RADIO TEST REPORT

Product	:	IEEE 802.11ax/ac/a/b/g/n 2x2 WiFi with Bluetooth5.2 M.2 LGA Type 1216 Module
Model Name	:	AP6275SDSR
FCC ID	:	RYK-AP6275SDSR
Test Regulation	:	FCC 47 CFR Part 15 Subpart C (Section 15.247)
Received Date	:	2022/8/31
Test Date	:	2022/8/31 ~ 2022/9/29
Issued Date	:	2022/12/23
Applicant	:	SparkLAN Communications, Inc. 5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067, Taiwan
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

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REVISION HISTORY

Original Test Report No.: 4790471812-US-R0-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4790471812-US-R0-V0	2022/12/23	-	Initial issue

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1. Attestation of Test Results

APPLICANT:	SparkLAN Communications, Inc. 5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067, Taiwan
MANUFACTURER:	SparkLAN Communications, Inc. 5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067, Taiwan
EUT DESCRIPTION:	IEEE 802.11ax/ac/a/b/g/n 2x2 WiFi with Bluetooth5.2 M.2 LGA Type 1216 Module
BRAND:	SparkLAN, Ampak
MODEL:	AP6275SDSR
SAMPLE STAGE:	Engineering Verification Test sample
DATE of TESTED:	2022/8/31 ~ 2022/9/29

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 : 2022/12/23
Project Handler

Approved and Authorized By:

Eric Lee Date : 2022/12/23
Senior Laboratory 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

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.

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.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	±2.9 dB
RF Conducted	9 kHz - 40GHz	±2.4 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	±1.9 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	±5.8 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	±4.8 dB

6. Equipment under Test

6.1. Description of EUT

Product	IEEE 802.11ax/ac/a/b/g/n 2x2 WiFi with Bluetooth5.2 M.2 LGA Type 1216 Module
Brand Name	SparkLAN, Ampak
Model Name	AP6275SDSR
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS15 802.11ax: up to MCS11
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ax (HE20)
Maximum Output Power	**Non-Beamforming mode:** 802.11b: 24.13 dBm 802.11g: 27.21 dBm 802.11ax (HE20): 27.23 dBm **Beamforming mode:** 802.11ax (HE20): 26.93 dBm
Normal Voltage	3.3Vdc
Sample ID	5297201

Note:

1. The model has two brand names as follows:

Brand	Product name	Model
SparkLAN	IEEE 802.11ax/ac/a/b/g/n 2x2 WiFi with Bluetooth5.2 M.2 LGA Type 1216 Module	AP6275SDSR
Ampak		

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

Modulation Mode	Tx,Rx Function
802.11b	1Tx Diversity, 2RX
802.11g	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11ax (HE20)	2TX,2RX

* The modulation and bandwidth are similar for 802.11n mode for HT20 and 802.11ax mode for HE20, therefore investigated worst case to representative mode in test report.

3. The EUT contains following accessory devices:

Product	Brand	Model	Description
Antenna 1	SparkLAN	AD-103AG	-
Antenna 2	SparkLAN	AD-301N	-
Antenna 3	SparkLAN	AD-302N	-
Antenna 4	SparkLAN	AD-303N	-
Antenna 5	SparkLAN	AD-305N	-
Antenna 6	SparkLAN	AD-308N	-
Antenna 7	SparkLAN	AD-309N	-
Antenna 8	SparkLAN	AD-310N	-
Antenna 9	SparkLAN	AD-311N	-
Antenna 10	GRAND-TEK Technology	103DG00000140	-
Antenna 11	GRAND-TEK Technology	103DG00000150	-

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, 802.11n (HT20) and 802.11ax (HE20) :

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

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/ 60~65%RH	3.3Vdc	2022/09/14~ 2022/09/19	Patrick Kuan
Radiated Spurious Emission	966-2	23~26°C/ 60~65%RH	3.3Vdc	2022/08/31~ 2022/09/29	Patrick Kuan
AC power Line Conducted Emission	SR1	23~26°C/ 60~65%RH	120Vac/60Hz from Host	2022/09/20~ 2022/09/20	Patrick Kuan

FCC Test Firm Registration Number: 498077

Sample Calculation:

Antenna Port Conducted Measurement:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBm) = Reading Value (dBm) +Attenuator Factor (dB) + Cable Loss (dB).
  Example: Result Value (10dBm) = Reading Value (-2dBm) +Attenuator Factor (10dB) + Cable Loss(2dB).
  *Test plot only shown the "Result Value".

Radiated Spurious Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).
  Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
  Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBm) + Antenna Factor (18.7dB/m) + Cable Loss (4.2dB) - Preamp Factor (28.5dB).

AC power Line Conducted Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV) = Reading Value (dBuV) + Correction Factor (dB).
  Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).
  Example: Result Value (53.7dBuV) = Reading Value (35.1dBm) + Insertion loss(18.1dB) + Cable loss(0.5dB).

6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Frequency Band (MHz)	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	SparkLAN	AD-103AG	Dipole	2400~2500	2.02	RP-SMA
					5150~5875	2.03	
2	Chain (0)+(1)	SparkLAN	AD-301N	Dipole	2400~2500	4.4	RP-SMA
					5150~5850	5.8	
3	Chain (0)+(1)	SparkLAN	AD-302N	Dipole	2400~2500	3.14	RP-SMA
					5150~5850	2.87	
4	Chain (0)+(1)	SparkLAN	AD-303N	Dipole	2400~2500	3.14	RP-SMA
					5150~5850	3.45	
5	Chain (0)+(1)	SparkLAN	AD-305N	Dipole	2400~2500	5	RP-SMA
					5150~5825	5.53	
6	Chain (0)+(1)	SparkLAN	AD-308N	Dipole	2400~2500	3	I-PEX
					5150~5825	5	
7	Chain (0)+(1)	SparkLAN	AD-309N	Dipole	2400~2500	1.68	I-PEX
					5150~5875	4.72	
8	Chain (0)+(1)	SparkLAN	AD-310N	Dipole	2400~2500	2.65	I-PEX
					5150~5875	4.86	
9	Chain (0)+(1)	SparkLAN	AD-311N	Dipole	2400~2500	2.67	I-PEX
					5150~5875	4.91	
10	Chain (0)+(1)	GRAND-TEK Technology	103DG00000140	Dipole	2400~2500	4.8	I-PEX
					5150~5875	5	
11	Chain (0)+(1)	GRAND-TEK Technology	103DG00000150	Dipole	2400~2500	2.5	I-PEX
					5150~5875	5.3	

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

- The fundamental of the dipole antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- The antennas AD-305N has the highest gain, the following conducted tests are all carried out using this antenna.
- 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.
- 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 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.
- 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).

Non-Beamforming mode:

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,2,6,10,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,2,6,10,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,2,6,10,11	MCS 0
Radiated Emissions (Below 1GHz)	802.11ax20	OFDMA	BPSK	1 to 11	6	MCS 0
AC Power Line Conducted Emission	802.11ax20	OFDMA	BPSK	1 to 11	6	MCS 0
*Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,2,6,10,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,2,6,10,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,2,6,10,11	MCS 0

*Note: For Antenna Port Conducted Measurement, inner channels only test conducted output power.

Beamforming mode:

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
*Antenna Port Conducted Measurement	802.11ax20	OFDMA	BPSK	1 to 11	1,2,6,10,11	MCS 0 Nss1

*Note:The worst condition of radiated spurious emission and maximum conducted output power were Found in Non-Beamforming mode. Therefore Beamforming mode only test conducted output power and recorded in test report.

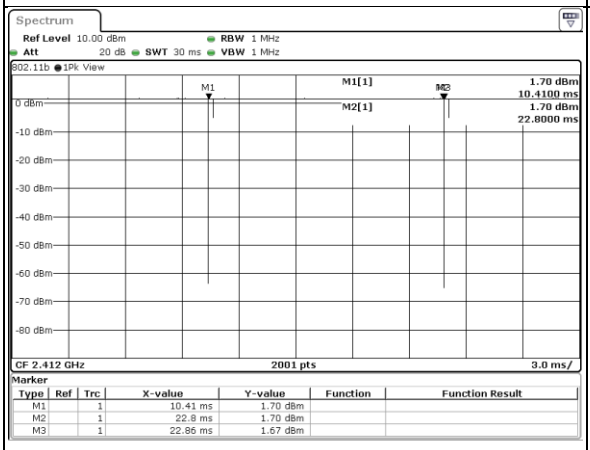
Simultaneously transmission condition:

Condition	Technology	
1	WLAN (2.4GHz)	BT-GFSK
Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.		

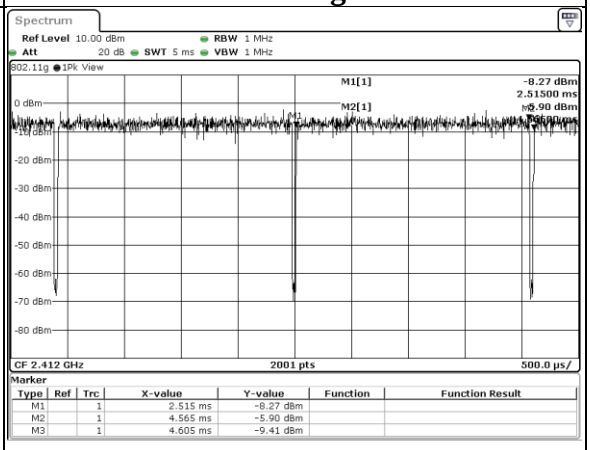
6.6. Duty cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle	Duty Factor (dB)	VBW Set (above 1GHz)
802.11b	12.390	12.450	0.9952	N/A	10Hz
802.11g	2.050	2.090	0.9809	N/A	10Hz
802.11ax(HE20)	1.480	1.510	0.9801	N/A	10Hz

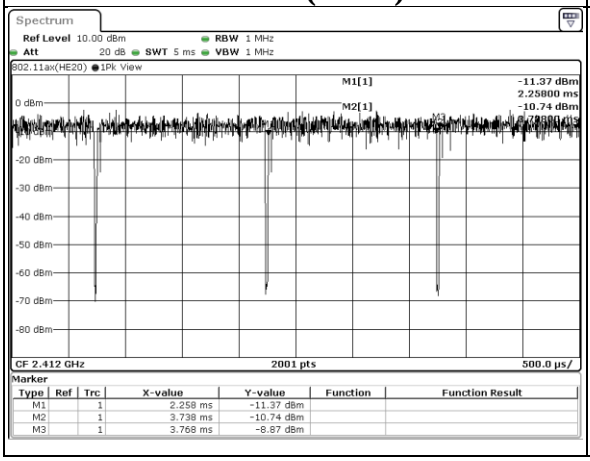
802.11b



802.11g



802.11ax(HE20)



7. Test Equipment

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2021/11/9	2022/11/8
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2021/12/10	2022/12/9
Loop Antenna	ETS lindgren	6502	00213440	2021/12/23	2022/12/22
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2022/2/8	2023/2/7
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2021/12/13	2022/12/12
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2021/12/17	2022/12/16
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2022/6/7	2023/6/6
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2022/2/16	2023/2/15
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2022/5/17	2023/5/16
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2021/12/3	2022/12/2
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2021/12/3	2022/12/2

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2021/10/29	2022/10/28
Pulse Power Sensor	Anritsu	MA2411B	1531202	2021/12/22	2022/12/21
Attenuator	EMCI	EMC-40ATK2W10	17002	2021/12/13	2022/12/12
Power Meter	Anritsu	ML2495A	1645002	2021/12/22	2022/12/21
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2021/11/15	2022/11/14
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2022/8/29	2023/8/28
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2022/8/30	2023/8/29
Cables	TITAN	CFD200	T0732ACFD20020A300-2	2022/4/9	2023/4/8

UL Software		
Description	**Name**	**Version**
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF-Conducted-FCC 15247	ver 1.0
AC power Line Conducted Emission	EZ_EMC	UL-3A1.2

8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Laptop	Lenovo	ThinkPad_T430	PB-8XTN7	Provide by lab

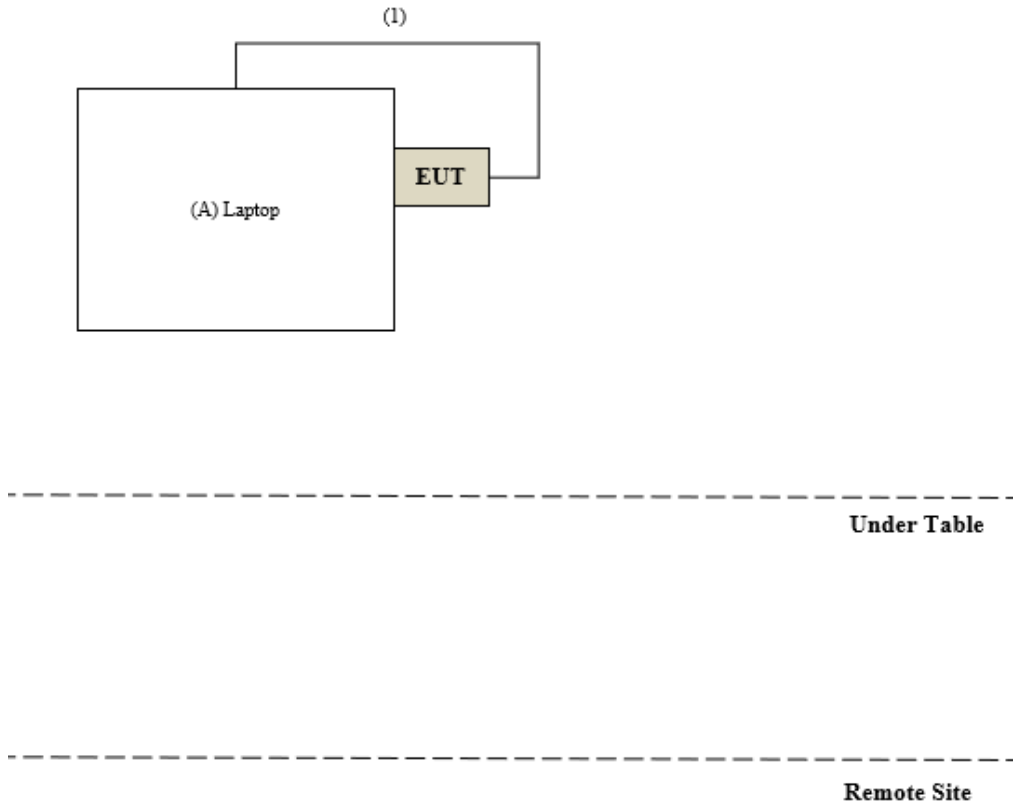
I/O Cables

ID	Equipment	Brand Name	Model Name	Length (m)	Remark
1	USB Type A to mini USB Type B Cable	N/A	N/A	0.9	Provide by Client

Test Setup

Controlled using a bespoke application (Typing RF command by terminal tool (ubuntu terminal)) 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



9. Test Results

9.1. 6dB Bandwidth

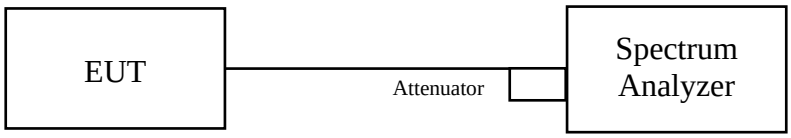
Requirements

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

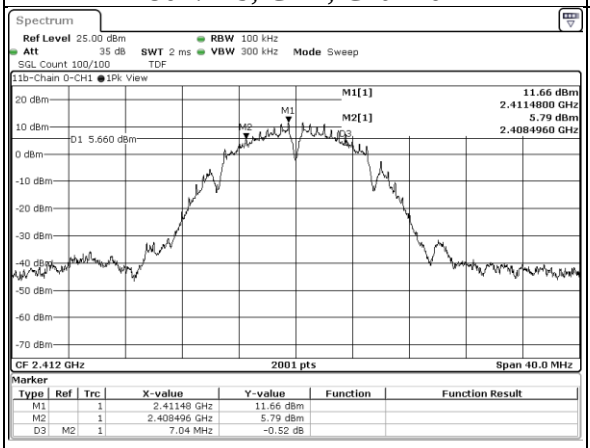


The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

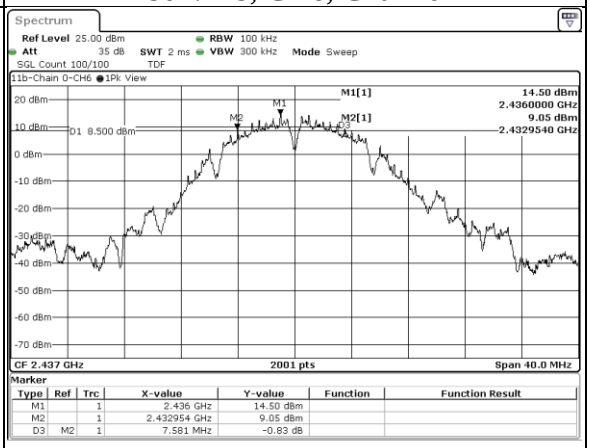
Test Data

Mode	CH	Freq (MHz)	6dB BW (MHz) Chain 0	Limit (MHz)	Result
802.11b	1	2412	7.040	0.5	PASS
	6	2437	7.581	0.5	PASS
	11	2462	7.588	0.5	PASS

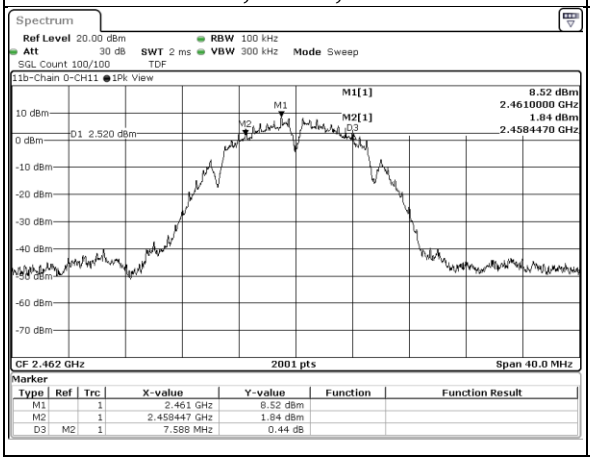
802.11b, CH1, Chain 0



802.11b, CH6, Chain 0

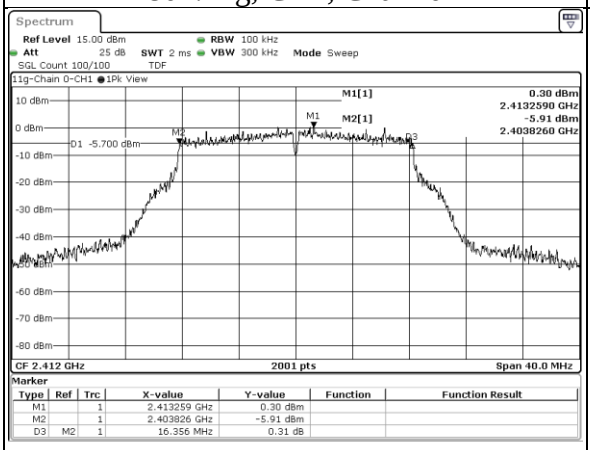


802.11b, CH11, Chain 0

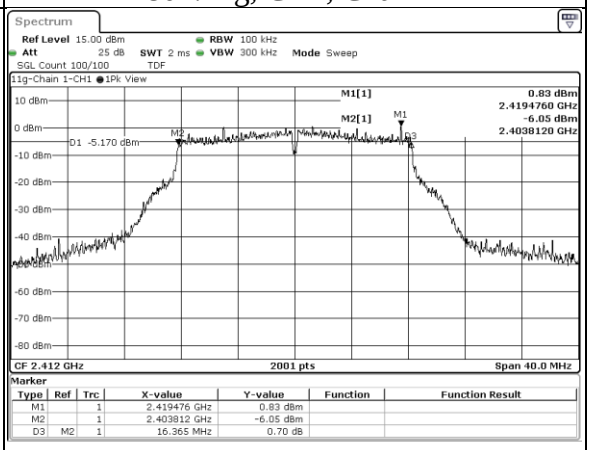


Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11g	1	2412	16.356	16.365	0.5	PASS
	6	2437	16.371	16.371	0.5	PASS
	11	2462	16.365	16.368	0.5	PASS

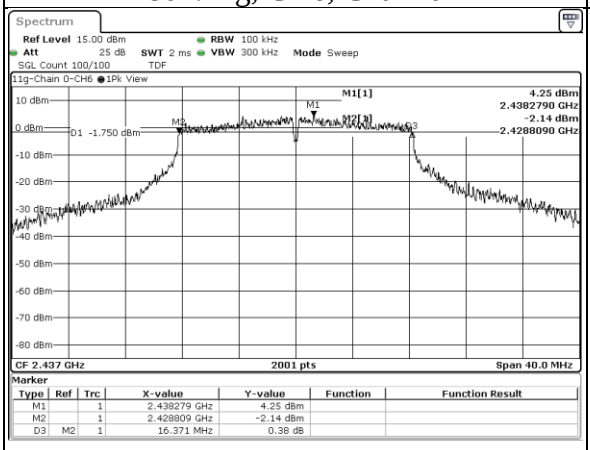
802.11g, CH1, Chain 0



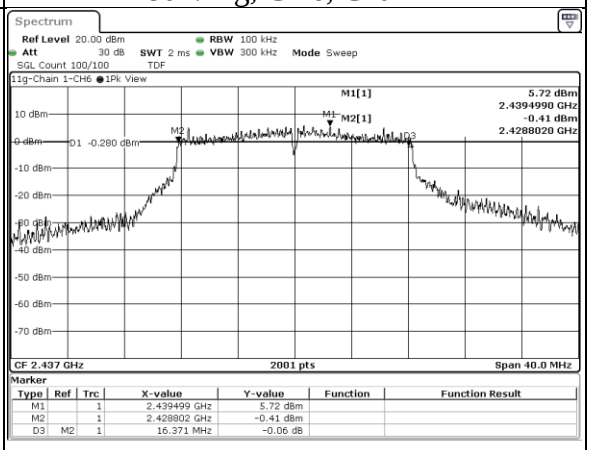
802.11g, CH1, Chain 1



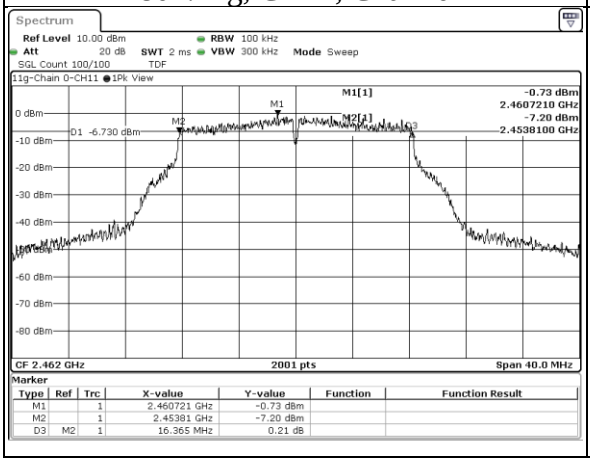
802.11g, CH6, Chain 0



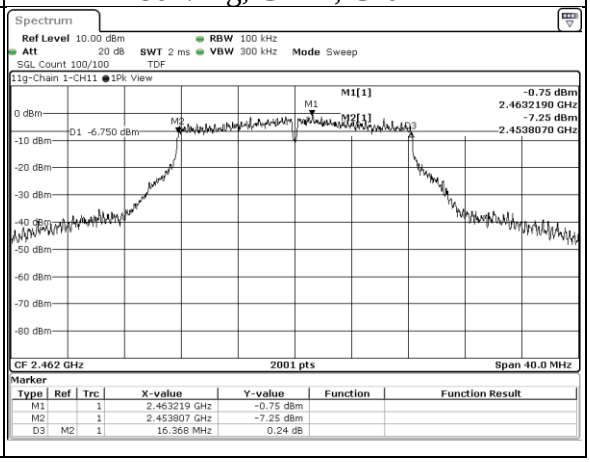
802.11g, CH6, Chain 1



802.11g, CH11, Chain 0

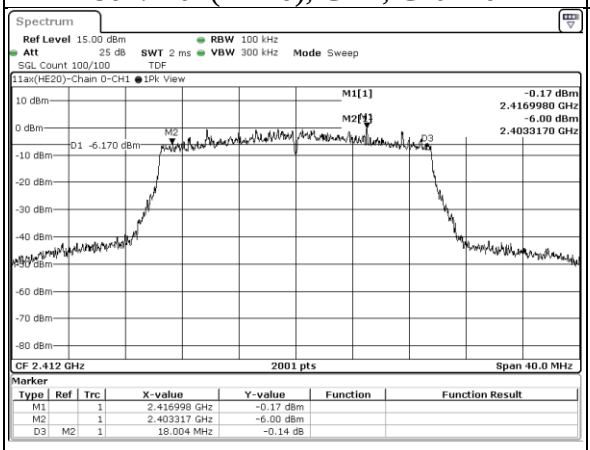


802.11g, CH11, Chain 1

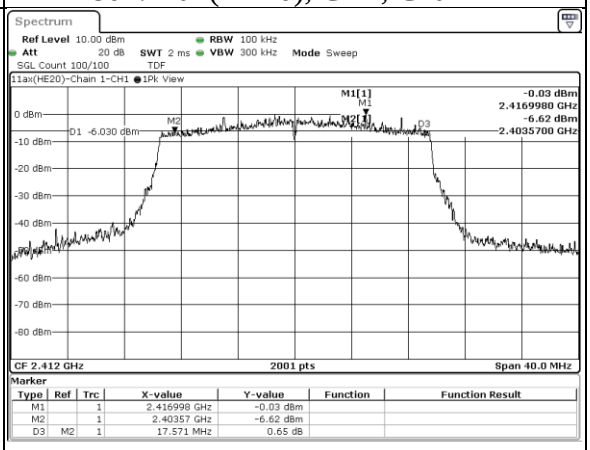


Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	1	2412	18.004	17.571	0.5	PASS
	6	2437	17.965	18.715	0.5	PASS
	11	2462	18.698	18.583	0.5	PASS

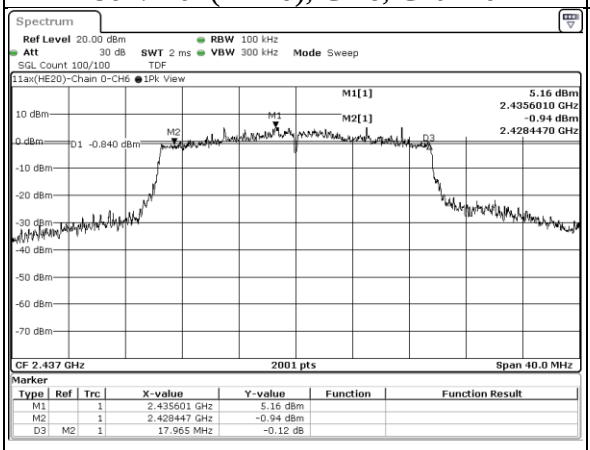
802.11ax(HE20), CH1, Chain 0



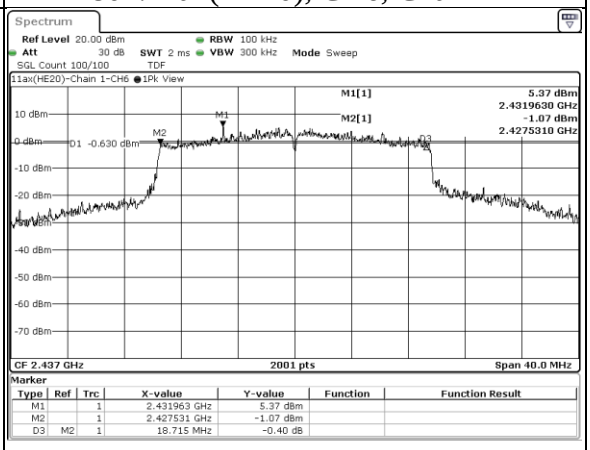
802.11ax(HE20), CH1, Chain 1



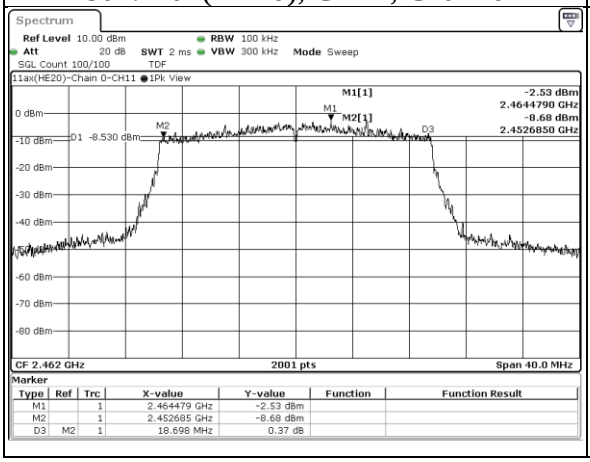
802.11ax(HE20), CH6, Chain 0



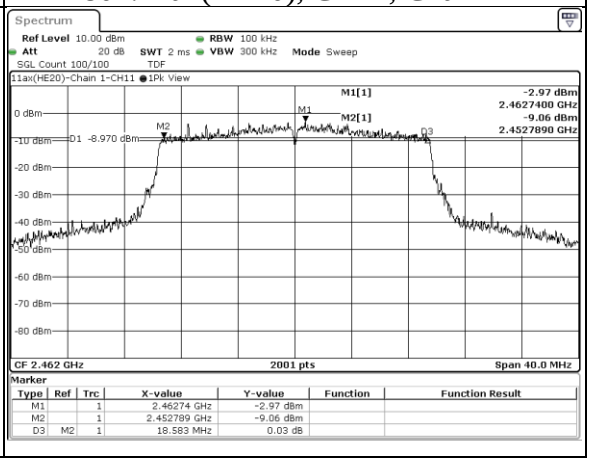
802.11ax(HE20), CH6, Chain 1



802.11ax(HE20), CH11, Chain 0



802.11ax(HE20), CH11, Chain 1



9.2. Conducted Output Power

Requirements

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

Note:

1. Directional Gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$ +...+$10^{Gn/20}$)^2 / Nant] dBi.

   N*a*nt: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas

2. Per KDB 662911 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 $\geq$ 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 $N_{ANT} \geq 5$.

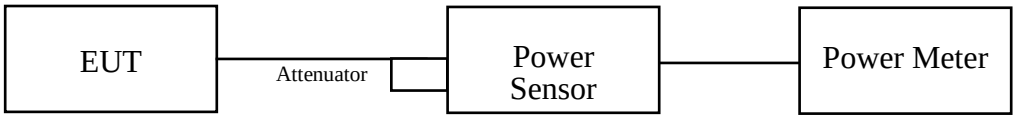
3. For example, AD-305N with the highest antenna gain (5 dBi), so it was used for transmit power measurement
   For Non-Beamforming Mode,
   Directional gain = 5 dBi + Array Gain = 5 dBi + 0 dB = 5 dBi

   For Beamforming Mode,
   Directional Gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$)^2 / Nant] dBi
   = 10 log[($10^{5/20}$ + $10^{5/20}$)^2 / 2] dBi
   = 10 log[($10^{5/20}$ + $10^{5/20}$)^2 / 2] dBi
   = 8.01 dBi

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

Non-Beamforming mode:

Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	146.893	21.67	30	PASS
2	2417	151.008	21.79	30	PASS
6	2437	258.821	24.13	30	PASS
10	2457	130.918	21.17	30	PASS
11	2462	90.157	19.55	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

802.11g

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.63	22.06	276.058	24.41	30	PASS
2	2417	24.00	23.05	452.898	26.56	30	PASS
6	2437	24.25	24.15	526.017	27.21	30	PASS
10	2457	23.85	24.01	494.311	26.94	30	PASS
11	2462	20.86	20.48	233.346	23.68	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

802.11ax (HE20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.42	20.63	225.944	23.54	30	PASS
2	2417	23.46	22.69	407.38	26.10	30	PASS
6	2437	24.30	24.13	528.445	27.23	30	PASS
10	2457	22.24	23.25	378.443	25.78	30	PASS
11	2462	18.97	17.96	141.254	21.50	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

Average Power (Reference Only)

802.11b

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2412	75.162	18.76
2	2417	87.902	19.44
6	2437	149.624	21.75
10	2457	69.343	18.41
11	2462	45.499	16.58

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	12.43	12.46	35.156	15.46
2	2417	14.81	14.55	58.749	17.69
6	2437	16.89	17.02	99.312	19.97
10	2457	15.31	16.18	75.509	18.78
11	2462	11.46	11.40	27.797	14.44

802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	11.66	11.36	28.314	14.52
2	2417	14.00	13.78	48.978	16.90
6	2437	17.13	17.16	103.753	20.16
10	2457	13.75	13.32	45.186	16.55
11	2462	9.41	9.34	17.338	12.39

Beamforming mode:

Peak Power

802.11ax (HE20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.07	20.36	210.378	23.23	27.99	PASS
2	2417	23.25	22.35	382.825	25.83	27.99	PASS
6	2437	23.94	23.89	493.174	26.93	27.99	PASS
10	2457	21.84	22.86	345.939	25.39	27.99	PASS
11	2462	18.67	17.79	133.66	21.26	27.99	PASS

Note: The directional gain = 8.01 dBi > 6 dBi, so the power limit shall be reduced.

Average Power (Reference Only)

802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	11.31	11.00	26.122	14.17
2	2417	13.61	13.45	45.082	16.54
6	2437	16.97	16.87	98.401	19.93
10	2457	13.58	13.08	43.152	16.35
11	2462	9.09	9.09	16.218	12.10

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 = 10 log[($10^{G1/20}$ + $10^{G2/20}$ +...+$10^{Gn/20}$)^2 / Nant] dBi.

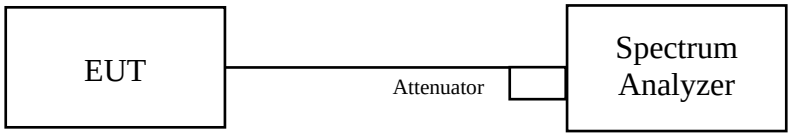
   N*a*nt: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas
   For example, AD-305N with the highest antenna gain (5 dBi), so it was used for power spectral measurement
   Directional Gain = $10\log[(10^{G1/20} + 10^{G2/20})^2 / \text{Nant}]$ dBi
   $= 10\log[(10^{5/20} + 10^{5/20})^2 / 2]$ dBi
   $= 10\log[(10^{5/20} + 10^{5/20})^2 / 2]$ dBi
   $= 8.01$ dBi

4. "PSD per chain" of the report shown is maximum value for each chain, at the "Total PSD" is summing entire spectra across corresponding frequency bins on the various outputs by computer, refer KDB 662911 Method a) for calculating total power density.

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



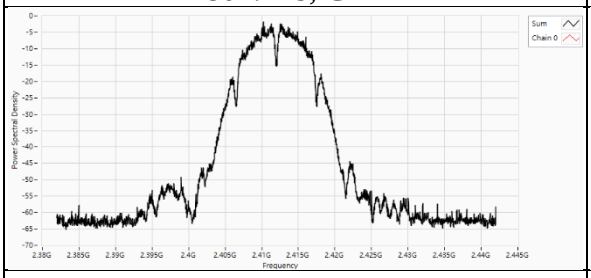
The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

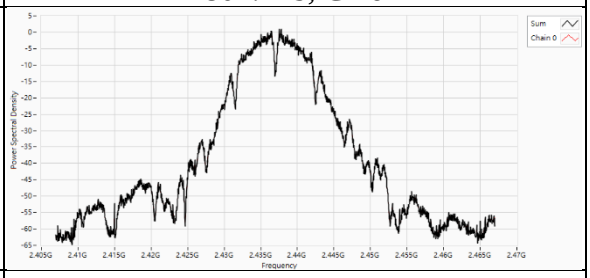
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11b	1	2412	-1.86	8	5	PASS
	6	2437	1.02	8	5	PASS
	11	2462	-4.93	8	5	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)
			Chain 0
802.11b	1	2412	-1.862
	6	2437	1.018
	11	2462	-4.925

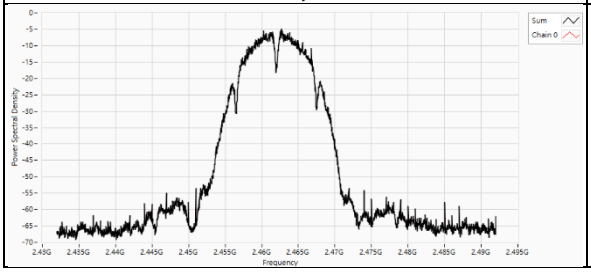
802.11b, CH1



802.11b, CH6



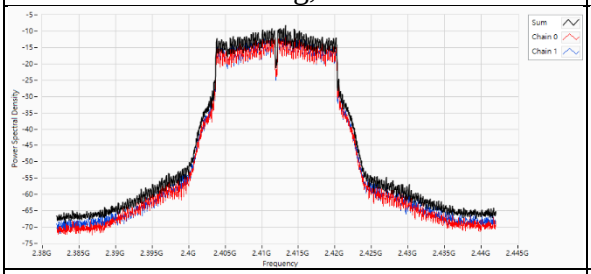
802.11b, CH11



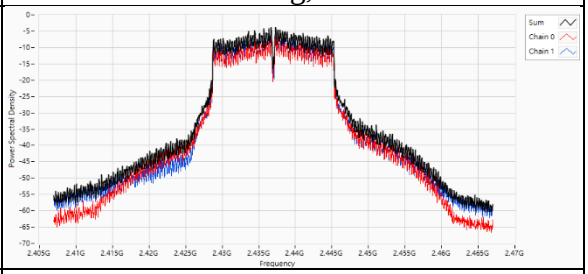
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11g	1	2412	-8.27	5.99	8.01	PASS
	6	2437	-3.74	5.99	8.01	PASS
	11	2462	-9.61	5.99	8.01	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11g	1	2412	-11.897	-10.746
	6	2437	-6.761	-6.36
	11	2462	-12.157	-12.778

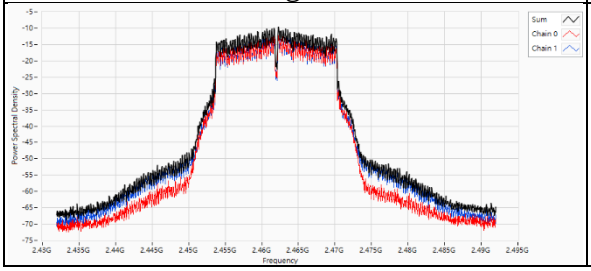
802.11g, CH1



802.11g, CH6



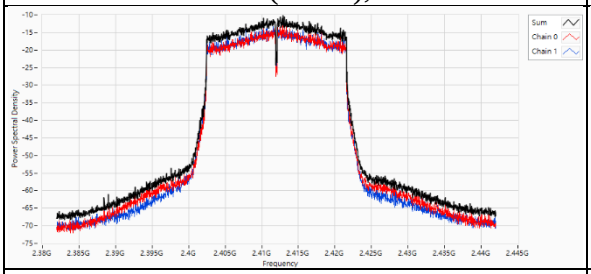
802.11g, CH11



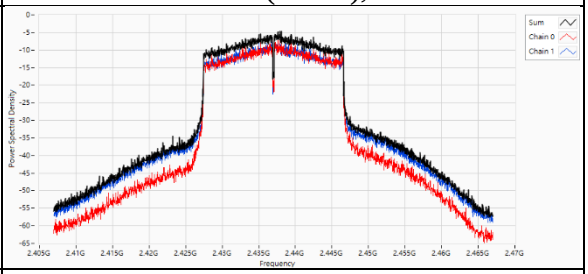
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11ax(HE20)	1	2412	-10.13	5.99	8.01	PASS
	6	2437	-4.59	5.99	8.01	PASS
	11	2462	-12.64	5.99	8.01	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11ax(HE20)	1	2412	-12.157	-13.363
	6	2437	-6.789	-7.765
	11	2462	-14.335	-13.955

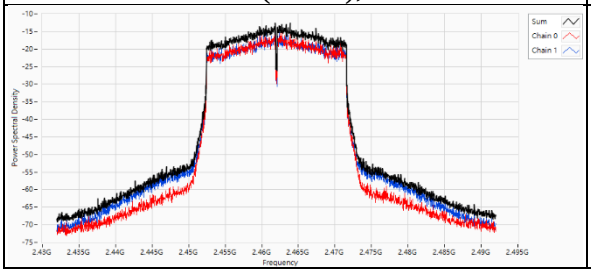
802.11ax(HE20), CH1



802.11ax(HE20), CH6



802.11ax(HE20), CH11



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

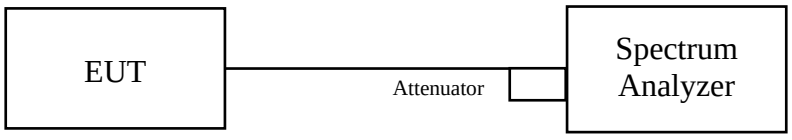
Measurement Procedure REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Set the span to 1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

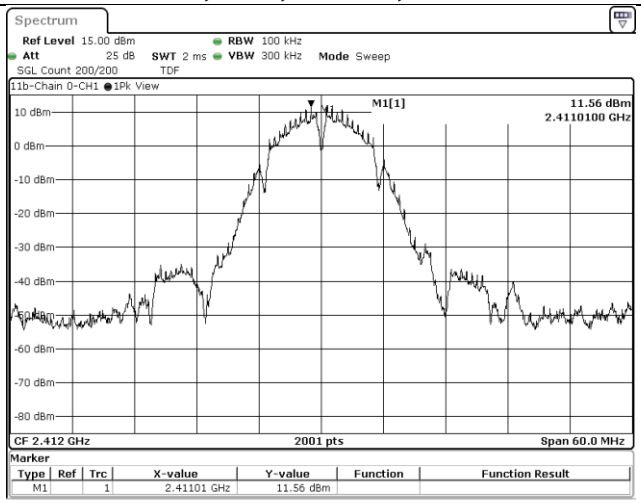
Test Setup



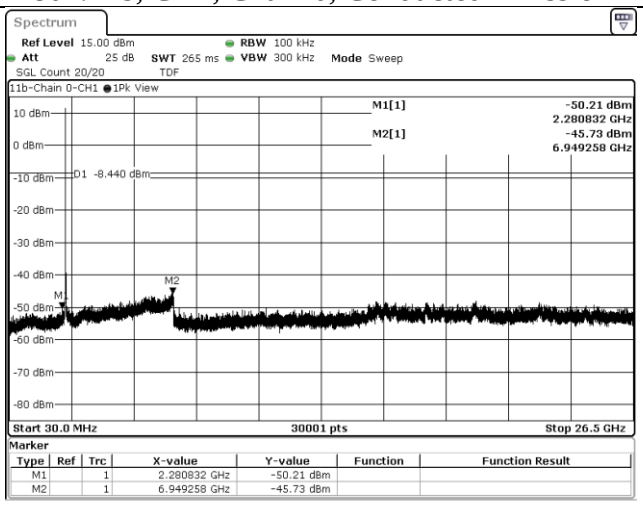
The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

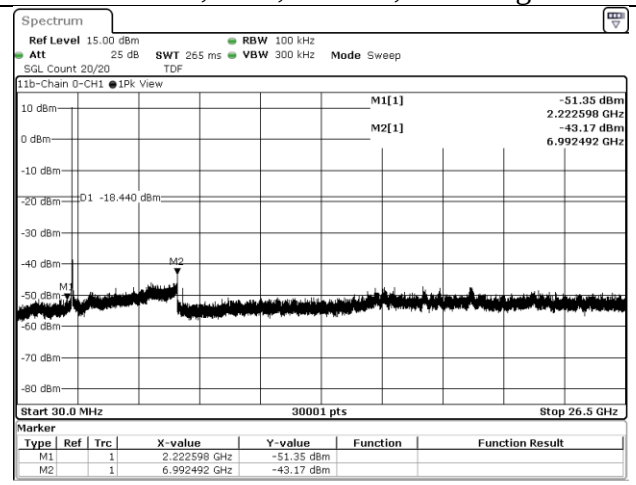
802.11b, CH1, Chain 0, Reference



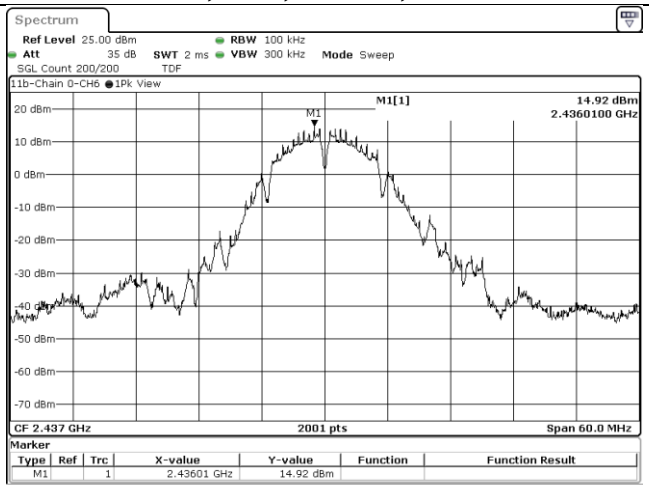
802.11b, CH1, Chain 0, Conducted Emission



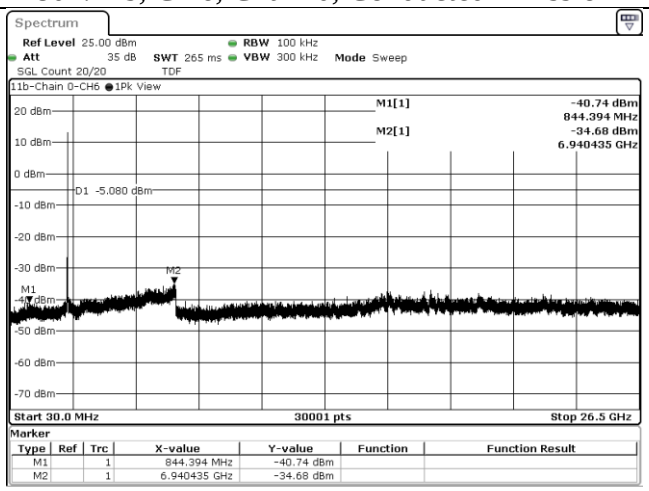
802.11b, CH1, Chain 0, Band edge



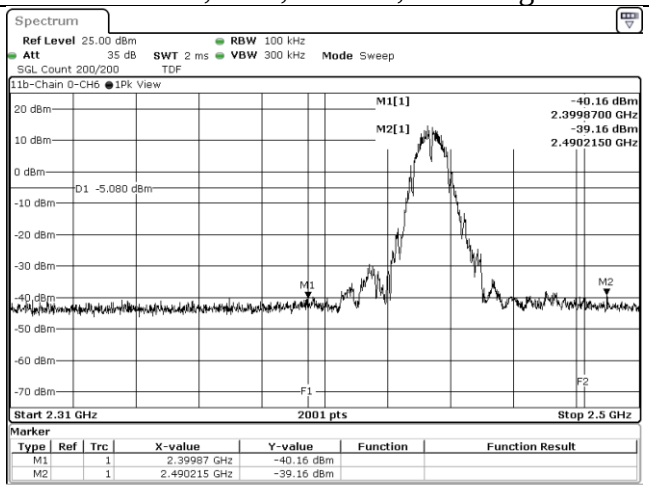
802.11b, CH6, Chain 0, Reference



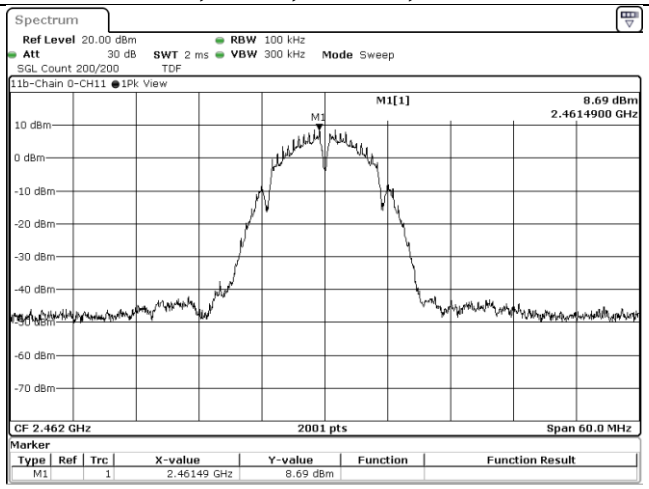
802.11b, CH6, Chain 0, Conducted Emission



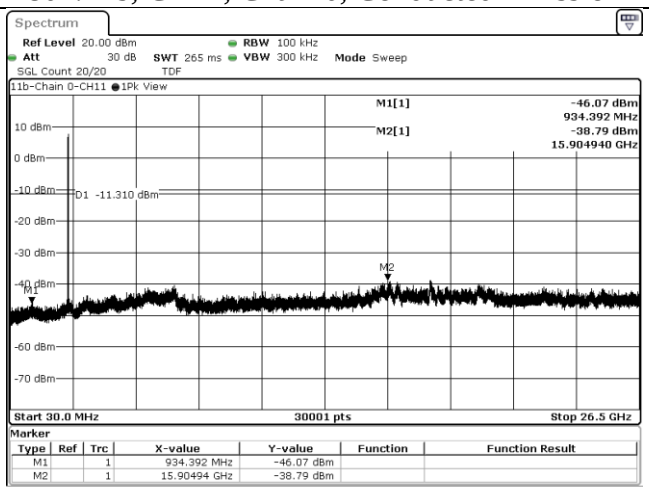
802.11b, CH6, Chain 0, Band edge



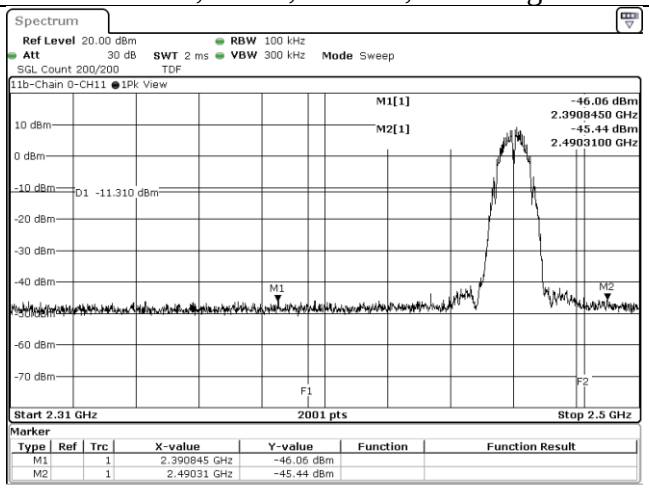
802.11b, CH11, Chain 0, Reference



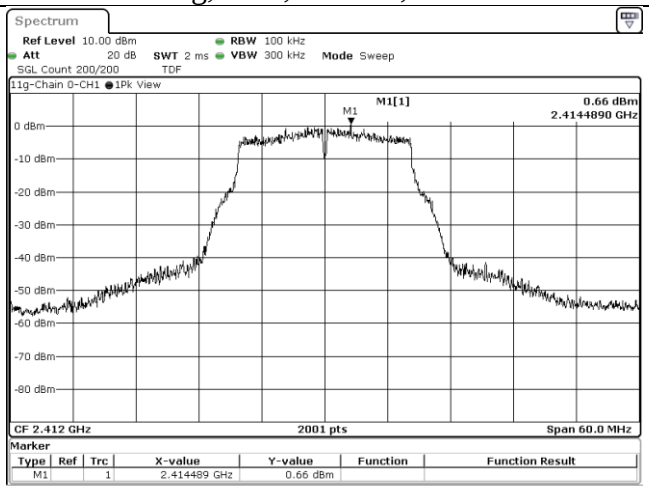
802.11b, CH11, Chain 0, Conducted Emission



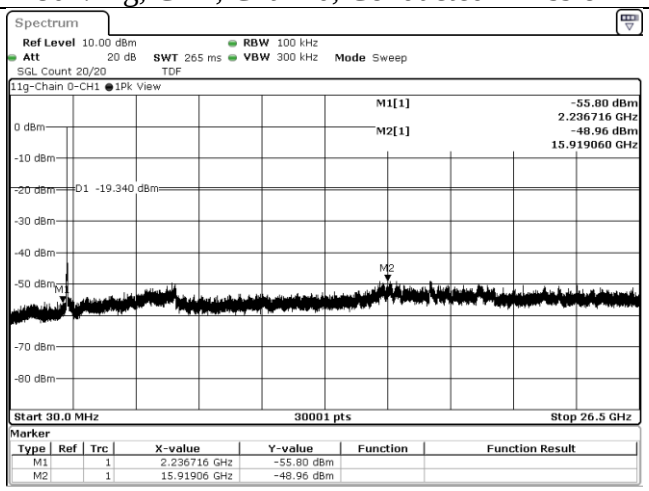
802.11b, CH11, Chain 0, Band edge



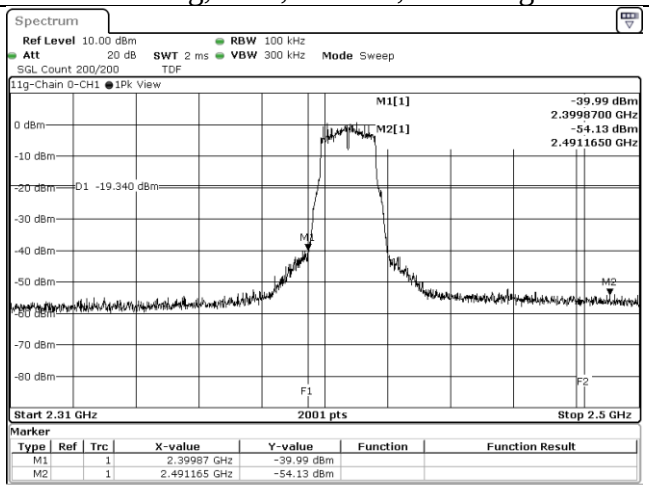
802.11g, CH1, Chain 0, Reference



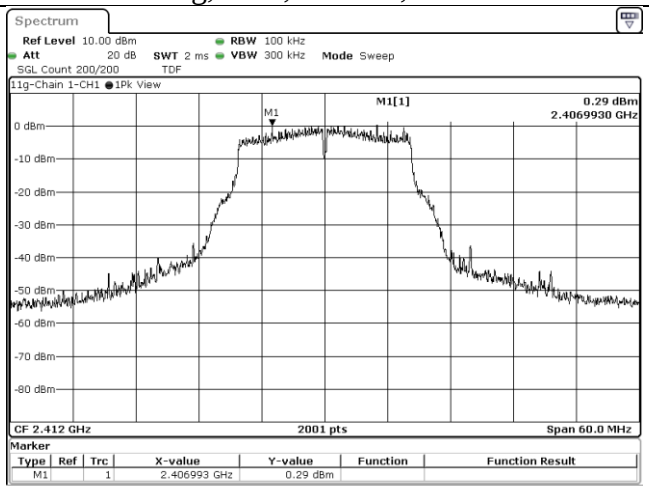
802.11g, CH1, Chain 0, Conducted Emission



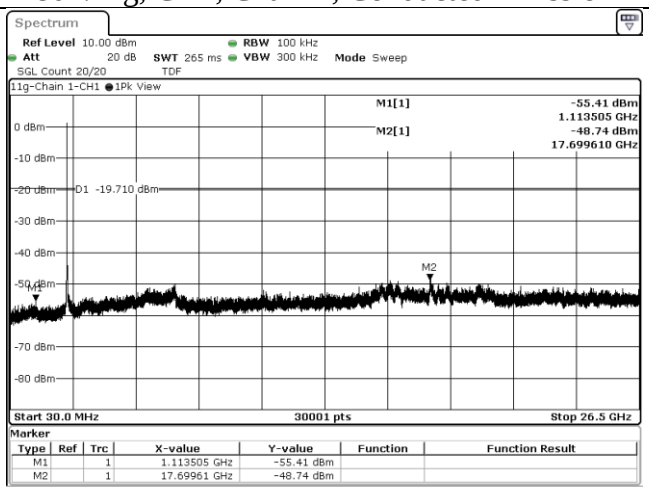
802.11g, CH1, Chain 0, Band edge



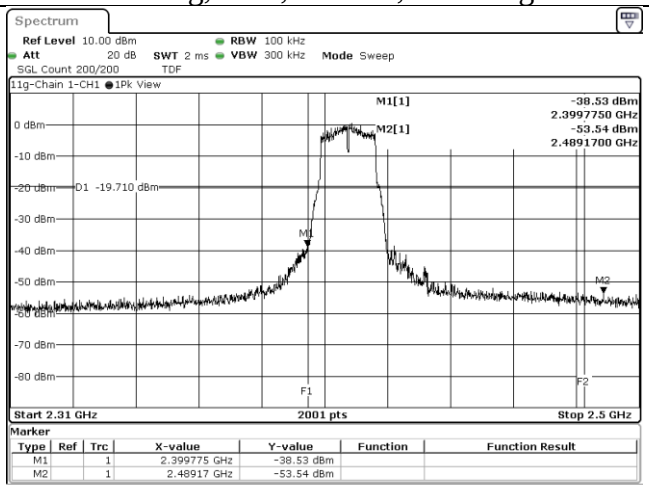
802.11g, CH1, Chain 1, Reference



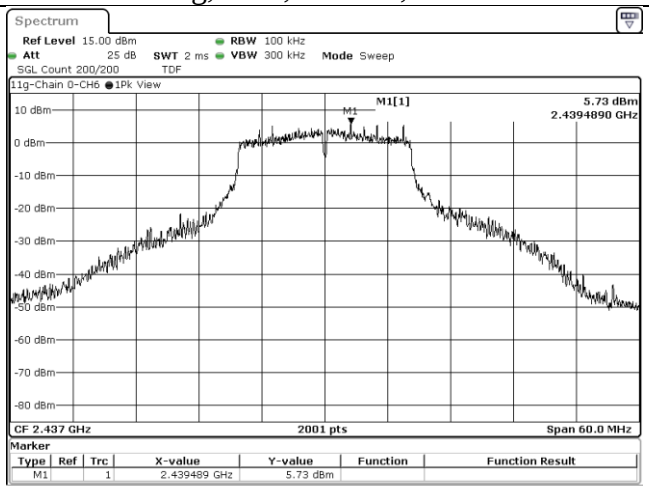
802.11g, CH1, Chain 1, Conducted Emission



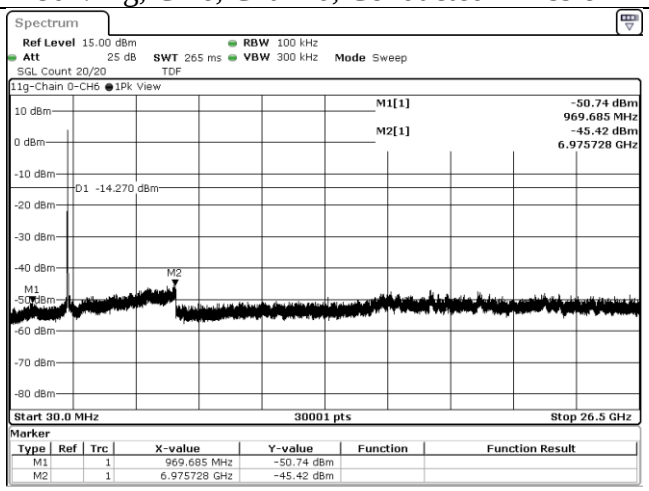
802.11g, CH1, Chain 1, Band edge



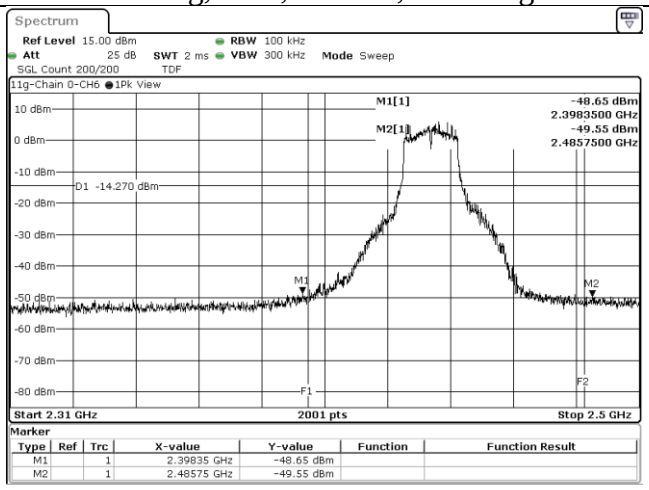
802.11g, CH6, Chain 0, Reference



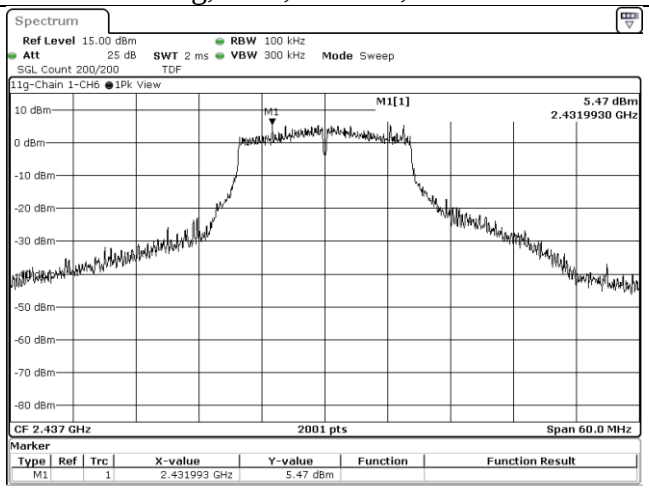
802.11g, CH6, Chain 0, Conducted Emission



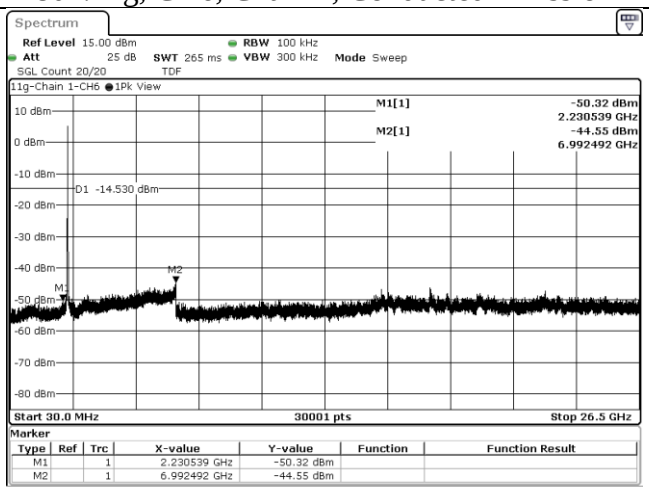
802.11g, CH6, Chain 0, Band edge



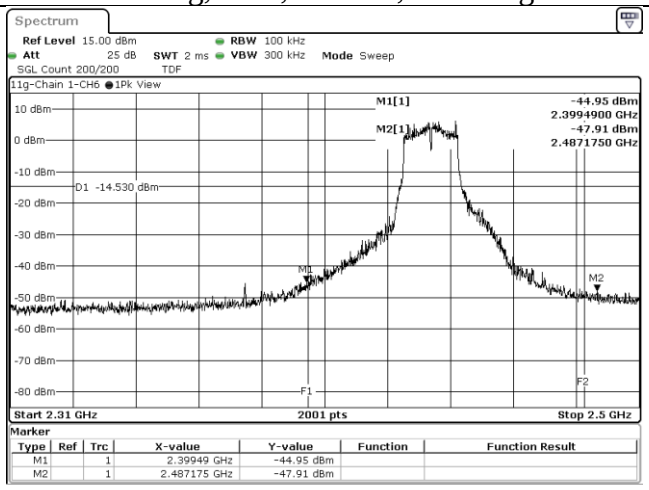
802.11g, CH6, Chain 1, Reference



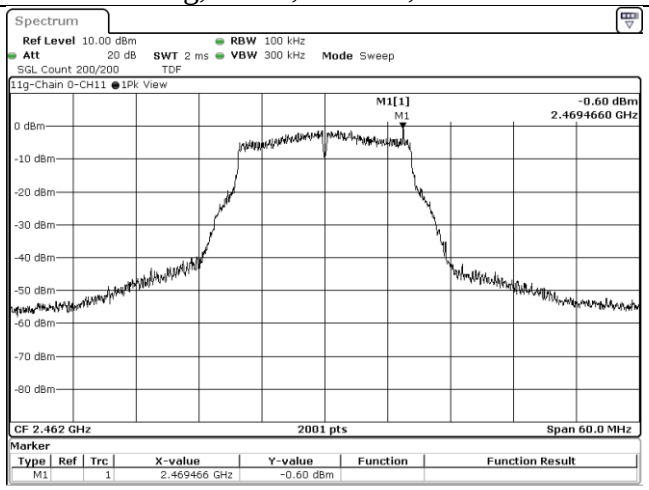
802.11g, CH6, Chain 1, Conducted Emission



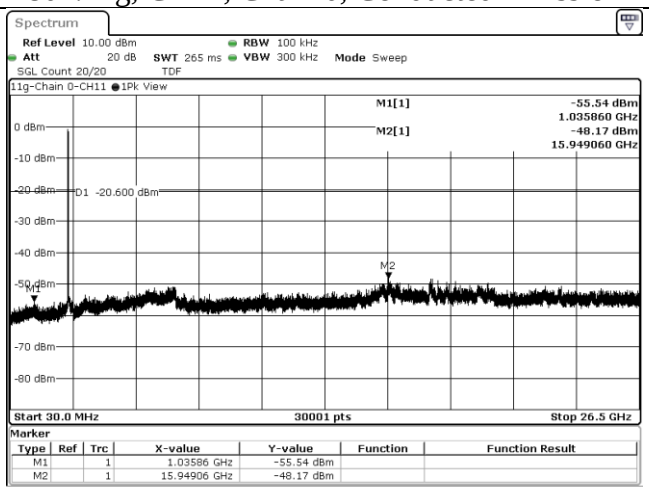
802.11g, CH6, Chain 1, Band edge



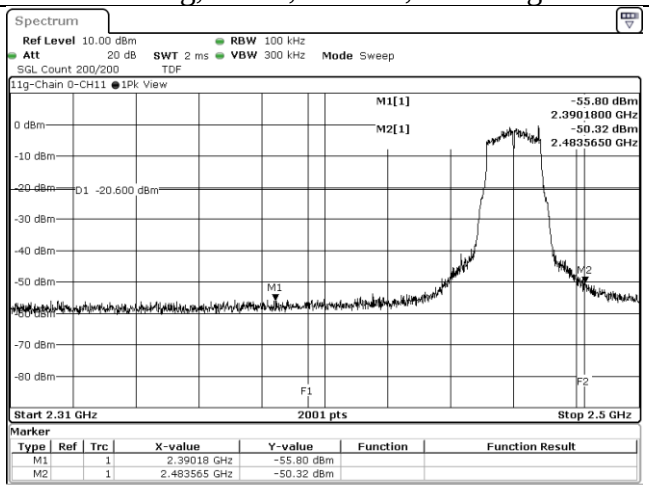
802.11g, CH11, Chain 0, Reference



802.11g, CH11, Chain 0, Conducted Emission



802.11g, CH11, Chain 0, Band edge



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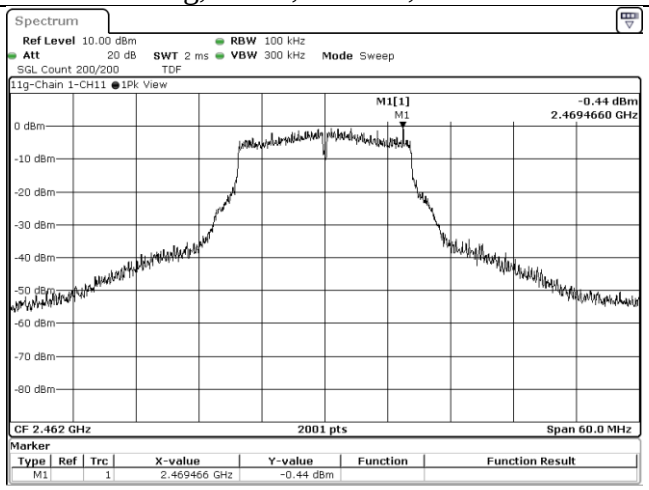
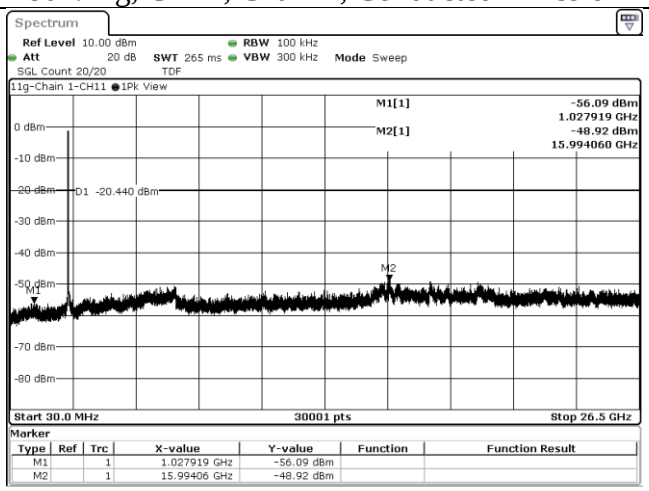
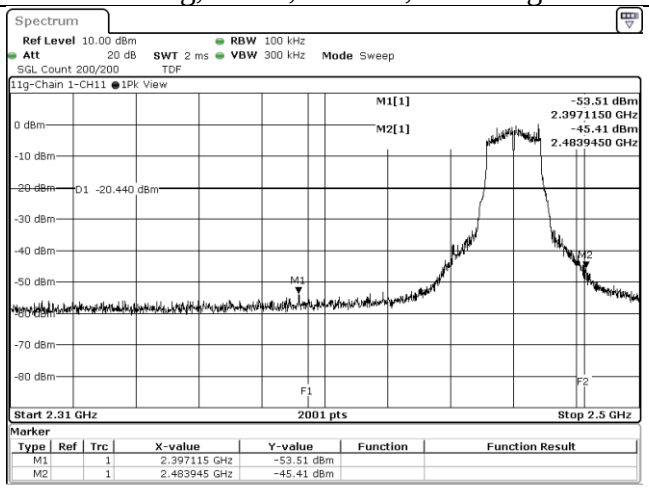


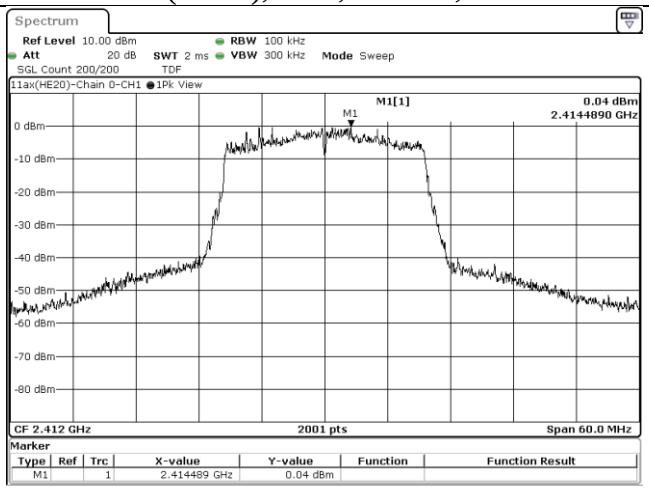
802.11g, CH11, Chain 1, Conducted Emission



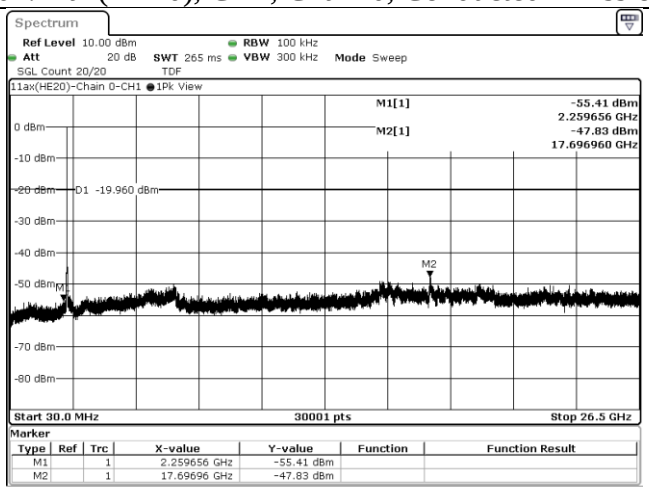
802.11g, CH11, Chain 1, Band edge



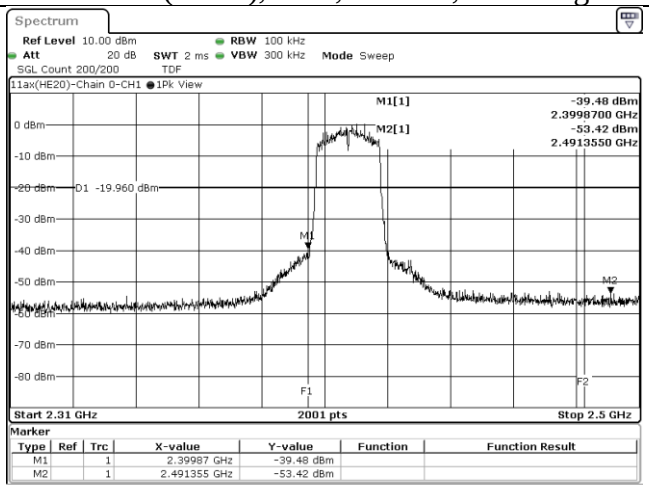
802.11ax(HE20), CH1, Chain 0, Reference



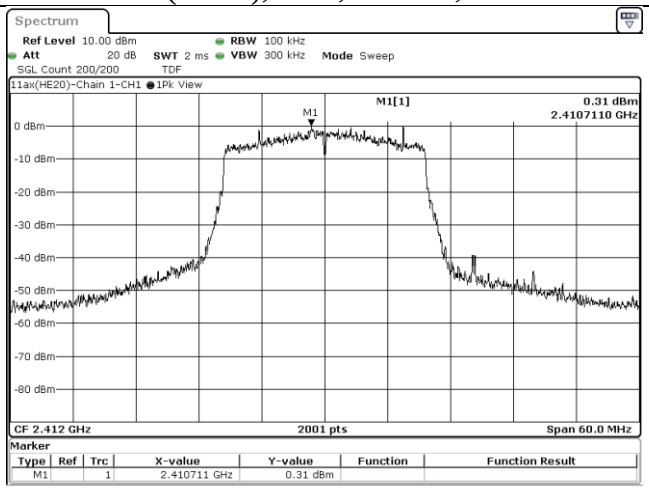
802.11ax(HE20), CH1, Chain 0, Conducted Emission



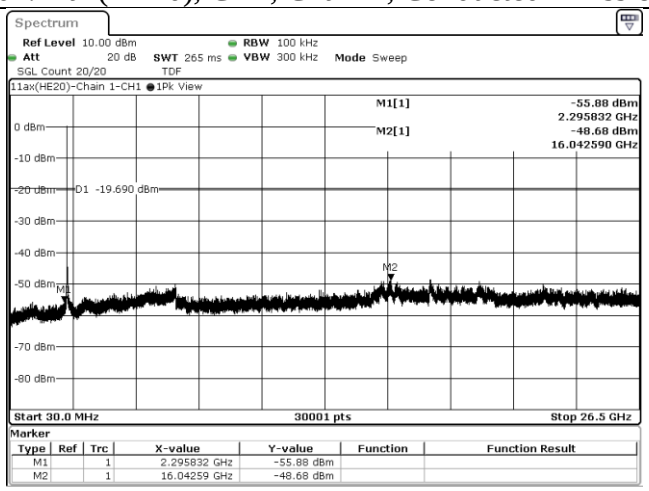
802.11ax(HE20), CH1, Chain 0, Band edge



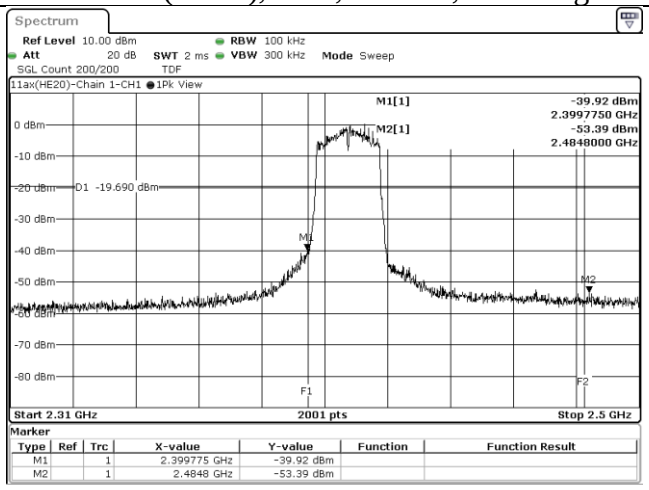
802.11ax(HE20), CH1, Chain 1, Reference



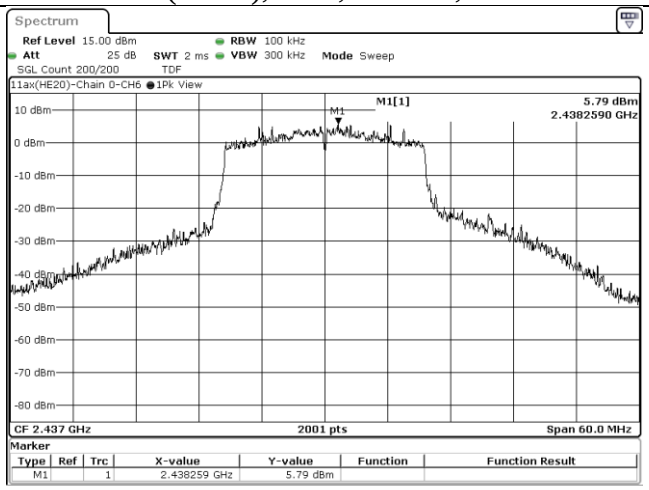
802.11ax(HE20), CH1, Chain 1, Conducted Emission



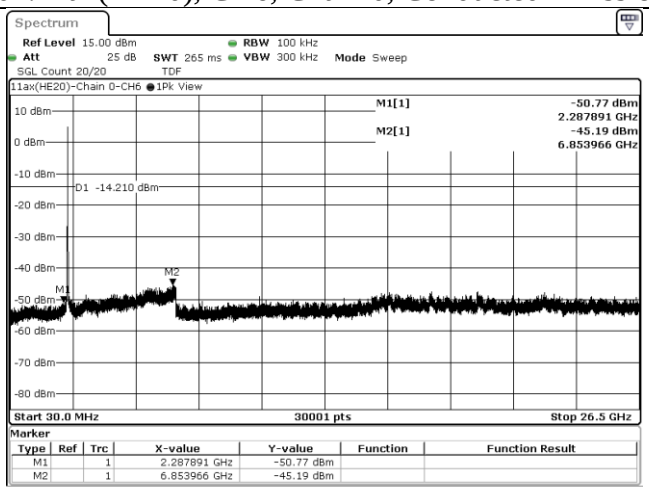
802.11ax(HE20), CH1, Chain 1, Band edge



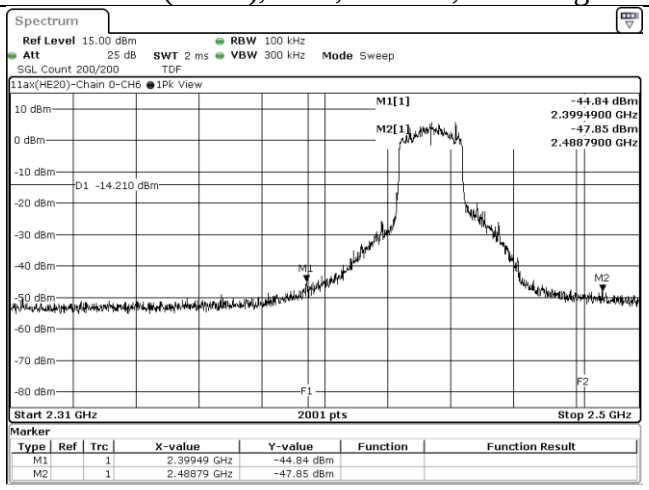
802.11ax(HE20), CH6, Chain 0, Reference



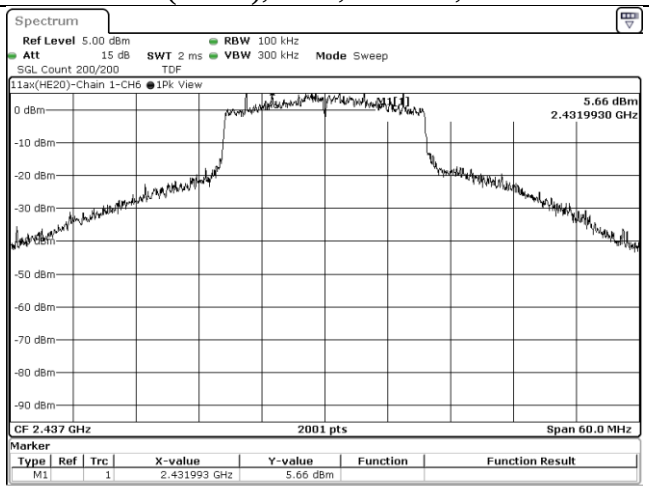
802.11ax(HE20), CH6, Chain 0, Conducted Emission



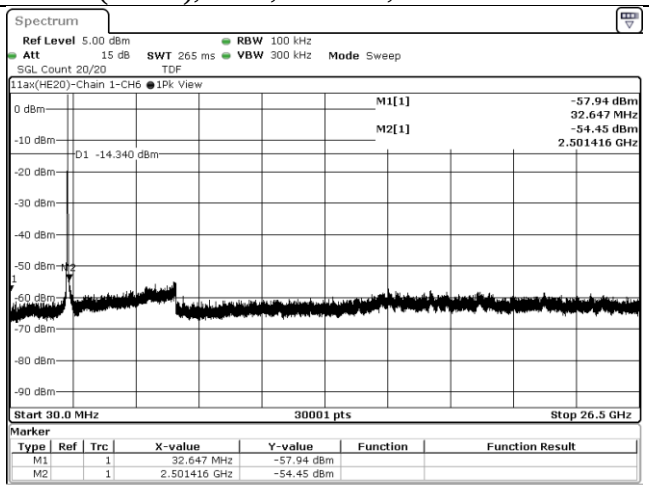
802.11ax(HE20), CH6, Chain 0, Band edge



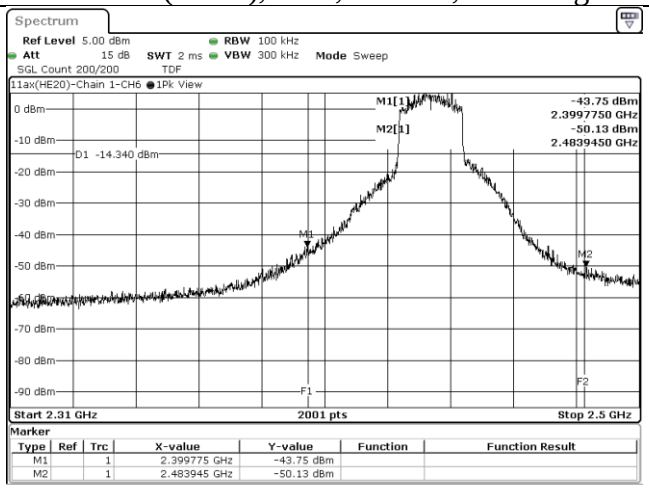
802.11ax(HE20), CH6, Chain 1, Reference



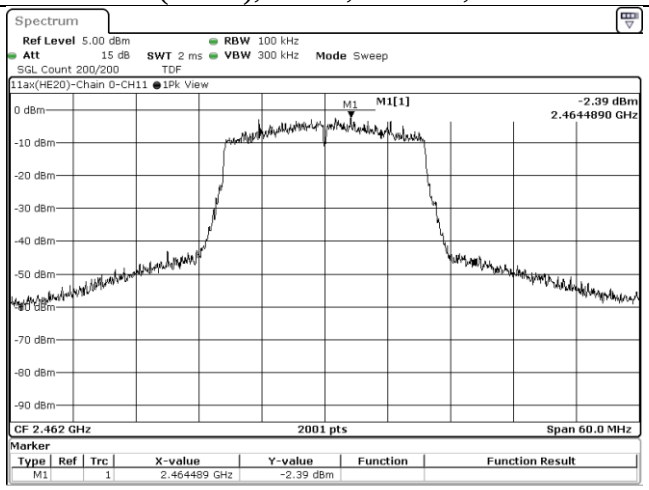
802.11ax(HE20), CH6, Chain 1, Conducted Emission



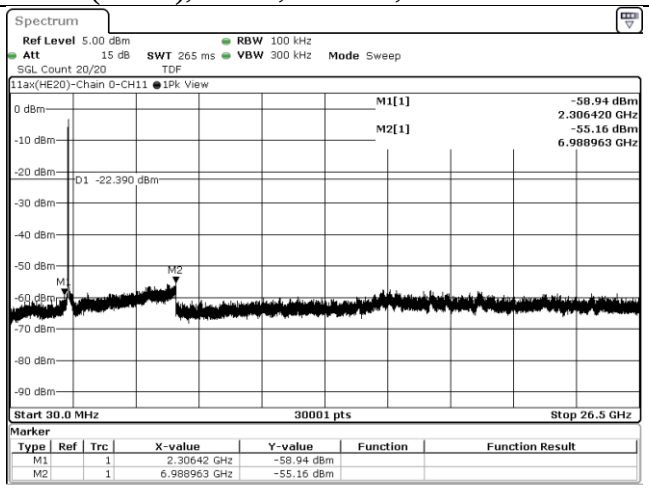
802.11ax(HE20), CH6, Chain 1, Band edge



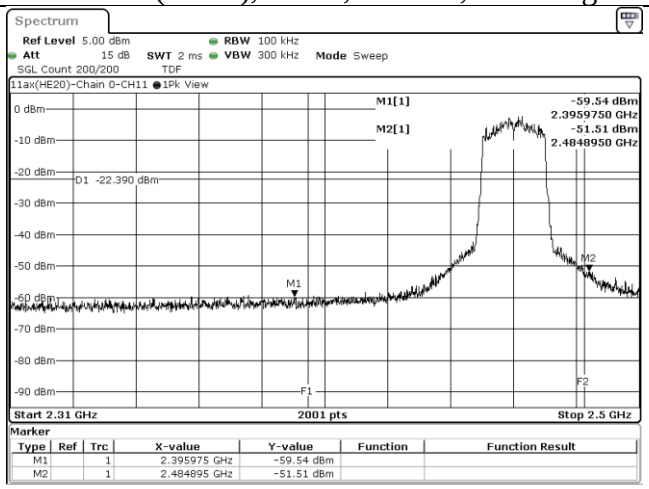
802.11ax(HE20), CH11, Chain 0, Reference



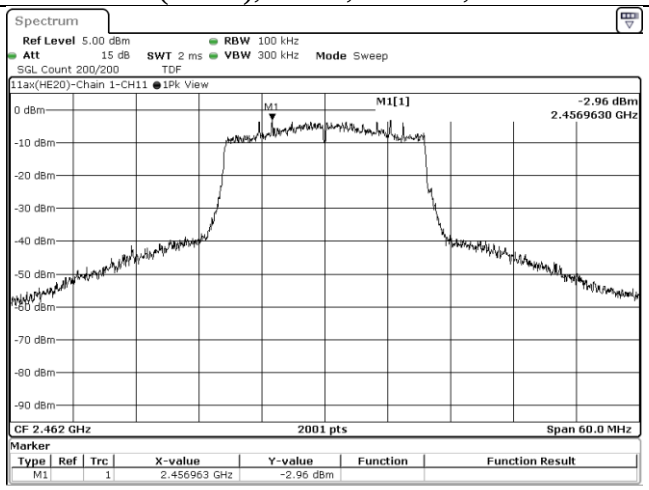
802.11ax(HE20), CH11, Chain 0, Conducted Emission



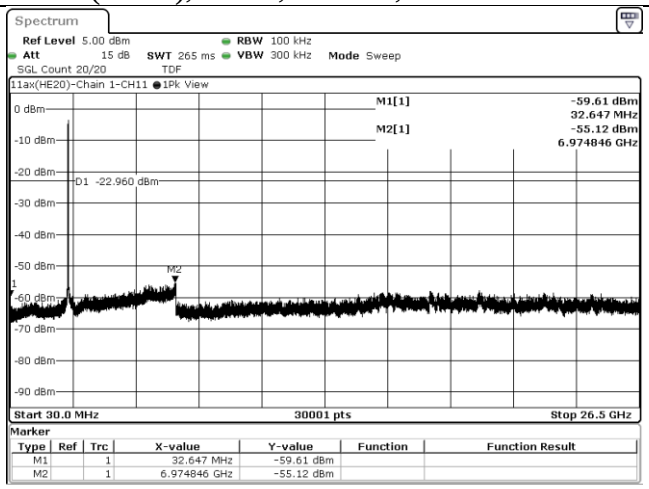
802.11ax(HE20), CH11, Chain 0, Band edge



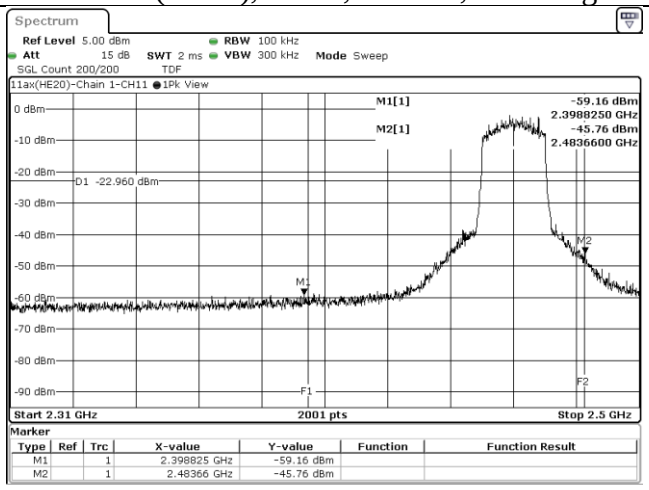
802.11ax(HE20), CH11, Chain 1, Reference



802.11ax(HE20), CH11, Chain 1, Conducted Emission



802.11ax(HE20), CH11, Chain 1, Band edge



9.5. Radiated Spurious Emission

Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Test Procedures

[For 9 kHz ~ 30 MHz]

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

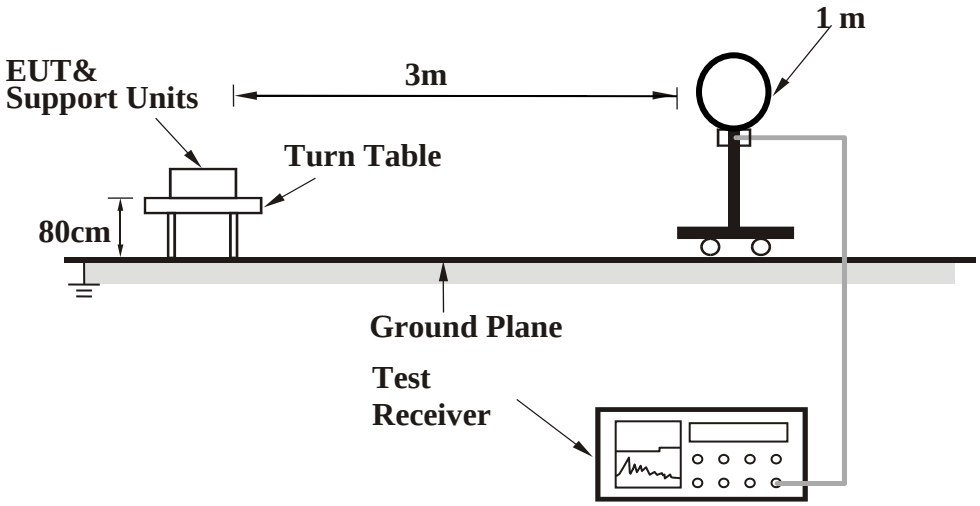
a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
802.11b	1MHz	Refer to section 6.6 for duty cycle.
802.11g		
802.11ax (HE20)		

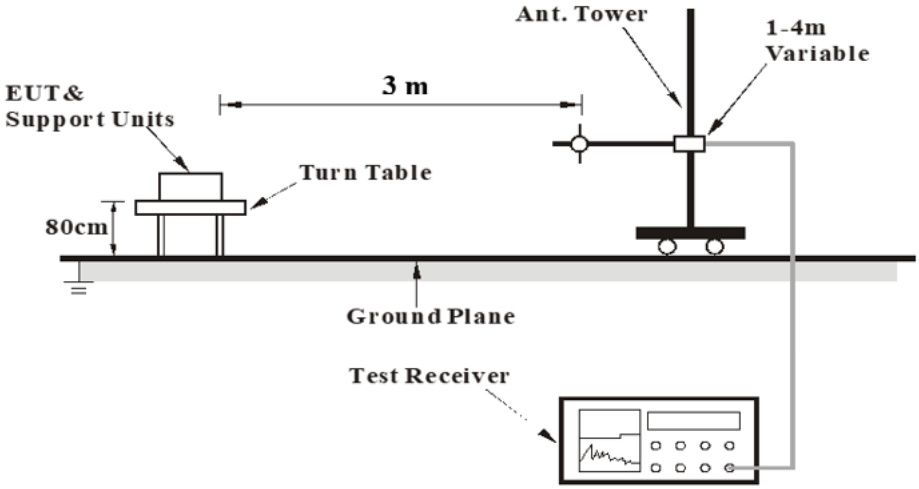
d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
e. Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
f. Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
g. Test data of Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
h. Test data of Notation "@" = Fundamental Frequency
i. Test data of Notation " * " = The peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

Test Setup

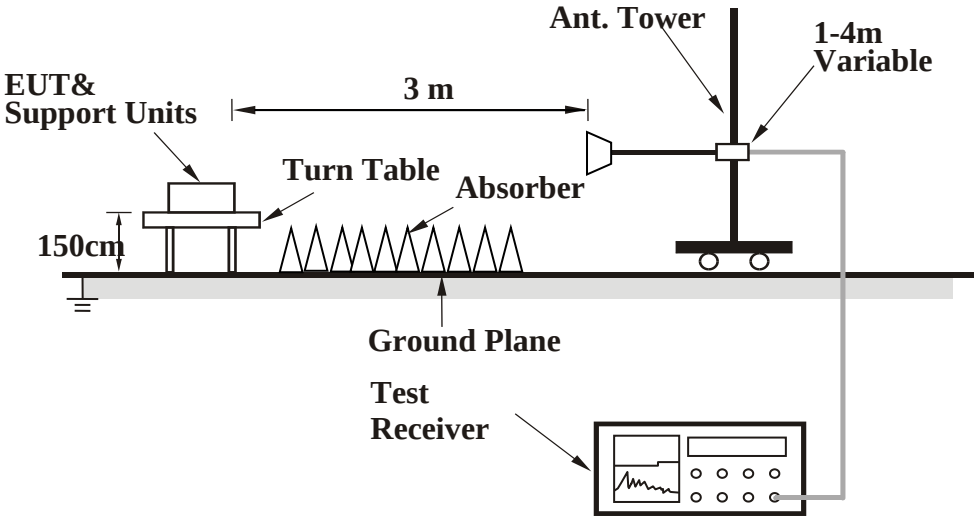
<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



<Frequency Range above 1 GHz>



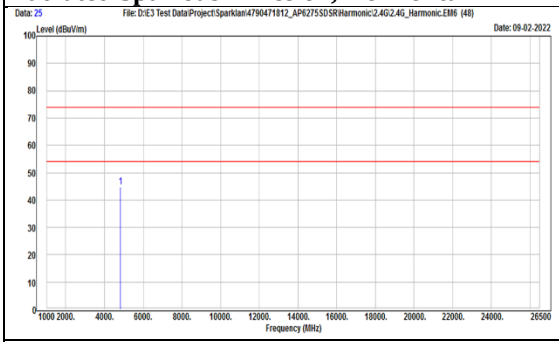
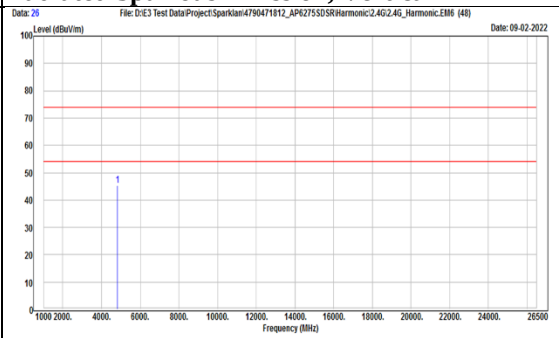
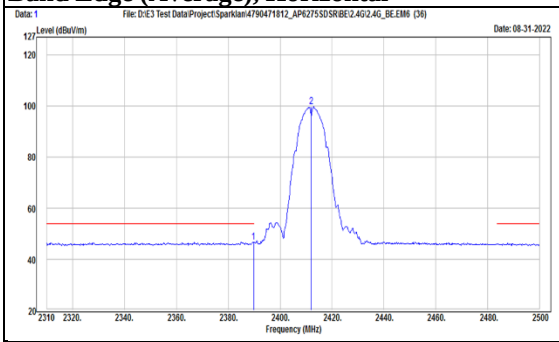
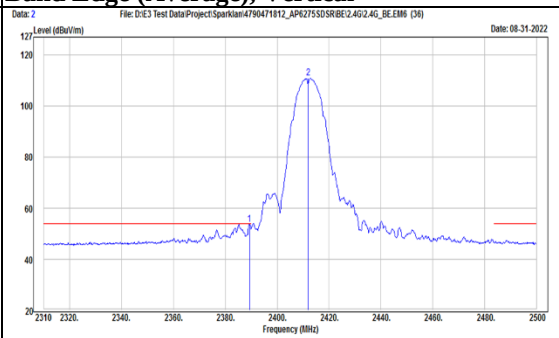
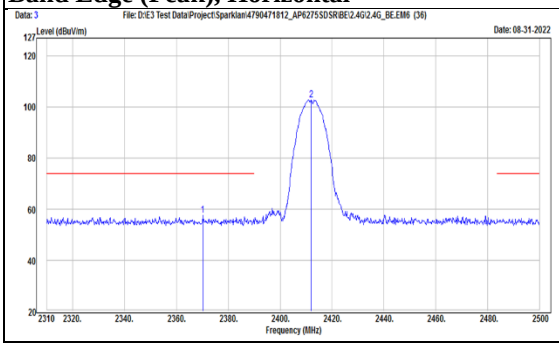
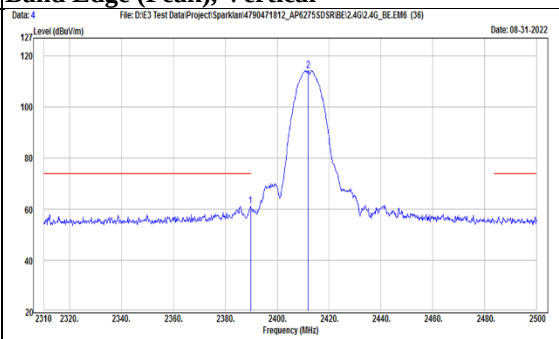
For the actual test configuration, please refer to the Setup Configurations.

Test Data

Above 1 GHz

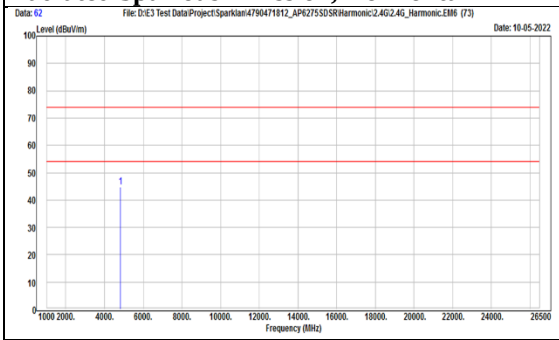
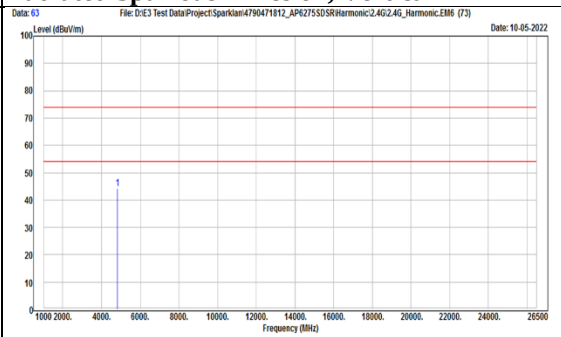
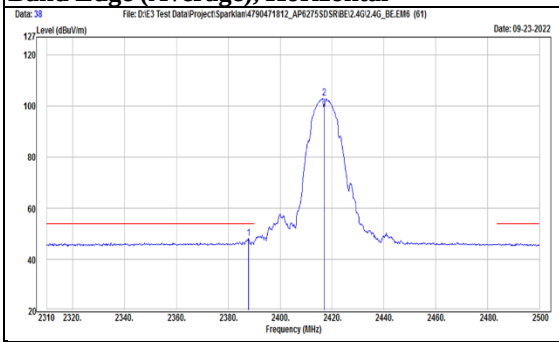
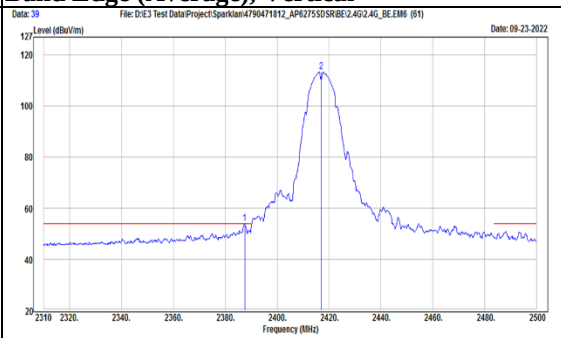
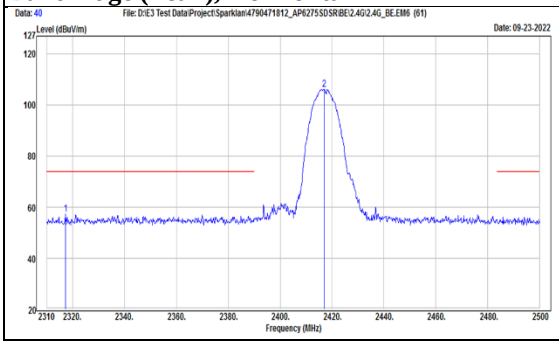
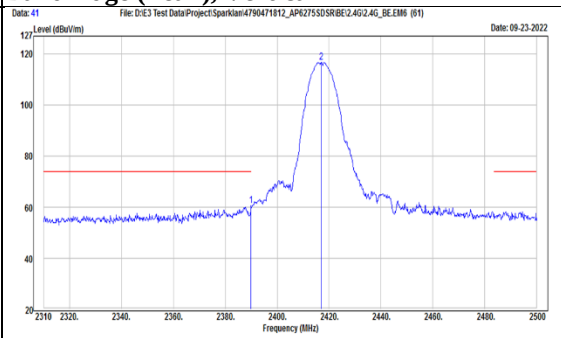
Mode	802.11b	Channel	1

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2370.23	41.85	15.86	57.71	74	-16.29	PK
		2389.8	30.89	15.82	46.71	54	-7.29	AVG
	@	2412	87	15.83	102.83	N/A	N/A	PK
	@	2412	83.83	15.83	99.66	N/A	N/A	AVG
	*	4824	42.4	2.35	44.75	74	-29.25	PK
Vertical		2389.42	37.89	15.82	53.71	54	-0.29	AVG
		2389.8	45.29	15.82	61.11	74	-12.89	PK
	@	2412	98.42	15.83	114.25	N/A	N/A	PK
	@	2412	95.1	15.83	110.93	N/A	N/A	AVG
	*	4824	42.94	2.35	45.29	74	-28.71	PK

TX, 802.11b (Ch 1) **Radiated Spurious Emission, Horizontal**	**TX, 802.11b (Ch 1)** **Radiated Spurious Emission, Vertical**
	
TX, 802.11b (Ch 1) **Band Edge (Average), Horizontal**	**TX, 802.11b (Ch 1)** **Band Edge (Average), Vertical**
	
TX, 802.11b (Ch 1) **Band Edge (Peak), Horizontal**	**TX, 802.11b (Ch 1)** **Band Edge (Peak), Vertical**
	

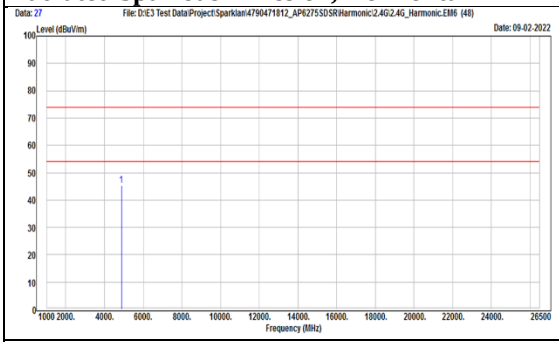
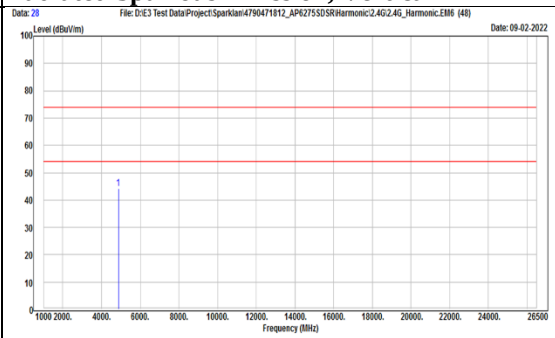
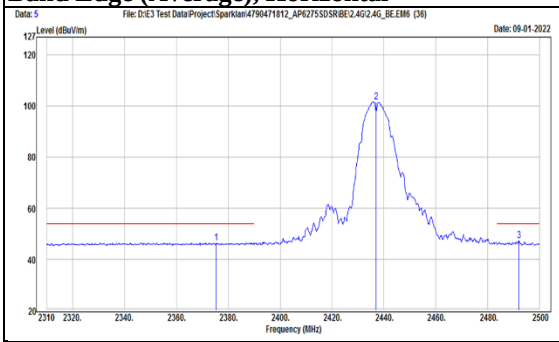
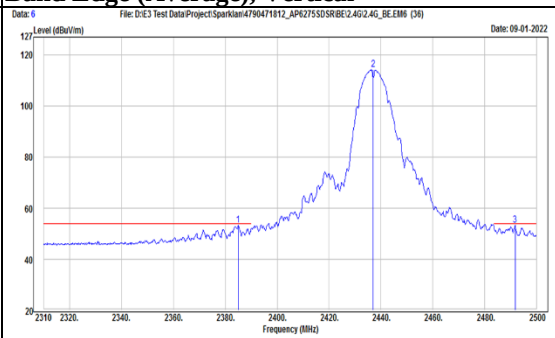
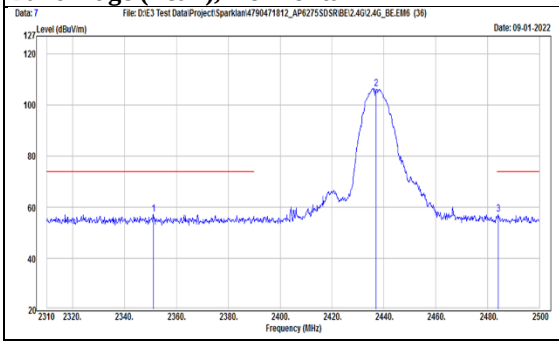
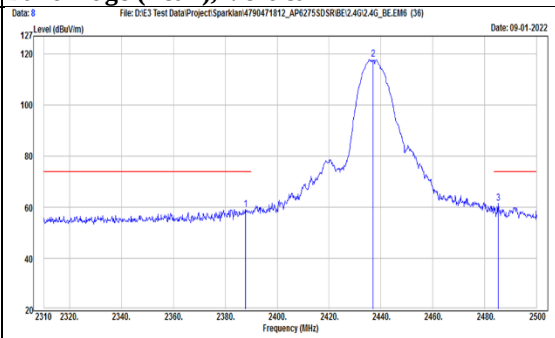
Mode	802.11b	Channel	2

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2317.41	41.36	15.85	57.21	74	-16.79	PK
		2387.9	32.31	15.82	48.13	54	-5.87	AVG
	@	2417	90.39	15.84	106.23	N/A	N/A	PK
	@	2417	87.13	15.84	102.97	N/A	N/A	AVG
	*	4834	42.35	2.36	44.71	74	-29.29	PK
Vertical		2387.52	38.06	15.82	53.88	54	-0.12	AVG
		2389.99	44.89	15.82	60.71	74	-13.29	PK
	@	2417	100.76	15.84	116.6	N/A	N/A	PK
	@	2417	97.41	15.84	113.25	N/A	N/A	AVG
	*	4834	41.84	2.36	44.2	74	-29.8	PK

TX, 802.11b (Ch 2) **Radiated Spurious Emission, Horizontal**	**TX, 802.11b (Ch 2)** **Radiated Spurious Emission, Vertical**
	
TX, 802.11b (Ch 2) **Band Edge (Average), Horizontal**	**TX, 802.11b (Ch 2)** **Band Edge (Average), Vertical**
	
TX, 802.11b (Ch 2) **Band Edge (Peak), Horizontal**	**TX, 802.11b (Ch 2)** **Band Edge (Peak), Vertical**
	

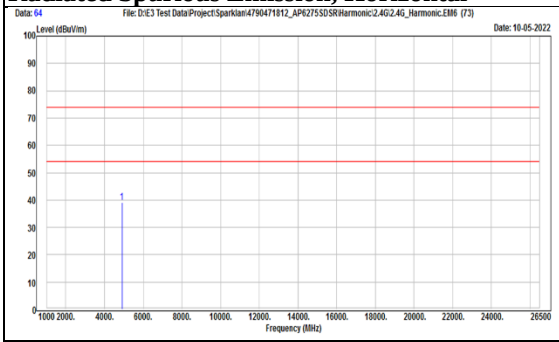
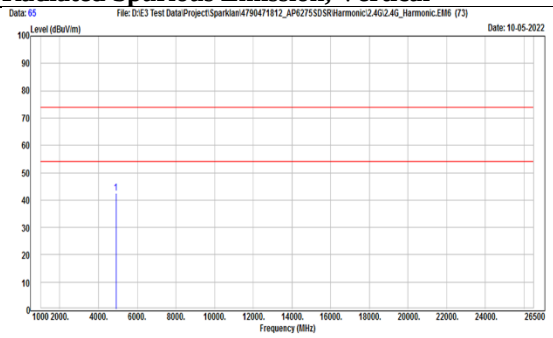
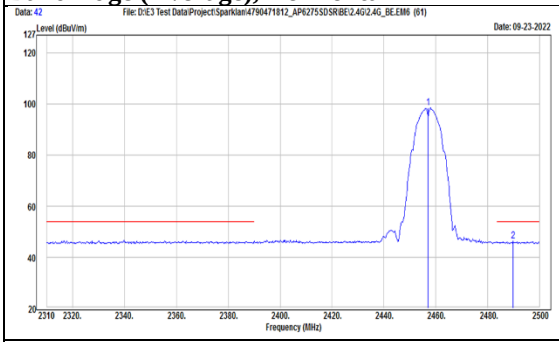
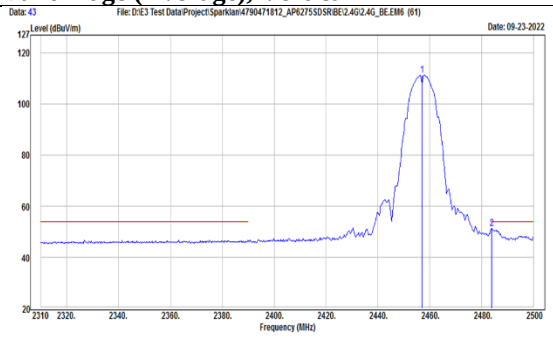
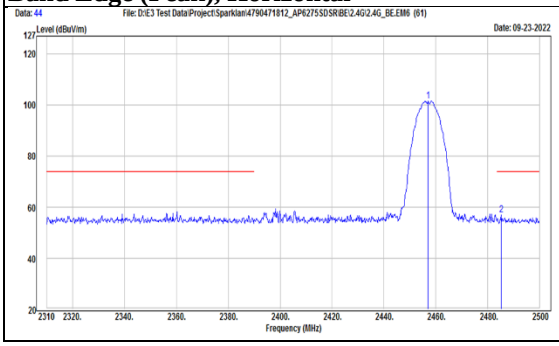
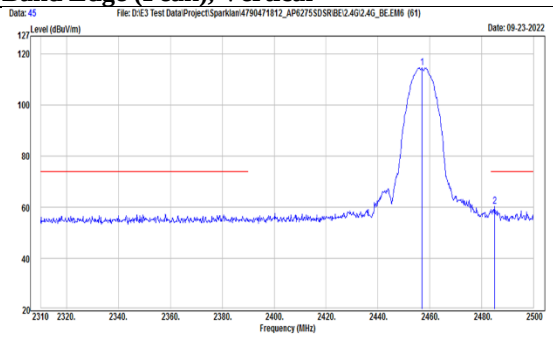
Mode	802.11b	Channel	6

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2351.23	41.33	15.91	57.24	74	-16.76	PK
		2375.36	30.63	15.85	46.48	54	-7.52	AVG
	@	2437	90.49	15.92	106.41	N/A	N/A	PK
	@	2437	85.67	15.92	101.59	N/A	N/A	AVG
		2484.04	41.64	15.68	57.32	74	-16.68	PK
		2492.02	31.55	15.62	47.17	54	-6.83	AVG
	*	4874	42.82	2.4	45.22	74	-28.78	PK
Vertical		2385.05	37.42	15.83	53.25	54	-0.75	AVG
		2387.9	43.2	15.82	59.02	74	-14.98	PK
	@	2437	101.86	15.92	117.78	N/A	N/A	PK
	@	2437	98.38	15.92	114.3	N/A	N/A	AVG
		2485.18	45.8	15.67	61.47	74	-12.53	PK
		2491.64	37.64	15.62	53.26	54	-0.74	AVG
	*	4874	41.78	2.4	44.18	74	-29.82	PK

TX, 802.11b (Ch 6) **Radiated Spurious Emission, Horizontal**	**TX, 802.11b (Ch 6)** **Radiated Spurious Emission, Vertical**
	
TX, 802.11b (Ch 6) **Band Edge (Average), Horizontal**	**TX, 802.11b (Ch 6)** **Band Edge (Average), Vertical**
	
TX, 802.11b (Ch 6) **Band Edge (Peak), Horizontal**	**TX, 802.11b (Ch 6)** **Band Edge (Peak), Vertical**
	

Mode	802.11b	Channel	10

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	@	2457	85.65	15.92	101.57	N/A	N/A	PK
	@	2457	82.51	15.92	98.43	N/A	N/A	AVG
		2485.18	41.4	15.67	57.07	74	-16.93	PK
		2489.74	30.66	15.63	46.29	54	-7.71	AVG
	*	4914	36.68	2.42	39.1	74	-34.9	PK
Vertical	@	2457	98.7	15.92	114.62	N/A	N/A	PK
	@	2457	95.35	15.92	111.27	N/A	N/A	AVG
		2483.85	35.64	15.68	51.32	54	-2.68	AVG
		2484.99	44.58	15.67	60.25	74	-13.75	PK
	*	4914	40.04	2.42	42.46	74	-31.54	PK

TX, 802.11b (Ch 10) **Radiated Spurious Emission, Horizontal**	**TX, 802.11b (Ch 10)** **Radiated Spurious Emission, Vertical**
	
TX, 802.11b (Ch 10) **Band Edge (Average), Horizontal**	**TX, 802.11b (Ch 10)** **Band Edge (Average), Vertical**
	
TX, 802.11b (Ch 10) **Band Edge (Peak), Horizontal**	**TX, 802.11b (Ch 10)** **Band Edge (Peak), Vertical**
	

Mode	802.11b	Channel	11

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	@	2462	86.01	15.87	101.88	N/A	N/A	PK
	@	2462	82.29	15.87	98.16	N/A	N/A	AVG
		2488.22	31.17	15.65	46.82	54	-7.18	AVG
		2489.36	40.95	15.64	56.59	74	-17.41	PK
	*	4924	36.89	2.4	39.29	74	-34.71	PK
Vertical	@	2462	97.9	15.87	113.77	N/A	N/A	PK
	@	2462	94.23	15.87	110.1	N/A	N/A	AVG
		2483.85	43.57	15.68	59.25	74	-14.75	PK
		2490.12	35.74	15.63	51.37	54	-2.63	AVG
	*	4924	39.75	2.4	42.15	74	-31.85	PK