User manual for

RAK4630 LoRa Module

WisDuo-LoRa Series

Version V1.0| Oct. 2020

1 Introduction

This document defines RAK4630 module and describes hardware interface which are connected with customers applications.

This document helps customers quickly understand the interface specifications, electrical and mechanical details, as well as other related information of RAK4630.

2 Overview

2.1 General description

RAK4630 is an embedded Lora and BLE5.0 wireless communication module, it includes an nRF52840 MCU and a SX1262 Lora chip, Ultra-low power consumption of 2.0uA in sleep mode.

The module complies with LoRaWAN 1.0.2 protocols, it also supports LoRa point to point communication. The module supports BLE 5.0 in addition to LoRa. Its RF communication capabilities make it suitable for a variety of applications in the IoT field.

2.2 Main Features

➢ LoRa module for Smart City, Smart Agriculture, Smart Industry

➢ TCXO crystal for LoRa chip

➢ Compact Form Factor: 15 x 23 x 3 mm

➢ 44 Pin Stamp Pad for PCB SMT mounting

➢ I/O ports: UART/I2C/GPIO/USB/SPI (optional NFC interface)

➢ Temperature range: -40°C to +85°C

➢ Supply voltage: 2.0 ~ 3.6V

➢ LoRa Frequency range: 863–870MHz (EU) / 902–915MHz (US)

➢ BLE Frequency range:2402-2480MHz

➢ Ultra-Low Power Consumption 2.0uA in sleep mode

➢ RF-Output Power : BLE: 4.17dBm(For FCC), 6.29dBm(For CE)
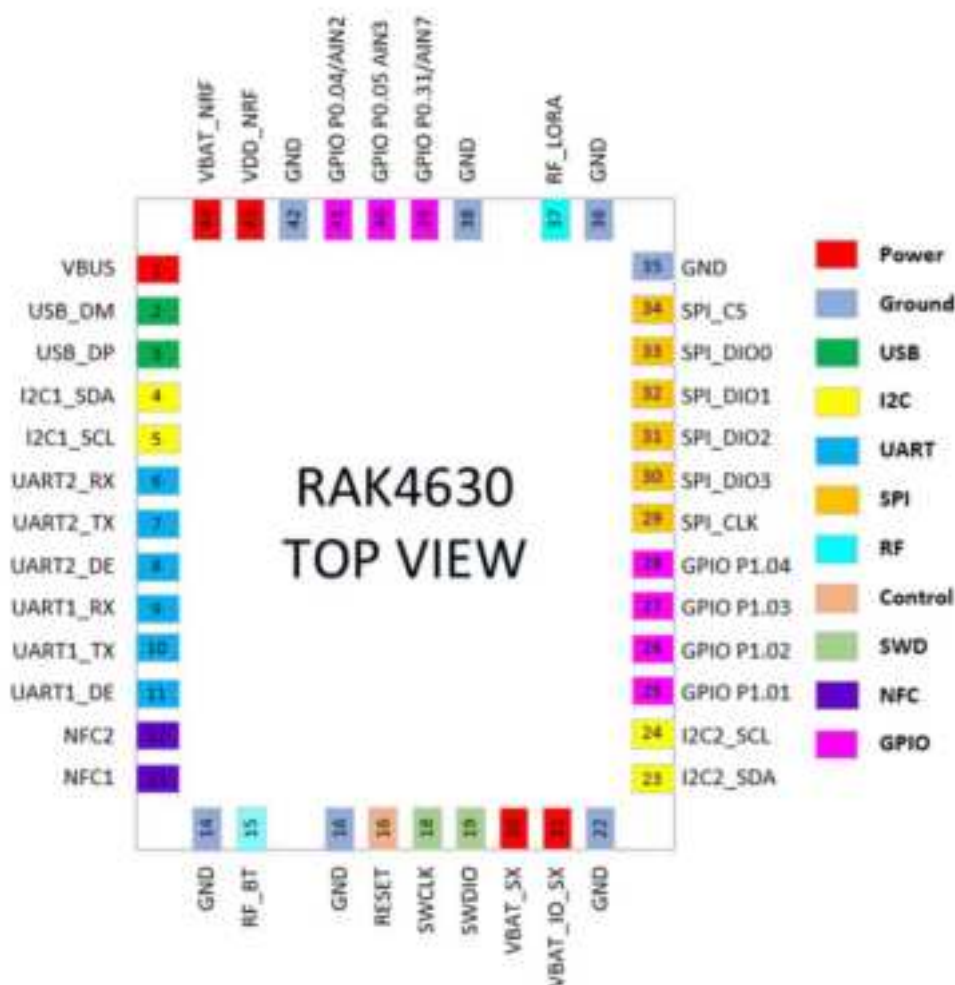　　　　　　　　　　　LoRa: 15.76dBm(For FCC), 13.26dBm(For CE)

2.3 Supported LoRaWAN Bands

The following table shows support LoRaWAN bands of RAK4630 module.

Table 1: Operating Frequencies

Region	Frequency (MHz)	
Indian	IN865	RAK4630(H)
Europe	EU868	RAK4630(H)
North America	US915	RAK4630(H)
Australia	AU915	RAK4630(H)
Korea	KR920	RAK4630(H)
Asia	AS923	RAK4630(H)
China	CN470	RAK4630(L)

2.4 Pin Assignment

The following figure shows the pin assignment of RAK4630 module.

Figure 1: Pin Assignment

NOTES

> ◇ For single 3.3V power supply, connect VBAT_BT, VDD_BT, VBAT_SX, VBAT_SX_IO together with 3.3V power
>
> ◇ For 3.6V li-SOCL2 battery, connect VBAT_BT AND VBAT_SX together with battery output, connect VDD_BT and VBAT_SX_IO together to set IO voltage level.
>
> ◇ For 4.2V li-MnO2 battery, connect VBAT_NRF with battery output, should add external DC-DC convert or LDO for VBAT_SX (3.3V), and connect VDD_BT and VBAT_SX_IO together to set IO voltage level.
>
> ◇ GND pins should be connected to ground in the design.

2.5 Pin Description

The following tables show the pin definition and description of RAK4630.

Table 2: Definition of I/O Parameters

Type	Type
PI	Power Input
PO	Power Output
DI	Digital Input
DO	Digital Output
IO	Bidirectional
AI	Analog Input
AO	Analog Output

Table 3: Pin Description

Power Supply				
Pin Name	Pin No.	Type	Description	Comment
VDD_NRF	43	PI	Power supply	
VBAT_NRF	44	PI	High Power supply	
VBAT_SX	20	PI	Supply for the RFIC	Supply for SX1262 VBAT
VBAT_SX_IO	21	PI	Supply for the Digital I/O interface pins	Supply for SX1262 VBAT_IO
GND	14,16,22,35,36,38,42		Ground	
I2C Interface				
Pin Name	Pin No.	Type	Description	Comment
I2C1_SDA	4	IO	I2C serial data	P0.13
I2C1_SCL	5	OD	I2C serial clock	P0.14
I2C2_SDA	23	IO	I2C serial data	P0.24

I2C2_SCL	24	OD	I2C serial clock	P0.25

USB Interface

Pin Name	Pin No.	Type	Description	Comment
VBUS	1	PI	USB power	5V input for 3.3V regulator
USB_DP	3	IO	USB differential data(+)	
USB_DM	2	IO	USB differential data(-)	

UART Interface

Pin Name	Pin No.	Type	Description	Comment
UART1_TX	10	DO	UART1 transmit	P0.20
UART1_RX	9	DI	UART1 receive	P0.19
UART1_DE	11	DI	UART1 detect	P0.21
UART2_TX	7	DO	UART2 transmit	P0.16
UART2_RX	6	DI	UART2 receive	P0.15
UART2_DE	8	DI	UART12detect	P0.17

Quad SPI Interface

Pin Name	Pin No.	Type	Description	Comment
SPI_CLK	29	DO	SPI clock	P0.03
SPI_CS	34	DO	SPI chip select	P0.26
SPI_DIO0	33	IO	SPI data input/output 0	P0.30
SPI_DIO1	32	IO	SPI data input/output 1	P0.29
SPI_DIO2	31	IO	SPI data input/output 2	P0.28
SPI_DIO3	30	IO	SPI data input/output 3	P0.02

SWD Interface

Pin Name	Pin No.	Type	Description	Comment
SWDIO	19	Debug	SWD I/O for debug and programming	
SWCLK	18	Debug	SWD clock input for debug and programming	

RESET

Pin Name	Pin No.	Type	Description	Comment
RESET	17	DI	Reset the module	

NFC Interface

Pin Name	Pin No.	Type	Description	Comment
NFC1	13	DI	NFC input 1	P0.09
NFC2	12	DI	NFC input 2	P0.10

Antenna Interface

Pin Name	Pin No.	Type	Description	Comment
RF_BT	15	IO	Bluetooth antenna interface	50Ω Impedance If unused, keep this pin open.
RF_LORA	37	IO	Lora antenna interface	50Ω Impedance If unused, keep this pin open.

GPIO Interface

Pin Name	Pin No.	Type	Description	Comment
GPIO P1.01	25	IO	General-purpose input/output	

GPIO P1.02	26	IO	General-purpose input/output	
GPIO P1.03	27	IO	General-purpose input/output	
GPIO P1.04	28	IO	General-purpose input/output	
ADC Interface				
Pin Name	Pin No.	Type	Description	Comment
GPIO P0.31	39	IO	General-purpose input/output	
AIN7		AI	General-purpose ADC interface	
GPIO P0.05	40	IO	General-purpose input/output	
AIN3		AI	General-purpose ADC interface	
GPIO P0.04	41	IO	General-purpose input/output	
AIN2		AI	General-purpose ADC interface	

2.6 Power Consumption

The following table show the power consumption.

Table 4: Power Consumption

Item	Power Consumption	Condition
Tx mode LoRa@15dBm	85mA	LoRa @ PA_BOOST&BT sleep
Tx mode LoRa@13dBm	80mA	LoRa @ PA_BOOST&BT sleep
Tx mode BT@4dBm	9mA	BT Tx mode & Lora sleep
Rx mode LoRa@37.5Kbps	17mA	LoRa @ Receive mode &BT sleep
Rx mode BT@2Mbps	11.5mA	BT Rx mode & Lora sleep
Sleep mode	2.0uA	LoRa&BT sleep

2.7 Absolute Maximum Ratings

The following table show the absolute maximum ratings of RAK4630

Table 5: Absolute Maximum Ratings

Symbol	Description	Min.	Nom.	Max.	Unit
VBAT_SX	LoRa chip supply voltage	-0.5	-	3.9	V
VBAT_SX_IO	LoRa chip supply for I/O pins	-0.5	-	3.9	V
VDD_NRF	MCU power supply	-0.3	-	3.9	V
VBUS	USB supply voltage	-0.3	-	5.8	V
VBAT_NRF	MCU high voltage power supply	-0.3	-	5.8	V
ESD HBM	Human Body Model	-	-	2000	V
ESD CDM	Charged Device Model	-	-	500	V

2.8 Recommended operating conditions

The following table shows the recommended operating conditions of RAK4630.

Table 6: Recommended operating conditions

Symbol	Description	Min.	Nom.	Max.	Unit
VBAT_SX	SX1262 supply voltage	2	3.3	3.7	V
VBAT_SX_IO	SX1262 supply for I/O pins	2	3.3	3.7	V
VDD_NRF	NRF52840 power supply	2	3.3	3.6	V
VBUS	VBUS USB supply voltage	4.35	5	5.5	V
VBAT_NRF	NRF52840 high voltage power supply	2.5	-	5.5	V

3 Mechanical Dimensions

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeter (mm), and the dimensions tolerances are ±0.05mm unless otherwise specified.

3.1 Top and Side Dimensions

The following figure shows the mechanical dimension of the RAK4630 module.

Figure 2: Top and Side Dimensions

3.2 Recommended Footprint

The following figure shows the recommended footprint of the RAK4630 module.
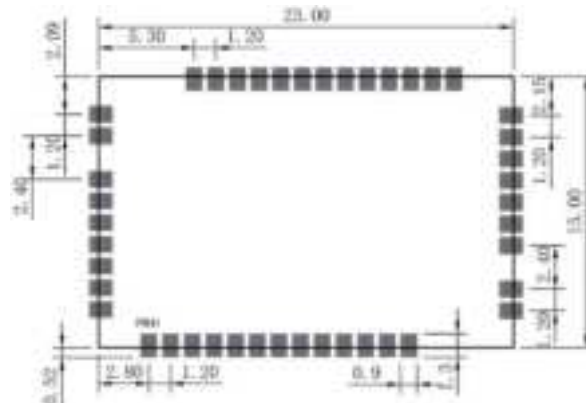
Figure 3: Recommended Footprint (Unit: mm)

3.3 Recommended Reflow Profile

The following figure shows the Recommended Reflow Soldering Thermal Profile of RAK4630.
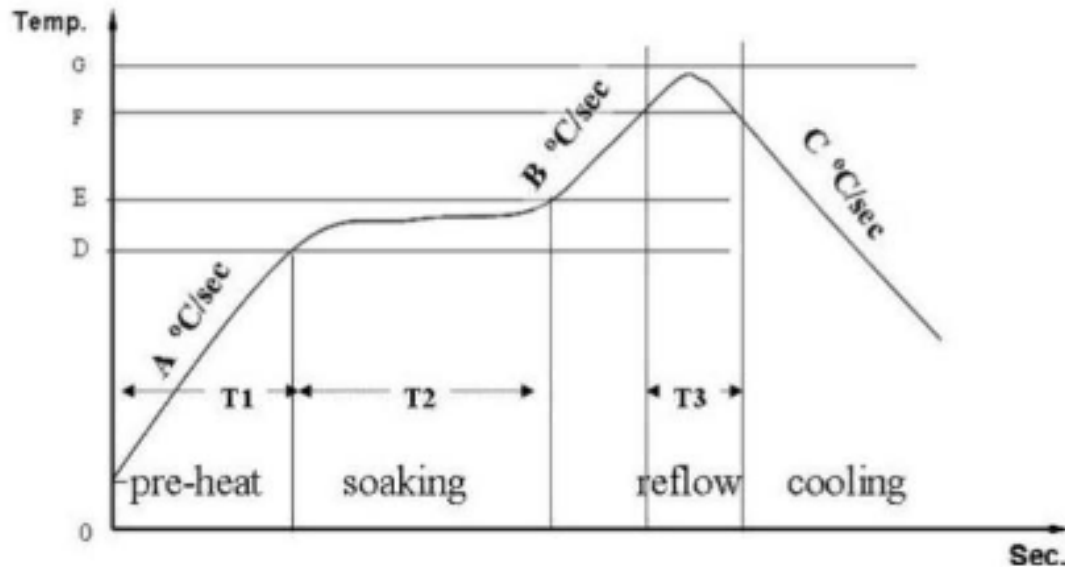

Figure 4: Recommended Reflow Soldering Thermal Profile

4 Certification Information

Conformity Assessment of the Radio Module to the RED

This radio module is for professional installation only. When installing this radio module permanently into a host product to a create new radio equipment device; the manufacturer responsible for placing the final radio product on the market in the EU must assess if the combination of this radio module and the host product complies with the essential requirements of the RE Directive 2014/53/EU.

Firmware version: V1.0

Test Antenna: Antenna 1(BLE Antenna): Internal Antenna and maximum gain 2.23dBi, Antenna 2(LoRa Antenna): External rod antenna and maximum gain 3.0dBi

The final radio product will need to be fully assessed to Article 3.1a of the RED, for product safety With regard to RF exposure for Article 3.1a of the RED, the manufacturer of the final radio product will need to assess if the compliance assessment of the original radio equipment/module remains relevant to the final radio product, or if further action is necessary.

This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

If the final radio equipment is used at the same distance from a person or domesticated

animal as the radio module was assessed, (for example: >20cm), then the final radio product assessment could conclude that the final radio product is compliant with the RF exposure requirements without additional actions.

If the final radio equipment is used at a closer distance from a person or domesticated animal than the radio module was assessed, then the final radio product assessment could not automatically conclude that the final radio product is compliant with the RF exposure requirements without additional actions; and further assessment is necessary.

The final radio product will need to be fully assessed to Article 3.1b of the RED, for EMC.

EMC testing of the radio module will have been performed on some sort of temporary host or test jig; but now the module is in a new host product and the EMC performance of the final radio product must be assessed. Most likely the host product will have its own EMC assessment for other functions, which should be performed with the radio module installed; and inclusion of the radio module into the host product will also require an assessment, such as to the relevant applicable part of EN 301 489, on the final radio product.

In theory, radio transmitter or receiver measurements made as conducted measurements at a radio module antenna port may be considered applicable to the radio performance of the final radio product. However, in this example, the radio module does not have an antenna port. The radio module has a pin which leads through a PCB trace to an antenna on the host product. If the manufacturer of the final radio product wishes to use conducted power, conducted emissions or receiver performance measurements from the radio module to show compliance of the final radio product, then they will need to exactly follow the detailed instructions from the radio module manufacturer; including input voltage, driver software, environmental conditions, antenna trace layout design construction and material, circuit board layout design construction and material, nearby circuitry, etc. In reality, it is expected that manufacturers of final radio products will need to test the output power, conducted spurious emissions and receiver performance requirements on the final radio product; and not take the results of those test cases from the radio module test reports. Radiated test cases will also need to be performed on the final radio product.

FCC Statement

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.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this 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.

RF Exposure Information

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 and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular.

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

To maintain compliance with FCC's RF Exposure guidelines, This equipment should be installed and operated with minimum distance of 20cm from your body.

2.7 Antennas

This radio transmitter FCC ID: **2AF6B-RAK4630**   has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Description	Antenna interface	Frequency Range (MHz)	Impedance (Ω)	Maximum antenna gain(dBi)
BLE Antenna	IPEX	2402-2480	50	2.23
LoRa Antenna	IPEX	902-915	50	3.00

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains FCC ID: **2AF6B-RAK4630** "

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B

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