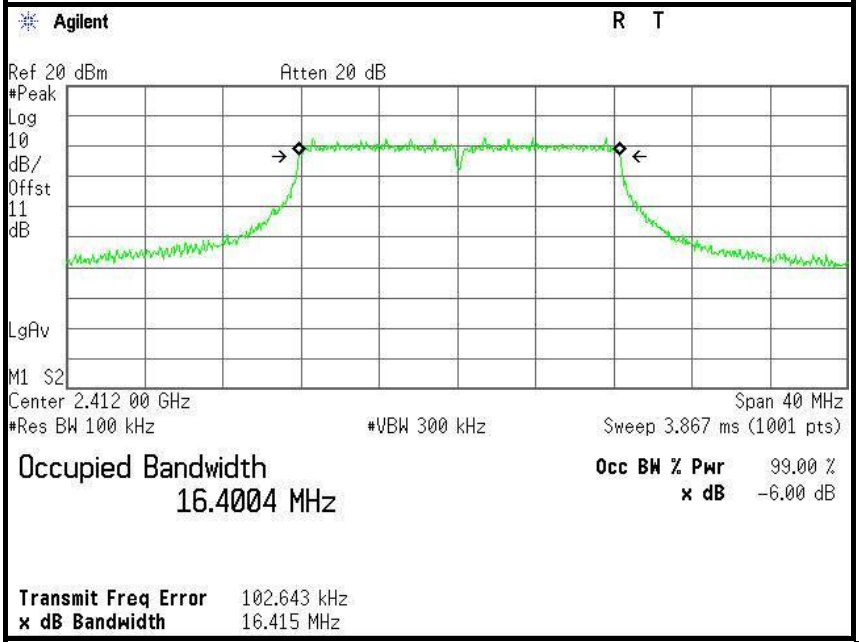
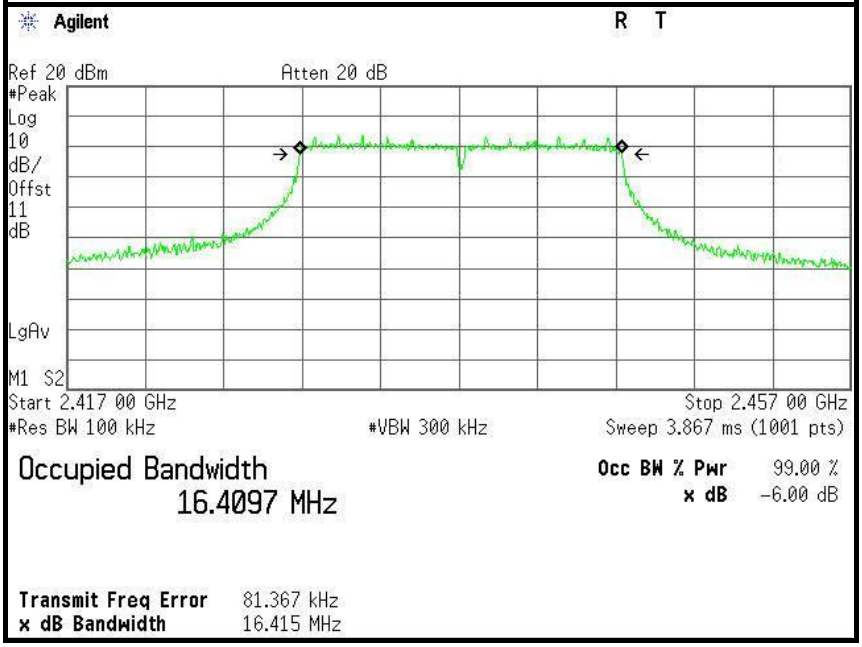
IEEE 802.11g mode

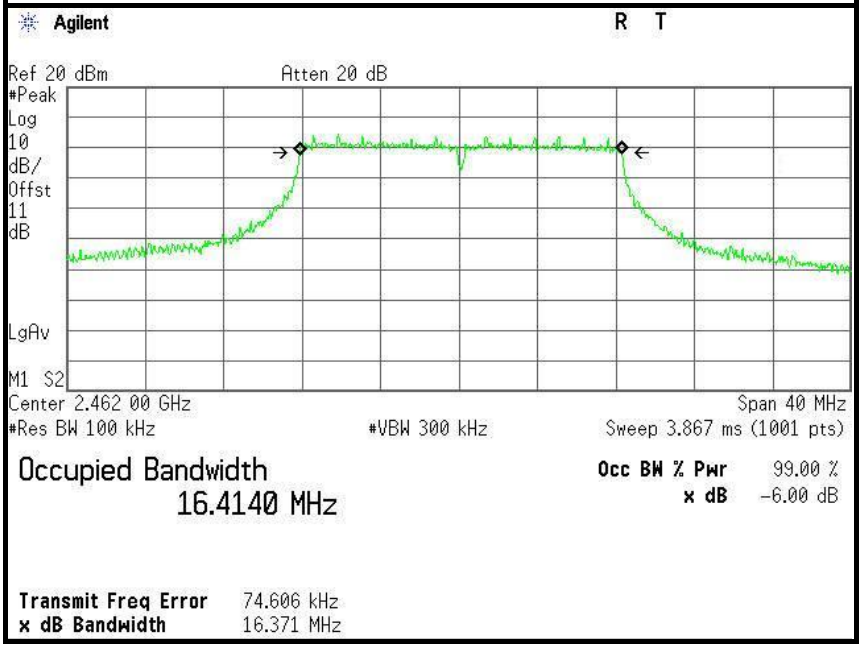
6dB Bandwidth (CH Low)



6dB Bandwidth (CH Mid)

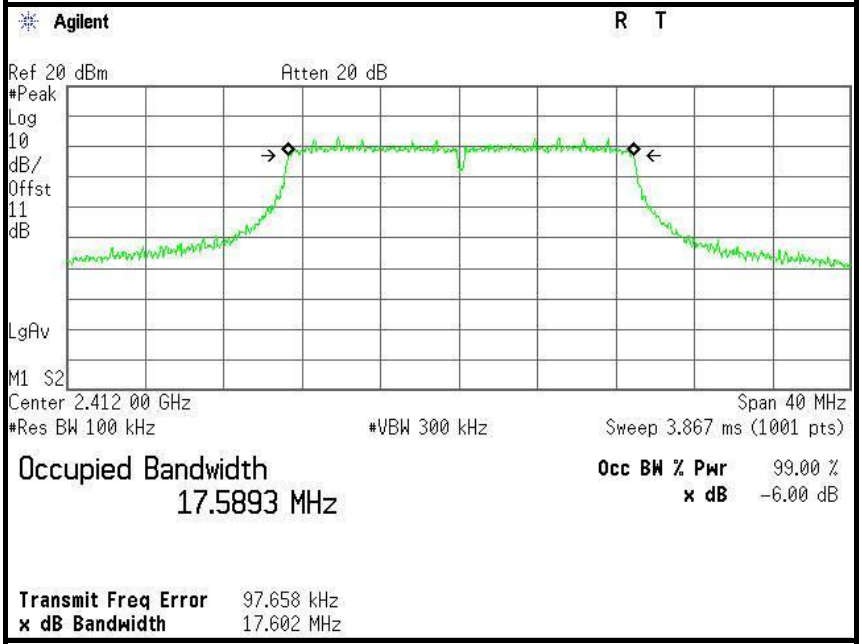


6dB Bandwidth (CH High)

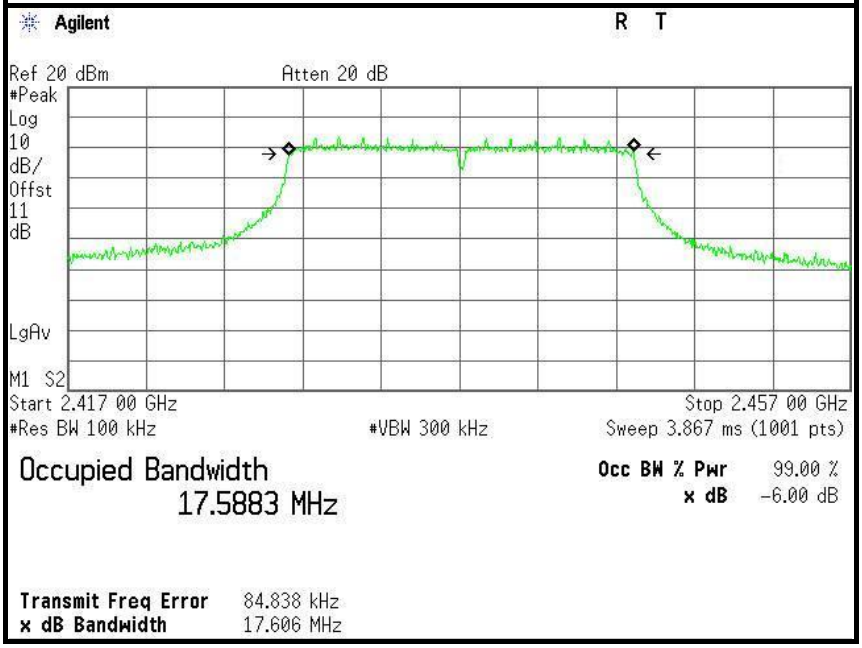


IEEE 802.11n HT20 MHz mode

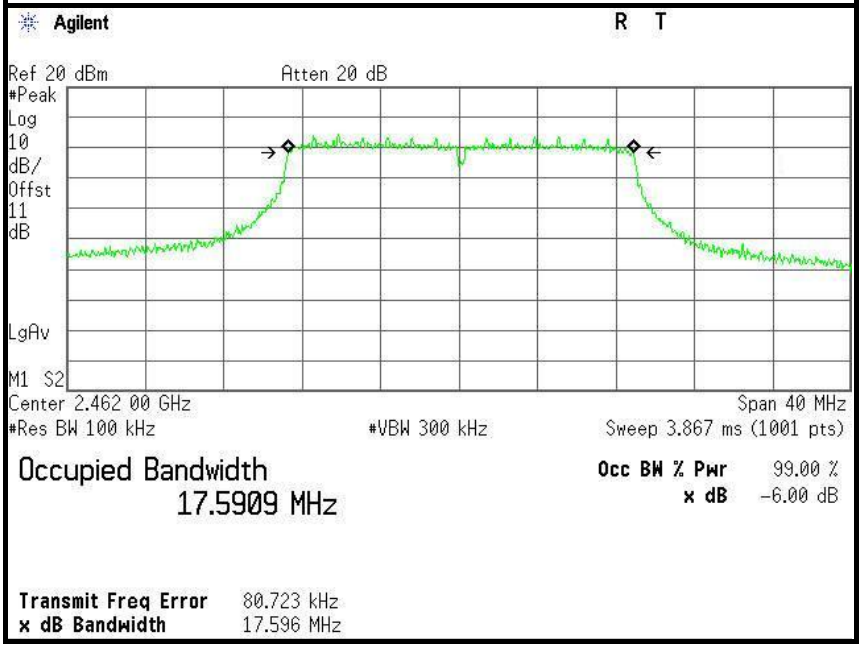
6dB Bandwidth (CH Low)



6dB Bandwidth (CH Mid)

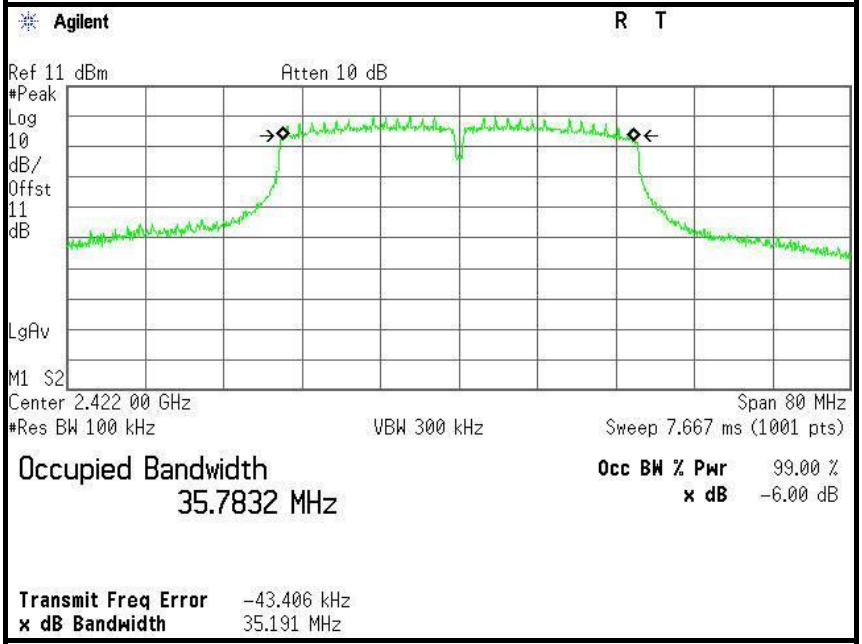


6dB Bandwidth (CH High)

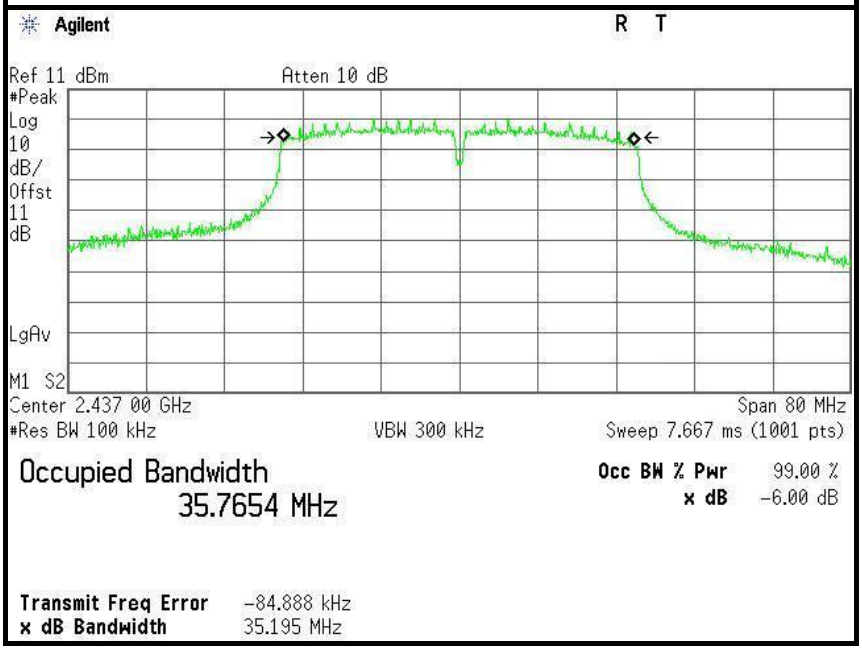


IEEE 802.11n HT40 MHz mode

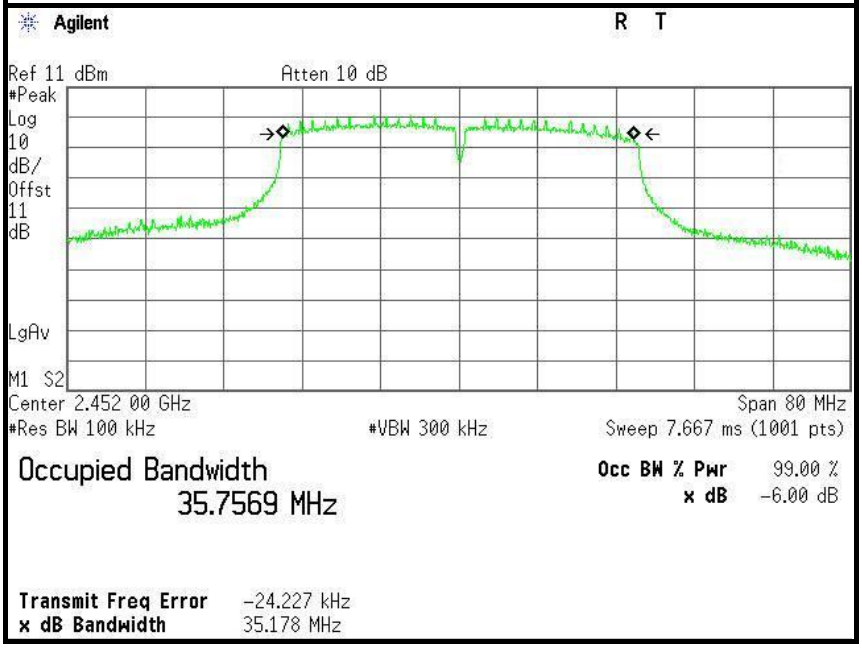
6dB Bandwidth (CH Low)



6dB Bandwidth (CH Mid)



6dB Bandwidth (CH High)



7.4. ANTENNA GAIN

MEASUREMENT

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal WLAN devices, the DSSS mode is used.

MEASUREMENT PARAMETERS

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	3 MHz
Video bandwidth	3 MHz
Trace-Mode	Max hold

LIMITS

FCC	IC
Antenna Gain	
6 dBi	

TEST RESULTS

IEEE 802.11b mode

T_{nom}	V_{nom}	Lowest channel 2412MHz	Middle channel 2437MHz	Highest channel 2462MHz
Conducted power [dBm/MHz] Measured with DSSS modulation		3.82	7.32	9.49
Radiated power [dBm/MHz] Measured with DSSS modulation		1.97	5.34	8.70
Gain [dBi] Calculated		-1.85	-1.98	-0.79
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)		

7.5. PEAK OUTPUT POWER

7.5.1. LIMITS

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.

2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.5.2. TEST INSTRUMENTS

Name of Equipment	Manufacturer	Model	Serial Number	Last Calibration	Calibration Due
Power Meter	Anritsu	ML2495A	1204003	02/21/2016	02/20/2017
Power Sensor	Anritsu	MA2411B	1126150	02/21/2016	02/20/2017

7.5.3. TEST PROCEDURES (please refer to measurement standard)

9.1.1 RBW ≥ *DTS bandwidth*

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the *DTS bandwidth*.
a) Set the RBW ≥ *DTS bandwidth*.
b) Set VBW ≥ 3 RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

9.1.2 Integrated band power method

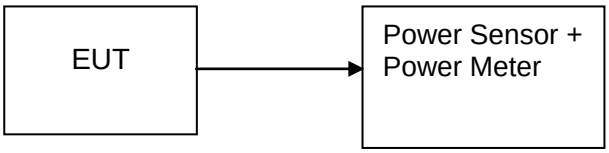
This procedure may be used when the maximum available RBW of the measurement instrument is less than the *DTS bandwidth*.

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ 3 RBW
c) Set the span ≥ 1.5 x DTS bandwidth.
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS bandwidth.

9.1.3 PKPM1 Peak power meter method

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

7.5.4. TEST SETUP



7.5.5. TEST RESULTS

No non-compliance noted

Test Data

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Peak / AVG	Result
Low	2412	12.34	0.01714	1	Peak	PASS
Mid	2437	15.53	0.03573			PASS
High	2462	18.01	0.06324			PASS
Low	2412	9.39	0.00869	1	AVG	PASS
Mid	2437	12.58	0.01811			PASS
High	2462	15.09	0.03228			PASS

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Peak / AVG	Result
Low	2412	24.31	0.26977	1	Peak	PASS
Mid	2437	24.75	0.29854			PASS
High	2462	24.98	0.31477			PASS
Low	2412	14.75	0.02985	1	AVG	PASS
Mid	2437	15.17	0.03289			PASS
High	2462	15.40	0.03467			PASS

Test mode: IEEE 802.11n HT20 MHz

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Peak / AVG	Result
Low	2412	24.21	0.26363	1	Peak	PASS
Mid	2437	24.21	0.26363			PASS
High	2462	24.60	0.28840			PASS
Low	2412	14.91	0.03097	1	AVG	PASS
Mid	2437	15.34	0.03420			PASS
High	2462	15.19	0.03304			PASS

Test mode: IEEE 802.11n HT40 MHz

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Peak / AVG	Result
Low	2422	23.82	0.24099	1	Peak	PASS
Mid	2437	24.11	0.25763			PASS
High	2452	24.11	0.25763			PASS
Low	2422	14.51	0.02825	1	AVG	PASS
Mid	2437	14.60	0.02884			PASS
High	2452	14.60	0.02884			PASS

7.6. BAND EDGES MEASUREMENT

7.6.1. LIMITS

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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. 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 Section 15.205(c)).

7.6.2. TEST INSTRUMENTS

Radiated Emission Test Site 966(2)					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
EMI TEST RECEIVER	Agilent	N9038A	US44300399	02/21/2016	02/20/2017
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	02/21/2016	02/20/2017
Amplifier	MITEQ	AM-1604-3000	1123808	02/21/2016	02/20/2017
High Noise Amplifier	Agilent	8449B	3008A01838	02/21/2016	02/20/2017
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170-497	02/21/2016	02/20/2017
Bilog Antenna	SCHAFFNER	CBL6143	5082	02/21/2016	02/20/2017
Horn Antenna	SCHWARZBECK	BBHA9120	D286	02/21/2016	02/20/2017
Loop Antenna	COM-POWER	AL-130	121044	02/21/2016	02/20/2017
Turn Table	N/A	N/A	N/A	N.C.R	N.C.R
Controller	Sunol Sciences	SC104V	022310-1	N.C.R	N.C.R
Controller	CT	N/A	N/A	N.C.R	N.C.R
Temp. / Humidity Meter	Anymetre	JR913	N/A	02/21/2016	02/20/2017
Antenna Tower	SUNOL	TLT2	N/A	N.C.R	N.C.R
Test S/W	FARAD	LZ-RF / CCS-SZ-3A2			

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

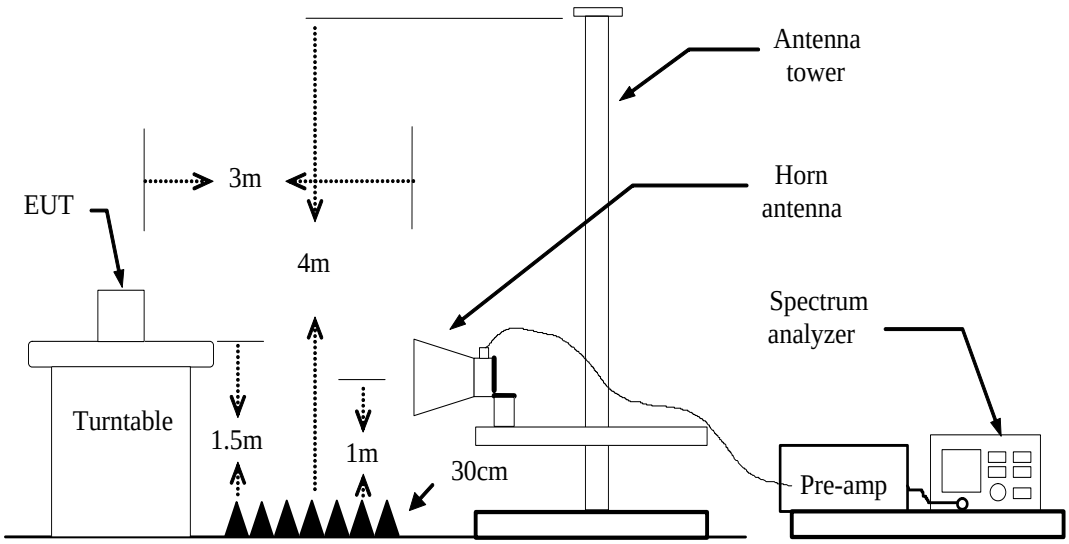
2. The FCC Site Registration number is 101879.

3. N.C.R = No Calibration Required.

7.6.3. TEST PROCEDURES (please refer to measurement standard)

1. The EUT is placed on a turntable, which is 1.5m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   (a) PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO
   (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO / Detector=Peak
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

7.6.4. TEST SETUP



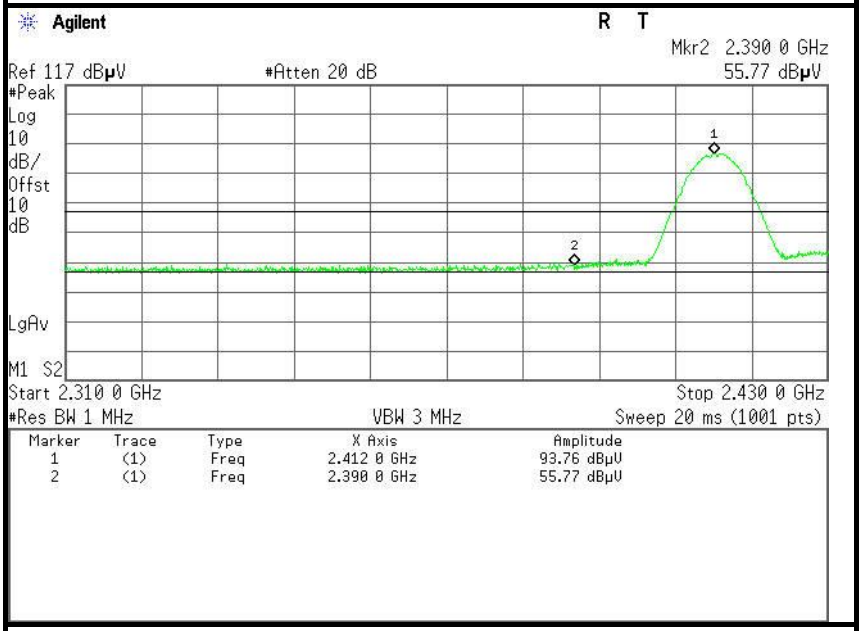
7.6.5. TEST RESULTS

Test Plot

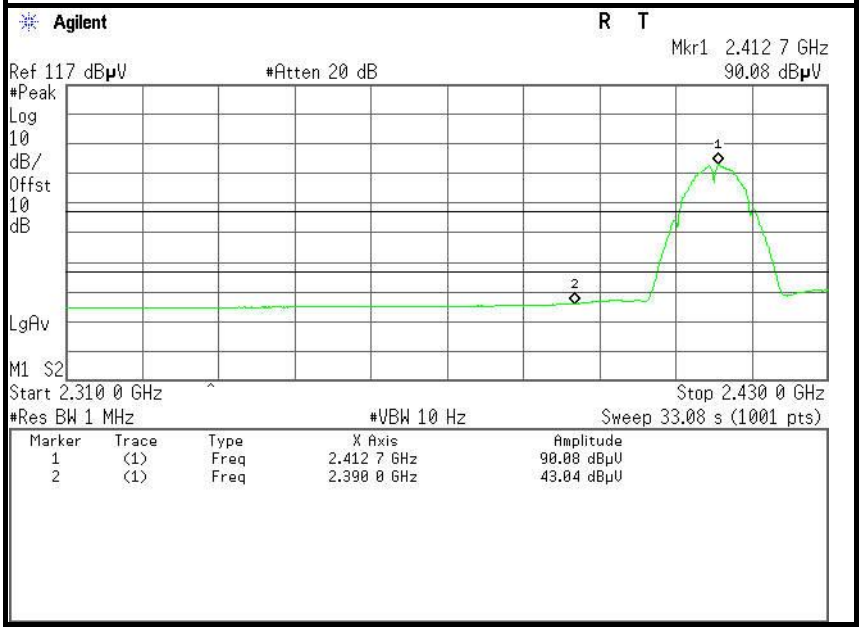
IEEE 802.11b mode

Band Edges (CH Low)

Detector mode: Peak **Polarity: Vertical**



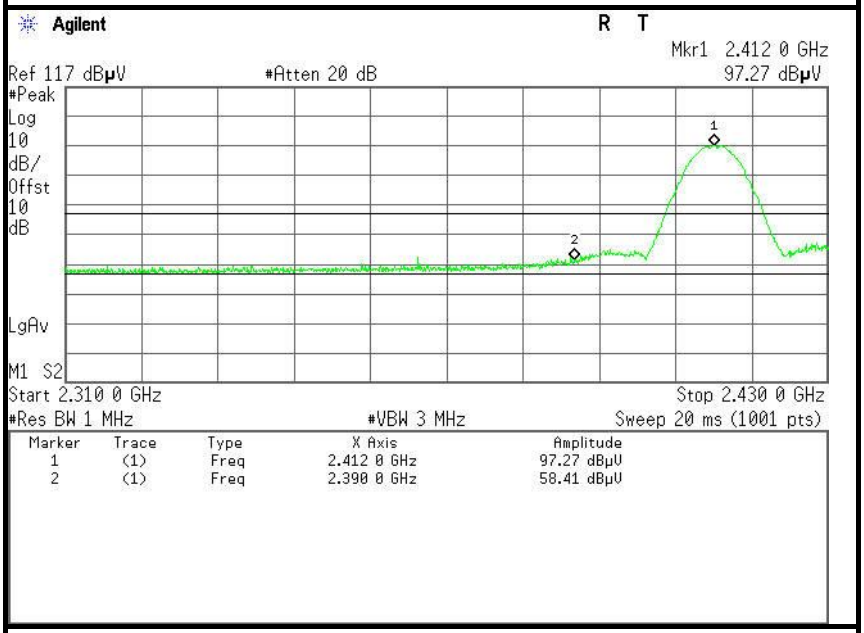
Detector mode: Average **Polarity: Vertical**



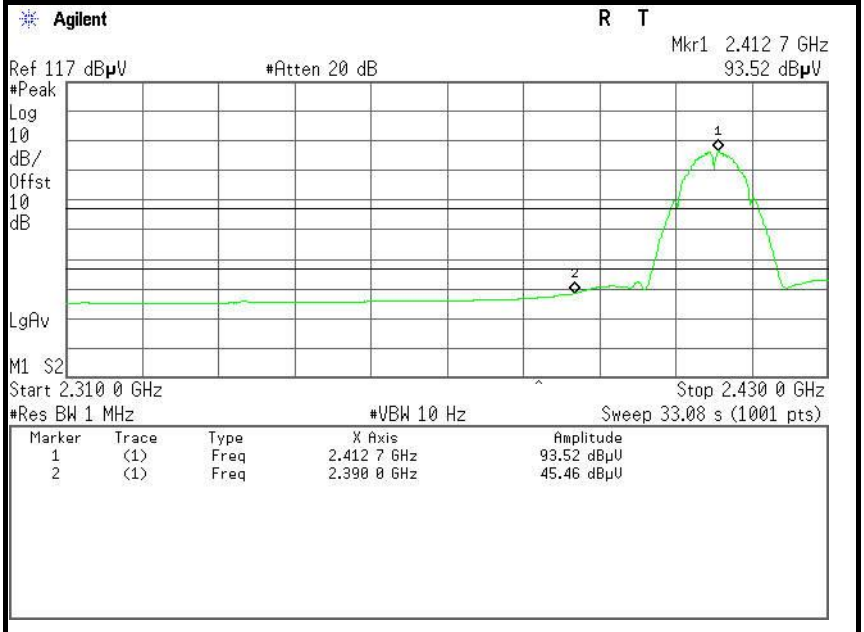
No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	49.17	-6.60	55.77	74.00	-18.23	Peak	Vertical
2	2390.0000	36.44	-6.60	43.04	54.00	-10.96	Average	Vertical

S

Detector mode: Peak **Polarity: Horizontal**



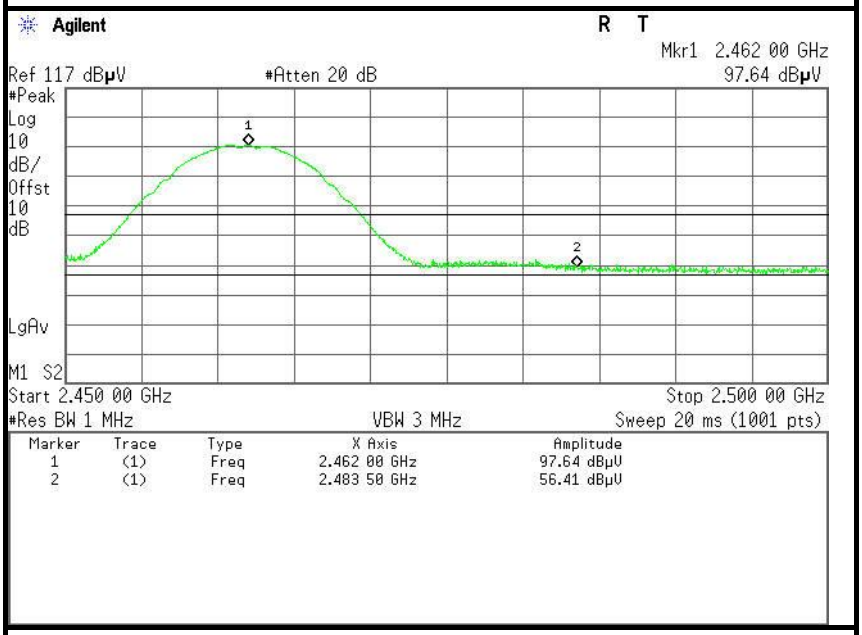
Detector mode: Average **Polarity: Horizontal**



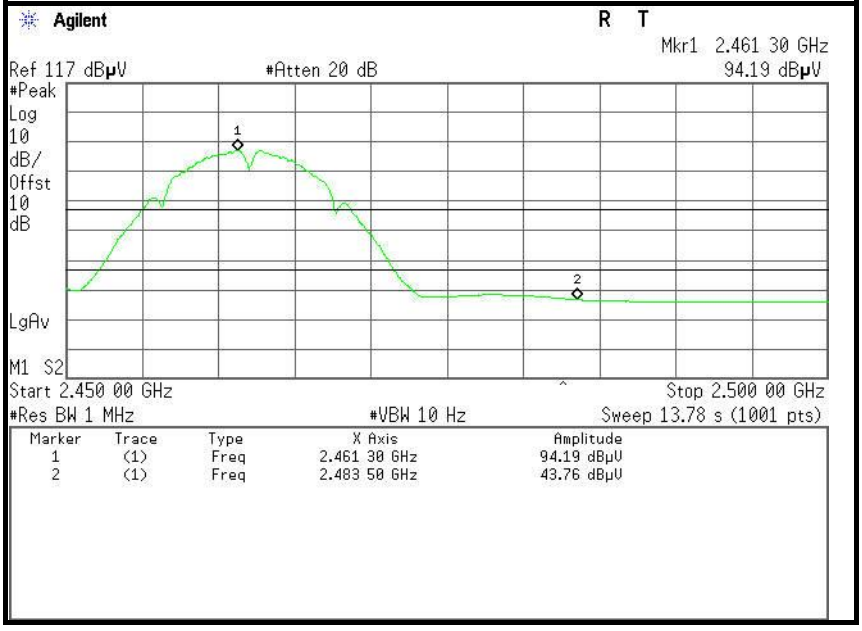
No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	51.81	-6.60	58.41	74.00	-15.59	Peak	Horizontal
2	2390.0000	38.86	-6.60	45.46	54.00	-8.54	Average	Horizontal

Band Edges (CH High)

Detector mode: Peak **Polarity: Vertical**

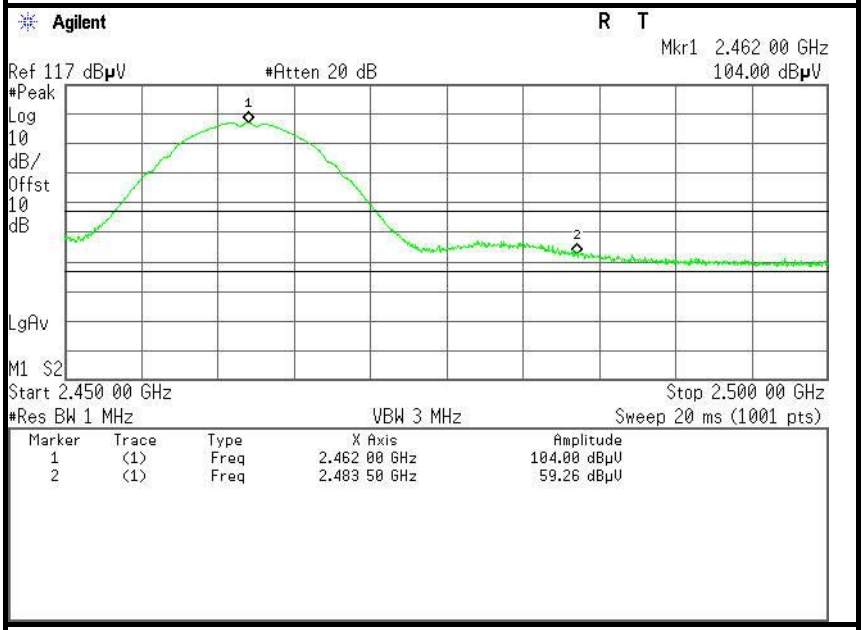


Detector mode: Average **Polarity: Vertical**

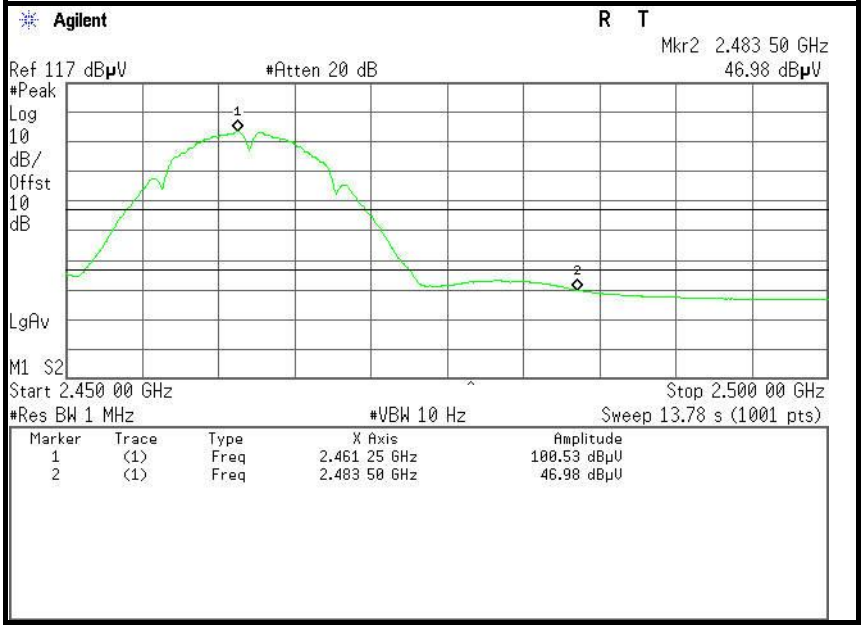


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	50.17	-6.24	56.41	74.00	-17.59	Peak	Vertical
2	2483.5000	37.52	-6.24	43.76	54.00	-10.24	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**

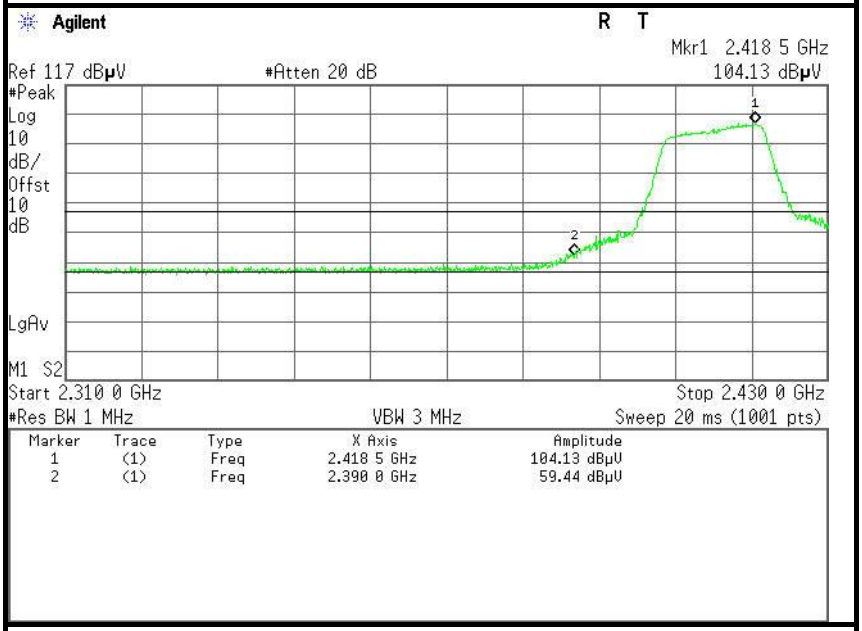


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	53.02	-6.24	59.26	74.00	-14.74	Peak	Horizontal
2	2483.5000	40.74	-6.24	46.98	54.00	-7.02	Average	Horizontal

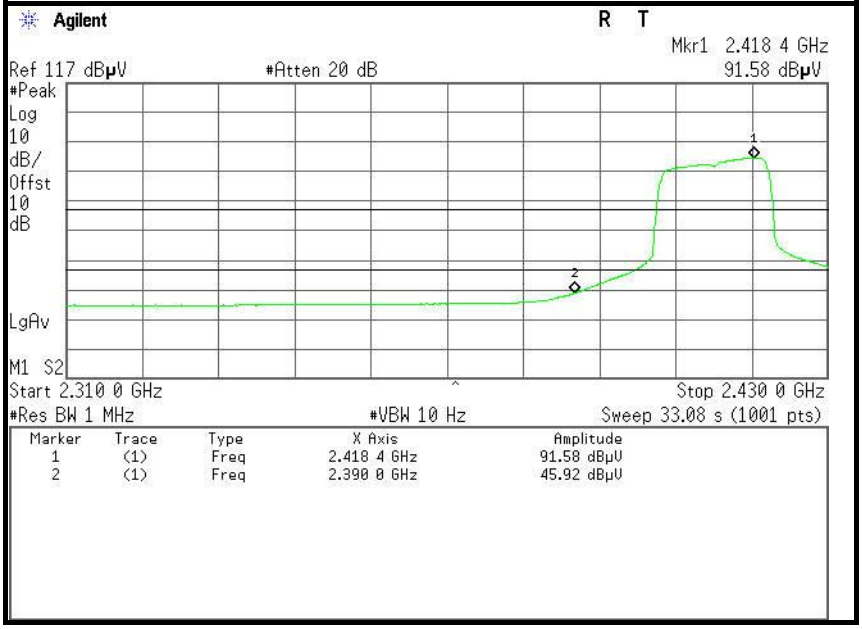
IEEE 802.11g mode

Band Edges (CH Low)

Detector mode: Peak **Polarity: Vertical**

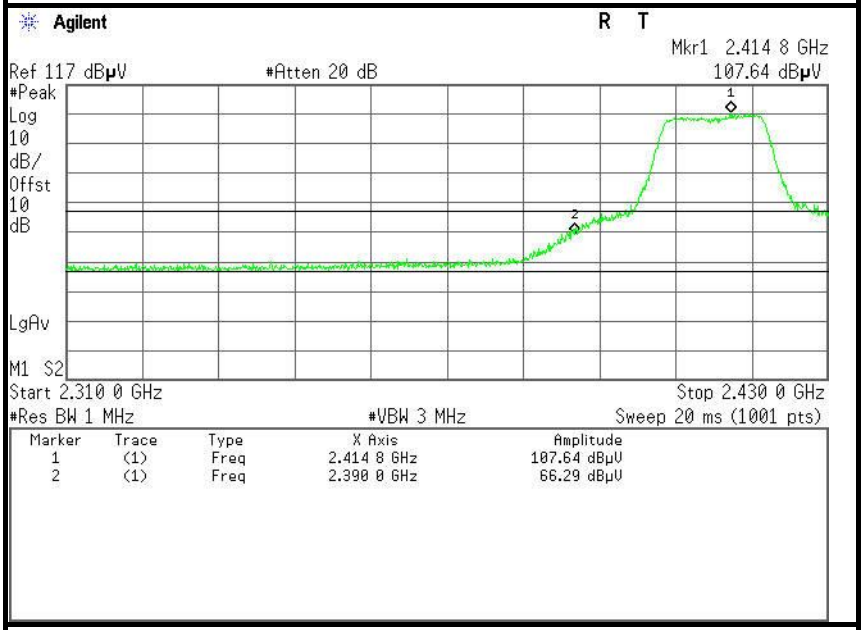


Detector mode: Average **Polarity: Vertical**

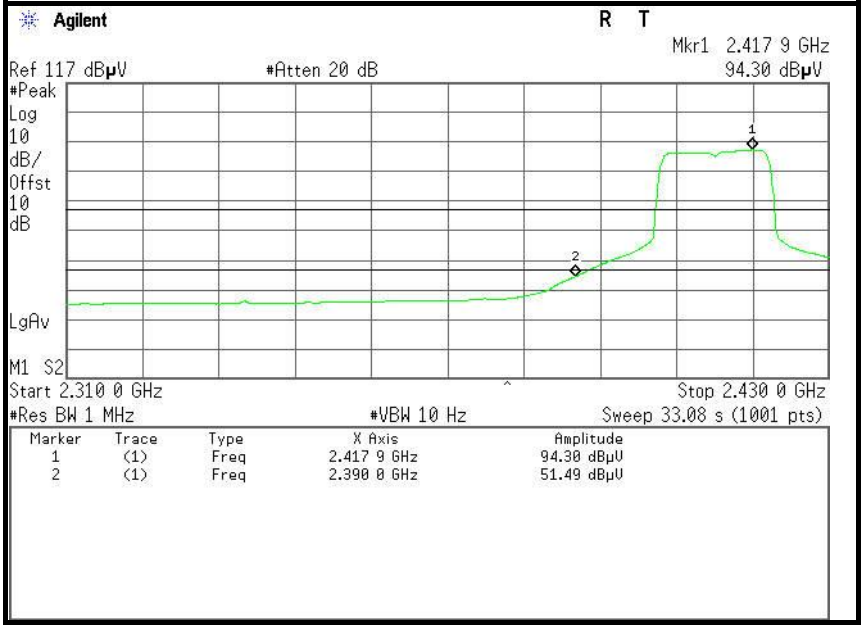


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	52.84	-6.60	59.44	74.00	-14.56	Peak	Vertical
2	2390.0000	39.32	-6.60	45.92	54.00	-8.08	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



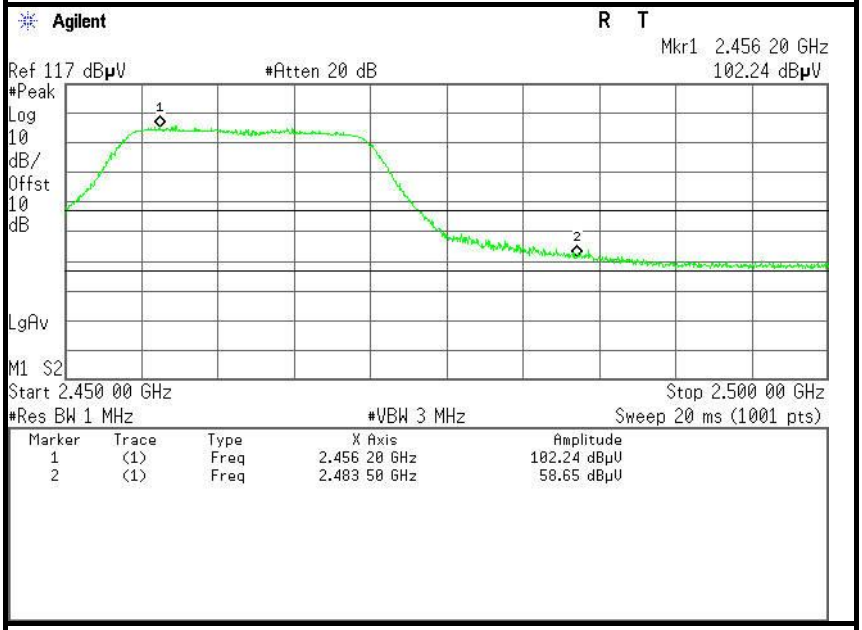
Detector mode: Average **Polarity: Horizontal**



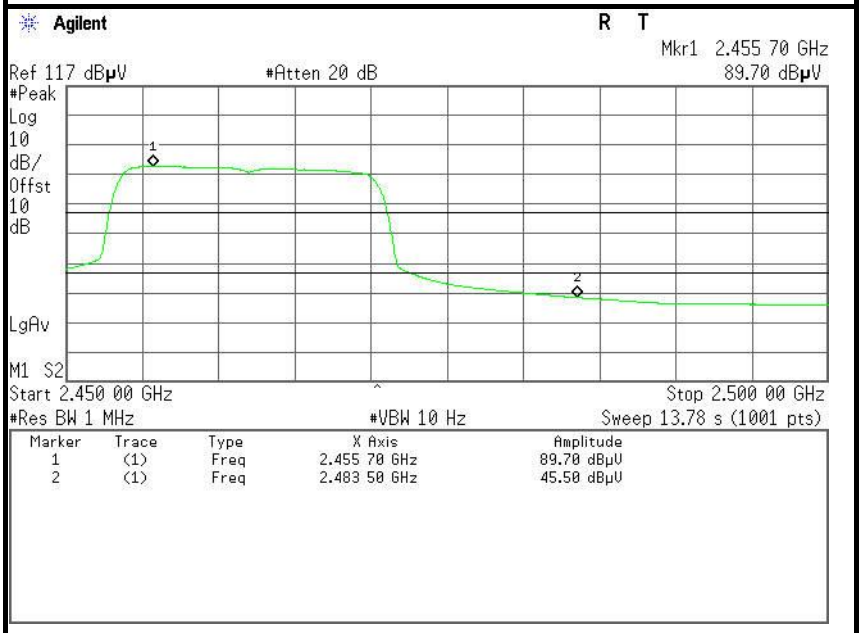
No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	59.69	-6.60	66.29	74.00	-7.71	Peak	Horizontal
2	2390.0000	44.89	-6.60	51.49	54.00	-2.51	Average	Horizontal

Band Edges (CH High)

Detector mode: Peak **Polarity: Vertical**

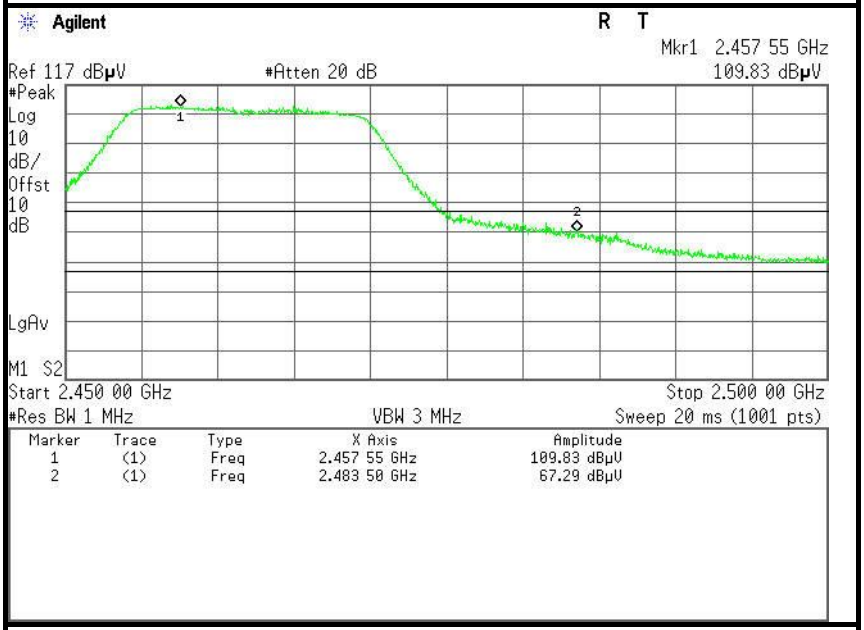


Detector mode: Average **Polarity: Vertical**

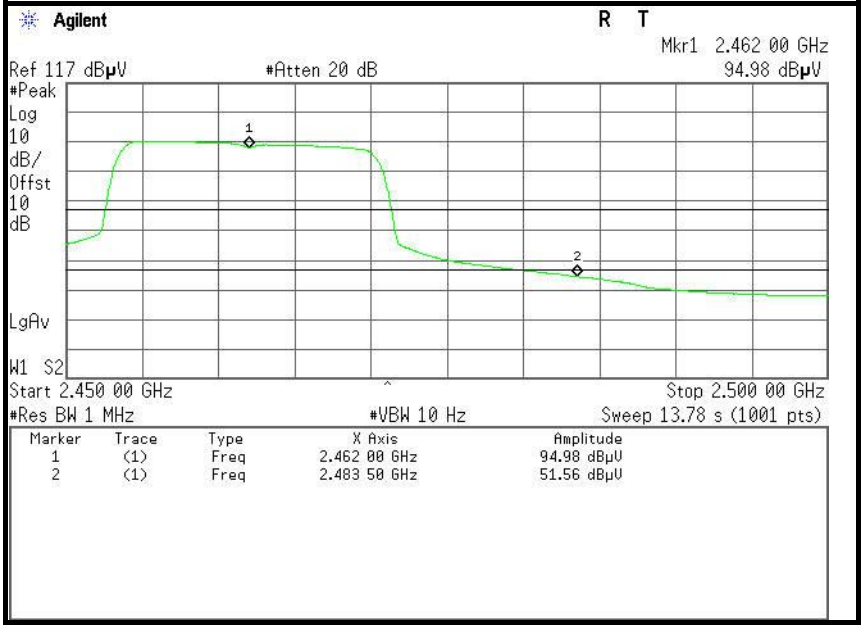


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	52.41	-6.24	58.65	74.00	-15.35	Peak	Vertical
2	2483.5000	39.26	-6.24	45.50	54.00	-8.50	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**

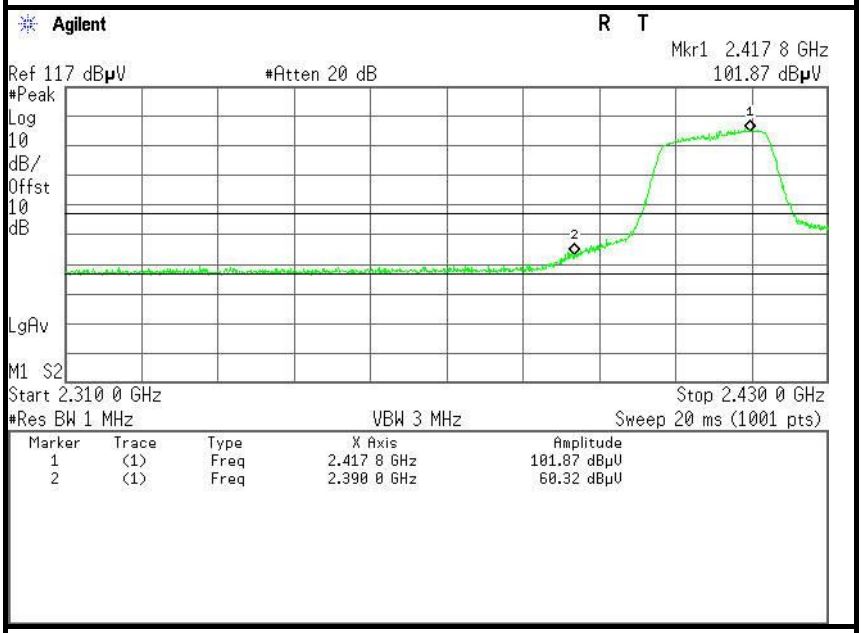


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	61.05	-6.24	67.29	74.00	-6.71	Peak	Horizontal
2	2483.5000	45.32	-6.24	51.56	54.00	-2.44	Average	Horizontal

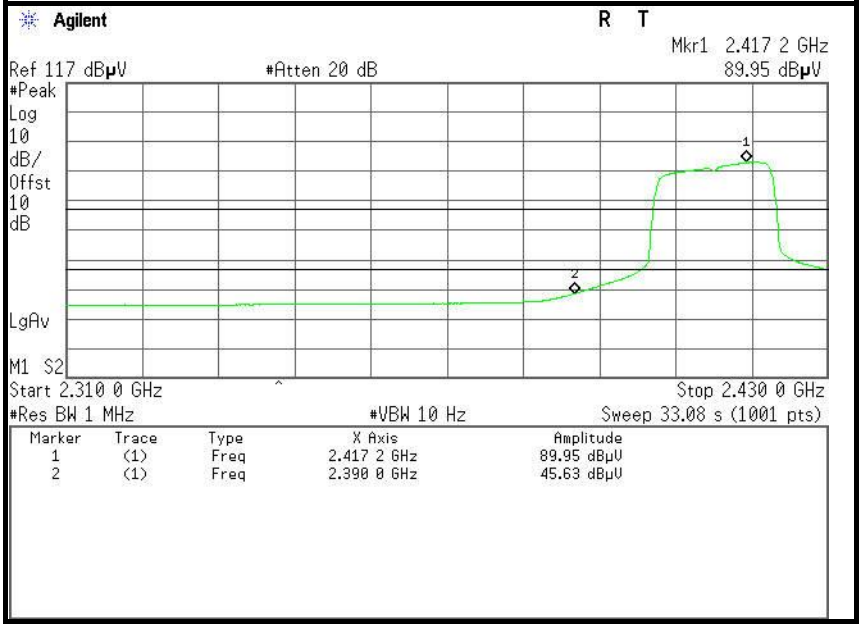
IEEE 802.11n HT20 MHz mode

Band Edges (CH Low)

Detector mode: Peak **Polarity: Vertical**

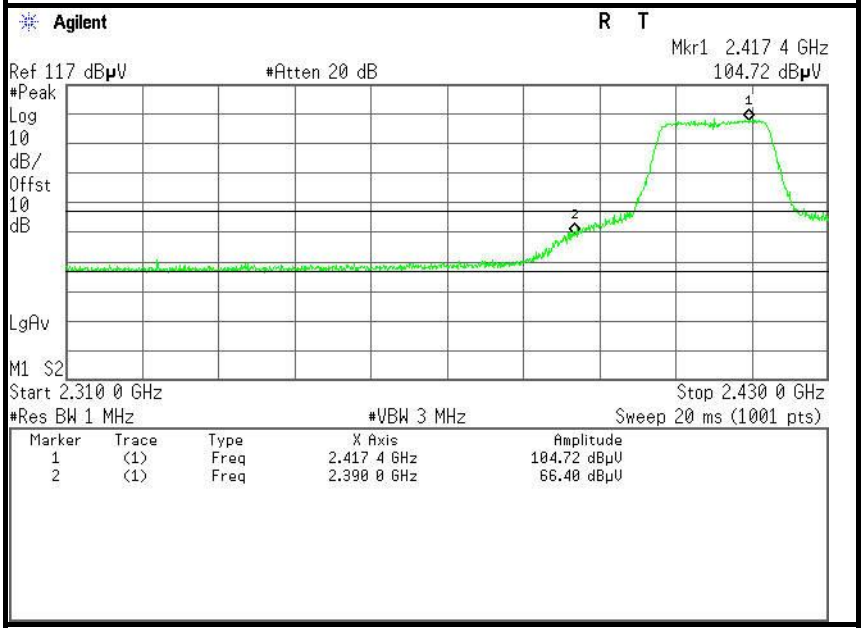


Detector mode: Average **Polarity: Vertical**

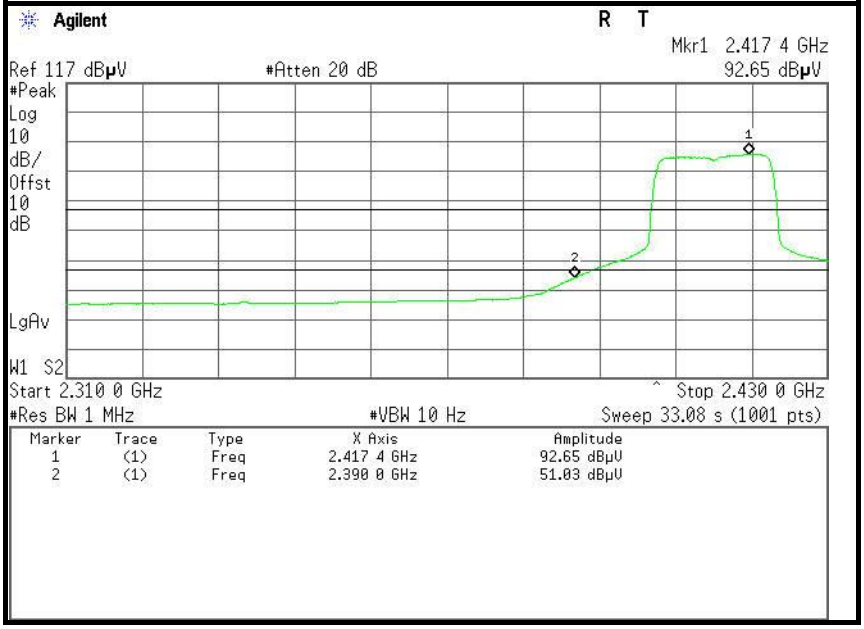


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	53.72	-6.60	60.32	74.00	-13.68	Peak	Vertical
2	2390.0000	39.03	-6.60	45.63	54.00	-8.37	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



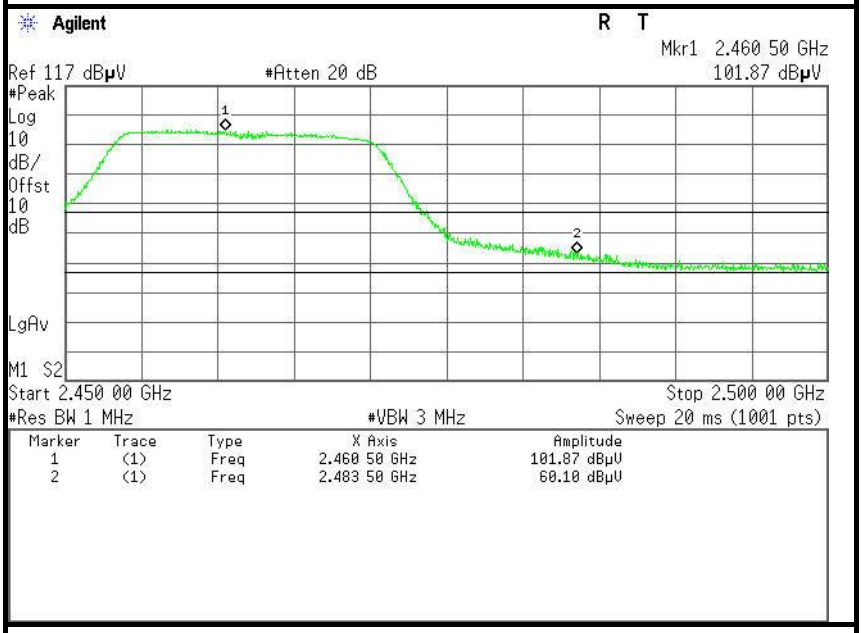
Detector mode: Average **Polarity: Horizontal**



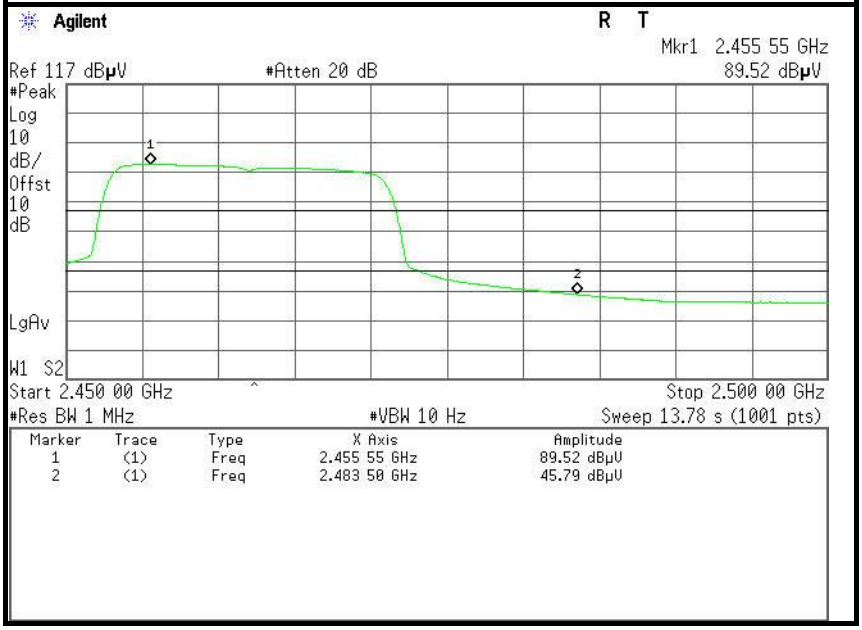
No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	59.80	-6.60	66.40	74.00	-7.60	Peak	Horizontal
2	2390.0000	44.43	-6.60	51.03	54.00	-2.97	Average	Horizontal

Band Edges (CH High)

Detector mode: Peak **Polarity: Vertical**

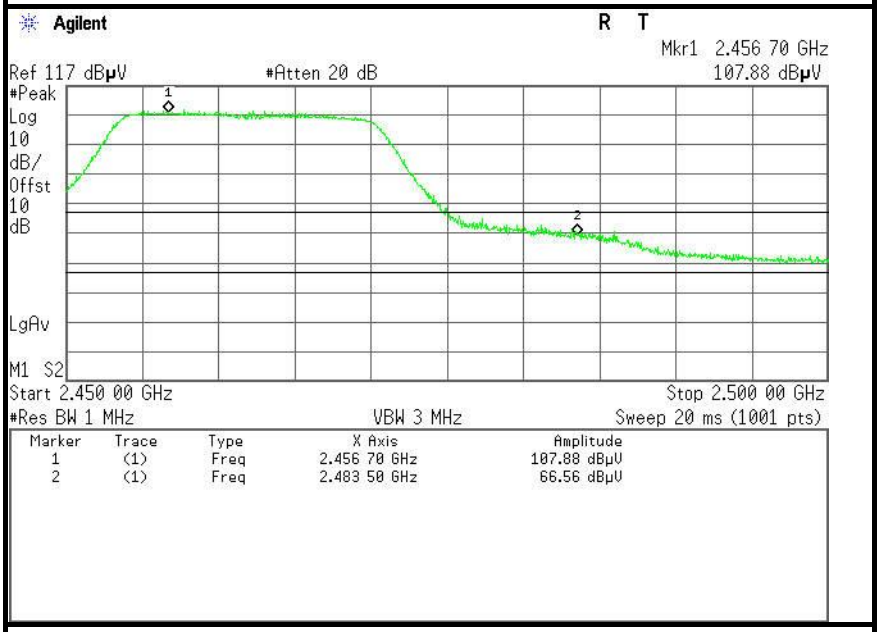


Detector mode: Average **Polarity: Vertical**

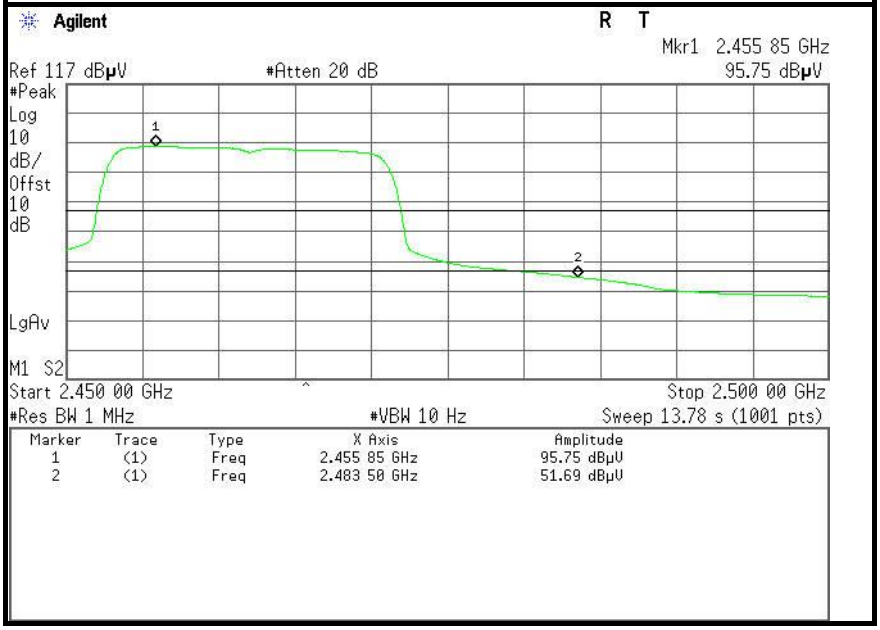


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	53.86	-6.24	60.10	74.00	-13.90	Peak	Vertical
2	2483.5000	39.55	-6.24	45.79	54.00	-8.21	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**

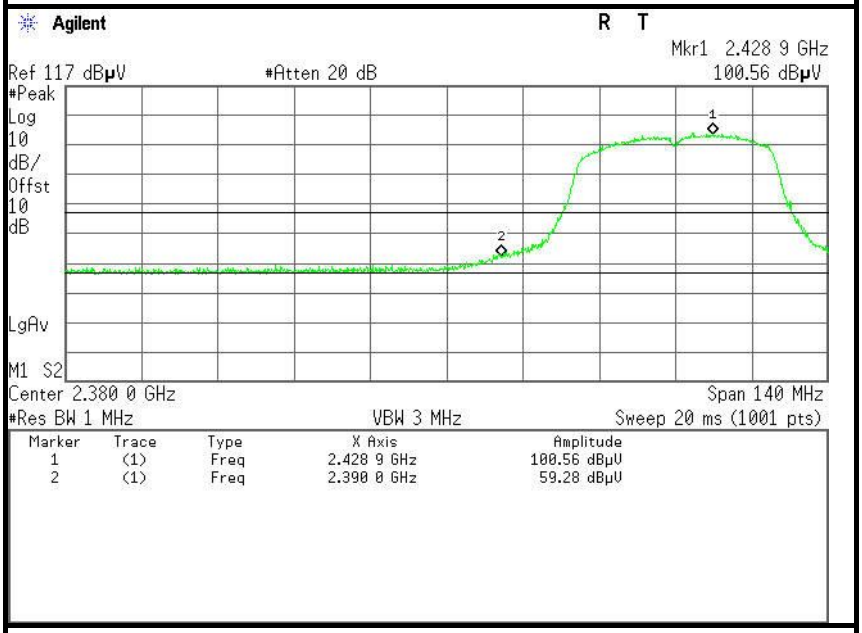


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	60.32	-6.24	66.56	74.00	-7.44	Peak	Horizontal
2	2483.5000	45.45	-6.24	51.69	54.00	-2.31	Average	Horizontal

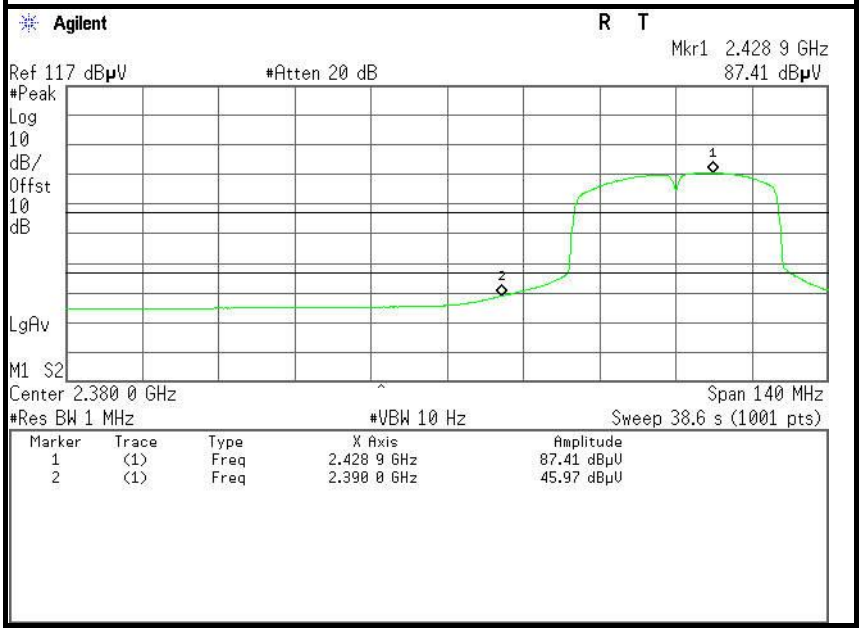
IEEE 802.11n HT40 MHz mode

Band Edges (CH Low)

Detector mode: Peak **Polarity: Vertical**

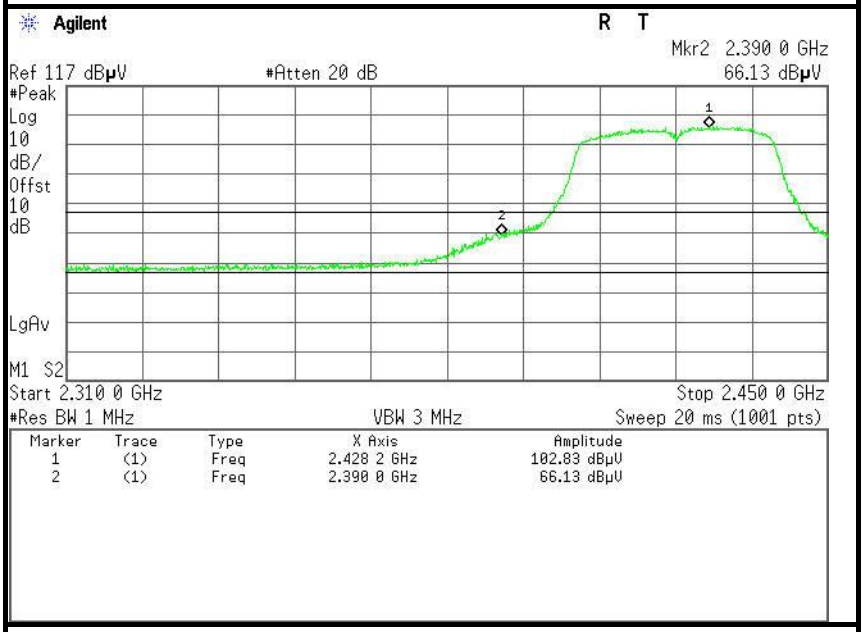


Detector mode: Average **Polarity: Vertical**

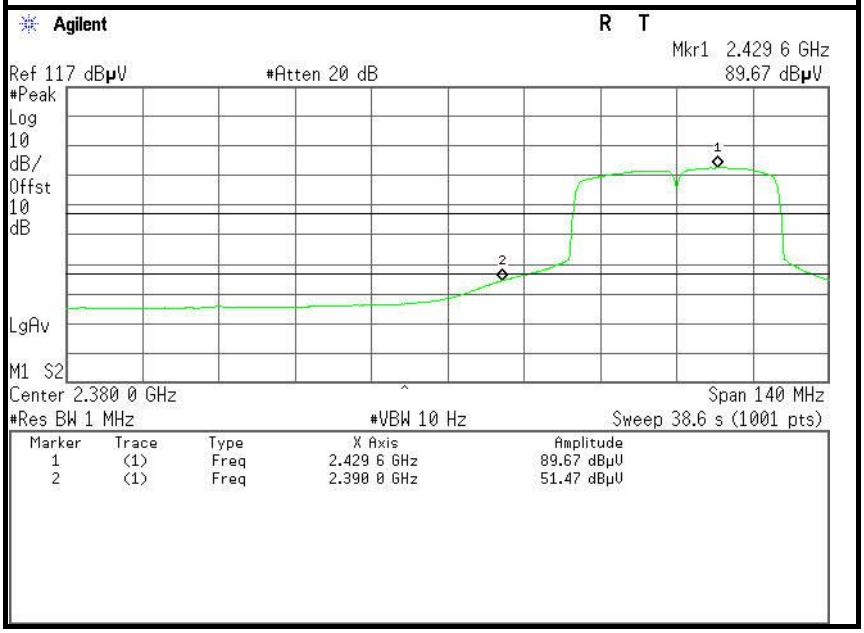


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	52.68	-6.60	59.28	74.00	-14.72	Peak	Vertical
2	2390.0000	39.37	-6.60	45.97	54.00	-8.03	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



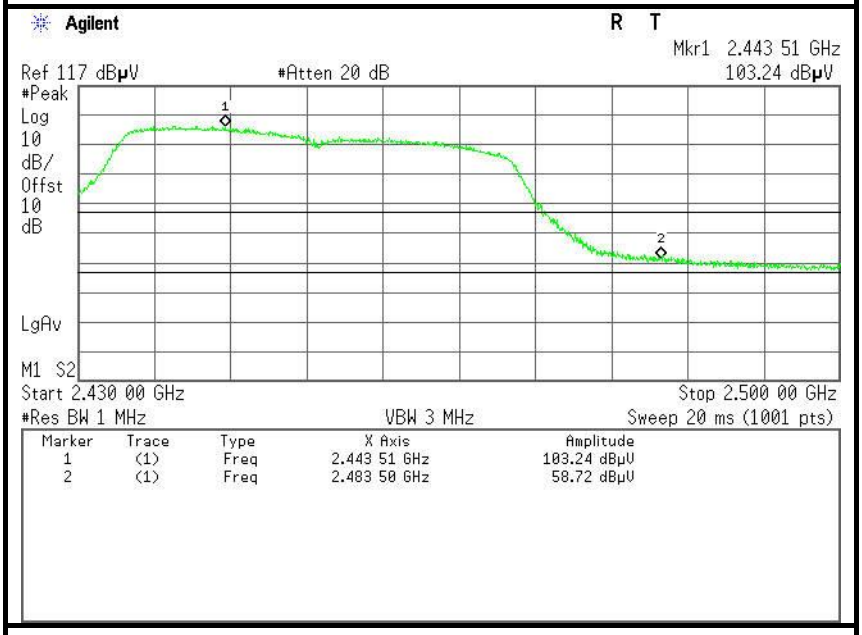
Detector mode: Average **Polarity: Horizontal**



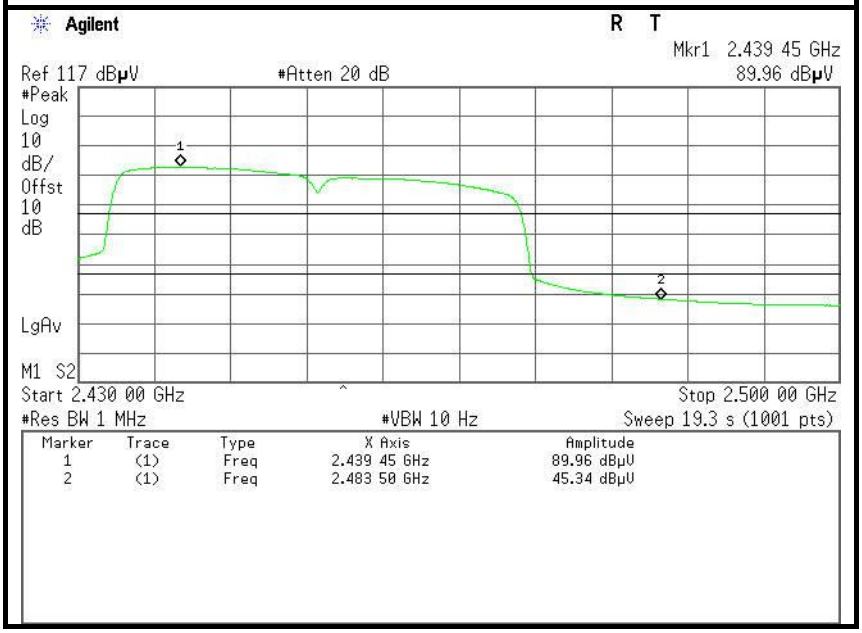
No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2390.0000	59.53	-6.60	66.13	74.00	-7.87	Peak	Horizontal
2	2390.0000	44.87	-6.60	51.47	54.00	-2.53	Average	Horizontal

Band Edges (CH High)

Detector mode: Peak **Polarity: Vertical**

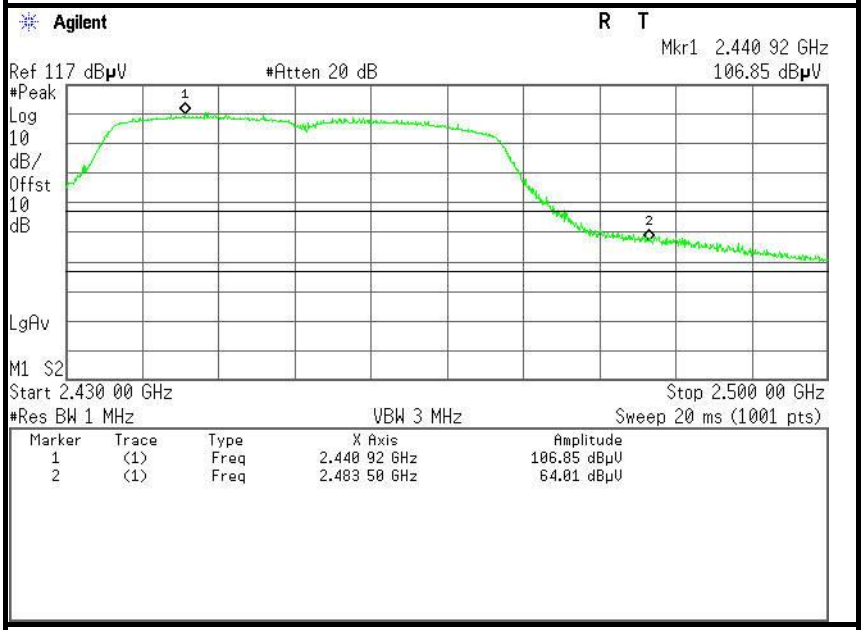


Detector mode: Average **Polarity: Vertical**

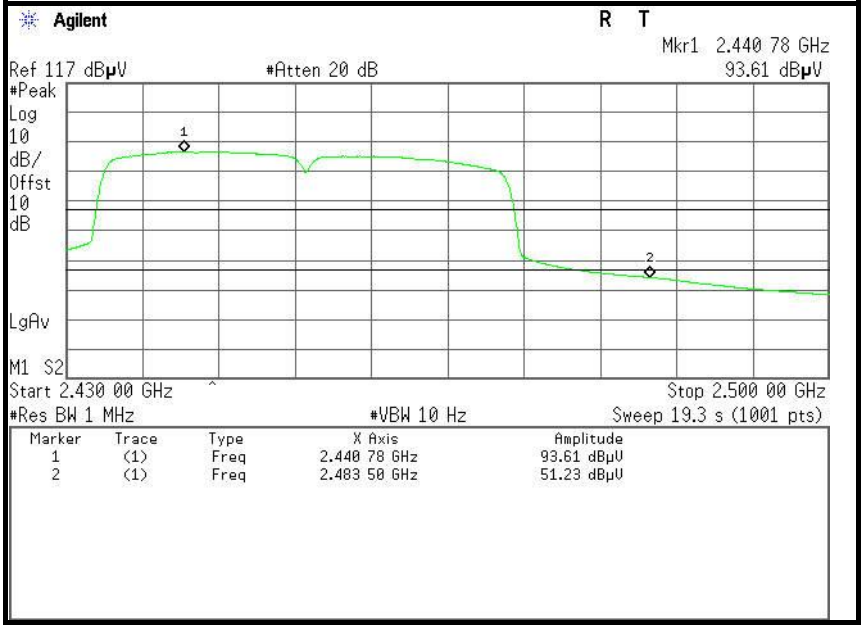


No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	52.48	-6.24	58.72	74.00	-15.28	Peak	Vertical
2	2483.5000	39.10	-6.24	45.34	54.00	-8.66	Average	Vertical

Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**



No.	Frequency (MHz)	Reading (dBuV)	Corrected (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Antenna Pole
1	2483.5000	57.77	-6.24	64.01	74.00	-9.99	Peak	Horizontal
2	2483.5000	44.99	-6.24	51.23	54.00	-2.77	Average	Horizontal

7.7. PEAK POWER SPECTRAL DENSITY MEASUREMENT

7.7.1. LIMITS

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

7.7.2. TEST INSTRUMENTS

Name of Equipment	Manufacturer	Model	Serial Number	Last Calibration	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US44300399	02/21/2016	02/20/2017

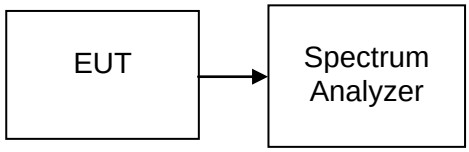
7.7.3. TEST PROCEDURES (please refer to measurement standard)

§15.247(e)specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission. The same method as used to determine the conducted output power shall be used to determine the power spectral density (i.e.,if peak-detected fundamental power was measured then use the peak PSD procedure and if average fundamental power was measured then use the average PSD procedure).

10.2 Method PKPSD (peak PSD)

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

7.7.4. TEST SETUP



7.7.5. TEST RESULTS

No non-compliance noted

Test Data

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2412	-13.83	8	PASS
Mid	2437	-9.65		PASS
High	2462	-7.01		PASS

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2412	-9.35	8	PASS
Mid	2437	-8.87		PASS
High	2462	-7.59		PASS

Test mode: IEEE 802.11n HT20 MHz

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2412	-10.14	8	PASS
Mid	2437	-7.96		PASS
High	2462	-7.47		PASS

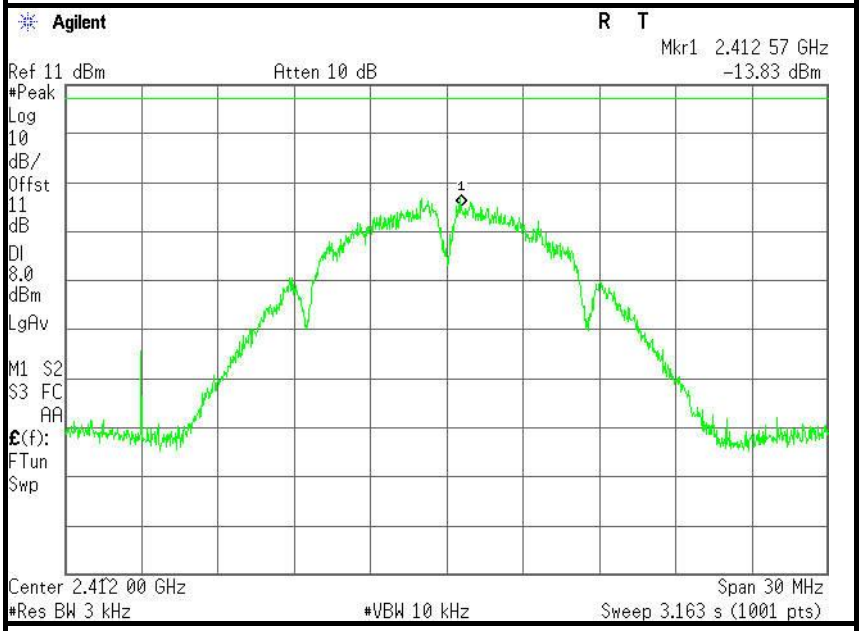
Test mode: IEEE 802.11n HT40 MHz

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2422	-13.10	8	PASS
Mid	2437	-11.64		PASS
High	2452	-9.04		PASS

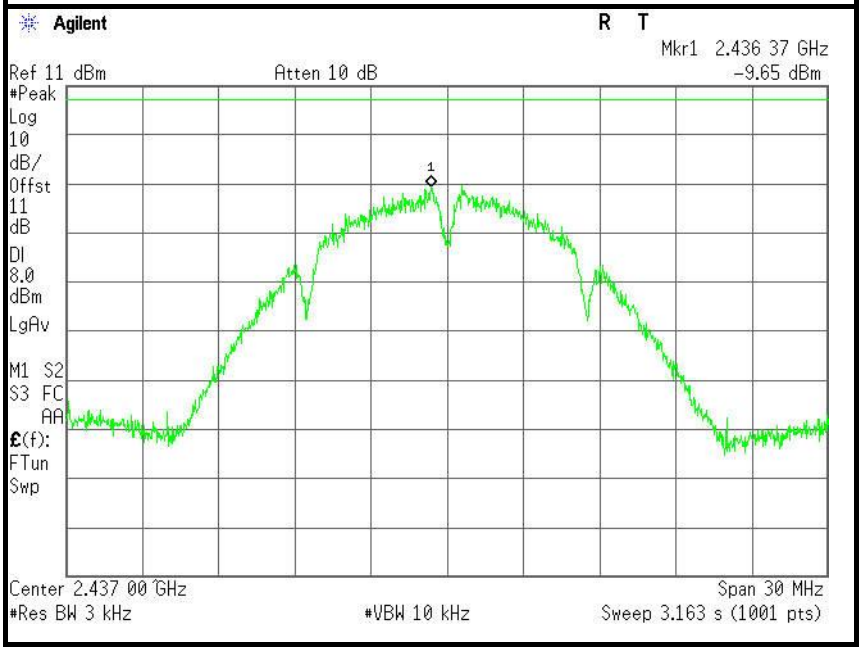
Test Plot

IEEE 802.11b mode

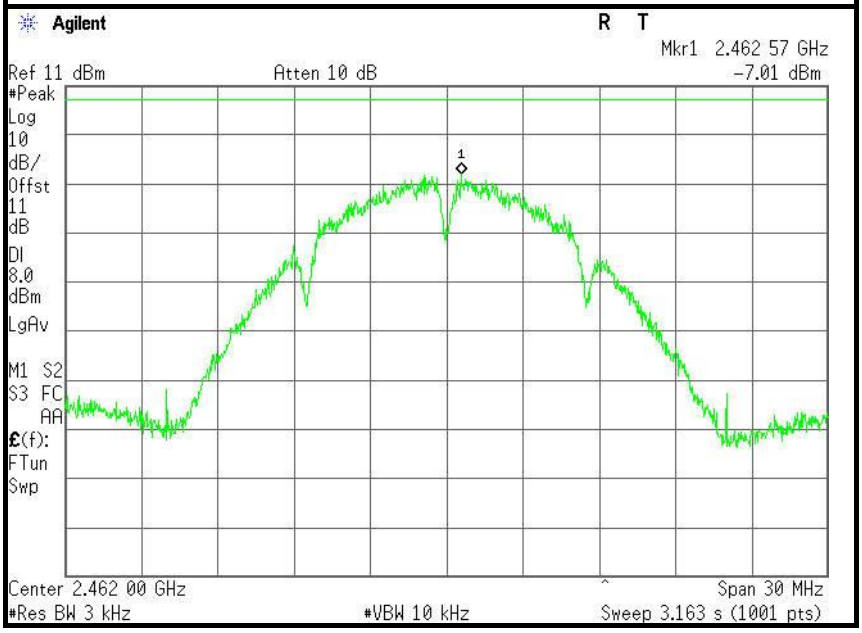
PPSD (CH Low)



PPSD (CH Mid)

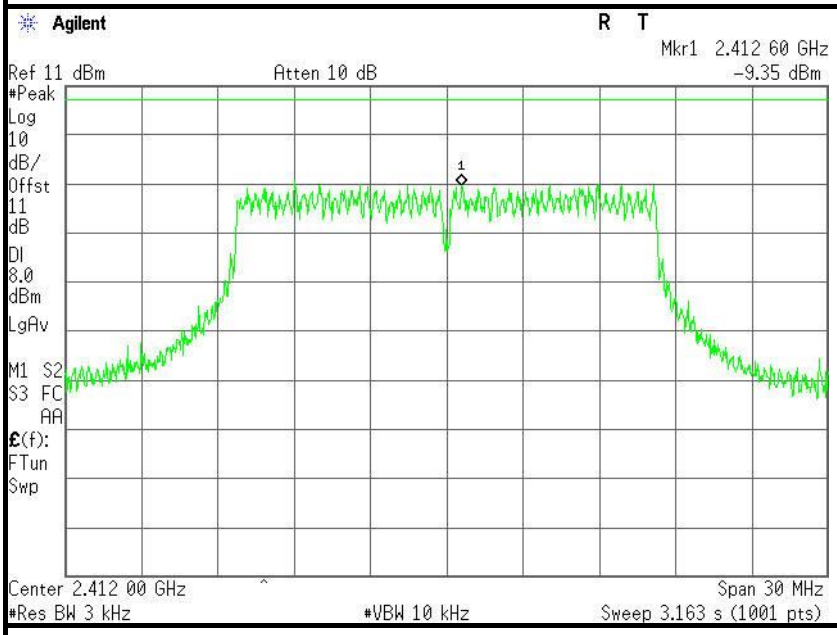


PPSD (CH High)

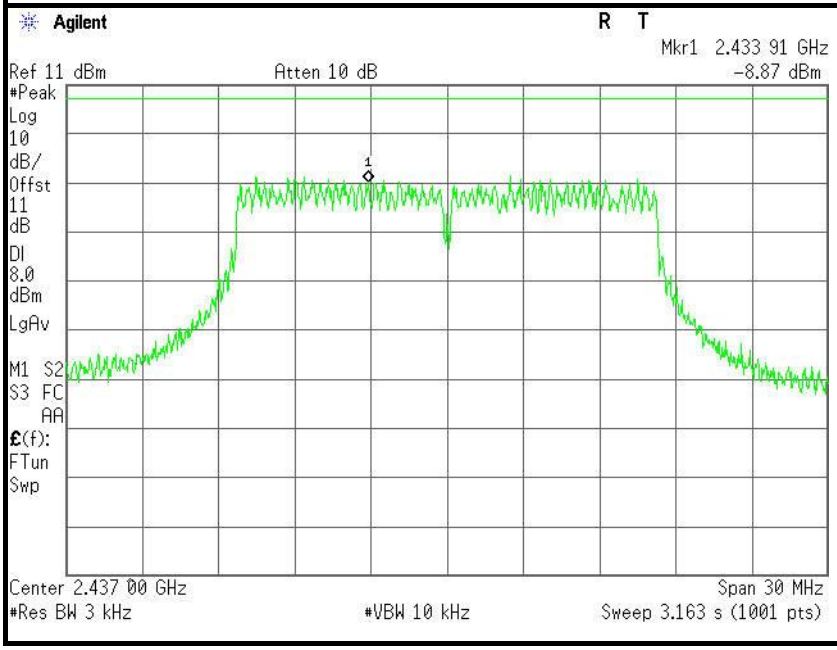


IEEE 802.11g mode

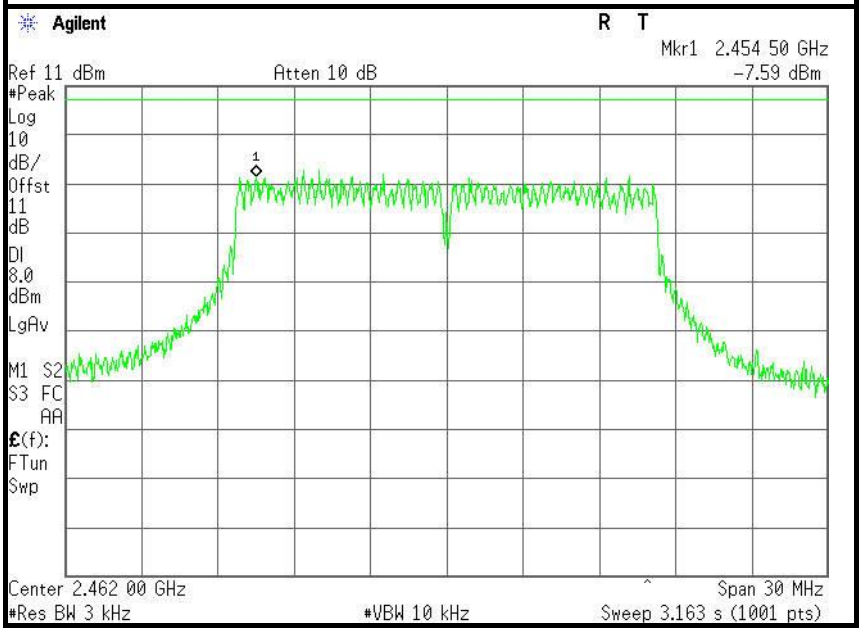
PPSD (CH Low)



PPSD (CH Mid)

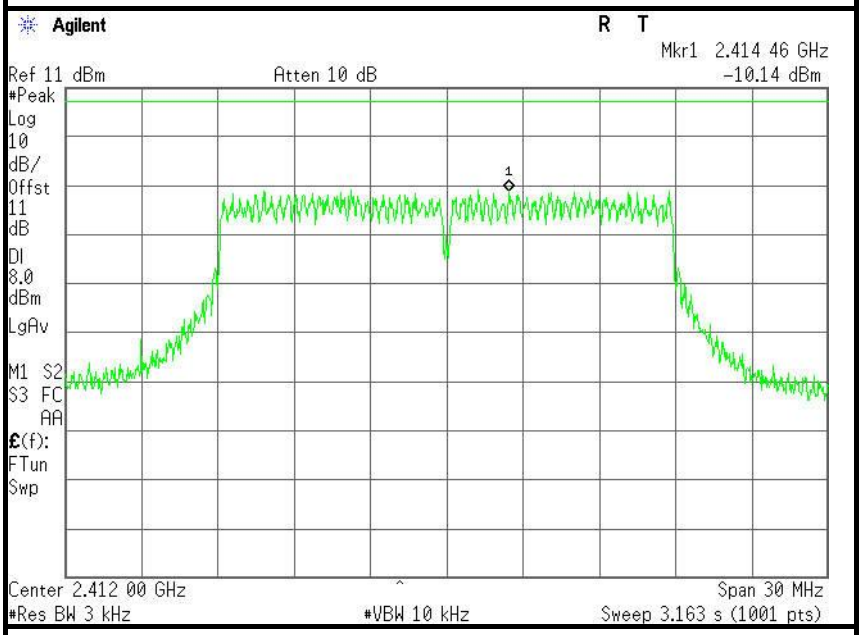


PPSD (CH High)

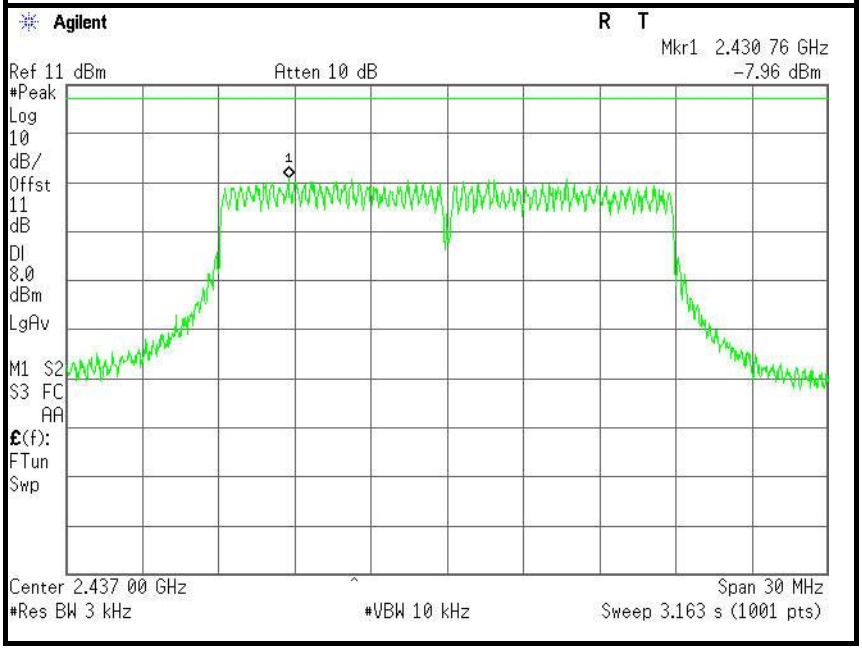


IEEE 802.11n HT20 MHz mode

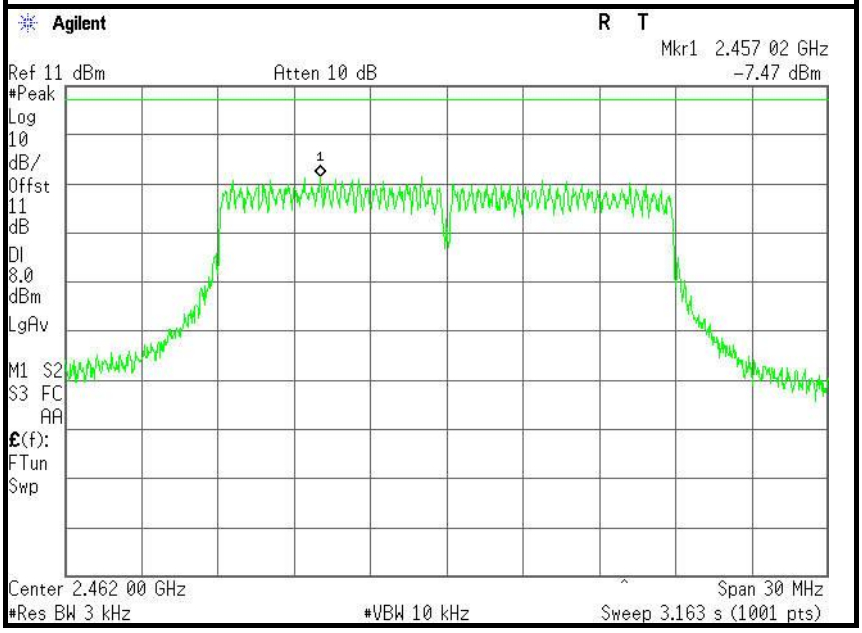
PPSD (CH Low)



PPSD (CH Mid)

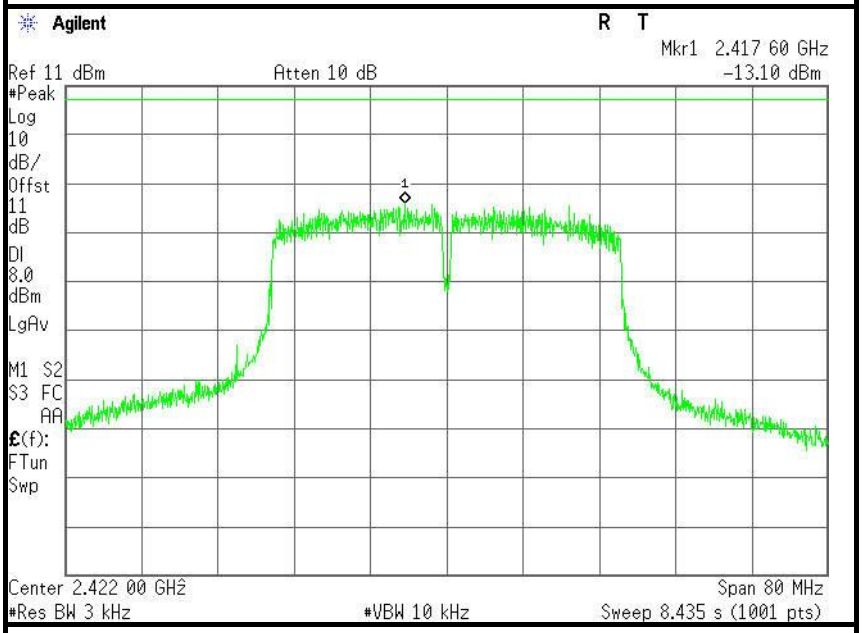


PPSD (CH High)

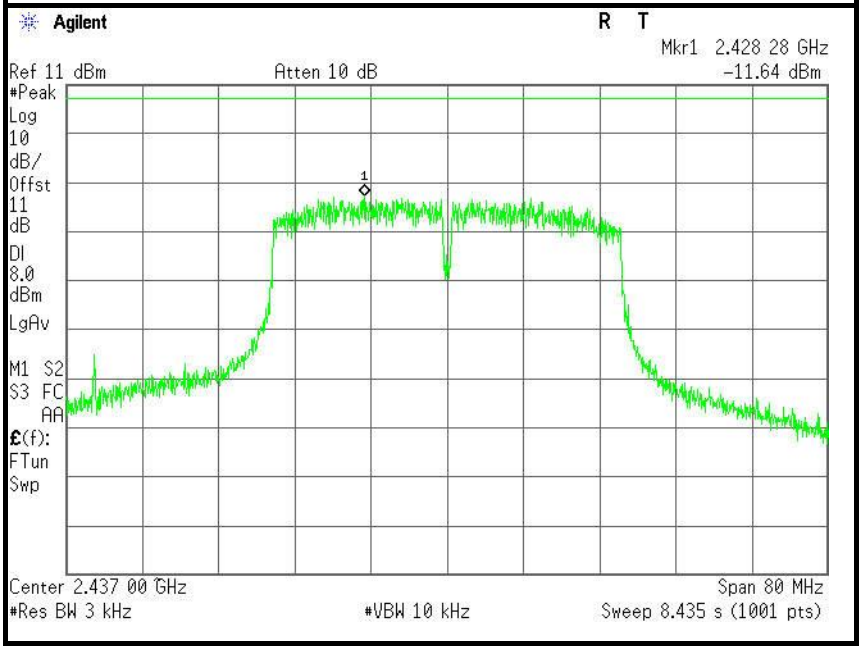


IEEE 802.11n HT40 MHz mode

PPSD (CH Low)



PPSD (CH Mid)



PPSD (CH High)