

## Introduction

### What is CRMXTM

CRMX is an acronym for Cognitive Radio MultipleXer - it is the first smart wireless system to automatically and continuously adapt to its surroundings in real time. CRMX was specifically developed to meet the demand for reliable, easy to use, and cost effective wireless lighting controls.

### CRMX Pluggy FX and Pluggy RX

#### Pluggy Radio Module

Building as a pin compatible replacement of the W-DMX TiNY module, LumenRadio offers CRXM Pluggy - the first plug-in module compatible with CRMX, CRMX2, W-DMX G3, G4S and G5.

Pluggy is tested according to ETSI EN 300 328 (v2.2.2) as well as pending FCC certification with a modular approval up to 50mW.

Pluggy allows for a flexible integration where the option to install the module or not can be done late in the manufacturing process, or even post-sales by a certified service technician.

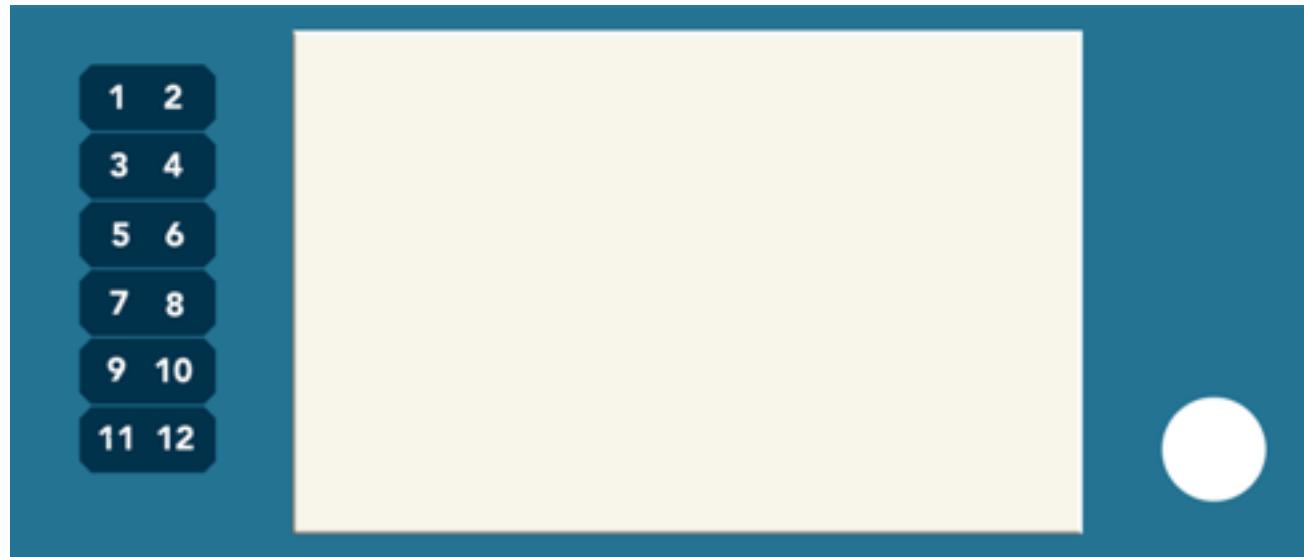
## Features

- Receives CRMX<sup>2</sup>, CRMX Classic, W-DMX G3, G4, G4S and G5.
- Transmits CRMX Classic, W-DMX G3 and G4S (FX version only)
- Supports ANSI E1.11 - DMX512-A and ANSI E1.20 - RDM (RDM in RX mode only, FX version only)
- Cognitive coexistence - dynamically avoids occupied frequencies (in CRMX modes)
- DMX fidelity and frame integrity
- DMX frame rate and frame size auto sensing
- Fixed 5 ms end-to-end latency
- U.FL/IPEX external antenna connector
- All configuration data is stored in non-volatile memory, 20 years data retention
- Pluggy contains upgradeable firmware for future proofing
- Over-the-air firmware upgrades

## Pin Assignments and Functions

This section describes the pin assignments and pin functions.

### Pin assignments

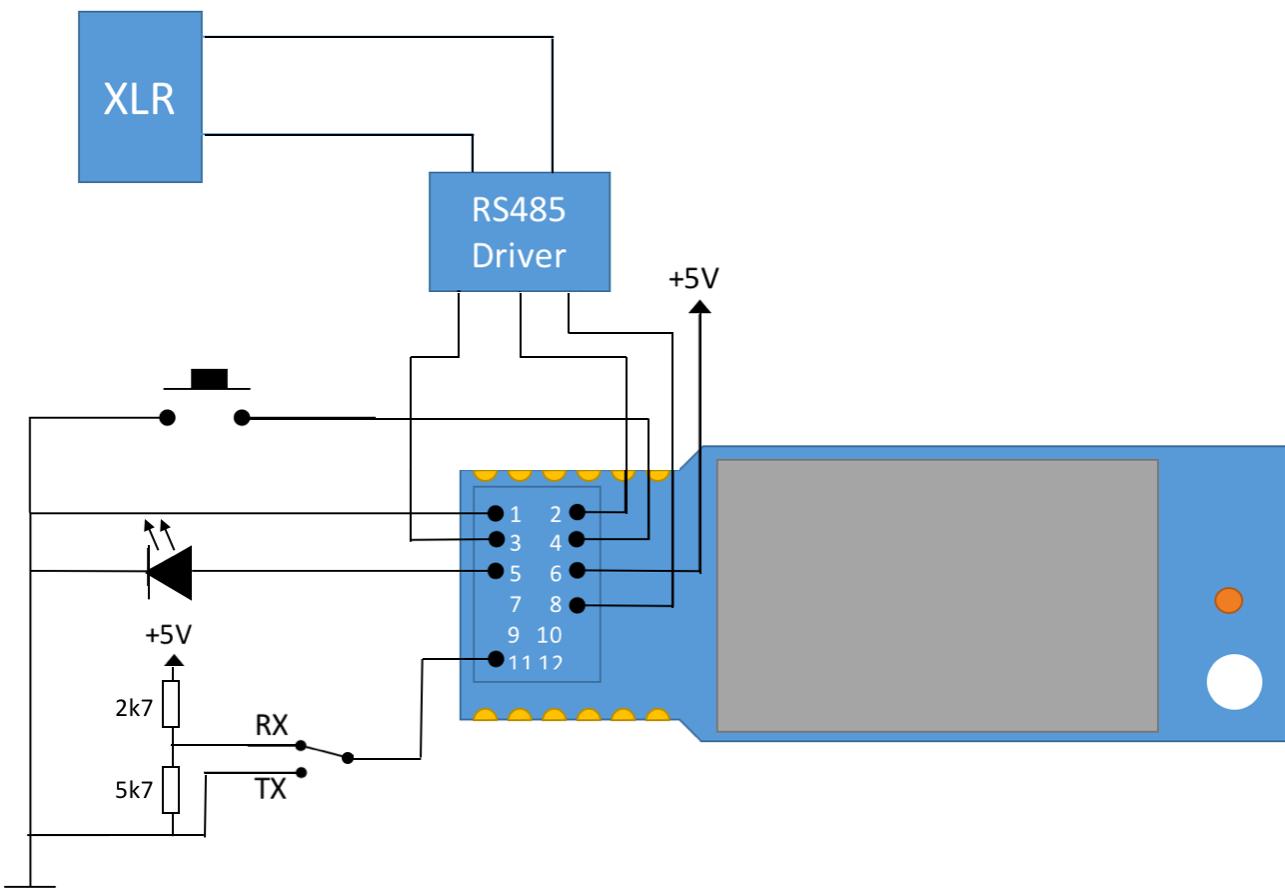


Module seen from the top

### Pin functions

Pin	Name	Pin type	Description
1	VSS	Power	Ground (0V)
2	DMX_RXD	Digital input	DMX RXD
3	DMX_TXD	Digital output	DMX TXD
4	LINK_SW	Digital input	Link control switch input
5	STATUS_LED	Digital output	Status LED
6	VDD	Power	Power supply (5V)
7	N.C.	No connection	Internal use only - do not connect
8	RS485_DIR	Digital output	RS485 driver direction control
9	RGB_RED	Digital output	RGB LED red signal
10	RGB_BLUE	Digital output	RGB LED blue signal
11	FLEX_MODE	Analog input	Flex mode selection pin (FX version only)
12	RGB_GREEN	Digital output	RGB LED green signal
ANT	RF_ANT	RF	Antenna connector

## Typical application circuit



Typical Application Circuit

## LED Outputs

## Status LED

The status LED (STATUS\_LED) indicates the status of the Pluggy module. The LED indicator pin is an output pin capable of sourcing 5mA at the 3.3V. An appropriate current limiting resistor must be connected in series with the LED.

## Receiver



Constant off (0V): Not linked to any transmitter



Flashing: off (0V) 100 ms / on (3.3V) 100 ms: linked to a transmitter, but no active radio link



Flashing: off (0V) 100 ms / on (3.3V) 900 ms: Active radio link, no DMX present



Constant on (3.3V): Active radio link, DMX data present

#### Transmitter (FX version only)



Flashing: off (0V) 100 ms / on (3.3V) 900 ms: Active radio link, no DMX present



Constant on (3.3V): Active radio link, DMX data present



Flashing: off (0V) 100 ms / on (3.3V) 100 ms: linking receivers



Flashing: off (0V) 200 ms / on (VDD) 200 ms: unlinking receivers

## RGB LED

### Receiver

In receiver mode the RGB LED indicates the signal quality of the received signal.

Color	Meaning	Comments
Green	>80%	Red = 0V, Green = 3.3V, Blue = 0V
Yellow	60-80%	Red = 3.3V, Green = 3.3V, Blue = 0V
Red	30-60%	Red = 3.3V, Green = 0V, Blue = 0V
White	<30%	Red = 3.3V, Green = 0V, Blue = 0V, 1Hz blink

### Transmitter (FX version only)

In transmitter mode the RGB LED indicates the currently used transmission protocol.

Color	Meaning	Comments
Black	CRMX	Red = 3.3V, Green = 3.3V, Blue = 3.3V
Green	W-DMX G3	Red = 0V, Green = 3.3V, Blue = 0V
Purple	W-DMX G4S	Red = 3.3V, Green = 0V, Blue = 3.3V

## Link switch input

The link switch input (LINK\_SW) can be used to interface with a momentary (monostable) closing push button to facilitate a simple user interface. This is an alternative to using the SPI interface to integrate into a host device's menu system.

This signal is Internally pulled high to 3.3V.

The switch input has several functions, please see the table below for details about the functions of the switch input.

Function	Conditions
Link	Only for transmitters. Pull signal low (button pressed) for 0.1-1 second.
Unlink	Hold signal low (button pressed) for >3 seconds.
Change RX/TX mode	See Mode selection for more info
Change TX protocol	See Mode selection for more info
Force firmware update mode	Hold signal low (button pressed) during power on, then release button.

## DMX Interface

The UART DMX/RDM interface of the Pluggy module consist of 3 digital signals that can be used to interface an RS485 driver IC compliant with the ANSI E1.11 DMX512-A standard to facilitate a DMX512-A compatible interface. Please refer to the example schematic for details on how to connect an RS485 driver IC. DE and DI signals shall both be connected to the direction pin (RS485\_DIR).

The DMX interface can also be used for CMOS/TTL level directly interfacing, for instance to a host CPU.

NOTE: Signal on RXD pin must NOT exceed 3.3V ! If 5V signal is used, a level shifting circuit must be used - for instance a voltage divider.

### DMX and RDM termination and line bias

DMX and RDM termination and line bias circuitry is not provided as part of Pluggy (since the data is provided at TTL level). This circuit is left to the device manufacturer to provide as required for each particular application and device.

Termination and line bias circuitry requirements shall follow "ANSI E1.20 - 2006 / Entertainment Technology-RDM-Remote Device Management over USITT DMX512 Networks" or later revisions.

IMPORTANT: Biasing is mandatory for all RDM implementations.

### DMX frame rate and size

Pluggy will auto sense the DMX frame rate and frame size and accept all variations that are within the USITT DMX-512 (1986 & 1990) and DMX-512-A standards.

Minimum DMX frame size is 1 slot and maximum is 512 slots.

Minimum DMX frame rate for normal operation is 0.8 frames per second and maximum is 830 frames per second.

Input frame rates below 0.8 frames per second, i.e. more than 1.25s has elapsed since the start of the last frame, will be treated as a loss of DMX. Pluggy modules in receiver mode will set the RS485 driver IC to input mode until another DMX frame is detected. Pluggy in transmitter mode will keep the RS485 driver in input mode.

CRMX will propagate DMX through the system maintaining the input frame rate and frame size with the exception of frame rates that exceed those allowed by the DMX 512-A standard. Different generations of W-DMX modes have individual behaviour in relation to frame rate and synchronisation.

Input DMX frame rates above 830 frames per second will propagate through the system at 830 frames per second to ensure that the DMX output is compliant with the DMX512-A standard.

## DMX start code frames

DMX packets with start codes other than the DMX default 0x00 (also known as the Null Start Code, or NSC) and the RDM start code (0xCC) will be propagated through the system, and are subject to the same rules and limitations as the null start code packets. Such frames are called Alternate Start Code, or ASC, frames.

## RDM start code frames

Frames with RDM start code (0xCC) are handled separately by transmitters in CRMX systems, as part of the proxy functionality. Transmitters manage the interleaving of RDM frames with null start code packets across the air, and may interleave other RDM frames that are needed to manage the proxy functionality. This may result in RDM frames appearing on the DMX/RDM interface in a different order than on the input of the transmitter.

All RDM frames are handled in compliance with the PLASA E1.20 standard.

Pluggy FX in transmitter nodes discards all frames with RDM start code (0xCC) and RDM draft start code (0xF0).

## Firmware update

The firmware in Pluggy can be updated. All manufacturers must consider the firmware update options to provide future proof integrations to the end-user.

## DMX interface

The preferred way to update firmware in Pluggy RX and Pluggy FX is via the DMX interface and the CRXM Upgrade cable. This requires the DMX interface to be accessible from outside the fixture.

See the link switch section for information on how to set Pluggy into firmware update mode. Use the CRXM Update utility to update the firmware.

## Over-the-air (OTA)

Pluggy FX and RX can be updated over-the-air by utilizing a special software tool that can be obtained from LumenRadio together with the CRXM Upgrade cable.

For details about updates or for recommendations, please contact support.

## Mode selection (FX version only)

This chapter describes the different methods of selecting between the different flex modes – also known as modes of operation. This only applies to Pluggy FX. Pluggy RX can not be configured for this as it is only a receiver module.

### Flex mode (RX/TX)

The Pluggy FX can act either as receiver or a transmitter of wireless DMX. The mode must be selected for the device to operate in the right way.

#### Selecting via input signal

Pin 11 on the module controls the flex mode selection behaviour. Note: Voltage on Pin 11 may not exceed 3.3V.

Voltage	Description
< 0.5V	Transmitter mode
1.5-1.8V	Software controlled
> 2.8V	Receiver mode

#### Software controlled mode selection

**At power up** Holding the link switch input low while powering up the device, and then releasing the input to go high within 3 seconds will toggle the RX/TX mode.

**During operation** By pressing the link switch shortly 5 times, and then press-and-hold the button for at least 3 seconds enters TX/RX mode selection. The Status LED will blink to indicate the currently selected mode. Press link switch momentarily to toggle mode, press-and-hold the link switch for at least 3 seconds to store the selection.

2 Hz blink: TX mode selected

5 Hz blink: RX mode selected

#### TX protocol selection

By pressing the link switch shortly 3 times, and then press-and-hold the button for at least 3 seconds enters TX protocol selection. The RGB LED will blink fast in different colors to indicate the currently selected protocol.

Press link switch momentarily to toggle mode, press-and-hold the link switch for at least 3 seconds to store the selection.

Color	Meaning	Comments
White	CRMX	Red = 3.3V, Green = 3.3V, Blue = 3.3V
Green	W-DMX G3	Red = 0V, Green = 3.3V, Blue = 0V
Purple	W-DMX G4S	Red = 3.3V, Green = 0V, Blue = 3.3V

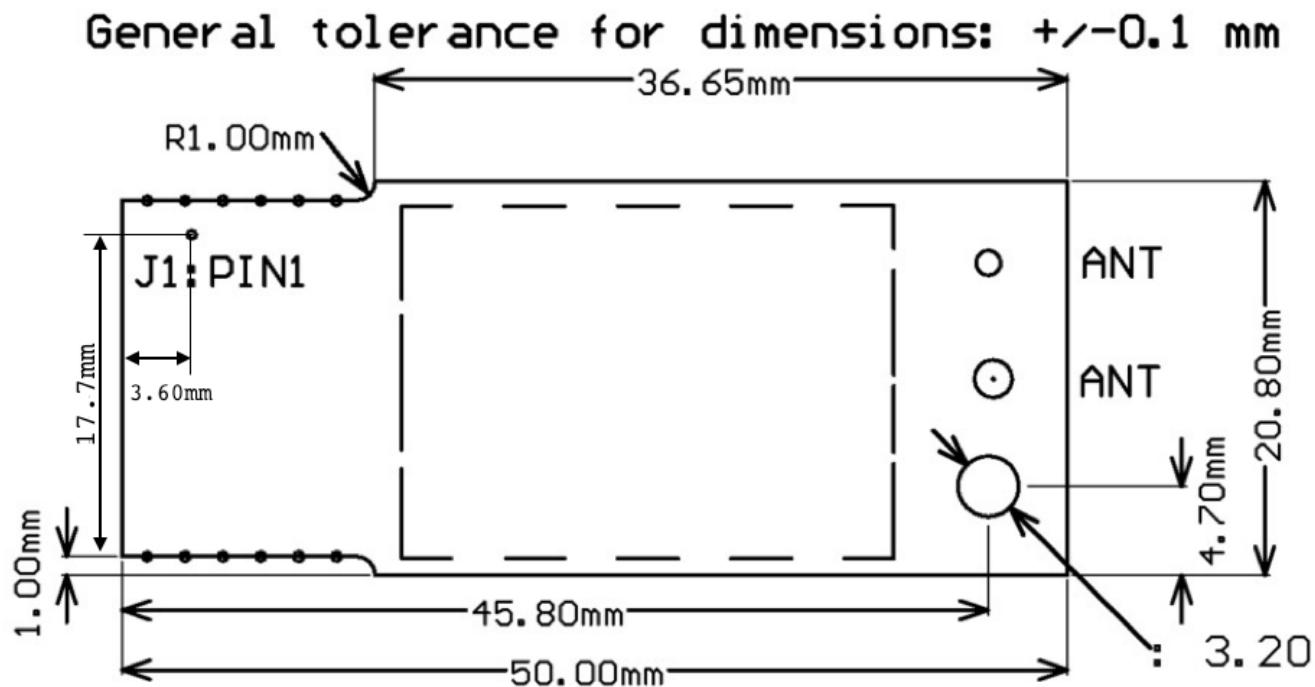
## Specifications

### Electrical

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{DD}$	Supply voltage	4.5	5.0	5.5	V
$I_{DD\_TX}$	Supply current TX mode		150	250	mA
$I_{DD\_RX}$	Supply current RX mode		50	100	mA
$T_A$	Operating temperature	-20		75	°C
$V_{IL}$	Input voltage logic low	0		0.9	V
$V_{IH}$	Input voltage logic high	2.5		3.3	V
$I_{LED}$	Max current drive on LED pins			5	mA
$f_{range}$	Operating frequency range	2402		2480	MHz
$RX_{sens}$	Receiver sensitivity (0.1% BER)		-88		MHz
$TX_{pout}$	TX output power <sup>1</sup>			16	dBm
$DMX_{size}$	DMX frame size (excluding start code)	0		512	
$DMX_{rate}$	DMX frame rate	0.8		830	fps

<sup>1</sup>From 2.15dBi antenna

### Mechanical



### Product marking

Products containing a Pluggy module shall be marked such that it is easy to identify the presence of LumenRadio's CRMX technology within the product. LumenRadio artwork is available by contacting us at [help@lumenradio.com](mailto:help@lumenradio.com)

In marketing materials the radio link shall be referred to as either a "wireless link", "LumenRadio wireless DMX", "CRMX wireless DMX", "LumenRadio inside", "Powered by LumenRadio" or similar. Additional body text is acceptable to explain this is a DMX receiver.

## Product documentation and menu systems

When referring to the Pluggy module and related behaviors within documentation and menu systems, the system should be referred to as a "wireless link" and/or "CRMX" (or derivations thereof).

Suggested terms and definitions are contained in the table below:

Term	Definition
CRMX Wireless link	The top level term used to describe the CRMX radio system.
Linked	The CRMX radio system has been linked with a compatible transmitter.
Unlinked	The CRMX radio system is awaiting linking from a compatible transmitter.

## Logo Syndication

By using CRMX modules in your product, you become one of LumenRadio's valued partners. Our website and catalog carry an array of partner logos and it is expected that your logo will be included alongside these. Marketing information, logos and case studies can be sent to the marketing contacts for inclusion in future marketing efforts.

## Production Testing

All CRMX modules are factory tested before being shipped. However, it is advised to perform some level of testing as part of your products overall test process. LumenRadio would be happy to advise on production testing – please contact LumenRadio for advice.

## Compliance information

FCCID: XRSPLUGGY101

IC: 8879A-CRMXPLUGGY

Model: CRMX Pluggy FX

## CE

Pluggy FX and Pluggy RX comply with the Essential Requirements of RED (Radio Equipment Directive) of the European Union (2014/53/EU). Pluggy FX and Pluggy RX meet the ETSI EN 300 328 V2.2.2 conformance standards for radio performance.

## FCC information

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference, and  
this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## FCC Radiation Exposure Statement

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device, for example, USB dongle like transmitters is forbidden. This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: XRSPLUGGY101 Or Contains FCC ID: XRSPLUGGY101"

When the module is installed inside another device, the user manual of this device must contain below warning statements:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

The end user manual shall include all required regulatory information/warning as shown in this manual, include:

This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

## Requirement per KDB996369 D03

### List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter.

### Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

### Limited module procedures

The module is a single module, not applicable.

### Trace antenna designs

Not applicable.

### RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

### Antennas

This radio transmitter has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. FCC ID: XRSPLUGGY101

Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Type of antenna	Gain of antenna	Frequency range
104-1001	Dipole	2.15 dBi	2400-2500 MHz

### Label and compliance information

The final end product must be labeled in a visible area with the following "Contains FCC ID: XRSPLUGGY101".

### Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

### Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

### Note EMI considerations

The host manufacturer is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

### How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacturer only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

## Industry Canada statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

This device may not cause interference.

This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

L'appareil ne doit pas produire de brouillage;

L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## Radiation Exposure Statement

The device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102 and compliance with RSS-102 RF exposure, users can obtain Canadian information on RF exposure and compliance. Le dispositif rencontre l'exemption des limites courantes d'évaluation dans la section 2.5 de RSS 102 et la conformité à l'exposition de RSS-102 rf, utilisateurs peut obtenir l'information canadienne sur l'exposition et la conformité de rf.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ou émetteur. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

This device complies with RSS 247 of Industry Canada. This Class B device meets all the requirements of the Canadian interference-causing equipment regulations. Cet appareil numérique de la Classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

The final end product must be labeled in a visible area with the following "Contains IC: 8879A-CRMXPLUGGY".

## Other Compliances

For other local compliance regulations (CE, UL, CSA, SRRC, C-Tick, etc.) you are responsible as the product manufacturer to ensure all required compliance testing is completed. LumenRadio are happy to advise on compliance testing – please contact LumenRadio for details.