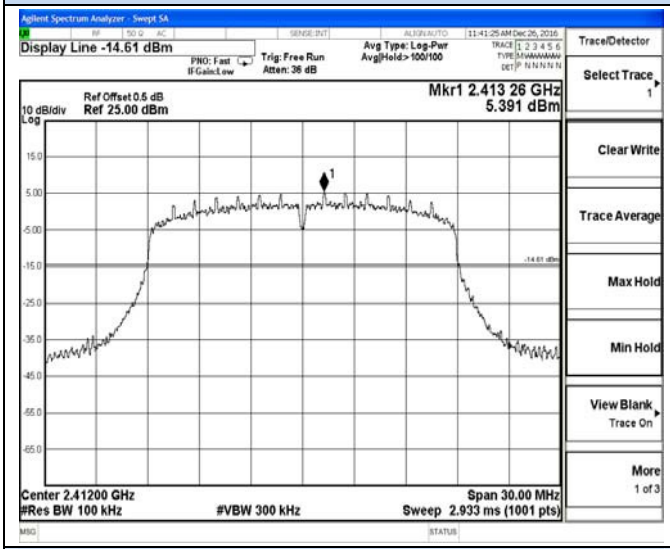
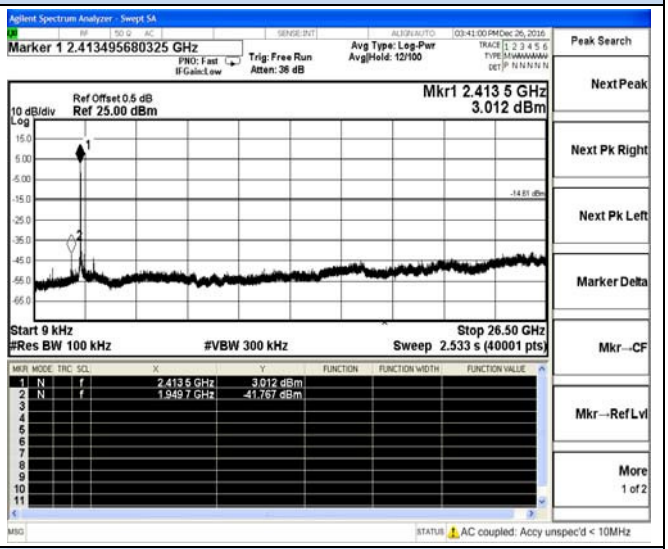
RF Conducted Spurious Emissions

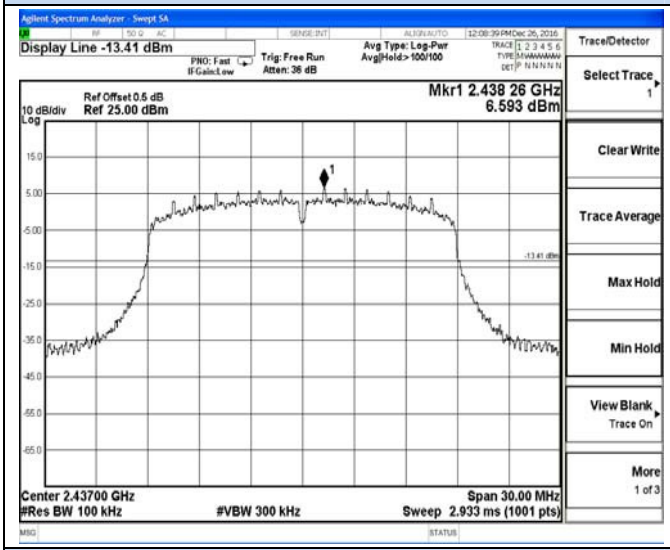
IEEE 802.11n HT20

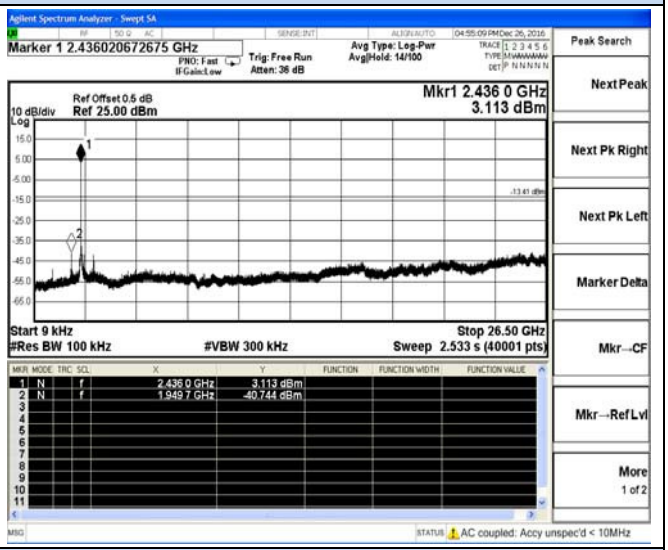
Antenna 0



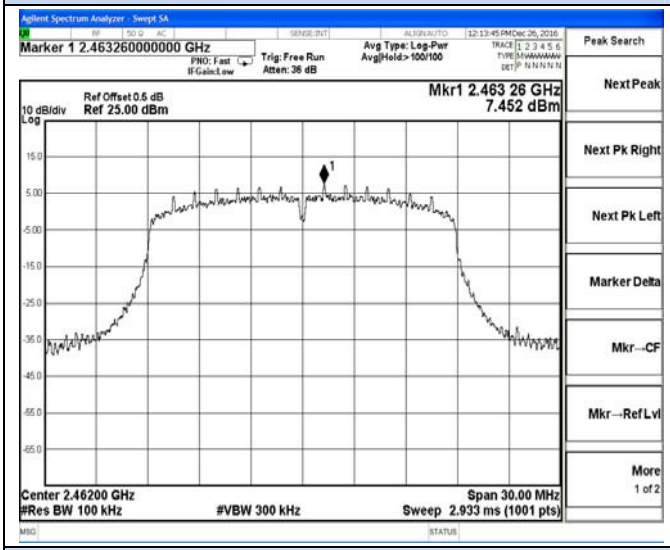


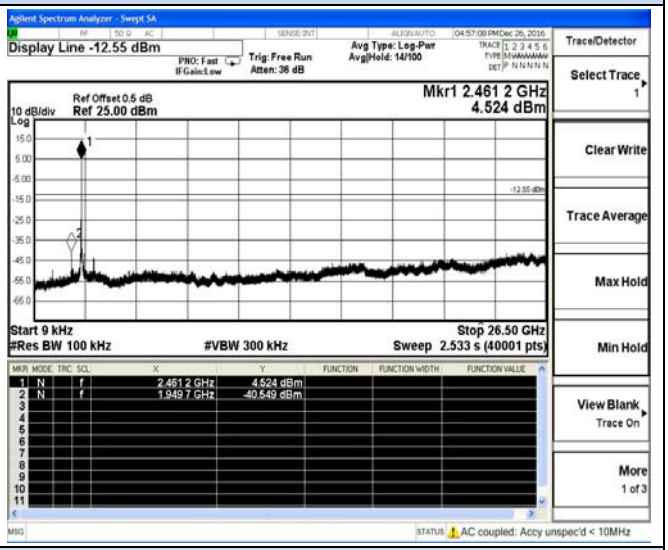
2397 MHz – 2427 MHz | 9 KHz – 26.5 GHz





2422 MHz – 2452 MHz | 9 KHz – 26.5 GHz



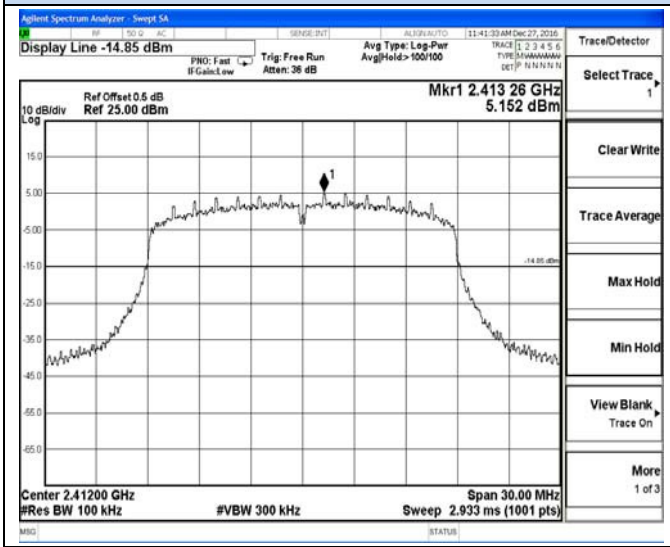


2447 MHz – 2477 MHz | 9 KHz – 26.5 GHz

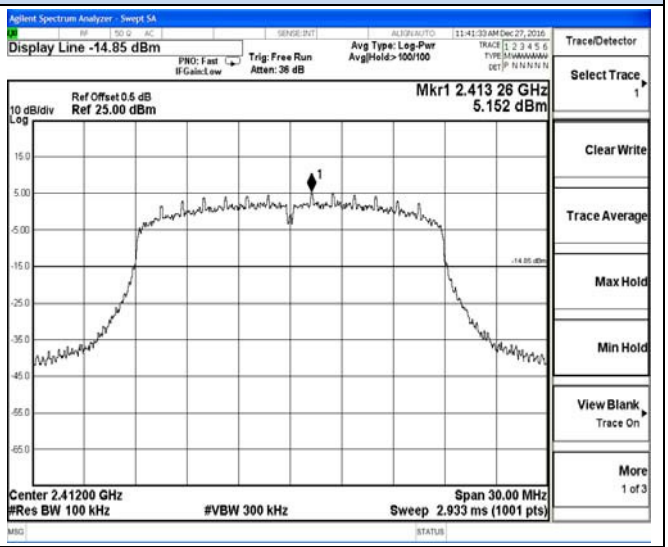
RF Conducted Spurious Emissions

IEEE 802.11n HT20

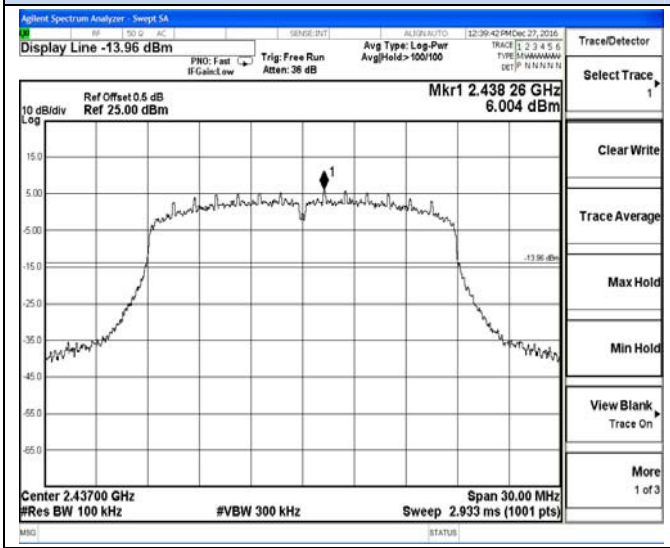
Antenna 1



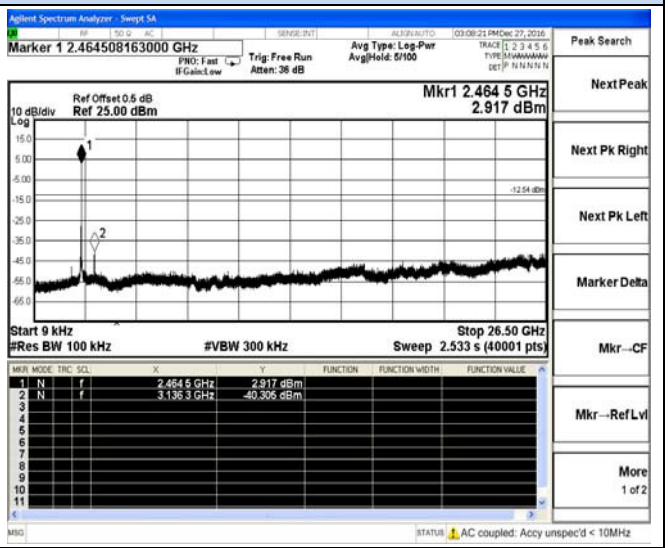
2397 MHz – 2427 MHz



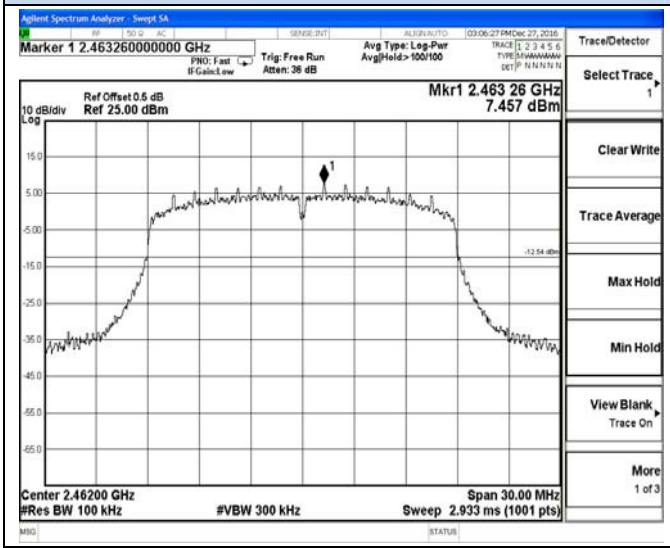
9 KHz – 26.5 GHz



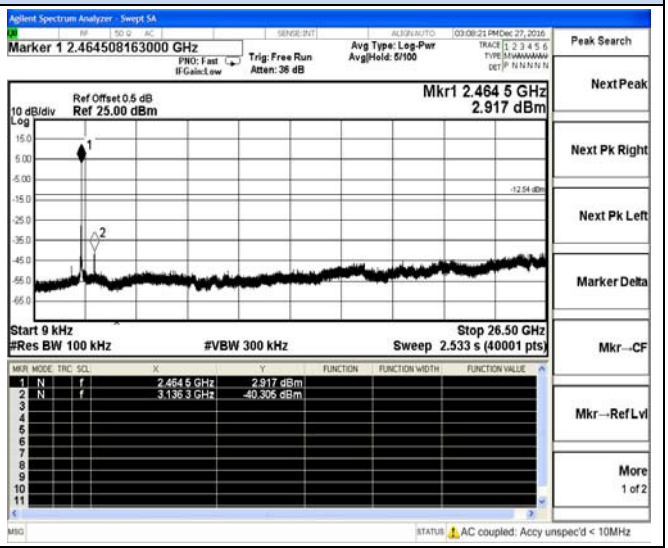
2422 MHz – 2452 MHz



9 KHz – 26.5 GHz



2447 MHz – 2477 MHz

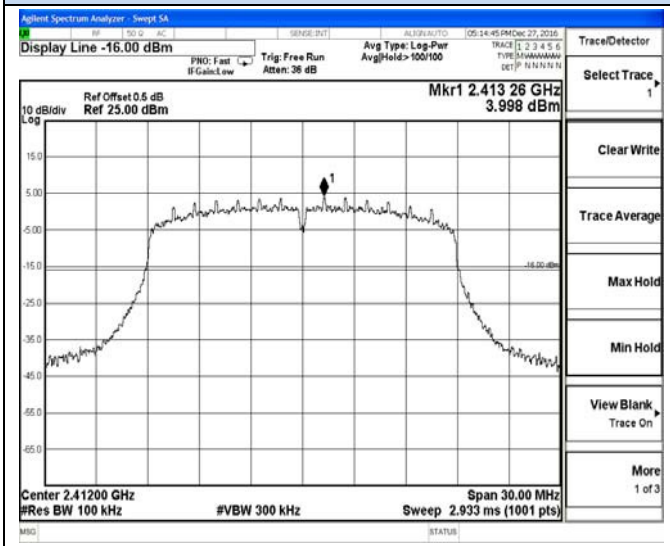


9 KHz – 26.5 GHz

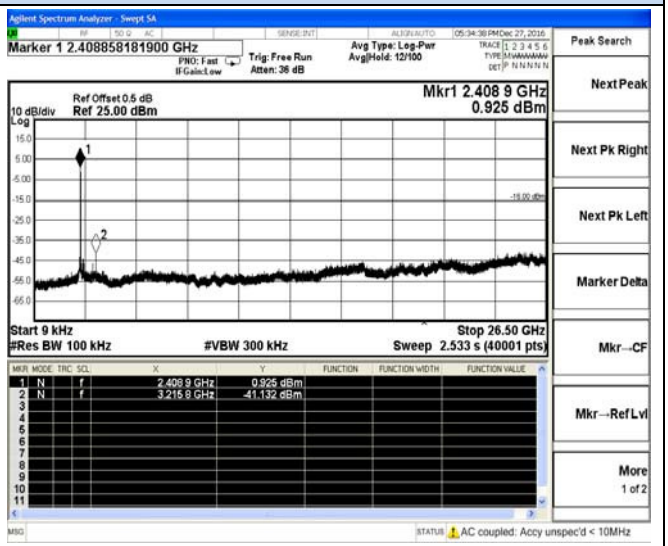
RF Conducted Spurious Emissions

IEEE 802.11n HT20

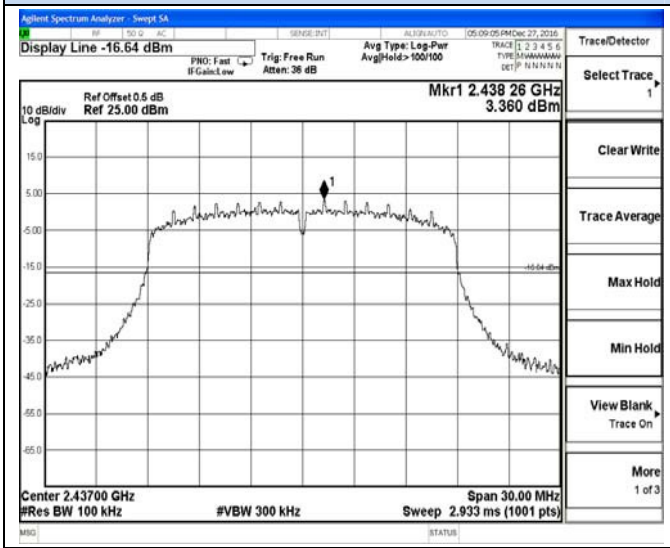
Antenna 2



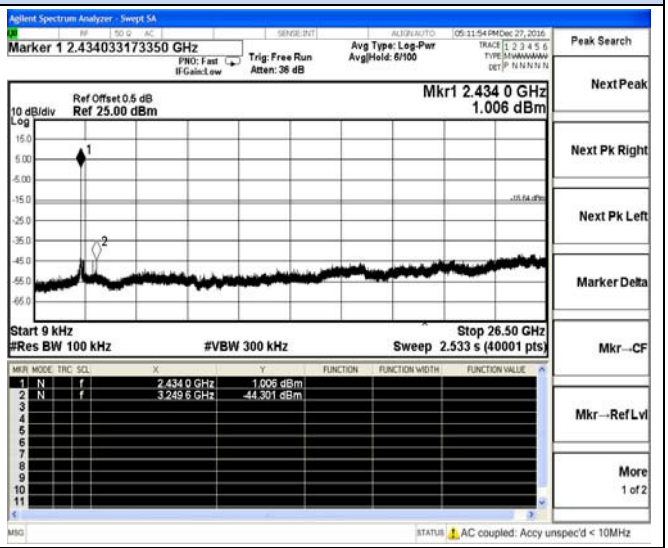
2397 MHz – 2427 MHz



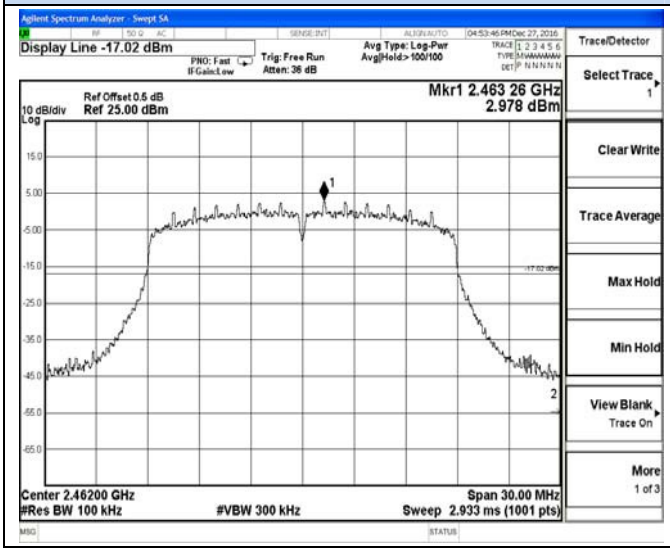
9 KHz – 26.5 GHz



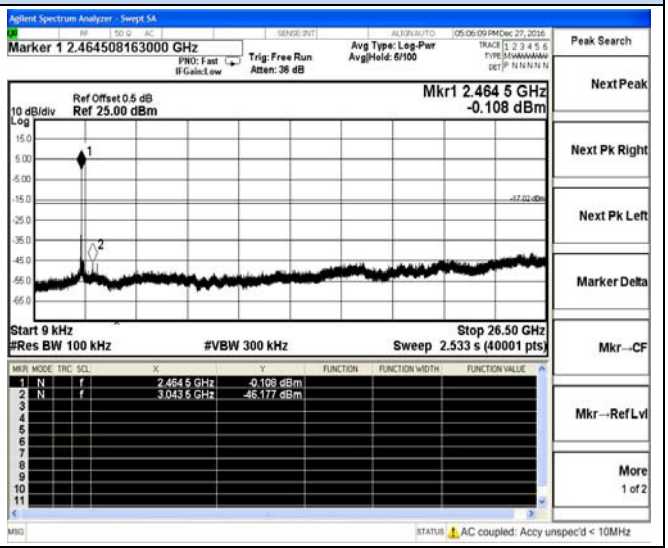
2422 MHz – 2452 MHz



9 KHz – 26.5 GHz



2447 MHz – 2477 MHz

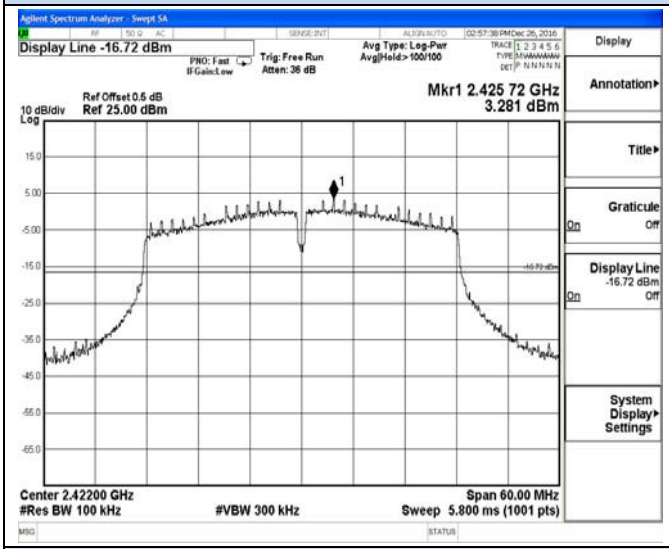


9 KHz – 26.5 GHz

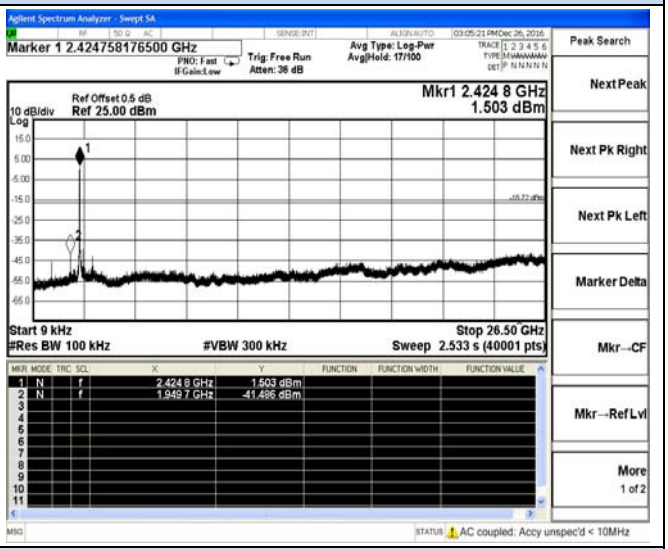
RF Conducted Spurious Emissions

IEEE 802.11n HT40

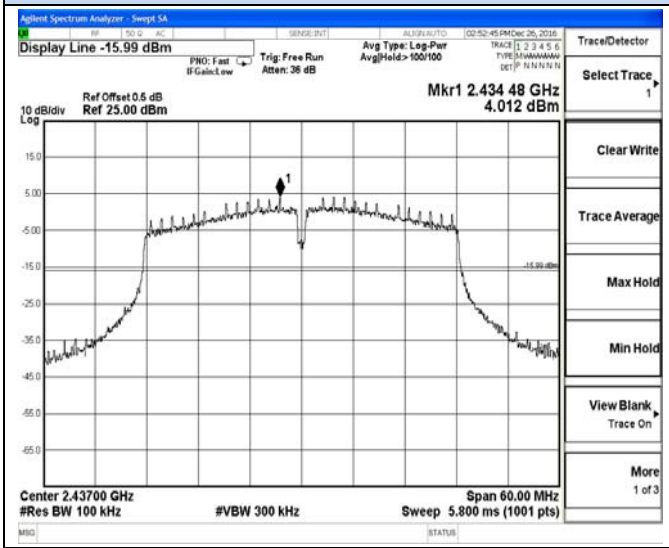
Antenna 0



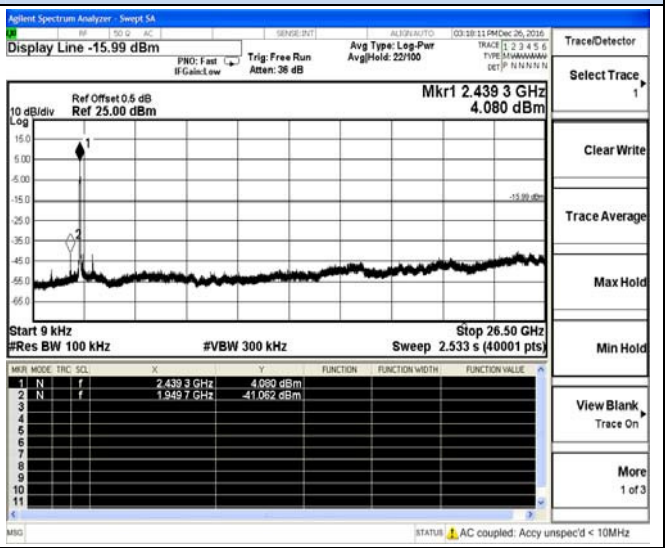
2392 MHz – 2452 MHz



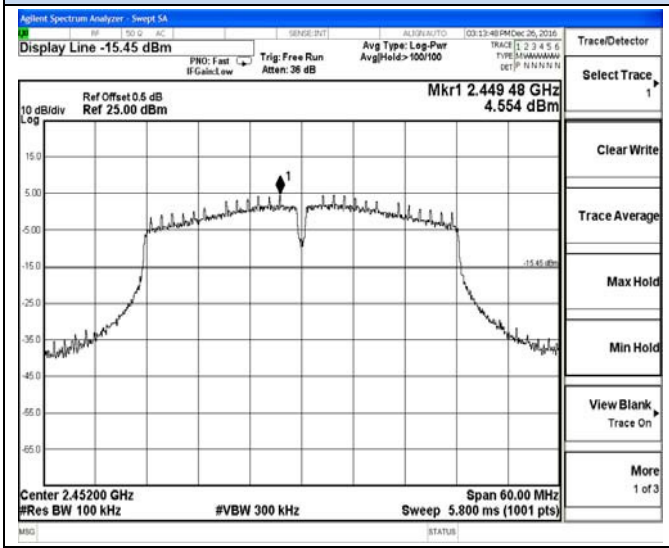
9 KHz – 26.5 GHz



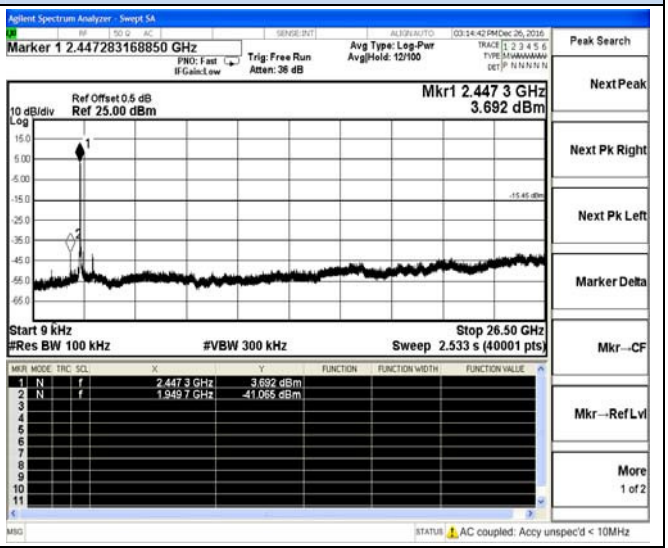
2407 MHz – 2467 MHz



9 KHz – 26.5 GHz



2422 MHz – 2482 MHz

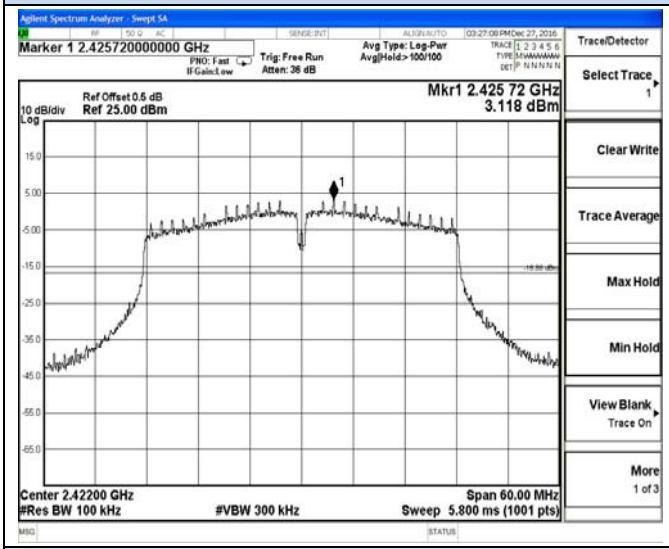


9 KHz – 26.5 GHz

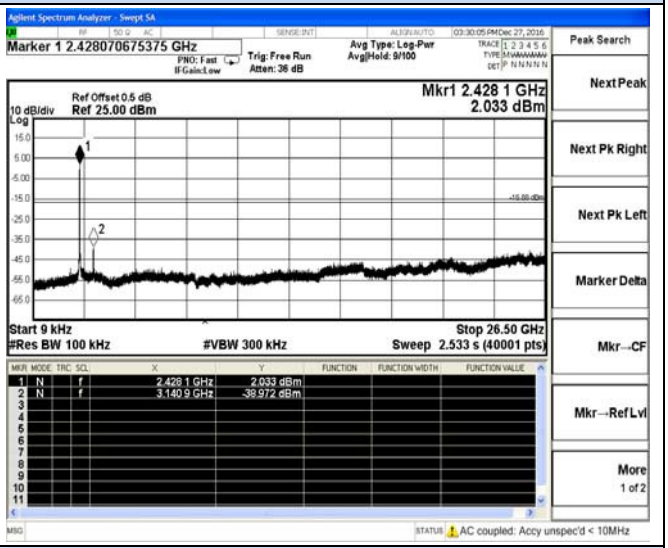
RF Conducted Spurious Emissions

IEEE 802.11n HT40

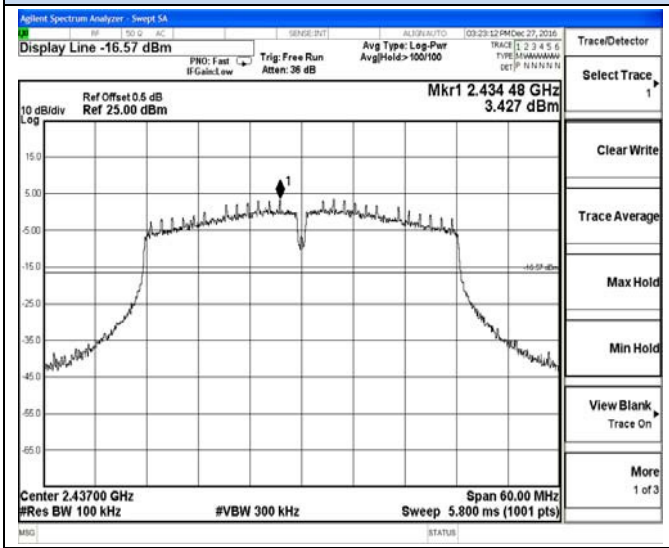
Antenna 1



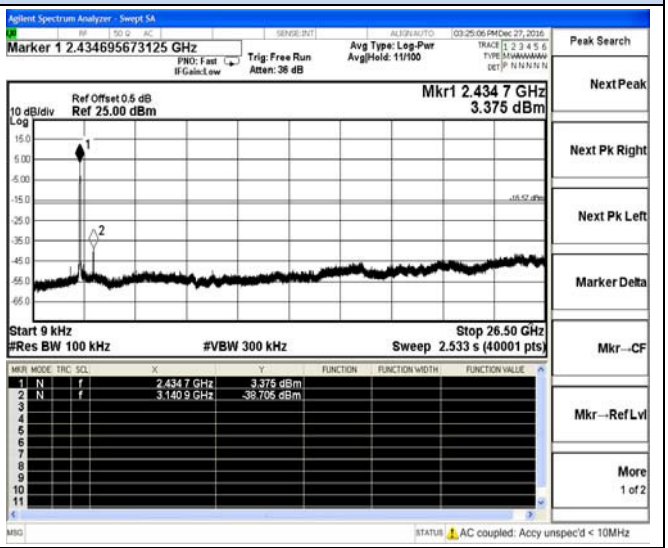
2392 MHz – 2452 MHz



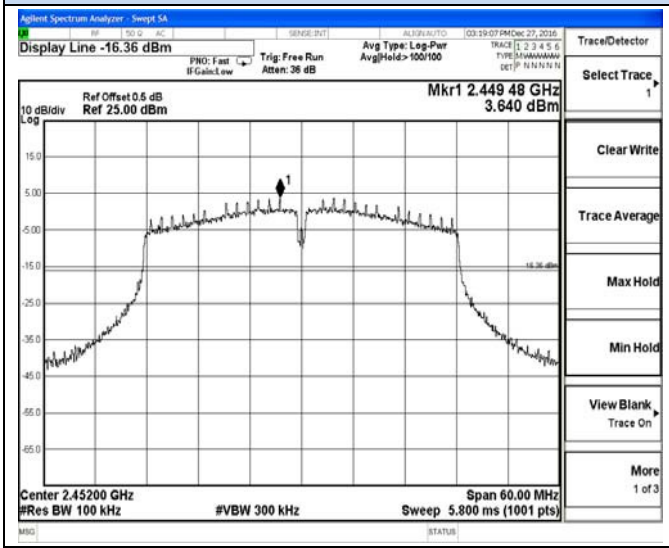
9 KHz – 26.5 GHz



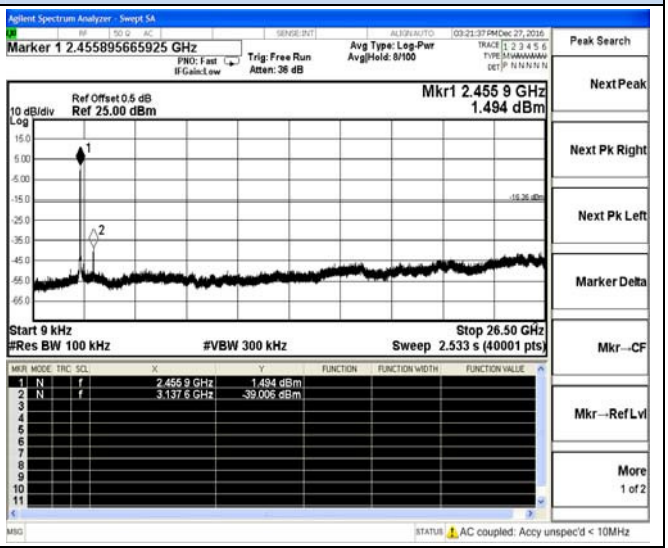
2407 MHz – 2467 MHz



9 KHz – 26.5 GHz



2422 MHz – 2482 MHz

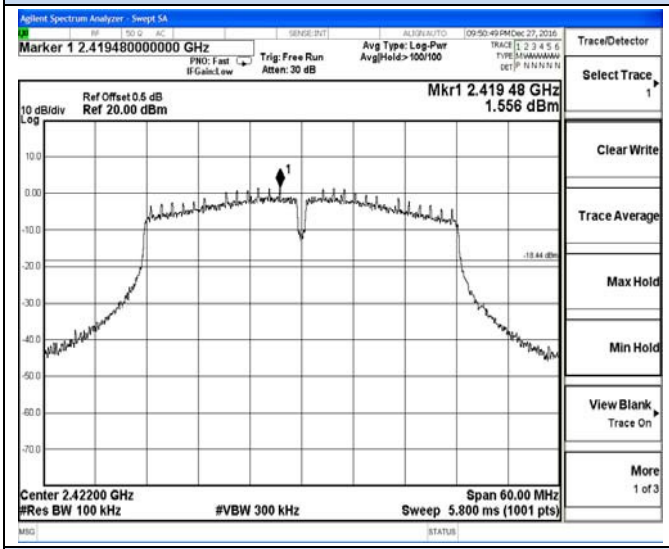


9 KHz – 26.5 GHz

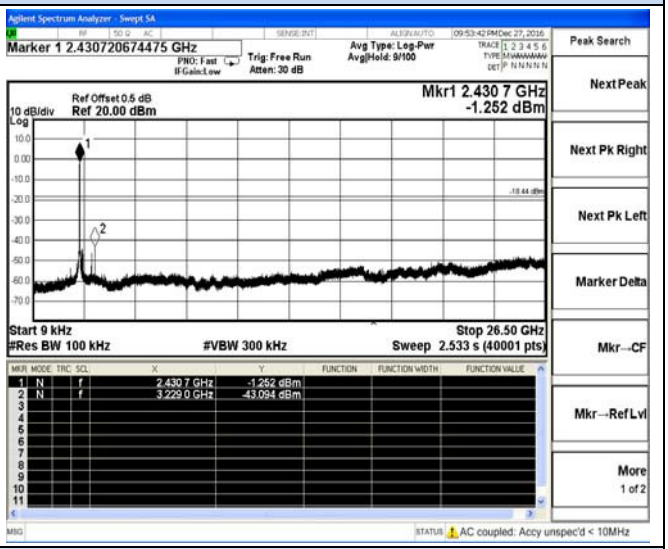
RF Conducted Spurious Emissions

IEEE 802.11n HT40

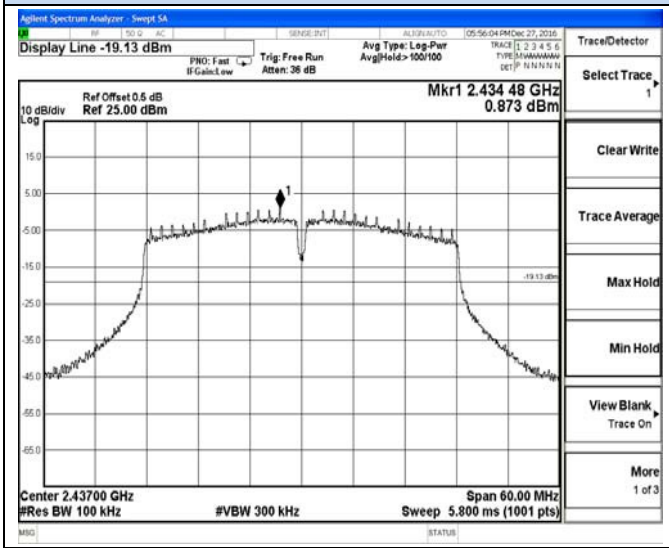
Antenna 2



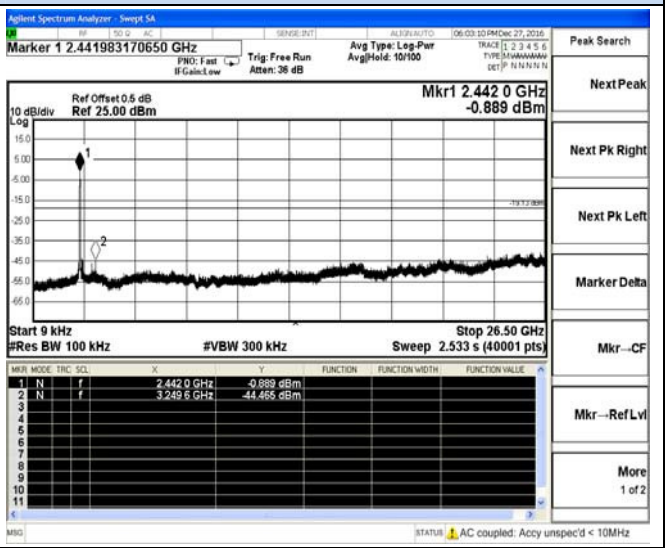
2392 MHz – 2452 MHz



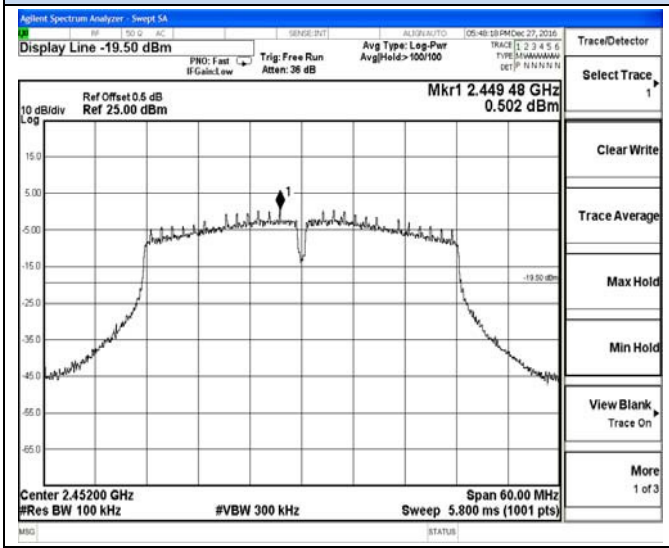
9 KHz – 26.5 GHz



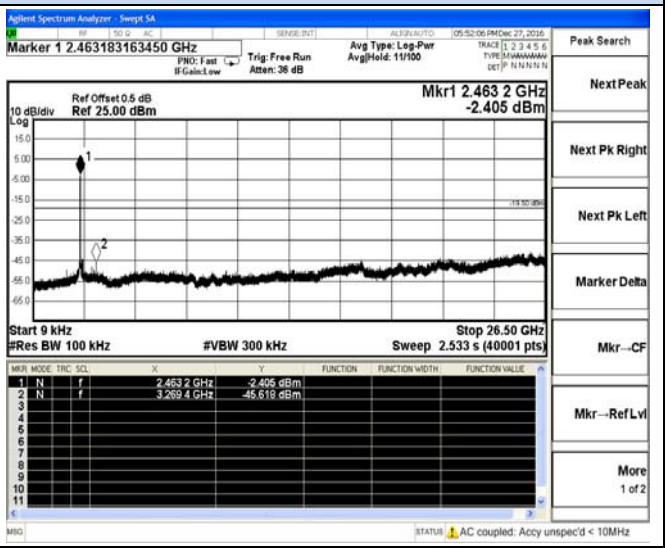
2407 MHz – 2467 MHz



9 KHz – 26.5 GHz



2422 MHz – 2482 MHz

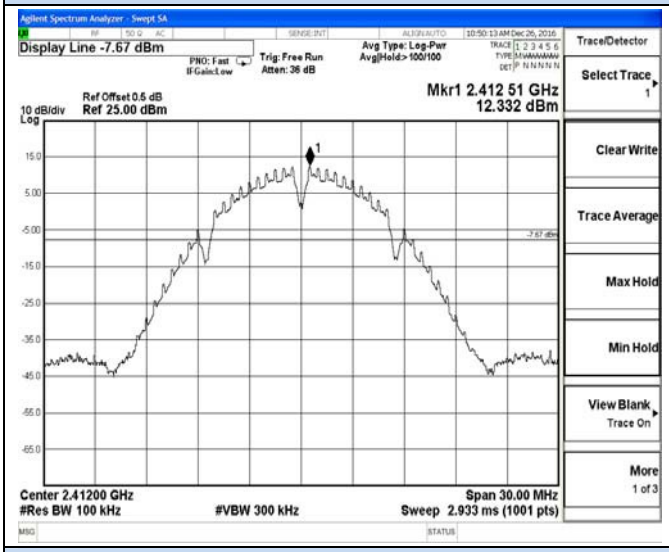


9 KHz – 26.5 GHz

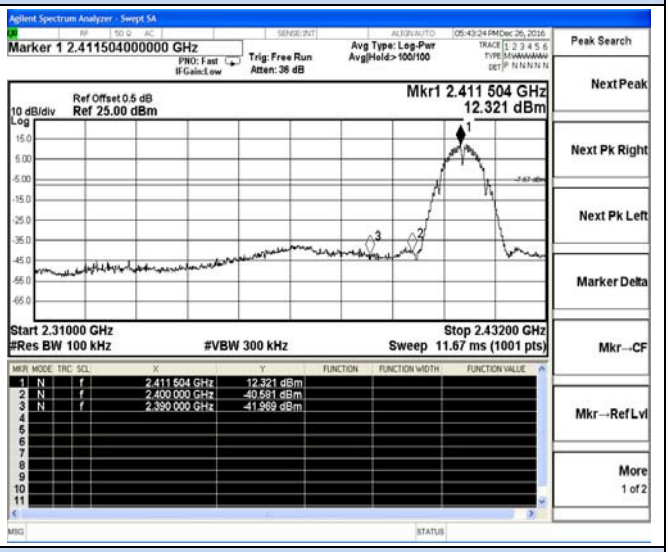
Band-edge measurements for conducted emissions

IEEE 802.11b

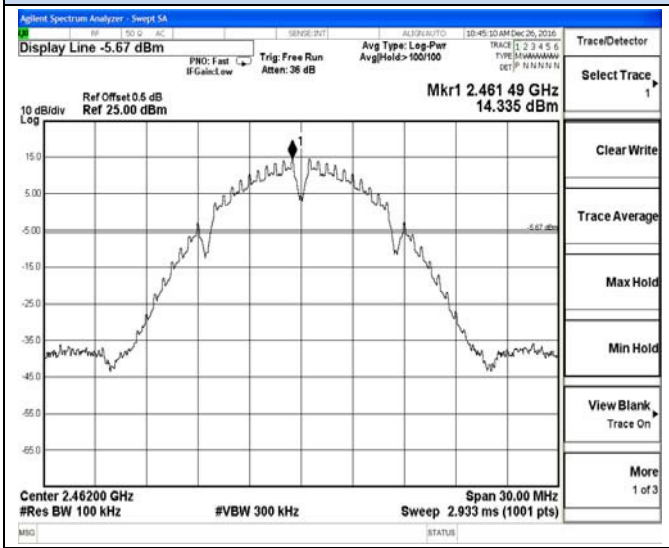
Antenna 0



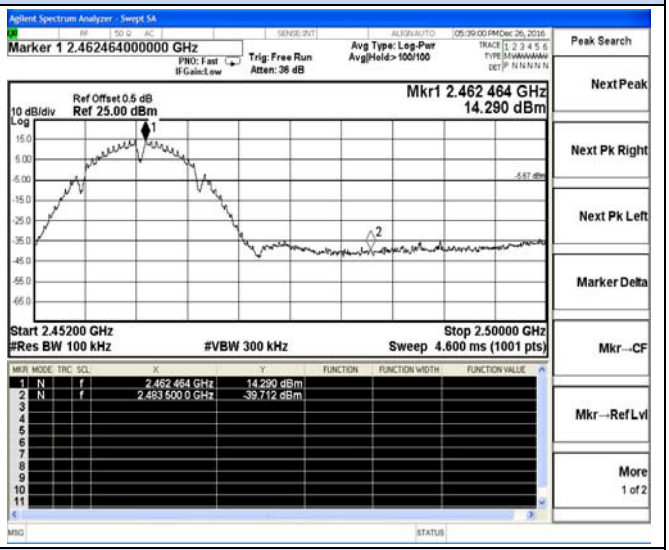
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz

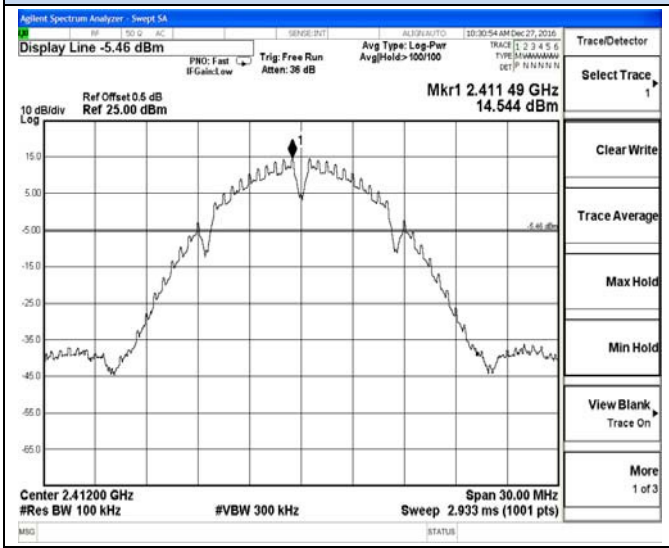


2447 MHz – 2477 MHz

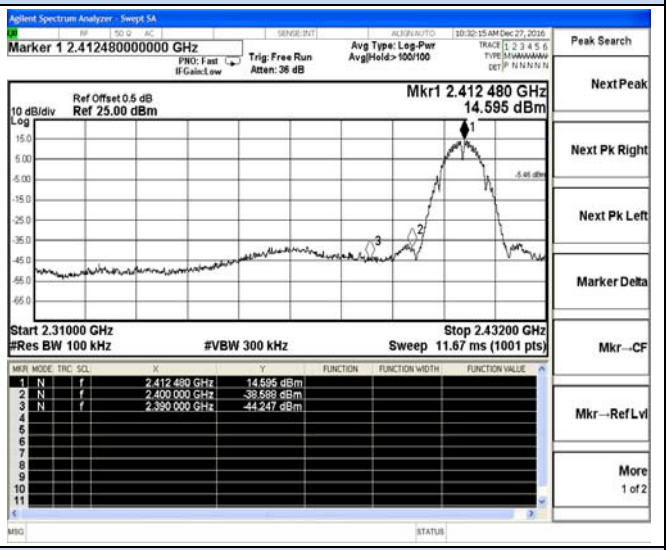


Channel 11 / 2462 MHz

Antenna 1



2397 MHz – 2427 MHz

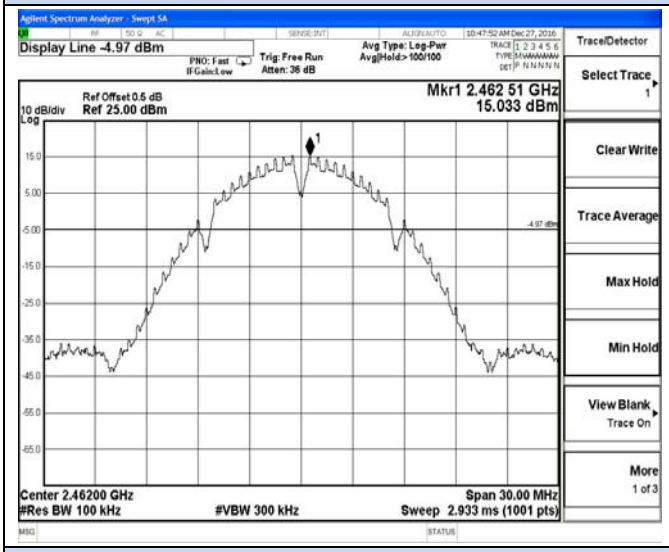


Channel 1 / 2412 MHz

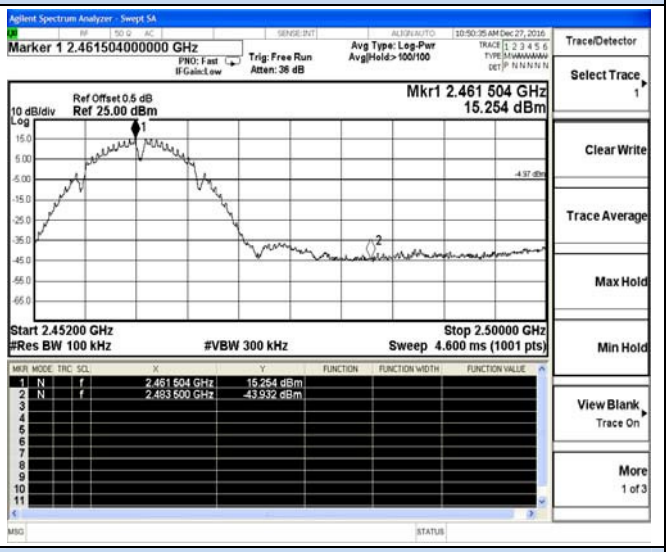
Band-edge measurements for conducted emissions

IEEE 802.11b

Antenna 1

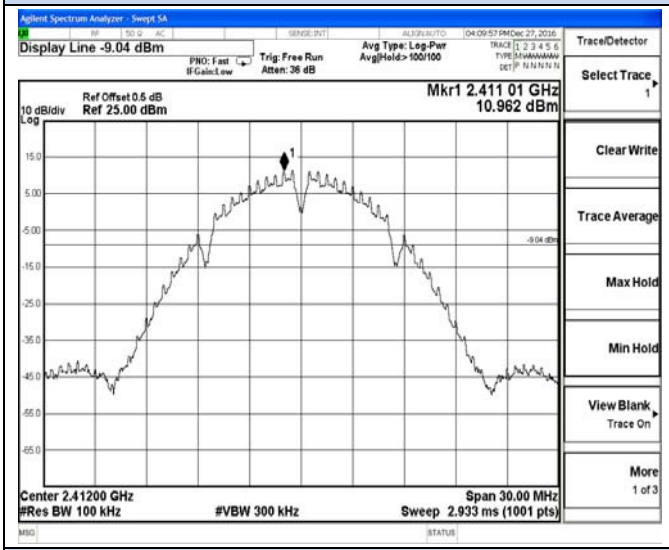


2447 MHz – 2477 MHz

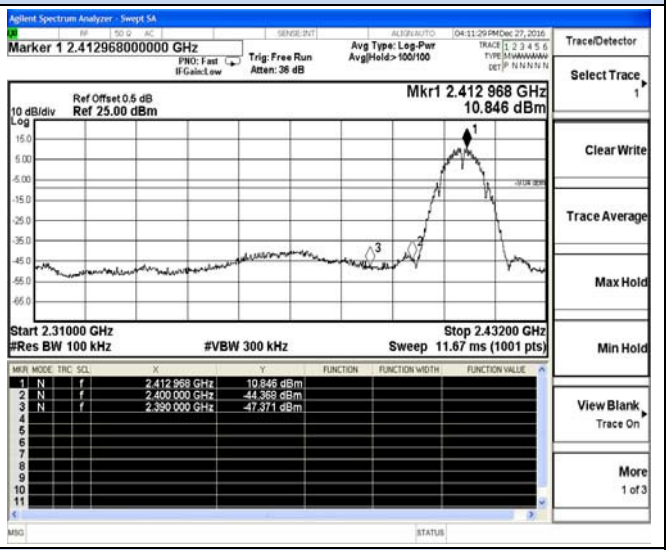


Channel 11 / 2462 MHz

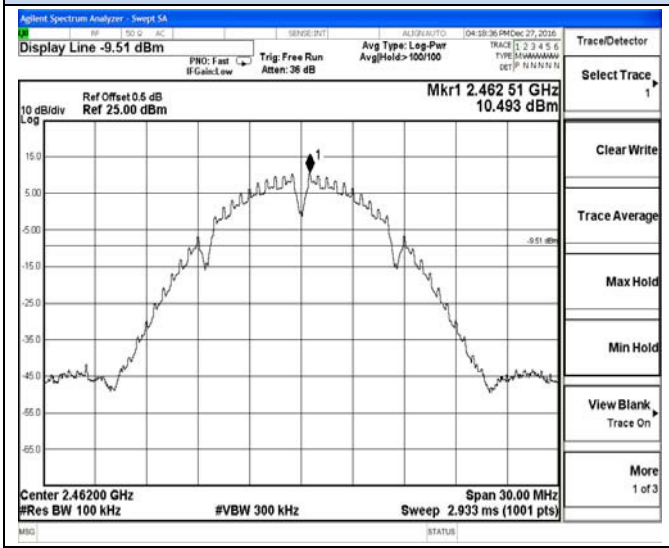
Antenna 2



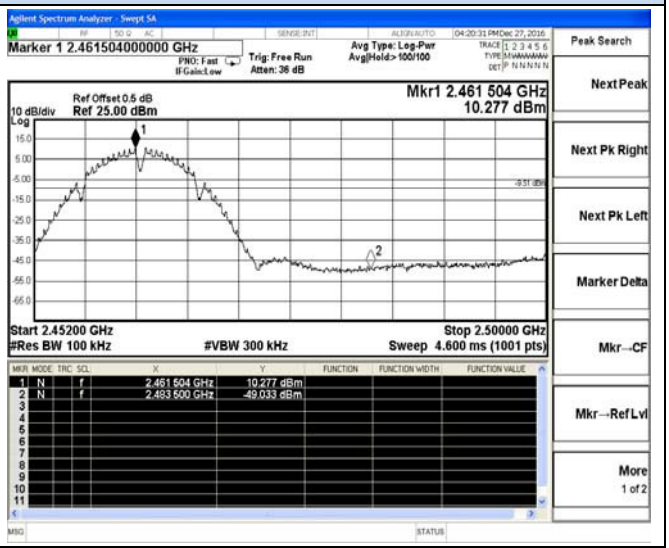
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



2447 MHz – 2477 MHz

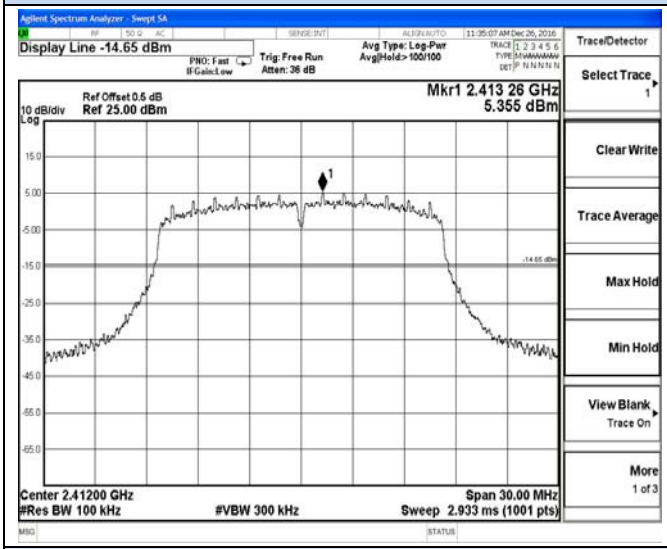


Channel 11 / 2462 MHz

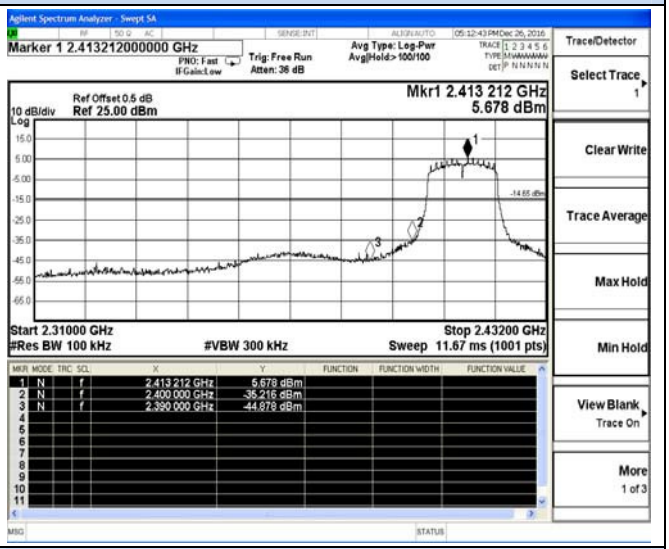
Band-edge measurements for conducted emissions

IEEE 802.11g

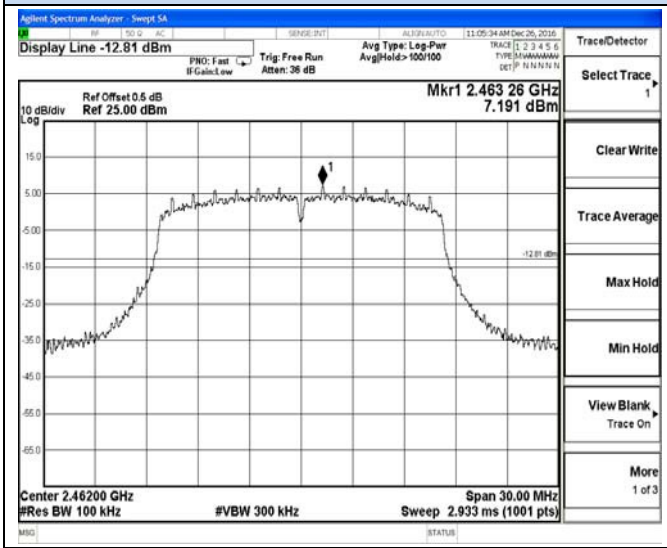
Antenna 0



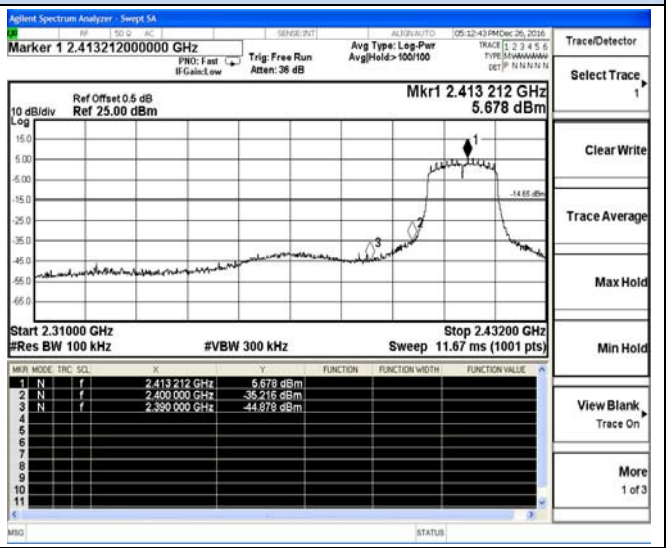
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz

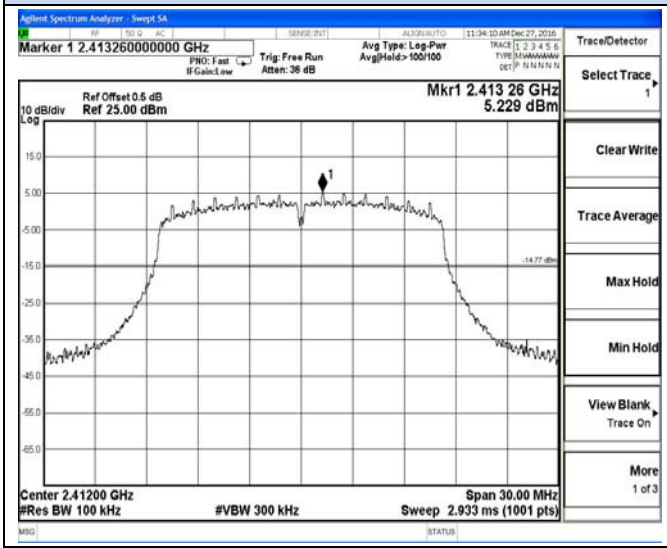


2447 MHz – 2477 MHz

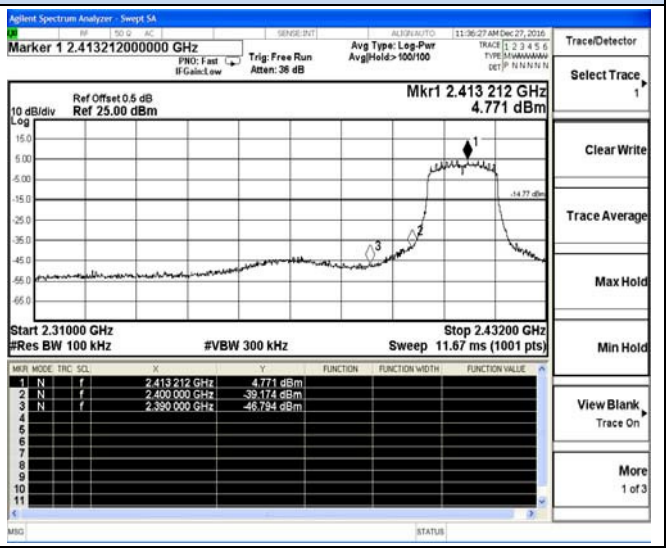


Channel 11 / 2462 MHz

Antenna 1



2397 MHz – 2427 MHz

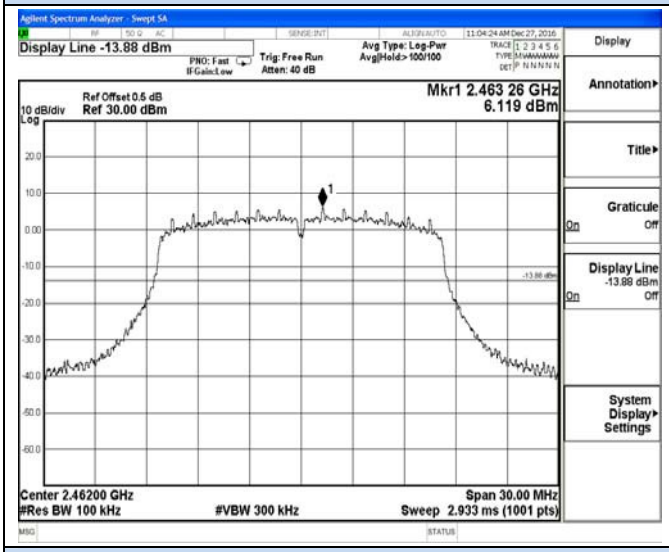


Channel 1 / 2412 MHz

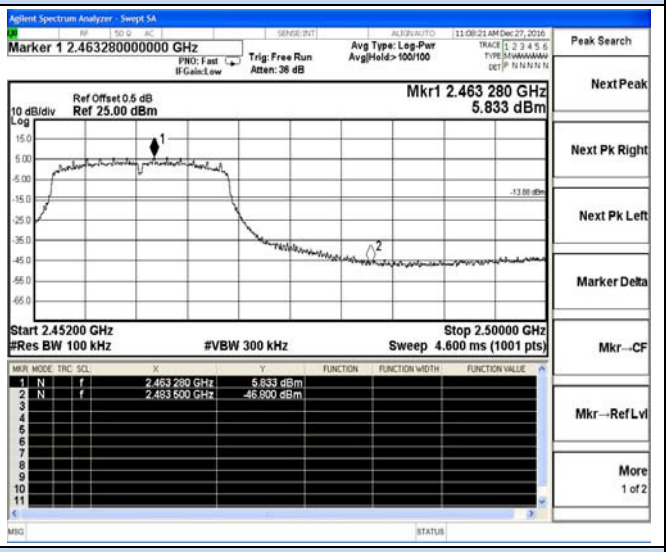
Band-edge measurements for conducted emissions

IEEE 802.11g

Antenna 1

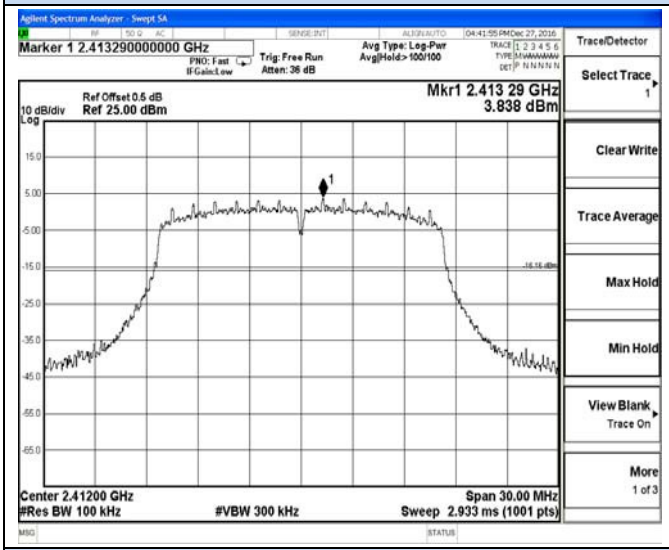


2447 MHz – 2477 MHz

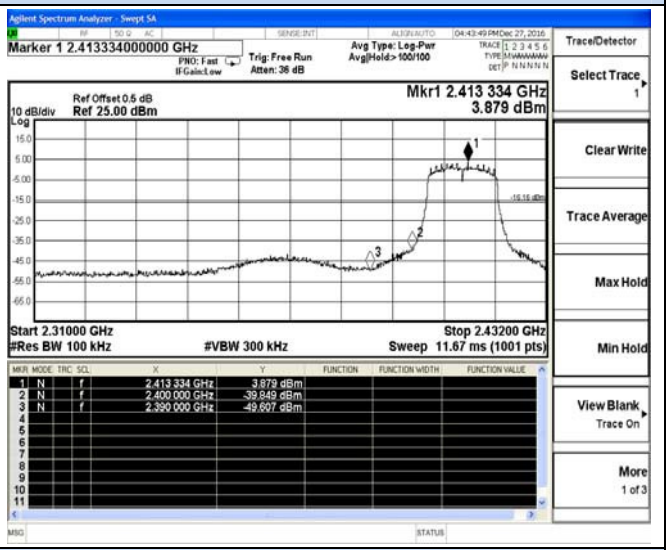


Channel 11 / 2462 MHz

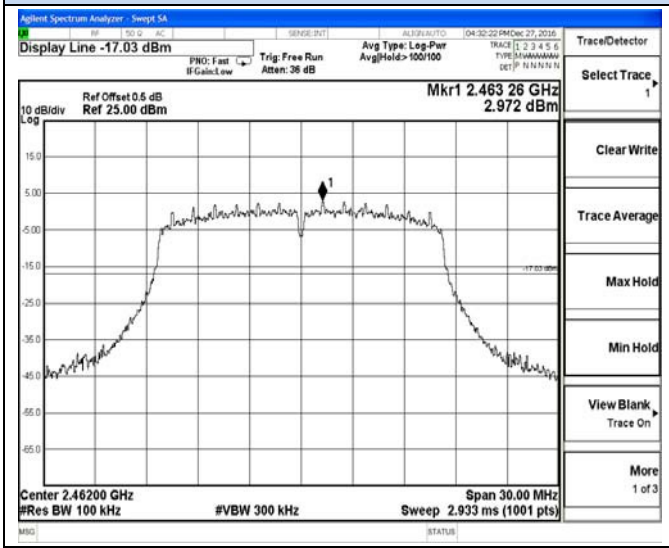
Antenna 2



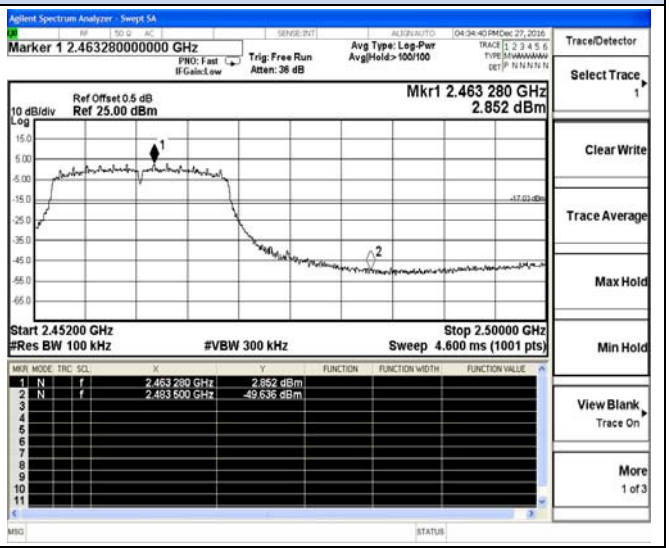
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



2447 MHz – 2477 MHz

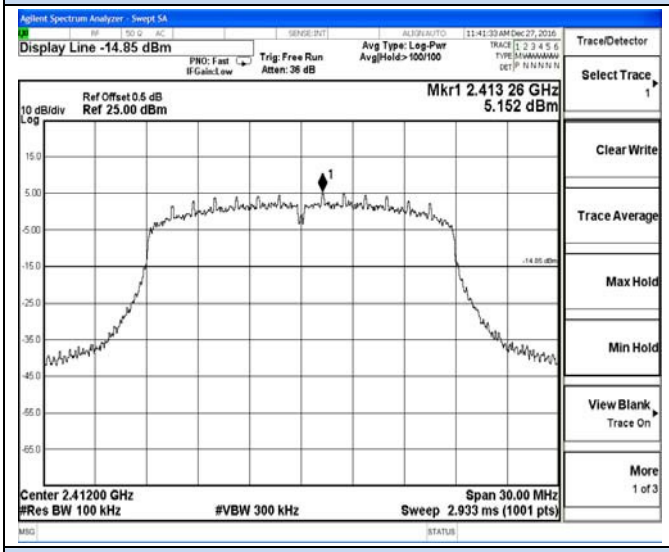


Channel 11 / 2462 MHz

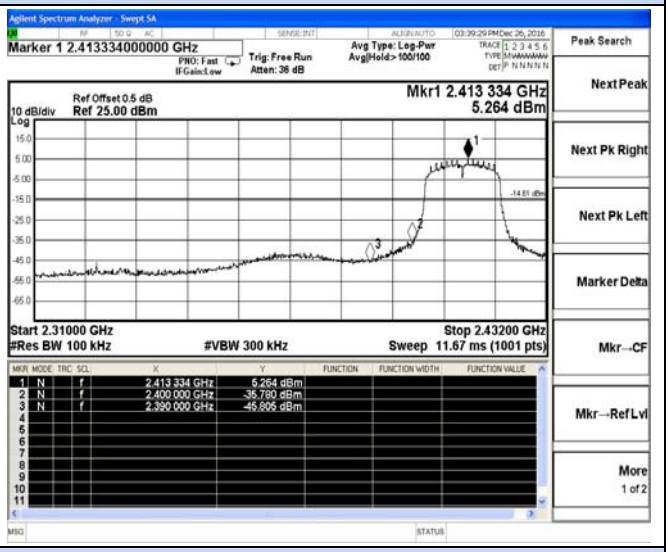
Band-edge measurements for conducted emissions

IEEE 802.11n HT20

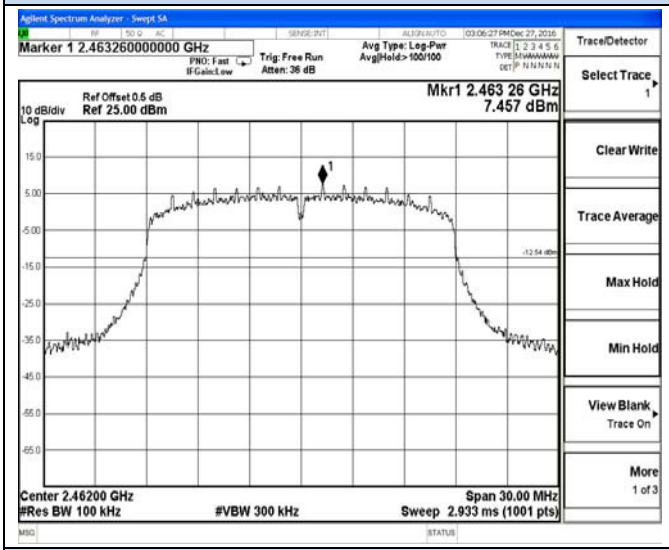
Antenna 0



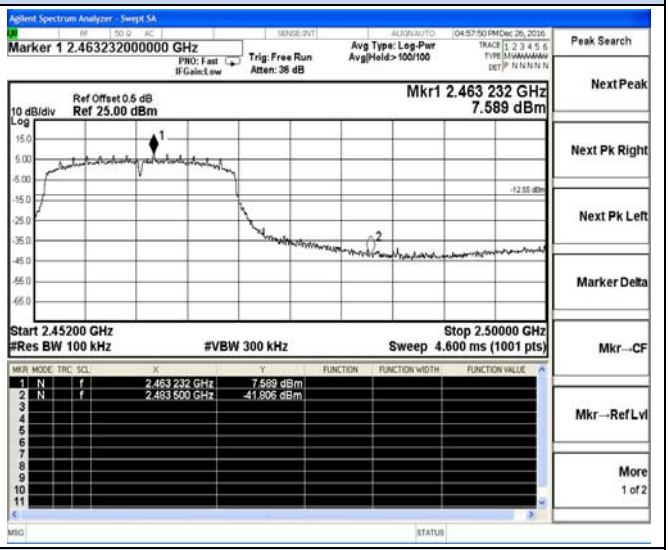
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz

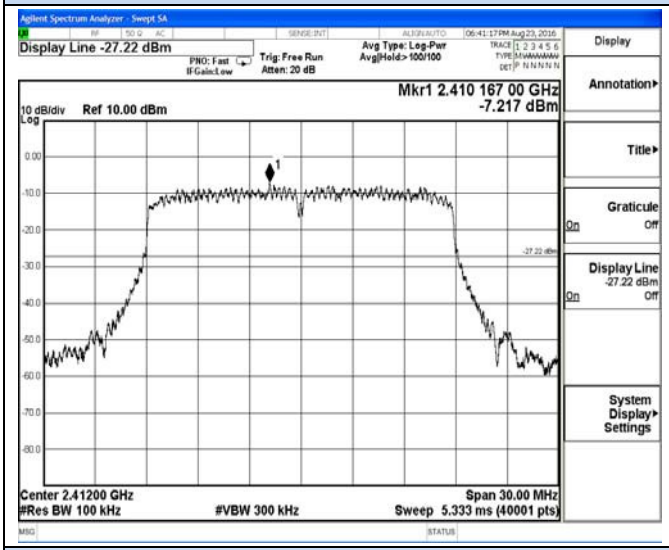


2447 MHz – 2477 MHz

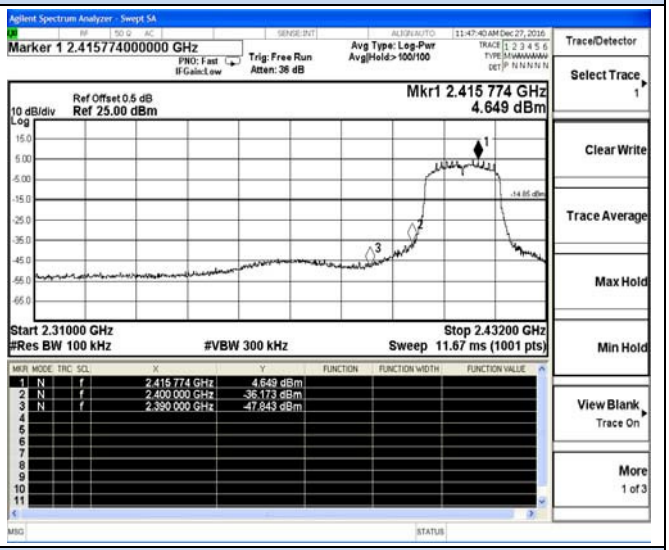


Channel 11 / 2462 MHz

Antenna 1



2397 MHz – 2427 MHz

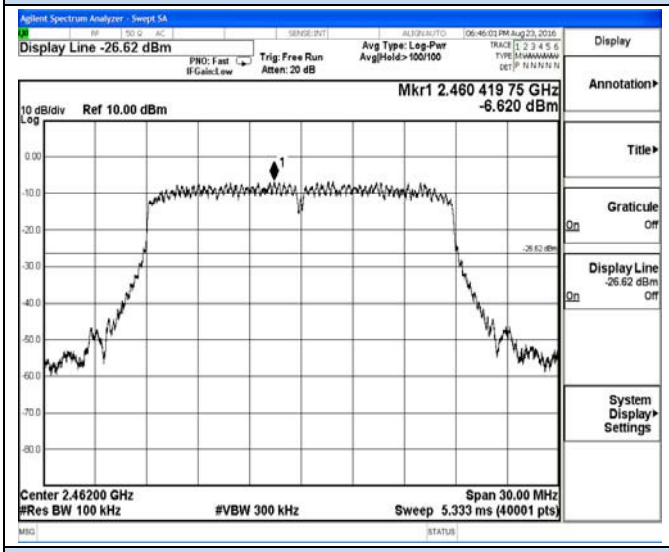


Channel 1 / 2412 MHz

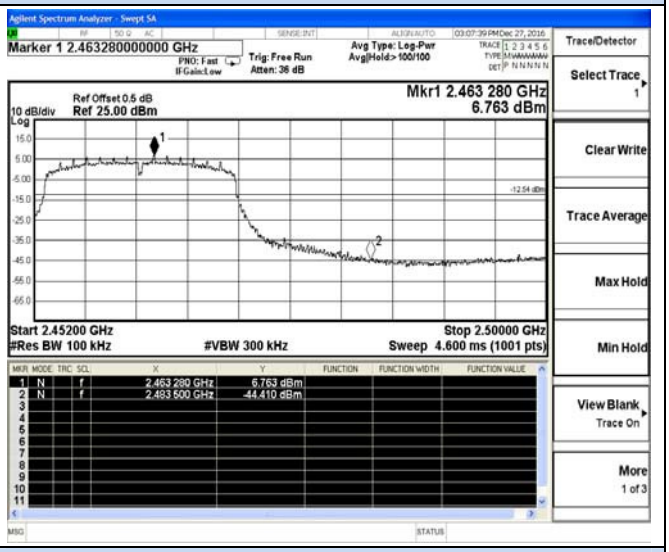
Band-edge measurements for conducted emissions

IEEE 802.11n HT20

Antenna 1

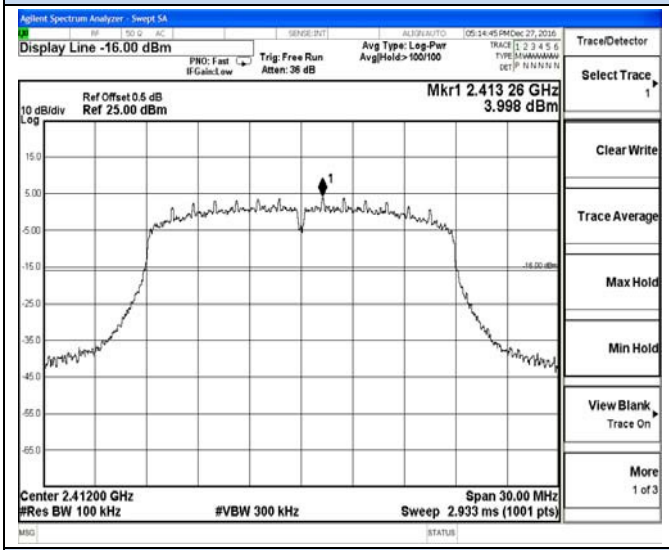


2447 MHz – 2477 MHz

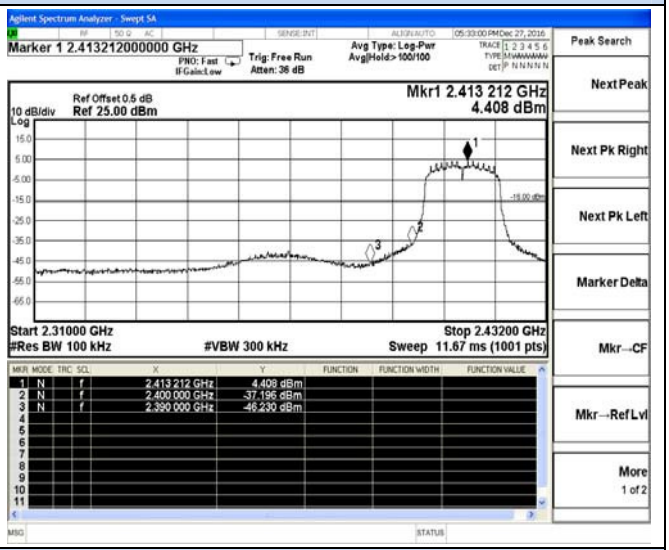


Channel 11 / 2462 MHz

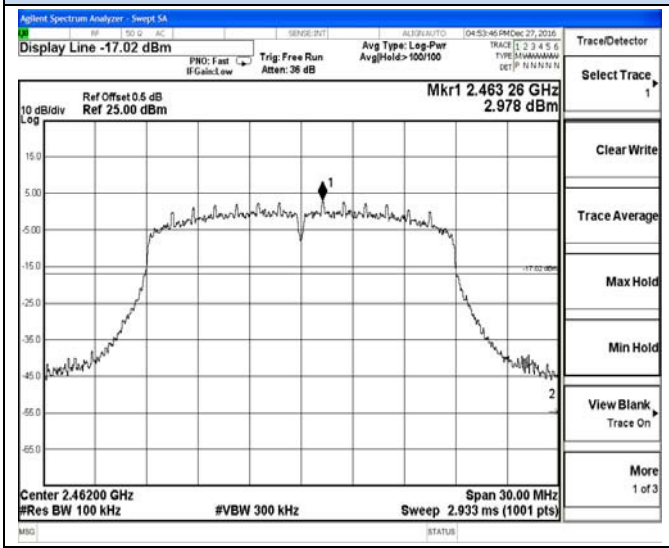
Antenna 2



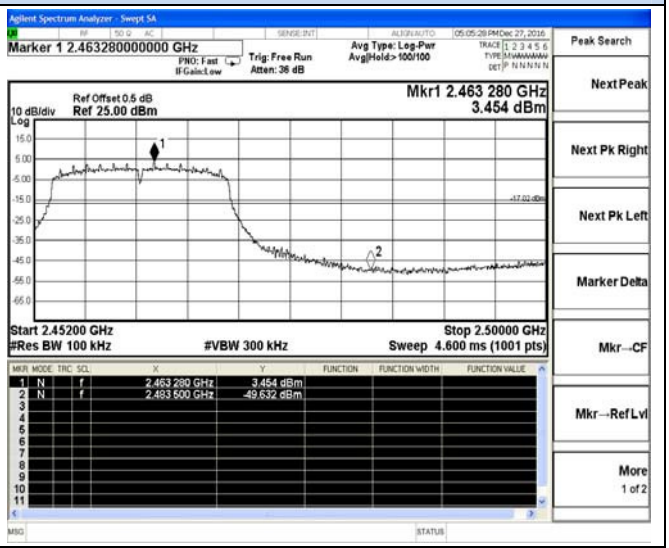
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



2447 MHz – 2477 MHz

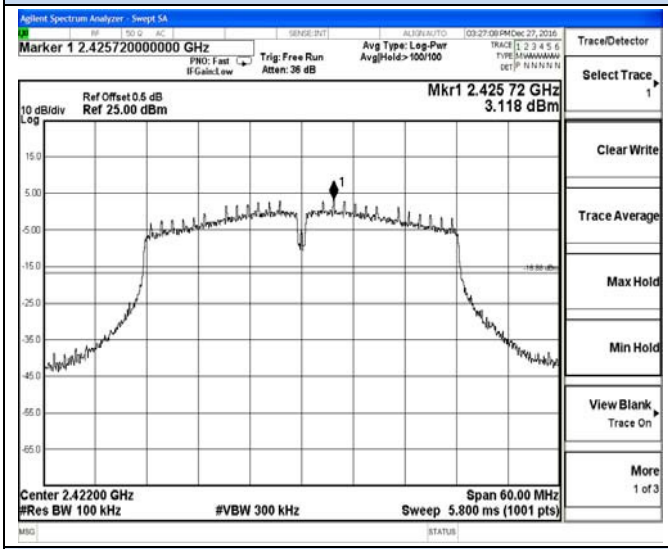


Channel 11 / 2462 MHz

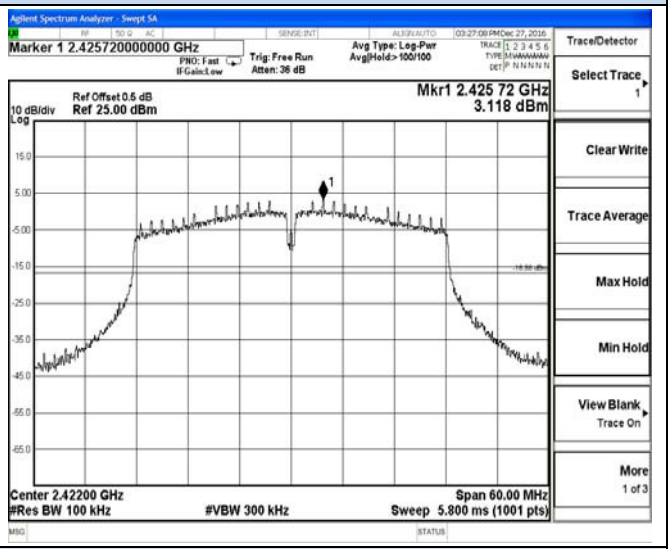
Band-edge measurements for conducted emissions

IEEE 802.11n HT40

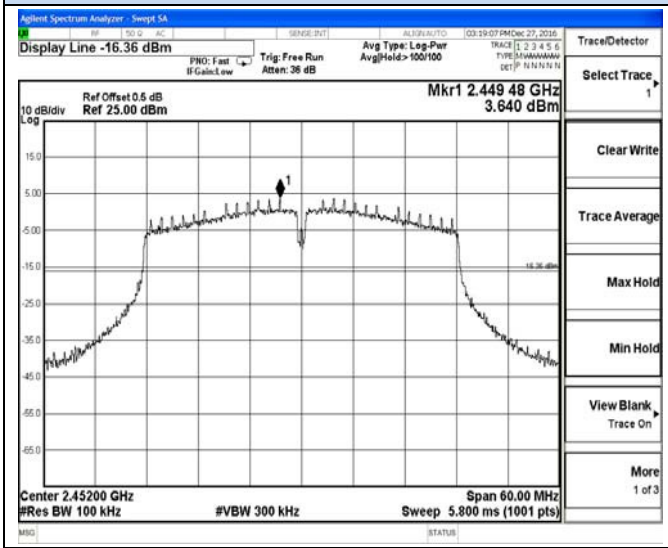
Antenna 0



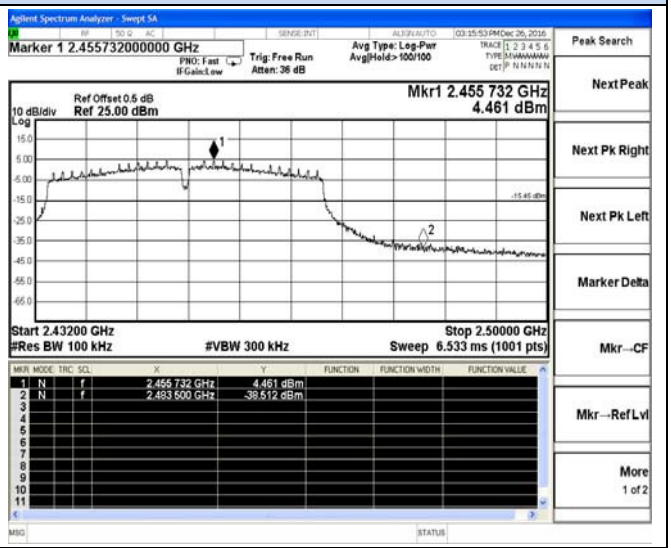
2392 MHz – 2452 MHz



Channel 3 / 2422 MHz

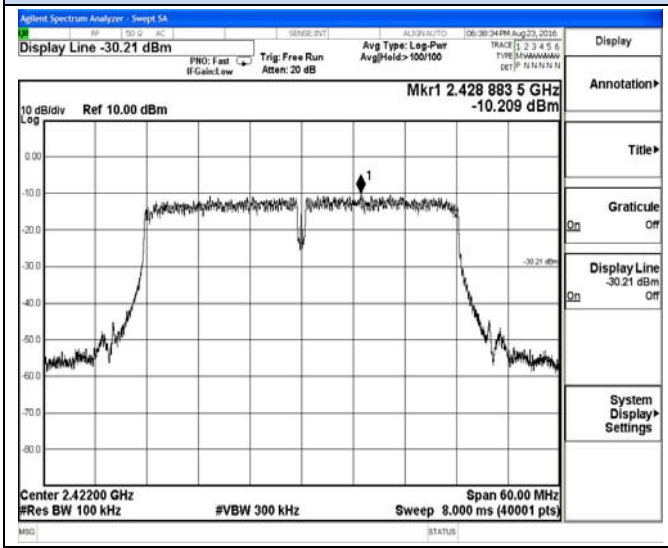


2422 MHz – 2482 MHz

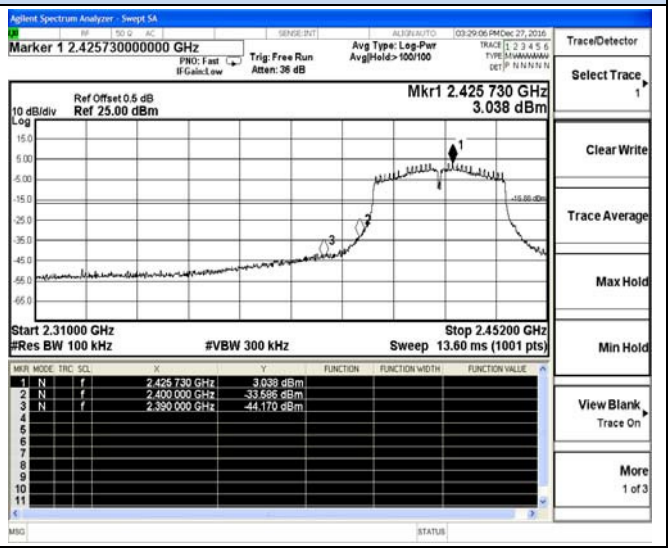


Channel 9 / 2452 MHz

Antenna 1



2392 MHz – 2452 MHz

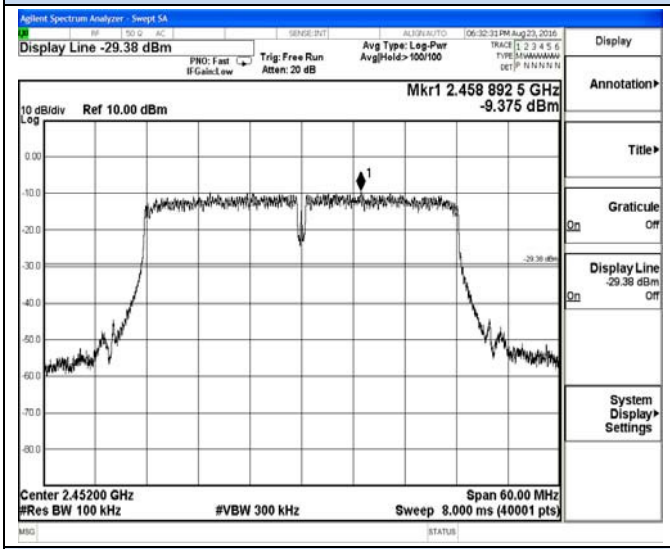


Channel 3 / 2422 MHz

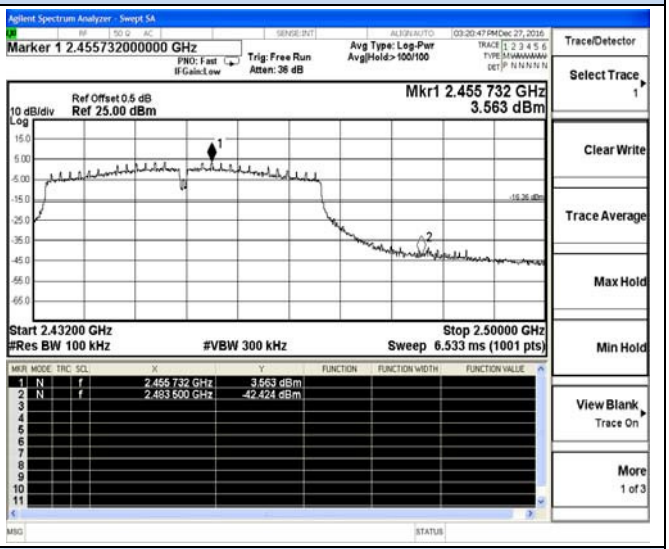
Band-edge measurements for conducted emissions

IEEE 802.11n HT40

Antenna 1

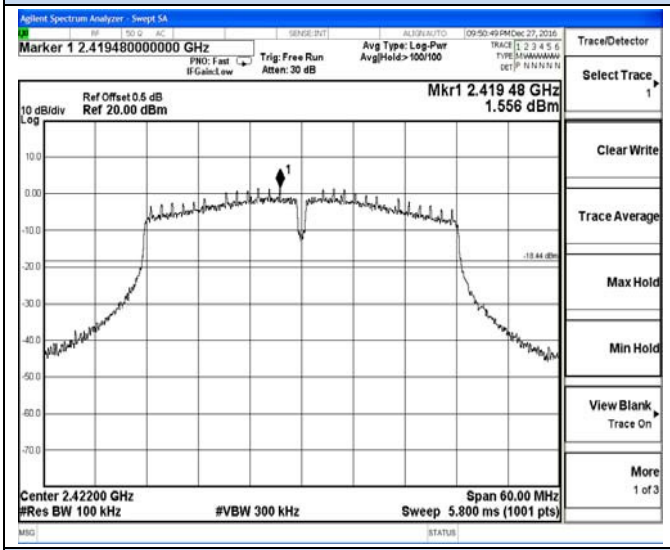


2422 MHz – 2482 MHz

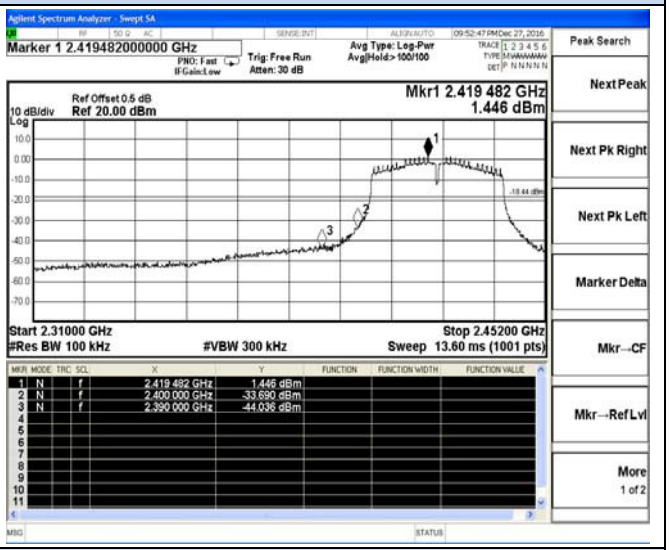


Channel 9 / 2452 MHz

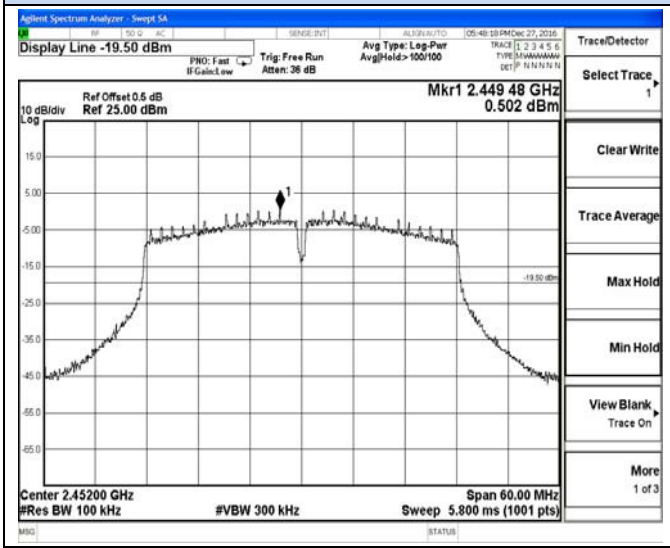
Antenna 1



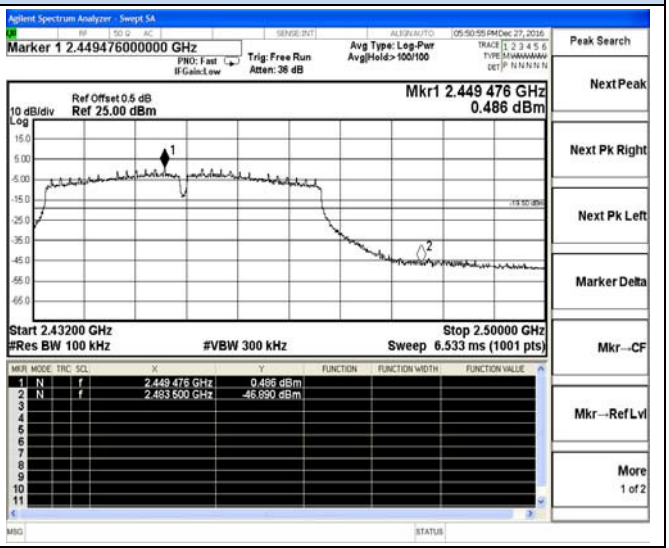
2392 MHz – 2452 MHz



Channel 3 / 2422 MHz



2422 MHz – 2482 MHz



Channel 9 / 2452 MHz

5.7. Power line conducted emissions

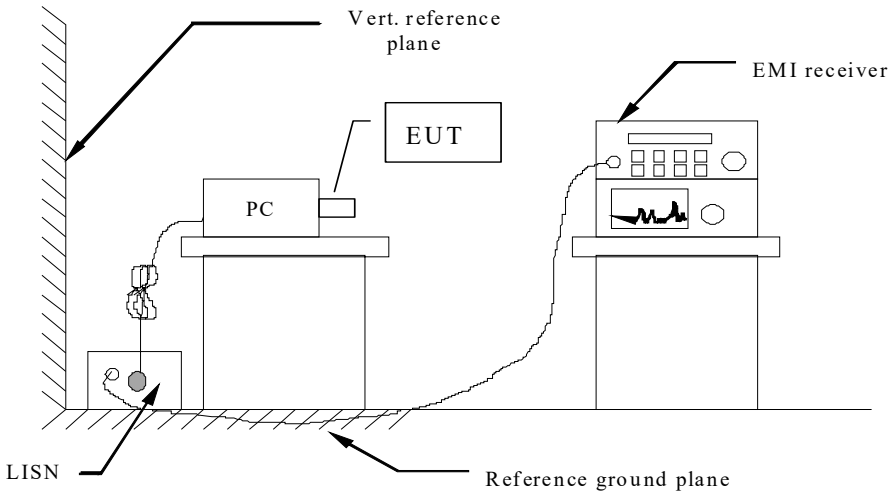
5.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, 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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.7.2 Block Diagram of Test Setup

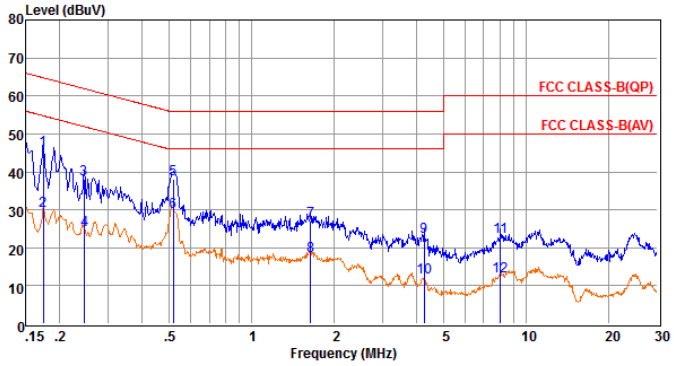


5.7.3 Test Results

PASS.

The test data please refer to following page.

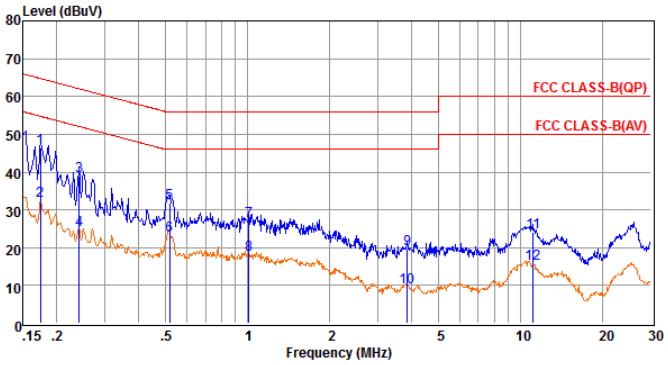
AC Conducted Emission @ AC 120V/60Hz @ IEEE 802.11b



Env. Ins: 24*/56%
Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dBuV	Remark
1	0.17	26.08	9.64	0.02	10.00	45.74	64.77	-19.03	QP
2	0.17	10.18	9.64	0.02	10.00	29.84	54.76	-24.92	Average
3	0.25	18.52	9.60	0.03	10.00	38.15	61.91	-23.76	QP
4	0.25	4.91	9.60	0.03	10.00	24.54	51.90	-27.36	Average
5	0.52	18.48	9.62	0.04	10.00	38.14	56.00	-17.86	QP
6	0.52	9.91	9.62	0.04	10.00	29.57	46.00	-16.43	Average
7	1.64	7.33	9.63	0.05	10.00	27.01	56.00	-28.99	QP
8	1.64	-1.70	9.63	0.05	10.00	17.98	46.00	-28.02	Average
9	4.25	3.21	9.65	0.06	10.00	22.92	56.00	-33.08	QP
10	4.25	-7.45	9.65	0.06	10.00	12.26	46.00	-33.74	Average
11	8.06	3.26	9.70	0.07	10.00	23.03	60.00	-36.97	QP
12	8.06	-7.19	9.70	0.07	10.00	12.58	50.00	-37.42	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

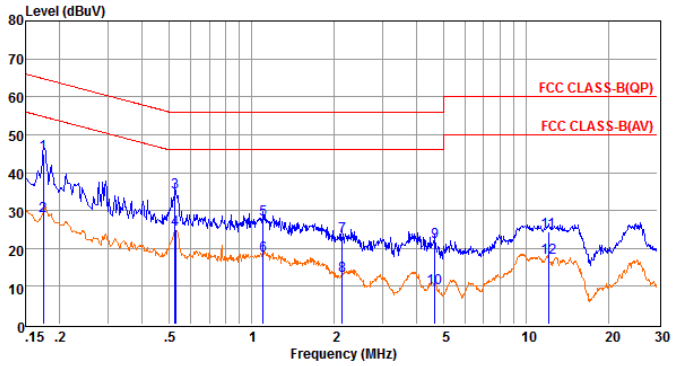


Env. Ins: 24*/56%
Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dBuV	Remark
1	0.17	26.73	9.60	0.02	10.00	46.35	64.77	-18.42	QP
2	0.17	12.73	9.60	0.02	10.00	32.35	54.76	-22.41	Average
3	0.24	19.28	9.63	0.03	10.00	38.94	62.04	-23.10	QP
4	0.24	4.96	9.63	0.03	10.00	24.62	52.04	-27.42	Average
5	0.52	12.29	9.62	0.04	10.00	31.95	56.00	-24.05	QP
6	0.52	3.63	9.62	0.04	10.00	23.29	46.00	-22.71	Average
7	1.01	7.29	9.63	0.05	10.00	26.97	56.00	-29.03	QP
8	1.01	-1.49	9.63	0.05	10.00	18.19	46.00	-27.81	Average
9	3.84	-0.07	9.65	0.06	10.00	19.64	56.00	-36.36	QP
10	3.84	-10.07	9.65	0.06	10.00	9.64	46.00	-36.36	Average
11	11.14	4.28	9.70	0.09	10.00	24.07	60.00	-35.93	QP
12	11.14	-4.10	9.70	0.09	10.00	15.69	50.00	-34.31	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

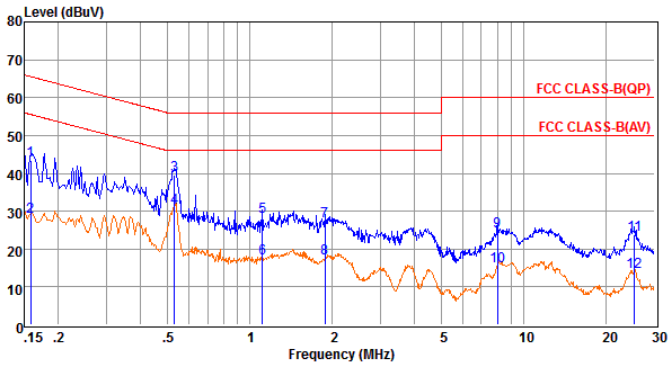
AC Conducted Emission @ AC 240V/50Hz @ IEEE 802.11b



Env. Ins: 24*/56%
Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dBuV	Remark
1	0.17	25.23	9.60	0.02	10.00	44.85	64.77	-19.92	QP
2	0.17	8.83	9.60	0.02	10.00	28.45	54.76	-26.31	Average
3	0.53	15.25	9.62	0.04	10.00	34.91	56.00	-21.09	QP
4	0.53	5.27	9.62	0.04	10.00	24.93	46.00	-21.07	Average
5	1.10	8.09	9.63	0.05	10.00	27.77	56.00	-28.23	QP
6	1.10	-1.51	9.63	0.05	10.00	18.17	46.00	-27.83	Average
7	2.13	3.54	9.64	0.05	10.00	23.23	56.00	-32.77	QP
8	2.13	-6.83	9.64	0.05	10.00	12.86	46.00	-33.14	Average
9	4.65	1.90	9.65	0.06	10.00	21.61	56.00	-34.39	QP
10	4.65	-10.09	9.65	0.06	10.00	9.62	46.00	-36.38	Average
11	12.06	4.65	9.70	0.09	10.00	24.44	60.00	-35.56	QP
12	12.06	-2.15	9.70	0.09	10.00	17.64	50.00	-32.36	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.



Env. Ins: 24*/56%
Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dBuV	Remark
1	0.16	23.86	9.68	0.02	10.00	43.56	65.56	-22.00	QP
2	0.16	8.92	9.68	0.02	10.00	28.62	55.55	-26.93	Average
3	0.53	19.75	9.62	0.04	10.00	39.41	56.00	-16.59	QP
4	0.53	11.40	9.62	0.04	10.00	31.06	46.00	-14.94	Average
5	1.11	8.79	9.63	0.05	10.00	28.47	56.00	-27.53	QP
6	1.11	-2.14	9.63	0.05	10.00	17.54	46.00	-28.46	Average
7	1.88	7.55	9.63	0.05	10.00	27.23	56.00	-28.77	QP
8	1.88	-2.07	9.63	0.05	10.00	17.61	46.00	-28.39	Average
9	8.02	4.96	9.70	0.07	10.00	24.73	60.00	-35.27	QP
10	8.02	-4.18	9.70	0.07	10.00	15.59	50.00	-34.41	Average
11	25.32	3.77	9.83	0.13	10.00	23.73	60.00	-36.27	QP
12	25.32	-5.92	9.83	0.13	10.00	14.04	50.00	-35.96	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

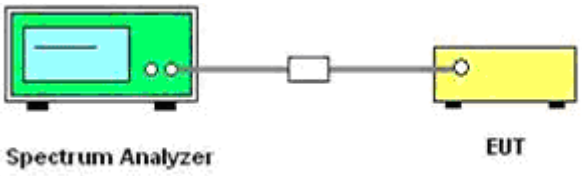
****Note: Pre-scan all modes and recorded the worst case results in this report (IEEE 802.11b).*

5.8 Band-edge measurements for radiated emissions

5.8.1. Standard Applicable

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. 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)).

5.8.2. Test Setup Layout



5.8.3. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.8.4. Test Procedures

According to KDB 558074 D01 V03 for Antenna-port conducted measurement. Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for Peak detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
    $E = EIRP – 20\log D + 104.8$

Where:
E = electric field strength in dBμV/m,
EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

11. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
12. Compare the resultant electric field strength level to the applicable regulatory limit.
13. Perform radiated spurious emission test duress until all measured frequencies were complete.

5.8.5 Test Results

For Antenna Chain 0

IEEE 802.11b								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-53.098	3.780	0.000	45.940	Peak	74.00	-28.060	PASS
2310.000	-67.168	3.780	0.000	31.870	AV	54.00	-22.130	PASS
2390.000	-50.890	3.780	0.000	48.148	Peak	74.00	-25.852	PASS
2390.000	-62.040	3.780	0.000	36.998	AV	54.00	-17.002	PASS
2413.517	4.140	3.780	0.000	103.178	Peak	---	---	PASS
2413.297	1.984	3.780	0.000	101.022	AV	---	---	PASS
2460.856	8.570	3.780	0.000	107.608	Peak	---	---	PASS
2461.206	6.903	3.780	0.000	105.941	AV	---	---	PASS
2483.500	-50.826	3.780	0.000	48.212	Peak	74.00	-25.788	PASS
2483.500	-55.603	3.780	0.000	43.435	AV	54.00	-10.565	PASS
2500.000	-50.846	3.780	0.000	48.192	Peak	74.00	-25.808	PASS
2500.000	-62.592	3.780	0.000	36.446	AV	54.00	-17.554	PASS

IEEE 802.11g								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Limit (dBuV/m)	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-52.160	3.780	0.000	46.878	Peak	74.00	-27.122	PASS
2310.000	-67.046	3.780	0.000	31.992	AV	54.00	-22.008	PASS
2390.000	-42.652	3.780	0.000	56.386	Peak	74.00	-17.614	PASS
2390.000	-54.262	3.780	0.000	44.776	AV	54.00	-9.224	PASS
2419.117	7.472	3.780	0.000	106.510	Peak	---	---	PASS
2418.373	-0.247	3.780	0.000	98.791	AV	---	---	PASS
2463.136	7.843	3.780	0.000	106.881	Peak	---	---	PASS
2462.934	0.423	3.780	0.000	99.461	AV	---	---	PASS
2483.500	-43.750	3.780	0.000	55.288	Peak	74.00	-18.712	PASS
2483.500	-54.613	3.780	0.000	44.425	AV	54.00	-9.575	PASS
2484.873	-44.145	3.780	0.000	54.893	Peak	74.00	-19.107	PASS
2500.000	-48.824	3.780	0.000	50.214	Peak	74.00	-23.786	PASS
2500.000	-58.975	3.780	0.000	40.063	AV	54.00	-13.937	PASS

IEEE 802.11 n HT20								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-56.231	3.780	0.000	42.807	Peak	74.00	-31.193	PASS
2310.000	-67.571	3.780	0.000	31.467	AV	54.00	-22.533	PASS
2390.000	-42.314	3.780	0.000	56.724	Peak	74.00	-17.276	PASS
2390.000	-56.794	3.780	0.000	42.244	AV	54.00	-11.756	PASS
2419.776	2.841	3.780	0.000	101.879	Peak	---	---	PASS
2419.983	-5.292	3.780	0.000	93.746	AV	---	---	PASS
2460.856	2.283	3.780	0.000	101.321	Peak	---	---	PASS
2460.645	-5.725	3.780	0.000	93.313	AV	---	---	PASS
2483.500	-49.756	3.780	0.000	49.282	Peak	74.00	-24.718	PASS
2483.500	-57.576	3.780	0.000	41.462	AV	54.00	-12.538	PASS
2485.696	-46.911	3.780	0.000	52.127	Peak	74.00	-21.873	PASS
2500.000	-54.999	3.780	0.000	44.039	Peak	74.00	-29.961	PASS
2500.000	-64.074	3.780	0.000	34.964	AV	54.00	-19.036	PASS

IEEE 802.11n HT40								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-58.403	3.780	0.000	40.635	Peak	74.00	-33.365	PASS
2310.000	-67.739	3.780	0.000	31.299	AV	54.00	-22.701	PASS
2390.000	-50.389	3.780	0.000	48.649	Peak	74.00	-25.351	PASS
2390.000	-57.779	3.780	0.000	41.259	AV	54.00	-12.741	PASS
2424.642	2.082	3.780	0.000	101.120	Peak	---	---	PASS
2424.352	-5.923	3.780	0.000	93.115	AV	---	---	PASS
2462.165	-0.375	3.780	0.000	98.663	Peak	---	---	PASS
2461.315	-7.568	3.780	0.000	91.470	AV	---	---	PASS
2483.500	-50.160	3.780	0.000	48.878	Peak	74.00	-25.122	PASS
2483.500	-55.192	3.780	0.000	43.846	AV	54.00	-10.154	PASS
2487.889	-47.991	3.780	0.000	51.047	Peak	74.00	-22.953	PASS
2500.000	-53.338	3.780	0.000	45.700	Peak	74.00	-28.300	PASS
2500.000	-61.675	3.780	0.000	37.363	AV	54.00	-16.637	PASS

For Antenna Chain 1

IEEE 802.11b								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-52.780	3.780	0.000	46.258	Peak	74.00	-27.742	PASS
2310.000	-67.176	3.780	0.000	31.862	AV	54.00	-22.138	PASS
2372.732	-48.244	3.780	0.000	50.794	Peak	74.00	-23.206	PASS
2390.000	-50.477	3.780	0.000	48.561	Peak	74.00	-25.439	PASS
2390.000	-62.105	3.780	0.000	36.933	AV	54.00	-17.067	PASS
2413.456	4.142	3.780	0.000	103.180	Peak	---	---	PASS
2413.310	1.985	3.780	0.000	101.023	AV	---	---	PASS
2460.880	8.581	3.780	0.000	107.619	Peak	---	---	PASS
2461.211	6.960	3.780	0.000	105.998	AV	---	---	PASS
2483.500	-51.044	3.780	0.000	47.994	Peak	74.00	-26.006	PASS
2483.500	-55.028	3.780	0.000	44.010	AV	54.00	-9.990	PASS
2487.561	-48.712	3.780	0.000	50.326	Peak	74.00	-23.674	PASS
2500.000	-50.742	3.780	0.000	48.296	Peak	74.00	-25.704	PASS
2500.000	-61.529	3.780	0.000	37.509	AV	54.00	-16.491	PASS

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IEEE 802.11g								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-51.807	3.780	0.000	47.231	Peak	74.00	-26.769	PASS
2310.000	-66.815	3.780	0.000	32.223	AV	54.00	-21.777	PASS
2390.000	-43.265	3.780	0.000	55.773	Peak	74.00	-18.227	PASS
2390.000	-54.142	3.780	0.000	44.896	AV	54.00	-9.104	PASS
2419.117	7.488	3.780	0.000	106.526	Peak	---	---	PASS
2418.458	-0.228	3.780	0.000	98.810	AV	---	---	PASS
2463.136	7.844	3.780	0.000	106.882	Peak	---	---	PASS
2463.002	0.775	3.780	0.000	99.813	AV	---	---	PASS
2483.500	-43.753	3.780	0.000	55.285	Peak	74.00	-18.715	PASS
2483.500	-53.208	3.780	0.000	45.830	AV	54.00	-8.170	PASS
2484.873	-44.144	3.780	0.000	54.894	Peak	74.00	-19.106	PASS
2500.000	-48.828	3.780	0.000	50.210	Peak	74.00	-23.79	PASS
2500.000	-58.831	3.780	0.000	40.207	AV	54.00	-13.793	PASS

IEEE 802.11 n HT20								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-55.273	3.780	0.000	43.765	Peak	74.00	-30.235	PASS
2310.000	-68.017	3.780	0.000	31.021	AV	54.00	-22.979	PASS
2390.000	-43.091	3.780	0.000	55.947	Peak	74.00	-18.053	PASS
2390.000	-56.972	3.780	0.000	42.066	AV	54.00	-11.934	PASS
2419.702	2.774	3.780	0.000	101.812	Peak	---	---	PASS
2419.971	-5.292	3.780	0.000	93.746	AV	---	---	PASS
2460.779	2.255	3.780	0.000	101.293	Peak	---	---	PASS
2460.539	-5.569	3.780	0.000	93.469	AV	---	---	PASS
2483.500	-49.961	3.780	0.000	49.077	Peak	74.00	-24.923	PASS
2483.500	-58.404	3.780	0.000	40.634	AV	54.00	-13.366	PASS
2487.955	-48.406	3.780	0.000	50.632	Peak	74.00	-23.368	PASS
2500.000	-53.856	3.780	0.000	45.182	Peak	74.00	-28.818	PASS
2500.000	-63.820	3.780	0.000	35.218	AV	54.00	-18.782	PASS

IEEE 802.11 n HT40								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-59.198	3.780	0.000	39.840	Peak	74.00	-34.16	PASS
2310.000	-67.956	3.780	0.000	31.082	AV	54.00	-22.918	PASS
2390.000	-50.632	3.780	0.000	48.406	Peak	74.00	-25.594	PASS
2390.000	-57.839	3.780	0.000	41.199	AV	54.00	-12.801	PASS
2424.550	1.966	3.780	0.000	101.004	Peak	---	---	PASS
2424.523	-5.094	3.780	0.000	93.944	AV	---	---	PASS
2462.219	0.231	3.780	0.000	99.269	Peak	---	---	PASS
2461.573	-7.613	3.780	0.000	91.425	AV	---	---	PASS
2483.500	-50.347	3.780	0.000	48.691	Peak	74.00	-25.309	PASS
2483.500	-55.570	3.780	0.000	43.468	AV	54.00	-10.532	PASS
2500.000	-54.490	3.780	0.000	44.548	Peak	74.00	-29.452	PASS
2500.000	-61.944	3.780	0.000	37.094	AV	54.00	-16.906	PASS

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For Antenna Chain 2

IEEE 802.11b								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-54.506	3.780	0.000	44.532	Peak	74.00	-29.468	PASS
2310.000	-67.150	3.780	0.000	31.888	AV	54.00	-22.112	PASS
2390.000	-49.906	3.780	0.000	49.132	Peak	74.00	-24.868	PASS
2390.000	-62.061	3.780	0.000	36.977	AV	54.00	-17.023	PASS
2413.383	6.325	3.780	0.000	105.363	Peak	---	---	PASS
2413.310	1.984	3.780	0.000	101.022	AV	---	---	PASS
2461.998	8.783	3.780	0.000	107.821	Peak	---	---	PASS
2461.206	6.919	3.780	0.000	105.957	AV	---	---	PASS
2483.500	-49.970	3.780	0.000	49.068	Peak	74.00	-24.932	PASS
2483.500	-55.629	3.780	0.000	43.409	AV	54.00	-10.591	PASS
2488.272	-49.103	3.780	0.000	49.935	Peak	74.00	-24.065	PASS
2500.000	-50.576	3.780	0.000	48.462	Peak	74.00	-25.538	PASS
2500.000	-61.522	3.780	0.000	37.516	AV	54.00	-16.484	PASS

IEEE 802.11g								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-52.456	3.780	0.000	46.582	Peak	74.00	-27.418	PASS
2310.000	-66.744	3.780	0.000	32.294	AV	54.00	-21.706	PASS
2390.000	-43.366	3.780	0.000	55.672	Peak	74.00	-18.328	PASS
2390.000	-54.100	3.780	0.000	44.938	AV	54.00	-9.062	PASS
2419.129	7.476	3.780	0.000	106.514	Peak	---	---	PASS
2418.495	-0.238	3.780	0.000	98.800	AV	---	---	PASS
2463.136	7.840	3.780	0.000	106.878	Peak	---	---	PASS
2463.011	0.608	3.780	0.000	99.646	AV	---	---	PASS
2483.500	-43.754	3.780	0.000	55.284	Peak	74.00	-18.716	PASS
2483.500	-53.990	3.780	0.000	45.048	AV	54.00	-8.952	PASS
2484.873	-44.147	3.780	0.000	54.891	Peak	74.00	-19.109	PASS
2500.000	-48.822	3.780	0.000	50.216	Peak	74.00	-23.784	PASS
2500.000	-58.683	3.780	0.000	40.355	AV	54.00	-13.645	PASS

IEEE 802.11n HT20								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-55.667	3.780	0.000	43.371	Peak	74.00	-30.629	PASS
2310.000	-56.965	3.780	0.000	42.073	AV	54.00	-11.927	PASS
2371.000	-53.061	3.780	0.000	45.977	AV	54.00	-8.023	PASS
2390.000	-40.475	3.780	0.000	58.563	Peak	74.00	-15.437	PASS
2390.000	-54.931	3.780	0.000	44.107	AV	54.00	-9.893	PASS
2419.800	2.808	3.780	0.000	101.846	Peak	---	---	PASS
2413.384	-10.152	3.780	0.000	88.886	AV	---	---	PASS
2460.899	2.255	3.780	0.000	101.293	Peak	---	---	PASS
2460.515	-5.569	3.780	0.000	93.469	AV	---	---	PASS
2483.500	-49.961	3.780	0.000	49.077	Peak	74.00	-24.923	PASS
2483.500	-58.404	3.780	0.000	40.634	AV	54.00	-13.366	PASS
2487.955	-48.406	3.780	0.000	50.632	Peak	74.00	-23.368	PASS
2500.000	-53.856	3.780	0.000	45.182	Peak	74.00	-28.818	PASS
2500.000	-63.820	3.780	0.000	35.218	AV	54.00	-18.782	PASS

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IEEE 802.11n HT40								
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
2310.000	-59.198	3.780	0.000	39.840	Peak	74.00	-34.160	PASS
2310.000	-67.956	3.780	0.000	31.082	AV	54.00	-22.918	PASS
2390.000	-50.632	3.780	0.000	48.406	Peak	74.00	-25.594	PASS
2390.000	-57.839	3.780	0.000	41.199	AV	54.00	-12.801	PASS
2424.695	1.966	3.780	0.000	101.004	Peak	---	---	PASS
2424.312	-5.904	3.780	0.000	93.134	AV	---	---	PASS
2462.240	-0.197	3.780	0.000	98.841	Peak	---	---	PASS
2461.322	-7.580	3.780	0.000	91.458	AV	---	---	PASS
2483.500	-51.013	3.780	0.000	48.025	Peak	74.00	-25.975	PASS
2483.500	-55.480	3.780	0.000	43.558	AV	54.00	-10.442	PASS
2487.998	-48.118	3.780	0.000	50.920	Peak	74.00	-23.080	PASS
2500.000	-54.824	3.780	0.000	44.214	Peak	74.00	-29.786	PASS
2500.000	-61.820	3.780	0.000	37.218	AV	54.00	-16.782	PASS

For Combined Antenna Chain 0, Antenna Chain 1 and Antenna Chain 2

IEEE 802.11n HT20											
Frequency (MHz)	Conducted Power (dBm)				Directional Gain (dB)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
	Antenna 0	Antenna 1	Antenna 2	Sum							
2310.000*	-56.231	-55.273	-55.667	-50.935	8.551*	0.000	52.874	Peak	74.00	-21.126	PASS
2310.000	-67.571	-68.017	-53.061	-52.778	8.551*	0.000	51.031	AV	54.00	-2.969	PASS
2390.000	-42.314	-43.091	-40.475	-37.046	8.551*	0.000	66.763	Peak	74.00	-7.237	PASS
2390.000	-56.794	-56.972	-54.931	-51.359	8.551*	0.000	52.450	AV	54.00	-1.550	PASS
2483.500*	-46.911	-48.406	-48.406	-43.077	8.551*	0.000	60.732	Peak	74.00	-13.268	PASS
2483.500	-57.576	-58.404	-58.404	-53.339	8.551*	0.000	50.470	AV	54.00	-3.530	PASS
2500.000	-54.999	-53.856	-53.856	-49.433	8.551*	0.000	54.376	Peak	74.00	-19.624	PASS
2500.000	-64.074	-63.820	-63.820	-59.132	8.551*	0.000	44.677	AV	54.00	-9.323	PASS

IEEE 802.11n HT40											
Frequency (MHz)	Conducted Power (dBm)				Directional Gain (dB)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Over limit dB	Verdict
	Antenna 0	Antenna 1	Antenna 2	Sum							
2310.000*	-58.403	-59.198	-59.198	-54.145	8.551*	0.000	49.664	Peak	74.00	-24.336	PASS
2310.000	-67.739	-67.956	-67.956	-63.111	8.551*	0.000	40.698	AV	54.00	-13.302	PASS
2390.000	-50.389	-50.632	-50.632	-45.778	8.551*	0.000	58.031	Peak	74.00	-15.969	PASS
2390.000	-57.779	-57.839	-57.839	-53.048	8.551*	0.000	50.761	AV	54.00	-3.239	PASS
2483.500*	-47.991	-50.347	-48.118	-43.921	8.551*	0.000	59.888	Peak	74.00	-14.112	PASS
2483.500	-55.192	-55.570	-55.480	-50.640	8.551*	0.000	53.169	AV	54.00	-0.831	PASS
2500.000	-53.338	-54.490	-54.824	-49.398	8.551*	0.000	54.411	Peak	74.00	-19.589	PASS
2500.000	-61.675	-61.944	-61.820	-57.040	8.551*	0.000	46.769	AV	54.00	-7.231	PASS

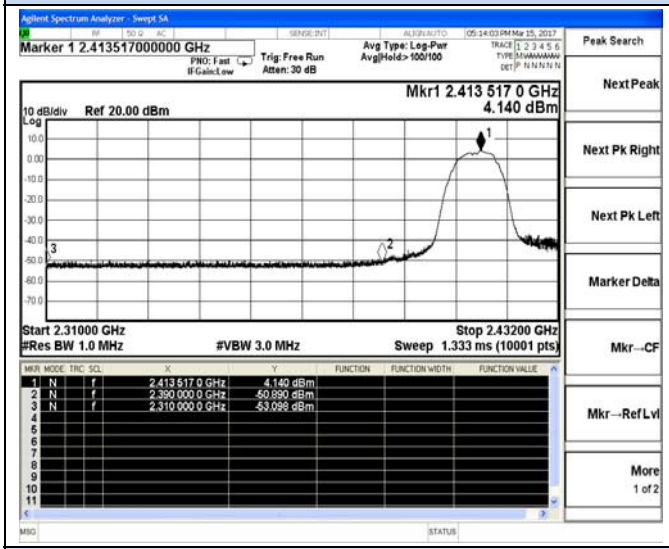
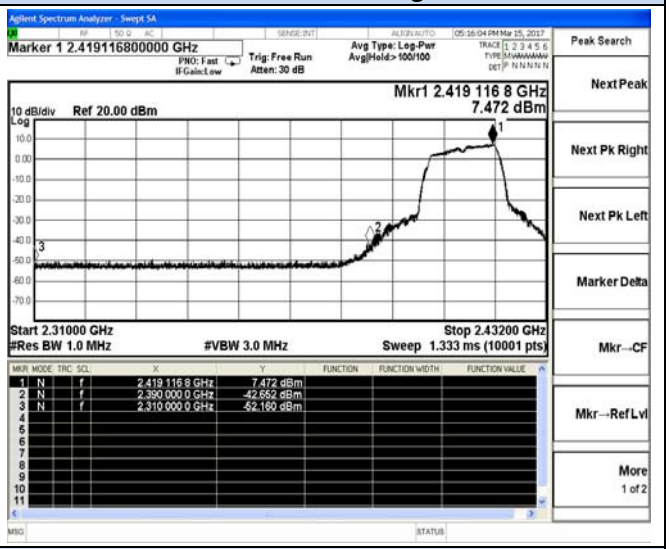
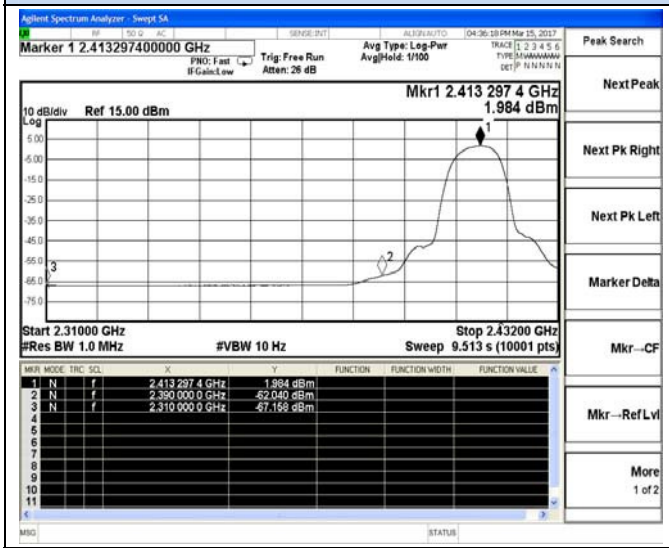
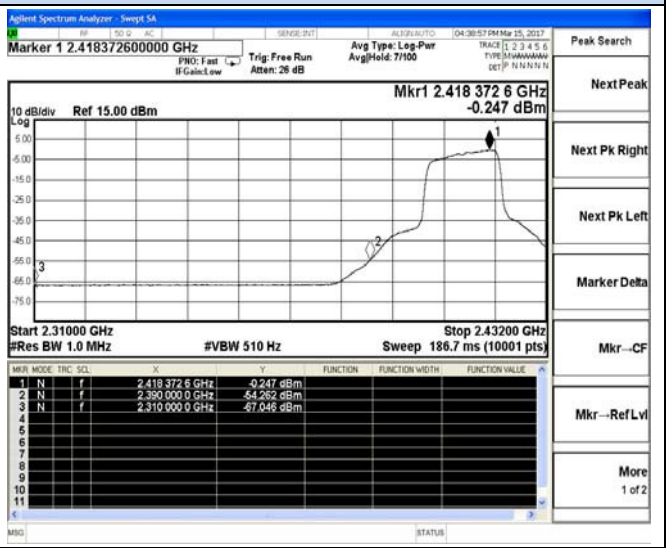
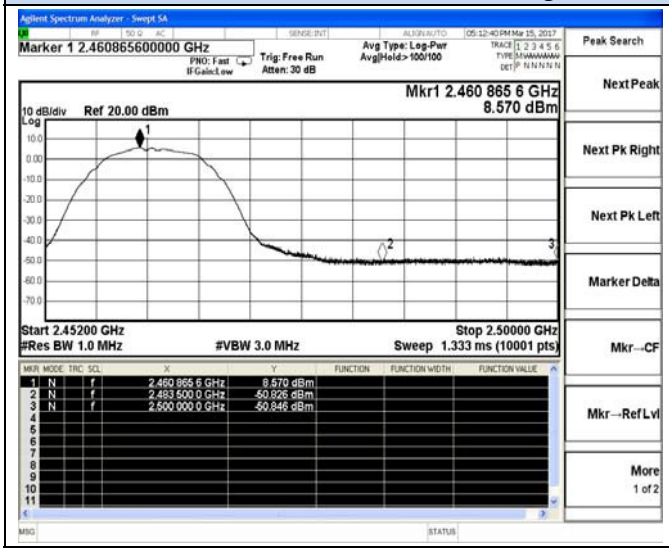
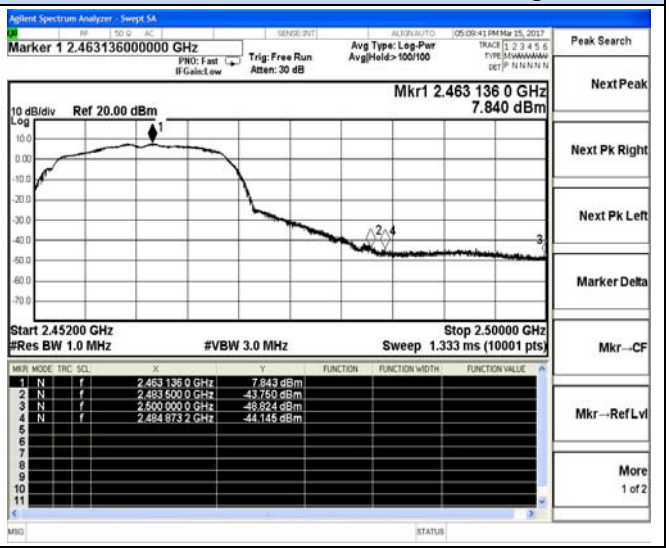
Remark:

1. *Measured Band-edge measurements for radiated emissions at difference data rate for each mode and recorded worst case for each mode.*
2. *Test results including cable loss;*
3. *Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;*
4. *"---"means that the fundamental frequency not for 15.209 limits requirement.*
5. *No need measure Average values if Peak values meets Average limits;*
6. ** means maximum values of frequency band 2310 – 2390 MHz, 2483.5 – 2500 MHz;*

7. *For MIMO with CCD technology device, The Directional Gain= Gain of individual transmit antennas (dBi) + Array gain;*
   Array gain = 10 log (N_{ant}), where N_{ant} is the number of transmit antennas.
8. **8.551=3.780+10*log(3).*
9. *Covert Radiated E Level At 3m = Conducted average power + Directional Gain + 104.77-20*log(3);*
10. *Please refer to following plots;*

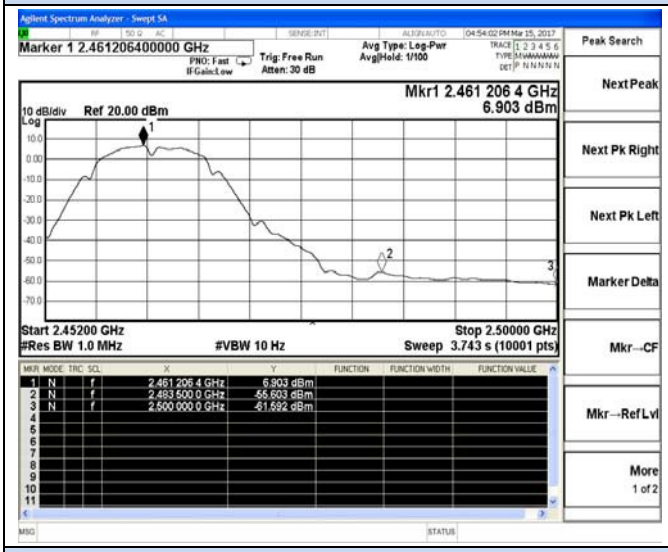
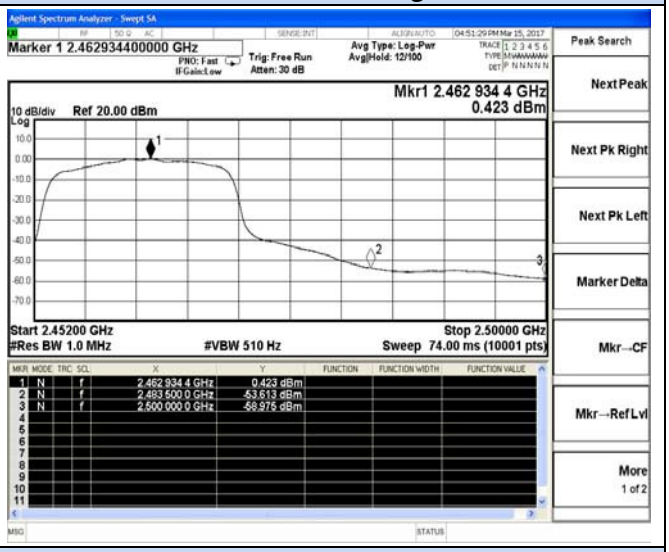
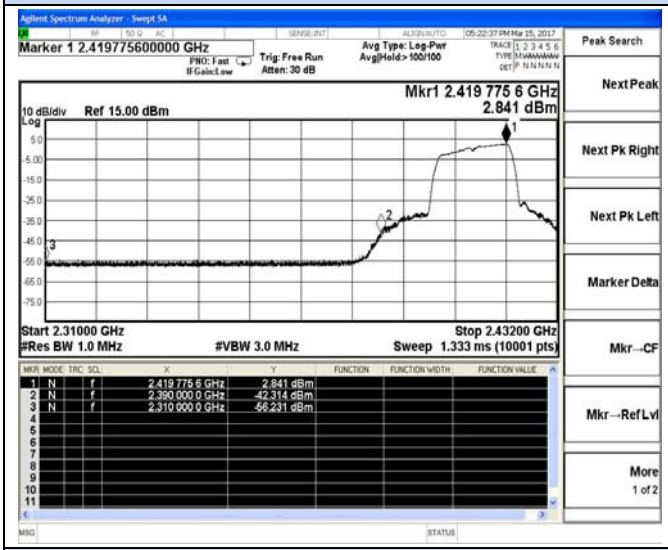
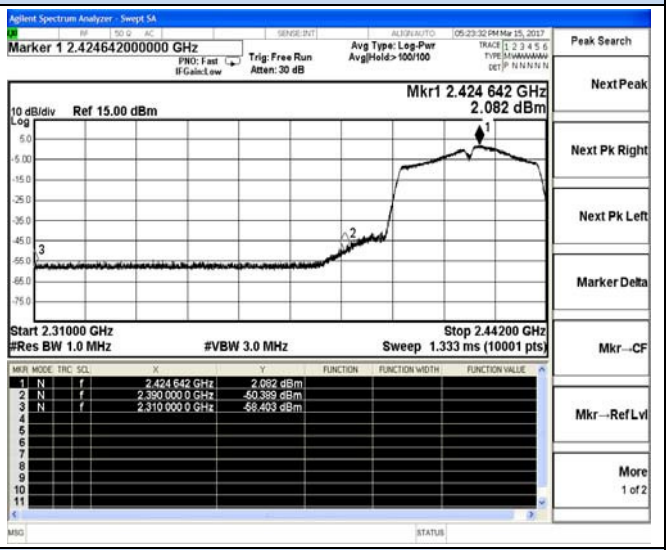
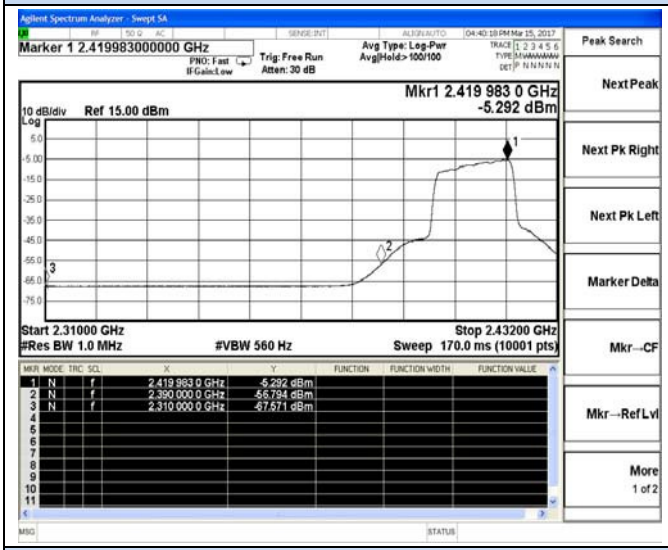
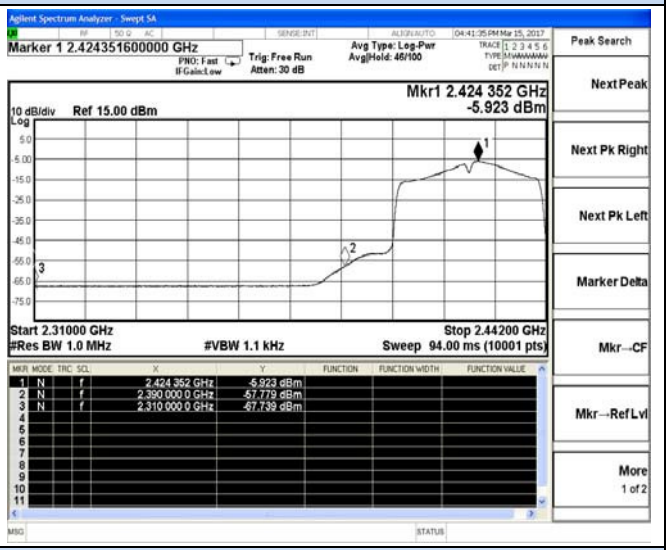
Band-edge measurements for radiated emissions

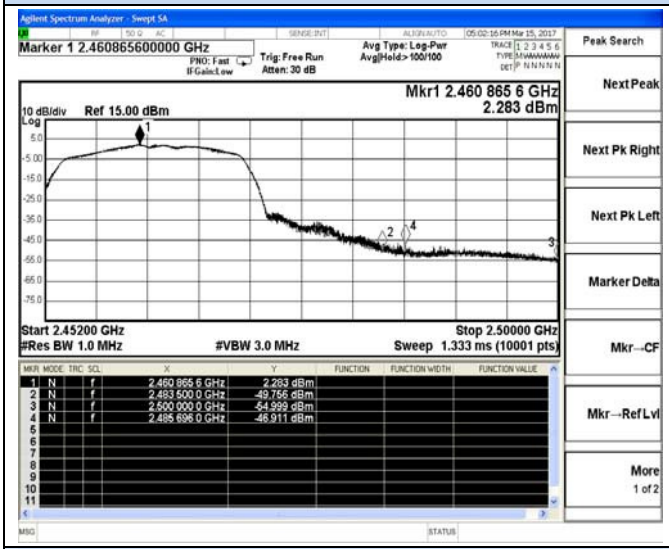
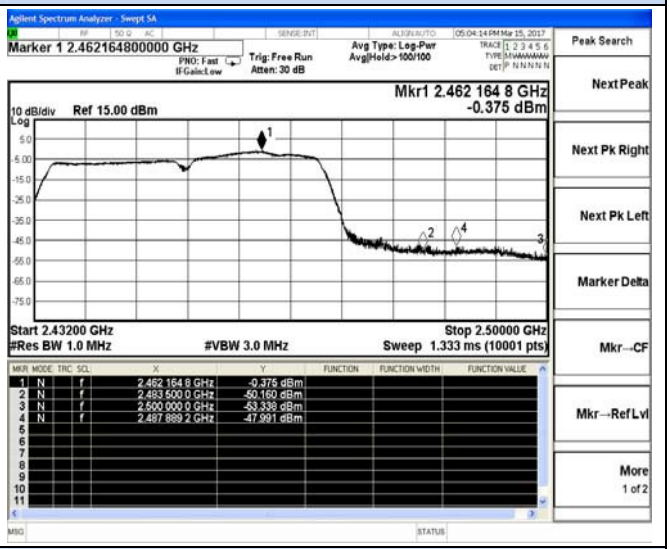
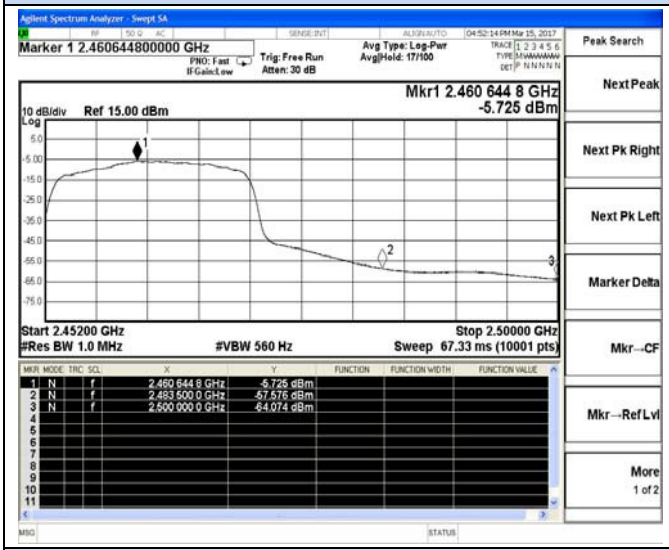
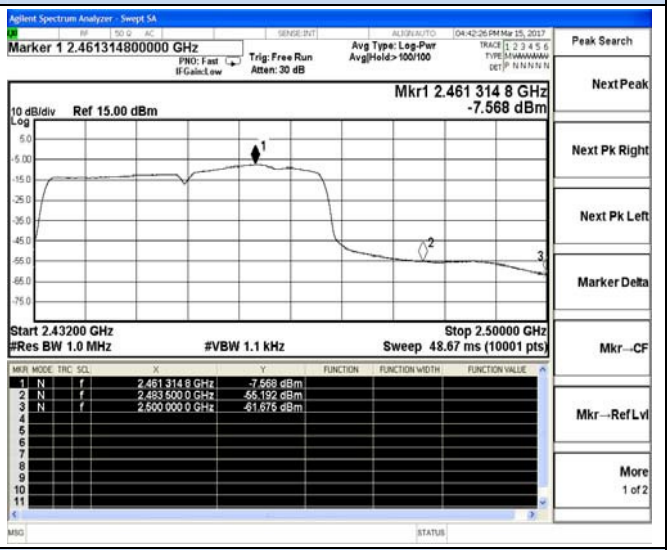
Antenna 0

IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz – Peak	Channel 1 / 2412 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 1 / 2412 MHz – Average
	
Channel 11 / 2412 MHz – Peak	Channel 11 / 2412 MHz – Peak

Band-edge measurements for radiated emissions

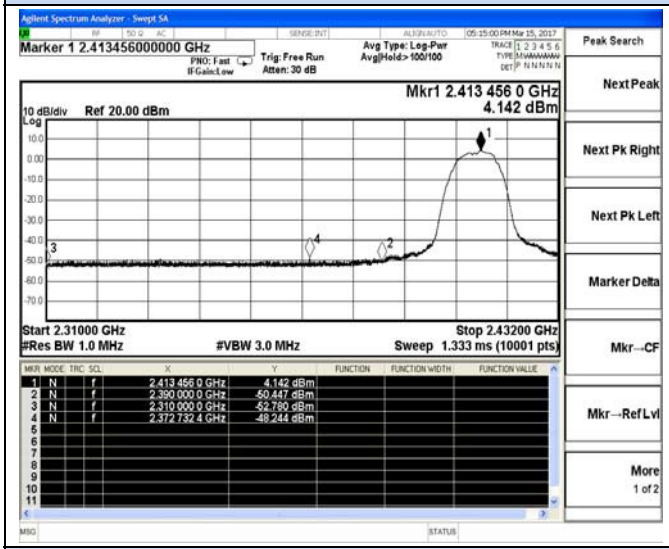
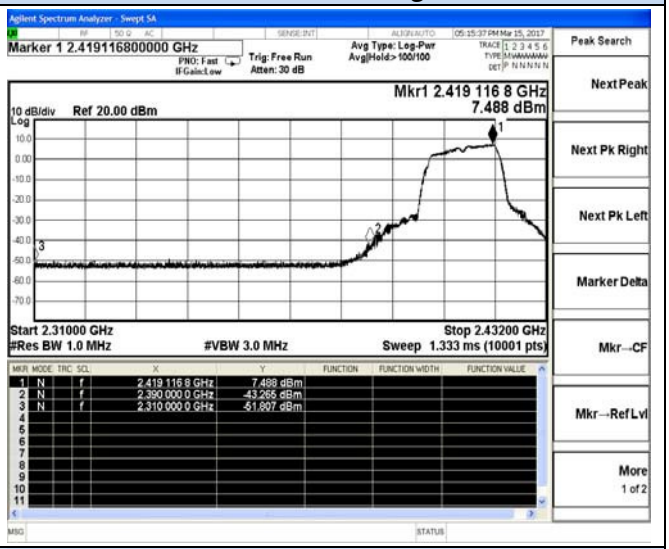
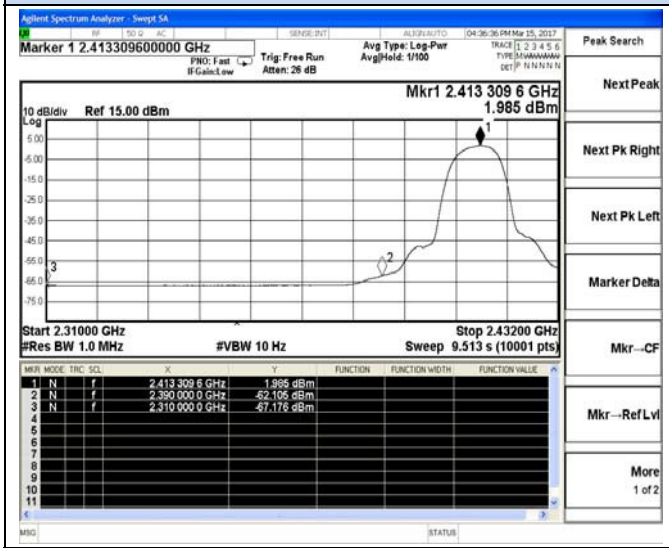
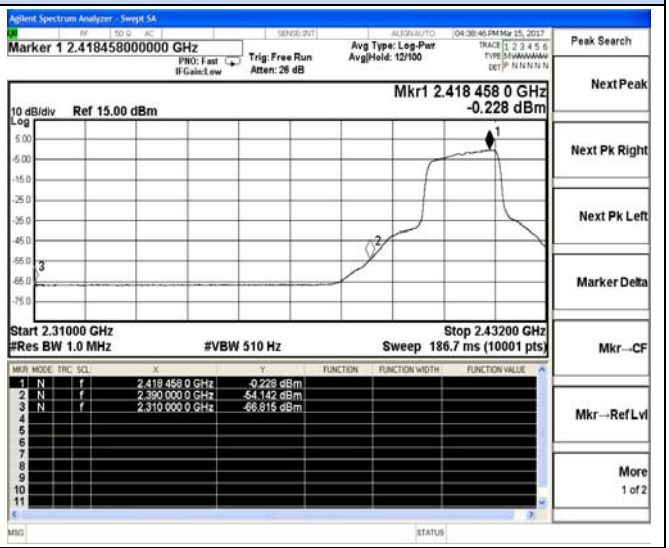
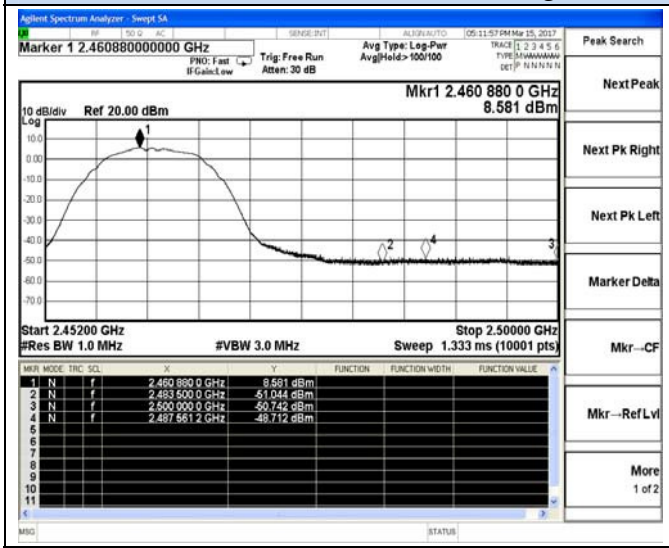
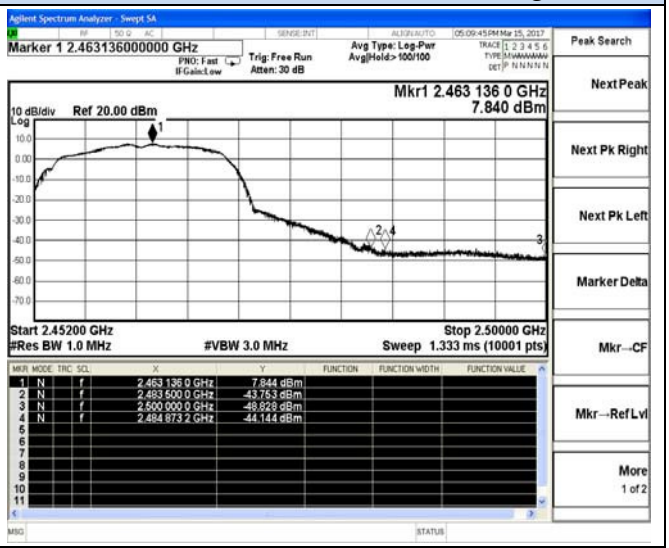
Antenna 0

IEEE 802.11b	IEEE 802.11g
	
Channel 11 / 2462 MHz – Average	Channel 11 / 2462 MHz – Average
IEEE 802.11n HT20	**IEEE 802.11n HT40**
	
Channel 1 / 2412 MHz – Peak	Channel 3 / 2422 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 3 / 2422 MHz – Average

Band-edge measurements for radiated emissions	
Antenna 0	
IEEE 802.11n HT20	IEEE 802.11n HT40
	
Channel 11 / 2462 MHz – Peak	Channel 9 / 2452 MHz – Peak
	
Channel 11 / 2462 MHz – Average	Channel 9 / 2452 MHz – Average

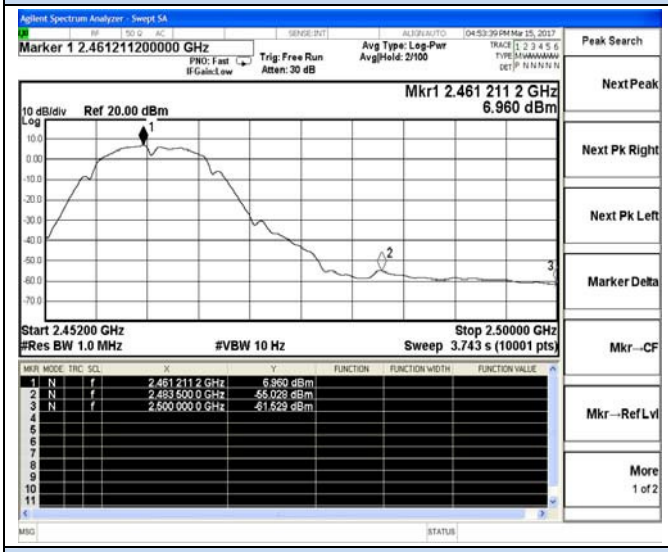
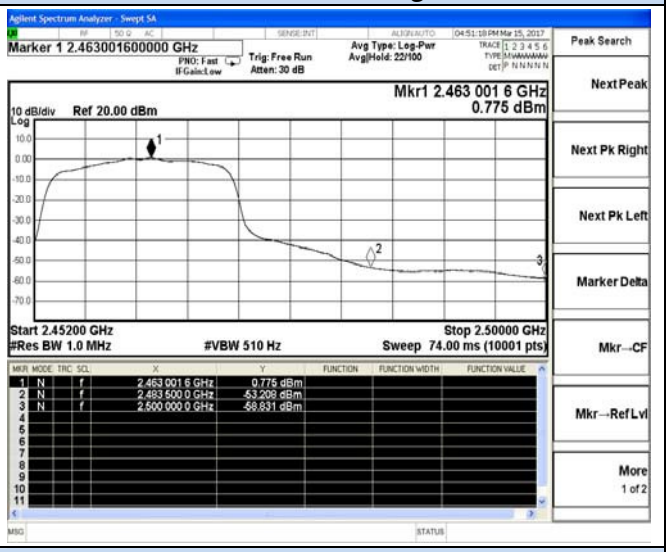
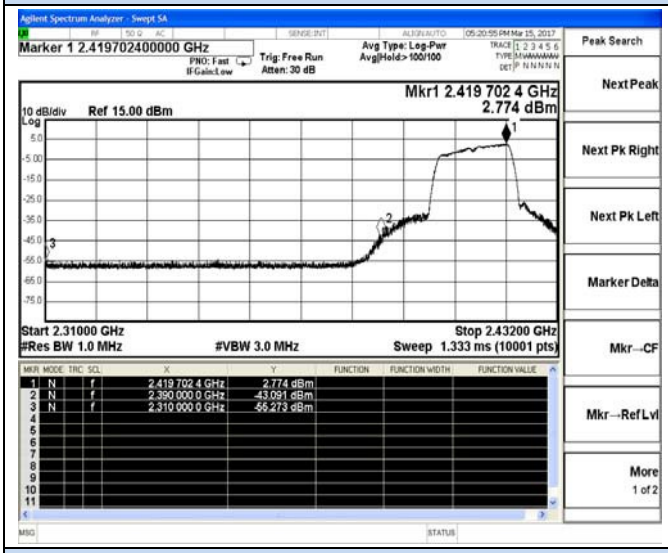
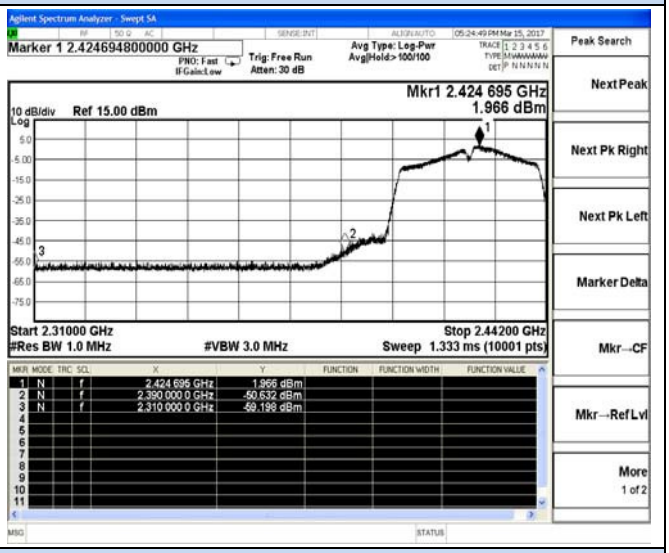
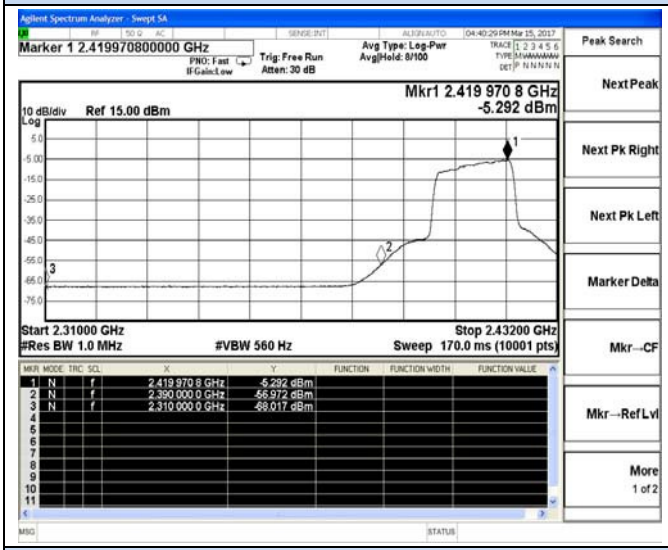
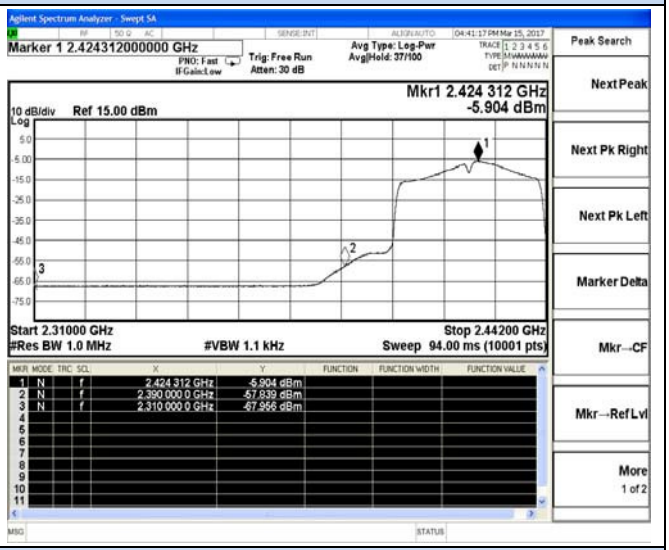
Band-edge measurements for radiated emissions

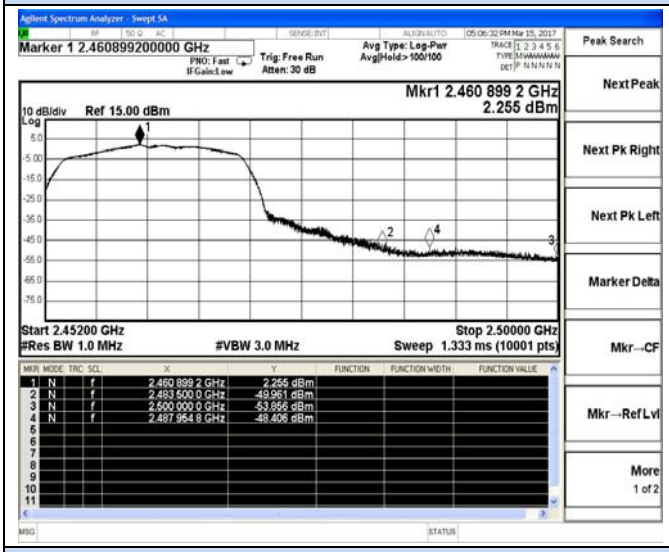
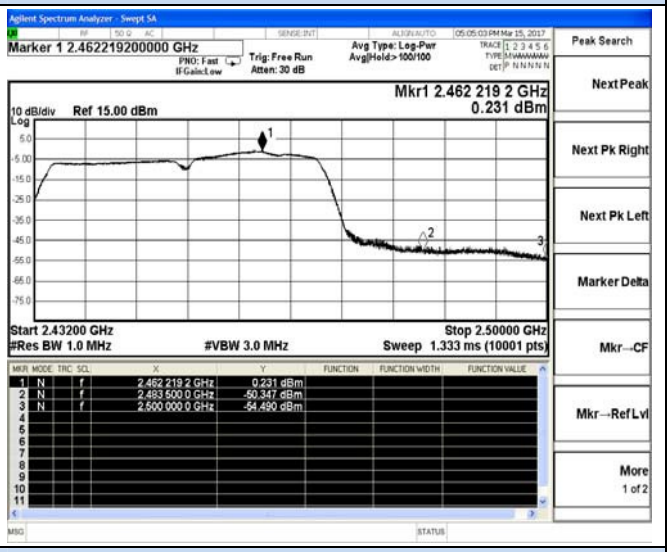
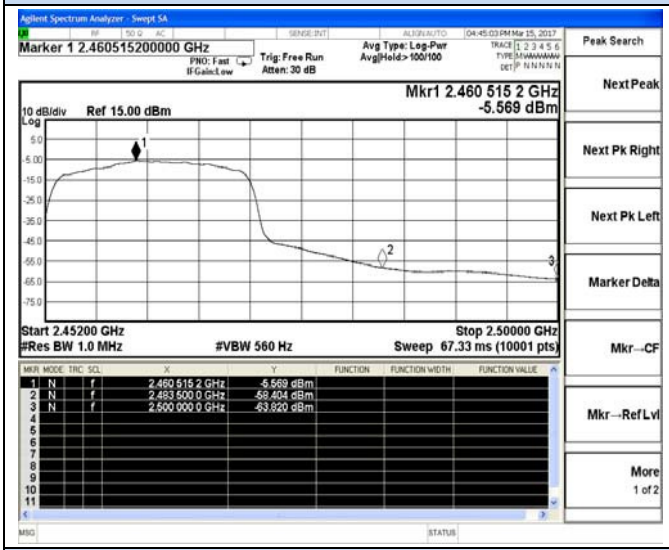
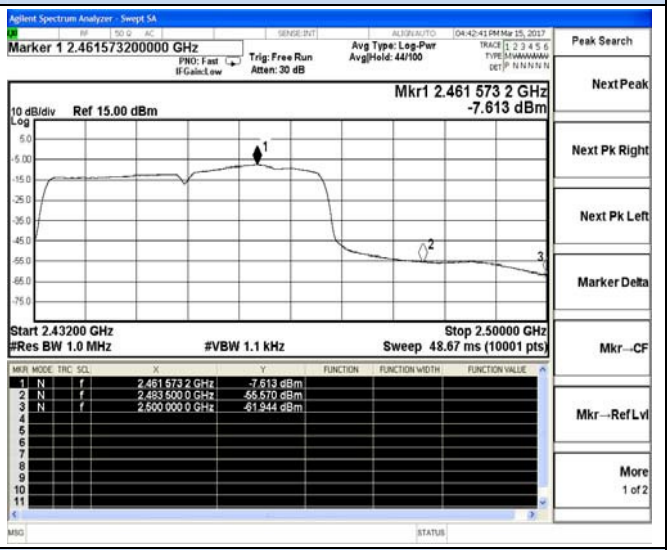
Antenna 1

IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz – Peak	Channel 1 / 2412 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 1 / 2412 MHz – Average
	
Channel 11 / 2412 MHz – Peak	Channel 11 / 2412 MHz – Peak

Band-edge measurements for radiated emissions

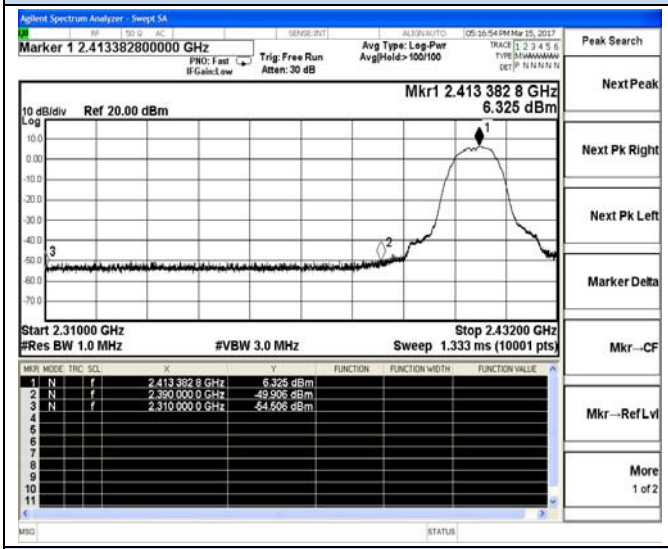
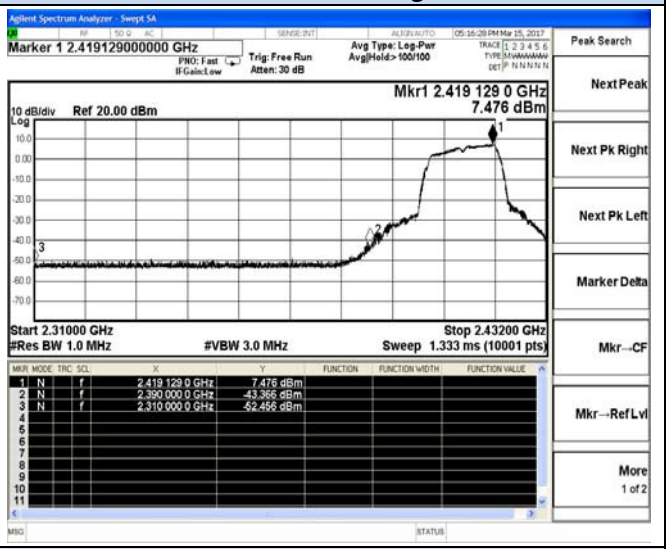
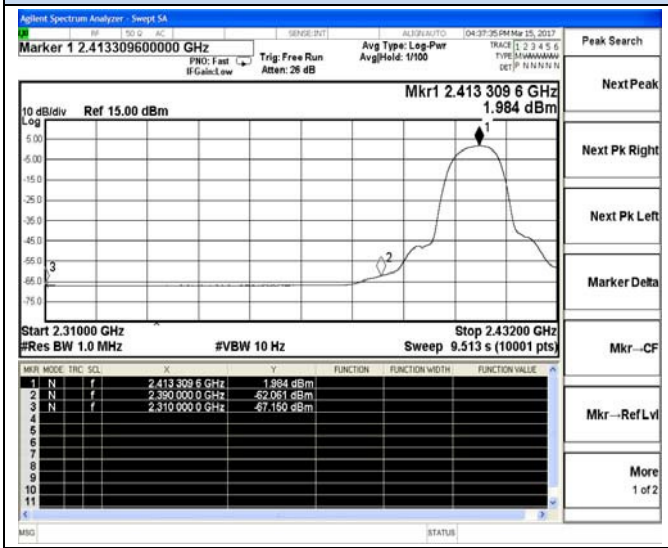
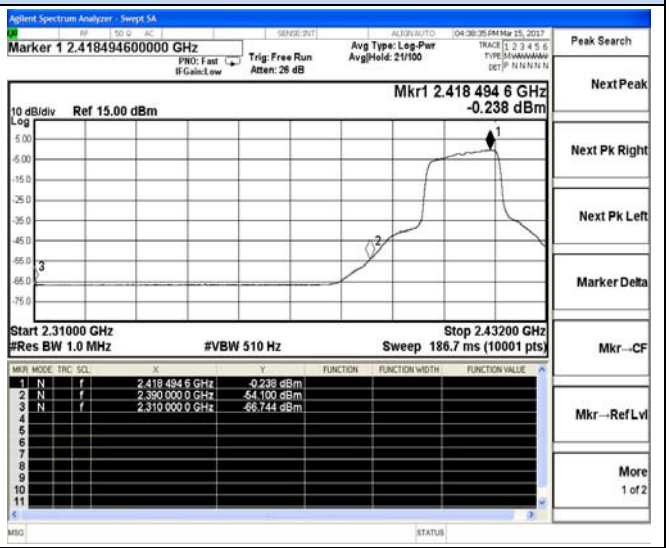
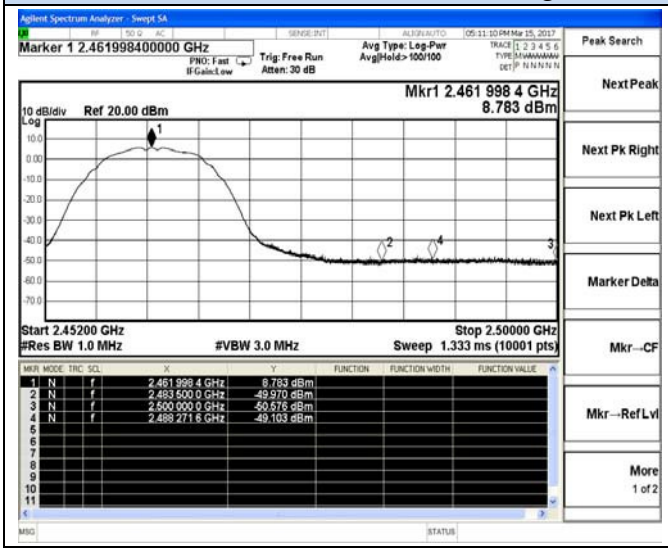
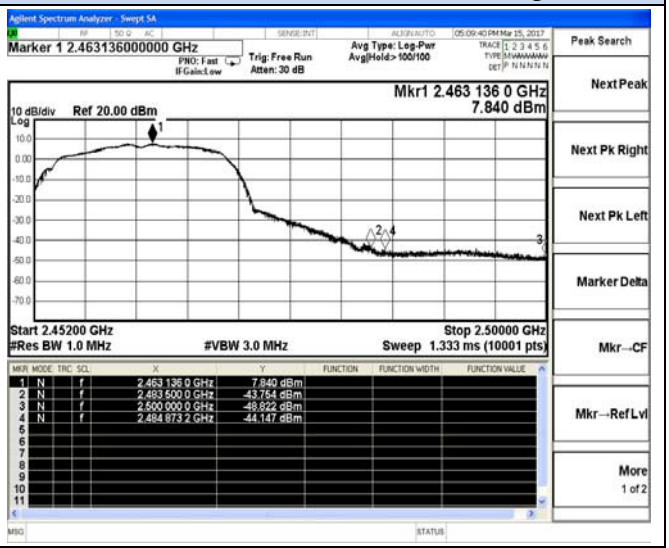
Antenna 1

IEEE 802.11b	IEEE 802.11g
	
Channel 11 / 2462 MHz – Average	Channel 11 / 2462 MHz – Average
IEEE 802.11n HT20	**IEEE 802.11n HT40**
	
Channel 1 / 2412 MHz – Peak	Channel 3 / 2422 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 3 / 2422 MHz – Average

Band-edge measurements for radiated emissions	
Antenna 1	
IEEE 802.11n HT20	IEEE 802.11n HT40
	
Channel 11 / 2462 MHz – Peak	Channel 9 / 2452 MHz – Peak
	
Channel 11 / 2462 MHz – Average	Channel 9 / 2452 MHz – Average

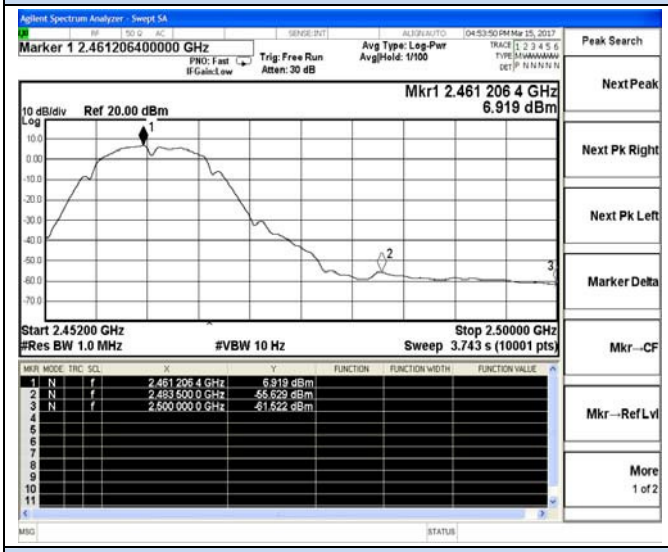
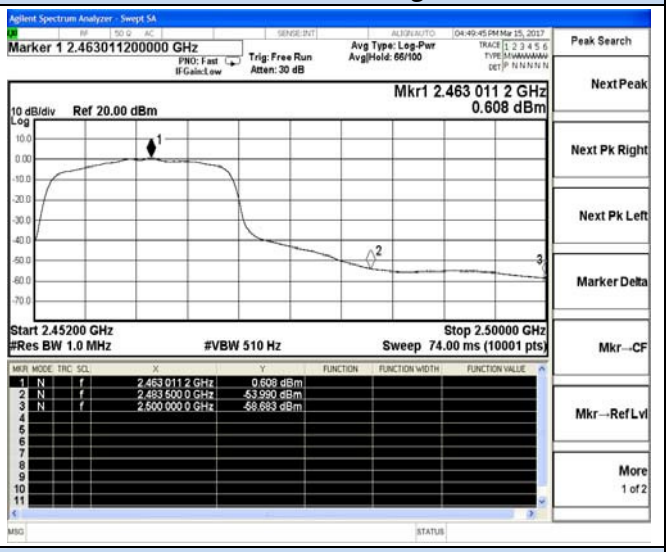
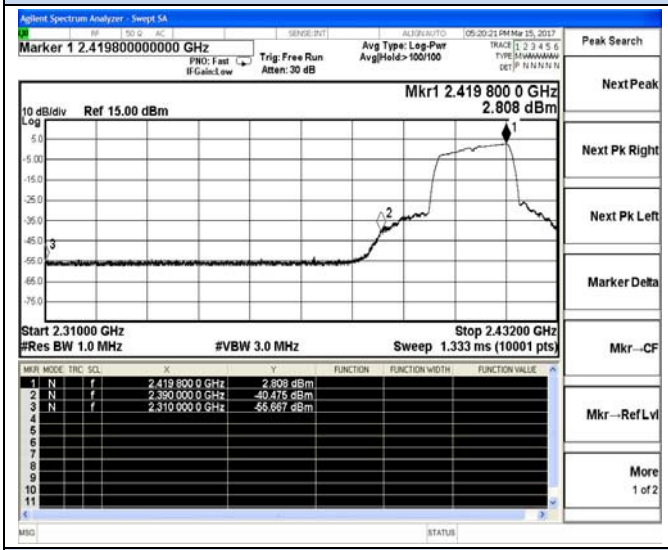
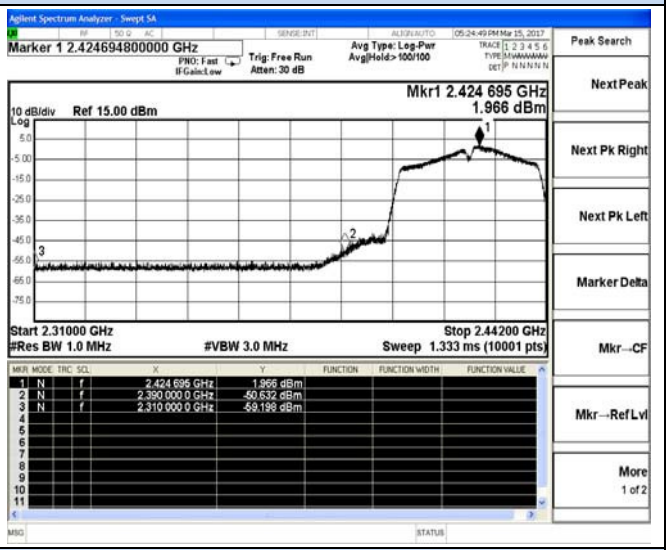
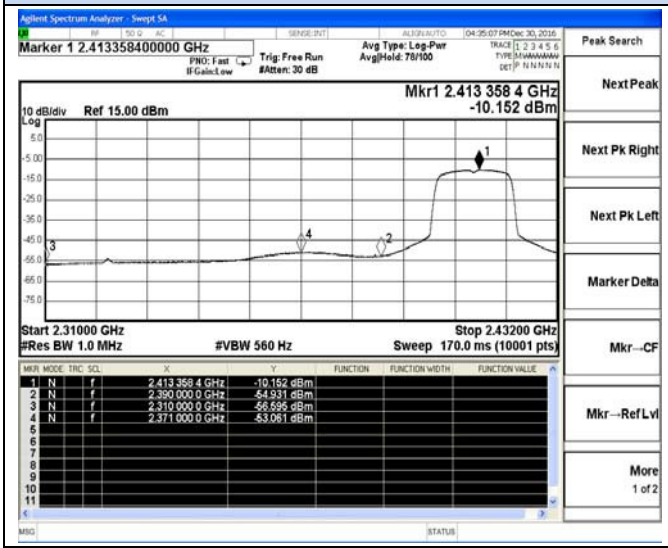
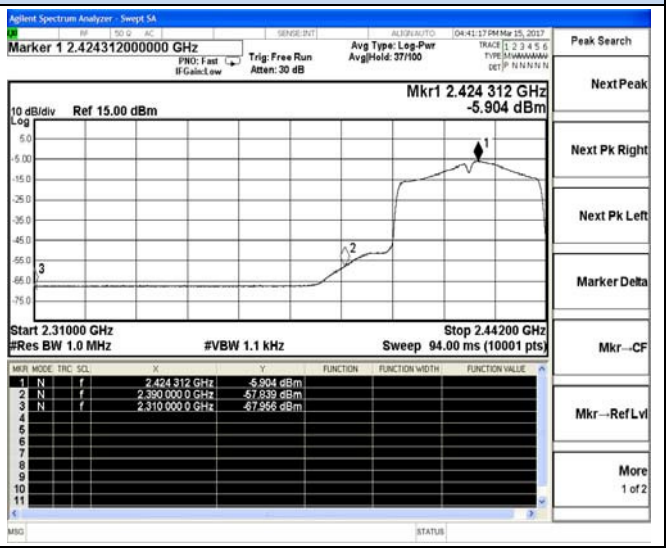
Band-edge measurements for radiated emissions

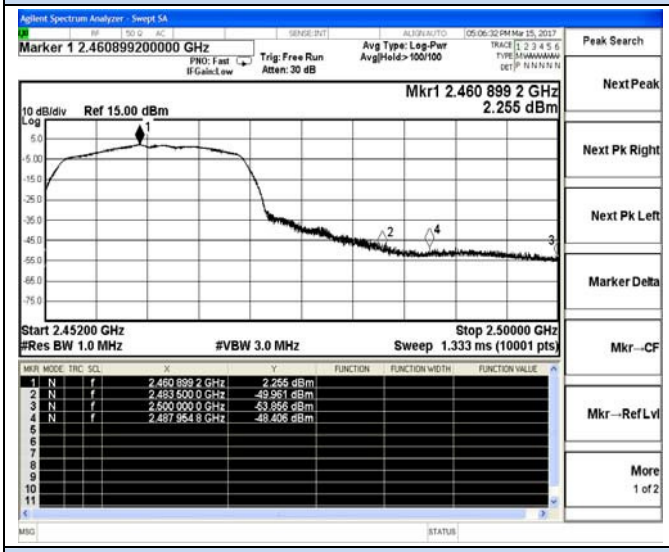
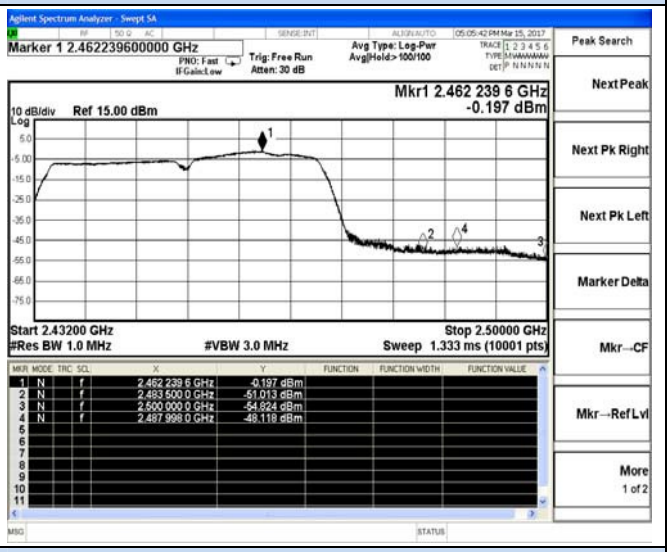
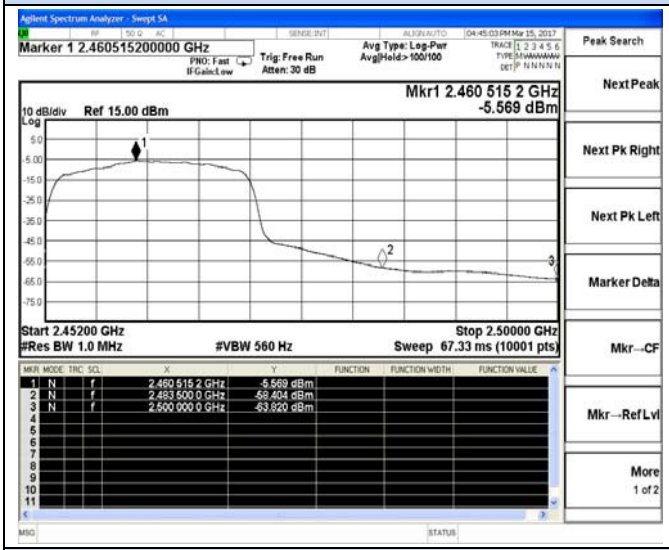
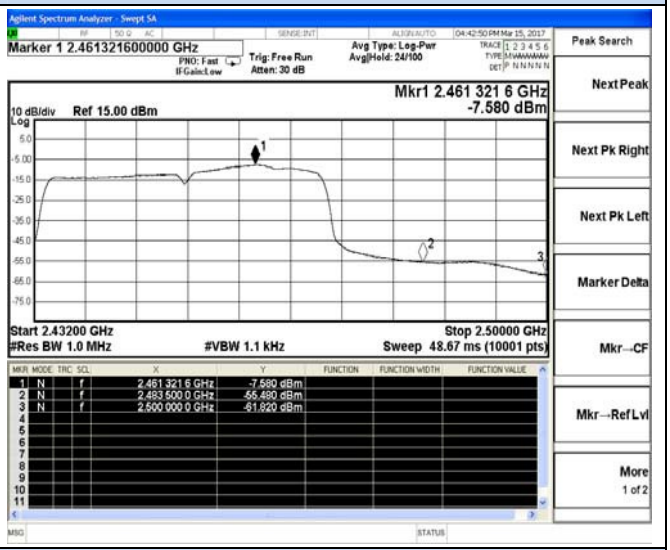
Antenna 2

IEEE 802.11b	IEEE 802.11g
	
Channel 1 / 2412 MHz – Peak	Channel 1 / 2412 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 1 / 2412 MHz – Average
	
Channel 11 / 2412 MHz – Peak	Channel 11 / 2412 MHz – Peak

Band-edge measurements for radiated emissions

Antenna 2

IEEE 802.11b	IEEE 802.11g
	
Channel 11 / 2462 MHz – Average	Channel 11 / 2462 MHz – Average
IEEE 802.11n HT20	**IEEE 802.11n HT40**
	
Channel 1 / 2412 MHz – Peak	Channel 3 / 2422 MHz – Peak
	
Channel 1 / 2412 MHz – Average	Channel 3 / 2422 MHz – Average

Band-edge measurements for radiated emissions	
Antenna 2	
IEEE 802.11n HT20	IEEE 802.11n HT40
	
Channel 11 / 2462 MHz – Peak	Channel 9 / 2452 MHz – Peak
	
Channel 11 / 2462 MHz – Average	Channel 9 / 2452 MHz – Average

5.9. Antenna Requirements

5.9.1. Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

5.9.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 3.78 which is an R-SMA antenna and no consideration of replacement. Please see EUT photo for details.

5.9.3. Results: Compliance.

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.

Conducted power refers ANSI C63.10:2013 Output power test procedure for DTS devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep Time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Note: 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 IEEE 802.11b mode is used.

Limits

FCC	ISED
Antenna Gain	
6 dBi	

Antenna Chain 0

T_{nom}	V_{nom}	Lowest Channel 2412 MHz	Middle Channel 2437 MHz	Highest Channel 2462 MHz
Conducted power [dBm] Measured with DSSS modulation		14.677	14.015	14.382
Radiated power [dBm] Measured with DSSS modulation		17.245	17.692	17.519
Gain [dBi] Calculated		2.568	3.677	3.137
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

Antenna Chain 1

T_{nom}	V_{nom}	Lowest Channel 2412 MHz	Middle Channel 2437 MHz	Highest Channel 2462 MHz
Conducted power [dBm] Measured with DSSS modulation		14.634	14.158	14.002
Radiated power [dBm] Measured with DSSS modulation		17.145	17.862	17.244
Gain [dBi] Calculated		2.511	3.704	3.242
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

Antenna Chain 2

T_{nom}	V_{nom}	Lowest Channel 2412 MHz	Middle Channel 2437 MHz	Highest Channel 2462 MHz
Conducted power [dBm] Measured with DSSS modulation		14.639	14.010	14.018
Radiated power [dBm] Measured with DSSS modulation		17.063	17.628	17.223
Gain [dBi] Calculated		2.424	3.618	3.205
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

6. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	June 18, 2016	June 17, 2017
Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	9kHz~40GHz	July 16, 2016	July 15, 2017
Signal analyzer	Agilent	N9020A	MY50510140	9kHz~26.5GHz	October 27, 2017	October 27, 2017
LISN	MESS Tec	NNB-2/16Z	99079	9KHz-30MHz	June 18, 2016	June 17, 2017
LISN (Support Unit)	EMCO	3819/2NM	9703-1839	9KHz-30MHz	June 18, 2016	June 17, 2017
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9KHz-30MHz	June 18, 2016	June 17, 2017
ISN	SCHAFFNER	ISN ST08	21653	9KHz-30MHz	June 18, 2016	June 17, 2017
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30M-18GHz 3m	June 18, 2016	June 17, 2017
Amplifier	SCHAFFNER	COA9231A	18667	9kHz-2GHzz	June 18, 2016	June 17, 2017
Amplifier	Agilent	8449B	3008A02120	1GHz-26.5GHz	July 16, 2016	July 15, 2017
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40GHz	July 16, 2016	July 15, 2017
Loop Antenna	R&S	HFH2-Z2	860004/001	9k-30MHz	June 18, 2016	June 17, 2017
By-log Antenna	SCHWARZBEC	VULB9163	9163-470	30MHz-1GHz	June 10, 2016	June 09, 2017
Horn Antenna	EMCO	3115	6741	1GHz-18GHz	June 10, 2016	June 09, 2017
Horn Antenna	SCHWARZBEC	BBHA9170	BBHA9170154	15GHz-40GHz	June 10, 2016	June 09, 2017
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz-1GHz	June 18, 2016	June 17, 2017
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1GHz-40GHz	June 18, 2016	June 17, 2017
Power Meter	R&S	NRVS	100444	DC-40GHz	June 18, 2016	June 17, 2017
Power Sensor	R&S	NRV-Z51	100458	DC-30GHz	June 18, 2016	June 17, 2017
Power Sensor	R&S	NRV-Z32	10057	30MHz-6GHz	June 18, 2016	June 17, 2017
AC Power Source	HPC	HPA-500E	HPA-9100024	AC 0~300V	June 18, 2016	June 17, 2017
DC power source	GW	GPC-6030D	C671845	DC 1V-60V	June 18, 2016	June 17, 2017
Temp. and Humidify Chamber	Giant Force	GTH-225-20-S	MAB0103-00	N/A	June 18, 2016	June 17, 2017
RF CABLE-1m	JYE Bao	RG142	CB034-1m	20MHz-7GHz	June 18, 2016	June 17, 2017
RF CABLE-2m	JYE Bao	RG142	CB)35-2m	20MHz-1GHz	June 18, 2016	June 17, 2017
EMC Test software	Audix	E3	N/A	N/A	N/A	N/A
Note: All equipment through GRGT EST calibration						

----------THE END OF REPORT----------