

User Manual for

LoRaConcentrator Module

Stamp Edition

RAK2245

Version V1.2 | February 2019



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Table of Contents

1 Overview	4
1.1 Introduction	4
1.2 Main Features	4
2 LoRa Concentrator Module RAK2245	5
2.1 Overview	5
2.2 Operating Frequencies	5
2.3 Pin Definition	6
2.4 Power Supply	7
2.5 SPI interface.....	7
2.6 UART and I2C.....	7
2.7 Digital IOs.....	8
2.8 LEDs 8	
2.9 Antenna RF interface	8
2.10 Electrical Characteristics.....	8
2.11.1 Absolute Maximum Rating.....	8
2.11.2 Maximum ESD.....	8
2.11.3 Operating Conditions	9
2.11.4 Power Consumption	9
2.11 RF Characteristics.....	10
2.12.1 Transmitter RF Characteristics	10
2.12.2 Receiver RF Characteristics	11
3 Source Codes	12
4 Setup Network Server and Frequencies	12
5 Warning.....	13
6 Contact Information	14
Shenzhen Business	14
Shenzhen Technical.....	14
7 Revision History	15
8 Document Summary	15

List of Tables

Table 1 Operating Frequencies	5
Table 2 Pin Definitions	7
Table 3 Absolute Maximum Ratings	8
Table 4 Maximum ESD Ratings	9
Table 5 Operation Temperature Range	9
Table 6 Power Consumption	9
Table 7 RF Output Power Level	10
Table 8 TX RF Characteristics	11
Table 9 RX RF Characteristics	11

List of Figures

Figure 1 Module Overview	5
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1 Overview

1.1 Introduction

The RAK2245 is a complete and cost efficient LoRa gateway solution base on Semtech SX1301 to help utilize the whole LoRa system development. Developers can integrate the Concentrator module into the main board to utilize the LoRa gateway function.

RAK2245 is available in multiple variants so it can be used for international standard bands. This ultra compact module measures just 60mm x 30mm x14,9mm is believed to be the world's smallest LoRaWAN gateway module which includes a GPS module and a Heat Sink for better performance and thermal heat dissipation management.

This has to be the best value and function for connectivity to address a variety of applications; like Smart Grid, Intelligent Farm and other IoT enterprise applications. Combined with a Stamp form factor, which enables easy integration into an application board and also ideal for manufacturing of small series. Another feature is the integration of Ublox GPS module which expands applications.

1.2 Main Features

- Compatible with Stamp edition specification with heat sink.
- SX1301 base band processor, emulates 49 x LoRa demodulators 10 parallel demodulation paths.
- 2 x SX125x Tx/Rx front-ends high/ low frequency.
- Supports 5V power supply, integrated level conversion circuit.
- TX power up to 11.73dBm, RX sensitivity down to -139dBm@SF12, BW 125KHz.
- Supports latest LoRaWAN 1.0.2 protocol.
- Supports global license-free frequency band (EU433, CN470, EU868, US915, AS923, AU915, KR920, IN865 and AS920).
- Supports SPI interface.
- Integrated the Ublox MAX-7Q GPS Module.

2 LoRa Concentrator Module RAK2245

2.1 Overview

The module which is the stamp edition as shown below. The outer dimension of the RAK2245 is 30.0 x 60.0 x 14.9mm (nominal value). And the 14.9mm includes the 9.5mm heat sink.

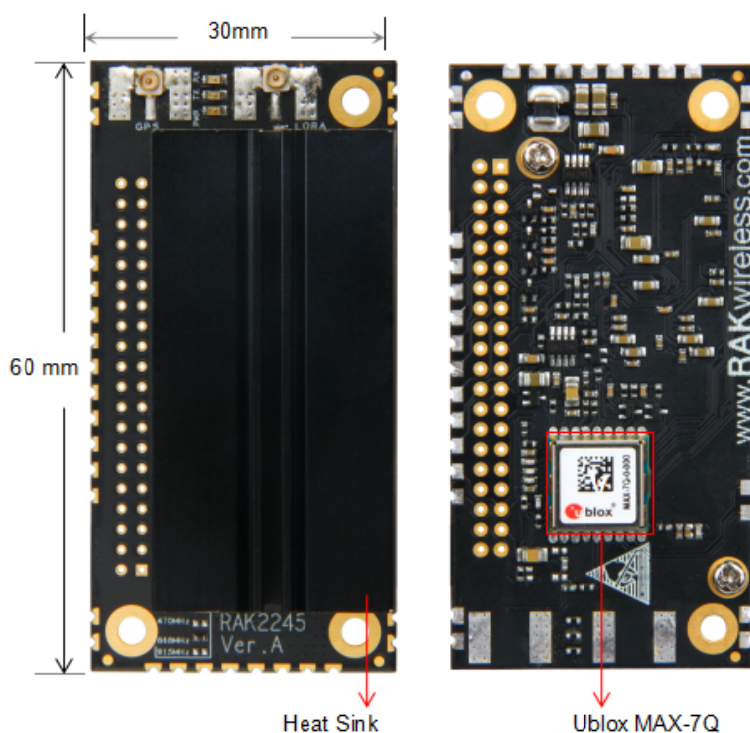


Figure 1 | Module Overview

2.2 Operating Frequencies

The board supports all LoRaWAN frequency channels as below. Which is easy to configure while building the firmware from the source code.

Region	Frequency (MHz)
North America	903-927.5Mhz

Table 1 | Operating Frequencies

2.3 Pin Definition

The pins of the RAK2245 shown as following figure.



Figure 2 | RAK2245 Pin Definition

The RAK2245 provides PINs at the bottom side. The description of the pins is given by the below table.

Pin	Name	Type	Description
A1	GND	GND	GND
A2	GND	GND	GND
A3	+5V	POWER	+5V Supply Voltage
A4	IOREF	POWER	Supply Voltage for Level Translator
A5	RESET_GPS	Input	GPS Module reset PIN
A6	STANDBY_GPS	Input	GPS Module standby PIN
A7	UART_TXD	UART	It should be connected to Main Board's UART_RXD. This pin is connected to GPS Module's UART_TXD internally.
A8	SPI_MOSI	SPI	It should be connected to Main Board's SPI_MOSI. And this pin has been connected to SX1301's SPI_MOSI internally.
A9	SPI_CS	SPI	It should be connected to Main Board's SPI_CS. And this pin has been connected to SX1301's SPI_CS internally.
A10	SPI_MISO	SPI	It should be connected to Main Board's SPI_MISO. And this pin has been connected to SX1301's SPI_MISO internally.
A11	SPI_CLK	SPI	It should be connected to Main Board's SPI_CLK. And this pin has been connected to SX1301's SPI_CLK internally.
A12	UART_RXD	UART	It should be connected to Main Board's UART_TXD. This pin is connected to GPS Module's UART_RXD internally.
A13	RST_BTN_N	RST	SX1301 RESET
A14	GND	GND	GND

A15	GND	GND	GND
B1	GND	GND	GND
B2	GND	GND	GND
B3	SDA_GPS	I2C	GPS Module I2C SDA
B4	SCL_GPS	I2C	GPS Module I2C SCL
B5	GND	GND	GND
B6	GND	GND	GND
G1	GND	GND	GND
G2	GND	GND	GND
G3	GND	GND	GND
G4	GND	GND	GND
G5	GND	GND	GND
G6	GND	GND	GND
G7	GND	GND	GND
G8	GND	GND	GND

Table 2 | Pin Definitions

7

2.4 Power Supply

RAK2245 module be supplied through the 5V power pins, it integrats the IOREF for Level Translator, can communicate with 3.3V, 1.8V and other different voltage interfaces.

2.5 SPI interface

The PINs on the bottom side provides an SPI connection, which allows direct access to the Sx1301 SPI interface. This gives the target system the possibility to use existing SPI interfaces to communicate.

After powering up RAK2245, it is required to reset SX1301 via PIN A13.

2.6 UART and I2C

The PINs on the bottom side provides an UART connection and I2C connection, which allows direct access to the GPS module. The 1PPS was connected to SX1301 internally.

2.7 Digital IOs

There are two digital IO PINs, which give the user a interface to reset the GPS module or set it into standby mode. They can be left open if you don't use them.

2.8 LEDs

3 x Green LED for indicating the status of PWR, TX, RX.

2.9 Antenna RF interface

The modules have two RF interfaces for LoRa antenna and GPS antenna over a standard UFL connectors (Hirose U. FL-R-SMT) with a characteristic impedance of 50OHM. The RF ports supports both Tx and Rx, providing the antenna interface.

2.10 Electrical Characteristics

In the following different electrical characteristics of the RAK2245 are listed. Furthermore details and other parameter ranges are available on request.

Note: Stress exceeding of one or more of the limiting values listed under "Absolute Maximum Ratings" may cause permanent damage to the radio module.

2.11.1 Absolute Maximum Rating

Limiting values given below are in accordance with the Absolute Maximum Rating System (IEC 134).

Parameter	Description	Min.	Typ.	Max.
Supply Voltage(VDD)	Input DC voltage	-0.3V	5.0V	5.5V
Operating Temperature	Temperature Range	-40°C		+85°C
RF Input Power				-15dBm

Table 3 | Absolute Maximum Ratings

2.11.2 Maximum ESD

The table below lists the maximum ESD.

Parameter	Min	Typical	Max	Remarks
ESD sensitivity for all pins except ANT			1000V	Human Body Model according to JESD22-A114
ESD sensitivity for ANT			1000V	Human Body Model according to JESD22-A114
ESD immunity for ANT			4000V	Contact Discharge according to IEC 61000-4-2
			8000V	Air Discharge according to IEC 61000-4-2

Table 4 | Maximum ESD Ratings

Note: The module is an Electrostatic Sensitive Device and require special precautions when handling.

2.11.3 Operating Conditions

The table below lists the operation temperature range.

Parameter	Min.	Typical	Max.	Remarks
Normal operating temperature	-20°C	+25°C	+65°C	Normal operating temperature range (fully functional and meet 3GPP specifications)
Extended operating temperature	-40°C	+25°C	+85°C	Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

Table 5 | Operation Temperature Range

2.11.4 Power Consumption

Mode	Condition	Min	Typical	Max
Active-Mode(TX)	TX enabled and RX disabled.		336mA	
Active-Mode(RX)	TX disabled and RX enabled.		360mA	

Table 6 | Power Consumption

2.11 RF Characteristics

2.12.1 Transmitter RF Characteristics

The RAK2245 has an excellent transmitter performance. It is highly recommended to use an optimized configuration for the power level configuration, which is part of the HAL. This results in a mean RF output power level and current consumption.

Note: The maximum output power setting should not exceed 11.73dBm.

	PA Control	DAC Control	MIX Control	DIG Gain	Nominal RF Power Level [dBm]
	0	3	8	0	-6
b	0	3	10	0	-3
l	0	3	14	0	0
7	1	3	9	3	4
	1	3	8	0	8
R	1	3	9	0	10
F	1	3	11	0	12
0	1	3	12	0	14
	1	3	13	0	16
p	2	3	12	0	17
n	2	3	13	0	19
	2	3	14	0	20
P	3	3	10	0	0
w	3	3	11	0	0
e	3	3	12	0	25
L	3	3	13	0	26
e	3	3	14	0	27
e					
I					

10

T=25°C, VDD=5V(Typ.) if nothing else stated.

Parameter	Condition	Min	Typ.	Max
Frequency Range		863MHz		870MHz
Modulation Techniques	FSK/LoRaTM			

TX Frequency Variation vs.		-3KHz	+3KHz
_a TX Power Variation vs. _b Temperature _I	Temperature	Power Level Setting :20	
	TX Power Variation vs.		
	Temperature	-5dBm	+5dBm
TX Power Variation		-1.5dBm	+1.5dBm

8 | TX RF Characteristics

2.12.2 Receiver RF Characteristics

It is highly recommended, to use optimized RSSI calibration values, which is part of the HAL v3.1. For both, Radio 1 and 2, the RSSI-Offset should be set -169.0. The following table gives typically sensitivity level of the RAK2245.

Signal Bandwidth/[KHz]	Spreading Factor	Sensitivity/[dBm]
125	12	-139
125	7	-126
250	12	-136
250	7	-123
500	12	-134
500	7	-120

9
| RX RF Characteristics

3 Source Codes

Here is the open source code link:

<https://github.com/RAKWireless/RAK2245-LoRaGateway-RPi-LoRa-Gateway-OS>

4 Setup Network Server and Frequencies

The default Settings are Built-In LoRaServer and EU868. If you get the others frequency, you must setup it firstly. For the detailed setup steps, please refer to the [Get_Start_with_RAK_LoRa_Develop_Kit.pdf](#).

5 Warning

FCC Warning: 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.

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

INTEGRATION INSTRUCTIONS

1. This module has been tested and found to comply with the FCC Part15.247 for Modular Approval.
2. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time- averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091. This modular should be installed and operated with minimum distance 20 cm between the radiator& your body.
3. The U.FL connector antenna has been approved for the modular. The maximum antenna gain is 3dBi. For situations where the host manufacturer is responsible for an external connector, the integration instructions shall inform the installer that a unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.
4. When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: — Contains FCC ID: 2AF6B-RAK2245.
5. The Shenzhen Rakwireless Technology Co., Ltd. uses various test mode programs for test set up which operate separate from production firmware. Host integrators should contact Shenzhen Rakwireless Technology Co., Ltd. for assistance with test modes needed for module/host compliance test requirements.
6. The Shenzhen Rakwireless Technology Co., Ltd. modular transmitter is only FCC authorized for the FCC Part15.247 listed on the grant, and that 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host

13

product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Manufacture name and address:

Shenzhen Rakwireless Technology Co., Ltd.

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6 Contact Information

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14



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7 Revision History

Revision	Description	Date
1.0	Initial version	2018-12-21
1.1	Modify Pin definition and Block Diagram	2019-01-23
1.2	Add source codes chapter	2019-02-14

8 Document Summary

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15



About RAKwireless:

RAKwireless is the pioneer in providing innovative and diverse cellular and LoRa connectivity solutions for IoT edge devices. It's easy and modular design can be used in different IoT applications and accelerate time-to-market.

For more information, please visit RAKwireless website at www.rakwireless.com.