RAK7248 WisGate Developer D4H Gateway Datasheet

Overview

Description

The WisGate Developer D4H RAK7248 is a LoRaWAN® Gateway that consists of Raspberry Pi4, RAK2287 Concentrator, and RAK2287 Pi HAT. RAK2287 includes a GPS module and a heat sink for better performance and thermal heat dissipation management, and its housing is built with an aluminum casing.

For the build-in RAK2287, it uses the **SX1302 chip** from Semtech which built-in LoRa® concentrator IP core is a powerful digital signal processing engine. It can receive up to **8 LoRa packets** with different spreading factors on different channels and available in multiple variants so it can be used for international standard bands. This unique capability allows implementing innovative network architectures advantageous over other short-range systems. RAK2287 Pi HAT is a converter board with Raspberry Pi form factor that enables the RAK2287 module to be mounted on the top of the Raspberry Pi. It integrates one (1) 40-pin female Pi HAT connector and one mPCIe connector to connect RAK2287 to the Raspberry Pi 4.

RAK7248 is ideal for prototyping, proof-of-concept demonstration, or 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-tech users to set up a 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 applications.

Features

- Computing with Raspberry Pi4 (Linux).
- Based on the LoRa Concentrator Engine: Semtech® SX1302.
- Built-in Ublox ZOE-M8Q GPS Module.
- Built-in Heat Sink for thermal heat dissipation management.
- Supports 5V/3A power supply.
- IP30 housing.
- TX power up to 27dBm, RX sensitivity down to -139 dBm @SF12, BW 125 KHz.
- LoRa® Frequency band support: RU864, IN865, EU868, US915, AU915, KR920, AS923.
- Includes Pi ready 'ID EEPROM', GPIO setup, and device tree can be automatically configured from vendor information.
- Supports a fully open source LoRaWAN server.

Specifications

Overview

The overview covers the RAK7248 board and block diagram.

Board Overview

The outer dimension of RAK7248 is **92x68.3x57.2 mm**.

Figure 1: Device Dimensions

Circuit Board Modules Stack

The figure below summarizes the basic building blocks of RAK7248. The RAK2287 is an essential part of it as it provides all LoRaWAN connectivity. It receives and transmits LoRa Frames and takes care of modulating/demodulating the signals among others. The processing of the LoRa Frames as well as higher-level protocol related tasks are done by the embedded host system (Raspberry Pi). Received and processed LoRa Frames are being sent to a LoRaWAN Server. The segmentation of protocol related tasks is outside the scope of this document.

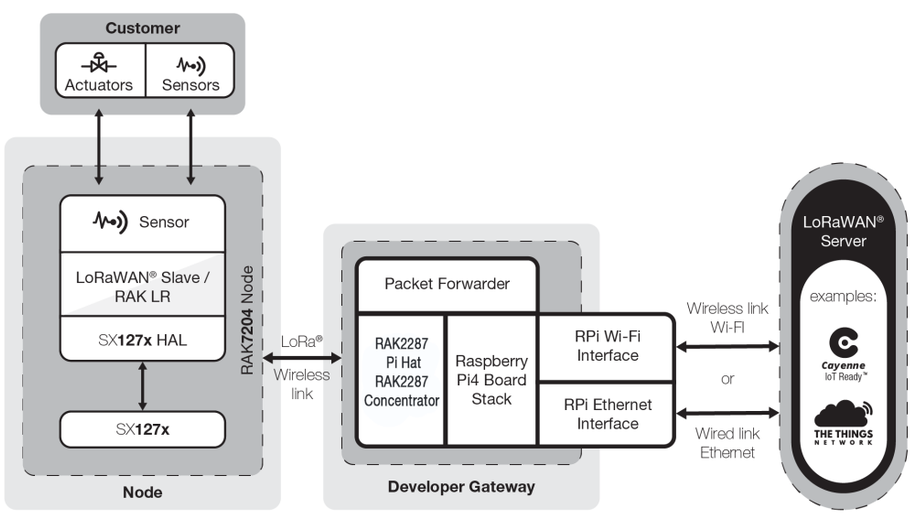

Figure 2: RAK7248 System Structure

Block Diagram

RAK7248 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 the embedded host system (Raspberry Pi4). Received and processed radio messages are being sent to a LoRaWAN server. The following figure shows the block diagram of RAK7248.

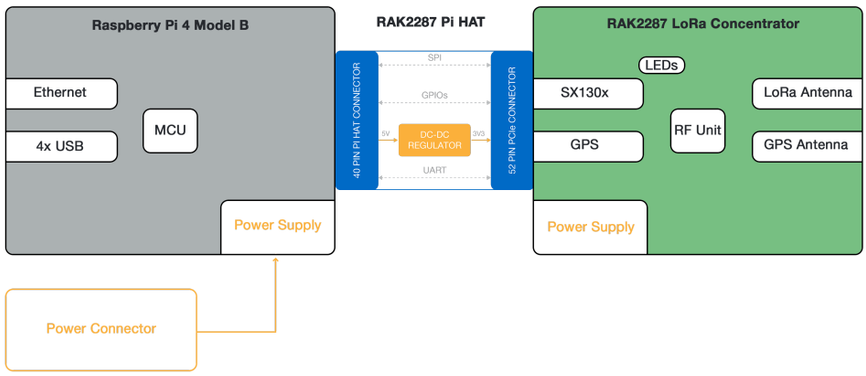

Figure 3: RAK7248 Block Diagram

> 📝 **NOTE**
>
> The concrete segmentation of the protocol related tasks is outside the scope of this document.

Hardware

Interfaces

The interface of RAK7248 is shown in the figure below.

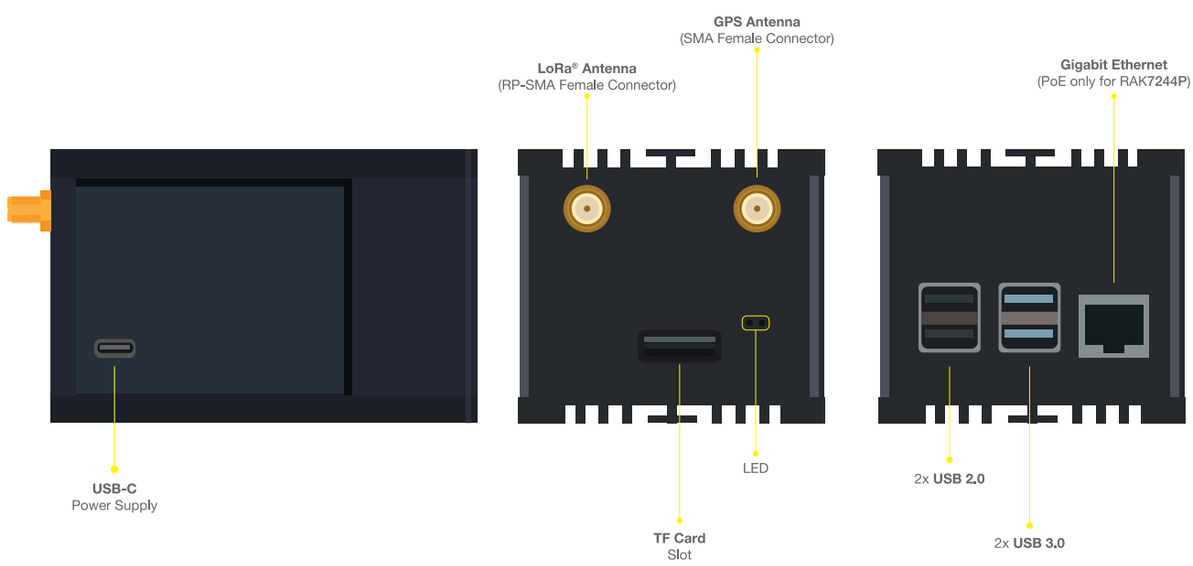

Figure 4: RAK7248 Interfaces

RF Characteristics

Operating Frequencies

The WisGate Developer D4H supports all LoRaWAN frequency channels as below. Which is easy to configure while building the firmware from the source code.

Region	Frequency (MHz)
Europe	EU868
North America	US915
Asia	AS923
Australia	AU915
Korea	KR920
India	IN865
Russia	RU864

LoRa® RF Characteristics

Transmitter RF Characteristics

The RAK2287 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	pwid control	Power
0	10	-6 dBm
0	13	-3 dBm
0	17	0 dBm
0	20	4 dBm
1	0	8 dBm
1	2	10 dBm
1	4	12 dBm
1	7	14 dBm
1	9	16 dBm
1	10	17 dBm
1	12	19 dBm
1	13	20 dBm
1	16	23 dBm
1	18	25 dBm
1	20	26 dBm
1	22	27 dBm

📝 **NOTE**

Normally, there is a ±1.5dB difference between the actual test value and the table data.

📝 **NOTE**

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

Parameter	Condition	Min	Typ.	Max
Frequency Range		902 MHz		928 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 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 the typical sensitivity level of the RAK2287.

Signal Bandwidth (Khz)	Spreading Factor	Sensitivity (dBm)
125	12	-139
125	7	-125
250	12	-136
250	7	-123
500	12	-134
500	7	-120

Antenna Specifications

LoRa Antenna

Overview

The LoRa Antenna with RP-SMA male connector shown in the figure below:

Figure 5: LoRa® Antenna

Antenna Dimension

The antenna's mechanical dimension is shown below:

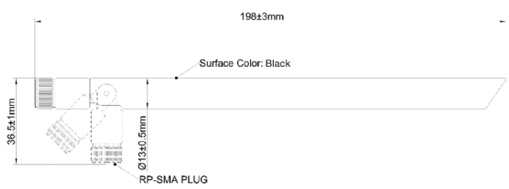

Figure 6: LoRa® Antenna Dimension (mm)

Antenna Parameters

Items	Specifications	Specifications
Frequency Range	863~870 MHz	902~928 MHz
Peak Gain	2.8 dBi	2.3 dBi
Voltage Standard Wave Ratio (VSWR)	≤1.5	≤1.5
Efficiency	>80%	>80%
Feed Impedance	50 Ohms	50 Ohms
Working Temperature & Humidity	T: -35~+75 ºC, H: 5~95%	T: -35~+75 ºC, H: 5~95%

GPS Antenna

Overview

The GPS antenna with SMA Male Connector for the WisGate D4H LPWAN Gateway is shown below

Figure 7: GPS Antenna

GPS Antenna Dimension

The antenna's mechanical dimension is shown below:

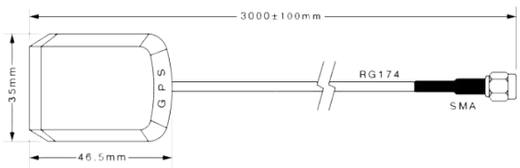

Figure 8: GPS Antenna Dimensions

GPS Environmental Requirements

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

GPS Antenna Parameters

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	-

Amplifier Specifications are listed below:

Item	Specifications
Frequency Range	1575.42 MHz
Gain	27 dB
VSWR	≤ 2.0 V
Noise Coefficient	≤ 2.0 dBm
DC Voltage	3 ~ 5 V
DC Current	5 ± 2 mA

Environmental test performance specifications are listed below:

Item	Normal Temp.	High Temp (1)	Low Temp (2)
Amplifier Gain	27 dB ± 2.0	27 dB ± 2.0	27 dB ± 2.0
VSWR	≤ 2.0	≤ 2.0	≤ 2.0
Noise Coefficient	≤ 2.0	≤ 2.0	≤ 2.0

📝 **NOTE**

1. **High Temperature**: For 24 hours, the device was enclosed into a chamber with temperature and humidity set to 85ºC and 95%, respectively. Then, for at least an hour, the temperature is set back to normal. **The device experienced no physical deformation.**
2. **Low Temperature**: For 24 hours, the device was enclosed into a chamber with a temperature set to -40ºC.Then, for at least an hour, the temperature is set back to normal. **The device experienced no physical deformation.**

Electrical Requirements

The WisGate Developer D4H operates at 5V/3A.

Parameter	Min.	Typical	Max
LoRa Tx mode	-	-	950 mA
Standby power	-	550 mA	-
Burn test mode	-	-	940 mA

📝 **NOTE**

- LoRa Tx mode: The LoRa module works at the maximum transmit power state.
- Burn test mode: Raspberry Pi CPU and memory are running at full capacity.

Environmental Requirements

The table below lists the operation and storage temperature requirements:

Parameter	Min.	Typical	Max
Operation Temperature Range	-10 ºC	+25 ºC	+55 ºC
Storage Temperature Range	-40 ºC		+85 ºC

Software

Firmware

Model	Raspberry Pi Board	Firmware Version	Source
RAK7248	Raspberry Pi 4	4.2.5R	Download

LoRaWAN

- Supports class A, C
- Supports connect to TTN server
- Supports LoRa package forward
- Supports build-in ChirpStack® LoRaWAN Server

Network Protocol Stack

- Supports 802.11ac
- Supports WiFi AP mode and Client mode
- Supports DHCP

Management

- Supports SSH

Models / Bundles

Part Number	Package	Description
RAK7248-03	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for EU868 region
RAK7248-04	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for US915 region
RAK7248-05	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for KR920 region
RAK7248-06	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for AS923 region
RAK7248-07	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for IN865 region
RAK7248-08	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for AU915 region
RAK7248-09	1pc LoRa Antenna 1pc GPS Antenna 1pc Power Adapter 1pc 16G SD card with pre-installed firmware	RAK7248 for RU864 region

Certification

FCC Caution

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

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.

📝 **IMPORTANT NOTE**

This equipment has been tested and found to comply with the limits for a Class B digital device, according 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 following 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.

FCC Radiation Exposure Statement

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

📝 **ISEDC Warning**

This device complies with Innovation, Science, and Economic Development 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.

Le présent appareil est conforme aux CNR d' Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. l'appareil nedoit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

📝 **ISEDC Warning**

The device complies with RF exposure guidelines, users can obtain Canadian information on RF exposure and compliance. The minimum distance from the body to use the device is 20 cm.

Le présent appareil est conforme Après examen de ce matériel aux conformité ou aux limites d’intensité de champ RF, les utilisateurs peuvent sur l’exposition aux radiofréquences et la conformité and compliance d’acquérir les informations correspondantes. La distance minimale du corps à utiliser le dispositif est de 20cm.