TEST REPORT

Applicant Name :	LEDVANCE LLC
Address :	200 Ballardvale St. Wilmington MA 01887, USA
Report Number :	SZNS211201-61914E-RF
FCC ID:	2AKGT-75797
IC	22089-75797

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2; RSS-247, ISSUE 2, FEBRUARY 2017

Sample Description

Product Type:	LED LAMP
Model No.:	60A19FILWCLWIFI
Date Received:	2021/12/01
Date of Test:	2021/12/24~2021/12/31
Report Date:	2022/01/05

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Fan Yang
EMC Engineer

Approved By:

Candy Li
EMC Engineer

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)

HVIN	60A19FILWCLWIFI
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Peak Output Power	Wi-Fi: 802.11b: 18.42dBm, 802.11g: 17.57dBm, 802.11n-HT20:17.83dBm 802.11n-HT40:15.95dBm BLE: 2.41dBm
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification*	2.69 dBi (It is provided by the applicant)
Voltage Range	AC 120V/60Hz
Sample serial number	SZNS211201-61914E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliant Testing of Unlicensed Wireless Devices and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247, Issue 2, February 2017.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
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 Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. 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.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel List

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.

Channel List

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

"Wifi Test Tool v1.6.0 release"* software was used and power level as below:

Item	Mode	Data Rate (Mbps)	Power Level*
Wi-Fi	802.11 b	1Mbps	43
	802.11 g	6Mbps	45
	802.11 n20	MCS0	45
	802.11 n40	MCS0	45
BLE	BLE-1M	1Mbps	Default

Support Equipment List and Details

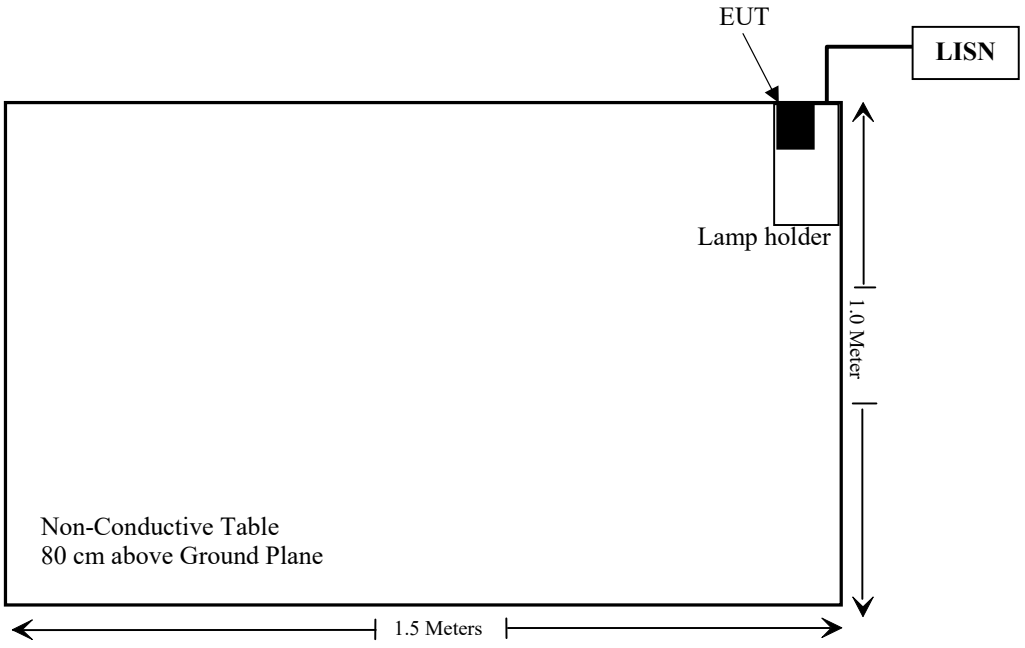
Manufacturer	Description	Model	Serial Number
Unknown	Lamp holder	Unknown	Unknown

External I/O Cable

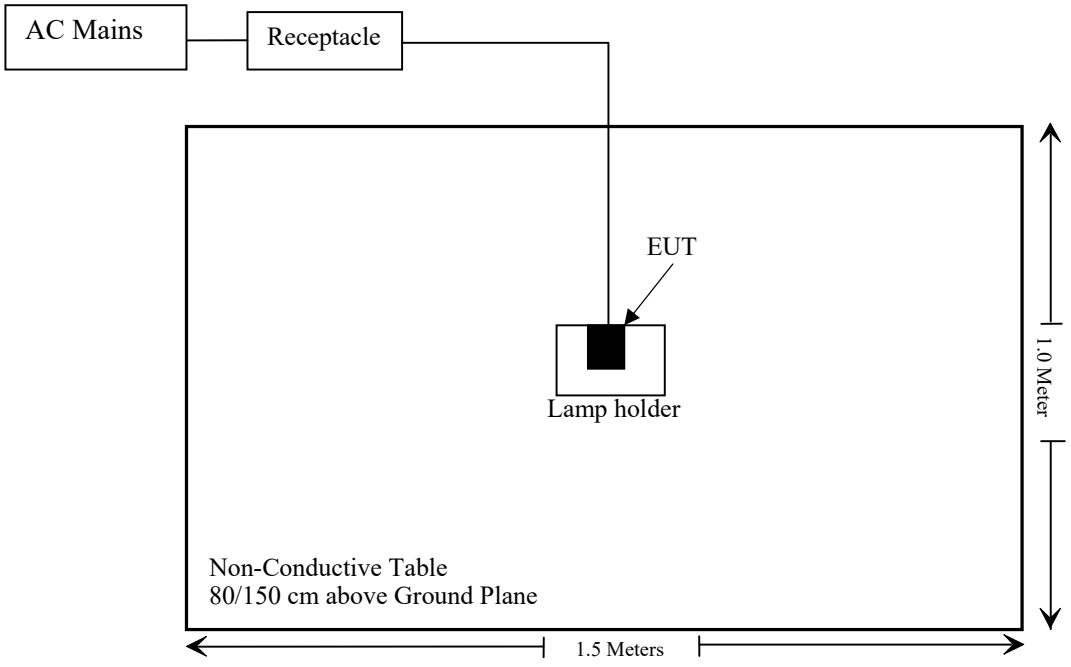
Cable Description	Length (m)	From	To
Un-shielding Un-Detachable AC Cable	2.0	Lamp holder	LISN/Socket

Block Diagram of Test Setup

For conducted emission:



For Radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result	Reference Data of Reference Report
§15.247 (i), §2.1091	RSS-102	Maximum Permissible Exposure(MPE) &Exemption Limits for Routine Evaluation – RF Exposure Evaluation	Compliant	/
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliant	/
§15.207 (a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant	/
§15.205, §15.209, §15.247(d)	RSS-GEN § 8.10 & RSS-247 § 5.5	Spurious Emissions	Compliant	/
§15.247 (a)(2)	RSS- Gen§6.7 RSS-247 § 5.2 (a)	99% Occupied Bandwidth & 6 dB Emission Bandwidth	Compliant*	Page 38-47& Page 60-63
§15.247(b)(3)	RSS-247 § 5.4(d)	Maximum Conducted Output Power	Compliant*	Page 48& Page 64
§15.247(d)	RSS-247 § 5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant*	Page 54-56& Page 67
§15.247(e)	RSS-247 § 5.2 (b)	Power Spectral Density	Compliant*	Page 49-53& Page 65-66

Compliant*: The RF module installed in EUT is electrical identical with the RF module used in LEDVANCE LLC's product LED LAMP(model number: 40A19FILWAWIFI, FCC ID: 2AKGT-75799, IC: 22089-75799), and the EUT had been tested and verified the conducted output power consistently with the reference device, test data please refer to report: SZNS211201-61912E-RF issued by Shenzhen Accurate Technology Co., Ltd., issused on 2022-01-05.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. 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

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

S = power density (in appropriate units, e.g. mW/cm^2)
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)

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)**			
2412-2462	2.69	1.86	19.0	79.43	20	**0.0294**	1
2402-2480	2.69	1.86	3.0	2.00	20	**0.0007**	1

Note: 1. The tune up conducted power was declared by the applicant
2. The BLE can't transmit at the same time with the 2.4G Wi-Fi.

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

Result: Compliant.

RSS-102 § 2.5.2 –EXEMPTION LIMITS FOR ROUTINE EVALUATION-RF EXPOSURE EVALUATION

Applicable Standard

According to RSS-102 § (2.5.2):

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:
• below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
• at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
• at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
• at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
• at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance). In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Result

Calculated Data:

For 2.4G Wi-Fi mode:
The max tune-up conducted output power is 19.0 dBm, antenna gain is 2.69dBi.
Time-averaged maximum e.i.r.p. of the device is 19.0dBm + 2.69dBi = 21.69dBm =0.148 W

The worst case is f = 2412 MHz:
The limit is $1.31 \times 10^{-2} f^{0.6834}$ W=2.68W

0.148W<2.68W

For BLE mode:
The max tune-up conducted output power is 3.0 dBm, antenna gain is 2.69dBi.
Time-averaged maximum e.i.r.p. of the device is 3.0dBm + 2.69dBi = 5.69dBm =0.004 W

The worst case is f = 2402 MHz:
The limit is $1.31 \times 10^{-2} f^{0.6834}$ W=2.68W

0.004W<2.68W

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

Result: Compliant.

§ 15.203 & RSS-Gen §6.8 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.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.
Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has an internal antenna arrangement which was permanently attached and the antenna gain is 2.69dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Type	Antenna Gain	Impedance	Frequency range
Monopole	2.69dBi	50Ω	2.4-2.5GHz

Result: Compliant.

§ 15.207 (a) & RSS-GEN §8.8 AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC § 15.207 (a) & RSS-GEN §8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 - AC Power Lines Conducted Emission Limits		
Frequency range (MHz)	Conducted limit (dBμV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56[1]	56 to 46[1]
0.5 – 5	56	46
5 – 30	60	50

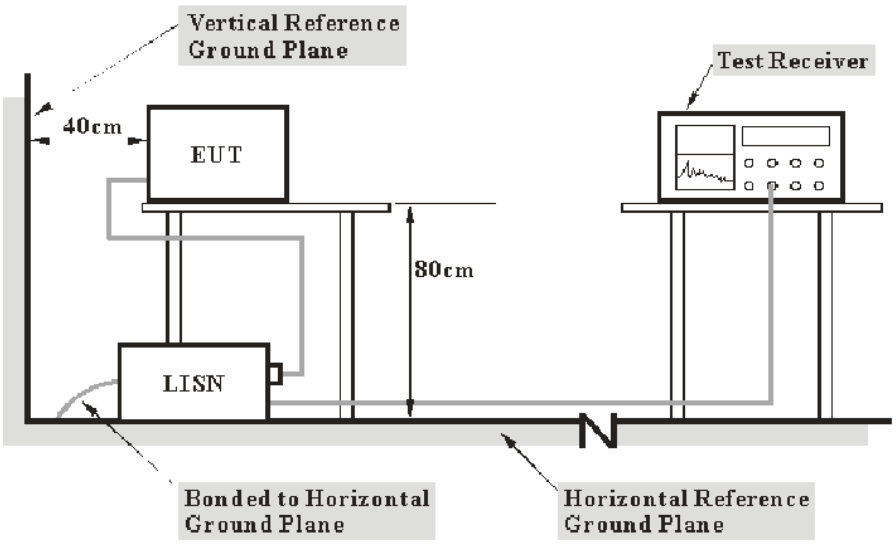
Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

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 & RSS-247/RSS-Gen limits.

The spacing between the peripherals was 10 cm.

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

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

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 Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Factor = LISN VDF + Cable Loss

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

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

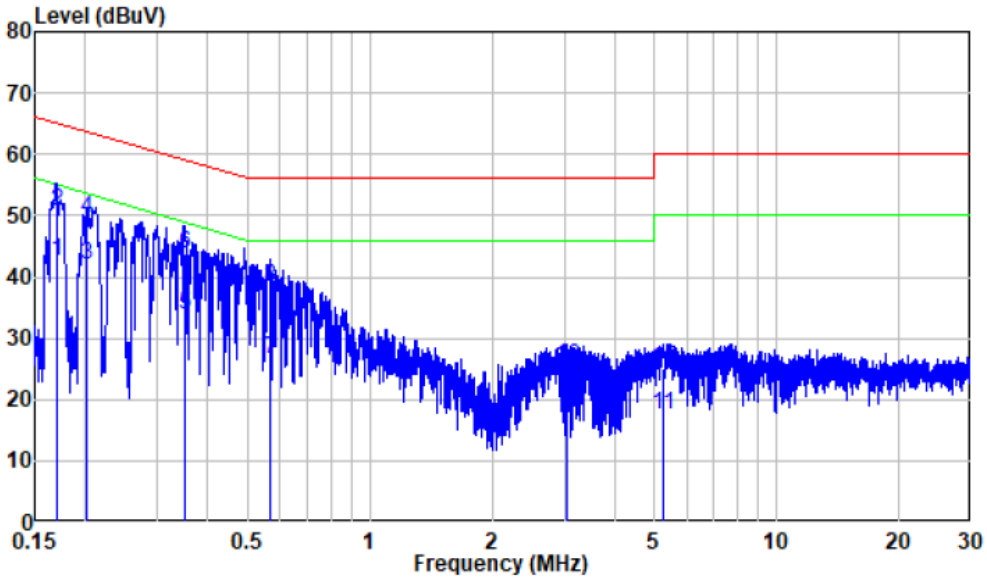
Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Duan on 2021-12-24.

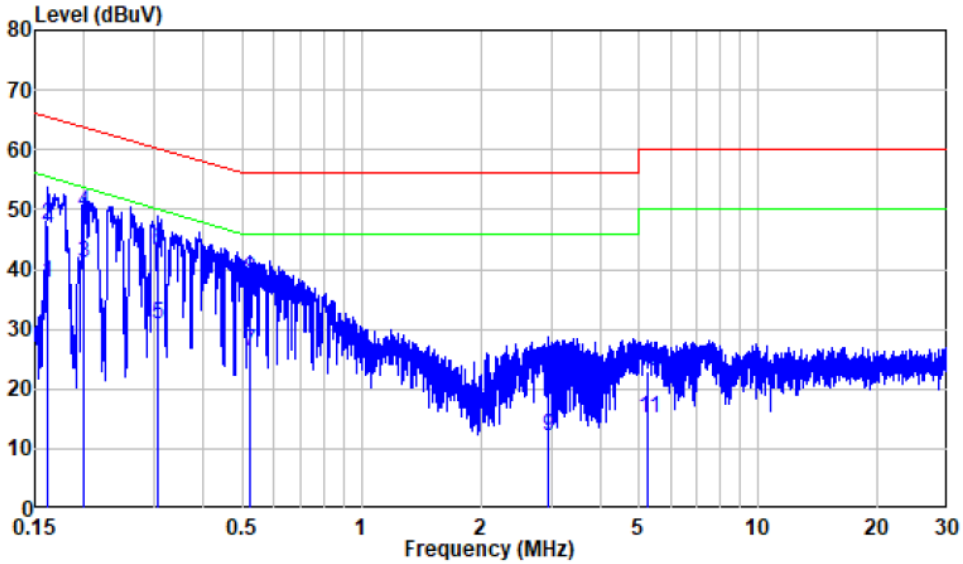
EUT operation mode: Transmitting (worst case is 802.11g mode, Low channel)

AC 120V/60 Hz, Line



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.169	9.86	32.75	42.61	54.99	-12.38	Average
2	0.169	9.86	40.82	50.68	64.99	-14.31	QP
3	0.202	9.80	32.10	41.90	53.52	-11.62	Average
4	0.202	9.80	39.57	49.37	63.52	-14.15	QP
5	0.349	9.80	23.90	33.70	48.98	-15.28	Average
6	0.349	9.80	33.94	43.74	58.98	-15.24	QP
7	0.568	9.81	16.81	26.62	46.00	-19.38	Average
8	0.568	9.81	28.44	38.25	56.00	-17.75	QP
9	3.045	9.93	8.61	18.54	46.00	-27.46	Average
10	3.045	9.93	15.31	25.24	56.00	-30.76	QP
11	5.249	10.00	7.41	17.41	50.00	-32.59	Average
12	5.249	10.00	15.14	25.14	60.00	-34.86	QP

AC 120V/60 Hz, Neutral



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.162	9.93	27.88	37.81	55.36	-17.55	Average
2	0.162	9.93	37.54	47.47	65.36	-17.89	QP
3	0.200	10.00	30.96	40.96	53.62	-12.66	Average
4	0.200	10.00	39.41	49.41	63.62	-14.21	QP
5	0.308	9.95	20.96	30.91	50.04	-19.13	Average
6	0.308	9.95	33.34	43.29	60.04	-16.75	QP
7	0.521	9.91	16.47	26.38	46.00	-19.62	Average
8	0.521	9.91	28.46	38.37	56.00	-17.63	QP
9	2.942	9.99	2.23	12.22	46.00	-33.78	Average
10	2.942	9.99	12.28	22.27	56.00	-33.73	QP
11	5.284	10.05	4.95	15.00	50.00	-35.00	Average
12	5.284	10.05	13.03	23.08	60.00	-36.92	QP

§15.205, §15.209, §15.247(d) & RSS-GEN § 8.10 & RSS-247 § 5.5 SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

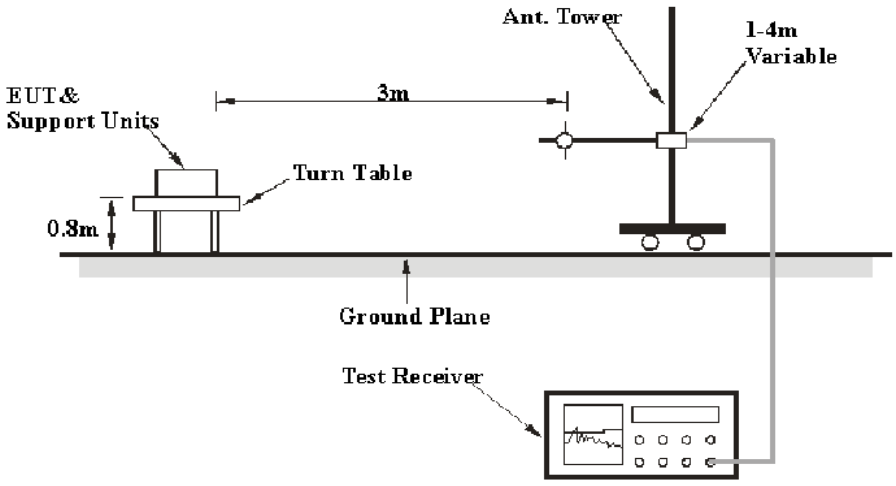
According to RSS-GEN § 8.10 & RSS-247 § 5.5

Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:(a) The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).(b) Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.(c) Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

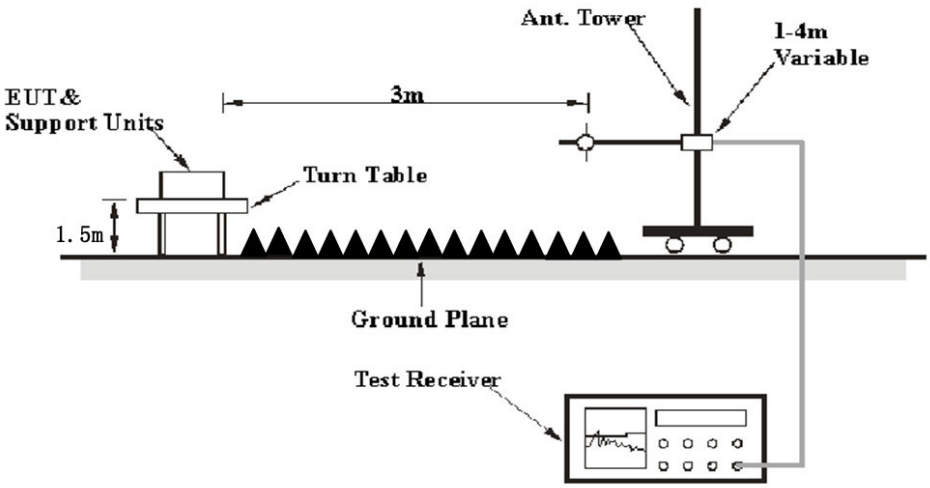
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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 & RSS-Gen. The specification used was the FCC 15.209, and FCC 15.247 & RSS-Gen limits.

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

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	Measurement
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.

Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.

Repeat above procedures until all measured frequencies were complete.

Corrected Amplitude & Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	64 %
ATM Pressure:	101.0 kPa

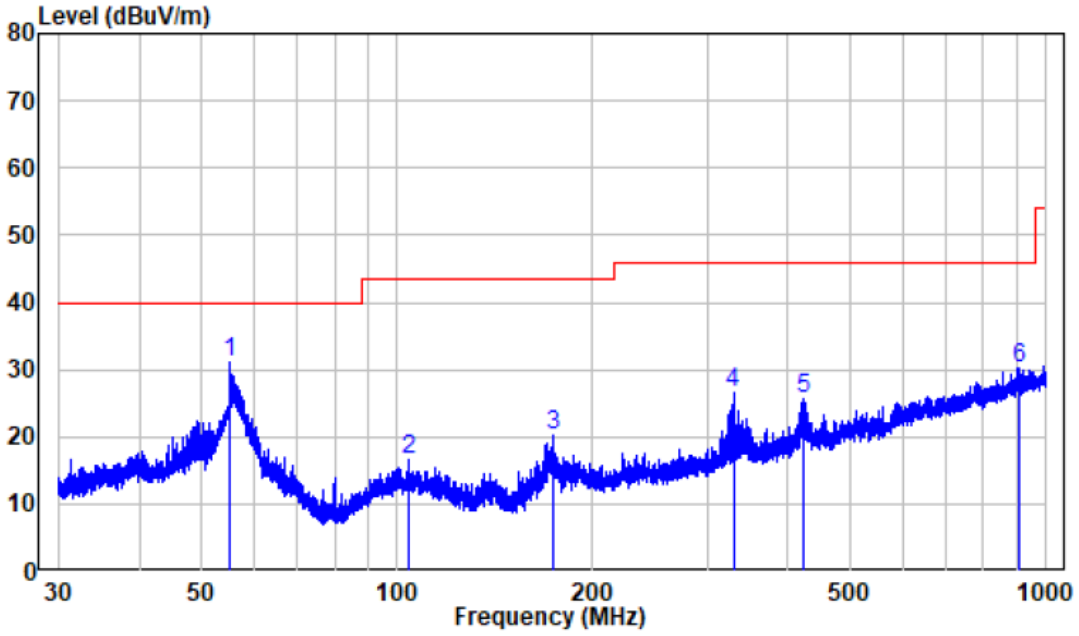
The testing was performed by Bin Deng on 2021-12-31 for below 1GHz and 2021-12-27 for above 1GHz.

EUT operation mode: Transmitting

(Pre-scan in the X, Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

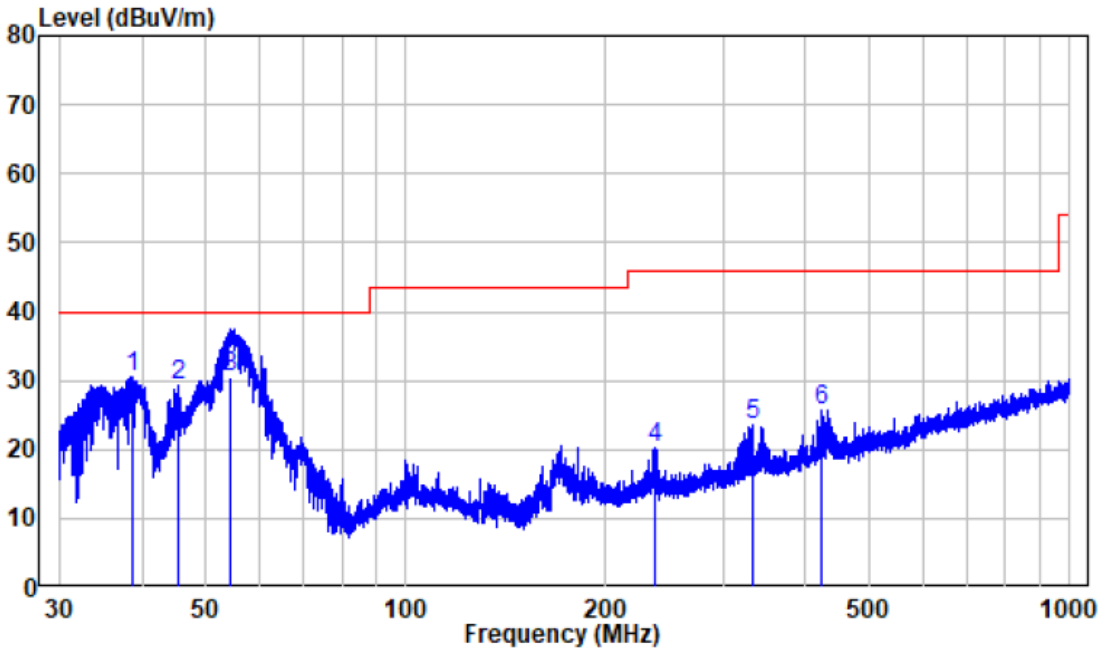
30 MHz~1 GHz: *(worst case is 802.11g mode, low channel)*

Horizontal



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	55.269	-10.26	41.25	30.99	40.00	-9.01	Peak
2	104.262	-11.77	28.50	16.73	43.50	-26.77	Peak
3	173.966	-13.18	33.45	20.27	43.50	-23.23	Peak
4	329.472	-8.01	34.47	26.46	46.00	-19.54	Peak
5	423.540	-5.94	31.56	25.62	46.00	-20.38	Peak
6	906.085	1.69	28.46	30.15	46.00	-15.85	Peak

Vertical



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	38.718	-10.65	41.21	30.56	40.00	-9.44	Peak
2	45.515	-9.97	39.14	29.17	40.00	-10.83	Peak
3	54.404	-10.32	40.89	30.57	40.00	-9.43	QP
4	237.060	-10.94	31.31	20.37	46.00	-25.63	Peak
5	332.810	-7.78	31.29	23.51	46.00	-22.49	Peak
6	422.428	-6.00	31.78	25.78	46.00	-20.22	Peak

1 GHz-25 GHz:

For Wi-Fi

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)				
802.11b Mode									
Low Channel (2412 MHz)									
2310	68.07	PK	106	2.4	H	-7.24	60.83	74	-13.17
2310	53.91	AV	106	2.4	H	-7.24	46.67	54	-7.33
2310	68.12	PK	118	2	V	-7.24	60.88	74	-13.12
2310	54.02	AV	118	2	V	-7.24	46.78	54	-7.22
2390	70.05	PK	231	2.2	H	-7.22	62.83	74	-11.17
2390	55.49	AV	231	2.2	H	-7.22	48.27	54	-5.73
2390	69.93	PK	140	1.4	V	-7.22	62.71	74	-11.29
2390	55.64	AV	140	1.4	V	-7.22	48.42	54	-5.58
4824	54.31	PK	234	1.6	H	-3.53	50.78	74	-23.22
4824	53.82	PK	196	1.5	V	-3.53	50.29	74	-23.71
Middle Channel (2437MHz)									
4874	54.28	PK	217	2.3	H	-3.41	50.87	74	-23.13
4874	54.65	PK	134	1.2	V	-3.41	51.24	74	-22.76
High Channel (2462 MHz)									
2483.5	69.58	PK	39	2.4	H	-7.2	62.38	74	-11.62
2483.5	56.09	AV	39	2.4	H	-7.2	48.89	54	-5.11
2483.5	69.44	PK	210	2.4	V	-7.2	62.24	74	-11.76
2483.5	55.99	AV	210	2.4	V	-7.2	48.79	54	-5.21
2500	68.60	PK	291	2.5	H	-7.18	61.42	74	-12.58
2500	55.86	AV	291	2.5	H	-7.18	48.68	54	-5.32
2500	69.17	PK	198	2.1	V	-7.18	61.99	74	-12.01
2500	55.95	AV	198	2.1	V	-7.18	48.77	54	-5.23
4924	54.75	PK	111	2.4	H	-3.16	51.59	74	-22.41
4924	54.82	PK	244	2.5	V	-3.16	51.66	74	-22.34

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)				
802.11g Mode									
Low Channel (2412 MHz)									
2310	68.00	PK	151	1.8	H	-7.24	60.76	74	-13.24
2310	54.42	AV	151	1.8	H	-7.24	47.18	54	-6.82
2310	68.57	PK	144	1.4	V	-7.24	61.33	74	-12.67
2310	54.47	AV	144	1.4	V	-7.24	47.23	54	-6.77
2390	69.64	PK	173	2.2	H	-7.22	62.42	74	-11.58
2390	55.68	AV	173	2.2	H	-7.22	48.46	54	-5.54
2390	69.71	PK	69	2.2	V	-7.22	62.49	74	-11.51
2390	55.84	AV	69	2.2	V	-7.22	48.62	54	-5.38
4824	53.82	PK	72	1.9	H	-3.53	50.29	74	-23.71
4824	53.91	PK	250	1.3	V	-3.53	50.38	74	-23.62
Middle Channel (2437 MHz)									
4874	54.4	PK	276	2	H	-3.41	50.99	74	-23.01
4874	54.66	PK	57	1.2	V	-3.41	51.25	74	-22.75
High Channel (2462 MHz)									
2483.5	69.59	PK	10	2.1	H	-7.2	62.39	74	-11.61
2483.5	56.01	AV	10	2.1	H	-7.2	48.81	54	-5.19
2483.5	69.82	PK	288	1.1	V	-7.2	62.62	74	-11.38
2483.5	55.85	AV	288	1.1	V	-7.2	48.65	54	-5.35
2500	68.39	PK	271	1.1	H	-7.18	61.21	74	-12.79
2500	55.92	AV	271	1.1	H	-7.18	48.74	54	-5.26
2500	68.31	PK	317	2.3	V	-7.18	61.13	74	-12.87
2500	56.01	AV	317	2.3	V	-7.18	48.83	54	-5.17
4924	54.00	PK	311	1.7	H	-3.16	50.84	74	-23.16
4924	54.21	PK	338	1.3	V	-3.16	51.05	74	-22.95

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)				
802.11n20 Mode									
Low Channel (2412 MHz)									
2310	68.13	PK	74	2.5	H	-7.24	60.89	74	-13.11
2310	54.63	AV	74	2.5	H	-7.24	47.39	54	-6.61
2310	67.94	PK	179	1.7	V	-7.24	60.70	74	-13.30
2310	54.57	AV	179	1.7	V	-7.24	47.33	54	-6.67
2390	70.01	PK	279	1.3	H	-7.22	62.79	74	-11.21
2390	55.82	AV	279	1.3	H	-7.22	48.60	54	-5.40
2390	69.64	PK	57	1.6	V	-7.22	62.42	74	-11.58
2390	55.94	AV	57	1.6	V	-7.22	48.72	54	-5.28
4824	54.00	PK	232	1.5	H	-3.53	50.47	74	-23.53
4824	53.94	PK	332	1.3	V	-3.53	50.41	74	-23.59
Middle Channel (2437MHz)									
4874	54.67	PK	279	1.8	H	-3.41	51.26	74	-22.74
4874	54.37	PK	14	1.9	V	-3.41	50.96	74	-23.04
High Channel (2462 MHz)									
2483.5	69.70	PK	25	2.1	H	-7.2	62.5	74	-11.5
2483.5	56.14	AV	25	2.1	H	-7.2	48.94	54	-5.06
2483.5	69.39	PK	314	2.5	V	-7.2	62.19	74	-11.81
2483.5	55.99	AV	314	2.5	V	-7.2	48.79	54	-5.21
2500	68.90	PK	296	1.9	H	-7.18	61.72	74	-12.28
2500	56.00	AV	296	1.9	H	-7.18	48.82	54	-5.18
2500	68.54	PK	166	1.2	V	-7.18	61.36	74	-12.64
2500	56.09	AV	166	1.2	V	-7.18	48.91	54	-5.09
4924	54.31	PK	211	2	H	-3.16	51.15	74	-22.85
4924	54.03	PK	290	1.9	V	-3.16	50.87	74	-23.13

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)				
802.11n40 Mode									
Low Channel (2422 MHz)									
2310	67.79	PK	99	1.8	H	-7.24	60.55	74	-13.45
2310	55.55	AV	99	1.8	H	-7.24	48.31	54	-5.69
2310	68.36	PK	310	2.2	V	-7.24	61.12	74	-12.88
2310	55.51	AV	310	2.2	V	-7.24	48.27	54	-5.73
2390	69.86	PK	150	1.8	H	-7.22	62.64	74	-11.36
2390	56.71	AV	150	1.8	H	-7.22	49.49	54	-4.51
2390	69.13	PK	63	1.2	V	-7.22	61.91	74	-12.09
2390	56.64	AV	63	1.2	V	-7.22	49.42	54	-4.58
4844	54.01	PK	24	2.1	H	-3.54	50.47	74	-23.53
4844	54.00	PK	73	1.4	V	-3.54	50.46	74	-23.54
Middle Channel (2437MHz)									
4874	54.23	PK	353	1.8	H	-3.41	50.82	74	-23.18
4874	54.55	PK	263	1.3	V	-3.41	51.14	74	-22.86
High Channel (2452 MHz)									
2483.5	69.46	PK	65	1.7	H	-7.2	62.26	74	-11.74
2483.5	57.01	AV	65	1.7	H	-7.2	49.81	54	-4.19
2483.5	69.52	PK	346	2	V	-7.2	62.32	74	-11.68
2483.5	57.03	AV	346	2	V	-7.2	49.83	54	-4.17
2500	68.86	PK	339	1.3	H	-7.18	61.68	74	-12.32
2500	57.18	AV	339	1.3	H	-7.18	50	54	-4
2500	69.03	PK	56	1.1	V	-7.18	61.85	74	-12.15
2500	57.13	AV	56	1.1	V	-7.18	49.95	54	-4.05
4904	54.07	PK	96	2	H	-3.26	50.81	74	-23.19
4904	54.38	PK	122	1.8	V	-3.26	51.12	74	-22.88

BLE:

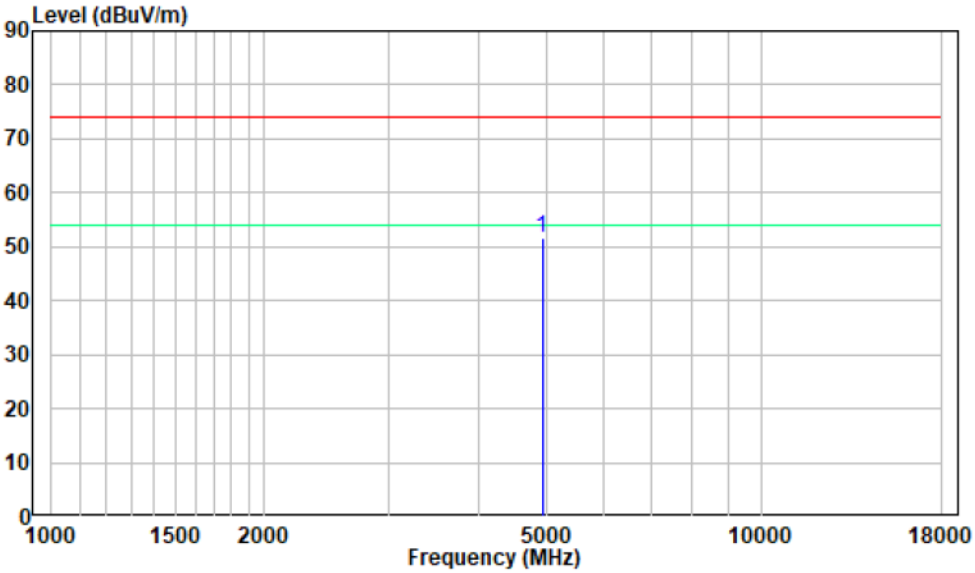
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2310	68.46	PK	90	1.7	H	-7.24	61.22	74	-12.78
2310	53.66	AV	90	1.7	H	-7.24	46.42	54	-7.58
2310	67.89	PK	109	1.9	V	-7.24	60.65	74	-13.35
2310	53.44	AV	109	1.9	V	-7.24	46.20	54	-7.80
2390	69.21	PK	269	2.2	H	-7.22	61.99	74	-12.01
2390	54.35	AV	269	2.2	H	-7.22	47.13	54	-6.87
2390	69.16	PK	102	1.3	V	-7.22	61.94	74	-12.06
2390	54.23	AV	102	1.3	V	-7.22	47.01	54	-6.99
4804	53.88	PK	98	2	H	-3.51	50.37	74	-23.63
4804	54.07	PK	52	1.5	V	-3.51	50.56	74	-23.44
Middle Channel (2440 MHz)									
4880	54.64	PK	254	2.4	H	-3.38	51.26	74	-22.74
4880	54.41	PK	230	1.3	V	-3.38	51.03	74	-22.97
High Channel (2480 MHz)									
2483.5	70.17	PK	201	2.4	H	-7.2	62.97	74	-11.03
2483.5	54.86	AV	201	2.4	H	-7.2	47.66	54	-6.34
2483.5	69.77	PK	121	2.4	V	-7.2	62.57	74	-11.43
2483.5	54.92	AV	121	2.4	V	-7.2	47.72	54	-6.28
2500	68.48	PK	124	2.4	H	-7.18	61.3	74	-12.7
2500	55.59	AV	124	2.4	H	-7.18	48.41	54	-5.59
2500	68.72	PK	115	1.9	V	-7.18	61.54	74	-12.46
2500	55.50	AV	115	1.9	V	-7.18	48.32	54	-5.68
4960	53.85	PK	137	1.9	H	-3.01	50.84	74	-23.16
4960	54.19	PK	32	1.9	V	-3.01	51.18	74	-22.82

Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level (Corrected Amplitude) = Factor + Reading
Margin = Absolute Level (Corrected Amplitude) – Limit
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was 20dB below to the limit of peak, which can be compliant to the average limit, so just peak value was recorded.

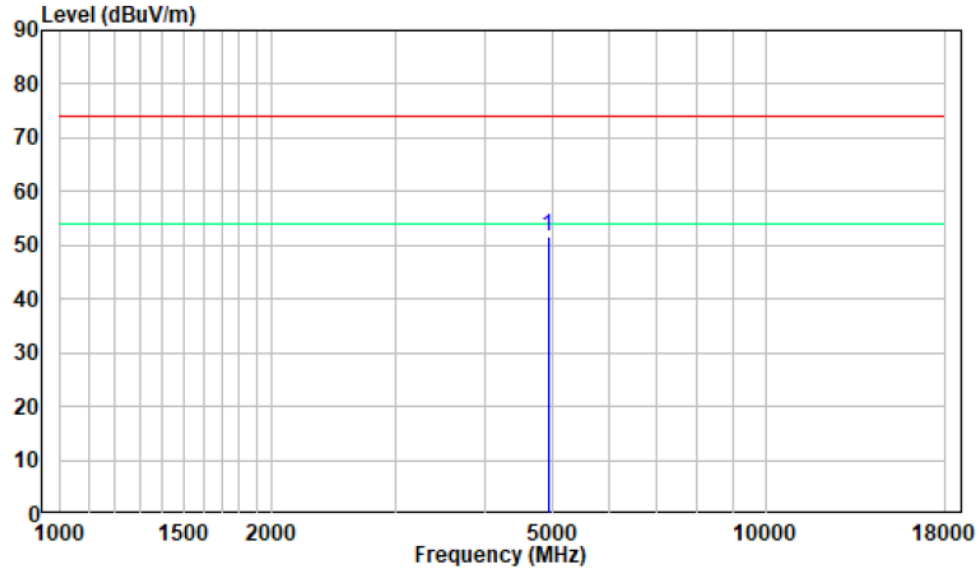
1-18 GHz:

Pre-scan plots:

802.11 b High Channel
Horizontal

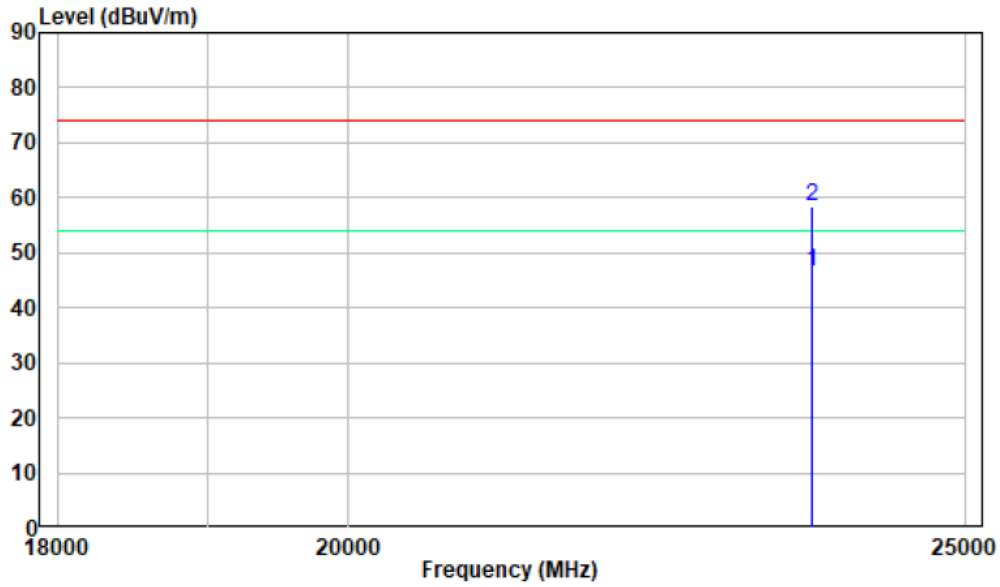


Vertical

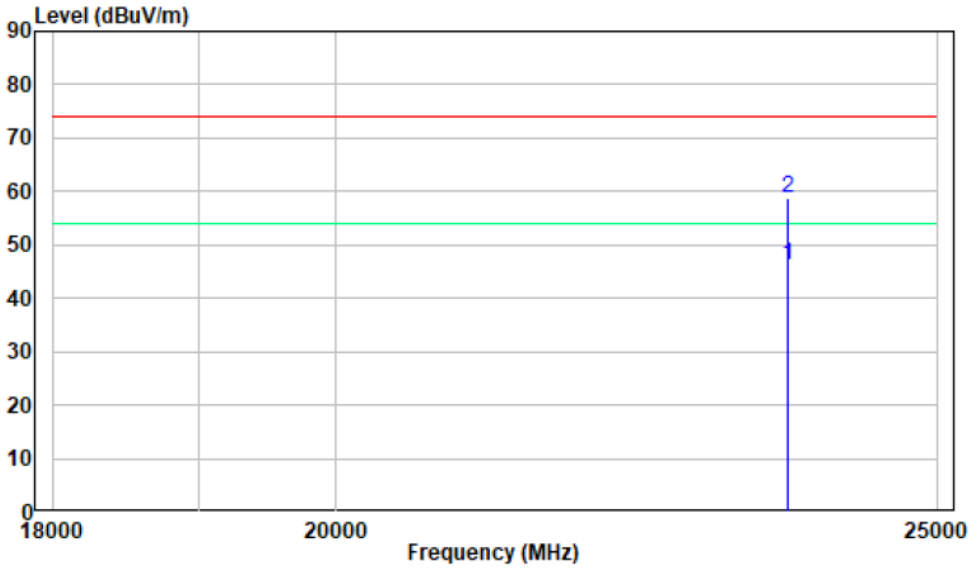


18 -25GHz:
Pre-scan plots:

802.11 b High Channel
Horizontal



Vertical



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