

FCC PART 15B, CLASS B MEASUREMENT AND TEST REPORT

For

Shenzhen RAKwireless Technology Co.,Ltd.

Room 506, Bldg B, New Compark, Pingshan First Road, Taoyuan Street, XiLi town,
Nanshan District, Shenzhen, China

FCC ID: 2AF6B-RAK7248

Report Type: Original Report	Product Type: WisGate
Report Number: RSZ200814003-00	
Report Date: 2020-09-07	
Jimmy Xiao <i>Jimmy Xiao</i>	
Reviewed By: RF Engineer	
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	WisGate
Tested Model	RAK7248
Voltage Range	DC 5V from adapter
Highest operating frequency	5825MHz
Date of Test	2020-08-26 to 2020-09-03
Sample serial number	RSZ200814003-RF-S1(Assigned by BACL, Shenzhen)
Received date	2020-08-14
Sample/EUT Status	Good condition
Adapter 1 information	Model: ABT030050 Input: AC 100-240V, 50/60Hz Output: DC 5V, 3A
Adapter 2 information	Model: RA040-0503000US Input: AC 100-240V, 50/60Hz, 0.6A Max Output: DC 5V, 3.0A

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A, B of the Federal Communication Commissions rules.

The objective of the manufacturer is to determine the compliance of the EUT with FCC Part 15 B.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expanded combined standard uncertainty of test at Bay Area Compliance Laboratories Corp. (Shenzhen) is shown as below. And the uncertainty will be taken into consideration for the test data recorded in the report

Parameter		uncertainty
Conducted Emissions		$\pm 1.95\text{dB}$
Radiated Emissions	Below 1GHz	$\pm 4.75\text{dB}$
	Above 1GHz	$\pm 4.88\text{dB}$

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a manufacturer testing fashion.

EUT Exercise Software

No exercise software was used.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

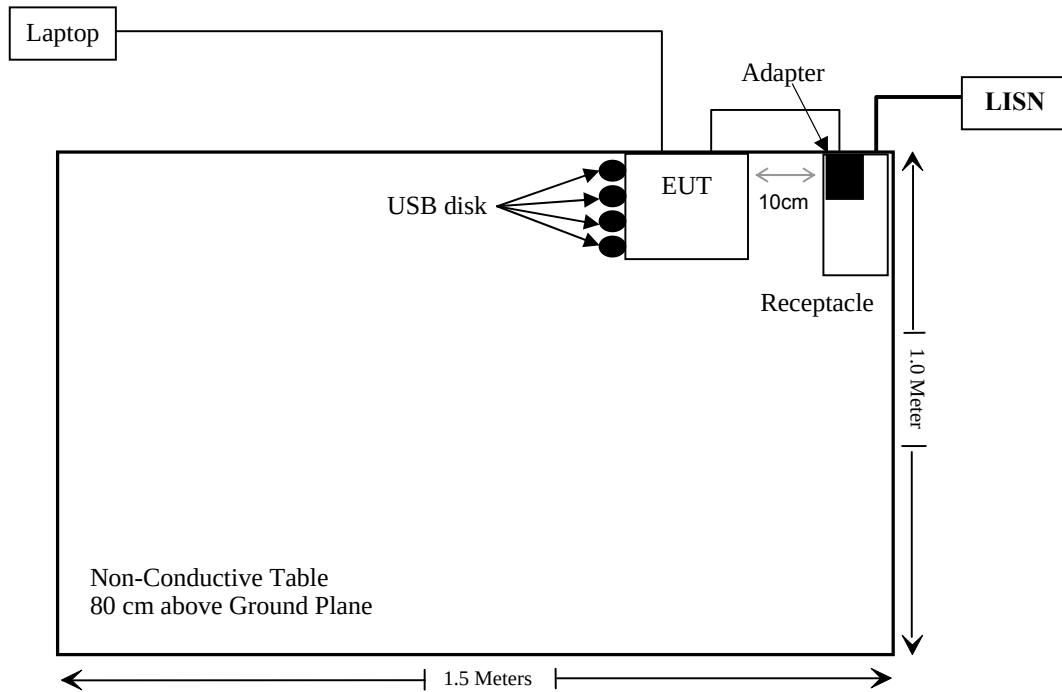
Manufacturer	Description	Model	Serial Number
Kingston	USB disk	DTSE9	DTSE9
Ilano	USB disk	Unknown	USB disk
BRL	USB disk	BRL	866.275.8378
Teclast	USB disk	8GB	8GB
Dell	Laptop	E5430	E5430

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielding Un-detachable USB Cable	1.0	EUT	Adapter
Un-shielding Detachable RJ45 Cable	10	EUT	Laptop

Block Diagram of Test Setup

For conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§15.107	AC Line Conducted Emissions	Compliance
§15.109	Radiated Spurious Emissions	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/08/04	2021/08/03
Rohde & Schwarz	LISN	ENV216	101613	2020/08/04	2021/08/03
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 4	EC-007	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Yijia	Temperature & Humidity Meter	TA218B	E0938	2019/10/14	2020/10/13
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-021304	2017/12/06	2020/12/05
Yijia	Temperature & Humidity Meter	TA218B	E0938	2019/10/14	2020/10/13
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28

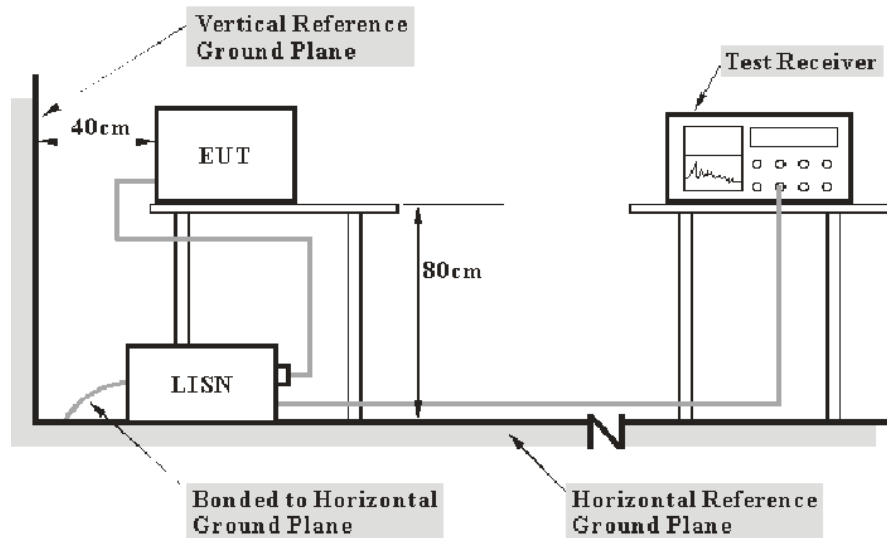
* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.107 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

According to FCC §15.107

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with per ANSI C63.4-2014. The related limit was specified in FCC Part 15.107.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the device was connected to the first LISN and the other relevant equipments were connected to the second LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

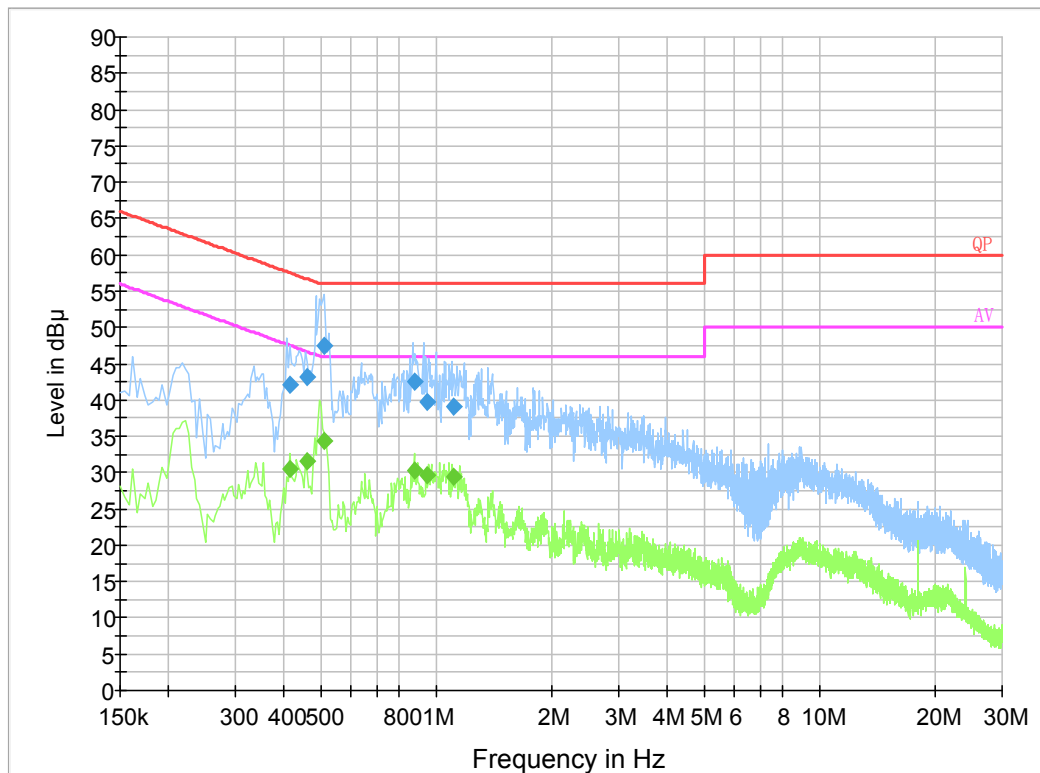
$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

Adapter 1 (Model: ABT030050)

Line:

Project No: RSZ200814003-RF
 Company Name: Shenzhen RAKwireless Technology Co.,Ltd.
 Model Number: RAK7248 EUT Number: RSZ200814003-RF-S1
 Test Standard: Part 15B
 Climatic: 25°C 65%RH 101kPa
 Test Date: 2020.9.03 Test Engineer: Haiguo Li
 Power Source: AC 120V 60Hz Port: L
 Test Mode: Working



Final Result 1

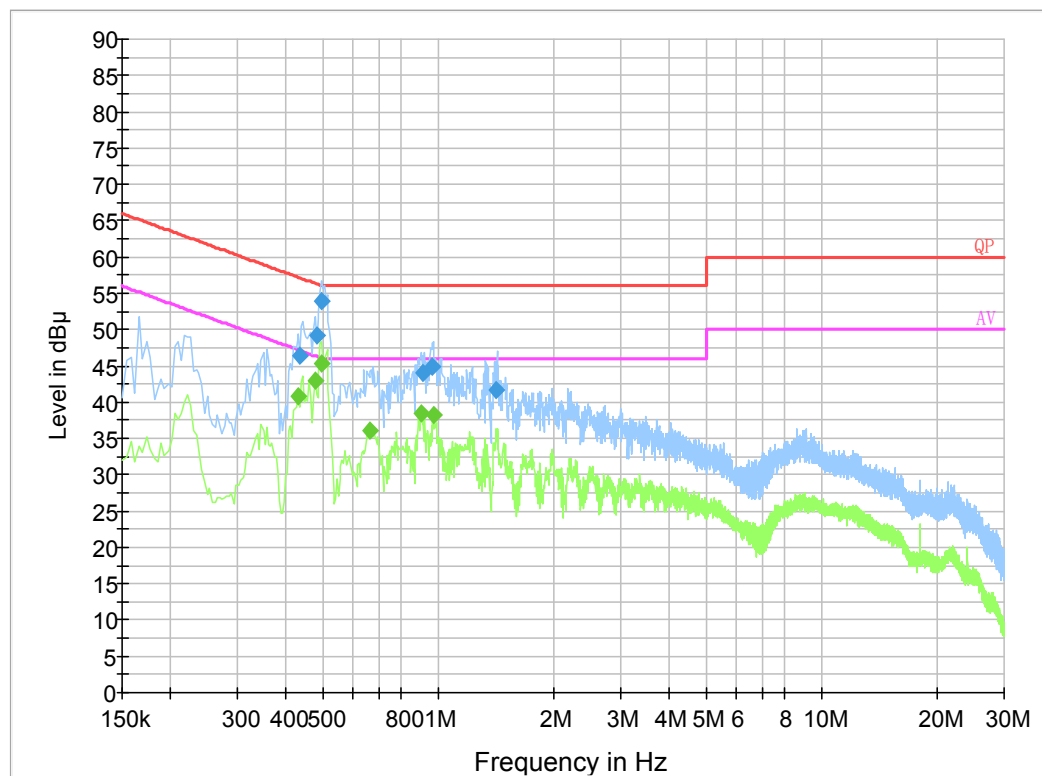
Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.416150	42.1	9.000	L1	19.9	15.4	57.5
0.459130	43.3	9.000	L1	19.8	13.4	56.7
0.510350	47.5	9.000	L1	19.8	8.5	56.0
0.880950	42.5	9.000	L1	19.8	13.5	56.0
0.943950	39.7	9.000	L1	19.8	16.3	56.0
1.109530	39.0	9.000	L1	19.8	17.0	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.416150	30.5	9.000	L1	19.9	17.0	47.5
0.459130	31.5	9.000	L1	19.8	15.2	46.7
0.510350	34.4	9.000	L1	19.8	11.6	46.0
0.880950	30.3	9.000	L1	19.8	15.7	46.0
0.943950	29.5	9.000	L1	19.8	16.5	46.0
1.109530	29.4	9.000	L1	19.8	16.6	46.0

Neutral:

Project No: RSZ200814003-RF
 Company Name: Shenzhen RAKwireless Technology Co.,Ltd.
 Model Number: RAK7248 EUT Number: RSZ200814003-RF-S1
 Test Standard: Part 15B
 Climatic: 25°C 65%RH 101kPa
 Test Date: 2020.9.03 Test Engineer: Haiguo Li
 Power Source: AC 120V 60Hz Port: N
 Test Mode: Working

**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
0.435550	46.3	9.000	N	19.8	10.8	57.1
0.485170	49.2	9.000	N	19.8	7.1	56.3
0.498530	54.0	9.000	N	19.8	2.0	56.0
0.916410	44.1	9.000	N	19.7	11.9	56.0
0.967390	44.9	9.000	N	19.8	11.1	56.0
1.412610	41.8	9.000	N	19.8	14.2	56.0

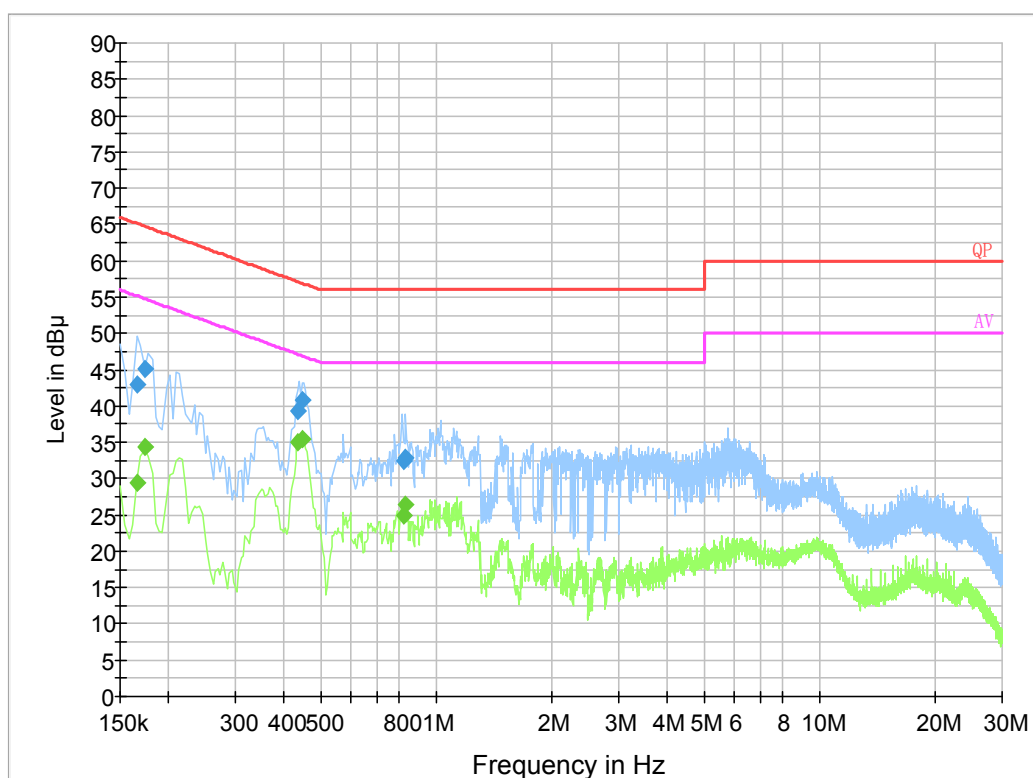
Final Result 2

Frequency (MHz)	Average (dB μV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μV)
0.430000	40.9	9.000	N	19.8	6.4	47.3
0.478000	42.9	9.000	N	19.8	3.5	46.4
0.498000	45.4	9.000	N	19.8	0.6	46.0
0.666000	36.0	9.000	N	19.8	10.0	46.0
0.906000	38.4	9.000	N	19.7	7.6	46.0
0.974000	38.2	9.000	N	19.8	7.8	46.0

Adapter 2 (Model: RA040-0503000US)

Line

Project No: RSZ200814003-RF
 Company Name: Shenzhen RAKwireless Technology Co.,Ltd.
 Model Number: RAK7248 EUT Number: RSZ200814003-RF-S1
 Test Standard: Part 15B
 Climatic: 25°C 65%RH 101 kPa
 Test Date: 2020.9.01 Test Engineer: Haiguo Li
 Power Source: AC 120V 60Hz Port: L
 Test Mode: Working

**Final Result 1**

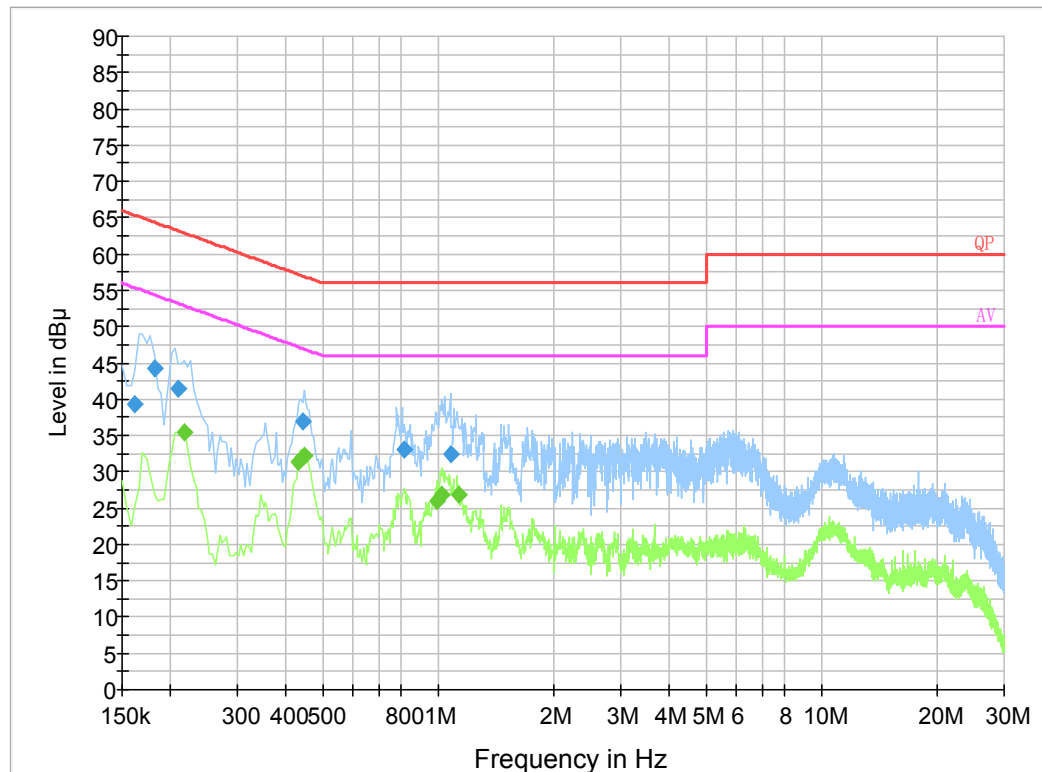
Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.165500	43.0	9.000	L1	19.9	22.2	65.2
0.174500	45.2	9.000	L1	19.9	19.5	64.7
0.436450	39.2	9.000	L1	19.8	17.9	57.1
0.447190	40.8	9.000	L1	19.8	16.2	56.9
0.825790	32.5	9.000	L1	19.8	23.5	56.0
0.833490	32.9	9.000	L1	19.8	23.1	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.165500	29.4	9.000	L1	19.9	25.8	55.2
0.174500	34.5	9.000	L1	19.9	20.2	54.7
0.436450	35.0	9.000	L1	19.8	12.1	47.1
0.447190	35.4	9.000	L1	19.8	11.5	46.9
0.825790	24.9	9.000	L1	19.8	21.1	46.0
0.833490	26.4	9.000	L1	19.8	19.6	46.0

Neutral:

Project No: RSZ200814003-RF
 Company Name: Shenzhen RAKwireless Technology Co.,Ltd.
 Model Number: RAK7248 EUT Number: RSZ200814003-RF-S1
 Test Standard: Part 15B
 Climatic: 25°C 65%RH 101 kPa
 Test Date: 2020.9.01 Test Engineer: Haiguo Li
 Power Source: AC 120V 60Hz Port: N
 Test Mode: Working

**Final Result 1**

Frequency (MHz)	QuasiPeak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.161500	39.3	9.000	N	19.8	26.1	65.4
0.182500	44.2	9.000	N	19.8	20.2	64.4
0.210500	41.4	9.000	N	19.8	21.8	63.2
0.443250	36.8	9.000	N	19.8	20.2	57.0
0.817910	33.2	9.000	N	19.8	22.8	56.0
1.085830	32.4	9.000	N	19.8	23.6	56.0

Final Result 2

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.218000	35.5	9.000	N	19.8	17.4	52.9
0.430000	31.4	9.000	N	19.8	15.9	47.3
0.450000	32.3	9.000	N	19.8	14.6	46.9
0.998000	26.0	9.000	N	19.8	20.0	46.0
1.022000	26.8	9.000	N	19.8	19.2	46.0
1.138000	26.8	9.000	N	19.8	19.2	46.0

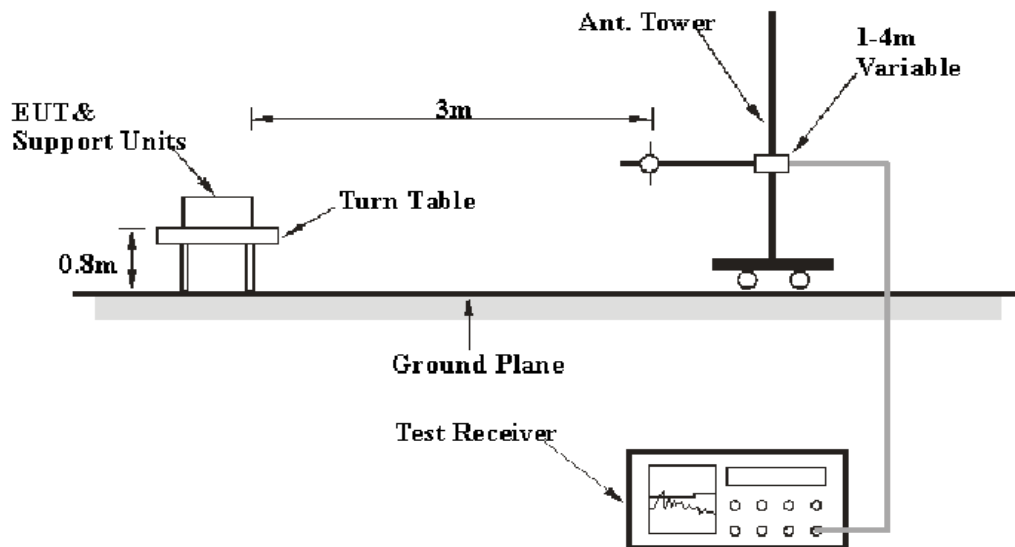
FCC §15.109 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

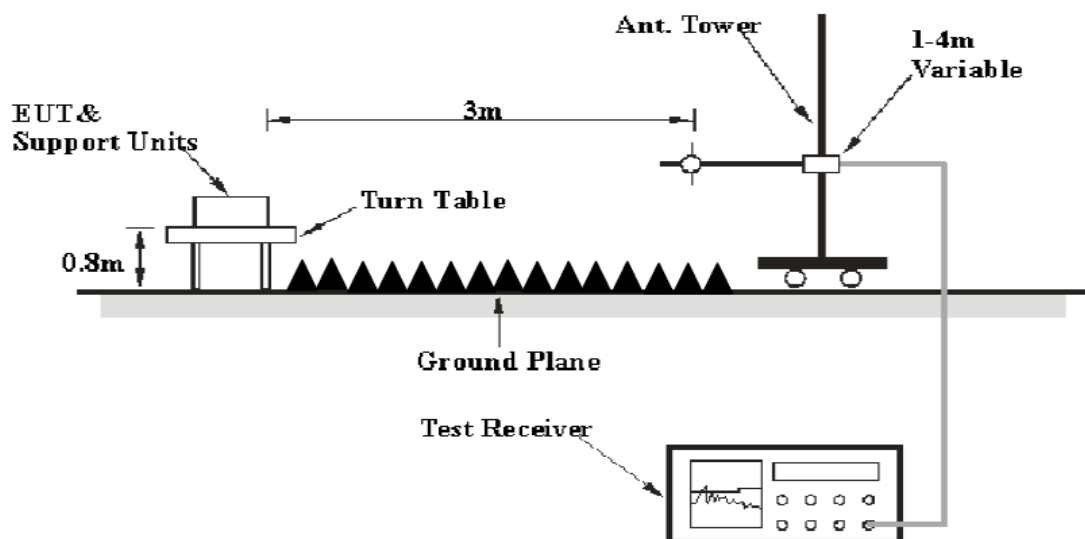
FCC §15.109

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4-2014. The specification used was the FCC Part 15.109 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

During the radiated emission test, the EMI test receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data

Environmental Conditions

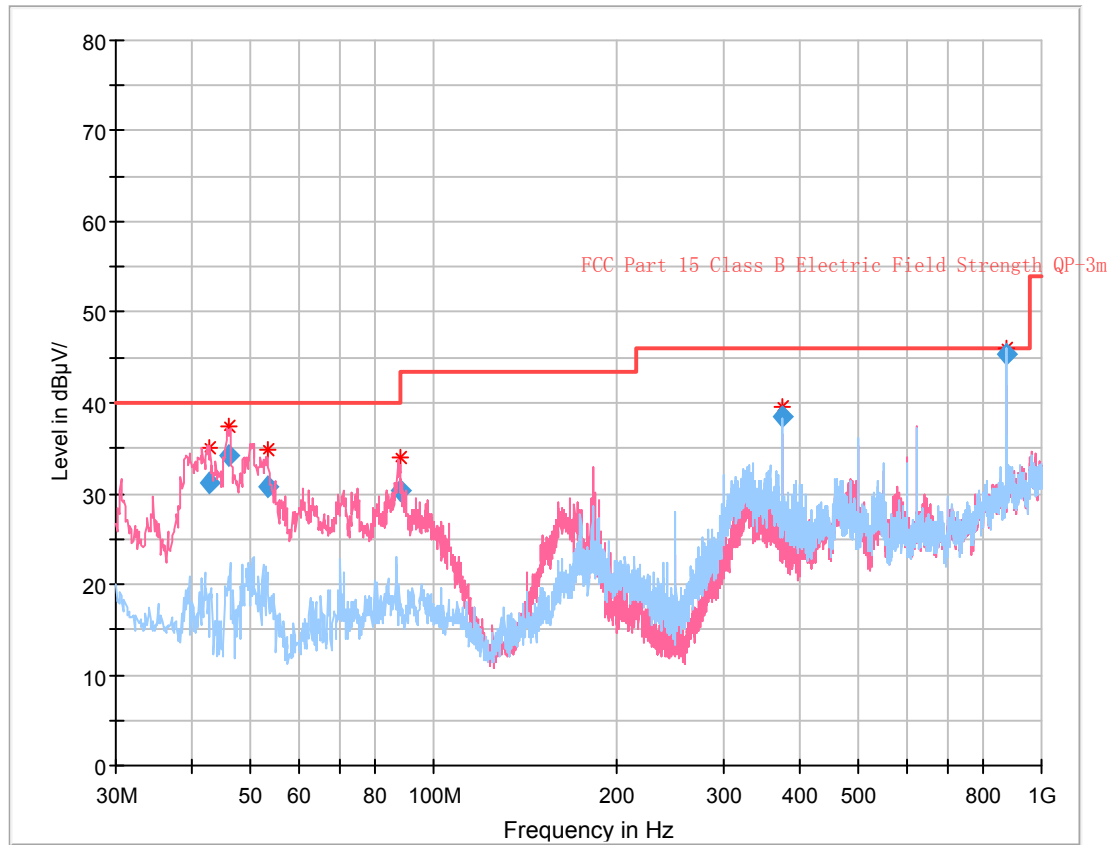
Temperature:	29 °C
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Harris He and Holland Yang on 2020-08-26 and 2020-09-01 for below 1GHz, by Leven Gan on 2020-08-26 for above 1GHz.

EUT Operation Mode: Working

30 MHz – 1 GHz:

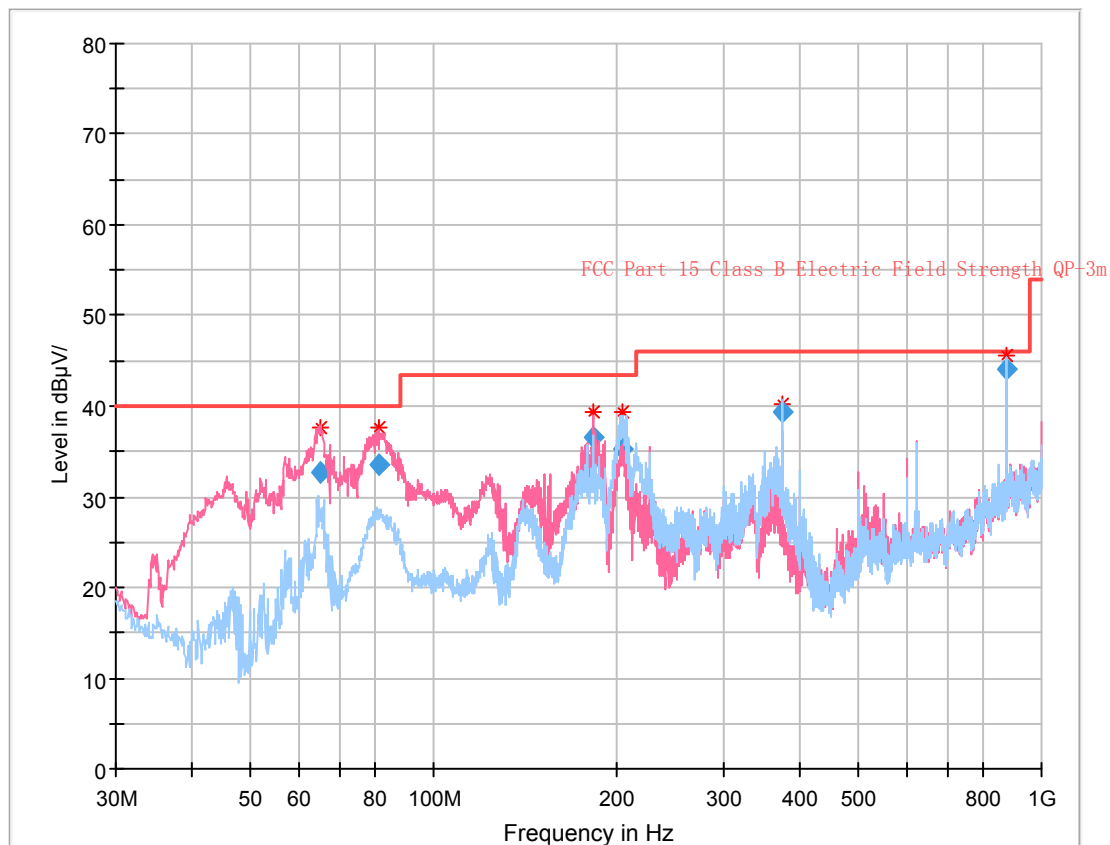
Adapter 1 (Model: ABT030050)



Final Result

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.636375	31.09	40.00	8.91	110.0	V	152.0	-15.6
46.071750	34.26	40.00	5.74	104.0	V	147.0	-17.8
53.170125	30.74	40.00	9.26	112.0	V	44.0	-19.8
87.982250	30.40	40.00	9.60	123.0	V	100.0	-19.2
374.999000	38.57	46.00	7.43	102.0	H	334.0	-10.6
875.009500	45.29	46.00	0.71	109.0	H	200.0	3.6

Adapter 2 (Model: RA040-0503000US)



Final Result

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
64.910625	32.61	40.00	7.39	102.0	V	322.0	-20.4
81.205125	33.56	40.00	6.44	111.0	V	94.0	-19.9
182.762375	36.54	43.50	6.96	104.0	V	42.0	-15.2
204.465750	35.34	43.50	8.16	168.0	H	222.0	-13.9
374.991125	39.26	46.00	6.74	103.0	H	76.0	-10.6
874.997000	44.10	46.00	1.90	109.0	H	164.0	3.6

1-29.125 GHz:

Frequency (MHz)	Measurement		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15B	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H / V)			Limit (dBμV/m)	Margin (dB)
1099.81	49.02	PK	57	2.4	H	-5.46	43.56	74	30.44
1099.81	44.68	Ave.	57	2.4	H	-5.46	39.22	54	14.78
1099.81	49.45	PK	33	1.0	V	-5.46	43.99	74	30.01
1099.81	44.71	Ave.	33	1.0	V	-5.46	39.25	54	14.75
1349.99	50.80	PK	338	2.2	H	-4.07	46.73	74	27.27
1349.99	45.85	Ave.	338	2.2	H	-4.07	41.78	54	12.22
1349.99	46.48	PK	252	2.2	V	-4.07	42.41	74	31.59
1349.99	37.10	Ave.	252	2.2	V	-4.07	33.03	54	20.97

Note:

- 1) Correction Factor=Antenna factor (RX) + cable loss – amplifier factor
- 2) Corrected Amplitude = Correction Factor + Reading
- 3) Margin = Limit - Corrected Amplitude

******* END OF REPORT *******