

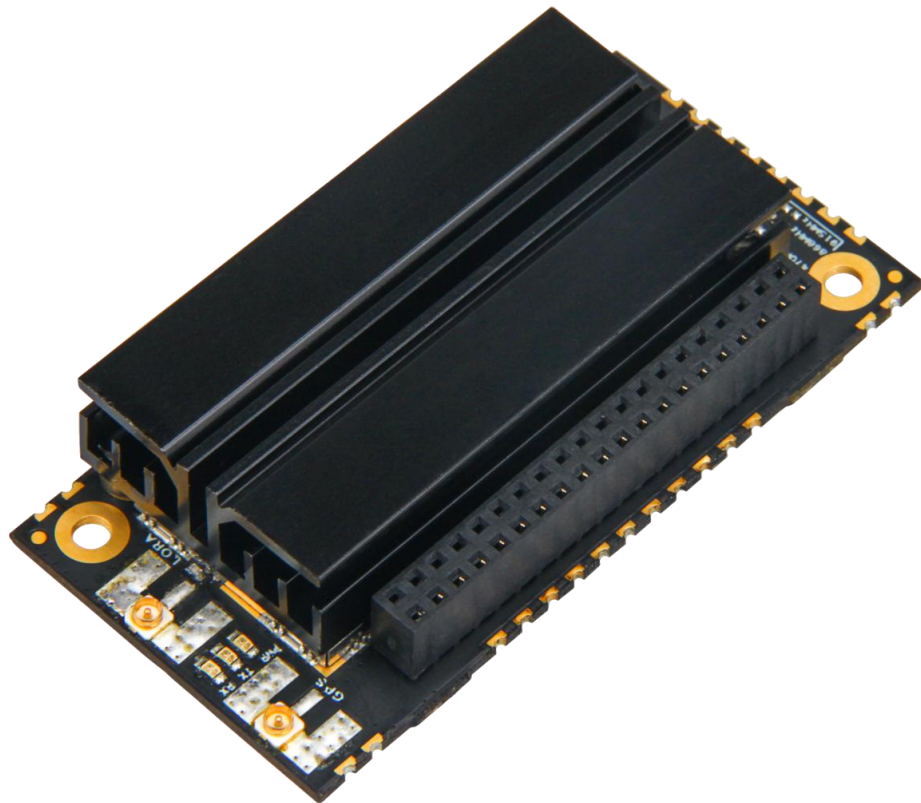
User Manual for

WisLink-LoRa Concentrator Module

96Boards IoT Edition

RAK2245 96Boards

Version V1.2 | February 2019



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1 Overview

1.1 Introduction

The RAK2245 96Boards is a complete and cost efficient LoRa gateway solution based on Semtech SX1301 to help utilize the whole LoRa system development. It is a Concentrator module with 96Boards form factor which can be plugged into IoT Edition 96Boards such as Nitrogen, Orange Pi 96Boards as a complete RF front end of LoRa gateway.

RAK2245 96Boards can support eight channels and available in multiple variants so it can be used for international standard bands. This ultra compact module measures just 60mm x 30mm x 19.8mm is believed to be the world's smallest 96Boards form factor 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 the 96Boards IoT edition, 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.

Note: There are 2 type version with RAK2245 Series for the various interface in GPS module.

If you need use the Cellular Module (RAK2013 series), you must select the RAK2245 series I2C version. If you don't need the Cellular Module, any version can be working well. The default version is UART.

1.2 Main Features

- Compatible with 96Boards IoT edition with heat sink.
- SX1301 base band processor, emulates 49 x LoRa demodulators 10 parallel demodulation paths, support 8 uplinks channel, 1 downlink channel.
- 2 x SX125x Tx/Rx front-ends high/ low frequency.
- Supports 5V power supply, integrated level conversion circuit.
- TX power up to 27dBm, 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.

1.3 Package Contents



Figure 1 | Package Contents

2 RAK2245 96Boards Board

2.1 Overview

The module which is the 96Boards edition as shown below. The outer dimension of the RAK2245 96Boards is 30.0 x 60.0 x 19.8mm (nominal value). And the 19.8mm includes the 9.5mm heat sink and the 7.5mm pin header.

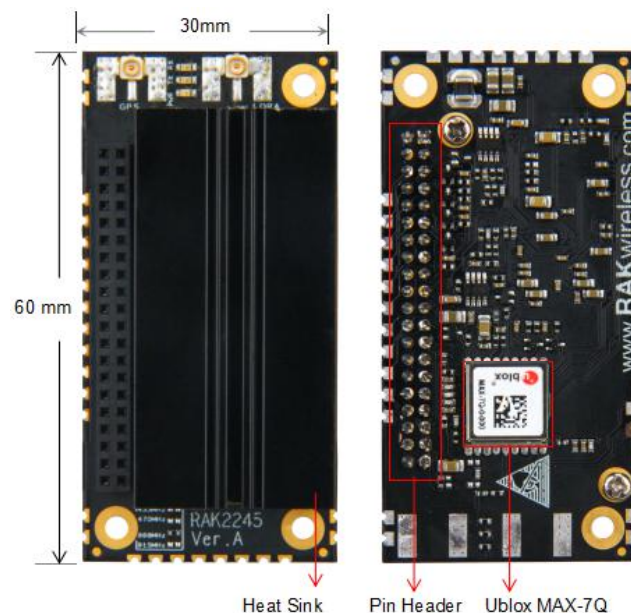


Figure 2 | Module Overview

2.2 Block diagram

The block diagram of RAK2245 96Boards shown as below.

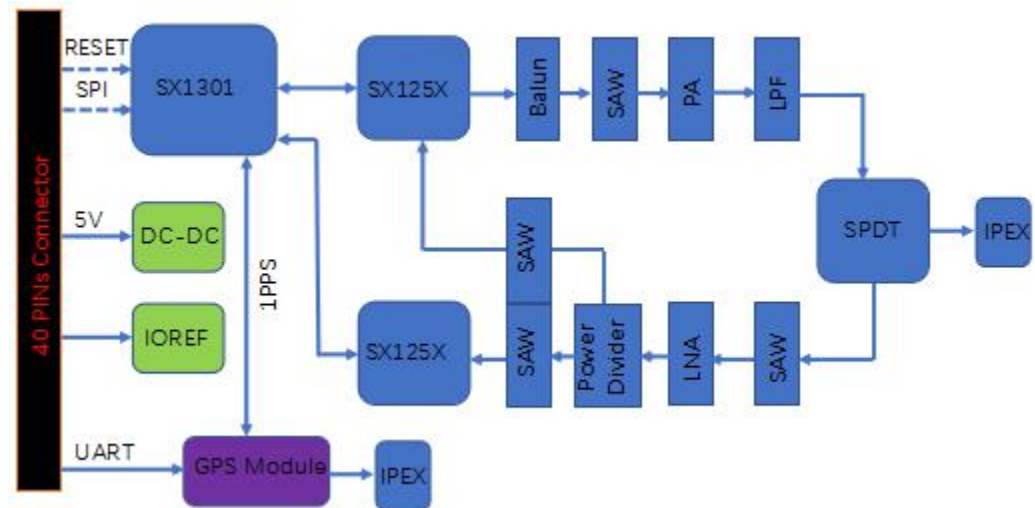


Figure 3 | RAK2245 96Boards Block Diagram

The SX1301 digital baseband chip contains 10 programmable reception paths. Those paths have differentiated levels of programmability and allow different use cases. It is important to understand the differences between those demodulation paths to make the best possible use from the system.

2.3 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	Freq. (MHz)
Europe	EU433, EU868
China	CN470
North America	US915
Asia	AS923, AS920
Australia	AU915
Korea	KR920
Indian	IN865

Table 1 | Operating Frequencies

2.4 Pin Definition

RAK2245 96Boards pin header shown as following figure.



TOPVIEW

LEGENDS: ● Pins with no connection
● Pins with connection

Figure 4 | RAK2245 96Boards Pin Header

The RAK2245 96Boards provides PINS at the bottom side. The description of the pins is given by the below table.

Pin	Name	Description	Pin	Name	Description
1	GND	GND	2	GND	GND
3	NC	No Connection	4	NC	No Connection
5	UART_RXD	It should be connected to 96Board's UART0_TXD. And this pin has been connected to GPS Module's UART_RXD internally.	6	RST_BTN_N	SX1301 RESET
7	UART_TXD	It should be connected to 96Board's UART0_RXD. And this pin has been connected to GPS Module's UART_TXD internally.	8	SPI_CLK	It should be connected to 96Board's SPI0_CLK. And this pin has been connected to SX1301's SPI_CLK internally.
9	NC	No Connection	10	SPI_MISO	It should be connected to 96Board's SPI0_DIN. And this pin has been connected to SX1301's SPI_MISO internally.
11	NC	No Connection	12	SPI_CS	It should be connected to 96Board's SPI0_CS. And this pin has been connected to SX1301's SPI_CS internally.
13	NC	No Connection	14	SPI_MOSI	It should be connected to 96Board's SPI0_DOUT. And this pin has been connected to SX1301's SPI_MOSI internally.
15	NC	No Connection	16	NC	No Connection
17	NC	No Connection	18	NC	No Connection



19	NC	No Connection	20	NC	No Connection
21	NC	No Connection	22	NC	No Connection
23	RESET_GPS	GPS Module reset PIN	24	STANDBY_GPS	GPS Module standby PIN
25	NC	No Connection	26	NC	No Connection
27	NC	No Connection	28	NC	No Connection
29	NC	No Connection	30	NC	No Connection
31	NC	No Connection	32	NC	No Connection
33	NC	No Connection	34	NC	No Connection
35	IOREF	+1.8V Supply Voltage for Level Translator	36	NC	No Connection
37	+5V	+5V Supply Voltage	38	NC	No Connection
39	GND	GND	40	GND	GND

Table 2 | Pin Definitions

2.5 Power Supply

RAK2245 96Boards module be supplied through the 5V power pins.

2.6 SPI interface

The PINs on the connector 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 96Boards, it is required to reset SX1301 via PIN 6.

2.7 UART

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

2.8 Digital IOs

There are two digital IO PINs, which give the user an interface to reset the GPS module or set it into standby mode.

2.9 LEDs

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

2.10 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.

2.11 Electrical Characteristics

In the following different electrical characteristics of the RAK2245 96Boards 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

Note: With RF output power level above +15 dBm, the minimum distance to the transmitter should be 1m to avoid too large input level.

2.11.2 Maximum ESD

The table below lists the maximum ESD.

Parameter	Min	Typical	Max	Remarks
ESD sensitivity for all pins except ANT1			1000V	Human Body Model according to JESD22-A114
ESD sensitivity for ANT1			1000V	Human Body Model according to JESD22-A114

ESD immunity for ANT1	4000V	Contact Discharge according to IEC 61000-4-2
	8000V	Air Discharge according to IEC 61000-4-2

Table 4 | Maximum ESD Ratings

Note: This module is electrostatic sensitive device and requires 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	-40°C	+25°C	+85°C	Normal operating temperature range (fully functional and meet 3GPP specifications)

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

2.12 RF Characteristics

2.12.1 Transmitter RF Characteristics

RAK2245 96Boards has an excellent transmitter performance. It is highly recommended to use optimized configuration for the power level configuration, which is part of HAL. This results in a mean RF output power level and current consumption.

PA Control	DAC Control	MIX Control	DIG Gain	Nom. RF Power Level
0	3	8	0	-6 dBm
0	3	10	0	-3 dBm
0	3	14	0	0



1	3	9	3	4 dBm
1	3	8	0	8 dBm
1	3	9	0	10 dBm
1	3	11	0	12 dBm
1	3	12	0	14 dBm
1	3	13	0	16 dBm
2	3	12	0	17 dBm
2	3	13	0	19 dBm
2	3	14	0	20 dBm
3	3	10	0	0
3	3	11	0	0
3	3	12	0	25 dBm
3	3	13	0	26 dBm
3	3	14	0	27 dBm

Table 7 | RF Output Power Level

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

Table 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 to

-169.0. The following table gives the typical sensitivity level of RAK2245 96Boards.

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

Table 9 | RX RF Characteristics

3 Source Codes

Here is the open source code link:

<https://github.com/RAKWireless/RAK2245-RAK831-LoRaGateway-RPi-Raspbian-OS>

4 Setup Network Server and Frequencies

The default Settings are Bulit-In LoraServer and EU868. If you get the others frequency, you must setup it firstly. For the detailed setup steps, please refer to this documentation, here is the link:

[Get Start with RAK2245&RAK831 RPi LoRa Gateway.pdf](#)

5 Contact Information

Please contact us if you need technical support or want to know more information.

Support center: <https://forum.rakwireless.com/>

Email us: info@rakwireless.com

6 Revision History

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

7 Document Summary

Prepared by	Checked by:	Approved by:
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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.