

TEST REPORT

Applicant: Lenovo (Beijing) Limited

Address of Applicant: 201-H2-6, Floor2, Building 2, No. 6 Shangdi West Road,
Haidian District, Beijing, China

Manufacturer: Lenovo (Beijing) Limited

Address of Manufacturer: 201-H2-6, Floor2, Building 2, No. 6 Shangdi West Road,
Haidian District, Beijing, China

Factory: Shenzhen Giec Digital Co., Ltd

Address of Factory: 1st&3rd Building, No.26 Puzai Road, Pingdi, Longgang
District, Shenzhen, China

Equipment Under Test (EUT)

Product Name: Wireless LAN / Bluetooth devices

Model No.: ECB-PR70

FCC ID: A5M-ECBPR70

Applicable standards: FCC CFR Title 47 Part 15 Subpart E Section 15.407

Date of sample receipt: July 06, 2020

Date of Test: July 07, 2020-August 06, 2020

Date of report issued: August 06, 2020

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Robinson Lo

Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	August 06, 2020	Original

Prepared By:



Date:

August 06, 2020

Project Engineer

Check By:


Reviewer

Date:

August 06, 2020

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4 Test Summary

Test Item	Section	Result
Antenna requirement	FCC part 15.203	Pass
AC Power Line Conducted Emission	FCC part 15.207	Pass
Conducted Peak Output Power	FCC part 15.407(a)(3)	Pass
Channel Bandwidth and 99% Occupied Bandwidth	FCC part 15.407(e)	Pass
Power Spectral Density	FCC part 15.407(a)(3)	Pass
Band Edge	FCC part 15.407(b)(4)	Pass
Spurious Emission	FCC part 15.205/15.209/15.407(b)(4)	Pass
Frequency Stability	FCC part 15.407(g)	Pass

Remarks:

1. Pass: The EUT complies with the essential requirements in the standard.
2. Test according to ANSI C63.10:2013.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

Product Name:	Wireless LAN / Bluetooth devices
Model No.:	ECB-PR70
Serial No.:	JK00001
Hardware Version:	V1.4
Software Version:	chestnut-userdebug 9 PQ2A.20190516.V002 171153 test-keys
Test sample(s) ID:	GTS202007000052-1
Sample(s) Status:	Engineer sample
Operation Frequency:	802.11a/802.11n(HT20)/802.11ac(HT20): 5745MHz ~ 5825MHz 802.11n(HT40)/ 802.11ac(HT40): 5755MHz ~ 5795MHz 802.11ac(HT80): 5775MHz
Channel numbers:	802.11a/802.11n(HT20)/802.11ac(HT20): 5 802.11n(HT40)/ 802.11ac(HT40): 2 802.11ac(HT80): 1
Channel bandwidth:	802.11a/802.11n(HT20)/802.11ac(HT20) : 20MHz 802.11n(HT40)/802.11ac(HT40) : 40MHz 802.11ac(HT80): 80MHz
Modulation technology:	Orthogonal Frequency Division Multiplexing (OFDM)
Antenna Type:	FPC Antenna
Antenna gain:	1.3dBi(declare by applicant)
Power supply:	DC 5V, 3A

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
149	5745MHz	151	5755MHz	153	5765MHz	155	5775MHz
157	5785MHz	159	5795MHz	161	5805MHz	163	5815MHz
165	5825MHz						

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Test channel	Frequency (MHz)		
	802.11 a/n/ac(HT20)	802.11 n/ac(HT40)	802.11ac(HT80)
Lowest channel	5745	5755	
Middle channel	5785		5775
Highest channel	5825	5795	

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode
<i>Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data. New battery is used during all test.</i>	

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:			
Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.			
Mode	Data rate	Mode	Data rate
802.11a	6Mbps	802.11n/ac(HT40)	13Mbps
802.11n/ac(HT20)	6.5Mbps	802.11ac(HT80)	29.3Mbps

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
N/A	POWER SUPPLY	S018BAU050030C	N/A
Lenovo	Notebook PC	E40	N/A

5.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations: FCC —Registration No.: 381383 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383. IC —Registration No.: 9079A The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A. CNAS (No. CNAS L5775) CNAS has accredited Global United Technology Services Co., Ltd., to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

5.5 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, sBaoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.6 Additional Instructions

Test Software	RF TEST TOOL
Power level setup	Default

6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 02 2020	July. 01 2025
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 25 2020	June. 24 2021
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 25 2020	June. 24 2021
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 25 2020	June. 24 2021
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 25 2020	June. 24 2021
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 25 2020	June. 24 2021
9	Coaxial Cable	GTS	N/A	GTS211	June. 25 2020	June. 24 2021
10	Coaxial cable	GTS	N/A	GTS210	June. 25 2020	June. 24 2021
11	Coaxial Cable	GTS	N/A	GTS212	June. 25 2020	June. 24 2021
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 25 2020	June. 24 2021
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 25 2020	June. 24 2021
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 25 2020	June. 24 2021
15	Band filter	Amindeon	82346	GTS219	June. 25 2020	June. 24 2021
16	Power Meter	Anritsu	ML2495A	GTS540	June. 25 2020	June. 24 2021
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 25 2020	June. 24 2021
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 25 2020	June. 24 2021
19	Splitter	Agilent	11636B	GTS237	June. 25 2020	June. 24 2021
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 25 2020	June. 24 2021
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 25 2020	June. 24 2021

Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.15 2019	May.14 2022
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 25 2020	June. 24 2021
4	ENV216 2-L-V-NETZNACHB.DE	ROHDE&SCHWARZ	ENV216	GTS226	June. 25 2020	June. 24 2021
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 25 2020	June. 24 2021
8	Absorbing clamp	Elektronik-Feinmechanik	MDS21	GTS229	June. 25 2020	June. 24 2021
9	ISN	SCHWARZBECK	NTFM 8158	GTD565	June. 25 2020	June. 24 2021

RF Conducted Test:						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 25 2020	June. 24 2021
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 25 2020	June. 24 2021
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 25 2020	June. 24 2021
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 25 2020	June. 24 2021
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 25 2020	June. 24 2021
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 25 2020	June. 24 2021
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 25 2020	June. 24 2021

General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 25 2020	June. 24 2021
2	Barometer	ChangChun	DYM3	GTS255	June. 25 2020	June. 24 2021

7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203
<i>15.203 requirement:</i> 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.	
E.U.T Antenna:	
<i>The antenna is FPC antenna, the best case gain of the antenna is 1.3dBi, reference to the appendix II for details</i>	

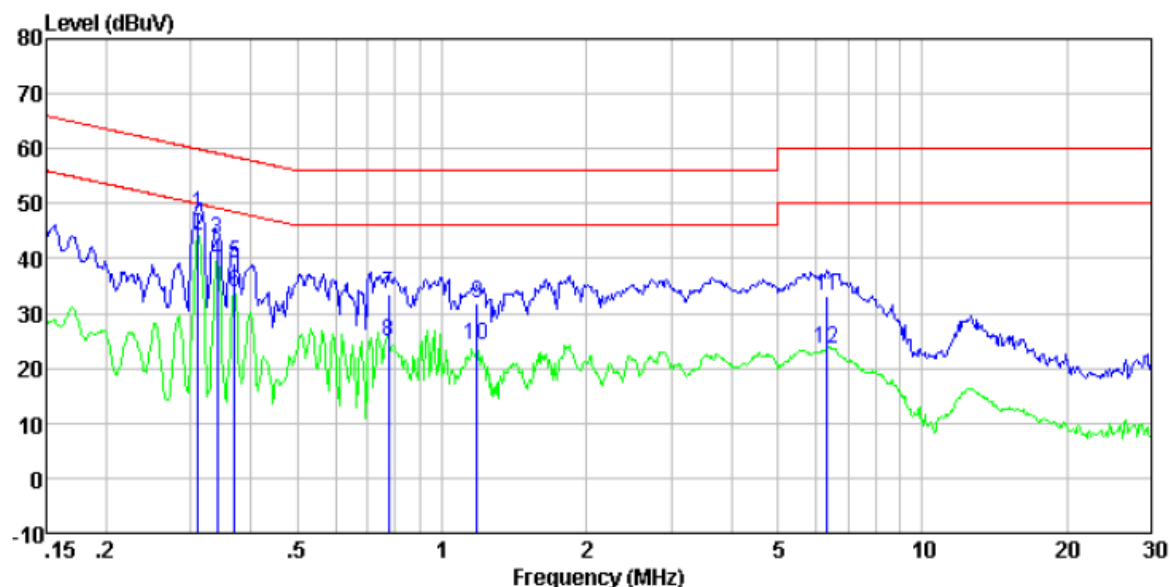
7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207					
Test Method:	ANSI C63.10:2013					
Test Frequency Range:	150KHz to 30MHz					
Class / Severity:	Class B					
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto					
Limit:	Frequency range (MHz)		Limit (dBuV)			
			Quasi-peak		Average	
	0.15-0.5		66 to 56*		56 to 46*	
	0.5-5		56		46	
	5-30		60		50	
* Decreases with the logarithm of the frequency.						
Test setup:	Reference Plane Test table/Insulation plane <i>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</i>					
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

Remark: Both high and low voltages have been tested to show only the worst low voltage test data.

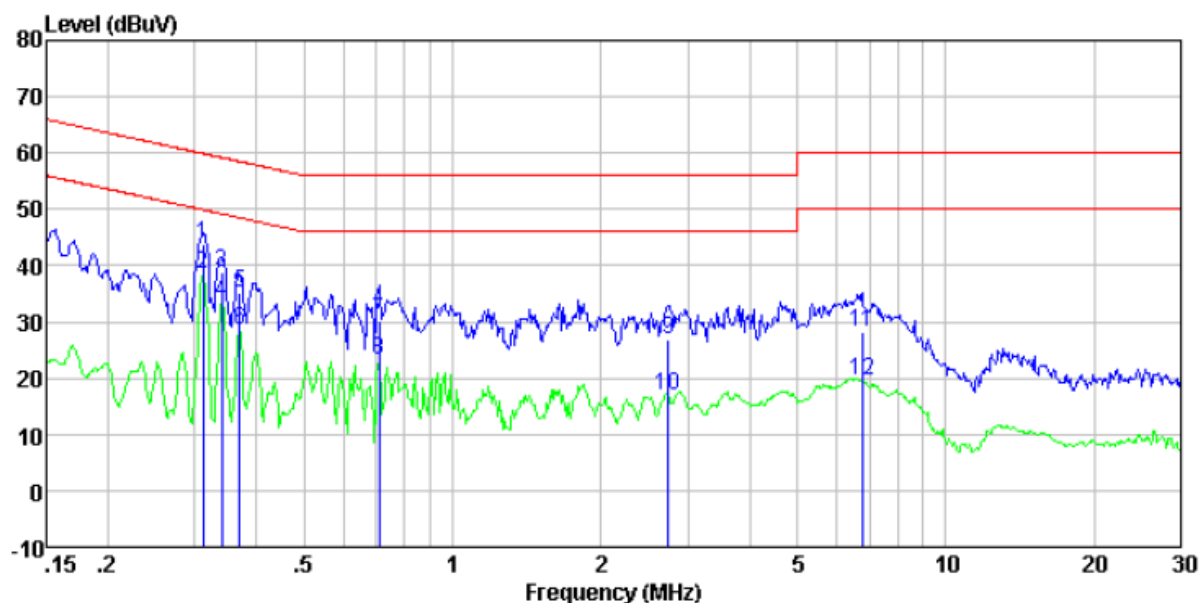
Measurement data

Line:



Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.31	27.77	20.39	0.10	48.26	59.97	-11.71	QP
0.31	23.59	20.39	0.10	44.08	49.97	-5.89	Average
0.34	23.06	20.38	0.10	43.54	59.18	-15.64	QP
0.34	19.02	20.38	0.10	39.50	49.18	-9.68	Average
0.37	18.85	20.37	0.10	39.32	58.52	-19.20	QP
0.37	13.37	20.37	0.10	33.84	48.52	-14.68	Average
0.78	13.07	20.24	0.14	33.45	56.00	-22.55	QP
0.78	4.55	20.24	0.14	24.93	46.00	-21.07	Average
1.18	11.32	20.20	0.16	31.68	56.00	-24.32	QP
1.18	3.75	20.20	0.16	24.11	46.00	-21.89	Average
6.35	12.71	20.20	0.18	33.09	60.00	-26.91	QP
6.35	3.19	20.20	0.18	23.57	50.00	-26.43	Average

Neutral:

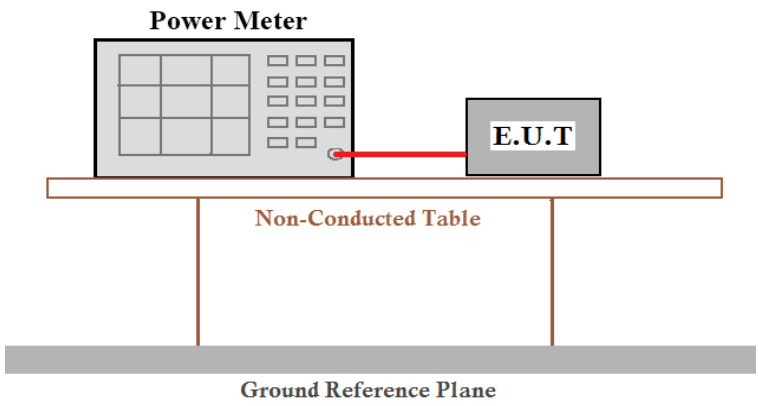


Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.31	23.26	20.39	0.10	43.75	59.93	-16.18	QP
0.31	18.14	20.39	0.10	38.63	49.93	-11.30	Average
0.34	18.38	20.38	0.10	38.86	59.18	-20.32	QP
0.34	12.99	20.38	0.10	33.47	49.18	-15.71	Average
0.37	14.57	20.37	0.10	35.04	58.52	-23.48	QP
0.37	8.05	20.37	0.10	28.52	48.52	-20.00	Average
0.71	9.88	20.26	0.13	30.27	56.00	-25.73	QP
0.71	2.85	20.26	0.13	23.24	46.00	-22.76	Average
2.74	6.47	20.20	0.19	26.86	56.00	-29.14	QP
2.74	-3.60	20.20	0.19	16.79	46.00	-29.21	Average
6.77	7.74	20.20	0.18	28.12	60.00	-31.88	QP
6.77	-0.94	20.20	0.18	19.44	50.00	-30.56	Average

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss
4. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both *limits and measurement with the average detector receiver is unnecessary*.

7.3 Conducted Peak Output Power

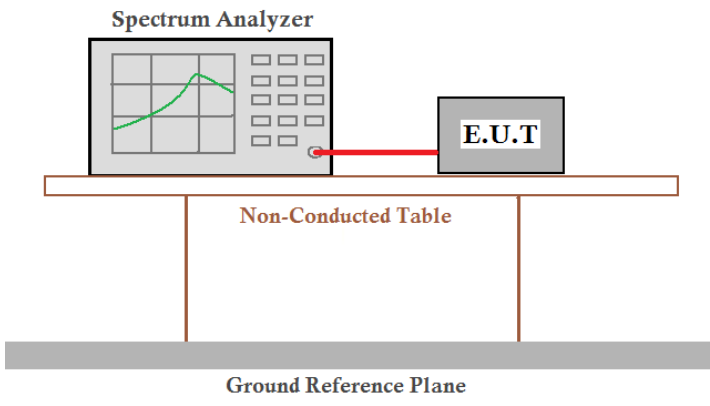
Test Requirement:	FCC Part15 E Section 15.407(a)(3)
Test Method:	ANSI C63.10:2013 and KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	30dBm
Test setup:	 The diagram illustrates the test setup. A Power Meter is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Power Meter and the E.U.T. are placed on a Non-Conducted Table. The table is supported by two vertical legs. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Test CH	Peak Output Power (dBm)						Limit(dBm)	Result
	802.11a	802.11n (HT20)	802.11ac (HT20)	802.11n (HT40)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	10.66	10.85	10.66	11.57	10.96	---	30.00	Pass
Middle	11.50	11.13	10.82	---	---	10.90		
Highest	11.10	10.80	10.87	11.11	10.99	---		

Remark: "---"is not applicable

7.4 Channel Bandwidth and 99% Occupied Bandwidth

Test Requirement:	FCC Part15 E Section 15.407(e)
Test Method:	ANSI C63.10:2013 and KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	>500KHz
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

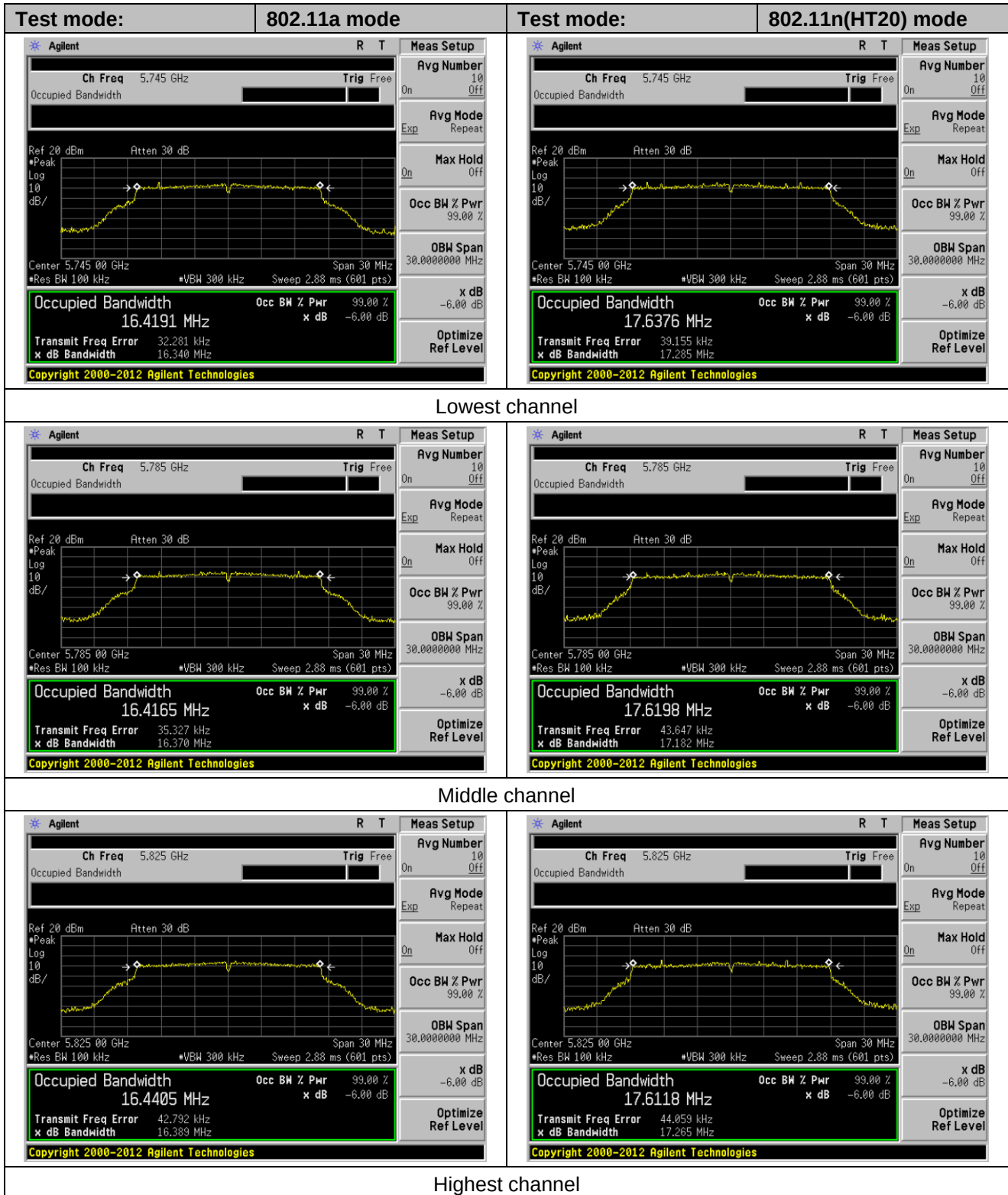
Test CH	Channel Bandwidth (MHz)						Limit (KHz)	Result
	802.11a	802.11n (HT20)	802.11ac (HT20)	802.11n (HT40)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.340	17.285	17.296	35.434	35.919	---	>500	Pass
Middle	16.370	17.182	17.275	---	---	75.536		
Highest	16.389	17.265	17.375	36.337	35.769	---		

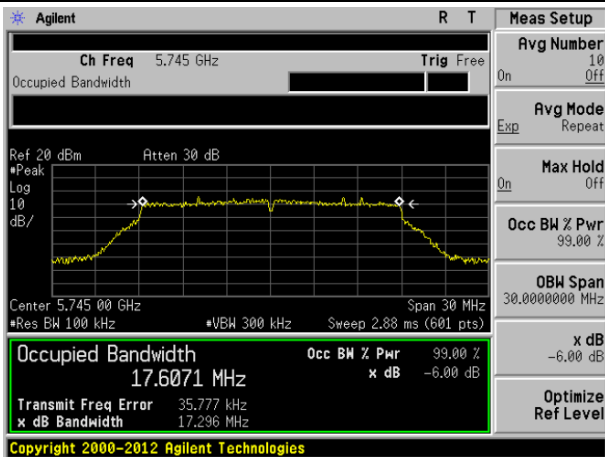
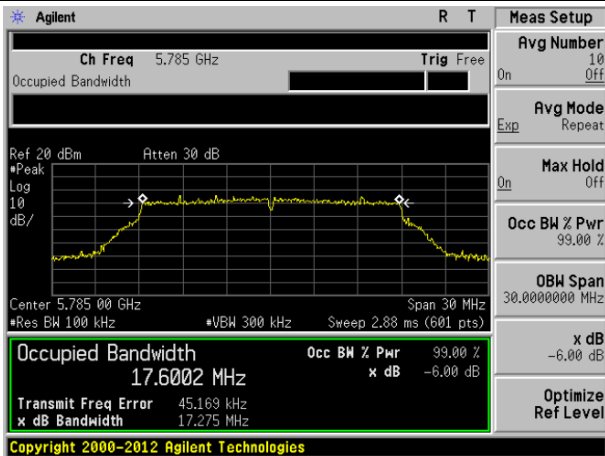
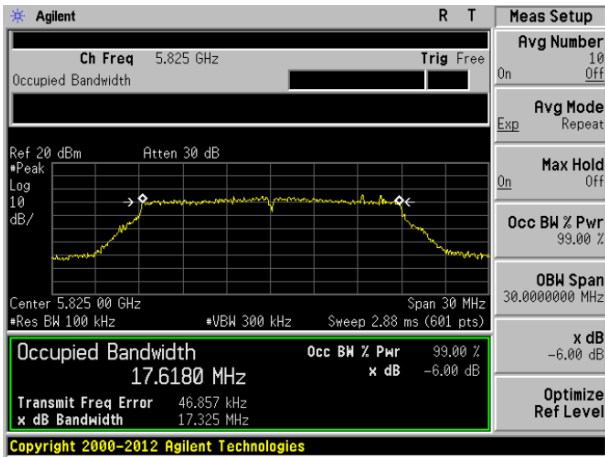
Test CH	99% Occupied Bandwidth (MHz)						Limit (KHz)	Result
	802.11a	802.11n (HT20)	802.11ac (HT20)	802.11n (HT40)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.5771	17.7139	17.7251	36.1667	36.0869	---	>500	Pass
Middle	16.5494	17.7294	17.7041	---	---	75.3932		
Highest	16.5749	17.7262	17.6846	36.1137	36.1292	---		

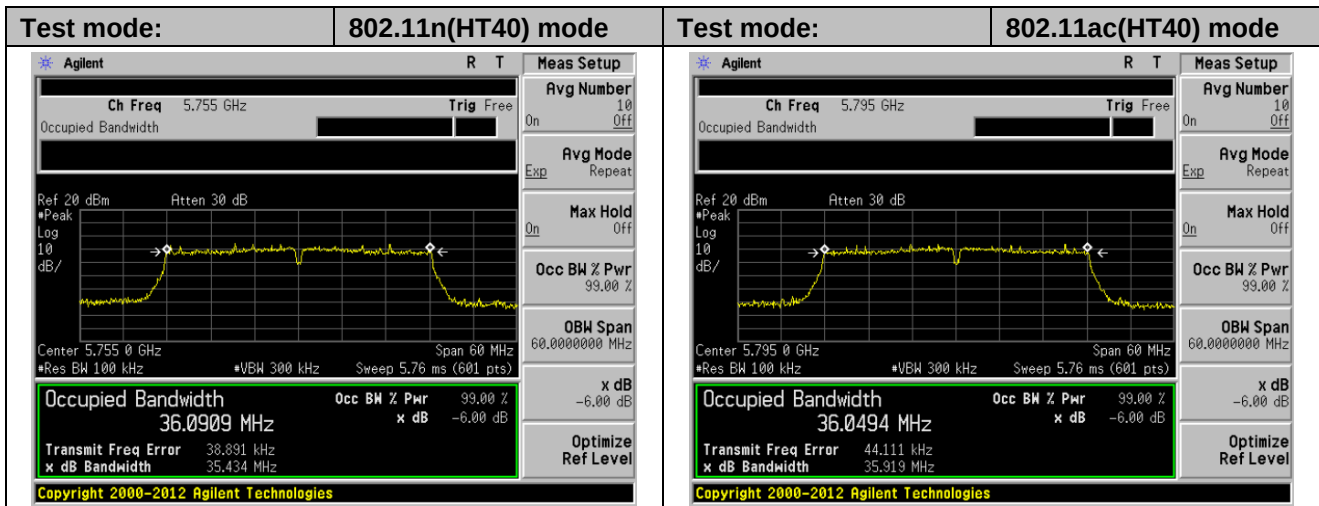
Remark: “---“is not applicable

Test plot as follows:

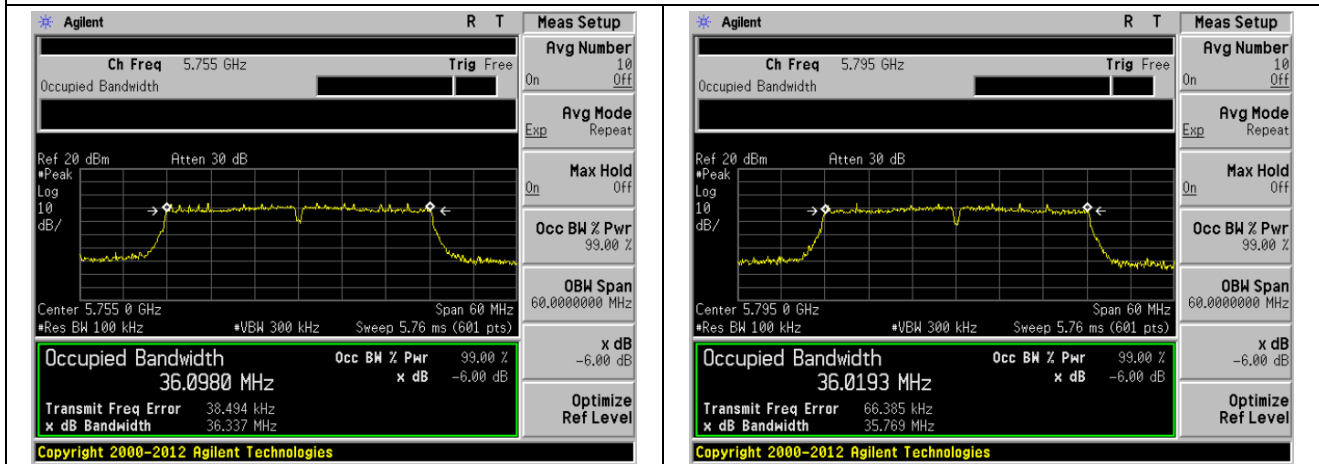
-6dB:



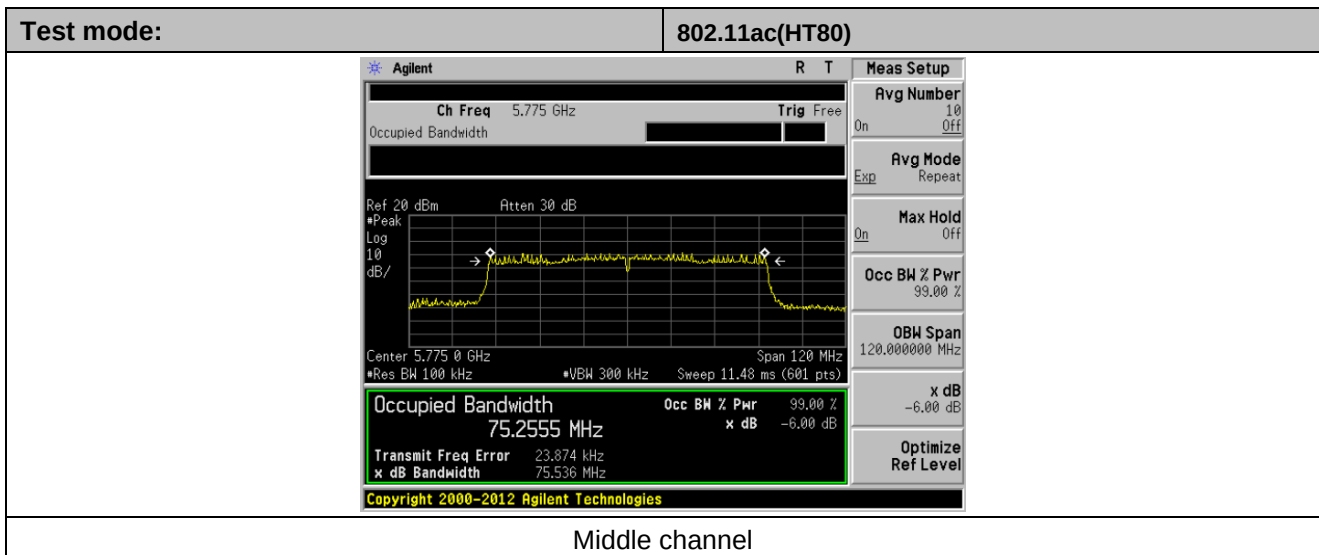
Test mode:	802.11ac(HT20) mode
	
Lowest channel	
	
Middle channel	
	
Highest channel	



Lowest channel

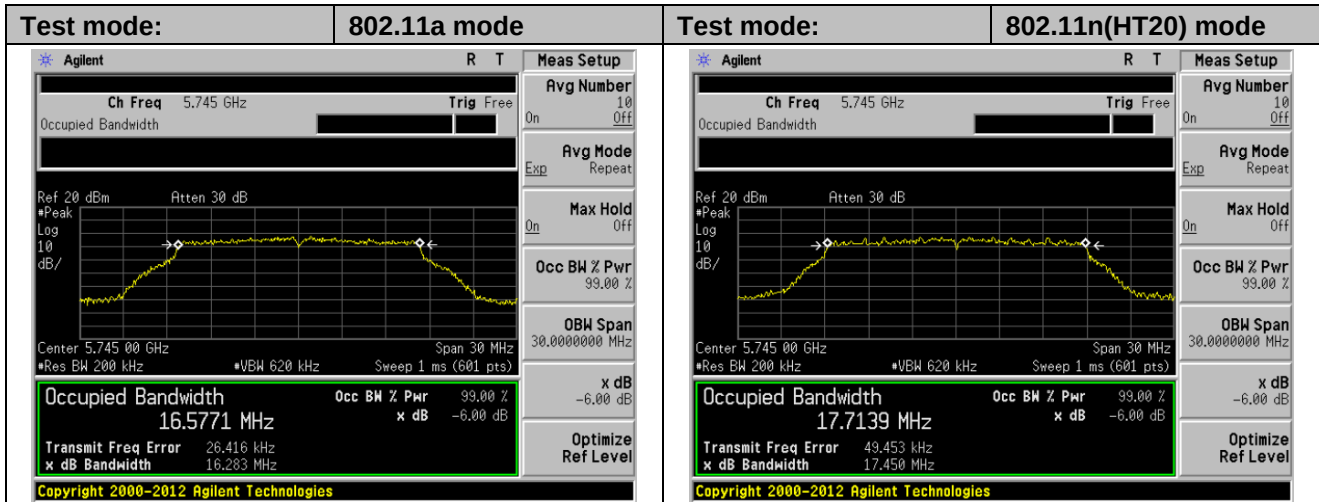


Highest channel

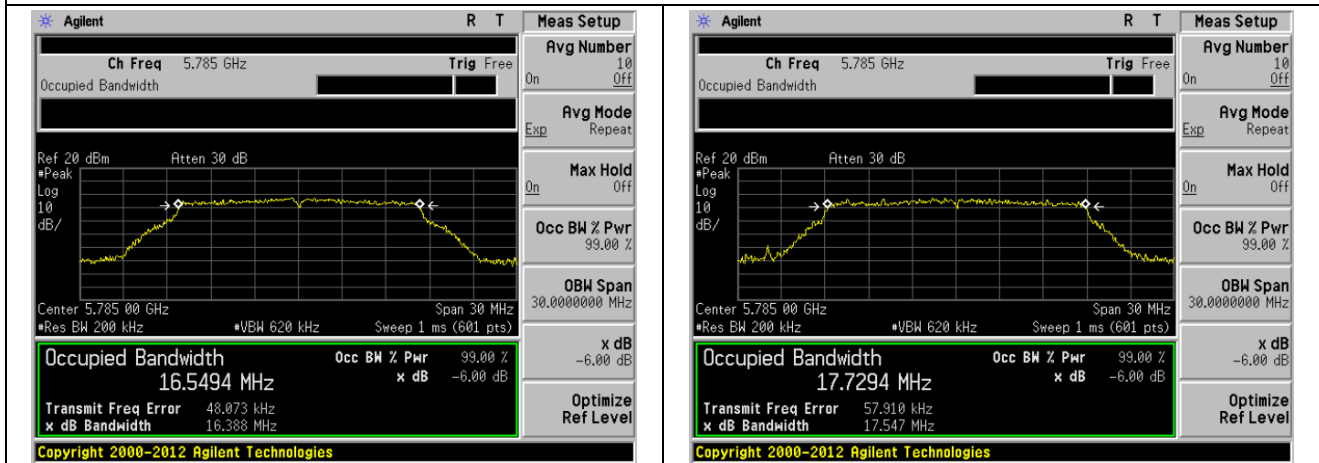


Middle channel

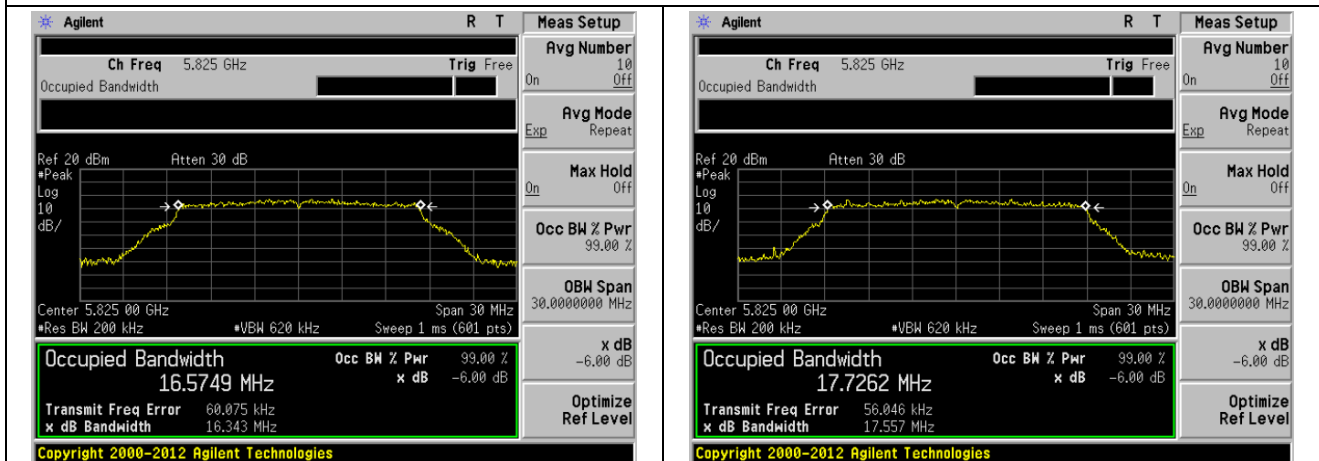
99%:



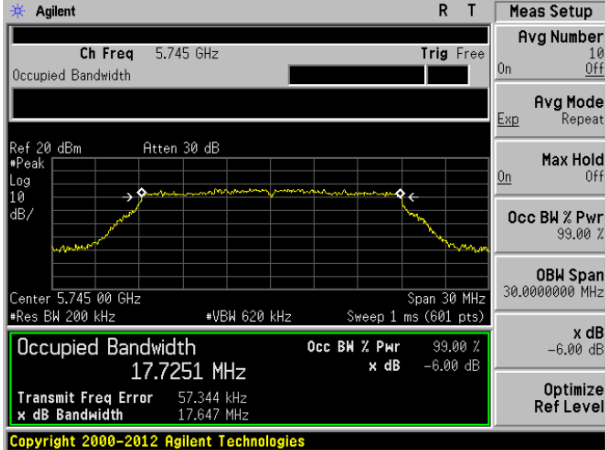
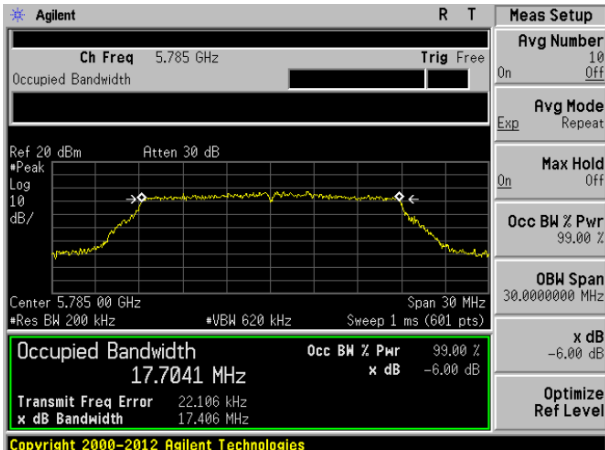
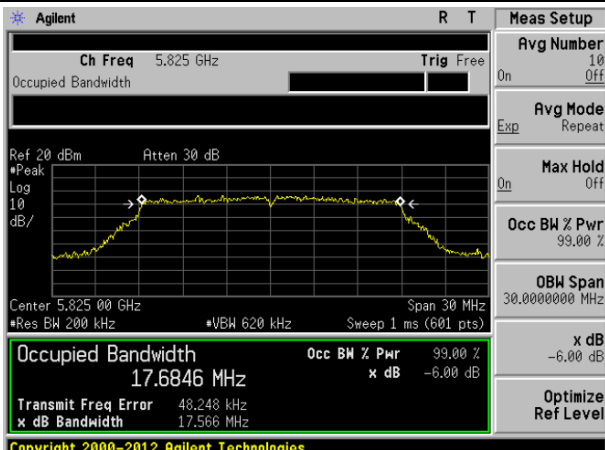
Lowest channel

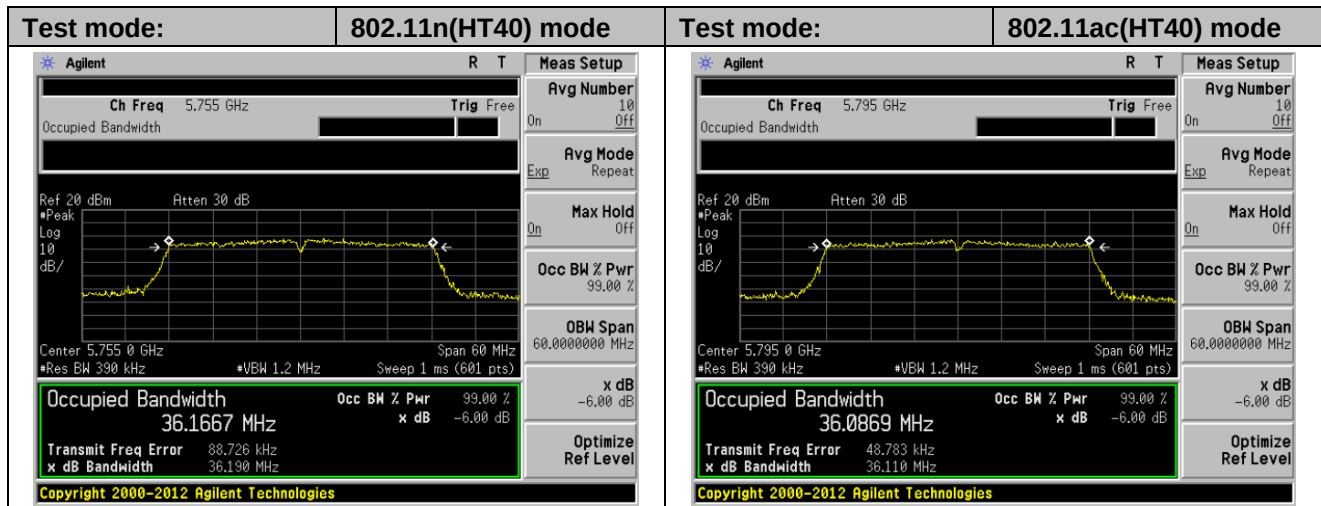


Middle channel

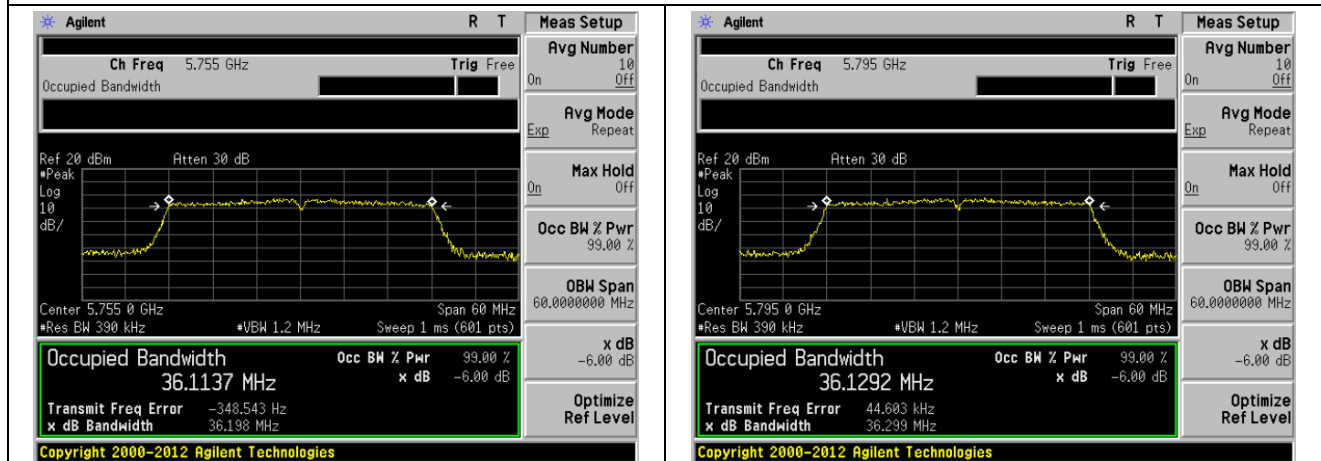


Highest channel

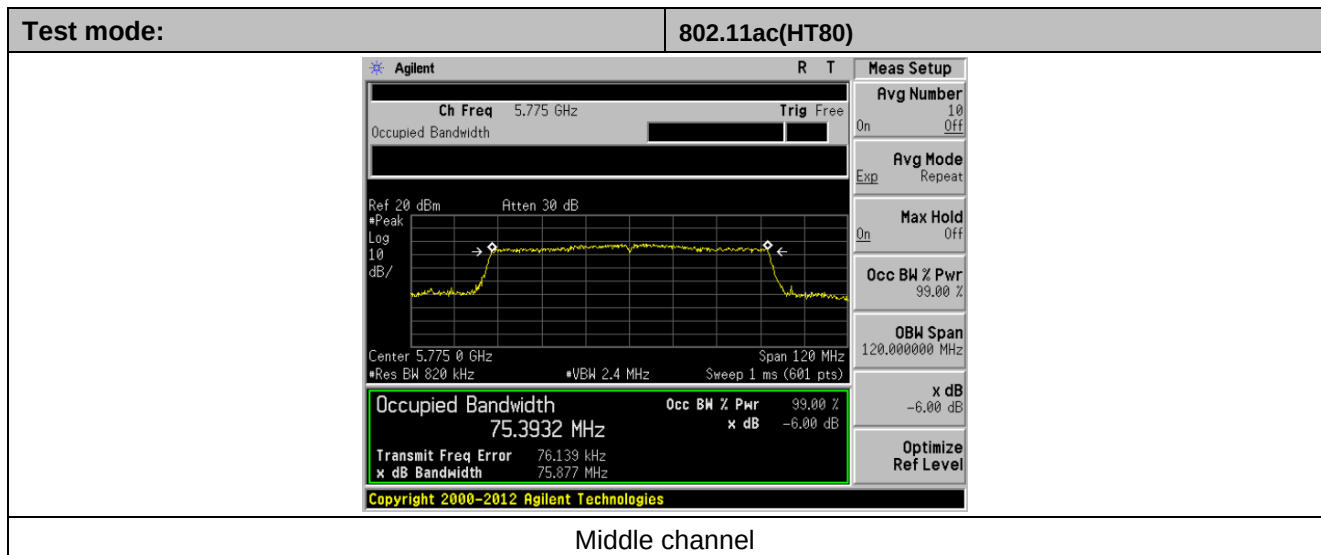
Test mode:	802.11ac(HT20) mode
	
Lowest channel	
	
Middle channel	
	
Highest channel	



Lowest channel

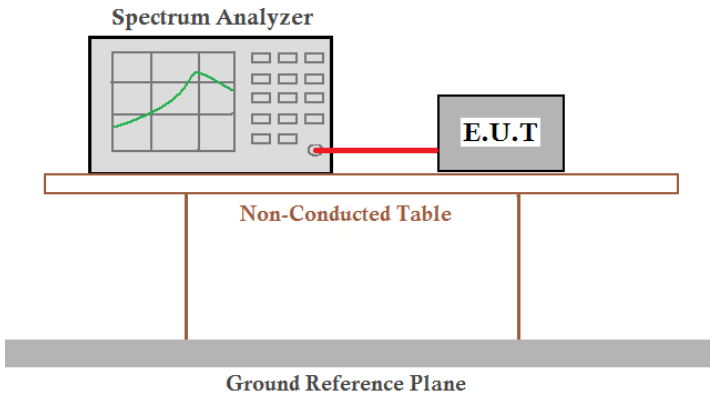


Highest channel



Middle channel

7.5 Power Spectral Density

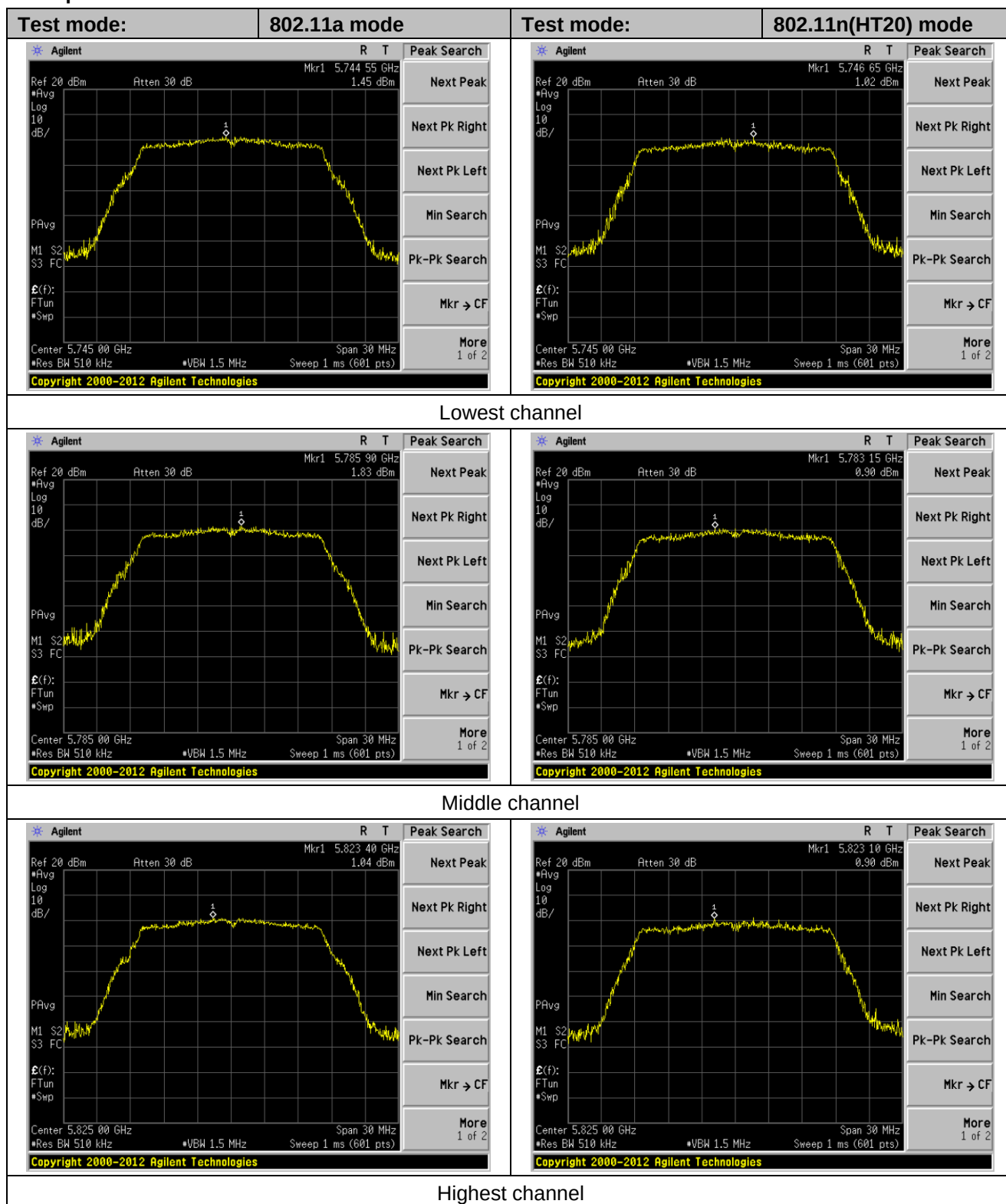
Test Requirement:	FCC Part15 E Section 15.407(a)(3)
Test Method:	ANSI C63.10:2013 and KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	30dBm/500kHz
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

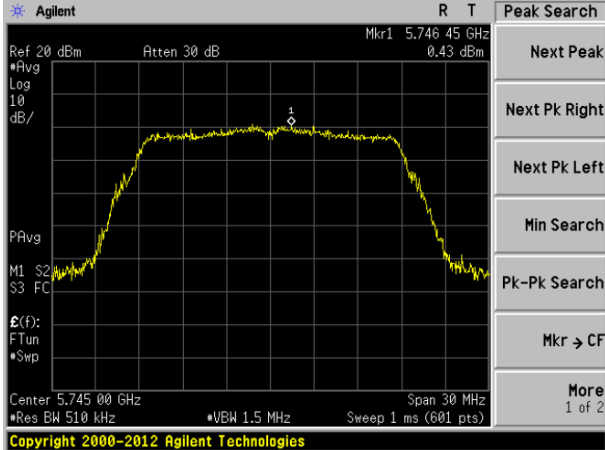
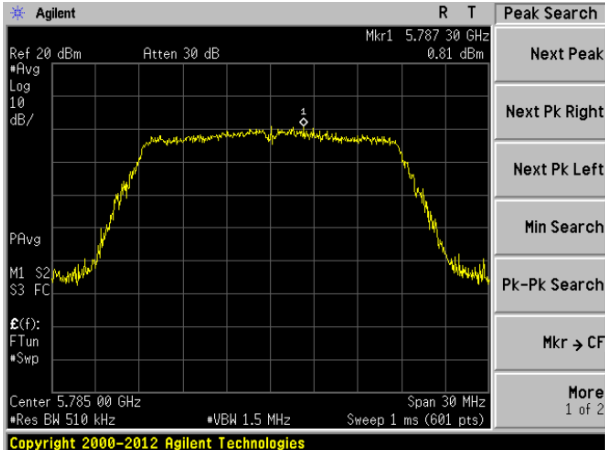
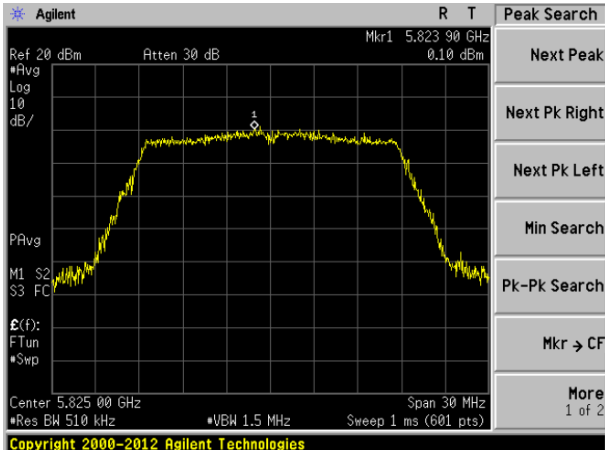
Measurement Data

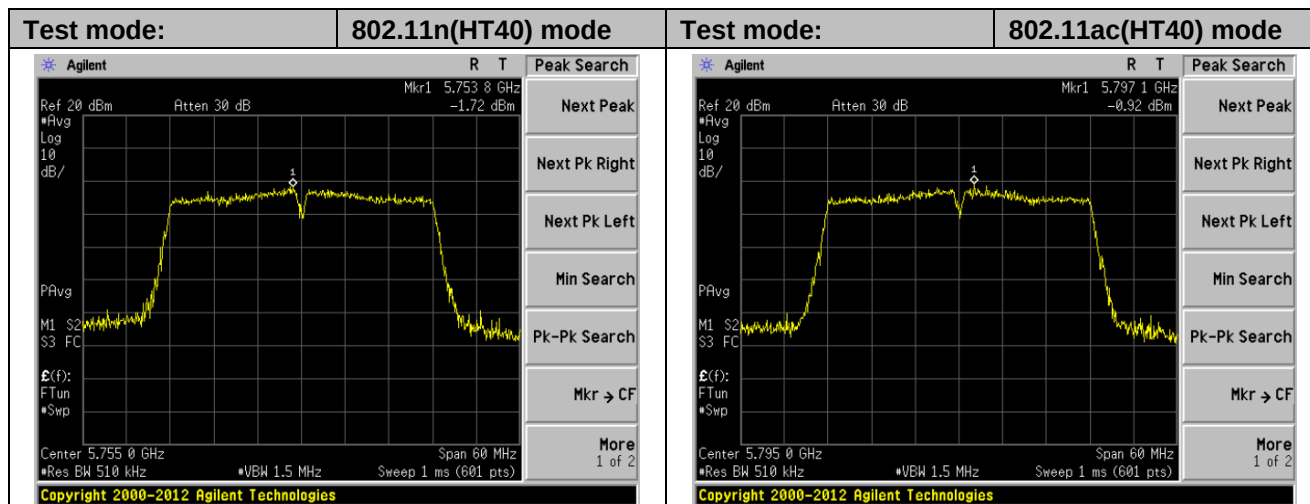
Test CH	Power Spectral Density (dBm/500kHz)						Limit (dBm/500k Hz)	Result
	802.11a	802.11n (HT20)	802.11ac (HT20)	802.11n (HT40)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	1.45	1.02	0.43	-1.72	-0.92	---	30.00	Pass
Middle	1.83	0.90	0.81	---	---	-6.49		
Highest	1.04	0.90	0.10	-2.33	-1.74	---		

Remark: “---”is not applicable

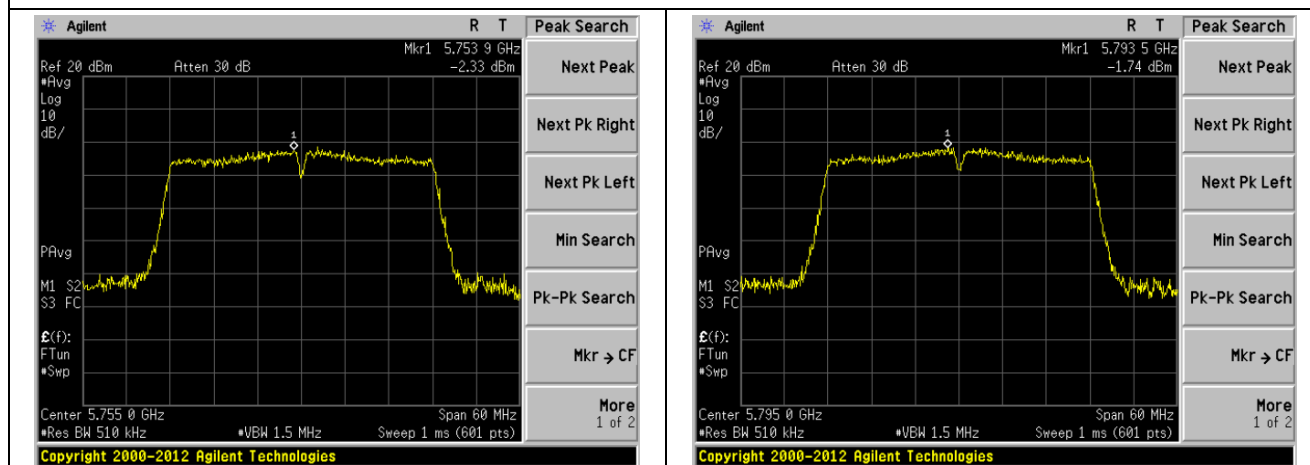
Test plot as follows:



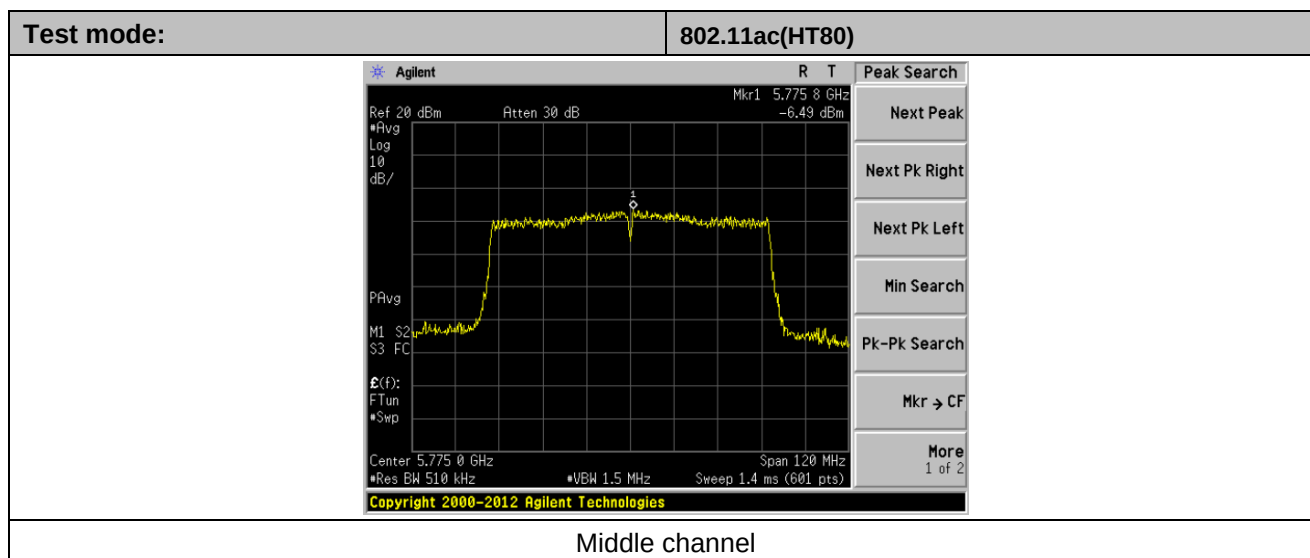
Test mode:	802.11ac(HT20) mode
	
Lowest channel	
	
Middle channel	
	
Highest channel	



Lowest channel



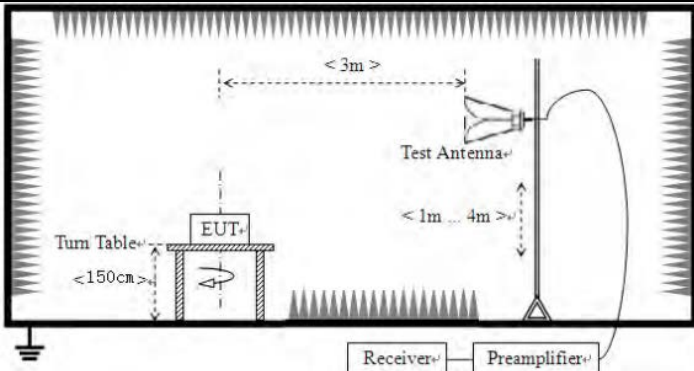
Highest channel



Middle channel

7.6 Band edge

7.6.1 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Frequency Range:	9kHz to 40GHz, only worse case is reported				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	Above 1GHz	Peak	1MHz	3MHz	Peak
		RMS	1MHz	3MHz	RMS
Limit:	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.				
Test setup:					
Test Procedure:	1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 7. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test				

	worst case mode is recorded in the report.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Remarks:

1. Only the worst case Main Antenna test data..
2. Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. The pre-test were performed on lowest, middle and highest frequencies, only the worst case's (lowest and highest frequencies) data was showed.
5. According to KDB 789033 D02v02r01 section G) 1) d),for measurements above 1000 MHz @3m distance, the limit of field strength is computed as follows:
 $E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2;$
 $E[\text{dBuV/m}] = -27 + 95.2 = 68.2\text{dBuV/m}.$
 $E[\text{dBuV/m}] = 10 + 95.2 = 105.2\text{dBuV/m}.$
 $E[\text{dBuV/m}] = 15.6 + 95.2 = 110.8\text{dBuV/m}.$
 $E[\text{dBuV/m}] = 27 + 95.2 = 122.2\text{dBuV/m}$

Measurement data:

IEEE 802.11a								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	26.79	32.36	9.72	23.83	45.04	68.2	-23.16	Horizontal
5700.00	26.06	32.5	9.79	23.84	44.51	105.2	-60.69	Horizontal
5720.00	25.54	32.53	9.81	23.85	44.03	110.8	-66.77	Horizontal
5725.00	29.12	32.53	9.83	23.86	47.62	122.2	-74.58	Horizontal
5850.00	26.54	32.7	9.99	23.87	45.36	122.2	-76.84	Horizontal
5855.00	28.91	32.72	9.99	23.88	47.74	110.8	-63.06	Horizontal
5875.00	29.93	32.74	10.04	23.89	48.82	105.2	-56.38	Horizontal
5925.00	26.99	32.8	10.11	23.9	46	68.2	-22.2	Horizontal
5650.00	28.94	32.36	9.72	23.83	47.19	68.2	-21.01	Vertical
5700.00	25.64	32.5	9.79	23.84	44.09	105.2	-61.11	Vertical
5720.00	28.74	32.53	9.81	23.85	47.23	110.8	-63.57	Vertical
5725.00	28.95	32.53	9.83	23.86	47.45	122.2	-74.75	Vertical
5850.00	29.63	32.7	9.99	23.87	48.45	122.2	-73.75	Vertical
5855.00	28.02	32.72	9.99	23.88	46.85	110.8	-63.95	Vertical
5875.00	28.89	32.74	10.04	23.89	47.78	105.2	-57.42	Vertical
5925.00	29.82	32.8	10.11	23.9	48.83	68.2	-19.37	Vertical

IEEE 802.11n HT20								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	28.45	32.36	9.72	23.83	46.7	68.2	-21.5	Horizontal
5700.00	25.16	32.5	9.79	23.84	43.61	105.2	-61.59	Horizontal
5720.00	27.09	32.53	9.81	23.85	45.58	110.8	-65.22	Horizontal
5725.00	29.92	32.53	9.83	23.86	48.42	122.2	-73.78	Horizontal
5850.00	25.45	32.7	9.99	23.87	44.27	122.2	-77.93	Horizontal
5855.00	25.38	32.72	9.99	23.88	44.21	110.8	-66.59	Horizontal
5875.00	25.33	32.74	10.04	23.89	44.22	105.2	-60.98	Horizontal
5925.00	28.83	32.8	10.11	23.9	47.84	68.2	-20.36	Horizontal
5650.00	27.90	32.36	9.72	23.83	46.15	68.2	-22.05	Vertical
5700.00	25.91	32.5	9.79	23.84	44.36	105.2	-60.84	Vertical
5720.00	29.79	32.53	9.81	23.85	48.28	110.8	-62.52	Vertical
5725.00	25.36	32.53	9.83	23.86	43.86	122.2	-78.34	Vertical
5850.00	28.18	32.7	9.99	23.87	47	122.2	-75.2	Vertical
5855.00	29.58	32.72	9.99	23.88	48.41	110.8	-62.39	Vertical
5875.00	25.80	32.74	10.04	23.89	44.69	105.2	-60.51	Vertical
5925.00	28.15	32.8	10.11	23.9	47.16	68.2	-21.04	Vertical

IEEE 802.11ac HT20								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	29.99	32.36	9.72	23.83	48.24	68.2	-19.96	Horizontal
5700.00	27.02	32.5	9.79	23.84	45.47	105.2	-59.73	Horizontal
5720.00	28.94	32.53	9.81	23.85	47.43	110.8	-63.37	Horizontal
5725.00	25.16	32.53	9.83	23.86	43.66	122.2	-78.54	Horizontal
5850.00	25.51	32.7	9.99	23.87	44.33	122.2	-77.87	Horizontal
5855.00	28.80	32.72	9.99	23.88	47.63	110.8	-63.17	Horizontal
5875.00	28.81	32.74	10.04	23.89	47.7	105.2	-57.5	Horizontal
5925.00	26.32	32.8	10.11	23.9	45.33	68.2	-22.87	Horizontal
5650.00	25.49	32.36	9.72	23.83	43.74	68.2	-24.46	Vertical
5700.00	25.53	32.5	9.79	23.84	43.98	105.2	-61.22	Vertical
5720.00	29.65	32.53	9.81	23.85	48.14	110.8	-62.66	Vertical
5725.00	27.32	32.53	9.83	23.86	45.82	122.2	-76.38	Vertical
5850.00	27.04	32.7	9.99	23.87	45.86	122.2	-76.34	Vertical
5855.00	25.97	32.72	9.99	23.88	44.8	110.8	-66	Vertical
5875.00	29.96	32.74	10.04	23.89	48.85	105.2	-56.35	Vertical
5925.00	28.68	32.8	10.11	23.9	47.69	68.2	-20.51	Vertical

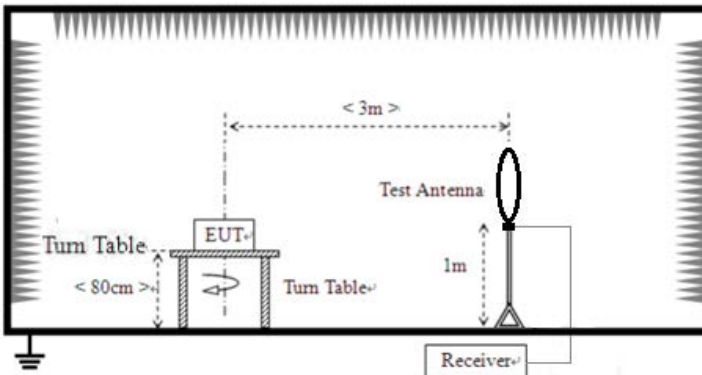
IEEE 802.11n HT40								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	27.66	32.36	9.72	23.83	45.91	68.2	-22.29	Horizontal
5700.00	25.05	32.5	9.79	23.84	43.5	105.2	-61.7	Horizontal
5720.00	29.97	32.53	9.81	23.85	48.46	110.8	-62.34	Horizontal
5725.00	28.70	32.53	9.83	23.86	47.2	122.2	-75	Horizontal
5850.00	25.35	32.7	9.99	23.87	44.17	122.2	-78.03	Horizontal
5855.00	27.06	32.72	9.99	23.88	45.89	110.8	-64.91	Horizontal
5875.00	29.41	32.74	10.04	23.89	48.3	105.2	-56.9	Horizontal
5925.00	28.71	32.8	10.11	23.9	47.72	68.2	-20.48	Horizontal
5650.00	27.20	32.36	9.72	23.83	45.45	68.2	-22.75	Vertical
5700.00	25.85	32.5	9.79	23.84	44.3	105.2	-60.9	Vertical
5720.00	29.10	32.53	9.81	23.85	47.59	110.8	-63.21	Vertical
5725.00	27.80	32.53	9.83	23.86	46.3	122.2	-75.9	Vertical
5850.00	26.86	32.7	9.99	23.87	45.68	122.2	-76.52	Vertical
5855.00	26.25	32.72	9.99	23.88	45.08	110.8	-65.72	Vertical
5875.00	29.51	32.74	10.04	23.89	48.4	105.2	-56.8	Vertical
5925.00	27.61	32.8	10.11	23.9	46.62	68.2	-21.58	Vertical

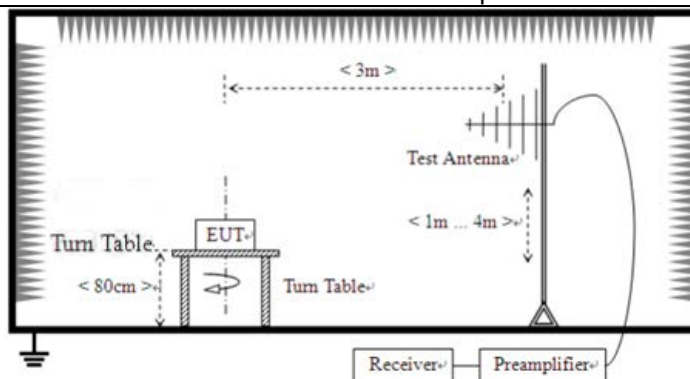
IEEE 802.11ac HT40								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	26.56	32.36	9.72	23.83	44.81	68.2	-23.39	Horizontal
5700.00	25.49	32.5	9.79	23.84	43.94	105.2	-61.26	Horizontal
5720.00	27.33	32.53	9.81	23.85	45.82	110.8	-64.98	Horizontal
5725.00	27.08	32.53	9.83	23.86	45.58	122.2	-76.62	Horizontal
5850.00	28.03	32.7	9.99	23.87	46.85	122.2	-75.35	Horizontal
5855.00	25.35	32.72	9.99	23.88	44.18	110.8	-66.62	Horizontal
5875.00	28.85	32.74	10.04	23.89	47.74	105.2	-57.46	Horizontal
5925.00	27.71	32.8	10.11	23.9	46.72	68.2	-21.48	Horizontal
5650.00	26.57	32.36	9.72	23.83	44.82	68.2	-23.38	Vertical
5700.00	29.43	32.5	9.79	23.84	47.88	105.2	-57.32	Vertical
5720.00	25.10	32.53	9.81	23.85	43.59	110.8	-67.21	Vertical
5725.00	27.67	32.53	9.83	23.86	46.17	122.2	-76.03	Vertical
5850.00	26.59	32.7	9.99	23.87	45.41	122.2	-76.79	Vertical
5855.00	26.46	32.72	9.99	23.88	45.29	110.8	-65.51	Vertical
5875.00	28.29	32.74	10.04	23.89	47.18	105.2	-58.02	Vertical
5925.00	25.81	32.8	10.11	23.9	44.82	68.2	-23.38	Vertical

IEEE 802.11ac HT80								
Peak value:								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
5650.00	26.14	32.36	9.72	23.83	44.39	68.2	-23.81	Horizontal
5700.00	26.22	32.5	9.79	23.84	44.67	105.2	-60.53	Horizontal
5720.00	25.28	32.53	9.81	23.85	43.77	110.8	-67.03	Horizontal
5725.00	29.97	32.53	9.83	23.86	48.47	122.2	-73.73	Horizontal
5850.00	25.37	32.7	9.99	23.87	44.19	122.2	-78.01	Horizontal
5855.00	29.98	32.72	9.99	23.88	48.81	110.8	-61.99	Horizontal
5875.00	25.01	32.74	10.04	23.89	43.9	105.2	-61.3	Horizontal
5925.00	26.69	32.8	10.11	23.9	45.7	68.2	-22.5	Horizontal
5650.00	28.67	32.36	9.72	23.83	46.92	68.2	-21.28	Vertical
5700.00	29.29	32.5	9.79	23.84	47.74	105.2	-57.46	Vertical
5720.00	29.30	32.53	9.81	23.85	47.79	110.8	-63.01	Vertical
5725.00	29.68	32.53	9.83	23.86	48.18	122.2	-74.02	Vertical
5850.00	27.88	32.7	9.99	23.87	46.7	122.2	-75.5	Vertical
5855.00	27.19	32.72	9.99	23.88	46.02	110.8	-64.78	Vertical
5875.00	27.59	32.74	10.04	23.89	46.48	105.2	-58.72	Vertical
5925.00	27.93	32.8	10.11	23.9	46.94	68.2	-21.26	Vertical

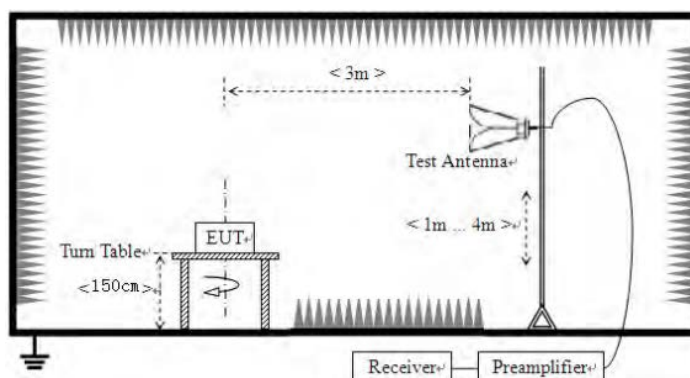
7.7 Spurious Emission

7.7.1 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209, Part 15E Section 15.407(b)(4)				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 40GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9kHz-150KHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz-30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
AV		1MHz	3MHz	Average Value	
Limit:	Frequency		Limit (uV/m)	Value	Measurement Distance
	0.009MHz-0.490MHz		2400/F(KHz)	QP	300m
	0.490MHz-1.705MHz		24000/F(KHz)	QP	300m
	1.705MHz-30MHz		30	QP	30m
	30MHz-88MHz		100	QP	3m
	88MHz-216MHz		150	QP	
	216MHz-960MHz		200	QP	
	960MHz-1GHz		500	QP	
	Frequency		Limit (dBm/MHz)		Remark
Above 1GHz		-27.0		Peak Value	
Test setup:	For radiated emissions from 9kHz to 30MHz				
					
	For radiated emissions from 30MHz to 1GHz				



For radiated emissions above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8m for below 1GHz and 1.5 meters for above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
7. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test

	worst case mode is recorded in the report.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

Remarks:

1. Only the worst case Main Antenna test data.
2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

Measurement Data:

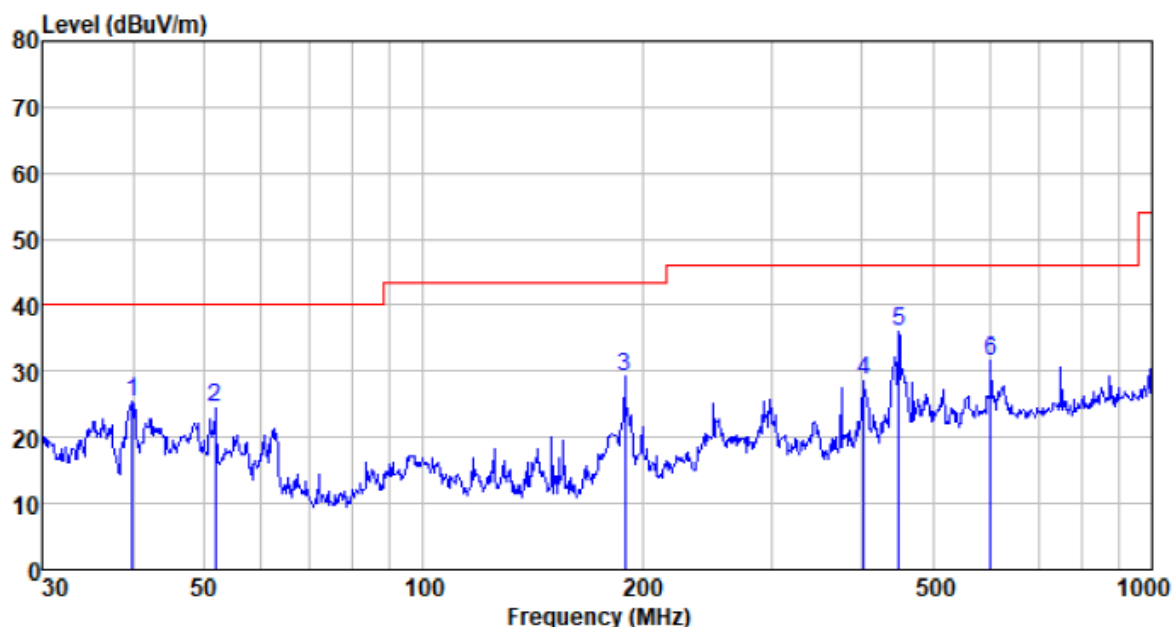
9 kHz ~ 30 MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Below 1GHz

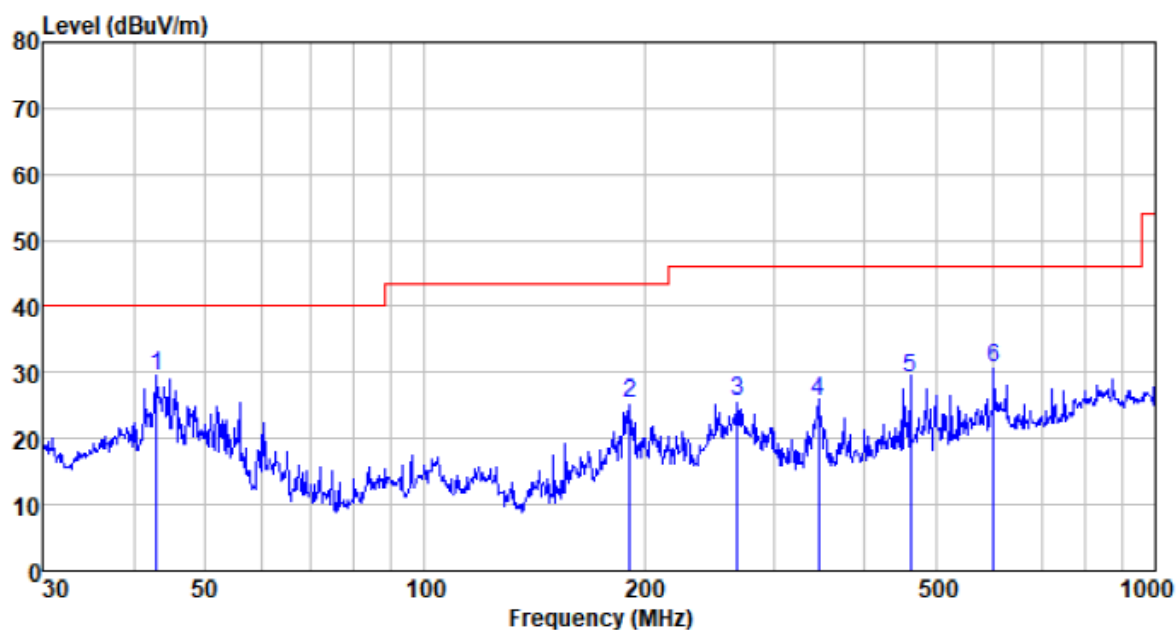
Pre-scan all test modes, found worst case at 802.11ac(HT80) 5775MHz, and so only show the test result of 802.11ac(HT80) 5775MHz

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
39.854	48.19	12.20	0.66	35.66	25.39	40.00	-14.61	QP
51.843	47.71	12.10	0.79	36.21	24.39	40.00	-15.61	QP
189.074	54.89	9.82	1.78	37.28	29.21	43.50	-14.29	QP
401.839	47.88	15.34	2.86	37.52	28.56	46.00	-17.44	QP
449.556	54.15	16.36	3.08	37.51	36.08	46.00	-9.92	QP
601.427	45.96	19.50	3.73	37.54	31.65	46.00	-14.35	QP

Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
42.900	52.45	12.23	0.69	35.83	29.54	40.00	-10.46	QP
191.074	50.78	9.95	1.80	37.29	25.24	43.50	-18.26	QP
267.546	48.12	12.69	2.21	37.39	25.63	46.00	-20.37	QP
345.595	46.20	14.45	2.60	37.47	25.78	46.00	-20.22	QP
462.346	47.11	16.61	3.14	37.51	29.35	46.00	-16.65	QP
601.427	45.11	19.50	3.73	37.54	30.80	46.00	-15.20	QP

Above 1GHz:

802.11a,11n(HT20),11ac(HT20),11n(HT40),11ac(HT40),11ac(HT80) all have been tested, only show the worst case

Test mode:		802.11a		Test channel:		lowest	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11490	19.65	21.64	41.29	74	-32.71	PK
V	17235	24.28	21.8	46.08	74	-27.92	PK
H	11490	21.59	21.83	43.42	74	-30.58	PK
H	17235	22.55	21.67	44.22	74	-29.78	PK

Test mode:		802.11a		Test channel:		Middle	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11570	24.03	21.64	45.67	74	-28.33	PK
V	17355	25.14	21.8	46.94	74	-27.06	PK
H	11570	24.10	21.83	45.93	74	-28.07	PK
H	17355	23.40	21.67	45.07	74	-28.93	PK

Test mode:		802.11a		Test channel:		Highest	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11650	24.68	21.64	46.32	74	-27.68	PK
V	17475	25.48	21.8	47.28	74	-26.72	PK
H	11650	23.24	21.83	45.07	74	-28.93	PK
H	17475	22.94	21.67	44.61	74	-29.39	PK

Test mode:		802.11ac(HT40)		Test channel:		Lowest	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11510	20.12	21.64	41.76	74	-32.24	PK
V	17265	19.22	21.8	41.02	74	-32.98	PK
H	11510	20.47	21.83	42.3	74	-31.7	PK
H	17265	23.86	21.67	45.53	74	-28.47	PK

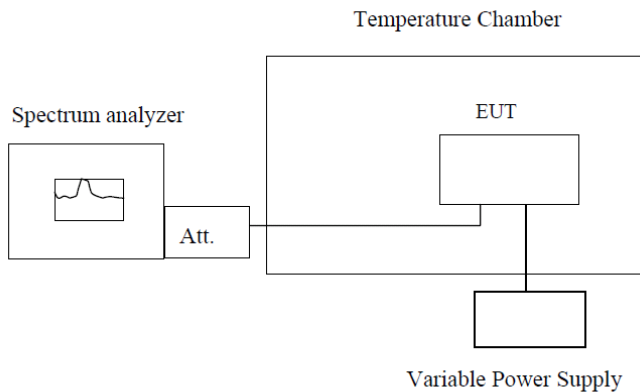
Test mode:		802.11ac(HT40)		Test channel:		Highest	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11590	19.27	21.64	40.91	74	-33.09	PK
V	17385	25.05	21.8	46.85	74	-27.15	PK
H	11590	23.44	21.83	45.27	74	-28.73	PK
H	17385	25.33	21.67	47	74	-27	PK

Test mode:		802.11ac(HT80)		Test channel:		Middle	
Antenna Pol.	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dBuV/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector
V	11550	25.09	21.64	46.73	74	-27.27	PK
V	17325	19.03	21.8	40.83	74	-33.17	PK
H	11550	21.25	21.83	43.08	74	-30.92	PK
H	17325	22.07	21.67	43.74	74	-30.26	PK

Notes:

1. Measure Level = Reading Level + Factor.
2. The test trace is same as the ambient noise (the test frequency range: 18GHz~40GHz), therefore no data appear in the report.
3. If the test result on peak is lower than average limit, then average measurement needn't be performed.

7.8 Frequency stability

Test Requirement:	FCC Part15 C Section 15.407(g)
Test Method:	ANSI C63.10:2013, FCC Part 2.1055
Limit:	Manufactures 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
Test Procedure:	The EUT was setup to ANSI C63.4, 2003; tested to 2.1055 for compliance to FCC Part 15.407(g) requirements.
Test setup:	 Note : Measurement setup for testing on Antenna connector
Test Instruments:	Refer to section 6 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Frequency stability versus Temp.						
Temp. (°C)	Power Supply (VAC)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute
			Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)
-30	NV	5745	5745.836	5745.541	5745.932	5745.361
		5755	5755.907	5755.871	5755.872	5755.800
		5775	5775.976	5775.525	5775.083	5775.153
-20	NV	5745	5745.944	5745.125	5745.043	5745.765
		5755	5755.019	5755.916	5755.720	5755.214
		5775	5775.448	5775.145	5775.789	5775.064
-10	NV	5745	5745.383	5745.069	5745.529	5745.383
		5755	5755.320	5755.782	5755.672	5755.678
		5775	5775.992	5775.947	5775.879	5775.089
0	NV	5745	5745.187	5745.003	5745.437	5745.689
		5755	5755.749	5755.148	5755.868	5755.532
		5775	5775.893	5775.130	5775.478	5775.752
10	NV	5745	5745.551	5745.024	5745.863	5745.627
		5755	5755.369	5755.857	5755.560	5755.973
		5775	5775.957	5775.515	5775.650	5775.659
20	NV	5745	5745.267	5745.710	5745.065	5745.077
		5755	5755.176	5755.990	5755.774	5755.518
		5775	5775.564	5775.730	5775.075	5775.843
30	NV	5745	5745.912	5745.261	5745.677	5745.736
		5755	5755.643	5755.601	5755.550	5755.383
		5775	5775.768	5775.425	5775.671	5775.013
40	NV	5745	5745.359	5745.030	5745.729	5745.469
		5755	5755.406	5755.635	5755.770	5755.465
		5775	5775.761	5775.903	5775.060	5775.944
50	NV	5745	5745.192	5745.690	5745.512	5745.457
		5755	5755.411	5755.848	5755.567	5755.132
		5775	5775.465	5775.158	5775.228	5775.130

Frequency stability versus Power Supply						
Temp. (°C)	Power Supply (VAC)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute
			Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)
NV	LV	5745	5745.428	5745.362	5745.643	5745.157
		5755	5755.039	5755.401	5755.237	5755.845
		5775	5775.883	5775.640	5775.347	5775.889
	NV	5745	5745.334	5745.285	5745.422	5745.789
		5755	5755.327	5755.323	5755.014	5755.141
		5775	5775.507	5775.272	5775.322	5775.476

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

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