Reject Frame

When a Hornet receives a frame from its local Host that cannot be processed (i.e. Bad CRC, etc) it responds with this frame back to the local Host.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'rj' (lower case)	2 bytes
Sequence Number	16 bit counter as contained in the original frame in error.	2 bytes
Source Address	Contains the address of the local Hornet originating this frame.	4 bytes
Destination Address	Contains 0x00000000 indicating the local Host as the destination.	4 bytes
Data Length	0x0001.	2 bytes
Error Code	Contains the reason for this failure. See the Error Codes section.	0 to 96 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 9 Reject Message Format

Configure Device Request

This frame is sent from a Host to a Hornet (either its local radio using address 0x00000000 or a remote radio) to modify the radio's Identification Field Table (See section on Identification Field Table).

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'CD'	2 bytes
Sequence Number	16 bit counter which matches the number from the request frame.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the Identification Fields that follow.	2 bytes
Identification Field(s)	Contains N Identification Fields to be set or deleted. Each entry is a combination of three values: 1-byte Field ID, 1-byte Length n-byte Value (if Length <> 0). If the Length==0, this Field ID should be deleted from the table.	0 to 96 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 10 Configure Device Request Message Format

Configure Device Reply

This message is sent back to the originator of the 'CD' request to indicate the disposition of the request.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'cd' (lower case)	2 bytes
Sequence Number	16 bit counter which matches the value in the original 'CD' request.	2 bytes
Source Address	Contains the address of the Hornet that received the request and generated this reply.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local host or is set to the address of a remote host that generated the original 'CD' request..	4 bytes
Data Length	0x0002.	2 bytes
Error Code	Error Code for the disposition of the original 'CD' request frame.	1 byte
Secondary Error Code	Currently unused.	1 byte
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 11 Configure Device Reply Message Format

Discover Device Request

This frame is sent out from a Host to find radios with Identification Field entries that match certain criteria (See the section on the Identification Field Table). For example, a request may be sent requesting all printers within listening range to respond with a Discover Device ('dd') Reply. If a device receives this request but the Identification Fields do not match then the device will not reply to the message. Normally this request would be broadcast (destination address = 0xFFFFFFFF), but it can be sent to a specific unit including to the locally attached Hornet (destination address = 0x00000000).

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'DD'	2 bytes
Sequence Number	16 bit counter which can be used to guarantee that multiple frames are in the correct sequence.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit, or set to 0xFFFFFFFF to broadcast to all Hornets within listening range.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the Identification Fields that follow.	2 bytes
Identification Field(s)	Contains N Identification Fields to be matched. Each entry is a combination of three values: 1-byte Field ID, 1-byte Length n-byte Value (if Length <> 0). Any or all bytes in the Value field may be replaced with the '?' character which is treated like a wild card (don't care) value when matching.	0 to 96 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the *end of a frame.*	1 byte = 0x03

Figure 12 Discover Device Request Message Format

Discover Device Reply

This frame is sent back to the Host that originated the Discover Device Request to indicate that a match has occurred. Note that any wildcard values in the data are replaced with the actual data in this reply.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'dd' (lower case)	2 bytes
Sequence Number	16 bit counter which matches the number from the request frame.	2 bytes
Source Address	Contains the address of the Hornet that received the request and generated this reply.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local host or is set to the address of a remote host that generated the original 'CD' request..	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the Identification Fields that follow.	2 bytes
Error Code	Error Code for the disposition of the original 'DD' frame.	1 byte
Secondary Error Code	Currently unused.	1 byte
Identification Field(s)	Contains all of the Identification Fields specified in the request with any wildcard values overwritten with the actual data. Only devices that matched perfectly respond. Each entry is a combination of three values: 1-byte Field ID, 1-byte Length n-byte Value (if Length <> 0).	0 to 96 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 13 Discover Device Reply Message Format

Query Device Request

This frame is sent to request the contents of one or more Identification Fields of a particular device. This is typically used to obtain the exact identification of a device such as its serial number.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'QD'	2 bytes
Sequence Number	16 bit counter which can be used to guarantee that multiple frames are in the correct sequence.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the Identification Fields that follow.	2 bytes
Identification Field ID List	Contains a list of IDs of Identification Fields to be returned in the Reply frame. Each entry contains only the single byte ID of the Identification Field to be returned.	N * 1 byte, where N is the number of Identification Fields to be returned.
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 14 Query Device Request Message Format

Query Device Reply

This frame is sent by the radio that received the Query Device Request frame to send back the contents of the requested Identification Fields.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'qd' (lower case)	2 bytes
Sequence Number	16 bit counter which matches the number from the Request Frame.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the Identification Fields that follow.	2 bytes
Error Code	Error Code for the disposition of the original 'QD' frame.	1 byte
Secondary Error Code	Currently unused.	1 byte
Identification Field(s)	Contains all of the Identification Fields specified in the request. Each entry is a combination of three values: 1-byte Field ID, 1-byte Length n-byte Value (if Length <> 0).	0 to 96 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 15 Query Device Reply Message Format

Xetron Utility Command Request

This frame is sent to request the contents of one or more Identification Fields of a particular device. This is typically used to obtain the exact identification of a device such as its serial number.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'XE'	2 bytes
Sequence Number	16 bit counter which can be used to guarantee that multiple frames are in the correct sequence.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the data that follow.	2 bytes
Subcommand Byte	Contains a single ASCII digit to indicate the kind of utility command that follows.	1 byte
Subcommand Specific Data	Depends on what subcommand is being executed. See table below.	0-127 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 16 Xetron Utility Request Message Format

The specific commands and what they mean are described in the following table:

Subcommand	Format [byte sequence]	Meaning
'M' Memory Command	[0] = 'M' [1] = address LSB [2] = address MSB [3] = size [4] = read/write flag. 0=read, 1=write, 2=write then freeze (have target go into a forever loop). [5]=memory bank select: 0=RAM/registers 1=EEPROM 2=Flash (code space). [6-69] = up to 64 bytes of Memory data written and/or read.	Commands the radio to read/write various ranges of its memory space. The reply returned is the same format as the request. This command is best executed using the EEPROM.EXE utility which supplies a user friendly view window. Internal RAM, I/O space, and code space can be read. All but the code space can be written. When reading back flash code space the data is scrambled and requires a code value and algorithm from Xetron to descramble it.
'P' Promiscuous Mode	[0] = 'P' [1] = 4 bit channel mask in bits 0-3 identifying which channels to listen on.	Commands the radio to enter a promiscuous mode from which there is no reply nor exit until a power cycle occurs. The radio will listen on the specified channels for activity and send everything that it hears back to the host in raw mode at 115.2kbps. This is designed to be used as a debugging tool and requires a Sniffer Utility to display the data. See separate documentation on this utility.
'R' Reset	[0] = 'R'	Commands the radio to reset itself and reload from the beginning. This command is often used after loading new EEPROM parameters that are only acted upon at power up. No reply frame is sent back.
'C' Calibration	[0] = 'C' [1] = LSB of number of iterations [2] = MSB of number of iterations [3] = starting value to use [4] = ending value to use [5] = enumeration value for which DAC write: 0=eNO_DAC, 1=eDAC_A, 2=eDAC_B. [6] = LSB of pacing delay [7] = MSB of pacing delay Reply frame only: [8] = RSSI value.	*Factory Command* Commands the radio to enter a calibration mode where streams of data packets are sent over the air. The data in the first packet is filled with the starting value and the DAC is set to this value as well. The next packet is filled with the next value and so on until the ending value is reached. Then the process is repeated until the specific number of iterations is reached. The pacing delay tells how much time to allow between each packet. The reply frame is formatted like the request but appends the RSSI value that is read at the end of the test. This command is normally used at the factory and is enacted by the EEPROM utility while the remote unit is driven by the Sniffer utility.
'T' Transparent Mode	[0] = 'T'	Commands the radio to enter Transparent Mode operation immediately. No reply frame is sent.

Figure 17 Xetron Utility Request Subcommand Format

Xetron Utility Reply

This frame is sent by the radio that received the Xetron Utility Request frame. Except where noted, the reply has the same format as the request. Some Xetron Utility subcommands such as "Reset" and "Promiscuous Mode" generate no reply frame.

Field Name	Description	Size / Format
Start of Text (STX)	Special Character designating the beginning of a frame.	1 byte = 0x02
Command String	'xe' (lower case)	2 bytes
Sequence Number	16 bit counter which can be used to guarantee that multiple frames are in the correct sequence.	2 bytes
Source Address	This field is set to 0x00000000 and is filled in with the radio's address before sending over the air if the destination is set to a remote unit.	4 bytes
Destination Address	This field is set to 0x00000000 to address the local radio or set to the address of a remote unit.	4 bytes
Data Length	16-bit integer identifying the number of bytes of data in all of the data that follow.	2 bytes
Subcommand Byte	Contains a single ASCII digit to indicate the kind of utility command that follows.	1 byte
Subcommand Specific Data	Depends on what command is being executed. See the description of each reply in the table shown under the request frame.	0-127 bytes
CRC	This is the 16-bit CRC-CCITT value over the entire frame as described above.	2 bytes
End of Text (ETX)	Special Character designating the end of a frame.	1 byte = 0x03

Figure 18 Xetron Utility Reply Message Format

Identification Field Table

Each Hornet device maintains a non-volatile table of Identification values that can be used to categorize the device to simplify network communication among a collection of radios. This table can be tailored to fit a variety of applications. There are 256 bytes of EEPROM reserved for this table and each entry in the table can be as long as desired within the limits of the protocol. (Since a frame can only hold a maximum of 96 bytes of data, the entry must confine itself so that a Discover Device or Query frame can contain it).

An entry consists of a single byte ID value, a length byte, and a Value string. Preferably the ID and Value fields should be ASCII so that they can be displayed by the EEPROM.EXE utility. There is no limit to the number of entries in the table as long as the limits of the total table size are considered. A table can be stored in a Hornet at the factory and it can also be loaded or modified in the field via Configure Device commands.

An example of a table stored in a device's EEPROM might be as follows:

ID	Max Length	Value
'1'	8 bytes	Serial Number of Device (i.e. '1234567890')
'2'	10 bytes	Category of Device (i.e. 'Printer ')
'3'	10 bytes	Model Number (i.e. 'HP 5700')
'4'	20 bytes	Owner ID (i.e. '8370400655-1655')

A primary device may send out a broadcast Discover Device request to find all Printers in a listening range and get back several Discover Device Replies. It may then Query each device that responded until it finds the one with the proper Owner ID. It may then write the address of this printer in its own table or simply remember the address in its own volatile memory and issue Send Data requests to the printer when it has data to print. Alternatively, a primary device may send out a broadcast Discover Device request with an Owner ID field and a Value of '8370400655-????' where the question marks indicate a wildcard. Then any devices that match the first part of the Owner ID field in listening range will respond.

Error Codes

Error Code Name	*Value*	Meaning
SUCCESS	0	No error occurred.
DESTINATION_NOT_FOUND	1	Tried to contact the remote device but it did not answer the Ring.
SUCCESS_NO_WAIT	2	Remote communication was successful but the remote device is programmed to respond before actually flushing the data to its host.
INVALID_VALUES	3	A request was sent which contained one or more fields with illegal values.
INTERNAL_ERROR	4	Hornet firmware error while interfacing to the hardware.
CRC_ERROR_HOST	5	Frame received from the Host over the serial port had a bad CRC.
INVALID_COMMAND	6	The Hornet received a frame with an invalid Command Field.
REMOTE_DESTINATION_ILLEGAL	7	This frame type cannot be sent over the air.
RNR_TIMEOUT	8	The Remote Hornet timed out waiting for its Host to assert RTS and accept the data. See the RNR Timeout setting in the EEPROM settings.
CAPACITY_EXCEEDED	9	A request was made which exceeded the capacity of the Hornet (for example the ID won't fit in the table).
LINK_TIMEOUT	10	The Hornet was communicating with a remote radio but did not get a proper response within the time allotted in the EEPROM settings.
ALL_CHANNELS_BUSY	11	The Hornet could not send data over the air because it could not find a channel that was idle.
NAK_RECEIVED	12	The Hornet exceeded its number of attempts to send a packet of data and received a NAK on the final attempt. See the Max Retries setting in the EEPROM settings.
HOST_OVERRUN	13	The remote Hornet received more data to send to its Host before it had finished flushing the previous data. See the 'Withhold Reply' setting in the EEPROM settings for the remote device.
NO_FRAME_RECEIVED	14	When the remote Hornet reassembled the packets that it received there was not a complete frame to process.
RING_TIMEOUT	15	An abnormal condition occurred in the Hornet while trying to Ring a remote radio. This is not the normal timeout condition (see DESTINATION_NOT_FOUND).
DESTINATION_LOST	16	The Hornet was communicating with a remote radio but lost the connection part way through and could not recover it.
CRC_ERROR_RF	17	A frame was reassembled from packets received over the air but the frame had a bad CRC. This is an abnormal condition and should not normally occur.
ILLEGAL_COMMAND	18	
WRONG_VC_RECEIVED	19	Packet received with wrong Virtual Circuit ID for this frame
RING_COLLISION	20	Incoming ring detected while attempting to send a ring. (internal error that causes a frame retry)
UNKNOWN_ERROR	254	This is a catch-all for any unexpected error that could not be identified in the Hornet firmware.

Figure 19 Error Codes

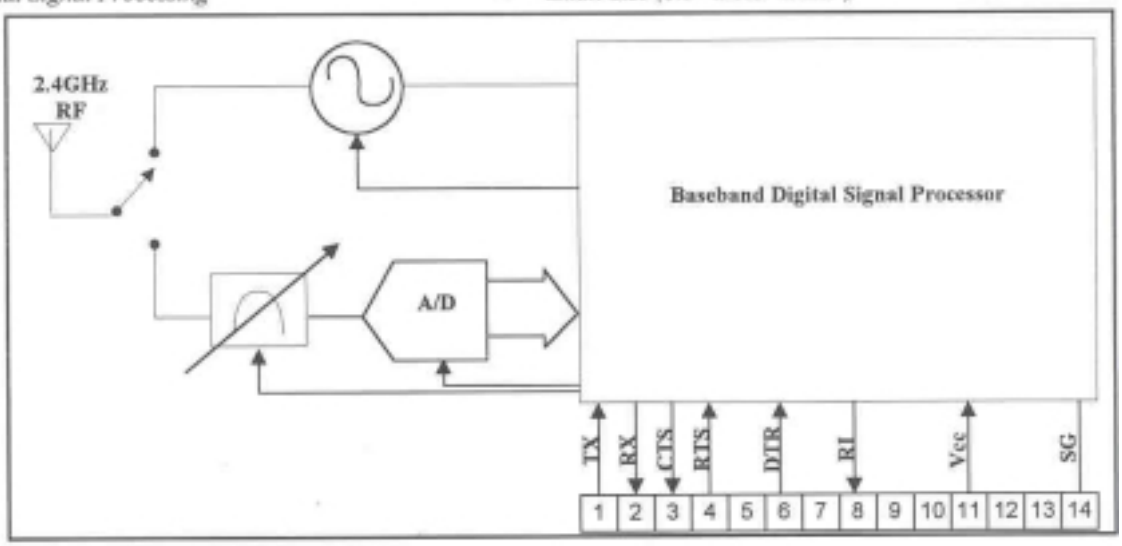
Appendix A
Specifications

Product Description

Xetron's *2.4 GHz HORNET* utilizes advanced DSP processing to direct sample the incoming RF waveform at 1 Million Samples per second (MSps) and digitally convert to a data stream for reliable bi-directional data transmission. It's small size, low power consumption and low cost make it ideal for integration into bar code data collection devices, wireless security, medical telemetry, automotive and other wireless data link applications.

Features

- *Fully Integrated Transceiver (data to antenna)*
- *2.4 GHz International Band*
- *Unlicensed Operation*
- *4 Channel Frequency Agility*
- *CSMA Collision Avoidance*
- *Digital Signal Processing*
- *Error Checking and Retransmission Protocol*
- *Point to Point and Point to Multi-Point Networking*
- *115.2 Kbps RF Channel Rate*
- *Programmable Serial Data Rate to 19.2 Kbps*
- *Low Power*
- *Small Size (1.5" x 1.0" x 0.3")*



Pin Function Description

Number	Name	Functional Description	Direction
1	TX	Transmit Data, 0 to 3.3 VDC Asynchronous Data	Input to Hornet
2	RX	Receive Data	Output from Hornet
3	CTS	Clear to Send, Transmit flow control to stop host data flow	Output from Hornet
4	RTS	Request to Send, RX flow control for host device to hold off radio data	Input to Hornet
5	*Reserved*		
6	DTR	Data Terminal Ready, Control signal used to power down the radio	Input to Hornet
7	*Reserved*		
8	RI	Ring Indicate, Indicates when the radio is ready to send data to the host	Output from Hornet
9	*Reserved*		
10	*Reserved*		
11	+3.3 VDC	Primary power to radio, +3.3 VDC ± 5%	Input to Hornet
12	Signal Ground	Signal ground return	
13	*Reserved*		
14	Power Ground	Power ground return	

Absolute Maximum Ratings

Rating	Pin	Symbol	Value	Units
Power Supply	11	Vcc	TBD	V
Input Signal Voltage	1,4	TX, RTS	TBD	V
DTR Control Signal	5	DTR	TBD	V

Recommended Operating Conditions

Rating	Pin	Symbol	Value	Unit
Power Supply Voltage	11	Vcc	+3.135 to +3.435	VDC
Ambient Temperature		Ta	-30 to +70	°C
Humidity (non-condensing)			0 to 95	%

Typical DC Characteristics (19.2 Kbps, Vcc=3.3VDC, -2 dBm Tx out)

Characteristic	Value	Unit
Transmit Current	30	ma
Active Receive Current	30	ma
Sleep Current	1.5	Ma
Receive Search Current (search for incoming Rf signal 25 times per second)	< 3	Ma
Power Down Current (DTR activated)	10	µA

Transceiver Performance

Characteristic	Value	Unit
Frequency Range	2.4 to 2.4835	GHz
Spread Method	Frequency Agile	
Number of RF Channels	4	
Channel Frequency:		
1	2.407	GHz
2	2.430	GHz
3	2.453	GHz
4	2.477	Ghz
Modulation	On-Off keyed	
Collision Avoidance	CSMA	
Bit Sampling Rate	1.152	MSps
Modulation Rate	230.4	Kbps
Channel Data Rate	115.2	Kbps
Transmit Power (Factory Set)	-2	dBm
Integrated Antenna Performance	+1	dBi
Receive Sensitivity		
@ 19.2 Kbps data throughput	-88	dBm
Error Detection Method	16 bit CRC (CCITT)	
Adjacent Channel Rejection		
1st Channel	25	dB
2nd Channel	35	dB
3rd Channel	45	dB
Rx to Tx / Tx to Rx Switching	1	µs

Transceiver Range

Transmit Power	Fade Margin	Range	Units
- 2 dBm	15 dB	100	ft
	25 dB	30	ft

Host Interface

Signal	Characteristic	Units
Serial Baud Rate (standard factory configuration – radio automatically wakes on detection of incoming serial data)	Programmable to 19.2	Kbps
Data (TX, RX)	Asynchronous	
Flow Control	CTS, RTS	

Mechanical Dimensions (all dimensions in inches)