FCC RF Test Report

APPLICANT	:	**iRobot Corporation**
EQUIPMENT	:	**Harpoon**
BRAND NAME	:	**iRobot**
MODEL NAME	:	**AXE-Y1**
FCC ID	:	**UFEAXE-Y1**
STANDARD	:	**47 CFR Part 15 Subpart E §15.407**
CLASSIFICATION	:	**(NII) Unlicensed National Information Infrastructure**

The product was received on Nov. 13, 2018 and testing was completed on Nov. 28, 2018. We, Sporton International (Kunshan) 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 test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

James Huang

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TESTING
NVLAP LAB CODE 600155-0

Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR8N1306D	Rev. 01	Initial issue of report	Jan. 04, 2019

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.403(i)	6dB, 26dB and 99% Occupied Bandwidth	> 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	15.407(b)(4)(i) &15.209(a)	Pass	Under limit 14.25 dB at 709.97 MHz
3.5	15.407(c)	Automatically Discontinue Transmission	Discontinue Transmission	Pass	-
3.6	15.203 & 15.407(a)	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

iRobot Corporation
8 Crosby Drive, Bedford, Massachusetts 01730, United States

1.2 Manufacturer

Huizhou BYD Electronic Co.,Ltd.
Xiangshui River,Economic Development Zone,Daya Bay,Huizhou,Guangdong Province,P.R.China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Harpoon
Brand Name	iRobot
Model Name	AXE-Y1
FCC ID	UFEAXE-Y1
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.a/n HT20/HT40 Bluetooth LE
HW Version	Harpoon B2
SW Version	lewis+2.0.0_rc13+tridentAPQ8009+0000
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	5745 MHz ~ 5825 MHz
Maximum Output Power	**<5745 MHz ~ 5825 MHz>** 802.11a : 11.14 dBm / 0.0130 W 802.11n HT20 : 11.04 dBm / 0.0127 W 802.11n HT40 : 11.09 dBm / 0.0129 W
99% Occupied Bandwidth	802.11a : 18.63 MHz 802.11n HT20 : 19.28 MHz 802.11n HT40 : 36.76 MHz
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
Antenna Type / Gain	PCB internal Antenna with gain 1.94 dBi

Remark: The antenna provided to the EUT, please refer to the following table.

Antenna No.	Brand	Model	Gain(dBi)	Antenna Type	Frequency range (GHz to GHz)
1	iRobot	AXE-Y1	3.04	PCB internal antenna	2.4-2.4835
1	iRobot	AXE-Y1	1.57	PCB internal antenna	5.15-5.25
1	iRobot	AXE-Y1	1.97	PCB internal antenna	5.25-5.35
1	iRobot	AXE-Y1	2.96	PCB internal antenna	5.47-5.725
1	iRobot	AXE-Y1	1.94	PCB internal antenna	5.725-5.85

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0).

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, 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 03CH06-KS	CN5013	630927

1.7 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.
- 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, the worst cases 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
	-	-	165	5825

Note: The above Frequency and Channel in "*" were 802.11n HT40.

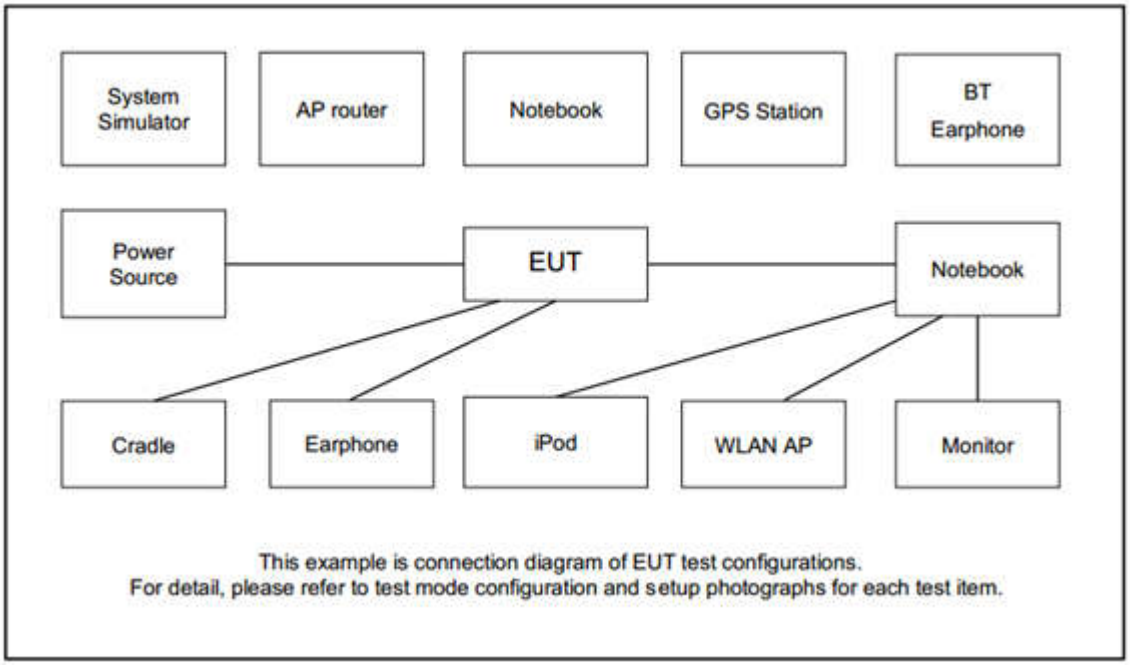
2.2 Test Mode

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

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

Ch. #		Band IV：5725-5850 MHz		
		802.11a	802.11n HT20	802.11n HT40
L	Low	149	149	151
M	Middle	157	157	-
H	High	165	165	159

2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous 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 and attenuator factor 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 7.00dB

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

= 7.00 (dB)

3 Test Result

3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement

3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

26dB and 99% Occupied bandwidth are reporting only.

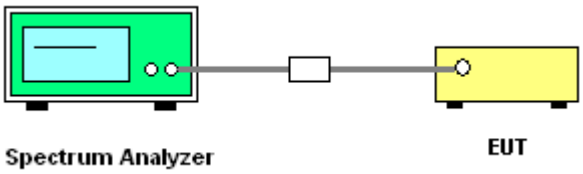
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section C) Emission bandwidth for the band 5.725-5.85GHz
2. Set RBW = 100kHz.
3. Set the VBW ≥ 3 x RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 6 dB down from the peak of the emission.
7. Measure and record the results in the test report.

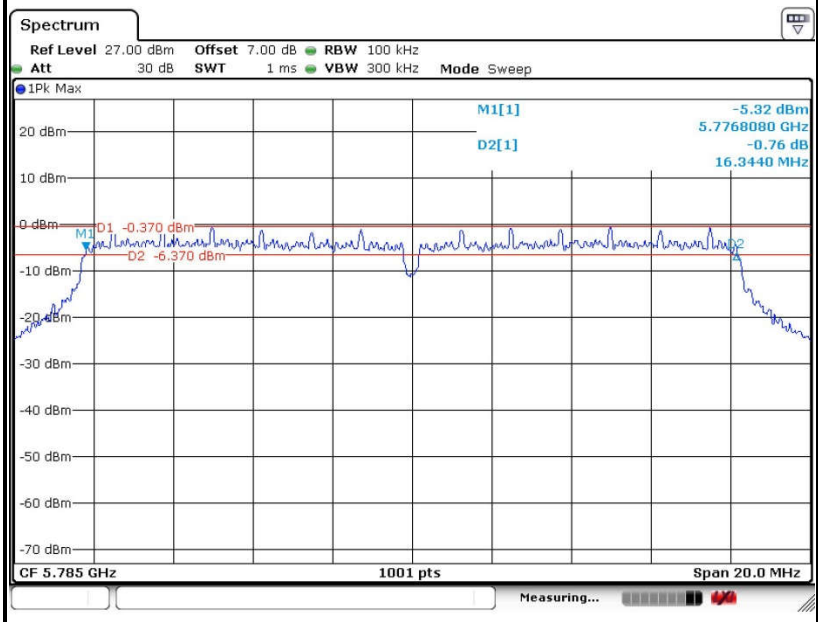
3.1.4 Test Setup



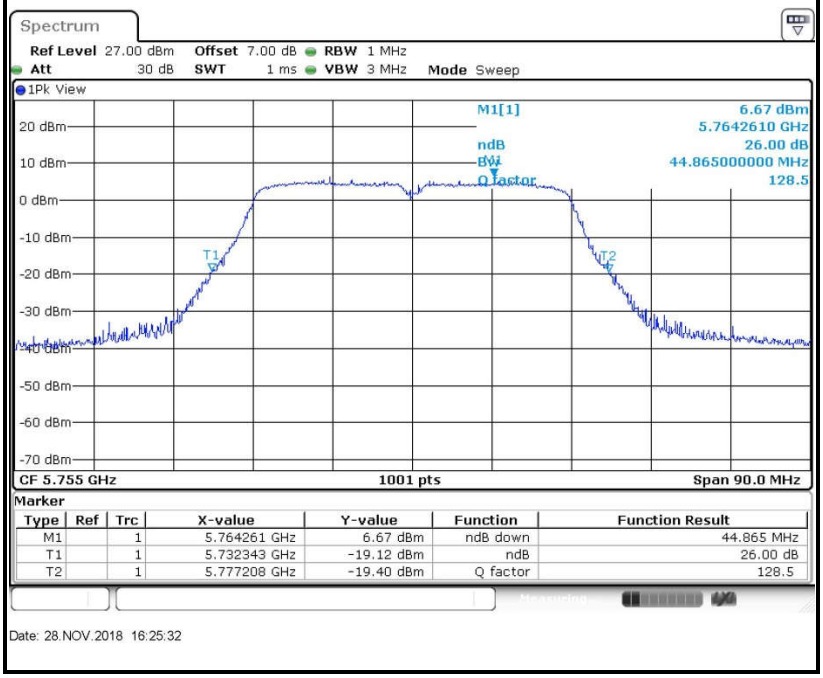
3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

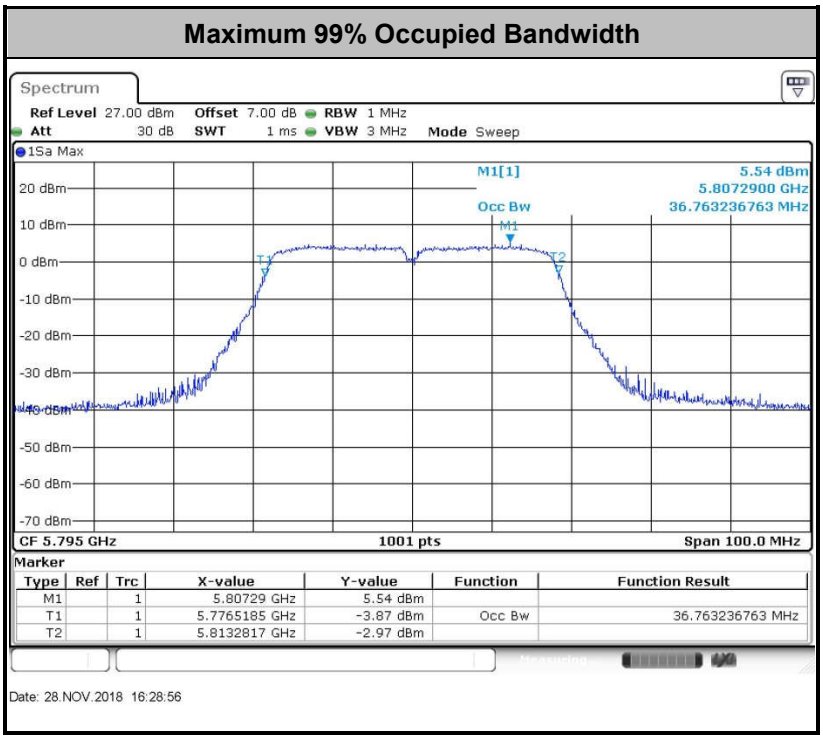
Minimum 6dB Bandwidth



Maximum 26dB Bandwidth



Maximum 99% Occupied Bandwidth



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Maximum Conducted Output Power Measurement

3.2.1 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.

3.2.2 Measuring Instruments

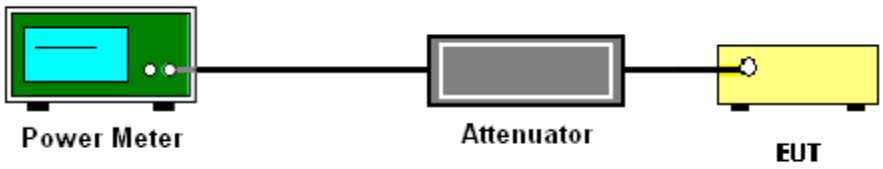
The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

The testing follows 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.

3.2.4 Test Setup



3.2.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz 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.

3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

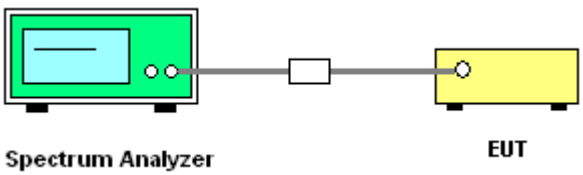
The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section F) Maximum power spectral density.

 # 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 = 300 kHz.
- Set VBW ≥ 1 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(500kHz/RBW) to the test result.
- 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.

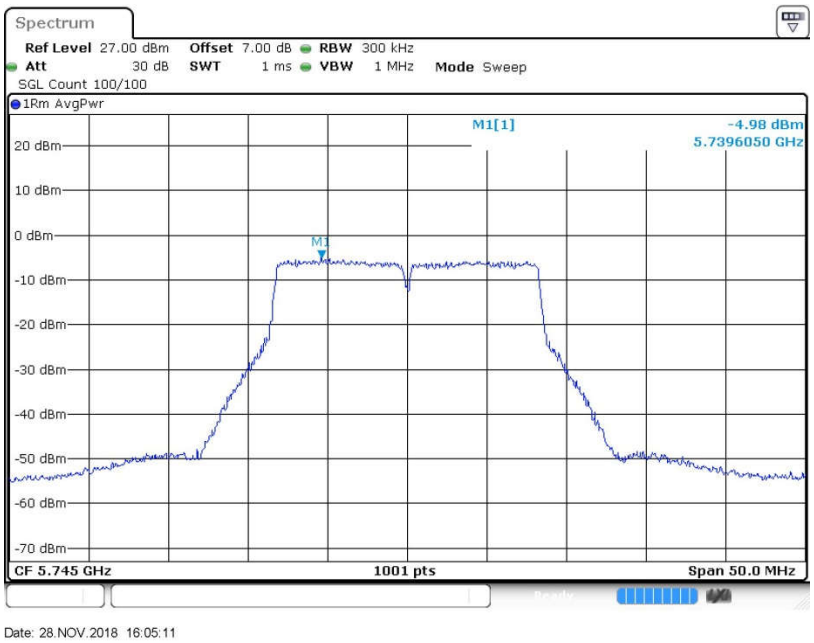
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

Worst Case Power Density (dBm/300KHz)



3.4 Unwanted Emissions Measurement

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

3.4.1 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

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

3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

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

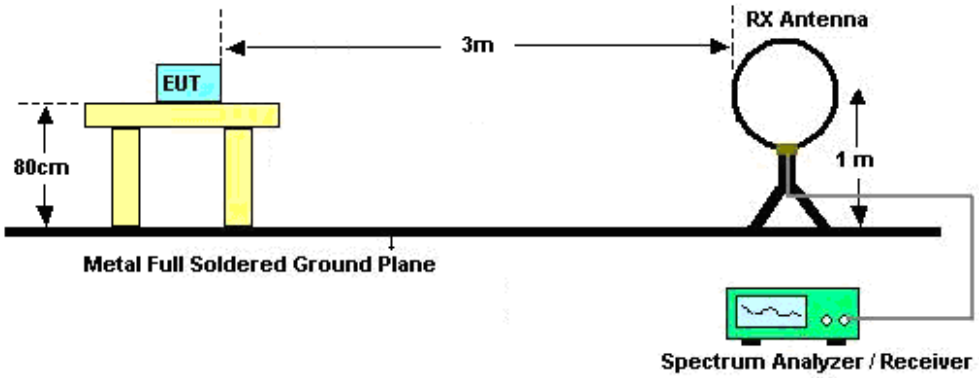
   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (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

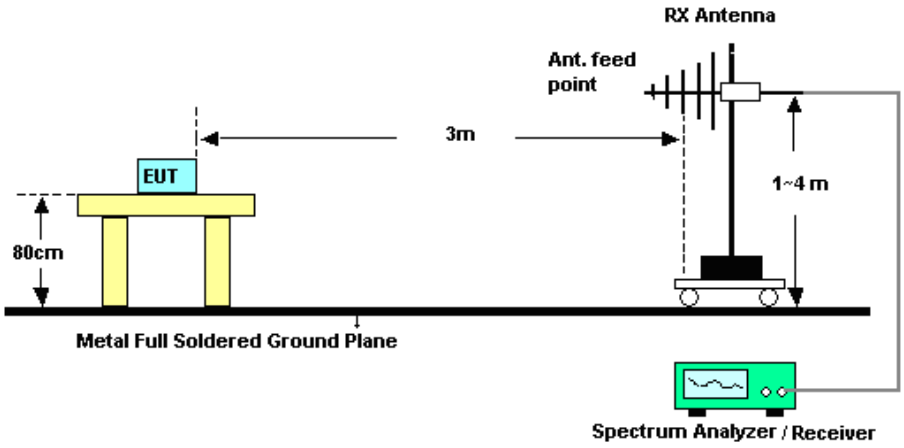
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting 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.

3.4.4 Test Setup

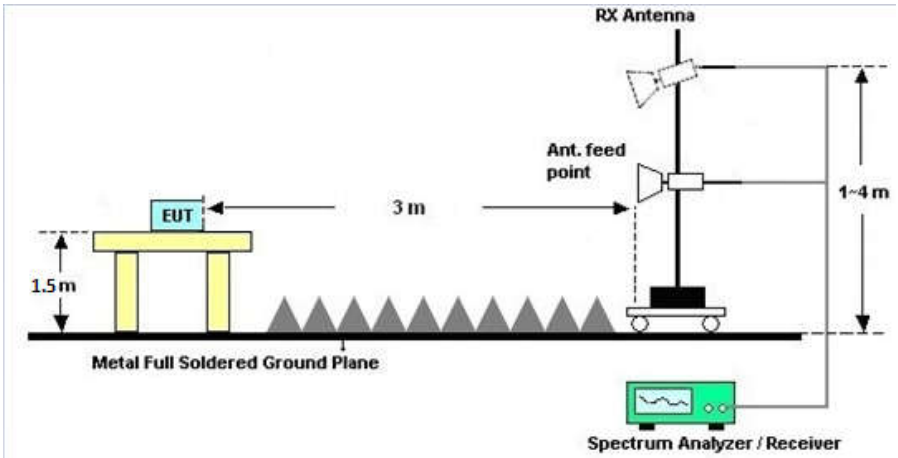
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.4.5 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 semi-Anechoic chamber, and the result came out very similar.

3.4.6 Test Result of Radiated Band Edges

Please refer to Appendix B.

3.4.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix B.

3.5 Automatically Discontinue Transmission

3.5.1 Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

3.5.2 Measuring Instruments

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

3.5.3 Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

3.6 Antenna Requirements

3.6.1 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.

3.6.2 Antenna Anti-Replacement Construction

Antenna permanently attached.

3.6.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

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	Aug. 07, 2018	Nov. 28, 2018	Aug. 06, 2019	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 18, 2018	Nov. 28, 2018	Jan. 17, 2019	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 18, 2018	Nov. 28, 2018	Jan. 17, 2019	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400023	3Hz~8.5GHz;Max 30dBm	Oct.12, 2018	Nov. 24, 2018	Oct.11, 2019	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57471084	10Hz-44GHz	Jun. 25, 2018	Nov. 24, 2018	Jun. 24, 2019	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 19, 2018	Nov. 24, 2018	Oct. 18, 2019	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	44483	30MHz-1GHz	Jan. 29, 2018	Nov. 24, 2018	Jan 28, 2019	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75957	1GHz~18GHz	Oct. 20, 2018	Nov. 24, 2018	Oct. 19, 2019	Radiation (03CH06-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA170249	15GHz~40GHz	Feb. 07, 2018	Nov. 24, 2018	Feb. 06, 2019	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Aug. 06, 2018	Nov. 24, 2018	Aug. 05, 2019	Radiation (03CH06-KS)
Amplifier	MITEQ	TTA1840-35-HG	2014749	18~40GHz	Feb. 08, 2018	Nov. 24, 2018	Feb. 07, 2019	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Apr.17, 2018	Nov. 24, 2018	Apr.16, 2019	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Dec. 16, 2017	Nov. 24, 2018	Dec. 15, 2018	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Nov. 24, 2018	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Nov. 24, 2018	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Nov. 24, 2018	NCR	Radiation (03CH06-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.9 dB

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

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

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

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

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

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

Appendix A. Conducted Test Results

Report Number : FR8N1306D

Test Engineer:	Silent Hai	Temperature:	21~25	°C
Test Date:	2018/11/28	Relative Humidity:	49~51	%

TEST RESULTS DATA
6dB and 26dB EBW and 99% OBW

Band IV									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)	6 dB Bandwidth (MHz)	6dB Bandwidth min. Limit (MHz)	Pass/Fail
11a	6M bps	1	149	5745	18.63	23.477	16.364	0.5	Pass
11a	6Mbps	1	157	5785	18.63	23.526	16.344	0.5	Pass
11a	6Mbps	1	165	5825	18.48	23.227	16.344	0.5	Pass
HT20	MCS 0	1	149	5745	19.18	23.576	17.602	0.5	Pass
HT20	MCS 0	1	157	5785	19.28	23.726	17.582	0.5	Pass
HT20	MCS 0	1	165	5825	19.28	23.576	17.562	0.5	Pass
HT40	MCS 0	1	151	5755	36.76	44.865	35.125	0.5	Pass
HT40	MCS 0	1	159	5795	36.76	44.775	35.524	0.5	Pass

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TEST RESULTS DATA
Average Power Table

Band IV										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)		Pass/Fail
11a	6M bps	1	149	5745	0.59	11.14	30.00	1.94		Pass
11a	6Mbps	1	157	5785	0.59	10.84	30.00	1.94		Pass
11a	6Mbps	1	165	5825	0.59	10.64	30.00	1.94		Pass
HT20	MCS 0	1	149	5745	0.63	10.98	30.00	1.94		Pass
HT20	MCS 0	1	157	5785	0.63	11.04	30.00	1.94		Pass
HT20	MCS 0	1	165	5825	0.63	10.71	30.00	1.94		Pass
HT40	MCS 0	1	151	5755	0.65	11.09	30.00	1.94		Pass
HT40	MCS 0	1	159	5795	0.65	10.69	30.00	1.94		Pass

Report Number : FR8N1306D

TEST RESULTS DATA
Power Spectral Density

Band IV										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	10log (500kHz /RBW) Factor (dB)	Average Power Density (dBm/500kHz)	Average PSD Limit (dBm/500kHz)	DG (dBi)	Pass/Fail
11a	6M bps	1	149	5745	0.59	2.22	-2.17	30.00	1.94	Pass
11a	6Mbps	1	157	5785	0.59	2.22	-3.10	30.00	1.94	Pass
11a	6Mbps	1	165	5825	0.59	2.22	-3.18	30.00	1.94	Pass
HT20	MCS 0	1	149	5745	0.63	2.22	-3.02	30.00	1.94	Pass
HT20	MCS 0	1	157	5785	0.63	2.22	-3.31	30.00	1.94	Pass
HT20	MCS 0	1	165	5825	0.63	2.22	-3.21	30.00	1.94	Pass
HT40	MCS 0	1	151	5755	0.65	2.22	-5.96	30.00	1.94	Pass
HT40	MCS 0	1	159	5795	0.65	2.22	-6.33	30.00	1.94	Pass

Appendix B. Radiated Spurious Emission

15E Band 4 - 5725~5850MHz

WIFI 802.11a (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11a CH 149 5745MHz		5636.4	48.67	-19.63	68.3	40.86	30.3	8.93	31.42	214	50	P	H
		5692.8	51.84	-48.15	99.99	43.63	30.72	8.98	31.49	214	50	P	H
		5705.6	49.68	-57.19	106.87	41.35	30.85	9	31.52	214	50	P	H
		5724.8	54.43	-67.41	121.84	45.95	30.99	9.01	31.52	214	50	P	H
		5750	102.86	-	-	94.25	31.13	9.03	31.55	214	50	P	H
		5750	95.38	-	-	86.77	31.13	9.03	31.55	214	50	A	H
		5645.2	48.34	-19.96	68.3	40.53	30.3	8.93	31.42	100	124	P	V
		5691.6	50.05	-49.06	99.11	41.84	30.72	8.98	31.49	100	124	P	V
		5703.2	48.44	-57.76	106.2	40.08	30.85	9	31.49	100	124	P	V
		5724.4	56.37	-64.56	120.93	47.89	30.99	9.01	31.52	100	124	P	V
		5742	102.54	-	-	93.93	31.13	9.03	31.55	100	124	P	V
		5742	95.3	-	-	86.69	31.13	9.03	31.55	100	124	A	V

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11a CH 165 5825MHz		5824	111.53	-	-	102.29	31.82	9.07	31.65	100	148	P	H
		5824	104.47	-	-	95.23	31.82	9.07	31.65	100	148	A	H
		5850.1	84.02	-38.05	122.07	74.68	31.96	9.06	31.68	100	148	P	H
		5856.4	76.96	-33.55	110.51	67.48	32.1	9.06	31.68	100	148	P	H
		5877.6	61.09	-42.28	103.37	51.59	32.15	9.05	31.7	100	148	P	H
		5928.8	51.15	-17.15	68.3	41.54	32.31	9.03	31.73	100	148	P	H
		5822	112.26	-	-	103.02	31.82	9.07	31.65	100	123	P	V
		5822	103.62	-	-	94.38	31.82	9.07	31.65	100	123	A	V
		5854.4	78.76	-33.51	112.27	69.28	32.1	9.06	31.68	100	123	P	V
		5855.1	75.79	-35.08	110.87	66.31	32.1	9.06	31.68	100	123	P	V
		5878.8	59.8	-42.68	102.48	50.3	32.15	9.05	31.7	100	123	P	V
		5934	50.85	-17.45	68.3	41.24	32.31	9.03	31.73	100	123	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

15E Band 4 5725~5850MHz

WIFI 802.11a (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11a CH 149 5745MHz		11490	46.62	-27.38	74	58.99	39.68	13.36	65.41	100	360	P	H
		11490	46.17	-27.83	74	58.54	39.68	13.36	65.41	100	0	P	V
802.11a CH 157 5785MHz		11570	44.57	-29.43	74	57.03	39.49	13.44	65.39	100	360	P	H
		11570	42.8	-31.2	74	55.26	39.49	13.44	65.39	100	0	P	V
802.11a CH 165 5825MHz		11650	44.09	-29.91	74	56.66	39.29	13.5	65.36	100	360	P	H
		11650	43.55	-30.45	74	56.12	39.29	13.5	65.36	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

15E Band 4 5725~5850MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT20 CH 149 5745MHz		5647.2	48.43	-19.87	68.3	40.62	30.3	8.93	31.42	100	152	P	H
		5693.2	51.2	-49.09	100.29	42.99	30.72	8.98	31.49	100	152	P	H
		5701.6	49.16	-56.59	105.75	40.8	30.85	9	31.49	100	152	P	H
		5723.6	53.06	-66.05	119.11	44.58	30.99	9.01	31.52	100	152	P	H
		5748	101.43	-	-	92.82	31.13	9.03	31.55	100	152	P	H
		5748	94.13	-	-	85.52	31.13	9.03	31.55	100	152	A	H
		5626.4	48.79	-19.51	68.3	40.97	30.33	8.92	31.43	100	124	P	V
		5694	50.26	-50.62	100.88	42.05	30.72	8.98	31.49	100	124	P	V
		5716.8	48.26	-61.75	110.01	39.93	30.85	9	31.52	100	124	P	V
		5724.8	54.41	-67.43	121.84	45.93	30.99	9.01	31.52	100	124	P	V
		5740	101.19	-	-	92.58	31.13	9.03	31.55	100	124	P	V
		5740	94.24	-	-	85.63	31.13	9.03	31.55	100	124	A	V

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT20 CH 165 5825MHz		5822	100.43	-	-	91.19	31.82	9.07	31.65	100	145	P	H
		5822	93.71	-	-	84.47	31.82	9.07	31.65	100	145	A	H
		5850.1	51.46	-70.61	122.07	42.12	31.96	9.06	31.68	100	145	P	H
		5864.8	49.19	-58.96	108.15	39.73	32.1	9.06	31.7	100	145	P	H
		5903.2	51.35	-33.04	84.39	41.8	32.21	9.05	31.71	100	145	P	H
		5972.8	50.27	-18.03	68.3	40.54	32.47	9.02	31.76	100	145	P	H
		5818	100.09	-	-	90.99	31.68	9.07	31.65	100	27	P	V
		5818	92.71	-	-	83.61	31.68	9.07	31.65	100	27	A	V
		5850.4	49.54	-71.85	121.39	40.2	31.96	9.06	31.68	100	27	P	V
		5874.4	49.71	-55.76	105.47	40.21	32.15	9.05	31.7	100	27	P	V
		5877.6	50.56	-52.81	103.37	41.06	32.15	9.05	31.7	100	27	P	V
		5935.2	49.91	-18.39	68.3	40.31	32.31	9.03	31.74	100	27	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

15E Band 4 5725~5850MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT20 CH 149 5745MHz		11490	45.37	-28.63	74	57.74	39.68	13.36	65.41	100	360	P	H
		11490	45.05	-28.95	74	57.42	39.68	13.36	65.41	100	0	P	V
802.11n HT20 CH 157 5785MHz		11570	43.08	-30.92	74	55.54	39.49	13.44	65.39	100	360	P	H
		11570	43.98	-30.02	74	56.44	39.49	13.44	65.39	100	0	P	V
802.11n HT20 CH 165 5825MHz		11650	44.19	-29.81	74	56.76	39.29	13.5	65.36	100	360	P	H
		11650	43.41	-30.59	74	55.98	39.29	13.5	65.36	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

15E Band 4 5725~5850MHz

WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT40 CH 151 5755MHz		5626	49.04	-19.26	68.3	41.22	30.33	8.92	31.43	100	150	P	H
		5668	49.69	-31.97	81.66	41.59	30.58	8.97	31.45	100	150	P	H
		5719.99	52.07	-58.83	110.9	43.59	30.99	9.01	31.52	100	150	P	H
		5723.6	54.56	-64.55	119.11	46.08	30.99	9.01	31.52	100	150	P	H
		5744	98.72	-	-	90.11	31.13	9.03	31.55	100	150	P	H
		5744	91.66	-	-	83.05	31.13	9.03	31.55	100	150	A	H
		5851.6	47.73	-70.92	118.65	38.39	31.96	9.06	31.68	100	150	P	H
		5858	49.04	-61.02	110.06	39.58	32.1	9.06	31.7	100	150	P	H
		5882.4	49.1	-50.7	99.8	39.6	32.15	9.05	31.7	100	150	P	H
		5933.2	49.2	-19.1	68.3	39.59	32.31	9.03	31.73	100	150	P	H
		5618.4	48.41	-19.89	68.3	40.59	30.33	8.92	31.43	100	31	P	V
		5693.2	48.88	-51.41	100.29	40.67	30.72	8.98	31.49	100	31	P	V
		5718	50.38	-59.96	110.34	41.9	30.99	9.01	31.52	100	31	P	V
		5723.2	54.18	-64.02	118.2	45.7	30.99	9.01	31.52	100	31	P	V
		5746	98.77	-	-	90.16	31.13	9.03	31.55	100	31	P	V
		5746	90.06	-	-	81.45	31.13	9.03	31.55	100	31	A	V
		5854.8	48.73	-62.63	111.36	39.25	32.1	9.06	31.68	100	31	P	V
		5869.6	49.12	-57.69	106.81	39.66	32.1	9.06	31.7	100	31	P	V
		5906.8	49.64	-32.09	81.73	40.05	32.26	9.04	31.71	100	31	P	V
		5946	49.1	-19.2	68.3	39.44	32.37	9.03	31.74	100	31	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT40 CH 159 5795MHz		5614	47.74	-20.56	68.3	39.91	30.36	8.9	31.43	100	148	P	H
		5688	48.14	-48.31	96.45	39.93	30.72	8.98	31.49	100	148	P	H
		5702.8	48.14	-57.95	106.09	39.78	30.85	9	31.49	100	148	P	H
		5722.4	48.22	-68.15	116.37	39.74	30.99	9.01	31.52	100	148	P	H
		5784	97.36	-	-	88.5	31.41	9.06	31.61	100	148	P	H
		5784	90.22	-	-	81.36	31.41	9.06	31.61	100	148	A	H
		5854.8	48.72	-62.64	111.36	39.24	32.1	9.06	31.68	100	148	P	H
		5864.4	49.48	-58.79	108.27	40.02	32.1	9.06	31.7	100	148	P	H
		5898.8	49.82	-37.83	87.65	40.27	32.21	9.05	31.71	100	148	P	H
		5966	49.85	-18.45	68.3	40.17	32.42	9.02	31.76	100	148	P	H
		5638.4	48.21	-20.09	68.3	40.4	30.3	8.93	31.42	100	27	P	V
		5684.8	48.69	-45.4	94.09	40.48	30.72	8.98	31.49	100	27	P	V
		5716.8	49.13	-60.88	110.01	40.8	30.85	9	31.52	100	27	P	V
		5723.2	47	-71.2	118.2	38.52	30.99	9.01	31.52	100	27	P	V
		5782	96.76	-	-	87.9	31.41	9.06	31.61	100	27	P	V
		5782	89.28	-	-	80.42	31.41	9.06	31.61	100	27	A	V
		5854.8	48.45	-62.91	111.36	38.97	32.1	9.06	31.68	100	27	P	V
		5856	49.52	-61.1	110.62	40.04	32.1	9.06	31.68	100	27	P	V
		5909.6	48.83	-30.83	79.66	39.26	32.26	9.04	31.73	100	27	P	V
		5972	49.79	-18.51	68.3	40.11	32.42	9.02	31.76	100	27	P	V

Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.

15E Band 4 5725~5850MHz

WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
802.11n HT40 CH 151 5755MHz		11510	43.8	-30.2	74	56.15	39.7	13.37	65.42	100	360	P	H
		11510	43.49	-30.51	74	55.84	39.7	13.37	65.42	100	0	P	V
802.11n HT40 CH 159 5795MHz		11590	45.5	-28.5	74	57.99	39.44	13.45	65.38	100	360	P	H
		11590	45.36	-28.64	74	57.85	39.44	13.45	65.38	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

15E Emission below 1GHz

5GHz WIFI 802.11a (LF @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	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)
5GHz 802.11a LF		40.67	20.59	-19.41	40	34.83	18.19	0.55	32.98			P	H
		159.98	24.17	-19.33	43.5	39.93	15.9	1.29	32.95			P	H
		226.91	29.5	-16.5	46	44.9	16	1.55	32.95			P	H
		460.68	28.81	-17.19	46	37.09	22.69	2.26	33.23			P	H
		709.97	31.75	-14.25	46	37.08	25.02	2.9	33.25	100	0	P	H
		882.63	31.21	-14.79	46	33.87	26.43	3.32	32.41			P	H
		38.73	20.33	-19.67	40	33.62	19.16	0.53	32.98			P	V
		65.89	20.62	-19.38	40	40.17	12.64	0.75	32.94			P	V
		460.68	28.9	-17.1	46	37.18	22.69	2.26	33.23			P	V
		594.54	30.09	-15.91	46	36.32	24.53	2.59	33.35	100	0	P	V
		786.6	29.31	-16.69	46	33.29	25.94	3.11	33.03			P	V
		998.06	30.95	-23.05	54	31.32	27.38	3.54	31.29			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 per 15.209(c).
!	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	Cable	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. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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)

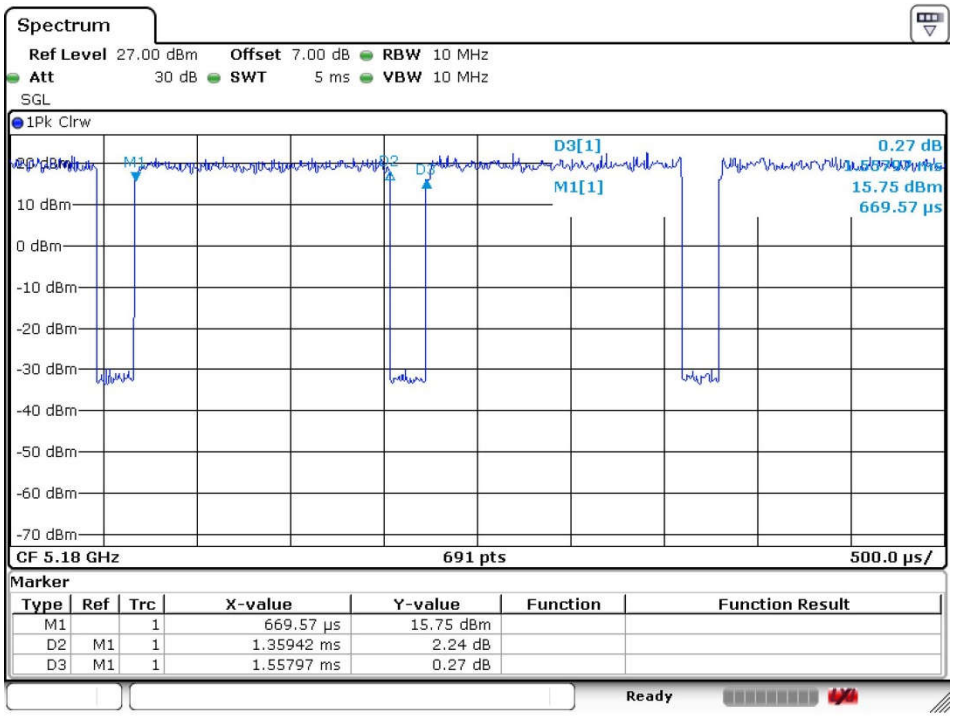
= -10.46(dB)

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

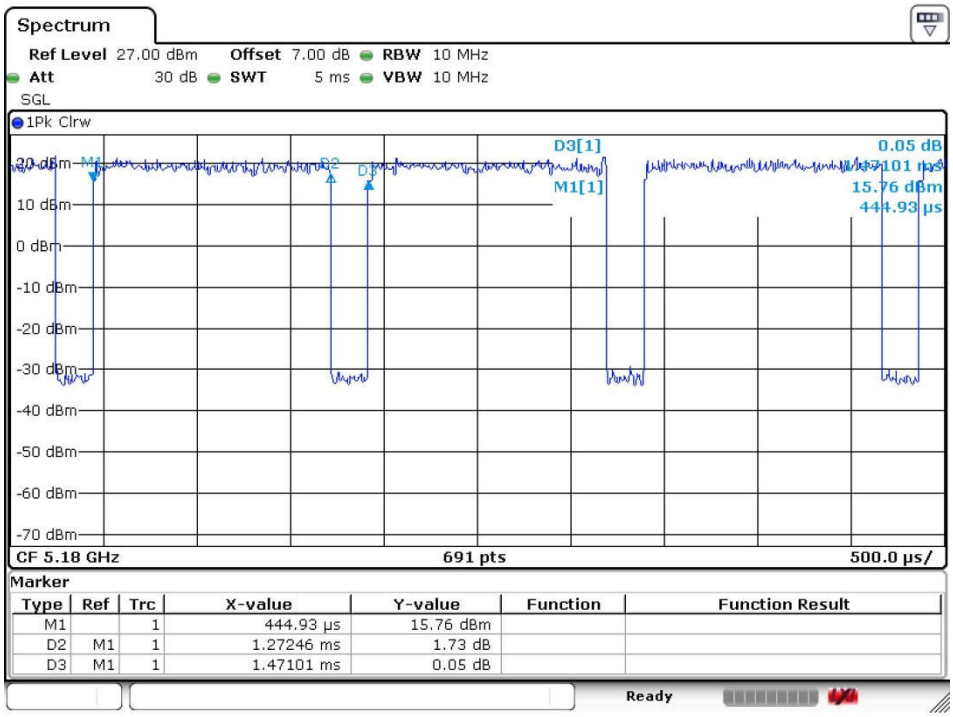
Appendix C. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11a	87.26	1.359	0.736	0.75KHz
802.11n HT20	86.50	1.272	0.786	0.82KHz
802.11n HT40	86.09	1.229	0.814	0.82KHz

802.11a



802.11n HT20



802.11n HT40