LoRa Module Datasheet

Part Number: MLORA100

rev 001

Zenseio LLC

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LORA MODULE OVERVIEW

This wireless communication module is a LoRa radio transceiver for Zenseio IoT platform. It provides long range, low power, and low cost wireless connectivity to remote sensors. It can connect to public or to private LoRaWAN networks through a variety of gateways from several vendors. It can also be used in peer-to-peer communication between client devices using LoRa, GFSK, or FSK modulation.

Figure 1: LoRa Communication Module

FEATURES

- License-free 915MHz version approved for North America
- Long range: up to 15 miles rural, 5 miles urban
- Excellent link budget, optimal for applications requiring extended range and robustness
- Exceptional phase noise, selectivity, receiver linearity, and IIP3 for significantly lower power consumption
- Low power: Sleep 150 uA, RX 13.5 mA, TX 43-125 mA (@ 3 – 18.5 dBm)
- LoRa, GFSK, and FSK transceiver modulation
- LoRaWAN compliant protocol
- Bidirectional communication
- Adaptive data rate (250 bps to 12.5 kbps)
- Built-in communication link security

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- SMA antenna connector
- FCC and IC certified for use in USA, Canada, Australia, New Zealand
- Globally unique 64-bit identifier (EUI-64)
- Industrial temperature range: -40 to +85 °C
- Size (LxWxH): 2.2” x 1.2” x 0.7” (55mm x 30mm x 18mm)

**BLOCK DIAGRAM**

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Figure 2: Block diagram

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Interfaces

PIN DESCRIPTIONS

Sensor Hub socket interfaces pins

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Power input at nominal 3.3V</td>
</tr>
<tr>
<td>GND</td>
<td>Power ground</td>
</tr>
<tr>
<td>PAD0</td>
<td>LoRa Module’s UART RX</td>
</tr>
<tr>
<td>PAD1</td>
<td>LoRa Module’s UART TX</td>
</tr>
<tr>
<td>PAD2</td>
<td>LoRa Module’s UART CTS</td>
</tr>
<tr>
<td>PAD3</td>
<td>LoRa Module’s UART RTS</td>
</tr>
<tr>
<td>PAD5</td>
<td>LoRa Module hardware reset input. Active LOW</td>
</tr>
</tbody>
</table>

Note: input/output reference is with respect to the Module. Input means that the Sensor Hub drives the pin.

Antenna Connector

LoRa Module does not have any built-in antenna and requires connection to an external antenna to function properly. The standard SMA RF connector serves this purpose.

Antenna

The radio module has been certified for use in USA, Canada, Australia, and New Zealand. However, to maintain FCC and IC modular “intentional radiator” certifications, the external antenna must be similar (equal or lower gain) to the one in Table 1

<table>
<thead>
<tr>
<th>Sleeve Dipole with 50 Ohm characteristic impedance</th>
<th>Gain 6 dBi</th>
</tr>
</thead>
</table>

Table 1: Tested external antenna type

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Technical specification

**ABSOLUTE MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>3.3V Regulated Supply Input Voltage</td>
<td>2.1</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>$V_{PIN}$</td>
<td>Pin voltage with respect to GND and VDD</td>
<td>-40</td>
<td>115</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STORAGE}$</td>
<td>Storage temperature</td>
<td>10</td>
<td>90</td>
<td>% RH</td>
</tr>
<tr>
<td>RH</td>
<td>relative humidity (non-condensing)</td>
<td>10</td>
<td>90</td>
<td>% RH</td>
</tr>
</tbody>
</table>

Table 2: Absolute Maximum Ratings

**RECOMMENDED OPERATING CONDITIONS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Nom</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>VDD</td>
<td>@ 3V and 25 °C</td>
<td>2.1</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>$I_{SLEEP}$</td>
<td>Sleep current consumption</td>
<td>@ 3V and 25 °C</td>
<td>150</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{IDLE}$</td>
<td>Idle current consumption</td>
<td>@ 3V and 25 °C</td>
<td>2.7</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{RX}$</td>
<td>Current consumption during RX</td>
<td>@ 3V and 25 °C</td>
<td>13.5</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{TX(3dBm)}$</td>
<td>Current consumption during TX at 3dBm</td>
<td>@ 3V and 25 °C</td>
<td>42.6</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{TX(18.5dBm)}$</td>
<td>Current consumption during TX at 18.5dBm</td>
<td>@ 3V and 25 °C</td>
<td>124.4</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Input Level</td>
<td></td>
<td></td>
<td>+10</td>
<td>dBm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{A}$</td>
<td>Temperature range</td>
<td>Industrial Temperature Range</td>
<td>-40</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Recommended Operating Conditions

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GENERAL SPECS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Band</td>
<td>902.0 MHz to 928.0 MHz</td>
<td></td>
</tr>
<tr>
<td>Modulation Method</td>
<td>FSK, GFSK, LoRa™</td>
<td>Software selectable</td>
</tr>
<tr>
<td>Sensitivity at 0.1% BER</td>
<td>-146 dBm</td>
<td>Depends on modulation. Expand Spreading Factor (SF).</td>
</tr>
<tr>
<td>RF TX Power</td>
<td>+3 dBm to +18.5 dBm</td>
<td>Adjustable with ~1 dBm granularity. See Table 5</td>
</tr>
<tr>
<td>Generated Conductive Harmonics Level</td>
<td>Below -70 dBm</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: General specifications

![Table 5: TX output power settings and expected current consumption](image_url)

Table 5: TX output power settings and expected current consumption

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Mechanical specifications

DIMENSIONS AND WEIGHT

<table>
<thead>
<tr>
<th>H x W x D Dimensions in inches (mm)</th>
<th>Weight in oz (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 x 1.2 x 0.7 (55 x 30 x 18)</td>
<td>0.35 (10)</td>
</tr>
</tbody>
</table>

Table 6: Dimensions and Weight

PCB LAND PATTERN

Figure 3: PCB land pattern and dimensions
CONNECTORS

Antenna SMA Connector

The external antenna must use a standard-polarity SMA male connector, having a center pin surrounded by barrel with inside threads.

![Antenna SMA connector](image)

Figure 4: Antenna SMA connector

MOUNTING HOLES

The module can be secured to the Sensor Hub with up to four M2x4mm screws.

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Regulatory Approval

This section outlines the regulatory information for the LoRa Module module for the following countries:

- United States
- Canada
- Australia
- New Zealand

UNITED STATES

The LoRa Module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” modular approval in accordance with Part 15.212 Modular Transmitter approval. Modular approval allows the end user to integrate the LoRa Module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance. The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

Labeling And User Information Requirements

The LoRa Module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording as follows:

Contains Transmitter Module FCC ID: T9JRN2903
or
Contains FCC ID: T9JRN2903
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.

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A user's manual for the finished product should include the following 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 or more 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.

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748 available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) https://apps.fcc.gov/oetcf/kdb/index.cfm

RF Exposure

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC). From the LoRa Module FCC Grant: Output power listed is conducted. This grant is valid only when the module is sold to OEM integrators and must be installed by the OEM or OEM integrators. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multi-transmitter product procedures.

Approved External Antenna Types

To maintain modular approval in the United States, only the antenna types that have been tested shall be used. It is permissible to use different antenna manufacturer provided the same antenna type and antenna gain (equal to or less than) is used. Testing of the LoRa Module was performed with the antenna types listed in Table 1 Tested External Antenna Type.
Helpful WebSites


CANADA

The LoRa Module has been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSS-Gen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

Labeling And User Information Requirements

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010): The host device shall be properly labeled to identify the module within the host device. 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 labeled 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: 6514A-RN2903.

User Manual Notice for License-Exempt Radio Apparatus (from Section 7.1.3 RSS-Gen, Issue 3, December 2010): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

This device complies with Industry Canada license-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.

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010): User manuals for transmitters shall display the following notice in a conspicuous location:

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

The above notice may be affixed to the device instead of displayed in the user manual. User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

Approved External Antenna Types

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010):
The LoRa Module can only be sold or operated with antennas with which it was approved. Transmitter may be approved with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type for which approval is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type having equal or lesser gain as an antenna that had been successfully tested with the

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transmitter, will also be considered approved with the transmitter, and may be used and marketed with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits. Testing of the LoRa Module was performed with the antenna types listed in Table 1 Tested External Antenna Type.

Helpful Websites

AUSTRALIA

LoRa Module RF transmitter test reports can be used in part to demonstrate compliance in accordance with ACMA Radio communications "Short Range Devices" Standard 2004 (The Short Range Devices standard calls up the AS/NZS 4268:2008 industry standard). The MRF89XAM9A module test reports can be used as part of the product certification and compliance folder. For more information on the RF transmitter test reports, contact Microchip Technology Australia office.

AS/NZS 4268:2008 refers to the USA FCC 15.247 RF standards, the frequency limits of 915 - 928 MHz apply in Australia.

To meet overall Australian end product compliance, the integrator must construct a compliance folder containing all relevant compliance test reports e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity) etc. It is the responsibility of the integrator to know what is required in the compliance folder for ACMA compliance. For more information on Australia compliance, refer to the Australian Communications and Media Authority web site [http://www.acma.gov.au/](http://www.acma.gov.au/)

Helpful Websites

NEW ZEALAND

LoRa Module RF transmitter test reports can be used in part to demonstrate compliance against the New Zealand "General User Radio License for Short Range Devices". New Zealand Radio communications (Radio Standards) Notice 2010 calls up the AS / NZS 4268:2008 industry standard. The LoRa Module test reports can be used as part of the product certification and compliance folder. For more information on the RF transmitter test reports, contact Microchip Technology. Information on the New Zealand short range devices license can be found in the following web links:

and

While the AS /NZS 4268:2008 refers to the USA FCC 15.247 and EN 300 220-1 V2.3.1 RF standards, the frequency limits of 921 MHz to 928 MHz apply in New Zealand.

To meet overall New Zealand end product compliance, the developer must construct a compliance folder containing all relevant compliance test reports e.g. RF, EMC, electrical safety and DoC (Declaration of Conformity) etc. It is the responsibility of the developer to know what is required in the compliance folder for New Zealand Radio communications. For more information on New Zealand compliance, refer to the web site http://www.rsm.govt.nz/

Helpful Websites


Revision history

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Author</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>v001</td>
<td>22-Aug-2016</td>
<td>RS</td>
<td>Initial release</td>
</tr>
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