RF Safety Compliance Information for FCC ID: QHC0001

The following document contains pertinent information related to the demonstration of compliance of the device under FCC ID QHC0001 to RF Safety Requirements and Regulations.

The document is divided into the following sections:

1. Statement of Applicable Rules for Devices Filed under FCC ID: QHC0001
2. Device operational configurations
3. Power Density Calculation

Appendix A - Typical Maximum Transmitter Duty Cycle Derivation
Appendix B – Installation Manual Excerpt on RF Safety

1. Statement of Applicable Rules

The CreataLink2 XT device falls into the definition of a mobile device as defined in Section 2.1091(b) of the FCC rules and must be utilized in such as way that it is greater than 20cm away from the body of persons nearby. As such, it is subject to the Maximum Power Exposure (MPE) limits specified in Section 1.1310, Table 1(B) for a product operating in the frequency range 300-1500MHz.

- Product Transmitter Operating Frequency range: 896-902Mhz
- MPE requirement for General Population/Uncontrolled Exposures:

  → Power Density not exceeding f/1500 mW/cm^2 with an averaging time of 6 minutes or
  → 0.601 mW/cm^2 at 902MHz

2. Device Configuration Options

The configuration of the device is defined by the following criteria:

- Output power
- Antenna gain of external antenna
- Transmitting data rate

The table below describes the worst-case available shipping configurations of this product:

Configuration	Output Power (mW)	Antenna Gain (dBi)	Antenna Gain (G)	Transmitting Data Rate (bps)
Configuration 1	2000	0	1	1600
Configuration 2	**2000**	**3**	**2**	**1600**
Configuration 3	2000	0	1	9600
Configuration 4	2000	3	2	9600

Table 1

Configuration 2 (in bold) is the worst-case operating configuration and is analyzed in Appendix A for determining maximum transmitter duty cycle for purposes of this submission.

3. Power Density Calculations

Power density for the product represented at 20cm is represented by the following formula:

Power Density @ Time Averaged Operation (Worst Case Duty Cycle)

$$\text{Power Density} = \frac{P_t * \text{Duty Cycle} * G}{4\pi * r^2} \quad \text{where}$$

P_t = Maximum conducted power (in mW) [2000mW]
G = Maximum antenna gain (in decimal) [2]
r = Distance from antenna (in cm) [20]
Duty Cycle = Maximum allowable transmitter % on time [43.6% or 0.436]
**For derivation of this duty cycle, see Appendix A.

The resultant power density @ 20cm = 0.347 mW/cm^2 versus a requirement of 0.601 mW/cm^2.

Appendix A – Typical Maximum Transmitter Duty Cycle Derivation

1. The ReFLEX Protocol Basics -

The ReFLEX protocol is a synchronous and scheduled protocol. Meaning, the transmitting device must be synchronized to the forward channel to be able to transmit and the network controller schedules device transmissions to optimally utilize the reverse or inbound channel capacity. The protocol bit stream is broken into frames of 1.875 seconds in length with each forward channel frame containing both system information and user data (when available to send).

Reverse channel/Inbound frames contain a aloha section reserved for requesting a time slot to transmit or for acknowledging a message. The aloha section of the frame is followed by the scheduled message section reserved for transmission of messages by devices as directed and scheduled by the network controller. For each 1.875-second frame, 1.68 seconds are maximally available for a single device to transmit on an unloaded network. The 1.68 seconds available for transmission is further broken down into 21 slots of 80ms each.

Reverse/inbound channel frame breakout:

1.875 second frame
- 0.195 seconds reserved for aloha transmissions
- 1.68 seconds for scheduled transmissions
  - 21 slots of 80ms length
    - 1 start address unit slot
    - 20 message data slots

2. Device Limitations Enforced in Firmware –

- The longest reverse/inbound channel message supported by the device is 2000 bytes (16,000 bits) of user data (max message size).
- At 1600bps, 2000 bytes (16000 bits) will require 9.63 frames to complete the transmission.
- Only 4 consecutive frames can be transmitted in before a non-transmitting frame is required to receive updated network synchronization.
- At the completion of the delivery of each message, operating system software provides delivery success/failure to an external application (200ms)
- If more application data is to be sent beyond the 2000 byte limit, the application must serially download a new message of maximum length 2000 bytes to the device at 9600 bps over an RS232 port with XMODEM transfer overhead requiring 2.1 seconds of download time.

3. Worst case (causing highest duty cycle) frame timing assumptions:

- A minimum of 1 frame delay time is required to obtain scheduling information from the system in response to an 'Inbound Message Request'.
- Assume that the received 'Scheduling' information from the system indicates that the inbound message transmission should begin in following frame.
- Assume 1 frame delay time for the system to acknowledge a complete inbound message.

4. Analysis of timing & frame sequence to deliver maximum size message:

The analysis starts with the assumption that a message has already been queued from the application and the device begins the delivery sequence in reference frame 1.

The complete cycle involving all steps indicated below can be repeated every 20 frames.

1600 bps Frame Sequence -
T R R T T T T R T T T T R T t R R T ^ T R R T T T T R T T T T R T T T T R T t R R T

		'Frame'	'Transmitter on time'
Transmit 'Inbound Message Req'	T	1	80.0 msec
Generic Receive Frame	R	2	0 msec
Receive Inbound Msg scheduling	R	3	0 msec
Transmit Data	T	4	1.68 sec
Transmit Data	T	5	1.68 sec
Transmit Data	T	6	1.68 sec
Transmit Data	T	7	1.68 sec
Generic Receive Frame	R	8	0 msec
Transmit Data	T	9	1.68 sec
Transmit Data	T	10	1.68 sec
Transmit Data	T	11	1.68 sec
Transmit Data	T	12	1.68 sec
Generic Receive Frame	R	13	0 msec
Transmit Data	T	14	1.68 sec
Partial Transmit Data	t	15	1.06 sec
Generic Receive Frame	R	16	0 msec
Receive system Ack	R	17	0 msec
Transmit final 'ACK Response'	T	18	80.0 msec
Application response delivery	^	19	0 msec
Application data download	#	20	0 msec

Span time before cycle repeats: 20 frames or 37.5 seconds
Total transmitter on time in cycle: 16.34 seconds

TRANSMITTER DUTY CYCLE: 43.6%

Where:

T- Transmit 'Inbound Message Request' to send Long Reverse
= 80.0 msec transmit time
T - Transmit ACK response that acknowledges completion of transaction
= 80.0 msec transmit time

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T - Transmission frame
       = 1.68 sec transmit time
t - Partial frame transmission
       = 1.06 msec transmit time
R - Generic Receive only frame
       = 0 msec transmit time
R - Receive Long Reverse scheduling info from system
       = 0 msec transmit time
R - Receive system Ack for completion of Long Reverse message
       = 0 msec transmit time
^ - Application sends new message to host to be transmitted (2.1 sec)
       = 0 msec transmit time
# - Application provided with response on success/failure of delivery (200msec)
       = 0 msec transmit time
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5. Summary

Given the operation of the ReFLEX protocol and the specifications of the device, the worst-case typical duty cycle is 43.6%.

Appendix B - Installation Manual Excerpt for RF Safety

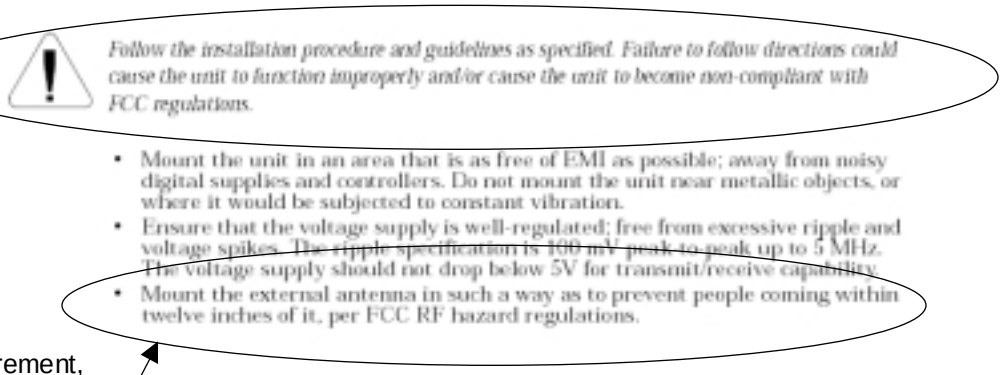
The following paragraphs are an excerpt from the product user manual. The circled areas are related to FCC compliance and RF Safety.

Installation

This chapter describes how to install the CreataLink2 XT device. Procedures are for basic external antenna installation.

Installation Overview

The data transceiver is a small, easy-to-operate product that requires comparatively little space. Installation requires common tools and equipment (see Table 5-2). A dimensional drawing is provided (see Figure 5-1).



Follow the installation procedure and guidelines as specified. Failure to follow directions could cause the unit to function improperly and/or cause the unit to become non-compliant with FCC regulations.

- Mount the unit in an area that is as free of EMI as possible; away from noisy digital supplies and controllers. Do not mount the unit near metallic objects, or where it would be subjected to constant vibration.
- Ensure that the voltage supply is well-regulated; free from excessive ripple and voltage spikes. The ripple specification is 100 mV peak-to-peak up to 5 MHz. The voltage supply should not drop below 5V for transmit/receive capability.
- Mount the external antenna in such a way as to prevent people coming within twelve inches of it, per FCC RF hazard regulations.

12-inch requirement, which is 30cm (exceeds 20cm requirement)