RAK11720 WisDuo LPWAN+BLE Module Datasheet

Overview

Description

RAK11720 is a low-power, long-range LoRaWAN module based on the Ambiq Apollo3 Blue AMA3B1KK-KBR-B0 SoC MCU. It supports Bluetooth 5.0 (Bluetooth Low Energy) and the SX1262 LoRa transceiver from Semtech. This module complies with LoRaWAN 1.0.3 specifications (Classes A, B, & C) and also supports LoRa Point-to-Point (P2P) communication, facilitating the quick implementation of customized LoRa networks. The module's dual RF communication capabilities (LoRa + BLE) make it suitable for various IoT applications, including home automation, sensor networks, building automation, and other IoT network applications.

The default RAK11720 firmware is based on RUI3 (RAKwireless Unified Interface). This allows easy use as a standalone module by developing custom firmware via Arduino-compatible RUI3 APIs. Sensors and other external peripherals can be interfaced directly, eliminating the need for an additional MCU. Additionally, RAK11720 can be interfaced with an external host MCU using AT commands via UART or a BLE connection.

> **NOTE**
>
> There are two variants available for the RAK11720 Module:
> (1) With MHF4 IPEX connector to connect external antennas
> (2) No IPEX connector but with RF pinout to connect custom antenna

Features

- Based on **AMA3B1KK-KBR-B0** and **SX1262**
- ARM Cortex-M4F
- 1 MB Flash and 348 KB SRAM
- **LoRaWAN 1.0.3** specification compliant

- **Supported bands**: EU433, CN470, IN865, EU868, AU915, US915, KR920, RU864, and AS923-1/2/3/4
- 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
- I/O ports: UART/I2C/SPI/ADC/GPIO
- Long-range - greater than 10 km with optimized antenna
- Ultra-low-power consumption of 2.37 µA in sleep mode
- **Supply Voltage**: 1.8 V ~ 3.6 V
- **Temperature range**: -40° C ~ 85° C

Specifications

Overview

Block Diagram

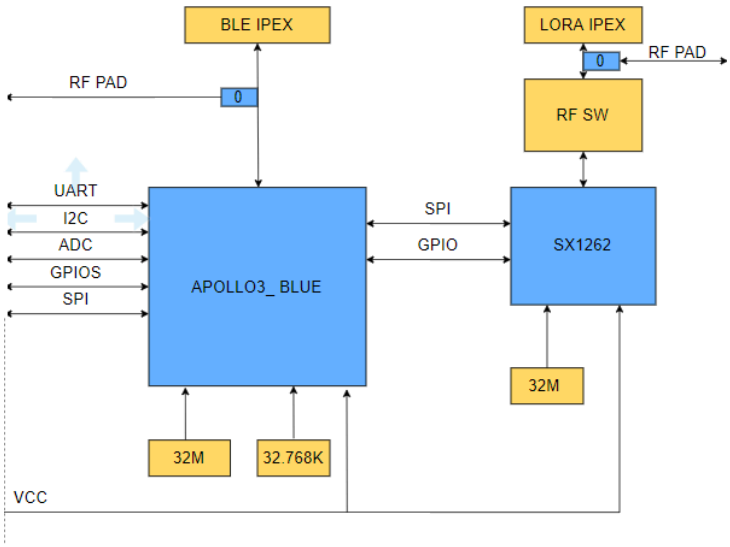

Figure 1: RAK11720 System Block Diagram

Hardware

The hardware specification is categorized into three parts: RF, electrical, and mechanical parameters. These include tabular data of the functionalities and standard values for the RAK11720 WisDuo LPWAN Module.

Interfaces

Module	Interfaces
RAK11720	UART0 (Default for AT command and FW update)

Pin Definition

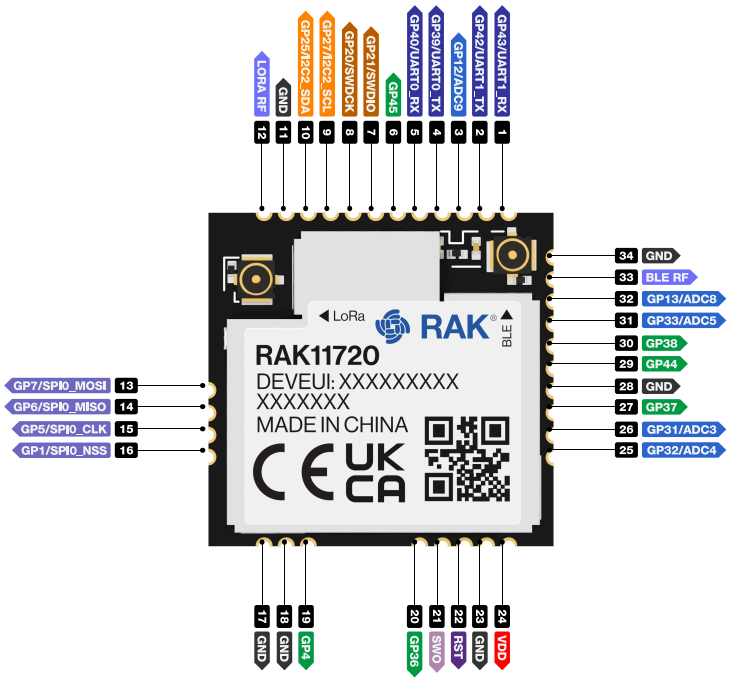

Figure 2: RAK11720 Pin Illustration

WARNING

When using `LORA RF` and `BLE RF` pins for antenna and not the IPEX connector variant, there are design considerations to make sure optimum RF performance.

- RF traces must be away from interference (switching nodes of DC-DC supplies, high-current/voltage pulses from controllers of inductive loads like motors, signal generators, etc.).
- RF traces must have 50 ohm impedance. It is advisable to use an impedance simulation software tool to achieve this requirement.
- If using an external antenna connector, place it close to the LoRa RF and BLE RF pins.
- Ground plane optimization is critical for certain antenna types like monopoles.
- The GND trace used for the RF return path must be directly connected to the GND plane and not treated as a thermal relief.
- It is recommended that RF traces be routed in curves, not sharp 90 degree angles.

> In addition, with our commitment to making IoT easy, we offer dedicated service for Antenna RF Design which includes PCB design, tuning, matching and RF testing.

Pin No.	Name	Type	Description
1	GP43/UART1_RX	I/O	GPIO and UART2 Interface (RX)
2	GP42/UART1_TX	I/O	GPIO and UART2 Interface (TX)
3	GP12/ADC9	I/O	GPIO and ADC
4	GP39/UART0_TX	I/O	GPIO and UART0 Interface(TX) - AT Command and FW Update
5	GP40/UART0_RX	I/O	GPIO and UART0 Interface (RX) - AT Command and FW Update
6	GP45	I/O	GPIO only
7	GP21/SWDIO		GPIO and SWD debug pin (SWDIO)
8	GP20/SWDCK		GPIO and SWD debug pin (SWDCK)
9	GP27/I2C2_SCL	I/O	GPIO and I2C2 (SCL)
10	GP25/I2C2_SDA	I/O	GPIO and I2C2 (SDA)
11	GND	POWER	Ground connections
12	LORA RF	RF	LORA RF Port (only available on **RAK11720 NO-IPEX connector variant**)
13	GP7/SPI0_MOSI	I/O	GPIO and SPI0 (MOSI)
14	GP6/SPI0_MISO	I/O	GPIO and SPI0 (MISO)
15	GP5/SPI0_CLK	I/O	GPIO and SPI0 (CLK)

Pin No.	Name	Type	Description
16	GP1/SPI0_NSS	I/O	GPIO and SPI0 (NSS)
17	GND	POWER	Ground connections
18	GND	POWER	Ground connections
19	GP4	I/O	GPIO only
20	GP36	I/O	GPIO only
21	SWO	I/O	SBL log output (BOOT pin)
22	RST		MCU Reset (nRST)
23	GND	POWER	Ground connections
24	VDD	POWER	VDD - Voltage Supply
25	GP32/ADC4	I/O	GPIO and ADC
26	GP31/ADC3	I/O	GPIO and ADC
27	GP37	I/O	GPIO only
28	GND	POWER	Ground connections
29	GP44	I/O	GPIO only
30	GP38	I/O	GPIO only
31	GP33/ADC5	I/O	GPIO and ADC
32	GP13/ADC8	I/O	GPIO and ADC
33	BLE RF	RF	BLE RF Port (only available on **RAK11720 NO-IPEX connector variant**)

Pin No.	Name	Type	Description
34	GND	POWER	Ground connections

RF Characteristics

The RAK11720 module supports the LoRaWAN bands, as shown in the table below. When buying an RAK11720 module, pay attention to specifying the correct core module, RAK11720 H/L, for your region. **H** denotes high-frequency regions and **L** denotes low-frequency regions.

Module	Region	Frequency
RAK11720 (L)	Europe	EU433
	China	CN470
RAK11720 (H)	Europe	EU868
	North America	US915
	Australia	AU915
	Korea	KR920
	Asia	AS923-1/2/3/4
	India	IN865
	Russia	RU864

Electrical Characteristics

Operating Voltage

Feature	Minimum	Typical	Maximum	Unit
VCC	1.8	3.3	3.6	Volts (V)

Operating Current

Feature	Condition	Minimum	Typical	Maximum	Unit
Operating Current	BLE TX Mode	-	12.7 @4.0 dBm	-	mA
	LORA TX Mode	-	87 @ 20 dBm, 868 MHz	-	mA

Sleep Current

Feature	Condition	Minimum (2.1 V)	Typical (3.3 V)	Maximum	Unit
Current Consumption	EU868	-	2.37	-	µA
	US915	-	2.37	-	µA
	CN470	-	2.37	-	µA

Mechanical Characteristics

Module Dimensions

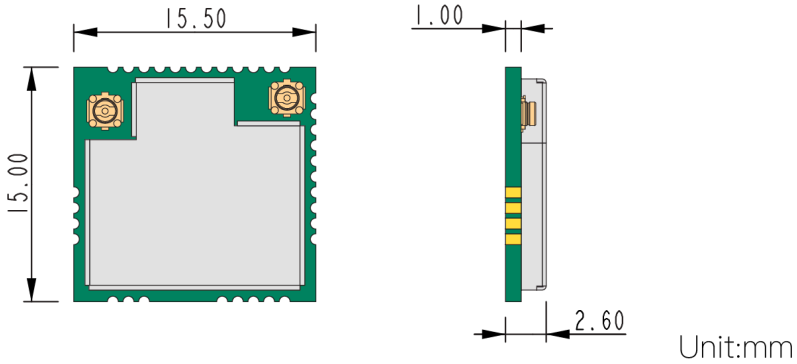

Figure 3: Board dimension

Layout Recommendation

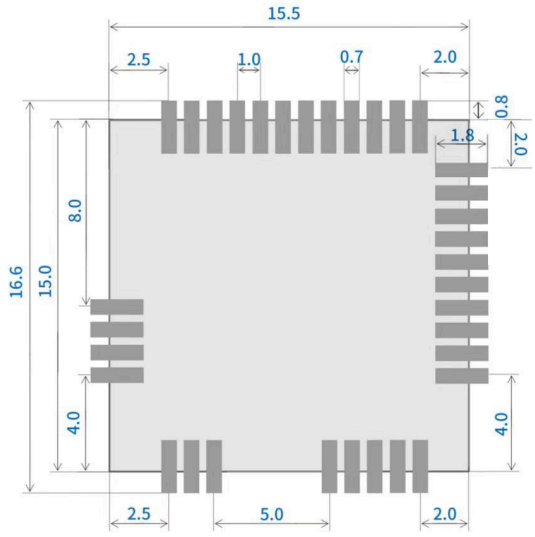

Figure 4: PCB footprint and recommendations

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

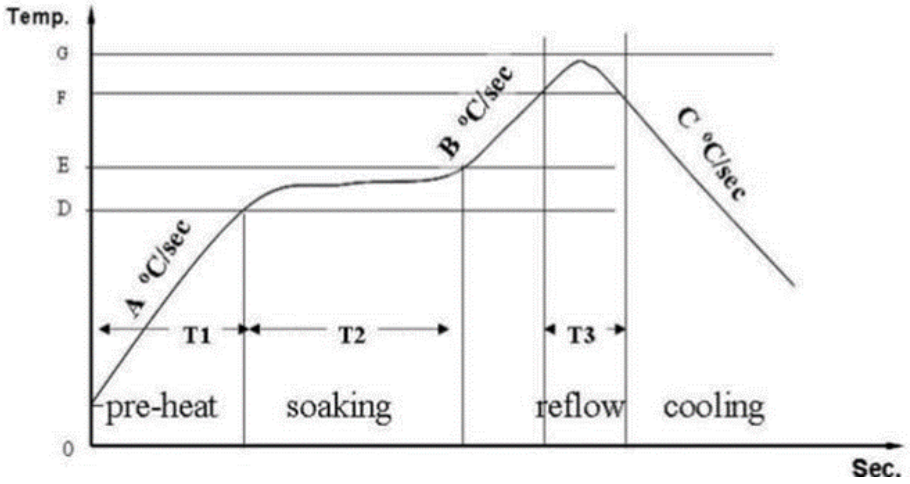

Figure 5: Reflow Profile for RAK11720

Standard conditions for reflow soldering:

- Pre-heating Ramp (A) (Initial temperature: 150° C): **1 ~ 2.5° C/sec**
- Soaking Time (T2) (150 ~ 180° C): **60 ~ 100 sec**
- Peak Temperature (G): **230 ~ 250° C**
- Reflow Time (T3) (> 220° C): **30 ~ 60 sec**
- Ramp-up Rate (B): **0 ~ 2.5° C/sec**
- Ramp-down Rate (C): **1 ~ 3° C/sec**

Firmware

Download the latest RAK11720 WisDuo LPWAN Module firmware provided below. RAK11720 (L) and RAK11720 (H) use the same firmware and it will automatically detect the variant of the module being used.

Model	Note	Source
RAK11720 (.bin via UART)	(default baudrate = 115200)	Download
RAK11720 (.bin via BLE)		Download
RAK11720 (.hex)		Download

Certification

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