor	
A0394DA-3	Blue	75	Armor	
A0394DA-4	Blue	100	Armor	
A0394DAC	Blue	10	Armor w/Teflon coating	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DAC-1	Blue	30	Armor w/Teflon coating	0.02 g to 100 g from 1 kHz to 20 kHz, 0.01 in/s to 4.35 in/s @ 1 kHz, and -40 °C to 125 °C.
A0394DAC-2	Blue	50	Armor w/Teflon coating	
A0394DAC-3	Blue	75	Armor w/Teflon coating	
A0394DAC-4	Blue	100	Armor w/Teflon coating	
			Armor w/Teflon coating	

Dimensional Drawings

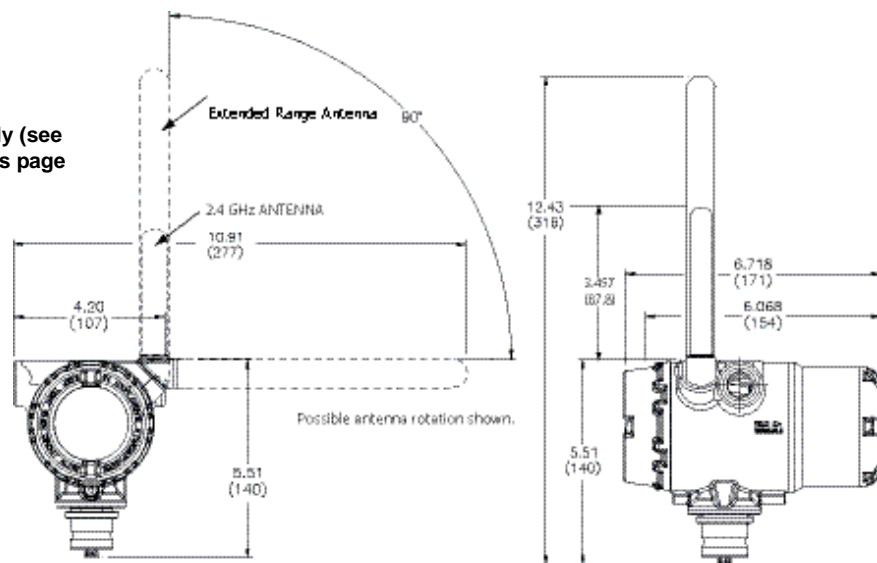
CSI 9420 Mount with brackets

Sensor specified separately (see Low-Power Sensor Options page A-5).



CSI 9420 Mount without brackets

Sensor specified separately (see Low-Power Sensor Options page A-5).



Dimensions are in inches (millimeters)

Appendix B: Product Certifications

NOTICE

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

Approved Manufacturing Locations

Emerson Process Management - MHM, Knoxville, Tennessee, USA

Wireless Certifications

Telecommunication 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 is working 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 and Telecommunications Terminal Equipment Directive (R&TTE)(1999/5/EC)

Emerson Process Management complies with the R&TTE Directive.

FCC and IC Approvals

This device 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 antenna separation distance of 20 cm from all persons.

Telecommunication Compliance

2.4 GHz:

FCC ID: LW2RM2510

IC ID: 2731A-RM2510

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).

CE Mark

The 2.4 GHz version of the device has been tested and complies with all relevant directives required for CE marking.



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 20 km from the center of Ny-Alesund.
Romania	Use on a secondary basis. Individual license required.

Electro Magnetic Compatibility (EMC) (2004/108/EC)

All Models: EN 61326-1, 61326-2-3: 2006

CSA - Canadian Standards Association

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

Hazardous Locations Certificates CSI 9420 Rev 3

North American Certifications

Factory Mutual (FM) Approvals

FM Non-incendive
Non-incendive for Class I, Division 2, Groups A, B, C, and D.
Temperature Codes T4 ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)
($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD
Ambient temperature limits: -40 to 80°C
For use with Rosemount power module pack P/N 753-9220-XXXX (MHM-89002) only.
Enclosure Type 4X / IP66
Zone Marking: Class I, Zone 2, Group IIC

CSA - Canadian Standards Association

CSA for Class I, Division 2, Groups A, B, C, and D.
Temp Code T4 ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)
($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD
Enclosure Type 4X / IP66
For use with Rosemount power module pack P/N 753-9220-XXXX (MHM-89002) only.

European Certifications

ATEX Directive (94/9/EC)

Emerson Process Management complies with the ATEX Directive.

ATEX, Zone 2 (2.4 GHz only)

ATEX Category Marking:

 II 3 G

Ex ic IIC T4 Gc ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)
($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD

ATEX Certification Number: Baseefa09ATEX0060X

Condition for Safe Use

The apparatus has a plastic antenna which constitutes a potential electrostatic hazard. The antenna must not be rubbed or cleaned with solvents.

Sensor Terminal Output Parameters

$U_o = 5.2\text{V}$ $C_i = 1.9\text{nF}$

$I_o = 56\text{mA}$ $I_i = 0$

Diode barriers will be required if using an external power supply in a hazardous area.

Hazardous Locations Certificates CSI 9420 Rev 4 and Rev 5

North American Certifications

Factory Mutual (FM) Approvals

Intrinsically Safe for use in Class I, Division I, Groups C and D; Class 1, Division 2, Groups A, B, C, and D

Intrinsically Safe for use in Class I, Zone 0, AEx ia IIB Hazardous (Classified) Locations

Temperature Codes T4 ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)

($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD

Ambient temperature limits: -40 to 80°C

For use with Emerson Battery Pack Model 701PBKKF Only

Enclosure Type 4X / IP66

Zone Marking: Class I, Zone 0, Group IIB

CSA - Canadian Standards Association

CSA for Class I, Division 1, Groups C, D.

Temp Code T4 ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)

($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD

Enclosure Type 4X / IP66

For use with Emerson Battery Pack Model 701PBKKF Only

European Certifications

ATEX Directive (94/9/EC)

Emerson Process Management complies with the ATEX Directive.

ATEX, Zone 0

ATEX Category Marking:

 II 1 G

Ex ia IIB T4 Ga ($-40^{\circ}\text{C} \leq T_a \leq 85^{\circ}\text{C}$)

($-20^{\circ}\text{C} \leq T_a \leq 80^{\circ}\text{C}$) with LCD

($-10^{\circ}\text{C} \leq T_a \leq 50^{\circ}\text{C}$) in case of connection with HART Communicator certified BVS 03 ATEX E 347
or BVS 09 ATEX E 023

For use with Emerson Battery Pack Model 701PBKKF

ATEX Certification Number: LCIE 12 ATEX 3057 X

IECEx

Special Conditions for Safe Use (X)

The apparatus has a plastic antenna which constitutes a potential electrostatic hazard. The antenna must not be rubbed or cleaned with solvents.

1. The antenna may present a potential electrostatic ignition hazard and must not be rubbed or cleaned with a dry cloth.
2. The apparatus may be equipped with an aluminum alloy or stainless-steel enclosure. The aluminum alloy enclosure is given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a zone 0 environment.
3. For use with Emerson Battery Pack Model 701PBKKF only.
4. Intrinsically Safe when installed per drawing D25418.

Sensor Terminal Output Parameters

$V_{oc}/U_o = 7.8 \text{ V}$

$I_{sc}/I_o = 158 \text{ mA}$

$P_o = 309 \text{ mW}$

$C_a/C_o = 2 \text{ uF}$

$L_a/L_o = 5 \text{ mH}$

Appendix C: Velocity, PeakVue, and Temperature

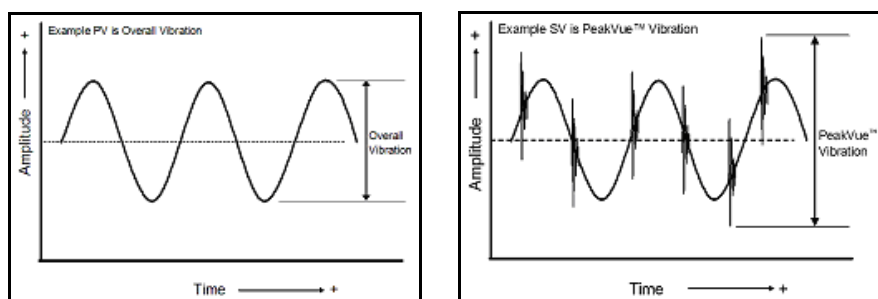
Overall Velocity

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

The CSI 9420 uses (low-frequency) Overall Velocity in conjunction with (high-frequency) PeakVue to provide a holistic solution across frequency while optimizing the usage of the limited power and bandwidth available in a wireless device. The majority of developing fault conditions will be manifested with a monotonic increase in one or both of these key parameters.

The difference in the vibration waveform and the associated measurement for Overall Vibration versus PeakVue is depicted conceptually in the illustrations below. Overall Vibration provides an indication of the total low-frequency energy in the waveform. PeakVue, on the other hand, provides an indication of the maximum excursion in the waveform, which is how indications of many developing bearing faults are first manifested.

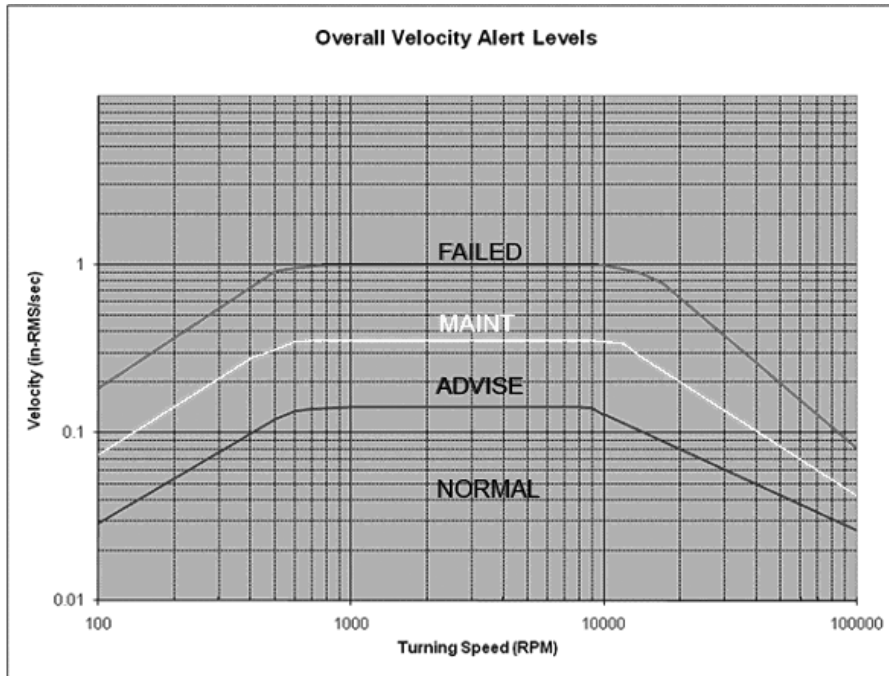
Figure C-1. Overall Vibration (left) and PeakVue (right) charts



While PeakVue is extremely useful for providing an early indication of impact-related faults in rolling-element bearings, there are many more general applications where a low-frequency measurement is more appropriate. Furthermore, virtually all vibration analysts are very familiar with the Overall Velocity measurement and use it as part of their existing vibration programs. As a result, while it may not be possible to obtain a measurement result comparable to the PeakVue value reported by the CSI 9420 with a non-CSI handheld vibration analyzer, the Overall Velocity measurement is ubiquitous throughout the industry and should be easy to correlate with the results from handheld instruments.

There are, however, a number of different methods for measuring and reporting Overall Velocity, so it is important to ensure that the measurement conditions are similar when trying to duplicate the value reported by the CSI 9420 with that of a handheld. The CSI 9420 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 depicted graphically in the figure below.

Figure C-2. 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 the following table:

Table C-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

It is important to note that the Overall Velocity thresholds in the graph are for root-mean-square (RMS) velocity in units of inches per second. Particularly in digital acquisition systems, it is customary to make the measurement and do the calculation with RMS quantities. While it is accepted practice in the industry to convert between RMS and peak values using the well-known 1.4142 conversion factor, it is not technically correct to do so except for a pure sinusoidal

waveform. For this reason the CSI 9420 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.

The default levels in the CSI 9420 for ADVISE, MAINTENANCE, and FAILED alerts are 0.14 in/s RMS, 0.35 in/s RMS and 1.0 in/s RMS, respectively.

PeakVue

PeakVue is a patented technique that is extremely useful for isolating high-frequency phenomena associated with developing faults, especially in rolling-element bearings.

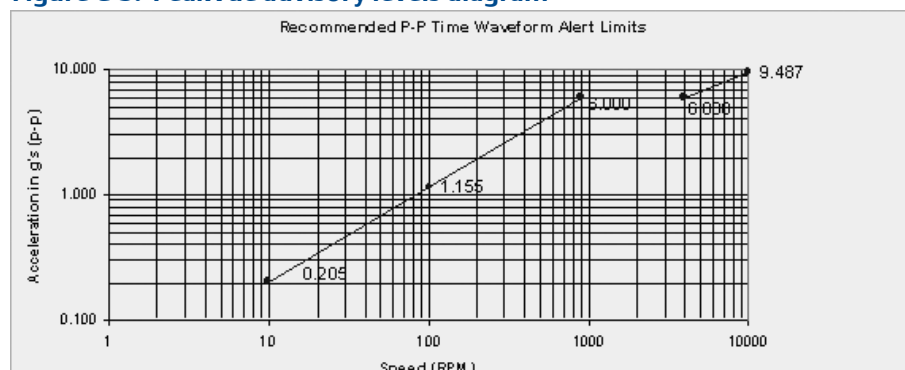
The premise for PeakVue is that the high-frequency components are not readily detected with more conventional measurements such as overall velocity, low-frequency energy (LFE), or digital overall. This is because the low-frequency measurements either average the energy or provide an energy summation 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 depicted conceptually in the illustrations below. Overall Vibration provides an indication of the total low-frequency energy in the waveform. PeakVue, on the other hand, provides an indication of the maximum excursion in the waveform, which is how indications of many developing bearing faults are first manifested.

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.

Based on years of experience with this technology, Emerson Process Management has developed advisory levels for PeakVue, which are illustrated in the graph below.

Figure C-3. PeakVue advisory levels diagram



The equations that govern this curve are:

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

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

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

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

Again, keep in mind that these 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.

Utilizing the embedded PeakVue technology, the CSI 9420 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. Example data from one of the sites is provided below. Notice in this 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.

Figure C-4. 4600 HP fan motor - OH (Overall)

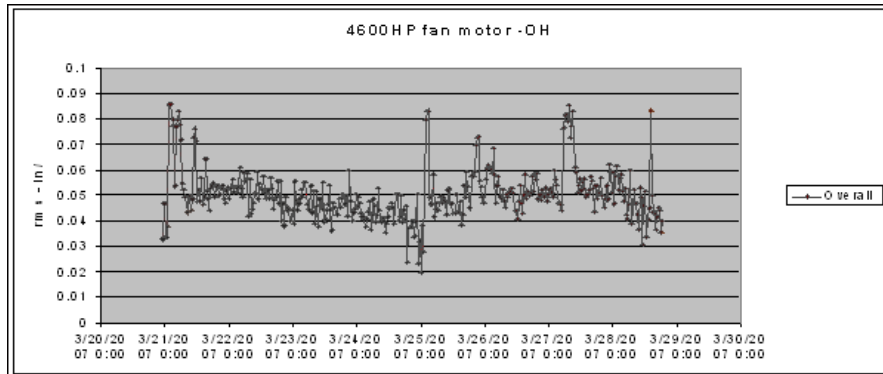
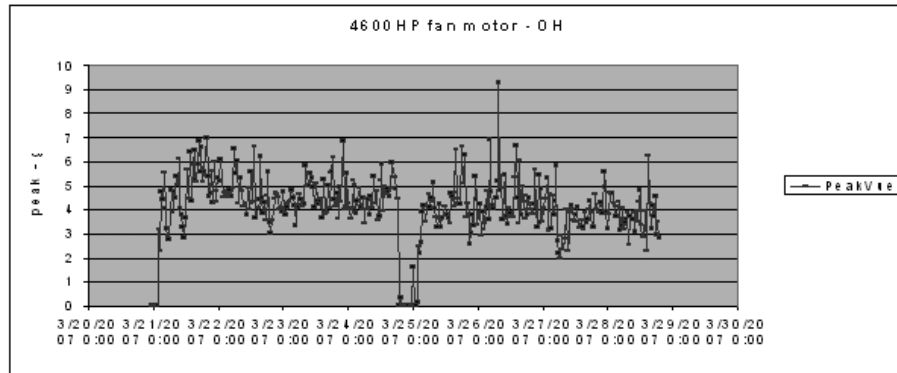


Figure C-5. 4600 HP fan motor - OH (PeakVue)



The user at this location removed the defective bearing, and the photographs below clearly show the developing problem that was the source of the impacting. After replacing the bearing, the PeakVue vibration is significantly reduced, indicating that the problem has been resolved. This is clearly shown in the data following the photographs.



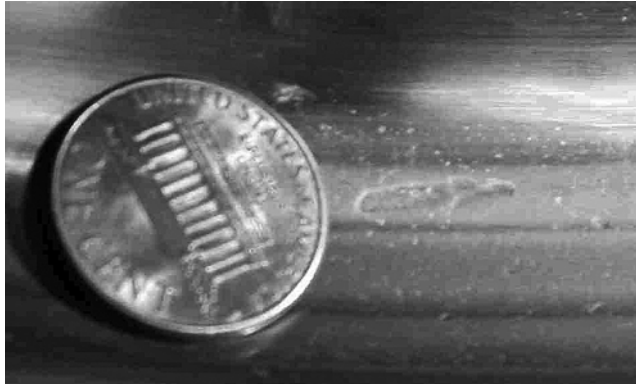
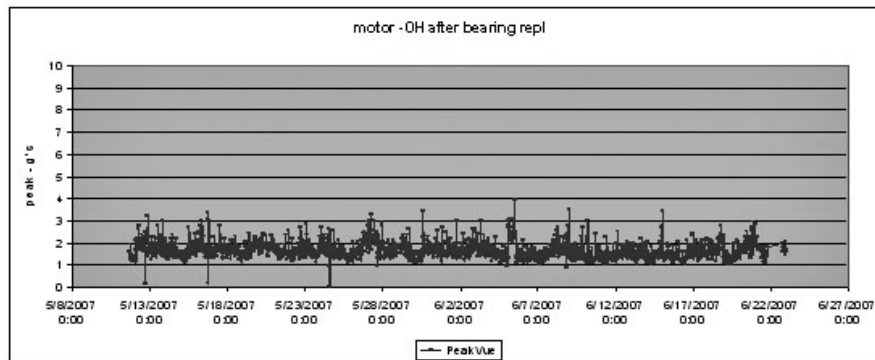


Figure C-6. Motor - OH After Bearing Replaced (PeakVue)



Temperature

The levels at which to set temperature alerts depend on a variety of factors including the specific process, the operating environment, and the characteristics of the equipment being monitored. This discussion provides some generic guidelines, given some knowledge of the variables involved, for setting the thresholds for your specific CSI 9420 installation. Keep in mind, though, that 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 the 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 constantly to 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. Be advised, however, that there are issues with this methodology (i.e., it does not work well) in areas with large variations in ambient temperature.

Thresholds may also be selected based on some absolute temperature limit. In practice, this is much easier to maintain but it is not as effective at detecting early failures as relative monitoring.

"Relative" Temperature Monitoring

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

- $T_{\text{Advise}} = 10\text{ }^{\circ}\text{C}$ increase
- $T_{\text{Maintenance}} = 15\text{ }^{\circ}\text{C}$ increase
- $T_{\text{Failed}} = 20\text{ }^{\circ}\text{C}$ increase

For example, assume 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. So, your "baseline" relative difference is 30 °C. Using the above guidelines, you should choose the Advise, Maintenance, and Failed levels for a difference of 40 °C, 45 °C, and 50 °C, respectfully. 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).

Absolute Temperature Monitoring

For monitoring a driven component (e.g., a pump or a fan), there are no generic rules for determining the default levels without some a priori knowledge of the steady-state baseline (good) value. In general, the Advisory level should be set about 10 °C to 20 °C above this baseline, with the Maintenance level about 10 °C above Advisory 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 temperature, T_{rise} , for the appropriate type of motor adjusted for high ambient temperature (T_a) effects.

Use the following relationships to determine T_{rise} .

- $T_{rise} = 65\text{ °C} + \text{serv_fact_temp}$; for class A insulation
- $T_{rise} = 85\text{ °C} + \text{serv_fact_temp}$; for class B insulation
- $T_{rise} = 110\text{ °C} + \text{serv_fact_temp}$; for class F insulation
- $T_{rise} = 130\text{ °C} + \text{serv_fact_temp}$; for class H insulation
- $T_{rise} = 150\text{ °C} + \text{serv_fact_temp}$; for class N insulation

$\text{serv_fact_temp} =$

- 5 for service factor of 1.15 or greater
- -5 for either open or 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,

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

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

$$T_w = T_{rise} + 40\text{ °C}$$

If $T_a > 40\text{ °C}$, then

$$T_w = T_{rise} + 40\text{ °C} - (T_a - 40\text{ °C})$$

Again, if T_a is unavailable assume 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,

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

$$T_{f_advisory} = T_{f_fault} - 20\text{ °C}$$

Error Indications and Steady-state Determination

1. Do not use any data readings collected within 30 seconds of motor start up.
2. Check for error indications.
 - If $T_f > 150\text{ }^{\circ}\text{C}$, the sensor is shorted
 - If $T_f < -40\text{ }^{\circ}\text{C}$, the sensor is open or wire is broken.
3. Steady State is defined to have been reached when over any 5 minute time interval, the maximum variation in temperature is less than 2 °F.

Appendix D: Accelerometer Installation for EMI/RFI Consideration

Introduction

The CSI 9420 Wireless Vibration Transmitter uses an accelerometer to measure vibration. The process involves a piezoelectric element, which produces a time-waveform whose voltage amplitude is proportional to acceleration. The input bandwidth of the measurement is approximately 20 kHz. This waveform is then digitized and analyzed within the CSI 9420 to produce the desired vibration parameters. Due to the high-frequency nature of the measurement, it is inherently susceptible to electro-magnetic interference (EMI) and radio-frequency interference (RFI), which can cause distortions in the measurement. This appendix discusses a number of things that can be done to eliminate, or at least significantly reduce, these effects.

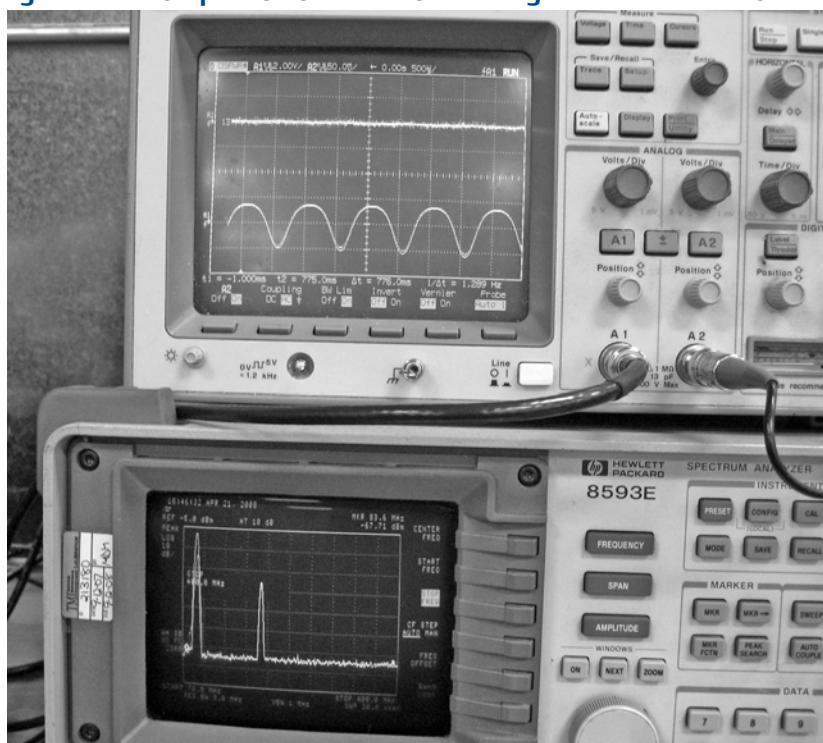
NOTICE

The mitigating strategies discussed in this appendix apply only to the measuring of vibration. An accelerometer measures only vibration. If you use a sensor that has both vibration and embedded temperature capabilities, these strategies will only work for the vibration measurement part of the sensor.

Examples of the Effect

The primary source of the susceptibility is the cable between the accelerometer and the transmitter housing. Longer cable lengths act like antennas at high frequencies, and as such receive RF energy and transfer it to the measurement electronics. Then, the silicon P/N junctions in the accelerometer demodulate the RF energy to produce energy in the valid measurement band of the transducer, which is indistinguishable from the signals it is specifically designed to detect.

Figure D-1. Comparison of accelerometer signal with and without interference



Refer to Figure D-1 for a comparison of the same signal measured on an accelerometer with and without interference. This is a photograph of two lab instruments. The instrument on the top is an oscilloscope, which displays a signal (in volts) in the time domain (i.e., signal amplitude as a function of time). The instrument on the bottom is a spectrum analyzer, which displays a signal (in volts) in the frequency domain (i.e., signal amplitude as a function of frequency). The oscilloscope trace on the top (A2) is the signal measured with no RFI effect. The oscilloscope trace on the bottom (A1) is the signal in the presence of interference on a completely unmitigated accelerometer. The spectrum analyzer display is the frequency spectrum representation of the signal with interference.

Mitigations

There are four basic things that can be done to reduce the effects of EMI on the measurement:

1. Reduce cable length
2. Run cable through conductive conduit, grounded at both ends
3. Install ferrites on the cable

4. Avoid running cable such that it matches the polarization of expected interference sources

Each of these items will be discussed in detail in subsequent sections. Keep in mind, however, that the best approach may be different depending on the application and on local installation codes.

Reduce Cable Length

Accelerometers are available with 3-meter (10-ft), 10-m (30-ft), 15-m (50-ft), or 30-m (100-ft) cable lengths. Because the cable is the most susceptible component for the measurement system, the best way to avoid the problem of EMI/RFI is to minimize the cable. When planning the installation, keep in mind that shorter cable lengths significantly improve immunity to EMI/RFI and try to keep the cable runs as short as reasonably possible. Also, since even 3-m cables have some susceptibility in the presence of high-intensity RF fields, it is strongly recommended that you consider other mitigations discussed later in this appendix.

NOTICE

Emerson does not recommend the use of longer cables.

Conductive Conduit

Running the cable through conductive conduit provides additional shielding and increases immunity to EMI/RFI. For best results, the conduit should be grounded at both ends. As a general rule, the conduit is automatically grounded at the transmitter because it screws into the transmitter housing, which is grounded. Ensuring the conduit is also grounded at the accelerometer end (and at points along the conduit run) reduces coupling of the interfering energy into the cable and propagating it along the cable into the accelerometer.

Refer to Figure D-2 for an illustration of running the accelerometer through conduit grounded on both ends. Notice that, as a general rule, the transmitter housing itself is grounded through the base where it is mounted. Then, since the conduit is electrically connected to the transmitter housing, this effectively grounds the conduit at the transmitter end. Grounding the conduit at the accelerometer end as well significantly reduces the possibility that energy due to EMI/RFI can be coupled into the accelerometer cable. When employing this method, minimize the length of cable that is outside of the conduit by running the conduit as close as reasonably possible to the point where the accelerometer is mounted to the equipment being monitored.

Figure D-2. Illustration of grounded conduit for added RFI protection



Ferrites

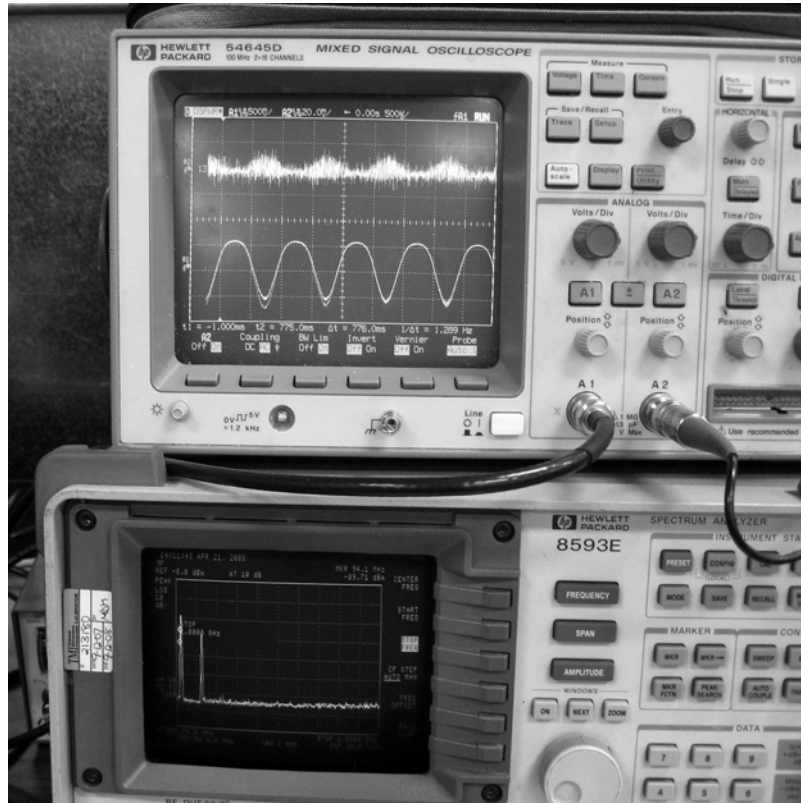
The accelerometers are shipped with ferrites installed at the accelerometer end. To maintain the stated performance of the accelerometer (Appendix A), these should not be removed.

Refer to Figure D-3 for a comparison of two accelerometers in the presence of a high-intensity RF field (10 V/m). The oscilloscope (the instrument on top) is the time-domain representation of the signals.

The upper trace (A2) is a standard (non-armor-jacketed) 3-m cable, without conduit, with polarization matching that of the interference field, and with two ferrites installed at the accelerometer end of the cable. The resulting interference is about 10 mV peak-to-peak, which is equivalent to a perturbation of about 0.2 g's peak to the acceleration measurement.

The lower trace (A1) is a 3-meter cable of the same type, without conduit, with polarization matching that of the interference field. In this case there are no ferrites installed, and the resulting interference is about 1.2 V peak-to-peak, which is equivalent to a perturbation of about 24 g's peak to the acceleration measurement.

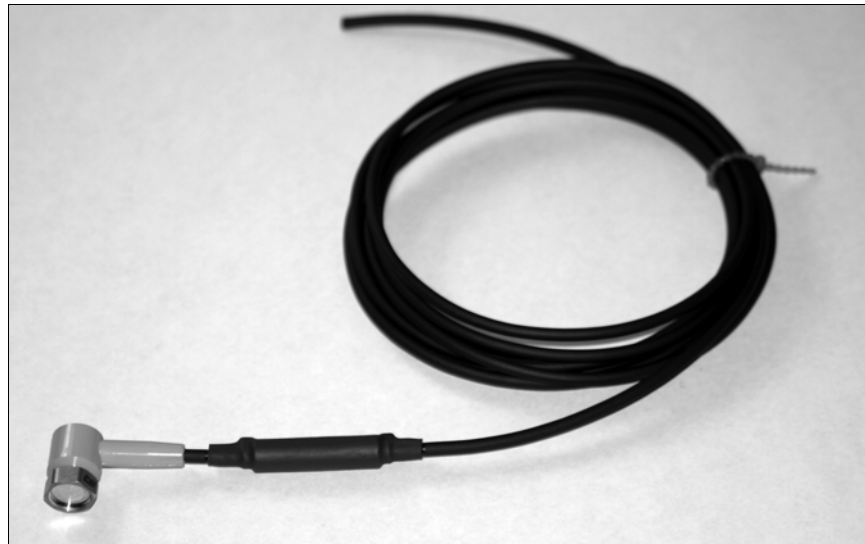
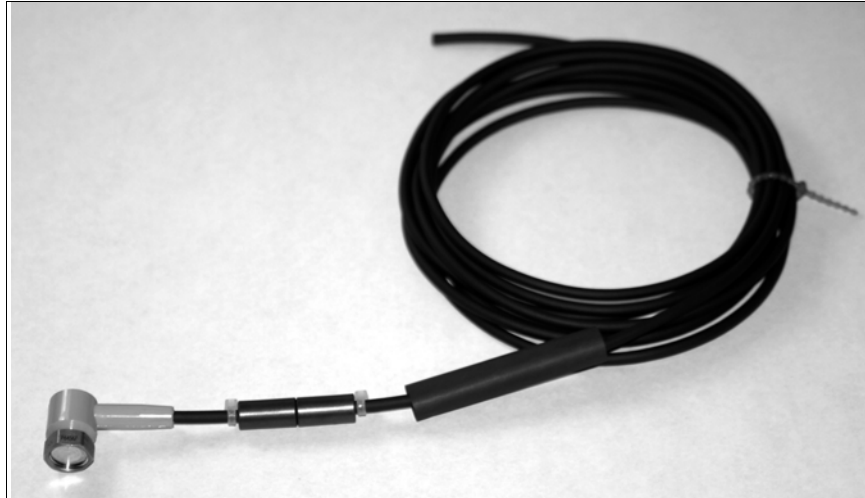
Figure D-3. Comparison of accelerometer signals in the presence of high-intensity interference with and without mitigation



Obviously, the ferrites provide a huge amount of RFI suppression and are needed to maintain measurement integrity in the presence of strong electromagnetic interference. The ferrites installed on the accelerometer cables that are shipped from the factory should not be removed; even if other mitigations are applied.

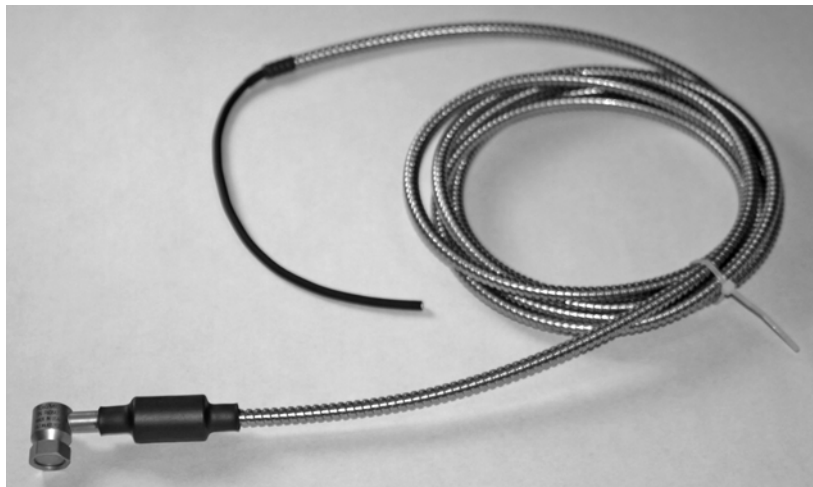
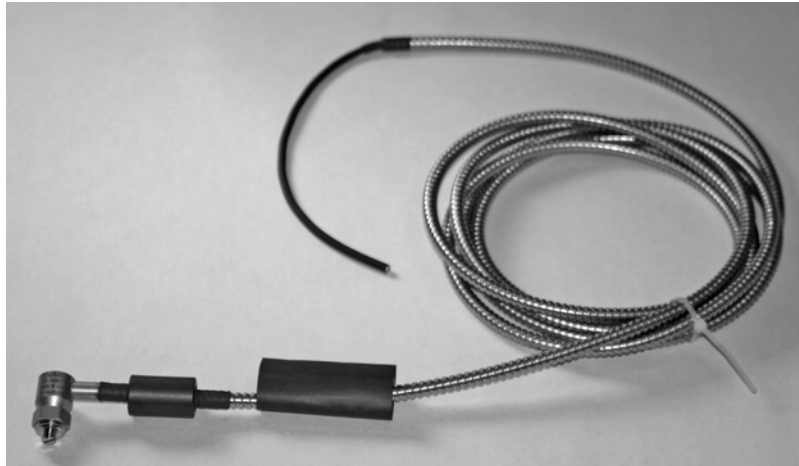
To meet the stated performance criteria, the standard accelerometer cable has two (2) ferrites installed. These are Steward part number 28B0355-000, which each provide 205 ohms of reactance at 100 MHz. Refer to Figure D-4 for a photograph of the standard accelerometer with ferrites installed as shipped from the factory.

Figure D-4. The 3-m / 10-ft standard accelerometer cable with ferrites installed (as shipped from the factory)



To meet the stated performance criteria, the armor-jacketed accelerometer cable has one (1) ferrite installed. It is Steward part number 28B0672-000, which provides 245 ohms of reactance at 100 MHz. Refer to Figure D-5 for a photograph of the armor-jacketed accelerometer with the ferrite installed as shipped from the factory.

Figure D-5. The 3-m / 10-ft armor-jacketed accelerometer cable with ferrite installed (as shipped from the factory)



If additional immunity is required, additional ferrites with similar characteristics may be installed.

After accelerometer installation is complete, and accelerometer cables have been run through conduit (if applicable), and the cable has been cut to the desired length, ferrites may also be placed on the other end of the cable or at points along the cable.

NOTICE

The performance of the accelerometer is not maintained beyond a 3-m / 10-ft cable-length unless additional ferrites are installed as described below.

All low-power sensors for use with the CSI 9420 are shipped with additional ferrites if their cable lengths exceed 3 meters. To ensure compliance with the CE directive, if the cable length exceeds 3 meters, ferrite installation at the site is required for all standard sensor configurations (1 accelerometer, 1 accelerometer with embedded temperature, or 2 accelerometers). Detailed installation instructions are provided below.

These ferrites are not installed on the accelerometer cable at the factory because they must be installed on the “transmitter” end of the cable and the cables are typically cut to length at the site. Again, to maintain compliance with the CE directive, sensors with cables longer than 3 meters must have these additional ferrites, quantity of 3 per cable, installed. It is not necessary to install the ferrites if the cable length is less than 3 meters.

From a compliance perspective, it is not necessary to install the ferrites if the cable is in ferromagnetic conduit (e.g., galvanized steel) because of the additional shielding this type of conduit provides. Note that the conduit entry of the device is ½” NPT. If the ferrites are installed with conduit, a wider conduit (e.g., ¾” NPT or M20) is required to accommodate the ferrites and an adapter is required at the conduit entry of the device.

The ferrites provided with the sensors that have standard (polyurethane) cables are Fair-Rite P/N 0431173951 (MHM-94985). These ferrites simply snap onto the cable near the point where the cable enters the transmitter housing. If desired, it is acceptable, but not required, to use wire-ties and/or heat-shrink with these ferrites.

A photograph of the ferrites and an accelerometer with a standard cable, prior to installation, is shown in Figure D-6.

Figure D-6. Transmitter (CSI 9420), accelerometer with standard cable longer than 3 meters, and ferrites, pre-installation



The procedure for installing the ferrites on the standard cable is as follows:

1. After cutting the accelerometer cable to the required length, make the standard connections to the CSI 9420 terminal block and grounding screw.
2. Snap the first of three attenuator ferrites (MHM-94985) at the location on the cable approximately 1 inch from the point where the cable enters the gland.
3. Snap the second ferrite onto the cable adjacent to the first; then snap the remaining ferrite adjacent to the second.
4. When installing the ferrites, take care that adequate force is applied in their closure so that the keeper latches fully engage, thereby assuring the ferrites remain securely fastened to the cable.

The photograph in Figure D-7 below shows an example of how everything looks after the ferrites have been installed.

Figure D-7. Transmitter (CSI 9420), accelerometer with standard cable longer than 3 meters, and ferrites, after installation



The ferrites provided with the sensors that have armor-jacketed cables are Fair-Rite P/N 2631665702. These slide onto the cable and must have wire-ties and/or heat-shrink, or some similar mechanism, to hold them in place.

A photograph of the ferrites and an armor jacketed accelerometer cable is shown in Figure D-8.

Figure D-8. Transmitter (CSI 9420), accelerometer with armor-jacketed cable, and ferrites, pre-installation



The procedure for installing the ferrites on the armor-jacketed cable is as follows:

1. After cutting the accelerometer cable to the required length, make the standard connections to the CSI 9420 terminal block and grounding screw.
2. Slide the first of the three ferrites at the location on the cable approximately 1 inch from the point where the cable enters the gland.
3. Secure the ferrite using wire tie, heat-shrink, or other method approved for your location.
4. Slide the second and third ferrites onto the cable adjacent to the first and secure in place.

The photograph in Figure D-9 shows an example of how everything looks after the ferrites have been installed.

Figure D-9. Transmitter (CSI 9420), accelerometer with armor-jacketed cable, and ferrites, after installation



An additional ferrite is needed for devices that are using an external DC supply. This ferrite is included with the transmitter if the external power option is ordered. The photograph in Figure D-10 shows an example.

This is a snap-on ferrite. However, depending on the size of wire used, it may be necessary to secure the ferrite in place.

Figure D-10. Transmitter (CSI 9420), external power option, with ferrite, after installation



The ferrite provided is Fair-Rite p/n 0431164281, which has a reactance that ranges from 28 Ω at 1 MHz to 310 Ω at 100 MHz and 240 Ω at 250 MHz. It supports a maximum cable diameter of 0.260 inch (6.6 mm).

Polarization

The maximum coupling onto the cable occurs when the polarization of the interfering signal matches the cable run. In most cases intermittent interference sources, such as hand-held walkie-talkies or tablet computers, are naturally vertically polarized because of the way a human being holds these items during normal usage. As a result, installations with long vertical runs of cable are more susceptible to EMI/RFI than horizontal runs of similar length. Refer to Figure for an illustration of cable installation for improved immunity to vertically polarized interference. Refer to Figure D-11 for an illustration of cable installation that increases susceptibility to vertically polarized interference.

Figure D-11. RFI source cross-polarized with long cable run results in minimum interference



Figure D-12. RFI source polarization coincident with long cable run results in maximum interference



Summary

To maximize immunity to EMI/RFI, consider the following when planning the installation of the CSI 9420 and its accelerometers:

- Minimize accelerometer cable lengths.
- Consider running accelerometer cables in conductive conduit, grounded on both ends.
- Use ferrites to attenuate interference that couples into the accelerometer cable.
- Avoid vertical cable runs because this geometry increases susceptibility to vertically polarized interferers.
- Ensure the installation conforms to all local codes and regulations.

