XStream-PKG-T™ Telephone RF Modem (Beta)

Product Manual v4.30 Beta

XStream RF Modem Part Numbers:

X09-001PK...-T...	X24-009PK...-T...	XH9-001PK...-T...
X09-009PK...-T...	X24-019PK...-T...	XH9-009PK...-T...
X09-019PK...-T...		XH9-019PK...-T...

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Contents

XStream Telephone RF Modem

The XStream-PKG-T RF Modem extends the performance of data systems by providing a wireless link that plugs into existing telephone lines.

MaxStream RF Modems handle the complexities inherent to wireless communications (modulation, demodulation, frequency synthesizers, amplifiers, filters, FCC approvals, etc.), so OEMs and integrators can focus resources beyond the wireless portion of their data systems.

Features

Long Range at a Low Cost

9XStream (900 MHz) Range:

- Indoor/Urban: **up to 1500'** (450 m)
- Outdoor line-of-sight:
  up to 7 miles (11 km) w/ dipole antenna
- Outdoor line-of-sight:
  up to 20 miles (32 km) w/ high gain antenna

24XStream (2.4 GHz) Range:

- Indoor/Urban: **up to 600'** (180 m)
- Outdoor line-of-sight:
  up to 3 miles (5 km) w/ dipole antenna
- Outdoor line-of-sight:
  up to 10 miles (16 km) w/ high gain antenna

Receiver sensitivity: **-110 dBm** (900 MHz),
−105 dBm (2.4G) [-93 dBm is industry average]

Advanced Networking & Security

True Peer-to-Peer (no "master" required)

Point-to-Point, Point-to-Multipoint, Multidrop

Retries and Acknowledgements

Up to 65,000 networking addresses available

Easy-to-Use

FCC and other agency approved

Plug-and-Play
(no configuration required)

Advanced configurations using Windows software and AT Commands

Transparent Operation

Portable (small form factor & low power)

Software-selectable serial interfacing

MODBUS, $\overline{CTS}$, $\overline{RTS}$, $\overline{DCD}$ & $\overline{DTR}$ I/O Support

Support for multiple data formats

XII™ Interference Immunity

Power-saving Sleep Modes

FHSS (Frequency Hopping Spread Spectrum)

Worldwide Acceptance

FCC Certified (USA) [Go to Appendix A for FCC Requirements]
Devices that contain XStream RF Modems can inherit MaxStream's FCC Certification

IC (Industry Canada) **Certified**

ISM (Industrial, Scientific & Medical) frequency band

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

9XStream-PKG-T (900 MHz) RF Modems approved for use in **US**, **Canada**, **Australia**, **Israel** (and more). 24XStream-PKG-T (2.4 GHz) adds **EU** (Europe) and other approvals

Block Diagram

Figure 1.   PKG-T RF Modem Internal Block Diagram
(Low-asserted signals distinguished by horizontal line over pin name.)
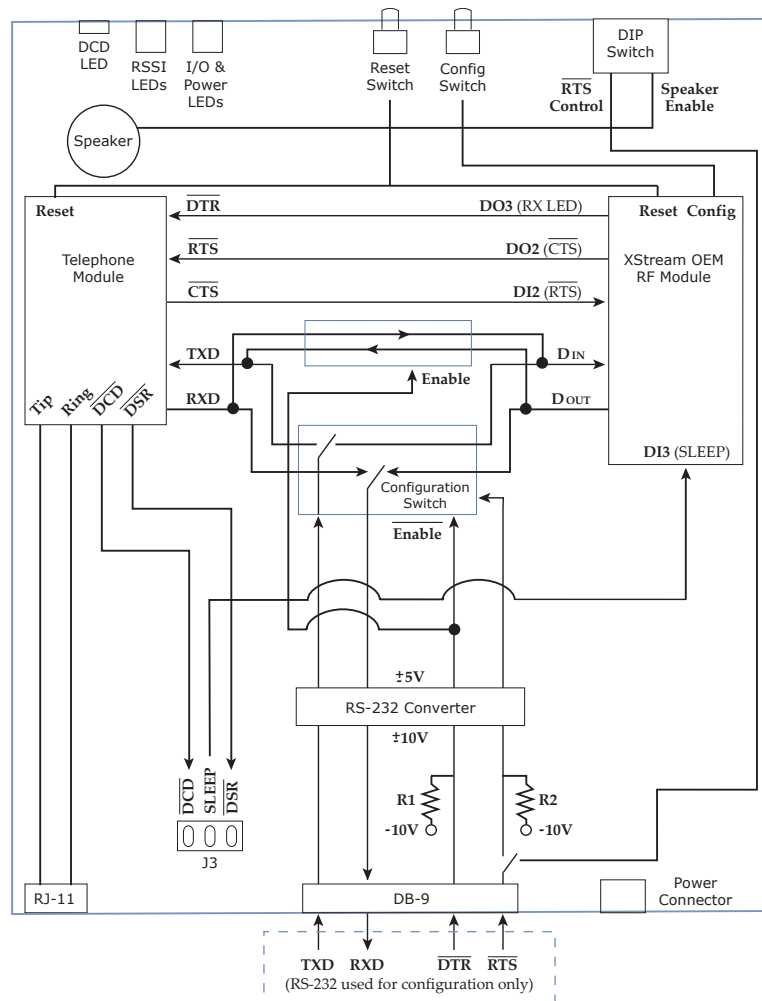
The PKG-T RF Modem provides an RF link between devices out-of-box and without configuration. If more advanced features are needed, the XStream OEM RF Module and Telephone Module can be configured via the DB-9 connector or an RF link. In the PKG-T RF Modem's default state (when nothing is attached to the DB-9 connector), the Telephone Module communicates directly with the XStream Module and receives commands through an RF Link [Shown in Figure 9].

When an RS-232 cable is connected to the DB-9 connector of the PKG-T RF Modem, the XStream OEM RF Module and the Telephone Module can be configured by controlling the $\overline{DTR}$ and $\overline{RTS}$ lines of the DB-9 connector. Table 1 demonstrates the RS-232 levels required to configure the XStream Module or Telephone Module. [See "Telephone Module Configuration" & "XStream OEM RF Module Configuration" sections for more information.]

Table 1.   Signal Routing between RS-232 DB-9 connector, XStream OEM RF Module & Telephone Module
(Low-asserted signals distinguished by horizontal line over pin name.)

$\overline{DTR}$	$\overline{RTS}$	Result
+10V	+10V	DB-9 connects to XStream OEM RF Module for configuration.
+10V	-10V	DB-9 connects to Telephone Module for configuration.
-10V (default state)	-10V / +10V (default state)	XStream OEM RF Module and Telephone Module are connected to each other and not to DB-9. This is the default state of the RF Modem (when DB-9 is not connected).

XStream-PKG-T Interface

Front and Back Views
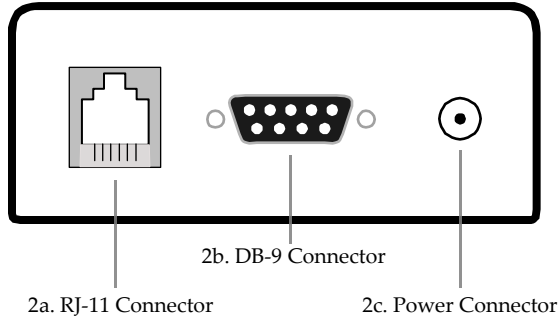
2a. RJ-11 Connector

Standard RJ-11 connector is used to connect to telephone lines. [Pin descriptions on page 4]

Figure 2.   Front View

2b. DB-9 Connector

2a. RJ-11 Connector   2c. Power Connector

2b. DB-9 Connector

Standard female DB-9 (RS-232) DCE connector is primarily used as a medium to configure parameters of the XStream OEM RF Module and the Telephone Modem. [Pin descriptions on page 4]

2c. Power Connector

7-28 VDC Power Connector – Installing internal jumpers J1 & J5 allows the unit to be powered with a regulated 5V supply.

2a. DIP Switch

DIP Switch enables up-front control to speaker and $\overline{RTS}$ functions.

Figure 3.   Back View

3d. Antenna Port   3g. $\overline{DCD}$ LED

3c. Reset Switch   3f. RSSI LEDs

3b. Config Switch   3e. I/O & Power LEDs

3a. DIP Switch

Speaker Control ON (audio output from speaker)

Speaker Control OFF (no signal to speaker)

$\overline{RTS}$ Control ON Allows user to control $\overline{RTS}$ though DB-9 Connector

$\overline{RTS}$ Control OFF (defaults to high TTL state (+ 5V))

3b. Config (Configuration) Switch

Configuration Switch provides an alternate way to enter AT Command Mode. To enter AT Command Mode at the RF Modem's default baud rate, read the Reset Switch entry [3c].

3c. Reset Switch

Reset Switch forces both the Telephone Module and the OEM RF Module into reset (or re-boot).

This switch can also be used with the Config Switch [3b] to enter the OEM RF Module into AT Command Mode. To do so: Simultaneo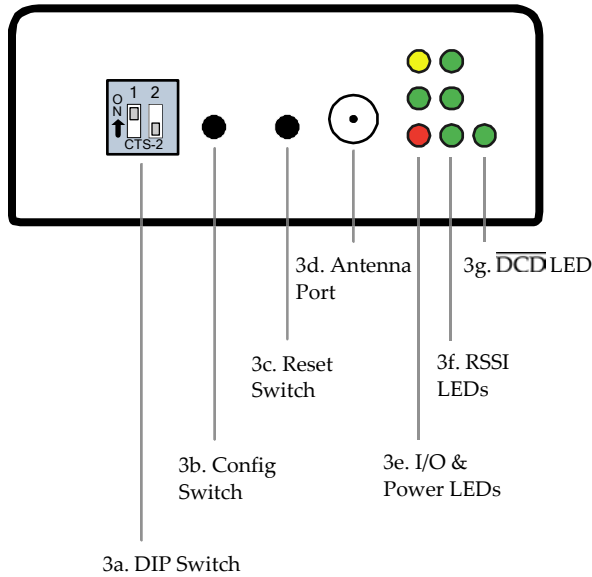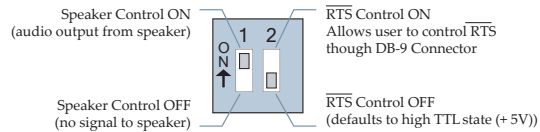usly press the Reset and Config switches, release the Reset Switch, then after 1 sec. release the Config Switch. Module then enters AT Command Mode at the module's default baud rate.

3d.   Antenna Port

50Ω RF signal connector for connecting to external antenna -Antenna connector type is RPSMA (Reverse Polarity SMA).

3e, 3f, & 3g. LED Indicators

Table 2.   LED indicators and their meanings

3e. I/O & Power LEDs	3f. RSSI LEDs	3g. $\overline{DCD}$ (Data Carrier Detect) LED
LED indicators visualize diagnostic status information. The RF Modem's status is represented as follows: Yellow (top LED) = Serial Data Out (to host) Green (middle) = Serial Data In (from host) Red (bottom) = Power/TX Indicator Red light is on when powered, off briefly during RF transmission)	Used to determine RSSI (Received Signal Strength Indicator) and fade margin available in the RF link: 3 Green LEDs ON = Very Strong (> 30 dB fade margin) 2 Green LEDs ON = Strong (> 20 dB fade margin) 1 Green LED ON = Moderate (> 10 dB fade margin) 0 Green LED ON = Weak (< 10 dB fade margin) Fade Margin = Amount by which a received signal level may be reduced without causing system performance to fall below a specified threshold value.	Illuminated green LED indicates telephone connection is established and $\overline{DCD}$ (Data Carrier Detect) is asserted. This signal is asserted by the Telephone Module.

Signal Pinouts

RJ-11 Connector Signal Pinouts

Figure 4.   Tip and Ring Pins of the RJ-11 Connector
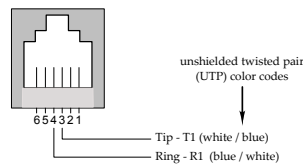
Table 3.   RJ-11 Signals and their implementations on the XStream-PKG-T RF Modem

Pin	Pin Name	Description	Implementation
3	T1	Tip	Dial-tone and talk circuit
4	R1	Ring	Dial-tone and talk circuit
1, 2, 5, 6	not used		

DB-9 Connector Signal Pinouts

Figure 5.   Pins of the Female DB-9 (RS-232) Connector
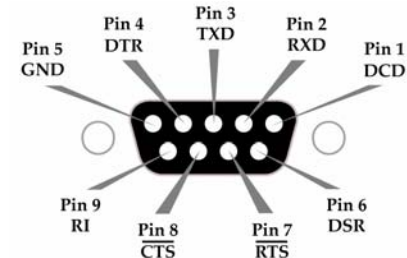
Table 4.   DB-9 (RS-232) Signals and their implementations on the XStream-PKG-T RF Modem
(Low-asserted signals are distinguished by horizontal line over pin name.)

Pin	Pin Name	Description	Implementation
1	$\overline{\text{DCD}}$	Data-Carrier-Detect	Set to +5V
2	RXD	Received Data	Serial Data OUT of the RF Modem (to host, from over-the-air))
3	TXD	Transmitted Data	Serial Data IN to the RF Modem (from host, to be transmitted over-the-air)
4	$\overline{\text{DTR}}$	Data-Terminal-Ready	Enables configuration (Serial Method) of XStream OEM RF Module or Telephone Module
5	GND	Ground	Ground
6	$\overline{\text{DSR}}$	Data-Set-Ready	Set to +5V
7	$\overline{\text{RTS}}$	Request-to-Send	Connects DB-9 data lines to XStream OEM RF Module or Telephone Module when $\overline{\text{DTR}}$ asserted (+10V)
8	$\overline{\text{CTS}}$	Clear-to-Send	Set to +5V
9	RI	Ring Indicator	not used

Jumpers

Table 5.   Jumpers on the XIB-T Interface Board

Jumper	Description
J3	Connects either $\overline{\text{DCD}}$ or $\overline{\text{DSR}}$ of the Telephone Modem to DI3 (SLEEP) of the XStream OEM RF Module.

Non-populated J1 and J5 jumpers are also available for bypassing the 5V and high input voltage regulators. Contact MaxStream Technical support for more information.

Operations

Data Radio System Components

XStream Radio Modems are designed to provide a transparent RF link between devices in a data radio system. The following devices will be used to illustrate basic XStream-PKG-T Telephone RF Modem operations:

XStream-PKG-T Telephone RF Modem ("PKG-T") = RF modem encases an XStream OEM RF Module, XIB-T Interface Board and Telephone Module. The PKG-T can be identified by its RJ-11 connector (for connecting to phone lines), DB-9 connector (for configuring modem) and 2-switch DIP Switch.

XStream-PKG-R RS-232/485 RF Modem ("PKG-R") = RF modem encases an XStream OEM RF Module and an XIB-R Interface Board. The PKG-R can be identified by its DB-9 connector and 6-switch DIP Switch.

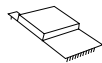**XStream OEM RF Module ("OEM RF Module")** = Self-contained unit that is mounted inside the PKG-T and PKG-R RF Modems. The OEM RF Module is configurable for advanced functionality such as networking, serial interfacing, sleep (low power) modes and diagnostics. This module modulates and demodulates data and it is responsible for long range RF data communications between RF Modems.

Telephone Module = Self-contained unit that is mounted inside the PKG-T Telephone RF Modem. The Telephone Module is configurable and it enables the XStream-PKG-T RF Modem to transmit and receive data over analog telephone lines.
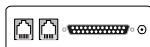
Telephone Modem = Modem enables a digital computer to transmit and receive data over analog telephone lines.

System Description

The XStream-PKG-T Telephone RF Modem allows data to be sent over an RF link through an on-board telephone module to a remote telephone modem. The PKG-T can be used with MaxStream's PKG-R (RS-232/485) or PKG-U (USB) RF Modems to wirelessly send and receive serial data. [A data radio system that uses the PKG-T and PKG-R Modems is shown in Figure 6.]

The PKG-T offers advanced functionality to provide a transparent cable replacement solution. The XStream OEM RF Modules can be configured to pass I/O lines such as $\overline{\text{DTR}}$, $\overline{\text{DCD}}$, $\overline{\text{CTS}}$ and $\overline{\text{RTS}}$ between the PKG-T's on-board Telephone Module and a host device [Figure 6]. The Telephone Module on the PKG-T is easily configured using standard AT Commands. The Telephone Module supports an extensive set of AT Commands [Tables 6-8, 10]. The on-board XStream OEM RF Module also supports an extensive set of AT Commands [Table 11].

Figure 6. **PKG-T RF Modem in a Point-to-Multipoint Data Radio System**
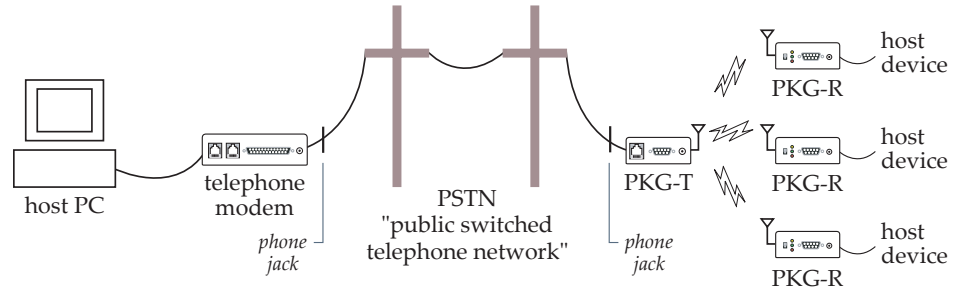
Figure 7. **XStream-PKG-T Telephone RF Modem replaces the need for the following components that previously would have been necessary for connecting into telephone lines**

DB-9 to DB-25 adapter

Telephone Modem   PKG-R RS-232/485 RF modem
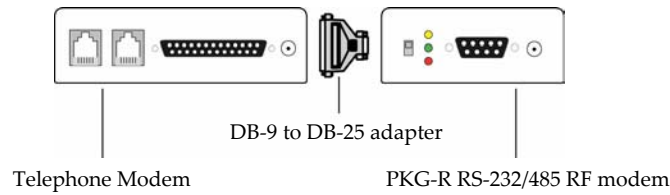
Telephone Module Configuration

The Telephone Module features a rich set of AT commands that allow flexibility in operations. On power-up or reset, the Telephone Module operates in command mode and will accept AT commands either from an RS-232 serial cable or from an RF link. These two methods are described below:

Hands-on Example

An example that steps through both configuration methods is on page 17.

Method 1 – Serial Method:

Configurations made via the serial line [Example shown in "X-CTU Software" section]

1   Connect an RS-232 cable to the DB-9 connector of the PKG-T RF Modem.

2.   Move DIP Switch 2 ($\overline{RTS}$ control) to the OFF (down) position.

3.   Assert $\overline{DTR}$ (+10V). Most serial communications software (including X-CTU) will assert $\overline{DTR}$ when the serial com port is opened.

Figure 8. **Serial Configuration Method Setup**

RS-232 cable

Computer (DTE)   PKG-T RF Modem (DCE)
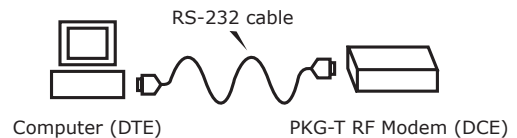
Method 2 – RF Link Method

Configurations made via a remote PKG RF Modem

1.   Detach cable from the DB-9 connector (Absence of the cable will automatically assert $\overline{DTR}$ (-10V RS-232 level)).

2.   Then connect wirelessly to the RF Modem (AT Commands are sent from a PC to a device such as the PKG-R RS-232/485 RF Modem via a serial port. The PKG-R Modem then relays commands over-the-air to the PKG-T Telephone RF Modem.)

Figure 9. **RF Link Configuration Method Setup**

RS-232 cable   phone cable

Computer (DTE)   PKG-R RF Modem (DCE)   PKG-T RF Modem (DCE)   Phone Jack

AT Command Mode

Telephone Module AT Commands can be sent using MaxStream's X-CTU Software (recommended) or other serial communications software such as "HyperTerminal". AT commands are sent using ASCII commands and parameters. The Telephone Module expects numeric values in decimal and AT commands are sent as follows:

Figure 10. Syntax for sending Telephone Module AT Commands:

"AT" Prefix + **ASCII Command** + **Space** (Optional) + **Parameter** (Optional, DEC) + **Carriage Return**

Example: ATS0 10<CR>

The Telephone Modem ignores spaces, parenthesis and quotation marks in a command string. Multiple commands and parameters can be combined into a single line. The command line can include a backspace character (See S-Parameter "S5") that will delete the previous character. The last character in a command is the termination character (See S-Parameter "S3"). The modem executes the full command once it receives the termination character.

Command Echo

The Telephone Module may echo characters (default state). The echo can be turned off or on using the "E" command as described in Table 8.

System Response

Once a command is sent to the Telephone Module, the module will parse and execute the command. Upon successful execution of the command, the Telephone Module will return an "OK" message. If execution of an invalid command results in an error, the remainder of the command will not be executed and the Telephone Module will return an "ERROR" message.

Aborting Commands

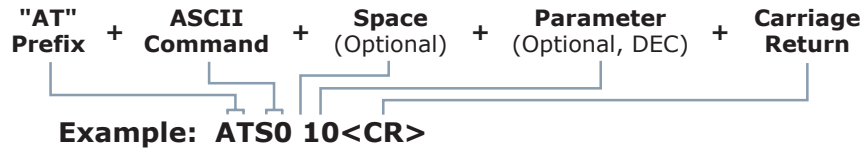Some commands that require time to execute may be aborted during operation. A single character may be sent to the module to abort the currently executing command.

Reading & Saving Parameter Values

The values of most AT settings can be read using "&V" command. Once a set of commands have been programmed to a module, the entire profile can be saved using the "&W" command [Table 7]. The Telephone Module can store two different profiles. Either profile can be loaded on a hard or soft reset using "&Y" Command [Table 7] or "Z" Command [Table 8].

Disconnecting a Call

Below are three methods that can be used to disconnect a call:

1. Resetting the Telephone Module's power (by clicking the "Reset Switch" of the RF Modem [Figure 3c]) will disconnect and put the module back to the OFF line state.

2. A remote device can also cause the module to disconnect. If the remote device disconnects, the local module will automatically sense the loss of the carrier signal then return to the OFF line state.

3. "ATH" or "ATZ" commands can also be used to disconnect a call. In order to issue a command to the Telephone Module when it is ON line, the module must be placed into the "ON Line Command State".

    This is accomplished by issuing a special escape sequence. The default value of this three digit escape sequence is the "+" character [See S-Parameter "S2"]. The "+++" is guarded by a 1-second delay before and after it is sent [See S-Parameter "S12"]. When the module detects the escape sequence, the "OK" result will be displayed and the module is in the On Line Command State. The "ATH" or "ATZ" commands can now be issued to disconnect the call.

AT Commands Unique to the Telephone Module

Table 6. Telephone Module AT Commands – Dial Commands

AT Command	AT Command Description
Dial Commands	
0-9	**DTMF Digits.**
A-D	**DTMF Digits.**
*	**Star Digit.** (tone dialing only)
#	**Gate Digit.** (tone dialing only)
T	**Tone Dialing.**
P	**Pulse Dialing.**
R	(Command is accepted but not acted on)
S = n	**Dial Stored Number.** Dial the number stored in the directory (n = 0-3). See "&Z" Command.
,	**Pause.** Wait for S8 time.
;	**Remain.** Remain in AT Command Mode after Dialing
"	(Ignored – may be used to format dial string)
<space>	(Ignored)
( )	(Ignored – may be used to format dial string)
W	**Wait for Dial Tone.** Waits for dial tone until timeout specified by "S7" expires. If no dial tone is detected, module returns on-hook and generates error message.
@	**Wait for Silence.** Waits for at least 5 x 1 second of silence before continuing with next dial string parameter. If silence is not detected before the "S7" timeout expires, the module will terminate the call with NO ANSWER message.
!	**Flash.** Module goes on-hook according to time specified in "S29".

Table 7. Telephone Module AT Commands – Ampersand Commands
(Low-asserted signals are distinguished by horizontal line over pin name.)

AT Command	Parameters
Ampersand Commands	
&Cn	n=0 $\overline{DCD}$ Always On n=1 Module Controls $\overline{DCD}$ (default)
&Dn	n=0 Ignore $\overline{DTR}$ n=1 $\overline{DTR}$ drop puts module in command mode without disconnecting n=2 $\overline{DTR}$ drop causes the module to hang up (default) n=3 $\overline{DTR}$ drop causes module to perform a soft reset as if the Z command were received
&Fn	n=0 Restore Factory Configuration 0 n=1 Restore Factory Configuration 1
&Gn	n=0 No Guard Tone (default) n=2 1800 Hz Guard Tone
&Kn	n=0 Disables flow control n=3 Enables $\overline{RTS}$ / $\overline{CTS}$ hardware flow control (default) n=4 Enables XON/XOFF software flow control n=5 Enables transparent XON/XOFF software flow control
&Rn	n=0 $\overline{CTS}$ follows $\overline{RTS}$. $\overline{RTS}$ - $\overline{CTS}$ delay set by "S26" S-Parameter. n=1 $\overline{CTS}$ always asserted.
&Sn	n=0 $\overline{DSR}$ Always On (default) n=1 Module Controls $\overline{DSR}$
&Tn	n=0 Terminates test in progress n=1 Begin Analog Loopback Test
&V	Diagnostic command - Reports current configuration, stored user profiles and first 4 stored telephone numbers
&V1	Diagnostic command - Shows statistics for most recent connection
&Wn	n=0 Store configuration as profile 0 n=1 Store configuration as profile 1
&Yn	n=0 Hard reset restores profile 0 n=1 Hard reset restores profile 1
&Zn	Stores telephone number dial string (to 31 digits) into n (n = 0 - 3)

Table 8.   Telephone Module AT Commands – Other Commands

AT Command	Parameters	
Other Module Commands		
A;	Module will go off-hook and attempt to answer an incoming call	
A/	Repeat Previous Command	
En;	n=0	Disable Command Echo
	n=1	Enable Command Echo (default)
Hn;	n=0	Module will hang up.
	n=1	If on-hook, module will go off-hook and enter command mode
Ln;	n=0	Low volume on speaker line
	n=1	Low volume on speaker line (default)
	n=2	Medium volume
	n=3	High Volume
Mn;	n=0	Speaker is always off
	n=1	Speaker is on while establishing connection, but off when receiving carrier (default)
	n=2	Speaker always on
	n=3	Speaker on while answering, off when receiving carrier and when dialing
On;	n=0	Enter on-line data mode without a retrain
	n=1	Enter on-line data mode with a retrain
Qn;	n=0	Enable results codes to DTE (default)
	n=1	Disable results codes to DTE
Wn;	n=0	Upon connect, module reports only DTE speed (i.e. CONNECT 9600) (default)
	n=1	Upon connect, module reports modulation, line speed, error correction protocol, and DTE speed
	n=2	Upon connect, module reports DCE speed
Zn;	n=0	Soft reset and restore profile 0
	n=1	Soft reset and restore profile 1

S-Parameters

Reading and Setting S-Parameters

Commands that begin with the letter "S" are called S-Parameters. The number following the "S" indicates the parameter number. The Telephone Module can select an active S-Parameter and (where applicable) perform read/write operations. Commands can be performed on an S-Parameter as follows:

> ATSn – Makes S-Parameter n active
>
> ATSn=v – Sets S-Parameter n to value v
>
> ATSn? – Reads current value of S-Parameter n

Once a register is made active (the last register accessed), the register name is optional and can be omitted from subsequent read/write commands that reference the same register. This is show in the table below.

Table 9.   Sample read and write commands using active register

Command	System Response
ATS7	Make "S7" Parameter Active
AT=51	Set "S7" to 51 (decimal)
AT?	Read Value of "S7"

If the number n (or the value v on a write) is out of range or invalid, the module will return the "ERROR" message. All S-Parameter values and responses are in decimal format. The S-Parameters can be read at once using "&V" command [Table 7].

Table 10. Telephone Module AT Commands – S-Parameters

AT Command	Description	Parameter Range	Default
S-Parameters			
S0	**Number of Rings before Auto-Answer.** The number of rings before module will automatically answer.	0 - 255	0 (no Auto-Answer)
S1	**Ring Counter.** Counts Number of Rings, clears count after 8 seconds of no ring.	0 - 255	n/a
S2	**Escape Code Char.** Holds ASCII value of escape character.	0 - 255	43 ("+" char)
S3	**Carriage Return Char.** Holds ASCII value of carriage return character.	0 - 127	13 (carriage return)
S4	**Line Feed Char.** Holds ASCII value of line feed character.	0 – 127 [ASCII decimal]	10 (line feed)
S5	**Backspace Char.** Holds ASCII value of backspace character.	0 – 32 [ASCII decimal]	8 (backspace)
S6	**Wait Time/Dial Tone.** The length of time module will wait for dial tone when encountering a "W" dial modifier before returning "NO DIAL TONE" message.	2 - 255 [x 1 second]	2
S7	**Wait Time/Carrier.** The length of time module will wait: - for carrier before hanging up - for silence when encountering the "@" dial modifier before continuing with the next dial string parameter - for dial tone when encountering a "W" dial modifier before continuing with the next dial string parameter.	1 - 255 [x 1 second]	50
S8	**Pause Time.** Sets time that module must pause when the "," character is encountered in the dial string.	2 - 255 [x 1 second]	2
S9	**Carrier Detect Time.** No value can be written.	Not configurable [x 1 ms]	600
S10	**Carrier Loss Time.** Time that module waits before hanging up after losing carrier. The actual wait time is (S10 - S9), so "S10" must be set to a value greater than "S9".	6 - 255 [x 100 ms]	14
S11	**Dial Tone Duration.** Sets tone duration for DTMF dialing.	50 - 255 [x 1 ms]	95
S12	**Escape Code Time.** Required maximum time period of silence between receipt of the last character of the three escape character sequence and sending of the "OK" result code. If any characters are detected during this time, "OK" will not be sent.	0 - 255 [x 20 ms]	50 (1 second)
S26	$\overline{RTS}$ / $\overline{CTS}$ **Delay Time.** The time delay before the module turns on $\overline{CTS}$ after detecting OFF to ON $\overline{RTS}$ transition (when "&R0" command is set).	0 - 255 [x 10 ms]	1
S29	**On-hook Time.** Sets length of time that the module will go on-hook when it encounters Flash ("!") dial modifier in dial string.	Not configurable [x 10 ms]	70 (country-dependent, not configurable)
S30	**Disconnect Inactivity Timer.** The length of time that the module will stay online before disconnecting when no data is sent or received.	0 - 255 [x 100 ms]	0 (disabled)

XStream OEM RF Module Configuration

The XStream OEM RF Module is configured through the DB-9 connector of the PKG-T unit. To configure the XStream OEM RF Module, DIP Switch 2 must be ON (up) and both $\overline{RTS}$ and $\overline{DTR}$ must be asserted (+10V RS-232 logic).

Figure 11. Hardware Setup for XStream OEM RF Module Configuration
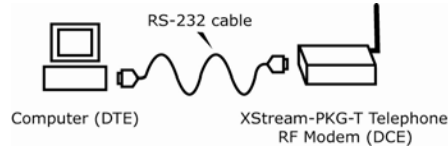

XStream OEM RF Module parameters are grouped into the following five categories:

- AT Command Mode Options
- Diagnostics
- Networking
- Serial Interfacing Options
- Sleep (Low Power)

XStream OEM RF Module Configuration steps-to-follow

1. Attach RS-232 cable to DB-9 connectors of the XStream-PKG-T RF Modem and a PC.
2. Move DIP Switch 2 ($\overline{RTS}$ Control) to the ON (up) position.
3. Launch MaxStream's X-CTU Software and click the "Terminal" tab
4. Enter the AT Command Mode Sequence "---" [see below].
5. Use the syntax illustrated in [Figure 12] to execute AT Commands.
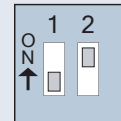
The AT Command Mode Sequence is used to ready the OEM RF Module to recognize AT Commands and Parameters. Each component of the sequence is editable via the command listed in parentheses.

- Guard Time Before (AT Command) = "1" second
- Three copies of the Command Sequence Character (CC Command) = "---"
- Guard Time After (BT Command) = "1" second

IMPORTANT: The default Command Sequence Character ("–") is unique to the XStream–PKG–T Telephone RF Modem. All other MaxStream Radio Modems use the "+" character as their default.

Parameters can be read and modified by sending AT Commands to the OEM RF Module via MaxStream's X-CTU Software or other serial communications software such as "HyperTerminal". XStream Module commands are explained in further detail in the "XStream Advanced Programming & Configuration" manual. This manual is located on in the 'documentation → XStream Product Family' folder of the MaxStream CD and under the 'Downloads' section of the following web page: www.maxstream.net/helpdesk/.

A terminal program has been built into the X-CTU software and can be accessed through the "Terminal" tab. Use the following syntax when issuing AT Commands and terminal software:

Figure 12. Syntax for sending XStream OEM RF Module AT Commands:
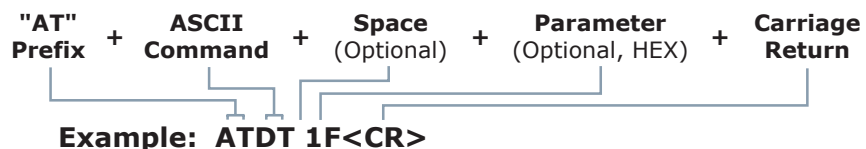
Preceding example would change "Destination Address" of the XStream OEM RF Module to "1F".

AT Commands Unique to the XStream OEM RF Module

Table 11. **XStream OEM AT Commands as of Beta Firmware Version 4.30** (Short Reference)

AT Command	Binary Command	AT Command Name	Range	Command Category	# Bytes Returned	Factory Default
AT	0x05 (5d)	Guard Time After	0x02 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0x0A (10d)
BD	0x15 (21d)	Baud Rate	0 – 6	Serial Interfacing	1	RF data rate
BK v4.30*	0x2E (46d)	Break Passing	0 - 1	Serial Interfacing	1	0 (disabled)
BO v4.30*	0x30 (48d)	Break Timeout	0 – 0xFFFF	Serial Interfacing	2	0 (no timeout)
BT	0x04 (4d)	Guard Time Before	0 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0x0A (10d)
CC	0x13 (19d)	Command Sequence Character	0x20 – 0x7F	AT Command Mode Options	1	0x2B ("+")
CD v 4.30*	0x28 (40d)	DO3 Configuration	0 – 3	Serial Interfacing	1	0
CN	0x09 (9d)	Exit AT Command Mode	none	AT Command Mode Options	n/a	None
CO v 4.30*	0x2F (47d)	DO3 Timer	0 – 0xFFFF (x 1 sec)	Serial Interfacing	2	0
CS v 4.27D*	0x1F (31d)	DO2 Configuration	0 – 4	Serial Interfacing	1	0
CT	0x06 (6d)	AT Command Mode Timeout	0x02 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0xC8 (200d)
DR v 4.30*	0x2D (45d)	DI3 Configuration	0 – 1	Serial Interfacing	1	0 (disabled)
DT	0x00 (0d)	Destination Address	0 – 0xFFFF	Networking	2	0
E0	0x0A (10d)	Echo Off	none	AT Command Mode Options	n/a	None
E1	0x0B (11d)	Echo On	none	AT Command Mode Options	n/a	None
ER	0x0F (15d)	Receive Error Count	0 – 0xFFFF	Diagnostic	2	0
FH	0x0D (13d)	Force Wake-up Initializer	none	Sleep (Low Power)	n/a	None
FL	0x07 (7d)	Software Flow Control	0 – 1	Serial Interfacing	1	0
FT v 4.27B*	0x24 (36d)	Flow Control Threshold	0 – 0xFF (bytes)	Serial Interfacing	2	Varies
GD	0x10 (16d)	Receive Good Count	0 – 0xFFFF	Diagnostic	2	0
HP	0x11 (17d)	Hopping Channel	0 – 6	Networking	1	0
HT	0x03 (3d)	Time before Wake-up Initializer	0 – 0xFFFF (x 100 ms)	Sleep (Low Power)	2	0xFFFF (disabled)
ID v 4.27C*	0x27 (39d)	Modem VID	0 – 0xFFFF (Read-only)	Networking	2	none
LH	0x0C (12d)	Wake-up Initializer Timer	0 – 0xFF (x 100 ms)	Sleep (Low Power)	1	1
MD v 4.30*	0x32 (50d)	Multipoint Configuration	0 - 2	Networking	1	0
MK	0x12 (18d)	Address Mask	0 – 0xFFFF	Networking	2	0xFFFF
MY v 4.30*	0x2A (42d)	Source Address	0 – 0xFFFF	Networking	2	0xFFFF (disabled)
NB v 4.30*	0x23 (35d)	Parity	0 – 5	Serial Interfacing	1	0
PC v 4.22*	0x1E (30d)	Power-up Mode	0 – 1	AT Command Mode Options	1	0
PK v 4.30*	0x29 (41d)	Packet Size	0x01 – 0x100	Serial Interfacing	2	0x40 (64d)
PW v 4.22*	0x1D (29d)	Pin Wake-up	0 – 1	Sleep (Low Power)	1	0
RB v 4.30*	0x20 (32d)	Transmission Threshold	0x01 – DO buffer size	Serial Interfacing	2	1
RE	0x0E (14d)	Restore Defaults	None	Diagnostic	n/a	None
RN v 4.22*	0x19 (25d)	Delay Slots	0 – 0XFF (slots)	Networking	1	0
RO v 4.30*	0x21 (33d)	Time before Transmission	0 – 0xFFFF (x 0.2 ms)	Serial Interfacing	2	0x20 (32d)
RP v 4.2AA*	0x22 (34d)	RSSI PWM Timer	0 - 0x7F (x 100 ms)	Diagnostic	1	0
RR v 4.22*	0x18 (24d)	Retries	0 – 0xFF	Networking	1	0
RS v 4.22*	0x1C (28d)	RSSI	0x06 – 0x36 (Read-only)	Diagnostic	1	None
RT	0x16 (22d)	DI2 Configuration	0 - 3	Serial Interfacing	1	0
SH v 4.27C*	0x25 (37d)	Serial Number High	0 – 0xFFFF (Read-only)	Diagnostic	2	None
SL v 4.27C*	0x26 (38d)	Serial Number Low	0 – 0xFFFF (Read-only)	Diagnostic	2	None
SM	0x01 (1d)	Sleep Mode	0 – 8	Sleep (Low Power)	1	0
ST	0x02 (2d)	Time before Sleep	0x10 – 0xFFFF (x 100 ms)	Sleep (Low Power)	2	0x64 (100d)
SY	0x17 (23d)	Time before Initialization	0 – 0xFF (x 100 ms)	Networking	1	0 (disabled)
TO v4.30*	0x31 (49d)	DI2 Timer	0 – 0xFFFF (x 1 sec.)	Serial Interfacing	2	0 (no timeout)
TR v 4.22*	0x1B (27d)	Transmit Error Count	0 – 0xFFFF	Diagnostic	2	0
TT v 4.22*	0x1A (26d)	Streaming Limit	0 – 0xFFFF [0 = disabled]	Networking	2	0xFFFF
VR	0x14 (20d)	Firmware Version	0 x 0xFFFF (Read-only)	Diagnostic	2	None
WR	0x08 (8d)	Write	none	(Special)	n/a	None

* Firmware Version in which the command was first introduced. All subsequent versions also support the command.

MORE INFO: Refer to "Appendix C" & the "XStream Advanced Programming and Configuration" manual for more detailed information about the AT Commands available to the XStream OEM RF Module.

X-CTU Software

X-CTU software can be used to setup and monitor XStream-PKG-T RF Modems communications. The software provides an easy-to-use interface that is divided into four tabs.

- **PC Settings** tab - Setup PC serial com ports to interface with XStream RF Modem
- **Range Test** tab – Test Modem Range
- **Terminal** tab – Configure and read XStream RF Module & Telephone Module parameters
- **Modem Configuration** tab – DO NOT USE when configuring the XStream-PKG-T RF Modem. The "Modem Configuration" tab is used to configure XStream OEM RF Modules that are mounted to the XIB-R (RS-232/485) and XIB-U (USB) Interface Boards.

To Install X-CTU Software:

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

Figure 13. **Terminal tab of the X-CTU Software**
(Used to configure the XStream OEM RF Module and Telephone Module – image depicts results from the example shown on the next page)
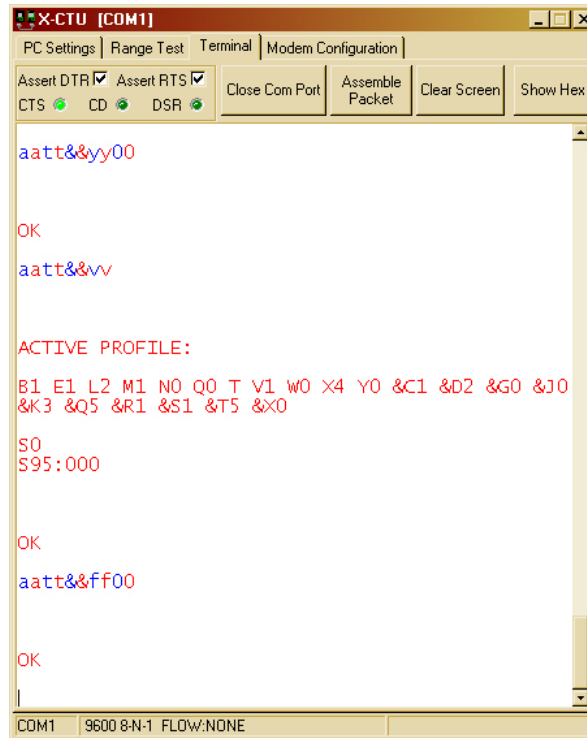
## Example: Telephone Module Configuration (Serial & RF Link Methods)

The following example illustrates module configurations using "Serial" and "RF Link" configuration methods. This example requires one XStream-PKG-T Telephone RF Modem, one XStream-PKG-R RS-232/485 RF Modem, one PC (or laptop), two power supplies and one RS-232 cable.

Setup and Telephone Configuration (Using the "Serial" Configuration Method)

1. Attach RS-232 cable to the DB-9 ports of the PKG-T Modem and a PC [Figure 8].

2. Move DIP Switch 2 of the PKG-T Modem to the **OFF** (down) position [As is shown in the illustration to the right]. NOTE: When configuring an XStream OEM RF Module rather than a Telephone Module, DIP Switch 2 would have to be in the ON (up) position.)

3. Connect power to the XStream-PKG-T RF Modem.

4. On the laptop (or PC) launch the X-CTU Software (or HyperTerminal Software).

5. Click on the "PC Settings" tab and make sure the serial com port's baud rate and parity settings match values currently stored in the PKG-T Modem.

6. Click the "Terminal" tab of the X-CTU Software and type in any character.

→ The Telephone Modem in the PKG-T will automatically detect the initial character (blue font) and echo the character back (red font), verifying a connection is established.

→ If no character is echoed back, try the following:
   1) Make sure the PKG-T Modem is connected to the same serial com port that is selected on the "PC Settings" tab of the X-CTU Software.
   2) Reset PKG-T RF Modem by removing, then restoring power.

7. Type the following AT Command in the "Terminal" tab of the X-CTU Software:

Command*	**System Response**
ATL2	OK (Turns speaker to medium volume) ▼

Telephone Module Configuration (Using the "RF Link" Configuration Method)

In this section of the example, AT Commands will be sent to a PKG-R (RS-232/485) RF Modem from a PC via serial connections. The PKG-R Modem will then relay the commands over-the-air to a receiving PKG-T Telephone RF Modem [As shown in Figure 9 on page 9].

8. Move DIP Switch 1 of the PKG-R Modem to the ON (up) position and all remaining switches to the OFF (down) positions.

9. Remove RS-232 cable from XStream-PKG-T Telephone RF Modem's DB-9 connector and connect it to the DB-9 connector of the PKG-R Modem. Verify both the PKG-R and PKG-T Modems are powered [as indicated by the red LEDs].

10. Click the "Terminal" tab of the X-CTU Software and enter any character.

→ The Telephone Modem in the PKG-T will automatically detect the initial character (blue font) and echo the character back (red font), thus verifying an RF link is established.

11. Type the following AT Commands
   (Echo is on by default so all characters will appear in duplicate):

Command*	**System Response**
AT&S1	**OK** (Enables Telephone Module control of $\overline{DSR}$)
ATS30=20	**OK** (Sets 2 sec. timeout - time of inactivity before disconnect)
AT&W0	**OK** (Stores current settings as Profile "0")
AT&Y0	**OK** (Hard reset then restores Profile "0")
AT&V	**<Lists Module Parameter Values> OK** (Views profile "0")
At&F0	**OK** (Restores factory default configuration "0")

* Conclude each command line with carriage return ("Enter" key)

Appendix A:
Agency Certifications

FCC Compliance

The MaxStream XStream-PKG-T Telephone RF Modem complies with Part 15 of the FCC Rules. In order to inherit MaxStream's FCC Certification, compliance requires the following be stated:

FCC ID: **OUR9XSTREAM** (for 900 MHz) or **OUR-24XSTREAM** (for 2.4 GHz)
This 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.

OEM Labeling Requirements

Label Warning

⚠ 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 14.   Required FCC Label for OEM products containing 9XStream (900 MHz) OEM RF Module

Contains FCC ID: OUR9XSTREAM
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.

Figure 15.   Required FCC Label for OEM products containing 24XStream (2.4 GHz) OEM RF Module

Contains FCC ID: OUR–24XSTREAM
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

Adherence to the following is required:

IMPORTANT: The 9XStream (900 MHz) and 24XStream (2.4 GHz) OEM Modules have 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 their final product to comply with unintentional radiators (FCC section 15.107 and 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

IMPORTANT: The XStream–PKG–T Telephone RF Modems have been certified for remote and base radio applications. If the XStream will be used for portable applications, the device must undergo SAR testing.

NOTE:

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:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experience radio/TV technician for help.

Antenna Warning

⚠ WARNING: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in Tables 12 & 13 of Appendix A. When integrated in OEM products, fixed antennas require installation preventing end–users from replacing them with non–approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

9XStream-PKG-T (900 MHz) Approved Antenna List

Table 12. XStream-PKG-T 900 MHz Approved Antennas with Separation Distances compliant with FCC Exposure Requirements

Manufacturer	900 MHz Part Number	Type	Gain	Application	Minimum Separation Distance
*	*	Yagi	6.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	7.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-Y8	Yagi	8.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	9.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	10.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-Y11	Yagi	11.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-F2	Omni Direct.	2.2 dBi	Fixed **	20 cm
MaxStream	A09-F5	Omni Direct.	5.2 dBi	Fixed **	20 cm
MaxStream	A09-F8	Omni Direct.	8.2 dBi	Fixed **	20 cm
*	*	Omni Direct.	9.2 dBi	Fixed **	20 cm
*	*	Omni Direct.	7.2 dBi	Fixed **	20 cm
MaxStream	A09-M7	Omni Direct.	7.2 dBi	Fixed **	20 cm
MaxStream	A09-H	1/2 wave antenna	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-HBMM-P5I	1/2 wave antenna	2.1 dBi	Fixed/Mobile **	1cm
MaxStream	A09-QBMM-P5I	1/4 wave antenna	1.9 dBi	Fixed/Mobile **	1cm
*	*	1/4 wave integrated wire antenna	1.9 dBi	Fixed/Mobile **	1cm

*   FCC-approved antennas not inventoried by MaxStream – Contact MaxStream (801) 765-9885) for information.

**   Can be approved for portable applications if integrator gains approval by undergoing SAR (Specific Absorption Rate) testing.

MaxStream radio modems are pre-FCC approved for use in fixed base station and mobile applications. As long as the antenna is mounted at least 20 cm (8 in) from nearby persons, the application is considered a mobile application. If the antenna will be mounted closer than 20 cm to nearby persons, then the application is considered "portable" and requires an additional test performed on the final product. This test is called the Specific Absorption Rate (SAR) testing and measures the emissions from the radio modem and how they affect the person.

RF Exposure

> ⚠️ WARNING: This equipment is approved only for mobile and base station transmitting devices, separation distances of (i) 20 centimeters or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains ≥ 6 dBi should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

In order to fulfill the FCC Certification requirements, the OEM must comply with FCC 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 13].

2.   The 9XStream-PKG-T Telephone RF Modem (900 MHz) may be used only with Approved Antennas that have been tested with this module. [Table 12]

24XStream-PKG-T (2.4 GHz) Approved Antenna List

Table 13.   **XStream-PKG-T 2.4 GHz Approved Antennas with Separation Distances compliant with FCC Exposure Requirements**

Manufacturer	2.4 GHz Part Number	Type	Gain	Application	Minimum Separation Distance
*	*	Yagi	6 dBi	Fixed **	2m
*	*	Yagi	8.8 dBi	Fixed **	2m
*	*	Yagi	9 dBi	Fixed **	2m
*	*	Yagi	10 dBi	Fixed **	2m
*	*	Yagi	11 dBi	Fixed **	2m
*	*	Yagi	12 dBi	Fixed **	2m
*	*	Yagi	12.5 dBi	Fixed **	2m
*	*	Yagi	13.5 dBi	Fixed **	2m
*	*	Yagi	15 dBi	Fixed **	2m
*	*	Omni Direct.	2.1 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	3 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	5 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	7.2 dBi	Fixed **	2m
*	*	Omni Direct.	8 dBi	Fixed **	2m
*	*	Omni Direct.	9.5 dBi	Fixed **	2m
*	*	Omni Direct.	10 dBi	Fixed **	2m
*	*	Omni Direct.	12 dBi	Fixed **	2m
*	*	Omni Direct.	15 dBi	Fixed **	2m
MaxStream	A24-P8	Panel	8.5 dBi	Fixed **	2m
MaxStream	A24-P13	Panel	13 dBi	Fixed **	2m
*	*	Panel	14 dBi	Fixed **	2m
*	*	Panel	15 dBi	Fixed **	2m
*	*	Panel	16 dBi	Fixed **	2m
MaxStream	A24-P19	Panel	19 dBi	Fixed **	2m
MaxStream	A24-HABMM-P6I	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-HBMM-P6I	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-HABSM	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-QABMM-P6I	Monopole	1.9 dBi	Fixed/Mobile **	20 cm
*	A24-Q1	Monopole	1.9 dBi	Fixed/Mobile **	20 cm
*	*	Monopole	1.9 dBi	Fixed/Mobile **	20 cm

  *   FCC-approved antennas not inventoried by MaxStream – Contact MaxStream (801) 765-9885) for information.

  **   Can be approved for portable applications if integrator gains approval by undergoing SAR (Specific Absorption Rate) testing.

RF Exposure

⚠️ WARNING: This equipment is approved only for mobile and base station transmitting devices, separation distances of (i) 20 centimeters or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains ≥ 6 dBi should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

In order to fulfill the FCC Certification requirements, the OEM must comply with FCC 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 14].

2. The 24XStream (2.4 GHz) OEM RF Module may be used only with Approved Antennas that have been tested with this module. [Table 13]

European Compliance (2.4 GHz only)

The 24XStream has been certified for several European countries. For a complete list, go to www.maxstream.net.

If the 24XStream modules 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 XStream 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. Changes or modifications not expressly approved by MaxStream could void the user's authority to operate the equipment.

OEM Labeling Requirements

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

Figure 16.   CE Label Requirements

* > 5 mm
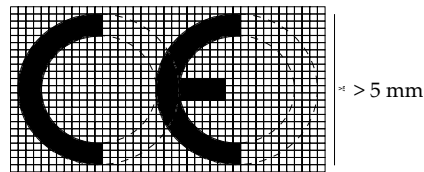
The CE mark shall consist of the initials "CE" taking the following form:

- 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.

Furthermore, since the usage of the 2400 – 2483.5 MHz band is not harmonized throughout Europe, the Restriction sign must be placed to the right of the 'CE' marking as shown below. See the R&TTE Directive, Article 12 and Annex VII for more information

Figure 17.   CE Label Required on OEM Equipment

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).

24XStream Declarations of Conformity

MaxStream has issued Declarations of Conformity for the 24XStream modules concerning emissions, EMC and safety. These files are located in the 'documentation' folder of the MaxStream CD.

Important Note

MaxStream does not list the entire set of requirements 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 24XStream module, 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/

Notifications and Required Information

Since the 2.4 GHz band is not harmonized throughout Europe, a notification must be sent to each country prior to shipping product according to Article 6.4 of the R&TTE Directive. A list of national contacts for most European countries may be found at www.ero.dk/.

The following technical data (relating to the 24XStream) is often required in filling out a notification form.

- Frequency Band: 2400 – 2483.5 MHz
- Modulation: Frequency Shift Keying
- Channel Spacing: 400 kHz
- ITU Classification: 400KF1D
- Output Power: 100 mW EIRP
- Notified Body Number: 0891

Contact MaxStream (801) 765-9885 if additional information is required.

Table 14. **Antennas approved for use with 24XStream (2.4 GHz) PKG-T RF Modems in Europe**

Manufacturer	Part Number	Type	Gain	Application	Minimum Separation Distance
MaxStream	A24-HABMM-P6I	Dipole	2.1 dBi	Fixed/Mobile *	20 cm
MaxStream	A24-HBMM-P6I	Dipole	2.1 dBi	Fixed/Mobile *	20 cm
MaxStream	A24-HABSM	Dipole	2.1 dBi	Fixed/Mobile *	20 cm
MaxStream	A24-QABMM-P6I	Monopole	1.9 dBi	Fixed/Mobile *	20 cm
MaxStream	A24-QBMM-P6I	Monopole	1.9 dBi	Fixed/Mobile *	20 cm
MaxStream	A24-Q1	Monopole	1.9 dBi	Fixed/Mobile *	20 cm

* Can be approved for portable applications if integrator gains approval by undergoing SAR (Specific Absorption Rate) testing.

Appendix B: Specifications

XStream PKG-T Telephone RF Modem Specifications

Figure 18.   XStream-PKG-T Telephone RF Modem (900 MHz & 2.4 GHz) Specifications

Specification	9XStream-PKG-T (900 MHz)		24XStream-PKG-T (2.4 GHz)	
Performance				
Indoor/Urban Range	Up to 1500' (450 m)		Up to 600' (180 m)	
Outdoor LOS Range	Up to 7 miles (11 km) w/ dipole antenna Up to 20 miles (32 km) w/ high-gain antenna		Up to 3 miles (5 km) w/ dipole antenna Up to 10 miles (16 km) w/ high-gain antenna	
Serial Data Throughput	**9600 bps**	**19.2 kbps**	**9600 bps**	**19.2 kbps**
RF Baud Rate	10,000 bps	20,000 bps	10,000 bps	20,000 bps
Transmit Power Output	100 mW (20 ± 2 dBm)	100 mW (20 ± 2 dBm)	50 mW (17 ± 2 dBm)	50 mW (17 ± 2 dBm)
Receiver Sensitivity	-110 dBm	-107 dBm	-105 dBm	-102 dBm
General				
Frequency	902-928 MHz		2.4000-2.4835 GHz	
Spread Spectrum	Frequency Hopping, Wide band FM modulator			
Network Topology	Peer-to-Peer, Point-to-multipoint, Point-to-Point, Multidrop			
Channel Capacity	7 hop sequences share 25 frequencies			
I/O Data Rate	Software selectable 1200 - 57600 bps			
Power Requirements				
Supply Voltage	7-28 VDC (optional jumpers allow the XIB-T to be powered with a 5V supply)			
Transmit (TX) Current	240 mA		250 mA	
Receive (RX) Current	135 mA		175 mA	
Power Down Current	TBD			
Physical Properties				
Enclosure				
Enclosure Size				
Operating Temperature	0 to 70° C (commercial), -40 to 85° C (industrial)			
Antenna				
Type	½ wave dipole whip, 6.75" (17.1 cm), 2.1 dBi Gain			
Connector	Reverse-polarity SMA (RPSMA)			
Impedance	50 ohms unbalanced			
Certifications				
FCC Part 15.247	OUR9XSTREAM		OUR-24XSTREAM	
Industry Canada (IC)	4214A-9XSTREAM		4214A 12008	
Europe	N/A		ETSI, CE	

CAD Drawings

Figure 19. XStream-PKG-T (Telephone) RF Modem (RJ-11 and DB-9 Connectors)
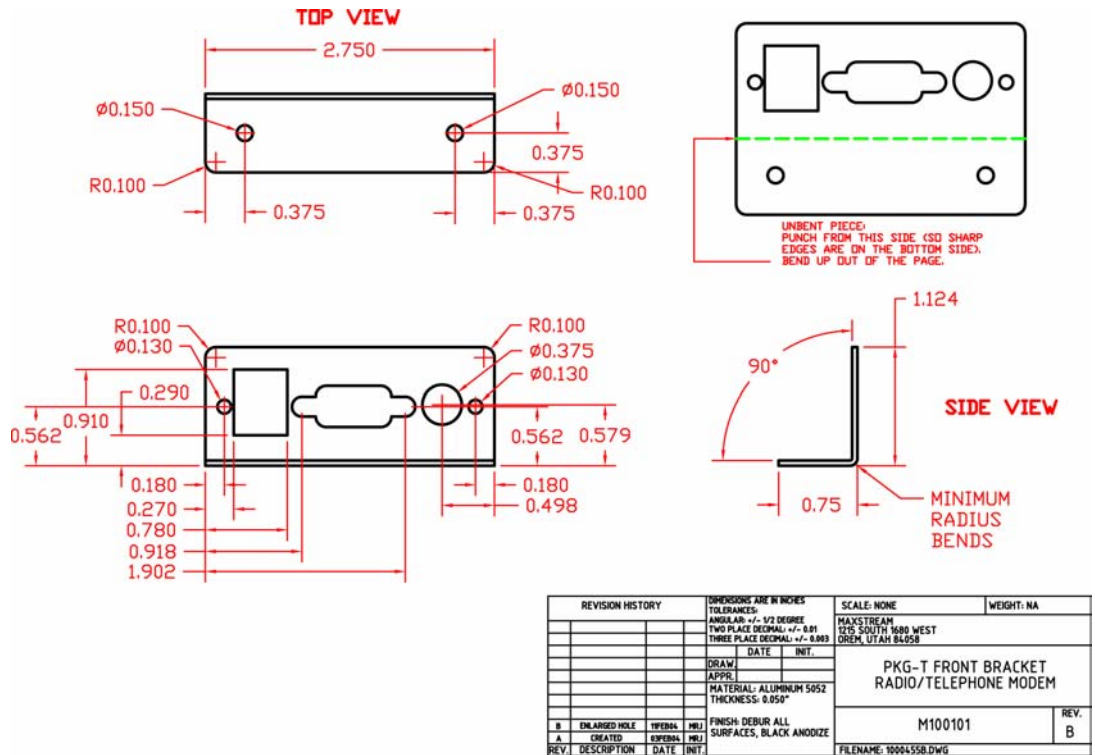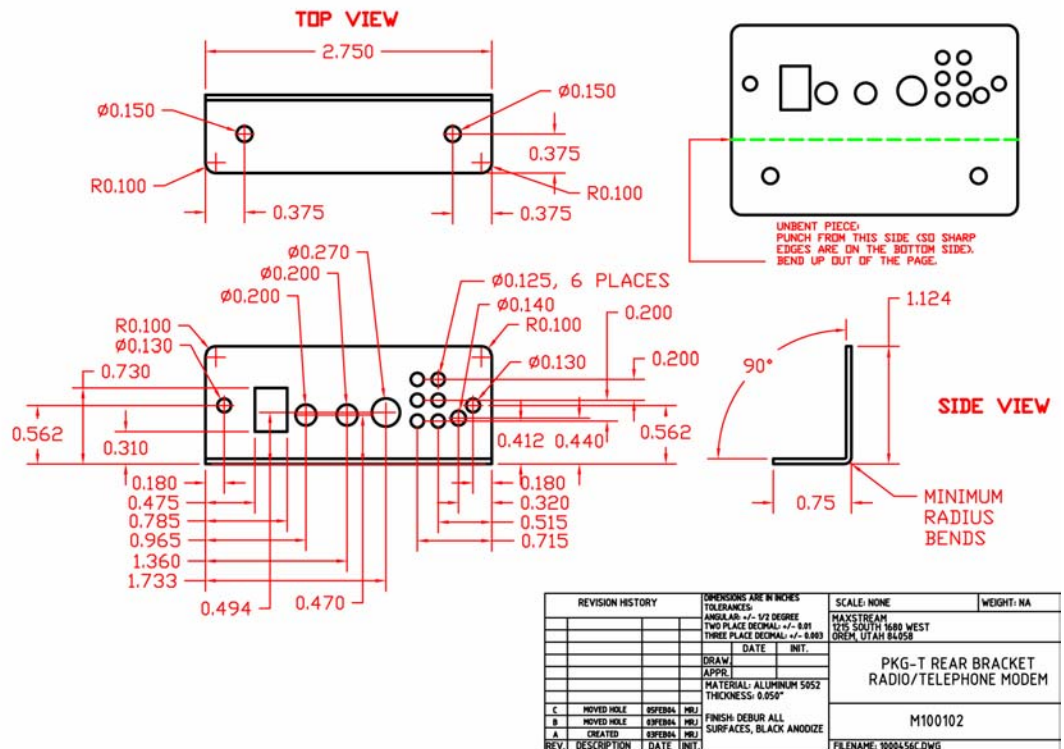

Figure 20. XStream-PKG-T (Telephone) RF Modem (LEDs)

Appendix C: OEM RF Module Commands

AT Commands Unique to the XStream OEM RF Module

Table 15. **XStream OEM RF Module AT Commands** (Longer Reference)

Command Category	AT Command	Binary Command	AT Command Description	Parameters	# Bytes Returned	Factory Default
(Special)	WR	0x8 (DEC "8")	**Write.** Write parameters to radio modem's non-volatile memory for changes to persist through next power-up or reset.	none	n/a	none
AT Command Mode Options	AT	0x05 (DEC "5")	**Guard Time After.** Set required DI pin silent time after the Command Sequence Characters of the AT Command Mode Sequence (BT+ CC + AT). The silent time is used to prevent inadvertent entrance into AT Command Mode.	Range: 0 – 0xFFFF (x 100 ms)	2	0xA (DEC "10")
	BT	0x04 (DEC "4")	**Guard Time Before.** Set required DI pin silent time before the Command Sequence Characters of the Command Mode Sequence (BT+ CC + AT). The silent time is used to prevent inadvertent entrance into AT Command Mode.	Range: 0 – 0xFFFF (x 100 ms)	2	0xA (DEC "10")
	CC	0x13 (DEC "19")	**Command Sequence Character**. Set the ASCII character to be used between Guard Times of the AT Command Mode Sequence (BT+ CC + AT). The AT Command Mode Sequence enters the radio modem to AT Command Mode (from Idle Mode).	Range: 0x20 – 0x7F	1	0x2B (plus sign (+) in ASCII)
	CN	0x09 (DEC "9")	**Exit AT Command Mode.** Explicitly exit AT Command Mode and return modem to Idle Mode.	none	n/a	none
	CT	0x6 (DEC "6")	**AT Command Mode Timeout.** Set time period of inactivity (no valid commands received) after which the radio modem automatically exits from AT Command Mode and returns to Idle Mode.	Range: 0x02 – 0xFFFF (x 100 ms)	2	0xC8 (DEC "200")
	E0	0xA (DEC "10")	**Echo Off.** Turn off local echo in AT Command Mode.	none	n/a	none
	E1	0xB (DEC "11")	**Echo On.** Turn on local echo in AT Command Mode.	none	n/a	none
	PC v 4.22*	0x1E (DEC "30")	**Power-up Mode.** Select initial mode of operation after power-up, reset and wake from pin sleep. Parameter value '1' causes the radio modem to power directly to AT Command Mode instead of Idle Mode (default).	Range: 0 – 1 0 = Power-up to Idle Mode 1 = AT Command Mode	1	0
Diagnostic	ER	0xF (DEC "15")	**Receive Error Count.** Number of RF Packets detected by the receiver but not sent out the DO pin of radio modem due to bit errors. ((May be written to clear count)	Range: 0 – 0xFFFF	2	0
	GD	0x10 (DEC "16")	**Receive Good Count.** Number of RF Packets successfully received. (May be written to clear count)	Range: 0 – 0xFFFF	2	0
	RE	0xE (DEC "14")	**Restore Defaults.** Restore radio modem parameters to the factory default configuration.	none	n/a	none
	RP v 4.2AA*	0x22 (DEC "34")	**RSSI PWM Timer.** Enable a PWM (pulse width modulation) output on the config pin (pin 9 of the OEM RF Module) which shows signal strength of RF packets.	Range: 0 – 0x7F (x 100 ms)	1	0 (disabled)

* Firmware version in which the AT Command was introduced. All subsequent firmware versions also support the command.

Table 16 (continued). XStream OEM RF Module AT Commands (Longer Reference)

Command Category	AT Command	Binary Command	AT Command Description	Parameters	# Bytes Returned	Factory Default
Diagnostic (continued)	**RS** v 4.22*	0x1C (DEC "28")	**RSSI.** Receive Signal Strength Indicator) Read the signal level of last good RF Packet received. Larger numbers indicate stronger signals.	Range: 0x06 – 0x36 (Read-only)	1	none
	SH v 4.27C*	0x25 (DEC "37")	**Serial Number High.** Read High 16 bits of unique serial number of radio modem.	0 – 0xFFFF (Read-only)	2	none
	SL v 4.27C*	0x26 (DEC "38")	**Serial Number Low.** Read Low 16 bits of unique serial number of radio modem.	0 – 0xFFFF (Read-only)	2	none
	TR v 4.22*	0x1B (DEC "27")	**Transmit Error Count.** Number of RF packets sent with no ACK packet received. (When RR > 0).	Range: 0 – 0xFFFF	2	0
	VR	0x14 (DEC "20")	**Firmware Version.** Read firmware version currently loaded on radio modem.	0 x 0xFFFF (Read-only)	2	none
Networking	**DT**	0x0 (DEC "0")	**Destination Address.** Set the address that identifies the destination of the RF packet. Only radio modems having matching addresses can communicate with each other. If source addressing is disabled (MY = 0xFFFF), DT serves as both source and destination address.	Range: 0 – 0xFFFF	2	0
	HP	0x11 (DEC "17")	**Hopping Channel.** Select hopping channel on which radio modem communicates. These channels are not non-interfering.	Range: 0 - 6	1	0
	ID v 4.27C*	0x27 (DEC "39")	**Modem VID.** Read radio modem VID (Vendor Identification Number). Only radio modems with matching VIDs can communicate with each other.	Range: 0 – 0xFFFF (Read-only)	2	none
	MK	0x12 (DEC "18")	**Address Mask.** Set address mask to configure local and global address space.	Range: 0 – 0xFFFF	2	0xFFFF (DEC "65535")
	MY v 4.30*	0x2A (DEC "42")	**Source Address.** Enable source addressing. When MY = 0xFFFF, DT serves as both source and destination address.	Range: 0 – 0xFFFF	2	0xFFFF (disabled)
	RN v 4.22*	0x19 (DEC "25")	**Delay Slots.** Specify maximum number of delay slots used for random back-off algorithm after transmission failure.	Range: 0 – 0Xff (slots)	1	0
	RR v 4.22*	0x18 (DEC "24")	**Retries.** Set maximum number of RF Packet attempts. Receiving radio modem(s) must also have RR set to a non-zero value.	Range: 0 – 0xFF [0 = disabled]	1	0
	SY	0x17 (DEC "23")	**Time before Initialization.** Set mode that allows RF packets to be received with a shorter RF Initializer. **Warning**: This command is only useful in a limited number of applications. Please see XStream Advanced manual before using.	Range: 0 – 0xFF (x 100 ms)	1	0 (disabled)
	TT v 4.22*	0x1A (DEC "26")	**Streaming Limit.** Set maximum number of continuous bytes transmitted by one radio modem before forcing a delay that allows other radio modems to transmit.	Range: 0 – 0xFFFF	2	0xFFFF (DEC "65535")
Serial Interfacing	**BD**	0x15 (DEC "21")	**Baud Rate.** Set serial data rate (baud rate at which radio modem interfaces with host). Serial data rate is different than RF data rate which is fixed and set at the factory. If the serial data rate is set higher than the RF data rate, CTS may need to be observed in order to prevent DI buffer overrun.	Range: 0 – 6 0 = 1200 bps 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400 6 = 57600	1	Set to equal modem's fixed RF data rate.
	BK v 4.30*	0x2E (DEC "46")	**Break Passing.**	Range: 0 – 1 0 = Disabled 1 = Enabled	1	0 (disabled)
	BO v 4.30*	0x30 (DEC "48")	**Break Timeout.**	Range: 0 – 0xFFFF	2	0 (no timeout)
	CD v 4.30*	0x28 (DEC "40")	**DO3 Configuration.** Select behavior of Digital Output 3 (RX LED signal – pin 7 of the OEM RF Module).	Range: 0 – 3 0 = RX LED 1 = high 2 = low 3 = carrier detect	1	0
	CO v 4.30*	0x2F (DEC "47")	**DO3 Timer.** Return Digital Output 3 to default after no Data Input 3 status information is received during the time period. Use with CD = 1 or 2.	0 - 0xFFFF (x 1 sec)	2	0

* Firmware version in which the AT Command was introduced. All subsequent firmware versions also support the command.

Table 16 (continued). XStream OEM RF Module AT Commands (Longer Reference)

Command Category	AT Command	Binary Command	AT Command Description	Parameters	# Bytes Returned	Factory Default
Serial Interfacing (continued)	CS v 4.27D*	0x1F (DEC "31")	**DO2 Configuration.** Select behavior of Digital Output 2 (CTS signal is pin 1 of OEM RF Module).	Range: 0 – 4 0 = normal 1 = RS-485 enable low 2 = high 3 = RS-485 enable high 4 = low	1	0
	DR v 4.30*	0x2D (DEC "45")	**DI3 Configuration.** Enable Digital Input 3 to transmit its input state to DO3 of receiver radio modem. (Sleep signal pin 2 of OEM RF Module). Use with CD=1 or 2 and CO on the remote radio.	Range: 0 – 1 0 = DI3 I/O passing disabled 1 = DI3 I/O passing enabled	1	0
	FL	0x7 (DEC "7")	**Software Flow Control.** Enable serial software flow control on the radio modem. (Hardware flow control (CTS) is on by default.)	Range: 0 - 1 0 = disable 1 = enabled	1	0
	FT v 4.27B*	0x24 (DEC "36")	**Flow Control Threshold.** Assert CTS or XOFF when FT bytes are in the receiver DO buffer.	Range: 0x0 - Receive buffer size (bytes)	2	buffer size less 0x11 bytes
	NB v 4.27B*	0x23 (DEC "35")	**Parity.** Select parity format. Settings 0-4 transfer only 8 bits out the antenna port and generate the parity bit on the radio modem receiving side.	Range: 0 – 5 0 = 8-none-1, 7-any-1 1 = 8-even-1 2 = 8-odd-1 3 = 8-mark-1 4 = 8-space-1 5 = 9 bit data	1	0
	PK v 4.30*	0x29 (DEC "41")	**Packet Size.** Set maximum RF Packet size.	Range: 0x01 – 0x100	2	0x40 (DEC "64")
	RB v 4.30*	0x20 (DEC "32")	**Transmission Threshold.** Begin RF transmission after receiving RB serial bytes in the UART buffer of the radio modem. If RO parameter is "0", no transmission starts until "RB" bytes are received.	Range: 0x01 – DO buffer size	2	1
	RO v 4.30*	0x21 (DEC "33")	**Time before Transmission.** Begin RF transmission after DI silent time of RO. TX begins when either RO or RB criteria are met.	Range: 0 – 0xFFFF (x 0.2 ms) [0 = disabled]	2	0x20 (DEC "32")
	RT	0x16 (DEC "22")	**DI2 Configuration.** Select function for Digital Input 2 (RTS/CMD signal - pin 5 of OEM RF Module).	Range: 0 - 2 0 = Disabled 1 = Binary commands 2 = RTS flow control	1	0
	TO v 4.30*	0x31 (DEC "49")	**DI2 Timer.**	0 – 0xFFFF (x 1 second)	2	0 (no timeout)
Sleep (Low Power)	FH	0xD (DEC "13")	**Force Wake-up Initializer.** Force Wake-up Initializer to be sent on next transmission.	none	n/a	none
	HT	0x3 (DEC "3")	**Time before Wake-up Initializer.** Set time period of inactivity (no serial or RF data is sent or received) before a Wake-up Initializer is sent. Base station tracks awake-status of remote radios. HT of base radio should be set shorter than ST of remote radios.	Range: 0 – 0xFFFF (x 100 ms) [0xFFFF = no initializer will be sent]	2	0xFFFF (DEC "65535")
	LH	0xC (DEC "12")	**Wake-up Initializer Timer.** Set time of the Wake-up Initializer used to wake remote radios in cyclic sleep. Length of Wake-up Initializer should be longer than that of the remote modem's cyclic sleep cycle (SM 3 - 8).	Range: 0 – 0xFF (x 100 ms)	1	1
	PW v 4.22*	0x1D (DEC "29")	**Pin Wake-up.** Enable pin wake-up from Cyclic Sleep Mode.	Range: 0 – 1 0 = disabled 1 = enabled	1	0
	SM	0x1 (DEC "1")	**Sleep Mode.** Specify Sleep Mode settings.	Range: 0 – 8 0 = No sleep 1 = Pin Sleep 2 = Serial Port Sleep 3 = Cyclic 0.5 seconds 4 = Cyclic 1 seconds 5 = Cyclic 2 seconds 6 = Cyclic 4 seconds 7 = Cyclic 8 seconds 8 = Cyclic 16 seconds	1	0
	ST	0x2 (DEC "2")	**Time before Sleep.** Set time period of inactivity (no serial or RF data is sent or received) before activating Sleep Mode. Use with Cyclic Sleep and Serial Port Sleep. (see SM Command)	Range: 0x10 – 0xFFFF (x 100 ms)	2	0x64 (DEC "100")

* Firmware version in which the AT Command was introduced. All subsequent firmware versions also support the command.
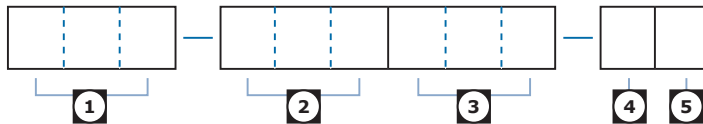
Appendix D: Additional Information

1-Year Warranty

The XStream-PKG-T Telephone RF Modem from MaxStream, Inc. (the "Product") is 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. THEREFOR, 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.

XStream-PKG RF Modem Part Numbers

Figure 21.   **XStream-PKG RF Modem Part Number Key**

Divisions of XStream-PKG RF Modem part numbers:

1   Operating Frequency
    X09   =   915 MHz
    X24   =   2.4 GHz
    XH9   =   923 MHz

2   RF Data Rate (Baud)
    001   =   1200 baud
    009   =   9600 baud
    019   =   19200 baud

3   PKG Temperature Ratings
    PKC   =   Commercial: 0 to 70° C
    PKI   =   Industrial: -40 to 85° C. Embedded RF Module is Conformal Coated
    PKT   =   Tested Industrial: -40 to 85° C. Embedded RF Module
              is Conformal Coated & 100 % tested

4   Interfacing Mode
    E   =   Ethernet
    R   =   RS-232, RS-485/422
    T   =   Telephone
    U   =   USB

5   Accessories Package
    A   =   Accessories Package (specific to the Interfacing Mode) Included
    (blank) means that the accessories package is not included

For Example: X09-009PKC-TA = XStream Product Family, 900 MHz, 9600 Baud, Commercial Temperature Rating, Telephone Interface, w/ Accessories Package

Appendix E: Troubleshooting and FAQs

Contact MaxStream

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

MaxStream technical support engineers are versed in RF and EE technologies and are accessible via the means listed below. By contacting MaxStream technical support, OEMs and integrators will benefit from many years of combined RF experience.

Please use the following resources for additional support:

Documentation: www.maxstream.net/helpdesk/

Technical Support: Phone: (866) 765-9885 U.S. & 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]