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TEST REPORT

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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 : 2019-10-25

2. Use of Report : -

3. Name of Product and Model : Mobile Phone / SM-A515F/DS

4. Manufacturer and Country of Origin : SAMSUNG ELECTRONICS VIETNAM CO.,LTD./ Vietnam

5. FCC ID : A3LSMA515F

6. Date of Test : 2019-11-11 to 2019-11-27

7. Test Standards : FCC Part 15 Subpart E, 15.407

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

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Jaehyong Lee (Signature)

2019-11-28

KCTL Inc.

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Report revision history

Date	Revision	Page No
2019-11-28	Initial report	-

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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 VIETNAM CO.,LTD.
Address	:	Kcn Yen Binh1, huyen pho Yen Tinh Thai Nguyen 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-A515F/DS
Derivative model	:	SM-A515F
Modulation technique	:	Bluetooth(BDR/EDR)_ GFSK, π/4DQPSK, 8DPSK
		Bluetooth(BLE), ANT+_GFSK
		WIFI(802.11b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM
		LTE_QPSK, 16QAM
		WCDMA_QPSK
		GSM_GMSK, 8-PSK
Number of channels	:	Bluetooth(BDR/EDR), ANT+_79ch / Bluetooth(BLE)_40ch
		11 ch: 802.11b/g/n_HT20
		UNII-1: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
		UNII-2A: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
		UNII-2C: 12 ch (20 MHz), 6 ch (40 MHz), 3 ch (80 MHz)
		UNII-3: 5 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
Power source	:	DC 3.85 V
Antenna specification	:	LTE/WCDMA_FPCB Antenna
		WIFI/Bluetooth(BDR/EDR/BLE)/ANT+_FPCB Antenna
Antenna gain	:	WIFI/Bluetooth(BDR/EDR/BLE)/ANT+ : -4.70 dBi
		UNII-1 -4.10 dBi
		UNII-2A -4.74 dBi
		UNII-2C -3.92 dBi
		UNII-3 -4.40 dBi

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Frequency range	:	Bluetooth(BDR/EDR/BLE), ANT+_2 402 ㎒ ~ 2 480 ㎒ 2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20) UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n_HT40/ac_VHT40) UNII-1: 5 210 ㎒ (802.11ac_VHT80) UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n_HT40/ac_VHT40) UNII-2A: 5 290 ㎒ (802.11ac_VHT80) UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n_HT40/ac_VHT40) UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80) UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n_HT40/ac_VHT40) UNII-3: 5 775 ㎒ (802.11ac_VHT80) LTE Band 2_1 850.7 ㎒ ~ 1 909.3 ㎒ LTE Band 4_1 710.7 ㎒ ~ 1 754.3 ㎒ LTE Band 5_824.7 ㎒ ~ 848.3 ㎒ LTE Band 12_699.7 ㎒ ~ 715.3 ㎒ LTE Band 13_779.5 ㎒ ~ 784.5 ㎒ LTE Band 17_706.5 ㎒ ~ 713.5 ㎒ LTE Band 26_824.7 ㎒ ~ 848.3 ㎒, 814.7 ㎒ ~ 823.3 ㎒ LTE Band 41_2 498.5 ㎒ ~ 2 687.5 ㎒ LTE Band 66_1 710.7 ㎒ ~ 1 779.3 ㎒ GSM 850_824.2 ㎒ ~ 848.8 ㎒ GSM 1900_1 850.2 ㎒ ~ 1 909.8 ㎒ WCDMA 850_826.4 ㎒ ~ 846.6 ㎒ WCDMA 1700_1 712.4 ㎒ ~ 1 752.6 ㎒ WCDMA 1900_1 852.4 ㎒ ~ 1 907.6 ㎒
Software version	:	A515F.001
Hardware version	:	REV0.1
Test device serial No.	:	Conducted(cecbed2e6a3f7e34) Radiated(R38MA05XG0M, R38MA05WHQF)
Operation temperature	:	-30 ℃ ~ 50 ℃

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
Earphone	Samsung Electronics Co., Ltd.	EHS61ASFBE	-	-
Travel Adapter	Samsung Electronics Co., Ltd.	EP-TA200	R37M6LAKG31DK3	AC 100-240V 50-60 Hz, 9.0V-1.67A 5.0V-2.0A
Micro USB Data Cable	Samsung Electronics Co., Ltd.	-	-	-

2.2. Information about derivative model

The difference between basic model and derivative models is:

SM-A515F
- It does not support Dual-Sim card, support Single-Sim card and changed from Dual SIM tray to single SIM tray.

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2.3. Frequency/channel operations

This device contains the following capabilities:
WIFI(2.4㎓ band 802.11b/g/n(HT20), 5㎓ band 802.11a/n(HT20/HT40)/ac(VHT/20/40/80)), Bluetooth(BDR/EDR/BLE), ANT+
LTE Band 2, LTE Band 4, LTE Band 5, LTE Band 12, LTE Band 13, LTE Band 17, LTE Band 26, LTE Band41, WCDMA 850, WCDMA 1700, WCDMA 1900, GSM 850, GSM 1900

UNII-1

Ch.	Frequency (㎒)
36	5 180
40	5 200
48	5 240

UNII-2A

Ch.	Frequency (㎒)
52	5 260
56	5 280
64	5 320

UNII-2C

Ch.	Frequency (㎒)
100	5 500
120	5 600
140	5 700
144	5 720

UNII-3

Ch.	Frequency (㎒)
149	5 745
157	5 785
165	5 825

Table 2.3-1. 802.11a/n/ac_HT20/VHT20 mode

UNII-1

Ch.	Frequency (㎒)
38	5 190
46	5 230

UNII-2A

Ch.	Frequency (㎒)
54	5 270
62	5 310

UNII-2C

Ch.	Frequency (㎒)
102	5 510
118	5 590
140	5 700
142	5 710

UNII-3

Ch.	Frequency (㎒)
151	5 755
159	5 795

Table 2.3-2. 802.11n/ac_HT40/VHT40 mode

UNII-1

Ch.	Frequency (㎒)
42	5 210

UNII-2A

Ch.	Frequency (㎒)
58	5 290

UNII-2C

Ch.	Frequency (㎒)
106	5 530
122	5 610
134	5 670
138	5 690

UNII-3

Ch.	Frequency (㎒)
155	5 775

Table 2.3-3. 802.11ac_VHT80 mode

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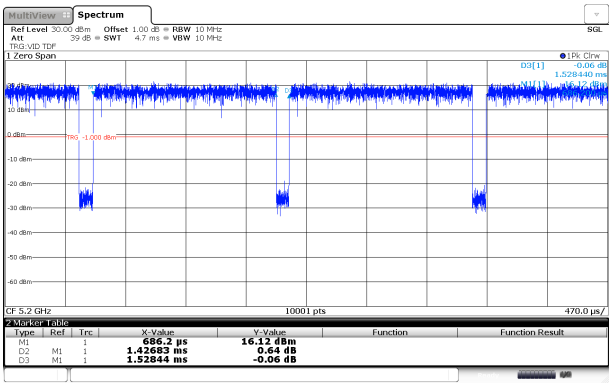
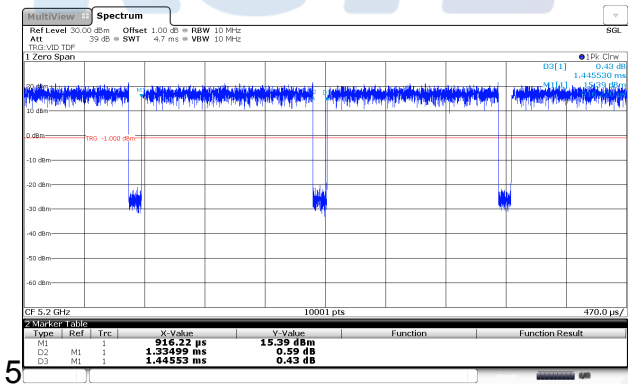
2.4. Duty Cycle Correction Factor

- 802.11a



Note1) : Period : 1.528 4 ㎳, On time : 1.426 8 ㎳
Note2) : DCCF = 10 log(1 / x) = 10 log(1/0.934) = 0.299 ㏈, x = 1.426 8/1.528 4 = 0.934 (93.4%)
Note3) : 802.11a is a non-continuous transmission (duty cycle < 98 %)

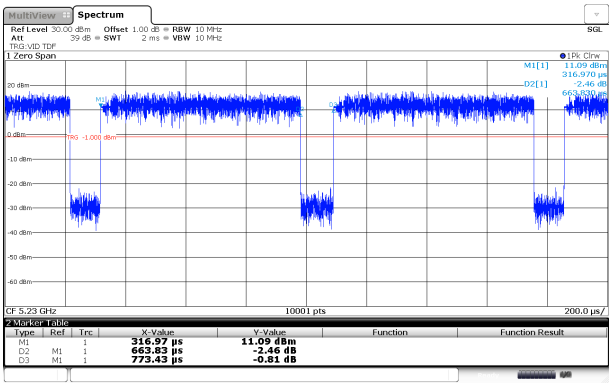
- 802.11n HT20



5

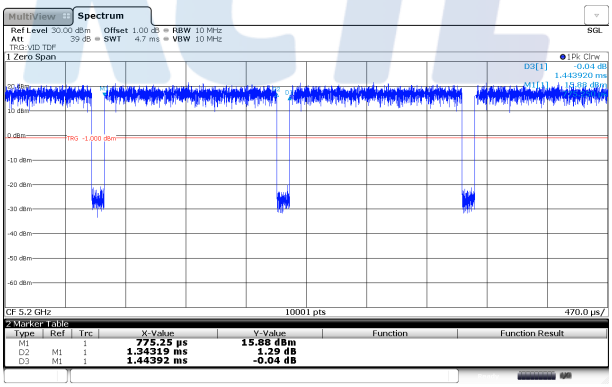
Note1) : Period : 1.445 5 ㎳, On time : 1.335 ㎳
Note2) : DCCF = 10 log(1 / x) = 10 log(1/0.924) = 0.345 ㏈, x = 1.335/1.445 5 = 0.924 (92.4%)
Note3) : 802.11n_HT20 is a non-continuous transmission (duty cycle < 98 %)

- 802.11n HT40



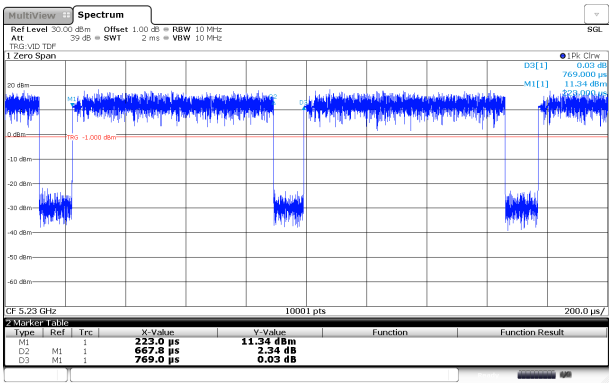
Note1) : Period : 0.773 4 ㎳, On time : 0.663 8 ㎳
Note2) : DCCF = 10 log(1 / x) = 10 log(1/0.858) = 0.664 ㏈, x = 0.663 8/0.773 4 = 0.858 (85.8%)
Note3) : 802.11n HT40 is a non-continuous transmission (duty cycle < 98 %)

- 802.11ac VHT20



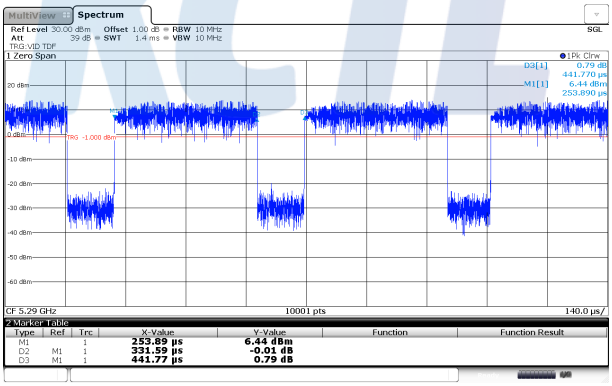
Note1): period: 1.443 9 ㎳, On time: 1.343 2 ㎳
Note2): DCCF = 10 log(1 / x) = 10 log(1/0.930) = 0.314 ㏈, x = 1.343 2/1.443 9 = 0.93 (93.0%)
Note3): 802.11ac VHT20 is a non-continuous transmission (duty cycle < 98%)

- 802.11ac VHT40



Note1): period: 0.769 ㎳, On time: 0.667 8 ㎳
Note2): DCCF = 10 log(1 / x) = 10 log(1/0.868) = 0.613 ㏈, x = 0.667 8/0.769 = 0.868 (86.8%)
Note3): 802.11ac VHT40 is a non-continuous transmission (duty cycle < 98 %)

- 802.11ac VHT80



Note1): period: 0.441 8 ㎳, On time: 0.331 6 ㎳
Note2): DCCF = 10 log(1 / x) = 10 log(1/0.751) = 1.246 ㏈, x = 0.331 6/0.441 8 = 0.751 (75.1%)
Note3): 802.11ac VHT80 is a non-continuous transmission (duty cycle < 98 %)

3. Antenna requirement

Requirement of FCC part section 15.203, 15.407:
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.

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4. Summary of tests

FCC Part section(s)	Parameter	Test results
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Maximum power spectral density	Pass
15.407(a)	26 ㏈ Channel Bandwidth	Pass
15.407(e)	6 ㏈ Channel Bandwidth	Pass
15.407(g)	Frequency stability	Pass
15.407(b), 15.205(a), 15.209(a)	Spurious emission	Pass
	Band-edge, restricted band	Pass
15.207(a)	Conducted Emissions	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. Per evaluation report, all of the data contained herein is re-used from the reference
   FCC ID : A3LSMA515FN
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. The worst-case data rates were:
   SISO Antenna: 802.11b mode : 1Mbps
   802.11g mode : 6Mbps
   802.11n HT20 mode : MCS0
   802.11n HT40 mode : MCS0
   802.11n VHT20 mode : MCS0
   802.11n VHT40 mode : MCS0
   802.11n VHT80 mode : MCS0

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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	1.76 dB	
Conducted spurious emissions	4.03 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.28 dB
	30 MHz ~ 300 MHz	4.98 dB
	300 MHz ~ 1 000 MHz	5.14 dB
	1 GHz ~ 6 GHz	6.70 dB
	Above 6 GHz	6.60 dB
Conducted emissions	9 kHz ~ 150 kHz	3.66 dB
	150 kHz ~ 30 MHz	3.26 dB

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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.

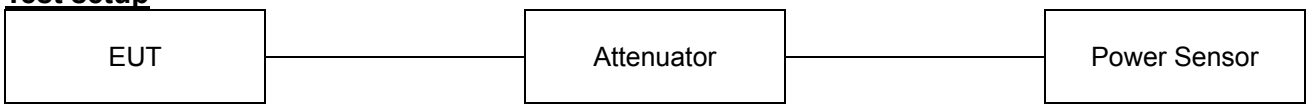
Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	9.93	16 000	12.39
50	9.96	17 000	12.81
100	10.01	18 000	12.93
200	10.11	19 000	13.05
300	10.19	20 000	13.32
400	10.26	21 000	13.19
500	10.31	22 000	13.39
600	10.35	23 000	13.50
700	10.42	24 000	13.43
800	10.39	25 000	13.93
900	10.48	26 000	13.53
1 000	10.46	26 500	13.74
2 000	10.81	27 000	13.79
3 000	11.00	28 000	14.04
4 000	11.19	29 000	13.70
5 000	11.42	30 000	14.09
6 000	11.61	31 000	14.12
7 000	11.66	32 000	14.94
8 000	11.72	33 000	15.01
9 000	11.79	34 000	15.47
10 000	12.12	35 000	15.53
11 000	12.15	36 000	15.62
12 000	12.30	37 000	16.10
13 000	12.80	38 000	16.24
14 000	12.47	39 000	16.25
15 000	12.60	40 000	16.48

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 12.3.3.2 and 14.2
KDB 789033 D02 v02r01 - Section E.2.d) or e)
KDB 662911 D01 v02r01 – Section E).1)

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

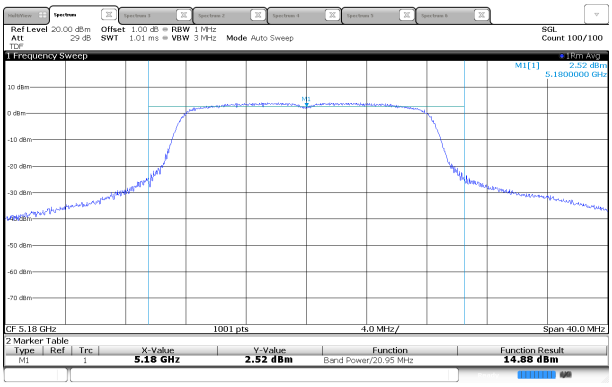
Test mode	Band	Freq (MHz)	Measured power (dBm)	DCCF (dB)	Conducted output power (dBm) Average	Conducted Power Limit (dBm)
802.11a	UNII-1	5 180	14.88	0.30	15.18	23.98
		5 200	14.81	0.30	15.11	
		5 240	15.17	0.30	15.47	
	UNII-2A	5 260	14.48	0.30	14.78	23.98
		5 280	14.81	0.30	15.11	
		5 320	14.51	0.30	14.81	
	UNII-2C	5 500	14.81	0.30	15.11	23.98
		5 600	14.69	0.30	14.99	
		5 700	14.86	0.30	15.16	
		5 720	14.68	0.30	14.98	22.91
	UNII-3	5 745	14.64	0.30	14.94	30.00
		5 785	14.51	0.30	14.81	
		5 825	14.79	0.30	15.09	
802.11n HT20	UNII-1	5 180	14.83	0.35	15.18	23.98
		5 200	14.47	0.35	14.82	
		5 240	14.87	0.35	15.22	
	UNII-2A	5 260	14.33	0.35	14.68	23.98
		5 280	14.90	0.35	15.25	
		5 320	14.39	0.35	14.74	
	UNII-2C	5 500	14.38	0.35	14.73	23.98
		5 600	14.65	0.35	15.00	
		5 700	14.79	0.35	15.14	
		5 720	14.49	0.35	14.84	23.01
	UNII-3	5 745	14.50	0.35	14.85	30.00
		5 785	14.55	0.35	14.90	
		5 825	14.66	0.35	15.01	
802.11n HT40	UNII-1	5 190	11.19	0.66	11.85	23.98
		5 230	13.24	0.66	13.90	
	UNII-2A	5 270	13.28	0.66	13.94	23.98
		5 310	11.92	0.66	12.58	
	UNII-2C	5 510	12.26	0.66	12.92	23.98
		5 590	13.54	0.66	14.20	
		5 670	13.25	0.66	13.91	
		5 710	13.35	0.66	14.01	
	UNII-3	5 755	13.25	0.66	13.91	30.00
		5 795	13.21	0.66	13.87	

Test mode	Band	Freq (MHz)	Measured power (dBm)	DCCF (dB)	Conducted output power (dBm) Average	Conducted Power Limit (dBm)
802.11ac VHT20	UNII-1	5 180	14.68	0.31	14.99	23.98
		5 200	14.45	0.31	14.76	
		5 240	14.86	0.31	15.17	
	UNII-2A	5 260	14.40	0.31	14.71	23.98
		5 280	14.84	0.31	15.15	
		5 320	14.69	0.31	15.00	
	UNII-2C	5 500	14.46	0.31	14.77	23.98
		5 600	14.65	0.31	14.96	
		5 700	14.72	0.31	15.03	
		5 720	14.61	0.31	14.92	23.38
	UNII-3	5 745	14.55	0.31	14.86	30.00
		5 785	14.52	0.31	14.83	
		5 825	14.77	0.31	15.08	
802.11ac VHT40	UNII-1	5 190	11.27	0.61	11.88	23.98
		5 230	13.23	0.61	13.84	
	UNII-2A	5 270	13.51	0.61	14.12	23.98
		5 310	12.27	0.61	12.88	
	UNII-2C	5 510	12.17	0.61	12.78	23.98
		5 590	13.69	0.61	14.30	
		5 670	13.19	0.61	13.80	
		5 710	13.35	0.61	13.96	
	UNII-3	5 755	13.09	0.61	13.70	30.00
		5 795	13.25	0.61	13.86	
802.11ac VHT80	UNII-1	5 210	8.70	1.25	9.95	23.98
	UNII-2A	5 290	10.37	1.25	11.62	23.98
	UNII-2C	5 530	10.21	1.25	11.46	23.98
		5 610	12.04	1.25	13.29	
		5 690	11.79	1.25	13.04	
	UNII-3	5 775	11.50	1.25	12.75	30.00

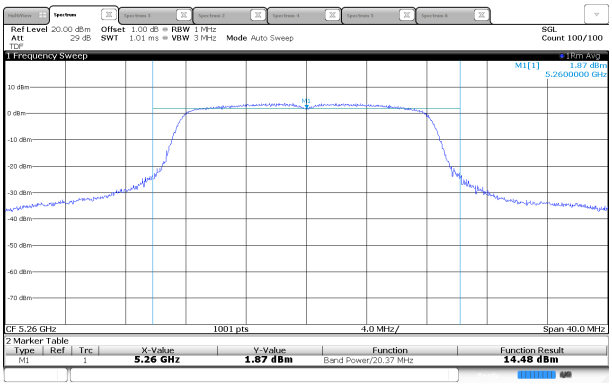
Note:
1. Conducted Output power Calculation:

Conducted Output power = Measured power(dB m) + DCCF (dB)

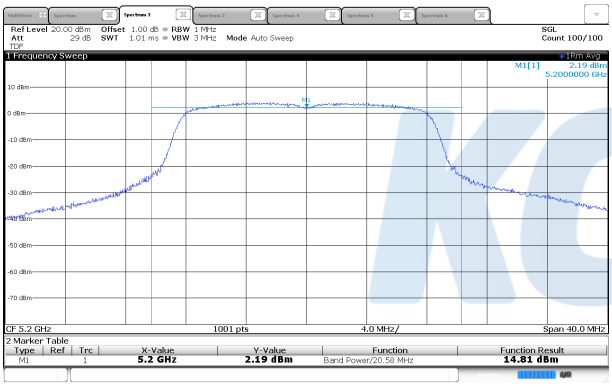
UNII-1 / 802.11a / Low ch.



UNII-2A / 802.11a / Low ch.



UNII-1 / 802.11a / Mid ch.



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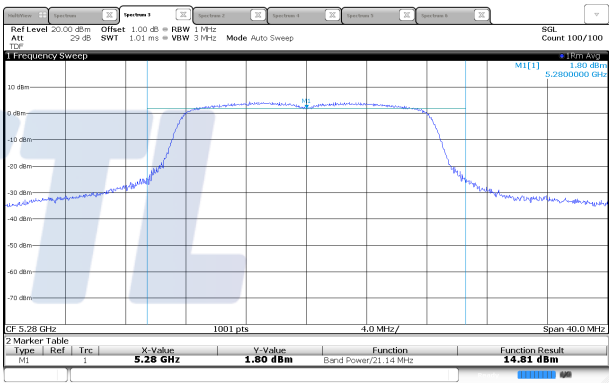
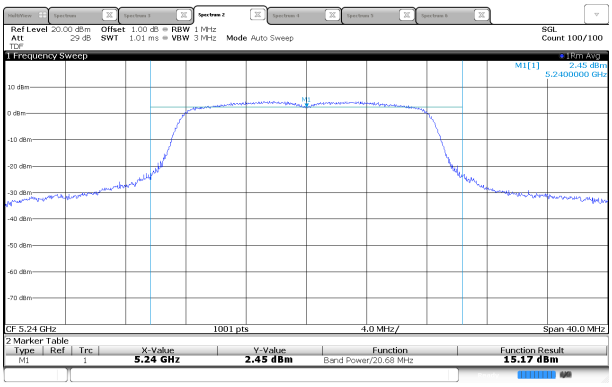


UNII-1 / 802.11a / High ch.



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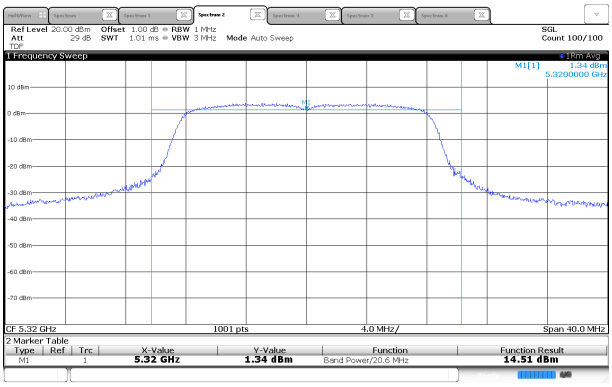

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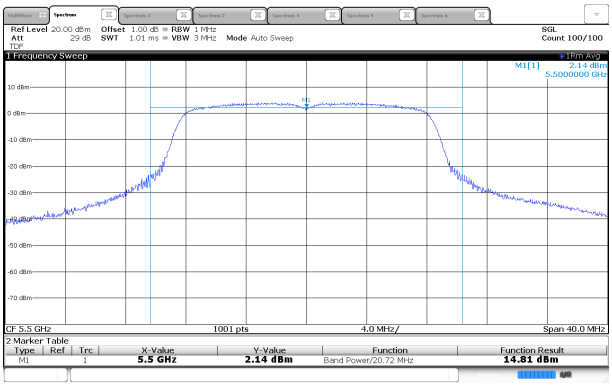
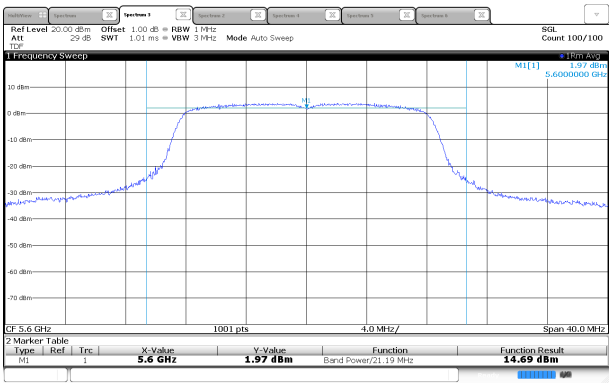
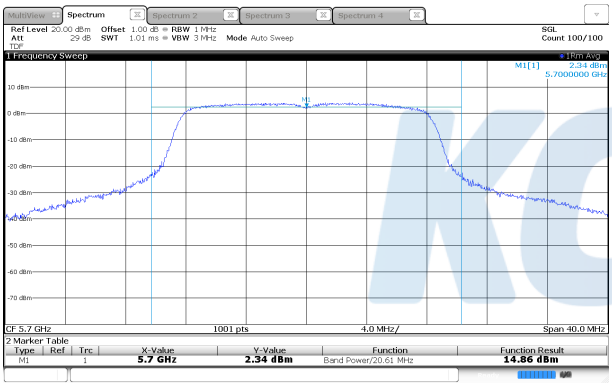
UNII-2C / 802.11a / Low ch.



UNII-2C / 802.11a / Mid ch.



UNII-2C / 802.11a / High ch.



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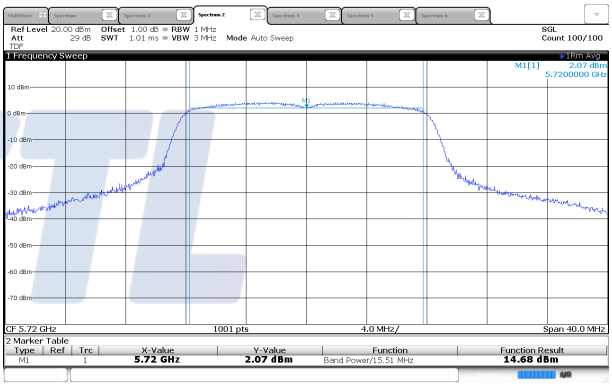
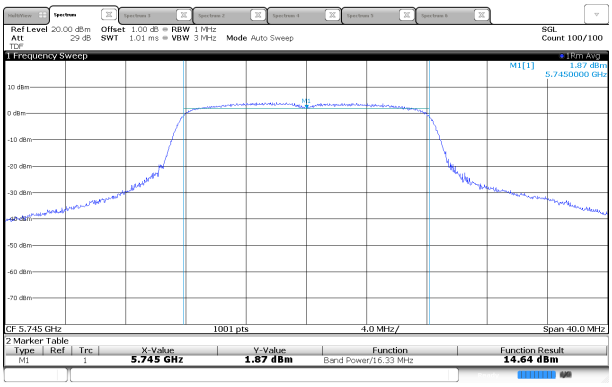
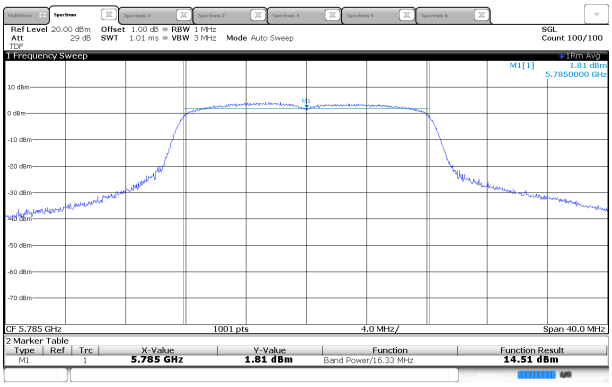


UNII-3 / 802.11a / Low ch.	UNII-3 / 802.11a / Mid ch.
	
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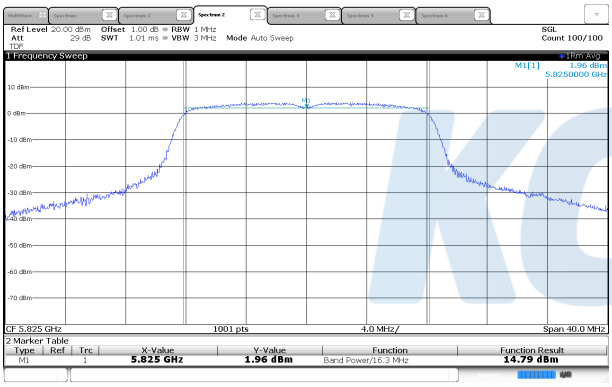	blank

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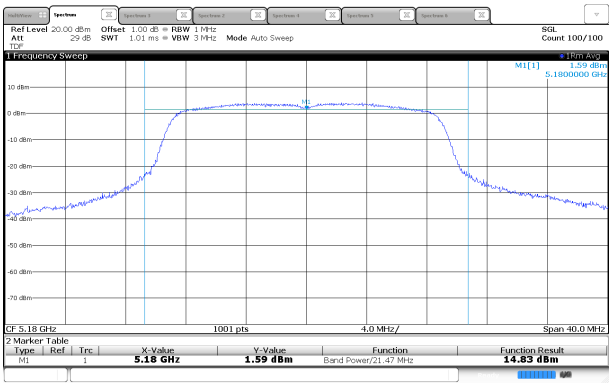
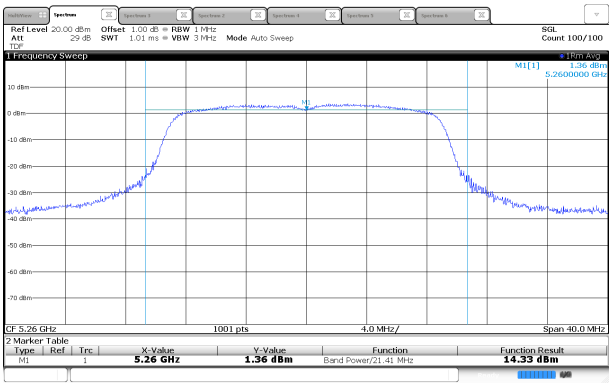
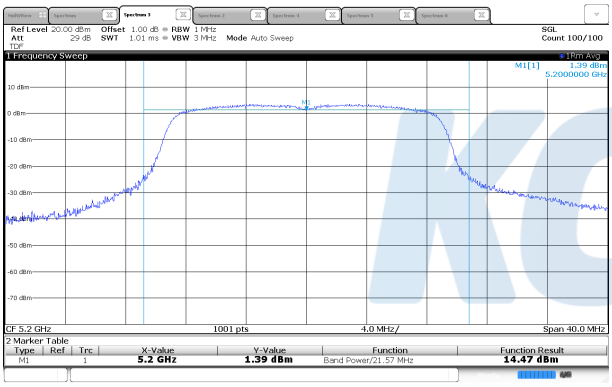


UNII-2A / 802.11n HT20 / Low ch.



UNII-1 / 802.11n HT20 / Mid ch.



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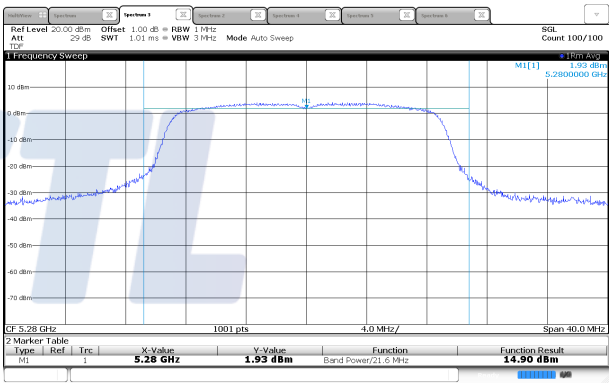
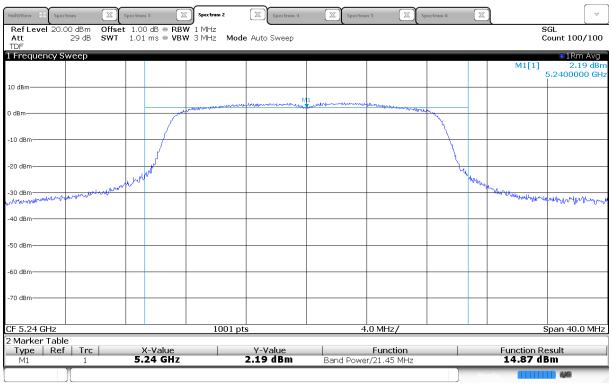
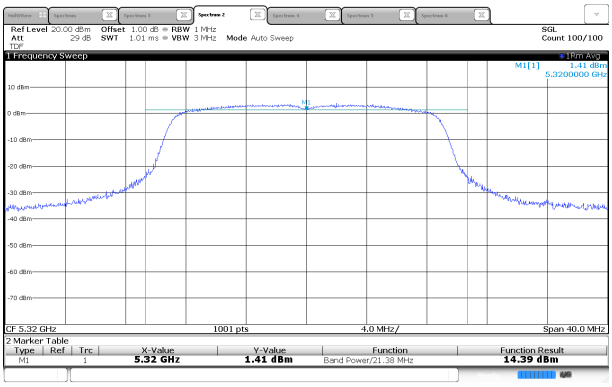


UNII-1 / 802.11n HT20 / High ch.



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



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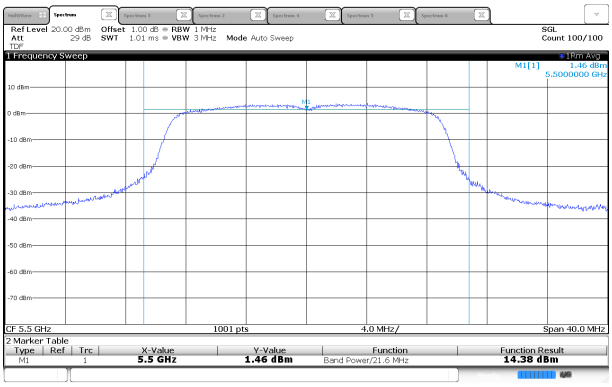
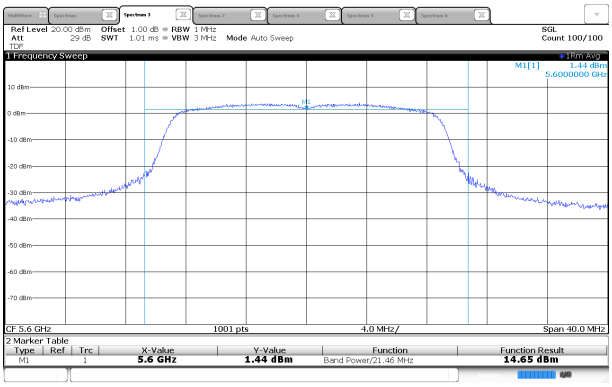
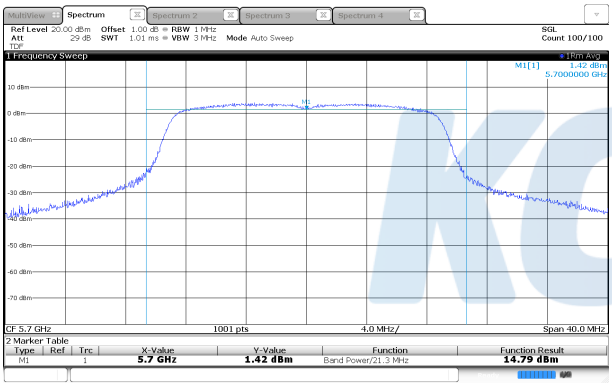
UNII-2C / 802.11n HT20 / Low ch.



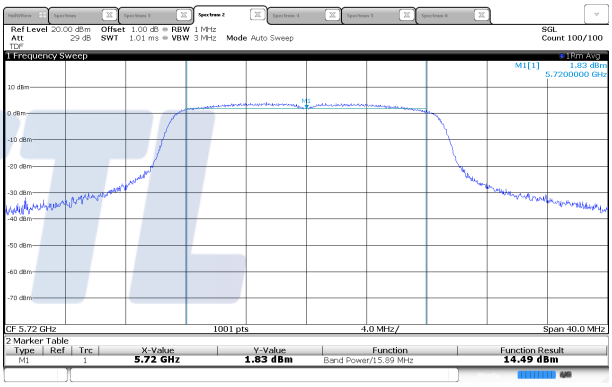
UNII-2C / 802.11n HT20 / Mid ch.



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



UNII-2C / 802.11n HT20 / Straddle ch.



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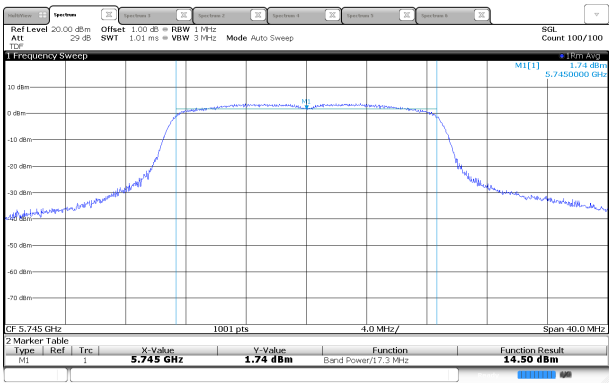
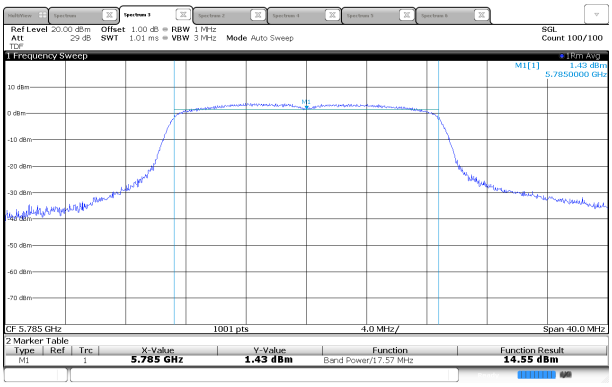
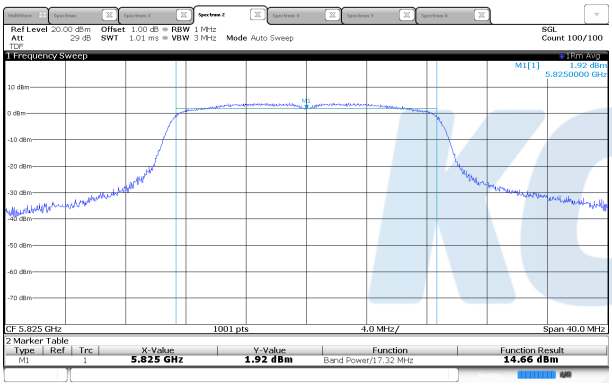
UNII-3 / 802.11n HT20 / Low ch.	UNII-3 / 802.11n HT20 / Mid ch.
	
UNII-3 / 802.11n HT20 / High ch.	
	blank

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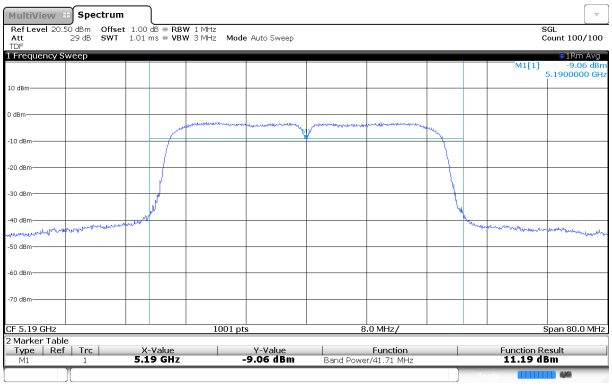
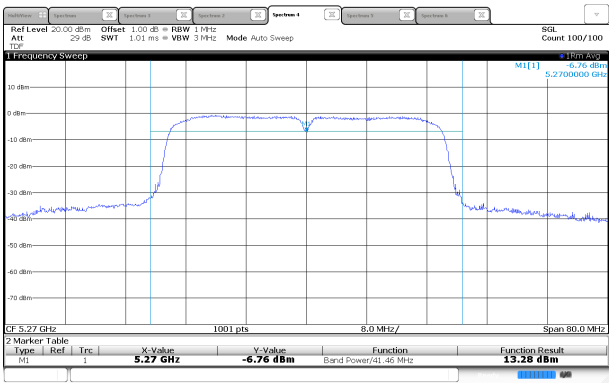
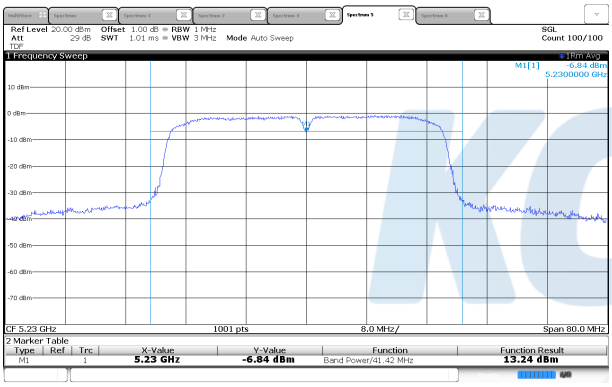


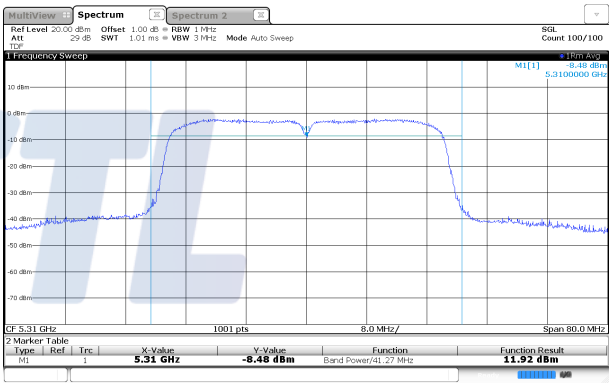
UNII-2A / 802.11n HT40 / Low ch.



UNII-1 / 802.11n HT40 / High ch.



UNII-2A / 802.11n HT40 / High ch.



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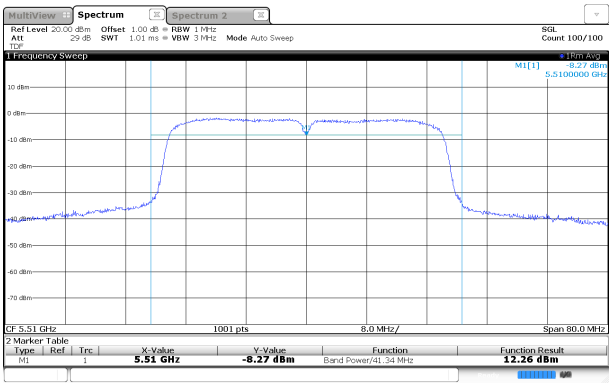
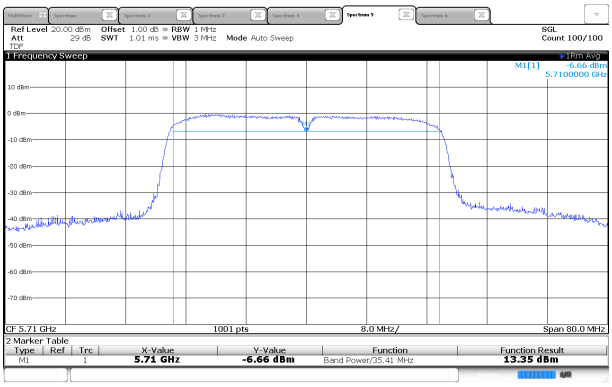
UNII-2C / 802.11n HT40 / Low ch.



UNII-2C / 802.11n HT40 / Straddle ch.



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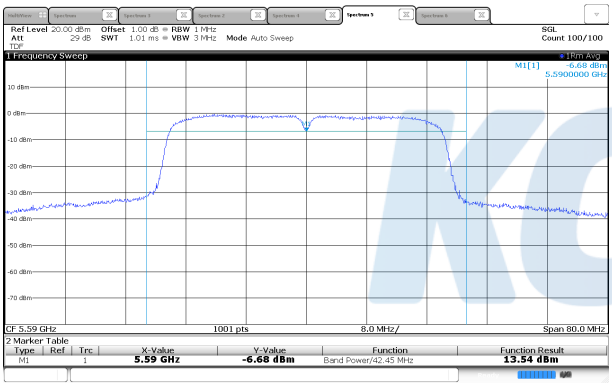

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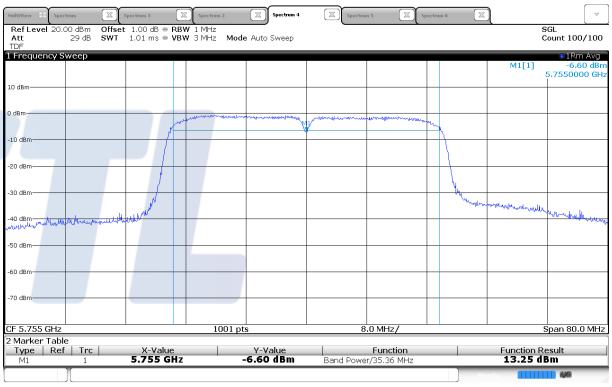

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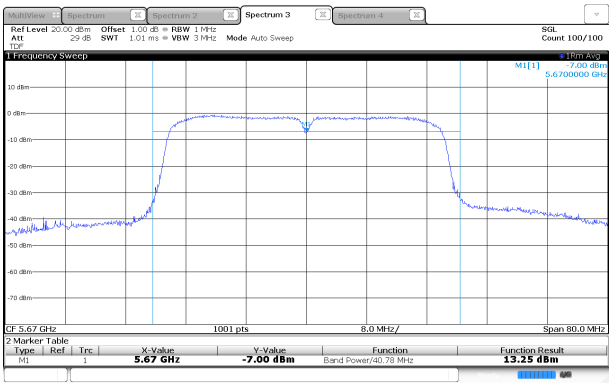

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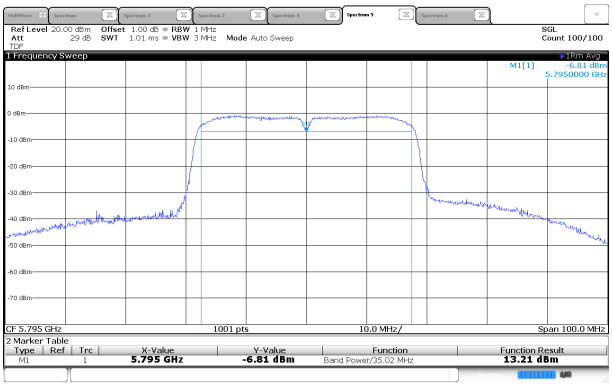
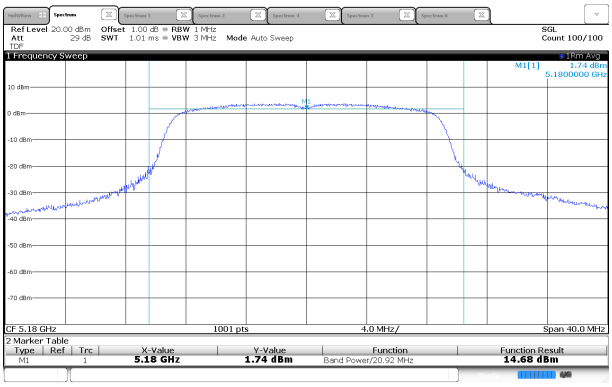
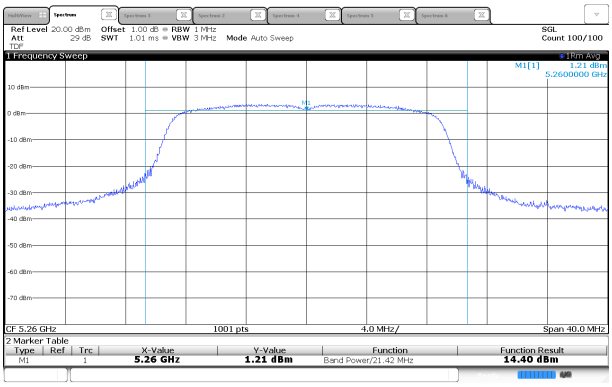


UNII-1 / 802.11ac VHT20 / Low ch.



UNII-2A / 802. 11ac VHT20 / Low ch.



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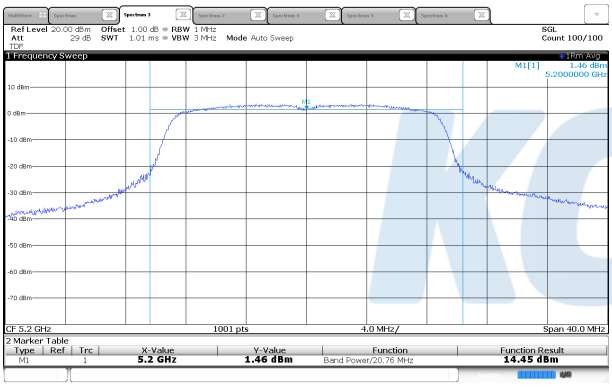
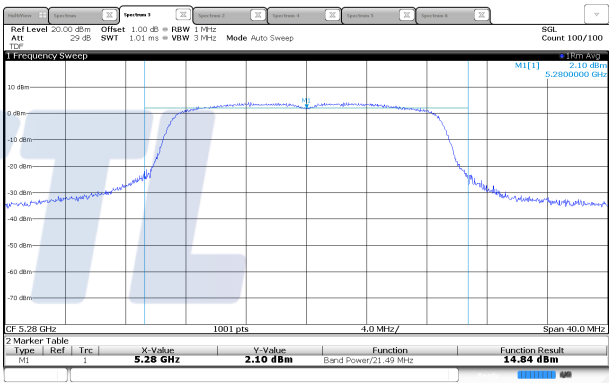


UNII-2A / 802. 11ac VHT20 / Mid ch.



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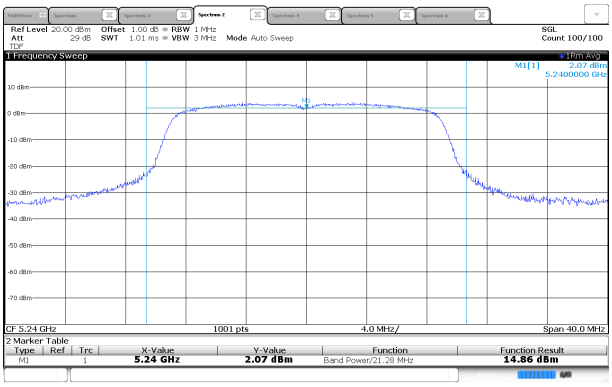

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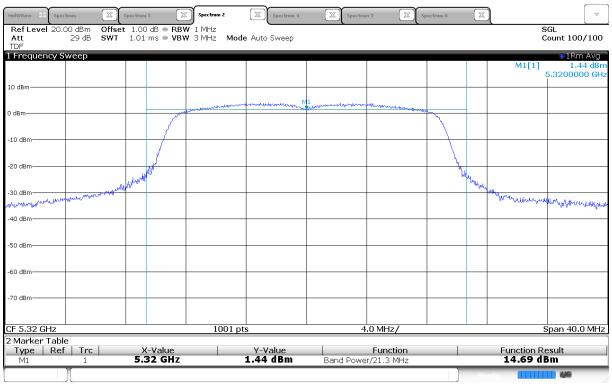

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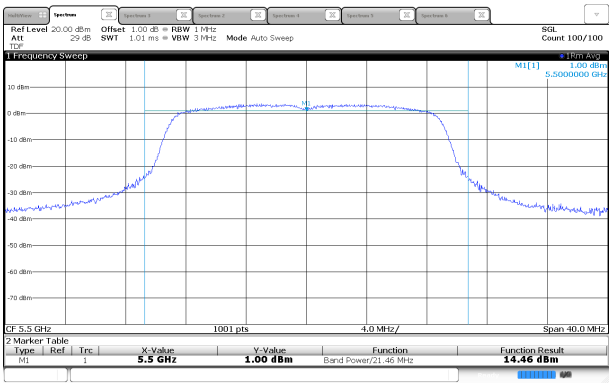
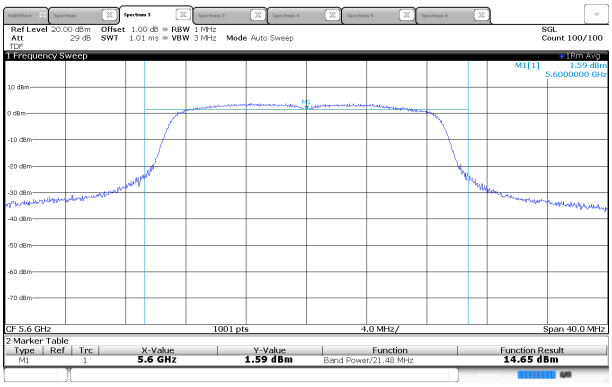


UNII-2C / 802. 11ac VHT20 / Mid ch.



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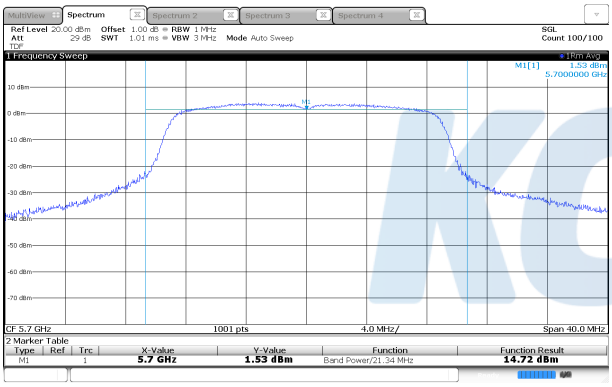

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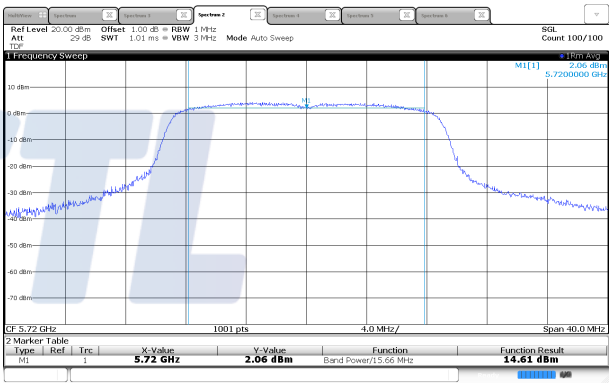

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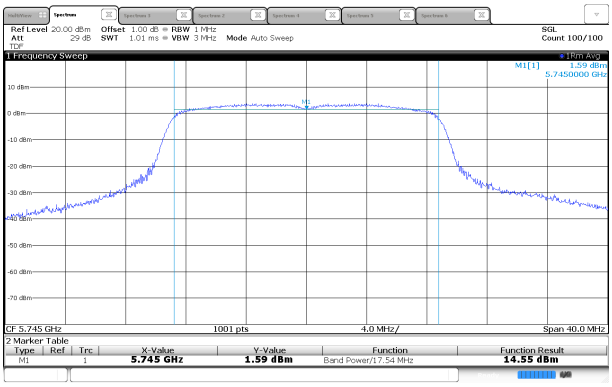

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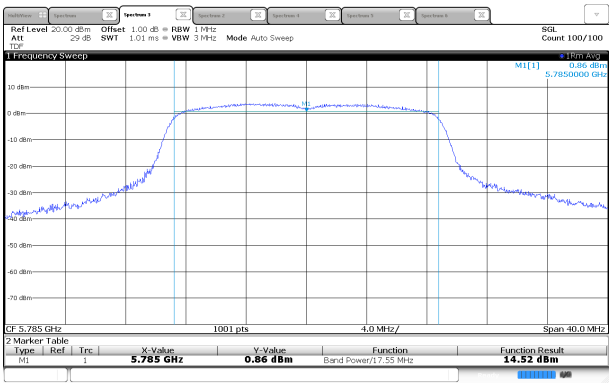

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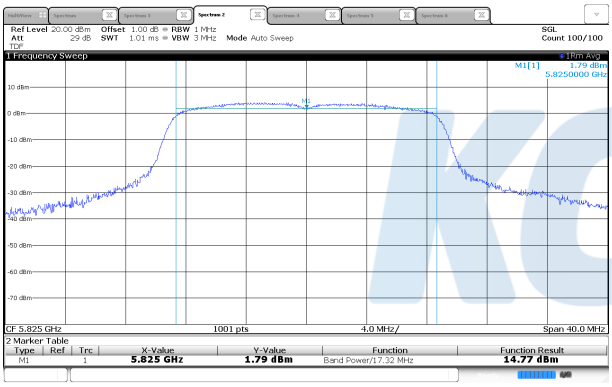

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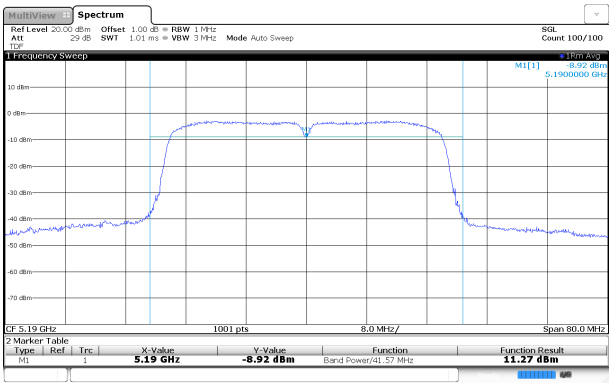

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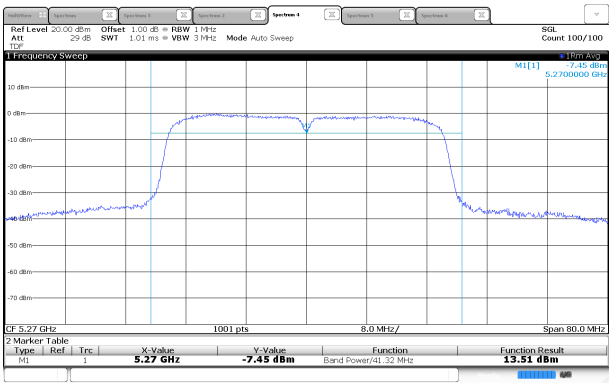

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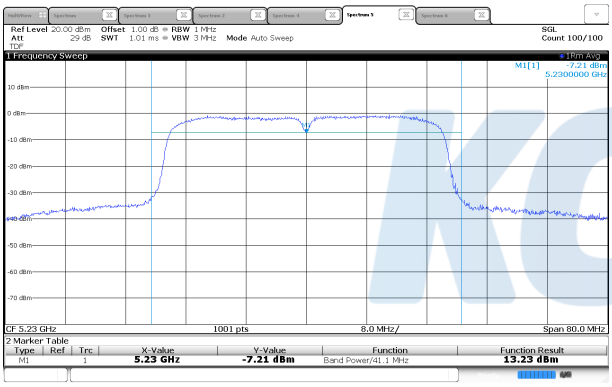

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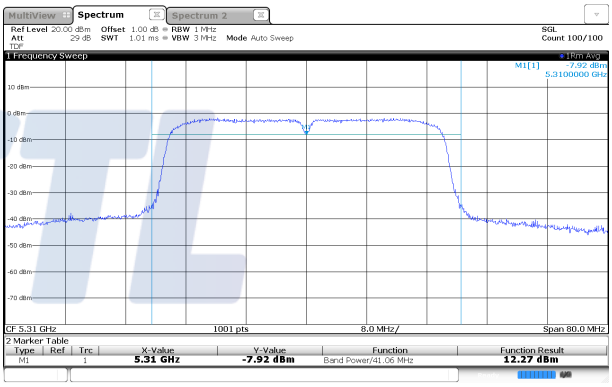

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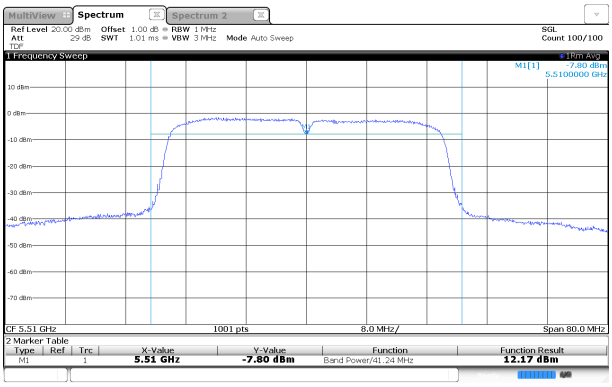

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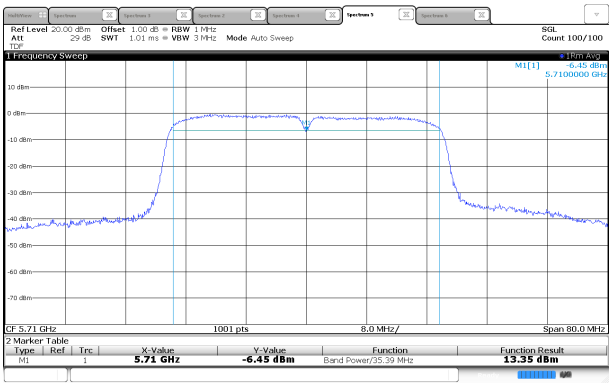

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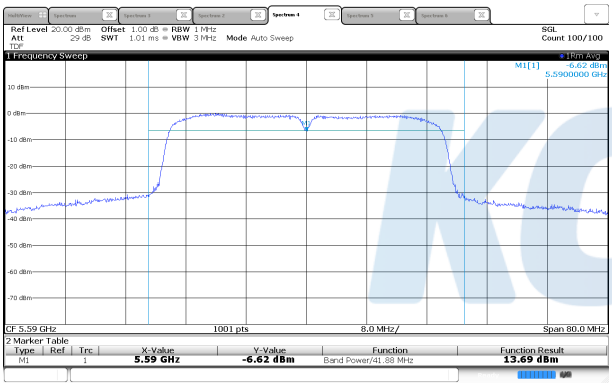

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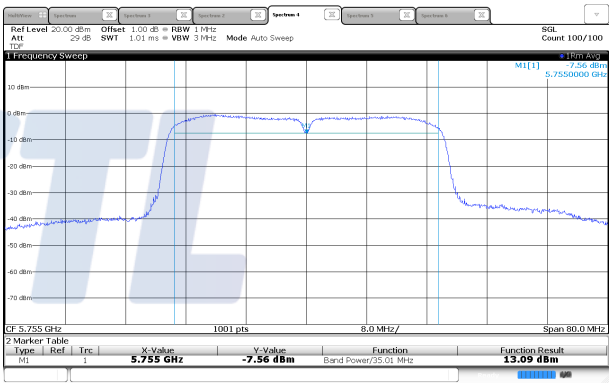

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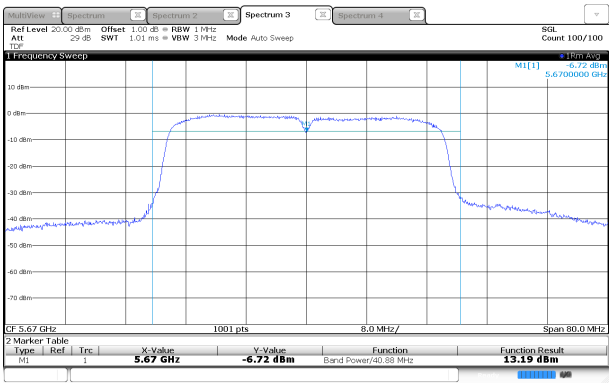

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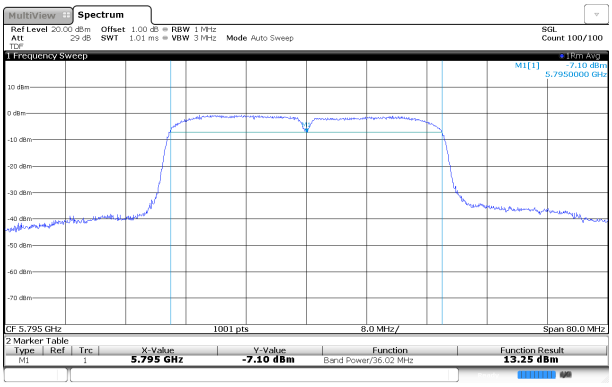

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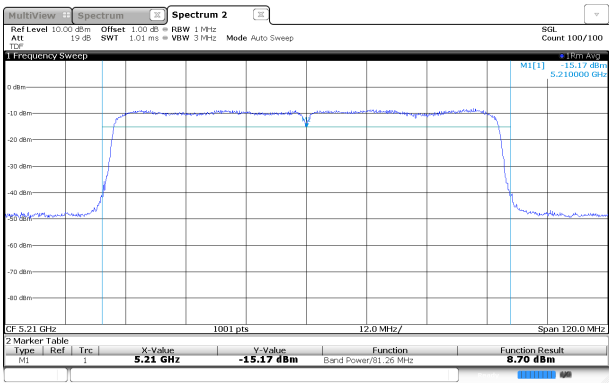

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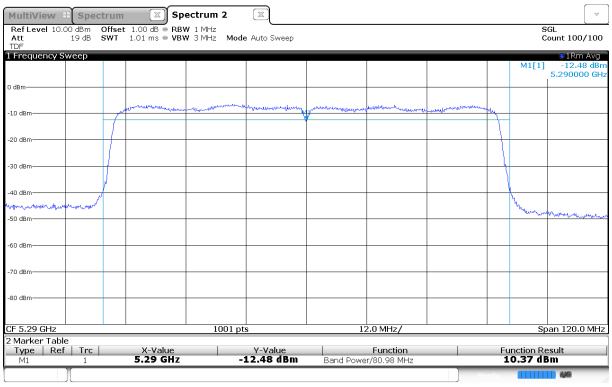

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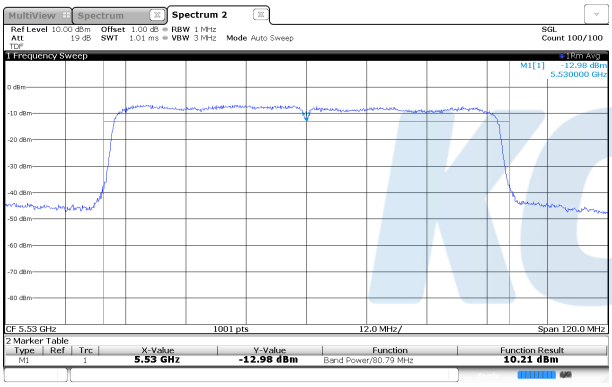

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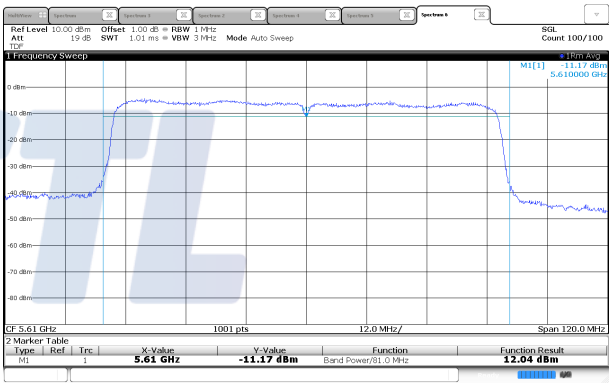

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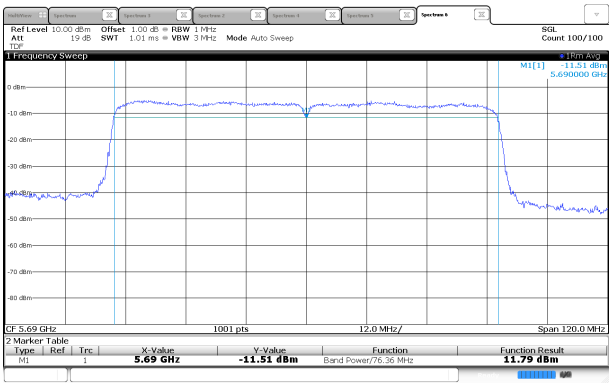

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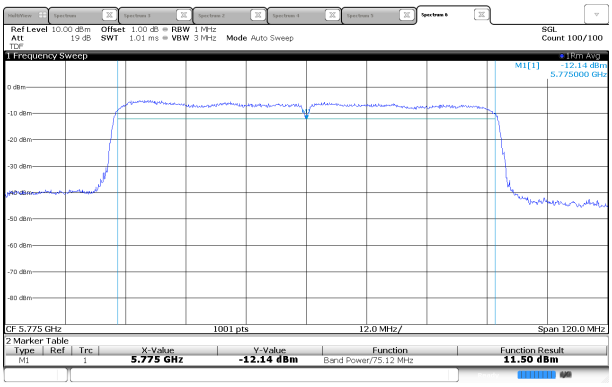


7.2. Maximum Power Spectral Density

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

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
KDB 662911 D01 v02r01 - Section E). 2)

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 (MHz)	Measured PSD (dB m/MHz)	DCCF (dB)	Maximum PSD (dB m/MHz)	Limit (dB m/MHz)
802.11a	UNII-1	5 180	4.37	0.30	4.67	11
		5 200	4.39	0.30	4.69	
		5 240	4.28	0.30	4.58	
	UNII-2A	5 260	4.08	0.30	4.38	11
		5 280	4.50	0.30	4.80	
		5 320	4.15	0.30	4.45	
	UNII-2C	5 500	4.37	0.30	4.67	11
		5 600	4.42	0.30	4.72	
		5 700	4.25	0.30	4.55	
		5 720	4.38	0.30	4.68	
802.11n HT20	UNII-1	5 180	4.61	0.35	4.96	11
		5 200	4.38	0.35	4.73	
		5 240	4.39	0.35	4.74	
	UNII-2A	5 260	4.07	0.35	4.42	11
		5 280	4.51	0.35	4.86	
		5 320	4.19	0.35	4.54	
	UNII-2C	5 500	3.98	0.35	4.33	11
		5 600	4.25	0.35	4.60	
		5 700	3.92	0.35	4.27	
		5 720	4.16	0.35	4.51	
802.11n HT40	UNII-1	5 190	-2.22	0.66	-1.56	11
		5 230	-0.72	0.66	-0.06	
	UNII-2A	5 270	-0.49	0.66	0.17	11
		5 310	-1.32	0.66	-0.66	
	UNII-2C	5 510	-1.04	0.66	-0.38	11
		5 590	-0.38	0.66	0.28	
		5 670	-0.71	0.66	-0.05	
		5 710	-0.37	0.66	0.29	

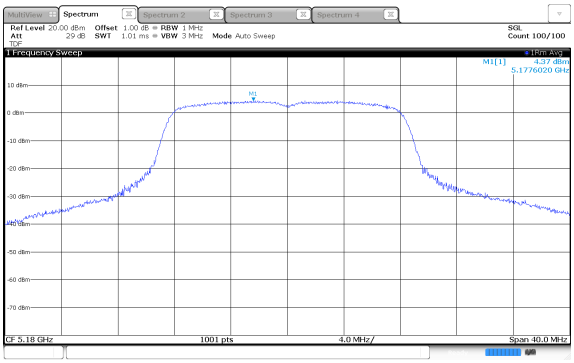
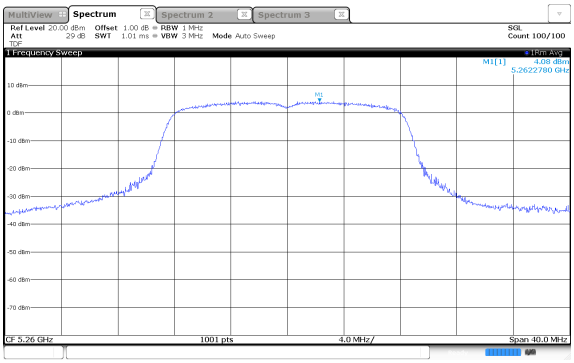
This test report shall not be reproduced, except in full, without the written approval

Test mode	Band	Frequency (MHz)	Measured PSD (dB m/MHz)	DCCF (dB)	Maximum PSD (dB m/MHz)	Limit (dB m/MHz)
802.11ac VHT20	UNII-1	5 180	4.13	0.31	4.44	11
		5 200	3.93	0.31	4.24	
		5 240	4.30	0.31	4.61	
	UNII-2A	5 260	3.92	0.31	4.23	11
		5 280	4.45	0.31	4.76	
		5 320	4.17	0.31	4.48	
	UNII-2C	5 500	4.08	0.31	4.39	11
		5 600	4.12	0.31	4.43	
		5 700	3.82	0.31	4.13	
		5 720	4.22	0.31	4.53	
802.11ac VHT40	UNII-1	5 190	-2.09	0.61	-1.48	11
		5 230	-0.64	0.61	-0.03	
	UNII-2A	5 270	-0.30	0.61	0.31	11
		5 310	-1.10	0.61	-0.49	
	UNII-2C	5 510	-1.28	0.61	-0.67	11
		5 590	0.21	0.61	0.82	
		5 670	-0.39	0.61	0.22	
		5 710	-0.32	0.61	0.29	
802.11ac VHT80	UNII-1	5 210	-7.40	1.25	-6.15	11
	UNII-2A	5 290	-6.32	1.25	-5.07	11
	UNII-2C	5 530	-6.10	1.25	-4.85	11
		5 610	-4.18	1.25	-2.93	
		5 690	-4.45	1.25	-3.20	

This test report shall not be reproduced, except in full, without the written approval

Test mode	Band	Frequency (MHz)	Measured PSD (dBm)	Duty Factor (dB)	Maximum PSD (dBm /500 kHz)	Limit (dBm /500 kHz)
802.11a	UNII-3	5 745	1.31	0.30	1.61	30
		5 785	1.21	0.30	1.51	
		5 825	1.41	0.30	1.71	
802.11n HT20		5 745	1.18	0.35	1.53	
		5 785	1.37	0.35	1.72	
		5 825	1.43	0.35	1.78	
802.11n HT40		5 755	-3.32	0.66	-2.66	
		5 795	-3.15	0.66	-2.49	
802.11ac VHT20		5 745	1.17	0.31	1.48	
		5 785	1.21	0.31	1.52	
		5 825	1.17	0.31	1.48	
802.11ac VHT40		5 755	-3.46	0.61	-2.85	
		5 795	-3.04	0.61	-2.43	
802.11ac VHT80		5 775	-7.63	1.25	-6.38	

Notes:
1. Maximum PSD calculation
- Maximum PSD = Measured PSD + DCCF

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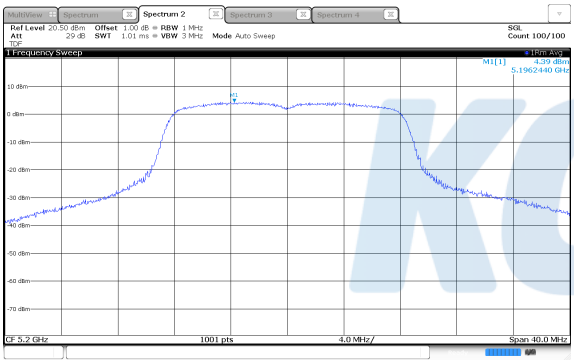	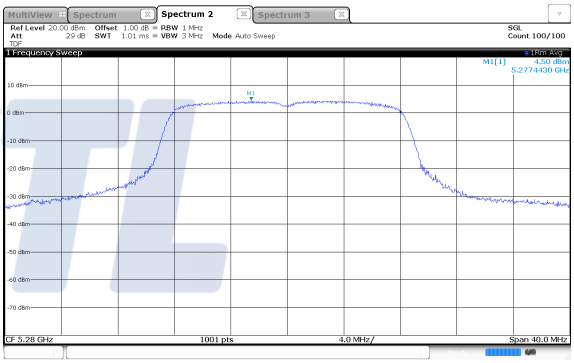
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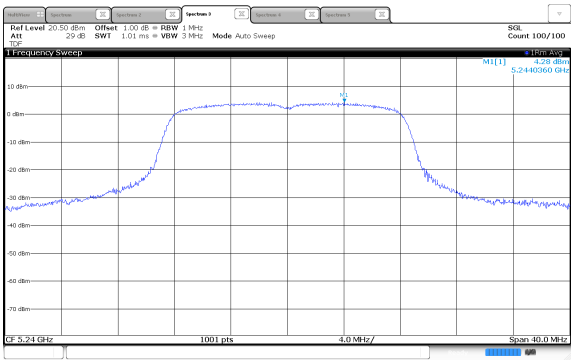	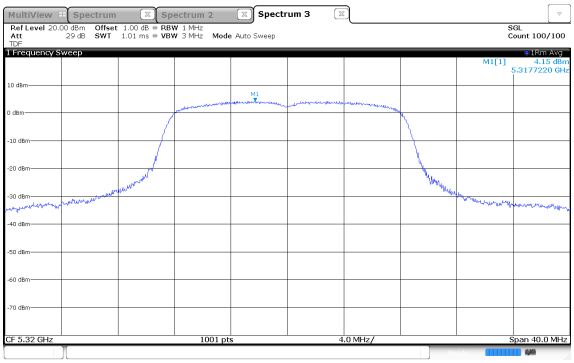

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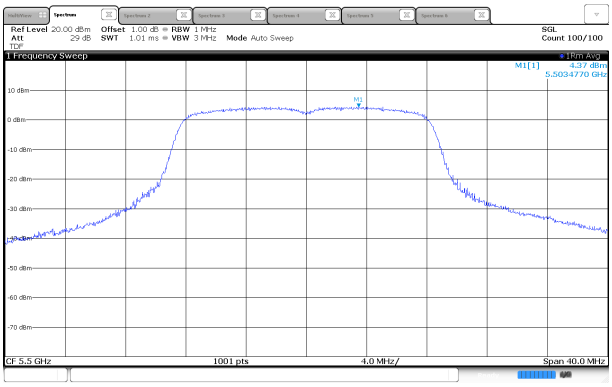	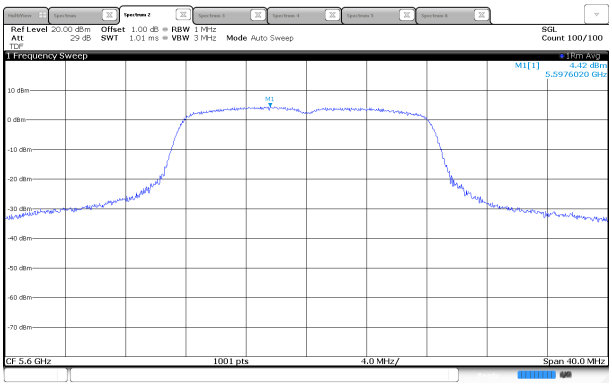
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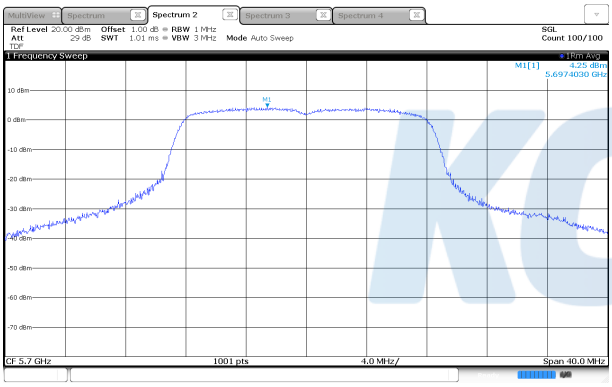
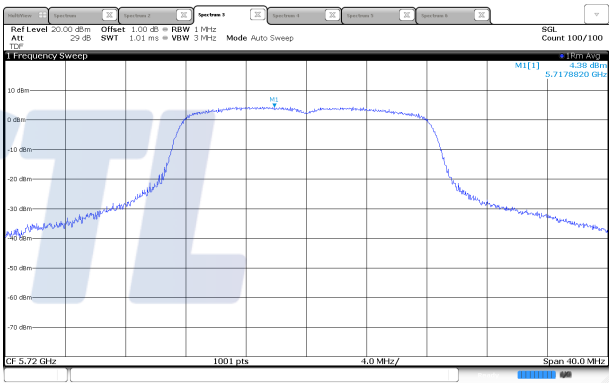
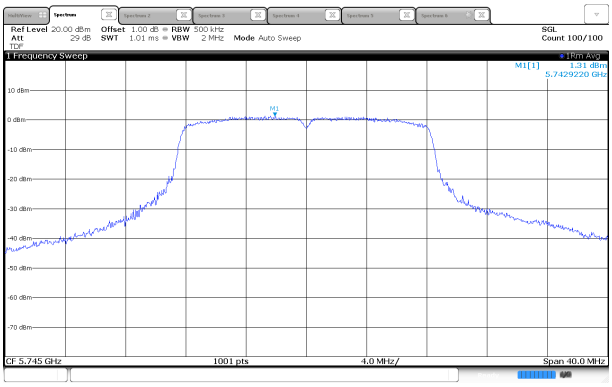
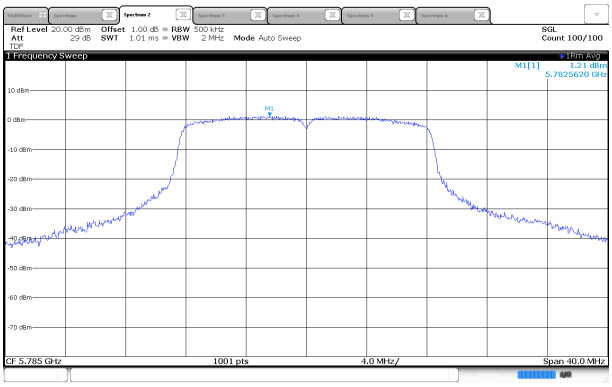
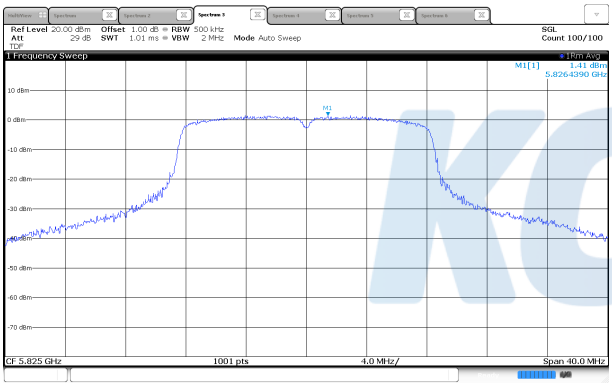
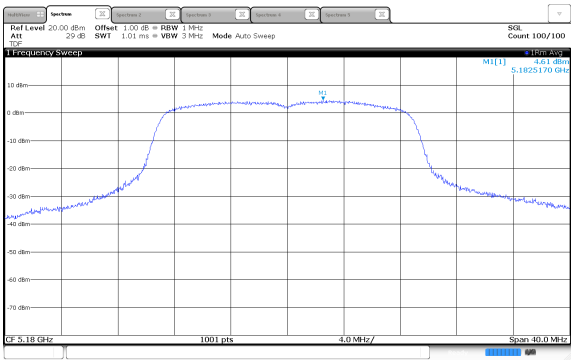
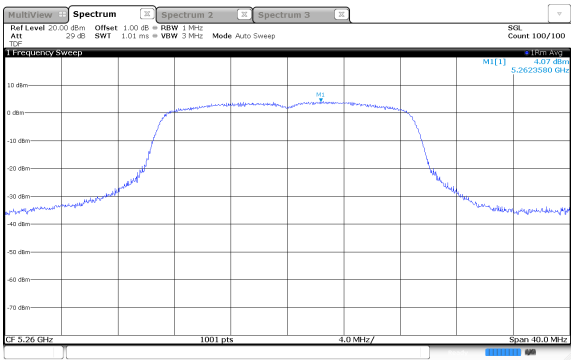
	

UNII-3 / 802.11a / Low ch.	UNII-3 / 802.11a / Mid ch.
	
UNII-3 / 802.11a / High ch.	
	blank

UNII-1 / 802.11n HT20 / Low ch.	UNII-2A / 802.11n HT20 / Low ch.
	
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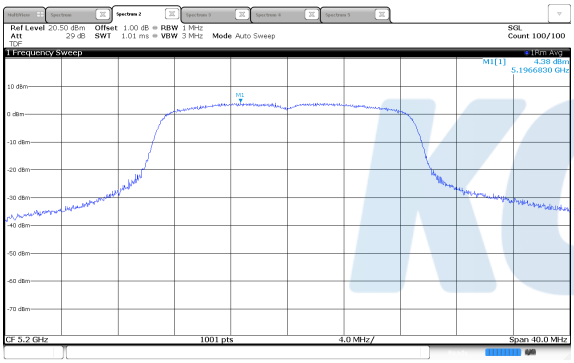
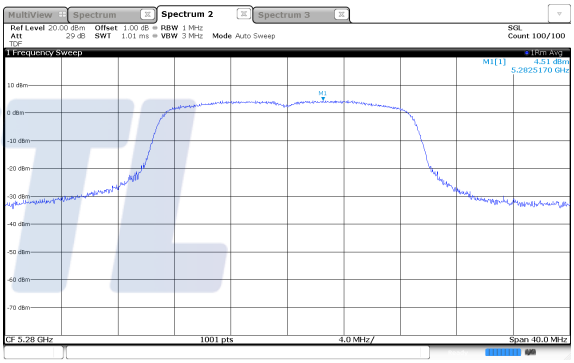
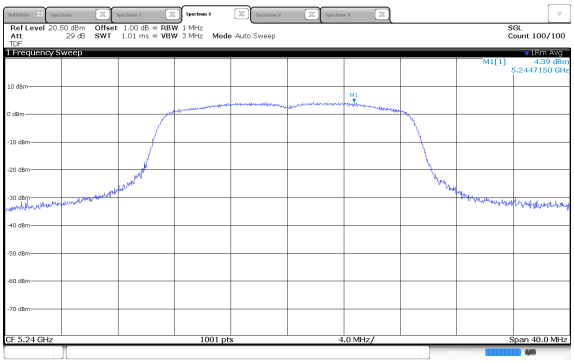
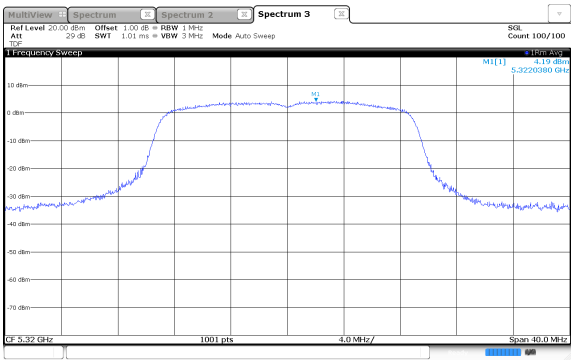
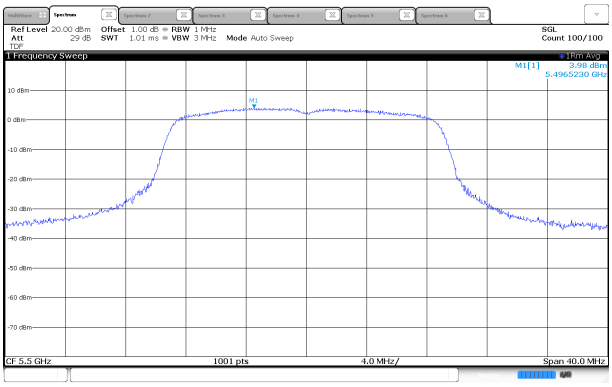
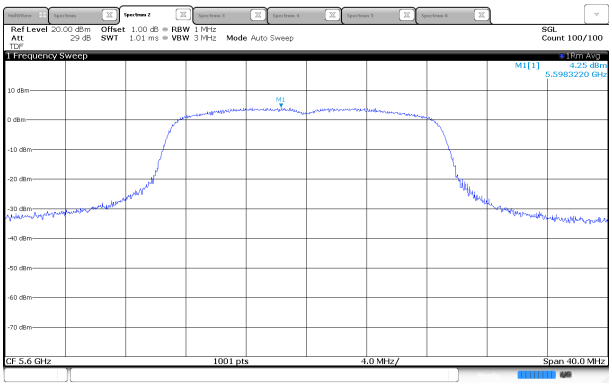
	
UNII-1 / 802.11n HT20 / High ch.	**UNII-2A / 802.11n HT20 / High ch.**
	

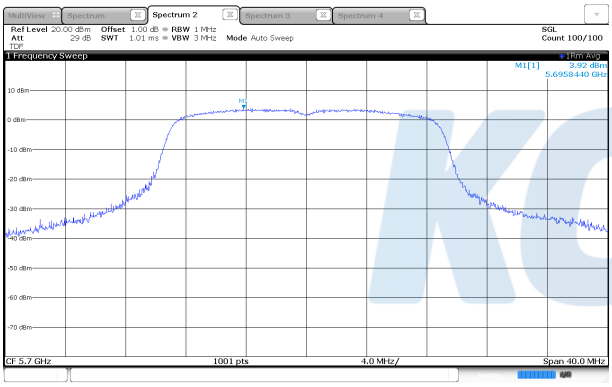
UNII-2C / 802.11n HT20 / Low ch.



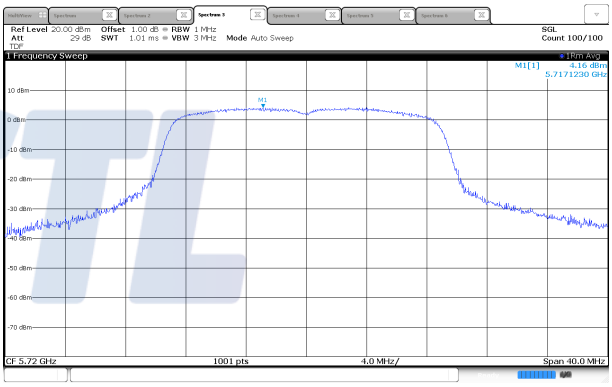
UNII-2C / 802.11n HT20 / Mid ch.

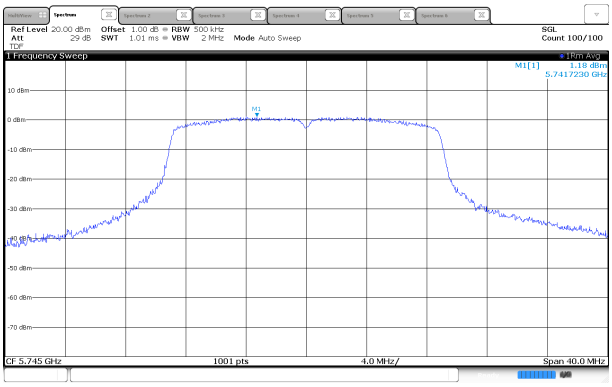
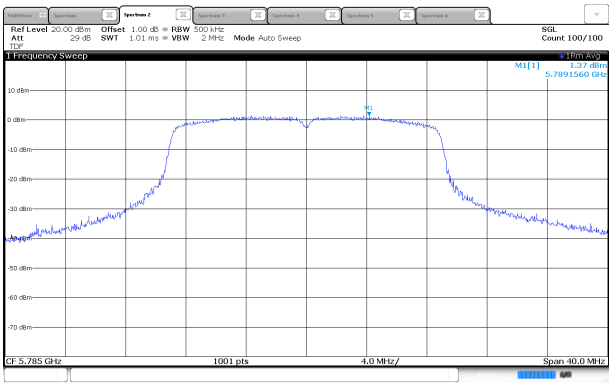
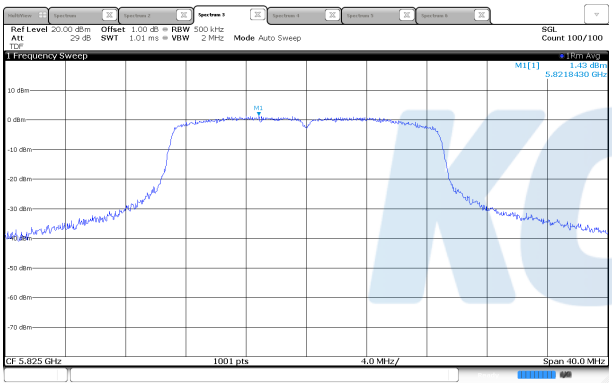


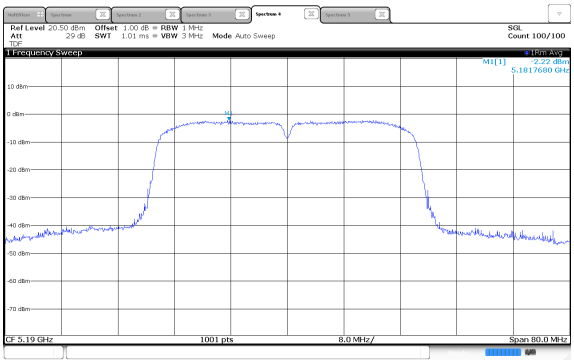
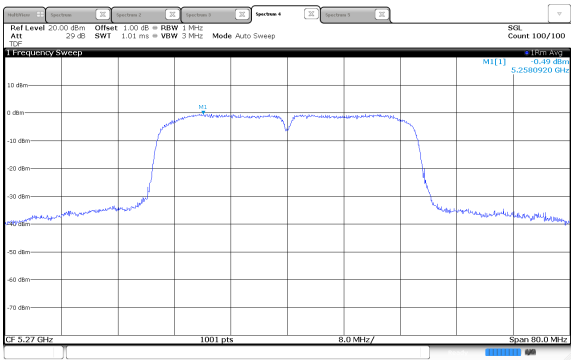
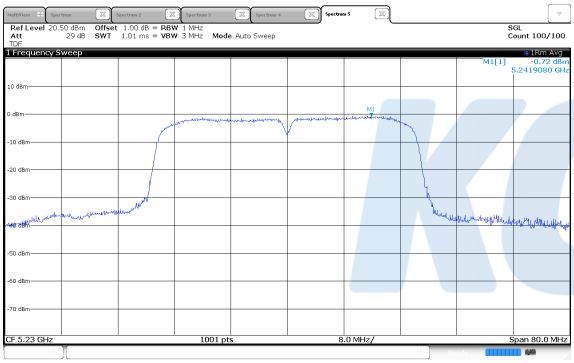
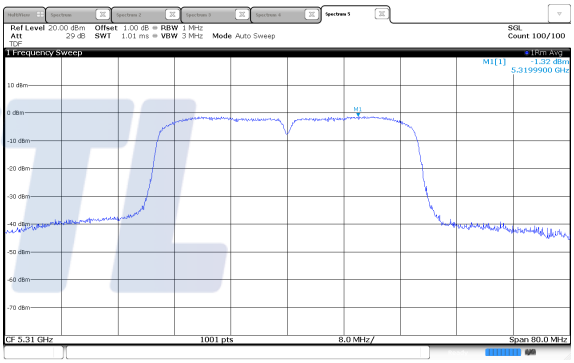
UNII-2C / 802.11n HT20 / High ch.



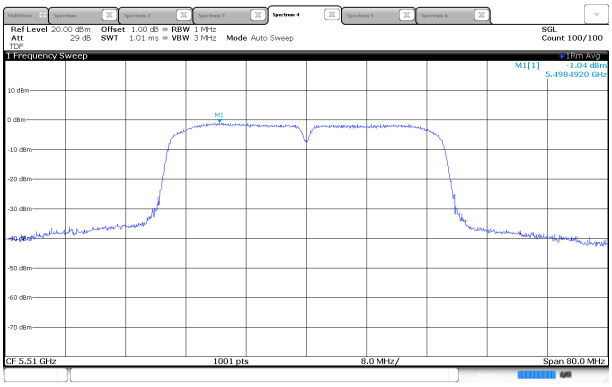
UNII-2C / 802.11n HT20 / Straddle ch.



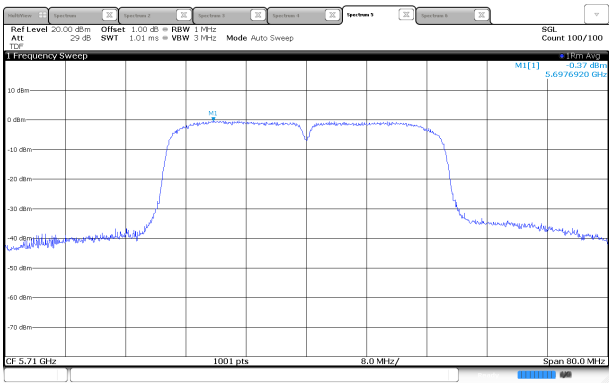
UNII-3 / 802.11n HT20 / Low ch.	UNII-3 / 802.11n HT20 / Mid ch.
	
UNII-3 / 802.11n HT20 / High ch.	
	blank

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.**
	

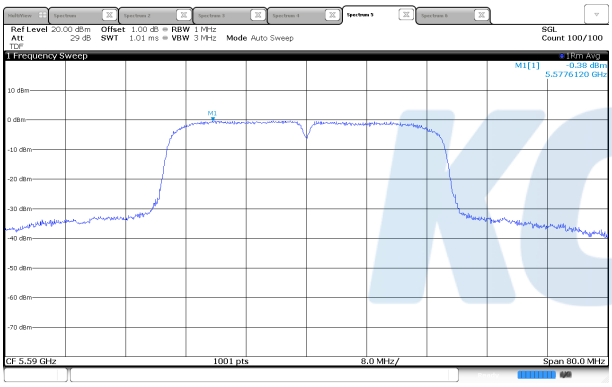
UNII-2C / 802.11n HT40 / Low ch.



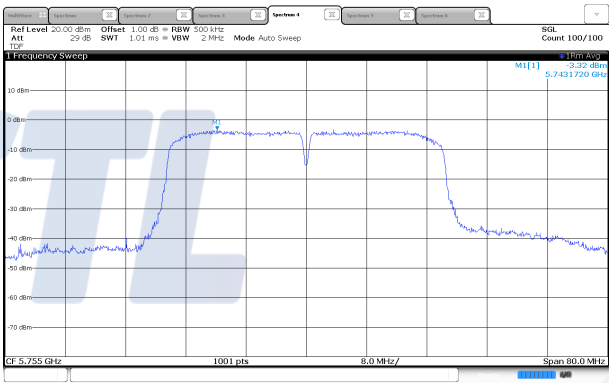
UNII-2C / 802.11n HT40 / Straddle ch.



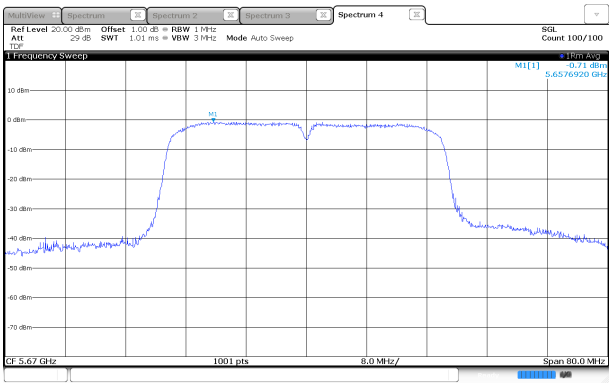
UNII-2C / 802.11n HT40 / Mid ch.



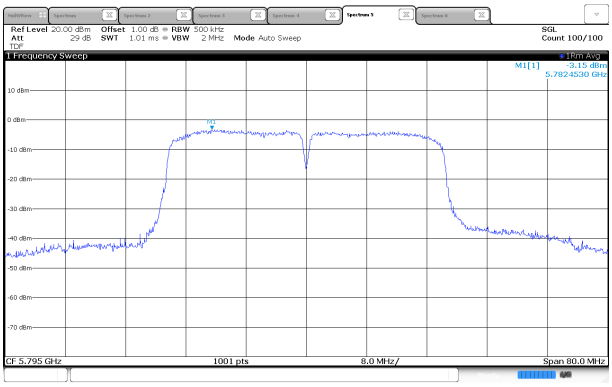
UNII-3 / 802.11n HT40 / Low ch.

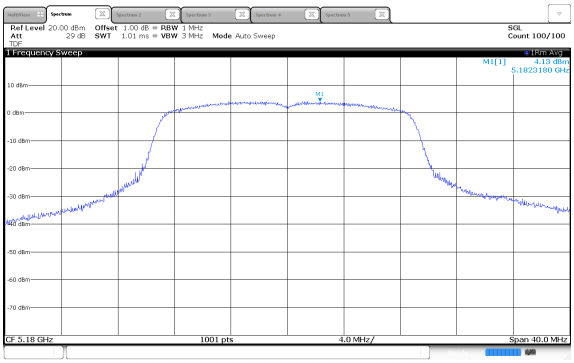
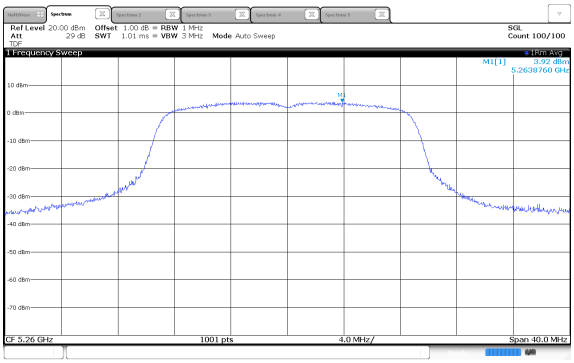
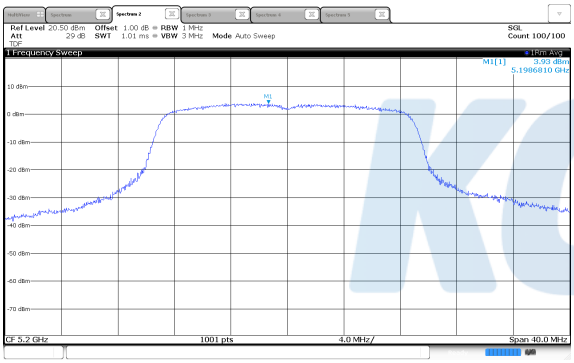
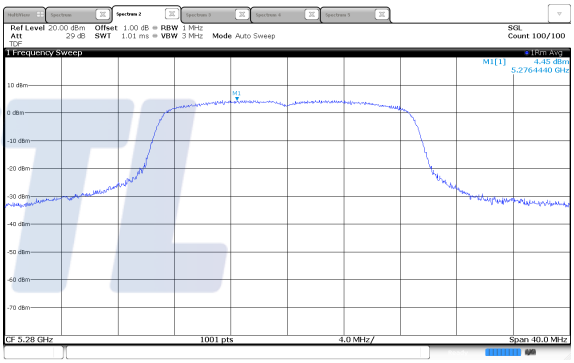
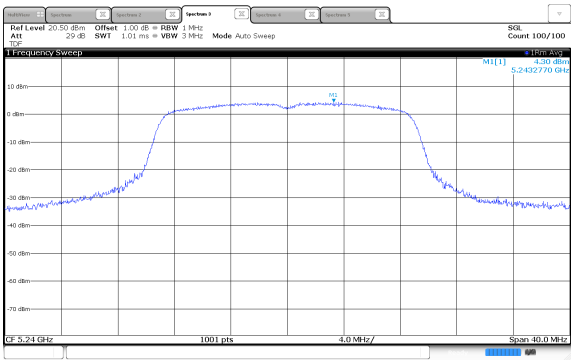
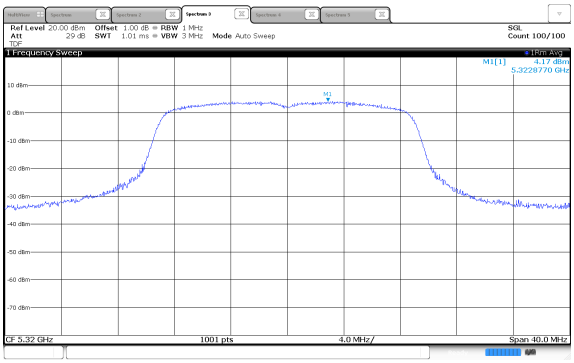


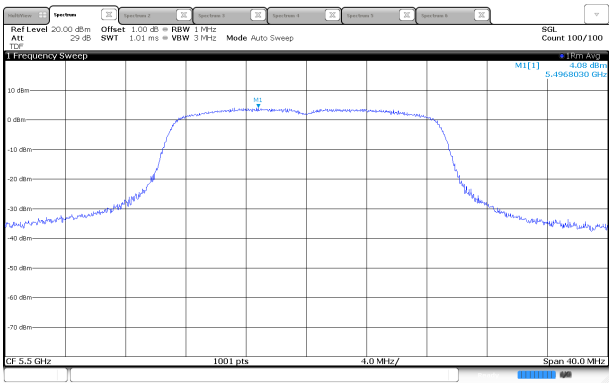
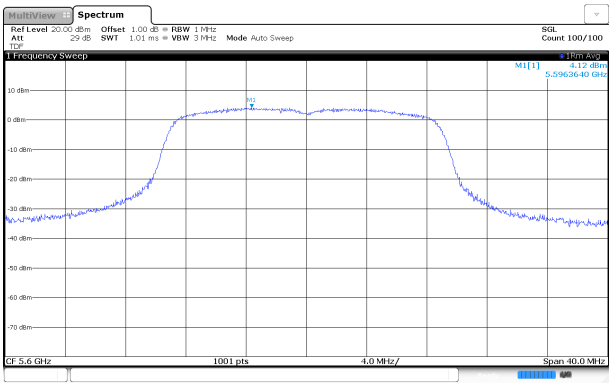
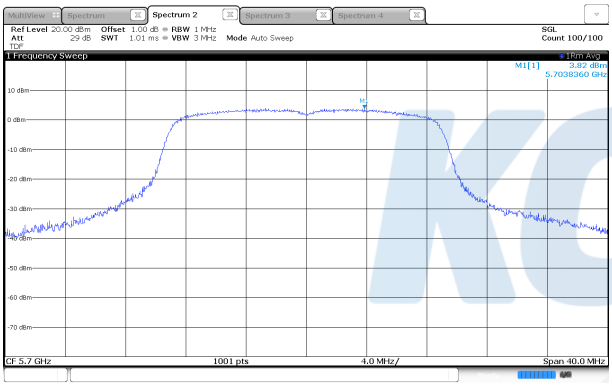
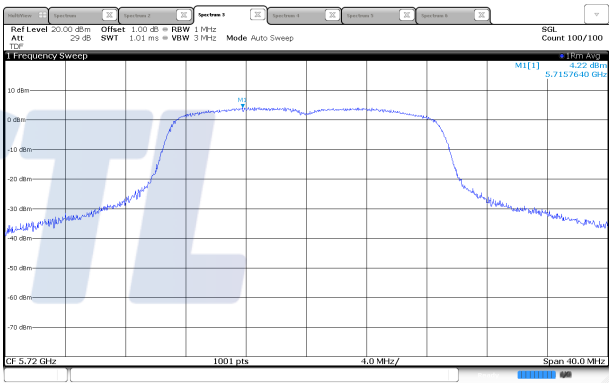
UNII-2C / 802.11n HT40 / High ch.

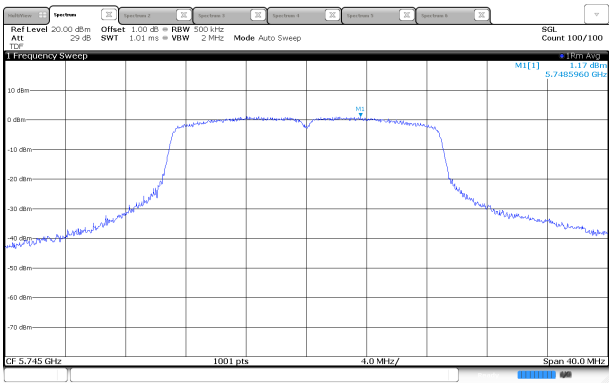
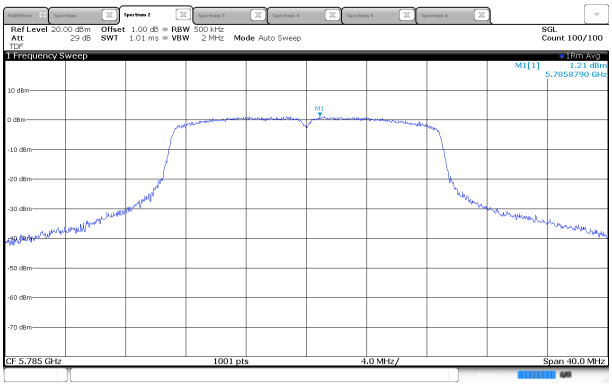
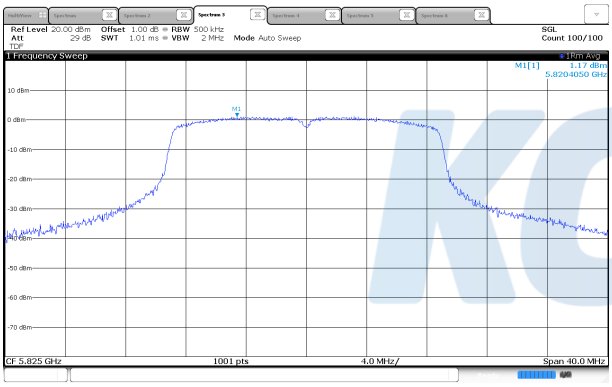


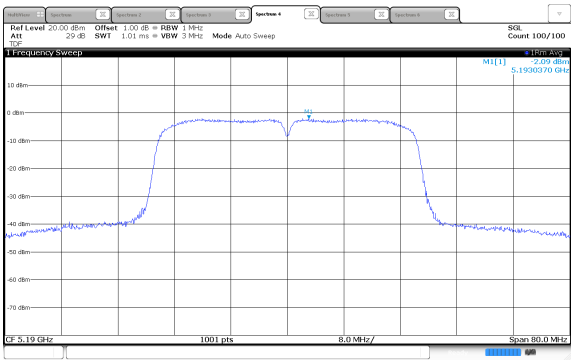
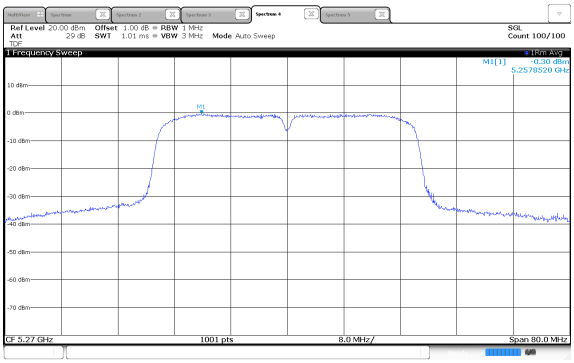
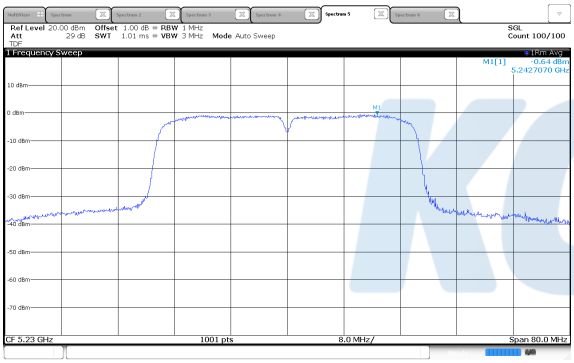
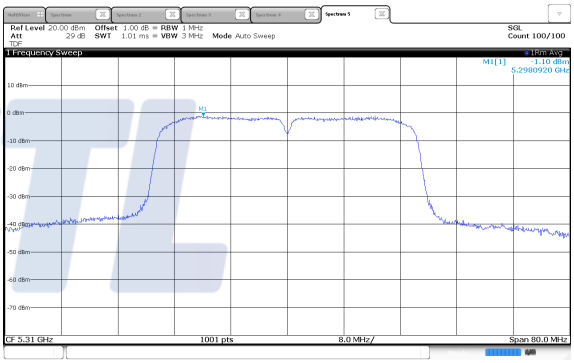
UNII-3 / 802.11n HT40 / High ch.



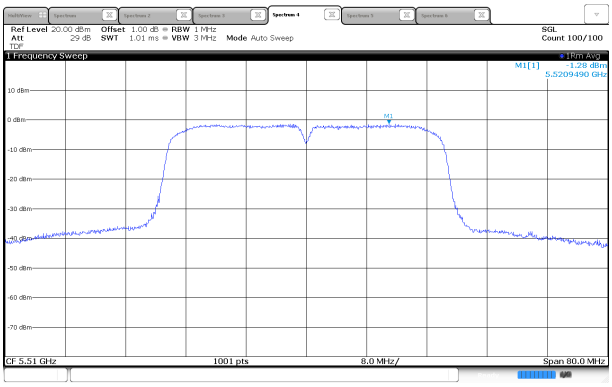
UNII-1 / 802.11ac VHT20 / Low ch.	UNII-2A / 802. 11ac VHT20 / Low ch.
	
UNII-1 / 802. 11ac VHT20 / Mid ch.	**UNII-2A / 802. 11ac VHT20 / Mid ch.**
	
UNII-1 / 802. 11ac VHT20 / High ch.	**UNII-2A / 802. 11ac VHT20 / High ch.**
	

UNII-2C / 802. 11ac VHT20 / Low ch.	UNII-2C / 802. 11ac VHT20 / Mid ch.
	
UNII-2C / 802. 11ac VHT20 / High ch.	**UNII-2C 802. 11ac VHT20 / Straddle ch.**
	

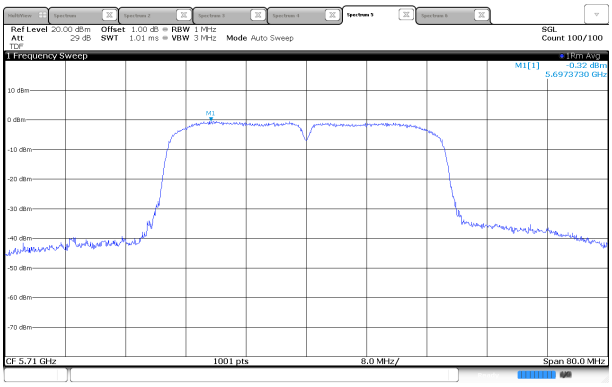
UNII-3 / 802. 11ac VHT20 / Low ch.	UNII-3 / 802. 11ac VHT20 / Mid ch.
	
UNII-3 802. 11ac VHT20 / High ch.	
	blank

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.**
	

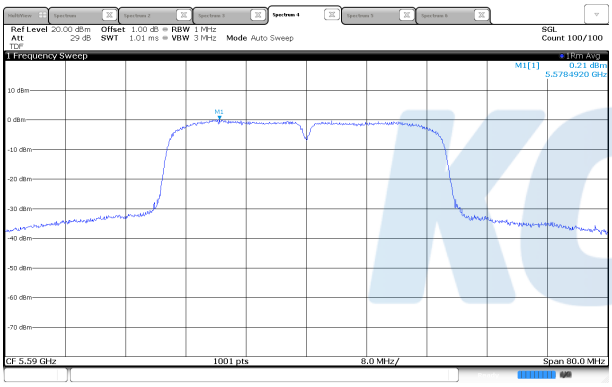
UNII-2C / 802.11ac VHT40 / Low ch.



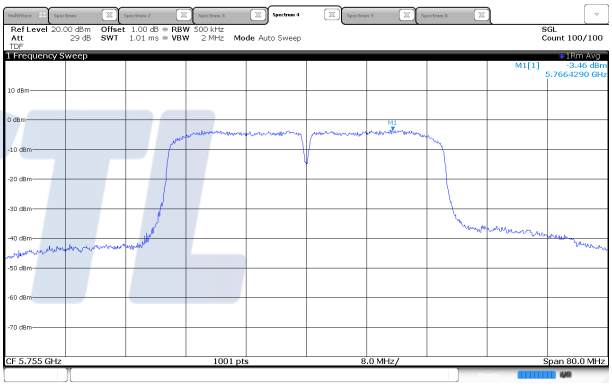
UNII-3 / 802.11ac VHT40 / Straddle ch.



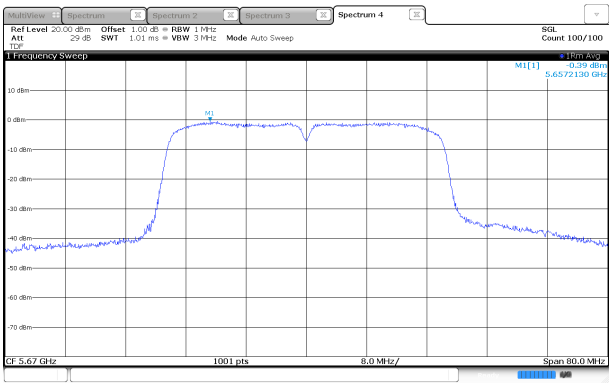
UNII-2C / 802.11ac VHT40 / Mid ch.



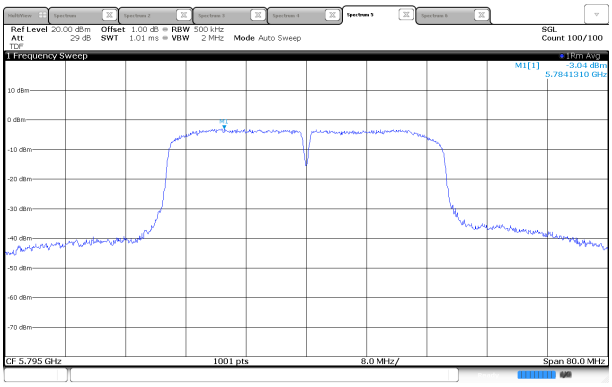
UNII-3 / 802.11ac VHT40 / Low ch.



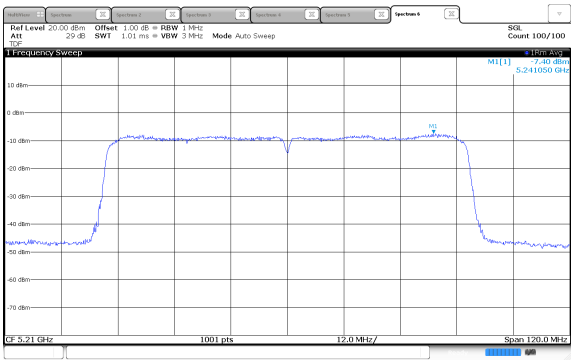
UNII-2C / 802.11ac VHT40 / High ch.



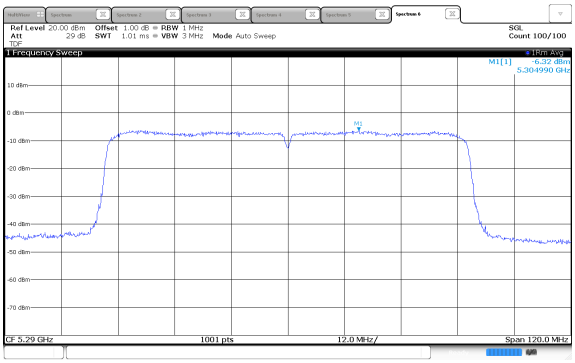
UNII-3 / 802.11ac VHT40 / High ch.



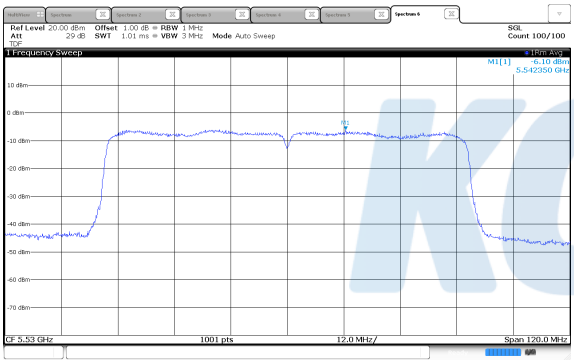
UNII-1 / 802.11ac VHT80 / Low ch.



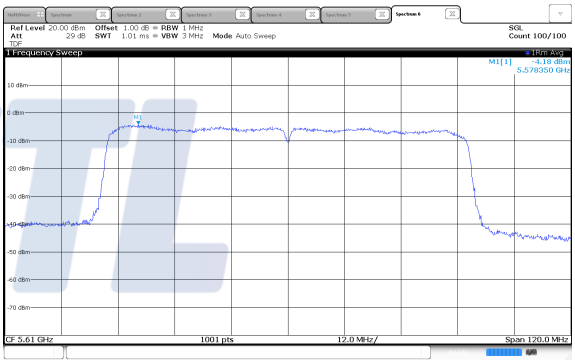
UNII-2A / 802.11ac VHT80 / Low ch.



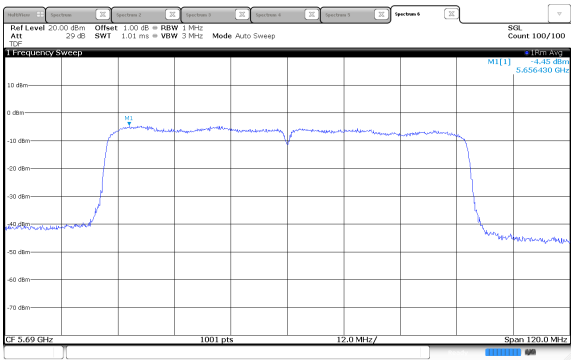
UNII-2C / 802.11ac VHT80 / Low ch.



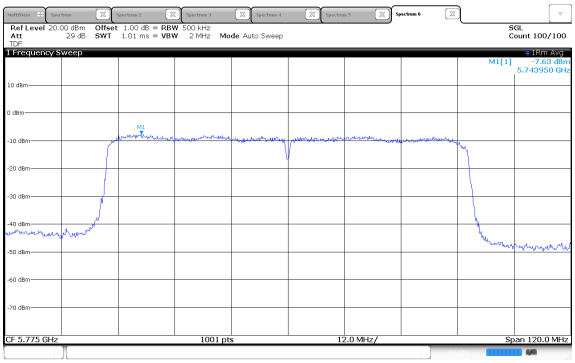
UNII-2C / 802.11ac VHT80 / High ch.



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

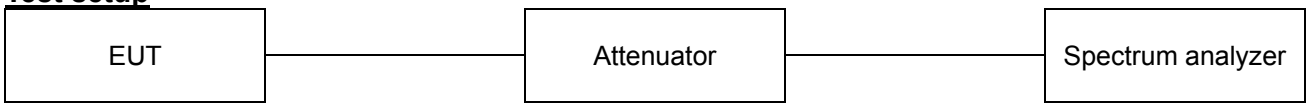


UNII-3 / 802.11ac VHT80 / Low ch.



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 (26dBbandwidth)
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.

Notes:

1. [1)] means Band-crossing channels.

Test results

26 dB bandwidth

Test mode	Band	Frequency(MHz)	Measured Bandwidth (MHz)
802.11a	UNII-1	5 180	20.95
		5 200	20.58
		5 240	20.68
	UNII-2A	5 260	20.37
		5 280	21.14
		5 320	20.60
	UNII-2C	5 500	20.72
		5 600	21.19
		5 700	20.61
		5 720[1)]	15.51
802.11n HT20	UNII-1	5 180	21.47
		5 200	21.57
		5 240	21.45
	UNII-2A	5 260	21.41
		5 280	21.60
		5 320	21.38
	UNII-2C	5 500	21.60
		5 600	21.46
		5 700	21.30
		5 720[1)]	15.89
802.11n HT40	UNII-1	5 190	41.71
		5 230	41.42
	UNII-2A	5 270	41.46
		5 310	41.27
	UNII-2C	5 510	41.34
		5 590	42.45
		5 670	40.78
		5 710[1)]	35.41

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Test mode	Band	Frequency(㎒)	Measured Bandwidth (㎒)
802.11ac VHT20	UNII-1	5 180	20.92
		5 200	20.76
		5 240	21.28
	UNII-2A	5 260	21.42
		5 280	21.49
		5 320	21.30
	UNII-2C	5 500	21.46
		5 600	21.48
		5 700	21.34
		5 720[1)]	15.67
802.11ac VHT40	UNII-1	5 190	41.57
		5 230	41.10
	UNII-2A	5 270	41.32
		5 310	41.06
	UNII-2C	5 510	41.24
		5 590	41.88
		5 670	40.88
		5 710[1)]	35.39
802.11ac VHT80	UNII-1	5 210	81.26
	UNII-2A	5 290	80.98
	UNII-2C	5 530	80.79
		5 610	81.00
		5 690[1)]	76.36

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99% bandwidth

Test mode	Band	Frequency(㎒)	Measured Bandwidth (MHz)
802.11a	UNII-1	5 240	16.58
	UNII-2A	5 260	16.42
802.11n HT20	UNII-1	5 240	17.66
	UNII-2A	5 260	17.61
802.11n HT40	UNII-1	5 230	36.71
	UNII-2A	5 270	36.48
802.11ac VHT20	UNII-1	5 240	17.60
	UNII-2A	5 260	17.62
802.11ac VHT40	UNII-1	5 230	36.17
	UNII-2A	5 270	36.05
802.11ac VHT80	UNII-1	5 210	75.45
	UNII-2A	5 290	75.33

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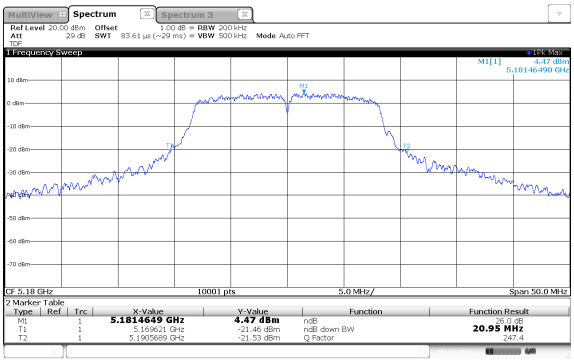
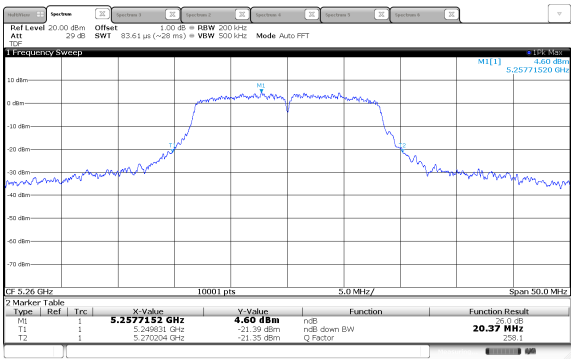
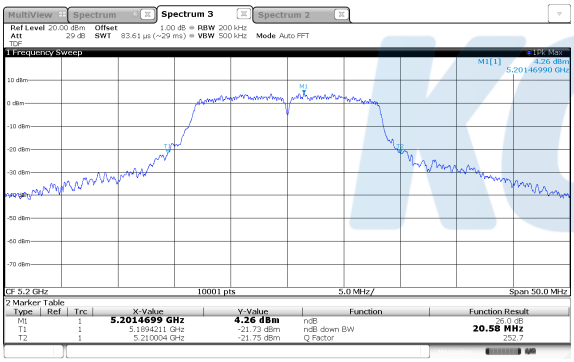
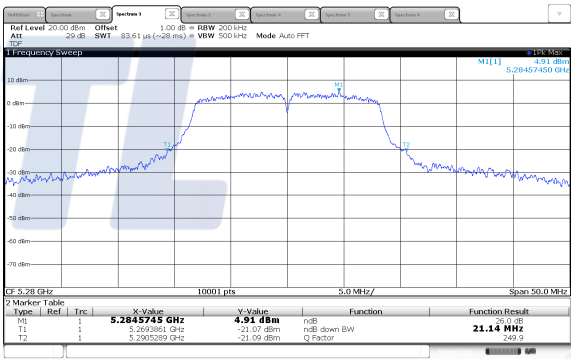
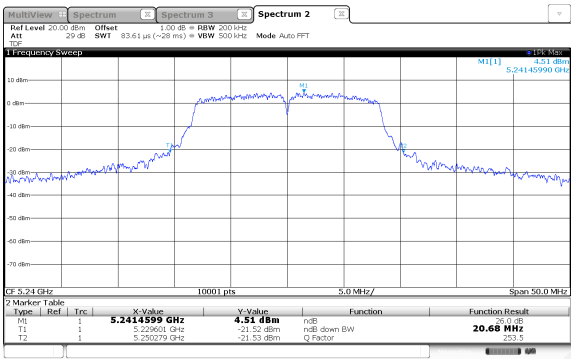
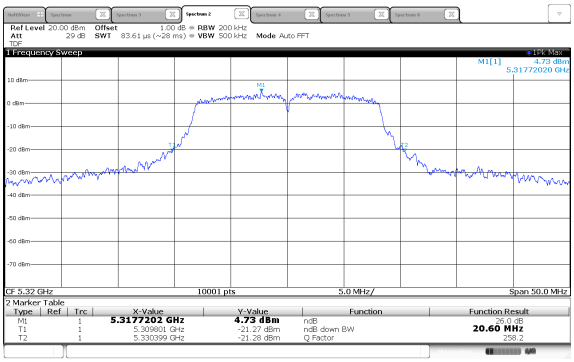
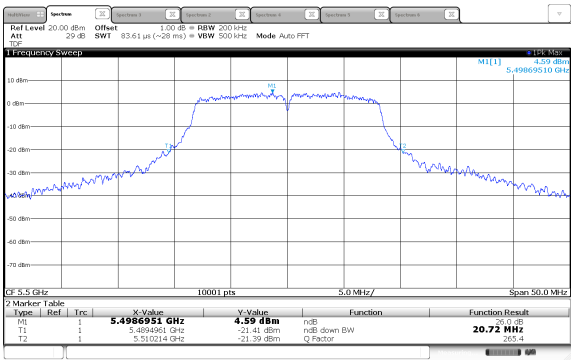
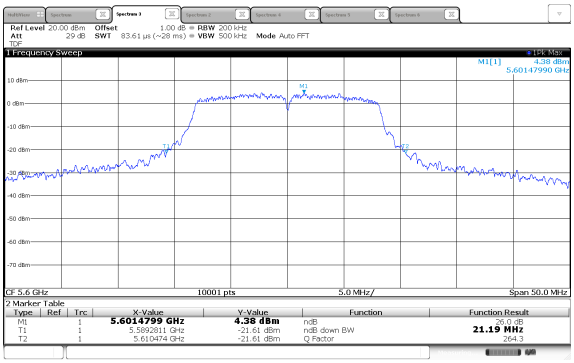
26 dB bandwidth

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

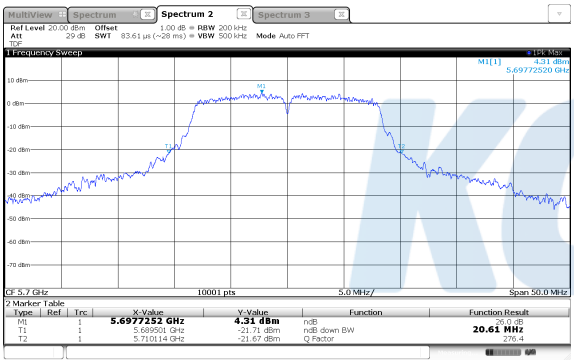
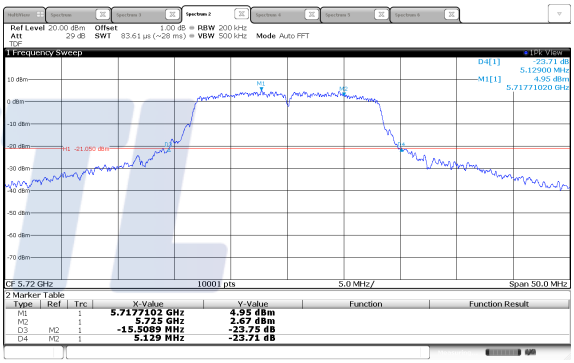
UNII-2C / 802.11a / Low ch.



UNII-2C / 802.11a / Mid ch.



UNII-2C / 802.11a / High ch.



UNII-2C / 802.11a / Straddle ch.