



FCC RF Test Report

APPLICANT : Motorola Solutions Inc.
EQUIPMENT : WAVE Two-Way Mobile Radio
BRAND NAME : Motorola Solutions
MODEL NAME : TLK 150
MODEL NUMBER : HK2131A
FCC ID : AZ492FT7127
STANDARD : FCC Part 15 Subpart E §15.407
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure

The product was received on Nov. 04, 2019 and testing was completed on Jan. 15, 2020. 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.

Jason Jia

Reviewed by: Jason Jia / Supervisor

James Huang

Approved by: James Huang / Manager



Sporton International (Kunshan) Inc.

***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China***



TABLE OF CONTENTS

REVISION HISTORY.....	3
SUMMARY OF TEST RESULT	4
1 GENERAL DESCRIPTION	5
1.1 Applicant	5
1.2 Manufacturer	5
1.3 Product Feature of Equipment Under Test.....	5
1.4 Product Specification of Equipment Under Test.....	5
1.5 Modification of EUT	6
1.6 Testing Location	6
1.7 Test Software.....	6
1.8 Applicable Standards.....	6
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST	7
2.1 Carrier Frequency and Channel	7
2.2 Test Mode.....	7
2.3 Connection Diagram of Test System.....	8
2.4 Support Unit used in test configuration and system	8
2.5 EUT Operation Test Setup	8
2.6 Measurement Results Explanation Example.....	9
3 TEST RESULT	10
3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement	10
3.2 Maximum Conducted Output Power Measurement	13
3.3 Power Spectral Density Measurement	14
3.4 Unwanted Emissions Measurement	16
3.5 Automatically Discontinue Transmission	20
3.6 Antenna Requirements	21
4 LIST OF MEASURING EQUIPMENT	22
5 UNCERTAINTY OF EVALUATION	23
APPENDIX A. CONDUCTED TEST RESULTS	
APPENDIX B. RADIATED SPURIOUS EMISSION	
APPENDIX C. DUTY CYCLE PLOTS	
APPENDIX D. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR9N0421E	Rev. 01	Initial issue of report	Feb. 21, 2020
FR9N0421E	Rev. 02	Update the equipment name.	Mar. 10, 2020

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 10.58 dB at 5964.80 MHz
-	15.207	AC Conducted Emission	15.207(a)	Not Required	-
3.5	15.407(c)	Automatically Discontinue Transmission	Discontinue Transmission	Pass	-
3.6	15.203 & 15.407(a)	Antenna Requirement	N/A	Pass	-
Remark: Not required 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

Motorola Solutions Inc.
8000 West Sunrise Boulevard, Fort Lauderdale, Florida

1.2 Manufacturer

Motorola Solutions Malaysia Sdn. Bhd.
Plot 2A, Medan Bayan Lepas, Mukim 12, S.W.D. 11900 Bayan Lepas, Penang, Malaysia.

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	WAVE Two-Way Mobile Radio
Brand Name	Motorola Solutions
Model Name	TLK 150
Model Number	HK2131A
FCC ID	AZ492FT7127
EUT supports Radios application	WCDMA/LTE/GNSS WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11 a/n HT20/HT40 Bluetooth BR/EDR/LE
IMEI Code	Conducted: 352704110003325 Radiation: N/A
HW Version	P2
SW Version	TLK150_BASE_ENG_D03.00.32_APPS_D03.00.36
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 : 14.25 dBm / 0.0266 W 802.11n HT20 : 12.15 dBm / 0.0164 W 802.11n HT40 : 11.47 dBm / 0.0140 W
99% Occupied Bandwidth	802.11a : 16.73 MHz 802.11n HT20 : 17.73 MHz 802.11n HT40 : 36.06 MHz
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
Antenna Type / Gain	Chip Antenna with gain 0.1 dBi



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/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International (Kunshan) Inc.		
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.
	03CH06-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH06-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.
- ♦ 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: 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)
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.

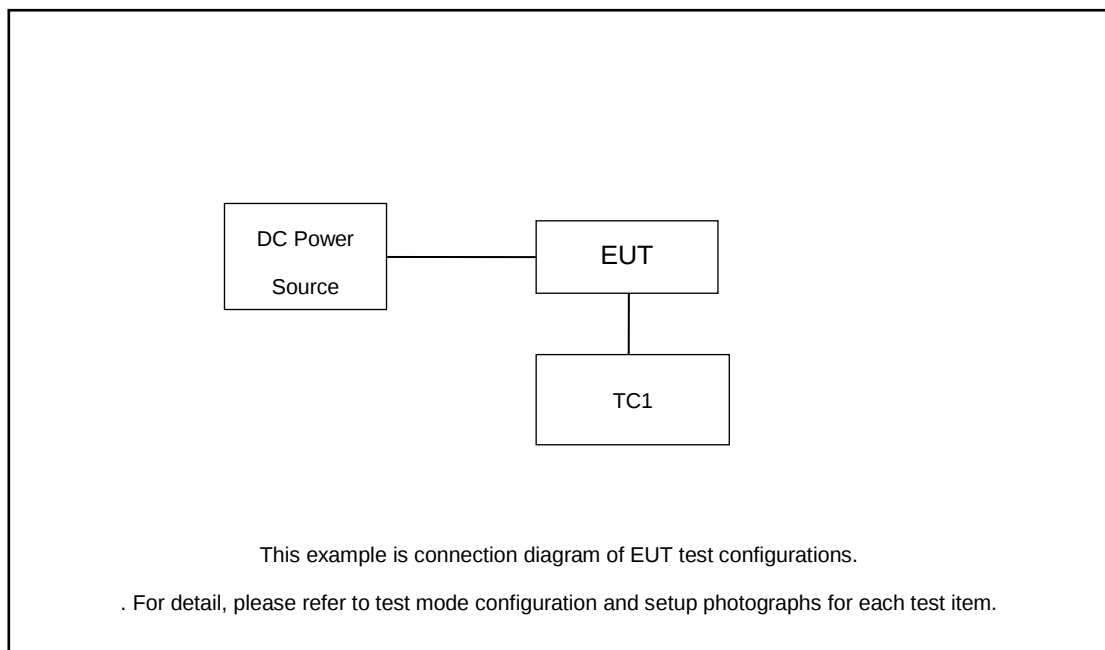
2.2 Test Mode

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
Remark: test mode: DC power supply + EUT + TC1 TC1: External speaker(AC000240A01)+ External Mic (PMMN4129A)+ Footswitch (RLN4836AR)+ Footswitch (RLN4856A)+ Ignition Sense Cable with Housing Connector(HKN9327BR)	

Ch. #		Band IV : 5745-5825 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 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	DC Power Supply	GW	GPS-3030D	N/A	N/A	Unshielded, 1.8 m

2.5 EUT Operation Test Setup

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



2.6 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 and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 7.0dB.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)}. \\ &= 7.0 \text{ (dB)}\end{aligned}$$

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.

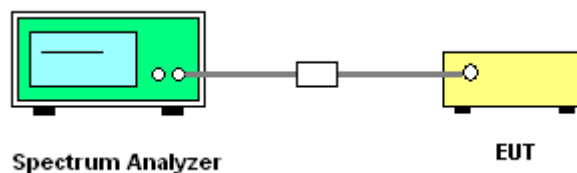
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

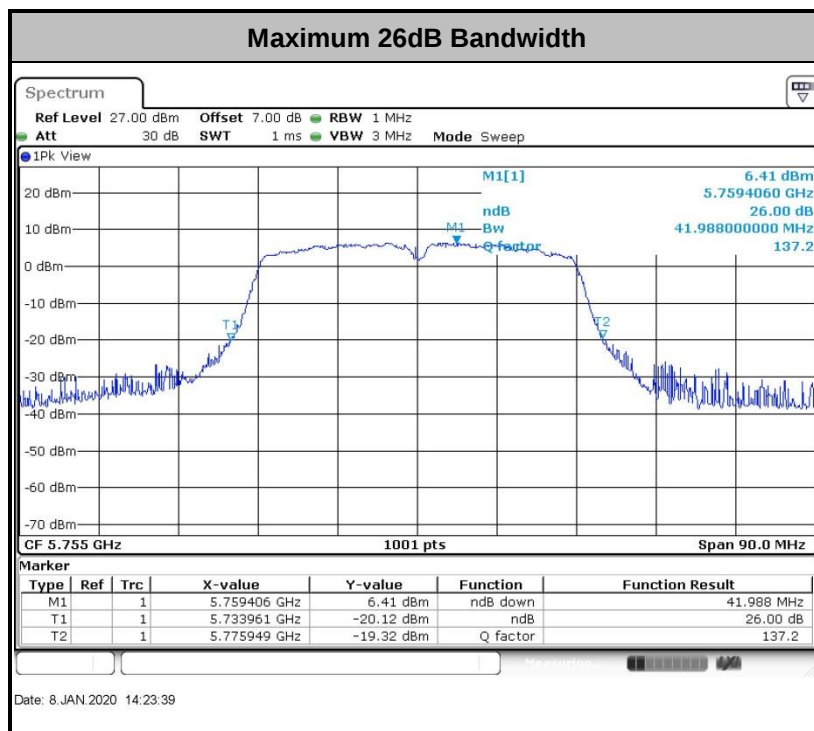
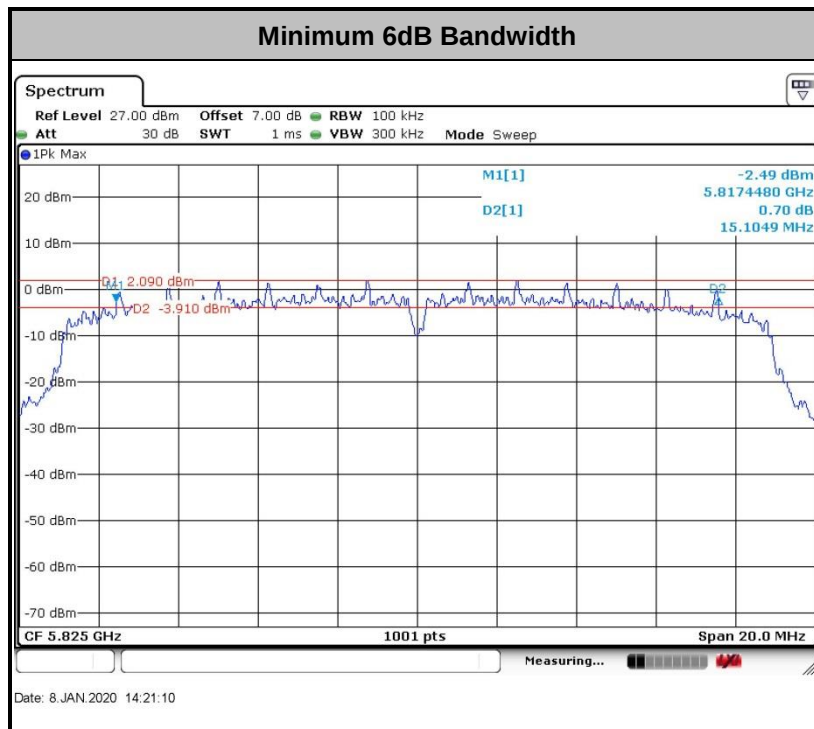
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section C) Emission bandwidth for the band 5.725-5.85GHz
2. Set RBW = 100kHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is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

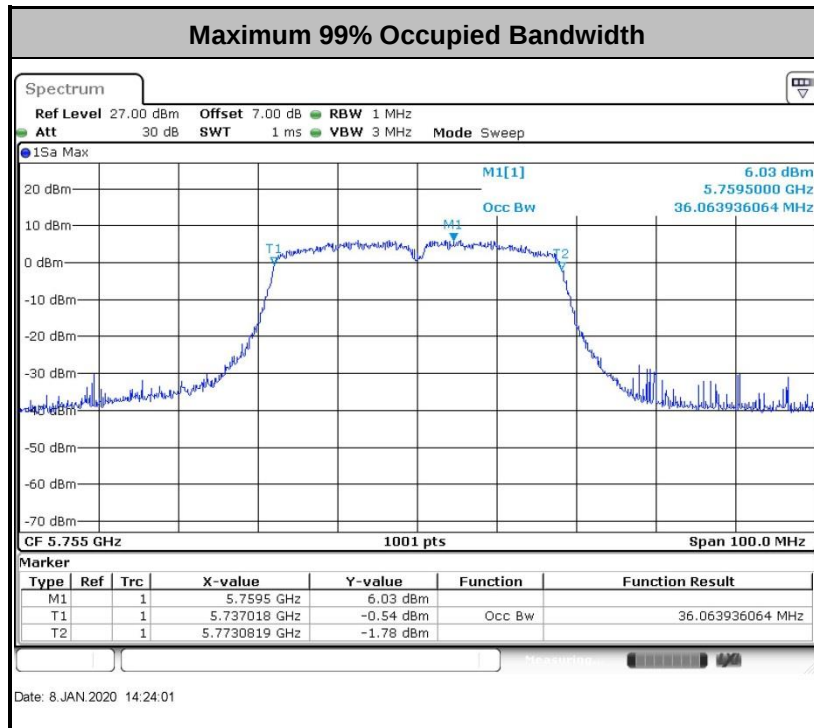
3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.





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.

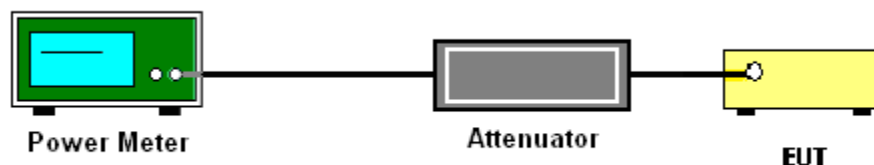
3.2.3 Test Procedures

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

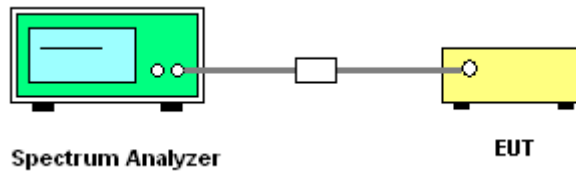
The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section F) Maximum power spectral density.

Method SA-2

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

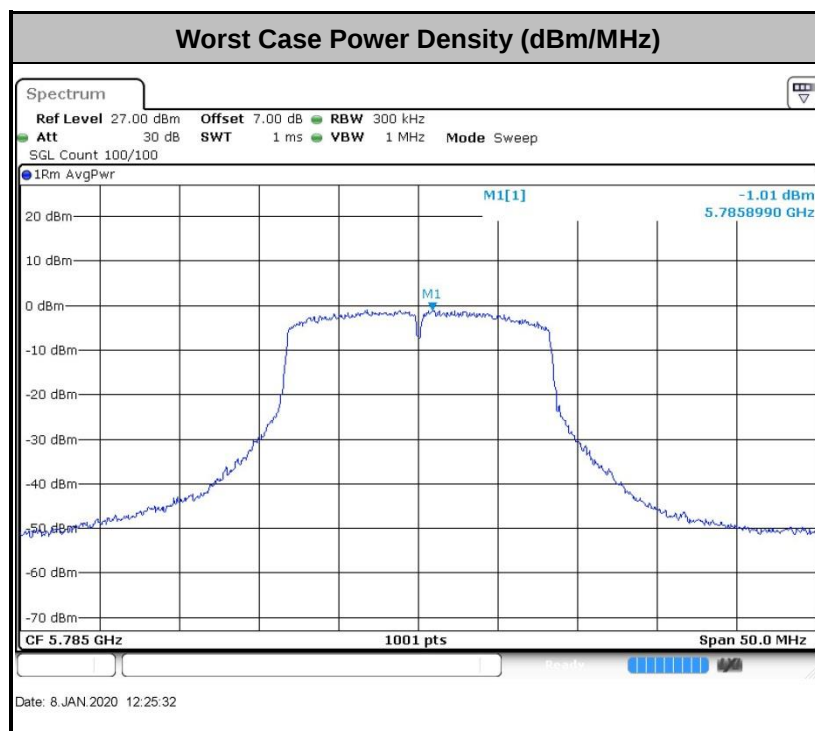
- Measure the duty cycle.
 - Set span to encompass the entire emission bandwidth (EBW) of the signal.
 - Set RBW = 300 kHz.
 - Set VBW $\geq$ 1 MHz.
 - Number of points in sweep $\geq$ 2 Span / RBW.
 - Sweep time = auto.
 - Detector = RMS
 - Trace average at least 100 traces in power averaging mode.
 - Add $10 \log(500\text{kHz}/\text{RBW})$ 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.
-
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.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



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	68.2

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

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

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

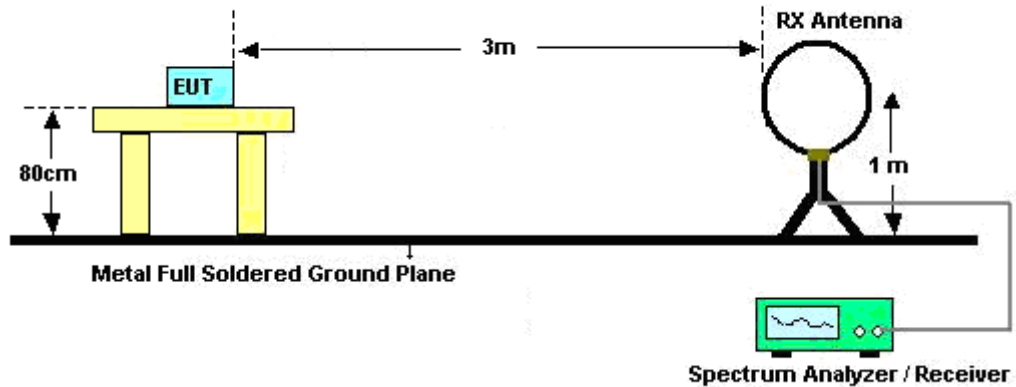
The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

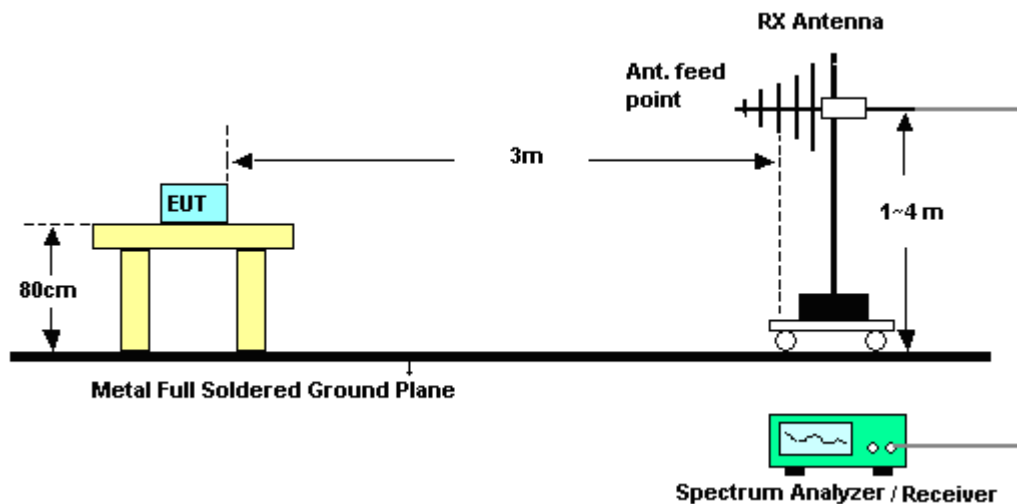
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
Section G) Unwanted emissions measurement.
 - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
 - RBW = 120 kHz
 - VBW = 300 kHz
 - Detector = Peak
 - Trace mode = max hold
 - (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz
 - RBW = 1 MHz
 - VBW $\geq$ 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 $\geq$ 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

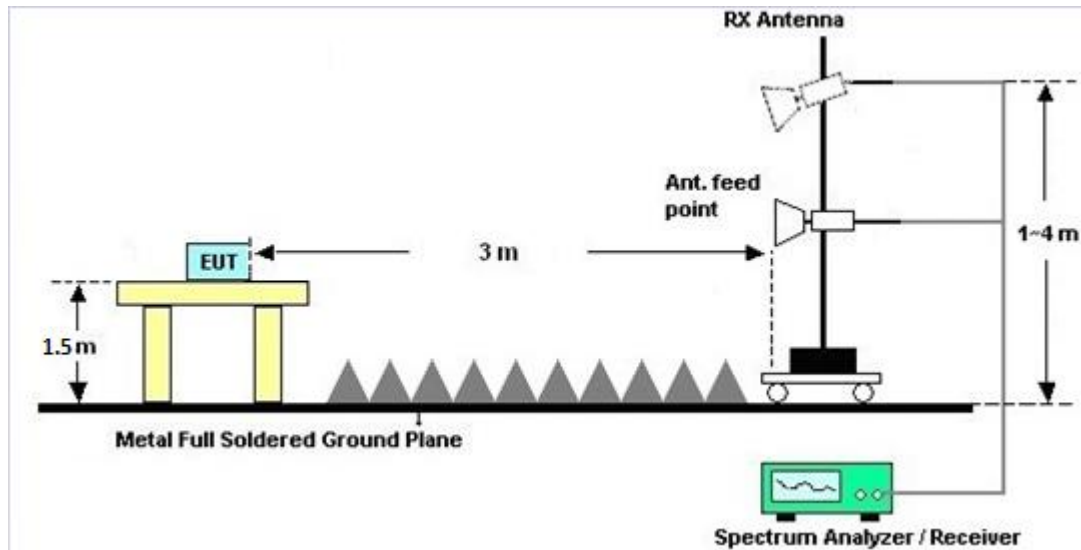
For radiated emissions below 30MHz



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

An embedded-in antenna design is used.

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, 2019	Jan. 08, 2020	Aug. 06, 2020	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 14, 2019	Jan. 08, 2020	Jan. 13, 2020	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 14, 2019	Jan. 08, 2020	Jan. 13, 2020	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz~44GHz	Apr. 16, 2019	Jan. 15, 2020	Apr. 18, 2020	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	May 30, 2019	Jan. 15, 2020	May 29, 2020	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Jan. 27, 2019	Jan. 15, 2020	Jan. 26, 2020	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 08, 2020	Jan. 15, 2020	Jan. 07, 2021	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Aug. 06, 2019	Jan. 15, 2020	Aug. 05, 2020	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	1Ghz-18Ghz	Apr. 17, 2019	Jan. 15, 2020	Apr. 16, 2020	Radiation (03CH06-KS)
Amplifier	MITEQ	TTA1840-35-HG	2014749	18~40GHz	Jan. 14, 2020	Jan. 15, 2020	Jan. 13, 2021	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 15, 2019	Jan. 15, 2020	Apr. 14, 2020	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jan. 15, 2020	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jan. 15, 2020	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jan. 15, 2020	NCR	Radiation (03CH06-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
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Appendix A. Conducted Test Results

Report Number : FR9N0421E

Test Engineer:	Aly Cao	Temperature:	21~25	°C
Test Date:	2020/1/8	Relative Humidity:	51~54	%

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	16.73	20.779	15.3247	0.5	Pass
11a	6Mbps	1	157	5785	16.73	20.679	15.1249	0.5	Pass
11a	6Mbps	1	165	5825	16.73	20.679	15.3047	0.5	Pass
HT20	MCS 0	1	149	5745	17.68	21.628	15.1249	0.5	Pass
HT20	MCS 0	1	157	5785	17.73	21.578	15.1449	0.5	Pass
HT20	MCS 0	1	165	5825	17.73	21.429	15.1049	0.5	Pass
HT40	MCS 0	1	151	5755	36.06	41.988	35.0849	0.5	Pass
HT40	MCS 0	1	159	5795	36.06	41.628	35.0849	0.5	Pass

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	0.22	14.21	30.00	0.10		Pass
11a	6Mbps	1	157	5785	0.22	14.25	30.00	0.10		Pass
11a	6Mbps	1	165	5825	0.22	14.07	30.00	0.10		Pass
HT20	MCS 0	1	149	5745	0.24	12.02	30.00	0.10		Pass
HT20	MCS 0	1	157	5785	0.24	12.15	30.00	0.10		Pass
HT20	MCS 0	1	165	5825	0.24	11.97	30.00	0.10		Pass
HT40	MCS 0	1	151	5755	0.50	11.46	30.00	0.10		Pass
HT40	MCS 0	1	159	5795	0.50	11.47	30.00	0.10		Pass

TEST RESULTS DATA
Power Spectral Density

Band IV										
Mod.	Data Rate	N _{TX}	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	0.22	2.22	1.38	30.00	0.10	Pass
11a	6Mbps	1	157	5785	0.22	2.22	1.43	30.00	0.10	Pass
11a	6Mbps	1	165	5825	0.22	2.22	1.28	30.00	0.10	Pass
HT20	MCS 0	1	149	5745	0.24	2.22	-0.94	30.00	0.10	Pass
HT20	MCS 0	1	157	5785	0.24	2.22	-1.02	30.00	0.10	Pass
HT20	MCS 0	1	165	5825	0.24	2.22	-1.08	30.00	0.10	Pass
HT40	MCS 0	1	151	5755	0.50	2.22	-4.86	30.00	0.10	Pass
HT40	MCS 0	1	159	5795	0.50	2.22	-4.80	30.00	0.10	Pass



Appendix B. Radiated Spurious Emission

Band 4 - 5725~5850MHz

WIFI 802.11a (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11a CH 149 5745MHz		5608	57.03	-11.27	68.3	41.24	34.6	11.39	30.2	271	74	P	H
		5692.4	56.18	-43.52	99.7	40.19	34.7	11.52	30.23	271	74	P	H
		5717.6	61.15	-49.08	110.23	45.04	34.77	11.58	30.24	271	74	P	H
		5724.8	69.31	-52.53	121.84	53.2	34.77	11.58	30.24	271	74	P	H
		5740	106.43	-	-	90.28	34.8	11.61	30.26	271	74	P	H
		5740	98.69	-	-	82.54	34.8	11.61	30.26	271	74	A	H
		5635.6	57.1	-11.2	68.3	41.2	34.67	11.42	30.19	298	167	P	V
		5652.4	56.34	-13.74	70.08	40.38	34.7	11.45	30.19	298	167	P	V
		5716	59.64	-50.14	109.78	43.6	34.73	11.55	30.24	298	167	P	V
		5724.8	68.37	-53.47	121.84	52.26	34.77	11.58	30.24	298	167	P	V
		5740	105.43	-	-	89.28	34.8	11.61	30.26	298	167	P	V
		5740	98.17	-	-	82.02	34.8	11.61	30.26	298	167	A	V



WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11a CH 165 5825MHz		5850	58.26	-67.04	125.3	41.8	35	11.79	30.33	266	74	P	H
		5858.4	56.89	-53.06	109.95	40.38	35.03	11.82	30.34	266	74	P	H
		5911.2	57.86	-20.62	78.48	41.23	35.13	11.87	30.37	266	74	P	H
		5939.2	57.3	-11	68.3	40.59	35.2	11.9	30.39	266	74	P	H
		5824	104.55	-	-	88.13	34.97	11.76	30.31	266	74	P	H
		5824	96.97	-	-	80.55	34.97	11.76	30.31	266	74	A	H
		5850.4	56.8	-67.35	124.15	40.34	35	11.79	30.33	275	172	P	V
		5856.8	57.19	-53.21	110.4	40.67	35.03	11.82	30.33	275	172	P	V
		5892.4	56.63	-35.76	92.39	40.04	35.1	11.85	30.36	275	172	P	V
		5964.8	57.72	-10.58	68.3	40.98	35.23	11.91	30.4	275	172	P	V
		5824	104.34	-	-	87.92	34.97	11.76	30.31	275	172	P	V
		5824	96.9	-	-	80.48	34.97	11.76	30.31	275	172	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 4 5725~5850MHz

WIFI 802.11a (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11a		11490	41.38	-32.62	74	50.12	38.08	16.03	62.85	100	360	P	H
CH 149		11490	42.23	-31.77	74	50.97	38.08	16.03	62.85	100	360	P	V
5745MHz													
802.11a		11570	42.16	-31.84	74	50.62	38.17	16.11	62.74	100	360	P	H
CH 157		11570	42.24	-31.76	74	50.7	38.17	16.11	62.74	100	360	P	V
5785MHz													
802.11a		11650	43.83	-30.17	74	52.03	38.24	16.18	62.62	100	360	P	H
CH 165		11650	41.66	-32.34	74	49.86	38.24	16.18	62.62	100	360	P	V
5825MHz													
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 4 5725~5850MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 149 5745MHz		5644	56.69	-11.61	68.3	40.79	34.67	11.42	30.19	271	74	P	H
		5670.8	56.15	-27.58	83.73	40.18	34.7	11.48	30.21	271	74	P	H
		5706.8	56.58	-50.63	107.21	40.54	34.73	11.55	30.24	271	74	P	H
		5724.8	58.46	-63.38	121.84	42.35	34.77	11.58	30.24	271	74	P	H
		5746	103.23	-	-	87.08	34.8	11.61	30.26	271	74	P	H
		5746	96.09	-	-	79.94	34.8	11.61	30.26	271	74	A	H
		5643.6	56.04	-12.26	68.3	40.14	34.67	11.42	30.19	303	168	P	V
		5679.6	57.09	-33.15	90.24	41.14	34.7	11.48	30.23	303	168	P	V
		5710.4	56.01	-52.2	108.21	39.97	34.73	11.55	30.24	303	168	P	V
		5722.8	59.68	-57.6	117.28	43.57	34.77	11.58	30.24	303	168	P	V
		5746	103.77	-	-	87.62	34.8	11.61	30.26	303	168	P	V
		5746	96.18	-	-	80.03	34.8	11.61	30.26	303	168	A	V



WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 165 5825MHz		5850.4	55.99	-68.16	124.15	39.53	35	11.79	30.33	264	73	P	H
		5856.8	56.94	-53.46	110.4	40.42	35.03	11.82	30.33	264	73	P	H
		5920.4	57.9	-13.79	71.69	41.27	35.13	11.87	30.37	264	73	P	H
		5938.8	56.56	-11.74	68.3	39.85	35.2	11.9	30.39	264	73	P	H
		5824	101.9	-	-	85.48	34.97	11.76	30.31	264	73	P	H
		5824	94.76	-	-	78.34	34.97	11.76	30.31	264	73	A	H
		5852.4	56.39	-62	118.39	39.93	35	11.79	30.33	305	170	P	V
		5868.4	57.51	-49.64	107.15	41	35.03	11.82	30.34	305	170	P	V
		5917.6	57.09	-16.67	73.76	40.46	35.13	11.87	30.37	305	170	P	V
		5997.2	57.43	-10.87	68.3	40.61	35.3	11.94	30.42	305	170	P	V
		5824	101.82	-	-	85.4	34.97	11.76	30.31	305	170	P	V
		5824	94.28	-	-	77.86	34.97	11.76	30.31	305	170	A	V
Remark		1. No other spurious found. 2. All results are PASS against Peak and Average limit line.											



Band 4 5725~5850MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20		11490	42.05	-31.95	74	50.79	38.08	16.03	62.85	100	360	P	H
CH 149 5745MHz		11490	40.91	-33.09	74	49.65	38.08	16.03	62.85	100	360	P	V
802.11n HT20		11570	41.52	-32.48	74	49.98	38.17	16.11	62.74	100	360	P	H
CH 157 5785MHz		11570	42.42	-31.58	74	50.88	38.17	16.11	62.74	100	360	P	V
802.11n HT20		11650	41.9	-32.1	74	50.1	38.24	16.18	62.62	100	360	P	H
CH 165 5825MHz		11650	43.09	-30.91	74	51.29	38.24	16.18	62.62	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 4 5725~5850MHz

WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 151 5755MHz		5645.6	56.21	-12.09	68.3	40.31	34.67	11.42	30.19	301	76	P	H
		5694.4	55.91	-45.26	101.17	39.92	34.7	11.52	30.23	301	76	P	H
		5712.8	61.26	-47.63	108.89	45.22	34.73	11.55	30.24	301	76	P	H
		5724	62.22	-57.8	120.02	46.11	34.77	11.58	30.24	301	76	P	H
		5854.8	54.72	-56.76	111.48	38.2	35.03	11.82	30.33	301	76	P	H
		5874.4	56.29	-49.18	105.47	39.72	35.07	11.84	30.34	301	76	P	H
		5905.6	57.43	-25.19	82.62	40.79	35.13	11.87	30.36	301	76	P	H
		5925.6	56.97	-11.33	68.3	40.29	35.17	11.88	30.37	301	76	P	H
		5752	99.18	-	-	82.97	34.83	11.64	30.26	301	76	P	H
		5752	99.18	-	-	82.97	34.83	11.64	30.26	301	76	A	H
		5626.8	56.51	-11.79	68.3	40.68	34.63	11.4	30.2	297	167	P	V
		5689.2	57.04	-40.3	97.34	41.05	34.7	11.52	30.23	297	167	P	V
		5719.8	60.2	-50.64	110.84	44.09	34.77	11.58	30.24	297	167	P	V
		5720.4	64.81	-47	111.81	48.7	34.77	11.58	30.24	297	167	P	V
		5850.8	55.89	-67.11	123	39.43	35	11.79	30.33	297	167	P	V
		5868.8	56.6	-50.43	107.03	40.09	35.03	11.82	30.34	297	167	P	V
		5887.2	56.61	-39.63	96.24	40.06	35.07	11.84	30.36	297	167	P	V
		5969.6	56.33	-11.97	68.3	39.59	35.23	11.91	30.4	297	167	P	V
		5746	99.95	-	-	83.8	34.8	11.61	30.26	297	167	P	V
		5746	92.39	-	-	76.24	34.8	11.61	30.26	297	167	A	V



WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 159 5795MHz		5618.8	56.92	-11.38	68.3	41.09	34.63	11.4	30.2	266	73	P	H
		5677.6	56.95	-31.81	88.76	40.98	34.7	11.48	30.21	266	73	P	H
		5702.4	57.6	-48.37	105.97	41.55	34.73	11.55	30.23	266	73	P	H
		5720.8	54.51	-58.21	112.72	38.4	34.77	11.58	30.24	266	73	P	H
		5854.8	55.63	-55.85	111.48	39.11	35.03	11.82	30.33	266	73	P	H
		5873.2	56.12	-49.68	105.8	39.55	35.07	11.84	30.34	266	73	P	H
		5914	56.86	-19.55	76.41	40.23	35.13	11.87	30.37	266	73	P	H
		5971.2	56.42	-11.88	68.3	39.68	35.23	11.91	30.4	266	73	P	H
		5788	98.92	-	-	82.62	34.9	11.7	30.3	266	73	P	H
		5788	91.46	-	-	75.16	34.9	11.7	30.3	266	73	A	H
		5622	55.35	-12.95	68.3	39.52	34.63	11.4	30.2	297	169	P	V
		5690	56	-41.93	97.93	40.01	34.7	11.52	30.23	297	169	P	V
		5715.6	56.19	-53.48	109.67	40.15	34.73	11.55	30.24	297	169	P	V
		5724.8	55.14	-66.7	121.84	39.03	34.77	11.58	30.24	297	169	P	V
		5852.8	54.74	-62.5	117.24	38.28	35	11.79	30.33	297	169	P	V
		5871.6	56.53	-49.72	106.25	39.96	35.07	11.84	30.34	297	169	P	V
		5891.6	56.26	-36.72	92.98	39.67	35.1	11.85	30.36	297	169	P	V
		5930.4	56.37	-11.93	68.3	39.69	35.17	11.88	30.37	297	169	P	V
		5788	98.98	-	-	82.68	34.9	11.7	30.3	297	169	P	V
		5788	91.8	-	-	75.5	34.9	11.7	30.3	297	169	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 4 5725~5850MHz

WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40		11510	41.51	-32.49	74	50.21	38.1	16.05	62.85	100	360	P	H
CH 151 5755MHz		11510	42.4	-31.6	74	51.1	38.1	16.05	62.85	100	360	P	V
802.11n HT40		11590	43.66	-30.34	74	52.06	38.18	16.13	62.71	100	360	P	H
CH 159 5795MHz		11590	42.1	-31.9	74	50.5	38.18	16.13	62.71	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Band 4 5725~5850MHz

Emission below 1GHz

5GHz WIFI 802.11a (LF @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
5GHz 802.11a LF		30.97	22.15	-17.85	40	30.13	23.52	1.1	32.6	-	-	P	H
		63.95	18.42	-21.58	40	36.67	12.58	1.49	32.32	-	-	P	H
		78.5	24.68	-15.32	40	42.86	12.7	1.49	32.37	-	-	P	H
		115.36	30.75	-12.75	43.5	43.3	17.89	1.73	32.17	100	360	P	H
		220.12	23.1	-22.9	46	37.38	15.3	2.34	31.92	-	-	P	H
		256.98	24.5	-21.5	46	34.33	19.46	2.52	31.81	-	-	P	H
		42.61	27.04	-12.96	40	41.23	17.1	1.15	32.44	-	-	P	V
		75.59	26.87	-13.13	40	45.05	12.7	1.44	32.32	-	-	P	V
		115.36	22.21	-21.29	43.5	34.76	17.89	1.73	32.17	-	-	P	V
		195.87	28.31	-15.19	43.5	42.57	15.54	2.21	32.01	-	-	P	V
		221.09	30.56	-15.44	46	44.74	15.4	2.34	31.92	100	360	P	V
		256.98	29.88	-16.12	46	39.71	19.46	2.52	31.81	-	-	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	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		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	95.00	2.0652	0.4842	0.51KHz
802.11n HT20	94.66	1.9275	0.5188	0.56KHz
802.11n HT40	89.12	0.9493	1.0534	1.1KHz

802.11a

