

RADIO TEST REPORT

Product : IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module

Model Name : ACB-QCA206x

Series Model : ACB-QCA2066-0WI1, ACB-QCA2066-0WX1,
ACB-QCA2066-5WI1, ACB-QCA2066-5WX1,
ACB-QCA2066-0WI4, ACB-QCA2066-0WX4,
ACB-QCA2066-5WI4, ACB-QCA2066-5WX4

FCC ID : 2AE3B-ACB-QCA206X

Test Regulation : FCC 47 CFR Part 15 Subpart C (Section 15.247)

Received Date : 2023/6/26

Test Date : 2023/7/1 ~ 2023/8/11

Issued Date : 2023/9/6

Applicant : VOXMICRO LTD
20955 Pathfinder Rd., STE 100, Diamond Bar, California
91765, USA

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building A, B and E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



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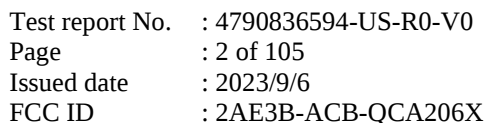
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Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1



Original Test Report No.: 4790836594-US-R0-V0

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1. Attestation of Test Results

APPLICANT: VOXMICRO LTD
20955 Pathfinder Rd., STE 100, Diamond Bar, California 91765,
USA

MANUFACTURER: VOXMICRO LTD
8F.-3, No.5, Aly. 22, Ln. 513, Rueiguang Rd., Neihs Dist., Taipei
City 114, Taiwan

EUT DESCRIPTION: IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module

BRAND: AIRETOS

MODEL: ACB-QCA206x

SERIES MODEL: ACB-QCA2066-0WI1, ACB-QCA2066-0WX1,
ACB-QCA2066-5WI1, ACB-QCA2066-5WX1,
ACB-QCA2066-0WI4, ACB-QCA2066-0WX4,
ACB-QCA2066-5WI4, ACB-QCA2066-5WX4

SAMPLE STAGE: Engineering Verification Test sample

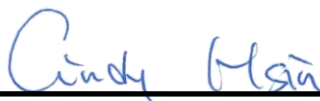
DATE of TESTED: 2023/7/1 ~ 2023/8/11

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.

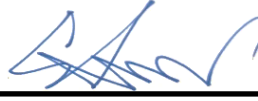
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions 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
Project Handler

Date : 2023/9/6

Approved and Authorized By:

Eric Lee
Senior Laboratory Engineer

Date : 2023/9/6

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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

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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.

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5. Measurement Uncertainty

For statement of conformity, Simple acceptance (Section 4.3.4 of ISO Guide 115) 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 $k=2$.

Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	± 3.1 dB
RF Conducted	9 kHz - 40GHz	± 2.3 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	± 3.2 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	± 6.1 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	± 5.1 dB

6. Equipment under Test

6.1. Description of EUT

Product	IEEE 802.11ax/ac/a/b/g/n WiFi6E with BT5.2 Module
Brand Name	AIRETOS
Model Name	ACB-QCA206x
Series Model	ACB-QCA2066-0WI1, ACB-QCA2066-0WX1, ACB-QCA2066-5WI1, ACB-QCA2066-5WX1, ACB-QCA2066-0WI4, ACB-QCA2066-0WX4, ACB-QCA2066-5WI4, ACB-QCA2066-5WX4
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 1024QAM, 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 802.11ac: up to MCS9 802.11ax: up to MCS11
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20) 7 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
Maximum Output Power	802.11b: 26.36 dBm 802.11g: 27.84 dBm 802.11ax (HE20): 27.86 dBm 802.11ax (HE40): 24.58 dBm
Normal Voltage	3.3 Vdc from host system
Sample ID	6199534

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Note:

1. The models difference table as below:

Model	Difference
ACB-QCA206x	Market assignment classification for application and grade finish
ACB-QCA2066-0WI1	
ACB-QCA2066-0WX1	
ACB-QCA2066-5WI1	
ACB-QCA2066-5WX1	
ACB-QCA2066-0WI4	
ACB-QCA2066-0WX4	
ACB-QCA2066-5WI4	
ACB-QCA2066-5WX4	

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
802.11ac (VHT20)	2TX,2RX
802.11ac (VHT40)	2TX,2RX
802.11ax (HE20)	2TX,2RX
802.11ax (HE40)	2TX,2RX

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40 and 802.11ax mode for HE20 / HE40, therefore investigated worst case to representative mode in test report.

3. The EUT contains following accessory devices:

Product	Brand	Model	Description
Antenna	OXFORDTEC	WANT-4DBI-SMA	-

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20), 802.11ac (VHT20), 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	-	-

7 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

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

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	21~28°C/ 51~69%RH	3.3 Vdc from host system	2023/07/18~ 2023/08/11	Rex Chen
Radiated Spurious Emission	966-2	21~28°C/ 51~69%RH	3.3 Vdc from host system	2023/07/01~ 2023/08/11	Rex Chen
AC power Line Conducted Emission	SR1	21~28°C/ 51~69%RH	3.3 Vdc from host system	2023/08/07~ 2023/08/11	Rex Chen

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 (40.1dBuV) + 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 (35.1dBuV) + Insertion loss(18.1dB) + Cable loss(0.5dB).

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6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)
1	Chain (0+1)	OXFORDTEC	WANT-4DBI-SMA	Omni	3.5

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, the laboratory shall not be held responsible.

6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the omni 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 EUT has nine types for model: ACB-QCA206x, ACB-QCA2066-0WI1, ACB-QCA2066-0WX1, ACB-QCA2066-5WI1, ACB-QCA2066-5WX1, ACB-QCA2066-0WI4, ACB-QCA2066-0WX4, ACB-QCA2066-5WI4 and ACB-QCA2066-5WX4. The worst case was ACB-QCA206x by pretest. Therefore the test data of the ACB-QCA206x was recorded in this report only.
- 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).

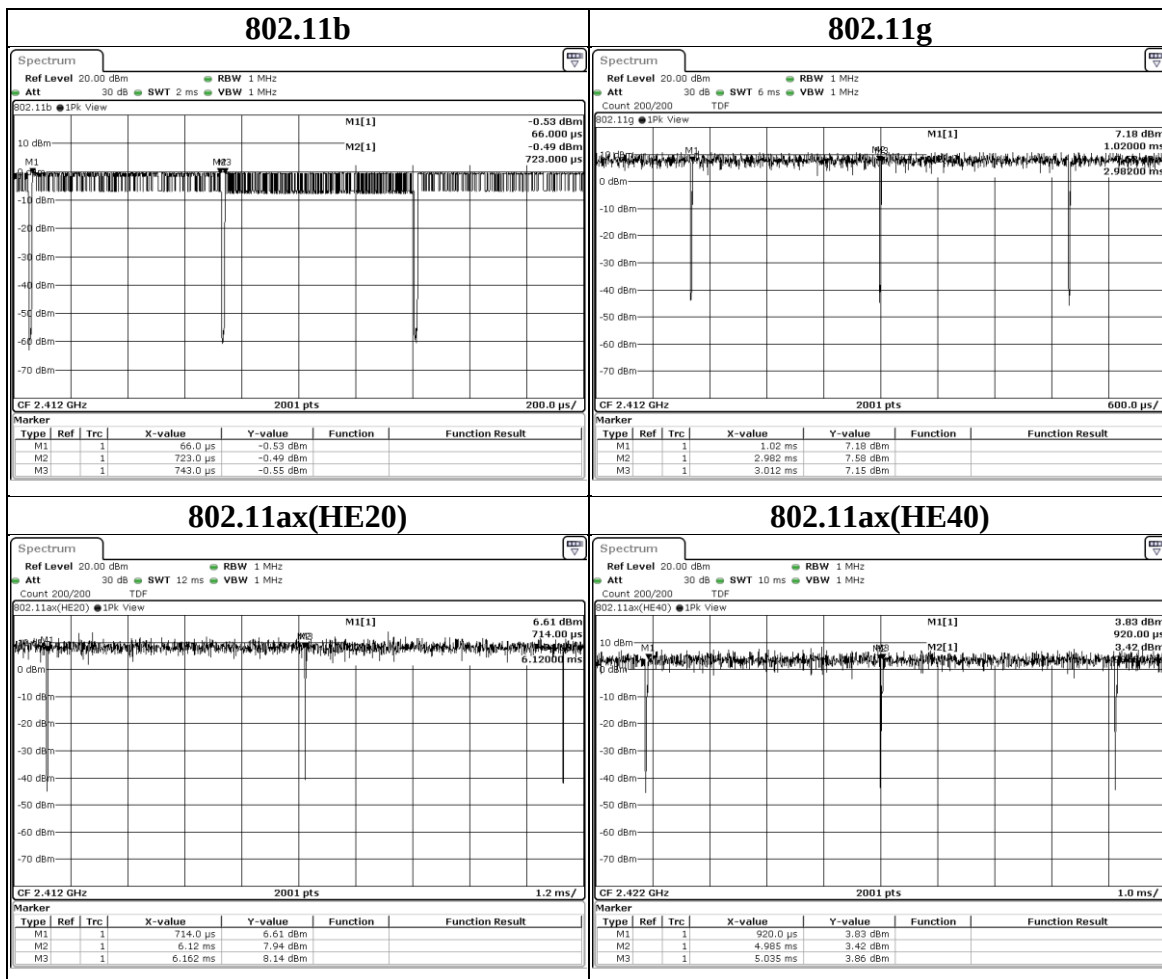
Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,10,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,6,10,11	6 Mbps
	802.11ax20	OFDM	BPSK	1 to 11	1,6,10,11	HE0
	802.11ax40	OFDM	BPSK	3 to 9	3,6,9	HE0
Radiated Emissions (Below 1GHz)	802.11ax20	OFDM	BPSK	1 to 11	6	HE0
AC Power Line Conducted Emission	802.11ax20	OFDM	BPSK	1 to 11	6	HE0
Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,10,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,6,10,11	6 Mbps
	802.11ax20	OFDM	BPSK	1 to 11	1,6,10,11	HE0
	802.11ax40	OFDM	BPSK	3 to 9	3,6,9	HE0

Simultaneously transmission condition:

Condition	Technology	
1	BT-EDR	WLAN (2.4GHz)
2	WLAN (2.4GHz)	WLAN (5GHz)
3	WLAN (2.4GHz)	WLAN (6GHz)
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	0.657	0.677	0.9705	0.13	2kHz
802.11g	1.962	1.992	0.9849	N/A	10Hz
802.11ax(HE20)	5.406	5.448	0.9923	N/A	10Hz
802.11ax(HE40)	4.065	4.115	0.9878	N/A	10Hz



7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2023/4/7	2024/4/6
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2022/12/13	2023/12/12
Loop Antenna	ETS lindgren	6502	00213440	2023/1/4	2024/1/3
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2023/2/13	2024/2/12
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2022/12/21	2023/12/20
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2022/12/30	2023/12/29
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2023/6/7	2024/6/6
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2023/2/17	2024/2/16
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2023/5/9	2024/5/8
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2022/12/1	2023/11/30
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2022/12/1	2023/11/30

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2022/10/24	2023/10/23
Attenuator	EMCI	EMC-40ATK2W10	17002	2022/12/9	2023/12/8
Pulse Power Sensor	Anritsu	MA2411B	1531202	2023/1/4	2024/1/3
Power Meter	Anritsu	ML2495A	1645002	2023/1/4	2024/1/3
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2022/11/10	2023/11/9
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2023/5/24	2024/5/23
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2022/8/30	2023/8/29
Cables	TITAN	CFD200	T0732ACFD200 20A300-2	2023/5/23	2024/5/22

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

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8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Test Tool	NA	NA	NA	Supplied by client
B	Monitor	Dell	SE2417HG	NA	Provide by lab
C	Computer	Intel	Intel(R) Core(TW) i7-4790 CPU @ 3.60GHz	NA	Supplied by client
D	Keyboard	Dell	KB216t	NA	Provide by lab
E	Mouse	Dell	MS116p	NA	Provide by lab

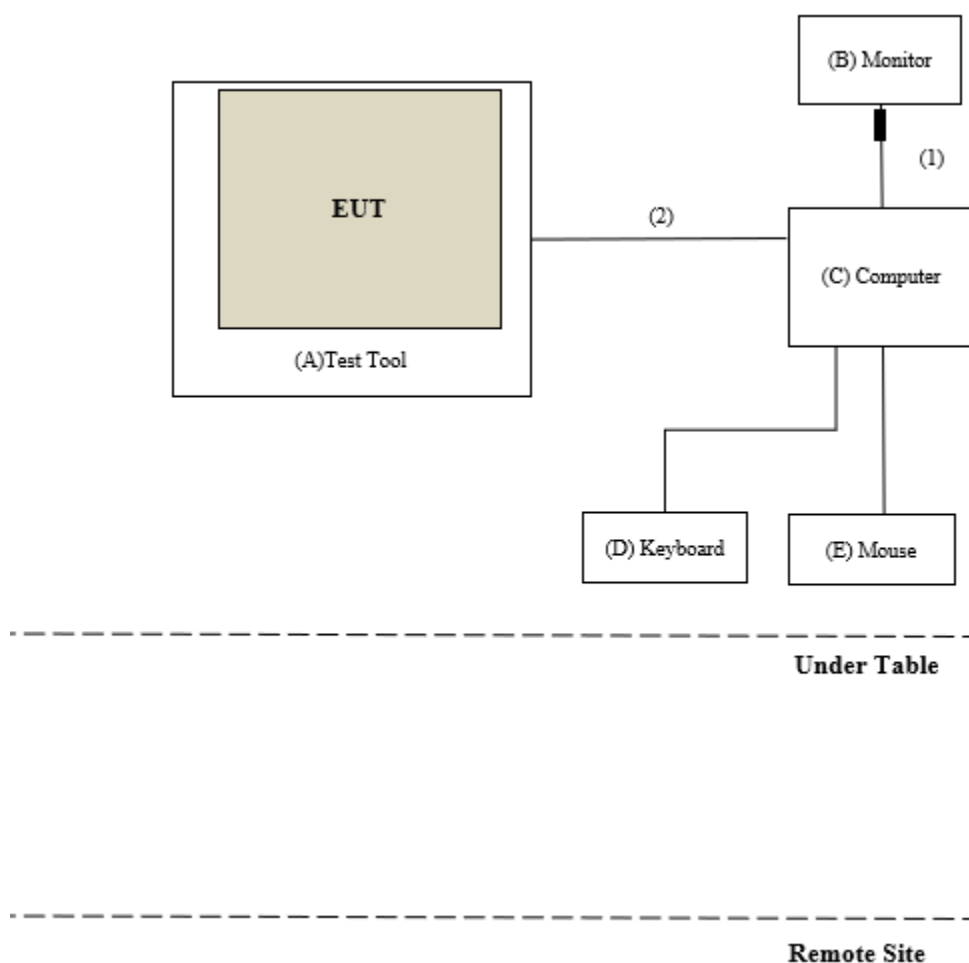
I/O Cables

ID	Equipment	Brand Name	Model Name	Length (m)	Remark
1	HDMI Cable	EATON	P568010	1.44	Provide by lab with one core
2	Fiber Cable	NA	NA	0.5	Supplied by client

Test Setup

Controlled using a bespoke application (QSPR Version 5.0-00202) 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



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9. Test Results

9.1. 6dB Bandwidth

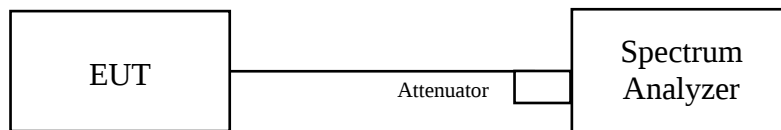
Requirements

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

Test procedure

- Set resolution bandwidth (RBW) = 100kHz.
- Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- 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.
- The test spectrum plot only presents the worst-case value.

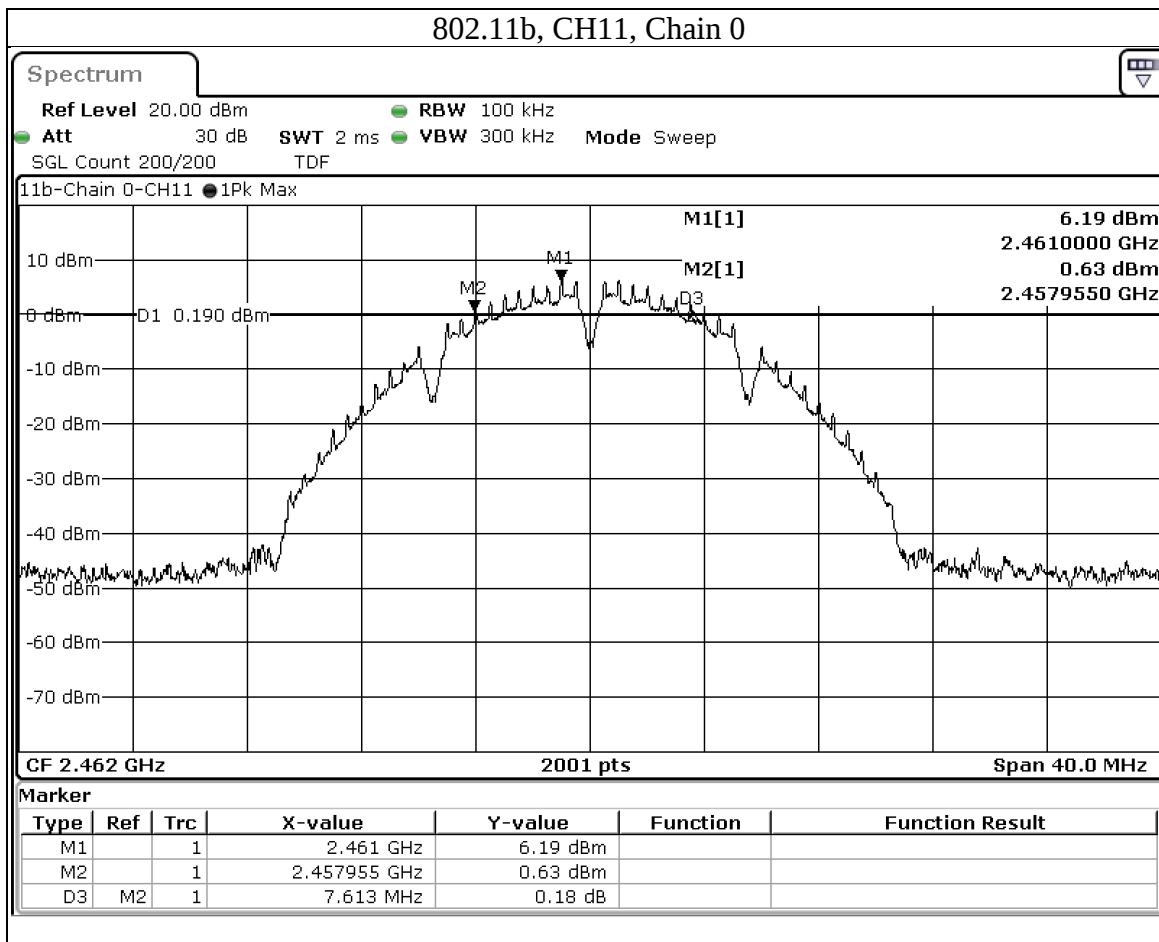
Test Setup



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)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11b	1	2412	8.085	8.035	0.5	PASS
	6	2437	8.082	8.079	0.5	PASS
	10	2457	8.506	8.039	0.5	PASS
	11	2462	7.613	8.039	0.5	PASS



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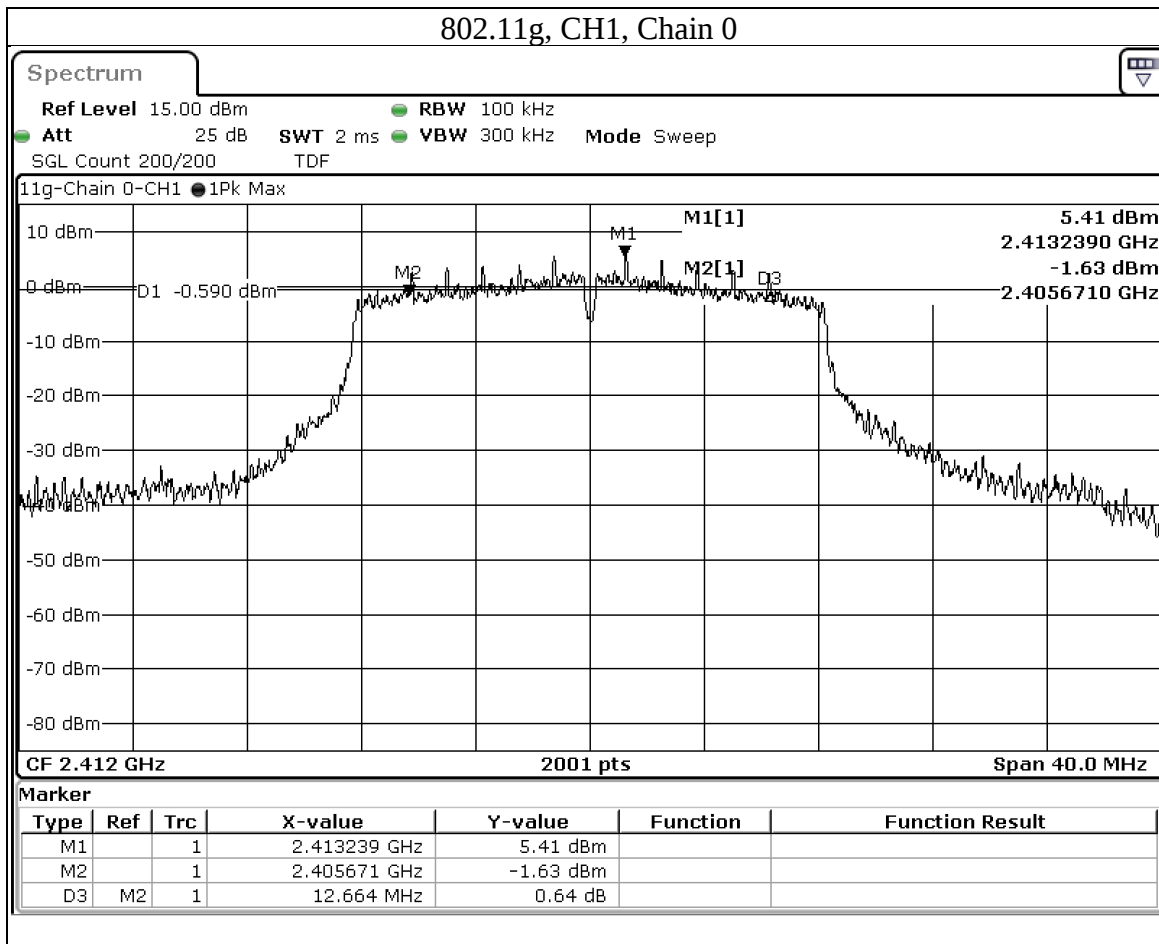
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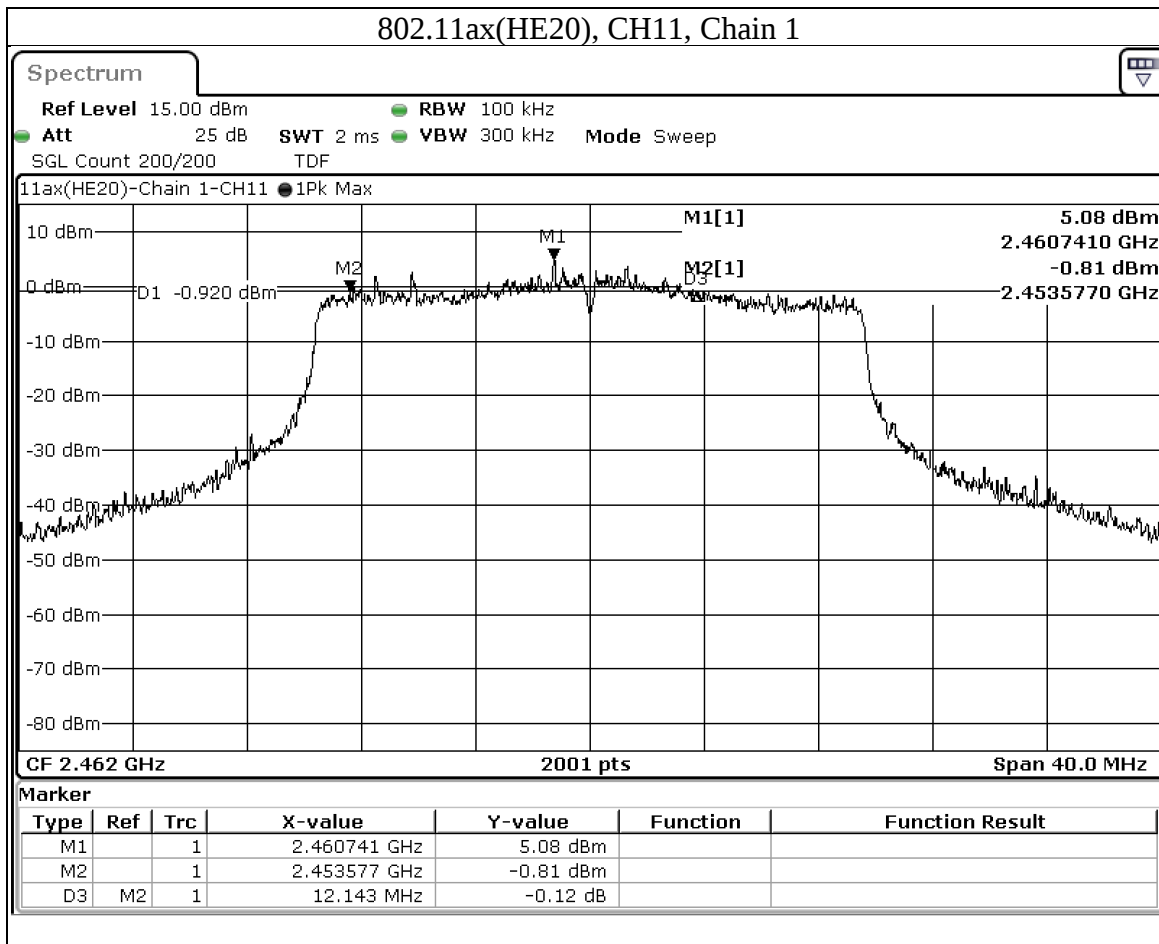
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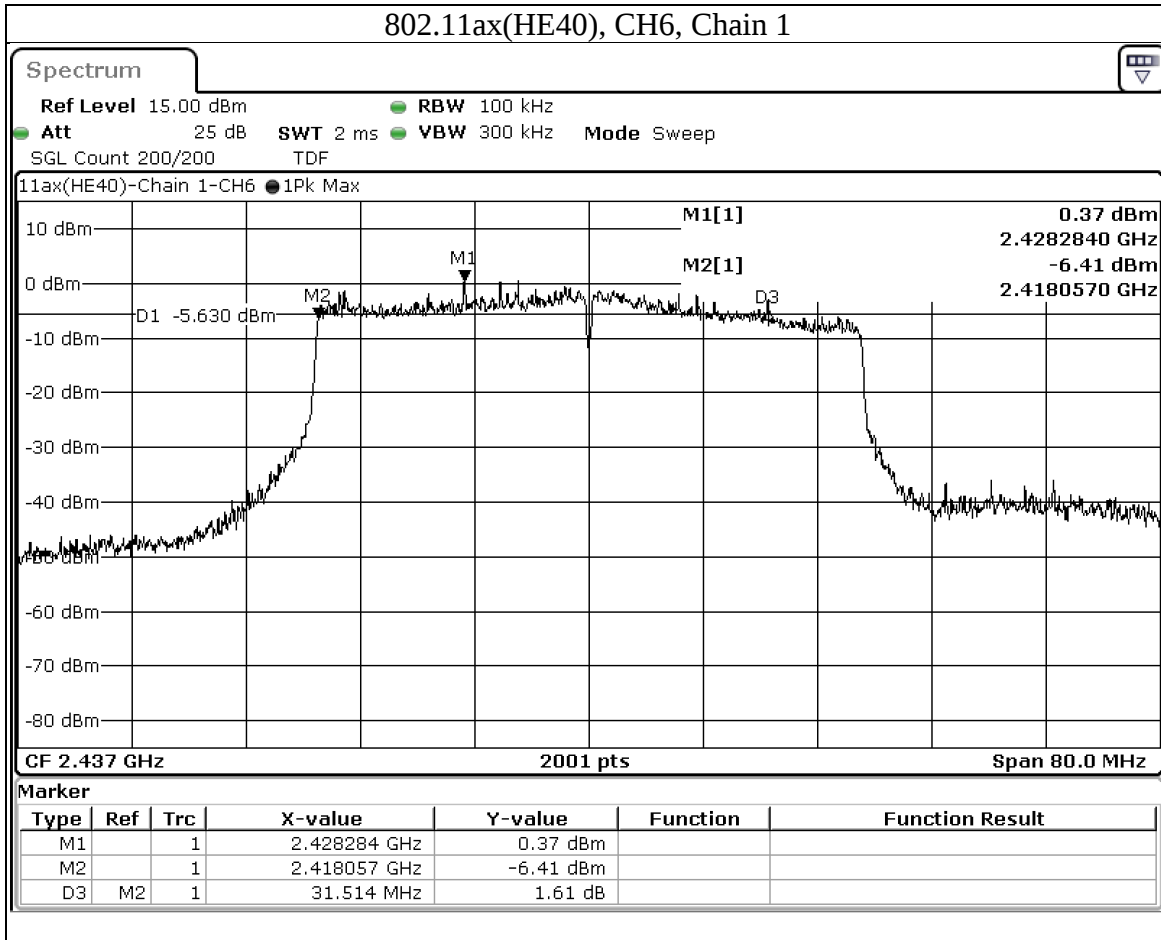
Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11g	1	2412	12.664	14.032	0.5	PASS
	6	2437	15.066	14.452	0.5	PASS
	10	2457	16.009	15.331	0.5	PASS
	11	2462	15.276	15.084	0.5	PASS



Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	1	2412	13.232	13.936	0.5	PASS
	6	2437	17.175	18.069	0.5	PASS
	10	2457	18.579	17.677	0.5	PASS
	11	2462	16.887	12.143	0.5	PASS



Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE40)	3	2422	33.158	32.711	0.5	PASS
	6	2437	36.433	31.514	0.5	PASS
	9	2452	36.558	35.129	0.5	PASS



9.2. Conducted Output Power

Requirements

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

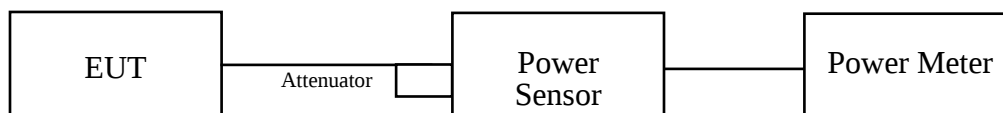
Note:

1. P_{Out} = maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi, B is the 26 dB emission bandwidth in megahertz
2. Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / N_{\text{ant}}]$ dBi.
Nant: Number of Transmit Antennas
G1, G2,..., Gn: Gain of Individual Antennas
Example: two antenna and gain 3.5 dBi / 3.5 dBi, so if it was used for TxBF power measurement
Directional Gain = $10 \log[(10^{3.5/20} + 10^{3.5/20})^2 / 2]$ dBi = 6.51 dBi
3. Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices, CDD
Array Gain = 0 dB (i.e., no array gain) for $N_{\text{ANT}} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;
Array Gain = $5 \log(N_{\text{ANT}}/N_{\text{SS}})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{\text{ANT}} \geq 5$.
Example: Maximum antenna gain = 3.5 dBi and $N_{\text{ANT}} \leq 4$, so if it was used for CDD power measurement
Directional Gain = 5 dBi + Array Gain = 3.5 dBi + 0 dB = 3.5 dBi
4. For power measurement of KDB 662911 is used with multiple transmitter output. Total conducted power is the sum of the conducted power levels measured at the various output ports.

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	21.68	21.50	288.403	24.60	30	PASS
6	2437	23.47	23.22	432.514	26.36	30	PASS
10	2457	20.21	20.66	221.309	23.45	30	PASS
11	2462	17.72	18.31	127.057	21.04	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	21.83	22.23	319.154	25.04	30	PASS
6	2437	24.54	25.11	608.135	27.84	30	PASS
10	2457	22.42	22.94	371.535	25.70	30	PASS
11	2462	21.35	22.09	298.538	24.75	30	PASS

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	22.98	22.23	365.595	25.63	30	PASS
6	2437	24.47	25.19	610.942	27.86	30	PASS
10	2457	22.15	22.95	361.41	25.58	30	PASS
11	2462	21.05	21.18	258.821	24.13	30	PASS

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802.11ax (HE40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	20.66	21.08	244.906	23.89	30	PASS
6	2437	21.86	21.26	287.078	24.58	30	PASS
9	2452	19.65	20.06	193.642	22.87	30	PASS

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Average Power (Reference Only)

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	19.05	19.04	160.694	22.06
6	2437	21.38	20.75	256.448	24.09
10	2457	17.90	18.13	126.765	21.03
11	2462	15.35	15.87	72.946	18.63

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.82	16.20	79.799	19.02
6	2437	19.99	20.01	199.986	23.01
10	2457	17.08	17.53	107.647	20.32
11	2462	15.60	16.30	78.886	18.97

802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.24	15.63	69.984	18.45
6	2437	19.56	19.62	181.97	22.60
10	2457	16.02	16.51	84.723	19.28
11	2462	14.51	15.19	61.235	17.87

802.11ax (HE40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	14.48	14.65	57.28	17.58
6	2437	14.83	14.74	60.256	17.80
9	2452	13.47	13.88	46.666	16.69

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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 $PSD = 8 - (G_{TX} - 6)$).

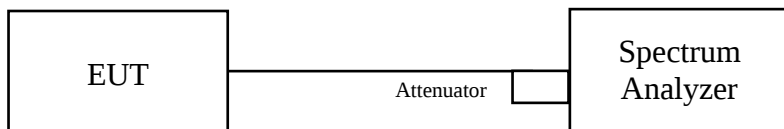
Note:

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 = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / Nant]$ dBi.
Nant: Number of Transmit Antennas
G1, G2,..., Gn: Gain of Individual Antennas
Example: two antenna and gain 3.5 dBi / 3.5 dBi, so if it was used for power density measurement
Directional Gain = $10 \log[(10^{3.5/20} + 10^{3.5/20})^2 / 2]$ dBi = 6.51 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.
5. Method a) of power density measurement of KDB 662911 is used for calculating total power density with multiple transmitter output. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d. Set the VBW $\geq 3 \times \text{RBW}$.
- 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.
- j. The test spectrum plot only presents the worst-case value.

Test Setup



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

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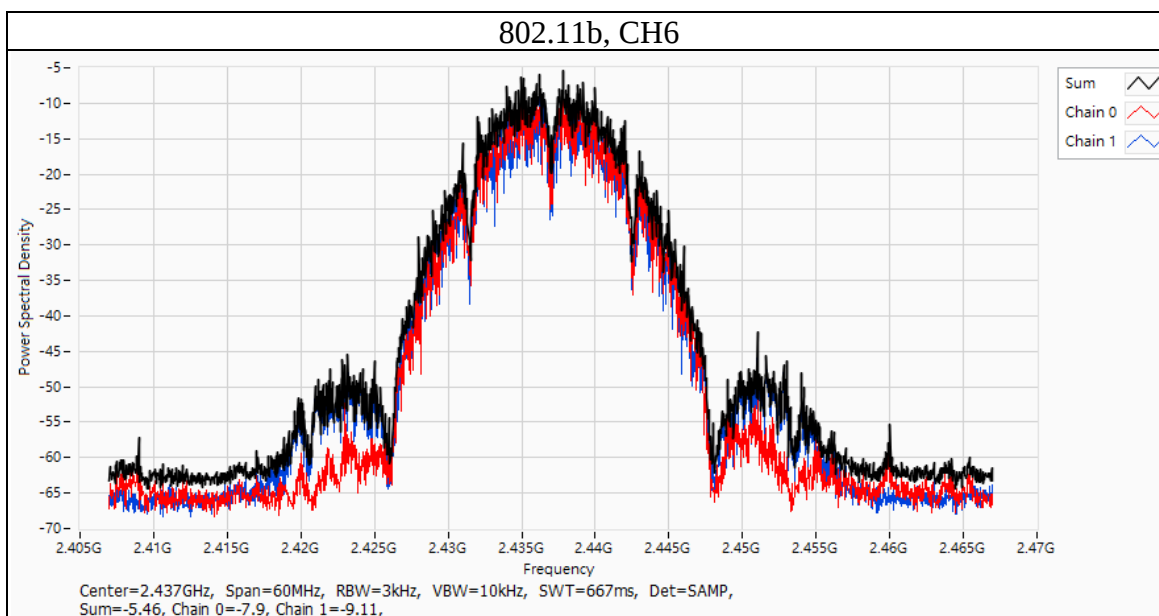
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Test Data

Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11b	1	2412	-7.88	7.49	6.51	PASS
	6	2437	-5.46	7.49	6.51	PASS
	10	2457	-7.83	7.49	6.51	PASS
	11	2462	-9.27	7.49	6.51	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11b	1	2412	-9.89	-10.439
	6	2437	-7.8	-7.935
	10	2457	-10.378	-10.099
	11	2462	-12.239	-12.005



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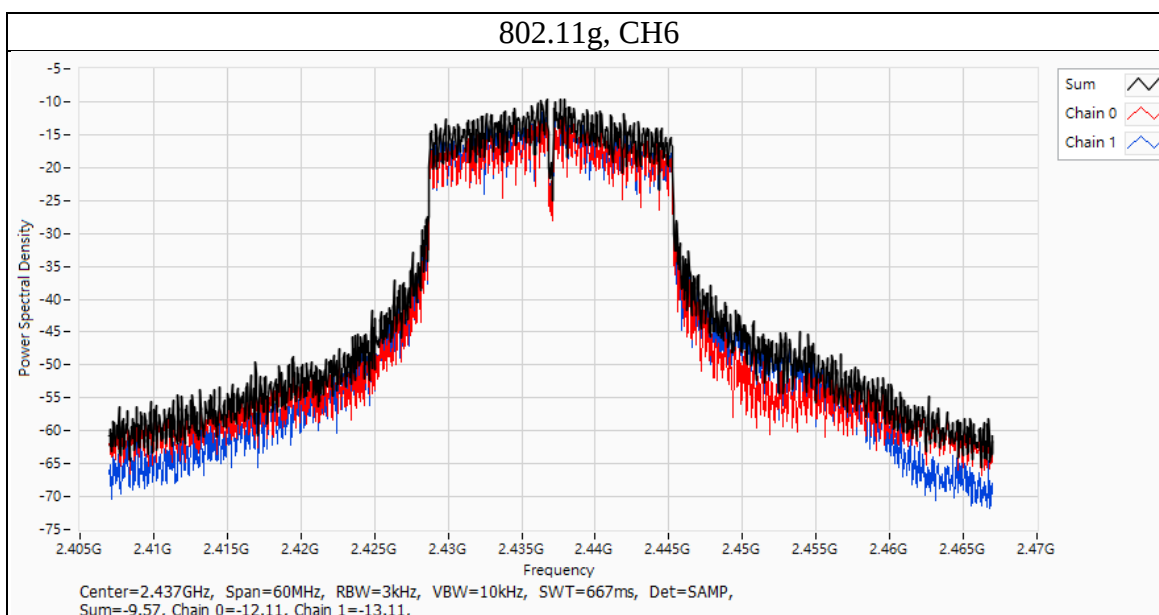
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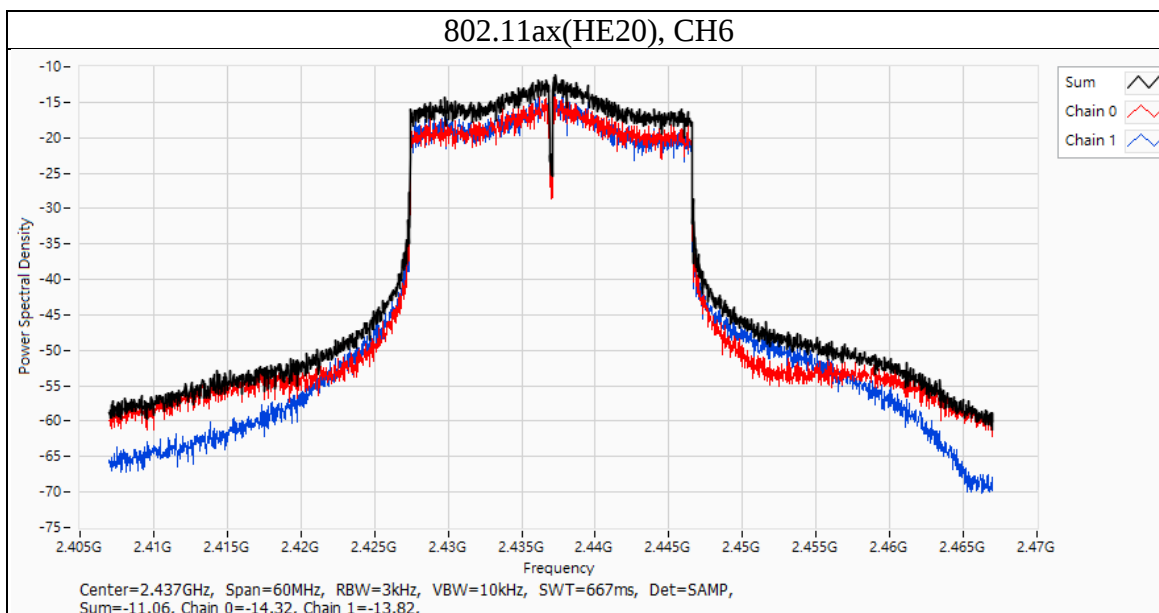
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11g	1	2412	-13.12	7.49	6.51	PASS
	6	2437	-9.57	7.49	6.51	PASS
	10	2457	-11.04	7.49	6.51	PASS
	11	2462	-13.42	7.49	6.51	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11g	1	2412	-16.375	-15.415
	6	2437	-11.857	-11.697
	10	2457	-14.412	-13.718
	11	2462	-15.847	-15.997



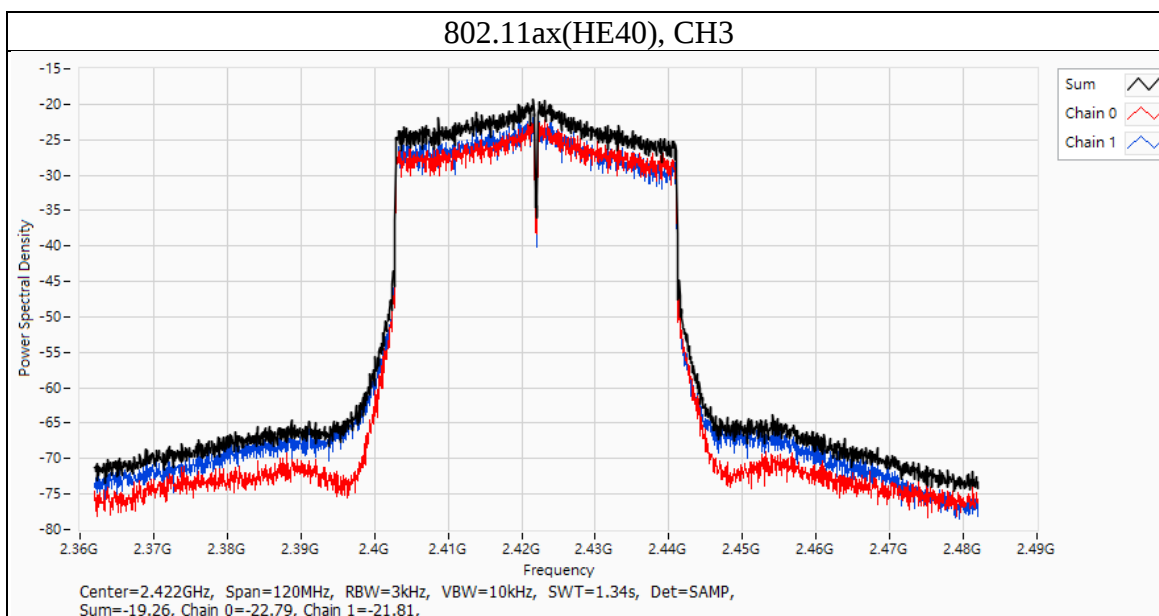
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11ax(HE20)	1	2412	-15.94	7.49	6.51	PASS
	6	2437	-11.06	7.49	6.51	PASS
	10	2457	-14.87	7.49	6.51	PASS
	11	2462	-15.9	7.49	6.51	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11ax(HE20)	1	2412	-18.649	-17.932
	6	2437	-13.931	-13.821
	10	2457	-17.193	-16.793
	11	2462	-18.927	-18.518



Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11ax(HE40)	3	2422	-19.26	7.49	6.51	PASS
	6	2437	-19.4	7.49	6.51	PASS
	9	2452	-20.04	7.49	6.51	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11ax(HE40)	3	2422	-22.244	-21.812
	6	2437	-21.788	-22.288
	9	2452	-23.002	-22.371



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

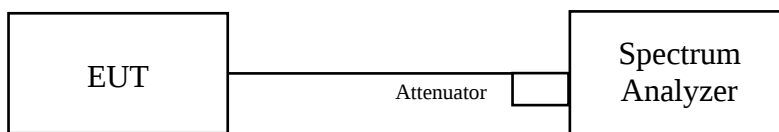
Measurement Procedure REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 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 $\geq$ 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.

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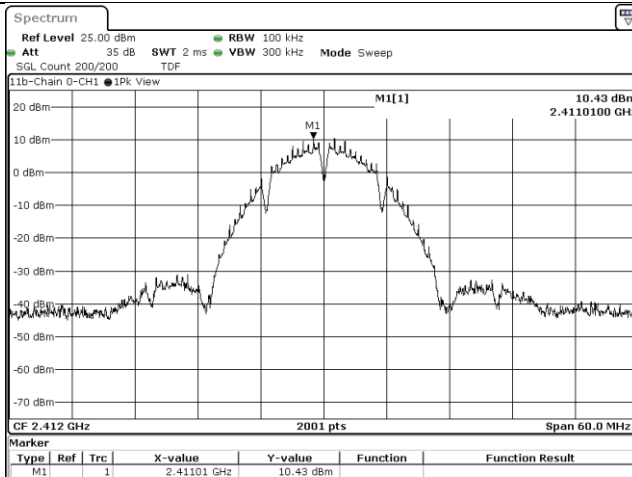
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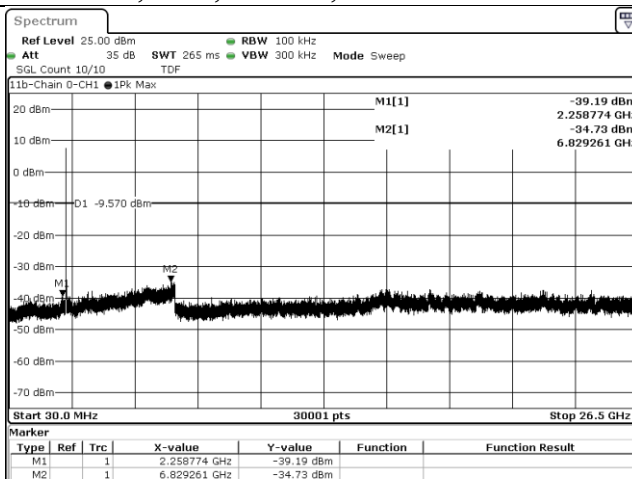
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Test Data

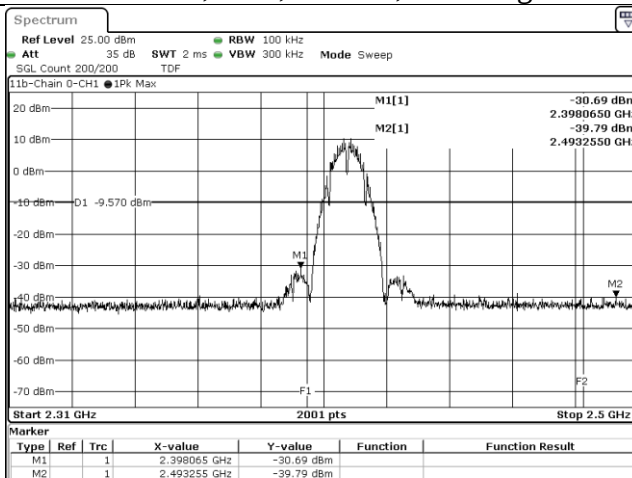
802.11b, CH1, Chain 0, Reference



802.11b, CH1, Chain 0, Conducted Emission



802.11b, CH1, Chain 0, Band edge



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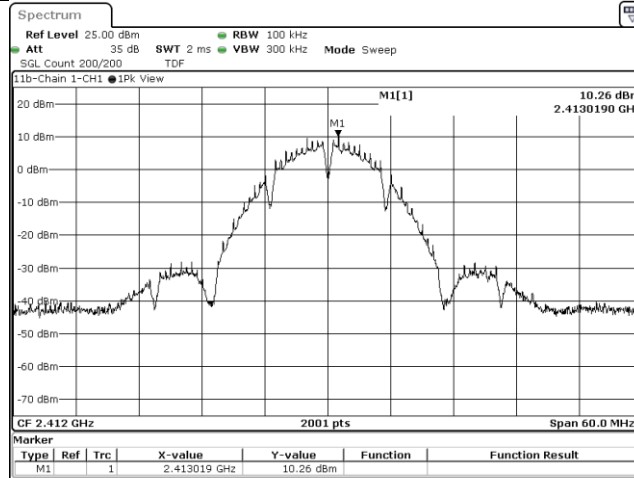
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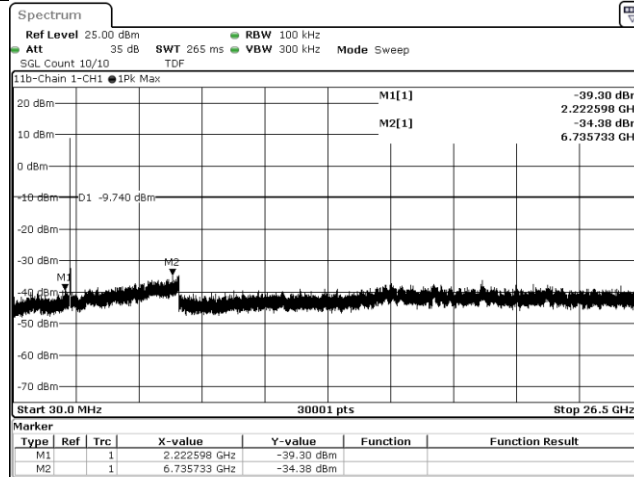
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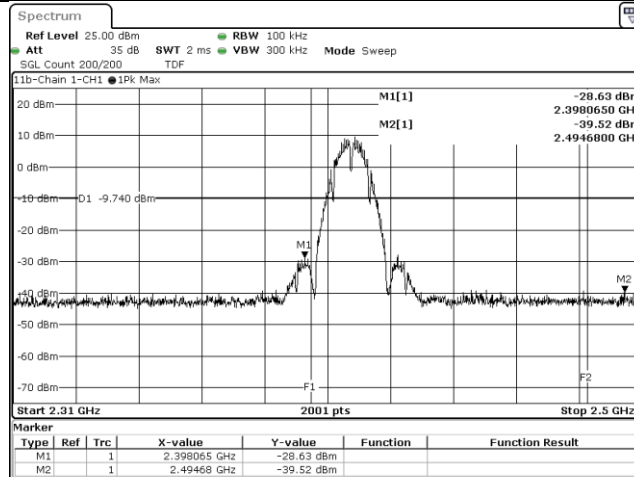
802.11b, CH1, Chain 1, Reference



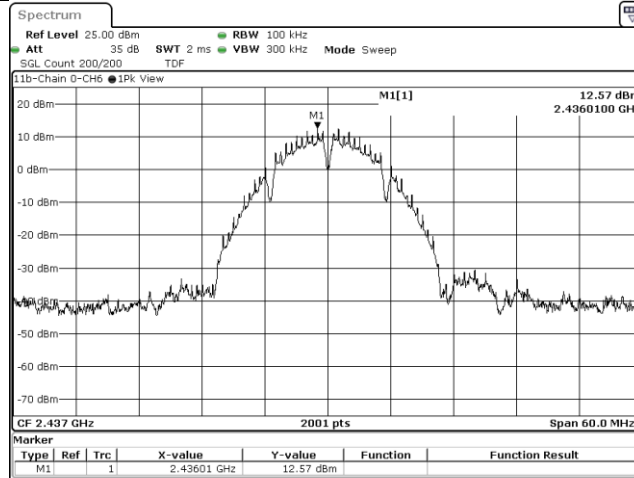
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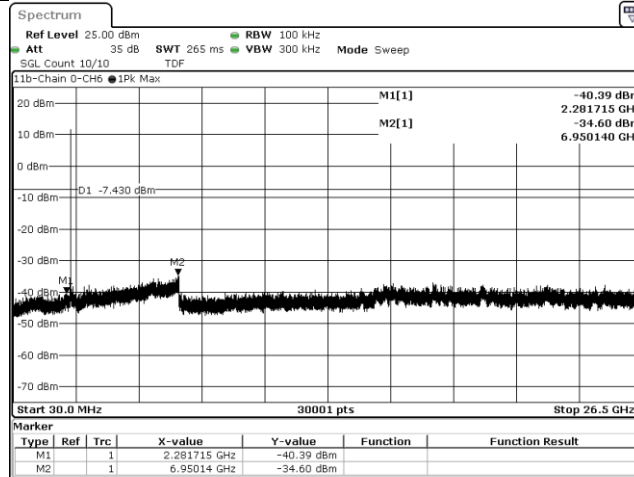
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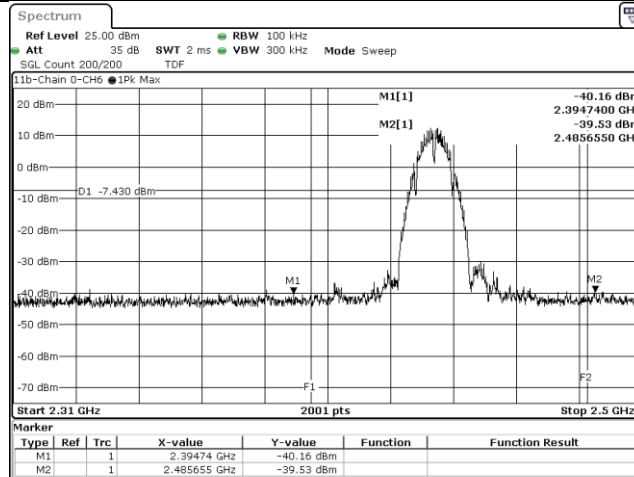
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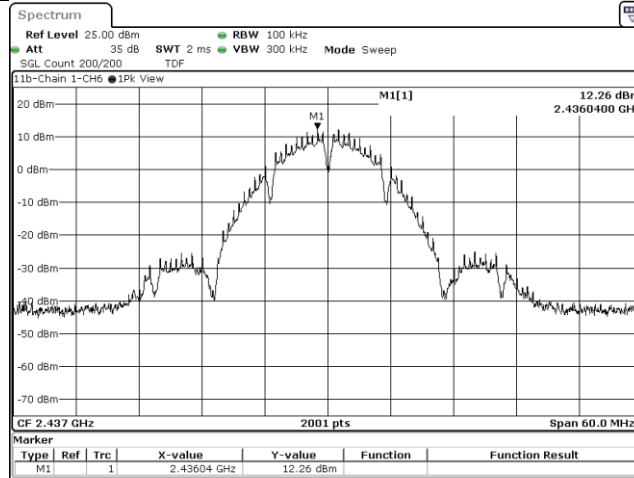
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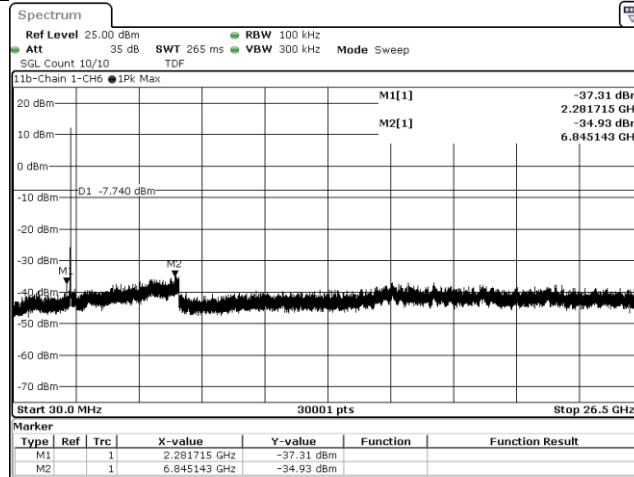
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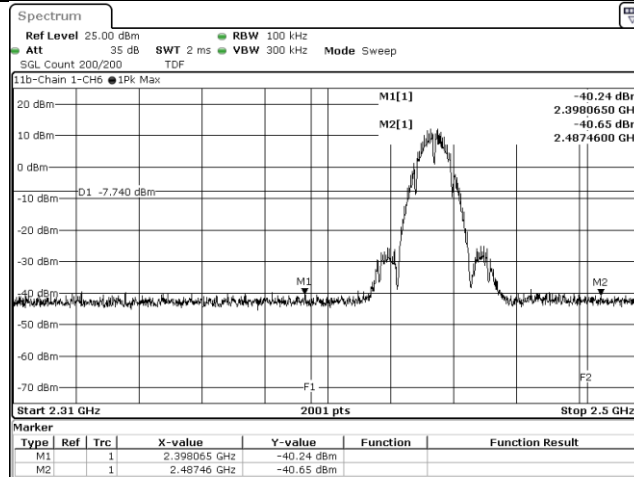
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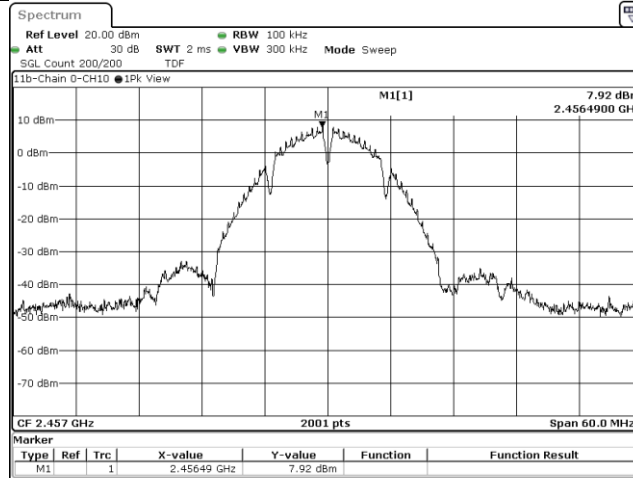
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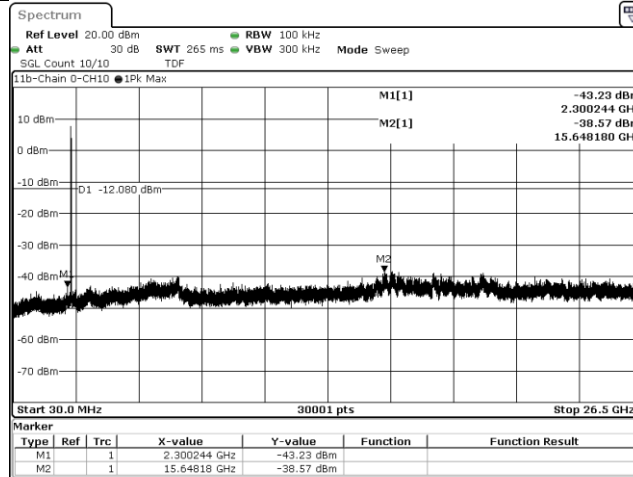
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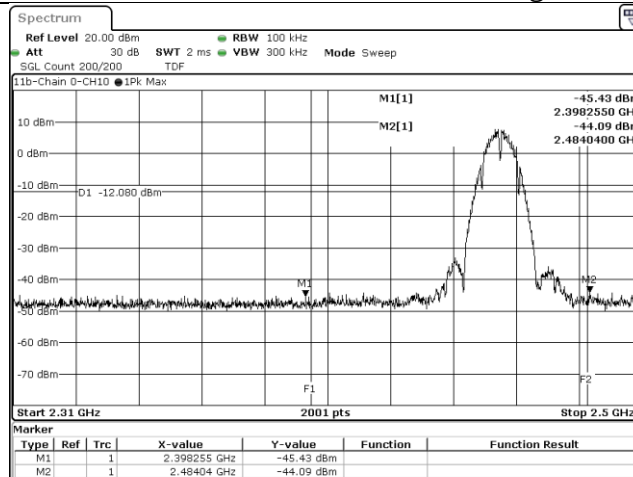
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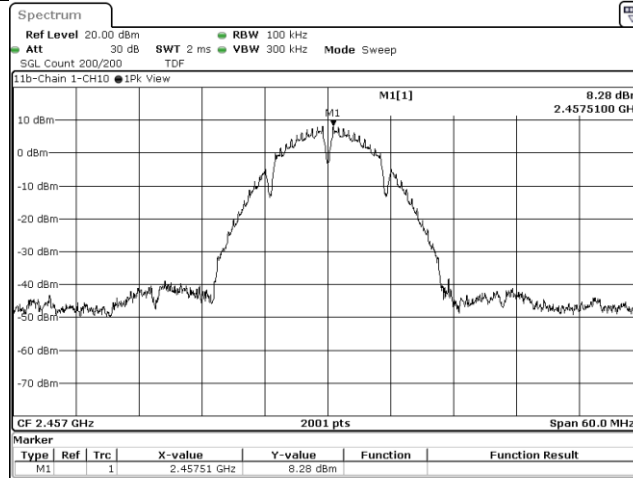
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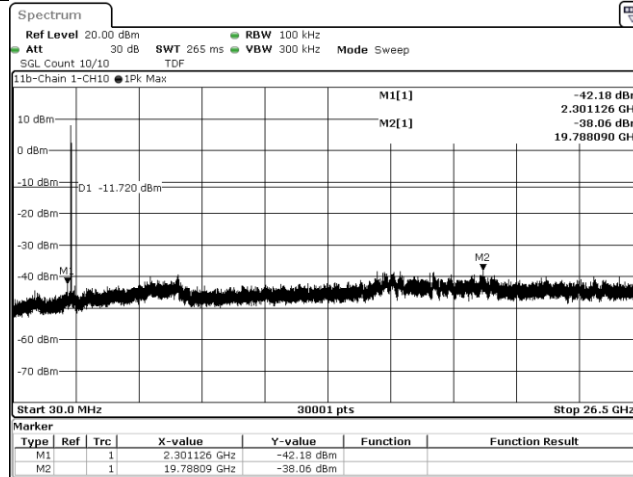
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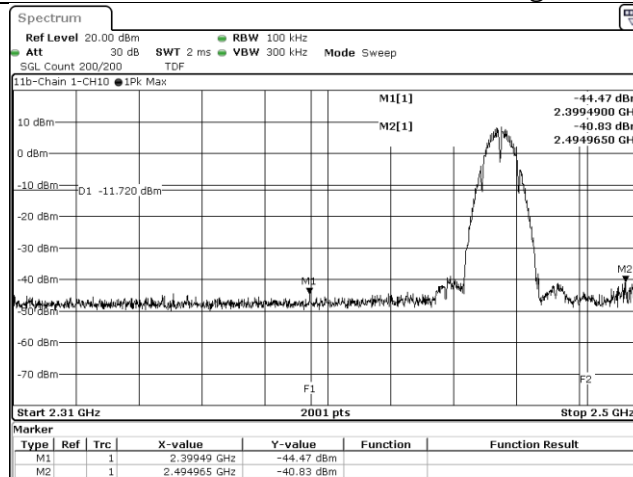
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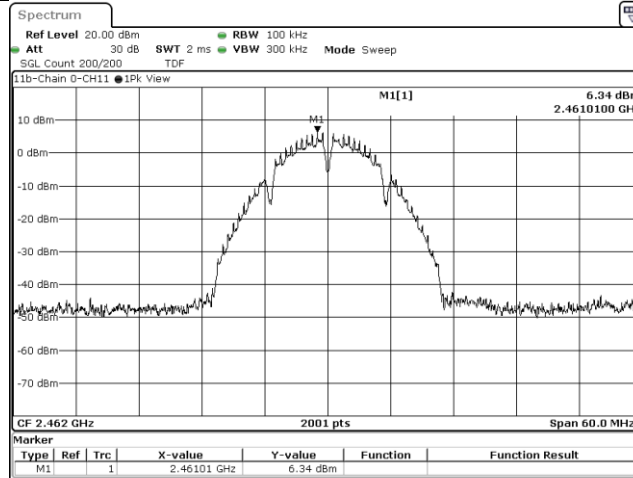
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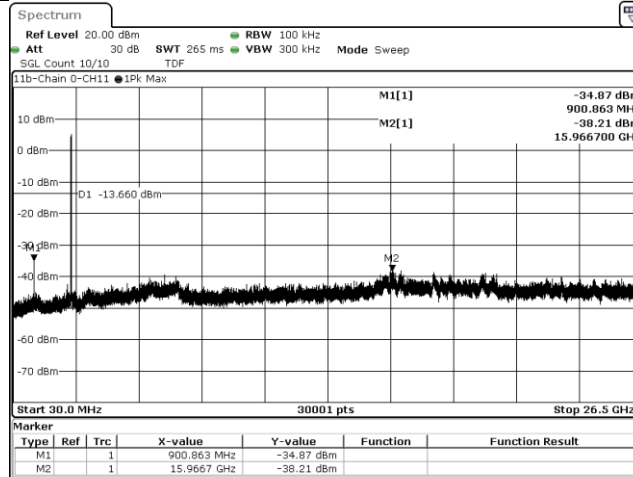
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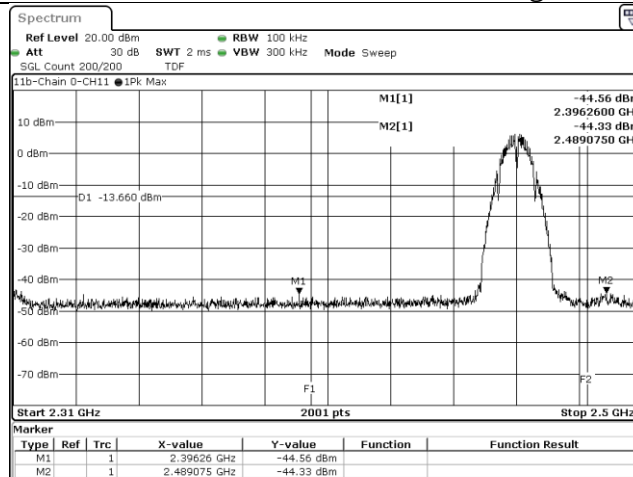
802.11b, CH11, Chain 0, Reference



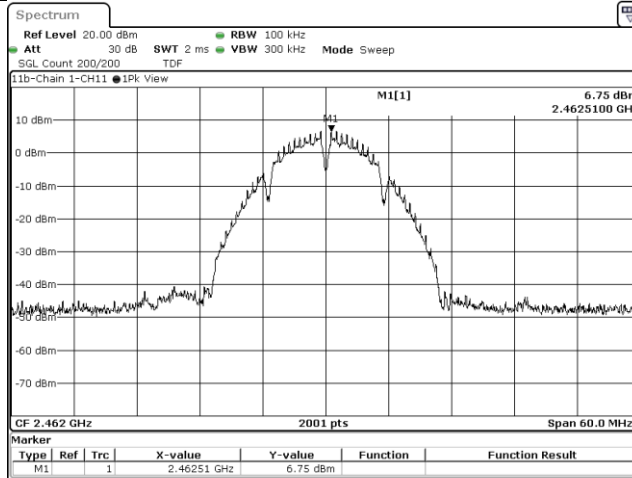
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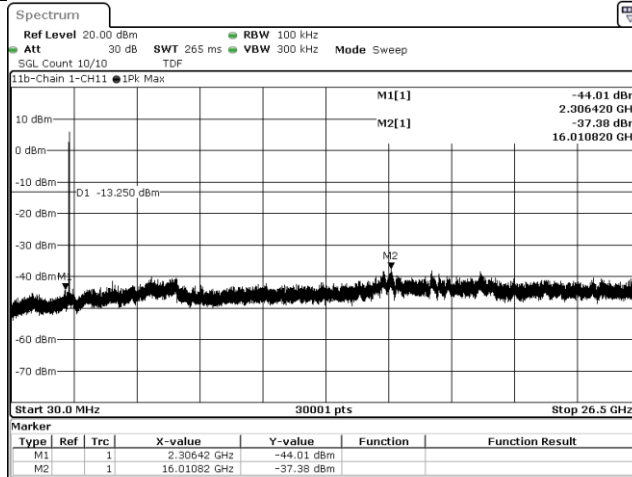
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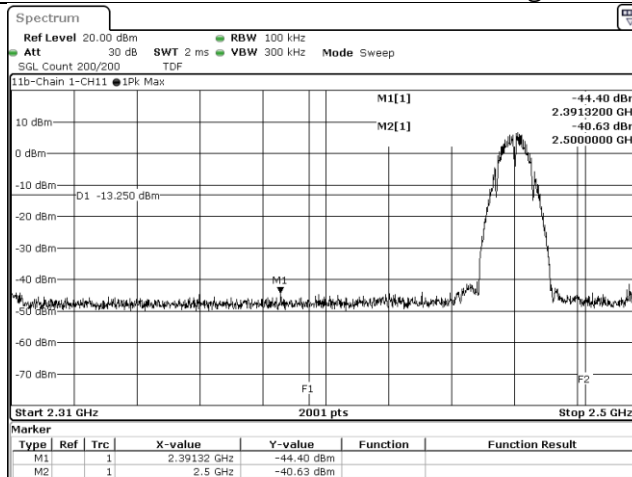
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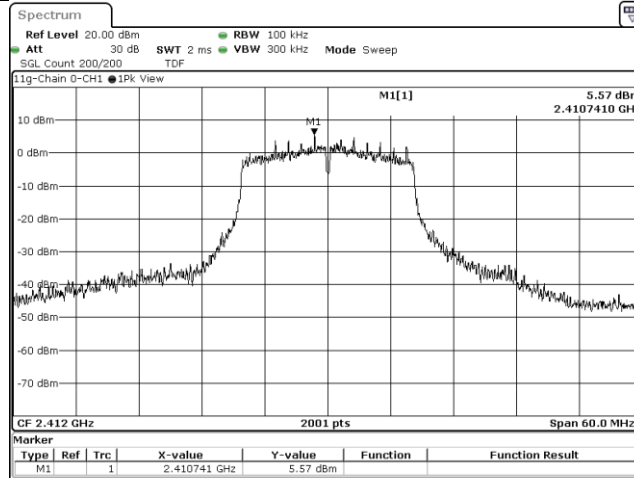
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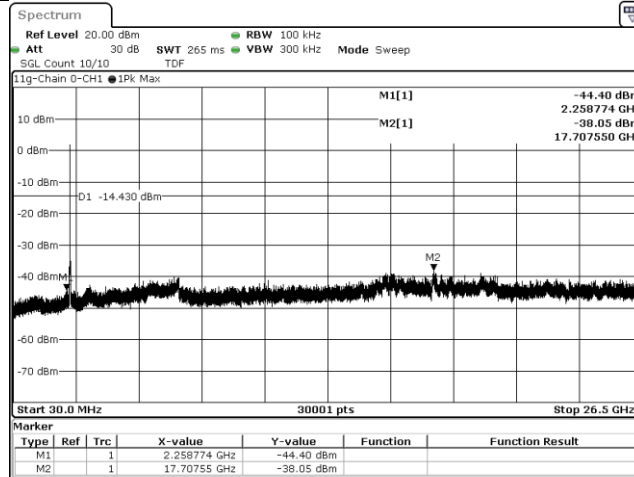
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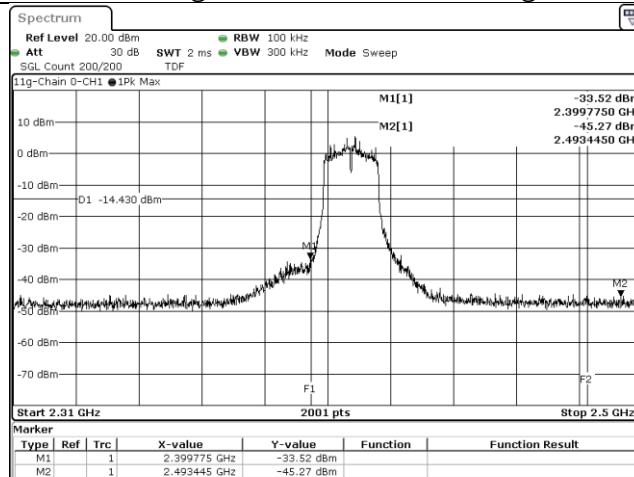
802.11g, CH1, Chain 0, Reference



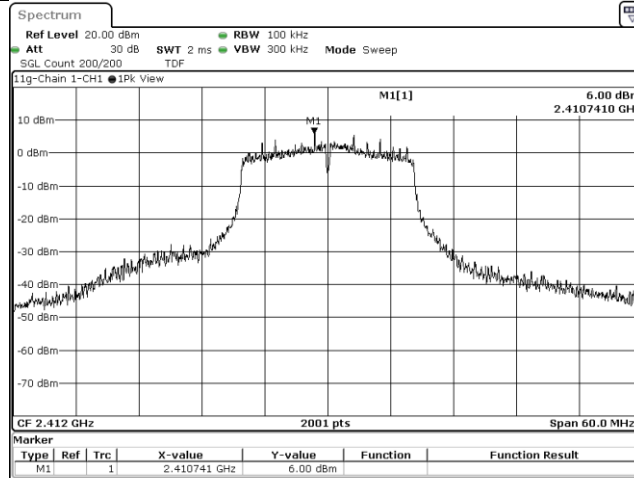
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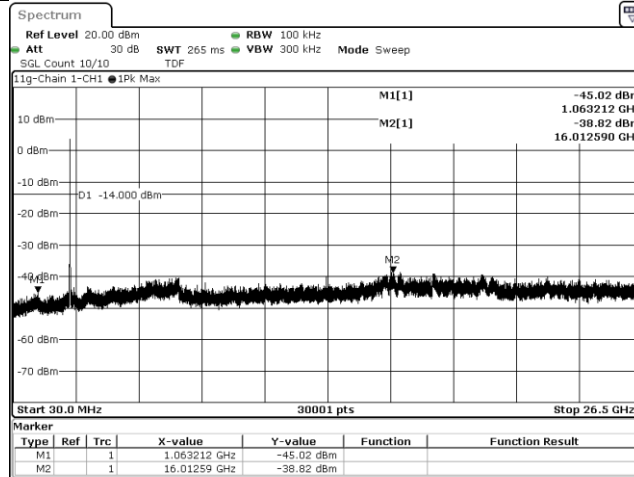
802.11g, CH1, Chain 0, Band edge



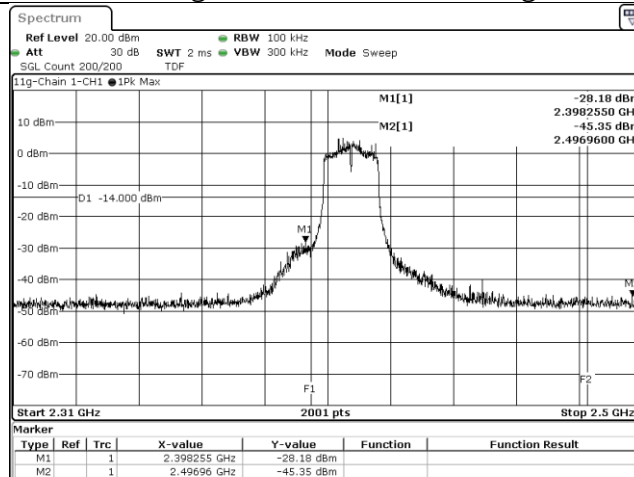
802.11g, CH1, Chain 1, Reference



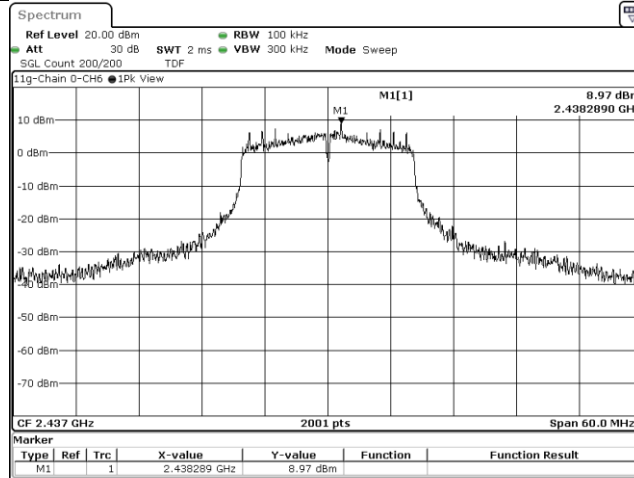
802.11g, CH1, Chain 1, Conducted Emission



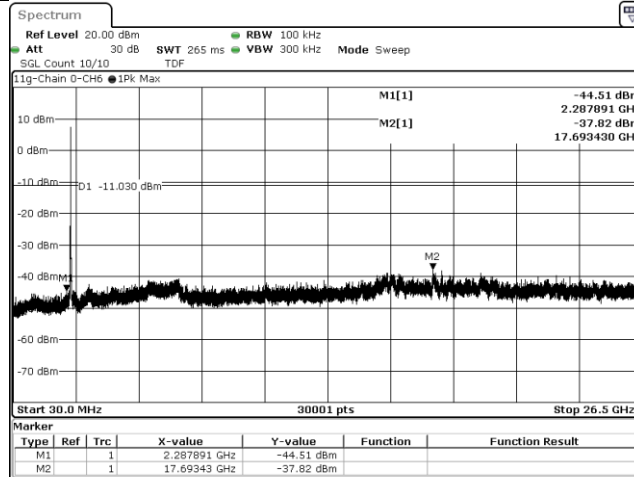
802.11g, CH1, Chain 1, Band edge



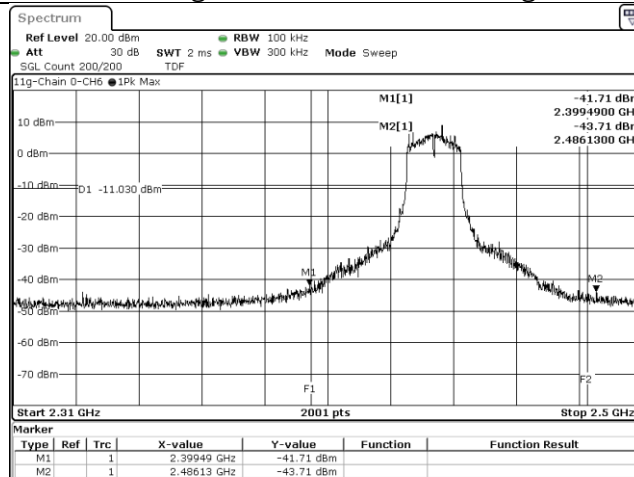
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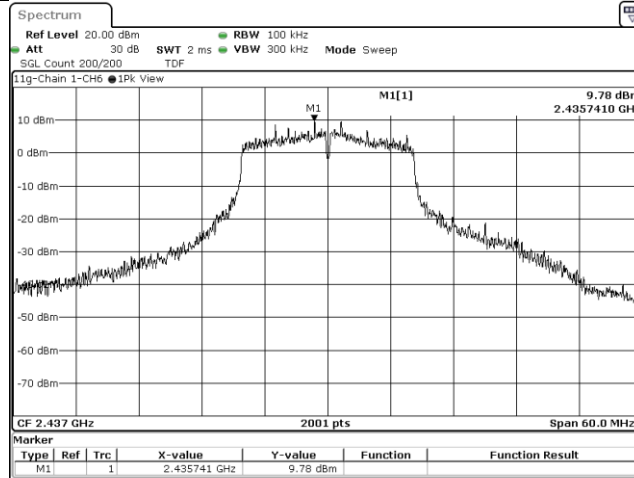
802.11g, CH6, Chain 0, Conducted Emission



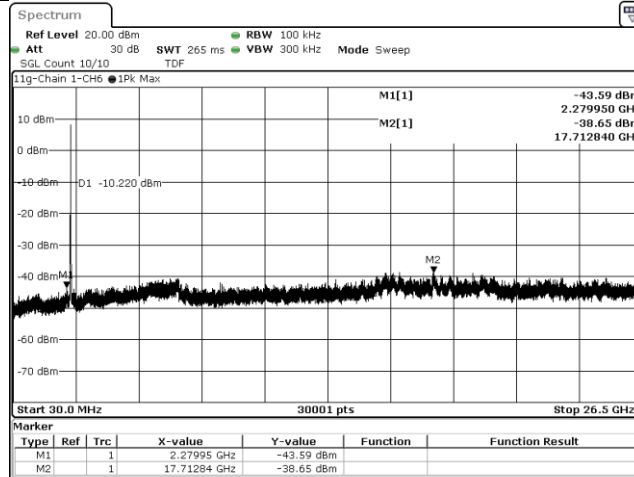
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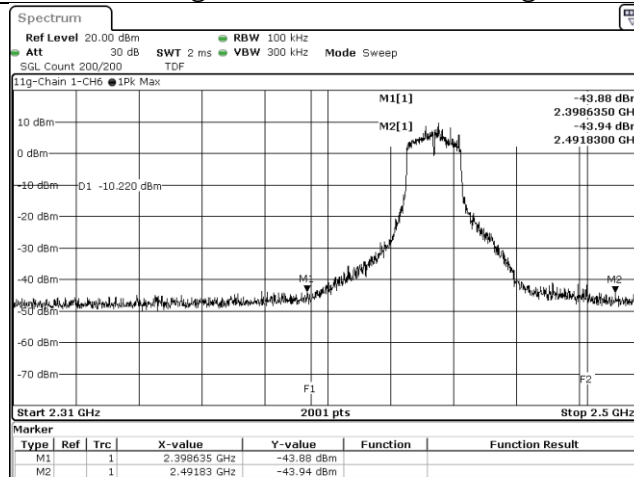
802.11g, CH6, Chain 1, Reference



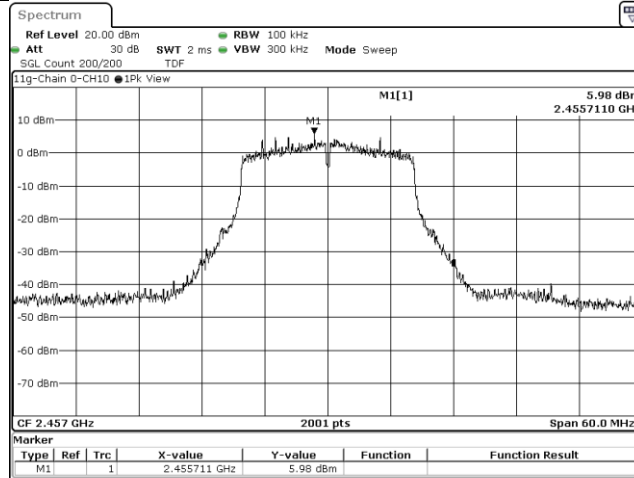
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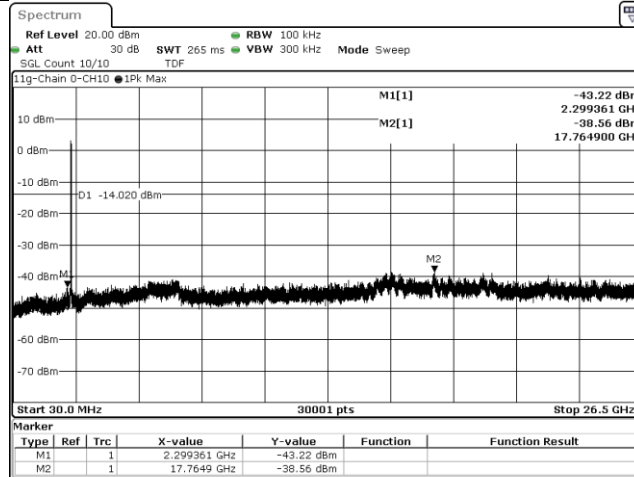
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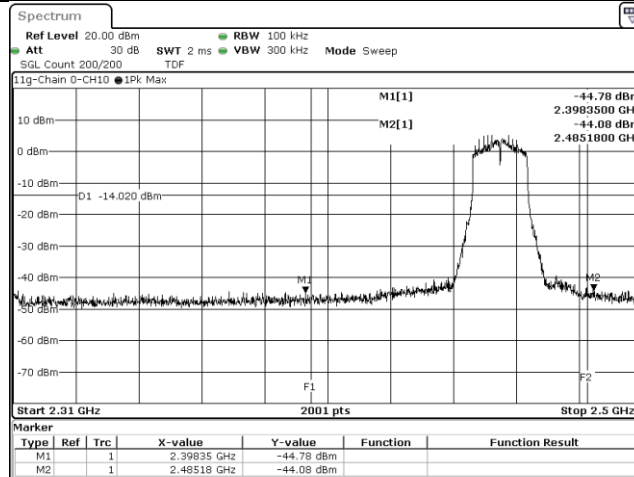
802.11g, CH10, Chain 0, Reference



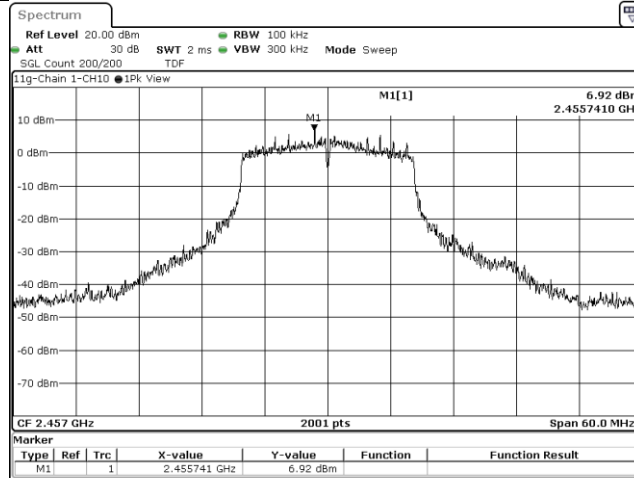
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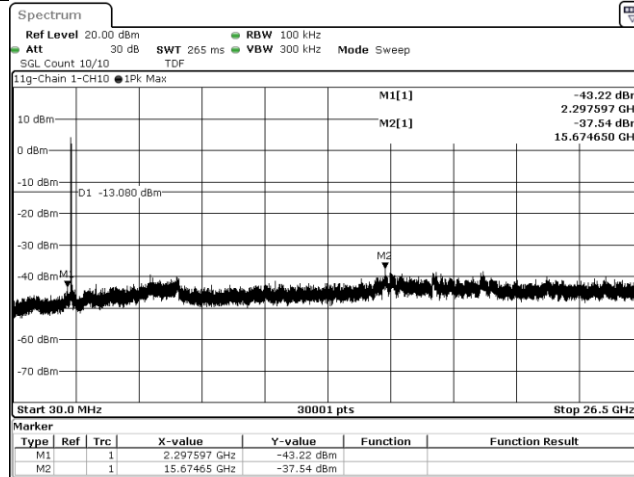
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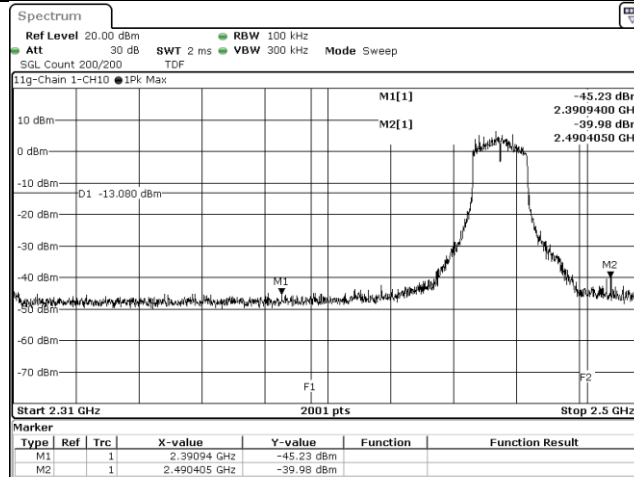
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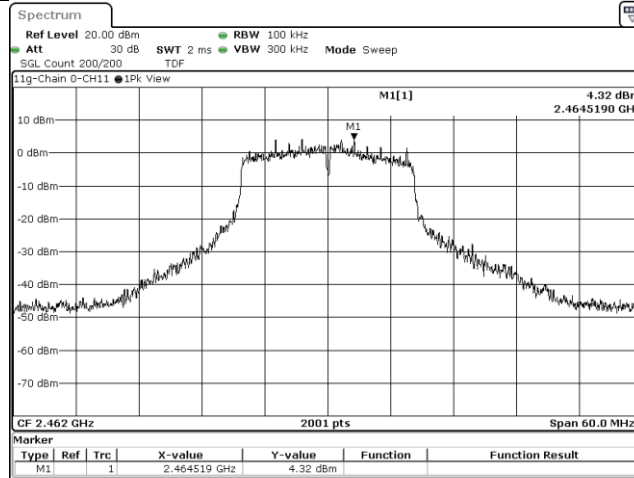
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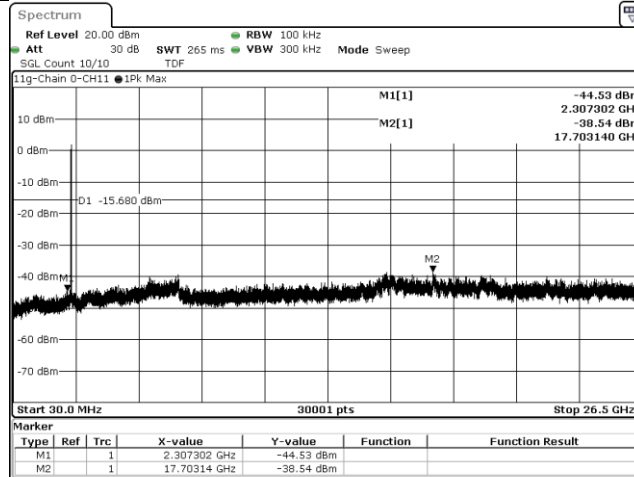
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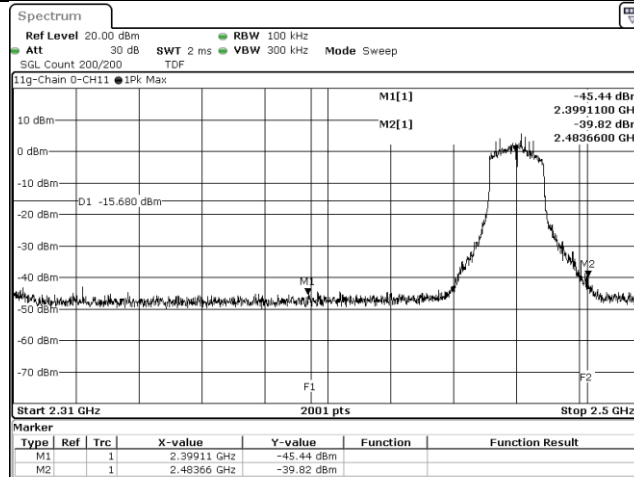
802.11g, CH11, Chain 0, Reference



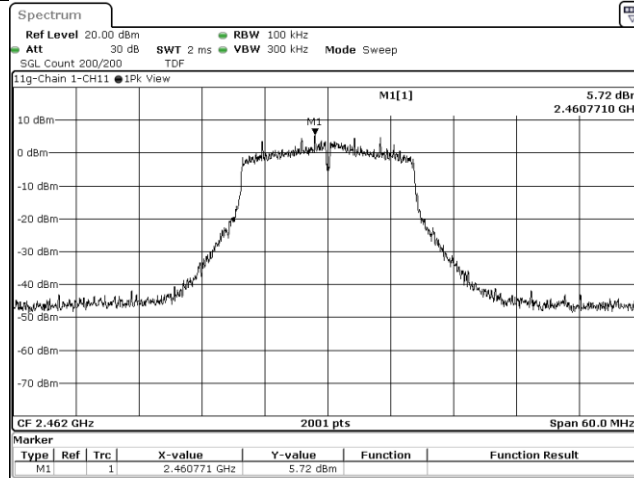
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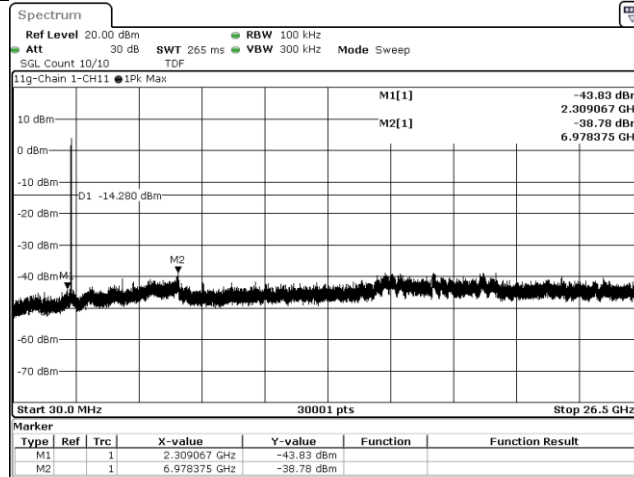
802.11g, CH11, Chain 0, Band edge



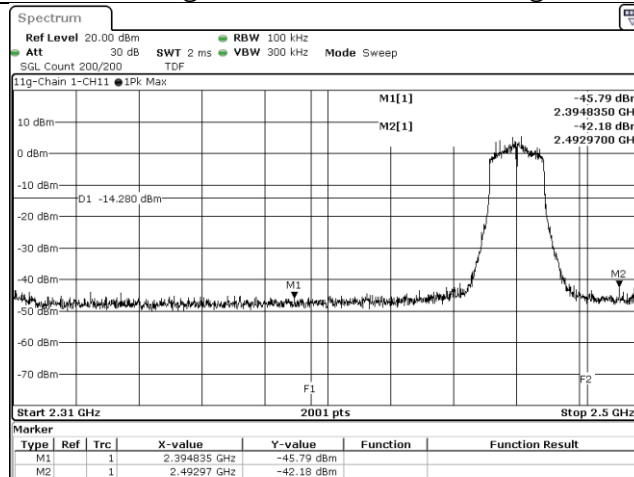
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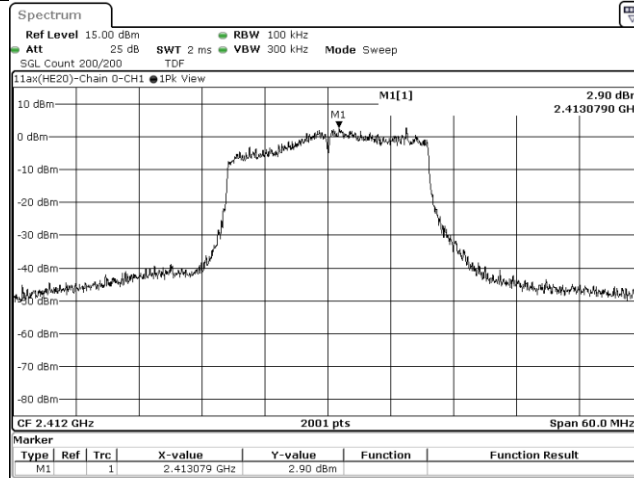
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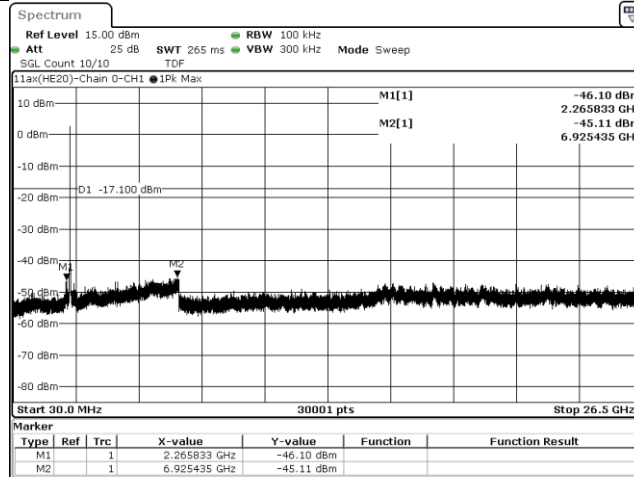
802.11g, CH11, Chain 1, Band edge



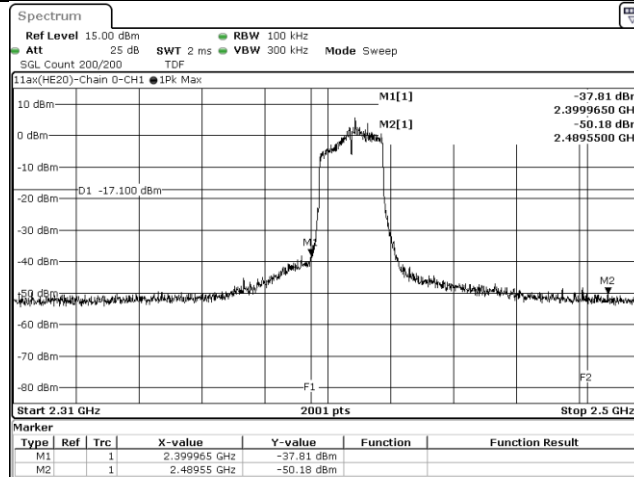
802.11ax(HE20), CH1, Chain 0, Reference



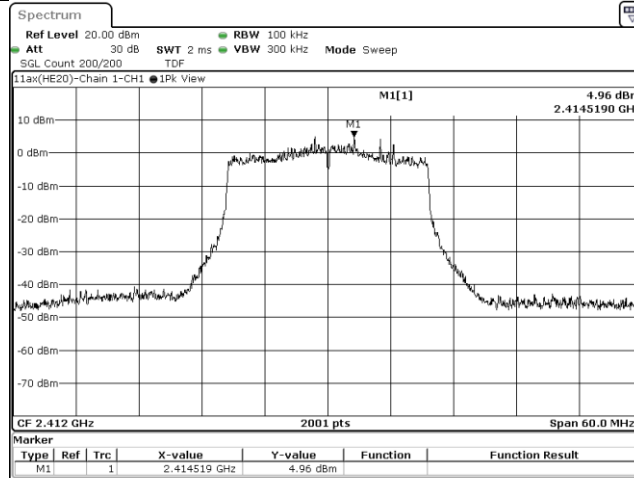
802.11ax(HE20), CH1, Chain 0, Conducted Emission



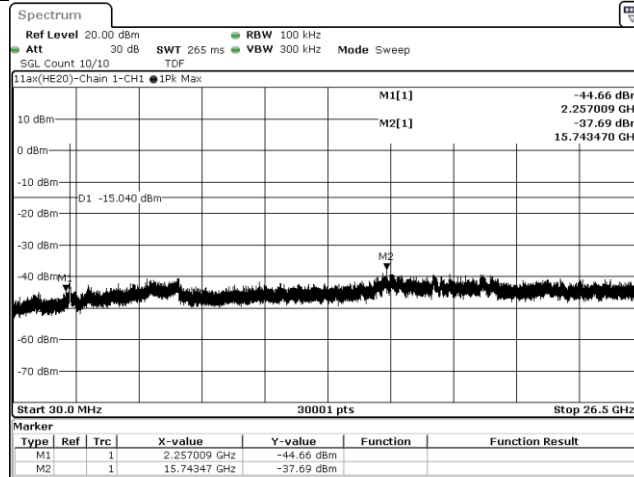
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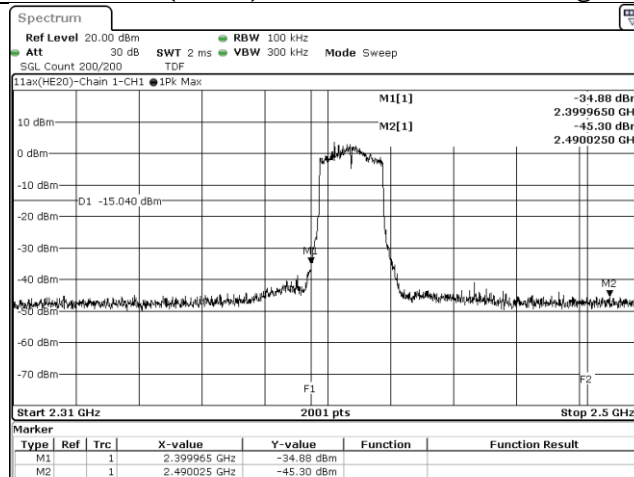
802.11ax(HE20), CH1, Chain 1, Reference



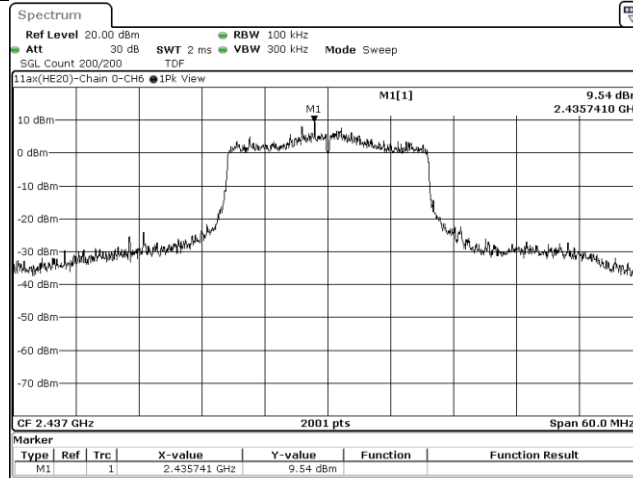
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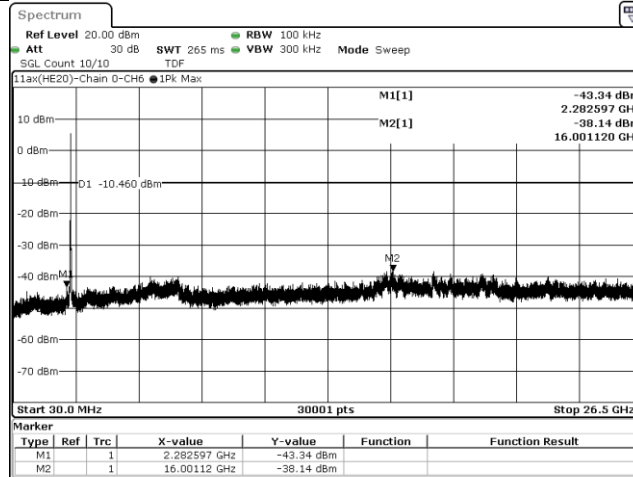
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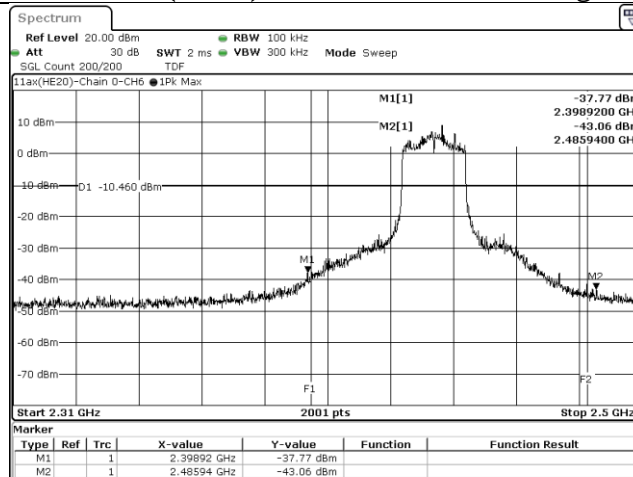
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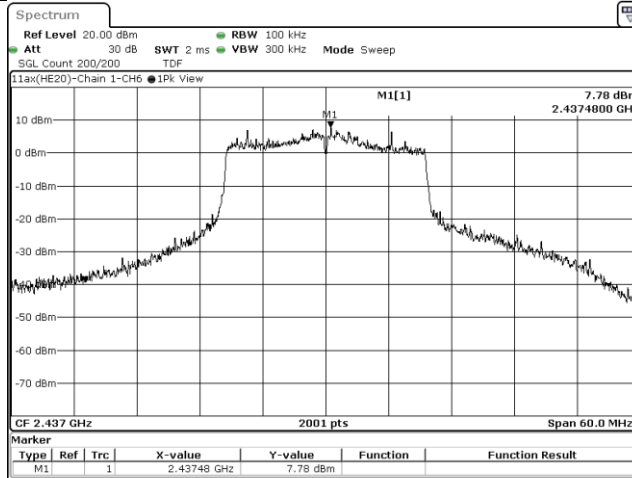
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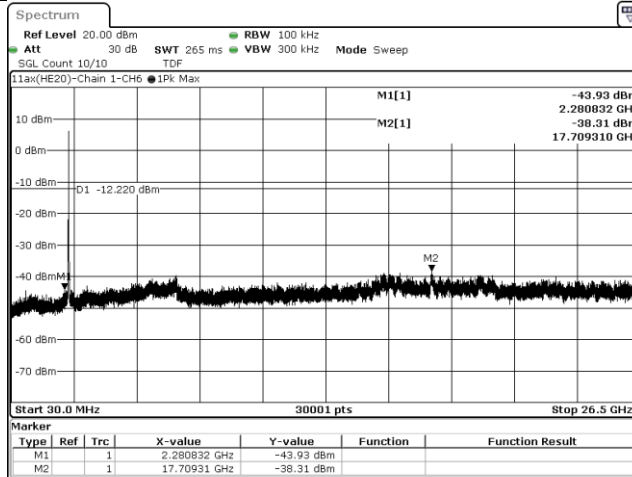
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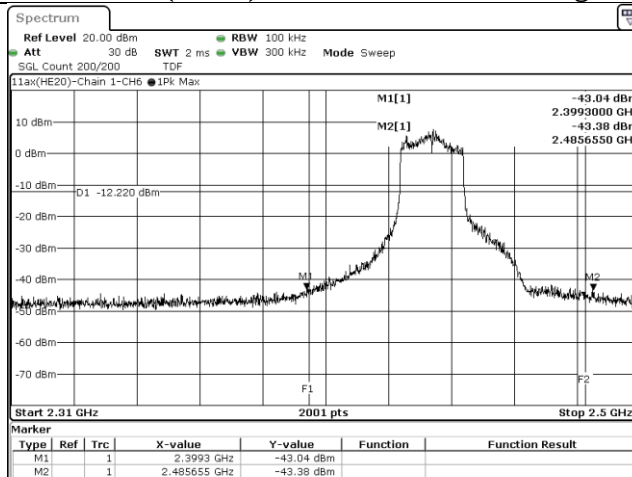
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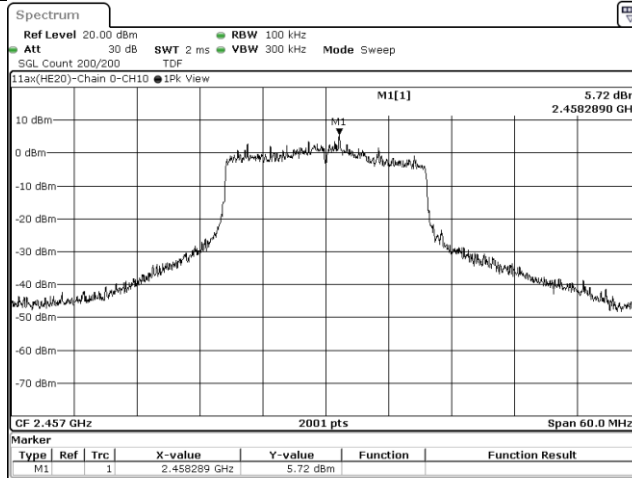
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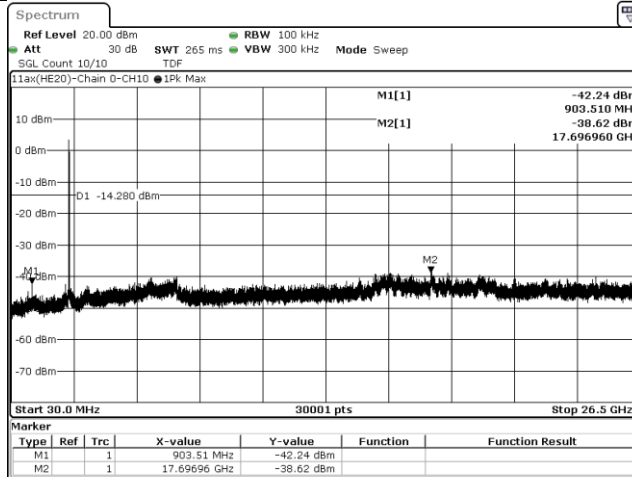
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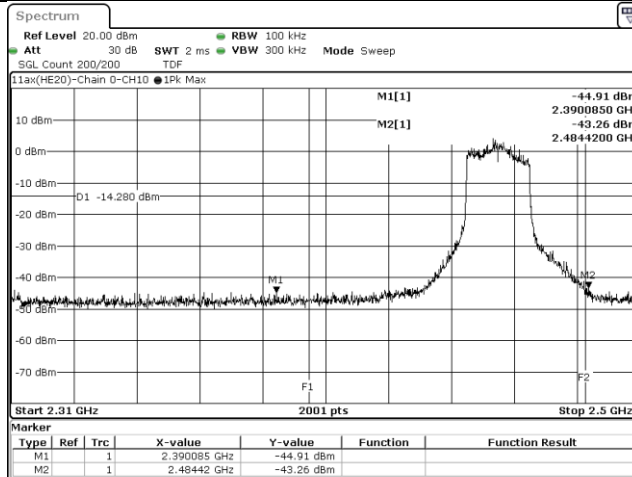
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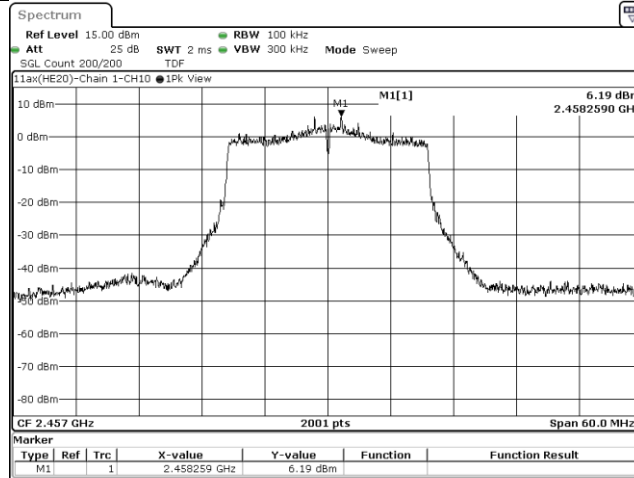
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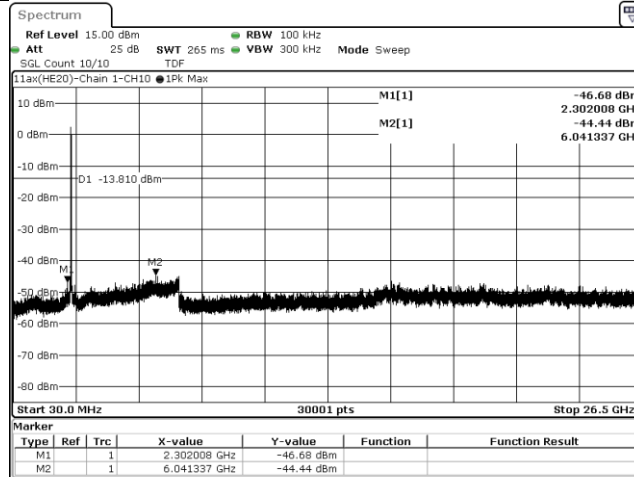
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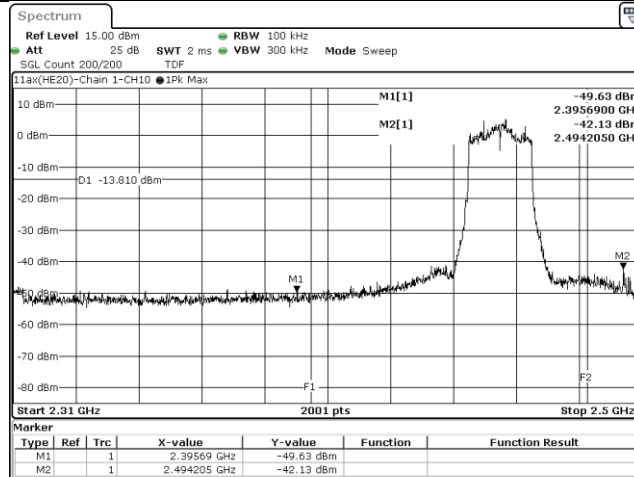
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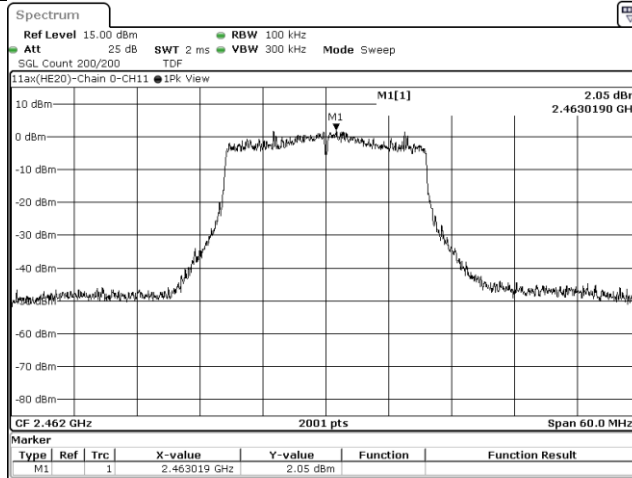
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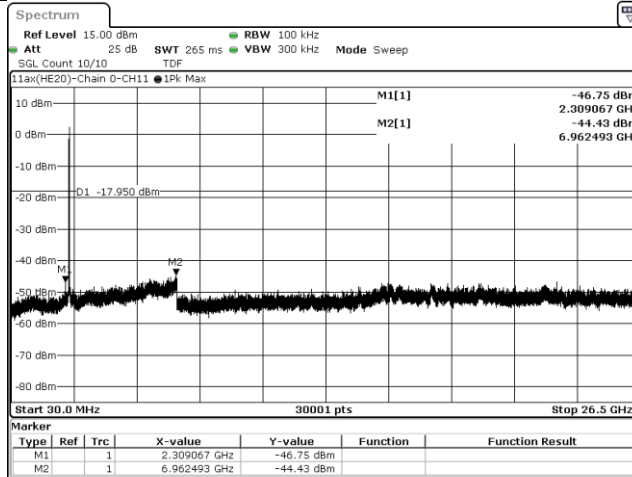
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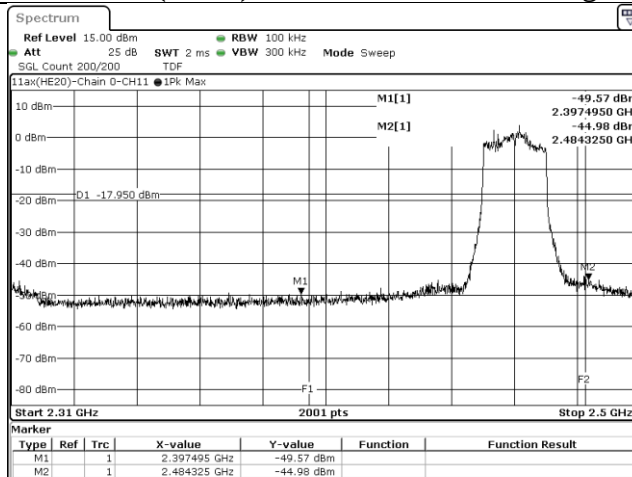
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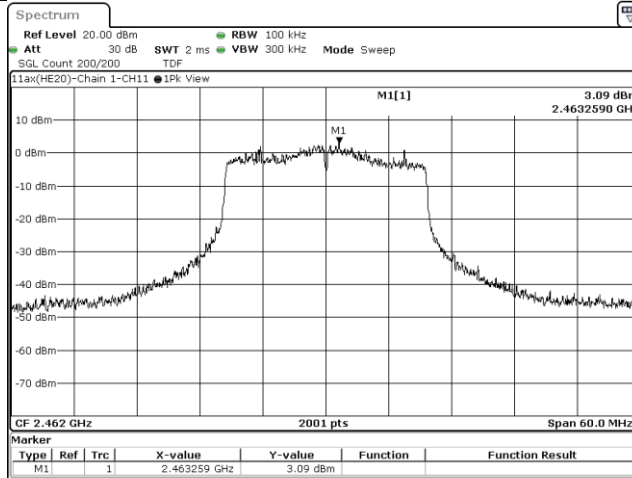
802.11ax(HE20), CH11, Chain 0, Conducted Emission



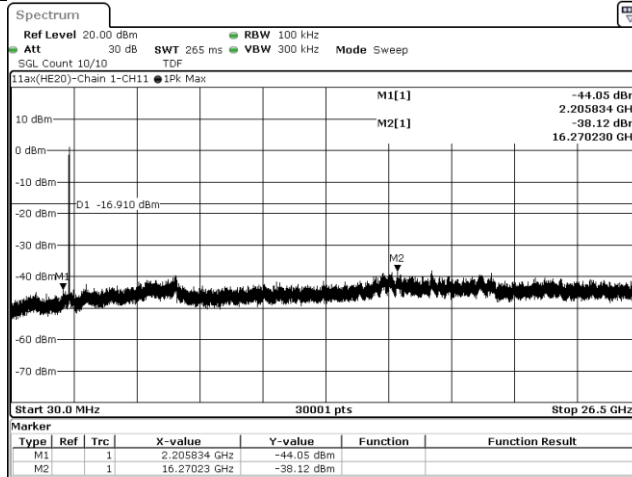
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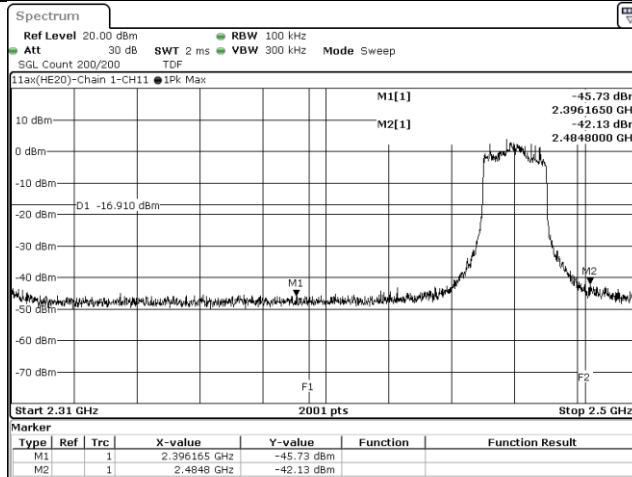
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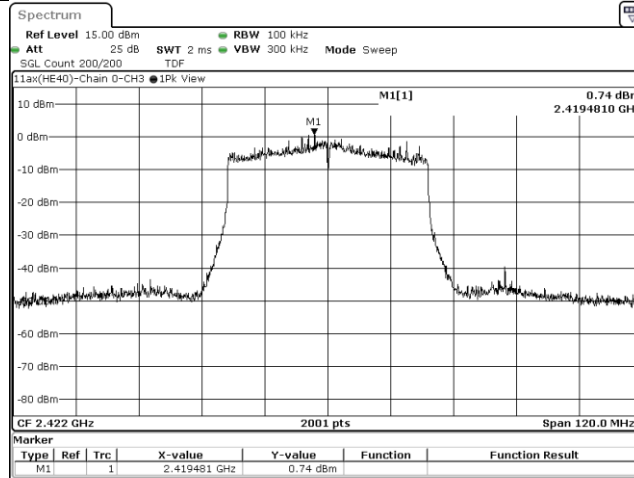
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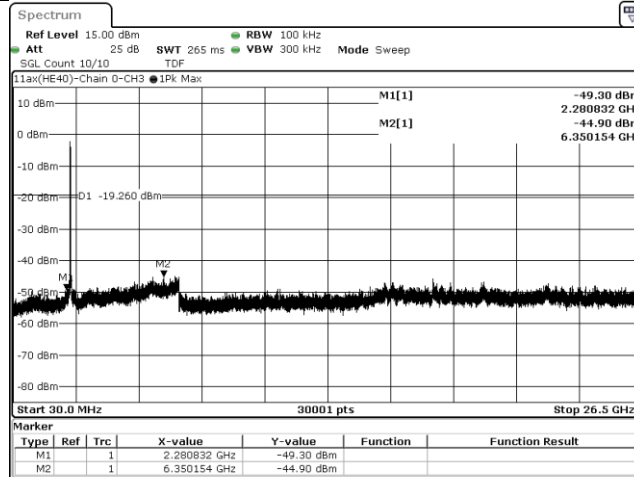
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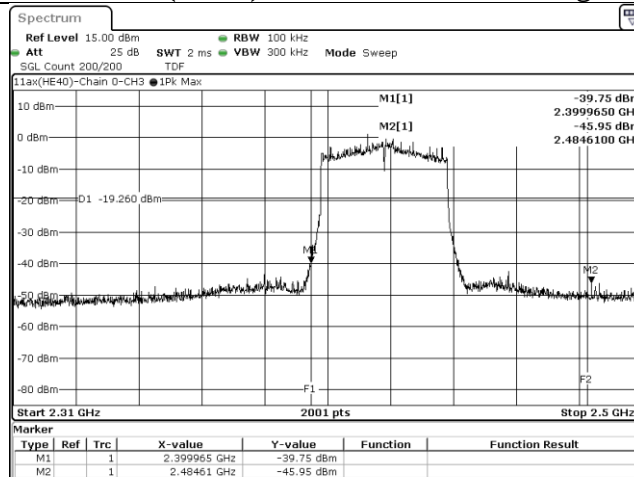
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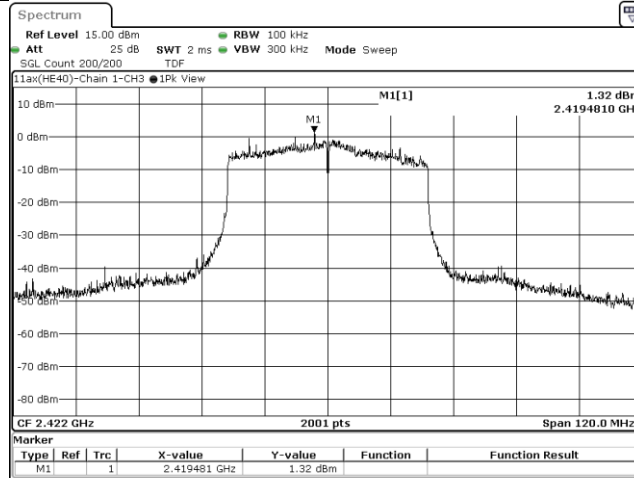
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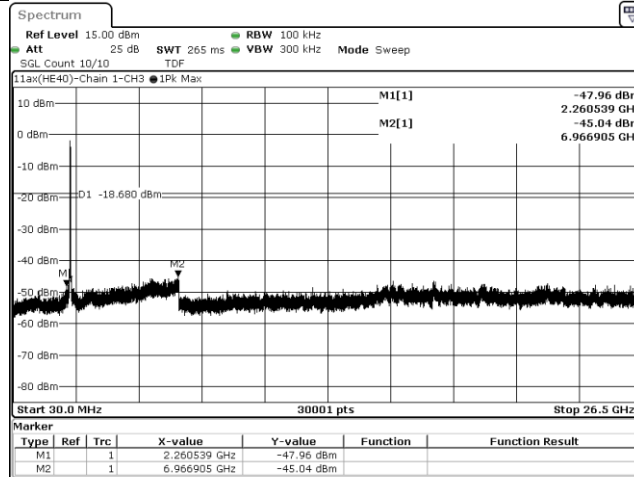
802.11ax(HE40), CH3, Chain 0, Band edge



802.11ax(HE40), CH3, Chain 1, Reference



802.11ax(HE40), CH3, Chain 1, Conducted Emission



802.11ax(HE40), CH3, Chain 1, Band edge

