# Shenzhen Rakwireless Technology RAK5146 WisLink LPWAN Module User Manual



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PRODUCT NAME: WisLink LPWAN Concentrator

MODEL NAME: RAK5146

Contents



## Product description

RAK5146 is a WisLink LPWAN Concentrator Module with mini-PCIe form factor based on Semtech SX1303 and SX1262 for Listen Before Talk feature, which enables easy integration into an existing router or other network equipment to give it LPWAN Gateway capabilities. It can be used in any embedded platform offering a free miniPCIe slot with SPI/USB connection. Furthermore, ZOE- M8Q GPS chip is integrated onboard.

This module is an exceptional, complete, and cost-efficient gateway solution offering up to 10 programmable parallel demodulation paths, 8 x 8 channel LoRa packet detectors, 8 x SF5-SF12 LoRa demodulators, and 8 x SF5- SF10 LoRa demodulators. It is capable of detecting an uninterrupted combination of packets at 8 different spreading factors and 10 channels with continuous demodulation of up to 16 packets. This product is best for smart metering fixed networks and Internet-of-Things (IoT) applications.

**Manufacturer's address:**

Shenzhen RAKwireless Technology Co., Ltd.
Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi Town Nanshan District, Shenzhen, China

**Instructions for use and safety information:**


Forsafe commissioning, please read this manual and the documentation of your product. The complete documentation and further information about your product can be found in the RAKwireless Documentation Center: **https://docs.rakwireless.com/Product-Categories/WisLink**. To do this, enter the product name or item number in the search box and click Search.

## Product specifications

| Feature | Specifications |
|---|---|
| Form factor | Mini PCI express |
| LoRa feature | Baseband processor Semtech SX1302 |
| | emulates 8x 8 channel LoRa packet detectors |
| | 8x SF5-SF12 LoRa demodulators, 8x SF5-SF10 LoRa demodulators |
| | Rx sensitivity down to -139dBm@SF12, BW 125 kHz. |
| | Supports **global license-free frequency band** (EU868, CN470, US915, AS923, AU915, KR920, IN865)* |
| | Listen Before Talk (optional) |
| | Fine Time Stamp (optional) |
| Frequency** | EU433/CN470/EU868/US915/AS923/AU915/IN865/KR920 |
| Power supply | 3.3v |
| Compatibility | RJ45 (10/100 Mbps) |
| Antenna | LoRa: |
| | GPS: |

*Supported bands depends of the model.

## Interfaces

RAK5146 Interfaces are listed below:

- **Power Supply** – The RAK5146 concentrator module must be supplied through the 3.3Vaux pins by a DC power supply. The voltage needs to be stable since the current drawn can vary significantly during operation based on the power consumption profile of the SX1303 chip (for more information, see the **SX1303 Datasheet (opens new window)**).

- **SPI Interface** – SPI interface mainly provides for the Host_SCK, Host_MISO, Host_MOSI, Host_CSN pins of the system connector. The SPI interface gives access to the configuration register of SX1303 via a synchronous full-duplex protocol. Only the slave side is implemented.
- **USB Interface** – The USB interface mainly provides for the USB_D+, USB_D- pins of the system connector. The USB interface gives access to the configuration register of SX1303 via an MCU STM32L412KBU6. Only the slave side is implemented.
- **UART and I2C Interface** – RAK5146 integrates a ZOE-M8Q GPS module which has UART and I2C interface. The PINs on the golden finger provide a UART connection and an I2C connection, which allows direct access to the GPS module. The PPS signal is not only connected to SX1303 internally but also connected to the golden finger which can be used by the host board.
- **GPS_PPS** – RAK5146 includes the GPS_PPS input for received packets time-stamped and Fine timestamp.
- **RESET** – RAK5146 SPI card includes the RESET active-high input signal to reset the radio operations as specified by the SX1303 Specification. RAK5146 USB card's RESET is controlled by MCU.
- **Antenna RF Interface** – The module have one RF interface over a standard UFL connector (Hirose U. FL-RSMT) with a characteristic impedance of 50Ω. The RF port (J1) supports both Tx and Rx, providing the antenna interface

**Notes:**

- Do not power the module without connected antenna/s. This may damage the radios.

## Electrical requirements

ELECTRICAL REQUIREMENTS

Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only. Operating the module at these or any conditions other than those specified in the Operating Conditions sections of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

The operating condition range defines those limits within which the functionality of the device is guaranteed. Where application information is given, it is advisory only and does not form part of the specification.

ABSOLUTE MAXIMUM RATING
The limiting values given below are following the Absolute Maximum Rating System (IEC 134).

| Symbol | Description | Condition | Min | Max |
|---|---|---|---|---|
| 3.3Vaux | Module supply voltage | Input DC voltage at 3.3Vaux pins | -0.3 V | 3.6 V |
| USB | USB D+/D- pins | Input DC voltage at USB interface pins | | 3.6 V |
| RESET | RAK5146 reset input | Input DC voltage at RESET input pin | -0.3 V | 3.6 V |
| SPI | SPI interface | Input DC voltage at SPI interface pin | -0.3 V | 3.6 V |
| GPS_PPS | GPS 1 PPS input | Input DC voltage at GPS_PPS input pin | -0.3 V | 3.6 V |
| Rho_ANT | Antenna ruggedness | Output RF load mismatch ruggedness at ANT1 | | 10:1 VSWR |
| Tstg | Storage temperature | | -40 °C | 85 °C |

| Parameter | Min | Typical | Max | Remarks |
|---|---|---|---|---|
| ESD_HBM | | | 1000 V | Charged Device Model JESD22-C101 CLASS III |
| ESD_CDM | | | 1000 V | Charged Device Model JESD22-C101 CLASS III |

**NOTE**

Although this module is designed to be as robust as possible, electrostatic discharge (ESD) can damage this module. This module must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

POWER CONSUMPTION
POWER SUPPLY RANGE
Input voltage at **3.3Vaux** must be above the normal operating range minimum limit to switch on the module.

| Symbol | Parameter | Min | Typical | Max |
|---|---|---|---|---|
| 3.3Vaux | Module supply operating input voltage | 3 V | 3.3 V | 3.6 V |

#### 4.1 Quick Start Guide

This guide is based on Raspberry Pi Single board computer and Raspbian Operating System.

1. Connect the RAK5146 LPWAN module to the Raspberry Pi with mPCIe to USB convertor or with the dedicated RAK Pi HAT.
2. Download and install Raspbian Buster LITE
3. Use “sudo raspi-config” command, enable spi and i2c interface, disable login shell over serial and enable serial port hardware.
4. Clone the installer and start the installation (More installation options can be found in “sudo ./install.sh –help”).

$ sudo apt update; sudo apt install git -y
$ git clone **https://github.com/RAKWireless/rak_common_for_gateway.git ~/rak_common_for_gateway**
$ cd ~/rak_common_for_gateway
$ sudo ./install.sh

5. Next you will see some messages as follow. Please select the corresponding hardware model.

Please select your gateway model:

* 1.RAK2245
* 2.RAK7243/RAK7244 no LTE
* 3.RAK7243/RAK7244 with LTE
* 4.RAK2247(USB)
* 5.RAK2247(SPI)
* 6.RAK2246
* 7.RAK7248 no LTE (RAK2287 SPI + raspberry pi)
* 8.RAK7248 with LTE (RAK2287 SPI + LTE + raspberry pi)
* 9.RAK2287 USB
* 10.RAK5146 USB

Please enter 1-10 to select the model:

6. Wait a moment and the installation is complete.
7. For more other features, please use “sudo gateway-config”.

## WisLink LPWAN RAK5146 models

In general, the RAK5146’s variation is the defined as **RAK5146 – XYZ**, **where X, Y, Z is the model variant.** Take a look at the tables below to know the variants and their specification.

| Symbol | Description |
| --- | --- |
| X - Supported region | 1 - US915; 2 - EU868 |
| Y - Interface type | 1 - SPI; 2 - USB |
| Z - Additional features | 0 - No additional features; 2 - LBT; 5 - GPS; 6 - LBT+GPS |

| Model | Frequency | USB | SPI | LBT | GPS |
| --- | --- | --- | --- | --- | --- |
| RAK5146-126 | US915 | √ | | √ | √ |
| RAK5146-122 | US915 | √ | | √ | |
| RAK5146-125 | US915 | √ | | | √ |
| RAK5146-120 | US915 | √ | | | |

| Symbol | | Description | | | |
|---|---|---|---|---|---|
| RAK5146-115 | US915 | | √ | | √ |
| RAK5146-110 | US915 | | √ | | |
| RAK5146-226 | EU868 | √ | | √ | √ |
| RAK5146-222 | EU868 | √ | | √ | |
| RAK5146-225 | EU868 | √ | | | √ |
| RAK5146-220 | EU868 | √ | | | |
| RAK5146-215 | EU868 | | √ | | √ |
| RAK5146-210 | EU868 | | √ | | |

**Note:**

Detailed Quick Start Guides for the modules are available in the RAKwireless Documentation Center: **https://docs.rakwireless.com/Product-Categories/WisLink/RAK5146/**

## SIMPLIFIED EU DECLARATION OF CONFORMITY

## Certification warning

### Statement

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.

FCC Caution:

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

FCC 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.”

IC 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.

This equipment complies with Industry Canada & FCC radiation exposure limits: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.

The proposed FCC IC label format is to be placed on the module. If it is not visible when the module is installed into the system,
“Contains FCC ID: 2AF6B-RAK5146, Contains IC: 25908- RAK5146” shall be placed on the outside of final host system.

**Labelling**

— This radio transmitter [25908- RAK5146] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. 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 info**

| model | Manufacturer | Antenna Gain | Antenna Type | Connector type Type |
|---|---|---|---|---|
| RAKARG15 | Shenzhen RAKwireless Technology Co., Ltd | 8dBi | Fiber Glass Antenna | N-type male connector |
| RAKARG14 | | 5.8dBi | Fiber Glass Antenna | N-type male connector |
| RAKARG19 | | 5.1dBi | Fiber Glass Antenna | N-type male connector |
| RAKARJ14 | | 2.3 dBi | Dipole Antenna | RPSMA connector |
| RAKARJ16 | | 2.3 dBi | Dipole Antenna | RPSMA connector |
| ANT-916-CW-HWR | Linx Technologies: | 1.2 dBi | Dipole Antenna | RPSMA connector |

## Documents / Resources

| | |
|---|---|
|  | Shenzhen Rakwireless Technology RAK5146 WisLink LPWAN Module [pdf] User Manual RAK5146, 2AF6B-RAK5146, 2AF6BRAK5146, RAK5146 WisLink LPWAN Module, WisLink LP WAN Module |

## References

- WisLink | RAKwireless Documentation Center
- RAKwireless Documentation Center
- GitHub - RAKWireless/rak_common_for_gateway
- Raspberry Pi OS – Raspberry Pi