



Electromagnetic Compatibility Test Report

Test Report No: MOT 171011

Issued on: June 06, 2012 Rev.4

Product Name

EWP2200 Semi Rugged VoWLAN Phone

**Tested According to
FCC 47 CFR, Part 15, Subpart C
IC RSS-210, Issue 8**

**Tests Performed for
Motorola Solutions, Inc.**

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ELECTRICAL TESTING
CERT #1633.01

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Test Report details:

Test commencement date: 08.09.2011
Test completion date: 22.09.2011
Customer's representative: Eli Basri
Issued on: 08.05.2011

Revision details:

Version	Date	Details/Reasons	Page no
Rev. 1	17.10.2011	-	-
Rev. 2	08.05.2012	Comment 20: Frequency range was revised	7
		Comment 21: PSD procedure was revised	9
		Comment 11: Test method for bandedge measurement was changed	9
		Comment 7: Test procedure of Radiated Emissions Measurements in the restricted bands was corrected	9
		Comment 6: Test procedure of Radiated Emission measurements was corrected	9
		Comment 8: Worst Case Result definition was corrected	10
		Comment 9: Test procedure for Power Line Emission measurements was corrected	10
		Comment 22: Measurement unit was changed to KHz in the Test results table	13
		Comment 26: Additional two channels 2417 & 2457 MHz were measured	22
		Comment 23: All PSD results were corrected to two decimal places	24
		Comment 24: The limit value was changed from -30 dBc to -20 dBc	33
		Comment 26: Additional two channels 2417 & 2457 MHz were measured	54
		Comment 25: Fundamental frequencies were corrected (typos)	55
		Comment 12: Definition of the emission level measured was corrected	76

Version	Date	Details/Reasons	Page no
Rev. 3	30.05.2012	Comment 2: In Sec. 4.4 Band edge locations indicated on the plots 4.4.27 – 4.4.36	48-52
		Comment 4: Section 2.1 updated	9
		Comment 5: Section 2.1 updated	9
		Comment 6: In Section 4.2 “Measured Peak Power” was replaced with “Measured Average Power”	22/23
		Comment 13: 2.4 GHz band updated	7
		Comment 14: Section 2.1 was revised & In Section 4.2 “Measured Peak Power” was replaced with “Measured Average Power”	9/22/23
		Comment 15: Extra plot was removed.in Sec.4.4	-
		Comment 16: In Sec.4.5 a note explaining why for the emissions at 2417 MHz and 2457 MHz were also measured for 802.11gn operation.	54
		Comment 17: Test results sentence corrected In Sec.4.11	110
Rev .4	10.06.12	Comment 2:Retesting was performed in order to clarify the location of bandedge	48-52
	10.06.12	Comment 3: the list of measuring equipment used was revised according to the last calibration data	115
	10.06.12	Comment 6: The S.A setting was removed because an average power meter was actually used	22
	10.06.12	Comment 7 (former 17) :the statement was removed	111
	10.06.12	Comment 8 (former 17): retesting conducted emission on AC leads performed	112

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was set up and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

WLAN 802.11b/g/n/a

Test Spec. Clause	Test Case	Remarks
47 CFR §15.247 (a) (2) RSS-210 section A8.2 (1)	6 dB Bandwidth	Comply
47 CFR §15.247 (b) (3) & RSS-210 section A8.4 (4)	Maximum Peak Output Power,	Comply
47 CFR §15.247 (e) & RSS-210 Section A8.2 (2)	Peak power spectral density	Comply
47 CFR §15.247 (d) & RSS-210 Section A8.5	Conducted Spurious Emissions	Comply
47 CFR §15.247 (d) & §15.205 & RSS-210 section A8.5	Spurious Radiated Emissions, Restricted Bands	Comply
47 CFR §15.247 (d), & §15.205, & §15.209(a)	Spurious Radiated Emissions, Restricted Bands	Comply
47 CFR §15.109/209 & RSS-GEN section 7.2.3.2	Radiated Emission, Receive Mode	Comply
47 CFR §15.203 & RSS - Gen. Section 7.1.4	Antenna Connector Requirements	Comply
47 CFR §15.407(b)(6) & §15.107/207, ICES-003 RSS-GEN section 7.2.3.2	Power line Emission measurements	Comply

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1. General Description

Product name: EWP2200 Semi Rugged VoWLAN Phone

Model: EWP2200

FCC ID: AZ489FT7052

IC ID: 109U-89FT7052

Description:

The EUT is a Smartphone which provides mobile voice and data communications over wireless network to users inside an enterprise.

It is capable of operating in the unlicensed 2.4 GHz band using 802.11b/g/n protocols or in applicable 5 GHz bands using the 802.11a/n protocol.

The EUT also contains a Bluetooth technology for short range interfaces and EWP2200 has an additional 3.2Mp auto-focus camera.

Maximum Peak Output Power:

2.4 GHz Band

74.64mW for WLAN 802.11b

68.08mW for WLAN 802.11g

64.57mW for WLAN 802.11n

5 GHz Band

77.09mW for WLAN 802.11n

72.61mW for WLAN 802.11a

Frequency range:

802.11b/g/n: 2.412 – 2.462 GHz

802.11a/n: 5.725-5.85GHz

Transmit Data rate:

Protocol	Rate [Mbps]							
	1	2	5.5	11				
802.11b	1	2	5.5	11				
802.11g	6	9	12	18	24	36	48	54
802.11n	6.5	13	19.5	26	39	52	58.5	65
802.11a	6	9	12	18	24	36	48	54

Type of Modulation:

Protocol	Modulation
802.11b	DSSS (DQPSK, DBPSK), CCK
802.11g	DSSS/OFDM (64QAM, 16QAM, QPSK, BPSK, DQPSK, DBPSK)
802.11n	DSSS/OFDM (64QAM, 16QAM, QPSK, BPSK, DQPSK, DBPSK)
802.11a	DSSS/OFDM (64QAM, 16QAM, QPSK, BPSK, DQPSK, DBPSK)

Antenna Specification:

Type: BT WLAN a/b/g/n: Integral (on board) PIFA Dual Band

Antenna Gain:

2412MHz +2.4dBi
2437MHz +2.4dBi
2462MHz +3.0dBi
2472MHz +3.0dBi
2484MHz +3.2dBi
5180MHz +2.0dBi
5320MHz +2.4dBi
5540MHz +2.0dBi
5660MHz +1.9dBi
5805MHz +2.3dBi

2. Method of Measurements

2.1. Conducted RF Measurements:

The RF output of the transmitter under test was directly connected to the input of the Spectrum analyzer through a specialized antenna connector provided by the manufacturer, and an attenuator as specified. The external attenuator and cable loss were added to the reading. Worst-case results of the various modulation modes (where applicable) were reported.

For PSD, emission peak was zoomed within the pass band with spectrum analyzer's settings as reported (Sweep time=Span/3kHz)

For Maximum Conducted Output Power an Average Power Meter was used.

For spurious emissions measurement, the spectrum from 9 KHz to 40GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

For bandedge measurement allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.

Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 1MHz to 25GHz was investigated following the guidelines in ANSI C63.4-2003, with the transmitter set to the lowest, middle and highest channel frequencies. Measurements were performed with peak detector and repeated averaged with VBW=10Hz. Only Peak detection plots are presented. Worst-case results of the various modulation modes (where applicable) were reported.

2.2. Radiated Emission measurements:

Measurements were performed at a 3-meter measurement distance in the semi-anechoic chamber in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions. The test program of exercising the equipment ensured that various parts of the EUT were exercised to permit detection of all EUT disturbances.

An appropriate antenna depending upon the frequency range, per ANSI C63.4-2003 clause 4.1.5 was used. While the turntable was being rotated, the height of the antenna was varied from 1 to 4m for the frequency range of 30MHz to 1GHz. The highest radiated emission was detected by manipulating the EUT through three axis(x,y,z) and system cables, a worst-case results are reported by max hold function

This process was repeated for both antenna polarizations. The spectrum up to 40GHz was investigated for spurious emissions, using a band-reject filter where appropriate.

The amplitudes of worst-case emission were measured with the detector modes and resolution bandwidths over various frequency ranges according to the requirements of ANSI C63.4-2003 clause 4.2.

2.3. Worst Case Results:

In order to determine the worst case emissions for all modes/data rates/tests, all modes/data rates were investigated for each required test to determine which produces the worst- case data and then full testing was performed in that mode/data rate

2.4. Power Line Emission measurements:

The EUT was placed on a non-conductive table/support 80 cm above the reference ground plane. The EUT was configured in accordance with ANSI C63.4-2003 using a 50 μ H/50 ohm LISN.

Compliance with the provisions was based on the measurements of the radio frequency voltage between each line and the ground at the power terminal.

3. Test Facility & Uncertainty of Measurement

3.1. Accreditation/ Registration reference:

- A2LA Certificate Number: 1633.01

3.2. Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom Group

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-8443

3m Anechoic Chamber:

The 3m-screened chamber is used in two configurations: the semi-anechoic configuration for Radiated Emission measurements and the full-anechoic configuration for Radiated Immunity tests.

Semi Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥ 80 dB at 15 kHz ≥ 90 dB at 100 kHz Electric field > 120 dB from 1MHz to 1GHz > 110 dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Frankonia hybrid absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	± 3.49 dB, 30MHz to 1GHz
Transmission Loss measured at 5 positions, at 1.5m height	± 3 dB, 1GHz to 18GHz

Full-Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	7m x 4m x 3m
Antenna height	1.55m at Horizontal & Vertical polarizations
Shielding Effectiveness	Magnetic field $\geq 80\text{dB}$ at 15 kHz $\geq 90\text{dB}$ at 100 kHz Electric field $> 120\text{dB}$ from 1MHz to 1GHz $> 110\text{dB}$ from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Frankonia hybrid absorbing material in selected positions on the walls and floor
Field Uniformity to EN61000-4-3	$\pm 3\text{dB}$ 80MHz to 18GHz

3.3. Uncertainty of Measurement:

Test Name	Test Method & Range	Uncertainty	
		Combined std. Uc(y) [dB]	Expanded U [dB]
Radiated Emission	30MHz÷230MHz, Horiz. polar.	1.8	3.6
	30MHz÷230MHz, Ver. polar.	2.0	3.9
	230MHz÷1000MHz, Horiz. polar.	1.5	3.0
	230MHz÷1000MHz, Vert. polar.	1.5	3.0
Conducted Emission	9 kHz÷150 kHz	1.4	2.8
	150 kHz÷30MHz	1.1	2.2

4. WLAN 802.11b/g/n/a: Report of Measurements and Examinations

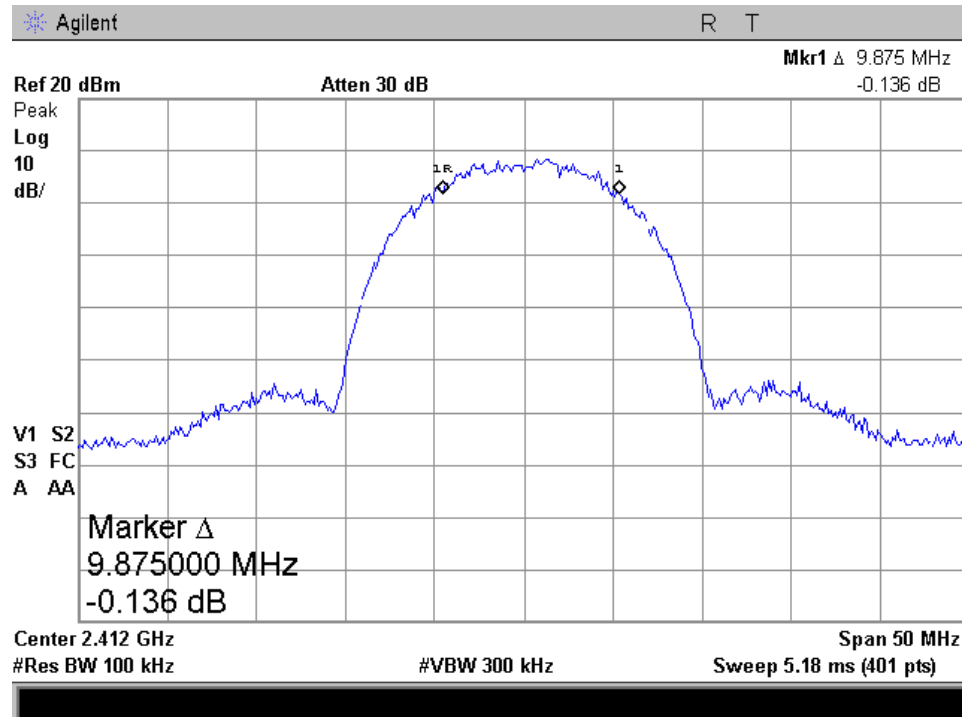
4.1. 6 dB Bandwidth

Reference document:	47 CFR §15.247 (a) (2)		
Test Requirements:	Systems using digital modulation techniques may operate in 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.		
Test setup:	See sec 2.1	Pass	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.1.1 - Plot 4.1.15	

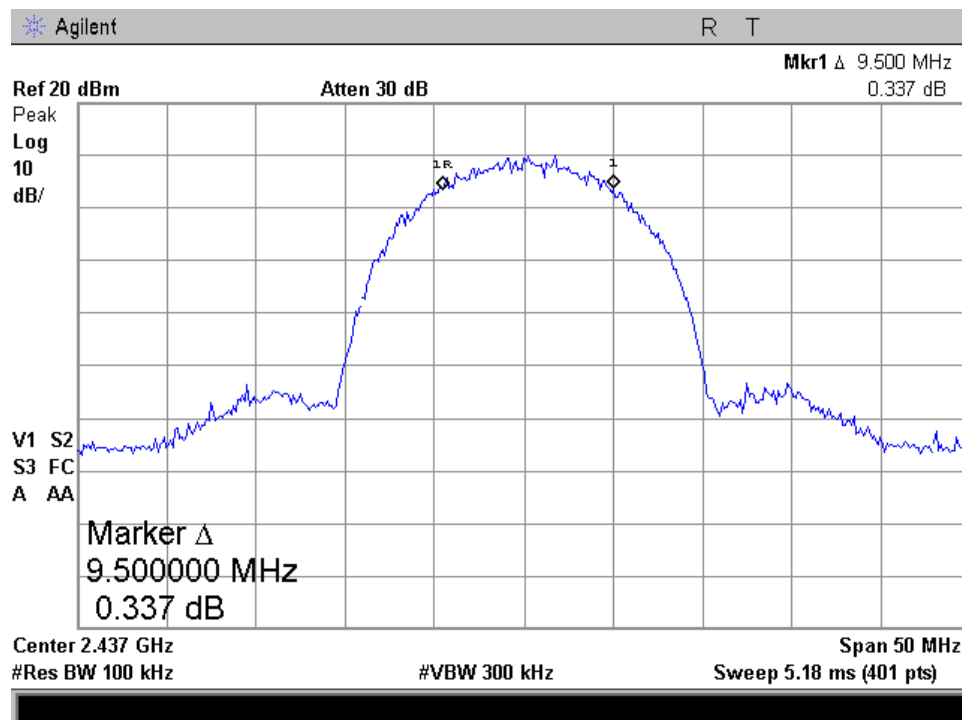
Test results

Frequency [MHz]	Data Rate [Mbps]	6 dB Bandwidth [kHz]	Limit [kHz]
802.11b Mode			
2412	11	9875	>500
2437	11	9500	>500
2462	11	10250	>500
802.11g Mode			
2412	54	15875	>500
2437	54	15750	>500
2462	54	16500	>500
802.11n Mode			
2412	MCS7	17250	>500
2437	MCS7	17125	>500
2462	MCS7	17250	>500
802.11a Mode			
5745	54	15771	>500
5785	54	16391	>500
5825	54	16103	>500
802.11n Mode			
5745	MCS7	16952	>500
5785	MCS7	16056	>500
5825	MCS7	16466	>500

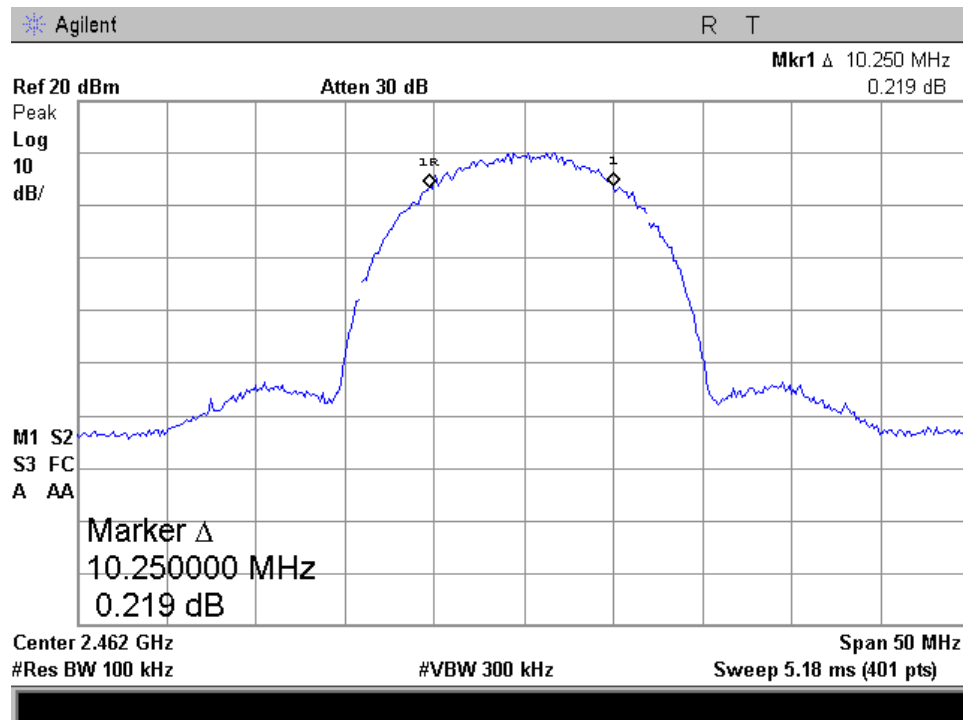
802.11b Mode
Plot 4.1.1



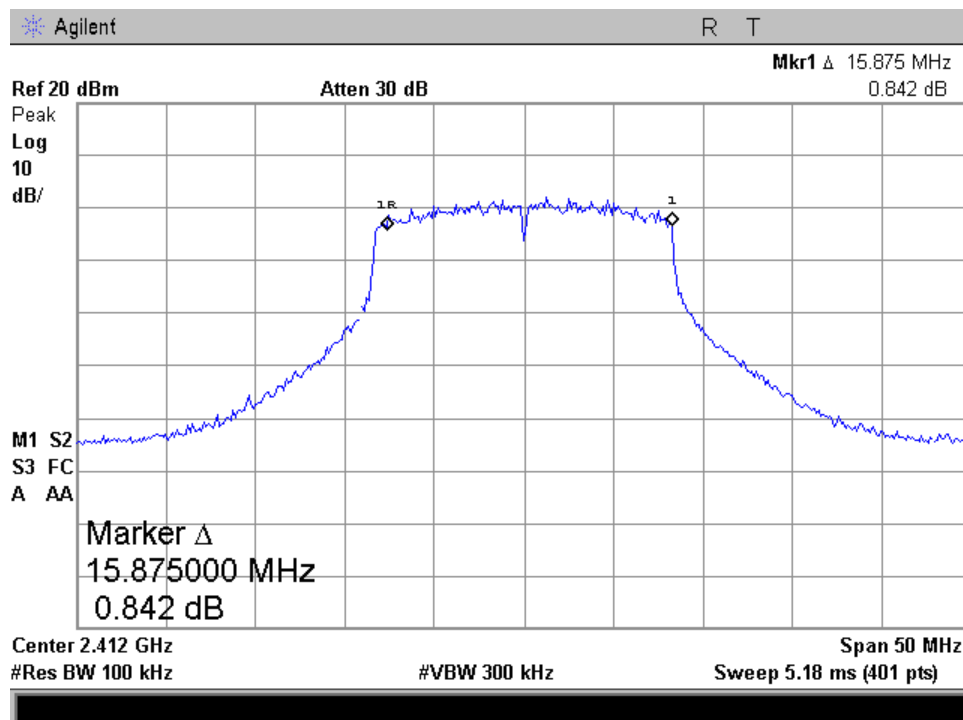
Plot 4.1.2



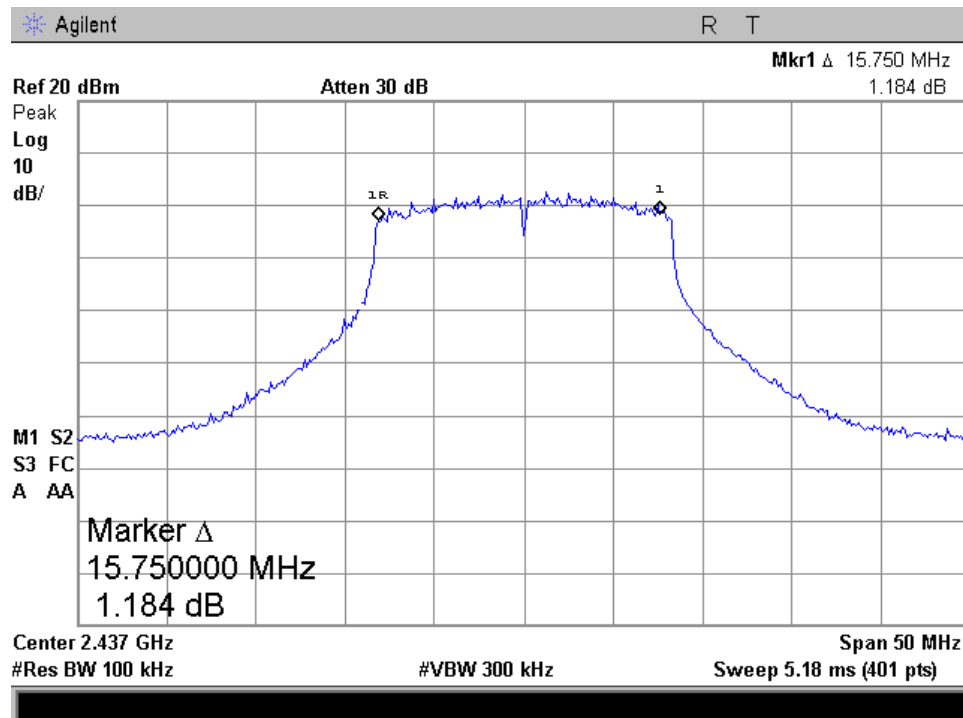
Plot 4.1.3



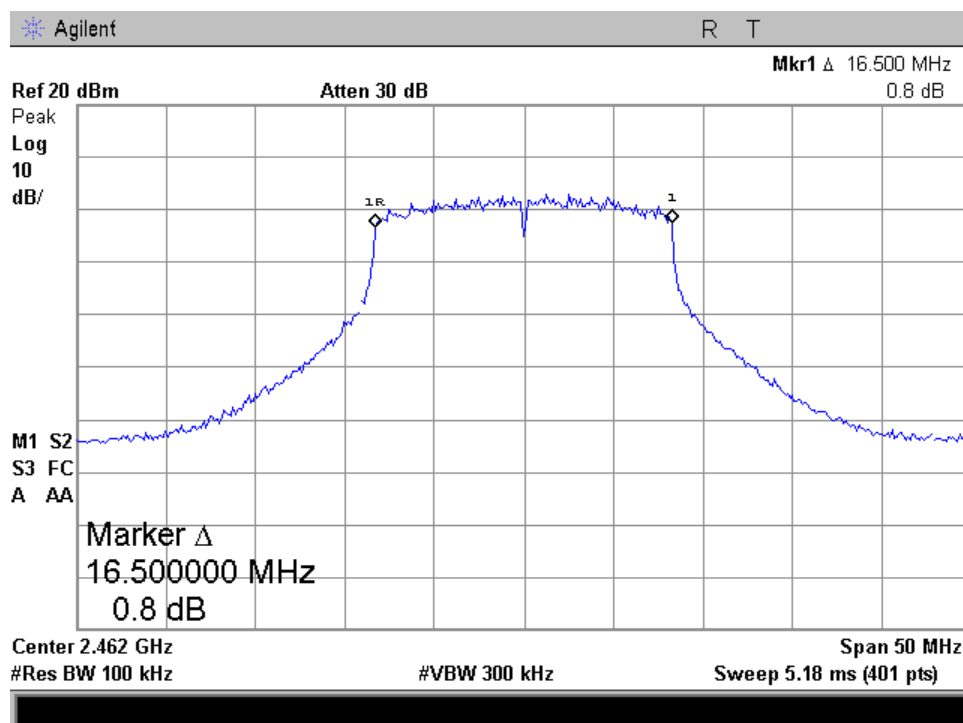
802.11g Mode
Plot 4.1.4



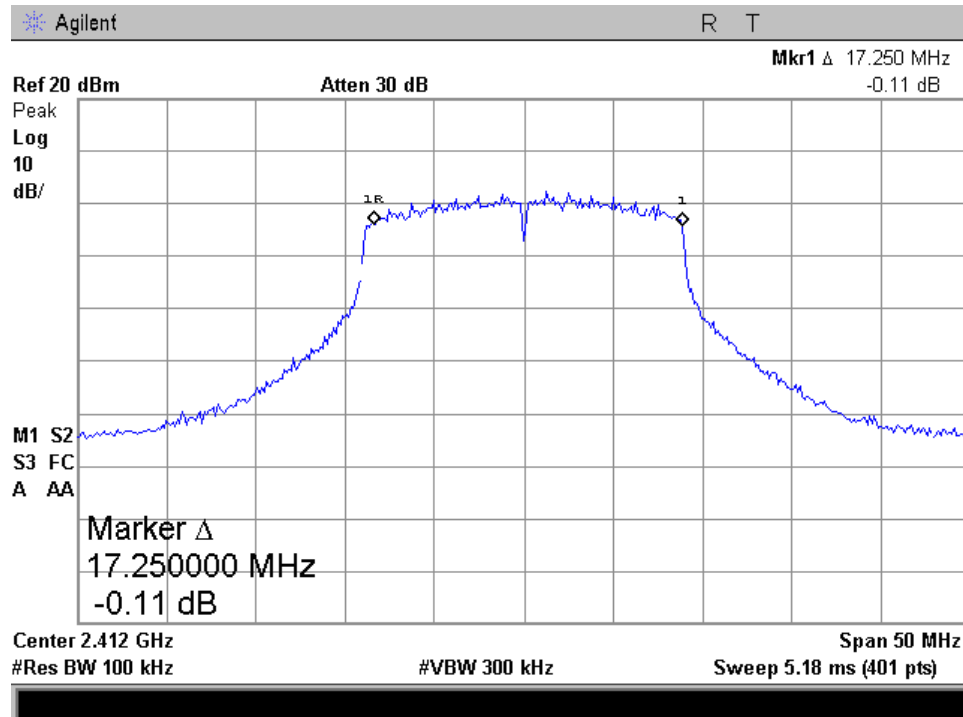
Plot 4.1.5



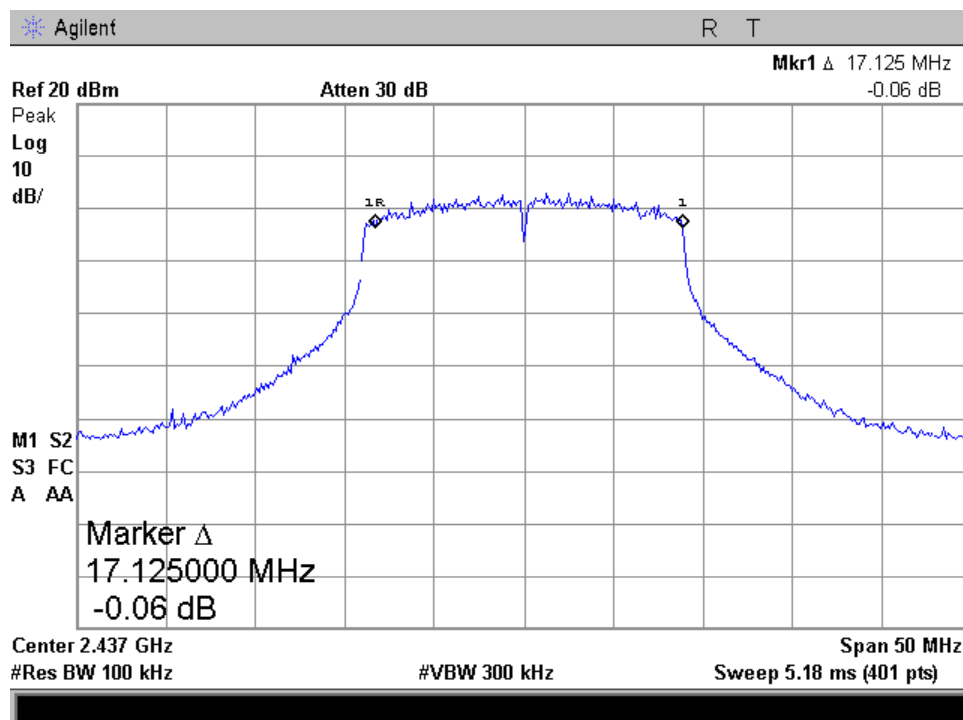
Plot 4.1.6



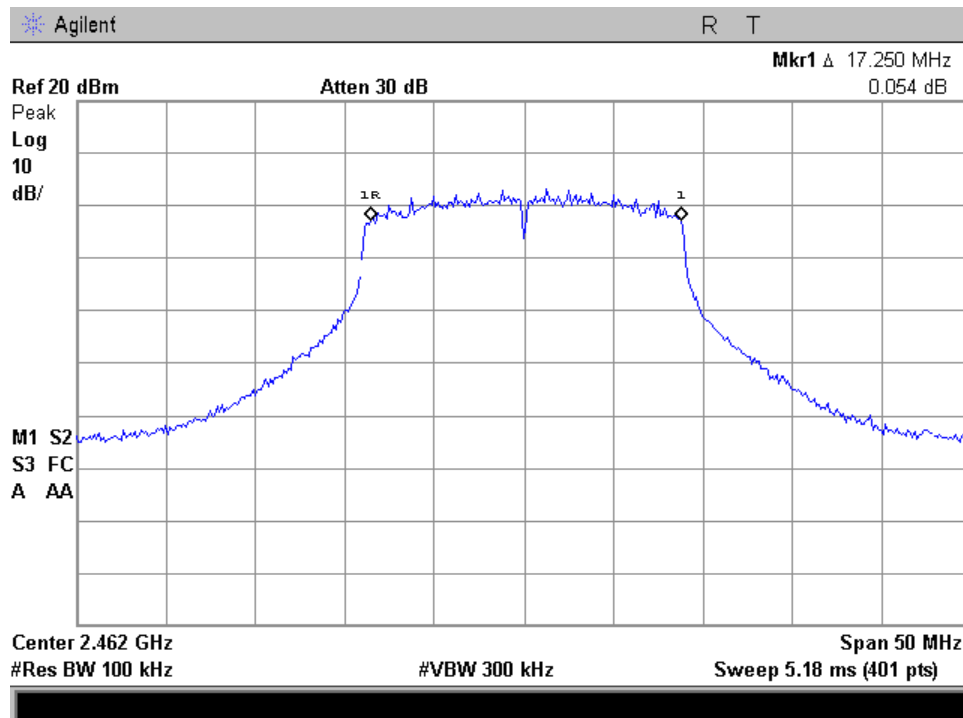
802.11n Mode
Plot 4.1.7



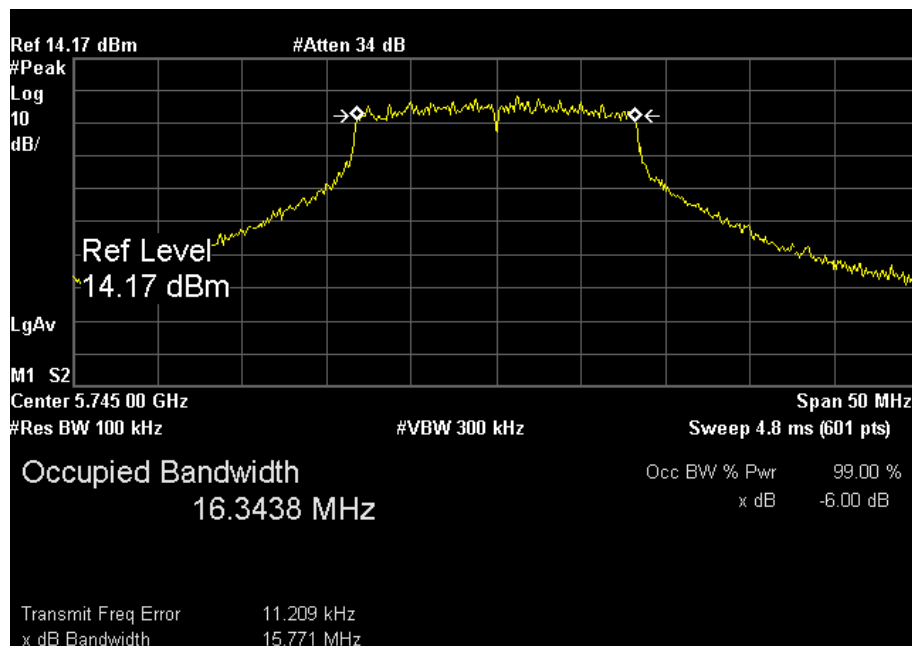
Plot 4.1.8



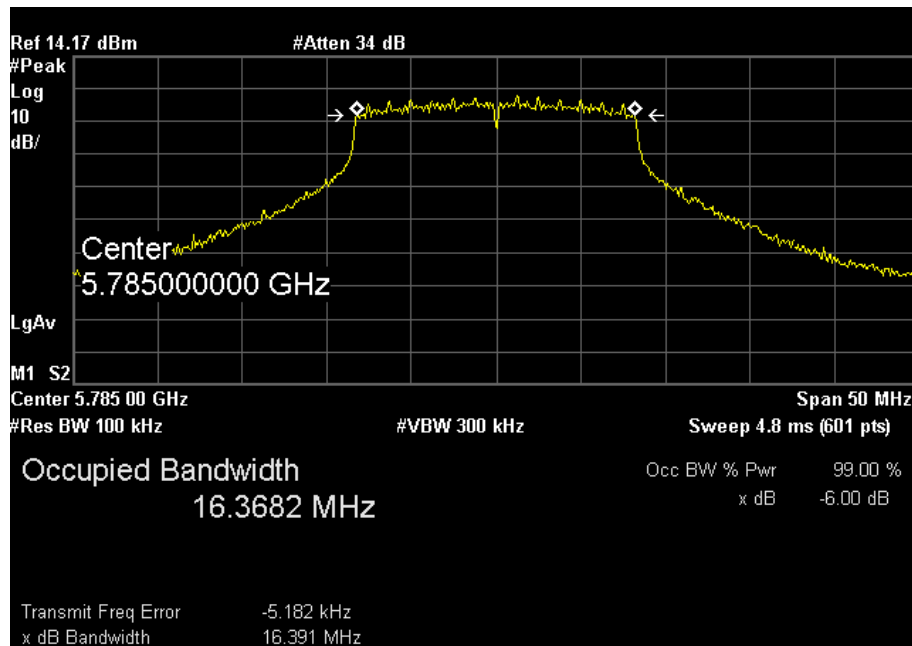
Plot 4.1.9



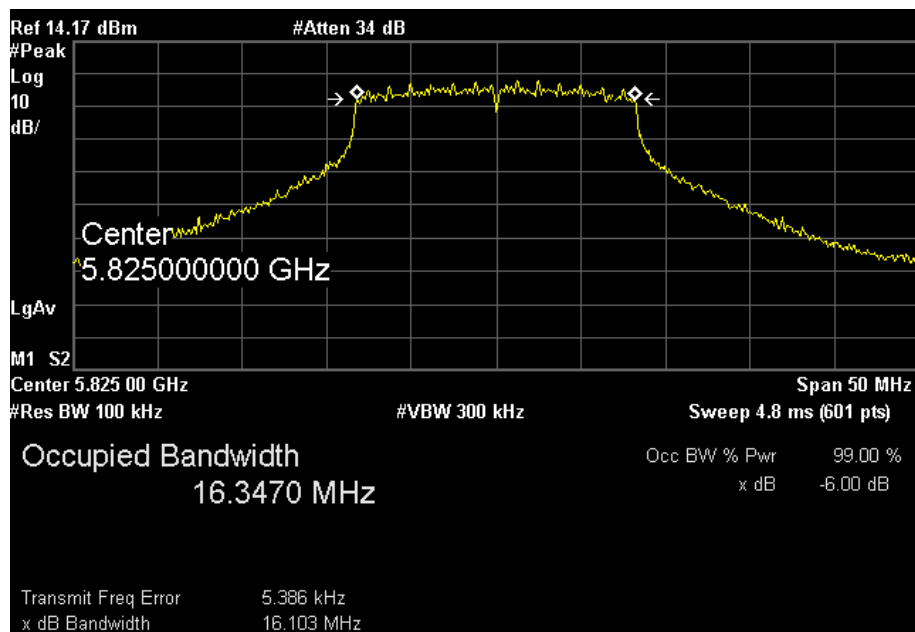
802.11a Mode
Plot 4.1.10



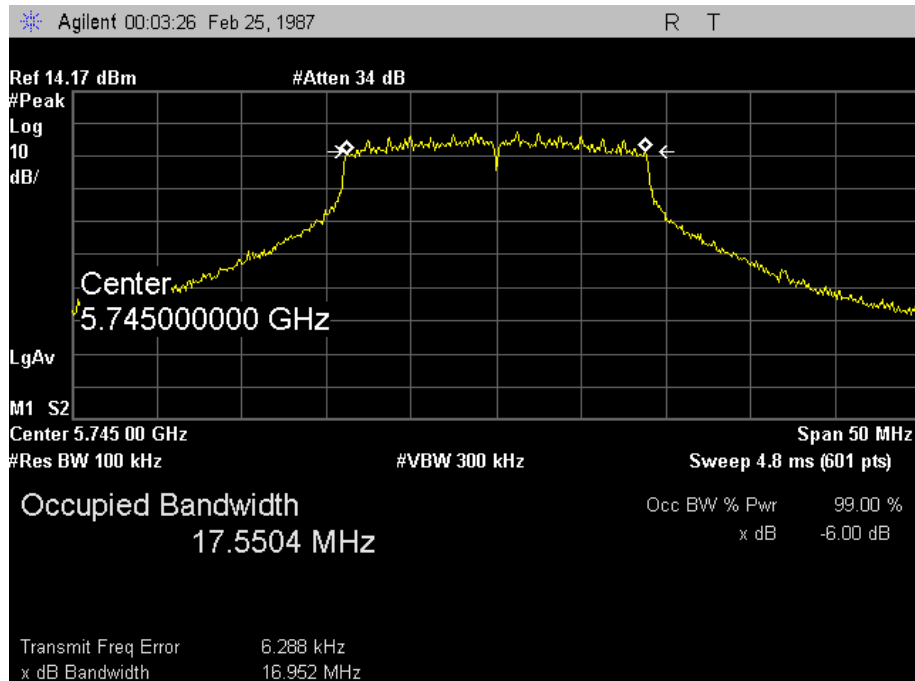
Plot 4.1.11



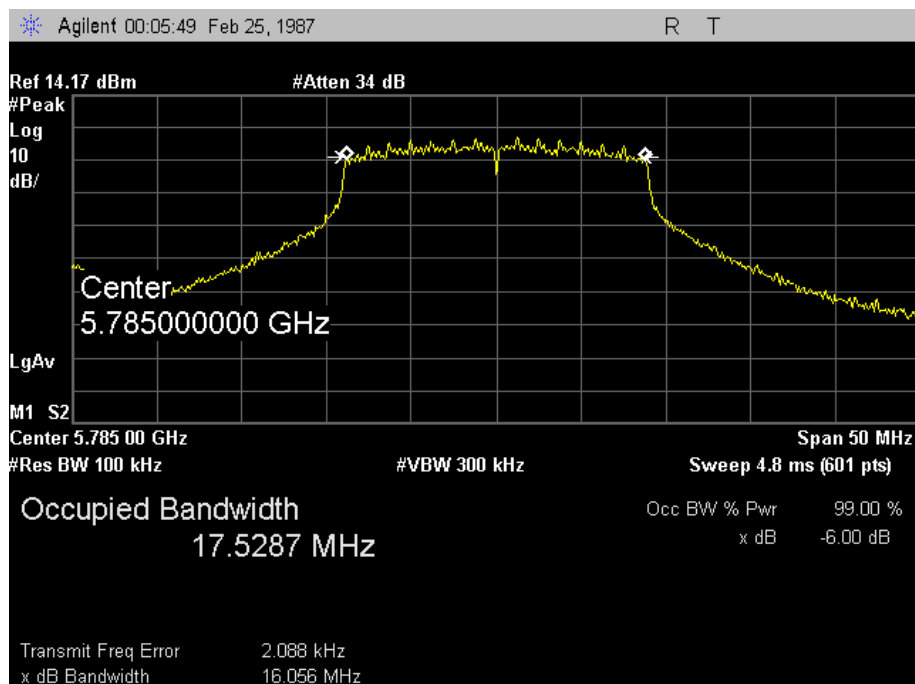
Plot 4.1.12



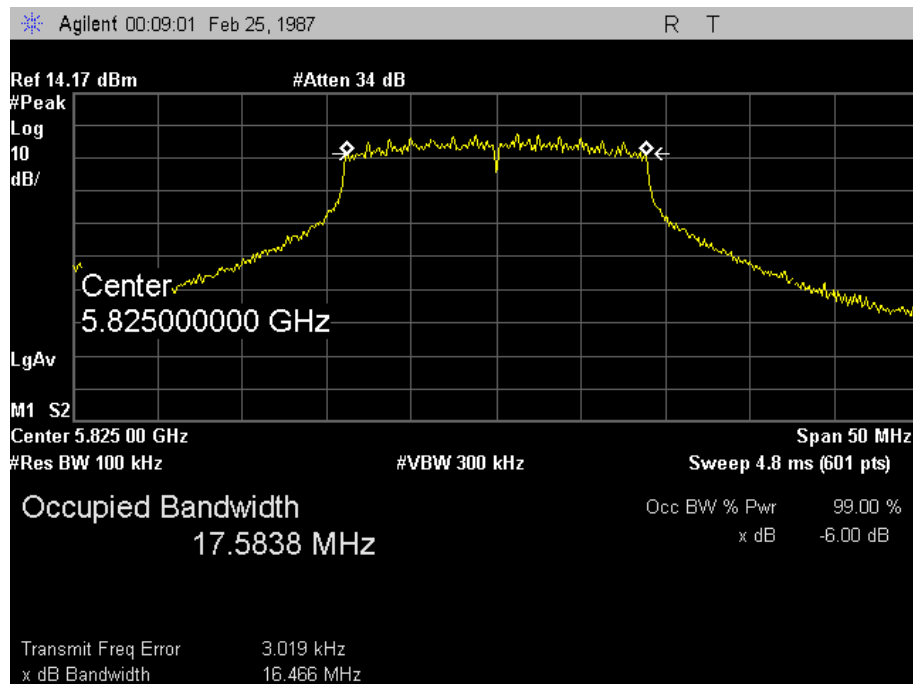
802.11n Mode
Plot 4.1.13



Plot 4.1.14



Plot 4.1.15



4.2. Maximum Peak Output Power, 2400-2483.5 MHz & 5725-5850 MHz

Reference document:	47 CFR §15.247 (b) (3)		
Test Requirements:	The maximum peak output power of the intentional radiator for systems using digital modulation in the 2400-2483.5 MHz & 5725-5850 MHz bands shall not exceed 1 Watt. Transmitters operating in the 2400-2483.5 & 5725-5850 MHz bands that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the arrays, i.e. the sum of the power supplied to the antenna elements, shall not exceed the limit calculated below. The total conducted output power shall be reduced by 1dB below the specified limit for each 3 dB that the directional gain of the antenna array exceeds 6dBi.		
Test setup:	See sec 2.1	Pass	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	---	

Test Results:

2400-2483.5 MHz Band

Frequency [MHz]	Data Rate [Mbps]	Average Output Power* [dBm]	Average Output Power* [mW]	Limit [dBm]	Margin [dB]
802.11b Mode					
2412	1	18.66	73.45	30.00	11.34
2437	1	18.73	74.64	30.00	11.27
2462	1	18.62	72.78	30.00	11.38
802.11g Mode					
2412	6.00	14.82	30.34	30.00	-15.18
2417	6.00	18.45	69.98	30.00	-11.55
2437	6.00	18.33	68.08	30.00	-11.67
2457	6.00	18.39	69.00	30.00	-11.61
2462	6.00	14.95	31.26	30.00	-15.05
802.11n Mode					
2412	MCS0	14.87	30.69	30.00	-15.13
2417	MCS0	18.37	68.70	30.00	-11.63
2437	MCS0	18.10	64.57	30.00	-11.9
2457	MCS0	18.47	70.30	30.00	-11.53
2462	MCS0	14.96	31.33	30.00	-15.04

5725 – 5845 MHz Band

Frequency [MHz]	Data Rate [Mbps]	Average Output Power* [dBm]	Average Output Power* [mW]	Limit [dBm]	Margin [dB]
802.11a Mode					
5745	6	18.56	71.78	30.00	11.44
5785	6	18.37	68.71	30.00	11.63
5825	6	18.61	72.61	30.00	11.39
802.11n Mode					
5745	MCS0	18.32	67.92	30.00	11.68
5785	MCS0	18.45	69.98	30.00	11.55
5825	MCS0	18.87	77.09	30.00	11.13

* Corrected for external attenuations.

4.3. Peak power spectral density

Reference document:	47 CFR §15.247 (e)		
Test Requirements:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.		
Test setup:	See sec 2.1	Pass	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 3 kHz, VBW: 10 kHz, Sweep Time: 100s		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.3.1 - Plot 4.3.15	

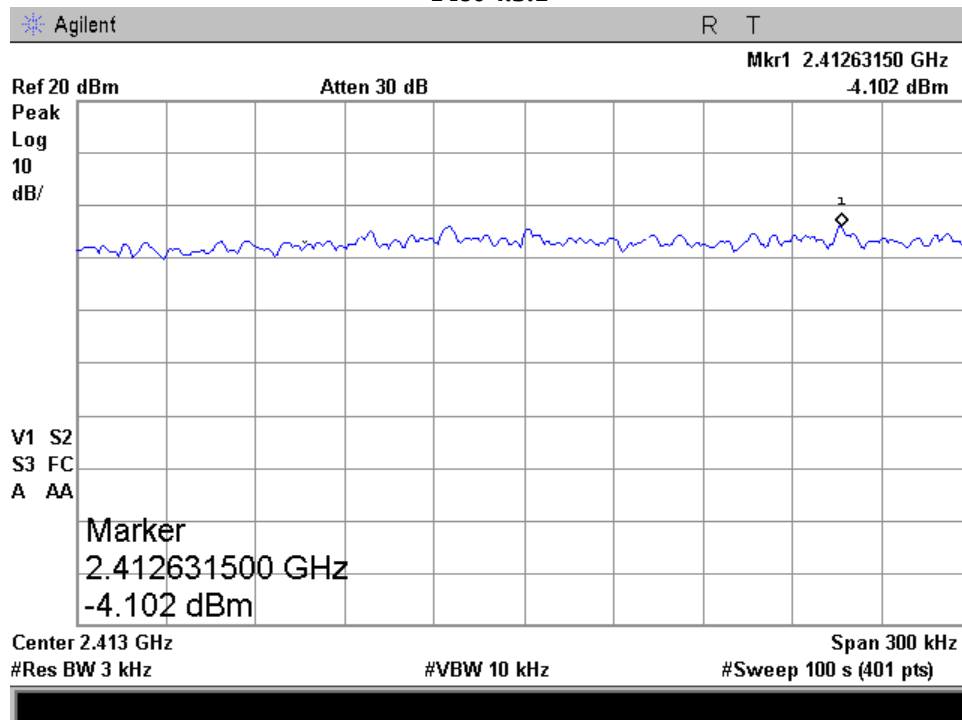
Test Results:

Frequency [MHz]	Data Rate [Mbps]	Measured PSD [dBm/3kHz]	Limit PSD [dBm/3kHz]	Margin [dB]
802.11b Mode				
2412	1	-4.10	8.00	-12.1
2437	1	-3.71	8.00	-11.71
2462	1	-3.74	8.00	-11.74
802.11g Mode				
2412	6	-7.92	8.00	-15.91
2437	6	-7.44	8.00	-15.44
2462	6	-8.87	8.00	-16.87
802.11n Mode				
2412	MCS0	-6.48	8.00	-14.48
2437	MCS0	-5.47	8.00	-13.47
2462	MCS0	-8.50	8.00	-16.50

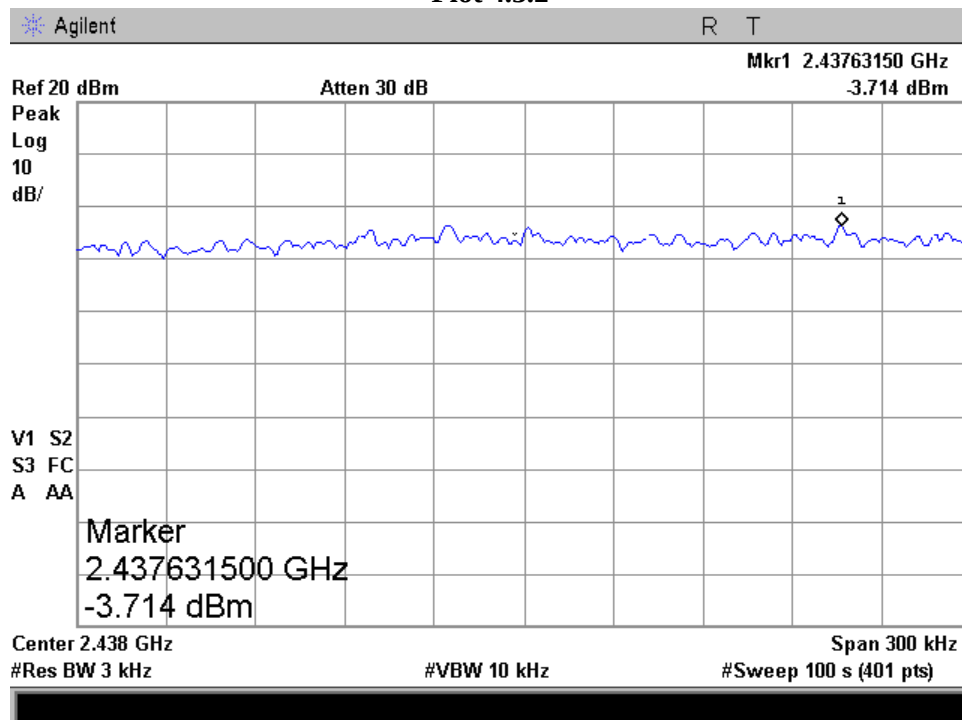
5725 MHz-5850 MHz bands

802.11 a Mode				
5745	6	-6.57	8.00	-14.57
5785	6	-6.82	8.00	-14.82
5825	6	-7.86	8.00	-15.86
802.11n Mode				
5745	MCS0	-8.76	8.00	-16.76
5785	MCS0	-6.96	8.00	-14.96
5825	MCS0	-7.16	8.00	-15.16

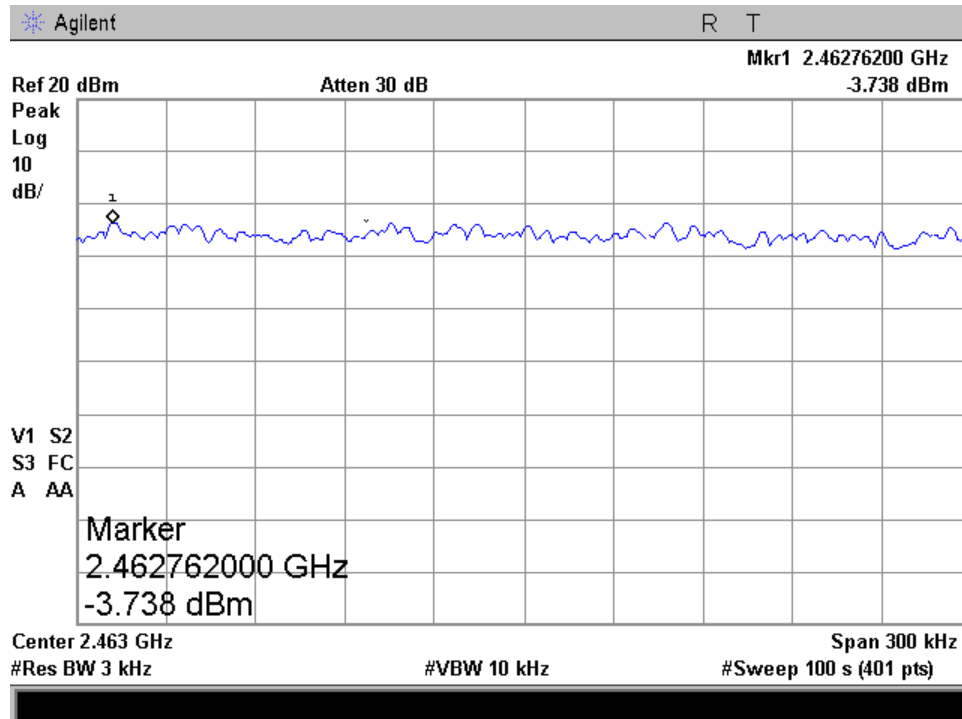
802.11b Mode
Plot 4.3.1



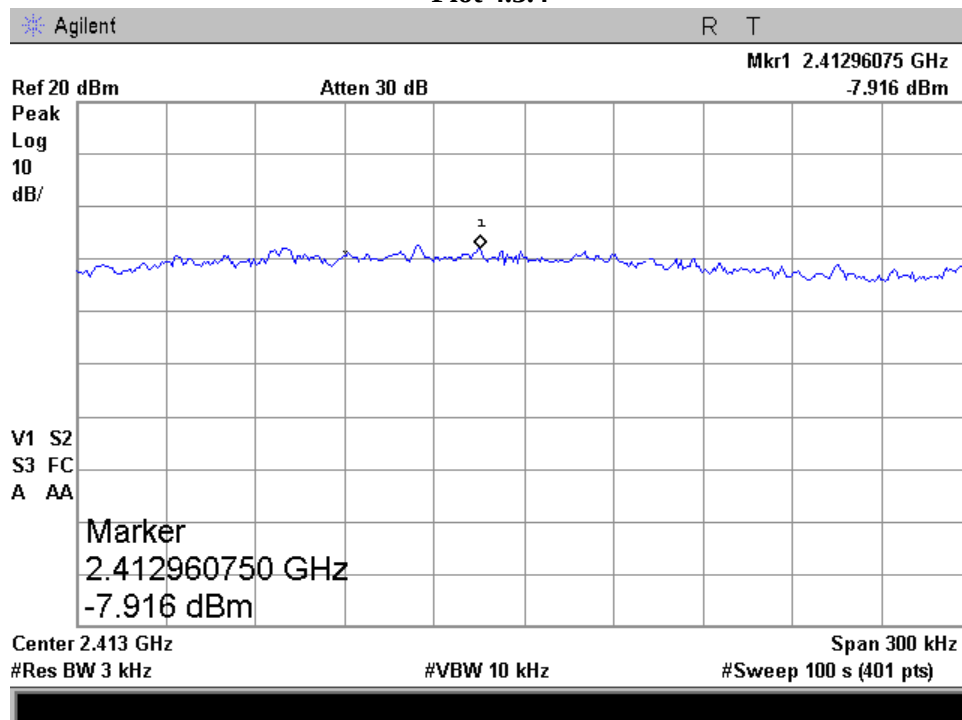
Plot 4.3.2



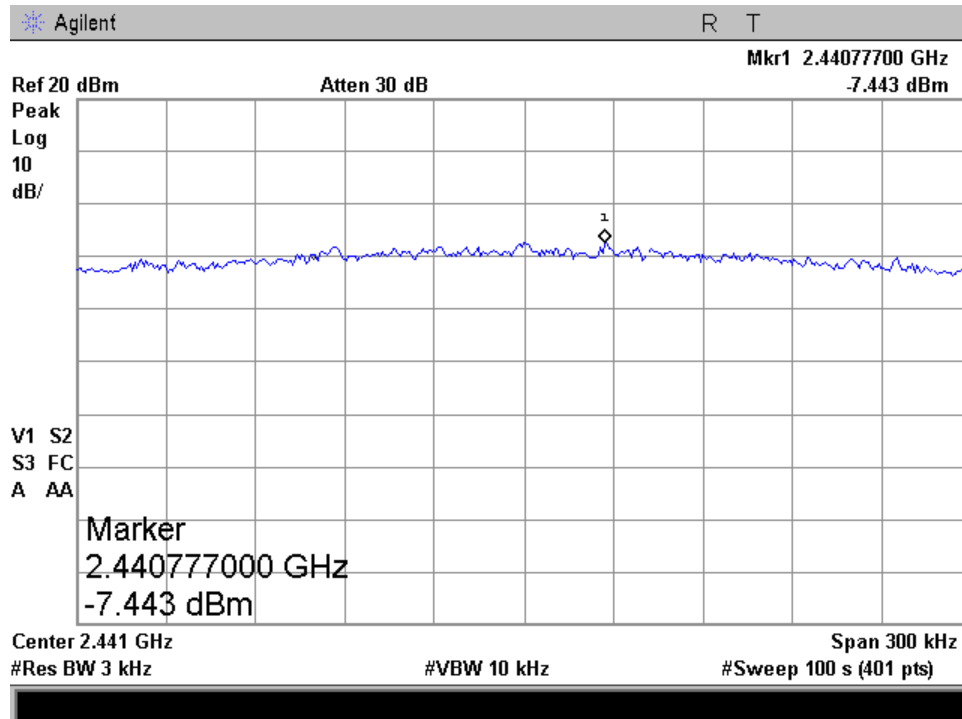
Plot 4.3.3



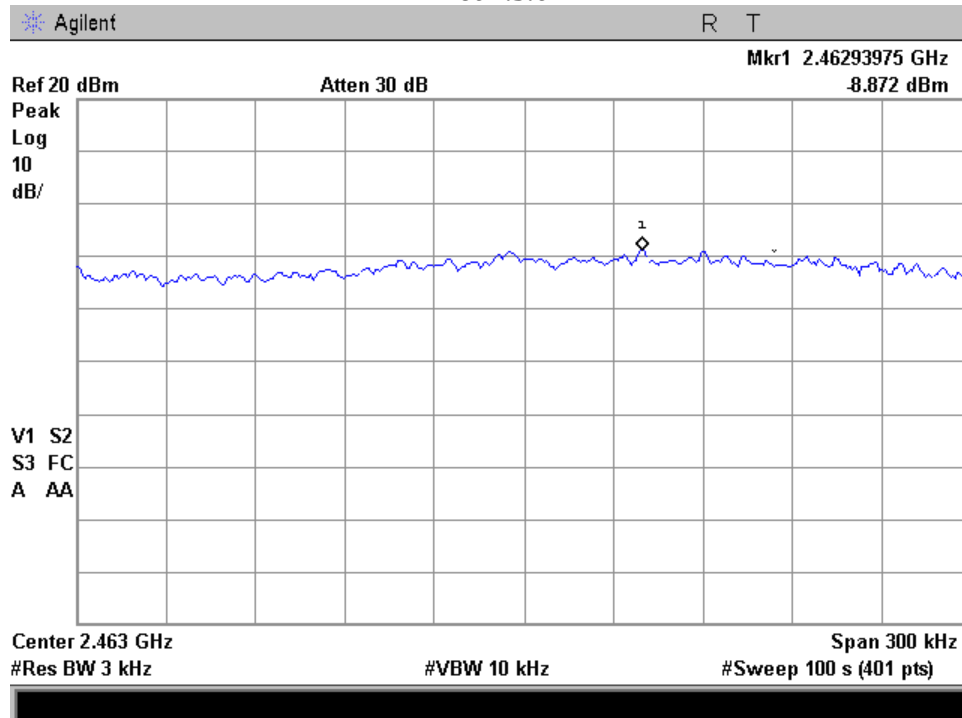
802.11g Mode
Plot 4.3.4



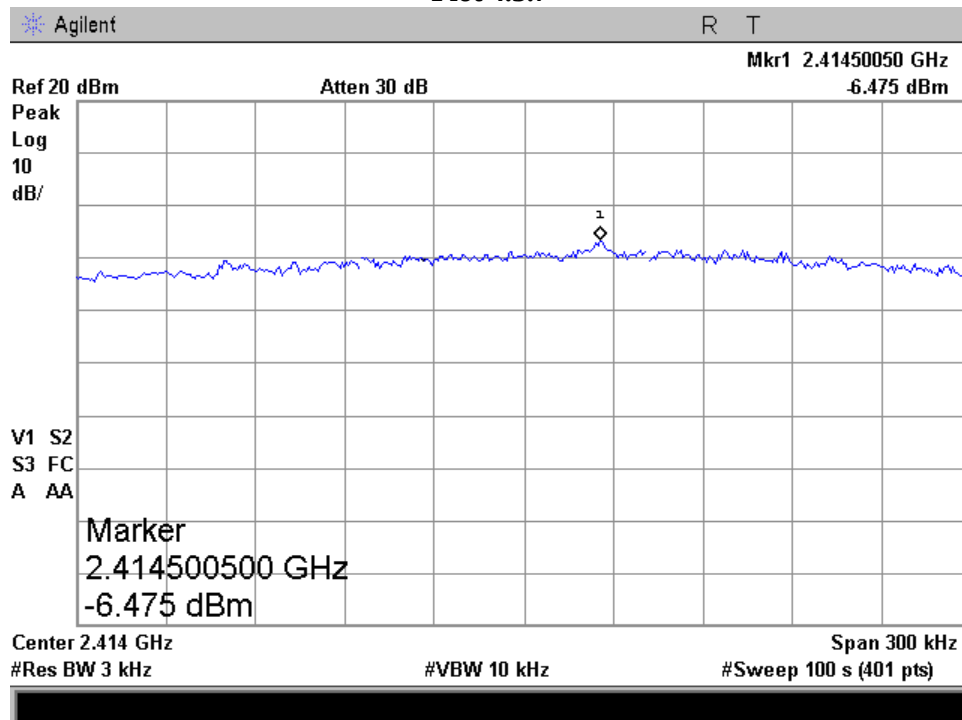
Plot 4.3.5



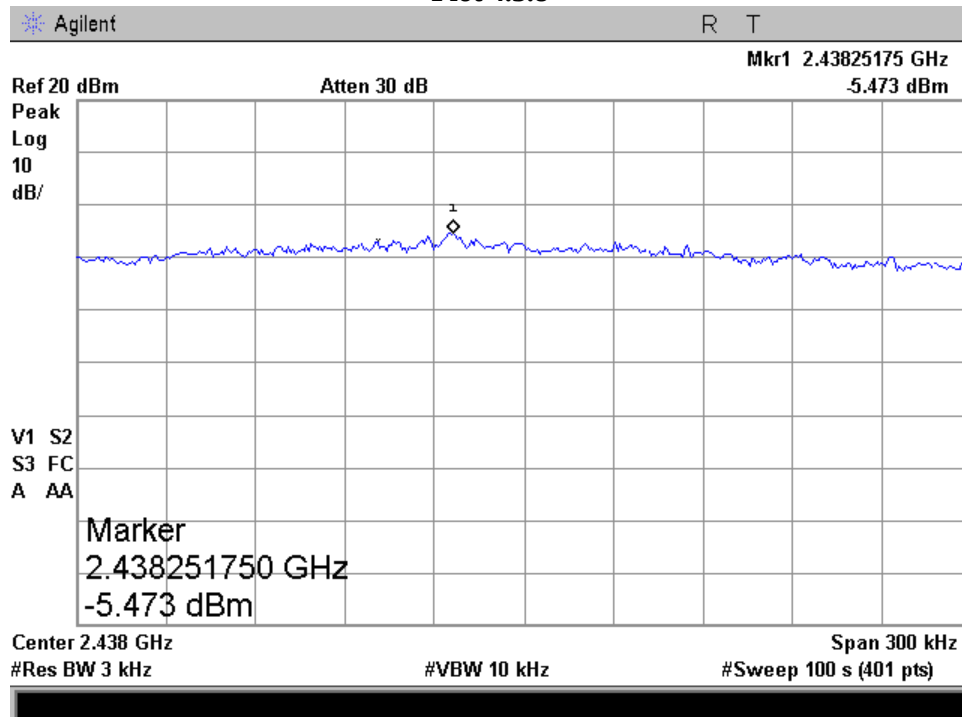
Plot 4.3.6



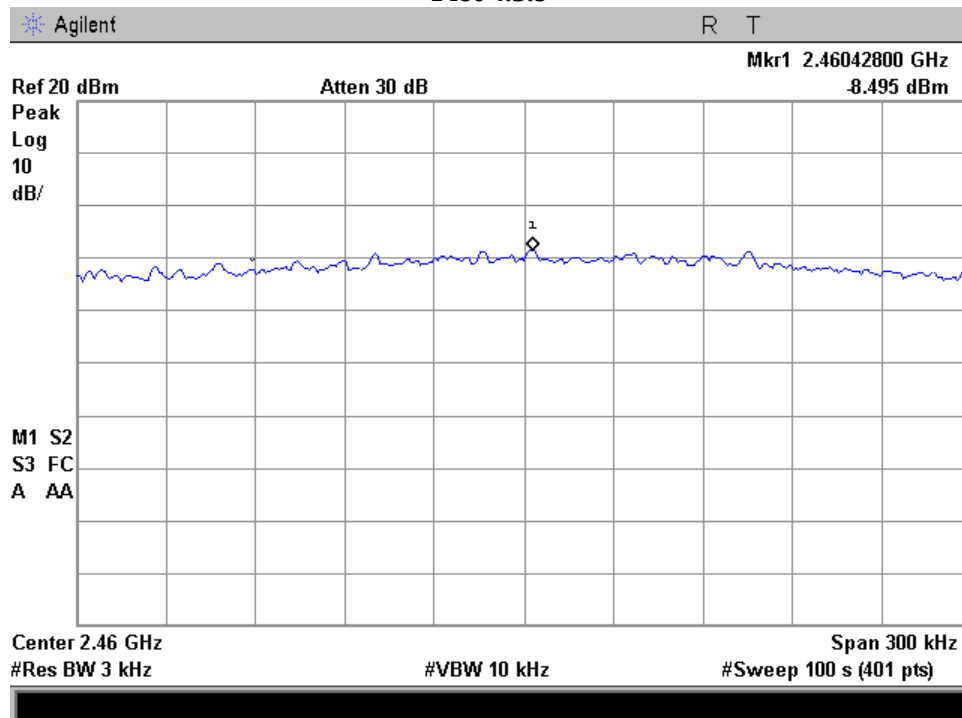
802.11n Mode
Plot 4.3.7



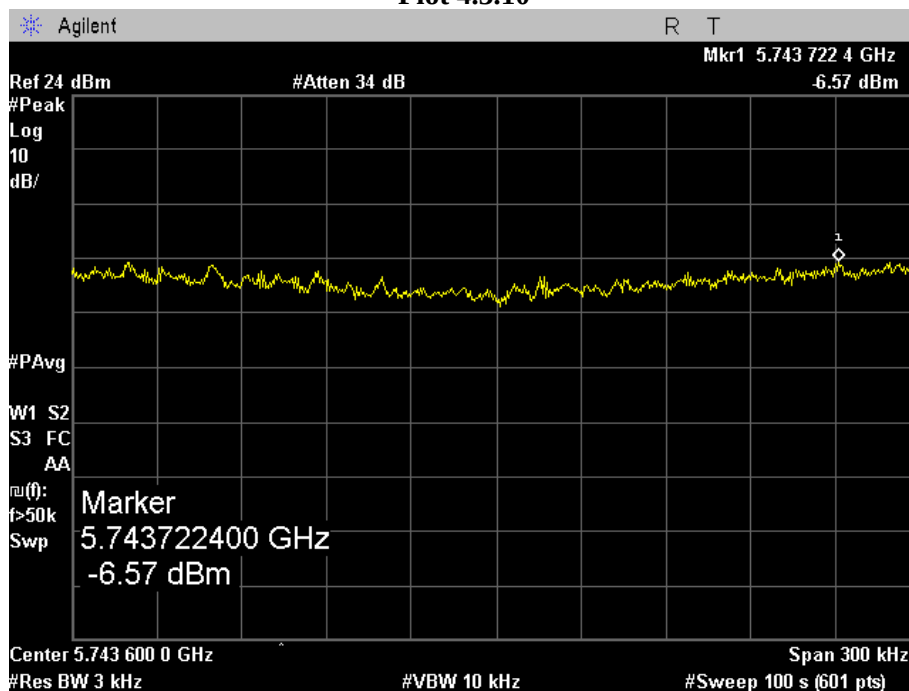
Plot 4.3.8



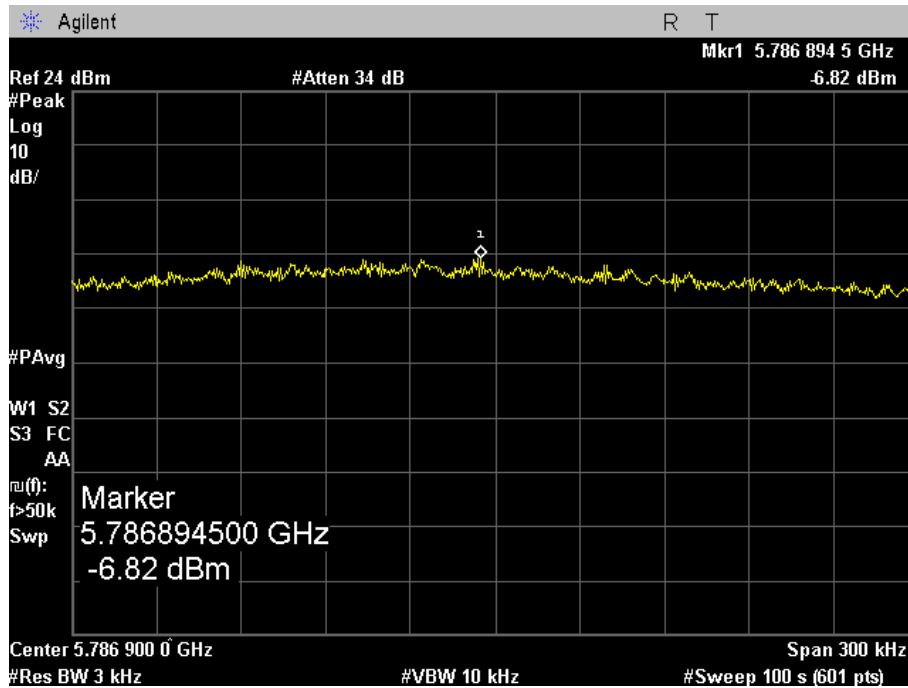
Plot 4.3.9



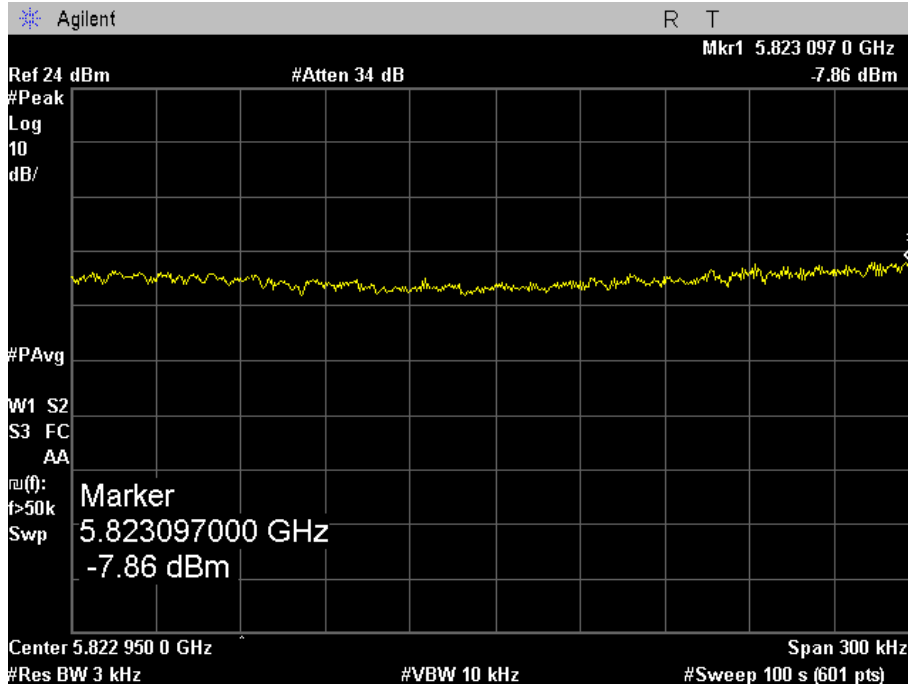
802.11 a Mode
Plot 4.3.10



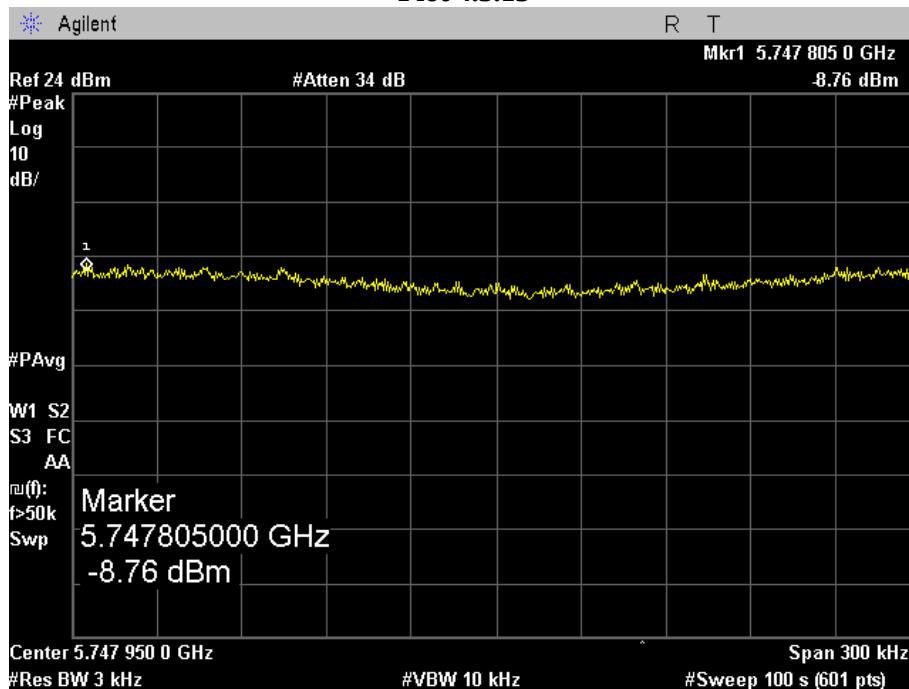
Plot 4.3.11



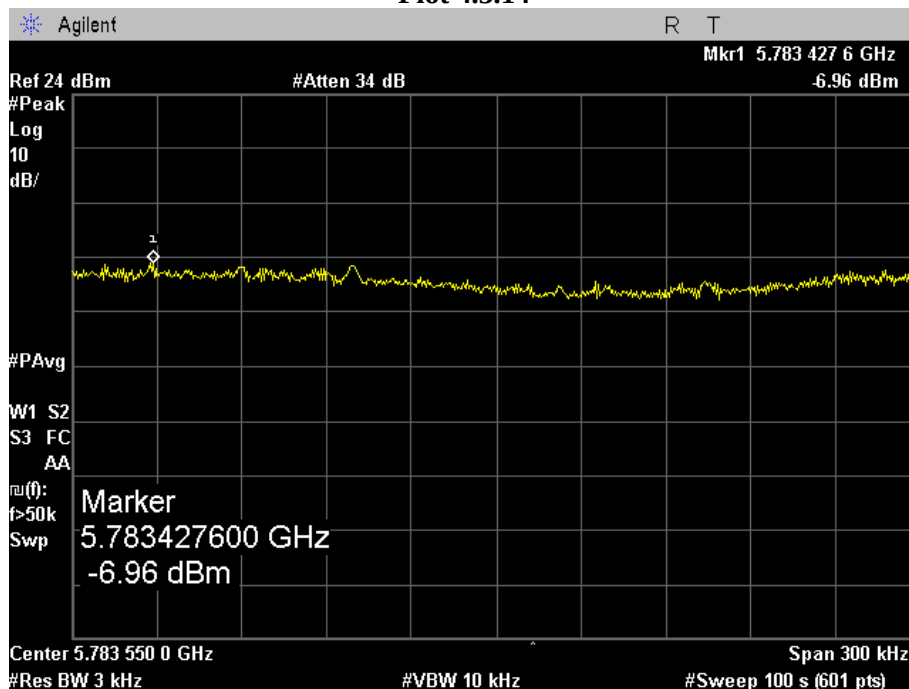
Plot 4.3.12



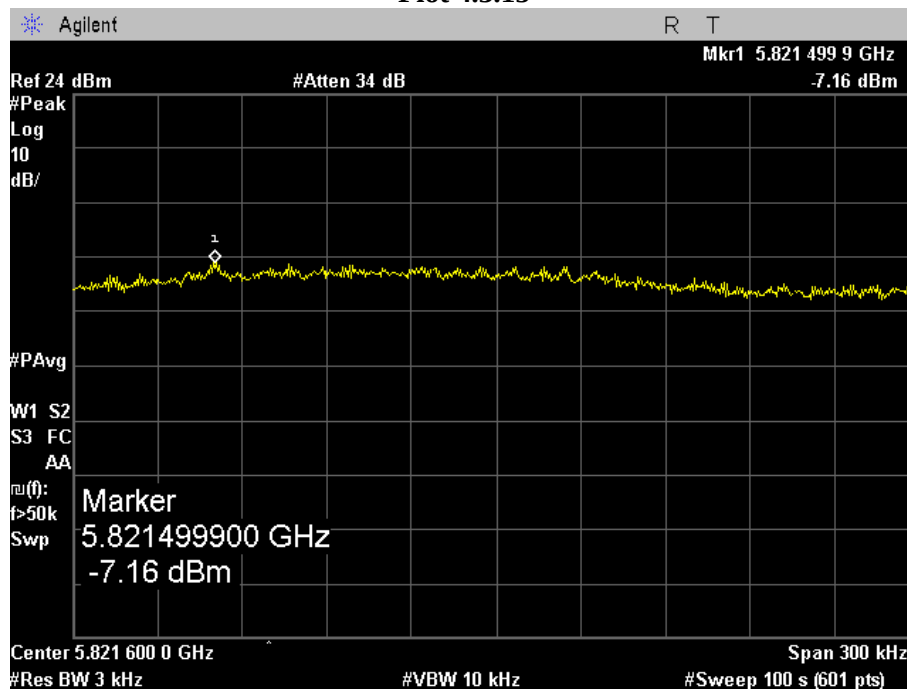
802.11n Mode
Plot 4.3.13



Plot 4.3.14



Plot 4.3.15



4.4. Conducted Spurious Emissions

Reference document:	47 CFR §15.247 (d)		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the digitally modulated 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 30dB instead of 20dB. Attenuation below the general limits specified in Section §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c).		
Test setup:	See sec 2.1	Pass	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100kHz, VBW:300kHz		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.4.1- Plot 4.4.37	

Test results:

2400-2483.5 MHz Band & 5725 MHz-5850 MHz bands

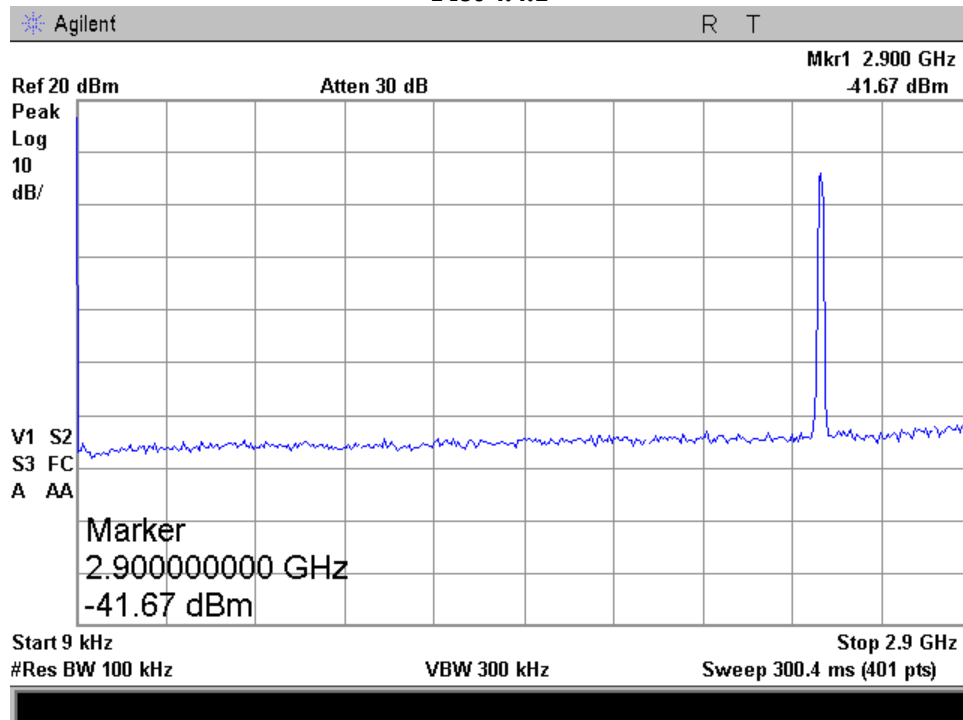
Spurious

Frequency [MHz]	Data Rate [Mbps]	Measured [dBc]	Limit [dBc]	Result
802.11b Mode				
2412	11	*	-20	Comply
2437	11	*	-20	Comply
2462	11	*	-20	Comply
802.11g Mode				
2412	54	*	-20	Comply
2437	54	*	-20	Comply
2462	54	*	-20	Comply
802.11n mode				
2412	MCS7	*	-20	Comply
2437	MCS7	*	-20	Comply
2462	MCS7	*	-20	Comply
802.11a mode				
5745	54	*	-20	Comply
5785	54	*	-20	Comply
5825	54	*	-20	Comply
802.11n mode				
5745	MCS7	*	-20	Comply
5785	MCS7	*	-20	Comply
5825	MCS7	*	-20	Comply

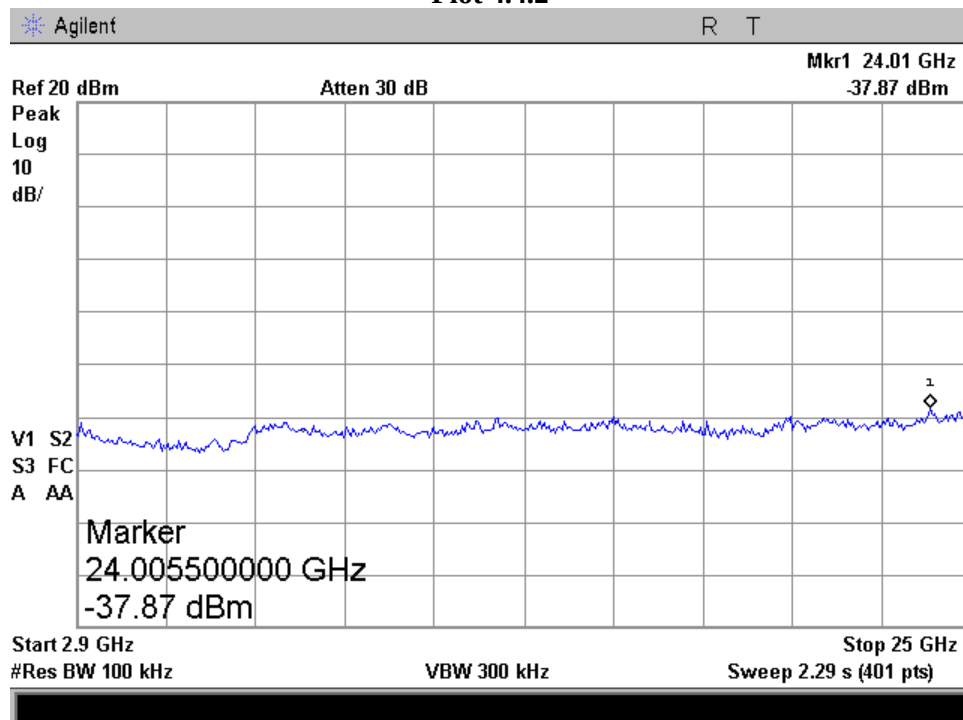
Band Edge

Frequency [MHz]	Data Rate [Mbps]	Measured [dBc]	Limit [dBc]	Result
802.11b Mode				
2412	11	-43.83	-20	Comply
2462	11	-55.22	-20	Comply
802.11g Mode				
2412	54	-33.63	-20	Comply
2462	54	-50.42	-20	Comply
802.11n Mode				
2412	MCS7	-32.90	-20	Comply
2462	MCS7	-49.20	-20	Comply
802.11a Mode				
5745	54	-47.91	-20	Comply
5825	54	-50.85	-20	Comply
802.11n Mode				
5745	MCS7	-49.06	-20	Comply
5825	MCS7	-52.36	-20	Comply

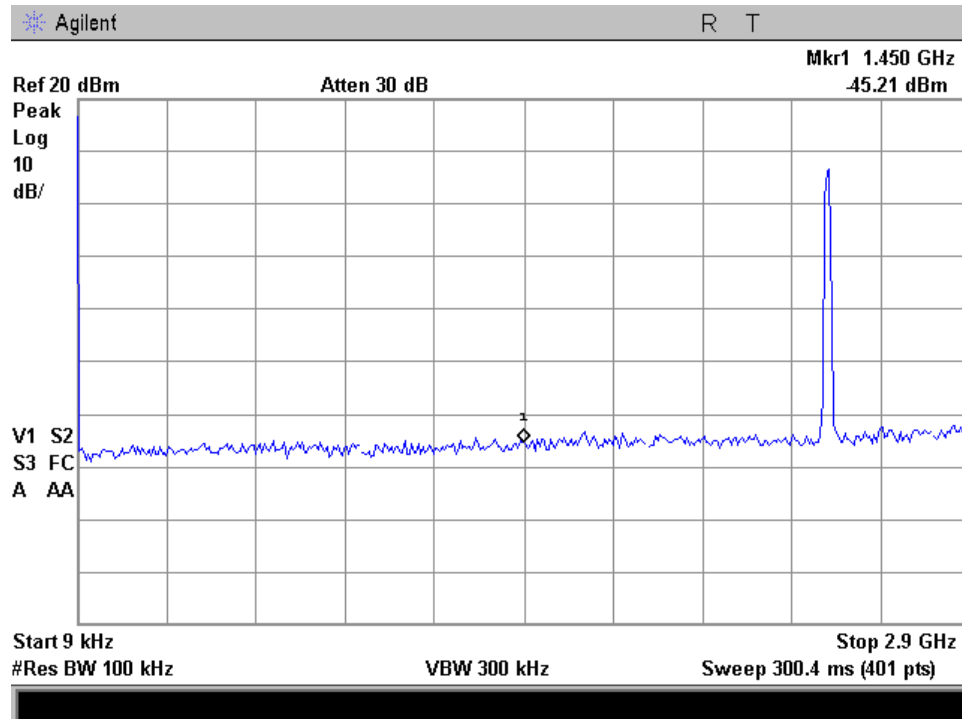
802.11b Mode
Plot 4.4.1



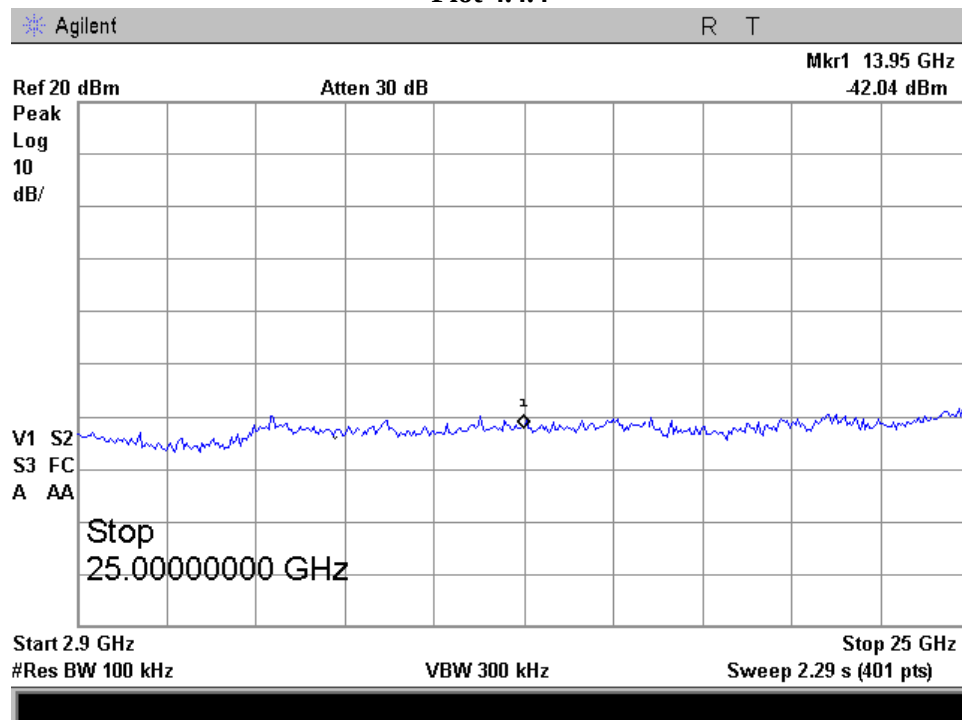
Plot 4.4.2



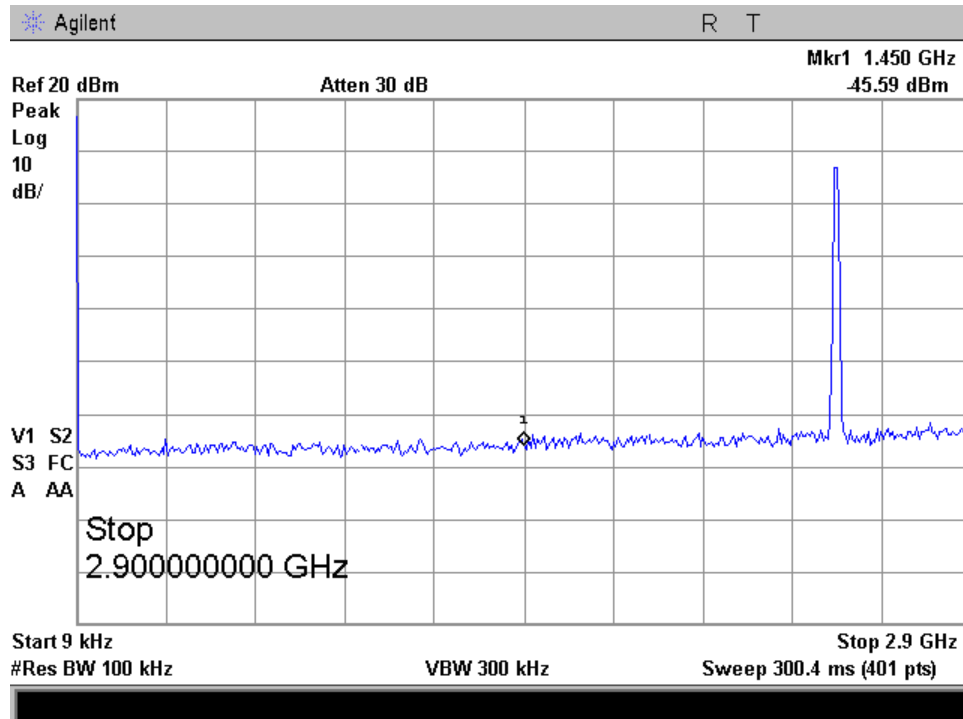
Plot 4.4.3



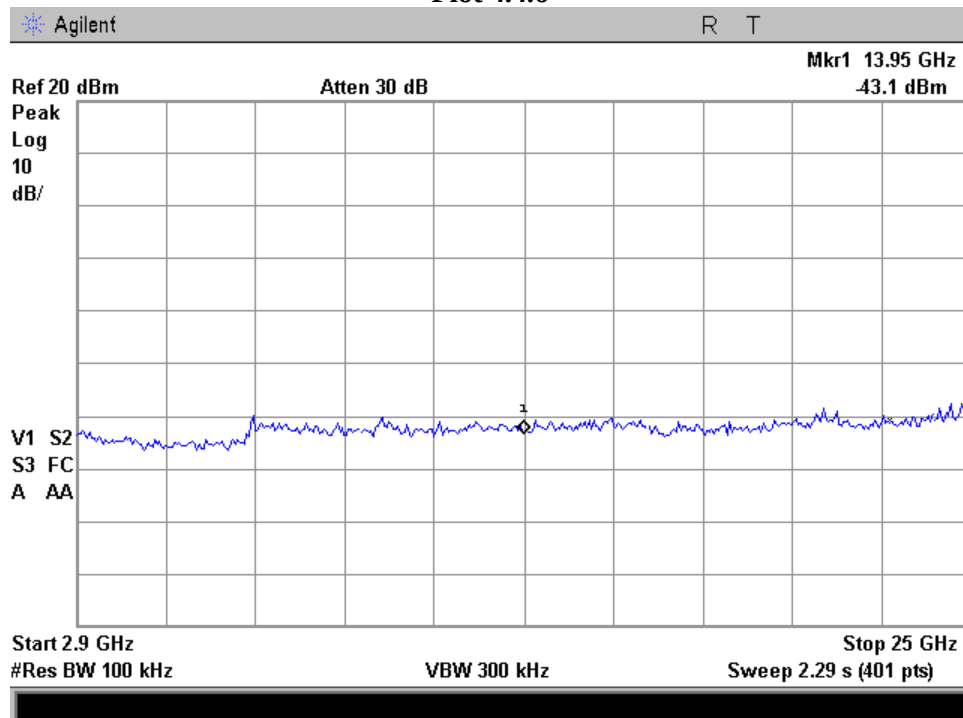
Plot 4.4.4



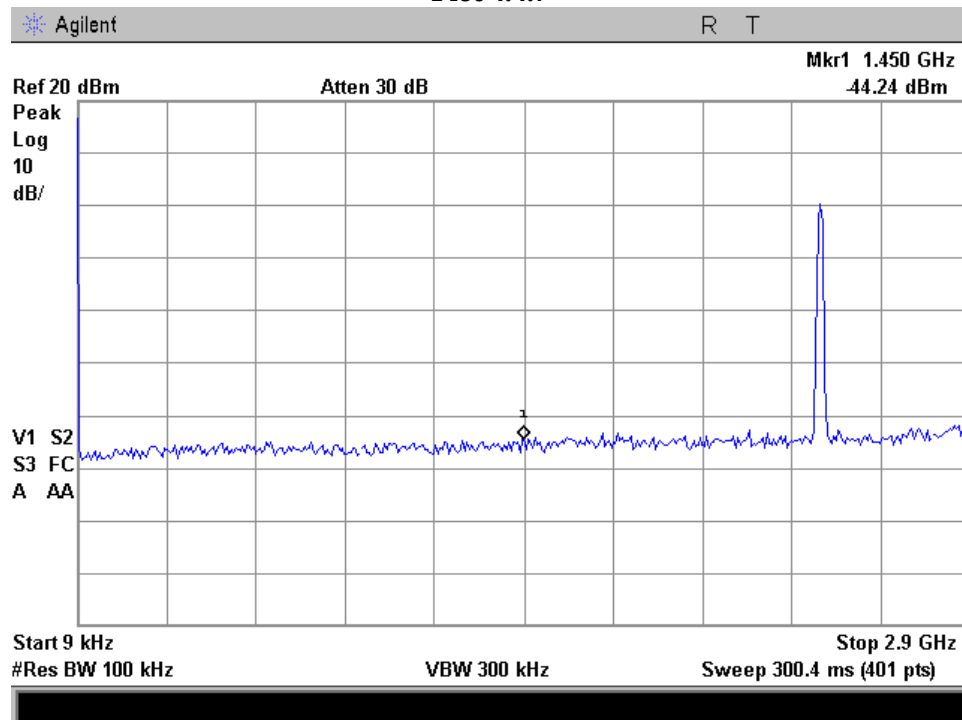
Plot 4.4.5



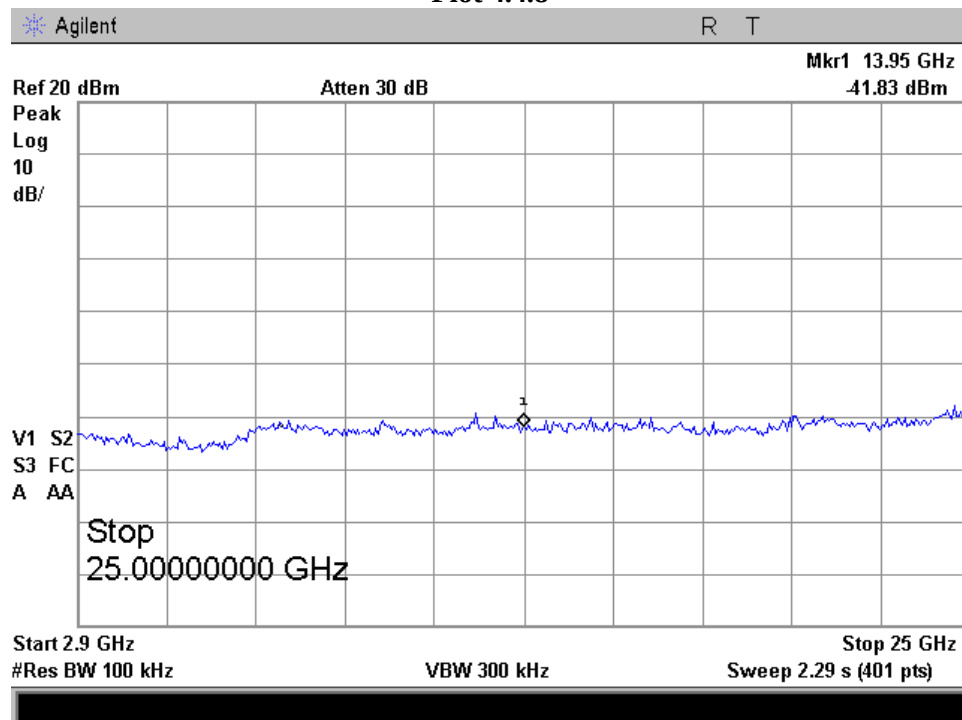
Plot 4.4.6



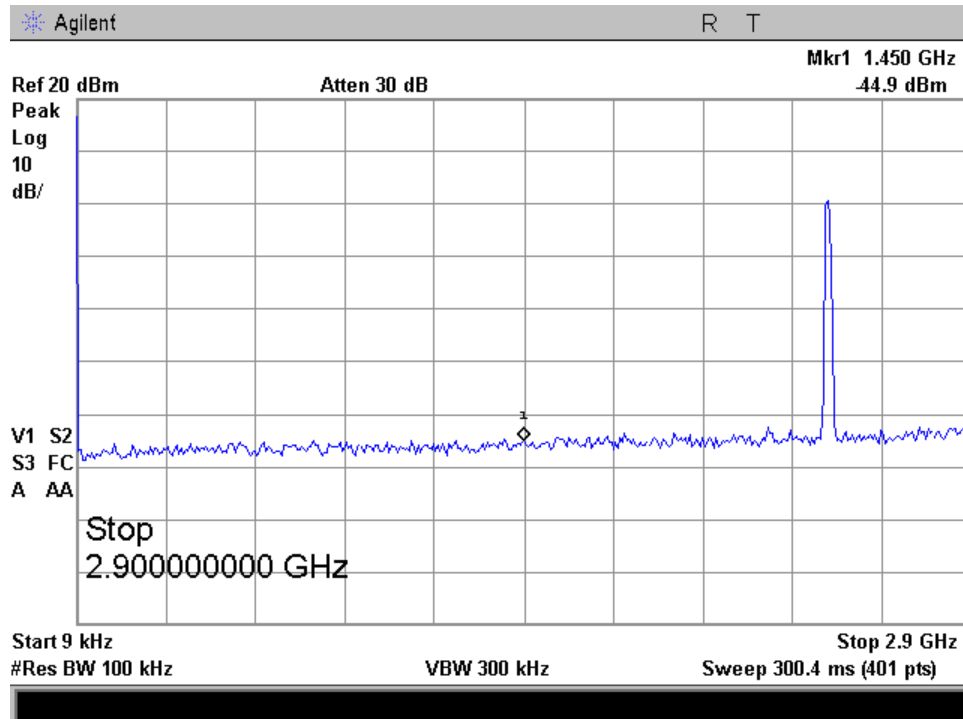
802.11g Mode
Plot 4.4.7



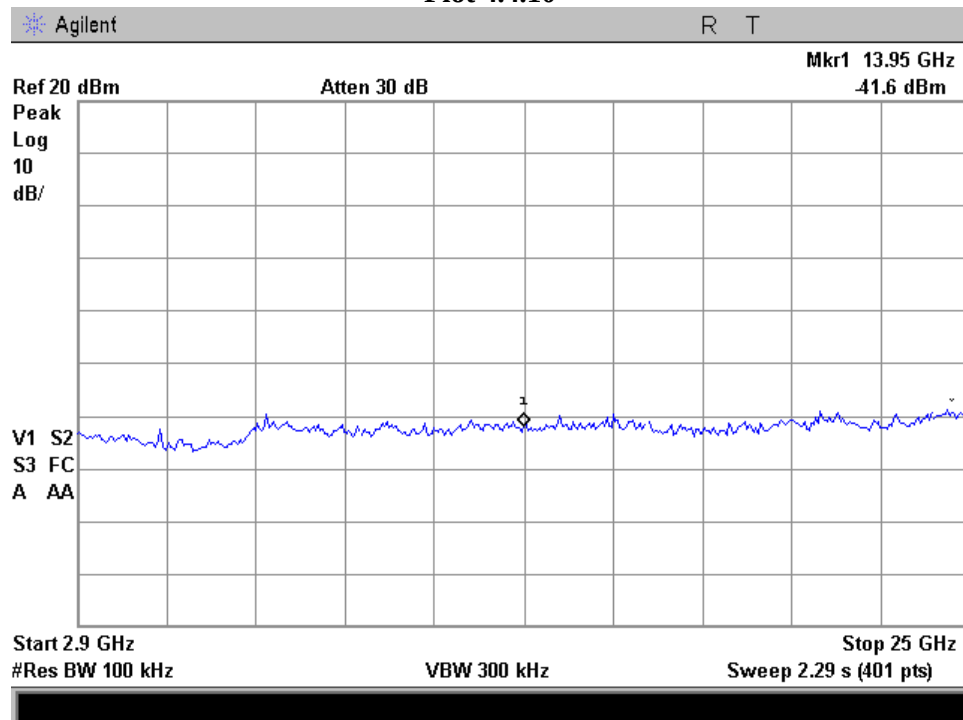
Plot 4.4.8



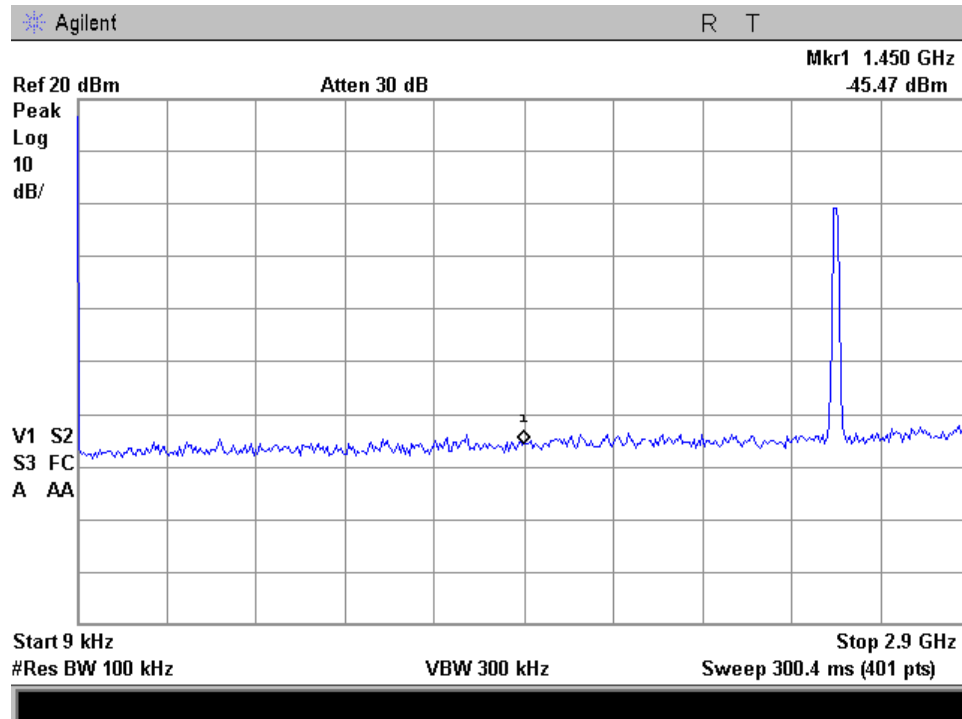
Plot 4.4.9



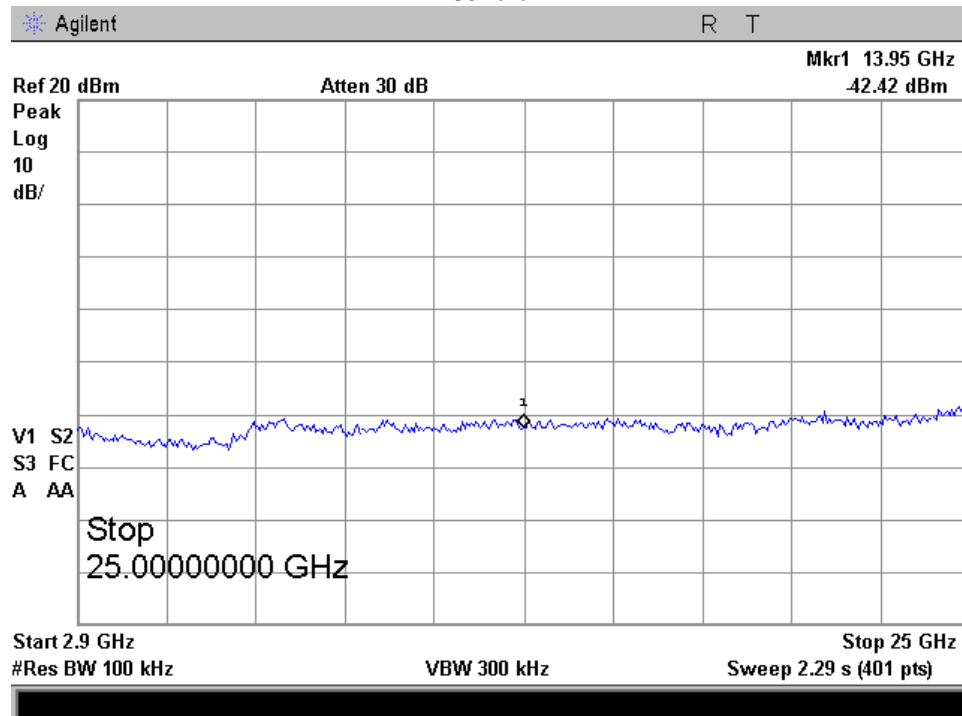
Plot 4.4.10



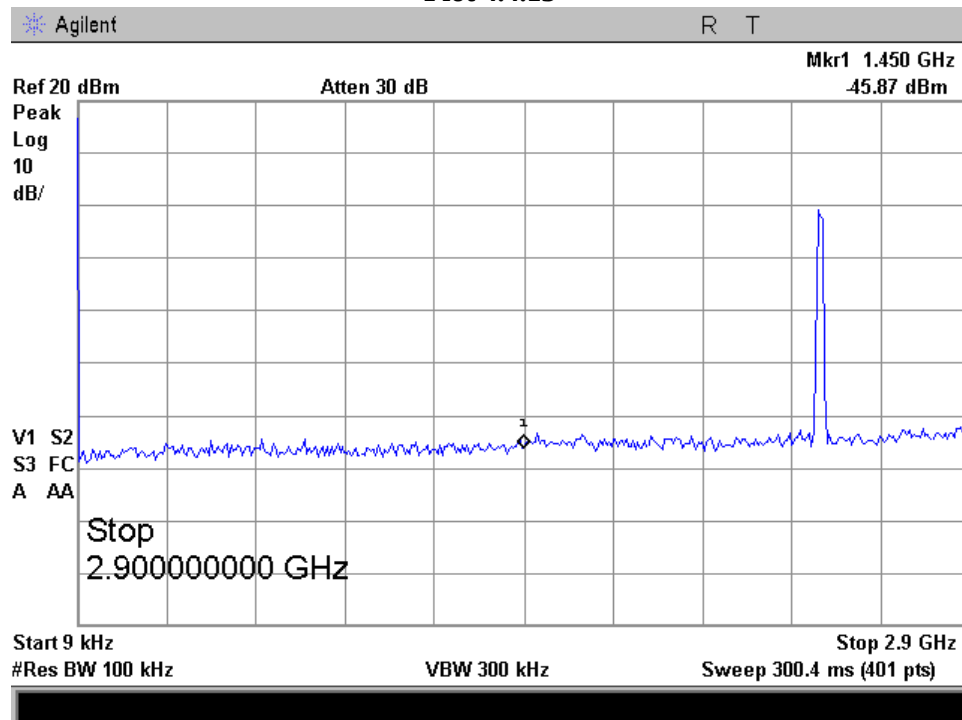
Plot 4.4.11



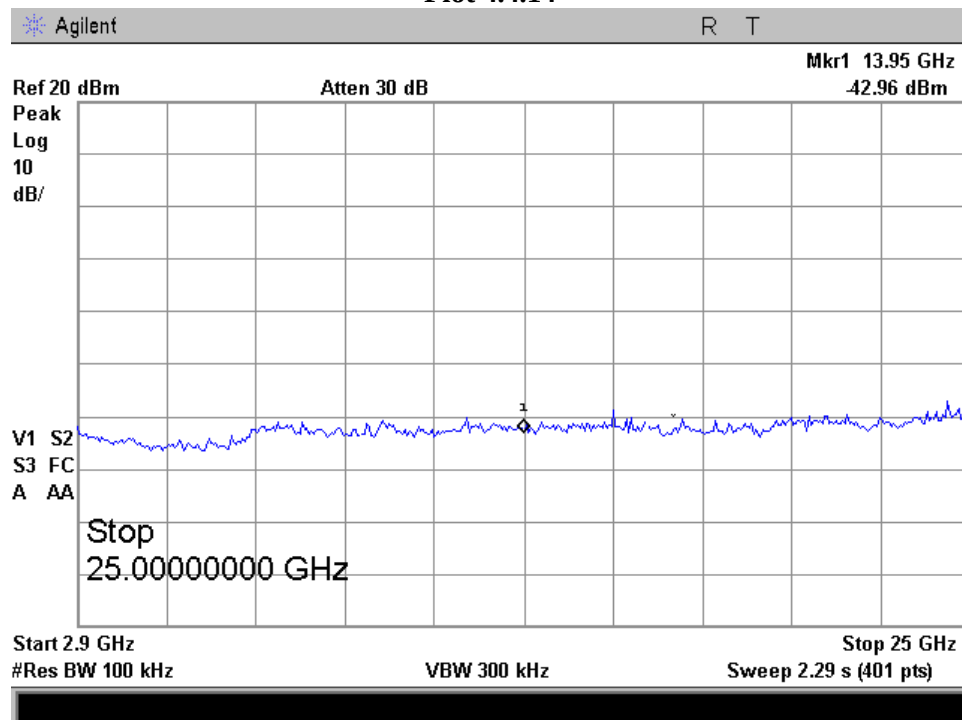
Plot 4.4.12



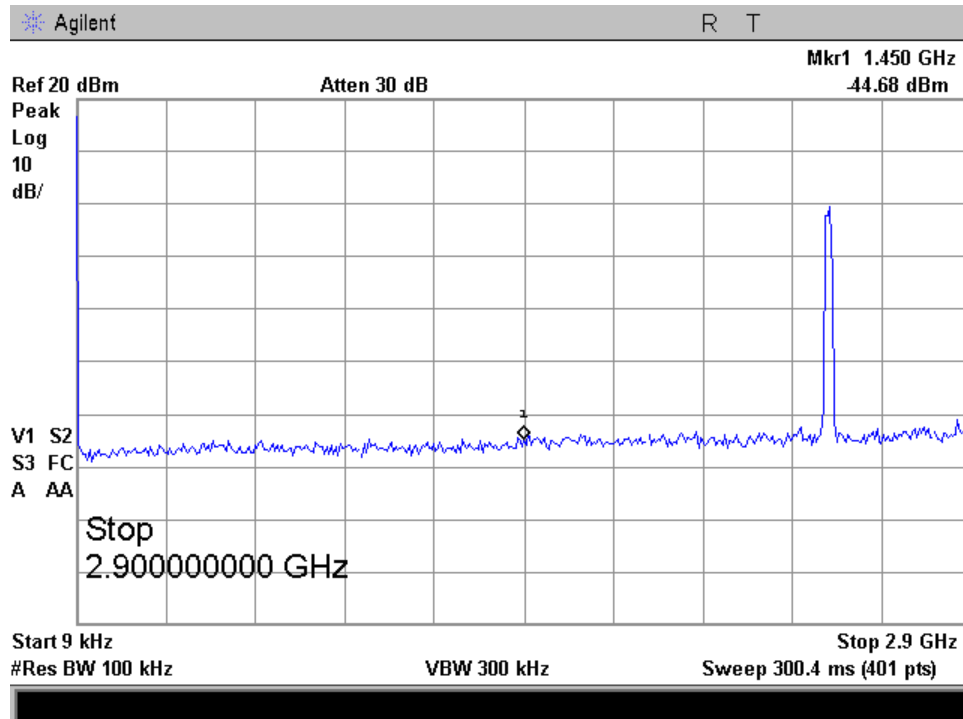
802.11 n Mode
Plot 4.4.13



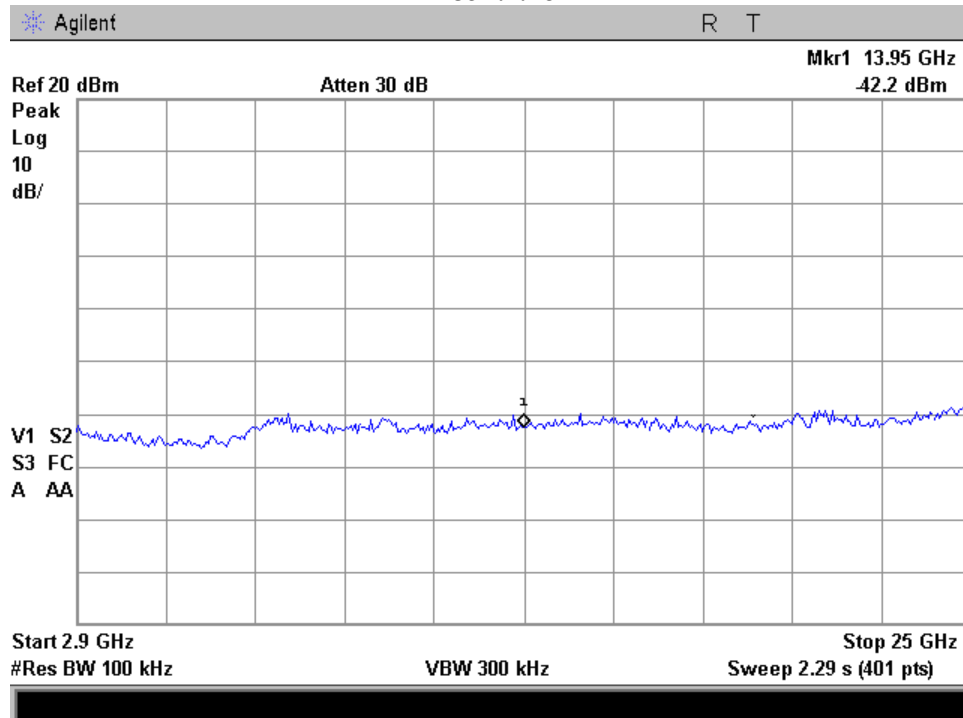
Plot 4.4.14



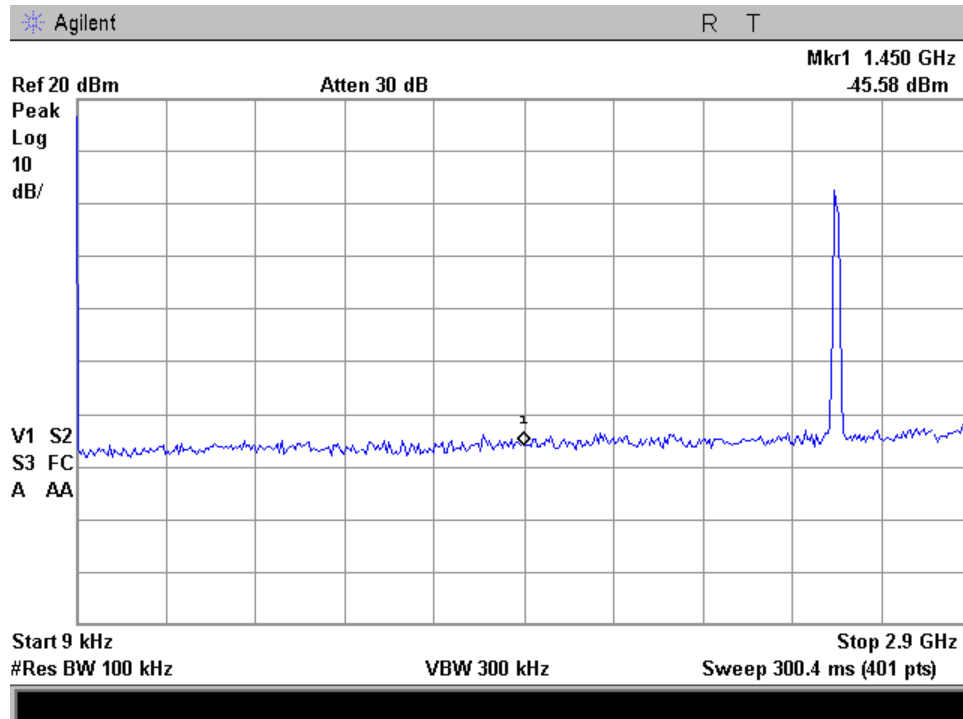
Plot 4.4.15



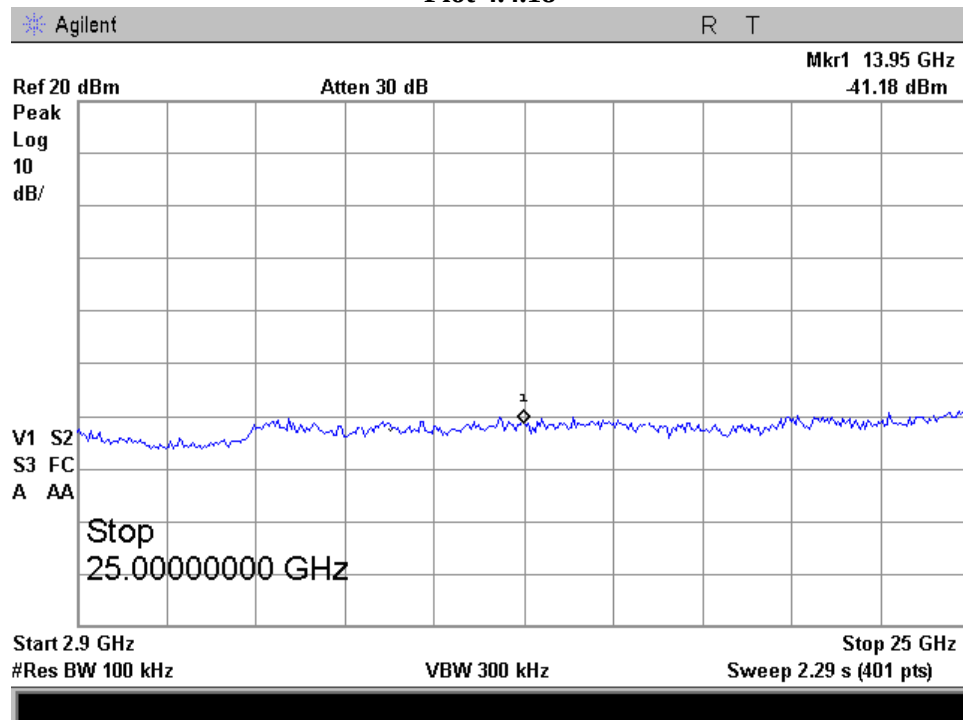
Plot 4.4.16



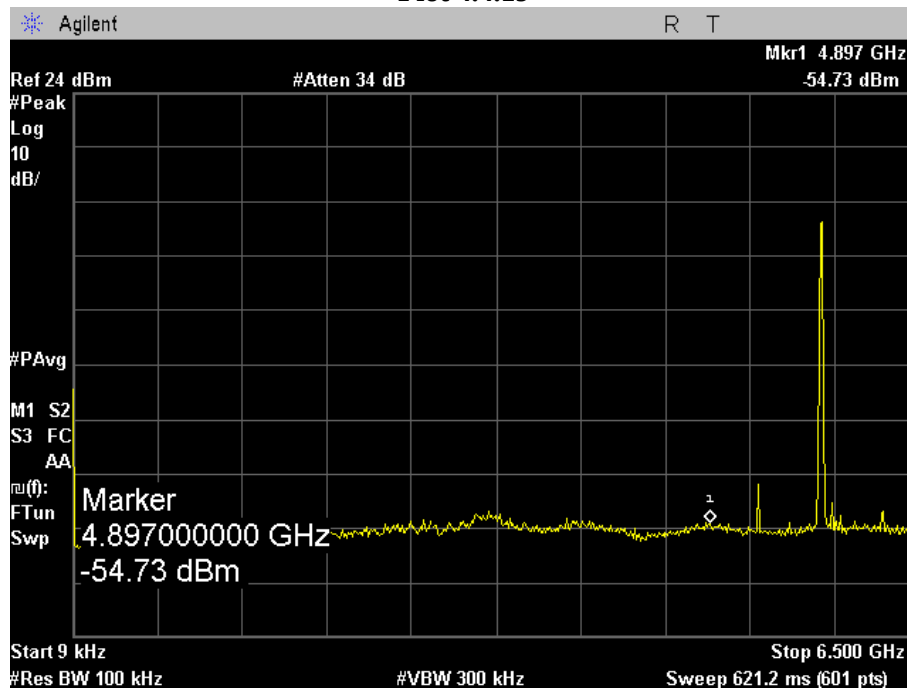
Plot 4.4.17



Plot 4.4.18



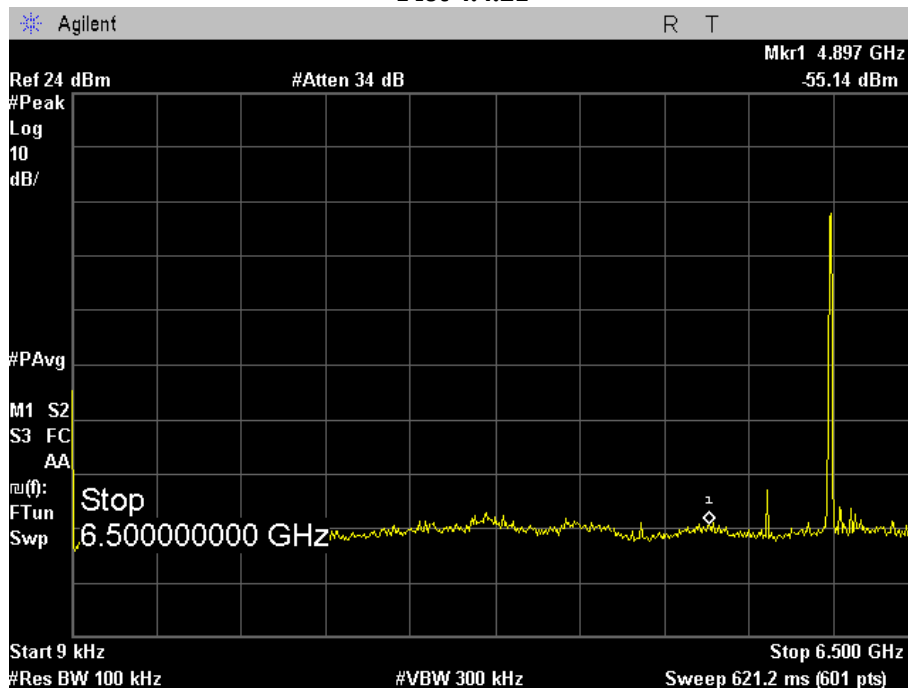
802.11a Mode
Plot 4.4.19



Plot 4.4.20



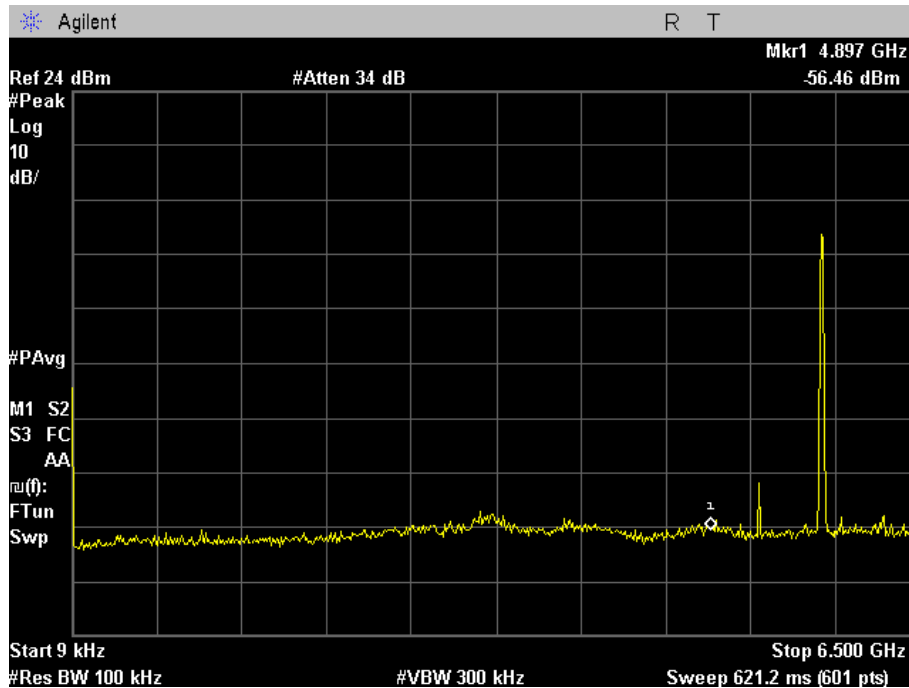
802.11a Mode
Plot 4.4.21



Plot 4.4.22



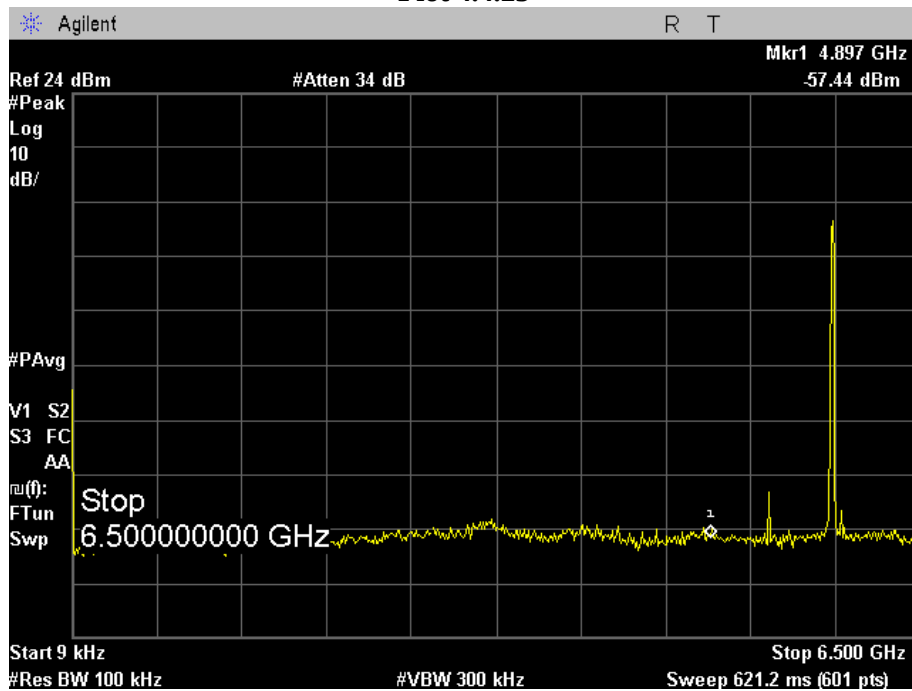
802.11n Mode
Plot 4.4.23



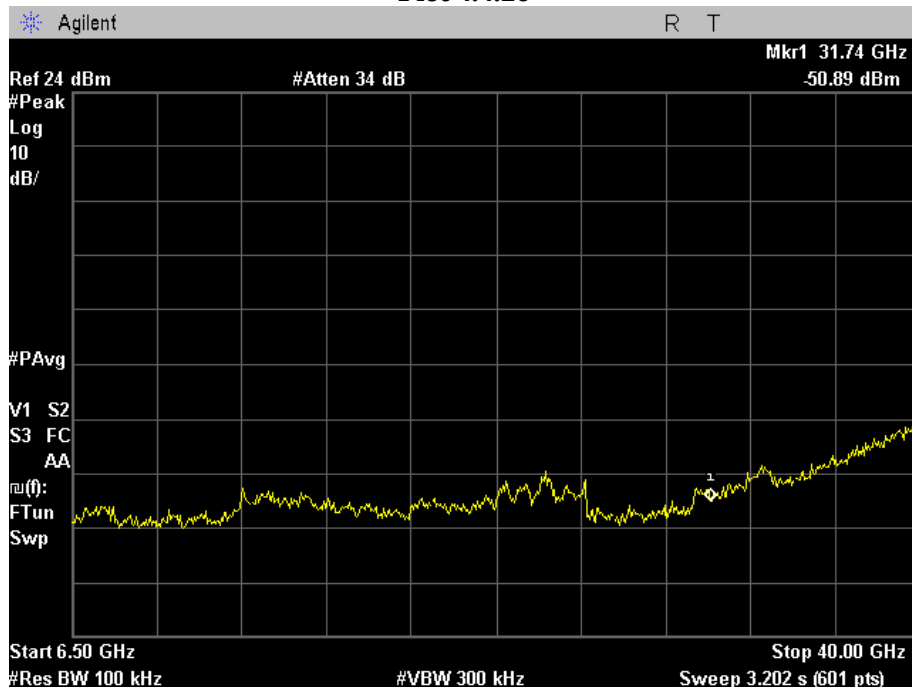
Plot 4.4.24



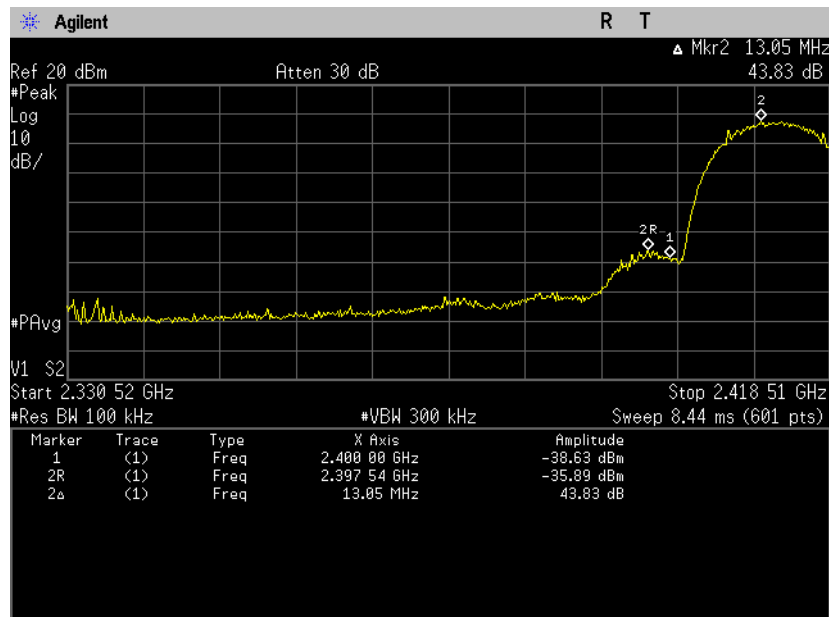
802.11n Mode
Plot 4.4.25



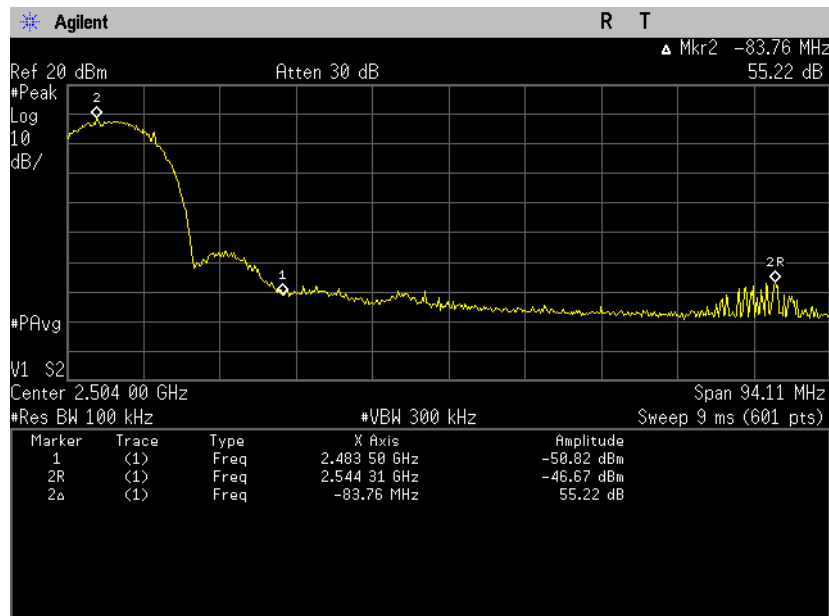
Plot 4.4.26



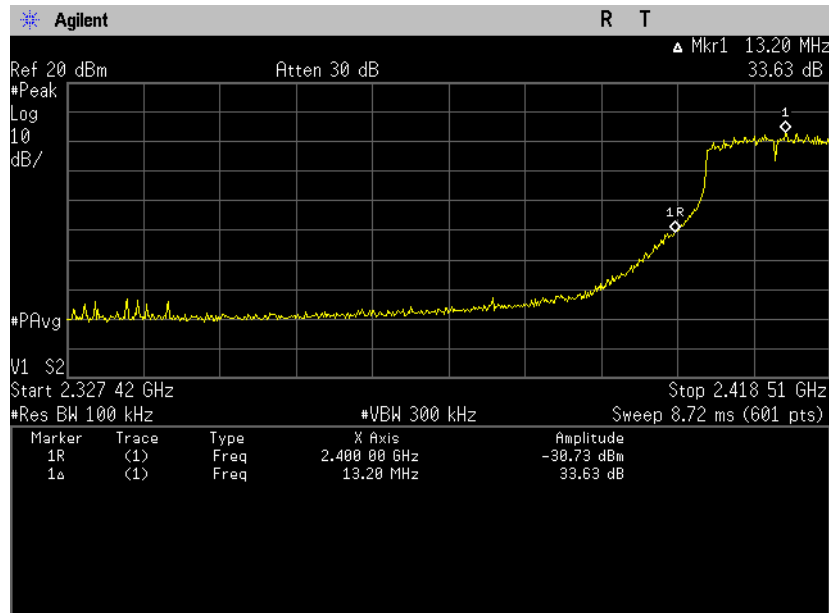
Band Edge, 802.11b Mode, 2412 MHz
Plot 4.4.27



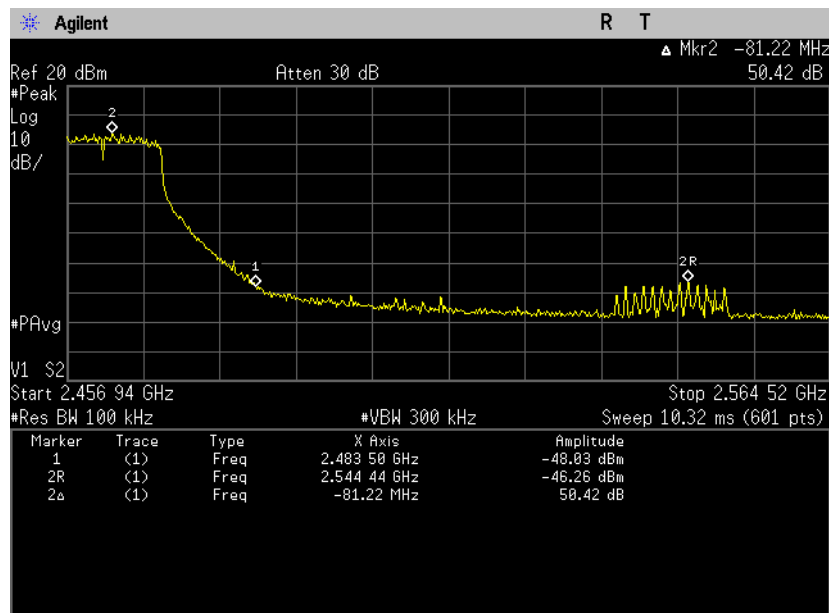
Band Edge, 802.11b Mode, 2462 MHz
Plot 4.4.28



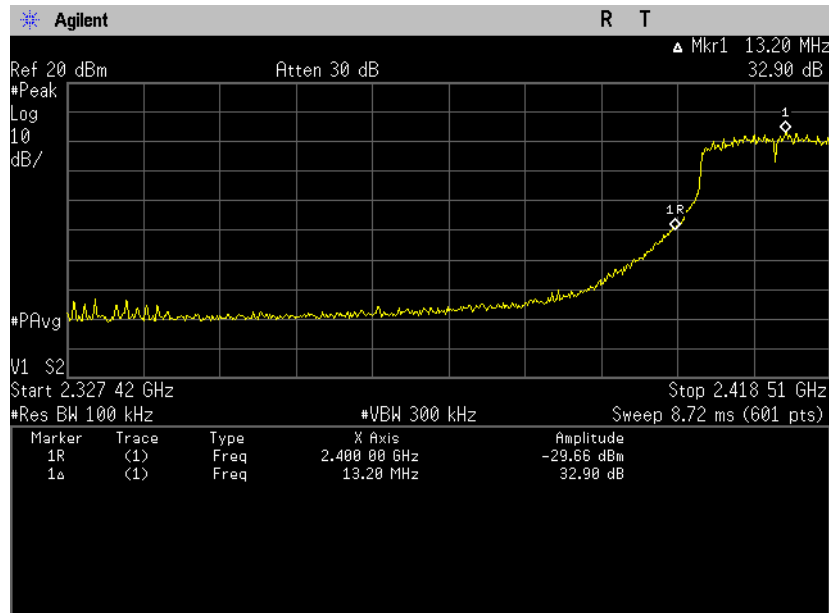
Band Edge, 802.11g Mode, 2412 MHz
Plot 4.4.29



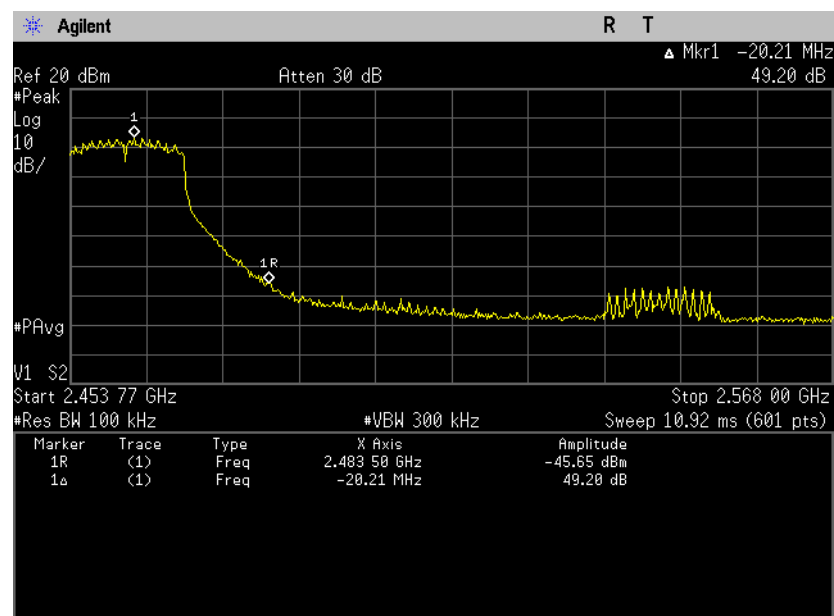
Band Edge, 802.11g Mode, 2462 MHz
Plot 4.4.30



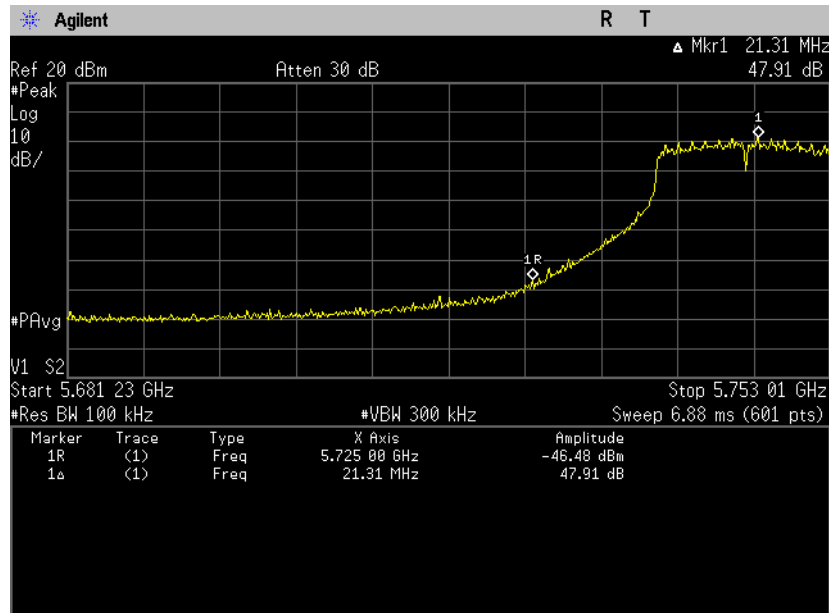
Band Edge, 802.11n Mode, 2412 MHz
Plot 4.4.31



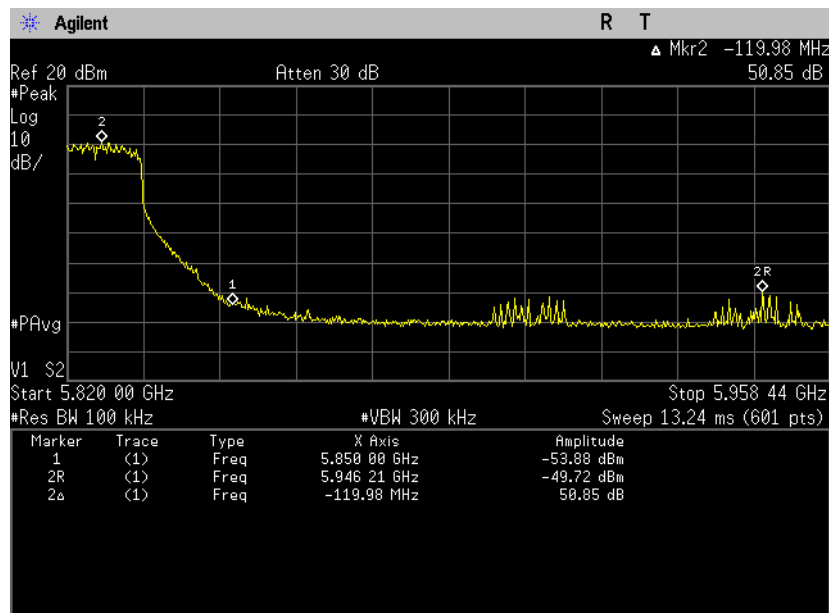
Band Edge, 802.11n Mode, 2462 MHz
Plot 4.4.32



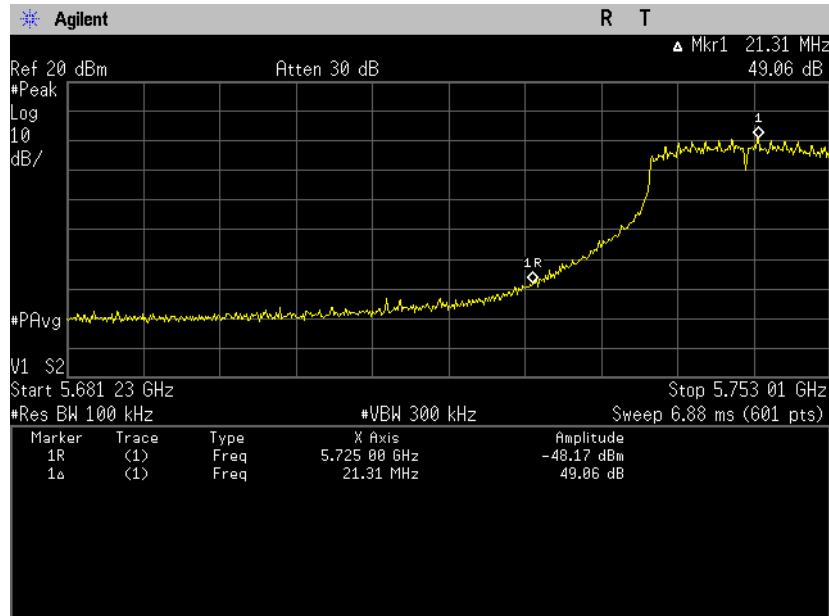
Band Edge, 802.11a Mode, 5745 MHz
Plot 4.4.33



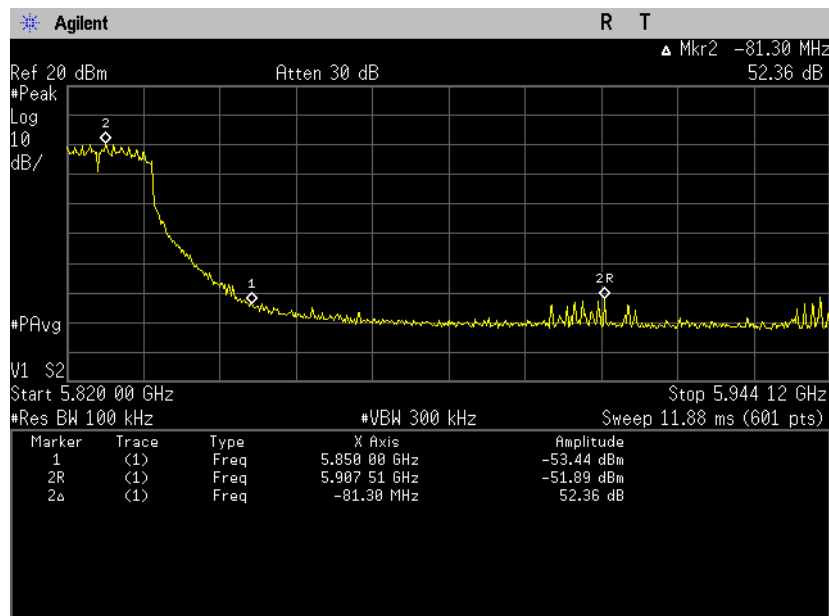
Band Edge, 802.11a Mode, 5825 MHz
Plot 4.4.34



Band Edge, 802.11n Mode, 5745 MHz
Plot 4.4.35



Band Edge, 802.11n Mode, 5825 MHz
Plot 4.4.36



4.5. Spurious Radiated Emissions, Restricted Bands 2310-2390MHz & 2483.5-2500MHz

Reference document:	47 CFR §15.247 (d) & §15.205		
Test Requirements:	Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.2	Pass	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	Peak: RBW= 1MHz, VBW= 3MHz, Average: VBW= 10 Hz		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.5.1 to Plot 4.5.40	

Test results:

All measurements were performed in horizontal and vertical polarizations; the results show the worst case.

Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
WLAN 802.11b							
2412	1	2360	Peak	H	61.99	74	12.01
2412	1	2386	Average	H	48.29	54	5.71
2412	1	2389	Peak	V	62.09	74	11.91
2412	1	2332	Average	V	48.79	54	5.21
2462	1	2494	Peak	H	61.79	74	12.21
2462	1	2494	Average	H	47.94	54	6.06
2462	1	2492	Peak	V	60.22	74	13.78
2462	1	2484	Average	V	47.96	54	6.04
WLAN 802.11g							
2412	6	2339	Peak	H	64.88	74	9.12
2412	6	2387	Average	H	53.05	54	0.95
2412	6	2372	Peak	V	63.41	74	10.59
2412	6	2388	Average	V	51.51	54	2.49
2417	6	2389	Peak	H	70.60	74	3.40
2417	6	2390	Average	H	52.18	54	1.82
2417	6	2390	Peak	V	69.69	74	4.31
2417	6	2390	Average	V	52.50	54	1.50
2457	6	2493	Peak	H	65.66	74	8.34
2457	6	2485	Average	H	51.75	54	2.25
2457	6	2487	Peak	V	65.31	74	8.69
2457	6	2484	Average	V	51.71	54	2.29
2462	6	2494	Peak	H	64.96	74	9.04
2462	6	2484	Average	H	52.99	54	1.01
2462	6	2497	Peak	V	65.13	74	8.87

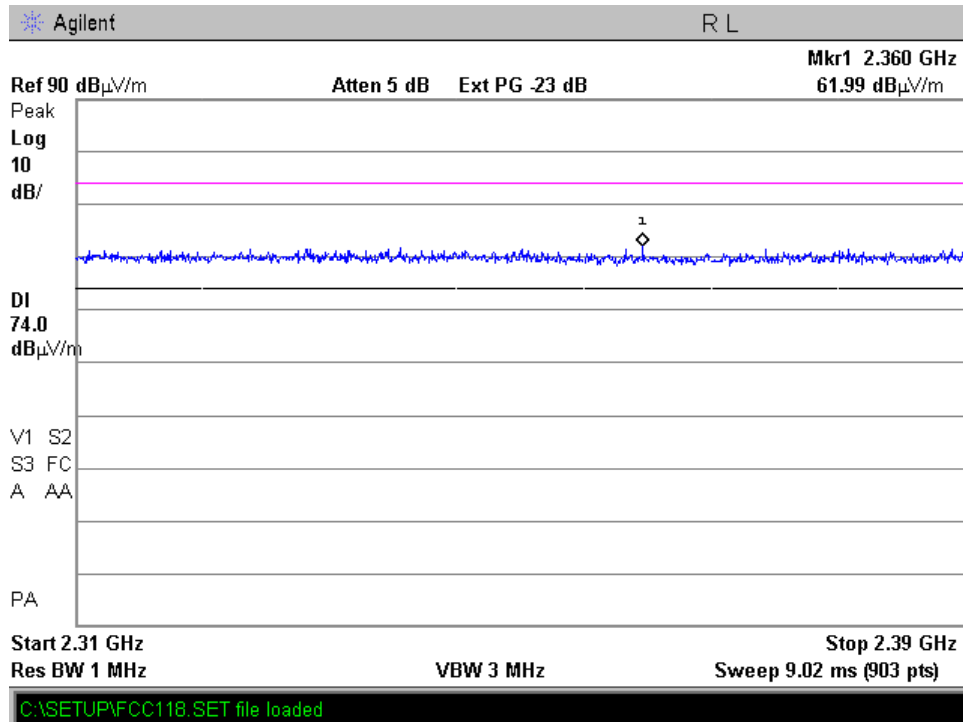
2462	6	2497	Average	V	53.12	54	0.88
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Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
WLAN 802.11n							
2462	6.5	2497	Peak	H	65.66	74	8.34
2462	6.5	2489	Average	H	49.91	54	4.09
2462	6.5	2489	Peak	V	65.74	74	8.26
2462	6.5	2489	Average	V	50.08	54	3.92
2457*	6.5	2486	Peak	H	65.78	74	8.22
2457*	6.5	2484	Average	H	51.83	54	2.17
2457*	6.5	2494	Peak	V	66.49	74	7.51
2457*	6.5	2486	Average	V	51.47	54	2.53
2417*	6.5	2390	Peak	H	70.08	74	3.92
2417*	6.5	2390	Average	H	53.37	54	0.63
2417*	6.5	2390	Peak	V	66.82	74	7.18
2417*	6.5	2390	Average	V	52.26	54	1.74
2412	6.5	2330	Peak	H	61.86	74	12.14
2412	6.5	2387	Average	H	53.13	54	0.87
2412	6.5	2342	Peak	V	66.98	74	7.02
2412	6.5	2342	Average	V	52.91	54	1.09

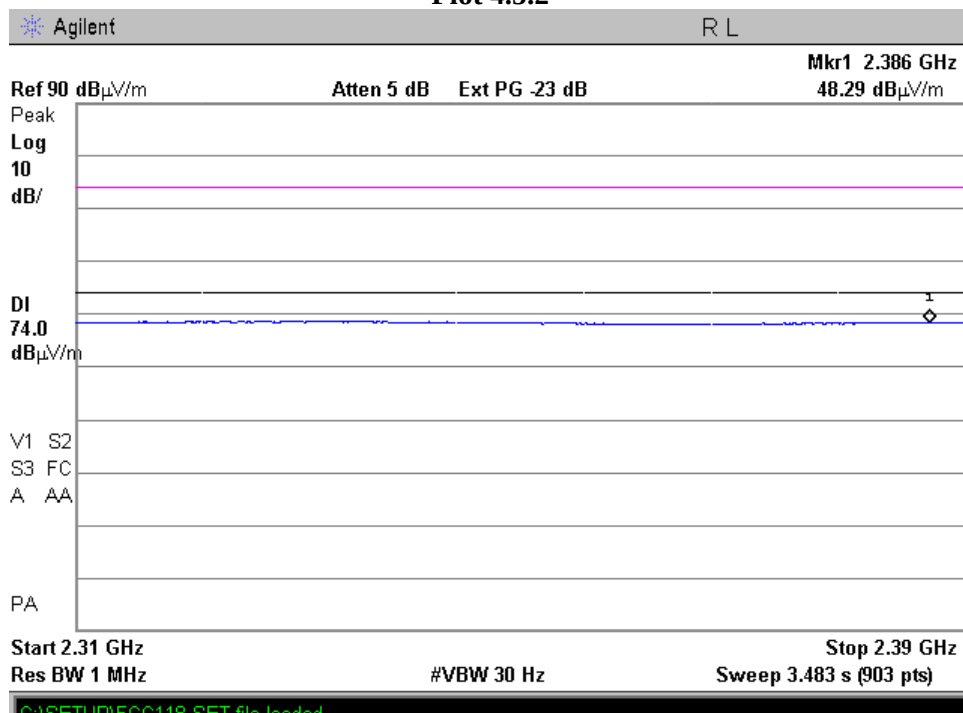
Note: Spurious Emission [dBμV/m] = measured [dBμV] + Correction-factor [dB (1/m)]
Correction Factor = Antenna factor + Cable Loss

* Initially measurements were made on 2412 MHz and 2462 MHz frequencies and margin detected was less than 1dB. The FCC requires that, in such a case (margin<1dB), testing is also required to be performed on the channels closest to the band edges that operate at full power.

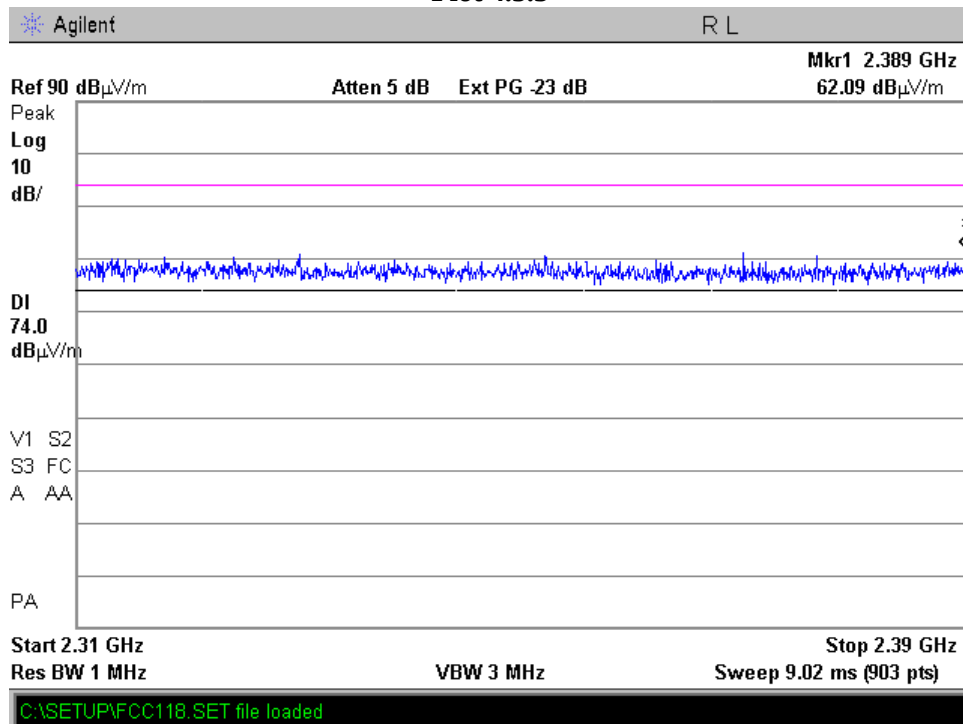
WLAN 802.11b, 2412 MHz, 1Mbps
Lowest Frequency
Horizontal Polarization
Peak
Plot 4.5.1



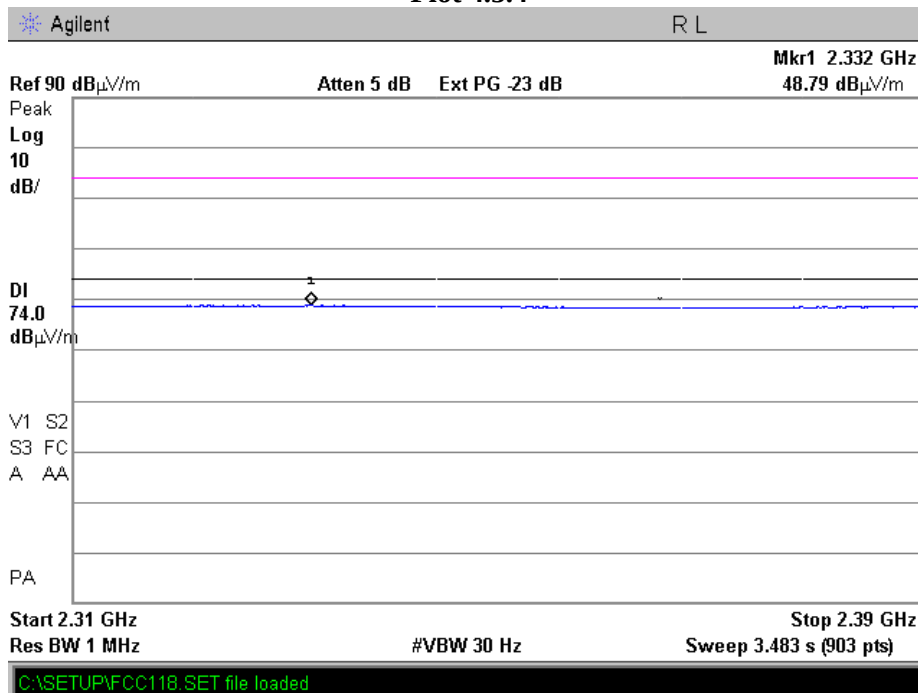
Horizontal Polarization
Average
Plot 4.5.2



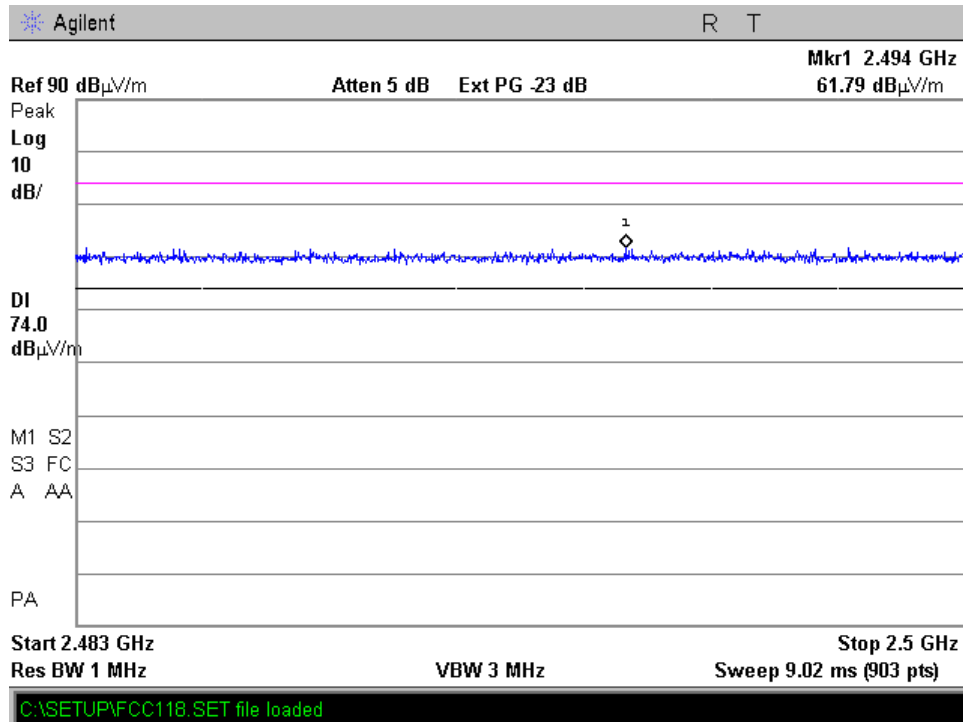
**Vertical Polarization
Peak
Plot 4.5.3**



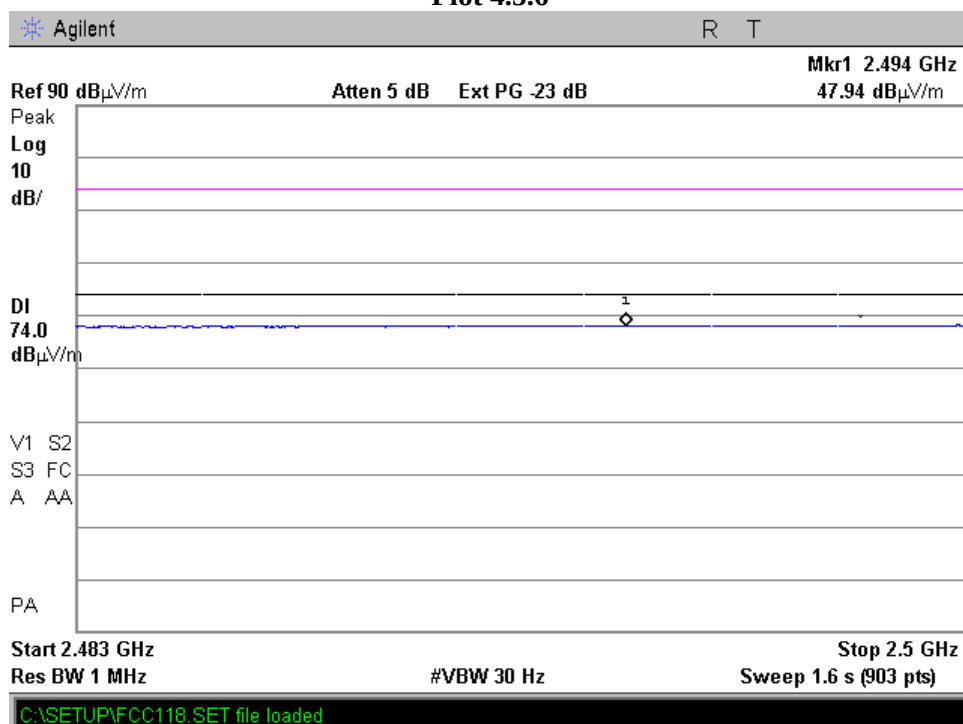
**Vertical Polarization
Average
Plot 4.5.4**



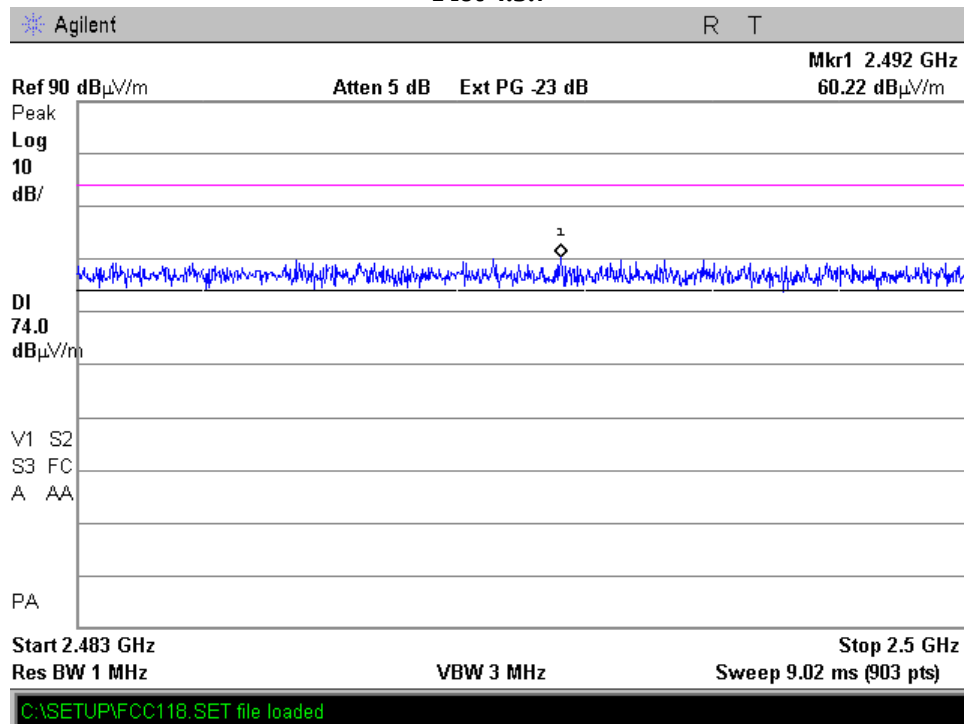
WLAN 802.11b, 2462 MHz, 1Mbps
Highest Frequency Horizontal Polarization
Peak
Plot 4.5.5



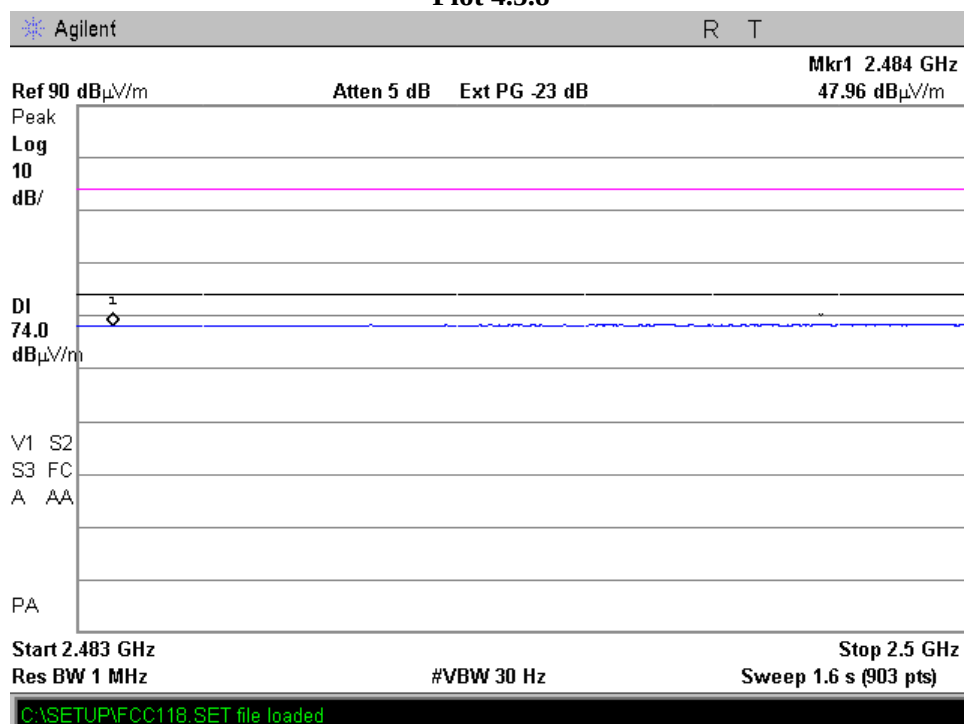
Horizontal Polarization
Average
Plot 4.5.6



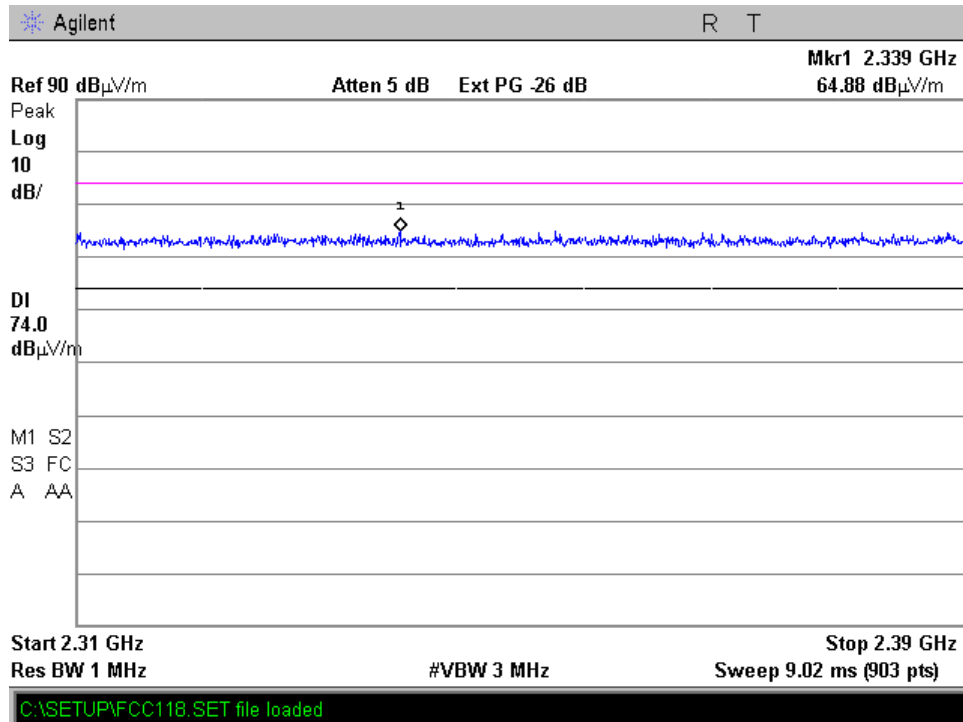
**Vertical Polarization
Peak
Plot 4.5.7**



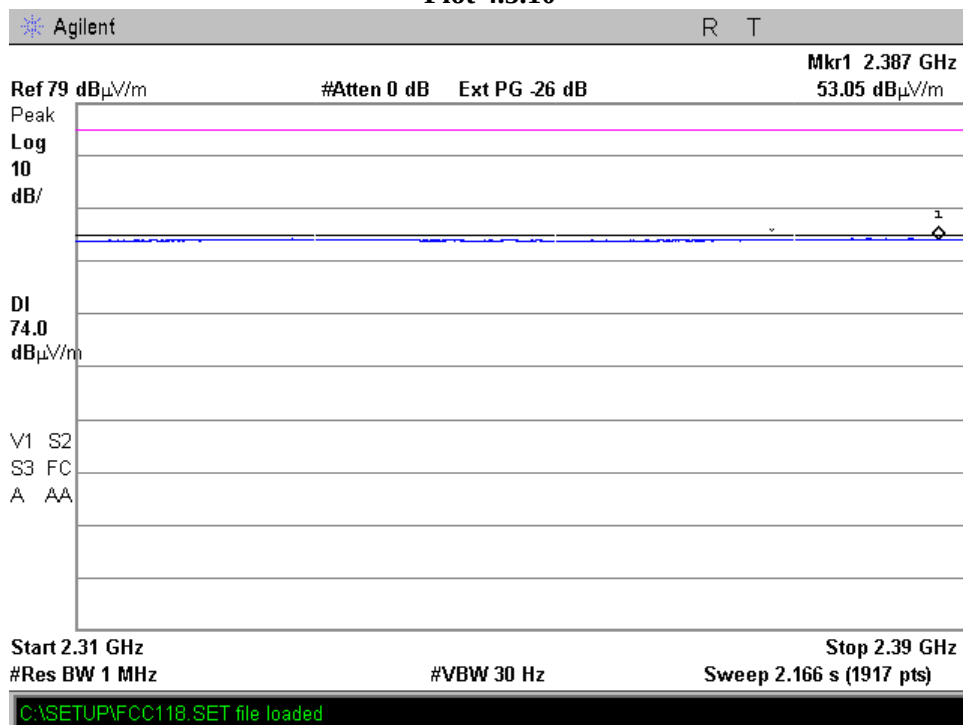
**Vertical Polarization
Average
Plot 4.5.8**



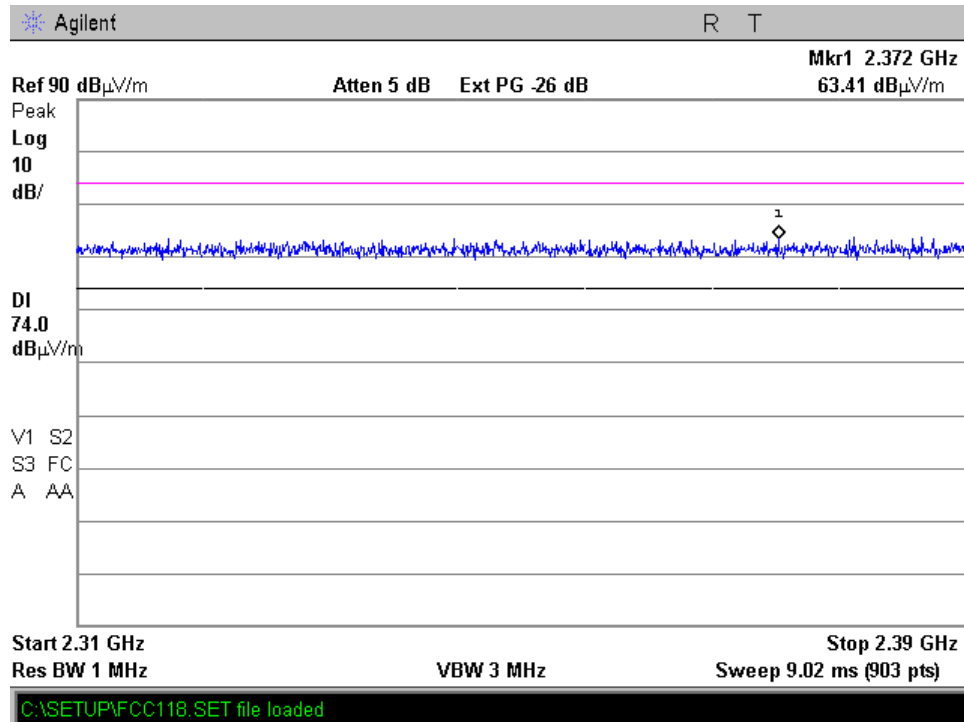
WLAN 802.11g, 2412 MHz, 6 Mbps
Lowest Frequency Horizontal Polarization
Peak
Plot 4.5.9



Horizontal Polarization
Average
Plot 4.5.10



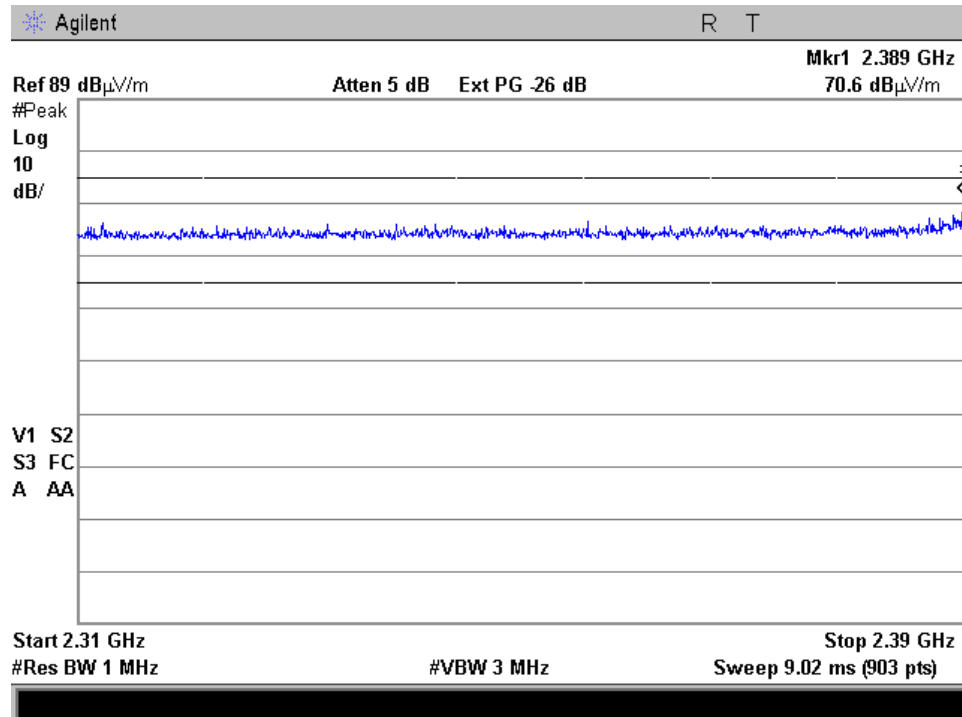
Vertical Polarization
Peak
Plot 4.5.11



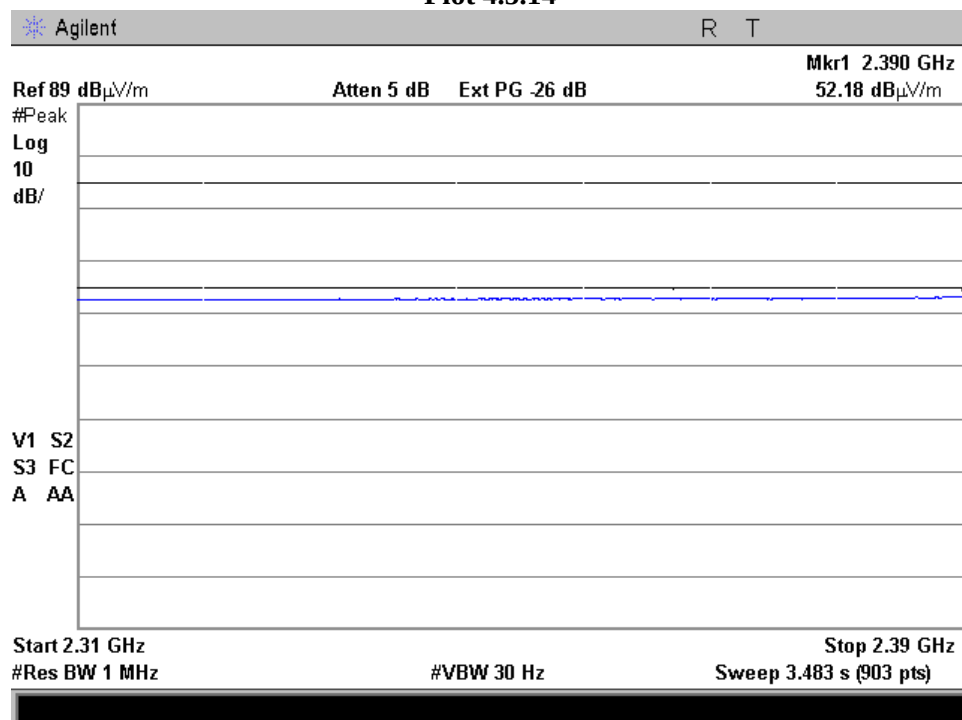
Vertical Polarization
Average
Plot 4.5.12



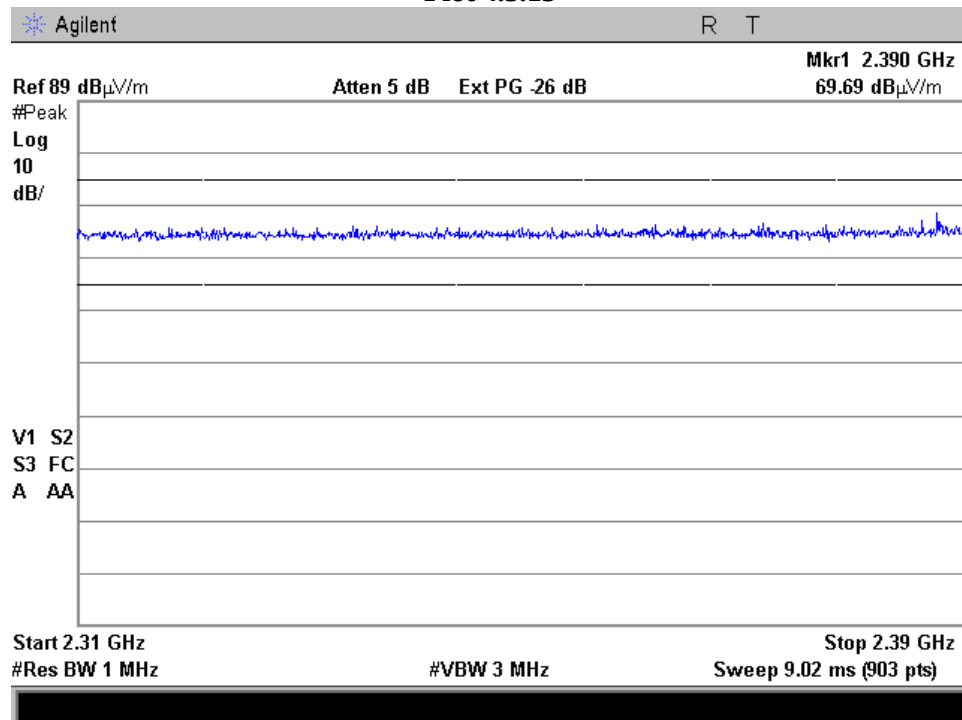
WLAN 802.11g, 2417 MHz, 6 Mbps
Lowest Frequency Horizontal Polarization
Peak
Plot 4.5.13



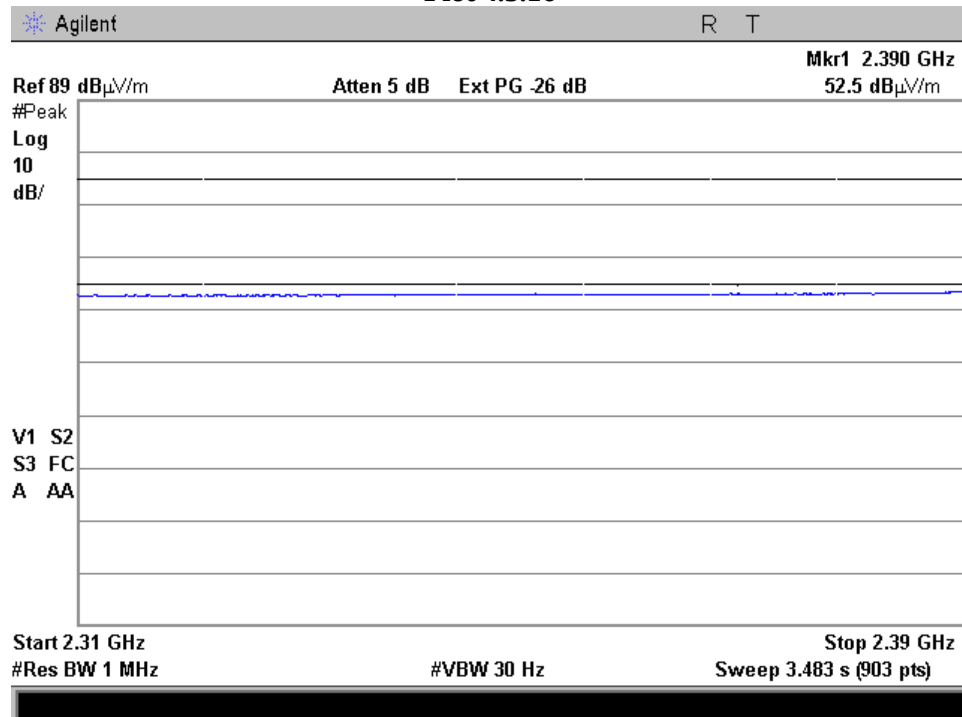
Horizontal Polarization
Average
Plot 4.5.14



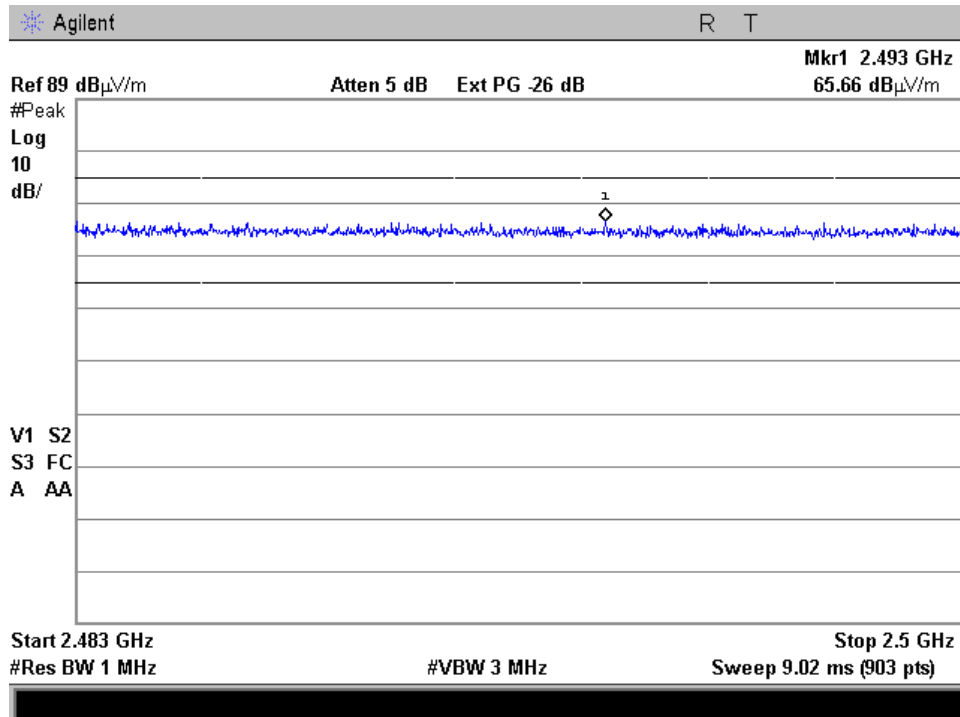
**Vertical Polarization
Peak
Plot 4.5.15**



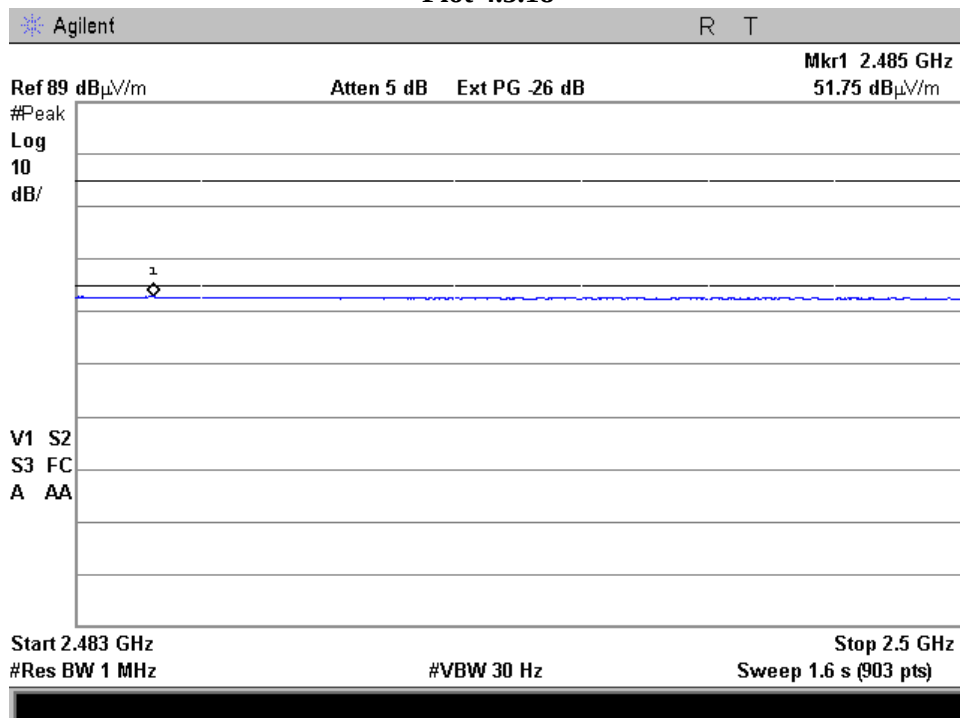
**Vertical Polarization
Average
Plot 4.5.16**



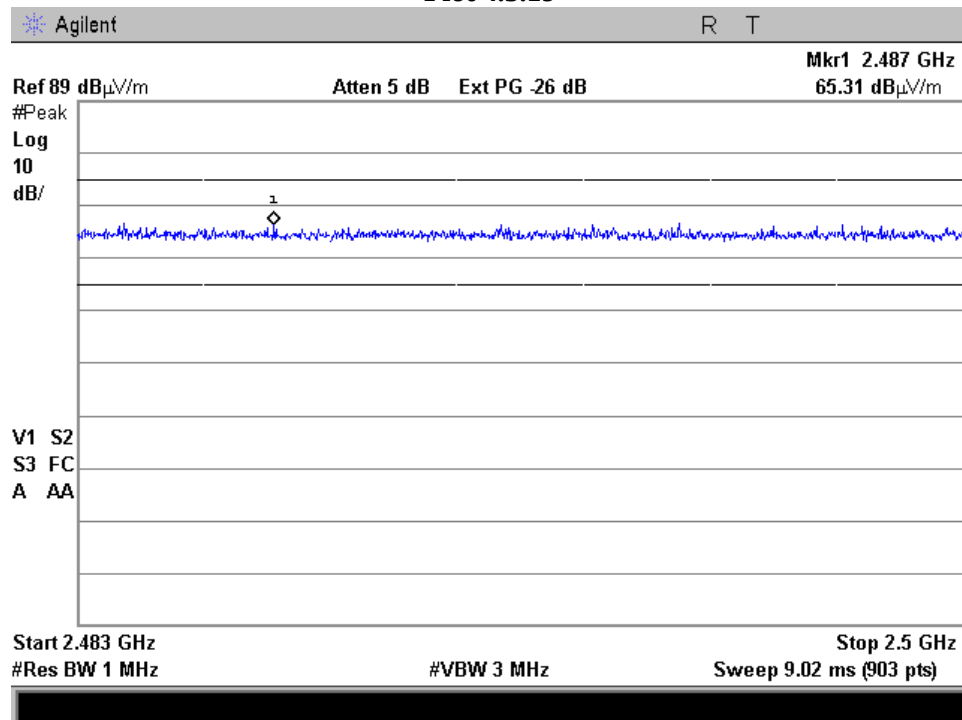
WLAN 802.11g, 2457 MHz, 6 Mbps
Lowest Frequency Horizontal Polarization
Peak
Plot 4.5.17



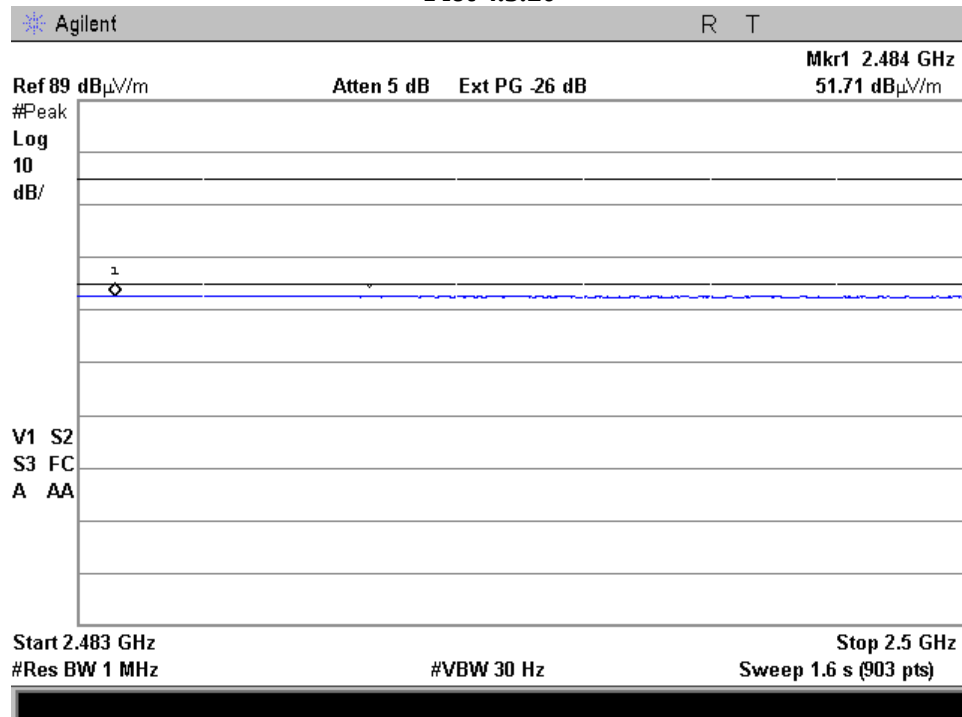
Horizontal Polarization
Average
Plot 4.5.18



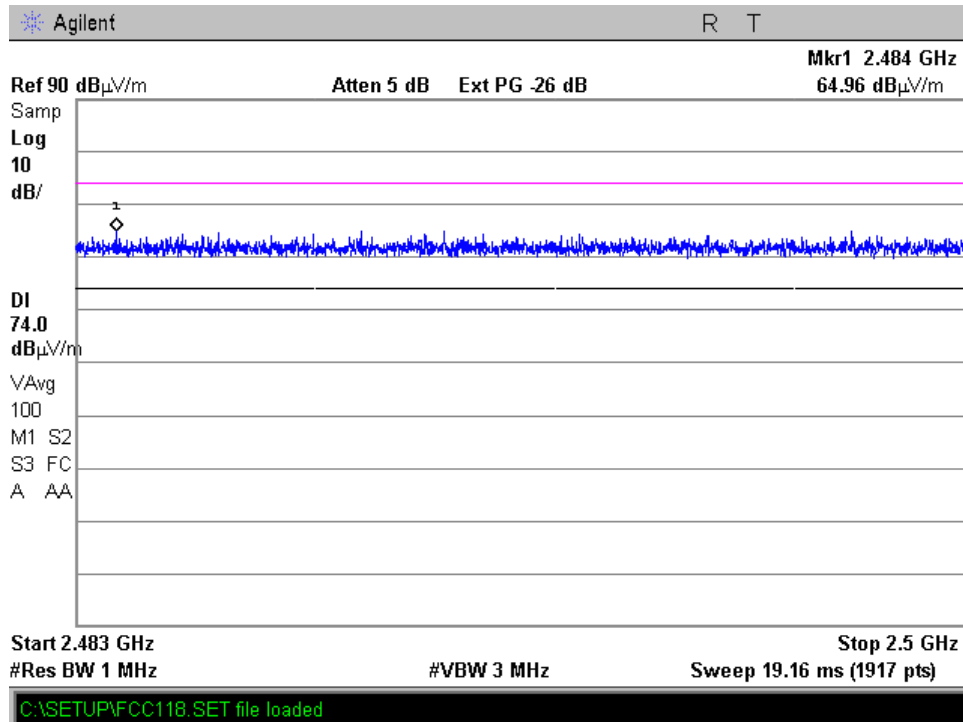
**Vertical Polarization
Peak
Plot 4.5.19**



**Vertical Polarization
Average
Plot 4.5.20**



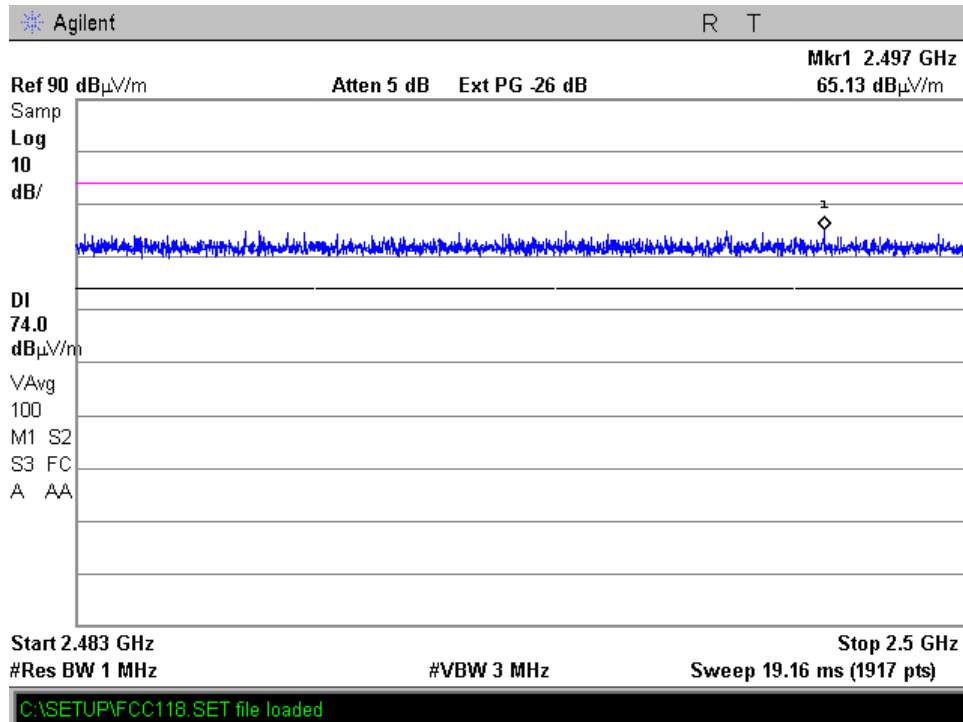
WLAN 802.11g, 2462 MHz, 6 Mbps
High Frequency Horizontal Polarization
Peak
Plot 4.5.21



Horizontal Polarization
Average
Plot 4.5.22



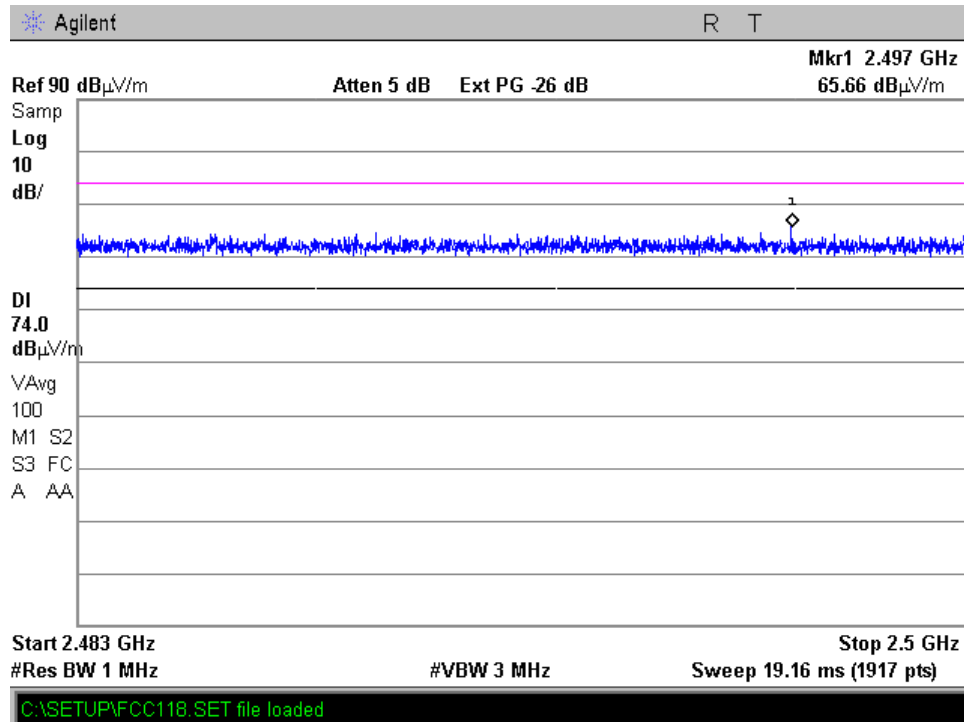
WLAN 802.11g, 2462 MHz, 6 Mbps
High Frequency Vertical Polarization
Peak
Plot 4.5.23



Vertical Polarization
Average
Plot 4.5.24



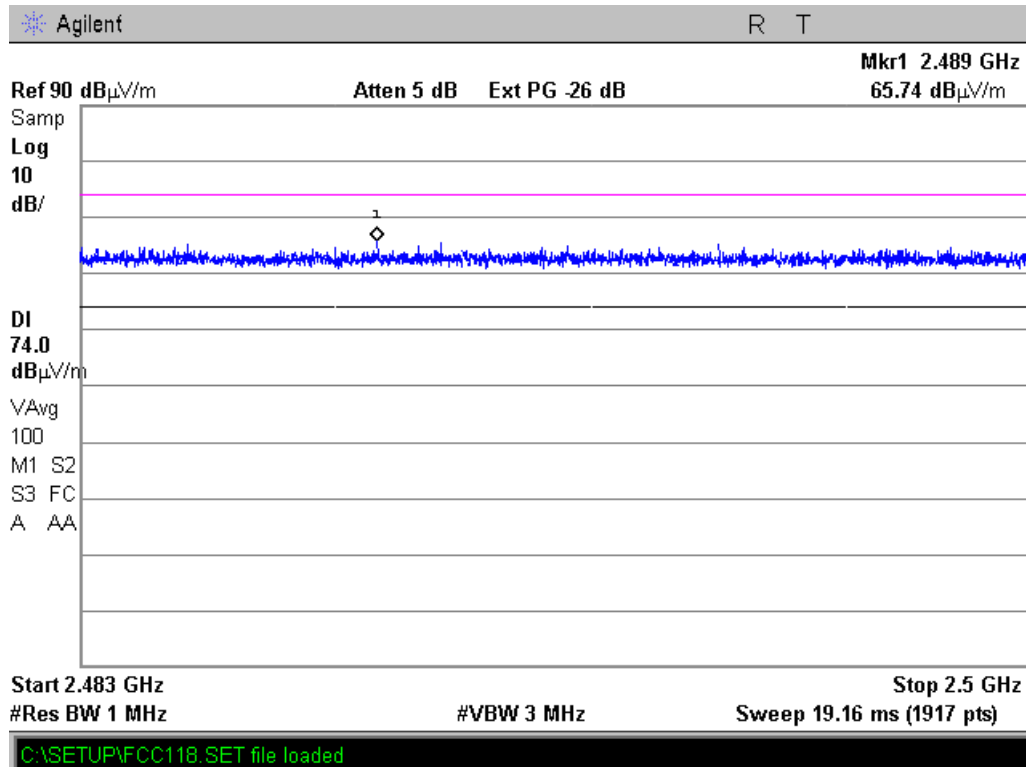
WLAN 802.n 2462 MHz, 6.5Mbps
Highest Frequency Horizontal Polarization
Peak
Plot 4.5.25



Horizontal Polarization
Average
Plot 4.5.26



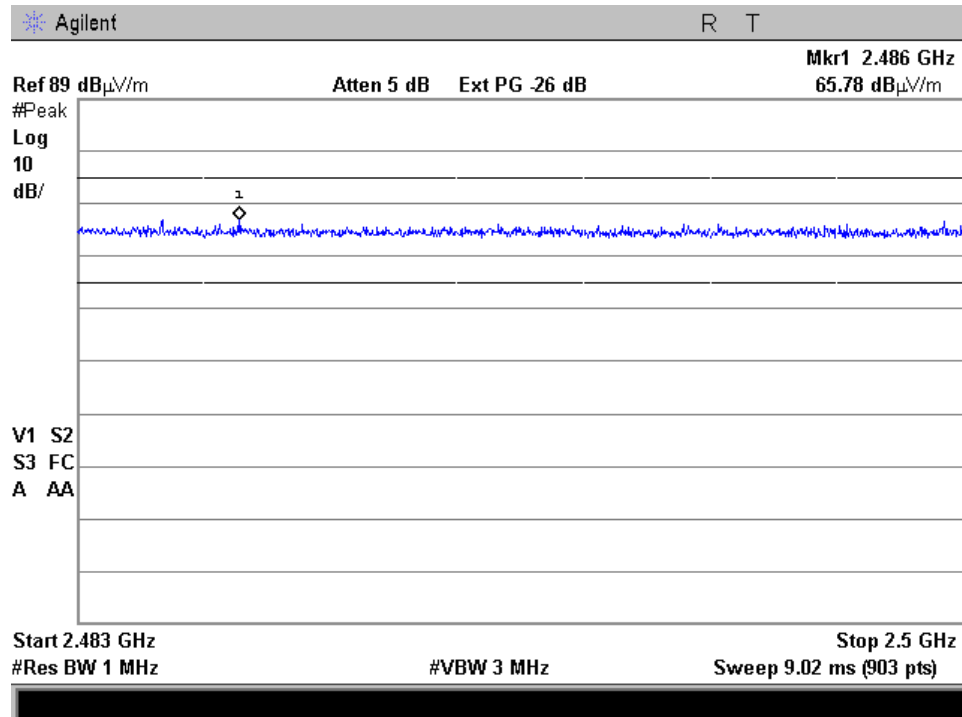
Vertical Polarization
Peak
Plot 4.5.27



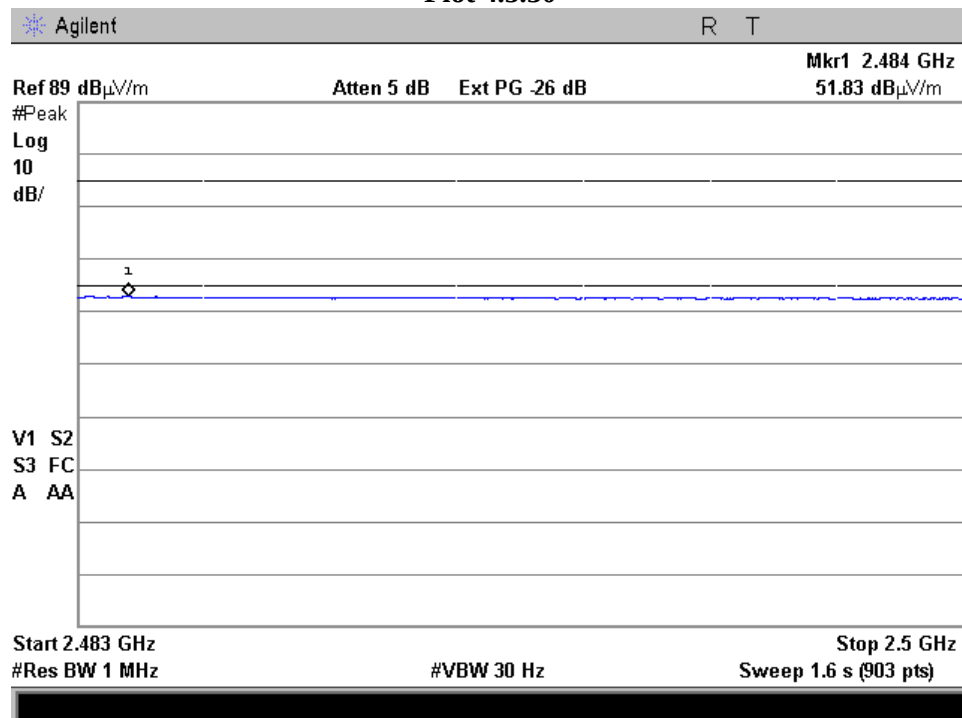
Vertical Polarization
Average
Plot 4.5.28



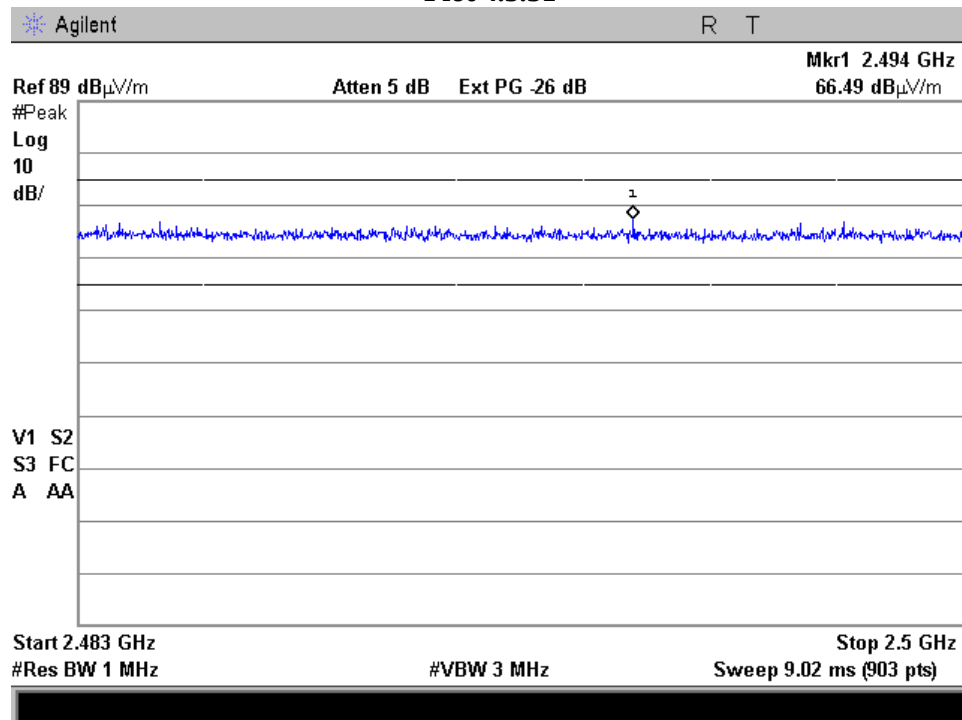
WLAN 802.n 2457 MHz, 6.5Mbps
Highest Frequency Horizontal Polarization
Peak
Plot 4.5.29



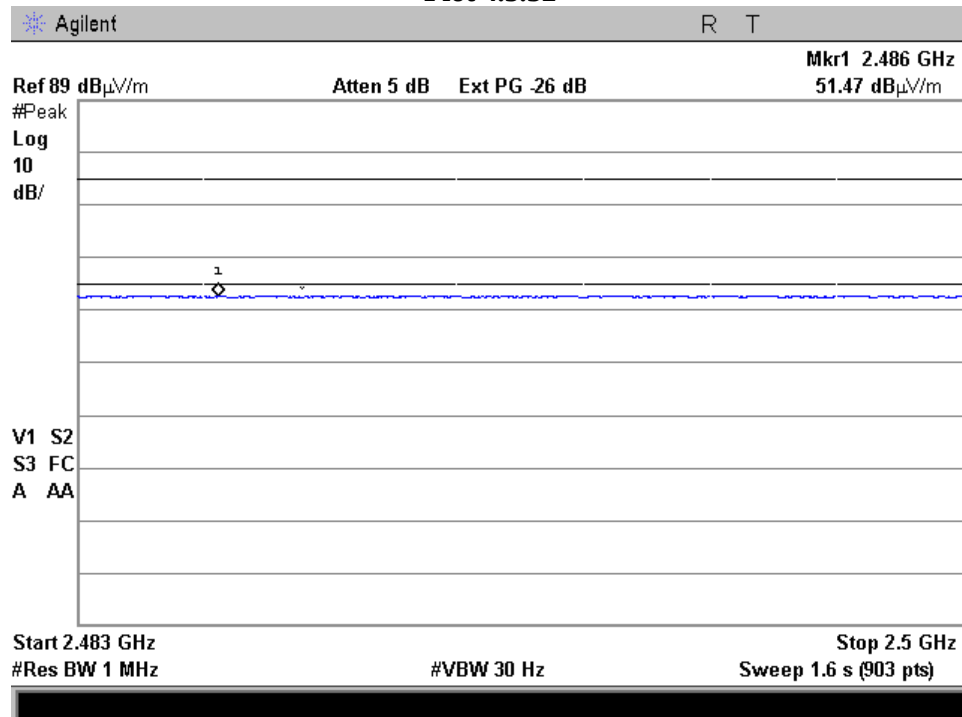
Horizontal Polarization
Average
Plot 4.5.30



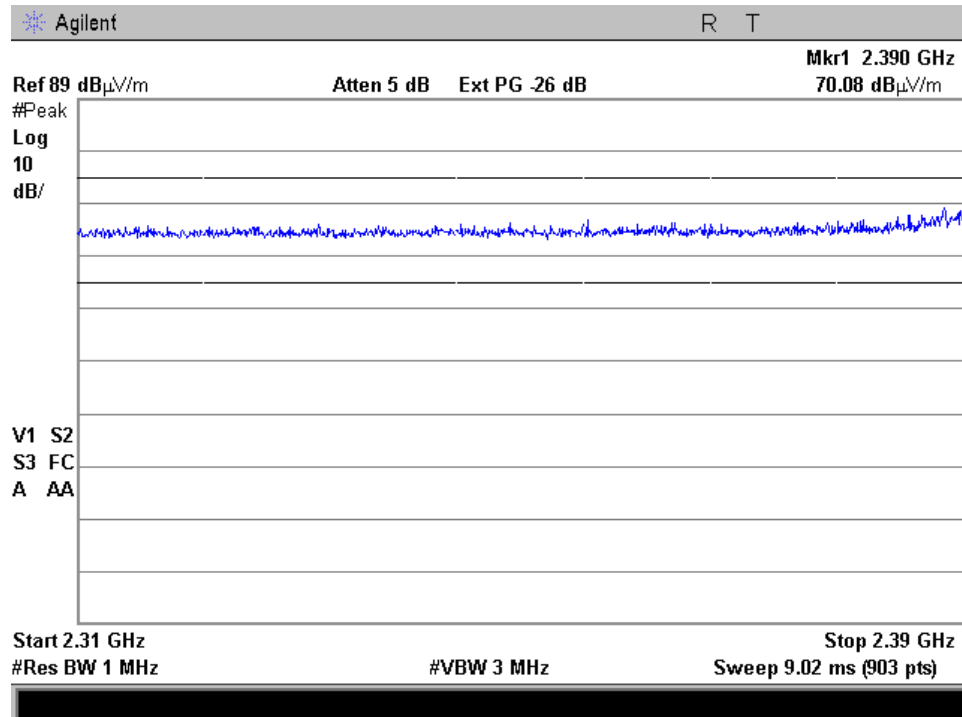
**Vertical Polarization
Peak
Plot 4.5.31**



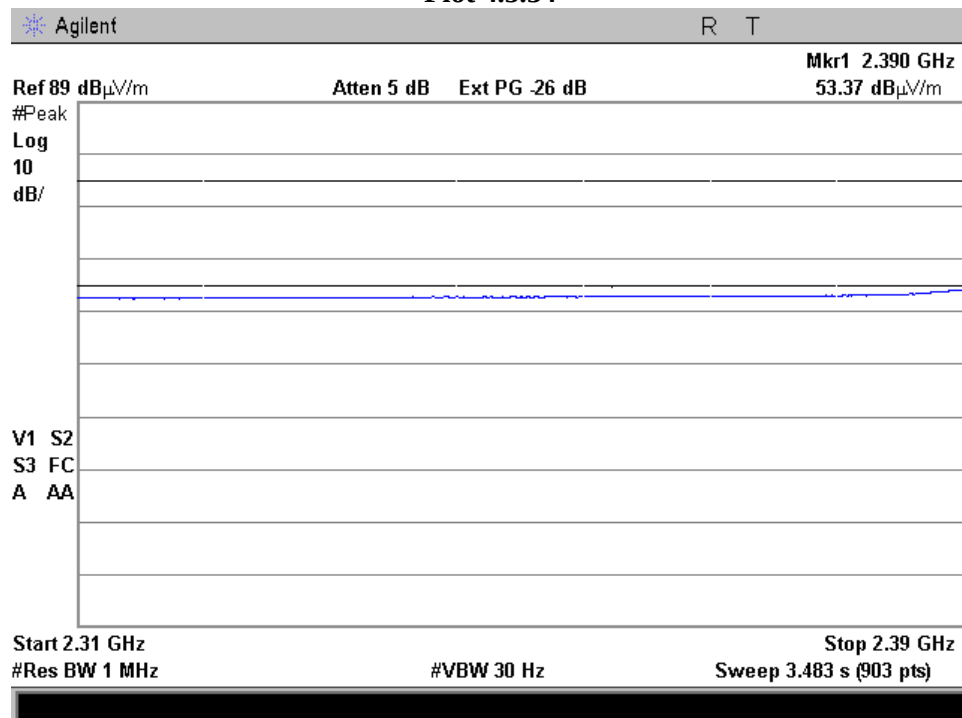
**Vertical Polarization
Average
Plot 4.5.32**



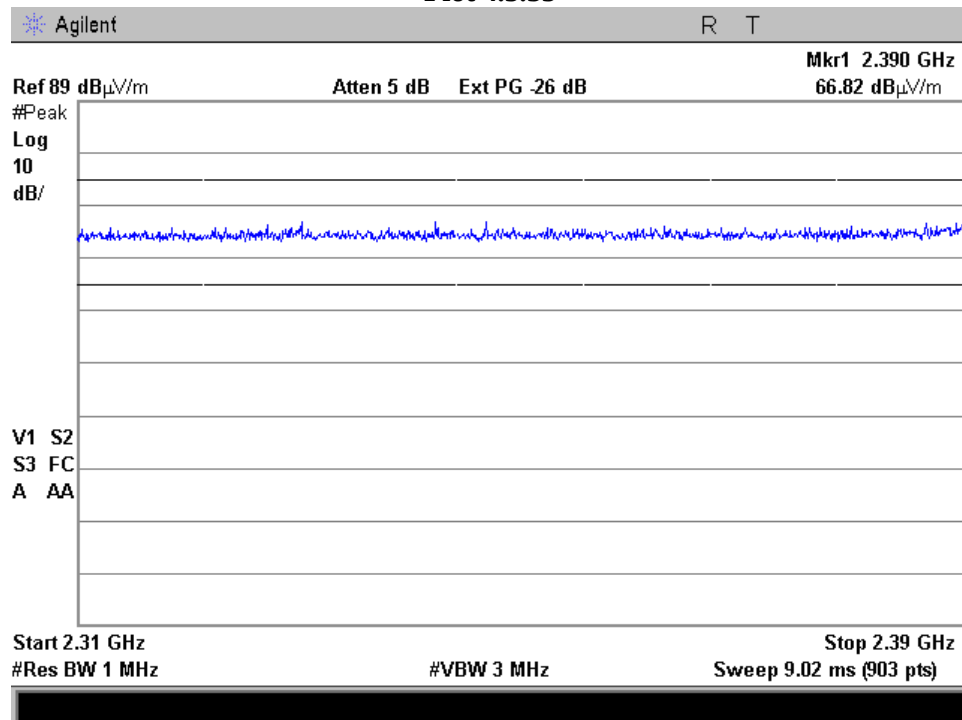
WLAN 802.n 2417 MHz, 6.5Mbps
Highest Frequency Horizontal Polarization
Peak
Plot 4.5.33



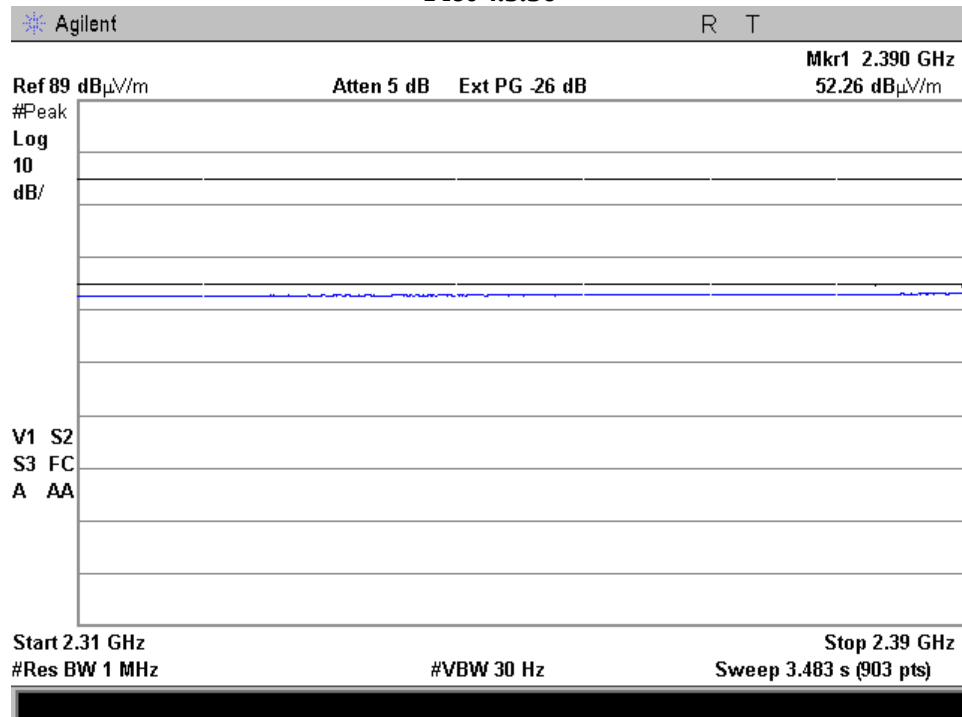
Horizontal Polarization
Average
Plot 4.5.34



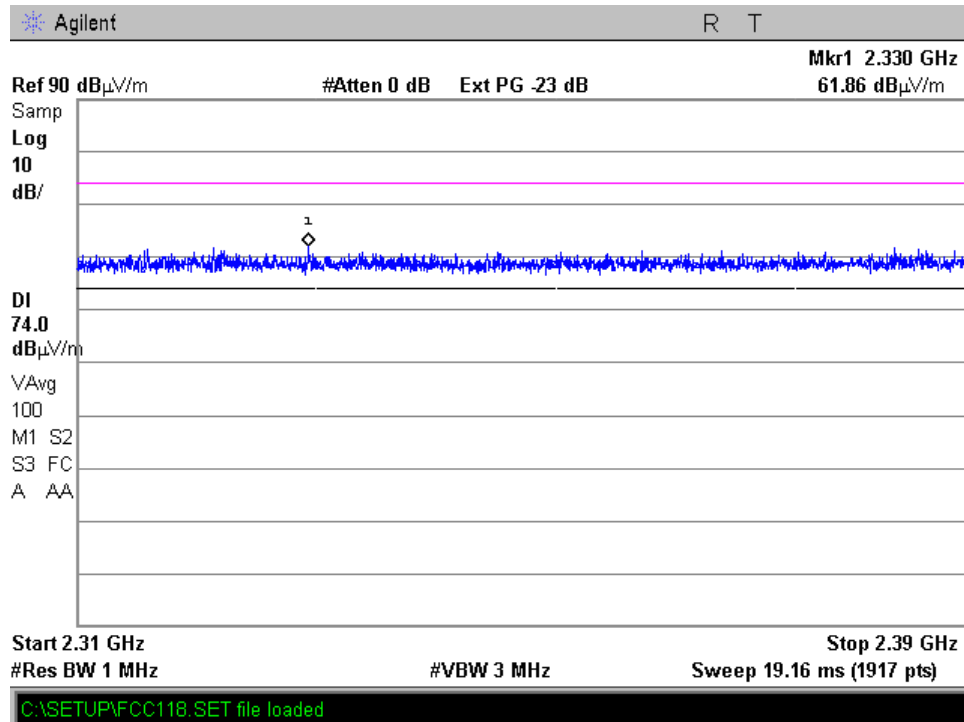
**Vertical Polarization
Peak
Plot 4.5.35**



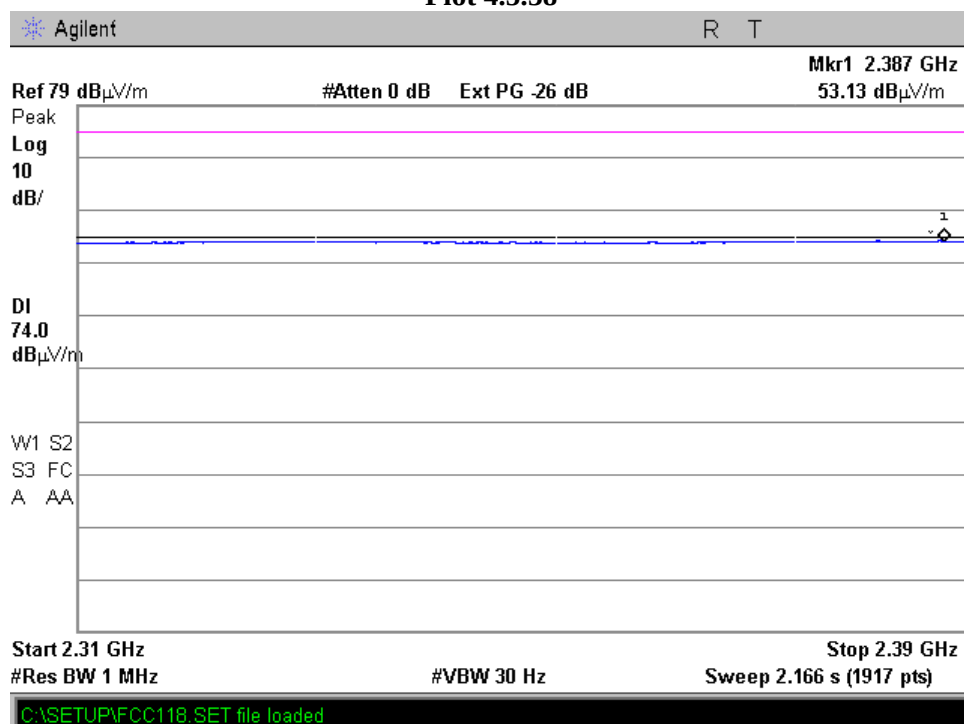
**Vertical Polarization
Average
Plot 4.5.36**



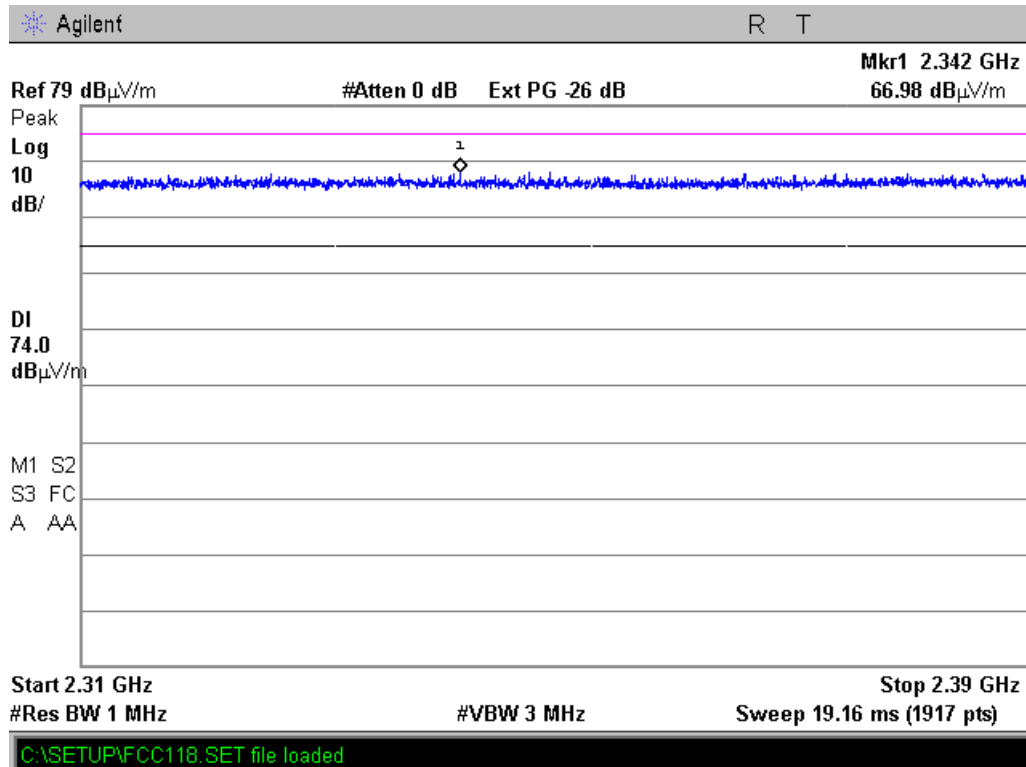
WLAN 802.n 2412 MHz, 6.5Mbps
Lowest Frequency Horizontal Polarization
Peak
Plot 4.5.37



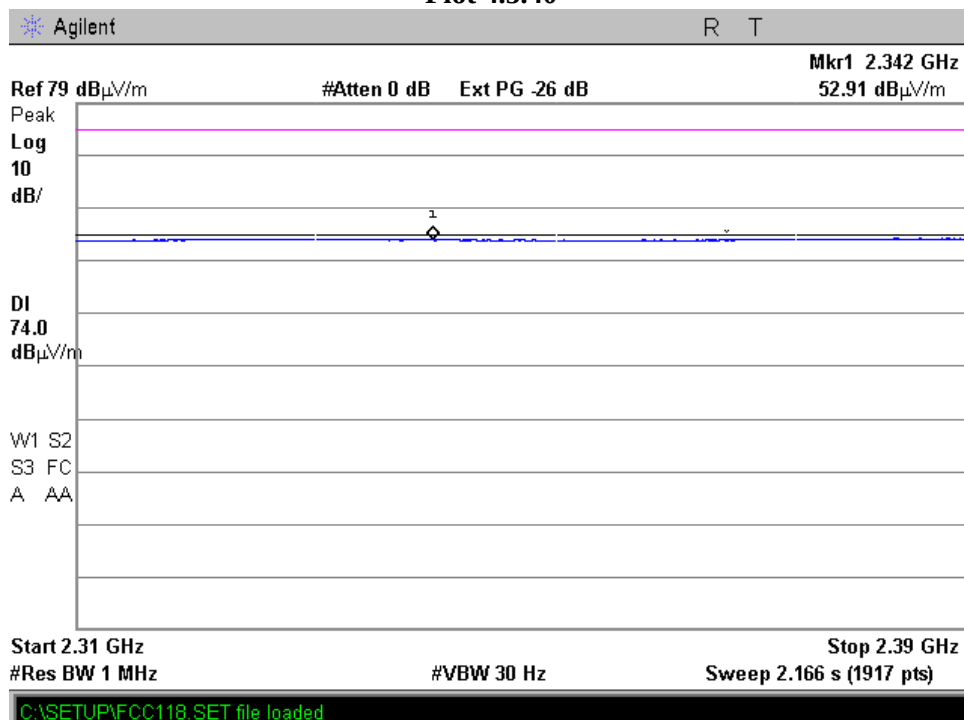
Horizontal Polarization
Average
Plot 4.5.38



Vertical Polarization
Peak
Plot 4.5.39



Vertical Polarization
Average
Plot 4.5.40



4.6. Spurious Radiated Emissions, Restricted Bands

Reference document:	47 CFR §15.247 (d), & §15.205, & §15.209(a)		
Test Requirements:	The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.209(a).		
Test setup:	See sec 2.2, with Band Reject filter	Pass	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	f >1GHz: Peak: RBW= 1MHz, VBW= 3MHz, Average: VBW= 10 Hz f <1GHz: RBW: 120kHz, VBW: 300kHz		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.6.1 - Plot 4.6.50	

Test results: 2.4 GHz Bands

All measurements were performed in horizontal and vertical polarizations; the results show the worst case.

Channel Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
WLAN 802.11b							
No emissions were found							

WLAN 802.11g							
Channel Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
No emissions were found							

WLAN 802.11 n							
Channel Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
No emissions were found							

5 GHz Bands

WLAN 802.11 a							
Channel Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
No emissions were found							

WLAN 802.11 n							
Channel Frequency [MHz]	Data Rate [Mbps]	Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
No emissions were found							

Test results below 1GHz:

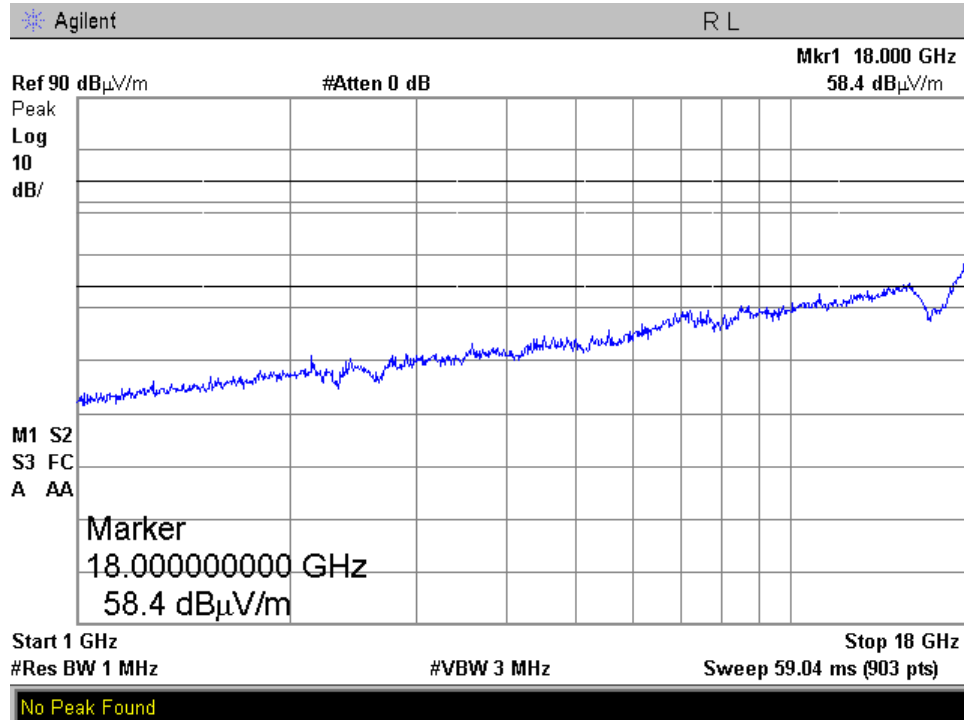
All measurements were done in horizontal and vertical polarizations; the results show the worst case for all frequencies.

Emission Frequency [MHz]	Detector Type	Polarization H/V	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
32.61	QP	V	29.5	40	-10.5

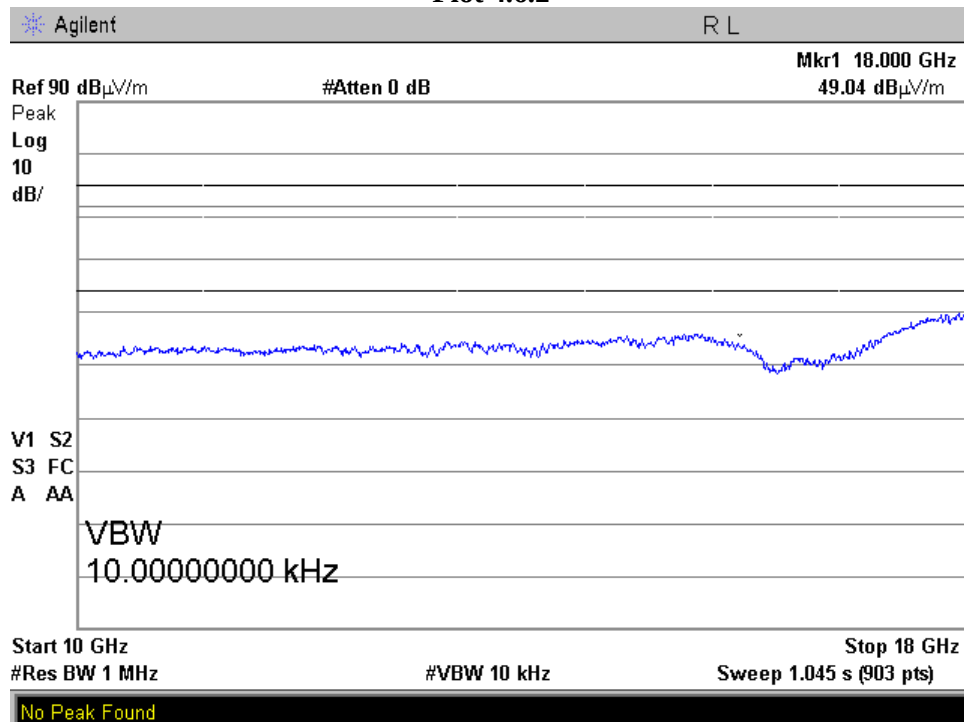
Note: Spurious Emission [dBμV/m] = measured [dBμV] + Correction-factor [dB (1/m)]

Correction Factor = Antenna factor + Cable Loss + Filter I/L.

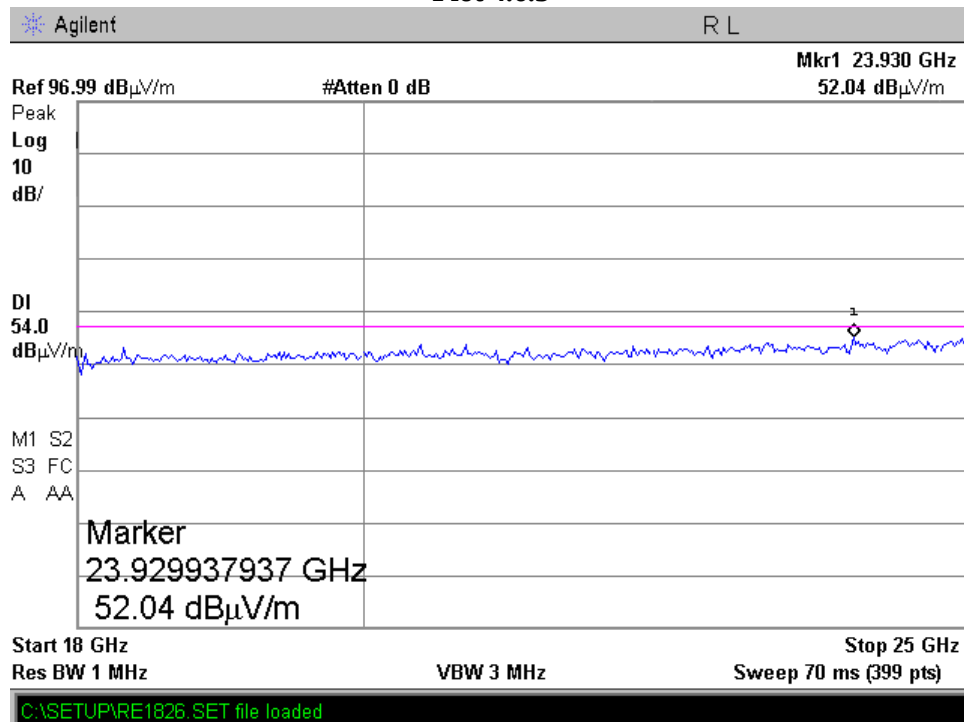
WLAN 802.11b, 2412 MHz, 1 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.1



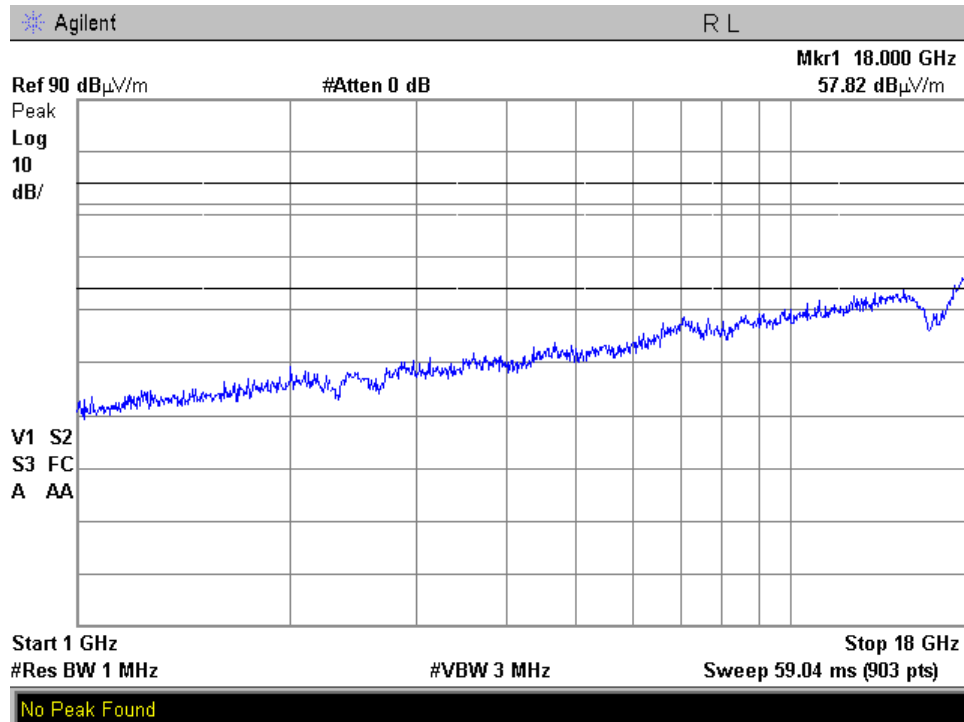
Horizontal & Vertical Polarization
Plot 4.6.2



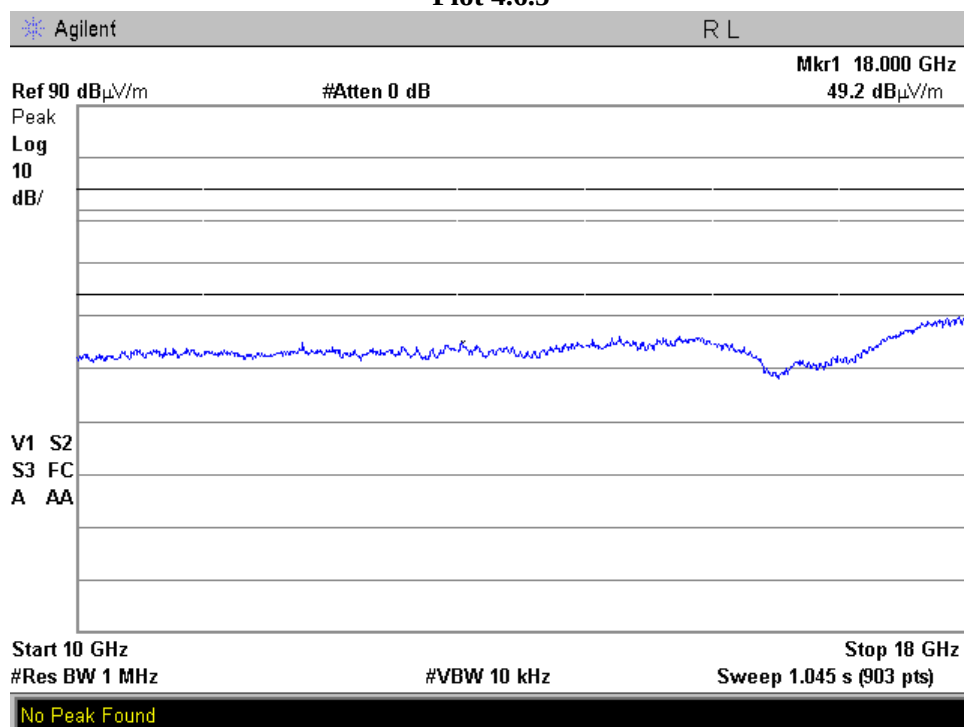
Horizontal & Vertical Polarization
Plot 4.6.3



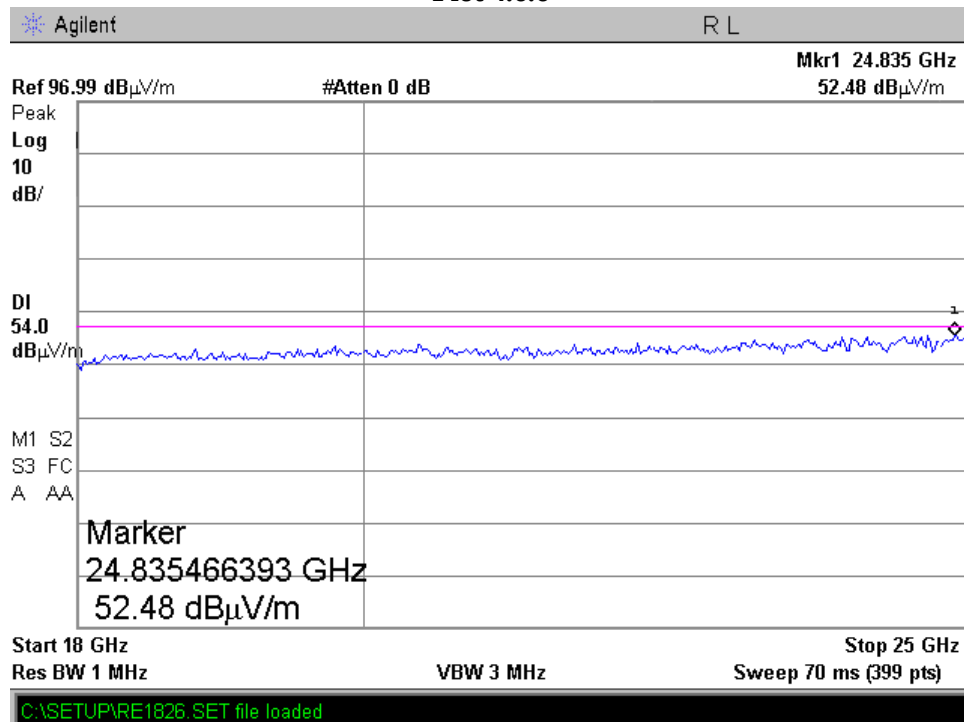
WLAN 802.11b, 2437 MHz, 11 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.4



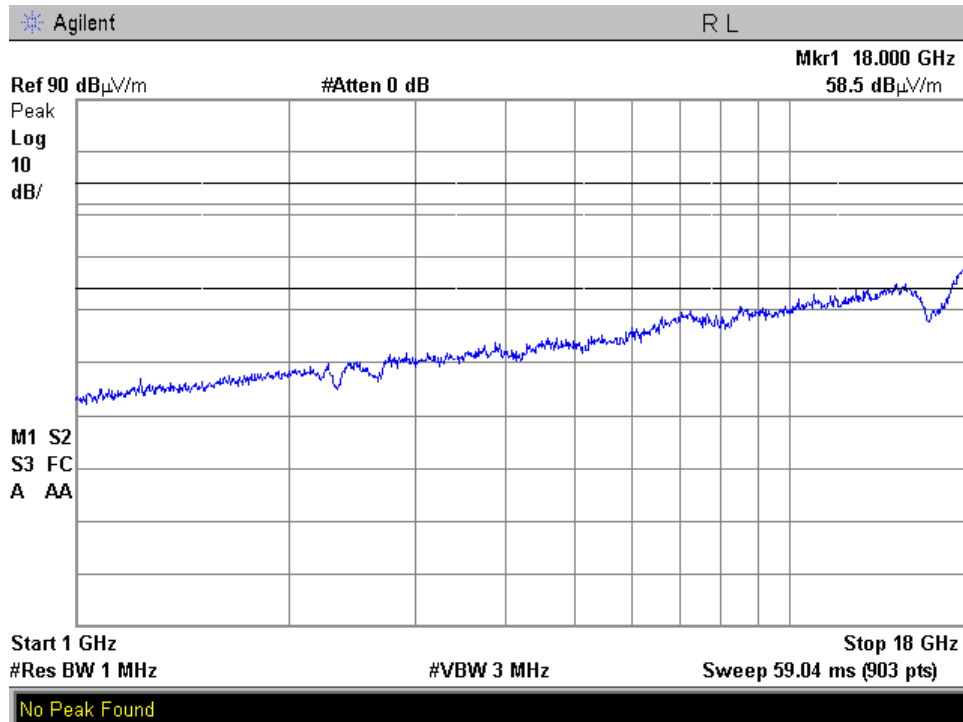
Horizontal & Vertical Polarization
Plot 4.6.5



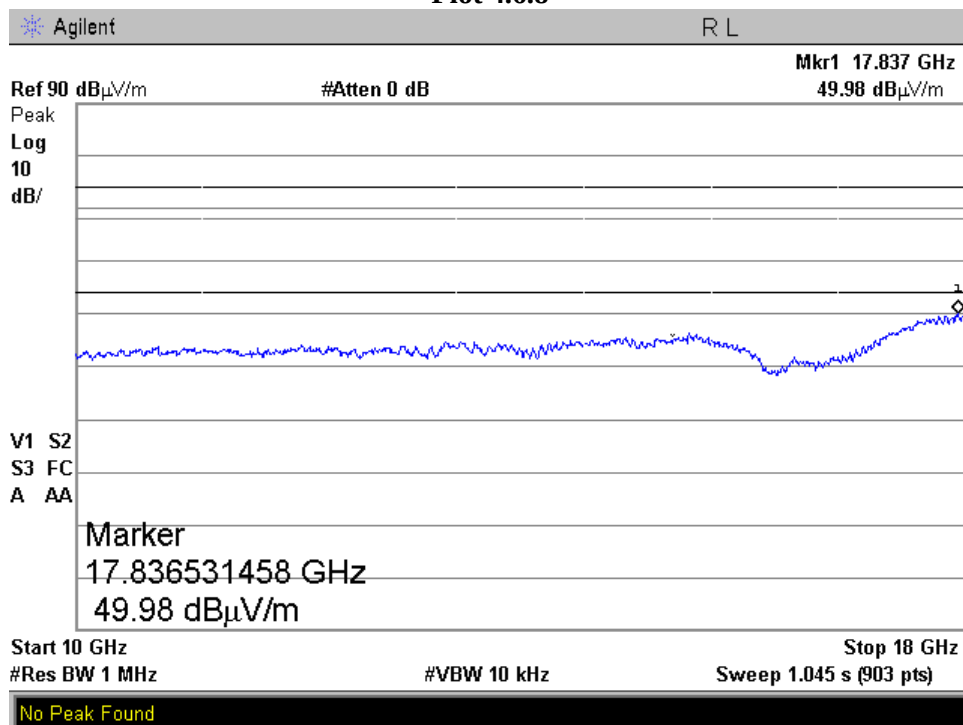
Horizontal & Vertical Polarization
Plot 4.6.6



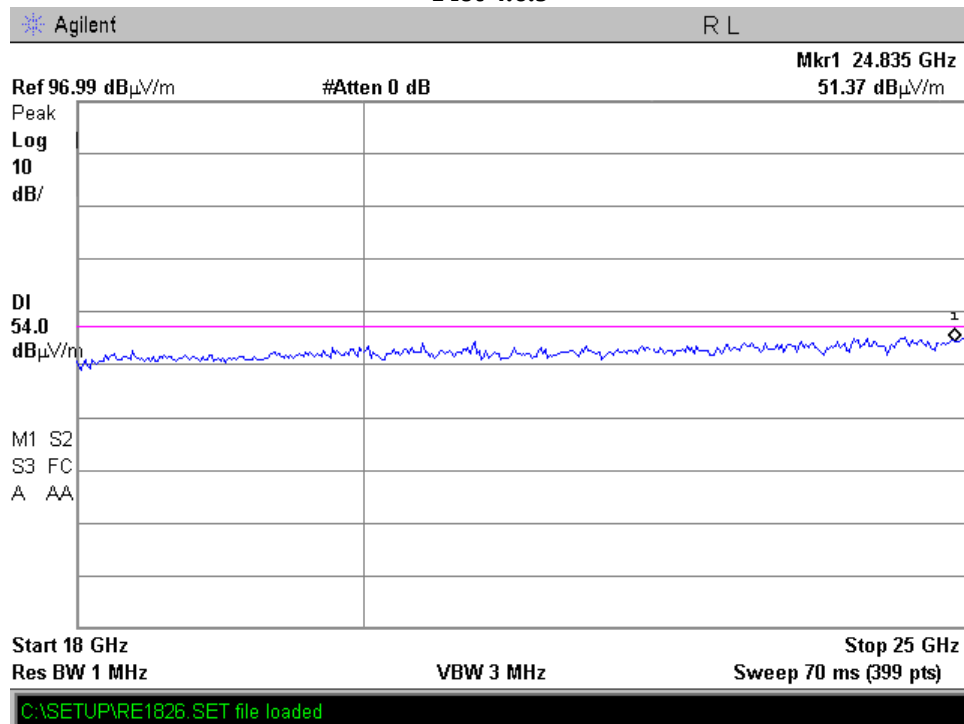
WLAN 802.11b, 2462 MHz, 11 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.7



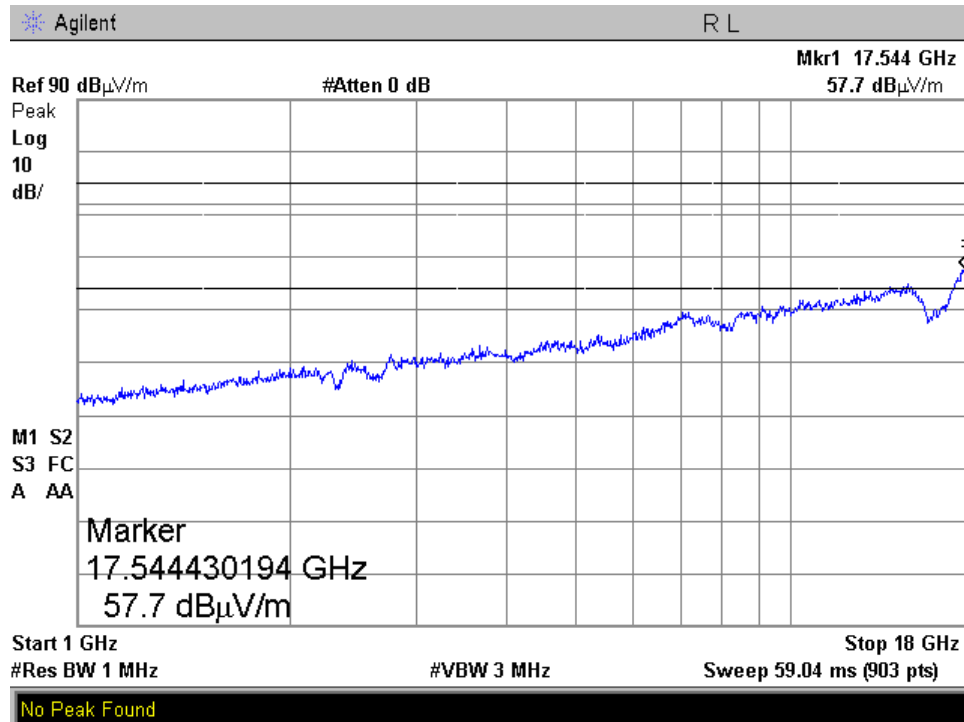
Horizontal & Vertical Polarization
Plot 4.6.8



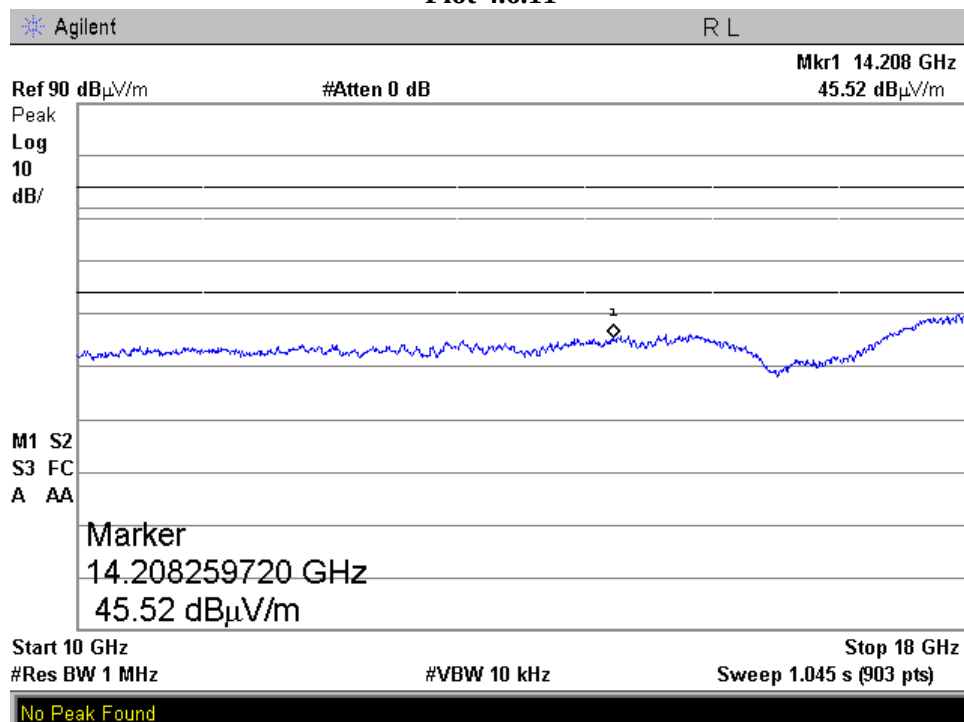
Horizontal & Vertical Polarization
Plot 4.6.9



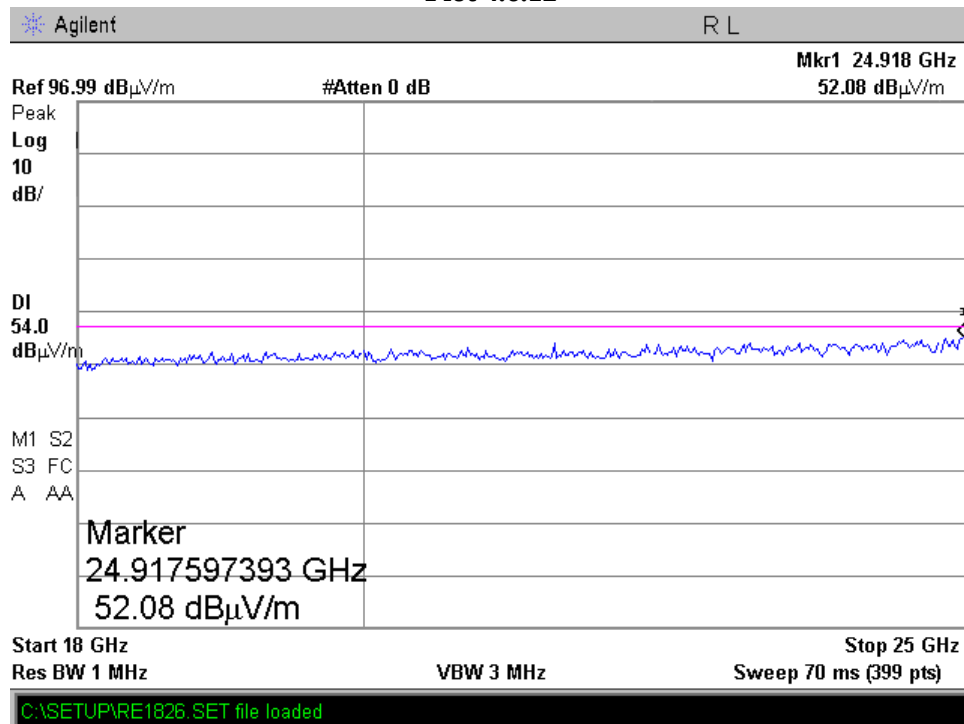
WLAN 802. 1g, 2412 MHz, 6 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.10



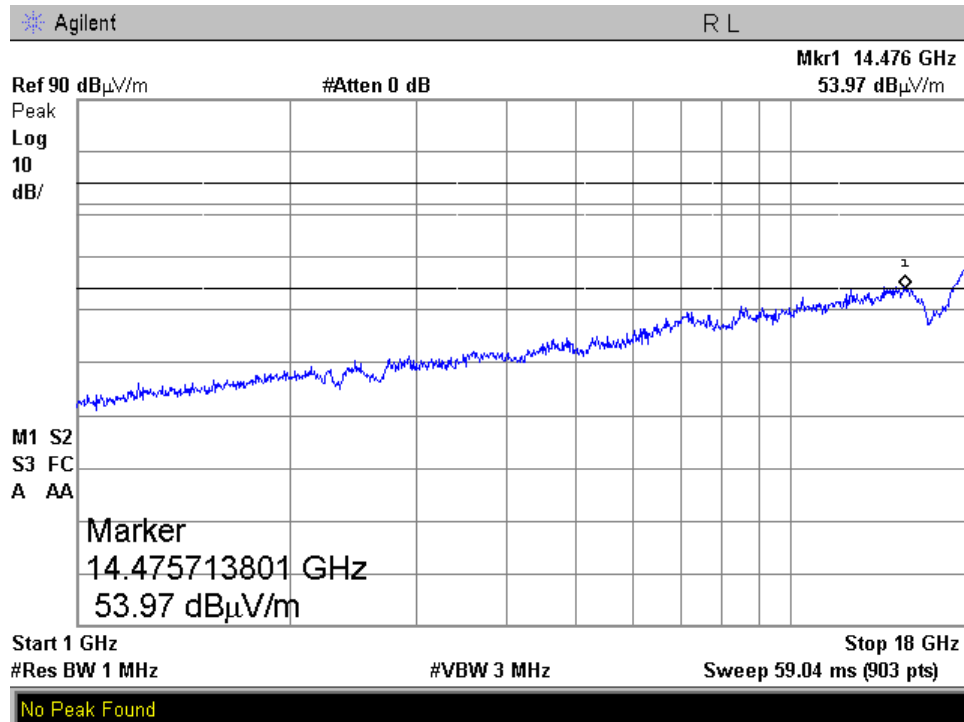
Horizontal & Vertical Polarization
Plot 4.6.11



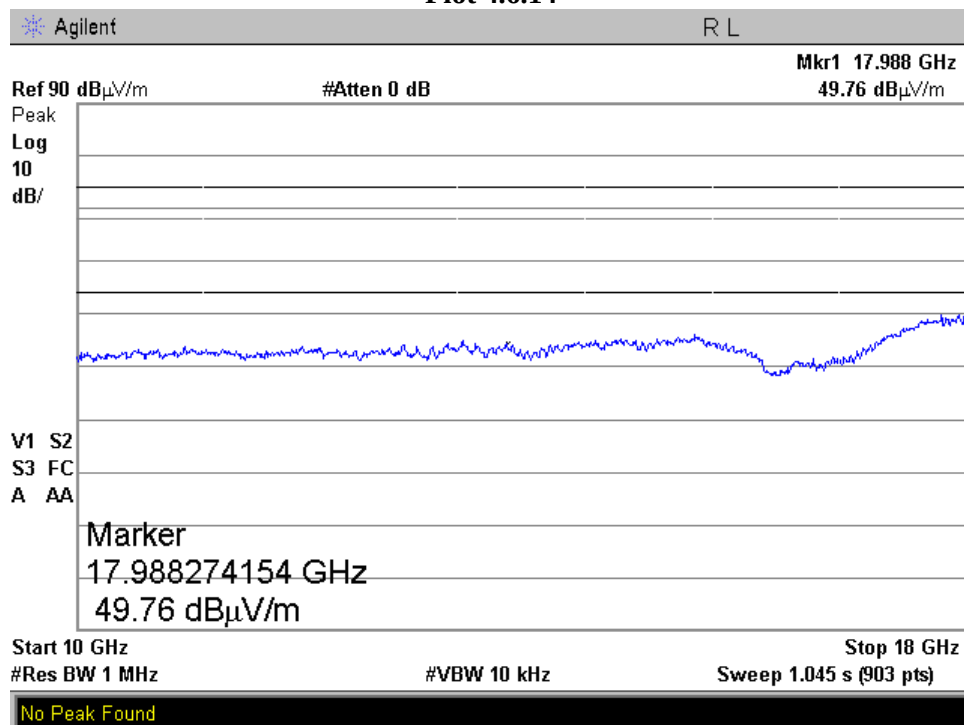
Horizontal & Vertical Polarization
Plot 4.6.12



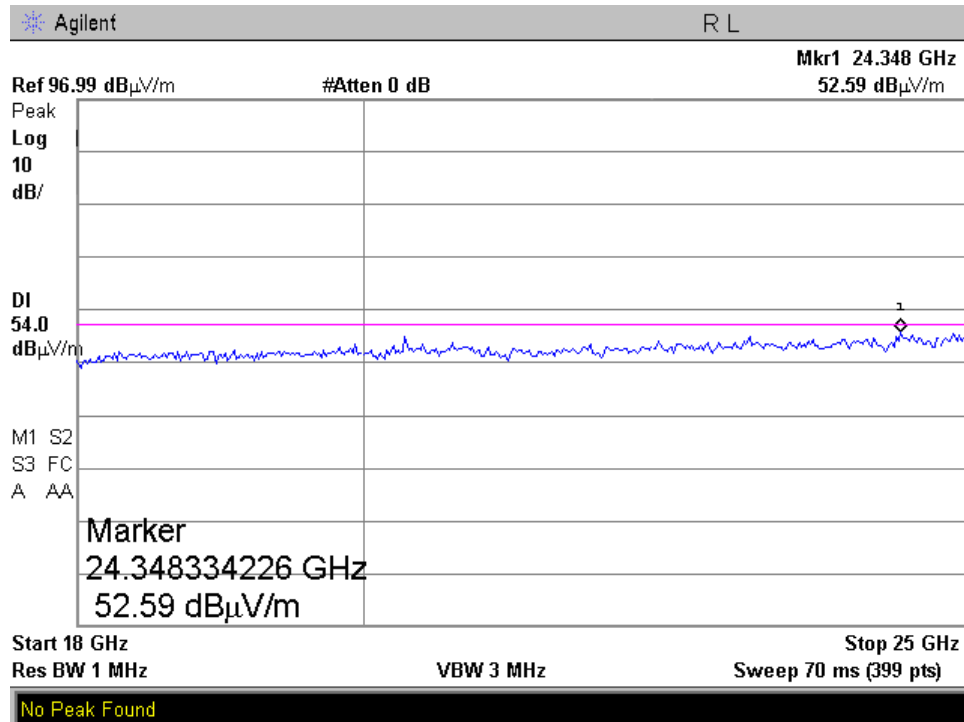
WLAN 802. 54g, 2437 MHz, 54 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.13



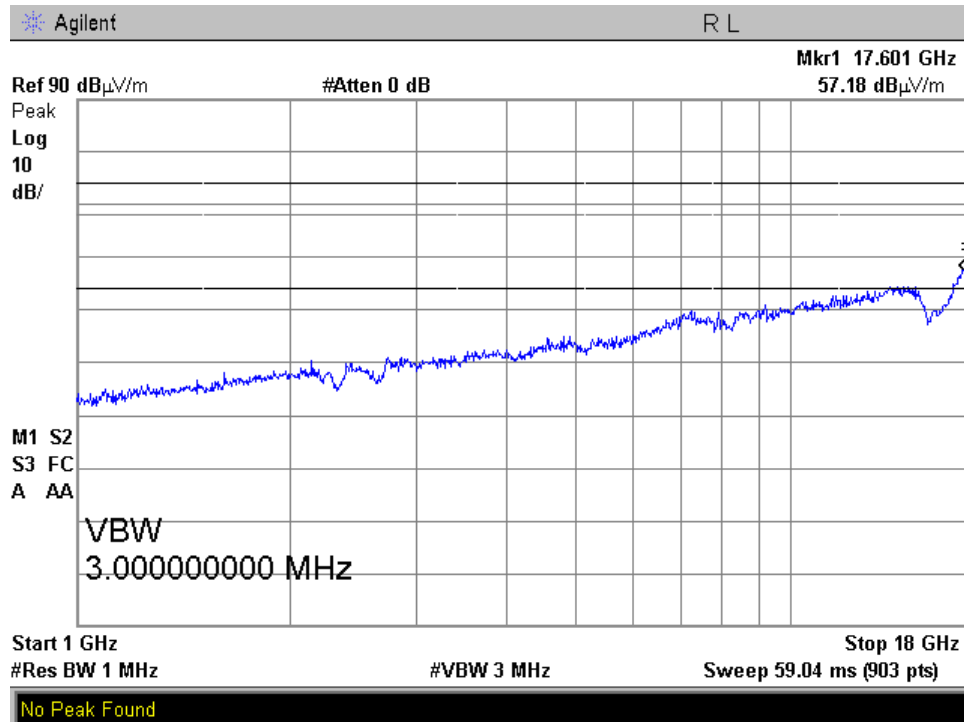
Horizontal & Vertical Polarization
Plot 4.6.14



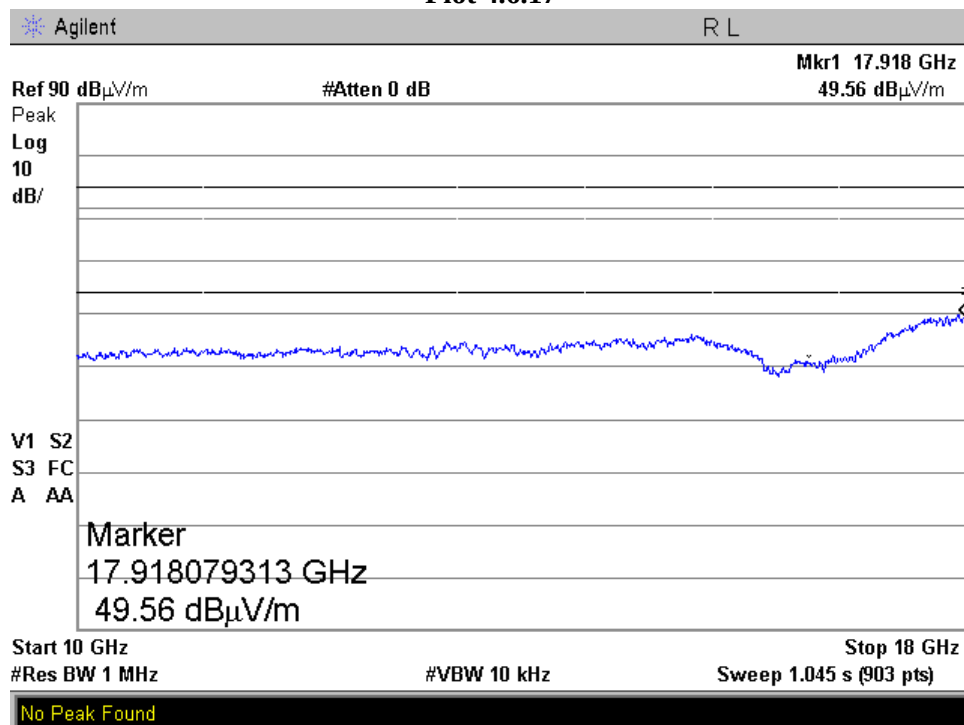
Horizontal & Vertical Polarization
Plot 4.6.15



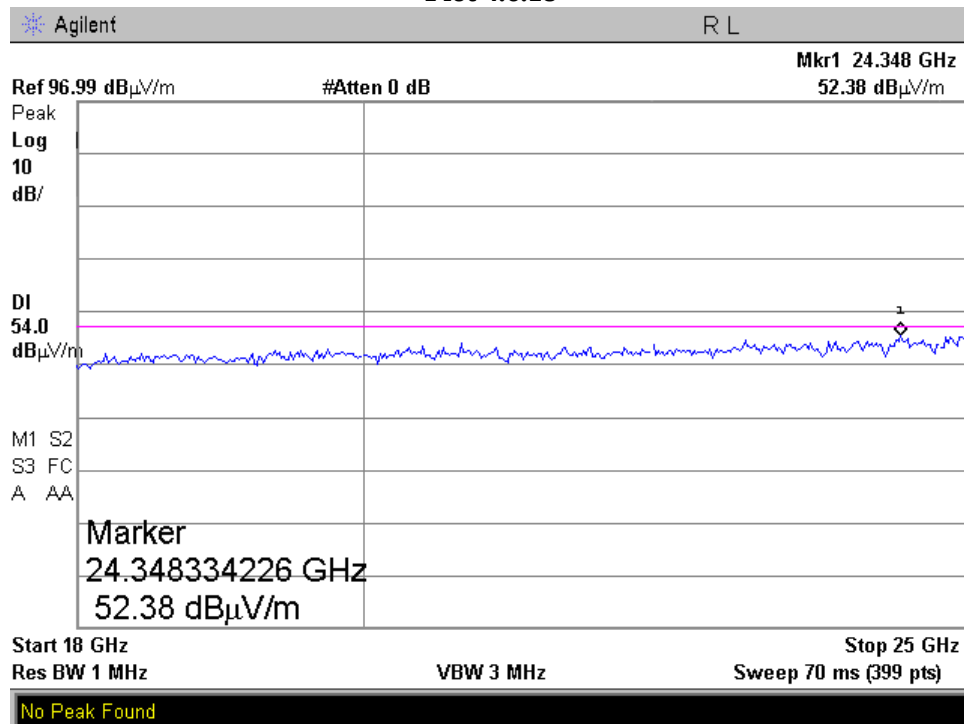
WLAN 802. 6g, 2462 MHz, 6 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.16



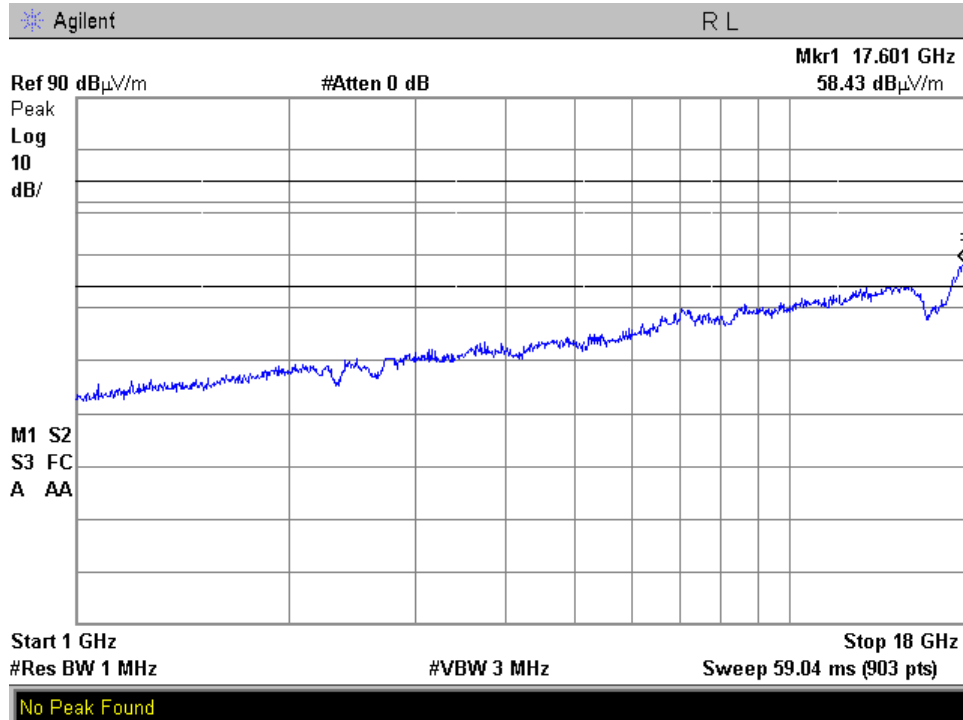
Horizontal & Vertical Polarization
Plot 4.6.17



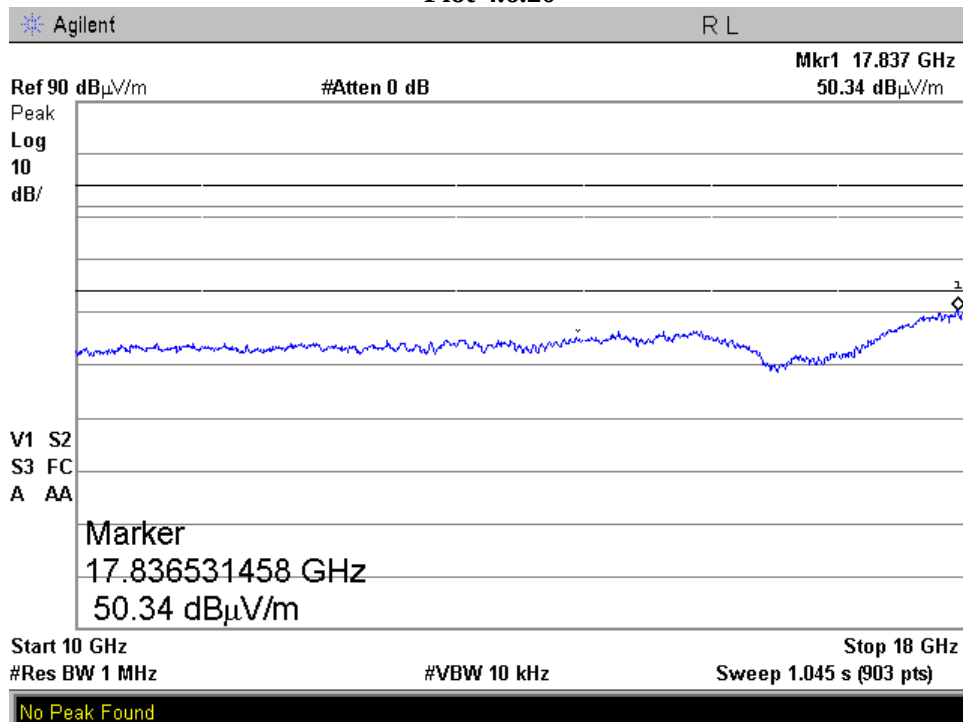
Horizontal & Vertical Polarization
Plot 4.6.18



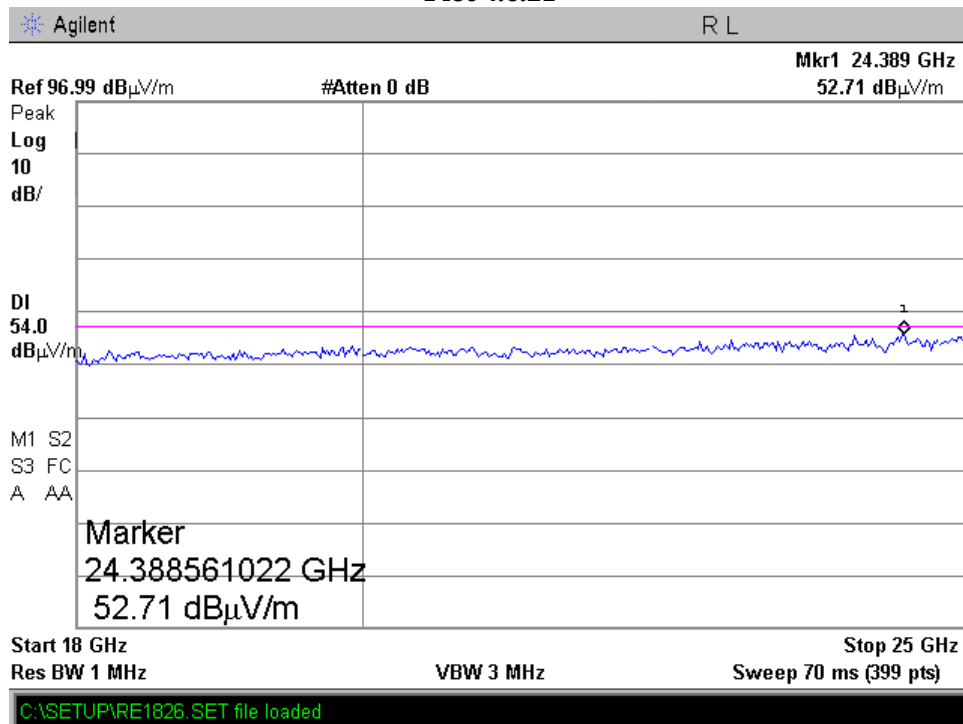
WLAN 802.11n, 2412 MHz, msc0 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.19



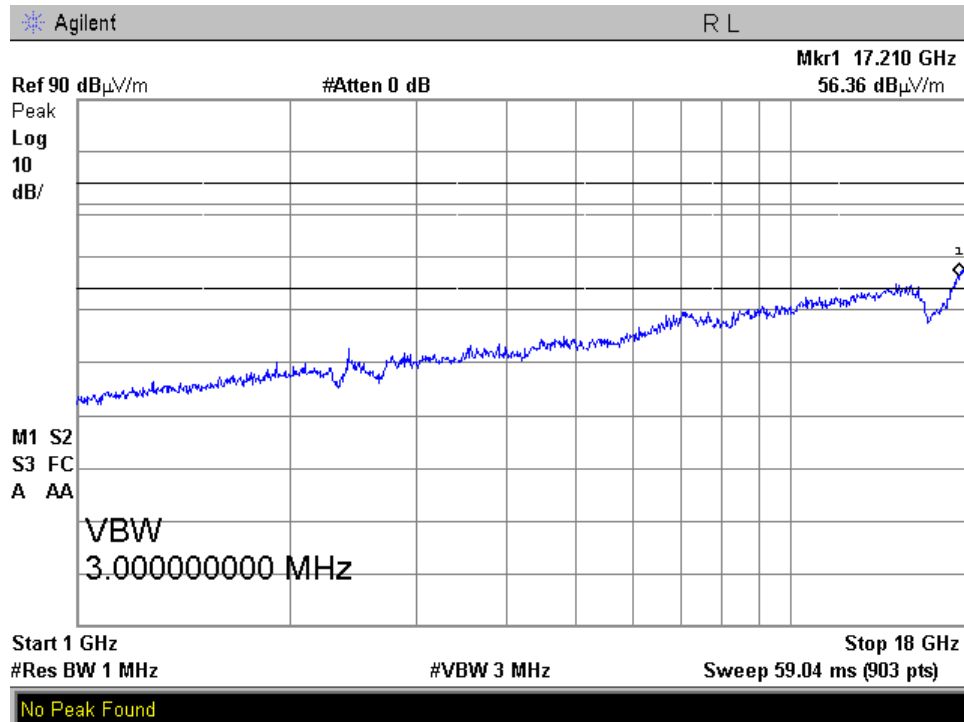
Horizontal & Vertical Polarization
Plot 4.6.20



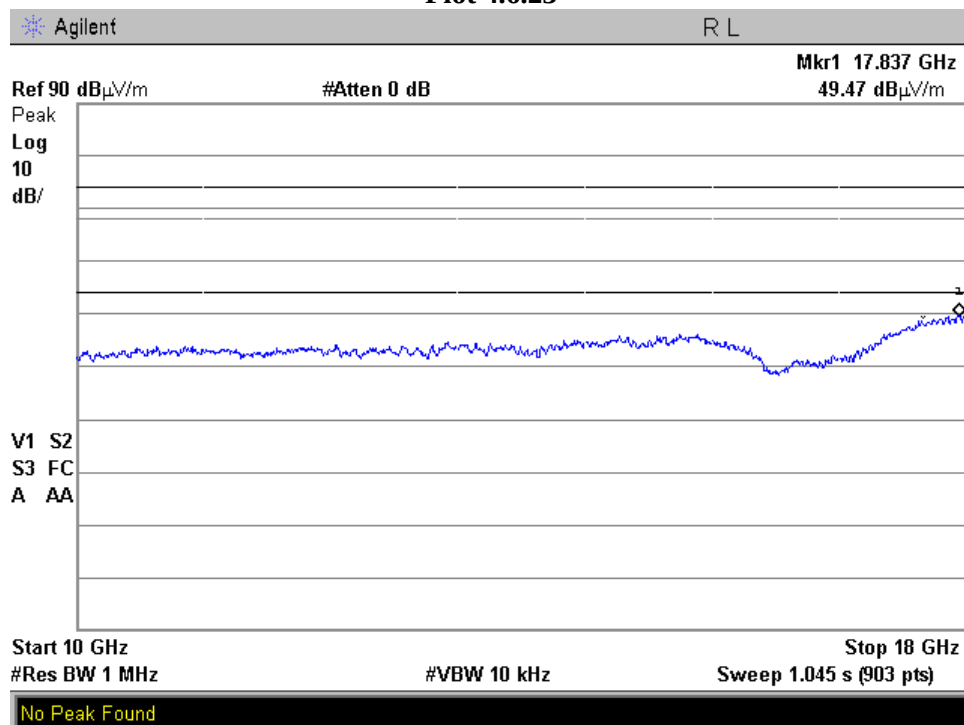
Horizontal & Vertical Polarization
Plot 4.6.21



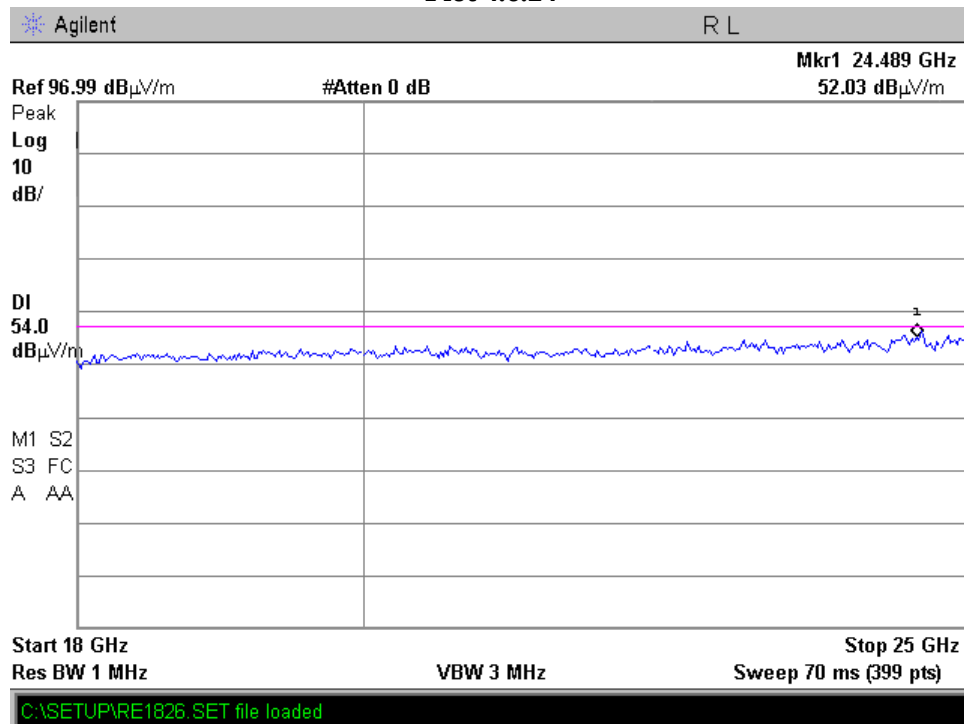
WLAN 802.11n, 2437 MHz, msc7 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.22



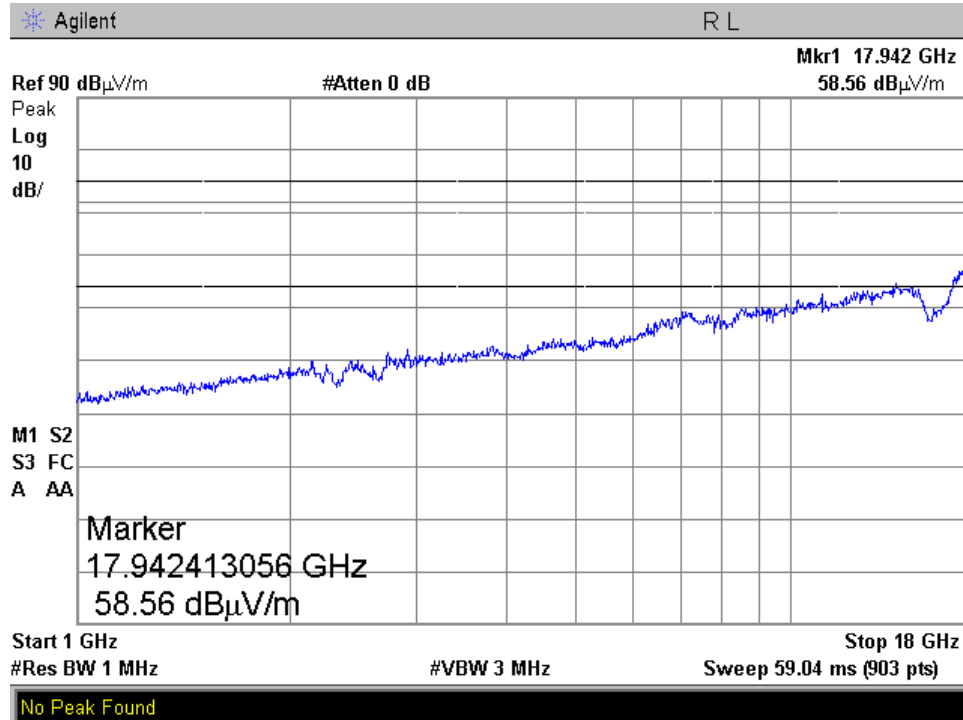
Horizontal & Vertical Polarization
Plot 4.6.23



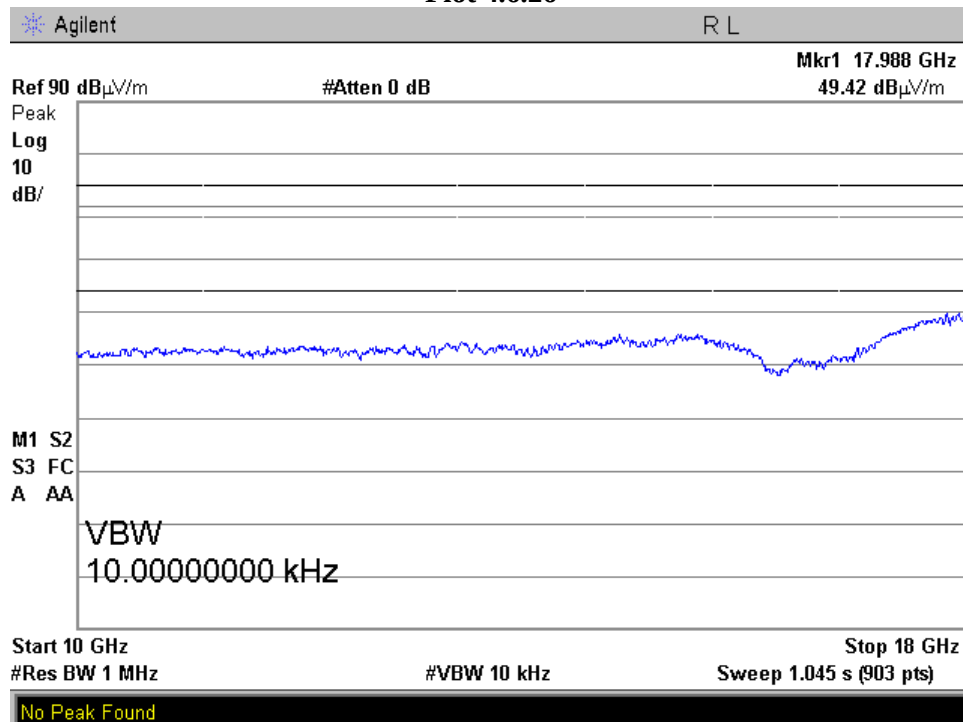
Horizontal & Vertical Polarization
Plot 4.6.24



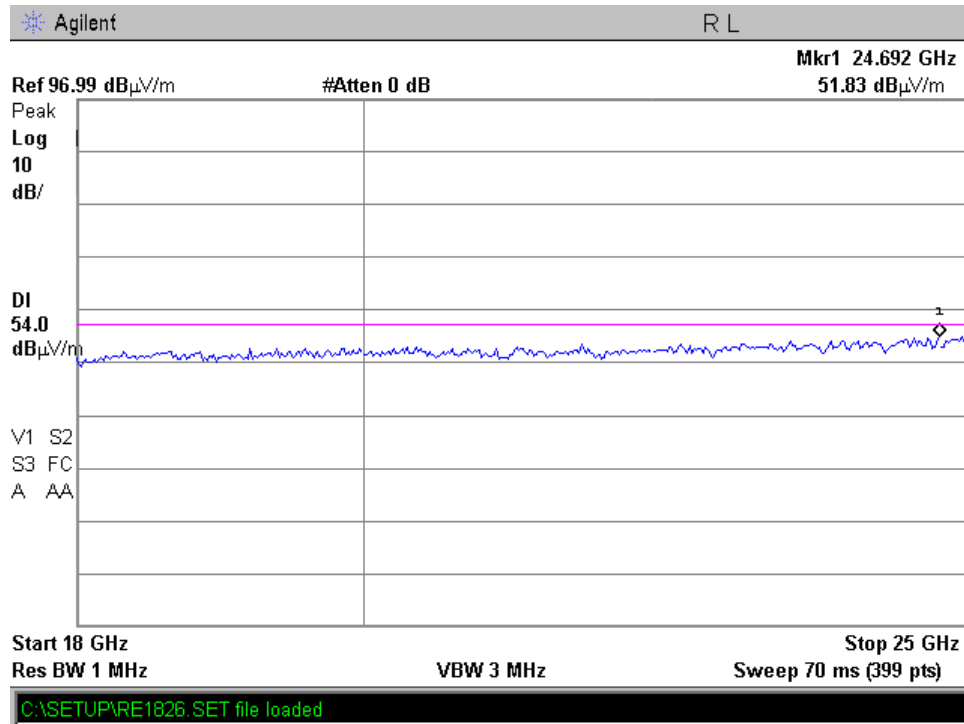
WLAN 802.11n, 2462MHz, msc7 Mbps
Lowest Frequency
Horizontal & Vertical Polarization
Plot 4.6.25



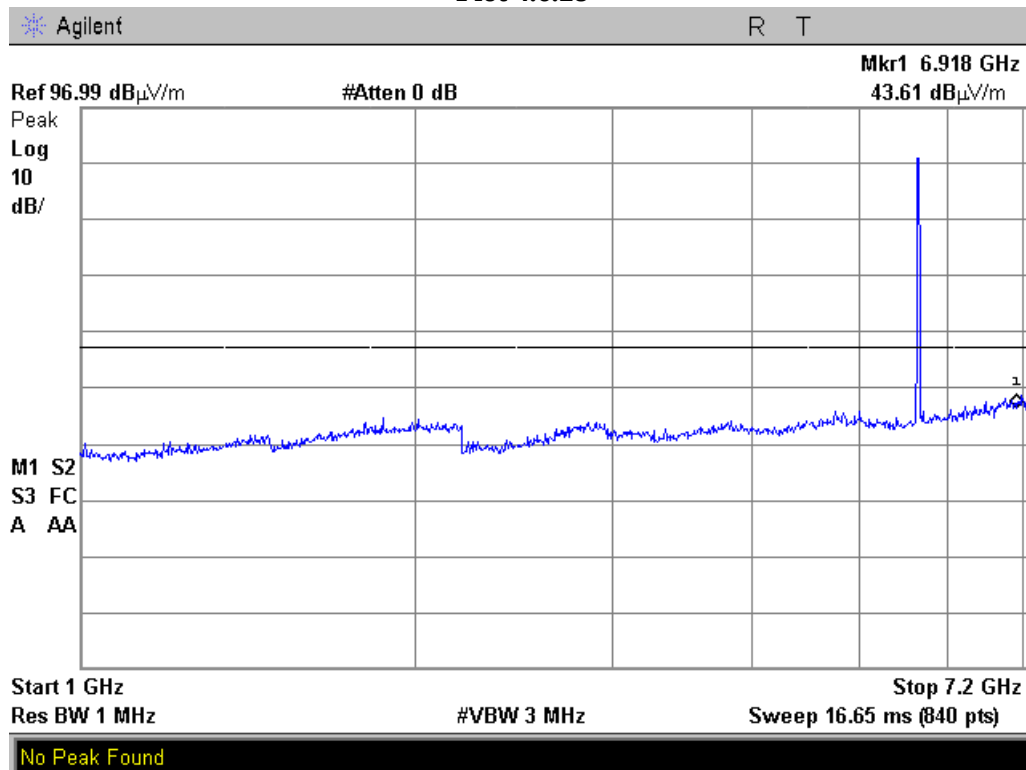
Horizontal & Vertical Polarization
Plot 4.6.26



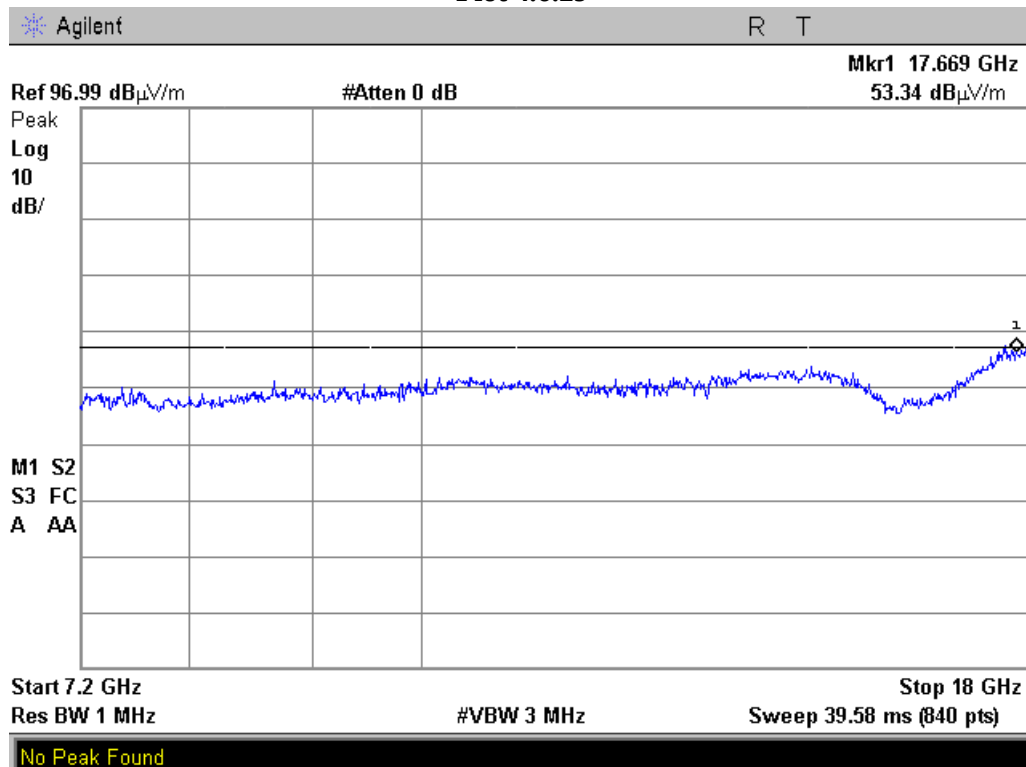
Horizontal & Vertical Polarization
Plot 4.6.27



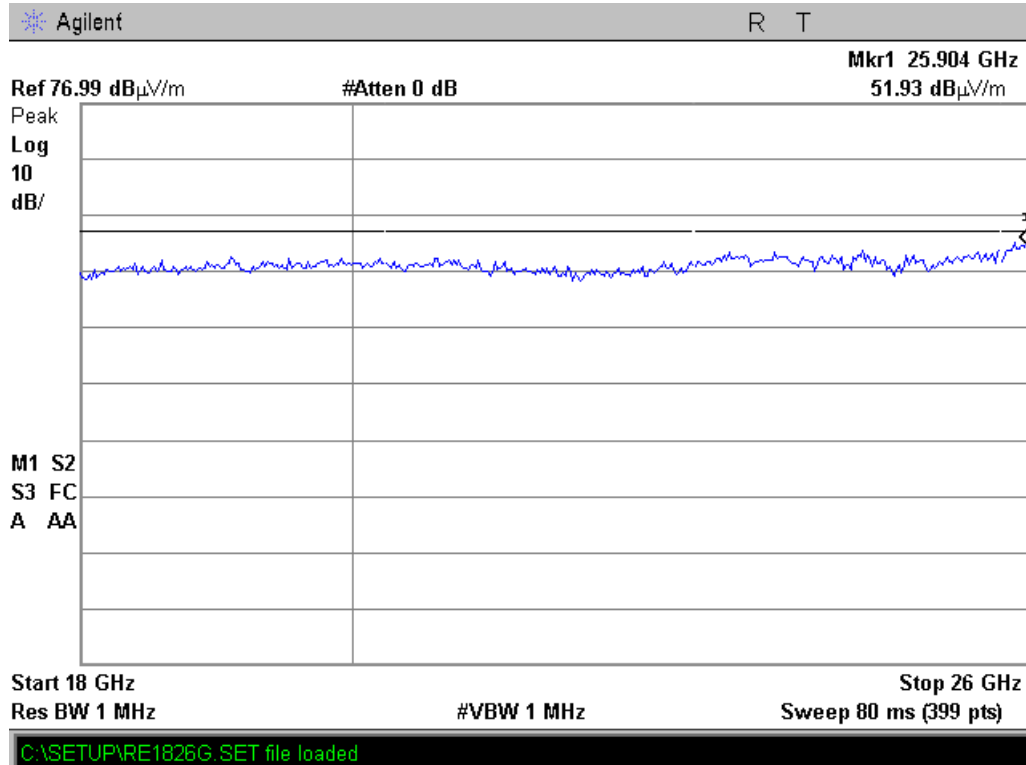
WLAN 802.11n, 5745 MHz msc7 Mbps
Horizontal & Vertical Polarization
Plot 4.6.28



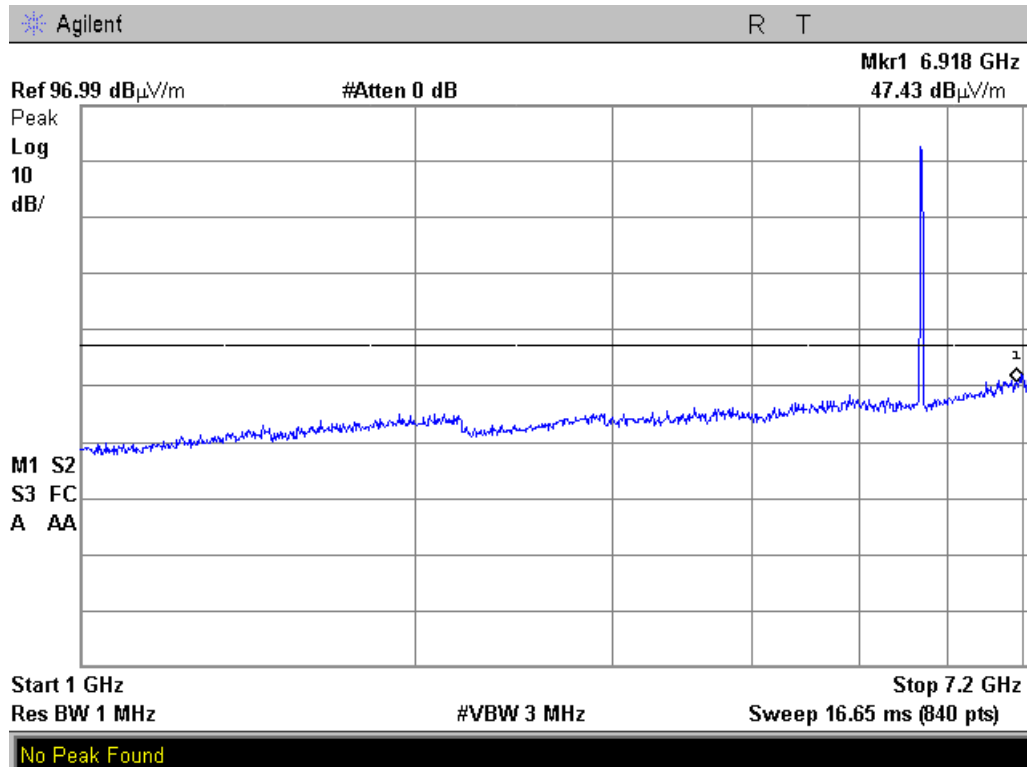
Horizontal & Vertical Polarization
Plot 4.6.29



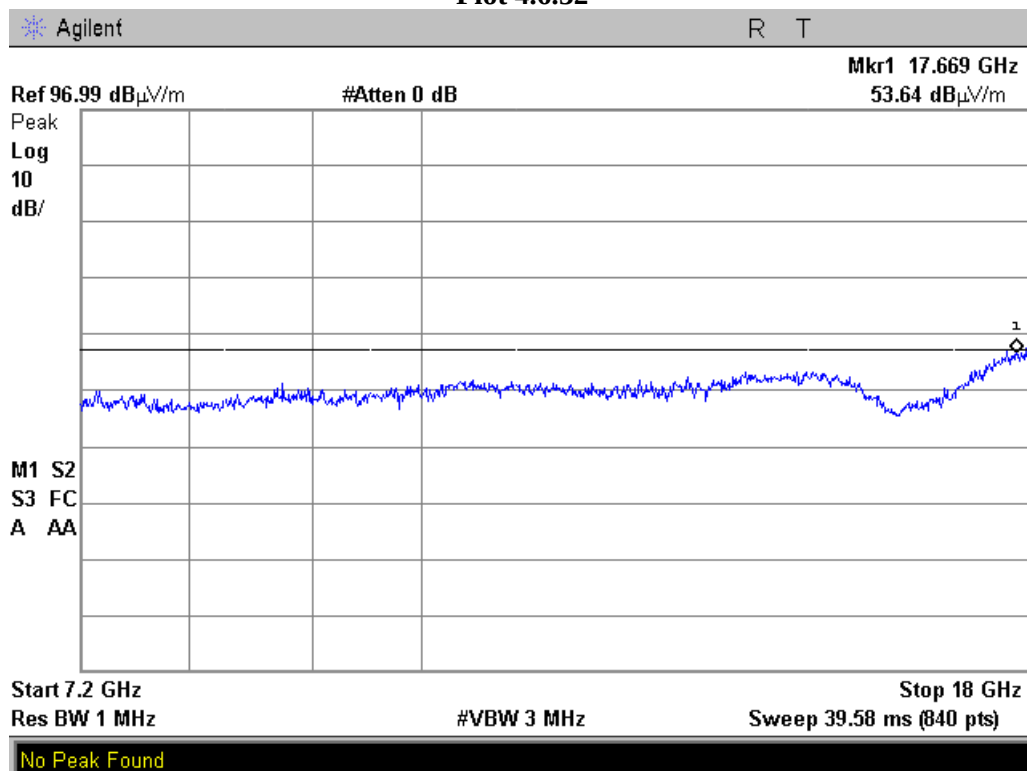
WLAN 802.11n
Horizontal & Vertical Polarization
Plot 4.6.30



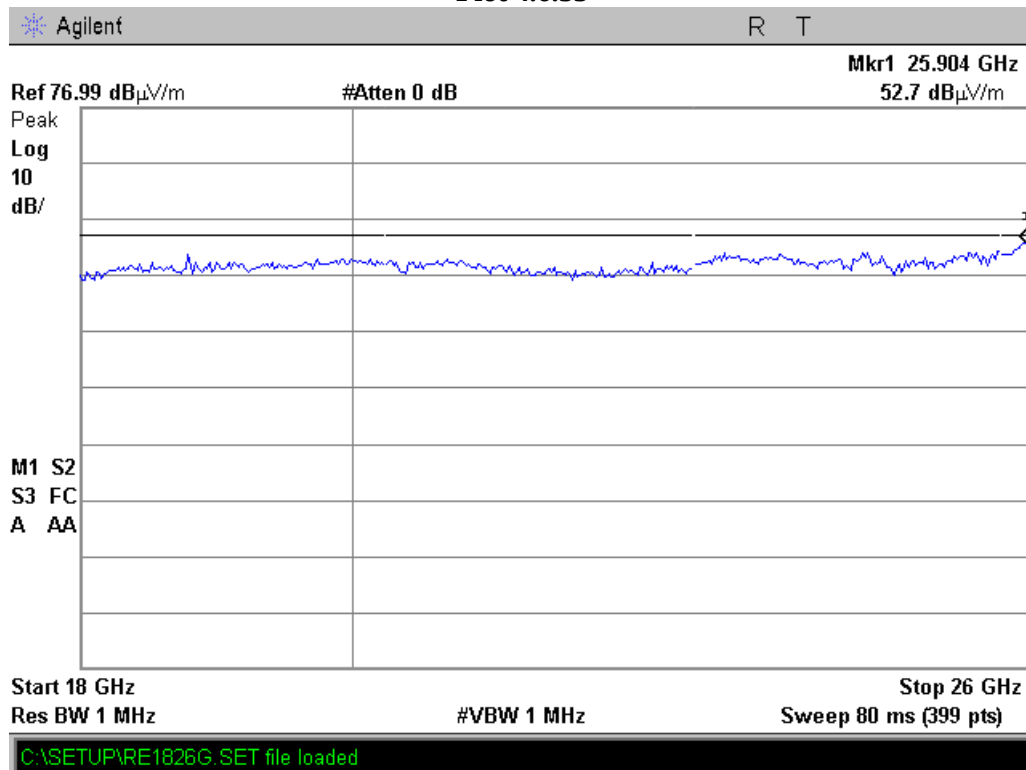
802.11n 5785 MHz
Horizontal & Vertical Polarization
Plot 4.6.31



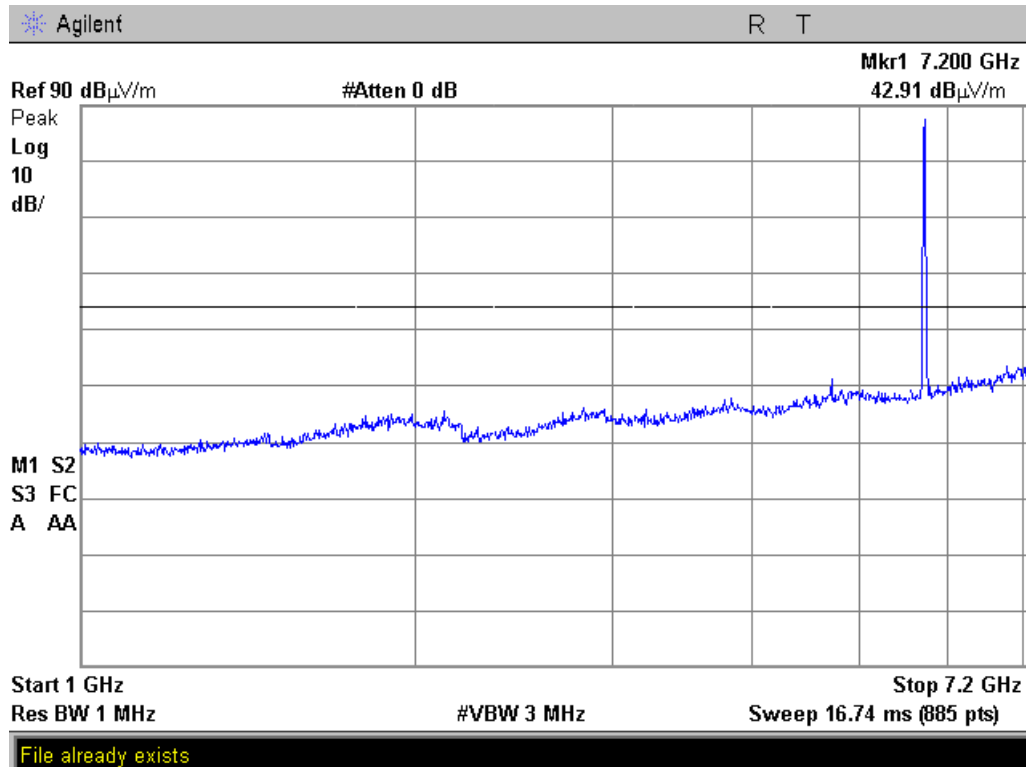
Horizontal & Vertical Polarization
Plot 4.6.32



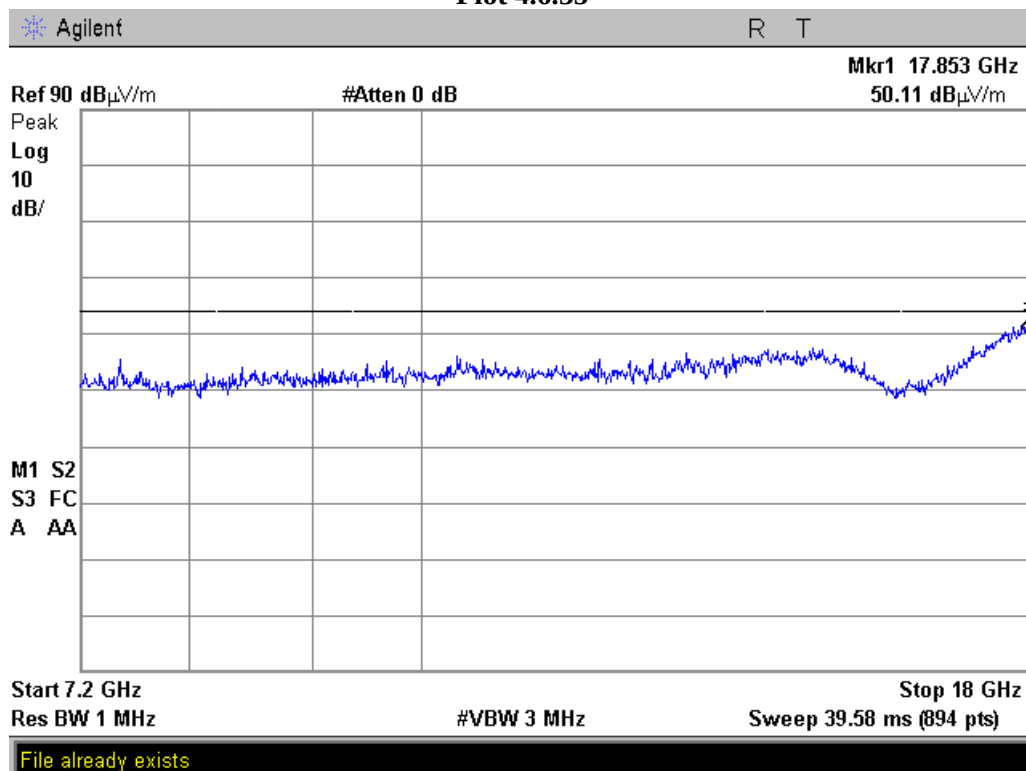
Horizontal & Vertical Polarization
Plot 4.6.33



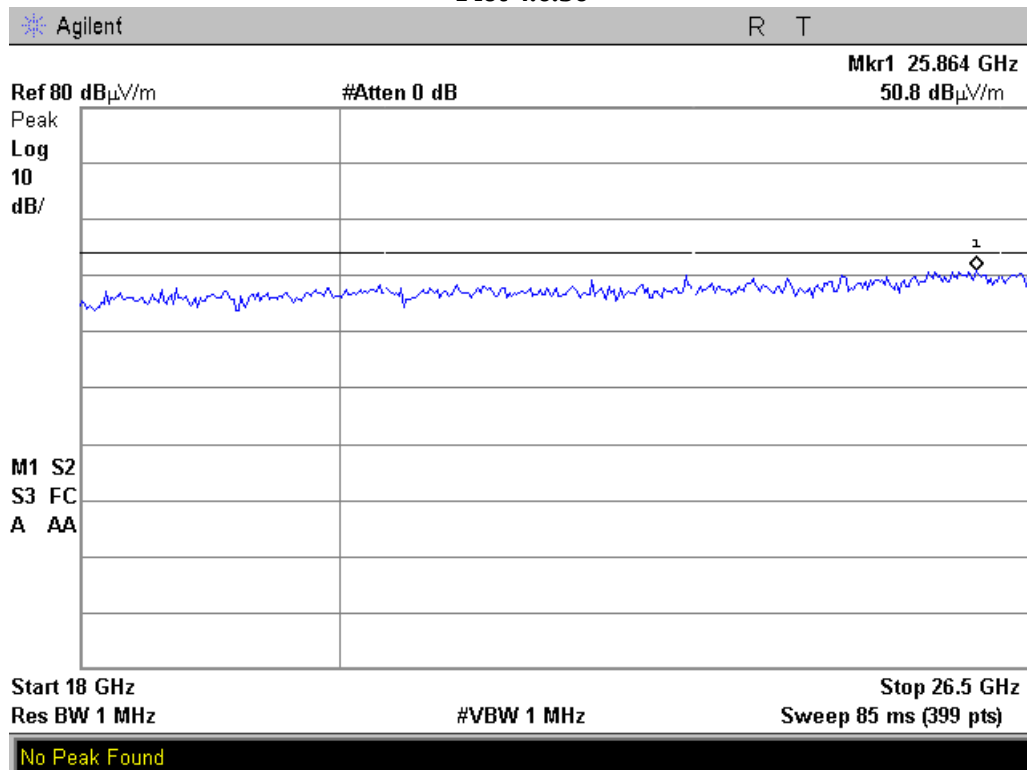
WLAN 802.11n Mode 5805 - 5825MHz
Horizontal & Vertical Polarization
Plot 4.6.34



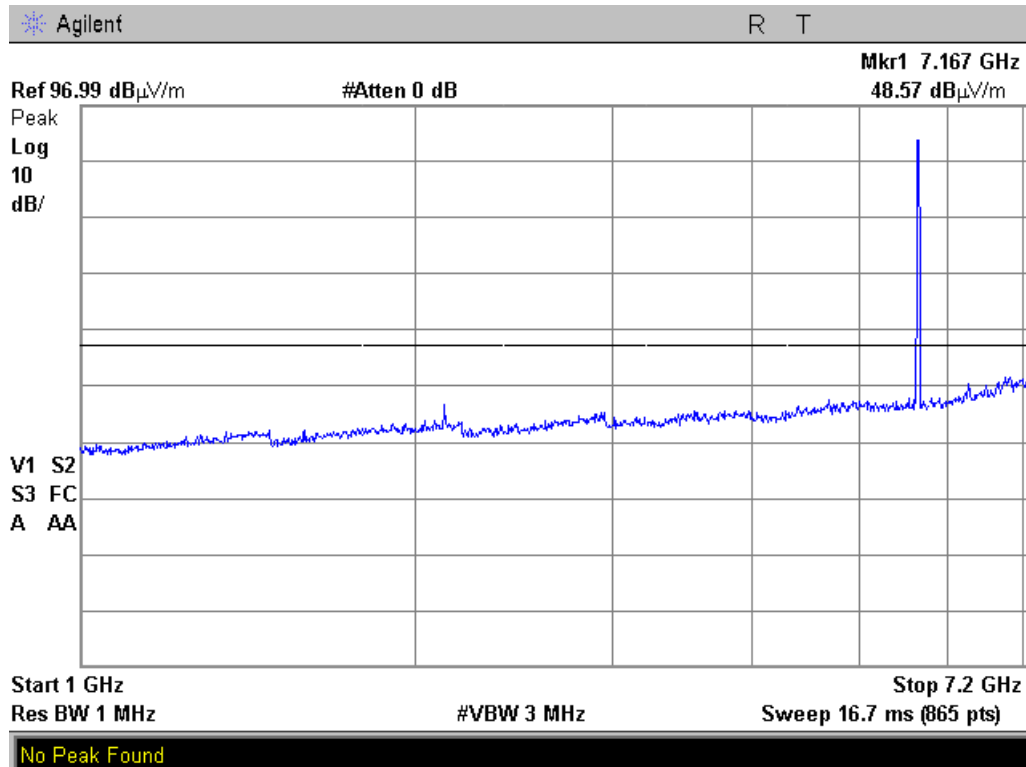
Horizontal & Vertical Polarization
Plot 4.6.35



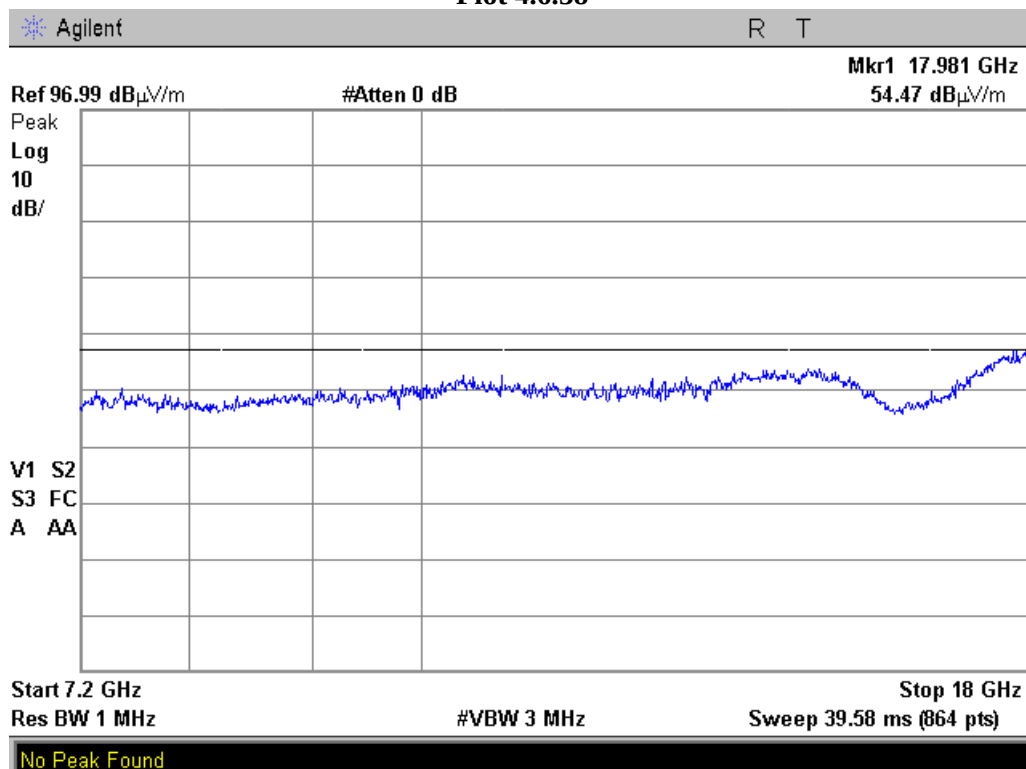
Horizontal & Vertical Polarization
Plot 4.6.36



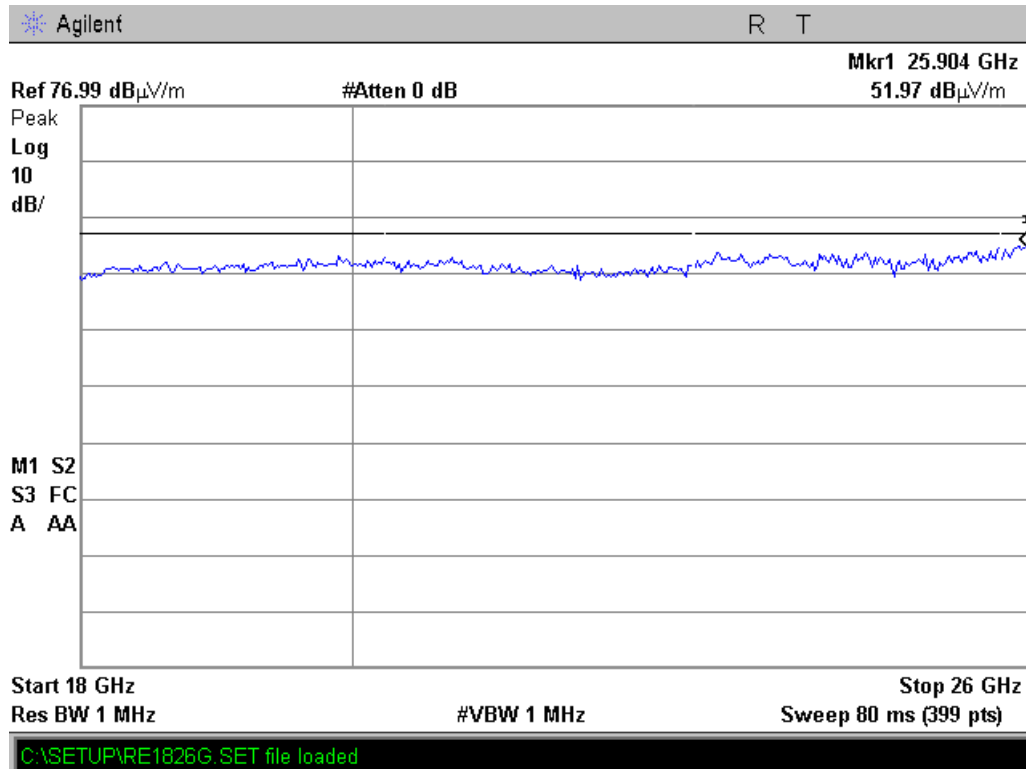
WLAN 802.11a, 5745 MHz, 54 Mbps
Horizontal & Vertical Polarization
Plot 4.6.37



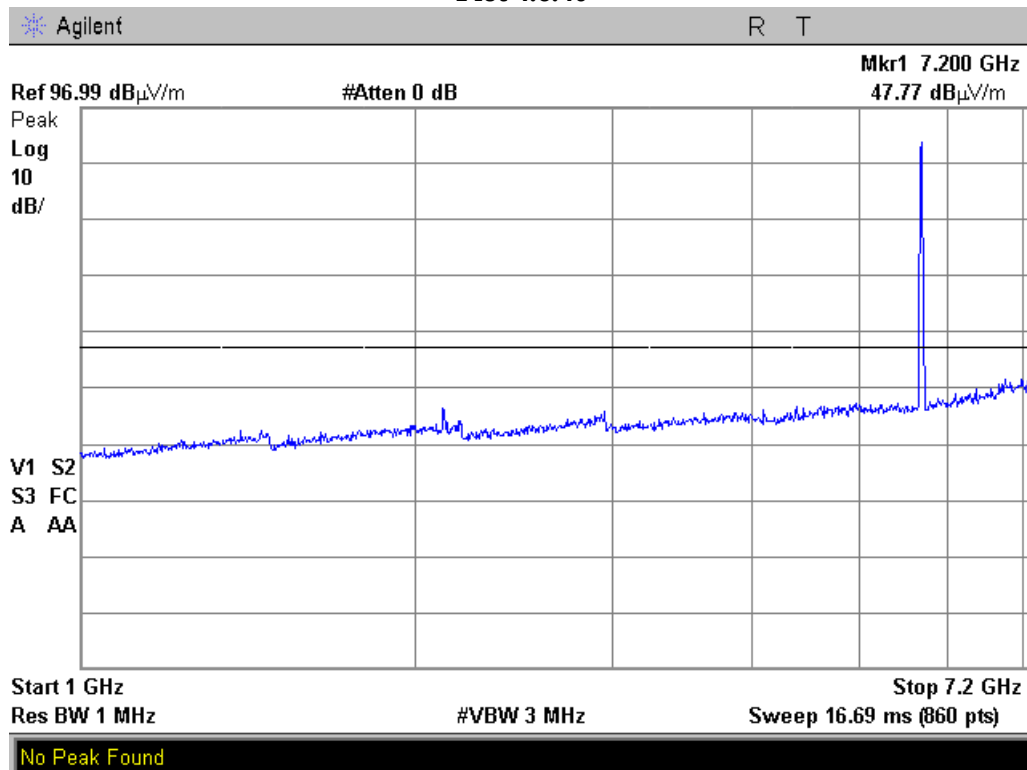
Horizontal & Vertical Polarization
Plot 4.6.38



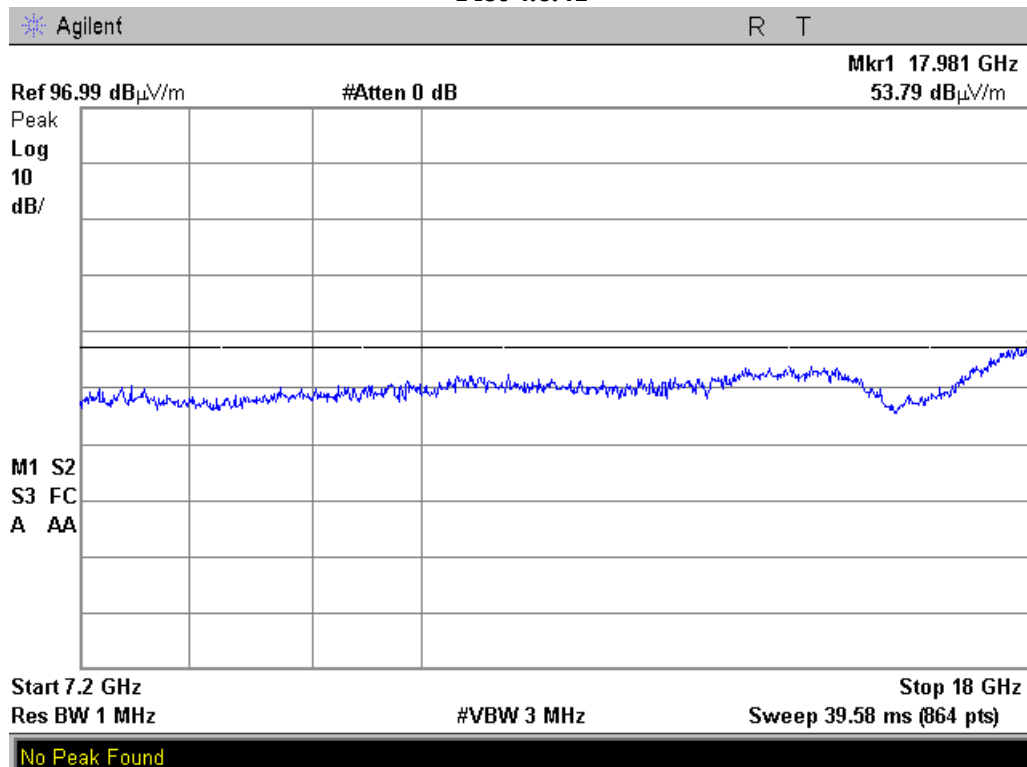
Horizontal & Vertical Polarization
Plot 4.6.39



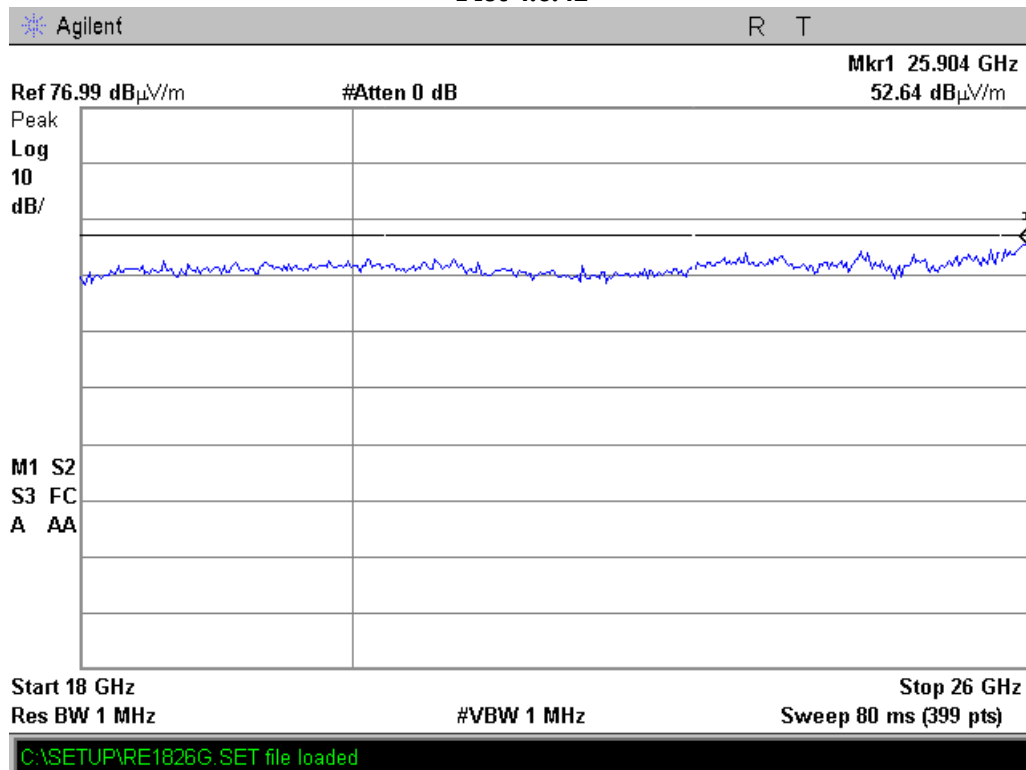
5785 MHz
Horizontal & Vertical Polarization
Plot 4.6.40



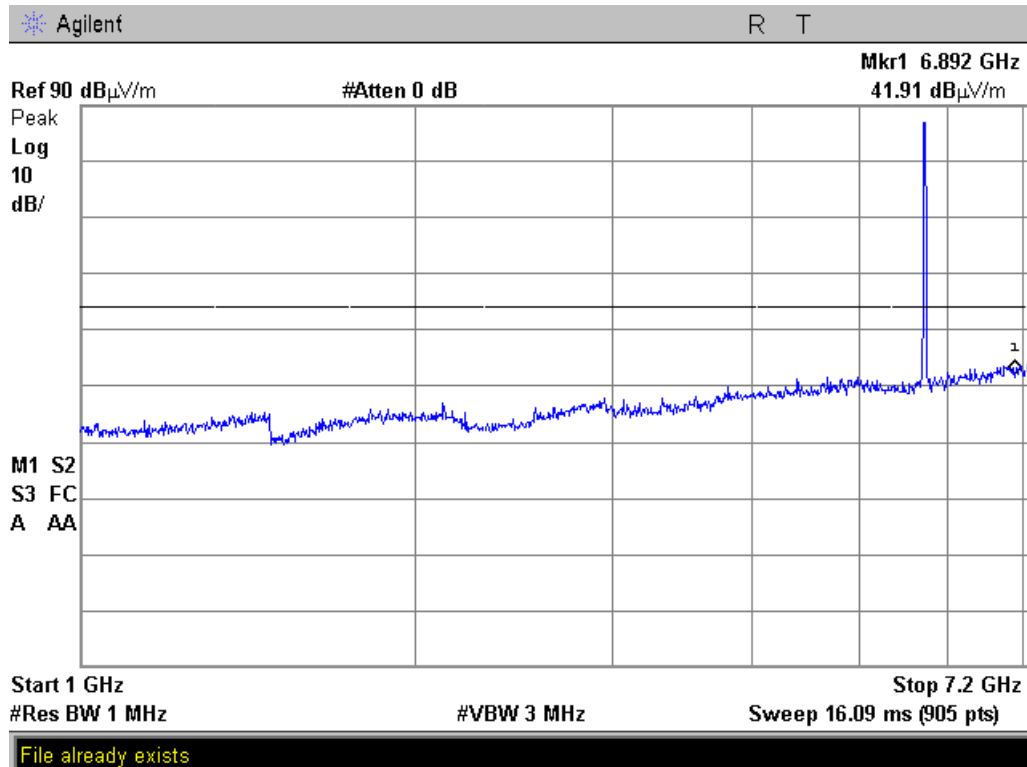
Horizontal & Vertical Polarization
Plot 4.6.41



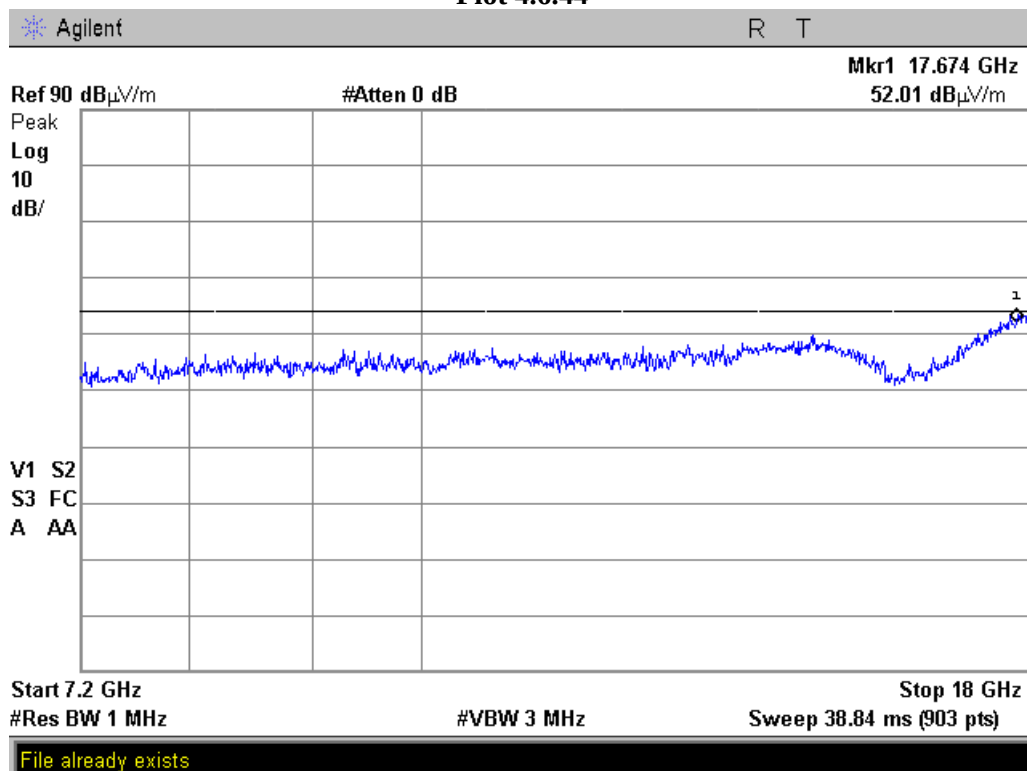
Horizontal & Vertical Polarization
Plot 4.6.42

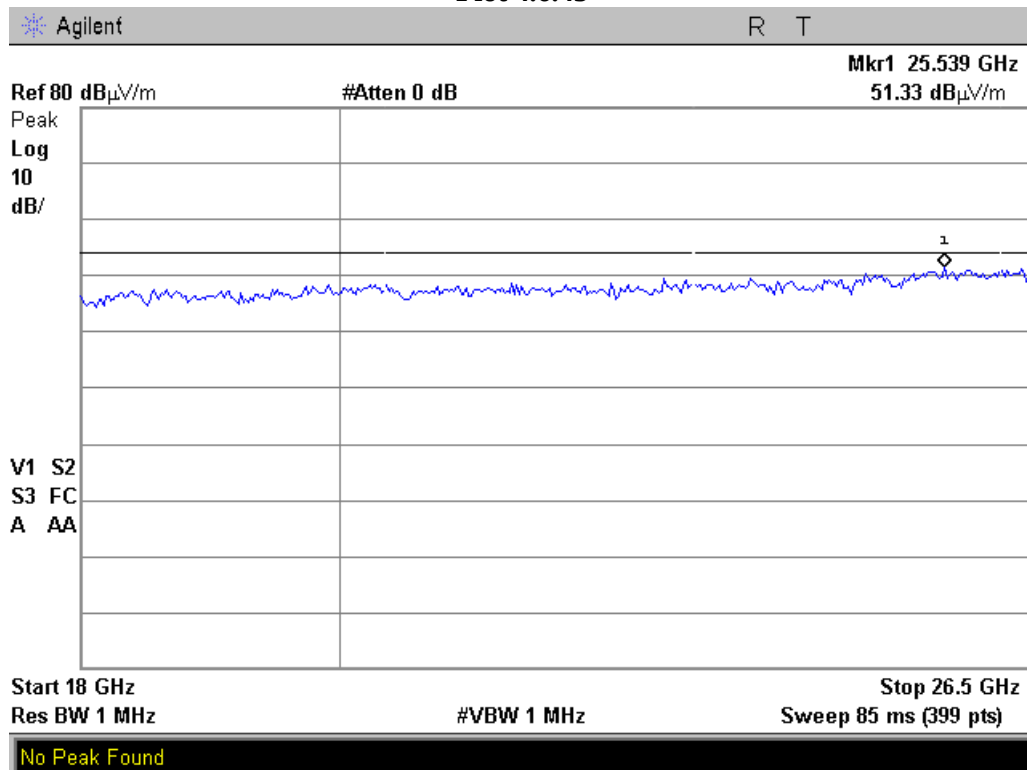


5805 MHz 5825 MHz
Horizontal & Vertical Polarization
Plot 4.6.43



Horizontal & Vertical Polarization
Plot 4.6.44

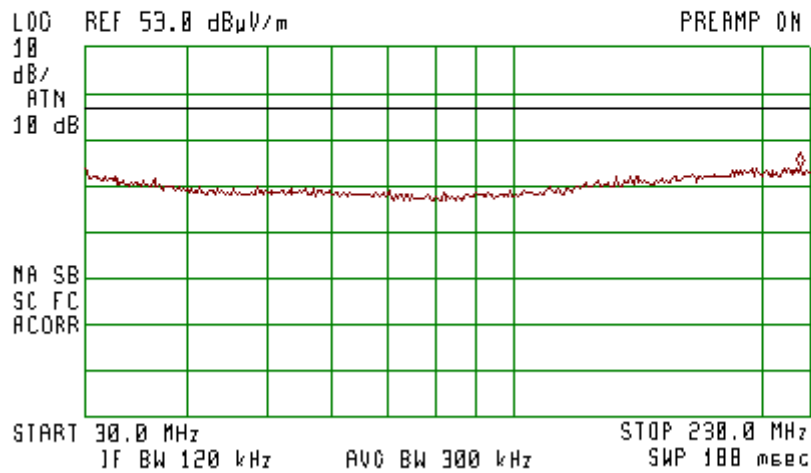




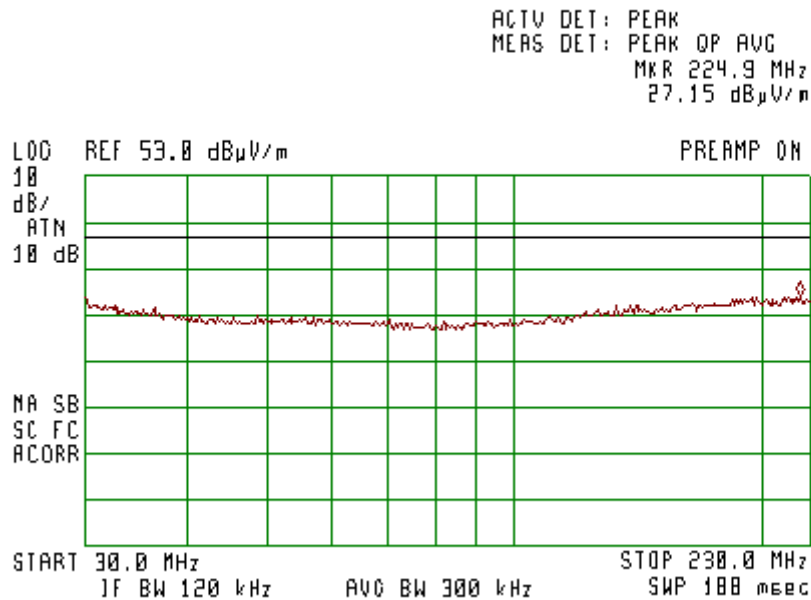
**Lowest
Radiated Spurious Emissions Below 1 GHz
Worst case for all modes and all frequencies
Horizontal Polarization
Plot 4.6.46**



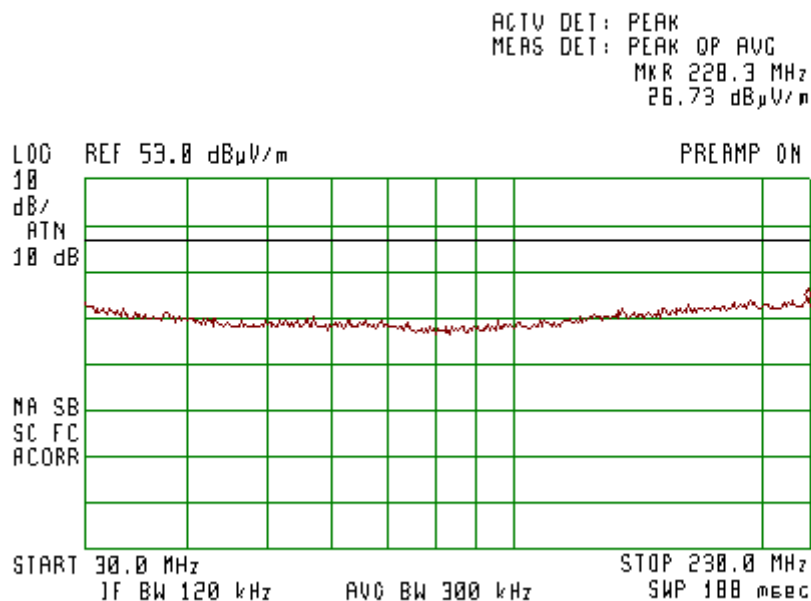
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 224.9 MHz
27.15 dB μ V/m



Radiated Spurious Emissions Below 1 GHz
Worst case for all modes and all frequencies
Horizontal Polarization
Plot 4.6.47

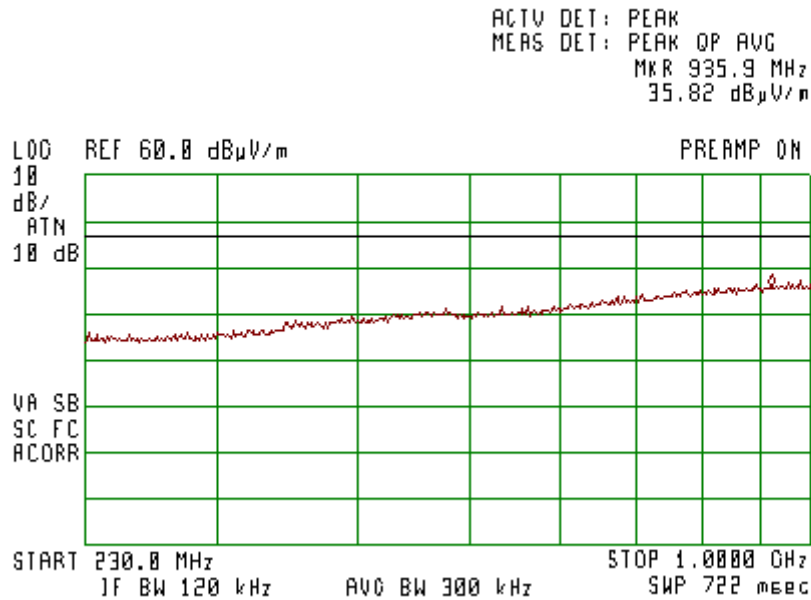


Vertical Polarization
Plot 4.6.48



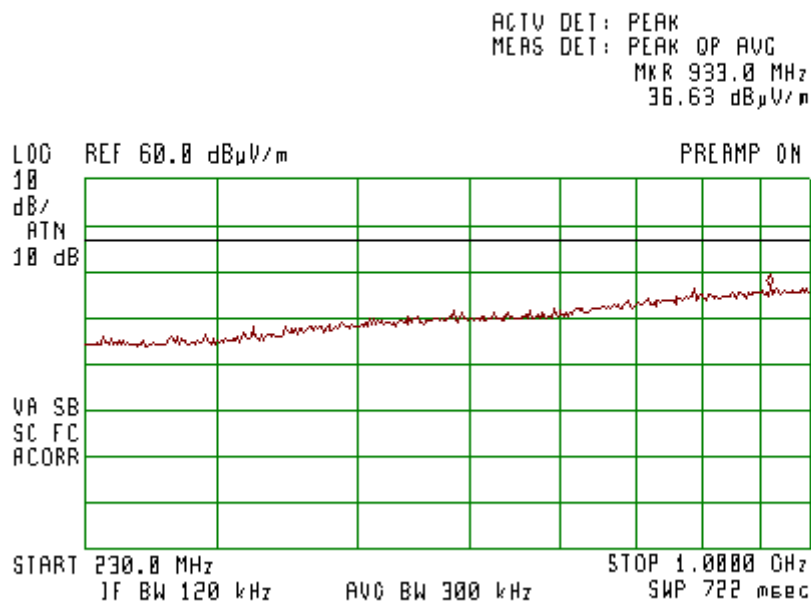
Horizontal Polarization
Plot 4.6.49

(49)



Vertical Polarization
Plot 4.6.50

(50)



4.7. Power Line Emissions measurements

Reference document:	47 CFR §15.107/207		
Test Requirements:	The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in §15.107. The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.207. Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Sec.15.207.		
Test setup:	See Sec. 2.5	Pass	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted Emissions		
S.A. Settings:	f <30MHz; RBW: 9kHz, VBW:30kHz		
Radio device:	Idle		
Environment conditions:	Ambient Temperature: 21°C	Relative Humidity: 54%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.7.1 - Plot 4.7.4	

Test Results:

Worst case results of unintentional emissions and emissions measured at the charger 110VAC port.

“Phase” Lead

Frequency [MHz]	Measured Result [dBμV]		Class B Limits [dBμV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.164503	39.3	33.5	65.23	55.23	-25.93	-21.73	Pass
0.301373	38.4	28.3	60.20	50.20	-21.80	-21.90	Pass
0.387508	39.4	28.7	58.12	48.12	-18.72	-19.42	Pass
0.437968	36	26.6	57.10	47.10	-21.10	-20.50	Pass
0.612763	33.9	31.3	56.00	46.00	-22.10	-14.70	Pass
1.329588	34.9	27.1	56.00	46.00	-21.10	-18.90	Pass

“Neutral” Lead

Frequency [MHz]	Measured Result [dBμV]		Class B Limits [dBμV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.167929	38.5	27.1	65.06	55.06	-26.56	-27.96	Pass
0.313961	34.6	25	59.87	49.87	-25.27	-24.87	Pass
0.436265	29.3	32.3	57.13	47.13	-27.83	-14.83	Pass
0.739105	33.6	25	56.00	46.00	-22.40	-21.00	Pass
13.86253	28.4	18.9	60.00	50.00	-31.60	-31.10	Pass
20.122139	25.3	17.6	60.00	50.00	-34.70	-32.40	Pass

Measured at the PC 110VAC port

“Phase” Lead

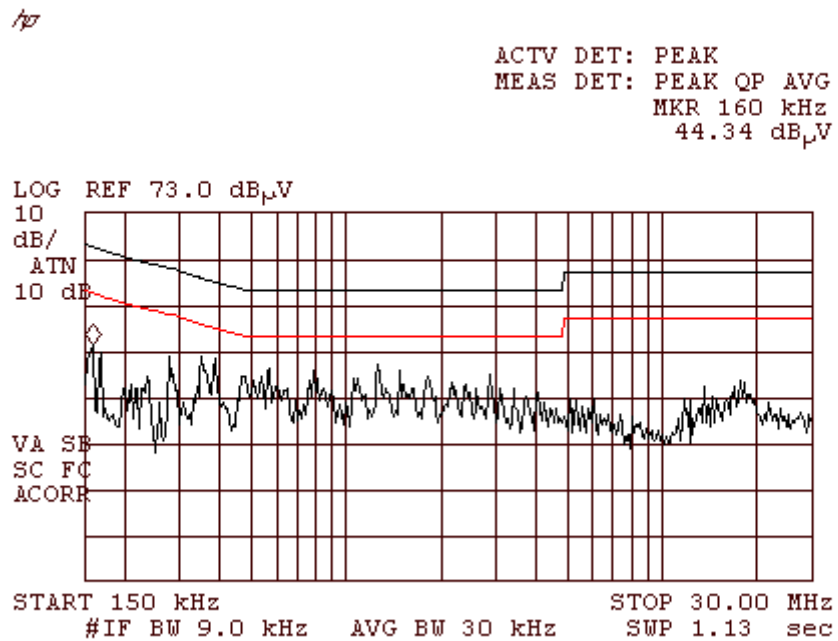
Frequency [MHz]	Measured Result [dBμV]		Class B Limits [dBμV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.151193	61	46.5	65.93	55.93	-4.93	-9.43	Pass
0.161335	52.5	42.5	65.39	55.39	-12.89	-12.89	Pass
0.24966	41.2	26.9	61.77	51.77	-20.57	-24.87	Pass
0.532615	36.3	27.8	56.00	46.00	-19.70	-18.20	Pass
0.640305	33.5	24	56.00	46.00	-22.50	-22.00	Pass
2.30781	28.4	21.2	56.00	46.00	-27.60	-24.80	Pass

“Neutral” Lead

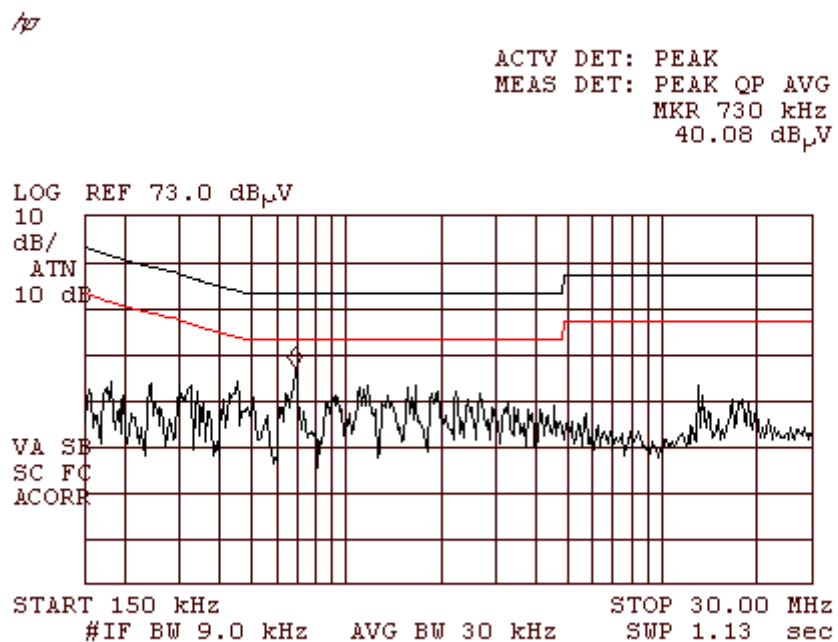
Frequency [MHz]	Measured Result [dBμV]		Class B Limits [dBμV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.15	59.6	44.4	66.00	56.00	-6.40	-11.60	Pass
0.173615	50.9	33.7	64.79	54.79	-13.89	-21.09	Pass
0.62653	36.8	22	56.00	46.00	-19.20	-24.00	Pass
1.56796	30.1	22.6	56.00	46.00	-25.90	-23.40	Pass
2.06515	29.7	23.6	56.00	46.00	-26.30	-22.40	Pass
16.436685	30.7	23.7	60.00	50.00	-29.30	-26.30	Pass

Measured at the charger 110VAC port

**Phase Lead
Plot 4.7.1**

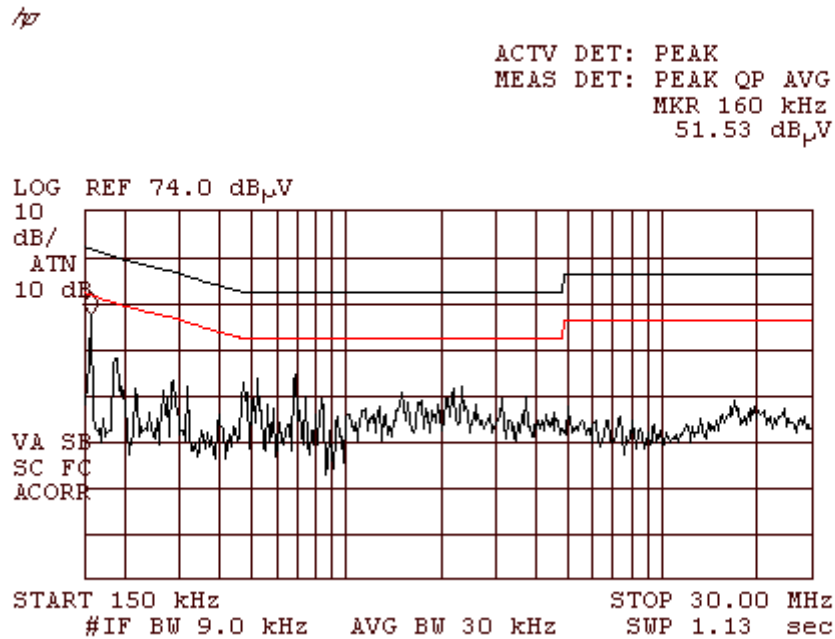


**Neutral Lead
Plot 4.7.2**

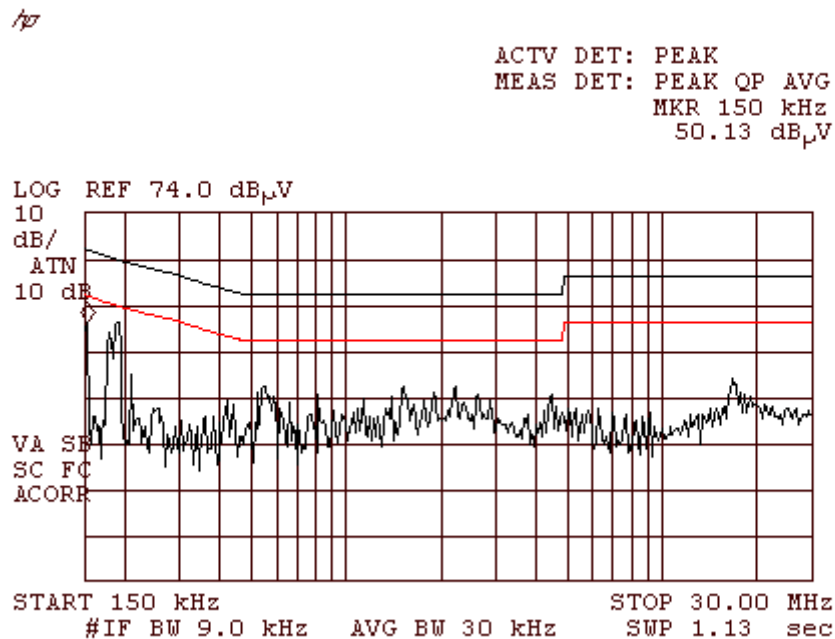


Measured at the PC 110VAC port

**Phase Lead
Plot 4.7.3**



**Neutral Lead
Plot 4.7.4**



5. Appendix

Appendix A: List of Measuring Equipment used:

Equipment	Manufacturer/ Model	Serial Number	Due date
CISPR16 EMI Receiver	HP8546A	3710A00392	17-11-12
Spectrum Analyzer 100 Hz ÷ 26.5 GHz	Agilent E7405A	US41160436	24-11-12
LNA Amplifier 1 GHz ÷ 18 GHz	AMP – 5D-010180-30-10P-GW	618653	07-03-13
Power meter	Agilent N1911A	MY45100784	12-10-12
Dual Ridged Guide Ant.1-18 GHz	A.R.A DRG 118/A	17188	23-01-13
Antenna 15 GHz ÷ 40 GHz	Schwarzbeck BBHA 9170	BBHA9170214	03-02-13
Turn table	HD100	100/693	-
Antenna Mast	HD 100	100/693	-
Biconical 20 –200 MHz	Seibersdorf, PBA 320	301	20-01-15
Log-Periodic 200 – 1000 MHz	Schwarzbeck VUSLP9111	VUSLP9111184	20-01-15
Pre-Amplifier	MiTeq, AMF-5F-18002650-30-10P	945372	07-03-13
LISN	Fischer 50/250-25-2	-	05-03-13
Transient Limiter	HP11947A	-	05-03-13
Notch Filter	Micro-Tronics BRM50702-05	0001	04-03-13

Appendix B: Accreditation Certificate



End of the Test Report