

# 1. Radio Frequency Exposure

## RESULT:

Pass

Test standard : FCC Part 2: Section 2.1091  
KDB 447498 D01 General RF Exposure Guidance v06  
RSS-102 Issue 6, December 2023

## 1.1 Product Technical Information

The EUT is a WisBlock LPWAN Module which supports Lora and Bluetooth Low Energy technologies.

### Previous Antenna information:

For LoRa:

Antenna #	Model	Antenna Gain	Antenna Type	Connector Type
1#	RAKARJ14	2.3 dBi	Dipole Antenna	RP-SMA connector
2#	RAKARJ16	2.3 dBi	Dipole Antenna	RP-SMA connector

Note:

1. When connecting to the module, all antennas listed above need to transfer to an IPEX connector.
2. Antennas 1# and 2# have the same type and similar in-band and out-of-band characteristics and only the color of enclosure different, they are considered as equivalent antennas. Thus, the antenna 1# was selected to be tested.

For BLE:

Antenna #	Model	Antenna Gain	Antenna Type	Connector Type
1#	R S2B1BH2A1B01000	3.12 dBi	PCB Layout Antenna	IPEX connector

### Current Antenna information:

LoRa: a new dipole fiberglass antenna with 3dBi

BLE: N/A.

This report is for FCC CIIPC and ISED C4PC as changed transmit antennas and will be installed into HOST LoRa communication expansion module (M/N: MOD-C1-LORA-900) and disabled BLE function via software, radiated spurious emissions for LoRa re-performed.

### Configuration 1:

Data Rate	SF (Spreading factor)	Operating Frequency
0	LoRa Modulation: SF10 / Bandwidth 125 kHz	915.1 – 927.7 MHz
1	LoRa Modulation: SF9 / Bandwidth 125 kHz	
2	LoRa Modulation: SF8 / Bandwidth 125 kHz	
3	LoRa Modulation: SF7 / Bandwidth 125 kHz	
4	LoRa Modulation: SF8 / Bandwidth 500 kHz	915.8 – 927.0 MHz

### Configuration 2:

Data Rate	SF (Spreading factor)	Operating Frequency
0	LoRa Modulation: SF12 / Bandwidth 500 kHz	902.5 – 927.1 MHz
1	LoRa Modulation: SF11 / Bandwidth 500 kHz	
2	LoRa Modulation: SF10 / Bandwidth 500 kHz	
3	LoRa Modulation: SF9 / Bandwidth 500 kHz	
4	LoRa Modulation: SF8 / Bandwidth 500 kHz	
6	LoRa Modulation: SF7 / Bandwidth 500 kHz	

For details refer to the User Manual, Technical Description and Circuit Diagram.

General Information of EUT	Value
Kind of Equipment	WisDuo LPWAN+BLE Module

Type Designation	RAK11720
FCC ID	2AF6B-RAK11720
IC	25908-RAK11720
HVIN	RAK11720
FVIN	RUI_3.5.2+user_final.hex
HMN	MOD-C1-LORA-900
Operating Voltage	DC 5V
<b>Technical Specification of Lora DTS</b>	
Operating Frequency	915.8 – 927.0 MHz 902.5 – 927.1 MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4 for 903 – 914.2 MHz and 915.8 – 927.0 MHz SF7-SF12 / DR0 to DR5 for 902.5 – 927.1 MHz
Channel Number	8 channels for 915.8 – 927.0 MHz 43 channels for 902.5 – 927.1 MHz
Channel Separation	1.6 MHz
Occupied Bandwidth	500 kHz
Antenna Number:	1
Antenna Gain and Type:	Dipole fiberglass antenna with 3dBi
<b>Technical Specification of Lora FHSS</b>	
Frequency Range	915.1 – 927.7 MHz
Type of Modulation	Lora
Data Rate	SF7 to SF10 / DR0 to DR3
Channel Number	64 channels (Upstream)
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz
Antenna Number:	1
Antenna Gain and Type:	Dipole fiberglass antenna with 3dBi

## 1.2 Product Classification

This device defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at 20 cm is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

## 1.3 Radio Frequency Exposure Limit

For FCC:

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A) Limits for Occupational/Controlled Exposure</b>				
0.3-3.0	614	1.63	*100	<6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	<6
30-300	61.4	0.163	1.0	<6
300-1,500	--	--	f/300	<6
1,500-100,000	--	--	1.0	<6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-3.0	614	1.63	*100	<30
3.0-30	824/f	2.19/f	*(180/f <sup>2</sup> )	<30
30-300	27.5	0.073	0.2	<30

300-1,500	--	--	f/1500	<30
1,500-100,000	--	--	1.0	<30

f = frequency in MHz. \* = Plane-wave equivalent power density.

For IC:

Frequency range (MHz)	Electric field (V <sub>RMS</sub> /m)	Magnetic field (A <sub>RMS</sub> /m)	Power density (W/m <sup>2</sup> )	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	58.07 / $f^{0.25}$	0.1540 / $f^{0.25}$	8.944 / $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 × 10 <sup>-4</sup> $f^{0.5}$	6.67 × 10 <sup>-5</sup> $f$	616000/ $f^{1.2}$

Note:  $f$  is frequency in MHz.

## 1.4 Radio Frequency Exposure Calculation Formula

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

or:

$$S = \frac{EIRP}{4\pi R^2}$$

where: EIRP = equivalent (or effective) isotropically radiated power

## 1.5 Calculation Result

### 1.5.1 Stand-alone transmission MPE

#### LoRa Configuration 1

Mode	Band	PG <sub>conducted</sub> (dBm)	ANT Gain (dBi)	Power Density (mW/cm <sup>2</sup> )	FCC Limit (mW/cm <sup>2</sup> )
Lora	902-928MHz	21.31	3	0.054	0.601

Mode	Band	PG <sub>conducted</sub> (dBm)	ANT Gain (dBi)	Power Density (W/m <sup>2</sup> )	IC Limit (W/m <sup>2</sup> )
Lora	902-928MHz	21.31	3	0.537	2.74

**LoRa Configuration 2**

Mode	Band	PG <sub>conducted</sub> (dBm)	ANT Gain (dBi)	Power Density (mW/cm <sup>2</sup> )	FCC Limit (mW/cm <sup>2</sup> )
Lora	902-928MHz	21.36	3	0.054	0.601

Mode	Band	PG <sub>conducted</sub> (dBm)	ANT Gain (dBi)	Power Density (W/m <sup>2</sup> )	IC Limit (W/m <sup>2</sup> )
Lora	902-928MHz	21.36	3	0.543	2.74

Note: R = 0.2m

**1.5.2 Simultaneous transmission MPE**

N/A.