

# XStream™ AT Commands

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XStream Product Family  
Modes of Operation  
Radio Modem Configuration  
Advanced Networking and Security  
Appendices



## Advanced Manual v4.29

Standard AT Commands Configurations

Products Supported:      XStream OEM RF Modules (900 MHz & 2.4 GHz)  
                                 XStream-PKG-R RS-232/485 RF Modems (900 MHz & 2.4 GHz)  
                                 XStream-PKG-U USB RF Modems (900 MHz & 2.4 GHz)  
                                 XStream-PKG-E Ethernet RF Modems (900 MHz & 2.4 GHz)



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# XStream Radio Modems

This advanced manual provides more detailed information about standard AT Commands used to configure products within the XStream Product Family. The XStream Product Family consists of:

- 9XStream (900 MHz) & 24XStream (2.4 GHz) **OEM RF Modules**
- 9XStream-PKG-R & 24XStream-PKG-R **RS-232/485 RF Modems**
- 9XStream-PKG-U & 24XStream-PKG-U **USB RF Modems**
- 9XStream-PKG-E & 24XStream-PKG-E **Ethernet RF Modems**

## XStream Product Family 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** (2.4 GHz) [-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 (ACK)

7 hopping channels each with over  
65,000 available network addresses

### Easy-to-Use

FCC & international agency approved

No configuration required

Advanced configurations using  
standard AT Commands

Transparent Operation  
(replaces serial wires)

Portable (small form factor  
& low power)

Software-selectable serial interfacing  
MODBUS,  $\overline{\text{CTS}}$ ,  $\overline{\text{RTS}}$ ,  $\overline{\text{DCD}}$  &  $\overline{\text{DTR}}$   
I/O Support

Support for multiple data formats  
(parity, start and stop bits, etc.)

XII™ Interference Immunity

Power-saving Sleep Modes

FHSS (Frequency Hopping  
Spread Spectrum)

## Worldwide Acceptance

**FCC Certified** (USA) [Go to Appendix A for FCC Requirements]

Systems that contain XStream RF Modems can inherit MaxStream's FCC Certification

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

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

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



## XStream AT Commands (Short Reference)

**Table 1. XStream AT Commands**  
(Modules expect numerical values in hexadecimal. “d” denotes decimal equivalents)

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
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 4.29D*	0x28 (40d)	DO3 Configuration	0 – 2	Serial Interfacing	1	0
CN	0x09 (9d)	Exit AT Command Mode	none	AT Command Mode Options	n/a	none
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)
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	0x0 – 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
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
MK	0x12 (18d)	Address Mask	0 – 0xFFFF	Networking	2	0xFFFF
NB v 4.27B*	0x23 (35d)	Parity	0 – 4	Serial Interfacing	1	0
PC v 4.22*	0x1E (30d)	Power-up Mode	0 – 1	AT Command Mode Options	1	0
PW v 4.22*	0x1D (29d)	Pin Wake-up	0 – 1	Sleep (Low Power)	1	0
RE	0x0E (14d)	Restore Defaults	None	(Special)	n/a	none
RN v 4.22*	0x19 (25d)	Delay Slots	0 – 0xFF (slots)	Networking	1	0
RO v 4.2AA*	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 - 2	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)
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 introduced. All subsequent firmware versions also support the command.

## AT Command (Long Descriptions)

Commands and parameters are listed alphabetically. Command categories are designated between the "< >" symbols that follow each command title. XStream Radio Modems expect numerical values in hexadecimal. Hexadecimal values are designated by a "0x" prefix.

### AT (Guard Time After) Command

<AT Command Mode Options> AT Command is used to set the time-of-silence that follows the command sequence character (CC Command). By default, 1 second must elapse before entering another character. The AT Command Mode Sequence used to enter AT Command Mode is as follows:

- No characters sent for 1 second [BT (Guard Time Before) Command]
- Send three plus characters "+++" [CC (Command Sequence Character) Command]
- No characters sent for 1 second [AT (Guard Time After) Command]

All of the values in this sequence can be adjusted. AT Command is used to adjust the period of silence that follows the command sequence character.

**AT Command:** AT

**Binary Command:** 0x05 (5 decimal)

**Parameter Range:** 0x02 - 0xFFFF (x 100 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0x0A (10 decimal)

**Related Commands:** BT (Guard Time Before), CC (Command Sequence Character)

### BD (Baud Rate) Command

<Serial Interfacing> BD Command allows the user to adjust the UART baud rate and thus modify the rate at which serial data is sent to the module. Baud rates range from 1200 to 57600 baud (bps). The new baud rate does not take effect until CN (Exit AT Command Mode) Command is issued.

Note: If the serial data rate is set to exceed the fixed RF data rate of the XStream radio modem, may need to be implemented as is described in the "Signal Pinouts" section of this Manual.

**AT Command:** BD

**Binary Command:** 0x15 (21 decimal)

**Parameter Range:** 0 - 6

**# of bytes returned:** 1

**Default Parameter Value:** Equal to radio modem's fixed RF data rate.

Parameter Values	Configuration
0	1200 Baud (bps)
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600

## BT (Guard Time Before) Command

<AT Command Mode Options> AT Command is used to set the DI pin silence time that precedes the command sequence character (CC Command). By default, 1 second must elapse before entering another character. The default sequence used to enter AT Command Mode is as follows:

- No characters sent for 1 second [BT (Guard Time Before) Command]
- Send three plus characters “+++” [CC (Command Sequence Character) Command]
- No characters sent for 1 second [AT (Guard Time After) Command]

All of the values in this sequence can be adjusted. BT Command is used to adjust the period of silence that precedes the command sequence character.

**AT Command:** BT

**Binary Command:** 0x04 (4 decimal)

**Parameter Range:** 0 - 0xFFFF (x 100 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0x0A (10 decimal)

**Related Commands:** AT (Guard Time After), CC (Command Sequence Character)

## CC (Command Sequence Character) Command

<AT Command Mode Options> CC Command is used to 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). The default sequence used to enter AT Command Mode is as follows:

- No characters sent for 1 second [BT (Guard Time Before) Command]
- Send three plus characters “+++” [CC (Command Sequence Character) Command]
- No characters sent for 1 second [AT (Guard Time After) Command]

All of the values in this sequence can be adjusted. CC Command is used to change the command sequence character.

**AT Command:** CC

**Binary Command:** 0x13 (19 decimal)

**Parameter Range:** 0x20 – 0x7F

**# of bytes returned:** 1

**Default Parameter Value:** 0x2B (ASCII “+” sign)

**Related Commands:** AT (Guard Time After), BT (Guard Time Before)

## CD (DO3 Configuration) Command

<AT Command Mode Options> CD Command is used to redefine the RX LED I/O line (OEM RF Module Pin 7).

**AT Command:** CD

**Binary Command:** 0x28 (40 decimal)

**Parameter Range:** 0 – 2

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Minimum Firmware Version Required:** 4.29D

Parameter Values	Configuration
0	RX LED
1	high
2	low

## CN (Exit AT Command Mode) Command

<AT Command Mode Options> CN Command is used to explicitly exit AT Command Mode.

**AT Command:** CN

**Binary Command:** 0x09 (9 decimal)

## CS (DO2 Configuration) Command

<Serial Interfacing> CS Command is used to modify the behavior of the  $\overline{\text{CTS}}$  signal such that it either provides RS-232 flow control, enables RS-485 transmission / reception or determines RS-422 transmit enable. By default,  $\overline{\text{CTS}}$  provides RS-232 flow control. CS Parameter must be adjusted for the module to operate in RS-485/422 environments.

**AT Command:** CS

**Binary Command:** 0x1F (31 decimal)

**Parameter Range:** 0 – 4

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Minimum Firmware Version Required:** 4.27D

Parameter Values	Configuration
0	Normal
1	RS-485 enable low
2	high
3	RS-485 enable high
4	low

## CT (AT Command Mode Timeout) Command

<AT Command Mode Options> CT Command sets the amount of time before AT Command Mode is exited automatically. AT Command Mode can be exited manually using CN (Exit AT Command Mode) Command or, after a "CT" time of inactivity, the module exits AT Command Mode on its own and returns to Idle Mode.

**AT Command:** CT

**Binary Command:** 0x06 (6 decimal)

**Parameter Range:** 0 - 0xFFFF (x 100 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0xC8 (200 decimal, which equals 20 seconds)

## DT (Destination Address) Command

<Networking> DT Command is used to set the networking address of an XStream Radio Modem. XStream Radio Modems uses three network layers –Vendor Identification Number (ATID), Channels (ATHP), and Destination Addresses (ATDT). DT Command assigns an address to a radio modem that enables it to communicate only with other radio modems having the same addresses. This is similar in nature to interconnecting several PCs under a common hub. All modules that share the same Destination Address can communicate freely with each other. Radio modems in the same network with a different Destination Address (than that of the transmitter) will listen to all transmissions to stay synchronized, but will not send any of the data out their serial ports.

**AT Command:** DT

**Binary Command:** 0

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0

**Related Commands:** HP (Hopping Channel), ID (Modem VID), MK (Address Mask)

## E0 (Echo Off) Command

<AT Command Mode Options> E0 Command turns off character echo in AT Command Mode. All typed characters will not show up on the terminal unless the communications terminal has been configured to display characters.

**AT Command:** E0

**Binary Command:** 0x0A (10 decimal)

## E1 (Echo On) Command

<AT Command Mode Options> E1 Command turns on the echo in AT Command Mode. All typed characters will show up on the terminal when the communications terminal has been configured to display characters.

**AT Command:** E1

**Binary Command:** 0x0B (11 decimal)

## ER (Receive Error Count) Command

<Diagnostic> ER Command can be used to set the receive-error count to a particular value. This value is reset to 0 after every reset and is not non-volatile (Value does not persist in the radio modem’s memory after a power-up sequence). Once the “Receive Error Count” reaches its maximum value (up to 0xFFFF), it remains at its maximum count value until the maximum count value is explicitly changed or the radio modem is reset.

**AT Command:** ER

**Binary Command:** 0x0F (15 decimal)

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0

**Related Commands:** GD (Receive Good Count)

## FH (Force Wake-up Initializer) Command

<Sleep (Low Power)> FH Command is used to force a Wake-up Initializer to be sent on the next transmit. (WR (Write) Command does not need to be issued with FH Command.)

**AT Command:** FH

**Binary Command:** 0x0D (13 decimal)

## FL (Software Flow Control) Command

<Serial Interfacing> FL Command is used to adjust serial flow control. Hardware flow control is implemented with the XStream Module as the  $\overline{\text{CTS}}$  pin (which regulates when serial data can be transferred to the module). FL Command can be used to allow software flow control to also be enabled. XON character to use is 0x11 (17 decimal). XOFF character to use is 0x13 (19 decimal)

**AT Command:** FL

**Binary Command:** 0x07 (7 decimal)

**Parameter Range:** 0 – 1

**# of bytes returned:** 1

**Default Parameter Value:** 0

Parameter Values	Configuration
0	Disable software flow control
1	Enable software flow control



## FT (Flow Control Threshold) Command

---

<Serial Interfacing> FT Command is used to assert  $\overline{\text{CTS}}$  or XOFF software flow control when FT bytes are in the receiver DO buffer.

**AT Command:** FT

**Binary Command:** 0x24 (36 decimal)

**Parameter Range:** Receive buffer size (minus) 0x11 bytes

**# of bytes returned:** 2

**Default Parameter Value:** 0x11 (decimal 17)

**Minimum Firmware Version required:** 4.27B

## GD (Receive Good Count) Command

---

<Diagnostic> GD Command can be used to set the count of good received RF packets. This value is reset to "0x00" after every reset and is not non-volatile (Value does not persist in the module's memory after a power-up sequence). Once the "Receive Good Count" reaches its maximum value (up to 0xFFFF), it remains at its maximum count value until the maximum count value is manually changed or the module is reset.

**AT Command:** GD

**Binary Command:** 0x10 (16 decimal)

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0

**Related Commands:** ER (Receive Error Count)

## HP (Hopping Channel) Command

---

<Networking> HP Command is used to set the module's hopping channel number. A channel is one of three layers of addressing available to the XStream radio modem. In order for modules to communicate with each other, the modules must have the same channel number since each network uses a different hopping sequence. Different channels can be used to prevent modules in one network from listening to transmissions of another.

**AT Command:** HP

**Binary Command:** 0x11 (17 decimal)

**Parameter Range:** 0 - 6

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Related Commands:** DT (Destination Address), ID (Modem VID), MK (Address Mask)

## HT (Time before Wake-up Initializer) Command

---

<Sleep (Low Power)> If any radio modems within range are running in a “Cyclic Sleep” setting, a wake-up initializer must be used by the transmitter for the other modules to synchronize to the transmitter [see LH (“Wake-up Initializer Timer”) Command]. When a receiving module in Cyclic Sleep wakes, it must detect the wake-up initializer portion of the RF packet in order to synchronize to the transmitter and receive data. The value of HT Parameter tells the transmitter, “After a period of inactivity (no transmitting or receiving) lasting “HT” amount of time, send a long wake-up initializer”. HT Parameter should be set to match the inactivity timeout [specified by ST (Time before Sleep) Command] used by the receiver(s).

From the receiver perspective, after “HT” time elapses and the inactivity timeout [ST (Time before Sleep) Command] is met, the receiver goes into cyclic sleep. Once it enters cyclic sleep, the only way for the module to be able to receive data from a transmitter is to first detect the wake-up initializer and synchronize to the transmitter. A long wake-up initializer must be used to ensure quick synchronization from all receivers in cyclic sleep. Thus, when time “HT” time elapses (matching the inactivity timeout); the transmitter then knows that it needs to send a long Wake-up Initializer for all receivers to be able to synchronize to its next transmission. Matching “HT” to the time specified by ST Command on the receiver(s) guarantees that all receivers will detect the next transmission.

**AT Command:** HT

**Binary Command:** 0x03 (3 decimal)

**Parameter Range:** 0 - 0xFFFF (x 100 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0xFFFF (means no long Wake-up Initializer will be sent)

**Related Commands:** LH (Wake-up Initializer Timer), SM (Sleep Mode), ST (Time before Sleep)

## ID (Modem VID) Command

---

<Networking> ID Command reads and reports the module’s VID. VID is a MaxStream-specific acronym that stands for “Vendor Identification Number”. This number is factory-set and allows modules with matching VIDs to communicate. Modules with non-matching VIDs will not receive unintended data transmission.

**AT Command:** ID

**Binary Command:** 0x27 (39 decimal)

**Parameter Range:** 0 – 0xFFFF (Read-only)

**# of bytes returned:** 2

**Minimum Firmware Version required:** 4.27C

## LH (Wake-up Initializer Timer)

<Sleep (Low Power)> LH Command adjusts the duration of time in which the RF initializer is sent. When receiving modules are put into Cyclic Sleep Mode, they power-down after a period of inactivity [specified by ST (Time before Sleep) Command] and will periodically awaken and listen for transmitted data. In order for the receiving modules to synchronize with the transmitter, they must detect ~35ms of the wake-up initializer (which contains synchronization information).

LH Command must be used whenever a receiver is operating in Cyclic Sleep Mode. This lengthens the Wake-up Initializer to a specific amount of time (in tenths of a second). The Wake-up Initializer Time must be longer than the cyclic sleep time that is determined by SM (Sleep Mode) Command. If the wake-up initializer time were less than the Cyclic Sleep interval, the connection would be at risk of missing the wake-up initializer transmission.

**AT Command:** LH

**Binary Command:** 0x0C (12 decimal)

**Parameter Range:** 0 - 0xFF (x 100 ms)

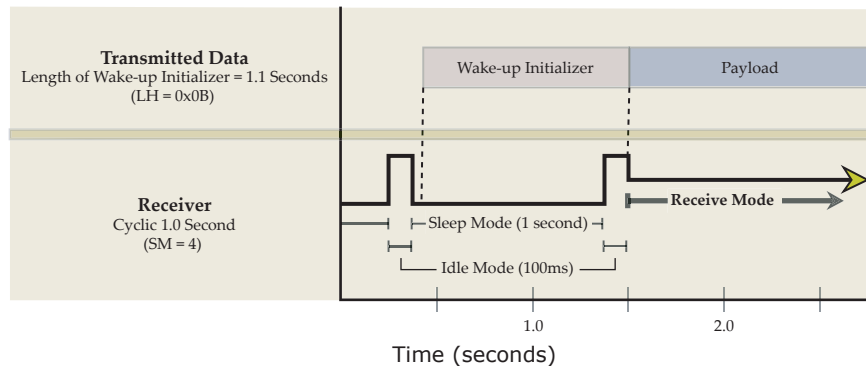
**# of bytes returned:** 1

**Default Parameter Value:** 1

**Related Commands:** HT (Time before Wake-up Initializer), SM (Sleep Mode), ST (Time before Sleep)

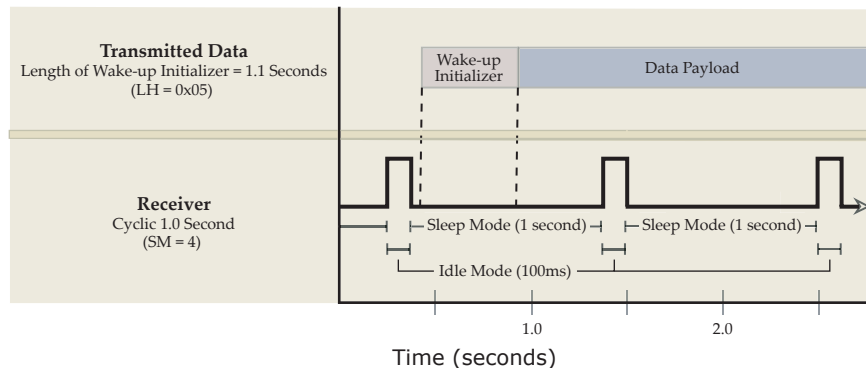
**Figure 1. Correct Configuration (LH > SM):**

The length of the wake-up initializer exceeds the time interval of Cyclic Sleep. The receiver is guaranteed to detect the wake-up initializer and receive the accompanying payload data.



**Figure 2. Incorrect Configuration (LH < SM):**

The length of the wake-up initializer is shorter than the time interval of Cyclic Sleep. This configuration is vulnerable to the receiver waking and missing the wake-up initializer (and therefore also the accompanying payload data).



## MK (Address Mask) Command

<Networking> MK Command is used to set the "Address Mask". All data packets contain the Destination Address of the transmitting module. When an RF data packet is received, the transmitter's Destination Address is logically "ANDed" (bitwise) with the Address Mask of the receiver. The resulting value must match the Destination Address or the Address Mask of the receiver for the packet to be received and sent out the module's DO serial port. If the "ANDed" value does not match either the Destination Address or the Address Mask of the receiver, the packet is discarded. (All "0" values are treated as "irrelevant" values and ignored.)

**AT Command:** MK

**Binary Command:** 0x12 (18 decimal)

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0xFFFF (When set to this value, the Destination Address of the transmitter must exactly match the Destination Address of the receiver.)

**Related Commands:** DT (Destination Address), HP (Hopping Channel)

## NB (Parity) Command

<Serial Interfacing> NB Command allows parity for the module to be changed.

**AT Command:** NB

**Binary Command:** 0x23 (35 decimal)

**Parameter Range:** 0 - 4

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Minimum Firmware Version required:**  
4.27B

Parameter Values	Configuration
0	8-bit (no parity) or 7-bit (any parity)
1	8-bit even parity
2	8-bit odd parity
3	8-bit mark parity
4	8-bit space parity

## PC (Power-up to AT Mode) Command

<AT Command Mode Options> PC Command allows the module to power-up directly into AT Command Mode from reset or power-on. If PC Command is enabled with SM Parameter set to 1, the SLEEP Pin (DI3-Pin 2) can be used to enter the module into AT Command Mode. When the SLEEP pin is de-asserted (low), the module will Wake-up into AT Command Mode. This behavior allows modem DTR emulation.

**AT Command:** PC

**Binary Command:** 0x1E (30 decimal)

**Parameter Range:** 0 - 1

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Minimum Firmware Version required:** 4.22

Parameter Values	Configuration
0	Power-up to Idle Mode
1	Power-up to AT Command Mode

NOTE: If using the XStream-PKG-R (RS-232/485) RF Modem or XIB-R (RS-232/485) Interface Board, the J7 jumper must be populated in order to use PC Command.

## PW (Pin Wake-up) Command

<Sleep (Low Power)> Under normal operation, a module in Cyclic Sleep Mode cycles from an active state to a low-power state at regular intervals until data is ready to be received. If the PW Parameter is set to 1, the DI3-SLEEP Pin (Pin 2) can be used to awaken the module from Cyclic Sleep. If the SLEEP Pin is de-asserted (low), the module will be fully operational and will not go into Cyclic Sleep. Once SLEEP is asserted, the module will remain active for the period of time specified by ST (Time before Sleep) Command, and will return to Cyclic Sleep Mode (if no data is ready to be transmitted). PW Command is only valid if Cyclic Sleep has been enabled.

**AT Command:** PW

**Parameter Range:** 0 – 1

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Binary Command:** 0x1D (29 decimal)

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

**Minimum Firmware Version required:** 4.22

Parameter Values	Configuration
0	Disabled
1	Enabled

## RE (Restore Defaults) Command

<Diagnostic> RE Command restores all configurable parameters to factory default settings. However, RE Command will not write the default values to non-volatile (persistent) memory. Unless the WR (Write) Command is issued after the RE command, the default settings will not be saved in the event of module reset or power-down.

**AT Command:** RE

**Binary Command:** 0x0E (14 decimal)

## RN (Delay Slots) Command

<Networking> RN Command is only applicable if retries have been enabled [RR (Retries) Command], or if forced delays will be inserted into a transmission [see TT (Streaming Limit) Command]. RN Command is used to adjust the time delay that the transmitter inserts before attempting to resend a packet. If the transmitter fails to receive an acknowledgement after sending a packet, it will insert a random number of delay slots (ranging from 0 to (RN minus 1)) before attempting to resend the packet. Each delay slot lasts for a period of 38ms.

If two modules attempted to transmit at the same time, the random time delay after packet failure would allow one of the two modules to transmit the packet successfully, while the other would wait until the channel opens up to begin transmission.

**AT Command:** RN

**Binary Command:** 0x19 (25 decimal)

**Parameter Range:** 0 - 0xFF

**# of bytes returned:** 1

**Default Parameter Value:** 0 (No delay slots inserted)

**Related Commands:** RR (Retries), TT (Streaming Limit)

**Minimum Firmware Version required:** 4.22

## RO (Time before Transmission) Command

<Serial Interfacing> RO Command is used to specify the timeout value (in 0.2 ms increments) when transmission starts after receiving serial data. If the "RB" parameter is "0", this command has no effect. After a serial byte is received and if no other byte is received before the RO timeout, the transmission will start.

**AT Command:** RO

**Binary Command:** 0x21 (33 decimal)

**Parameter Range:** 0 – 0xFFFF (x 0.2 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0x20 (32 decimal)

**Minimum Firmware Version required:** 4.2AA

## RP (RSSI PWN Timer) Command

<Diagnostic> RP Command is used to enable a PWM ("Pulse Width Modulation") output on the config pin (pin 9 of the OEM RF Module) which is calibrated to show the level the received RF signal is above the sensitivity level of the radio modem. The PWM pulses vary from zero to 95 percent. Zero percent means the received RF signal is at or below the published sensitivity level of the radio modem. The following table shows levels above sensitivity and PWM values.

The total period of the PWM output is 8.32 ms. There are 40 steps in the PWM output and therefore a minimum step size is 0.208 ms.

A non-zero value defines the time that the PWM output will be active with the RSSI value of the last received RF packet. After the set time

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

dBm above Sensitivity	PWM percentage (high period/ total period)
10	47.5
20	62.5
30	77.5

PWM output shares the config input pin. When the radio modem is powered, the config pin will be an input. During the power-up sequence, the config pin will be read to determine whether the radio modem is going into AT Command Mode. After this, if RP parameter is a non-zero value, the config pin will be configured as an output and set low until the first RF packet is received. With a non-zero RP parameter, the config pin will be an input for RP ms after power up.

**AT Command:** RP

**Binary Command:** 0x22 (34 decimal)

**Parameter Range:** 0 - 0x7F (x 100 ms)

**# of bytes returned:** 1

**Default Parameter Value:** 0 (disabled)

**Minimum Firmware Version required:** 4.2AA

## RR (Retries) Command

<Networking> RR Command specifies the number of retries that can be sent for a given RF packet. Once RR Command is enabled (set to a non-zero value), RF packet acknowledgements and retries are enabled. After transmitting a packet, the transmitter will wait to receive an acknowledgement from a receiver. If the acknowledgement is not received in the period of time specified by the RN (Delay Slots) Command, the transmitter will transmit the original packet again. The packet will be transmitted repeatedly until an acknowledgement is received or until the packet has been sent RR times.

**Note:** For retries to work correctly, all radio modems in the system must have retries enabled.

**AT Command:** RR

**Binary Command:** 0x18 (24 decimal)

**Parameter Range:** 0 - 0xFF

**# of bytes returned:** 1

**Default Parameter Value:** 0 (disabled)

**Minimum Firmware Version required:** 4.22

## RS (RSSI) Command

<Diagnostic> RS Command returns the signal level of the last packet received. This command is useful for determining range characteristics of the XStream Modules under various conditions of noise and distance. Once the command is issued, the module will return a value between 0x6 and 0x36 where 0x36 represents a very strong signal level and 0x4 indicates a low signal level.

**AT Command:** RS

**Binary Command:** 0x1C (28 decimal)

**# of bytes returned:** 1

**Minimum Firmware Version required:** 4.22

## RT (DI2 Configuration) Command

<Serial Interfacing> RT Command must be issued to enable binary programming and  $\overline{\text{RTS}}$  flow control. RT command dictates how pin 5 (DI2- $\overline{\text{RTS}}$ /CMD) of the XStream OEM RF Module is used.

**AT Command:** RT

**Binary Command:** 0x16 (22 decimal)

**Parameter Range:** 0 - 2

**# of bytes returned:** 1

**Default Parameter Value:** 0

Parameter Values	Configuration
0	Disabled
1	Enable Binary Commands
2	Enable RTS flow control

## SH (Serial Number High) Command

<Diagnostic> SH Command reads and returns the module serial number high word.

**AT Command:** SH

**Binary Command:** 0x25 (37 decimal)

**Parameter Range:** 0 - 0xFFFF (Read-only)

**# of bytes returned:** 2

**Related Commands:** SL (Serial Number Low Word)

**Minimum Firmware Version required:** 4.27C

## SL Command (Serial Number Low Word)

<Diagnostic> The SH Command reads and reports the module serial number low word.

**AT Command:** SL

**Binary Command:** 0x26 (38 decimal)

**Parameter Range:** 0 x 0xFFFF (Read-only)

**# of bytes returned:** 2

**Related Commands:** SH (Serial Number High Word)

**Minimum Firmware Version required:** 4.27C

## SM (Sleep Mode) Command

<Sleep Mode (Low Power)> SM Command is used to adjust Sleep Mode settings. By default, Sleep Mode is disabled and the module remains continually active. SM Command allows the module to run in a lower-power state and be configured in one of eight settings.

Cyclic Sleep settings wake the module after the amount of time designated by SM Command. If the module detects a wake-up initializer during the time it is awake, it will synchronize with the transmitter and start receiving data after the wake-up initializer runs its duration. Otherwise, it returns to Sleep Mode and continue to cycle in and out of inactivity until the Wake-up Initializer is detected. If a Cyclic Sleep setting is chosen, the ST, LH and HT parameters must also be set as described in the "Sleep Mode" section of this manual.

Parameter Values	Configuration
0	Disabled
1	Pin Sleep
2	Serial Port Sleep
3	Cyclic 0.5 second sleep (Module wakes every 0.5 seconds)
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

**AT Command:** SM

**Binary Command:** 0x01 (1 decimal)

**Parameter Range:** 0 – 8

**# of bytes returned:** 1

**Default Parameter Value:** 0

**Related Commands:** Pin Sleep – PC, PW  
Serial Port Sleep – ST  
Cyclic Sleep – ST, LH, HT, PW

## ST (Time before Sleep) Command

<Sleep Mode (Low Power)> ST Command sets the period of time (in tenths of seconds) in which the module remains inactive before entering into Sleep Mode. For example, if the ST Parameter is set to 0x64 ("100" decimal), the module will enter into Sleep mode after 10 seconds of inactivity (no transmitting or receiving). This command can only be used if either Cyclic Sleep or Serial Port Sleep Mode settings have been selected using SM (Sleep Mode) Command.

**AT Command:** ST

**Binary Command:** 2

**Parameter Range:** 0x10 – 0xFFFF (x 100 ms)

**# of bytes returned:** 2

**Default Parameter Value:** 0x64 (100 decimal)

**Related Commands:** SM (Sleep Mode), LH (Wake-up Initializer Timer), HT (Time before Wake-up Initializer)



## SY (Time before Initialization) Command

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<Networking> SY Command keeps a communication channel open as long as module transmits or receives before the active connection expires. It can be used to reduce latency in a query/response sequence and should be set 100 ms longer than the delay between transmissions.

This command allows multiple XStream Modules to share a hopping channel for a given amount of time after receiving data. By default, all packets include a Wake-up Initializer that contains channel information used to synchronize any listening receivers to the transmitter's hopping pattern. Once a new module comes within range or is powered on within range, it is able to instantly synchronize to the transmitter and start receiving data. If no new modules are introduced into the system, the synchronization information becomes redundant once modules have become synchronized.

SY Command allows the modules to remove this information from the Wake-up Initializer after the initial synchronization. For example, changing the SY Parameter to 0x14 (20 decimal) allows all modules to remain in sync for 2 seconds after the last data packet was received. Synchronization information is not re-sent unless transmission stops for more than 2 seconds. This command allows significant savings in packet transmission time.

<p><b>Warning:</b> Not recommended for use in an interference-prone environment. Interference can break up the session and the communications channel will not be available again until SY time expires.</p>
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With SY set to zero, the channel session is opened and closed with each transmission - resulting in a more robust link with a little more latency.

**AT Command:** SY

**Binary Command:** 0x17 (23 decimal)

**Parameter Range:** 0 - 0xFF (tenths of seconds)

**# of bytes returned:** 1

**Default Parameter Value:** 0 (Channel synchronization information is sent with each packet.)

## TR (Transmit Error Count) Command

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<Diagnostic> TR Command records the number of retransmit failures. This number is incremented each time a packet is not acknowledged within the number of retransmits specified by the RR (Retries) Command. It therefore counts the number of packets that were not successfully received and have been dropped. The TR Parameter is not non-volatile and will therefore be reset to '0x0' when the module is reset.

**AT Command:** TR

**Binary Command:** 0x1B (27 decimal)

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0

**Related Command:** RR (Retries)

**Minimum Firmware Version required:** 4.22

## TT (Streaming Limit) Command

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<Networking> TT Command is used to simulate full-duplex behavior. TT Command defines a limit on the number of bytes that can be sent out before a random delay is issued. If a modem is sending a continuous stream of RF data, a delay is inserted which stops its transmission and allows other modules time to transmit (once it sends number of bytes specified by TT Command). Inserted random delay lasts between 1 & 'RN + 1' delay slots, where each delay slot lasts 38ms.

**AT Command:** TT

**Binary Command:** 0x1A (26 decimal)

**Parameter Range:** 0 - 0xFFFF

**# of bytes returned:** 2

**Default Parameter Value:** 0xFFFF (65535 decimal)

**Related Commands:** RN (Delay Slots)

**Minimum Firmware Version required:** 4.22

## VR (Firmware Version) Command

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<Diagnostic> VR Command returns the Firmware Version of the XStream Module.

**AT Command:** VR

**Binary Command:** 0x14 (20 decimal)

**Parameter Range:** 0 – 0xFFFF (Read-only)

**# of bytes returned:** 2

## WR (Write) Command

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<(Special)> WR Command writes configurable parameters to the radio modem's non-volatile memory. (Parameter values remain in the modem's memory until overwritten by future use of WR Command) If changes are made without writing them to non-volatile memory, the radio modem reverts back to previously saved parameters the next time the module is powered-on.

**AT Command:** WR

**Binary Command:** 0x08 (8 decimal)

## Appendix A: Troubleshooting & FAQs

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### Contact MaxStream

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

MaxStream technical support engineers are versed in RF (radio frequency) and EE (Electrical Engineering) technologies and are accessible via the means listed below. By contacting MaxStream technical support, OEMs and integrators benefit from many years of RF experience.

Please use the following resources for additional support:

**Documentation:** [www.maxstream.net/helpdesk/](http://www.maxstream.net/helpdesk/)

**Technical Support:** Phone. (866) 765-9885 U.S. & Canada  
(801) 765-9885 Worldwide

Live Chat. [www.maxstream.net](http://www.maxstream.net)

E-Mail. [rf-xperts@maxstream.net](mailto:rf-xperts@maxstream.net)

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