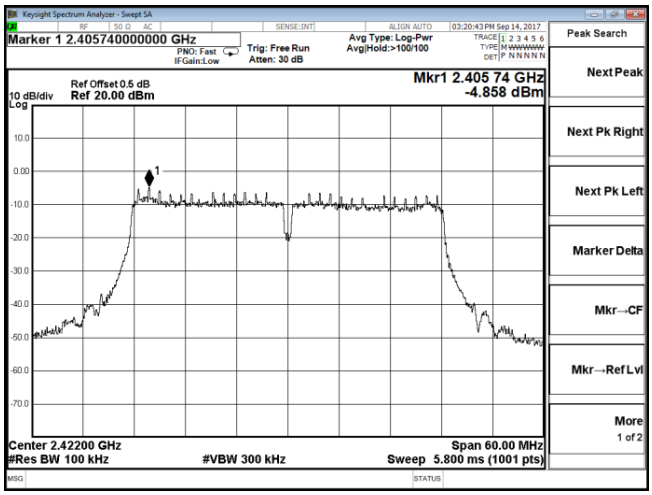
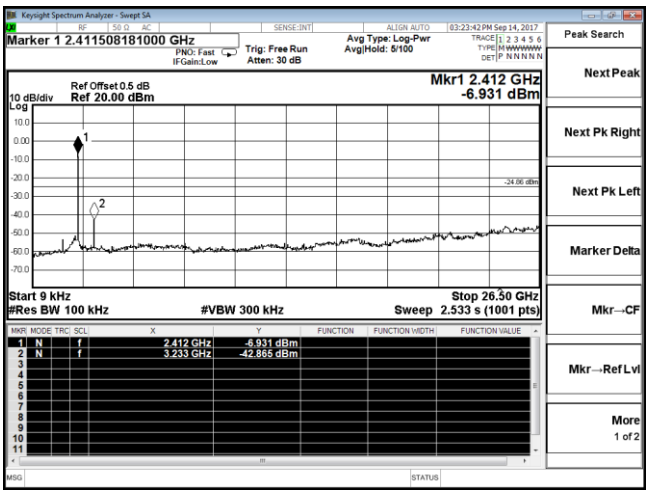
RF Conducted Spurious Emissions

IEEE 802.11n HT40

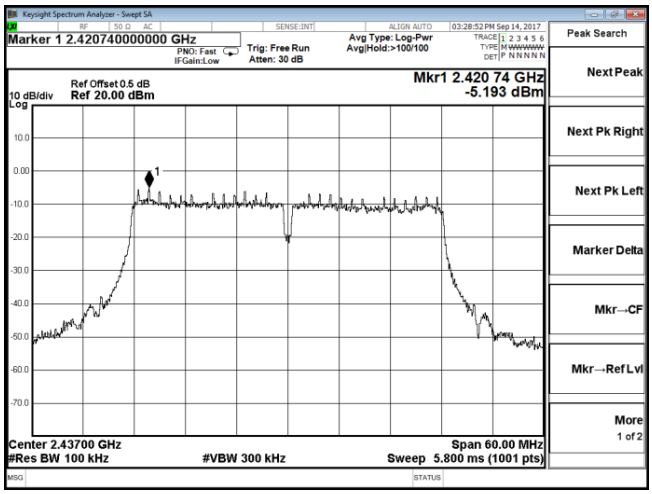
Chain 0



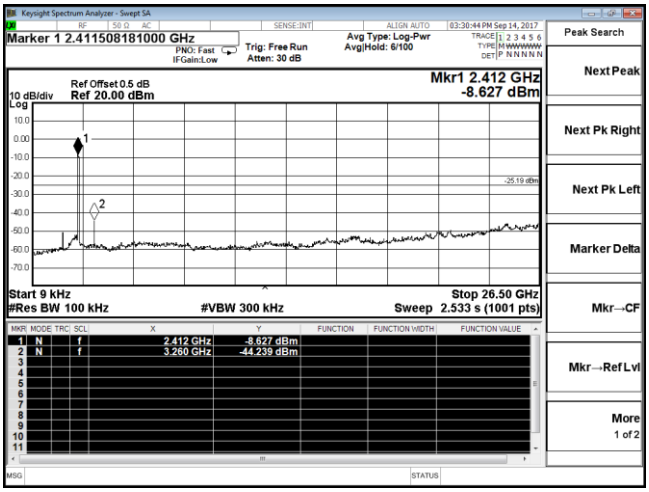
2392 MHz – 2452 MHz



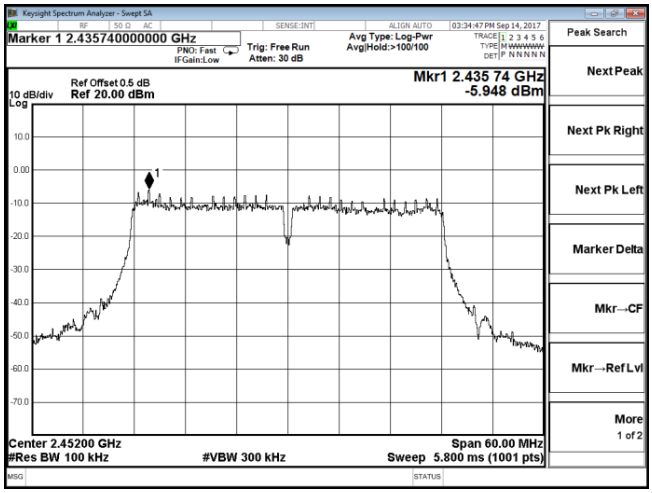
9 KHz – 26.5 GHz



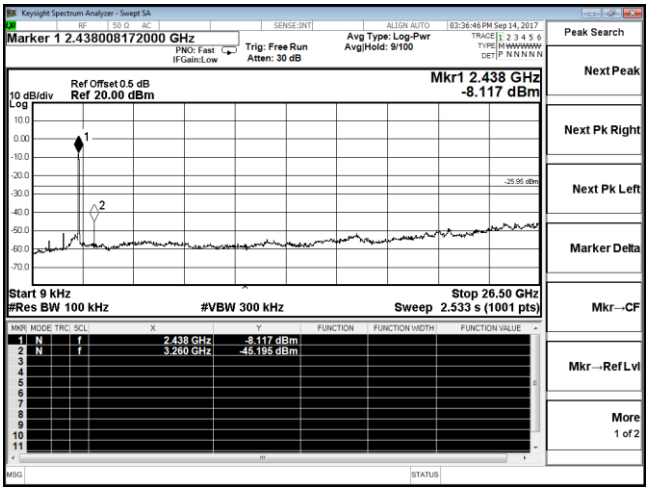
2407 MHz – 2467 MHz



9 KHz – 26.5 GHz



2422 MHz – 2482 MHz

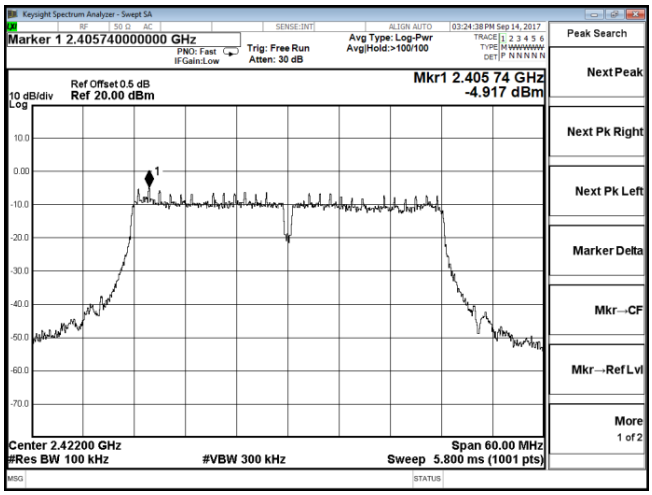


9 KHz – 26.5 GHz

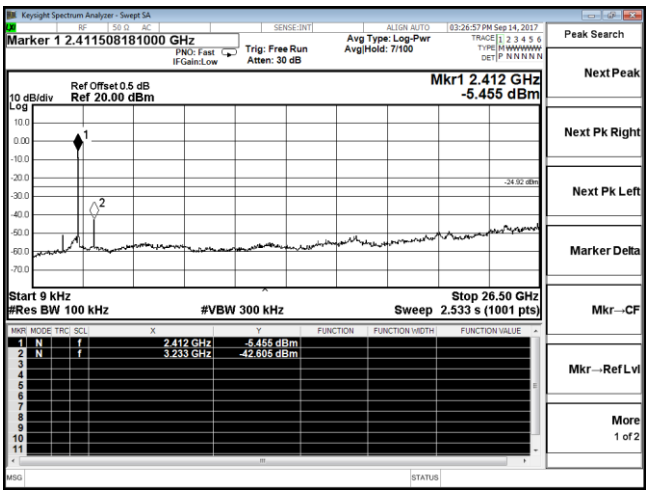
RF Conducted Spurious Emissions

IEEE 802.11n HT40

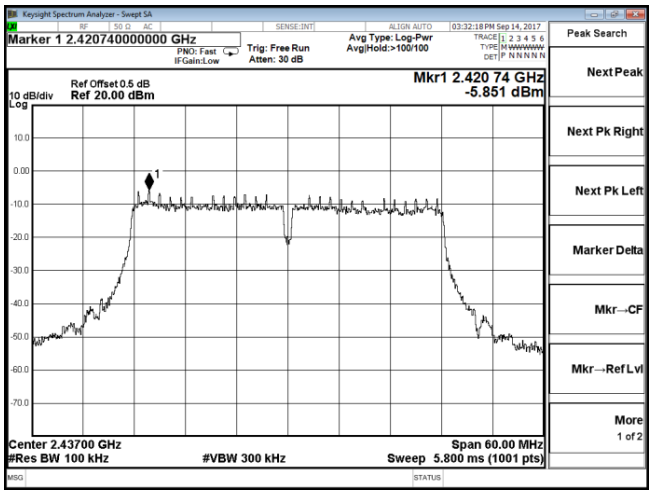
Chain 1



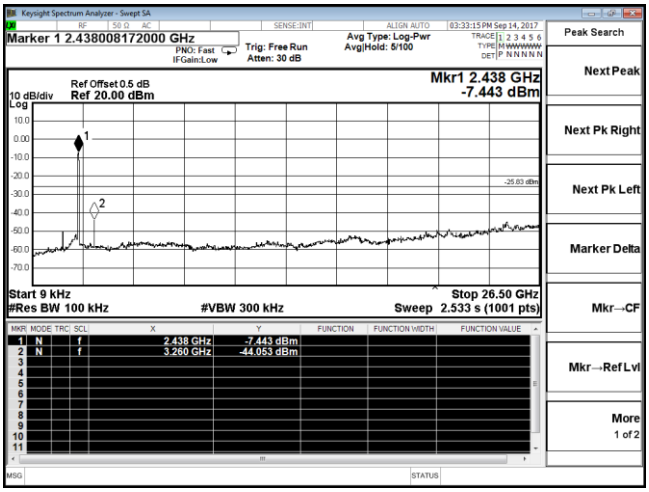
2392 MHz – 2452 MHz



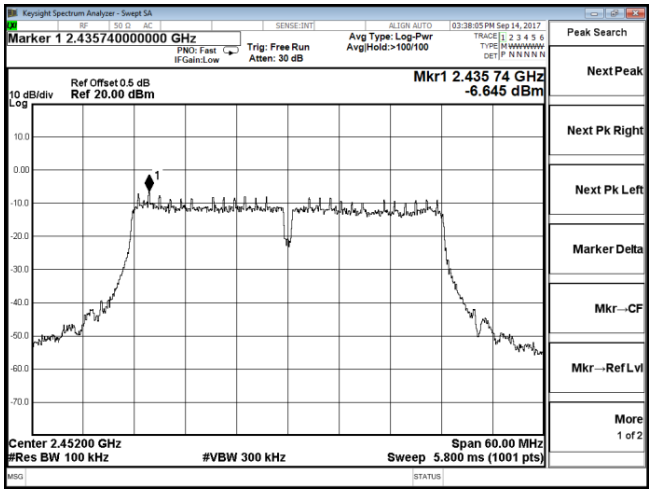
9 KHz – 26.5 GHz



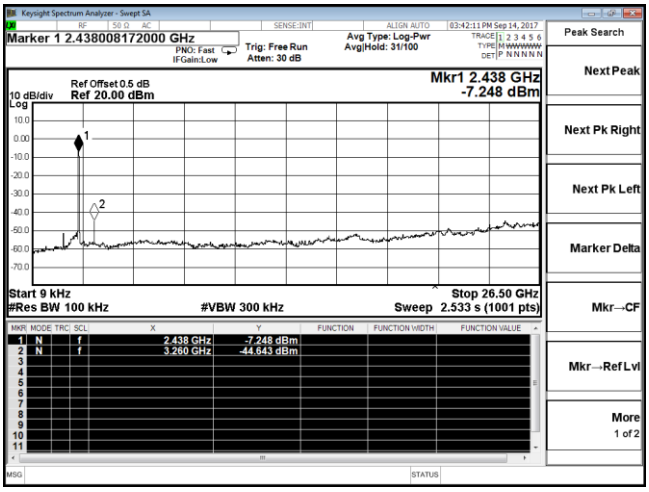
2407 MHz – 2467 MHz



9 KHz – 26.5 GHz

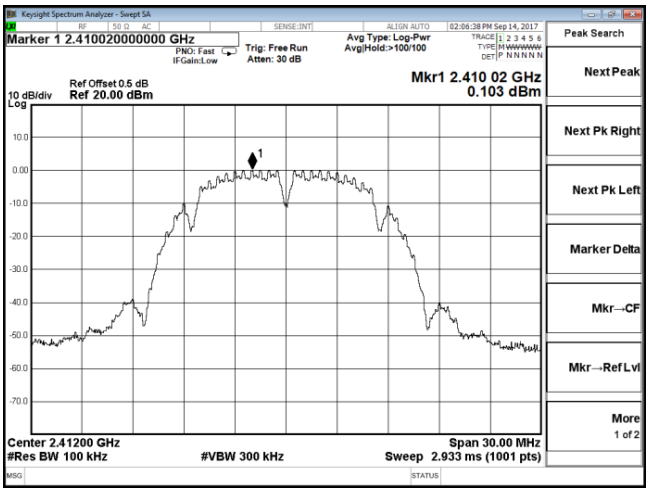
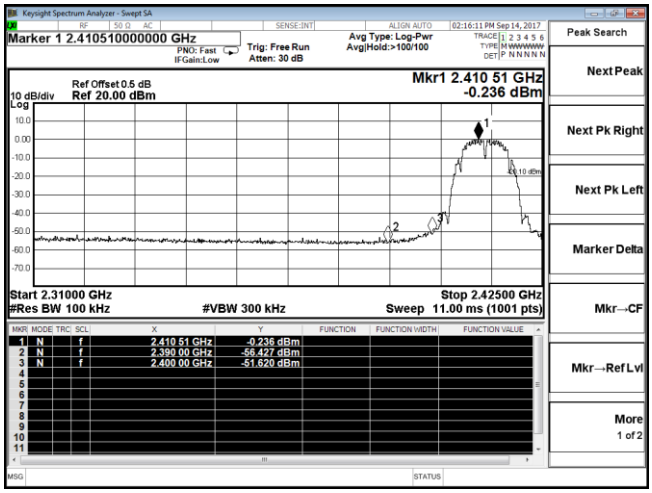
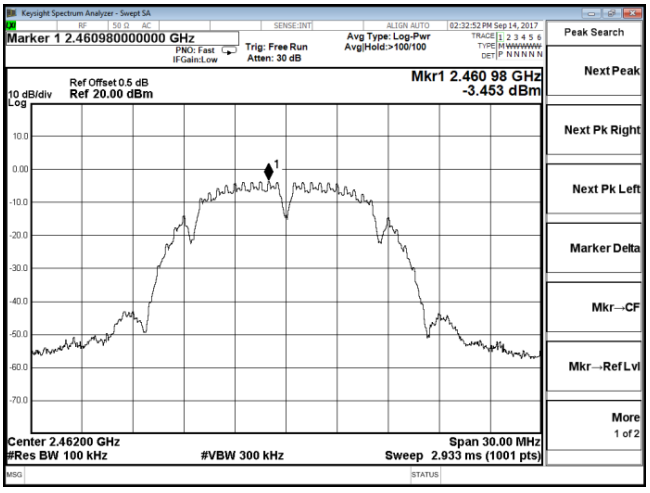
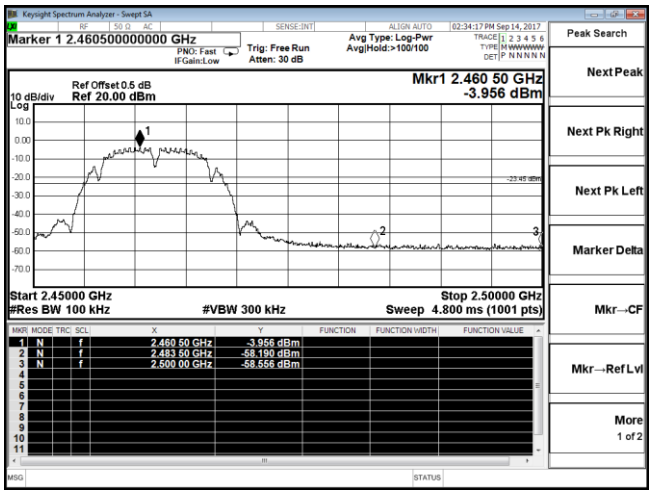


2422 MHz – 2482 MHz



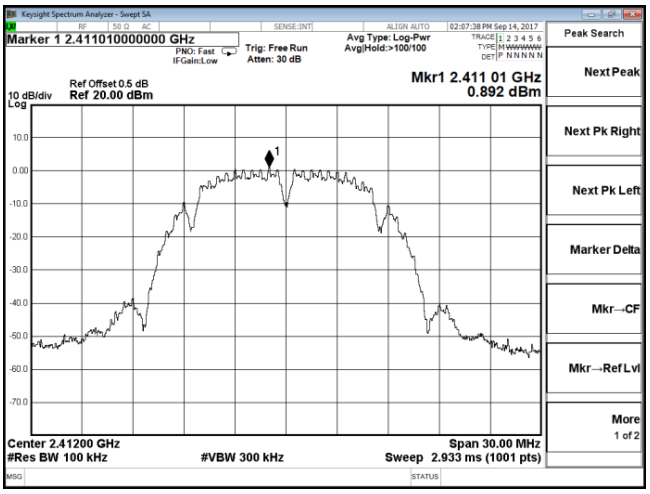
9 KHz – 26.5 GHz

5.6.7. Test Results of Band Edges Test

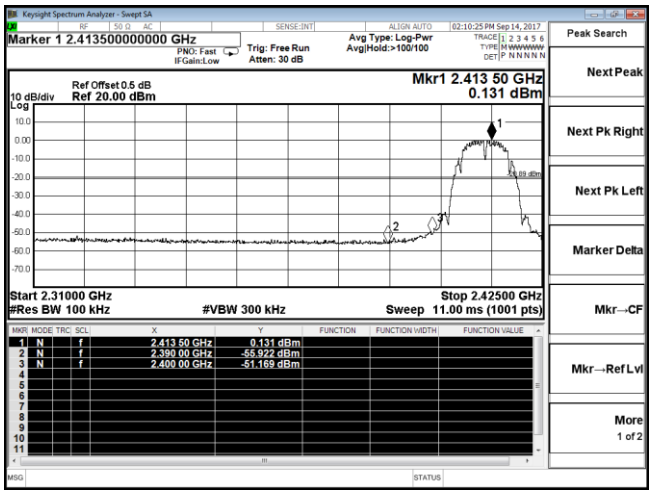
Band-edge measurements for conducted emissions	
IEEE 802.11b	
Chain 0	
	
2397 MHz – 2427 MHz	Channel 1 / 2412 MHz
	
2447 MHz – 2477 MHz	Channel 11 / 2462 MHz

IEEE 802.11b

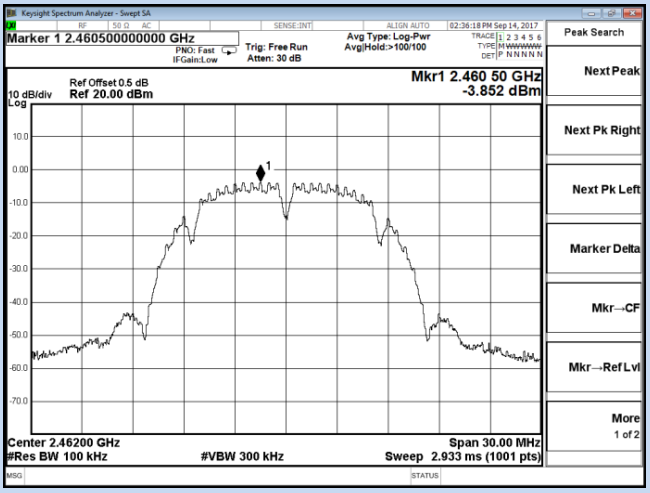
Chain 1



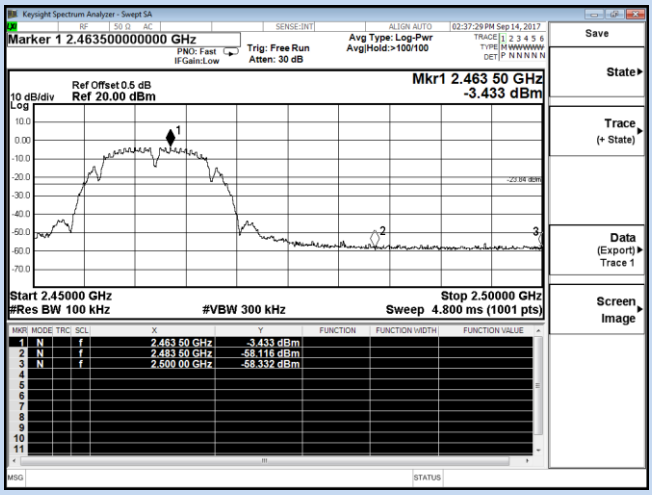
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



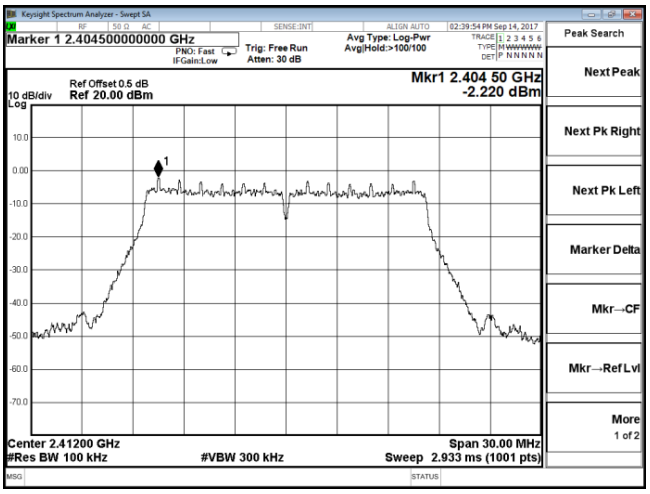
2447 MHz – 2477 MHz



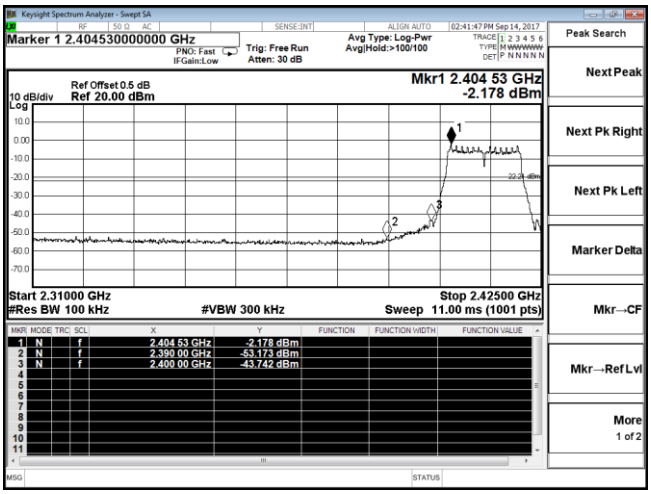
Channel 11 / 2462 MHz

IEEE 802.11g

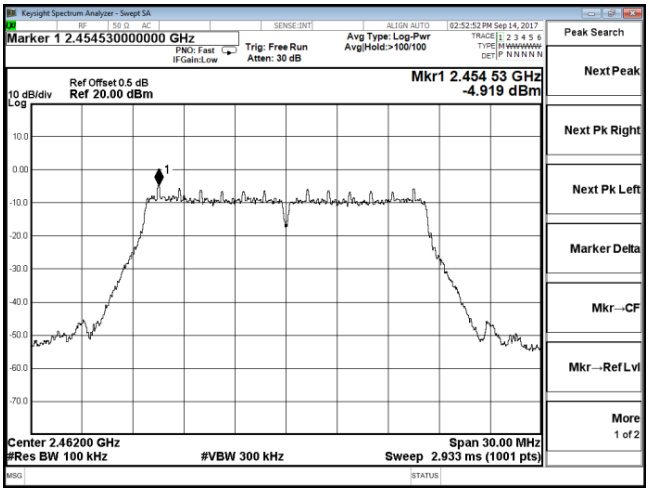
Chain 0



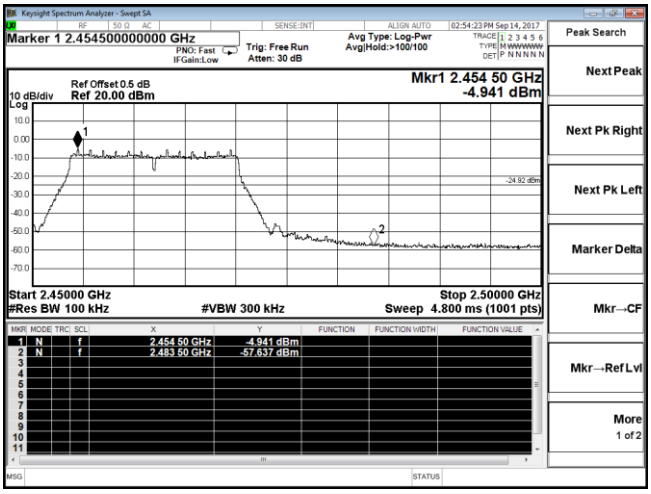
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



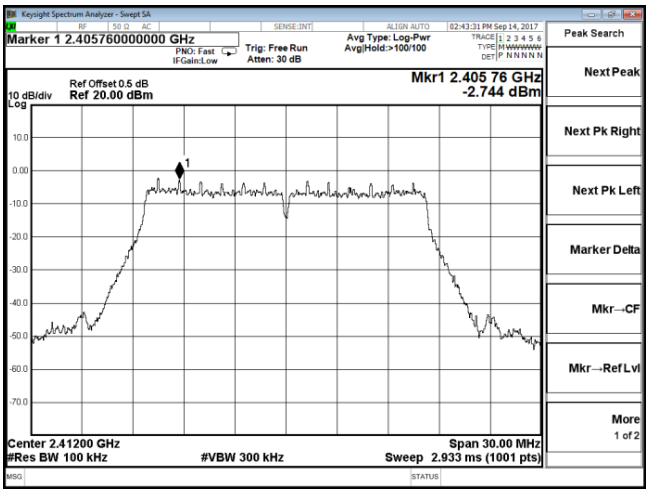
2447 MHz – 2477 MHz



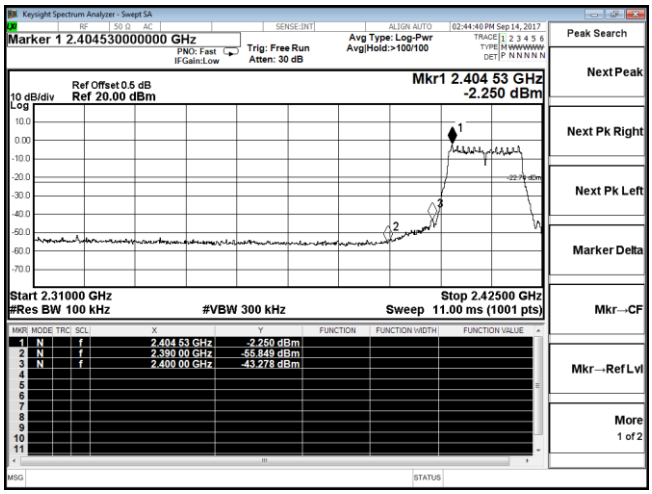
Channel 11 / 2462 MHz

IEEE 802.11g

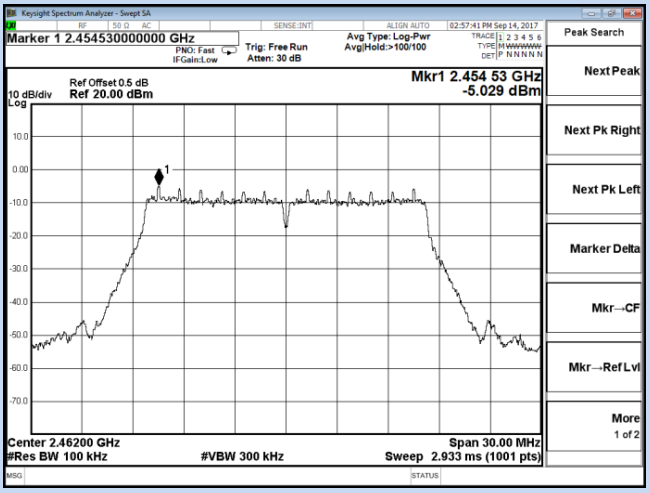
Chain 1



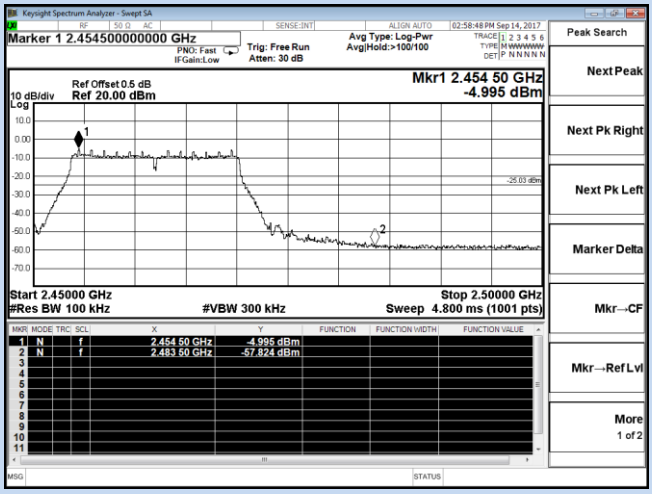
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



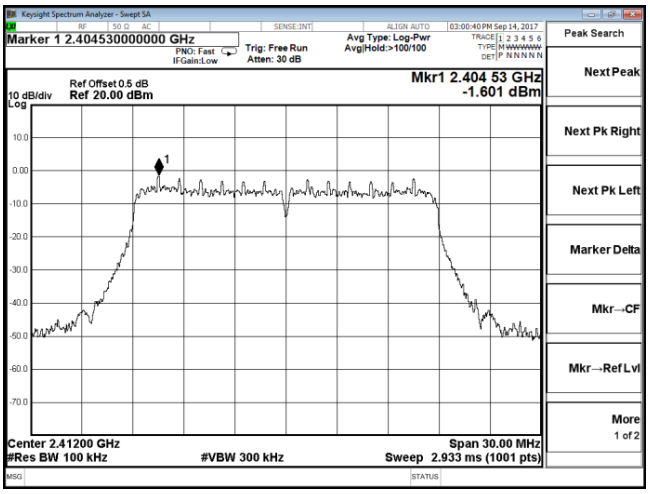
2447 MHz – 2477 MHz



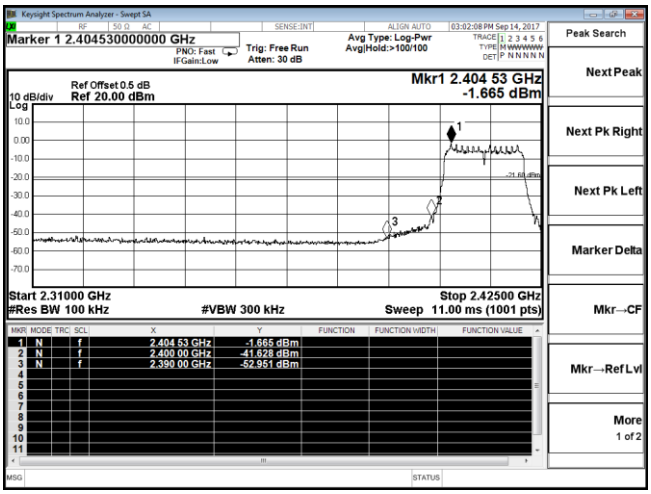
Channel 11 / 2462 MHz

IEEE 802.11n HT20

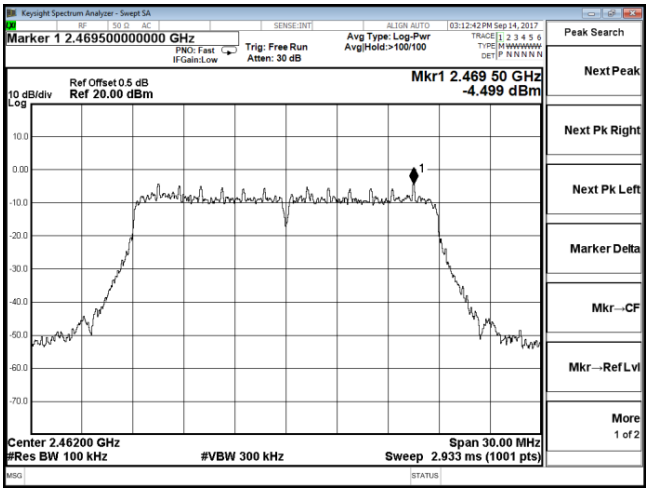
Chain 0



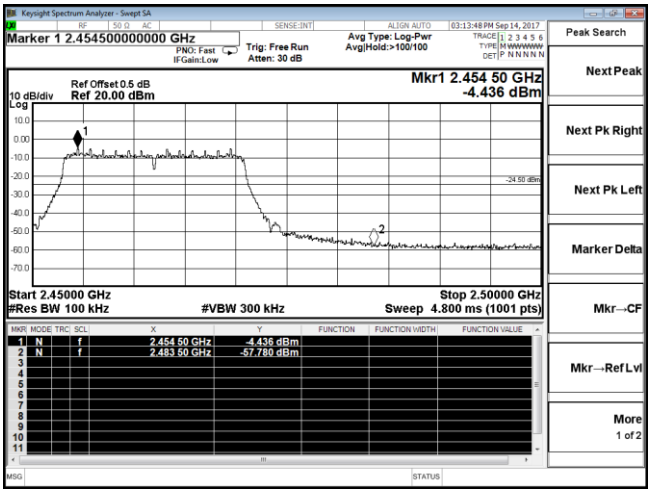
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



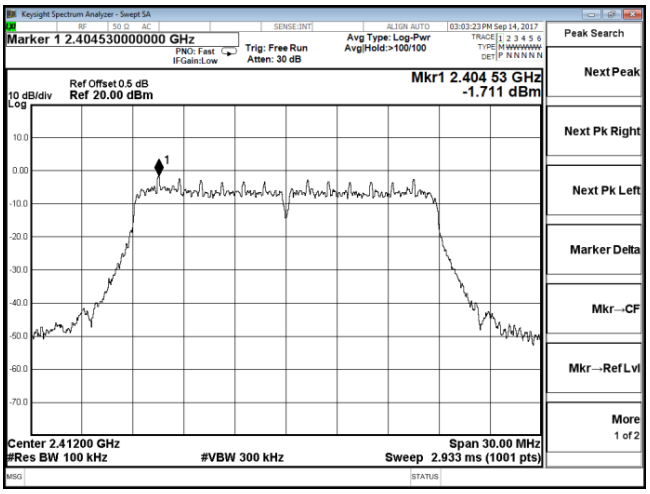
2447 MHz – 2477 MHz



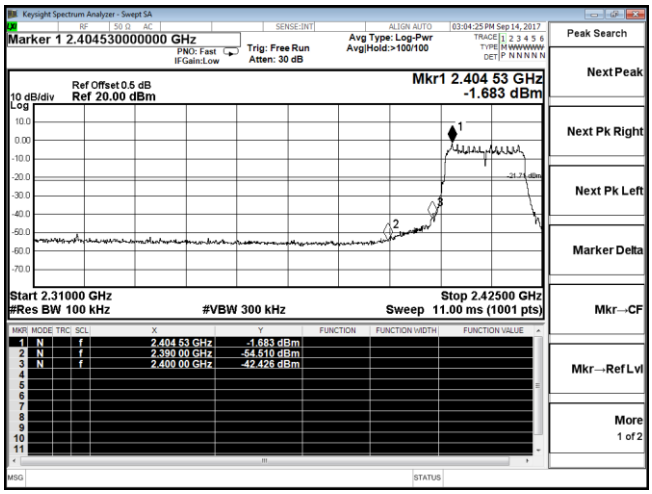
Channel 11 / 2462 MHz

IEEE 802.11n HT20

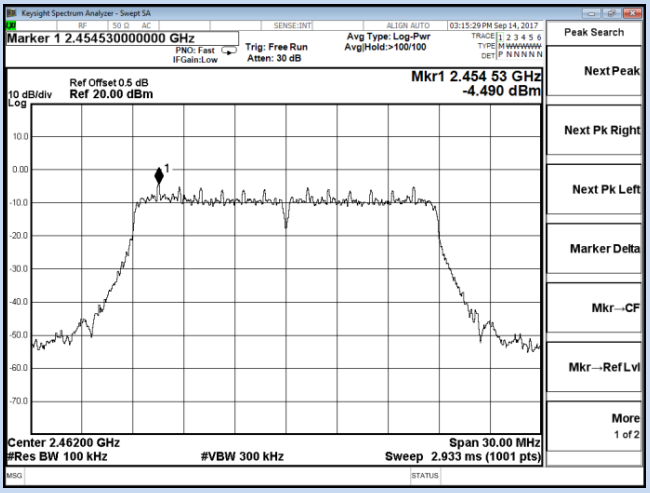
Chain 1



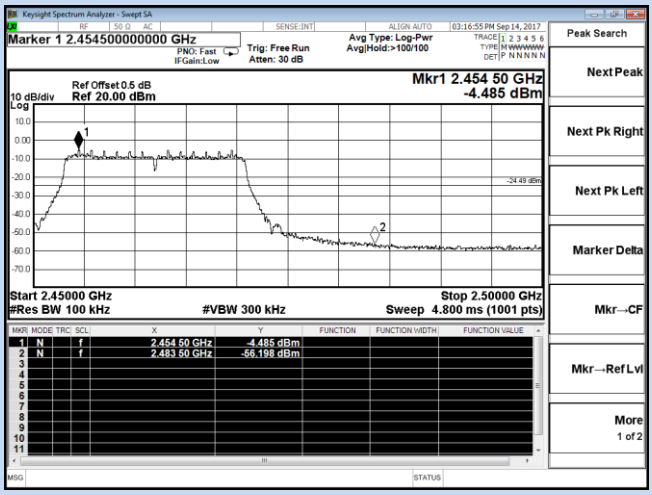
2397 MHz – 2427 MHz



Channel 1 / 2412 MHz



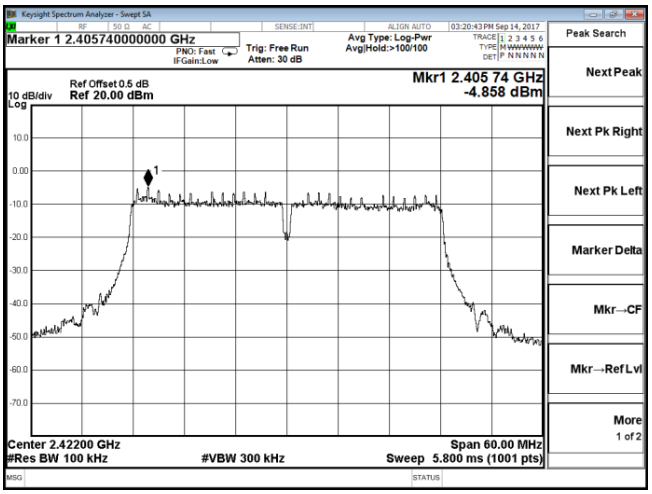
2447 MHz – 2477 MHz



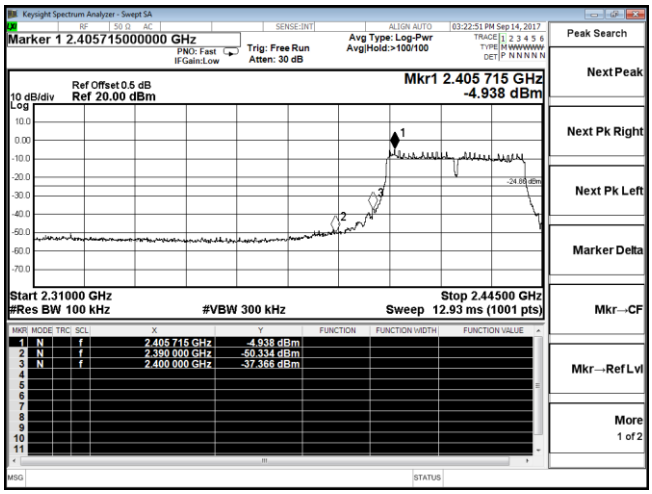
Channel 11 / 2462 MHz

IEEE 802.11n HT40

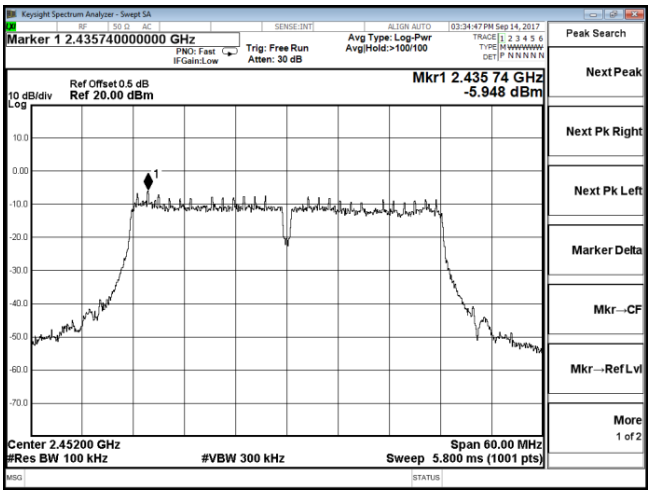
Chain 0



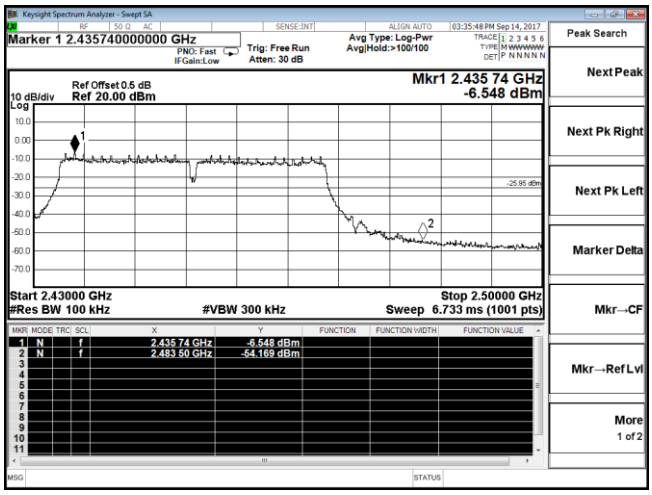
2392 MHz – 2452 MHz



Channel 3 / 2422 MHz



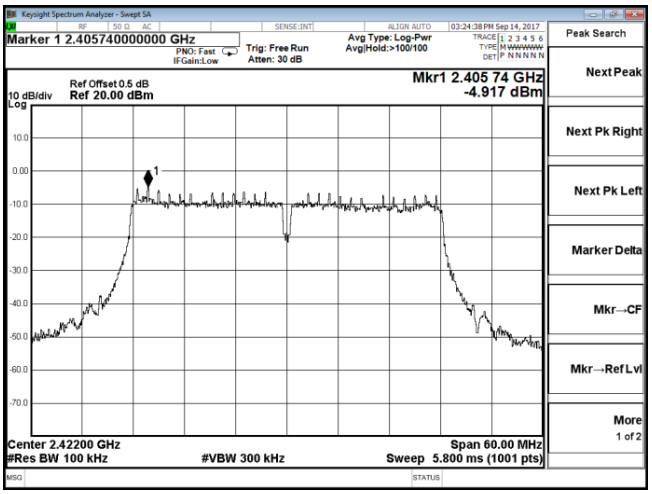
2422 MHz – 2482 MHz



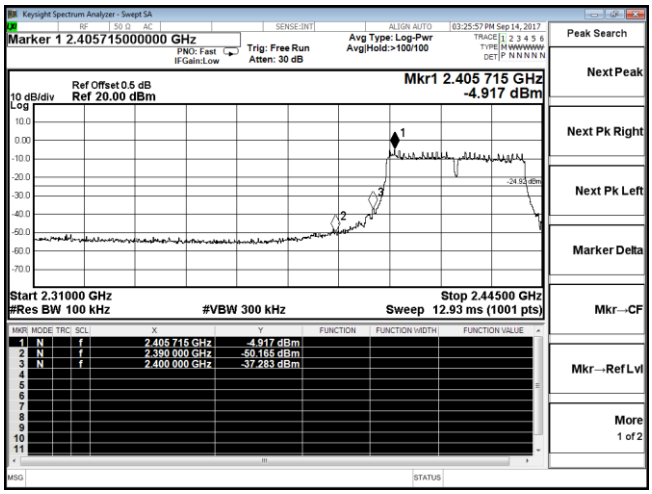
Channel 9 / 2452 MHz

IEEE 802.11n HT40

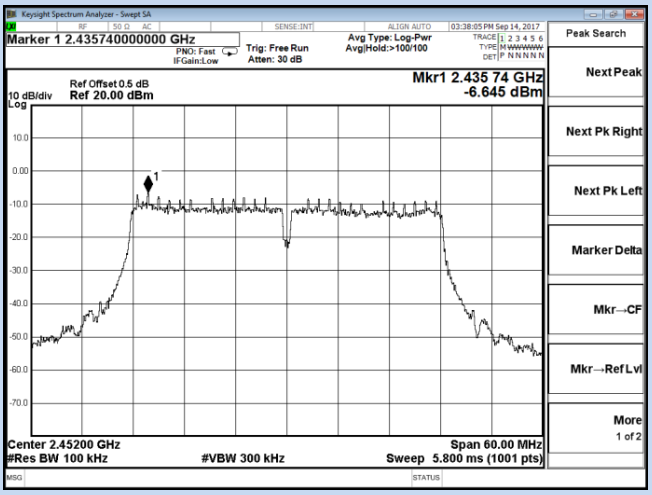
Chain 1



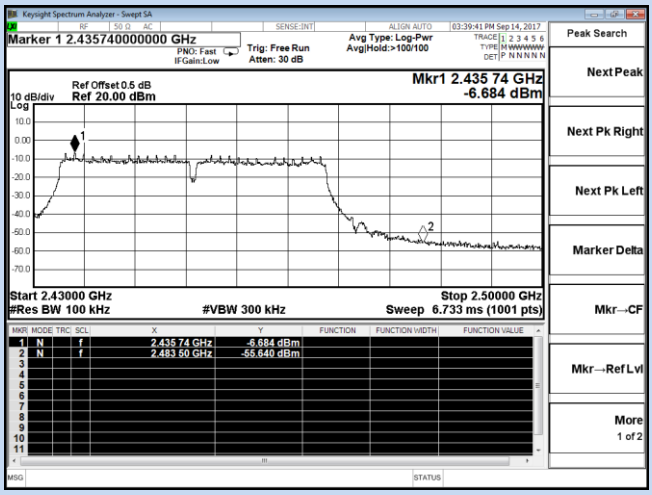
2392 MHz – 2452 MHz



Channel 3 / 2422 MHz



2422 MHz – 2482 MHz



Channel 9 / 2452 MHz

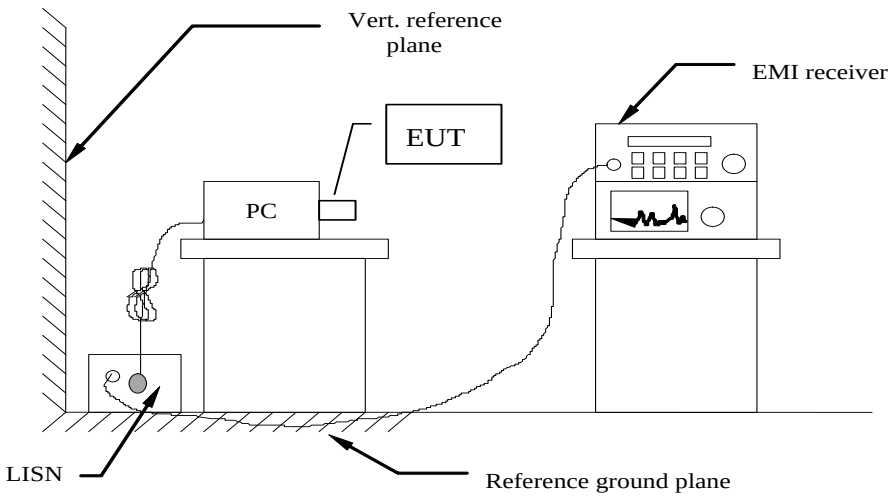
5.7. Power line conducted emissions

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 is 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

5.7.2 Block Diagram of Test Setup

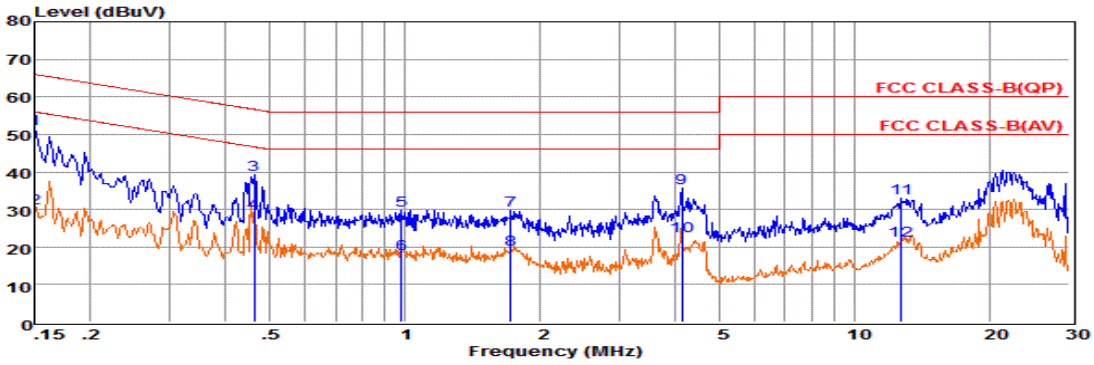


5.7.3 Test Results

PASS.

The test data please refer to following page.

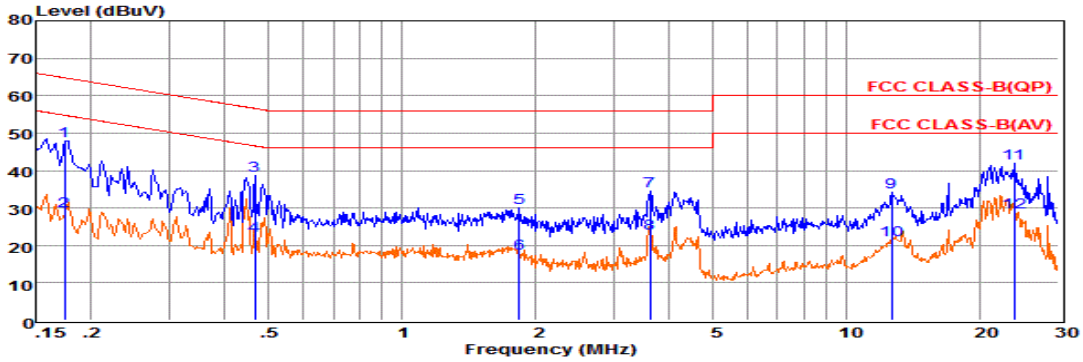
Temperature	24.5℃	Humidity	56.2%
Test Engineer	Jayden Zhuo	Test Date	September 13, 2017
Test result for 802.11b (AC 120V) (AC/DC Charger for Buoy)			



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.15	31.88	9.57	0.02	10.00	51.47	66.00	-14.53	QP
2	0.15	10.76	9.57	0.02	10.00	30.35	55.99	-25.64	Average
3	0.46	19.46	9.62	0.04	10.00	39.12	56.67	-17.55	QP
4	0.46	9.58	9.62	0.04	10.00	29.24	46.67	-17.43	Average
5	0.98	10.12	9.63	0.05	10.00	29.80	56.00	-26.20	QP
6	0.98	-1.44	9.63	0.05	10.00	18.24	46.00	-27.76	Average
7	1.72	10.11	9.64	0.05	10.00	29.80	56.00	-26.20	QP
8	1.72	-0.25	9.64	0.05	10.00	19.44	46.00	-26.56	Average
9	4.14	16.00	9.65	0.06	10.00	35.71	56.00	-20.29	QP
10	4.14	3.29	9.65	0.06	10.00	23.00	46.00	-23.00	Average
11	12.72	13.13	9.70	0.09	10.00	32.92	60.00	-27.08	QP
12	12.72	1.82	9.70	0.09	10.00	21.61	50.00	-28.39	Average

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

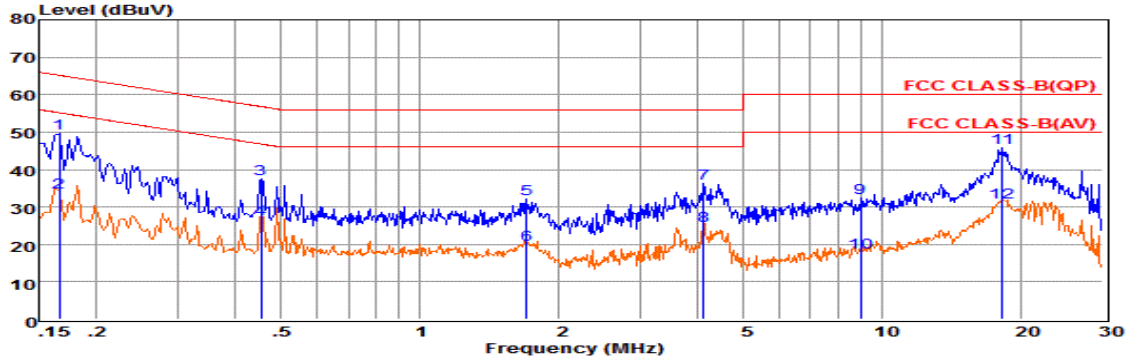


Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.17	28.33	9.64	0.02	10.00	47.99	64.77	-16.78	QP
2	0.17	9.49	9.64	0.02	10.00	29.15	54.76	-25.61	Average
3	0.47	18.98	9.62	0.04	10.00	38.64	56.58	-17.94	QP
4	0.47	2.99	9.62	0.04	10.00	22.65	46.58	-23.93	Average
5	1.84	10.27	9.63	0.05	10.00	29.95	56.00	-26.05	QP
6	1.84	-1.87	9.63	0.05	10.00	17.81	46.00	-28.19	Average
7	3.62	14.69	9.65	0.06	10.00	34.40	56.00	-21.60	QP
8	3.62	3.36	9.65	0.06	10.00	23.07	46.00	-22.93	Average
9	12.65	14.39	9.73	0.09	10.00	34.21	60.00	-25.79	QP
10	12.65	1.52	9.73	0.09	10.00	21.34	50.00	-28.66	Average
11	23.89	22.03	9.82	0.13	10.00	41.98	60.00	-18.02	QP
12	23.89	8.91	9.82	0.13	10.00	28.86	50.00	-21.14	Average

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

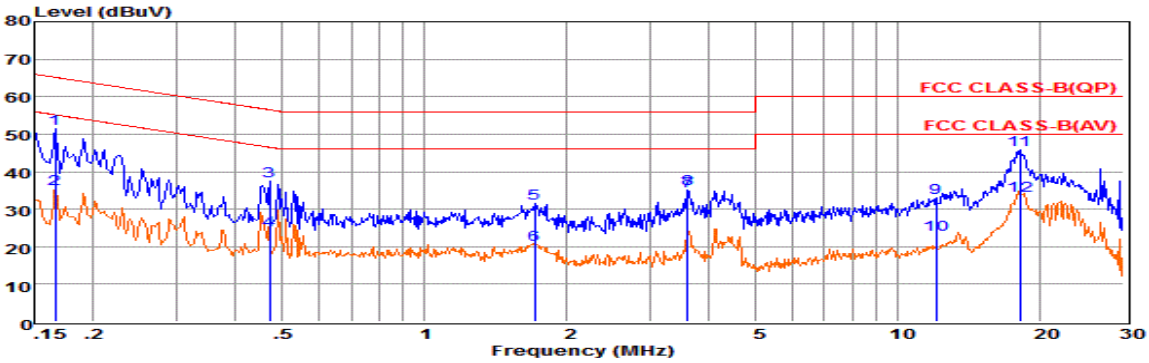
Temperature	24.5℃	Humidity	56.2%
Test Engineer	Jayden Zhuo	Test Date	September 13, 2017
Test result for 802.11b (AC 240V) (AC/DC Charger for Buoy)			



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.17	29.95	9.59	0.02	10.00	49.56	65.16	-15.60	QP
2	0.17	14.36	9.59	0.02	10.00	33.97	55.16	-21.19	Average
3	0.45	17.76	9.62	0.04	10.00	37.42	56.80	-19.38	QP
4	0.45	7.09	9.62	0.04	10.00	26.75	46.80	-20.05	Average
5	1.70	12.54	9.64	0.05	10.00	32.23	56.00	-23.77	QP
6	1.70	0.34	9.64	0.05	10.00	20.03	46.00	-25.97	Average
7	4.11	16.68	9.65	0.06	10.00	36.39	56.00	-19.61	QP
8	4.11	5.36	9.65	0.06	10.00	25.07	46.00	-20.93	Average
9	8.96	12.52	9.69	0.08	10.00	32.29	60.00	-27.71	QP
10	8.96	-2.05	9.69	0.08	10.00	17.72	50.00	-32.28	Average
11	18.23	25.91	9.74	0.11	10.00	45.76	60.00	-14.24	QP
12	18.23	11.49	9.74	0.11	10.00	31.34	50.00	-18.66	Average

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

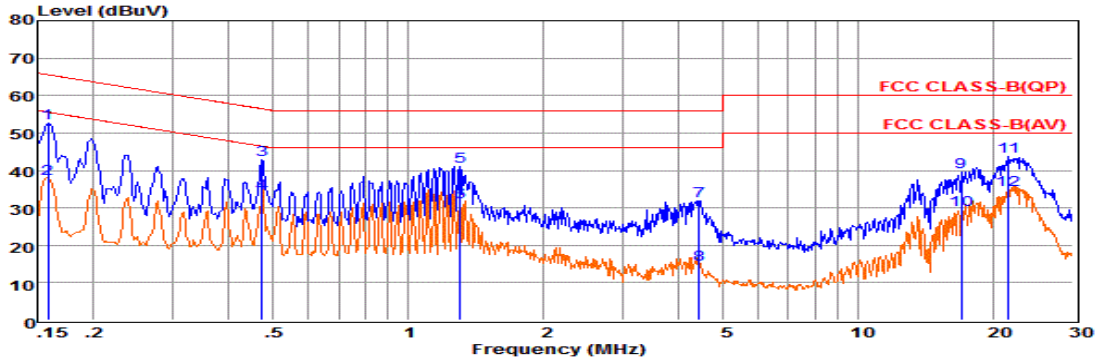


Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.17	31.73	9.66	0.02	10.00	51.41	65.16	-13.75	QP
2	0.17	15.58	9.66	0.02	10.00	35.26	55.16	-19.90	Average
3	0.47	17.69	9.62	0.04	10.00	37.35	56.49	-19.14	QP
4	0.47	4.79	9.62	0.04	10.00	24.45	46.49	-22.04	Average
5	1.71	11.98	9.63	0.05	10.00	31.66	56.00	-24.34	QP
6	1.71	0.83	9.63	0.05	10.00	20.51	46.00	-25.49	Average
7	3.60	15.05	9.65	0.06	10.00	34.76	56.00	-21.24	QP
8	3.60	15.71	9.65	0.06	10.00	35.42	46.00	-10.58	Average
9	12.06	13.31	9.73	0.09	10.00	33.13	60.00	-26.87	QP
10	12.06	3.51	9.73	0.09	10.00	23.33	50.00	-26.67	Average
11	18.14	25.86	9.81	0.11	10.00	45.78	60.00	-14.22	QP
12	18.14	13.57	9.81	0.11	10.00	33.49	50.00	-16.51	Average

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

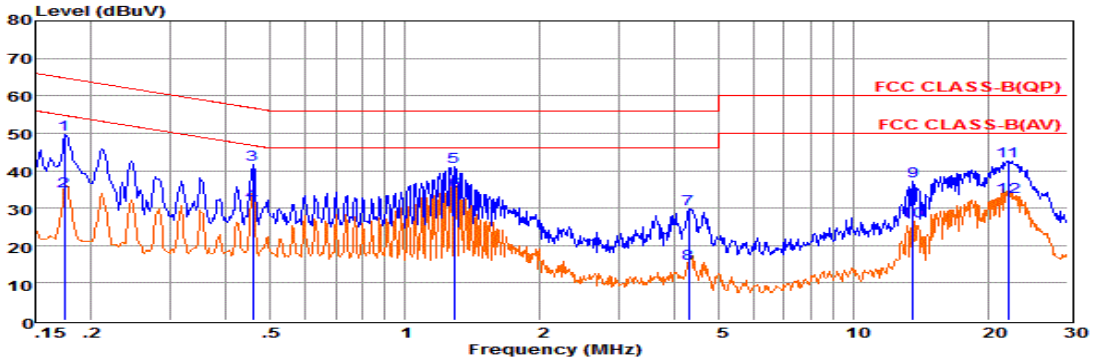
Temperature	24.5℃	Humidity	56.2%
Test Engineer	Jayden Zhuo	Test Date	September 13, 2017
Test result for 802.11b (AC 120V) (AC/DC Charger for Submersible Drone)			



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.16	33.14	9.58	0.02	10.00	52.74	65.56	-12.82	QP
2	0.16	18.19	9.58	0.02	10.00	37.79	55.55	-17.76	Average
3	0.47	23.26	9.62	0.04	10.00	42.92	56.45	-13.53	QP
4	0.47	14.29	9.62	0.04	10.00	33.95	46.45	-12.50	Average
5	1.30	21.44	9.63	0.05	10.00	41.12	56.00	-14.88	QP
6	1.30	11.79	9.63	0.05	10.00	31.47	46.00	-14.53	Average
7	4.43	12.14	9.65	0.06	10.00	31.85	56.00	-24.15	QP
8	4.43	-4.73	9.65	0.06	10.00	14.98	46.00	-31.02	Average
9	16.93	19.81	9.73	0.11	10.00	39.65	60.00	-20.35	QP
10	16.93	9.62	9.73	0.11	10.00	29.46	50.00	-20.54	Average
11	21.60	23.83	9.72	0.12	10.00	43.67	60.00	-16.33	QP
12	21.60	14.81	9.72	0.12	10.00	34.65	50.00	-15.35	Average

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

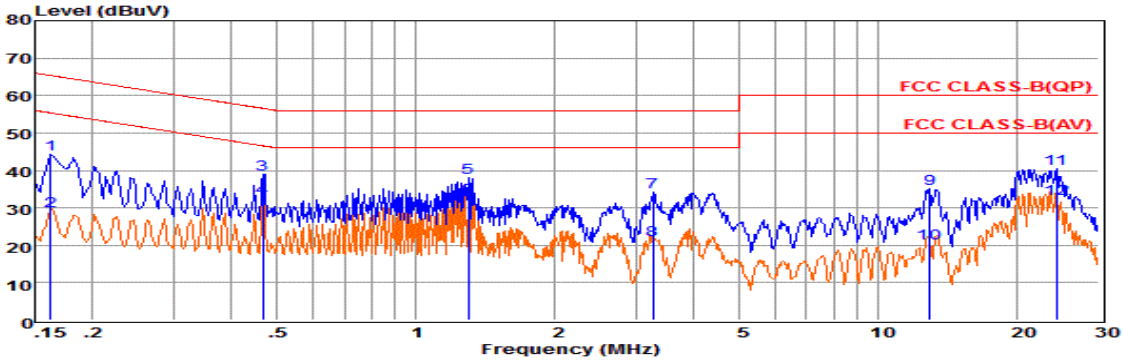


Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.17	29.95	9.64	0.02	10.00	49.61	64.77	-15.16	QP
2	0.17	14.72	9.64	0.02	10.00	34.38	54.76	-20.38	Average
3	0.46	22.11	9.62	0.04	10.00	41.77	56.71	-14.94	QP
4	0.46	11.73	9.62	0.04	10.00	31.39	46.71	-15.32	Average
5	1.29	21.27	9.63	0.05	10.00	40.95	56.00	-15.05	QP
6	1.29	14.67	9.63	0.05	10.00	34.35	46.00	-11.65	Average
7	4.29	9.96	9.65	0.06	10.00	29.67	56.00	-26.33	QP
8	4.29	-4.61	9.66	0.06	10.00	15.11	46.00	-30.89	Average
9	13.55	17.27	9.74	0.10	10.00	37.11	60.00	-22.89	QP
10	13.55	6.74	9.74	0.10	10.00	26.58	50.00	-23.42	Average
11	22.06	22.66	9.81	0.12	10.00	42.59	60.00	-17.41	QP
12	22.06	12.96	9.81	0.12	10.00	32.89	50.00	-17.11	Average

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

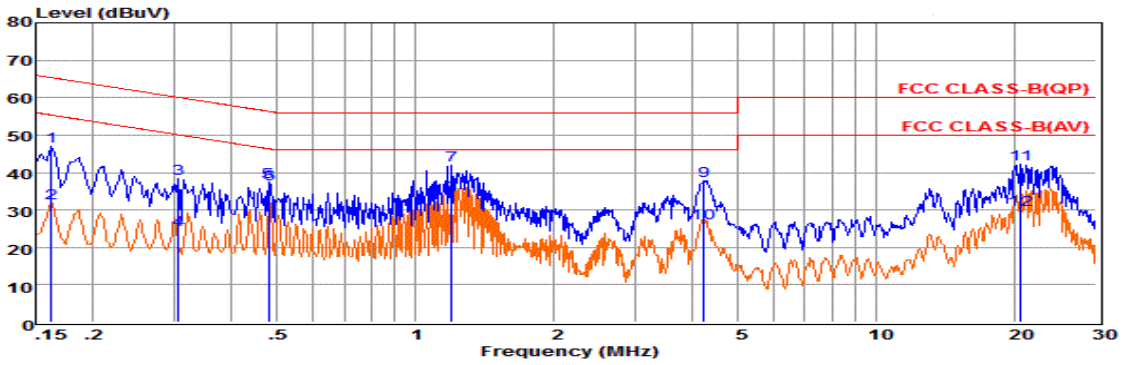
Temperature	24.5℃	Humidity	56.2%
Test Engineer	Jayden Zhuo	Test Date	September 13, 2017
Test result for 802.11b (AC 240V) (AC/DC Charger for Submersible Drone)			



Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.16	24.74	9.59	0.02	10.00	44.35	65.34	-20.99	QP
2	0.16	9.60	9.59	0.02	10.00	29.21	55.33	-26.12	Average
3	0.47	19.41	9.62	0.04	10.00	39.07	56.58	-17.51	QP
4	0.47	13.12	9.62	0.04	10.00	32.78	46.58	-13.80	Average
5	1.30	18.40	9.63	0.05	10.00	38.08	56.00	-17.92	QP
6	1.30	12.99	9.63	0.05	10.00	32.67	46.00	-13.33	Average
7	3.26	14.39	9.65	0.06	10.00	34.10	56.00	-21.90	QP
8	3.26	1.84	9.65	0.06	10.00	21.55	46.00	-24.45	Average
9	12.92	15.26	9.70	0.09	10.00	35.05	60.00	-24.95	QP
10	12.92	0.68	9.70	0.09	10.00	20.47	50.00	-29.53	Average
11	24.27	20.51	9.71	0.13	10.00	40.35	60.00	-19.65	QP
12	24.27	12.50	9.71	0.13	10.00	32.34	50.00	-17.66	Average

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



Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dB	Limit dBuV	Over dBuV	Remark dB
1	0.16	27.25	9.67	0.02	10.00	46.94	65.34	-18.40	QP
2	0.16	12.08	9.67	0.02	10.00	31.77	55.33	-23.56	Average
3	0.31	18.80	9.60	0.03	10.00	38.43	60.06	-21.63	QP
4	0.31	5.09	9.60	0.03	10.00	24.72	50.06	-25.34	Average
5	0.48	17.90	9.62	0.04	10.00	37.56	56.32	-18.76	QP
6	0.48	17.27	9.62	0.04	10.00	36.93	46.32	-9.39	Average
7	1.20	22.25	9.63	0.05	10.00	41.93	56.00	-14.07	QP
8	1.20	14.30	9.63	0.05	10.00	33.98	46.00	-12.02	Average
9	4.22	18.07	9.65	0.06	10.00	37.78	56.00	-18.22	QP
10	4.23	6.83	9.65	0.06	10.00	26.54	46.00	-19.46	Average
11	20.59	22.21	9.87	0.12	10.00	42.20	60.00	-17.80	QP
12	20.60	10.16	9.87	0.12	10.00	30.15	50.00	-19.85	Average

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

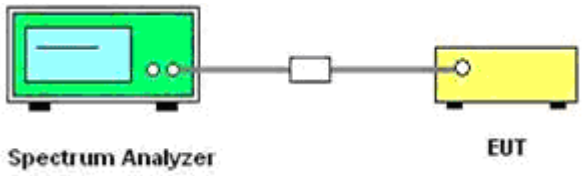
****Note: Pre-scan all modes and recorded the worst case results in this report (802.11b).*

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 – 20log 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	-41.902	3.0	0.000	56.356	Peak	74.00	-17.644	PASS
2310.000	-56.678	3.0	0.000	41.580	AV	54.00	-12.420	PASS
2390.000	-40.157	3.0	0.000	58.101	Peak	74.00	-15.899	PASS
2390.000	-55.461	3.0	0.000	42.797	AV	54.00	-11.203	PASS
2483.500	-44.218	3.0	0.000	54.040	Peak	74.00	-19.960	PASS
2483.500	-59.302	3.0	0.000	38.956	AV	54.00	-15.044	PASS
2500.000	-47.242	3.0	0.000	51.016	Peak	74.00	-22.984	PASS
2500.000	-59.711	3.0	0.000	38.547	AV	54.00	-15.453	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	-41.386	3.0	0.000	56.872	Peak	74.00	-17.128	PASS
2310.000	-56.490	3.0	0.000	41.768	AV	54.00	-12.232	PASS
2390.000	-42.924	3.0	0.000	55.334	Peak	74.00	-18.666	PASS
2390.000	-55.890	3.0	0.000	42.368	AV	54.00	-11.632	PASS
2483.500	-46.746	3.0	0.000	51.512	Peak	74.00	-22.488	PASS
2483.500	-59.291	3.0	0.000	38.967	AV	54.00	-15.033	PASS
2500.000	-47.467	3.0	0.000	50.791	Peak	74.00	-23.209	PASS
2500.000	-59.975	3.0	0.000	38.283	AV	54.00	-15.717	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	-40.772	3.0	0.000	57.486	Peak	74.00	-16.514	PASS
2310.000	-55.820	3.0	0.000	42.438	AV	54.00	-11.562	PASS
2390.000	-41.888	3.0	0.000	56.370	Peak	74.00	-17.630	PASS
2390.000	-55.960	3.0	0.000	42.298	AV	54.00	-11.702	PASS
2483.500	-45.649	3.0	0.000	52.609	Peak	74.00	-21.391	PASS
2483.500	-59.094	3.0	0.000	39.164	AV	54.00	-14.836	PASS
2500.000	-47.259	3.0	0.000	50.999	Peak	74.00	-23.001	PASS
2500.000	-59.961	3.0	0.000	38.297	AV	54.00	-15.703	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	-37.183	3.0	0.000	61.075	Peak	74.00	-12.925	PASS
2310.000	-53.851	3.0	0.000	44.407	AV	54.00	-9.593	PASS
2390.000	-42.796	3.0	0.000	55.462	Peak	74.00	-18.538	PASS
2390.000	-56.283	3.0	0.000	41.975	AV	54.00	-12.025	PASS
2483.500	-44.617	3.0	0.000	53.641	Peak	74.00	-20.359	PASS
2483.500	-57.618	3.0	0.000	40.640	AV	54.00	-13.360	PASS
2500.000	-48.056	3.0	0.000	50.202	Peak	74.00	-23.798	PASS
2500.000	-59.884	3.0	0.000	38.374	AV	54.00	-15.626	PASS

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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	-42.618	3.0	0.000	55.640	Peak	74.00	-18.360	PASS
2310.000	-56.660	3.0	0.000	41.598	AV	54.00	-12.402	PASS
2390.000	-38.767	3.0	0.000	59.491	Peak	74.00	-14.509	PASS
2390.000	-55.529	3.0	0.000	42.729	AV	54.00	-11.271	PASS
2483.500	-44.675	3.0	0.000	53.583	Peak	74.00	-20.417	PASS
2483.500	-59.310	3.0	0.000	38.948	AV	54.00	-15.052	PASS
2500.000	-46.746	3.0	0.000	51.512	Peak	74.00	-22.488	PASS
2500.000	-59.780	3.0	0.000	38.478	AV	54.00	-15.522	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	-43.968	3.0	0.000	54.290	Peak	74.00	-19.710	PASS
2310.000	-56.565	3.0	0.000	41.693	AV	54.00	-12.307	PASS
2390.000	-43.340	3.0	0.000	54.918	Peak	74.00	-19.082	PASS
2390.000	-55.916	3.0	0.000	42.342	AV	54.00	-11.658	PASS
2483.500	-46.696	3.0	0.000	51.562	Peak	74.00	-22.438	PASS
2483.500	-59.238	3.0	0.000	39.020	AV	54.00	-14.980	PASS
2500.000	-48.016	3.0	0.000	50.242	Peak	74.00	-23.758	PASS
2500.000	-59.953	3.0	0.000	38.305	AV	54.00	-15.695	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	-40.209	3.0	0.000	58.049	Peak	74.00	-15.951	PASS
2310.000	-55.788	3.0	0.000	42.470	AV	54.00	-11.530	PASS
2390.000	-43.258	3.0	0.000	55.000	Peak	74.00	-19.000	PASS
2390.000	-55.944	3.0	0.000	42.314	AV	54.00	-11.686	PASS
2483.500	-45.987	3.0	0.000	52.271	Peak	74.00	-21.729	PASS
2483.500	-59.080	3.0	0.000	39.178	AV	54.00	-14.822	PASS
2500.000	-47.602	3.0	0.000	50.656	Peak	74.00	-23.344	PASS
2500.000	-60.010	3.0	0.000	38.248	AV	54.00	-15.752	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	-37.636	3.0	0.000	60.622	Peak	74.00	-13.378	PASS
2310.000	-53.923	3.0	0.000	44.335	AV	54.00	-9.665	PASS
2390.000	-42.968	3.0	0.000	55.290	Peak	74.00	-18.710	PASS
2390.000	-56.282	3.0	0.000	41.976	AV	54.00	-12.024	PASS
2483.500	-43.263	3.0	0.000	54.995	Peak	74.00	-19.005	PASS
2483.500	-57.640	3.0	0.000	40.618	AV	54.00	-13.382	PASS
2500.000	-47.723	3.0	0.000	50.535	Peak	74.00	-23.465	PASS
2500.000	-59.820	3.0	0.000	38.438	AV	54.00	-15.562	PASS

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For Combined Antenna Chain 0 and Antenna Chain 1

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
	Chain 0	Chain 1	Sum							
2310.000*	-40.772	-40.209	-37.471	6.010*	0.000	63.797	Peak	74.00	-10.203	PASS
2310.000	-55.820	-55.788	-52.794	6.010*	0.000	48.474	AV	54.00	-5.526	PASS
2390.000	-41.888	-43.258	-39.509	6.010*	0.000	61.759	Peak	74.00	-12.241	PASS
2390.000	-55.960	-55.944	-52.942	6.010*	0.000	48.326	AV	54.00	-5.674	PASS
2483.500*	-45.649	-45.987	-42.804	6.010*	0.000	58.464	Peak	74.00	-15.536	PASS
2483.500	-59.094	-59.080	-56.077	6.010*	0.000	45.191	AV	54.00	-8.809	PASS
2500.000	-47.259	-47.602	-44.417	6.010*	0.000	56.851	Peak	74.00	-17.149	PASS
2500.000	-59.961	-60.010	-56.975	6.010*	0.000	44.293	AV	54.00	-9.707	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
	Chain 0	Chain 1	Sum							
2310.000*	-37.636	-37.636	-34.626	6.010*	0.000	66.642	Peak	74.00	-7.358	PASS
2310.000	-53.923	-53.923	-50.913	6.010*	0.000	50.355	AV	54.00	-3.645	PASS
2390.000	-42.968	-42.968	-39.958	6.010*	0.000	61.310	Peak	74.00	-12.690	PASS
2390.000	-56.282	-56.282	-53.272	6.010*	0.000	47.996	AV	54.00	-6.004	PASS
2483.500*	-43.263	-43.263	-40.253	6.010*	0.000	61.015	Peak	74.00	-12.985	PASS
2483.500	-57.640	-57.640	-54.630	6.010*	0.000	46.638	AV	54.00	-7.362	PASS
2500.000	-47.723	-47.723	-44.713	6.010*	0.000	56.555	Peak	74.00	-17.445	PASS
2500.000	-59.820	-59.820	-56.810	6.010*	0.000	44.458	AV	54.00	-9.542	PASS

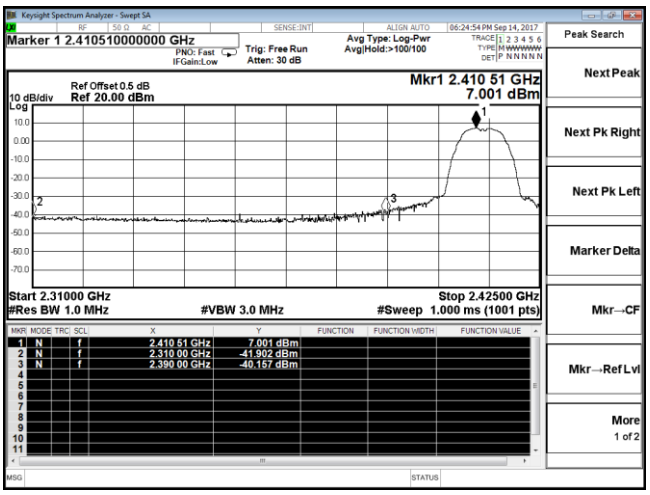
Remark:

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. *Covert Radiated E Level At 3m = Conducted average power + Directional Gain + 104.77-20*log(2);*
9. *Please refer to following plots;*

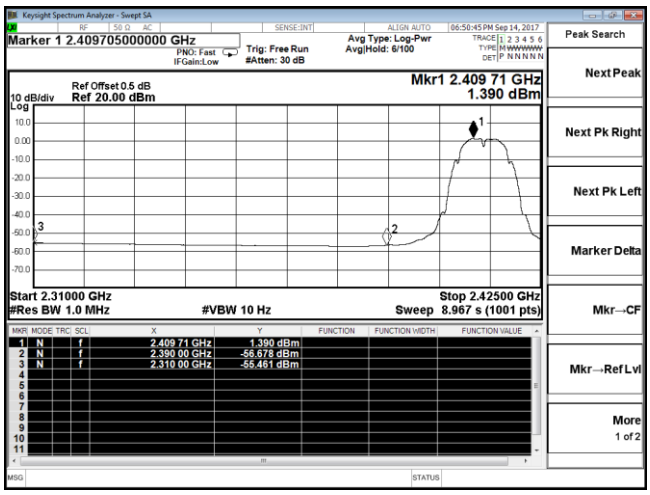
Band-edge measurements for radiated emissions

IEEE 802.11b

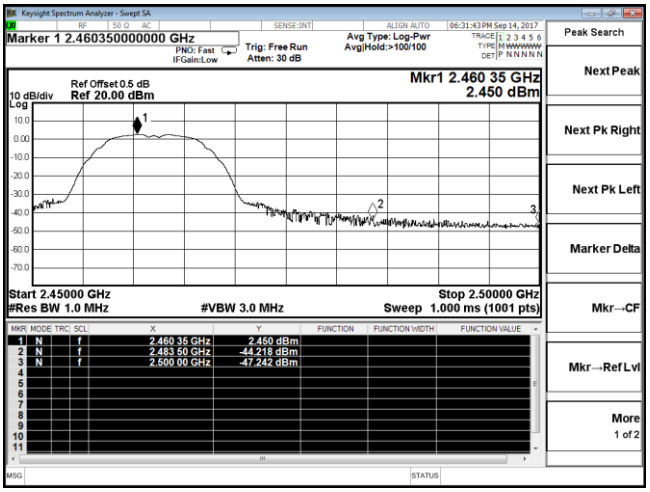
Chain 0



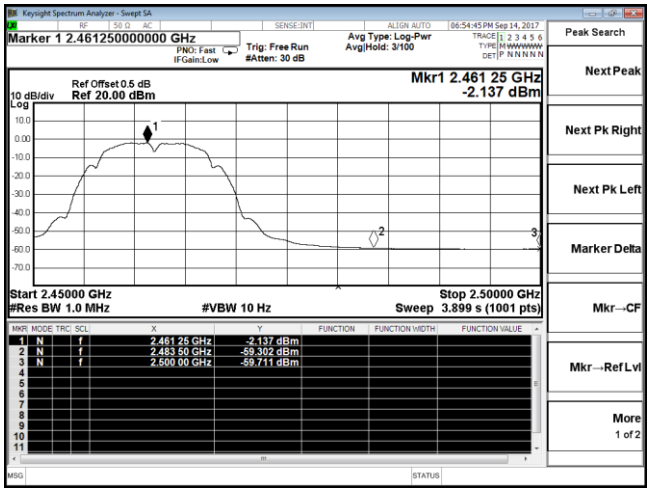
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average

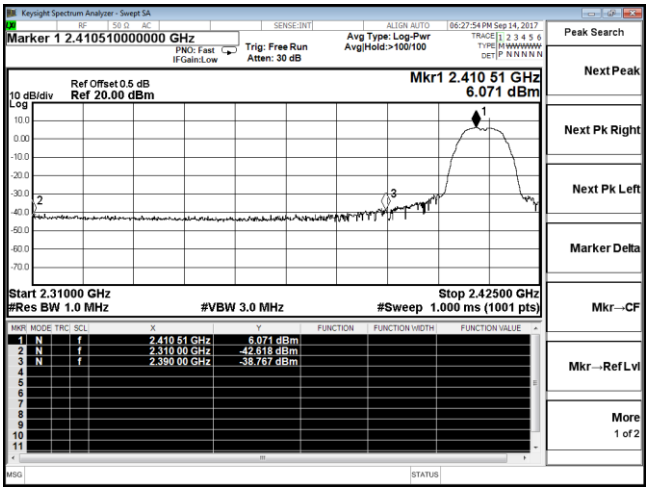


Channel 11 / 2462 MHz – Peak

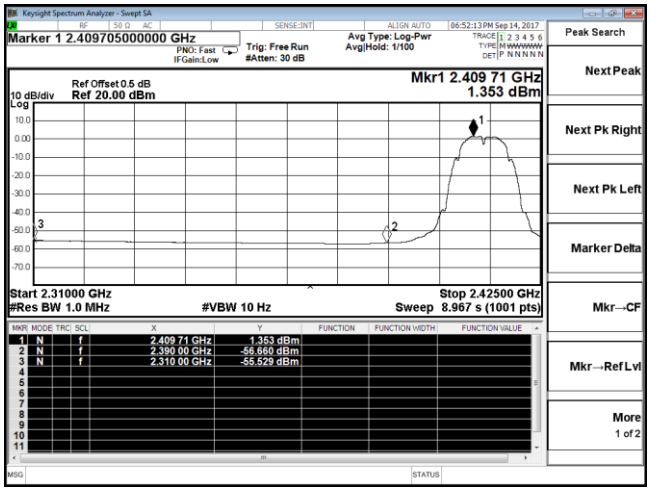


Channel 11 / 2462 MHz – Average

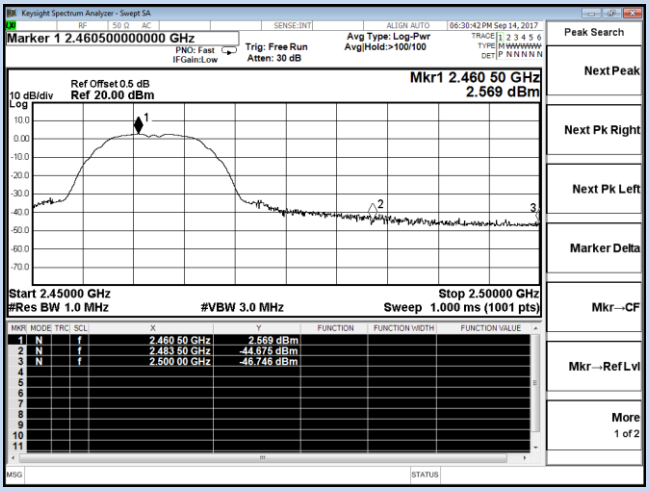
Chain 1



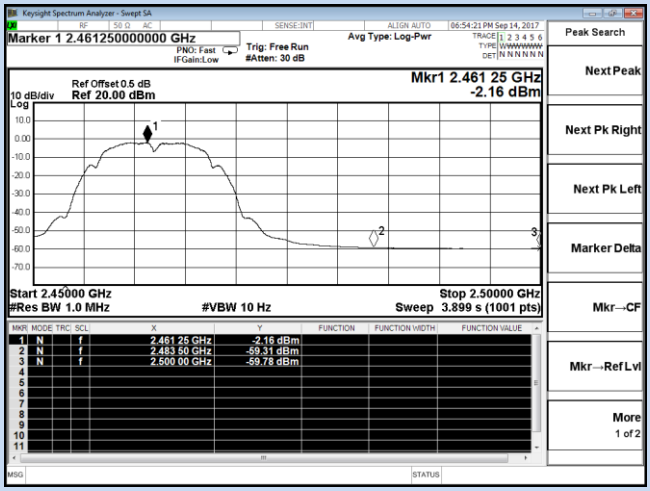
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average



Channel 11 / 2462 MHz – Peak

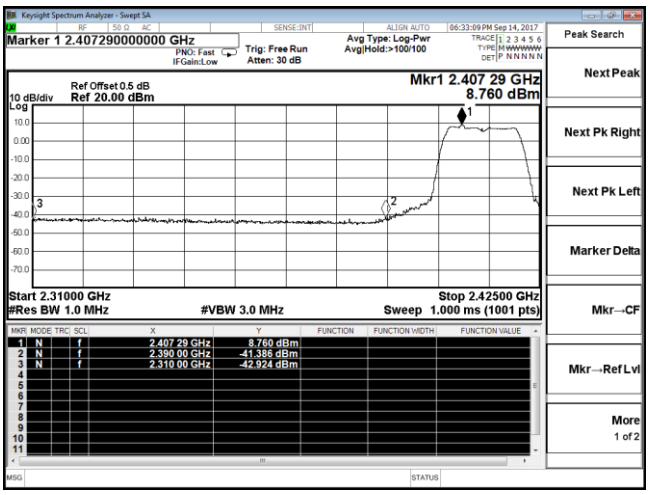


Channel 11 / 2462 MHz – Average

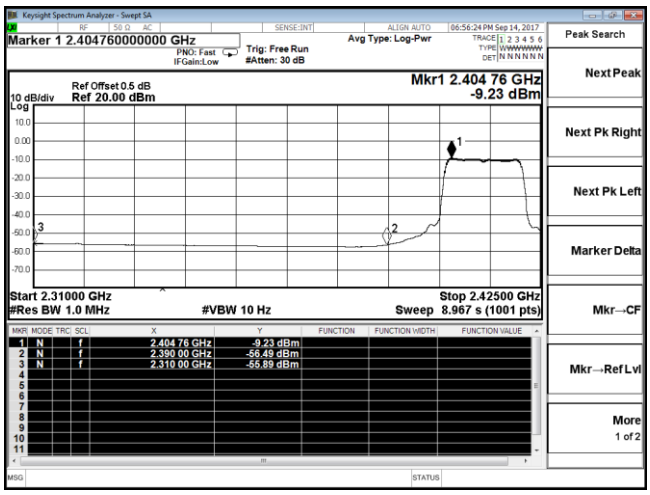
Band-edge measurements for radiated emissions

IEEE 802.11g

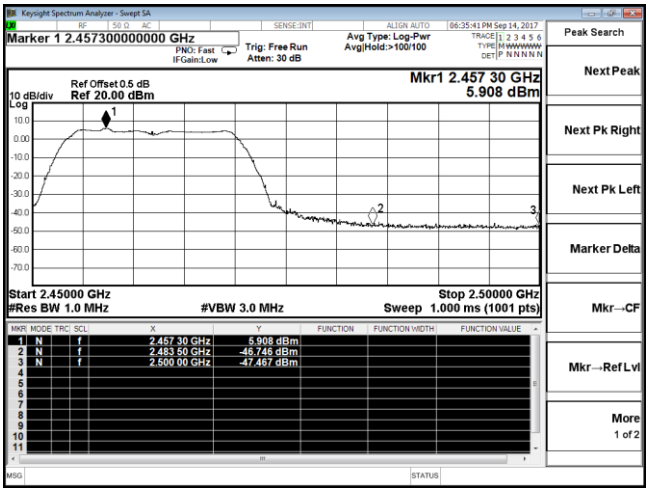
Chain 0



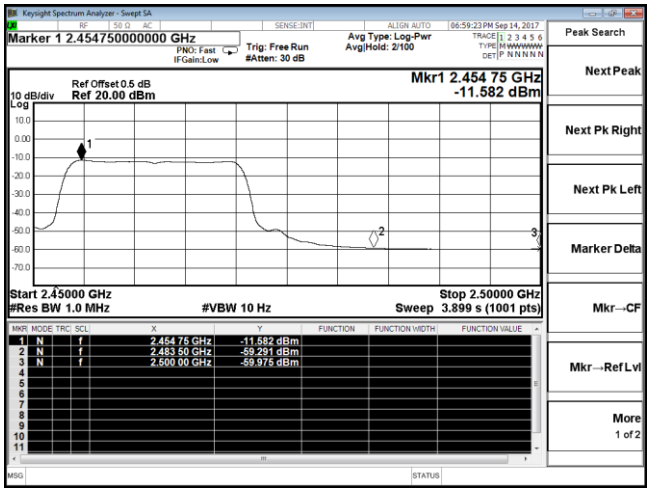
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average

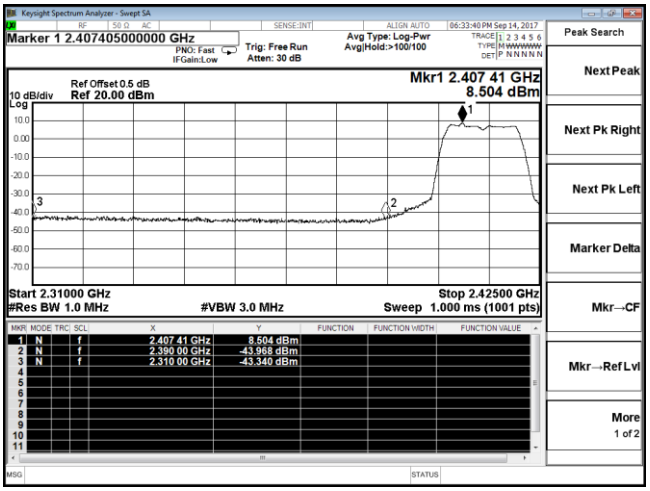


Channel 11 / 2462 MHz – Peak

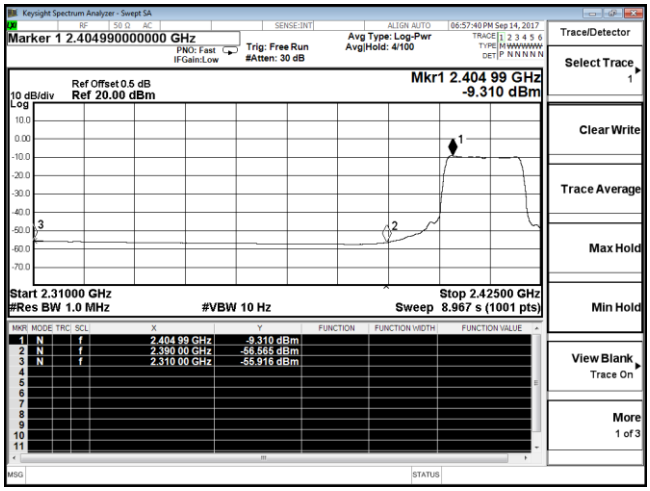


Channel 11 / 2462 MHz – Average

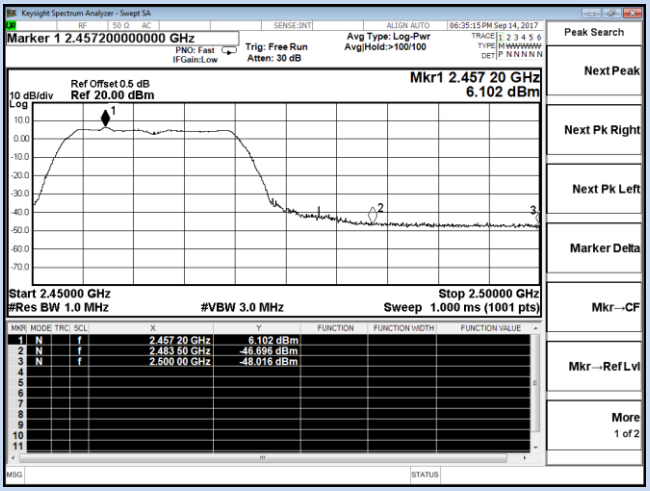
Chain 1



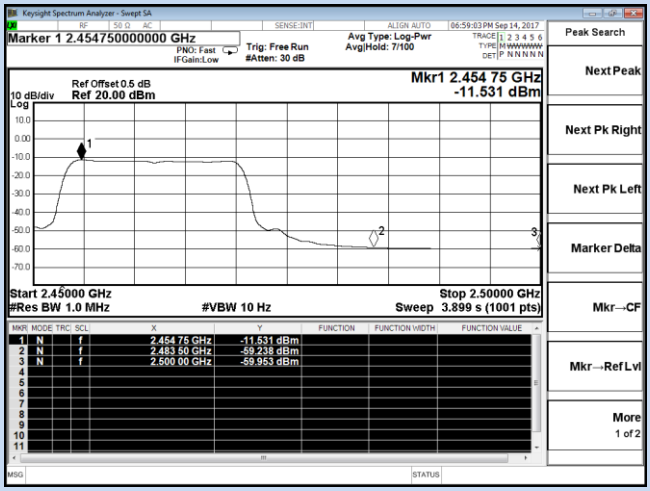
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average



Channel 11 / 2462 MHz – Peak

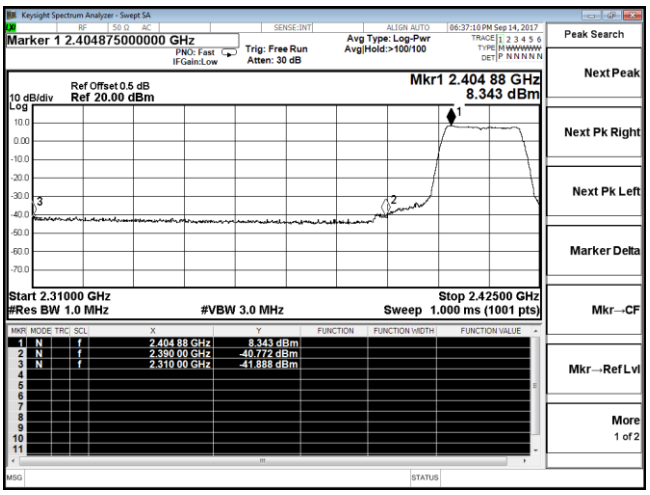


Channel 11 / 2462 MHz – Average

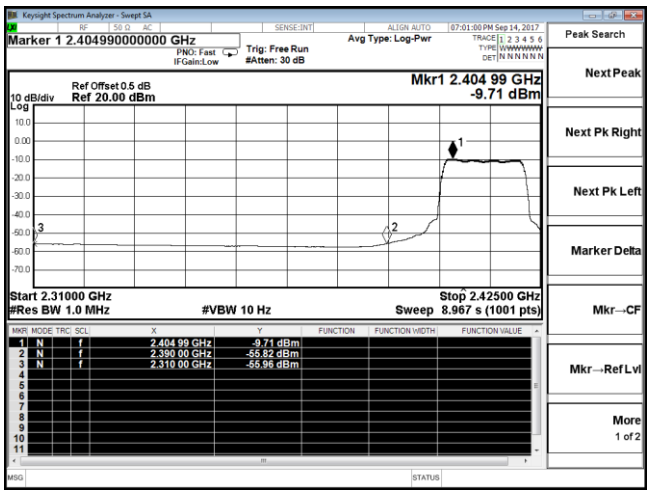
Band-edge measurements for radiated emissions

IEEE 802.11n HT20

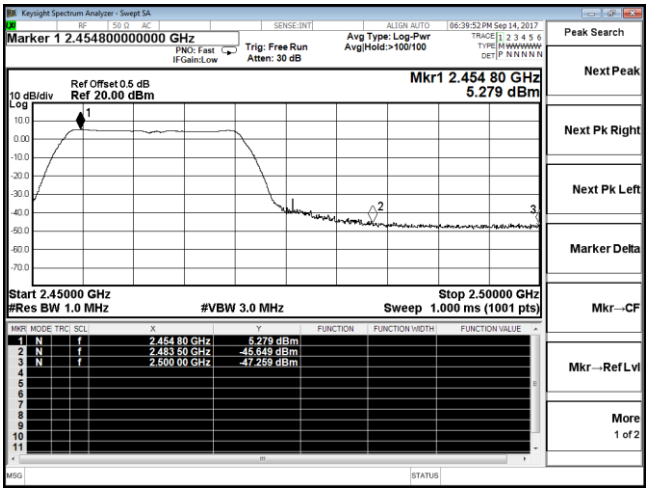
Chain 0



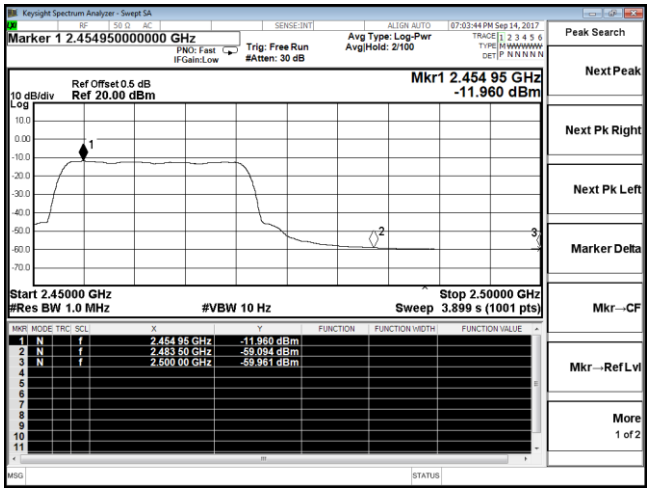
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average

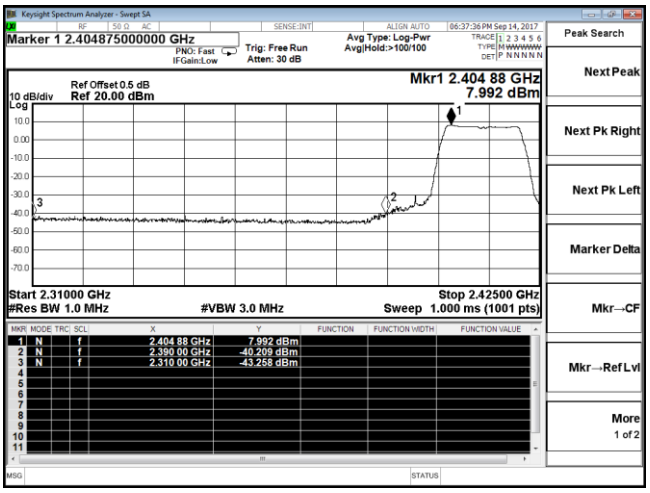


Channel 11 / 2462 MHz – Peak

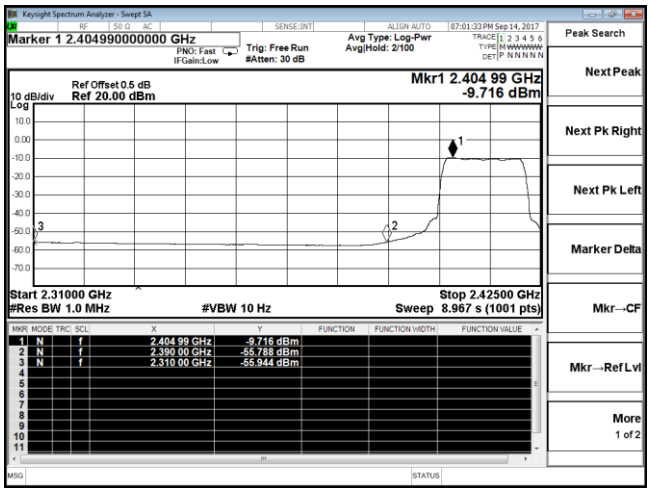


Channel 11 / 2462 MHz – Average

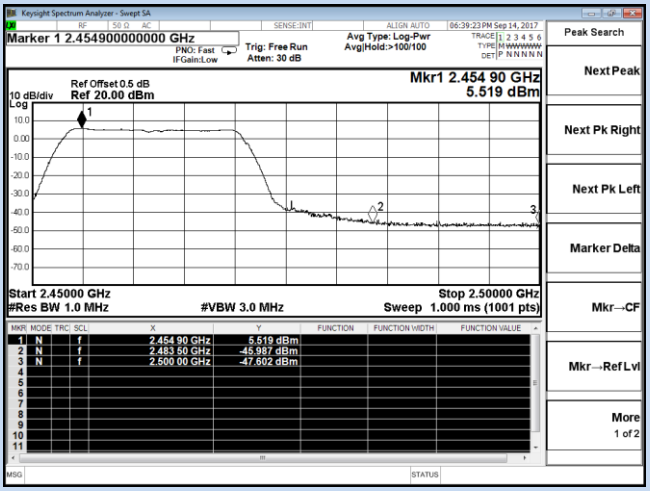
Chain 1



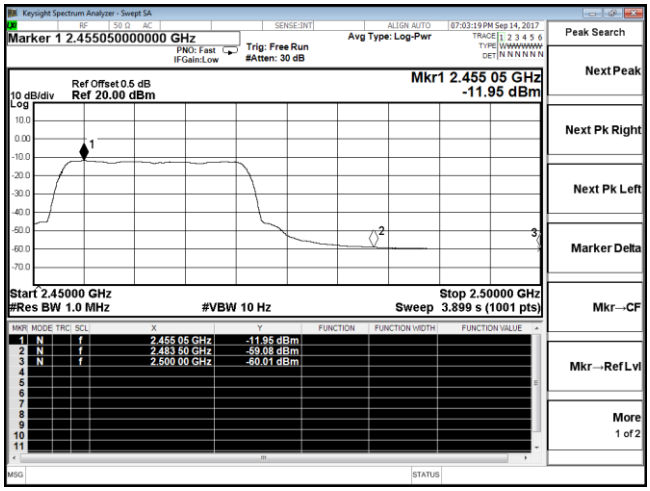
Channel 1 / 2412 MHz – Peak



Channel 1 / 2412 MHz – Average



Channel 11 / 2462 MHz – Peak

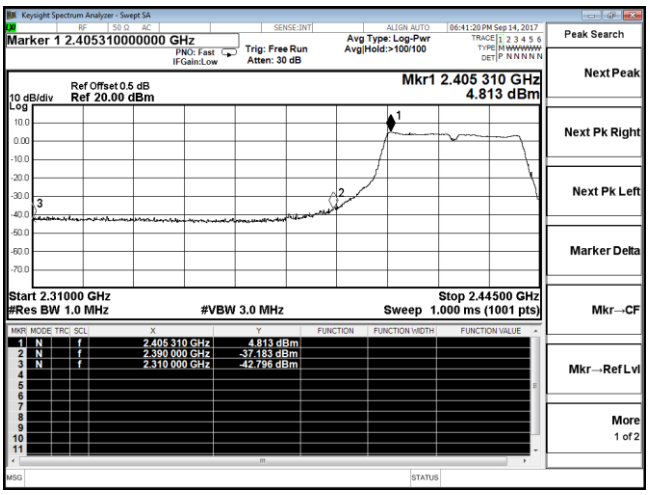


Channel 11 / 2462 MHz – Average

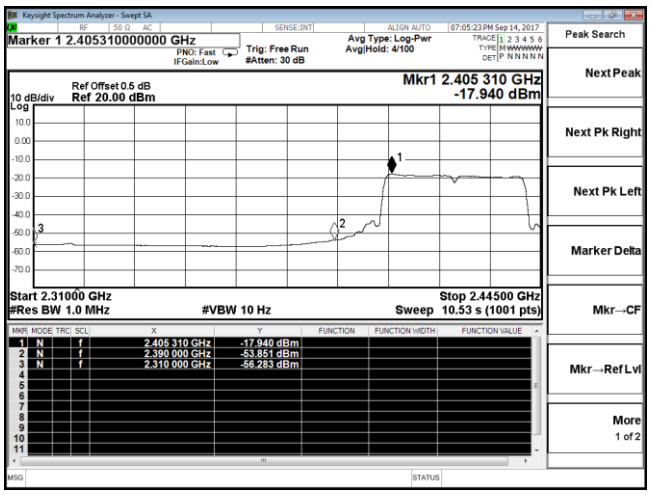
Band-edge measurements for radiated emissions

IEEE 802.11n HT40

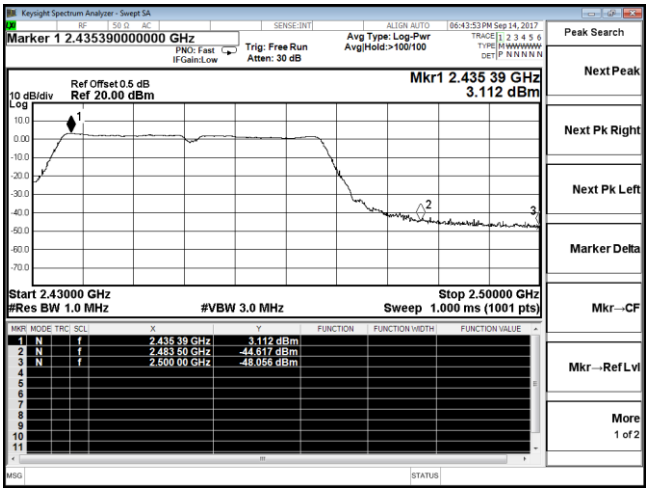
Chain 0



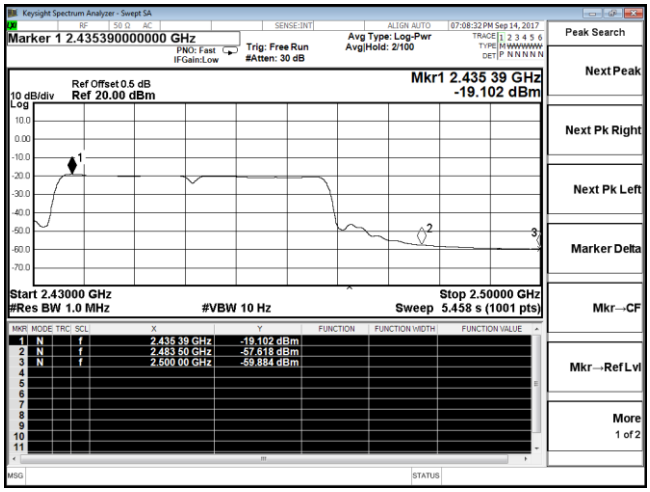
Channel 3 / 2422 MHz – Peak



Channel 3 / 2422 MHz – Average

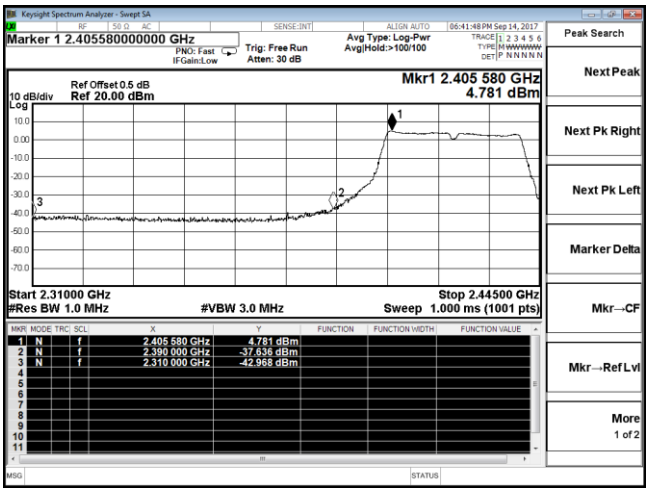


Channel 9 / 2452 MHz – Peak

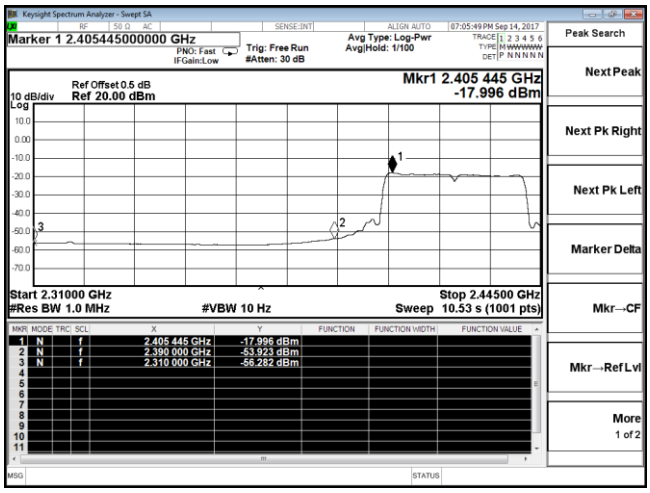


Channel 9 / 2452 MHz – Average

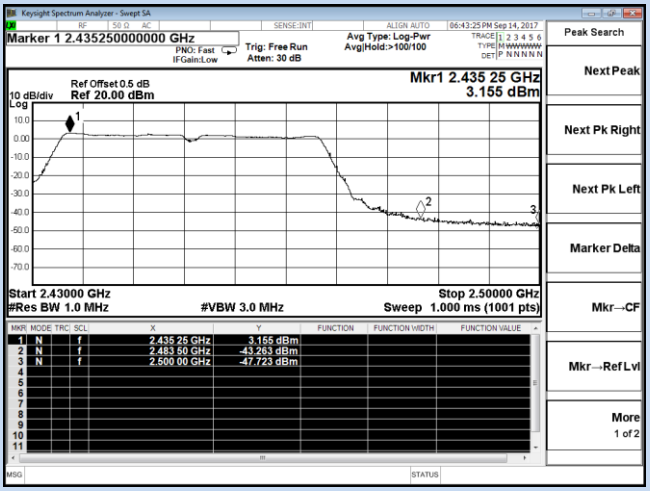
Chain 1



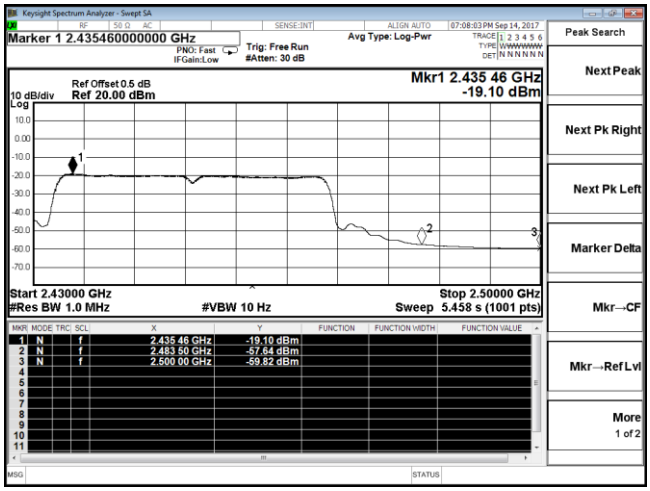
Channel 3 / 2422 MHz – Peak



Channel 3 / 2422 MHz – Average



Channel 9 / 2452 MHz – Peak



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 Connected Construction

5.9.2.1. Standard Applicable

According to § 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.

5.9.2.2. Antenna Connector Construction

The directional gains of antenna(s) used for transmitting is 3.0dBi, and the antenna(s) is integral antenna which is connected to the EUT and no consideration of replacement. Please see EUT photo for details.

5.9.2.3. 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		4.73	1.89	1.73
Radiated power [dBm] Measured with DSSS modulation		7.127	4.879	4.327
Gain [dBi] Calculated		2.397	2.989	2.597
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		4.13	1.81	1.66
Radiated power [dBm] Measured with DSSS modulation		6.548	4.603	4.327
Gain [dBi] Calculated		2.418	2.793	2.667
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

6. LIST OF MEASURING EQUIPMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	Power Meter	R&S	NRVS	100444	2017-06-17	2018-06-16
2	Power Sensor	R&S	NRV-Z81	100458	2017-06-17	2018-06-16
3	Power Sensor	R&S	NRV-Z32	10057	2017-06-17	2018-06-16
4	ESA-E SERIES SPECTRUM ANALYZER	Agilent	E4407B	MY41440754	2016-11-18	2017-11-17
5	MXA Signal Analyzer	Agilent	N9020A	MY49100040	2017-06-17	2018-06-16
6	SPECTRUM ANALYZER	R&S	FSP	100503	2017-06-17	2018-06-16
7	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2017-06-17	2018-06-16
8	Positioning Controller	MF	MF-7082	/	2017-06-17	2018-06-16
9	EMI Test Software	AUDIX	E3	N/A	2017-06-17	2018-06-16
10	EMI Test Receiver	R&S	ESR 7	101181	2017-06-17	2018-06-16
11	AMPLIFIER	QuieTek	QTK-A2525G	CHM10809065	2016-11-18	2017-11-17
12	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2017-06-23	2018-06-22
13	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2017-05-02	2018-05-01
14	Horn Antenna	EMCO	3115	6741	2017-06-23	2018-06-22
15	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2016-09-22	2017-09-21
16	Broadband Preamplifier	SCHWARZBECK	BBV 9719	9719-025	2016-09-22	2017-09-21
17	RF Cable-R03m	Jye Bao	RG142	CB021	2017-06-17	2018-06-16
18	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2017-06-17	2018-06-16
19	TEST RECEIVER	R&S	ESCI	101142	2017-06-17	2018-06-16
20	RF Cable-CON	UTIFLEX	3102-26886-4	CB049	2017-06-17	2018-06-16
21	10dB Attenuator	SCHWARZBECK	MTS-IMP136	261115-001-0032	2017-06-17	2018-06-16
22	Artificial Mains	R&S	ENV216	101288	2017-06-17	2018-06-16
Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.						

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7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files **Appendix A** for Test Setup Photographs of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files **Appendix B** for External Photographs of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files **Appendix C** for Internal Photographs of the EUT.

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