

User Manual for

WisGate RAK7248

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1. Overview

1.1. Introduction

The RAK7248 WisGate is a device that consists of Raspberry Pi 4 Model B, RAK2287 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.

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 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 RAK2287 module.

WisGate 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 applications.



Figure 1 | WisGateOverview

1.2. Main Features

- Computing with Raspberry Pi4 Model B(Linux).
- 64-bit SX1302 base band processor, 500 kHz LoRa reception with 8 x 8 channels LoRa® packet detectors, 8 x SF5-SF12 LoRa® demodulators, 8 x SF5-SF10 LoRa® demodulators.
- Built-in the GPSModule.
- Built-in Heat Sink for thermal heat dissipationmanagement.
- Supports 5V/3A powersupply.
- RX sensitivity down to -139dBm@SF12, BW500KHz.
- 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 motherboardstandoff.
- Includes Pi ready 'ID EEPROM', GPIO setup and device tree can be automatically configured from vendorinformation.
- Supports fully open source code connected to a LoRaWANserver.

1.3. Package Contents



WisGate (1x)

LoRa Antenna (1x)



GPS Antenna (1x)

Power Adapter (1x)

Figure 2 | Package Contents

2. WisGate RAK7248

2.1. Overview

The shell of RAK7248 is made of metal

The outer dimension of WisGate is 92 x 68.3 x 57.2 mm as shown below.



Figure 3 | Outer Dimensions

2.2. Interface





Figure 4 | Interfaces

2.3. System Structure

The following figure shows the basic concept for LoRaWAN system. RAK7248 WisGate 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.

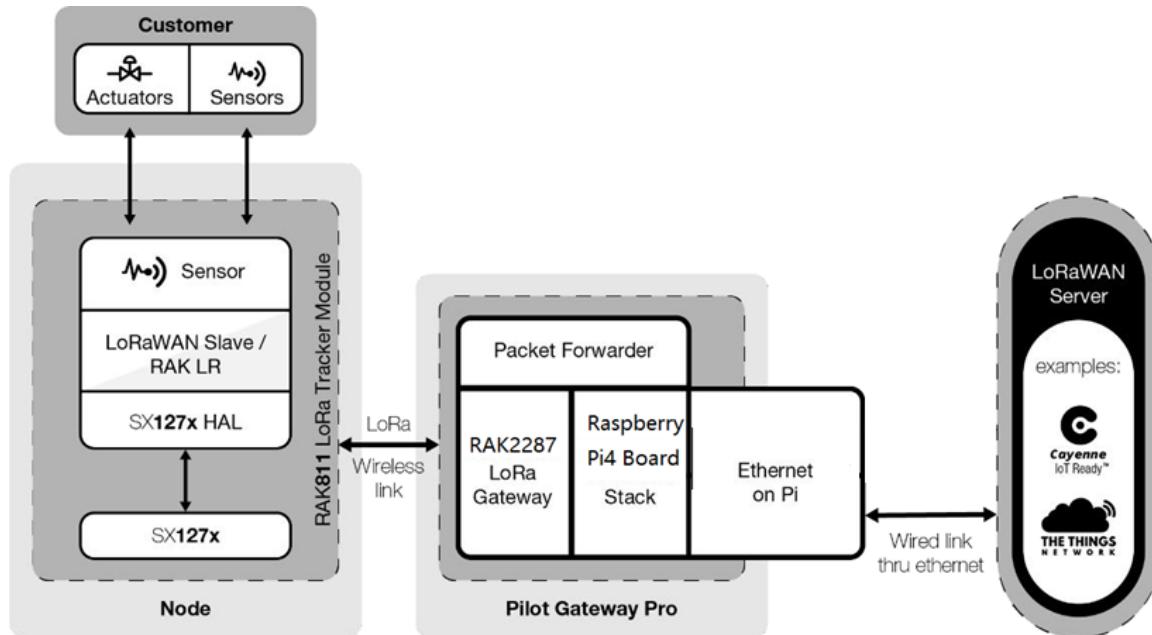


Figure 5 | WisGate System Structure

2.4. RaspberryPi

- Processor:Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- Memory:2GB LPDDR4
- I/O Port:Gigabit Ethernet;2 x USB 3.0 ports;2 x USB 2.0 ports
- Connectivity:2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wirelessLAN, Bluetooth, BLE

2.5. LoRa Operating Frequencies

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

Region	Frequency
Europe	EU433,EU868
China	CN470
North American	US915
Asia	AS923,AS920
Australia	AU915
Korea	KR920
Indian	IN865

Table 1 | LoRa Operating Frequencies

2.6. Hardware Structure

RAK2003 Pi HAT is a carrier board of RAK2287 LoRa Concentrator which follows the Pi HAT standard, and can be mounted to Pi board with 40-pin connector. RAK2003 and RAK2287 are connected by PCI-E interface.

2.7. Power Requirements

The WisGate operates at 5V/3A. It can be powered by micro USB with 5V.

Parameter	Min.	Typical	Max.
LoRa Txmode	-	-	950mA
Standby mode	-	550mA	-
Burntest mode			930mA

Table 2 | Power consumption

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

2.8. Environmental Requirements

The table below lists the operation and storage temperature requirements:

Parameter	Min.	Typical	Max.
Operation Temperature Range	-20 °C	+25 °C	+65 °C
Extended Temperature Range	-40 °C		+85 °C
Storage Temperature Range	-40 °C		+85 °C

Table 3| Environment Requirements

2.9. LoRa RF Characteristics

2.9.1 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.

Frequency Range	Transmit Power	Modulation Technique
923.3-927.5 MHz	13.39dBm	LoRa / FSK

Table 4| TX RF Characteristics

2.9.2 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 RAK2287.

Signal Bandwidth / [KHz]	Spreading Factor	Sensitivity / [dBm]
500	12	-134
500	7	-120

Table 5| 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:

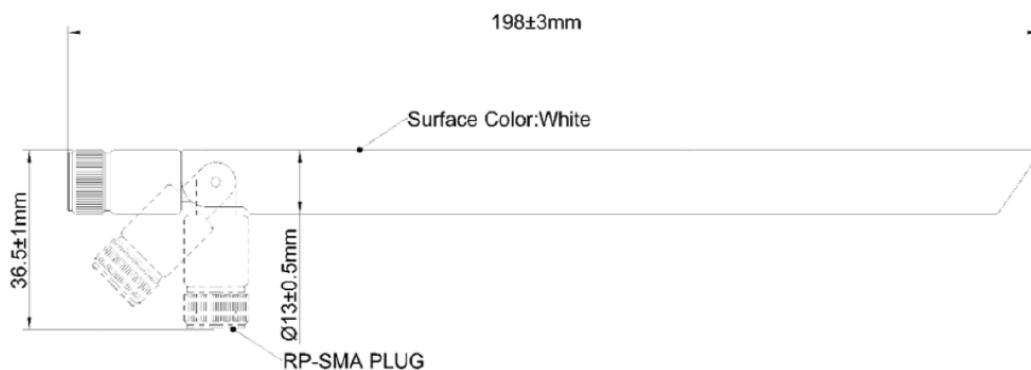


Figure 7 | LoRa Antenna Dimension

3.1.3 Antenna Parameter

Model		KRAKBJ2701C01C
Electrical Specifications	Frequency Range	902MHz~928MHz
	Peak Gain	2.3 dBi
	VSWR	≤ 1.5
	Efficiency	>80%
	Feed Impedance	50 Ohms
	Polarization	Vertical

Mechanical Specifications	Cover material(color)	Plastic(Black)
	Interface	RPSMA
	Dimensions (mm)	Φ13.0mm x 198.0mm
	Operation Temp (°C)	-30°C ~ +75°C
	Humidity range	5%~95%

Table 6 | LoRa Antenna Parameter

3.2. GPS Antenna

3.2.1 Overview

The GPS antenna for WisGate is shown below.



Figure 8 | GPS Antenna

3.2.2 GPS Antenna Dimensions

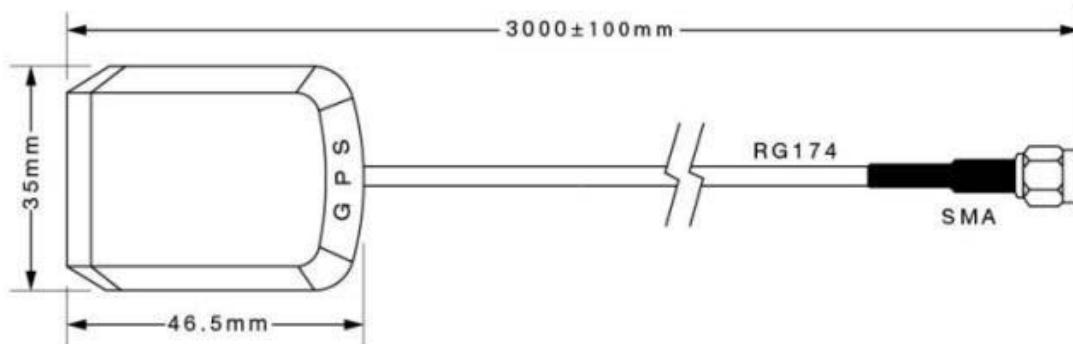


Figure 9 | GPS Antenna Dimensions

3.2.3 GPS Environmental Requirements

The antenna environmental requirements are listed in the table below:

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

Table 7| GPS Environmental Requirements

3.2.4GPS 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/ 30mm ² 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/ 70mm ² GND Plane	4.5	±0.5
Axial Ratio (dB) w/ 70mm ² GND Plane	3.0	±0.2
Polarization	Right-Handed Circular	-
Impedance (Ω)	50	-
Frequency Temperature Coefficient (ppm/°C)	0±10	-

Table 8| GPS Antenna Paramete

Amplifier Specifications are listed in the table 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

Table 9| Amplifier Specifications

Environmental test performance specifications are listed below:

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

1. High temperature test: soap in temperature (85° C) and humidity (95%) chamber for 24-hour and return to normal temperature (at least for 1-hour) without visual shapechange.

2. Low temperature test: soap in temperature (-40° C) chamber for 24-hour and return to normal temperature (at least for 1-hour) without visual shapechange.
Table 10| Environmental Test Performance

4. FCCCaution

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:

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.
- 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 minimum distance 20cm between the radiator& your body.

5. ISEDC Warning

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:

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 n'edoit 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.

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

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.

6. Revision History

Revision	Description	Date
1.0	Initial Release	August 13, 2020
1.1	Add FCC/ISEDC information	September 10, 2020
1.2	Change product name	September 14, 2020
1.3	Add Raspberry Pi Hardware information	September 15, 2020

7. Document Summary

Prepared by	Checked by:	Approved by:
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**About RAKwireless:**

RAKwireless is a pioneer in providing innovative and diverse Cellular and LoRaWAN connectivity solutions for both Edge and Gateway IoT devices. We believe that through easy to use and modular designs we can accelerate the time to market for various IoT Applications in order to optimize system deployment in both Developer and Commercial settings.