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# Drop-in Networking Professional Development Kit **GETTING STARTED GUIDE**

ZB Series



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## OBJECTIVES

Upon completing this kit, you will be able to:

- Set up a Drop-in Network
- Perform a range test of the XBee® radios in the kit
- Discover wireless devices in an XBee network
- Run applications written in Python® on a ConnectPort™ X gateway and PC
- Send and receive data from wireless devices over an Ethernet/IP network
- Use resources to develop embedded applications
- Use resources to manage Drop-in Networks



As an integral part of the Drop-in Networking strategy, the Python custom development environment is incorporated by Digi into each ConnectPort X gateway. Unlike many development proprietary embedded development platforms, Digi's integration of the universal Python scripting language provides customers a truly open standard for complete control over the connections to devices, manipulation of data, and event-based actions. For more information about Digi's Python custom development platform, visit our Python portal today at:

<http://www.digi.com/technology/drop-in-networking/pdr.jsp>

## QUESTIONS?

For technical assistance with your Drop-in Network, call:

**1-800-903-8430 (US Only)**

**Digi contact numbers outside US:**

Country	Toll Free Number
Argentina	00-800-3444-3666
Australia	0011-800-3444-3666
Brazil	0021-800-3444-3666
China North	00-800-3444-3666
China South	00-800-3444-3666
France	00-800-3444-3666
Germany	00-800-3444-3666
Hong Kong	001-800-3444-3666
India	000-800-100-3383
Israel	00-800-3444-3666
Italy	00-800-3444-3666
Japan	For calls from KDD fixed land-line phones: 010-800-3444-3666 From KDD public and mobile phones: 001-010-800-3444-3666 For non-KDD phones: 122-001-010-800-3444-3666
Korea	002-800-3444-3666
Mexico	001-800-903-8430
Netherlands	00-800-3444-3666
New Zealand	00-800-3444-3666
South Thailand	001-800-3444-3666
Spain	00-800-3444-3666
United Kingdom	00-800-3444-3666

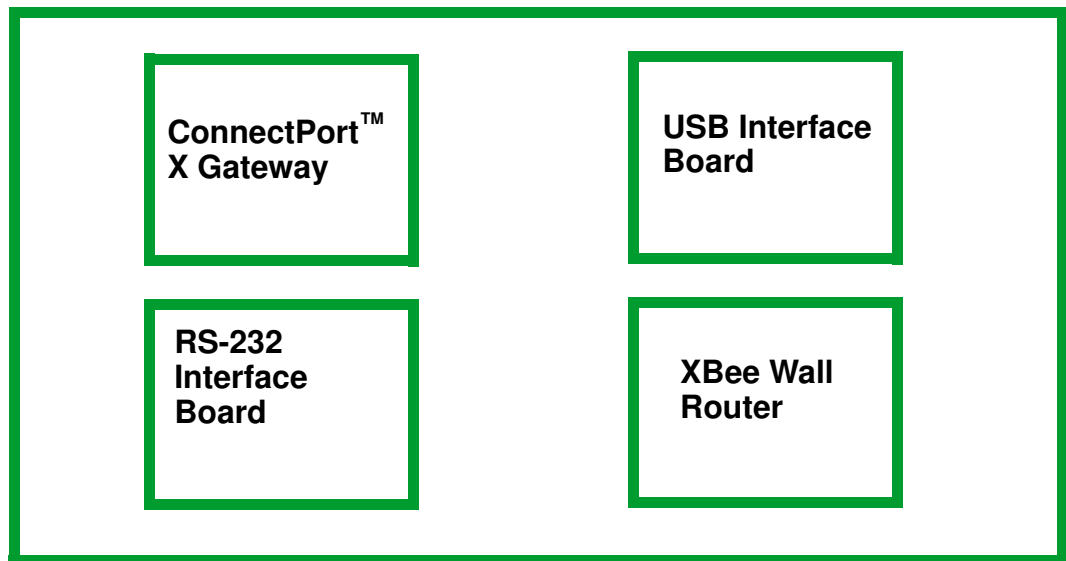
# Contents

<b>OBJECTIVES</b> .....	<b>3</b>
<b>QUESTIONS?</b> .....	<b>4</b>
<b>Connect the gateway and USB interface board</b> .....	<b>7</b>
Connect and power on gateway .....	8
Connect and power on USB interface board .....	12
LEDs and buttons for interface boards .....	14
<b>Perform a range test</b> .....	<b>17</b>
What is a range test?.....	17
Equipment used in range test.....	17
Install and start X-CTU software.....	17
X-CTU user interface.....	18
Discover nodes.....	19
Run range test.....	21
What does this test show you?.....	22
<b>Use gateway to discover nodes</b> .....	<b>23</b>
Connect the gateway to Ethernet and discover it.....	23
Connect and power on RS-232 interface board .....	25
Plug in the XBee Wall Router .....	27
View nodes .....	30
<b>Run gateway and PC demo applications</b> .....	<b>35</b>
Install Drop-in Networking software/documentation on PC .....	35
Upload the gateway demo application to gateway .....	37
Run the gateway demo application .....	38
Run the PC companion application .....	40
<b>Manage Drop-in Networks</b> .....	<b>45</b>
Congratulations! .....	45
Use Connectware Manager.....	45
Contact Digi.....	46



## Connect the gateway and USB interface board

The Drop-in Networking Professional Development Kit contains several boxes:



To run the kit, you will also need:



**A PC, configured to obtain an IP address automatically**

**Hardware & Software Setup CD**



Digi ConnectPort X gateways are available in multiple configurations: XBee-to-Ethernet, XBee-to-WiFi, and XBee-to-Cellular. The latter two configurations enable end-to-end wireless device connectivity.



Connect the gateway and USB interface board

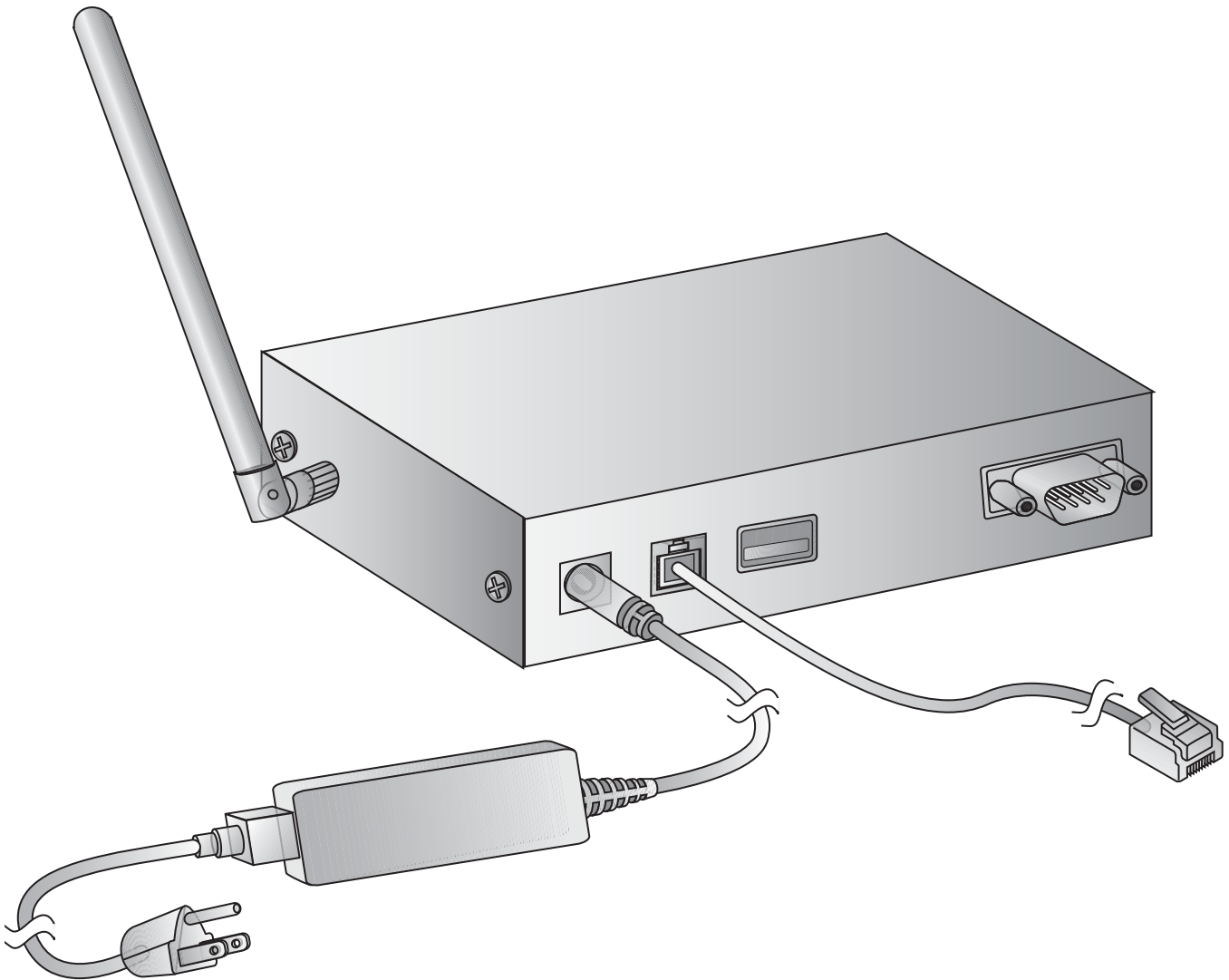
## Connect and power on gateway

1. Open and unpack the box labeled **ConnectPort X4 Gateway**.
2. Connect the power supply to the gateway and turn the connector clockwise to tighten. Connect the power supply to an outlet.

**Note (International version only):** Connect the power supply to a power cord (not included), and the power cord to an outlet.

3. Connect the antenna to the barrel connector on the gateway. Turn the connector clockwise to tighten.

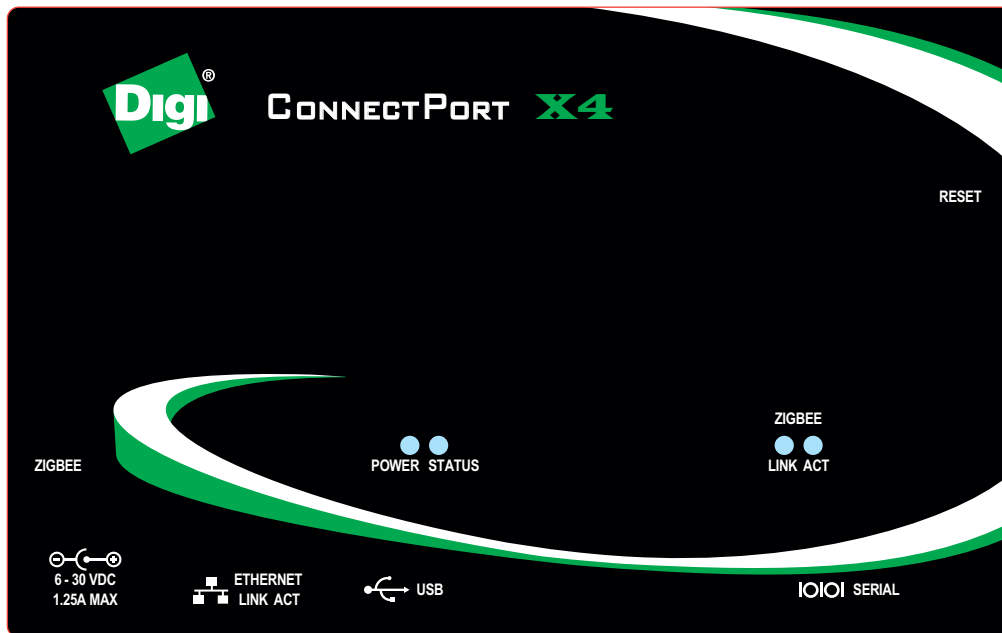
**Note:** Do **not** connect the cross-over Ethernet cable at this time.



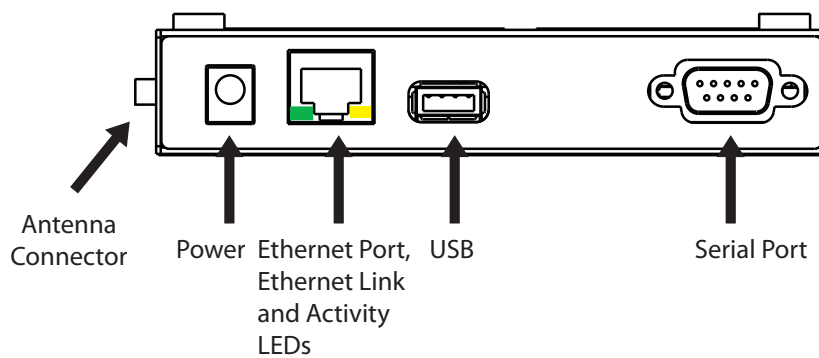
## LEDs and buttons

The gateway has several LEDs that indicate activity, and a Reset button.

## Top panel



## Back panel

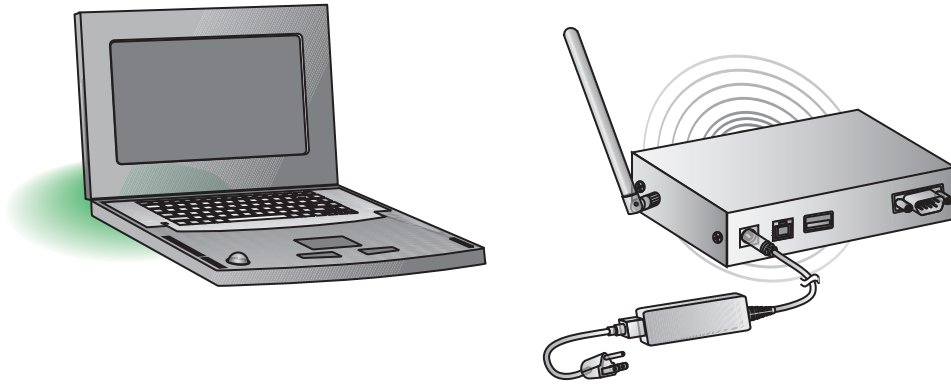


Connect the gateway and USB interface board

LED/button	Color and Light Pattern	Description
Power LED	Blue	Power is applied.
	Not illuminated	No power.
Status LED	Yellow	Blinks during product initialization and factory reset, using the light patterns below. During normal device operation after initialization and factory reset, this LED is off and should never blink. If it blinks constantly, contact Digi Technical Support.
	1-1-1 blinking yellow	Firmware is initializing.
	1-5-1 blinking yellow	Device configuration has been restored to its factory defaults.
	Other blinking yellow	Contact Digi Technical Support.
ZigBee/XBee Link LED	Green	Indicates that the XBee RF module in the gateway has associated with an XBee network: For more information on this indicator, see the description of the D5 (DIO5 Configuration) parameter in the product manual for the XBee module.
	Solid green	XBee module in gateway is associated (or coordinator is started).
	Fast blinking (20 Hz) green	An Ident (identify) button has been pressed on a remote node.
	Slow (1 Hz) blinking green	XBee module in gateway is not associated.
	Off	XBee module in gateway is disabled or not recognized.
ZigBee/XBee Activity LED	Yellow	On for 25 ms when data is sent or received from the XBee module in the gateway.
Ethernet Link LED	Solid yellow	Ethernet link is up.
Ethernet Activity LED	Blinking green	Ethernet traffic is on the link.
Reset button	N/A	<b>Single press:</b> Performs equivalent of a power-cycle. <b>Press and hold:</b> Resets device configuration settings to factory defaults (factory reset).

Connect the gateway and USB interface board

Now, your network looks like this:

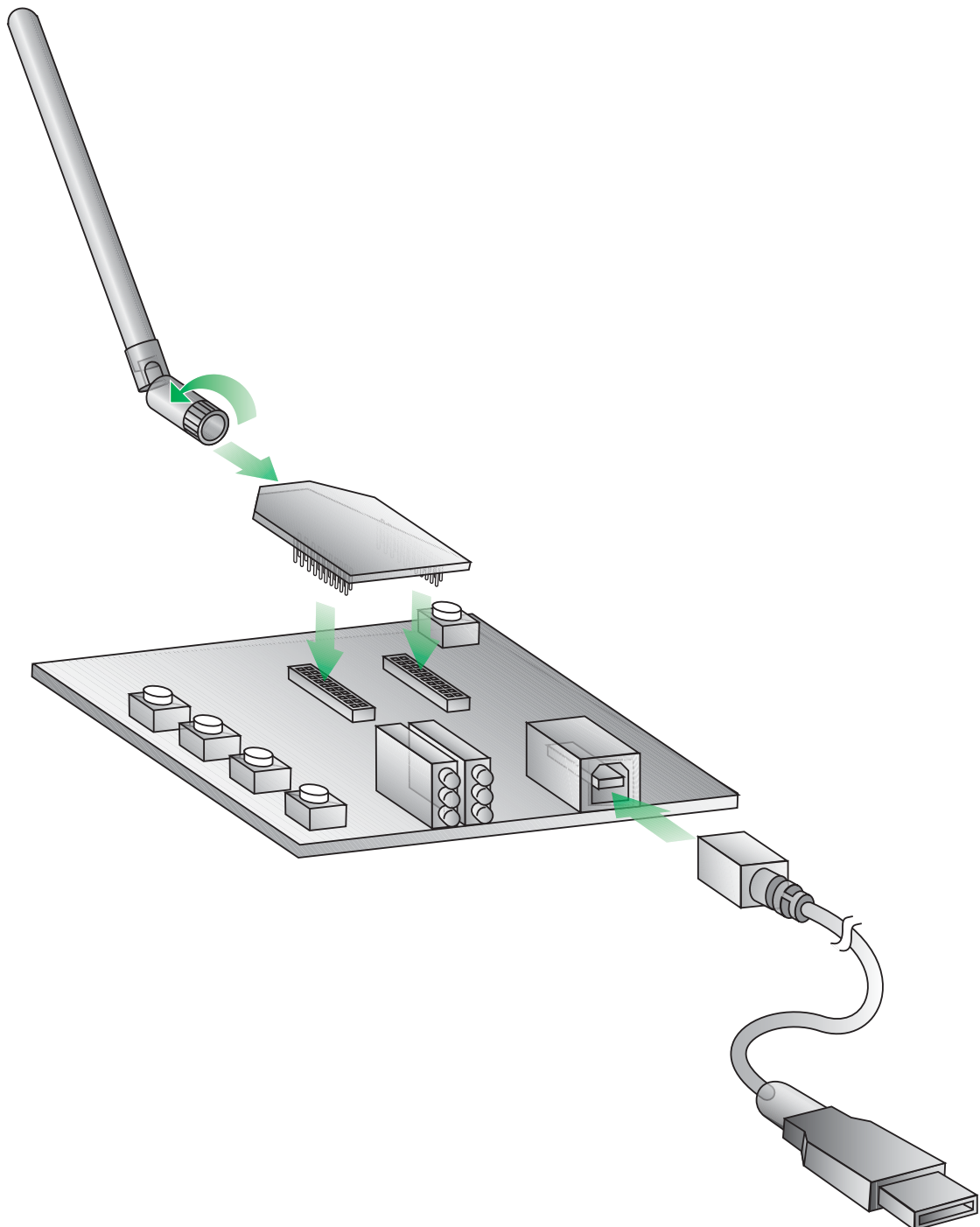


Gateway connected to power only

Connect the gateway and USB interface board

## Connect and power on USB interface board

1. Open and unpack the box labeled **XBee USB Interface Board**.
2. Connect the XBee-PRO module to the connectors on the interface board. Orient the board and connector pins as shown in the diagram.
3. Connect the antenna to the RPSMA antenna connector on the XBee-PRO module. Turn the connector clockwise to tighten.
4. Connect the USB cable to the USB port on the interface board and PC.



## Install USB driver

The USB interface board is a "plug-and-play" device that should be detected by the PC automatically. After the USB interface board is detected, a wizard for installing USB drivers is launched. To interface between the modem and a PC, two drivers must be installed: a USB driver, and a virtual COM port driver that makes the USB port look and perform like a physical COM port. The USB drivers are included on the Hardware & Software Setup CD.

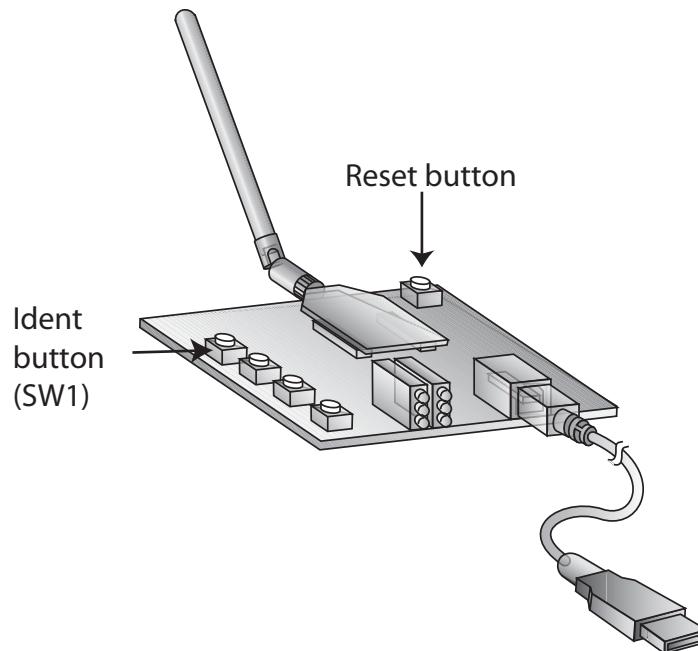
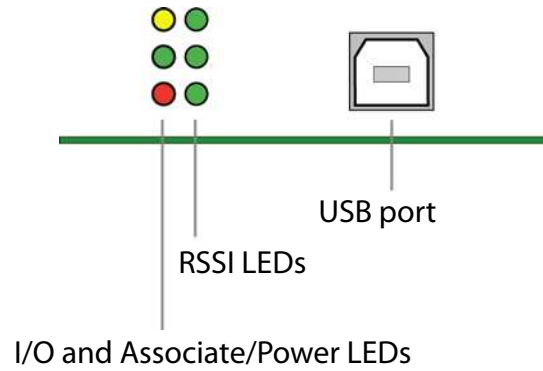
1. Verify that the Hardware & Software Setup CD is inserted into the drive.
2. Connect the XBee module to a PC using a USB cable. The **Found New Hardware Wizard** dialog box is displayed.
3. Select **Install from a specific list or location (Advanced)**; then click **Next**.
4. Select **Search for the best driver in these locations** and **Search removable media (CD-ROM...)**. Then click **Next**.  
A **Hardware Installation Windows Logo Testing** alert box is displayed.
5. Click **Continue Anyway**.
6. Click **Finish**.
7. You are prompted to install another driver, the virtual COM port driver. Repeat steps 3 through 6 to install this driver.

Connect the gateway and USB interface board

## LEDs and buttons for interface boards

The XBee interface boards in the kit have several LEDs that indicate network activity and signal strength, plus several buttons.

### USB interface board



## LED and button descriptions/behaviors

LED/button	Description																
<b>I/O and Associate/Power LEDs</b>	Indicate RF module activity: <ul style="list-style-type: none"> <li>• <b>Yellow (top LED):</b> Serial Data Out (to host)</li> <li>• <b>Green (middle):</b> Serial Data In (from host)</li> <li>• <b>Red (bottom):</b> Associate/Power Indicator. Indicates both power to the interface board and the network association status for the XBee module in the interface board.               <p><b>Solid red:</b> XBee module powered and not associated to a network.</p> <p><b>Blinking red:</b> XBee module has associated to a network.</p>               For more information on this indicator, see the description of the D5 (DIO5 Configuration) parameter in the product manual for the XBee module.</li> </ul>																
<b>RSSI (signal strength) LEDs</b>	Indicate the amount of fade margin present in an active wireless link. The fade margin is the difference between the incoming signal strength and the module's receiver sensitivity. <ul style="list-style-type: none"> <li>• <b>3 LEDs on:</b> Very Strong Signal (&gt; 30 dB fade margin)</li> <li>• <b>2 LEDs on:</b> Strong Signal (&gt; 20 dB fade margin)</li> <li>• <b>1 LED on:</b> Moderate Signal (&gt; 10 dB fade margin)</li> <li>• <b>0 LED on:</b> Weak Signal (&lt; 10 dB fade margin)</li> </ul>																
<b>Reset button</b>	Performs equivalent of a power-cycle.																
<b>Ident button (SW1 on the interface board)</b>	Performs actions for commissioning the XBee module in a network. Consecutive button presses must occur within 800ms second of each other to perform desired actions. <table border="1"> <thead> <tr> <th>Button press</th> <th>Network association</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Single</td> <td>Associated</td> <td> <ul style="list-style-type: none"> <li>• If unit is asleep, wakes unit for 30 seconds.</li> <li>• Sends a Node Identification broadcast transmission. All devices receiving this transmission blink their Associate LED rapidly for 1 second. All API devices that receive this transmission send a Node Identification frame out their UART (universal asynchronous receiver/transmitter) (API ID 0x95).</li> </ul> </td> </tr> <tr> <td>Unassociated</td> <td> <ul style="list-style-type: none"> <li>• If unit is asleep, wakes unit for 30 seconds.</li> <li>• Blinks a numeric error code on the Assc LED, indicating the cause of join failure.               <p><b>1 blink:</b> Scan found no PANs.</p> <p><b>2 blinks:</b> Scan found no valid PANs based on current SC (Scan Channel) and ID (PAN ID) settings.</p> <p><b>3 blinks:</b> Valid Coordinator or Routers found, but they are not allowing joining (NJ expired).</p> <p><b>7 blinks:</b> Node Joining attempt failed.</p> <p><b>10 blinks:</b> Coordinator Start attempt failed.</p> </li> </ul> </td> </tr> <tr> <td>Two</td> <td>Associated</td> <td>           Temporarily enables joining on the unit and the entire network for 1 minute (if the XBee module's NJ command setting is less than 255). If joining is permanently enabled on a module (NJ = 255), joining remains permanently enabled, and this button press has no effect.         </td> </tr> <tr> <td>Four</td> <td>Associated/Unassociated</td> <td>           Unit leaves PAN, if associated, and issues a factory reset to restore default parameters. Default PAN ID is <b>0</b>.         </td> </tr> </tbody> </table>			Button press	Network association	Action	Single	Associated	<ul style="list-style-type: none"> <li>• If unit is asleep, wakes unit for 30 seconds.</li> <li>• Sends a Node Identification broadcast transmission. All devices receiving this transmission blink their Associate LED rapidly for 1 second. All API devices that receive this transmission send a Node Identification frame out their UART (universal asynchronous receiver/transmitter) (API ID 0x95).</li> </ul>	Unassociated	<ul style="list-style-type: none"> <li>• If unit is asleep, wakes unit for 30 seconds.</li> <li>• Blinks a numeric error code on the Assc LED, indicating the cause of join failure.               <p><b>1 blink:</b> Scan found no PANs.</p> <p><b>2 blinks:</b> Scan found no valid PANs based on current SC (Scan Channel) and ID (PAN ID) settings.</p> <p><b>3 blinks:</b> Valid Coordinator or Routers found, but they are not allowing joining (NJ expired).</p> <p><b>7 blinks:</b> Node Joining attempt failed.</p> <p><b>10 blinks:</b> Coordinator Start attempt failed.</p> </li> </ul>	Two	Associated	Temporarily enables joining on the unit and the entire network for 1 minute (if the XBee module's NJ command setting is less than 255). If joining is permanently enabled on a module (NJ = 255), joining remains permanently enabled, and this button press has no effect.	Four	Associated/Unassociated	Unit leaves PAN, if associated, and issues a factory reset to restore default parameters. Default PAN ID is <b>0</b> .
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Four	Associated/Unassociated	Unit leaves PAN, if associated, and issues a factory reset to restore default parameters. Default PAN ID is <b>0</b> .															



Connect the gateway and USB interface board

## Perform a range test

### What is a range test?

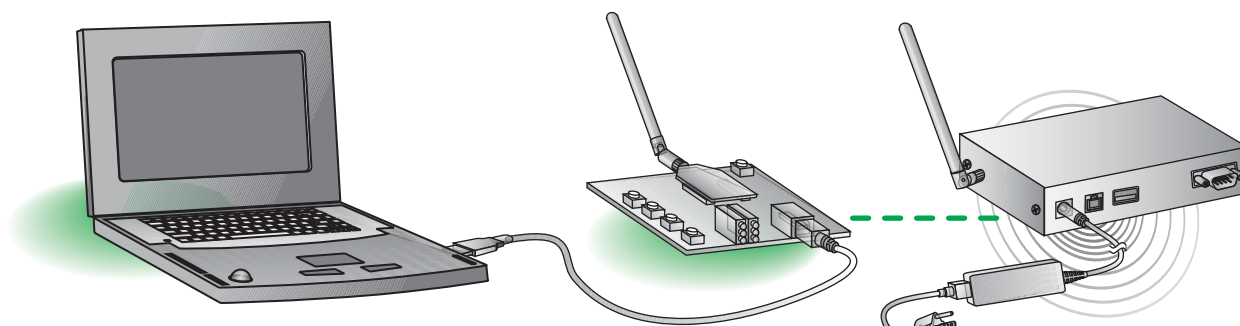
A range test demonstrates the real-world RF range of the XBee embedded modules in the Drop-in Networking Professional Development Kit.

This range information is useful when planning for and deploying an actual network.

### Equipment used in range test

The range test uses this equipment:

- PC
- USB interface board, connected to the PC via the USB cable
- ConnectPort X gateway



### Install and start X-CTU software

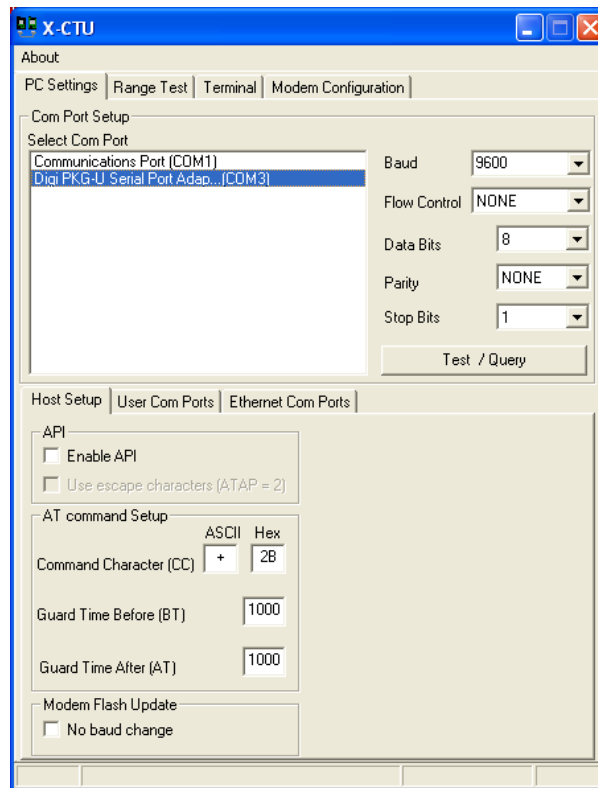
X-CTU is a software tool for configuring XBee modules that is included on the Hardware & Software Setup CD. X-CTU is used to run the range test.

To install X-CTU:

1. Insert the **Hardware & Software Setup CD** in the PC's CD-ROM/DVD drive. The CD should auto-launch when placed in the CD-ROM drive. If not, browse to the CD using Explorer and double click **start.exe**.
2. On the Home page, click **Modules, Sensors & Adapters Documentation/Software**.
3. Click **XBee Modules > XBee XB Module**.
4. Click **Install X-CTU (EXE)**.
5. When prompted to check the Web for updates, ensure your PC is connected to the Internet and click **Yes**.
6. When installation completes, to start X-CTU, select **Start > Programs > Digi > X-CTU**.

Perform a range test

The X-CTU software interface is displayed.



## X-CTU user interface

The X-CTU interface has several tabs:

- **PC Settings:** Sets up PC serial COM ports to interface with the XBee module.
- **Range Test:** Tests the range of wireless links under varying conditions.
- **Terminal:** Reads and sets communications parameters on the XBee module and monitors data communications.
- **Modem Configuration:** Reads and sets configuration parameters on the XBee module.

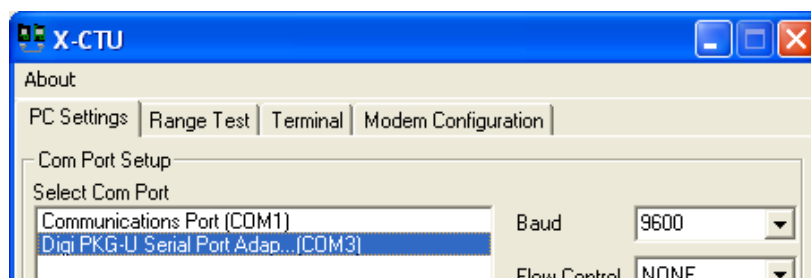
For more information on X-CTU functions, features, and controls, see the X-CTU Configuration Test Utility Software manual, available for downloading at [www.digi.com](http://www.digi.com).

## Discover nodes

This kit demonstrates discovering nodes from a variety of interfaces. In this first instance, node discovery is done through X-CTU.

This procedure involves entering command mode and sending AT commands. If you are unfamiliar with either concept, see the Command Mode section of the XBee module's product manual.

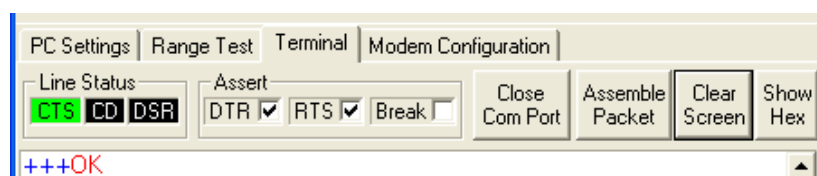
1. In the X-CTU interface, on the **PC Settings** tab, select the COM port to which the USB interface board is attached; this is the COM port created during USB driver installation. Select **DIGI-PKG-U (Serial Port Adap...)**



2. On the **Terminal** tab, enter command mode. This mode eliminates over-the-air communications for the XBee module, and allows internal communication with the XBee module parameters. There is a one-second "guard time" before and after entering command mode, and a ten-second timeout.

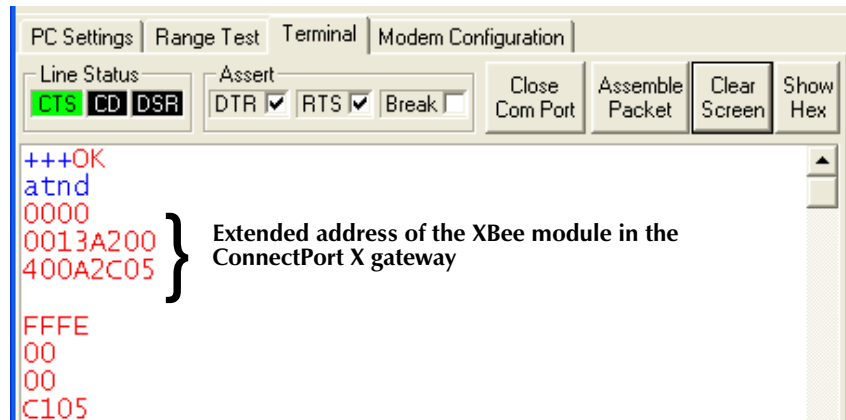
To enter command mode, enter **+++** with no carriage return.

When command mode is entered, an **OK** message is displayed.



3. Enter the **atnd** (Node Discover) command followed by a carriage return. This command discovers and reports all modules on its current operating channel and PAN ID (ID parameter). All powered nodes that have joined the network respond to this command with their device information.

One node should be returned: the ConnectPort X gateway. The gateway is identified by the **extended address** of its integrated XBee module. Every XBee device will have a unique extended address. In X-CTU, this address is split over two lines, as shown:

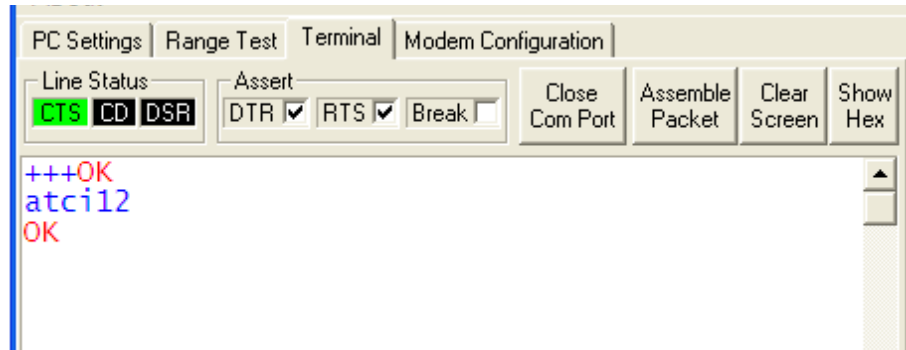


**Note:** If you encounter problems in this step, there is a way to force the XBee module on the interface board to leave any XBee network it may have joined and attempt to join an XBee network. Press the Ident/SW1 button on the USB interface board four times to attempt to associate to the gateway. Association is indicated by a blinking red LED. See "LEDs and buttons" on page 9.

## Run range test

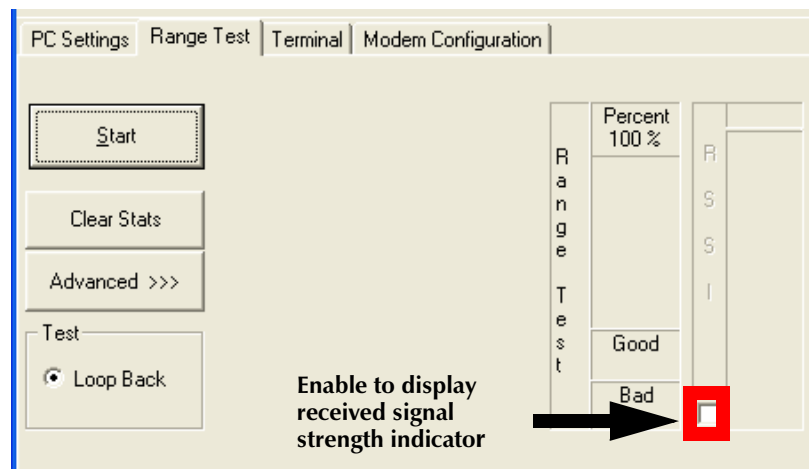
1. On the **Terminal** tab, re-enter command mode by typing **+++** with no carriage return.
2. Set loopback mode for the XBee module on the gateway. Enter this command:

**atci12**

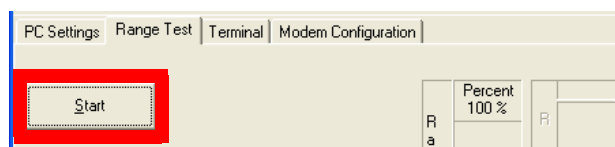


The **atci12** command (Destination Cluster ID=12, Loopback) sets the cluster ID on packets transmitted from the XBee module. Packets sent with this cluster ID value are sent back to the originator when received by the recipient (the XBee module in the gateway).

3. Click the **Range Test** tab.
4. Enable the checkbox in the RSSI part of the display to display the received signal strength indicator.

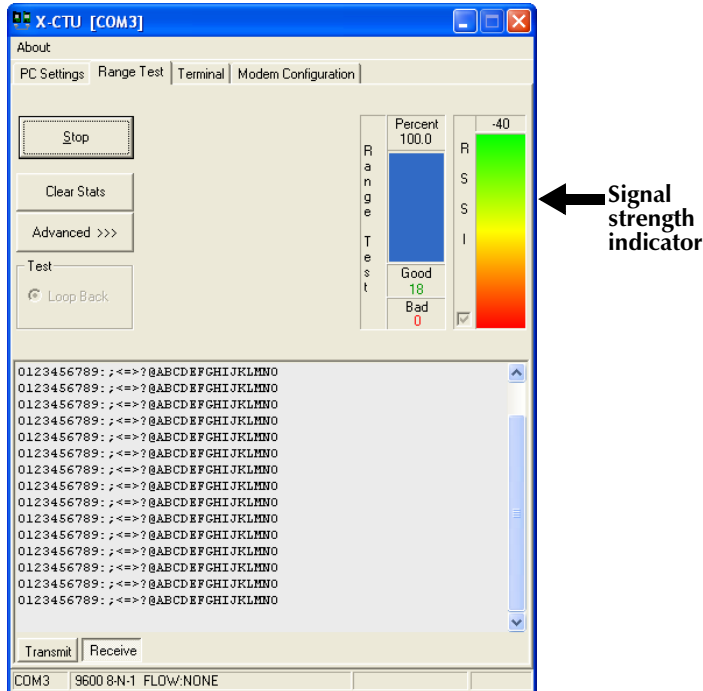


5. Click the **Start** button to start the range test.



The range test runs indefinitely until you click **Stop**.

As the test runs, the **0123...LMNO** data is the default data packet that is transmitted and received between the radios. The **Percent** field indicates true link quality by showing the percentage of successful packet transmissions. If the **RSSI** checkbox is enabled, the signal strength of packets received by the XBee module on the USB interface board is displayed.



6. Test the range of the wireless link between the XBee modules on the interface board and gateway:
  - Move the PC and USB interface board away from the gateway, or remove the antenna from the USB interface board's XBee module.
  - Click **Start** again.
  - Observe how the signal strength indicator changes.
7. Click **Stop** to end the range test.

## What does this test show you?

The range test gives a sense of the range of the kit's XBee modules. When deploying an actual network, multiple range tests are recommended to test for varying conditions in your application. If a range test indicates there is not enough range in an area where network devices must reside, you can install XBee Wall Routers to extend the range. The XBee Wall Router is designed primarily to "patch" areas within an XBee network where signal erosion or loss occurs due to distance limitations or interference.

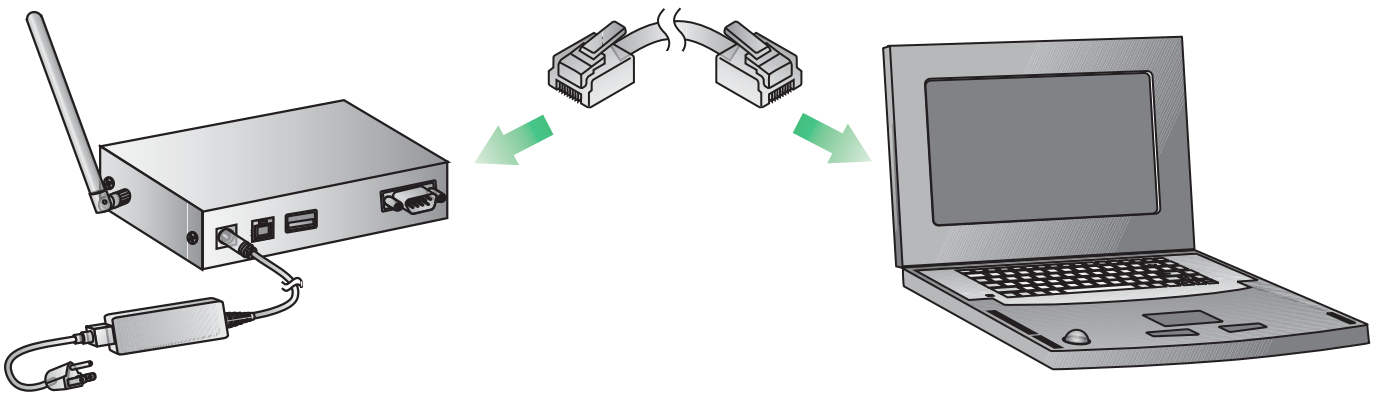
## Use gateway to discover nodes

In this task, you will connect the rest of the kit's devices and use the gateway's web interface to find and view all nodes in the Drop-in Network.

### Connect the gateway to Ethernet and discover it

Up to this point, you have been working from the point of view of the embedded XBee modules in an XBee network. Now, you will view and manage the network devices from the Ethernet network.

1. Connect the crossover Ethernet cable to the **Ethernet** port of the gateway, and the other end to the Ethernet port of the PC.

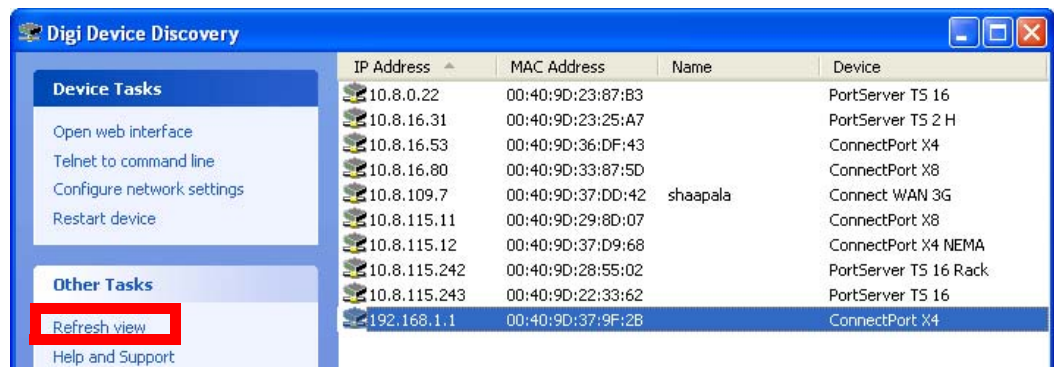


2. To find the gateway in the Ethernet network, run the Digi Device Discovery application, included on the Hardware & Software Setup CD. Insert the CD into the PC's CD/DVD drive.
3. Click **Gateway, Host PC & Enterprise Documentation/Software**.
4. Click **Gateways**.
5. Click **Configuration**.
6. Click **Digi Device Discovery (EXE)**.



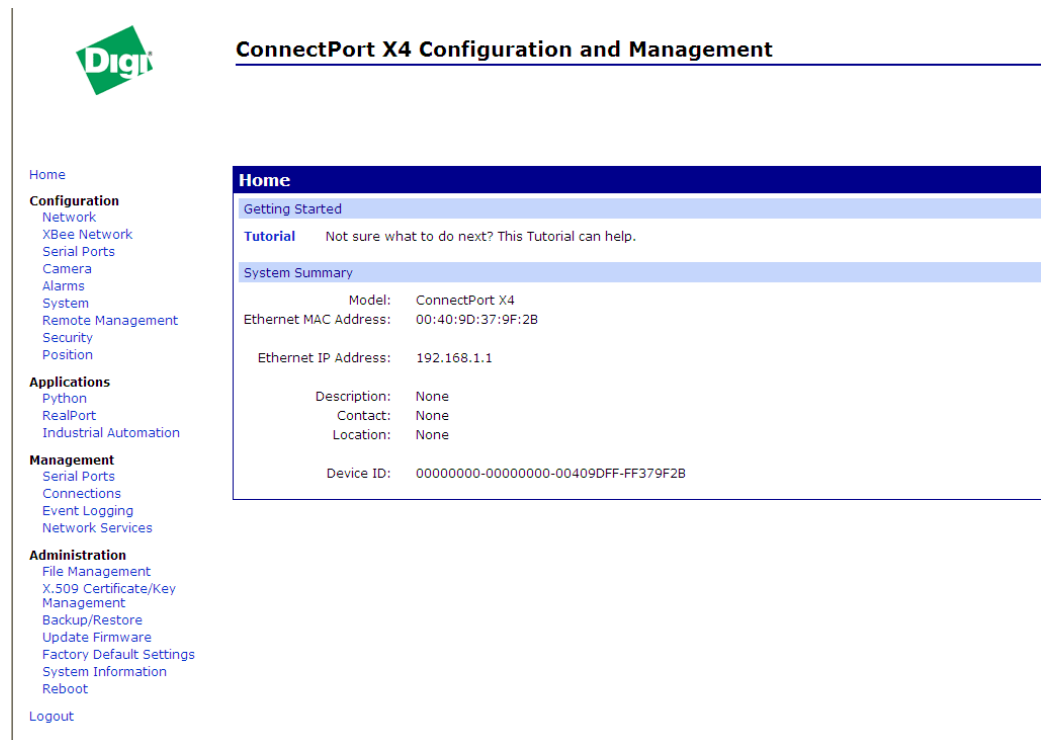
Use gateway to discover nodes

The Digi Device Discovery application is opened. It displays all Digi devices on the Ethernet network.



**Note:** If the gateway does not display, click **Refresh View**. If it still does not display, make sure any Windows firewalls are disabled. If the gateway is displayed with a label showing it as misconfigured, under **Device Tasks**, select **Configure network settings** and select **Obtain Network Settings Automatically**. Click **Save**. Answer **OK** when prompted for a restart.

7. Locate the ConnectPort X gateway in the device list by its **MAC address**. This address is printed on a label on the bottom of the gateway. Note that this MAC address is for the Digi Connect ME Ethernet module in the gateway, not the XBee module.
8. Double-click the ConnectPort X gateway. The web interface of the gateway is opened.



## Connect and power on RS-232 interface board

Now, add the RS-232 interface board to the network.

1. Open and unpack the box labeled **RS-232 Interface Board**.
2. Connect the XBee module to the connectors on the interface board. Orient the board and connector pins as shown in the diagram.
3. Connect the male null modem adapter to the serial port of the interface board.
4. Connect the serial loopback plug to the male null modem adapter and tighten connections.
5. Connect the power supply to the interface board.

**International version only:** Select the plug type that is appropriate for your country from the plugs included in the **RS-232 Interface Board** box. Attach the plug to the power supply, and plug the power supply into an outlet.

