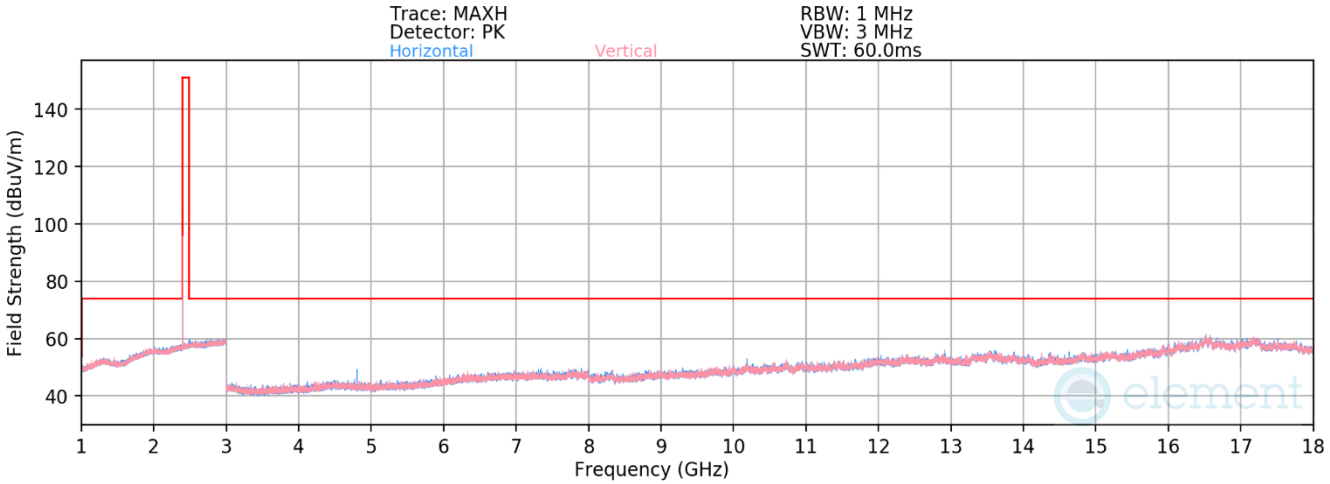
7.7.1 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Antenna WF8 (Common)

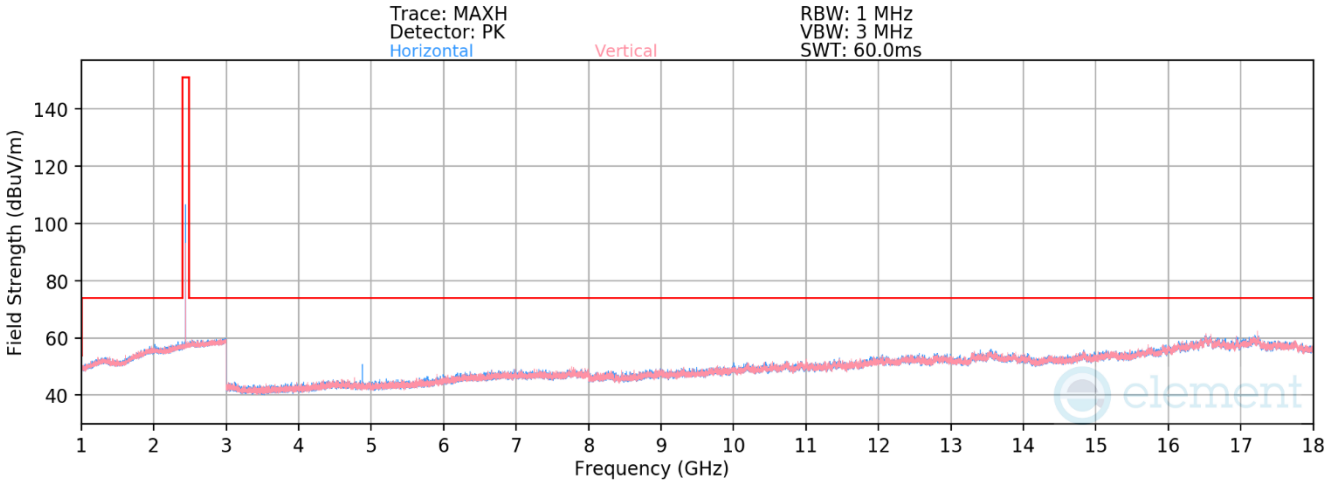


Plot 7-89. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Common) (1Mbps, iPA – Ch. 0)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

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]
4804.00	Average	H	239	246	-69.54	7.31	44.78	53.98	-9.20
4804.00	Peak	H	239	246	-63.49	7.31	50.82	73.98	-23.16
12010.00	Average	H	-	-	-84.09	19.31	42.22	53.98	-11.76
12010.00	Peak	H	-	-	-71.85	19.31	54.46	73.98	-19.52

Table 7-19. Radiated Measurements Antenna WF8 (Common)

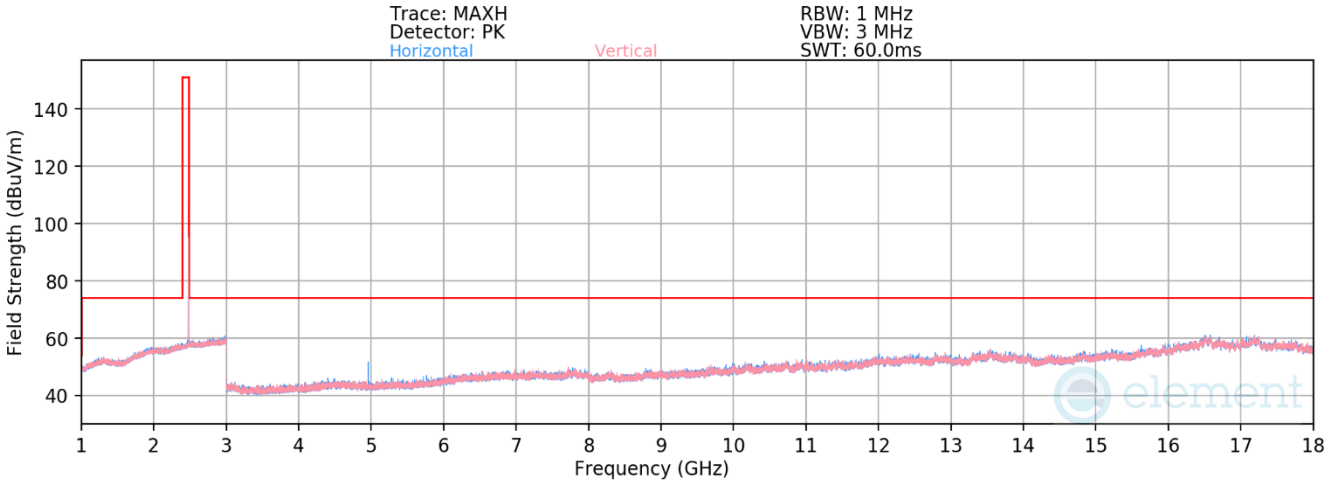


Plot 7-90. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Common) (1Mbps, iPA – Ch. 19)

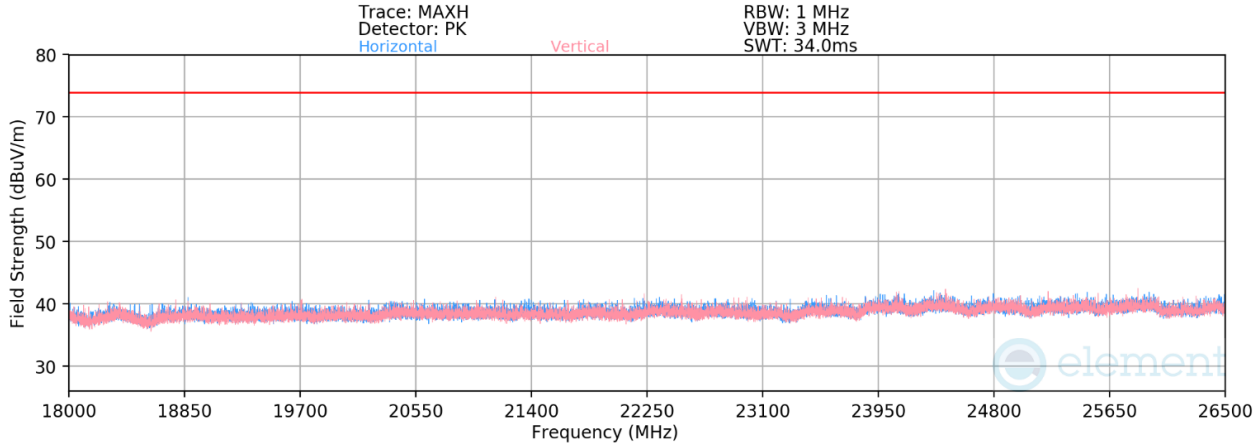
Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2440MHz
Channel:	19

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]
4880.00	Average	H	233	247	-67.70	7.65	46.95	53.98	-7.03
4880.00	Peak	H	233	247	-62.10	7.65	52.55	73.98	-21.43
7320.00	Average	V	-	-	-81.33	11.38	37.06	53.98	-16.92
7320.00	Peak	V	-	-	-70.06	11.38	48.32	73.98	-25.66
12200.00	Average	V	-	-	-84.10	19.04	41.94	53.98	-12.04
12200.00	Peak	V	-	-	-73.05	19.04	52.98	73.98	-21.00

Table 7-20. Radiated Measurements Antenna WF8 (Common)



Plot 7-91. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Common) (1Mbps iPA – Ch. 39)



Plot 7-92. Radiated Spurious Emissions Above 18GHz Antenna WF8 (Common) (1Mbps iPA – Ch. 39)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz
Channel:	39

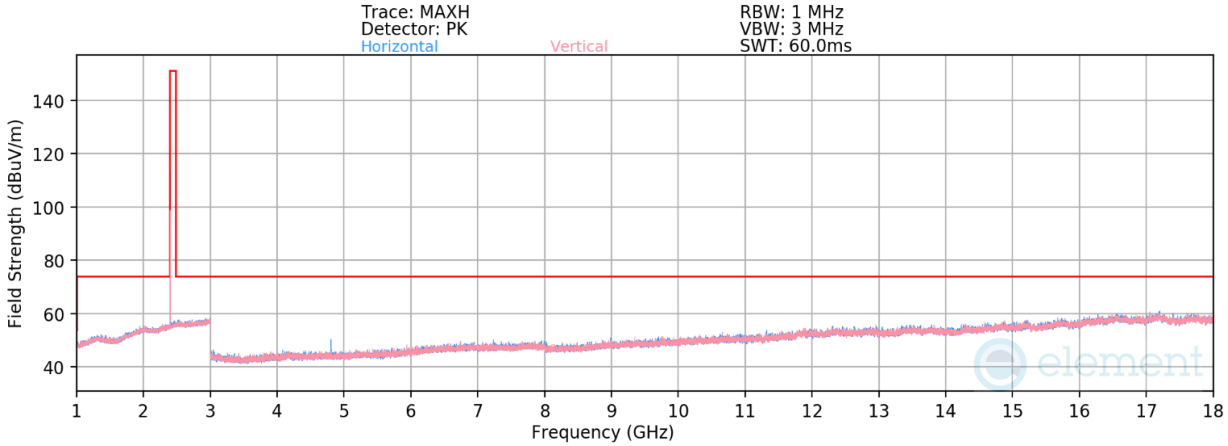
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Average	H	233	247	-66.00	6.52	47.53	53.98	-6.45
4960.00	Peak	H	233	247	-60.65	6.52	52.87	73.98	-21.11
7440.00	Average	H	-	-	-81.91	10.26	35.35	53.98	-18.63
7440.00	Peak	H	-	-	-70.31	10.26	46.95	73.98	-27.03
12400.00	Average	H	-	-	-84.19	15.85	38.66	53.98	-15.32
12400.00	Peak	H	-	-	-71.69	15.85	51.16	73.98	-22.82

Table 7-21. Radiated Measurements Antenna WF8 (Common)

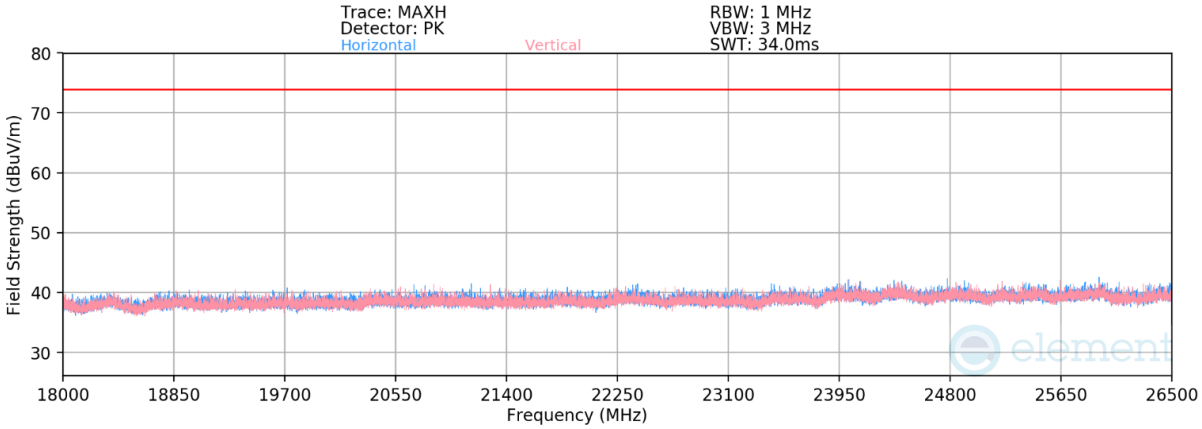
7.7.2 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Antenna WF8 (Dedicated)



Plot 7-93. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Dedicated) (1Mbps, iPA – Ch. 0)

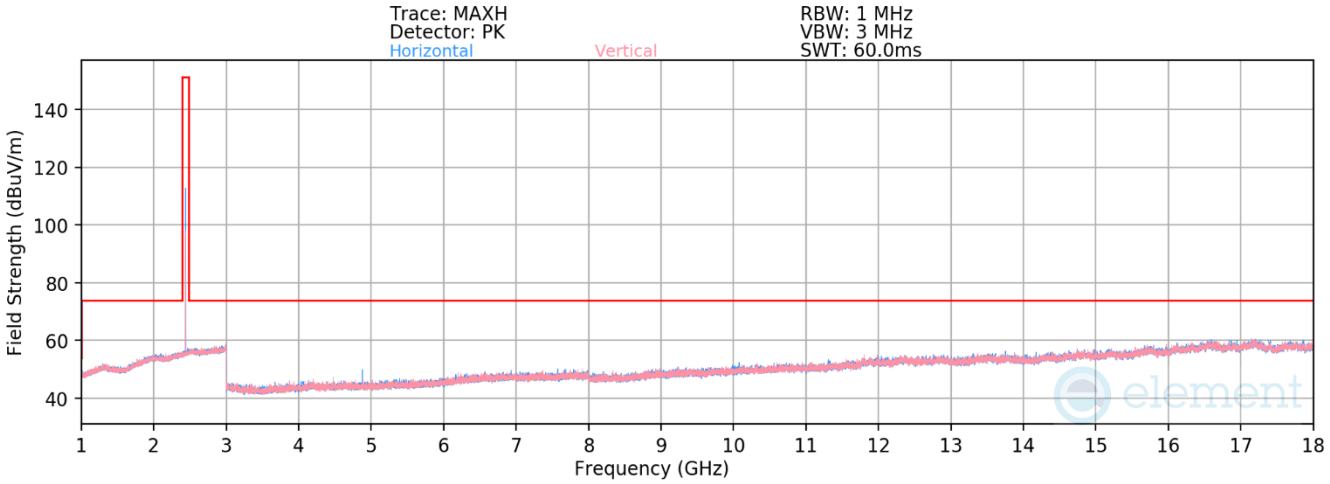


Plot 7-94. Radiated Spurious Emissions Above 18GHz Antenna WF8 (Dedicated) (1Mbps, iPA – Ch. 0)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

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]
4804.00	Average	H	235	240	-66.98	7.06	47.08	53.98	-6.90
4804.00	Peak	H	235	240	-61.37	7.06	52.69	73.98	-21.29
12010.00	Average	V	-	-	-82.36	18.28	42.92	53.98	-11.06
12010.00	Peak	V	-	-	-71.11	18.28	54.17	73.98	-19.81

Table 7-22. Radiated Measurements Antenna WF8 (Dedicated)

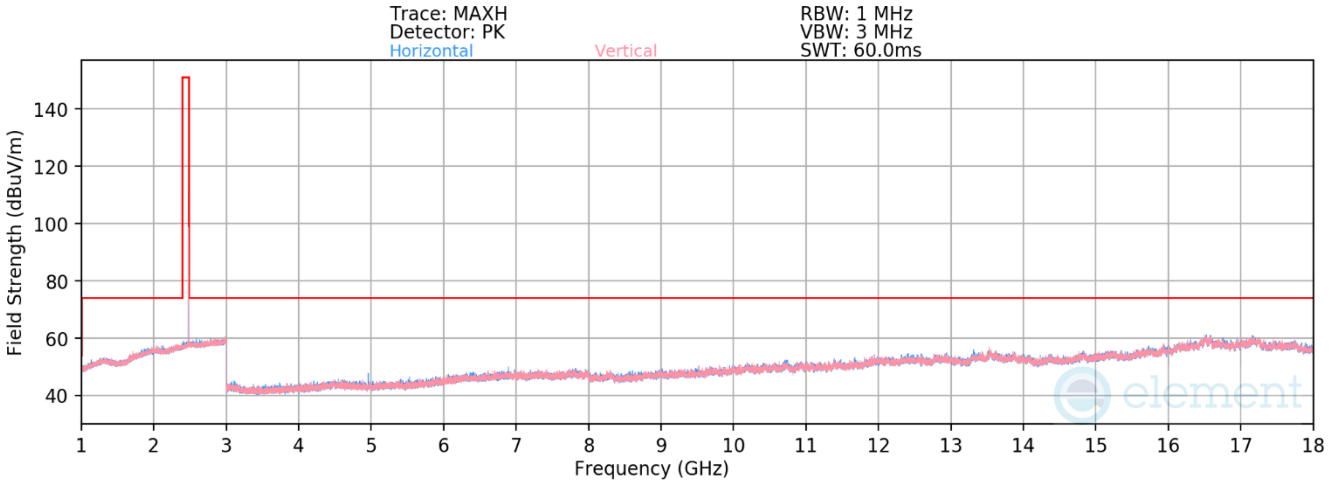


Plot 7-95. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Dedicated) (1Mbps, iPA – Ch. 19)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2440MHz
Channel:	19

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]
4880.00	Average	H	216	242	-68.09	7.57	46.48	53.98	-7.50
4880.00	Peak	H	216	242	-62.46	7.57	52.12	73.98	-21.86
7320.00	Average	H	-	-	-79.89	10.60	37.71	53.98	-16.27
7320.00	Peak	H	-	-	-68.86	10.60	48.74	73.98	-25.24
12200.00	Average	H	-	-	-82.52	18.45	42.93	53.98	-11.05
12200.00	Peak	H	-	-	-71.49	18.45	53.95	73.98	-20.03

Table 7-23. Radiated Measurements Antenna WF8 (Dedicated)



Plot 7-96. Radiated Spurious Emissions 1-18GHz Antenna WF8 (Dedicated) (1Mbps iPA – Ch. 39)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz
Channel:	39

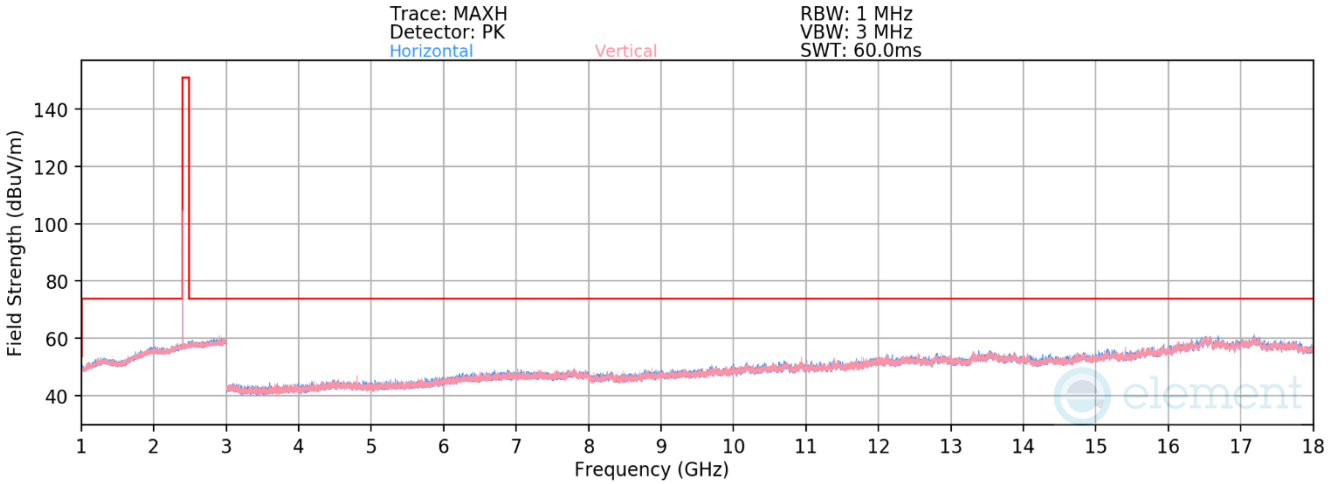
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Average	V	280	186	-71.22	7.30	43.08	53.98	-10.90
4960.00	Peak	V	280	186	-63.49	7.30	50.81	73.98	-23.17
7440.00	Average	V	-	-	-79.55	10.51	37.96	53.98	-16.02
7440.00	Peak	V	-	-	-68.45	10.51	49.06	73.98	-24.92
12400.00	Average	V	-	-	-82.70	18.99	43.29	53.98	-10.69
12400.00	Peak	V	-	-	-71.31	18.99	54.67	73.98	-19.31

Table 7-24. Radiated Measurements Antenna WF8 (Dedicated)

7.7.3 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Antenna WF7b (Common)

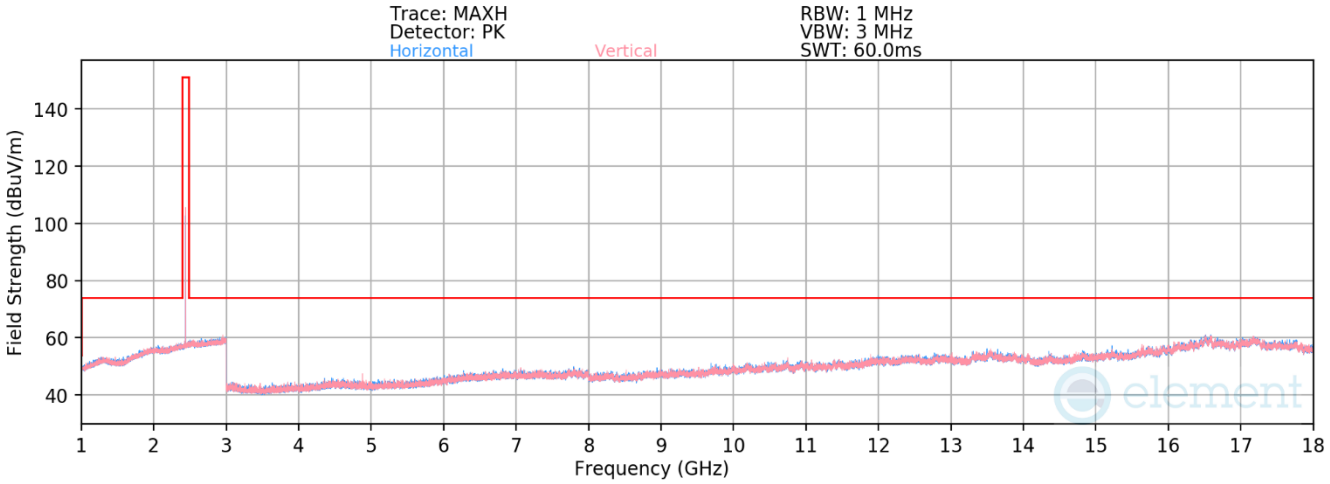


Plot 7-97. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Common) (1Mbps, iPA – Ch. 0)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

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]
4804.00	Average	V	293	200	-71.39	7.31	42.92	53.98	-11.06
4804.00	Peak	V	293	200	-64.38	7.31	49.94	73.98	-24.04
12010.00	Average	V	-	-	-83.48	18.77	42.29	53.98	-11.69
12010.00	Peak	V	-	-	-72.59	18.77	53.18	73.98	-20.80

Table 7-25. Radiated Measurements Antenna WF7b (Common)

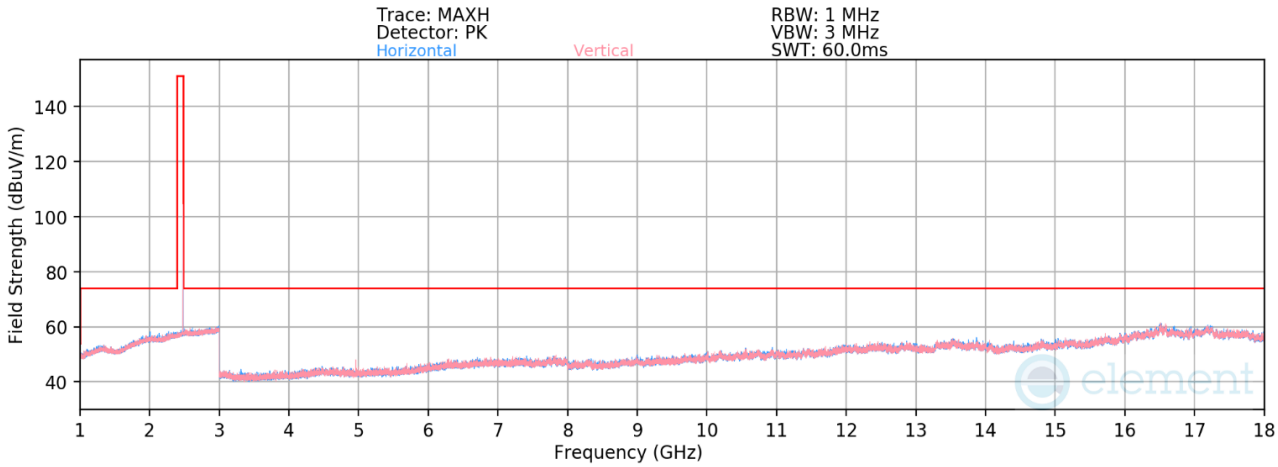


Plot 7-98. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Common) (1Mbps, iPA – Ch. 19)

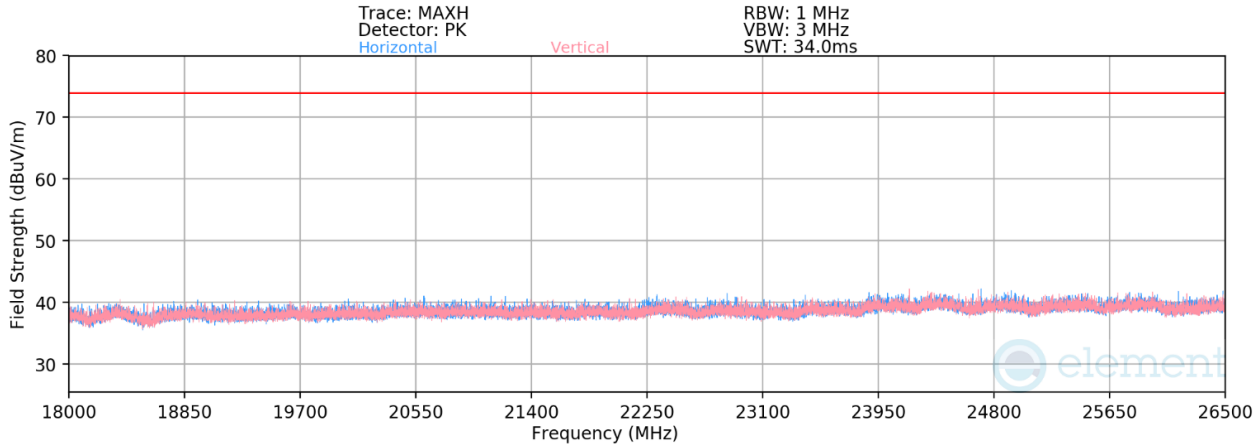
Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2440MHz
Channel:	19

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]
4880.00	Average	V	305	200	-71.14	7.65	43.51	53.98	-10.47
4880.00	Peak	V	305	200	-65.04	7.65	49.61	73.98	-24.37
7320.00	Average	H	-	-	-81.20	11.38	37.18	53.98	-16.80
7320.00	Peak	H	-	-	-69.49	11.38	48.89	73.98	-25.09
12200.00	Average	H	-	-	-83.89	18.71	41.82	53.98	-12.16
12200.00	Peak	H	-	-	-72.37	18.71	53.34	73.98	-20.64

Table 7-26. Radiated Measurements Antenna WF7b (Common)



Plot 7-99. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Common) (1Mbps iPA – Ch. 39)



Plot 7-100. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Common) (1Mbps iPA – Ch. 39)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz
Channel:	39

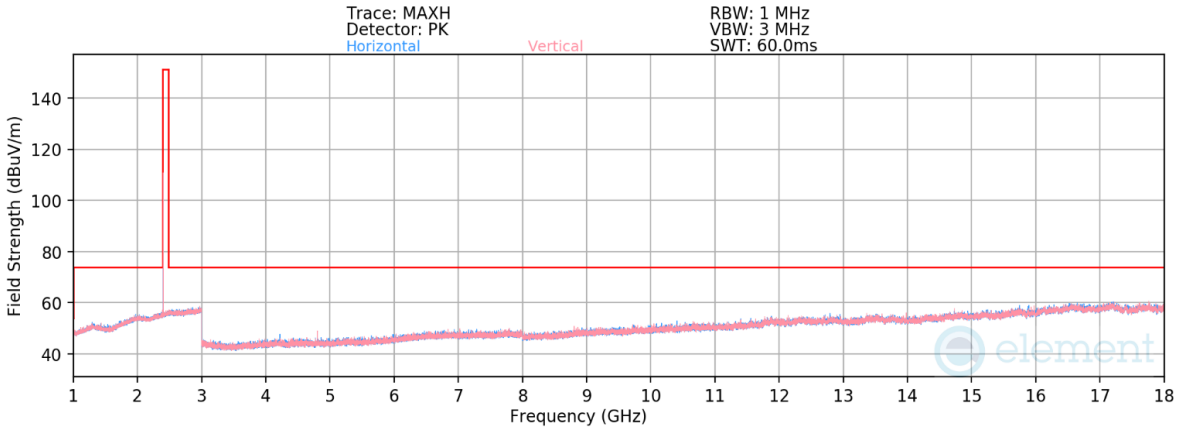
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Average	V	289	196	-68.69	7.25	45.57	53.98	-8.41
4960.00	Peak	V	289	196	-63.23	7.25	51.02	73.98	-22.96
7440.00	Average	V	-	-	-81.97	11.82	36.86	53.98	-17.12
7440.00	Peak	V	-	-	-70.02	11.82	48.81	73.98	-25.17
12400.00	Average	V	-	-	-84.12	19.48	42.36	53.98	-11.62
12400.00	Peak	V	-	-	-71.88	19.48	54.61	73.98	-19.37

Table 7-27. Radiated Measurements Antenna WF7b (Common)

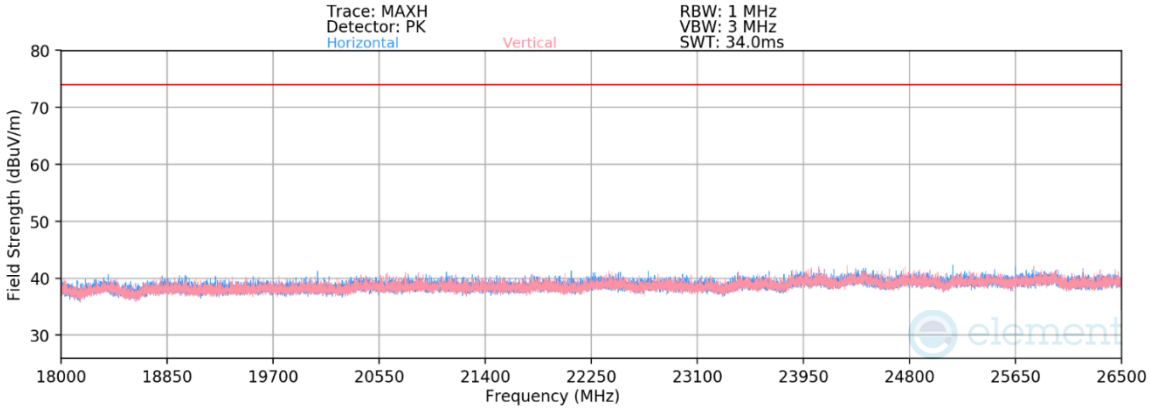
7.7.4 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Antenna WF7b (Dedicated)



Plot 7-101. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Dedicated) (1Mbps, iPA – Ch. 0)

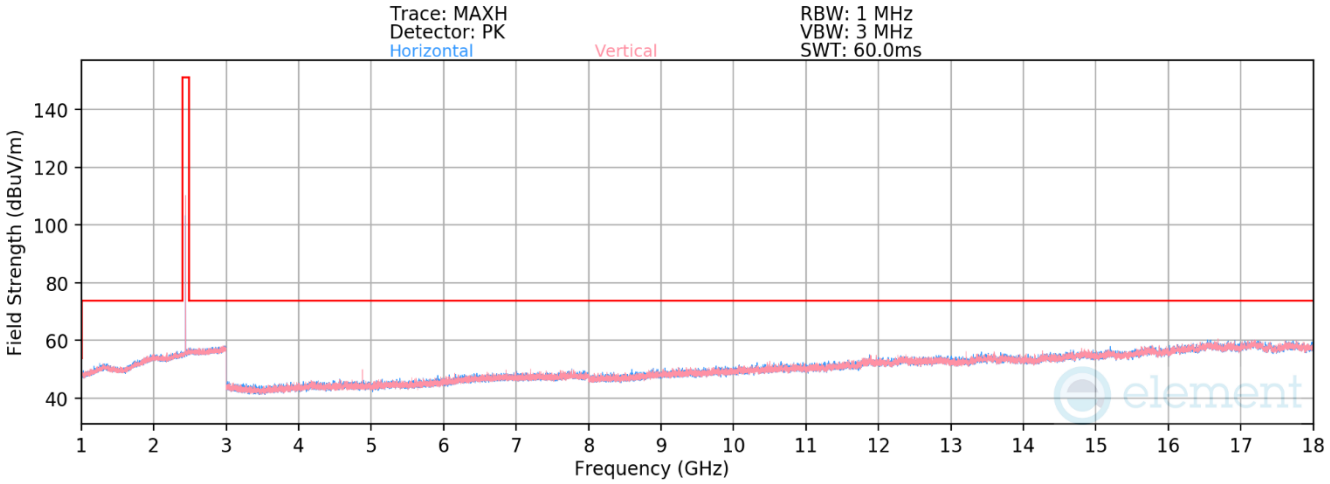


Plot 7-102. Radiated Spurious Emissions Above 18GHz Antenna WF7b (Dedicated) (1Mbps, iPA – Ch. 0)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

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]
4804.00	Average	H	235	240	-68.61	7.06	45.45	53.98	-8.53
4804.00	Peak	H	235	240	-62.49	7.06	51.57	73.98	-22.41
12010.00	Average	V	-	-	-82.33	18.28	42.95	53.98	-11.03
12010.00	Peak	V	-	-	-71.39	18.28	53.89	73.98	-20.09

Table 7-28. Radiated Measurements Antenna WF7b (Dedicated)

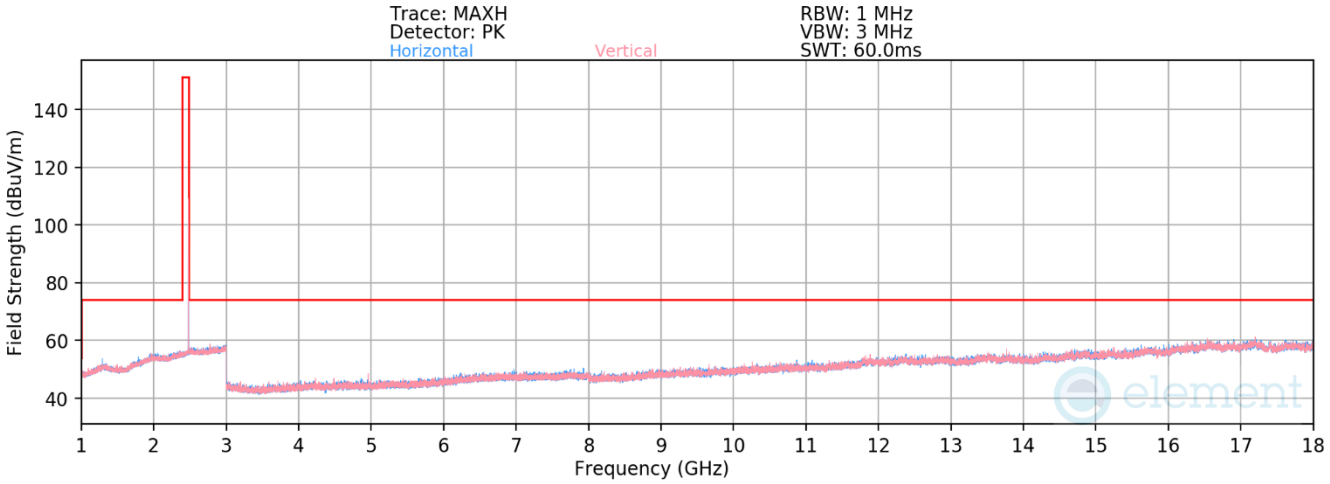


Plot 7-103. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Dedicated) (1Mbps, iPA – Ch. 19)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2440MHz
Channel:	19

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]
4880.00	Average	H	216	242	-68.09	7.57	46.48	53.98	-7.50
4880.00	Peak	H	216	242	-62.46	7.57	52.12	73.98	-21.86
7320.00	Average	H	-	-	-79.89	10.60	37.71	53.98	-16.27
7320.00	Peak	H	-	-	-68.86	10.60	48.74	73.98	-25.24
12200.00	Average	H	-	-	-82.52	18.45	42.93	53.98	-11.05
12200.00	Peak	H	-	-	-71.49	18.45	53.95	73.98	-20.03

Table 7-29. Radiated Measurements Antenna WF7b (Dedicated)



Plot 7-104. Radiated Spurious Emissions 1-18GHz Antenna WF7b (Dedicated) (1Mbps iPA – Ch. 39)

Bluetooth Mode:	LE
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz
Channel:	39

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]
4960.00	Average	V	280	186	-71.22	7.30	43.08	53.98	-10.90
4960.00	Peak	V	280	186	-63.49	7.30	50.81	73.98	-23.17
7440.00	Average	V	-	-	-79.55	10.51	37.96	53.98	-16.02
7440.00	Peak	V	-	-	-68.45	10.51	49.06	73.98	-24.92
12400.00	Average	V	-	-	-82.70	18.99	43.29	53.98	-10.69
12400.00	Peak	V	-	-	-71.31	18.99	54.67	73.98	-19.31

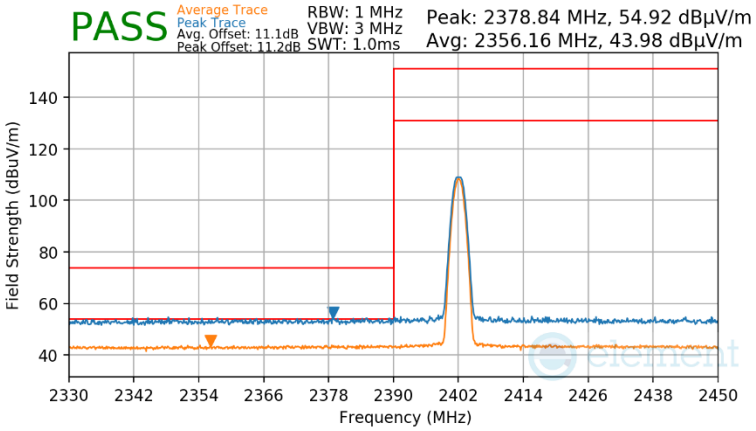
Table 7-30. Radiated Measurements Antenna WF7b (Dedicated)

7.7.5 Radiated Restricted Band Edge Measurements

§15.205 §15.209; RSS-Gen [8.9]

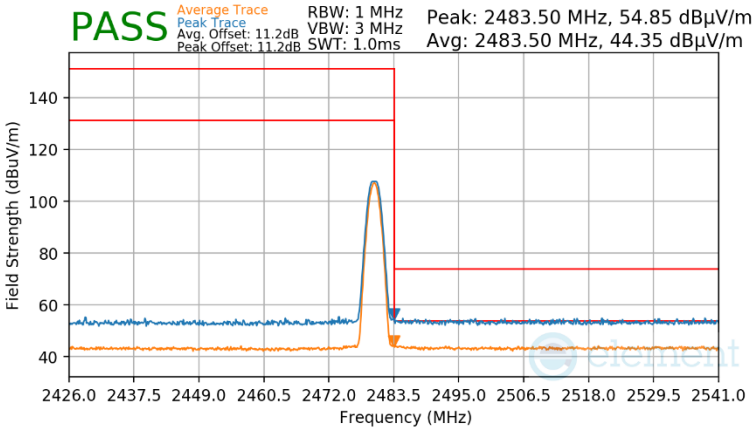
Antenna WF8 (Common)

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



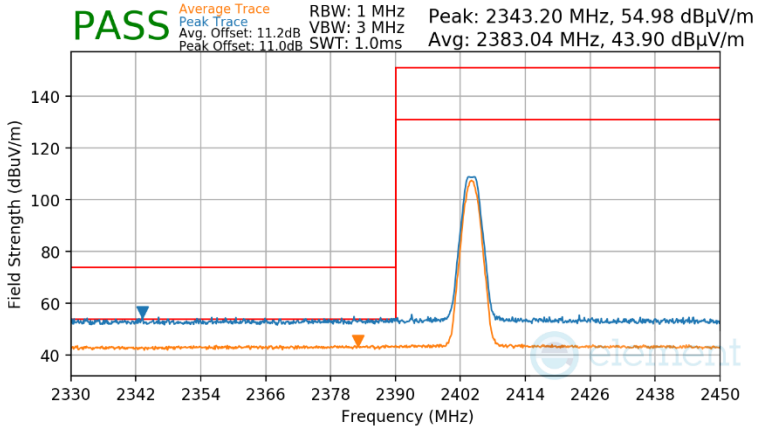
Plot 7-105. Radiated Restricted Lower Band Edge Measurement Antenna WF8 (Common) (Average & Peak)

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



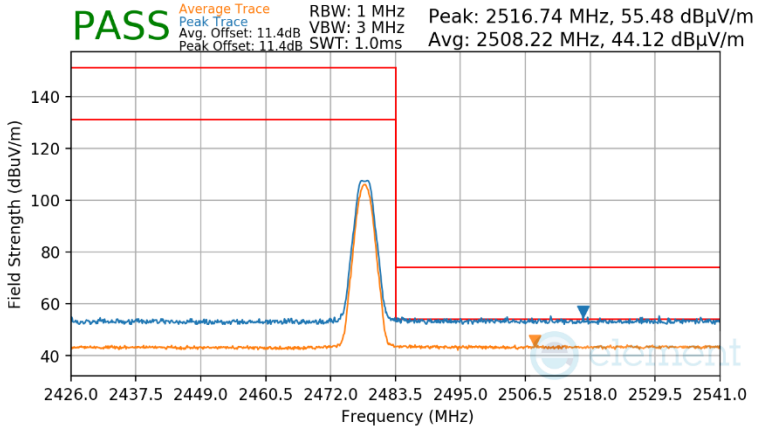
Plot 7-106. Radiated Restricted Upper Band Edge Measurement Antenna WF8 (Common) (Average & Peak)

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



Plot 7-107. Radiated Restricted Lower Band Edge Measurement Antenna WF8 (Common) (Average & Peak)

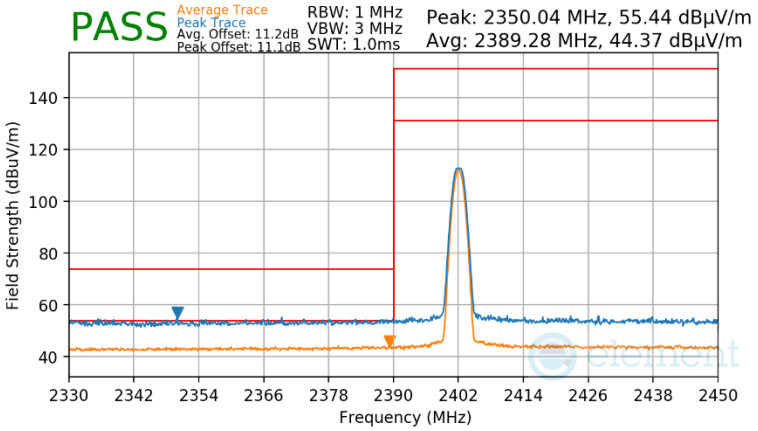
Bluetooth Mode:	LE
Data Rate:	2Mbps
Power Scheme:	iPA
Measurement Distance:	3 Meters
Operating Frequency:	2478MHz
Channel:	38



Plot 7-108. Radiated Restricted Upper Band Edge Measurement Antenna WF8 (Common) (Average & Peak)

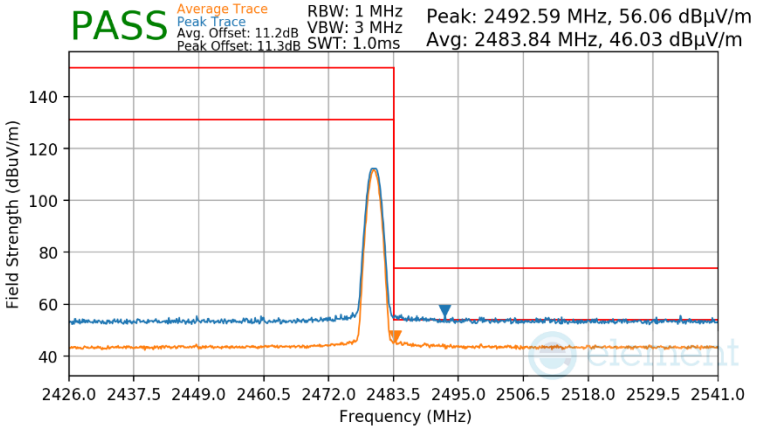
Antenna WF8 (Dedicated)

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



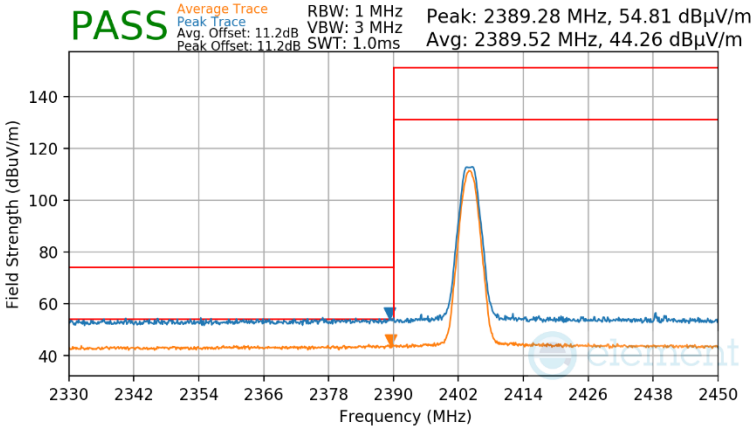
Plot 7-109. Radiated Restricted Lower Band Edge Measurement Antenna WF8 (Dedicated) (Average & Peak)

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



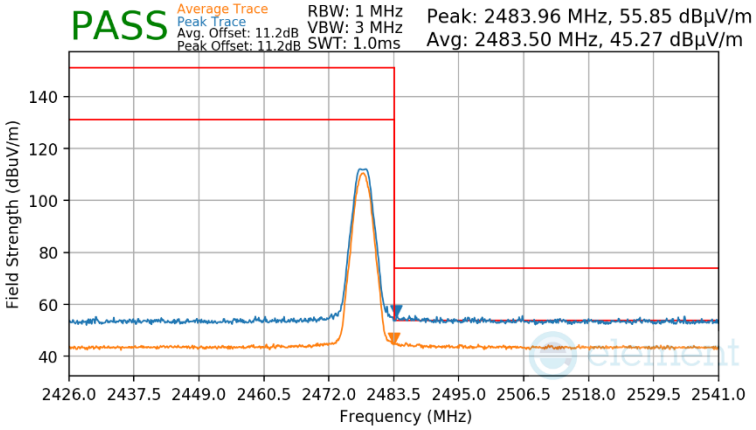
Plot 7-110. Radiated Restricted Upper Band Edge Measurement Antenna WF8 (Dedicated) (Average & Peak)

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



Plot 7-111. Radiated Restricted Lower Band Edge Measurement Antenna WF8 (Dedicated) (Average & Peak)

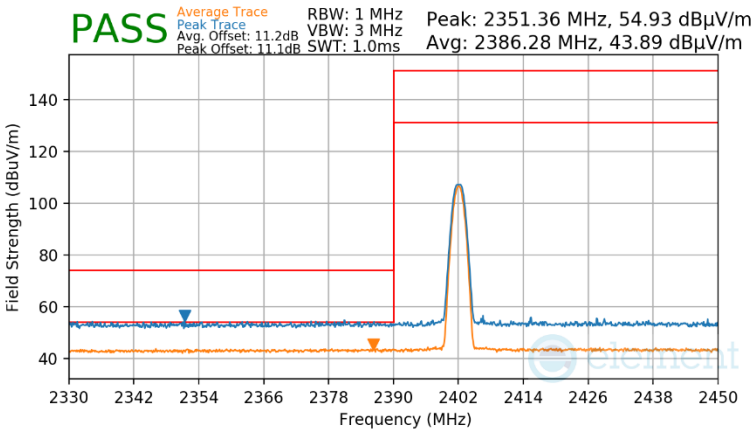
Bluetooth Mode:	LE
Data Rate:	2Mbps
Power Scheme:	iPA
Measurement Distance:	3 Meters
Operating Frequency:	2478MHz
Channel:	38



Plot 7-112. Radiated Restricted Upper Band Edge Measurement Antenna WF8 (Dedicated) (Average & Peak)

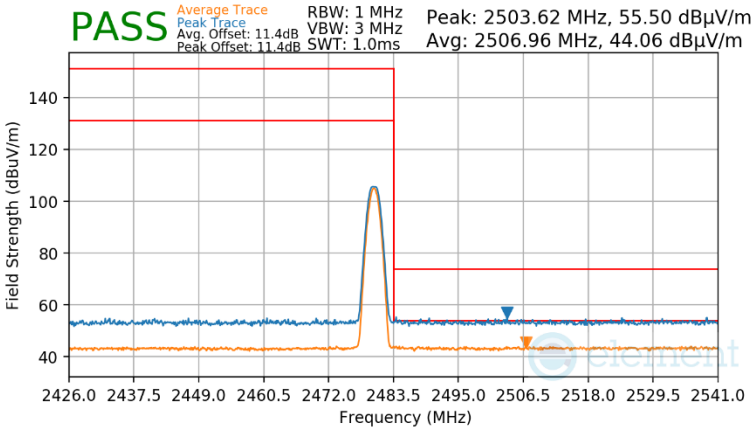
Antenna WF7b (Common)

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



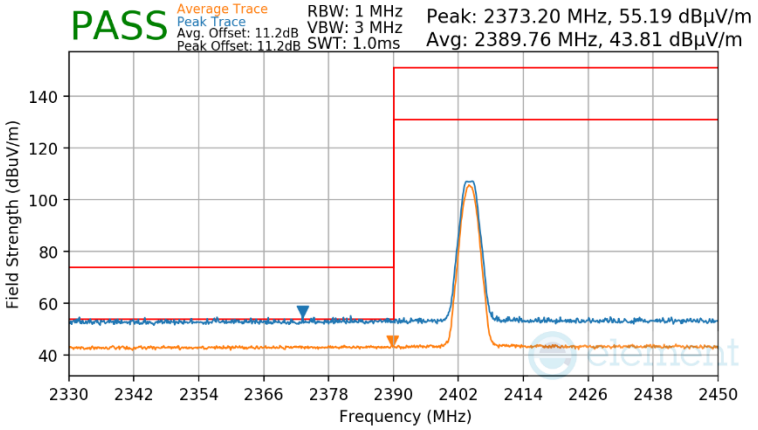
Plot 7-113. Radiated Restricted Lower Band Edge Measurement Antenna WF7b (Common) (Average & Peak)

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



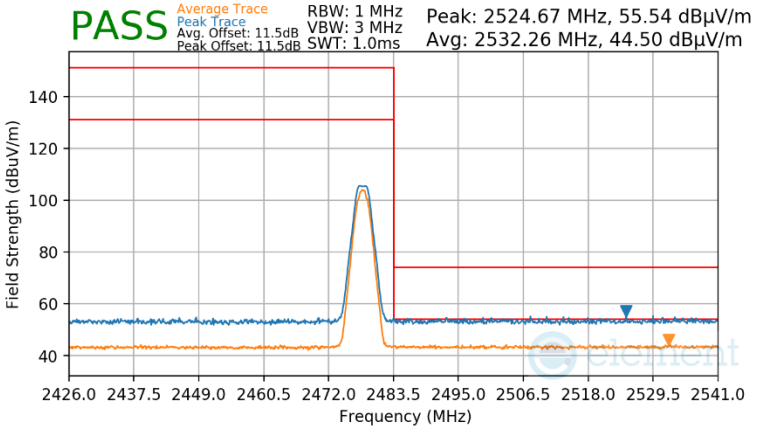
Plot 7-114. Radiated Restricted Upper Band Edge Measurement Antenna WF7b (Common) (Average & Peak)

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



Plot 7-115. Radiated Restricted Lower Band Edge Measurement Antenna WF7b (Common) (Average & Peak)

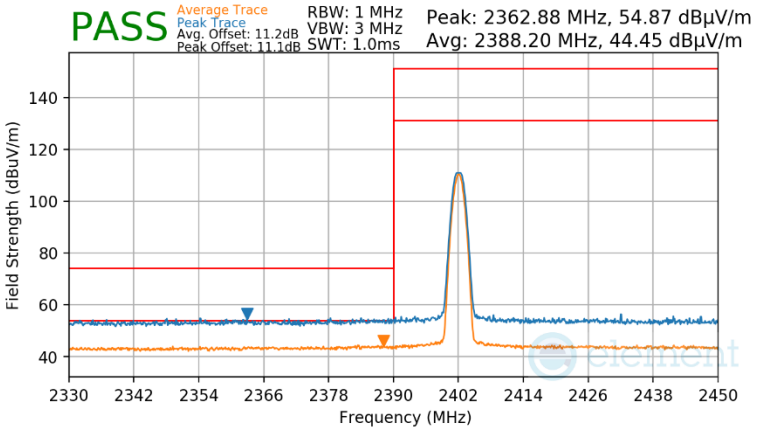
Bluetooth Mode:	LE
Data Rate:	2Mbps
Power Scheme:	iPA
Measurement Distance:	3 Meters
Operating Frequency:	2478MHz
Channel:	38



Plot 7-116. Radiated Restricted Upper Band Edge Measurement Antenna WF7b (Common) (Average & Peak)

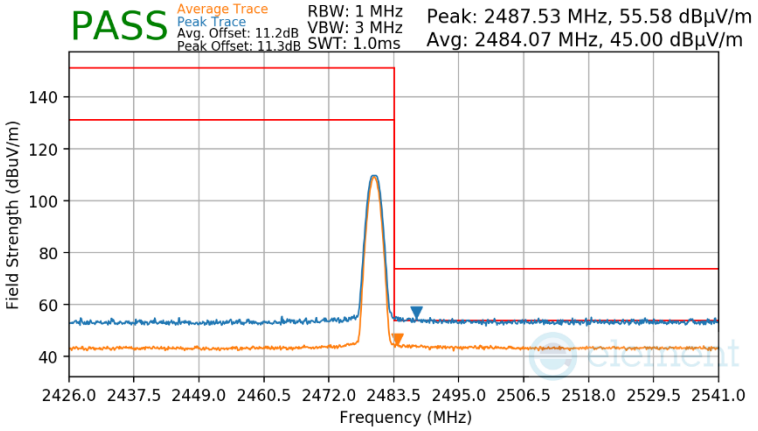
Antenna WF7b (Dedicated)

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



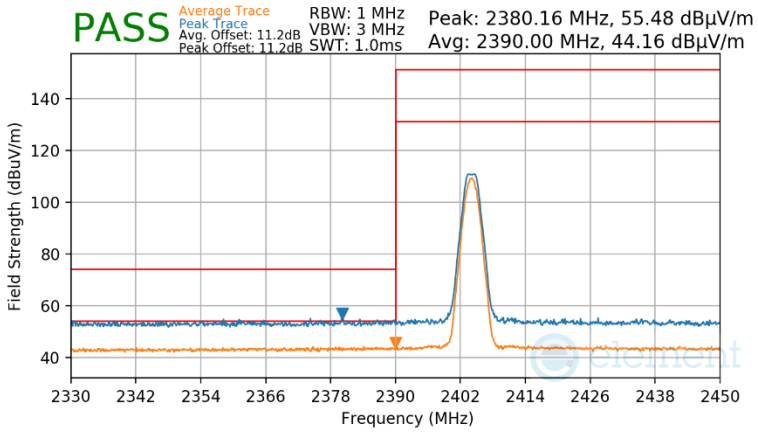
Plot 7-117. Radiated Restricted Lower Band Edge Measurement Antenna WF7b (Dedicated) (Average & Peak)

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



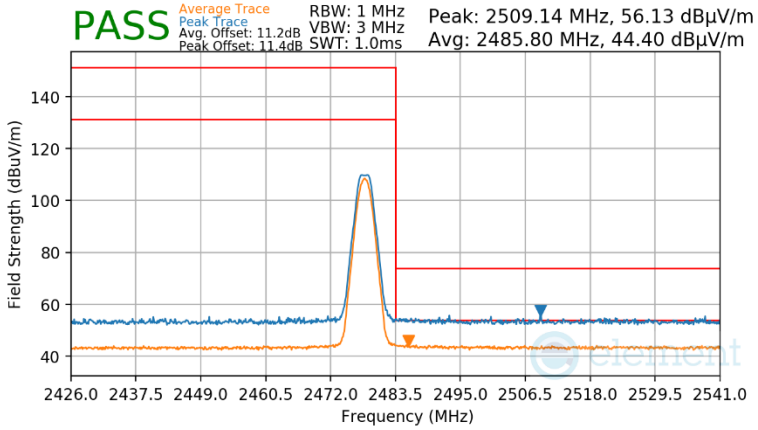
Plot 7-118. Radiated Restricted Upper Band Edge Measurement Antenna WF7b (Dedicated) (Average & Peak)

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



Plot 7-119. Radiated Restricted Lower Band Edge Measurement Antenna WF7b (Dedicated) (Average & Peak)

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



Plot 7-120. Radiated Restricted Upper Band Edge Measurement Antenna WF7b (Dedicated) (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 7-31 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 7-31. Radiated Limits

Test Procedures Used

ANSI C63.10-2020

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.

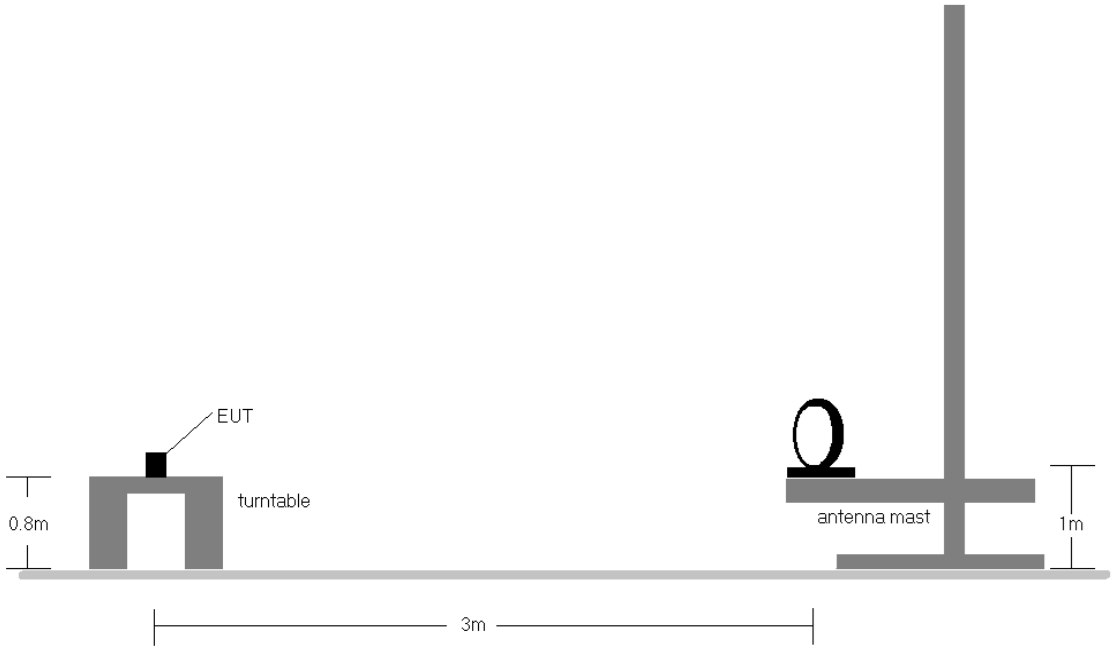


Figure 7-7. Radiated Test Setup < 30MHz

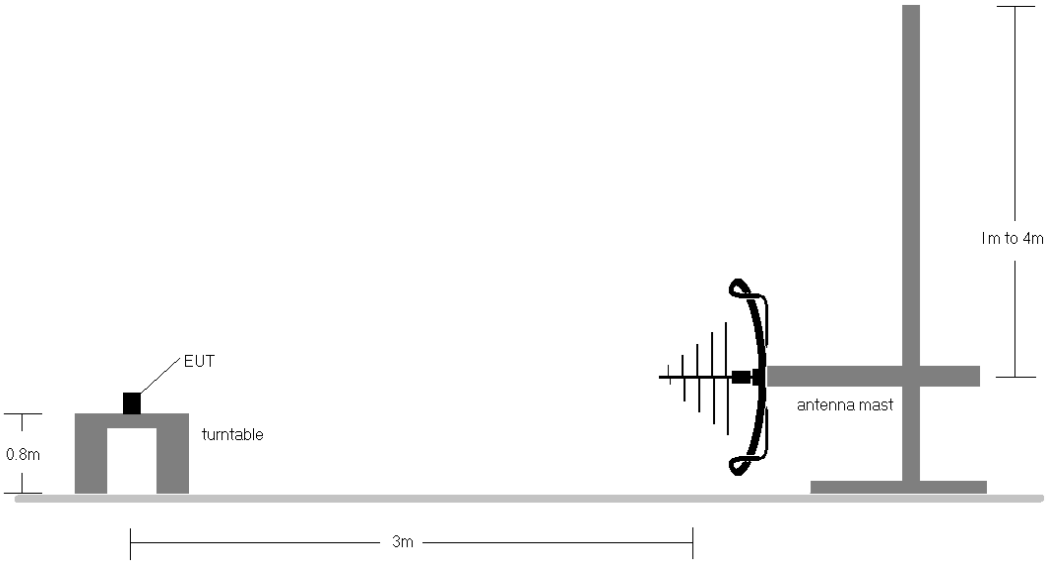


Figure 7-8. Radiated Test Setup < 1GHz

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 7-31.
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 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

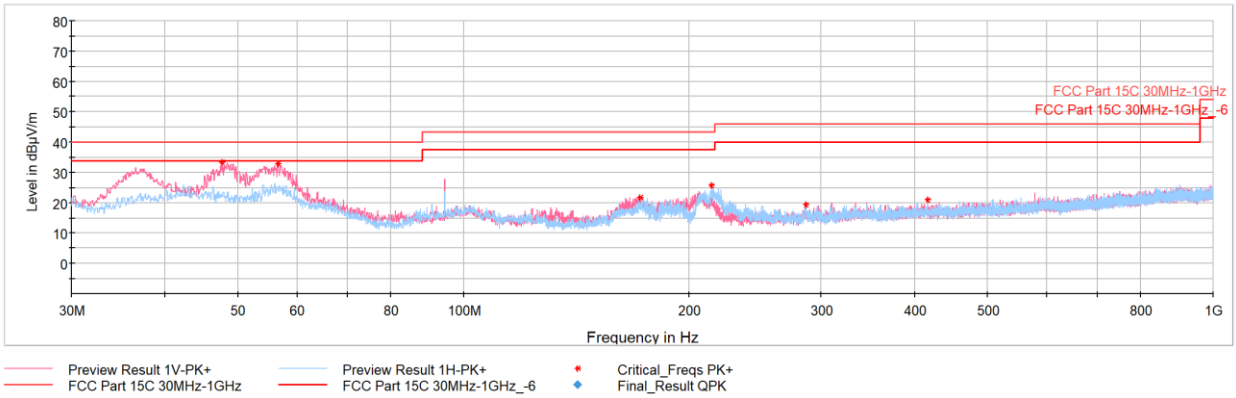
Determining Spurious Emissions Levels

- 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 $_{[dB\mu V/m]}$

7.8.1 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

Antenna WF8 (Common)



Plot 7-121. Radiated Spurious Emissions Below 1GHz Antenna WF8 (Common) (1Mbps, iPA – Ch.39, Pol. H & V, with AC/DC Adapter)

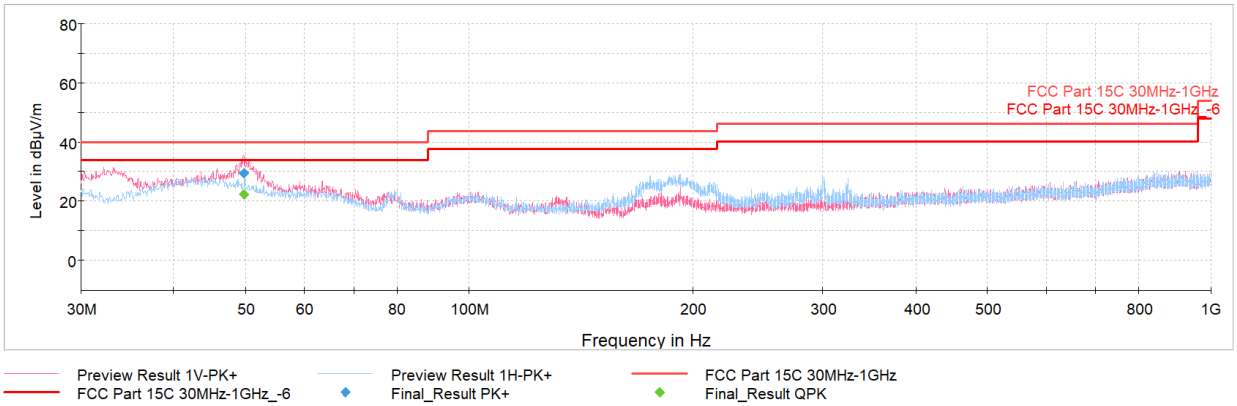
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
47.65	Max Peak	V	100	8	-58.04	-15.45	33.51	40.00	-6.49
56.58	Max Peak	V	100	32	-57.84	-16.29	32.87	40.00	-7.13
172.06	Max Peak	V	100	15	-65.14	-19.97	21.89	43.52	-21.63
214.15	Max Peak	H	100	156	-63.29	-17.90	25.81	43.52	-17.71
285.79	Max Peak	H	100	68	-71.73	-15.81	19.46	46.02	-26.56
415.67	Max Peak	H	200	107	-73.89	-12.22	20.89	46.02	-25.13

Table 7-32. Radiated Spurious Emissions Below 1GHz Antenna WF8 (Common) (1Mbps, iPA – Ch.39, Pol. H & V, with AC/DC Adapter)

7.8.2 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

Antenna WF8 (Dedicated)



Plot 7-122. Radiated Spurious Emissions Below 1GHz Antenna WF8 (Dedicated) (1Mbps, iPA – Ch.0, Pol. H & V, with AC/DC Adapter)

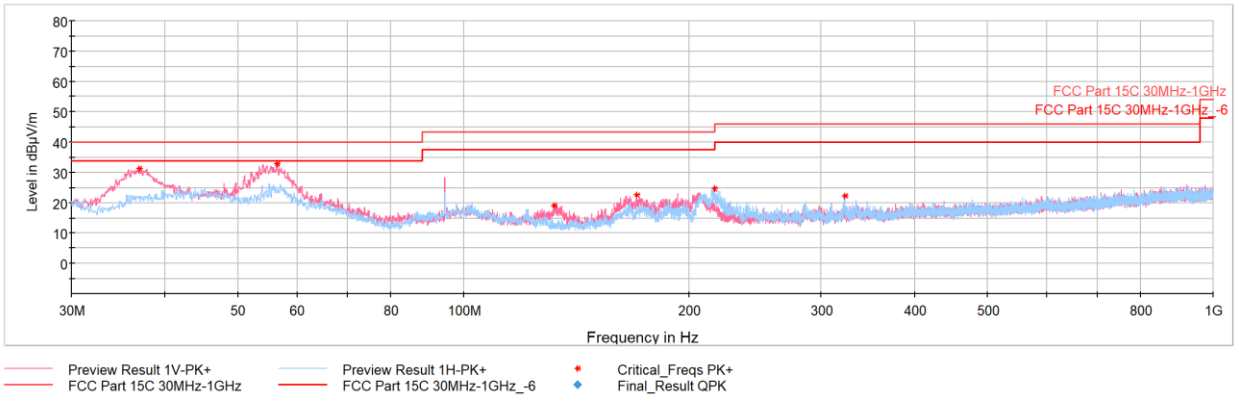
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Limit [dBµV/m]	Margin [dB]
49.69	Quasi-Peak	V	100	13	-70.38	-14.26	40.00	-17.64
79.28	Max Peak	H	200	94	-61.50	-21.56	40.00	-16.06
131.46	Max Peak	V	100	214	-65.19	-19.76	43.52	-21.47
192.04	Max Peak	H	200	347	-61.51	-16.28	43.52	-14.31
300.68	Max Peak	H	100	264	-65.31	-13.34	46.02	-17.67
659.05	Max Peak	V	300	139	-74.17	-5.79	46.02	-18.98

Table 7-33. Radiated Spurious Emissions Below 1GHz Antenna WF8 (Dedicated) (1Mbps, iPA – Ch.0, Pol. H & V, with AC/DC Adapter)

7.8.3 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

Antenna WF7b (Common)



Plot 7-123. Radiated Spurious Emissions Below 1GHz Antenna WF7b (Common) (1Mbps, iPA – Ch.39, Pol. H & V, with AC/DC Adapter)

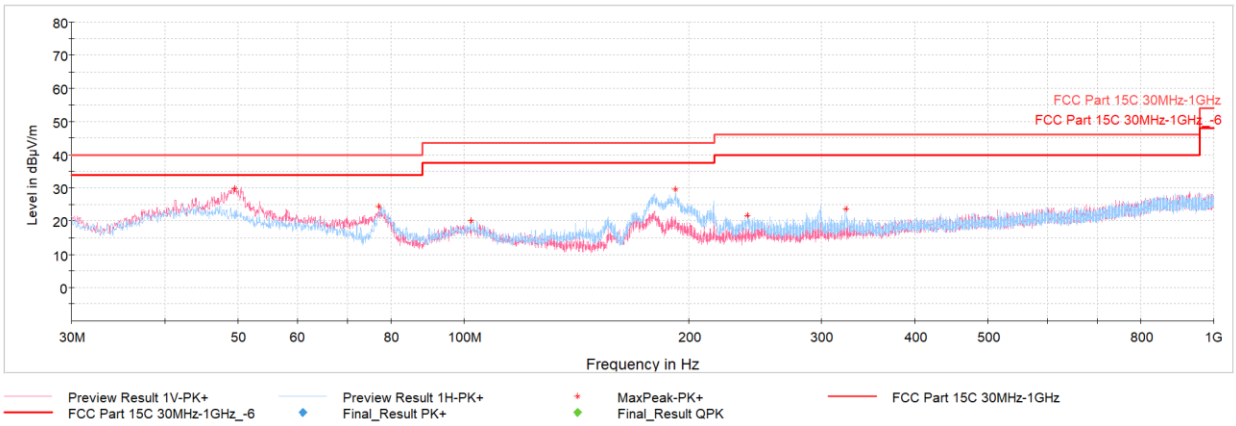
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
36.94	Max Peak	V	100	15	-57.37	-18.23	31.40	40.00	-8.60
56.48	Max Peak	V	100	32	-57.90	-16.28	32.82	40.00	-7.18
132.29	Max Peak	V	100	15	-66.82	-21.02	19.16	43.52	-24.36
170.31	Max Peak	V	100	80	-64.16	-20.19	22.65	43.52	-20.87
215.85	Max Peak	H	100	168	-64.65	-17.76	24.59	43.52	-18.93
322.31	Max Peak	H	100	15	-70.29	-14.54	22.17	46.02	-23.85

Table 7-34. Radiated Spurious Emissions Below 1GHz Antenna WF7b (Common) (1Mbps, iPA – Ch.39, Pol. H & V, with AC/DC Adapter)

7.8.4 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

Antenna WF7b (Dedicated)



Plot 7-124. Radiated Spurious Emissions Below 1GHz Antenna WF7b (Dedicated) (1Mbps, iPA – Ch.0, 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]
49.55	Max Peak	V	100	359	-63.01	-14.28	29.71	40.00	-10.29
77.09	Max Peak	V	100	105	-61.20	-21.38	24.42	40.00	-15.58
102.27	Max Peak	H	100	138	-70.42	-16.41	20.17	43.52	-23.35
191.51	Max Peak	H	100	198	-61.01	-16.40	29.59	43.52	-13.93
239.13	Max Peak	H	100	16	-70.52	-14.76	21.72	46.02	-24.30
323.57	Max Peak	H	100	102	-70.64	-12.58	23.78	46.02	-22.24

Table 7-35. Radiated Spurious Emissions Below 1GHz Antenna WF7b (Dedicated) (1Mbps, iPA – Ch.0, 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 7-36. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2020, 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.

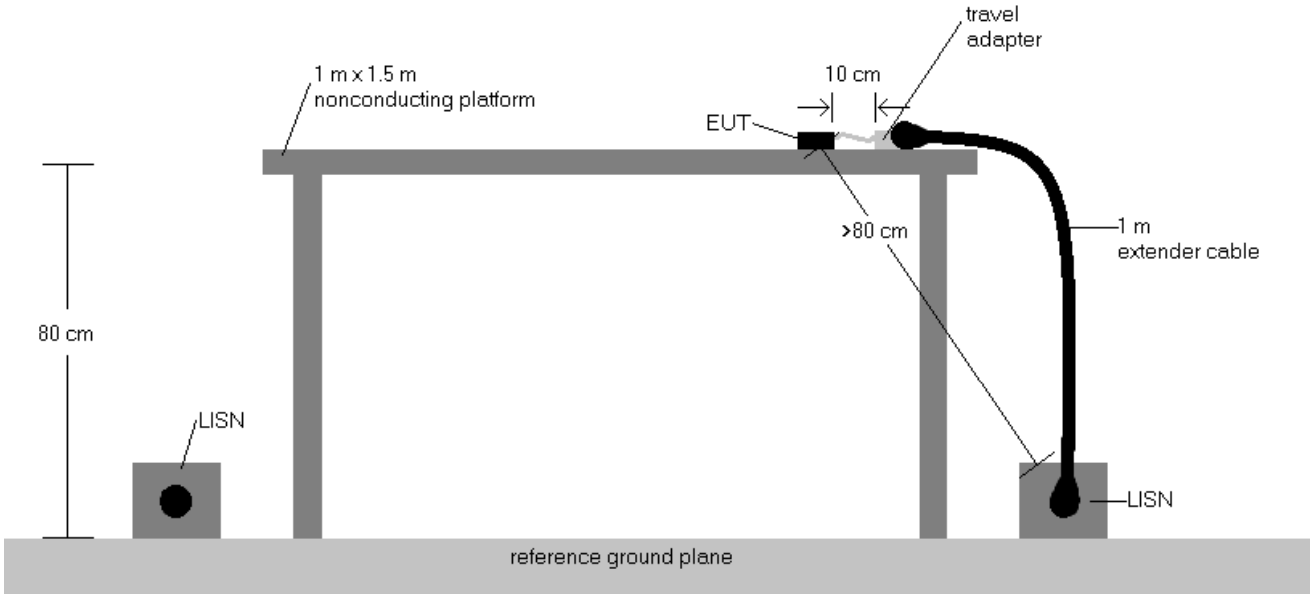
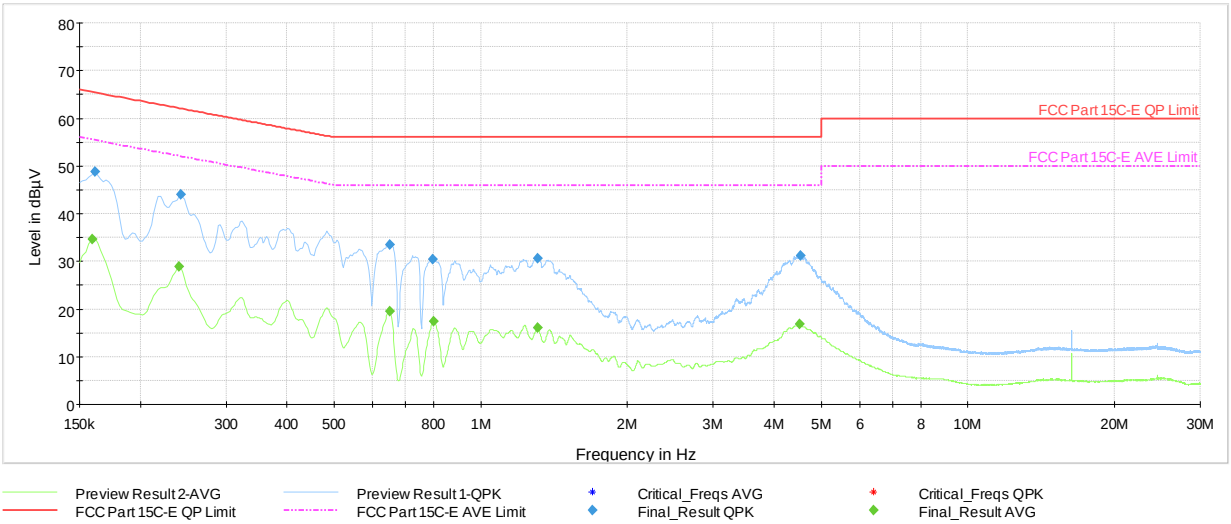


Figure 7-9. Test Instrument & Measurement Setup

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.

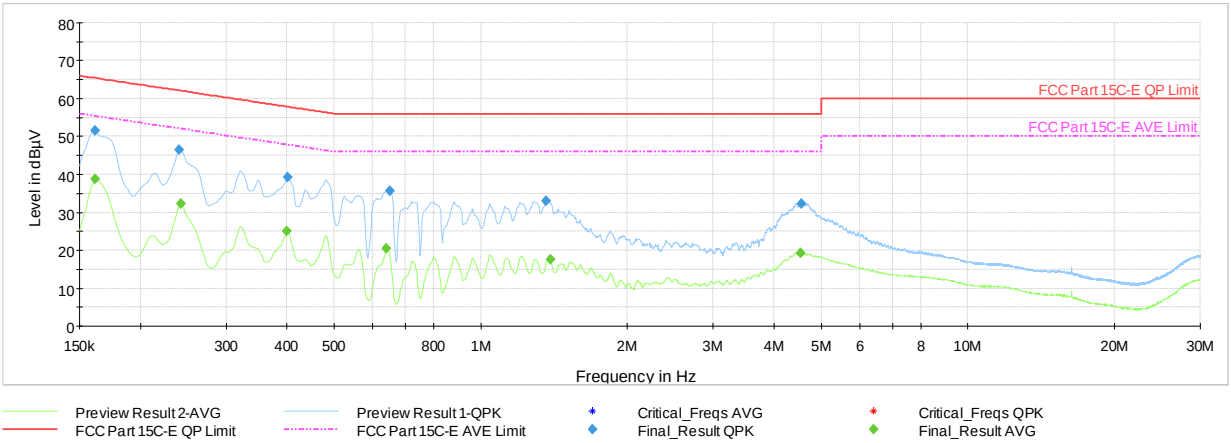
Antenna WF8 (Common)



Plot 7-125. AC Line Conducted Plot with Bluetooth LE Antenna WF8 (Common) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.159	FINAL	---	34.69	55.52	-20.83	L1	GND
0.161	FINAL	48.85	---	65.40	-16.55	L1	GND
0.240	FINAL	---	28.91	52.10	-23.19	L1	GND
0.242	FINAL	44.08	---	62.02	-17.94	L1	GND
0.650	FINAL	---	19.53	46.00	-26.47	L1	GND
0.650	FINAL	33.45	---	56.00	-22.55	L1	GND
0.796	FINAL	30.40	---	56.00	-25.60	L1	GND
0.800	FINAL	---	17.34	46.00	-28.66	L1	GND
1.307	FINAL	30.60	---	56.00	-25.40	L1	GND
1.307	FINAL	---	16.10	46.00	-29.90	L1	GND
4.506	FINAL	---	16.78	46.00	-29.22	L1	GND
4.538	FINAL	31.19	---	56.00	-24.81	L1	GND

Table 7-37. AC Line Conducted Data with Bluetooth LE Antenna WF8 (Common) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)

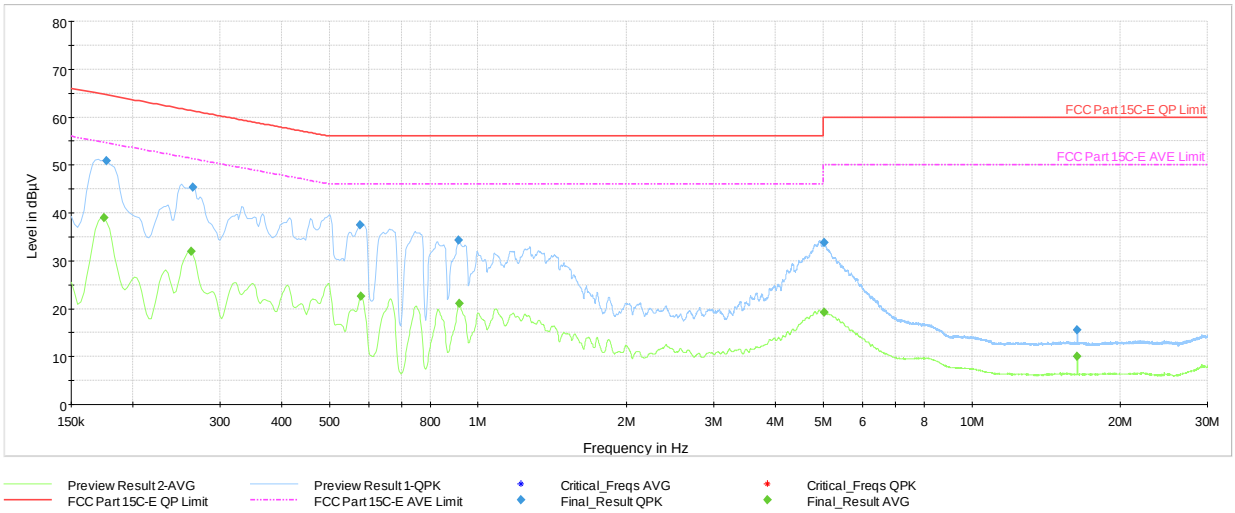


Plot 7-126. AC Line Conducted Plot with Bluetooth LE Antenna WF8 (Common) (N, 1Mbps iPA – Ch.0, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.161	FINAL	---	38.78	55.40	-16.62	N	GND
0.161	FINAL	51.53	---	65.40	-13.87	N	GND
0.240	FINAL	46.52	---	62.10	-15.58	N	GND
0.242	FINAL	---	32.22	52.02	-19.80	N	GND
0.400	FINAL	---	25.06	47.86	-22.80	N	GND
0.402	FINAL	39.22	---	57.81	-18.60	N	GND
0.641	FINAL	---	20.56	46.00	-25.44	N	GND
0.650	FINAL	35.57	---	56.00	-20.43	N	GND
1.361	FINAL	33.04	---	56.00	-22.96	N	GND
1.388	FINAL	---	17.57	46.00	-28.43	N	GND
4.535	FINAL	---	19.18	46.00	-26.82	N	GND
4.547	FINAL	32.31	---	56.00	-23.69	N	GND

Table 7-38. AC Line Conducted Data with Bluetooth LE Antenna WF8 (Common) (N, 1Mbps iPA – Ch.0 with AC/DC Adapter)

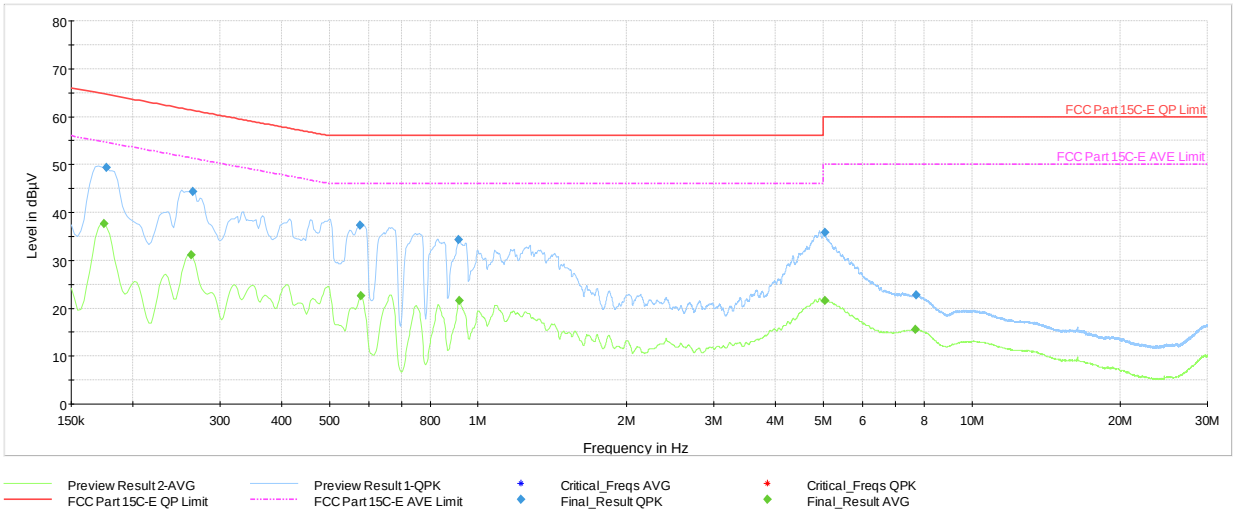
Antenna WF8 (Dedicated)



Plot 7-127. AC Line Conducted Plot with Bluetooth LE Antenna WF8 (Dedicated) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.18	FINAL	---	39.00	54.73	-15.73	L1	GND
0.18	FINAL	50.96	---	64.63	-13.67	L1	GND
0.26	FINAL	---	31.97	51.35	-19.38	L1	GND
0.27	FINAL	45.40	---	61.28	-15.88	L1	GND
0.58	FINAL	37.52	---	56.00	-18.48	L1	GND
0.58	FINAL	---	22.52	46.00	-23.48	L1	GND
0.91	FINAL	34.26	---	56.00	-21.74	L1	GND
0.92	FINAL	---	21.08	46.00	-24.92	L1	GND
5.03	FINAL	33.88	---	60.00	-26.12	L1	GND
5.03	FINAL	---	19.25	50.00	-30.75	L1	GND
16.36	FINAL	---	9.98	50.00	-40.02	L1	GND
16.36	FINAL	15.62	---	60.00	-44.38	L1	GND

Table 7-39. AC Line Conducted Data with Bluetooth LE Antenna WF8 (Dedicated) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)

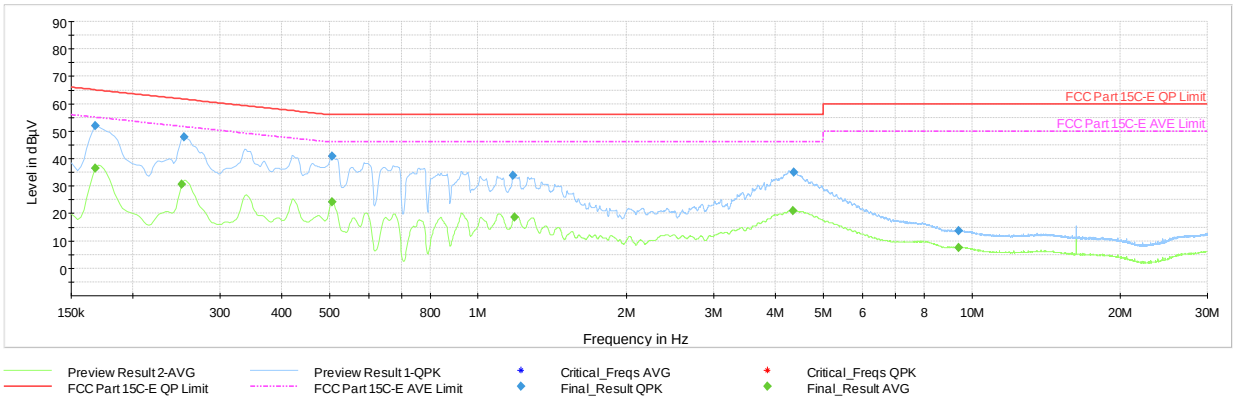


Plot 7-128. AC Line Conducted Plot with Bluetooth LE Antenna WF8 (Dedicated) (N, 1Mbps iPA – Ch.0, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.18	FINAL	---	37.66	54.73	-17.07	N	GND
0.18	FINAL	49.43	---	64.63	-15.20	N	GND
0.26	FINAL	---	31.20	51.35	-20.15	N	GND
0.27	FINAL	44.35	---	61.28	-16.93	N	GND
0.58	FINAL	37.38	---	56.00	-18.62	N	GND
0.58	FINAL	---	22.63	46.00	-23.37	N	GND
0.91	FINAL	34.36	---	56.00	-21.64	N	GND
0.92	FINAL	---	21.58	46.00	-24.42	N	GND
5.03	FINAL	35.89	---	60.00	-24.11	N	GND
5.03	FINAL	---	21.61	50.00	-28.39	N	GND
7.70	FINAL	---	15.58	50.00	-34.42	N	GND
7.70	FINAL	22.77	---	60.00	-37.23	N	GND

Table 7-40. AC Line Conducted Data with Bluetooth LE Antenna WF8 (Dedicated) (N, 1Mbps iPA – Ch.0 with AC/DC Adapter)

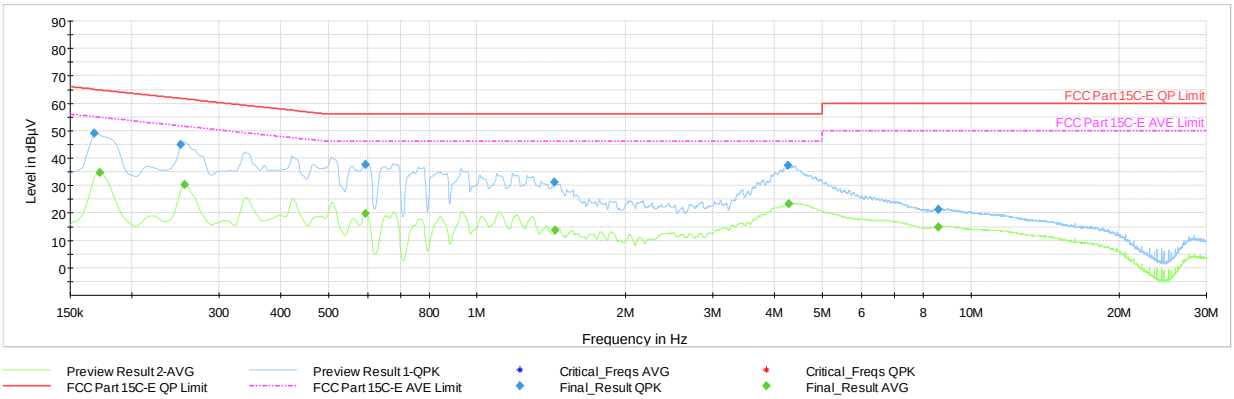
Antenna WF7b (Common)



Plot 7-129. AC Line Conducted Plot with Bluetooth LE Antenna WF7b (Common) (L1, 1Mbps iPA – Ch.39 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.168	FINAL	—	36.55	55.06	-18.51	L1	GND
0.168	FINAL	51.9	—	65.06	-13.20	L1	GND
0.251	FINAL	—	30.55	51.72	-21.17	L1	GND
0.254	FINAL	48.0	—	61.64	-13.64	L1	GND
0.506	FINAL	—	24.27	46.00	-21.73	L1	GND
0.506	FINAL	40.9	—	56.00	-15.11	L1	GND
1.178	FINAL	33.8	—	56.00	-22.22	L1	GND
1.187	FINAL	—	18.56	46.00	-27.44	L1	GND
4.344	FINAL	—	20.85	46.00	-25.15	L1	GND
4.358	FINAL	34.9	—	56.00	-21.06	L1	GND
9.389	FINAL	—	7.63	50.00	-42.37	L1	GND
9.389	FINAL	13.6	—	60.00	-46.42	L1	GND

Table 7-41. AC Line Conducted Data with Bluetooth LE Antenna WF7b (Common) (L1, 1Mbps iPA – Ch.39 with AC/DC Adapter)

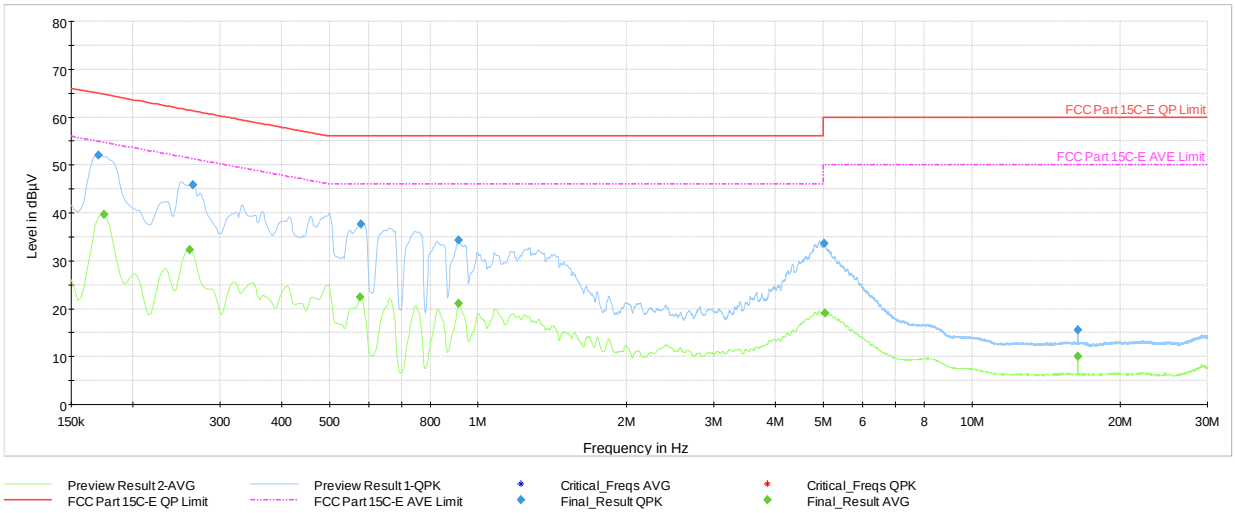


Plot 7-130. AC Line Conducted Plot with Bluetooth LE Antenna WF7b (Common) (N, 1Mbps iPA – Ch.39, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.168	FINAL	49.0	—	65.06	-16.02	N	GND
0.173	FINAL	—	34.76	54.84	-20.08	N	GND
0.251	FINAL	45.1	—	61.72	-16.63	N	GND
0.256	FINAL	—	30.35	51.57	-21.22	N	GND
0.593	FINAL	—	19.90	46.00	-26.10	N	GND
0.593	FINAL	37.8	—	56.00	-18.21	N	GND
1.433	FINAL	31.2	—	56.00	-24.85	N	GND
1.439	FINAL	—	13.56	46.00	-32.44	N	GND
4.261	FINAL	37.5	—	56.00	-18.52	N	GND
4.274	FINAL	—	23.29	46.00	-22.71	N	GND
8.583	FINAL	21.3	—	60.00	-38.66	N	GND
8.590	FINAL	—	14.96	50.00	-35.04	N	GND

Table 7-42. AC Line Conducted Data with Bluetooth LE Antenna WF7b (Common) (N, 1Mbps iPA – Ch.39 with AC/DC Adapter)

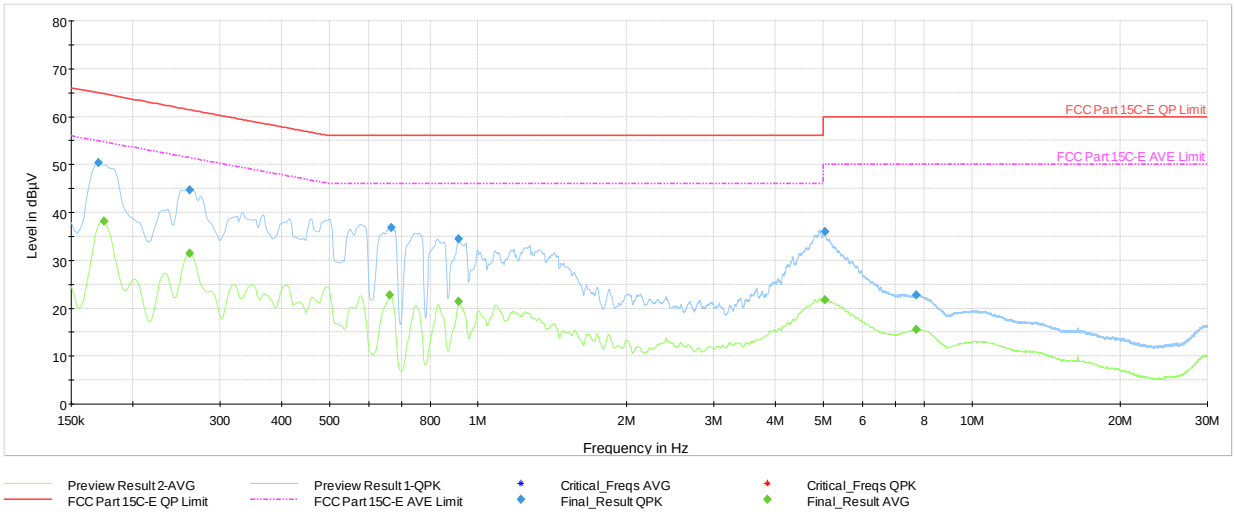
Antenna WF7b (Dedicated)



Plot 7-131. AC Line Conducted Plot with Bluetooth LE Antenna WF7b (Dedicated) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.17	FINAL	52.11	---	64.95	-12.84	L1	GND
0.18	FINAL	---	39.66	54.73	-15.07	L1	GND
0.26	FINAL	---	32.38	51.42	-19.04	L1	GND
0.27	FINAL	45.91	---	61.28	-15.37	L1	GND
0.58	FINAL	---	22.37	46.00	-23.63	L1	GND
0.58	FINAL	37.64	---	56.00	-18.36	L1	GND
0.91	FINAL	34.27	---	56.00	-21.73	L1	GND
0.91	FINAL	---	21.02	46.00	-24.98	L1	GND
5.03	FINAL	33.68	---	60.00	-26.32	L1	GND
5.03	FINAL	---	19.07	50.00	-30.93	L1	GND
16.40	FINAL	---	9.98	50.00	-40.02	L1	GND
16.40	FINAL	15.57	---	60.00	-44.43	L1	GND

Table 7-43. AC Line Conducted Data with Bluetooth LE Antenna WF7b (Dedicated) (L1, 1Mbps iPA – Ch.0 with AC/DC Adapter)



Plot 7-132. AC Line Conducted Plot with Bluetooth LE Antenna WF7b (Dedicated) (N, 1Mbps iPA – Ch.0, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.17	FINAL	50.32	---	64.95	-14.63	N	GND
0.18	FINAL	---	38.09	54.73	-16.64	N	GND
0.26	FINAL	---	31.52	51.42	-19.90	N	GND
0.26	FINAL	44.63	---	61.42	-16.79	N	GND
0.66	FINAL	---	22.80	46.00	-23.20	N	GND
0.67	FINAL	36.88	---	56.00	-19.12	N	GND
0.91	FINAL	34.40	---	56.00	-21.60	N	GND
0.91	FINAL	---	21.42	46.00	-24.58	N	GND
5.04	FINAL	36.04	---	60.00	-23.96	N	GND
5.04	FINAL	---	21.70	50.00	-28.30	N	GND
7.70	FINAL	---	15.56	50.00	-34.44	N	GND
7.70	FINAL	22.84	---	60.00	-37.16	N	GND

Table 7-44. AC Line Conducted Data with Bluetooth LE Antenna WF7b (Dedicated) (N, 1Mbps iPA – Ch.0 with AC/DC Adapter)

8 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Tablet Device FCC ID: BCGA3354 and IC: 579C-A3354** 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.