5.6. Power line conducted emissions

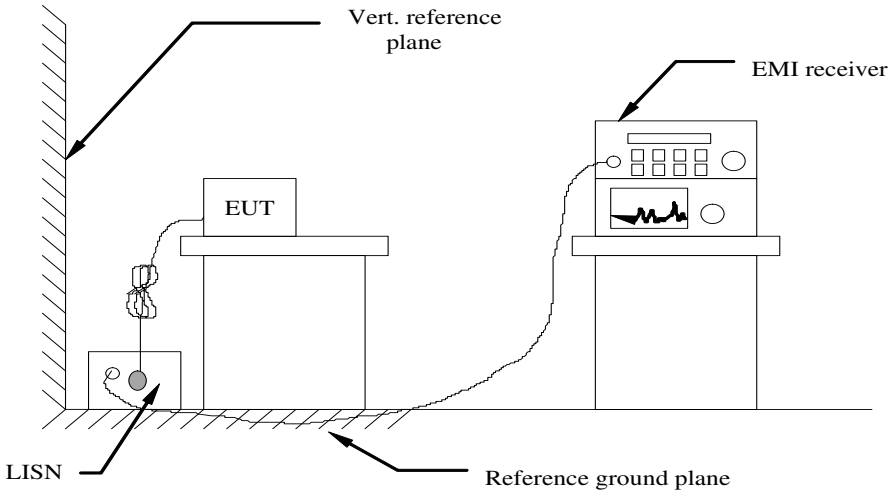
5.6.1 Standard Applicable

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

5.6.2 Block Diagram of Test Setup



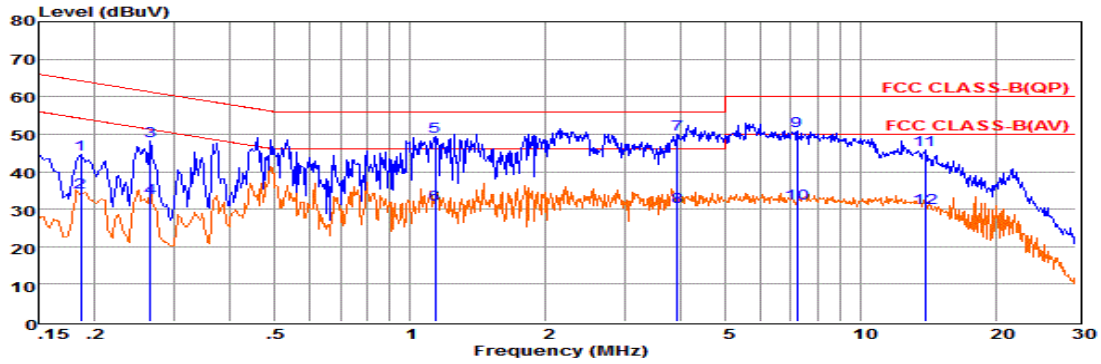
5.6.3 Test Results

PASS.

The test data please refer to following page.

AC Conducted Emission of power by adapter @ AC 120V/60Hz @ IEEE 802.11ac (worst case)

Line

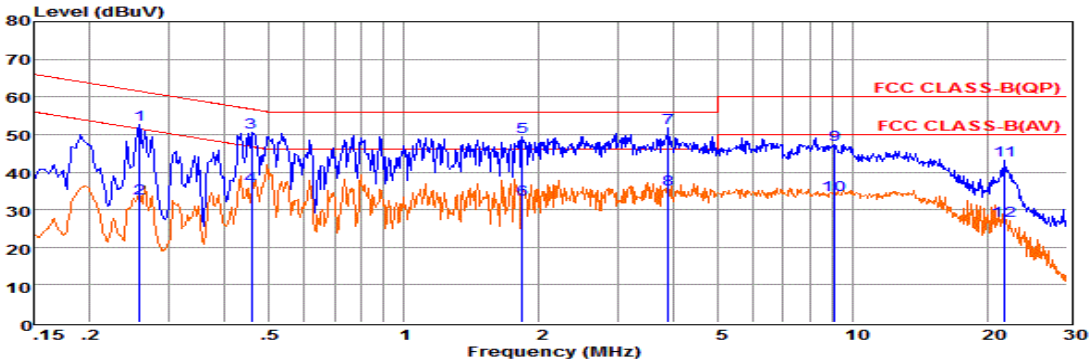


Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.19	25.12	9.62	0.02	10.00	44.76	64.20	-19.44	QP
2	0.19	14.79	9.62	0.02	10.00	34.43	54.19	-19.76	Average
3	0.27	28.39	9.63	0.03	10.00	48.05	61.25	-13.20	QP
4	0.27	13.24	9.63	0.03	10.00	32.90	51.24	-18.34	Average
5	1.14	29.78	9.63	0.05	10.00	49.46	56.00	-6.54	QP
6	1.14	11.60	9.63	0.05	10.00	31.28	46.00	-14.72	Average
7	3.92	30.11	9.65	0.06	10.00	49.82	56.00	-6.18	QP
8	3.92	10.99	9.65	0.06	10.00	30.70	46.00	-15.30	Average
9	7.21	31.11	9.68	0.07	10.00	50.86	60.00	-9.14	QP
10	7.21	11.63	9.68	0.07	10.00	31.38	50.00	-18.62	Average
11	13.91	25.97	9.71	0.10	10.00	45.78	60.00	-14.22	QP
12	13.92	10.56	9.71	0.10	10.00	30.37	50.00	-19.63	Average

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

Neutral



Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.26	32.89	9.60	0.03	10.00	52.52	61.51	-8.99	QP
2	0.26	13.52	9.60	0.03	10.00	33.15	51.51	-18.36	Average
3	0.46	30.79	9.62	0.04	10.00	50.45	56.71	-6.26	QP
4	0.46	16.71	9.62	0.04	10.00	36.37	46.71	-10.34	Average
5	1.84	29.72	9.63	0.05	10.00	49.40	56.00	-6.60	QP
6	1.84	12.94	9.63	0.05	10.00	32.62	46.00	-13.38	Average
7	3.88	32.11	9.65	0.06	10.00	51.82	56.00	-4.18	QP
8	3.88	15.76	9.65	0.06	10.00	35.47	46.00	-10.53	Average
9	9.11	27.56	9.71	0.08	10.00	47.35	60.00	-12.65	QP
10	9.11	13.97	9.71	0.08	10.00	33.76	50.00	-16.24	Average
11	21.83	23.26	9.82	0.12	10.00	43.20	60.00	-16.80	QP
12	21.83	7.27	9.82	0.12	10.00	27.21	50.00	-22.79	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 (IEEE 802.11ac VHT20 mode (High Channel, Combined Antenna Chain0 and Antenna Chain1)).*

5.7 Undesirable Emissions Measurement

5.7.1 Limit

According to ξ15.407 (b) Undesirable emission limits. Except as shown in paragraph (b) (7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(a) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(b) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(c) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(d) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

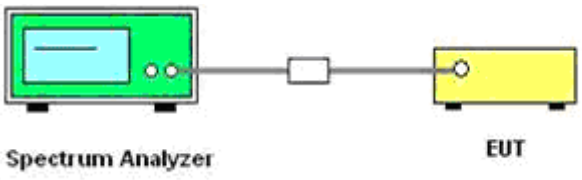
(e) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(f) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(g) The provisions of §15.205 apply to intentional radiators operating under this section.

(h) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

5.7.2 Test Configuration



5.7.3 Test Procedure

According to KDB789033 D02 General UNII Test Procedures New Rules v01 Section G: Unwanted Emission Measurement

1. Unwanted Emissions in the Restricted Bands

a) For all measurements, follow the requirements in section II.G.3. “General Requirements for Unwanted Emissions Measurements.”

b) At frequencies below 1000 MHz, use the procedure described in section II.G.4. “Procedure for Unwanted Emissions Measurements below 1000 MHz.”

c) At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in sections II.G.5. and II.G.6, respectively, must satisfy the respective peak and average limits. If all peak measurements satisfy the average limit, then average measurements are not required.

d) For conducted measurements above 1000 MHz, EIRP shall be computed as specified in section II.G.3.b) and then field strength shall be computed as follows (see KDB Publication 412172):

i) E[dBµV/m] = EIRP[dBm] - 20 log (d[meters]) + 104.77, where E = field strength and d = distance at which field strength limit is specified in the rules;

ii) E[dBμV/m] = EIRP[dBm] + 95.2, for d = 3 meters

e) For conducted measurements below 1000 MHz, the field strength shall be computed as specified in d), above, and then an additional 4.7 dB shall be added as an upper bound on the field strength that would be observed on a test range with a ground plane for frequencies between 30 MHz and 1000 MHz, or an additional 6 dB shall be added for frequencies below 30 MHz.

2. Unwanted Emissions that fall Outside of the Restricted Bands

a) For all measurements, follow the requirements in section II.G.3. “General Requirements for Unwanted Emissions Measurements.”

b) At frequencies below 1000 MHz, use the procedure described in section II.G.4. “Procedure for Unwanted Emissions Measurements below 1000 MHz.”

c) At frequencies above 1000 MHz, use the procedure for maximum emissions described in section II.G.5., “Procedure for Unwanted Maximum Unwanted Emissions Measurements Above 1000 MHz.”

d) Section 15.407(b) (1-3) specifies the unwanted emissions limit for the U-NII-1 and 2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz. However, an out-of-band emission that complies with both the average and peak limits of Section 15.209 is not required to satisfy the -27 dBm/MHz dBm/MHz peak emission limit.

i) Section 15.407(b) (4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b) (4) (i). An alternative to the band emissions mask is specified in Section 15.407(b) (4) (ii). The alternative limits are based on the highest antenna gain specified in the filing. There are also marketing and importation restrictions for the alternative limit.

e) If radiated measurements are performed, field strength is then converted to EIRP as follows:

i) EIRP = ((E×d) ^2) / 30

Where:

- E is the field strength in V/m;
- d is the measurement distance in meters;
- EIRP is the equivalent isotopically radiated power in watts;

ii) Working in dB units, the above equation is equivalent to:
EIRP [dBm] = E [dBμV/m] + 20 log (d [meters]) - 104.77

iii) Or, if d is 3 meters:
EIRP [dBm] = E [dBμV/m] - 95.23

3) Radiated versus Conducted Measurements.

The unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance provided that the following steps are performed:

(i) Cabinet emissions measurements. A radiated test shall be performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna may be replaced by a termination matching the nominal impedance of the antenna.

(ii) Impedance matching. Conducted tests shall be performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT.

(iii) EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) 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.3 However, for devices that operate in multiple bands using the same transmit antenna, the highest gain of the antenna within the operating band nearest to the out-of-band frequency being measured may be used in lieu of the overall highest gain when measuring emissions at frequencies within 20% of the absolute frequency at the nearest edge of that band, but in no case shall a value less than 2 dBi be selected.

(iv) EIRP adjustments for multiple outputs. For devices with multiple outputs occupying the same or overlapping frequency ranges in the same band (e.g., MIMO or beamforming devices), compute the total EIRP as follows:

- Compute EIRP for each output, as described in (iii), above.
- Follow the procedures specified in KDB Publication 662911 for summing emissions across the outputs or adjusting emission levels measured on individual outputs by 10 log (N_{ANT}), where N_{ANT} is the number of outputs.
- Add the array gain term specified in KDB Publication 662911 for out-of-band and spurious signals.

(v) Direction of maximum emission.

For all radiated emissions tests, measurements shall correspond to the direction of maximum emission level for each measured emission (see ANSI C63.10 for guidance).

5.7.4 Test Results

IEEE 802.11a (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.08	2.0	0.000	55.18	PEAK	74.00	PASS
5150.0	-41.16	2.0	0.000	56.10	PEAK	74.00	PASS
4500.0	-51.74	2.0	0.000	45.52	AV	54.00	PASS
5150.0	-50.27	2.0	0.000	46.99	AV	54.00	PASS
5350.0	-41.60	2.0	0.000	55.66	PEAK	74.00	PASS
5460.0	-32.44	2.0	0.000	64.82	PEAK	74.00	PASS
5350.0	-51.73	2.0	0.000	45.53	AV	54.00	PASS
5460.0	-47.54	2.0	0.000	49.72	AV	54.00	PASS

IEEE 802.11n HT20 (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-40.94	2.0	0.000	56.32	PEAK	74.00	PASS
5150.0	-40.67	2.0	0.000	56.59	PEAK	74.00	PASS
4500.0	-51.76	2.0	0.000	45.50	AV	54.00	PASS
5150.0	-50.26	2.0	0.000	47.00	AV	54.00	PASS
5350.0	-41.24	2.0	0.000	56.02	PEAK	74.00	PASS
5460.0	-40.10	2.0	0.000	57.16	PEAK	74.00	PASS
5350.0	-51.76	2.0	0.000	45.50	AV	54.00	PASS
5460.0	-52.03	2.0	0.000	45.23	AV	54.00	PASS

IEEE 802.11ac VHT20 (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-41.49	2.0	0.000	55.77	PEAK	74.00	PASS
5150.0	-40.83	2.0	0.000	56.43	PEAK	74.00	PASS
4500.0	-51.68	2.0	0.000	45.58	AV	54.00	PASS
5150.0	-50.26	2.0	0.000	47.00	AV	54.00	PASS
5350.0	-41.90	2.0	0.000	55.36	PEAK	74.00	PASS
5460.0	-40.67	2.0	0.000	56.59	PEAK	74.00	PASS
5350.0	-51.79	2.0	0.000	45.47	AV	54.00	PASS
5460.0	-52.06	2.0	0.000	45.20	AV	54.00	PASS

IEEE 802.11n HT40 (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-41.76	2.0	0.000	55.50	PEAK	74.00	PASS
5150.0	-41.20	2.0	0.000	56.06	PEAK	74.00	PASS
4500.0	-51.72	2.0	0.000	45.54	AV	54.00	PASS
5150.0	-50.24	2.0	0.000	47.02	AV	54.00	PASS
5350.0	-41.60	2.0	0.000	55.66	PEAK	74.00	PASS
5460.0	-42.31	2.0	0.000	54.95	PEAK	74.00	PASS
5350.0	-51.46	2.0	0.000	45.80	AV	54.00	PASS
5460.0	-51.77	2.0	0.000	45.49	AV	54.00	PASS

IEEE 802.11ac VHT40 (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.73	2.0	0.000	54.53	PEAK	74.00	PASS
5150.0	-40.24	2.0	0.000	57.02	PEAK	74.00	PASS
4500.0	-51.71	2.0	0.000	45.55	AV	54.00	PASS
5150.0	-50.24	2.0	0.000	47.02	AV	54.00	PASS
5350.0	-41.42	2.0	0.000	55.84	PEAK	74.00	PASS
5460.0	-41.69	2.0	0.000	55.57	PEAK	74.00	PASS
5350.0	-51.52	2.0	0.000	45.74	AV	54.00	PASS
5460.0	-51.72	2.0	0.000	45.54	AV	54.00	PASS

IEEE 802.11ac VHT80 (Antenna Chain0)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.28	2.0	0.000	54.98	PEAK	74.00	PASS
5150.0	-40.26	2.0	0.000	57.00	PEAK	74.00	PASS
4500.0	-51.68	2.0	0.000	45.58	AV	54.00	PASS
5150.0	-50.01	2.0	0.000	47.25	AV	54.00	PASS
5350.0	-41.33	2.0	0.000	55.93	PEAK	74.00	PASS
5460.0	-41.82	2.0	0.000	55.44	PEAK	74.00	PASS
5350.0	-50.88	2.0	0.000	46.38	AV	54.00	PASS
5460.0	-51.24	2.0	0.000	46.02	AV	54.00	PASS

IEEE 802.11a (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.14	2.0	0.000	55.12	PEAK	74.00	PASS
5150.0	-40.87	2.0	0.000	56.39	PEAK	74.00	PASS
4500.0	-51.81	2.0	0.000	45.45	AV	54.00	PASS
5150.0	-50.30	2.0	0.000	46.96	AV	54.00	PASS
5350.0	-41.20	2.0	0.000	56.06	PEAK	74.00	PASS
5460.0	-41.66	2.0	0.000	55.60	PEAK	74.00	PASS
5350.0	-51.05	2.0	0.000	46.21	AV	54.00	PASS
5460.0	-51.28	2.0	0.000	45.98	AV	54.00	PASS

IEEE 802.11n HT20 (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.52	2.0	0.000	54.74	PEAK	74.00	PASS
5150.0	-39.19	2.0	0.000	58.07	PEAK	74.00	PASS
4500.0	-51.80	2.0	0.000	45.46	AV	54.00	PASS
5150.0	-50.31	2.0	0.000	46.95	AV	54.00	PASS
5350.0	-41.57	2.0	0.000	55.69	PEAK	74.00	PASS
5460.0	-41.69	2.0	0.000	55.57	PEAK	74.00	PASS
5350.0	-51.84	2.0	0.000	45.42	AV	54.00	PASS
5460.0	-52.16	2.0	0.000	45.10	AV	54.00	PASS

IEEE 802.11ac VHT20 (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-41.28	2.0	0.000	55.98	PEAK	74.00	PASS
5150.0	-41.05	2.0	0.000	56.21	PEAK	74.00	PASS
4500.0	-51.83	2.0	0.000	45.43	AV	54.00	PASS
5150.0	-50.39	2.0	0.000	46.87	AV	54.00	PASS
5350.0	-41.81	2.0	0.000	55.45	PEAK	74.00	PASS
5460.0	-42.10	2.0	0.000	55.16	PEAK	74.00	PASS
5350.0	-51.88	2.0	0.000	45.38	AV	54.00	PASS
5460.0	-52.10	2.0	0.000	45.16	AV	54.00	PASS

IEEE 802.11n HT40 (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.15	2.0	0.000	55.11	PEAK	74.00	PASS
5150.0	-41.11	2.0	0.000	56.15	PEAK	74.00	PASS
4500.0	-51.80	2.0	0.000	45.46	AV	54.00	PASS
5150.0	-50.34	2.0	0.000	46.92	AV	54.00	PASS
5350.0	-41.31	2.0	0.000	55.95	PEAK	74.00	PASS
5460.0	-40.96	2.0	0.000	56.30	PEAK	74.00	PASS
5350.0	-51.58	2.0	0.000	45.68	AV	54.00	PASS
5460.0	-51.84	2.0	0.000	45.42	AV	54.00	PASS

IEEE 802.11ac VHT40 (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-42.79	2.0	0.000	54.47	PEAK	74.00	PASS
5150.0	-39.87	2.0	0.000	57.39	PEAK	74.00	PASS
4500.0	-51.82	2.0	0.000	45.44	AV	54.00	PASS
5150.0	-50.30	2.0	0.000	46.96	AV	54.00	PASS
5350.0	-41.06	2.0	0.000	56.20	PEAK	74.00	PASS
5460.0	-41.99	2.0	0.000	55.27	PEAK	74.00	PASS
5350.0	-51.57	2.0	0.000	45.69	AV	54.00	PASS
5460.0	-51.80	2.0	0.000	45.46	AV	54.00	PASS

IEEE 802.11ac VHT80 (Antenna Chain1)							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
4500.0	-41.81	2.0	0.000	55.45	PEAK	74.00	PASS
5150.0	-39.69	2.0	0.000	57.57	PEAK	74.00	PASS
4500.0	-51.70	2.0	0.000	45.56	AV	54.00	PASS
5150.0	-49.94	2.0	0.000	47.32	AV	54.00	PASS
5350.0	-41.29	2.0	0.000	55.97	PEAK	74.00	PASS
5460.0	-41.54	2.0	0.000	55.72	PEAK	74.00	PASS
5350.0	-50.89	2.0	0.000	46.37	AV	54.00	PASS
5460.0	-51.26	2.0	0.000	46.00	AV	54.00	PASS

IEEE 802.11n HT20 (Combined Antenna Chain0 and Antenna Chain1)									
Frequency (MHz)	Conducted Power (dBm)			Directional Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
	Chain0	Chain1	Sum						
4500.000	-40.94	-42.52	-38.65	5.010	0.000	61.62	PEAK	74.00	PASS
4500.000	-40.67	-39.19	-36.86	5.010	0.000	63.41	PEAK	74.00	PASS
5150.000	-51.76	-51.80	-48.77	5.010	0.000	51.50	AV	54.00	PASS
5150.000	-50.26	-50.31	-47.27	5.010	0.000	53.00	AV	54.00	PASS
5350.000	-41.24	-41.57	-38.39	5.010	0.000	61.88	PEAK	74.00	PASS
5350.000	-40.10	-41.69	-37.81	5.010	0.000	62.46	PEAK	74.00	PASS
5460.000	-51.76	-51.84	-48.79	5.010	0.000	51.48	AV	54.00	PASS
5460.000	-52.03	-52.16	-49.08	5.010	0.000	51.19	AV	54.00	PASS

IEEE 802.11ac VHT20 (Combined Antenna Chain0 and Antenna Chain1)									
Frequency (MHz)	Conducted Power (dBm)			Directional Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
	Chain0	Chain1	Sum						
4500.000	-41.49	-41.28	-38.37	5.010	0.000	61.90	PEAK	74.00	PASS
4500.000	-40.83	-41.05	-37.93	5.010	0.000	62.34	PEAK	74.00	PASS
5150.000	-51.68	-51.83	-48.74	5.010	0.000	51.53	AV	54.00	PASS
5150.000	-50.26	-50.39	-47.31	5.010	0.000	52.96	AV	54.00	PASS
5350.000	-41.90	-41.81	-38.84	5.010	0.000	61.43	PEAK	74.00	PASS
5350.000	-40.67	-42.10	-38.32	5.010	0.000	61.95	PEAK	74.00	PASS
5460.000	-51.79	-51.88	-48.82	5.010	0.000	51.45	AV	54.00	PASS
5460.000	-52.06	-52.10	-49.07	5.010	0.000	51.20	AV	54.00	PASS

IEEE 802.11n HT40 (Combined Antenna Chain0 and Antenna Chain1)									
Frequency (MHz)	Conducted Power (dBm)			Directional Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
	Chain0	Chain1	Sum						
4500.000	-41.76	-42.15	-38.94	5.010	0.000	61.33	PEAK	74.00	PASS
4500.000	-41.20	-41.11	-38.14	5.010	0.000	62.13	PEAK	74.00	PASS
5150.000	-51.72	-51.80	-48.75	5.010	0.000	51.52	AV	54.00	PASS
5150.000	-50.24	-50.34	-47.28	5.010	0.000	52.99	AV	54.00	PASS
5350.000	-41.60	-41.31	-38.44	5.010	0.000	61.83	PEAK	74.00	PASS
5350.000	-42.31	-40.96	-38.57	5.010	0.000	61.70	PEAK	74.00	PASS
5460.000	-51.46	-51.58	-48.51	5.010	0.000	51.76	AV	54.00	PASS
5460.000	-51.77	-51.84	-48.79	5.010	0.000	51.48	AV	54.00	PASS

IEEE 802.11ac VHT40 (Combined Antenna Chain0 and Antenna Chain1)									
Frequency (MHz)	Conducted Power (dBm)			Directional Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
	Chain0	Chain1	Sum						
4500.000	-42.73	-42.79	-39.75	5.010	0.000	60.52	PEAK	74.00	PASS
4500.000	-40.24	-39.87	-37.04	5.010	0.000	63.23	PEAK	74.00	PASS
5150.000	-51.71	-51.82	-48.75	5.010	0.000	51.52	AV	54.00	PASS
5150.000	-50.24	-50.30	-47.26	5.010	0.000	53.01	AV	54.00	PASS
5350.000	-41.42	-41.06	-38.23	5.010	0.000	62.04	PEAK	74.00	PASS
5350.000	-41.69	-41.99	-38.83	5.010	0.000	61.44	PEAK	74.00	PASS
5460.000	-51.52	-51.57	-48.53	5.010	0.000	51.74	AV	54.00	PASS
5460.000	-51.72	-51.80	-48.75	5.010	0.000	51.52	AV	54.00	PASS

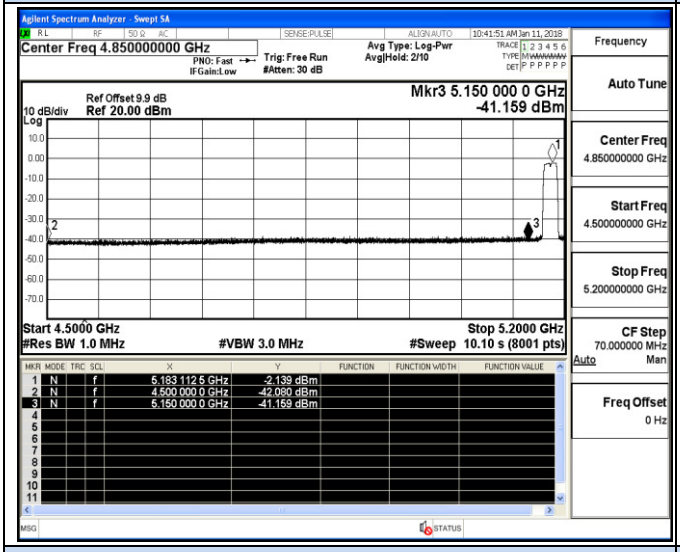
IEEE 802.11ac VHT80 (Combined Antenna Chain0 and Antenna Chain1)									
Frequency (MHz)	Conducted Power (dBm)			Directional Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
	Chain0	Chain1	Sum						
4500.000	-42.28	-41.81	-39.03	5.010	0.000	61.24	PEAK	74.00	PASS
4500.000	-40.26	-39.69	-36.96	5.010	0.000	63.31	PEAK	74.00	PASS
5150.000	-51.68	-51.70	-48.68	5.010	0.000	51.59	AV	54.00	PASS
5150.000	-50.01	-49.94	-46.96	5.010	0.000	53.31	AV	54.00	PASS
5350.000	-41.33	-41.29	-38.30	5.010	0.000	61.97	PEAK	74.00	PASS
5350.000	-41.82	-41.54	-38.67	5.010	0.000	61.60	PEAK	74.00	PASS
5460.000	-50.88	-50.89	-47.87	5.010	0.000	52.40	AV	54.00	PASS
5460.000	-51.24	-51.26	-48.24	5.010	0.000	52.03	AV	54.00	PASS

Remark:

1. *Measured Undesirable emission 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 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11a VHT20, IEEE 802.11ac VHT40, IEEE 802.11ac VHT80;*
4. *Covert Radiated E Level At 3m = Conducted average power + Directional Gain + 104.77-20*log(3);*
5. *Please refer to following test plots;*

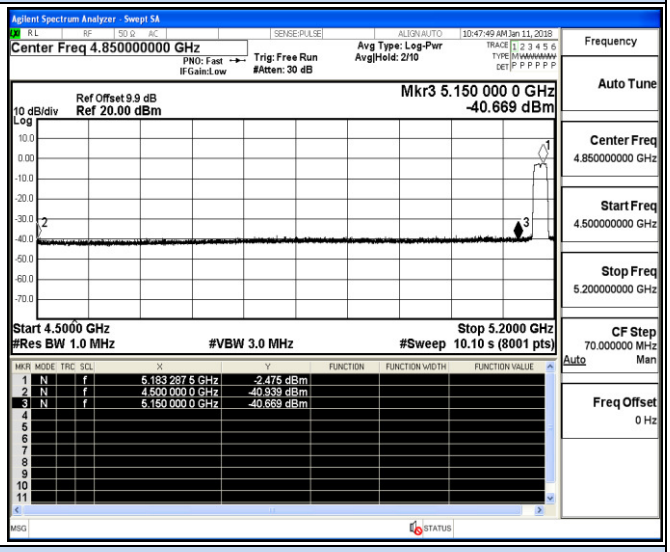
Undesirable emission

IEEE 802.11a @ Chain0

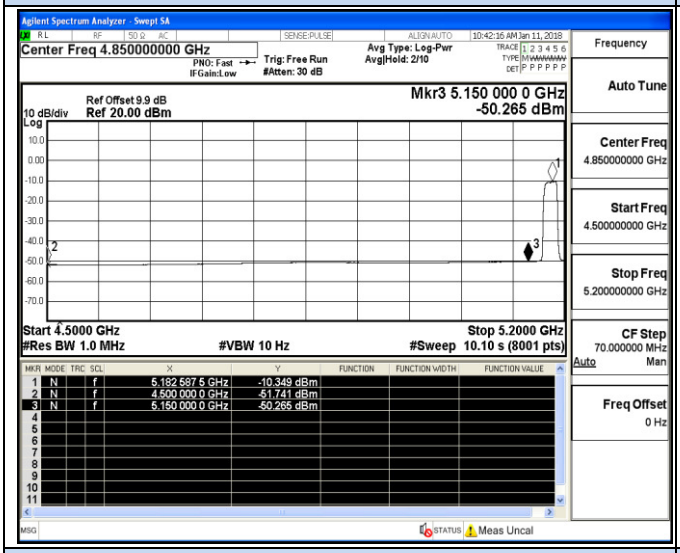


Channel 36 / 5180 MHz – Peak

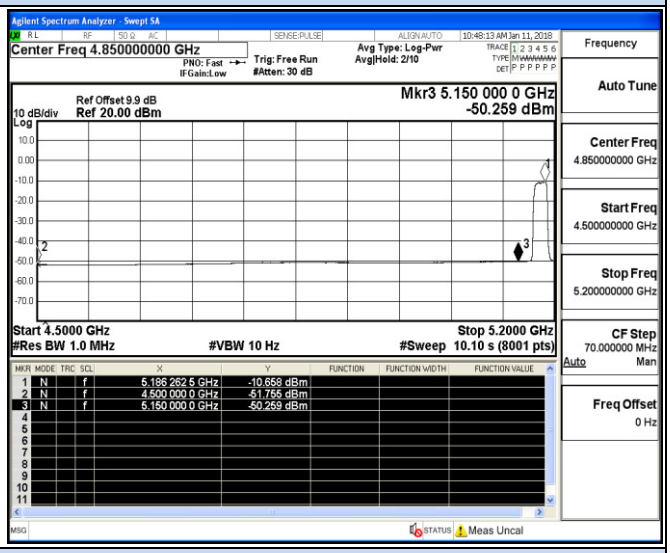
IEEE 802.11n HT20 @ Chain0



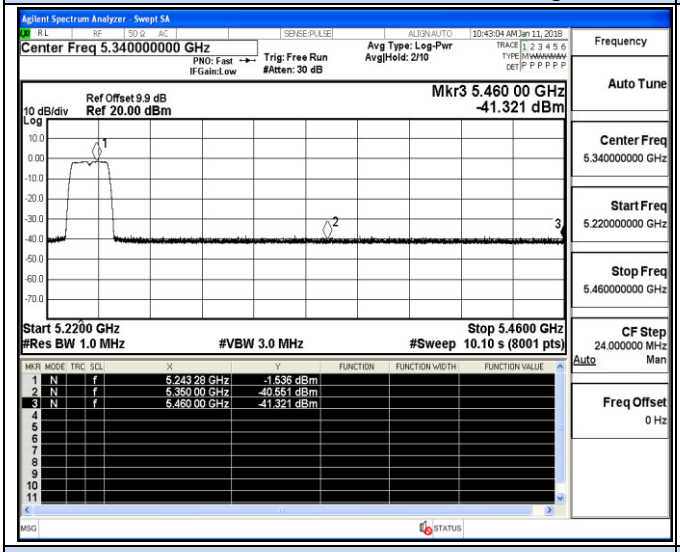
Channel 36 / 5180 MHz – Peak



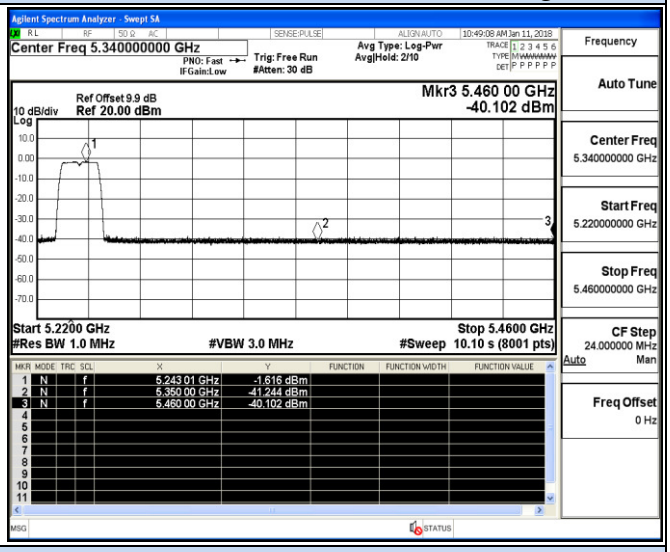
Channel 36 / 5180 MHz – Average



Channel 36 / 5180 MHz – Average



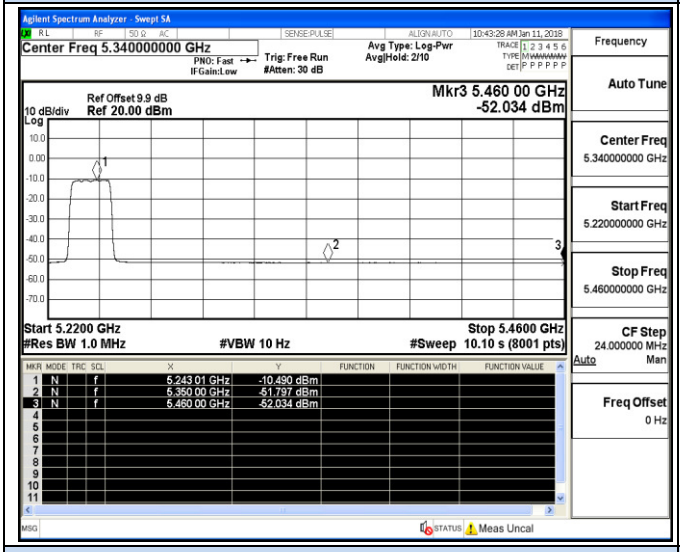
Channel 48 / 5240 MHz – Peak



Channel 48 / 5240 MHz – Peak

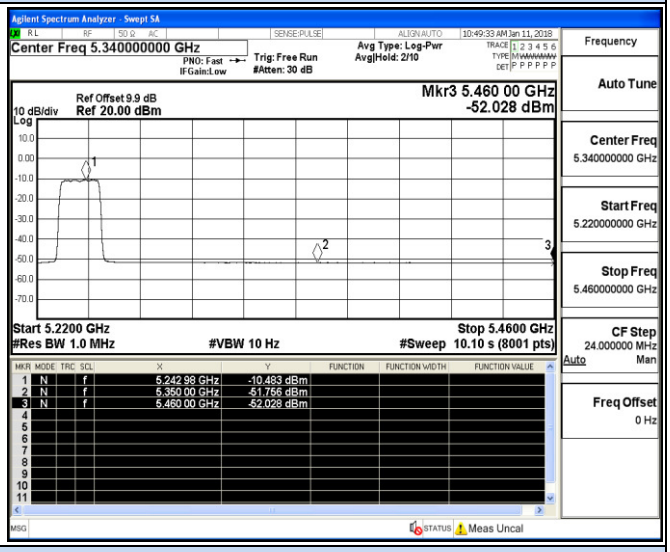
Undesirable emission

IEEE 802.11a @ Chain0



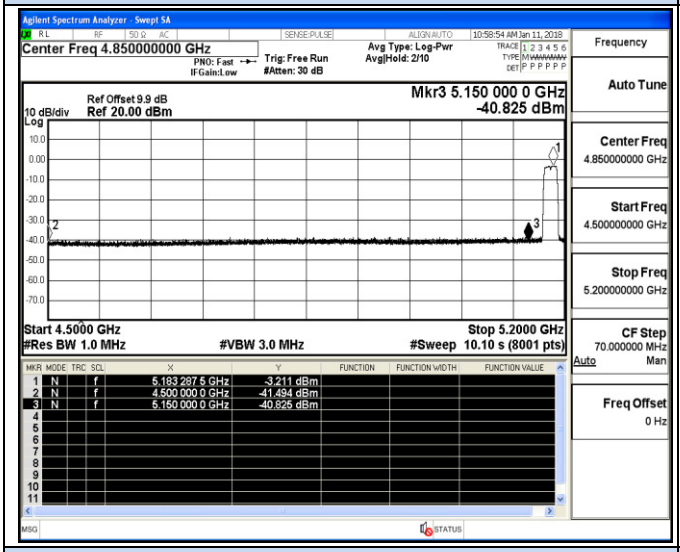
Channel 48 / 5240 MHz – Average

IEEE 802.11n HT20 @ Chain0



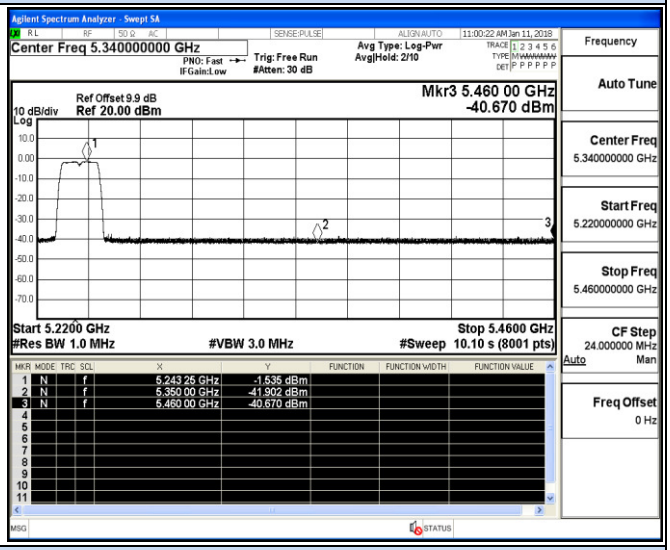
Channel 48 / 5240 MHz – Average

IEEE 802.11ac VHT20 @ Chain0

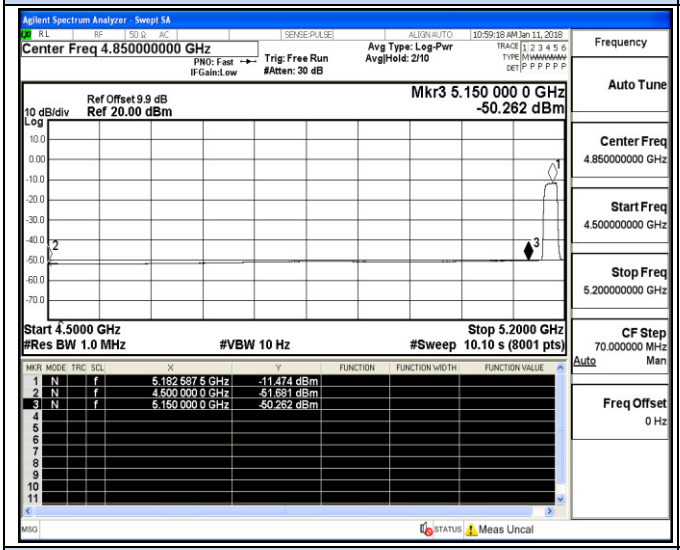


Channel 36 / 5180 MHz – Peak

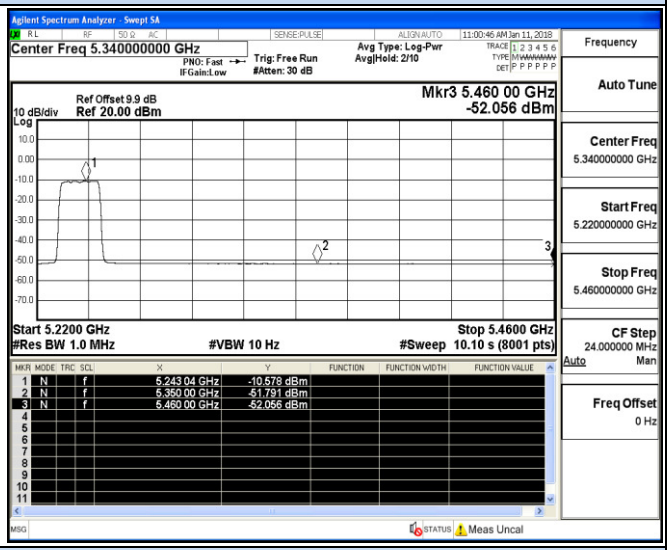
IEEE 802.11ac VHT20 @ Chain0



Channel 48 / 5240 MHz – Peak



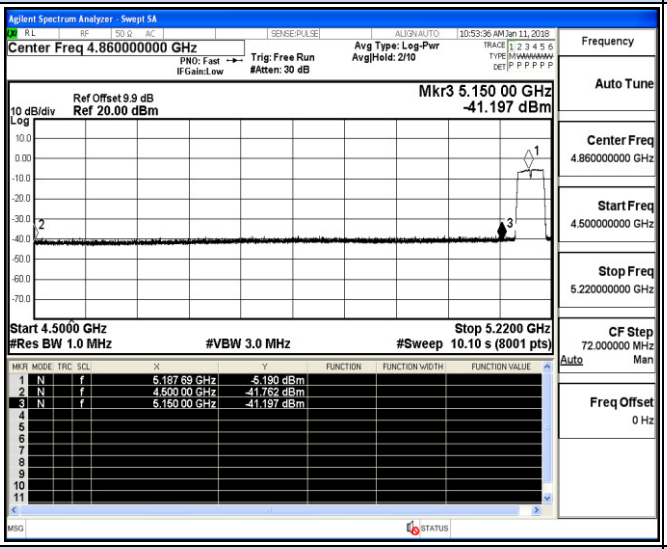
Channel 36 / 5180 MHz – Average



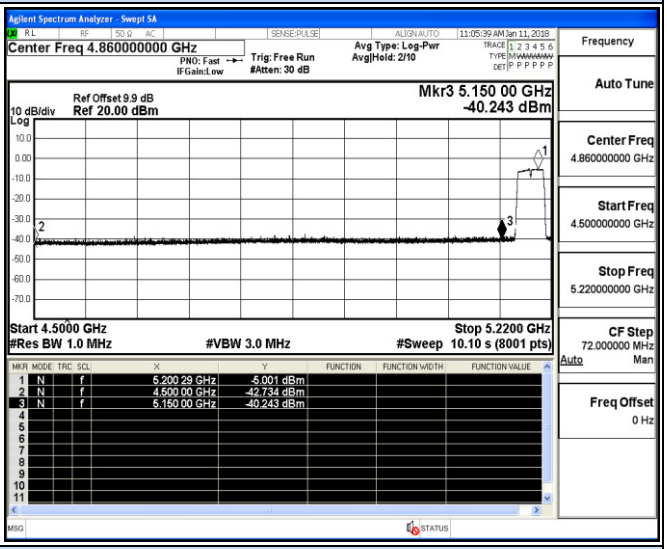
Channel 48 / 5240 MHz – Average

Undesirable emission

IEEE 802.11n HT40 @ Chain0

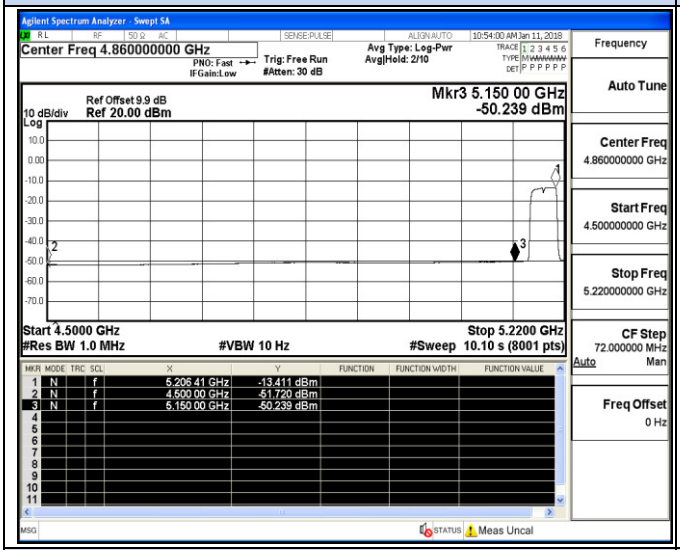


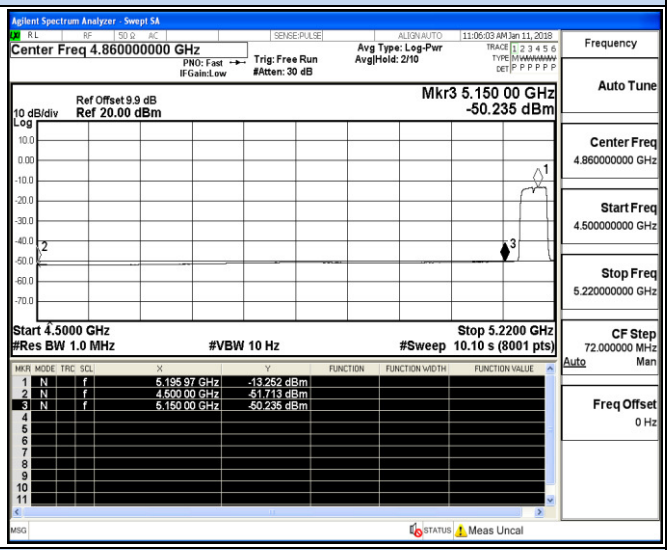
IEEE 802.11ac VHT40 @ Chain0



Channel 38 / 5190 MHz – Peak

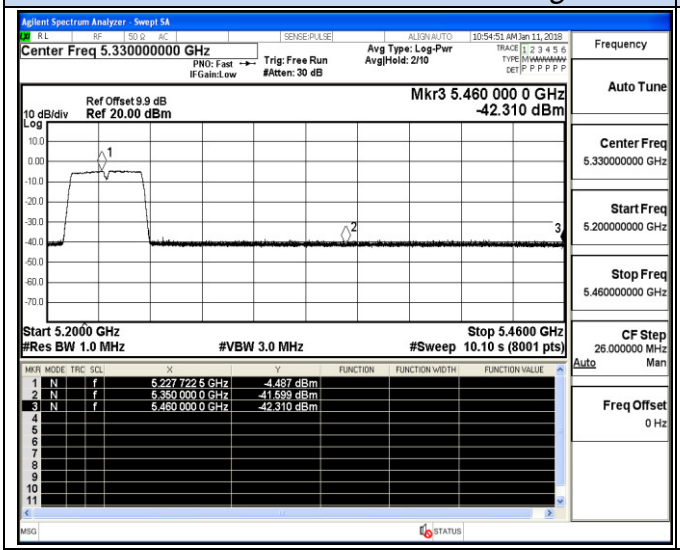
Channel 38 / 5190 MHz – Peak

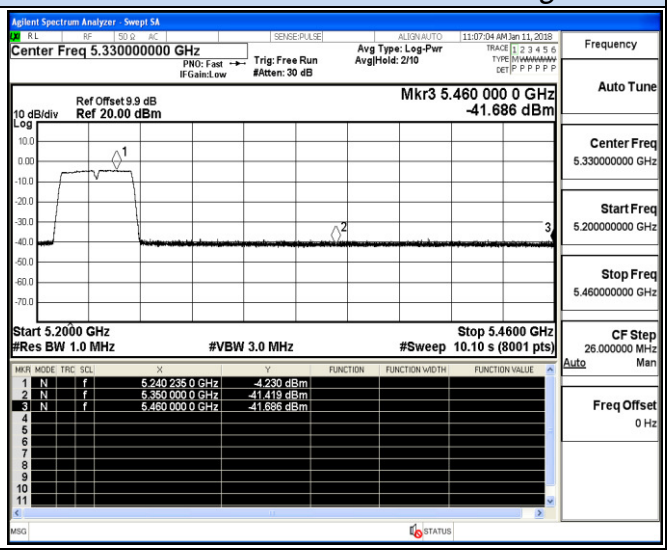




Channel 38 / 5190 MHz – Average

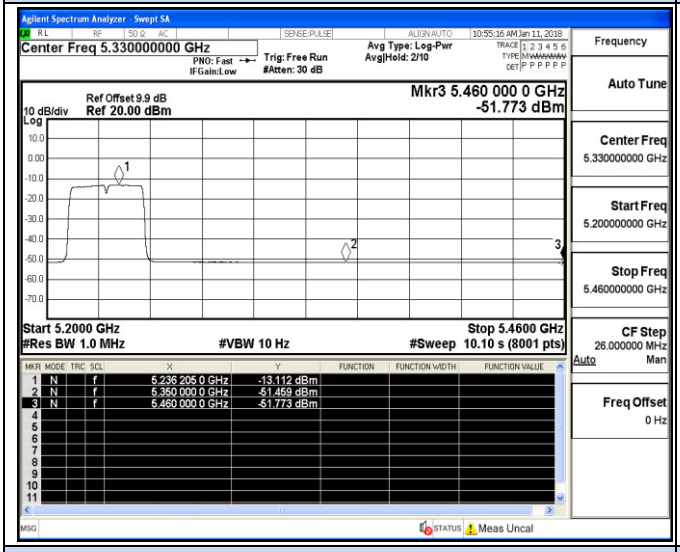
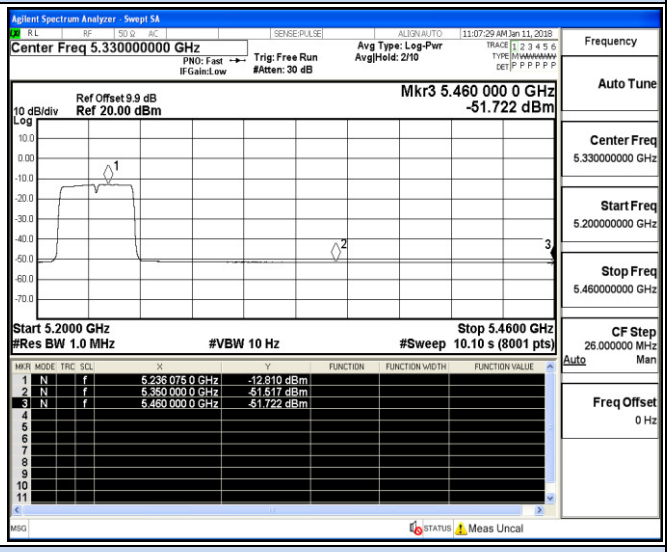
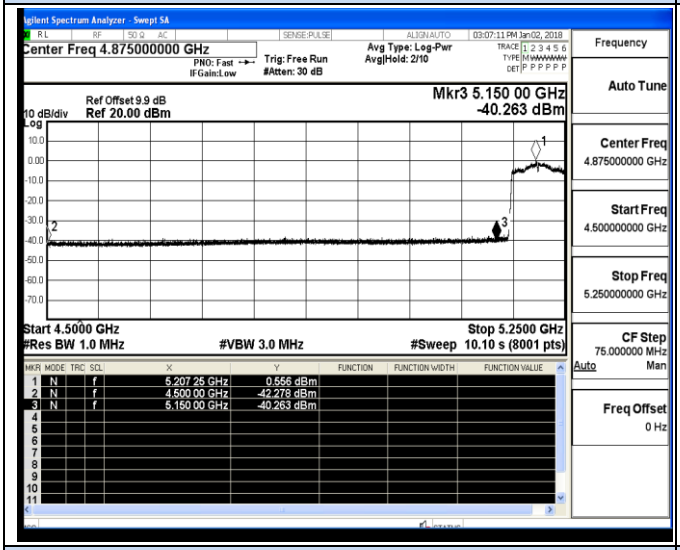
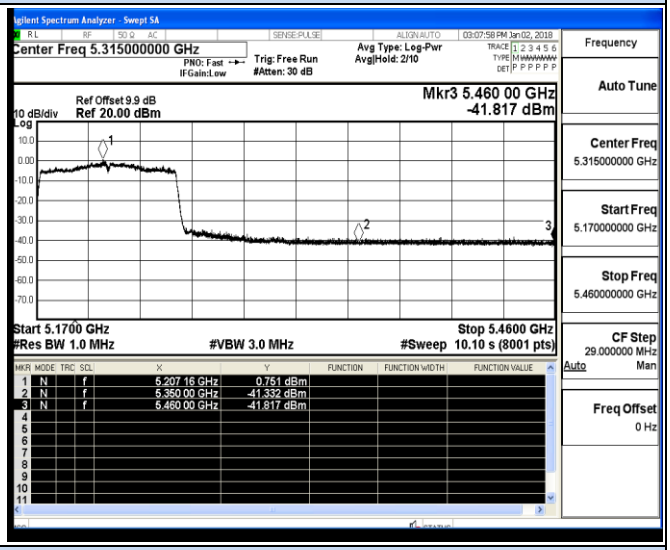
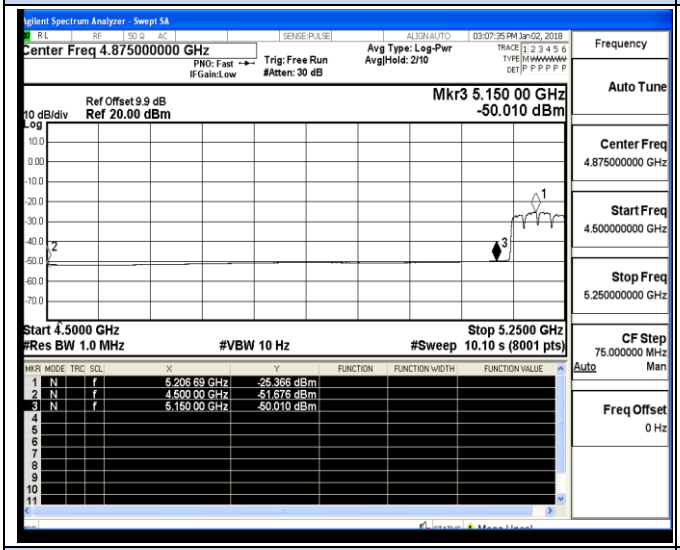
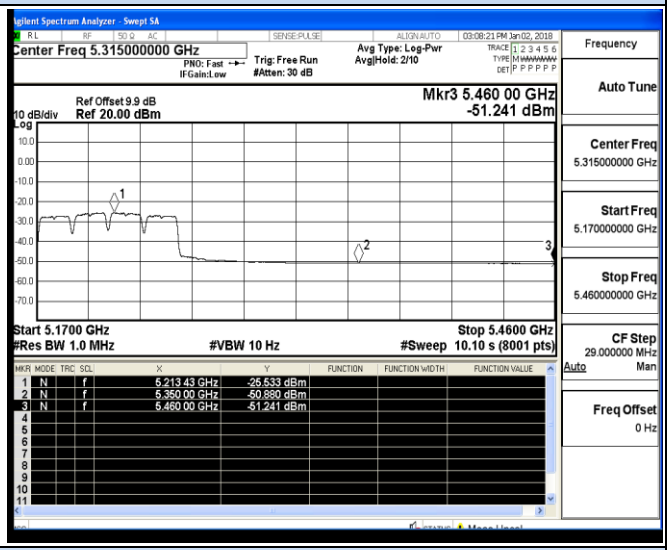
Channel 38 / 5190 MHz – Average





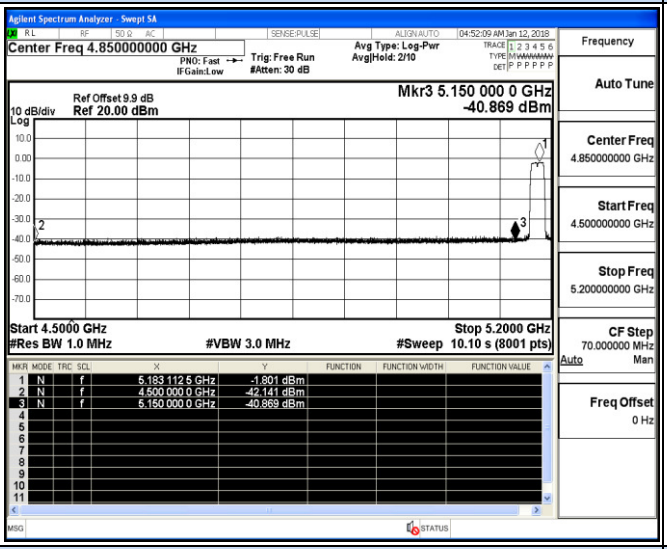
Channel 46 / 5230 MHz – Peak

Channel 46 / 5230 MHz – Peak

Undesirable emission	
IEEE 802.11n HT40 @ Chain0	IEEE 802.11ac VHT40 @ Chain0
	
Channel 46 / 5230 MHz – Average	Channel 46 / 5230 MHz – Average
IEEE 802.11ac VHT80 @ Chain0	IEEE 802.11ac VHT80 @ Chain0
	
Channel 42 / 5210 MHz – Peak	Channel 42 / 5210 MHz – Peak
	
Channel 42 / 5210 MHz –Average	Channel 42 / 5210 MHz –Average

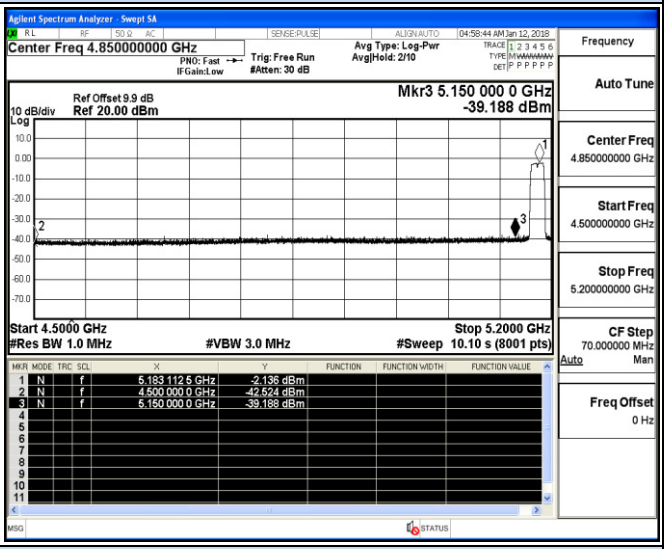
Undesirable emission

IEEE 802.11a @ Chain1

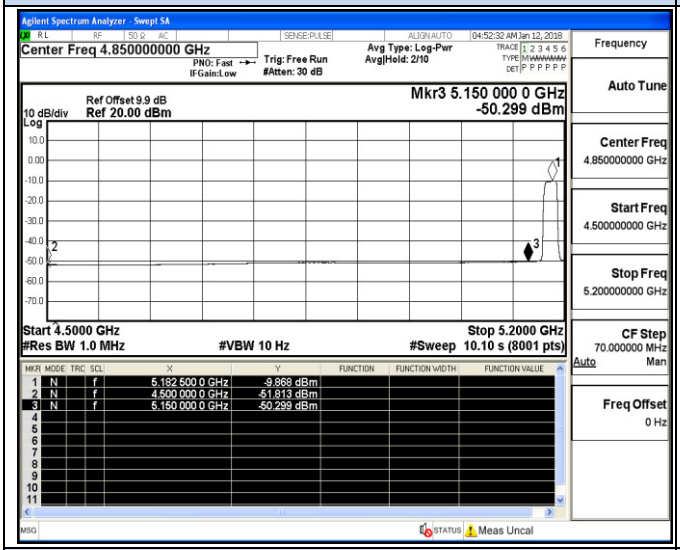


Channel 36 / 5180 MHz – Peak

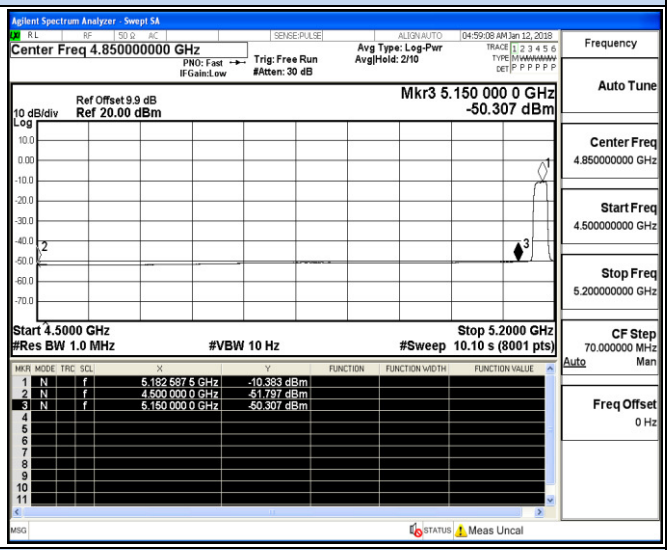
IEEE 802.11n HT20 @ Chain1



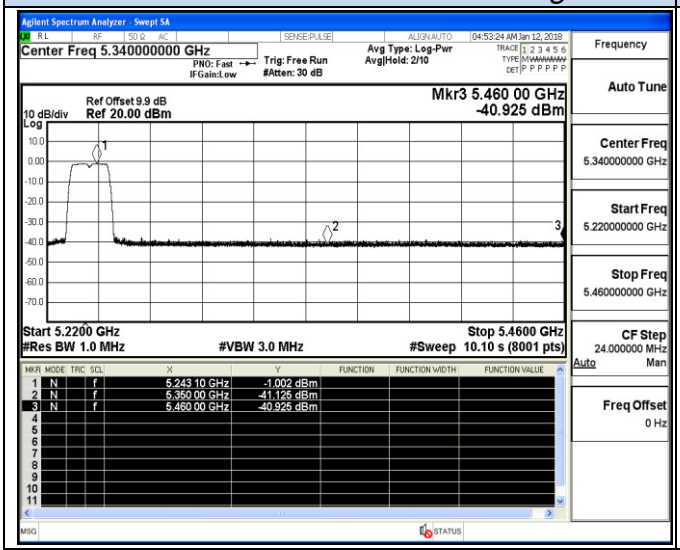
Channel 36 / 5180 MHz – Peak



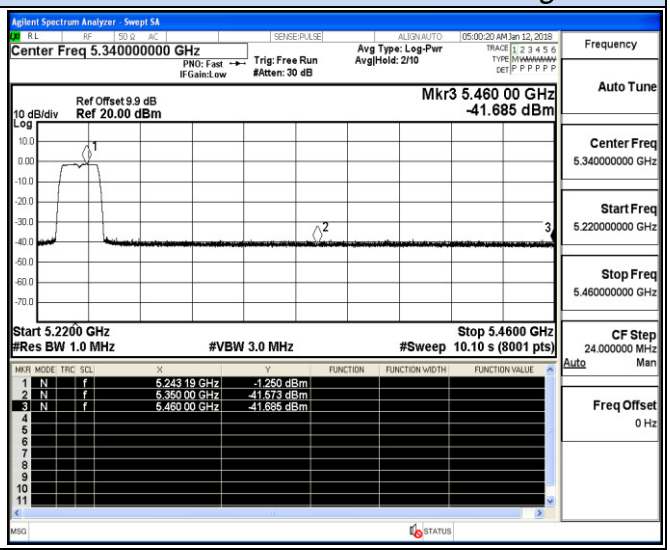
Channel 36 / 5180 MHz – Average



Channel 36 / 5180 MHz – Average



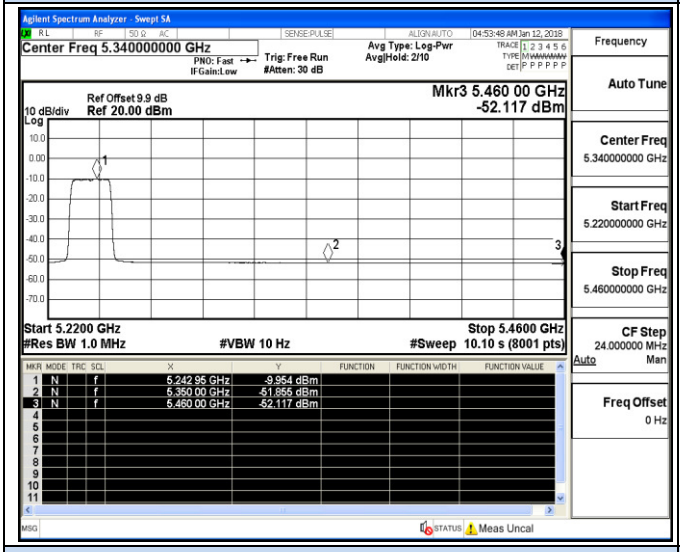
Channel 48 / 5240 MHz – Peak



Channel 48 / 5240 MHz – Peak

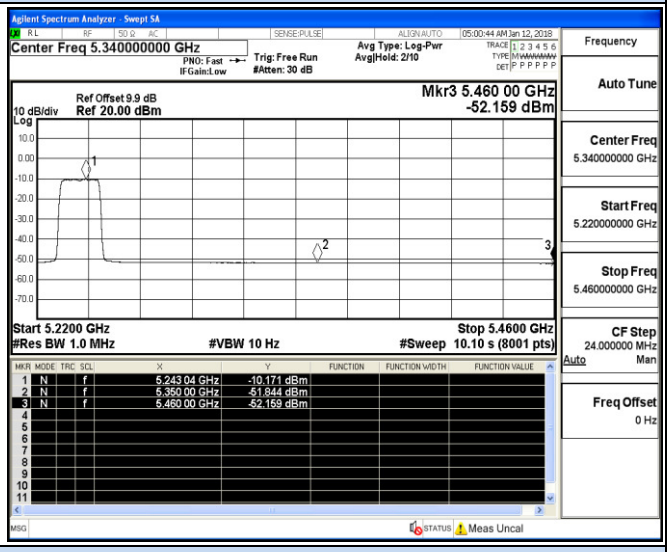
Undesirable emission

IEEE 802.11a @ Chain1



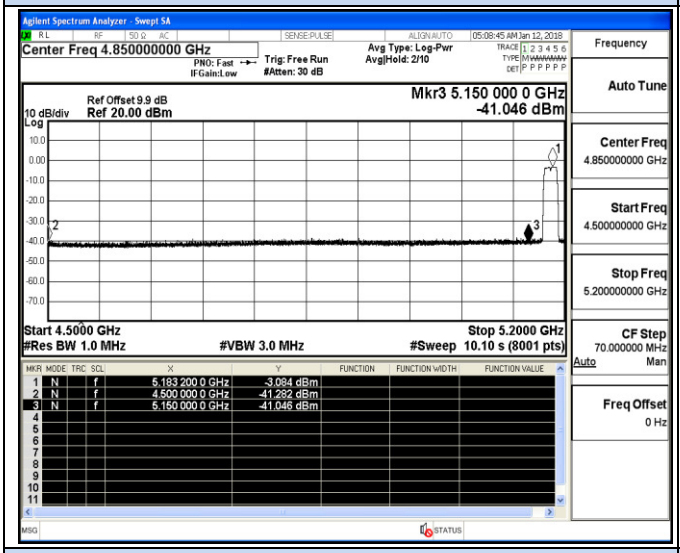
Channel 48 / 5240 MHz – Average

IEEE 802.11n HT20 @ Chain1



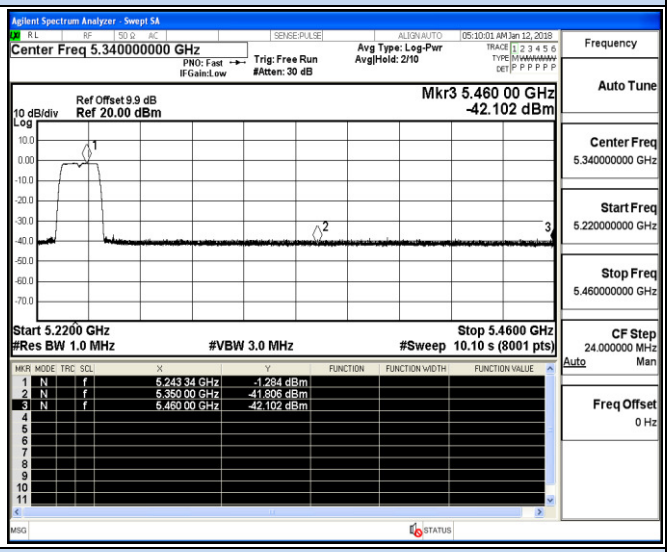
Channel 48 / 5240 MHz – Average

IEEE 802.11ac VHT20 @ Chain1

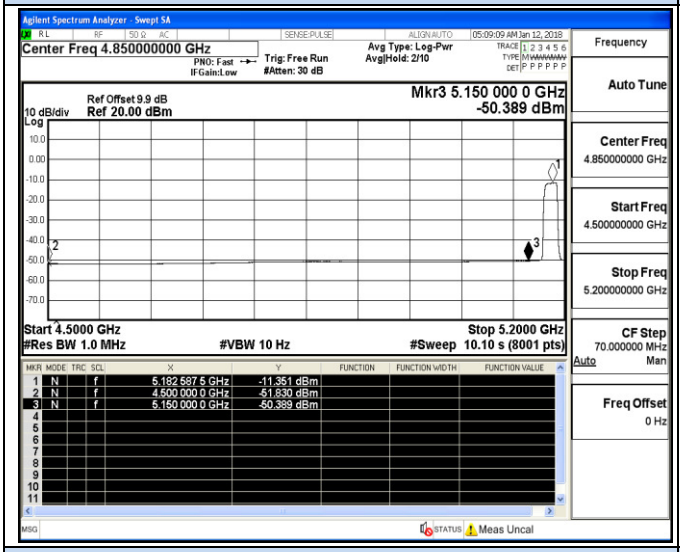


Channel 36 / 5180 MHz – Peak

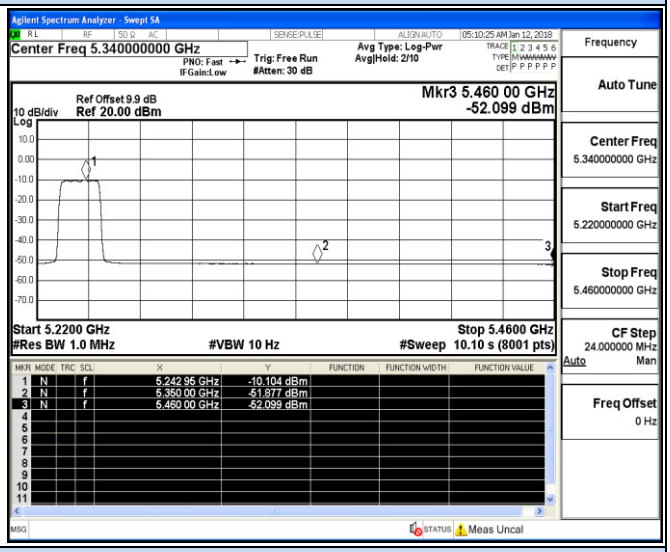
IEEE 802.11ac VHT20 @ Chain1



Channel 48 / 5240 MHz – Peak



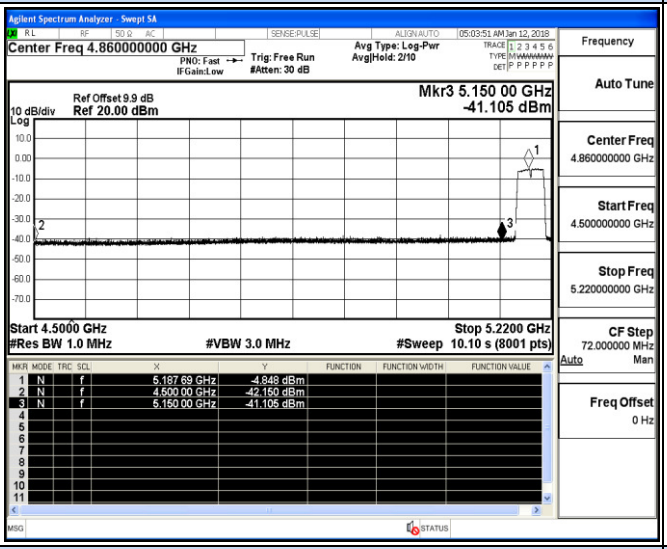
Channel 36 / 5180 MHz – Average



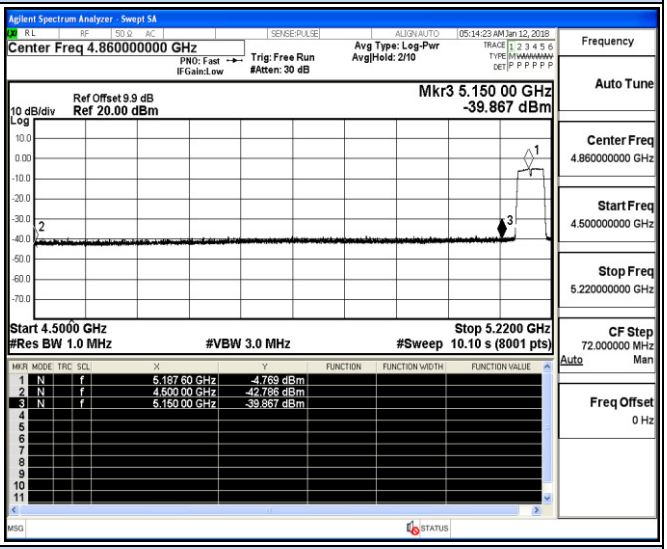
Channel 48 / 5240 MHz – Average

Undesirable emission

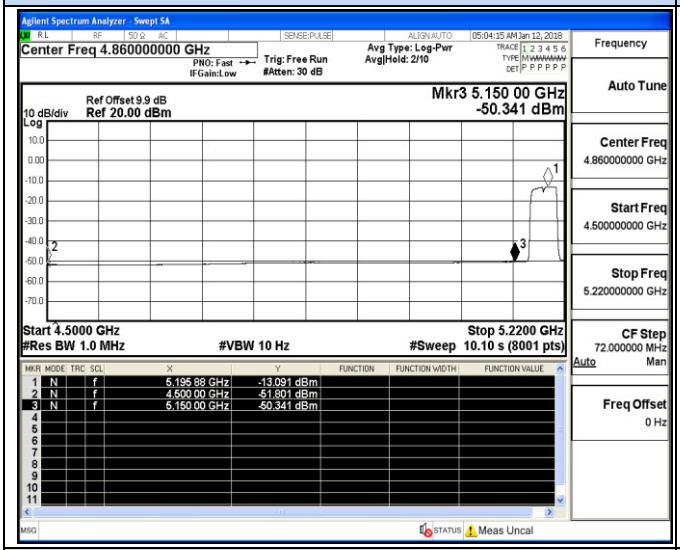
IEEE 802.11n HT40 @ Chain1



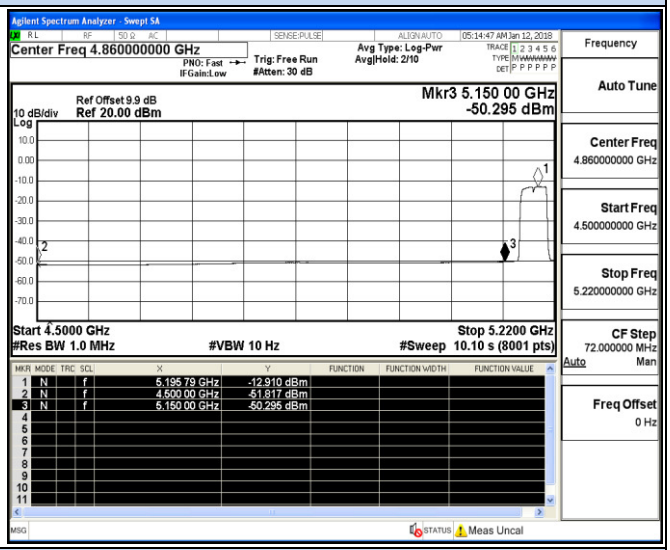
IEEE 802.11ac VHT40 @ Chain1



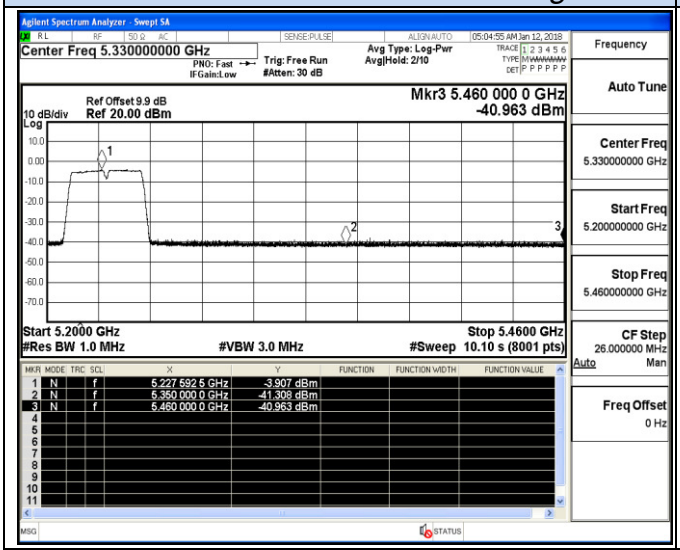
Channel 38 / 5190 MHz – Peak



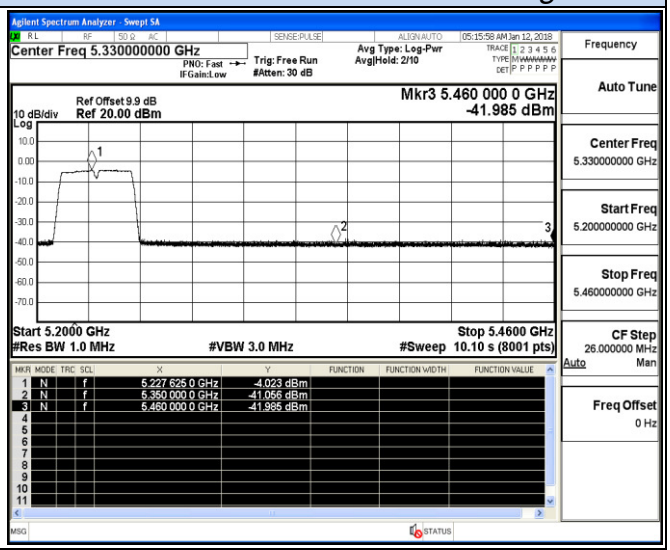
Channel 38 / 5190 MHz – Peak



Channel 38 / 5190 MHz – Average



Channel 38 / 5190 MHz – Average

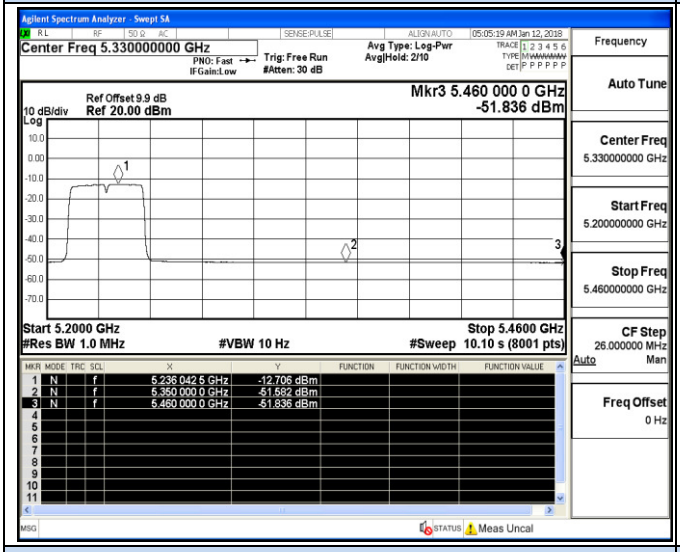


Channel 46 / 5230 MHz – Peak

Channel 46 / 5230 MHz – Peak

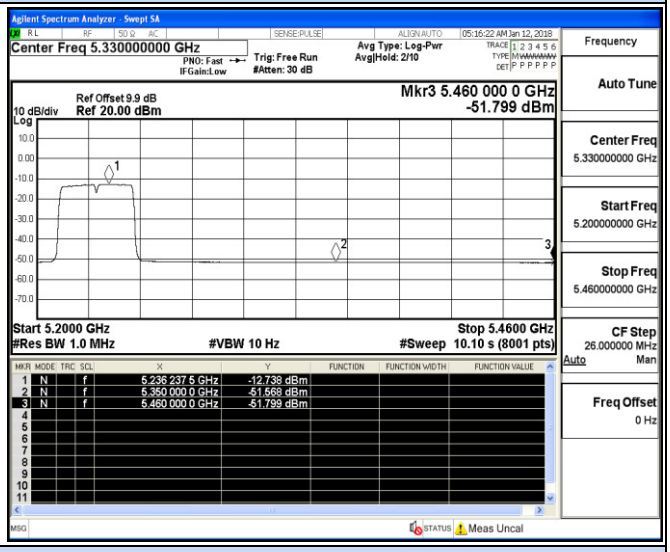
Undesirable emission

IEEE 802.11n HT40 @ Chain1



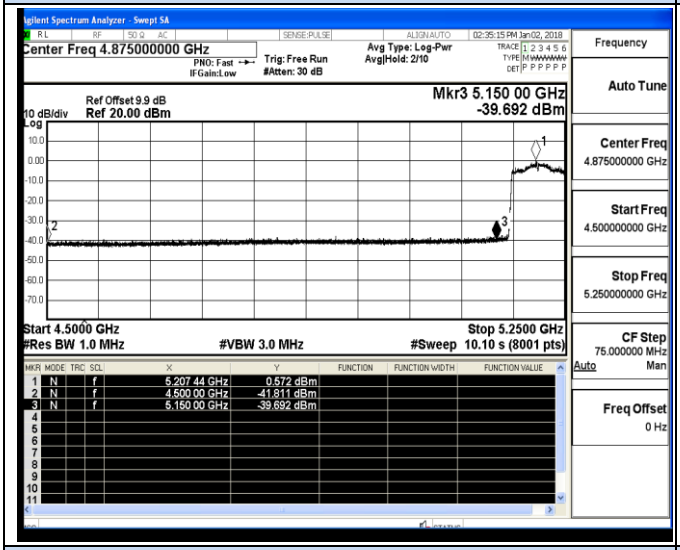
Channel 46 / 5230 MHz – Average

IEEE 802.11ac VHT40 @ Chain1



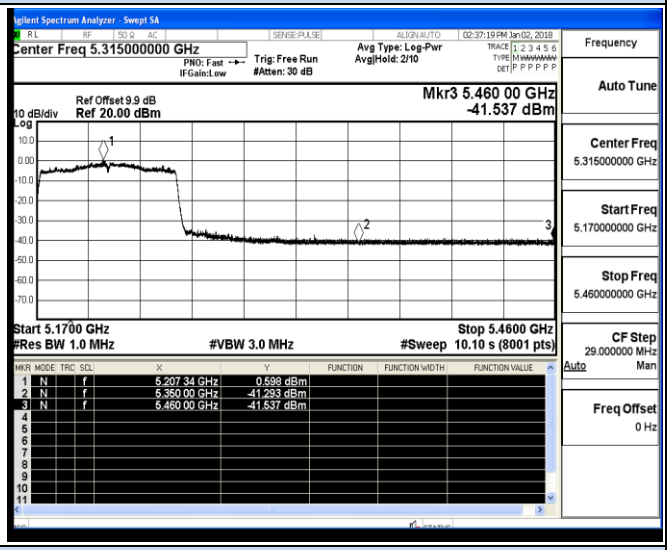
Channel 46 / 5230 MHz – Average

IEEE 802.11ac VHT80 @ Chain1

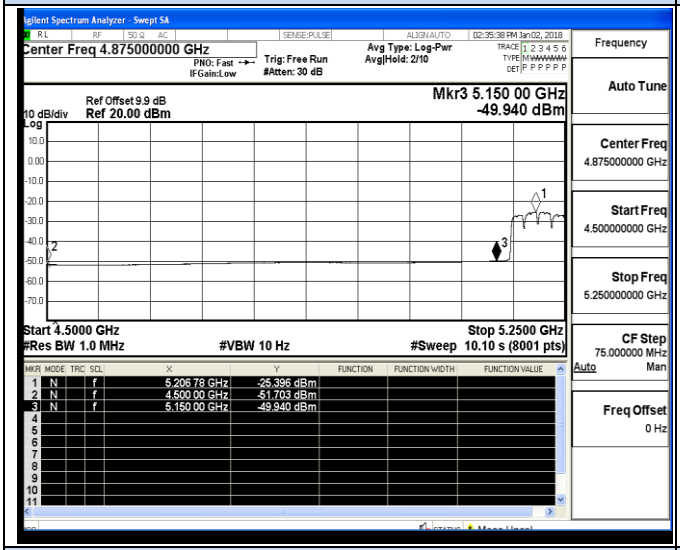


Channel 42 / 5210 MHz – Peak

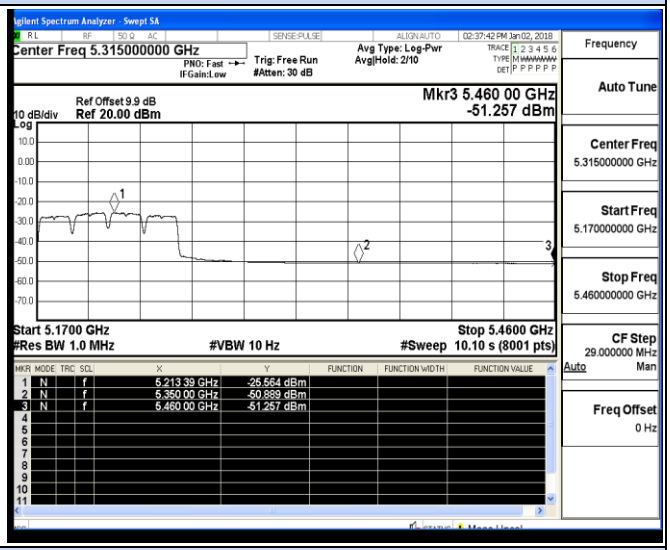
IEEE 802.11ac VHT80 @ Chain1



Channel 42 / 5210 MHz – Peak



Channel 42 / 5210 MHz –Average



Channel 42 / 5210 MHz –Average

5.8. Antenna Requirements

5.8.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.8.2 Antenna Connected Construction

5.8.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

5.8.2.2. Antenna Connector Construction

The gains of antenna used for transmitting is 2.0dBi, and the antenna is a PIFA antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

5.8.2.3. 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 NII 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

Limits

FCC	ISED
Antenna Gain	
6 dBi	

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 WLAN devices, the OFDM (IEEE 802.11a) mode is used;

Antenna Chain0

T_{nom}	V_{nom}	Lowest Channel 5180 MHz	Middle Channel 5220 MHz	Highest Channel 5240 MHz
Conducted power [dBm] Measured with DSSS modulation		6.31	7.25	7.42
Radiated power [dBm] Measured with DSSS modulation		8.14	9.24	9.33
Gain [dBi] Calculated		1.83	1.99	1.91
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

Antenna Chain1

T_{nom}	V_{nom}	Lowest Channel 5180 MHz	Middle Channel 5220 MHz	Highest Channel 5240 MHz
Conducted power [dBm] Measured with DSSS modulation		6.85	7.41	7.56
Radiated power [dBm] Measured with DSSS modulation		8.66	9.32	9.46
Gain [dBi] Calculated		1.81	1.91	1.90
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	2017-11-17	2018-11-16
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	2017-11-17	2018-11-16
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	2017-09-21	2018-09-20
16	Broadband Preamplifier	SCHWARZBECK	BBV 9719	9719-025	2017-09-21	2018-09-20
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
23	RF Control Unit	Tonscend	JS0806-2	178060073	2017-10-28	2018-10-27
24	BT/WIFI Test Software	Tonscend	JS1120-3	/	N/A	N/A
Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.						

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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