FCC Part 15E
Measurement and Test Report

For

Qolsys, Inc.

1900 The Alameda, 4th Floor, San Jose, CA 95126, USA

FCC ID: 2AAJXQS-IQRMT

FCC Rule(s):	FCC Part 15.407
Product Description:	Tablet Computer
Tested Model:	IQ Remote
Report No.:	STRD1810081I-1
Sample Receipt Date:	2018-11-23
Tested Date:	2018-11-23 to 2018-11-27
Issued Date:	2018-11-28
Tested By:	Mike Shi / Engineer
Reviewed By:	Silin Chen / EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager

Prepared By:

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Qolsys, Inc.
Address of applicant:	1900 The Alameda, 4th Floor, San Jose, CA 95126, USA
Manufacturer:	Chengdu Vantron Technology, Ltd.
Address of manufacturer:	No.5 GaoPeng Road, Hi-Tech Zone, Chengdu, SiChuan, P.R. China 610045

General Description of EUT	
Product Name:	Tablet Computer
Brand Name:	/
Model No.:	IQ Remote
Adding Model(s):	/
Rated Voltage:	Battery:DC3.7V
Battery Capacity:	2400mAh
Power Adapter:	MODEL: SW-070100AU INPUT: AC100-240~ 50/60Hz 0.A Max OUTPUT: DC7V,1000mA
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Support Standards:	802.11a, 802.11n(HT20) , 802.11n-HT40, 802.11ac-VH80
Frequency Range:	5150-5250MHz, 5725-5850MHz
RF Output Power:	8.92dBm (Conducted)
Type of Modulation:	QPSK, 16QAM, 64QAM
Data Rate:	6-54Mbps, up to 433.3Mbps
Type of Antenna:	Integral
Antenna Gain:	2dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.407: General technical requirements.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
KDB789033 D02 v02r01:GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB789033 D02 v02r01
The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Table for parameters of Test Software setting

Enter "3646631+=" into the calculator to enter the engineer mode, you can start to test. During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Mode	Test Frequency (MHz)												
	NCB: 20MHz												
	5180	5200	5240	5260	5300	5320	5500	5580	5700	5720	5745	5785	5825
802.11a 6Mbps	10	10	10	/	/	/	/	/	/	/	10	10	10
802.11n-HT20 MCS0	10	10	10	/	/	/	/	/	/	/	10	10	10
Mode	NCB: 40MHz												
	5190	5230	5270	5310	5510	5550	5670	5710	5755	5795			
802.11n-HT40 MCS0	10	10	/	/	/	/	/	/	10	10			
Mode	NCB: 80MHz												
	5210		5290		5530		5610		5690		5775		
802.11ac-VH80 MCS0/Nss2	10		/		/		/		/		10		

1.5 EUT Operating during test

EUT was programmed to be in continuously transmitting mode. During the test, EUT operation to normal function and programs under Android were executed.

1.6 Test Facility

FCC – Registration No.: 125990

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

1.7 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	802.11a	5180MHz, 5200MHz, 5240MHz, 5745MHz, 5785MHz,5825MHz
TM2	802.11n-HT20	5180MHz, 5200MHz, 5240MHz,5745MHz, 5785MHz,5825MHz
TM3	802.11n-HT40	5190MHz, 5230MHz, 5755MHz,5795MHz
TM4	802.11ac-VH80	5210MHz, 5775 MHz
Note: All test modes (different data rate and different modulation) are performed, but only the worst case is recorded in this report.		

Test Conditions	
Temperature:	22~25 °C
Relative humidity	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
DC CABLE	1.5	Unshielded	Without Core

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB CABLE	0.8	Shielded	Without Core

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.8 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	9-150kHz ±3.74dB
		0.15-30MHz ±3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ±4.52dB
		0.2-1GHz ±5.56dB
		1-6GHz ±3.84dB
		6-18GHz ±3.92dB

1.9 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2018-05-22	2019-05-21
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2018-05-22	2019-05-21
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2018-05-22	2019-05-21
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2018-05-22	2019-05-21
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2018-05-22	2019-05-21
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2020-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2020-06-07
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2017-06-08	2020-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2020-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2018-05-22	2019-05-21
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2018-05-22	2019-05-21
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2018-05-22	2019-05-21
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2018-05-22	2019-05-21
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2018-05-22	2019-05-21
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2018-05-22	2019-05-21
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2018-05-22	2019-05-21
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2018-05-22	2019-05-21
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2018-05-22	2019-05-21
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2018-05-22	2019-05-21
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2018-03-19	2019-03-18
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2018-03-19	2019-03-18
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2018-03-19	2019-03-18
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2018-03-19	2019-03-18
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2018-03-19	2019-03-18

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203; § 15.405	Antenna Requirement	Compliant
§ 15.207; § 15.407(b)(6)	Conducted Emission	Compliant
§ 15.407(a)(1),(2)	Power Spectral Density	Compliant
§ 15.407(e)	Emission Bandwidth and Occupied Bandwidth	Compliant
§ 15.407(a)(1),(2)	Maximum Conducted Output Power	Compliant
§ 15.407(b)(1),(2),(3),(4)	Undesirable emission	Compliant
§ 15.205; § 15.407(b)(1),(2),(3)	Radiated Emission	Compliant
§ 15.407(g)	Frequency Stability	Compliant
§ 15.407(h)	Dynamic Frequency Selection (DFS)	Compliant

N/A: not applicable

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the MPE Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

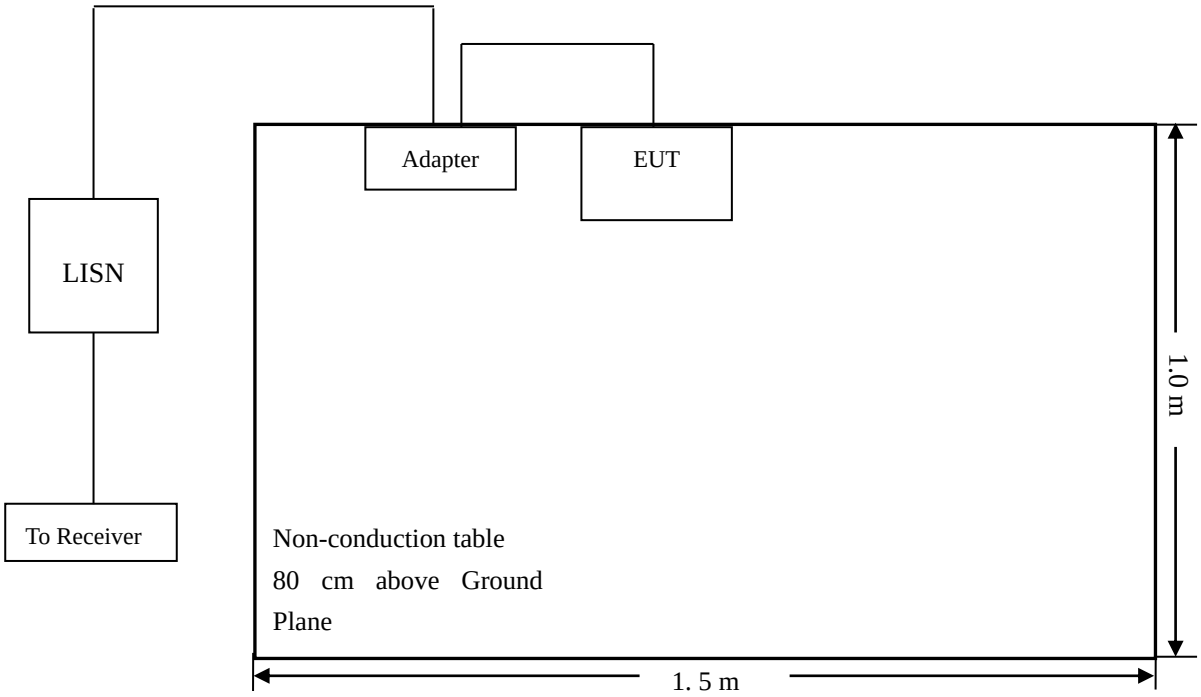
This product has an integral antenna, fulfill the requirement of this section.

5. Conducted Emissions

5.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

5.2 Basic Test Setup Block Diagram



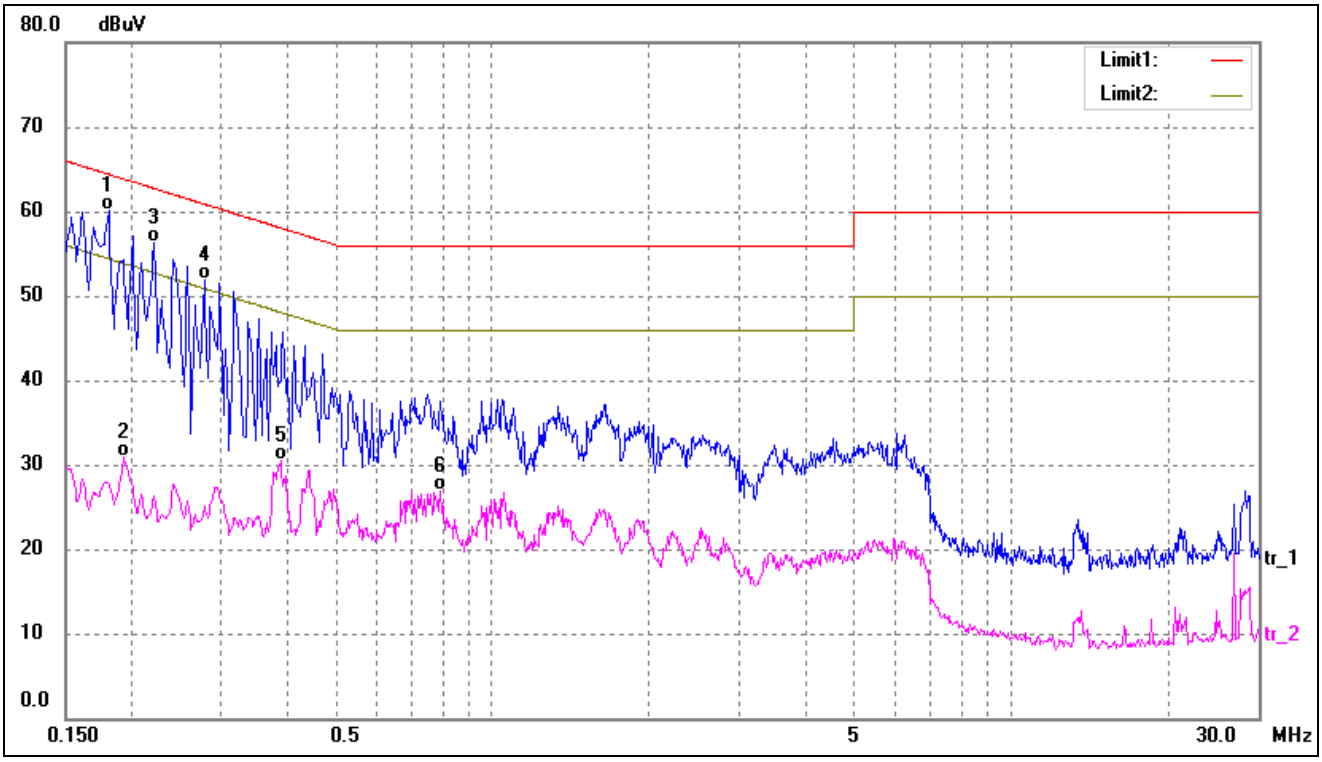
5.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency ..... 150 kHz
Stop Frequency ..... 30 MHz
Sweep Speed ..... Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth ..... 9 kHz
Quasi-Peak Adapter Mode ..... Normal

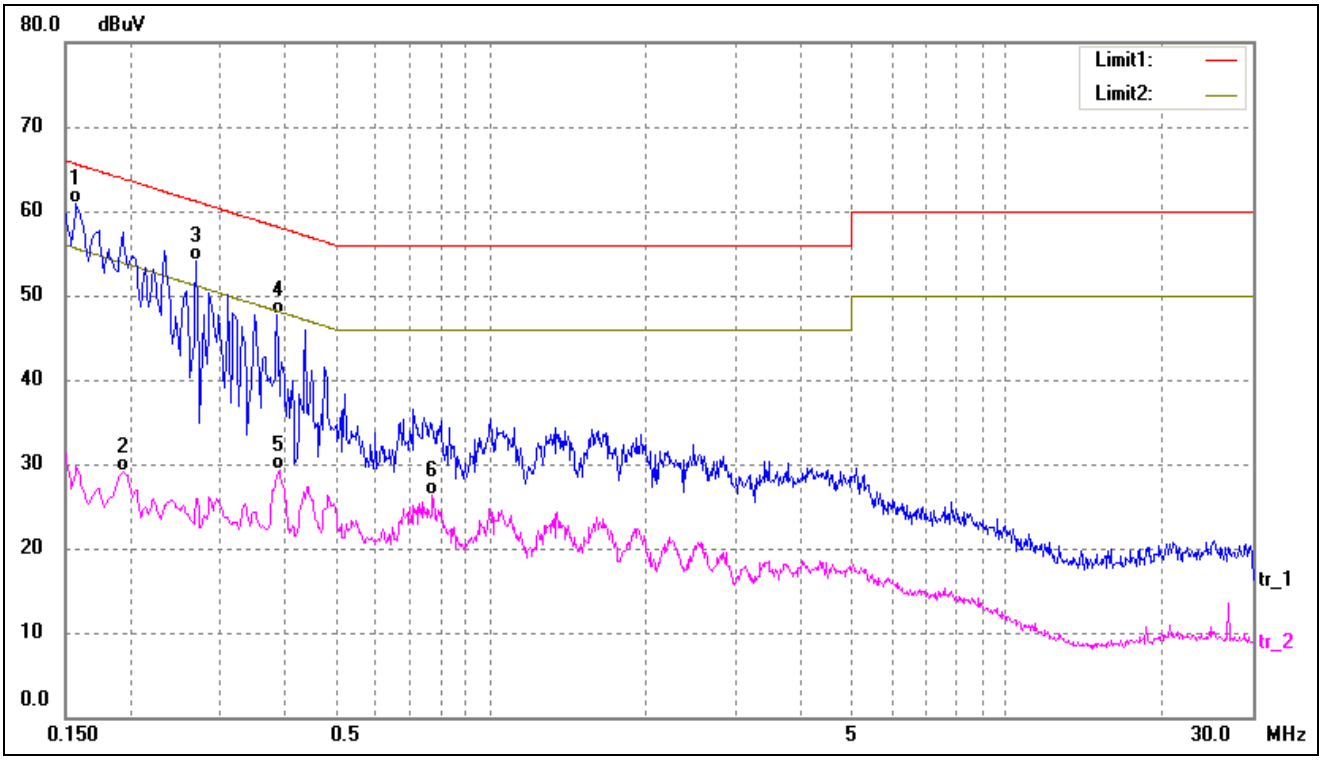
5.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1*	0.1820	49.91	10.11	60.02	64.39	-4.37	QP
2	0.1940	20.77	10.12	30.89	53.86	-22.97	AVG
3	0.2220	46.23	10.14	56.37	62.74	-6.37	QP
4	0.2780	41.67	10.17	51.84	60.88	-9.04	QP
5	0.3900	20.30	10.25	30.55	48.06	-17.51	AVG
6	0.7940	16.45	10.43	26.88	46.00	-19.12	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1*	0.1580	50.79	10.10	60.89	65.56	-4.67	QP
2	0.1940	18.94	10.12	29.06	53.86	-24.80	AVG
3	0.2700	43.95	10.17	54.12	61.12	-7.00	QP
4	0.3860	37.38	10.24	47.62	58.15	-10.53	QP
5	0.3900	19.03	10.25	29.28	48.06	-18.78	AVG
6	0.7740	15.81	10.41	26.22	46.00	-19.78	AVG

6. Power Spectral Density

6.1 Standard Applicable

Section 15.407(a) Power limits:

(1) For the band 5.15-5.25 GHz.
(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

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

6.2 Test Procedure

According to 789033 D02 v02r01 General UNII Test Procedures New Rules v02, the following is the measurement procedure.
For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500kHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in section II.B.l.a).
b) Set VBW ≥ 3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10log(1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

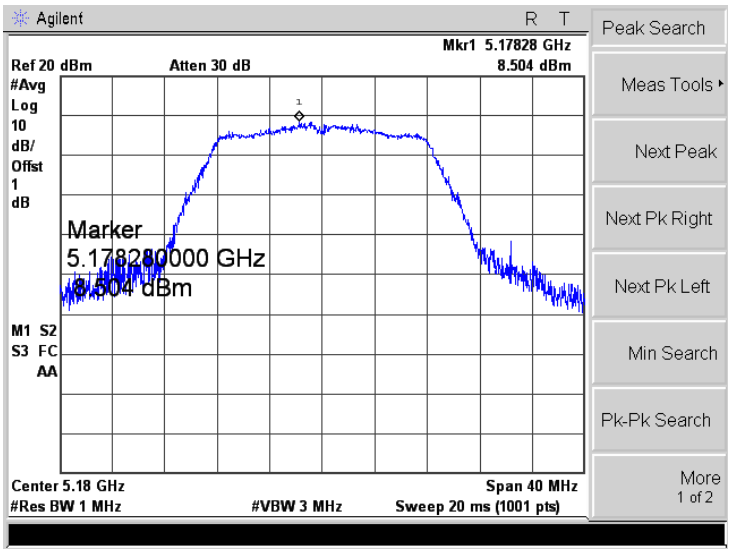
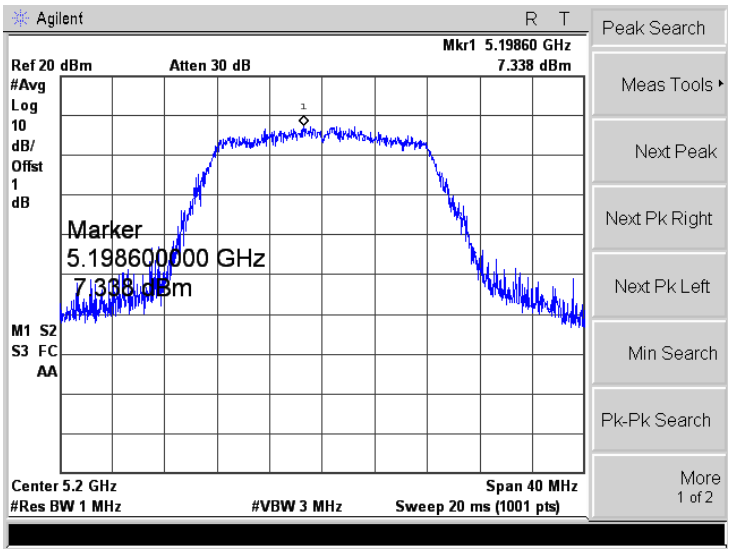
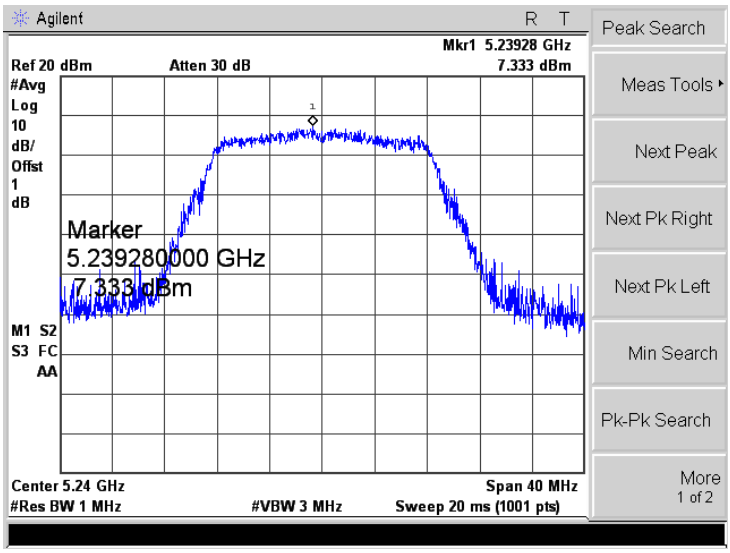
Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for the sections 5.c) and 5.d) above, since RBW=100 kHZ is available on nearly all spectrum analyzers.

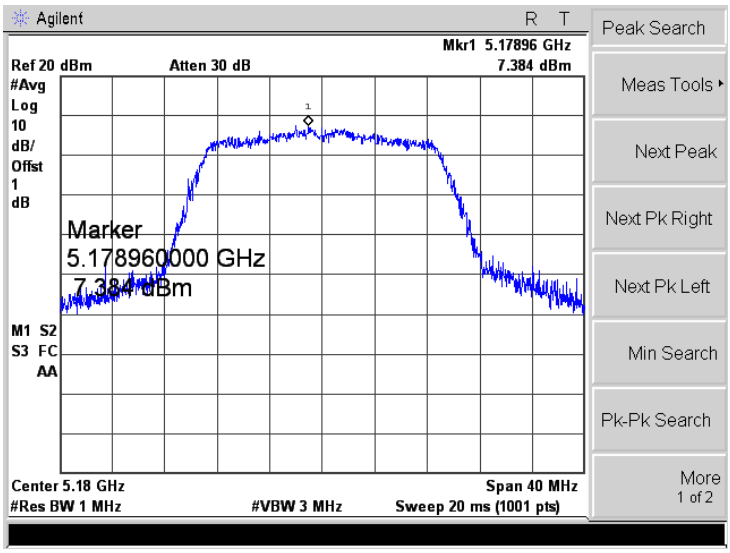
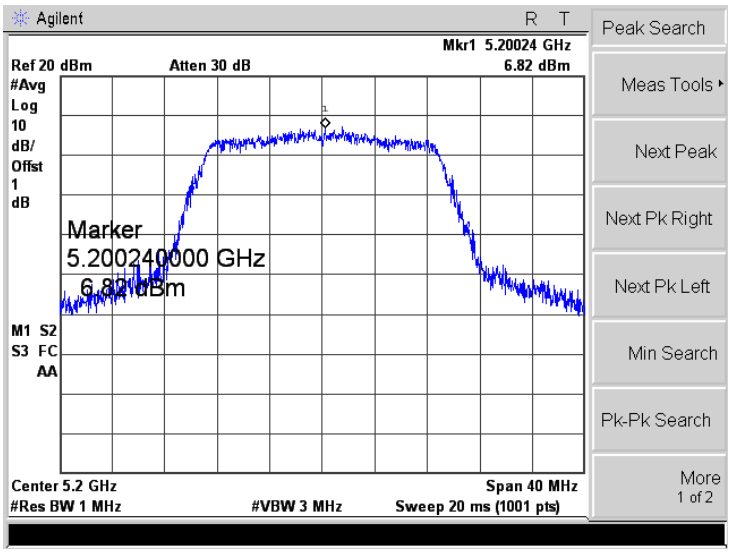
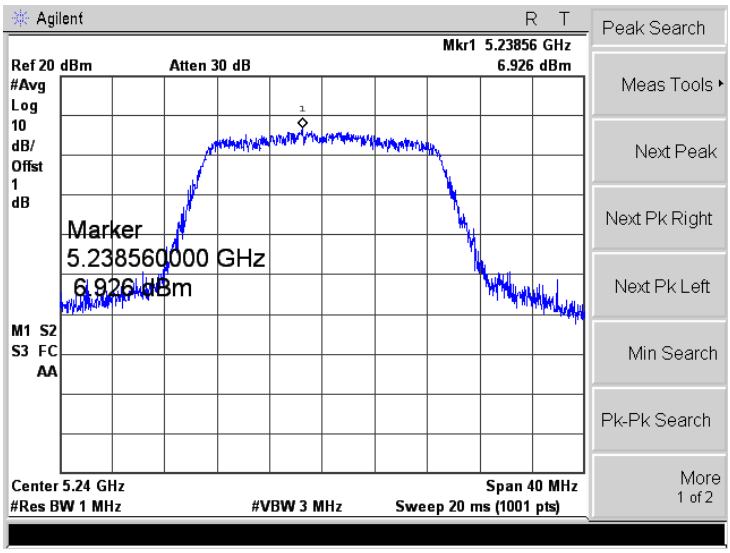
6.3 Summary of Test Results/Plots

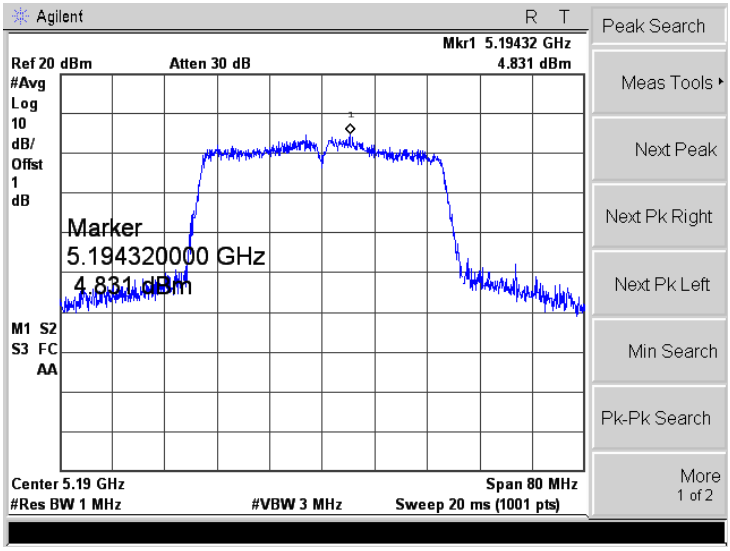
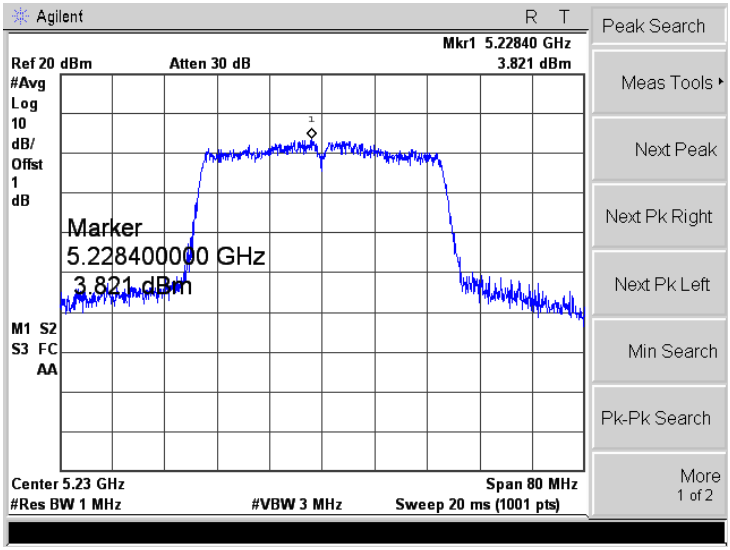
U-NII-1:5150-5250MHz			
Operating mode	Test Channel	Power Spectral Density dBm/MHz	Limit (dBm/MHz)
802.11a	5180	8.504	11
	5200	7.338	11
	5240	7.333	11
802.11n-HT20	5180	7.384	11
	5200	6.820	11
	5240	6.926	11
802.11n-HT40	5190	4.831	11
	5230	3.821	11
802.11ac-HT80	5210	0.398	11

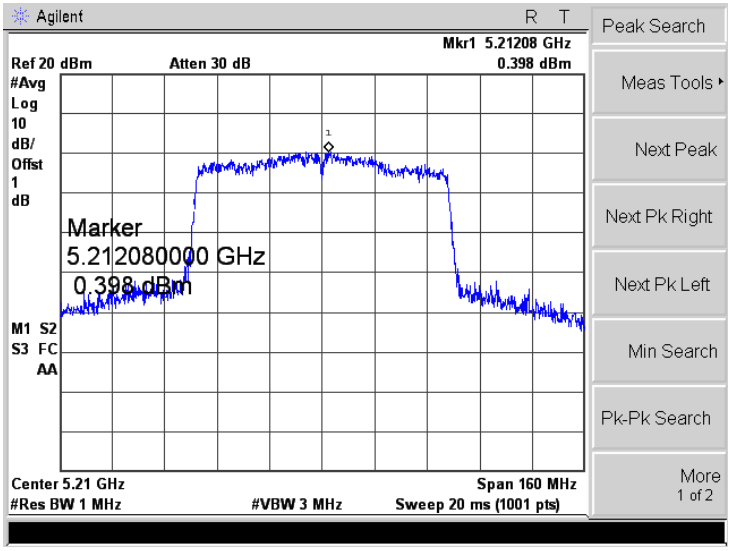
U-NII-3: 5725-5850MHz					
Operating mode	Test Channel	Power Spectral Density dBm/300kHz	Factor	Power Spectral Density* dBm/500kHz	Limit dBm/500kHz
802.11a	5745	0.543	2.22	2.763	30
	5785	1.050	2.22	3.270	30
	5825	0.802	2.22	3.022	30
802.11n-HT20	5745	-0.736	2.22	1.484	30
	5785	0.956	2.22	3.176	30
	5825	-0.111	2.22	2.109	30
802.11n HT40	5755	-1.951	2.22	0.269	30
	5795	-2.327	2.22	-0.107	30
802.11ac VH80	5775	-5.130	2.22	-2.910	30
*Note: Maximum PSD=PSD(dBm/300kHz)+10log(500kHz/300kHz)=2.22					

➢ 5150-5250MHz

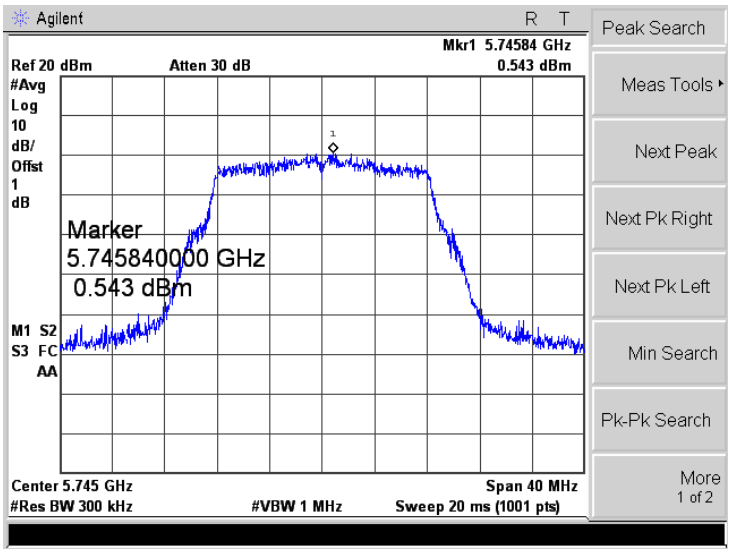
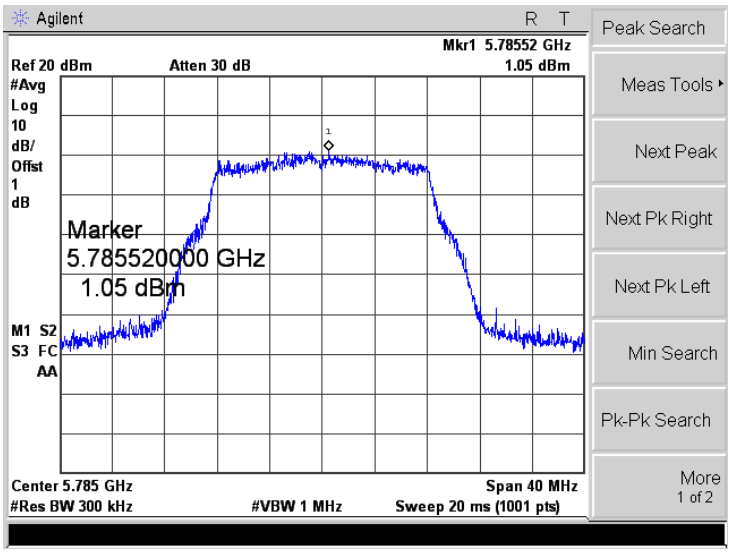
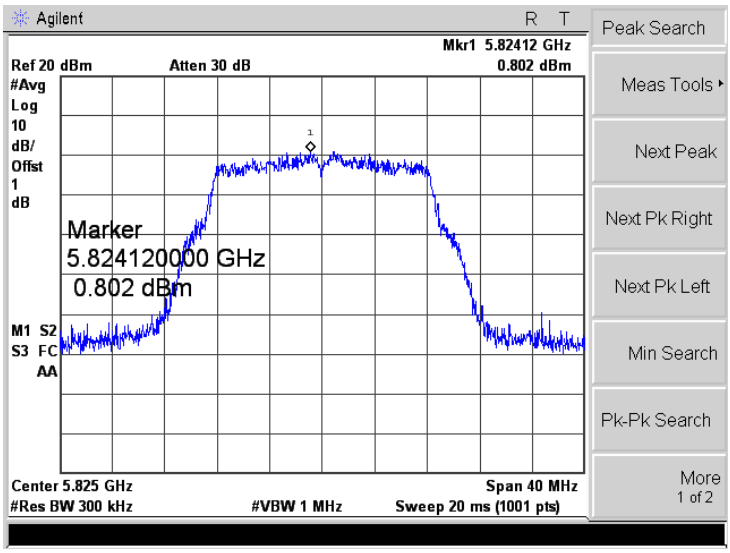
Mode:	**802.11a**
5180MHz	
5200MHz	
5240MHz	

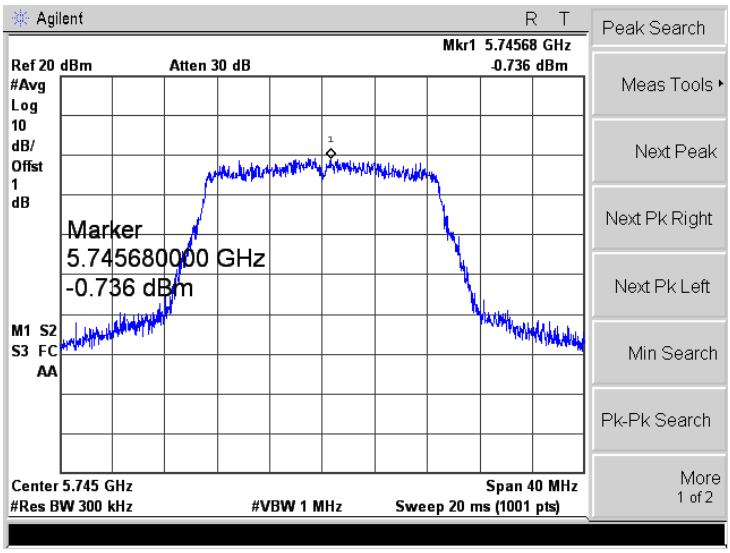
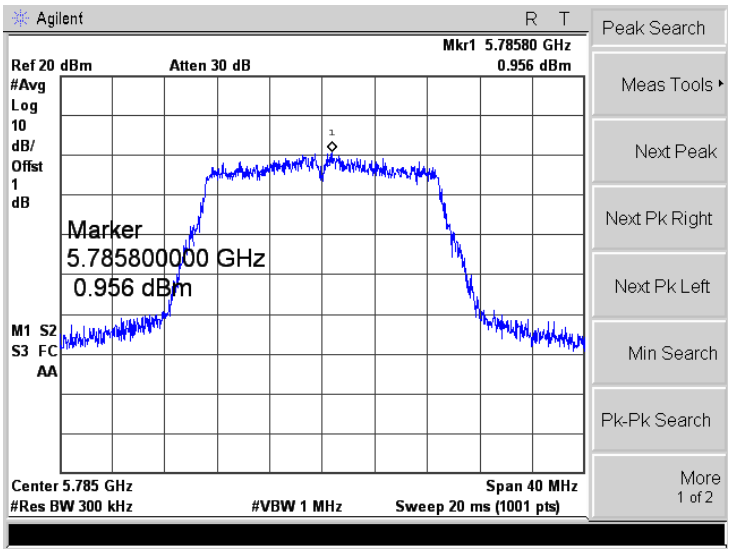
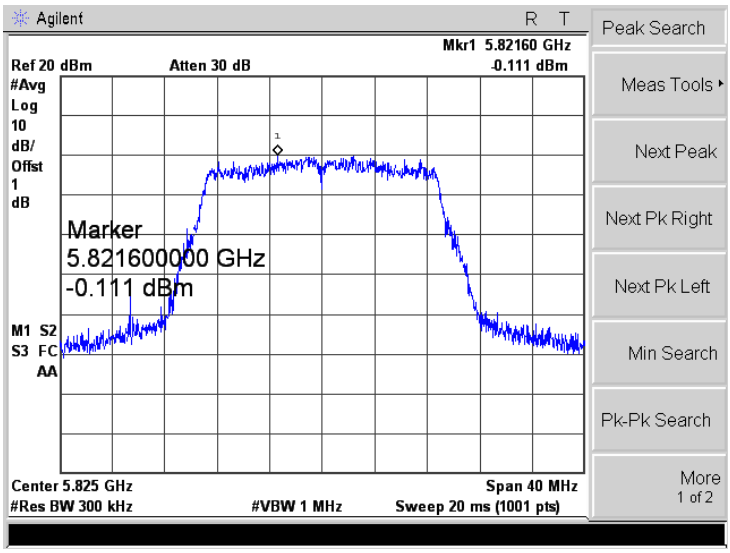
Mode:	802.11n-HT20
5180MHz	
5200MHz	
5240MHz	

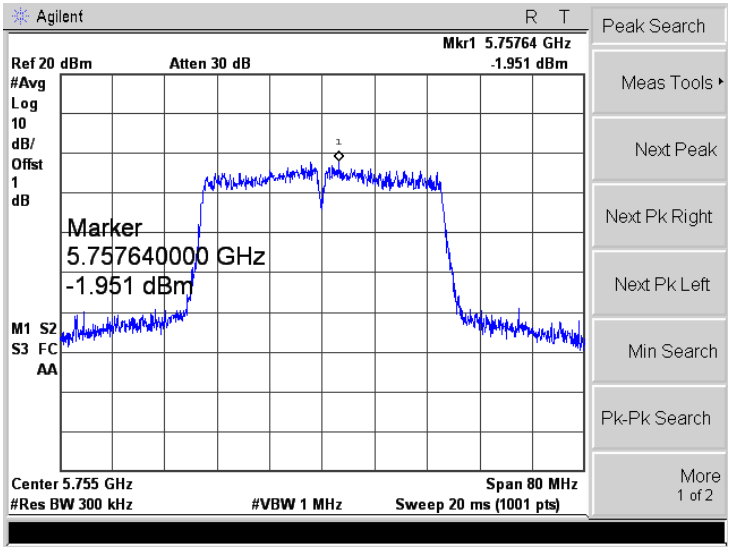
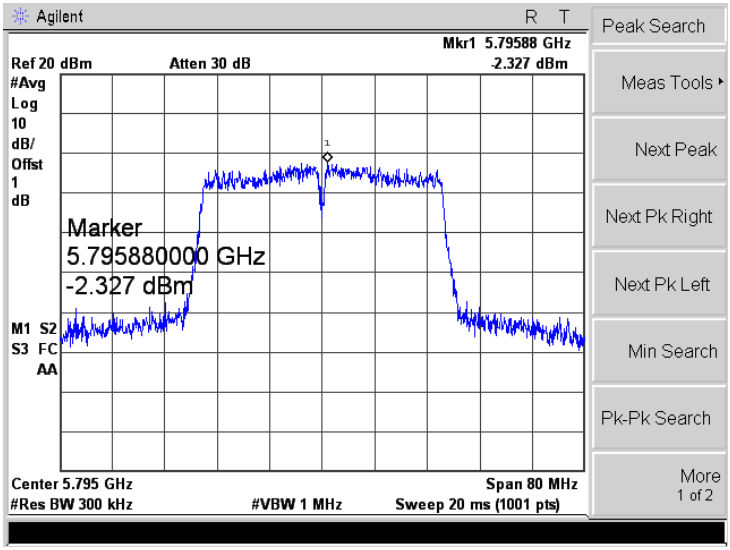
Mode:	802.11n-HT40
5190 MHz	
5230 MHz	

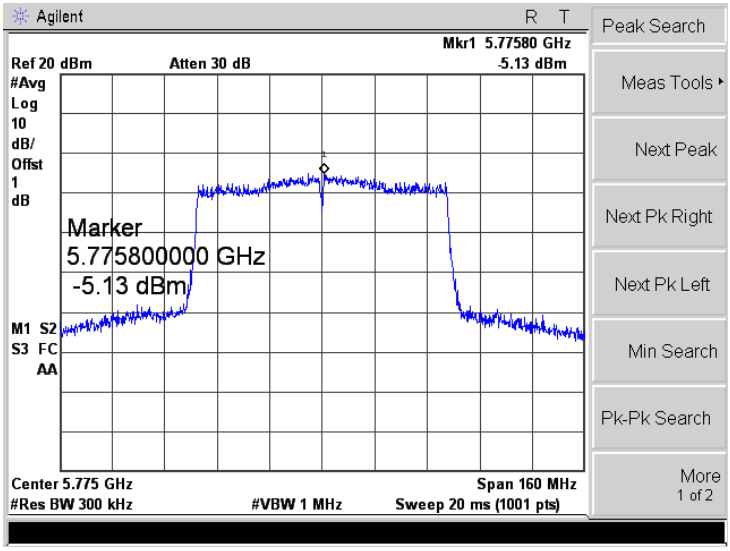
Mode:	802.11ac VH80
5210MHz	

➢ 5725-5850MHz

Mode:	**802.11a**
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT20
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT40
5755MHz	
5795MHz	

Mode:	802.11ac VH80
5775MHz	

7. Emission Bandwidth and Occupied Bandwidth

7.1 Standard Applicable

According to 15.407 (a) and (e)

(1) For the band 5.15-5.25 GHz.
(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

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

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

7.2 Test Procedure

According to 789033 D02 v02r0r section C&D, the following is the measurement procedure.

1. Emission Bandwidth (EBW)
a) Set RBW = approximately 1% of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare

this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

D. 99 Percent Occupied Bandwidth
The 99-percent occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission. Measurement of the 99-percent occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in section II.G.3.d). Measurements of 99-percent occupied bandwidth may also optionally be used in lieu of the EBW to 789033 D02 v02r01 General UNII Test Procedures New Rules v01 define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in section II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).

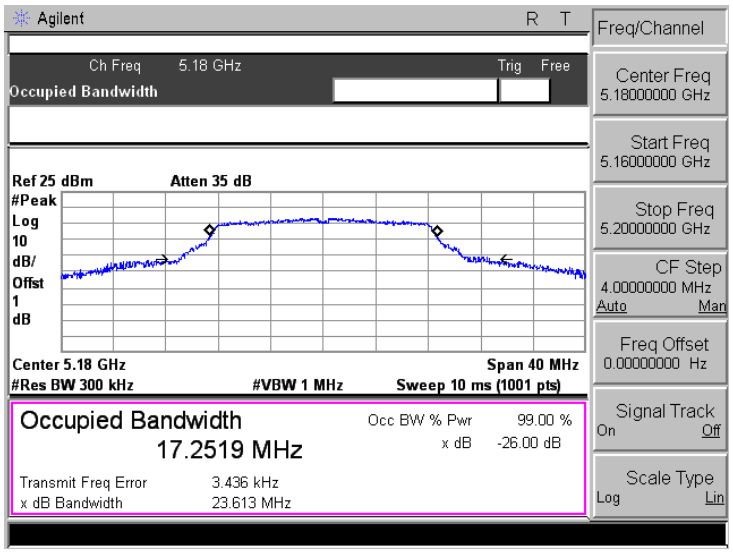
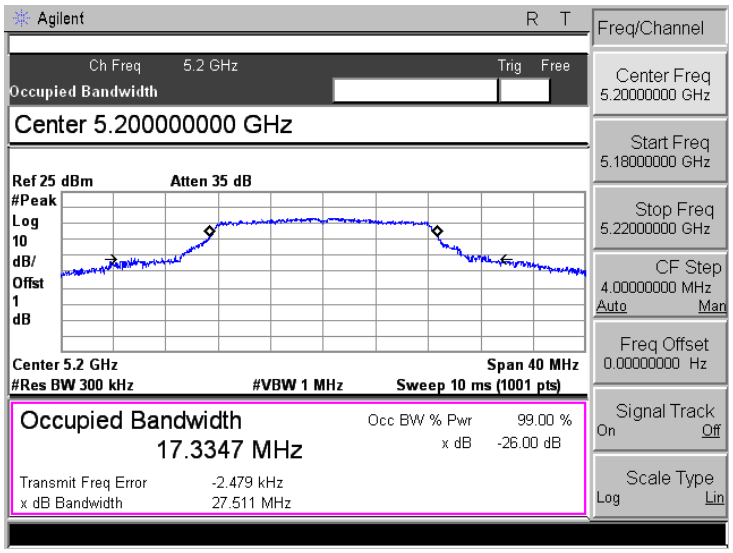
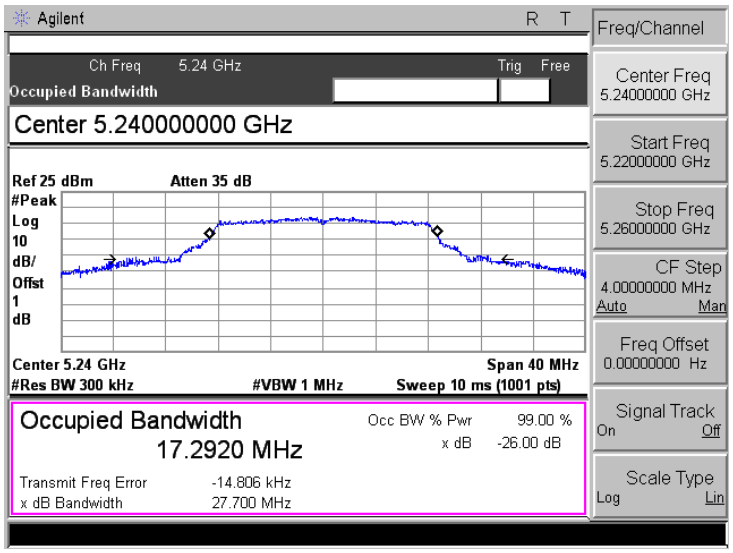
The following procedure shall be used for measuring (99 %) power bandwidth:
1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ≥ 3 * RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

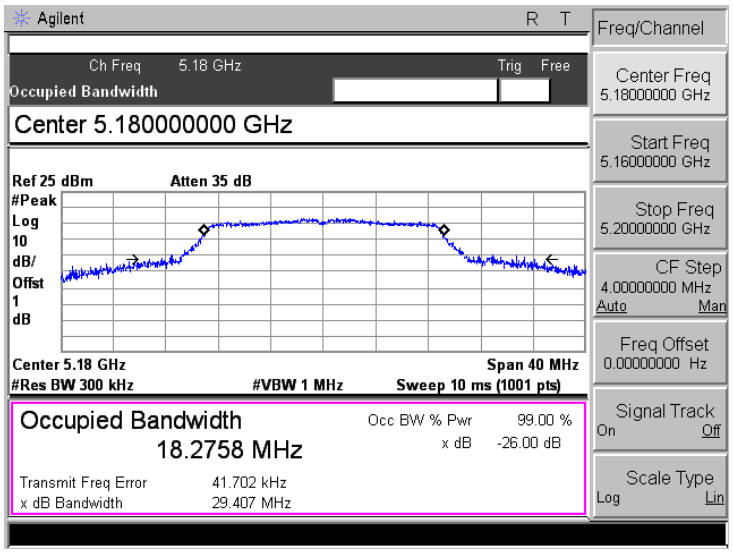
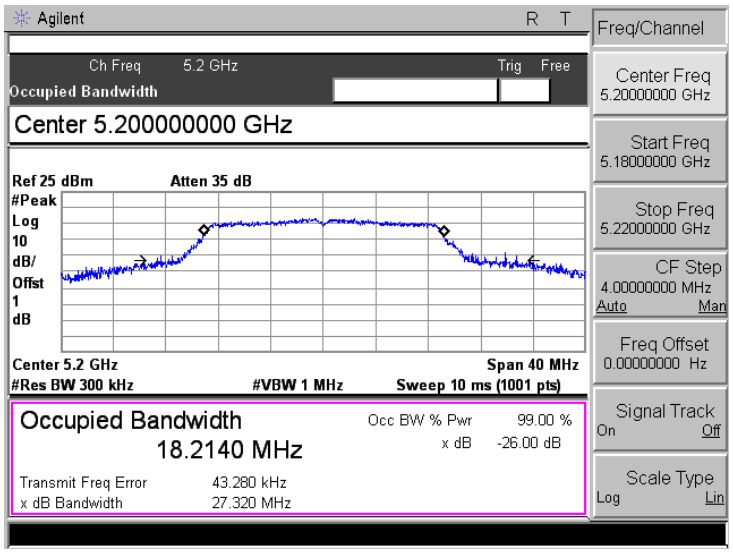
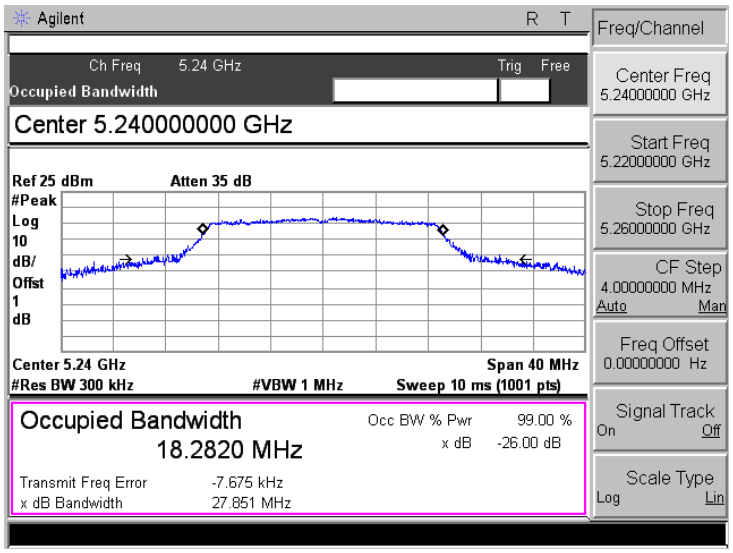
7.3 Summary of Test Results/Plots

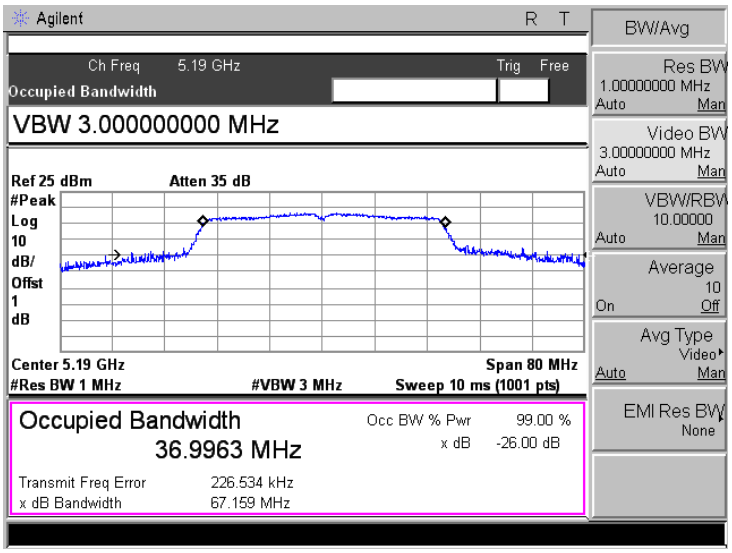
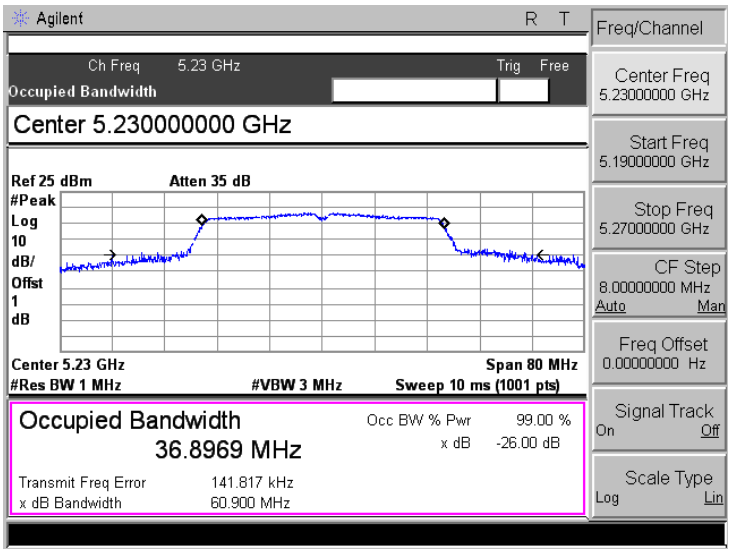
U-NII-1:5150-5250MHz				
Test Mode	**Test Channel MHz**	**26 dB Bandwidth MHz**	**99% Bandwidth MHz**	**Limit MHz**
802.11a	5180	23.613	17.2519	Pass
	5200	27.511	17.3347	Pass
	5240	27.700	17.2920	Pass
802.11n-HT20	5180	29.407	18.2758	Pass
	5200	27.320	18.2140	Pass
	5240	27.851	18.2820	Pass
802.11n-HT40	5190	67.159	36.9963	Pass
	5230	60.900	36.8969	Pass
802.11ac-HT80	5210	88.099	75.6859	Pass

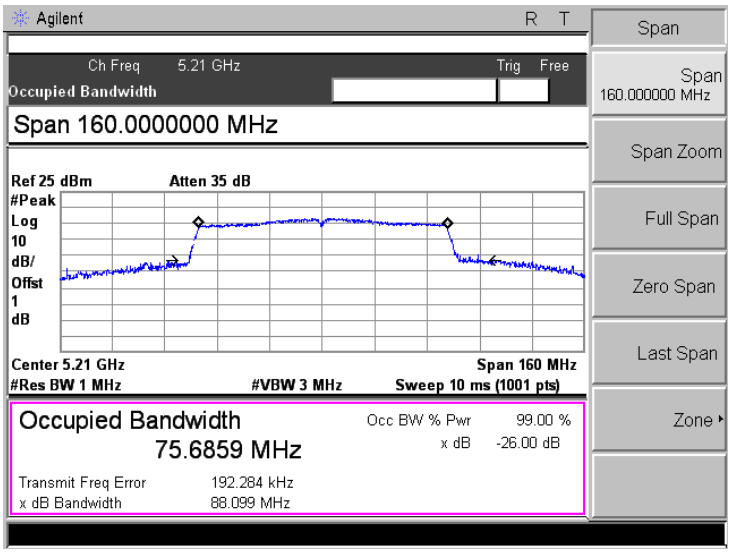
U-NII-3:5725-5850MHz				
Test Mode	**Test Channel MHz**	**6 dB Bandwidth MHz**	**99% Bandwidth MHz**	**Limit MHz**
802.11a	5745	16.249	17.2595	≥500
	5785	16.421	17.2876	≥500
	5825	16.383	17.2095	≥500
802.11n-HT20	5745	17.531	18.3351	≥500
	5785	17.449	18.1677	≥500
	5825	17.505	17.1883	≥500
802.11n-HT40	5755	37.0198	36.106	≥500
	5795	36.8705	35.944	≥500
802.11ac-HT80	5775	75.470	76.1321	≥500

➢ 5150-5250MHz

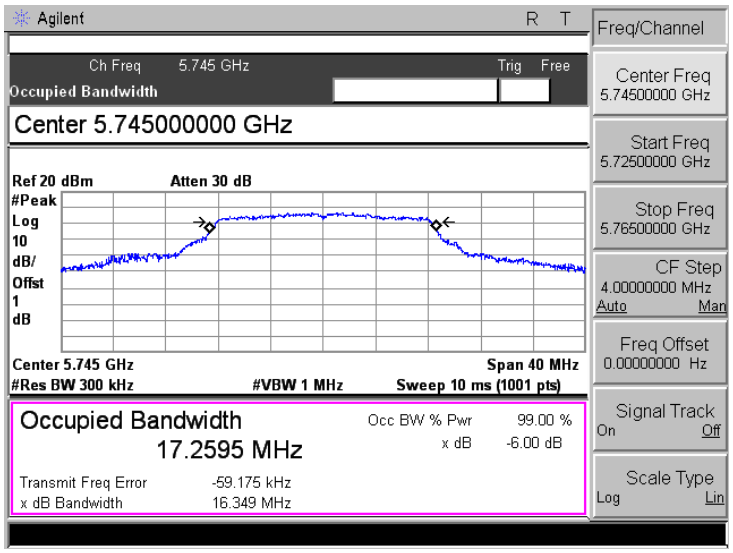
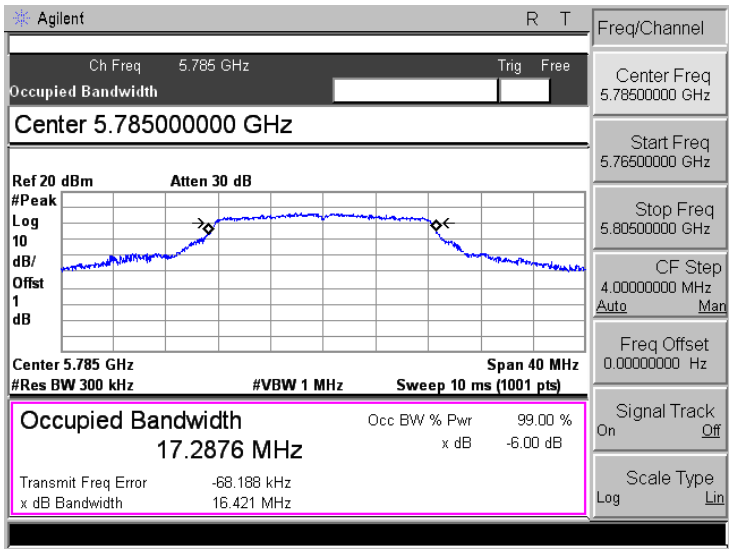
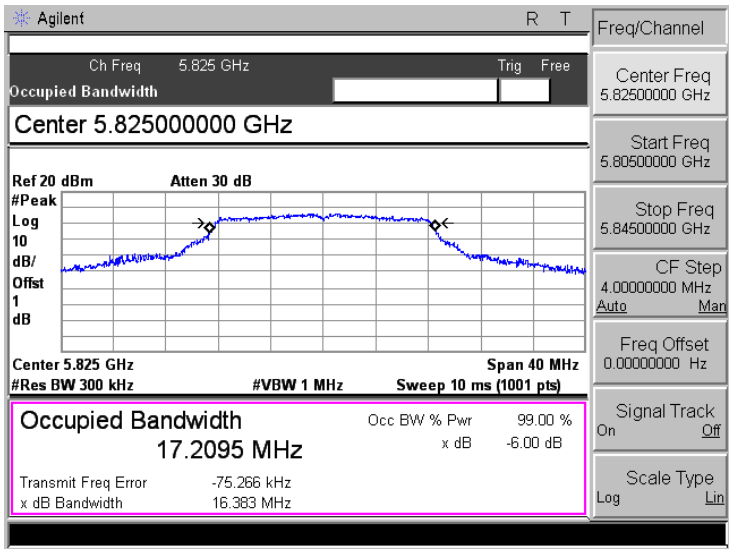
Mode:	**802.11a**
5180MHz	
5200MHz	
5240MHz	

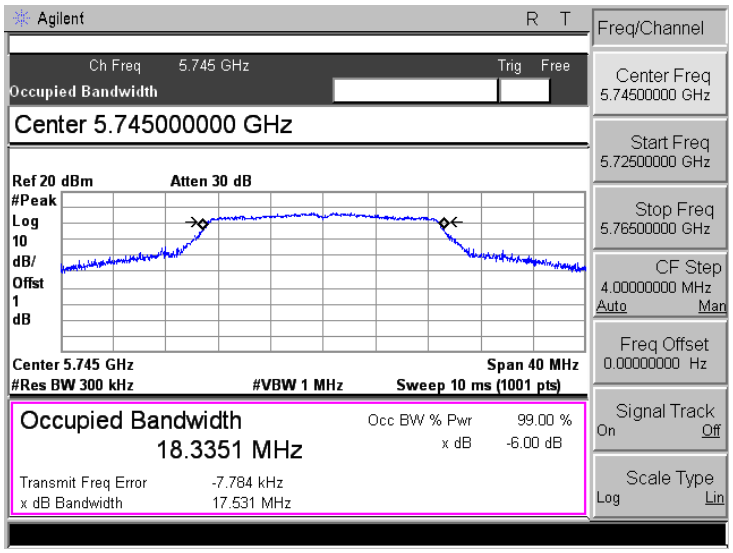
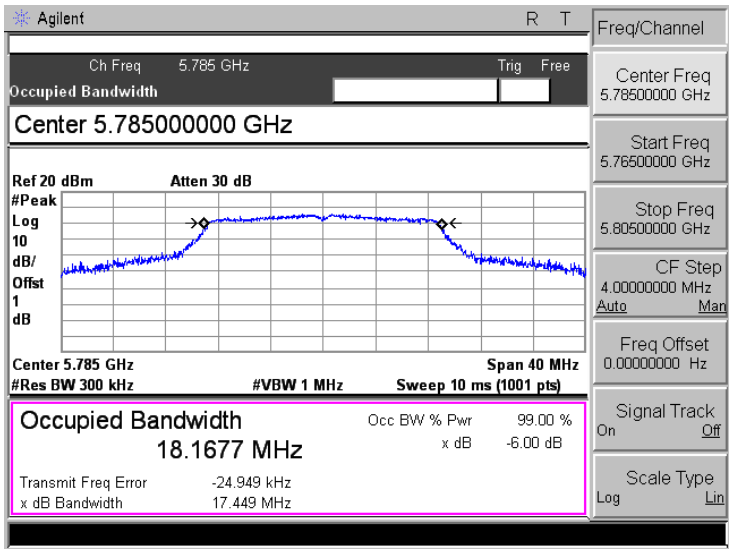
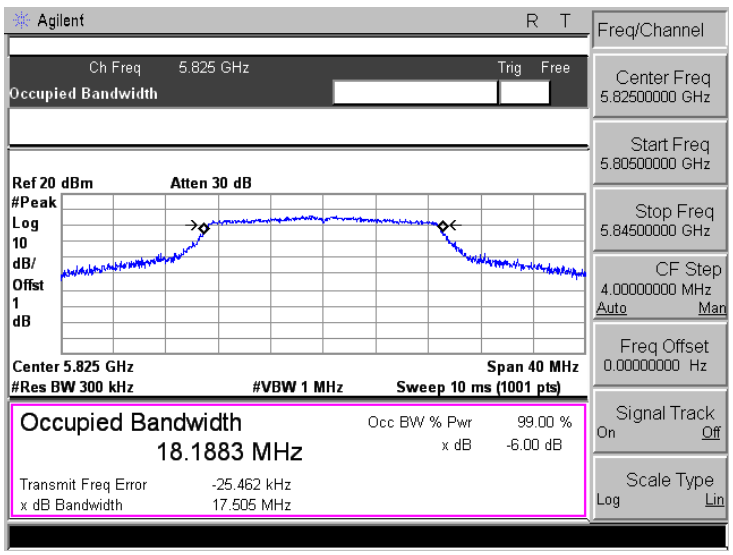
Mode:	802.11n-HT20
5180MHz	
5200MHz	
5240MHz	

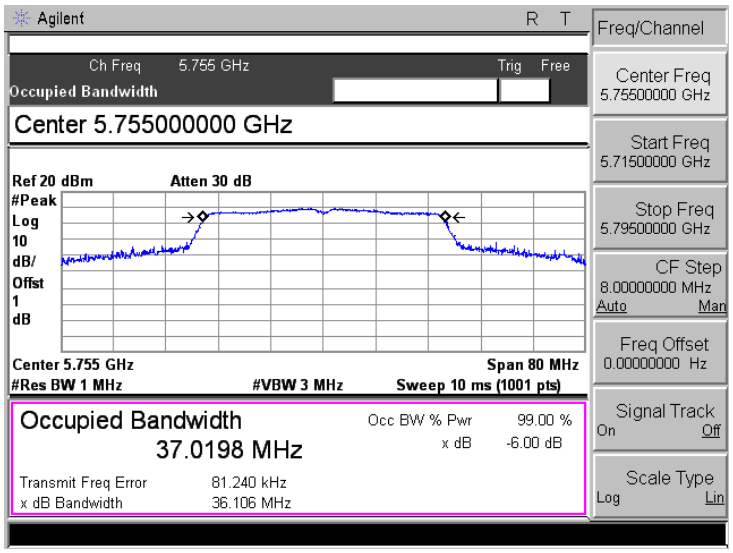
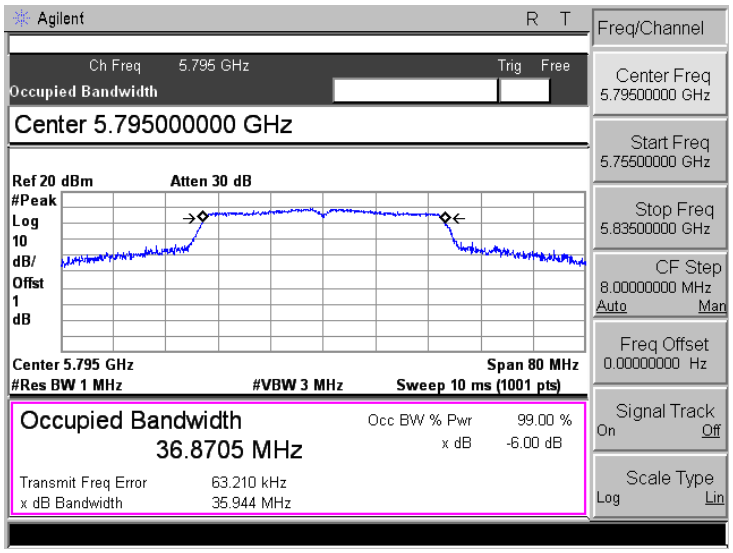
Mode:	802.11n-HT40
5190 MHz	
5230 MHz	

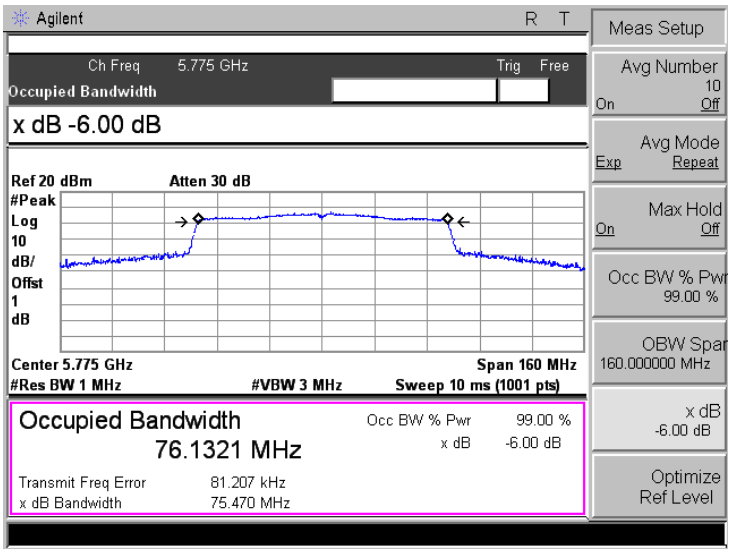
Mode:	802.11ac VH80
5210MHz	

➢ 5725-5850MHz

Mode:	**802.11a**
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT20
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT40
5755 MHz	
5795 MHz	

Mode:	802.11ac VH80
5775 MHz	

8. Maximum Conducted Output Power

8.1 Standard Applicable

Section 15.407(a) Power limits:

(1) For the band 5.15-5.25 GHz.
(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz 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.

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

8.2 Test Procedure

According to KDB789033 D02 v02r01 section E, the following is the measurement procedure.

(i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto.

(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.

(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".

(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.

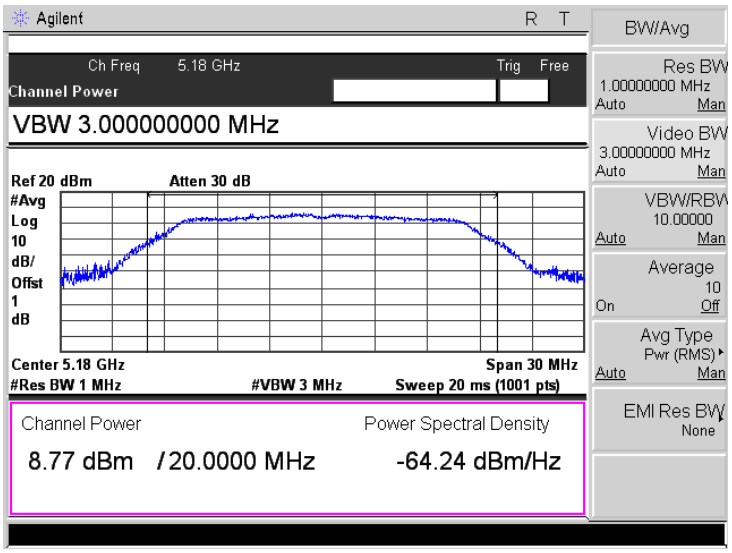
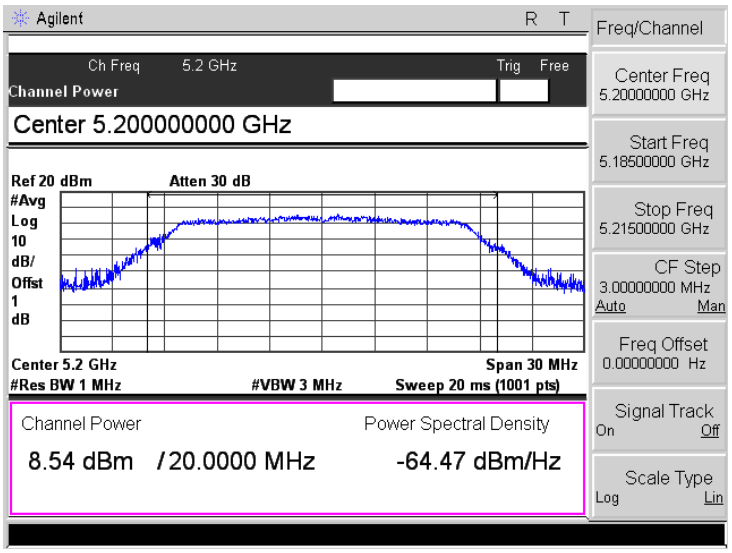
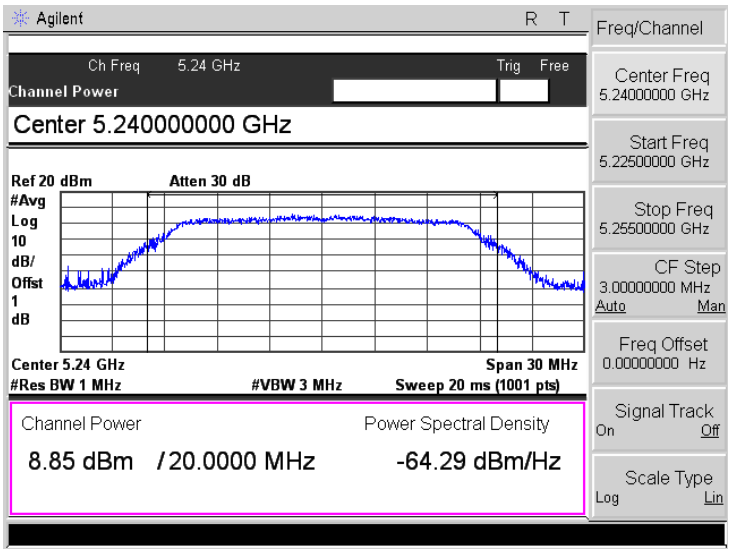
(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

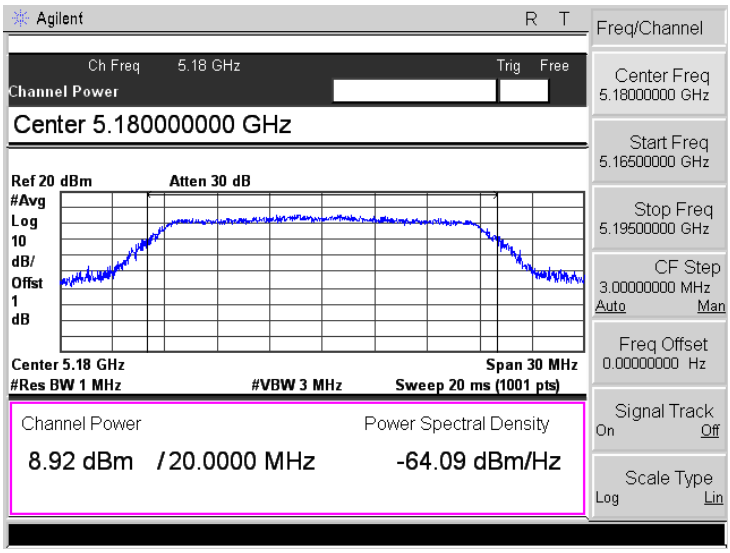
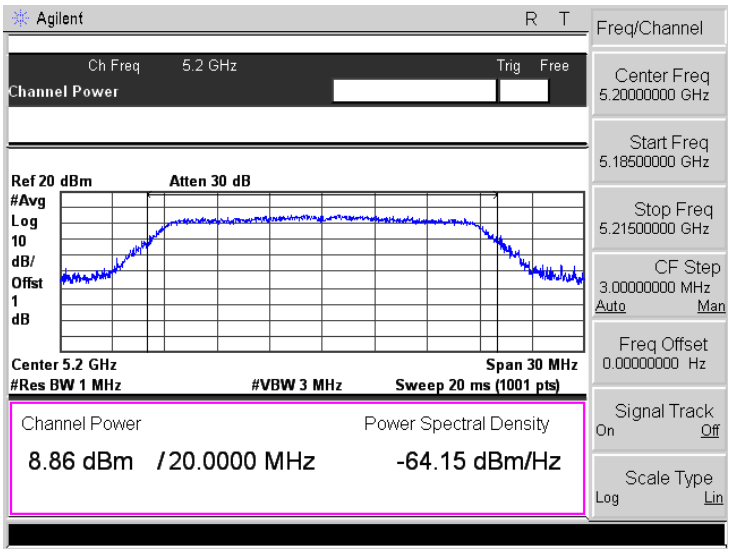
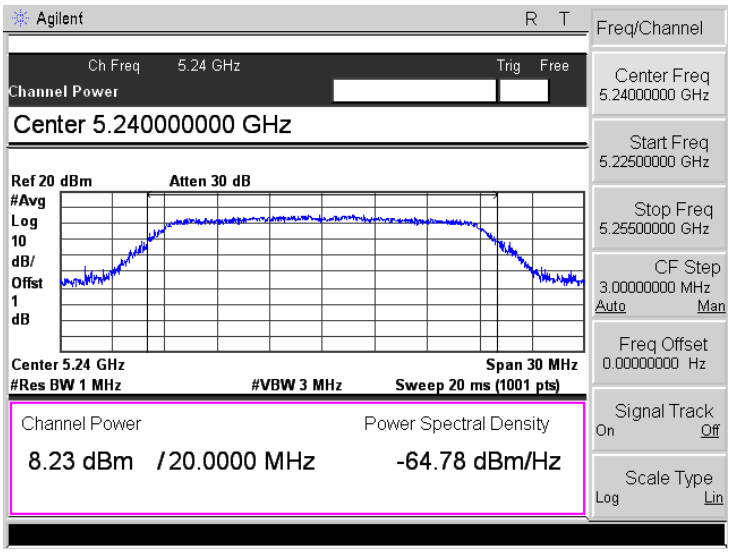
8.3 Summary of Test Results/Plots

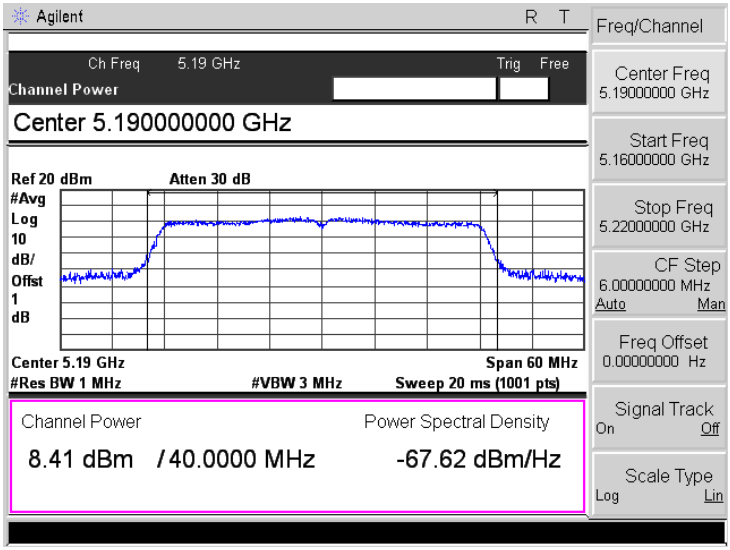
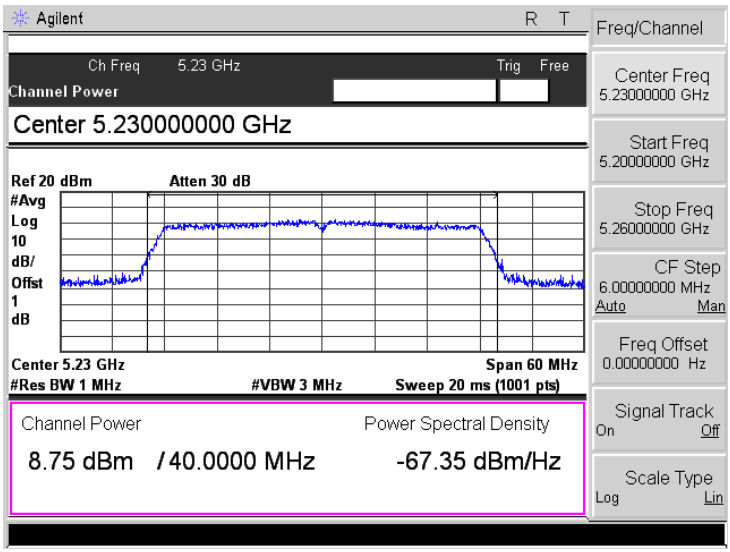
U-NII-1:5150-5250MHz				
Test mode	Frequency MHz	Output Power dBm	Output Power mW	Limit mW
802.11a	5180	8.77	7.53	250
	5200	8.54	7.14	250
	5240	8.85	7.67	250
802.11n-HT20	5180	8.92	7.80	250
	5200	8.86	7.69	250
	5240	8.23	6.65	250
802.11n-HT40	5190	8.41	6.93	250
	5230	8.75	7.50	250
802.11ac VH80	5180	8.24	6.67	250

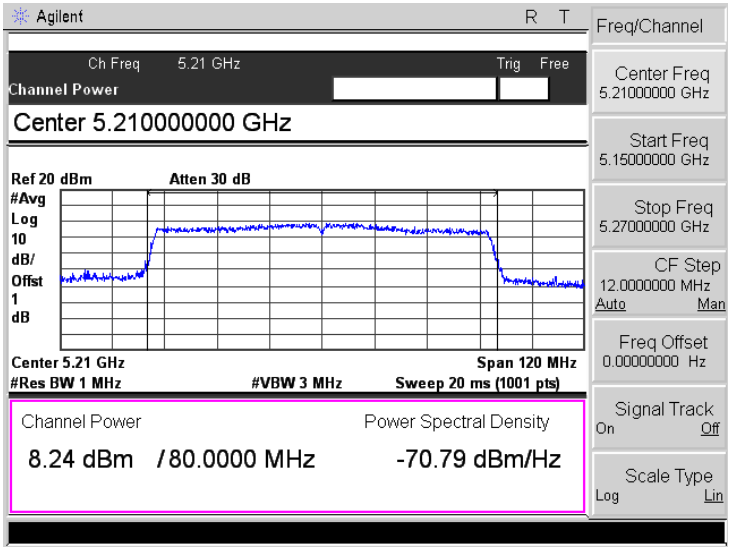
U-NII-3:5725-5850MHz				
Test mode	Frequency MHz	Output Power dBm	Output Power mW	Limit mW
802.11a	5745	8.85	7.67	1000
	5785	8.34	6.82	1000
	5825	8.29	6.75	1000
802.11n-HT20	5745	8.23	6.65	1000
	5785	8.40	6.92	1000
	5825	7.91	6.18	1000
802.11n-HT40	5755	8.41	6.93	1000
	5795	8.35	6.84	1000
802.11ac VH80	5775	7.88	6.14	1000

➢ 5150-5250MHz

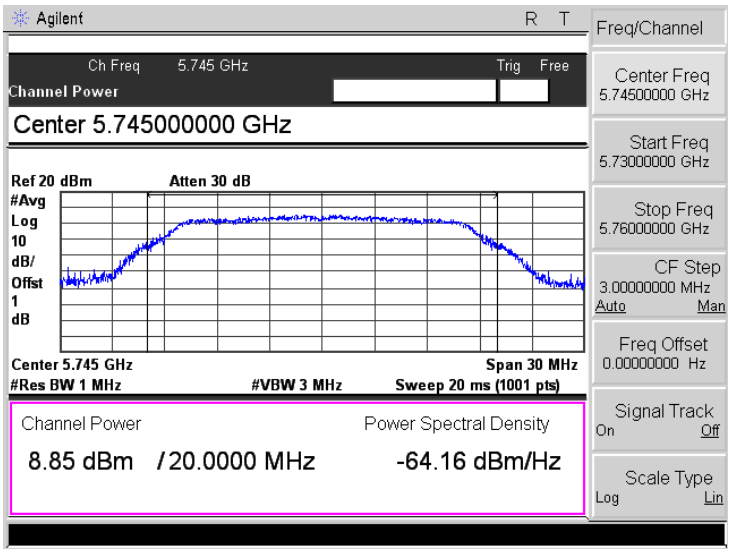
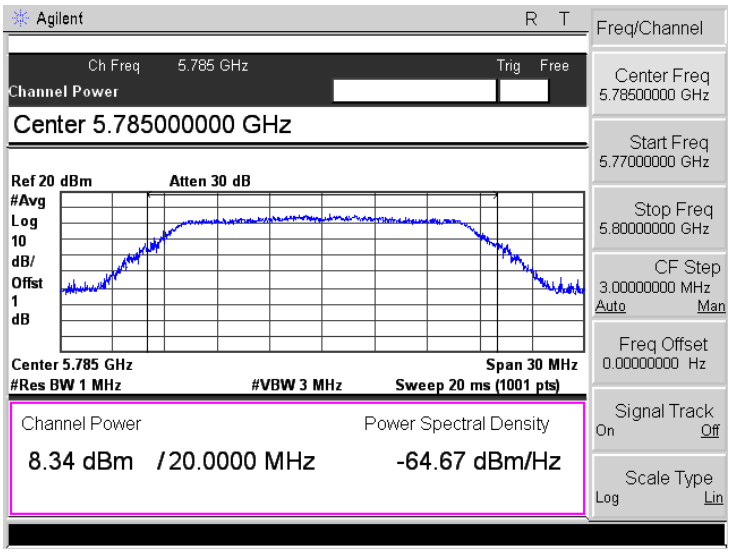
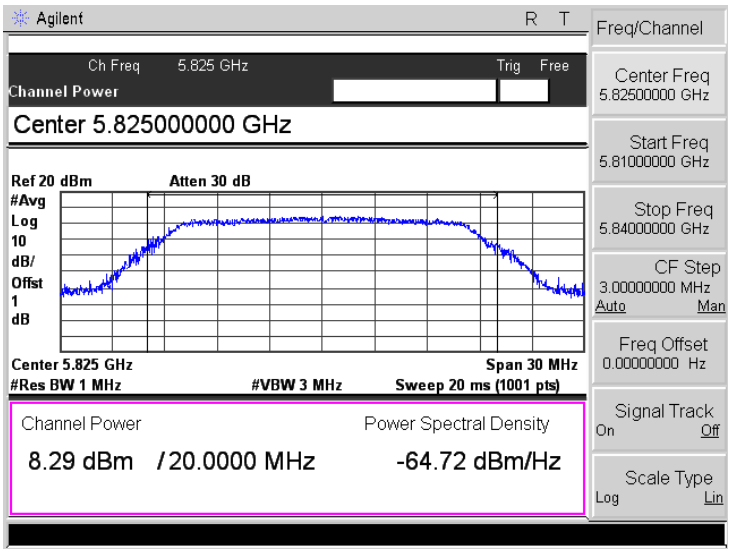
Mode:	**802.11a**
5180MHz	
5200MHz	
5240MHz	

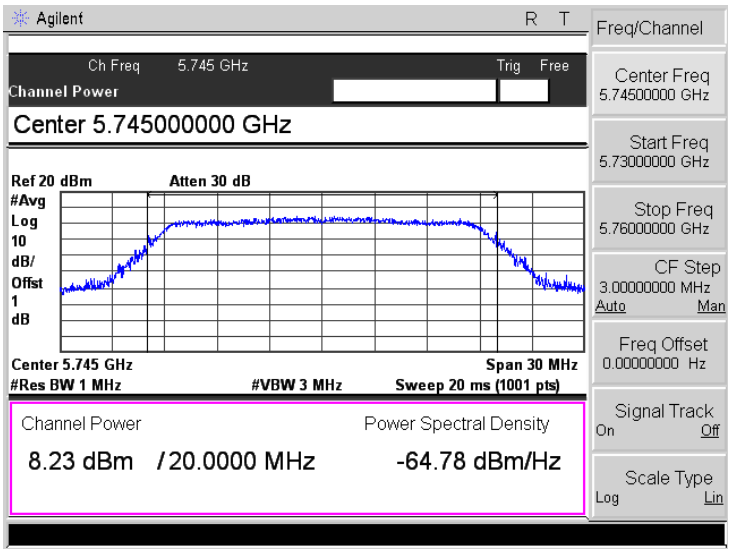
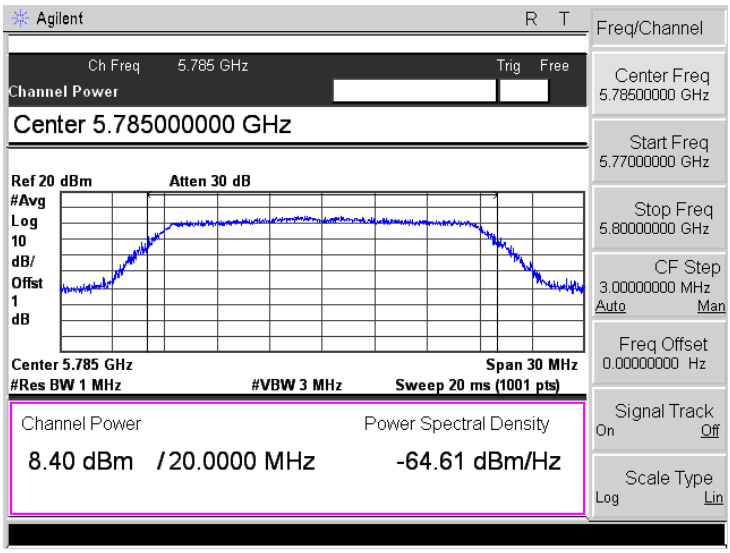
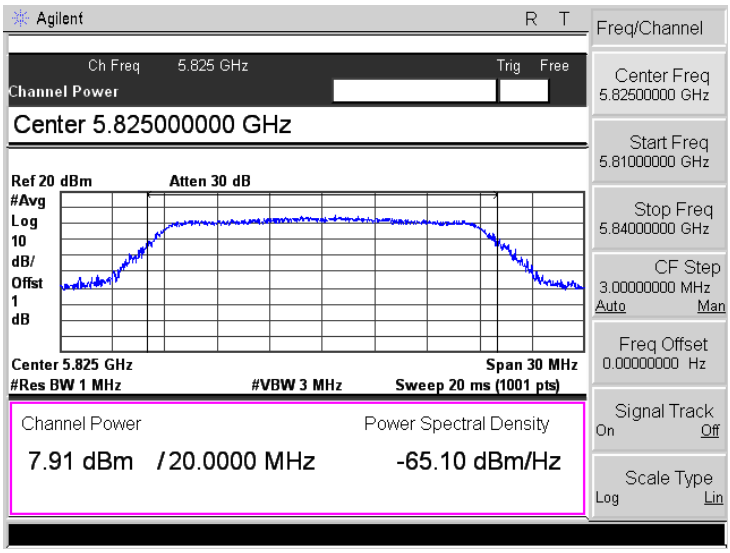
Mode:	802.11n-HT20
5180MHz	
5200MHz	
5240MHz	

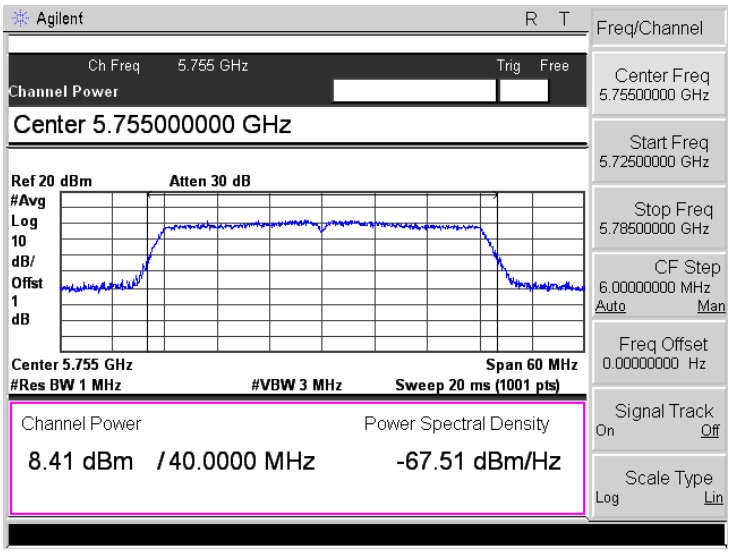
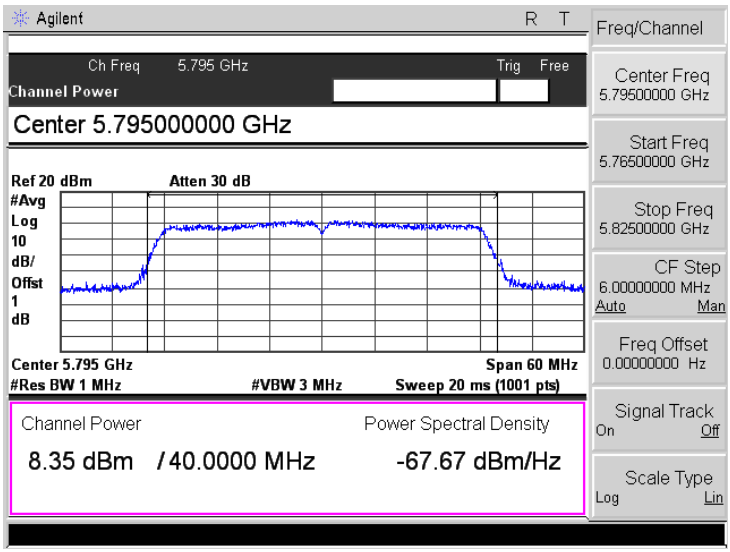
Mode:	802.11n-HT40
5190 MHz	
5230 MHz	

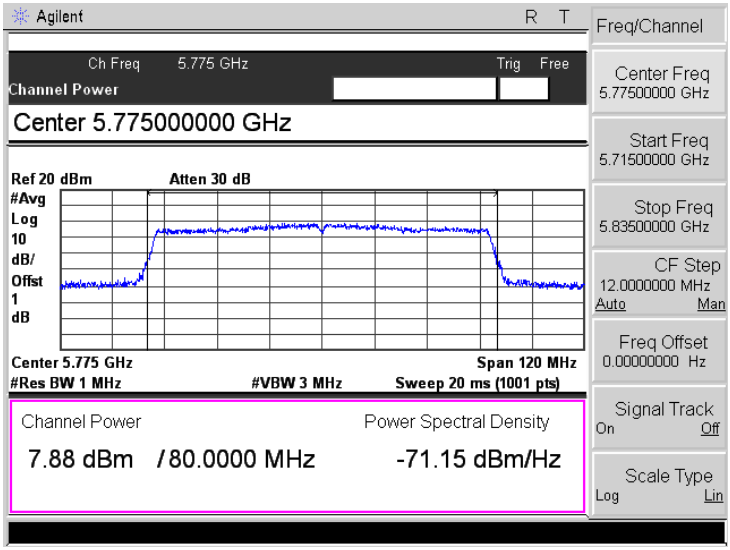
Mode:	802.11ac VH80
5180MHz	

➢ 5725-5850MHz

Mode:	**802.11a**
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT20
5745MHz	
5785MHz	
5825MHz	

Mode:	802.11n-HT40
5755 MHz	
5795 MHz	

Mode:	802.11ac VH80
5775 MHz	

9. Radiated Spurious Emissions

9.1 Standard Applicable

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:

(1) 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.

(2) 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.

(3) 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.

(4) 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.

According to §15.407(b)(6), 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.

According to §15.407(b)(7), The provisions of §15.205 apply to intentional radiators operating under this section.

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

EIRP = ((E*d)^2) / 30

where:

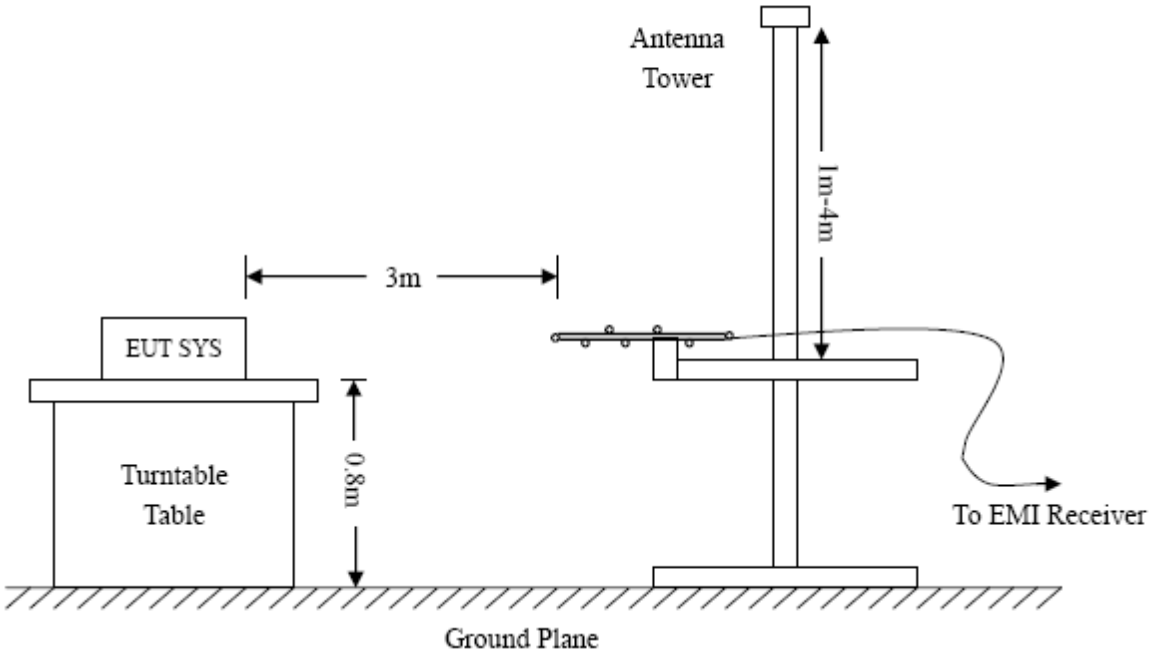
- E is the field strength in V/m;
- d is the measurement distance in meters;
- EIRP is the equivalent isotropically radiated power in watts.

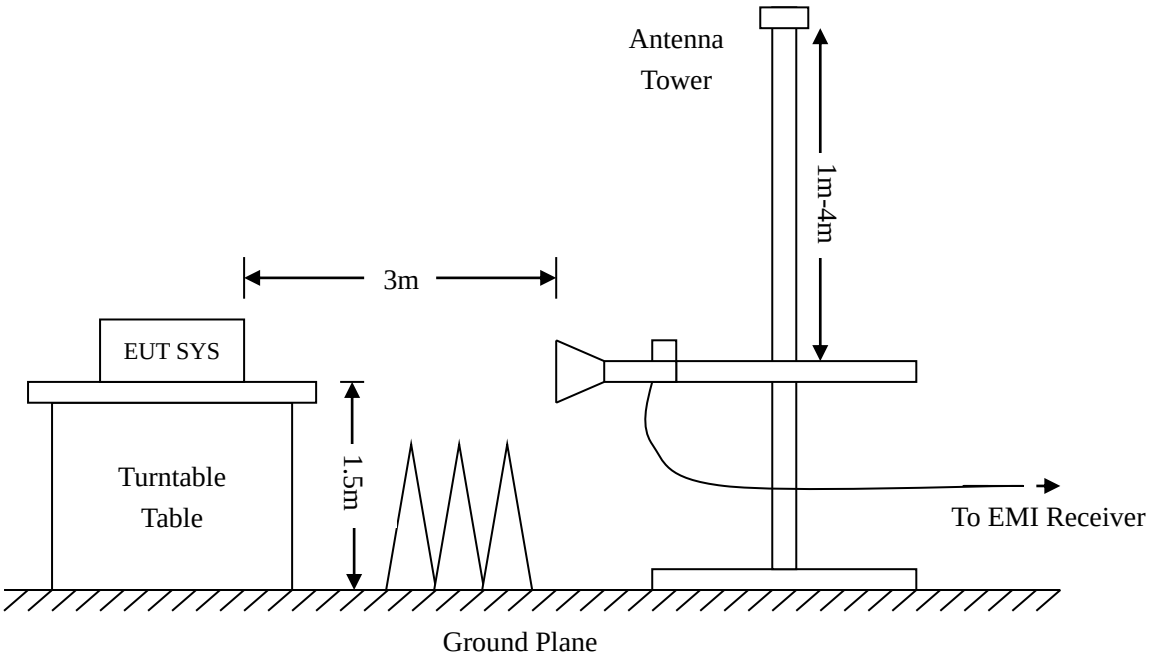
9.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.407(b)(6) and FCC Part 15.209 Limit..

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.


Antenna
Tower
1m-4m
3m
EUT SYS
Turntable
Table
0.8m
To EMI Receiver
Ground Plane


Antenna
Tower
1m-4m
3m
EUT SYS
Turntable
Table
1.5m
To EMI Receiver
Ground Plane

9.3 Test Receiver Setup

During the radiated emission test for above 1GHz, the test receiver was set with the following configurations:

For peak detector:
RBW = 1000kHz, VBW = 3000kHz, Sweep Time = Auto

For average detector:
RBW = 1000kHz, VBW = 10Hz, Sweep Time = Auto

9.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

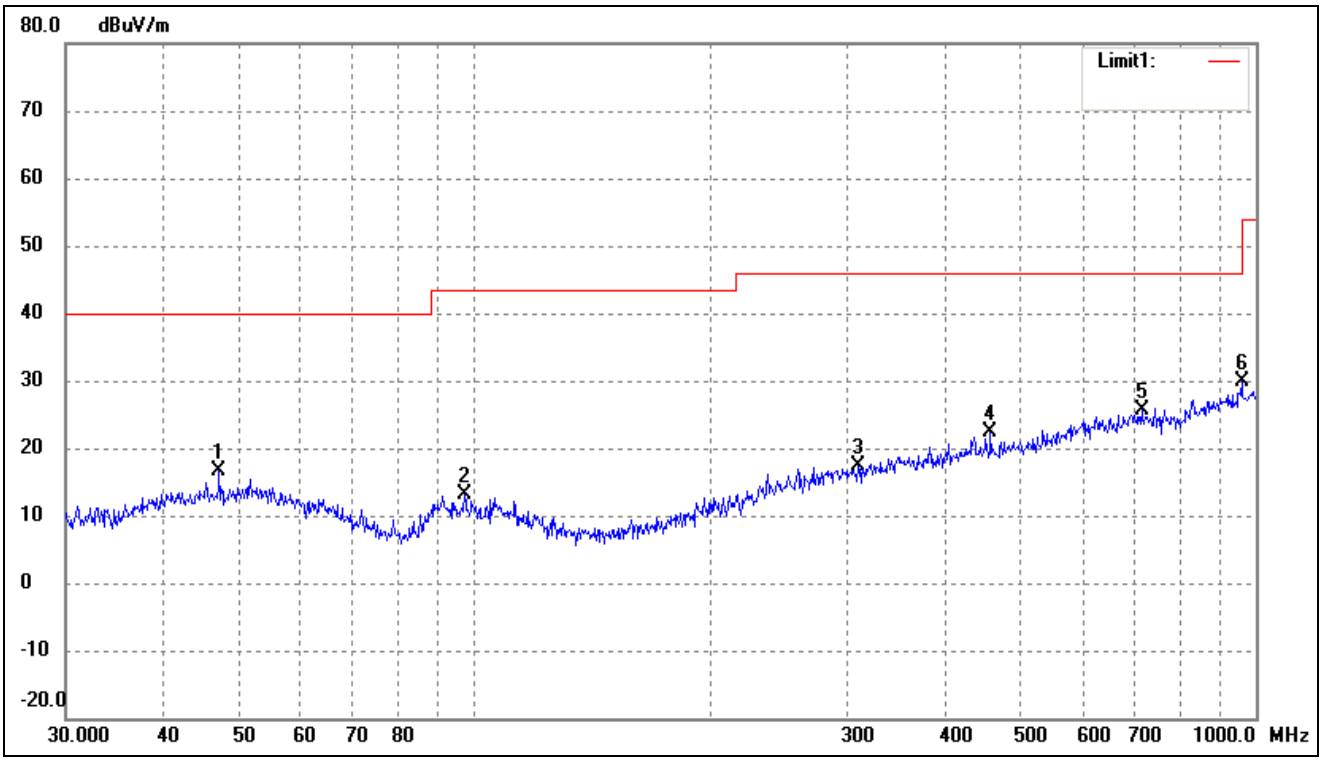
Margin = Corr. Ampl. – FCC Part 15 Limit

9.5 Summary of Test Results/Plots

Note: *this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

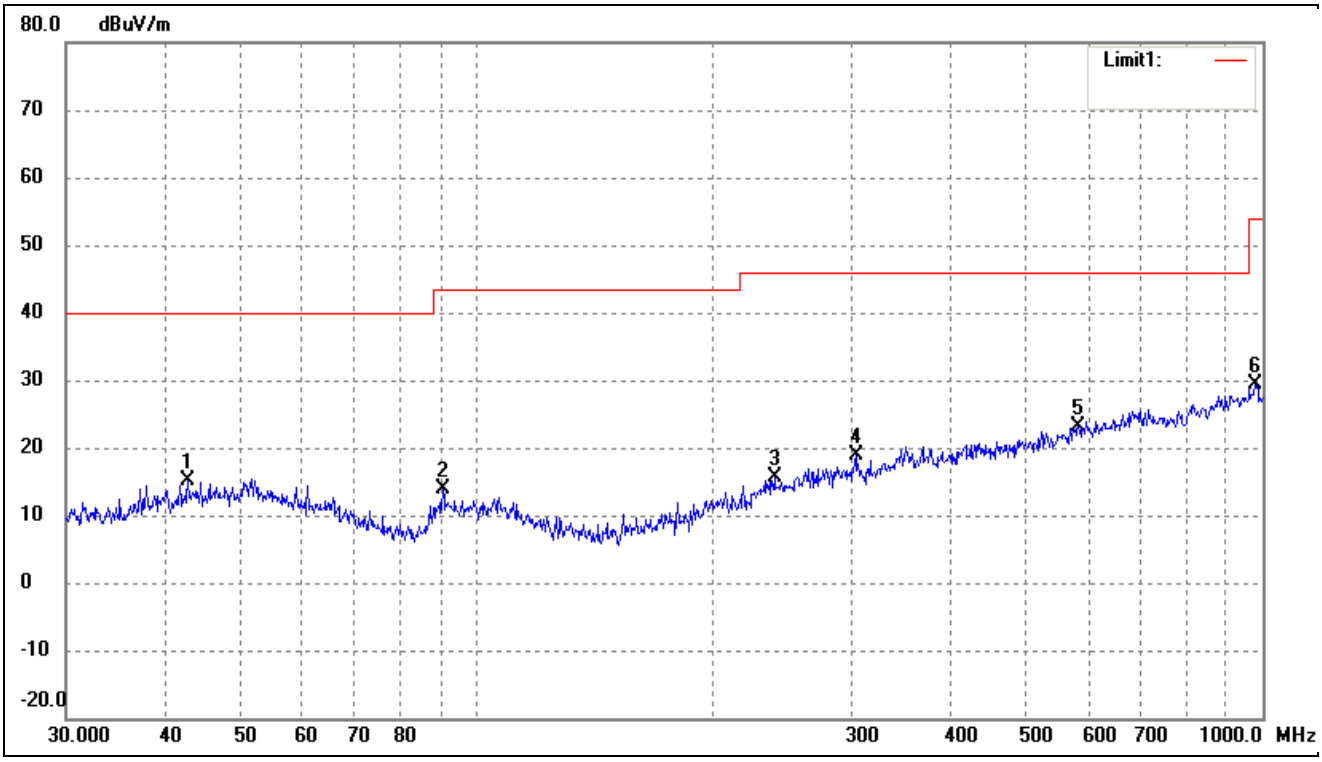
➢ Spurious Emission From 30 MHz to 1 GHz

➢ Test Channel	Low	Polarity:	Horizontal



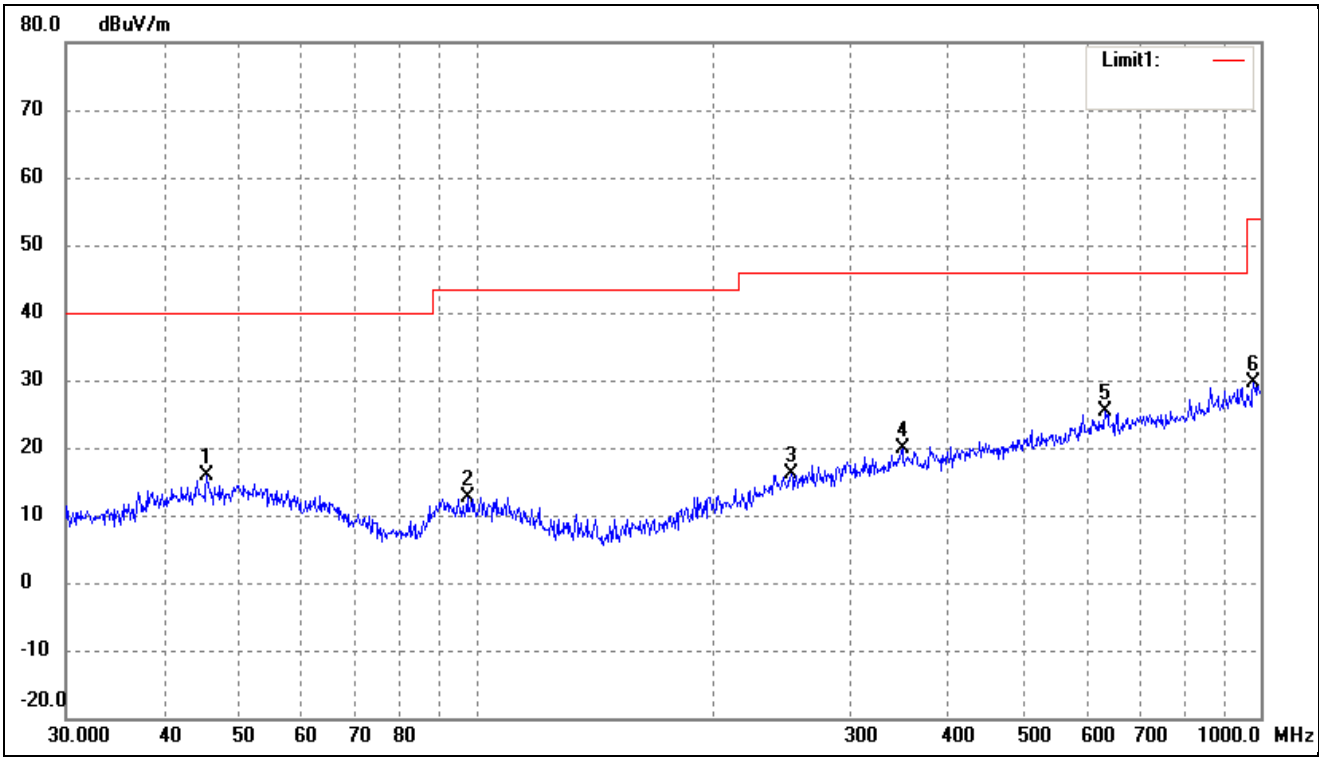
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	47.1599	28.27	-11.72	16.55	40.00	-23.45	304	100	peak
2	97.1148	27.37	-14.15	13.22	43.50	-30.28	94	100	peak
3	309.9977	25.63	-8.31	17.32	46.00	-28.68	288	100	peak
4	457.5073	28.42	-6.03	22.39	46.00	-23.61	107	100	peak
5	714.1734	27.55	-1.90	25.65	46.00	-20.35	274	100	peak
6	958.7943	28.04	1.80	29.84	46.00	-16.16	166	100	peak

Test Channel	Low	Polarity:	Vertical



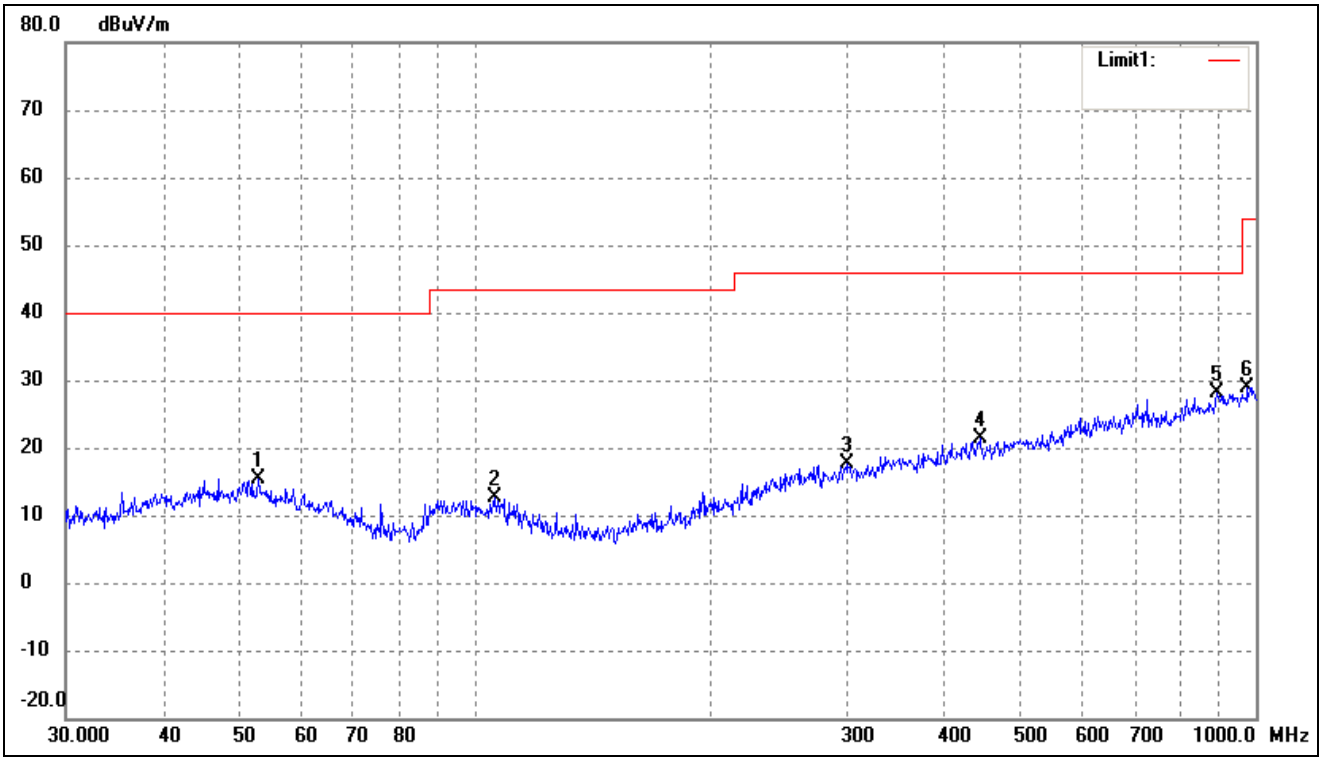
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	42.8998	27.27	-12.16	15.11	40.00	-24.89	328	100	peak
2	90.5374	27.28	-13.51	13.77	43.50	-29.73	95	100	peak
3	239.1473	25.78	-10.11	15.67	46.00	-30.33	263	100	peak
4	303.5437	26.98	-8.22	18.76	46.00	-27.24	101	100	peak
5	582.7425	26.67	-3.61	23.06	46.00	-22.94	251	100	peak
6	979.1804	27.16	2.24	29.40	54.00	-24.60	99	100	peak

Test Channel	Middle	Polarity:	Horizontal



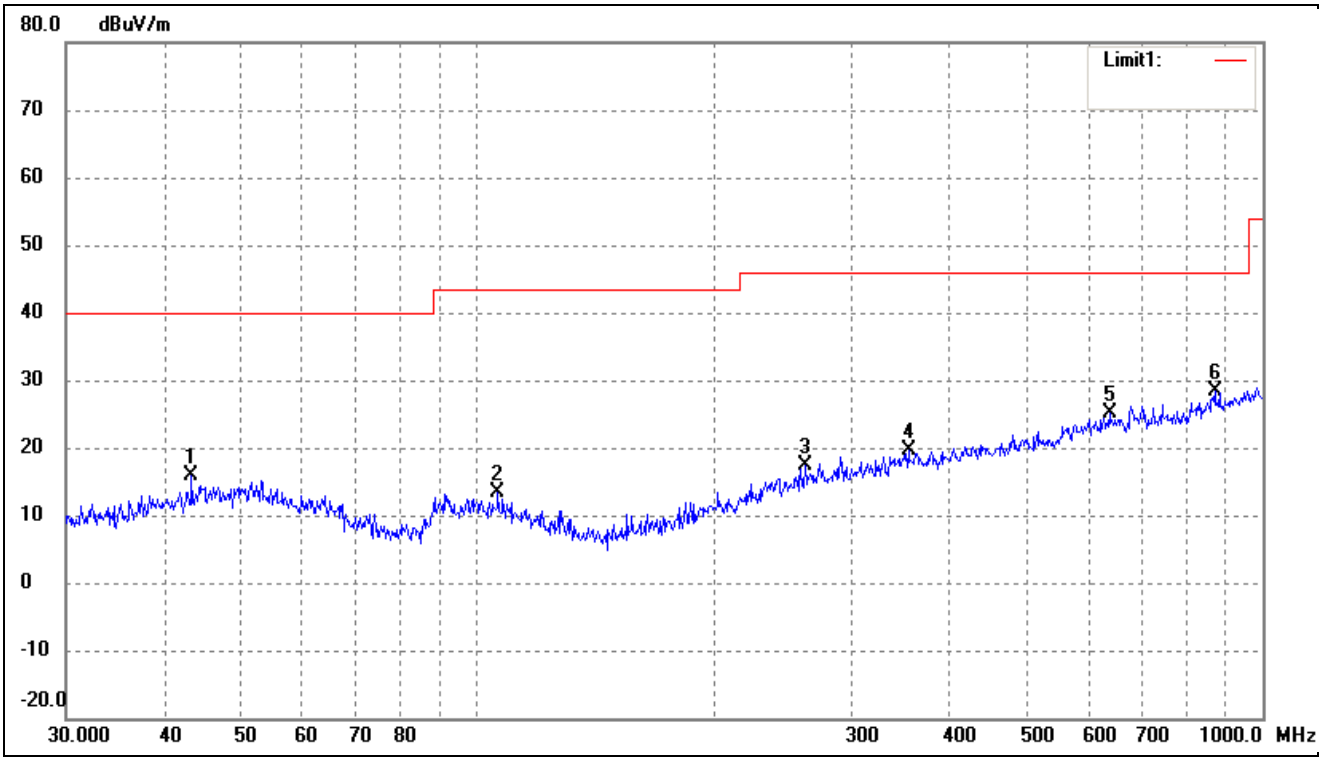
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	45.3755	27.83	-11.88	15.95	40.00	-24.05	334	100	peak
2	97.4560	26.82	-14.11	12.71	43.50	-30.79	188	100	peak
3	252.0627	25.79	-9.71	16.08	46.00	-29.92	69	100	peak
4	349.2500	26.91	-6.91	20.00	46.00	-26.00	307	100	peak
5	633.9073	28.01	-2.71	25.30	46.00	-20.70	88	100	peak
6	979.1804	27.43	2.24	29.67	54.00	-24.33	140	100	peak

Test Channel	Middle	Polarity:	Vertical



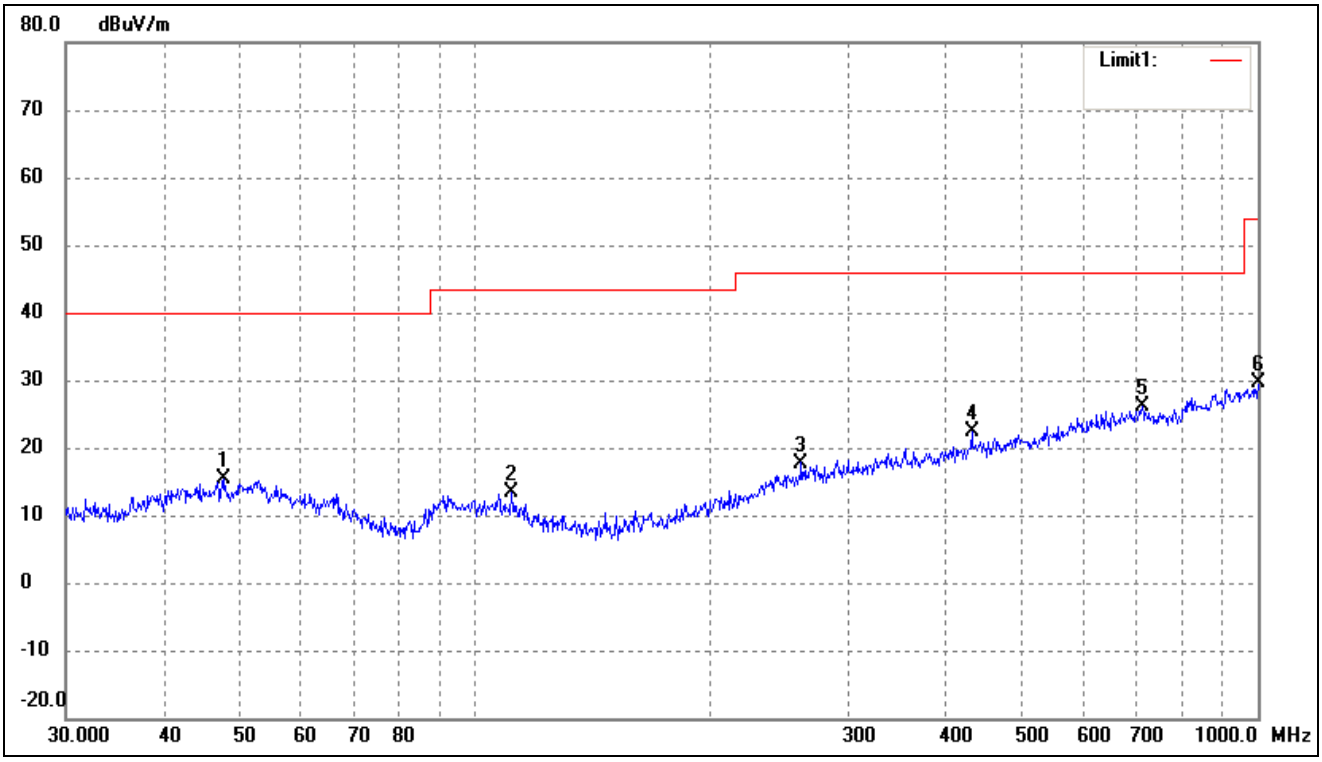
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	52.9453	27.16	-11.72	15.44	40.00	-24.56	252	100	peak
2	106.0126	26.04	-13.48	12.56	43.50	-30.94	266	100	peak
3	300.3673	25.70	-8.15	17.55	46.00	-28.45	84	100	peak
4	443.2943	27.42	-6.13	21.29	46.00	-24.71	350	100	peak
5	890.7278	27.51	0.64	28.15	46.00	-17.85	95	100	peak
6	975.7529	26.88	2.09	28.97	54.00	-25.03	251	100	peak

Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	43.3534	27.95	-12.11	15.84	40.00	-24.16	182	100	peak
2	106.3850	26.88	-13.51	13.37	43.50	-30.13	126	100	peak
3	261.9753	26.44	-9.18	17.26	46.00	-28.74	80	100	peak
4	354.1831	26.59	-6.99	19.60	46.00	-26.40	136	100	peak
5	638.3686	27.79	-2.69	25.10	46.00	-20.90	352	100	peak
6	869.1302	28.06	0.38	28.44	46.00	-17.56	209	100	peak

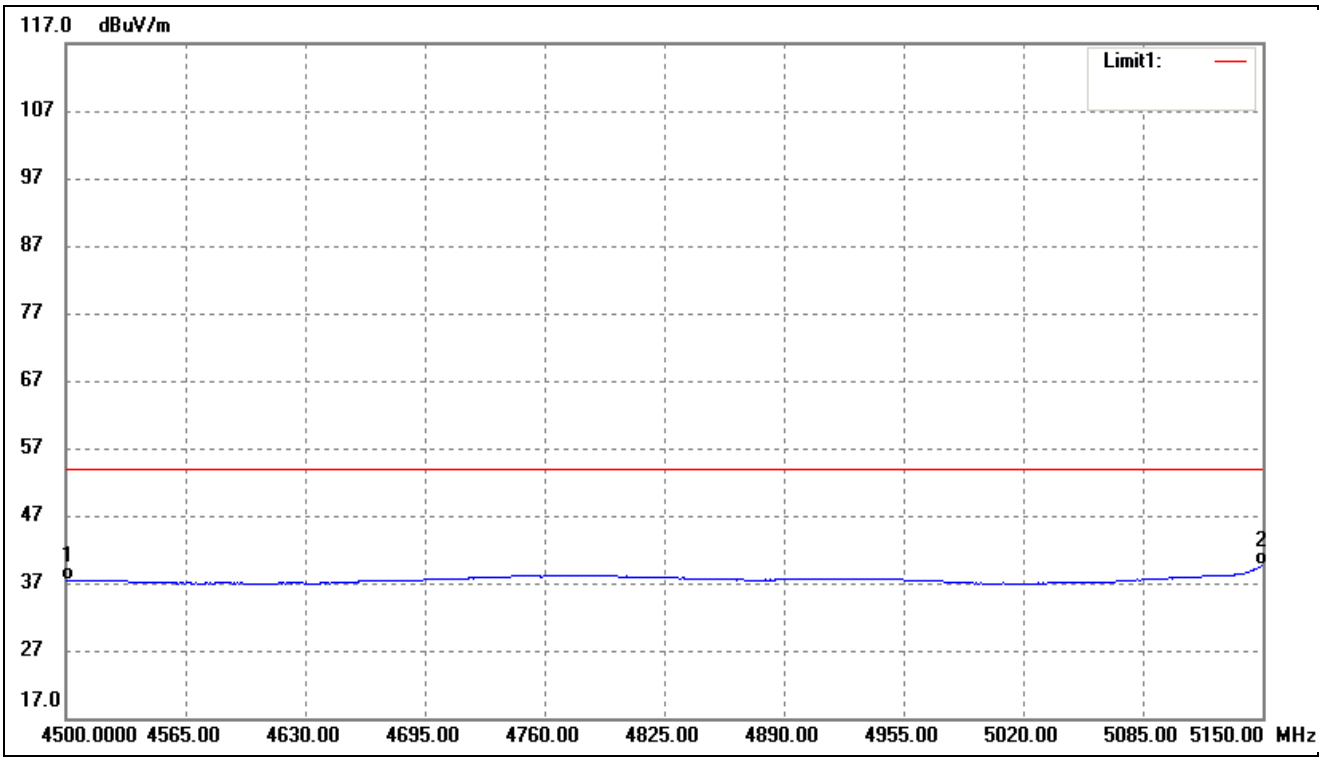
Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	47.6586	27.12	-11.69	15.43	40.00	-24.57	53	100	peak
2	111.3468	27.49	-14.12	13.37	43.50	-30.13	95	100	peak
3	261.0583	27.02	-9.27	17.75	46.00	-28.25	75	100	peak
4	431.0316	28.46	-6.06	22.40	46.00	-23.60	114	100	peak
5	711.6734	27.93	-1.86	26.07	46.00	-19.93	215	100	peak
6	1000.0000	27.54	2.20	29.74	54.00	-24.26	344	100	peak

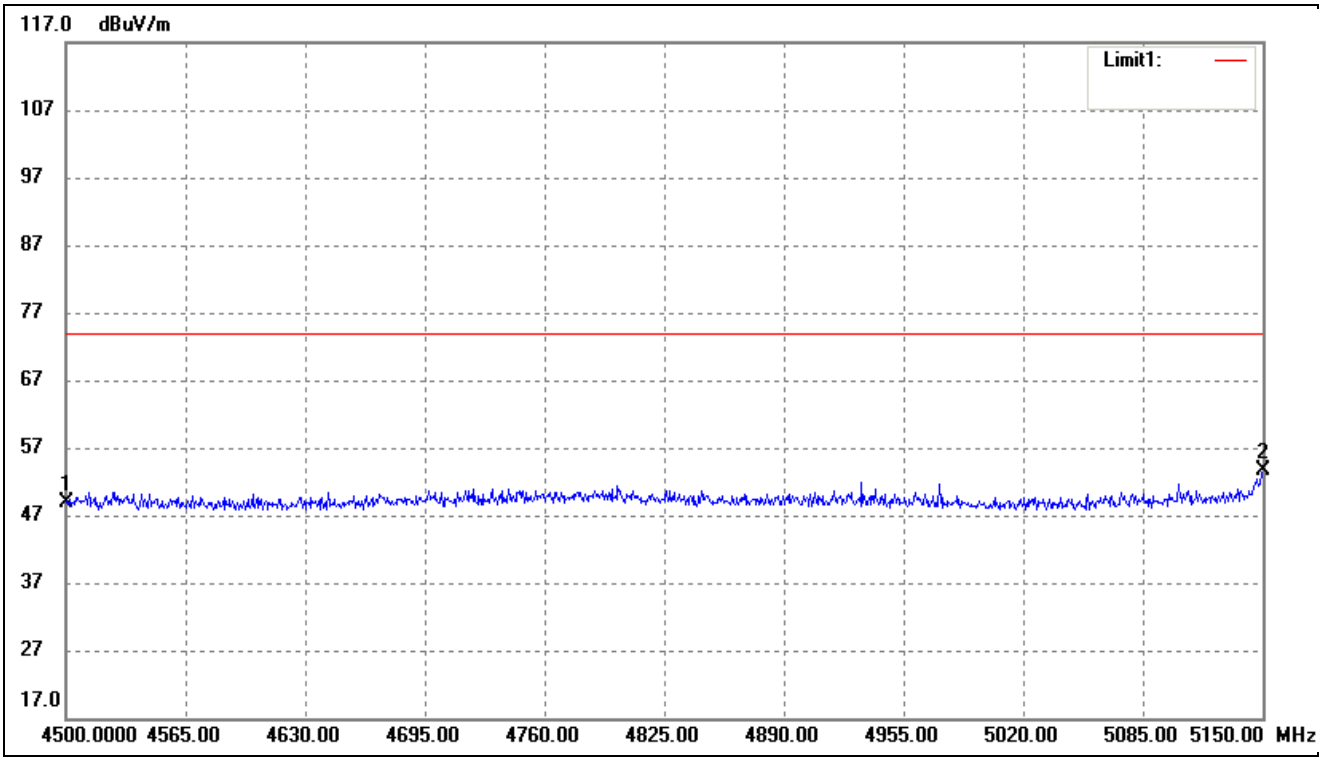
➢ Restricted band

Test Channel	4500-5150MHz	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	4500.000	41.22	-3.77	37.45	54.00	-16.55	115	100	AVG
2	5150.000	42.65	-2.99	39.66	54.00	-14.34	160	100	AVG

Test Channel	4500-5150MHz	Polarity:	Vertical(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	4500.000	52.58	-3.77	48.81	74.00	-25.19	71	100	peak
2	5150.000	56.56	-2.99	53.57	74.00	-20.43	178	100	peak

Note: The Restricted Bandedge was tested in Horizontal /Vertical and the worst case position data was reported.

- For the frequency band worst case 5.150-5250GHz (802.11a)
- Harmonics And Spurious Emissions

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
Low Channel (5180MHz)										
10360	PK	50.7	360	V	40.7	10.9	39.6	61.3	74	-12.7
10360	PK	50.8	360	H	40.7	10.9	39.6	62.9	74	-11.1
10360	AV	37.3	360	V	40.7	10.9	39.6	48.5	54	-5.5
10360	AV	35.5	360	H	40.7	10.9	39.6	46.9	54	-7.1
High Channel (5240MHz)										
10480	PK	51.5	360	V	40.7	10.9	39.6	64.2	74	-9.8
10480	PK	51.8	360	H	40.7	10.9	39.6	64.6	74	-9.4
10480	AV	36.3	360	V	40.7	10.9	39.6	47.3	54	-6.7
10480	AV	34.8	360	H	40.7	10.9	39.6	46.4	54	-7.6

- Out of Band edge for 5150-5250MHz

Test CH.	**Test Segment**	**Result**	**Limit**
	MHz	**dBm/MHz**	**dBm/MHz**
Lowest	Below 5150	-33.82	-27
Highest	Above 5350	-34.72	-27
Note: the data just list the worst cases			

- For the frequency band worst case 5.725-5.850GHz (802.11a)
- Harmonics And Spurious Emissions

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
Low Channel (5725MHz)										
11490	PK	57.0	360	V	38.9	9.8	40.1	66.4	74	-7.6
11490	PK	57.8	360	H	38.9	9.8	40.1	65.5	74	-8.5
11490	AV	35.0	360	V	38.9	9.8	40.1	42.2	54	-11.8
11490	AV	38.1	360	H	38.9	9.8	40.1	47.8	54	-6.2
High Channel (5825MHz)										
11610	PK	57.3	360	V	38.9	9.8	40.1	65.7	74	-8.3
11610	PK	56.6	360	H	38.9	9.8	40.1	64.1	74	-9.9
11610	AV	39.2	360	V	38.9	9.8	40.1	46.3	54	-7.7
11610	AV	38.2	360	H	38.9	9.8	40.1	48.2	54	-5.8

- Out of Band edge for 5725-5850MHz

Test CH.	**Test Segment**	**Result**	**Limit**
	MHz	**dBm/MHz**	**dBm/MHz**
Lowest	Below 5715	-33.83	-27
	5715 to 5725	-34.38	-17
Highest	5850 to 5860	-34.32	-17
	Above 5860	-33.29	-27
Note: the data just list the worst cases			

Note: this EUT was tested in the low, high channel and the worst case position data was reported.

10. Frequency Stability

10.1 Standard Applicable

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

10.2 Test Procedure

According to §2.1055, the following test procedure was performed.
The Frequency Stability is measured directly with a Frequency Domain Analyzer. Frequency Deviation in ppm is calculated from the measured peak to peak value.
The Carrier Frequency Stability over Power Supply Voltage and over Temperature is measured with a Frequency Domain Analyzer in histogram mode.

10.3 Summary of Test Results/Plots

U-NII-1:5150-5250MHz worst case at 802.11a middle channel				
Voltage(%)	Power(VDC)	TEMP(℃)	Freq.Dev(Hz)	Deviation
100%	3.7	-30	20	0.0038
100%		-20	43	0.0082
100%		-10	64	0.0123
100%		0	27	0.0051
100%		+10	36	0.0070
100%		+20	43	0.0083
100%		+30	39	0.0076
100%		+40	70	0.0134
100%		+50	53	0.0102
Low Battery power	3.3	+20	46	0.0088
High Battery power	4.2	+20	57	0.0110

U-NII-1:5725-5850MHz worst case at 802.11a middle channel				
Voltage(%)	Power(VDC)	TEMP(℃)	Freq.Dev(Hz)	Deviation
100%	3.7	-30	48	0.0083
100%		-20	66	0.0114
100%		-10	23	0.0040
100%		0	44	0.0076
100%		+10	51	0.0087
100%		+20	48	0.0082
100%		+30	28	0.0049
100%		+40	38	0.0065
100%		+50	49	0.0084
Low Battery power	3.3	+20	38	0.0065
High Battery power	4.2	+20	64	0.0110

******* END OF REPORT *******