Prüfbericht-Nr.: *Test report no.:*	**CN2155OB 002**	**Auftrags-Nr.:** *Order no.:*	168339882	Seite 1 von 25 *Page 1 of 25*
Kunden-Referenz-Nr.: *Client reference no.:*	**N/A**	**Auftragsdatum:** *Order date:*	2021-10-20	
Auftraggeber: *Client:*	**Shenzhen RAKwireless Technology Co.,Ltd.** Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town Nanshan District, Shenzhen, Guangdong, P.R. China			
Prüfgegenstand: *Test item:*	WisGate Edge Pro			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	RAK7289 (Trademark: RAK)			
Auftrags-Inhalt: *Order content:*	Type Test			
Prüfgrundlage: *Test specification:*	*CFR47 FCC Part 15: Subpart C Section 15.247 *RSS-247 Issue 2			

Wareneingangsdatum: *Date of sample receipt:*	2021-10-25	Refer to photos document
Prüfmuster-Nr.: *Test sample no:*	A003147238	
Prüfzeitraum: *Testing period:*	2021-10-26 – 2021-11-08	
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	**genehmigt von:** *authorized by:*	X Winnie Hou
Datum: *Date:* 2021-12-30	Signed by: Alex Lan	**Ausstellungsdatum:** *Issue date:* 2021-12-30	Signed by: Winnie Hou
Stellung / Position	Senior Project Engineer	**Stellung** / Position	Department Manager

Sonstiges */ Other:*

* The 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 module, 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

Contents

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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

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
Radiated Emission (3m SAC)	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, Lora and GNSS functions.

Note: This product contains transmitter modules.

2.4GHz Wi-Fi module	Contains FCC ID: 2AF6B-RAK634 Contains IC: 25908-RAK634
Lora+GNSS module	Contains FCC ID: 2AF6B-RAK5146 Contains IC: 25908-RAK5146

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	RAK7289
Trade Mark	RAK
Input Voltage	DC 12V via DC source or DC 37 ~57V via POE adapter
Testing Voltage	AC 120V, 60Hz or DC 12V
POE Adapter information	Model:R012-4800500 Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 48.0V, 0.5A 24.0W

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 Gain:	5.4dBi for Ant0 5.0dBi for Ant1

Technical Specification of Lora DTS	
Operating Frequency	923.3 - 927.5MHz
Type of Modulation	Lora
Data Rate	SF7 – SF12 / DR8 – DR13
Channel Number	8 channels
Channel Separation	600 KHz
Occupied Bandwidth	500 KHz
Antenna Gain:	5.0dBi or 5.8dBi or 8dBi (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
Antenna Gain:	5.0dBi or 8dBi (Fiber Glass Antenna)

3.3 Independent Operation Modes

The basic operation modes are:

A, On, WIFI link + Lora link + GNSS 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
Portable Laptop	Lenovo	ThinkPad T480	10Q67059

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)

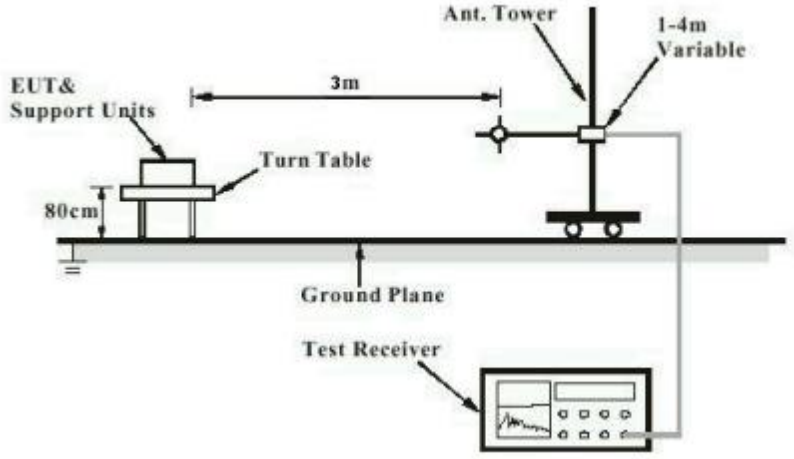
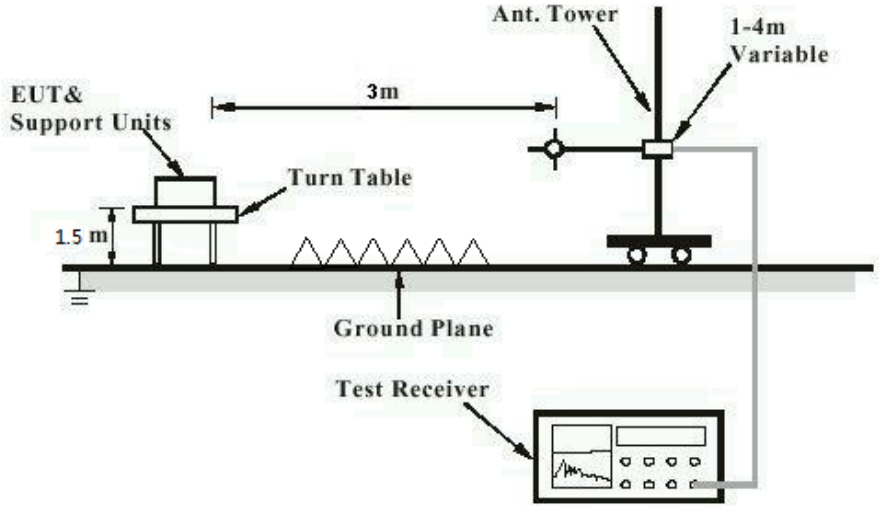


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)



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 RSS-247 Issue 2
Basic standard	:	ANSI C63.10
Limit	:	KDB 996369 D04 The emissions not exceed the highest limit.
Kind of test site	:	3m Semi-anechoic Chamber

Test Setup

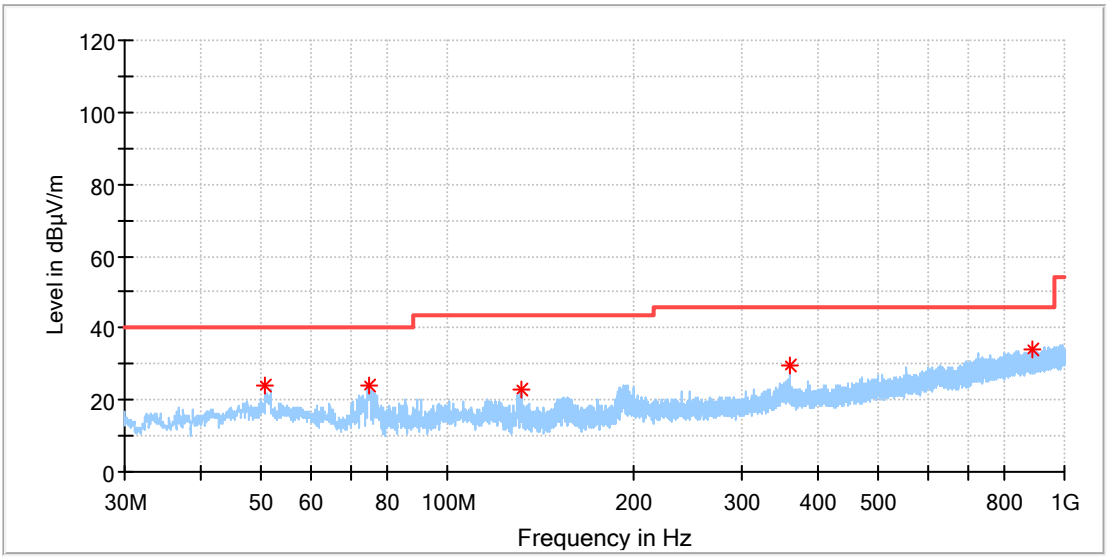
Date of testing	:	2021-11-08
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Earthing	:	Connected
Ambient temperature	:	24. ℃
Relative humidity	:	50 %
Atmospheric pressure	:	101 kPa

Note1: The test plots of Co-located radiated spurious emissions beyond the limit are the fundamental radio frequency of Lora and Wi-Fi.
Note2: The host has one or two identical Lora modules, below test data were performed with two Lora modules.

Lora 5dBi

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289
Test Mode:	WIFI 2.4G_11b + Lora DTS 500K
Order No/Sample No:	168339882/A003147238-004
Test Voltage::	120V/60Hz
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.709500	23.75	40.00	16.25	100.0	H	141.0	-18.3
74.426000	24.13	40.00	15.87	100.0	H	359.0	-23.2
132.189500	22.84	43.50	20.66	100.0	H	296.0	-22.0
359.994000	29.44	46.00	16.56	100.0	H	262.0	-14.6
884.424500	34.26	46.00	11.74	100.0	H	191.0	-5.1

EUT Information

EUT Name:	WisGate Edge Pro
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Order No/Sample No:	168339882/A003147238-004
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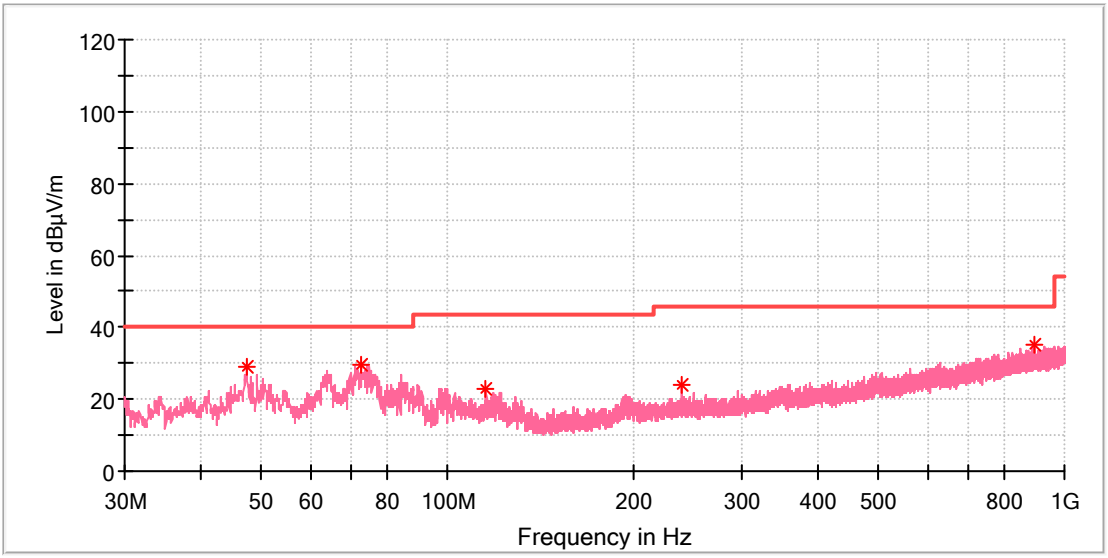

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.266000	28.93	40.00	11.07	100.0	V	234.0	-18.5
72.437500	29.37	40.00	10.63	100.0	V	266.0	-22.6
115.602500	22.66	43.50	20.84	100.0	V	1.0	-19.9
240.005000	24.25	46.00	21.75	100.0	V	189.0	-17.7
891.602500	35.10	46.00	10.90	100.0	V	273.0	-5.1

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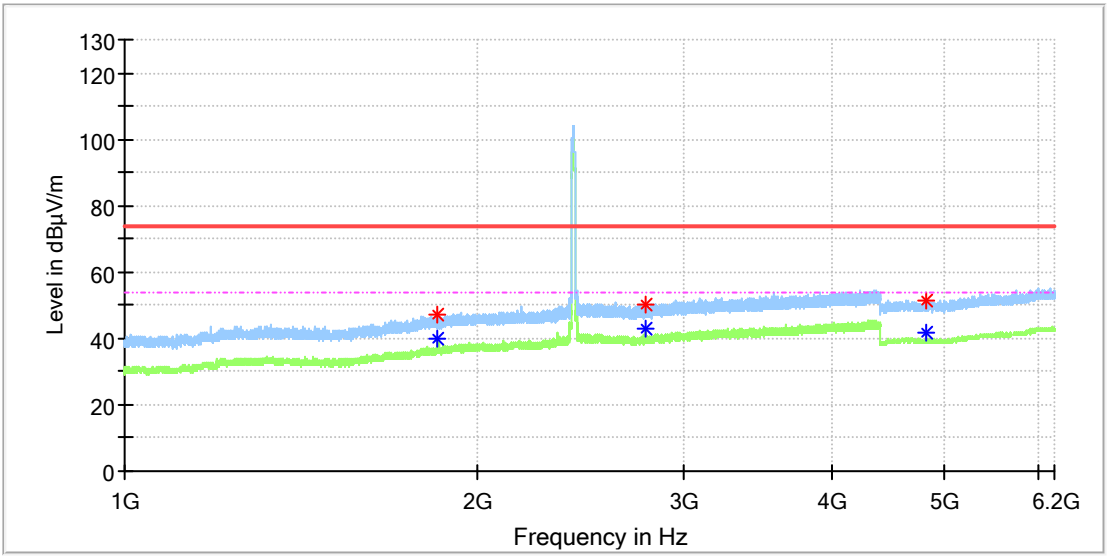

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1850.170000	46.88	---	74.00	27.12	150.0	H	0.0	5.0
1850.170000	---	40.00	54.00	14.00	150.0	H	0.0	5.0
2775.310000	49.96	---	74.00	24.04	150.0	H	143.0	7.9
2775.480000	---	42.69	54.00	11.31	150.0	H	165.0	7.9
4823.500000	51.21	---	74.00	22.79	150.0	H	139.0	11.8
4823.500000	---	41.73	54.00	12.27	150.0	H	139.0	11.8

EUT Information

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Order No/Sample No:	168339882/A003147238-004
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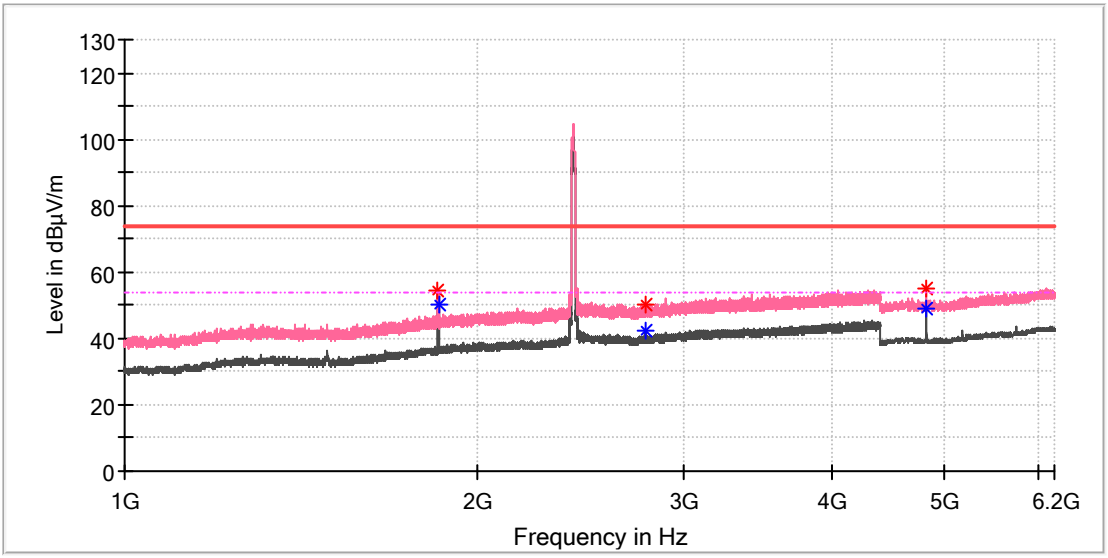

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1849.660000	54.62	---	74.00	19.38	150.0	V	85.0	5.0
1850.850000	---	50.06	54.00	3.94	150.0	V	85.0	5.0
2775.650000	50.14	---	74.00	23.86	150.0	V	297.0	7.9
2775.650000	---	42.58	54.00	11.42	150.0	V	297.0	7.9
4823.500000	---	48.87	54.00	5.13	150.0	V	187.0	11.8
4824.000000	55.15	---	74.00	18.85	150.0	V	187.0	11.8

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289
Test Mode:	WIFI 2.4G_11b + Lora DTS 500K
Order No/Sample No:	168339882/A003147238-004
Test Voltage::	120V/60Hz
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
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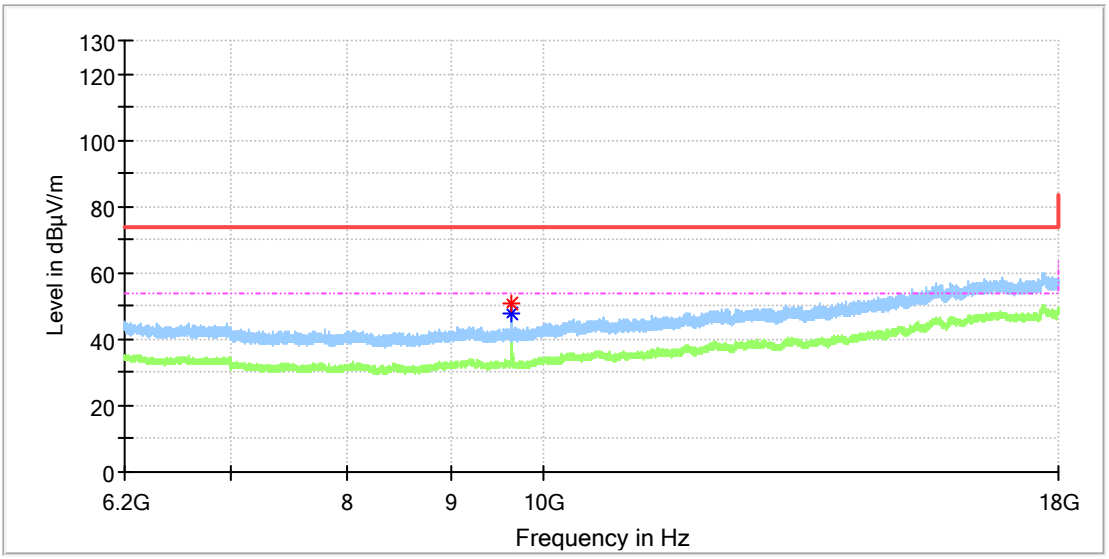

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9648.058333	50.58	---	74.00	23.42	150.0	H	123.0	10.4
9648.058333	---	47.47	54.00	6.53	150.0	H	123.0	10.4

EUT Information

EUT Name:	WisGate Edge Pro
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Test Mode:	WIFI 2.4G_11b + Lora DTS 500K
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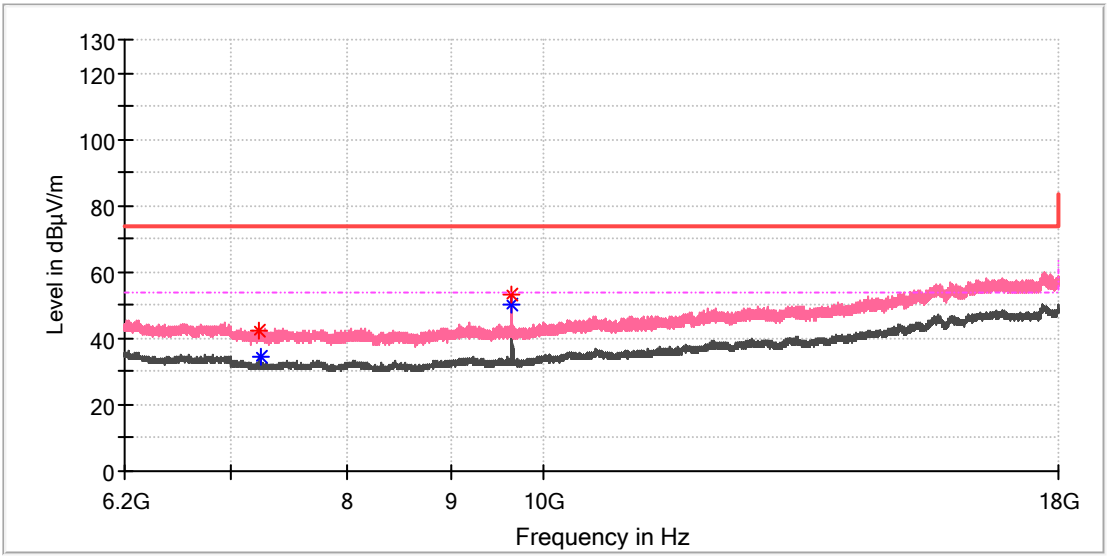

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7233.975000	42.20	---	74.00	31.80	150.0	V	178.0	8.6
7237.908333	---	34.47	54.00	19.53	150.0	V	164.0	8.6
9647.566667	53.24	---	74.00	20.76	150.0	V	149.0	10.4
9648.058333	---	50.32	54.00	3.68	150.0	V	135.0	10.4

Lora 8dBi

EUT Information

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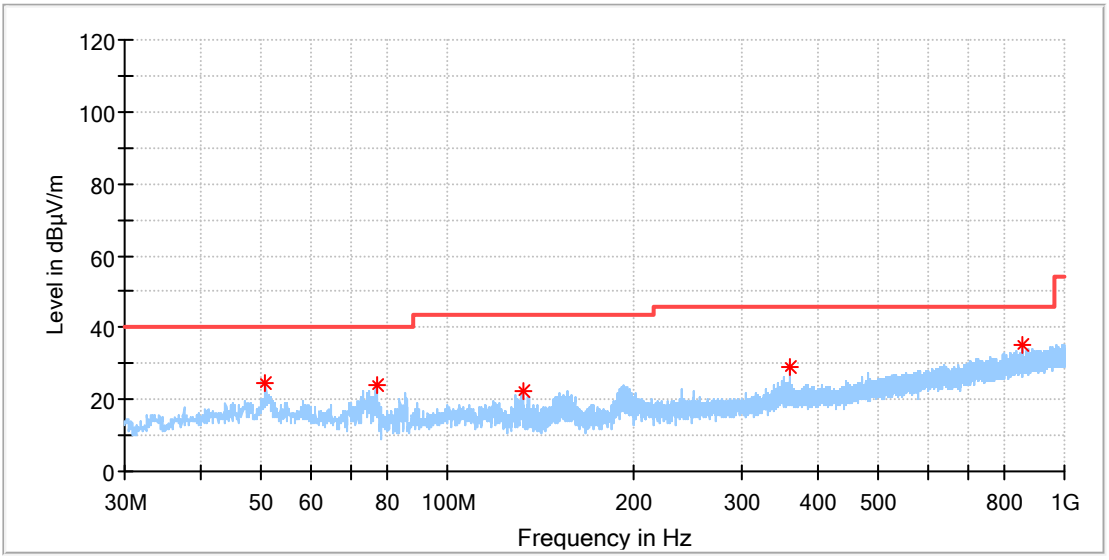
Test Voltage::	120V/60Hz
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.758000	24.65	40.00	15.35	100.0	H	38.0	-18.3
76.705500	23.75	40.00	16.25	100.0	H	338.0	-23.4
132.335000	22.37	43.50	21.14	100.0	H	306.0	-22.0
360.042500	28.88	46.00	17.12	100.0	H	263.0	-14.6
853.384500	34.88	46.00	11.12	100.0	H	317.0	-5.5

EUT Information

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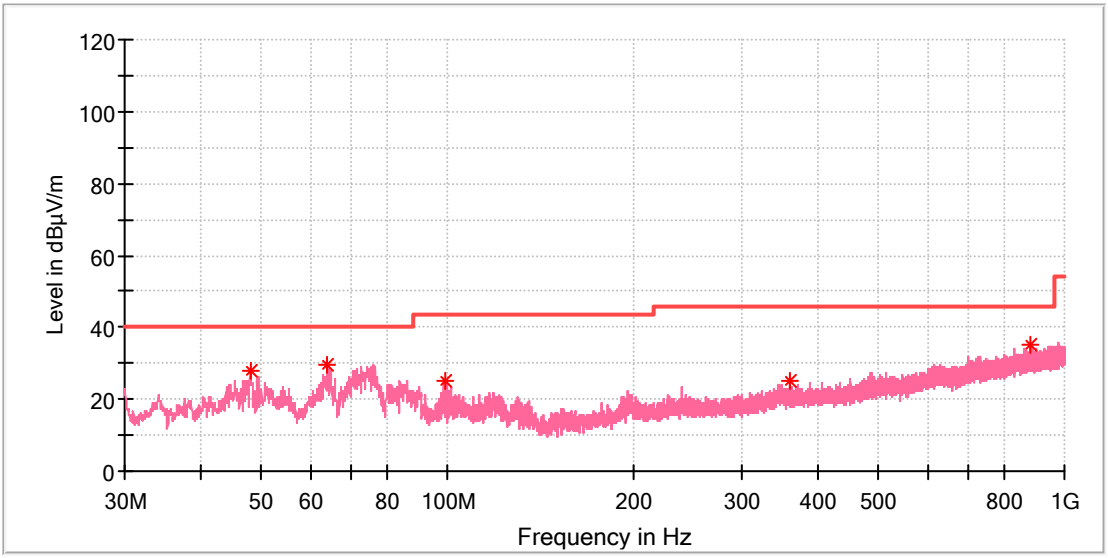

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.945000	27.74	40.00	12.26	100.0	V	171.0	-18.4
64.047000	29.59	40.00	10.41	100.0	V	13.0	-19.8
98.870000	24.86	43.50	18.64	100.0	V	265.0	-19.2
359.994000	24.84	46.00	21.16	100.0	V	213.0	-14.6
879.235000	35.42	46.00	10.58	100.0	V	290.0	-5.1

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289
Test Mode:	WIFI 2.4G_11b + Lora DTS 500K
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Test Voltage::	120V/60Hz
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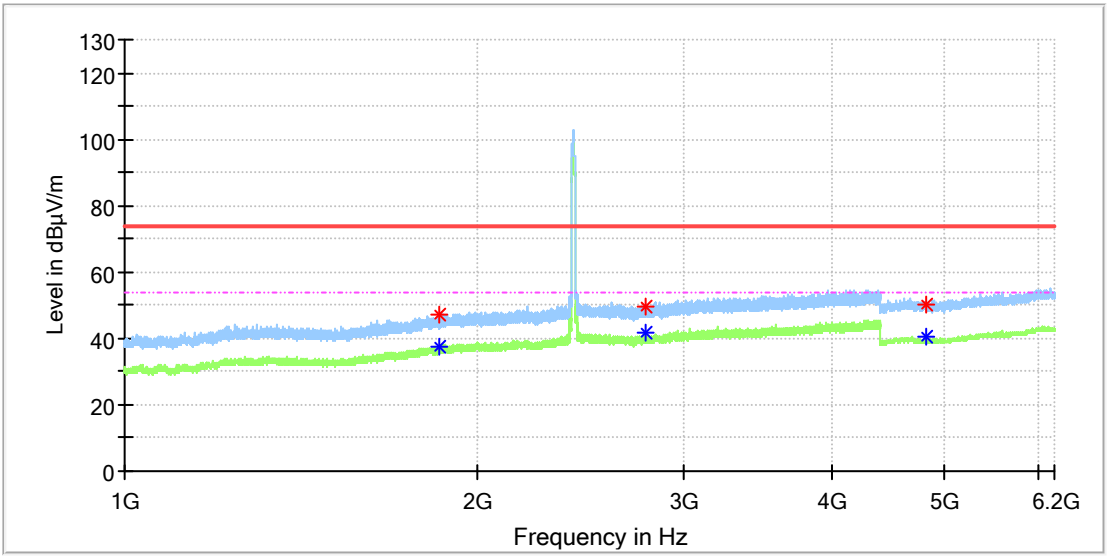
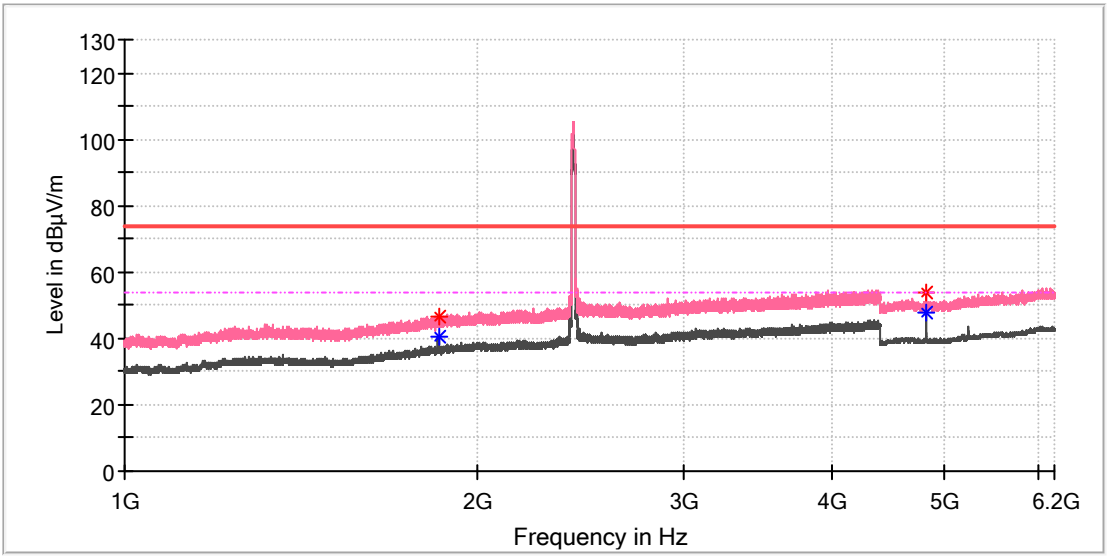


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1855.440000	---	37.47	54.00	16.53	150.0	H	284.0	5.0
1857.140000	46.89	---	74.00	27.11	150.0	H	273.0	5.1
2774.460000	49.39	---	74.00	24.61	150.0	H	123.0	7.9
2774.800000	---	41.87	54.00	12.13	150.0	H	123.0	7.9
4823.500000	50.47	---	74.00	23.53	150.0	H	125.0	11.8
4824.000000	---	40.80	54.00	13.20	150.0	H	125.0	11.8

EUT Information

EUT Name:	WisGate Edge Pro
Model:	RAK7289
Test Mode:	WIFI 2.4G_11b + Lora DTS 500K
Order No/Sample No:	168339882/A003147238-004
Test Voltage::	120V/60Hz
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1850.510000	46.60	---	74.00	27.40	150.0	V	0.0	5.0
1850.510000	---	40.28	54.00	13.72	150.0	V	0.0	5.0
4823.500000	---	47.90	54.00	6.10	150.0	V	179.0	11.8
4824.000000	54.08	---	74.00	19.92	150.0	V	187.0	11.8

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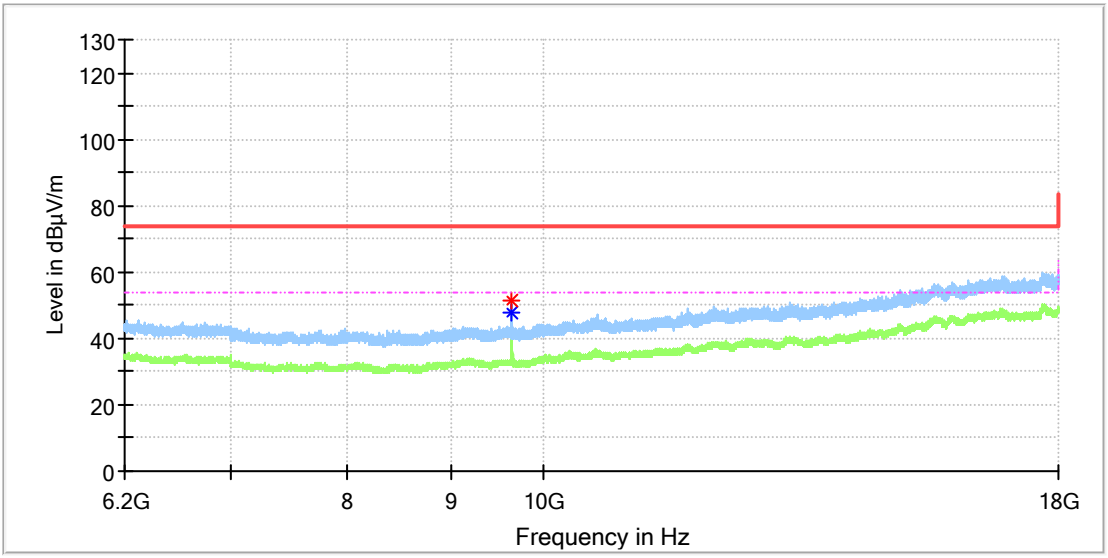

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9648.058333	51.33	---	74.00	22.67	150.0	H	127.0	10.4
9648.058333	---	47.66	54.00	6.34	150.0	H	127.0	10.4

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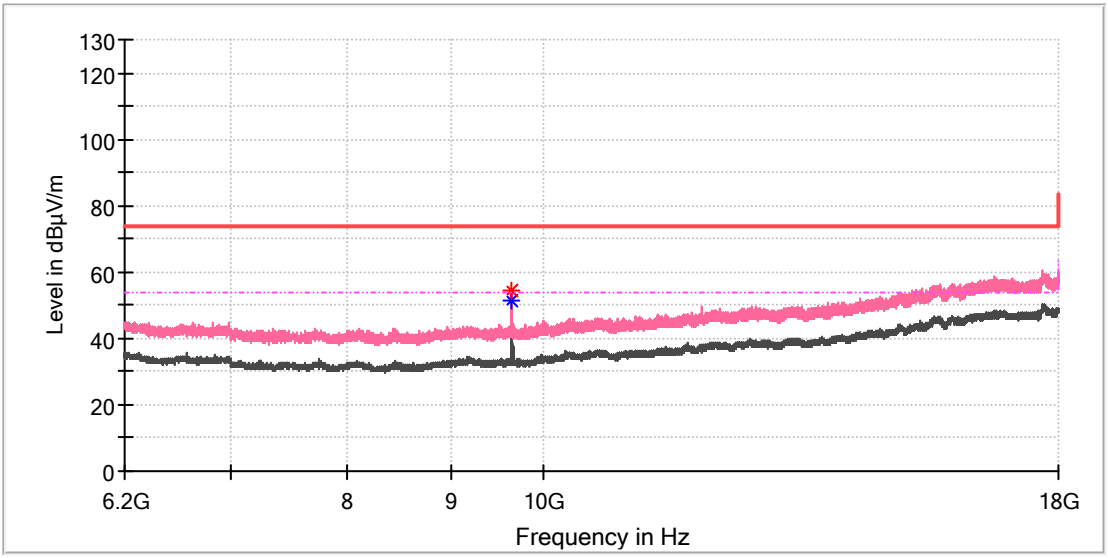

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9647.566667	54.46	---	74.00	19.54	150.0	V	144.0	10.4
9648.058333	---	50.95	54.00	3.05	150.0	V	144.0	10.4

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