RAK3172-SiP WisDuo LPWAN SiP Datasheet

Overview

Description

RAK3172-SiP (and RAK3172LP-SiP variant) are low-power long-range transceivers based on STM32WLE5JC SoC in a System-in-Package form factor. These two modules use different RF output paths to optimize current consumption depending on the application. RAK3172-SiP uses RFO_HP while RAK3172LP-SiP uses the RFO_LP of the STM32WL SoC transceiver.

WisDuo SiP LoRa modules provide a small-size, easy-to-use, low-power solution for long-range wireless data applications. These modules comply with Class A, B, & C of LoRaWAN 1.0.3 specifications. They can easily connect to different LoRaWAN server platforms like TheThingsNetwork (TTN), Helium, Chirpstack, Actility, etc. It also supports, LoRa Point-to-Point (P2P) communication mode, which helps you in implementing your own customized long-range LoRa network quickly.

You can configure the mode and operation of the RAK3172-SiP/RAK3172LP-SiP using AT commands via UART interface or create custom firmware using RUI3 API. RAK3172-SiP/RAK3172LP-SiP are very small in size and offer low-power features that are very suitable for battery-powered applications.

Features

- Based on **STM32WLE5JC**
- Two variants available
  - RAK3172-SiP (uses RFO_HP)
  - RAK3172LP-SiP (uses RFO_LP)
- System-in-Package form factor
- RUI3 API compatible
- **LoRaWAN 1.0.3** specification compliant
- **Supported bands**: IN865, EU868, AU915, US915, KR920, RU864, and AS923
- LoRaWAN Activation by OTAA/ABP
- LoRa Point-to-Point (P2P) communication
- Custom firmware using Arduino via RUI3 API
- Easy-to-use AT Command set via UART interface
- Long-range - up to 15 km with optimized antenna
- ARM Cortex-M4 32-bit
- 256 kbytes flash memory with ECC
- 64 kbytes RAM
- Ultra-low power consumption of 1.69 µA in sleep mode
- **Supply voltage**: 2.0 V ~ 3.6 V
- **Temperature range**: -40° C ~ 85° C
- **Size**: 12 mm x 12 mm x 1.22 mm
- **Package**: LGA73 type

Specifications

This section covers the hardware and software specifications of RAK3172-SiP. Also, it includes the block diagram and the updated firmware link of the RAK3172-SiP WisDuo module.

Overview

Block Diagram

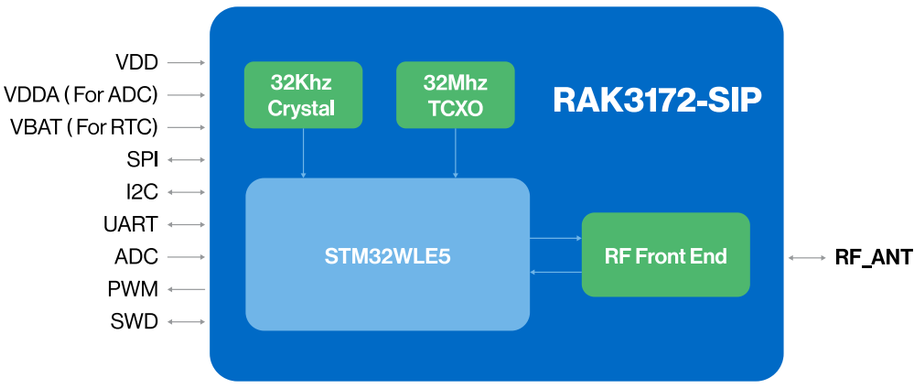

Figure 1: RAK3172-SiP system block diagram

Hardware

The hardware specification is categorized into six parts. It discusses the interfacing, pinouts, and their corresponding functions and diagrams. It also covers the rf, electrical, mechanical, and environmental parameters that include the tabular data of the functionalities and standard values of the RAK3172-SiP WisDuo LPWAN SiP Module.

> 📝 **NOTE:**
>
> For the reference application schematic of RAK3172-SiP with minimum components requirements, refer to the RAK3272-SiP Breakout Board Datasheet.

Interfaces

Module	Interfaces
RAK3172-SiP	UART2 (Default for AT Command), UART1
RAK3172LP-SiP	UART2 (Default for AT Command), UART1

Pin Definition

You can check the pin definitions on the table and illustration, as shown in **Figure 2**.

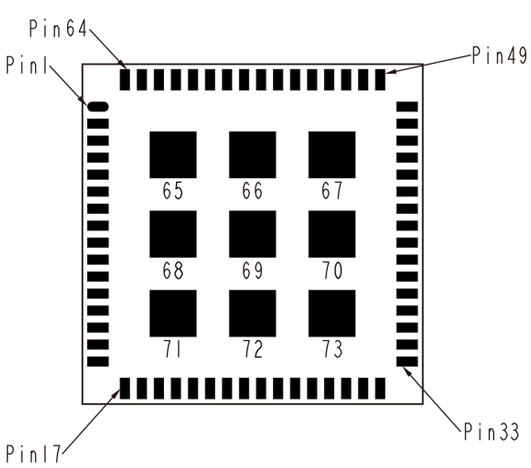

Figure 2: RAK3172-SiP top view pin diagram

> ⚠️ **WARNING**
>
> Make sure there is no ground plane (in all layers of the PCB) under the `RF_OUT` trace path to eliminate the possible effects of unwanted stray capacitance which can cause degradation of the RF signal levels.

Pin No.	Name	Type	Description
1	PA13	I	Reserved - SWD debug pin (SWDIO)
2	PA14	O	Reserved - SWD debug pin (SWCLK)
3	VDD		VDD
4	VBAT		VDD (For RTC)
5	PC13	I/O	GPIO
6	VREF+		Input reference voltage for ADC
7	VDDA		External power supply for the analog sections (ADC Converter)
8	PA15	I/O	GPIO or PIN_A4
9	PB15	I/O	GPIO
10	VFBSMPS		DC-DC switching power feedback
11	VDDMPS		DC-DC switching power input
12	GND		Ground
13	VLXSMPS		DC-DC switching output
14	PB3	I/O	GPIO or PIN_A0
15	PB4	I/O	GPIO or PIN_A1
16	PB5	I/O	GPIO
17	PB6/UART1_TX	I/O	GPIO or UART1_TX
18	PB7/UART1_RX	I/O	GPIO or UART1_RX
19	PB8	I/O	GPIO
20	PB9	I/O	GPIO
21	PC0	I/O	GPIO

Pin No.	Name	Type	Description
22	PC1	I/O	GPIO
23	PC2	I/O	GPIO
24	PC3	I/O	GPIO
25	PC4	I/O	GPIO
26	PC5	I/O	GPIO
27	PC6	I/O	GPIO
28	GND		Ground
29	PA2/UART2_TX	O	Reserved - UART2/LPUART1 Interface (AT Commands and FW Update)
30	PA3/UART2_RX	I	Reserved - UART2/LPUART1 Interface (AT Commands and FW Update)
31	PA4	I/O	GPIO or SPI1 (SPI1_CS)
32	PA5	I/O	GPIO or SPI1 (SPI1_CLK)
33	PA6	I/O	GPIO or SPI1 (SPI1_MISO)
34	PA7	I/O	GPIO or SPI1 (SPI1_MOSI)
35	GND		Ground
36	GND		Ground
37	RF_OUT	O	RF Output
38	GND		Ground
39	GND		Ground
40	NC		Not connected
41	NC		Not connected
42	NC		Not connected
43	BOOT 0	I	Boot Mode Select pin (Activates STM32WL UART Bootloader when HIGH)
44	NRST	I	MCU Reset (NRST)

Pin No.	Name	Type	Description
45	NC		Not connected
46	GND		Ground
47	GND		Ground
48	PB11	I/O	GPIO
49	PB10	I/O	GPIO
50	PA9	I/O	GPIO or I2C_SCL
51	PA8	I/O	GPIO
52	GND		Ground
53	VDDPA		RF PA power input
54	VDDRF		RF Segment power input
55	VDD		VDD
56	GND		Ground
57	PB1	I/O	GPIO
58	PB2	I/O	GPIO or PIN_A2
59	PB12	I/O	GPIO
60	PB13	I/O	GPIO
61	PB14	I/O	GPIO
62	PA10	I/O	GPIO or PIN_A3 or I2C_SDA
63	PA11	I/O	GPIO
64	PA12	I/O	GPIO
65-73	GND		Ground

RF Characteristics

The RAK3172-SiP supports the frequency of operation from 863 to 930 Mhz.

Operating Frequencies

Region	Frequency
Europe	EU868
North America	US915
Australia	AU915
Korea	KR920
Asia	AS923-1/2/3/4
India	IN865
Russia	RU864

Electrical Characteristics

Absolute Maximum Ratings

Parameter	Minimum	Typical	Maximum	Unit
VDD and GPIO	-0.3 V	-	3.9	Volts (V)

Operating Voltage

Parameter	Minimum	Typical	Maximum	Unit
VCC	1.8	-	3.6	Volts (V)
VDDA (ADC or COMP used)	1.71	-	3.6	Volts (V)
VDDA (VREFBUF used)	2.4	-	3.6	Volts (V)
VDDA (ADC, COMP, or VREFBUF not used)	0	-	3.6	Volts (V)
VBAT	1.55	-	3.6	Volts (V)
VDDSMPS	1.8	-	3.6	Volts (V)
VDDRF	1.8	-	3.6	Volts (V)
VDDPA	1.8	-	3.6	Volts (V)
VREF+	2.0	-	VDDA	Volts (V)
VREF+ (VDDA < 2 V)	VDDA	-	VDDA	Volts (V)

Operating Current

RAK3172-SiP (uses RFO_HP RF output)

Parameter	Condition	Current Consumption (Typical)
TX mode	20 dBm	87 mA
RX mode	-	6.14 mA
Sleep mode	-	1.69 uA

RAK3172LP-SiP (uses RFO_LP RF output)

Parameter	Condition	Current Consumption (Typical)
TX mode	14 dBm	39.1 mA
	12 dBm	33 mA
	10 dBm	28 mA
	8 dBm	25 mA
RX mode	-	9.69 mA
Sleep mode	-	2.1 uA

Mechanical Characteristics

Module Dimensions

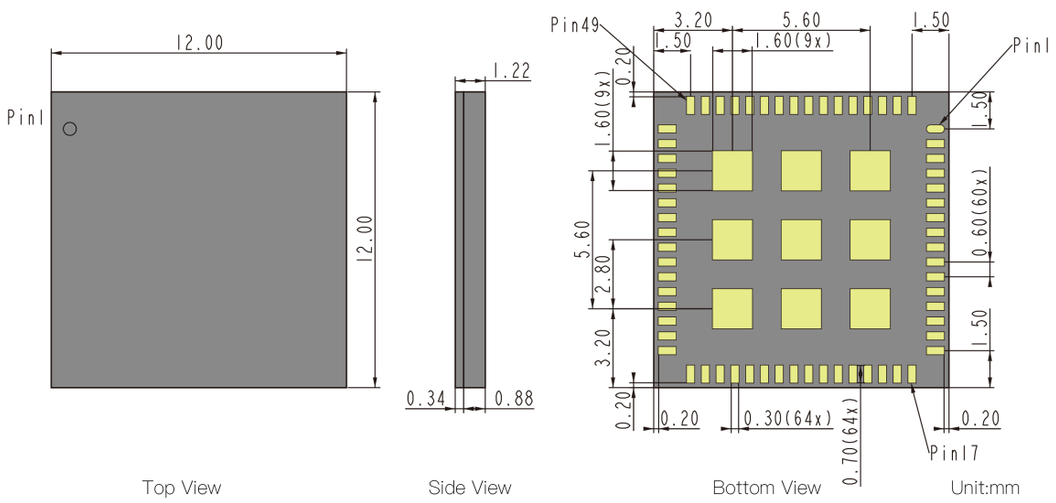

Figure 3: RAK3172-SiP mechanical dimension

Layout Recommendation

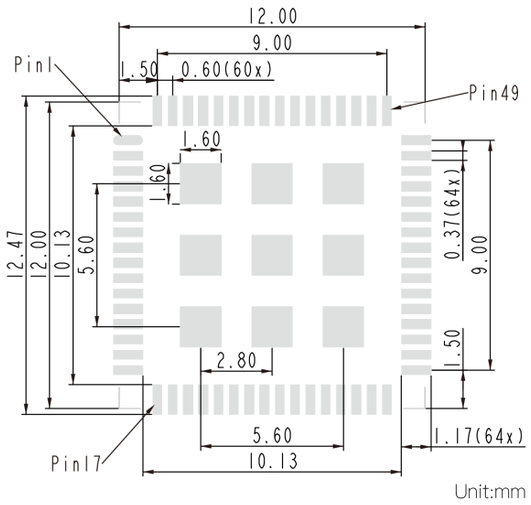

Figure 4: RAK3172-SiP layout

Environmental Characteristics

Operating Temperature

Feature	Minimum	Typical	Maximum	Unit
Operating Temperature	-40	25	85	°C

Storage Temperature

Feature	Minimum	Typical	Maximum	Unit
Storage Temperature	-40	-	85	°C

Recommended Reflow Profile

> ⚠ **WARNING**
>
> - On SMT reflow process, follow MSL3 (Moisture Sensitivity Level 3) guidance for PCBA assembly.
> - Before SMT reflow, it is recommended to bake at 125° C for 12 hours first to reduce the risk of soldering issues and abnormalities.

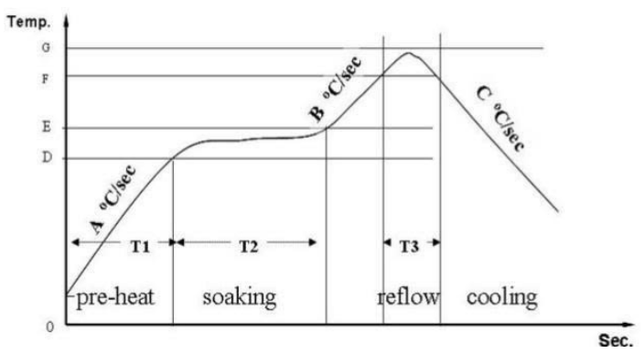

Figure 5: Reflow profile for RAK3172-SiP

Standard conditions for reflow soldering:

- Pre-heating Ramp (A) (Initial temperature: 150° C): **1~2.5° C/sec**
- Soaking Time (T2) (110~190° C): **90~120 sec**
- Peak Temperature (G): **240~245° C**
- Reflow Time (T3) (240-245° C): **50~70 sec**
- Ramp-up Rate (B): **1-3° C/sec**
- Ramp-down Rate (C): **1~5° C/sec**

Software

Download the latest RAK3172-SiP WisDuo LPWAN SiP firmware provided below.

- The **bin file** contains the application code only and you need the RAK DFU Tool to upload this file to RAK3172-SiP via UART.
- The **hex file** contains both the bootloader and the application code. You need to use STM32CubeProgrammer to upload this.

RAK3172-SiP uses UART2 serial pins to upload the latest firmware.

Firmware/OS

Download the latest RAK3172-SiP and RAK3172LP-SiP Breakout Board firmware provided below.

Model	Version	Source
RAK3272-SiP (.bin)	RUI3 (App only)	Download
RAK3272-SiP (.hex)	RUI3 (Bootloader and App)	Download
RAK3272LP-SiP (.bin)	RUI3 (App only)	Download
RAK3272LP-SiP (.hex)	RUI3 (Bootloader and App)	Download

Certification

Last Updated: 9/19/2023, 2:53:54 AM