RADIO TEST REPORT

Product	:	802.11ac Ceiling-mount AP
Model Name	:	VigorAP 1000
Series Model	:	VigorAP 1000C
FCC ID	:	VGYAP1000C
Test Regulation	:	FCC 47 CFR Part 15 Subpart C (Section 15.247)
Received Date	:	Feb. 27, 2020
Test Date	:	Apr. 21, 2020 ~ Jun. 12, 2020
Issued Date	:	Jul. 8, 2020
Applicant	:	DrayTek Corp. No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan 303 R.O.C
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

REVISION HISTORY

Original Test Report No.: 4789387588-US-R0-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4789387588-US-R0-V0	Jun. 30, 2020	-	Initial issue
-	4789387588-US-R0-V0	Jul. 8, 2020	P.9 P.13	Modify Note 1. Modify section 6.5.

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1. Attestation of Test Results

APPLICANT:	DrayTek Corp. No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan 303 R.O.C
MANUFACTURER	DrayTek Corp. No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan 303 R.O.C
EUT DESCRIPTION:	802.11ac Ceiling-mount AP
BRAND:	DrayTek
MODEL:	VigorAP 1000
SERIES MODEL:	VigorAP 1000C
SAMPLE STAGE:	Engineering sample
DATE of TESTED:	Apr. 21, 2020 ~ Jun. 12, 2020

APPLICABLE STANDARDS	
STANDARD	**Test Results**
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin Date : Jul. 8, 2020
Project Handler

Approved and Authorized By:

Howard Kao Date : Jul. 8, 2020
Project Engineer

2. Summary of Test Results

Summary of Test Results		
FCC Clause	**Test Items**	**Result**
15.247(a)(2)	6dB Bandwidth	PASS
15.247(b)	Conducted Output Power	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Antenna Port Emission	PASS
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS

Note:
1. For the Radiated Band Edge test plots were recorded in Appendix I, the Radiated Emissions test plots were recorded in Appendix II.

3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor k=2.

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	1.7
RF Conducted	9 kHz - 40GHz	2	1.0
Radiated disturbance below 30MHz	9 kHz - 30 MHz	2	2.2
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	2	5.3
Radiated disturbance above 1GHz	1GHz ~ 40GHz	2	4.8

6. Equipment under Test

6.1. Description of EUT

Product	802.11ac Ceiling-mount AP
Brand Name	DrayTek
Model Name	VigorAP 1000
Series Model	VigorAP 1000C
S/N	19C001DAA04F33C
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS15
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Maximum Output Power	802.11b: 27.57 dBm 802.11g: 29.97 dBm 802.11n (HT20): 29.79 dBm 802.11n (HT40): 26.33 dBm
Normal Voltage	12Vdc from adapter

Note:

1. The models difference table as below:

Main Model	Function				
	Antenna		Wi-Fi		
	PIFA Internal	Dipole External	2.4G	5G1	5G2
VigorAP 1000	-	V	V	V	V
Series Model	**Function difference**				
	Antenna		Wi-Fi		
	PIFA Internal	Dipole External	2.4G	5G1	5G2
VigorAP 1000C	V	-	V	V	V

- The model: VigorAP 1000C is sold in black and white. The internal structure is the same but the color is different.
- There are two modules in the EUT. For Wi-Fi 5GHz use, 5G1 only supports Tx with UNII-1, and 5G2 only supports Tx with UNII-3.

2. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11b	2TX,2RX
802.11g	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX

3. The EUT contains following accessory devices

Product	Brand	Model	Description
Dipole antenna 1	Angeei	DPD2430SRW	Antenna gain: 2.4~2.49GHz: 2.3 dBi 5.15~5.85GHz: 3.5 dBi
Dipole antenna 2	Walsin	RFDPA131300SBLB805	Antenna gain: 2.4~2.49GHz: 2.3 dBi 5.15~5.85GHz: 3.9 dBi
AC adapter	Channel Well Technology	2ABL024F	Input: 100-240V, 50-60Hz, 0.8A Output: 12.0V 2.0A Length: 1.5m
Mounting Bracket	N/A	N/A	N/A
Ethernet Cable	N/A	N/A	Length: 3.0m

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz	-	-

7 channels are provided for 802.11n (HT40):

Channel	Frequency	Channel	Frequency
3	2422MHz	7	2442MHz
4	2427MHz	8	2447MHz
5	2432MHz	9	2452MHz
6	2437MHz	-	-

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	23~26°C / 62~66%RH	120Vac / 60 Hz	Apr. 21, 2020 ~ Jun. 12, 2020	Carlos Chen
Radiated Spurious Emission	966-2	21~27°C / 55~68%RH	120Vac / 60 Hz	Apr. 24, 2020 ~ May 6, 2020	Carlos Chen
AC power Line Conducted Emission	SR1	24~26°C / 63~68%RH	120Vac / 60 Hz	Jun. 11, 2020	Carlos Chen

FCC Test Firm Registration Number: 498077

6.4. Description Of Available Antennas

For VigorAP 1000

Antenna	Brand Name	Model Name	Antenna Type	Antenna Gain(dBi)
Chain(0)	Angeei	DPD2430SRW	Dipole	2.3
Chain(1)	Walsin	RFDPA131300SBLB805	Dipole	2.3

For VigorAP 1000C

Antenna	Brand Name	Model Name	Antenna Type	Antenna Gain(dBi)
Chain(0)	Radiation Technology	C0504-ANG0002	PIFA	1
Chain(1)	Radiation Technology	C0504-ANG0003	PIFA	1

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

6.5. Test Mode Applicability and Tested Channel Detail

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- The fundamental of the EUT was investigated in three orthogonal axes X/Y/Z, it was determined that X axis was worst-case. Therefore, all final radiated testing was performed with the EUT in X axis.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case)
- The difference between the VigorAP1000 and VigorAP1000C is of the antenna type. Therefore, the antenna Port Conducted Measurement is the same, but both of the radiated tests are the complete test.
- After pre-scan, the dipole antenna of Walsin was decided to worst-case and use to all related test for AP1000C.

Non-Beamforming Mode

Model: VigorAP1000

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
	802.11n(HT40)	OFDM	BPSK	3 to 9	3,6,9	MCS0
Radiated Emissions (Below 1GHz)	802.11b	DSSS	DBPSK	1 to 11	11	1.0
AC Power Line Conducted Emission	802.11b	DSSS	DBPSK	1 to 11	11	1.0
Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
	802.11n(HT40)	OFDM	BPSK	3 to 9	3,6,9	MCS0

Model: VigorAP1000C

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
	802.11n(HT40)	OFDM	BPSK	3 to 9	3,6,9	MCS0
Radiated Emissions (Below 1GHz)	802.11n(HT40)	OFDM	BPSK	3 to 9	3	MCS0
AC Power Line Conducted Emission	802.11n(HT40)	OFDM	BPSK	3 to 9	3	MCS0

Co-Location Mode

Model: VigorAP1000

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions	802.11b	DSSS	DBPSK	1 to 11	6+48+165	1.0
	802.11ac(VHT20)	OFDM	BPSK	36 to 48		MCS0
				149 to 165		

Model: VigorAP1000C

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions	802.11b	DSSS	DBPSK	1 to 11	6+48+149	1.0
	802.11a	OFDM	BPSK	36 to 48		6.0
				149 to 165		

6.6. Duty cycle

Non-Beamforming Mode

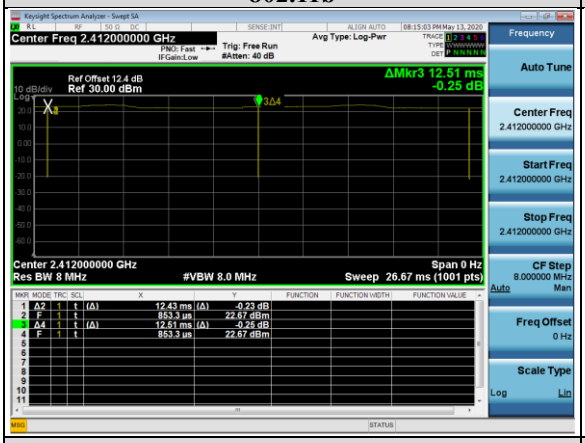
802.11b: Duty cycle = 12.43/12.51 = 0.994, duty cycle of test signal is ≥ 98 %, duty factor is not required.

802.11g: Duty cycle = 2.061/2.15 = 0.959, Duty factor = 10 * log(1/0.959) = 0.18

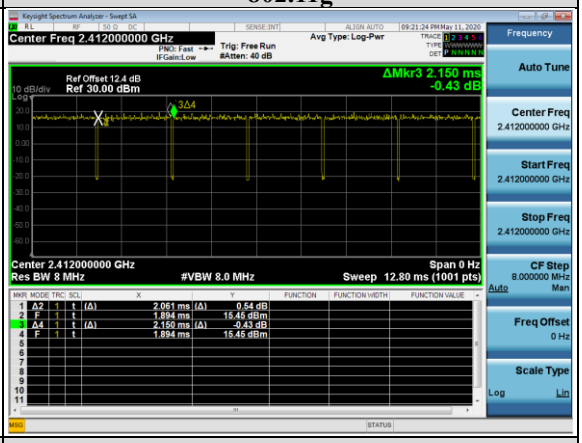
802.11n (HT20): Duty cycle = 5/5.08 = 0.984, duty cycle of test signal is ≥ 98 %, duty factor is not required.

802.11n (HT40): Duty cycle = 2.432/2.509 = 0.97, Duty factor = 10 * log(1/0.97) = 0.14

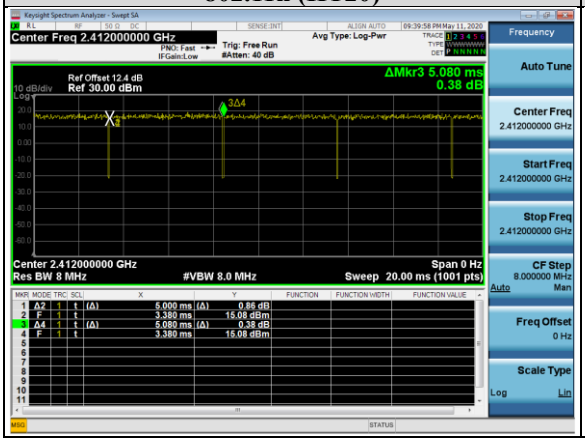
802.11b



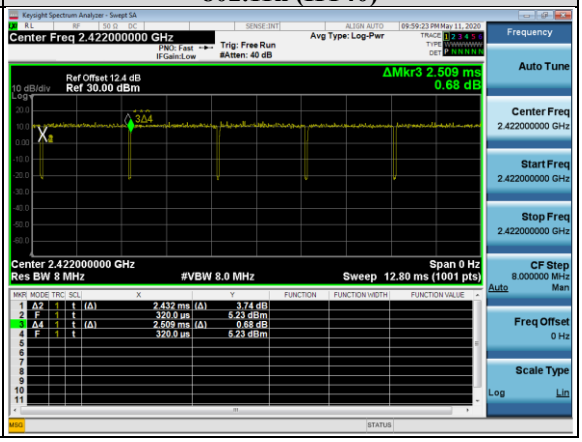
802.11g



802.11n (HT20)



802.11n (HT40)



7. Test Equipment

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Cal. Interval**
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 13, 2019	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Dec. 17, 2019	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 19, 2019	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 3, 2020	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 3, 2020	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	Dec. 27, 2019	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Feb. 4, 2020	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Feb. 4, 2020	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	May 8, 2019 May 19, 2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	Jan. 8, 2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	Jan. 8, 2020	1 year

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Cal. Interval**
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 6, 2019	1 year
Pulse Power Sensor	Anrisu	MA2411B	1531202	Dec. 23, 2019	1 year
Power Meter	Anrisu	ML2495A	1645002	Dec. 23, 2019	1 year
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	Nov. 19, 2019	1 year
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	Aug. 8, 2019	1 year
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	Aug. 6, 2019	1 year
Cables	HARBOUR INDUSTRIES	LL142	170205-5000-1	Feb. 5, 2020	1 year

UL Software		
Description	**Name**	**Version**
Radiated measurement	EZ_EMC	1.1.4.2
Conducted measurement	Keysight.TestSystem	1.0.0.0
AC power Line Conducted Emission	EZ_EMC	1.1.4.2

8. Description of Test Setup

Support Equipment

Equipment	Brand Name	Model Name	S/N	Remark
Notebook	DELL	Latitude E5470	3JFKWF2	N/A
Notebook	DELL	Latitude E5470	JVSKWF2	N/A
Connector	N/A	N/A	N/A	RJ-45 to RJ-45
USB Device	SP Widget	TOUCH T03	N/A	8GB
PoE injector	Bullet POE	BPI1000-GH	1804240137	I/P: 100-240 Vac O/P: 30W
Rx Device (BF Client)	DrayTek	VigorAP 1000C	N/A	FW: 1.3.3_RC4

I/O Cables

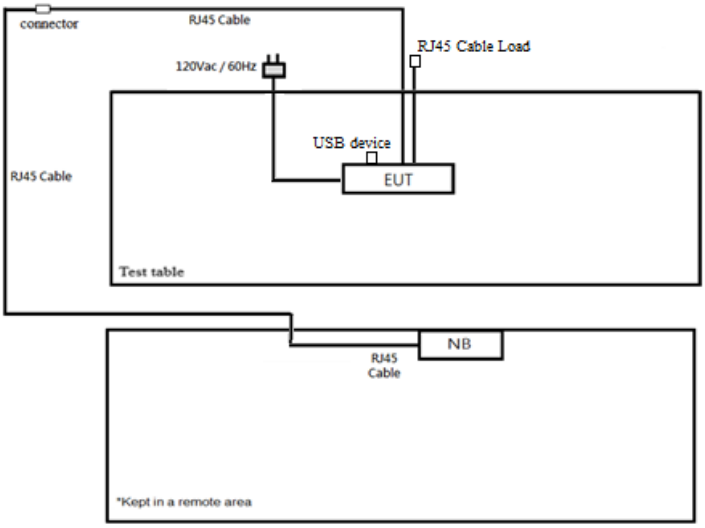
Equipment	Brand Name	Model Name	S/N	Remark
RJ-45 cable	N/A	N/A	N/A	Length : 10m
RJ-45 cable	N/A	N/A	N/A	Length : 1.5m
RJ-45 cable	N/A	N/A	N/A	Length : 1.5m

Test Setup

Controlled using a bespoke application (QRCT v3.0.210.0) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test

Non-Beamforming Mode



9. Test Results

9.1. 6dB Bandwidth

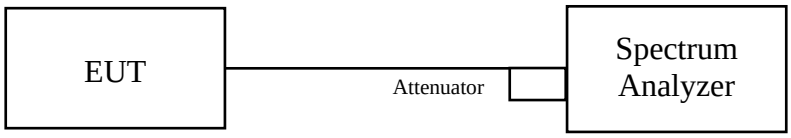
Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	8.073	8.073	0.5	Pass
6	2437	8.077	8.081	0.5	Pass
11	2462	8.073	8.081	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.316	16.338	0.5	Pass
6	2437	16.353	16.338	0.5	Pass
11	2462	16.293	16.342	0.5	Pass

802.11n (HT20)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.436	17.321	0.5	Pass
6	2437	17.535	17.55	0.5	Pass
11	2462	17.13	17.531	0.5	Pass

802.11n (HT40)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
3	2422	35.032	35.115	0.5	Pass
6	2437	35.077	35.115	0.5	Pass
9	2452	35.07	35.1	0.5	Pass

Spectrum Plot of Worst Value	
802.11b_Chain 0 / CH11	802.11g_Chain 0 / CH11
	
802.11n (HT20)_Chain 0 / CH1	802.11n (HT40)_Chain 0 / CH3
	

9.2. Conducted output power

Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

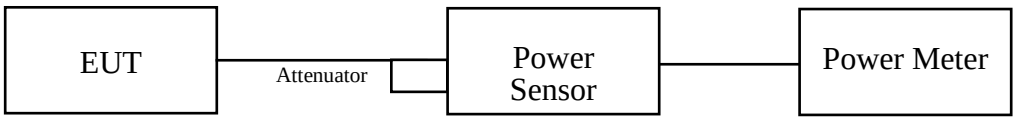
Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = 10 log(N_{ANT}/N_{SS}) dB.

Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Test Setup



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.

Test Data

Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	22.51	23.02	378.685	25.78	30	Pass
6	2437	24.43	24.69	571.774	27.57	30	Pass
11	2462	22.29	23.05	371.271	25.70	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	19.66	20.34	200.613	23.02	30	Pass
6	2437	26.91	27.01	993.251	29.97	30	Pass
11	2462	19.48	20.02	189.178	22.77	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	19.82	20.38	205.084	23.12	30	Pass
6	2437	26.71	26.85	952.985	29.79	30	Pass
11	2462	18.43	19.32	155.17	21.91	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	18.07	18.68	137.911	21.40	30	Pass
6	2437	23.07	23.56	429.754	26.33	30	Pass
9	2452	17.97	18.65	135.943	21.33	30	Pass

Average Power (Reference Only)

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	20.04	20.62	216.27	23.35
6	2437	22.09	22.31	332.024	25.21
11	2462	19.88	20.49	209.219	23.21

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	13.89	14.33	51.593	17.13
6	2437	21.24	21.82	285.1	24.55
11	2462	13.47	14.19	48.475	16.86

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	13.51	14.01	47.616	16.78
6	2437	20.45	20.92	234.512	23.70
11	2462	12.22	12.92	36.26	15.59

802.11n (HT40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	11.75	12.12	31.255	14.95
6	2437	16.61	17.03	96.28	19.84
9	2452	11.55	12.19	30.847	14.89

9.3. Power Spectral Density

Requirements

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz (If G_{TX} > 6 dBi, then PSD = 8 – (G_{TX} – 6)).

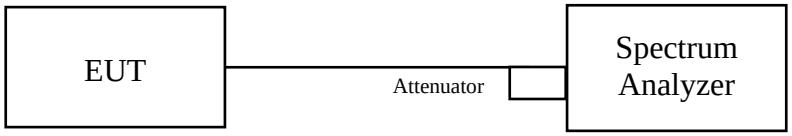
Note:
1. PSD = power spectral density that he same method as used to determine the conducted output power shall be used to determine the power spectral density. And power spectral density in dBm/MHz.
2. G_{TX} = the maximum transmitting antenna directional gain in dBi.
3. Directional Gain = G_{ant} + 10 log (Nant) dBi.

   N*a*nt: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas (Same for Each Antenna)

Test procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

802.11b

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-6.04	3.01	-3.03	8	Pass
	6	2437	-5.25	3.01	-2.24	8	Pass
	11	2462	-6.19	3.01	-3.18	8	Pass
1	1	2412	-6.10	3.01	-3.09	8	Pass
	6	2437	-5.39	3.01	-2.38	8	Pass
	11	2462	-5.80	3.01	-2.79	8	Pass

NOTE: Directional gain = 5.31 dBi < 6 dBi, so the limit no need to reduced.

802.11g

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-13.43	3.01	-10.42	8	Pass
	6	2437	-7.50	3.01	-4.49	8	Pass
	11	2462	-15.12	3.01	-12.11	8	Pass
1	1	2412	-12.98	3.01	-9.97	8	Pass
	6	2437	-7.31	3.01	-4.30	8	Pass
	11	2462	-14.11	3.01	-11.10	8	Pass

NOTE: Directional gain = 5.31 dBi < 6 dBi, so the limit no need to reduced.

802.11n (HT20)

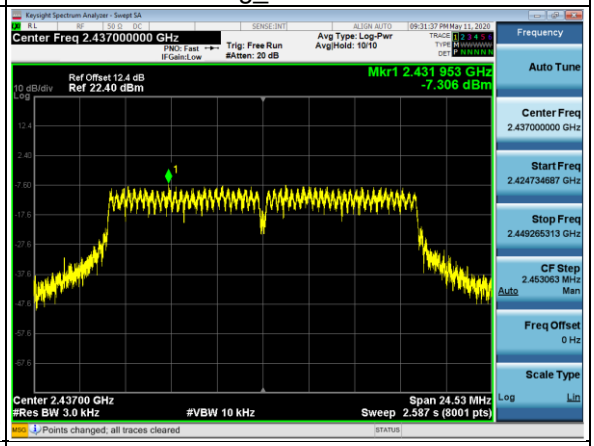
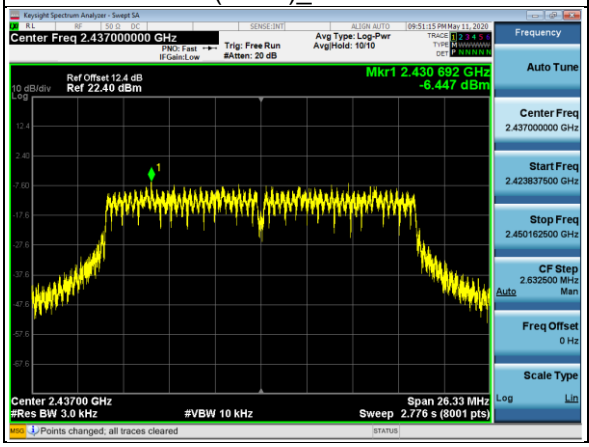
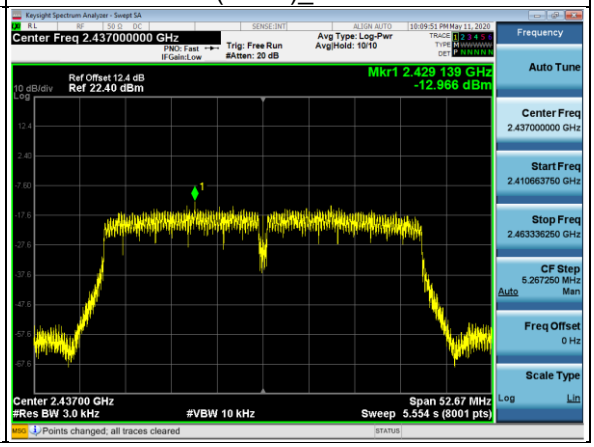
TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-13.97	3.01	-10.96	8	Pass
	6	2437	-7.00	3.01	-3.99	8	Pass
	11	2462	-16.34	3.01	-13.33	8	Pass
1	1	2412	-14.06	3.01	-11.05	8	Pass
	6	2437	-6.45	3.01	-3.44	8	Pass
	11	2462	-15.84	3.01	-12.83	8	Pass

NOTE: Directional gain = 5.31 dBi < 6 dBi, so the limit no need to reduced.

802.11n (HT40)

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	3	2422	-18.30	3.01	-15.29	8	Pass
	6	2437	-12.97	3.01	-9.96	8	Pass
	9	2452	-18.87	3.01	-15.86	8	Pass
1	3	2422	-17.97	3.01	-14.96	8	Pass
	6	2437	-13.80	3.01	-10.78	8	Pass
	9	2452	-18.07	3.01	-15.06	8	Pass

NOTE: Directional gain = 5.31 dBi < 6 dBi, so the limit no need to reduced.

Spectrum Plot of Worst Value	
802.11b_Chain 0 / CH6	802.11g_Chain 1 / CH6
	
802.11n (HT20)_Chain 1 / CH6	802.11n (HT40)_Chain 0 / CH6
	

9.4. Conducted Out of Band Emission

Requirements

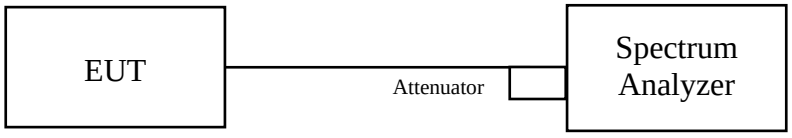
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b) (3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209 (a) is not required.

Test procedure

Measurement Procedure REF
a. Set the RBW = 100 kHz.
b. Set the VBW ≥ 300 kHz.
c. Set the span to 1.5 times the DTS bandwidth.
d. Detector = peak.
e. Sweep time = auto couple.
f. Trace mode = max hold.
g. Allow trace to fully stabilize.
h. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE
a. Set RBW = 100 kHz.
b. Set VBW ≥ 300 kHz.
c. Detector = peak.
d. Sweep = auto couple.
e. Trace Mode = max hold.
f. Allow trace to fully stabilize.
g. Use the peak marker function to determine the maximum amplitude level.

Test Setup



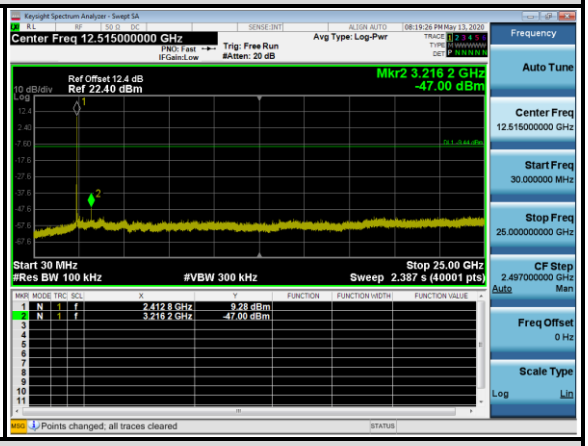
The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

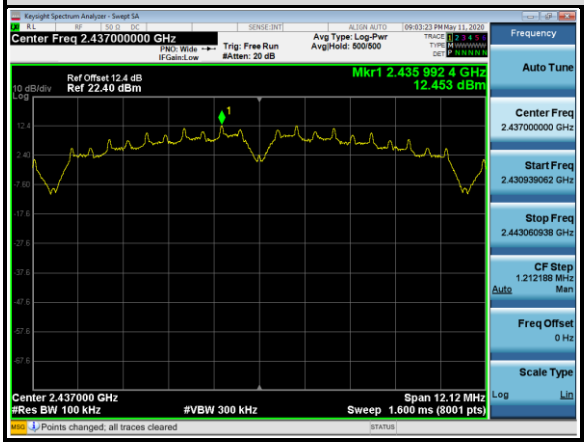
802.11b

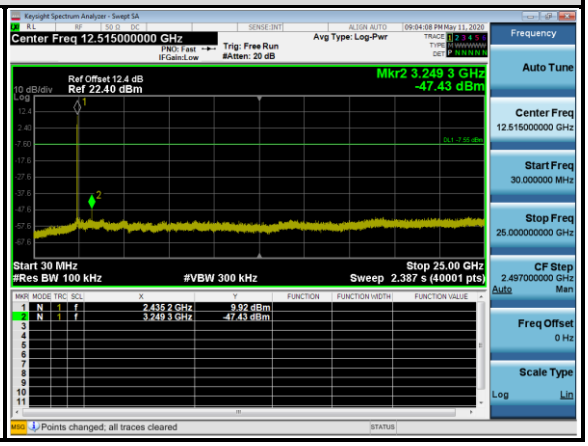
CHAIN 0

Ch 1

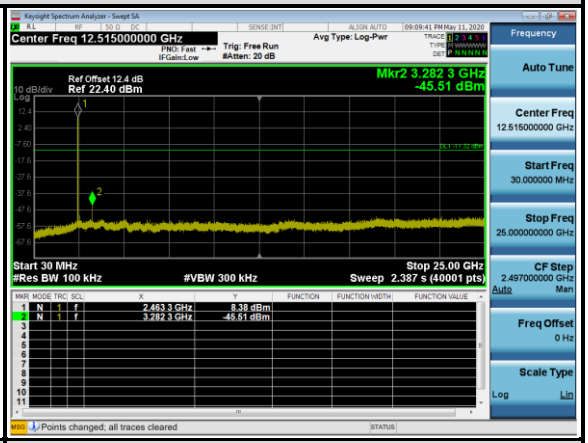


Ch 6

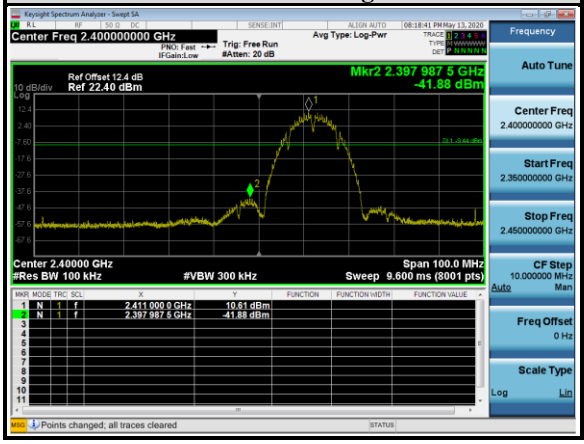




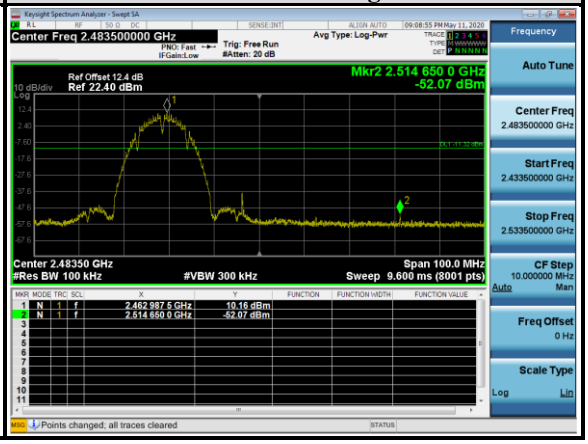
Ch 11



Ch 1 Band Edge

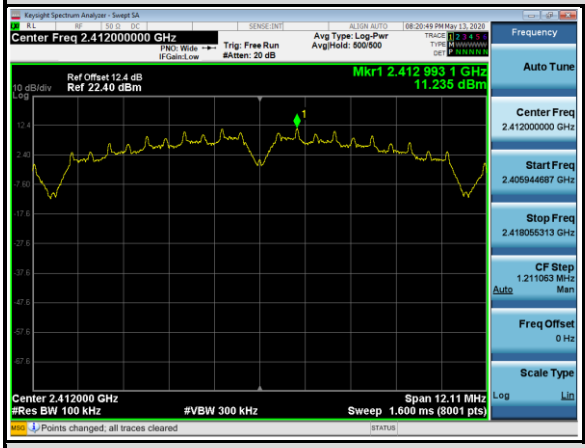


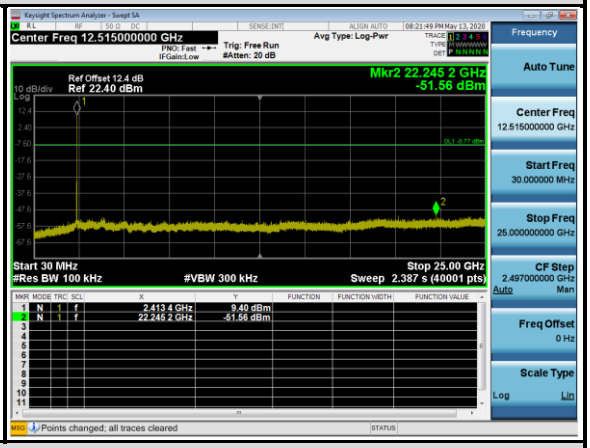
Ch 11 Band Edge



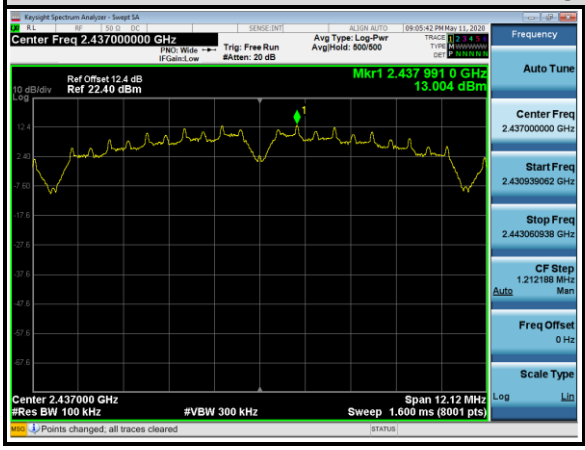
CHAIN 1

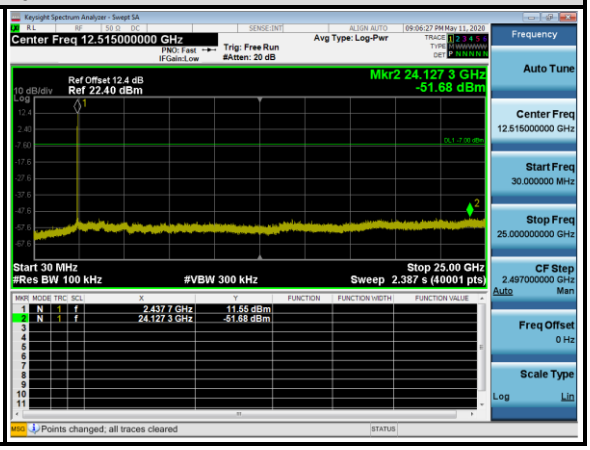
Ch 1





Ch 6





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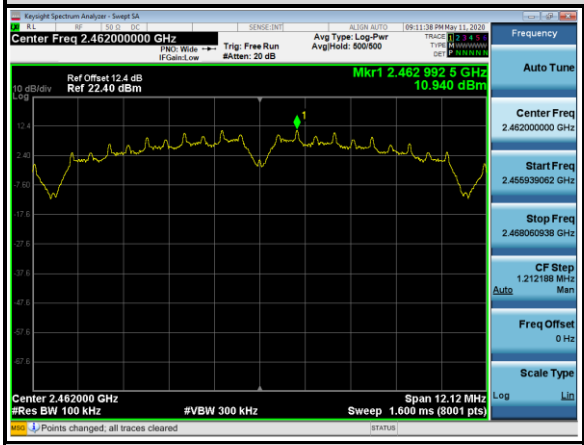
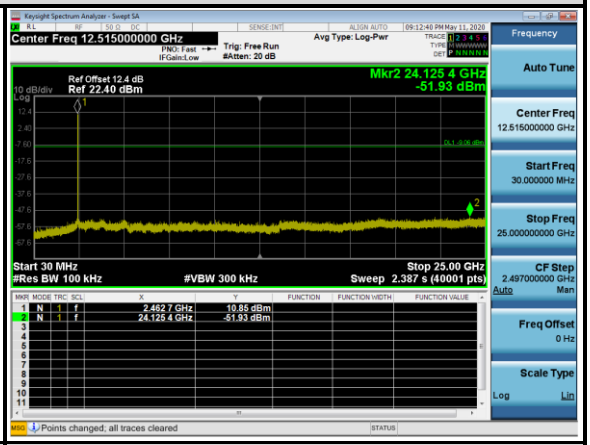
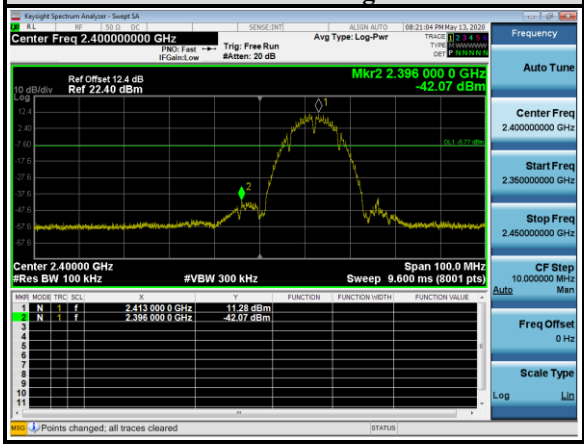
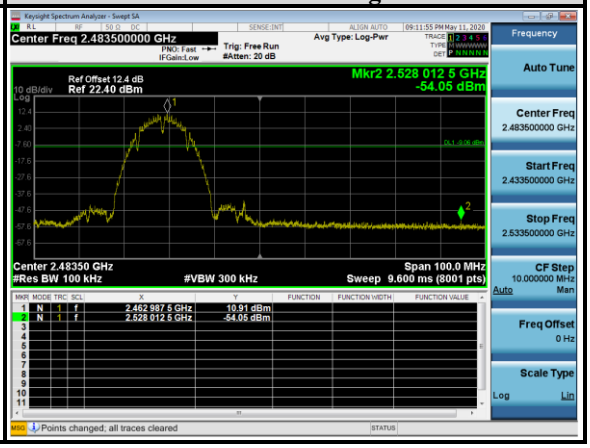




Ch 1 Band Edge



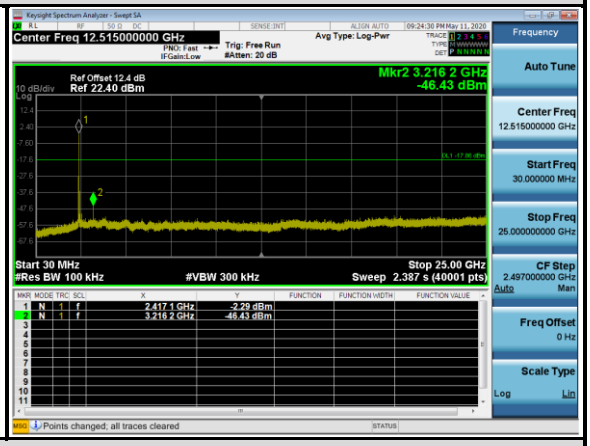
Ch 11 Band Edge



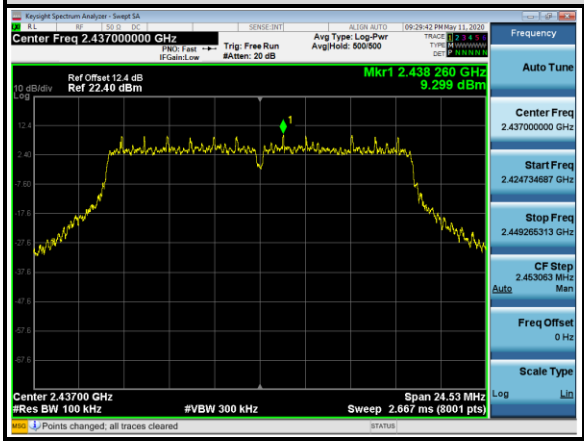
802.11g

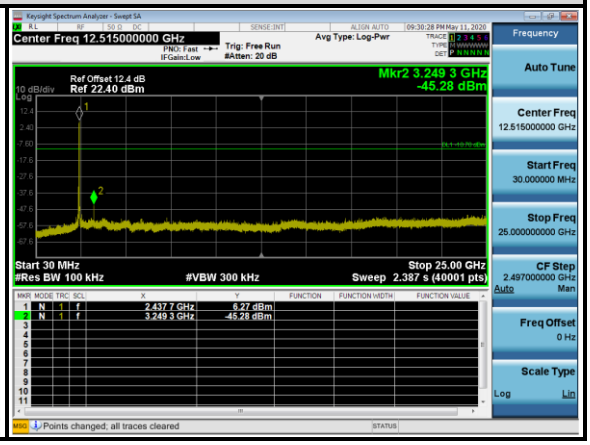
CHAIN 0

Ch 1

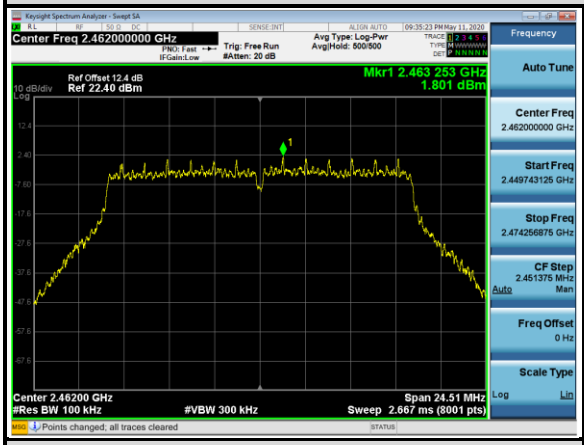


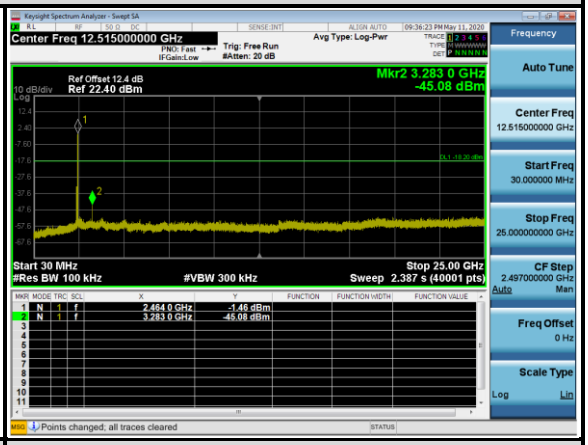
Ch 6



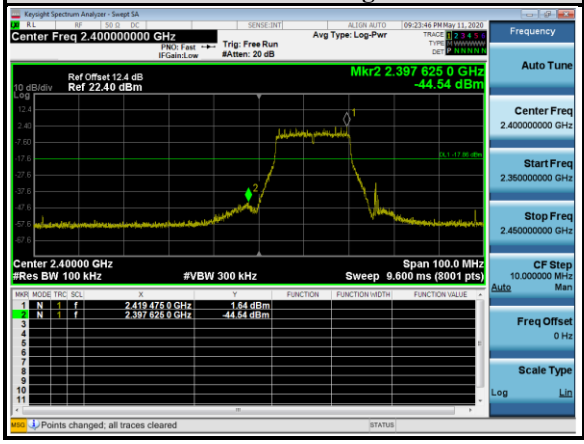


Ch 11

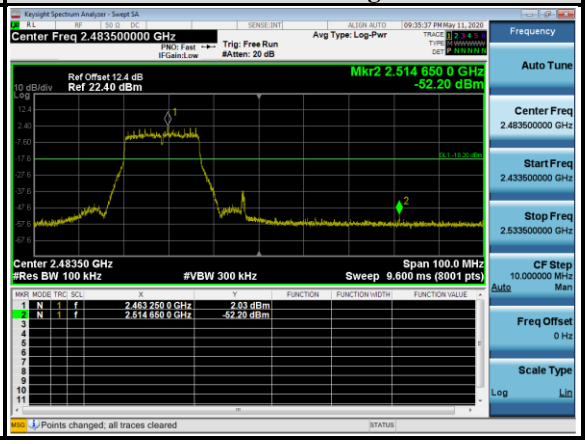




Ch 1 Band Edge

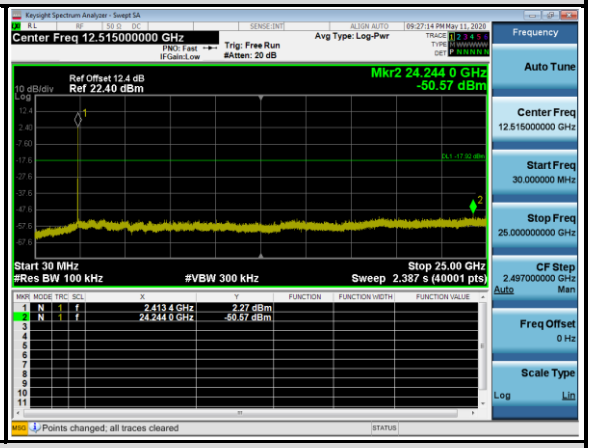


Ch 11 Band Edge

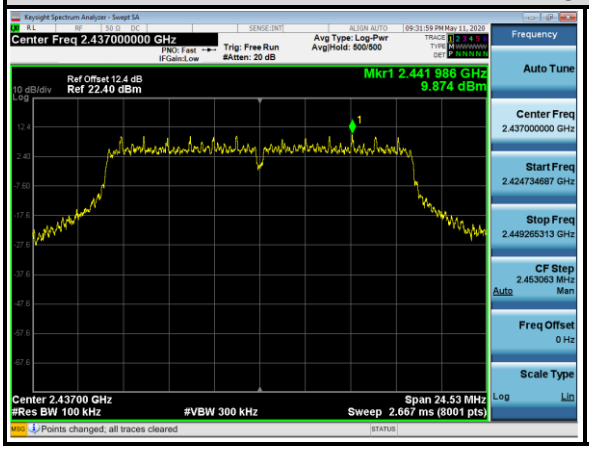


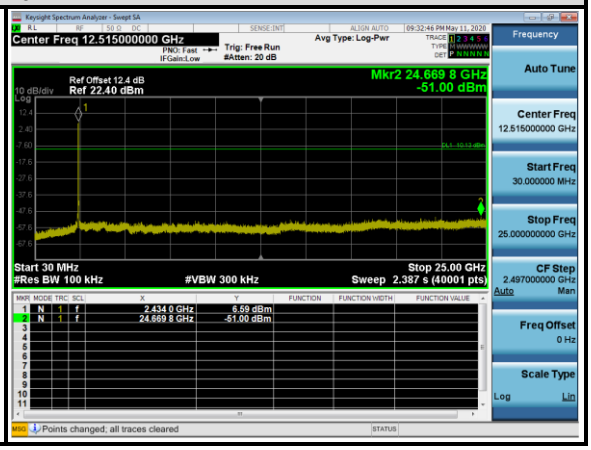
CHAIN 1

Ch 1

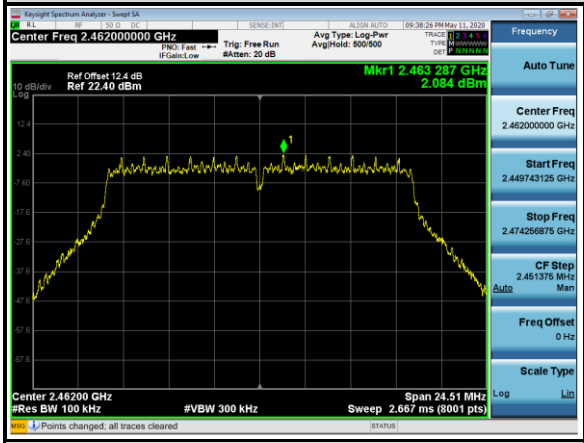


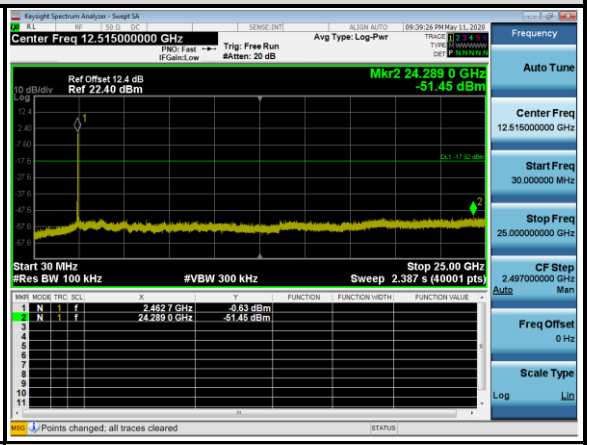
Ch 6



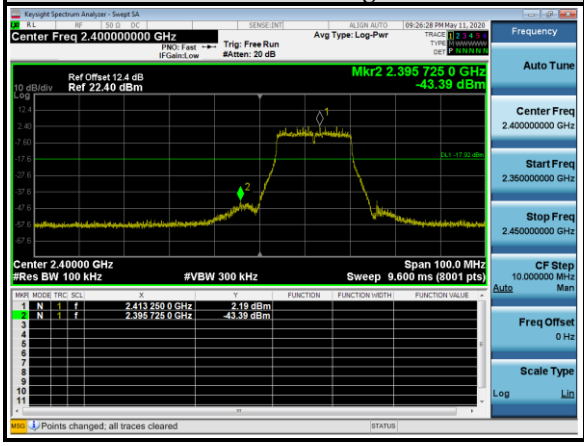


Ch 11

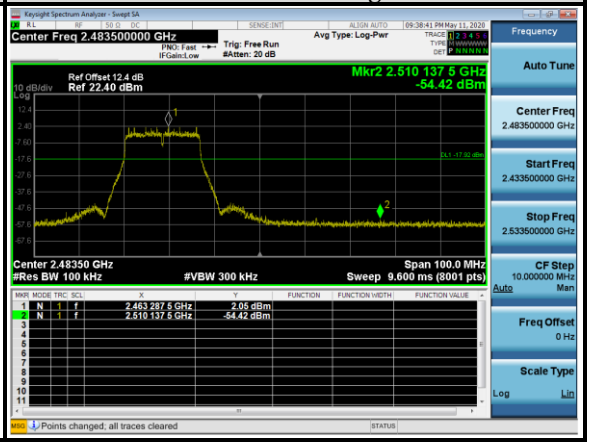




Ch 1 Band Edge



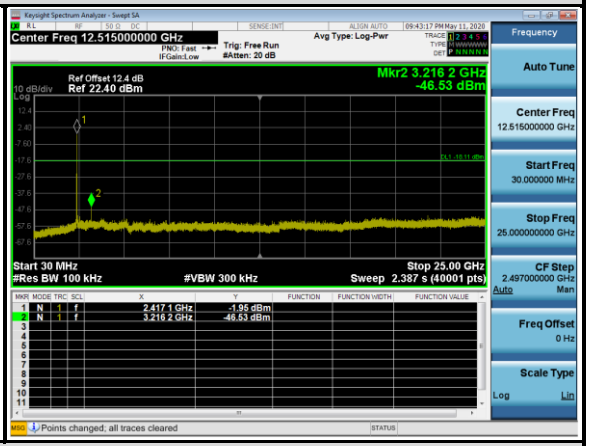
Ch 11 Band Edge



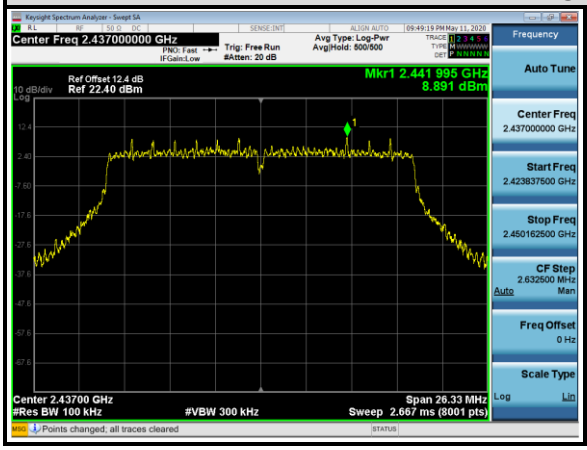
802.11n (HT20)

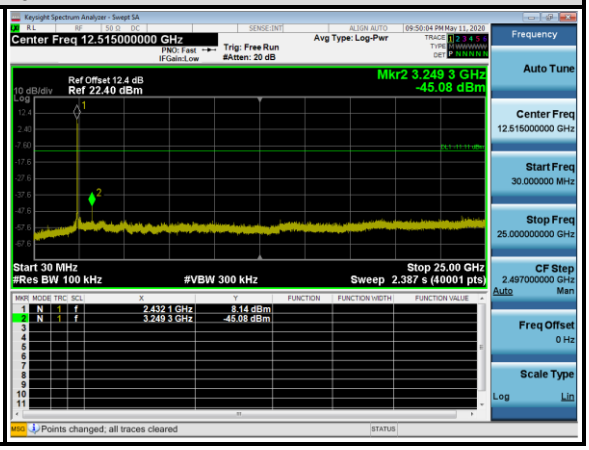
CHAIN 0

Ch 1

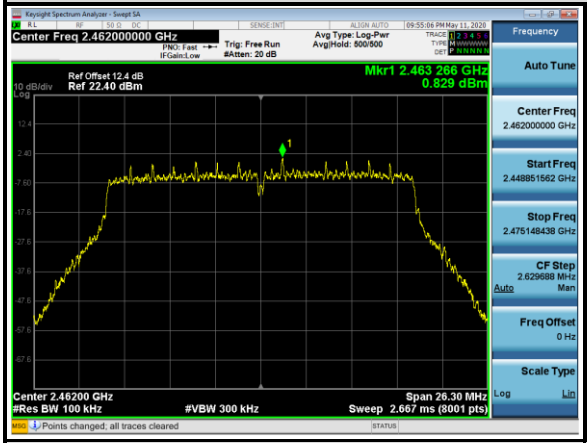


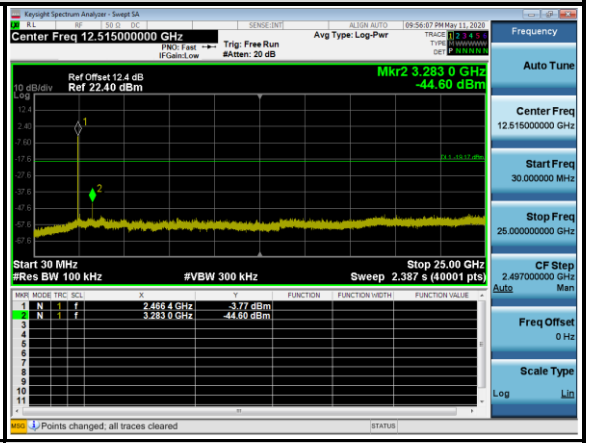
Ch 6



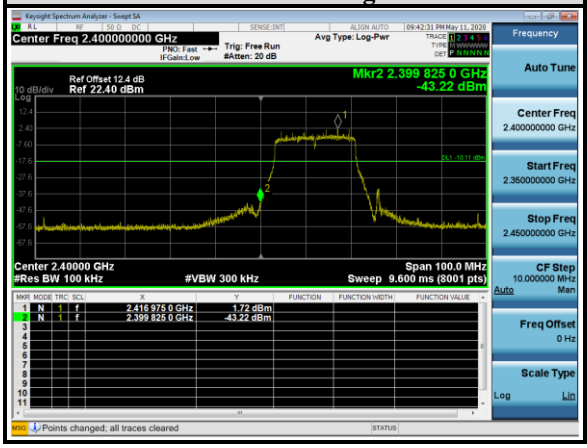


Ch 11

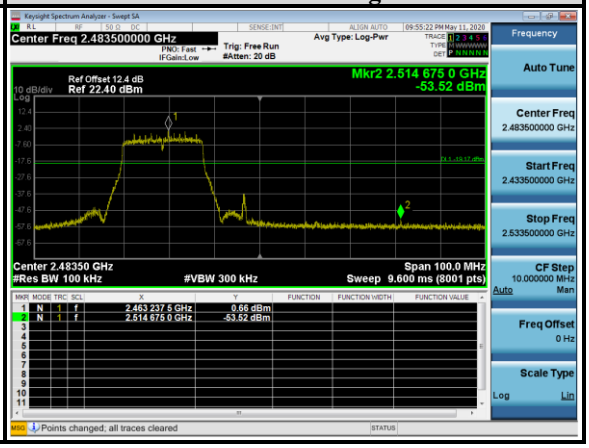




Ch 1 Band Edge

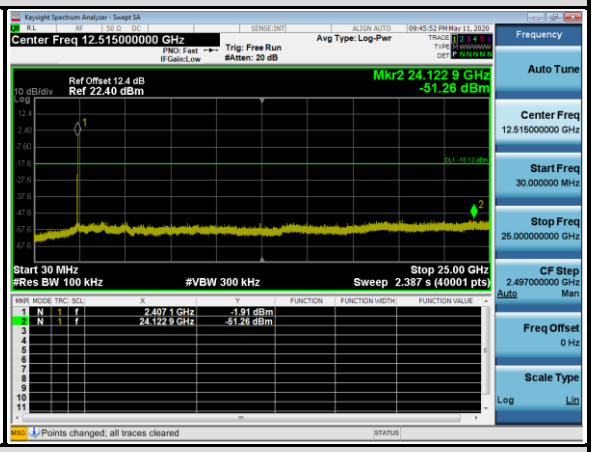


Ch 11 Band Edge



CHAIN 1

Ch 1



Ch 6