FCC TEST REPORT

For

ChargePoint, Inc.

WIFI & BT Module

Test Model: SU60-2230C

Prepared for	:	ChargePoint, Inc.
Address	:	254 E. Hacienda Ave, Campbell, CA 95008, USA
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
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Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	June 06, 2022
Number of tested samples	:	2
Sample No.	:	A060122034-1
Serial number	:	Prototype
Date of Test	:	June 06, 2022 ~ July 01, 2022
Date of Report	:	July 01, 2022

FCC TEST REPORT
FCC CFR 47 PART 15E (15.407)

Report Reference No.	**:**	**LCSA060122034EB**
Date of Issue	:	July 01, 2022
Testing Laboratory Name.....	**:**	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name	**:**	**ChargePoint, Inc.**
Address	:	254 E. Hacienda Ave, Campbell, CA 95008, USA
Test Specification		
Standard.....	:	FCC CFR 47 PART 15E (15.407) RSS-247 Issue 2 / RSS-Gen Issue 5 / ANSI C63.10: 2013
Test Report Form No.....	**:**	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

EUT Description.	**:**	**WIFI & BT Module**
Trade Mark	:	ChargePoint
Test Model.....	:	SU60-2230C
Ratings	:	Input: DC 5V
Result	:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Vera Deng/ Administrator	Jin Wang/ Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : **LCSA060122034EB**	July 01, 2022 Date of issue

EUT.....	: WIFI & BT Module
Test Model.....	: SU60-2230C
Applicant.....	**: ChargePoint, Inc.**
Address.....	: 254 E. Hacienda Ave, Campbell, CA 95008, USA
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: ChargePoint, Inc.**
Address.....	: 254 E. Hacienda Ave, Campbell, CA 95008, USA
Telephone.....	: /
Fax.....	: /
Factory.....	**: ChargePoint, Inc.**
Address.....	: 254 E. Hacienda Ave, Campbell, CA 95008, USA
Telephone.....	: /
Fax.....	: /

Test Result:	**Positive**

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Report Version	Issue Date	Revision Content	Revised By
000	July 01, 2022	Initial Issue	---

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

This test report was prepared on behef of ChargePoint, Inc., and their product model: SU60-2230C, FCCID:W38-60SIPT, IC:8854A-602230C, or the “EUT” as referred to in this report.

The EUT is WIFI&BT module and is contain within a Network Module host device which also contains a Cell Modem.

1.2 Objective

This report was prepared on behef of ChargePoint, Inc. in accordance with FCC CFR47 §15.407 and ISEDC RSS-247 Issue 2, February 2017.

The objective was to determine compliance with FCC Part 15.407 and ISEDC RSS-247 for Anterna Requirement, RF Exposure & Radiated Spurious Emissions.

This project was a Permissive Change II submission for the purpose of changing the Wifi/BT module antenna used by the EUT, disabling DFS band and enabling co-location with cell modem(FCCID:W38-201903EG25G, IC:8854A-201903EG25G).

1.3 Related Submittal(s)/Grant(s)

Equipment Class:NII, FCC ID :W38-60SIPT, IC:8854A-602230C

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions form Low-Voltage Electrical and Electronic Equipment in the range of 9kHz to 40GHz, and FCC KDB 798033 D02 General UNII Test Procedure New Rules v02r01.

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
DELL	Notebook	G15 5520	---	FCC

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1.3. Description of Test Facility

NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.
Test Firm Registration Number: 254912.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.4. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.5. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
		30MHz~200MHz	±2.96dB	(1)
		200MHz~1000MHz	±3.10dB	(1)
		1GHz~26.5GHz	±3.80dB	(1)
		26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2. SYSTEM TEST CONFIGURATION

2.1. Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 789033 D03 General UNII Test Procedures New Rules v02r01

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software provided by application.

Power Settings:

Modulation	Frequency(MHz)	Power Setting
802.11a	5180	17
	5220	19
	5240	19
802.11n20	5180	17
	5220	19
	5240	19
802.11n40	5190	15
	5230	17
802.11ac20	5180	17
	5220	19
	5240	19
802.11ac40	5190	15
	5230	17
802.11ac80	5210	12
802.11a	5745	19
	5785	19
	5825	20
802.11n20	5745	19
	5785	19
	5825	20
802.11n40	5755	18
	5795	18
802.11ac20	5745	19
	5785	19
	5825	20
802.11ac40	5755	18
	5795	18
802.11ac80	5775	15

Antenna & Bandwidth

Antenna	Chain0 (ANT0)			Chain1 (ANT1)			Simultaneously
Bandwidth Mode	20MHz	40MHz	80MHz	20MHz	40MHz	80MHz	/
IEEE 802.11a	☑	☐	☐	☑	☐	☐	☐
IEEE 802.11n	☑	☑	☐	☑	☑	☐	☑
IEEE 802.11ac	☑	☑	☑	☑	☑	☑	☑

Data rates tested:

IEEE 802.11a Mode: 6 Mbps.

IEEE 802.11n HT20 Mode: MCS0.

IEEE 802.11n HT40 Mode: MCS0.

IEEE 802.11ac VHT20 Mode: MCS0

IEEE 802.11ac VHT40 Mode: MCS0

IEEE 802.11ac VHT80 Mode: MCS0

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart E		
FCC Rules	Description of Test	Result
§15.209, §15.407(b) RSS-247 6.2.1.1 RSS-Gen	Emissions in Restricted Bands	Compliant
§15.209, §15.407(b) RSS-247 6.2.1.1 RSS-Gen	Radiated Emissions	Compliant
§15.203 RSS-Gen	Antenna Requirements	Compliant
§15.407 §2.1093 RSS-102	RF Exposure	Compliant

5. TEST RESULT

5.1 Emissions in Restricted Bands

5.1.1 Limit

According to ξ15.407 (b) Undesirable emission limits. Except as shown in paragraph (b) (7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(a) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(b) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(c) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(d) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

(e) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

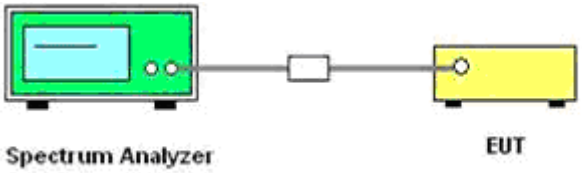
(f) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(g) The provisions of §15.205 apply to intentional radiators operating under this section.

(h) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

According to RSS-247 section 6.2.1.2: For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250- 5350 MHz band.

5.1.2 Test Configuration



5.1.3 Test Procedure

According to KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section G: Unwanted Emission Measurement

1. Unwanted Emissions in the Restricted Bands

a) For all measurements, follow the requirements in section II.G.3. “General Requirements for Unwanted Emissions Measurements.”

b) At frequencies below 1000 MHz, use the procedure described in section II.G.4. “Procedure for Unwanted Emissions Measurements below 1000 MHz.”

c) At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in sections II.G.5. and II.G.6, respectively, must satisfy the respective peak and average limits. If all peak measurements satisfy the average limit, then average measurements are not required.

d) For conducted measurements above 1000 MHz, EIRP shall be computed as specified in section II.G.3.b) and then field strength shall be computed as follows (see KDB Publication 412172):

i) E[dBµV/m] = EIRP[dBm] - 20 log (d[meters]) + 104.77, where E = field strength and d = distance at which field strength limit is specified in the rules;

ii) E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters

e) For conducted measurements below 1000 MHz, the field strength shall be computed as specified in d), above, and then an additional 4.7 dB shall be added as an upper bound on the field strength that would be observed on a test range with a ground plane for frequencies between 30 MHz and 1000 MHz, or an additional 6 dB shall be added for frequencies below 30 MHz.

2. Unwanted Emissions that fall Outside of the Restricted Bands

a) For all measurements, follow the requirements in section II.G.3. “General Requirements for Unwanted Emissions Measurements.”

b) At frequencies below 1000 MHz, use the procedure described in section II.G.4. “Procedure for Unwanted Emissions Measurements below 1000 MHz.”

c) At frequencies above 1000 MHz, use the procedure for maximum emissions described in section II.G.5., “Procedure for Unwanted Maximum Unwanted Emissions Measurements Above 1000 MHz.”

d) Section 15.407(b) (1-3) specifies the unwanted emissions limit for the U-NII-1 and 2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz. However, an out-of-band emission that complies with both the average and peak limits of Section 15.209 is not required to satisfy the -27 dBm/MHz dBm/MHz peak emission limit.

i) Section 15.407(b) (4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b) (4) (i). An alternative to the band emissions mask is specified in Section 15.407(b) (4) (ii). The alternative limits are based on the highest antenna gain specified in the filing. There are also marketing and importation restrictions for the alternative limit.

e) If radiated measurements are performed, field strength is then converted to EIRP as follows:

i) EIRP = ((E×d) ^2) / 30

Where:

- E is the field strength in V/m;
- d is the measurement distance in meters;
- EIRP is the equivalent isotopically radiated power in watts;

ii) Working in dB units, the above equation is equivalent to:

EIRP [dBm] = E [dBµV/m] + 20 log (d [meters]) - 104.77

iii) Or, if d is 3 meters:

EIRP [dBm] = E [dBµV/m] - 95.23

3) Radiated versus Conducted Measurements.

The unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance provided that the following steps are performed:

(i) Cabinet emissions measurements. A radiated test shall be performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna may be replaced by a termination matching the nominal impedance of the antenna.

(ii) Impedance matching. Conducted tests shall be performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT.

(iii) EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater.3 However, for devices that operate in multiple bands using the same transmit antenna, the highest gain of the antenna within the operating band nearest to the out-of-band frequency being measured may be used in lieu of the overall highest gain when measuring emissions at frequencies within 20% of the absolute frequency at the nearest edge of that band, but in no case shall a value less than 2 dBi be selected.

(iv) EIRP adjustments for multiple outputs. For devices with multiple outputs occupying the same or overlapping frequency ranges in the same band (e.g., MIMO or beamforming devices), compute the total EIRP as follows:

- Compute EIRP for each output, as described in (iii), above.
- Follow the procedures specified in KDB Publication 662911 for summing emissions across the outputs or adjusting emission levels measured on individual outputs by 10 log (N_{ANT}), where N_{ANT} is the number of outputs.
- Add the array gain term specified in KDB Publication 662911 for out-of-band and spurious signals.

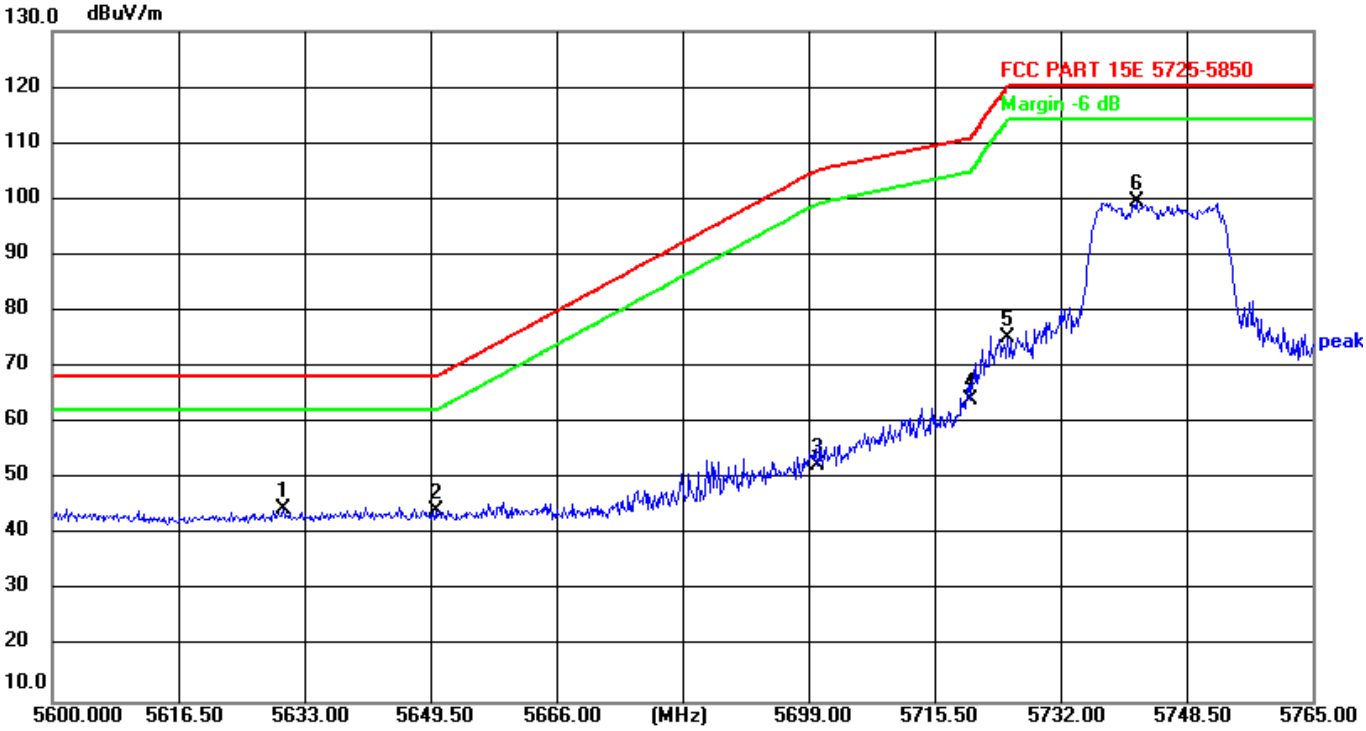
(v) Direction of maximum emission.

For all radiated emissions tests, measurements shall correspond to the direction of maximum emission level for each measured emission (see ANSI C63.10 for guidance).

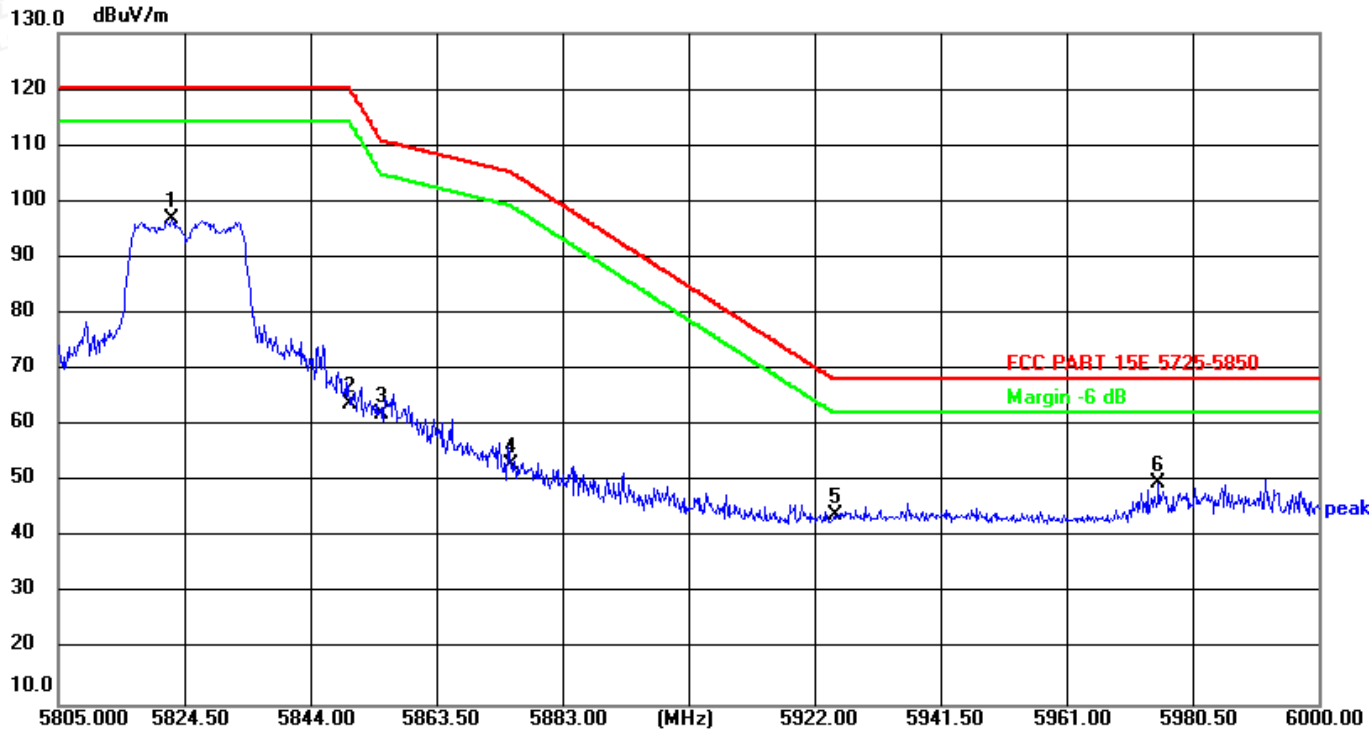
5.1.4 Test Results

PASS

Worst case: Test result for IEEE 802.11ac20(5.8GWIFI) Mode (High Channel)
Horizontal

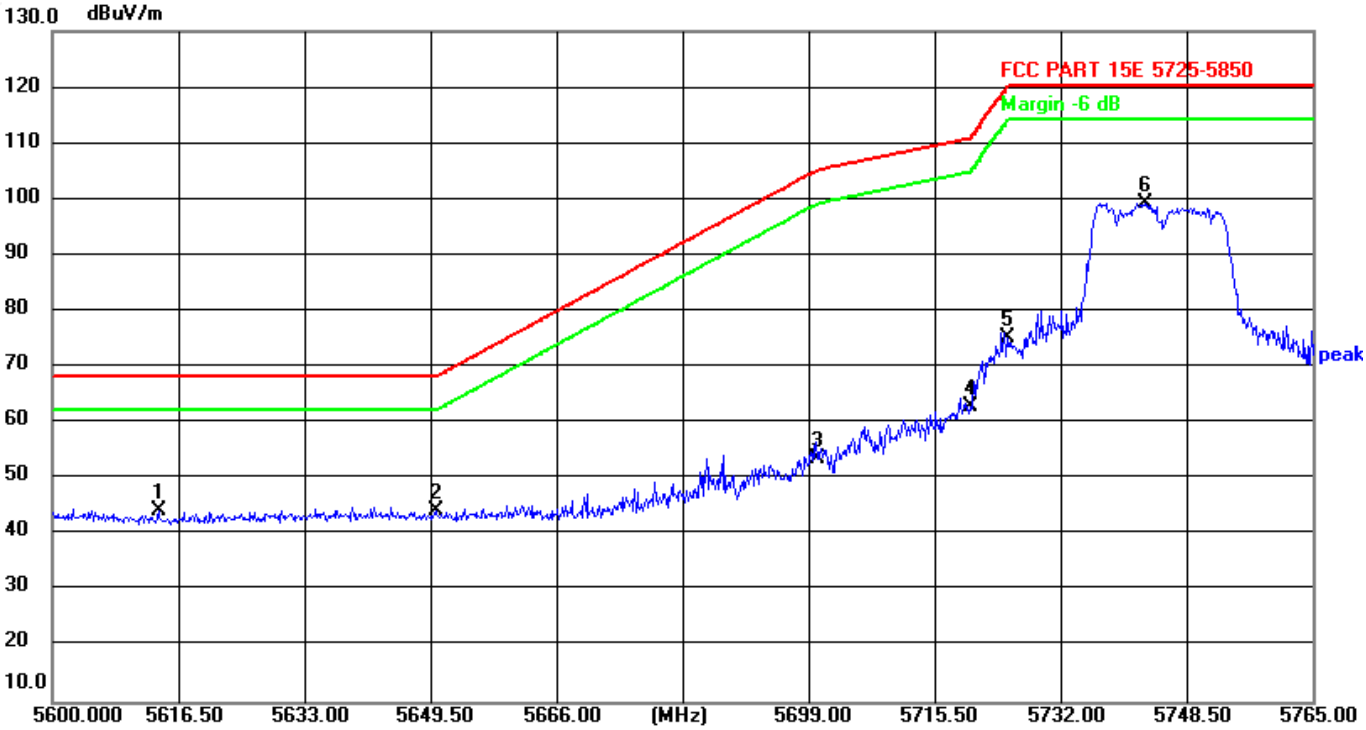


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5630.195	47.99	-3.33	44.66	68.20	-23.54	peak
2	5650.000	47.61	-3.35	44.26	68.20	-23.94	peak
3	5700.000	55.83	-3.40	52.43	105.20	-52.77	peak
4	5720.000	67.61	-3.43	64.18	110.80	-46.62	peak
5	5725.000	78.67	-3.42	75.25	120.20	-44.95	peak
6	5741.900	102.92	-3.44	99.48	120.20	-20.72	peak

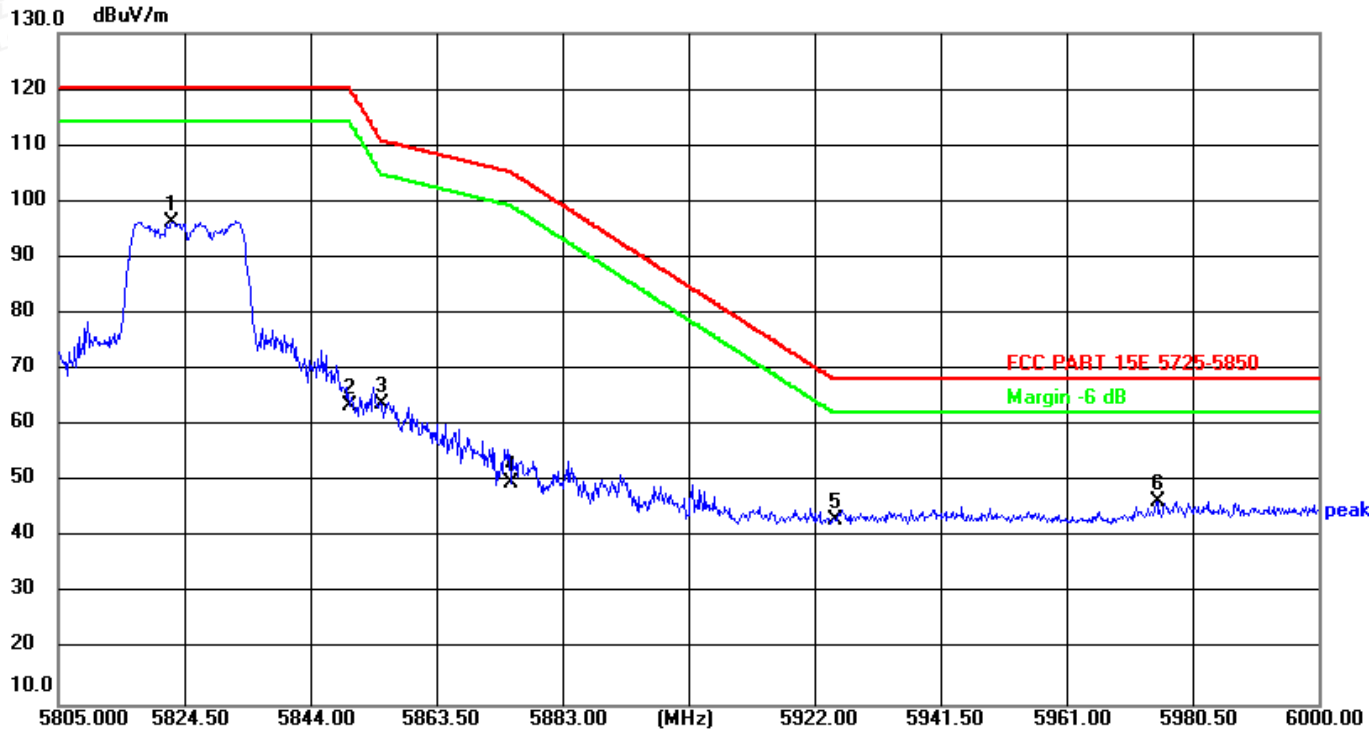


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5822.550	100.26	-3.52	96.74	120.20	-23.46	peak
2	5850.000	67.33	-3.54	63.79	120.20	-56.41	peak
3	5855.000	65.47	-3.54	61.93	110.80	-48.87	peak
4	5875.000	56.62	-3.57	53.05	105.20	-52.15	peak
5	5925.000	47.81	-3.62	44.19	68.20	-24.01	peak
6	5975.235	53.44	-3.66	49.78	68.20	-18.42	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5613.860	47.58	-3.32	44.26	68.20	-23.94	peak
2	5650.000	47.71	-3.35	44.36	68.20	-23.84	peak
3	5700.000	57.12	-3.40	53.72	105.20	-51.48	peak
4	5720.000	66.39	-3.43	62.96	110.80	-47.84	peak
5	5725.000	78.65	-3.42	75.23	120.20	-44.97	peak
6	5743.055	102.69	-3.44	99.25	120.20	-20.95	peak



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5822.550	99.80	-3.52	96.28	120.20	-23.92	peak
2	5850.000	67.02	-3.54	63.48	120.20	-56.72	peak
3	5855.000	67.44	-3.54	63.90	110.80	-46.90	peak
4	5875.000	53.45	-3.57	49.88	105.20	-55.32	peak
5	5925.000	46.87	-3.62	43.25	68.20	-24.95	peak
6	5975.040	50.22	-3.66	46.56	68.20	-21.64	peak

Remark:

1. *Measured Undesirable emission at difference data rate for each mode and recorded worst case for IEEE 802.11ac20(5.8GWIFI) Mode (High Channel);*
2. *Emission level (dBuV/m) = 20 log Emission level (uV/m). Margin= Level-limit;*
3. *Factor=Antenan Factor+Cable Loss-Pre Factor;Level=Reading+Factor.*

5.2. Radiated Emissions Measurement

5.2.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293.	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
\2\ Above 38.6

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz (68.2dBuV/m at 3m).

In addition, In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

According to RSS-247 section 6.2.1.2: For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250- 5350 MHz band.

According to RSS-247 section 6.2.2.2: All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p.; or All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device, except devices installed in vehicles, shall be labelled or include in the user manual the

following text “for indoor use only.”

According to RSS-247 section 6.2.3.2: Emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the emission limit of -27 dBm/MHz e.i.r.p. at 5850 MHz instead of 5725 MHz.

In case the emission fall within the restricted band specified on RSS-Gen Issue 5, then the RSS-Gen Issue 5 limit in the table below has to be followed.

Frequencies (MHz)	Magnetic field strength (H-Field) (μA/m)	Measurement Distance (meters)
0.009~0.490	6.37/F (F in kHz)	300
0.490~1.705	63.7/F (F in kHz)	30
1.705~30.0	0.08	30

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

5.2.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

5.2.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 1.0 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

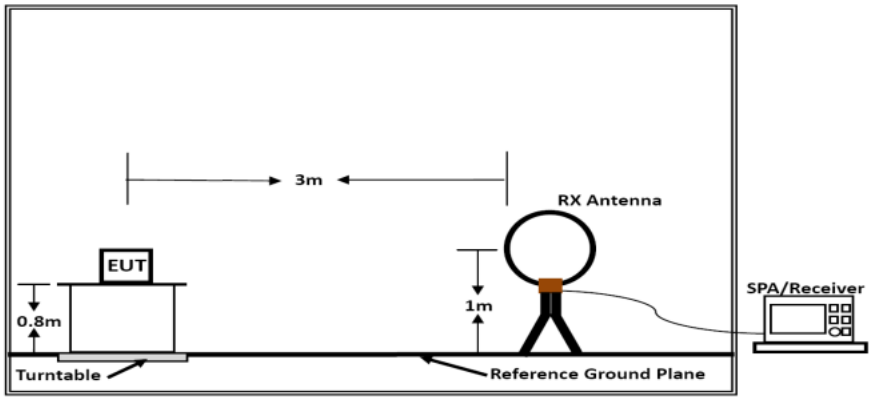
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

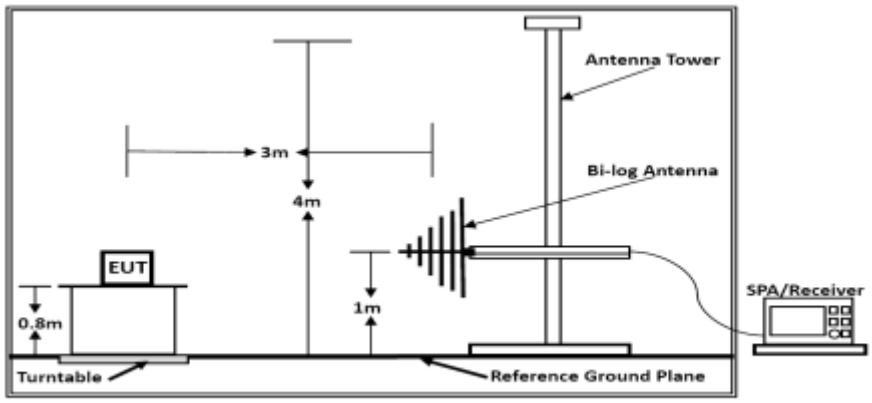
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

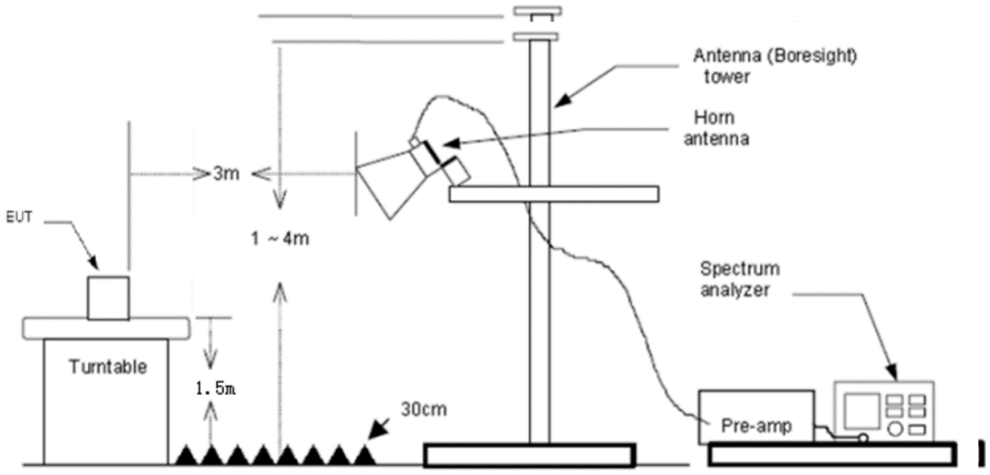
5.2.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.6. Results of Radiated Emissions (9 KHz~30MHz)

Temperature	23.5℃	Humidity	52.2%
Test Engineer	Ling Zhu	Configurations	IEEE 802.11a/n/ac

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dB)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

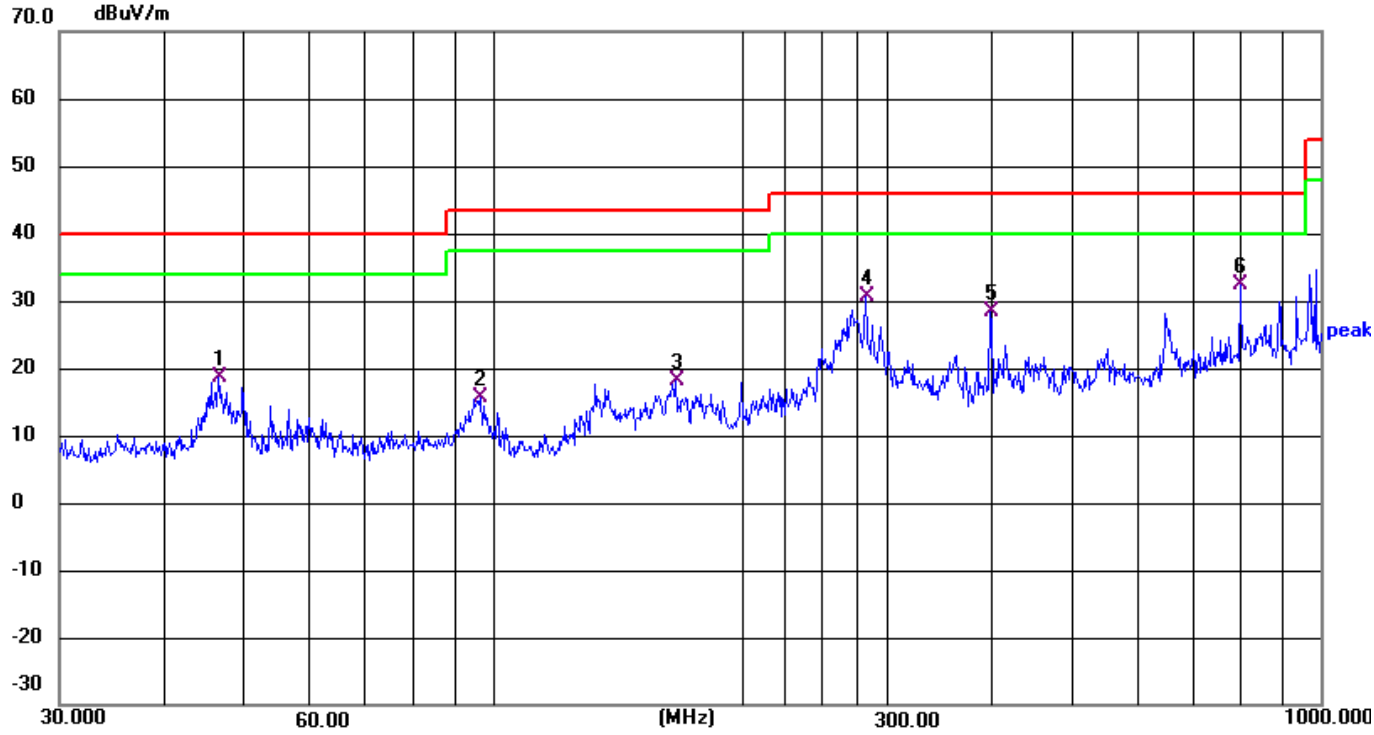
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

5.2.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	23.5℃	Humidity	52.2%
Test Engineer	Ling Zhu		

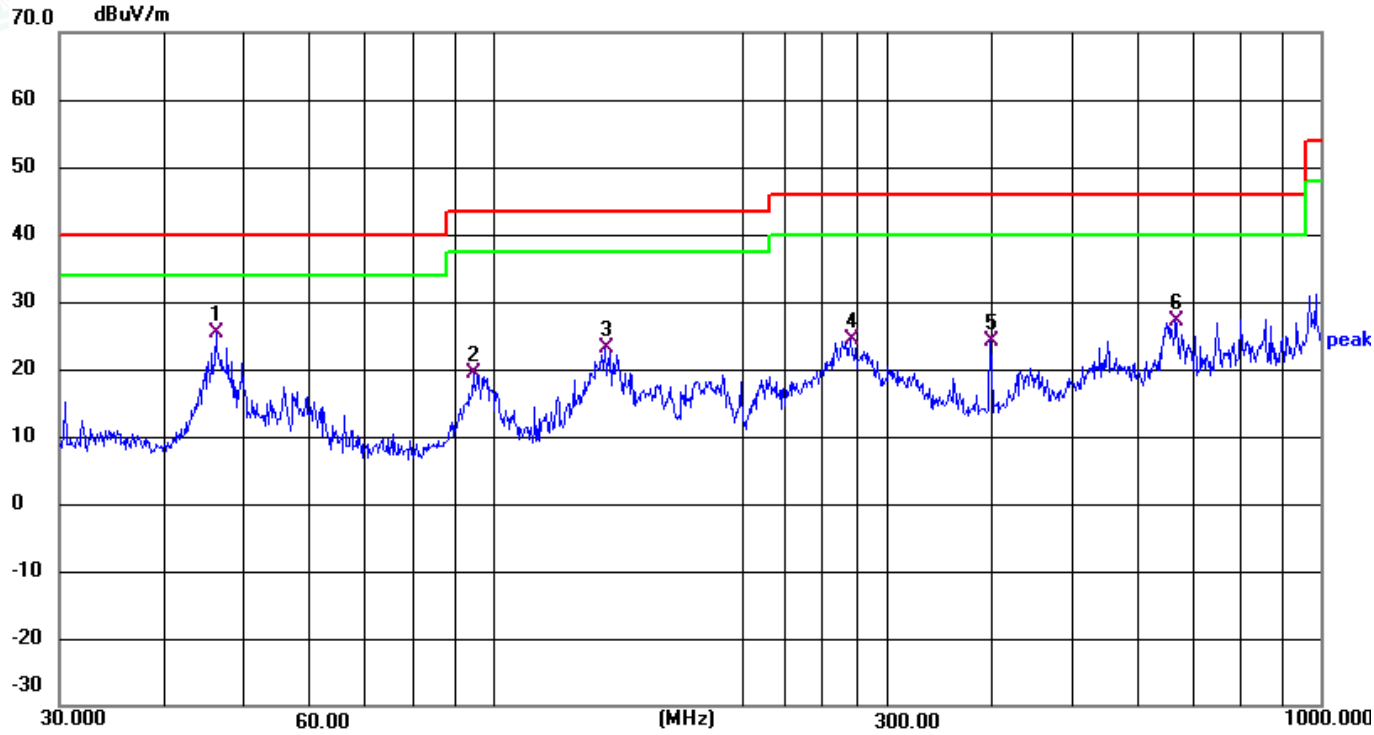
Worst case: Test result for IEEE 802.11ac20(5.2GWIFI) Mode (High Channel)

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	46.6664	35.68	-16.95	18.73	40.00	-21.27	QP
2	96.7749	34.13	-18.41	15.72	43.50	-27.78	QP
3	166.6514	37.60	-19.58	18.02	43.50	-25.48	QP
4	281.9946	45.94	-15.43	30.51	46.00	-15.49	QP
5	399.0302	42.87	-14.43	28.44	46.00	-17.56	QP
6	798.9797	42.41	-9.96	32.45	46.00	-13.55	QP

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	46.3402	42.24	-16.93	25.31	40.00	-14.69	QP
2	94.7601	37.90	-18.55	19.35	43.50	-24.15	QP
3	136.9391	44.05	-20.80	23.25	43.50	-20.25	QP
4	270.3748	39.71	-15.42	24.29	46.00	-21.71	QP
5	399.0302	38.47	-14.43	24.04	46.00	-21.96	QP
6	668.1423	38.20	-11.06	27.14	46.00	-18.86	QP

Note:

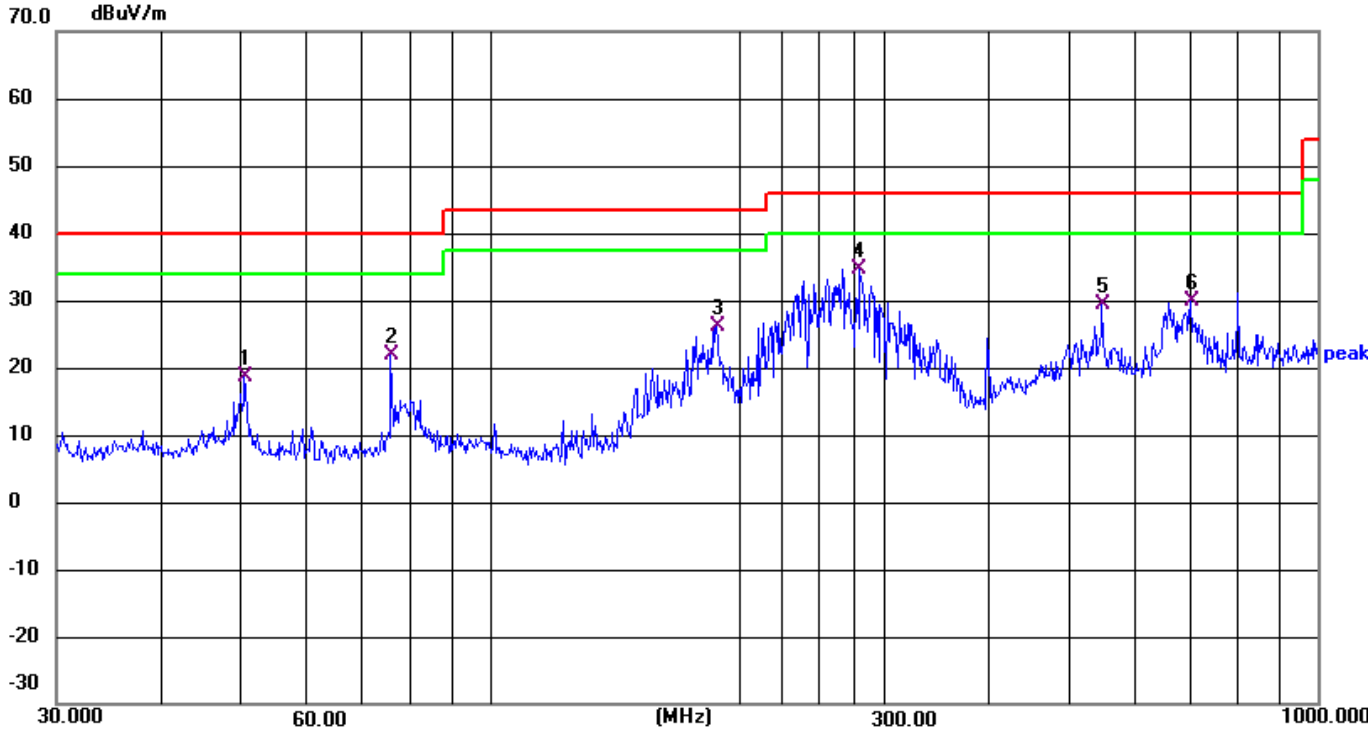
(1). Pre-scan all modes and recorded the worst case results in this report IEEE 802.11ac20(5.2GWIFI) Mode (High Channel)

2). Emission level (dBuV/m) = 20 log Emission level (uV/m). Margin= Level-limit;

3). Factor=Antenan Factor+Cable Loss-Pre Factor;Level=Reading+Factor.

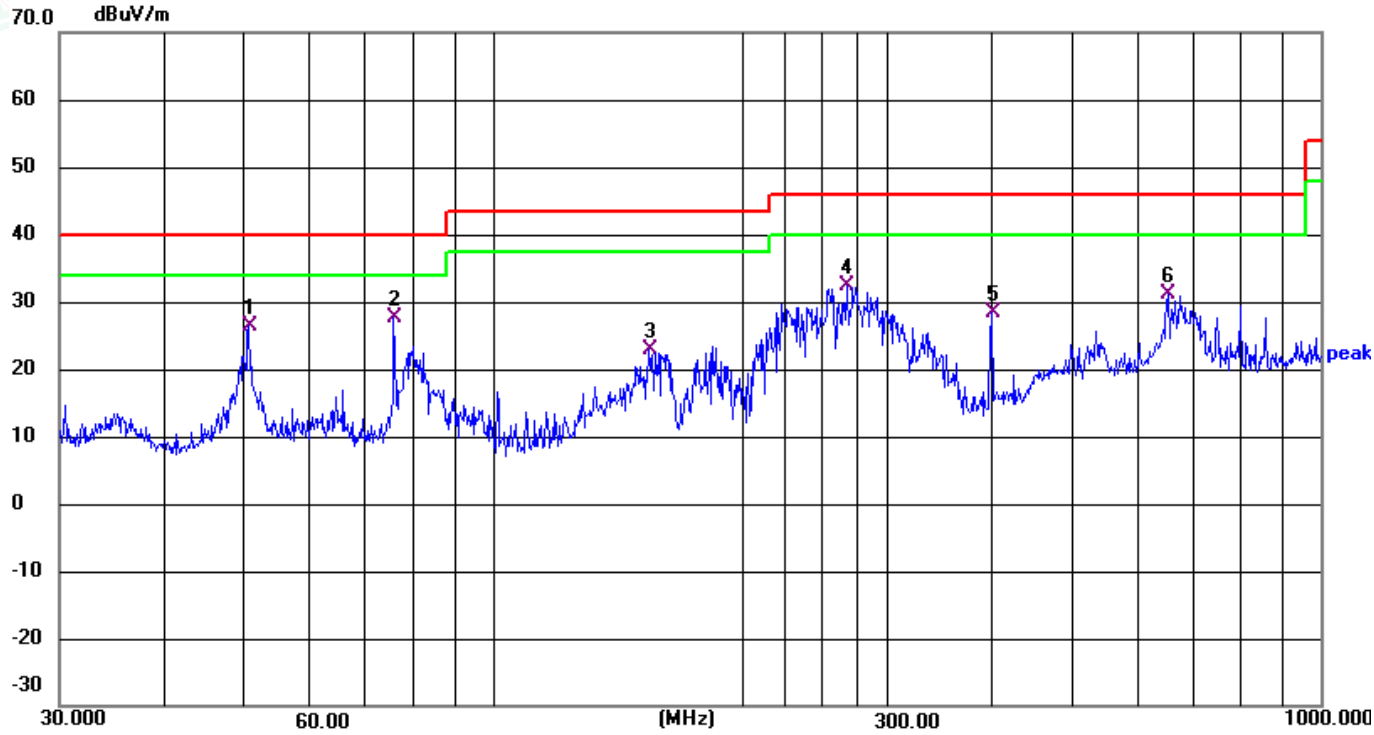
Worst case: Test result for IEEE 802.11ac20(5.8GWIFI) Mode (High Channel)

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	50.5860	35.88	-17.15	18.73	40.00	-21.27	QP
2	75.9773	41.62	-19.72	21.90	40.00	-18.10	QP
3	187.7530	43.79	-17.64	26.15	43.50	-17.35	QP
4	280.0237	50.08	-15.41	34.67	46.00	-11.33	QP
5	549.0195	41.18	-11.83	29.35	46.00	-16.65	QP
6	701.7610	40.88	-10.89	29.99	46.00	-16.01	QP

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	50.7637	43.67	-17.18	26.49	40.00	-13.51	QP
2	75.9773	47.36	-19.72	27.64	40.00	-12.36	QP
3	154.2786	42.57	-19.76	22.81	43.50	-20.69	QP
4	267.5455	47.75	-15.43	32.32	46.00	-13.68	QP
5	400.4319	42.86	-14.41	28.45	46.00	-17.55	QP
6	654.2318	42.08	-11.03	31.05	46.00	-14.95	QP

Note:

(1). Pre-scan all modes and recorded the worst case results in this report IEEE 802.11ac20(5.8GWIFI) Mode (High Channel)

2). Emission level (dBuV/m) = 20 log Emission level (uV/m). Margin= Level-limit;

3). Factor=Antenan Factor+Cable Loss-Pre Factor;Level=Reading+Factor.

5.2.8. Results for Radiated Emissions (1 – 40 GHz)

Note: All the modes have been tested and recorded worst mode in the report.

5.2GWIFI:

IEEE 802.11a

Channel 36 / 5180 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.54	58.58	33.06	35.04	3.94	60.54	68.20	-7.66	Peak	Horizontal
15.54	41.50	33.06	35.04	3.94	43.46	54.00	-10.54	Average	Horizontal
15.54	58.41	33.06	35.04	3.94	60.37	68.20	-7.83	Peak	Vertical
15.54	39.86	33.06	35.04	3.94	41.82	54.00	-12.18	Average	Vertical

Channel 40 / 5200 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.60	57.11	33.16	35.15	3.96	59.08	68.20	-9.12	Peak	Horizontal
15.60	38.63	33.16	35.15	3.96	40.60	54.00	-13.40	Average	Horizontal
15.60	58.19	33.16	35.15	3.96	60.16	68.20	-8.04	Peak	Vertical
15.60	34.92	33.16	35.15	3.96	36.89	54.00	-17.11	Average	Vertical

Channel 48 / 5240 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.72	58.98	33.26	35.14	3.98	61.08	68.20	-7.12	Peak	Horizontal
15.72	40.18	33.26	35.14	3.98	42.28	54.00	-11.72	Average	Horizontal
15.72	55.44	33.26	35.14	3.98	57.54	68.20	-10.66	Peak	Vertical
15.72	38.43	33.26	35.14	3.98	40.53	54.00	-13.47	Average	Vertical

IEEE 802.11n HT20 (Worst Case:Ant0 + Ant1)

Channel 36 / 5180 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.54	58.98	33.06	35.04	3.94	60.94	68.20	-7.26	Peak	Horizontal
15.54	40.90	33.06	35.04	3.94	42.86	54.00	-11.14	Average	Horizontal
15.54	57.05	33.06	35.04	3.94	59.01	68.20	-9.19	Peak	Vertical
15.54	42.23	33.06	35.04	3.94	44.19	54.00	-9.81	Average	Vertical

Channel 40 / 5200 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.60	58.81	33.16	35.15	3.96	60.78	68.20	-7.42	Peak	Horizontal
15.60	40.46	33.16	35.15	3.96	42.43	54.00	-11.57	Average	Horizontal
15.60	55.45	33.16	35.15	3.96	57.42	68.20	-10.78	Peak	Vertical
15.60	35.79	33.16	35.15	3.96	37.76	54.00	-16.24	Average	Vertical

Channel 48 / 5240 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.72	59.94	33.26	35.14	3.98	62.04	68.20	-6.16	Peak	Horizontal
15.72	40.87	33.26	35.14	3.98	42.97	54.00	-11.03	Average	Horizontal
15.72	54.65	33.26	35.14	3.98	56.75	68.20	-11.45	Peak	Vertical
15.72	35.91	33.26	35.14	3.98	38.01	54.00	-15.99	Average	Vertical

IEEE 802.11ac VHT20(Worst Case:Ant0 + Ant1)

Channel 36 / 5180 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.54	58.54	33.06	35.04	3.94	60.50	68.20	-7.70	Peak	Horizontal
15.54	41.95	33.06	35.04	3.94	43.91	54.00	-10.09	Average	Horizontal
15.54	57.97	33.06	35.04	3.94	59.93	68.20	-8.27	Peak	Vertical
15.54	38.19	33.06	35.04	3.94	40.15	54.00	-13.85	Average	Vertical

Channel 40 / 5200 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.60	56.74	33.16	35.15	3.96	58.71	68.20	-9.49	Peak	Horizontal
15.60	40.70	33.16	35.15	3.96	42.67	54.00	-11.33	Average	Horizontal
15.60	56.20	33.16	35.15	3.96	58.17	68.20	-10.03	Peak	Vertical
15.60	35.81	33.16	35.15	3.96	37.78	54.00	-16.22	Average	Vertical

Channel 48 / 5240 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.72	58.98	33.26	35.14	3.98	61.08	68.20	-7.12	Peak	Horizontal
15.72	41.65	33.26	35.14	3.98	43.75	54.00	-10.25	Average	Horizontal
15.72	57.28	33.26	35.14	3.98	59.38	68.20	-8.82	Peak	Vertical
15.72	38.05	33.26	35.14	3.98	40.15	54.00	-13.85	Average	Vertical

IEEE 802.11n HT40(Worst Case:Ant0 + Ant1)

Channel 38 / 5190 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.57	56.91	33.06	35.04	3.94	58.87	68.20	-9.33	Peak	Horizontal
15.57	41.84	33.06	35.04	3.94	43.80	54.00	-10.20	Average	Horizontal
15.57	56.70	33.06	35.04	3.94	58.66	68.20	-9.54	Peak	Vertical
15.57	39.93	33.06	35.04	3.94	41.89	54.00	-12.11	Average	Vertical

Channel 46 / 5230 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.69	55.88	33.16	35.15	3.96	57.85	68.20	-10.35	Peak	Horizontal
15.69	40.20	33.16	35.15	3.96	42.17	54.00	-11.83	Average	Horizontal
15.69	55.72	33.16	35.15	3.96	57.69	68.20	-10.51	Peak	Vertical
15.69	37.20	33.16	35.15	3.96	39.17	54.00	-14.83	Average	Vertical

IEEE 802.11ac VHT40(Worst Case:Ant0 + Ant1)

Channel 38 / 5190 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.57	58.36	33.06	35.04	3.94	60.32	68.20	-7.88	Peak	Horizontal
15.57	42.71	33.06	35.04	3.94	44.67	54.00	-9.33	Average	Horizontal
15.57	57.10	33.06	35.04	3.94	59.06	68.20	-9.14	Peak	Vertical
15.57	39.56	33.06	35.04	3.94	41.52	54.00	-12.48	Average	Vertical

Channel 46 / 5230 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
15.69	58.05	33.16	35.15	3.96	60.02	68.20	-8.18	Peak	Horizontal
15.69	40.15	33.16	35.15	3.96	42.12	54.00	-11.88	Average	Horizontal
15.69	56.65	33.16	35.15	3.96	58.62	68.20	-9.58	Peak	Vertical
15.69	39.59	33.16	35.15	3.96	41.56	54.00	-12.44	Average	Vertical

IEEE 802.11ac VHT80(Worst Case:Ant0 + Ant1)

Channel 42 / 5210 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol
15.63	54.42	33.06	35.15	3.96	56.29	68.20	-11.91	Peak	Horizontal
15.63	42.08	33.06	35.15	3.96	43.95	54.00	-10.05	Average	Horizontal
15.63	57.70	33.06	35.15	3.96	59.57	68.20	-8.63	Peak	Vertical
15.63	42.96	33.06	35.15	3.96	44.83	54.00	-9.17	Average	Vertical

5.8GWIFI:

IEEE 802.11a

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.09	33.23	35.04	3.91	63.19	68.20	-5.01	Peak	Horizontal
17.235	43.40	33.23	35.04	3.91	45.50	54.00	-8.50	Average	Horizontal
17.235	58.45	33.23	35.04	3.91	60.55	68.20	-7.65	Peak	Vertical
17.235	42.28	33.23	35.04	3.91	44.38	54.00	-9.62	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.12	33.27	35.15	3.93	62.17	68.20	-6.03	Peak	Horizontal
17.355	42.62	33.27	35.15	3.93	44.67	54.00	-9.33	Average	Horizontal
17.355	59.63	33.27	35.15	3.93	61.68	68.20	-6.52	Peak	Vertical
17.355	41.06	33.27	35.15	3.93	43.11	54.00	-10.89	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	61.25	33.32	35.14	3.97	63.40	68.20	-4.80	Peak	Horizontal
17.475	44.93	33.32	35.14	3.97	47.08	54.00	-6.92	Average	Horizontal
17.475	59.71	33.32	35.14	3.97	61.86	68.20	-6.34	Peak	Vertical
17.475	41.31	33.32	35.14	3.97	43.46	54.00	-10.54	Average	Vertical

IEEE 802.11n HT20(Worst Case:Ant0 + Ant1)

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.52	33.23	35.04	3.91	63.62	68.20	-4.58	Peak	Horizontal
17.235	42.14	33.23	35.04	3.91	44.24	54.00	-9.76	Average	Horizontal
17.235	58.23	33.23	35.04	3.91	60.33	68.20	-7.87	Peak	Vertical
17.235	40.50	33.23	35.04	3.91	42.60	54.00	-11.40	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.90	33.27	35.15	3.93	62.95	68.20	-5.25	Peak	Horizontal
17.355	41.04	33.27	35.15	3.93	43.09	54.00	-10.91	Average	Horizontal
17.355	59.17	33.27	35.15	3.93	61.22	68.20	-6.98	Peak	Vertical
17.355	41.51	33.27	35.15	3.93	43.56	54.00	-10.44	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	60.30	33.32	35.14	3.97	62.45	68.20	-5.75	Peak	Horizontal
17.475	46.23	33.32	35.14	3.97	48.38	54.00	-5.62	Average	Horizontal
17.475	59.02	33.32	35.14	3.97	61.17	68.20	-7.03	Peak	Vertical
17.475	44.64	33.32	35.14	3.97	46.79	54.00	-7.21	Average	Vertical

IEEE 802.11ac VHT20(Worst Case:Ant0 + Ant1)

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.94	33.23	35.04	3.91	64.04	68.20	-4.16	Peak	Horizontal
17.235	44.72	33.23	35.04	3.91	46.82	54.00	-7.18	Average	Horizontal
17.235	55.56	33.23	35.04	3.91	57.66	68.20	-10.54	Peak	Vertical
17.235	44.96	33.23	35.04	3.91	47.06	54.00	-6.94	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.04	33.27	35.15	3.93	62.09	68.20	-6.11	Peak	Horizontal
17.355	42.22	33.27	35.15	3.93	44.27	54.00	-9.73	Average	Horizontal
17.355	59.87	33.27	35.15	3.93	61.92	68.20	-6.28	Peak	Vertical
17.355	40.93	33.27	35.15	3.93	42.98	54.00	-11.02	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	60.79	33.32	35.14	3.97	62.94	68.20	-5.26	Peak	Horizontal
17.475	43.49	33.32	35.14	3.97	45.64	54.00	-8.36	Average	Horizontal
17.475	58.73	33.32	35.14	3.97	60.88	68.20	-7.32	Peak	Vertical
17.475	44.02	33.32	35.14	3.97	46.17	54.00	-7.83	Average	Vertical

IEEE 802.11n HT40(Worst Case:Ant0 + Ant1)

Channel 151 / 5755 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.265	60.33	33.23	35.04	3.91	62.43	68.20	-5.77	Peak	Horizontal
17.265	44.04	33.23	35.04	3.91	46.14	54.00	-7.86	Average	Horizontal
17.265	58.67	33.23	35.04	3.91	60.77	68.20	-7.43	Peak	Vertical
17.265	41.79	33.23	35.04	3.91	43.89	54.00	-10.11	Average	Vertical

Channel 159 / 5795 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.385	59.71	33.23	35.04	3.91	61.81	68.20	-6.39	Peak	Horizontal
17.385	42.97	33.23	35.04	3.91	45.07	54.00	-8.93	Average	Horizontal
17.385	56.12	33.23	35.04	3.91	58.22	68.20	-9.98	Peak	Vertical
17.385	41.69	33.23	35.04	3.91	43.79	54.00	-10.21	Average	Vertical

IEEE 802.11ac VHT40(Worst Case:Ant0 + Ant1)

Channel 151 / 5755 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.265	59.88	33.23	35.04	3.91	61.98	68.20	-6.22	Peak	Horizontal
17.265	40.81	33.23	35.04	3.91	42.91	54.00	-11.09	Average	Horizontal
17.265	56.57	33.23	35.04	3.91	58.67	68.20	-9.53	Peak	Vertical
17.265	37.96	33.23	35.04	3.91	40.06	54.00	-13.94	Average	Vertical

Channel 159 / 5795 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.385	59.32	33.23	35.04	3.91	61.42	68.20	-6.78	Peak	Horizontal
17.385	42.48	33.23	35.04	3.91	44.58	54.00	-9.42	Average	Horizontal
17.385	57.40	33.23	35.04	3.91	59.50	68.20	-8.70	Peak	Vertical
17.385	39.50	33.23	35.04	3.91	41.60	54.00	-12.40	Average	Vertical

IEEE 802.11ac VHT80(Worst Case:Ant0 + Ant1)

Channel 155 / 5775 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol
17.325	58.20	33.27	35.15	3.93	60.25	68.20	-7.95	Peak	Horizontal
17.325	41.56	33.27	35.15	3.93	43.61	54.00	-10.39	Average	Horizontal
17.325	60.65	33.27	35.15	3.93	62.70	68.20	-5.50	Peak	Vertical
17.325	42.27	33.27	35.15	3.93	44.32	54.00	-9.68	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz ~ 40GHz, emissions are attenuated more than 20dB below the permissible limits generated frequency to 30MHz.
2). Radiated emissions measured in frequency range from 9 KHz ~ 40GHz were made with an instrument using Peak detector mode.
3). 18~40GHz at least have 20dB margin. No recording in the test report.
4). Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20, IEEE 802.11ac VHT40, IEEE 802.11ac VHT80;
5). Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

6). Margin=Reading level+Cab loss+Ant Fac-Pre Fac-Limit

5.3. Antenna Requirements

5.3.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

And according to FCC 47 CFR Section 15.407 (a), if 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 6dBi.

According to RSS-Gen,

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.9 When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device’s antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

5.3.2 Antenna Connected Construction

5.3.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

5.3.2.2. Antenna Connector Construction

The gains of antenna used for transmitting is 6.7dBi(Max), and the antenna is an Ceramic Antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details, meet RSS-Gen antenna requirement.

5.3.2.3. Results: Compliance.

5.4. RF Exposure

5.4.1 Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

RSS-102 Section 2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation
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 MHz6 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/f0.5 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 x 10-2 f0.6834 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.

5.4.2 Limit

5.4.2.1 Refer Evaluation Method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

RSS-102 Issue 5 March 2015: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

5.4.2.2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	(900/f2)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f2)*	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

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	0.73/ ƒ	-	6**
1.1-10	87/ $ƒ^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $ƒ^{0.25}$	0.1540/ $ƒ^{0.25}$	8.944/ $ƒ^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $ƒ^{0.3417}$	0.008335 $ƒ^{0.3417}$	0.02619 $ƒ^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $ƒ^{1.2}$
150000-300000	0.158 $ƒ^{0.5}$	4.21 x 10^{-4} $ƒ^{0.5}$	6.67 x 10^{-5} ƒ	616000/$ƒ^{1.2}$

Note: ƒ is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

5.4.3. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna

5.4.4. Antenna Information

Antenna can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Notes
Antenna 0	Ceramic Antenna	2400 MHz – 2500 MHz 5000 MHz -6000 MHz	3.4 dBi(max.) For2400 MHz – 2500 MHz 6.7dBi(max.) For 5000 MHz – 6000 MHz	WLAN Antenna
Antenna 1	Ceramic Antenna	2400 MHz – 2500 MHz 5000 MHz -6000 MHz	3.4 dBi(max.) For2400 MHz – 2500 MHz 6.7dBi(max.) For 5000 MHz – 6000 MHz	BT/WLAN Antenna

5.4.5. Measurement Results

5.4.5.1. Standalone MPE Evaluation

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 50 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

[Antenna 0]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
5.2GWIFI (IEEE 802.11ac20)	19.00	79.4328	6.7	4.6774	0.0739	1.0000
5.2GWIFI (IEEE 802.11ac20)	19.00	79.4328	6.7	4.6774	0.0739	1.0000

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Power Density (W/m^2)	MPE Exclusion Limits (W/m^2)	MPE $_{Ratio}$
	dBm	W					
5.2GWIFI (IEEE 802.11ac20)	19.00	0.0794	6.7	4.6774	0.7391	9.01	0.082
5.2GWIFI (IEEE 802.11ac20)	19.00	0.0794	6.7	4.6774	0.7391	9.69	0.076

[Antenna1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
5.2GWIFI (IEEE 802.11ac20)	19.00	79.4328	6.7	4.6774	0.0739	1.0000
5.8GWIFI (IEEE 802.11ac20)	19.00	79.4328	6.7	4.6774	0.0739	1.0000

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Power Density (W/m^2)	MPE Exclusion Limits (W/m^2)	MPE $_{Ratio}$
	dBm	W					
5.2GWIFI (IEEE 802.11ac20)	19.00	0.0794	6.7	4.6774	0.7391	9.01	0.082
5.8GWIFI (IEEE 802.11ac20)	19.00	0.0794	6.7	4.6774	0.7391	9.69	0.076

Remark:

1. Output power including turn-up tolerance;
2. Output power is burst average power;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer;
4. MPE values = $PG/4\pi R^2$
5. recorded the worst case results in this antennas

5.4.5. Simultaneous Transmission MPE

The sample support one BT&BLE&2.4GWLAN&5GWIFI and another one 2.4GWLAN&5GWIFI transmit antenna, so need consider simultaneous transmission;

Simultaneous transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

∑∑of MPE ratios ≤ 1.0

Mode	MPE1 Max.	MPE2 Max.	∑ MPE ratios	Limit	Results
5.2GWIFI(Ant0)+BLE(Ant1)	0.0739	0.0055	0.0794	1.000	Pass
5.2GWIFI(Ant0)+5.2GWIFI(Ant1)	0.0739	0.0739	0.1478	1.000	Pass

Note: recorded the worst case results in this antennas simultaneous transmission MPE.

Mode	MPE1 Max.	MPE2 Max.	∑ MPE ratios	Limit	Results
5.2GWIFI(Ant0)+BT(Ant1)	0.082	0.022	0.104	1.000	Pass
5.2GWIFI(Ant0)+2.4GWIFI(Ant1)	0.082	0.138	0.220	1.000	Pass
5.2GWIFI(Ant0)+5.2GWIFI(Ant1)	0.082	0.082	0.164	1.000	Pass
5.2GWIFI(Ant0)+5.8GWIFI(Ant1)	0.082	0.076	0.158	1.000	Pass
5.8GWIFI(Ant0)+BT(Ant1)	0.076	0.022	0.098	1.000	Pass
5.8GWIFI(Ant0)+2.4GWIFI(Ant1)	0.076	0.138	0.214	1.000	Pass
5.8GWIFI(Ant0)+5.2GWIFI(Ant1)	0.076	0.082	0.158	1.000	Pass
5.8GWIFI(Ant0)+5.8GWIFI(Ant1)	0.076	0.076	0.152	1.000	Pass

Note: recorded the worst case results in this antennas simultaneous transmission MPE.

6. LIST OF MEASURING EQUIPMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Power Meter	R&S	NRVS	100444	2022-06-16	2023-06-15
2	Power Sensor	R&S	NRV-Z81	100458	2022-06-16	2023-06-15
3	Power Sensor	R&S	NRV-Z32	10057	2022-06-16	2023-06-15
4	Test Software	Tonscend	JS1120-2	/	N/A	N/A
5	RF Control Unit	Tonscend	JS0806-2	N/A	2021-11-16	2022-11-15
6	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2021-11-16	2022-11-15
7	DC Power Supply	Agilent	E3642A	N/A	2021-11-25	2022-11-24
8	EMI Test Software	AUDIX	E3	/	N/A	N/A
9	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2022-06-16	2023-06-15
10	Positioning Controller	MF	MF7082	MF78020803	2022-06-16	2023-06-15
11	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2021-07-25	2024-07-24
12	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2021-07-25	2024-07-24
13	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2021-07-01	2024-06-30
14	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2020-09-20	2023-09-19
15	Broadband Preamplifier	SCHWARZBECK	BBV9745	9719-025	2022-06-16	2023-06-15
16	EMI Test Receiver	R&S	ESR 7	101181	2022-06-16	2023-06-15
17	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2021-11-16	2022-11-15
18	Broadband Preamplifier	/	BP-01M18G	P190501	2022-06-16	2023-06-15
19	6dB Attenuator	/	100W/6dB	1172040	2022-06-16	2023-06-15
20	3dB Attenuator	/	2N-3dB	/	2021-11-16	2022-11-15
21	EMI Test Receiver	R&S	ESPI	101840	2022-06-16	2023-06-15
22	Artificial Mains	R&S	ENV216	101288	2022-06-16	2023-06-15
23	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2022-06-16	2023-06-15
24	EMI Test Software	Farad	EZ	/	N/A	N/A

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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