FCC RADIO TEST REPORT

FCC ID	:	**SWX-GBE**
Equipment	:	**GigaBeam**
Brand Name	:	**Ubiquiti**
Model name	:	**GBE**
Marketing Name	:	**GigaBeam**
Applicant	:	**Ubiquiti Netwroks, Inc.** **685 Third Avenue, 27th Floor New York, New York 10017 USA**
Manufacturer	:	**Ubiquiti Netwroks, Inc.** **685 Third Avenue, 27th Floor New York, New York 10017 USA**
Standard	:	**FCC Part 15 Subpart E §15.407**

The product was received on Jul. 02, 2019 and testing was started from Jul. 03, 2019 and completed on Jul. 09, 2019. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International (USA) Inc., the test report shall not be reproduced except in full.

Approved by: Ken Chen

Sporton International (USA) Inc.

1175 Montague Expressway, Milpitas, CA 95035

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR190701001C	01	Initial issue of report	Jul. 19, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.403 (i)	6dB & 26dB Bandwidth	Not Required	-
-	2.1049	99% Occupied Bandwidth	Not Required	-
3.1	15.407 (a)	Maximum Conducted Output Power	Pass	-
-	15.407 (a)	Power Spectral Density	Not Required	-
3.2	15.407(b)	Unwanted Emissions	Pass	Under limit 1.00 dB at 5925.400 MHz
3.3	15.207	AC Conducted Emission	Pass	Under limit 5.78 dB at 0.570 MHz
-	15.407 (c)	Automatically Discontinue Transmission	Not Required	-
3.4	15.203 & 15.407 (a)	Antenna Requirement	Pass	-

Remark:
1. Not required means after assessing, test items are not necessary to carry out.
2. This is a variant report. All the test cases were performed on original report which can be referred to Sporton Report Number FR921415AN.

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Report Producer: Aileen Huang

1 General Description

1.1 Product Feature of Equipment Under Test

Wi-Fi 2.4GHz 802.11n, Wi-Fi 5GHz 802.11n/ac, Wi-Fi 60GHz 802.11ad, and GNSS

Product Specification subjective to this standard	
Antenna Type	WLAN 2.4GHz: Internal Antenna WLAN 5GHz: Internal Antenna Wi-Fi 60GHz: Antenna Array (SWL-14 Sector) GPS/Glonass/SBAS: Patch Antenna

1.2 Modification of EUT

No modifications are made to the EUT during all test items.

1.3 Testing Location

Test Site	Sporton International (USA) Inc.		
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL : 408 9043300		
Test Site No.	**Sporton Site No.**		
	TH01-CA	CO01-CA	03CH01-CA

Note: The test site complies with ANSI C63.4 2014 requirement.

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5725-5850 MHz Band 4 (U-NII-3)	149	5745	157	5785
	151*	5755	159*	5795
	153	5765	161	5805
	155#	5775	165	5825

Note:

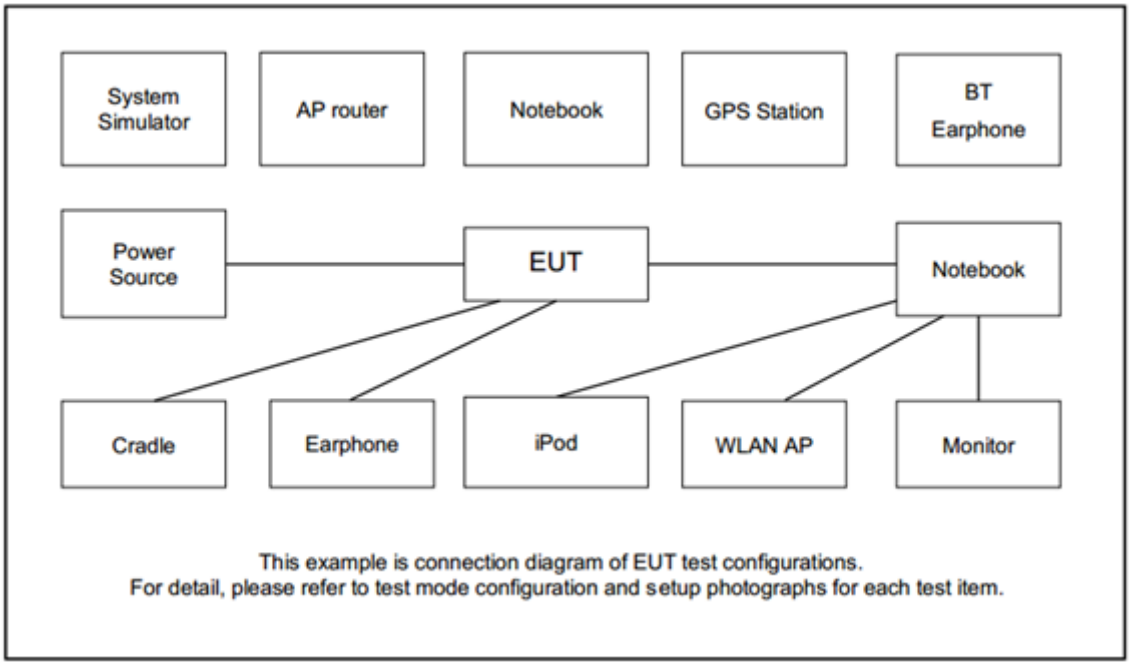
1. The above Frequency and Channel in "*" were 802.11n HT40 and 802.11ac VHT40.
2. The above Frequency and Channel in "#" were 802.11ac VHT80.

2.2 Test Mode

Test Cases	
AC Conducted Emission	Mode 1： 60GHz Tx + PoE Charging

Ch. #		Band IV：5725-5850 MHz
		802.11ac VHT40
L	Low	-
M	Middle	-
H	High	165

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Laptop	TOSHIBA	E45w-C4200X	CJ6UPA5165WB	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

3 Test Result

3.1 Maximum Conducted Output Power Measurement

3.1.1 Limit of Maximum Conducted Output Power

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

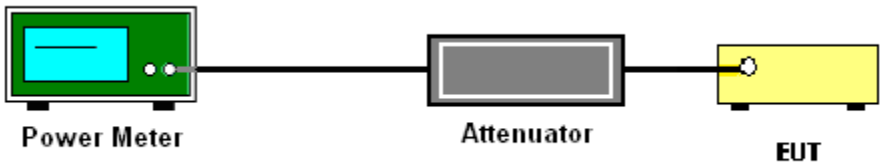
3.1.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor, 10 log(1/x), where x is the duty cycle.

3.1.4 Test Setup



3.1.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.

3.2 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.2.1 Limit of Unwanted Emissions

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

15.407(b)(4)(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.

(2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

Frequency (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

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(3) KDB789033 D02 v02r01 G)2)c)

(i) Section 15.407(b)(1) to (b)(3) specify the unwanted emission limits for the U-NII-1 and U-NII-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.3

(ii) Section 15.407(b)(4) specifies the unwanted emission limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are in terms of a Peak detector. 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 devices using the alternative limit.[4]

Note 3: 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 peak emission limit.

Note 4: Only devices with antenna gains of 10 dBi or less may be approved using the emission limits specified in Section 15.247(d) till March 2, 2018; all other devices operating in this band must use the mask specified in Section 15.407(b)(4)(i).

3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

(1) Procedure for Unwanted Emissions Measurements Below 1000MHz

- RBW = 120 kHz
- VBW = 300 kHz
- Detector = Peak
- Trace mode = max hold

(2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak
- Sweep time = auto
- Trace mode = max hold

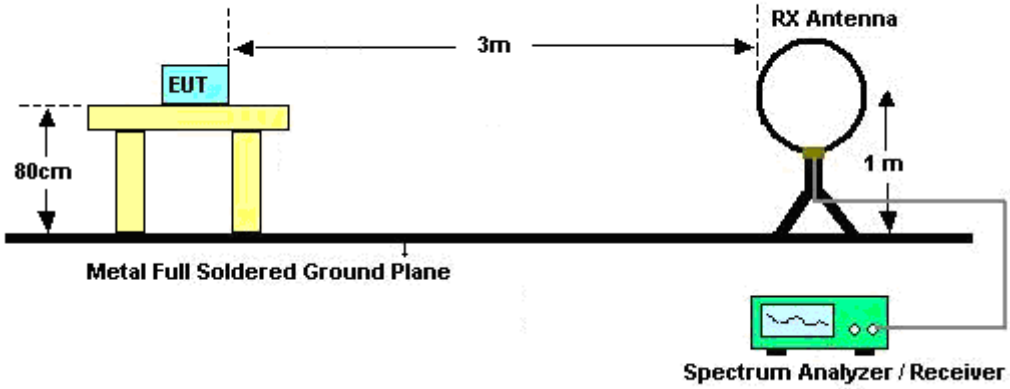
(3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

- RBW = 1 MHz
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

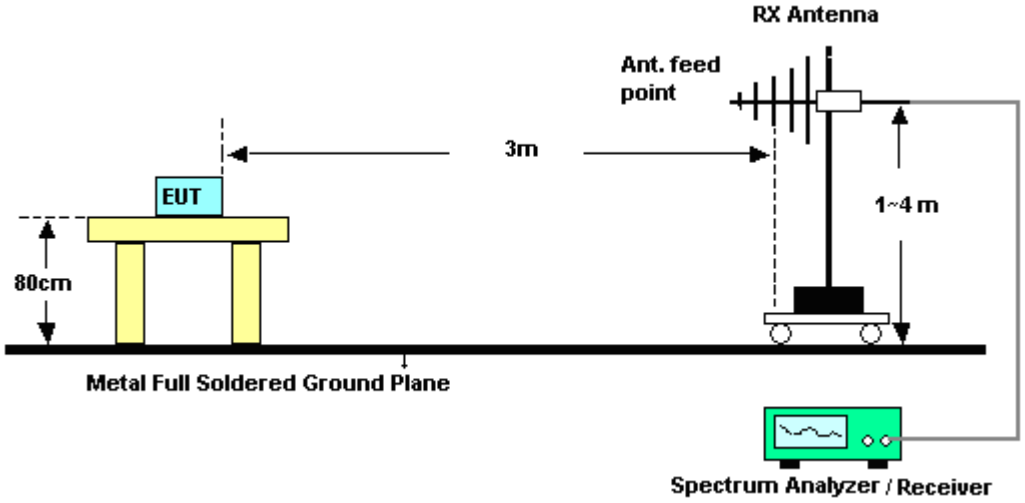
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.2.4 Test Setup

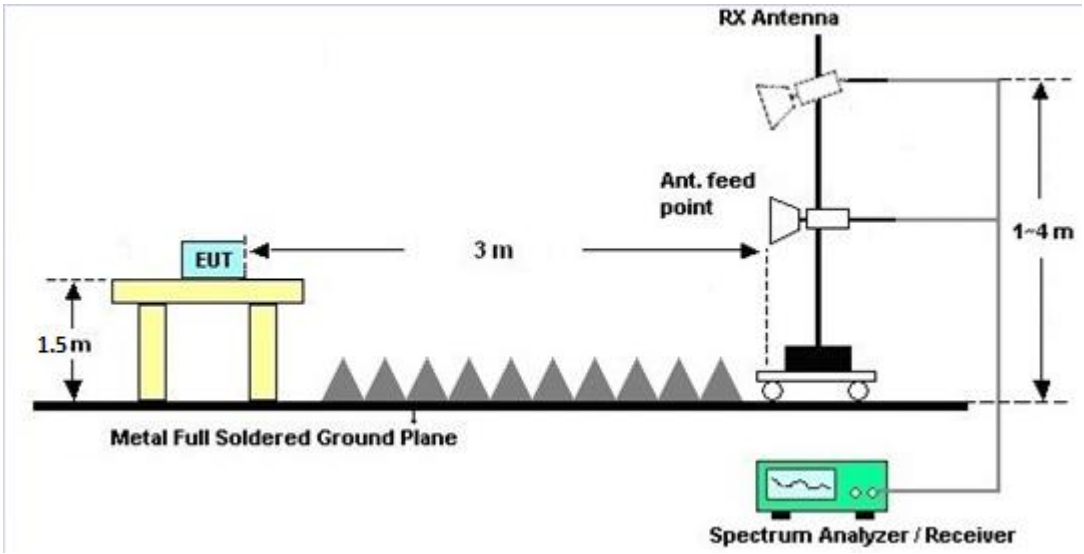
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.5 Test Results of Radiated Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.2.6 Test Result of Radiated Band Edges

Please refer to Appendix C and D.

3.2.7 Duty Cycle

Please refer to Appendix E.

3.2.8 Test Result of Unwanted Radiated Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C and D.

3.3 AC Conducted Emission Measurement

3.3.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

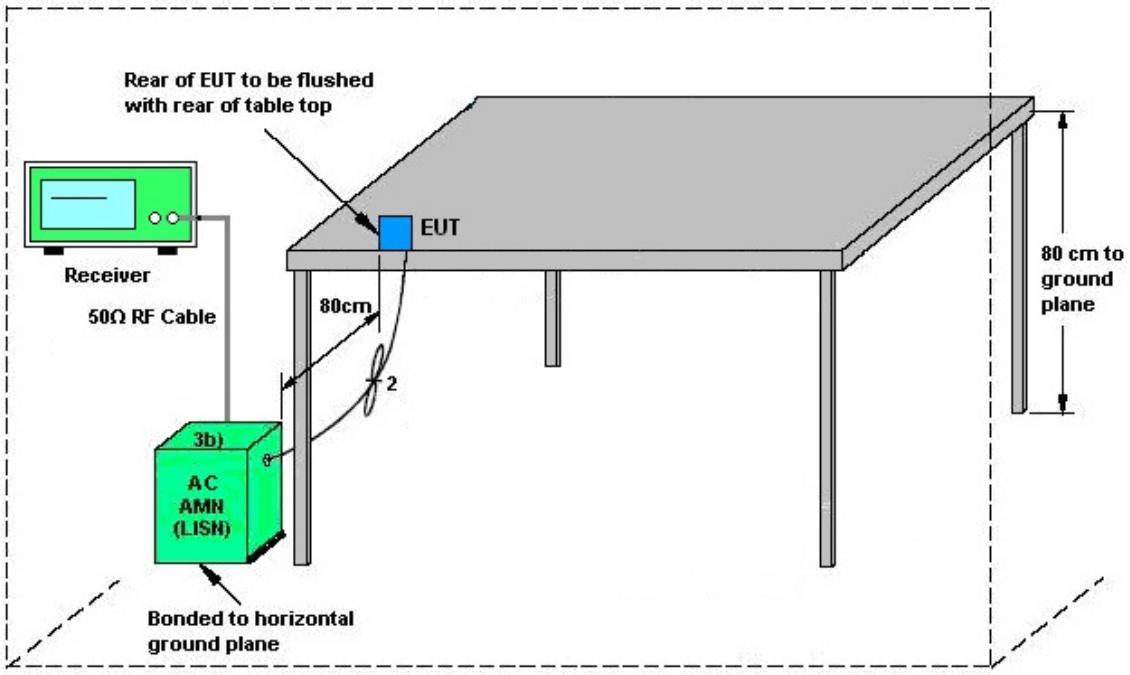
3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

3.3.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.3.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.4 Antenna Requirements

3.4.1 Standard Applicable

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.4.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.4.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = GANT + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = 10 log(NANT/NSS=1) dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with GANT set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

<CDD Modes>

			DG for Power	Power Limit Reduction
	Ant. 1 (dBi)	Ant. 2 (dBi)	(dBi)	(dB)
Band IV	10.00	10.00	10.00	4.00

Power Limit Reduction = DG(Power) – 6dBi, (min = 0)

PSD Limit Reduction = DG(PSD) – 6dBi, (min = 0)

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Bilog Antenna	TESEQ	6111D	50392	30MHz~1GHz	May 15, 2019	Jul. 08, 2019	May 14, 2020	Radiation (03CH01-CA)
Horn Antenna	SCHWARZBECK	BBHA 9120D	01894	1GHz~18GHz	Jul. 30, 2018	Jul. 08, 2019	Jul. 29, 2019	Radiation (03CH01-CA)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170 00841	18GHz~40GHz	Jul. 31, 2018	Jul. 08, 2019	Jul. 30, 2019	Radiation (03CH01-CA)
Preamplifier	EMEC	EMC18G40G	060725	18GHz~40GHz	Jul. 27, 2018	Jul. 08, 2019	Jul. 26, 2019	Radiation (03CH01-CA)
Amplifier	SONOMA	310N	372241	N/A	Aug. 02, 2018	Jul. 08, 2019	Aug. 01, 2019	Radiation (03CH01-CA)
Preamplifier	Keysight	83017A	MY532703 21	1GHz~26.5GHz	Sep. 27, 2018	Jul. 08, 2019	Sep. 26, 2019	Radiation (03CH01-CA)
Preamplifier	Jet-Power	JPA0118-55-303	171000180 0055000	1GHz~18GHz	Jul. 31, 2018	Jul. 08, 2019	Jul. 30, 2019	Radiation (03CH01-CA)
EMI Test Receiver	R&S	ESU26	100049	20Hz~26.5GHz	Aug. 23, 2018	Jul. 08, 2019	Aug. 22, 2019	Radiation (03CH01-CA)
Filter	Wainwright	WLK12-1200-1272-11000-40SS	SN1	1.2G Low Pass	Aug. 03, 2018	Jul. 08, 2019	Aug. 02, 2019	Radiation (03CH01-CA)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN9	3G Highpass	Aug. 03, 2018	Jul. 08, 2019	Aug. 02, 2019	Radiation (03CH01-CA)
Notch Filter	Wainwright	WRCJV10-2375-2400-2483-2508-40SS	SN4	Notch Filter	Aug. 03, 2018	Jul. 08, 2019	Aug. 02, 2019	Radiation (03CH01-CA)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jul. 08, 2019	N/A	Radiation (03CH01-CA)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jul. 08, 2019	N/A	Radiation (03CH01-CA)
LISN	TESEQ	NNB51	47407	N/A	Jun. 26, 2019	Jul. 03, 2019	Jun. 25, 2020	Conduction (CO01-CA)
EMI Test Receiver	R&S	ESU26	100123	20Hz~26.5GHz	Aug. 28, 2018	Jul. 03, 2019	Aug. 27, 2019	Conduction (CO01-CA)
Pulse limiter with 10dB attenuation	R&S	VTSD 9561-F N	9561-F-N00412	N/A	Jun. 11, 2019	Jul. 03, 2019	Jun. 10, 2020	Conduction (CO01-CA)
Power Meter	Anritsu	ML2495A	1804004	N/A	Aug. 09, 2018	Jul. 09, 2019	Aug. 08, 2019	Conducted (TH01-CA)
Power Sensor	Anritsu	MA2411B	1726149	300MHz~40GHz	Aug. 09, 2018	Jul. 09, 2019	Aug. 08, 2019	Conducted (TH01-CA)
Spectrum Analyzer	Rohde & Schwarz	FSV 40	101089	10Hz~40GHz	Aug. 23, 2018	Jul. 09, 2019	Aug. 22, 2019	Conducted (TH01-CA)
Temperature & Humidity Chamber	ESPEC	SH-642	93012171	N/A	Apr. 12, 2019	Jul. 09, 2019	Apr. 11, 2020	Conducted (TH01-CA)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**1.7**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.4**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.5**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.9**

Appendix A. Test Result of Conducted Test Items

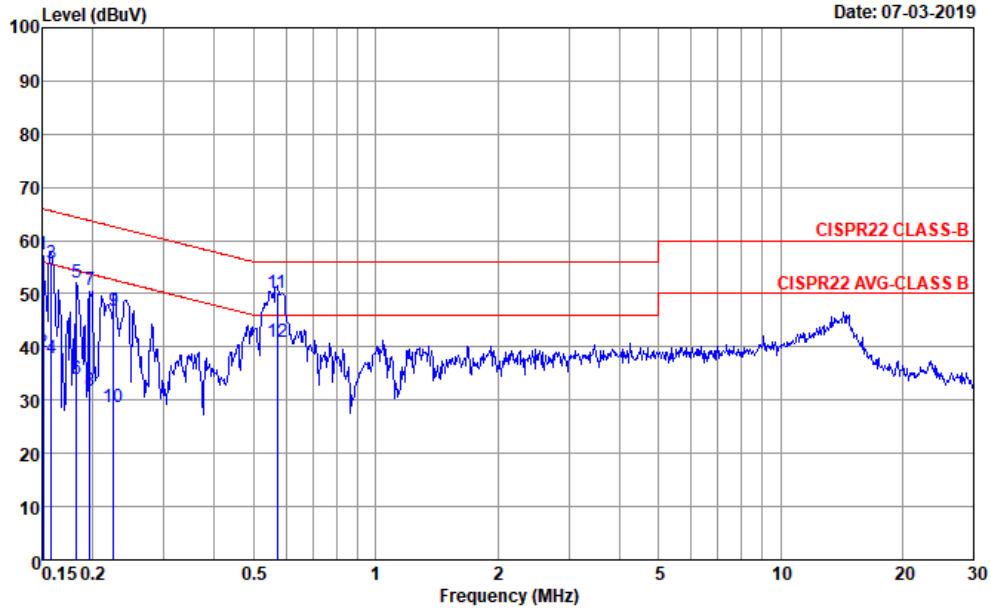
Test Engineer:	Jordan Huang	Temperature:	21~25	°C
Test Date:	2019/7/9	Relative Humidity:	51~54	%

TEST RESULTS DATA
Average Power Table

Band IV												
Mod.	Data Rate	NTx	CH.	Freq. (MHz)	Average Conducted Power (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2	
HT20	MCS0	2	149	5745	22.72	22.67	25.70	26.00		10.00		Pass
HT20	MCS0	2	157	5785	22.58	22.67	25.63	26.00		10.00		Pass
HT20	MCS0	2	165	5825	22.62	22.37	25.51	26.00		10.00		Pass
HT40	MCS0	2	151	5755	22.62	22.59	25.61	26.00		10.00		Pass
HT40	MCS0	2	159	5795	22.61	22.62	25.62	26.00		10.00		Pass
VHT20	MCS0	2	149	5745	22.63	22.65	25.65	26.00		10.00		Pass
VHT20	MCS0	2	157	5785	22.54	22.62	25.59	26.00		10.00		Pass
VHT20	MCS0	2	165	5825	22.55	22.37	25.47	26.00		10.00		Pass
VHT40	MCS0	2	151	5755	22.70	22.52	25.62	26.00		10.00		Pass
VHT40	MCS0	2	159	5795	22.68	22.55	25.62	26.00		10.00		Pass
VHT80	MCS0	2	155	5775	22.64	22.63	25.65	26.00		10.00		Pass

Appendix B. AC Conducted Emission Test Results

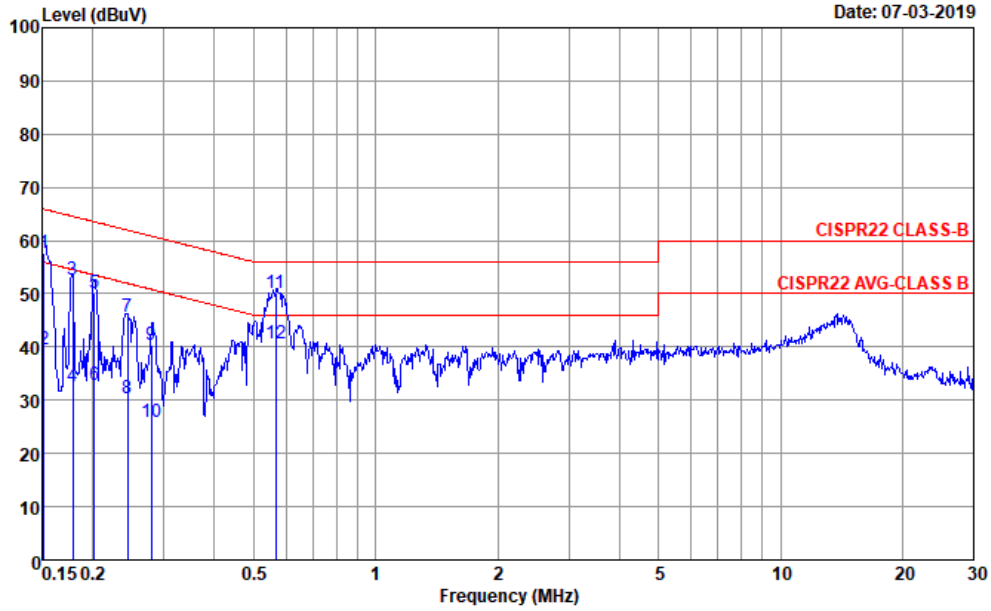
Test Engineer :	Leo Liu	Temperature :	20~23℃
		Relative Humidity :	47~50%
Test Voltage :	120Vac / 60Hz	Phase :	Line



Site : CO01-CA
Condition : CISPR22 CLASS-B NNB51_L1_USA407 LINE
Pretest : 190701001
Power : AVR 120Vac/60Hz
EUT : 60GHz AP

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Aux Factor	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	dB		
1	0.15	57.26	-8.70	65.96	37.30	9.84	0.06	10.06	QP	LINE
2	0.15	39.06	-26.94	66.00	19.10	9.84	0.06	10.06	Average	LINE
3	0.16	55.76	-9.80	65.56	35.80	9.84	0.06	10.06	QP	LINE
4	0.16	37.76	-28.24	66.00	17.80	9.84	0.06	10.06	Average	LINE
5	0.18	52.17	-12.20	64.37	32.20	9.84	0.07	10.06	QP	LINE
6	0.18	34.07	-31.93	66.00	14.10	9.84	0.07	10.06	Average	LINE
7	0.20	50.57	-13.19	63.76	30.60	9.84	0.07	10.06	QP	LINE
8	0.20	31.67	-34.33	66.00	11.70	9.84	0.07	10.06	Average	LINE
9	0.23	46.68	-15.93	62.61	26.70	9.85	0.07	10.06	QP	LINE
10	0.23	28.58	-37.42	66.00	8.60	9.85	0.07	10.06	Average	LINE
11	0.57	50.22	-5.78	56.00	30.21	9.86	0.07	10.08	QP	LINE
12	0.57	41.02	-18.98	60.00	21.01	9.86	0.07	10.08	Average	LINE

Test Engineer :	Leo Liu	**Temperature :**	**20**~23℃
		Relative Humidity :	**47**~50%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral



Site : CO01-CA
Condition : CISPR22 CLASS-B NNB51_N_USA407 NEUTRAL
Pretest : 190701001
Power : AVR 120Vac/60Hz
EUT : 60GHz AP

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Aux Factor	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	dB		
1	0.15	57.58	-8.33	65.91	37.60	9.86	0.06	10.06	QP	NEUTRAL
2	0.15	39.58	-26.33	65.91	19.60	9.86	0.06	10.06	Average	NEUTRAL
3	0.18	52.59	-11.96	64.55	32.60	9.86	0.07	10.06	QP	NEUTRAL
4	0.18	32.69	-31.86	64.55	12.70	9.86	0.07	10.06	Average	NEUTRAL
5	0.20	50.19	-13.35	63.54	30.20	9.86	0.07	10.06	QP	NEUTRAL
6	0.20	32.99	-30.55	63.54	13.00	9.86	0.07	10.06	Average	NEUTRAL
7	0.24	45.59	-16.36	61.95	25.60	9.86	0.07	10.06	QP	NEUTRAL
8	0.24	30.29	-31.66	61.95	10.30	9.86	0.07	10.06	Average	NEUTRAL
9	0.28	40.30	-20.55	60.85	20.30	9.86	0.07	10.07	QP	NEUTRAL
10	0.28	25.90	-34.95	60.85	5.90	9.86	0.07	10.07	Average	NEUTRAL
11	0.57	50.03	-5.97	56.00	30.01	9.87	0.07	10.08	QP	NEUTRAL
12	0.57	40.63	-15.37	56.00	20.61	9.87	0.07	10.08	Average	NEUTRAL

Appendix C. Radiated Spurious Emission

Test Engineer :	Leo Liu	Temperature :	20~23°C
		Relative Humidity :	53~55%

Band 4 - 5725~5850MHz

WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		5629.475	58.57	-9.63	68.2	45.18	32.13	11.17	29.91	213	180	P	H
		5699	65.47	-38.99	104.46	51.93	32.2	11.27	29.93	213	180	P	H
		5718.125	68.24	-42.04	110.28	54.67	32.22	11.29	29.94	213	180	P	H
		5723.975	70.09	-49.77	119.86	56.51	32.22	11.3	29.94	213	180	P	H
	*	5825	120.37	-	-	106.58	32.33	11.44	29.98	213	180	P	H
	*	5825	111.7	-	-	97.91	32.33	11.44	29.98	213	180	A	H
		5851.2	98.94	-20.52	119.46	85.11	32.35	11.47	29.99	213	180	P	H
		5860.6	97.93	-11.3	109.23	84.08	32.36	11.48	29.99	213	180	P	H
		5875.8	83.08	-21.53	104.61	69.2	32.38	11.5	30	213	180	P	H
		5925.4	67.2	-1	68.2	53.21	32.43	11.57	30.01	213	180	P	H
802.11ac													H
VHT40													H
CH 165		5649.275	57.41	-10.79	68.2	43.97	32.15	11.2	29.91	200	189	P	V
5825MHz		5699.225	63.25	-41.38	104.63	49.71	32.2	11.27	29.93	200	189	P	V
		5717.675	67.8	-42.35	110.15	54.23	32.22	11.29	29.94	200	189	P	V
		5721.05	67.54	-45.65	113.19	53.96	32.22	11.3	29.94	200	189	P	V
	*	5825	115.47	-	-	101.68	32.33	11.44	29.98	202	189	P	V
	*	5825	105.89	-	-	92.1	32.33	11.44	29.98	202	189	A	V
		5851.8	97.54	-20.56	118.1	83.71	32.35	11.47	29.99	202	189	P	V
		5860.4	95.75	-13.54	109.29	81.9	32.36	11.48	29.99	202	189	P	V
		5880.6	86.4	-14.64	101.04	72.51	32.38	11.51	30	202	189	P	V
		5929.6	65.63	-2.57	68.2	51.63	32.43	11.58	30.01	202	189	P	V
													V
													V

Band 4 5725~5850MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ac VHT40 CH 165 5825MHz		7561	55.84	-18.16	74	62.33	36.56	13.39	56.44	274	235	P	H
		7561	51.77	-2.23	54	58.26	36.56	13.39	56.44	274	235	A	H
		11650	49.28	-24.72	74	53.34	39.77	15.87	59.7	100	0	P	H
		14887	58.56	-9.64	68.2	60.23	41.77	17.85	61.29	103	122	P	H
		14887	47.24	-6.76	54	48.91	41.77	17.85	61.29	103	122	A	H
		17475	49.98	-18.22	68.2	46.25	42.21	19.19	57.67	100	0	P	H
		11650	48.92	-25.08	74	52.98	39.77	15.87	59.7	100	0	P	V
		14986	55.41	-12.79	68.2	57.19	41.53	17.9	61.21	120	162	P	V
		14986	47.03	-6.97	54	48.81	41.53	17.9	61.21	120	162	A	V
		17475	49.22	-18.98	68.2	45.49	42.21	19.19	57.67	100	0	P	V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

5GHz WIFI 802.11ac VHT40 (LF @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		112.45	29.65	-13.85	43.5	42.95	17.25	1.87	32.35	-	-		H
		159.98	30.16	-13.34	43.5	43.81	16.6	2.17	32.34	-	-		H
		226.91	29.61	-16.39	46	43.55	15.89	2.67	32.37	-	-		H
		364.65	29.57	-16.43	46	37.92	20.99	3.27	32.47	-	-		H
		395.69	30.1	-15.9	46	37.71	21.63	3.42	32.48	-	-		H
		874.87	33.28	-12.72	46	31.1	29.1	5.22	31.76	100	0		H
													H
													H
													H
													H
5GHz													H
802.11n													H
VHT40		49.4	35.26	-4.74	40	51.72	14.5	1.44	32.4	100	0		V
LF		101.78	28.03	-15.47	43.5	42.39	16.26	1.73	32.35	-	-		V
		144.46	24.71	-18.79	43.5	37.54	17.5	2.02	32.35	-	-		V
		226.91	25.02	-20.98	46	38.96	15.89	2.54	32.37	-	-		V
		407.33	27	-19	46	34.07	22.14	3.28	32.49	-	-		V
		876.81	32.28	-13.72	46	30.05	29.14	4.84	31.75	-	-		V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

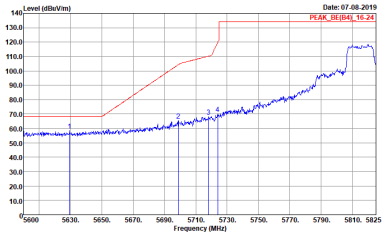
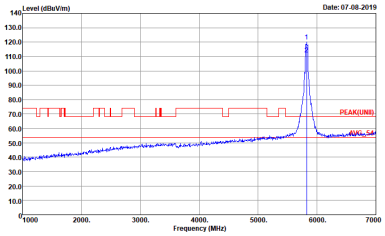
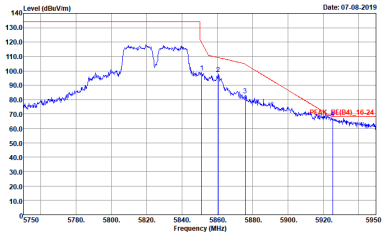
Both peak and average measured complies with the limit line, so test result is "PASS".

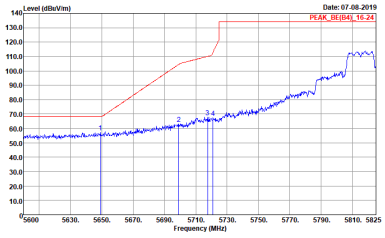
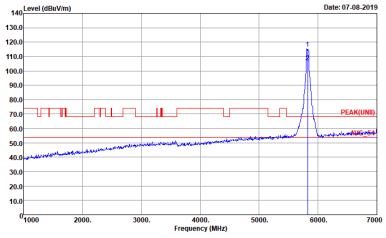
Appendix D. Radiated Spurious Emission Plots

Test Engineer :	Leo Liu	**Temperature :**	20~23°C
		Relative Humidity :	53~55%

Band 4 - 5725~5850MHz

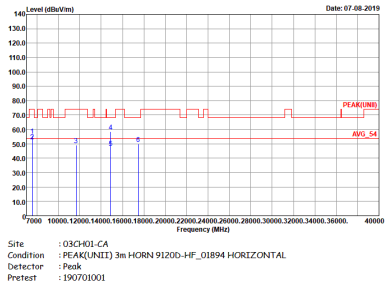
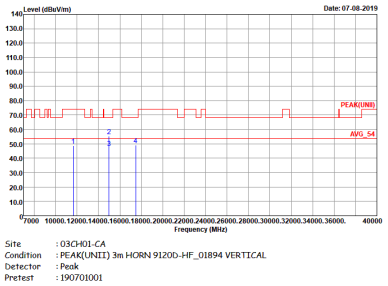
WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ac VHT40 CH165 5825MHz	
1+2	Horizontal	Fundamental
Peak	 Site : 03CH01-CA Condition : PEAK_BE(B4)_16-24 3m HORN 9120D-HF_01894 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36	 Site : 03CH01-CA Condition : PEAK(UNII) 3m HORN 9120D-HF_01894 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36
Peak	 Site : 03CH01-CA Condition : PEAK_BE(B4)_16-24 3m HORN 9120D-HF_01894 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36	Left blank

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ac VHT40 CH165 5825MHz	
1+2	Vertical	Fundamental
Peak	 Site : 03CH01-CA Condition : PEAK_BE(B4)_16-24 3m HORN 9120D-HF_01894 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36	 Site : 03CH01-CA Condition : PEAK(UNII) 3m HORN 9120D-HF_01894 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36
Peak	 Site : 03CH01-CA Condition : PEAK_BE(B4)_16-24 3m HORN 9120D-HF_01894 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Pretest : 190701001 Power : AVR 120Vac/60Hz Plane : Z Settings : 36	Left blank

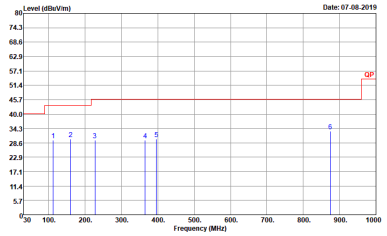
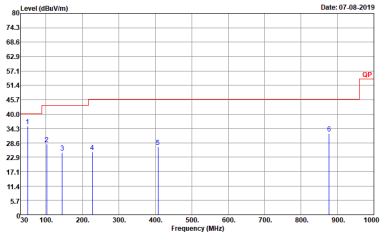
Band 4 - 5725~5850MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI	Band 4 5725~5850MHz Harmonic @ 3m	
ANT	802.11ac VHT40 CH165 5825MHz	
1+2	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

5GHz WIFI 802.11ac VHT40 (LF)

WIFI	5GHz 5725~5850MHz	
ANT	802.11ac VHT40 LF	
1+2	Horizontal	Vertical
QP / Peak		

Site : 03CH01-CA
Condition : QP 3m BILOG 6111D-LF_50392 HORIZONTAL
Pretest : 190701001
Power : AVR 120Vac/60Hz

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Cable Factor	Preamp Loss	Factor	A/Pos	T/Pos	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	
1	112.45	29.65	-13.85	43.50	42.95	17.25	1.73	32.35	---	---	Peak
2	159.98	30.16	-13.34	43.50	43.81	16.60	2.01	32.34	---	---	Peak
3	226.91	29.61	-16.39	46.00	43.55	15.89	2.41	32.37	---	---	Peak
4	364.65	29.57	-16.43	46.00	37.92	20.99	2.99	32.47	---	---	Peak
5	395.69	30.10	-15.90	46.00	37.71	21.63	3.06	32.48	---	---	Peak
6	874.87	33.28	-12.72	46.00	31.10	29.10	4.46	31.76	100	0	Peak

Site : 03CH01-CA
Condition : QP 3m BILOG 6111D-LF_50392 VERTICAL
Pretest : 190701001
Power : AVR 120Vac/60Hz

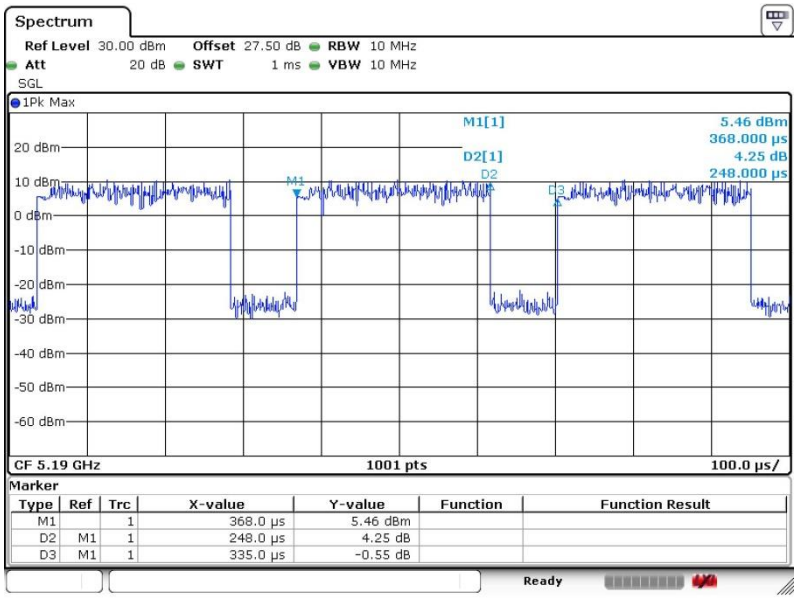
	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Cable Factor	Preamp Loss	Factor	A/Pos	T/Pos	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	
1	49.40	35.26	-4.74	40.00	51.72	14.50	1.35	32.40	100	0	Peak
2	101.78	28.03	-15.47	43.50	42.39	16.26	1.67	32.35	---	---	Peak
3	144.46	24.71	-18.79	43.50	37.54	17.50	1.92	32.35	---	---	Peak
4	226.91	25.02	-20.98	46.00	38.96	15.89	2.41	32.37	---	---	Peak
5	407.33	27.00	-19.00	46.00	34.07	22.14	3.09	32.49	---	---	Peak
6	876.81	32.28	-13.72	46.00	30.05	29.14	4.47	31.75	---	---	Peak

Appendix E. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
1+2	5GHz 802.11ac VHT40 for Ant. 1	74.03	248	4.03	10kHz	1.31
1+2	5GHz 802.11ac VHT40 for Ant. 2	75.84	248	4.03	10kHz	1.20

MIMO <Ant. 1>

802.11ac VHT40



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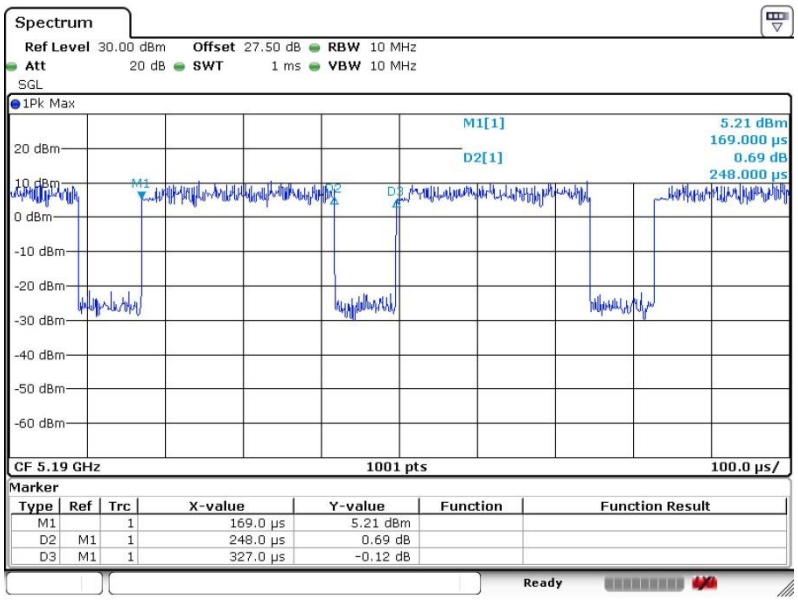
MIMO <Ant. 2>

802.11ac VHT40



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