TEST REPORT

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR23-SRF0174-B Page (1) of (128)	eurofins | KCTL

1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2023-03-14

2. Use of Report : Certification

3. Name of Product / Model : Notebook PC / NP935QNA

4. Manufacturer / Country of Origin : Samsung Electronics Co., Ltd. / Vietnam

5. FCC ID : A3LNP935QNA

6. Date of Test : 2023-04-15 to 2023-05-25

7. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

8. Test method used : FCC Part 15 Subpart E, 15.407

9. Test Result : Refer to the test result in the test report

	Tested by	Technical Manager
Affirmation	Name : Sunghyun Yoon (Signature)	Name : Seungyong Kim (Signature)

2023-06-05

Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2023-05-26	Originally issued	-
2023-06-01	Updated	4,10,24,66
2023-06-05	Updated	10, 24, 25

Note. The report No. KR23-SRF0174-A is superseded by the report No. KR23-SRF0174-B.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1. General information

Client	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Manufacturer	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Factory	:	SAMSUNG ELECTRONICS VIETNAM CO.,LTD.
Address	:	Khu Cong nghiep Ten Phong 1, Yen Trung, Yen Phong, Bac Ninh, Vietnam
Laboratory	:	Eurofins KCTL Co.,Ltd.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 CAB Identifier: KR0040 ISED Number: 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	Notebook PC				
Model	:	NP935QNA				
Modulation technique		WIFI(802.11a/b/g/n/ac/ax)	:	DSSS, OFDM, OFDMA		
Number of channels		UNII-1	:	4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒), 1 ch (160 ㎒)		
		UNII-2A	:	4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)		
		UNII-2C	:	12 ch (20 ㎒), 6 ch (40 ㎒), 3 ch (80 ㎒), 1 ch (160 ㎒)		
		UNII-3	:	5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒), 1 ch (160 ㎒)		
Power source	:	DC 11.58 V				
Antenna specification		Antenna 1 (Aux)	:	PIFA Antenna		
		Antenna 2 (Main)	:	PIFA Antenna		
Antenna gain	:	Antenna 1 (Aux)			Antenna 2 (Main)	
		UNII-1	:	3.21 dBi	UNII-1	: 3.63 dBi
		UNII-2A	:	3.84 dBi	UNII-2A	: 3.67 dBi
		UNII-2C	:	3.59 dBi	UNII-2C	: 4.22 dBi
		UNII-3	:	2.19 dBi	UNII-3	: 4.22 dBi
Frequency range		UNII-1	:	5 180 ㎒ ~ 5 240 ㎒	(802.11a/n/ac/ax_HT20/VHT20/HE20)	
		UNII-1	:	5 190 ㎒ ~ 5 230 ㎒	(802.11n/ac/ax_HT40/VHT40/HE40)	
		UNII-1	:	5 210 ㎒	(802.11ac/ax_VHT80/HE80)	
		UNII-1	:	5 250 ㎒	(802.11ac/ax_VHT160/HE160)	
		UNII-2A	:	5 260 ㎒ ~ 5 320 ㎒	(802.11a/n/ac/ax_HT20/VHT20/HE20)	
		UNII-2A	:	5 270 ㎒ ~ 5 310 ㎒	(802.11n/ac/ax_HT40/VHT40/HE40)	
		UNII-2A	:	5 290 ㎒	(802.11ac/ax_VHT80/HE80)	
		UNII-2C	:	5 500 ㎒ ~ 5 720 ㎒	(802.11a/n/ac/ax_HT20/VHT20/HE20)	
		UNII-2C	:	5 510 ㎒ ~ 5 710 ㎒	(802.11n/ac/ax_HT40/VHT40/HE40)	
		UNII-2C	:	5 530 ㎒ ~ 5 690 ㎒	(802.11ac/ax_VHT80/HE80)	
		UNII-2C	:	5 570 ㎒	(802.11ac/ax_VHT160/HE160)	
		UNII-3	:	5 745 ㎒ ~ 5 825 ㎒	(802.11a/n/ac/ax_HT20/VHT20/HE20)	
		UNII-3	:	5 755 ㎒ ~ 5 795 ㎒	(802.11n/ac/ax_HT40/VHT40/HE40)	
		UNII-3	:	5 775 ㎒	(802.11ac/ax_VHT80/HE80)	
Software version	:	NP930QNA.001				
Hardware version	:	REV0.1				
Test device serial No.	:	Conducted	:	KQZZ930W300160T		
		Radiated	:	KQZZ930W300364Z, KQZZ930W300219W		
Operation temperature	:	10 ℃ ~ 35 ℃				

Notes.
- This device does not support SISO mode in UNII band.

2.1. Frequency/channel operations

This device contains the following capabilities:
WLAN (11a/b/g/n/ac/ax), Bluetooth (BDR/EDR/BLE)

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
36	5 180	52	5 260	100	5 500	149	5 745
40	5 200	56	5 280	120	5 600	157	5 785
48	5 240	64	5 320	140	5 700	165	5 825
				144	5 720		

Table 2.1.1. 802.11a/n/ac HT20/VHT20 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
38	5 190	54	5 270	102	5 510	151	5 755
46	5 230	62	5 310	118	5 590	159	5 795
				134	5 670		
				142	5 710		

Table 2.1.2. 802.11n/ac HT40/VHT40 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
42	5 210	58	5 290	106	5 530	155	5 775
				122	5 610		
				138	5 690		

Table 2.1.3. 802.11ac VHT80 mode

UNII-1,2A		UNII-2C	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
50	5 250	114	5 570

Table 2.1.4. 802.11ac VHT160 mode

2.2. Simultaneous Tx Condition

The device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the Bluetooth, 5 ㎓ or 6 ㎓ bands simultaneously on each antenna.

Simultaneous Tx condition – not RSDB

Mode	# of TX	WLAN 5 ㎓		WLAN 6 ㎓		Bluetooth	Report
		ANT 1	ANT 2	ANT 1	ANT 2	ANT 1	
WLAN + Bluetooth	2	O	O	-	-	O	√
	2	-	-	O	O	O	

Notes.

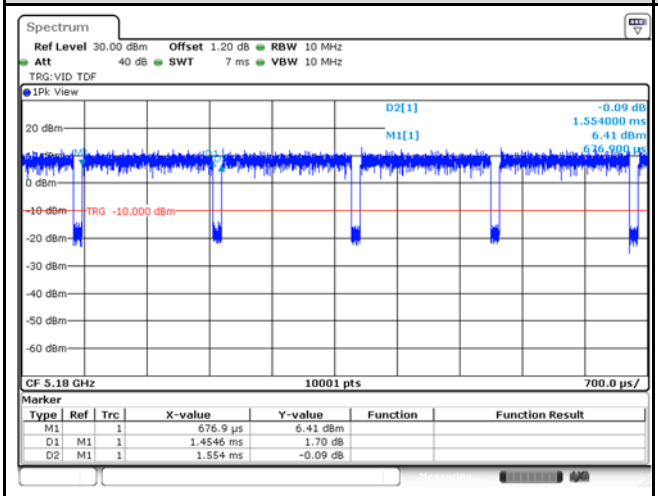
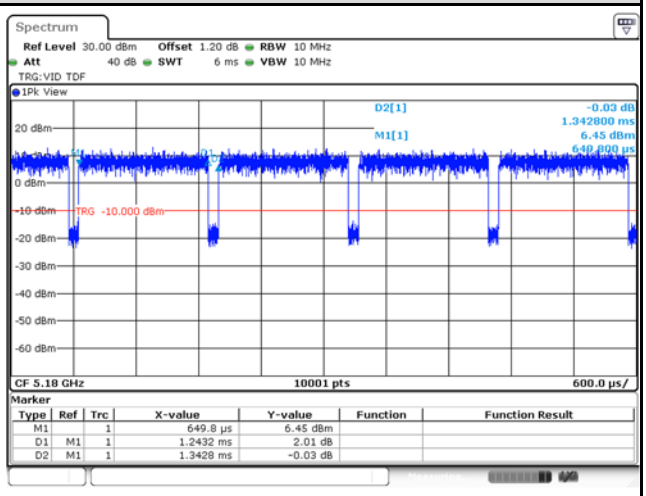
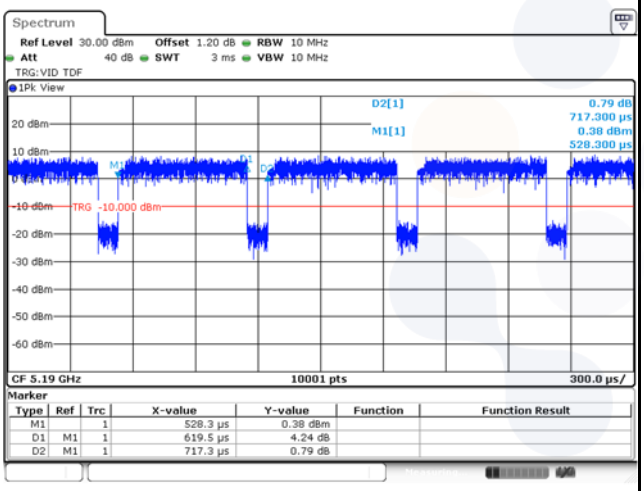
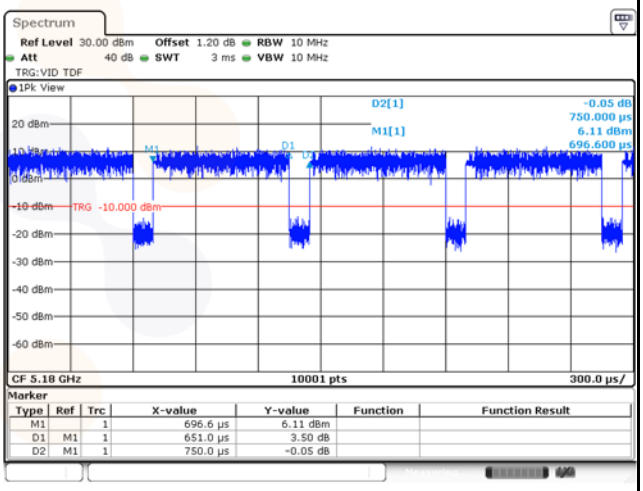
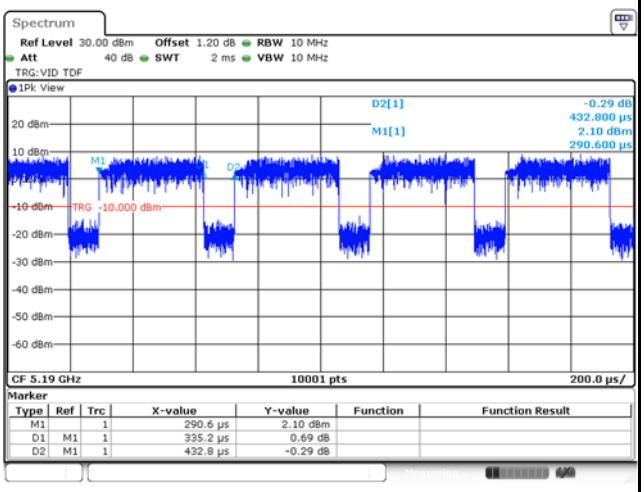
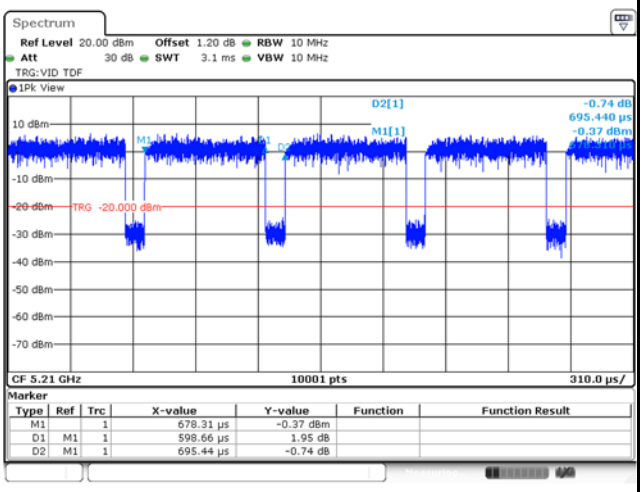
Simultaneous condition was performed as a worst case which is configured as a combination of lowest margin for each mode during radiated spurious emission.

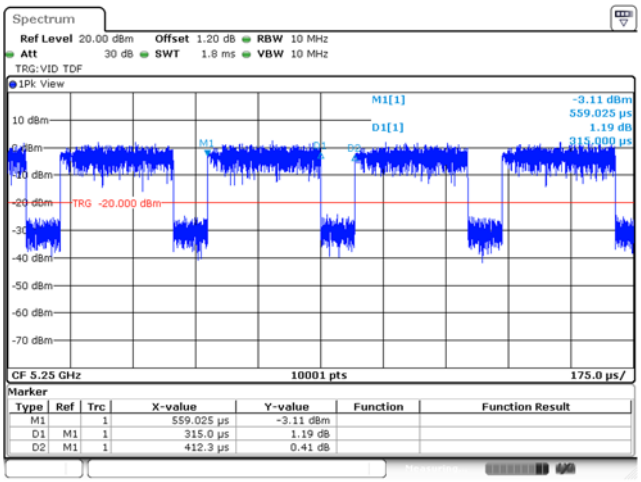
2.3. Duty Cycle Factor

Test mode	Period (ms)	T_{on} time (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	1.554	1.455	0.926 3	92.63	0.29
802.11n_HT20	1.343	1.243	0.925 5	92.55	0.34
802.11n_HT40	0.717	0.620	0.864 7	86.47	0.63
802.11ac_VHT20	0.750	0.651	0.868 0	86.80	0.61
802.11ac_VHT40	0.433	0.335	0.773 7	77.37	1.11
802.11ac_VHT80	0.695	0.599	0.861 9	86.19	0.65
802.11ac_VHT160	0.412	0.315	0.764 6	76.46	1.17

Notes.

1. Duty cycle (Linear) = T_{on} time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not compensated to average result if duty cycle is more than 98%

802.11a	802.11n_HT20
	
802.11n_HT40	**802.11ac_VHT20**
	
802.11ac_VHT40	**802.11ac_VHT80**
	

802.11ac_VHT160	
	Blank

3. Antenna requirement

Requirement of FCC part section 15.203

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

- The transmitter has permanently attached PIFA Antenna (Internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.407.

3.1 Antenna information

Mode	CDD	MIMO
	ANT 1 + 2	ANT 1 + 2
802.11a	√	√
802.11n HT20	√	√
802.11n HT40	√	√
802.11ac VHT20	√	√
802.11ac VHT40	√	√
802.11ac VHT80	√	√
802.11ac VHT160	√	√

√ = Support, ✕ = Not support

3.2 Directional Gain Calculations

According to clause F), 2), d), (i) of KDB 662911 D01 Multiple Transmitter Output, Directional gain may be calculated by using the formulas as below.

3.2.1. Directional Antenna Gain

Band	ANT 1 Gain (dBi)	ANT 2 Gain (dBi)	Power Directional Gain (dBi)
UNII 1	3.21	3.63	6.43
UNII 2A	3.84	3.67	6.77
UNII 2C	3.59	4.22	6.92
UNII 3	2.19	4.22	6.27

Note.

1) Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, …, G_N dBi
   Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi
2) 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 if the antenna exceeds 6 dBi.

Sample calculation

In case of UNII 1, directional gain = $10 \log[(10^{3.21/20} + 10^{3.63/20})^2 / 2] = 6.43$ dBi.

4. Summary of tests

FCC Part section(s)	Parameter	Test Condition	Test results
15.407(a)	Maximum conducted output power	Conducted	Pass
15.407(a)	Maximum power spectral density		Pass
15.407(a)	26 dB Channel Bandwidth		Pass
15.407(e)	6 dB Channel Bandwidth		Pass
15.207(a)	AC Conducted Emissions		Pass
15.407(b), 15.205(a), 15.209(a)	Spurious emission	Radiated	Pass
	Band-edge, restricted band		Pass

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. All the radiated tests have been performed two modes (Notebook and Tablet mode) and the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z.
   Worst case: Notebook mode, X axis
4. All configurations have been performed (stand-alone, stand-alone with TA, with accessories) and the worst case is Stand-alone with TA.
5. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 662911 D01 v02r01
   - KDB 789033 D02 v02r01
6. Based on the baseline scan, the worst-case data rates were:
   802.11a mode: 6Mbps
   802.11n HT20 mode: MCS0
   802.11n HT40 mode: MCS0
   802.11ac VHT20 mode: MCS0
   802.11ac VHT40 mode: MCS0
   802.11ac VHT80 mode: MCS0
   802.11ac VHT160 mode: MCS0

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.3 dB	
Radiated spurious emissions	Below 30 ㎒:	2.3 dB
	30 ㎒ ~ 1 000 ㎒	2.5 dB
	1 000 ㎒ ~ 18 000 ㎒	4.7 dB
	Above 18 000 ㎒	4.8 dB
Conducted emissions	9 ㎑ ~ 150 ㎑	2.7 dB
	150 ㎑ ~ 30 ㎒	2.7 dB

6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.
With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

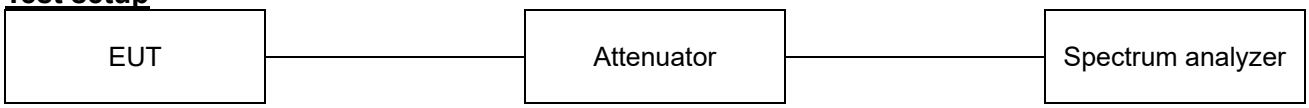
Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	10.13	9 000	12.63
50	10.17	10 000	12.80
100	10.26	11 000	12.96
200	10.37	12 000	13.27
300	10.45	13 000	13.39
400	10.53	14 000	13.51
500	10.61	15 000	13.59
600	10.66	16 000	13.68
700	10.71	17 000	13.59
800	10.76	18 000	13.73
900	10.81	19 000	13.76
1 000	10.84	20 000	13.88
2 000	11.21	21 000	14.22
3 000	11.51	22 000	14.09
4 000	11.74	23 000	14.16
5 000	11.95	24 000	14.17
6 000	12.06	25 000	14.19
7 000	12.33	26 000	14.50
8 000	12.44	26 500	14.59

Notes:
Offset(㏈) = RF cable loss(㏈) + Attenuator(㏈)

7. Test results

7.1. Maximum conducted output power

Test setup



Limit

According to §15.407(a)

Band	EUT category		Conducted output power limit
UNII-1		Outdoor access point	1 W (30 dBm)
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	250 mW (23.98 dBm)
UNII-2A	√		250 mW or 11 dBm + 10logB[1)]
UNII-2C	√		250 mW or 11 dBm + 10logB[1)]
UNII-3	√		1 W (30 dBm)

Note:

1) Conducted output power limit B is the 26 dB emission bandwidth.

Test procedure

ANSI C63.10-2013-Section 12.3.2.4 or 12.3.3.1, 14.2
KDB 789033 D02 v02r01 - Section E.2.d) or E.3.a)
KDB 662911 D01 v02r01 – Section E).1) and Section F)

Test settings

Used test method is Section E.2.d)

◆ **KDB 789033 D02 v02r01**

Section E.2.d)

Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction):

(i) Measure the duty cycle, x, of the transmitter output signal as described in II.B..

(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(iii) Set RBW = 1 ㎒

(iv) Set RBW ≥ 3 ㎒

(v) Number of points in sweep ≥ 2 x span/RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)

(vi) Sweep time = auto.

(vii) Detector = power averaging (rms), if available. Otherwise use sample detector mode.

(viii) Do not use sweep triggering. Allow the sweep to “free run.”

(ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.

(x) 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 ㎒ intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(xi) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log(1/0,25) = 6 ㏈ if the duty cycle is 25%.

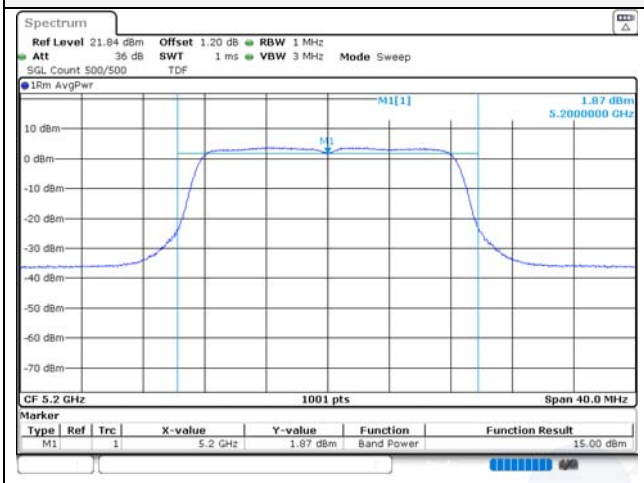
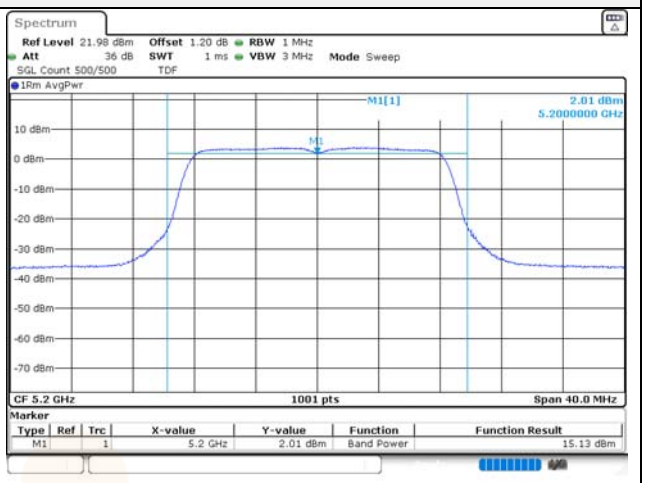
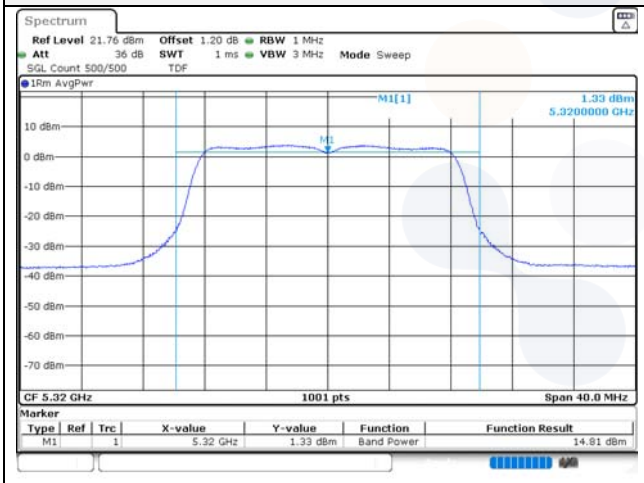
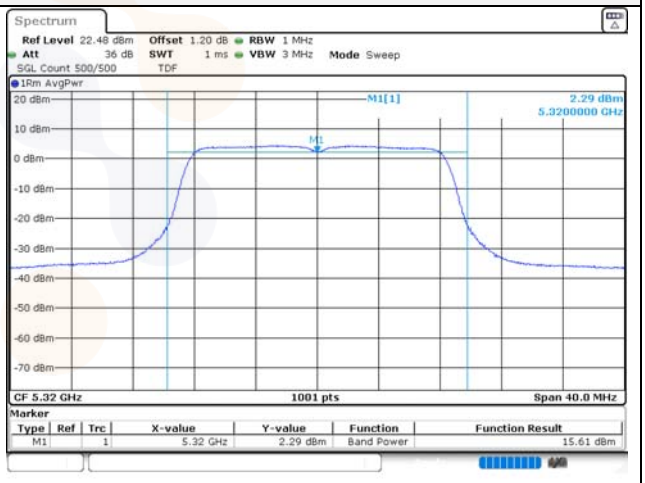
Test results

Test mode	Band	Frequency (㎒)	Measured output power				Limit (dBm)
			Reading (dBm)		DCF (dB)	Result (dBm)	
			ANT1	ANT2			
802.11a	UNII 1	5 180	15.08	15.04	0.29	18.36	23.55
		5 200	15.00	15.13		18.37	
		5 240	15.06	14.39		18.04	
	UNII 2A	5 260	14.71	14.63		17.97	23.13
		5 280	14.74	14.65		18.00	
		5 320	14.81	15.61		18.53	
	UNII 2C	5 500	15.11	14.69		18.21	22.98
		5 600	15.19	15.07		18.43	
		5 700	14.97	14.62		18.10	
	UNII 3	5 745	15.50	15.41		18.76	29.73
		5 785	15.10	14.33		18.03	
		5 825	14.55	15.22		18.20	
802.11n HT20	UNII 1	5 180	14.85	14.84	0.34	18.20	23.55
		5 200	14.77	14.90		18.19	
		5 240	14.85	14.21		17.89	
	UNII 2A	5 260	14.56	14.45		17.86	23.21
		5 280	14.56	14.50		17.88	
		5 320	14.64	15.64		18.52	
	UNII 2C	5 500	14.96	14.56		18.11	23.06
		5 600	15.04	14.96		18.35	
		5 700	14.82	14.49		18.01	
	UNII 3	5 745	15.24	15.23		18.59	29.73
		5 785	14.86	14.22		17.90	
		5 825	14.38	15.13		18.12	
802.11n HT40	UNII 1	5 190	13.00	12.06	0.63	16.20	23.55
		5 230	13.04	11.82		16.11	
	UNII 2A	5 270	12.14	12.08		15.75	23.21
		5 310	12.50	12.97		16.38	
	UNII 2C	5 510	12.65	11.90		15.93	23.06
		5 590	12.48	12.07		15.92	
		5 670	12.47	13.00		16.38	
	UNII 3	5 755	13.24	12.11		16.35	29.73
		5 795	12.22	11.70		15.61	

Test mode	Band	Frequency (㎒)	Measured output power				Limit (dBm)
			Reading (dBm)		DCF (dB)	Result (dBm)	
			ANT1	ANT2			
802.11ac VHT20	UNII 1	5 180	12.99	12.10	0.61	16.19	23.55
		5 200	12.94	12.19		16.20	
		5 240	12.75	11.79		15.92	
	UNII 2A	5 260	12.25	11.90		15.70	23.21
		5 280	12.28	11.91		15.72	
		5 320	12.55	12.72		16.26	
	UNII 2C	5 500	12.49	11.89		15.82	23.06
		5 600	12.75	12.12		16.07	
		5 700	12.53	11.85		15.82	
	UNII 3	5 745	12.99	12.66		16.45	29.73
		5 785	12.77	11.60		15.84	
		5 825	12.07	12.74		16.04	
802.11ac VHT40	UNII 1	5 190	12.14	11.84	1.11	16.11	23.55
		5 230	12.28	11.59		16.07	
	UNII 2A	5 270	11.82	11.57		15.82	23.21
		5 310	11.75	12.12		16.06	
	UNII 2C	5 510	11.69	11.55		15.74	23.06
		5 590	12.04	11.86		16.07	
		5 670	11.73	12.13		16.05	
	UNII 3	5 755	12.23	11.51		16.01	29.73
		5 795	11.77	11.48		15.75	
802.11ac VHT80	UNII 1	5 210	12.95	11.91	0.65	16.12	23.55
	UNII 2A	5 290	12.25	11.83		15.71	23.21
	UNII 2C	5 530	12.43	12.16		15.96	23.06
		5 610	12.37	12.06		15.88	
	UNII 3	5 775	12.52	11.66		15.77	29.73
802.11ac VHT160	UNII 1	5 250	11.59	10.36	1.17	15.20	23.21
	UNII 2C	5 570	11.46	10.21		15.06	23.06

Note.
1. Result(dBm) = $10\log(10^{(ANT\ 1/10)} + 10^{(ANT\ 2/10)})$ + D.C.F
2. Directional gains are greater than 6 dBi, So the limits are reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

In order to simplify the report, attached plots were the worst case per bandwidth

ANT 1	ANT 2
UNII-1 / 802.11a / Mid ch.	
	
UNII-2A / 802.11a / High ch.	
	
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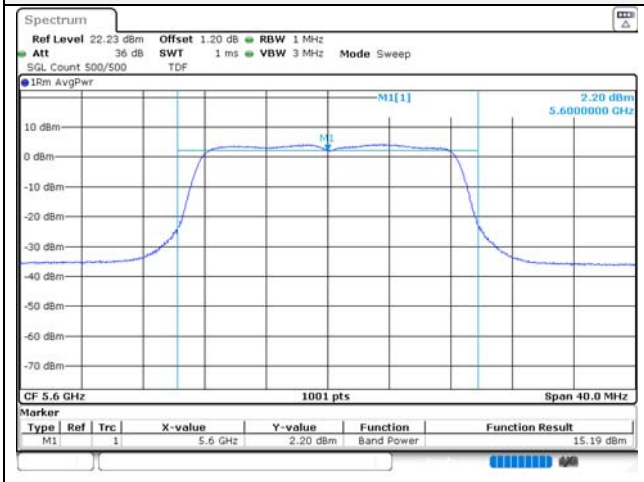	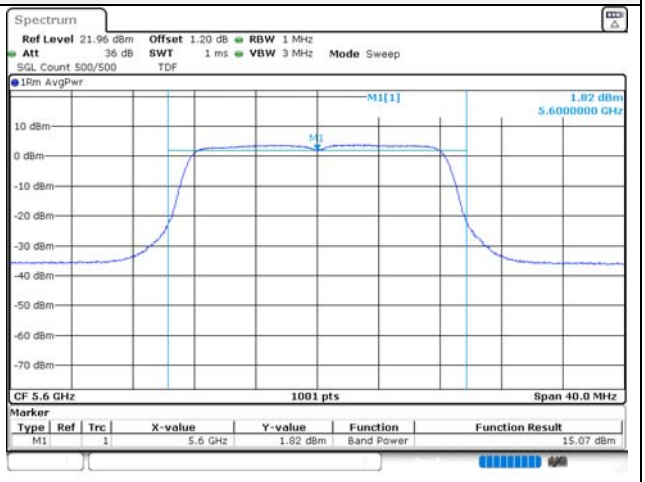

ANT 1	ANT 2
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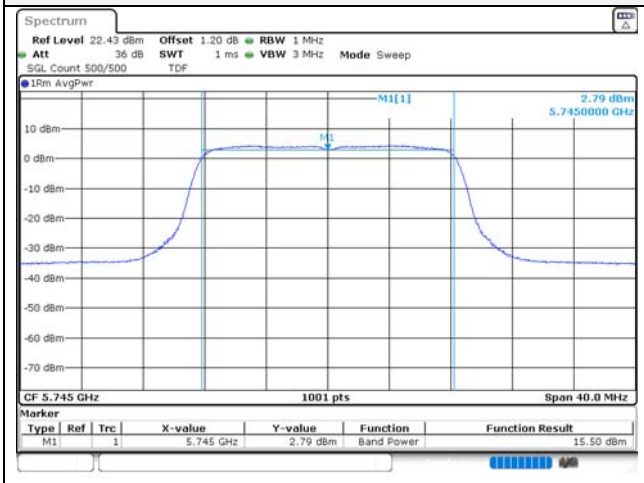
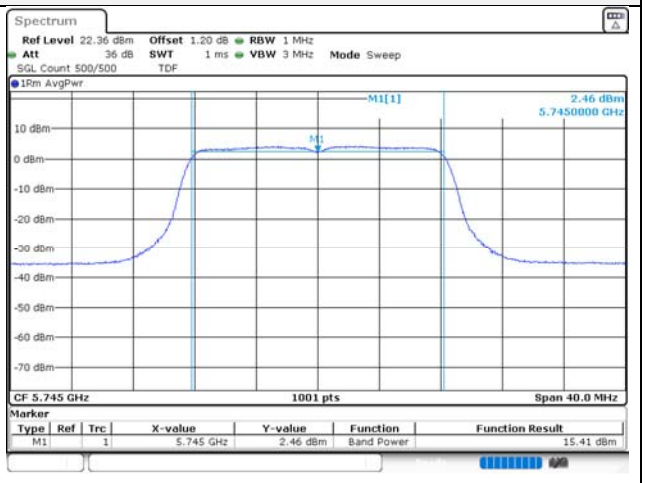
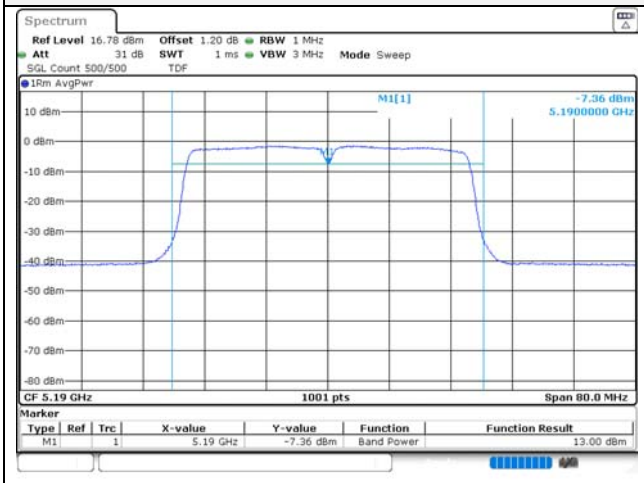
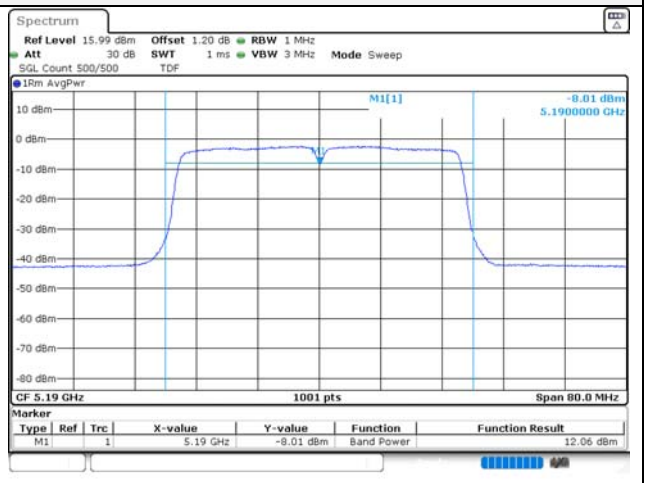
	

ANT 1	ANT 2
UNII-1 / 802.11n HT40 / Low ch.	
	
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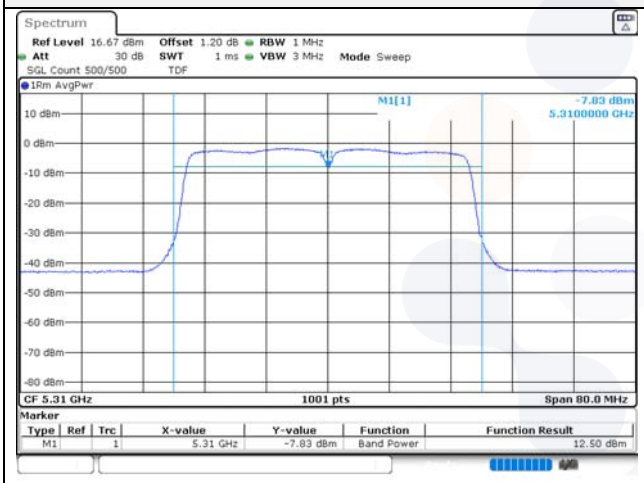	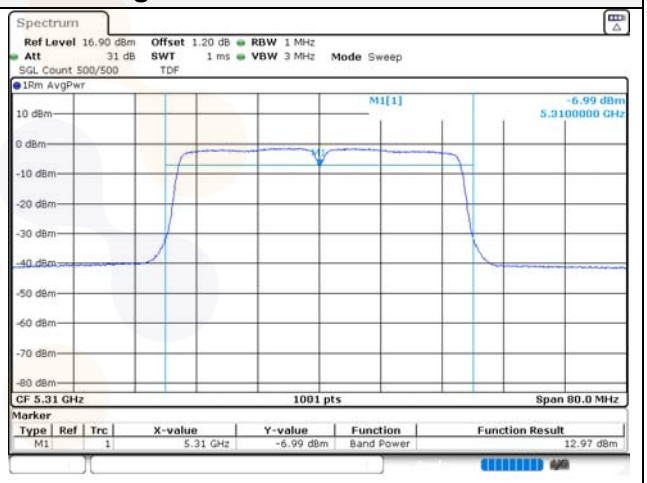
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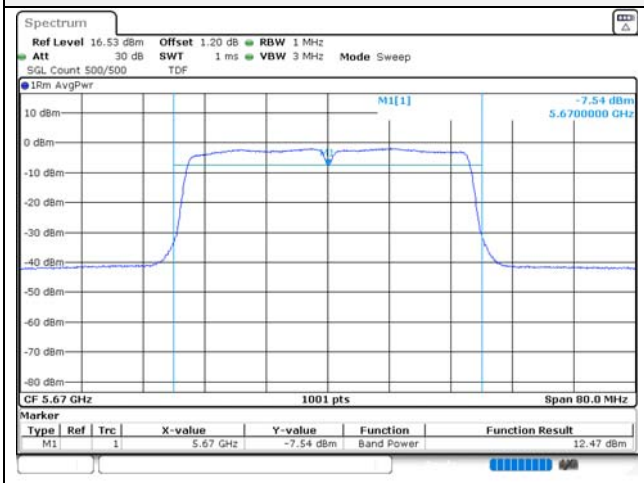
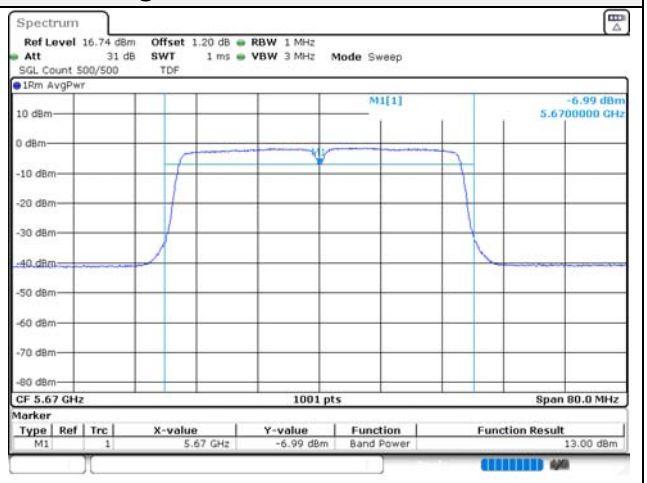
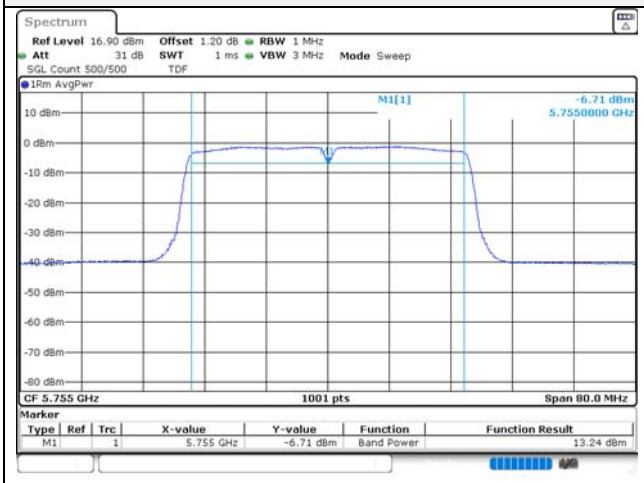
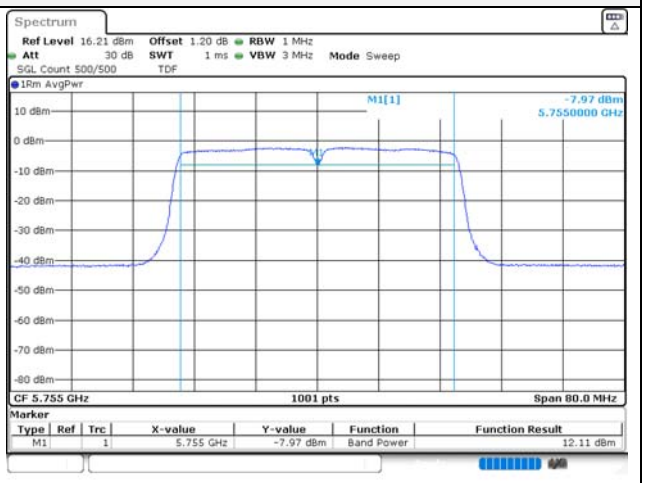
	

ANT 1	ANT 2
UNII-3 / 802.11n HT40 / Low ch.	
	

ANT 1	ANT 2
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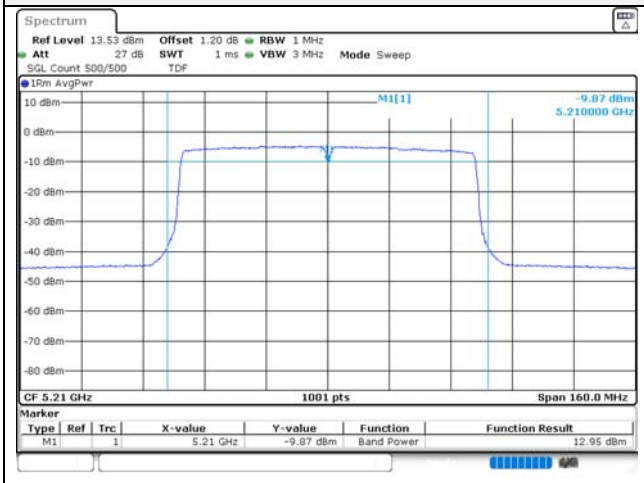	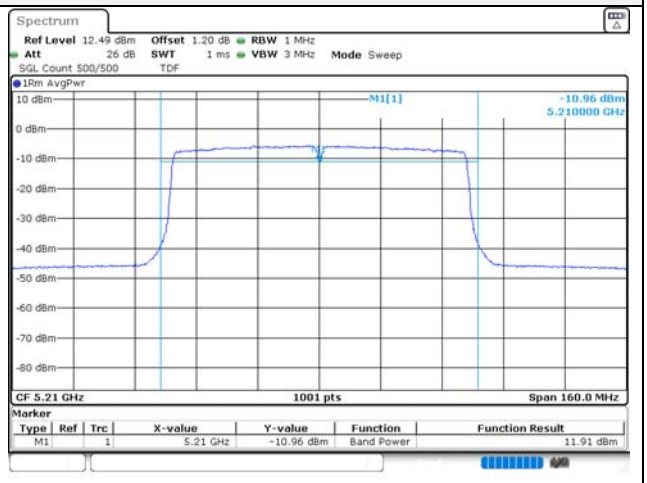
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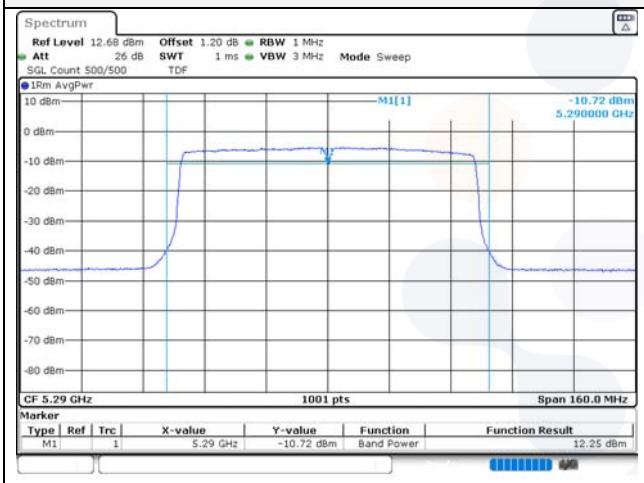	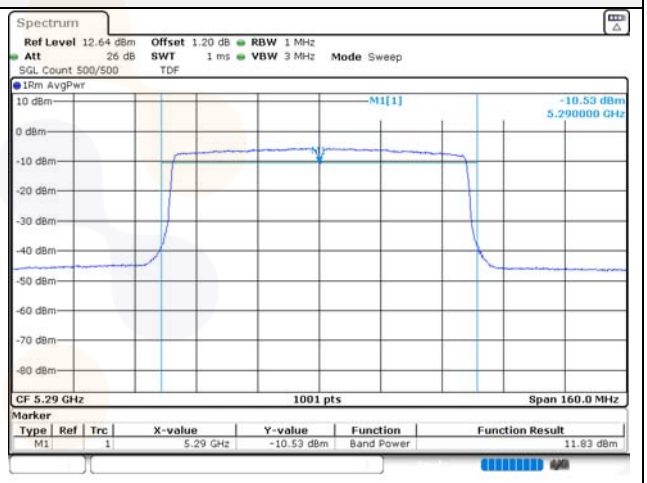
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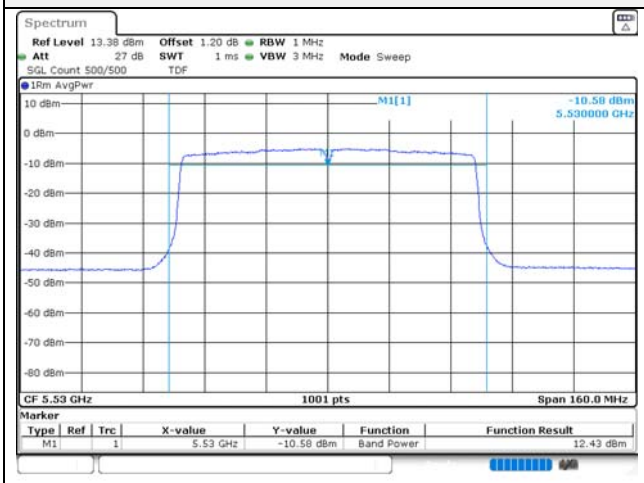
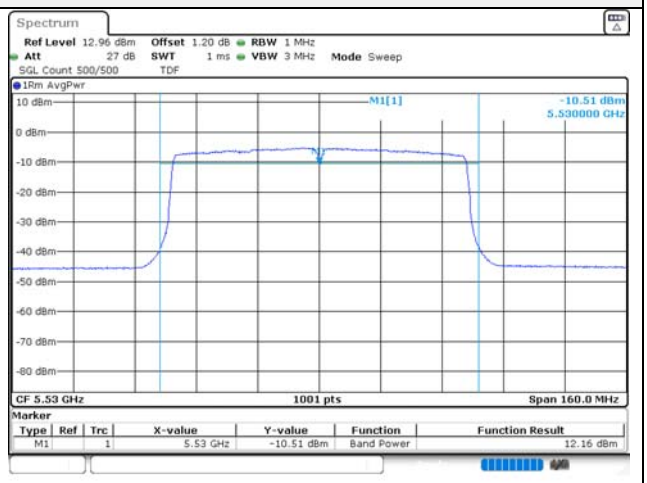
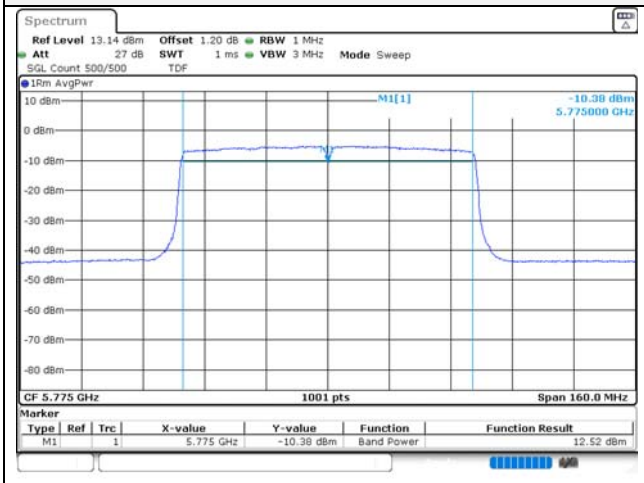
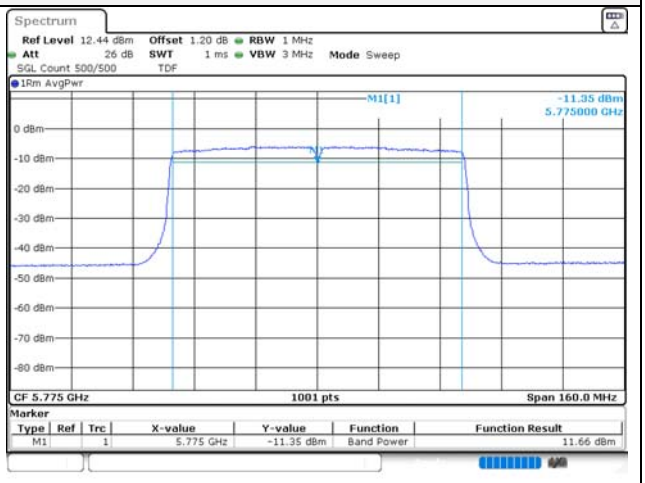
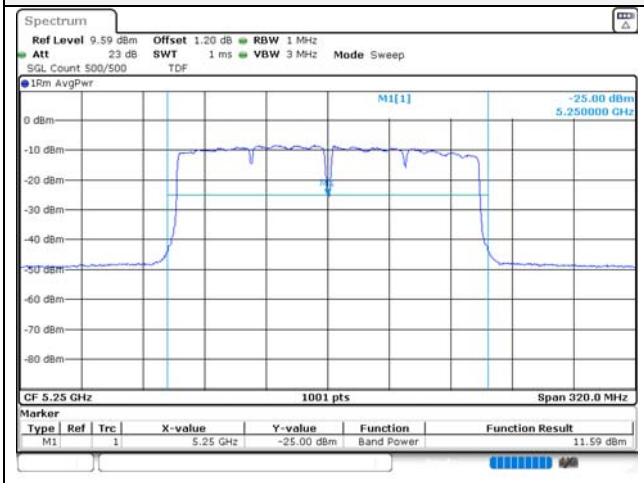
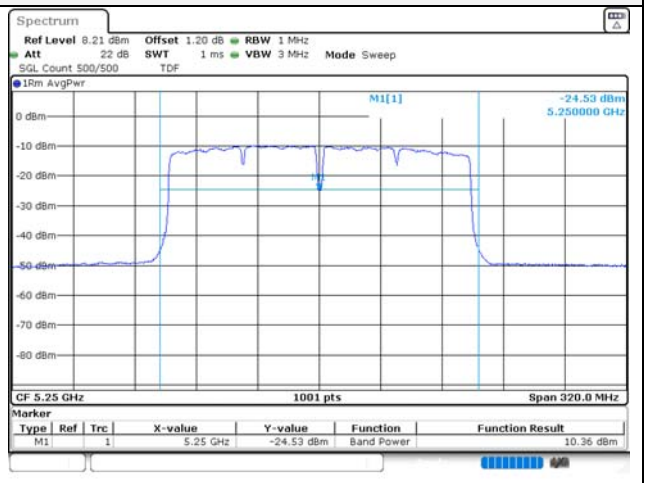
	

ANT 1	ANT 2
UNII-3 / 802.11ac VHT80 / Mid ch.	
	

ANT 1	ANT 2
UNII-1 / 802.11ac VHT160 / Mid ch.	
	
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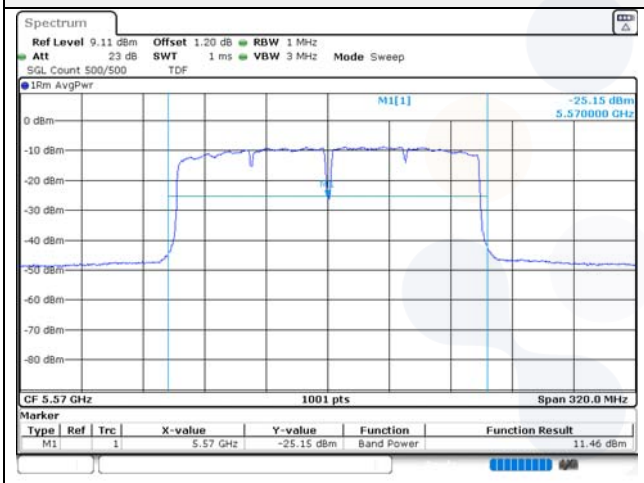
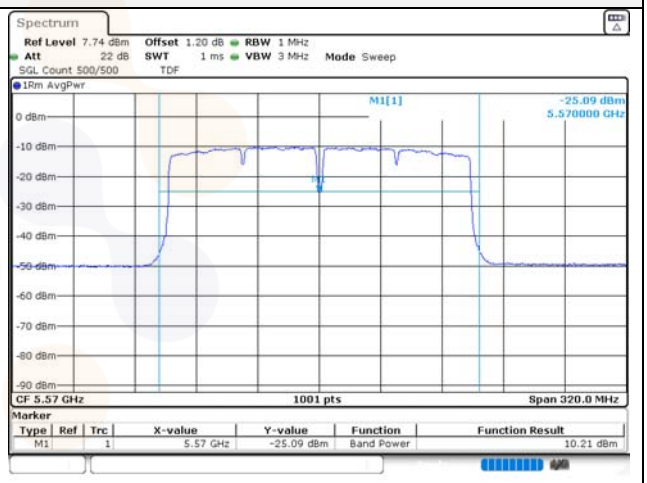
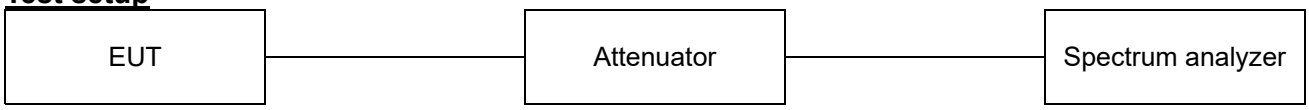
	

7.2. Maximum Power Spectral Density

Test setup



Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	17dBm/MHz
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	11 dBm /MHz
UNII-2A	√		11 dBm /MHz
UNII-2C	√		11 dBm /MHz
UNII-3	√		30 dBm /500 kHz

Test procedure

ANSI C63.10-2013 Section 12.3.2.2, 14.3.2.2
KDB 789033 D02 v02r01 - Section E and F
KDB 662911 D01 v02r01 - Section E). 2) and Section F)

Test settings

Section F

The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission. Refer to III.A for additional guidance for devices that use channel aggregation.

1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled,
   “Compute power….” (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
2. Search function on the instrument to find the peak of the spectrum and record its value.
3. Adjustments to the peak value of the spectrum, if applicable:

   a) If Method SA-2 or SA-2 Alternative was used, add 10 log (1/x), where x is the duty cycle, to the peak of the spectrum.
   b) If Method SA-3 Alternative was used and the linear mode was used in II.E.2.g) (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
4. The result is the Maximum PSD over 1 MHz reference bandwidth
5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in Section 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 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 ㎒, or 500 ㎑). If measurements are performed using a reduced resolution bandwidth (< 1 ㎒, or < 500 ㎑) and integrated over 1 ㎒, or 500 ㎑ bandwidth, the following adjustments to the procedures apply:

a) Set RBW≥1/T, where T is defined in II.B.I.a).
b) Set VBW≥3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 ㎑, add 10 log (500 ㎑ /RBW) to the measured result, whereas RBW (<500 ㎑) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
d) If measurement bandwidth of Maximum PSD is specified in 1 ㎒, add 10 log (1㎒/RBW) to the measured result, whereas RBW (< 1 ㎒) 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 ㎑ for the II.F.5.c) and II.F.5.d), since RBW=100 ㎑ is available on nearly all spectrum analyzers.
- Method SA-2 is used.

Test results

Test mode	Band	Frequency (㎒)	Measured PSD (dBm/㎒)		DCF (dB)	Maximum PSD (dB m/㎒)	Limit (dBm/㎒)
			ANT1	ANT2			
802.11a	UNII 1	5 180	3.90	3.80	0.29	7.15	10.57
		5 200	3.77	3.95		7.16	
		5 240	3.92	3.19		6.87	
	UNII 2A	5 260	3.59	3.52		6.86	10.23
		5 280	3.78	3.50		6.94	
		5 320	3.86	4.63		7.56	
	UNII 2C	5 500	3.96	3.43		7.00	10.08
		5 600	4.16	3.84		7.30	
		5 700	3.77	3.31		6.85	
802.11n HT20	UNII 1	5 180	3.44	3.54	0.34	6.84	10.57
		5 200	3.55	3.42		6.84	
		5 240	3.48	2.74		6.48	
	UNII 2A	5 260	3.20	3.09		6.50	10.23
		5 280	3.46	3.24		6.70	
		5 320	3.37	4.22		7.17	
	UNII 2C	5 500	3.64	3.03		6.70	10.08
		5 600	3.91	3.53		7.07	
		5 700	3.56	2.94		6.61	
802.11n HT40	UNII 1	5 190	-1.43	-2.18	0.63	1.85	10.57
		5 230	-1.05	-2.11		2.09	
	UNII 2A	5 270	-1.79	-2.18		1.66	10.23
		5 310	-1.39	-1.39		2.25	
	UNII 2C	5 510	-1.46	-2.35		1.76	10.08
		5 590	-1.35	-2.21		1.88	
		5 670	-1.45	-1.40		2.22	
802.11ac VHT20	UNII 1	5 180	1.40	0.55	0.61	4.62	10.57
		5 200	1.25	0.63		4.57	
		5 240	1.19	0.31		4.39	
	UNII 2A	5 260	0.92	0.52		4.34	10.23
		5 280	0.75	0.42		4.21	
		5 320	1.08	1.22		4.77	
	UNII 2C	5 500	0.96	0.41		4.31	10.08
		5 600	1.17	0.69		4.56	
		5 700	0.99	0.38		4.32	

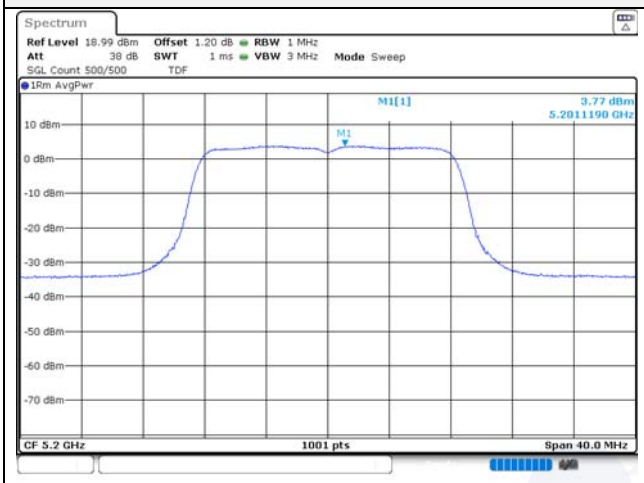
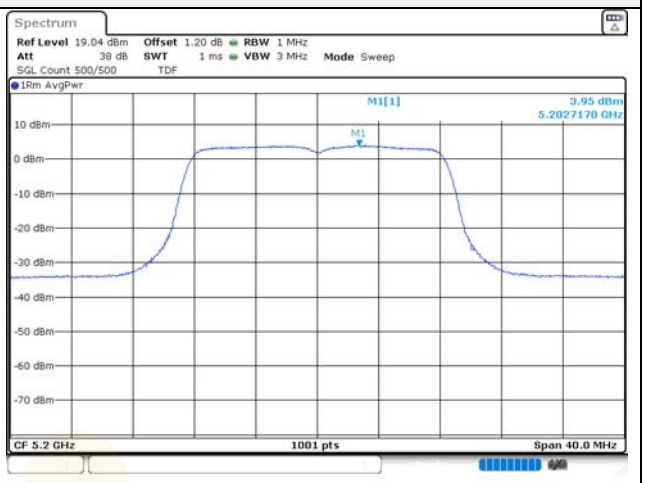
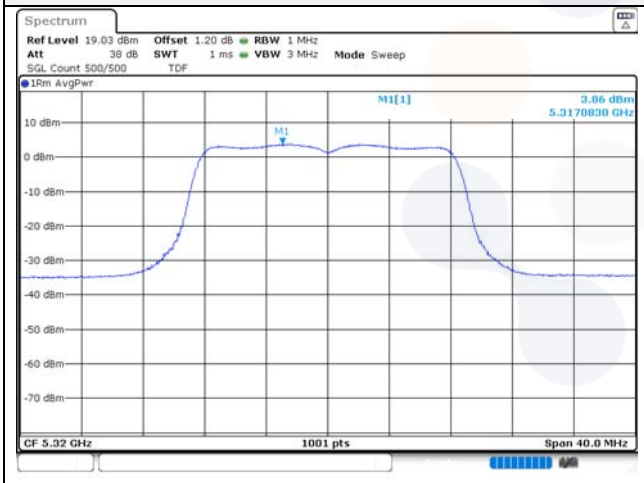
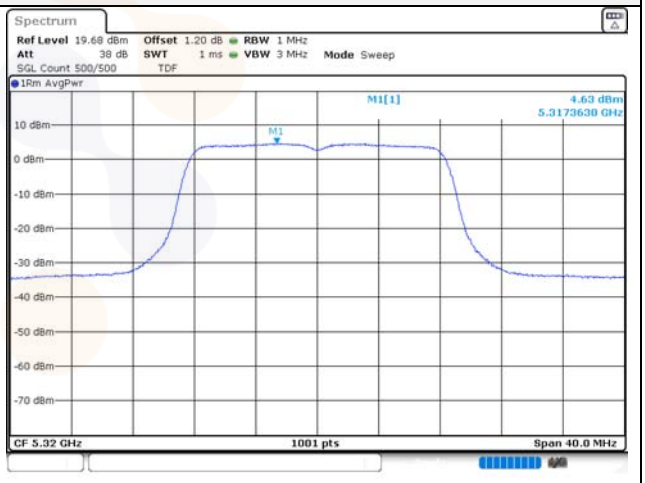
Test mode	Band	Frequency (㎒)	Measured PSD (dBm/㎒)		DCF (dB)	Maximum PSD (dB m/㎒)	Limit (dBm/㎒)
			ANT1	ANT2			
802.11ac VHT40	UNII 1	5 190	-2.08	-2.73	1.11	1.73	10.57
		5 230	-1.79	-2.74		1.88	
	UNII 2A	5 270	-2.51	-2.86		1.44	10.23
		5 310	-2.41	-1.90		1.97	
	UNII 2C	5 510	-2.43	-2.96		1.43	10.08
		5 590	-2.58	-2.59		1.54	
		5 670	-2.43	-1.84		2.00	
802.11ac VHT80	UNII 1	5 210	-4.49	-5.69	0.65	-1.39	10.57
	UNII 2A	5 290	-5.26	-5.67		-1.80	10.23
	UNII 2C	5 530	-5.03	-5.39		-1.55	10.08
		5 610	-5.11	-5.35		-1.57	
802.11ac VHT160	UNII 1	5 250	-8.48	-9.64	1.17	-4.84	10.23
	UNII 2C	5 570	-8.55	-10.24		-5.13	10.08

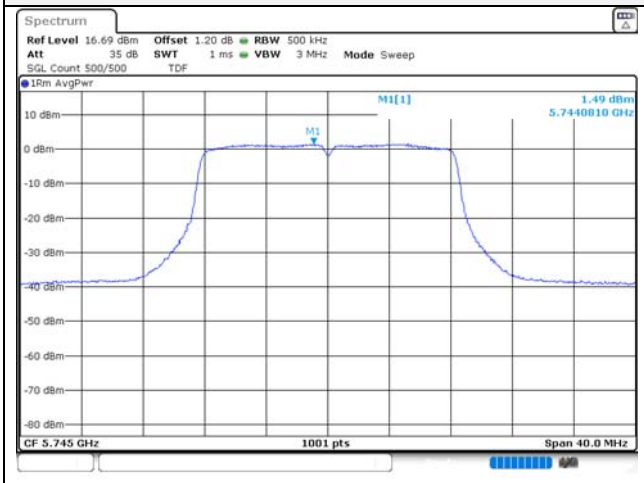
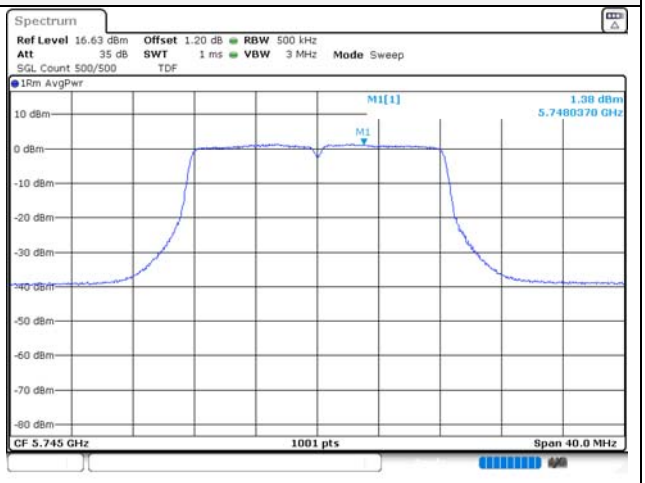
Test mode	Band	Frequency (㎒)	Measured PSD (dBm/㎒)		DCF (dB)	Maximum PSD (dBm /500 ㎑)	Limit (dBm /500 ㎑)
			ANT1	ANT2			
802.11a	UNII 3	5 745	1.49	1.38	0.29	4.74	29.73
		5 785	1.04	0.29		3.98	
		5 825	0.40	1.24		4.14	
802.11n HT20		5 745	1.13	1.19	0.34	4.51	
		5 785	0.65	0.02		3.70	
		5 825	0.01	0.99		3.88	
802.11n HT40		5 755	-4.11	-4.79	0.63	-0.80	
		5 795	-4.93	-5.16		-1.40	
802.11ac VHT20		5 745	-1.30	-1.54	0.61	2.20	
		5 785	-1.71	-2.60		1.49	
		5 825	-2.26	-1.56		1.72	
802.11ac VHT40		5 755	-4.80	-5.27	1.11	-0.91	
		5 795	-5.45	-5.56		-1.38	
802.11ac VHT80		5 775	-7.89	-8.80	0.65	-4.66	

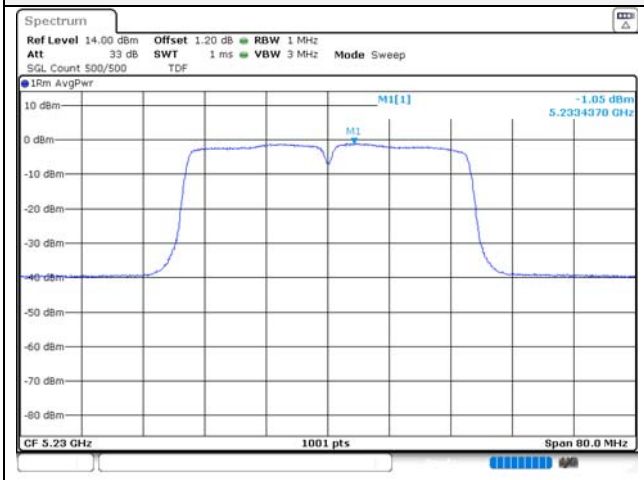
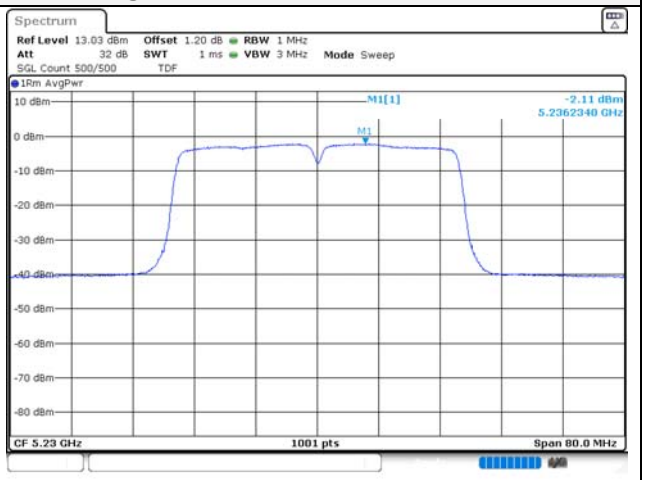
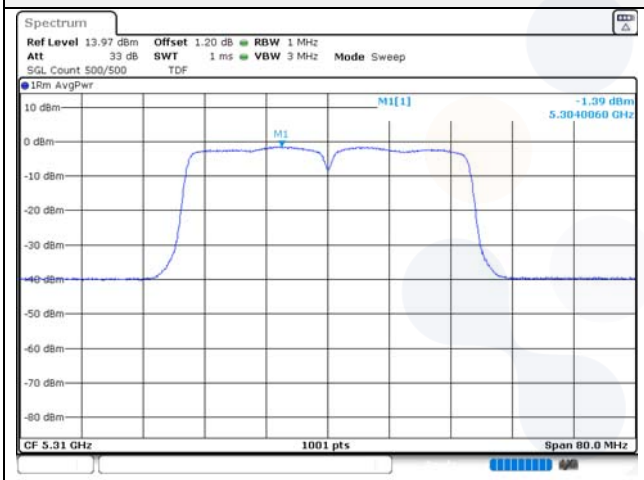
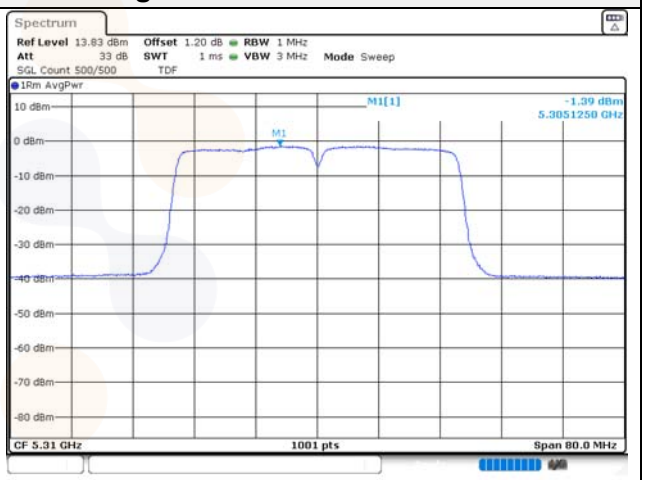
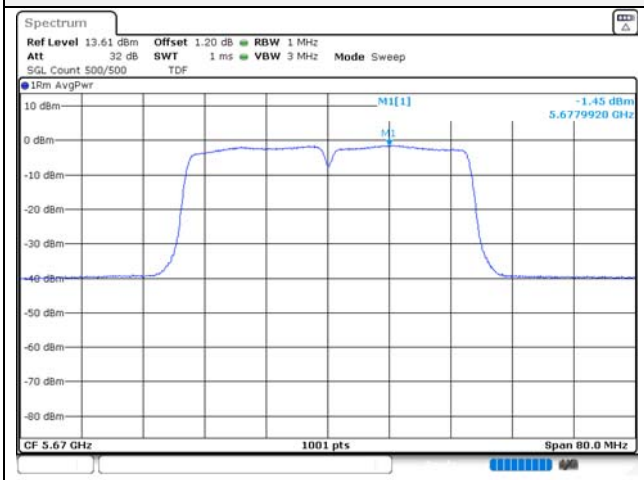
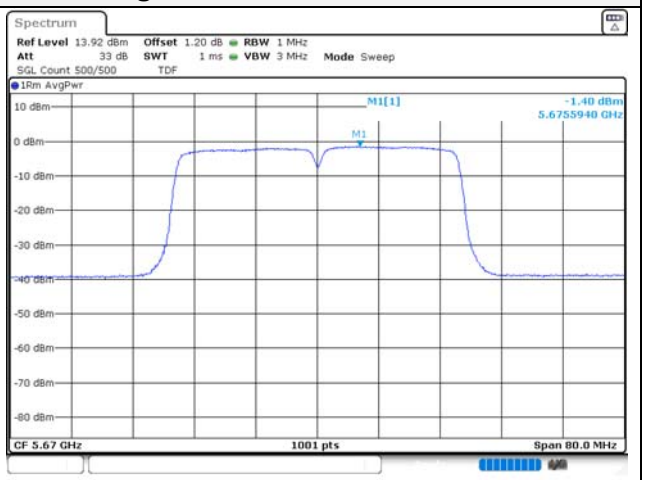
Notes:

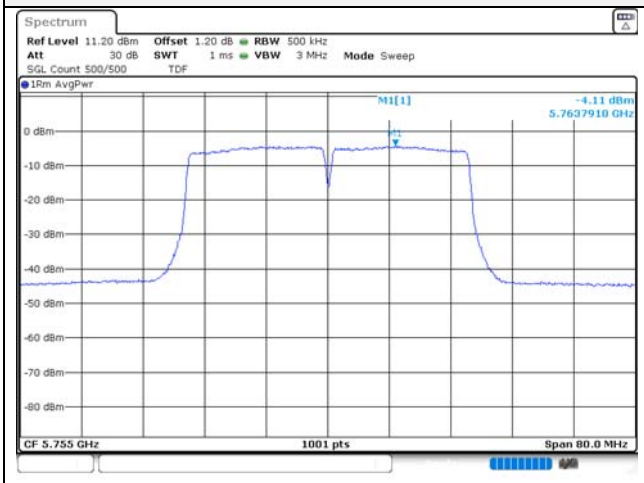
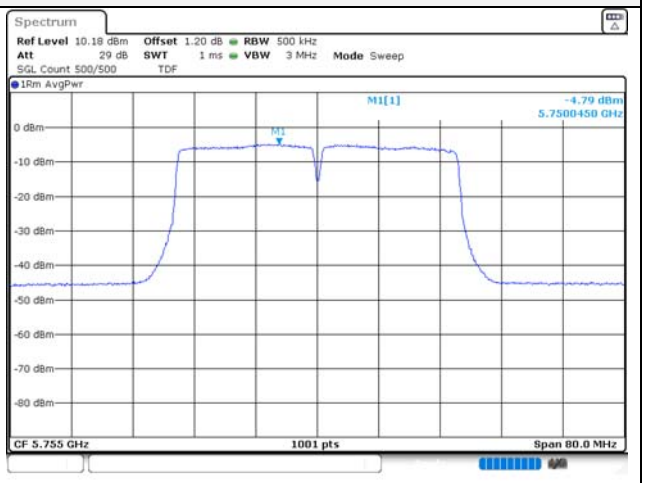
1. Maximum PSD calculation
- Maximum PSD = Measured 10log($10^{(ANT\ 1/10)}$ + $10^{(ANT\ 2/10)}$) + D.C.F
2. Directional gains are greater than 6 dBi, So the limits are reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

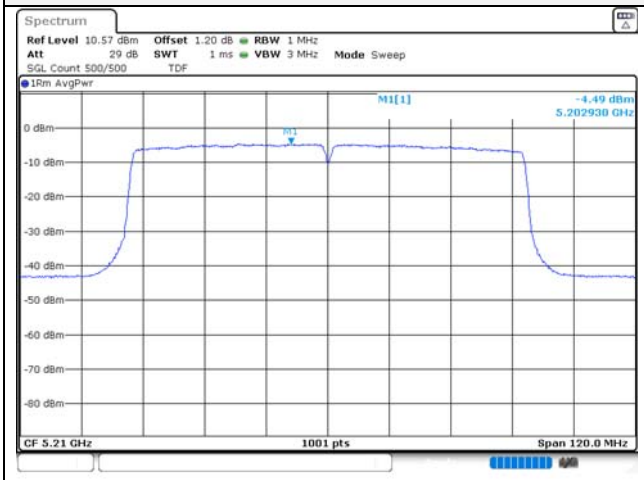
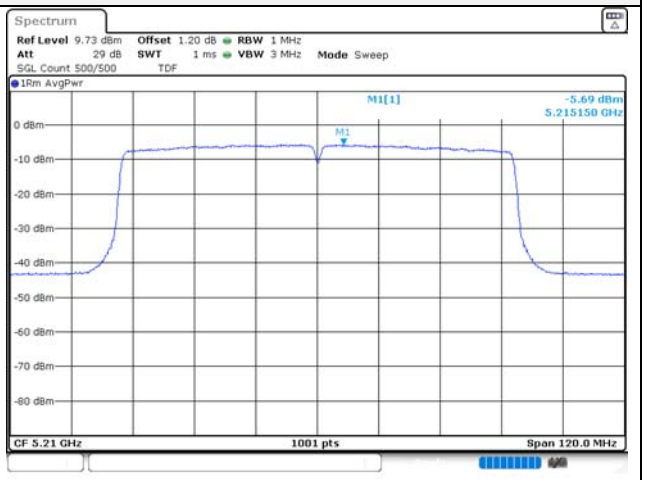
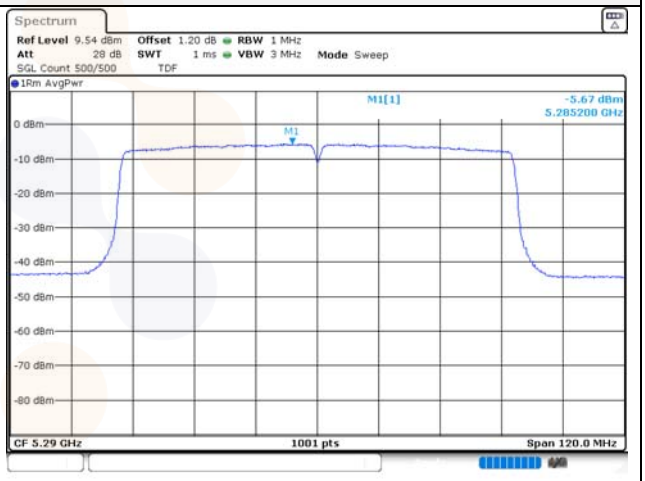
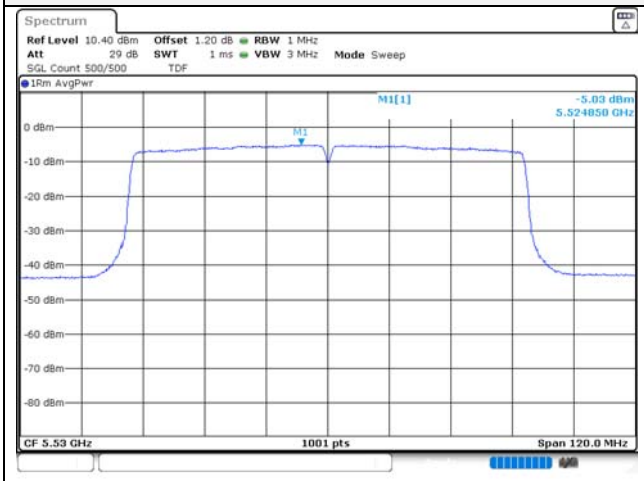
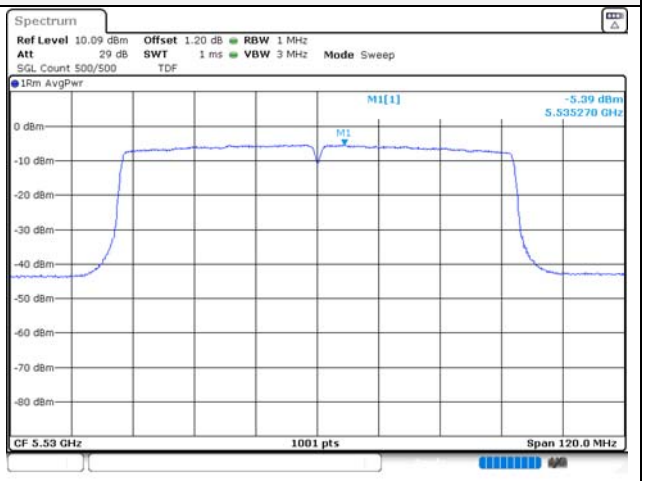
In order to simplify the report, attached plots were the worst case per bandwidth

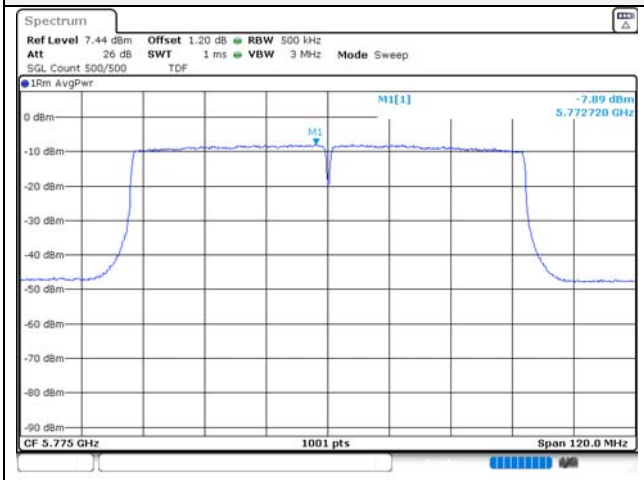
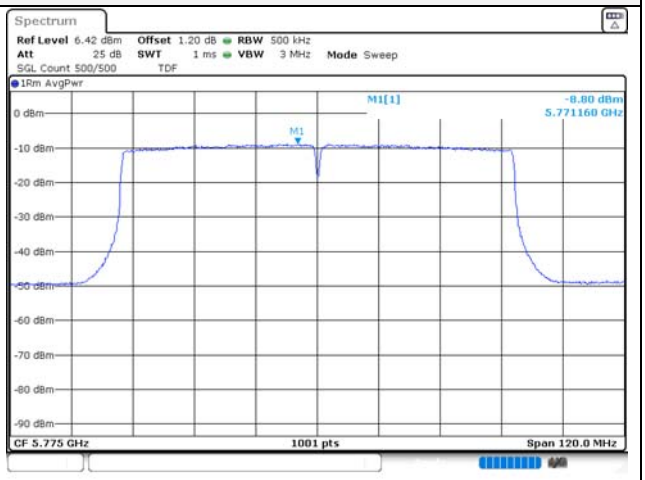
ANT 1	ANT 2
UNII-1 / 802.11a / Mid ch.	
	
UNII-2A / 802.11a / High ch.	
	
UNII-2C / 802.11a / Mid ch.	
	

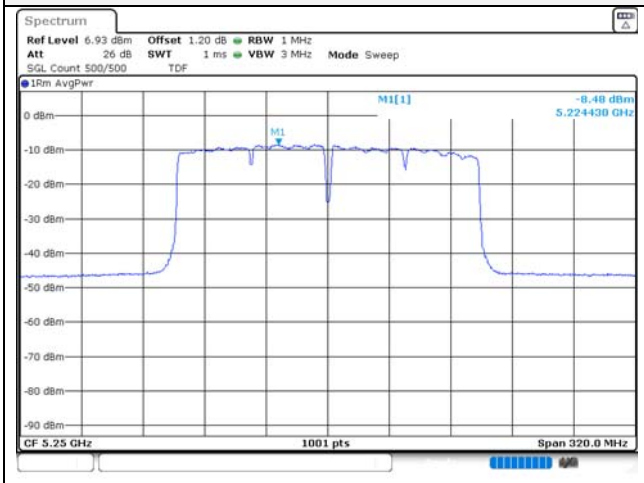
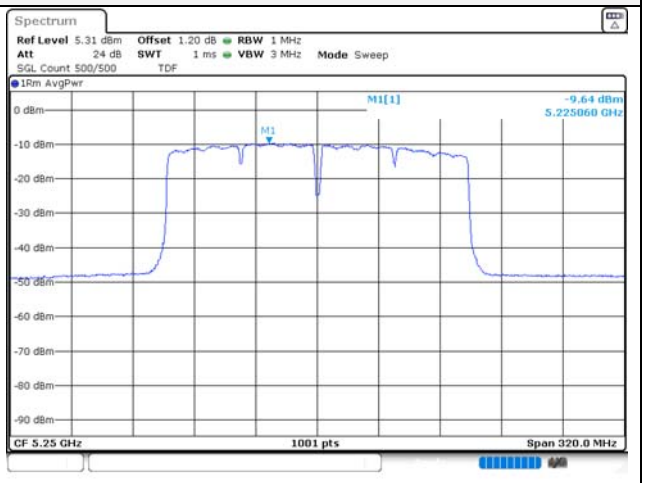
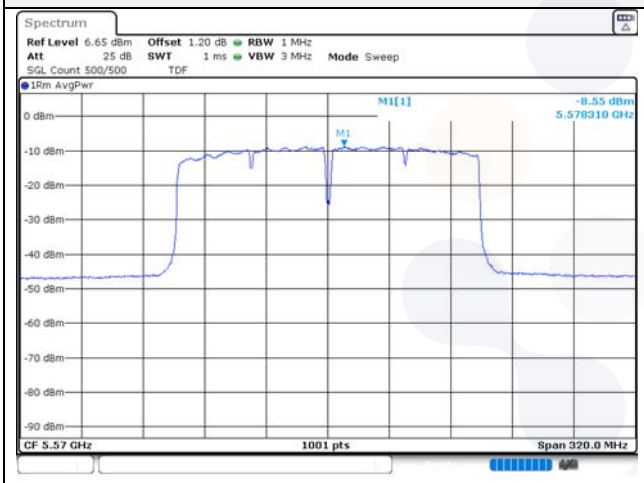
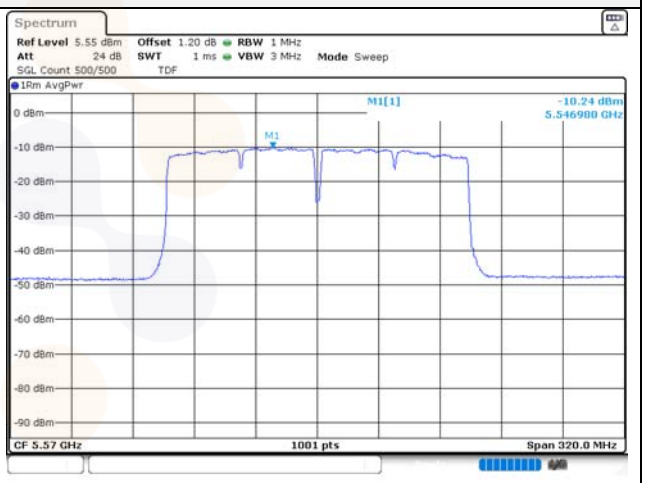
ANT 1	ANT 2
UNII-3 / 802.11a / Low ch.	
	

ANT 1	ANT 2
UNII-1 / 802.11n HT40 / High ch.	
	
UNII-2A / 802.11n HT40 / High ch.	
	
UNII-2C / 802.11n HT40 / High ch.	
	

ANT 1	ANT 2
UNII-3 / 802.11n HT40 / Low ch.	
	

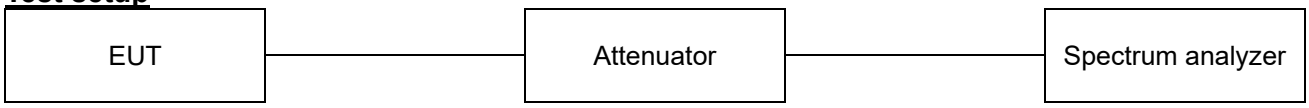
ANT 1	ANT 2
UNII-1 / 802.11ac VHT80 / Mid ch.	
	
UNII-2A / 802.11ac VHT80 / Mid ch.	
	
UNII-2C / 802.11ac VHT80 / Low ch.	
	

ANT 1	ANT 2
UNII-3 / 802.11ac VHT80 / Mid ch.	
	

ANT 1	ANT 2
UNII-1 / 802.11ac VHT160 / Mid ch.	
	
UNII-2C / 802.11ac VHT160 / Mid ch.	
	

7.3. 26 dB Bandwidth & 99% Bandwidth

Test setup



Limit

N/A

Test procedure

ANSI C63.10-2013 Section 12.4
KDB 789033 D02 v02r01 - Section C.1 (26dB bandwidth)
KDB 789033 D02 v02r01 - Section D (99% bandwidth)

Test settings

1. 26 dB Bandwidth

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. 99% Occupied Bandwidth

a. Set center frequency to the nominal EUT channel center frequency.
b. Set span = 1.5 times to 5.0 times the OBW.
c. Set RBW = 1% to 5% of the OBW
d. Set VBW ≥ 3 x RBW
e. 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.
f. Use the 99% power bandwidth function of the instrument (if available).
g. 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.

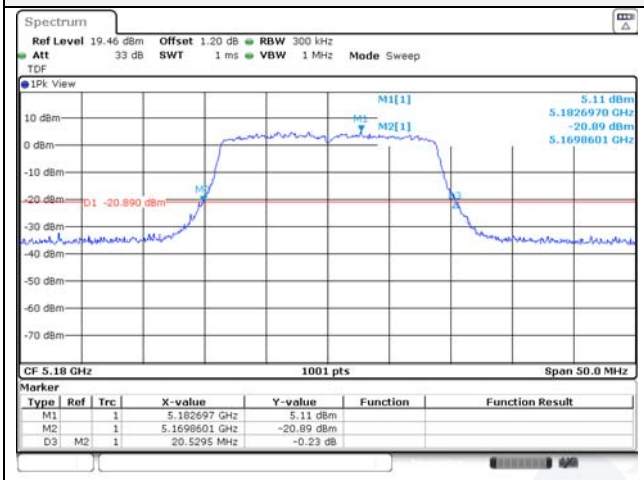
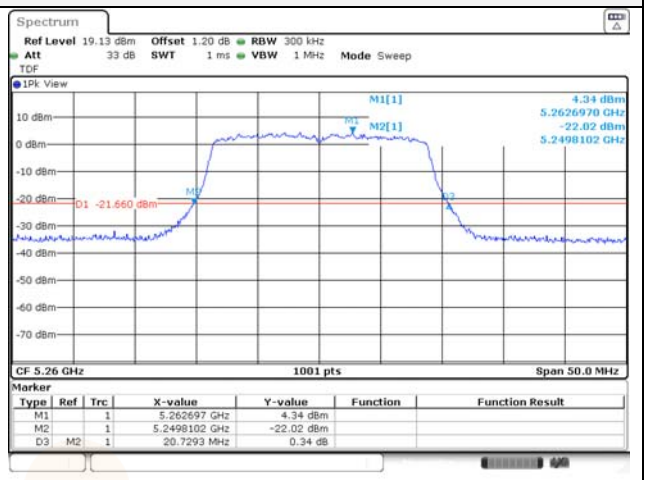
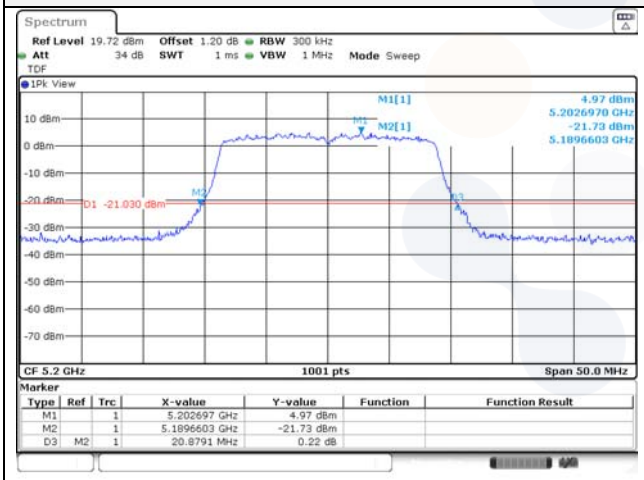
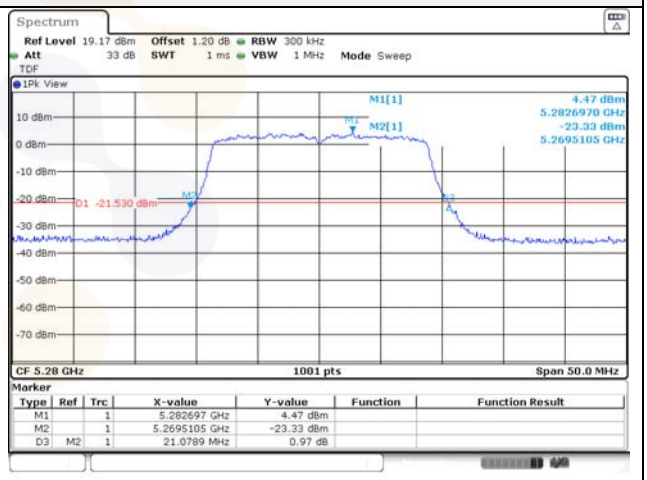
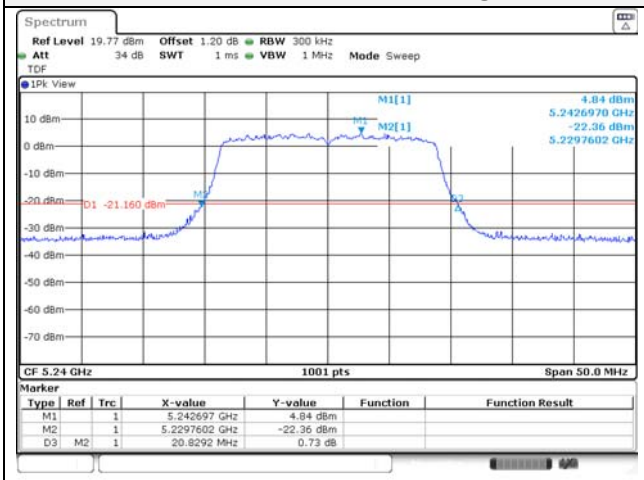
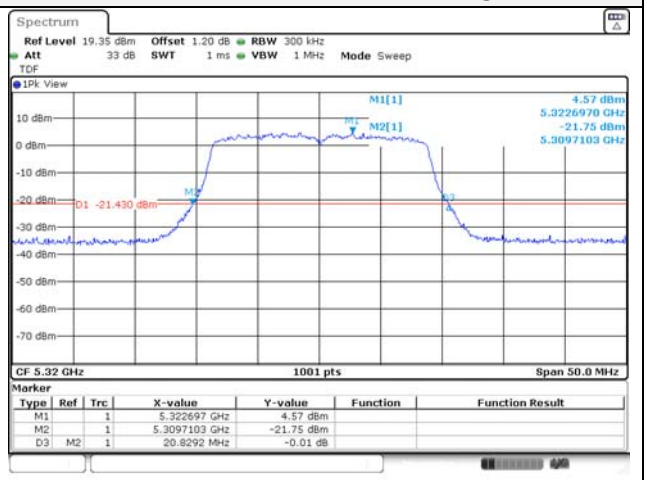
Test results

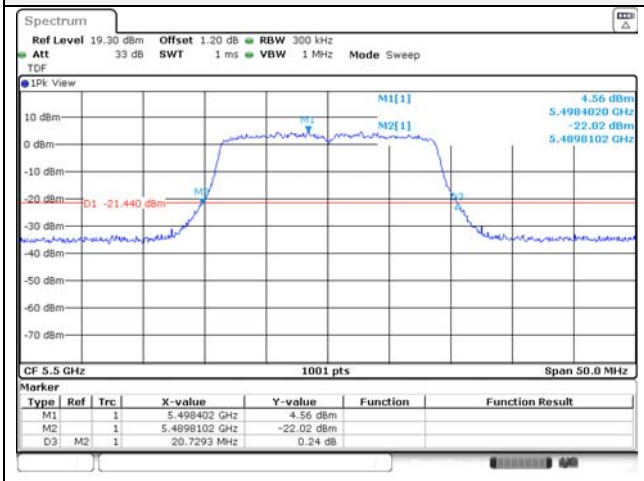
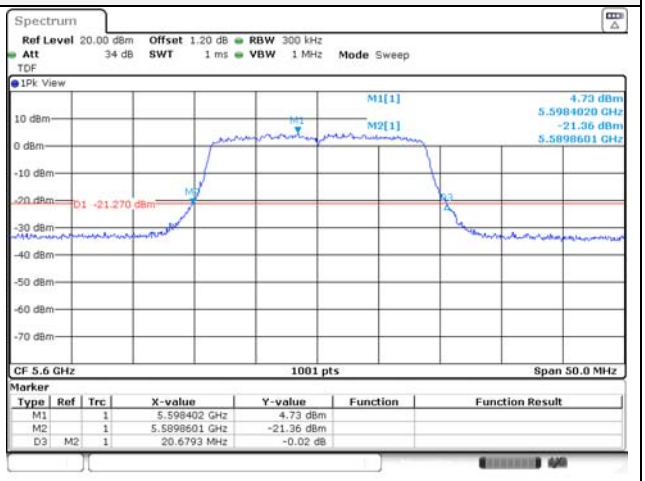
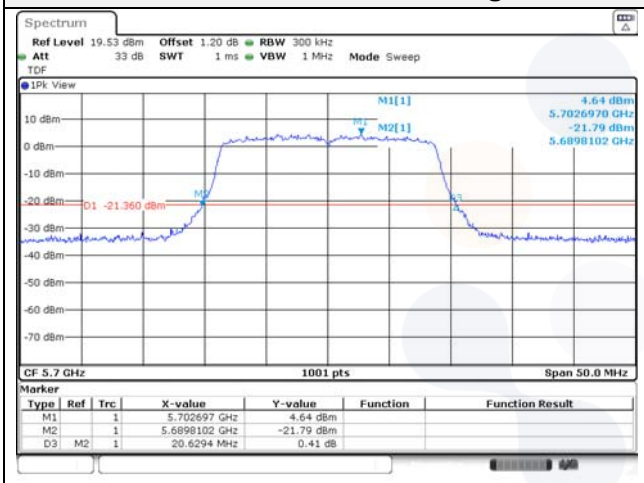
Test mode	Band	Frequency(㎒)	26 dB bandwidth (㎒)		99% bandwidth (㎒)	
			ANT1	ANT2	ANT1	ANT2
802.11a	UNII-1	5 180	19.58	19.43	16.48	16.48
		5 200	19.53	19.53	16.48	16.48
		5 240	19.83	19.53	16.48	16.48
	UNII-2A	5 260	19.63	19.58	16.48	16.48
		5 280	19.73	19.48	16.53	16.48
		5 320	19.73	19.58	16.48	16.43
	UNII-2C	5 500	19.68	19.63	16.53	16.48
		5 600	19.53	19.48	16.48	16.48
		5 700	19.63	19.68	16.53	16.43
802.11n HT20	UNII-1	5 180	20.88	20.68	17.63	17.58
		5 200	20.88	20.48	17.63	17.58
		5 240	20.88	20.73	17.63	17.58
	UNII-2A	5 260	20.83	20.53	17.63	17.58
		5 280	20.98	20.48	17.63	17.58
		5 320	20.58	20.68	17.58	17.58
	UNII-2C	5 500	20.88	20.48	17.63	17.63
		5 600	20.88	20.48	17.63	17.58
		5 700	20.88	20.58	17.68	17.63
802.11n HT40	UNII-1	5 190	40.46	40.16	36.06	36.06
		5 230	40.46	40.06	36.16	36.06
	UNII-2A	5 270	40.36	40.16	36.06	36.16
		5 310	40.16	40.06	36.06	36.06
	UNII-2C	5 510	40.26	40.16	36.06	36.06
		5 590	40.16	40.06	36.06	36.16
		5 670	40.06	40.26	36.16	36.16

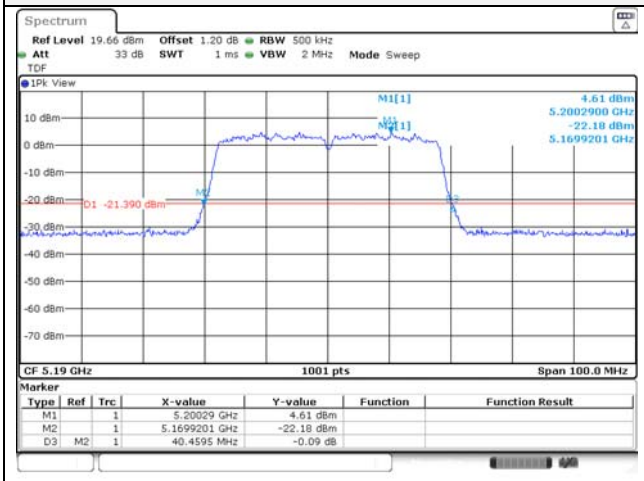
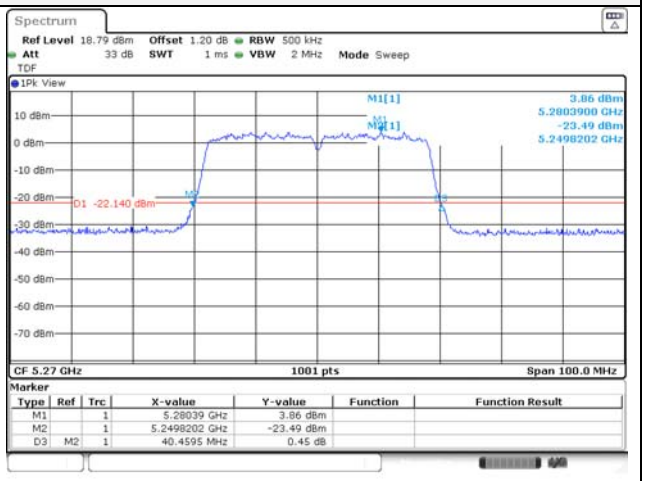
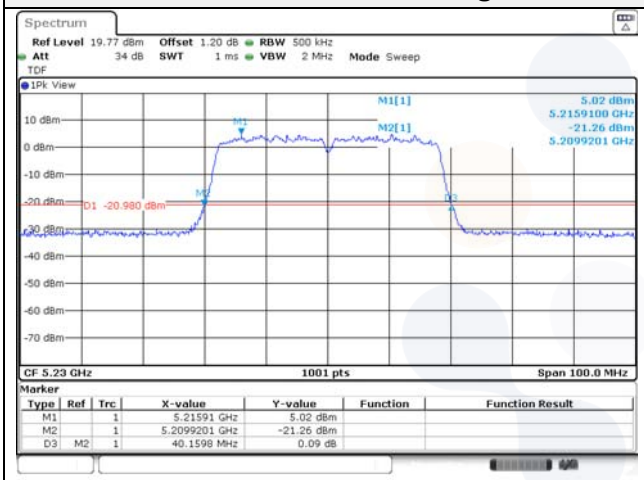
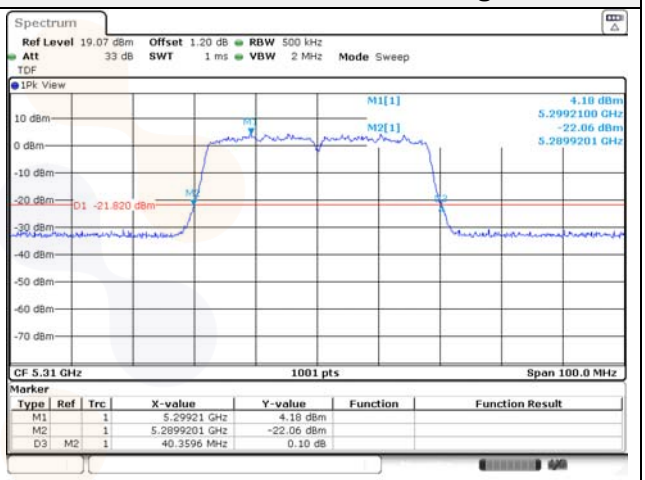
Test mode	Band	Frequency(㎒)	26 dB bandwidth (㎒)		99% bandwidth (㎒)	
			ANT1	ANT2	ANT1	ANT2
802.11ac VHT20	UNII-1	5 180	20.53	20.38	17.63	17.58
		5 200	20.88	20.33	17.63	17.63
		5 240	20.83	20.38	17.63	17.58
	UNII-2A	5 260	20.73	20.38	17.63	17.58
		5 280	21.08	20.38	17.63	17.58
		5 320	20.83	20.38	17.68	17.63
	UNII-2C	5 500	20.73	20.43	17.63	17.58
		5 600	20.68	20.33	17.68	17.58
		5 700	20.63	20.33	17.63	17.63
802.11ac VHT40	UNII-1	5 190	40.46	39.66	36.06	36.06
		5 230	40.16	39.66	36.06	36.06
	UNII-2A	5 270	40.46	39.76	36.16	36.06
		5 310	40.36	39.66	36.06	36.06
	UNII-2C	5 510	40.16	39.56	36.16	36.06
		5 590	40.16	39.36	36.16	36.06
		5 670	40.16	39.56	36.16	36.16
802.11ac VHT80	UNII-1	5 210	83.32	82.48	75.52	75.40
	UNII-2A	5 290	83.92	82.36	75.52	75.52
	UNII-2C	5 530	82.60	82.84	75.40	75.40
		5 610	83.20	82.48	75.52	75.52
802.11ac VHT160	UNII 1	5 250	166.55	165.91	154.73	154.09
	UNII 2C	5 570	166.23	166.87	154.41	154.73

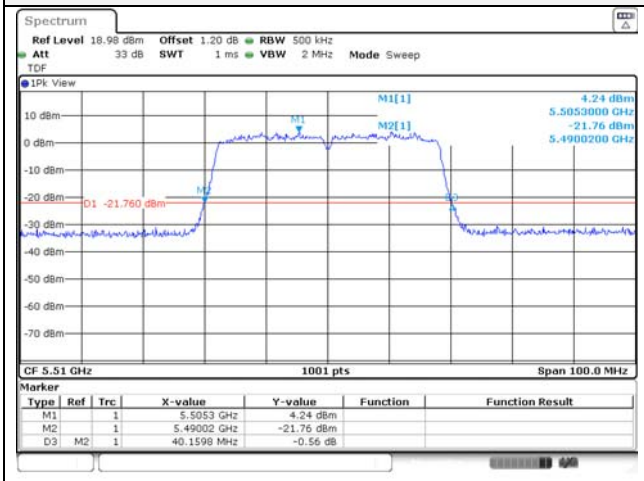
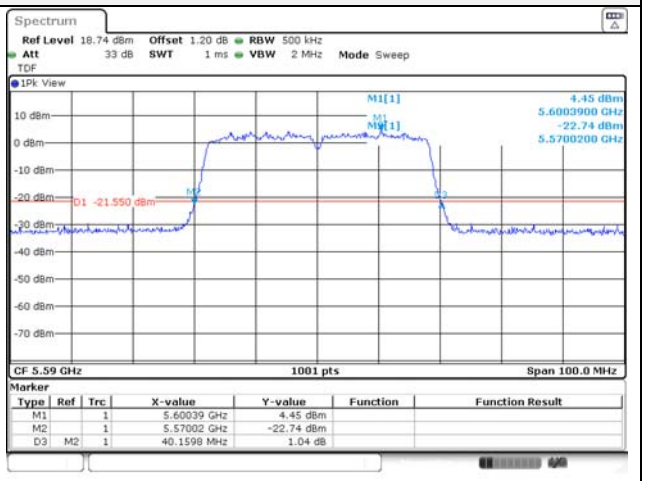
In order to simplify the report, only ANT1 11ac mode test plots are attached.

26 dB bandwidth

UNII-1 / 802.11ac VHT20 / Low ch.	UNII-2A / 802.11ac VHT20 / Low ch.
	
UNII-1 / 802.11ac VHT20 / Mid ch.	**UNII-2A / 802.11ac VHT20 / Mid ch.**
	
UNII-1 / 802.11ac VHT20 / High ch.	**UNII-2A / 802.11ac VHT20 / High ch.**
	

UNII-2C / 802.11ac VHT20 / Low ch.	UNII-2C / 802.11ac VHT20 / Mid ch.
	
UNII-2C / 802.11ac VHT20 / High ch.	
	Blank

UNII-1 / 802.11ac VHT40 / Low ch.	UNII-2A / 802.11ac VHT40 / Low ch.
	
UNII-1 / 802.11ac VHT40 / High ch.	**UNII-2A / 802.11ac VHT40 / High ch.**
	

UNII-2C / 802.11ac VHT40 / Low ch.	UNII-2C / 802.11ac VHT40 / Mid ch.
	
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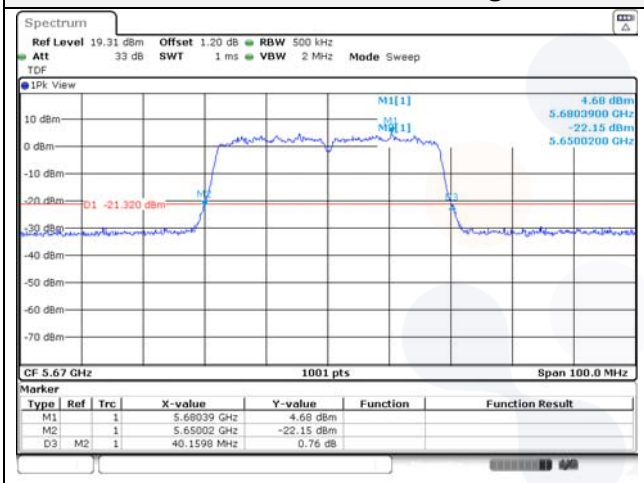
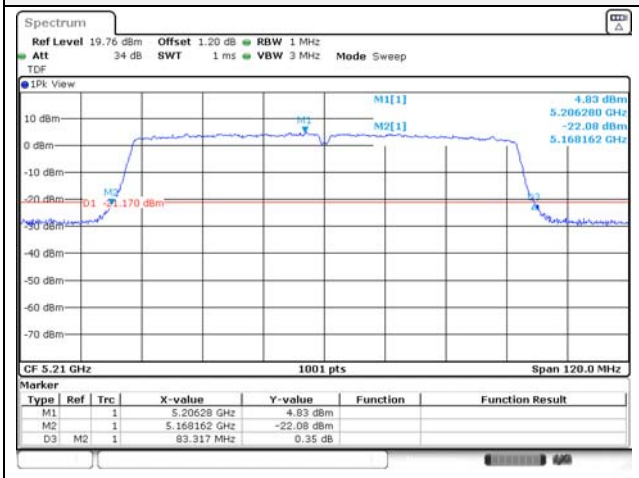
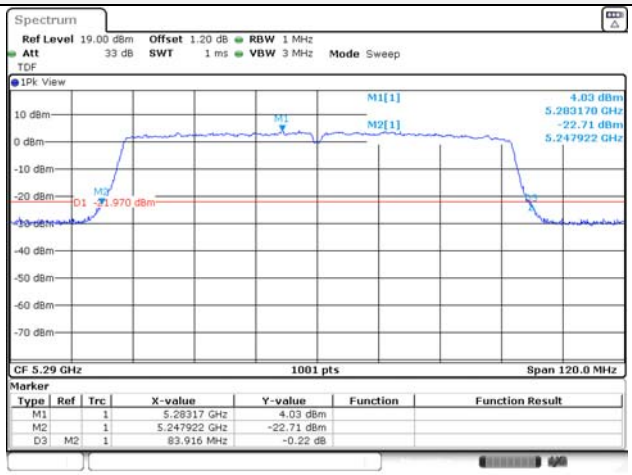
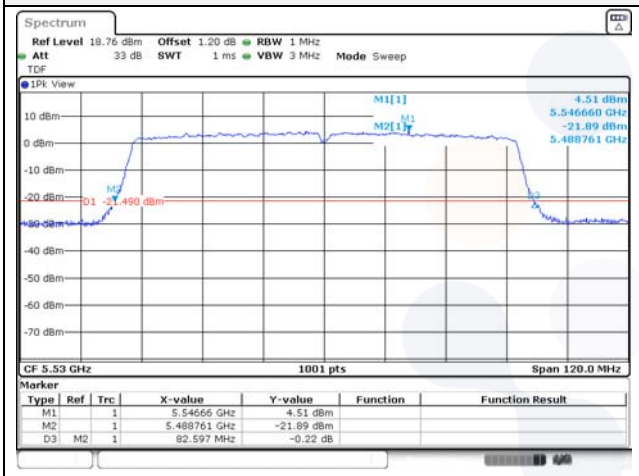
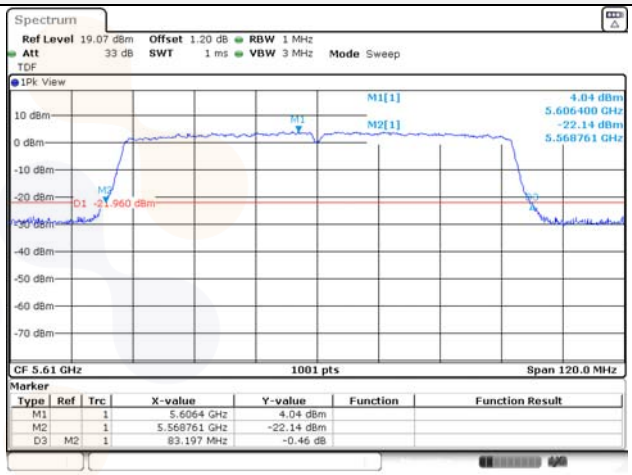
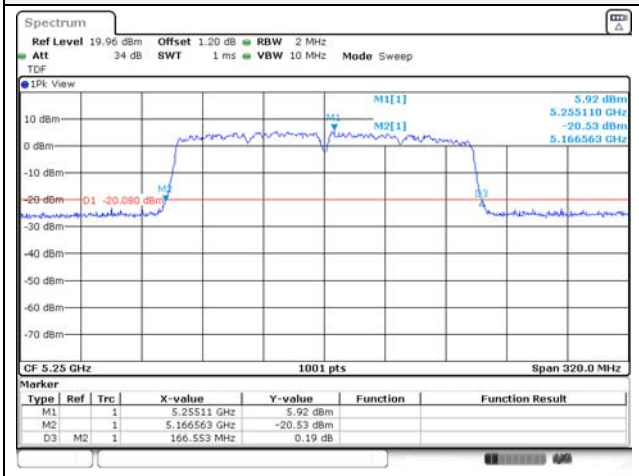
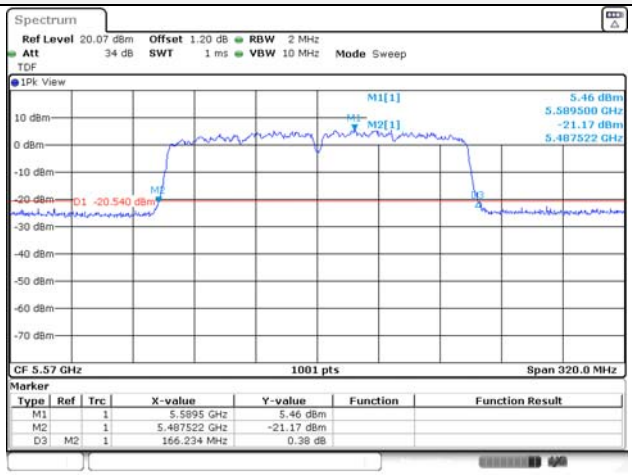
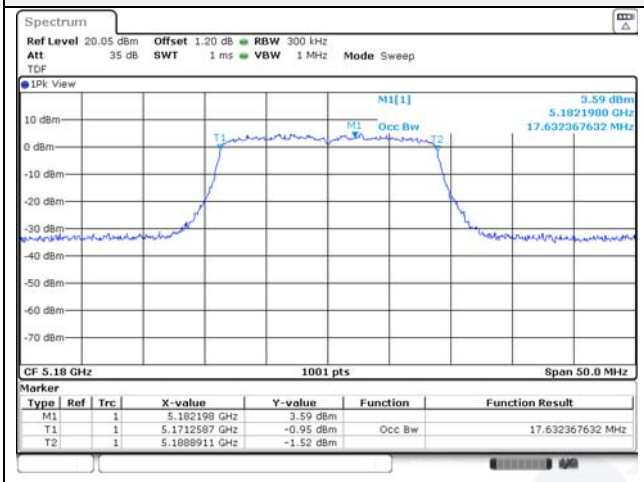
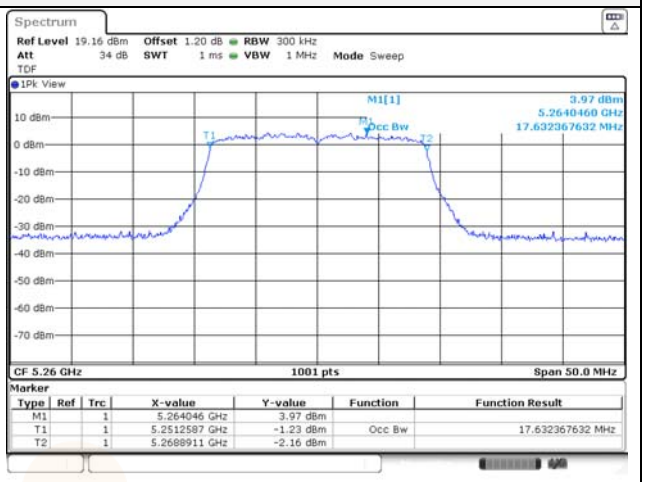
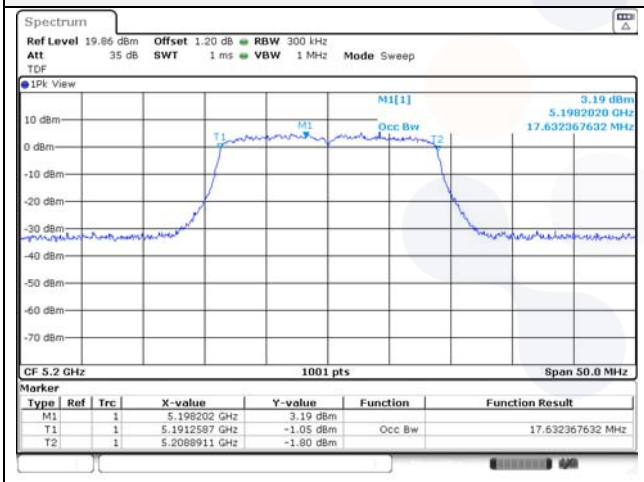
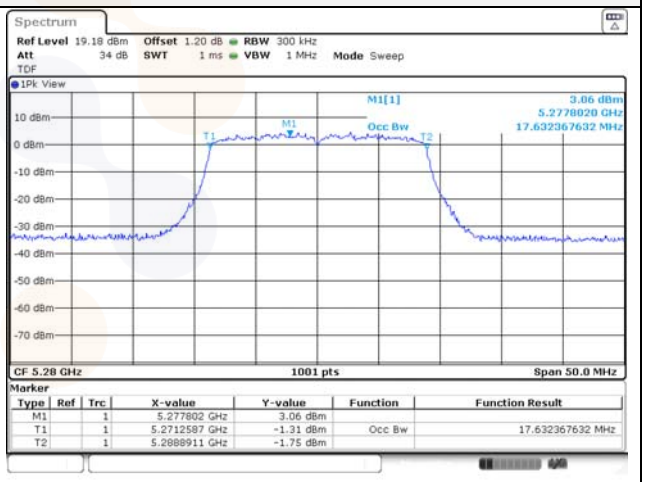
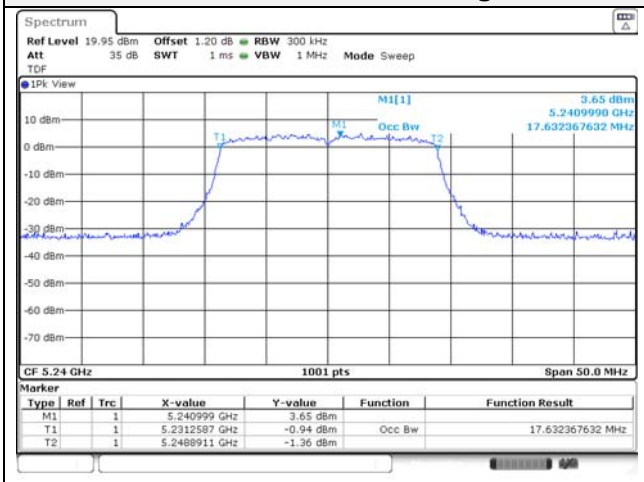
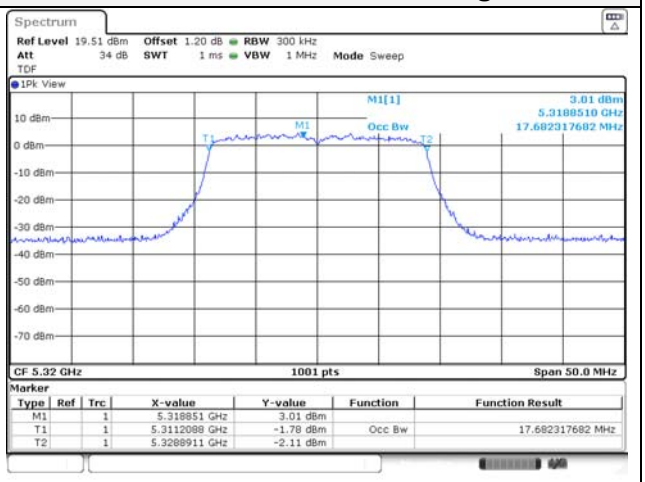
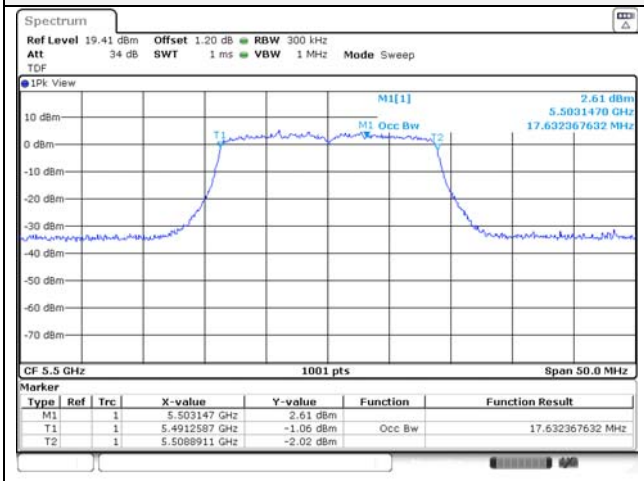
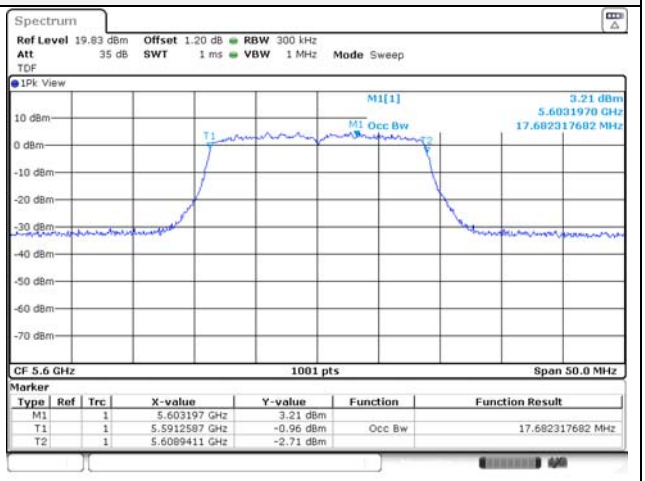
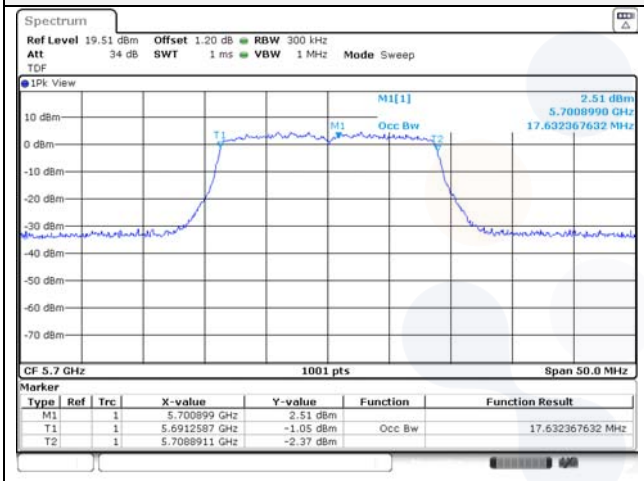
	Blank

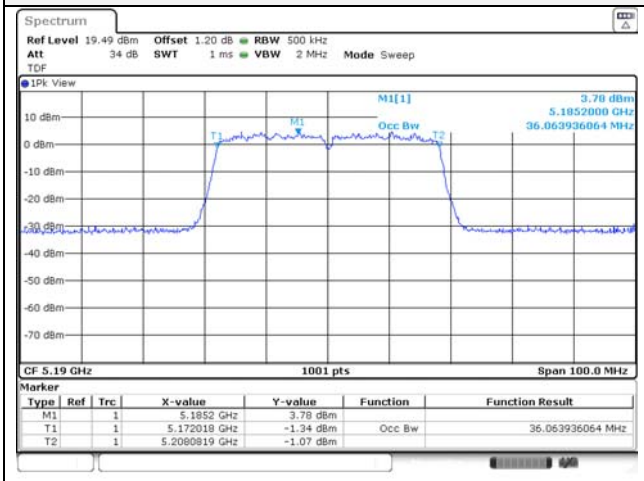
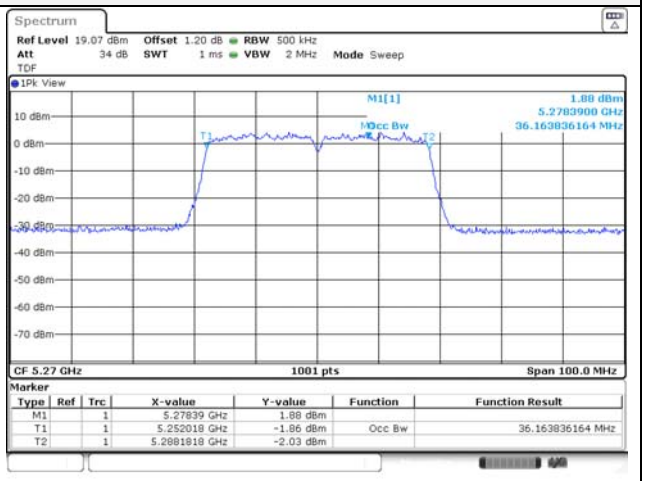
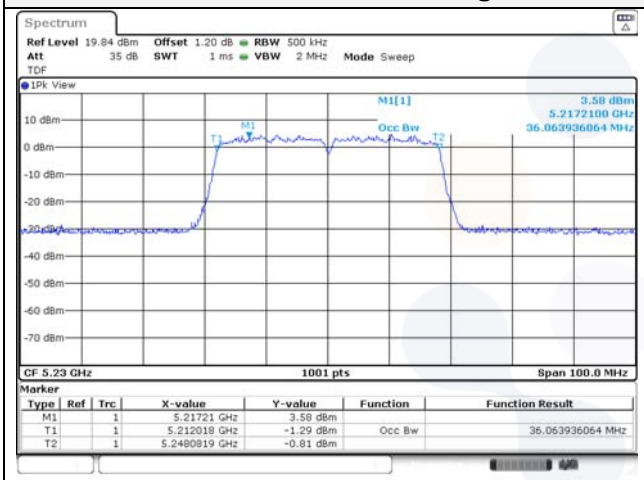
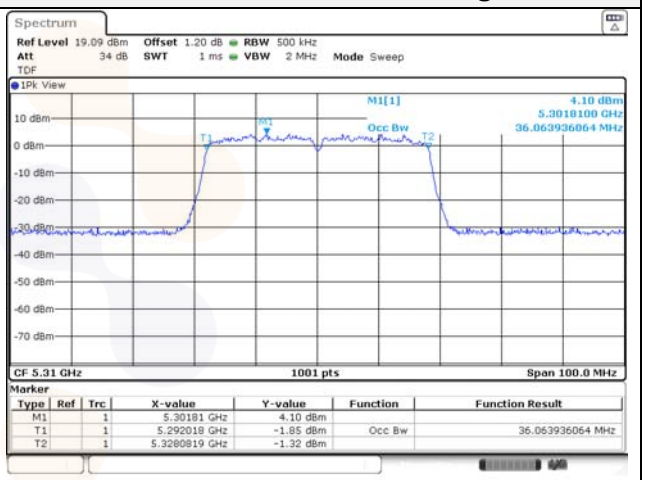
UNII-1 / 802.11ac VHT80 / Mid ch.	UNII-2A / 802.11ac VHT80 / Mid ch.
	
UNII-2C / 802.11ac VHT80 / Low ch.	**UNII-2C / 802.11ac VHT80 / High ch.**
	
UNII-1 / 802.11ac VHT160 / Mid ch.	**UNII-2C / 802.11ac VHT160 / Mid ch.**
	

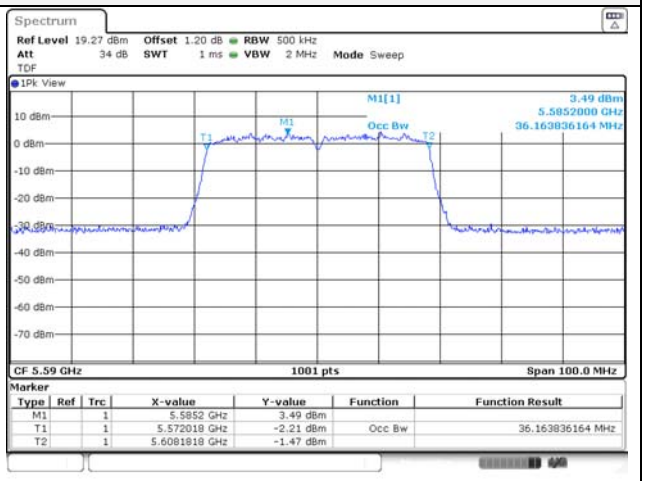
In order to simplify the report, only ANT1 11ac mode test plots are attached.

99% bandwidth

UNII-1 / 802.11ac VHT20 / Low ch.	UNII-2A / 802.11ac VHT20 / Low ch.
	
UNII-1 / 802.11ac VHT20 / Mid ch.	**UNII-2A / 802.11ac VHT20 / Mid ch.**
	
UNII-1 / 802.11ac VHT20 / High ch.	**UNII-2A / 802.11ac VHT20 / High ch.**
	

UNII-2C / 802.11ac VHT20 / Low ch.	UNII-2C / 802.11ac VHT20 / Mid ch.
	
UNII-2C / 802.11ac VHT20 / High ch.	
	Blank

UNII-1 / 802.11ac VHT40 / Low ch.	UNII-2A / 802.11ac VHT40 / Low ch.
	
UNII-1 / 802.11ac VHT40 / High ch.	**UNII-2A / 802.11ac VHT40 / High ch.**
	

UNII-2C / 802.11ac VHT40 / Low ch.	UNII-2C / 802.11ac VHT40 / Mid ch.
	
UNII-2C / 802.11ac VHT40 / High ch.	
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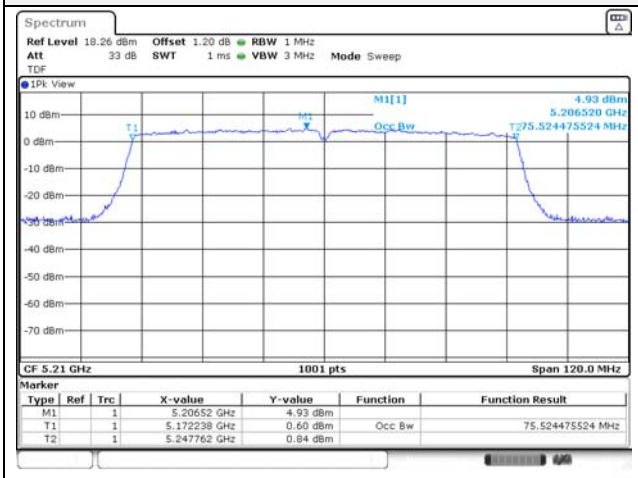
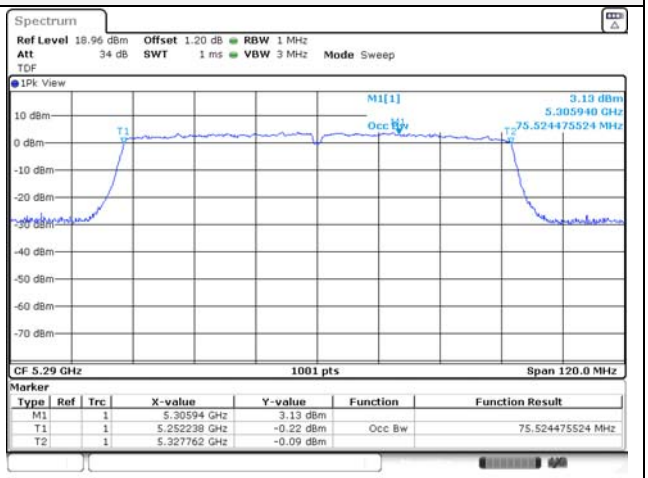
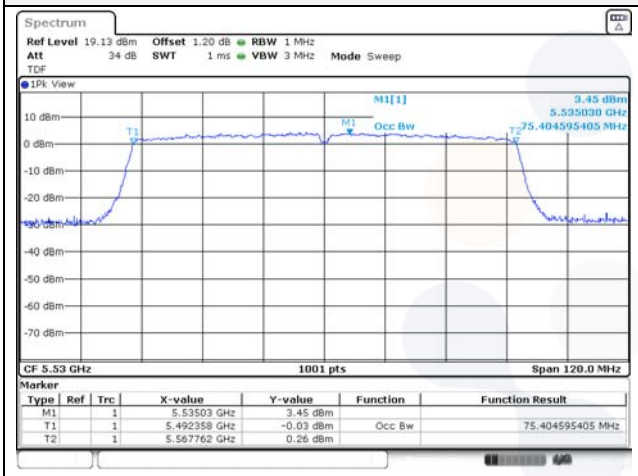
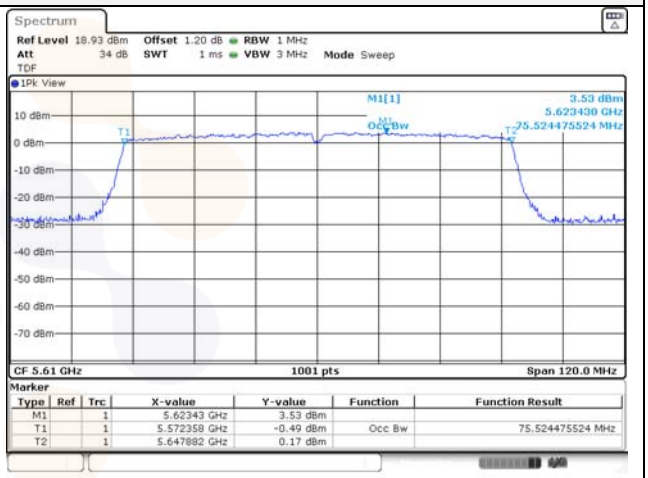
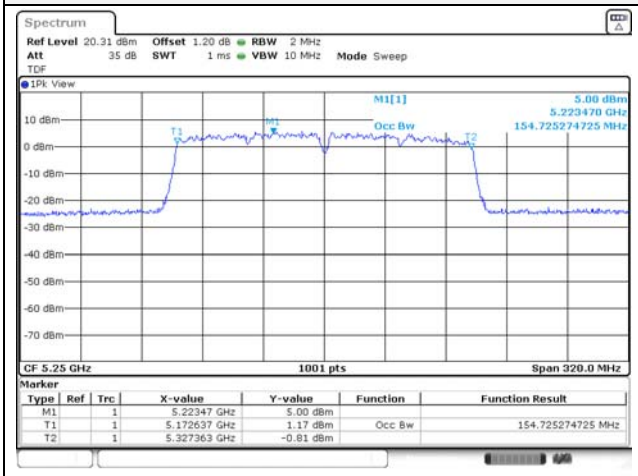
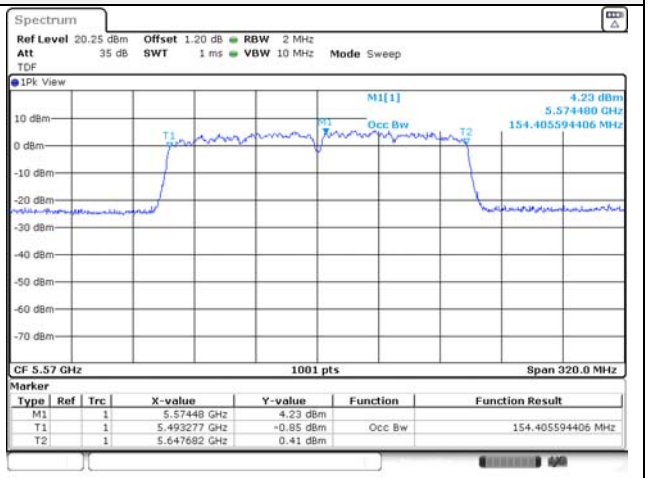
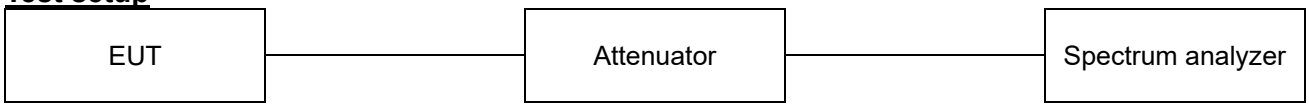
UNII-1 / 802.11ac VHT80 / Mid ch.	UNII-2A / 802.11ac VHT80 / Mid ch.
	
UNII-2C / 802.11ac VHT80 / Low ch.	**UNII-2C / 802.11ac VHT80 / High ch.**
	
UNII-1 / 802.11ac VHT160 / Mid ch.	**UNII-2C / 802.11ac VHT160 / Mid ch.**
	

7.4. 6 dB Bandwidth & 99% Bandwidth

Test setup



Limit

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

Test procedure

ANSI C63.10-2013 Section 6.9.2
KDB 789033 D02 v02r01 - Section C.2

Test settings

Minimum Emission Bandwidth for the band 5.725−5.85 ㎓

Section 15.407(e) specifies the minimum 6 ㏈ emission bandwidth of at least 500 ㎑ for the band 5.725−5.85 ㎓. The following procedure shall be used for measuring this bandwidth:

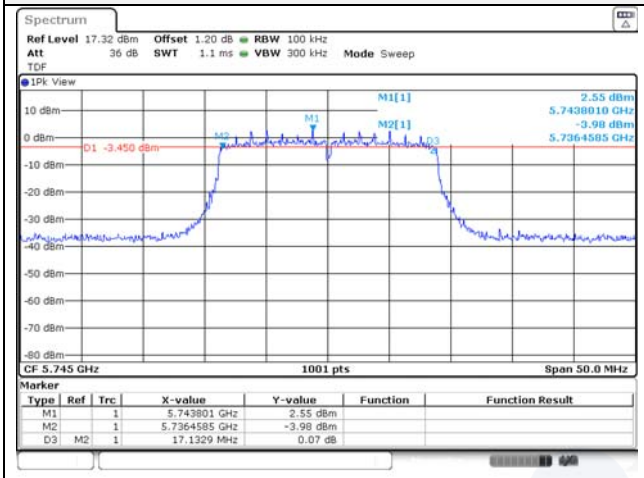
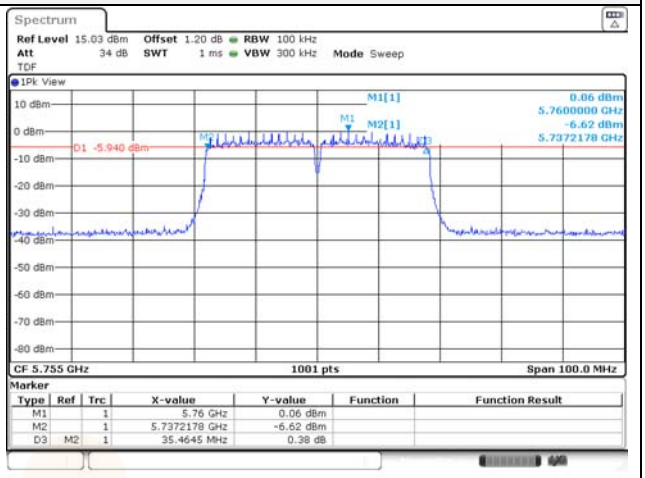
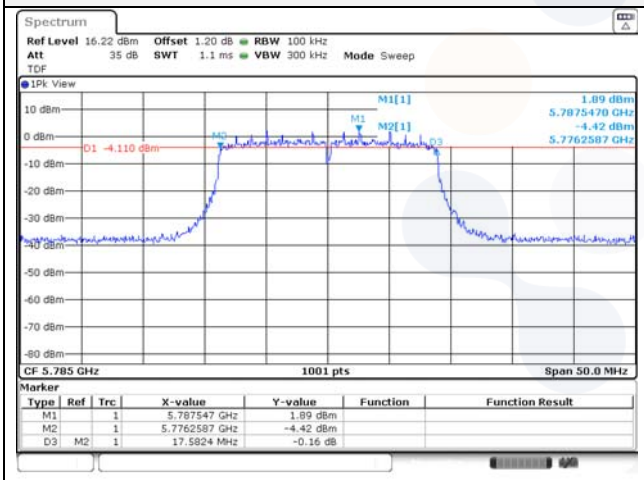
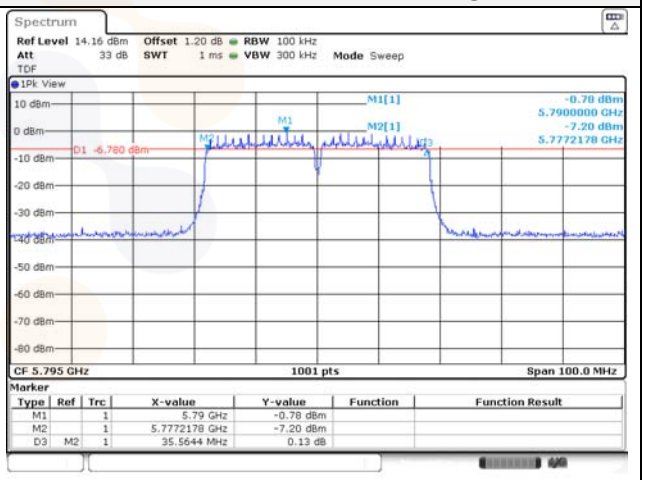
1. Set RBW = 100 ㎑.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

Test results

Test mode	Band	Frequency (㎒)	6㏈ bandwidth (㎒)		Limit (㎒)	99% bandwidth (㎒)	
			ANT1	ANT2		ANT1	ANT2
802.11a	UNII-3	5 745	16.43	16.43	0.50	16.48	16.48
		5 785	16.38	16.43	0.50	16.48	16.43
		5 825	16.38	16.43	0.50	16.48	16.43
802.11n HT20	UNII-3	5 745	17.13	16.93	0.50	17.68	17.63
		5 785	17.63	17.28	0.50	17.63	17.63
		5 825	17.63	17.38	0.50	17.68	17.63
802.11n HT40	UNII-3	5 755	35.46	35.56	0.50	36.16	36.16
		5 795	35.46	35.46	0.50	36.16	36.16
802.11ac VHT20	UNII-3	5 745	17.13	17.63	0.50	17.63	17.58
		5 785	17.58	17.63	0.50	17.63	17.63
		5 825	17.58	17.63	0.50	17.63	17.58
802.11ac VHT40	UNII-3	5 755	35.46	35.26	0.50	36.16	36.16
		5 795	35.56	36.46	0.50	36.06	36.16
802.11ac VHT80	UNII-3	5 775	75.52	75.40	0.50	75.40	75.52

In order to simplify the report, only ANT1 11ac mode test plots are attached.

6 dB bandwidth

UNII-3 / 802.11ac VHT20 / Low ch.	UNII-3 / 802.11ac VHT40 / Low ch.
	
UNII-3 / 802.11ac VHT20 / Mid ch.	**UNII-3 / 802.11ac VHT40 / High ch.**
	
UNII-3 / 802.11ac VHT20 / High ch.	**UNII-3 / 802.11ac VHT80 / Low ch.**