ZigBee SMT RF Module Development Kit

GETTING STARTED GUIDE

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Our support staff is available to assist with compiling code, embedded module examples, and explaining hardware and RF networking, but they cannot write or review your code. Support for this kit is always free and unlimited.

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Section 1: Objectives

This guide demonstrates how to set up a wireless link using the XBee ZB SMT RF Module, allowing the user to evaluate the hardware over varying ranges and conditions. It covers these tasks:

- Installing software
- Setting up the network
- Establishing over the air communications
- Setting up a range test
- Performing a range test
- Exploring advanced configurations

Create a long range wireless link in minutes!

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Section 2: Installing and Using Software

Installing USB Drivers

The USB interface board is a “plug-and-play” device that should be detected by the PC automatically. If you are using **Windows 7**, driver installation is not required, and the USB interface board can be connected to the computer immediately. If you are using **Windows XP, Vista, or 2000**, download and install the driver as per the directions below.

To install the USB driver:

1. Download the driver setup file at: http://ftp1.digi.com/support/driver/FTDI_Windows_Driver_Setup.exe.
2. Double-click on the setup file. A window will pop up during installation and automatically close when the process is complete.

The USB interface board may now be connected to the computer.

Installing X-CTU Software

The software needed to use this kit is called **X-CTU**. Please download it at http://ftp1.digi.com/support/utilities/40003002_a.exe.

X-CTU is a stand-alone tool for configuring XBee modules and running a range test. To install X-CTU:

1. Browse to the folder to which you saved the above install file.
2. Double click on the installer file and follow the X-CTU Setup Wizard.
3. When asked if you would like to check Digi’s website for firmware updates, click **Yes**.
4. After the firmware updates are complete, click **Close**.
5. Start X-CTU by double clicking on the X-CTU icon placed on your desktop, or by selecting **Start > Programs > Digi > X-CTU**.

The X-CTU software is now ready to be used.

Setting Up the Network

Each network requires one and only one coordinator. For more information on the function of the coordinator, see the Product Manual for the XBee ZB SMT RF Module, available online at http://www.digi.com/products/wireless/zigbee-mesh/xbee-smt.jsp#docs.

Running the X-CTU Software

1. Under the **PC Settings** tab, select the PC serial COM port that will be used. The standard COM port for the 9-pin serial port is COM 1. The USB ports will be labeled as USB Serial Port and are assigned a number based on your PC’s settings.

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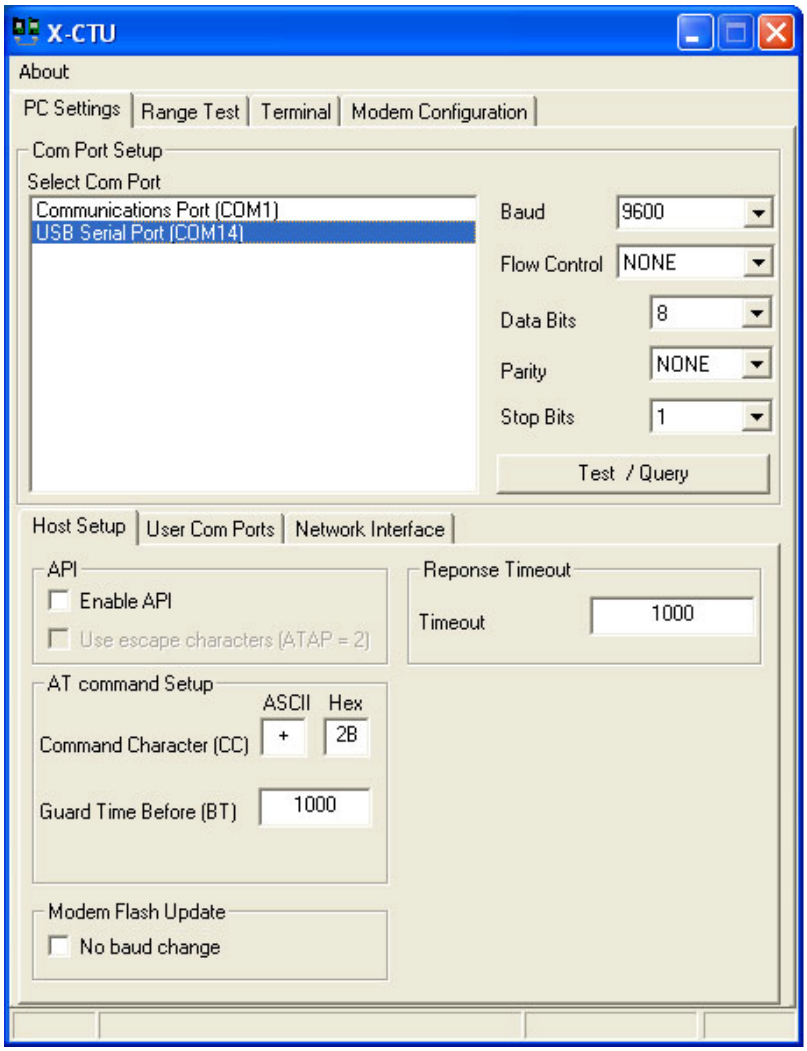

The X-CTU baud rate must match the module's BD parameter for proper communication. The module default is 9600 baud.

2. Verify that the baud rate and data settings match the internal settings of the modules. The default settings for the modules are Baud Rate: 9600, Flow Control: HARDWARE, Data Bits: 8, Parity: None, and Stop Bits: 1.

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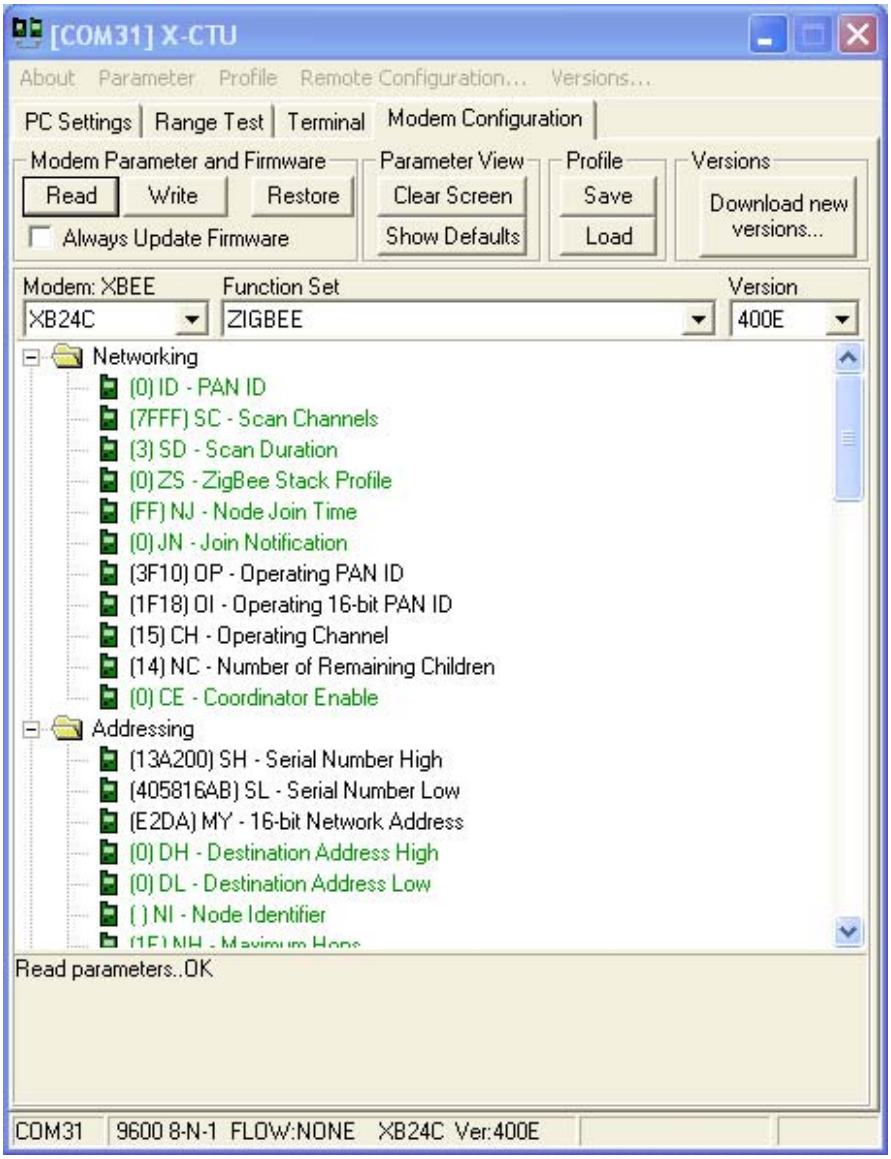
3. In the X-CTU **Modem Configuration** tab, click **Read**.



X-CTU displays the available settings for the module.

4. Every network must start with a coordinator. The following procedure will set one device as the coordinator.
   a. Click on **CE - Coordinator Enable** and select **1-Enabled**.
   b. Then click the **Write** button.

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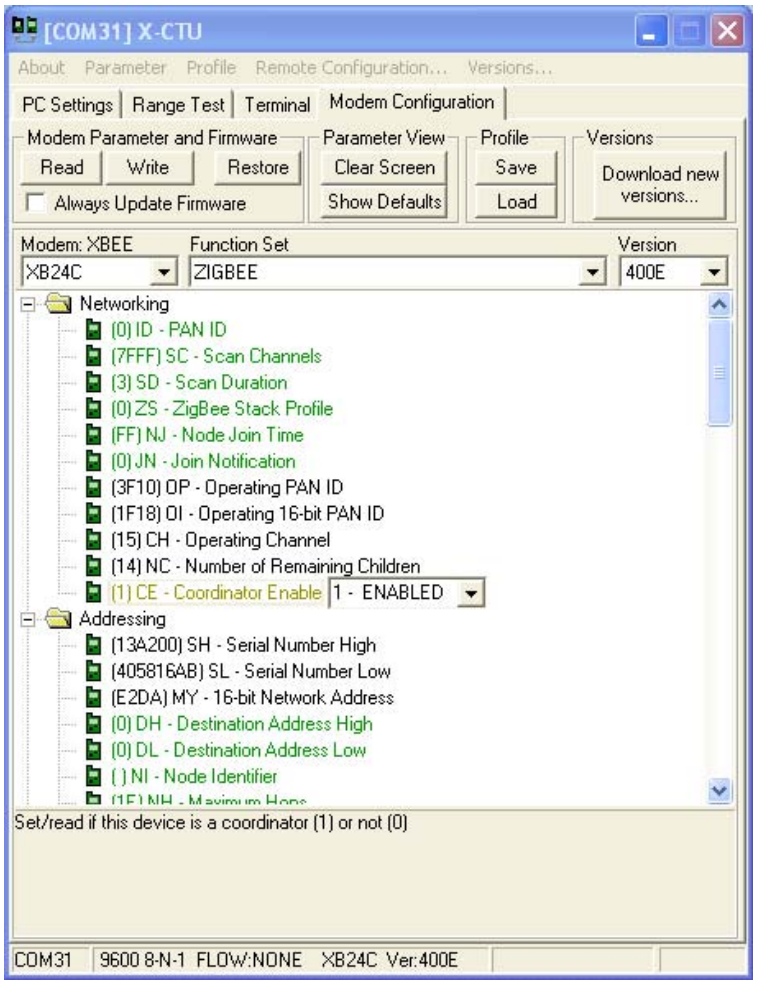

Use the parameter window shown above to designate one device as the coordinator.

5. (Optional) If you are working in an area where other ZigBee networks are running, it is possible for non-coordinator modules to join an unintended network. To avoid this situation, you can set a unique PAN ID for all of the modules you need to be on the same network. To set the PAN ID:
   a. Click on **ID - PAN ID** and enter a hex number (for example, A3 in the figure below) from 0x00 to 0xFF.
   b. Then click the **Write** button.

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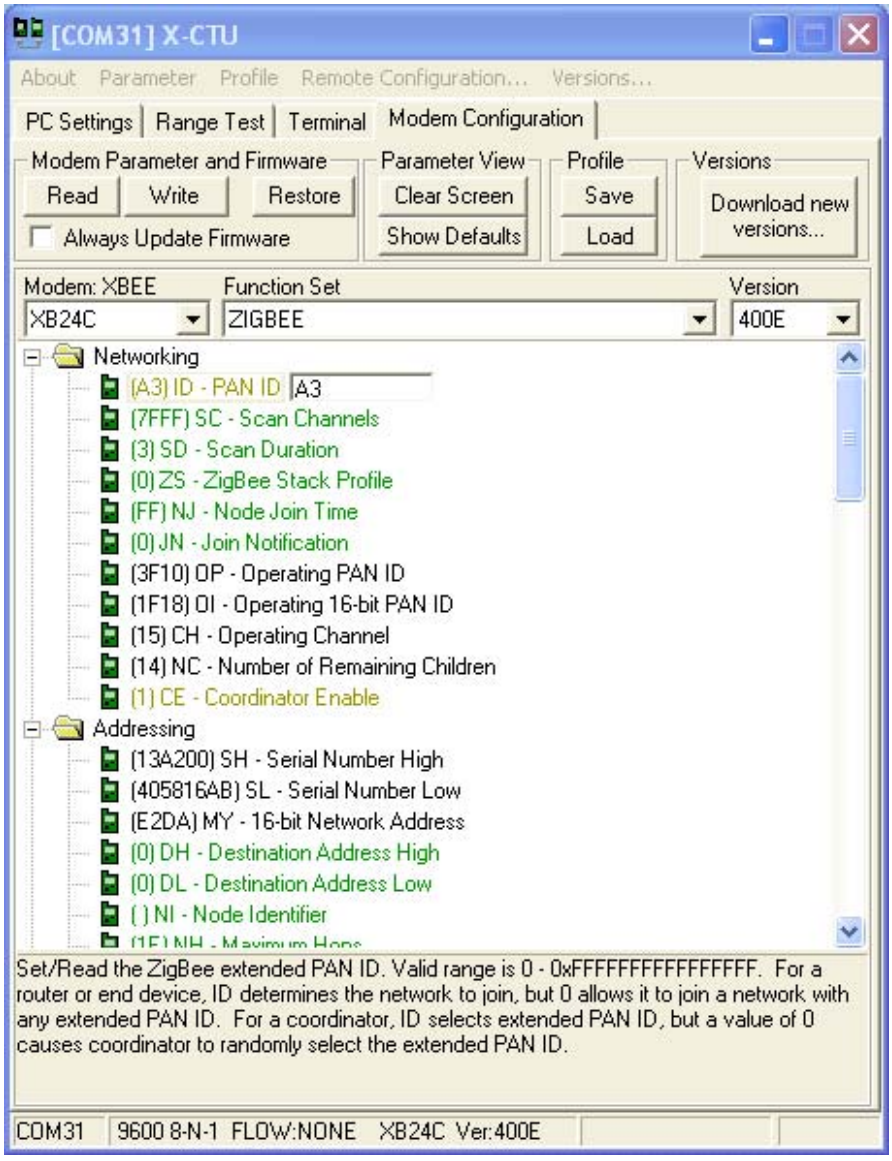

Note: You can set multiple parameters at once and then click the **Write** button to save them in the module.

7. Once the modules are configured, a network can be established. To establish network connections, do the following:
   a. Connect non-coordinator modules in the network to the computer using the USB cable (two are included in the kit). The modules will form a network within a few seconds. In order to interact with the module, you will need to connect it to the computer using a USB cable. Once the network is established, the red LED near the USB connector on the USB interface board will flash. Coordinators will flash at a rate of about once per second, and routers will flash at a rate of about twice per second.
   b. Open an X-CTU window for each module connected to the computer, select the appropriate COM port, and go to the **Terminal** tab. USB interface boards

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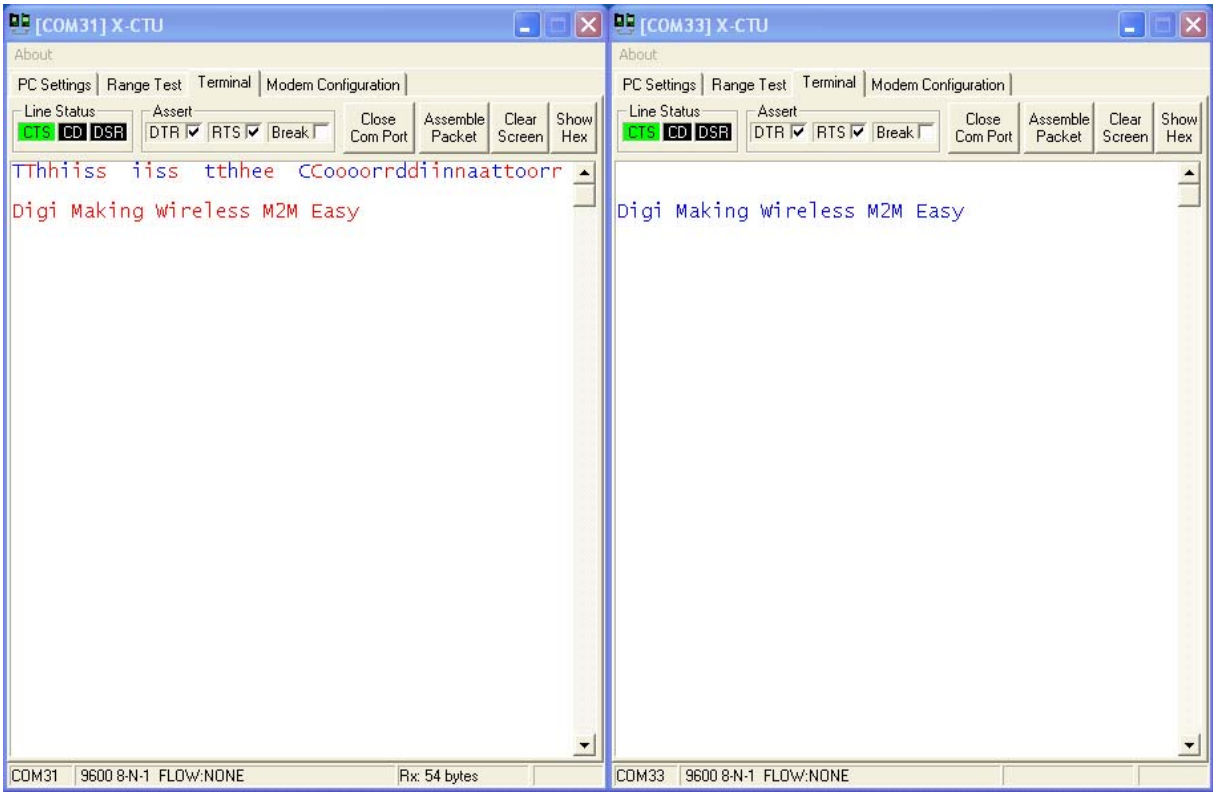
can be connected one by one to the network and computer so you can identify which module goes with which COM port.

Note: X-CTU only looks for available COM ports on start-up. If you plug in a USB interface board after starting X-CTU, it will not be detected unless you close and re-start X-CTU.

8. In this configuration, the modules are set up to communicate with the coordinator. Using the Terminal tab as shown below, any text entered in the window of a non-coordinator module's window will show up in the window of the coordinator. Text entered in the coordinator window will show up in the coordinator window as a repeat of the character. This is because the default destination address is the coordinator address (0x00). Text transmitted is shown in blue while text received is shown in red.



9. Unicast transmission is also possible. More information on unicast transmissions is available in the Product Manual.
10. The other form of communication is broadcast transmission, where one module transmits to all the other modules in the network. More information on broadcast communication is available in the Product Manual.

Note: Examples of different transmission modes are in the Product Manual under Data Transmission Examples.

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Section 3: Performing a Range Test

What Is a Range Test?

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

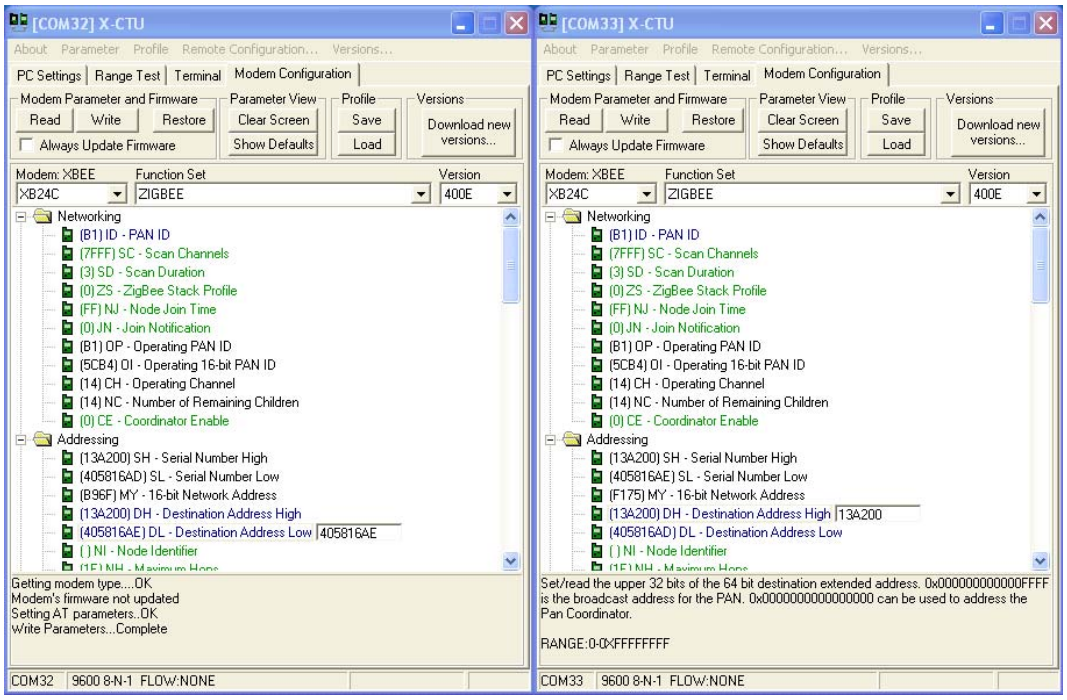
This range information is useful when planning for and deploying an actual network.

Setting Up the Modules for the Range Test

Select two modules to use in the range test, and do the following:

1. Connect them to the computer using USB cables. (You should have already done this in the previous section.) On the **Modem Configuration** tab, click **Read** to view the configuration on each module.
2. Enter the **SH - Serial Number High** from the first module into the **DH - Destination Address High** of the second module.
3. Enter the **SL - Serial Number Low** from the first module into the **DL - Destination Address Low** of the second module.
4. Click the **Write** button to save the addresses into the first module.
5. Repeat this process for the second module. (See figure below)

Note: The default destination address is 0x00 (the coordinator). If you are using the coordinator as one of the range test modules, then only the coordinator's DH and DL parameters need to be configured with the SH and SL values of the non-coordinator.



Note: This process can be done one module at a time, by recording the address from one module to enter into the other module.

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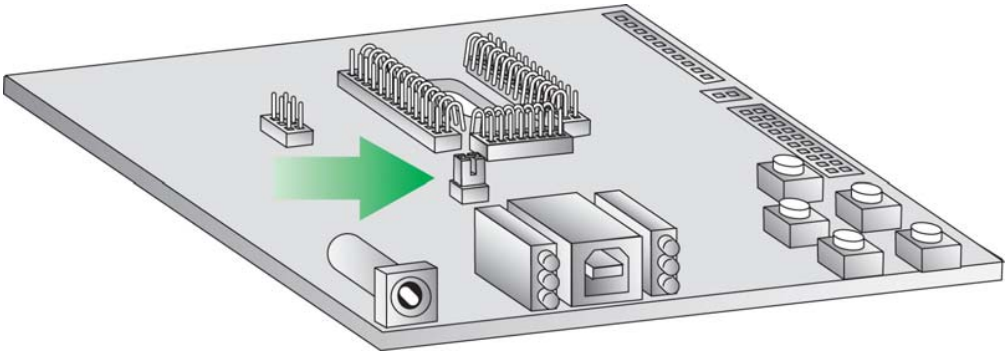
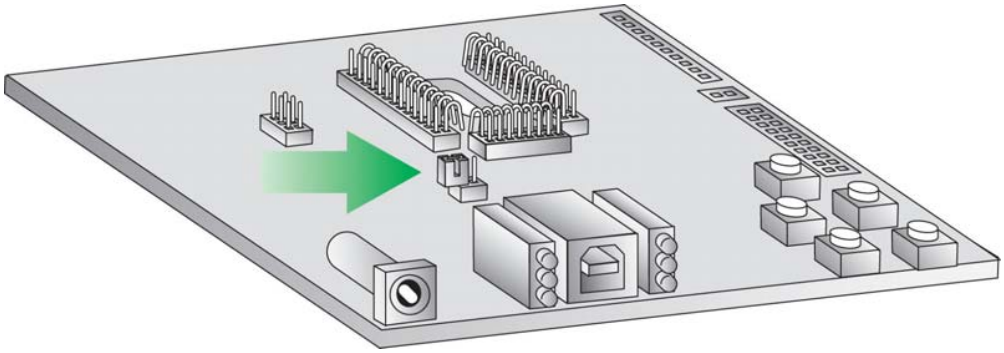
Select one module to be the loopback module, and install the jumper as shown below:



Remove the USB cable.

For the other modules, the jumper can either be removed or placed so it is only on one pin, as shown below.



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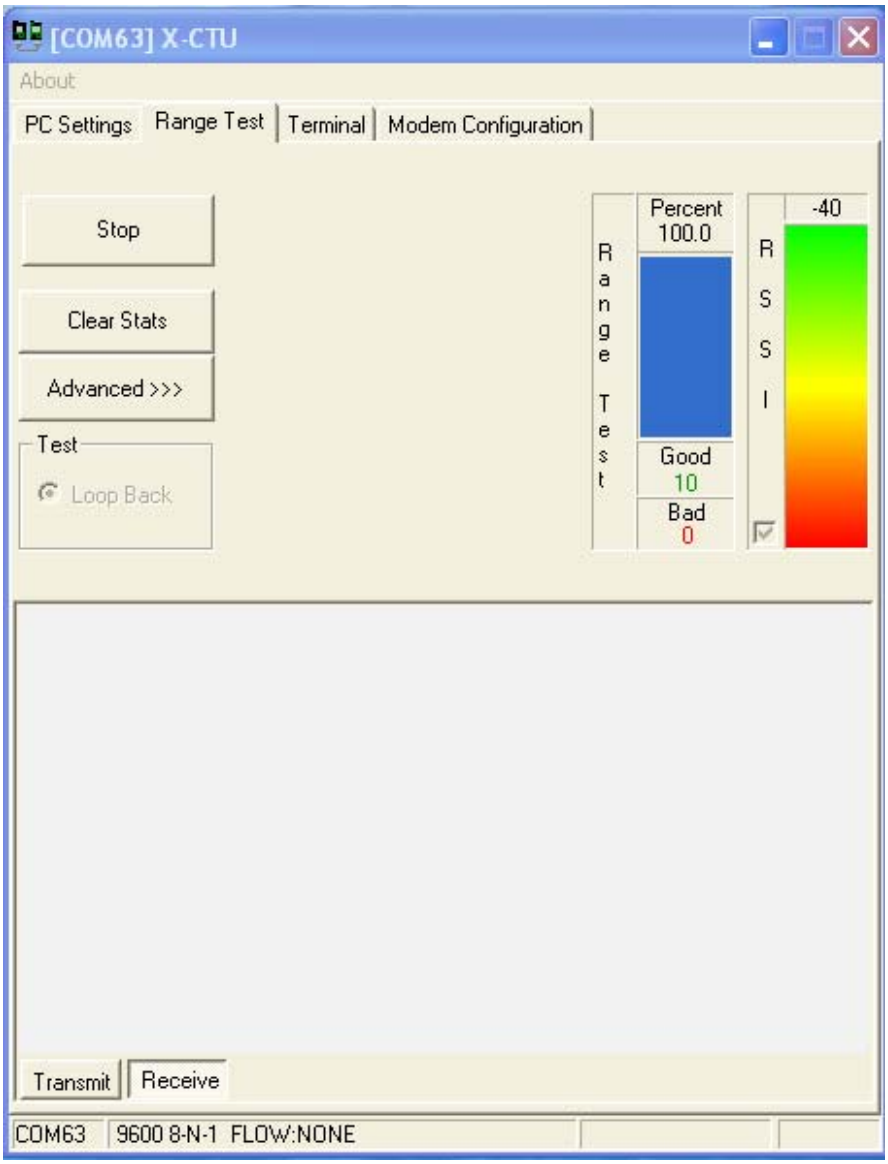
Running the Range Test

1. In X-CTU, select the **Range Test** tab.



Clicking the **Advanced>>>** button displays several more options. If you run the range test with several more mesh radios acting as intermediaries, you will want to increase the **Data receive timeout** value to compensate for the additional latency.

2. (Optional) Check the RSSI box to enable the Received Signal Strength Indicator. The RSSI value indicates the signal strength of the last packet that the module received.
3. Click **Start** to begin the range test.
4. Monitor the link quality by reading the **Percent** section of the **Range Test** tab. This section displays the running percentage of good packets sent to the receiving radio and looped back to the base.
5. Leave the loopback module in place as the remote loopback radio.

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6. To increase the range, move to a position where you are receiving packets. Put another module from the kit in this position and connect it to a power supply. Within ten seconds, your roving module should be able to receive packets at a longer range as the mesh network transmits the packets from radio to radio.
7. Click **Stop** to end the range test.

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Section 4: Exploring Advanced Configurations

Embedding the RF Module

XBee modules are designed for embedding into systems. They are designed for both UART and SPI capability for ease of communication with other parts of the system. Information on UART and SPI communication can be found in the Product Manual online at http://www.digi.com/products/wireless/zigbee-mesh/xbee-smt.jsp#docs.

The Product Manual also contains information on manufacturing considerations, antenna keepout areas, design considerations, programming commands, etc. This is a useful reference for including the XBee in your system.

Configuring the RF Module

In the X-CTU **Modem Configuration** tab, click Read (see **Setting Up the Network** in Section 2). Select any module parameters you want to change (e.g. Destination Address, Encryption, etc.) and type in or select the desired value. Then click **Write** to save the changes to non-volatile memory.

Parameters shown in green are still set to default values. Parameters in blue have been changed. Parameters in black are read-only, with the exception of the encryption key, KY.

This is one of several configuration methods. Refer to the Product Manual for more information. To restore the module back to default settings, click **Restore**.

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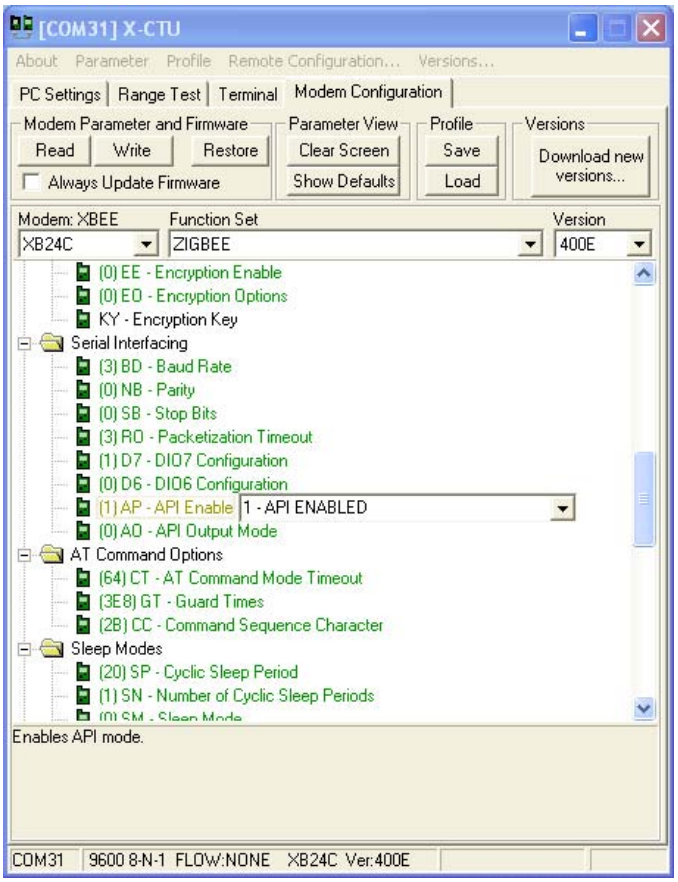
Configuring Remote Modules

XBee modules can also be configured “over-the-air” using X-CTU. In order to use this feature, your base device must be configured for API mode.



To configure parameters on a remote module, set **AP-API Enable = 1 API ENABLED** on your base module and then click **Write** to save to non-volitile memory. For more information on the different API settings, see the API section of the Product Manual.

To send “over-the-air” commands:

1. Click the **Remote Configuration** option at the top of the window.
2. Click **Open COM Port** and **Discover** from the menu bar at the top of the Network window. A list of all the nodes in the network will appear.
3. Select a node from the list to configure. You can interact with it as though it were connected to your computer directly.
4. Click **Read**, **Write**, or **Restore** parameters on the main X-CTU window, and those changes will occur over the air on the remote module selected in the Network window.

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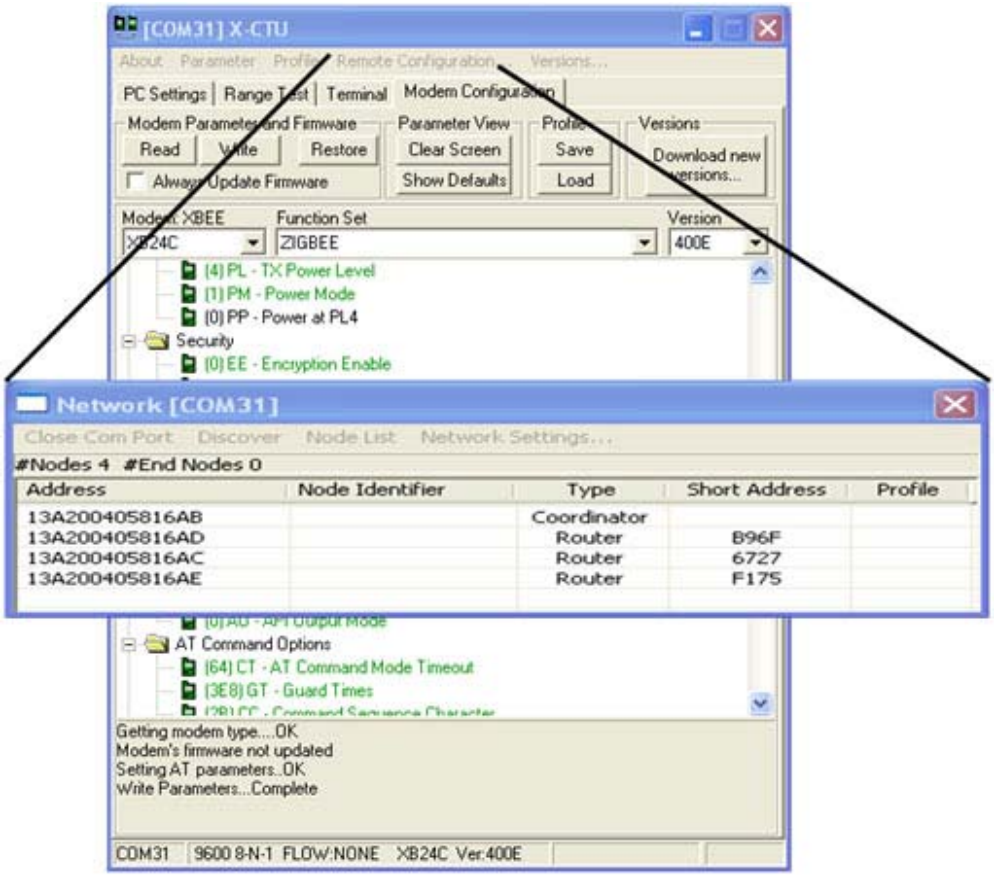

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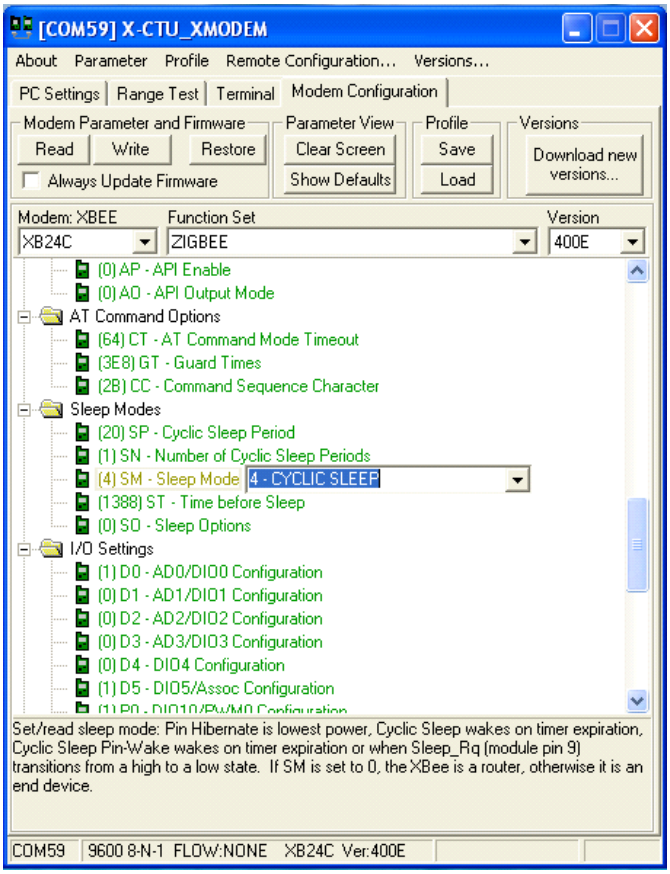
Setting Module as End Device

1. In the Modem Configuration tab, click **Read**.
2. Scroll through the list of displayed parameters and find the Sleep Modes section.
3. Click on **SM-Sleep Mode** and select **4-Cyclic Sleep** from the drop-down box.



4. Click **Write**. Again, a progress bar will be displayed in the Network window as the new parameter is written into memory.
5. Using the other default sleep settings the remote module will sleep for 320 ms at a time. To illustrate, the Associate LED should be flashing approximately 3 times per second as the radio alternately sleeps and checks for input.
6. You may close the Network window when finished.

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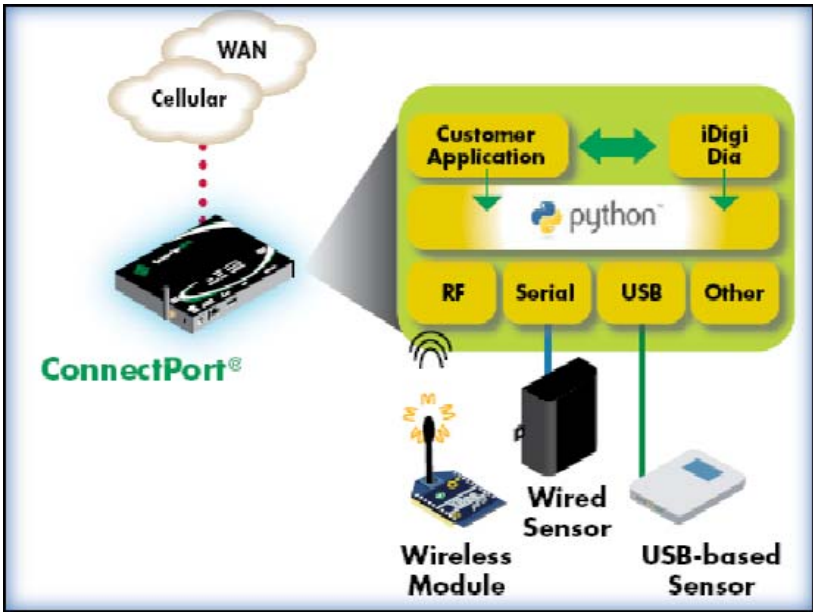
Managing the Network

Using Gateways

Now that you have an RF network running, it is important to know how to manage the network. X-CTU software and the various RF module features provide good tools for on-site XBee configuration, firmware upgrades, and network diagnostics. However, in many cases it is necessary for the end user to be able to perform these functions from a remote location via the Internet. Digi has solved this problem by creating RF-to-Internet gateways to allow monitoring and control of your RF network through the Internet.



In the diagram above, a Digi ConnectPort gateway is used to connect an RF network (plus other peripherals) to the Internet via either the Ethernet port or a cellular WAN connection. Note that gateways are programmable and can also be used to run local monitoring/control of the RF network, with or without Internet connectivity. See www.digi.com/products/wirelessdropinnetworking/gateways for an overview of Digi gateways.

Understanding Cloud Connectivity

On a larger scale, the next task is to manage several gateways with multiple RF networks. Challenges with managing gateways include knowledge of IP addresses, access through firewalls, security and reliability of servers, scalability as the number of gateways grows, and ongoing maintenance for each of these functions. iDigi™ Manager Pro is Digi's device management solution.

iDigi Manager Pro is a subscription-based solution that offers robust network management capability and on-demand scalability hosted on a high-availability, commercial-class cloud platform. iDigi is monitored by Digi's operations organization continuously and provides both Tier 1 and Tier 2 support.

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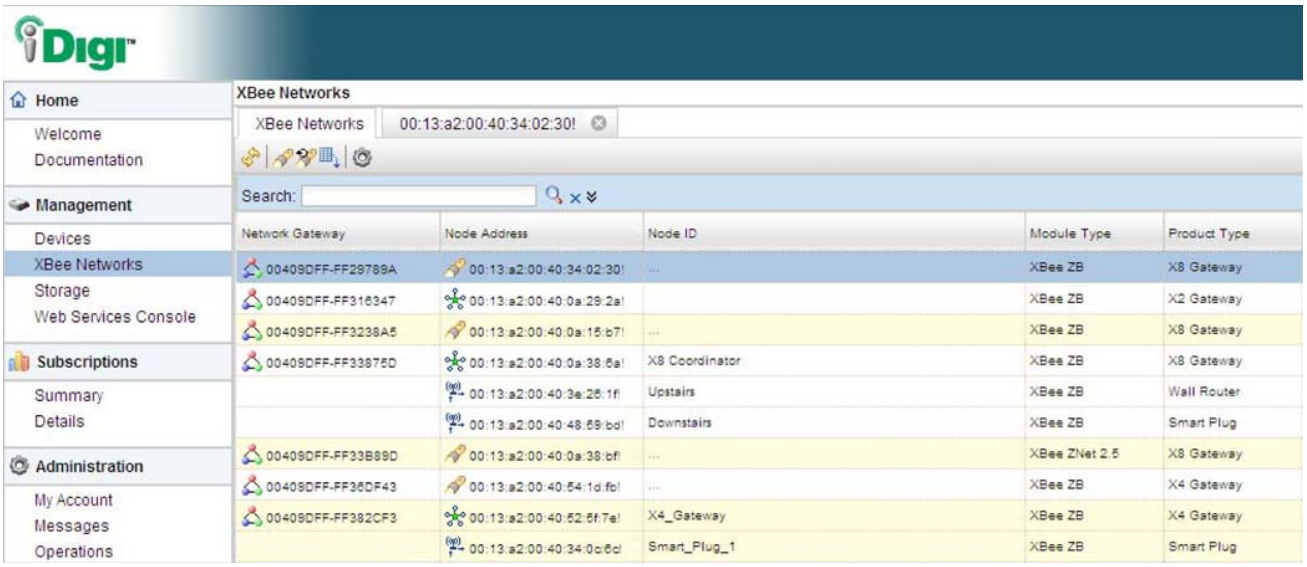

The image above shows the secure connection to your gateway or end device after logging on to your iDigi account. Learn more about managing your remote devices at www.idigi.com. Digi provides end-to-end products and services in order to make wireless M2M easy.

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