Received Signal Strength Indication

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Application Note

Abstract

This document discusses the measurement of received RF signals and how these measurements are read and reported using MaxStream radio modems and software.

Testing Link Quality

MaxStream recommends determining communication link quality before installing a data radio system in order to save time and set performance expectations. There are several ways to characterize the reliability of the communication link. For characterizing link quality outside of a host system, MaxStream provides the X-CTU software that will enable a loopback test and indicate performance. For measuring link quality inside a host system, MaxStream provides a signal strength value.

Receive Signal Strength Indication

MaxStream radio modems contain receivers that are capable of receiving and amplifying very weak signals from a distant transmitter. The weakest signal a receiver can successfully pick up and demodulate at an acceptable bit-error rate is called *receiver sensitivity*.

If a distant transmitter is moved closer to a receiver, the strength of the transmitted signal at the receiving antenna will increase. Measuring the strength of the signal at the receiving antenna is one method of determining the quality of the communication link. (For a discussion on link quality and Link Margin, see pg. 2 of "Indoor Wireless" application note).

## RSSI on MaxStream Radio Modems

The XStream™ Product Family

The 9Xstream and the 24XStream both use the same method to report signal strength. The "RS" AT command stores the received signal strength for the last good RF packet that was received (For more detail on RS and other AT commands, consult the XStream Advanced Programming and Configuration manual). The value of RS will typically range from 6 – 54 (0x06 – 0x36 hex). If the unit has just been powered-on or if the radio has not received any valid packets, RS command will report a value of zero. A value of 0x36 will usually be read if a packet is received with both radios in close proximity on a test bench. A reading of 0x36 roughly corresponds to a signal level of –35 dB. On the 9XStream X09-009 OEM RF Module, the receiver sensitivity is –110 dBm. A 0x06 reading corresponds to the 9XStream's sensitivity level. The 48 possible values that the RS register can report represent the approximate range from –35 dBm to –110 dBm with each value representing a little less than 2 dB.

RSSI reading is a measure of signal strength. Because the received signal strength can vary due to multipath, interference or other environmental effects, it may not give a true indication of communication performance or range. Table 1 displays values returned by RS command and the corresponding dBm level.

Table 1.   XStream RSSI Values

Signal(dBm)	X09-009	X09-019	X24-009	X24-019
-35	50	51	51	52
-40	49	50	50	51
-45	48	49	49	50
-50	47	48	48	49
-55	46	46	47	48
-60	45	45	46	46
-65	44	44	45	45
-70	42	42	44	44
-75	41	41	42	42
-80	39	39	40	40
-85	37	37	37	37
-90	34	34	34	34
-95	30	30	30	29
-100	24	25	23	22
-105	17	18	14	14
-108	11	12	12	12

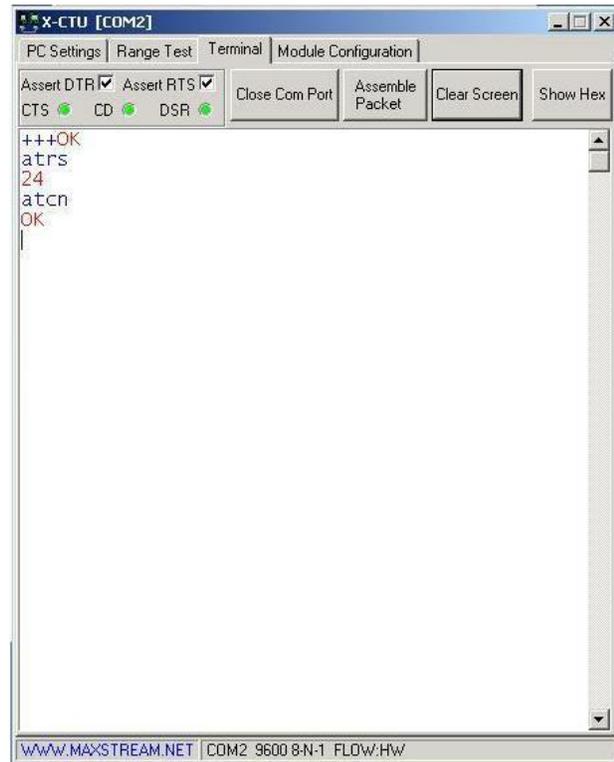**Figure 1.   RSSI Plot**
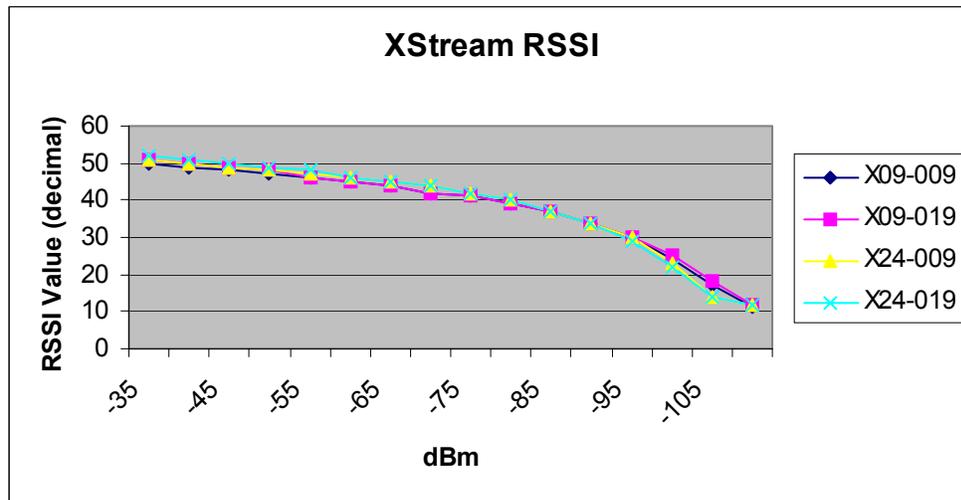
Example: RSSI Using AT Commands

Using a terminal you can query the RSSI using AT command mode by sending:

+++   // Enter command mode

ATRS<CR>   // Query the RS register

ATCN<CR>   // Exit command mode

Figure 2.   Terminal Window

In Figure 2, the '24' returned by the radio is a hex value representing the signal strength of the last packet received by the radio. The 'atcn' command was sent afterwards to exit AT command mode. (The radio modem would automatically exit from AT Command Mode after a time period determined by the CT (Time before Exit AT Command Mode) parameter.

RSSI Using Binary Commands

Before issuing any binary commands, the RT parameter must be set to 1 on the radio for the radio to recognize the RTS/CMD pin.

To query RSSI:

Assert the RTS/CMD pin	// Enter into command mode
Send a 0x9C	// A 0x9C (hex) queries the RS register
De-assert the RTS/CMD pin	//exit command mode

The response will be sent out the DOUT (Data Out) pin. For more details on using binary commands, consult the binary commands application note.

The XCite^{TM} Product Family

The XCite family does not have an RS Command, but rather uses DB Command to report signal strength. DB command reports the negative signal strength in decibels of the last good received RF packet. With the DB value, a lower number indicates a stronger signal and a higher number indicates a weaker signal. For the 9600 baud radios, typical values will range from 0x25 (strong signal) to 0x6A (weak signal).

Example: RSSI Using AT Commands

Using a terminal you can query RSSI in decibels using AT command mode by sending:
+++   // Enter AT Command Mode
ATDB<CR>   // Query the DB register

The XCite family does not support binary commands. The AT & BT parameters can be set to low values to facilitate quick RSSI readings.

Conclusion

While RSSI can be used as a tool to give an indication of link quality, it does not always give definitive results. In addition to normal variation in received signal levels, the signal level can also be affected by in-band interference sources. When this occurs, a strong signal level can be reported, but data can be corrupted. Communication systems should be designed with some link margin (see pg. 2 of "Indoor Wireless" application note) to ensure reliable communications in changing conditions.

In environments where it is desired to test signal quality, a loopback test should be performed to give the best indication of link quality by measuring actual data transfer success. The percentage of good packets received during a loopback test is the surest way to get an idea of the quality of communication in a data radio system.

Contact Information

Please use the following resources for additional support:

Documentation   http://www.maxstream.net/support/

Technical Support   Live Chat: www.MaxStream.net

                        Phone: (801) 765-9885

                        E-Mail: support@MaxStream.net

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