7.7 Radiated Spurious Emissions – Below 1GHz

§15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-216 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-216. Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Peak Field Strength Measurements

7. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
8. RBW = 120kHz (for emissions from 30MHz – 1GHz)
9. VBW = 300kHz
10. Detector = quasi-peak
11. Sweep time = auto couple
12. Trace mode = max hold
13. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

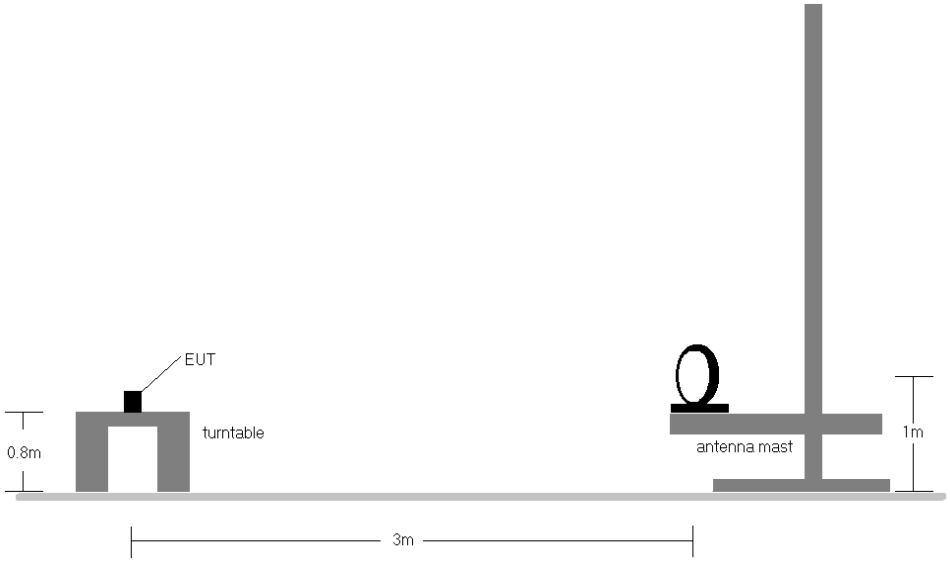


Figure 7-6. Radiated Test Setup < 30MHz

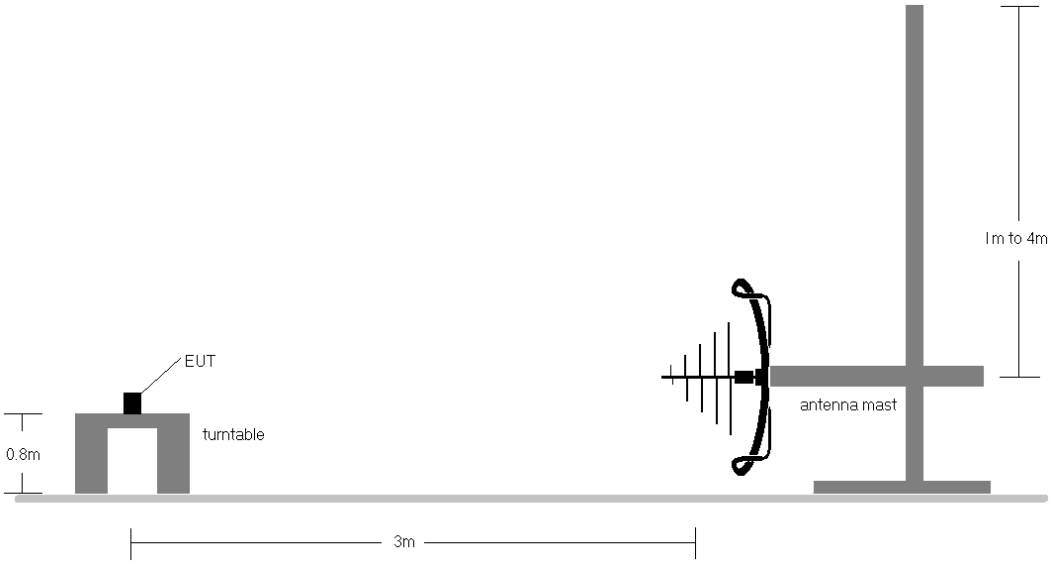


Figure 7-7. Radiated Test Setup < 1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-216.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes. For below 30MHz the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
3. This unit was tested with its standard battery.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector on emissions that were within 6dB of the limit.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. Both configurations below were investigated, and the worst case has been reported.
    a. EUT powered by AC/DC adaptor via USB-C cable with wire charger
    b. EUT powered by host PC via USB-C cable with wire charger
10. All antenna configurations were investigated and only the worst case is reported.
11. The unit was tested with all possible modes and only the highest emission is reported.

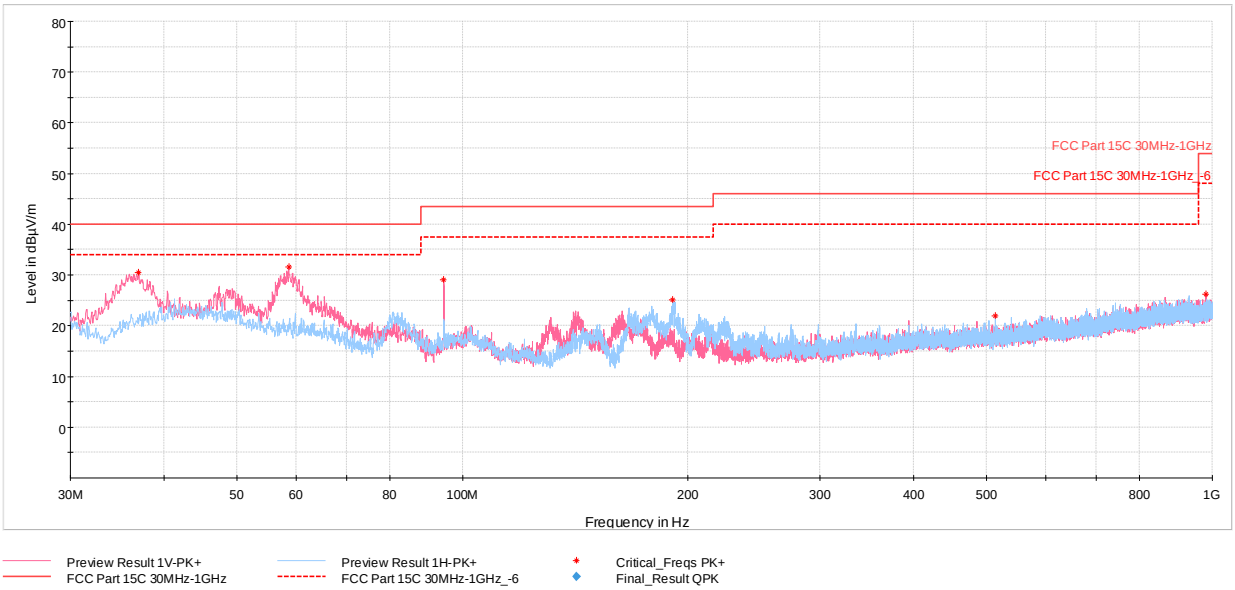
Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$ - Preamp Gain $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

CDD/SDM Radiated Spurious Emissions Measurements (Below 1GHz)

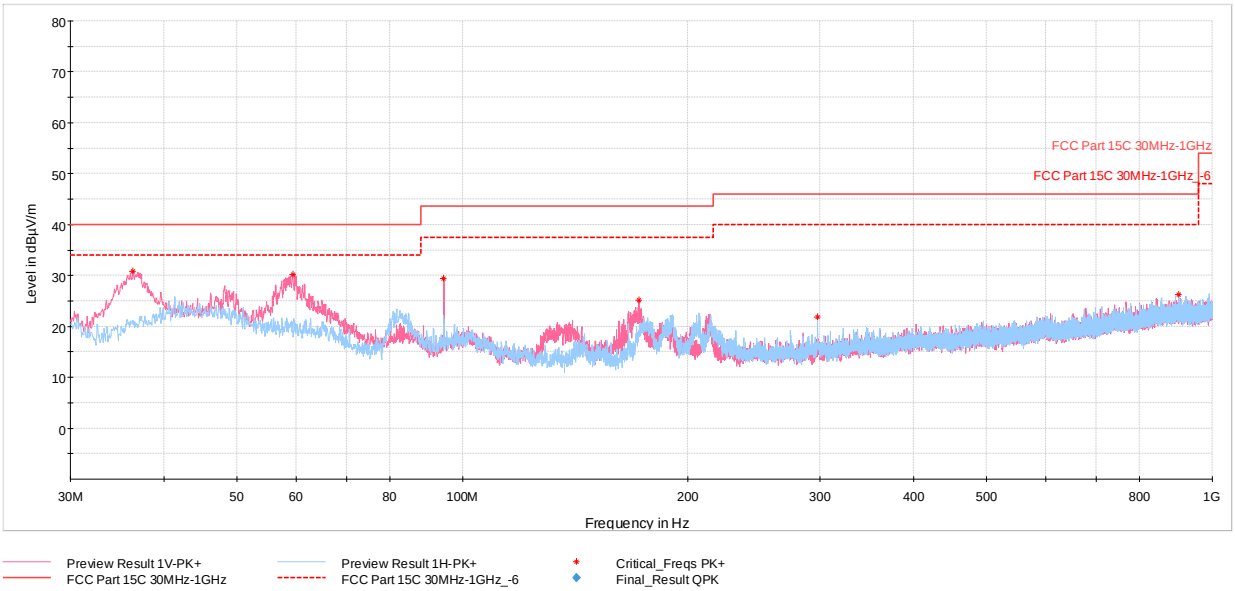
§15.209; RSS-Gen [8.9]



Plot 7-1247. Radiated Spurious Emissions below 1GHz CDD, 802.11n, Ch.40 with AC/DC Adapter

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
36.98	Max peak	V	100	303	-58.31	-18.22	30.47	40.00	-9.53
58.66	Max peak	V	100	197	-58.78	-16.66	31.56	40.00	-8.44
94.46	Max peak	V	100	215	-58.83	-19.06	29.11	43.52	-14.41
190.78	Max peak	H	100	241	-63.58	-18.32	25.10	43.52	-18.42
513.74	Max peak	H	200	175	-74.37	-10.73	21.90	46.02	-24.12
980.99	Max peak	V	300	110	-77.14	-3.67	26.19	53.98	-27.79

Table 7-217. Radiated Spurious Emissions below 1GHz, 802.11n, Ch.40 with AC/DC Adapter



Plot 7-1248. Radiated Spurious Emissions below 1GHz CDD, 802.11ax (SU), Ch.40 with AC/DC Adapter

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
36.35	Max Peak	V	100	15	-57.76	-18.37	30.87	40.00	-9.13
59.44	Max Peak	V	100	223	-59.93	-16.81	30.26	40.00	-9.74
94.46	Max Peak	V	100	165	-58.58	-19.06	29.36	43.52	-14.16
171.96	Max Peak	V	100	104	-61.83	-19.98	25.19	43.52	-18.33
297.33	Max Peak	H	100	295	-69.77	-15.34	21.89	46.02	-24.13
901.01	Max Peak	H	200	297	-76.45	-4.23	26.32	46.02	-19.70

Table 7-218. Radiated Spurious Emissions below 1GHz, 802.11ax (SU), Ch.40 with AC/DC Adapter

7.8 AC Line-Conducted Emissions Measurement

§15.407; RSS-Gen [8.8]

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for AC Line conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-219. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

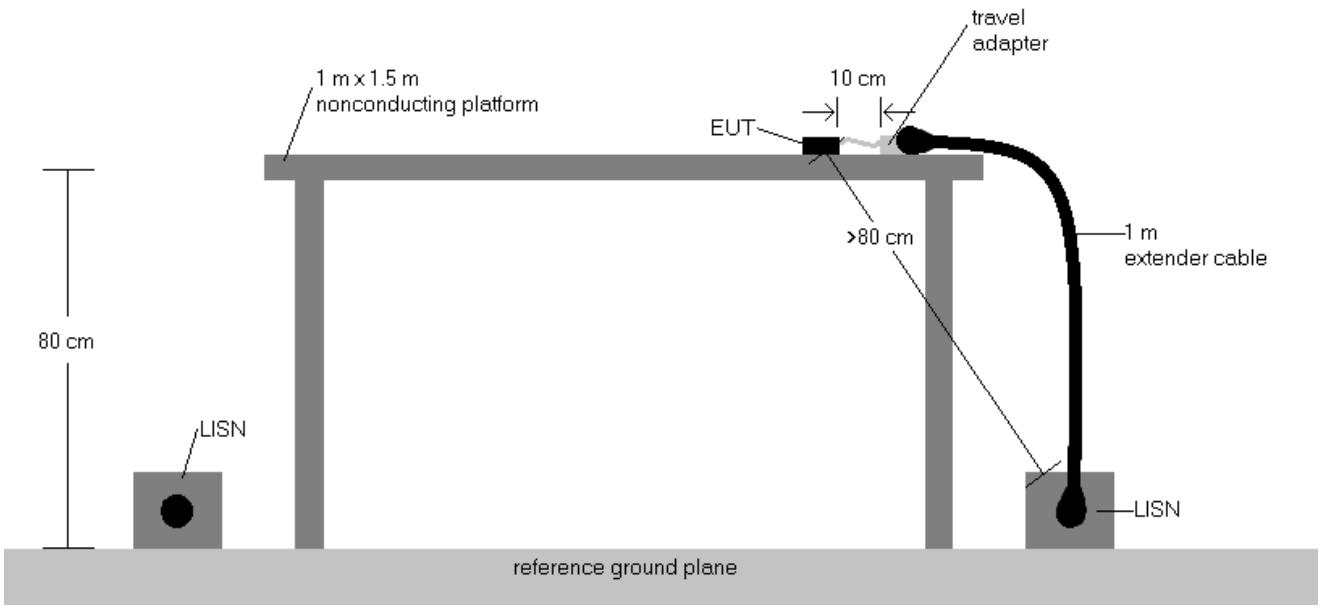
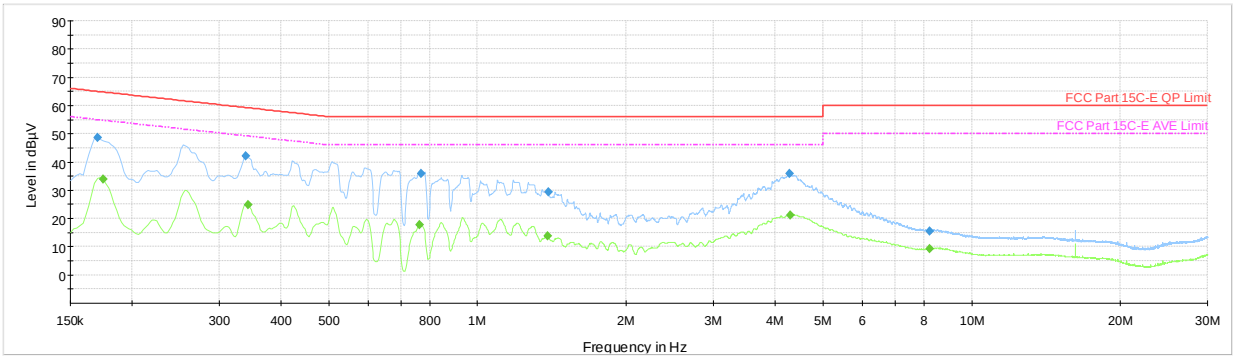


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

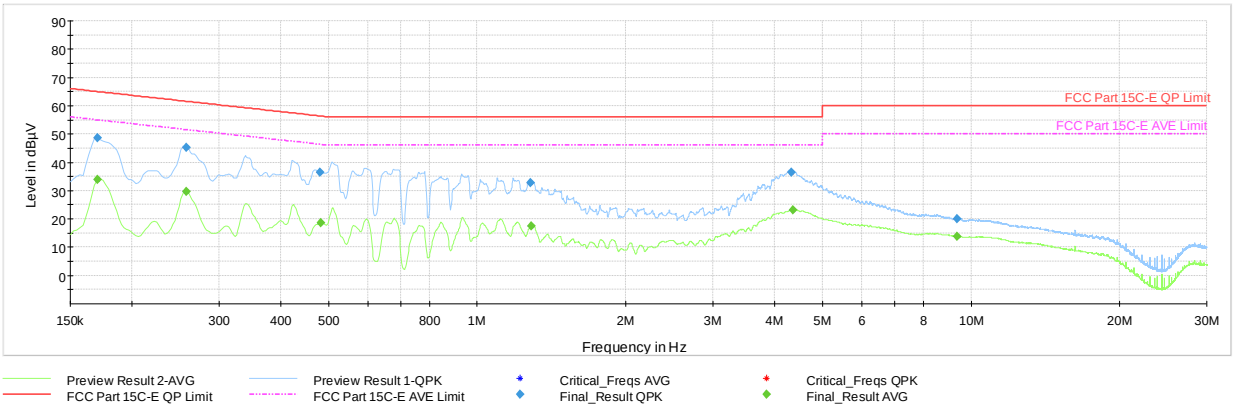
1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
2. Both configurations below were investigated, and the worst case has been reported.
    a. EUT powered by AC/DC adaptor via USB-C cable with wire charger
    b. EUT powered by host PC via USB-C cable with wire charger
3. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
4. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
5. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Correction Factor (dB)
6. Margin (dB) = QP/AV Level (dBμV) - QP/AV Limit (dBμV)
7. Traces shown in plots are made using quasi-peak and average detectors.
8. Deviations to the Specifications: None.
9. The unit was tested with all possible modes and only the highest emission is reported.



Plot 7-1249. AC Line Conducted Plot with 802.11n CDD – Ch.40 (L1), with AC/DC adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.170	FINAL	48.7	—	64.95	-16.27	L1	GND
0.175	FINAL	—	33.77	54.73	-20.96	L1	GND
0.339	FINAL	42.3	—	59.23	-16.98	L1	GND
0.344	FINAL	—	24.87	49.12	-24.25	L1	GND
0.762	FINAL	—	17.82	46.00	-28.18	L1	GND
0.769	FINAL	35.8	—	56.00	-20.20	L1	GND
1.388	FINAL	—	13.81	46.00	-32.19	L1	GND
1.390	FINAL	29.5	—	56.00	-26.54	L1	GND
4.272	FINAL	36.0	—	56.00	-20.02	L1	GND
4.292	FINAL	—	21.23	46.00	-24.77	L1	GND
8.228	FINAL	15.6	—	60.00	-44.43	L1	GND
8.234	FINAL	—	9.26	50.00	-40.74	L1	GND

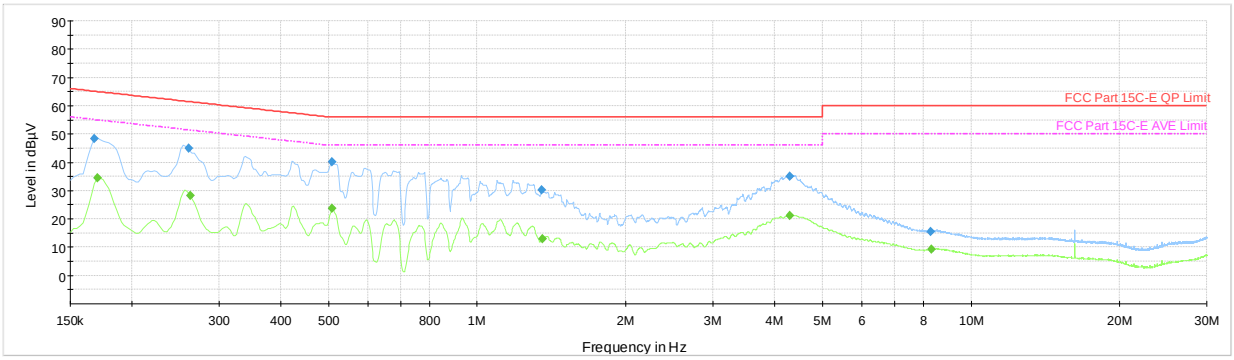
Table 7-220. AC Line Conducted Data with 802.11n – Ch.40 (L1) with AC/DC adapter



Plot 7-1250. AC Line Conducted Plot with 802.11n CDD – Ch.40 (N), with AC/DC adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.170	FINAL	—	33.97	54.95	-20.98	N	GND
0.170	FINAL	48.7	—	64.95	-16.29	N	GND
0.258	FINAL	—	29.78	51.50	-21.71	N	GND
0.258	FINAL	45.3	—	61.50	-16.25	N	GND
0.481	FINAL	36.5	—	56.33	-19.84	N	GND
0.483	FINAL	—	18.57	46.29	-27.71	N	GND
1.280	FINAL	32.8	—	56.00	-23.24	N	GND
1.286	FINAL	—	17.48	46.00	-28.52	N	GND
4.326	FINAL	36.4	—	56.00	-19.56	N	GND
4.353	FINAL	—	23.00	46.00	-23.00	N	GND
9.368	FINAL	19.9	—	60.00	-40.08	N	GND
9.375	FINAL	—	13.72	50.00	-36.28	N	GND

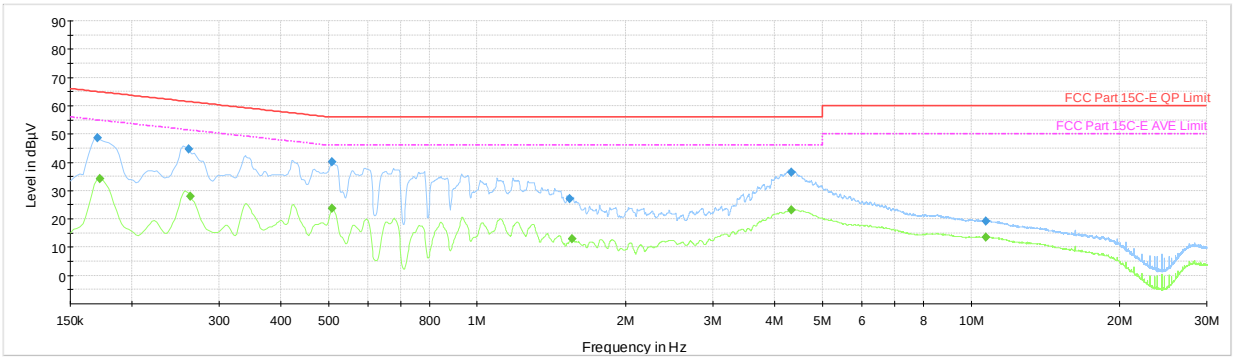
Table 7-221. AC Line Conducted Data with 802.11n – Ch.40(N), with AC/DC adapter



Plot 7-1251. AC Line Conducted Plot with 802.11ax(SU) SDM – Ch.40 (L1), with AC/DC adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.168	FINAL	48.5	—	65.06	-16.61	L1	GND
0.170	FINAL	—	34.39	54.95	-20.56	L1	GND
0.260	FINAL	45.1	—	61.42	-16.34	L1	GND
0.263	FINAL	—	28.15	51.35	-23.20	L1	GND
0.508	FINAL	—	23.63	46.00	-22.37	L1	GND
0.508	FINAL	40.2	—	56.00	-15.76	L1	GND
1.349	FINAL	30.3	—	56.00	-25.69	L1	GND
1.354	FINAL	—	12.96	46.00	-33.04	L1	GND
4.297	FINAL	35.1	—	56.00	-20.87	L1	GND
4.299	FINAL	—	21.28	46.00	-24.72	L1	GND
8.295	FINAL	15.5	—	60.00	-44.49	L1	GND
8.300	FINAL	—	9.13	50.00	-40.87	L1	GND

Table 7-222. AC Line Conducted Data with 802.11ax(SU) – Ch.40 (L1) with AC/DC adapter



Plot 7-1252. AC Line Conducted Plot with 802.11ax(SU) SDM – Ch.40 (N), with AC/DC adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.170	FINAL	48.7	—	64.95	-16.21	N	GND
0.173	FINAL	—	34.26	54.84	-20.58	N	GND
0.260	FINAL	44.8	—	61.42	-16.63	N	GND
0.263	FINAL	—	27.96	51.35	-23.40	N	GND
0.508	FINAL	—	23.76	46.00	-22.24	N	GND
0.508	FINAL	40.2	—	56.00	-15.82	N	GND
1.538	FINAL	27.0	—	56.00	-28.96	N	GND
1.559	FINAL	—	13.01	46.00	-32.99	N	GND
4.322	FINAL	—	23.09	46.00	-22.91	N	GND
4.324	FINAL	36.4	—	56.00	-19.58	N	GND
10.694	FINAL	—	13.54	50.00	-36.46	N	GND
10.694	FINAL	19.3	—	60.00	-40.69	N	GND

Table 7-223. AC Line Conducted Data with 802.11ax(SU) SDM – Ch.36 (N), with AC/DC adapter

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Apple Tablet Device FCC ID: BCGA2436** and **IC: 579C-A2436** is in compliance with Part 15 Subpart E (15.407) of the FCC Rules and RSS-247 of the Innovation, Science and Economic Development Canada Rules.