



# User guide / operational instruction

## Timo Two FX

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PA4 (2019-08-15)

### SUMMARY

This document describes the technical and user aspects of the Timo Two FX radio module.

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# 1 Introduction

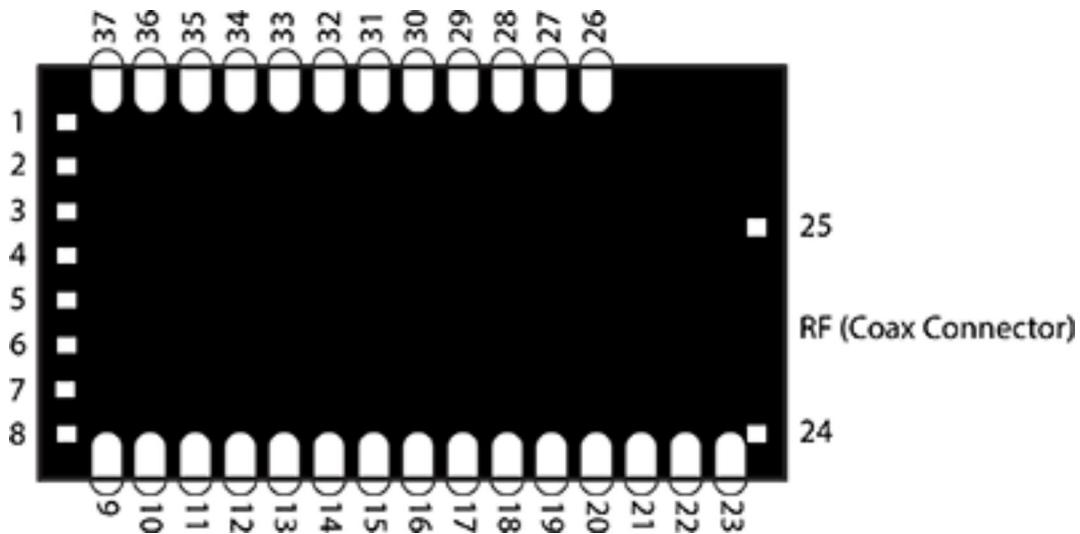
## 1.1 Features

- Supports ANSI E1.11 - DMX512-A and ANSI E1.20 - RDM
- Connectivity based on Bluetooth Smart, allowing for easy connection from any phone or tablet
- Cognitive coexistence - dynamically avoids occupied frequencies
- DMX fidelity and frame integrity
- DMX frame rate and frame size auto sensing
- Fixed 5 ms end-to-end latency
- Small footprint at 18.5 mm x 33.5 mm
- U.FL/IPEX external antenna connector
- All configuration data is stored in non-volatile memory, 20 years data retention
- Over-the-air firmware upgrades

# 2 Pin assignment and functions

This section describes the pin assignments and pin functions.

## 2.1 Pin assignments



Module seen from the top

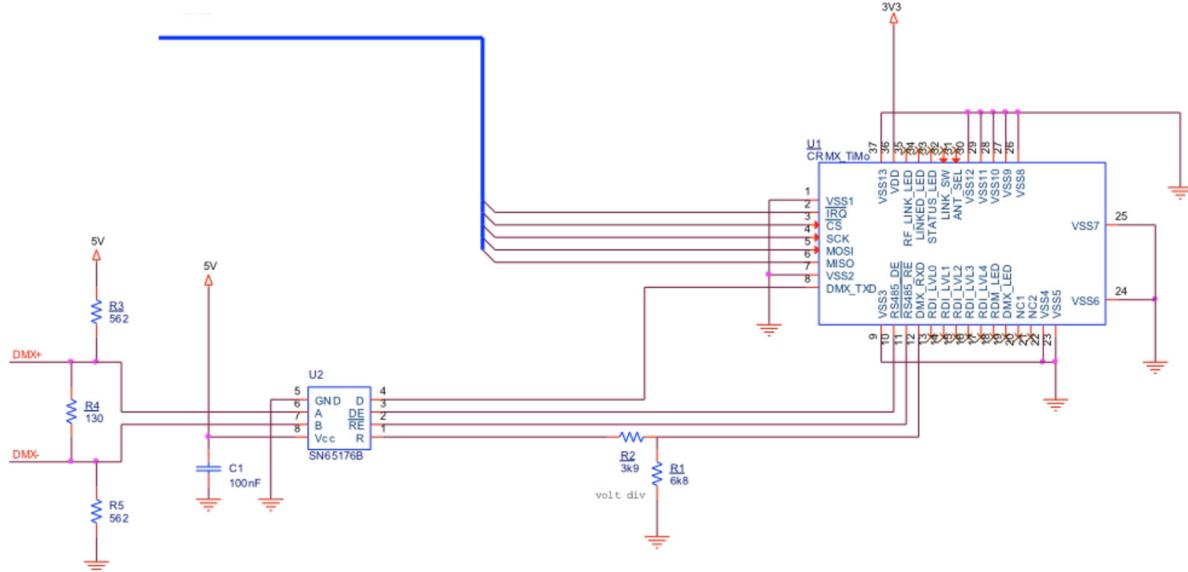
## 2.2 Pin functions

Pin	Name	Pin type	Description
<b>1</b>	VSS	Power	Ground
<b>2</b>	IRQ	Digital output	Interrupt signal, active low
<b>3</b>	CS	Digital Input	Chip select, active low
<b>4</b>	SCK	Digital input	SPI clock

<b>5</b>	MOSI	Digital input	SPI Master out, slave in
<b>6</b>	MISO	Digital output	SPI Master in, slave out
<b>7</b>	VSS	Power	Ground
<b>8</b>	DMX_TX	Digital output	DMX TXD
<b>9</b>	VSS	Power	Ground
<b>10</b>	RS485_DE	Digital output	RS485 control signal
<b>11</b>	RS485_RE	Digital output	RS485 control signal
<b>12</b>	DMX_RXD	Digital input	DMX RXD (3.3V max)
<b>13</b>	RDI_LVL0	Digital output	LED control
<b>14</b>	RDI_LVL1	Digital output	LED control
<b>15</b>	RDI_LVL2	Digital output	LED control
<b>16</b>	RDI_LVL3	Digital output	LED control
<b>17</b>	RDI_LVL4	Digital output	LED control
<b>18</b>	RDM	Digital output	LED control
<b>19</b>	DMX	Digital output	LED control
<b>20</b>	N.C.	No connection	Do not connect
<b>21</b>	N.C.	No connection	Do not connect
<b>22</b>	VSS	Power	Ground
<b>23</b>	VSS	Power	Ground
<b>24</b>	VSS	Power	Ground
<b>25</b>	VSS	Power	Ground
<b>26</b>	VSS	Power	Ground
<b>27</b>	VSS	Power	Ground
<b>28</b>	SCL	Digital input/output	I2C clock to RGB LED driver <sup>1</sup>
<b>29</b>	SDA	Digital input/output	I2C clock to RGB LED driver <sup>1</sup>
<b>30</b>	VSS	Power	Ground
<b>31</b>	N.C.	No connection	Do not connect
<b>32</b>	LINK_SW	Digital input	Link control switch input
<b>33</b>	STATUS_LED	Digital output	LED control
<b>34</b>	LINKED	Digital output	LED control
<b>35</b>	RF_LINK	Digital output	LED control
<b>36</b>	VDD	Power	3.3VDC
<b>37</b>	VSS	Power	Ground
<b>ANT</b>	RF ANT	RF	Antenna connector

<sup>1</sup>Shall be pulled high (to Vcc) through a 4.7 kOhm resister if RGB LED is used.

## 2.3 Typical Application Circuit



## 3 Reference design and PCB mounting

### 3.1 Reference design files

A complete reference design including PCB layout and PCB design guidelines is available from LumenRadio to make integration easier. Please send your inquiry to LumenRadio for details.

### 3.2 PCB mounting

#### 3.2.1 Antenna

The antenna connector of the module is of u.FL type. A coax cable with a characteristic impedance of 50 ohm shall be used to connect an antenna.

The antenna shall have a characteristic impedance of 50 ohm at 2.45GHz.

#### 3.2.2 Layout considerations for the main board

TimoTwo has been specifically designed in order to achieve good RF performance. In order to maintain this, there are some guidelines that we would like to stress:

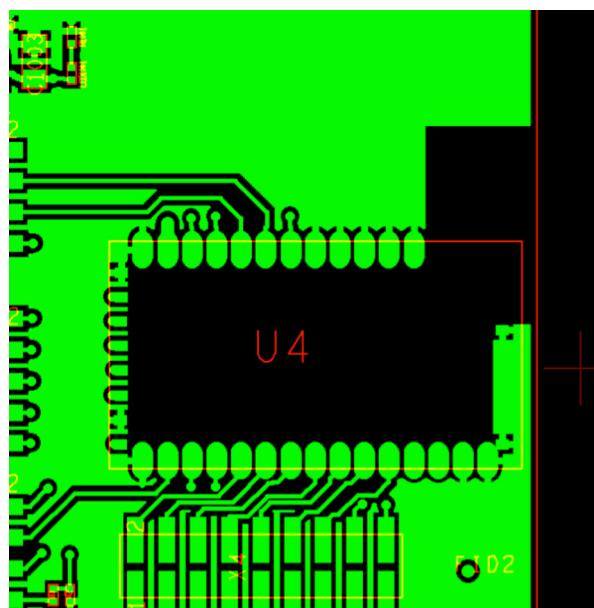
The use of ground planes also on the main board cannot be emphasized enough. Good decoupling of any high speed digital circuitry is a must. Many embedded type microprocessors today have clock frequencies with clocks or overtones that reach well into the GHz range. It is perfectly possible for an embedded design to pass any EMC certification and still cause disturbances that will block the RF reception of the TimoTwo module. The sensitivity of the TimoTwo receiver is -96dBm therefore it is recommended to keep disturbances below -100dBm in the frequency range of operation.

A near field probe connected to a spectrum analyzer will show if there are any disturbances present on the 2.45 GHz band generated by the microprocessor or any other device that is placed on the main board. Pay special attention to readymade LAN-products "Server in a RJ connector". They pass EMC certifications, but some of them radiate badly on 2.45 GHz. If disturbances can be seen on a spectrum analyzer - then the TimoTwo module will have impaired reception.

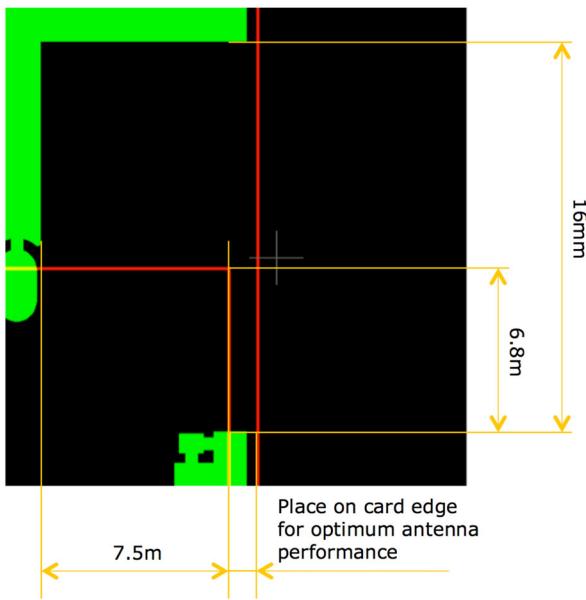
TimoTwo has a supply voltage decoupling on the circuit board. The supply voltage still needs to be adequately filtered. If any disturbance or intermittent communication failures occur, as one of the trouble shooting steps - check the supply voltage for drop-outs, switch supply ripple etc.

### 3.2.3 Layout Example

1. The TOP layer inside the footprint must be free from copper. There is a ground plane on the module, but there are also supply lines. It is an unnecessary risk to rely on solder mask lacquer for isolation.
2. An area around the board edge must be kept clear from copper on all layers as depicted in the picture below.



Minimum dimensions for ground plane clearance for optimum performance are shown below:



## 4 Specifications

### 4.1 Electrical

Symbol	Parameter	Min	Typ	Max	Unit
$V_{DD}$	Supply voltage	3.0	3.3	3.6	V
$I_{DD}$	Supply current		150	250	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 on LED pins			5	mA
$f_{range}$	Operating frequency range	2402		2480	MHz
$R_{X_{sens}}$	Receiver sensitivity		-96		dBm
$TX_{pout}$	TX output power <sup>1</sup>	5		20	dBm

<sup>1</sup>From 2dBi antenna

## 5 Compliance information

### 5.1 FCC information

#### 5.1.1 Federal Communication Commission Interference Statement

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 generates, 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 of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### **FCC Caution**

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

#### **5.1.2 FCC Declaration of Conformity**

We LumenRadio AB, Svangatan 2B, 41668 Gothenburg, Sweden, declare under our sole responsibility that Mira MWA-N2 comply with Part 15 of FCC Rules.

#### **5.1.3 FCC Radiation Exposure Statement**

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. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device is intended only for OEM integrators under the following conditions:

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- (2) The transmitter module may not be co-located with any other transmitter or antenna,

#### **IMPORTANT NOTE:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

#### **5.1.4 End Product Labeling**

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labelled in a visible area with the following: "Contains FCC ID: 2ABYNDMXTTF".

#### **5.1.5 Manual Information to the End User**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

## 5.2 Industry Canada statement

This device complies with Industry Canada licence-exempt RSS standard(s). 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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### **Caution Exposure:**

This device meets the exemption from the routine evaluation limits in section 2.5 of RSS102 and users can obtain Canadian information on RF exposure and compliance.

Le dispositif répond à l'exemption des limites d'évaluation de routine dans la section 2.5 de RSS102 et les utilisateurs peuvent obtenir des renseignements canadiens sur l'exposition aux RF et le respect.

This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Cet équipement doit être installé et utilisé avec une distance minimale de 20 centimètres entre le radiateur et votre corps.

### **The final end product must be labeled in a visible area with the following:**

The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains transmitter module IC: 20034-DMXTTF

where 20034-DMXTTF is the module's certification number.

## 5.3 CE

Mira MWA-N2 and TimoTwo comply with the Essential Requirements of RED (Radio Equipment Directive) of the European Union (2014/53/EU). Mira MWA-N2 and TimoTwo meet the ETSI EN 300 328 V2.1.1 conformance standards for radio performance.

## 5.4 Compliance Marking

### 5.4.1 FCC & Industry Canada

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.

An end product, incorporating a CRMX module, does not require additional testing or authorization for the CRMX transmitter (or transceiver, in the case of RDM or Flex products). Host end products can use the FCC ID of the certified module as the FCC ID of the host end product. A label displaying the CRMX module's FCC ID must be affixed and visible on the host end product for approval

FCC IDs are required for host end products with radio transmitters.

#### 5.4.2 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 [help@lumenradio.com](mailto:help@lumenradio.com) for details.

## 6 History

Revision	Description	Date
PA1	Original version	2019-06-03
PA2	Updated FCC and. IC statements	2019-07-03
PA3	Corrected typo in FCC and IC IDs	2019-08-13
PA4	Corrected format of OC ID.	2019-08-15

KDB 996369 D03 statements

2.2 List of applicable FCC rules:

The module complies with FCC Part 15.247.

FCC ID: 2ABYNDMXTTF on User manual and on the external of the packaging.

2.3 Summarize the specific operational use conditions

2.4 Limited module procedures

The module is not a limited module.

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be collocated or operating

in conjunction with any other antenna or transmitter.

2.7 Antennas

The EUT use a permanently attached antenna which is unique.

2.8 Label and compliance information

The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2ABYNDMXTTF

2.9 Information on test modes and additional testing requirements

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04

Module Integration Guide for testing the host products. The host manufacturer may operate their

product during the measurements. In setting up the configurations, if the pairing and call box options

for testing does not work, then the host product manufacturer should coordinate with the module

manufacturer for access to test mode software.

The module has been certified for Portable applications. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.

2.11 Note EMI Considerations

host manufacture 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

2.12 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 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 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 manufacture only needs to do an