# XBee-PRO PKG-U™ USB RF Modem



**Product Manual v1.0**
For XBee-PRO RF Modem Part Numbers: XBP24-PKC-...-U...

ZigBee™/IEEE® 802.15.4 RF Modems by MaxStream, Inc.


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# 1. XBee-PRO USB RF Modem

The XBee-PRO USB RF Modem is a ZigBee/IEEE 802.15.4 compliant solution that has USB interfacing built-in to its design. Out-of-box, the modem is equipped to sustain excellent range (2-3x the range of standard ZigBee modems) and requires no additional configuration for RF communications.

The modem transfers a standard asynchronous serial data stream between two or more devices. Simply feed data into one modem, then the data is sent out the other end of the wireless link. Its built-in USB interface allows for rapid integration into existing data systems.

## 1.1. Features Overview

**High Performance, Low Cost**

Range

- Indoor/Urban: **up to 300'** (100m)
- Outdoor line-of-sight: **up to 4000'** (300m)

Transmit Power: **100 mW** (20dBm) EIRP (with 2.1 dB antenna)

Receiver Sensitivity: **-100 dBm**

RF Data Rate: **250,000 bps**

**Advanced Networking & Security**

Retries and Acknowledgements

DSSS (Direct Sequence Spread Spectrum)

13 direct sequence channels, each with over 65,000 unique network addresses available

Point-to-point, point-to-multipoint and peer-to-peer topologies supported

Unicast and Broadcast Modes supported

128-bit Encryption (downloadable firmware version coming soon)

Self-routing/Self-healing mesh networking (downloadable firmware version coming soon)

**Low Power**

Power Currents

- Receive Current: 90 mA
- Transmit Current: 300 mA
- Power-down Current: < 25 mA

**Easy-to-Use**

No configuration necessary for out-of box RF communications

Free X-CTU Software (Testing and configuration software)

Built-in USB interfacing

Small form factor

Network compatible with other ZigBee/802.15.4 devices

**Free & Unlimited Technical Support**

### 1.1.1. Worldwide Acceptance

**FCC Approval PENDING** (USA) Refer to Appendix A [p20] for FCC Requirements. Systems that include XBee-PRO RF Modems inherit MaxStream's FCC Certifications.

**ISM** (Industrial, Scientific & Medical) 2.4 GHz frequency band

Manufactured under **ISO 9001:2000** registered standards

XBee-PRO RF Modems are optimized for use in **US**, **Canada**, **Australia, Israel and Europe** (contact MaxStream for complete list of approvals).

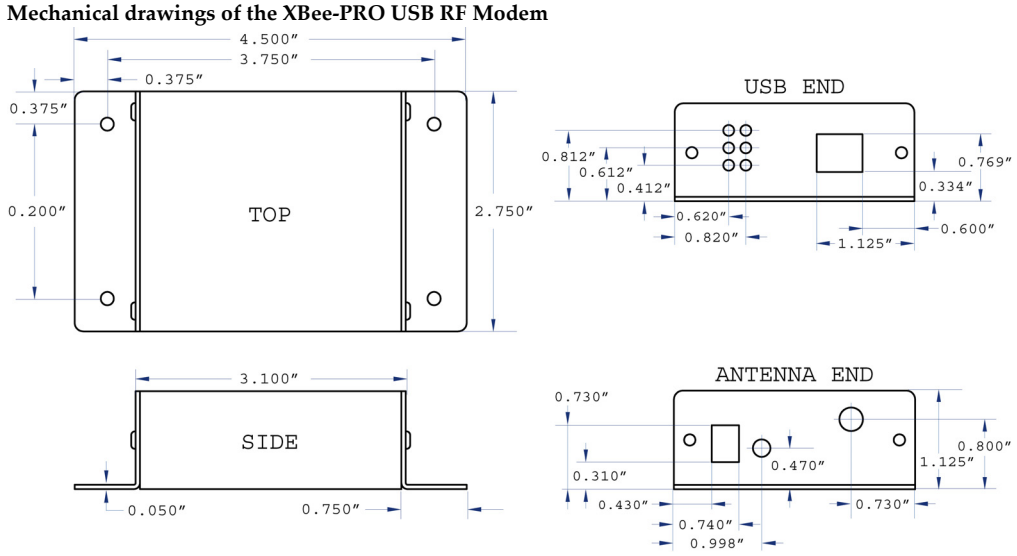
## 1.2. Specifications

**Table 1-01. Specifications of the XBee-PRO PKG-U USB RF Modem**

| Specification | XBee-PRO USB RF Modem |
|---|---|
| **Performance** | |
| Indoor/Urban Range (w/ 2.1 dB dipole antenna) | up to 300' (100 m) |
| Outdoor/Urban Range (w/ 2.1 dB dipole antenna) | up to 4000' (1200 m) |
| Transmit Power Output | 60 mW, 100 mw (20 dBm) EIRP |
| Receiver Sensitivity | -100 dBm (1% packet error rate) |
| Interface Data Rate | 1200 - 115200 bps (non-standard baud rates also supported) |
| RF Data Rate | 250,000 bps |
| **Networking & Security** | |
| Frequency | ISM 2.4 GHz |
| Modulation | DSSS (Direct Sequence Spread Spectrum),<br>OQPSK (Offset Quadrature Phase Shift Keying) |
| Supported Network Topologies | Point-to-point, Point-to-Multipoint, Peer-to-Peer & Mesh (coming soon) |
| Number of Channels (software selectable) | 13 Direct Sequence Channels |
| Addressing Layers | PAN ID, Channel & Source/Destination Addresses |
| **Antenna** | |
| Connector | RPSMA (reverse polarity SMA) |
| Impedance | 50 ohms unbalanced |
| **Power Requirements** | |
| Power Supply | Powered through USB port |
| Receive Current | 90 mA |
| Transmit Current | 300 mA (Average current when streaming data (@9600bps) = 92 mA) |
| Power-down Current | < 25 mA |
| **Physical Properties** | |
| Size | 4.500" x 2.750" x 1.125" (11.4cm x 7.0cm x 2.9cm) |
| Weight | 5.25 oz. (150 g) |
| Data Connection | USB |
| Operating Temperature | 0 - 70° C (Commercial) |
| **Certifications (partial list)** | |
| FCC Part 15.247 | pending |
| Industry Canada | pending |
| Europe | pending |

## 1.3. Mechanical Drawings

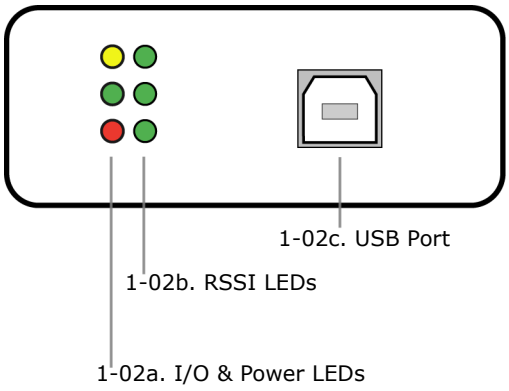
**Figure 1-01. Mechanical drawings of the XBee-PRO USB RF Modem**



## 1.4. Physical Interface

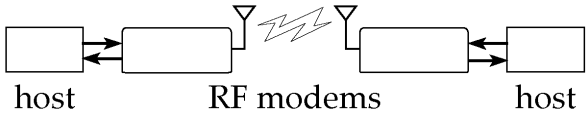
Figure 1-02. Front View




### 1-02a. I/O & Power LEDs

LEDs indicate RF modem activity as follows:

Yellow (top LED) = Serial Data Out (to host)
Green (middle) = Serial Data In (from host)
Red (bottom) = Power/TX Indicator (Red LED is illuminated when RF modem is powered)




### 1-02b. RSSI LEDs

RSSI LEDs indicate the amount of fade margin present in an active wireless link. Fade margin is defined as the difference between the incoming signal strength and the modem's receiver sensitivity.

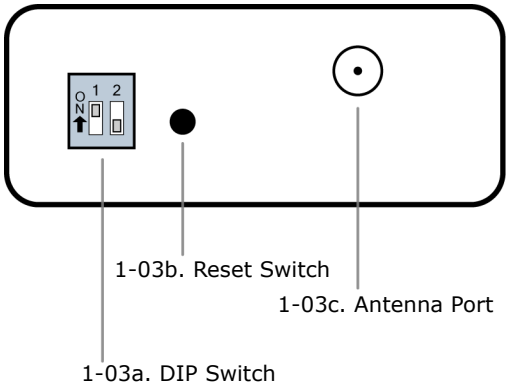
3 LEDs ON = Very Strong Signal (> 30 dB fade margin)
2 LEDs ON = Strong Signal (> 20 dB fade margin)
1 LED ON = Moderate Signal (> 10 dB fade margin)
0 LED ON = Weak Signal (< 10 dB fade margin)

### 1-02c. USB Port

Standard Type-B USB connector is used to communicate with USB host and power the RF modem.

### 1-03a. DIP Switch

Figure 1-03. Back View




DIP Switch functions are not supported in this release. Future downloadable firmware versions will support the DIP Switch configurations.

### 1-03b Reset Switch

The Reset Switch is used to reset (re-boot) the RF modem.

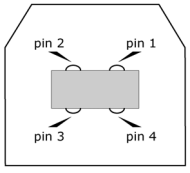
### 1-03c. Antenna Port

Port is a 50Ω RF signal connector for connecting to an external antenna. The connector type is RPSMA (Reverse Polarity SMA) female. The connector has threads on the outside of a barrel and a male center conductor.

## 1.5. Pin Signals

Table 1-02. USB signals and their implantations on the XBee-PRO RF Modem

| Pin | Name | Description | Implementation |
|---|---|---|---|
| 1 | VBUS | Power | Power the RF modem |
| 2 | D- | Transmitted & Received Data | Transmit data to and from the RF modem |
| 3 | D+ | Transmitted & Received Data | Transmit data to and from the RF modem |
| 4 | GND | Ground Signal | Ground |



# 2. RF Modem Operation

After the appropriate drivers have been installed and the XBee-PRO USB RF Modem is connected to the USB port, the PC will see the modem as a standard com port. This com port redirection can only occur after installing the 'Hardware USB Bus' and 'Virtual Com Port' drivers [see instructions below]. Once the USB connection is made and drivers are installed, any software that is able to communicate through a com port can be used to interface with the modem. MaxStream's proprietary X-CTU Software includes a 'Terminal' tab that can be used for configuring the modem and monitoring communications. Alternatively, software such as HyperTerminal can be used.

## 2.1. Driver Installations

The XBee-PRO USB RF Modem is a "plug-and-play" device that should automatically be detected by the PC. To interface between the modem and a PC, two drivers must be installed. After the modem is detected, the PC will display an installation wizard that facilitates driver installations. Drivers for Windows, Macintosh & LINUX operating systems are included on the MaxStream CD.

**To Install Drivers:**

The following steps were recorded while using the Windows XP operating system.

1. Connect the XBee-PRO RF Modem to a PC using a USB cable.
   ["Found New Hardware Wizard" dialog box appears.]
2. Verify the MaxStream CD is inserted into the drive.
3. Select "Install from a specific list or location (Advanced)" option;
   then select the 'Next' button.
4. a. Select the 'Search for the best driver in these locations' option.
   b. Check 'Search removable media (CD-ROM...)' box; then select the 'Next' button.
   [Hardware Installation "Windows Logo Testing" alert box appears.]
5. Select the 'Continue Anyway' button.
6. Select the 'Finish' button.
7. Repeat steps 2 through 6 to install the next driver.
8. Reboot computer if prompted to do so.

### 2.1.1. USB Background Information

USB has two types of devices: Those that supply drivers (a host, such as a PC); and those that require a driver (a client, such as the XBee-PRO USB RF Modem). When a USB client is plugged into a host, the host prompts for a driver. Once a driver is located, the host loads the driver on the first use of the USB client; then reloads the installed driver on all subsequent uses.

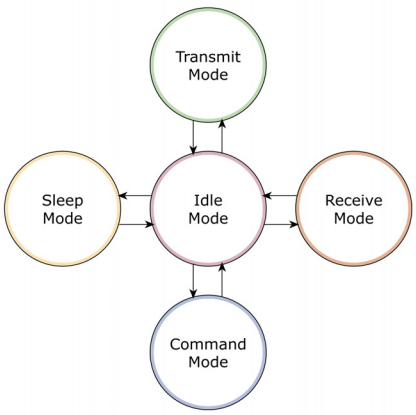
A USB client should not be plugged into another client. If another USB client (such as a USB video camera) is plugged into a MaxStream USB RF modem (also a client), the devices will not communicate. It would be incorrect to attach a USB modem to a host on one end and attach a USB modem to a USB client at the other end. Virtually all USB peripherals (video cameras, PDA cradles, printers, etc.) are USB clients.

Some client devices can act as a host. This is known as "USB on-the-go". An appropriate USB on-the-go enabled device (such as a PDA with USB on-the-go support) may connect to and utilize a MaxStream USB RF Modem. Contact MaxStream for information about device drivers.

## 2.2. Modes of Operation

XBee-PRO RF Modems operate in five modes.

**Figure 2-01. XBee-PRO RF Modem Modes of Operation**
(The RF Modems operate in one mode at a time.)




When not receiving or transmitting data, the RF modem is in Idle Mode. The RF modem shifts into the other modes of operation under the following conditions:

- Serial data is received in the DI Buffer (Transmit Mode)
- Valid RF data is received through the antenna (Receive Mode)
- Sleep Mode condition is met (Sleep Mode)
- Command Mode Sequence is issued (Command Mode)

### 2.2.1. Sleep Mode

Sleep Modes enable the RF modem to enter states of low-power consumption when not in use. In order to enter Sleep Mode, one of the following conditions must be met (in addition to the modem having a non-zero SM parameter value):

- DTR (Data Terminal Ready) is de-asserted.
- The modem is idle (no data transmission or reception) for the amount of time defined by the ST (Time before Sleep) parameter. [NOTE: ST is only active when SM = 4-8.]

**Table 2-01. Sleep Mode Configurations**

| Sleep Mode Setting | Transition into Sleep Mode | Transition out of Sleep Mode | Characteristics | Related Commands | Power Consumption |
|---|---|---|---|---|---|
| Pin Hibernate (SM = 1) | De-assert DTR | Assert DTR | Pin/Host-controlled | (SM) | < 25 mA |
| Pin Doze (SM = 2) | De-assert DTR | Assert DTR | Pin/Host-controlled | (SM) | < 25 mA |
| Cyclic Sleep (SM = 4 - 6) | Automatic transition to Sleep Mode as defined by the SM (Sleep Mode) and ST (Time before Sleep) parameters. | Transition occurs after the cyclic sleep time interval elapses. The time interval is defined by the SP (Cyclic Sleep Period) parameter. | RF Modem wakes in pre-determined time intervals to detect if RF data is present. | (SM), SP, ST | < 25 mA when sleeping |

The SM command is central to setting Sleep Mode configurations. By default, Sleep Modes are disabled (SM = 0) and the modem remains in Idle/Receive Mode. When in this state, the modem is constantly ready to respond to serial or RF activity.

#### Pin/Host-controlled Sleep Modes

**Pin Hibernate (SM = 1)**

- Pin/Host-controlled
- Typical power-down current: < 25 mA
- Wake-up time: 13.2 msec

Use this mode to wake a sleeping modem by asserting DTR. Pin Hibernate Mode minimizes quiescent power (power consumed when in a state of rest or inactivity).

Pin Hibernate Mode is level-activated; when DTR is de-asserted, the modem will finish any transmitting or receiving activities, enter Idle Mode and then enter the state of sleep. The modem will not respond to either serial or RF activity while in pin sleep. The modem will wake when DTR is asserted and is ready to transmit or receive when the $\overline{\text{CTS}}$ line is low.

**Pin Doze (SM = 2)**

- Pin/Host-controlled
- Typical power-down current: < 25 mA
- Wake-up time: 2 msec

Use this mode to wake a sleeping modem by asserting DTR. This pin-controlled Sleep Mode minimizes wake-up time.

Pin Doze Mode is level-activated; when the DTR is de-asserted, the modem will finish any transmitting or receiving activities, enter Idle Mode and then enter the sleep state. The modem will not respond to either serial or RF activity while in pin sleep. The modem will wake when DTR is asserted and is ready to transmit or receive when the $\overline{\text{CTS}}$ line is low.

### Cyclic Sleep Modes

**Cyclic Sleep Remote (SM = 4)**

- Typical Power-down Current: < 25 mA (when asleep)
- Wake-up time: 2 msec

Use this mode to have a modem periodically check for data. Cyclic Sleep Mode configures the modem to sleep, then wake once a cycle to check for data from a modem configured as a Cyclic Sleep Coordinator (SM = 6). The Cyclic Sleep Remote sends a poll request to the coordinator at a specific interval set by the SP (Cyclic Sleep Period) parameter. The coordinator will transmit any queued data addressed to that specific remote upon receiving the poll request. If no data is queued for the remote, the coordinator will not transmit and the remote will return to sleep for another cycle. If queued data is transmitted back to the remote, it will stay awake to allow for back and forth communication until the ST (Time before Sleep) timer expires.

Also note that $\overline{\text{CTS}}$ will go low each time the remote wakes, allowing for communication initiated by the remote host if desired.

**Cyclic Sleep Remote with Pin Wake-up (SM = 5)**

Use this mode to wake a sleeping remote modem through either the RF interface or by the assertion of DTR for event-driven communications. The cyclic sleep mode works as described above (SM = 4) with the addition of a pin-controlled wake-up at the remote modem. The modem will wake quickly when a low is detected and set $\overline{\text{CTS}}$ low as soon as it is ready to transmit or receive. Any activity will reset the ST (Time before Sleep) timer so the modem will go back to sleep only after DTR is de-asserted and there is no activity for the duration of the timer.

**Cyclic Sleep Coordinator (SM = 6)**

- Typical current = Receive current
- Always awake

Use this mode to configure a modem to wake cyclic sleeping remotes through the RF interface. The cyclic sleep coordinator will accept a message addressed to a specific remote 16 or 64-bit address and hold it in a buffer until the remote wakes up and sends a poll to request the message. Messages that are not sent directly, must be buffered and requested are called "Indirect messages". The coordinator will only queue one indirect message at a time. The coordinator will hold the indirect message for a period 2.5 times the sleeping period indicated by the SP (Cyclic Sleep Period) parameter. The coordinator's SP parameter should be set to match the value used by the remotes. Also, the ST parameters of the coordinator and remotes should be set to the same value because the coordinator will track the 'awake' period of the recent 10 remotes to wake up. If the coordinator receives additional messages addressed to a remote that should be awake, the coordinator will send a direct message to that remote instead of queuing it. The coordinator is always awake so that any remote unit can transmit either a poll request or a data message at any time.

## 2.2.2. Command Mode

To modify or read RF Modem parameters, the modem must first enter into Command Mode - a state in which incoming characters are interpreted as commands. A robust set of AT Commands are available for programming and customizing the modem.

### AT Commands

**To Enter AT Command Mode:**

Send the 3-character command sequence "+++" and observe guard times before and after the command characters. [Refer to the "Default AT Command Mode Sequence" below.]

Default AT Command Mode Sequence (for transition to Command Mode):

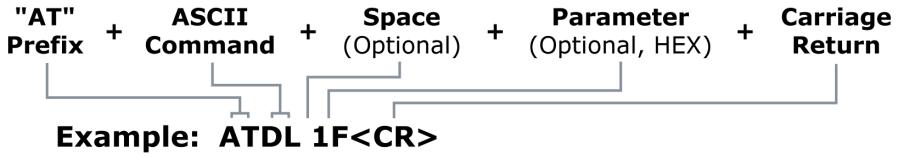
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]
- Input three plus characters ("+++") within one second [CC (Command Sequence Character) parameter = 0x2B.]
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8]

All of the parameter values in the sequence can be modified to reflect user preferences.

**To Send AT Commands:**

Send AT commands and parameters using the syntax shown below.

**Figure 2-02. Syntax for sending AT Commands**




To read a parameter value stored in the RF modem's register, leave the parameter field blank.

The preceding example would change the RF modem Destination Address (Low) to "0x1F". To store the new value to non-volatile (long term) memory, subsequently send the WR (Write) command.

For modified parameter values to persist in the modem's registry, changes must be saved to non-volatile memory using the WR (Write) Command. Otherwise, parameters are restored to previously saved values after the modem is powered off and then on again (or re-booted).

**System Response.** When a command is sent to the RF modem, the modem will parse and execute the command. Upon successful execution of a command, the modem returns an "OK" message. If execution of a command results in an error, the modem returns an "ERROR" message.

**To Exit AT Command Mode:**

1. Send ATCN (Exit Command Mode) Command.

   [OR]

2. If no valid AT Commands are received within the time specified by CT (Command Mode Timeout) Command, the RF modem automatically returns to Idle Mode.

For an example that illustrates programming the RF modem using AT Commands, refer to the "RF Modem Configuration" chapter [p12].

## 2.3. Networking Modes

Before transmitting data over-the-air, the RF modem will first undergo CCA (Clear Channel Assessment). If the CCA fails, the packet will not be transmitted.

### 2.3.1. Addressing Overview

Packets can be sent and received using a 16-bit or a 64-bit address (802.15.4 protocol). A unique 64-bit IEEE source address is assigned at the factory and can be read with the SL (Serial Number Low) and SH (Serial Number High) parameters.

To send a packet to a specific RF modem using 64-bit addressing, set the Destination Address (DL + DH) to match the Source Address (SL + SH) of the intended destination RF modem. To send a packet to a specific RF modem using 16-bit addressing, set the DL (Destination Address Low) parameter to the MY (Source Address) parameter and set the DH (Destination Address High) parameter to "0x00000000."

### 2.3.2. Unicast Mode

Unicast Mode enables acknowledged communications. While in this mode, receiving modems send an ACK (acknowledgement) of RF packet reception to the transmitter. If the transmitting modem does not receive the ACK, the transmitter will re-send the packet up to three times until the ACK is received.

Unicast Mode is the only mode that supports retries.

**Unicast Communications using 16-bit addressing**
The following table shows a sample configuration that would enable Unicast Mode communications using 16-bit short addresses.

**Table 2-02. Sample Unicast Configuration (using 16-bit addressing)**

| Parameter | RF Modem 1 | RF Modem 2 |
|---|---|---|
| MY (Source Address) | 0x01 | 0x02 |
| DH (Destination Address High) | 0 | 0 |
| DL (Destination Address Low) | 0x02 | 0x01 |

**Unicast Communications using 64-bit addressing**
The RF modem's serial number (SL parameter concatenated to the SH parameter) can be used as a 64-bit source address when the MY (16-bit Source Address) parameter is disabled. When the MY parameter is disabled (set MY to 0xFFFF), the modem's source address is set to the 64-bit IEEE address stored in the SH and SL parameters.

To send a packet to a specific modem, set the Destination Address (DL + DH) so it matches the Source Address (SL + SH) of the intended destination modem.

### 2.3.3. Broadcast Mode

Any RF modem will accept a packet that contains a broadcast address. When configured to operate in Broadcast Mode, receiving modems do not send ACKs (Acknowledgements) and transmitting RF modems do not automatically re-send packets as is the case in Unicast Mode.

To send a broadcast packet to all modems regardless of 16-bit or 64-bit addressing, set destination addresses of all the modems as shown below.

Sample Configuration (All modems in the network):

- DL (Destination Low Address) = 0x0000FFFF
- DH (Destination High Address) = 0x00000000

NOTE: When programming the modem, parameters are entered in hexadecimal notation (without the "0x" prefix). Leading zeros may be omitted.

For more information regarding RF modem parameter modification, refer to the "Command Mode" [p10] and "RF Modem Configuration" [p12] sections.

# 3. RF Modem Configuration

## 3.1. Programming the RF Modem

Refer to the "Command Mode" section [p10] for more information about entering Command Mode, sending AT commands and exiting Command Mode.

### 3.1.1. Programming Examples

**Setup**

The programming examples in this section require the installation of MaxStream's X-CTU Software and a USB connection to a PC.

1. Install MaxStream's X-CTU Software to a PC by double-clicking the "setup_X-CTU.exe" file. (The file is located on the MaxStream CD and under the 'Software' section of the following web page: www.maxstream.net/helpdesk/download.php)
2. Connect the RF modem to a PC.
3. Launch the X-CTU Software and select the 'PC Settings' tab. Verify the baud and parity settings of the Com Port match those of the RF modem.

NOTE: Failure to enter AT Command Mode is most commonly due to baud rate mismatch. Ensure the 'Baud' setting on the 'PC Settings' tab matches the interface data rate of the RF modem (by default, BD parameter = 3 (which corresponds to 9600 bps)).

**Sample Configuration: Modify RF Modem Destination Address**

Example: Utilize the 'Terminal' tab of the X-CTU Software to change the RF modem's DL (Destination Address Low) parameter and save the new address to non-volatile memory.

After establishing a serial connection between the RF modem and a PC [refer to the 'Setup' section above], select the 'Terminal' tab of the X-CTU Software and enter the following command lines ('CR' stands for carriage return):

Method 1 (One line per command))

| Send AT Command | System Response |
|---|---|
| +++ | OK <CR> (Enter into Command Mode) |
| ATDL <Enter> | {current value} <CR> (Read Destination Address Low) |
| ATDL1A0D <Enter> | OK <CR> (Modify Destination Address Low) |
| ATWR <Enter> | OK <CR> (Write to non-volatile memory) |
| ATCN <Enter> | OK <CR> (Exit Command Mode) |

Method 2 (Multiple commands on one line)

| Send AT Command | System Response |
|---|---|
| +++ | OK <CR> (Enter into Command Mode) |
| ATDL <Enter> | {current value} <CR> (Read Destination Address Low) |
| ATDL1A0D,WR,CN <Enter> | OK <CR> (Execute commands) |

**Sample Configuration: Restore RF Modem Defaults**

Example: Utilize the 'Modem Configuration' tab of the X-CTU Software to restore default parameter values of the RF modem.

After establishing a connection between the RF modem and a PC [refer to the 'Setup' section above], select the 'Modem Configuration' tab of the X-CTU Software.

1. Select the 'Read' button.
2. Select the 'Restore' button.

## 3.2. XBee-PRO Command Reference Table

**Table 3-01. XBee-PRO Commands** (RF modems expect numerical values in hexadecimal. Hexadecimal values are designated by the "0x" prefix. Decimal equivalents are designated by the "d" suffix.)

| AT Command | Command Category | Name and Description | Parameter Range | Default |
|---|---|---|---|---|
| BD | Serial Interfacing | **Interface Data Rate**. Set/Read the serial interface data rate for communications between the RF modem serial port and host. | 0 - 7<br>(custom rates also supported) | 3 |
| CC | AT Command Mode Options | **Command Sequence Character**. Set/Read the ASCII character value to be used between Guard Times of the AT Command Mode Sequence (GT+CC+GT). The AT Command Mode Sequence enters the RF modem to AT Command Mode. | 0 - 0xFF | 0x2B<br>('+' ASCII) |
| CH | Networking & Security | **Channel**. Set/Read the channel number used for transmitting and receiving between RF modems. Uses 802.15.4 protocol channel numbers. | 0x0C - 0x18 | 0x0C (12d) |
| CN | AT Command Mode Options | **Exit Command Mode**. Explicitly exit AT Command Mode. | - | - |
| CT | AT Command Mode Options | **Command Mode Timeout.** Set/Read the period of inactivity (no valid commands received) after which the RF modem automatically exits AT Command Mode and returns to Idle Mode. | 2 - 0xFFFF [x 100 ms] | 0x64 (100d) |
| DB | Diagnostics | **Received Signal Strength**. Read signal level [in dB] of last good packet received (RSSI). Absolute value is reported. (For example: 0x58 = -88 dBm) Reported value is accurate between -40 dBm and RX sensitivity. | 0 - 0x64 [read-only] | - |
| DH | Networking & Security | **Destination Address High**. Set/Read the upper 32 bits of the 64-bit destination address. When combined with DL, it defines the destination address used for transmission. To transmit using a 16-bit address, set DH parameter to zero and DL less than 0xFFFF. 0x000000000000FFFF is the broadcast address for the PAN. | 0 - 0xFFFFFFFF | 0 |
| DL | Networking & Security | **Destination Address Low**. Set/Read the lower 32 bits of the 64-bit destination address. When combined with DH, DL defines the destination address used for transmission. To transmit using a 16-bit address, set DH parameter to zero and DL less than 0xFFFF. 0x000000000000FFFF is the broadcast address for the PAN. | 0 - 0xFFFFFFFF | 0 |
| GT | AT Command Mode Options | **Guard Times**. Set required period of silence before and after the Command Sequence Characters of the AT Command Mode Sequence (GT+ CC + GT). The period of silence is used to prevent inadvertent entrance into AT Command Mode. | 0x02 - 0xFFFF [x 1 ms] | 0x3E8<br>(1000d) |
| ID | Networking & Security | **PAN ID**. Set/Read the PAN (Personal Area Network) ID.<br>0xFFFF indicates a message for all PANs. | 0xFFFF | 0x3332<br>(13106d) |
| MY | Networking & Security | **16-bit Source Address.** Set/Read the RF modem 16-bit source address. Set MY = 0xFFFF to disable reception of packets with 16-bit addresses. 64-bit source address (serial number) and broadcast address (0x000000000000FFFF) is always enabled. | 0 - 0xFFFF | 0 |
| P0 | Diagnostics | **PWM0 Configurations.** Select/Read function for PWM0. | 0 - 1 | 1 |
| PL | RF Interfacing | **Power Level.** Select/Read power level at which the RF modem transmits. | 0 - 4 | 4 |
| RE | (Special) | **Restore Defaults.** Restore RF modem parameters to factory defaults. Follow with WR command to save values to non-volatile memory. | - | - |
| RN | Networking & Security | **Random Delay Slots.** Set/Read the minimum value of the back-off exponent in the CSMA-CA algorithm that is used for collision avoidance. If RN = 0, collision avoidance is disabled during the first iteration of the algorithm (802.15.4 - macMinBE). | 0 - 3 | 0 |
| RO | Serial Interfacing | **Packetization Timeout**. Set/Read number of character times of inter-character delay required before transmission. Set to zero to transmit characters as they arrive instead of buffering them into one RF packet. | 0 - 0xFF [x character times] | 3 |
| RP | Diagnostics | **RSSI PWM Timer.** Enable a PWM (pulse width modulation) output (on pin 3 of the RF modems) which shows RX signal strength. | 0 - 0xFF [x 100 ms] | 0x28 (40d) |
| SH | Diagnostics | **Serial Number High**. Read high 32 bits of the RF modem's unique IEEE 64-bit address. 64-bit source address is always enabled. | 0 - 0xFFFFFFFF [read-only] | Factory-set |
| SL | Diagnostics | **Serial Number Low**. Read low 32 bits of the RF modem's unique IEEE 64-bit address. 64-bit source address is always enabled. | 0 - 0xFFFFFFFF [read-only] | Factory-set |
| SM | Sleep (Low Power) | **Sleep Mode**. Set/Read Sleep Mode configurations. | 0 - 6 | 0 |
| SP | Sleep (Low Power) | **Cyclic Sleep Period.** Set/Read sleep period for cyclic sleeping remotes. Maximum sleep period is 268 seconds (0x68B0). | 0x01 - 0x68B0 [x 10 ms] | 0x64 (100d) |
| ST | Sleep (Low Power) | **Time before Sleep.** Set/Read time period of inactivity (no serial or RF data is sent or received) before activating Sleep Mode. The ST parameter is only valid with Cyclic Sleep settings (SM = 4 - 6). Set ST on Cyclic Sleep Coordinator to match Cyclic Sleep Remotes. | 0x01 - 0xFFFF [x 1 ms] | 0x1388<br>(5000d) |
| VR | Diagnostics | **Firmware Version**. Read firmware version of the RF modem. | 0 - 0xFFFF [read-only] | Factory-set |
| WR | (Special) | **Write**. Write parameter values to RF modem's non-volatile memory so that modifications persist through subsequent power-up or reset. | - | - |

## 3.3. XBee-PRO Command Descriptions

Command descriptions in this section are listed alphabetically. Command categories are designated within "< >" symbols that follow each command title. XBee-PRO RF Modems expect parameter values in hexadecimal (designated by the "0x" prefix).

### BD (Interface Data Rate) Command

<Serial Interfacing> The BD command is used to set and read the serial interface data rate (baud rate) used between the RF modem and host. This parameter determines the rate at which serial data is sent to the RF modem from the host. Modified interface data rates do not take effect until the CN (Exit AT Command Mode) command is issued and the system returns the 'OK' response.

When parameters 0-7 are sent to the RF modem, the respective interface data rates are used (as shown in the table on the right).

The RF data rate is not affected by the BD parameter. If the interface data rate is set higher than the RF data rate, a flow control configuration may need to be implemented.

AT Command: ATBD

Parameter Range: 0 – 7 (standard rates)

| Parameter | Configuration (bps) |
|---|---|
| 0 | 1200 |
| 1 | 2400 |
| 2 | 4800 |
| 3 | 9600 |
| 4 | 19200 |
| 5 | 38400 |
| 6 | 57600 |
| 7 | 115200 |

Default Parameter Value:3

**Non-standard Interface Data Rates:**
When parameter values outside the range of standard baud rates are sent, the closest interface data rate represented by the number is stored in the BD register. For example, a rate of 19200 bps can be set by sending the following command line "ATBD4B00". NOTE: When using MaxStream's X-CTU Software, non-standard interface data rates can only be set and read using the X-CTU 'Terminal' tab. Non-standard rates are not accessible through the 'Modem Configuration' tab.

When the BD command is sent with a non-standard interface data rate, the UART will adjust to accommodate the requested interface rate. In most cases, the clock resolution will cause the stored BD parameter to vary from the parameter that was sent (refer to the table below). Reading the BD command (send "ATBD" command without an associated parameter value) will return the value that was actually stored to the BD register.

**Table 3-02. Parameters Sent Versus Parameters Stored**

| BD Parameter Sent (HEX) | Interface Data Rate (bps) | BD Parameter Stored (HEX) |
|---|---|---|
| 0 | 1200 | 0 |
| 4 | 19,200 | 4 |
| 7 | 115,200 | 7 |
| 12C | 300 | 12B |
| 1C200 | 115,200 | 1B207 |

### CC (Command Sequence Character) Command

<AT Command Mode Options> The CC command is used to set and read the ASCII character used between guard times of the AT Command Mode Sequence (GT + CC + GT). This sequence enters the RF modem into AT Command Mode so that data entering the modem from the host is recognized as commands instead of payload.

AT Command: ATCC

Parameter Range: 0 – 0xFF

Default Parameter Value: 0x2B (ASCII "+")

Related Commands: GT (Guard Times)

Refer to the Command Mode section [p10] for more information regarding the AT Command Mode Sequence.

### CH (Channel) Command

<Networking & Security> The CH command is used to set and read the channel on which RF connections are made between RF modems. The channel is one of three network layers available to the RF modem. The other layers are the PAN ID (ID command) and destination addresses (DL & DH commands).

| |
|---|
| AT Command: ATCH |
| Parameter Range: 0x0C – 0x18 |
| Default Parameter Value: 0x0C (12 decimal) |
| Related Commands: ID (PAN ID), DL (Destination Address Low, DH (Destination Address High) |

In order for RF modems to communicate with each other, the RF modems must share the same channel number. Different channels can be used to prevent RF modems in one network from listening to transmissions of another.

*The RF modem uses channel numbers of the 802.15.4 standard.*

*Center Frequency = 2.405 + (CH - 11d) * 5 MHz (d = decimal)*

Refer to the "Addressing Overview" section [p11] for more information.

### CN (Exit AT Command Mode) Command

<AT Command Mode Options> The CN command is used to explicitly exit the RF modem from AT Command Mode.

| |
|---|
| AT Command: ATCN |

### CT (Command Mode Timeout) Command

<AT Command Mode Options> The CT command is used to set and read the amount of inactive time that elapses before the RF modem automatically exits from AT Command Mode and returns to Idle Mode.

Use the CN (Exit AT Command Mode) command to exit AT Command Mode manually.

| |
|---|
| AT Command: ATCT |
| Parameter Range: 2 – 0xFFFF [x 100 milliseconds] |
| Default Parameter Value: 0x64 (100 decimal, which equals 10 decimal seconds) |
| Number of bytes returned: 2 |
| Related Command: CN (Exit AT Command Mode) |

### DB (Received Signal Strength) Command

<Diagnostics> The DB parameter is used to read the received signal strength (in dBm) of the last RF packet received. Reported values are accurate between -40 dBm and the RF modem's receiver sensitivity.

| |
|---|
| AT Command: ATDB |
| Parameter Range: 0 – 0x64 [read-only] |

Absolute values are reported. For example: 0x58 = -88 dBm. If no packets have been received (since last reset, power cycle or sleep event), "0" will be reported.

### DH (Destination Address High) Command

<Networking & Security> The DH command is used to set and read the upper 32 bits of the RF modem's 64-bit destination address. When combined with the DL (Destination Address Low) parameter, it defines the destination address used for transmission.

| |
|---|
| AT Command: ATDH |
| Parameter Range: 0 – 0xFFFFFFFF |
| Default Parameter Value: 0 |
| Related Commands: DL (Destination Address Low), CH (Channel), ID (PAN VID), MY (Source Address) |

RF modems will only communicate with other RF modems having the same channel (CH parameter), PAN ID (ID parameter) and destination address (DH + DL parameters).

To transmit using a 16-bit address, set the DL parameter to zero and the DH parameter less than 0xFFFF. 0x000000000000FFFF (DH concatenated to DL) is the broadcast address for the PAN.

Refer to the "Addressing Overview" section [p11] for more information.

### DL (Destination Address Low) Command

<Networking & Security> The DL command is used to set and read the lower 32 bits of the RF modem's 64-bit destination address. When combined with the DH (Destination Address High) parameter, it defines the destination address used for transmission.

| |
|---|
| AT Command: ATDL |
| Parameter Range: 0 - 0xFFFFFFFF |
| Default Parameter Value: 0 |
| Related Commands: DH (Destination Address High), CH (Channel), ID (PAN VID), MY (Source Address) |

RF modems will only communicate with other RF modems having the same channel (CH parameter), PAN ID (ID parameter) and destination address (DH + DL parameters).

To transmit using a 16-bit address, set the DL parameter to zero and the DH parameter less than 0xFFFF. 0x000000000000FFFF (DH concatenated to DL) is the broadcast address for the PAN.

Refer to the "Addressing Overview" section [p11] for more information.

### GT (Guard Times) Command

<AT Command Mode Options> GT Command is used to set the DI (data in from host) time-of-silence that surrounds the AT command sequence character (CC Command) of the AT Command Mode sequence (GT + CC + GT).

| |
|---|
| AT Command: ATGT |
| Parameter Range: 0x02 – 0xFFFF [x 1 millisecond] |
| Default Parameter Value: 0x3E8 |
| Related Commands: CC (Command Sequence Character) |

The DI time-of-silence is used to prevent inadvertent entrance into AT Command Mode.

Refer to the Command Mode section [p10] for more information regarding the AT Command Mode Sequence.

### ID (Pan ID) Command

<Networking & Security> The ID command is used to set and read the PAN (Personal Area Network) ID of the RF modem. Only RF modems with matching PAN IDs can communicate with each other. RF modems with non-matching PAN IDs will not receive unintended data transmission.

| |
|---|
| AT Command: ATID |
| Parameter Range: 0 – 0xFFFF |
| Default Parameter Value: 0x3332 (13106 decimal) |

Setting ID to 0xFFFF indicates a global message for all PANs.

Refer to the "Addressing Overview" section [p11] for more information.

### MY (16-bit Source Address) Command

<Networking & Security> The MY command is used to set and read the 16-bit source address of the RF modem.

By setting MY to 0xFFFF, the reception of RF packets having a 16-bit address is disabled. The 64-bit address is the module serial number and is always enabled.

| |
|---|
| AT Command: ATMY |
| Parameter Range: 0 – 0xFFFF |
| Default Parameter Value: 0 |
| Related Commands: DH (Destination Address High), DL (Destination Address Low), CH (Channel), ID (PAN ID) |

Refer to the "Addressing Overview" section [p11] for more information.

### P0 (PWM0 Configuration) Command

<Diagnostics> The P0 command is used to select and read the function for PWM0 (Pulse Width Modulation output 0 - pin 6).

Note: The second character in the command is a zero ("0"), not the letter "O".

AT Command: ATP0

Parameter Range: 0 – 1

| Parameter | Configuration |
|---|---|
| 0 | Disabled |
| 1 | RSSI PWM0 enabled |

Default Parameter Value: 1

### PL (Power Level) Command

<RF Interfacing> The PL command is used to select and read the power level at which the RF modem transmits (conducted power).

AT Command: ATPL

Parameter Range: 0 – 4

| Parameter | Configuration |
|---|---|
| 0 | 10 dBm |
| 1 | 12 dBm |
| 2 | 14 dBm |
| 3 | 16 dBm |
| 4 | 18 dBm |

Default Parameter Value: 4

### RE (Restore Defaults) Command

<(Special)> The RE command is used to restore all configurable parameters to their factory default settings. The RE command does not write restored values to non-volatile (persistent) memory. Issue the WR (Write) command after issuing the RE command to save restored parameter values to non-volatile memory.

AT Command: ATRE

### RN (Random Delay Slots) Command

<Networking & Security> The RN command is used to set and read the minimum value of the back-off exponent in the CSMA-CA algorithm. The CSMA-CA algorithm was engineered for collision avoidance (random delays are inserted to prevent data loss caused by data collisions).

AT Command: ATRN

Parameter Range: 0 – 3

Default Parameter Value: 0

If RN = 0, collision avoidance is disabled during the first iteration of the algorithm (802.15.4 - macMinBE).

CSMA-CA stands for "Carrier Sense Multiple Access - Collision Avoidance". Unlike CSMA-CD (reacts to network transmissions after collisions have been detected), CSMA-CA acts to prevent data collisions before they occur. As soon as a modem receives a packet that is to be transmitted, it checks if the channel is clear (no other modem is transmitting). If the channel is clear, the packet is sent over-the-air. If the channel is not clear, the RF modem waits for a randomly selected period of time, then checks again to see if the channel is clear. After a time, the process ends and the data is lost.

### RO (Packetization Timeout) Command

<Serial Interfacing> The RO command is used to set and read the number of character times of inter-character delay required before transmission. RF transmission commences when data is detected in the DI (data in from host) buffer and RO character times of silence are detected on the UART receive lines (after receiving at least 1 byte).

AT Command: ATRO

Parameter Range: 0 – 0xFF [x character times]

Default Parameter Value: 3

(RF transmission will also commence when 100 bytes (maximum packet size) are received in the DI buffer.)

Set the RO parameter to '0' to transmit characters as they arrive instead of buffering them into one RF packet.

### RP (RSSI PWM Timer) Command

<Diagnostics> The RP command is used to enable PWM (Pulse Width Modulation) output on the RF modem. The output is calibrated to show the level a received RF signal is above the sensitivity level of the RF modem. The PWM pulses vary from zero to 95 percent. Zero to twenty-nine percent means the received RF signal is at or below the published sensitivity level of the RF modem. The following table shows levels above sensitivity and PWM values.

AT Command: ATRP

Parameter Range: 0 – 0xFF [x 100 milliseconds]

Default Parameter Value: 0x28 (40 decimal)

The total period of the PWM output is 8.32 ms. Because there are 40 steps in the PWM output, the minimum step size is 0.208 ms.

**Table 3-03. PWM Percentages**

| dB above Sensitivity | PWM percentage* (high period / total period) |
|---|---|
| 10 | 46.0% |
| 20 | 63.0% |
| 30 | 80.1% |

* PWM% = (295 + (17.5 * dBm above sensitivity)) / 10.24

A non-zero value defines the time that the PWM output will be active with the RSSI value of the last received RF packet. After the set time when no RF packets are received, the PWM output will be set low (0 percent PWM) until another RF packet is received. The PWM output will also be set low at power-up until the first RF packet is received. A parameter value of 0xFF permanently enables the PWM output and it will always reflect the value of the last received RF packet.

### SH (Serial Number High) Command

<Diagnostics> The SH command is used to read the high 32 bits of the RF modem's unique IEEE 64-bit address.

The RF modem serial number is set at the factory and is read-only.

AT Command: ATSH

Parameter Range: 0 – 0xFFFFFFFF [read–only]

Related Commands: SL (Serial Number Low), MY (Source Address)

### SL (Serial Number Low) Command

<Diagnostics> The SL command is used to read the low 32 bits of the RF modem's unique IEEE 64-bit address.

The RF modem serial number is set at the factory and is read-only.

AT Command: ATSL

Parameter Range: 0 – 0xFFFFFFFF [read–only]

Related Commands: SH (Serial Number High), MY (Source Address)

### SM (Sleep Mode) Command

<Sleep Mode (Low Power)> The SM command is used to set and read RF modem Sleep Mode settings. By default, Sleep Modes are disabled (SM = 0) and the RF modem remains in Idle/Receive Mode. When in this state, the RF modem is constantly ready to respond to either serial or RF activity.

AT Command: ATSM

Parameter Range: 0 – 6

| Parameter | Configuration |
|---|---|
| 0 | Disabled |
| 1 | Pin Hibernate |
| 2 | Pin Doze |
| 3 | (reserved) |
| 4 | Cyclic Sleep Remote |
| 5 | Cyclic Sleep Remote (with Pin Wake-up) |
| 6 | Cyclic Sleep Coordinator |

Default Parameter Value: 0

Related Commands: SP (Cyclic Sleep Period), ST (Time before Sleep)

### SP (Cyclic Sleep Period) Command

<Sleep Mode (Low Power)> The SP command is used to set and read the duration of time in which a remote RF modem sleeps. After the cyclic sleep period is over, the RF modem wakes and checks for data. If data is not present, the RF modem goes back to sleep. The maximum sleep period is 268 seconds (SP = 0x68B0).

The SP parameter is only valid if the RF modem is configured to operate in Cyclic Sleep (SM = 4-6).

AT Command: ATSP

Parameter Range: 1 – 0x68B0 [x 10 milliseconds]

Default Parameter Value: 0x64 (100 decimal)

Related Commands: SM (Sleep Mode), ST (Time before Sleep)

### ST (Time before Sleep) Command

<Sleep Mode (Low Power)> The ST command is used to set and read the period of time that the RF modem remains inactive (no transmitting or receiving) before entering into Sleep Mode.

For example, if the ST parameter is set to its default value of 0x1388 (5000 decimal), the RF modem will enter into Sleep mode after 5 seconds of inactivity. This command can only be used if Cyclic Sleep settings have been selected using SM (Sleep Mode) Command (SM = 4-6).

AT Command: ATST

Parameter Range: 1 – 0xFFFF [x 1 millisecond]

Default Parameter Value: 0x1388 (5000 decimal)

Related Commands: SM (Sleep Mode), SP (Cyclic Sleep Period)

### VR (Firmware Version) Command

<Diagnostics> The VR command is used to read which firmware version is stored in the RF modem.

AT Command: ATVR

Parameter Range: 1 – 0xFFFF [read only]

### WR (Write) Command

<(Special)> The WR command is used to write configurable parameters to the RF modem's non-volatile memory (Parameter values remain in RF modem's memory until overwritten by subsequent use of the WR Command).

AT Command: ATWR

If changes are made without writing them to non-volatile memory, the RF modem reverts back to previously saved parameters the next time the RF modem is powered-on.

# Appendix A: Agency Certifications

## FCC Certification (pending)

The XBee-PRO RF Modem complies with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

To fulfill FCC Certification requirements, the OEM must comply with the following regulations:

1. The system integrator must ensure that the text on the external label provided with this device is placed on the outside of the final product [Figure A-01].
2. The XBee-PRO RF Modem may be used only with approved antennas that have been tested with this modem.

### OEM Labeling Requirements

WARNING: The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown in the figure below.

**Figure A-01. Required FCC Label for OEM products containing the XBee-PRO RF Modem**

Contains FCC ID: PENDING

The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

### FCC Notices

**IMPORTANT:** The XBee-PRO USB RF Modem has been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by MaxStream could void the user's authority to operate the equipment.

**IMPORTANT:** OEMs must test final product to comply with unintentional radiators (FCC section 15.107 & 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

**IMPORTANT:** The RF modem has been certified for remote and base radio applications. If the modem will be used for portable applications, the device must undergo SAR testing.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Re-orient or relocate the receiving antenna, Increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or Consult the dealer or an experienced radio/TV technician for help.

# European Certification (pending)

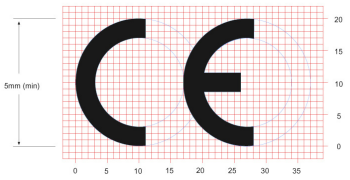
The XBee-PRO RF Modem has been certified for use in several European countries. For a complete list, refer to www.maxstream.net.

If the XBee-PRO RF Modems are incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive. Furthermore, the manufacturer must maintain a copy of the XBee-PRO user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

## OEM Labeling Requirements

The 'CE' marking must be affixed to a visible location on the OEM product.

**Figure A-02. CE Labeling Requirements**




The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

## Restrictions

France - France imposes restrictions on the 2.4 GHz band. Go to www.art-telecom.Fr or contact MaxStream for more information.

Norway - Norway prohibits operation near Ny-Alesund in Svalbard. More information can be found at the Norway Posts and Telecommunications site (www.npt.no).

## Declarations of Conformity

MaxStream has issued Declarations of Conformity for the XBee-PRO RF Modems concerning emissions, EMC and safety. Files are located in the 'documentation' folder of the MaxStream CD.

Important Note

MaxStream does not list the entire set of standards that must be met for each country. MaxStream customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. For more information relating to European compliance of an OEM product incorporating the XBee-PRO RF Modem, contact MaxStream, or refer to the following web sites:

CEPT ERC 70-03E - Technical Requirements, European restrictions and general requirements: Available at www.ero.dk/.

R&TTE Directive - Equipment requirements, placement on market: Available at www.ero.dk/.

# Appendix B: Additional Information

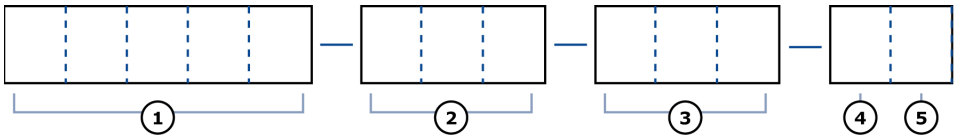
## 1-Year Warranty

XBee-PRO RF Modems from MaxStream, Inc. (the "Product") are warranted against defects in materials and workmanship under normal use, for a period of 1-year from the date of purchase. In the event of a product failure due to materials or workmanship, MaxStream will repair or replace the defective product. For warranty service, return the defective product to MaxStream, shipping prepaid, for prompt repair or replacement.

The foregoing sets forth the full extent of MaxStream's warranties regarding the Product. Repair or replacement at MaxStream's option is the exclusive remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND MAXSTREAM SPECIFICALLY DISCLAIMS ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MAXSTREAM, ITS SUPPLIERS OR LICENSORS BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS, OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES. THEREFORE, THE FOREGOING EXCLUSIONS MAY NOT APPLY IN ALL CASES. This warranty provides specific legal rights. Other rights which vary from state to state may also apply.

## Ordering Information

**Figure B-01. Divisions of the XBee-PRO RF Modem Part Numbers**




**1 Product Family**
XBP24 = XBee-PRO 2.4 GHz

**2 Temperature Rating**
PKC = Commercial (0 to 70° C)
PKI = Industrial (-40 to 85° C)
PKD = Class I, Division 2

**3 Protocol**
001 = 802.15.4
002 = ZigBee

**4 Interface**
R = RS-232
U = USB

**5 Accessories Package**
A = Accessories package (specific to Interface) included
(blank) means the accessories package is not included

For example:

XBP24-PKC-001-UA = XBee-PRO RF Modem (2.4 GHz), Commercial temperature rating, IEEE 802.15.4 standard, USB Interface w/ accessories

## Contact MaxStream

Free and unlimited technical support is included with every MaxStream Radio Modem sold.

For the best in wireless data solutions and support, please use the following resources:

| | | |
|---|---|---|
| Documentation: | www.maxstream.net/helpdesk/download.php | |
| Technical Support: | Phone. | (866) 765-9885 toll-free U.S.A. & Canada<br>(801) 765-9885 Worldwide |
| | Live Chat. | www.maxstream.net |
| | E-Mail. | rf-xperts@maxstream.net |

MaxStream office hours are 8:00 am - 5:00 pm [U.S. Mountain Standard Time]