FCC TEST REPORT

For

Autonomic Controls, Inc.

MMS-1e MIRAGE MEDIA STREAMER

Test Model: AU-MMS-1e-R2

Prepared for	:	Autonomic Controls, Inc.
Address	:	28 Kaysal Court, Armonk, NY 10504, USA

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com

Date of receipt of test sample	:	Jul 05, 2017
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Jul 05, 2017~Jul 12, 2017
Date of Report	:	Jul 21, 2017

FCC TEST REPORT FCC CFR 47 PART 15 E(15.407):2017	
Report Reference No. ..... :	**LCS170705112AE**
Date of Issue..... :	Jul 21, 2017
Testing Laboratory Name ..... :	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address..... :	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure ..... :	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name..... :	**Autonomic Controls, Inc.**
Address..... :	28 Kaysal Court, Armonk, NY 10504, USA
Test Specification	
Standard ..... :	FCC CFR 47 PART 15 E(15.407):2017 / ANSI C63.10: 2013
Test Report Form No..... :	LCSEMC-1.0
TRF Originator..... :	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF ..... :	Dated 2011-03
Shenzhen LCS Compliance Testing Laboratory Ltd. All rights reserved. This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen LCS Compliance Testing Laboratory Ltd. is acknowledged as copyright owner and source of the material. Shenzhen LCS Compliance Testing Laboratory Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.	
Test Item Description..... :	**MMS-1e MIRAGE MEDIA STREAMER**
Trade Mark..... :	AUTONOMIC
Test Model ..... :	AU-MMS-1e-R2
Ratings ..... :	DC 5.2V/2.1A by power adapter Adapter input:100-240VAC, 50/60Hz, 0.5A
Result ..... :	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
		
Calvin Weng/ Administrators	Dick Su / Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : LCS170705112AE	Jul 21, 2017 Date of issue

Test Model.....	: AU-MMS-1e-R2
EUT.....	: MMS-1e MIRAGE MEDIA STREAMER
Applicant.....	**: Autonomic Controls, Inc.**
Address.....	: 28 Kaysal Court, Armonk, NY 10504, USA
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen ZHIQU Technology Limited**
Address.....	: RM1101, Tower B, Haisong Building, Tairan 9th Road, Futian District, Shenzhen, China.
Telephone.....	: /
Fax.....	: /
Factory.....	**: Shenzhen ZHIQU Technology Limited**
Address.....	: RM1101, Tower B, Haisong Building, Tairan 9th Road, Futian District, Shenzhen, China.
Telephone.....	: /
Fax.....	: /

Test Result	Positive

The test report merely corresponds to the test sample.

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

Revision History

Revision	Issue Date	Revisions	Revised By
000	Jul 21, 2017	Initial Issue	Gavin Liang

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	MMS-1e MIRAGE MEDIA STREAMER
Test Model	:	AU-MMS-1e-R2
Hardware Version	:	V1.0
Software Version	:	V1.0
Power Supply	:	DC 5.2V/2.1A by power adapter Adapter input:100-240VAC, 50/60Hz, 0.5A
EUT Supports Radios Application	:	2.4GHz WIFI/5G WIFI
WIFI(2.4GHz Band)	:	
Operating Frequency	:	2412-2462MHz
Channel Spacing	:	5MHz
Channel Number	:	11 Channel for 20MHz bandwidth(2412~2462MHz) 7 channels for 40MHz bandwidth(2422~2452MHz)
Modulation Type	:	802.11b: DSSS; 802.11g/n: OFDM
Antenna Description	:	PCB Antenna, 3dBi(Max.)
Antenna connector type	:	IPEX connector
WIFI(5GHz Band)	:	
Operating Frequency	:	5180.00-5240.00MHz / 5745.00-5825.00MHz
Channel Number	:	9 Channel for 20MHz Bandwidth 4 channels for 40MHz Bandwidth
Modulation Type	:	802.11a/n: OFDM
Antenna Description	:	PCB Antenna, 3dBi(Max.) for 5.2G band 3dBi(Max.) for 5.8G band
Antenna connector type	:	IPEX connector

1.2. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Shenzhen ZHIQU Technology Limited	Power Adapter	XS-0522100DH	---	FCC VoC

1.3. External I/O

I/O Port Description	Quantity	Cable
USB Port	2	N/A
Analog	1	N/A
Coax Digital	1	N/A
HDMI	1	1m unshielded cable
RJ45	1	N/A
Power Port	1	1.2m unshielded cable

1.4. Associated test equipment

AE Description	Manufacturer	Model No.
HDMI Monitor	Sony	KDL-32W700B

1.5. Description of Test Facility

CNAS Registration Number. is L4595.

FCC Registration Number. is 899208.

Industry Canada Registration Number. is 9642A-1.

ESMD Registration Number. is ARCB0108.

UL Registration Number. is 100571-492.

TUV SUD Registration Number. is SCN1081.

TUV RH Registration Number. is UA 50296516-001

There is one 3m semi-anechoic chamber and one line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4: 2014, CISPR 32/EN 55032 and CISPR16-1-4 SVSWR requirements.

1.6. List Of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	Jun 18, 2017	Jun 17, 2018
Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	9kHz~40GHz	Jul 16, 2016	Jul 15, 2017
LISN	MESS Tec	NNB-2/16Z	99079	9KHz-30MHz	Jun 18, 2017	Jun 17, 2018
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9KHz-30MHz	Jun 18, 2017	Jun 17, 2018
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30M-18GHz	Jun 18, 2017	Jun 17, 2018
Amplifier	SCHAFFNER	COA9231A	18667	9kHz-2GHzz	Apr 18, 2017	Apr 17, 2018
Amplifier	Agilent	8449B	3008A02120	1GHz-26.5GHz	Apr 18, 2017	Apr 17, 2018
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40GHz	Apr 18, 2017	Apr 17, 2018
Loop Antenna	R&S	HFH2-Z2	860004/001	9k-30MHz	Apr 18, 2017	Apr 17, 2018
By-log Antenna	SCHWARZBECK	VULB9163	9163-470	30MHz-1GHz	Apr 18, 2017	Apr 17, 2018
Horn Antenna	EMCO	3115	6741	1GHz-18GHz	Apr 18, 2017	Apr 17, 2018
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	15GHz-40GHz	Apr 18, 2017	Apr 17, 2018
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz-1GHz	Jun 18, 2017	Jun 17, 2018
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1GHz-40GHz	Jun 18, 2017	Jun 17, 2018
Power Meter	R&S	NRVS	100444	DC-40GHz	Jun 18, 2017	Jun 17, 2018
Power Sensor	R&S	NRV-Z51	100458	DC-30GHz	Jun 18, 2017	Jun 17, 2018
Power Sensor	R&S	NRV-Z32	10057	30MHz-6GHz	Jun 18, 2017	Jun 17, 2018
AC Power Source	HPC	HPA-500E	HPA-9100024	AC 0~300V	Jun 18, 2017	Jun 17, 2018
Temp. and Humidigy Chamber	Giant Force	GTH-225-20-S	MAB0103-00	N/A	Jun 18, 2017	Jun 17, 2018
RF CABLE-1m	JYE Bao	RG142	CB034-1m	20MHz-7GHz	Jun 18, 2017	Jun 17, 2018
RF CABLE-2m	JYE Bao	RG142	CB035-2m	20MHz-1GHz	Jun 18, 2017	Jun 17, 2018
MXA Signal Analyzer	Agilent	N9020A	MY50510140	10Hz~26.5GHz	Oct 27, 2016	Oct 26, 2017

1.6. Statement of The Measurement Uncertainty

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

1.7. Measurement Uncertainty

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

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

1.8. Description Of Test Modes

The EUT has been tested under operating condition.

The EUT was set to transmit at 100% duty cycle.

For pre-testing, when performed power line conducted emission measurement, the input Voltage/Frequency AC 120V/60Hz and AC 240V/50Hz were used. Only recorded the worst case in this report.

Worst-case mode and channel used for 150kHz-30 MHz power line conducted emissions was determined to be 802.11a mode(Low Channel, 5180-5240MHz Band).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was determined to be 802.11a mode(Low Channel, 5180-5240MHz Band).

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:
802.11a Mode: 6 Mbps, OFDM.
802.11n(HT20) Mode: MCS0, OFDM.
802.11n(HT40) Mode: MCS0, OFDM.

Support Bandwidth For 5G WIFI Part:

Bandwidth Mode	20MHz	40MHz	80MHz
802.11a	☑	☐	☐
802.11n(HT20)	☑	☐	☐
802.11n(HT40)	☐	☑	☐

Channel & Frequency:

Frequency Band	Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
5180~5240MHz	36	5180	44	5220
	38	5190	46	5230
	40	5200	48	5240
	42	5210	/	/
For 802.11a/n(HT20), Channel 36, 40 and 48 were tested. For 802.11n(HT40), Channel 38 and 46 were tested.				
5745~5825MHz	149	5745	155	5775
	151	5755	159	5795
	153	5765	161	5805
	157	5785	165	5825
For 802.11a/n(HT20), Channel 149, 157 and 165 were tested. For 802.11n(HT40), Channel 151 and 159 were tested.				

The MPtool.exe software was used to set the EUT continuously transmitting in different channel & different operating mode. For software power setting table, see as below:

5.2G band

Operating mode	802.11a	802.11n20
Channel 36	36	34
Channel 40	35	34
Channel 48	35	34

Operating mode	802.11n(HT40)
Channel 38	34
Channel 46	33

5.8G band

Operating mode	802.11a	802.11n20
Channel 149	35	34
Channel 157	34	35
Channel 165	34	34

Operating mode	802.11n(HT40)
Channel 151	34
Channel 159	34

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10: 2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd..

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to FCC's request, Test Procedure 789033 D02 General UNII Test Procedures New Rules v01r04 is required to be used for this kind of FCC 15.407 UII device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E

2.3. General Test Procedures

2.3.1 Conducted Emissions

According to the requirements in Section 6.2 of ANSI C63.10: 2013, AC power-line conducted emissions shall be measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table and the turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10: 2013

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmit condition.

3.2. EUT Exercise Software

N/A

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart E		
FCC Rules	**Description of Test**	**Result**
§15.407(a)	Maximum Conducted Output Power	Compliant
§15.407(a)	Power Spectral Density	Compliant
§15.407(e)	6dB & 26dB Bandwidth	Compliant
§15.205, §15.407(b)	Radiated Spurious Emissions and Band Edge	Compliant
§15.407(g)	Frequency Stability	Compliant
§15.407(h)	Transmit Power Control (TPC)	N/A
§15.207(a)	Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant

Note: The customer declared frequency stability is better than 20ppm which ensures that the signal remains in the allocated bands under all operational conditions stated in the user manual. For test data, please refer to the relative setion.

5. TEST RESULT

5.1. Maximum Conducted Output Power Measurement

5.1.1. Standard Applicable

According to §15.407(a)(1)(i), For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

According to §15.407(a)(1)(ii), For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

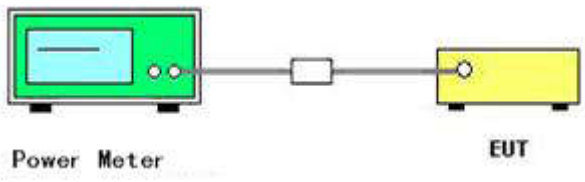
According to §15.407(a)(1)(iv), For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

According to §15.407(a)(3), For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

5.1.2. Test Procedures

The transmitter output (antenna port) was connected to the power meter.

5.1.3. Test Setup Layout



5.1.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.5. Test Result of Maximum Conducted Output Power

Temperature	25℃	Humidity	60%
Test Engineer	Chaz Liu	Configurations	802.11a/n

Maximum Conducted Output Power Measurement Result For 5180~5240MHz Band

Mode	Channel	Frequency (MHz)	Conducted Power (dBm, Average)	Max. Limit (dBm)	Result
802.11a	36	5180	17.88	24	Complies
	40	5200	17.29	24	Complies
	48	5240	17.09	24	Complies
802.11n(HT20)	36	5180	15.52	24	Complies
	40	5200	15.87	24	Complies
	48	5240	15.47	24	Complies
802.11n(HT40)	38	5190	15.91	24	Complies
	46	5230	15.17	24	Complies

Maximum Conducted Output Power Measurement Result For 5745~5825MHz Band

Mode	Channel	Frequency (MHz)	Conducted Power (dBm, Average)	Max. Limit (dBm)	Result
802.11a	149	5745	15.95	30	Complies
	157	5785	14.49	30	Complies
	165	5825	14.20	30	Complies
802.11n(HT20)	149	5745	15.59	30	Complies
	157	5785	14.71	30	Complies
	165	5825	14.32	30	Complies
802.11n(HT40)	151	5755	15.50	30	Complies
	159	5795	15.20	30	Complies

5.2. Power Spectral Density Measurement

5.2.1. Standard Applicable

According to §15.407(a)(1)(i), For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

According to §15.407(a)(1)(ii), For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

According to §15.407(a)(1)(iv), For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

According to §15.407(a)(3), For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

5.2.2. Test Procedures

1) The transmitter was connected directly to a Spectrum Analyzer through a directional couple.

2) The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.

3) Set the RBW/VBW = 1MHz/3MHz For the 5.15-5.25GHz band;

Set the RBW/VBW = 300KHz/1MHz For the 5.725-5.85GHz band.

4) Set the span to encompass the entire emission bandwidth of the signal.

5) Detector = RMS.

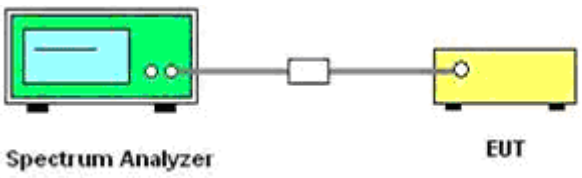
6) Sweep time = auto couple.

7) Trace mode = max hold.

8) Allow trace to fully stabilize.

9) Use the peak marker function to determine the maximum amplitude level.

5.2.3. Test Setup Layout



5.2.4. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.5. Test Result of Power Spectral Density

Temperature	25℃	Humidity	60%
Test Engineer	Chaz Liu	Configurations	802.11a/n

Power Spectral Density Measurement Result For 5180~5240MHz Band

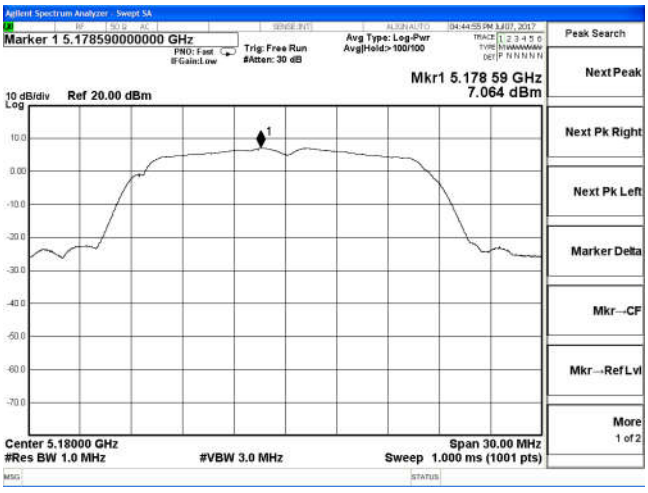
Mode	Channel	Frequency (MHz)	Power Density (dBm/MHz)	Max. Limit (dBm/MHz)	Result
802.11a	36	5180	7.064	11	Complies
	40	5200	6.887	11	Complies
	48	5240	6.440	11	Complies
802.11n(HT20)	36	5180	6.750	11	Complies
	40	5200	6.454	11	Complies
	48	5240	6.250	11	Complies
802.11n(HT40)	38	5190	3.584	11	Complies
	46	5230	3.713	11	Complies

Power Spectral Density Measurement Result For 5745~5825MHz Band

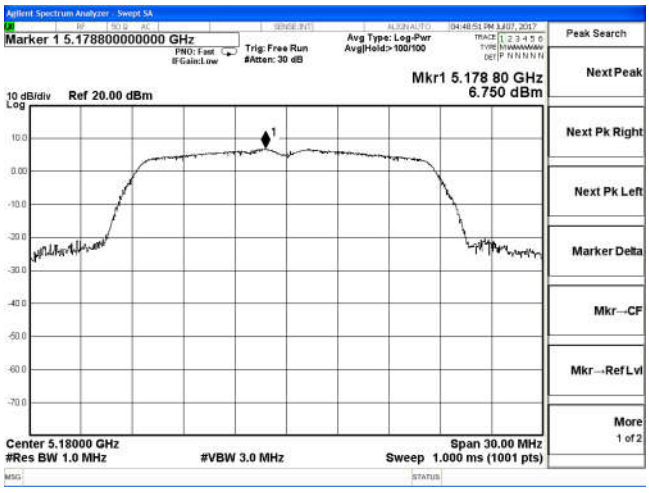
Mode	Channel	Frequency (MHz)	Power Density (dBm/300KHz)	BW correction factor	Power Density (dBm/500KHz)	Max. Limit (dBm/500KHz)	Result
802.11a	149	5745	1.272	2.218	3.490	30	Complies
	157	5785	-0.420	2.218	1.798	30	Complies
	165	5825	-1.858	2.218	0.360	30	Complies
802.11n(HT20)	149	5745	0.652	2.218	2.870	30	Complies
	157	5785	-0.809	2.218	1.409	30	Complies
	165	5825	-1.361	2.218	0.857	30	Complies
802.11n(HT40)	151	5755	-2.382	2.218	-0.164	30	Complies
	159	5795	-4.160	2.218	-1.942	30	Complies

Note: BW correction factor = 10log(500kHz/RBW) = 10 log(500kHz/300KHz)
The measured power density (dBm) has the offset with cable loss already.

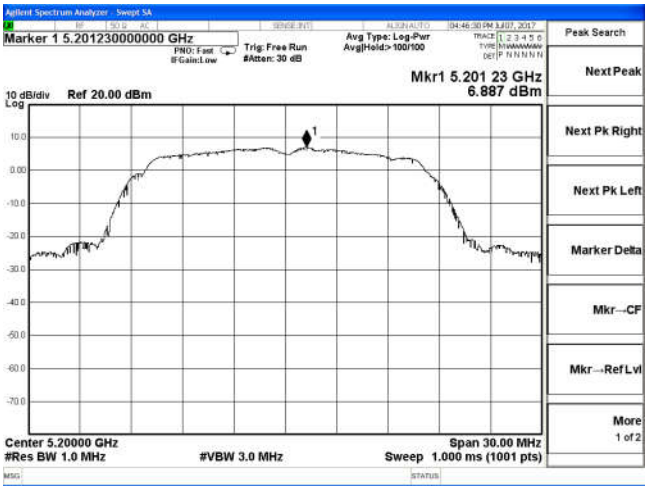
Test Result of Power Spectral Density



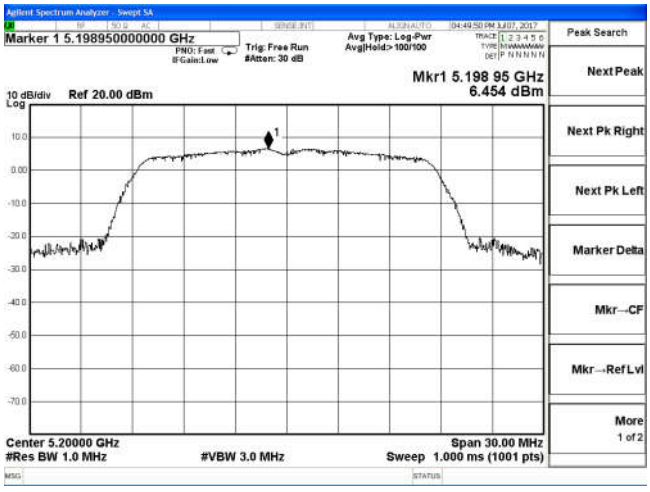
802.11a_Low Channel / 5180MHz



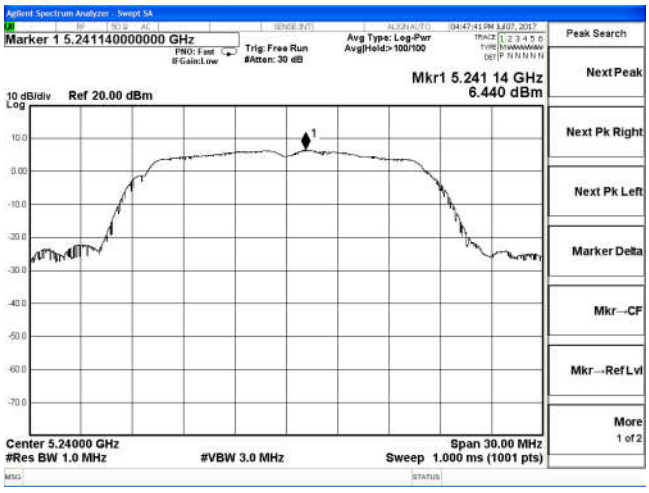
802.11n HT20_Low Channel / 5180MHz



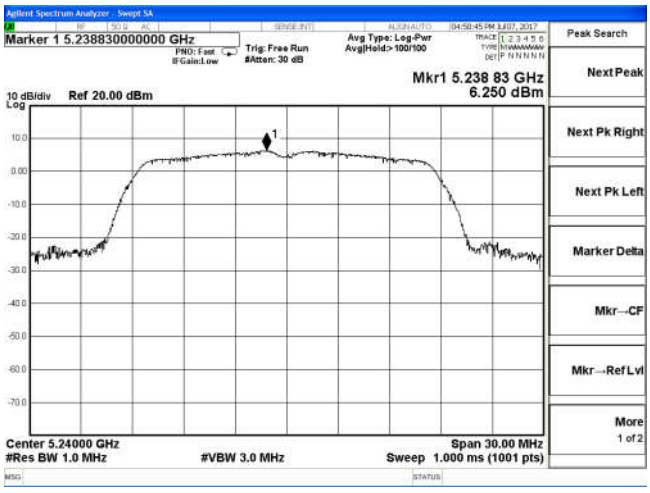
802.11a_Middle Channel / 5200MHz



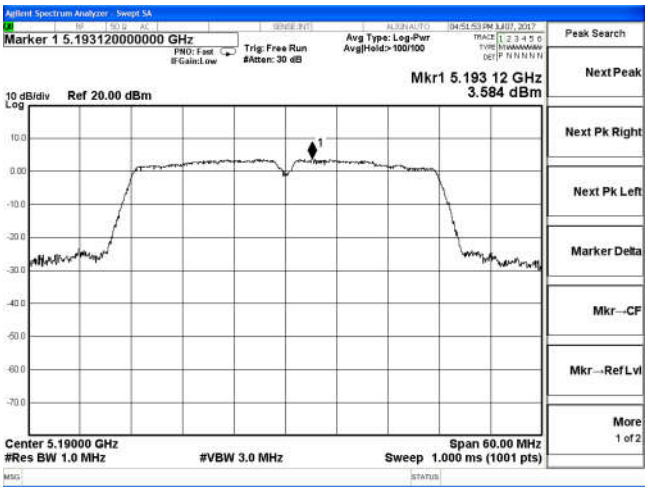
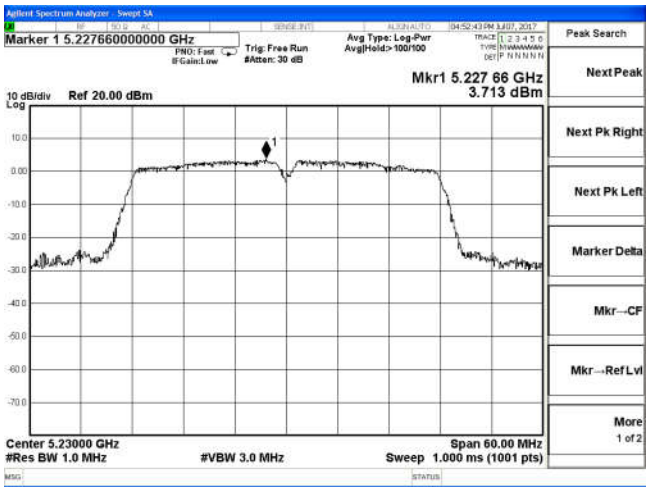
802.11n HT20_Middle Channel / 5200MHz



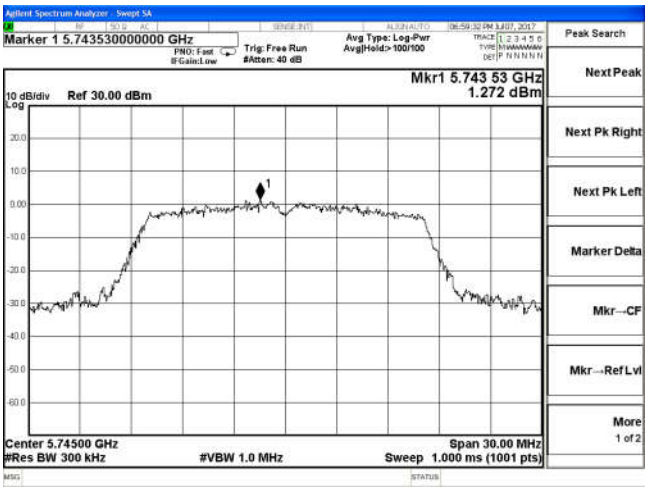
802.11a_High Channel / 5240MHz



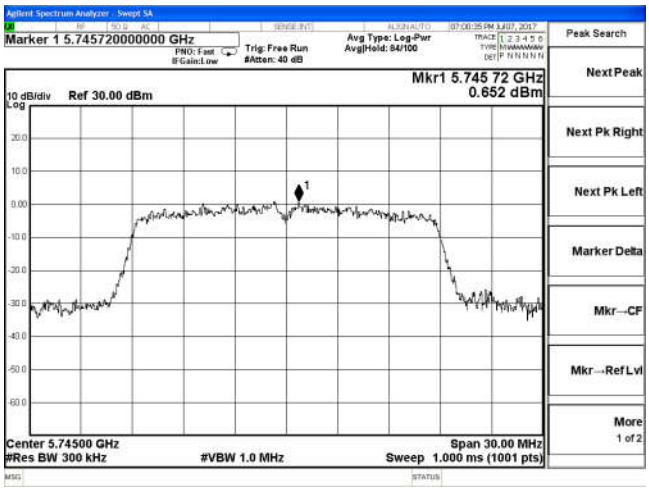
802.11n HT20_High Channel / 5240MHz

Test Result of Power Spectral Density	
	
802.11n HT40_Low Channel / 5190MHz	**802.11n HT40_High Channel / 5230MHz**

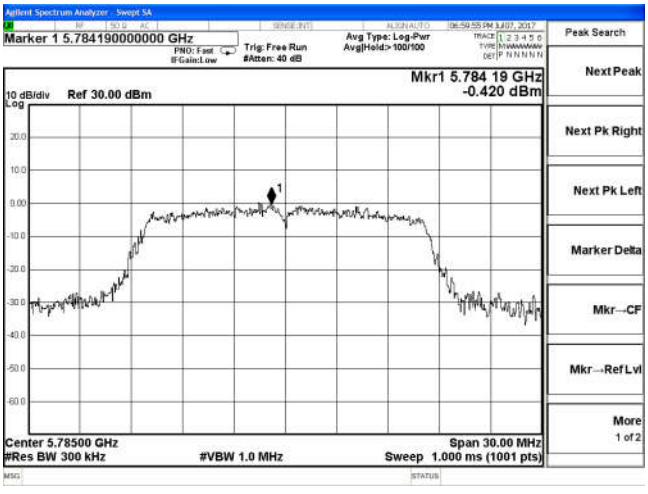
Test Result of Power Spectral Density



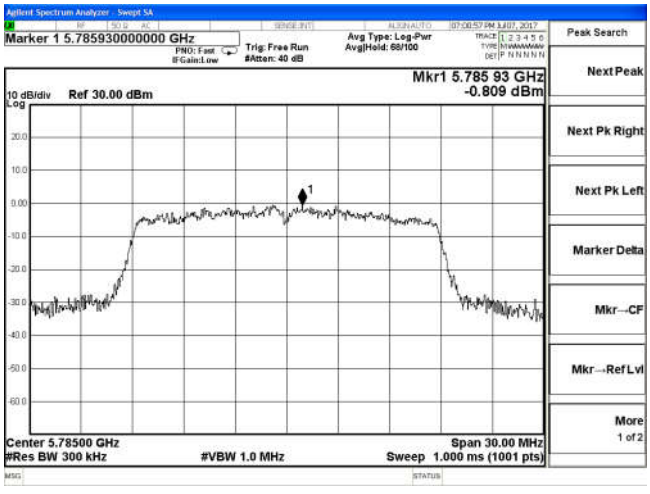
802.11a_Low Channel / 5745MHz



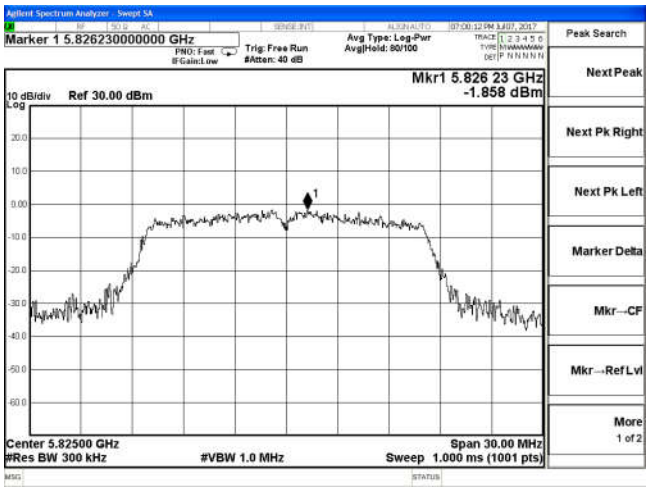
802.11n HT20_Low Channel / 5745MHz



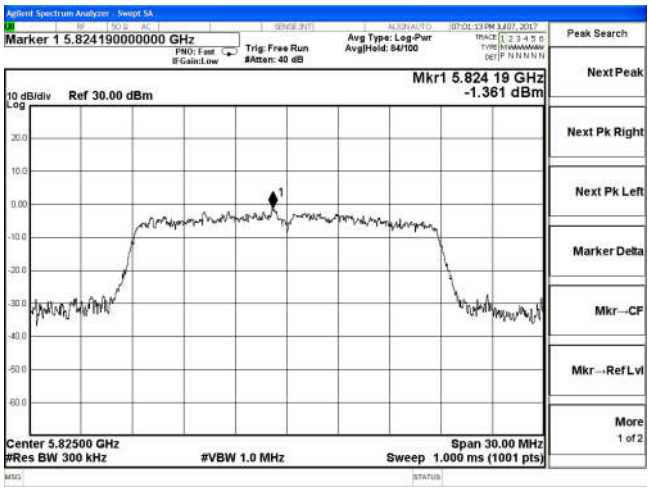
802.11a_Middle Channel / 5785MHz



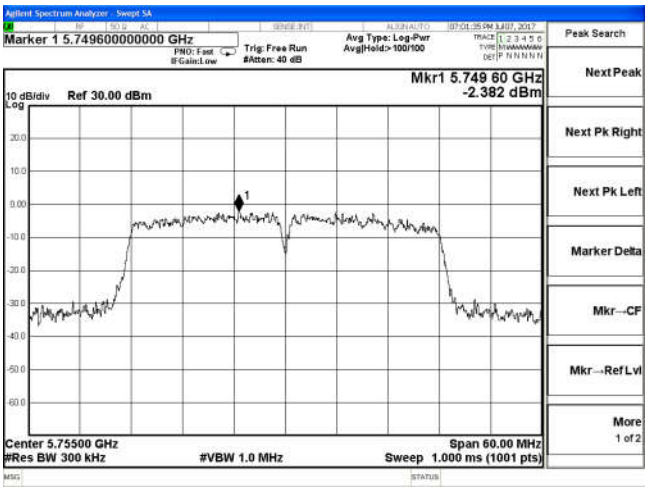
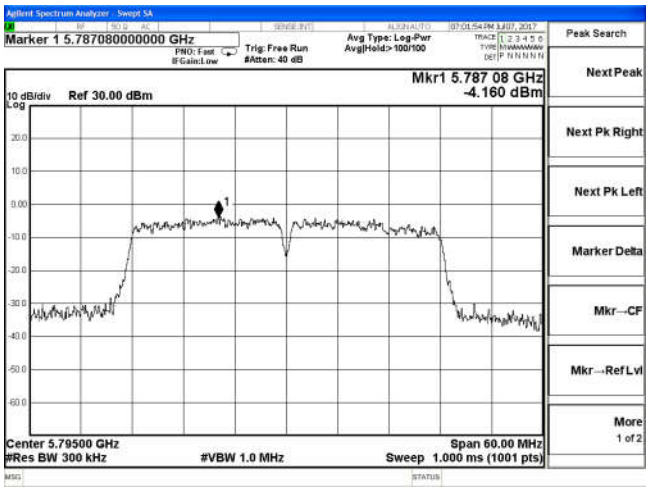
802.11n HT20_Middle Channel / 5785MHz



802.11a_High Channel / 5825MHz



802.11n HT20_High Channel / 5825MHz

Test Result of Power Spectral Density	
	
802.11n HT40_Low Channel / 5755MHz	**802.11n HT40_High Channel / 5795MHz**

5.3. 6dB & 26dB Bandwidth Measurement

5.3.1. Standard Applicable

According to §15.407(e): Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

There is no restriction limits for 26dB & 99% occupied bandwidth, report only for reference.

5.3.2. Instruments Setting

The following table is the setting of the Spectrum Analyzer.

6dB Bandwidth Measurement (Only For 5745~5825MHz Band)	
Spectrum Parameter	Setting
Attenuation	Auto
RBW	100KHz
VBW	⩾ 3 x RBW
Detector	Peak
Trace	Max Hold

26dB & 99%Bandwidth Measurement (Only For 5180~5240MHz Band)	
Spectrum Parameter	Setting
Attenuation	Auto
RBW	approximately 1% of the emission bandwidth
VBW	⩾ RBW
Detector	Peak
Trace	Max Hold

5

5.3.3. Test Procedures

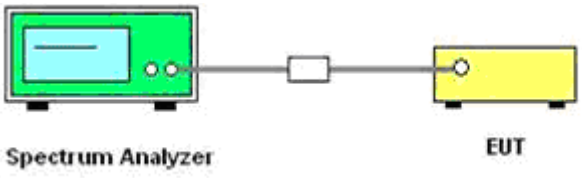
1) The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.

2) The resolution bandwidth and the video bandwidth were set according to KDB 789033 D02 General UNII Test Procedures New Rules v01r04

3) For 5745~5825MHz Band, Measured the maximum width of the emission that is 6dB down from the peak of the emission.

4) For 5180~5240MHz Band, Measured the maximum width of the emission that is 26dB down from the peak of the emission. Record the 26dB & 99% Bandwidth.

5.3.4. Test Setup Layout



5.3.5. EUT Operation during Test

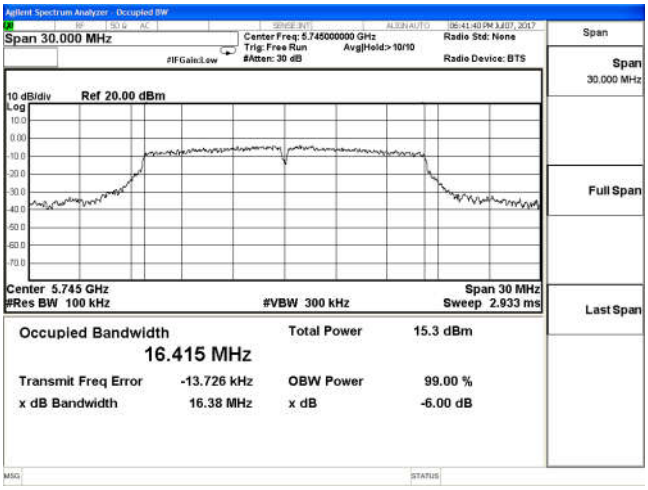
The EUT was programmed to be in continuously transmitting mode.

5.3.6. Test Result of Spectrum Bandwidth

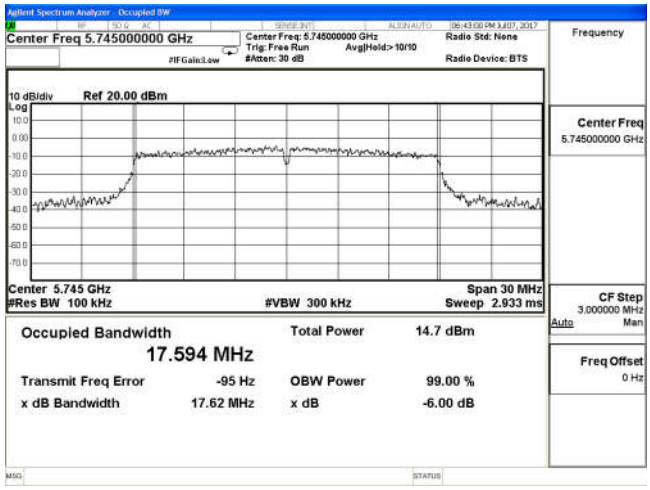
Temperature	25°C	Humidity	60%
Test Engineer	Chaz Liu	Configurations	802.11a/n

Mode	Channel	Frequency	6dB Bandwidth (MHz)	Min. Limit (kHz)	Result
802.11a	149	5745	16.38	500	Complies
	157	5785	16.38	500	Complies
	165	5825	16.39	500	Complies
802.11n(HT20)	149	5745	17.62	500	Complies
	157	5785	17.61	500	Complies
	165	5825	17.63	500	Complies
802.11n(HT40)	151	5755	36.11	500	Complies
	159	5795	36.11	500	Complies

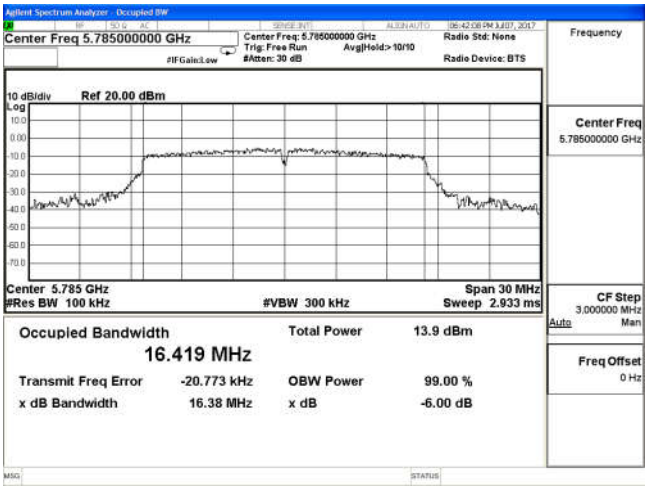
Test Result of 6dB Bandwidth



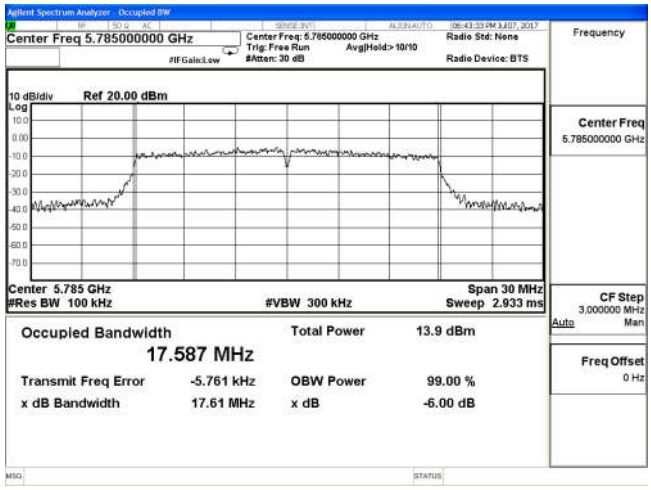
802.11a_Low Channel / 5745MHz



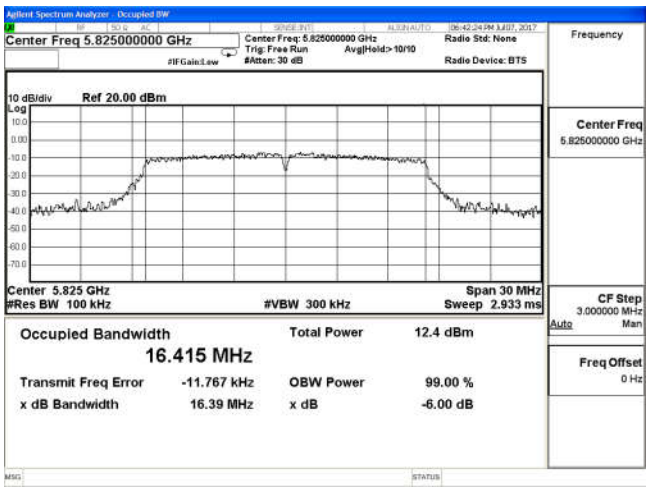
802.11n HT20_Low Channel / 5745MHz



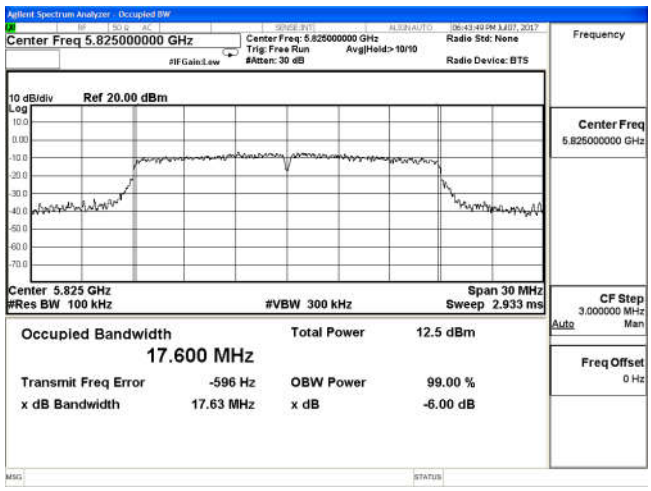
802.11a_Middle Channel / 5785MHz



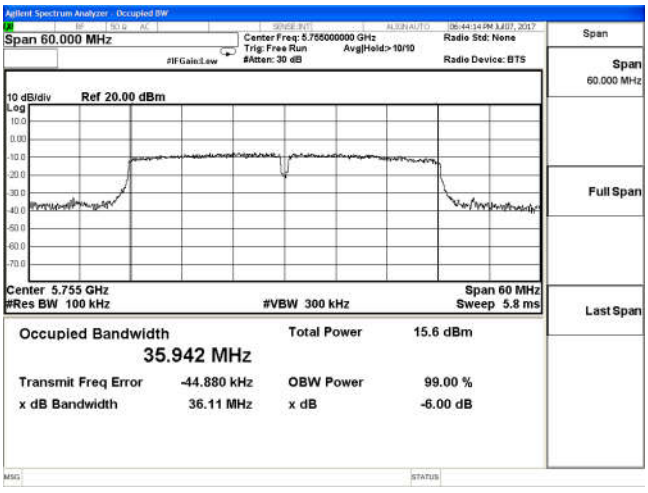
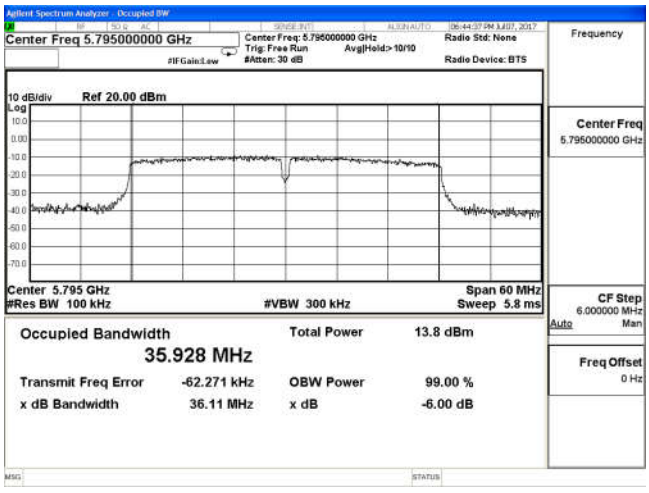
802.11n HT20_Middle Channel / 5785MHz



802.11a_High Channel / 5825MHz

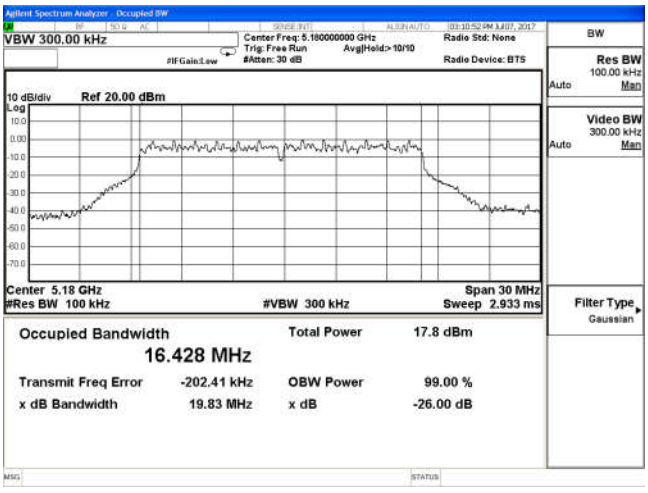


802.11n HT20_High Channel / 5825MHz

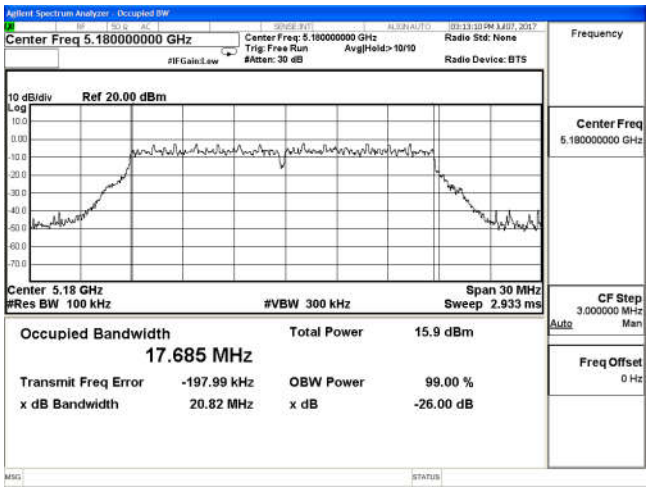
Test Result of 6dB Bandwidth	
	
802.11n HT40_Low Channel / 5755MHz	**802.11n HT40_High Channel / 5795MHz**

Mode	Channel	Frequency (MHz)	26dB BW (MHz)	99% BW (MHz)	Limit
802.11a	36	5180	19.83	16.428	Non-specified
	40	5200	20.05	16.424	
	48	5240	19.90	16.436	
802.11n(HT20)	36	5180	20.82	17.685	
	40	5200	20.73	17.674	
	48	5240	20.94	17.663	
802.11n(HT40)	38	5190	39.08	35.931	
	46	5230	39.12	35.915	

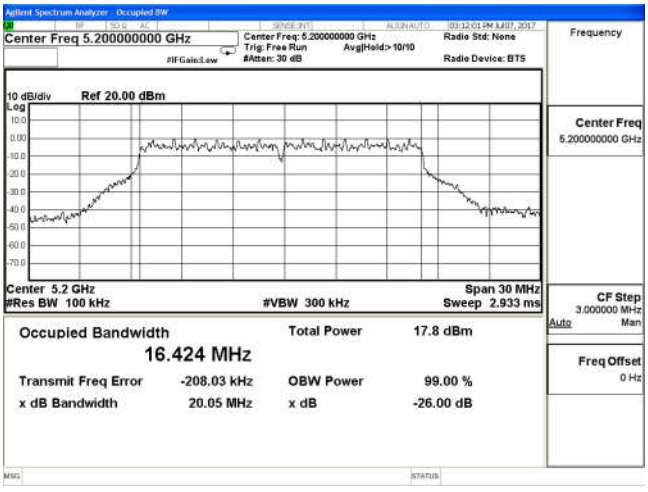
Test Result of 26dB Bandwidth & 99% Bandwidth



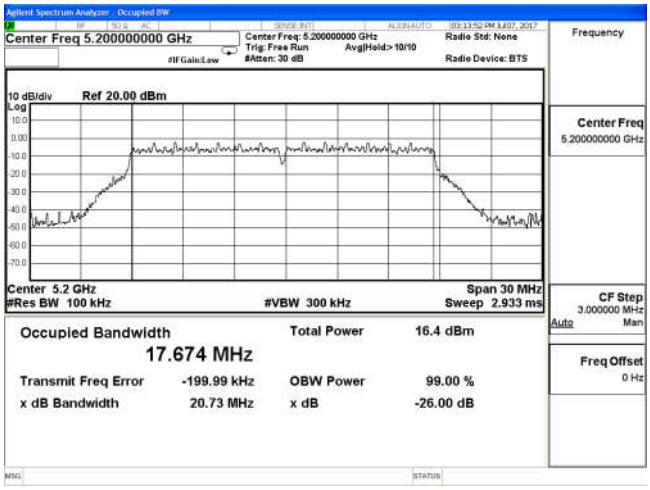
802.11a_Low Channel / 5180MHz



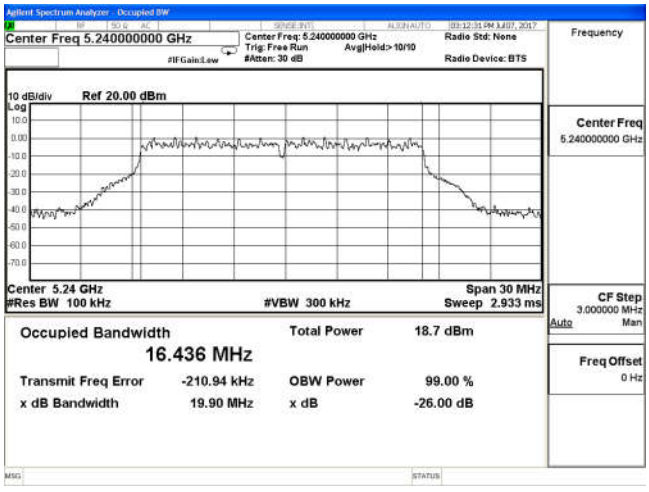
802.11n HT20_Low Channel / 5180MHz



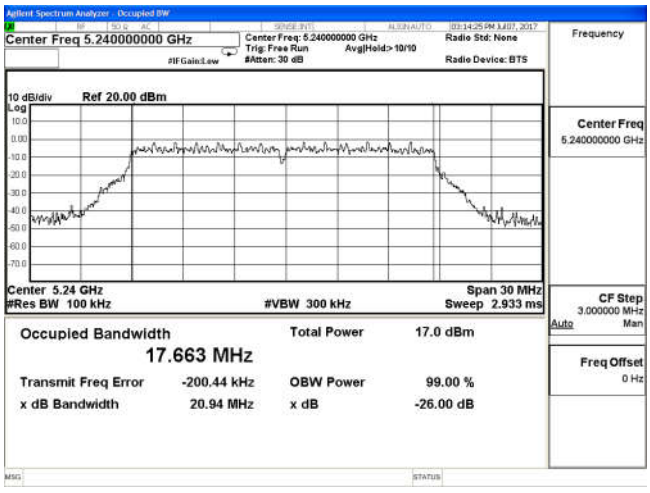
802.11a_Middle Channel / 5220MHz



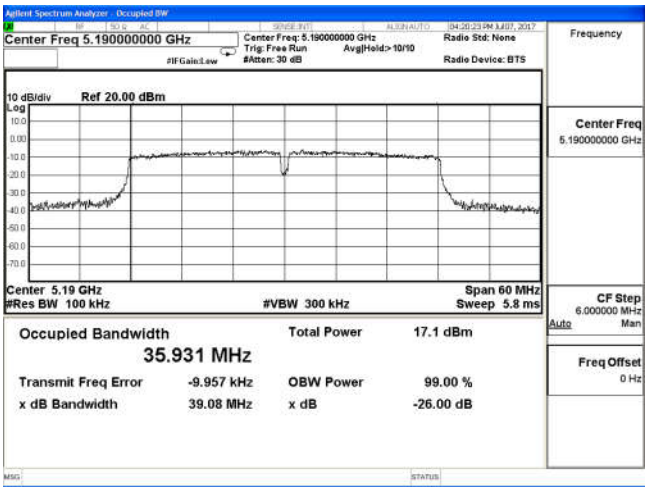
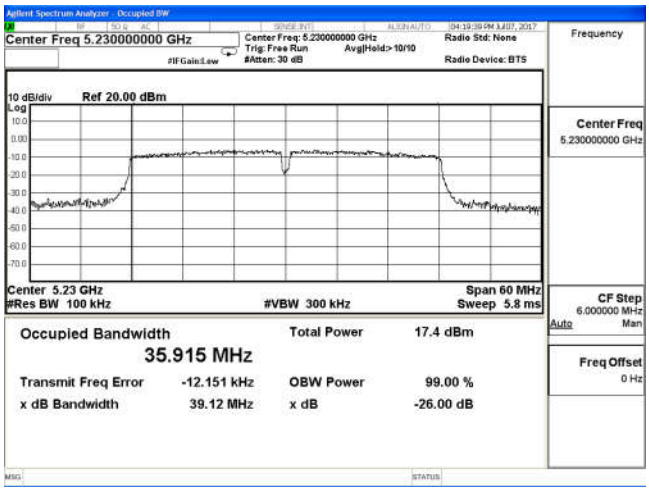
802.11n HT20_Middle Channel / 5220MHz



802.11a_High Channel / 5240MHz



802.11n HT20_High Channel / 5240MHz

Test Result of 26dB Bandwidth & 99% Bandwidth	
	
802.11n HT40_Low Channel / 5190MHz	**802.11n HT40_High Channel / 5230MHz**

5.4. Radiated Emissions Measurement

5.4.1. Standard Applicable

According to §15.407 (b)(1) to (6):

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz (68.3dBuV/m at 3m).

For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz (78.3dBuV/m at 3m); for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz (68.3dBuV/m at 3m).

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

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

5.4.2. Instruments Setting

The following table is the setting of spectrum analyzer and receiver.

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

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 100kHz for QP

5.4.3. Test Procedures

1) **Sequence of testing 9 kHz to 30 MHz**

Setup:

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

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

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

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

--- The antenna height is 0.8 meter.

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

Final measurement:

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

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

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

2) **Sequence of testing 30 MHz to 1 GHz**

Setup:

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

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

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

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

--- The antenna is polarized vertical and horizontal.

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

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

Final measurement:

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

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

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

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

3) **Sequence of testing 1 GHz to 18 GHz**

Setup:

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

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

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

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

--- Keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

Premeasurement:

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

--- The antenna is polarized vertical and horizontal.

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

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

Final measurement:

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

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

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

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

4) **Sequence of testing above 18 GHz**

Setup:

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

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

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

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

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

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

--- Keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

Premeasurement:

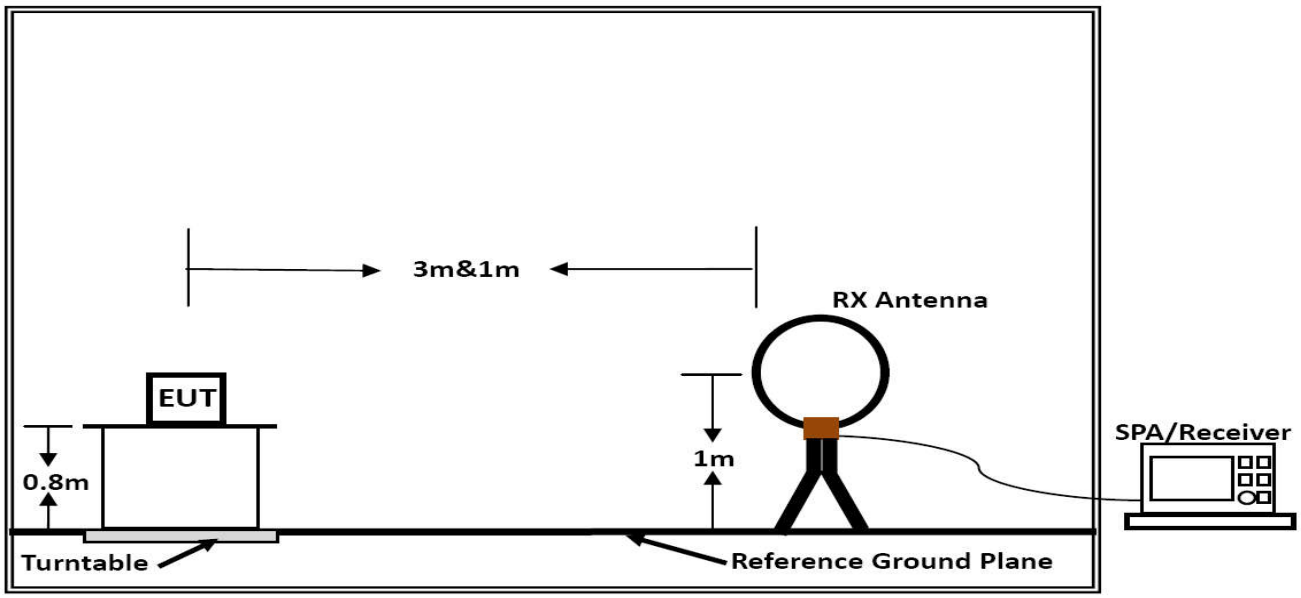
--- The antenna is moved spherical over the EUT in different polarisations of the antenna.

Final measurement:

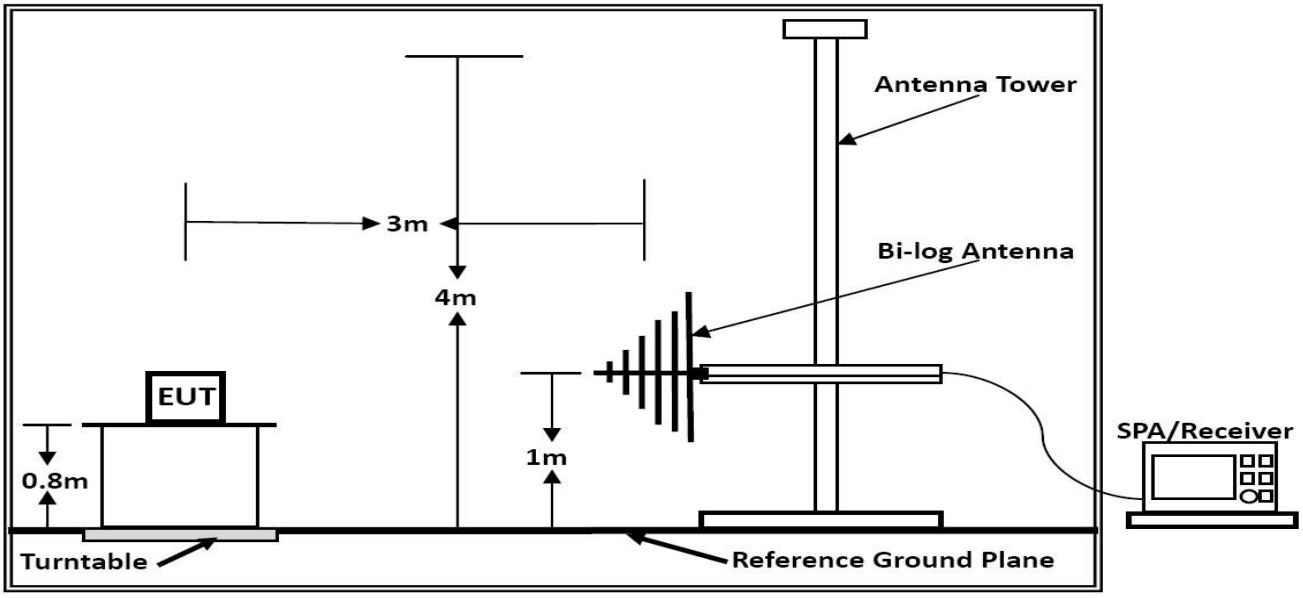
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

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

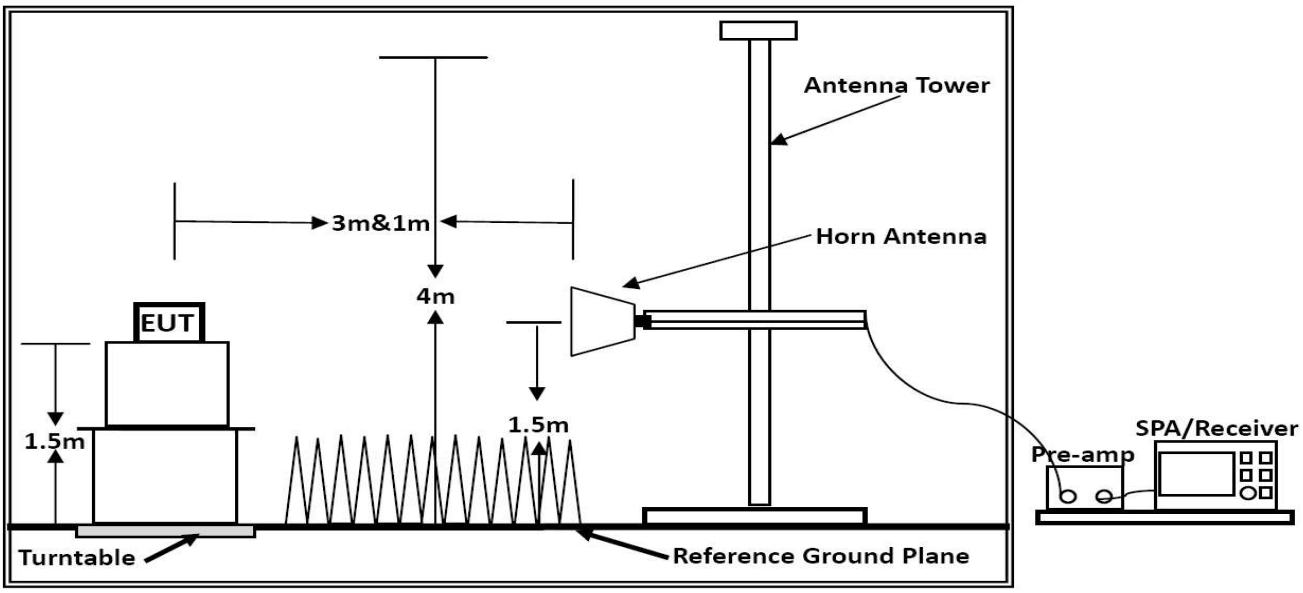
5.4.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1.5m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1.5m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Results of Radiated Emissions (9kHz~30MHz)

Temperature	25℃	Humidity	60%
Test Engineer	Chaz Liu	Configurations	802.11a/n

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

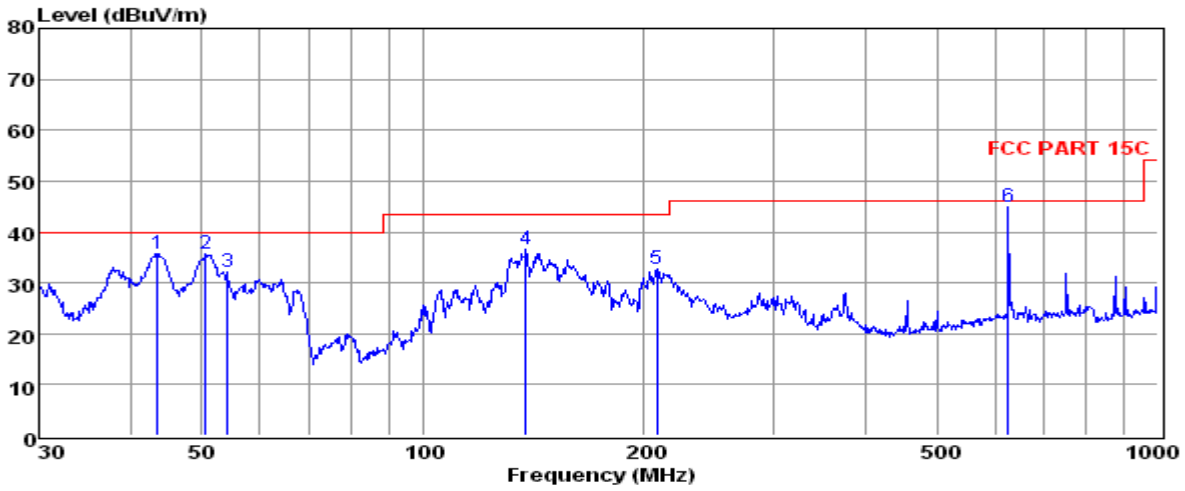
Note:

The radiated emissions from 9kHz to 30MHz are at least 20dB below the official limit and no need to report.

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

Note: Only record the worst test result in this report.

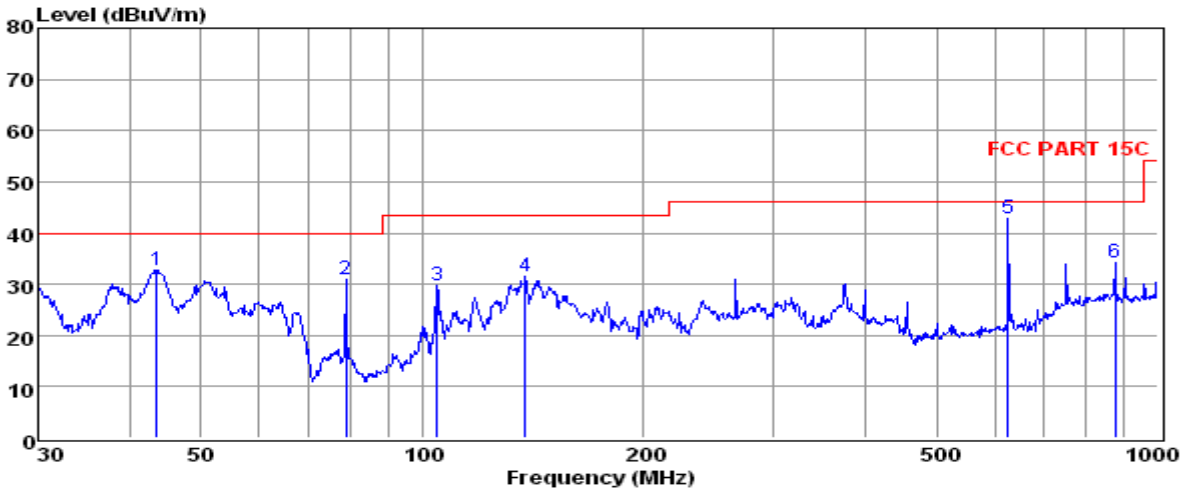
Horizontal:



	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	43.51	21.76	0.41	13.56	35.73	40.00	-4.27	QP
2	50.59	21.95	0.54	13.22	35.71	40.00	-4.29	QP
3	54.26	18.48	0.46	13.05	31.99	40.00	-8.01	QP
4	137.90	27.38	0.70	8.35	36.43	43.50	-7.07	QP
5	207.85	20.92	0.86	10.82	32.60	43.50	-10.90	QP
6	625.08	24.89	1.49	18.54	44.92	46.00	-1.08	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

Vertical:



	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	43.51	18.76	0.41	13.56	32.73	40.00	-7.27	QP
2	78.69	22.13	0.47	8.35	30.95	40.00	-9.05	QP
3	104.54	16.50	0.61	12.75	29.86	43.50	-13.64	QP
4	137.90	22.38	0.70	8.35	31.43	43.50	-12.07	QP
5	625.08	22.89	1.49	18.54	42.92	46.00	-3.08	QP
6	875.25	11.51	1.87	20.84	34.22	46.00	-11.78	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

****Note:*
Pre-scan all mode and recorded the worst case results in this report (802.11a mode(Low Channel, 5180-5240MHz Band)).
Emission level (dBuV/m) = 20 log Emission level (uV/m).
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.
Only recorded the worst test case in this report.

5.4.8. Results for Radiated Emissions (Above 1GHz)

Note: Only recorded the worst test result in this report.

The Worst Test Result For 5180~5240MHz Band.

802.11a / Channel 36

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.36	45.60	33.21	35.82	9.52	52.51	74.00	-21.49	Peak	Horizontal
10.36	34.62	33.21	35.82	9.52	41.53	54.00	-12.47	Average	Horizontal
10.36	46.79	32.82	35.82	9.52	53.31	74.00	-20.69	Peak	Vertical
10.36	35.31	32.82	35.82	9.52	41.83	54.00	-12.17	Average	Vertical

802.11a / Channel 40

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.40	45.87	33.21	35.82	9.52	52.78	74.00	-21.22	Peak	Horizontal
10.40	35.44	33.21	35.82	9.52	42.35	54.00	-11.65	Average	Horizontal
10.40	47.10	32.82	35.82	9.52	53.62	74.00	-20.38	Peak	Vertical
10.40	35.68	32.82	35.82	9.52	42.20	54.00	-11.80	Average	Vertical

802.11a / Channel 48

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.48	46.57	33.21	35.82	9.52	53.48	74.00	-20.52	Peak	Horizontal
10.48	35.65	33.21	35.82	9.52	42.56	54.00	-11.44	Average	Horizontal
10.48	47.66	32.82	35.82	9.52	54.18	74.00	-19.82	Peak	Vertical
10.48	36.05	32.82	35.82	9.52	42.57	54.00	-11.43	Average	Vertical

802.11n(HT20) / Channel 36

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.36	45.22	33.21	35.82	9.52	52.13	74.00	-21.87	Peak	Horizontal
10.36	34.43	33.21	35.82	9.52	41.34	54.00	-12.66	Average	Horizontal
10.36	46.30	32.82	35.82	9.52	52.82	74.00	-21.18	Peak	Vertical
10.36	34.77	32.82	35.82	9.52	41.29	54.00	-12.71	Average	Vertical

802.11n(HT20) / Channel 40

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.40	45.87	33.21	35.82	9.52	52.78	74.00	-21.22	Peak	Horizontal
10.40	34.87	33.21	35.82	9.52	41.78	54.00	-12.22	Average	Horizontal
10.40	46.97	32.82	35.82	9.52	53.49	74.00	-20.51	Peak	Vertical
10.40	35.49	32.82	35.82	9.52	42.01	54.00	-11.99	Average	Vertical

802.11n(HT20) / Channel 48

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.48	46.43	33.21	35.82	9.52	53.34	74.00	-20.66	Peak	Horizontal
10.48	35.30	33.21	35.82	9.52	42.21	54.00	-11.79	Average	Horizontal
10.48	47.29	32.82	35.82	9.52	53.81	74.00	-20.19	Peak	Vertical
10.48	35.76	32.82	35.82	9.52	42.28	54.00	-11.72	Average	Vertical

802.11n(HT40) / Channel 38

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.38	46.04	33.21	35.82	9.52	52.95	74.00	-21.05	Peak	Horizontal
10.38	35.14	33.21	35.82	9.52	42.05	54.00	-11.95	Average	Horizontal
10.38	47.24	32.82	35.82	9.52	53.76	74.00	-20.24	Peak	Vertical
10.38	35.68	32.82	35.82	9.52	42.20	54.00	-11.80	Average	Vertical

802.11n(HT40) / Channel 46

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
10.46	46.13	33.21	35.82	9.52	53.04	74.00	-20.96	Peak	Horizontal
10.46	35.35	33.21	35.82	9.52	42.26	54.00	-11.74	Average	Horizontal
10.46	47.21	32.82	35.82	9.52	53.73	74.00	-20.27	Peak	Vertical
10.46	35.78	32.82	35.82	9.52	42.30	54.00	-11.70	Average	Vertical

Notes:

1. *Measuring frequencies from 9k~40GHz, No emission found between lowest internal used/generated frequency to 30MHz.*
2. *Radiated emissions measured in frequency range from 30MHz~40GHz were made with an instrument using Peak detector mode.*
3. *The radiated emissions from 18GHz to 40GHz are at least 20dB below the official limit and no need to report.*

The Worst Test Result For 5745~5825MHz Band.

802.11a / Channel 149

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.49	46.95	33.92	36.09	10.26	55.04	74.00	-18.96	Peak	Horizontal
11.49	36.34	33.92	36.09	10.26	44.43	54.00	-9.57	Average	Horizontal
11.49	48.16	33.99	35.99	10.26	56.42	74.00	-17.58	Peak	Vertical
11.49	36.85	33.99	35.99	10.26	45.11	54.00	-8.89	Average	Vertical

802.11a / Channel 157

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.57	46.77	33.92	36.09	10.26	54.86	74.00	-19.14	Peak	Horizontal
11.57	35.73	33.92	36.09	10.26	43.82	54.00	-10.18	Average	Horizontal
11.57	47.92	33.99	35.99	10.26	56.18	74.00	-17.82	Peak	Vertical
11.57	36.37	33.99	35.99	10.26	44.63	54.00	-9.37	Average	Vertical

802.11a / Channel 165

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.65	46.51	33.92	36.09	10.26	54.60	74.00	-19.40	Peak	Horizontal
11.65	35.64	33.92	36.09	10.26	43.73	54.00	-10.27	Average	Horizontal
11.65	47.40	33.99	35.99	10.26	55.66	74.00	-18.34	Peak	Vertical
11.65	35.98	33.99	35.99	10.26	44.24	54.00	-9.76	Average	Vertical

802.11n(HT20) / Channel 149

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.49	47.05	33.92	36.09	10.26	55.14	74.00	-18.86	Peak	Horizontal
11.49	36.16	33.92	36.09	10.26	44.25	54.00	-9.75	Average	Horizontal
11.49	48.03	33.99	35.99	10.26	56.29	74.00	-17.71	Peak	Vertical
11.49	36.71	33.99	35.99	10.26	44.97	54.00	-9.03	Average	Vertical

802.11n(HT20) / Channel 157

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.57	46.85	33.92	36.09	10.26	54.94	74.00	-19.06	Peak	Horizontal
11.57	36.41	33.92	36.09	10.26	44.50	54.00	-9.50	Average	Horizontal
11.57	48.11	33.99	35.99	10.26	56.37	74.00	-17.63	Peak	Vertical
11.57	36.59	33.99	35.99	10.26	44.85	54.00	-9.15	Average	Vertical

802.11n(HT20) / Channel 165

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.65	46.67	33.92	36.09	10.26	54.76	74.00	-19.24	Peak	Horizontal
11.65	36.01	33.92	36.09	10.26	44.10	54.00	-9.90	Average	Horizontal
11.65	47.81	33.99	35.99	10.26	56.07	74.00	-17.93	Peak	Vertical
11.65	36.29	33.99	35.99	10.26	44.55	54.00	-9.45	Average	Vertical

802.11n(HT40) / Channel 151

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.51	50.09	33.92	36.09	10.26	58.18	74	-15.82	Peak	Horizontal
11.51	39.04	33.92	36.09	10.26	47.13	54	-6.87	Average	Horizontal
11.51	50.91	33.99	35.99	10.26	59.17	74	-14.83	Peak	Vertical
11.51	39.45	33.99	35.99	10.26	47.71	54	-6.29	Average	Vertical

802.11n(HT40) / Channel 159

Freq. GHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
11.59	49.51	33.92	36.09	10.26	57.60	74	-16.40	Peak	Horizontal
11.59	38.75	33.92	36.09	10.26	46.84	54	-7.16	Average	Horizontal
11.59	50.63	33.99	35.99	10.26	58.89	74	-15.11	Peak	Vertical
11.59	39.22	33.99	35.99	10.26	47.48	54	-6.52	Average	Vertical

Notes:

1. *Measuring frequencies from 9k~40GHz, No emission found between lowest internal used/generated frequency to 30MHz.*
2. *Radiated emissions measured in frequency range from 30MHz~40GHz were made with an instrument using Peak detector mode.*
3. *The radiated emissions from 18GHz to 40GHz are at least 20dB below the official limit and no need to report.*

5.4.9. Undesirable Emissions Measurement

5.4.9.1 Limit

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

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

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

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

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

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

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

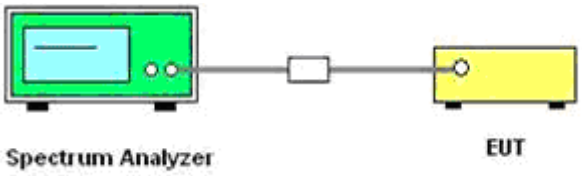
(e) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

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

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

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

5.4.9.2 Test Configuration



5.4.9.3 Test Procedure

According to KDB789033 D02 General UNII Test Procedures New Rules v01 Section G: Unwanted Emission Measurement

1. Unwanted Emissions in the Restricted Bands

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

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

c) At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in sections II.G.5. and II.G.6, respectively, must satisfy the

respective peak and average limits. If all peak measurements satisfy the average limit, then average measurements are not required.

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

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

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

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

2. Unwanted Emissions that fall Outside of the Restricted Bands

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

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

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

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

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

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

i) EIRP = ((E×d) ^2) / 30

Where:

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

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

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

iii) Or, if d is 3 meters:

EIRP [dBm] = E [dBμV/m] - 95.23

3) Radiated versus Conducted Measurements.

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

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

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

(iii) EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater.3 However, for devices that operate in multiple bands using the same transmit antenna, the highest gain of the antenna within the operating band nearest to the out-of-band frequency being measured may be

used in lieu of the overall highest gain when measuring emissions at frequencies within 20% of the absolute frequency at the nearest edge of that band, but in no case shall a value less than 2 dBi be selected.

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

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

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

5.4.9.4 Test Results

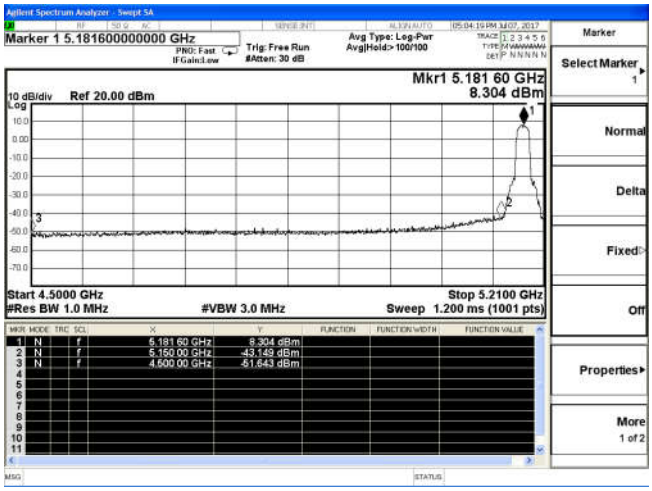
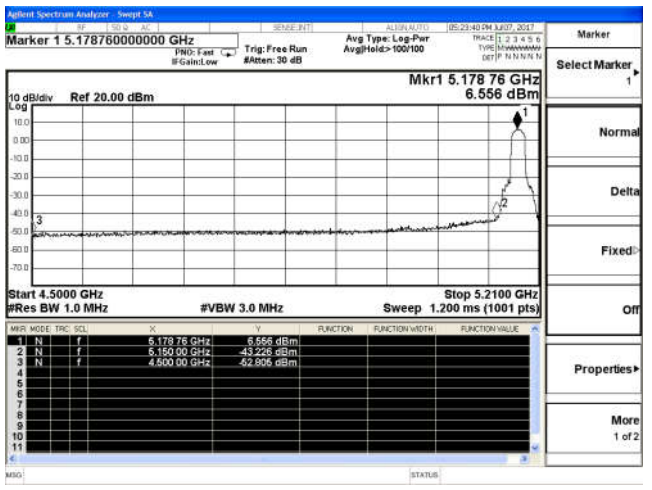
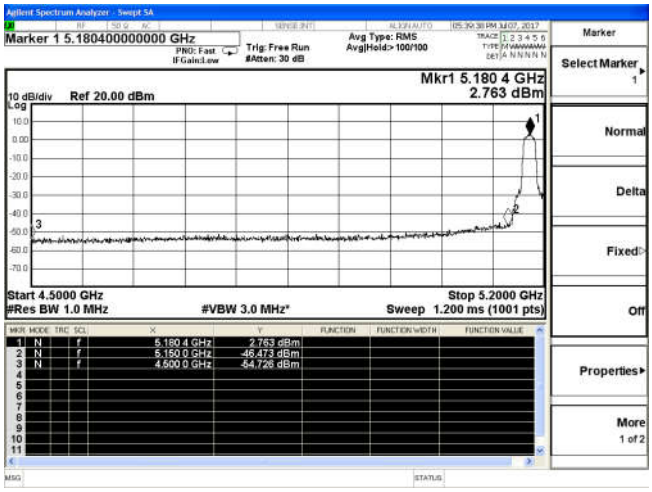
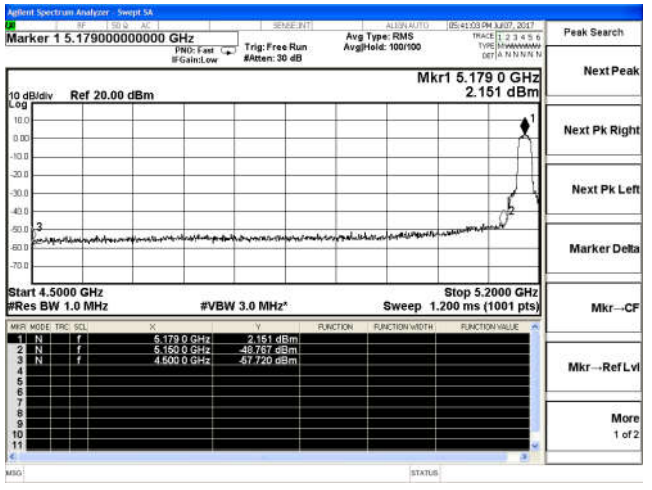
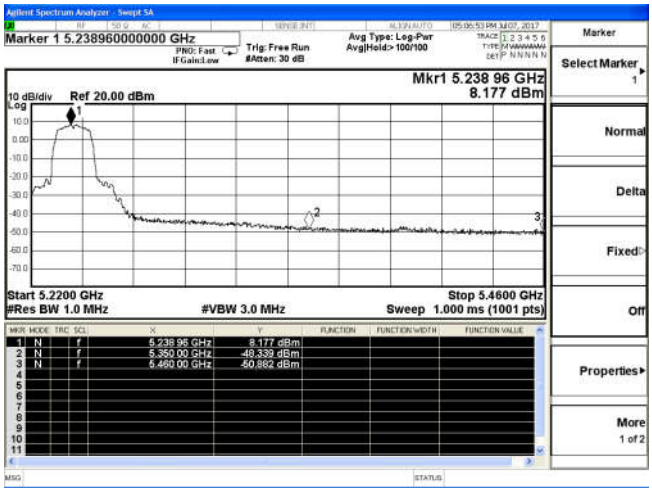
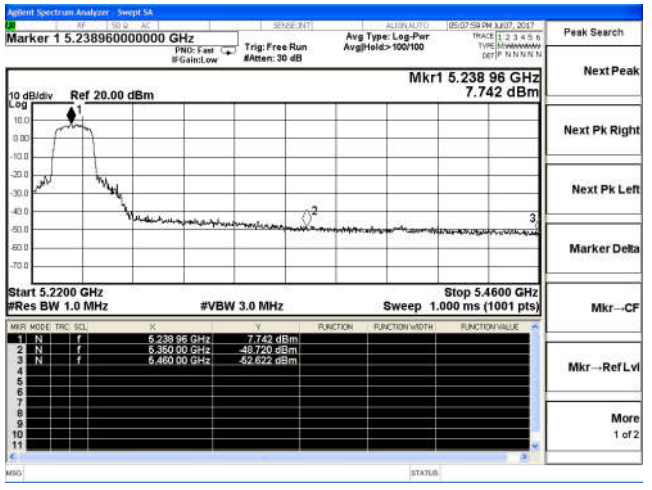
IEEE 802.11a							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.000	-51.643	3.000	0.000	46.557	Peak	74.000	PASS
4500.000	-54.726	3.000	0.000	43.474	Average	54.000	PASS
5150.000	-43.149	3.000	0.000	55.051	Peak	74.000	PASS
5150.000	-46.473	3.000	0.000	51.727	Average	54.000	PASS
5350.000	-48.339	3.000	0.000	49.861	Peak	74.000	PASS
5350.000	-51.281	3.000	0.000	46.919	Average	54.000	PASS
5460.000	-50.882	3.000	0.000	47.318	Peak	74.000	PASS
5460.000	-53.339	3.000	0.000	44.861	Average	54.000	PASS

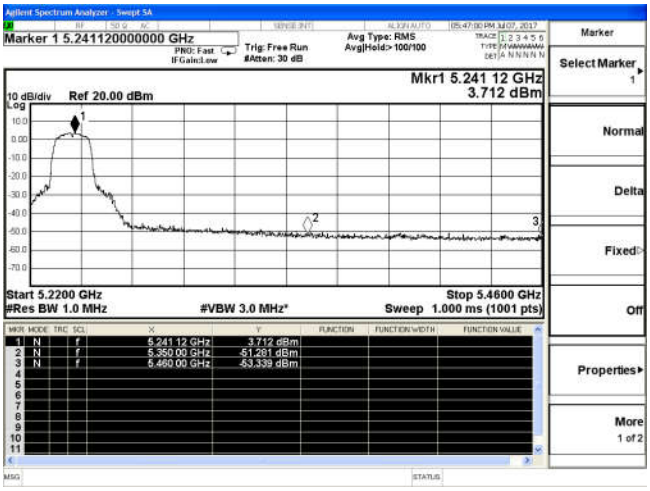
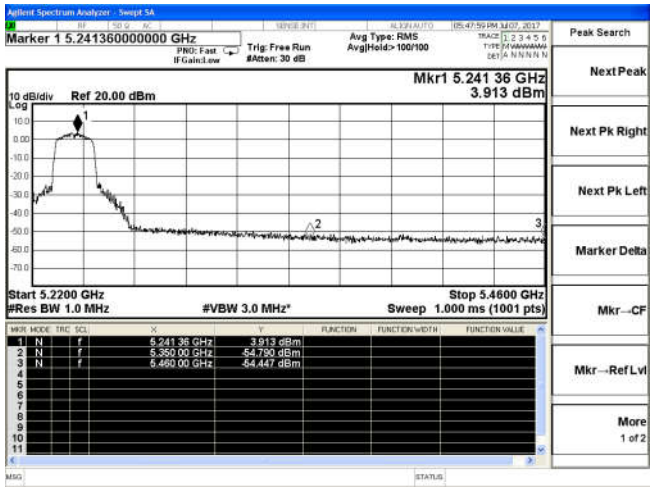
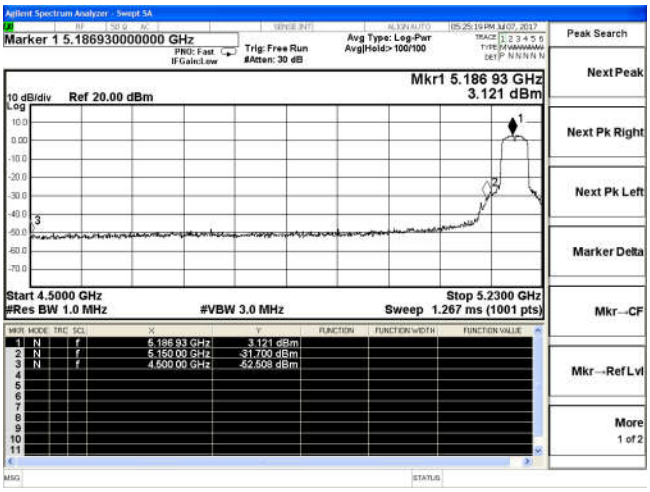
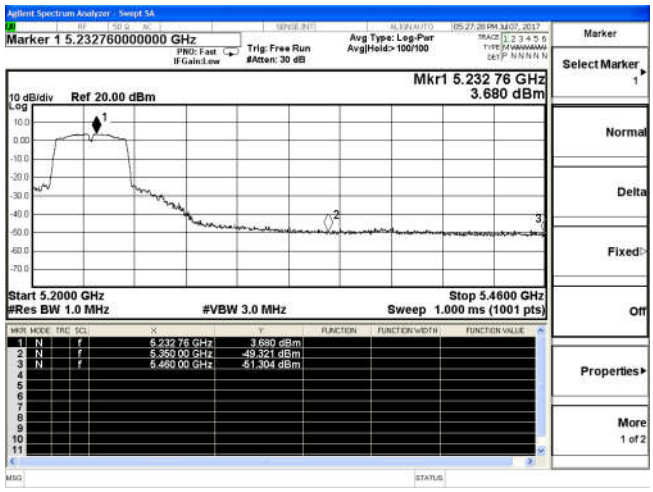
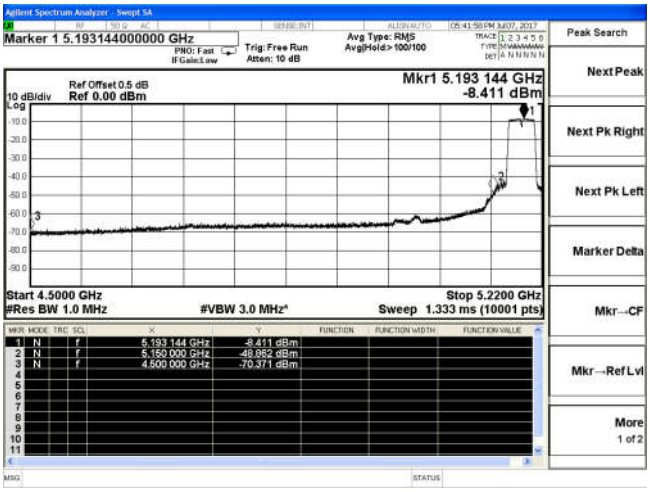
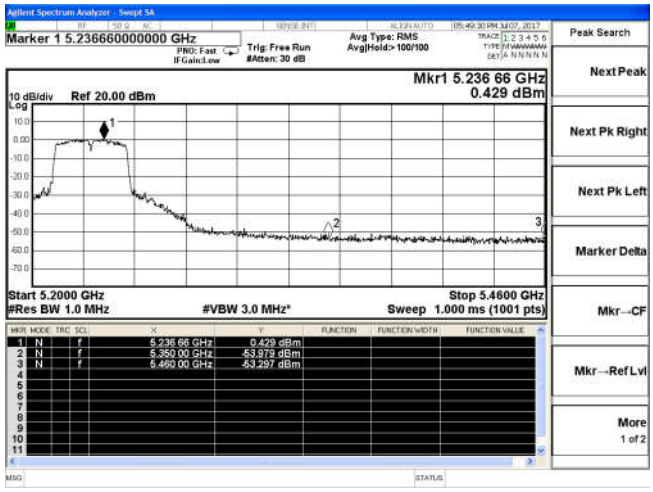
IEEE 802.11n HT20							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.000	-52.805	3.000	0.000	45.395	Peak	74.000	PASS
4500.000	-57.720	3.000	0.000	40.480	Average	54.000	PASS
5150.000	-43.226	3.000	0.000	54.974	Peak	74.000	PASS
5150.000	-48.767	3.000	0.000	49.433	Average	54.000	PASS
5350.000	-48.720	3.000	0.000	49.480	Peak	74.000	PASS
5350.000	-54.790	3.000	0.000	43.410	Average	54.000	PASS
5460.000	-52.622	3.000	0.000	45.578	Peak	74.000	PASS
5460.000	-54.447	3.000	0.000	43.753	Average	54.000	PASS

IEEE 802.11n HT40							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.000	-52.508	3.000	0.000	45.692	Peak	74.000	PASS
4500.000	-70.371	3.000	0.000	27.829	Average	54.000	PASS
5150.000	-31.700	3.000	0.000	66.500	Peak	74.000	PASS
5150.000	-48.862	3.000	0.000	49.338	Average	54.000	PASS
5350.000	-49.321	3.000	0.000	48.879	Peak	74.000	PASS
5350.000	-53.979	3.000	0.000	44.221	Average	54.000	PASS
5460.000	-51.304	3.000	0.000	46.896	Peak	74.000	PASS
5460.000	-53.297	3.000	0.000	44.903	Average	54.000	PASS

Remark:

1. *Measured Undesirable emission at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE;*
4. *Covert Radiated E Level At 3m = Conducted average power + Directional Gain + 104.8-20*log(3);*
5. *Please refer to following test plots;*

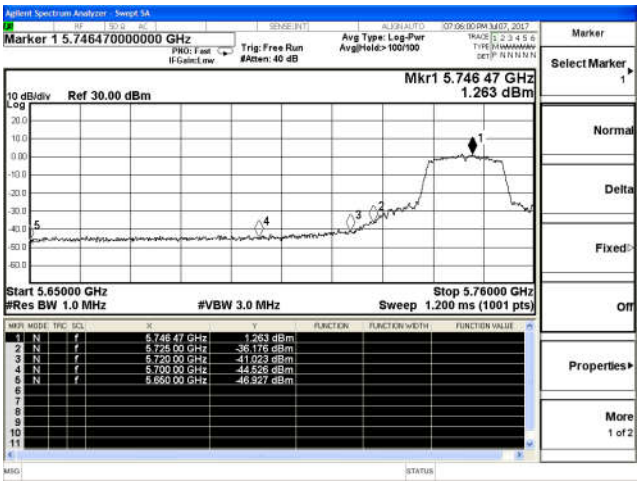
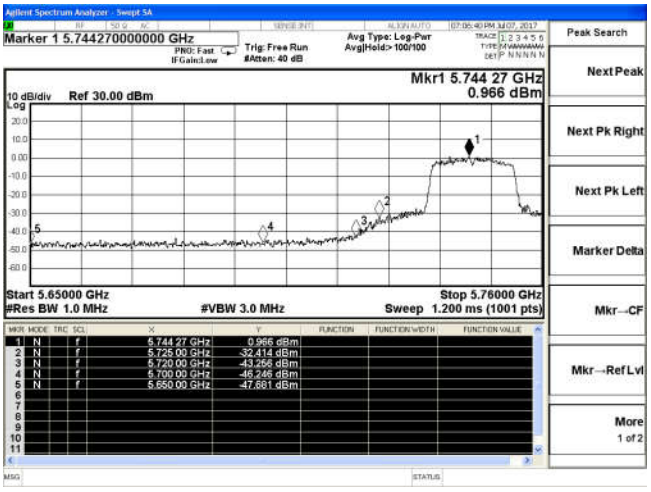
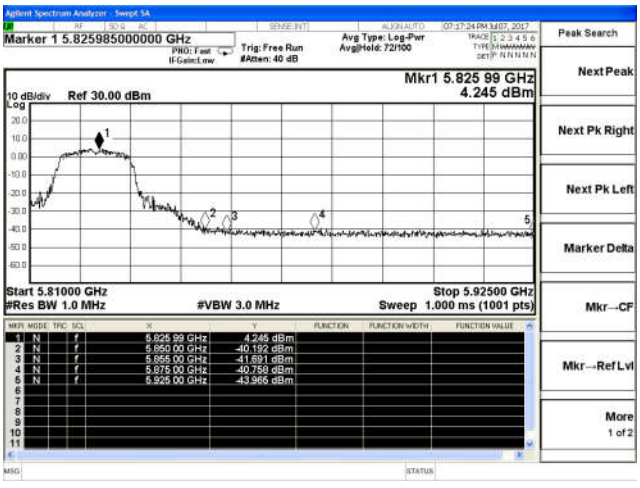
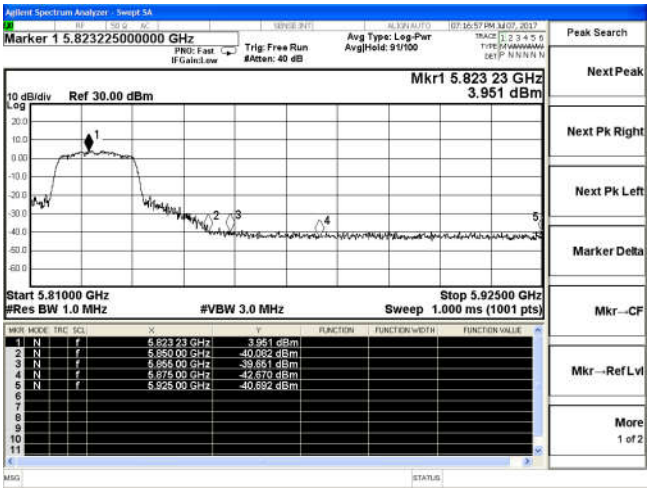
Undesirable emission	
IEEE 802.11a	IEEE 802.11n HT20
	
Channel 36 / 5180 MHz – Peak	Channel 36 / 5180 MHz – Peak
	
Channel 36 / 5180 MHz – Average	Channel 36 / 5180 MHz – Average
	
Channel 48 / 5240 MHz – Peak	Channel 48 / 5240 MHz – Peak

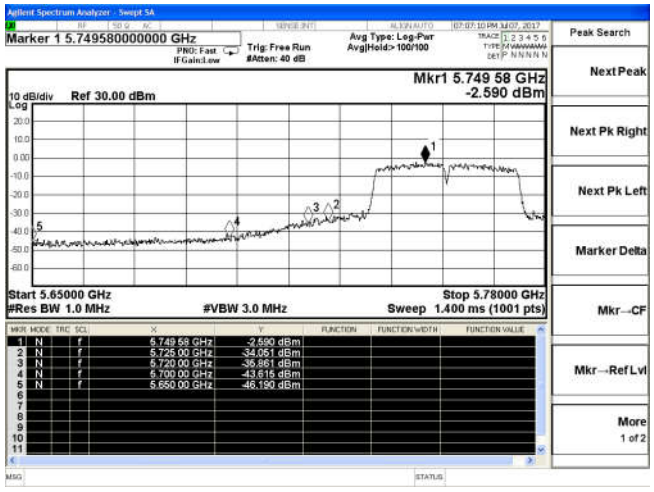
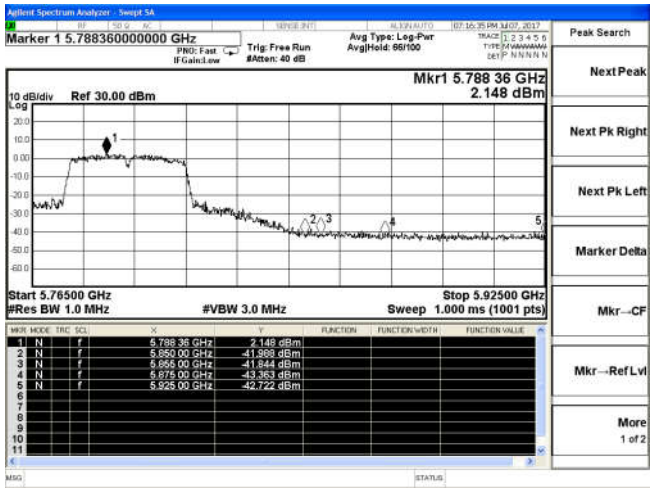
Undesirable emission	
IEEE 802.11a	IEEE 802.11n HT20
	
Channel 48 / 5240 MHz – Average	Channel 48 / 5240 MHz – Average
IEEE 802.11n HT40	IEEE 802.11n HT40
	
Channel 38 / 5190 MHz – Peak	Channel 46 / 5230 MHz – Peak
	
Channel 38 / 5190 MHz – Average	Channel 46 / 5230 MHz – Average

IEEE 802.11a							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Margin (dB)	Verdict
5650.000	-46.927	3.000	-43.927	Peak	-27.000	-16.927	PASS
5700.000	-44.526	3.000	-41.526	Peak	10.000	-51.526	PASS
5720.000	-41.023	3.000	-38.023	Peak	15.600	-53.623	PASS
5725.000	-36.176	3.000	-33.176	Peak	27.000	-60.176	PASS
5850.000	-40.192	3.000	-37.192	Peak	27.000	-64.192	PASS
5855.000	-41.691	3.000	-38.691	Peak	15.600	-54.291	PASS
5875.000	-40.758	3.000	-37.758	Peak	10.000	-47.758	PASS
5925.000	-43.965	3.000	-40.965	Peak	-27.000	-13.965	PASS

IEEE 802.11n HT20							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Margin (dB)	Verdict
5650.000	-47.681	3.000	-44.681	Peak	-27.000	-17.681	PASS
5700.000	-46.246	3.000	-43.246	Peak	10.000	-53.246	PASS
5720.000	-43.256	3.000	-40.256	Peak	15.600	-55.856	PASS
5725.000	-32.414	3.000	-29.414	Peak	27.000	-56.414	PASS
5850.000	-40.082	3.000	-37.082	Peak	27.000	-64.082	PASS
5855.000	-39.651	3.000	-36.651	Peak	15.600	-52.251	PASS
5875.000	-42.670	3.000	-39.670	Peak	10.000	-49.670	PASS
5925.000	-40.692	3.000	-37.692	Peak	-27.000	-10.692	PASS

IEEE 802.11n HT40							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Margin (dB)	Verdict
5650.000	-46.190	3.000	-43.190	Peak	-27.000	-16.190	PASS
5700.000	-43.615	3.000	-40.615	Peak	10.000	-50.615	PASS
5720.000	-35.861	3.000	-32.861	Peak	15.600	-48.461	PASS
5725.000	-34.051	3.000	-31.051	Peak	27.000	-58.051	PASS
5850.000	-41.988	3.000	-38.988	Peak	27.000	-65.988	PASS
5855.000	-41.844	3.000	-38.844	Peak	15.600	-54.444	PASS
5875.000	-43.363	3.000	-40.363	Peak	10.000	-50.363	PASS
5925.000	-42.722	3.000	-39.722	Peak	-27.000	-12.722	PASS

Unwanted emission	
IEEE 802.11a	IEEE 802.11n HT20
	
Channel 149 / 5745 MHz – Peak	Channel 149 / 5745 MHz – Peak
	
Channel 165 / 5825 MHz – Peak	Channel 165 / 5825 MHz – Peak

Unwanted emission	
IEEE 802.11n HT40	
	
Channel 151 / 5755 MHz – Peak	
	
Channel 159 / 5795 MHz – Peak	

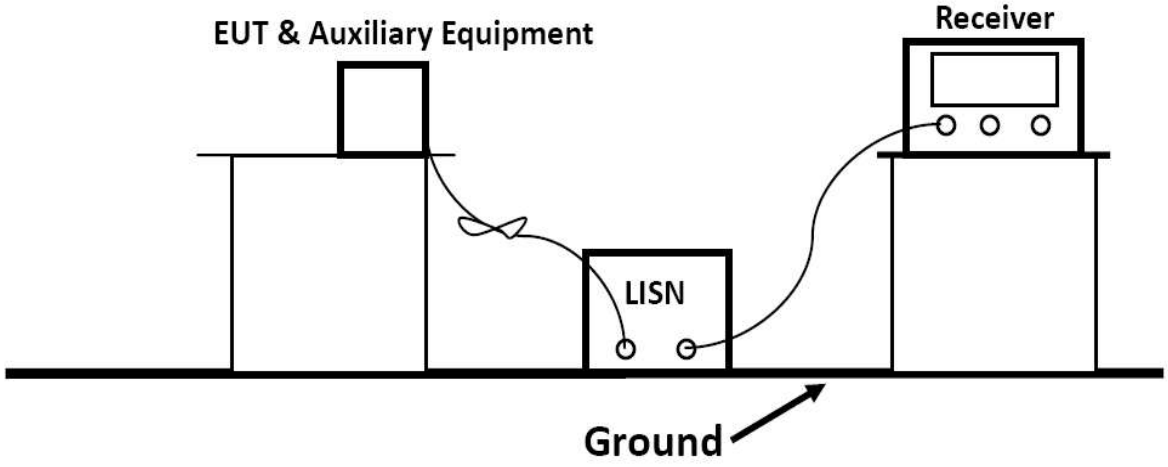
5.5. Power line conducted emissions

5.5.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

5.5.2 Block Diagram of Test Setup



5.5.3 Test Results

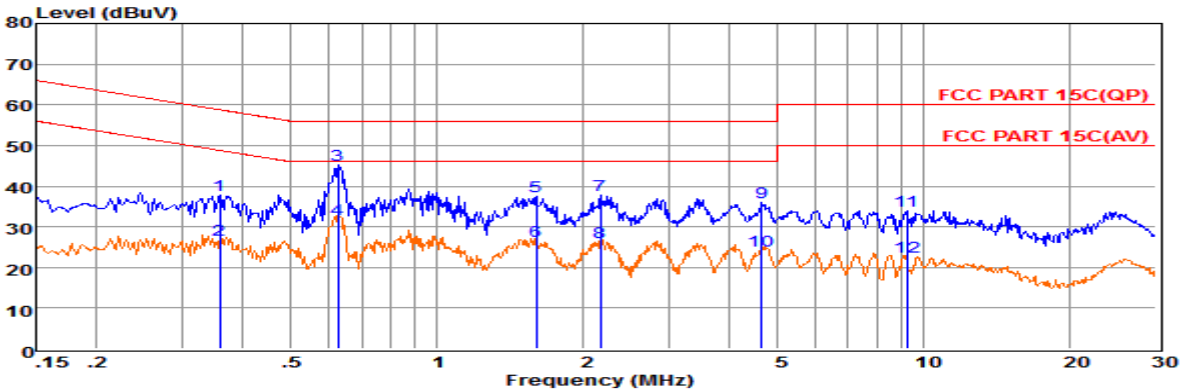
PASS.

Only recorded the worst test case in this report.

The test data please refer to following page.

Test Result For Line Power Input AC 240V/50Hz (Worst Case)

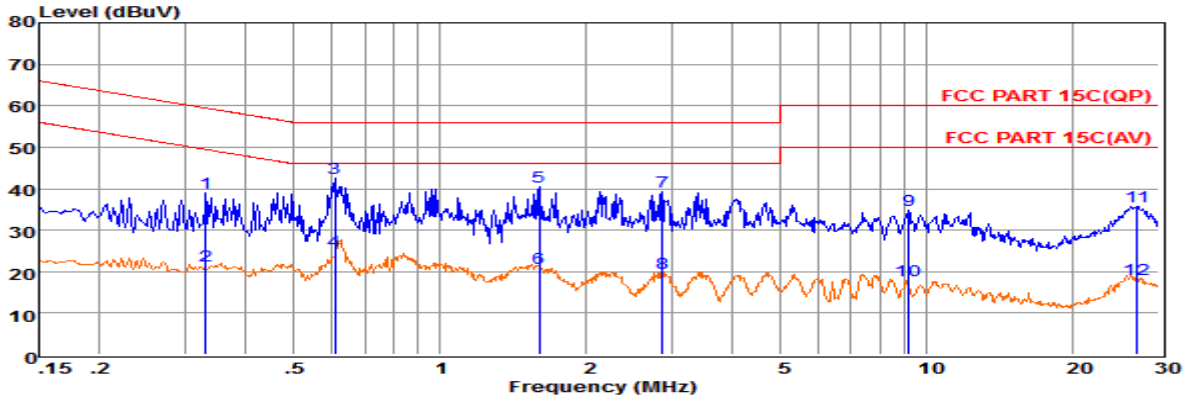
Line:



	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.36	18.13	9.62	0.03	10.00	37.78	58.78	-21.00	QP
2	0.36	7.05	9.62	0.03	10.00	26.70	48.78	-22.08	Average
3	0.63	25.48	9.63	0.04	10.00	45.15	56.00	-10.85	QP
4	0.63	12.03	9.63	0.04	10.00	31.70	46.00	-14.30	Average
5	1.60	17.73	9.64	0.05	10.00	37.42	56.00	-18.58	QP
6	1.60	6.73	9.64	0.05	10.00	26.42	46.00	-19.58	Average
7	2.17	17.99	9.64	0.05	10.00	37.68	56.00	-18.32	QP
8	2.17	6.52	9.64	0.05	10.00	26.21	46.00	-19.79	Average
9	4.65	16.35	9.65	0.06	10.00	36.06	56.00	-19.94	QP
10	4.65	4.28	9.65	0.06	10.00	23.99	46.00	-22.01	Average
11	9.25	14.19	9.69	0.08	10.00	33.96	60.00	-26.04	QP
12	9.25	2.77	9.69	0.08	10.00	22.54	50.00	-27.46	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

Neutral:



	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.33	19.35	9.61	0.03	10.00	38.99	59.44	-20.45	QP
2	0.33	1.73	9.61	0.03	10.00	21.37	49.44	-28.07	Average
3	0.61	23.00	9.63	0.04	10.00	42.67	56.00	-13.33	QP
4	0.61	5.30	9.63	0.04	10.00	24.97	46.00	-21.03	Average
5	1.60	20.74	9.63	0.05	10.00	40.42	56.00	-15.58	QP
6	1.60	1.20	9.63	0.05	10.00	20.88	46.00	-25.12	Average
7	2.87	19.63	9.64	0.06	10.00	39.33	56.00	-16.67	QP
8	2.87	-0.14	9.64	0.06	10.00	19.56	46.00	-26.44	Average
9	9.20	14.97	9.71	0.08	10.00	34.76	60.00	-25.24	QP
10	9.21	-2.09	9.71	0.08	10.00	17.70	50.00	-32.30	Average
11	27.13	15.88	9.83	0.13	10.00	35.84	60.00	-24.16	QP
12	27.13	-1.95	9.83	0.13	10.00	18.01	50.00	-31.99	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

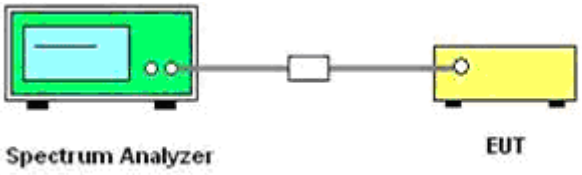
Note: Pre-scan all modes and recorded the worst case results in this report.

5.6. Frequency Stability

5.6.1 Standard Applicable

According to §15.407 (g):Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

5.6.2. Test Setup Layout



5.6.3. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6.4. Test Result of Frequency Stability

Temperature	25℃	Humidity	60%
Test Engineer	Chaz Liu	Configurations	802.11a/n

Test condition		Norminal Frequency(MHz)	Test result (MHz)	Deviation(ppm)	Limit
Temp(℃)	Voltage(ac)				
20	102	5180.0000	5180.0178	3.43	Non-specified
	120	5180.0000	5180.0238	4.60	
	138	5180.0000	5180.0226	4.36	

Test condition		Norminal Frequency(MHz)	Test result (MHz)	Deviation(ppm)	Limit
Voltage(ac)	Temp(℃)				
120	-20	5180.0000	5180.0236	4.56	Non-specified
	-10	5180.0000	5180.0226	4.37	
	0	5180.0000	5180.0228	4.40	
	10	5180.0000	5180.0250	4.83	
	20	5180.0000	5180.0189	3.65	
	30	5180.0000	5180.0171	3.30	
	40	5180.0000	5180.0184	3.55	
	50	5180.0000	5180.0175	3.38	

Test condition		Norminal Frequency(MHz)	Test result (MHz)	Deviation(ppm)	Limit
Temp(℃)	Voltage(ac)				
20	102	5745.0000	5745.0234	4.08	Non-specified
	120	5745.0000	5745.0204	3.55	
	138	5745.0000	5745.0198	3.45	

Test condition		Norminal Frequency(MHz)	Test result (MHz)	Deviation(ppm)	Limit
Voltage(ac)	Temp(℃)				
120	-20	5745.0000	5745.0196	3.41	Non-specified
	-10	5745.0000	5745.0178	3.10	
	0	5745.0000	5745.0183	3.19	
	10	5745.0000	5745.0241	4.19	
	20	5745.0000	5745.0202	3.51	
	30	5745.0000	5745.0198	3.45	
	40	5745.0000	5745.0158	2.75	
	50	5745.0000	5745.0243	4.23	

5.7. Antenna Requirements

5.7.1. Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.7.2. Antenna Connector Construction

The antenna used for transmitting is permanently attached and no consideration of replacement. Please see EUT photo for details.

The directional gains of antenna used for transmitting is 3.00 dBi, and the antenna is an internal antenna connect to PCB board(connector type: IPEX connector) and no consideration of replacement. Please see EUT photo for details.

5.7.3. Results: Compliance.

6. PHOTOGRAPHS OF TEST SETUP

Please refer to seperated file for Setup photographs.

----------THE END OF REPORT----------