XBee XTender™ RF Bridge

Product Manual v1.x2x

For RF Bridge Part Numbers: XBXT-PKI-U, XBXT-PKI-UA
XBXTH-PKI-U, XBXTH-PKI-UA

Stand-alone RF Bridge for connecting XBee and 9XTend Data Radio Networks

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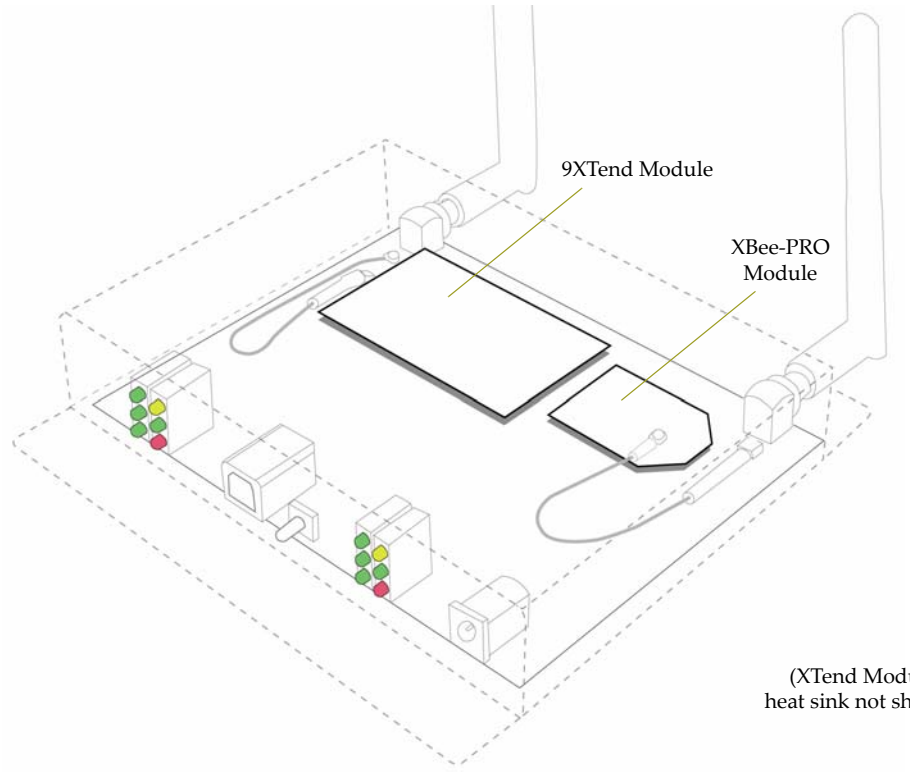
1. XBee XTender RF Bridge

OEMs and system integrators can now extend the reach of ZigBee/802.15.4 networks using MaxStream's XBee XTender RF Bridge. The bridge couples the flexibility of ZigBee/802.15.4 networks with the long range capabilities of MaxStream's 1 Watt 9XTend RF Module.

The RF bridge houses one XBee-PRO and one 9XTend Module. The bridging of data between the embedded modules is bidirectional and allows data to be passed seamlessly from one RF protocol to the other. The XBee-PRO operates within the ISM 2.4 GHz frequency band and the 9XTend within the ISM 900 MHz band.

Figure 1-01. Inside View of the RF Bridge



1.1. Worldwide Acceptance

FCC Approval (USA) Refer to Appendix A [p26] for FCC Requirements. Systems that contain the XBee XTender RF Bridge inherit MaxStream certifications.

ISM (Industrial, Scientific & Medical) 900 MHz & 2.4 GHz frequency bands

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

The XBee XTender RF Bridge is optimized for use in the **US**, **Canada**, **Australia and Israel** (contact MaxStream for complete list of agency approvals).

1.2. Specifications

Table 1-01. Specifications of the XBee XTender RF Bridge

Specification	XBee XTender RF Bridge
Power Requirements	
Supply Voltage	7 - 28 VDC
Operating Current (Transmit) on the 9XTend	1.2 A (@ 9 VDC)
Operating Current (Receive) on the 9XTend	200 mA (@ 9 VDC)
General	
Operating Frequencies	ISM 2.4 GHz (XBee-PRO) and 900 MHz (9XTend)
Dimensions	5.52" x 5.53" x 1.14" (14.02cm x 14.05cm x 2.89cm)
Weight	11 oz. (312 g)

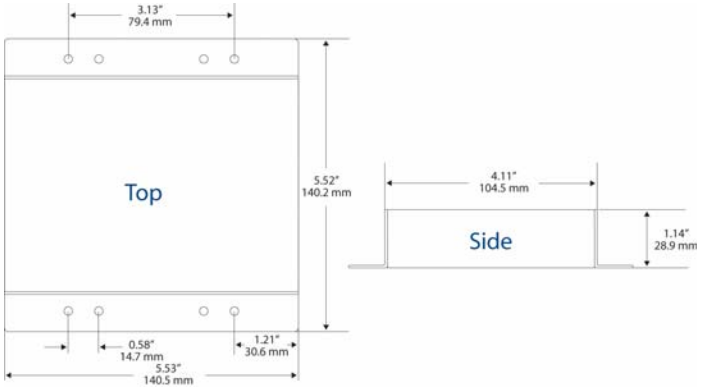
Table 1-02. Specifications of the Embedded OEM RF Modules

Specification	XBee-PRO OEM RF Module	9XTend OEM RF Module
Performance		
Range: Indoor/Urban	up to 300' (100 m)	up to 3000' (900 m)
Range: Outdoor RF line-of-sight (w/ 2.1 dB dipole antenna)	up to 1 mile (1500 m)	up to 14 miles (22 km) (up to 40 miles (64 km) with high-gain antenna)
RF Data Rate	up to 250,000 bps	up to 125,000 bps
Serial Interface Data Rate* (software selectable)	1200 - 115200 bps (non-standard baud rates also supported)	10 - 230400 bps (non-standard baud rates also supported)
Receiver Sensitivity	-99 dBm (@250,000 bps RF data rate)	-99 dBm (@125,000 bps RF data rate)
General		
Operating Frequency	ISM 2.4 GHz	ISM 900 MHz
Operating Temperature	-40 to 85º C (industrial)	-40 to 85º C (industrial)
Agency Certifications		
United States (FCC Part 15.247)	pending	pending
Industry Canada (IC)	pending	pending

* Both embedded RF modules ship with their BD (Interface Data Rate) parameters set to 7 (115200 bps).

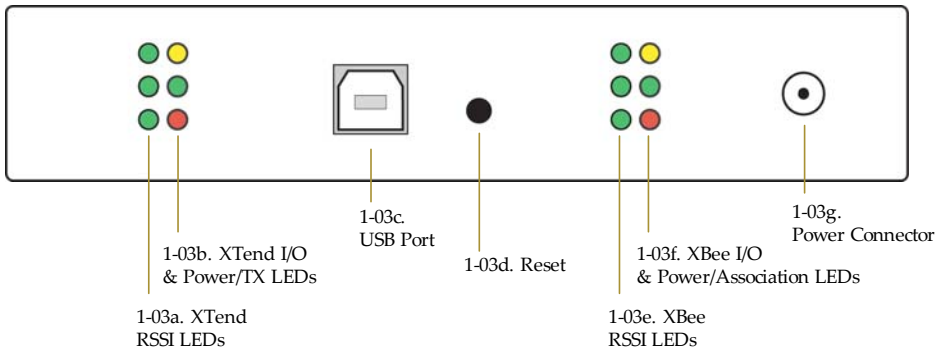
1.2.1. Mechanical Drawings

Figure 1-02. Mechanical Drawings of the XBee XTender RF Bridge



1.3. External Interface

Figure 1-03. Front View



1-03a. XTend 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 bridge'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) or no data received

1-03b. XTend I/O and Power/TX LEDs

LEDs indicate RF bridge activity as follows:

Yellow (top LED)	=	Serial Data Out (to XBee Module)
Green (middle)	=	Serial Data In (from XBee Module)
Red (bottom)	=	Power/TX (Transmit) Indicator - This LED is on when the bridge is powered; it pulses on/off during RF transmission.

1-03c. USB Port

Standard Type-B OEM connector is used for configuring, updating and monitoring the embedded OEM RF modules (using MaxStream's X-CTU Software terminal).

1-03d. Reset

The Reset Switch is used to reset (re-boot) the RF bridge. This switch only applies when using the 'Terminal' tab of the X-CTU Software.

1-03e. XBee RSSI LEDs

RSSI LEDs indicate the amount of fade margin present in an active wireless link - refer to the values cited under the "1-03a. XTend RSSI LEDs" description.

1-03f. XBee I/O & Power/Association LEDs

LEDs indicate RF bridge activity as follows:

Yellow (top LED)	=	Serial Data Out (to XTend Module)
Green (middle)	=	Serial Data In (from XTend Module)
Red (bottom)	=	Power/Association Indicator - LED blinks 1x/sec when the bridge is powered and 2x/sec when the embedded XBee-PRO Module is associated to an XBee/XBee-PRO Coordinator.

1-03g. Power Connector

7 - 28 VDC power connector

The antenna ports on the back side of the RF bridge are 50Ω RF signal connectors. The connector type is RPSMA (Reverse Polarity SMA) female. Both connectors have threads on the outside of a barrel and a male center conductor.

1.4. Quick Start Guide

This section provides step-by-step instruction on how to setup a bridged RF link.

Hardware Requirements:

- 1 XBee XTender RF Bridge
- 1 XBee RF Module Assembly
  (XBee or XBee-PRO RF Module mounted to an RS-232 interface board (part# XBIB-R))
- 1 XTend RF Module Assembly
  (9XTend RF Module mounted to an RS-232 Interface Board (part# XTIB-R))
- Accessories (1 Serial Loopback Adapter, 1 RS-232 cable, 4 Antennas and 3 power supplies)
  Power supply voltages: XBee XTender RF Bridge (7-28 VDC), XTend RF Module Assembly (7-28 VDC), XBee RF Module Assembly (5-14 VDC)
- Host PC (Windows 2000 or XP) with an available USB port and loaded with X-CTU Software

Software Setup

Configure the RF modules in the bridged RF link using the following parameter values:

Table 1-03. RF Module Profiles (use default parameter values for all parameters not noted)

RF Module Parameter	Base	RF Bridge		Remote
	9XTend	9XTend	XBee-PRO	XBee/XBee-PRO
AP (API Enable)	0 (API disabled)	0 (API disabled)	1 (API enabled)	0 (API disabled)
BD (Interface Data Rate)	7 (115,200 bps)	7 (115,200 bps)	7 (115,200 bps)	7 (115,200 bps)

Hardware Setup

In this example, the 9XTend Module functions as the base (connected to the host PC) and the XBee Module as the remote. A USB connection can be used in lieu of the RS-232 connection to connect the base module to a host PC.

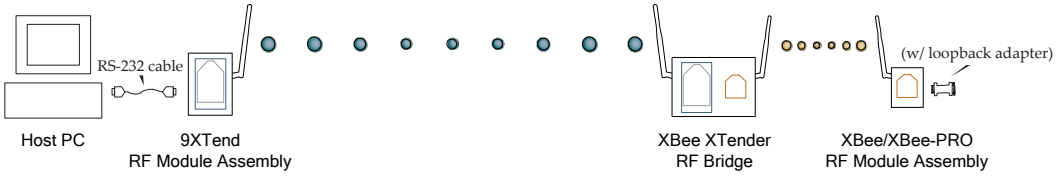
WARNING:
When 9XTend Modules are operating at 1 Watt power output, observe a minimum separation distance of 2' (0.6m) between 9XTend modules. Transmitting in close proximity of other modules can damage module front ends.

1. Base Setup: Mount a 9XTend Module to an XTend RS-232 interface board (XTIB-R) and connect the RF module assembly to the RS-232 port of a host PC.

   Set switches 1, 5 & 6 of the XTend RS-232 interface board DIP switch to their ON (up) positions and all remaining switches OFF (down).

2. Remote Setup: Mount an XBee or XBee-PRO Module to an RS-232 interface board and connect the serial loopback adapter to its serial port (the loopback adapter configures the module assembly to function as a repeater by looping data back into the module for re-transmission).
3. Verify an antenna is connected to each of the four modules in the link and each of the three nodes is powered.

Figure 1-04. Bridged RF Links



Begin Range Test and Monitor Communications

1. Launch MaxStream's X-CTU Software version 5.0.2.0 or later (after installing the X-CTU Software [p10] and USB drivers [p14]).
2. Select the "PC Settings" tab and verify the 'Baud', 'Data Bits', 'Parity' and 'Stop Bits' values are compatible with parameter values of the base module [Figure 1-03].
3. Select the Com Port from the list that will be used to connect to the base.
4. Check the 'Enable API' check box.
5. Select the "Range Test" tab and enter '0' (zero) in the 'Destination Address' text field. Enter a text string such as 'test' in the 'TX Data' field (test will fail if no value is entered).
6. Select the 'Start' button to begin range test.

   Use the diagnostic tools on the "Range Test" tab to monitor communications.

   Observe the RSSI LEDs on each node to determine RF link quality. Observe the TX/RX LEDs to monitor data transmission and reception [refer to Figure 1-03 on p6].

2. RF Bridge Operation

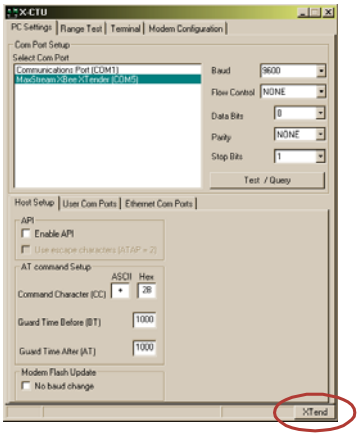
2.1. Serial Communications

When RF data is received on either of the RF bridge antennas, the data is seamlessly carried across the bridge and transmitted out of the other antenna. The USB interface can be used to monitor data traffic without interfering with normal bridge operation. Data can be monitored in either direction (XBee --> XTend or XTend --> XBee), but not both directions at the same time.

The RTS and DTR lines of the RF bridge control I/O lines of the embedded RF modules. The state of the RTS and DTR lines can be controlled using a button located on the bottom-right of MaxStream's X-CTU Software interface.

When clicked, the button label changes and consequently the states of the RTS and DTR lines is also changed as reflected in the table and data flow diagrams below.

For more information regarding the X-CTU Software, refer to p10.



2.1.1. Internal Data Flow

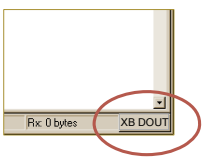
Table 2-01. Pin Signals

X-CTU Button Label	RTS	DTS	Description
XB DOUT	De-asserted (low)	De-asserted (low)	Monitor XBee-PRO data out communications. The "XB DOUT" button option is only available on the X-CTU Terminal tab. [Figure 2-01]
XT DOUT	Asserted (high)	Asserted (high)	Monitor 9XTend data out communications The "XT DOUT" button option is only available on the X-CTU Terminal tab. [Figure 2-02]
XBee	Asserted (high)	De-asserted (low)	Configure XBee-PRO Module parameters [Figure 3-03]
XTend	De-asserted (low)	Asserted (high)	Configure 9XTend Module parameters [Figure 3-04]

Figure 2-01. Data Flow Diagram (RF Data Received by the XBee-PRO Module)

"XB DOUT" button (only available on the X-CTU Terminal tab)

RTS de-asserted (low)
DTR de-asserted (low)



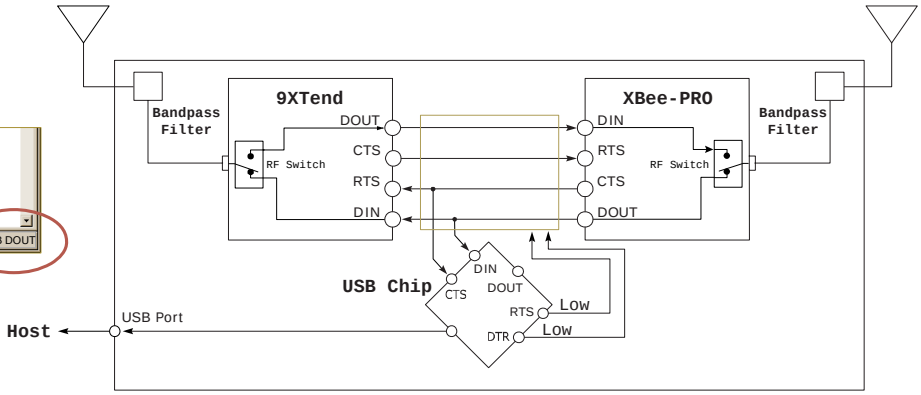
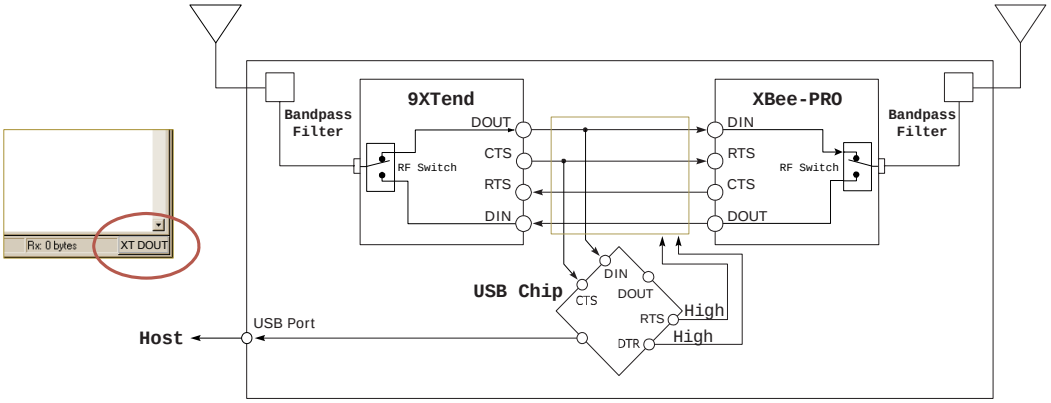


Figure 2-02. Data Flow Diagram (RF Data received by the 9XTend Module

"XT DOUT" button (only available on the X-CTU Terminal tab)

RTS asserted (high)
DTR asserted (high)



When bridging data, the USB port typically does not come into play; however, the USB port is necessary for configuring either of the embedded RF modules. Refer to the RF Module Configuration chapter [p10] to view the applicable RTS/DTR data flow diagrams.

2.1.2. Transparent Operation

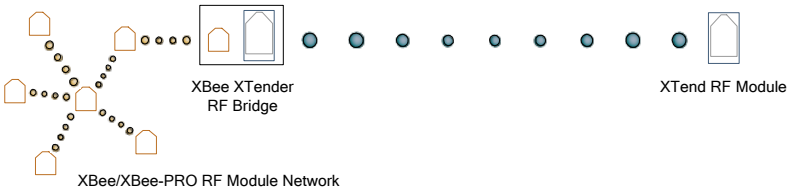
The embedded 9XTend RF Module of the RF bridge ships configured to operate in Transparent Mode - the module acts as a serial line replacement. When in Transparent Mode, all UART data received through a DIN (Data In) pin is bridged and queued up for RF transmission. When RF data is received, the data is bridged and sent out the other module's DOUT (Data Out) pin.

The bridge operates as described above unless the Command Mode Sequence is detected. (The Command Mode Sequence consists of three copies of the command sequence character [CC parameter] surrounded by before and after guard times.)

If the DI buffer becomes full, hardware or software flow control must be implemented in order to prevent overflow (loss of data between the host and bridge).

The illustration below depicts sample network configuration that uses the XBee XTender RF Bridge to extend the reach of star network comprised of XBee/XBee-PRO Modules.

Figure 2-03. Sample Network Topology that Utilizes the XBee XTender RF Bridge



2.1.3. API Operation

The embedded XBee-PRO RF Module of the RF bridge ships configured to operate in API Mode. The frame-based API extends the level to which a host application can interact with the networking capabilities of the embedded modules. When in API mode, all data entering and leaving the bridge is contained in frames that define operations or events within the bridge.

When the embedded XBee-PRO Module is operating in API Mode (AP (API Enable) parameter = 1 or 2), the 9XTend Module must operate in Transparent Mode (AP = 0).

Refer to the "API Operation" sections of the respective OEM RF module product manuals for more detailed information regarding API Mode.

3. RF Module Configuration

The modules inside the RF bridge are configurable and each has its own unique command set. Several commands names and parameters are common to both modules; however, refer to their respective command reference tables as many command attributes and behaviors will vary.

- XBee-PRO Command Reference Table [p15]
- XTend Command Reference Table [p22]

MaxStream recommends using its X-CTU Software and accompanying USB drivers when configuring module parameters.

NOTE: The embedded modules ship containing parameter profiles that differ from their default values. To restore MaxStream's recommended configurations, use the 'Load' button on the Modem Configuration tab of the X-CTU Software to navigate to the appropriate parameter profiles (instead of using the RE (Restore Defaults) command). After selecting a profile, select the 'Write' button to save profile parameter values to the module's non-volatile memory.

Affected XBee-PRO parameters: AP (API Enable) = 1, BD (Interface Data Rate) = 7 (115.2 kbps)
Affected 9XTend parameter: BD (Interface Data Rate) = 7 (115.2 kbps)

3.1. X-CTU Software

X-CTU is a MaxStream-provided software program that can be used to interface with and configure the embedded RF Modules. The software application is organized into the following four tabs:

- PC Settings tab - Setup PC serial ports for interfacing with the embedded RF modules.
- Range Test tab - Test the RF module's range and monitor packets sent and received.
- Terminal tab - Set/Read RF module parameters using AT Commands and monitor data communications.
- Modem Configuration tab - Set/Read RF module parameters and upgrade module firmware.

To Install X-CTU Software

Double-click the "setup_X-CTU.exe" file and follow prompts of the installation screens. This file is located in the 'software' folder of the MaxStream CD and also under the 'Downloads' section of the following web page: www.maxstream.net/support/downloads.php

3.1.1. PC Settings

In order to access embedded module parameters, the 'Baud', 'Data Bits', 'Parity' and 'settings of the PC com port must match those of the module. Use the PC Settings tab of the X-CTU Software to set the PC com port settings.

Figure 3-01. X-CTU PC Settings tab

NOTE: Failure to enter AT command mode is most commonly due to baud rate mismatch. Use the BD (Interface Data Rate) and NB (Parity) commands to set or read the module settings that correspond with the PC settings. The default interface data rate 'Baud' for the embedded XBee-PRO and 9XTend Modules is 115200 bps. Default values for the 'Data Bits', 'Parity' and 'Stop Bits' settings are '8', 'NONE' and '1' respectively.

3.1.2. Switching between Modules

Both the XBee-PRO and 9XTend Modules can be configured using the X-CTU Software. The RF Bridge uses its RTS and DTR lines to control the lines going in and out of the embedded RF modules. The RTS and DTR lines therefore control which module is able to receive commands. The X-CTU Software provides a simple method for controlling the state of these lines.

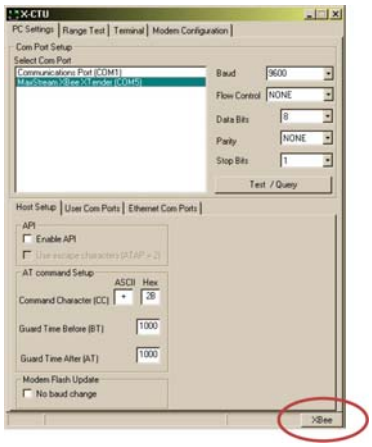
Use the button located on the bottom-right of the X-CTU Software interface to control which module to configure.

- To configure XBee-PRO Module parameters, click the button until it reads 'XBee'. [Refer to p13 for a configuration example.]
- To configure 9XTend Module parameters, click the button until it reads 'XTend'. [Refer to p13 for a configuration example.]

This button on the bottom-right of the X-CTU interface controls the state of the RTS and DTR lines inside the RF bridge and therefore provides control of which module parameters are accessible.

Figure 3-02. X-CTU Software Interface

(The button that is used to control which module has focus is highlighted.)



The following diagrams depict how the RTS and DTR enable the embedded modules to be configured. The X-CTU Software provides a simple method for manipulating the states of these lines.

Figure 3-03. Data Flow Diagram (XBee-PRO Module configuration)

"XBee" button
RTS asserted (high)
DTR de-asserted (low)

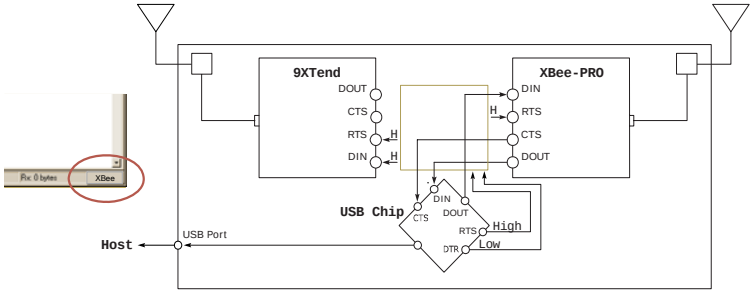
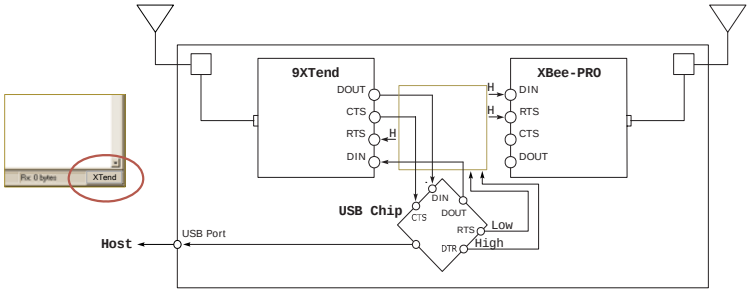


Figure 3-04. Data Flow Diagram (9XTend Module configuration)

"XTend" button
RTS de-asserted (low)
DTR asserted (high)



For more detailed information regarding the configuration of the embedded XBee–PRO and 9XTend Modules, refer to their respective product manuals.

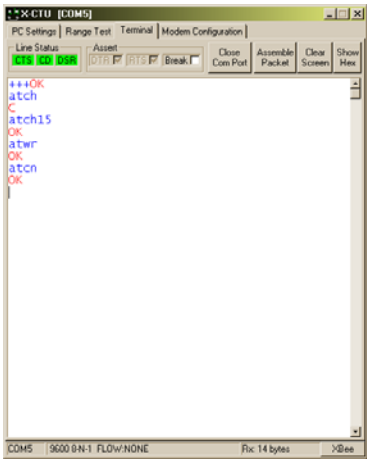
3.1.3. Command Mode

To modify or read RF module parameters, the modules must first enter into AT Command Mode - a state in which incoming characters are interpreted as commands. Both the "Terminal" and "Modem Configuration" tabs of the X-CTU Software can be used to read or set module parameters.

Terminal tab

A terminal program has been built into the X-CTU software and is located under the Terminal tab.

Figure 3-05. X-CTU Terminal tab
(Note that the bottom-right button indicates that the XBee-PRO Module is setup for receiving 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):

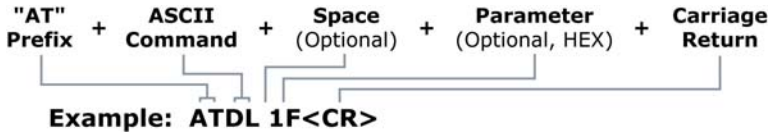
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8 on the XBee-PRO, AT (Guard Time After) parameter = 0x0A on the 9XTend)
- Input three plus characters ("+++") within one second [CC (Command Sequence Character) parameter = 0x2B.]
- No characters sent for one second [GT (Guard Times) parameter = 0x3E8 on the XBee-PRO, AT (Guard Time After) parameter = 0x0A on the 9XTend)]

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 3-06. Syntax for sending AT Commands



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

In the preceding example, an XBee-PRO's Destination Low Address would be changed to "0x1F". (Note that the DL parameter is not applicable to 9XTend Modules; however, the cited syntax is still correct.)

For modified parameter values to persist in the module'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 bridge is powered off and then on again (or re-booted).

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

Programming Example (using the Terminal tab):

Modify the DL (Destination Address Low) parameter of the embedded XBee-PRO Module

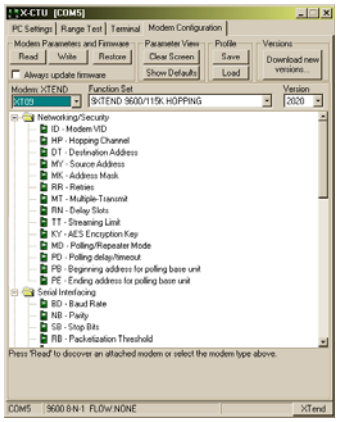
1. Install both the X-CTU Software and USB Drivers.
2. Launch the X-CTU Software and select the "PC Settings" tab.
3. Verify the 'Baud', 'Data Bits', 'Parity' and 'Stop Bits' settings match those stored on the module (When the RF bridge ships, the parameter settings of the embedded RF modules are set to '115200', '8', 'NONE' and '1' respectively).
4. Select the Com Port from the Com Port list named 'MaxStream XBee XTender (COMx)'.
5. Select the "Terminal" tab.
6. Click the button on the bottom-right of the interface until it reads "XBee". (This asserts (high) the RTS line and de-asserts (low) the DTR line.)
7. Enter the Command Mode Sequence ("+++" by default). The 'OK' message indicates the system has granted access to the module's parameter registry.
8. Issue the following AT commands:
   ATCH (System returns current Operating Channel.)
   ATCH15 (CH parameter is changed to '0x15'. System returns 'OK' message.)
   ATWR (New value is written to non-volatile memory. System returns 'OK' message.)
   ATCN (Module exits from AT Command Mode. System returns 'OK' message.)

Modem Configuration tab

The X-CTU "Modem Configuration" tab provides an easy-to-use interface for reading and setting RF module parameters.

Figure 3-07. X-CTU Modem Configuration tab

(Note that the bottom-right button indicates that the 9XTend Module is setup for receiving commands.)



Programming Example (using the Modem Configuration tab):

Restore default parameter values of the embedded 9XTend Module

1. Install both the X-CTU Software and USB Drivers.
2. Launch the X-CTU Software and select the "PC Settings" tab.
3. Verify the 'Baud', 'Data Bits', 'Parity' and 'Stop Bits' settings match those stored on the module (When the RF bridge ships, the parameter settings of the embedded RF modules are set to '115200', '8', 'NONE' and '1' respectively).
4. Select the Com Port from the Com Port list named "MaxStream XBee XTender (COMx)".
5. Select the "Modem Configuration" tab.
6. Click the button on the bottom-right of the interface until it reads "XTend". (This de-asserts (low) the RTS line and asserts (high) the DTR line.)
7. Select the 'Restore' button.
   (Default parameter values are restored and automatically written to the module's non-volatile memory.)

Firmware Upgrades

Use the “Modem Configuration” tab of the X-CTU Software to update the firmware versions of the modules inside the RF bridge.

To Update Firmware

1. Launch the X-CTU Software and select the “Modem Configuration” tab.
2. Select the ‘Download New Versions...’ button.
3. Select the ‘Web’ button to download the most recent shipping firmware versions of the XBee-PRO and 9XTend modules. Select the ‘File’ button to import from a specific location that contains the desired firmware (such as the folders contained on the MaxStream CD or folders already downloaded from the MaxStream web site).

3.1.4. USB Drivers

The XBee XTender RF Bridge is a "plug-and-play" device that should automatically be detected by the PC. To interface between the bridge and a PC, two drivers must be installed. After the bridge is detected, the PC will display an installation wizard that facilitates driver installations. Since the X-CTU Software requires use of the Windows platform, the Windows drivers must be used.

To Install Drivers:

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

1. Connect the XBee XTender RF Bridge 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.

3.2. Command Reference Tables

Each of the embedded RF modules has its own unique command set:

- XBee-PRO Command Reference Table [below]
- XTend Command Reference Table [p22]

Refer to the respective product manuals for more detailed information regarding commands.

3.2.1. XBee-PRO Command Reference Table

Special

Table 3-01. XBee-PRO Commands - Special

AT Command	Command Category	Name and Description	Parameter Range	Default
WR	Special	Write. Write parameter values to non-volatile memory so that parameter modifications persist through subsequent power-up or reset. Note: Once WR is issued, no additional characters should be sent to the bridge until after the response "OK\r" is received.	-	-
RE	Special	Restore Defaults. Restore bridge parameters to factory defaults.	-	-
FR (v1.x80*)	Special	Software Reset. Responds immediately with an OK then performs a hard reset ~100ms later.	-	-

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

Networking & Security

Table 3-02. XBee XTender Commands - Networking & Security (Sub-categories designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
CH	Networking {Addressing}	Channel. Set/Read the channel number used for transmitting and receiving data between RF bridges (uses 802.15.4 protocol channel numbers).	0x0C - 0x17	0x0C (12d)
ID	Networking {Addressing}	PAN ID. Set/Read the PAN (Personal Area Network) ID. Use 0xFFFF to broadcast messages to all PANs.	0 - 0xFFFF	0x3332 (13106d)
DH	Networking {Addressing}	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 {Addressing}	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
MY	Networking {Addressing}	16-bit Source Address. Set/Read the RF bridge 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
SH	Networking {Addressing}	Serial Number High. Read high 32 bits of the RF bridge's unique IEEE 64-bit address. 64-bit source address is always enabled.	0 - 0xFFFFFFFF [read-only]	Factory-set
SL	Networking {Addressing}	Serial Number Low. Read low 32 bits of the RF bridge's unique IEEE 64-bit address. 64-bit source address is always enabled.	0 - 0xFFFFFFFF [read-only]	Factory-set
RR (v1.xA0*)	Networking {Addressing}	XBee Retries. Set/Read the maximum number of retries the bridge will execute in addition to the 3 retries provided by the 802.15.4 MAC. For each XBee retry, the 802.15.4 MAC can execute up to 3 retries.	0 - 6	0
RN	Networking {Addressing}	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 [exponent]	0
MM (v1.x80*)	Networking {Addressing}	MAC Mode. Set/Read MAC Mode value. MAC Mode enables/disables the use of a MaxStream header in the 802.15.4 RF packet. When Mode 0 is enabled (MM=0), duplicate packet detection is enabled as well as certain AT commands. Modes 1 and 2 are strict 802.15.4 modes.	0 - 2 0 = MaxStream Mode 1 = 802.15.4 (no ACKs) 2 = 802.15.4 (with ACKs)	0
NI (v1.x80*)	Networking {Identification}	Node Identifier. Stores a string identifier. The register only accepts printable ASCII data. A string can not start with a space. Carriage return ends command. Command will automatically end when maximum bytes for the string have been entered. This string is returned as part of the ND (Node Discover) command. This identifier is also used with the DN (Destination Node) command.	20-character ASCII string	-

Table 3-02. XBee XTender Commands - Networking & Security (Sub-categories designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
ND (v1.x80*)	Networking {Identification}	Node Discover. Discovers and reports all RF bridges found. The following information is reported for each bridge discovered (the example cites use of Transparent operation (AT command format) - refer to the long ND command description regarding differences between Transparent and API operation). MY<CR> SH<CR> SL<CR> DB<CR> NI<CR><CR> The amount of time the bridge allows for responses is determined by the NT parameter. In Transparent operation, command completion is designated by a <CR> (carriage return). ND also accepts a Node Identifier as a parameter. In this case, only a bridge matching the supplied identifier will respond.	optional 20-character NI value	
NT (v1.xA0*)	Networking {Identification}	Node Discover Time. Set/Read the amount of time a node will wait for responses from other nodes when using the ND (Node Discover) command.	0x01 - 0xFC	0x19
DN (v1.x80*)	Networking {Identification}	Destination Node. Resolves an NI (Node Identifier) string to a physical address. The following events occur upon successful command execution: 1. DL and DH are set to the address of the bridge with the matching Node Identifier. 2. "OK" is returned. 3. RF bridge automatically exits AT Command Mode If there is no response from a bridge within 200 msec or a parameter is not specified (left blank), the command is terminated and an "ERROR" message is returned.	20-character ASCII string	-
CE (v1.x80*)	Networking {Association}	Coordinator Enable. Set/Read the coordinator setting.	0 - 1 0 = End Device 1 = Coordinator	0
SC (v1.x80*)	Networking {Association}	Scan Channels. Set/Read list of channels to scan for all Active and Energy Scans as a bitfield. This affects scans initiated in command mode (AS, ED) and during End Device Association and Coordinator startup: bit 0 - 0x0B bit 4 - 0x0F bit 8 - 0x13 bit12 - 0x17 bit 1 - 0x0C bit 5 - 0x10 bit 9 - 0x14 bit13 - 0x18 bit 2 - 0x0D bit 6 - 0x11 bit 10 - 0x15 bit14 - 0x19 bit 3 - 0x0E bit 7 - 0x12 bit 11 - 0x16 bit 15 - 0x1A	0 - 0xFFFF [bitfield] (bits 0, 14, 15 not allowed on the XBee-PRO)	0x1FFE (all XBee-PRO Channels)
SD (v1.x80*)	Networking {Association}	Scan Duration. Set/Read the scan duration exponent. *End Device* - Duration of Active Scan during Association. On beacon system, set SD = BE of coordinator. SD must be set at least to the highest BE parameter of any Beaconing Coordinator with which an End Device or Coordinator wish to discover. *Coordinator* - If 'ReassignPANID' option is set on Coordinator [refer to A2 parameter], SD determines the length of time the Coordinator will scan channels to locate existing PANs. If 'ReassignChannel' option is set, SD determines how long the Coordinator will perform an Energy Scan to determine which channel it will operate on. 'Scan Time' is measured as (# of channels to scan] * (2 ^ SD) * 15.36ms). The number of channels to scan is set by the SC command. The XBee can scan up to 16 channels (SC = 0xFFFF). The XBee PRO can scan up to 13 channels (SC = 0x3FFE). Example: The values below show results for a 13 channel scan: If SD = 0, time = 0.18 sec SD = 8, time = 47.19 sec SD = 2, time = 0.74 sec SD = 10, time = 3.15 min SD = 4, time = 2.95 sec SD = 12, time = 12.58 min SD = 6, time = 11.80 sec SD = 14, time = 50.33 min	0-0x0F [exponent]	4
A1 (v1.x80*)	Networking {Association}	End Device Association. Set/Read End Device association options. bit 0 - ReassignPanID 0 - Will only associate with Coordinator operating on PAN ID that matches bridge ID 1 - May associate with Coordinator operating on any PAN ID bit 1 - ReassignChannel 0 - Will only associate with Coordinator operating on matching CH Channel setting 1 - May associate with Coordinator operating on any Channel bit 2 - AutoAssociate 0 - Device will not attempt Association 1 - Device attempts Association until success Note: This bit is used only for Non-Beacon systems. End Devices in Beacon-enabled system must always associate to a Coordinator bit 3 - PollCoordOnPinWake 0 - Pin Wake will not poll the Coordinator for indirect (pending) data 1 - Pin Wake will send Poll Request to Coordinator to extract any pending data bits 4 - 7 are reserved	0 - 0x0F [bitfield]	0

Table 3-02. XBee XTender Commands - Networking & Security (Sub-categories designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
A2 (v1.x80*)	Networking {Association}	Coordinator Association. Set/Read Coordinator association options. bit 0 - ReassignPanID 0 - Coordinator will not perform Active Scan to locate available PAN ID. It will operate on ID (PAN ID). 1 - Coordinator will perform Active Scan to determine an available ID (PAN ID). If a PAN ID conflict is found, the ID parameter will change. bit 1 - ReassignChannel - 0 - Coordinator will not perform Energy Scan to determine free channel. It will operate on the channel determined by the CH parameter. 1 - Coordinator will perform Energy Scan to find a free channel, then operate on that channel. bit 2 - AllowAssociation - 0 - Coordinator will not allow any devices to associate to it. 1 - Coordinator will allow devices to associate to it. bits 3 - 7 are reserved	0 - 7 [bitfield]	0
AI (v1.x80*)	Networking {Association}	Association Indication. Read errors with the last association request: 0x00 - Successful Completion - Coordinator successfully started or End Device association complete 0x01 - Active Scan Timeout 0x02 - Active Scan found no PANs 0x03 - Active Scan found PAN, but the CoordinatorAllowAssociation bit is not set 0x04 - Active Scan found PAN, but Coordinator and End Device are not configured to support beacons 0x05 - Active Scan found PAN, but the Coordinator ID parameter does not match the ID parameter of the End Device 0x06 - Active Scan found PAN, but the Coordinator CH parameter does not match the CH parameter of the End Device 0x07 - Energy Scan Timeout 0x08 - Coordinator start request failed 0x09 - Coordinator could not start due to invalid parameter 0x0A - Coordinator Realignment is in progress 0x0B - Association Request not sent 0x0C - Association Request timed out - no reply was received 0x0D - Association Request had an Invalid Parameter 0x0E - Association Request Channel Access Failure. Request was not transmitted - CCA failure 0x0F - Remote Coordinator did not send an ACK after Association Request was sent 0x10 - Remote Coordinator did not reply to the Association Request, but an ACK was received after sending the request 0x11 - [reserved] 0x12 - Sync-Loss - Lost synchronization with a Beaconing Coordinator 0x13 - Disassociated - No longer associated to Coordinator	0 - 0x13 [read-only]	-
DA (v1.x80*)	Networking {Association}	Force Disassociation. End Device will immediately disassociate from a Coordinator (if associated) and reattempt to associate.	-	-
FP (v1.x80*)	Networking {Association}	Force Poll. Request indirect messages being held by a coordinator.	-	-

Table 3-02. XBee XTender Commands - Networking & Security (Sub-categories designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
AS (v1.x80*)	Networking {Association}	Active Scan. Send Beacon Request to Broadcast Address (0xFFFF) and Broadcast PAN (0xFFFF) on every channel. The parameter determines the time the radio will listen for Beacons on each channel. A PanDescriptor is created and returned for every Beacon received from the scan. Each PanDescriptor contains the following information: CoordAddress (SH, SL)<CR> CoordPanID (ID)<CR> CoordAddrMode <CR> 0x02 = 16-bit Short Address 0x03 = 64-bit Long Address Channel (CH parameter) <CR> SecurityUse<CR> ACLEntry<CR> SecurityFailure<CR> SuperFrameSpec<CR> (2 bytes): bit 15 - Association Permitted (MSB) bit 14 - PAN Coordinator bit 13 - Reserved bit 12 - Battery Life Extension bits 8-11 - Final CAP Slot bits 4-7 - Superframe Order bits 0-3 - Beacon Order GtsPermit<CR> RSSI<CR> (RSSI is returned as -dBm) TimeStamp<CR> (3 bytes) <CR> A carriage return <CR> is sent at the end of the AS command. The Active Scan is capable of returning up to 5 PanDescriptors in a scan. The actual scan time on each channel is measured as Time = [(2 ^SD PARAM) * 15.36] ms. Note the total scan time is this time multiplied by the number of channels to be scanned (16 for the XBee and 13 for the XBee-PRO). Also refer to SD command description.	0 - 6	-
ED (v1.x80*)	Networking {Association}	Energy Scan. Send an Energy Detect Scan. This parameter determines the length of scan on each channel. The maximal energy on each channel is returned & each value is followed by a carriage return. An additional carriage return is sent at the end of the command. The values returned represent the detected energy level in units of -dBm. The actual scan time on each channel is measured as Time = [(2 ^ED) * 15.36] ms. Note the total scan time is this time multiplied by the number of channels to be scanned (refer to SD parameter).	0 - 6	-
EE (v1.xA0*)	Networking {Security}	AES Encryption Enable. Disable/Enable 128-bit AES encryption support. Use in conjunction with the KY command.	0 - 1	0 (disabled)
KY (v1.xA0*)	Networking {Security}	AES Encryption Key. Set the 128-bit AES (Advanced Encryption Standard) key for encrypting/decrypting data. The KY register cannot be read.	0 - (any 16-Byte value)	-

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

RF Interfacing

Table 3-03. XBee/XBee-PRO Commands - RF Interfacing

AT Command	Command Category	Name and Description	Parameter Range	Default
PL	RF Interfacing	Power Level. Select/Read the power level at which the RF bridge transmits conducted power. *NOTE: XBee-PRO RF Bridges optimized for use in Japan contain firmware that limits transmit power output to 10 dBm. If PL=4 (default), the maximum power output level is fixed at 10 dBm.*	0 - 4 (XBee / XBee-PRO) 0 = -10 / 10 dBm 1 = -6 / 12 dBm 2 = -4 / 14 dBm 3 = -2 / 16 dBm 4 = 0 / 18 dBm	4
CA (v1.x80*)	RF Interfacing	CCA Threshold. Set/read the CCA (Clear Channel Assessment) threshold. Prior to transmitting a packet, a CCA is performed to detect energy on the channel. If the detected energy is above the CCA Threshold, the bridge will not transmit the packet.	0 - 0x50 [-dBm]	0x2C (-44d dBm)

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

Sleep (Low Power)

Table 3-04. XBee XTender Commands - Sleep (Low Power)

AT Command	Command Category	Name and Description	Parameter Range	Default
SM	Sleep (Low Power)	Sleep Mode. <NonBeacon firmware> Set/Read Sleep Mode configurations.	0 - 5 0 = No Sleep 1 = Pin Hibernate 2 = Pin Doze 3 = Reserved 4 = Cyclic sleep remote 5 = Cyclic sleep remote w/ pin wake-up 6 = [Sleep Coordinator] for backwards compatibility w/ v1.x6 only; otherwise, use CE command.	0
ST	Sleep (Low Power)	Time before Sleep. <NonBeacon firmware> Set/Read time period of inactivity (no serial or RF data is sent or received) before activating Sleep Mode. ST parameter is only valid with Cyclic Sleep settings (SM = 4 - 5). Coordinator and End Device ST values must be equal. Also note, the GT parameter value must always be less than the ST value. (If GT > ST, the configuration will render the bridge unable to enter into command mode.) If the ST parameter is modified, also modify the GT parameter accordingly.	1 - 0xFFFF [x 1 ms]	0x1388 (5000d)
SP	Sleep (Low Power)	Cyclic Sleep Period. <NonBeacon firmware> Set/Read sleep period for cyclic sleeping remotes. Coordinator and End Device SP values should always be equal. To send Direct Messages, set SP = 0. *End Device* - SP determines the sleep period for cyclic sleeping remotes. Maximum sleep period is 268 seconds (0x68B0). *Coordinator* - If non-zero, SP determines the time to hold an indirect message before discarding it. A Coordinator will discard indirect messages after a period of (2.5 * SP).	0 - 0x68B0 [x 10 ms]	0
DP (1.x80*)	Sleep (Low Power)	Disassociated Cyclic Sleep Period. <NonBeacon firmware> *End Device* - Set/Read time period of sleep for cyclic sleeping remotes that are configured for Association but are not associated to a Coordinator. (i.e. If a device is configured to associate, configured as a Cyclic Sleep remote, but does not find a Coordinator, it will sleep for DP time before reattempting association.) Maximum sleep period is 268 seconds (0x68B0). DP should be > 0 for NonBeacon systems.	1 - 0x68B0 [x 10 ms]	0x3E8 (1000d)

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

Serial Interfacing

Table 3-05. XBee-PRO Commands - Serial Interfacing

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 bridge serial port and host. Request non-standard baud rates with values above 0x80 using a terminal window. Read the BD register to find actual baud rate achieved.	0 - 7 (standard baud rates) 0 = 1200 bps 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600 7 = 115200 0x80 - 0x1C200 (non-standard baud rates)	3
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
AP (v1.x80*)	Serial Interfacing	API Enable. Disable/Enable API Mode.	0 - 2 0 = Disabled 1 = API enabled 2 = API enabled (w/escaped control characters)	0
PR (v1.x80*)	Serial Interfacing	Pull-up Resistor Enable. Set/Read bitfield to configure internal pull-up resistor status for I/O lines Bitfield Map: bit 0 - AD4/DIO4 (pin11) bit 1 - AD3 / DIO3 (pin17) bit 2 - AD2/DIO2 (pin18) bit 3 - AD1/DIO1 (pin19) bit 4 - AD0 / DIO0 (pin20) bit 5 - RTS / AD6 / DIO6 (pin16) bit 6 - DTR / SLEEP_RQ / DI8 (pin9) bit 7 - DIN/CONFIG (pin3) Bit set to “1” specifies pull-up enabled; “0” specifies no pull-up	0 - 0xFF	0xFF

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

I/O Settings

NOTE: The "I/O Settings" commands listed below refer to the I/O lines of the OEM RF module embedded inside the boxed RF modem. Implementation of these commands requires board-level development and is not supported through the serial connection of the RF bridge.

Table 3-06. XBee-PRO Commands - I/O Settings (sub-category designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
D8	I/O Settings	DI8 Configuration. Select/Read options for the DI8 line (pin 9) of the RF bridge.	0 - 1 0 = Disabled 3 = DI (1,2,4 & 5 n/a)	0
D7 (v1.x80*)	I/O Settings	DIO7 Configuration. Select/Read settings for the DIO7 line (pin 12) of the RF bridge. Options include CTS flow control and I/O line settings.	0 - 1 0 = Disabled 1 = CTS Flow Control 2 = (n/a) 3 = DI 4 = DO low 5 = DO high	1
D6 (v1.x80*)	I/O Settings	DIO6 Configuration. Select/Read settings for the DIO6 line (pin 16) of the RF bridge. Options include RTS flow control and I/O line settings.	0 - 1 0 = Disabled 1 = RTS flow control 2 = (n/a) 3 = DI 4 = DO low 5 = DO high	0
D5 (v1.x80*)	I/O Settings	DIO5 Configuration. Configure settings for the DIO5 line (pin 15) of the RF bridge. Options include Associated LED indicator (blinks when associated) and I/O line settings.	0 - 1 0 = Disabled 1 = Associated indicator 2 = ADC 3 = DI 4 = DO low 5 = DO high	1
D0 - D4 (v1.xA0*)	I/O Settings	(DIO4 -DIO4) Configuration. Select/Read settings for the following lines: AD0/DIO0 (pin 20), AD1/DIO1 (pin 19), AD2/DIO2 (pin 18), AD3/DIO3 (pin 17), AD4/DIO4 (pin 11). Options include: Analog-to-digital converter, Digital Input and Digital Output.	0 - 1 0 = Disabled 1 = (n/a) 2 = ADC 3 = DI 4 = DO low 5 = DO high	0
IU (v1.xA0*)	I/O Settings	I/O Output Enable. Disables/Enables I/O data received to be sent out UART. The data is sent using an API frame regardless of the current AP parameter value.	0 - 1 0 = Disabled 1 = Enabled	1
IT (v1.xA0*)	I/O Settings	Samples before TX. Set/Read the number of samples to collect before transmitting data. Maximum number of samples is dependent upon the number of enabled inputs.	1 - 0xFF	1
IS (v1.xA0*)	I/O Settings	Force Sample. Force a read of all enabled inputs (DI or ADC). Data is returned through the UART. If no inputs are defined (DI or ADC), this command will return error.	8-bit bitmap (each bit represents the level of an I/O line setup as an output)	-
IO (v1.xA0*)	I/O Settings	Digital Output Level. Set digital output level to allow DIO lines that are setup as outputs to be changed through Command Mode.	-	-
IC (v1.xA0*)	I/O Settings	DIO Change Detect. Enables/Disables the monitoring of the change detect feature on DIO lines 0-7. If a change is detected, data is transmitted with DIO data only. Any samples queued and waiting for transmission will be sent first.	0 - 0xFF [bitfield]	0 (disabled)
IR (v1.xA0*)	I/O Settings	Sample Rate. Set/Read sample rate. When set, this parameter causes the bridge to sample all enabled inputs at a specified interval.	0 - 0xFFFF [x 1 msec]	0
AV (v1.xA0*)	I/O Settings	ADC Voltage Reference. <XBee-PRO only> Set/Read ADC reference voltage switch.	0 - 1 0 = VREF pin 1 = Internal	0
IA (v1.xA0*)	I/O Settings {I/O Line Passing}	I/O Input Address. Set/Read addresses of bridge to which outputs are bound. Setting all bytes to 0xFF will not allow any received I/O packet to change outputs. Setting address to 0xFFFF will allow any received I/O packet to change outputs.	0 - 0xFFFFFFFFFFFFFFFF	0xFFFFFFFF FFFFFFFF
T0 - T7 (v1.xA0*)	I/O Settings {I/O Line Passing}	(D0 - D7) Output Timeout. Set/Read Output timeout values for lines that correspond with the D0 - D7 parameters. When output is set (due to I/O line passing) to a non-default level, a timer is started which when expired will set the output to it default level. The timer is reset when a valid I/O packet is received.	0 - 0xFF [x 100 ms]	0xFF
P0	I/O Settings {I/O Line Passing}	PWM0 Configuration. Select/Read function for PWM0 pin.	0 - 2 0 = Disabled 1 = RSSI 2 = PWM Output	1

Table 3-06. XBee-PRO Commands - I/O Settings (sub-category designated within {brackets})

AT Command	Command Category	Name and Description	Parameter Range	Default
P1 (v1.xA0*)	I/O Settings {I/O Line Passing}	PWM1 Configuration. Select/Read function for PWM1 pin.	0 - 2 0 = Disabled 1 = RSSI 2 = PWM Output	0
M0 (v1.xA0*)	I/O Settings {I/O Line Passing}	PWM0 Output Level. Set/Read the PWM0 output level.	0 - 0x03FF	-
M1 (v1.xA0*)	I/O Settings {I/O Line Passing}	PWM1 Output Level. Set/Read the PWM0 output level.	0 - 0x03FF	-
PT (v1.xA0*)	I/O Settings {I/O Line Passing}	PWM Output Timeout. Set/Read output timeout value for both PWM outputs. When PWM is set to a non-zero value: Due to I/O line passing, a time is started which when expired will set the PWM output to zero. The timer is reset when a valid I/O packet is received.]	0 - 0xFF [x 100 ms]	0xFF
RP	I/O Settings {I/O Line Passing}	RSSI PWM Timer. Set/Read PWM timer register. Set the duration of PWM (pulse width modulation) signal output on the RSSI pin. The signal duty cycle is updated with each received packet and is shut off when the timer expires.]	0 - 0xFF [x 100 ms]	0x28 (40d)

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

Diagnostics

Table 3-07. XBee XTender Commands - Diagnostics

AT Command	Command Category	Name and Description	Parameter Range	Default
VR	Diagnostics	Firmware Version. Read firmware version of the RF bridge.	0 - 0xFFFF [read-only]	Factory-set
VL (v1.x80*)	Diagnostics	Firmware Version - Verbose. Read detailed version information (including application build date, MAC, PHY and bootloader versions).	-	-
HV (v1.x80*)	Diagnostics	Hardware Version. Read hardware version of the RF bridge.	0 - 0xFFFF [read-only]	Factory-set
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]	-
EC (v1.x80*)	Diagnostics	CCA Failures. Reset/Read count of CCA (Clear Channel Assessment) failures. This parameter value increments when the bridge does not transmit a packet because it detected energy above the CCA threshold level set with CA command. This count saturates at its maximum value. Set count to “0” to reset count.	0 - 0xFFFF	-
EA (v1.x80*)	Diagnostics	ACK Failures. Reset/Read count of acknowledgment failures. This parameter value increments when the bridge expires its transmission retries without receiving an ACK on a packet transmission. This count saturates at its maximum value. Set the parameter to “0” to reset count.	0 - 0xFFFF	-
ED (v1.x80*)	Diagnostics	Energy Scan. Send ‘Energy Detect Scan’. ED parameter determines the length of scan on each channel. The maximal energy on each channel is returned and each value is followed by a carriage return. Values returned represent detected energy levels in units of -dBm. Actual scan time on each channel is measured as Time = [(2 ^ SD) * 15.36] ms. Total scan time is this time multiplied by the number of channels to be scanned.	0 - 6	-

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

AT Command Options

Table 3-08. XBee XTender Commands - AT Command Options

AT Command	Command Category	Name and Description	Parameter Range	Default
CT	AT Command Mode Options	Command Mode Timeout. Set/Read the period of inactivity (no valid commands received) after which the RF bridge automatically exits AT Command Mode and returns to Idle Mode.	2 - 0xFFFF [x 100 ms]	0x64 (100d)
CN	AT Command Mode Options	Exit Command Mode. Explicitly exit the bridge from AT Command Mode.	--	--
AC (v1.xA0*)	AT Command Mode Options	Apply Changes. Explicitly apply changes to queued parameter value(s) and re-initialize bridge.	--	--
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.	2 - 0x0CE4 [x 1 ms]	0x3E8 (1000d)
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 bridge into AT Command Mode.	0 - 0xFF	0x2B (‘+’ ASCII)

* Firmware version in which the command was first introduced (firmware versions are numbered in hexadecimal notation.)

3.2.2. XTend Command Reference Table

Table 3-9. XTend Commands (The embedded modules expect numerical values in hexadecimal. Hexadecimal values are designated by a "0x" prefix. Decimal equivalents are designated by a "d" suffix.)

AT Command	Binary Command	Command Category	Name and Description	Parameter Range	Factory Default
%V	0x3B (59d)	Diagnostics	Board Voltage. Read supply voltage to module (VCC) multiplied by 65536 (eg. 5.02V = 5.02*65536 = 0x5051F, maximum of 5 digits returned).	0x2CCCA - 0x5BFFA [read-only]	--
AM	0x40 (64d)	Networking & Security	Auto-set MY. Automatically set the MY (Source Address) parameter from the factory-set serial number of the module.	--	--
AP v2.x20*	--	Serial Interfacing	API Enable. Set/read API setting.	0 - 2 0 = Disabled 1 = API enabled 2 = API enabled (w/escaped control characters)	1
AT	0x05 (5d)	Command Mode Options	Guard Time After. Set/read required DI pin silent time that follows the Command Sequence Characters of the AT Command Mode Sequence (BT+CC+AT). The DI silent time is used to prevent inadvertent entrance into Command Mode.	2 - (ATST-3) [x 100 msec]	0x0A (10d)
BD	0x15 (21d)	Serial Interfacing	Interface Data Rate. Select/read serial interface rate (speed for data transfer between radio modem and host). Serial data rate does not have to match the RF data rate (adjustable using the BR command). If the serial data rate is set higher than the RF data rate, CTS may be needed to prevent DI buffer overrun.	0 - 8 (standard baud rates) 0 = 1200 bps 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600 7 = 115200 8 - 230400 0x39 - 0x1C9C38 (non-standard rates)	7
BR	0x39 (57d)	RF Interfacing	RF Data Rate. Select RF data rate (over-the-air transmission rate).	0 - 1 0 = 9600 1 = 115200	1
BT	0x04 (4d)	Command Mode Options	Guard Time Before. Set/read required DI pin silent time before the Command Sequence Characters of the Command Mode Sequence (BT+CC+AT). The DI silent time is used to prevent inadvertent entrance into Command Mode.	0 - 0xFFFF [x 100 msec]	0x0A (10d)
CC	0x13 (19d)	Command Mode Options	Command Sequence Character. Set/read ASCII character to be used between Guard Times of the AT Command Mode Sequence (BT+CC+AT). The AT Command Mode Sequence causes the module to enter Command Mode.	0x20 - 0x7F	0x2B ["+"] (43d)
CD	0x28 (40d)	Serial Interfacing	GPO2 Configuration. Select/read behavior of the GPO2 pin signal.	0 - 4 0 = RX LED 1 = Default High 2 = Default Low 3 = (reserved) 4 = RX LED (valid address only)	2
CF	--	Command Mode Options	Number Base. Set/read the command formatting setting.	0 - 2 0 = Commands use default number base; decimal commands may output units 1 = All commands forced to unsigned, unit-less hex 2 = Commands utilize their default number base; no units are output	1
CN	0x09 (9d)	Command Mode Options	Exit Command Mode. Explicitly exit module from AT Command Mode.	--	--
CS	0x1F (31d)	Serial Interfacing	GPO1 Configuration. Select/read behavior of the GPO1 pin signal.	0 - 4 0 = RS-232 CTS flow control 1 = RS-485 TX enable low 2 = High 3 = RS-485 TX enable high 4 = Low	0
CT	0x06 (6d)	Command Mode Options	Command Mode Timeout. Set/read time period of inactivity (no valid commands received) after which the module automatically exits from Command Mode.	2 - 0xFFFF [x 100 ms]	0xC8 (200d)

Table 3-9. XTend Commands (The embedded modules expect numerical values in hexadecimal. Hexadecimal values are designated by a "0x" prefix. Decimal equivalents are designated by a "d" suffix.)

AT Command	Binary Command	Command Category	Name and Description	Parameter Range	Factory Default
DB	0x36 (54d)	Diagnostics	Received Signal Strength. Read signal level of last good packet received (RSSI) in dB (reports absolute value, eg. -88dBm = 0x58. Accurate between -40 dBm to RX sensitivity).	0x6E - 0x28 [read-only]	--
DT	0x00 (0d)	Networking & Security	Destination Address. Set/read module's destination address.	0 - 0xFFFF	0
E0	0x0A (10d)	Command Mode Options	Echo Off. Turn off character echo while in AT Command Mode. By default, echo is off.	--	--
E1	0x0B (11d)	Command Mode Options	Echo On. Enable character echo while in AT Command Mode. Each typed character will be echoed back to the terminal when ATE1 is active. E0 (Echo Off) is the default.	--	--
ER	0x0F (15d)	Diagnostics	Receive Error Count. Set/read number of RF Packets rejected because of bit errors in packet.	0 - 0xFFFF	0
FH	0x0D (13d)	Sleep (Low Power)	Force Wake-up Initializer. Force a Wake-up Initializer to be sent on the next transmission. Use only when cyclic sleep is enabled on remotes.	--	--
FL	0x07 (7d)	Serial Interfacing	Software Flow Control. Select/read flow control options. Enables software flow control (XON/XOFF) between module and host.	0 - 1 0 = Disable 1 = Enable	0
FS	0x3E (62d)	RF Interfacing	Forced Sync Time. Normally, only the first packet of a continuous stream contains the full RF initializer. The RF modules then remain synchronized for subsequent packets of the stream. This parameter can be used to periodically force an RF initializer during such streaming (only applies to streaming data).	0 - 0xFFFF [x 10 msec]	0
FT	0x24 (36d)	Serial Interfacing	Flow Control Threshold. Set/read flow control threshold. De-assert CTS and/or send XOFF when FT bytes are in the DI buffer.	0 - (DI buffer size - 0x11) [Bytes]	DI buffer size minus 0x11
GD	0x10 (16d)	Diagnostics	Receive Good Count. Set/read number of RF Packets successfully received.	0 - 0xFFFF	0
HP	0x11 (17d)	Networking & Security	Hopping Channel. Set/read spread spectrum channel on which module communicates. Separate channels minimize interference between multiple sets of modules operating in the same vicinity.	0 - 9	0
HT	0x03 (3d)	Sleep (Low Power)	Time before Wake-up Initializer. Set/read time of inactivity (no serial or RF data is sent or received) before a Wake-up Initializer is sent. HT should be set shorter than the ST value of all remotes.	0 - 0xFFFF [x 100 msec]	0xFFFF (65535d)
HV	--	Diagnostics	Hardware Version. Read module hardware version number.	0 - 0xFFFF [read-only]	--
ID	0x27 (39d)	Networking & Security	Modem VID. Set/read module Vendor Identification Number (VID). Only modems with matching VIDs can communicate with each other.	0 - 0x7FFF (user-settable) 0x8000 - 0xFFFF (factory-set, read-only)	0x3332 (13106d)
KY	0x3C (60d)	Networking & Security	AES Encryption Key. Set/read AES encryption settings. Set 256-bit key (64 hex digits) on multiple modules for encrypted RF communication. Reading parameter returns a '0' (encryption disabled) or '1' (enabled). For security reasons, the key cannot be read.	0 - (Any other 64-digit hex valid key)	0 (disabled)
LH	0x0C (12d)	Sleep (Low Power)	Wake-up Initializer Timer. Set/read time of the Wake-up Initializer used to wake remote modules that are in cyclic sleep mode. Time of Wake-up Initializer should be longer than that of the remote's cyclic sleep cycle (SM = 4-8).	0 - 0xFF [x 100 msec]	1
MD v2.x20*	0x31 (49d)	Networking & Security	RF Mode. Set/read the RF mode. A polling base is responsible for polling remotes. A polling remote needs a poll in order to transmit. A repeater re-sends RF data unless it is to self or it has been seen. Repeater end node handles repeated messages, but will not repeat.	0 - 6 0 = Transparent Mode (Repeater Base) 1-2 = [reserved - not used] 3 = Polling Base 4 = Polling Remote 5 = Repeater 6 = Repeater End Node	0
MK	0x12 (18d)	Networking & Security	Address Mask. Set/read the module address mask for configuration of local and global address spaces.	0 - 0xFFFF	0xFFFF (65535d)

Table 3-9. XTend Commands (The embedded modules expect numerical values in hexadecimal. Hexadecimal values are designated by a "0x" prefix. Decimal equivalents are designated by a "d" suffix.)

AT Command	Binary Command	Command Category	Name and Description	Parameter Range	Factory Default
MT	0x3D (61d)	Networking & Security	**Multi-Transmit.** Set/read number or retransmissions. If MT parameter is a non-zero value, RR is ignored and all packets are sent MT+1 times without any delay between transmissions.	0 - 0xFF	0
MY	0x2A (42d)	Networking & Security	**Source Address.** Set/read module's source address. If set to 0xFFFF, then the DT address is used for both source and destination addresses.	0 - 0xFFFF	0xFFFF (65535d)
NB	0x23 (35d)	Serial Interfacing	**Parity.** Select parity settings for UART communications.	0 - 4 0 = 8-bit (no parity or 7-bit (any parity) 1 = 8-bit even 2 = 8-bit odd 3 = 8-bit mark 4 = 8-bit space	0
PB v2.x20*	0x45 (69d)	Networking & Security	**Polling Begin Address.** Set/read beginning address for polling base unit (only applies when MD=3).	0 - 0xFFFF	0
PD v2.x20*	0x47 (71d)	Networking & Security	**Minimum Polling Delay.** Set/read polling delay for base node or polling timeout for remote node. Polling delay is time between polling cycles on base unit measured in milliseconds. Polling timeout is the amount of time the remote unit will hold data from the serial port before it discards it. Time measured in hundredths of seconds.	0 - 0xFFFF (Base: (x 1 ms), Remote: [x 10 ms])	0
PE v2.x20*	0x46 (70d)	Networking & Security	**Polling End Address.** Set/read ending address for polling base unit (only applies when MD=3).	0 - 0xFFFF	0
PK	0x29 (41d)	RF Interfacing	**Maximum RF Packet Size.** Set/read maximum RF packet size. Must be 256 (0x100) or less for 9600 bps RF rate (BR=0) and 2048 (0x800) or less for 115200 bps RF rate (BR=1).	1 - 0x800 [Bytes]	varies
PL	0x3A (58d)	RF Interfacing	**TX Power Level.** Select transmit power level. Note that modem requires 5 VDC supply (or greater) for full 1 Watt output power. If supply voltage is less than 5V, the radio will transmit at the highest power level possible and set a warning flag.	0 - 4 0 = 1 mW 1 = 10 mW 2 = 100 mW 3 = 500 mW 4 = 1000 mW (1 Watt)	4 (1 Watt)
PW	0x1D (29d)	Sleep (Low Power)	**Pin Wake-up.** Select/read pin wake-up options.	0 - 1 0 = Disabled 1 = Enabled	0
RB	0x20 (32d)	Serial Interfacing	**Packetization Threshold.** Set/read character threshold. RF transmission begins after receiving RB bytes or after receiving at least 1 byte and observing RO character times of silence on the UART.	1 - Current value of PK	0x800 (2048d)
RC	--	Diagnostics	**Ambient Power - Single Channel.** Read the power level on a given channel	0 - 0x31 [dBm, read-only]	--
RE	0x0E (14d)	(Special)	**Restore Defaults.** Restore module parameters to factory defaults.	--	--
RM	--	Diagnostics	**Ambient Power - All Channels.** Read power levels on all channels	No parameter - 0x7D0	--
RN	0x19 (25d)	Networking & Security	**Delay Slots.** Set/read the maximum number of delay slots used for random back-off algorithm used after transmission failure. A delay slot is 5 msec (if BR=1) and 54 msec (BR=0).	0 - 0xFF [slots]	0
RO	0x21 (33d)	Serial Interfacing	**Packetization Timeout.** RF transmission begins after receiving RB bytes or after receiving at least 1 byte and seeing RO character times of silence on the UART. If RO=0, RB bytes must be received before beginning transmission.	0 - 0xFFFF [x UART character time]	3
RP	0x22 (34d)	Diagnostics	**RSSI PWM Timer.** Set/read duration of PWM (pulse width modulation) output on pin 11. The PWM output encodes fade margin (RX signal strength relative to RX sensitivity) by varying the duty cycle of a 125Hz square wave.	0 - 0xFF [x 100 msec]	0x20 (32d)

Table 3-9. XTend Commands (The embedded modules expect numerical values in hexadecimal. Hexadecimal values are designated by a "0x" prefix. Decimal equivalents are designated by a "d" suffix.)

AT Command	Binary Command	Command Category	Name and Description	Parameter Range	Factory Default
RR	0x18 (24d)	Networking & Security	Retries. Set/read maximum number of RF packet delivery attempts. If RR is non-zero and MT is zero, packets sent from the module will request an acknowledgement and can be resent up to RR times if no ACKs are received.	0 - 0xFF	0x0A (10d)
RT	0x16 (22d)	Serial Interfacing	GPI1 Configuration. Select/read behavior of the GPI1 pin signal.	0 - 2 0 = Disabled 1 = Enable Binary Programming 2 = Enable RTS Flow Control	0
SB	0x37 (55d)	Serial Interfacing	Stop Bits. Select/read number of stop bits used for UART communications.	0 - 1 0 = 1 stop bit 1 = 2 stop bits	0
SH	0x25 (37d)	Diagnostics	Serial Number High. Read high 16 bits of 32-bit unique serial number.	0 - 0xFFFF [read-only]	varies
SL	0x26 (38d)	Diagnostics	Serial Number Low. Read low 16 bits of 32-bit unique serial number.	0 - 0xFFFF [read-only]	varies
SM	0x01 (1d)	Sleep (Low Power)	Sleep Mode. Select/read Sleep Mode options. Cyclic sleep can be used to trade idle current consumption for transmission latency.	0 - 8 0 = Disabled 1 = Pin Sleep 2 = Serial Port Sleep 3 = [reserved] 4 = Cyclic 1.0 second sleep 5 = Cyclic 2.0 second sleep 6 = Cyclic 4.0 second sleep 7 = Cyclic 8.0 second sleep 8 = Cyclic 16.0 second sleep	0
ST	0x02 (2d)	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 (only valid with Cyclic and Serial Port Sleep settings).	(ATAT+3) - 0x7FFF [x 100 msec]	0x64 (100d)
TP	0x38 (56d)	Diagnostics	Board Temperature. Read current temperature of module in degrees Celsius (8-bit twos complement, eg. 26C = 0x1A, -10C = 0xF6).	0 - 0x7F [read-only]	--
TR	0x1B (27d)	Diagnostics	Delivery Failure Count. Read number of RF packets sent where retries expire with no ACK received (when RR>0).	0 - 0xFFFF [read-only]	0
TT	0x1A (26d)	Networking & Security	Streaming Limit. Set/read maximum number of continuous bytes transmitted by one module before forcing a delay that allows other modules to transmit.	0 - 0xFFFF	0 (disabled)
TX	0x3F (63d)	RF Interfacing	Transmit Only. Select TX/RX or TX-only.	0 - 1 0 = TX & RX 1 = TX-only	0
VL	--	Diagnostics	Firmware Version - verbose. Read verbose firmware version of module.	Returns string [read-only]	--
VR	0x14 (20d)	Diagnostics	Firmware Version. Read module firmware version number.	0 - 0xFFFF [read-only]	--
WA	--	Diagnostics	Active Warning Numbers. Read warning numbers of all active warnings (1 warning number / line).	Returns string	--
WN	--	Diagnostics	Warning Data. Read data for all active and sticky warnings.	Returns string	--
WR	0x08 (8d)	(Special)	Write. Write parameter values to non-volatile memory so that parameter modifications persist through subsequent power-up or reset. Note: Once WR is issued, no additional characters should be sent to the module until after the response "OK\r" is received.	--	--
WS	--	Diagnostics	Sticky Warning Numbers. Read warning numbers of all warnings active since the last use of the WS or WN command.	Returns string	--

* Firmware version in which command and parameter options were first supported

Appendix A: Agency Certifications

FCC Certification

XBee XTender RF Bridges comply 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. XBee XTender RF Bridges may only be used with antennas that have been tested and approved for use with this bridge [refer to the antenna tables in this section].

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 XTender RF Bridge

Contains FCC ID: FCC-Pending

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

FCC Notices

IMPORTANT: The XBee XTender OEM RF Bridge has been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). 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 bridge has been certified for remote and base radio applications. If the bridge 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.

FCC-approved Antennas

XBee XTender RF Bridges can be installed using antennas and cables constructed with standard connectors (Type-N, SMA, TNC, etc.) if the installation is performed professionally and according to FCC guidelines. For installations not performed by a professional, non-standard connectors (RPSMA, RPTNC, etc.) must be used.

XBee-PRO OEM RF Modules

The embedded XBee-PRO RF Module is FCC-approved for fixed base station and mobile applications on channels 0x0C - 0x17 (XBee-PRO). If the antenna is mounted at least 20cm (8 in.) from nearby persons, the application is considered a mobile application. Antennas not listed in the table must be tested to comply with FCC Section 15.203 (Unique Antenna Connectors) and Section 15.247 (Emissions). Cable-loss is required when using antennas listed in Table A-02).

Table A-01. Antennas approved for use with the XBee-PRO RF Bridges (Cable-loss is not required)

Part Number	Type (Description)	Gain	Application*	Min. Separation
A24-HSM-450	Dipole (Half-wave articulated RPSMA - 4.5")	2.1 dBi	Fixed/Mobile	20 cm
A24-HABSM	Dipole (Articulated RPSMA)	2.1 dBi	Fixed	20 cm

Table A-02. Antennas approved for use with the XBee-PRO RF Bridges (Cable-loss is Required)

Part Number	Type (Description)	Gain	Application*	Min. Separation	Required Cable-loss
A24-C1	Surface Mount	-1.5 dBi	Fixed/Mobile	20 cm	-
A24-Y4NF	Yagi (4-element)	6.0 dBi	Fixed	2 m	8.1 dB
A24-Y6NF	Yagi (6-element)	8.8 dBi	Fixed	2 m	10.9 dB
A24-Y7NF	Yagi (7-element)	9.0 dBi	Fixed	2 m	11.1 dB
A24-Y9NF	Yagi (9-element)	10.0 dBi	Fixed	2 m	12.1 dB
A24-Y10NF	Yagi (10-element)	11.0 dBi	Fixed	2 m	13.1 dB
A24-Y12NF	Yagi (12-element)	12.0 dBi	Fixed	2 m	14.1 dB
A24-Y13NF	Yagi (13-element)	12.0 dBi	Fixed	2 m	14.1 dB
A24-Y15NF	Yagi (15-element)	12.5 dBi	Fixed	2 m	14.6 dB
A24-Y16NF	Yagi (16-element)	13.5 dBi	Fixed	2 m	15.6 dB
A24-Y16RM	Yagi (16-element, RPSMA connector)	13.5 dBi	Fixed	2 m	15.6 dB
A24-Y18NF	Yagi (18-element)	15.0 dBi	Fixed	2 m	17.1 dB
A24-F2NF	Omni-directional (Fiberglass base station)	2.1 dBi	Fixed/Mobile	20 cm	4.2 dB
A24-F3NF	Omni-directional (Fiberglass base station)	3.0 dBi	Fixed/Mobile	20 cm	5.1 dB
A24-F5NF	Omni-directional (Fiberglass base station)	5.0 dBi	Fixed/Mobile	20 cm	7.1 dB
A24-F8NF	Omni-directional (Fiberglass base station)	8.0 dBi	Fixed	2 m	10.1 dB
A24-F9NF	Omni-directional (Fiberglass base station)	9.5 dBi	Fixed	2 m	11.6 dB
A24-F10NF	Omni-directional (Fiberglass base station)	10.0 dBi	Fixed	2 m	12.1 dB
A24-F12NF	Omni-directional (Fiberglass base station)	12.0 dBi	Fixed	2 m	14.1 dB
A24-F15NF	Omni-directional (Fiberglass base station)	15.0 dBi	Fixed	2 m	17.1 dB
A24-W7NF	Omni-directional (Base station)	7.2 dBi	Fixed	2 m	9.3 dB
A24-M7NF	Omni-directional (Mag-mount base station)	7.2 dBi	Fixed	2 m	9.3 dB
A24-P8SF	Flat Panel	8.5 dBi	Fixed	2 m	8.6 dB
A24-P8NF	Flat Panel	8.5 dBi	Fixed	2 m	8.6 dB
A24-P13NF	Flat Panel	13.0 dBi	Fixed	2 m	13.1 dB
A24-P14NF	Flat Panel	14.0 dBi	Fixed	2 m	14.1 dB
A24-P15NF	Flat Panel	15.0 dBi	Fixed	2 m	15.1 dB
A24-P16NF	Flat Panel	16.0 dBi	Fixed	2 m	16.1 dB
A24-P19NF	Flat Panel	19.0 dBi	Fixed	2 m	19.1 dB

*** If using the RF bridge in a portable application** (For example - If the bridge is used in a handheld device and the antenna is less than 20cm from the human body when the device is operation): The integrator is responsible for passing additional SAR (Specific Absorption Rate) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. The required SAR testing measures emissions from the bridge and how they affect the person. The testing results will be submitted to the FCC for approval prior to selling the integrated unit.

9XTend OEM RF Modules

Antenna Options (1-watt transmit power output or lower)

Table A-03. Half-wave antennas (approved when operating at 1-watt power output or lower)

Part Number	Type	Connector	Gain	Application
A09-HSM-7	Straight half-wave	RPSMA	3.0 dBi	Fixed / Mobile
A09-HASM-675	Articulated half-wave	RPSMA	2.1 dBi	Fixed / Mobile
A09-HABMM-P6I	Articulated half-wave w/ 6" pigtail	MMCX	2.1 dBi	Fixed / Mobile
A09-HABMM-6-P6I	Articulated half-wave w/ 6" pigtail	MMCX	2.1 dBi	Fixed / Mobile
A09-HBMM-P6I	Straight half-wave w/ 6" pigtail	MMCX	2.1 dBi	Fixed / Mobile
A09-HRSM	Right angle half-wave	RPSMA	2.1 dBi	Fixed
A09-HASM-7	Articulated half-wave	RPSMA	2.1 dBi	Fixed
A09-HG	Glass mounted half-wave	RPSMA	2.1 dBi	Fixed
A09-HATM	Articulated half-wave	RPTNC	2.1 dBi	Fixed
A09-H	Half-wave dipole	RPSMA	2.1 dBi	Fixed

Table A-04. Yagi antennas (approved when operating at 1-watt power output or lower)

Part Number	Type	Connector	Gain	Required Antenna Cable Loss	Application
A09-Y6	2 Element Yagi	RPN	6.1 dBi	0.1 dB*	Fixed / Mobile
A09-Y7	3 Element Yagi	RPN	7.1 dBi	1.1 dB*	Fixed / Mobile
A09-Y8	4 Element Yagi	RPN	8.1 dBi	2.1 dB*	Fixed / Mobile
A09-Y6TM	2 Element Yagi	RPTNC	6.1 dBi	0.1 dB*	Fixed / Mobile
A09-Y7TM	3 Element Yagi	RPTNC	7.1 dBi	1.1 dB*	Fixed / Mobile
A09-Y8TM	4 Element Yagi	RPTNC	8.1 dBi	2.1 dB*	Fixed / Mobile

Table A-05. Omni-directional base station antennas (approved when operating at 1-watt power output or lower)

Part Number	Type	Connector	Gain	Required Antenna Cable Loss	Application
A09-F0	Fiberglass Base Station	RPN	0 dBi	-	Fixed
A09-F1	Fiberglass Base Station	RPN	1.0 dBi	-	Fixed
A09-F2	Fiberglass Base Station	RPN	2.1 dBi	-	Fixed
A09-F3	Fiberglass Base Station	RPN	3.1 dBi	-	Fixed
A09-F4	Fiberglass Base Station	RPN	4.1 dBi	-	Fixed
A09-F5	Fiberglass Base Station	RPN	5.1 dBi	-	Fixed
A09-F6	Fiberglass Base Station	RPN	6.1 dBi	0.1 dB*	Fixed
A09-F7	Fiberglass Base Station	RPN	7.1 dBi	1.1 dB*	Fixed
A09-F8	Fiberglass Base Station	RPN	8.1 dBi	2.1 dB*	Fixed
A09-W7	Wire Base Station	RPN	7.1 dBi	1.1 dB*	Fixed
A09-F0	Fiberglass Base Station	RPSMA	0 dBi	-	Fixed
A09-F1	Fiberglass Base Station	RPSMA	1.0 dBi	-	Fixed
A09-F2	Fiberglass Base Station	RPSMA	2.1 dBi	-	Fixed
A09-F3	Fiberglass Base Station	RPSMA	3.1 dBi	-	Fixed
A09-F4	Fiberglass Base Station	RPSMA	4.1 dBi	-	Fixed
A09-F5	Fiberglass Base Station	RPSMA	5.1 dBi	-	Fixed
A09-F6	Fiberglass Base Station	RPSMA	6.1 dBi	0.1 dB*	Fixed
A09-F7	Fiberglass Base Station	RPSMA	7.1 dBi	1.1 dB*	Fixed
A09-F8	Fiberglass Base Station	RPSMA	8.1 dBi	2.1 dB*	Fixed
A09-W7SM	Wire Base Station	RPSMA	7.1 dBi	1.1 dB*	Fixed
A09-F0TM	Fiberglass Base Station	RPTNC	0 dBi	-	Fixed
A09-F1TM	Fiberglass Base Station	RPTNC	1.0 dBi	-	Fixed
A09-F2TM	Fiberglass Base Station	RPTNC	2.1 dBi	-	Fixed
A09-F3TM	Fiberglass Base Station	RPTNC	3.1 dBi	-	Fixed
A09-F4TM	Fiberglass Base Station	RPTNC	4.1 dBi	-	Fixed
A09-F5TM	Fiberglass Base Station	RPTNC	5.1 dBi	-	Fixed
A09-F6TM	Fiberglass Base Station	RPTNC	6.1 dBi	0.1 dB*	Fixed
A09-F7TM	Fiberglass Base Station	RPTNC	7.1 dBi	1.1 dB*	Fixed
A09-F8TM	Fiberglass Base Station	RPTNC	8.1 dBi	2.1 dB*	Fixed
A09-W7TM	Wire Base Station	RPTNC	7.1 dBi	1.1 dB*	Fixed

* FCC regulations stipulate a 36 dBm EIRP power requirement. Users implementing antenna gain greater than 6.0 dB must compensate for the added gain with cable loss. When operating at 1 W power output, the sum (in dB) of cable loss and antenna gain shall not exceed 6.0 dB.

Table A-06. Mag Mount antennas (approved when operating at 1-watt power output or lower)

Part Number	Type	Connector	Gain	Required Antenna Cable Loss	Application
A09-M0SM	Mag Mount	RPSMA	0 dBi	-	Fixed
A09-M2SM	Mag Mount	RPSMA	2.1 dBi	-	Fixed
A09-M3SM	Mag Mount	RPSMA	3.1 dBi	-	Fixed
A09-M5SM	Mag Mount	RPSMA	5.1 dBi	-	Fixed
A09-M7SM	Mag Mount	RPSMA	7.1 dBi	-1.1 dB*	Fixed
A09-M8SM	Mag Mount	RPSMA	8.1 dBi	-2.1 dB*	Fixed
A09-M0TM	Mag Mount	RPTNC	0 dBi	-	Fixed
A09-M2TM	Mag Mount	RPTNC	2.1 dBi	-	Fixed
A09-M3TM	Mag Mount	RPTNC	3.1 dBi	-	Fixed
A09-M5TM	Mag Mount	RPTNC	5.1 dBi	-	Fixed
A09-M7TM	Mag Mount	RPTNC	7.1 dBi	-1.1 dB*	Fixed
A09-M8TM	Mag Mount	RPTNC	8.1 dBi	-2.1 dB*	Fixed

Table A-07. Multi-path antennas (approved when operating at 1-watt power output or lower)

Part Number	Type	Connector	Gain	Application
A09-DPSM-P12F	omni directional permanent mount w/ 12ft pigtail	RPSMA	3.0 dBi	Fixed
A09-D3NF-P12F	omni directional magnetic mount w/ 12ft pigtail	RPN	3.0 dBi	Fixed
A09-D3SM-P12F	omni directional w/ 12ft pigtail	RPSMA	3.0 dBi	Fixed
A09-D3PNF	omni directional permanent mount	RPN	3.0 dBi	Fixed
A09-D3TM-P12F	omni directional w/ 12ft pigtail	RPTNC	3.0 dBi	Fixed
A09-D3PTM	omni directional permanent mount	RPTNC	3.0 dBi	Fixed
A92-D4PNF	900 MHz / 2.4GHz permanent mount	RPN	2.1 dBi	Fixed
A92-D4P	900 MHz / 2.4GHz permanent mount	RPSMA	2.1 dBi	Fixed
A92-D4PTM	900 MHz / 2.4GHz permanent mount	RPTNC	2.1 dBi	Fixed

* FCC regulations stipulate a 36 dBm EIRP power requirement. Users implementing antenna gain greater than 6.0 dB must compensate for the added gain with cable loss. When operating at 1 W power output, the sum (in dB) of cable loss and antenna gain shall not exceed 6.0 dB.

Antenna Options (100 mW transmit power output or lower)

Table A-08. Half-wave antennas (approved when operating at 100 mW power output or lower)

Part Number	Type	Connector	Gain	Application
A09-QW	Quarter-wave wire	Permanent	1.9 dBi	Fixed / Mobile
A09-QRAMM	3 " Quarter-wave wire	MMCX	2.1 dBi	Fixed / Mobile
A09-QSM-3	Quarter-wave straight	RPSMA	1.9 dBi	Fixed / Mobile
A09-QSM-3H	Heavy duty quarter-wave straight	RPSMA	1.9 dBi	Fixed / Mobile
A09-QBMM-P6I	Quarter-wave w/ 6" pigtail	MMCX	1.9 dBi	Fixed / Mobile
A09-QHRN	Miniature Helical Right Angle solder	Permanent	-1 dBi	Fixed / Mobile
A09-QHSN	Miniature Helical Right Angle solder	Permanent	-1 dBi	Fixed / Mobile
A09-QHSM-2	2" Straight	RPSMA	1.9 dBi	Fixed / Mobile
A09-QHRSM-2	2" Right angle	RPSMA	1.9 dBi	Fixed / Mobile
A09-QHRSM-170	1.7" Right angle	RPSMA	1.9 dBi	Fixed / Mobile
A09-QRSM-380	3.8" Right angle	RPSMA	1.9 dBi	Fixed / Mobile
A09-QAPM-520	5.2" Articulated Screw mount	Permanent	1.9 dBi	Fixed / Mobile
A09-QSPM-3	3" Straight screw mount	Permanent	1.9 dBi	Fixed / Mobile
A09-QAPM-3	3" Articulated screw mount	Permanent	1.9 dBi	Fixed / Mobile
A09-QAPM-3H	3" Articulated screw mount	Permanent	1.9 dBi	Fixed / Mobile

Table A-09. Yagi antennas (approved when operating at 100 mW power output or lower)

Part Number	Type	Connector	Gain	Application
A09-Y6	2 Element Yagi	RPN	6.1 dBi	Fixed / Mobile
A09-Y7	3 Element Yagi	RPN	7.1 dBi	Fixed / Mobile
A09-Y8	4 Element Yagi	RPN	8.1 dBi	Fixed / Mobile
A09-Y9	4 Element Yagi	RPN	9.1 dBi	Fixed / Mobile
A09-Y10	5 Element Yagi	RPN	10.1 dBi	Fixed / Mobile
A09-Y11	6 Element Yagi	RPN	11.1 dBi	Fixed / Mobile
A09-Y12	7 Element Yagi	RPN	12.1 dBi	Fixed / Mobile
A09-Y13	9 Element Yagi	RPN	13.1 dBi	Fixed / Mobile
A09-Y14	10 Element Yagi	RPN	14.1 dBi	Fixed / Mobile
A09-Y14	12 Element Yagi	RPN	14.1 dBi	Fixed / Mobile
A09-Y15	13 Element Yagi	RPN	15.1 dBi	Fixed / Mobile
A09-Y15	15 Element Yagi	RPN	15.1 dBi	Fixed / Mobile
A09-Y6TM	2 Element Yagi	RPTNC	6.1 dBi	Fixed / Mobile
A09-Y7TM	3 Element Yagi	RPTNC	7.1 dBi	Fixed / Mobile
A09-Y8TM	4 Element Yagi	RPTNC	8.1 dBi	Fixed / Mobile
A09-Y9TM	4 Element Yagi	RPTNC	9.1 dBi	Fixed / Mobile
A09-Y10TM	5 Element Yagi	RPTNC	10.1 dBi	Fixed / Mobile
A09-Y11TM	6 Element Yagi	RPTNC	11.1 dBi	Fixed / Mobile
A09-Y12TM	7 Element Yagi	RPTNC	12.1 dBi	Fixed / Mobile
A09-Y13TM	9 Element Yagi	RPTNC	13.1 dBi	Fixed / Mobile
A09-Y14TM	10 Element Yagi	RPTNC	14.1 dBi	Fixed / Mobile
A09-Y14TM	12 Element Yagi	RPTNC	14.1 dBi	Fixed / Mobile
A09-Y15TM	13 Element Yagi	RPTNC	15.1 dBi	Fixed / Mobile
A09-Y15TM	15 Element Yagi	RPTNC	15.1 dBi	Fixed / Mobile

IC (Industry Canada) Certification

Labeling Requirements

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display one of the following texts:

Contains Model XBee-PRO Radio, IC: 4214A-XBEEPRO
Contains Model 9XTend Radio, IC: 4214A-9XTEND

The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

Appendix B: Additional Information

1-Year Warranty

XBee XTender RF Bridges 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.

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/support/downloads.php	
Technical Support:	Phone.	(866) 765-9885 toll-free U.S.A. & Canada (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]

