Prüfbericht-Nr.: *Test report no.:*	**CN22RX13 001**	**Auftrags-Nr.:** *Order no.:*	168378328	Seite 1 von 24 *Page 1 of 24*
Kunden-Referenz-Nr.: *Client reference no.:*	**N/A**	**Auftragsdatum:** *Order date:*	2022-06-20	
Auftraggeber: *Client:*	**Shenzhen RAKwireless Technology Co.,Ltd.** Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, P.R. China			
Prüfgegenstand: *Test item:*	WisGate Edge Pro			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	RAK7289CV2H (Trademark: RAK, ARDUINO)			
Auftrags-Inhalt: *Order content:*	Type Test			
Prüfgrundlage: *Test specification:*	*CFR47 FCC Part 15: Subpart C Section 15.247 *CFR47 FCC Part 22 *CFR47 FCC Part 24 *CFR47 FCC Part 27		*RSS-247 Issue 2 *RSS-130 Issue 2 *RSS-132 Issue 3 *RSS-133 Issue 6 *RSS-139 Issue 3	

Wareneingangsdatum: *Date of sample receipt:*	2022-06-22	Refer to photos documents
Prüfmuster-Nr.: *Test sample no:*	A003285159-002	
Prüfzeitraum: *Testing period:*	2022-06-22 – 2022-07-25	
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüfergebnis*: *Test result*:*	Pass	

geprüft von: *tested by:*	X Alex Lan Signed by: Alex Lan	**genehmigt von:** *authorized by:*	X Winnie Hou Signed by: Winnie Hou
Datum: *Date:* 2022-08-05		**Ausstellungsdatum:** *Issue date:* 2022-08-08	
Stellung / Position	Assistant Project Manager	**Stellung** / Position	Department Manager

Sonstiges */ Other:*

* The LTE module, BLE module, Wi-Fi module and Lora module are combination in a new host, the co-located radiated spurious emission is arrange re-assessment.
* * This product contains transmitter modules; refer to clause 3.1 for details.

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Test Summary

5.1 Co-Located Radiated Spurious Emissions
RESULT: Pass
5.2 Conducted emissions
RESULT: Pass

Contents

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

None.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China

FCC Registration No.: 694916

IC Registration No.: 25069, CAB identifier: CN0078

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Unwanted Emission Testing (TS9975)				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EMI Test Receiver	R&S	ESR 7	102021	2022-08-10
Signal Analyzer	R&S	FSV 40	101439	2022-08-09
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2022-08-09
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2022-08-09
Amplifier	R&S	SCU-18F	180070	2022-08-09
Amplifier	R&S	SCU40A	100475	2022-08-09
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2022-08-08
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2022-08-08
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2022-08-08
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2022-09-13
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22
Conducted Emissions testing				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EMI Test Receiver	R&S	ESR3	102428	2022-08-10
Artificial Mains Network	R&S	ENV216	102333	2022-08-10
Impedance Stabilisation Network	R&S	ENY81	100323	2022-08-11
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table

Test	Parameters	uncertainty
Conducted Emission	Conducted emission 150kHz-30MHz (AMN)	± 3.70 dB ± 3.30 dB
Radiated Emission	Radiated emission 30MHz-1GHz	± 4.52 dB
	Radiated emission 1GHz-18GHz	± 4.37 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were at this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No. 362 Huanguan Road Middle, Longhua District, Shenzhen 518110, People's Republic of China. is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is a WisGate Edge Pro, which supports 2.4GHz Wi-Fi, BLE, Lora+GNSS and LTE functions.

Note: This product contains transmitter modules.

LTE module Model: EG95-NA	Contains FCC ID: XMR201807EG95NA Contains IC: 10224A-2018EG95NA
2.4GHz Wi-Fi module Model: RAK634	Contains FCC ID: 2AF6B-RAK634 Contains IC: 25908-RAK634
BLE module Model: RAK13400	Contains FCC ID: 2AF6B-RAK13400 Contains IC: 25908-RAK13400
Lora + GNSS module Model: RAK2287X	Contains FCC ID: 2AF6B-RAK2287X Contains IC: 25908-RAK2287X

Note: The test standard for frequency Bands 698-756 MHz and 777-787 MHz in LTE module test report is RSS-130 issue 1 and the essential requirements remain unchanged in the updated version RSS-130 issue 2, hence it has been updated in current test report without additional test.

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

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	WisGate Edge Pro
Type Designation	RAK7289CV2H
Trade Mark	RAK, ARDUINO
Input Voltage	DC 12V via DC Source or DC 37 ~57V via POE adapter
Testing Voltage	AC 120V, 60Hz or DC 48V

Technical Specification of Wi-Fi	
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)
Channel Separation	5 MHz
Number of Antenna:	2
Antenna Type	PIFA antenna
Antenna Gain:	4.5dBi for Ant0 4.5dBi for Ant1
Technical Specification of BLE	
Operating Frequency	2402 – 2480MHz
Type of Modulation	GFSK
Data Rate	125kbps, 500kbps, 1Mbps, 2Mbps
Channel Number	40 channels
Channel Separation	2 MHz
Number of Antenna:	1
Antenna Type:	PIFA antenna
Antenna Gain:	3.4 dBi
Technical Specification of Lora DTS	
Operating Frequency	904.6MHz, 923.3 - 927.5MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4 for 904.6MHz SF7 – SF12 / DR8 – DR13 for 923.3 - 927.5MHz
Channel Number	8 channels for 923.3 - 927.5MHz
Channel Separation	600 KHz
Occupied Bandwidth	500 KHz
Number of Antenna:	2
Antenna Gain:	5.1dBi (Fiber Glass Antenna)
Technical Specification of Lora Hybrid	
Frequency Range	903.9MHz - 905.3MHz
Type of Modulation	Lora
Data Rate	SF7 – SF10 / DR0 –DR3
Channel Number	8 channels
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz
Number of Antenna:	2
Antenna Gain:	5.1dBi (Fiber Glass Antenna)
Technical Specification of LTE	
Wireless Technology:	LTE & WCDMA
Operation Frequency band(s)	WCDMA Band: II, IV, V LTE Band: 2, 4, 5, 12, 13
Power Class:	Class 4
Type of Modulation:	BPSK, QPSK
Type of Antenna:	PIFA antenna
Antenna number:	2
Antenna Gain:	5.1dBi for Ant0 4.3dBi for Ant1

3.3 Independent Operation Modes

The basic operation modes are:

A, On, WIFI link + BLE link + LTE link + Lora DTS link

B, On, WIFI link + BLE link + LTE link + Lora DSS (Hybrid) link

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Block Diagram
- Schematics
- Photo Document
- User Manual

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10.

4.3 Special Accessories and Auxiliary Equipment

Table 3: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model No.	Serial Number or Rating
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	166305
Portable Laptop	Lenovo	ThinkPad T480	10Q67059
POE Adapter	RAK	R012-4800500	Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 48.0V, 0.5A 24.0W

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

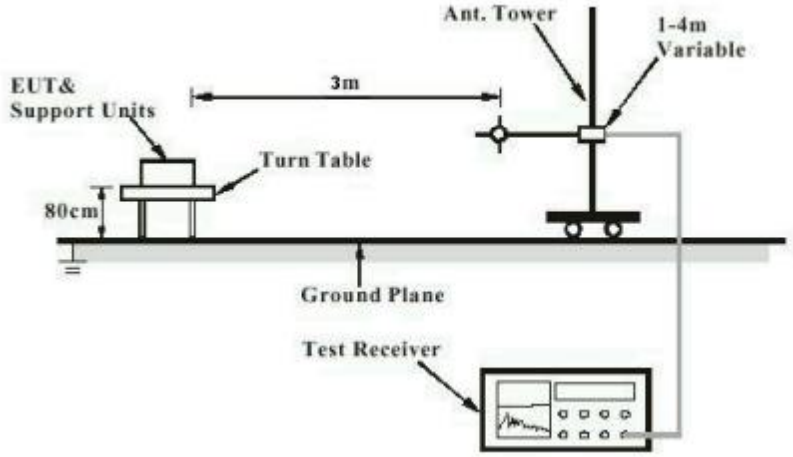


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

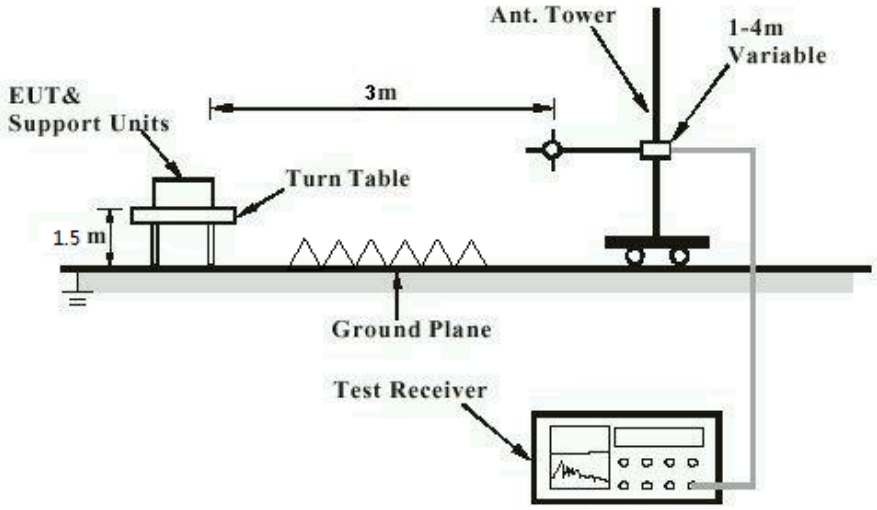
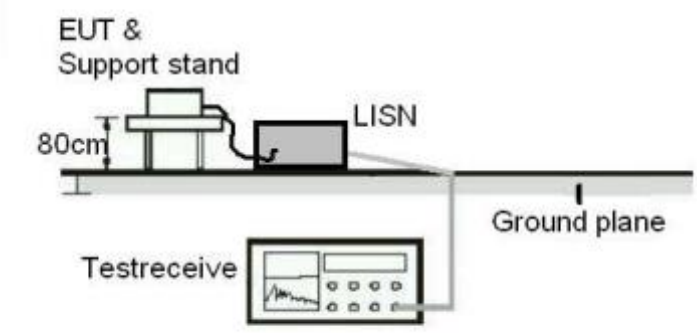


Diagram of Measurement Configuration for Mains Conduction Measurement



5 Test Results

5.1 Co-Located Radiated Spurious Emissions

RESULT: **Pass**

Test Specification

Test standard	:	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 22 CFR47 FCC Part 24 CFR47 FCC Part 27 RSS-247 Issue 2 RSS-130 Issue 2 RSS-132 Issue 3 RSS-133 Issue 6 RSS-139 Issue 3
Basic standard	:	ANSI C63.10 & ANSI C63.26
Limit	:	KDB 996369 D04 The emissions not exceed the highest limit.
Kind of test site	:	3m Semi-anechoic Chamber

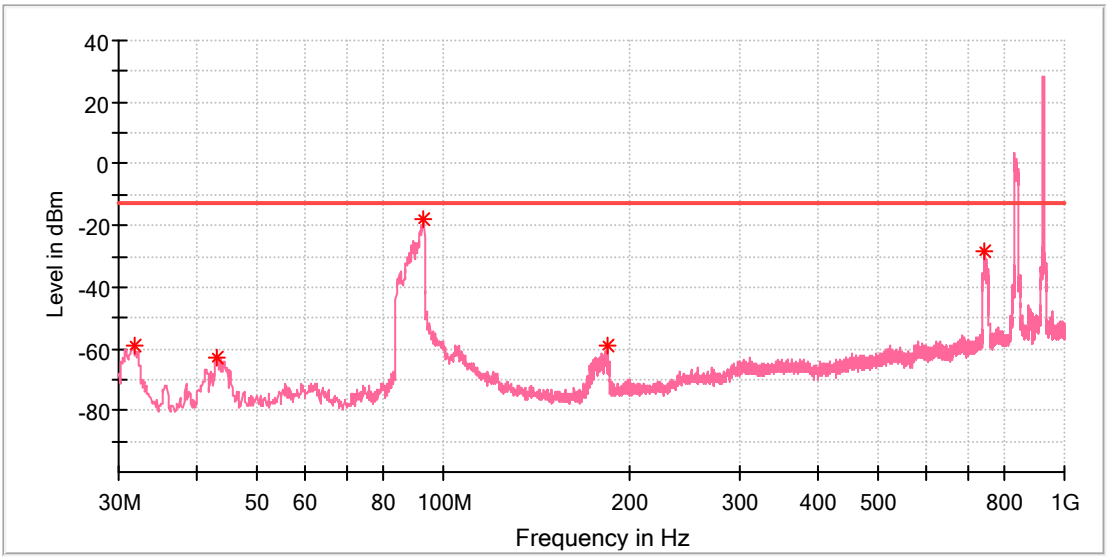
Test Setup

Date of testing	:	2022-06-22 to 2022-07-25
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A B
Earthing	:	Not Connected
Ambient temperature	:	22 ℃
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

Note: The test plots of Co-located radiated spurious emissions beyond the limit are the fundamental radio frequency of Lora, BLE, Wi-Fi and LTE.
For the measurement records, refer to the following plots, only the worst case mode are shown in this report.

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

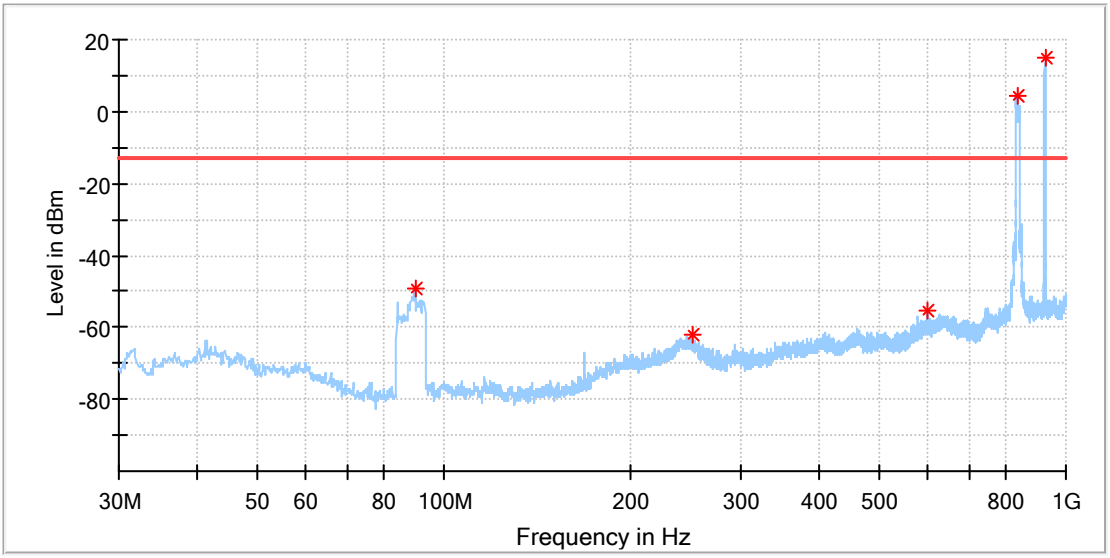


Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
31.818750	-58.98	-13.00	45.98	100.0	V	108.0	-128.2
43.216250	-62.85	-13.00	49.85	100.0	V	320.0	-123.9
93.050000	-17.65	-13.00	4.65	100.0	V	165.0	-102.0
184.108750	-59.25	-13.00	46.25	100.0	V	165.0	-119.7
741.980000	-28.62	-13.00	15.62	100.0	V	144.0	-102.0

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

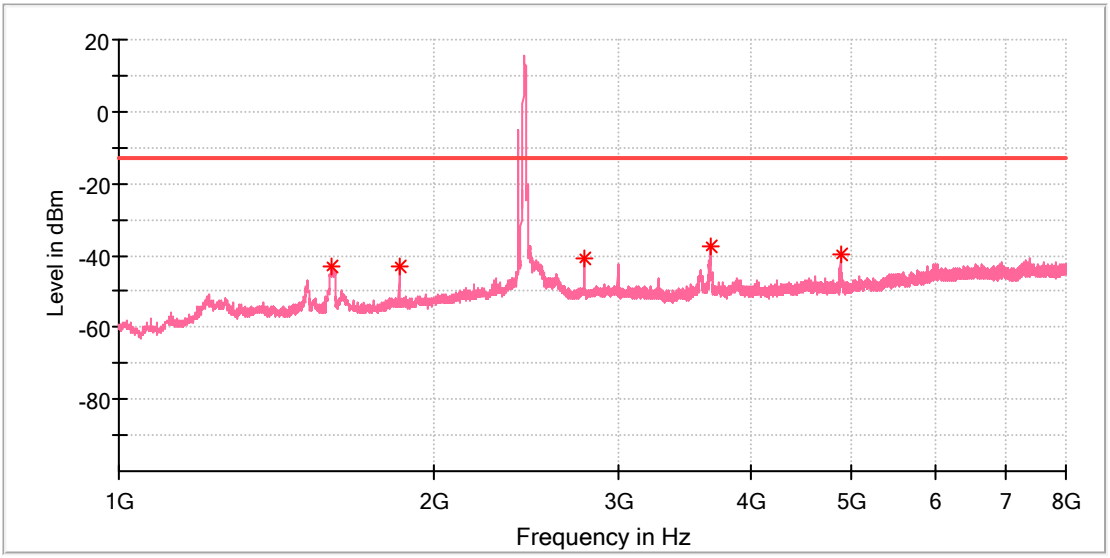


Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
89.776250	-49.17	-13.00	36.17	100.0	H	173.0	-123.1
250.553750	-61.83	-13.00	48.83	100.0	H	54.0	-110.2
600.117500	-55.40	-13.00	42.40	100.0	H	216.0	-105.4
834.615000	4.35	/	/	100.0	H	205.0	-102.2
925.188750	14.82	/	/	100.0	H	23.0	-103.0

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

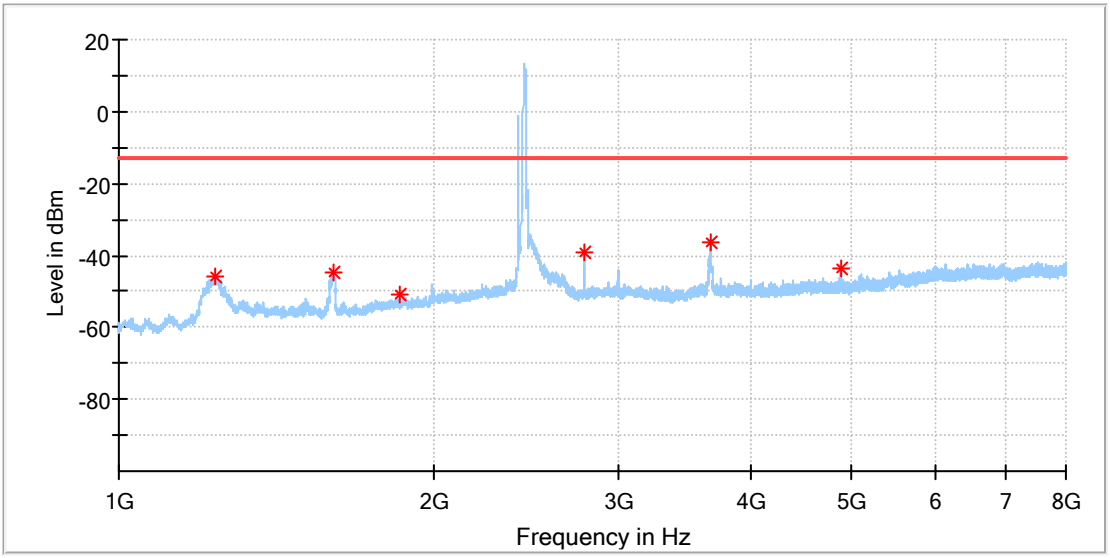


Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1597.500000	-43.32	-13.00	30.32	100.0	V	0.0	-92.9
1850.500000	-42.79	-13.00	29.79	100.0	V	341.0	-90.2
2775.000000	-40.80	-13.00	27.80	100.0	V	233.0	-87.3
3666.000000	-37.58	-13.00	24.58	100.0	V	55.0	-86.8
4874.000000	-39.62	-13.00	26.62	100.0	V	354.0	-85.9

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

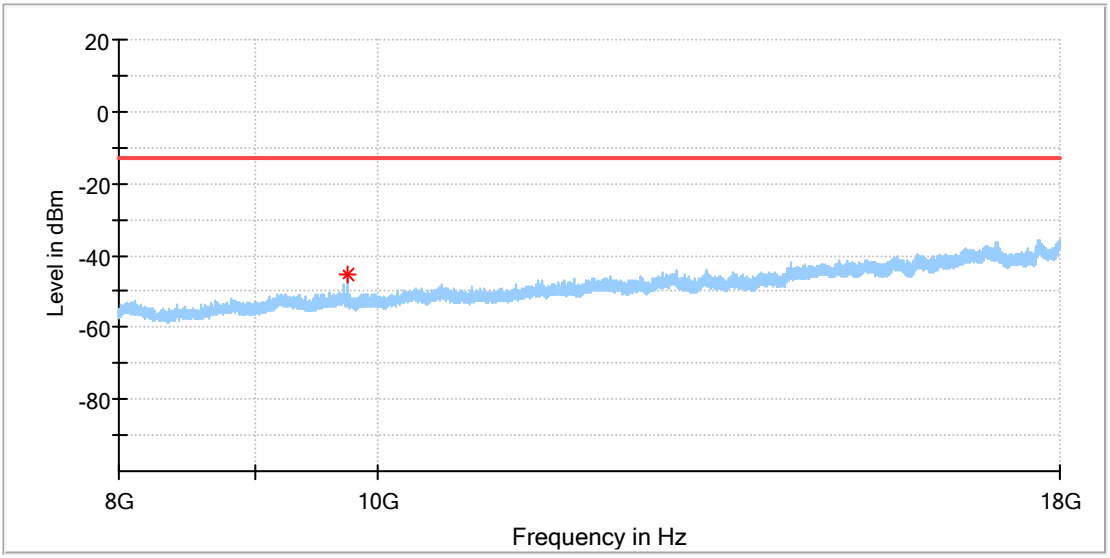


Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1233.500000	-45.69	-13.00	32.69	100.0	H	318.0	-92.8
1599.500000	-44.53	-13.00	31.53	100.0	H	47.0	-92.7
1850.000000	-51.08	-13.00	38.08	100.0	H	16.0	-90.5
2776.000000	-39.19	-13.00	26.19	100.0	H	125.0	-87.6
3667.000000	-36.30	-13.00	23.30	100.0	H	331.0	-86.7
4874.000000	-43.51	-13.00	30.51	100.0	H	63.0	-85.8

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

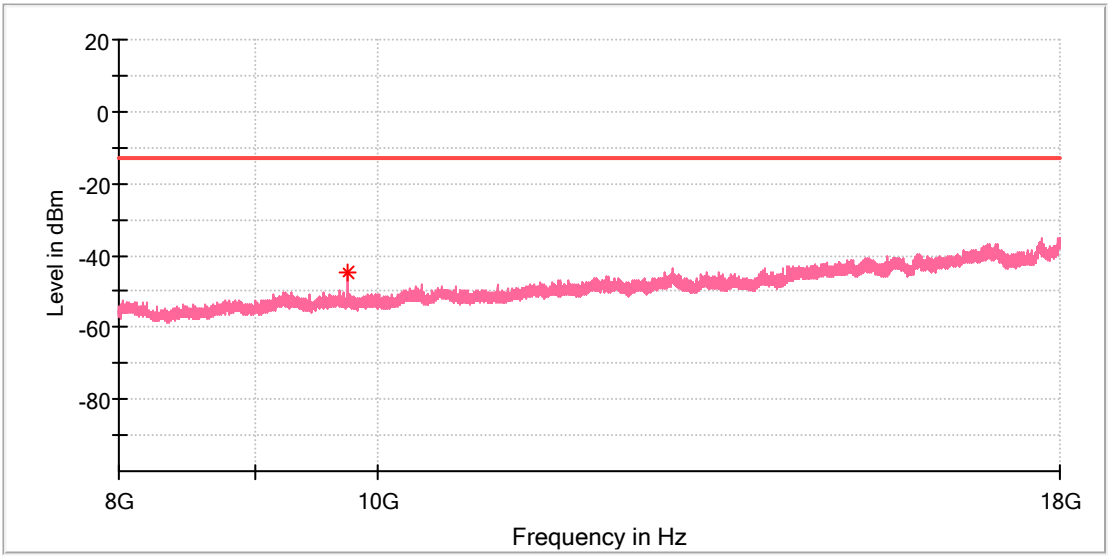


Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
9748.000000	-45.41	-13.00	32.41	100.0	H	68.0	-84.1

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289CV2H
Test Mode:	2.4GHz wifi + Lora 2287 + GPS + BLE + LTE
Order No/Sample No:	168378328/A003285159-002
Test Voltage::	120V/60Hz
Remark:	Temp 22 Humi:52%
Test Standard:	FCC Part 22
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
9747.500000	-44.86	-13.00	31.86	100.0	V	319.0	-84.2

5.2 Conducted emissions

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	:	ANSI C63.10: 2013
Frequency range	:	150KHz - 30MHz
Classification	:	Class B
Limit	:	FCC Part 15.207(a) RSS-Gen Table 4
Kind of test site	:	Shielded Room

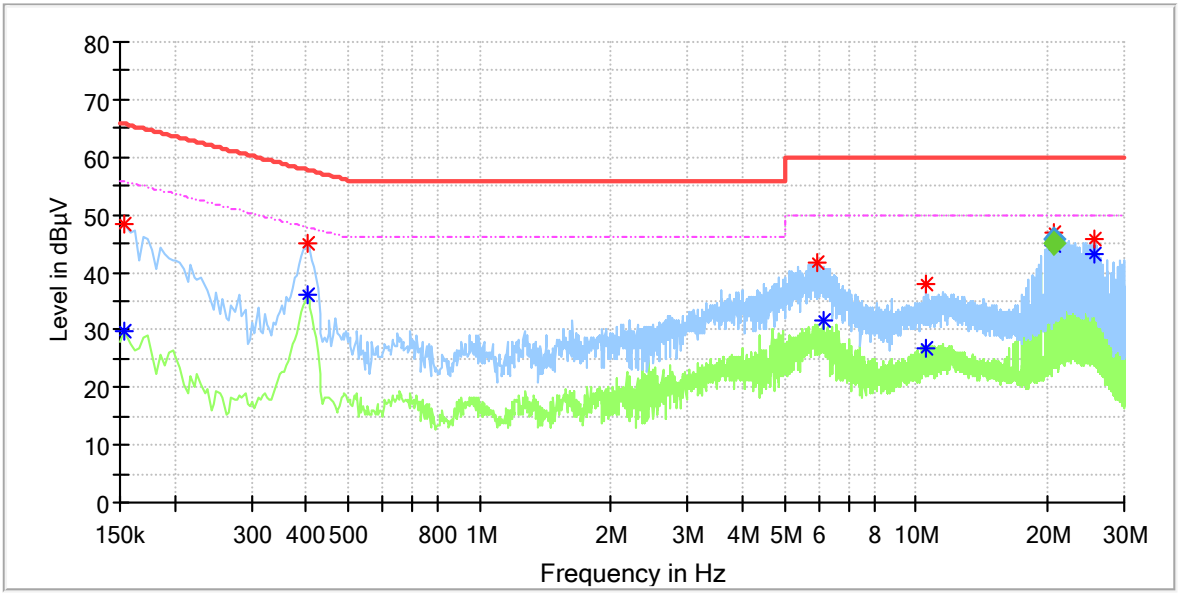
Test Setup

Date of testing	:	2022-06-22 to 2022-07-25
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A, B
Earthing	:	Not Connected
Ambient temperature	:	23.9 ℃
Relative humidity	:	51.4 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the following plots, only the worst case mode are shown in this report.

EUT Information

EUT Name:	WisGate Edge Pro
Order No:	168378328_P00734853
Model:	RAK7289CV2H
Test Mode:	operating
Test Voltage:	AC 120V/60Hz
Test By/Review By:	Kevin Zhou/Gary Chen
Test Standard:	FCC Part 15
Tem./Hum./Pressure:	23.9°C/51.4%/101kPa
Remark:	SR1



Critical_Freqs

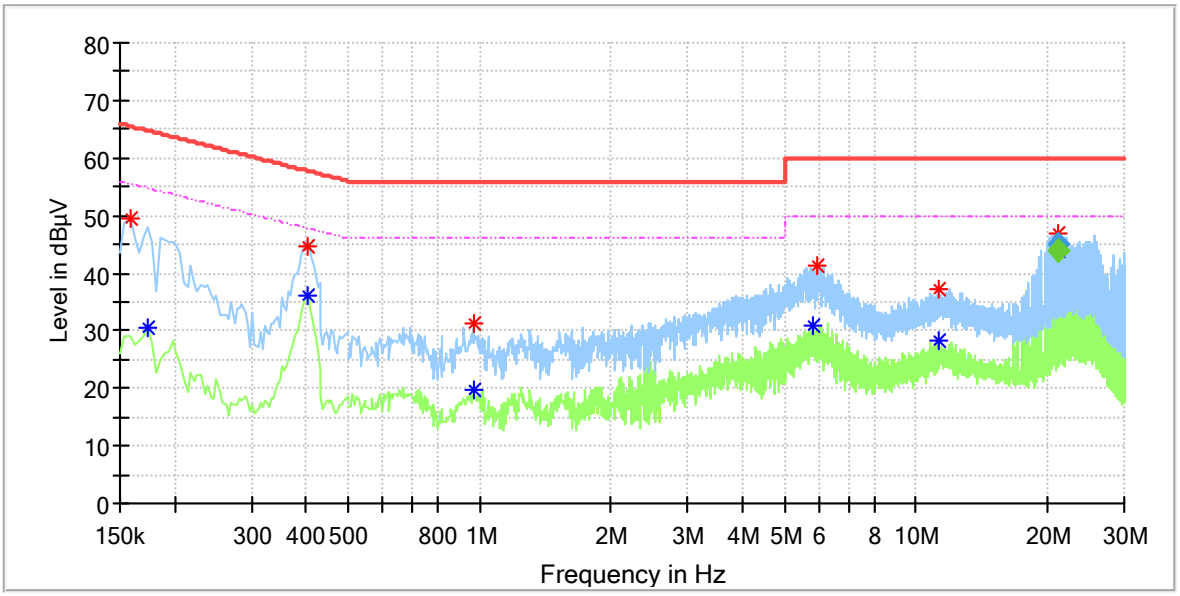
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.154000	---	29.61	55.78	26.18	L1	9.6
0.154000	48.33	---	65.78	17.45	L1	9.6
0.402000	44.89	---	57.81	12.92	L1	9.7
0.402000	---	35.95	47.81	11.87	L1	9.7
5.928000	41.63	---	60.00	18.37	L1	10.0
6.108000	---	31.47	50.00	18.53	L1	10.0
10.484000	37.85	---	60.00	22.15	L1	10.0
10.564000	---	26.94	50.00	23.06	L1	10.0
20.698500	46.99	---	60.00	13.01	L1	10.3
20.698500	---	44.68	50.00	5.32	L1	10.3
25.744000	45.84	---	60.00	14.16	L1	10.4
25.744000	---	43.06	50.00	6.94	L1	10.4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
20.698500	---	44.87	50.00	5.13	1000.0	9.000	L1	10.3
20.698500	45.85	---	60.00	14.15	1000.0	9.000	L1	10.3

EUT Information

EUT Name:	WisGate Edge Pro
Order No:	168378328_P00734853
Model:	RAK7289CV2H
Test Mode:	operating
Test Voltage:	AC 120V/60Hz
Test By/Review By:	Kevin Zhou/Gary Chen
Test Standard:	FCC Part 15
Tem./Hum./Pressure:	23.9°C/51.4%/101kPa
Remark:	SR1



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.158000	49.55	---	65.57	16.01	N	9.6
0.174000	---	30.55	54.77	24.21	N	9.6
0.402000	44.78	---	57.81	13.03	N	9.7
0.402000	---	36.05	47.81	11.76	N	9.7
0.968000	31.29	---	56.00	24.71	N	9.7
0.968000	---	19.82	46.00	26.18	N	9.7
5.832000	---	30.98	50.00	19.02	N	10.0
5.932000	41.13	---	60.00	18.87	N	10.0
11.228000	37.21	---	60.00	22.79	N	10.2
11.288000	---	28.13	50.00	21.87	N	10.2
21.202500	46.89	---	60.00	13.11	N	10.3
21.202500	---	43.97	50.00	6.03	N	10.3

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
21.202500	---	43.93	50.00	6.07	1000.0	9.000	N	10.3
21.202500	45.09	---	60.00	14.91	1000.0	9.000	N	10.3

7 List of Tables

8 List of Photographs