TEST REPORT

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Suwon-si, Gyeonggi-do, 16677, Korea
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1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2021-03-31

2. Use of Report : Certification

3. Name of Product / Model : Mobile Phone / SM-A225F/DSN

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

5. FCC ID : A3LSMA225F

6. Date of Test : 2021-04-08 to 2021-05-04

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

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

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

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

2021-05-18

KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2021-05-13	Originally issued	-
2021-05-17	Updated	1, 11
2021-05-18	Updated	11

Note. The report No. KR21-SRF0071-A is superseded by the report No. KR21-SRF0071-B.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	:	Yenphong 1 -I.P Yentrung Commune, Yenphong Dist., Bac Ninh Province, Vietnam
Laboratory	:	KCTL Inc.
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 Industry Canada Registration No. : 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	Mobile Phone
Model	:	SM-A225F/DSN
Derivative model	:	SM-A225F/N
Modulation technique	:	Bluetooth(BDR/EDR)_GFSK, π/4DQPSK, 8DPSK Bluetooth(BLE)_GFSK WIFI(802.11a/b/g/n/ac)_DSSS, OFDM LTE_QPSK, 16QAM, 64QAM WCDMA_QPSK GSM_GMSK, 8-PSK NFC_ASK
Number of channels	:	Bluetooth(BDR/EDR)_79 ch / Bluetooth(BLE)_40 ch 802.11b/g/n_HT20 : 13 ch UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2A: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2C: 12 ch (20 ㎒), 6 ch (40 ㎒), 3 ch (80 ㎒) UNII-3: 5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) NFC: 1 ch
Power source	:	DC 3.86 Ⅴ
Antenna specification	:	LTE/WCDMA/GSM_FPCB Antenna WIFI/Bluetooth(BDR/EDR/BLE)_FPCB Antenna NFC_FPCB Antenna

Antenna gain	:	WIFI/Bluetooth(BDR/EDR/BLE)_-2.10 dBi
		UNII-1 : -2.80 dBi
		UNII-2A : -3.60 dBi
		UNII-2C : -2.70 dBi
		UNII-3 : -2.70 dBi
Frequency range	:	Bluetooth(BDR/EDR/BLE)_2 402 ㎒ ~ 2 480 ㎒
		2 412 ㎒ ~ 2 472 ㎒ (802.11b/g/n_HT20)
		UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-1: 5 210 ㎒ (802.11ac_VHT80)
		UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-2A: 5 290 ㎒ (802.11ac_VHT80)
		UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80)
		UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n/ac_HT20/VHT20)
		UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n/ac_HT40/VHT40)
		UNII-3: 5 775 ㎒ (802.11ac_VHT80)
		LTE Band 5_824.7 ㎒ ~ 848.3 ㎒
		LTE Band 41_2 498.5 ㎒ ~ 2 687.5 ㎒
		GSM 850_824.2 ㎒ ~ 848.8 ㎒
		GSM 1900_1 850.2 ㎒ ~ 1 909.8 ㎒
		WCDMA 850_826.4 ㎒ ~ 846.6 ㎒
		NFC_13.56 ㎒
Software version	:	A225F.001
Hardware version	:	REV1.0
Test device serial No.	:	Conducted(R38R302E90Y, R38R302E8PW)
		Radiated(R38R302E8JK)
Operation temperature	:	-30 ℃ ~ 50 ℃

Note. The Product equality letter includes detailed information about the differences between basic and derivative model.

2.1. Frequency/channel operations

This device contains the following capabilities:
WiFi (802.11a/b/g/n/ac), Bluetooth (BDR/EDR/BLE), NFC
LTE Band 5, LTE Band 41, GSM 850, GSM 1900, WCDMA 850

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

2.2. Simultaneous Tx Condition

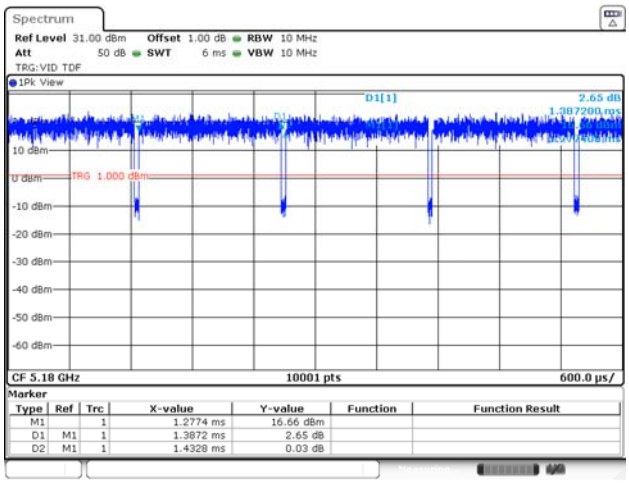
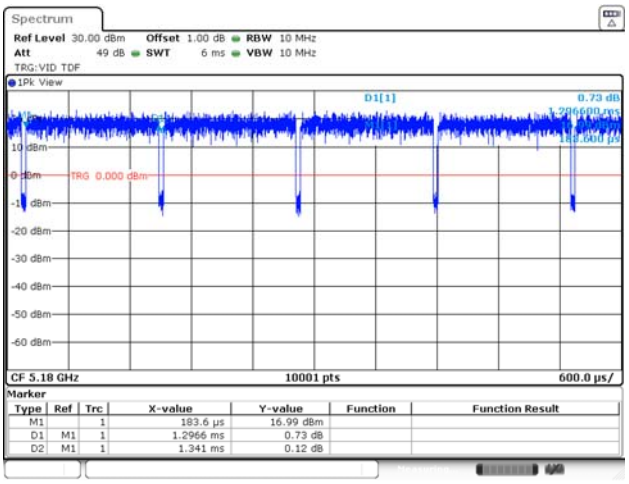
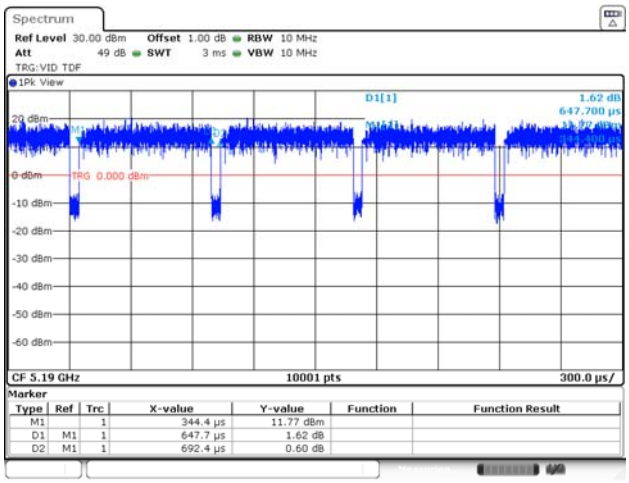
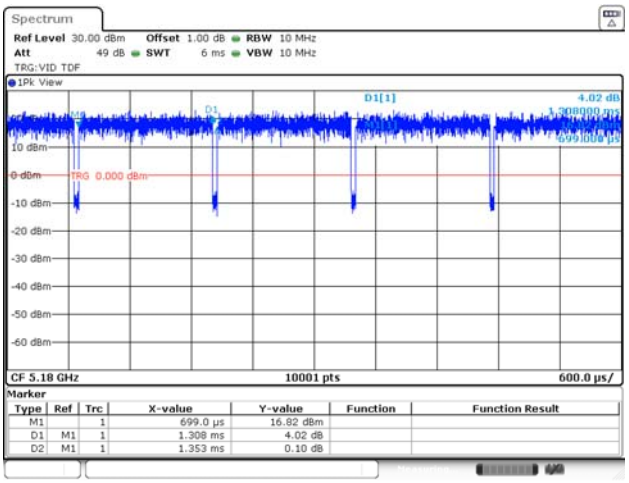
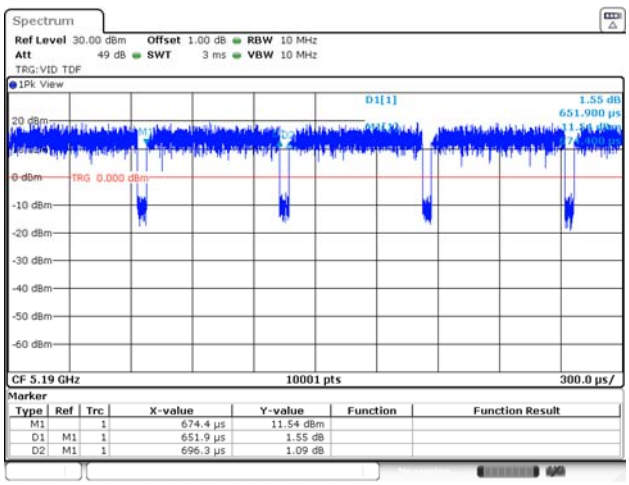
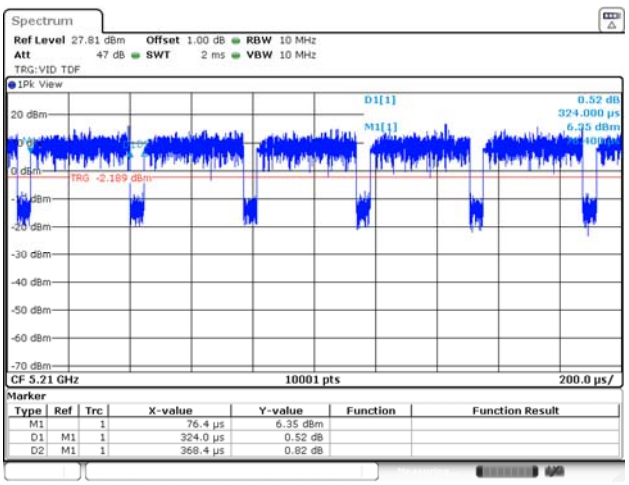
Mode	Bluetooth	WLAN 5 ㎓
WLAN 5 ㎓ + Bluetooth	O	O

2.3. Duty Cycle Factor

Test mode	Period (ms)	T_{on} time (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	1.432 8	1.387 2	0.968 2	96.82	0.14
802.11n_HT20	1.341 0	1.296 6	0.966 9	96.69	0.15
802.11n_HT40	0.692 4	0.647 7	0.935 4	93.54	0.29
802.11ac_VHT20	1.353 0	1.308 0	0.966 7	96.67	0.15
802.11ac_VHT40	0.696 3	0.651 9	0.936 2	93.62	0.29
802.11ac_VHT80	0.368 4	0.324 0	0.879 5	87.95	0.56

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**
	

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 FPCB Antenna (Internal antenna) on board.

4. Introduction

This report referenced from the FCC ID : A3LSMA225M
Based on their similarity, the FCC Part 15C (equipment class: NII) reuses the original model's result and do spot-check, following the FCC KDB 484596 D01 v01.
And the applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

4.1 Difference

The FCC ID: A3LSMA225F shares the same enclosure and circuit board as FCC ID: A3LSMA225M. The WIFI/BT/BLE/NFC/WCDMA/GSM/LTE antenna and surrounding circuitry and layout are identical between these two units.
As for all bands, they have been verified and the parent model test results under FCC ID : A3LSMA225M shall remain representative of FCC ID : A3LSMA225F.

Note. The Product equality letter includes detailed information about the differences between FCC ID: A3LSMA225M and FCC ID: A3LSMA225F.

4.2 Spot check verification data (Band-edge & Spurious emission)

Test band	Test item	Test mode	Channel	Measured frequency (㎒)	SM-A225M/DSN (dBμV)		SM-A225F/DSN (dBμV)		Deviation (dB)	
					Avg.	Peak	Avg.	Peak	Avg.	Peak
UNII-1	Band edge	802.11n HT40	38	4 500 ~ 5 150	43.87	55.61	44.30	55.70	-0.43	-0.09
	RSE	802.11n HT20	48	16 988.72	-	51.29	-	51.32	-	-0.03
UNII-2A	Band edge	802.11n HT40	62	5 350 ~ 5 460	48.06	58.78	48.07	60.25	-0.01	-1.47
	RSE	802.11a	52	16 848.92	-	51.79	-	51.23	-	0.56
UNII-2C	Band edge	802.11n HT20	140	5 728.45	-	59.91	-	60.11	-	-0.20
	RSE	802.11ac VHT 80	122	16 866.17	-	51.16	-	51.31	-	-0.15
UNII-3	Band edge	802.11ac VHT 20	165	5 892.59	-	51.38	-	52.11	-	-0.73
	RSE	802.11n HT40	151	16 285.06	-	51.47	-	51.12	-	0.35

Notes:
1. For FCC ID: A3LSMA225F has been verified the performance as for WIFI identical with the FCC ID: A3LSMA225M.
2. Comparison of two models, upper deviation is within 3 dB range and all test results are under FCC technical limits.
3. The test procedure(s) in this report were performed in accordance as following.
   - KDB 484596 D01 v01

4.3 Reference Detail

Reference application that contains the reused reference data in the individual test reports

Equipment Class	Reference FCC ID	Application Type	Reference Test report Number	Exhibit Type	Variant Test Report Number	Date Re-used
DTS	A3LSMA225M	Original	KR21-SRF0057 (802.11b/g/n)	Test report	KR21-SRF0070-B	All
			KR21-SRF0056 (Bluetooth LE)	Test report	KR21-SRF0069-B	All
DSS	A3LSMA225M	Original	KR21-SRF0055 (Bluetooth)	Test report	KR21-SRF0068-B	All
NII	A3LSMA225M	Original	KP21-SRF0058-A (802.11a/n/ac)	Test report	KR21-SRF0071-B	All
			KR21-SRF0059 (DFS)	Test report	KR21-SRF0075-A	All
DXX	A3LSMA225M	Original	KP21-SRF0063 (NFC)	Test report	KR21-SRF0074-B	All
PCE	A3LSMA225M	Original	KR21-SRF0062-A (2G, 3G)	Test report	KR21-SRF0073-B	Partial
			KR21-SRF0060 (LTE)	Test report	KR21-SRF0072-B	Partial

For this application the data reuse is summarized below for each equipment class

Equipment Class	Reference FCC ID	Application Type	Test Item	Data Re-used
DTS	A3LSMA225M	Original	WLAN (802.11b/g/n)	All
			Bluetooth LE	All
DSS	A3LSMA225M	Original	Bluetooth	All
NII	A3LSMA225M	Original	WLAN (802.11a/n/ac)	All
			DFS	All
DXX	A3LSMA225M	Original	NFC	All
PCE	A3LSMA225M	Original	2G, 3G	GSM 850, GSM 1900, WCDMA 850
			LTE	Band 5, Band 41

5. 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. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **X** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **X** orientation.
4. All the radiated tests have been performed several case.
   (Stand-alone, with TA, with Earphone)
   Worst case: Stand-alone
5. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - 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

6. 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	1.6 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.3 dB
	30 MHz ~ 300 MHz	2.2 dB
	300 MHz ~ 1 000 MHz	5.6 dB
	Above 1 GHz	5.7 dB
Conducted emissions	9 kHz ~ 150 kHz	3.7 dB
	150 kHz ~ 30 MHz	3.3 dB

7. 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.

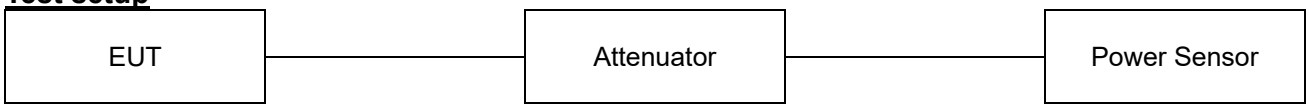
Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	9.87	9 000	10.87
50	9.89	10 000	10.93
100	9.92	11 000	10.92
200	9.97	12 000	11.21
300	10.01	13 000	11.17
400	10.04	14 000	11.26
500	10.07	15 000	11.27
600	10.08	16 000	10.97
700	10.11	17 000	11.26
800	10.15	18 000	11.08
900	10.17	19 000	10.81
1 000	10.19	20 000	11.05
2 000	10.74	21 000	11.50
3 000	10.34	22 000	11.22
4 000	10.30	23 000	11.43
5 000	10.33	24 000	11.34
6 000	10.46	25 000	11.42
7 000	10.50	26 000	11.73
8 000	10.80	26 500	12.07

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

8. Test results

8.1. 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 ㎽ (23.98 dBm)
UNII-2A	√		250 ㎽ or 11 dBm + 10logB[1)]
UNII-2C	√		250 ㎽ 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 12.3.3.2 and 14.2
KDB 789033 D02 v02r01 - Section E.2.d) or e)

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×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%.

Section E.2.e)
Method SA-2 Alternative (power averaging(rms) detection with slow sweep with each spectrum bin 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×span/RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(vi) Manually set sweep time ≥ 10 × (number of points in sweep) × (total on/off period of the transmitted signal).
(vii) Set detector = power averaging (rms)
(viii) Perform a single sweep.
(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 ㎒ intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

(x) 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%.

Section E.3.a)
Method PM (Measurement using an RF average power meter):

(xi) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five

(xii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in Ⅱ

(xiii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(xiv) Adjust the measurement in ㏈m by adding 10 log (1/x) where x is the duty cycle (e.g., 10 log (1/0.25) if the duty cycle is 25%).

Section E.3.b)
Method PM-G (Measurement using a gated RF average power meter):
Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Test results

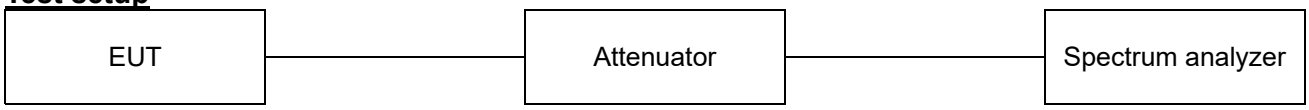
Test mode	Band	Frequency (㎒)	Measured output power			Limit (dBm)
			Reading (dBm)	DCF (dB)	Result (dBm)	
802.11a	UNII 1	5 180	15.01	0.14	15.15	23.98
		5 200	15.28	0.14	15.42	
		5 240	15.22	0.14	15.36	
	UNII 2A	5 260	15.26	0.14	15.40	23.94
		5 280	15.37	0.14	15.51	
		5 320	15.15	0.14	15.29	
	UNII 2C	5 500	14.84	0.14	14.98	23.98
		5 600	15.30	0.14	15.44	
		5 700	15.19	0.14	15.33	
	UNII 3	5 745	14.33	0.14	14.47	30.00
		5 785	14.29	0.14	14.43	
		5 825	14.13	0.14	14.27	
802.11n HT20	UNII 1	5 180	14.94	0.15	15.09	23.98
		5 200	14.97	0.15	15.12	
		5 240	15.18	0.15	15.33	
	UNII 2A	5 260	15.04	0.15	15.19	23.98
		5 280	15.05	0.15	15.20	
		5 320	14.99	0.15	15.14	
	UNII 2C	5 500	14.83	0.15	14.98	23.98
		5 600	15.31	0.15	15.46	
		5 700	15.11	0.15	15.26	
	UNII 3	5 745	13.90	0.15	14.05	30.00
		5 785	13.99	0.15	14.14	
		5 825	14.01	0.15	14.16	
802.11n HT40	UNII 1	5 190	14.01	0.29	14.30	23.98
		5 230	13.98	0.29	14.27	
	UNII 2A	5 270	14.08	0.29	14.37	23.98
		5 310	13.88	0.29	14.17	
	UNII 2C	5 510	13.34	0.29	13.63	23.98
		5 590	13.86	0.29	14.15	
		5 670	13.74	0.29	14.03	
	UNII 3	5 755	14.11	0.29	14.40	30.00
		5 795	14.21	0.29	14.50	

Test mode	Band	Frequency (㎒)	Measured output power			Limit (dBm)
			Reading (dBm)	DCF (dB)	Result (dBm)	
802.11ac VHT20	UNII 1	5 180	14.03	0.15	14.18	23.98
		5 200	13.87	0.15	14.02	
		5 240	13.97	0.15	14.12	
	UNII 2A	5 260	14.18	0.15	14.33	23.98
		5 280	13.89	0.15	14.04	
		5 320	14.29	0.15	14.44	
	UNII 2C	5 500	13.64	0.15	13.79	23.98
		5 600	14.17	0.15	14.32	
		5 700	14.11	0.15	14.26	
	UNII 3	5 745	12.58	0.15	12.73	30.00
		5 785	12.63	0.15	12.78	
		5 825	12.77	0.15	12.92	
802.11ac VHT40	UNII 1	5 190	13.94	0.29	14.23	23.98
		5 230	14.07	0.29	14.36	
	UNII 2A	5 270	14.12	0.29	14.41	23.98
		5 310	13.83	0.29	14.12	
	UNII 2C	5 510	13.36	0.29	13.65	23.98
		5 590	13.86	0.29	14.15	
		5 670	13.72	0.29	14.01	
	UNII 3	5 755	14.16	0.29	14.45	30.00
		5 795	14.24	0.29	14.53	
802.11ac VHT80	UNII 1	5 210	12.67	0.56	13.23	23.98
	UNII 2A	5 290	12.50	0.56	13.06	23.98
	UNII 2C	5 530	12.06	0.56	12.62	23.98
		5 610	12.64	0.56	13.20	
	UNII 3	5 775	13.04	0.56	13.60	30.00

Note.
1. Result(dBm) = Reading Power + D.C.F

8.2. 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

Notes:

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power And the peak power spectral density shall be reduced by the amount in dB that the directional gain if the antenna exceed 6 dBi

Test procedure

ANSI C63.10-2013 Section 12.3.2.2, 14.3.2.2
KDB 789033 D02 v02r01 - 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 1MHz 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 1MHz, 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 500 kHz 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 kHz, add 10 log (500 kHz /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 10 log (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 II.F.5.c) and II.F.5.d), since RBW=100 kHz is available on nearly all spectrum analyzers.

Test results

Test mode	Band	Frequency (㎒)	Measured PSD (dB㎽/㎒)	DCF (dB)	Maximum PSD (dB ㎽/㎒)	Limit (dB㎽/㎒)
802.11a	UNII 1	5 180	5.51	0.14	5.65	11
		5 200	5.62	0.14	5.76	
		5 240	5.90	0.14	6.04	
	UNII 2A	5 260	5.67	0.14	5.81	11
		5 280	5.71	0.14	5.85	
		5 320	5.45	0.14	5.59	
	UNII 2C	5 500	5.41	0.14	5.55	11
		5 600	5.80	0.14	5.94	
		5 700	5.74	0.14	5.88	
802.11n HT20	UNII 1	5 180	5.01	0.15	5.16	11
		5 200	5.13	0.15	5.28	
		5 240	5.14	0.15	5.29	
	UNII 2A	5 260	5.25	0.15	5.40	11
		5 280	5.14	0.15	5.29	
		5 320	5.00	0.15	5.15	
	UNII 2C	5 500	4.76	0.15	4.91	11
		5 600	5.51	0.15	5.66	
		5 700	5.56	0.15	5.71	
802.11n HT40	UNII 1	5 190	1.08	0.29	1.37	11
		5 230	1.05	0.29	1.34	
	UNII 2A	5 270	1.11	0.29	1.40	11
		5 310	1.19	0.29	1.48	
	UNII 2C	5 510	1.08	0.29	1.37	11
		5 590	1.23	0.29	1.52	
		5 670	1.20	0.29	1.49	
802.11ac VHT20	UNII 1	5 180	3.91	0.15	4.06	11
		5 200	4.49	0.15	4.64	
		5 240	4.36	0.15	4.51	
	UNII 2A	5 260	4.42	0.15	4.57	11
		5 280	4.25	0.15	4.40	
		5 320	4.41	0.15	4.56	
	UNII 2C	5 500	3.94	0.15	4.09	11
		5 600	4.55	0.15	4.70	
		5 700	4.70	0.15	4.85	

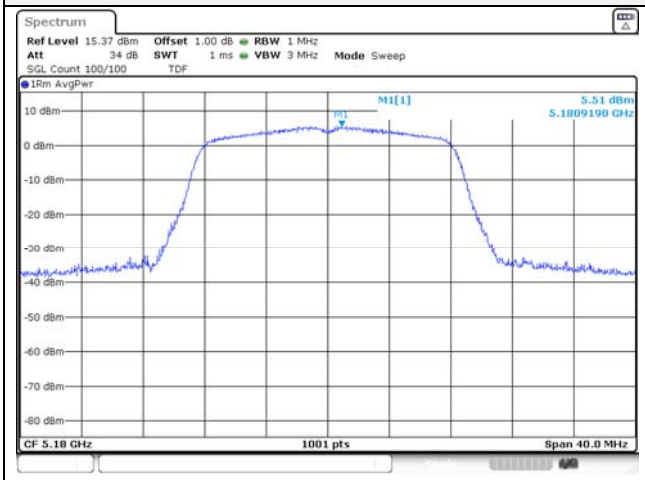
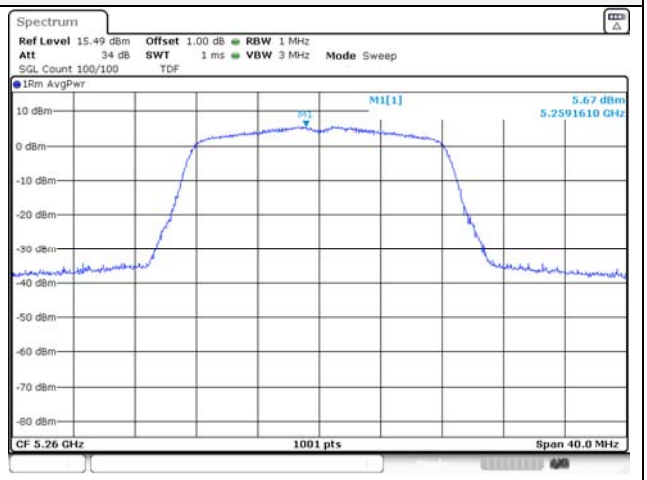
Test mode	Band	Frequency (㎒)	Measured PSD (dBm/㎒)	DCF (dB)	Maximum PSD (dBm/㎒)	Limit (dBm/㎒)
802.11ac VHT40	UNII 1	5 190	0.77	0.29	1.06	11
		5 230	1.12	0.29	1.41	
	UNII 2A	5 270	1.01	0.29	1.30	11
		5 310	1.26	0.29	1.55	
	UNII 2C	5 510	1.21	0.29	1.50	11
		5 590	1.54	0.29	1.83	
		5 670	1.19	0.29	1.48	
802.11ac VHT80	UNII 1	5 210	-3.23	0.56	-2.67	11
	UNII 2A	5 290	-3.09	0.56	-2.53	11
	UNII 2C	5 530	-3.37	0.56	-2.81	11
		5 610	-2.97	0.56	-2.41	

Test mode	Band	Frequency (㎒)	Measured PSD (dBm /500 ㎑)	DCF (dB)	Maximum PSD (dBm /500 ㎑)	Limit (dBm /500 ㎑)
802.11a	UNII 3	5 745	2.18	0.14	2.32	30
		5 785	2.17	0.14	2.31	
		5 825	2.29	0.14	2.43	
802.11n HT20		5 745	1.85	0.15	2.00	
		5 785	2.33	0.15	2.48	
		5 825	1.77	0.15	1.92	
802.11n HT40		5 755	-1.16	0.29	-0.87	
		5 795	-0.98	0.29	-0.69	
802.11ac VHT20		5 745	0.34	0.15	0.49	
		5 785	0.83	0.15	0.98	
		5 825	0.58	0.15	0.73	
802.11ac VHT40		5 755	-1.23	0.29	-0.94	
		5 795	-1.07	0.29	-0.78	
802.11ac VHT80		5 775	-5.59	0.56	-5.03	

Notes:
1. Maximum PSD calculation
- Maximum PSD = Measured PSD + D.C.F

Power Spectral Density

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

UNII-1 / 802.11a / Low ch.	UNII-2A / 802.11a / Low ch.
	
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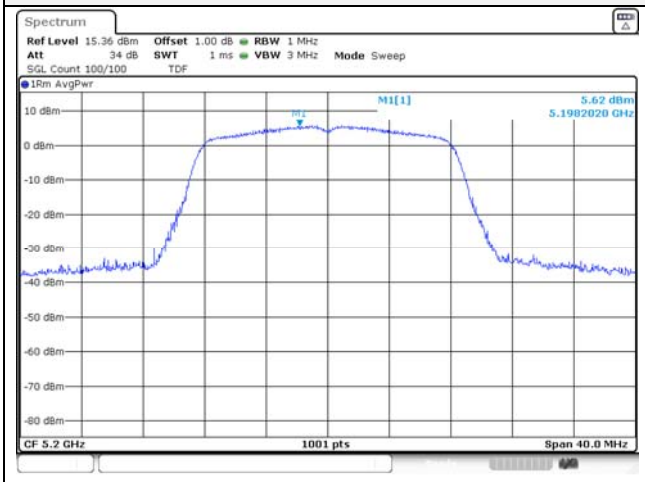	
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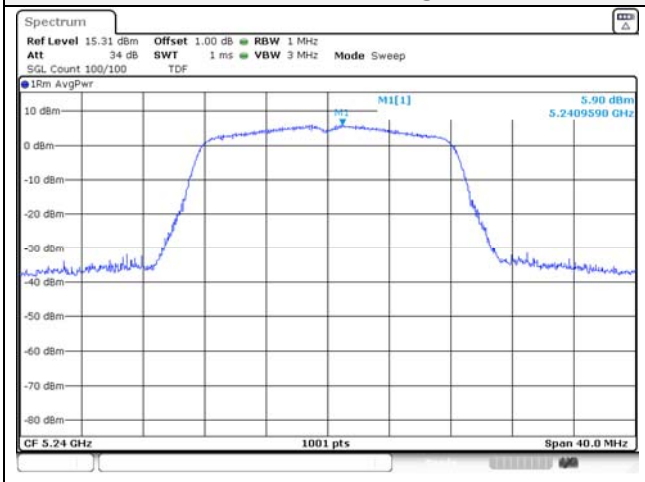
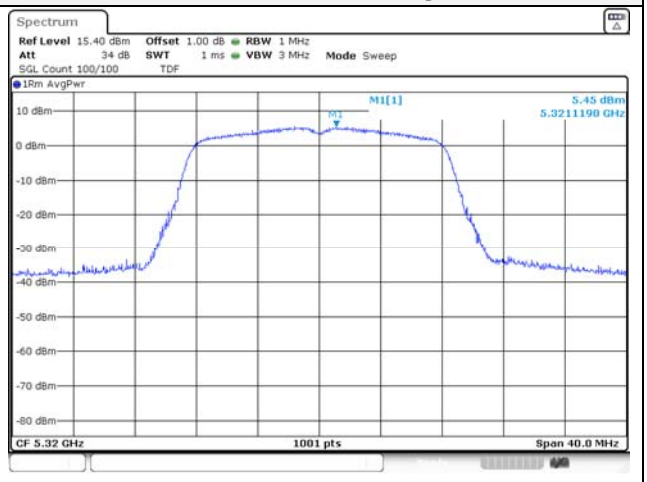
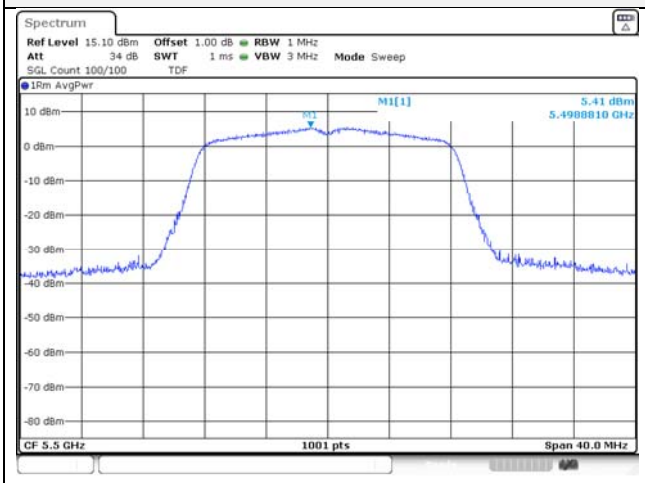
	

UNII-2C / 802.11a / Low ch.



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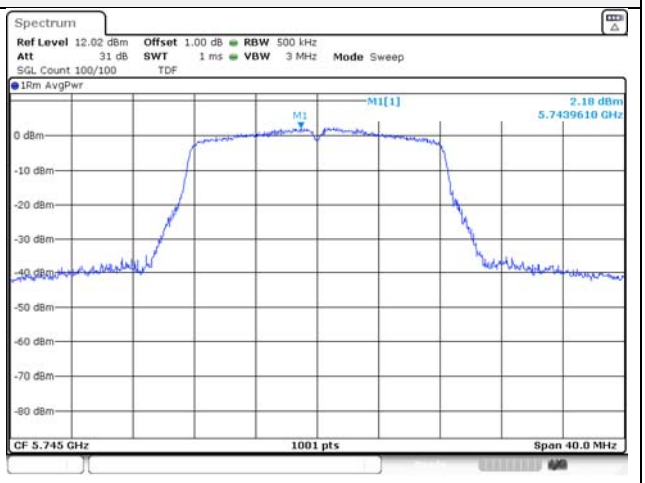

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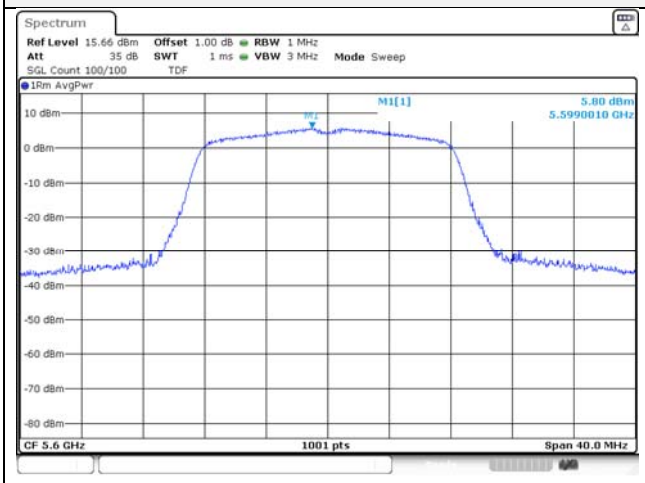

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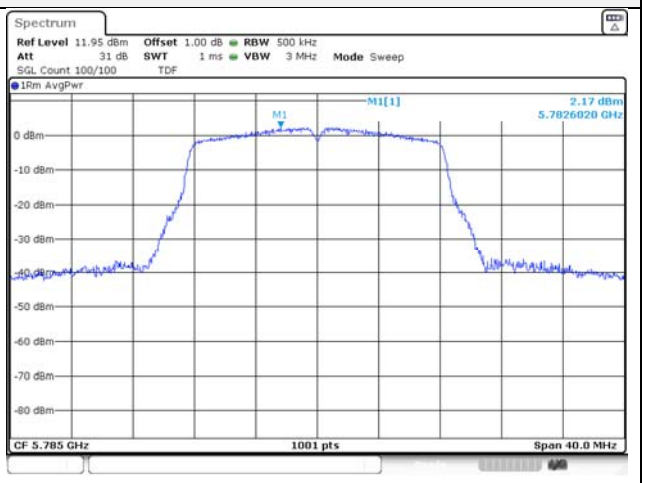

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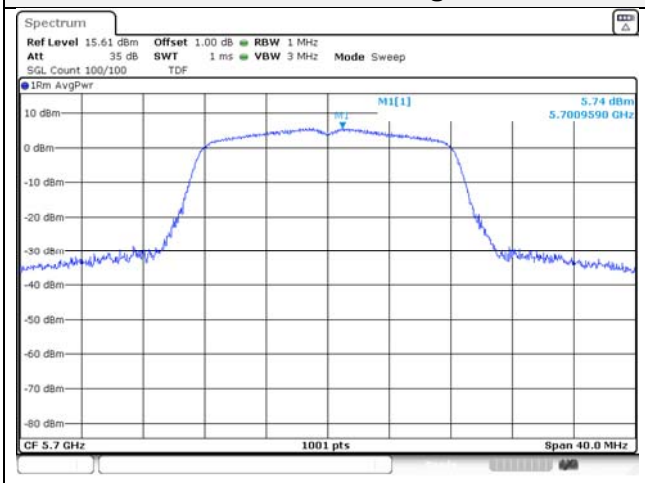

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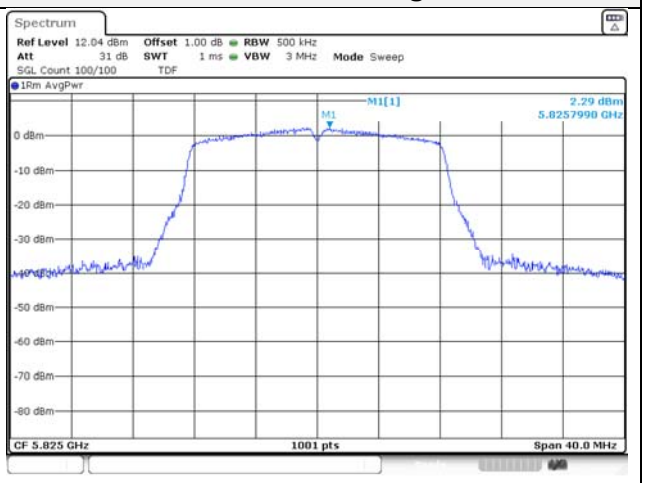

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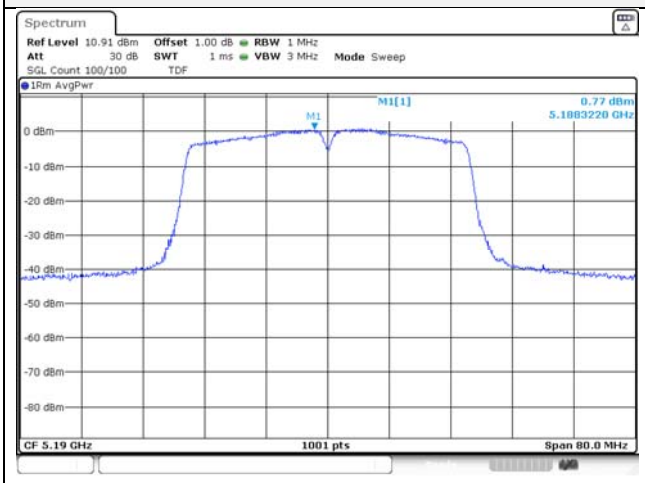
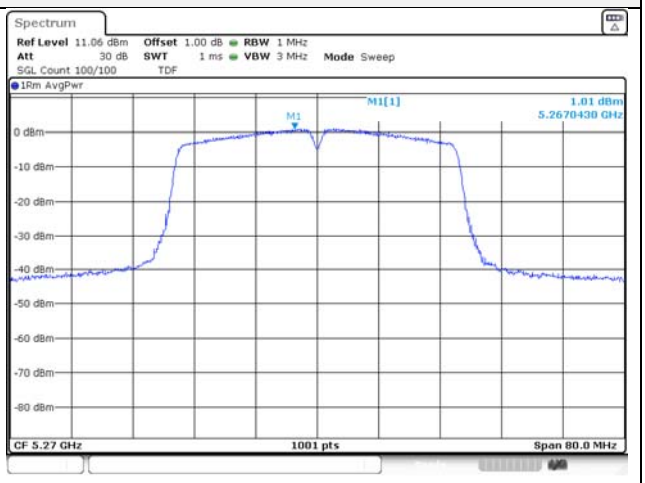
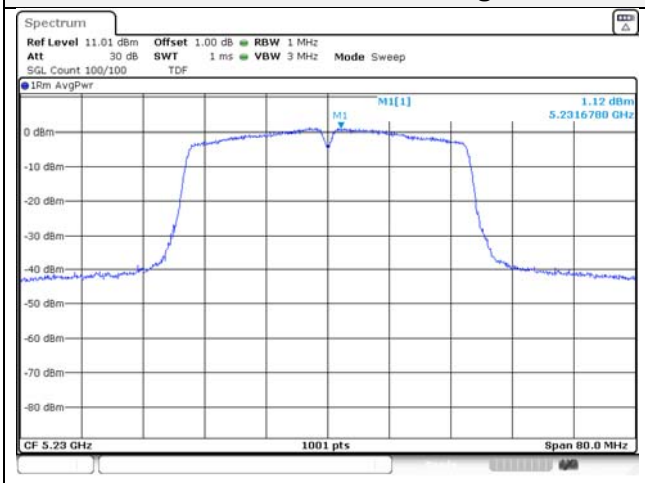
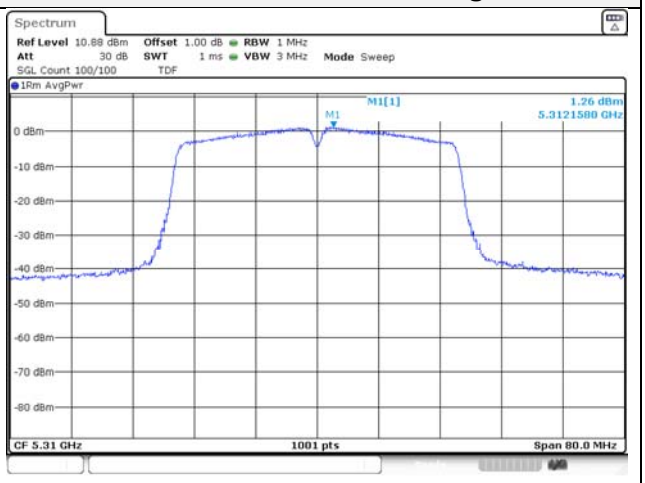
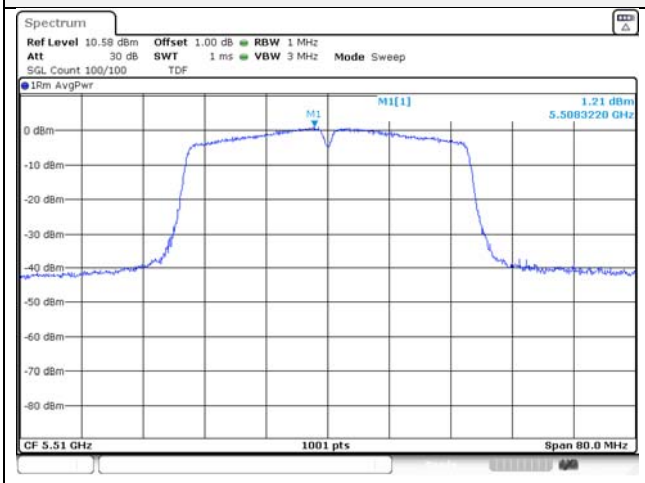
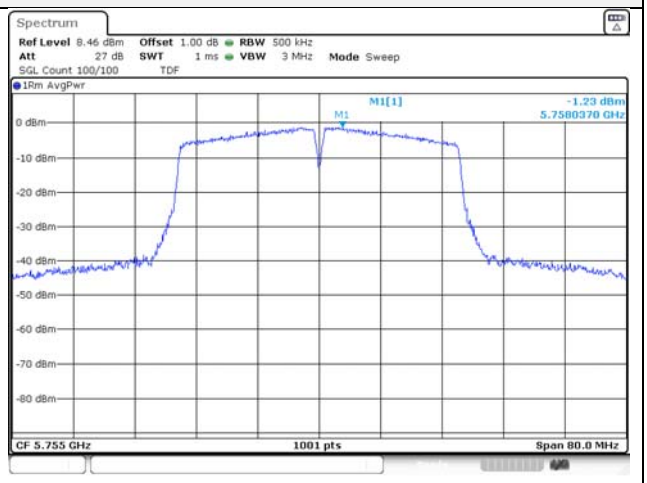
	
UNII-1 / 802.11ac VHT40 / High ch.	**UNII-2A 802.11ac VHT40 / High ch.**
	

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



UNII-3 / 802.11ac VHT40 / Low ch.



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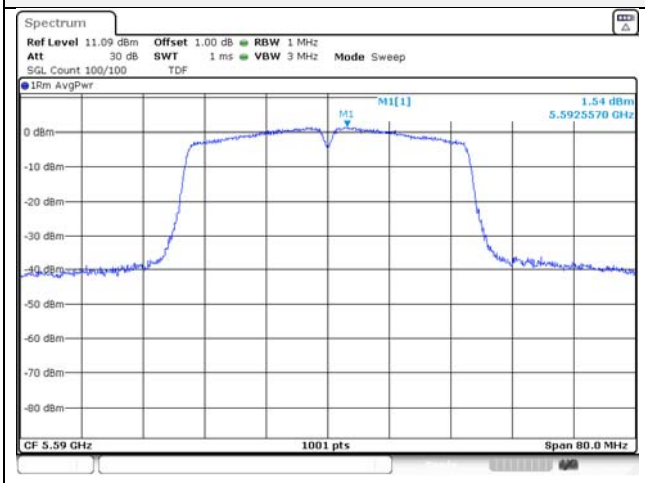

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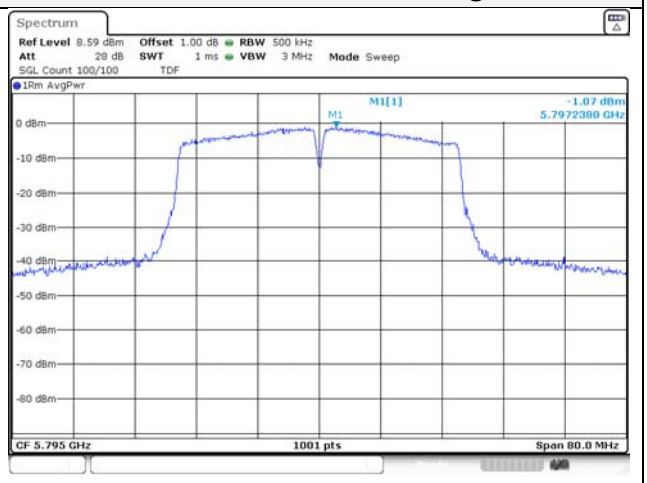

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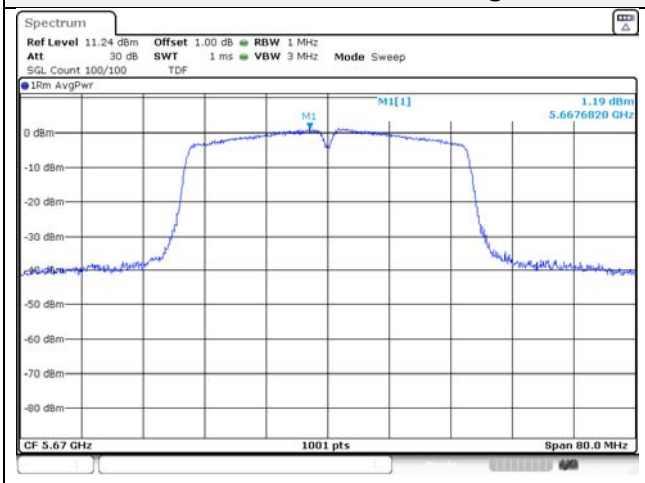

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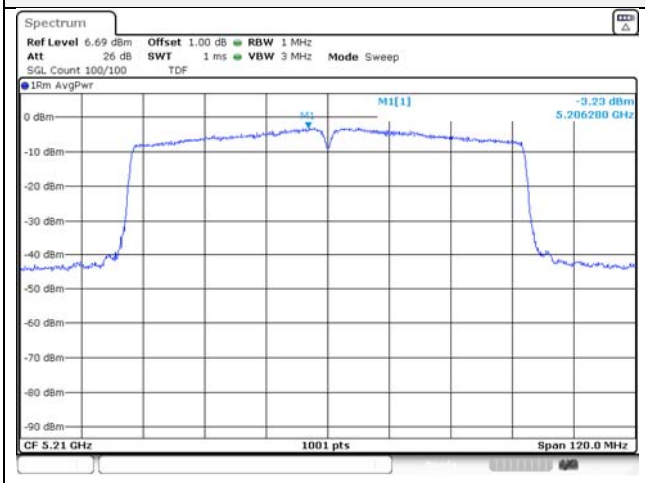
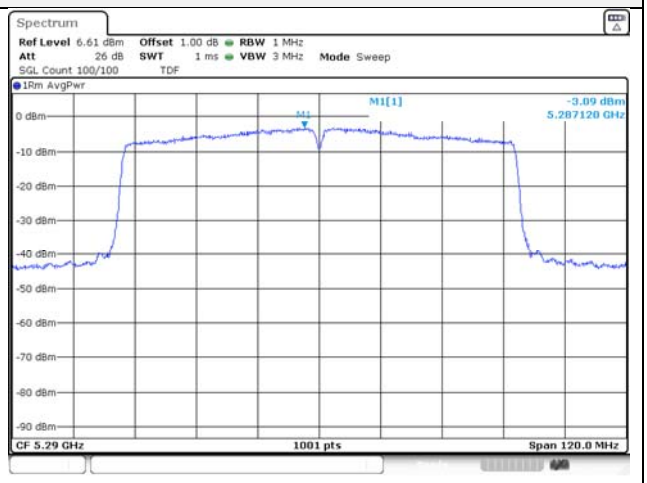
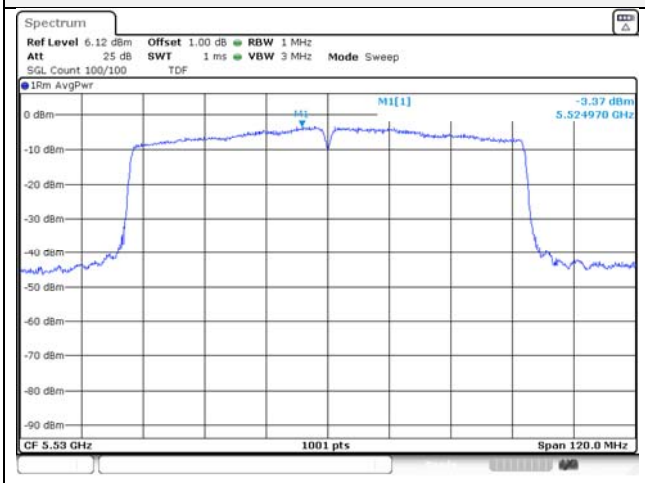
UNII-1 / 802.11ac VHT80 / Low ch.



UNII-2A / 802.11ac VHT80 / Low ch.



UNII-2C / 802.11ac VHT80 / Low ch.



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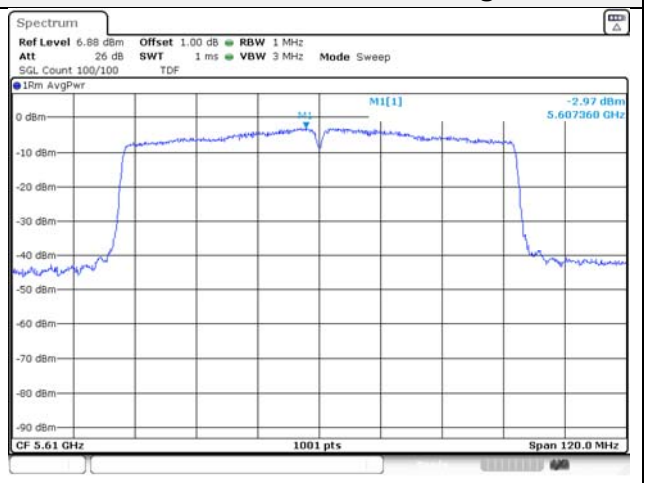

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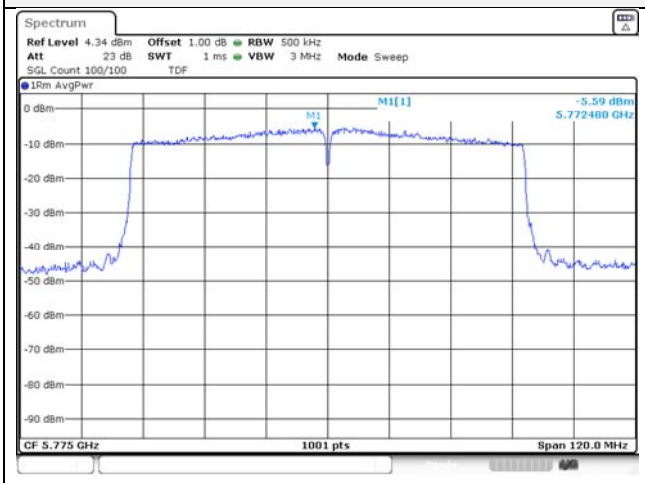

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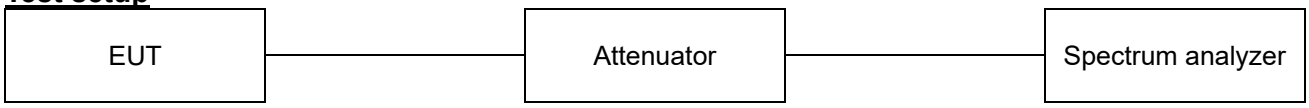
8.3. 26 dB Bandwidth & 99% Bandwidth

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

26 dB bandwidth

Test mode	Band	Frequency(㎒)	Measured Bandwidth (㎒)
802.11a	UNII-1	5 180	19.98
		5 200	19.68
		5 240	19.88
	UNII-2A	5 260	19.88
		5 280	19.83
		5 320	19.68
	UNII-2C	5 500	19.88
		5 600	20.08
		5 700	19.88
802.11n HT20	UNII-1	5 180	20.18
		5 200	20.18
		5 240	20.23
	UNII-2A	5 260	20.03
		5 280	20.28
		5 320	20.28
	UNII-2C	5 500	20.13
		5 600	20.58
		5 700	20.43
802.11n HT40	UNII-1	5 190	40.86
		5 230	40.76
	UNII-2A	5 270	41.06
		5 310	40.86
	UNII-2C	5 510	40.86
		5 590	41.16
		5 670	42.06

Test mode	Band	Frequency(㎒)	Measured Bandwidth (㎒)
802.11ac VHT20	UNII-1	5 180	20.13
		5 200	20.33
		5 240	20.08
	UNII-2A	5 260	20.13
		5 280	20.23
		5 320	20.23
	UNII-2C	5 500	20.08
		5 600	20.33
		5 700	20.18
802.11ac VHT40	UNII-1	5 190	40.56
		5 230	41.16
	UNII-2A	5 270	40.86
		5 310	40.56
	UNII-2C	5 510	41.06
		5 590	40.96
		5 670	40.96
802.11ac VHT80	UNII-1	5 210	81.16
	UNII-2A	5 290	81.52
	UNII-2C	5 530	81.16
		5 610	81.40

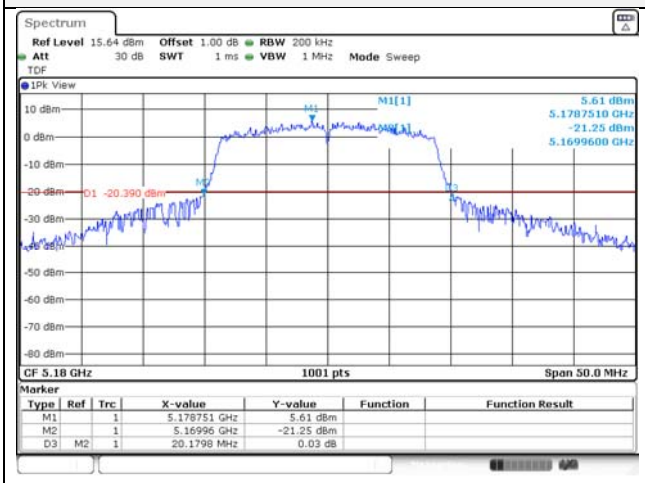
99% bandwidth

Test mode	Band	Frequency(㎒)	Measured Bandwidth (㎒)
802.11a	UNII-1	5 240	16.48
	UNII-2A	5 260	16.43
802.11n HT20	UNII-1	5 240	17.58
	UNII-2A	5 260	17.58
802.11n HT40	UNII-1	5 230	36.26
	UNII-2A	5 270	36.26
802.11ac VHT20	UNII-1	5 240	17.53
	UNII-2A	5 260	17.53
802.11ac VHT40	UNII-1	5 230	36.26
	UNII-2A	5 270	36.16
802.11ac VHT80	UNII-1	5 210	75.16
	UNII-2A	5 290	75.16

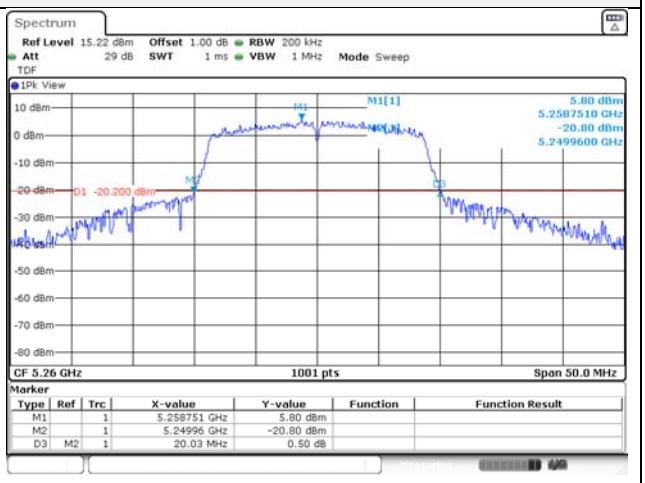
26 dB bandwidth

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

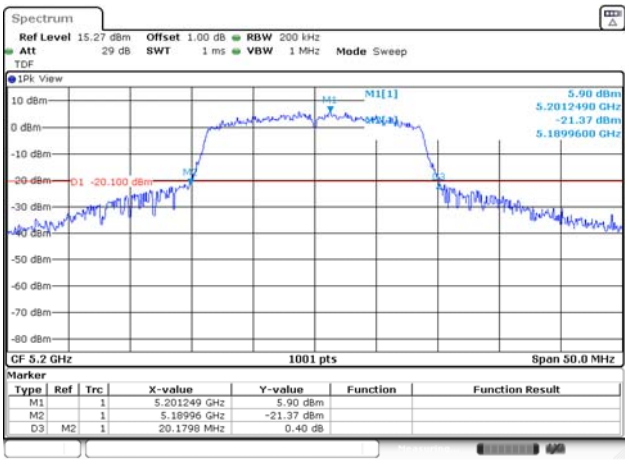
UNII-1 / 802.11n HT20 / Low ch.



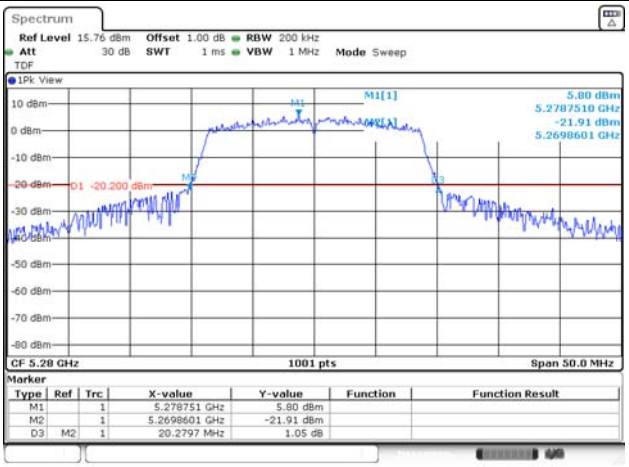
UNII-2A / 802.11n HT20 / Low ch.



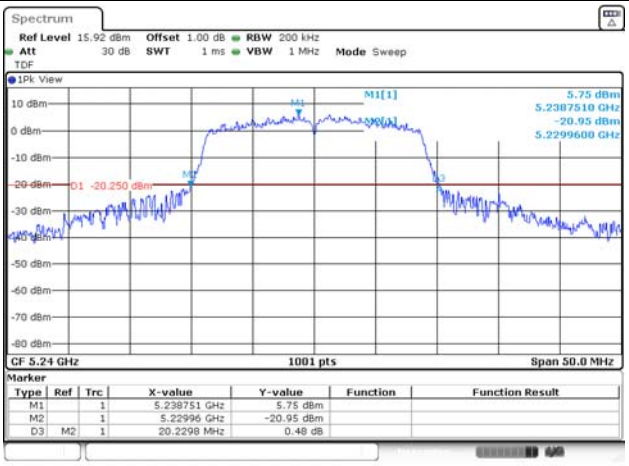
UNII-1 / 802.11n HT20 / Mid ch.



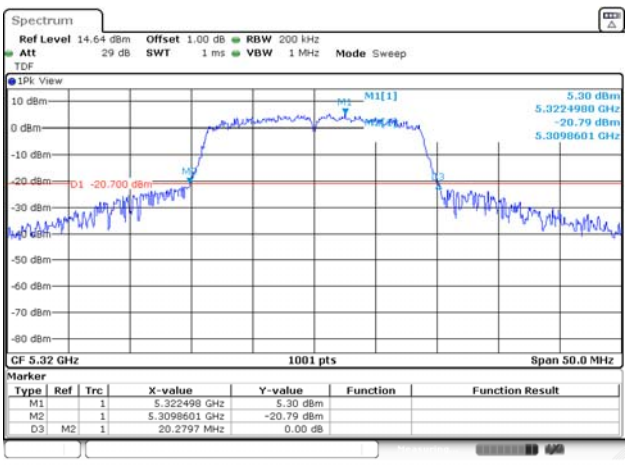
UNII-2A / 802.11n HT20 / Mid ch.

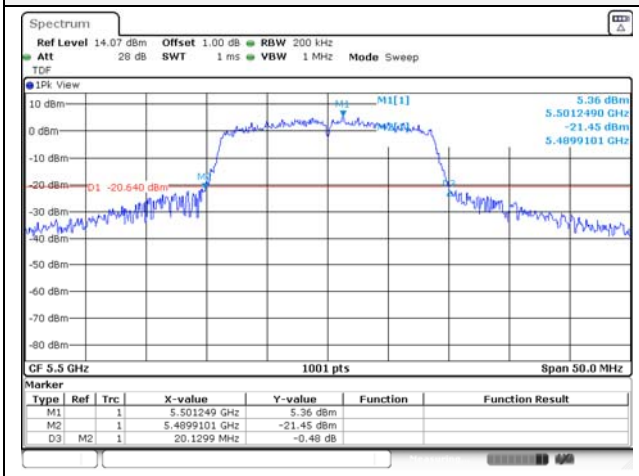
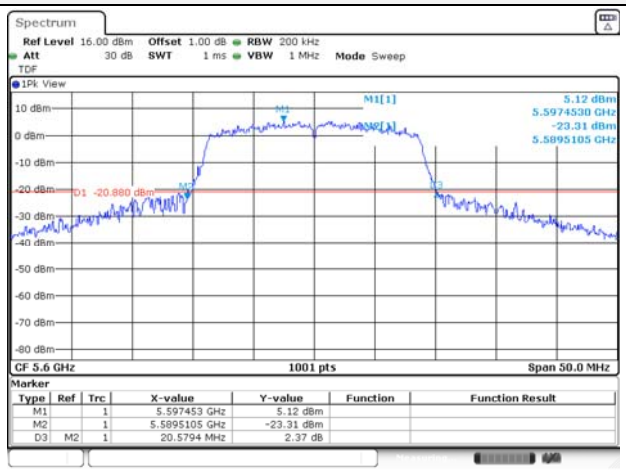
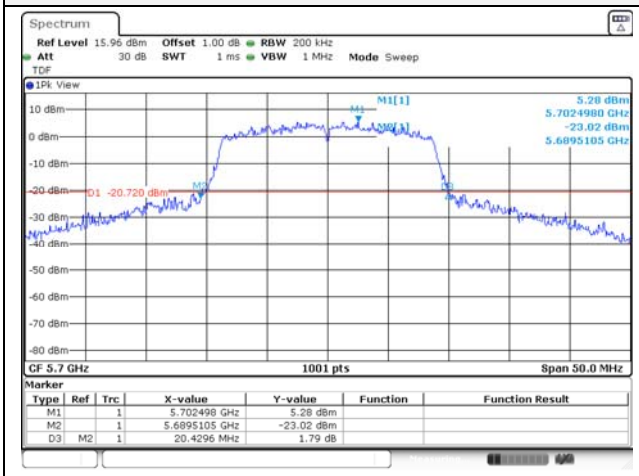


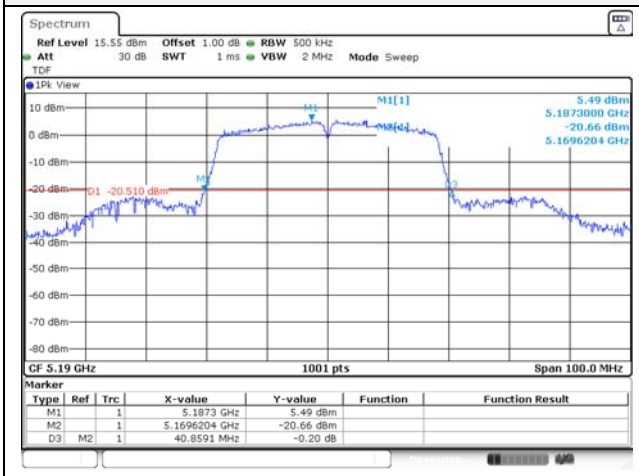
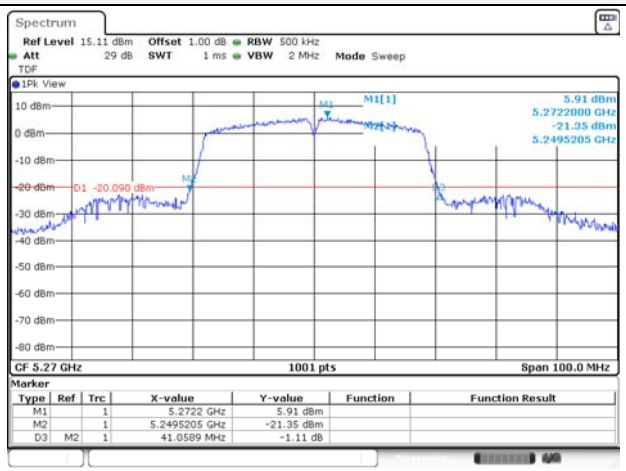
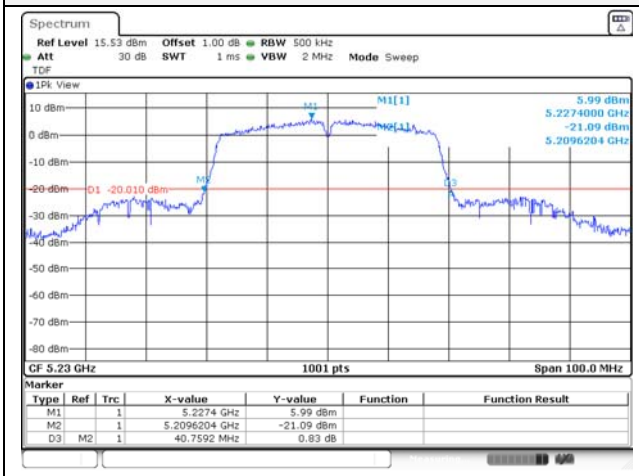
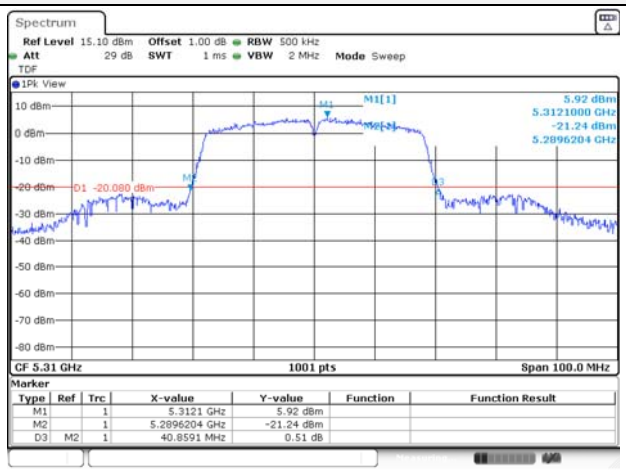
UNII-1 / 802.11n HT20 / High ch.

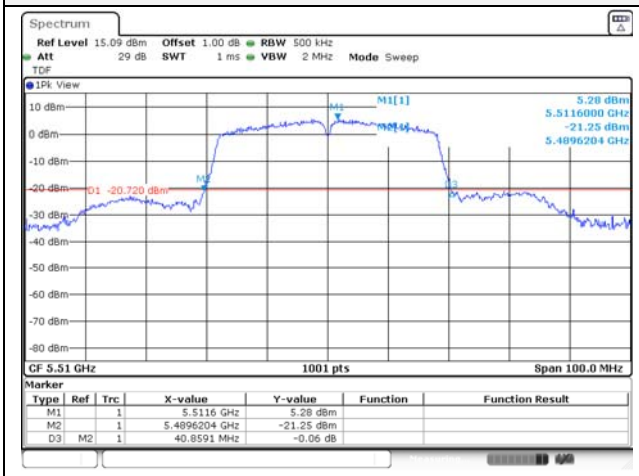
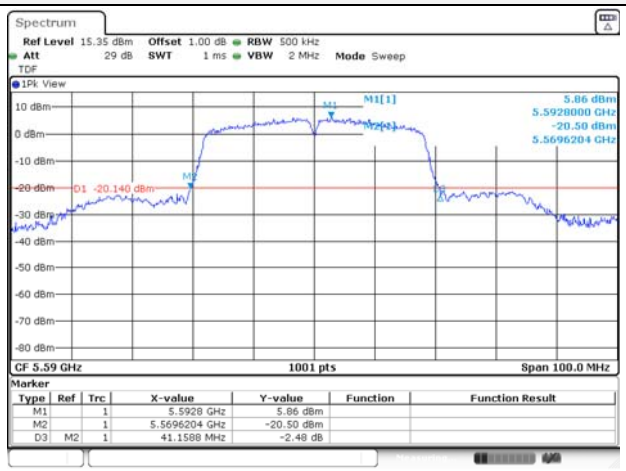
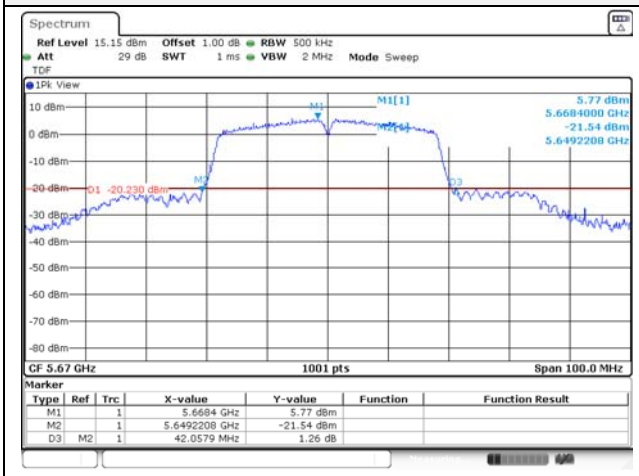


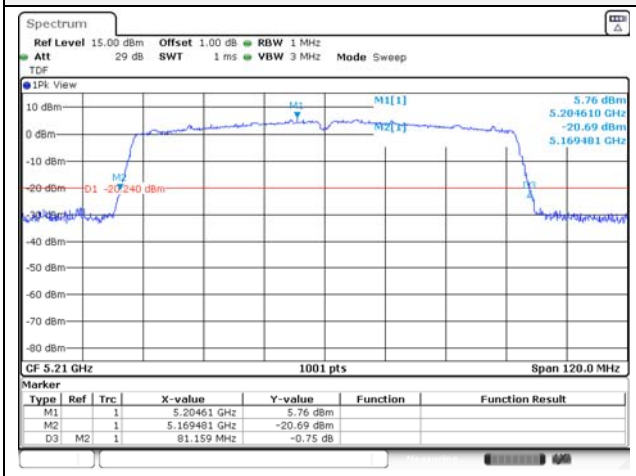
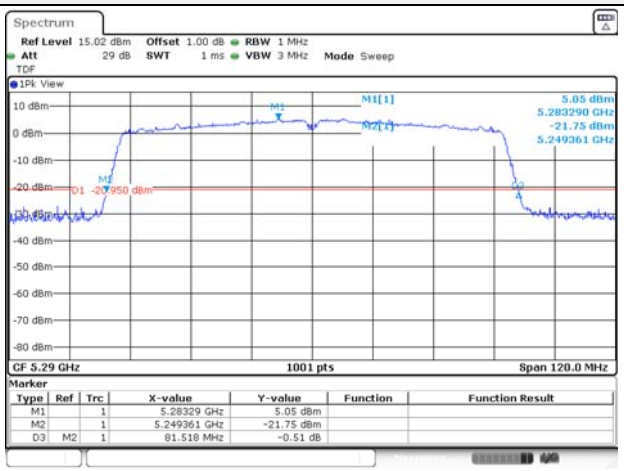
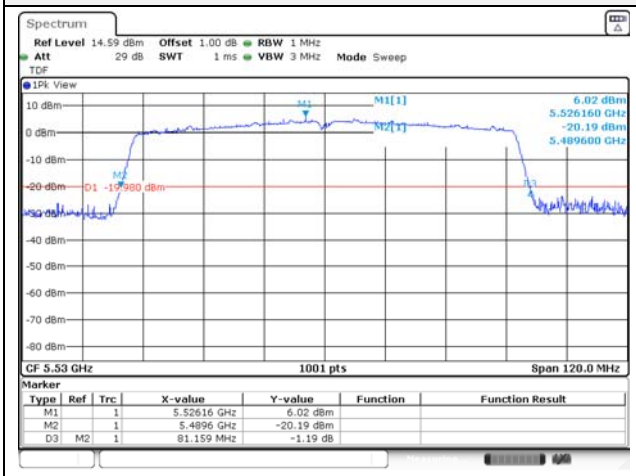
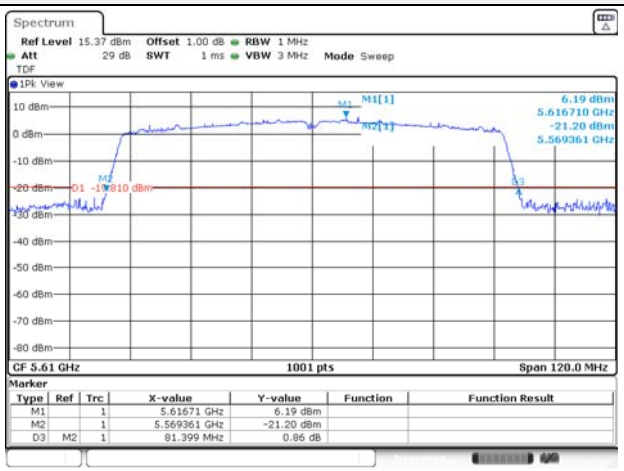
UNII-2A / 802.11n HT20 / High ch.



UNII-2C / 802.11n HT20 / Low ch.	UNII-2C / 802.11n HT20 / Mid ch.
	
UNII-2C / 802.11n HT20 / High ch.	
	Blank

UNII-1 / 802.11n HT40 / Low ch.	UNII-2A / 802.11n HT40 / Low ch.
	
UNII-1 / 802.11n HT40 / High ch.	**UNII-2A / 802.11n HT40 / High ch.**
	

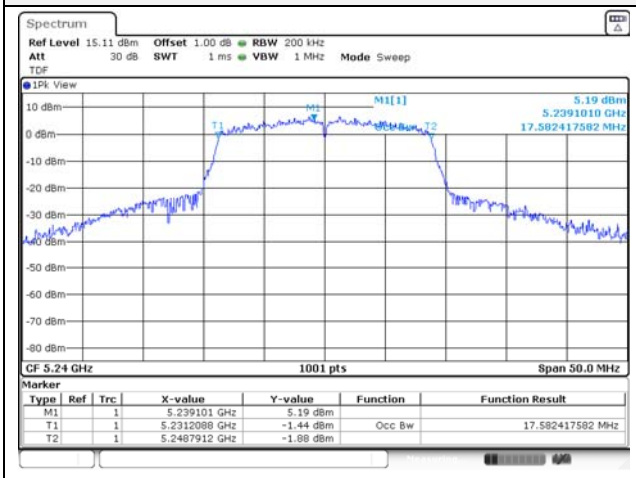
UNII-2C / 802.11n HT40 / Low ch.	UNII-2C / 802.11n HT40 / Mid ch.
	
UNII-2C / 802.11n HT40 / High ch.	
	Blank

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

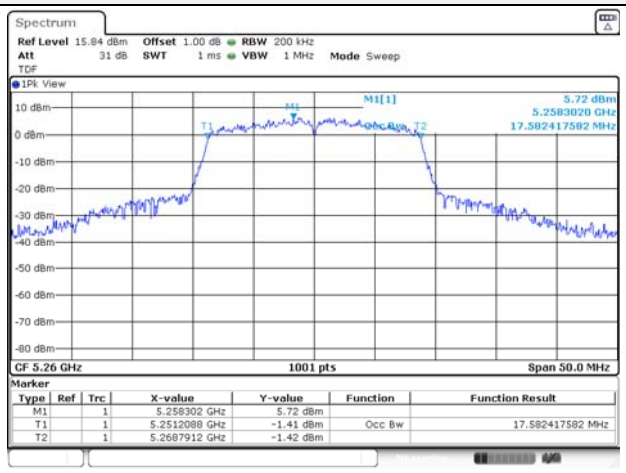
99% bandwidth

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

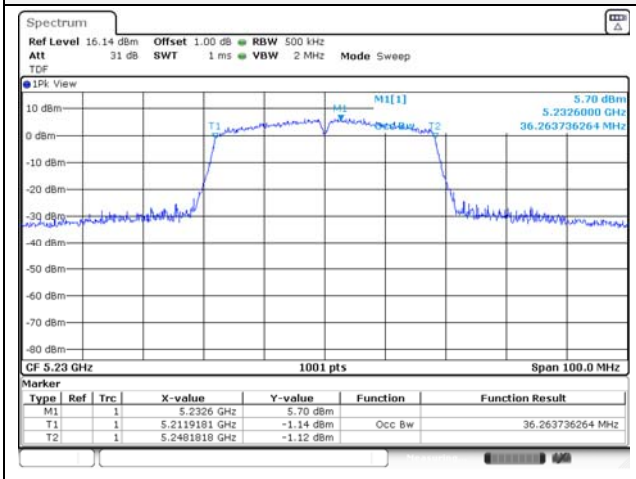
UNII-1 / 802.11n HT20 / 5 240 ㎒



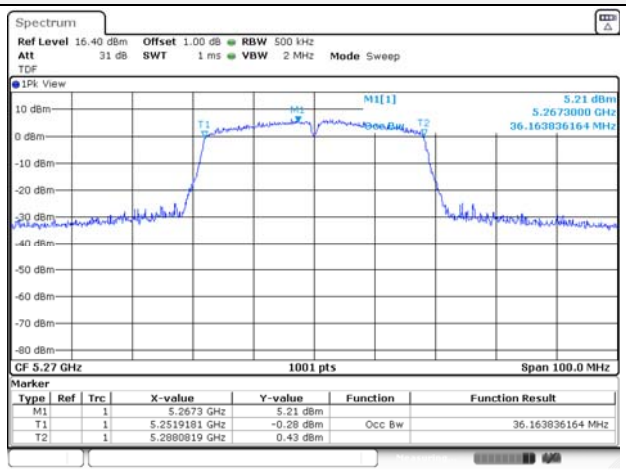
UNII-2A / 802.11n HT20 / 5 260 ㎒



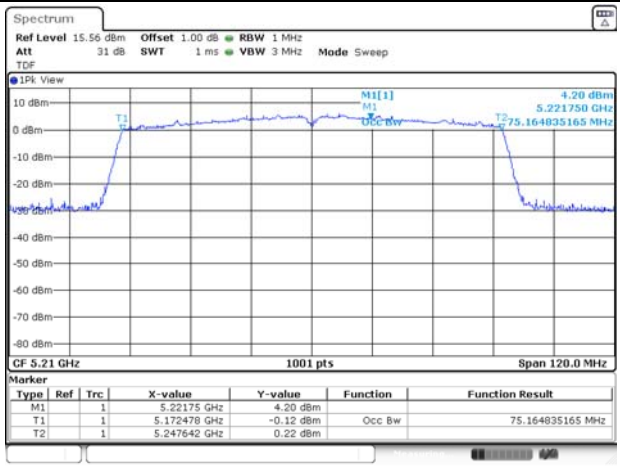
UNII-1 / 802.11ac VHT40 / 5 230 ㎒



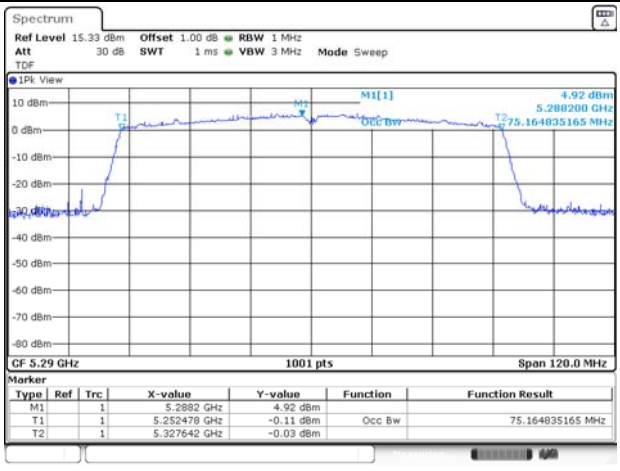
UNII-2A / 802.11ac VHT40 / 5 270 ㎒



UNII-1 / 802.11ac VHT80 / 5 210 ㎒

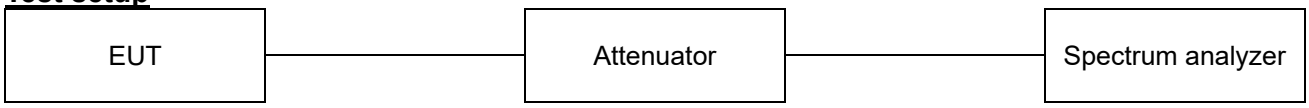


UNII-2A / 802.11ac VHT80 / 5 290 ㎒



8.4. 6 dB Bandwidth

Test setup



Limit

According to §15.407(e)
Within the 5.725-5.85 ㎓ band, the minimum 6 dB 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 dB 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 dB relative to the maximum level measured in the fundamental emission.

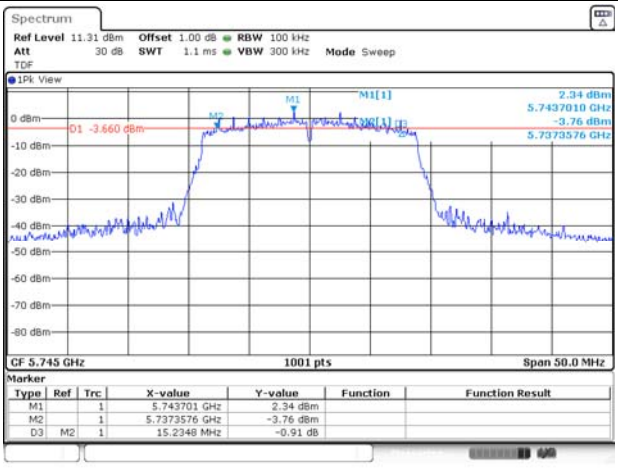
Test results

Test mode	Band	Frequency (㎒)	Measured Bandwidth (㎒)	Limit (㎒)
802.11a	UNII-3	5 745	15.13	0.50
		5 785	15.18	0.50
		5 825	15.23	0.50
802.11n HT20	UNII-3	5 745	15.23	0.50
		5 785	15.18	0.50
		5 825	15.23	0.50
802.11n HT40	UNII-3	5 755	35.26	0.50
		5 795	35.26	0.50
802.11ac VHT20	UNII-3	5 745	15.23	0.50
		5 785	15.13	0.50
		5 825	15.23	0.50
802.11ac VHT40	UNII-3	5 755	35.26	0.50
		5 795	35.26	0.50
802.11ac VHT80	UNII-3	5 775	75.28	0.50

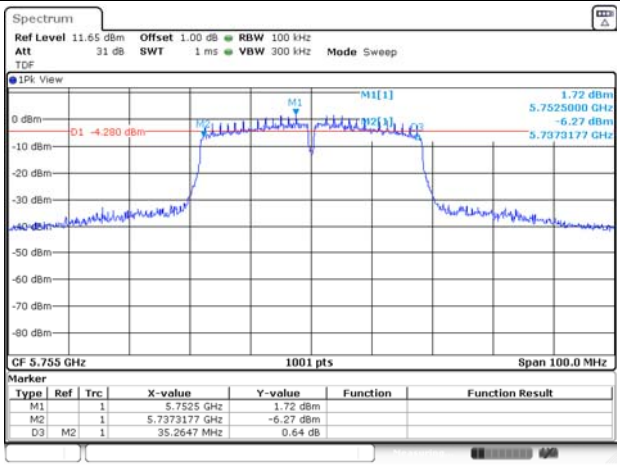
6 dB bandwidth

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

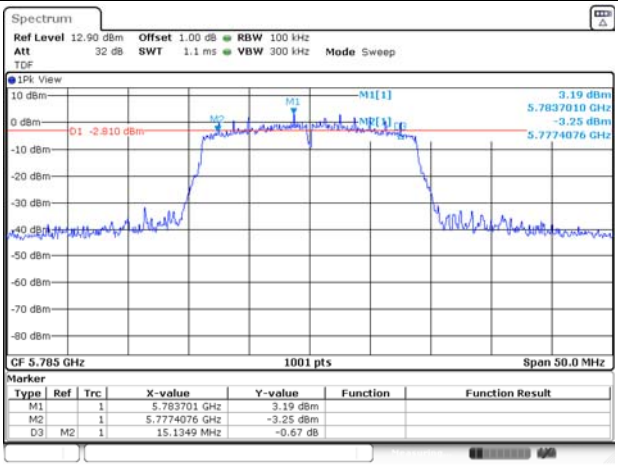
UNII-3 / 802.11ac VHT 20 / Low ch.



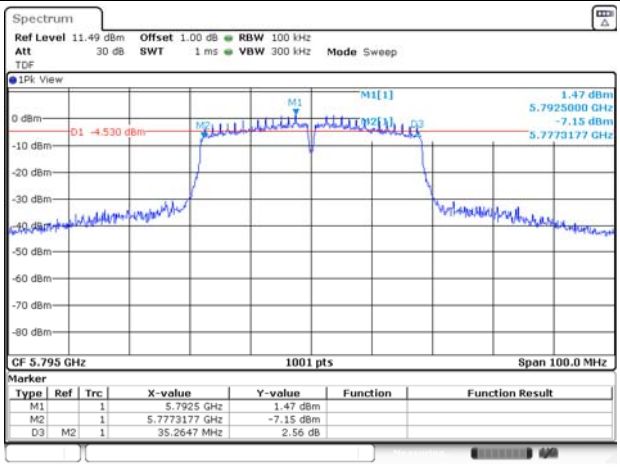
UNII-3 / 802.11ac VHT40 / Low ch.



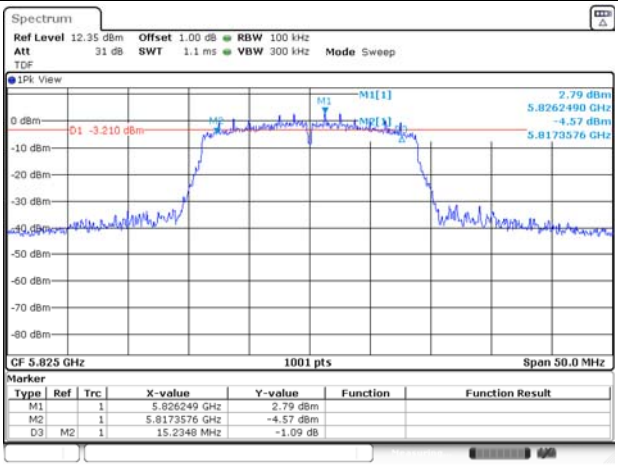
UNII-3 / 802.11ac VHT 20 / Mid ch.



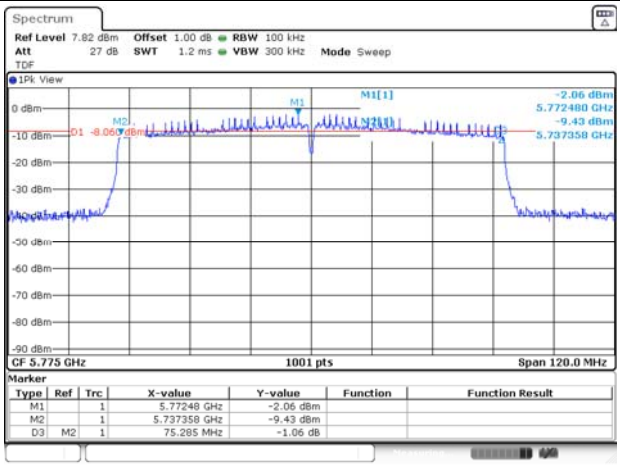
UNII-3 / 802.11ac VHT40 / High ch.



UNII-3 / 802.11ac VHT 20 / High ch.



UNII-3 / 802.11ac VHT80 / Low ch.



8.5. Straddle channel

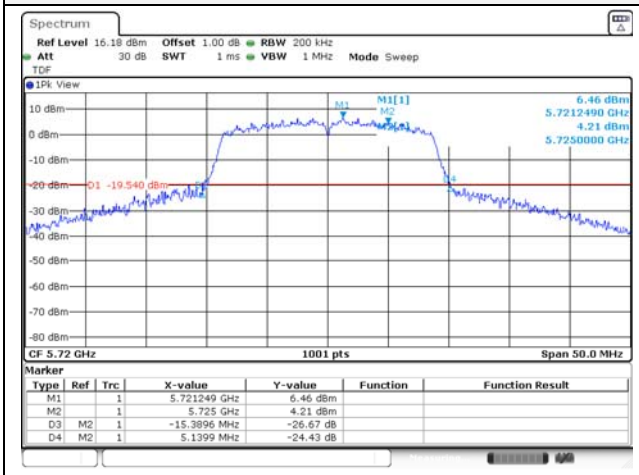
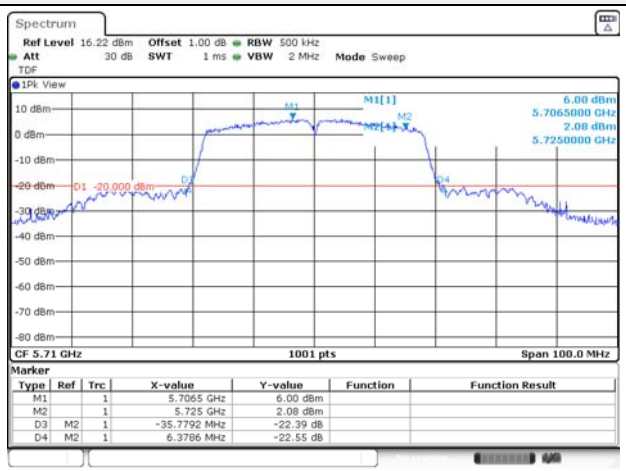
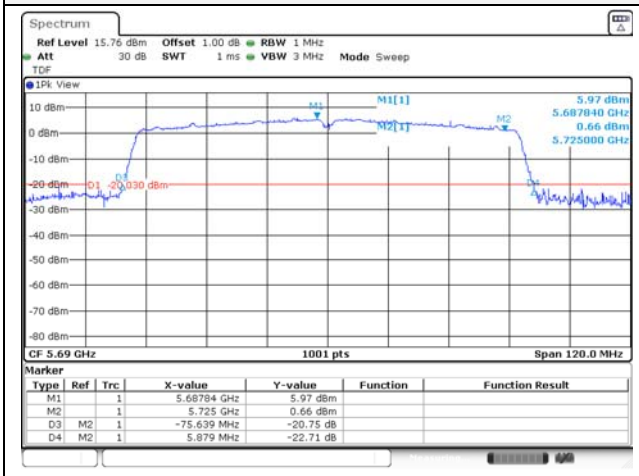
26dB bandwidth

Test mode	Band	Frequency (MHz)	26dB Bandwidth (MHz)
802.11a	UNII-2C	5 720	14.99
802.11n HT20			15.39
802.11ac VHT20			15.09
802.11a	UNII-3	5 720	4.99
802.11n HT20			5.14
802.11ac VHT20			5.04
802.11n HT40	UNII-2C	5 710	35.78
802.11ac VHT40			35.48
802.11n HT40	UNII-3	5 710	6.38
802.11ac VHT40			5.28
802.11ac VHT80	UNII-2C	5 690	75.64
	UNII-3	5 690	5.88

Notes:

1. [UNII-2C] 26dB Bandwidth = 5 725MHz – Measured Frequency[MHz]
2. [UNII-3] 26dB Bandwidth = Measured Frequency[MHz] – 5 725MHz

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

802.11n HT20	802.11n HT40
	
802.11ac VHT80	
	Blank

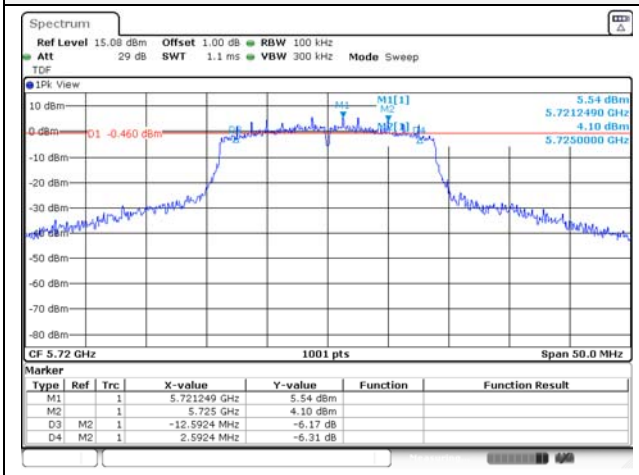
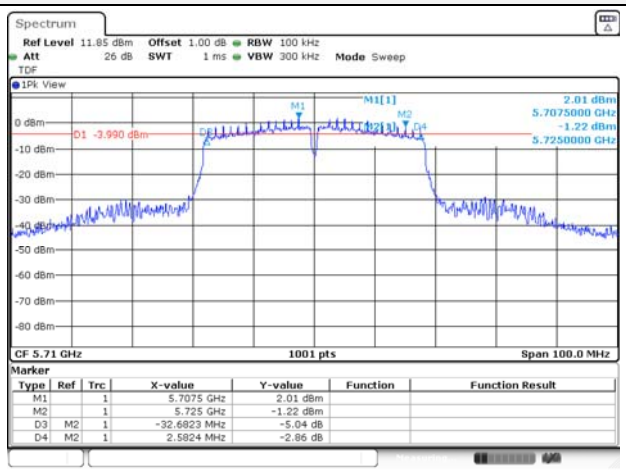
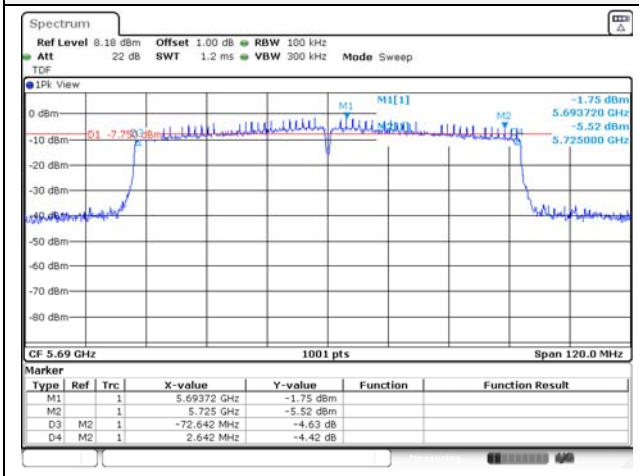
6dB bandwidth

Test mode	Band	Frequency (㎒)	6dB Bandwidth (㎒)	Limit (㎒)
802.11a	UNII-3	5 720	2.54	0.50
802.11n HT20			2.59	0.50
802.11ac VHT20			2.59	0.50
802.11n HT40	UNII-3	5 710	2.58	0.50
802.11ac VHT40			2.58	0.50
802.11ac VHT80	UNII-3	5 690	2.64	0.50

Notes:

1. 6dB Bandwidth = Measured Frequency[㎒] – 5 725㎒

In order to simplify the report, attached plots were only the Worst Case per bandwidth.

802.11n HT20	802.11n HT40
	
802.11ac VHT80	
	Blank

Output Power

Test mode	Band	Frequency (㎒)	Measured output power			Limit (dBm)
			Reading (dBm)	DCF (dB)	Result (dBm)	
802.11a	UNII-2C	5 720	15.34	0.14	15.48	22.76
802.11n HT20			14.99	0.15	15.14	22.87
802.11ac VHT20			14.02	0.15	14.17	22.79
802.11a	UNII-3	5 720	7.67	0.14	7.81	30.00
802.11n HT20			7.74	0.15	7.89	
802.11ac VHT20			6.75	0.15	6.90	
802.11n HT40	UNII-2C	5 710	14.48	0.29	14.77	23.98
802.11ac VHT40			14.45	0.29	14.74	
802.11n HT40	UNII-3	5 710	2.09	0.29	2.38	30.00
802.11ac VHT40			1.97	0.29	2.26	
802.11ac VHT80	UNII-2C	5 690	13.20	0.56	13.76	23.98
	UNII-3	5 690	-2.39	0.56	-1.83	30.00

Note.
1. Result(dBm) = Reading Power + D.C.F