User Manual for

Pilot Gateway Pro RAK7243

WisDevice Series

Version V1.1 | January 2019

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1 Overview

1.1 Introduction

The RAK7243 Pilot Gateway Pro is a device that consists of Raspberry Pi 3B+, RAK2245 Pi HAT which includes a GPS module and a Heat Sink for better performance and thermal heat dissipation management. And it's housing is built with an aluminum casing. Raspberry Pi 3B+ can support many functions, for marketing purpose, this module only support/enable USB port and Ethernet port in US, the other functions(2.4G WiFi,5G WiFi, Bluetooth, HDMI port, Audio port) have been forbidden by the manufacturer's software.

For the build-in RAK2245 Pi HAT, it uses the SX1301 chip from Semtech which built-in LoRa concentrator IP core is a powerful digital signal processing engine. It is able to receive up to 8 LoRa packets simultaneously sent with different spreading factors on different channels and available in multiple variants so it can be used for internartinal standard bands. This unique capability allows to implement innovative network architectures advantageous over other short range systems. It follows Raspberry Pi specifications and is easy to mount with Raspberry Pi and RAK2245 Pi HAT module.

Pilot Gateway Pro is ideal for prototyping, proof-of-concept demonstration or for the evaluation. It includes a ready to use LoRaWan Gateway OS that can be connected to a LoRaWan server. Also it is developer friendly and simple even for no-so-techy users to set up LoRaWan system. It 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 appli

Figure 1 | Pilot Gateway Pro Overview

1.2 Main Features

- Computing with Raspberry Pi 3B+(Linux).
- SX1301 base band processor, emulates 49 x LoRa demodulators 10 programmable parallel demodulation paths, support 8 uplinks channel, 1 downlink channel.
- Built-in the Ublox MAX-7Q GPS Module.
- Built-in Heat Sink for thermal heat dissipation management.
- TX power up to 11.73dBm, RX sensitivity down to -139dBm@SF12, BW 125KHz.
- LoRa frequency supports global license-free frequency band (EU433, CN470, EU868, US915, AS923, AU915, KR920, IN865 and AS920).
- Housing with top cover, body, bottom cover with riveted motherboard standoff.
- Includes Pi ready 'ID EEPROM', GPIO setup and device tree can be automatically configured from vendor information.
- Supports fully open source code connected to a LoRaWAN server.

2 Pilot Gateway Pro RAK7243

2.1 Overview

The outer dimension of Pilot Gateway Pro is 92 x 68.3 x 53.5 mm as shown below.

Figure 2 | Outer Dimensions

2.2 Interfaces

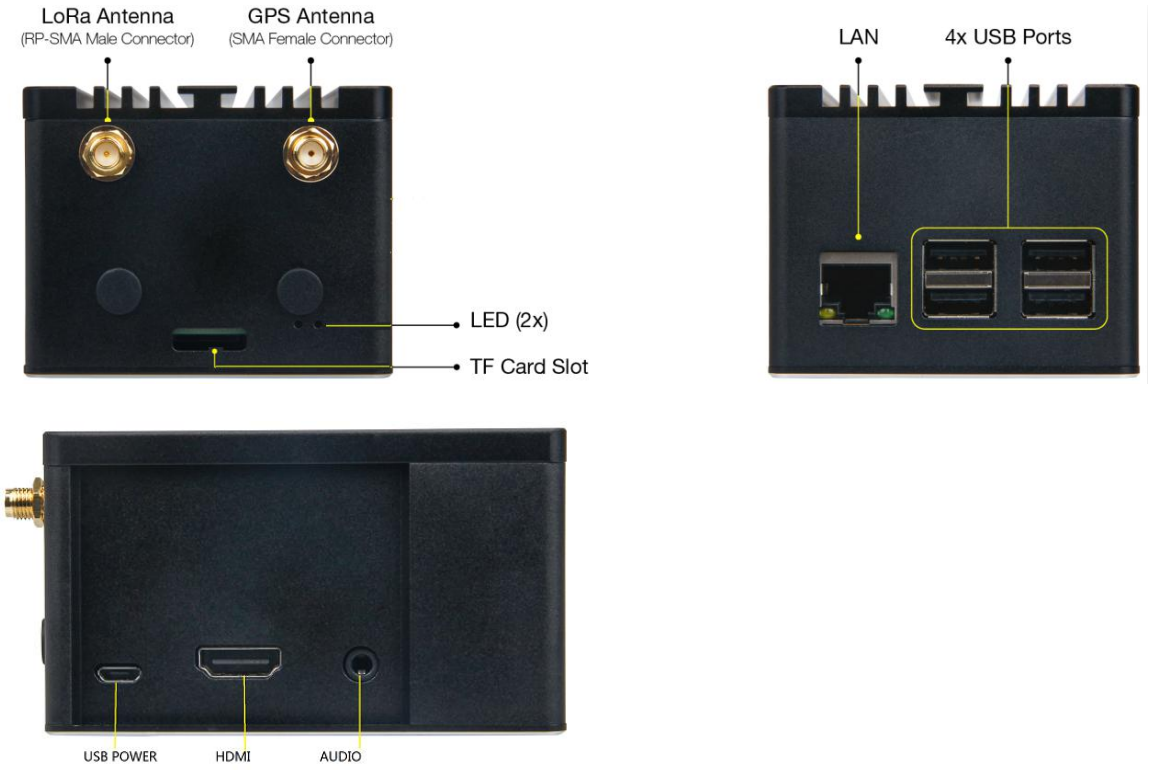

Figure 3 | Interfaces

2.3 System Structure

The following figure shows the basic concept for LoRaWAN system. RAK**7243** Pilot Gateway Pro is the central hardware solution for all LoRa based radio communication. It receives and transmits radio messages. The processing of radio messages as well as the protocol related tasks is done by embedded host system (Raspberry Pi). Received and processed radio messages are being sent to a LoRaWAN server. The concrete segmentation of the protocol related tasks is outside the scope of this document.

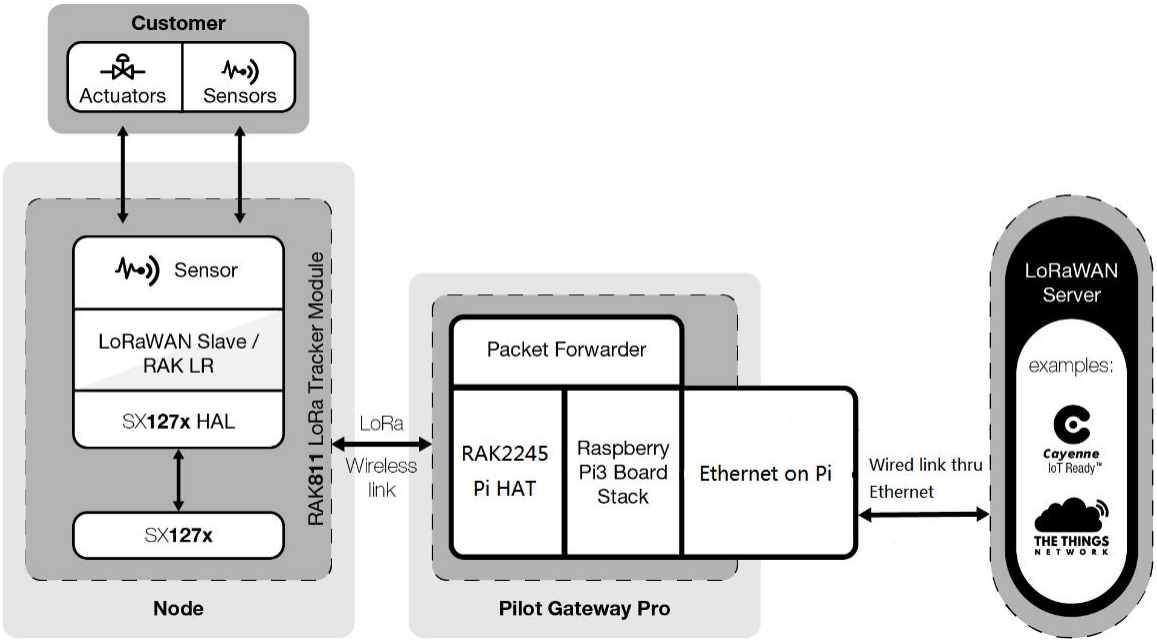

***Figure 4** | Pilot Gateway Pro System Structure*

2.4 LoRa Operating Frequencies

The Pilot Gateway Pro 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** | LoRa Operating Frequencies*

2.5 Hardware Structure

2.5.1 LoRa Concentrator RAK2245 Pi HAT

RAK2245 Pi HAT is a LoRa Concentrator board which follows the Pi HAT standard, and can be mounted to Pi board with 40-pin connector.

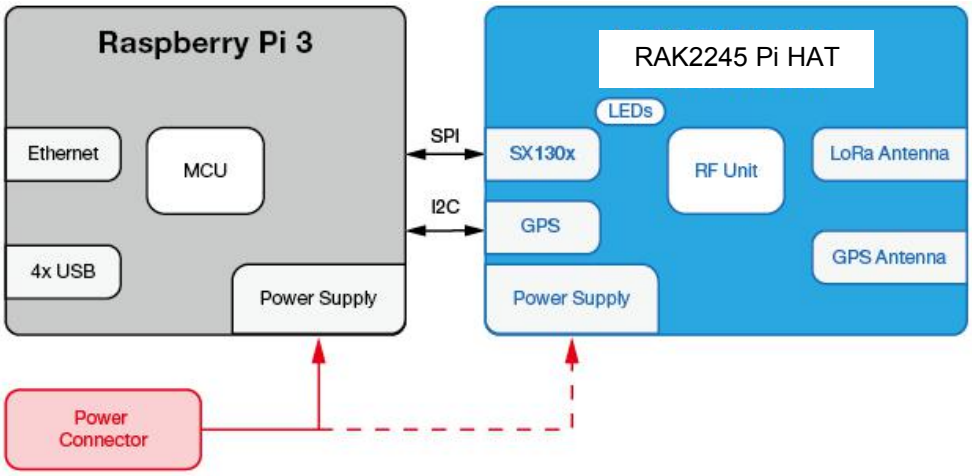

Figure 5 | LoRa Hardware Structure

2.6 Power Requirements

The Pilot Gateway Pro can be powered by micro USB with 5V.

Parameter	Min.	Typical	Max.
Active Mode(TX)		1500mA	
Active Mode(RX)		1560mA	

Table 2 | Power Requirements

2.7 Environmental Requirements

The table below lists the operation and storage temperature requirements:

Parameter	Min.	Typical	Max.
Operation Temperature Range	-35 ºC	+25 ºC	+55 ºC
Storage Temperature Range	-40 ˚C	+25 ºC	+55 ˚C

Table 3 | Environment Requirements

2.8 LoRa RF Characteristics

2.8.1 Transmitter RF Characteristics

The RAK**2245** 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
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 4** | RF Output Power Level*

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

Parameter	Condition	Min	Typ.	Max
Frequency Range		903 MHz		927.5 MHz
Modulation Techniques	FSK/LoRaTM			
TX Frequency Variation vs. Temperature	Power Level Setting : 20	-3 KHz		+3 KHz
TX Power Variation vs. Temperature		-5 dBm		+5 dBm
TX Power Variation		-1.5 dBm		+1.5 dBm

Table 5 | TX RF Characteristics

2.8.2 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

Table 6 | RX RF Characteristics

3 Antenna

3.1 LoRa Antenna

3.1.1 Overview

The LoRa Antenna with RP-SMA female connector shown as follow figures.

Figure 6 | LoRa Antenna Overview

3.1.2 Antenna Dimension

The antenna's mechanical dimension is shown below:

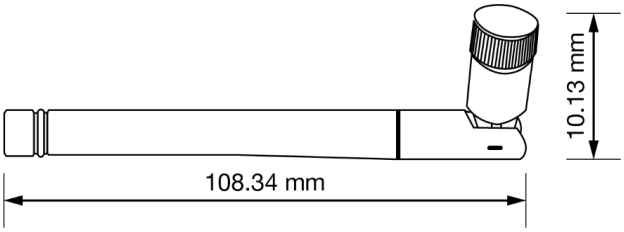

Figure 7 | LoRa Antenna Dimension

3.1.3 Antenna Parameter

Items	Specifications
Voltage Standard Wave Radio (VSWR)	1:1.5
Gain	2.0 dBi
Working Temperature & Humidity	T:-35 ºC ~ +80 ºC, H: 0% ~ 95%
Storage Temperature & Humidity	T:-40 ºC ~ +85 ºC, H: 0% ~ 95%

Table 7 | LoRa Antenna Parameter

3.2 GPS Antenna

3.2.1 Overview

The GPS antenna for Pilot Gateway Pro is shown below.

Figure 8 | GPS Antenna

3.2.2 GPS Antenna Dimensions

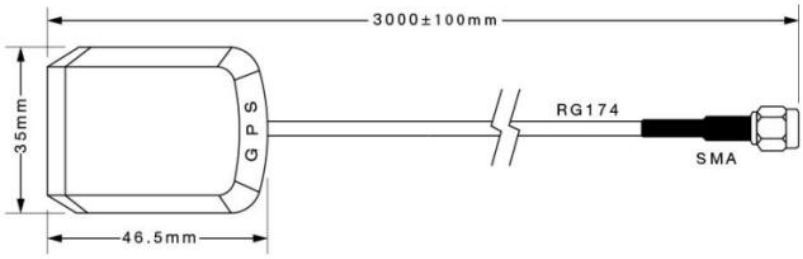

Figure 9 | GPS Antenna Dimensions

3.2.3 GPS Environmental Requirements

The antenna environmental requirements are listed in the table below:

Conditions	Temperature	Humidity
Working	-35 ºC ~ +80 ºC	0% ~ 95%
Storage	-40 ºC ~ +85 ºC	0% ~ 95%

Table 8 | GPS Environmental Requirements

3.2.4 GPS Antenna Parameter

Antenna specifications are listed in the table below:

Item	Specifications	PET
Range of Receiving Frequency	1575.42±1.1	±2.5
Center Frequency (MHz) w/ 30mm2 GND plane	1575.42	±3.0
Bandwidth (MHz) (Return Loss ≤ -10dB)	≥10	±0.5
VSWR (in Center Frequency)	≤2.0	±0.5
Gain (Zenith) (dBi Typ.) w/ 70mm2 GND Plane	4.5	±0.5
Axial Ratio (dB) w/ 70mm2 GND Plane	3.0	±0.2
Polarization	Right-Handed Circular	-
Impedance (Ω)	50	-
Frequency Temperature Coefficient (ppm/ºC)	0±10	-

Table 9 | GPS Antenna Parameter

4 Flash the Gateway Image

When you received your gateway, firstly you need flash the gateway image by yourself.

Please refer to the Image Start Quide for RAK7243, here is the link:

https://www.rakwireless.com/en/download/LoRa/Pilot-Gateway-Pro-RAK7243#Application-Notes

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.

Note: 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.

-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.

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20 cm between the radiator& your body.

Manufacture name and address：

Shenzhen Rakwireless Technology Co., Ltd.

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7 Revision History

Revision	Description	Date
1.0	Initial version	2018-12-21
1.1	Update the description, some pictures	2019-01-15

8 Document Summary

Document Name: RAK**7243** Pilot Gateway Pro User Manual

Revision Number: V1.0

Prepared by	Checked by:	Approved by:
Terry & Penn	Terry	

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.