FCC PART 15.247

TEST REPORT

For

Shenzhen RAKwireless Technology Co.,Ltd.

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FCC ID: 2AF6B-RAK7268C113

Report Type:	**Product Type:**
Original Report	WisGate

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Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	WisGate
Tested Model	RAK7268C-113
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz/2422-2452MHz
Transmit Power	BLE: 3.13Bm(LE 1M), 3.23dBm(LE 2M) Wi-Fi: 18.10dBm(802.11b), 16.14dBm(802.11g), 16.26dBm(802.11n-HT20), 15.78dBm(802.11n-HT40)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	1.75 dBi (It is provided by the applicant)
Voltage Range	DC 12V from adapter or DC 48V from POE
Date of Test	2020-08-28 to 2020-12-18
Sample serial number	RSZ200812006-RF-S2(Assigned by BACL, Shenzhen)
Received date	2020-08-12
Sample/EUT Status	Good condition
Adapter 1 information	Model: PSY1202000US Input: AC 100-240V, 50/60Hz, 1.3A Output: DC 12V, 2.0A
Adapter 2 information	Model: AD-0241200200US-1 Input: AC 100-240V, 50/60Hz, 0.6A Output: DC 12.0V, 2.0A

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

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 EUT has two antennas for Wi-Fi, it can operate in 802.11b/g/n20/n40 modes.

For 802.11b, 802.11g and 802.11n-HT20 mode, 11 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20, EUT was tested with Channel 1, 6 and 11.

For 802.11n-HT40, EUT was tested with Channel 3, 6 and 9.

For LE 1M&2M mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"SecurCRT.exe"* exercise software was used

The device was tested with the worst case was performed as below:

Mode	Data rate	Power level*		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	19	19	19
802.11g	6 Mbps	9	9	9
802.11n-HT20	MCS0	8	8	8
802.11n-HT40	MCS0	6	6	6
BLE	Default	0	0	0

The worse-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rated bandwidths, and modulations.
The device supports SISO and MIMO in all modes, per pretest, the MIMO mode was the worst mode for all the modes.

The software and power level was provided by the applicant.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
HIKVISION	Router	DS-3WR03-E	10021642429
GOSPELL	POE	G0720-480-050	200200015
Unknown	SD card	Unknown	SD card

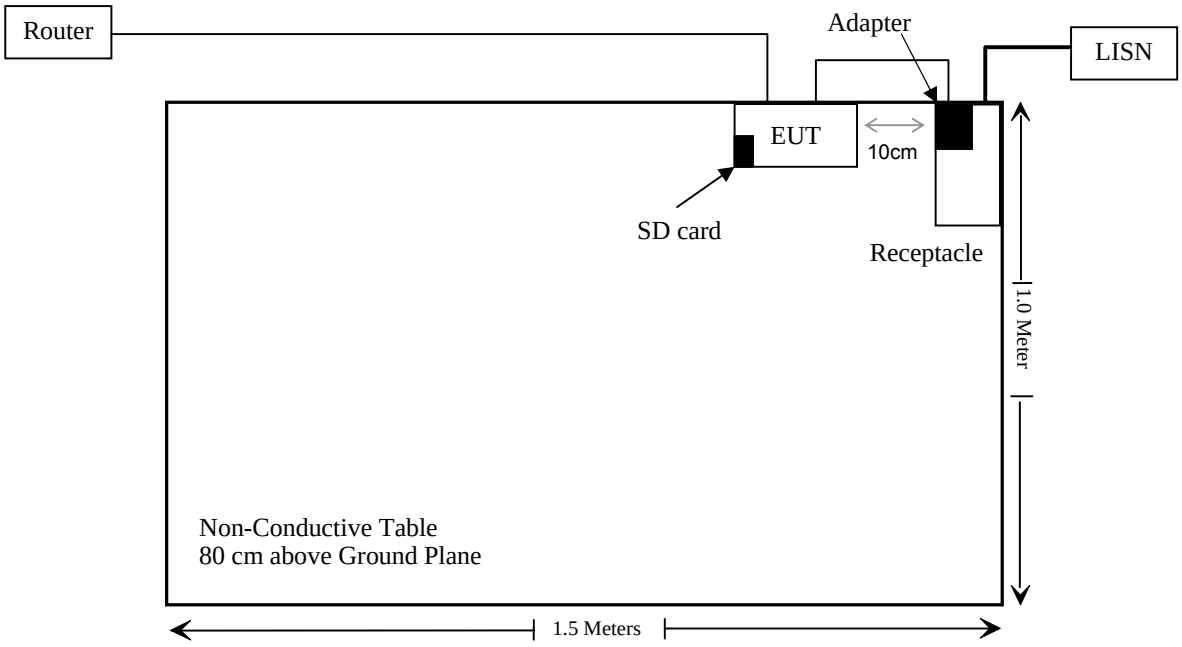
External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable DC Cable	0.6	EUT	Adapter
Un-shielding Detachable RJ45 Cable	1.2	EUT	POE
Un-shielding Detachable RJ45 Cable	10	Router	POE/EUT

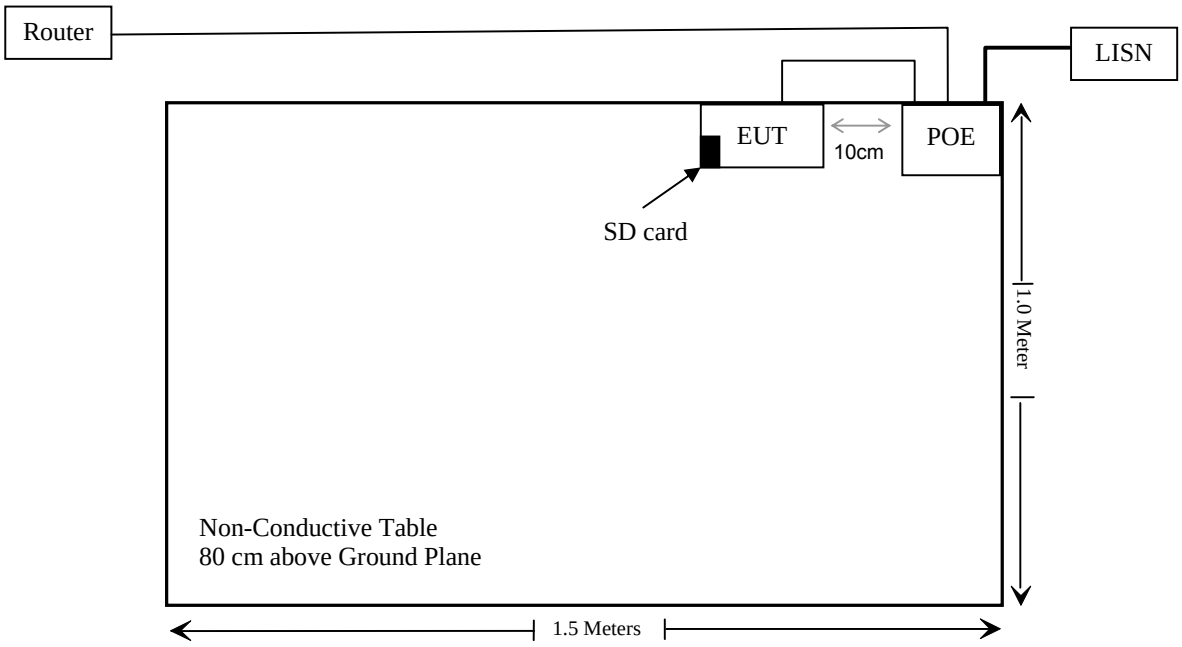
Block Diagram of Test Setup

For conducted emission:

Powered by adapter



Powered by POE



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i) & §1.1310 & §2.1091	Maximum Permissible exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance*
§15.247(b)(3)	Maximum Conducted Output Power	Compliance*
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance*
§15.247(e)	Power Spectral Density	Compliance*

Note:

Compliance*: The EUT and RAK7268-112 (FCC ID: 2AF6B-RAK7268112) have the same Wi-Fi and BLE module, so the section “Maximum Permissible exposure (MPE)”, “Antenna Requirement”, “AC Line Conducted Emissions” and “Spurious Emissions” were updated. All the other BLE & Wi-Fi test data are referred to the report RSZ200812005-00B with model number RAK7268-112 (FCC ID: 2AF6B-RAK7268112), issued on 2020-09-27 by Bay Area Compliance Laboratories Corp. (Shenzhen).

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions 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	2020/11/29	2021/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2020/11/29	2021/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test (30MHz-1GHz)					
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 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Radiated Emission Test (1GHz-25GHz)					
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
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/29	2021/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/06	2020/12/05
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05

*** 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 §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

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

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, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

Mode	Frequency (MHz)	Antenna Gain*		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	1.75	1.50	3.5	2.24	20	0.001	1.0
Wi-Fi	2412-2462	1.75	1.50	18.5	70.79	20	0.021	1.0
Lora	923.3-927.5	2.3	1.70	13.5	22.39	20	0.008	0.6
WCDMA Band II	1850-1910	2.3	1.70	25	316.23	20	0.107	1.0
WCDMA Band IV	1710-1755	3.4	2.19	25	316.23	20	0.138	1.0
WCDMA Band V	824-849	1.0	1.26	25	316.23	20	0.079	0.55
LTE Band 2	1850-1910	2.3	1.70	25	316.23	20	0.107	1.0
LTE Band 4	1710-1755	3.4	2.19	25	316.23	20	0.138	1.0
LTE Band 5	824-849	1.0	1.26	25	316.23	20	0.079	0.55
LTE Band 12	699-716	2.9	1.95	25	316.23	20	0.123	0.466
LTE Band 13	777-787	2.9	1.95	25	316.23	20	0.123	0.518

Note: 1.The tune up conducted power was declared by the applicant
2. Lora, BLE, Wi-Fi and WCDMA/LTE can transmit simultaneously for this device.
3. Please refer to the MPE report of the FCC ID: 2AF6B-RAK2287 for the Lora output power.
4. Please refer to the MPE report of the FCC ID: XMR201807EG95NA for the WCDMA/LTE output power.
5. The antenna gain was provided by the applicant.

So the worst simultaneous transmitting consideration:

The ratio=MPE_{BLE}/limit + $MPE_{Wi\text{-}Fi}$/limit + MPE_{Lora}/limit + MPE_{LTE}/limit
=0.001/1.0+0.021/1.0+0.008/0.6+0.123/0.466 =0.299＜1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has an internal antenna for BLE and two internal antennas for Wi-Fi, which were permanently attached and the antenna gain is 1.75dBi, fulfill the requirement of this section. Please refer to the EUT photos.

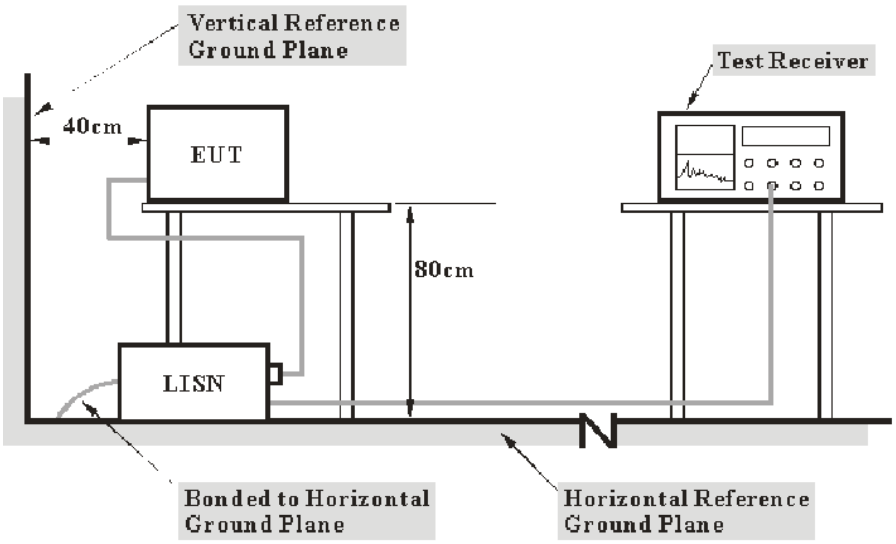
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

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 adapter was connected to the outlet of the LISN.

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

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

Corrected Factor & Margin Calculation

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

Correction Factor = LISN VDF + Cable Loss + 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:

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

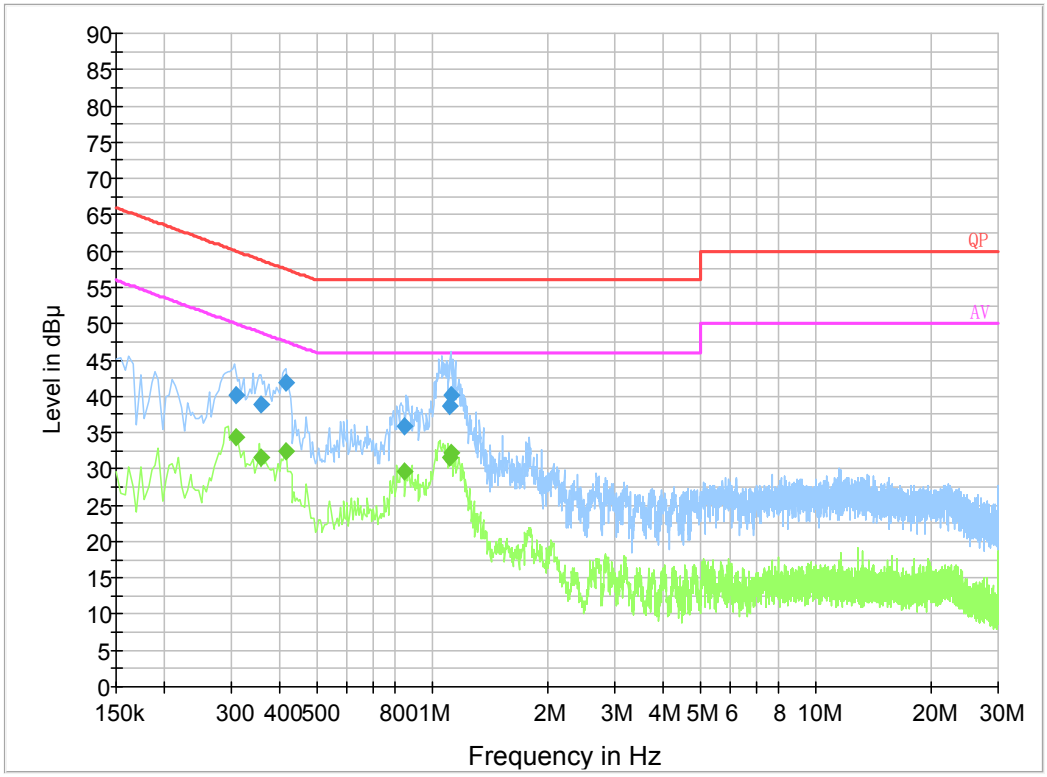
Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-12-17.

EUT operation mode: Transmitting (worst case at 802.11b mode, low channel

Powered by adapter 1 (Model: PSY1202000US):

AC 120V/60 Hz, Line



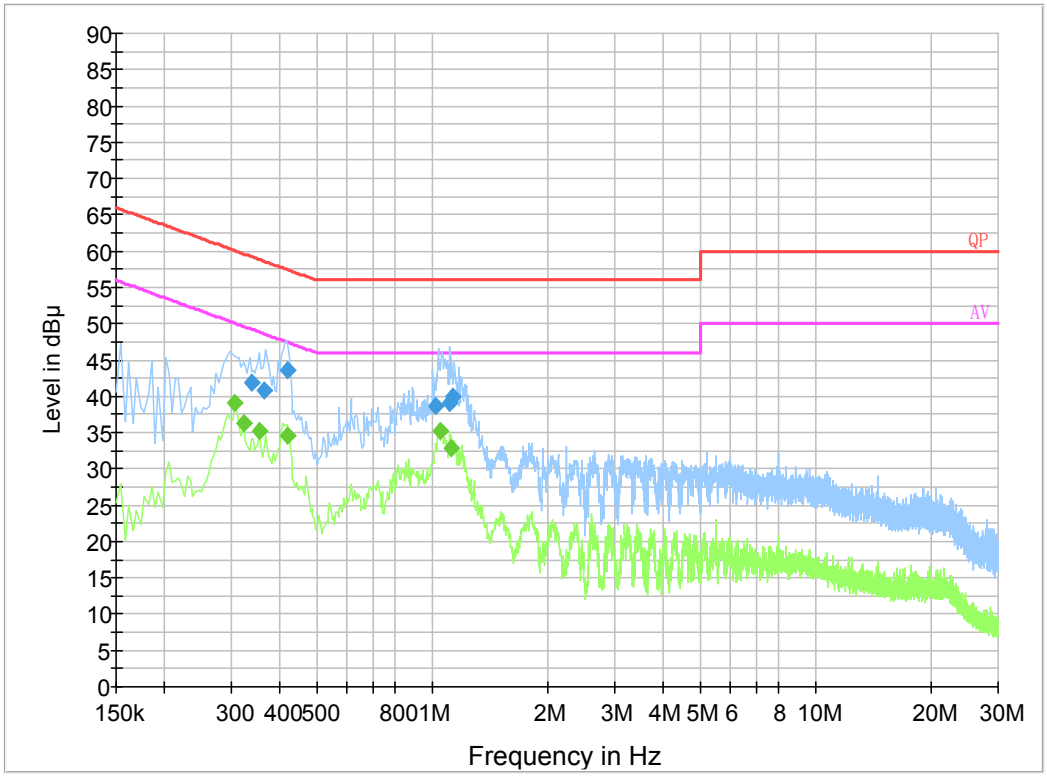
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.309410	40.1	9.000	L1	19.7	19.9	60.0
0.356630	39.0	9.000	L1	19.9	19.8	58.8
0.415730	41.8	9.000	L1	19.9	15.7	57.5
0.845130	35.9	9.000	L1	19.8	20.1	56.0
1.109230	38.6	9.000	L1	19.8	17.4	56.0
1.120930	40.1	9.000	L1	19.8	15.9	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.309410	34.4	9.000	L1	19.7	15.6	50.0
0.356630	31.6	9.000	L1	19.9	17.2	48.8
0.415730	32.4	9.000	L1	19.9	15.1	47.5
0.845130	29.7	9.000	L1	19.8	16.3	46.0
1.109230	31.7	9.000	L1	19.8	14.3	46.0
1.120930	32.3	9.000	L1	19.8	13.7	46.0

AC 120V/60 Hz, Neutral



Final Result 1

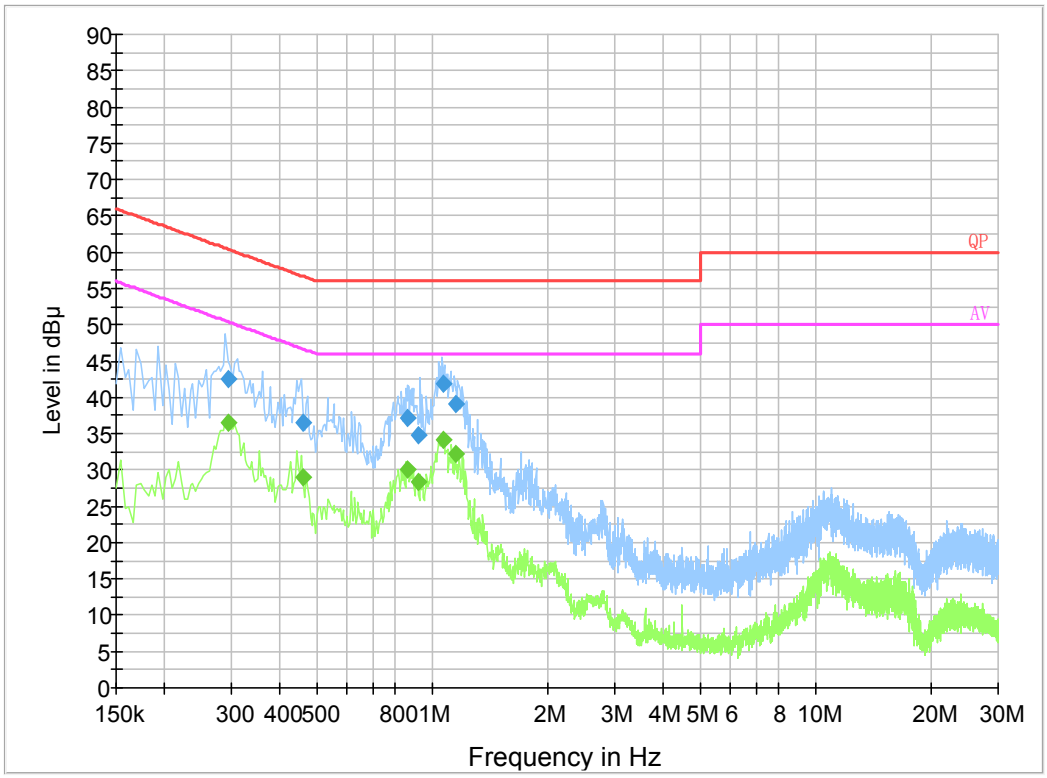
Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.339010	41.9	9.000	N	19.8	17.3	59.2
0.364450	40.9	9.000	N	19.9	17.7	58.6
0.419730	43.5	9.000	N	19.8	14.0	57.5
1.018910	38.6	9.000	N	19.8	17.4	56.0
1.109290	39.1	9.000	N	19.8	16.9	56.0
1.137110	39.9	9.000	N	19.8	16.1	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.306000	39.1	9.000	N	19.7	11.0	50.1
0.322000	36.2	9.000	N	19.8	13.5	49.7
0.354000	35.3	9.000	N	19.9	13.6	48.9
0.422000	34.7	9.000	N	19.8	12.7	47.4
1.050000	35.3	9.000	N	19.8	10.7	46.0
1.126000	32.8	9.000	N	19.8	13.2	46.0

Powered by adapter 2 (Model: AD-0241200200US-1):

AC 120V/60 Hz, Line



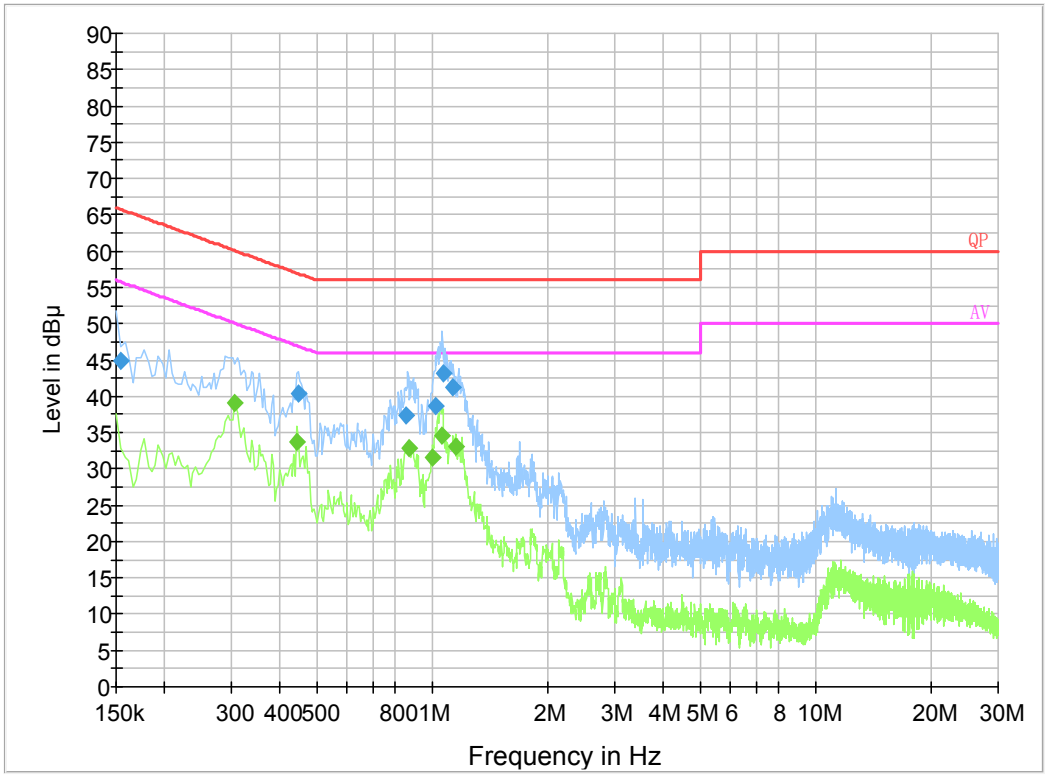
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.294500	42.5	9.000	L1	19.7	17.9	60.4
0.463130	36.4	9.000	L1	19.8	20.2	56.6
0.861010	37.2	9.000	L1	19.8	18.8	56.0
0.919990	34.8	9.000	L1	19.8	21.2	56.0
1.074010	41.8	9.000	L1	19.9	14.2	56.0
1.152810	39.1	9.000	L1	19.8	16.9	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.294500	36.4	9.000	L1	19.7	14.0	50.4
0.463130	29.0	9.000	L1	19.8	17.6	46.6
0.861010	30.0	9.000	L1	19.8	16.0	46.0
0.919990	28.4	9.000	L1	19.8	17.6	46.0
1.074010	34.2	9.000	L1	19.9	11.8	46.0
1.152810	32.2	9.000	L1	19.8	13.8	46.0

AC 120V/60 Hz, Neutral



Final Result 1

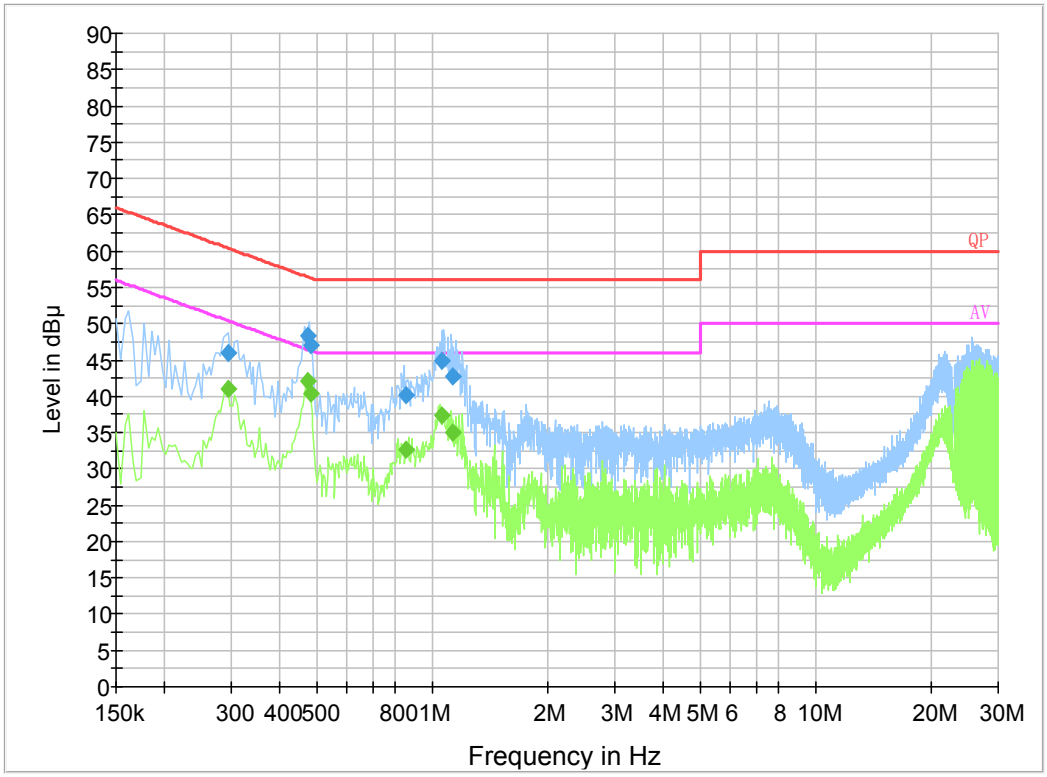
Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.154000	44.9	9.000	N	19.8	20.9	65.8
0.447250	40.4	9.000	N	19.8	16.5	56.9
0.857010	37.3	9.000	N	19.8	18.7	56.0
1.018850	38.7	9.000	N	19.8	17.3	56.0
1.074010	43.1	9.000	N	19.8	12.9	56.0
1.136930	41.3	9.000	N	19.8	14.7	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.306000	39.0	9.000	N	19.7	11.1	50.1
0.446000	33.7	9.000	N	19.8	13.2	46.9
0.870000	32.8	9.000	N	19.7	13.2	46.0
1.006000	31.5	9.000	N	19.8	14.5	46.0
1.058000	34.6	9.000	N	19.8	11.4	46.0
1.150000	33.0	9.000	N	19.8	13.0	46.0

Powered by POE:

AC 120V/60 Hz, Line



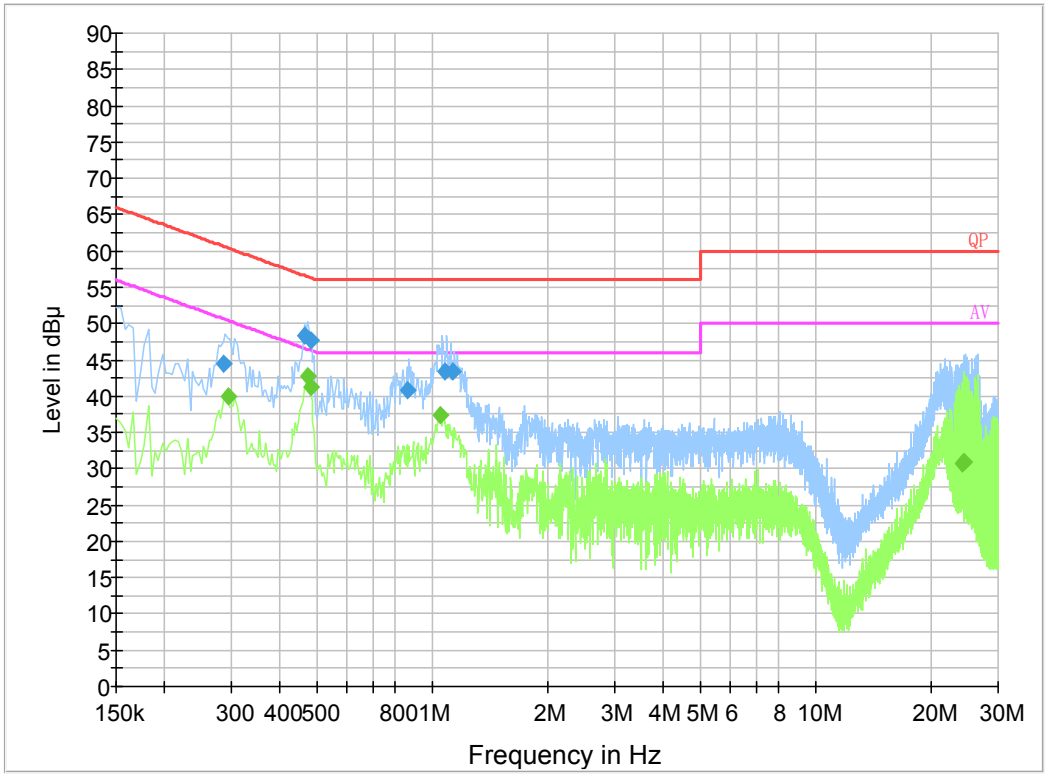
Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.293500	45.9	9.000	L1	19.7	14.5	60.4
0.474770	48.4	9.000	L1	19.8	8.0	56.4
0.482830	47.1	9.000	L1	19.8	9.2	56.3
0.857310	40.2	9.000	L1	19.8	15.8	56.0
1.065890	44.8	9.000	L1	19.9	11.2	56.0
1.129110	42.8	9.000	L1	19.8	13.2	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.293500	41.0	9.000	L1	19.7	9.4	50.4
0.474770	42.2	9.000	L1	19.8	4.2	46.4
0.482830	40.3	9.000	L1	19.8	6.0	46.3
0.857310	32.7	9.000	L1	19.8	13.3	46.0
1.065890	37.4	9.000	L1	19.9	8.6	46.0
1.129110	35.0	9.000	L1	19.8	11.0	46.0

AC 120V/60 Hz, Neutral



Final Result 1

Frequency (MHz)	QuasiPeak (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.285500	44.4	9.000	N	19.7	16.3	60.7
0.466890	48.4	9.000	N	19.8	8.2	56.6
0.482710	47.6	9.000	N	19.8	8.7	56.3
0.864950	40.7	9.000	N	19.8	15.3	56.0
1.085590	43.4	9.000	N	19.8	12.6	56.0
1.136810	43.3	9.000	N	19.8	12.7	56.0

Final Result 2

Frequency (MHz)	Average (dB µ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µ V)
0.294000	40.0	9.000	N	19.7	10.4	50.4
0.474000	42.8	9.000	N	19.8	3.6	46.4
0.482000	41.3	9.000	N	19.8	5.0	46.3
1.054000	37.4	9.000	N	19.8	8.6	46.0
24.182000	30.8	9.000	N	20.3	19.2	50.0
24.418000	30.9	9.000	N	20.3	19.1	50.0

Note:

1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

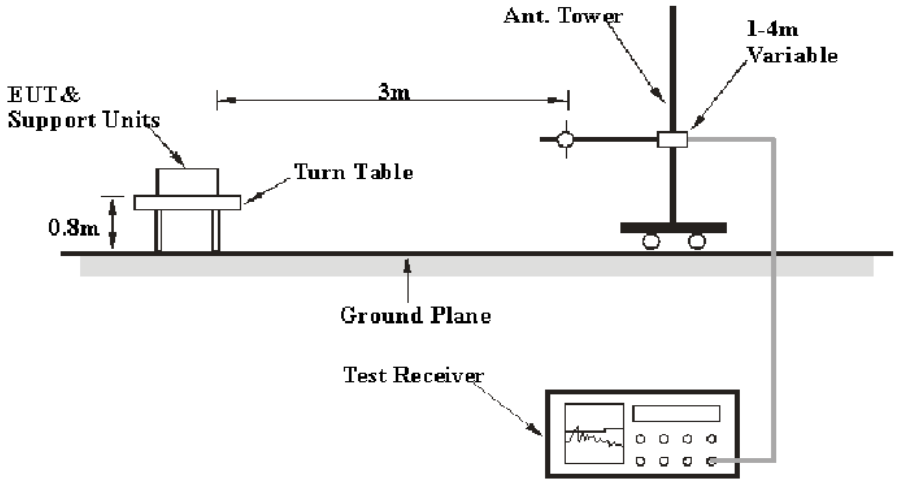
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

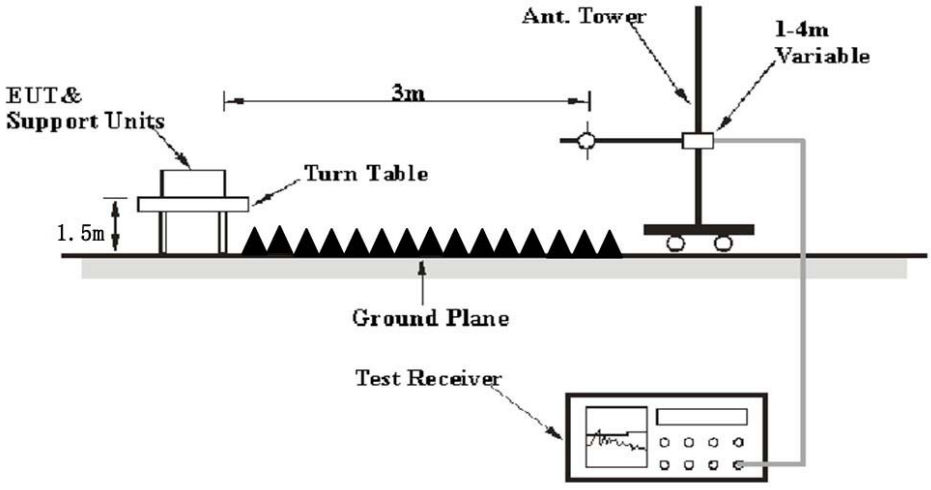
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurements
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection 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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

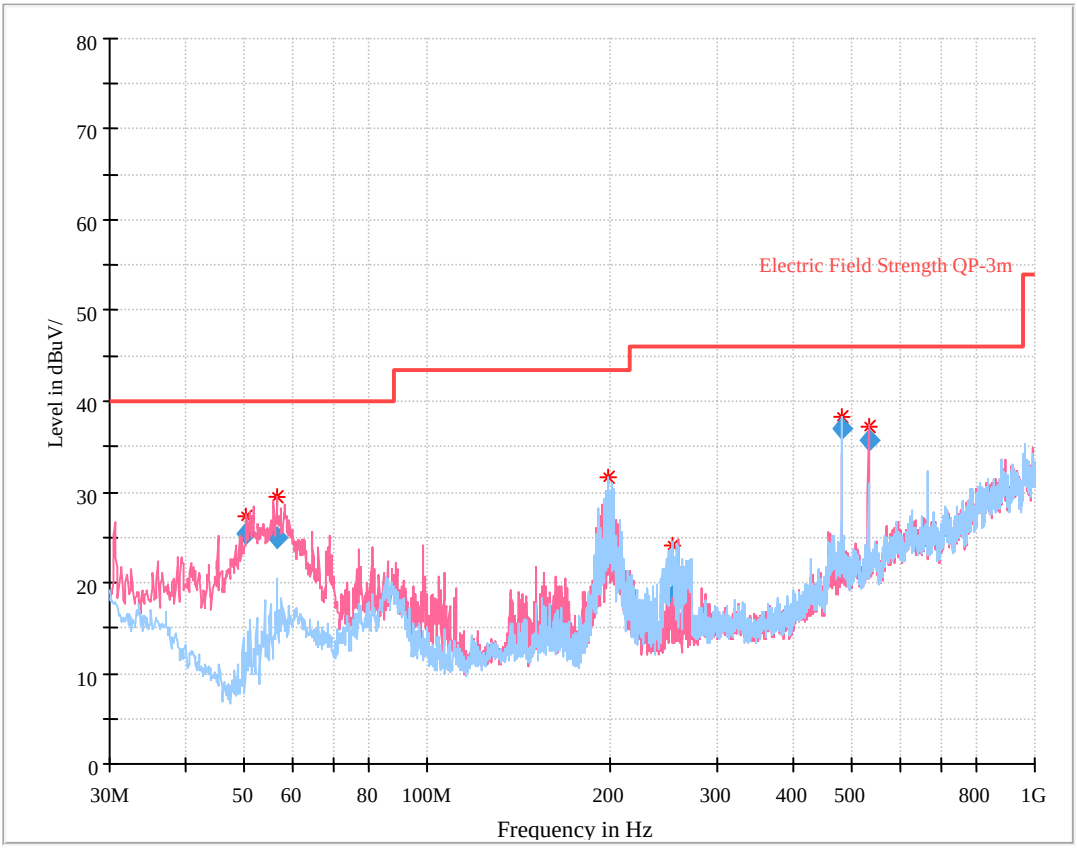
Temperature:	29 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Harris He on 2020-09-19 for below 1GHz and Leven Gan on 2020-08-28 and 2020-12-18 for above 1GHz.

Test mode: transmitting

Powered by adapter 1 (Model: PSY1202000US):

30 MHz~1 GHz: *(Worst case at 802.11b mode, low channel)*

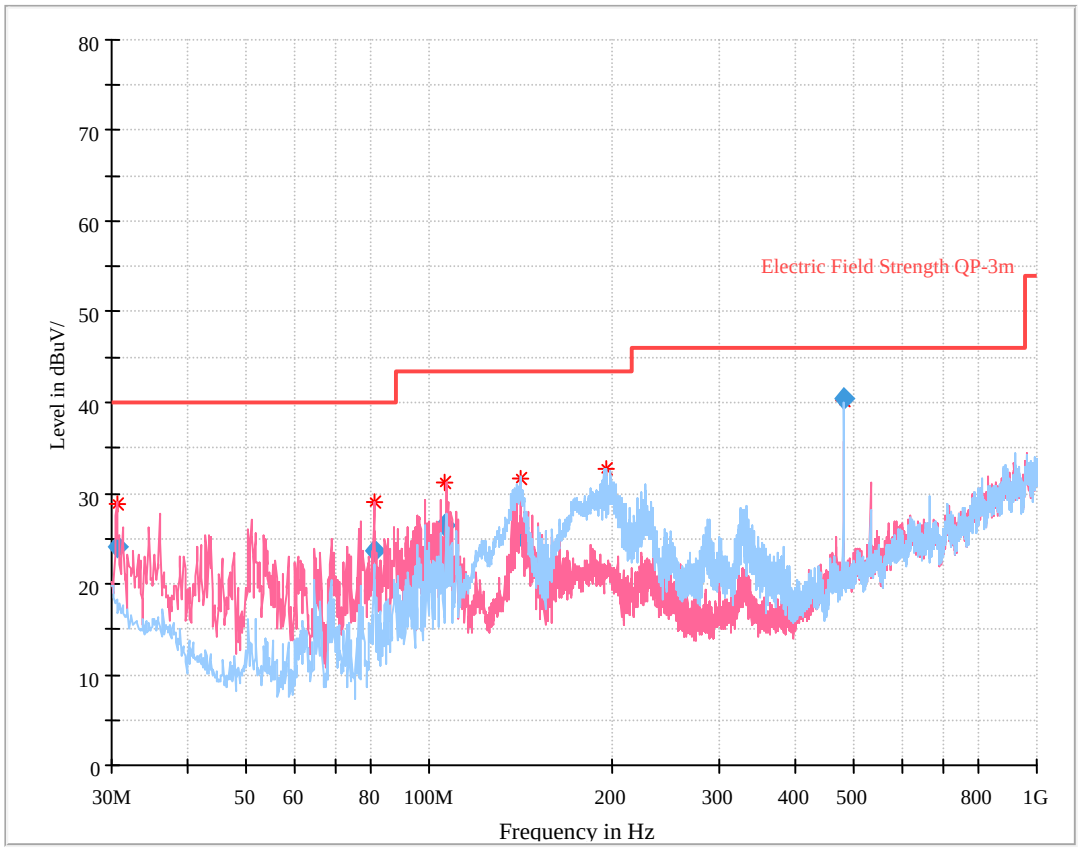


Final_Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
50.454750	25.31	40.00	14.69	112.0	V	330.0	-19.7
56.710875	24.85	40.00	15.15	109.0	V	223.0	-20.0
198.655250	24.78	43.50	18.72	173.0	H	323.0	-14.0
252.974250	18.52	46.00	27.48	115.0	H	44.0	-13.9
479.872500	36.94	46.00	9.06	203.0	H	33.0	-6.4
531.994000	35.65	46.00	10.35	104.0	V	29.0	-4.5

Powered by adapter 2 (Model: AD-0241200200US-1):

30 MHz~1 GHz: *(Worst case at 802.11b mode, low channel)*

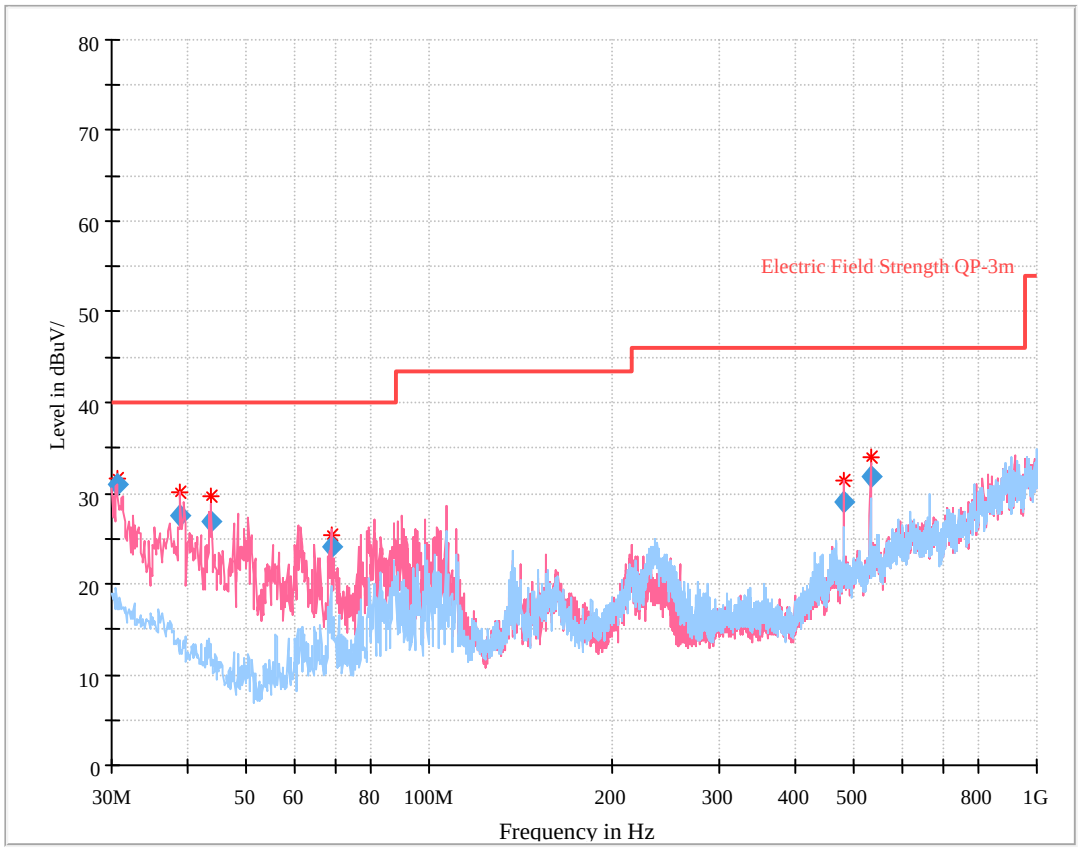


Final_Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.631125	24.02	40.00	15.98	135.0	V	157.0	-8.0
81.363000	23.60	40.00	16.40	398.0	V	152.0	-19.8
106.268125	26.52	43.50	16.98	122.0	V	244.0	-16.1
141.479125	25.45	43.50	18.05	206.0	H	126.0	-14.2
195.890500	29.69	43.50	13.81	109.0	H	110.0	-14.4
479.993375	40.34	46.00	5.66	177.0	H	190.0	-6.4

Powered by POE:

30 MHz~1 GHz: *(Worst case at 802.11b mode, low channel)*



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.582375	30.90	40.00	9.10	102.0	V	224.0	-8.0
38.946000	27.52	40.00	12.48	110.0	V	100.0	-13.1
43.815250	26.87	40.00	13.13	105.0	V	0.0	-16.5
69.009750	24.13	40.00	15.87	109.0	V	0.0	-20.6
480.070500	29.06	46.00	16.94	231.0	V	109.0	-6.4
531.982500	31.88	46.00	14.12	114.0	V	132.0	-4.5

1 GHz-25 GHz (LE 1M):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2384.63	28.89	PK	112	1.3	H	31.87	60.76	74	13.24
2384.63	14.98	Ave.	112	1.3	H	31.87	46.85	54	7.15
2486.36	28.51	PK	27	1.7	H	32.13	60.64	74	13.36
2486.36	14.83	Ave.	27	1.7	H	32.13	46.96	54	7.04
4804.00	46.83	PK	306	1.8	H	5.40	52.23	74	21.77
4804.00	37.12	Ave.	306	1.8	H	5.40	42.52	54	11.48
Middle Channel (2440 MHz)									
4880.00	45.29	PK	79	2.1	H	6.43	51.72	74	22.28
4880.00	35.11	Ave.	79	2.1	H	6.43	41.54	54	12.46
High Channel (2480 MHz)									
2388.16	28.36	PK	93	1.9	H	31.87	60.23	74	13.77
2388.16	14.23	Ave.	93	1.9	H	31.87	46.10	54	7.90
2484.36	29.66	PK	328	2.1	H	32.13	61.79	74	12.21
2484.36	15.12	Ave.	328	2.1	H	32.13	47.25	54	6.75
4960.00	45.51	PK	58	1.9	H	6.95	52.46	74	21.54
4960.00	35.93	Ave.	58	1.9	H	6.95	42.88	54	11.12

1 GHz-25 GHz (LE 2M):

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2384.63	28.99	PK	54	1.3	H	31.87	60.86	74	13.14
2384.63	14.86	Ave.	54	1.3	H	31.87	46.73	54	7.27
2487.26	28.61	PK	280	1.6	H	32.13	60.74	74	13.26
2487.26	14.36	Ave.	280	1.6	H	32.13	46.49	54	7.51
4804.00	46.29	PK	339	1.2	H	5.40	51.69	74	22.31
4804.00	36.51	Ave.	339	1.2	H	5.40	41.91	54	12.09
Middle Channel (2440 MHz)									
4880.00	45.86	PK	104	2.2	H	6.43	52.29	74	21.71
4880.00	35.49	Ave.	104	2.2	H	6.43	41.92	54	12.08
High Channel (2480 MHz)									
2373.46	28.68	PK	357	2.4	H	31.87	60.55	74	13.45
2373.46	14.56	Ave.	357	2.4	H	31.87	46.43	54	7.57
2483.55	30.21	PK	252	1.5	H	32.13	62.34	74	11.66
2483.55	15.18	Ave.	252	1.5	H	32.13	47.31	54	6.69
4960.00	45.26	PK	278	1.2	H	6.95	52.21	74	21.79
4960.00	35.49	Ave.	278	1.2	H	6.95	42.44	54	11.56

1 GHz-25 GHz (Wi-Fi):

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.61	29.12	PK	106	1.2	H	31.87	60.99	74	13.01
2389.61	14.83	Ave.	106	1.2	H	31.87	46.70	54	7.30
2484.33	28.69	PK	178	1.3	H	32.13	60.82	74	13.18
2484.33	14.51	Ave.	178	1.3	H	32.13	46.64	54	7.36
4824.00	44.63	PK	215	2.1	H	6.28	50.91	74	23.09
4824.00	33.10	Ave.	215	2.1	H	6.28	39.38	54	14.62
Middle Channel (2437 MHz)									
4874.00	45.21	PK	48	1.1	H	6.76	51.97	74	22.03
4874.00	34.13	Ave.	48	1.1	H	6.76	40.89	54	13.11
High Channel (2462 MHz)									
2383.16	28.59	PK	1	1.9	H	31.87	60.46	74	13.54
2383.16	14.91	Ave.	1	1.9	H	31.87	46.78	54	7.22
2483.69	28.91	PK	353	2.4	H	32.13	61.04	74	12.96
2483.69	15.33	Ave.	353	2.4	H	32.13	47.46	54	6.54
4924.00	45.63	PK	317	1.6	H	6.76	52.39	74	21.61
4924.00	35.27	Ave.	317	1.6	H	6.76	42.03	54	11.97

802.11g Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2359.69	28.91	PK	104	2.0	H	31.77	60.68	74	13.32
2359.69	14.49	Ave.	104	2.0	H	31.77	46.26	54	7.74
2487.16	28.73	PK	99	1.4	H	32.13	60.86	74	13.14
2487.16	14.81	Ave.	99	1.4	H	32.13	46.94	54	7.06
4824.00	43.89	PK	31	2.1	H	6.28	50.17	74	23.83
4824.00	28.87	Ave.	31	2.1	H	6.28	35.15	54	18.85
Middle Channel (2437 MHz)									
4874.00	43.99	PK	192	1.6	H	6.76	50.75	74	23.25
4874.00	28.82	Ave.	192	1.6	H	6.76	35.58	54	18.42
High Channel (2462 MHz)									
2376.39	29.01	PK	302	1.3	H	31.87	60.88	74	13.12
2376.39	14.88	Ave.	302	1.3	H	31.87	46.75	54	7.25
2485.16	28.73	PK	31	2.2	H	32.13	60.86	74	13.14
2485.16	14.95	Ave.	31	2.2	H	32.13	47.08	54	6.92
4924.00	43.86	PK	91	2.0	H	6.76	50.62	74	23.38
4924.00	28.79	Ave.	91	2.0	H	6.76	35.55	54	18.45

802.11n-HT20 Mode:

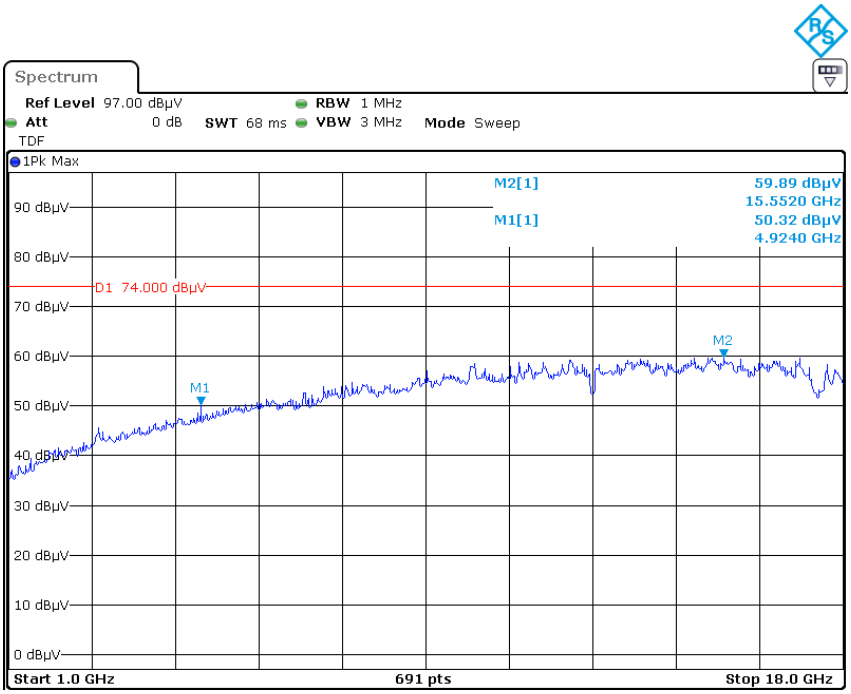
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2386.19	28.90	PK	34	1.8	H	31.87	60.77	74	13.23
2386.19	14.91	Ave.	34	1.8	H	31.87	46.78	54	7.22
2486.33	28.81	PK	67	1.4	H	32.13	60.94	74	13.06
2486.33	14.78	Ave.	67	1.4	H	32.13	46.91	54	7.09
4824.00	44.13	PK	268	2.3	H	6.28	50.41	74	23.59
4824.00	29.03	Ave.	268	2.3	H	6.28	35.31	54	18.69
Middle Channel (2437 MHz)									
4874.00	44.19	PK	231	2.3	H	6.76	50.95	74	23.05
4874.00	29.23	Ave.	231	2.3	H	6.76	35.99	54	18.01
High Channel (2462 MHz)									
2373.59	28.69	PK	78	2.5	H	31.87	60.56	74	13.44
2373.59	14.83	Ave.	78	2.5	H	31.87	46.70	54	7.30
2483.91	29.12	PK	269	1.3	H	32.13	61.25	74	12.75
2483.91	15.01	Ave.	269	1.3	H	32.13	47.14	54	6.86
4924.00	44.03	PK	202	1.8	H	6.76	50.79	74	23.21
4924.00	28.99	Ave.	202	1.8	H	6.76	35.75	54	18.25

802.11n-HT40 Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2422 MHz)									
2380.29	29.21	PK	33	1.0	H	31.87	61.08	74	12.92
2380.29	15.03	Ave.	33	1.0	H	31.87	46.90	54	7.10
2489.33	28.45	PK	206	1.4	H	32.13	60.58	74	13.42
2489.33	14.87	Ave.	206	1.4	H	32.13	47.00	54	7.00
4844.00	44.36	PK	343	2.4	H	6.28	50.64	74	23.36
4844.00	29.11	Ave.	343	2.4	H	6.28	35.39	54	18.61
Middle Channel (2437 MHz)									
4874.00	43.98	PK	297	1.3	H	6.76	50.74	74	23.26
4874.00	28.87	Ave.	297	1.3	H	6.76	35.63	54	18.37
High Channel (2452 MHz)									
2386.49	28.93	PK	36	1.7	H	31.87	60.80	74	13.20
2386.49	14.86	Ave.	36	1.7	H	31.87	46.73	54	7.27
2485.46	28.49	PK	38	1.5	H	32.13	60.62	74	13.38
2485.46	14.56	Ave.	38	1.5	H	32.13	46.69	54	7.31
4904.00	43.86	PK	16	1.5	H	6.76	50.62	74	23.38
4904.00	28.93	Ave.	16	1.5	H	6.76	35.69	54	18.31

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

Pre-scan with 802.11b Mode, High channel
Horizontal



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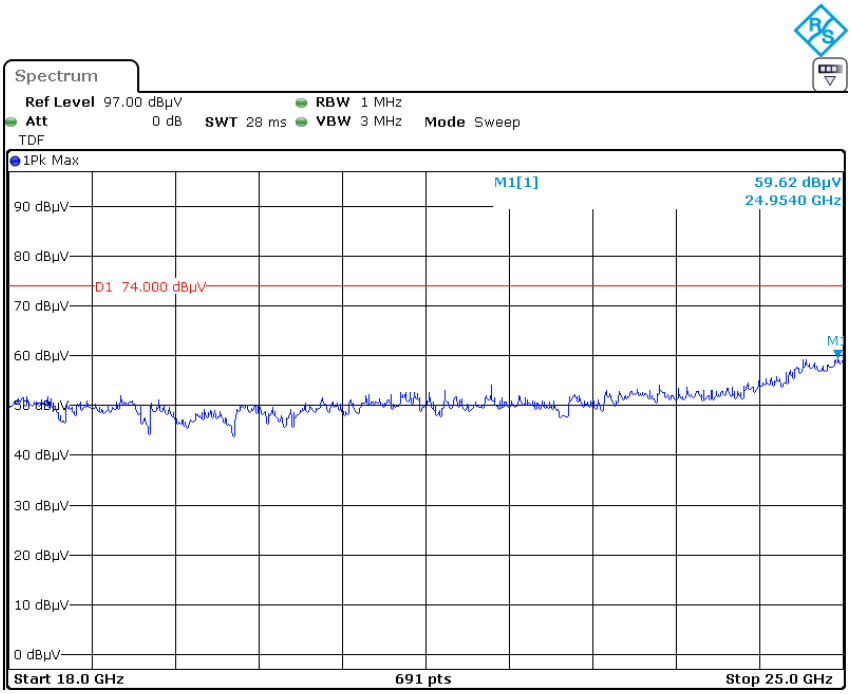

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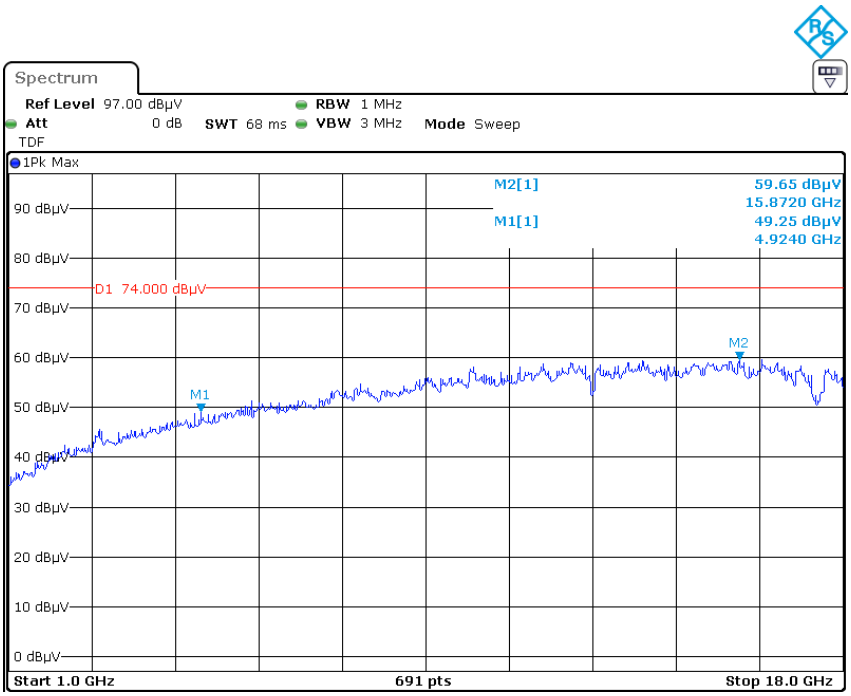
Vertical



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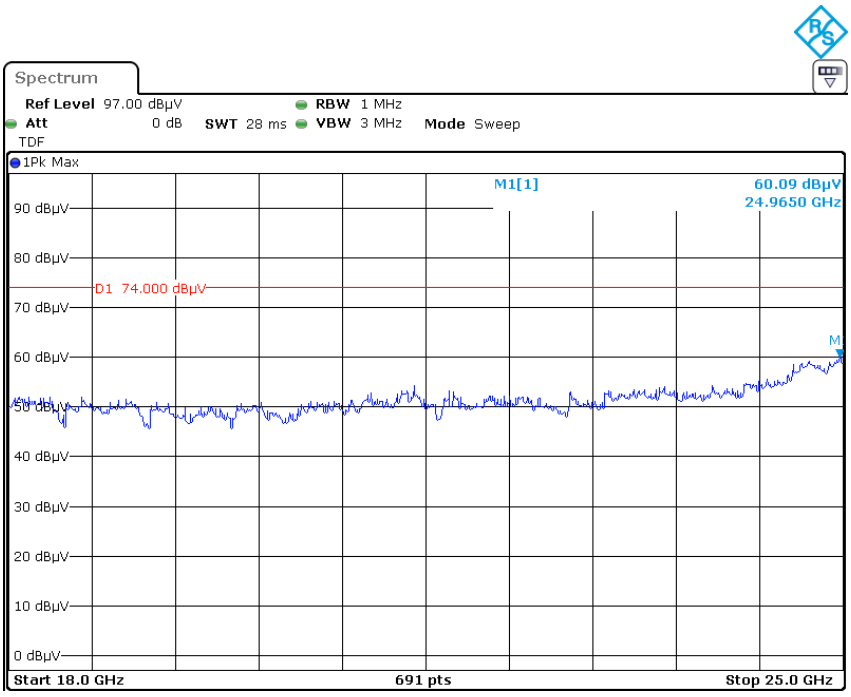

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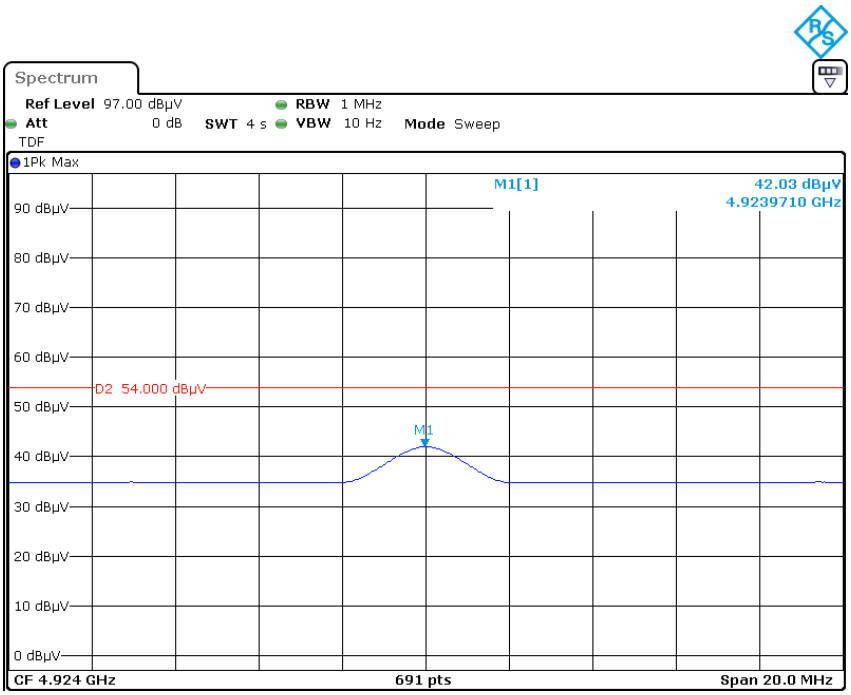
Pre-scan for Average
Horizontal



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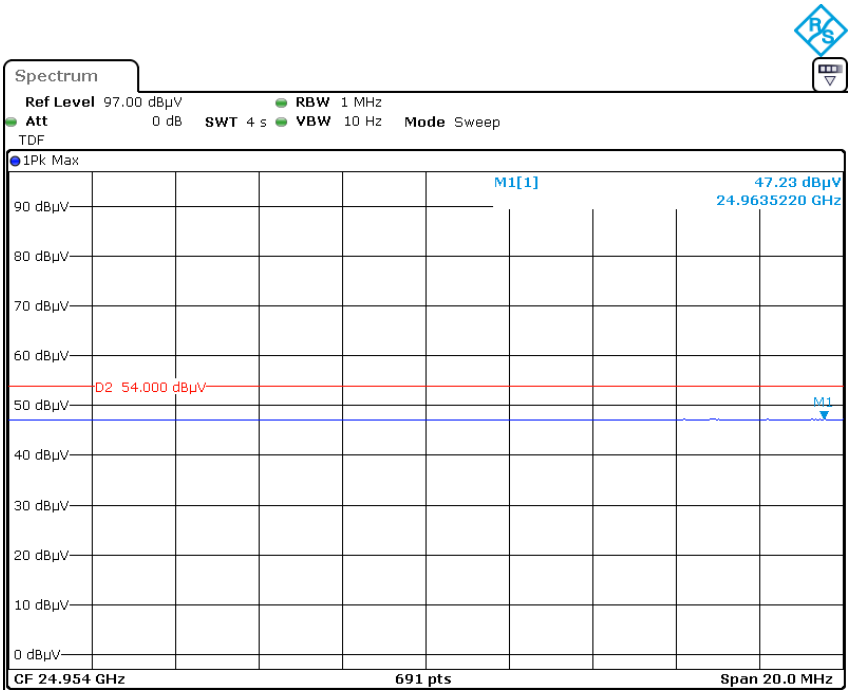

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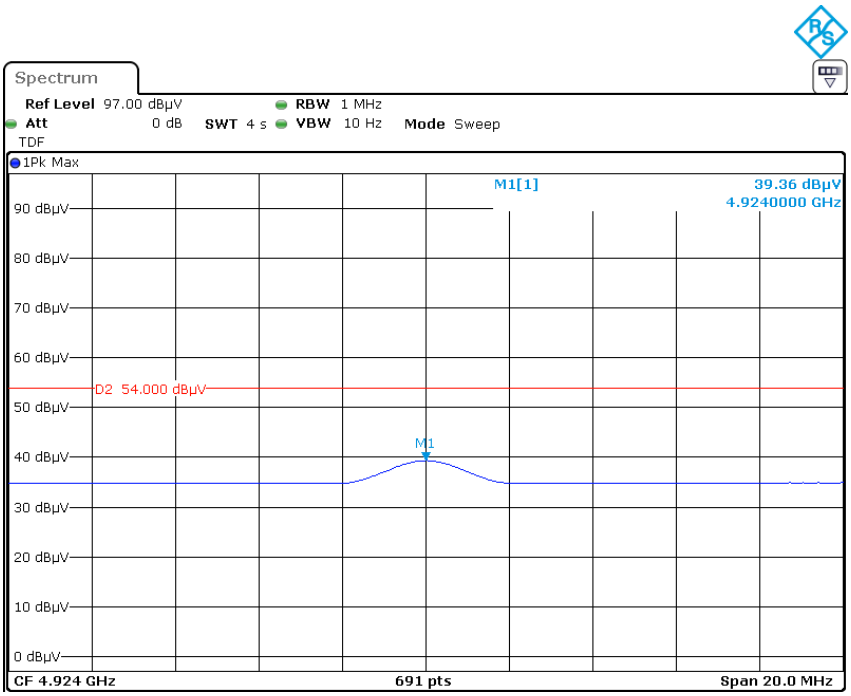
Vertical



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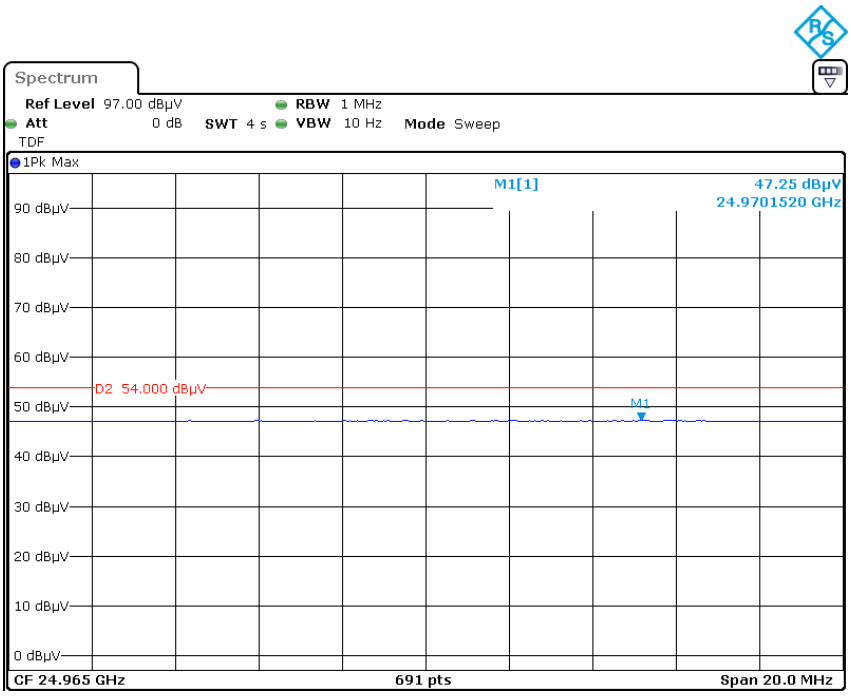

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******* END OF REPORT *******