

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 WisGate Edge Pro which supports Lora+GNSS, 2.4GHz Wi-Fi, BLE and WCDMA/LTE wireless technologies.

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

General Information of EUT	Description
Kind of Equipment:	WisGate Edge Pro
Type Designation:	RAK7229CV2
FCC ID:	2AF6B-RAK3400
IC:	25908-RAK3400
HMN:	RAK7229CV2
Operating Voltage:	DC 12V via DC Source or DC 37 ~ 57V via POE adapter
Testing Voltage:	AC 230V, 50Hz or DC 12V
Operating Temperature Range:	-30 °C ~ +55 °C
Remark: This product assemblies multi-transmitter modules: - LTE Module (FCC ID: XMR201807EG95NA, IC ID: 10224A-2018EG95NA) - Wi-Fi Module (FCC ID: 2AF6B-RAK634, IC ID: 25908-RAK634) - WisLink LPWAN Concentrator*2 (FCC ID: 2AF6B-RAK5148, FCC ID: 2AF6B-RAK5146, IC ID: 25908-RAK5148, IC ID: 25908-RAK5146) - WisDuo (FCC ID: 2AF6B-RAK3400, IC ID: 25908-RAK3400)	
The LTE module, BLE module, Wi-Fi module and Lora module are combination in a new host, the EMF is arrange re-assessment (CIIPC and C4PC for FCC ID: 2AF6B-RAK3400, IC: 25908-RAK3400).	
Technical Specification of LTE Module	
Characteristic	Description
Operating Frequency	WCDMA Band: II, IV, V LTE Band: 2, 4, 5, 12, 13
Type of Modulation	QPSK, 16QAM
Power Class	4
Antenna Number:	2
Antenna Gain:	5.1dBi for Ant0 (declared by client) 4.3dBi for Ant1 (declared by client)
Technical Specification of Wi-Fi Module	
Characteristic	Description
Operating Frequency	2412 - 2462 MHz for 802.11b/g/n(HT20) 2422 - 2452 MHz for 802.11n(HT40)
Type of Modulation	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM)
Data Rate:	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n
Channel Number:	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11n(HT40)
Antenna Number:	2412 - 2462 MHz for 802.11b/g/n(HT20)

	2422 - 2452 MHz for 802.11n(HT40)
Antenna Gain:	4.5dBi for Ant0 (declared by client) 4.5dBi for Ant1 (declared by client)
Technical Specification of WisLink LPWAN Concentrator	
Characteristic	Description
Operating Frequency	2403 MHz- 2479 MHz for 2.4GHz DTS LoRa 1559 MHz to 1610 MHz (receiver) for GPS L1
Type of Modulation	Chirp Spread Spectrum
Data Rate:	DR0-DR7
Antenna Number:	1
Antenna Gain:	8.00 dBi (declared by client) for Omni antenna
Technical Specification of WisLink LPWAN Concentrator	
Characteristic	Description
Operating Frequency	1. 923.3 - 927.5MHz for DTS LoRa 2. 903.9MHz - 905.3MHz for Hybrid LoRa 3. GNSS receiver: 1) GLONASS G1: 1559 to 1610 MHz (Operating Frequency: 1597-1607MHz) 2) GPS L1: 1559 to 1610 MHz (Operating Frequency: 1575.42MHz)
Type of Modulation	FSK/Lora
Data Rate:	Lora: SF7 – SF12 / DR8 – DR13, SF7 – SF10 / DR0 –DR3
Antenna Number:	1
Antenna Gain:	5.10 dBi (declared by client) for Fiber Glass Antenna
Technical Specification of WisDuo	
Characteristic	Description
Operating Frequency	2402 - 2480 MHz
Type of Modulation	GFSK
Data Rate:	1Mbps, 2Mbps
Antenna Number:	1
Antenna Gain:	3.4 dBi (declared by client) for Fiber Glass Antenna

Information of LTE Module	
Product Name	LTE Module
Model Number	EG95-NA
FCC ID	XMR201807EG95NA
IC ID	10224A-2018EG95NA
Information of Wi-Fi Module	
Product Name	Wi-Fi Module
Model Number	RAK634
FCC ID	2AF6B-RAK634
IC ID	25908-RAK634
Information of WisLink LPWAN Concentrator	
Product Name	WisLink LPWAN Concentrator
Model Number	RAK5148
FCC ID	2AF6B-RAK5148
IC ID	25908-RAK5148
Information of WisLink LPWAN Concentrator	
Product Name	WisLink LPWAN Concentrator
Model Number	RAK5146
FCC ID	2AF6B-RAK5146
IC ID	25908-RAK5146
Information of module WisDuo	
Product Name	WisDuo
Model Number	RAK3401

FCC ID	2AF6B-RAK3400
IC ID	25908-RAK3400

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 ²)	Average Time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	<6
3.0-30	1842/f	4.89/f	*(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1,500	--	--	f/300	<6
1,500-100,000	--	--	1.0	<6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-3.0	614	1.63	*100	<30
3.0-30	824/f	2.19/f	*(180/f ²)	<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 _{RMS} /m)	Magnetic field (A _{RMS} /m)	Power density (W/m ²)	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	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

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/cm²)

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

Mode	Band	PG (dBm)	PG (W)	Power Density (mW/cm ²)	FCC Limit (mW/cm ²)
Lora (RAK5146)	902-928MHz	30.49	1.11944	0.070	0.601
Lora (RAK5148)	2.4GHz	25.97	0.39537	0.025	1.0
BLE	2.4GHz	7.88	0.0061	0.0002	1.0
WIFI	2.4GHz	31.74	0.77983	0.094	1.0
WCDMA	II	29.0	0.79433	0.040	1.0
	VI	29.0	0.79433	0.040	1.0
	V	29.0	0.79433	0.040	0.55
LTE	2	29.0	0.79433	0.040	1.0
	4	29.0	0.79433	0.040	1.0
	5	29.0	0.79433	0.040	0.55
	12	29.0	0.79433	0.040	0.47
	13	29.0	0.79433	0.040	0.52

Mode	Band	PG (dBm)	PG (W)	Power Density (W/m ²)	IC Limit (W/m ²)
Lora (RAK5146)	902-928MHz	30.49	1.11944	0.701	2.74
Lora (RAK5148)	2.4GHz	25.97	0.39537	0.247	5.35
BLE	2.4GHz	7.88	0.0061	0	5.35
WIFI	2.4GHz	31.74	0.77983	0.935	5.35
WCDMA	II	28.0	0.63096	0.314	4.48
	VI	28.0	0.63096	0.314	4.24
	V	28.0	0.63096	0.314	2.58
LTE	2	28.5	0.70795	0.352	4.48
	4	28.5	0.70795	0.352	4.24
	5	28.5	0.70795	0.352	2.58
	12	28.5	0.70795	0.352	2.30
	13	28.5	0.70795	0.352	2.47

1.5.2 Simultaneous transmission MPE

FCC								
Operating Mode	Lora RAK5146	Lora RAK5148	BLE	WIFI	WCDMA /LTE	Sum Ratio	Limit	Verdict
Lora + 2.4GHz LoRa + BLE + WIFI + WCDMA/LTE	0.12	0.025	0.0002	0.094	0.085	0.324	<1	Pass
IC								
Operating Mode	Lora RAK5146	Lora RAK5148	BLE	WIFI	WCDMA /LTE	Sum Ratio	Limit	Verdict
Lora + 2.4GHz LoRa + BLE + WIFI + WCDMA/LTE	0.256	0.046	0	0.175	0.153	0.630	<1	Pass

Note:

1. WCDMA/LTE modes cannot transmit simultaneous.
2. R = 0.4m