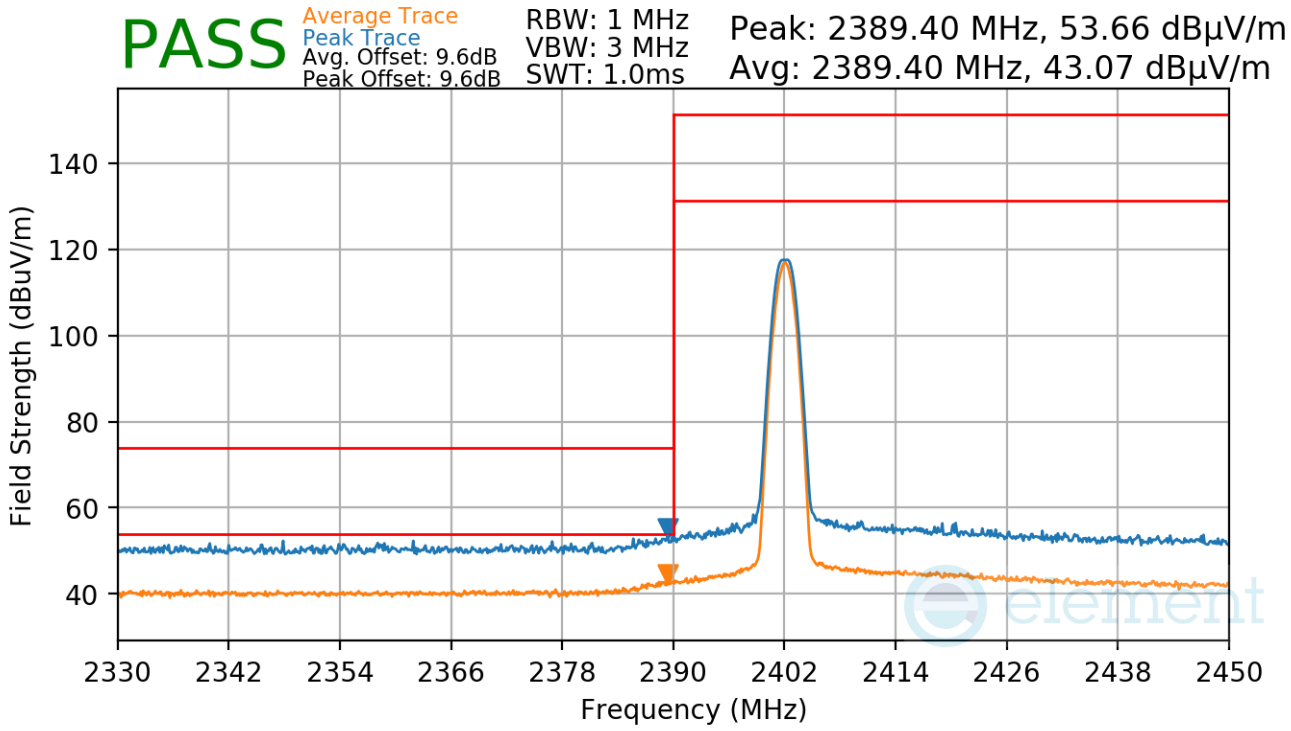
Radiated Restricted Band Edge Measurements

§15.205 §15.209; RSS-Gen [8.9]

TxBF

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

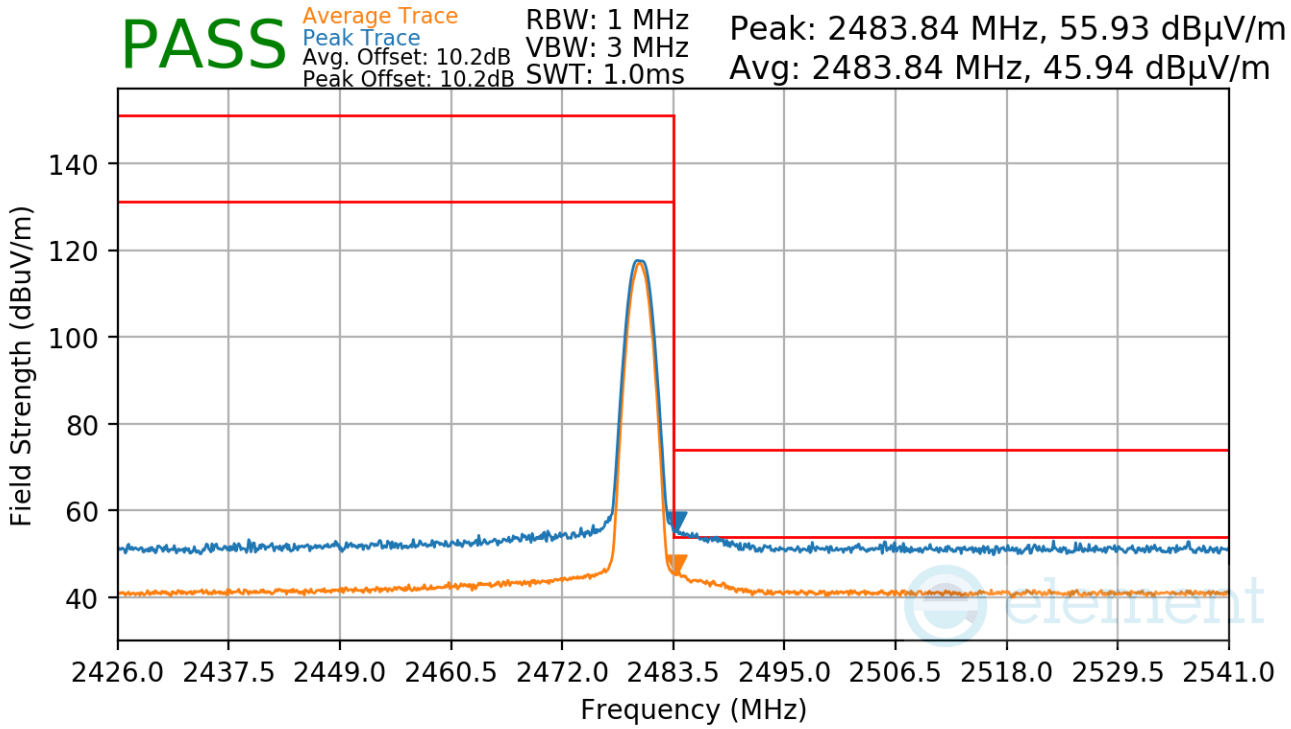


Plot 7-99. Radiated Restricted Lower Band Edge Measurement TxBF (Average & Peak)

Radiated Restricted Band Edge Measurements

§15.205 §15.209; RSS-Gen [8.9]

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	39

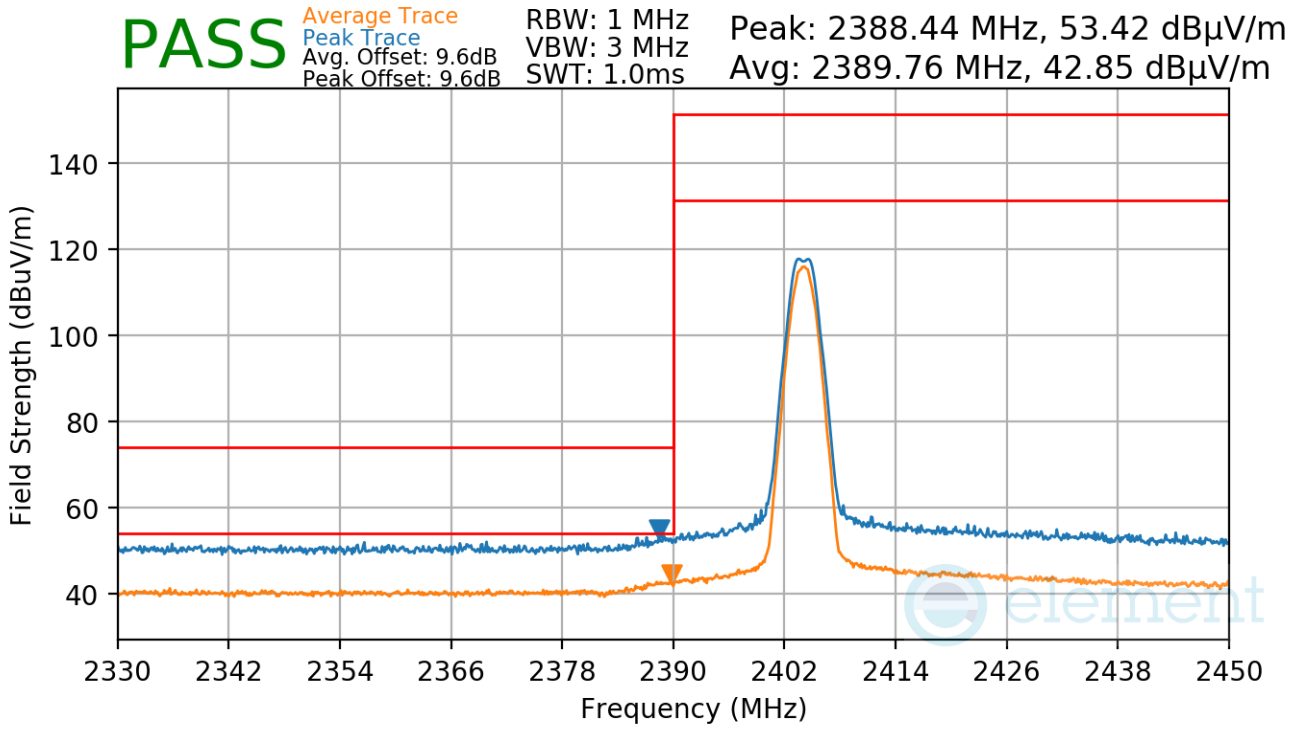


Plot 7-100. Radiated Restricted Upper Band Edge Measurement TxBF (Average & Peak)

Radiated Restricted Band Edge Measurements

§15.205 §15.209; RSS-Gen [8.9]

Bluetooth Mode:	LE
Data Rate:	2Mbps
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	2404MHz
Channel:	1

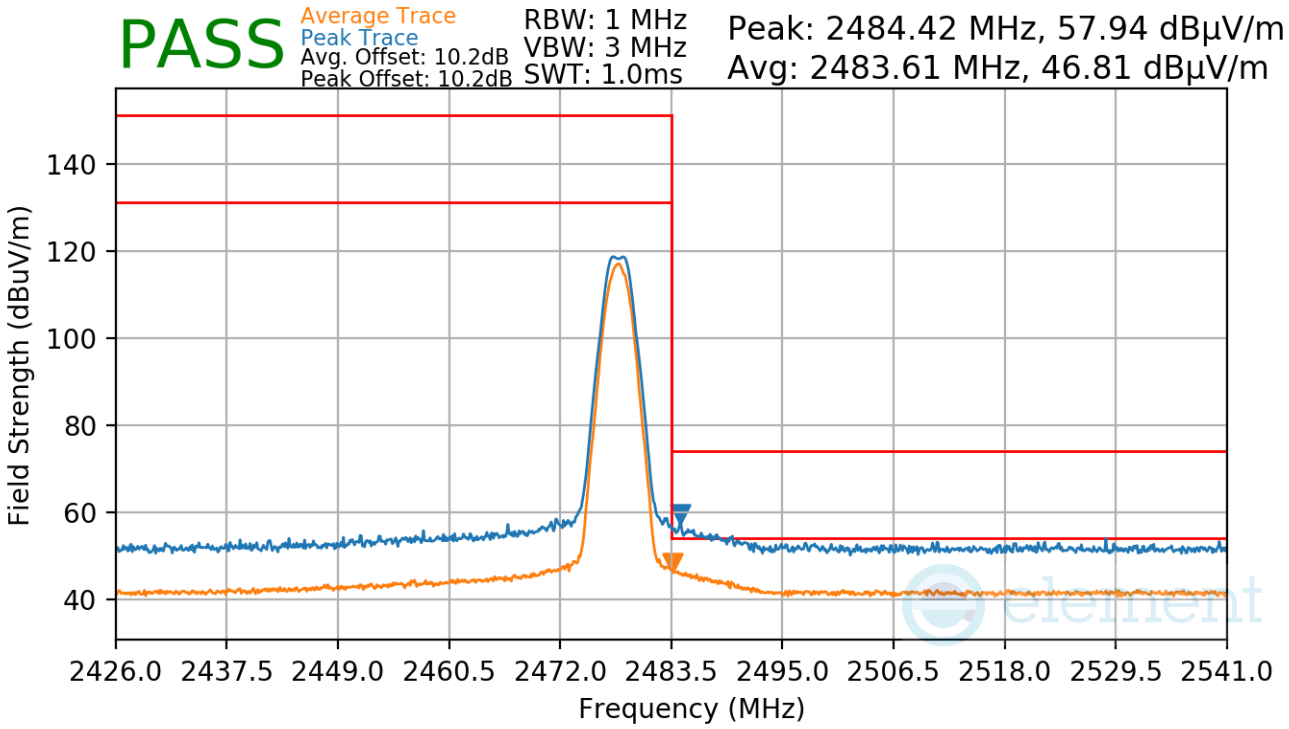


Plot 7-101. Radiated Restricted Lower Band Edge Measurement TxBF (Average & Peak)

Radiated Restricted Band Edge Measurements

§15.205 §15.209; RSS-Gen [8.9]

Bluetooth Mode:	LE
Data Rate:	2Mbps
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	2478MHz
Channel:	38



Plot 7-102. Radiated Restricted Upper Band Edge Measurement TxBF (Average & Peak)

7.8 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 7-23 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 7-23. 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

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. VBW = 300kHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Setup

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

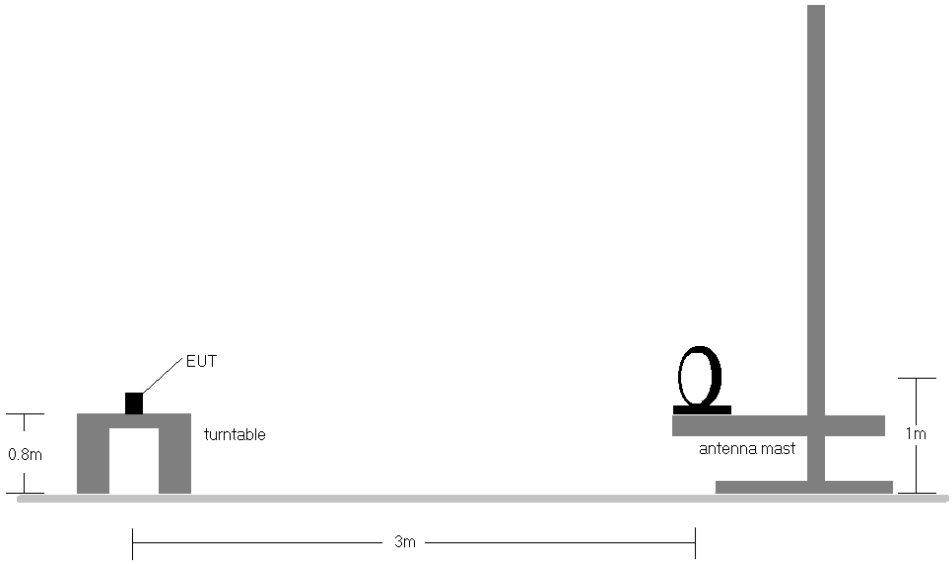


Figure 7-7. Radiated Test Setup < 30MHz

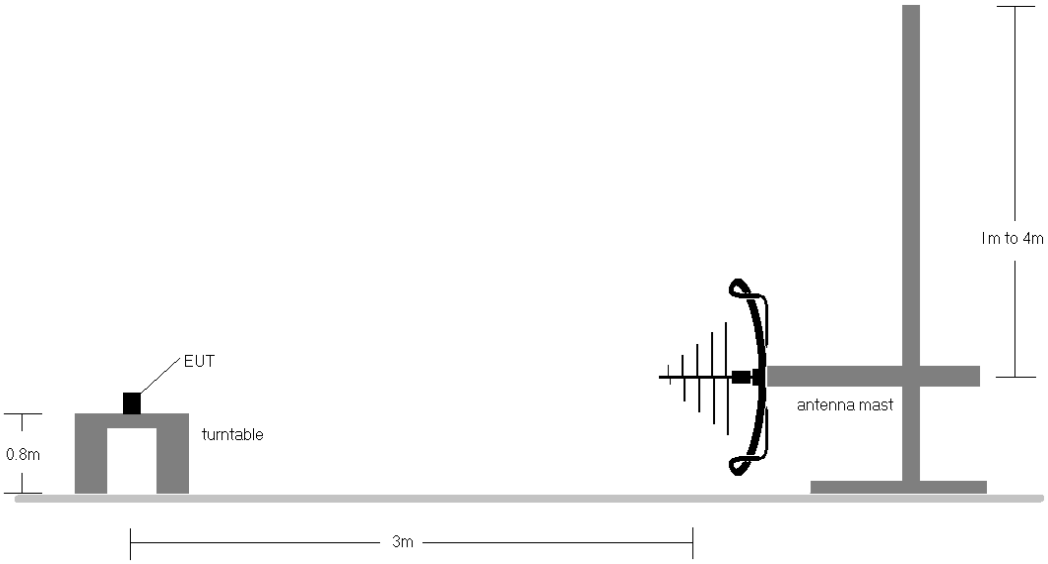


Figure 7-8. Radiated Test Setup < 1GHz

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 7-23.
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. All supported modulation, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.
10. 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

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 $_{[dB]}$ – Preamplifier Gain $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

TxBF

Plot 7-103. Radiated Spurious Emissions Below 1GHz TxBF (1Mbps, ePA – Ch.19, Pol. H & V, 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]
37.03	Max-Peak	V	100	294	-67.92	-15.22	23.86	40.00	-16.14
52.16	Max-Peak	V	100	222	-66.74	-13.17	27.09	40.00	-12.91
164.98	Max-Peak	H	100	238	-65.37	-19.41	22.22	43.52	-21.30
193.83	Max-Peak	H	100	232	-62.04	-16.98	27.98	43.52	-15.54
279.05	Max-Peak	H	100	13	-70.59	-15.06	21.35	46.02	-24.67
735.53	Max-Peak	H	100	222	-78.64	-5.77	22.59	46.02	-23.43

Table 7-24. Radiated Spurious Emissions Below 1GHz TxBF (1Mbps, ePA – Ch.19, Pol. H & V, with AC/DC Adapter)

7.9 AC Line-Conducted Emissions Measurement

§15.207; 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 7-25. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Subclause 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.

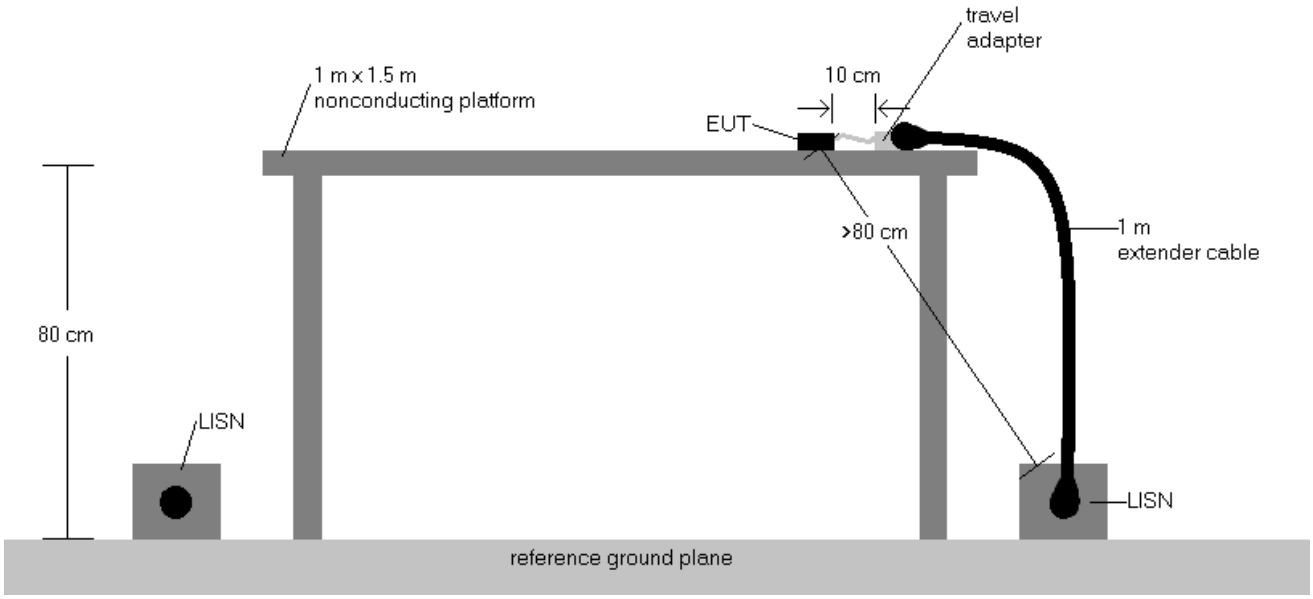
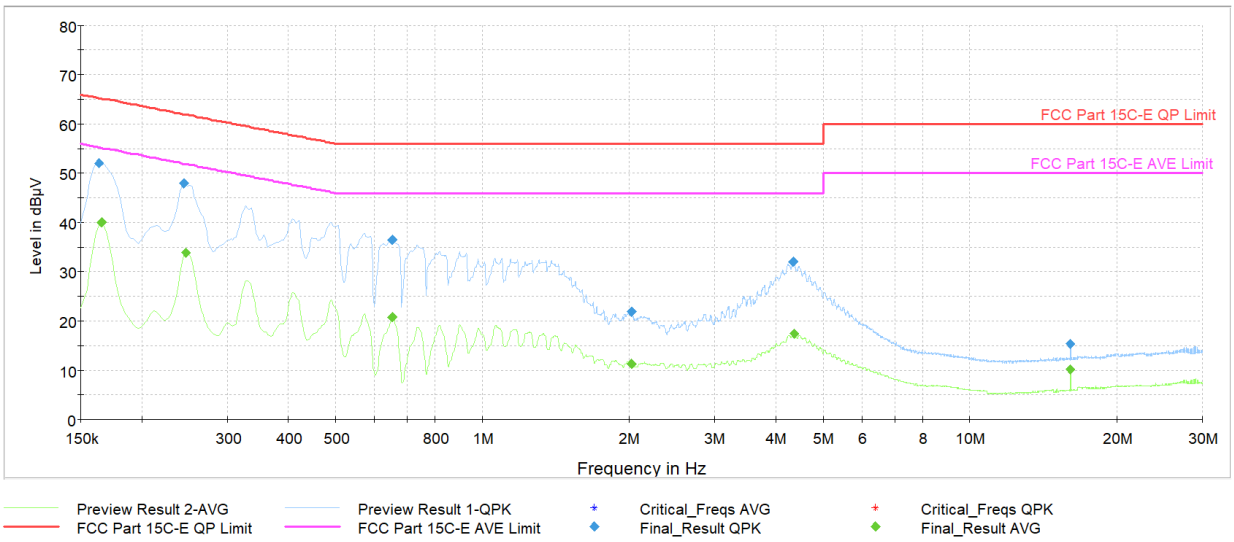


Figure 7-9. Test Instrument & Measurement Setup

Test Notes

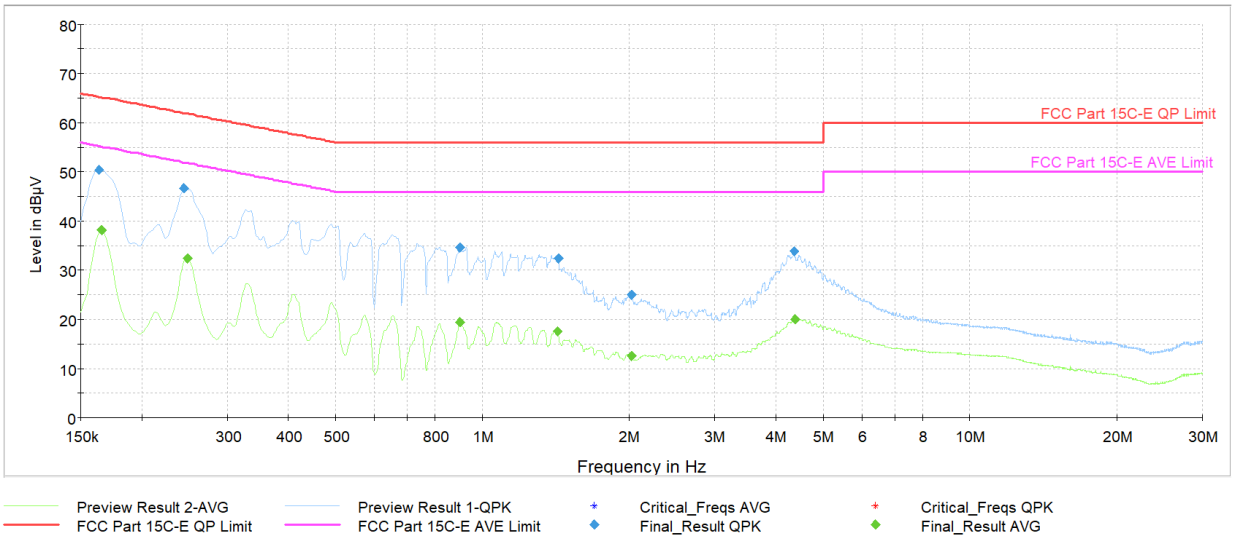
1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
2. Both configurations below were investigated, and the worst case has been reported.
    a. EUT powered by AC/DC adaptor via USB-C 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 Part 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 plot are made using a quasi peak and average detectors.
8. Deviations to the Specifications: None.



Plot 7-104. AC Line Conducted Plot with Bluetooth LE TxBF (L1, 1Mbps ePA – Ch.19 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.164	FINAL	52.0	—	65.28	-13.26	L1	GND
0.166	FINAL	—	39.92	55.17	-15.25	L1	GND
0.245	FINAL	48.1	—	61.94	-13.89	L1	GND
0.247	FINAL	—	33.96	51.87	-17.91	L1	GND
0.654	FINAL	—	20.70	46.00	-25.30	L1	GND
0.654	FINAL	36.5	—	56.00	-19.51	L1	GND
2.024	FINAL	21.9	—	56.00	-34.11	L1	GND
2.024	FINAL	—	11.36	46.00	-34.64	L1	GND
4.351	FINAL	32.0	—	56.00	-23.99	L1	GND
4.355	FINAL	—	17.35	46.00	-28.65	L1	GND
16.082	FINAL	—	10.25	50.00	-39.75	L1	GND
16.082	FINAL	15.4	—	60.00	-44.59	L1	GND

Table 7-26. AC Line Conducted Data with Bluetooth LE TxBF (L1, 1Mbps ePA – Ch.19 with AC/DC Adapter)



Plot 7-105. AC Line Conducted Plot with Bluetooth LE TxBF (N, 1Mbps ePA – Ch.19, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.164	FINAL	50.4	—	65.28	-14.87	N	GND
0.166	FINAL	—	38.12	55.17	-17.05	N	GND
0.245	FINAL	46.7	—	61.94	-15.29	N	GND
0.249	FINAL	—	32.41	51.79	-19.38	N	GND
0.897	FINAL	34.7	—	56.00	-21.32	N	GND
0.899	FINAL	—	19.42	46.00	-26.58	N	GND
1.428	FINAL	—	17.54	46.00	-28.46	N	GND
1.433	FINAL	32.3	—	56.00	-23.66	N	GND
2.022	FINAL	25.0	—	56.00	-31.04	N	GND
2.022	FINAL	—	12.59	46.00	-33.41	N	GND
4.360	FINAL	33.8	—	56.00	-22.17	N	GND
4.371	FINAL	—	20.06	46.00	-25.94	N	GND

Table 7-27. AC Line Conducted Data with Bluetooth LE TxBF (N, 1Mbps ePA – Ch.19 with AC/DC Adapter)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Tablet Device FCC ID: BCGA2899 and IC: 579C-A2899** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules and RSS-247 of the Innovation, Science and Economic Development Canada Rules.