

# Installation and Maintenance

## Bently Nevada™ Asset Condition Monitoring

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Essential Insight.mesh™

CE0976 ① FCC ② N21025



imagination at work

Part Number 185302-01  
Rev. NC (09/09)



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Ethernet, Internet Explorer

### **Contact Information**

The following contact information provided for those times when you cannot contact your local representative:

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|                 |  |
|-----------------|--|
| Mailing Address | 1631 Bently Parkway South<br>Minden, Nevada USA 89423<br>USA           |
| Telephone       | 1.775.782.3611<br>1.800.227.5514                                       |
| Fax             | 1.775.215.2873   |
| Internet        | <a href="http://www.ge-energy.com/bently">www.ge-energy.com/bently</a> |

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## Additional Information

### Notice:

This manual does not contain all the information required to operate and maintain the product. Refer to the following manuals for other required information.

200150, 200155, and 200157 Accelerometer Installation Guide (Part Number 164985-01)

200125 Trendmaster® 2000 Thermocouple (Part Number 149558-01)

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## 1. Introduction

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The Essential Insight.mesh™ wireless sensor network is a wireless data acquisition system that is fully integrated with the System 1® software. This manual introduces the components of the Essential Insight.mesh network and helps you plan and deploy this wireless system, and configure the required components in System 1 Configuration software. A typical system requires a Manager Gateway, Wireless Sensor Interface Modules (wSIMs), and Repeaters that create a robust, auto-forming mesh network. Each wSIM device has four channels that can each be individually configured to support vibration and temperature measurements.

|  | <b>Cautions</b>  |
|---|--|
|   | <b>If you plan to install components of this system at heights always use fall protection that meets requirements of local standards, and follow site safety instructions to ensure a safe work environment.</b> |
|   | <b>Do not subject battery modules to temperatures greater than 200°C.</b>  |
|   | <b>Do not subject wSIMs or Repeaters to temperatures greater than 85°C.</b>  |
|   | <b>When wiring up the power supply follow safe work practices (LOTO, energy isolation during maintenance or installation).</b>   |
|   | <b>Pinch hazard – wSIM and Repeater magnet mounts have pull strength of up to 200 lbs.</b>   |
|   | <b>Any changes or modifications not expressly approved by Bently Nevada LLC could void the user's authority to operate the equipment.</b>  |

**NOTE**

wSIMs and Repeaters can be cleaned with a damp cloth.

## 2. Components

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The Essential Insight.mesh wireless solution consists of the following components:

- wSIM
- Repeater
- Manager Gateway
- Transducers
- Power Module
- Cables and Connectors
- Optional Antenna

### 2.1 Wireless Sensor Interface Module (wSIM)



**P/N 185310-01**

A wSIM conditions and processes the signals received from the transducers. The wSIM has four transducer channels that can be individually configured to support vibration and temperature measurements.

Each wSIM operates both as an input module to capture the data and as a wireless router to route data packets. The wSIMs are powered by a replaceable power module that is attached to the wSIM.

RF Certifications: FCC: XFU-18531001, IC: 8349A-18531001

## NOTE

### FCC & IC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

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

The antenna used for this device must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

## 2.2 Repeater



P/N 185350-01

## Section 2 - Components

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A Repeater is a node added to the mesh network to improve data communication. The minimum transmitting range of a node is 50 m or 165 ft. Therefore, if the wSIMs are placed more than 50 m (165 ft) apart, a Repeater may be required between two nodes to ensure the integrity of the data communication paths. Repeaters can also be deployed to provide redundant paths, which are required in a mesh network to ensure network reliability.

Repeaters have the same specifications as a wSIM.

| <b>NOTE</b>   |
|---|
| <b>FCC &amp; IC Compliance</b><br>This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: <ul style="list-style-type: none"><li>• This device may not cause harmful interference.</li><li>• This device must accept any interference received, including interference that may cause undesired operation.</li></ul> |
| The antenna used for this device must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.  |

### 2.3 Manager Gateway

There are two models of the Manager Gateway: Rack-based and Remote Mount.

RF Certifications: FCC: XFU-18551001, IC: 8349A-18551001

Rack-based Manager Gateway: P/N 185510-01

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(Designed to fit into industry standard 19" (482.6 mm) wide equipment racks)

Remote Mount Manager Gateway: P/N 185511-01

Remote Mount Manager Gateway Base: P/N 179168-01 (Required to mount and interface to the 185511-01 Remote Mount Manager Gateway)

+24V Power Supply: P/N 02200794

Power Supply Wiring Harness: P/N 162003

(A two-wire, 7" (178mm) long wiring harness that can be used to connect the +24V supply to Manager Gateway)

USB to IrDA Converter: P/N 284888

Cat 5 10-Ft Crossover Cable: P/N 284988

The Manager Gateway operates as a network gateway that enables communication between the wireless mesh network, which uses Time Synchronized Mesh Protocol (TSMP) and the plant Ethernet network, which uses the TCP/IP protocol.

The Manager Gateway performs the following functions in the wireless network:

- Coordinates, manages, and optimizes the communication links between wSIMs and Repeaters in the wireless mesh network.
- Transmits their signals to the System 1 Data Acquisition computer over the Ethernet network.
- Acts as the Access Point to the wireless mesh network.
- Supports up to 100 nodes in a wireless mesh network.

## Section 2 - Components

When a Manager Gateway is mounted in a location that is shielded or that attenuates radio frequency communications, the optional antenna kit may need to be used. Use the antenna and cable in place of the standard antenna.

| <b>NOTE</b>   |  |
|---|--|
| <b>FCC &amp; IC Compliance</b><br>This device complies with Part 15 of the FCC Rules.<br>Operation is subject to the following two conditions: <ul style="list-style-type: none"><li>• This device may not cause harmful interference.</li><li>• This device must accept any interference, including interference that may cause undesired operation of the device.</li></ul> |  |
| <b>Any changes or modifications not expressly approved by Bently Nevada LLC could void the user's authority to operate the equipment.</b>   |  |
| The Manager Gateways is designed to operate with the antennas listed below that have a maximum gain of 2 dB. Antennas and cables not included in this list or having a gain greater than 2 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.  |  |
| <b>Antenna included P/N 283189:</b> ½ wave, 5", 2dBi antenna<br><b>Optional antenna kit P/N 185519-01:</b> 2.4Ghz, 12", 6dBi, antenna with 75-ft, 50 ohm cable (must be used together to meet maximum antenna gain. Do not modify the cable).   |  |
| To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.  |  |
| The antenna used for this device must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.  |  |

## 2.4 Power Modules

The wireless sensor network used with the Essential Insight.mesh system is optimized and finely tuned for applications that require low power and highly reliable periodic data collection.

The wSIMs and Repeaters are powered by integrated, replaceable battery power modules.

### 2.4.1 Battery Power Module

Wireless, Zone 0 Battery Power Module

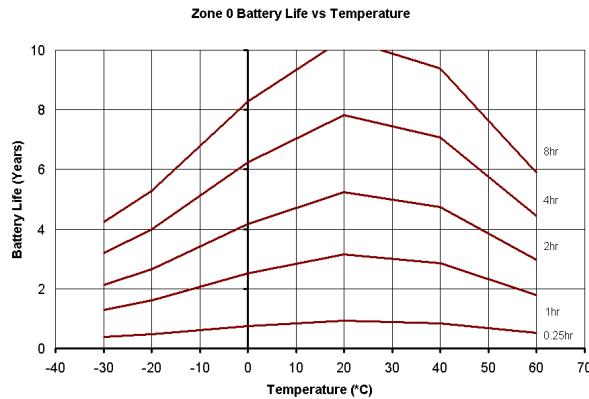


**P/N 185547-01**

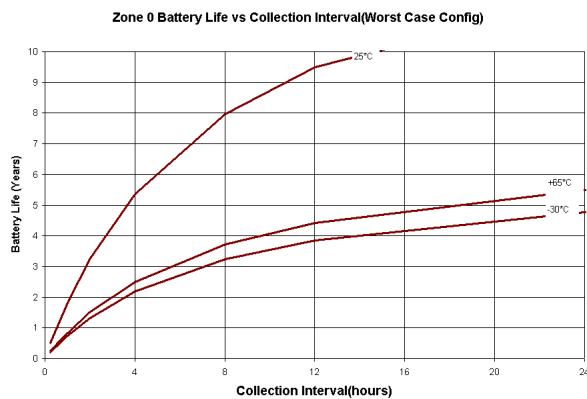
The battery power module consists of Lithium Thionyl Chloride C-Cells that have a typical life of 3-5 years depending on the type and frequency of the data collected. Extend the data collection interval to achieve a battery life of 5-10 years. Dynamic data collection, integration, high-pass filter corners below 10Hz, high resolution spectrums and use of the 200155 low freq accel consumes additional power and reduces battery life. See the graphs below for more information.

## Section 2 - Components

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Interval Curve (Battery Life vs. Temp)



Temperature Curves (Battery Life vs. Collection Interval)

## 2.5 Transducers

Accelerometers: P/N 200150, 200155, and 200157

Thermocouple: P/N 200125 K-Type and Standard J, T, and E type

A transducer is a device that measures a physical parameter (vibration or temperature) and provides an analog output signal that is proportional to the measured parameter. The transducers are installed

on the machine for which the parameter is to be measured and then connected to a wSIM.

The Essential Insight.mesh system supports the following measurements:

- Acceleration
- Velocity
- Temperature

### NOTE

Up to four transducers in any combination can be connected to one wSIM. Thus, a Manager Gateway supports a maximum of 400 channels.

## 2.6 Cables and Connectors

wSIM Accelerometer Cable: P/N 185555-02-2M

wSIM Accelerometer Cable: P/N 185555-04-4M

wSIM Accelerometer Cable: P/N 185555-06-6M

Trendmaster Cable - 15M: P/N 200152-15

Trendmaster Cable - 25M: P/N 200152-25

(Both extended length Trendmaster cables must be field terminated with the 162438-01 field connector kit)

## 2.7 Mounting Hardware

wSIM Magnet Mount Base: P/N 185560

wSIM Hex Mounting Base: P/N 185561-01

½-20, ¾" Flat Head Socket Cap Screw: P/N 283575

## Section 2 - Components

M12x1.75, 20mm Flat Head Socket Cap Screw: P/N 283611



Mounting Base and Cap Screw



Magnetic Mount



wSIM Hex Base with Screw

| Caution  |
|--|
| Pinch hazard – wSIM and Repeater magnet mounts have pull strength of up to 200 lbs.<br>Wear work gloves when handling. |



### 3. Planning Your Installation

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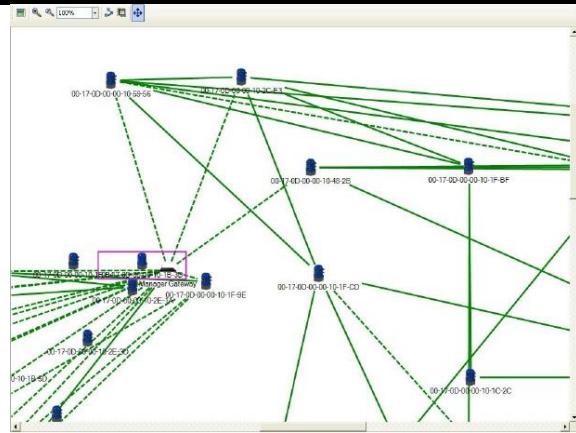
The Essential Insight.mesh network consists of wSIMs and Repeaters that form a multi-hopping, ad hoc mesh network. It is important to note that the 802.15.4 wireless standard that the Essential Insight.mesh wireless sensor network is based on is optimized and finely tuned for applications that require low power and highly reliable periodic data collection.

The Essential Insight.mesh system is optimized to conserve battery power such that the batteries in the power modules will typically last for up to four years when used with the default configuration. This level of performance is accomplished by selecting a realistic data collection interval, and the ongoing mesh network power optimization executed by the Manager Gateway.

In order to conserve power, the nodes in a mesh network spend most of their time in sleep mode. Nodes power up and are active to execute three functions:

- Sending a message to a neighbor.
- Listening for a node to communicate.
- Executing data collection.

The following diagram best describes the wireless network:



Wireless signals are carried by electromagnetic waves in the Radio Frequency (RF) bands. The frequency range used by the Essential Insight.mesh 802.15.4 wireless mesh network is 2.4 GHz-2.4835 GHz. The typical node to node communication range is 50-75 m (165-246 ft), occasionally achieving paths of 100 m (330 ft) and greater in outdoor, line of site applications.

Signals in an industrial environment do not usually follow a straight path on their way from the transmitter to the receiver and often propagate around numerous objects and obstacles. Understanding how wireless signals make their way passing through obstacles is important when considering how to position the wSIMs and Repeaters in a wireless mesh network.

When a wireless signal meets an obstacle in its path, a combination of events can occur. Some of the signal may pass through the object, some may be absorbed by the object, or some may be subjected to reflection, diffraction, or scattering.

**Absorption** - Certain insulating materials, such as concrete, water, or ceramics can absorb electromagnetic energy by converting it to heat. Locations surrounded by absorbing or shielding

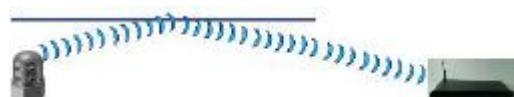
### Section 3 - Planning Your Installation

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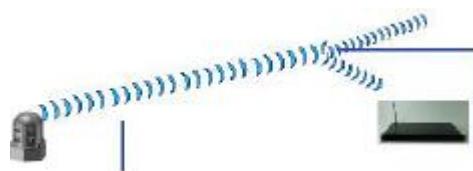
material may require the positioning of additional Repeaters at appropriate locations within the mesh network.



**Reflection** – When electromagnetic waves encounter objects that are much larger than the frequency of the wave, the waves can reflect or bounce back. Also, the signals can reflect more readily off conductive materials than insulators.



**Diffraction** – When electromagnetic waves encounter objects with sharp edges, like the corner of walls, the signal can split into secondary waves. If a signal is diffracted, the signal can then appear to bend around the object.



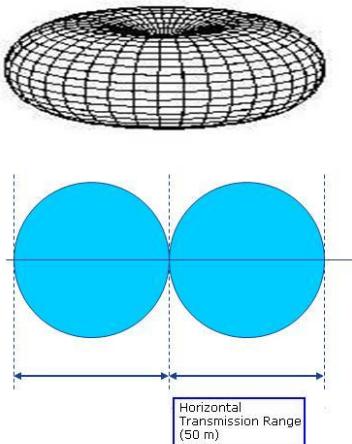
**Scattering** – When electromagnetic waves encounter objects that are much smaller than the frequency of the wave, the signal can diffuse or reflect in multiple directions. Scattering can occur when the signal encounters small surfaces. Rain, mist, hail, or snow can also cause scattering of signal.



Although it is not possible to list specific guidelines about how to minimize these effects, it is important to be aware of these effects whenever the wSIMs and Repeaters are positioned and mounted. It is also important to know that some of these effects, such as reflection and diffraction, can help the signal reach its destination due to multipath interference. Repeaters should be mounted in proper locations to provide redundant communication links and increase signal strength which will improve network path stability required for highly reliable communication.

An unobstructed, straight path causes the least amount of signal attenuation and results in the greatest path stability. Mounting locations that are high and are as removed from obstructions as possible result in greater path stability.

Antennas used in the components of the wireless system transmit Radio Frequency energy in a toroidal pattern horizontally from the antenna as shown in the blue region in the diagram below. Because of the shape of this transmission pattern, the typical transmission range of 50 m is oriented in a perpendicular direction from the axis of the antenna.



Here are a few points to remember during deployment:

- The typical transmitting range of a wSIM or a Repeater is 50–75 m.
- Every node should ideally see three other nodes to guarantee it has more than one path between it and another node. Multiple communication paths are required to increase network reliability and prevent a single path failure that would result in a loss of communication.

### 3.1 Designing the Layout

Before commissioning and installing the hardware components, you need to design a layout for deploying your wireless network. The radiation pattern of the antenna can be a factor when deciding on the location and mounting orientation of a wSIM or Repeater.

Follow the steps given below to design the layout of your wireless system.

1. Mark the locations of machines to be monitored on a paper copy of a plant map.
2. Identify the location of the Manager Gateway and the wSIMs on the Plant Map.
3. Use the map scale to draw 50 m circles around each machine.
4. Use the 50 m rule to verify that there are typically three other nodes within a 50–75 m radius. At least two adjacent nodes within a 50 m radius is the minimum requirement, but will result in decreased network reliability.
5. Add Repeaters as necessary to ensure that each node has two or more paths between itself and other nodes in the mesh network.

## 4. Commissioning Process

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Commissioning is a process used to form a wireless mesh network using the components of the Essential Insight.mesh wireless system. This is a pre-installation step that is usually performed indoors in an equipment room, or similar environment. This process requires both the hardware and software components.

Follow the commissioning steps shown below:

1. Attach power modules to the wSIMs and Repeaters
2. Setup the Manager Gateway
3. Commission the wSIMs and Repeaters
4. The Common Join Key
5. Verify the operation

### 4.1 Attach Power Modules to wSIMs and Repeaters

Attach the power modules to the wSIMs and Repeaters so that they charge up for approximately 45 minutes prior to turning them on. The battery power module is attached to a wSIM or Repeater using six #6 socket head cap screws (SHCS) that are integrated (captured) into the power module housing. When connecting the battery power module, ensure that the O-ring is in place on the top of the battery module and that the interface pins on the bottom of the wSIM or Repeater are lined up with the contacts on the battery module. Tighten the screws using a 7/64 in. hex wrench.



## 4.2 Setup the Manager Gateway

For this step, the Manager Gateway should be close to the commissioning computer. It can later be installed at another location.

Follow the steps given below to setup the Manager Gateway:

1. Remove the Manager Gateway (and power supply if required) from the box. Place the Manager Gateway on a flat surface near the commissioning computer.
2. Wire up the +24Vdc power supply to the Manager Gateway power connector.

Note: Ensure that the power supply is de-energized during this step.



3. Remove the Ethernet crossover cable from the case. Plug in one end into the Manager Gateway Ethernet port and the other end into an Ethernet port on the commissioning computer.
4. Set a static IP address on the commissioning computer that can communicate with the

## Section 4 - Commissioning Process

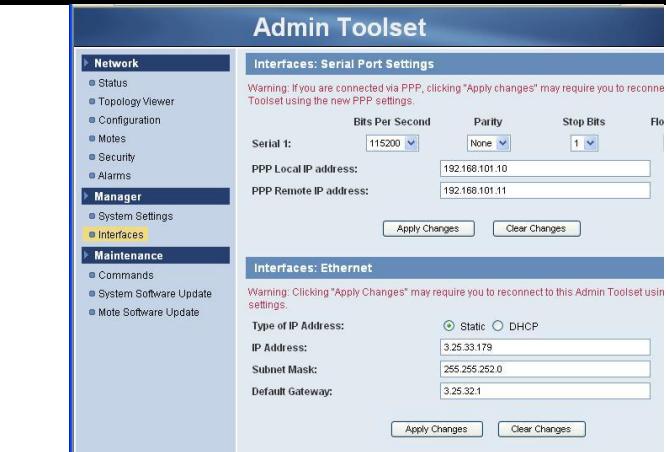
Manager Gateway's default IP address:  
192.168.99.100.

5. Energize the +24Vdc supply attached to the Manager Gateway.

### NOTE

Be sure the computer or network switch is powered on before the Manager Gateway. Failure to power up the Manager Gateway before it is attached to an energized network will result in failure of the Manager Gateway Ethernet communications. The correct power up sequence must be used.

6. Verify you can successfully ping (command executed at the Windows command prompt) the Manager Gateway to validate Ethernet communication.
7. Launch the Embedded webpage on the Manager Gateway (Admin Toolset) by typing the following in the Internet Explorer menu bar: <http://192.168.99.100>.
8. Click the **Yes** button if the Security Alert window appears. Sign in using the default user name: **system** and password: **system**.
9. Click **Interfaces**. Select either DHCP or Static IP address type. Assign a valid IP Address, Subnet Mask and Default Gateway for the network the Manager Gateway will reside on. Click **Apply Changes**.



## 4.3 The Join Key

A "Join Key" encrypts a request to join the network and thereby secures it. The Join Key for all the nodes on a Manager Gateway must be the same. Nodes whose Join Key does not match the Join Key configured in the Admin Toolset will not be allowed to join the Manager Gateway and therefore be prevented from joining the mesh network.

Manager Gateways shipped from the factory come with default settings for the Join Key. We recommend that you change the default setting.

The Join Key has 32 hexadecimal characters. This is an example of a valid Join Key:

445553544E4554574F524B53524F434B

## 4.4 Commission wSIMs and Repeaters

wSIMs and Repeaters must be commissioned to a Manager Gateway before being installed in the field.

Follow the steps given below to commission a wSIM or Repeater to a Manager Gateway:

## Section 4 - Commissioning Process

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1. Turn on the wSIM or Repeater by holding the magnet wand above the top LED and against the housing of the device for approximately 3 seconds.



2. You will observe the second LED from the top blink on, then off once. About 4 seconds later the LED will blink a second time. You will see the LEDs blink in a sweeping pattern from top to bottom and back indicating the micro processor is in its startup sequence. The complete power up sequence takes about 15 seconds.
3. Attach the USB to IrDA converter to the commissioning computer. Install the IrDA drivers from the CD included with the USB to IrDA converter if commissioning for the first time.

### NOTE

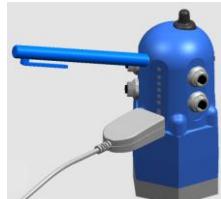
If the commissioning computer has an internal IrDA port, and you are using the USB IrDA connector, disable the internal IrDA port.

4. Click **Start, Programs, System 1, Tools, Essential Insight.mesh Utility.**  
(a) Click **Open Manager Gateway.**

- (b) Enter the Manager Gateway's IP Address.
- (c) Enter the default user name: **admin** and password: **admin**, and click **OK**.
- (d) Click on the **Uncommissioned Nodes** tab

5. Hold the IrDA reader such that it is pointing directly at the infrared transceiver window (below the bottom LED) on the wSIM or Repeater to be commissioned to the Manager Gateway. It must be held in place pointing at the window for the commissioning process to be successful.

6. Hold the magnet wand for 1 second above the top LED to activate the IrDA communications. You will see the LEDs blink in a sweeping pattern from top to bottom and back indicating the IrDA communications are on. The IrDA communications will remain active for 20 seconds. If the device is not commissioned during this time frame the node will need to be swiped with the magnet wand again to initiate the process.



7. Click on the **Commission Nodes** button. You will observe the IrDA icon in the tool tray change. The MAC address of the nodes will be displayed in the window. The "Successfully transmitted message" text will appear next to the node. The process takes

about 30 seconds, during which time the IrDA converter needs to be held steady. When complete the message next to the node will change to Commissioned.

8. When the last node is commissioned, close the Essential Insight.mesh Utility.

When the wSIM or Repeater is commissioned to a specific Manager Gateway, the nodes will appear in that Manager Gateway's table. The node's MAC address, name and other information is stored in the Manager Gateway's table.

## 4.5 Verify Operation

wSIMs and Repeaters that have been successfully commissioned into the network show up in the Essential Insight.mesh Utility software in the left hand pane with a status of *Operational*.

The Admin Toolset software also shows the status of commissioned wSIMs and Repeaters. On the **Network** menu, click **Motes** to view the status. After all of the wSIMs and Repeaters have been commissioned and are operational, the wireless mesh network begins to form.

### NOTE

The network formation increases as network reliability decreases. Some steps can be taken to reduce the time for the network to form. Keep the distance between nodes to 50M to 75M. Verify there are 3 other nodes within a 50M to 75M radius around the node. This will ensure there are multiple paths for communication to be established.

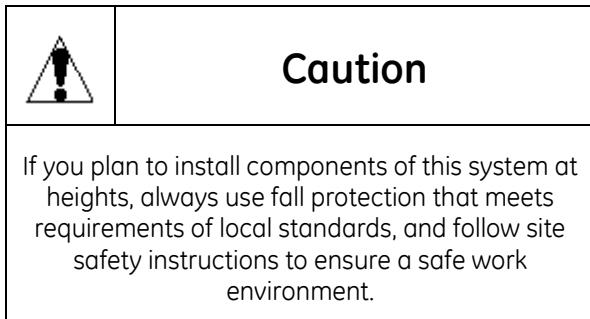


## 5. Installing Hardware

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The hardware components are installed in the following order:

1. Install the Manager Gateway
2. Install the wSIMs or Repeaters



### 5.1 Installing the Manager Gateway

Considerations for installing a Manager Gateway:

- Location
- Power availability
- Accessibility to plant network
- Proximity to nodes in the mesh network and antenna placement
- Accessibility to nearby nodes for redundant paths
- Redundant Manager Gateways

## 5.1.1 Mounting Considerations

There are two mounting options for a Manager Gateway: Rack Mount and Remote Mount.

**Rack Mount:** The rack mount Manager Gateway configuration allows you to install the Manager Gateway (P/N 185510-01) in an industry standard 19-inch instrument rack.

1. Attach the antenna included to the Manager Gateway after mounting in the rack.

If 110/220 VAC power is available, you can use the +24 Vdc industrial power supply to power the Manager Gateway.

If the rack mount Manager Gateway is mounted in a location where it cannot communicate with the nearest wSIMs or Repeaters then the optional antenna kit will be required (P/N 185519-01)

The 6dBi antenna and 23 m (75 Ft) cable included in this kit must be used together.

1. Attach the remote mount antenna to the cable included.
2. Attach the RF cable provided with the kit to the Manager Gateway.
3. Mount the antenna in the desired location using the bracket provided with the kit.

### NOTE

Any changes or modifications not expressly approved by Bently Nevada LLC could void the user's authority to operate the equipment

**NOTE**

The Manager Gateways is designed to operate with the antennas listed below that have a maximum gain of 2 dB. Antennas and cables not included in this list or having a gain greater than 2 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

**Antenna included P/N 283189:** ½ wave, 5", 2dBi antenna

**Optional antenna kit P/N 185519-01:** 2.4Ghz, 12", 6dBi, antenna with 75-ft, 50 ohm cable (must be used together to meet maximum antenna gain. Do not modify the cable).

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.



**Remote Mount:** The remote mount option provides fiberglass weather-proof housing and mounting hardware to install the Manager Gateway (P/N 185511-01). Install the base plate into the weather-proof (WP) housing, mount the Manager Gateway base module to the WP housing base plate, plug the Manager Gateway into the base module (P/N 179168-01) and secure using the captured screws affixed to the Manager Gateway.



### NOTE

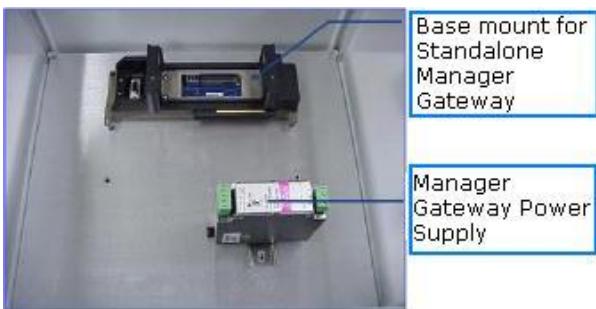
For the remote mount configuration, mount the +24 Vdc power supply to the included DIN rail, and connect it to the power connectors on the gateway base module. Ensure that the Manager Gateway is not energized.

Be sure to remove the guide pin cover in the remote Manager Gateway base prior to inserting the Manager Gateway.

The Manager Gateway has no hazardous area approvals at this time. It must be installed in a safe area, or in an appropriate housing that will meet the requirements of a local site certification.

## Section 5 - Installing Hardware

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## 5.2 Redundant Manager Gateway

A second Manager Gateway can be installed and configured to support automatic fail over. If the primary Manager Gateway fails the redundant Manager Gateway becomes the primary. The process does require the new primary Manager Gateway to reform the network before data collection will resume.

Contact Technical Support for up to date instructions to configure redundant Manager Gateways.

## 5.3 Installing a wSIM or Repeater

As both wSIMs and Repeaters operate as wireless routers, ensure that you consider the radio transmission issues during the mounting and installation of the wSIMs and Repeaters. Steps for mounting a wSIM or Repeater are:

- Choosing a mounting location.
- Mounting a wSIM or Repeater.
- Connecting transducers to the wSIM.

|  |                |
|--|----------------|
|   | <b>Caution</b> |
| If you use a Repeater with a magnet mount base we recommend the use of a fall prevention mechanism. Secure it to a suitable support to prevent the device from falling accidentally. We recommend you permanently mount the Repeater using a hex base that is installed using a drilled & tapped hole. |                |

## Section 5 - Installing Hardware

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wSIMs and Repeaters are designed for Zone 0 hazardous area approvals. Check with your Bently Nevada representative to find out which approvals are available for your region.

### 5.3.1 Choosing a Mounting Location

Mount the wSIMs in locations such that:

- The field wiring can be routed between the transducers and the wSIMs.
- The wSIM is installed such that there are 3 other nodes within a 50M to 75M radius around the node. This will ensure the wSIM will have multiple paths to communicate to resulting in highly reliable communications.

The mounting location for wSIMs requires a metal surface for the magnet mount option or an adequate substrate for drilling and taping a 12.7-mm (0.5-inch) hole to permanently mount the hex base mount. Only use the magnet mount on a ferrous metal surface.

The wSIM must be mounted such that the cable can be safely routed and secured to the point the transducer is mounted. The available cable lengths for the accelerometer and K-type thermocouple are 2 m, 4 m, and 6 m. There are also optional Trendmaster cables that can be used with the accelerometers. The 15 m (49ft) cable (P/N 200152-15), and 25m (82 ft) cable (P/N 200152-25) must be used with field termination connector (P/N 162438-01).



Cables for the 200125 K-Type thermocouple come with an integrated cable. Field connectors must be installed using the field termination connector (P/N 162438-01). These field termination connectors can also be used with industry standard K, J, T, and E-Type thermocouples.

## NOTE

The radiation pattern of the wSIM or Repeater antenna can be a factor when deciding on the location and mounting orientation of a wSIM or Repeater. Mount the wSIMs and Repeaters vertically for best results.

### 5.3.2 Mount a wSIM or Repeater

To mount a wSIM or Repeater:

1. Identify the mounting hardware.
2. Install the mounting base.
3. Mount the wSIM or Repeater to the mounting base and secure.

After a mounting location has been determined, mount the wSIM or Repeater using either the hex mounting base or the magnet mount.



Hex Mounting Base and  
Screw

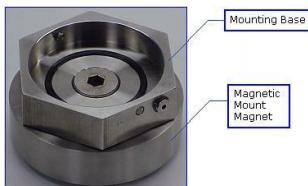


Magnet Mount  
Assembly

Notice that the screw provided allows the option to attach the hex mounting base to either a drilled & tapped substrate, or to the threaded hole in the magnet mount assembly.



Hex Mount Base with Screw



Hex Base Attached to Magnet Mount Assembly

**Screw Mount:** The screw mount option requires a substrate thick enough to drill and tap a 12.7-mm (0.5 inches) deep hole. Standard drilling and tapping tools are required. The mounting hole should be perpendicular to the surface. Drill and tap with the thread size of the mounting screw. Install the screw with a 5/16 in. hex wrench.

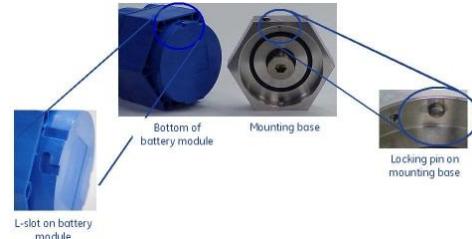
**Magnet Mount:** The Magnet mounting system uses a strong magnet to provide a fast and reliable method

of attaching wSIMs or Repeaters to ferrous metal surfaces. The mounting surface should be flat and larger in diameter than the magnet mount assembly.

|   |                |
|---|----------------|
|    | <b>Caution</b> |
| Pinch hazard – wSIM and Repeater magnet mounts have pull strength of up to 200 lbs. |                |

### 5.3.3 Mount a node to a Hex Mounting Base

A wSIM or Repeater is installed and secured to the Hex mounting base as shown below:



Follow the steps given below to install a wSIM or a Repeater on the mounting base:

1. Slide the base of the battery power module so that the two slots on the battery module line up with the locking pins on the hex mounting base. 
2. Twist the battery module clockwise until the locking pin slides to the end of the slot on the battery module and the corners of the hexagon surfaces are aligned. 

3. Tighten the locking screw on the mounting base using a 7/64 in. hex wrench.



### NOTE

A locking screw is used to prevent the battery module from accidentally vibrating and becoming loose from the mounting base.

### 5.3.4 Connecting Transducers to wSIMs

Transducers are connected to wSIMs using cables.

These are some guidelines for routing and protecting the cables from damage.

- Secure the cable at the transducer end and the wSIM end to protect the cable and the connectors.



- Route the cables so that they are not damaged or cause safety issues.
- Secure the cables at regular intervals.
- Avoid exceeding the bending radius of the cable.



## 6. Configuring Essential Insight.mesh in System 1®

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The Manager Gateway, the wSIMs and Repeaters commissioned to it, are grouped under the Essential Insight.mesh object using System 1 Configuration software. A mesh network consists of the Manager Gateway and the wSIMs and Repeaters commissioned to it. Components can be added to a configuration after they have been commissioned. Components are commissioned using the Essential Insight.mesh Utility software.

### 6.1 Configure the Network

Follow the steps listed below to configure an Essential Insight.mesh network using the System 1 Configuration software:

1. Select **Start, Programs, System 1, System 1 Configuration**.
2. Connect to an Enterprise.
3. To add an Essential Insight.mesh device, in the Instrument Hierarchy, right-click the **DAQ** object, point to **Add Instruments**, and click **Essential Insight.mesh** from the list of available options. Note: Only one Essential Insight.mesh object is allowed per DAQ.
4. To add a Manager Gateway right click on the **Essential Insight.mesh** object and click **Properties**. The **Essential Insight.mesh Configuration** dialog box will be displayed. in the **Essential Insight.mesh Configuration** dialog box, click the  button.

5. Type in the unique IP address assigned to the Manager Gateway in the **Manager Gateway IP Address** field. You will need to enter the appropriate information in the **Manager Gateway Port**, **Manager Gateway User Name**, and **Manager Gateway Password** boxes if this was changed through the Admin Toolset.
6. To add a wSIM or Repeater, in the **Essential Insight.mesh Configuration** dialog box, select the **Manager Gateway**, and then click the  detect nodes button.
7. Click **OK**. The Essential Insight.mesh device is added to the Instrument Hierarchy.
8. Save the Enterprise.

## 6.2 Data collection considerations

A wSIM collects one type of data (static or dynamic) for one channel at one time. So, for all four channels, it takes 8 different “collections” at different times. In between each collection, the node has to “re-charge”. This recharge time varies depending on wSIM temperature and channel configuration parameters.

So, in order to not conflict with other schedule times, dynamic data needs to be scheduled in between the static data collection times. Static data collection is offset from midnight. So a 2 hour collection rate will attempt to collect data on the even hours (0000, 0200, 0400, 0600, ... 2200) in the day.

We recommend that dynamic data be on the odd hours of the day, if you have a 2-hour static collection interval.

Assume a re-charge time of approximately 15 minutes between measurements. For collecting static data every 2 hours the data collection cycle is

## Section 6 - Configuring Essential Insight.mesh

Collect Channel 1 static...

Re-charge

Collect Channel 2 static...

Re-charge

Collect Channel 3 static...

Re-charge

Collect Channel 4 static...

Re-charge

With the assumption that the re-charge time is approximately 15 minutes, you can see that with a scheduled collection time of 2 hours, the time difference from the first to the last channel could be 45 minutes.

Further, transducer type, integration, low frequency high pass filter corners, and high resolution waveforms will result in longer collection periods that consume more power and result in the battery taking longer to recharge. If more power is consumed it takes more time to recharge before the next measurement can be made.

15 min static sample interval should be used as a temporary, bad actor analysis tool. Only one channel should be set to static data every 15 min to reduce delayed data collection on other channels.

High-resolution waveforms should only be used as a temporary, analysis tool during trouble shooting. For example, when a specific bearing defect is trying to be identified.

The recommended configuration is:

Channel 1 Static - 2 hours

Channel 2 Static - 2 hours

Channel 3 Static - 2 hours

Channel 4 Static - 2 hours

Channel 1 Dynamic - 1 per day scheduled  
on the odd hour (example 11 AM)

Channel 2 Dynamic - 1 per day scheduled  
on the odd hour different from other channels  
(example 1 PM)

Channel 3 Dynamic - 1 per day scheduled  
on the odd hour different from other channels  
(example 3 PM)

Channel 4 Dynamic - 1 per day scheduled  
on the odd hour different from other channels  
(example 5 PM)

### 6.3 Configure the Plant Map

Follow the steps listed below to configure the plant map.

1. Select **Start, Programs, System 1, System 1 Configuration**
2. Connect to an Enterprise.
3. Select a Manager Gateway.
4. Right click on the **Essential Insight.mesh** object and click **Properties**. The **Essential Insight.mesh Configuration** dialog box will be displayed.
5. Click the **Plant Map** tab and change the context of the dialog box to the plant map image.
6. Click on the **Load Background Image** button to import a plant layout plot. This is an optional step if the plant plot image is desired.

## Section 6 - Configuring Essential Insight.mesh

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7. Drag the Manager Gateway, wSIM, and Repeater icons to approximate locations on the plant map plot.
8. Click the **OK** button and save your enterprise.

The next time you open System 1 Display, go to the **Essential Insight.mesh Configuration** dialog and click **Plant Map**, you will see the plant map you configured. It will display lines showing the communication paths and relative signal strength between the different nodes. A solid line indicates a strong link. A dashed line indicates a path, which while still valid, is not at full signal strength.

Use the plant map to quickly discern if your network is healthy. Ideally, you want to see multiple paths from all nodes and validate the path stability of the paths are 50% or greater. While path stabilities less than 50% may still function the reliability may be decreased and a Repeater may need to be added to improve the reliability.



## 7. Verifying Setup

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You can verify that the configuration of the Essential Insight.mesh network is successful and that you are able to collect data.

Follow the steps given below to verify that you are able to collect static data:

1. Start the System 1 DAQ.
2. Click **Start, Programs, System 1, and System 1 Display**.
3. Connect to an Enterprise.
4. Navigate to the Manager Gateway node in the Instrument Hierarchy.
5. Expand the Manager Gateway hierarchy to view the operational wSIMs and Repeaters.
6. Right-click the **Manager Gateway** node, and click **Bargraph**.

Follow the steps given below to verify that you are able to collect dynamic data:

1. Start the System 1 DAQ.
2. Click **Start, Programs, System 1, and System 1 Display**.
3. Connect to an Enterprise.
4. Navigate to the Manager Gateway node in the Instrument Hierarchy.
5. Expand the Manager Gateway hierarchy to view the operational wSIMs and Repeaters and one of the configured vibration channels.

6. Click the expand icon next to the **Acceleration** channel.
7. Right click the desired Asynchronous Waveform, and click **Timebase** or **Spectrum Plot** to see the dynamic data.

### NOTE

By default, the static data is collected every two hours and dynamic data is collected once per day. You will need to wait until the configured time has passed and the data has had time to be sent to System 1. It can take several hours for a waveform packet to be sent over the mesh network.

## 8. Troubleshooting

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### 8.1 Replacing a Battery Power Module

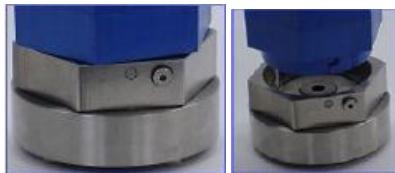
Battery power modules are attached to the bottom of the wSIMs or Repeaters using six socket head cap screws (shcs). The battery module is a potted unit; therefore, the whole module must be replaced when the batteries are exhausted.

The battery module can be replaced while the unit is running. There is no reason to disconnect transducer cables or turn the unit off. These are the steps to replace a battery power module.

1. Loosen the locking screw on the mounting base.



2. Unlock the battery power module by turning it counterclockwise, and then lifting it out of the hex mounting base.



3. Remove the battery power module by removing the six screws.



4. Remove the battery power module from the wSIM or Repeater. Note the screws are integrated into the battery power module housing.



5. Install a fresh battery power module. When installing fresh battery power modules, ensure that:
  - a. The O-ring is in place on the top of the battery module.
  - b. The interface pins on the bottom of the wSIM or Repeater are lined up with the contacts on the battery module.
6. If the wSIM or Repeater was off as the result of a totally depleted power module you will need to turn on using the magnet wand.

## 8.2 Replacing a Faulty Transducer

Transducers that are connected to wSIM channels can be replaced or changed while the wSIM is online.

If the replacement transducer is of same type as the old transducer, simply disconnect the old transducer from the wSIM connector, and connect the new one. The existing channel configuration is used to take a

measurement from the channel the new transducer is connected to.

If the replacement transducer is a different type than the old transducer, connect the new transducer, and reconfigure the wSIM channel for the new transducer using the System 1 Configuration software.

If the wSIM attempts to collect data while the transducer is disconnected or before the new configuration has arrived at the wSIM, a transducer error event will be added to the System Event List for that channel.

### NOTE

The new configuration takes some time to traverse the mesh network on its way between the Manager Gateway and the wSIM.

## 8.3 Replacing a Faulty wSIM or Repeater

To replace a faulty sensor unit, follow the steps given below:

1. Turn off the faulty wSIM or Repeater.
  - a. Turn the faulty device off and verify its' status changes to **Lost**. This will typically take 10 minutes or longer to propagate to the Manager Gateway.
2. Delete the wSIM or Repeater from the Manager Gateway's network table.
  - a. Launch putty or a similar utility. Login the Manager Gateway using the default username: **dustcli** and password: **dustcli**.

b. Once logged in, use the **sm** (show motes) command to display a list of nodes. Identify the **mote ID** of the node you wish to delete from the Manager Gateway table.

c. Use the **delete mote XX** command to delete the node from the Manager Gateway's network table. (XX is the mote ID from the show motes list).

d. Close the putty utility.

3. Delete the wSIM or Repeater from the System 1 configuration.

a. In the **Essential Insight.mesh Configuration** dialog box click the

 **detect motes** button. The wSIM or Repeater that was removed from the Manager Gateway network table will be displayed with a red mark through it.

b. Select the wSIM or the Repeater with the red mark, and click the

 **Delete** button.

c. Click **OK** and save the Enterprise.

4. Commission a new wSIM or Repeater.

5. Install the new wSIM or Repeater and configure using the System 1 Configuration software. See the commission wSIMs and Repeaters section of the manual for directions.

## 8.4 Changing the Manager Gateway Password

To change the password of a Manager Gateway, open the Essential Insight.mesh Utility software.

1. Click **Start, Programs, System 1, Tools**, and **Essential Insight.mesh Utility**.
2. Click **Open Manager**.
3. In the **Manager Properties** dialog box, type the **Port**, **IP Address**, **User Name**, and **Password** information.
4. On the **Tools** menu, click **Change Password**.

## 8.5 Reset a Manager Gateway to Factory Defaults

A Manager Gateway may need to be forced to the original factory default. This may be required if the device is decommissioned, but was not reset to the default state using the Admin Toolset web server during decommissioning. If communication cannot be established with a Manager Gateway that was previously used try the “hard” factory reset procedure.

Hardware reset to the factory defaults.

1. Power up the Manager Gateway.
2. Insert probes into the “A” and “B” holes on the Manager Gateway housing.
3. Press and hold the probes in the “A” and “B” holes. You will see the Reset LED on the Manager Gateway turn on and remain lit. Hold the probes to keep the LED on for 4 seconds.

4. Release the probe in "A" and keep holding the "B" probe. The Ethernet Subscription LED will blink 3 times.
5. Release the probe in the "B" hole.
6. Wait 90 seconds.
7. De-energize the Manager Gateway. The Manager Gateway is now in the factory default state and the IP address has been reset to 192.168.99.100. It can now be commissioned like a new Manager Gateway.