

PRO-FLEX SERIES TRANSCEIVER MODULES

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:

- *ProFLEX-01 Datasheet*

1.4 Revision History

Date	Change Description	Revision
	Initial release.	1.0

Table 1 Revision History

2 Host Protocol

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

2.1 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 identifies the intent of the packet.
Local/Remote	Designates whether the packet is intended for the local “hardwired” module (0x00) or the remote module (0x01). If targeting a remote module, then the local hardwired module forwards the message over the RF to the remote module. The remote module’s address is defined in the “Remote Address” field below.
Remote Address	Two byte address (LSB to MSB) of the remote module the message is intended for. In order for this address to be valid the “Local/Remote” field, described above, must be set to 0x01. When the “Local/Remote” field is 0x00 then this field is ignored.
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 through the Payload.
End Byte	The end byte is the last byte in a packet (0x04).

Table 2 Host Serial Protocol Field Descriptions

2.2 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 0x02)
< 0x01 0x08 0x02 0x00 0x00 0x00 0x0B 0x04 >

Module -> Host – (Respond with PAN ID – Type 0x82)
< 0x01 0x0B 0x82 0x00 0x00 0x00 0x64 0x00 0xF2 0x04 >

PRELIMINARY

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	Allow Remote	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 0x8F.

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
----------------	----------------	--------------	----------------	----------------	--------------	-------------

Figure 3 Module to Host

3.1.3 Allow Remote

This column will contain an “x” if the message supports being issued to a remote module. A remote module is a module that is not physically hardwired to the host device that issues the message. In general host messages can only be issued to a remote device that is on the same PAN ID and RF channel of the hardwired local module.

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
----------------	----------------	--------------	----------------	----------------	--------------	-------------

Figure 4 Allow Remote

3.1.4 Message Length

This column contains the length of the entire message, which consists of the header (6 bytes), payload, and trailer (2 bytes). The minimum sized message is 8 bytes and occurs in messages that contain no payload.

Host to Module	Module to Host	Allow Remote	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	Allow Remote	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	Allow Remote	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	Allow Remote	Message Length	Payload Length	Payload Name	Description
----------------	----------------	--------------	----------------	----------------	--------------	-------------

Figure 8 Description

3.2 Host Protocol Message Definitions

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.1 Query Firmware Version						
0x01	-		5	-		
-	0x81	X	12+n	1	Module Identifier	Identifies this module as a ProFlex module (0x02).
				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	-		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.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.4 Set Transceiver Address						
0x04	-		15	2	Short Transceiver Address	Two byte transceiver short address (LSB to MSB). Valid short addresses are 0 - 65,520 and 65,535 (0x0000 – 0xFFFF0 and 0xFFFF). When 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 long address set 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). Valid short addresses are 0 - 65,520 and 65,535 (0x0000 – 0xFFFF0 and 0xFFFF). When 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 long address set Short Address to 0xFFFF

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.6 Set RF Channel						
0x06	-		6	1	RF Channel	The RF channel that the transceiver operates on (11-26). 11 = 2405 12 = 2410 13 = 2415 14 = 2420 15 = 2425 16 = 2430 17 = 2435 18 = 2440 19 = 2445 20 = 2450 21 = 2455 22 = 2460 23 = 2465 24 = 2470 25 = 2475 26 = 2480
-	0x86		5	-		
3.2.7 Query RF Channel						
0x07	-		5	-		
-	0x87		6	1	RF Channel	The RF channel that the transceiver operates on (11-26).
3.2.8 Set Transmit Power Level						
0x08	-	X	6	1	RF Power Level	RF power level (0-19). Refer to Table 4 RF Power Settings in Appendix A for how the RF Power Level value relates to actual power level from the module.
-	0x88		5	-		
3.2.9 Query Transmit Power Level						
0x09	-		5	-		
-	0x89	X	6	1	RF Power Level	RF power level (0-19). Refer to Table 4 RF Power Settings in Appendix A for how the RF Power Level value relates to actual power level from the module.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
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)
				1	Reserved	Reserved for future use.
-	0x8A		5	-		
3.2.11 Query Receiver Configuration						
0x0B	-	X	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)
				1	Reserved	Reserved for future use.
3.2.12 Set Security						
0x0E	-	X	22	1	Security Enable/Disable	Whether or not encryption is enabled (0x01) or disabled (0x00).
				16	Security Key	Sixteen byte encryption key (MSB to LSB).
-	0x8E		5	-		
3.2.13 Query Security						
0x0F	-	X	5	-		
-	0x8F		22	1	Enable/Disable	Whether or not encryption is enabled (0x01) or disabled (0x00).
				16	Key	Sixteen byte encryption key (MSB to LSB).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.14 Set Basic RF Settings						
0x10	-		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). Valid short addresses are 0 - 65,520 and 65,535 (0x0000 – 0xFFFF0 and 0xFFFF). When 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 long address set Short Address to 0xFFFF
				1	RF Channel	The RF channel that the transceiver operates on (11-26).
				1	RF Power Level	RF power level (0-19). Refer to Table 4 RF Power Settings in Appendix A for how the RF Power Level value relates to actual power level from the module.
				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)
				1	Reserved	Reserved for future use.
				1	Reserved	Reserved for future use.
				1	Security Enable/Disable	Whether or not encryption is enabled (0x01) or disabled (0x00).
				16	Security Key	Sixteen byte encryption key (MSB to LSB).
-	0x90		5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.15 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). Valid short addresses are 0 - 65,520 and 65,535 (0x0000 – 0xFFFF0 and 0xFFFF). When 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 long address set Short Address to 0xFFFF
				1	RF Channel	The RF channel that the transceiver operates on (1-10).
				1	RF Power Level	RF power level (0-19). Refer to Table 4 RF Power Settings in Appendix A for how the RF Power Level value relates to actual power level from the module.
				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)
				1	Reserved	Reserved for future use.
				1	Reserved for Antenna Diversity	Not supported in Pro-FLEX
				1	Security Enable/Disable	Whether or not encryption is enabled (0x01) or disabled (0x00).
				16	Security Key	Sixteen byte encryption key (MSB to LSB).
3.2.16 Save Settings To Non-Volatile Memory						
0x12	-		5	-		
-	0x92	X	5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.17 Reset Request						
0x13	-		5	-		
-	0x93		5	-		
3.2.18 Query Supply Voltage						
0x14	-		5	-		
-	0x94	X	8	2	Supply ADC Reading	The supply voltage ADC reading (LSB to MSB). The supply voltage can be determined by the following formula: $\text{Supply Voltage} = ((\text{Supply ADC Reading} \times \text{Voltage Reference}) / 204750)$. Example: ADC Reading = 2750 Voltage Reference = 245 $\text{Supply Voltage} = (2750 \times 245) / 20,4750$ Supply Voltage = 3.36V
				1	Voltage Reference	The Voltage Reference used in the measurement multiplied by 100. For example the 1.47V reference will be passed as 147.
3.2.19 Query Statistics						
0x15	-		5	-		
-	0x95	X	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).
3.2.20 Clear Statistics						
0x16	-		5	-		
-	0x96		5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.21 Set Low Power Mode						
0x17	-		6	1	Reserved	Reserved for future use.
-	0x97		5	-		
3.2.22 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.
-	0x98		5	-		
3.2.23 Reserved for Query On-Chip Temperature Sensor						
0x1B	-		5	-		
-	0x9B	X	7	2	Supply ADC Reading	The supply voltage ADC reading (LSB to MSB). The temperature can be determined by the following formula: TEMP °C = (V - 0.894)/0.00366 where V = (ADC Reading * 1.47)/4095 Example: ADC Reading = 2800 Temp °C = (((2800*1.47)/4095)-0.894) / 0.00366) Temp °C = 30.4

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.24 Set Wakeup/Reset Settings						
0x1C	-		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" status alert 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" status alert message being sent to the host (see message type 0x9E).
	0x9C		5	-		
3.2.25 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" status alert 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" status alert message being sent to the host (see message type 0x9E).
3.2.26 Wakeup/Reset Alert Status						
			-	-		
	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).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.27 Set Static RF Test Mode						
0x1F	-		10	1	Test Mode	Test Mode: 0 = Idle (transmit and receive not active) 1 = Receive 2 = Transmit Unmodulated 0 3 = Reserved 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 (11-26).
				1	RF Power Level	RF power level used for the transmit modes (0-19). Refer to Table 4 RF Power Settings in Appendix A for how the RF Power Level value relates to actual power level from the module.
				1	Reserved for Antenna Diversity	Not supported in Pro-FLEX
				1	Reserved for RF Phy Mode	Not supported in Pro-FLEX
-	0x9F		5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.28 Send Simple RF Data Packet (Short Addressing)						
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	Retries On/Off	Indicates whether or not to use RF retries and acknowledgements (0x00 = off, 0x01 = on) for this RF message.
				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). (Valid Range is 1-100 bytes)
-	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).
3.2.29 Received Simple RF Data Packet (Short Addressing)						
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		11+n	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).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.30 Send Advanced RF Data Packet (Short Addressing) 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).						
0x22	-		11+n	1	Retries On/Off	Indicates whether or not to use retries and acknowledgements (0x00 = off, 0x01 = on) for this RF message.
				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). (Valid Range is 1-100 bytes)
-	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).
3.2.31 Received Advanced RF Data Packet (Short Addressing) 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		15+n	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.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				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).

3.2.32 Send Simple RF Data Packet (Long Addressing)

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	Retries On/Off	Indicates whether or not to use RF retries and acknowledgements (0x00 = off, 0x01 = on) for this RF 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.
				1	Packet ID	Packet ID.
				n	n Data Bytes	Data to be sent over the RF link (n bytes). (Valid Range is 1-100 bytes)
-	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).

3.2.33 Received Simple RF Data Packet (Long Addressing)

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		23+n	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.

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				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).
<p>3.2.34 Send Advanced RF Data Packet (Long Addressing)</p> <p>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).</p>						
0x26	-		17+n	1	Retries On/Off	Indicates whether or not to use retries and acknowledgements (0x00 = off, 0x01 = on) for this RF message.
				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). (Valid Range is 1-100 bytes)
-	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	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.35 Received Advanced RF Data Packet (Long Addressing) 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		27+n	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).
3.2.36 Set Repeater Configuration						
0x28	-		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 Repeater + 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	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.37 Query Repeater 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).
3.2.38 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	-		8+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. 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).
-	0xAA		6	1	Packet ID	Packet ID.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.39 Received Simple Repeated RF Data Packet						
<p>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.</p>						
NA	-		-	-		
-	0xAB		13+n to 34+n	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 ((1 - Number Repeaters) + 1). A repeat cycle consists of Number Repeaters slots plus 1 for an "Open Slot". 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).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.40 Send Advanced Repeated RF Data Packet This message is used to send a RF packet to a destination transceiver using the repeating mechanism and 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).						
0x2C	-		10+n	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).
-	0xAC		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).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.41 Received Advanced 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. 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). Also included along with the packet data, this message contains the source route through which the packet used to find its way to the destination.						
NA	-		-	-		
-	0xAD		17+n to 38+n			
				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.
				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 ((1 - Number Repeaters) + 1). A repeat cycle consists of Number Repeaters slots plus 1 for an "Open Slot". 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).

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				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).

3.2.42 Received Promiscuous Mode Packet

This message gets sent to the host when a RF packet is received from a transceiver in Promiscuous Mode.

Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
NA	-		-	-		
-	0xAE		19 + n or 25 + n or 31 + n	1	Frame Type	MAC_FRAME_TYPE_DATA = 1 is only type returned at present.
				1	Flags	Reserved
				1	Sequence Number	MAC Frame Sequence Number
				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.
				1	Destination Address Mode	2 = short addressing 3 = long addressing This byte can be used to see how many bytes will follow in the Destination Transceiver Address.
				2 or 8	Destination Transceiver Address	LSB to MSB If the Destination Address Mode is short this field will contain two-bytes for the short address. If the Destination Address Mode is long this field will contain eight-bytes for the long address.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				1	Source Address Mode	2 = short addressing 3 = long addressing This byte can be used to see how many bytes will follow in the Destination Transceiver Address.
				2 or 8	Source Transceiver Address	LSB to MSB If the Source Address Mode is short this field will contain two-bytes for the short address. If the Source Address Mode is long this field will contain eight-bytes for the long address.
				n	n Data Bytes	Data bytes received over the RF link (n bytes).

3.2.43 Send Remote Command/Response with Short Addressing

0x30			8+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 (0x0000 – 0xFFFF).
				1	Host Message Type	This is the host message type of the remote command/response. Example: Query Version = 0x01.
				n	Host Message Payload	This is the host message payload for this specific message type. Example: Response to remote query statistics (msg type 0x95) would send back 16 bytes total consisting of four bytes each for packets sent, acks received, packets received, broadcast packets received.
	0xB0		5	-		

3.2.44 Received Remote Command/Response with Short Addressing

NA	-		-	-		
-	0xB1		8+n	2	Source Transceiver Address	Two byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Host Message Type	This is the host message type of the remote command/response. Example: Query Version = 0x01.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				n	Host Message Payload	This is the host message payload for this specific message type. Example: Response to remote query statistics (msg type 0x95) would send back 16 bytes total consisting of four bytes each for packets sent, acks received, packets received, broadcast packets received.

3.2.45 Send Remote Command/Response with Long Addressing

0x32			14+n	8	Destination Transceiver Address	Eight byte destination transceiver address (LSB to MSB).
				1	Host Message Type	This is the host message type of the remote command/response. Example: Query Version = 0x01.
				n	Host Message Payload	This is the host message payload for this specific message type. Example: Response to remote query statistics (msg type 0x95) would send back 16 bytes total consisting of four bytes each for packets sent, acks received, packets received, broadcast packets received.
	0xB2		5	-		

3.2.46 Received Remote Command/Response with Long Addressing

NA	-		-	-		
-	0xB3		14+n	8	Source Transceiver Address	Eight byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Host Message Type	This is the host message type of the remote command/response. Example: Query Version = 0x01.
				n	Host Message Payload	This is the host message payload for this specific message type. Example: Response to remote query statistics (msg type 0x95) would send back 16 bytes total consisting of four bytes each for packets sent, acks received, packets received, broadcast packets received.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.47 Received Remote Command/Response with Long Addressing						
NA	-		-	-		
-	0xB3		14+n	8	Source Transceiver Address	Eight byte source transceiver address (LSB to MSB). This is the address of the device that originated the message.
				1	Host Message Type	This is the host message type of the remote command/response. Example: Query Version = 0x01.
				n	Host Message Payload	This is the host message payload for this specific message type. Example: Response to remote query statistics (msg type 0x95) would send back 16 bytes total consisting of four bytes each for packets sent, acks received, packets received, broadcast packets received.
3.2.48 Set Packet Error Rate Test Transmit Configuration						
0x40			11+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	Number of Packets to Transmit	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).
				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.
				n	OTA data	Data to send (1-95 bytes)
	0xC0		5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.49 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	Number of Packets to Receive	LSB to MSB. Valid range is 5-65,535.
				1	Number of RF Bytes	Number of RF Bytes to expect (1-105). 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	-		
3.2.50 Packet Error Rate Packet Results						
When in either transmit or receive PERT mode, and the options field was 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	Total Number Packets	This is the total number of packets that were supposed to be received based on Message Type 0x41. Sent LSB to MSB. Valid range is 5-65,535. PERT Success = Number of Packets Received/Total Number of Packets.

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
				2	Last Received Packet Number	<p>When in receive mode this indicates the number of the last packet received. Valid range is 0-65535, 0 = not yet received a packet. The purpose of this field is to indicate how far into the test we are, when in receive mode.</p> <p>This field should be ignored in transmit mode and will always return a zero.</p>
				4	LQI Tally	<p>A running total of LQI results, sent LSB to MSB, when in receive mode. Average LQI = LQI Tally / Number of Received Packets.</p> <p>This field should be ignored in transmit mode and will always return a zero.</p>

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.51 Set/Query Packet Error Rate 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	Total Number Packets	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 indicates the number of the last packet received. Valid range is 0-65535, 0 = not yet received a packet. 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
3.2.52 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 11 and the most significant bit corresponds to channel 26.
				1	Duration	Valid Range is 0-14
-	0xC4		5	-		

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Host to Module	Module to Host	Allow Remote	Message Length	Payload Length	Payload Name	Description
3.2.53 Channel Energy Scan Response						
N/A	-		23	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 11 and the most significant bit corresponds to channel 26.
				16	Energy Levels List	List of energy levels that is one byte for each channel representing the RF energy level that was measured. The order of the list starts with channel 11 and goes up to channel 26. Note that channels not scanned are returned in the list.
-	0xC5		5	-		

Table 3 Host Protocol Message Definitions

4 Appendix A

4.1 RF Power Settings

Setting	Register Value	RF Output Power	Current Consumption
0	0x49	7 dBm	75 mA
1			
2			
3			
4			
5			
6			
7			
8			
9			
10	0x79	12 dBm	85 mA
11			
12			
13	0x6C	16 dBm	100 mA
14			
15	0xE0	18 dBm	115 mA
16			
17	0xF9	20 dBm	145 mA
18			
19			

Table 4 RF Power Settings

The register values in Table 4 RF Power Settings are provided for FCC purposes only. User's do not have access to the register described in Table 4 using the host protocol described in this document.

5 Contacting LS Research

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