FCC RF Test Report

APPLICANT	:	Elo Touch Solutions, Inc.
EQUIPMENT	:	Mobile POS
BRAND NAME	:	ELO or elo
MODEL NAME	:	EMC0600S
FCC ID	:	RBWEMC0600
STANDARD	:	FCC Part 15 Subpart E §15.407
CLASSIFICATION	:	(NII) Unlicensed National Information Infrastructure
TEST DATE(S)	:	Nov. 19, 2021 ~ Dec. 08, 2021

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

Jason Jia

Reviewed by: Jason Jia / Supervisor

Alex Wang

Approved by: Alex Wang / Manager

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR142804-03D	Rev. 01	Initial issue of report	Jan. 21, 2022

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
–	2.1049 & 15.403(i)	26dB & 99% Bandwidth	-	Not Applicable	-
3.1	15.407(a)	Maximum Conducted Output Power	≤ 24 dBm	Pass	-
3.2	15.407(a)	Power Spectral Density	≤ 11 dBm	Pass	-
3.3	15.407(b)	Unwanted Emissions	15.407(b) & 15.209(a)	Pass	Under limit 4.01 dB at 5455.280 MHz
–	15.207	AC Conducted Emission	15.207(a)	Not Applicable	-
3.4	15.203 & 15.407(a)	Antenna Requirement	15.203 & 15.407(a)	Pass	-
Remark: Not Applicable means after assessing, test items are not necessary to carry out.					

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.

1 General Description

1.1 Applicant

Elo Touch Solutions, Inc.
670 N. McCarthy Blvd. Suite 100, Milpitas, CA 95035, United States

1.2 Manufacturer

Elo Touch Solutions, Inc.
670 N. McCarthy Blvd. Suite 100, Milpitas, CA 95035, United States

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Mobile POS
Brand Name	ELO or elo
Model Name	EMC0600S
FCC ID	RBWEMC0600
HW Version	A01
SW Version	5.000.009.0100+p
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This is a variant report for EMC0600S. The change note could be referred to the Class II permissive change letter which is exhibit separately. Based on the similarity between current and previous project, only the related test cases from original test report (Sporton Report Number 142804A) were verified for the differences.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	5180 MHz ~ 5240 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5700 MHz
Maximum Output Power to Antenna	**SISO <Ant.2>** **<5180 MHz ~ 5240 MHz>** 802.11a : 12.27 dBm / 0.0169 W **<5260 MHz ~ 5320 MHz>** 802.11a : 12.52 dBm / 0.0179 W **<5500 MHz ~ 5700 MHz >** 802.11a : 12.01 dBm / 0.0159 W **MIMO <Ant.1+2>** **<5180 MHz ~ 5240 MHz>** 802.11n HT20 : 15.24 dBm / 0.0334 W 802.11n HT40 : 14.43 dBm / 0.0277 W 802.11ac VHT20 : 13.19 dBm / 0.0208 W 802.11ac VHT40 : 13.31 dBm / 0.0214 W 802.11ac VHT80 : 13.00 dBm / 0.0200 W **<5260 MHz ~ 5320 MHz>** 802.11n HT20 : 15.45 dBm / 0.0351 W 802.11n HT40 : 14.58 dBm / 0.0287 W 802.11ac VHT20 : 13.31 dBm / 0.0214 W 802.11ac VHT40 : 13.65 dBm / 0.0232 W 802.11ac VHT80 : 13.42 dBm / 0.0220 W **<5500 MHz ~ 5700 MHz >** 802.11n HT20 : 15.15 dBm / 0.0327 W 802.11n HT40 : 14.32 dBm / 0.0270 W 802.11ac VHT20 : 12.96 dBm / 0.0198 W 802.11ac VHT40 : 13.33 dBm / 0.0215 W 802.11ac VHT80 : 13.11 dBm / 0.0205 W
Antenna Type / Gain	**<5150 MHz ~ 5250 MHz>** <Ant. 1> : PIFA Antenna with gain 0.58 dBi <Ant. 2> : PIFA Antenna with gain 2.35 dBi **<5250 MHz ~ 5350 MHz>** <Ant. 1> : PIFA Antenna with gain -0.30 dBi <Ant. 2> : PIFA Antenna with gain 2.90 dBi **<5470 MHz ~ 5725 MHz>** <Ant. 1> : PIFA Antenna with gain 0.44 dBi <Ant. 2> : PIFA Antenna with gain 3.69 dBi
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)

Note:

1. WLAN operation in 5600 MHz ~ 5650 MHz is notched.

2. Note: For 802.11n HT20 / ac VHT20 and 802.11n HT40 / ac VHT40 mode, the whole testing have assessed only 802.11n HT20/HT40 by referring to their maximum conducted power.

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	TH01-KS 03CH05-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH05-KS	AUDIX	E3	6.2009-8-24al

1.8 Applicable Standards

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

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

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

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: 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 (X plane) were recorded in this report.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5150-5250 MHz U-NII-1	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42#	5210		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5250-5350 MHz U-NII-2A	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58#	5290		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5470-5725 MHz U-NII-2C	100	5500	112	5560
	102*	5510	116	5580
	104	5520	132	5660
	106#	5530	134*	5670
	108	5540	136	5680
	110*	5550	140	5700

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

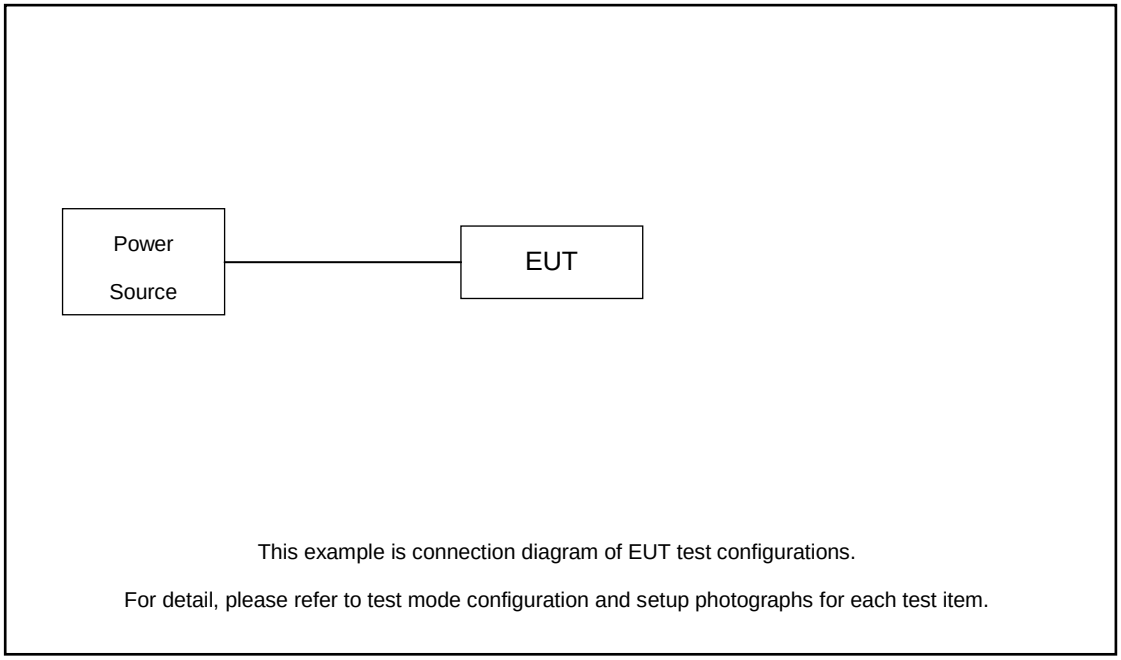
Final test modes are considering the modulation and worse data rates as below table.

MIMO Mode

Modulation	Data Rate
802.11ac VHT80	MCS0

Ch. #		U-NII-2C：5470-5725MHz
		802.11ac VHT80
L	Low	106
M	Middle	-
H	High	-

2.3 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuously transmit/receive.

2.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 6.80 dB.

Offset(dB) = RF cable loss(dB).

= 6.80 (dB)

3 Test Result

3.1 Maximum Conducted Output Power Measurement

3.1.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW.

For the 5.25–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm 10 log B, where B is the 26 dB emission bandwidth in megahertz.

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.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

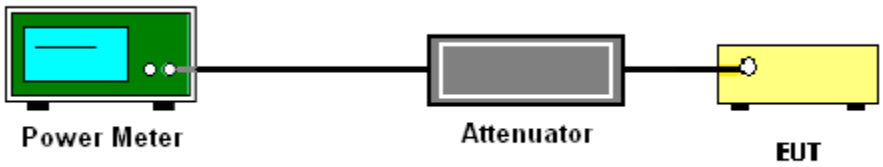
3.1.3 Test Procedures

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.
4. For MIMO mode, the measure-and-sum technique should be used for measuring the in-band transmit power of a device.

3.1.4 Test Setup



3.1.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.

3.2 Power Spectral Density Measurement

3.2.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

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.

3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section F) Maximum power spectral density.

 # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW ≥ 3 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- Add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add 10 log(1/0.25) = 6 dB if the duty cycle is 25 percent.

1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.
3. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (a): Measure and sum the spectra across the outputs.

The total final Power Spectral Density is the bin-by-bin summation to obtain the combined spectrum. For the device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

Method (b): Measure and sum spectral maxima across the outputs.

The measurement on each individual output were performed with the same span and number on each individual output. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs.

Method (c): Measure and add 10 log(N_{ANT}) dB, where N_{ANT} is the number of outputs.

The measurement on each individual output were performed with the same span and number on each individual output. The quantity 10 log(N_{ANT}) dB is added to each spectrum value before comparing to the emission limit.

3.2.4 Test Setup

3.2.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.3 Unwanted Emissions Measurement

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

3.3.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5725 MHz band: all emissions outside of the 5470-5725 MHz band shall not exceed an EIRP of -27 dBm/MHz.

(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

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

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

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 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

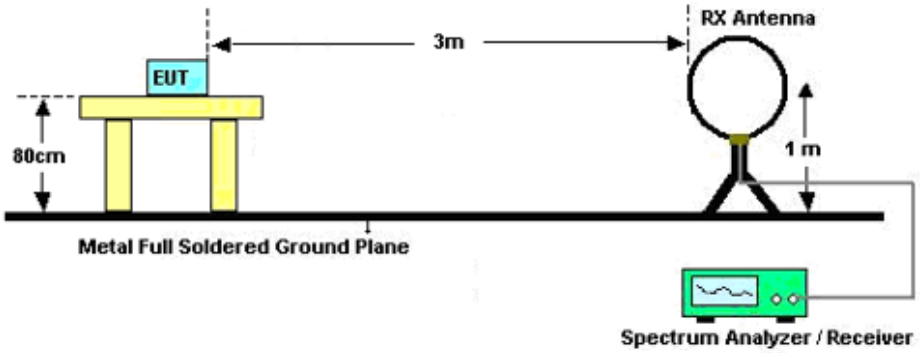
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - 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.

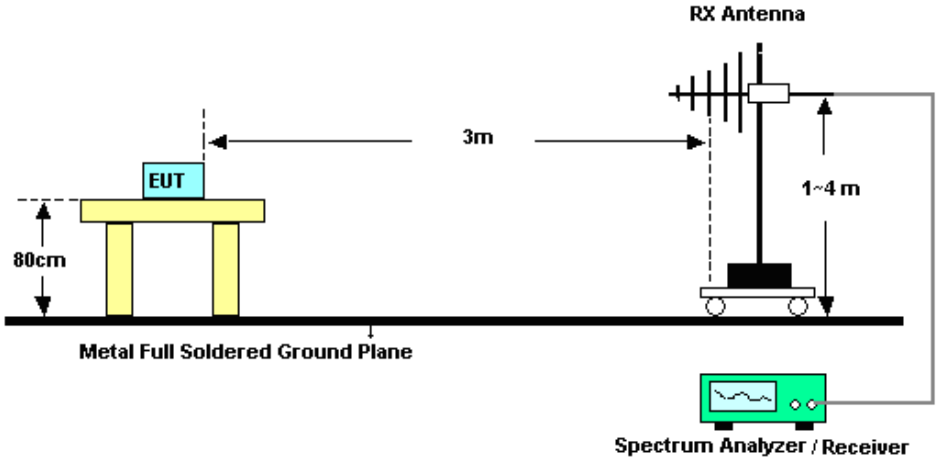
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband 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 peak 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.

3.3.4 Test Setup

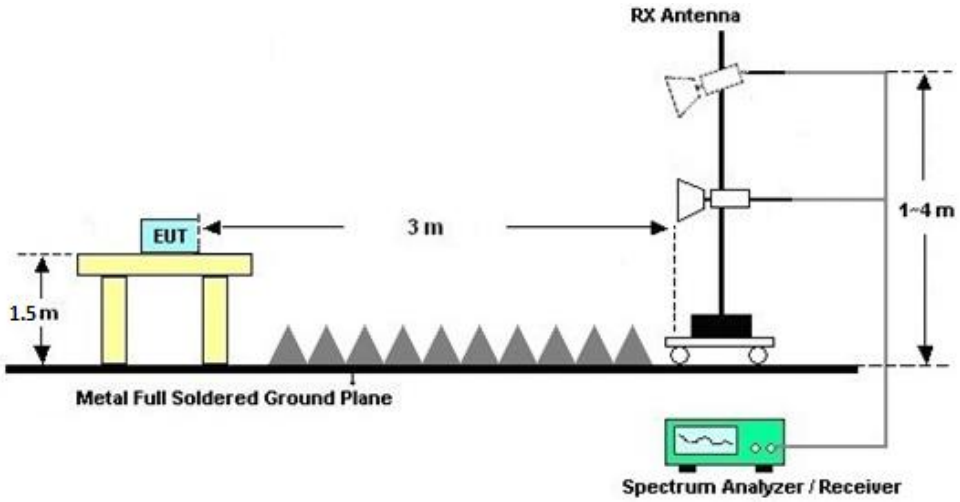
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.3.5 Test Results of Radiated Spurious 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 semi-Anechoic chamber, and the result came out very similar.

3.3.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.3.7 Duty Cycle

Please refer to Appendix C.

3.3.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

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 GANT 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.

	Ant. 1 (dBi)	Ant. 2 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
Band I	0.58	2.35	2.35	4.52	0.00	0.00
Band II	-0.30	2.90	2.90	4.46	0.00	0.00
Band III	0.44	3.69	3.69	5.23	0.00	0.00

Power limit reduction = Composite gain – 6dBi, (min = 0)

PSD limit reduction = Composite gain + PSD Array gain – 6dBi, (min = 0)

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 14, 2021	Nov. 19, 2021	Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 07, 2021	Nov. 19, 2021	Jan. 06, 2022	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 07, 2021	Nov. 19, 2021	Jan. 06, 2022	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 16, 2021	Dec. 08, 2021	Oct. 15, 2022	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44G,MAX 30dB	Apr. 13, 2021	Dec. 08, 2021	Apr. 12, 2022	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Dec. 08, 2021	Oct. 29, 2022	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	Jun. 04, 2021	Dec. 08, 2021	Jun. 03, 2022	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 24, 2021	Dec. 08, 2021	Apr. 23, 2022	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 06, 2021	Dec. 08, 2021	Jan. 05, 2022	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	Apr. 12, 2021	Dec. 08, 2021	Apr. 11, 2022	Radiation (03CH05-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 07, 2021	Dec. 08, 2021	Jan. 06, 2022	Radiation (03CH05-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2012228	1Ghz-18Ghz	Oct. 16, 2021	Dec. 08, 2021	Oct. 15, 2022	Radiation (03CH05-KS)
Amplifier	Keysight	83017A	MY53270316	500MHz~26.5GHz	Oct. 16, 2021	Dec. 08, 2021	Oct. 15, 2022	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Dec. 08, 2021	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Dec. 08, 2021	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Dec. 08, 2021	NCR	Radiation (03CH05-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

---------- THE END ----------

Appendix A. Conducted Test Results

Test Engineer:	HeYong	Temperature:	21~25	°C
Test Date:	2021/11/19	Relative Humidity:	51~54	%

TEST RESULTS DATA
Average Power Table

FCC U-NII-1 single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)			Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	36	5180	11.80	11.93		24.00	24.00	0.58	2.35		Pass
11a	6Mbps	1	44	5220	11.75	12.13		24.00	24.00	0.58	2.35		Pass
11a	6Mbps	1	48	5240	11.88	12.27		24.00	24.00	0.58	2.35		Pass

FCC U-NII-1 MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (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	36	5180	11.90	12.15	15.04	24.00		2.35			Pass
HT20	MCS0	2	44	5220	11.81	12.39	15.12	24.00		2.35			Pass
HT20	MCS0	2	48	5240	11.96	12.49	15.24	24.00		2.35			Pass
HT40	MCS0	2	38	5190	11.16	11.44	14.31	24.00		2.35			Pass
HT40	MCS0	2	46	5230	11.11	11.71	14.43	24.00		2.35			Pass
VHT20	MCS0	2	36	5180	9.79	9.95	12.88	24.00		2.35			Pass
VHT20	MCS0	2	44	5220	9.81	10.36	13.11	24.00		2.35			Pass
VHT20	MCS0	2	48	5240	9.96	10.39	13.19	24.00		2.35			Pass
VHT40	MCS0	2	38	5190	10.10	10.41	13.27	24.00		2.35			Pass
VHT40	MCS0	2	46	5230	10.01	10.58	13.31	24.00		2.35			Pass
VHT80	MCS0	2	42	5210	10.12	9.84	13.00	24.00		2.35			Pass

TEST RESULTS DATA
Power Spectral Density

FCC U-NII-1 single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	36	5180	1.36	1.73		11.00	11.00	0.58	2.35		Pass
11a	6Mbps	1	44	5220	1.88	2.27		11.00	11.00	0.58	2.35		Pass
11a	6Mbps	1	48	5240	1.57	1.96		11.00	11.00	0.58	2.35		Pass

FCC U-NII-1 MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
HT20	MCS0	2	36	5180			3.94	11.00		4.52			Pass
HT20	MCS0	2	44	5220			3.68	11.00		4.52			Pass
HT20	MCS0	2	48	5240			4.06	11.00		4.52			Pass
HT40	MCS0	2	38	5190			0.20	11.00		4.52			Pass
HT40	MCS0	2	46	5230			0.42	11.00		4.52			Pass
VHT80	MCS0	2	42	5210			-3.94	11.00		4.52			Pass

TEST RESULTS DATA
Average Power Table

FCC U-NII-2A single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		EIRP Power Limit (dBm)	Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	52	5260	12.03	12.47		23.98	23.98	-0.30	2.90	30	Pass
11a	6Mbps	1	60	5300	12.08	12.52		23.98	23.98	-0.30	2.90	30	Pass
11a	6Mbps	1	64	5320	12.06	12.39		23.98	23.98	-0.30	2.90	30	Pass

FCC U-NII-2A MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		EIRP Power Limit (dBm)	Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
HT20	MCS0	2	52	5260	12.11	12.74	15.45	23.98		2.90		30	Pass
HT20	MCS0	2	60	5300	12.19	12.68	15.45	23.98		2.90		30	Pass
HT20	MCS0	2	64	5320	12.08	12.62	15.37	23.98		2.90		30	Pass
HT40	MCS0	2	54	5270	11.31	11.82	14.58	23.98		2.90		30	Pass
HT40	MCS0	2	62	5310	11.13	11.83	14.50	23.98		2.90		30	Pass
VHT20	MCS0	2	52	5260	10.07	10.52	13.31	23.98		2.90		30	Pass
VHT20	MCS0	2	60	5300	9.88	10.53	13.23	23.98		2.90		30	Pass
VHT20	MCS0	2	64	5320	10.09	10.43	13.28	23.98		2.90		30	Pass
VHT40	MCS0	2	54	5270	10.37	10.90	13.65	23.98		2.90		30	Pass
VHT40	MCS0	2	62	5310	9.98	10.79	13.41	23.98		2.90		30	Pass
VHT80	MCS0	2	58	5290	10.39	10.42	13.42	23.98		2.90		30	Pass

TEST RESULTS DATA
Power Spectral Density

U-NII-2A single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	52	5260	1.74	2.23		11.00	11.00	-0.30	2.90		Pass
11a	6Mbps	1	60	5300	1.53	2.08		11.00	11.00	-0.30	2.90		Pass
11a	6Mbps	1	64	5320	1.69	1.97		11.00	11.00	-0.30	2.90		Pass

U-NII-2A MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
HT20	MCS0	2	52	5260			4.18	11.00		4.46			Pass
HT20	MCS0	2	60	5300			4.18	11.00		4.46			Pass
HT20	MCS0	2	64	5320			4.16	11.00		4.46			Pass
HT40	MCS0	2	54	5270			0.41	11.00		4.46			Pass
HT40	MCS0	2	62	5310			0.31	11.00		4.46			Pass
VHT80	MCS0	2	58	5290			-3.58	11.00		4.46			Pass

TEST RESULTS DATA
Average Power Table

FCC U-NII-2C single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		EIRP Power Limit (dBm)	Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	100	5500	11.78	11.97		23.98	23.98	0.44	3.69	30	Pass
11a	6Mbps	1	116	5580	11.87	12.01		23.98	23.98	0.44	3.69	30	Pass
11a	6Mbps	1	140	5700	11.46	11.97		23.98	23.98	0.44	3.69	30	Pass

FCC U-NII-2C MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		EIRP Power Limit (dBm)	Pass/Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
HT20	MCS0	2	100	5500	11.71	12.24	14.99	23.98		3.69		30	Pass
HT20	MCS0	2	116	5580	12.04	12.23	15.15	23.98		3.69		30	Pass
HT20	MCS0	2	140	5700	11.76	12.15	14.97	23.98		3.69		30	Pass
HT40	MCS0	2	102	5510	11.24	11.19	14.22	23.98		3.69		30	Pass
HT40	MCS0	2	110	5550	10.98	11.30	14.15	23.98		3.69		30	Pass
HT40	MCS0	2	134	5670	11.16	11.46	14.32	23.98		3.69		30	Pass
VHT20	MCS0	2	100	5500	9.57	9.92	12.76	23.98		3.69		30	Pass
VHT20	MCS0	2	116	5580	9.96	9.93	12.96	23.98		3.69		30	Pass
VHT20	MCS0	2	140	5700	9.62	9.92	12.78	23.98		3.69		30	Pass
VHT40	MCS0	2	102	5510	9.96	10.17	13.08	23.98		3.69		30	Pass
VHT40	MCS0	2	110	5550	9.74	10.26	13.02	23.98		3.69		30	Pass
VHT40	MCS0	2	134	5670	10.18	10.45	13.33	23.98		3.69		30	Pass
VHT80	MCS0	2	106	5530	10.22	9.97	13.11	23.98		3.69		30	Pass

TEST RESULTS DATA
Power Spectral Density

U-NII-2C single antenna													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
11a	6Mbps	1	100	5500	1.48	1.51		11.00	11.00	0.44	3.69		Pass
11a	6Mbps	1	116	5580	1.31	1.27		11.00	11.00	0.44	3.69		Pass
11a	6Mbps	1	140	5700	1.26	1.67		11.00	11.00	0.44	3.69		Pass

U-NII-2C MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2		
HT20	MCS0	2	100	5500			3.82	11.00		5.23			Pass
HT20	MCS0	2	116	5580			3.96	11.00		5.23			Pass
HT20	MCS0	2	140	5700			3.69	11.00		5.23			Pass
HT40	MCS0	2	102	5510			0.32	11.00		5.23			Pass
HT40	MCS0	2	110	5550			0.39	11.00		5.23			Pass
HT40	MCS0	2	134	5670			0.12	11.00		5.23			Pass
VHT80	MCS0	2	106	5530			-4.01	11.00		5.23			Pass

Appendix B. Radiated Spurious Emission

UNII 2C - 5470~5725MHz

WIFI 802.11ac VHT80 (Band Edge @ 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 VHT80 CH 106 5530MHz		5453.36	59.31	-14.69	74	45.31	35.32	11.91	33.23	100	172	P	H
		5469.84	58.5	-9.8	68.3	44.46	35.34	11.93	33.23	100	172	P	H
		5455.28	49.99	-4.01	54	35.99	35.32	11.91	33.23	100	172	A	H
	*	5530	98.37	-	-	84.03	35.39	11.97	33.02	100	172	P	H
		5530	90.28	-	-	75.94	35.39	11.97	33.02	100	172	A	H
		5735.4	56.17	-12.13	68.3	41.19	35.68	12.16	32.86	100	172	P	H
		5459.92	55.88	-18.12	74	41.88	35.32	11.91	33.23	100	259	P	V
		5460.88	56.02	-12.28	68.3	42.02	35.32	11.91	33.23	100	259	P	V
		5459.6	47.33	-6.67	54	33.33	35.32	11.91	33.23	100	259	A	V
	*	5524	93.51	-	-	79.17	35.39	11.97	33.02	100	259	P	V
		5524	84.92	-	-	70.58	35.39	11.97	33.02	100	259	A	V
		5736.12	55.66	-12.64	68.3	40.68	35.68	12.16	32.86	100	259	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

UNII 2C 5470~5725MHz

WIFI 802.11ac VHT80 (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 VHT80 CH 106 5530MHz		11059.05	44.59	-29.41	74	55.08	38.55	17.45	66.49	300	0	P	H
		11059.05	44.85	-29.15	74	55.34	38.55	17.45	66.49	300	0	P	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 VHT80 (LF)

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)
5GHz 802.11ac VHT80 LF		45.52	27.8	-12.2	40	42.77	16.92	1.03	32.92	-	-	P	H
		130.88	29.18	-14.32	43.5	42.55	17.73	1.74	32.84	-	-	P	H
		159.01	30.91	-12.59	43.5	44.55	17.29	1.92	32.85	-	-	P	H
		213.33	32.32	-11.18	43.5	46.07	17.13	2.22	33.1	-	-	P	H
		591.63	28.16	-17.84	46	31.4	25.57	3.71	32.52	-	-	P	H
		852.56	27.93	-18.07	46	28.85	27.21	4.46	32.59	-	-	P	H
		45.52	28.28	-11.72	40	43.25	16.92	1.03	32.92	-	-	P	V
		129.91	29.35	-14.15	43.5	42.72	17.74	1.73	32.84	-	-	P	V
		159.01	31.52	-11.98	43.5	45.16	17.29	1.92	32.85	-	-	P	V
		215.27	31.98	-11.52	43.5	45.6	17.25	2.23	33.1	-	-	P	V
		349.13	26.77	-19.23	46	35.44	21.38	2.85	32.9	-	-	P	V
		586.78	28.28	-17.72	46	31.5	25.61	3.7	32.53	-	-	P	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		(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 C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2	802.11ac VHT80	92.80	0.464	2.155	2.2kHz

802.11ac VHT80