SiFLEX02
Transceiver Module

Host Protocol Guide

Powered By

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1 Introduction

1.1 Purpose & Scope

The purpose of this document is to describe in detail the message protocol used to communicate between a Host Device and the RF Module microprocessor.

1.2 Audience

This document is intended to be read by engineers and technical management. A general knowledge of common engineering practices is assumed.

1.3 Applicable Documents

The reader should be familiar with the following documentation:

- *SiFLEX02 Datasheet*
- *SiFLEX02 Module User's Guide*

1.4 Revision History

Date	Change Description	Revision
8-3-09	Initial release.	1.0
11-3-09	Security and promiscuous mode are now supported. Updated power level and current table (Table 4). The following messages were changed – 0x0A, 0x0E, 0x10, 0x20, 0x22, 0x24, 0x26, 0x44, 0x8B, 0x91, 0xA1, 0xA3, 0xA5, 0xA7. The following messages were added - 0x0C, 0xD, 0x8C, 0x8D. The following message was removed - 0x0F.	1.1
6-15-10	Repeating and source routing are now supported. Added ability to disable Clear Channel Assessment (CCA) The following messages were changed – 0x20, 0x22, 0x24, 0x26. The following message are now supported – 0x28, 0x29, 0x2A, 0x2C, 0xA8, 0xA9, 0xAA, 0xAB, 0xAC, 0xAD. The following messages were added - 0x47, 0x48, 0xC7, 0xC8, 0xC9.	2.0
3-5-12	Added support for CTS host interface handshake signal, and min packet spacing. Added support for beacon messages. The following messages were added – 0x50 to 0x55 and 0xD0 to 0xD6.	3.0
5-24-16	Repeater Slot/Max Repeats 0XAB changed Updated to Laird format	3.1

Table 1 Revision History

2 Host Protocol

This document describes in detail the message protocol used to communicate between a Host Device and a SiFLEX02 RF Module microprocessor.

2.1 Default Serial Communications Settings

The serial communications interface to the module is via a simple UART. Transmit (TX) and receive (RX) are the only two signals required to communicate with the module, and the default communication settings are 19,200 baud, 8 data bits, no parity, and one stop bit (19,200 – 8N1).

2.2 Host Serial Protocol Overview

	Header			Payload	Trailer	
Field	Start Byte	Length	Type	Data	Checksum	End Byte
# Bytes	1	1	1	n	1	1

Figure 1 Host Protocol Message Format

Field Name	Field Description
Start Byte	The start byte is the first byte in a packet (0x01).
Length	The total length of the entire packet in bytes (5 + n).
Type	The packet type byte indentifies the intent of the packet.
Data	n bytes of data which pertains to the type of the packet. The data is variable depending on the type of packet. For some packets there is no data.
Checksum	The checksum is the least significant byte of the result of summing bytes from the Start Byte through the Payload.
End Byte	The end byte is the last byte in a packet (0x04).

Table 2 Host Serial Protocol Field Descriptions

2.3 Handshaking

The module supports handshaking with the host device for flow control. The Clear-to-Send (CTS) signal is an output from the module which is used to tell the host device that the module can accept serial packets. By default the handshaking signal is not used, however it can independently be enabled in the "Set Host Interface Configuration" message (type 0x50). The CTS signal is active low, meaning that when it is low (logic 0) the module is ready to accept data.

2.4 Wake Up From Low Power Mode

To wake the SiFLEX02 module out of low power mode, drive the UART receive pin (module pin #36) low for a minimum of 20uS. Alternatively a dummy byte of 0x00 can be sent, assuming the baud rate is 460,800 or below.

2.5 Packet Spacing

Care should be given with respect to how fast back-to-back packets are sent to the module. Depending on the serial host baud rate, and how much processing the module is doing, packets sent too close back-to-back could result in the second packet being dropped. In general 1msec of spacing should be more than adequate and could be much lower. The developer should characterize this time based on the specifics of their application.

The module will send out packets to the host device as fast as possible, which depending on the host application might be too fast resulting in the host losing packets. If this is a problem a minimum outgoing packet spacing can be configured with the "Set Host Interface Configuration" message (type 0x50).

2.6 Example Host Protocol Message Exchange

Below is an example that shows what a complete host serial packet would look like for a "Query PAN ID" and a "Respond with PAN ID" message exchange. This example assumes the PAN ID is being queried from the local "hardwired" module.

Host -> Module – (Query PAN ID – Type 0x03)
< 0x01 0x05 0x03 0x09 0x04 >

Module -> Host – (Respond with PAN ID – Type 0x83)
< 0x01 0x07 0x83 0x64 0x00 0xEF 0x04>

3 Host Protocol Message Definitions

The information contained in this section is abbreviated and omits the header and trailer information which is common to all serial host messages.

3.1 Host Protocol Field Descriptions

3.1.1 Host to Module

This field shows the message type for messages that get sent from the host device to the module, and are within the range of 0x01 through 0x7F.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 2 Host to Module

3.1.2 Module to Host

This field shows the message type for messages that get sent from the module to the host device, and are within the range of 0x81 through 0xFF.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 3 Module to Host

3.1.3 Manual Save

This column will contain an “x” if the settings contained in the message can be manually saved to non-volatile memory (NVM). To manually save the settings to NVM issue a “Save Settings To Non-Volatile Memory” command (Msg Type 0x12). All settings contained within messages that have an “x” in the Manual Save column are saved when the “Save Settings To NVM” command is issued. Therefore it is best to change all settings and then issue the “Save Settings to NVM” command only once.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 4 Manual Save

3.1.4 Message Length

This column contains the length of the entire message, which consists of the header (3 bytes), payload, and trailer (2 bytes). The minimum sized message is 5 bytes and occurs in messages that contain no payload.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 5 Message Length

3.1.5 Payload Field Length

This column lists the length in bytes of each payload field.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 6 Payload Field Length

3.1.6 Payload Field Name

This column contains a list of the fields that are contained within each message.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 7 Payload Field Name

3.1.7 Description

This column details what the message does or what is contained in the payload field.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

Figure 8 Description

3.2 Host Protocol Message Definitions

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.1 Query Firmware Version						
0x01	-		5	-		
-	0x81		12+n	1	Module Identifier	Identifies this module as a SiFLEX02 module (0x01).
				1	Version Major	Version major number.
				1	Version Minor	Version minor number.
				1	Version Month	Version month (1 - 12).
				1	Version Day	Version day (1 - 31).
				1	Version Year	Version year (0 - 99).
				1	Version String Length	Length of version string (0 - 32 bytes).
				n	Version String	Version string (0 - 32 bytes in length).
3.2.2 Set PAN ID						
0x02	-	X	7	2	PAN ID	Two byte PAN ID (LSB to MSB) of the network this transceiver should operate on.
-	0x82		5	-		
3.2.3 Query PAN ID						
0x03	-		5	-		
-	0x83		7	2	PAN ID	Two byte PAN ID (LSB to MSB) of the network this transceiver should operate on.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.4 Set Transceiver Address						
0x04	-	X	15	2	Short Transceiver Address	Two byte transceiver short address (LSB to MSB). When the short address is set to 0xFFFF the long address is used instead of the short address.
				8	Long Transceiver Address	Eight byte transceiver long address (LSB to MSB). Do not set the transceiver long address to a value of 0x0000000000000000. To use the long address, set the short address to 0xFFFF.
-	0x84		5	-		
3.2.5 Query Transceiver Address						
0x05	-		5	-		
-	0x85		15	2	Short Transceiver Address	Two byte transceiver short address (LSB to MSB). When the short address is set to 0xFFFF the long address is used instead of the short address.
				8	Long Transceiver Address	Eight byte transceiver long address (LSB to MSB). To use the long address, set the short address to 0xFFFF.
3.2.6 Set RF Channel						
0x06	-	X	6	1	RF Channel	The RF channel that the transceiver operates on (1-10). 1 = 906 MHz 2 = 908 MHz 3 = 910 MHz 4 = 912 MHz 5 = 914 MHz 6 = 916 MHz 7 = 918 MHz 8 = 920 MHz 9 = 922 MHz 10 = 924 MHz
-	0x86		5	-		
3.2.7 Query RF Channel						
0x07	-		5	-		
-	0x87		6	1	RF Channel	The RF channel that the transceiver operates on (1-10).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.8 Set Transmit Power Level						
0x08	-	X	6	1	RF Power Level	RF power level (0-21).
-	0x88		5	-		
3.2.9 Query Transmit Power Level						
0x09	-		5	-		
-	0x89		6	1	RF Power Level	RF power level (0-21).
3.2.10 Set Receiver Configuration						
0x0A	-	X	7	1	Receive Filters	Bitmask of the receive filtering. Bit 0: Allow Broadcast Address (0 = disable, 1 = enable) Bit 1: Allow Broadcast PAN ID (0 = disable, 1 = enable) Bit 2: Promiscuous Mode (0 = disable, 1 = enable) Bit 3: Allow Secured Packets (0 = disable, 1 = enable)
				1	Reserved	Reserved for future use. Set to 0.
-	0x8A		5	-		
3.2.11 Query Receiver Configuration						
0x0B	-		5	-		
-	0x8B		7	1	Receive Filters	Bitmask of the receive filtering. Bit 0: Allow Broadcast Address (0 = disable, 1 = enable) Bit 1: Allow Broadcast PAN ID (0 = disable, 1 = enable) Bit 2: Promiscuous Mode (0 = disable, 1 = enable) Bit 3: Allow Secured Packets (0 = disable, 1 = enable)
				1	Reserved	Reserved for future use. Set to 0.
3.2.12 Set Security Transmit Frame Counter						
0x0C	-		11	4	Transmit Frame Counter	Four byte transmit frame counter (LSB to MSB). This frame counter is used with RF messages transmitted with security to insure sequential freshness. This sets the starting frame count and is automatically incremented on every secured packet sent.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
				2	Reserved	Reserved for future use. Set to 0.
-	0x8C		5	-		
3.2.13 Query Security Transmit Frame Counter						
0x0D	-		5	-		
-	0x8D		11	4	Transmit Frame Counter	Four byte transmit frame counter (LSB to MSB). This frame counter is used with RF messages transmitted with security to insure sequential freshness. This returned value is the next frame count that will be transmitted with a secured message.
				2	Reserved	Reserved for future use. Set to 0.
3.2.14 Set Security Key						
0x0E	-	X	22	1	Reserved	Reserved for future use. Set to 0.
				16	Security Key	Sixteen byte encryption key (LSB to MSB).
-	0x8E		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.15 Set Basic RF Settings						
0x10	-	X	39	2	PAN ID	Two byte PAN ID (LSB to MSB) of the network this transceiver should operate on.
				2	Short Transceiver Address	Two byte transceiver short address (LSB to MSB). When the short address is set to 0xFFFF the long address is used instead of the short address.
				8	Long Transceiver Address	Eight byte transceiver long address (LSB to MSB). Do not set the transceiver long address to a value of 0x0000000000000000. To use the long address, set the short address to 0xFFFF.
				1	RF Channel	The RF channel that the transceiver operates on (1-10). 1 = 906 MHz 2 = 908 MHz 3 = 910 MHz 4 = 912 MHz 5 = 914 MHz 6 = 916 MHz 7 = 918 MHz 8 = 920 MHz 9 = 922 MHz 10 = 924 MHz
				1	RF Power Level	RF power level (0-21).
				1	Receive Filters	Bitmask of the receive filtering. Bit 0: Allow Broadcast Address (0 = disable, 1 = enable) Bit 1: Allow Broadcast PAN ID (0 = disable, 1 = enable) Bit 2: Promiscuous Mode (0 = disable, 1 = enable) Bit 3: Allow Secured Packets (0 = disable, 1 = enable)
				3	Reserved	Reserved for future use. Set to 0.
				16	Security Key	Sixteen byte encryption key (LSB to MSB).
-	0x90		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.16 Query Basic RF Settings						
0x11	-		5	-		
-	0x91		39	2	PAN ID	Two byte PAN ID (LSB to MSB) of the network this transceiver should operate on.
				2	Short Transceiver Address	Two byte transceiver short address (LSB to MSB). When the short address is set to 0xFFFF the long address is used instead of the short address.
				8	Long Transceiver Address	Eight byte transceiver long address (LSB to MSB). To use the long address, set the short address to 0xFFFF.
				1	RF Channel	The RF channel that the transceiver operates on (1-10).
				1	RF Power Level	RF power level (0-21).
				1	Receive Filters	Bitmask of the receive filtering. Bit 0: Allow Broadcast Address (0 = disable, 1 = enable) Bit 1: Allow Broadcast PAN ID (0 = disable, 1 = enable) Bit 2: Promiscuous Mode (0 = disable, 1 = enable) Bit 3: Allow Secured Packets (0 = disable, 1 = enable)
				3	Reserved	Reserved for future use. Set to 0.
				16	Reserved	For security purposes, security parameters cannot be read back.
3.2.17 Save Settings To Non-Volatile Memory (NVM)						
0x12	-		5	-		
-	0x92		5	-		
3.2.18 Reset Request						
0x13	-		5	-		
-	0x93		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.19 Query Supply Voltage						
0x14	-		5	-		
-	0x94		9	2	Supply ADC Reading	The supply voltage ADC reading (LSB to MSB). The supply voltage can be determined by the following formula: Supply Voltage = ((Supply ADC Reading x Voltage Reference) /409,400). Ex: Voltage Reference = 1.011v (1011), ADC Reading = 926, Supply Voltage => 3.27.
				2	Voltage Reference	The Voltage Reference in millivolts (LSB to MSB). For example a reference voltage of 1.011V will be passed as 1011.
3.2.20 Query Statistics						
0x15	-		5	-		
-	0x95		21	4	Packets Sent	Four byte value for RF packets sent (LSB to MSB).
				4	Acks Received	Four byte value for RF acknowledgements received (LSB to MSB).
				4	Packets Received	Four byte value for RF packets received (LSB to MSB).
				4	Broadcast Packets Received	Four byte value for RF broadcast packets received (LSB to MSB).
3.2.21 Clear Statistics						
0x16	-		5	-		
-	0x96		5	-		
3.2.22 Set Low Power Mode To wake the SiFLEX02 module out of low power mode, drive the UART receive pin (module pin #36) low for a minimum of 20uS. Alternatively a dummy byte of 0x00 can be sent, assuming the baud rate is 460,800 or below.						
0x17	-		6	1	Reserved	Reserved for future use. Set to 0.
-	0x97		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.23 Set Host Data Rate						
0x18	-		6	1	Baud Rate	Serial baud rate setting. 0 = 1,200, 1 = 2,400, 2 = 4,800, 3 = 9,600, 4 = 19,200, 5 = 38,400, 6 = 57,600, 7 = 115,200, 8 = 230,400, 9 = 460,800, 10 = 921,600. Note: When this command is sent to the module, not only is the baud rate changed, but all the settings are saved to NVM.
-	0x98		5	-		
3.2.24 Set RF Data Rate						
0x19	-	X	6	1	Data Rate	RF data rate setting. 0 = BPSK 40kbps 1 = OQPSK-SIN 250kbps 2 = OQPSK-SIN 1Mbps Scrambler On
-	0x99		5	-		
3.2.25 Query RF Data Rate						
0x1A	-		5	-		
-	0x9A		6	1	Data Rate	RF data rate setting. 0 = BPSK 40kbps 1 = OQPSK-SIN 250kbps 2 = OQPSK-SIN 1Mbps Scrambler On
3.2.26 Set Wakeup/Reset Settings						
0x1C	-	X	7	1	Wakeup Setting	Setting that determines behavior on a wakeup from sleep. When set to 0x00 the host is not alerted. When set to 0x01 a wakeup results in a "Wakeup/Reset Alert Status" message being sent to the host (see message type 0x9E).
				1	Reset Setting	Setting that determines behavior on a reset. When set to 0x00 the host is not alerted. When set to 0x01 a reset results in a "Wakeup/Reset Alert Status" message being sent to the host (see message type 0x9E).
-	0x9C		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.27 Query Wakeup/Reset Settings						
0x1D	-		5	-		
-	0x9D		7	1	Wakeup Setting	Setting that determines behavior on a wakeup from sleep. When set to 0x00 the host is not alerted. When set to 0x01 a wakeup results in a "Wakeup/Reset Alert Status" message being sent to the host (see message type 0x9E).
				1	Reset Setting	Setting that determines behavior on a reset. When set to 0x00 the host is not alerted. When set to 0x01 a reset results in a "Wakeup/Reset Alert Status" message being sent to the host (see message type 0x9E).
3.2.28 Wakeup/Reset Alert Status						
NA	-		-	-		
-	0x9E		6	1	Wakeup/ Reset Alert Status	The wakeup/reset alert status byte describes whether the module was awoken from sleep (0x00) or reset (0x01).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.29 Set Static RF Test Mode						
0x1F	-		11	1	Test Mode	Test Mode: 0 = Idle (transmit and receive not active) 1 = Receive 2 = Transmit Unmodulated 0 3 = Transmit Unmodulated 1 4 = Transmit Modulated 5 = Pseudo Random Binary Sequence (todo: validate if this is supported)
				1	RF Channel	The RF channel that the transceiver operates on while in test mode (1-10).
				1	RF Power Level	RF power level used for the transmit modes (0-21).
				1	Reserved	Reserved for future use. Set to 0.
				1	RF Phy Mode	RF physical layer mode which establishes the modulation format and RF data rate. 0 = BPSK 40kbps 1 = OQPSK-SIN 250kbps 2 = OQPSK-SIN 500kbps 3 = OQPSK-SIN 1Mbps Scrambler On 4 = OQPSK-SIN 1Mbps Scrambler Off 5 = OQPSK-RC 250kbps 6 = OQPSK-RC 500kbps 7 = OQPSK-RC 1Mbps Scrambler On 8 = OQPSK-RC 1Mbps Scrambler Off
				1	Matching Control	Capacitor Match Value (0-15): 0 = 0fF 1 = 36fF 2 = 72fF … 15 = 540fF
-	0x9F		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.30 Send Simple Short Addressing RF Data Packet This message is used to send a RF packet to a destination transceiver using short addressing. It is assumed that the destination transceiver's PAN ID is the same as the PAN ID of the source transceiver.						
0x20	-		9+n	1	Options	Bitmask of the transmit options. Bit 0: Retries/Acks (0 = disable, 1 = enable) Note: If CCA is disabled, Retries/Acks are not used. Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Disable CCA (0 = enable, 1 = disable)
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to. Setting this address to 0xFFFF results in the message being broadcast to all transceivers.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 112 if security is not used, and 1 and 98 if security is used.
-	0xA0		7	1	Packet ID	Packet ID.
				1	Ack/Nack	Acknowledgement or Non-Acknowledgement of the successful transmission of the RF packet (0x00 = Nack, 0x01 = Ack).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.31 Received Simple Short Addressing RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using short addressing. It is assumed that the source transceiver's PAN ID is the same as the PAN ID of the destination transceiver.						
NA	-		-	-		
-	0xA1		17+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to. This address should either be the source address of the transceiver that received it, or the broadcast address (0xFFFF).
				2	Source Transceiver Address	Two byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.32 Send Advanced Short Addressing RF Data Packet This message is used to send a RF packet to a destination transceiver using short addressing. In addition to the destination transceiver's ID, it is required to designate the destination PAN ID. This allows for sending packets between PANs (intra PAN).						
0x22	-		11+n	1	Options	Bitmask of the transmit options. Bit 0: Retries/Acks (0 = disable, 1 = enable) Note: If CCA is disabled, Retries/Acks are not used. Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Disable CCA (0 = enable, 1 = disable)
				2	Destination PAN ID	Two byte destination PAN ID (LSB to MSB). This is the PAN ID of the transceiver the message is being sent to. Setting this address to 0xFFFF results in the message being broadcast to all PAN IDs.
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to. Setting this address to 0xFFFF results in the message being broadcast to all transceivers.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 110 if security is not used, and 1 and 96 if security is used.
-	0xA2		7	1	Packet ID	Packet ID.
				1	Ack/Nack	Acknowledgement or Non-Acknowledgement of the successful transmission of the RF packet (0x00 = Nack, 0x01 = Ack).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.33 Received Advanced Short Addressing RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using short addressing. In addition to the transceiver IDs, this message includes both the source and destination PAN IDs. This allows for receiving packets between PANs (intra PAN).						
NA	-		-	-		
-	0xA3		21+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				2	Destination PAN ID	Two byte destination PAN ID (LSB to MSB). This is the PAN ID of the transceiver the message is being sent to. This address should either be the source PAN ID of the transceiver that received it or the broadcast PAN ID (0xFFFF).
				2	Source PAN ID	Two byte PAN ID (LSB to MSB) of the source transceiver. This is the PAN ID of the device that originated the message.
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is th address of the transceiver the message is being sent to. This address should either be the source address of the transceiver that received it, or the broadcast address (0xFFFF).
				2	Source Transceiver Address	Two byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.34 Send Simple Long Addressing RF Data Packet This message is used to send a RF packet to a destination transceiver using long addressing. It is assumed that the destination transceiver's PAN ID is the same as the PAN ID of the source transceiver.						
0x24	-		15+n	1	Options	Bitmask of the transmit options. Bit 0: Retries/Acks (0 = disable, 1 = enable) Note: If CCA is disabled, Retries/Acks are not used. Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Disable CCA (0 = enable, 1 = disable)
				8	Destination Transceiver Address	Eight byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 100 if security is not used, and 1 and 86 if security is used.
-	0xA4		7	1	Packet ID	Packet ID.
				1	Ack/Nack	Acknowledgement or Non-Acknowledgement of the successful transmission of the RF packet (0x00 = Nack, 0x01 = Ack).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.35 Received Simple Long Addressing RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using long addressing. It is assumed that the source transceiver's PAN ID is the same as the PAN ID of the destination transceiver.						
NA	-		-	-		
-	0xA5		29+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				8	Destination Transceiver Address	Eight byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to.
				8	Source Transceiver Address	Eight byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.36 Send Advanced Long Addressing RF Data Packet This message is used to send a RF packet to a destination transceiver using long addressing. In addition to the destination transceiver's ID, it is required to designate the destination PAN ID. This allows for sending packets between PANs (intra PAN).						
0x26	-		17+n	1	Options	Bitmask of the transmit options. Bit 0: Retries/Acks (0 = disable, 1 = enable) Note: If CCA is disabled, Retries/Acks are not used. Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Disable CCA (0 = enable, 1 = disable)
				2	Destination PAN ID	Two byte destination PAN ID (LSB to MSB). This is the PAN ID of the transceiver the message is being sent to. Setting this address to 0xFFFF results in the message being broadcast to all PAN IDs.
				8	Destination Transceiver Address	Eight byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 98 if security is not used, and 1 and 84 if security is used.
-	0xA6		7	1	Packet ID	Packet ID.
				1	Ack/Nack	Acknowledgement or Non-Acknowledgement of the successful transmission of the RF packet (0x00 = Nack, 0x01 = Ack).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.37 Received Advanced Long Addressing RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using long addressing. In addition to the transceiver IDs, this message includes both the source and destination PAN IDs. This allows for receiving packets between PANs (intra PAN).						
NA	-		-	-		
-	0xA7		33+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				2	Destination PAN ID	Two byte destination PAN ID (LSB to MSB). This is the PAN ID of the transceiver the message is being sent to. This address should either be the source PAN ID of the transceiver that received it or the broadcast PAN ID (0xFFFF).
				2	Source PAN ID	Two byte PAN ID (LSB to MSB) of the source transceiver. This is the PAN ID of the device that originated the message.
				8	Destination Transceiver Address	Eight byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to.
				8	Source Transceiver Address	Eight byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.38 Set FLEXConnect Configuration						
0x28	-	X	9	1	Max Repeaters	Maximum number of repeaters in the system (1-15).
				1	Max Repeats	Maximum number of repeats allowed (1-7). Note that maximum hop count is Max Repeats + 1.
				1	Device Type	Sets the device type as either a node (0x00), which does not repeat, or a repeater (0x01), which does repeat.
				1	Timeslot	The timeslot assigned to the repeater (1 - Max Repeaters).
-	0xA8		5	-		
3.2.39 Query FLEXConnect Configuration						
0x29	-		5	-		
-	0xA9		9	1	Max Repeaters	Maximum number of repeaters in the system (1-15).
				1	Max Repeats	Maximum number of repeats allowed (1-7). Note that maximum hop count is Max Repeats + 1.
				1	Device Type	Sets the device type as either a node (0x00), which does not repeat, or a repeater (0x01), which does repeat.
				1	Timeslot	The timeslot assigned to the repeater (1 - Max Repeaters).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.40 Send Simple Repeated RF Data Packet This message is used to send a RF packet to a destination transceiver using the repeating mechanism and short addressing. It is assumed that the destination transceiver's PAN ID is the same as the PAN ID of the source transceiver.						
0x2A	-		9+n	1	Options	Bitmask of the transmit options. Bit 0: Not used (always 0) Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Not used (always 0)
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to. Setting this address to 0xFFFF results in the message being broadcast to all transceivers.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 102, depending on the Max Repeats setting (see message 0x28) and security setting in the Options field. Security Disabled The maximum number of data bytes is calculated as follows: (108 – (3 x (Max Repeats + 1))). Security Enabled The maximum number of data bytes is calculated as follows: (94 – (3 x (Max Repeats + 1)))
-	0xAA		6	1	Packet ID	Packet ID.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.41 Received Simple Repeated RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using the repeating mechanism and short addressing. It is assumed that the source transceiver's PAN ID is the same as the PAN ID of the destination transceiver. In addition to the packet data, this message contains the source route through which the packet used to find its way to the destination.						
NA	-		-	-		
-	0xAB		19+n to 40+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				1	Packet ID	Packet ID.
				1	Number Repeaters/ Repeat Count	Upper nibble contains the number of repeaters in the system (1-15), and the lower nibble contains the repeat count (0-7).
				1	Repeater Slot/ Max Repeats	Upper 5 bits contains the repeater slot the message was sent in (0-15) where the 0 slot represents the original message. A repeat cycle consists of the total number of repeaters slots. The lower 3 bits indicate the maximum number of times a message could be repeated (1-7).
				2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to. This address should either be the source address of the transceiver that received it, or the broadcast address (0xFFFF).
				2-16	Source Route Address List	List containing two byte source transceiver addresses (LSB to MSB) for the route back to the source from which the message originated. The length of this field is calculated as follows ((Repeat Count x 2) + 2).
				0-7	Source Route LQI List	List containing one byte Link Quality Indication (LQI) for the route back to the source from which the message originated. The length of this field is equal to the Repeat Count .
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.42 Send Source Routed RF Data Packet This message is used to send a RF packet to a destination transceiver using the source routing mechanism and short addressing. It is assumed that the destination transceiver's PAN ID is the same as the PAN ID of the source transceiver. All source routed messages are sent with RF acks/retries enabled.						
0x2C	-		11+n to 25+n	1	Options	Bitmask of the transmit options. Bit 0: Retries/Acks (0 = disable, 1 = enable) Note: If CCA is disabled, Retries/Acks are not used. Bit 1: Use Security (0 = disable, 1 = enable) Bit 2: Disable CCA (0 = enable, 1 = disable)
				1	Packet ID	Packet ID.
				1	Reserved	Reserved for future use. Set to 0.
				1	Source Route Hops	Contains the number of hops this packet will have taken to reach the destination address (1-8).
				2-16	Source Route Address List	List containing two byte source route transceiver addresses (LSB to MSB) for the route to the destination address. The last address in the list is the destination address. The length of this field is calculated as follows (Source Route Hops x 2).
				n	n Data Bytes	Data to be sent over the RF link (n bytes). The valid range of data bytes is between 1 and 106, depending on the Source Route Hops field and security setting in the Options field. <u>Security Disabled</u> The maximum number of data bytes is calculated as follows: (109 – (3 x Source Route Hops)). <u>Security Enabled</u> The maximum number of data bytes is calculated as follows: (95 – (3 x Source Route Hops)).
-	0xAC		6	1	Packet ID	Packet ID.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.43 Received Source Routed RF Data Packet This message gets sent to the host when a RF packet is received from a transceiver using the source routing mechanism and short addressing. It is assumed that the source transceiver's PAN ID is the same as the PAN ID of the destination transceiver.						
NA	-		-	-		
-	0xAD		18+n to 39+n	1	Security Status	This byte indicates whether or not the received packet was secured (0 = not secured, 1 = secured). If the received packet was secured, the frame counter is valid, else the frame counter is all zeros.
				4	Frame Counter	Four byte frame counter (LSB to MSB) of the received packet, if the packet was secured. For non-secured packets the frame counter is all zeros.
				1	Reserved	Reserved for future use. Set to 0.
				1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				1	Packet ID	Packet ID.
				1	Number of Hops	Contains the number of hops this packet will have taken to reach the destination address (1-8).
				4-18	Source Route Address List	List containing two byte source transceiver addresses (LSB to MSB) for the route back to the source from which the message originated. The first address in the list is the source address, and the last address in the list is the destination address. The length of this field is calculated as follows (2 + (2 x Number of Hops)).
				0-7	Source Route LQI List	List containing one byte Link Quality Indication (LQI) for the route back to the source from which the message originated. The length of this field is calculated as follows (Number of Hops – 1).
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.44 Received Promiscuous Mode RF Data Packet This message gets sent to the host when a RF packet is received when the module is in promiscuous mode.						
N/A	-		-	-		
-	0xAE		13+n to 33+n	1	LQI	Link Quality Indicator which gives feedback to the strength of the received packet.
				4	Time Stamp	Four byte time stamp (LSB to MSB) in units of microseconds.
				2	Frame Control	Two byte Frame Control (LSB to MSB).
				1	Sequence Number	Sequence number.
				0 or 2	Destination PAN ID	Two byte destination PAN ID (LSB to MSB). This is the PAN ID of the transceiver the message is being sent to. Note that depending on the frame type this field may be omitted.
				0, 2, or 8	Destination Transceiver Address	Two or eight byte destination transceiver address (LSB to MSB). This is the address of the device that the message is being sent to. Note that depending on the frame type this field may be omitted.
				0 or 2	Source PAN ID	Two byte source PAN ID (LSB to MSB). This is the PAN ID of the transceiver which originated the message. Note that depending on the frame type this field may be omitted.
				0, 2, or 8	Source Transceiver Address	Two or eight byte source transceiver address (LSB to MSB). This is the address of the device that originated the message. Note that depending on the frame type this field may be omitted.
				n	n Frame Payload Bytes	Payload of the frame (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.45 Set Packet Error Rate Test Transmit Configuration						
0x40	-		12+n	2	Destination Transceiver Address	Two byte destination transceiver address (LSB to MSB). This is the address of the transceiver the message is being sent to.
				2	Packets to Transmit	This is the number of packets to be transmitted (LSB to MSB). Valid range is 5-65,535.
				1	Time Between Packets	Time from transmit complete to start of next transmit in 5msec ticks. A time of 100msec would result in this value being set to 20 (100msec / 5msec = 20). Valid range is 1-65,535.
				1	Send Ongoing Results	This field determines if the receive test results will be transmitted to the host every one second. 0 = Results not automatically sent. 1 = Results sent every one second.
				1	RF Retries	This field determines if MAC level RF retires are on. 0 = Do not use retries 1 = Use RF retries
				n	n Data Bytes	Data to send (1-105 bytes)
-	0xC0		5	-		
3.2.46 Set Packet Error Rate Test Receive Configuration						
0x41	-		11	2	Source Transceiver Address	Two byte source transceiver address (LSB to MSB). This is the address of the transceiver that is sending the message.
				2	Expected Packets to Receive	This is the number of packets expected to be received (LSB to MSB). Valid range is 5-65,535.
				1	Number of RF Bytes	Number of RF Bytes expected to be received (1-105). This should match length n in Message Type 0x40.
				1	Send Ongoing Results	This field determines if the receive test results will be transmitted to the host every one second. 0 = Results not automatically sent. 1 = Results sent every one second.
-	0xC1		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.47 Packet Error Rate Packet Results When in either transmit or receive PERT mode, and the "Send Ongoing Results" field is set to send results every second, this message will be sent every second to the host device.						
N/A	-		-	-		
-	0xC2		16	1	Test Mode	0 = Transmit mode. 1 = Receive mode.
				2	Packets Transmitted/ Received	This is the number of packets (LSB to MSB) that have either been transmitted or received, based on the Test Mode above.
				2	Packets to Transmit/ Expected Packets to Receive	This is the total number of packets (LSB to MSB) that are to be transmitted, or are expected to be received, based on the Test Mode above. Valid range is 5-65,535.
				2	Last Received Packet Number	When in receive mode this field indicates the number of the last packet received. The valid range is 0-65535, and a value of 0 means that a packet has not yet been received. The purpose of this field is to indicate how far into the test we are, when in receive mode. This field should be ignored in transmit mode and will always return a zero.
				4	LQI Tally	A running total of LQI results, sent LSB to MSB, when in receive mode. Average LQI = LQI Tally / Number of Received Packets. This field should be ignored in transmit mode and will always return a zero.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.48 Set/Query Packet Error Rate Test Status This message is used to stop a test in progress and/or query the test status.						
0x43	-		6	1	Cancel Test	This value if set to 1 will result in cancelling a test in progress, and if set to 0 will not affect the current state of the test.
-	0xC3		17	1	Test Status	0 = Packet error rate test is not in progress. 1 = Packet error rate test is in progress
				1	Test Mode	0 = Transmit mode. 1 = Receive mode.
				2	Packets Transmitted/ Received	This is the number of packets (LSB to MSB) that have either been transmitted or received, based on the Test Mode above.
				2	Packets to Transmit/ Expected Packets to Receive	This is the total number of packets (LSB to MSB) that are to be transmitted, or are expected to be received, based on the Test Mode above. Valid range is 5-65,535.
				2	Last Received Packet Number	When in receive mode this field indicates the number of the last packet received. The valid range is 0-65535, and a value of 0 means that a packet has not yet been received. The purpose of this field is to indicate how far into the test we are, when in receive mode. This field should be ignored in transmit mode and will always return a zero.
				4	LQI Tally	A running total of LQI results sent LSB to MSB. Average LQI = LQI Tally / Number of Received Packets.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.49 Channel Energy Scan						
0x44	-		8	2	Channel Mask	Two byte bitmask (LSB to MSB) of the RF channels to perform an energy scan on. The least significant bit corresponds to channel 1 and goes up bit by bit until channel 10.
				1	Scan Duration	The time to scan each channel (0 – 14). Duration Time 0 61.4 mS 1 92.2 mS 2 154 mS 3 276 mS 4 522 mS 5 1.01 S 6 2.00 S 7 3.96 S 8 7.90 S 9 15.8 S 10 31.5 S 11 62.9 S 12 126 S 13 252 S 14 503 S
-	0xC4		5	-		
3.2.50 Channel Energy Scan Response						
N/A	-		-	-		
-	0xC5		17	2	Channel Mask	Two byte bitmask (LSB to MSB) of the RF channels the energy scan was performed on. The least significant bit corresponds to channel 1 and goes up bit by bit until channel 10.
				10	Energy Levels List	List of energy levels that consists of one byte for each channel representing the RF energy level that was measured. The order of the list starts with channel 1 and goes up to channel 10. Note that channels not scanned are returned in the list.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.51 Calibrate ADC Reference						
0x46	-		7	2	Supply Voltage	The Supply Voltage in millivolts (LSB to MSB). For example a supply voltage of 3.311V will be passed as 33111. ***Note: This command is for production use only. Users should not issue this command to the module.
-	0xC6		5	-		
3.2.52 Start RF Range Test Note: Sending this message will start or restart the range test, and clear all statistics						
0x47	-		10	1	Test Mode	0 = Device is a slave (address = 200) 1 = Device is a master (address = 100)
				1	Master Options	Bitmask of range test mode options. Bit 0: 802.15.4 Retries/Acks (0 = disable, 1 = enable) Bit 1: Request Application Ack (0 = disable, 1 = enable)
				1	Channel	The RF channel that the transceiver operates on (1-10).
				2	Reserved	Reserved for future use. Set to 0.
-	0xC7		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.53 Query RF Range Test Results – Slave Device						
0x48	-		5	-		
-	0xC8		19	2	First Packet ID from Master	This is the packet ID (LSB to MSB) of the first received packet. Valid range is 0-65,535.
				2	Last Packet ID from Master	This is the packet ID (LSB to MSB) of the last received packet. Valid range is 0-65,535.
				2	Slave Packet Count	This is the number of packets received by the slave (LSB to MSB)
				2	Slave Battery Voltage	This is the last stored battery voltage of the slave device in mV. (i.e. a value of 3000 = 3000mV or 3.0V).
				2	Master Battery Voltage	This is the last reported battery voltage of the master device in mV. (i.e. a value of 3000 = 3000mV or 3.0V).
				4	Reserved	Reserved for future use. Set to 0.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.54 Received Range Test Packet						
N/A	-		-	-		
-	0xC9		27 + n	1	Test Mode	0 = Device is a slave (address = 200) 1 = Device is a master (address = 100)
				1	AppAck	0 = Message was sent w/o Application Ack 1 = Message was sent w/ Application Ack
				2	Packet ID	This is the packet ID (LSB to MSB) of the received packet. Valid range is 0-65,535.
				2	First Packet ID from Master	This is the packet ID (LSB to MSB) of the first received packet. Valid range is 0-65,535.
				2	Slave Packet Count	This is the number of packets received by the slave (LSB to MSB).
				2	Slave Battery Voltage	This is the last stored battery voltage of the slave device in mV. (i.e. a value of 3000 = 3000mV or 3.0V).
				1	Slave LQI	Link Quality Indicator (0-255 with 255 being the best link quality).
				1	Slave RSSI	Received signal strength in dBm.
				2	Master Packet Count	This is the number of packets received by the master (LSB to MSB).
				2	Master Battery Voltage	This is the last reported battery voltage of the master device in mV. (i.e. a value of 3000 = 3000mV or 3.0V).
				1	Master LQI	Link Quality Indicator (0-255 with 255 being the best link quality).
				1	Master RSSI	Received signal strength in dBm.
				4	Reserved	Reserved for future use. Set to 0.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.55 Repeater Test Mode – For Internal Use Only						
0x4D	-		10	1	Options	Bitmask of repeater test mode options. Bit 0: Ignore messages from our device address minu one. (0 = disable, 1 = enable).
				4	Reserved	Reserved for future use. Set to 0.
-	0xCD		5	-		
3.2.56 Enable/Disable Terminal Debug Messages – For Internal Use Only						
0x4E	-		7	1	Options	Bitmask of the terminal messages options. Bit 0: Repeater Diagnostics (0 = disable, 1 = enable)
				1	Reserved	Reserved for future use. Set to 0.
-	0xCE		5	-		
3.2.57 Terminal Debug Message – For Internal Use Only						
N/A	-					
-	0xCF		5+n	n	ASCII Message	String of ASCII characters to display in terminal window.
3.2.58 Set Host Interface Configuration						
0x50	-	X	16	1	Options	Bitmask of host interface options. Bit 0: Enable CTS Functionality (0 = disable, 1 = enable).
				1	Min Packet Spacing	This is the spacing between outgoing host packets (from module to host) in 200usec increments (LSB to MSB), from 0 to 51msec. Zero is no spacing. Example: a value of 10 would put approximately 2msec between outgoing packets.
				9	Reserved	Reserved for future use. Set to 0.
-	0xD0		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.59 Query Host Interface Configuration						
0x51	-		5	-		
	0xD1		16	1	Options	Bitmask of host interface options. Bit 0: Enable CTS Functionality (0 = disable, 1 = enable).
				1	Min Packet Spacing	This is the spacing between outgoing host packets (from module to host) in 200usec increments (LSB to MSB), from 0 to 51msec. Zero is no spacing. Example: a value of 10 would put approximately 2msec between outgoing packets.
				9	Reserved	Reserved for future use. Set to 0.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

3.2.60 Set Beacon Payload

Note: It is up to the host to ensure the beacon payload size does not exceed the maximum number of bytes allowed for the packet being transmitted.

The Beacon Payload will be sent based on the options set in "Set Beacon Options" message type 0x54.

Beacon message will always be sent broadcast.

Setting the Beacon Payload will disable periodic beacons.

0x52	-	X	15 + n	10	Reserved	Reserved for future use. Set to 0.
				n	Beacon Payload	Beacon payload to be sent over the RF link (n bytes) The valid range depends on the options set in the "S Beacon Options" message type 0x54. Simple Short The valid range of data bytes is between is 1 and 110 bytes. Advanced Short The valid range of data bytes is between is 1 and 108 bytes. Simple Repeated The valid range of data bytes is between 1 and 100, depending on the Max Repeats setting (see message 0x28). The maximum number of data bytes is calculated as follows: (106 – (3 x (Max Repeats + 1))).
-	0xD2		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.61 Query Beacon Payload						
0x53	-		5	-		
-	0xD3		15 + n	10	Reserved	Reserved for future use. Set to 0.
				n	Beacon Payload	Beacon payload to be sent over the RF link (n bytes) The valid range depends on the options set in the "S Beacon Options" message type 0x53. Simple Short The valid range of data bytes is between is 1 and 110 bytes. Advanced Short The valid range of data bytes is between is 1 and 108 bytes. Simple Repeated The valid range of data bytes is between 1 and 100, depending on the Max Repeats setting (see message 0x28). The maximum number of data bytes is calculated as follows: (106 – (3 x (Max Repeats + 1))).

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

3.2.62 Set Beacon Options

Note: Issuing this command to the module will disable periodic beacons. If the command is valid and beacons are requested to be enabled, the periodic beacons will be restarted.

0x54	-	X	19	1	Options	Enable transmission of a periodic beacon. Bit 0 = Enable Beacon (0 = Not Enabled, 1 = Enabled) Bit 1 = Send Host Ack on Beacon Tx (0 = Not Enabled 1 = Enabled) Bit 2 = Toggle Module Pin 15 on Beacon Tx (0 = Not Enabled, 1 = Enabled) Bit 3 = Toggle Module Pin 15 on Beacon Rx (0 = Not Enabled, 1 = Enabled)
				1	RF Msg Type of Beacon	0x00 = Simple Short 0x01 = Advanced Short 0x02 = Simple Repeated Note: Advanced Short messages will always be sent t the broadcast PAN.
				2	Beacon Header	This is the Header that will be appended to the front of the beacon payload (LSB to MSB). As such these bytes appear as the first two bytes in the payload fie of the RF Msg Type being used for the beacon.
				2	Beacon Interval	This is the interval between outgoing beacon packet in 50mS increments (LSB to MSB). Example: a value 10 would put approximately 500mS between outgoi packets. Range = 1 to 65,535 (50mS to 54.6 minutes Note: A beacon will not be sent out unless the beac payload has been setup (Message type 0x52).
				8	Reserved	Reserved for future use. Set to 0.
-	0xD4		5	-		

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description
3.2.63 Query Beacon Options						
0x55	-		5	-		
-	0xD5		19	1	Options	Enable transmission of a periodic beacon. Bit 0 = Enable Beacon (0 = Not Enabled, 1 = Enabled) Bit 1 = Send Host Ack on Beacon Tx (0 = Not Enabled 1 = Enabled) Bit 2 = Toggle Module Pin 15 on Beacon Tx (0 = Not Enabled, 1 = Enabled) Bit 3 = Toggle Module Pin 15 on Beacon Rx (0 = Not Enabled, 1 = Enabled)
				1	RF Msg Type of Beacon	0x00 = Simple Short 0x01 = Advanced Short 0x02 = Simple Repeated Note: Advanced Short messages will always be sent t the broadcast PAN.
				2	Beacon Header	This is the Header that will be appended to the front of the beacon payload (LSB to MSB). As such these bytes appear as the first two bytes in the payload fie of the RF Msg Type being used for the beacon.
				2	Beacon Interval	This is the interval between outgoing beacon packet in 50mS increments (LSB to MSB). Example: a value 10 would put approximately 500mS between outgoi packets. Range = 1 to 65,535 (50mS to 54.6 minutes Note: A beacon will not be sent out unless the beac payload has been setup (Message type 0x52)
				8	Reserved	Reserved for future use. Set to 0.

Host to Module	Module to Host	Manual Save	Message Length	Payload Length	Payload Name	Description

3.2.64 Beacon Message Transmit Host Ack

This message will be sent after a device transmits a beacon message if enabled in “Set Beacon Options” message type 0x54.

-	-		-	-		
-	0xD6		14	1	Status	0x00 = Failure to transmit beacon. 0x01 = Beacon successfully transmitted.
				8	Reserved	Reserved for future use. Set to 0.

Table 3 Host Protocol Message Definitions

4 Appendix A – Host Protocol Quick Start

4.1 Overview

The Host Protocol consists of a superset of commands to support a large variety of applications. Typical applications only require several commands to get up and running. This section will take you through configuring a pair of modules and sending and receiving RF messages between those modules.

4.2 Configure and Save Settings

The Host Protocol command 0x10 Set Basic RF Settings (section 3.2.15) can be used to configure all the primary settings.

4.2.1 PAN ID

The PAN ID or Personal Area Network ID is a 16-bit value used to distinguish networks from one another. All devices within a network should have the PAN ID configured the same. For this example the PAN ID will be set to 100 (0x0064).

4.2.2 Short/Long Addressing

Note that while the module supports both short and long addresses, only one address mode is allowed at any time. For example, a module can be configured with a short address of 0x0001, and a long address of 0x0000000000000001, however in this case only the short address applies. The reason for this is that in order to use the long address, the short address would need to be configured to 65,535 (0xFFFF). A module will only be able to send or receive RF messages using the same addressing mode the module is configured with.

4.2.2.1 Short Transceiver Address

The Short Transceiver Address is a 16-bit value used to identify a particular device. This address should be unique for each device in the network. The valid range of short addresses is 0 to 65,534 (0xFFFE). For this example the short addresses will be set to 1 (0x0001) and 2 (0x0002) on the two modules.

4.2.2.2 Long Transceiver Address

The Long Transceiver Address is a 64-bit value used to identify a particular device. In order to configure the module to use the long address, the short address must be set to 65,535 (0xFFFF). The long address should be unique for each device in the network. The valid range of long addresses is 0x0000000000000001 to 0xFFFFFFFFFFFFFFFE. For this example the long addresses are not used.

4.2.3 RF Channel

The RF Channel is used to configure on what frequency the module will communicate. All devices within a network should have the RF Channel configured the same. For this example the RF Channel will be set to 5, which equates to a center frequency of 914Mhz.

4.2.4 RF Power Level

The RF Power Level is used to configure the transmit power of the module. A low setting (0) will minimize the distance the module can transmit, while a high setting (21) will maximize the transmit distance. In most cases all devices within a network should have the RF Power Level configured the same. For this example the RF Power Level will be set to its maximum setting of 21, which equates to a output power of +24dbm (250mW).

4.2.5 Receive Filters

Broadcast messages are used to send messages to a group of devices. These groups could be all devices on the same PAN, or all devices on the same channel. The receive filters is a bitmask used to enable or disable the specific filters.

4.2.5.1 Allow Broadcast Address

The Allow Broadcast Address filter when set will allow the module to receive a message broadcast to all addresses on the same PAN ID.

4.2.5.2 Allow Broadcast PAN

The Allow Broadcast PAN filter when set will allow the module to receive a message broadcast to all PAN ID's.

4.2.5.3 Promiscuous Mode

The Promiscuous Mode filter when set will allow the module to receive all RF messages on the same RF channel. This is special sniffer mode used primarily for diagnostics. When in this mode do not transmit any RF messages.

4.2.5.4 Allow Secured Packets

The Allow Secured Packets filter when set will allow the module to receive RF messages that are transmitted with security enabled. This still assumes that the packet was addressed to the module. Note that if the security keys are different between the transmit and receive ends of the system, the received packet's payload will be garbled.

For this example all the filters will be disabled.

4.2.6 Security Key

The security key is a 16-byte (128-bit) key used to encrypt over-the-air messages if security is enabled. For the purpose of this quick start, security is disabled and hence the key is not used.

4.2.7 Configuring Modules

This section shows the steps and commands that get sent between a host device and radio module, to configure the basic RF settings and save them to Non-Volatile Memory (NVM).

Below is the list of steps that correlate to those shown in Figure 9.

Step 1: Configure Module 1 with basic RF settings (Msg Type 0x10)

Host -> Module
0x01 0x27 0x10 0x64 0x00 0x01 0x00 0x01 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x05 0x15 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xB8 0x04

Step 2: Module 1 sends host acknowledgement (Msg Type 0x90)

Module -> Host
0x01 0x05 0x90 0x96 0x04

Step 3: Save basic RF settings in Module 1 to NVM (Msg Type 0x12)

Host -> Module
0x01 0x05 0x12 0x18 0x04

Step 4: Module 1 sends host acknowledgement (Msg Type 0x92)

Module -> Host
0x01 0x05 0x92 0x98 0x04

Step 5: Configure Module 2 with basic RF settings (Msg Type 0x10)

Host -> Module
0x01 0x27 0x10 0x64 0x00 0x02 0x00 0x02 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x05 0x15 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xBA 0x04

Step 6: Module 2 sends host acknowledgement (Msg Type 0x90)

Module -> Host
0x01 0x05 0x90 0x96 0x04

Step 7: Save basic RF settings in Module 2 to NVM (Msg Type 0x12)

Host -> Module
0x01 0x05 0x12 0x18 0x04

Step 8: Module 2 sends host acknowledgement (Msg Type 0x92)

Module -> Host
0x01 0x05 0x92 0x98 0x04

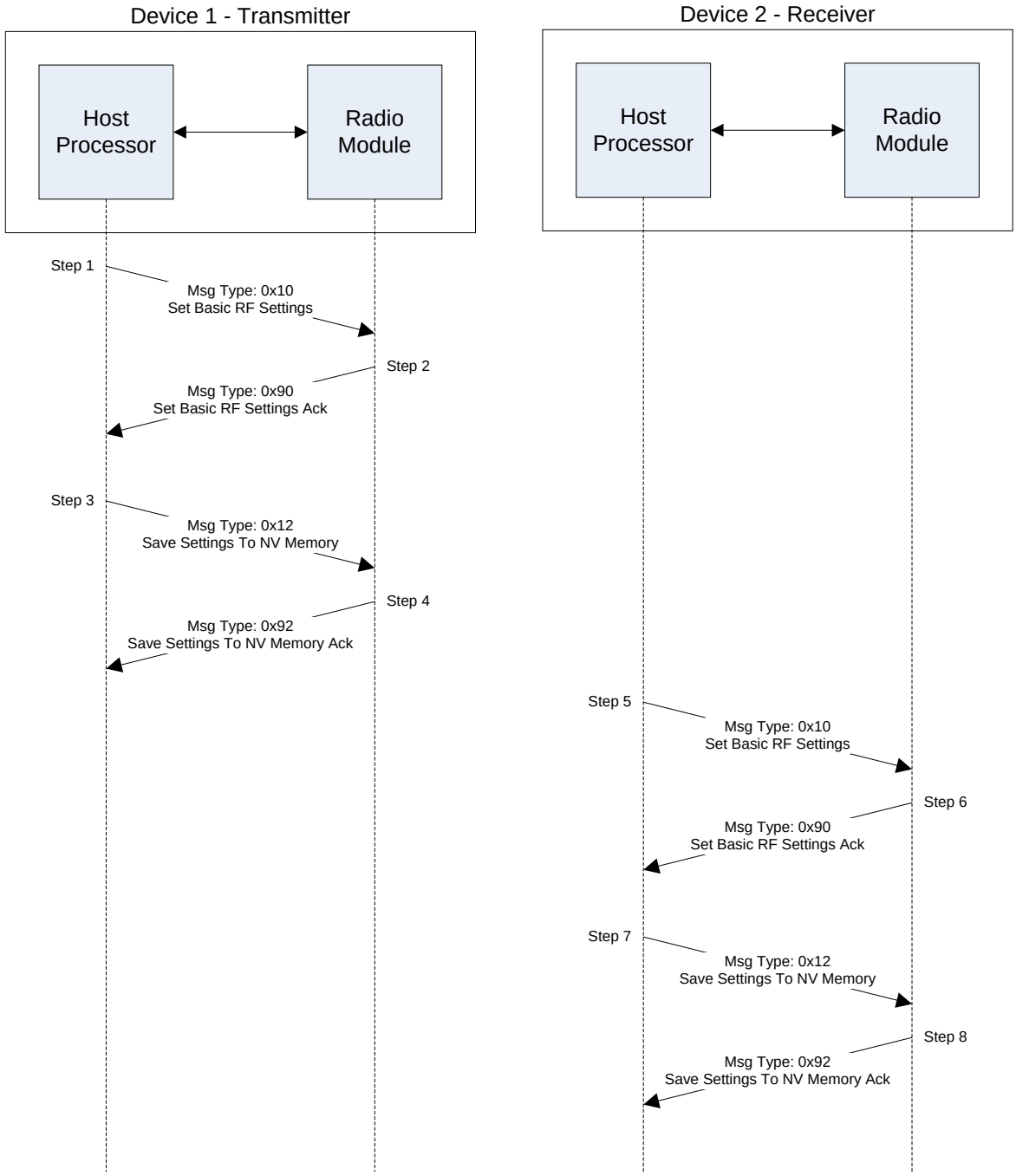

Figure 9 – Module Configuration

4.2.8 Send/Receive RF Messages without ACK

This section shows the steps and commands that get sent between a host device and radio module, to send and receive data over-the-air (OTA) using CCA without RF acks and retries or security. In the example below the data sent is ASCII 1234567890, and the packet id is 1.

Below is the list of steps that correlate to those shown in Figure 10.

Step 1: Command Module 1 to send OTA data (Msg Type 0x20)

Host1 -> Module1
01 13 20 00 02 00 01 31 32 33 34 35 36 37 38 39 30 44 04

Step 2: Module 1 sends data OTA

Step 3: Module 1 sends host acknowledgement (Msg Type 0xA0)

Module1 -> Host1
01 07 A0 01 01 AA 04

Step 4: Module 2 receives the OTA message and sends it to the host (Msg Type 0xA1)

Module2 -> Host2
01 1B A1 00 00 00 00 00 00 FF 02 00 01 00 01 31 32 33 34 35 36 37 38 39 30 CD 04

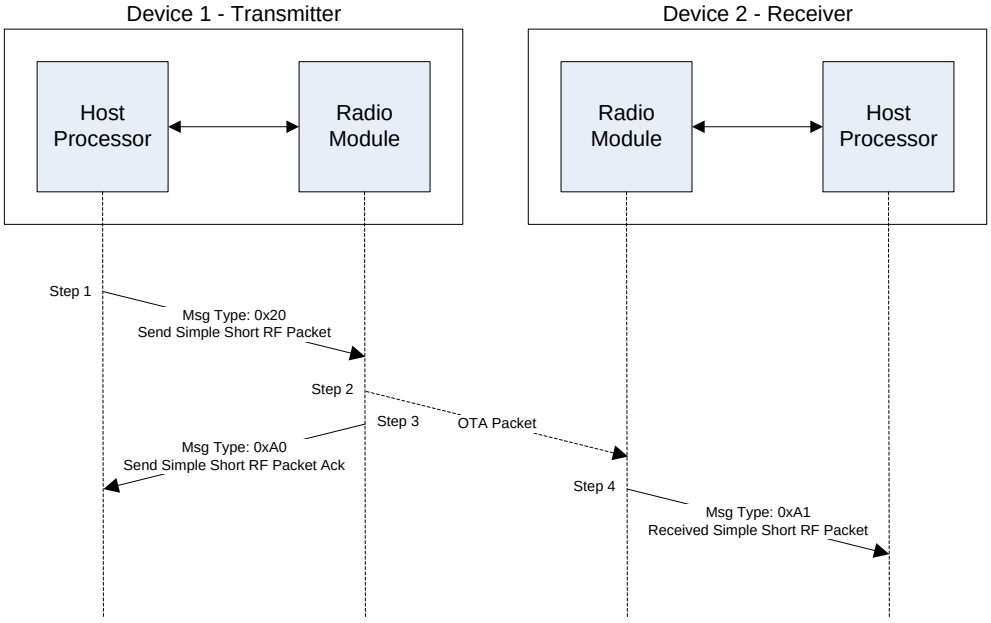

Figure 10 Send/Receive RF Message without RF Acks

4.2.9 Send/Receive RF Messages with ACK

This section shows the steps and commands that get sent between a host device and radio module, to send and receive data OTA with CCA enabled, using RF acks and retries, and once again no security. In the example below the data sent is ASCII 1234567890, and the packet id is 1.

Below is the list of steps that correlate to those shown in Figure 11.

Step 1: Command Module 1 to send OTA data (Msg Type 0x20)

```
Host1 -> Module1
01 13 20 01 02 00 01 31 32 33 34 35 36 37 38 39 30 45 04
```

Step 2: Module 1 sends data OTA

Step 3: Module 2 sends a RF acknowledgement back to Module 1.

Step 4: Module 2 receives the OTA message and sends it to the host (Msg Type 0xA1)

```
Module2 -> Host2
01 1B A1 00 00 00 00 00 00 FF 02 00 01 00 01 31 32 33 34 35 36 37 38 39
30 CD 04
```

Step 5: Module 1 sends host acknowledgement (Msg Type 0xA0)

```
Module1 -> Host1
01 07 A0 01 01 AA 04
```


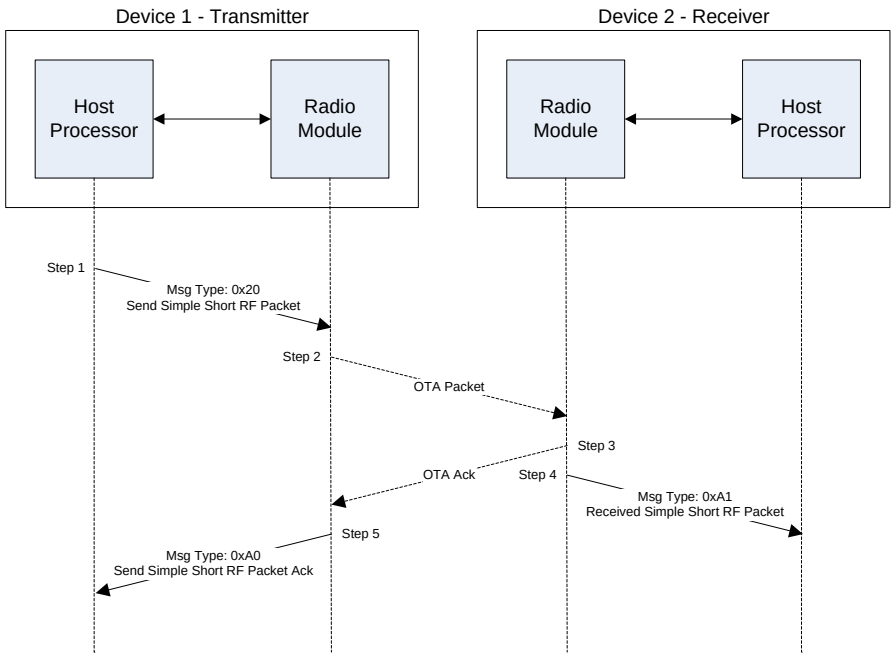

Figure 11 Send/Receive RF Message with RF Acks

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