

SS900FH

AT Command User Guide



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VERDI, NEVADA

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SS900FH AT Command Reference

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Command Reference Table

Hexadecimal values are designated by a "0x" prefix. Decimal equivalents are designated by a "d" suffix

CMD	Hex (Dec)	Description	Range	Category	# Bytes Returned	Factory Default
%V	0x3B (59d)	Board Voltage	0x2CCCA – 0x5BFFA [read-only]	Diagnostics	4	-
AM	0x40 (64d)	Auto-set MY	-	Networking & Security	-	-
AT	0x05 (5d)	Guard Time After	2 - (ATST-3) [x 100 msec]	Command Mode Options	2	0x0A (10d)
BD	0x15 (21d)	Baud Rate	0 - 8	Serial Interfacing	1	3
BR	0x39 (57d)	RF Data Rate	0 - 1	RF Interfacing	1	1
BT	0x04 (4d)	Guard Time Before	0 – 0xFFFF [x 100 msec]	Command Mode Options	2	0x0A (10d)
CC	0x13 (19d)	Command Sequence Character	0x20 - 0x7F	Command Mode Options	1	0x2B ["+"] (43d)
CD	0x28 (40d)	GPO2 Configuration	0 - 2	Serial Interfacing	1	2
CF	-	Number Base	0 - 2	Command Mode Options	1	1
CN	0x09 (9d)	Exit Command Mode	-	Command Mode Options	-	-
CS	0x1F (31d)	GPO1 Configuration	0 - 4	Serial Interfacing	1	0
CT	0x06 (6d)	Command Mode Timeout	2 – 0xFFFF [x 100 ms]	Command Mode Options	2	0xC8 (200d)
DB	0x36 (54d)	Received Signal Strength	0x6E to 0x28 [read-only]	Diagnostics	2	-
DT	0x00 (0d)	Destination Address	0 - 0xFFFF	Networking & Security	2	0
E0	0x0A (10d)	Echo Off	-	Command Mode Options	-	-
E1	0x0B (11d)	Echo On	-	Command Mode Options	-	-
ER	0x0F (15d)	Receive Error Count	0 – 0xFFFF	Diagnostics	2	0
FH	0x0D (13d)	Force Wake-up Initializer	-	Sleep (Low Power)	-	-
FL	0x07 (7d)	Software Flow Control	0 - 1	Serial Interfacing	1	0
FS	0x3E (62d)	Forced Sync Time	1 – 0xFFFF [x 10 msec]	RF Interfacing	2	0
FT	0x24 (36d)	Flow Control Threshold	0 – DI Buffer size (bytes)	Serial Interfacing	2	varies
GD	0x10 (16d)	Receive Good Count	0 – 0xFFFF	Diagnostics	2	0
HP	0x11 (17d)	Hopping Channel	0 - 9	Networking & Security	1	0
HT	0x03 (3d)	Time before Wake-up Initializer	0 – 0xFFFF [x 100 msec]	Sleep (Low Power)	2	0xFFFF (65535d)
HV	-	Hardware Version	0 – 0xFFFF [read-only]	Diagnostics	2	-
ID	0x27 (39d)	Modem VID	0 - 0x7FFF (user-settable) 0x8000 - 0xFFFF (factory-set)	Networking & Security	2	0x3332 (13106d)
KY	0x3C (60d)	AES Encryption Key	0 – (Any other 64-digit hex valid key)	Networking & Security	2	0

CMD	Hex (Dec)	Description	Range	Category	# Bytes Returned	Factory Default
LH	0x0C (12d)	Wake-up Initializer Timer	0 – 0xFF [x 100 msec]	Sleep (Low Power)	1	1
MK	0x12 (18d)	Address Mask	0 - 0xFFFF	Networking & Security	2	0xFFFF (65535d)
MT	0x3D (61d)	Multi-Transmit	0 – 0xFF	Networking & Security	1	0
MY	0x2A (42d)	Source Address	0 - 0xFFFF	Networking & Security	2	0xFFFF (65535d)
NB	0x23 (35d)	Parity	0 - 4	Serial Interfacing	1	0
PK	0x29 (41d)	Maximum RF Packet Size	1 – 0x800 [Bytes]	RF Interfacing	2	0x800 (2048d)
PL	0x3A (58d)	TX Power Level	0 - 4	RF Interfacing	1	4 [1 Watt]
PW	0x1D (29d)	Pin Wake-up	0 - 1	Sleep (Low Power)	1	0
RB	0x20 (32d)	Packetization Threshold	1 - Current value of PK	Serial Interfacing	2	0x800 (2048d)
RC	-	Ambient Power - Single Channel	0 – 0x31 [dBm, read-only]	Diagnostics	1	-
RE	0x0E (14d)	Restore Defaults	-	(Special)	-	-
RM	-	Ambient Power - All Channels	No parameter – 0x7D0	Diagnostics	2	-
RN	0x19 (25d)	Delay Slots	0 – 0xFF (slots)	Networking & Security	1	0
RO	0x21 (33d)	Packetization Timeout	0 – 0xFFFF [x UART character time]	Serial Interfacing	2	3
RP	0x22 (34d)	RSSI PWM Timer	0 – 0xFF [x 100 msec]	Diagnostics	1	0x20 (32d)
RR	0x18 (24d)	Retries	0 – 0xFF	Networking & Security	1	0x0A (10d)
RT	0x16 (22d)	GPI1 Configuration	0 - 2	Serial Interfacing	1	0
SB	0x37 (55d)	Stop Bits	0 - 1	Serial Interfacing	1	0
SH	0x25 (37d)	Serial Number High	0 – 0xFFFF [read-only]	Diagnostics	2	varies
SL	0x26 (38d)	Serial Number Low	0 – 0xFFFF [read-only]	Diagnostics	2	varies
SM	0x01 (1d)	Sleep Mode	0 - 2, 4 - 8; 3 reserved	Sleep (Low Power)	1	0
ST	0x02 (2d)	Time before Sleep	(ATAT+3) – 0x7FFF [x 100 msec]	Sleep (Low Power)	2	0x64 (100d)
TP	0x38 (56d)	Board Temperature	0 – 0x7F [read-only]	Diagnostics	1	-
TR	0x1B (27d)	Delivery Failure Count	0 – 0xFFFF [read-only]	Diagnostics	2	0
TT	0x1A (26d)	Streaming Limit	0 – 0xFFFF [0 = disabled]	Networking & Security	2	0
TX	0x3F (63d)	Transmit Only	0 - 1	RF Interfacing	1	0
VL	-	Firmware Version - verbose	Returns string	Diagnostics	-	-
VR	0x14 (20d)	Firmware Version	0 - 0xFFFF [read-only]	Diagnostics	2	-
WA	-	Active Warning Numbers	Returns string	Diagnostics	-	-
WN	-	Warning Data	Returns string	Diagnostics	-	-
WR	0x08 (8d)	Write	-	(Special)	-	-
WS	-	Sticky Warning Numbers	Returns string	Diagnostics	-	-

%V (Board Voltage) Command

<Diagnostics> %V Command is used to read the current voltage of the prName Module circuit board.

Sample Output: 5.02 V (when ATCF = 0) 5051F
(when ATCF = 1) * 5.02 (when ATCF = 2)

* When CF = 1 (default), a hex integer is shown that is equal to (voltage * 65536d).

AT Command: AT%V

Binary Command: 0x3B (59 decimal)

Parameter Range (read-only):
0x2CCCA – 0x5BFFA
(2.80 – 5.75 decimal)

Number of bytes returned: 4

AM (Auto-set MY) Command

<Networking & Security> AM Command is used to automatically set the MY (Source Address) parameter from the factory-set module serial number. The address is formed with bits 29, 28 and 13-0 of the serial number (in that order). The value is displayed as a result of this command.

AT Command: ATAM

Binary Command: 0x40 (64 decimal)

Parameter Range: 0 – 0xFFFF

AP (API Enable) Command

<Serial Interfacing> The AP command is used to enable the module to operate using the frame-based API operation.

AT Command: ATAP

Parameter Range: 0 – 2

Parameter	Configuration
0	API Disabled (Transparent Operation)
1	API enabled (w/out escaped characters)
2	API enabled (with escaped characters)

Default Parameter Value: 0

Number of bytes returned: 1

Minimum Firmware Version Required: 2.x20

AT (Guard Time After) Command

<Command Mode Options> AT Command is used to set/read the time-of-silence that follows the command sequence character (CC Command). By default, 1 second must elapse before and after the command sequence character.

Refer to the AT Commands section [p**Error! Bookmark not defined.**] to view the default AT Command Mode sequence.

AT Command: ATAT

Binary Command: 0x05 (5 decimal)

Parameter Range: 2 – (ATST-3), up
to 0x7FFC
[x 100 milliseconds]

Default Parameter Value: 0x0A (10 decimal)

Number of bytes returned: 2

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

BD (Baud Rate) Command

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

When parameters 0-8 are sent to the module, the respective interface data rates are used (as shown in the table on the right).

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

The range between standard and non-standard baud rates (0x09 - 0x38) is invalid.

Non-standard Interface Data Rates:

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

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

AT Command: ATBD

Binary Command: 0x15 (21 decimal)

Parameter Ranges: 0 - 8 (standard rates)
0x39 - 0x1C9C38 (non-standard rates)

Parameter	Configuration (bps)
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200
8	230400

Non-standard baud rates supported as of firmware v2.x20

Default Parameter Value: 3

Number of bytes returned: 1

Parameter Sent versus Parameters Stored

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

BR (RF Data Rate) Command

<RF Interfacing> BR Command is used to set/read the RF data rate (rate that RF data is transmitted over-the-air) of the module.

AT Command: ATBR

Binary Command: 0x39 (57 decimal)

Parameter Range: 0 – 1

Parameter	Configuration (bps)
0	9600
1	115200

Default Parameter Value: 1

Number of bytes returned: 1

BT (Guard Time Before) Command

<Command Mode Options> BT Command is used to set/read the time-of-silence that precedes the command sequence character (CC Command) of the AT Command Mode Sequence (BT + CC + AT). By default, 1 second must elapse before and after the command sequence character.

The times-of-silence surrounding the command sequence character are used to prevent inadvertent entrance into AT Command Mode.

Refer to the 'Command Mode' section [p20] for more information regarding the AT Command Mode Sequence

AT Command: ATBT

Binary Command: 0x04 (4 decimal)

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

Default Parameter Value: 0x0A (10 decimal)

Number of bytes returned: 2

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

CC (Command Sequence Character) Command

<Command Mode Options> CC Command is used to set/read the ASCII character used between Guard Times of the AT Command Mode Sequence (BT+ CC + AT). The AT Command Mode Sequence activates AT Command Mode (from Idle Mode).

Refer to the AT Commands section to view the default AT Command Mode sequence.

AT Command: ATCC

Binary Command: 0x13 (19 decimal)

Parameter Range: 0x20 – 0x7F

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

Number of bytes returned: 1

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

CD (GPO2 Configuration) Command

<Serial Interfacing> CD Command is used to select/read the behavior of the GPO2 line.

AT Command: ATCD

Binary Command: 0x28 (40 decimal)

Parameter Range: 0 – 2

Parameter	Configuration
0	RX LED
1	Default high
2	Default low
3	(reserved)
4	RX LED (valid address only)

Default Parameter Value: 2

Number of bytes returned: 1

CF (Number Base) Command

<Command Mode Options> CF command is used to set/read command formatting setting. The following commands are always entered and read in hex, no matter the CF setting:

- VR (Firmware Version)
- HV (Hardware Version)
- KY (AES Encryption Key)

AT Command: ATCF

Parameter Range: 0 – 2

Parameter Configuration	
0	Commands utilize default number base; decimal commands may output units
1	All commands are forced to unsigned, unit-less hex
2	Commands utilize their default number base; no units output

Default Parameter Value: 1

Number of bytes returned: 1

CN (Exit Command Mode) Command

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

AT Command: ATCN

Binary Command: 0x09 (9 decimal)

CS (GP01 Configuration) Command

<Serial Interfacing> CS Command is used to select the behavior of the GP01 pin. This output can provide RS-232 flow control, control the TX enable signal (for RS-485 or RS-422 operations), or set the default level for the I/O line passing function.

By default, GP01 provides RS-232 $\overline{\text{CTS}}$ (Clear-to-Send) flow control.

AT Command: ATCS

Binary Command: 0x1F (31 decimal)

Parameter Range: 0 – 4

Parameter	Configuration
0	RS-232 $\overline{\text{CTS}}$ flow control
1	RS-485 TX enable low
2	high
3	RS-485 TX enable high
4	low

Default Parameter Value: 0

Number of bytes returned: 1

Related Commands: RT (GP11 Configuration), TO (GP01 Timeout)

CT (Command Mode Timeout) Command

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

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

AT Command: ATCT

Binary Command: 0x06 (6 decimal)

Parameter Range: 2 - 0xFFFF
[x 100 milliseconds]

Default Parameter Value: 0xC8 (200d)

Number of bytes returned: 2

Related Commands: CN (Exit AT Command Mode)

DB (Received Signal Strength) Command

<Diagnostics> DB Command is used to read the receive signal strength (in decibels relative to milliWatts) of the last received packet. This parameter is useful in determining range characteristics of prName Modules under various conditions.

In default mode, this command shows the power level in signed decimal format, with the units (dBm). If CF is set to 1, the magnitude of the value is presented in unsigned hex. If CF is set to 2, the value is presented in decimal, but without the units.

Sample Output: -88 dBm (with ATCF = 0)
 58 (with ATCF = 1)
 -88 (with ATCF = 2)

NOTE: If the DB register is read before the module has received an RF packet, the module will return a value of 0x8000 (which means no packets have yet been received).

AT Command: ATDB

Binary Command: 0x36 (54 decimal)

Parameter Range (read-only):

0x6E – 0x28

(-110 to -40 Decimal)

Number of bytes returned: 2

DT (Destination Address) Command

<Networking & Security> DT Command is used to set/read the networking address of the prName Module. prName Modules uses three network layers – Vendor Identification Number (ATID), Channels (ATHP), and Destination Addresses (ATDT). DT Command assigns an address to a module that enables it to communicate only with other modules having the same addresses. All modules that share the same Destination Address can communicate freely with each other.

Modules 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.

Refer to the 'Addressing' sections for more information.

AT Command: ATDT

Binary Command: 0x00

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0

Number of bytes returned: 2

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

E0 (Echo Off) Command

<Command Mode Options> E0 Command turns off character echo in AT Command Mode. By default, echo is off.

AT Command: ATE0

Binary Command: 0x0A (10 decimal)

E1 (Echo On) Command

<Command Mode Options> E1 Command turns on the character echo in AT Command Mode. Each typed character will be echoed back to the terminal when ATE1 is active. E0 is the default.

AT Command: ATE1

Binary Command: 0x0B (11 decimal)

ER (Receive Error Count) Command

<Diagnostics> Set/Read the number of receive-errors. The error count records the number of packets partially received then aborted on a reception error. This value returns to 0 after a reset and is not non-volatile (Value does not persist in the module'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 module is reset.

The ER parameter is not reset by pin, serial port or cyclic sleep modes.

AT Command: ATER

Binary Command: 0x0F (15 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0

Number of bytes returned: 2

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 transmission. WR (Write) Command does not need to be issued with FH Command.

Use only with cyclic sleep modes active on remote modules.

AT Command: ATFH

Binary Command: 0x0D (13 decimal)

FL (Software Flow Control) Command

<Serial Interfacing> FL Command is used to configure software flow control. Hardware flow control is implemented with the prName Module as the GP01 pin (\overline{CTS}), 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 used is 0x11 (17 decimal). XOFF character used is 0x13 (19 decimal).

AT Command: ATFL

Binary Command: 0x07 (7 decimal)

Parameter Range: 0 – 1

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

Default Parameter Value: 0

Number of bytes returned: 1

FS (Forced Synch Time) Command

<RF Interfacing> The FS Command only applies to streaming data. Normally, only the first packet of a continuous stream contains the full RF initializer. Modules then remain synchronized for subsequent packets of the stream. The FS parameter can be used to periodically force an RF initializer during streaming. Any break in UART character reception long enough to drain the DI Buffer (UART receive buffer) and cause a pause in RF data transmission will also cause an RF initializer to be inserted on the next transmission.

AT Command: ATFS

Binary Command: 0x3E (62 decimal)

Parameter Range: 0 – 0xFFFF
[x 10 milliseconds]

Default Parameter Value: 0

Number of bytes returned: 2

FT (Flow Control Threshold) Command

<Serial Interfacing> Set/Read the flow control threshold. When FT bytes have accumulated in the DI buffer, \overline{CTS} is de-asserted or the XOFF software flow control character is transmitted.

AT Command: ATFT

Binary Command: 0x24 (36 decimal)

Parameter Range: 0 – (DI buffer size minus 0x11) bytes

Default Parameter Value: DI Buffer size minus 0x11 (decimal 17)

Number of bytes returned: 2

GD (Receive Good Count) Command

<Diagnostics> Set/Read the count of good received RF packets. Parameter value is reset to 0 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. The GD parameter is not reset by pin, serial port or cyclic sleep modes.

AT Command: ATGD

Binary Command: 0x10 (16 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0

Number of bytes returned: 2

Related Commands: ER (Receive Error Count)

HP (Hopping Channel) Command

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

AT Command: ATHP

Binary Command: 0x11 (17 decimal)

Parameter Range: 0 – 9

Default Parameter Value: 0

Number of bytes returned: 1

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

HT (Time before Wake-up Initializer) Command

<Sleep (Low Power)> Set/read time of inactivity (no serial or RF data is sent or received) before a wake-up initializer is sent by a TX module. HT should be set shorter than inactivity timeout [ST Command] time of any RX modules operating in Cyclic Sleep (SM=4-8). The wake-up initializer sent by the TX module instructs all RX modules to remain awake to receive RF data.

From the RX module perspective: After HT time elapses and the inactivity timeout [ST Command] is met, the RX module goes into cyclic sleep. In cyclic sleep, the RX module wakes once per sleep interval [SM Command] to check for a wake-up initializer. When a wake-up initializer is detected, the module stays awake to receive data. The wake-up initializer must be longer than the cyclic sleep interval to ensure that sleeping modules detect incoming data. When HT time elapses, the TX module knows it needs to send a wake-up Initializer for all RX modules to remain awake and receive the next transmission.

AT Command: ATHT

Binary Command: 0x03 (3 decimal)

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

Default Parameter Value: 0xFFFF (wake-up initializer will not be sent)

Number of bytes returned: 2

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

HV (Hardware Version) Command

<Diagnostics> HV Command is used to read the hardware version of the module.

AT Command: ATHV

Parameter Range (read-only): 0 – 0xFFFF

Number of bytes returned: 2

ID (Modem VID) Command

<Networking & Security> ID Command is used to set/read the VID (Vendor Identification Number) of the module. Modules must have matching VIDs in order to communicate.

AT Command: ATID

Binary Command: 0x27 (39 decimal)

Parameter Range:
0 – 0x7FFF (user-settable)
0x8000 – 0xFFFF (factory-set)

Default Parameter Value: 0x3332 (13106d)

Number of bytes returned: 2

KY (AES Encryption Key) Command

<Networking & Security> KY Command is used to set the 256-bit AES (Advanced Encryption Standard) key for encryption/decryption of data. Once set, the key cannot be read out of the module by any means. The entire payload of the packet is encrypted using the key and the CRC is computed across the ciphertext. When encryption is turned on, each packet carries an additional 16 bytes to convey the random CBC Initialization Vector (IV) to the receiver(s).

A Module with the wrong key (or no key) will still receive encrypted data, but the resultant data driven out the serial port will be meaningless. Likewise, a module with a key will still receive unencrypted data sent from a module without a key, but the output will be meaningless. Because CBC mode is utilized, repetitive data appears different in different transmissions due to the randomly-generated IV.

AT Command: ATKY

Binary Command: 0x3C (60 decimal)

Parameter Range:
0 – (any other 64-digit hex valid key)

Default Parameter Value: 0 (disabled)

Number of bytes returned: 2

Number Base: Always Hexadecimal

LH (Wake-up Initializer Timer) Command

<Sleep (Low Power)> LH Command is used to set/read the duration of time for which the wake-up 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 remain awake, they must detect ~35ms of the wake-up initializer.

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.

Refer to the Sleep Mode section to view diagrams of correct and incorrect configurations. The images help visualize the importance that the value of LH be greater than the value of SM.

AT Command: ATLH

Binary Command: 0x0C (12 decimal)

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

Default Parameter Value: 1

Number of bytes returned: 1

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

MD (RF Mode) Command

<Networking & Security> The MD command is used to select/read the settings that enable the Polling and Repeater Modes on the module.

Polling Mode - A 'Polling Base' is responsible for polling remotes. A 'Polling Remote' requires a poll in order to transmit.

Repeater Mode - A 'Repeater' re-sends RF data unless the transmission is addressed to it or if the transmission has already been detected. A 'Repeater End Node' handles repeated messages, but will not repeat the message over-the-air.

Refer to the Polling and Repeater Mode sections of the 'RF Communication Modes' chapter for more information.

AT Command: ATMD

Binary Command: 0x31 (49 decimal)

Parameter Range: 0 – 6

Parameter	Configuration
0	Transparent Operation (Repeater Base)
1	[reserved - not used]
2	[reserved - not used]
3	Polling Base
4	Polling Remote
5	Repeater
6	Repeater End Node

Default Parameter Value: 0

Number of bytes returned: 1

Minimum Firmware Version Required: 2.x20

MK (Address Mask) Command

<Networking & Security> The MK command is used to set/read the Address Mask of a module.

All RF data packets contain the Destination Address of the TX (transmitting) module. When a packet is received, the TX module Destination Address is logically "ANDed" (bitwise) with the Address Mask of the RX (receiving) module. The resulting value must match the Destination Address or Address Mask of the RX module for the packet to be received and sent out the RX module's DO (Data Out) pin. If the "ANDed" value does not match the Destination Address or Address Mask of the RX module, the packet is discarded.

Sniffer Mode (when MK = 0): ACK requests are ignored and every RX (receive) frame is sent to the UART, without regard for repeated frames.

All "0" values are treated as irrelevant values and ignored.

AT Command: ATMK

Binary Command: 0x12 (18 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0xFFFF (65535d)

Number of bytes returned: 2

Related Commands: DT (Destination Address), HP (Hopping Channel), ID (Modem VID), MY (Source Address)

MT (Multi-Transmit) Command

<Networking & Security> MT packets do not request an acknowledgement from the receiving module(s). MT takes precedence over RR, so if both MT and RR are non-zero, then MT+1 packets will be sent, with no ACK requests. When a receiving module receives a packet with remaining forced retransmissions, it calculates the length of the packet and inhibits transmission for the amount of time required for all retransmissions.

Thereafter, a random number of delay slots are inserted between 0 and RN before transmission is allowed from the receiving module(s). This prevents all listening modules from transmitting at once upon conclusion of a multiple transmission event, as long as RN is non-zero.

NOTE: The actual number of forced transmissions is the parameter value plus one. For example, if MT=1, two transmissions of each packet will be sent.

AT Command: ATMT

Binary Command: 0x3D (61 decimal)

Parameter Range: 0 – 0xFF

Default Parameter Value: 0 (no forced retransmissions)

Number of bytes returned: 1

Related Commands: Networking (DT, MK, MY, RN, TT), Serial Interfacing (BR, PK, RB, RO), RF Interfacing (FS)

MY (Source Address) Command

<Networking & Security> Set/Read the source address of the module. Refer to the 'Addressing' section for more information.

AT Command: ATMY

Binary Command: 0x2A (42 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0xFFFF (Disabled – DT (Destination Address) parameter serves as both source and destination address.)

Number of bytes returned: 2

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

NB (Parity) Command

<Serial Interfacing> Select/Read parity settings for UART communications.

AT Command: ATNB

Binary Command: 0x23 (35 decimal)

Parameter Range: 0 – 4

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

Default Parameter Value: 0

Number of bytes returned: 1

PB (Polling Begin Address) Command

<Networking & Security> PB command is used to set/read the module's Polling Begin Address - the first address polled when Polling Mode is enabled.
Polling Operations: The 'Polling Base' (MD = 3) cycles through a sequential range of addresses, polling each 'Polling Remote' (MD = 4). The base then waits for a response & proceeds to the next 'Polling Remote'. Each 'Polling Remote' responds by sending the data from the Data In buffer following the RB & RO parameters. When there is no eligible data to send, the 'Polling Remote' will not respond. The 'Polling Base' will move to the next address in the polling sequence after a short delay.

AT Command: ATPB

Binary Command: 0x45 (69 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0

Number of bytes returned: 2

Related Commands: MD (RF Mode), PE (Polling End Address), PD (Minimum Polling Delay)

Minimum Firmware Version Required: 2.x20

PD (Minimum Polling Delay) Command

<Networking & Security> The PD command is used to set/read Polling Delay (Base, MD=3) or Polling Timeout (Remote, MD=4).
 Polling Delay (Base) is the time between polling cycles. The Polling Base will start the polling cycle after sending the first poll. After the polling cycle has completed, the timer is restarted.
 Polling Timeout (Remote) is the amount of time the remote unit will hold data from the serial port before discarding it. Data entered within the PD time of the poll is transmitted and not discarded.

AT Command: ATPD

Binary Command: 0x47 (71 decimal)

Parameter Range: 0 - 0xFFFF
 (Base: [x 1ms], Remote: [x 10ms])

Default Parameter Value: 0

Number of bytes returned: 2

Related Commands: MD (RF Mode), PB (Polling Begin Address), PE (Polling End Address)

Minimum Firmware Version Required: 2.x20

PE (Polling End Address) Command

<Networking & Security> PE command is used to set/read the module's Polling End Address - the last address polled when Polling Mode is enabled.
Polling Operations: The 'Polling Base' (MD = 3) cycles through a sequential range of addresses, polling each 'Polling Remote' (MD = 4). The base then waits for a response & proceeds to the next 'Polling Remote'. Each 'Polling Remote' responds by sending data from the DI buffer following the RB & RO parameters. When there is no eligible data to send, the 'Polling Remote' will not respond. The 'Polling Base' will move to the next address in the polling sequence after a short delay.

AT Command: ATPE

Binary Command: 0x46 (70 decimal)

Parameter Range: 0 – 0xFFFF

Default Parameter Value: 0

Number of bytes returned: 2

Related Commands: MD (RF Mode), PB (Polling Begin Address), PD (Minimum Polling Delay)

Minimum Firmware Version Required: 2.x20

PK (Maximum RF Packet Size) Command

<RF Interfacing> PK Command is used to set/read the maximum size of RF packets. The maximum packet size can be used along with RB/RO to implicitly set the channel dwell time.

If PK is set above 256 and BR is subsequently changed to 0, then PK will automatically be lowered to 256 and a warning will be raised (see BR (RD Data Rate) and WN (Warning Data) Commands for details).

Changes to this parameter may have a secondary effect on the RB (Packet Control Characters) Parameter. RB must always be less than or equal to PK. If PK is changed to a value less than the current value of RB, RB is automatically lowered to be equal to PK.

* When BR = 0, the maximum PK value is 0x100 (256d). When BR = 1, the maximum PK value is 0x800 (2048d).

AT Command: ATPK

Binary Command: 0x29 (41 decimal)

Parameter Range: 1 – 0x800 [Bytes]

Default Parameter Value: 0x800*
(2048 decimal)

Number of bytes returned: 2

Related Commands: BR (RF Data Rate) RB (Packetization Threshold), RO (Packetization Timeout), WN (Warning Data)

PL (Power Level) Command

<RF Interfacing> PL Command is used to set/read the power level at which the module transmits.

AT Command: ATPL

Binary Command: 0x3A (58 decimal)

Parameter Range: 0 – 4

Parameter	Configuration
0	1 mW
1	10 mW
2	100 mW
3	500 mW
4	1000 mW (1 Watt)

Default Parameter Value: 4

Number of bytes returned: 1

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 SLEEP Pin 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: ATPW

Binary Command: 0x1D (29 decimal)

Parameter Range: 0 – 1

Parameter	Configuration
0	Disabled
1	Enabled

Default Parameter Value: 0

Number of bytes returned: 1

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

RB (Packetization Threshold) Command

<Serial Interfacing> RF transmission will commence when data is in the DI Buffer and either of the following criteria are met:

- RO character times of silence on the UART receive lines (ignored if RO = 0)
- RB characters have been received by the UART (ignored if RB = 0)

If PK is lowered below the value of RB, RB is automatically lowered to match PK.

Note: RB and RO criteria only apply to the first packet of a multi-packet transmission. If data remains in the DI Buffer after the first packet, transmissions will continue in streaming manner until there is no data left in the DI Buffer (UART receive buffer).

AT Command: ATRB

Binary Command: 0x20 (32 decimal)

Parameter Range: 0 – Current value of PK Parameter (up to 0x800 Bytes)

Default Parameter Value: 0x800

Number of bytes returned: 2

Related Commands: BR (RF Data Rate), PK (RF Packet Size), RO (Packetization Timeout)

RC (Ambient Power – Single Channel) Command

<Diagnostics> RC Command is used to examine and report the power level on a given channel.

Sample output: -78 dBm [when CF = 0]
 4e [when CF = 1]
 -78 [when CF = 2]

AT Command: ATRC

Parameter Range (read-only): 0 – 0x31 [dBm]

Number of bytes returned: 1

Related Commands: RM (Ambient Power – All channels)

RE (Restore Defaults) Command

<Diagnostics> RE Command is used to restore 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 restored default settings will not be saved in the event of module reset or power-down.

AT Command: ATRE

Binary Command: 0x0E (14 decimal)

RM (Ambient Power – All Channels) Command

<Diagnostics> RM Command is used to examine and report the power levels on all channels. If no parameter is given, then the channels will be scanned once. If a parameter is given, the channels will be repeatedly scanned for that number of seconds (up to 2000d), and the maximum power level seen for each channel is reported (i.e. peak hold).

A graphical spectrum analyzer application can be implemented by repeatedly calling ATRM with no arguments and reading the resultant 50 power levels (easiest to do when CF = 1 or 2).

Sample output [when CF = 0]: Ch 0: -100 dBm
 Ch 1: -103 dBm
 ..
 Ch 49: -99 dBm

Sample output [when CF = 1]: 64
 -67
 ...
 -63

Sample output [when CF = 2]: -100
 -103
 ...
 -99

AT Command: ATRM

Parameter Range (read-only): no parameter – 0x7D0 (2000d)

Number of bytes returned: 2

Related Commands: RC (Ambient Power – Single channel)

RN (Delay Slots) Command

<Networking & Security> RN Command is used to set/read the time delay that the transmitting module inserts before attempting to resend a packet. If the transmitting module fails to receive an acknowledgement after sending a packet, it inserts 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 38 ms.

If two modules attempt to transmit at the same time, the random time delay after packet failure allows only one module to transmit the packet successfully; while the other module waits until the channel available for RF transmission.

RN Command is only applicable if retries have been enabled [RR (Retries) Command] or if forced delays will be inserted into a transmission [TT (Streaming Limit) Command].

AT Command: ATRN

Binary Command: 0x19 (25 decimal)

Parameter Range: 0 – 0xFF [38 ms slots]

Default Parameter Value: 0 (no delay slots inserted)

Number of bytes returned: 1

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

RO (Packetization Timeout) Command

<Serial Interfacing> RO Command is used to set/read the Packetization Timeout setting. RF transmission commences when data is in the DI buffer and either of the following criteria are met:

RO character times of silence on the UART receive lines (ignored if RO = 0)

RB characters have been received by the UART (ignored if (RB = 0)

RB and RO criteria only apply to the first packet of a multi-packet transmission. If data remains in the DI Buffer (UART receive) after the first packet, transmissions will continue in streaming manner until there is no data left in the DI Buffer (UART receive).

When RO is the transmission-beginning criteria: The actual time between the reception of the last character from the UART and the beginning of RF transmission will be at least 800 μ sec longer than the actual RO time to allow for transmission setup. Additionally, it is subject to 100 - 200 μ sec of additional uncertainty, which could be significant for small values of RO at high UART bit rates.

The RO timer calculates the correct UART character time (10, 11, or 12 bits) based on the following criteria:

1 start bit

8 data bits

0 or 1 parity bit (as set by ATNB)

1 or 2 stop bits (as set by ATSB)

AT Command: ATRO

Binary Command: 0x21 (33 decimal)

Parameter Range: 0 – 0xFFFF
[x UART character times]

Default Parameter Value: 0x03 (3 decimal)

Number of bytes returned: 2

Related Commands: RB (Packetization Threshold)

RP (RSSI PWM Timer) Command

RP Command is used to enable a PWM (“Pulse Width Modulation”). The pin is calibrated to show the difference between received signal strength and the sensitivity level of the module. 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 module. The following table shows dB levels above sensitivity and PWM values:

The total time period of the PWM output is 8.32 ms. PWM output consists of 40 steps and therefore the minimum step size is 0.208 ms.

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

AT Command: ATRP

Binary Command: 0x22 (34 decimal)

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

Default Parameter Value: 0x20 (32 decimal)

Number of bytes returned: 1

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

Pin 11 of the encased OEM RF module is shared between PWM output and Config input. When the module is powered, the Config pin is an input. During the power-up sequence, if RP parameter is a non-zero value, the Config pin is configured as an output and set low until the first RF packet is received. With a non-zero RP parameter, the Config pin is an input for RP ms after power up.

RR (Retries) Command

<Networking & Security> RR Command is used to set/read the number of retries that can be sent for a given RF packet. When RR Command is enabled (non-zero value) and when MT Command equals zero, RF packet acknowledgements and retries are enabled.

After transmitting a packet, the transmitting module waits to receive an acknowledgement from a receiving module. If the acknowledgement is not received in the period of time specified by RN (Delay Slots) Command, the original packet is transmitted again. The RF packet is transmitted repeatedly until an acknowledgement is received or until the packet is sent RR times.

AT Command: ATRR

Binary Command: 0x18 (24 decimal)

Parameter Range: 0 – 0xFF

Default Parameter Value: 0x0A (10 decimal)

Number of bytes returned: 1

RT (GPI1 Configuration) Command

RT Command is used to set/read the behavior of the GPI1 pin. The pin can be configured to enable binary programming or RTS flow control.

AT Command: ATRT

Binary Command: 0x16 (22 decimal)

Parameter Range: 0 – 2

Parameter	Configuration
0	disabled
1	Enable Binary Programming
2	Enable RTS Flow Control

Default Parameter Value: 0

Number of bytes returned: 1

SB (Stop Bits) Command

<Serial Interfacing> SB Command is used to set/read the number of stop bits in the data packets.

AT Command: ATSB

Binary Command: 0x37 (55 decimal)

Parameter Range: 0 – 1

Parameter	Configuration
0	1 stop bit
1	2 stop bits

Default Parameter Value: 0

Number of bytes returned: 1

SH (Serial Number High) Command

<Diagnostics> SH Command is used to set/read the serial number high word of the module.

AT Command: ATSH

Binary Command: 0x25 (37 decimal)

Parameter Range (read-only): 0 – 0xFFFF

Number of bytes returned: 2

Related Commands: SL (Serial Number Low)

SL (Serial Number Low) Command

<Diagnostics> SL Command is used to set/read the serial number low word of the module.

AT Command: ATSL

Binary Command: 0x26 (38 decimal)

Parameter Range (read-only): 0 – 0xFFFF

Number of bytes returned: 2

Related Commands: SH (Serial Number High)

SM (Sleep Mode) Command

<Sleep Mode (Low Power)> SM Command is used to set/read the module's Sleep Mode settings that configure the module to run in states that require minimal power consumption. Refer to the Sleep Mode section for more information.

AT Command: ATSM

Binary Command: 0x01

Parameter Range: 0 – 8

Parameter Value	Configuration
0	Disabled
1	Pin Sleep
2	Serial Port Sleep
3	[reserved – not used]
4	Cyclic 1.0 second sleep (Module wakes every 1.0 second)
5	Cyclic 2.0 second sleep
6	Cyclic 4.0 second sleep
7	Cyclic 8.0 second sleep
8	Cyclic 16.0 second sleep

Default Parameter Value: 0

Number of bytes returned: 1

Related Commands:

Pin Sleep – PC (Power-up Mode), PW (Pin Wake-up)

Serial Port Sleep – ST (Time before Sleep)

Cyclic Sleep – ST (Time before Sleep), LH (Wake-up Initializer Timer), HT (Time Before Wake-up Initializer), PW (Pin Wake-up)

VL (Firmware Version - verbose) Command

<Diagnostics> VL Command is used to read the verbose firmware version of the prName Module.

Sample output: Firmware version 0.8, Apr 16 2004 10:46:57

AT Command: ATVL

Parameter Range: Returns string

Number of bytes returned: 2

VR (Firmware Version) Command

<Diagnostics> VR Command is used to read the firmware version of the prName Module.

AT Command: ATVR

Binary Command: 0x14 (20 decimal)

Parameter Range (read-only): 0 – 0xFFFF

Number of bytes returned: 2

WA (Active Warning Numbers) Command

<Diagnostics> WA Command reports the warning numbers of all active warnings - one warning number per line. No further information is shown and warning counts are not reset.

Sample Output (indicates warnings 1 and 3 are currently active): 1 3 OK

AT Command: ATWA

Parameter Range: Returns string –
one warning number per line.

WN (Active Warning Numbers) Command

<Diagnostics> WN Command is used to report detailed data for all active and sticky warnings.

AT Command: ATWN

- Warning number & description
- Number of occurrences since the last WN or WS command
- Whether the warning is currently active

Parameter Range: Returns string

Warnings which are not currently active, and have not been active since the last WN or WS command, are not displayed. WN Command also resets all non-zero warning counts, except for warnings that are presently active, which are set to 1.

Sample output: Warning 1: Under-voltage 3 occurrences; presently active
 Warning 4: Over-temperature 5 occurrences; presently inactive.

Warning Number	Description
1	Under-voltage. This is caused if the supply voltage falls below the minimum threshold for the lowest power level (2.8 V). If/when the voltage rises above the threshold, the warning is deactivated. The module will not transmit below this voltage threshold.
2	Over-voltage. This is caused if the supply voltage exceeds 5.75 V. Transmission is not allowed while this warning is active.
3	Under-temperature. This is caused if the temperature sensed by the module is less than -40 C. The module does not artificially limit operation while this warning is active, but module functionality is not guaranteed.
4	Over-temperature. This is caused if the temperature sensed by the module is greater than 105 C. The module does not allow transmission nor reception while this warning is active. The warning is deactivated when the temperature falls to 100 C.
5	Power reduced. This is caused if the transmit power has to be reduced from the level programmed by PL Command due to insufficient supply voltage. The 1 W power level requires 4.75 V or higher; 500 mW requires 3.0 V or higher; 100 mW, 10 mW and 1 mW require 2.8 V or higher.
6	Default calibration data in flash. This is caused if the module-specific power calibration data is either not present or is invalid, or if none of the parameters have been modified from their default values. Power levels may be incorrect.
7	Default configuration parameters in flash. This is caused if the user-modifiable parameters (i.e. those stored by a 'WR' command) in flash are all the compiled-in default values. This is caused if the user configuration is found to be not present or invalid at power-up and there is no user custom configuration, or if no user-modifiable parameters have been modified from the compiled-in defaults. Note that modification of one or more parameters without the subsequent ATWR to commit the changes to flash will not deactivate this warning, since it reflects the status of the parameters in flash. Note as well that this warning does not reflect usage of the custom configuration defaults, only usage of the compiled-in defaults.
8	Default factory configuration parameters in flash. This is caused if the factory parameters (i.e. those stored by a 'WP' command) in flash are all the default values. This is caused if the factory configuration is found to be not present or invalid at power-up, or if no factory parameters have been modified. Note that modification of one or more parameters without the subsequent ATWP to commit the changes to flash will not deactivate this warning, since it reflects the status of the parameters in flash.

WR (Write) Command

<(Special)> WR Command writes configurable parameters to the module's non-volatile memory (Parameter values remain in the module's memory until overwritten by future use of WR Command).

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

AT Command: ATWR

Binary Command: 0x08

WS (Sticky Warning Numbers) Command

<Diagnostics> WS Command reports the warning numbers of all warnings which have been active since the last use of WS or WN command, including any warnings which are currently active. No further information is shown.

This command also resets all non-zero warning counts, except for warnings that are presently active, which are set to 1.

AT Command: ATWS

Parameter Range (read-only): 1 – 8

Number of bytes returned: 1
