RAK2245 Pi HAT WisLink LPWAN Concentrator Datasheet

Overview

Description

The **RAK2245 Pi HAT WisLink LPWAN Concentrator** is a module with Raspberry PI form factor. It can be plugged into Raspberry PI such as Raspberry Pi 3 Model B+ as a complete RF front end of gateway. It supports eight channels and is available for LoRaWAN global frequency bands. The board is the smallest gateway concentrator which integrates the **Ublox MAX-7Q GPS Module** and heat sink.

The board can provide low data rate LoRa radio links at ultra-fast speed. It is powered by a **Semtech SX1301** transceiver concentrator that is capable of managing packets from many remotely dispersed end-points. Two Semtech SX125X are integrated for RF front end I/Q transceivers.

The RAK2245 Pi HAT is a complete and cost efficient gateway solution that can help you develop a full LoRa system. This is an economical way to create different solutions like smart grids, intelligent farms and other IoT applications. It is also ideal for manufacturing small series that can expand into more applications.

Features

- Compatible with Raspberry Pi 3 Model B+ edition
- Integrated Ublox MAX-7Q GPS Module and heat sink
- SX1301 base band processor, emulates 49 x LoRa demodulators, 10 parallel demodulation paths, supports 8 uplink / 1 downlink channels
- Two (2) units of SX125x Tx/Rx front-ends for high/ low frequency
- Supports 5 V power supply, integrated level conversion circuit
- TX power up to 27 dBm, RX sensitivity down to -139 dBm @ SF12, BW 125 kHz
- Supports latest LoRaWAN 1.0.2 protocol
- Supports global license-free frequency band (EU433, CN470, EU868, US915, AS923, AU915, KR920 and IN865)
- Supports SPI, UART, I2C interface

Specifications

Overview

The overview shows the top view of the RAK2245 Pi HAT board and its corresponding outer dimension. It also presents the block diagram that shows how the board works.

Board Overview

RAK2245 Pi HAT Module with Raspberry Pi connector is shown above, it has outer dimensions of **56 x 65 x 22 mm** (±2 mm).

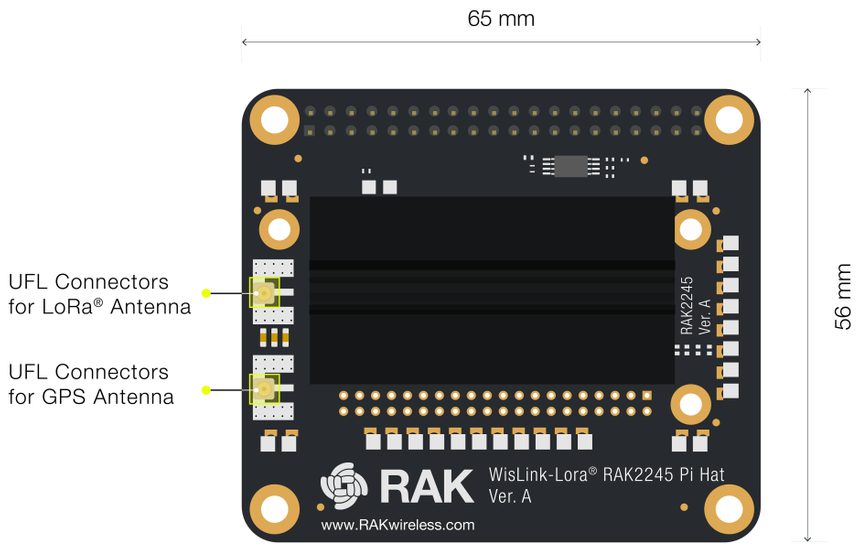

Figure 1: RAK2245 Pi HAT WisLink LPWAN Concentrator Dimensions

Block Diagram

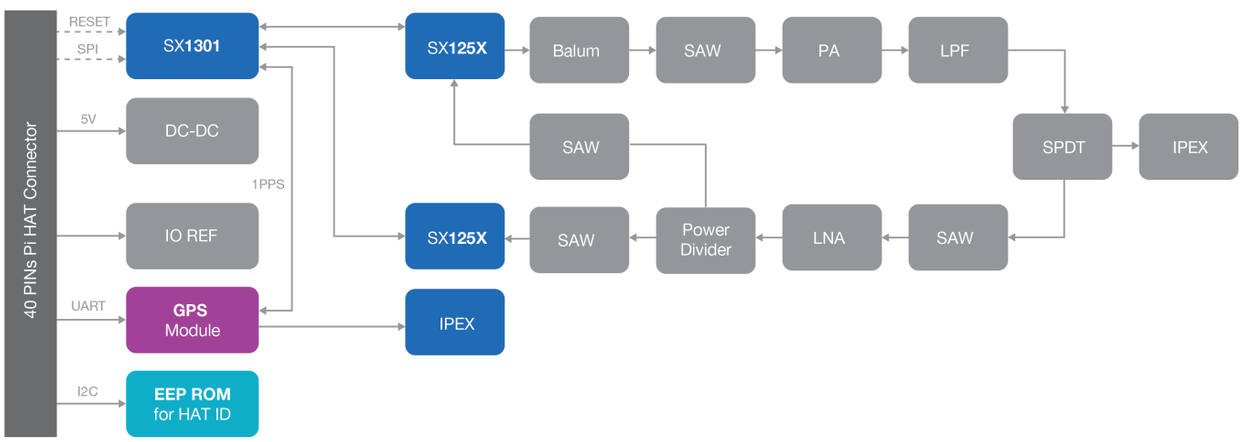

Figure 2: RAK2245 Pi Hat Block Diagram

Hardware

The hardware is categorized into five parts. It discusses the interfacing, pinouts and its corresponding functions and diagrams. It also covers the parameters and standard values of the board in terms of electrical and environmental.

Interface

The SX1301 digital baseband chip contains **ten (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 of the system.

Power Supply

RAK2245 Pi HAT module is powered through **5 V or 3.3 V power pins**.

SPI Interface

The pin 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 with the module.

> 📝 **NOTE**
>
> Reset SX1301 via Pin 11 after turning on RAK2245 Pi HAT.

UART and I²C

UART and I2C connections are also included on the pin connector. These connections allow direct access to the GPS module. The 1PPS is connected internally to SX1301.

Digital IOs

There are two (2) digital IO PINs, which give the user an interface to reset the GPS module or set it into standby mode.

LEDs

There are **three (3) Green LED** that indicate the status of PWR, TX, RX.

Antenna RF Interface

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

Pin Definition

The pin connector of RAK2245 Pi HAT is located at the bottom side. Refer to the diagram and table below for the description and numbering of each pins.

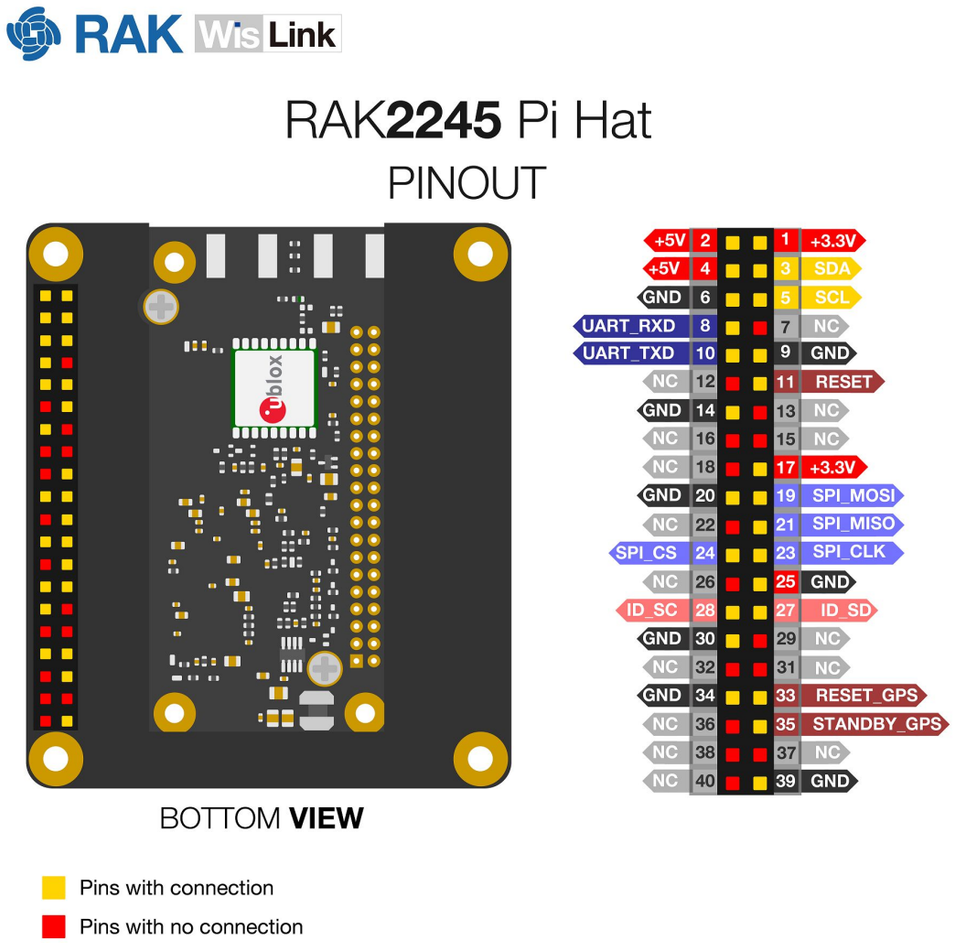

Figure 3: Pinout Diagram

Pin	Name	Description
1	3.3V	3.3 V Supply Voltage
2	5V	5 V Supply Voltage
3	SDA	I²C SDA (Connect to GPS Module I²C_SDA)
4	5V	5 V Supply Voltage
5	SCL	I²C SCL (Connect to GPS Module I²C_SCL)
6	GND	Ground
7	NC	No Connection
8	UART_RXD	It should be connected to RASPBERRY PI's UART_TXD. This pin is connected to GPS Module's UART_RXD internally.
9	GND	Ground
10	UART_TXD	It should be connected to RASPBERRY PI's UART_RXD. This pin is connected to GPS Module's UART_TXD internally
11	RESET	SX1301 RESET (GPIO17 of Raspberry Pi)
12	NC	No Connection
13	NC	No Connection
14	GND	Ground
15	NC	No Connection
16	NC	No Connection
17	3.3V	3.3 V Supply Voltage
18	NC	No Connection
19	SPI_MOSI	It should be connected to RASPBERRY PI's SPI_MOSI. This pin is connected to SX1301's SPI_MOSI internally.
20	GND	Ground
21	SPI_MISO	It should be connected to RASPBERRY PI's SPI_MISO. This pin is connected to SX1301's SPI_MISO internally.
22	NC	No Connection
23	SPI_CLK	It should be connected to RASPBERRY PI's SPI_SCLK. This pin is connected to SX1301's SPI_CLK internally.

Pin	Name	Description
24	SPI_CS	It should be connected to RASPBERRY PI's SPI_CE0. This pin is connected to SX1301's SPI_CS internally.
25	GND	Ground
26	NC	No Connection
27	ID_SD	I²C_SDA for HAT ID EEPROM
28	ID_SC	I²C_SCL for HAT ID EEPROM
29	NC	No Connection
30	GND	Ground
31	NC	No Connection
32	NC	No Connection
33	RESET_GPS	GPS Module Reset Pin (GPIO 13 of Raspberry Pi)
34	GND	Ground
35	STANDBY_GPS	GPS Module standby PIN (GPIO19 of Raspberry Pi)
36	NC	No Connection
37	NC	No Connection
38	NC	No Connection
39	GND	Ground
40	NC	No Connection

RF Characteristics

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)
Europe	EU433, EU868
China	CN470
North America	US915
Asia	AS923
Australia	AU915
Korea	KR920
Indian	IN865

Transmitter RF

The RAK2245 Pi HAT 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.

PA Control	DAC Control	MIX Control	DIG Gain	Normal RF Power Level (dbm)
0	3	8	0	-6
0	3	10	0	-3
0	3	14	0	0
1	3	9	3	4
1	3	8	0	8
1	3	9	0	10
1	3	11	0	12
1	3	12	0	14
1	3	13	0	16
2	3	12	0	17
2	3	13	0	19
2	3	14	0	20
3	3	10	0	0
3	3	11	0	0
3	3	12	0	25
3	3	13	0	26
3	3	14	0	27

- At **T=25° C**, **Vdd = 5 V** (Typical) if nothing else stated

Parameter	Condition	Min	Typ.	Max
Frequency Range		863 MHz		870 MHz
Modulation Techniques	FSK/LoRa			
TX Frequency Variation vs Temperature	Power Level Setting: 20	-3 kHz		+3 kHz
TX Power Variation vs Temperature	Power Level Setting: 20	-5 dBm		+5 dbm
TX Power Variation		-1.5 dBm		+1.5 dBm

Receiver RF

We recommended that you to use optimized RSSI calibration values which are part of HAL v3.1. For both Radio 1 and 2, the RSSI-offset should be set to -169. The following table gives the typical sensitivity level of RAK2245 Pi HAT.

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

Electrical Characteristics

The following are the electrical characteristics of RAK2245 Pi HAT. Contact the RAK support if you need other details for your project.

Absolute Maximum Rating

The values and range given below are all in accordance with the Absolute Maximum Rating System (IEC 134).

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

> 📝 **NOTE**
>
> With RF output power level above +15 dBm a minimum distance to a transmitter should be 1 m for avoiding too large input level.

Maximum ESD

The table below lists the maximum ESD.

Parameter	Min	Typical	Max	Remarks
ESD sensitivity for all pins except ANT1			1 kV	Human Body Model according to JESD22-A114
ESD sensitivity for ANT1			1 kV	Human Body Model according to JESD22-A114
ESD immunity for ANT1			4 kV	Contact Discharge according to IEC 61000-4-2
			8 kV	Air Discharge according to IEC 61000-4-2

📝 **NOTE**

The module is an Electrostatic Sensitive Device and requires special precautions when handling.

Power Consumption

Mode	Condition	Min	Typical	Max
Active-Mode (TX)	TX Enabled and RX Disabled		336 mA	
Active-Mode (RX)	TX Disabled and RX Enabled		360 mA	

Environmental Requirements

Operating Conditions

The table below lists the operation temperature range.

Parameter	Min.	Typical	Max	Remarks
Normal Operating Temperature	-40° C	+25° C	+85° C	Fully functional and meets 3GPP specifications

Firmware

Download the latest firmware of RAK2245 Pi HAT in the table provided below.

Model	Raspberry Pi Board	Firmware Version	Source
RAK2245 Pi Hat	Raspberry Pi 3B+ and 4	V4.2.5R	Download

Models / Bundles

Ordering Information

Part Number	Package	Description
RAK2243-0X-R01	1x board, 1x LoRa Antenna and 1x GPS Active Antenna retail package	Supports 433 / 470 / 868 / 915 / 923 / 920 / 865 MHz
RAK2243-0X-C10	10-piece board and Antennas carton package	Supports 433 / 470 / 868 / 915 / 923 / 920 / 865 MHz

Certification

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