	RF_LINK	1	R	0	0 = No radio link, 1 = Active radio link
	Reserved	2	-	-	Reserved for future use
	DMX	3	R	0	0 = No DMX from TX, 1 = DMX from TX
	Reserved	4-6	-	-	Reserved for future use
	UPDATE_MODE	7	R	0	0 = chip operational, 1 = In driver update mode
02	**IRQ_MASK**				**IRQ mask register**
	RX_DMX_IRQ_EN	0	R/W	0	Enable DMX frame reception interrupt
	LOST_DMX_IRQ_EN	1	R/W	0	Enable loss of DMX interrupt
	DMX_CHANGED_IRQ_EN	2	R/W	0	Enable DMX changed interrupt
	RF_LINK_IRQ_EN	3	R/W	0	Enable radio link status change interrupt
	ASC_IRQ_EN	4	R/W	0	Enable alternative start code interrupt
	Reserved	5-7	-	-	Reserved for future use
03	**IRQ_FLAGS**				**IRQ flags register**
	RX_DMX_IRQ	0	R	0	Complete DMX frame received interrupt
	LOST_DMX_IRQ	1	R	0	Loss of DMX interrupt
	DMX_CHANGED_IRQ	2	R	0	DMX changed in DMX window interrupt
	RF_LINK_IRQ	3	R	0	Radio link status change interrupt
	ASC_IRQ	4	R	0	Alternative start code frame received interrupt
	Reserved	5-6	-	-	Reserved for future use
	SPI_DEVICE_BUSY	7	R	0	SPI slave device is busy and cannot comply with command. Command sequence MUST be restarted.
04	**DMX_WINDOW**				**Status register**
	START_ADDRESS	0-15	R/W	0	Start address of DMX window
	WINDOW_SIZE	16-31	R/W	512	Length of DMX window
05	**ASC_FRAME**				**ASC frame info register**
	START_CODE	0-7	R	0	Start code of received ASC frame
	ASC_FRAME_LENGTH	8-23	R	0	Length of received ASC frame (0-512)
06	**LINK_QUALITY**				**Radio link quality register**
	PDR	0-7	R	-	Packet delivery rate (display as %) 0 = 0%, 255 = 100%
07	**ANTENNA**				**Antenna selection register**
	ANT_SEL	0	R/W	0/1[3]	0 = On-board chip antenna, 1 = IPEX/u.FL connector
	Reserved	1-7	-	-	Reserved for future use
10	**VERSION**				**Version register**
	DRIVER_VERSION	0-31	R	-	Driver version
	HW_REVISION	32-64	R	-	Hardwarerevision
20	**BINDING_UID**				**RDM binding UID register**
	UID	0-47	R/W	0	RDM UID of the host device

[3] Depending on the value of ANT_SEL pin.

Interrupts

The IRQ pin is used to indicate that there is one (or more) pending interrupt that have been enabled through the IRQ_MASK register. The IRQ pin is also used to indicate that the SPI slave is ready to receive the second transaction of an ongoing SPI command sequence.

The IRQ pin will always go high (inactive) after a successful SPI transaction. If any interrupts are pending, or when the chip is ready for the second transaction in a SPI command sequence it will be indicated through a high-to-low transition on the IRQ pin.

RX_DMX_IRQ

Asserted when a complete DMX frame has been received. Cleared by issuing a READ_DMX command sequence.

LOST_DMX_IRQ

Asserted when DMX stream is lost. This may be an effect of losing radio link, or if DMX stream in to the transmitter is terminated (for instance the DMX cable to the transmitter is unplugged). Cleared by reading the STATUS register.

DMX_CHANGED_IRQ

Asserted when a complete DMX frame has been received and any slot within the DMX window has changed value. Cleared by issuing a READ_DMX command sequence.

RF_LINK_IRQ

Asserted whenever the state of the radio link has changed. This may be:

- radio link is lost
- radio link is established
- receiver got paired to transmitter
- receiver got unpaired from transmitter

Cleared by reading the STATUS register.

ASC_IRQ

Asserted when a complete ASC frame has been received. Cleared by reading the ASC_FRAME register.

DMX Window register

The DMX_WINDOW register is used for setting up the DMX window filtering function. Please refer to the section about DMX window on page 19 for more details.

Antenna selection

This register allows for controlling if the on-board chip antenna or an external antenna connected to the IPEX/u.FL connector is being used. This register overrides the selection made via the ANT_SEL pin. ANT_SEL pin is internally pulled high to default to IPEX/u.FL connector.

	Brand	Model Name	Gain(dBi)	Photo
External Antenna	CRMX	104-1001	2.15	
Internal Antenna	JOHANSON TECHNOLOGY	2450AT18A100	0.5	

Version register

This section describes the data that can be read from the VERSION register.

Hardware revision

Hardware revision is a 32bit number that shall be translated into a string. It indicates the revision number of the TiMo module. For instance the 32 bit value in hexadecimal form 0x000A0001 corresponds to module revision “000A0001”.

Driver version

The driver version is a 32bit value that shall be translated into a string on the form X.Y.Z.Y where X is the most significant byte of the 32 bit version number and Y is the least significant byte. For instance the 32 bit value 0x01000103 shall be presented as 1.0.1.3 on any UI or in any written representation.

Binding UID

The binding UID register can be written by the host processor to match the fixture’s RDM UID. This will result in SuperNova combing the devices together in the UI representation, resulting in a better user experience with a more user-friendly interface.

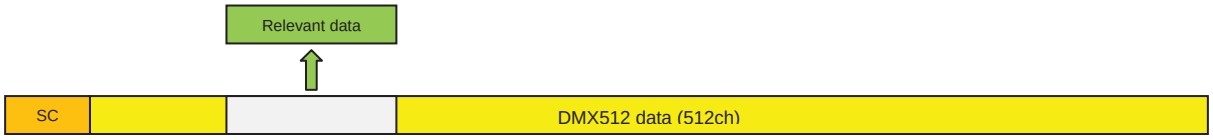
DMX Interface

SPI

DMX data is available to be read over SPI. This applies to both Null Start Code (NSC) data and Alternate Start Code (ASC) data.

DMX window

The DMX window feature allows a host CPU to set up a span of DMX slots (aka. a DMX window) that the host is interested of. This will reduce the load of the host since it does not need to buffer and parse the entire DMX frame.
Instead the host can get an interrupt request (DMX_CHANGED_IRQ) from TiMo RX RDM whenever data has changed inside the DMX window.
RX_DMX_IRQ is not affected by the settings of the DMX window.



Reading DMX data over SPI

When reading DMX data over SPI, the longest block of data possible to read is 128 bytes. If it is required to read more than 128 bytes this must be done by performing multiple consecutive READ_DMX command sequences.

The internal data block counter is reset when the end of the DMX window is reached, or if any other command is being sent to the SPI slave.

Please note that RDM start code messages are not currently supported over the SPI interface, so RDM communications shall be carried out over the UART DMX/RDM interface (pins 8, 10, 11 and 12).

UART DMX/RDM interface

The UART DMX/RDM interface of the TiMo RX RDM consist of 4 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.

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

NOTE: Signal on RXD pin must **NOT**exceedV_{DD}! If 5V signal is used, a level shifting circuit must be used. Please see example schematics on page 7for details on how to use a 5V IC.

DMX and RDM termination and line bias

DMX and RDM termination and line bias circuitry is not provided as part of TiMo (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

TiMo RX RDM 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 last frame, will be treated as a loss of DMX and the RS485 driverIC will be set in a high-impedance/tri-state mode until another DMX frame is detected.

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.

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 codes

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) arehandled 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 can appear on the DMX/RDM interface in a different order than on the input of the transmitter.
All RDM frames are handling in compliance with the PLASA E1.20 standard.

Alternate start code frames

ASC (Alternate Start Code) frames can be read separately from the SPI interface or the DMX/RDM interface. Over SPI, the ASC_FRAME register contains basic information about the last received ASC frame. The information available in this register is start code and length (number of slots).

Reading ASC data over SPI

When reading ASC data over SPI, the longest block of data possible to read is 128 bytes. If it is required to read more than 128 bytes this must be done by performing multiple consecutive READ_ASC command sequences.

The internal data block counter is reset when the end of the ASC frame is reached, or if any other command is being sent to the SPI slave.

Output Power

The radio output power of the TiMo module can not be directly controlled. Instead the radio output power is automatically adjusted to match the output power from the transmitter.

Radio driver update

The radio drivers in TiMo RX RDM can be updated. This can be performed via SPI from a host processor in a fixture, or over the air or via the DMX/RDM interface.
For details about updates, please contact LumenRadio.

Specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Supply voltage	3.0	3.3	3.6	V
I_{DD}	Supply current[4]			25	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)		-93		dBm
DMX_{size}	DMX frame size (excluding start code)	0		512	
DMX_{rate}	DMX frame rate	0.8		830[5]	fps

[4]Not including current for driving LEDs
[5]Limited to 830fps on DMX output by DMX512-A standard

Product marking

Products containing the TiMo RX RDM shall be marked such that it is easy to identify the presence of CRMX technology within the product. A “CRMX inside” artwork is available from LumenRadio.

In marketing materials the radio link shall be referred to as either a “wireless link”, “CRMX wireless DMX” or “CRMX inside”. Additional body text is acceptable to explain this is a DMX receiver. The wireless link must not be referred to as “W-DMX”, “WDMX” nor only “Wireless DMX” in any literature related to products using the TiMo RX RDM.

Product documentation and menu systems

When referring to the TiMo RX RDM and related behaviors within documentation and menu systems, the system should be referred to as a “wireless link” and/or “CRMX” (or derivations thereof), and must not be referred to as “W-DMX”, “WDMX” or similar, nor only “Wireless DMX”. “CRMX wireless DMX” is accepted.

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 LumenRadios valued partners. Our website and catalog carry an array of partners 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 (listed on page 28) for inclusion in future marketing efforts.

Design Verification

LumenRadio operates a full RF laboratory in Sweden and can offer design verification and testing services – please contact LumenRadio for advice.

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

FCC information

FCC Information to User

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' authority to operate the equipment.

FCC Guidelines for Human Exposure

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 anyother antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

FCC Radio Frequency Interference Warnings & Instructions

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following methods:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver

- Connect the equipment into an electrical outlet on a circuit different from that which the radio receiver is connected
- Consult the dealer or an experienced radio/TV technician for help.

Modifications made to the product, unless expressly approved by LumenRadio AB., could void the user's right to operate the equipment.

Industry Canada statement

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présentappareilnumeriquenémet pas de bruits radioélectriquesdépassant les limitesapplicables aux appareilsnumériques de la classe B prescritesdans le Réglementsur le broullageradioélectriqueédicté par le ministére des Communications du Canada.

CE

TiMo RX RDM complies with the Essential Requirements of the R&TTE Directive of the European Union (1999/5/EC). TiMo RX RDM meets the ETSI EN 300 328 V1.8.1 and ETSI EN 300 328 V1.9.1 conformance standards for radio performance.

Compliance Marking

FCC

The CRMX modules are certified for FCC as a single-modular transmitter.

CRMX modules are FCC certified radio module that carries a “Modular” grant CRMX radio modules complies to the “Intentional Radiator” portion (Part 15c) for FCC certification: Part 15.247 Transmitter tests.

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: XRSCRMXTIMO101” or “Contains FCC ID: XRSCRMXTIMO101”.

When the module is installed inside another device, the user manual of this device must contain below warning statements:
1. 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.
(2) This device must accept any interference received, including interference that may cause undesired operation.
2. 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.

Industry Canada

Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage;
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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.

If the IC 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 IC: 8879A-CRMXT101".

When the module is installed inside another device, the user manual of this device must contain below warning statements:
1. This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
2. Cet appareil est conforme aux CNR exemptes de licence d'Industrie Canada . Son fonctionnement est soumis aux deux conditions suivantes :
(1) Ce dispositif ne peut causer d'interférences ; et
(2) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.
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 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 IC 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. Cette modulaire doit

être installé et utilisé à une distance minimum de 20 cm entre le radiateur et le corps de l'utilisateur.

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.

Order codes

Order code	Item
800-8105	TiMo RX RDM

LumenRadio Contacts

Sales: sales@lumenradio.com
Technical: support@lumenradio.com
Marketing: sales@lumenradio.com
Telephone: +46 (0)31 301 03 70

Mechanical specifications

TiMo RX RDM

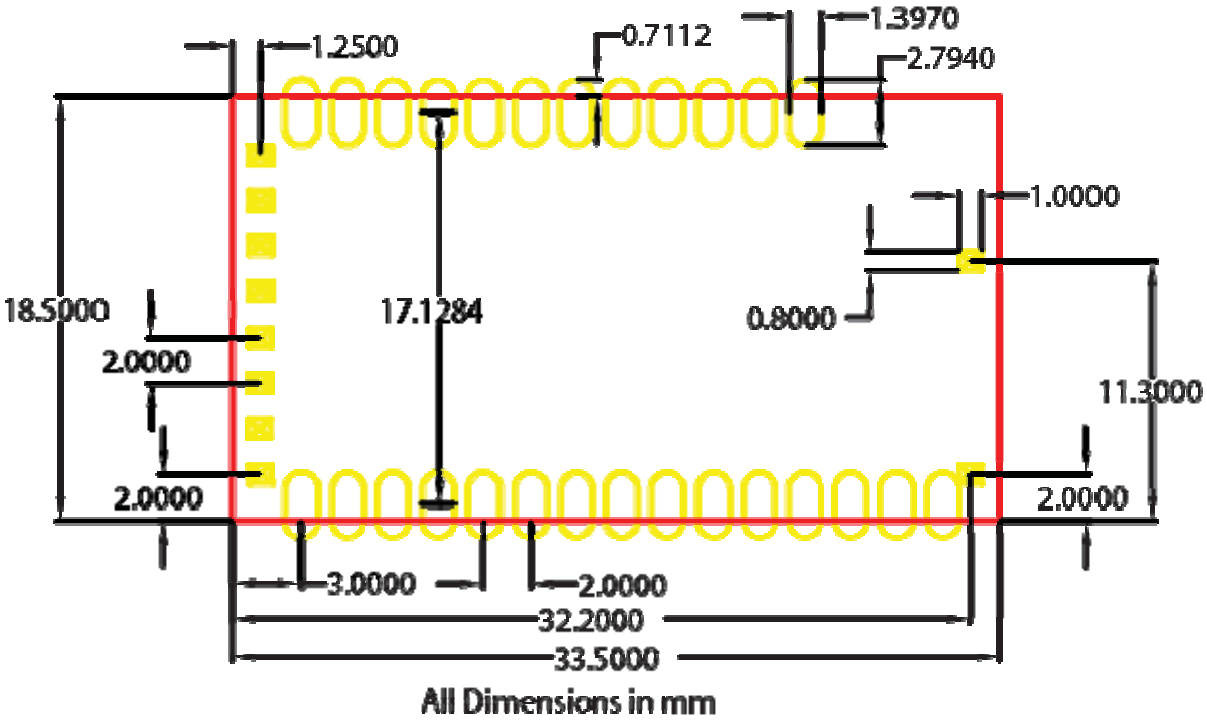


Figure 5: Mechanical specifications

Revision history

Document revision	Release date	Comment	Status
A	2014-10-02	First release	Released