

FCC TEST REPORT

For

Shenzhen AlldoCube Technology and Science Co.,Ltd

Tablet PC

Test Model: iplay10

Additional Model No.: U83

Prepared for : Shenzhen AlldoCube Technology and Science Co.,Ltd
Address : Building No.1, Suwang Industrial Park, Xiahenglang Dalang, Longhua District, Shenzhen, China

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample : June 20, 2017
Number of tested samples : 1
Serial number : Prototype
Date of Test : June 20, 2017~July 12, 2017
Date of Report : July 12, 2017

FCC TEST REPORT

FCC CFR 47 PART 15 E(15.407): 2016

Report Reference No. : **LCS170718077AE**

Date of Issue..... : July 12, 2017

Testing Laboratory Name : **Shenzhen LCS Compliance Testing Laboratory Ltd.**

Address..... : 1F., Xingyuan Industrial Park, Tongda Road, Bao'an Blvd., 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..... : **Shenzhen AlldoCube Technology and Science Co.,Ltd**

Address..... : Building No.1, Suwang Industrial Park, Xiahenglang Dalang, Longhua District, Shenzhen, China

Test Specification

Standard : FCC CFR 47 PART 15 E(15.407): 2016

Test Report Form No...... : LCSEMC-1.0

TRF Originator : Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF : Dated 2011-03

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EUT Description..... : **Tablet PC**

Trade Mark..... : ALLDOCUBE

Model/ Type reference..... : ipplay10

Ratings..... : DC 3.70V by Rechargeable Li-ion Polymer Battery(6000mAh)
Recharged by DC 5V/2000mA SWITCHING ADAPTOR

Result : **Positive**

Compiled by:




Leo Lee/ File administrators

Supervised by:



Glin Lu/ Technique principal

Approved by:



Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. :	LCS170718077AE	<u>July 12, 2017</u> Date of issue
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EUT.....	: Tablet PC
Type / Model.....	: ipplay10
Applicant.....	: Shenzhen AlldoCube Technology and Science Co.,Ltd
Address.....	: Building No.1, Suwang Industrial Park, Xiahenglang Dalang, Longhua District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	: Shenzhen AlldoCube Technology and Science Co.,Ltd
Address.....	: Building No.1, Suwang Industrial Park, Xiahenglang Dalang, Longhua District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Factory.....	: Shenzhen Alldocube Technology And Science Co.,Ltd
Address.....	: Building No.1, Suwang Industrial Park, Xiahenglang Dalang, Longhua District, Shenzhen, China
Telephone.....	: /
Fax.....	: /

Test Result:	Positive
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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
00	July 12, 2017	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: Tablet PC
Model Number	: U83, iplay10
Model Declaration	: PCB board, structure and internal of these model(s) are the same, Only models name is different for these models.
Test Model	: iplay10
Hardware version	: E2.1
Software version	: V1.0
Power Supply	: DC 3.70V by Rechargeable Li-ion Polymer Battery(6000mAh) : Recharged by DC 5V/2000mA SWITCHING ADAPTOR
Bluetooth	: Supported BT 4.2
Operation frequency	: 2402MHz-2480MHz
Channel Spacing	: 1MHz for Bluetooth 4.2(DSS); 2MHz for Bluetooth 4.2(DTS);
Modulation Type	: GFSK, $\pi/4$ DQPSK, 8DPSK for Bluetooth 4.2(DSS); : GFSK for Bluetooth 4.2(DTS)
Bluetooth Version	: 4.2
Channel Number	: 79 Channels for Bluetooth 4.2(DSS);40 Channels for Bluetooth 4.2(DTS) : Supported 802.11b/802.11g/802.11n/802.11a/802.11ac IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz
WLAN	IEEE 802.11n HT20:2412-2462MHz/5180-5240MHz/5745-5825MHz
Operation Frequency	: IEEE 802.11n HT40:2422 – 2452 MHz/5190-5230MHz/5755-5795MHz IEEE 802.11a: 5180-5240MHz/5745-5825MHz IEEE 802.11ac VHT20: 5180-5240MHz/5745-5825MHz IEEE 802.11ac VHT40: 5190-5230MHz/5755-5795MHz IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)
Modulation Type	: IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK) IEEE 802.11a: OFDM (64QAM, 16QAM,QPSK,BPSK) IEEE 802.11ac: OFDM (64QAM, 16QAM,QPSK,BPSK) 11 Channels for 2412.00-2462.00MHz(802.11b/g/n HT20) 7 Channels for 2422.00-2452.00MHz(802.11n HT40)
Channel Number	: 4 Channels for 5180.00-5240.00MHz(802.11a/ac VHT20/n HT20) : 5 Channels for 5745.00-5825.00MHz(802.11a/ac VHT20/n HT20) 2 Channels for 5190.00-5230.00MHz(802.11ac VHT40/n HT40) 2 Channels for 5755.00-5795.00MHz(802.11ac VHT40/n HT40)
Antenna Type	: PIFA Antenna
Antenna Gain	: 3.0dBi (Max.) for 2.4G Band; 3.3dBi (Max.) for 5.2G Band; : 3.6dBi (Max.) for 5.8G Band
Extreme temp. Tolerance	: -30°C to +50°C
Extreme vol. Limits	: 3.40VDC to 4.20VDC (Nominal: 3.70VDC)

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
SHENZHEN FUJIA APPLIANCE CO.,LTD.	SWITCHING ADAPTOR	FJ-SW12605 02000UU	--	FCC VoC

1.3. External I/O Port

I/O Port Description	Quantity	Cable
Micro USB Port	1	0.8m, unshielded
DC 5V Charging Port	1	N/A
TF Card Slot	1	N/A
Mini HDMI Port	1	N/A
Earphone Jack	1	N/A

1.4. 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

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. 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.

1.6. 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.

1.7. Description of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be IEEE 802.11a mode (High Channel).

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be IEEE 802.11a mode(High Channel).

Pre-test AC conducted emission at both power adapter and charge from PC mode, recorded worst case.

Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/50Hz, recorded worst case.

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

IEEE 802.11a Mode: 6 Mbps, OFDM.

IEEE 802.11ac VHT20 Mode: MCS0

IEEE 802.11n HT20 Mode: MCS0, OFDM.

IEEE 802.11ac VHT40 Mode: MCS0, OFDM.

IEEE 802.11n HT40 Mode: MCS0, OFDM.

Antenna & Bandwidth

Antenna			
Bandwidth Mode	20MHz	40MHz	80MHz
IEEE 802.11a	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IEEE 802.11n	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
IEEE 802.11ac	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Channel & Frequency:

Frequency Band	Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
5745~5825MHz	149	5745	155	5775
	151	5755	159	5795
	153	5765	161	5805
	157	5785	165	5825
For IEEE 802.11a/n HT20/ac VHT20, Channel 149, 157 and 165 were tested.				
For IEEE 802.11n HT40/ac VHT40, Channel 151 and 159 were tested.				

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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 v01r03 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

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT 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, which is 0.8 m above ground plane. 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 transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by engineering mode (Power on the Tablet PC, Click **Settings**→**About tablet**→Click on “**Model number**” **8 times continuously** to enter engineering mode).

3.3. Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	PC	Lenovo	Ideapad	A131101550	/	/	DOC
2	Power adapter	Lenovo	CPA-A090	36200414	1.00m	unshielded	DOC

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 Bandwidth	Compliant
§15.407(b)	Radiated Emissions	Compliant
§15.407(b)	Band edge Emissions	Compliant
§15.407(g)	Frequency Stability	Note
§15.207(a)	Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant
§2.1093	RF Exposure	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.

5. TEST RESULT

5.1. On Time and Duty Cycle

5.1.1. Standard Applicable

None; for reporting purpose only.

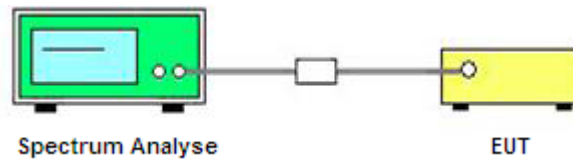
5.1.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of the spectrum analyzer.

5.1.3. Test Procedures

1. Set the Centre frequency of the spectrum analyzer to the transmitting frequency;
2. Set the span=0MHz, RBW=8MHz, VBW=50MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

5.1.4. Test Setup Layout



5.1.5. EUT Operation during Test

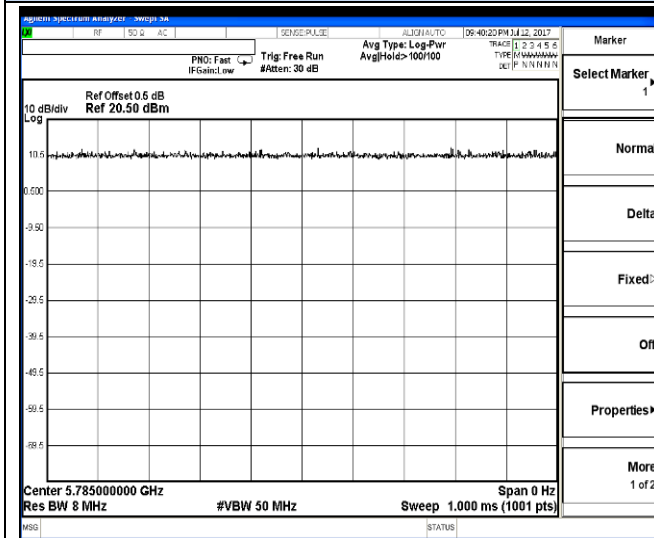
The EUT was programmed to be in continuously transmitting mode.

5.1.6. Test result

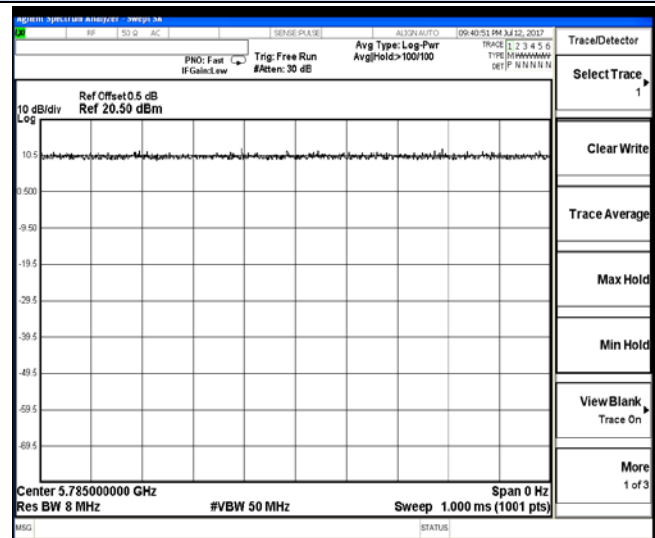
Mode	On Time B (ms)	Period (ms)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW(KHz)
IEEE 802.11a	5.0	5.0	1	100%	0	0.01
IEEE 802.11n HT20	5.0	5.0	1	100%	0	0.01
IEEE 802.11ac VHT20	5.0	5.0	1	100%	0	0.01
IEEE 802.11n HT40	5.0	5.0	1	100%	0	0.01
IEEE 802.11ac VHT40	5.0	5.0	1	100%	0	0.01
IEEE 802.11ac VHT80	5.0	5.0	1	100%	0	0.01

Note: Duty Cycle Correction Factor=10log(1/Duty cycle)

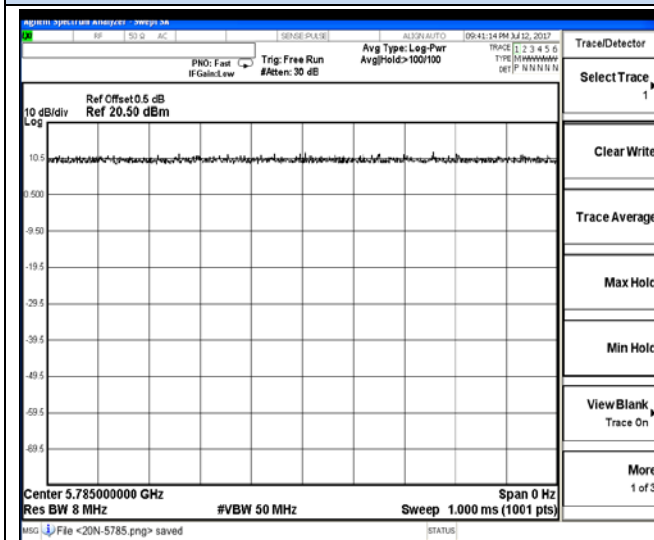
On Time and Duty Cycle



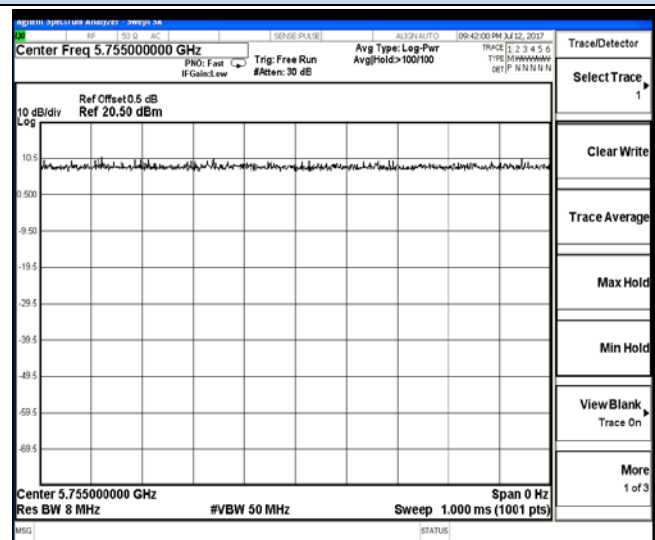
IEEE 802.11a



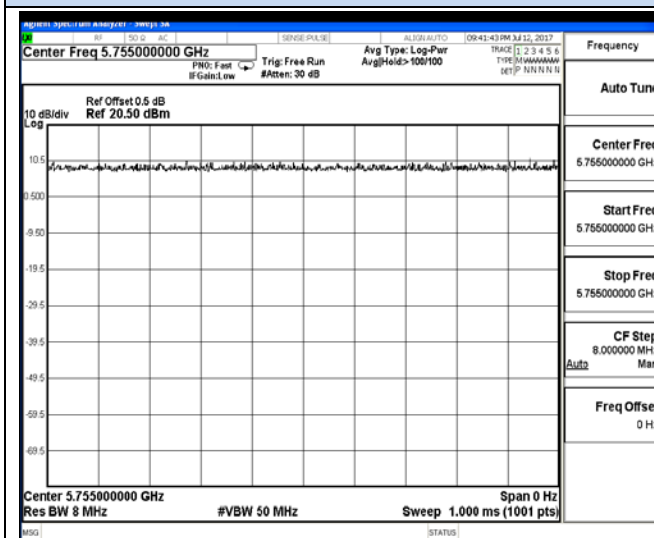
IEEE 802.11n HT20



IEEE 802.11ac VHT20



IEEE 802.11n HT40



IEEE 802.11ac VHT40

5.2. Maximum Conducted Output Power Measurement

5.2.1. Standard Applicable

For 5725~5850MHz

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

5.2.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of the power meter.

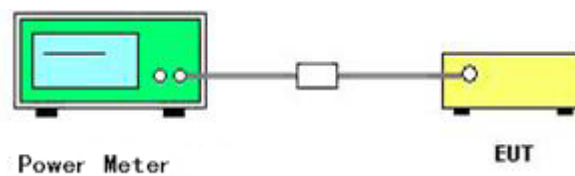
5.2.3. Test Procedures

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

According to KDB 789033 D02 Section 3 (a) Method PM (Measurement using an RF average power meter):

- (i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
 - The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
 - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
 - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- (ii) If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in section II.B.
- (iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

5.2.4. Test Setup Layout



5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.2.6. Test Result of Maximum Conducted Output Power

Temperature	25°C	Humidity	60%
Test Engineer	Jayden Zhuo	Configurations	IEEE 802.11a/n/ac

Test Mode	Channel	Frequency (MHz)	AVG Conducted Power (dBm)	Duty Cycle Factor (dB)	Report Conducted Power (dBm)	Maximum Limit (dBm)	Result
IEEE 802.11a	149	5745	13.01	0.000	13.01	30	Complies
	157	5785	12.31	0.000	12.31		
	165	5825	12.77	0.000	12.77		
IEEE 802.11n HT20	149	5745	12.37	0.000	12.37	30	Complies
	157	5785	12.23	0.000	12.23		
	165	5825	11.89	0.000	11.89		
IEEE 802.11ac VHT20	149	5745	11.89	0.000	11.89	30	Complies
	157	5785	11.57	0.000	11.57		
	165	5825	12.06	0.000	12.06		
IEEE 802.11n HT40	151	5755	12.88	0.000	12.88	30	Complies
	159	5795	12.87	0.000	12.87		
IEEE 802.11ac VHT40	151	5755	12.59	0.000	12.59	30	Complies
	159	5795	12.59	0.000	12.59		

Remark:

1. Measured output power 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 802.11a VHT20, IEEE 802.11ac VHT40;
4. Report conducted power = Measured conducted average power + Duty Cycle factor;

5.3. Power Spectral Density Measurement

5.3.1. Standard Applicable

For 5725~5850MHz

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

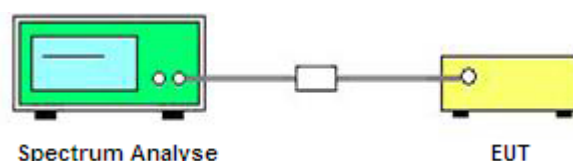
5.3.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.3.3. 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 = 300 kHz
- 4). Set the VBW $\geq 3 \times$ RBW
- 5). Span=Encompass the entire emissions bandwidth (EBW) of the signal
- 6). Detector = RMS.
- 7). Sweep time = auto couple.
- 8). Trace mode = max hold.
- 9). Allow trace to fully stabilize.
- 10). If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log (500 \text{ kHz}/\text{RBW})$ to the measured result, whereas RBW ($< 500 \text{ kHz}$) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
- 11). If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10 \log (1\text{MHz}/\text{RBW})$ to the measured result, whereas RBW ($< 1 \text{ MHz}$) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
- 12). Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

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 Power Spectral Density

Temperature	25°C	Humidity	60%
Test Engineer	Jayden Zhuo	Configurations	IEEE 802.11a/n/ac

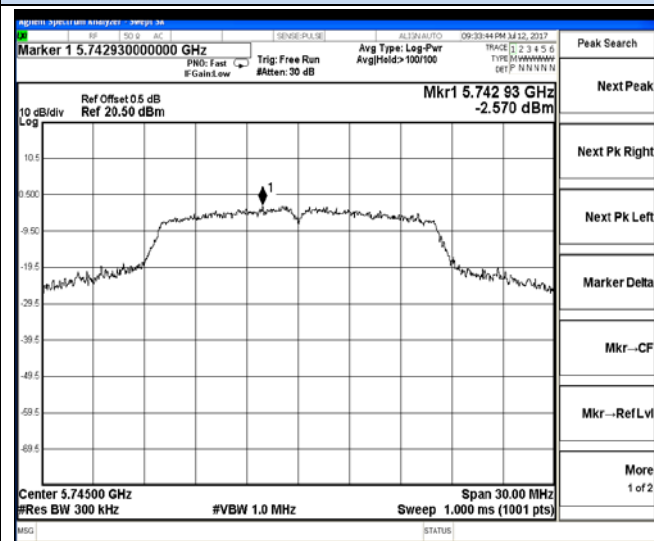
Test Mode	Channel	Frequency (MHz)	Power Density (dBm/300KHz)	Duty cycle factor (dB)	RBW factor (dB)	Report conducted PSD dBm/500KHz)	Maximum Limit (dBm/500KHz)	Result
IEEE 802.11a	149	5745	-2.570	0.000	2.218	-0.352	30	Complies
	157	5785	-3.217	0.000	2.218	-0.999		
	165	5825	-2.736	0.000	2.218	-0.518		
IEEE 802.11n HT20	149	5745	-2.385	0.000	2.218	-0.167	30	Complies
	157	5785	-3.751	0.000	2.218	-1.533		
	165	5825	-3.163	0.000	2.218	-0.945		
IEEE 802.11ac VHT20	149	5745	-3.492	0.000	2.218	-1.274	30	Complies
	157	5785	-3.901	0.000	2.218	-1.683		
	165	5825	-3.400	0.000	2.218	-1.182		
IEEE 802.11n HT40	151	5755	-5.565	0.000	2.218	-3.347	30	Complies
	159	5795	-5.859	0.000	2.218	-3.641		
IEEE 802.11ac VHT40	151	5755	-5.559	0.000	2.218	-3.341	30	Complies
	159	5795	-6.062	0.000	2.218	-3.844		

Remark:

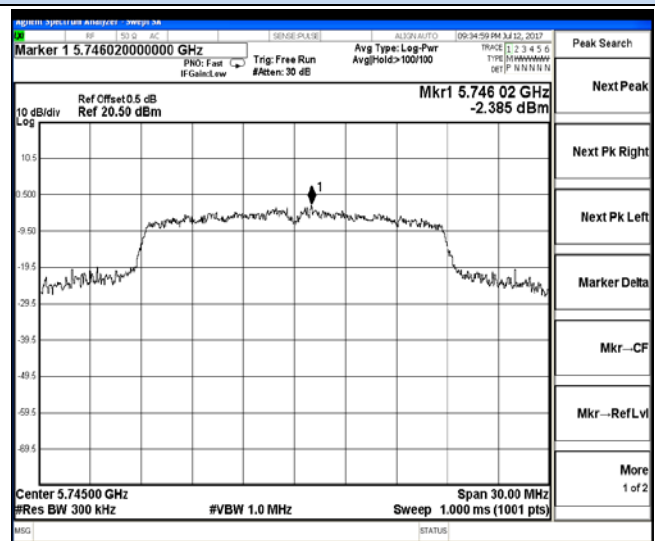
1. Measured power spectrum density at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40;
4. Report conducted PSD = measured conducted PSD + Duty Cycle factor + RBW factor;
5. $RBW\ factor = 10 \log (500\ KHz / 300\ KHz) = 2.218\ dB$;
6. Please refer to following test plots;

Power Spectral Density

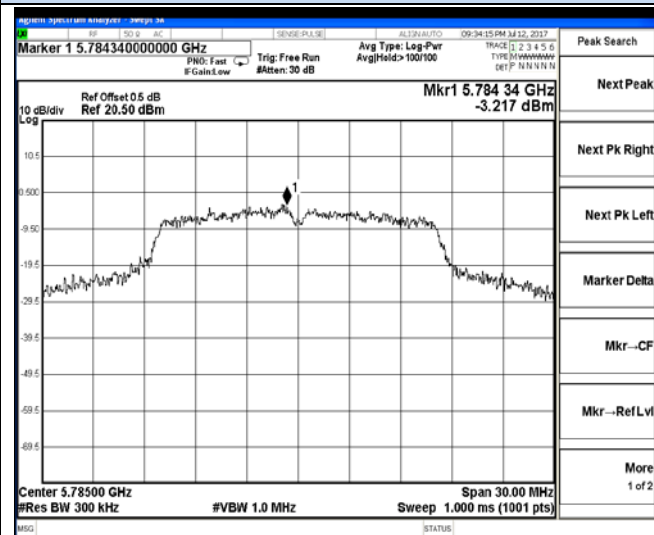
IEEE 802.11a



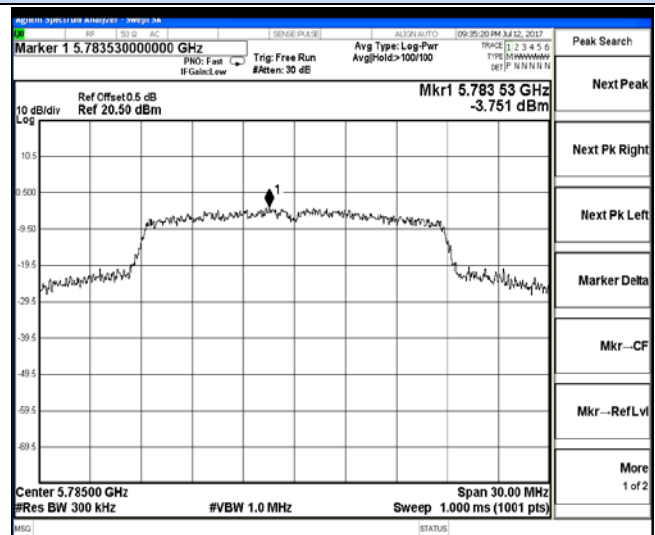
IEEE 802.11n HT20



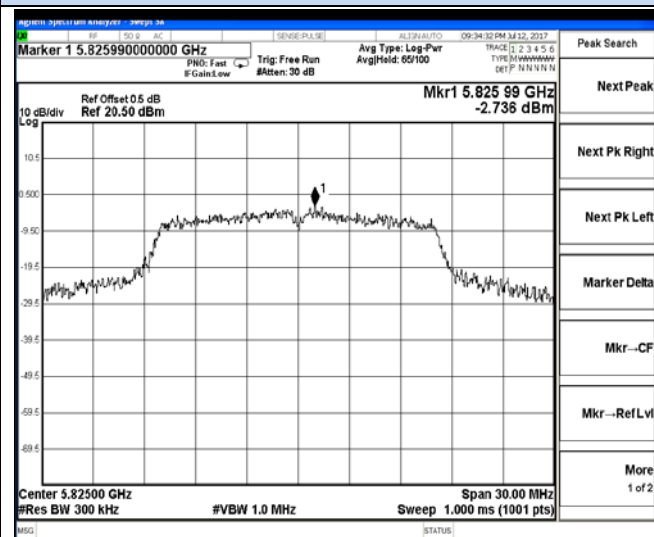
Channel 149 / 5745 MHz



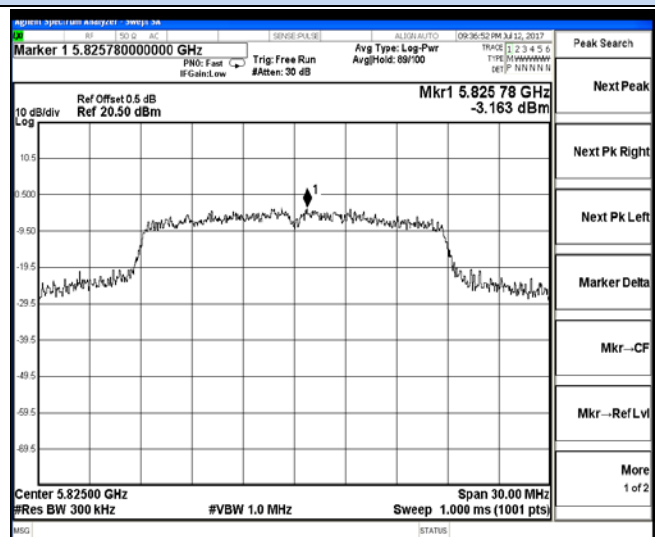
Channel 149 / 5745 MHz



Channel 157 / 5785 MHz



Channel 157 / 5785 MHz



Channel 165 / 5825 MHz

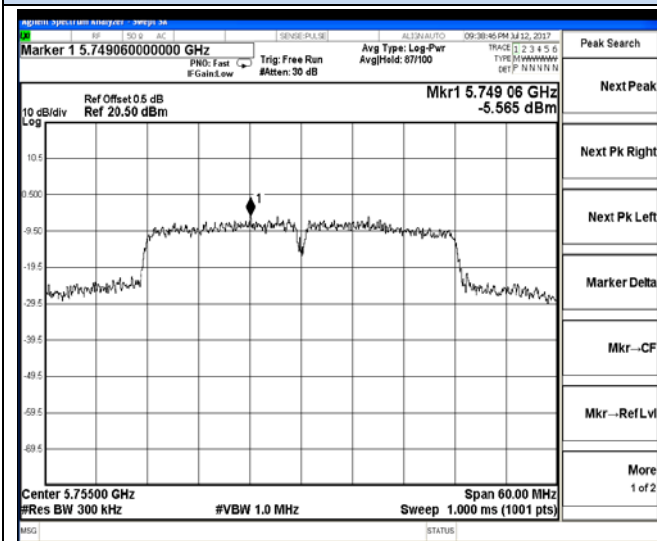


Channel 165 / 5825 MHz

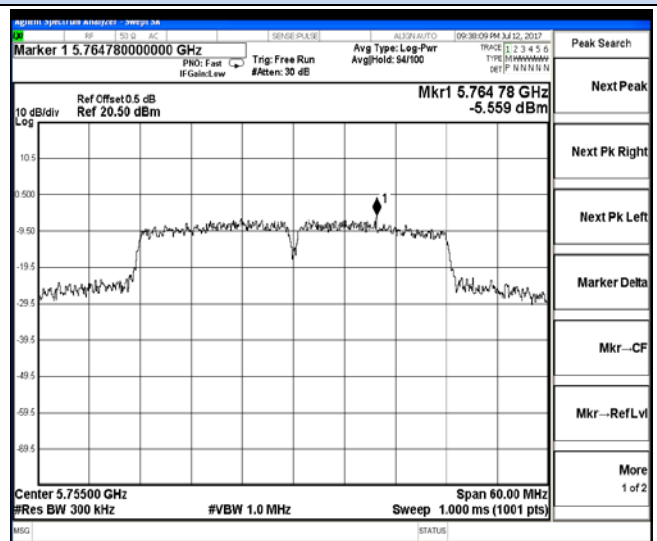


Power Spectral Density

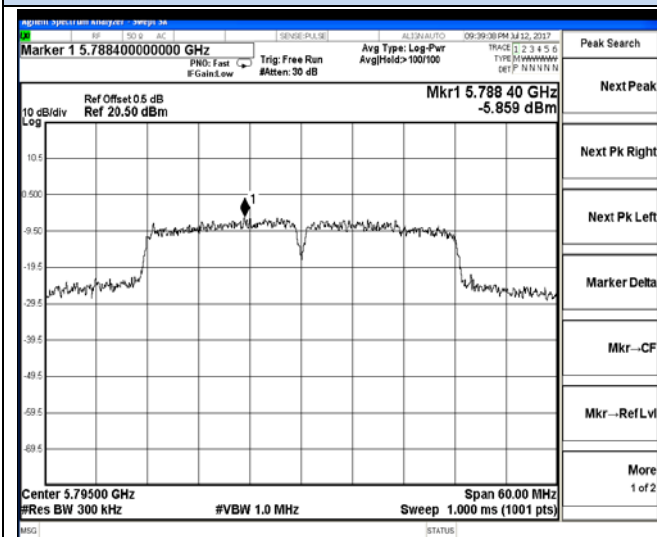
IEEE 802.11n HT40



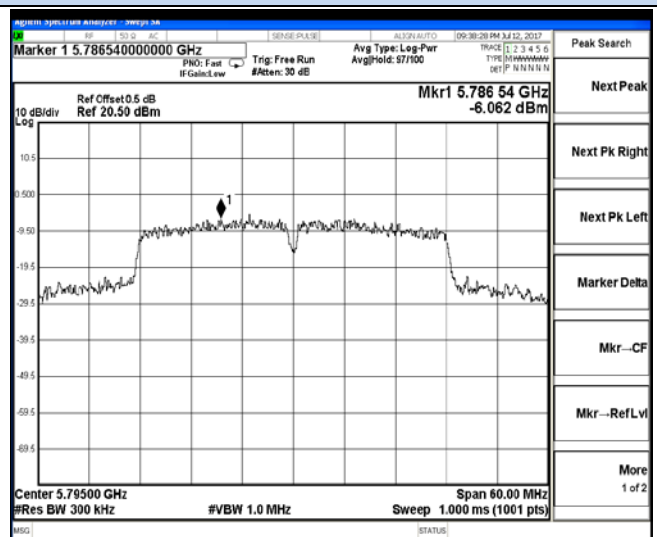
IEEE 802.11ac VHT40



Channel 151 / 5755 MHz

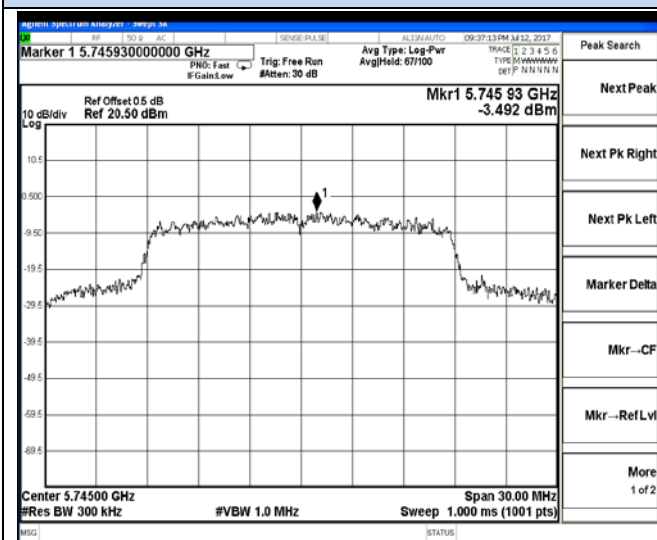


Channel 151 / 5755 MHz



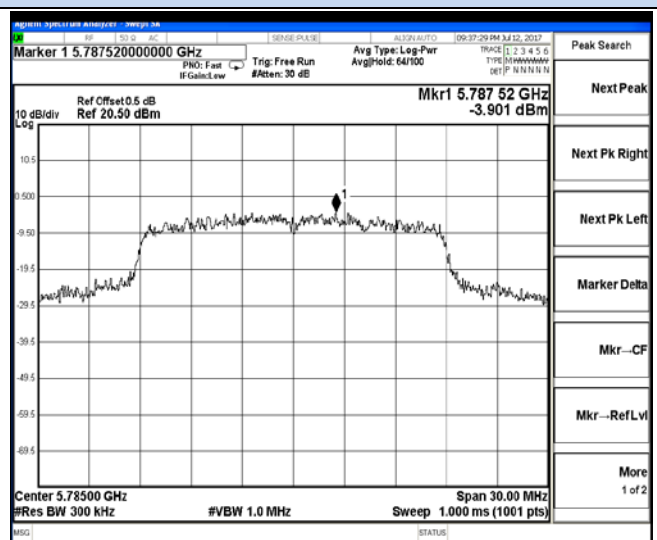
Channel 159 / 5795 MHz

IEEE 802.11ac VHT20



Channel 159 / 5795 MHz

IEEE 802.11ac VHT20

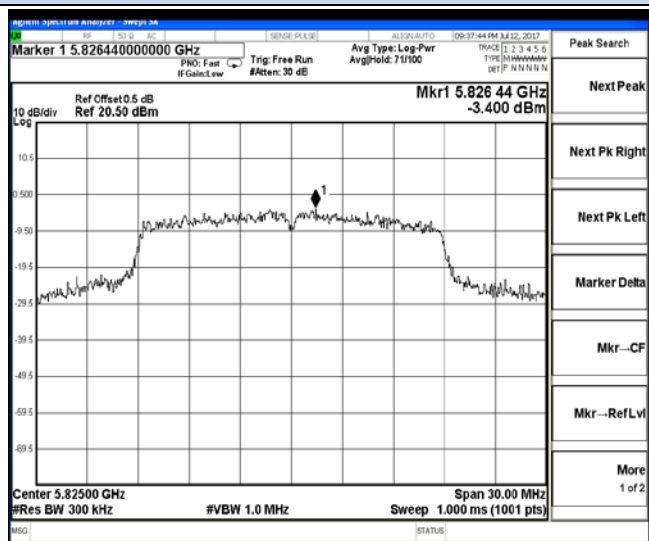


Channel 149 / 5745 MHz

Channel 157 / 5785 MHz

Power Spectral Density

IEEE 802.11ac VHT20



Channel 165 / 5825 MHz

5.4. 6dB Occupied Bandwidth Measurement

5.4.1. Standard Applicable

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

5.4.2. Measuring Instruments and Setting

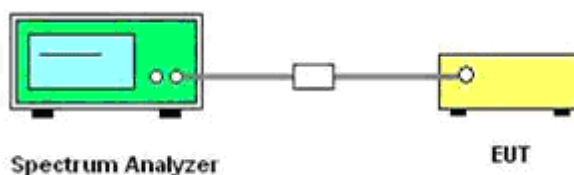
Please refer to equipment list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span	> 26dB Bandwidth
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 100 KHz and the video bandwidth of 300 KHz were used.
3. Measured the spectrum width with power higher than 6dB below carrier.

5.4.4. Test Setup Layout



5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.4.6. Test Result of 6dB Occupied Bandwidth

Temperature	25°C	Humidity	60%
Test Engineer	Jayden Zhuo	Configurations	IEEE 802.11a/n/ac

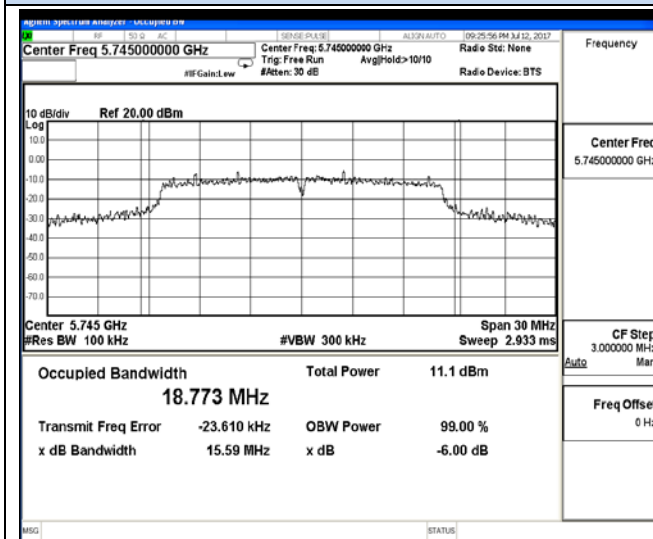
Test Mode	Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limits (MHz)	Verdict
IEEE 802.11a	149	5745	16.380	≥0.500	Complies
	157	5785	16.420		
	163	5825	16.400		
IEEE 802.11n HT20	149	5745	17.590	≥0.500	Complies
	157	5785	17.600		
	163	5825	17.610		
IEEE 802.11ac VHT20	149	5745	17.600	≥0.500	Complies
	157	5785	17.590		
	163	5825	17.640		
IEEE 802.11n HT40	151	5755	36.370	≥0.500	Complies
	159	5795	36.360		
IEEE 802.11ac VHT40	151	5755	36.370	≥0.500	Complies
	159	5795	36.350		

Remark:

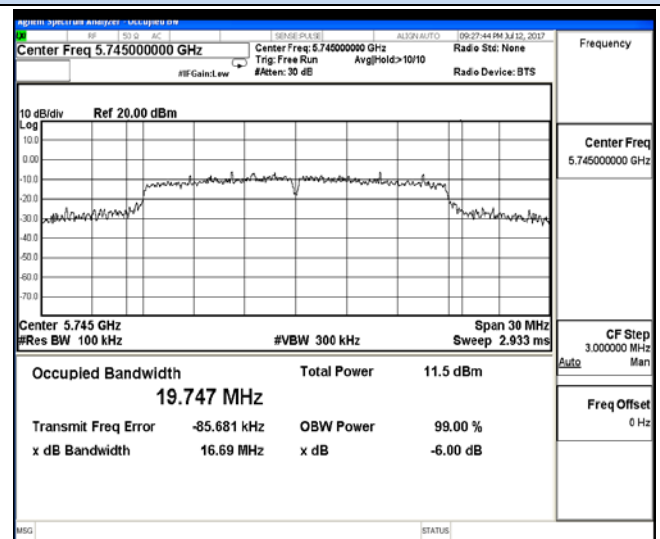
1. Measured 6dB bandwidth at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40;
4. Please refer to following test plots;

6dB Occupied Bandwidth

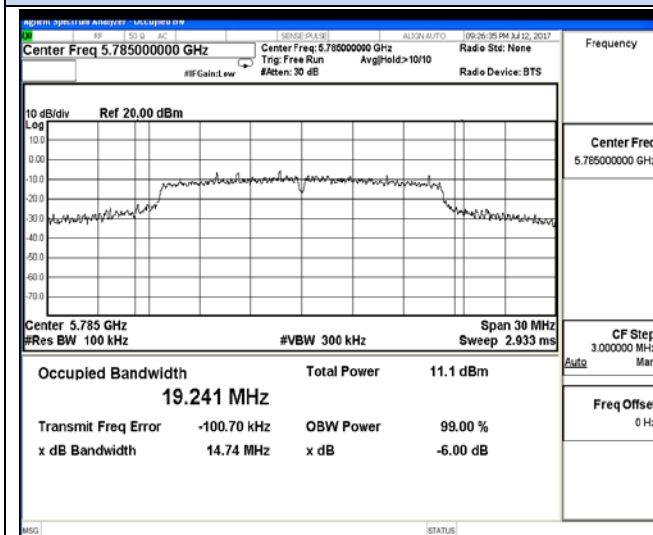
IEEE 802.11a



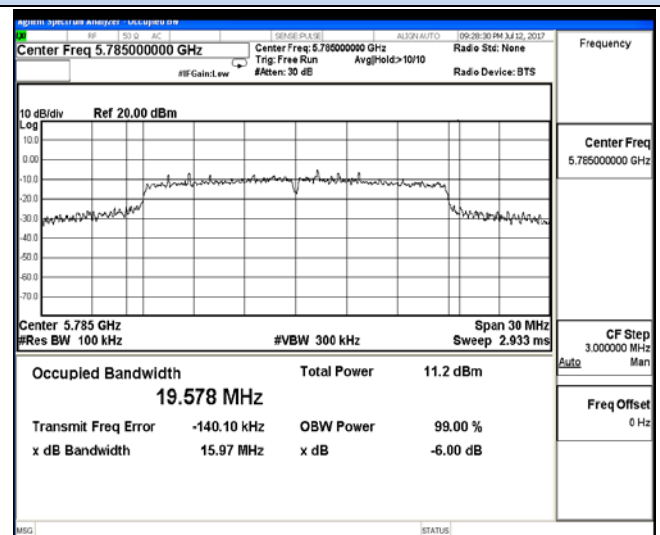
IEEE 802.11n HT20



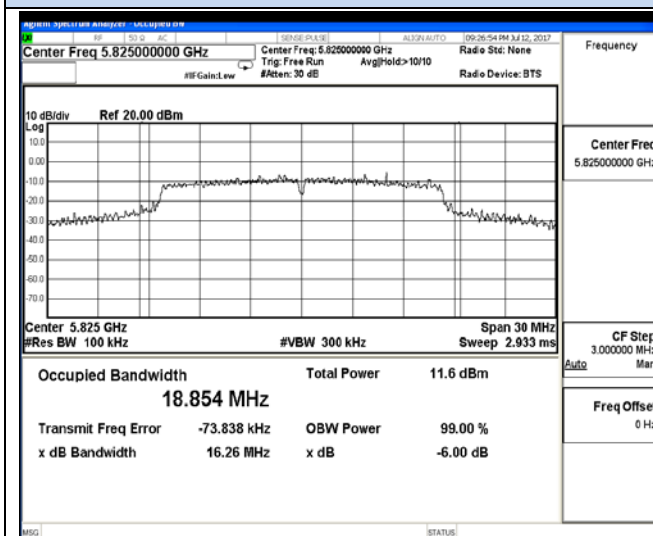
Channel 149 / 5745 MHz



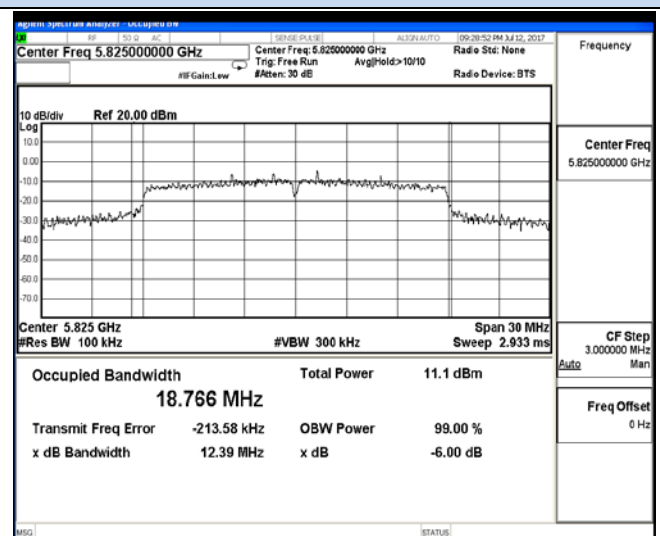
Channel 149 / 5745 MHz



Channel 157 / 5785 MHz



Channel 157 / 5785 MHz



Channel 165 / 5825 MHz

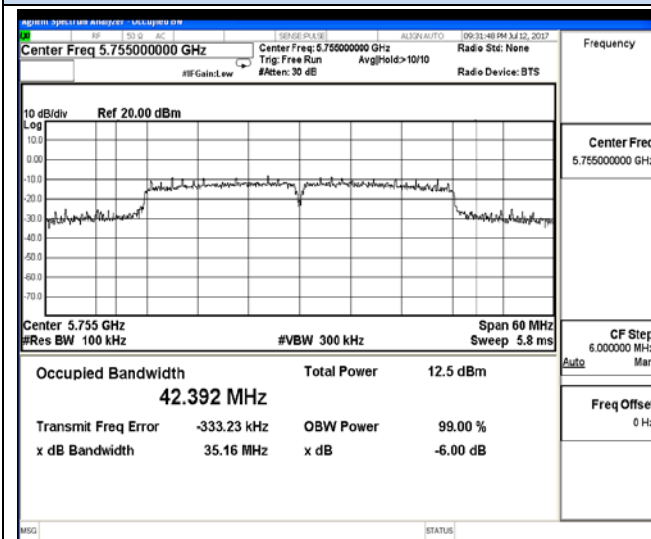


Channel 165 / 5825 MHz

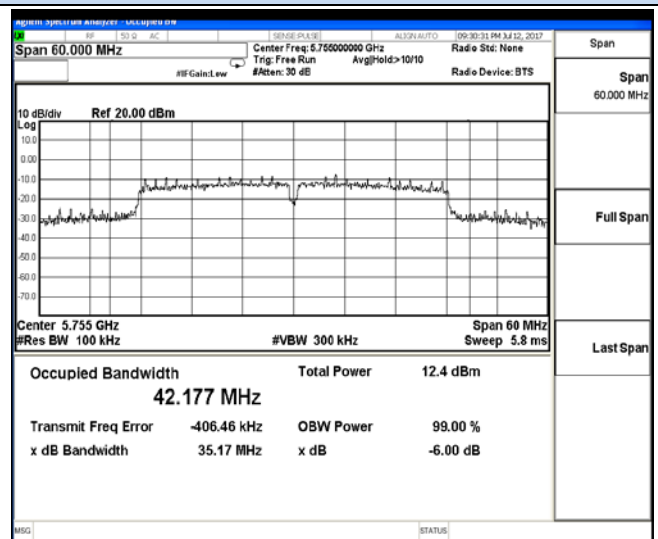


6dB Occupied Bandwidth

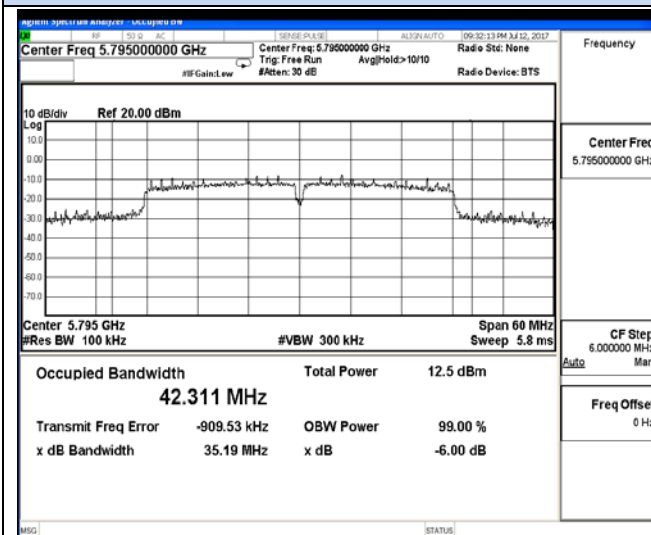
IEEE 802.11n HT40



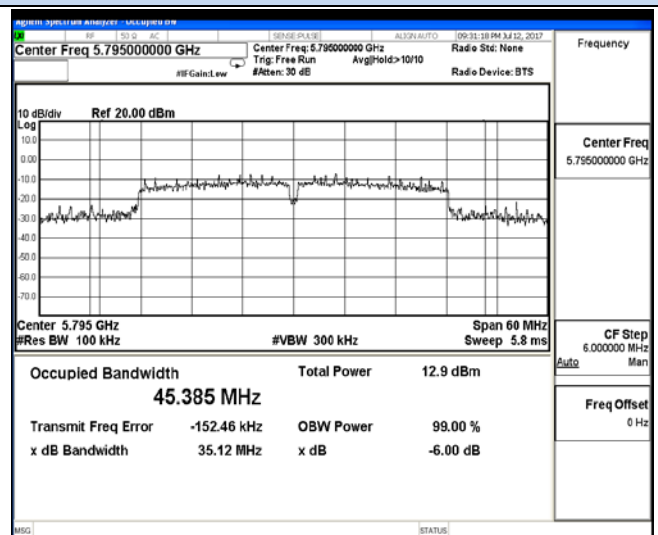
IEEE 802.11ac VHT40



Channel 151 / 5755 MHz

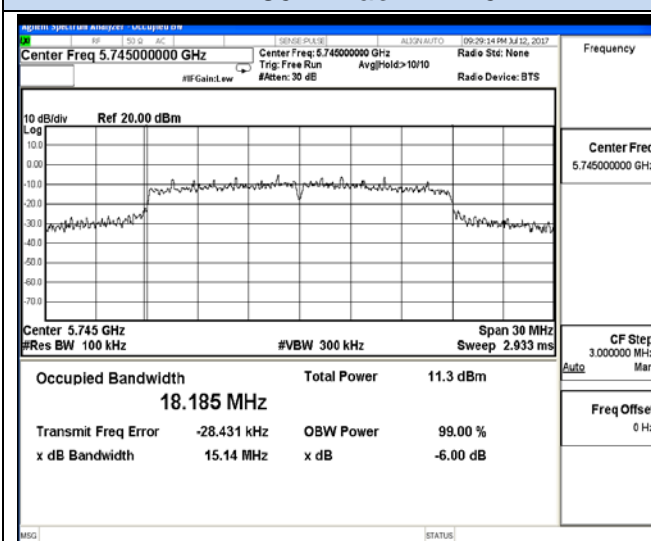


Channel 151 / 5755 MHz



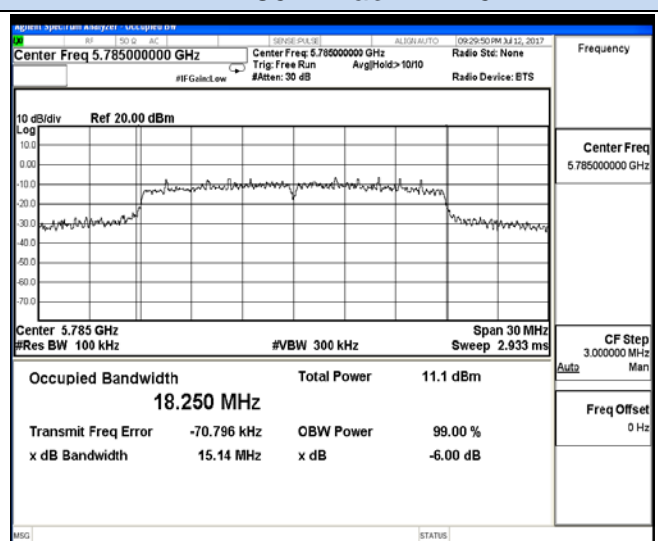
Channel 159 / 5795 MHz

IEEE 802.11ac VHT20



Channel 159 / 5795 MHz

IEEE 802.11ac VHT20

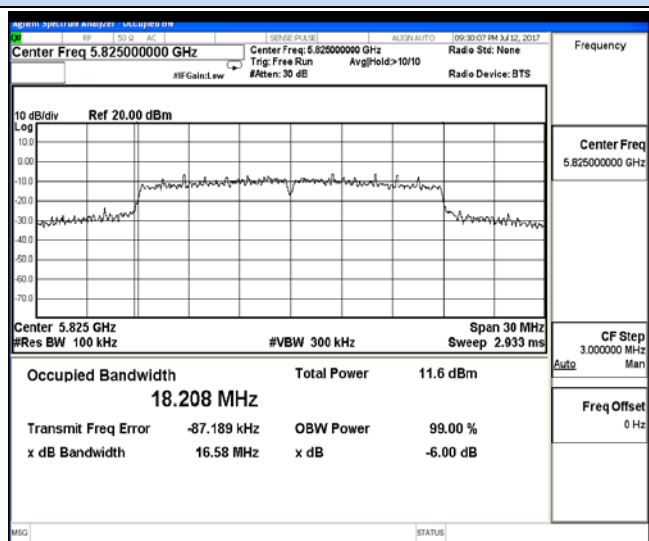


Channel 149 / 5745 MHz

Channel 157 / 5785 MHz

6dB Occupied Bandwidth

IEEE 802.11ac VHT20



Channel 165 / 5825 MHz

5.5. Radiated Emissions Measurement

5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

For transmitters operating in the 5.725-5.85 GHz band:

All emissions shall be limited to a level of -27 dBm/MHz(68.2dBuV/m at 3m) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz(105.2dBuV/m at 3m) 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(110.8dBuV/m at 3m) 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(122.2dBuV/m at 3m) at the band edge.

In addition, 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

5.5.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

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

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.5.3. 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 ($\pm 45^\circ$) 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.

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 ($\pm 45^\circ$) 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.

Premeasurement:

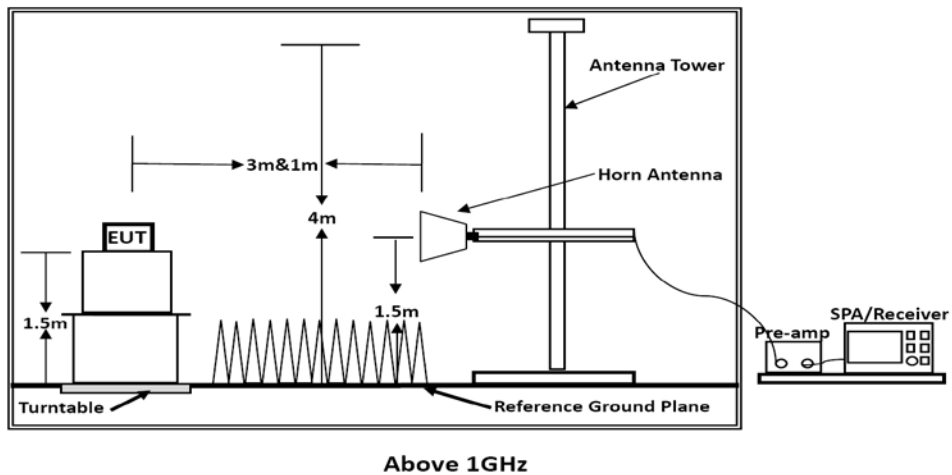
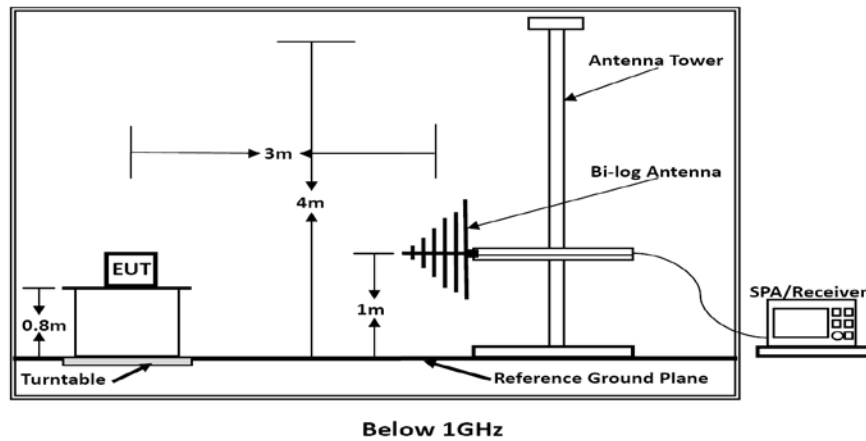
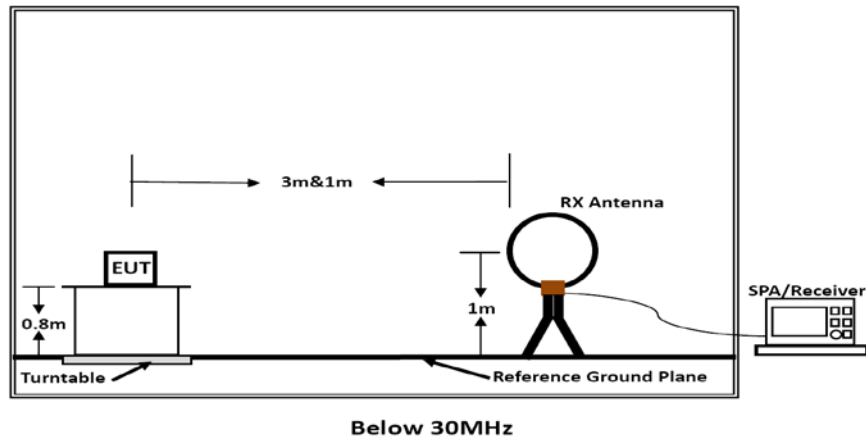
- The antenna is moved spherical over the EUT in different polarizations of the antenna.

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.

5.5.4. Test Setup Layout

For radiated emissions below 30MHz



Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1.5m]})$ (dB);

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

5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.5.6. Results of Radiated Emissions (9 KHz~30 MHz)

Temperature	25°C	Humidity	60%
Test Engineer	Jayden Zhuo	Configurations	IEEE 802.11a/n/ac

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

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

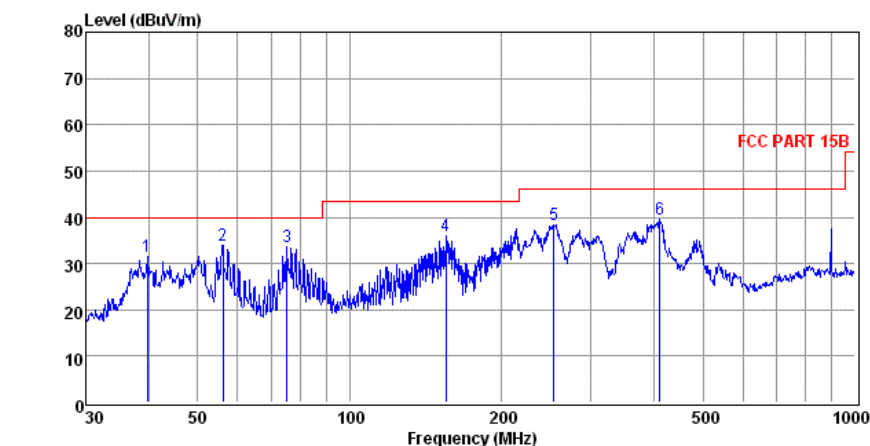
Limit line = specific limits (dBuV) + distance extrapolation factor.

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

Temperature	25°C	Humidity	60%
Test Engineer	Jayden Zhuo	Configurations	IEEE 802.11a, 5825MHz

Test result for IEEE 802.11a - 5825MHz

Horizontal:



pol:

HORIZONTAL

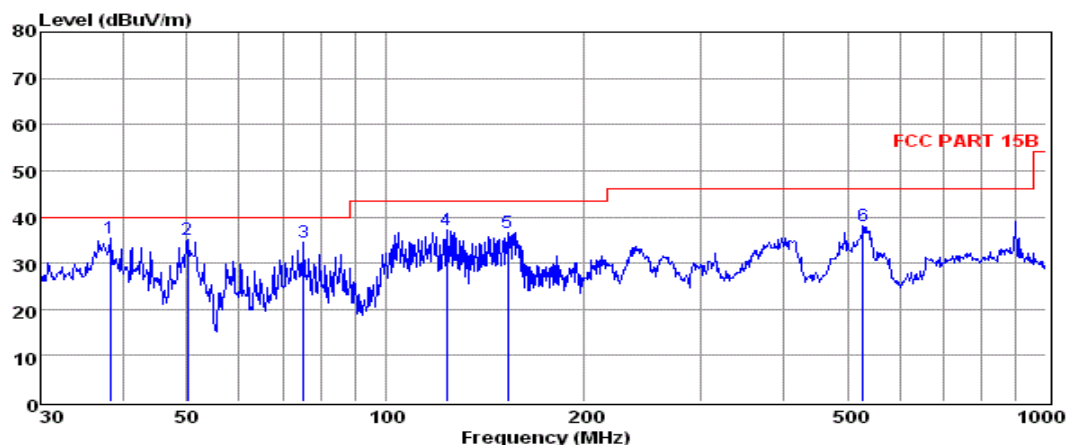
	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	39.71	17.65	0.38	13.51	31.54	40.00	-8.46	QP
2	56.00	20.59	0.47	12.95	34.01	40.00	-5.99	QP
3	75.18	25.25	0.54	7.83	33.62	40.00	-6.38	QP
4	154.82	26.72	0.76	8.46	35.94	43.50	-7.56	QP
5	253.84	25.29	0.90	12.06	38.25	46.00	-7.75	QP
6	410.38	23.11	1.28	15.27	39.66	46.00	-6.34	QP

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that are 20dB below the official limit are not reported

Vertical:



pol:

VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	38.21	21.95	0.38	13.12	35.45	40.00	-4.55	QP
2	50.06	21.37	0.54	13.25	35.16	40.00	-4.84	QP
3	75.18	26.09	0.54	7.83	34.46	40.00	-5.54	QP
4	123.70	26.68	0.71	9.91	37.30	43.50	-6.20	QP
5	153.20	27.39	0.73	8.39	36.51	43.50	-6.99	QP
6	528.25	19.47	1.46	17.11	38.04	46.00	-7.96	QP

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that ate 20db blow the official limit are not reported

Note:

Pre-scan all modes and recorded the worst case results in this report (IEEE 802.11a-5825MHz).

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

5.5.8. Results for Radiated Emissions (Above 1GHz)

IEEE 802.11a

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.22	33.23	35.04	3.91	63.32	74.00	-10.68	Peak	Horizontal
17.235	43.93	33.23	35.04	3.91	46.03	54.00	-7.97	Average	Horizontal
17.235	57.82	33.23	35.04	3.91	59.92	74.00	-14.08	Peak	Vertical
17.235	43.77	33.23	35.04	3.91	45.87	54.00	-8.13	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.90	33.27	35.15	3.93	62.95	74.00	-11.05	Peak	Horizontal
17.355	42.41	33.27	35.15	3.93	44.46	54.00	-9.54	Average	Horizontal
17.355	59.93	33.27	35.15	3.93	61.98	74.00	-12.02	Peak	Vertical
17.355	39.83	33.27	35.15	3.93	41.88	54.00	-12.12	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	61.17	33.32	35.14	3.97	63.32	74.00	-10.68	Peak	Horizontal
17.475	45.43	33.32	35.14	3.97	47.58	54.00	-6.42	Average	Horizontal
17.475	59.86	33.32	35.14	3.97	62.01	74.00	-11.99	Peak	Vertical
17.475	43.86	33.32	35.14	3.97	46.01	54.00	-7.99	Average	Vertical

IEEE 802.11n HT20

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.21	33.23	35.04	3.91	63.31	74.00	-10.69	Peak	Horizontal
17.235	43.56	33.23	35.04	3.91	45.66	54.00	-8.34	Average	Horizontal
17.235	57.44	33.23	35.04	3.91	59.54	74.00	-14.46	Peak	Vertical
17.235	41.71	33.23	35.04	3.91	43.81	54.00	-10.19	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.38	33.27	35.15	3.93	62.43	74.00	-11.57	Peak	Horizontal
17.355	42.31	33.27	35.15	3.93	44.36	54.00	-9.64	Average	Horizontal
17.355	58.32	33.27	35.15	3.93	60.37	74.00	-13.63	Peak	Vertical
17.355	43.30	33.27	35.15	3.93	45.35	54.00	-8.65	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	60.81	33.32	35.14	3.97	62.96	74.00	-11.04	Peak	Horizontal
17.475	44.28	33.32	35.14	3.97	46.43	54.00	-7.57	Average	Horizontal
17.475	60.69	33.32	35.14	3.97	62.84	74.00	-11.16	Peak	Vertical
17.475	44.08	33.32	35.14	3.97	46.23	54.00	-7.77	Average	Vertical

IEEE 802.11ac VHT20

Channel 149 / 5745 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.235	61.22	33.23	35.04	3.91	63.32	74.00	-10.68	Peak	Horizontal
17.235	44.29	33.23	35.04	3.91	46.39	54.00	-7.61	Average	Horizontal
17.235	56.44	33.23	35.04	3.91	58.54	74.00	-15.46	Peak	Vertical
17.235	42.89	33.23	35.04	3.91	44.99	54.00	-9.01	Average	Vertical

Channel 157 / 5785 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.355	60.03	33.27	35.15	3.93	62.08	74.00	-11.92	Peak	Horizontal
17.355	43.35	33.27	35.15	3.93	45.40	54.00	-8.60	Average	Horizontal
17.355	58.79	33.27	35.15	3.93	60.84	74.00	-13.16	Peak	Vertical
17.355	41.59	33.27	35.15	3.93	43.64	54.00	-10.36	Average	Vertical

Channel 163 / 5825 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.475	62.47	33.32	35.14	3.97	64.62	74.00	-9.38	Peak	Horizontal
17.475	43.92	33.32	35.14	3.97	46.07	54.00	-7.93	Average	Horizontal
17.475	59.37	33.32	35.14	3.97	61.52	74.00	-12.48	Peak	Vertical
17.475	44.71	33.32	35.14	3.97	46.86	54.00	-7.14	Average	Vertical

IEEE 802.11n HT40

Channel 151 / 5755 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.265	61.55	33.23	35.04	3.91	63.65	74.00	-10.35	Peak	Horizontal
17.265	44.45	33.23	35.04	3.91	46.55	54.00	-7.45	Average	Horizontal
17.265	58.53	33.23	35.04	3.91	60.63	74.00	-13.37	Peak	Vertical
17.265	41.89	33.23	35.04	3.91	43.99	54.00	-10.01	Average	Vertical

Channel 159 / 5795 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.385	58.10	33.23	35.04	3.91	60.20	74.00	-13.80	Peak	Horizontal
17.385	44.04	33.23	35.04	3.91	46.14	54.00	-7.86	Average	Horizontal
17.385	56.08	33.23	35.04	3.91	58.18	74.00	-15.82	Peak	Vertical
17.385	42.02	33.23	35.04	3.91	44.12	54.00	-9.88	Average	Vertical

IEEE 802.11ac VHT40

Channel 151 / 5755 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.265	59.55	33.23	35.04	3.91	61.65	74.00	-12.35	Peak	Horizontal
17.265	42.66	33.23	35.04	3.91	44.76	54.00	-9.24	Average	Horizontal
17.265	58.55	33.23	35.04	3.91	60.65	74.00	-13.35	Peak	Vertical
17.265	39.49	33.23	35.04	3.91	41.59	54.00	-12.41	Average	Vertical

Channel 159 / 5795 MHz

Freq GHz	Read Level dBuV	Ant. Fac dB/m	Pre. Fac dB	Cab.Los dB	Measured Level dBuV	Limit Line dBuV/m	Over limit dB	Remark	Pol/Phase
17.385	57.47	33.23	35.04	3.91	59.57	74.00	-14.43	Peak	Horizontal
17.385	40.15	33.23	35.04	3.91	42.25	54.00	-11.75	Average	Horizontal
17.385	58.00	33.23	35.04	3.91	60.10	74.00	-13.90	Peak	Vertical
17.385	36.91	33.23	35.04	3.91	39.01	54.00	-14.99	Average	Vertical

Notes:

- 1). Measuring frequencies from 9 KHz ~ 40 GHz, No emission found between lowest internal used/generated frequency to 30MHz.
- 2). Radiated emissions measured in frequency range from 9 KHz ~ 40 GHz were made with an instrument using Peak detector mode.
- 3). 18~40GHz at least have 20dB margin. No recording in the test report.
- 4). Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40;
- 5). Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

5.6. Power line conducted emissions

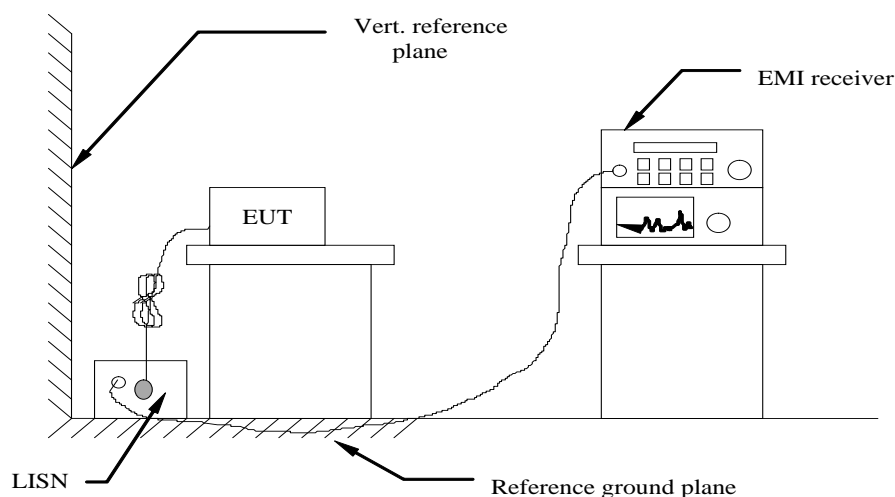
5.6.1 Standard Applicable

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 are listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	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

* Decreasing linearly with the logarithm of the frequency

5.6.2 Block Diagram of Test Setup



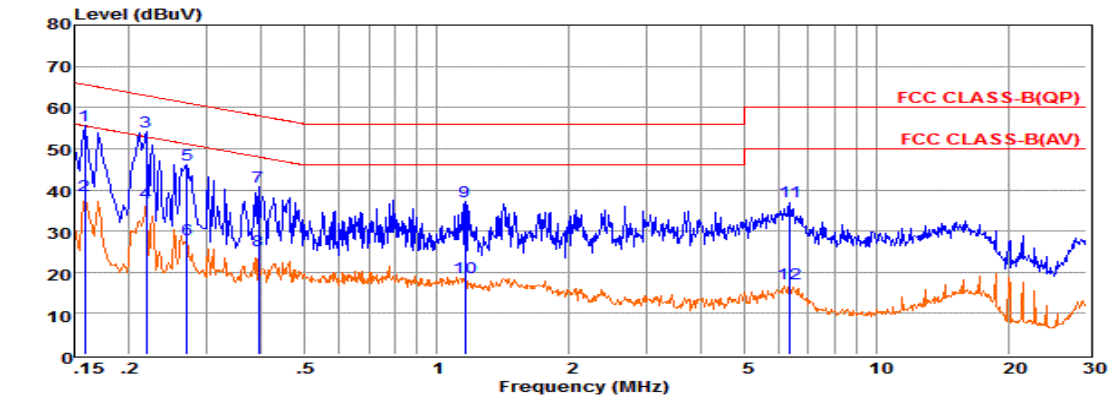
5.6.3 Test Results

PASS.

The test data please refer to following page.

AC Conducted Emission of power by adapter @ AC 120V/60Hz @ IEEE 802.11a (worst case)

Line

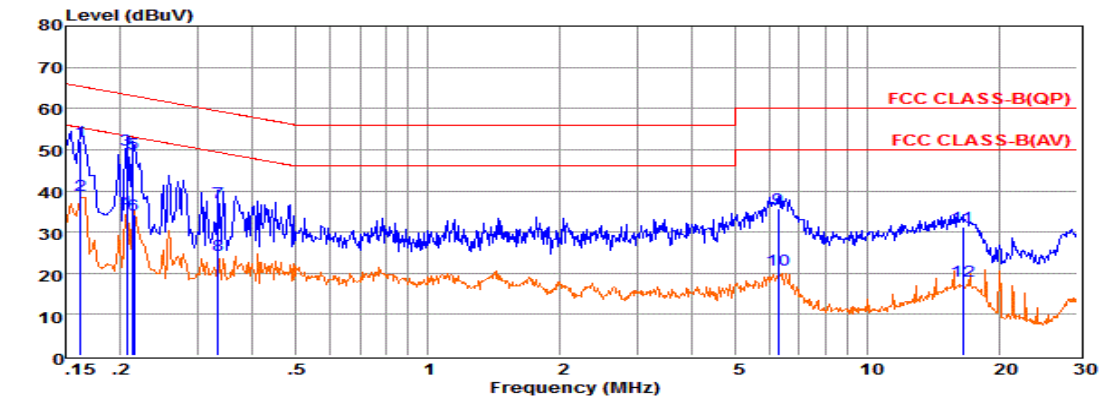


Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.16	35.94	9.58	0.02	10.00	55.54	65.56	-10.02	QP
2	0.16	18.96	9.58	0.02	10.00	38.56	55.55	-16.99	Average
3	0.22	34.34	9.63	0.03	10.00	54.00	62.88	-8.88	QP
4	0.22	17.34	9.63	0.03	10.00	37.00	52.88	-15.88	Average
5	0.27	26.34	9.63	0.03	10.00	46.00	61.12	-15.12	QP
6	0.27	8.41	9.63	0.03	10.00	28.07	51.11	-23.04	Average
7	0.39	21.05	9.62	0.04	10.00	40.71	57.99	-17.28	QP
8	0.39	5.53	9.62	0.04	10.00	25.19	47.99	-22.80	Average
9	1.16	17.42	9.63	0.05	10.00	37.10	56.00	-18.90	QP
10	1.16	-0.82	9.63	0.05	10.00	18.86	46.00	-27.14	Average
11	6.35	17.50	9.67	0.07	10.00	37.24	60.00	-22.76	QP
12	6.35	-2.49	9.67	0.07	10.00	17.25	50.00	-32.75	Average

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

Neutral



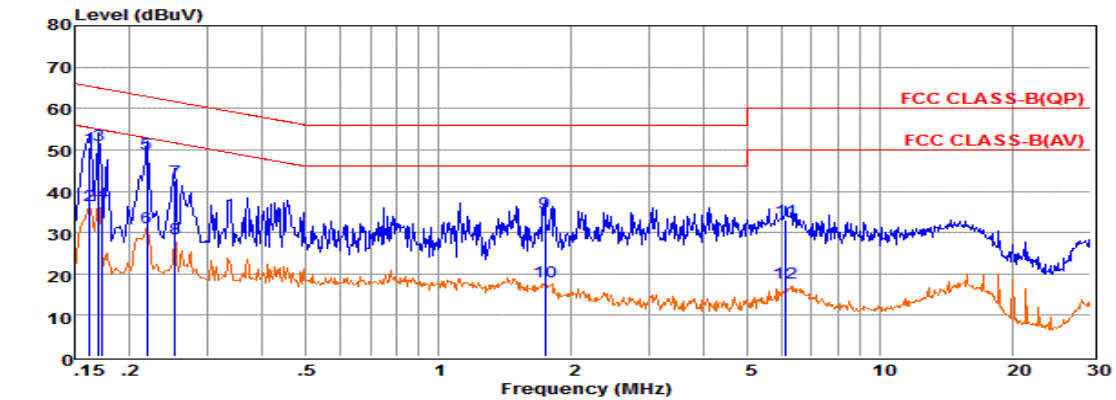
Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.16	32.23	9.67	0.02	10.00	51.92	65.34	-13.42	QP
2	0.16	19.26	9.67	0.02	10.00	38.95	55.34	-16.39	Average
3	0.21	30.39	9.59	0.03	10.00	50.01	63.36	-13.35	QP
4	0.21	15.49	9.59	0.03	10.00	35.11	53.36	-18.25	Average
5	0.21	29.40	9.59	0.03	10.00	49.02	63.05	-14.03	QP
6	0.21	14.45	9.59	0.03	10.00	34.07	53.03	-18.96	Average
7	0.33	17.62	9.61	0.03	10.00	37.26	59.35	-22.09	QP
8	0.33	4.63	9.61	0.03	10.00	24.27	49.35	-25.08	Average
9	6.25	15.94	9.68	0.07	10.00	35.69	60.00	-24.31	QP
10	6.25	0.97	9.68	0.07	10.00	20.72	50.00	-29.28	Average
11	16.49	11.39	9.76	0.11	10.00	31.26	60.00	-28.74	QP
12	16.50	-1.59	9.76	0.11	10.00	18.28	50.00	-31.72	Average

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

AC Conducted Emission of power by adapter @ AC 240V/50Hz @ IEEE 802.11a (worst case)

Line

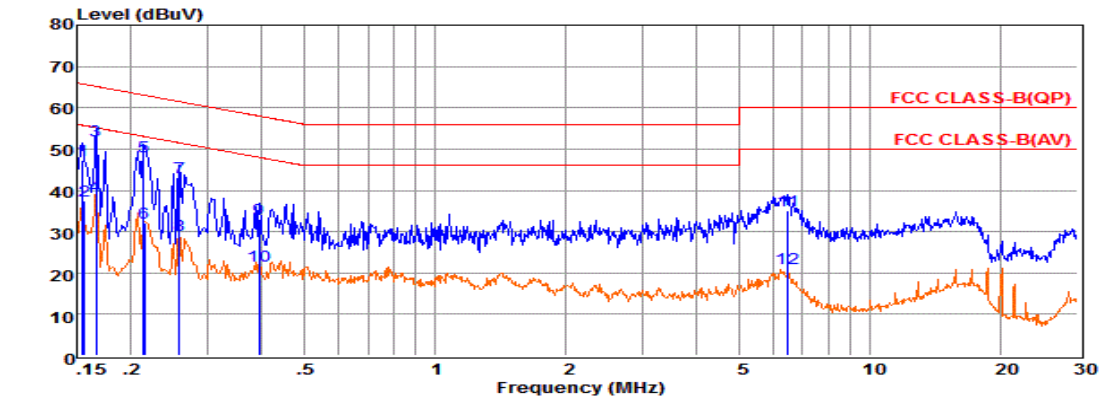


Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.16	31.01	9.59	0.02	10.00	50.62	65.34	-14.72	QP
2	0.16	16.88	9.59	0.02	10.00	36.49	55.34	-18.85	Average
3	0.17	31.56	9.60	0.02	10.00	51.18	64.94	-13.76	QP
4	0.17	17.59	9.60	0.02	10.00	37.21	54.79	-17.58	Average
5	0.22	29.36	9.63	0.03	10.00	49.02	62.88	-13.86	QP
6	0.22	11.66	9.63	0.03	10.00	31.32	52.87	-21.55	Average
7	0.25	22.91	9.63	0.03	10.00	42.57	61.64	-19.07	QP
8	0.25	8.98	9.63	0.03	10.00	28.64	51.64	-23.00	Average
9	1.74	15.12	9.64	0.05	10.00	34.81	56.00	-21.19	QP
10	1.74	-1.60	9.64	0.05	10.00	18.09	46.00	-27.91	Average
11	6.12	13.42	9.67	0.07	10.00	33.16	60.00	-26.84	QP
12	6.12	-1.79	9.67	0.07	10.00	17.95	50.00	-32.05	Average

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

Neutral



Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.15	27.55	9.69	0.02	10.00	47.26	65.74	-18.48	QP
2	0.16	17.65	9.69	0.02	10.00	37.36	55.68	-18.32	Average
3	0.17	32.39	9.66	0.02	10.00	52.07	65.16	-13.09	QP
4	0.17	18.92	9.66	0.02	10.00	38.60	55.16	-16.56	Average
5	0.21	28.55	9.59	0.03	10.00	48.17	63.05	-14.88	QP
6	0.21	12.49	9.59	0.03	10.00	32.11	53.04	-20.93	Average
7	0.26	23.44	9.60	0.03	10.00	43.07	61.51	-18.44	QP
8	0.26	9.54	9.60	0.03	10.00	29.17	51.51	-22.34	Average
9	0.39	13.30	9.61	0.04	10.00	32.95	57.99	-25.04	QP
10	0.39	1.98	9.61	0.04	10.00	21.63	47.99	-26.36	Average
11	6.49	15.34	9.68	0.07	10.00	35.09	60.00	-24.91	QP
12	6.49	1.44	9.68	0.07	10.00	21.19	50.00	-28.81	Average

Remarks: 1. Measured = Reading + LISNFac + 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 (IEEE 802.11a).

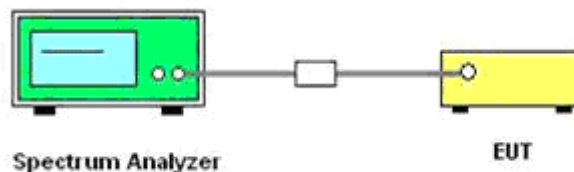
5.7 Undesirable Emissions Measurement

5.7.1 Limit

According to §15.407 (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.

5.7.2 Test Configuration



5.7.3 Test Procedure

1. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
2. Set the RBW = 1MHz.
3. Set the VBW \geq 3MHz
4. Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This ensures that bin-to-bin spacing is $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)
5. Manually set sweep time $\geq 10 \times (\text{number of points in sweep}) \times (\text{total on/off period of the transmitted signal})$.
6. Set detector = power averaging (rms).
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.

5.7.4 Test Results

IEEE 802.11a							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Over limit (dB)	Verdict
5650.000	-49.228	3.600	-45.628	Peak	-27.000	-18.628	PASS
5700.000	-46.783	3.600	-43.183	Peak	10.000	-53.183	PASS
5720.000	-30.356	3.600	-26.756	Peak	15.600	-42.356	PASS
5725.000	-22.229	3.600	-18.629	Peak	27.000	-45.629	PASS
5850.000	-33.211	3.600	-29.611	Peak	27.000	-56.611	PASS
5855.000	-39.942	3.600	-36.342	Peak	15.600	-51.942	PASS
5875.000	-49.467	3.600	-45.867	Peak	10.000	-55.867	PASS
5925.000	-50.278	3.600	-46.678	Peak	-27.000	-19.678	PASS

IEEE 802.11n HT20							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Over limit (dB)	Verdict
5650.000	-50.686	3.600	-47.086	Peak	-27.000	-20.086	PASS
5700.000	-48.855	3.600	-45.255	Peak	10.000	-55.255	PASS
5720.000	-33.740	3.600	-30.140	Peak	15.600	-45.740	PASS
5725.000	-23.194	3.600	-19.594	Peak	27.000	-46.594	PASS
5850.000	-31.035	3.600	-27.435	Peak	27.000	-54.435	PASS
5855.000	-34.504	3.600	-30.904	Peak	15.600	-46.504	PASS
5875.000	-49.365	3.600	-45.765	Peak	10.000	-55.765	PASS
5925.000	-50.836	3.600	-47.236	Peak	-27.000	-20.236	PASS

IEEE 802.11ac VHT20							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Over limit (dB)	Verdict
5650.000	-51.118	3.600	-47.518	Peak	-27.000	-20.518	PASS
5700.000	-48.783	3.600	-45.183	Peak	10.000	-55.183	PASS
5720.000	-32.088	3.600	-28.488	Peak	15.600	-44.088	PASS
5725.000	-26.241	3.600	-22.641	Peak	27.000	-49.641	PASS
5850.000	-33.119	3.600	-29.519	Peak	27.000	-56.519	PASS
5855.000	-37.464	3.600	-33.864	Peak	15.600	-49.464	PASS
5875.000	-48.345	3.600	-44.745	Peak	10.000	-54.745	PASS
5925.000	-50.762	3.600	-47.162	Peak	-27.000	-20.162	PASS

IEEE 802.11n HT40							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Over limit (dB)	Verdict
5650.000	-49.397	3.600	-45.797	Peak	-27.000	-18.797	PASS
5700.000	-32.456	3.600	-28.856	Peak	10.000	-38.856	PASS
5720.000	-21.764	3.600	-18.164	Peak	15.600	-33.764	PASS
5725.000	-21.925	3.600	-18.325	Peak	27.000	-45.325	PASS
5850.000	-35.896	3.600	-32.296	Peak	27.000	-59.296	PASS
5855.000	-36.617	3.600	-33.017	Peak	15.600	-48.617	PASS
5875.000	-45.621	3.600	-42.021	Peak	10.000	-52.021	PASS
5925.000	-51.659	3.600	-48.059	Peak	-27.000	-21.059	PASS

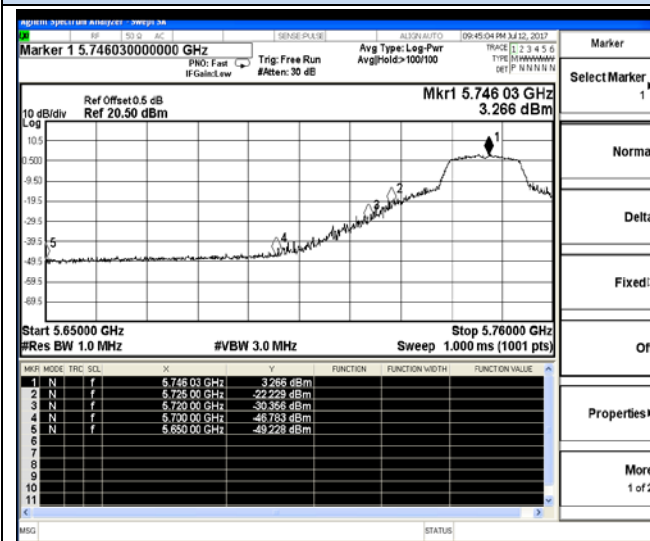
IEEE 802.11ac VHT40							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm/1MHz)	Detector	Limit (dBm/1MHz)	Over limit (dB)	Verdict
5650.000	-51.910	3.600	-48.310	Peak	-27.000	-21.310	PASS
5700.000	-35.844	3.600	-32.244	Peak	10.000	-42.244	PASS
5720.000	-23.481	3.600	-19.881	Peak	15.600	-35.481	PASS
5725.000	-21.693	3.600	-18.093	Peak	27.000	-45.093	PASS
5850.000	-35.090	3.600	-31.490	Peak	27.000	-58.490	PASS
5855.000	-35.958	3.600	-32.358	Peak	15.600	-47.958	PASS
5875.000	-45.937	3.600	-42.337	Peak	10.000	-52.337	PASS
5925.000	-50.996	3.600	-47.396	Peak	-27.000	-20.396	PASS

Remark:

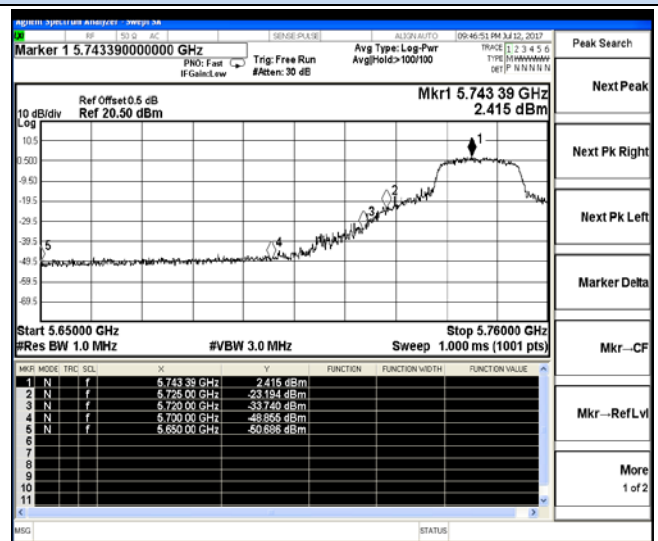
1. Measured unwanted emission at difference data rate for each mode and recorded worst case for each mode.
2. Test results including cable loss;
3. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40;
4. $E.I.R.P = \text{Conducted power} + \text{Directional Gain}$
5. 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.
6. $\text{Over limit} = \text{EIRP} - \text{Limit}$
7. Please refer to following test plots;

Unwanted emission

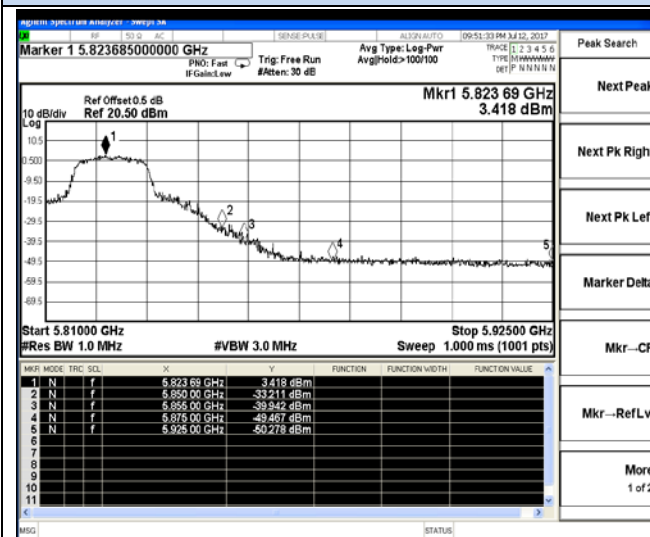
IEEE 802.11a



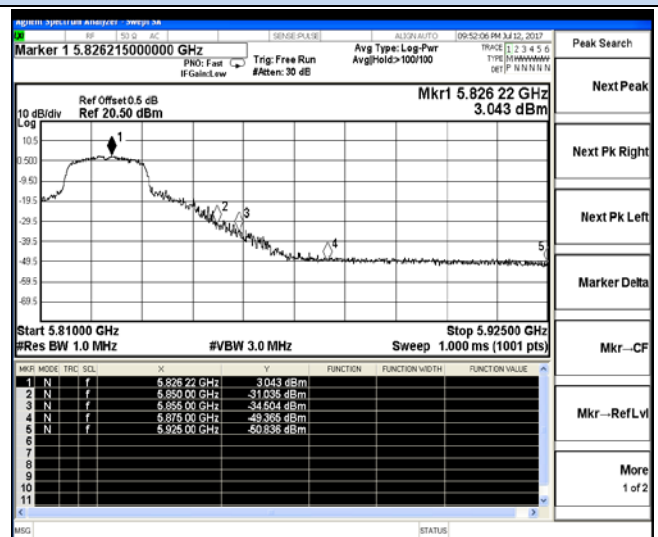
IEEE 802.11n HT20



Channel 149 / 5745 MHz – Peak

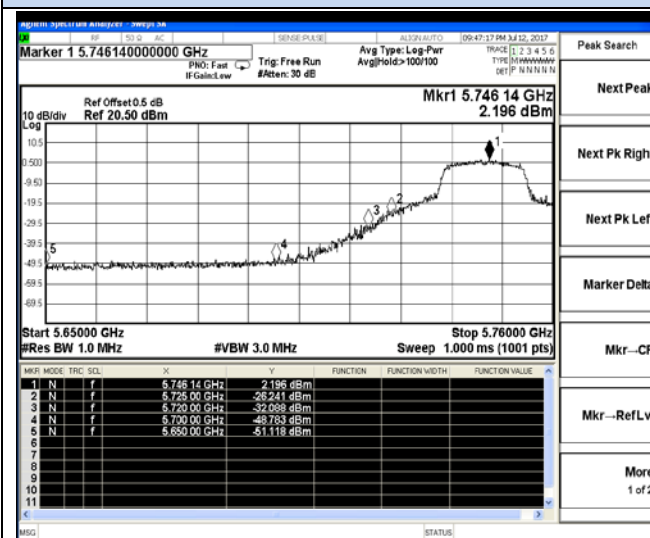


Channel 149 / 5745 MHz – Peak



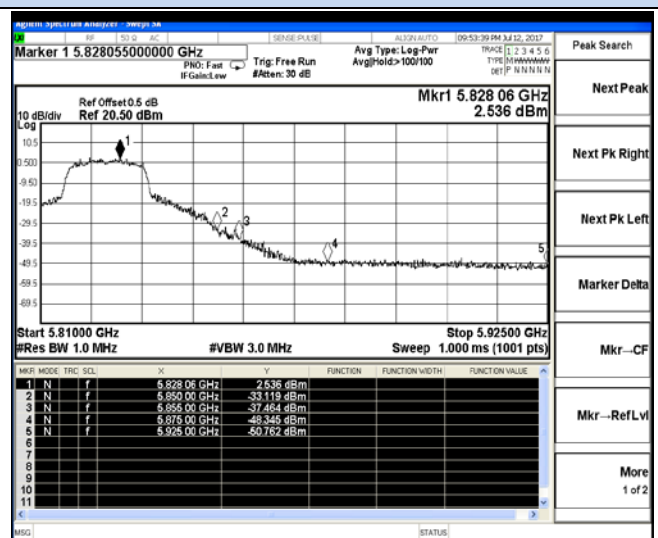
Channel 165 / 5825 MHz – Peak

IEEE 802.11ac VHT20



Channel 165 / 5825 MHz – Peak

IEEE 802.11ac VHT20

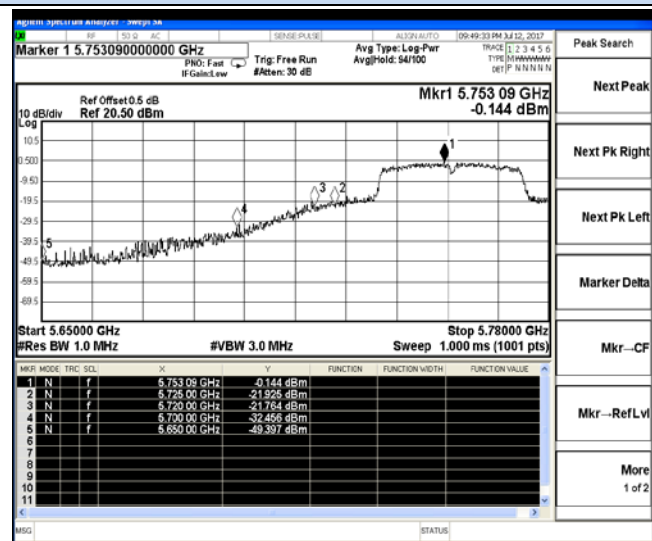


Channel 149 / 5745 MHz – Peak

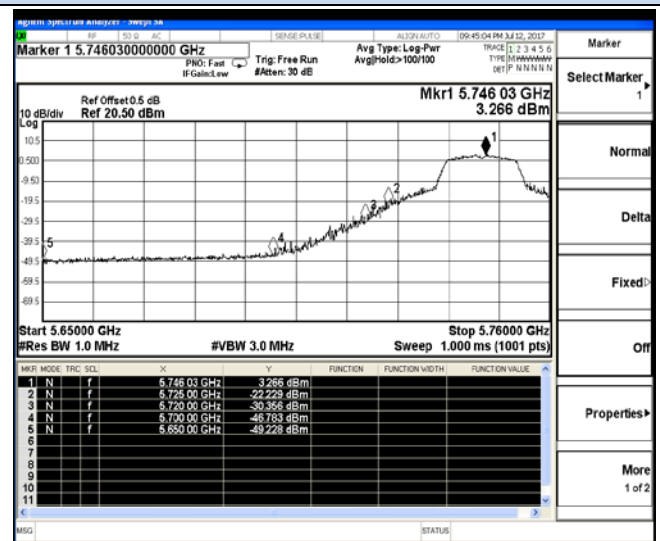
Channel 165 / 5825 MHz – Peak

Unwanted emission

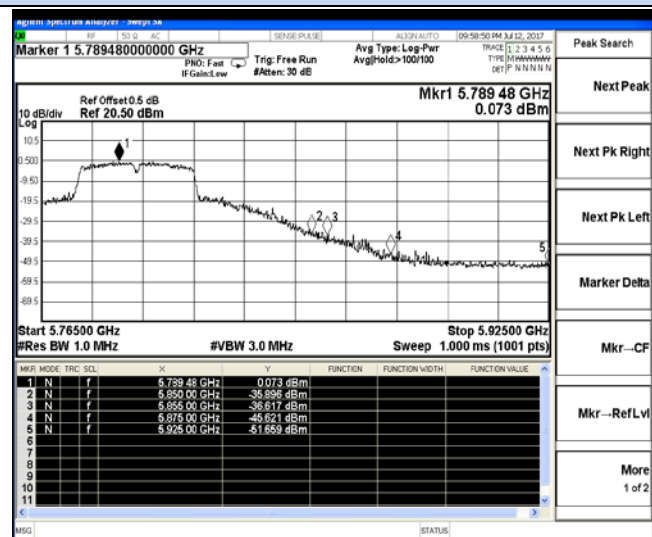
IEEE 802.11n HT40



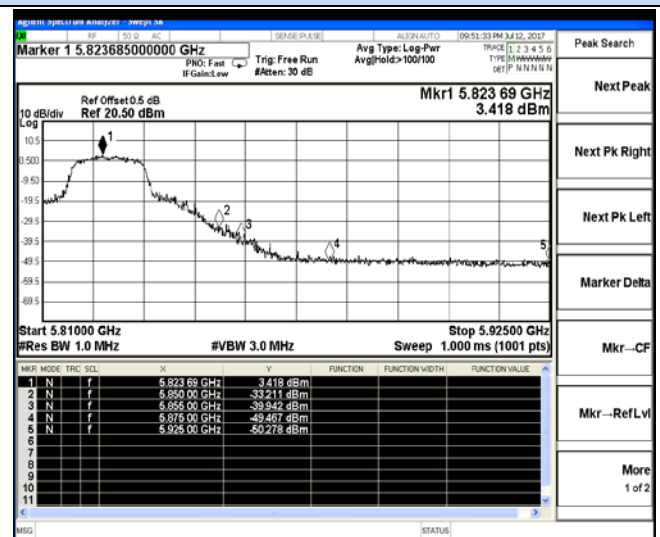
IEEE 802.11ac VHT40



Channel 151 / 5755 MHz – Peak



Channel 151 / 5755 MHz – Peak



Channel 159 / 5795 MHz – Peak

Channel 159 / 5795 MHz – Peak

5.8. Antenna Requirements

5.8.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.8.2 Antenna Connected Construction

5.8.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

5.8.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 3.6dBi, and the antenna is a PIFA antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

The WLAN and BT share same modular and same antenna;

5.8.2.3. Results: Compliance.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Conducted power refers ANSI C63.10:2013 Output power test procedure for NII devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep Time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	ISED
Antenna Gain	
6 dBi	

Note: The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For WLAN devices, the OFDM (IEEE 802.11a) mode is used;

T _{nom}	V _{nom}	Lowest Channel 5745 MHz	Middle Channel 5785 MHz	Highest Channel 5825 MHz
Conducted power [dBm] Measured with DSSS modulation		4.896	4.743	4.811
Radiated power [dBm] Measured with DSSS modulation		7.971	8.249	7.795
Gain [dBi] Calculated		3.075	3.506	2.984
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

6. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	June 18, 2017	June 17, 2018
Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	9kHz~40GHz	July 16, 2016	July 15, 2017
Signal analyzer	Agilent	N9020A	MY50510140	9kHz~26.5GHz	October 27, 2016	October 27, 2017
LISN	MESS Tec	NNB-2/16Z	99079	9KHz-30MHz	June 18, 2017	June 17, 2018
LISN (Support Unit)	EMCO	3819/2NM	9703-1839	9KHz-30MHz	June 18, 2017	June 17, 2018
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9KHz-30MHz	June 18, 2017	June 17, 2018
ISN	SCHAFFNER	ISN ST08	21653	9KHz-30MHz	June 18, 2017	June 17, 2018
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30M-18GHz	June 18, 2017	June 17, 2018
Amplifier	SCHAFFNER	COA9231A	18667	9kHz-2GHz	June 18, 2017	June 17, 2018
Amplifier	Agilent	8449B	3008A02120	1GHz-26.5GHz	July 16, 2016	July 15, 2017
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40GHz	July 16, 2016	July 15, 2017
Loop Antenna	R&S	HFH2-Z2	860004/001	9k-30MHz	June 18, 2017	June 17, 2018
By-log Antenna	SCHWARZBECK	VULB9163	9163-470	30MHz-1GHz	June 10, 2017	June 09, 2018
Horn Antenna	EMCO	3115	6741	1GHz-18GHz	June 10, 2017	June 09, 2018
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	15GHz-40GHz	June 10, 2017	June 09, 2018
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz-1GHz	June 18, 2017	June 17, 2018
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1GHz-40GHz	June 18, 2017	June 17, 2018
Power Meter	R&S	NRVS	100444	DC-40GHz	June 18, 2017	June 17, 2018
Power Sensor	R&S	NRV-Z81	100458	DC-30GHz	June 18, 2017	June 17, 2018
Power Sensor	R&S	NRV-Z32	10057	30MHz-6GHz	June 18, 2017	June 17, 2018
AC Power Sourer	HPC	HPA-500E	HPA-9100024	AC 0~300V	June 18, 2017	June 17, 2018
DC power Sourer	GW	GPC-6030D	C671845	DC 1V-60V	June 18, 2017	June 17, 2018
Temp. and Humidify Chamber	Giant Force	GTH-225-20-S	MAB0103-00	N/A	June 18, 2017	June 17, 2018
RF CABLE-1m	JYE Bao	RG142	CB034-1m	20MHz-7GHz	June 18, 2017	June 17, 2018
RF CABLE-2m	JYE Bao	RG142	CB)35-2m	20MHz-1GHz	June 18, 2017	June 17, 2018
EMC Test software	Audix	E3	N/A	N/A	N/A	N/A

Note: All equipment through GRGT EST calibration

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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