7.6 Radiated Spurious Emission – Above 1GHz

§15.407(b) §15.205 §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 its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. All channels and power schemes were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.25 GHz band shall not exceed an EIRP of −27 dBm/MHz.

For transmitters operating in the 5.725 – 5.85 GHz band: 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.

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 7-28 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-28. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Subclauses 12.7.7.2, 12.7.6, 12.7.5
KDB 789033 D02 v02r01 – Section G

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Averaging type = power (RMS)
7. Sweep time = auto couple
8. Trace was averaged over 100 sweeps

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
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 diagram below.

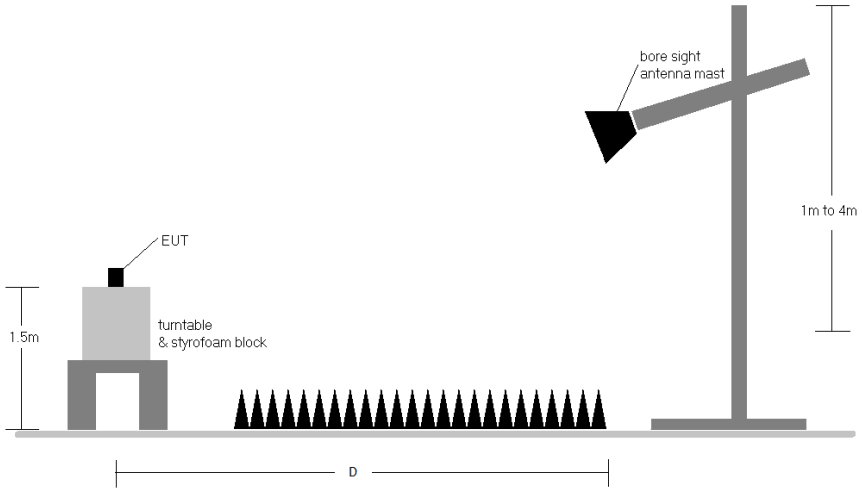


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

1. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-28.
2. All spurious emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-28. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dBμV/m.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas.
6. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
8. All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported.

Sample Calculations

Determining Spurious Emissions Levels

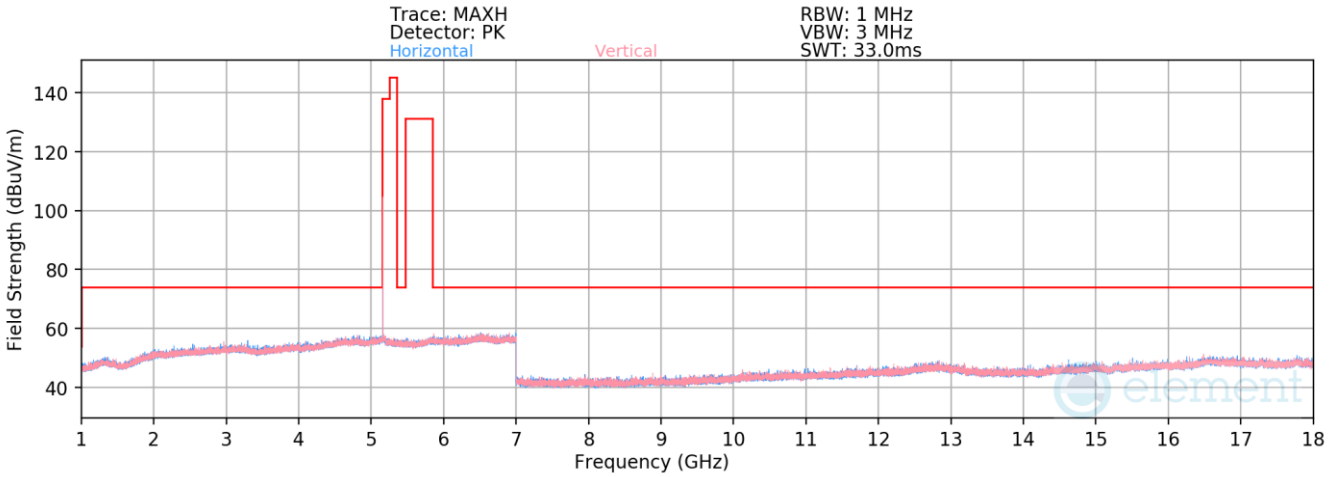
- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$ – Preamplifier Gain $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.6.1 was calculated using the formula:

  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

Antenna WF7a

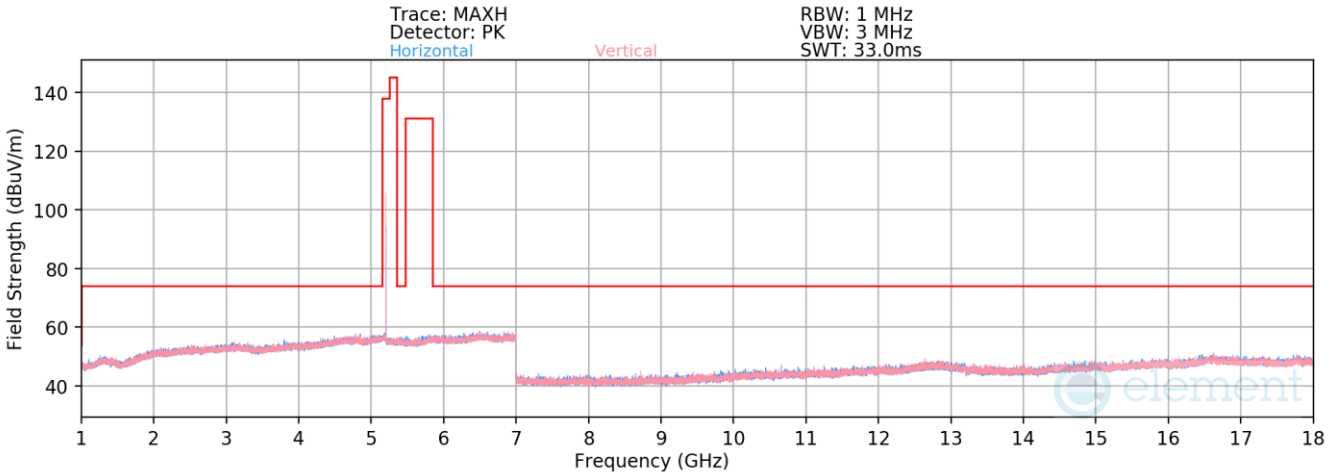


Plot 7-100. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5162MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5162MHz

	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]
	10324.00	Peak	V	236	57	-65.64	5.91	47.27	68.20	-20.93
*	15486.00	Average	V	-	-	-81.62	12.24	37.62	53.98	-16.36
*	15486.00	Peak	V	-	-	-69.79	12.24	49.45	73.98	-24.53

Table 7-29. Radiated Spurious Emissions Measurements Antenna WF7a

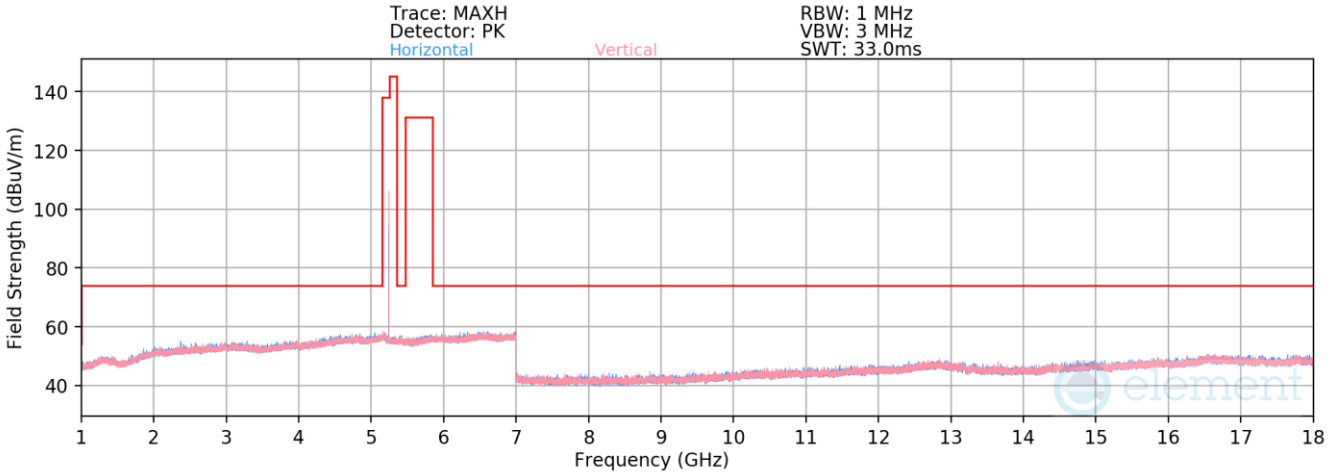


Plot 7-101. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5204MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5204MHz

	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]
	10408.00	Peak	V	257	68	-66.43	6.27	46.84	68.20	-21.36
*	15612.00	Average	V	-	-	-81.53	12.66	38.13	53.98	-15.85
*	15612.00	Peak	V	-	-	-69.73	12.66	49.93	73.98	-24.05

Table 7-30. Radiated Spurious Emissions Measurements Antenna WF7a

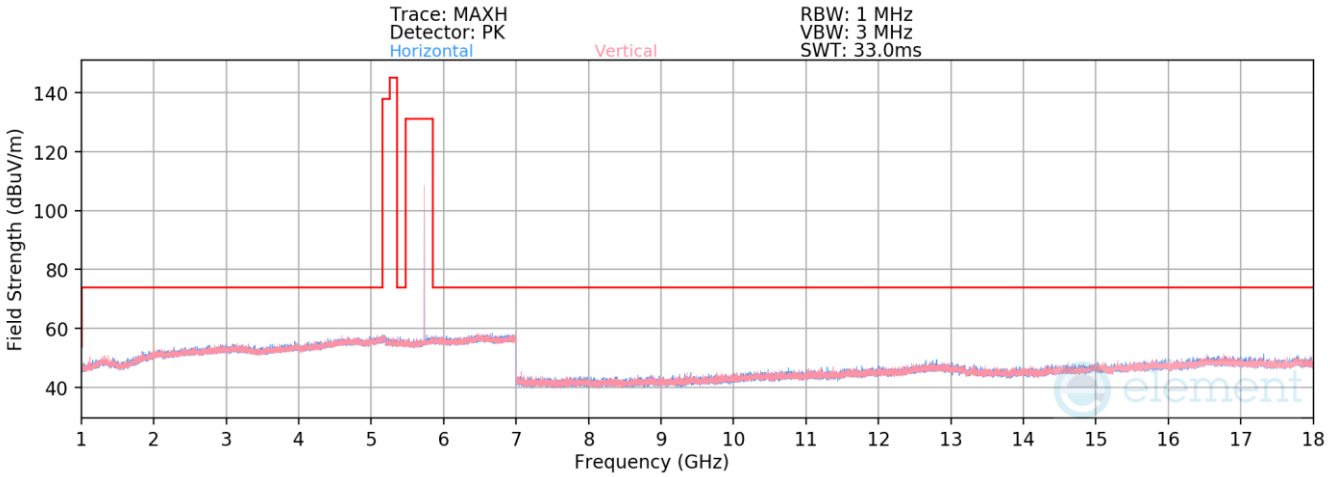


Plot 7-102. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5245MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5245MHz

	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]
	10490.00	Peak	V	243	72	-67.54	6.51	45.97	68.20	-22.23
*	15735.00	Average	V	-	-	-81.84	13.10	38.26	53.98	-15.72
*	15735.00	Peak	V	-	-	-70.55	13.10	49.55	73.98	-24.43

Table 7-31. Radiated Spurious Emissions Measurements Antenna WF7a

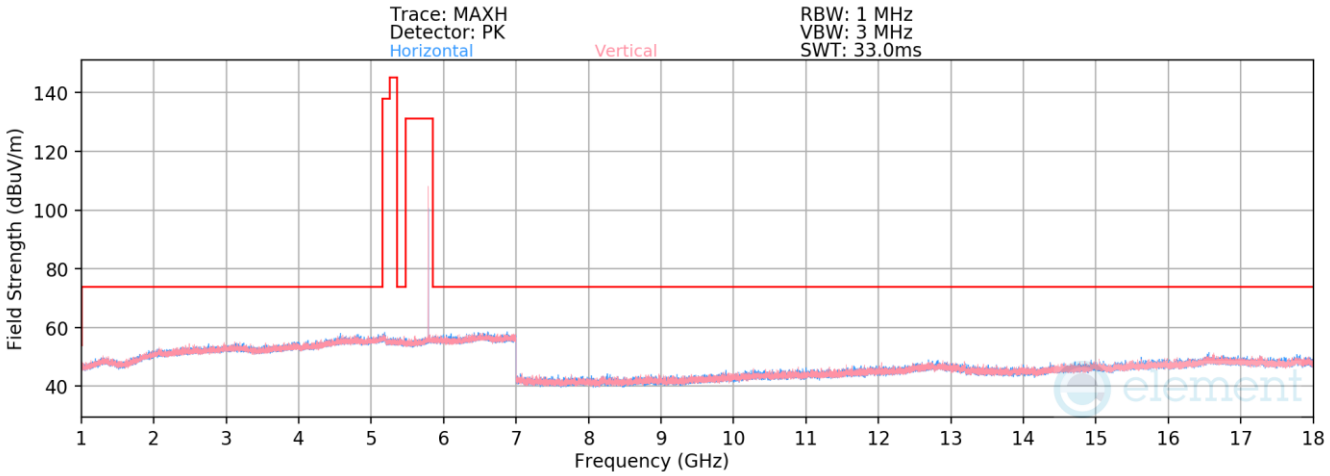


Plot 7-103. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5733MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5733MHz

	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]
*	11466.00	Average	V	-	-	-79.51	7.47	34.96	53.98	-19.02
*	11466.00	Peak	V	-	-	-67.96	7.47	46.51	73.98	-27.47
	17199.00	Peak	V	-	-	-71.73	14.96	50.23	68.20	-17.97

Table 7-32. Radiated Spurious Emissions Measurements Antenna WF7a

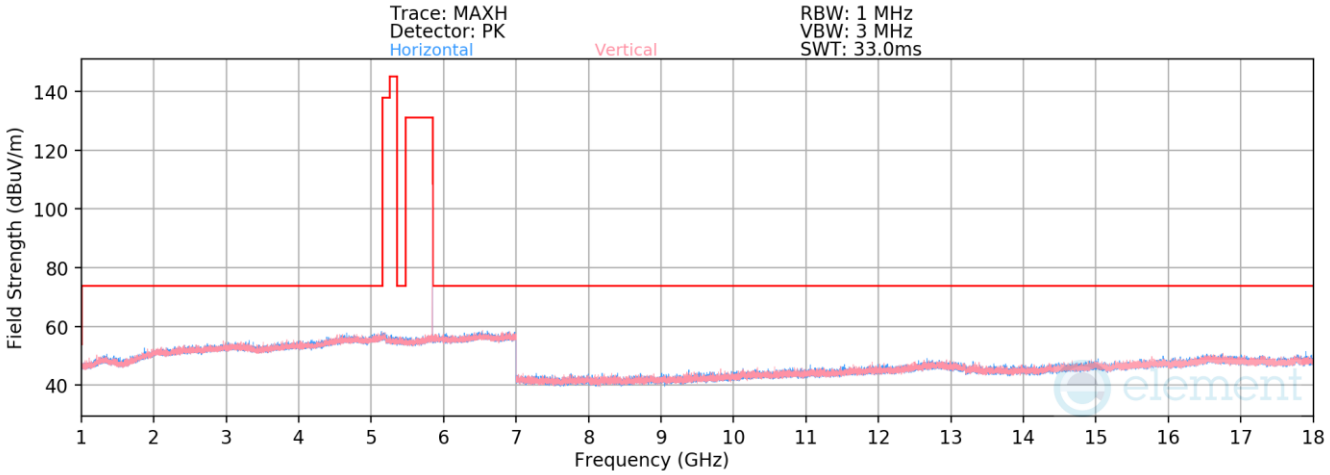


Plot 7-104. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5789MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5789MHz

	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]
*	11578.00	Average	V	-	-	-78.92	7.44	35.52	53.98	-18.46
*	11578.00	Peak	V	-	-	-67.79	7.44	46.65	73.98	-27.33
	17367.00	Peak	V	-	-	-71.45	14.88	50.43	68.20	-17.77

Table 7-33. Radiated Spurious Emissions Measurements Antenna WF7a



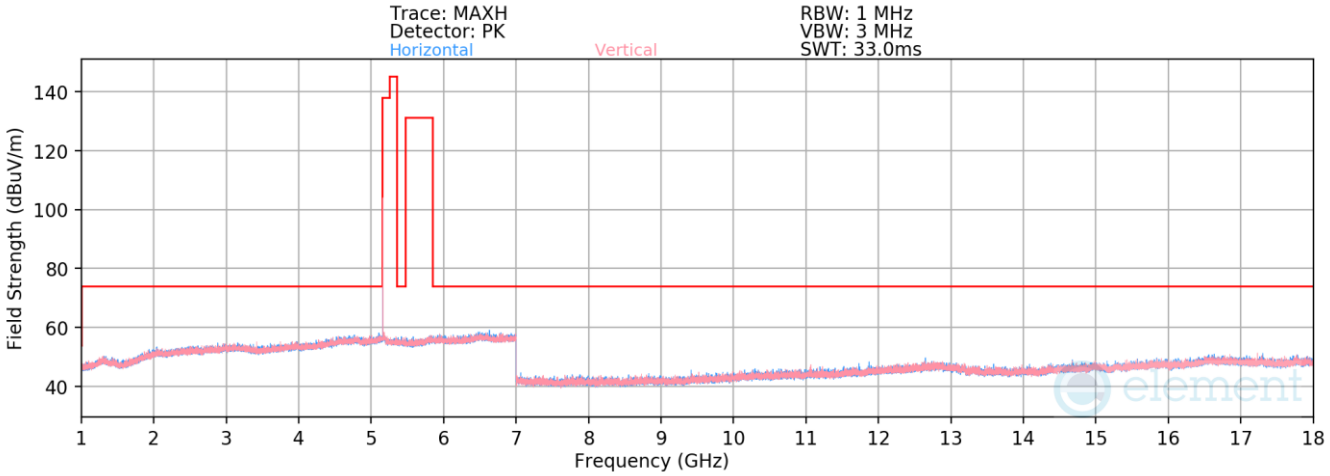
Plot 7-105. Radiated Spurious Emissions 1-18GHz Antenna WF7a (BDR GFSK ePA – 5844MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5844MHz

	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]
*	11688.00	Average	V	222	75	-76.32	7.86	38.54	53.98	-15.44
*	11688.00	Peak	V	222	75	-67.60	7.86	47.26	73.98	-26.72
	17532.00	Peak	V	-	-	-72.05	15.50	50.45	68.20	-17.75

Table 7-34. Radiated Spurious Emissions Measurements Antenna WF7a

Antenna WF2a

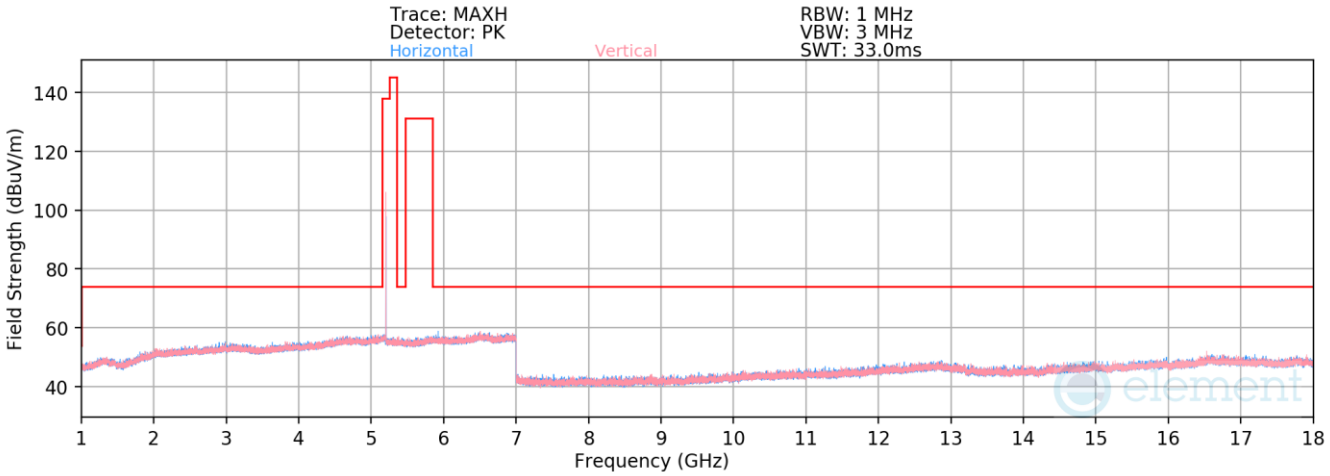


Plot 7-106. Radiated Spurious Emissions 1-18GHz Antenna WF2a (BDR GFSK ePA – 5162MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5162MHz

	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]
	10324.00	Peak	V	-	-	-66.93	5.91	45.98	68.20	-22.22
*	15486.00	Average	V	-	-	-81.78	12.24	37.46	53.98	-16.52
*	15486.00	Peak	V	-	-	-70.06	12.24	49.18	73.98	-24.80

Table 7-35. Radiated Spurious Emissions Measurements Antenna WF2a

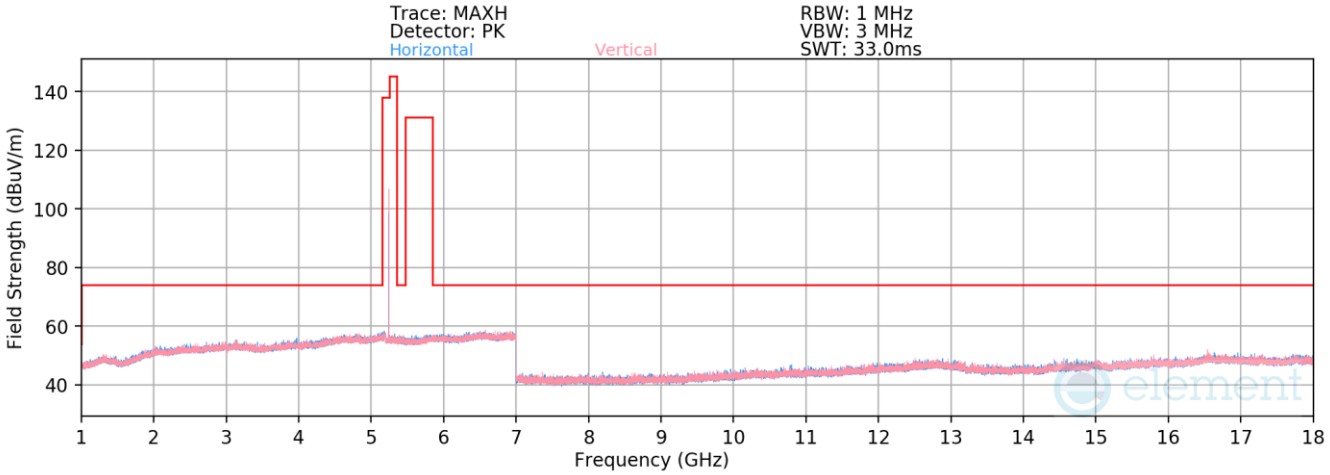


Plot 7-107. Radiated Spurious Emissions 1-18GHz Antenna WF2a (BDR GFSK ePA – 5204MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5204MHz

	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]
	10408.00	Peak	V	-	-	-67.77	6.27	45.50	68.20	-22.70
*	15612.00	Average	V	-	-	-81.60	12.66	38.06	53.98	-15.92
*	15612.00	Peak	V	-	-	-70.11	12.66	49.55	73.98	-24.43

Table 7-36. Radiated Spurious Emissions Measurements Antenna WF2a

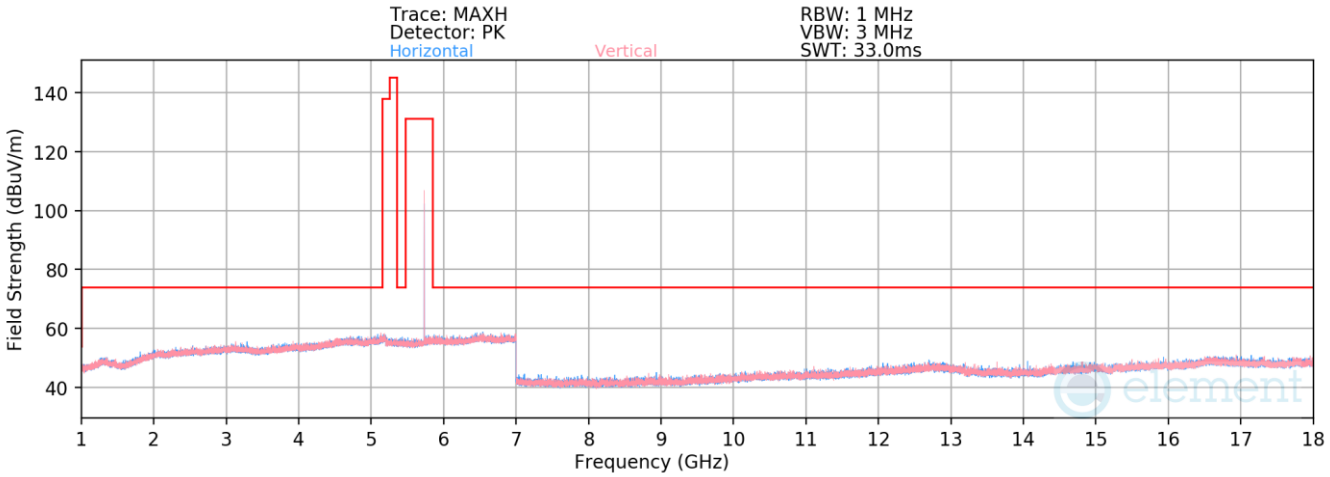


Plot 7-108. Radiated Spurious Emissions 1-18GHz Antenna WF2a (BDR GFSK ePA – 5245MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5245MHz

	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]
	10490.00	Peak	V	-	-	-66.93	6.51	46.58	68.20	-21.62
*	15735.00	Average	V	-	-	-81.97	13.10	38.13	53.98	-15.85
*	15735.00	Peak	V	-	-	-70.02	13.10	50.08	73.98	-23.90

Table 7-37. Radiated Spurious Emissions Measurements Antenna WF2a

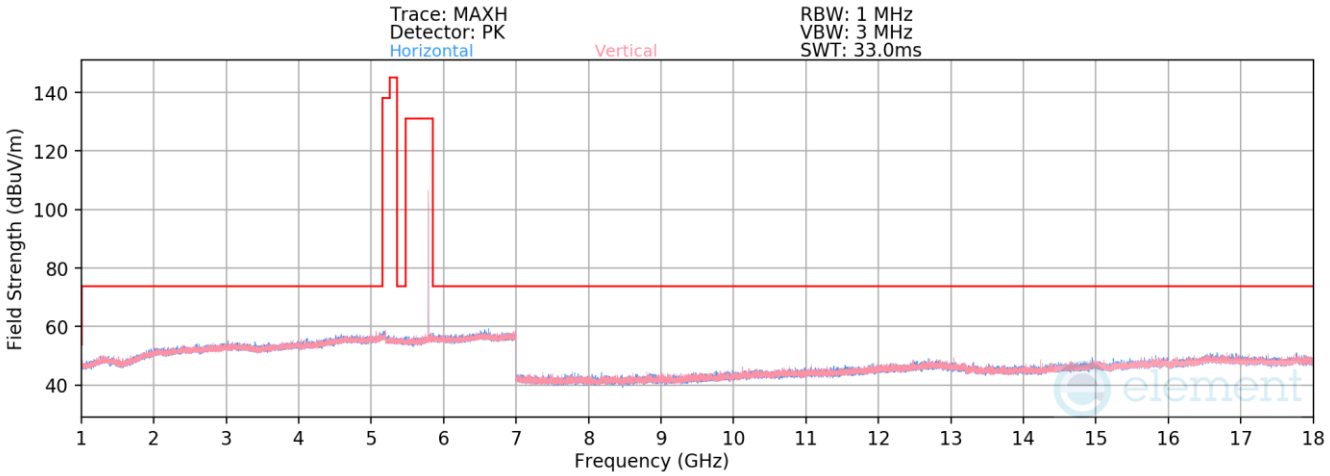


Plot 7-109. Radiated Spurious Emissions 1-18GHz WF2a (BDR GFSK ePA – 5733MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5733MHz

	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]
*	11466.00	Average	V	-	-	-79.60	7.47	34.87	53.98	-19.11
*	11466.00	Peak	V	-	-	-68.45	7.47	46.02	73.98	-27.96
	17199.00	Peak	V	-	-	-71.71	14.96	50.25	68.20	-17.95

Table 7-38. Radiated Spurious Emissions Measurements Antenna WF2a

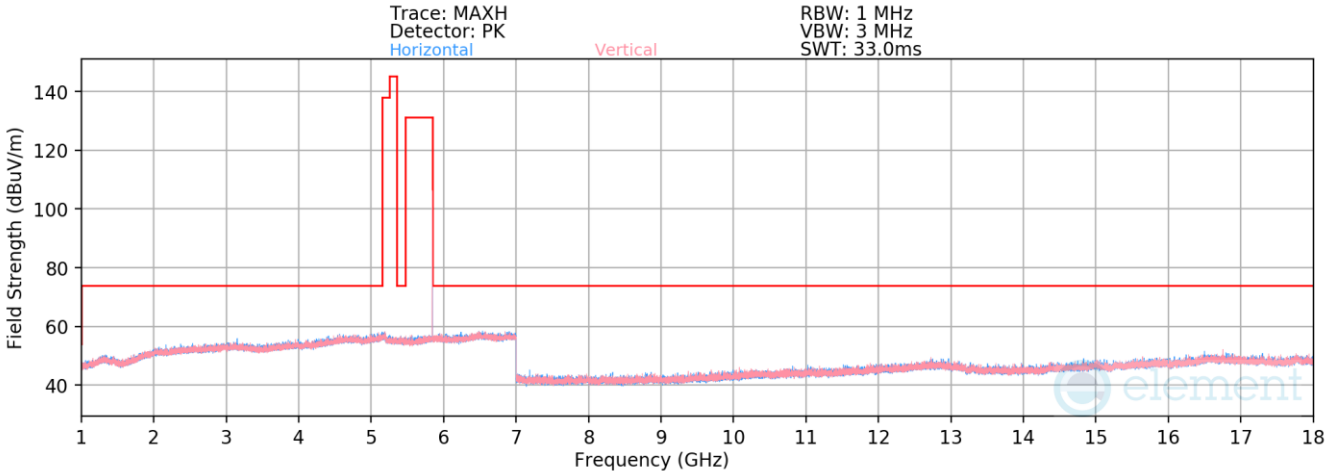


Plot 7-110. Radiated Spurious Emissions 1-18GHz Antenna WF2a (BDR GFSK ePA – 5789MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5789MHz

	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]
*	11578.00	Average	V	-	-	-79.33	7.44	35.11	53.98	-18.87
*	11578.00	Peak	V	-	-	-67.39	7.44	47.05	73.98	-26.93
	17367.00	Peak	V	-	-	-71.24	14.88	50.64	68.20	-17.56

Table 7-39. Radiated Spurious Emissions Measurements Antenna WF2a



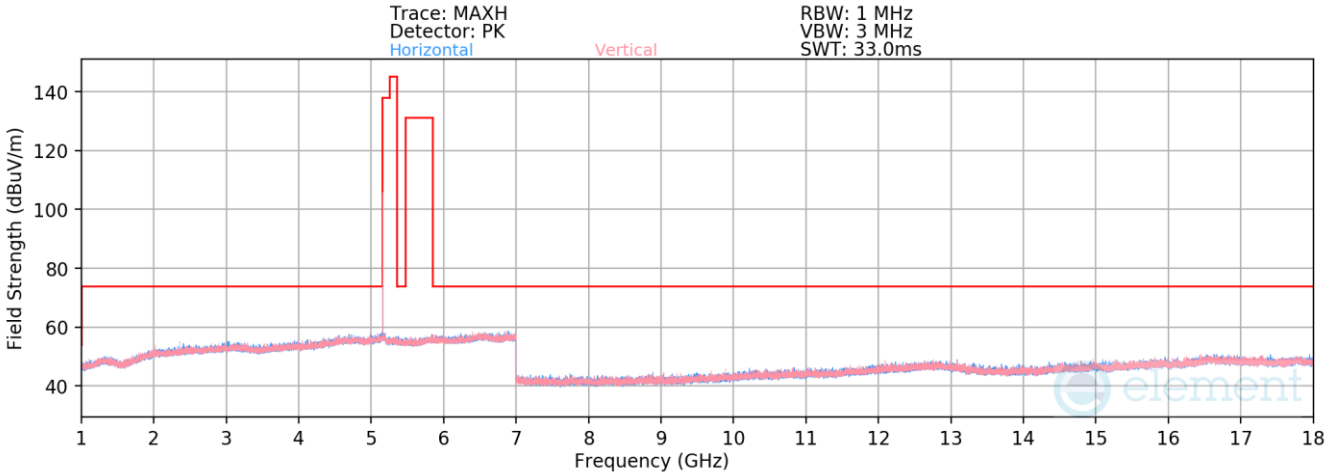
Plot 7-111. Radiated Spurious Emissions 1-18GHz Antenna WF2a (BDR GFSK ePA – 5844MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5844MHz

	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]
*	11688.00	Average	V	-	-	-79.65	7.86	35.21	53.98	-18.77
*	11688.00	Peak	V	-	-	-68.05	7.86	46.81	73.98	-27.17
	17532.00	Peak	V	-	-	-72.03	15.50	50.47	68.20	-17.73

Table 7-40. Radiated Spurious Emissions Measurements Antenna WF2a

Antenna WF7b

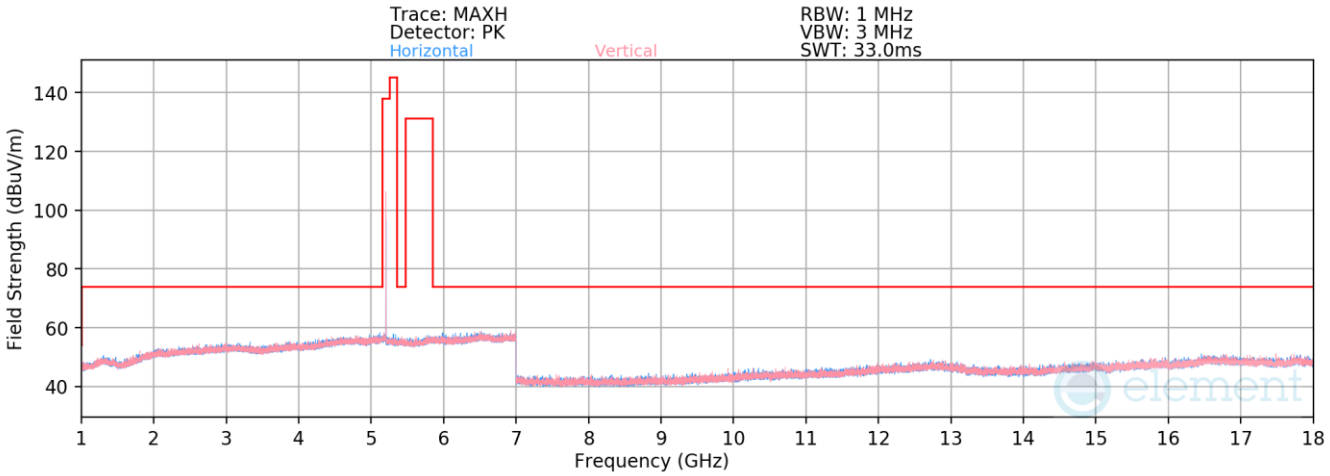


Plot 7-112. Radiated Spurious Emissions 1-18GHz Antenna WF7b (BDR GFSK ePA – 5162MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5162MHz

	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]
	10324.00	Peak	V	250	68	-66.25	5.91	46.66	68.20	-21.54
*	15486.00	Average	V	-	-	-81.55	12.24	37.69	53.98	-16.29
*	15486.00	Peak	V	-	-	-70.11	12.24	49.13	73.98	-24.85

Table 7-41. Radiated Spurious Emissions Measurements Antenna WF7b

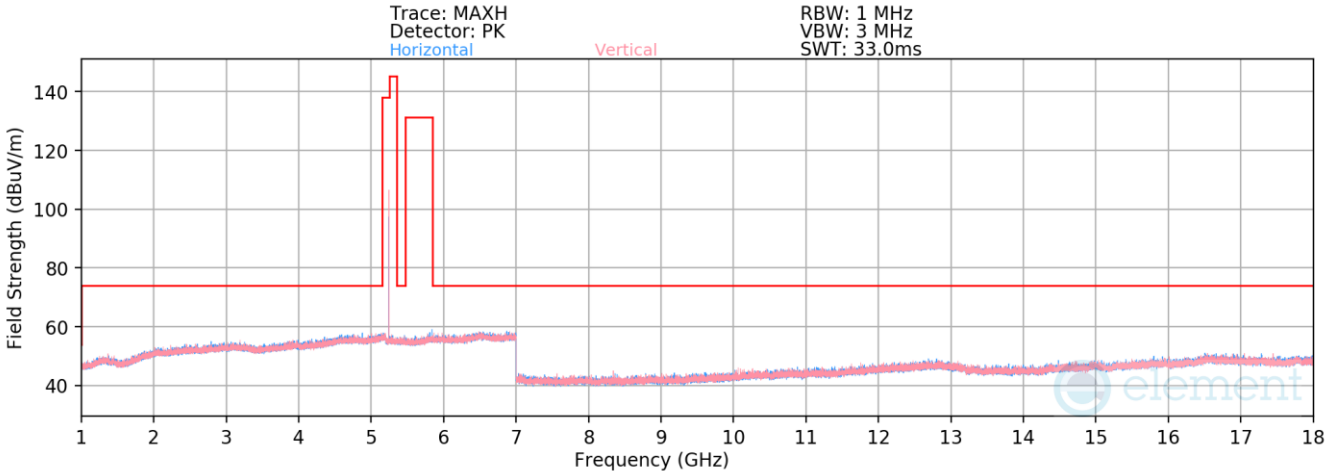


Plot 7-113. Radiated Spurious Emissions 1-18GHz Antenna WF7b (BDR GFSK ePA – 5204MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5204MHz

	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]
	10408.00	Peak	V	243	69	-65.84	6.27	47.43	68.20	-20.77
*	15612.00	Average	V	-	-	-81.55	12.66	38.11	53.98	-15.87
*	15612.00	Peak	V	-	-	-70.18	12.66	49.48	73.98	-24.50

Table 7-42. Radiated Spurious Emissions Measurements Antenna WF7b

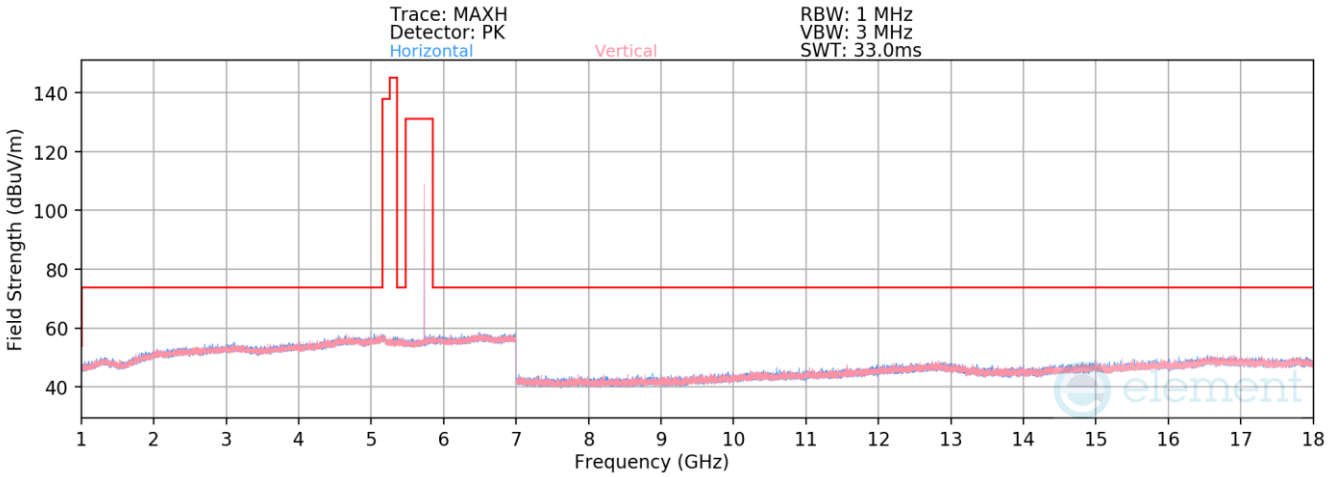


Plot 7-114. Radiated Spurious Emissions 1-18GHz Antenna WF7b (BDR GFSK ePA – 5245MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5245MHz

	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]
	10490.00	Peak	V	236	69	-67.09	6.51	46.42	68.20	-21.78
*	15735.00	Average	V	-	-	-81.64	13.10	38.46	53.98	-15.52
*	15735.00	Peak	V	-	-	-70.56	13.10	49.54	73.98	-24.44

Table 7-43. Radiated Spurious Emissions Measurements Antenna WF7b

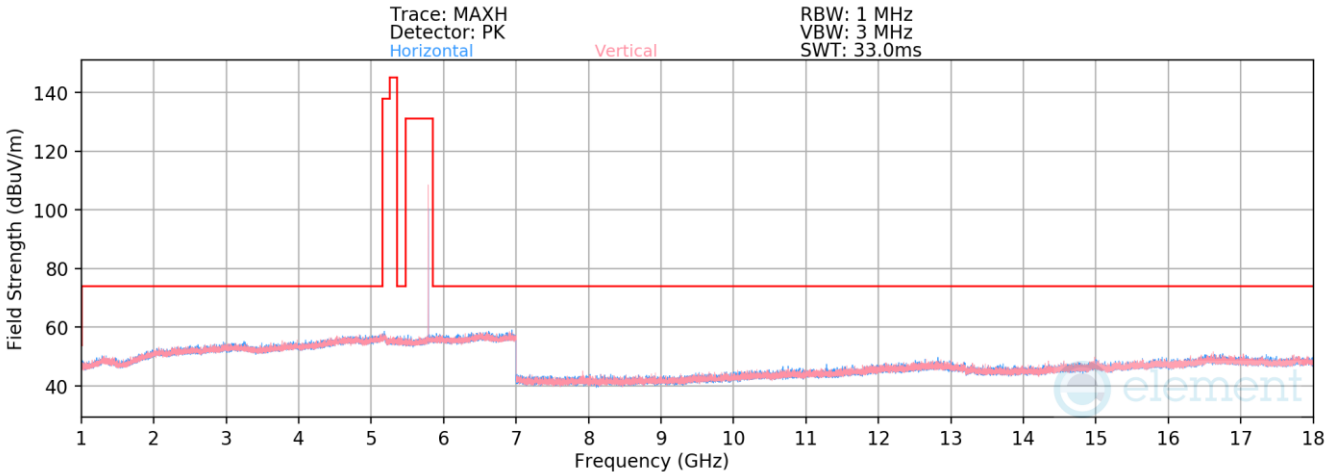


Plot 7-115. Radiated Spurious Emissions 1-18GHz WF7b (BDR GFSK ePA – 5733MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5733MHz

	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]
*	11466.00	Average	V	-	-	-79.44	7.47	35.03	53.98	-18.95
*	11466.00	Peak	V	-	-	-67.78	7.47	46.69	73.98	-27.29
	17199.00	Peak	V	-	-	-71.80	14.96	50.16	68.20	-18.04

Table 7-44. Radiated Spurious Emissions Measurements Antenna WF7b

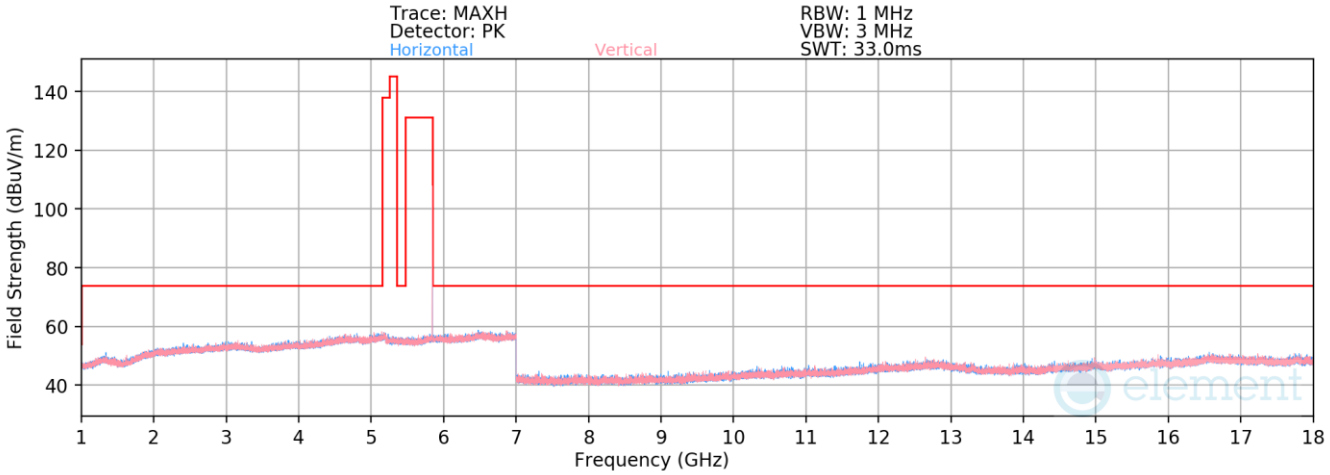


Plot 7-116. Radiated Spurious Emissions 1-18GHz Antenna WF7b (BDR GFSK ePA – 5789MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5779MHz

	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]
*	11578.00	Average	V	-	-	-79.17	7.44	35.27	53.98	-18.71
*	11578.00	Peak	V	-	-	-67.07	7.44	47.37	73.98	-26.61
	17367.00	Peak	V	-	-	-71.74	14.88	50.14	68.20	-18.06

Table 7-45. Radiated Spurious Emissions Measurements Antenna WF7b



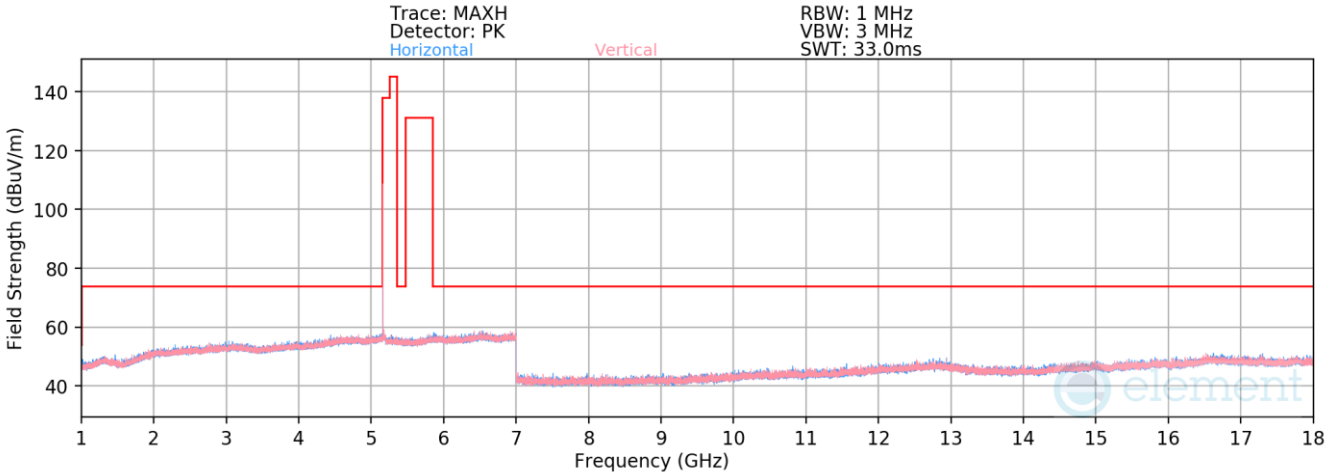
Plot 7-117. Radiated Spurious Emissions 1-18GHz Antenna WF7b (BDR GFSK ePA – 5844MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5844MHz

	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]
*	11688.00	Average	V	250	147	-76.59	7.86	38.27	53.98	-15.71
*	11688.00	Peak	V	250	147	-67.12	7.86	47.74	73.98	-26.24
	17532.00	Peak	V	-	-	-71.54	15.50	50.96	68.20	-17.24

Table 7-46. Radiated Spurious Emissions Measurements Antenna WF7b

TxBF

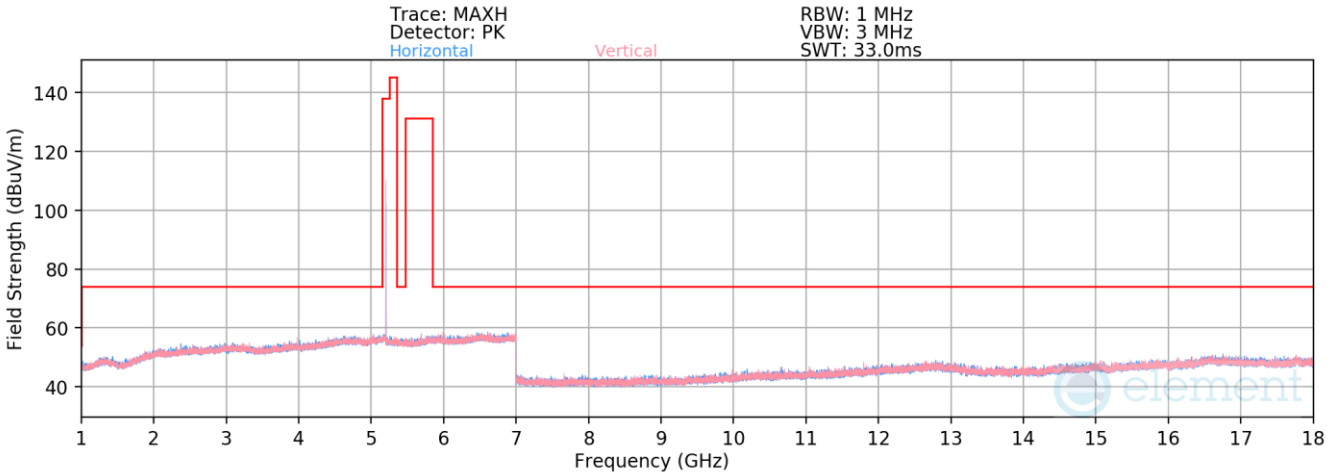


Plot 7-118. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5162MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5162MHz

	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]
	10324.00	Peak	V	-	-	-66.50	5.91	46.41	68.20	-21.79
*	15486.00	Average	V	-	-	-81.76	12.24	37.48	53.98	-16.50
*	15486.00	Peak	V	-	-	-70.42	12.24	48.82	73.98	-25.16

Table 7-47. Radiated Spurious Emissions Measurements TxBF

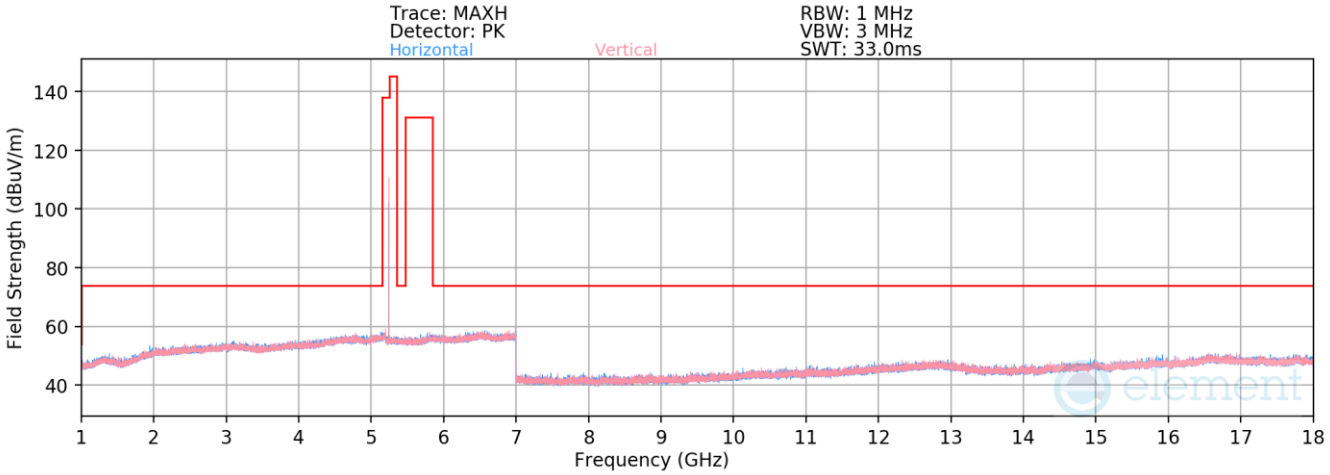


Plot 7-119. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5204MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5204MHz

	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]
	10408.00	Peak	V	-	-	-67.36	6.27	45.91	68.20	-22.29
*	15612.00	Average	V	-	-	-81.65	12.66	38.01	53.98	-15.97
*	15612.00	Peak	V	-	-	-69.86	12.66	49.80	73.98	-24.18

Table 7-48. Radiated Spurious Emissions Measurements TxBF

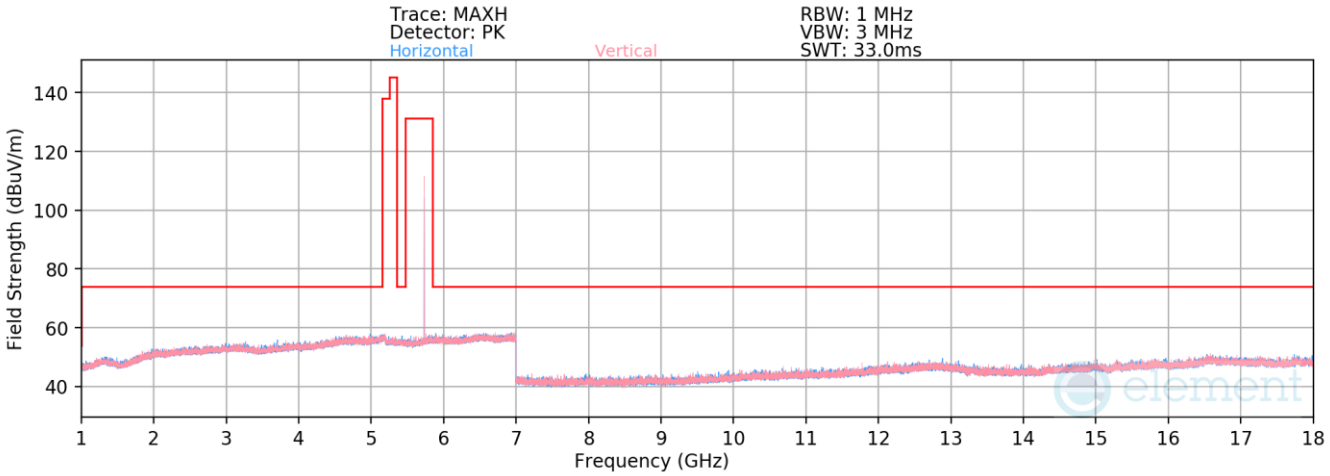


Plot 7-120. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5245MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5245MHz

	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]
	10490.00	Peak	V	-	-	-67.83	6.51	45.68	68.20	-22.52
*	15735.00	Average	V	-	-	-82.05	13.10	38.05	53.98	-15.93
*	15735.00	Peak	V	-	-	-70.68	13.10	49.42	73.98	-24.56

Table 7-49. Radiated Spurious Emissions Measurements TxBF

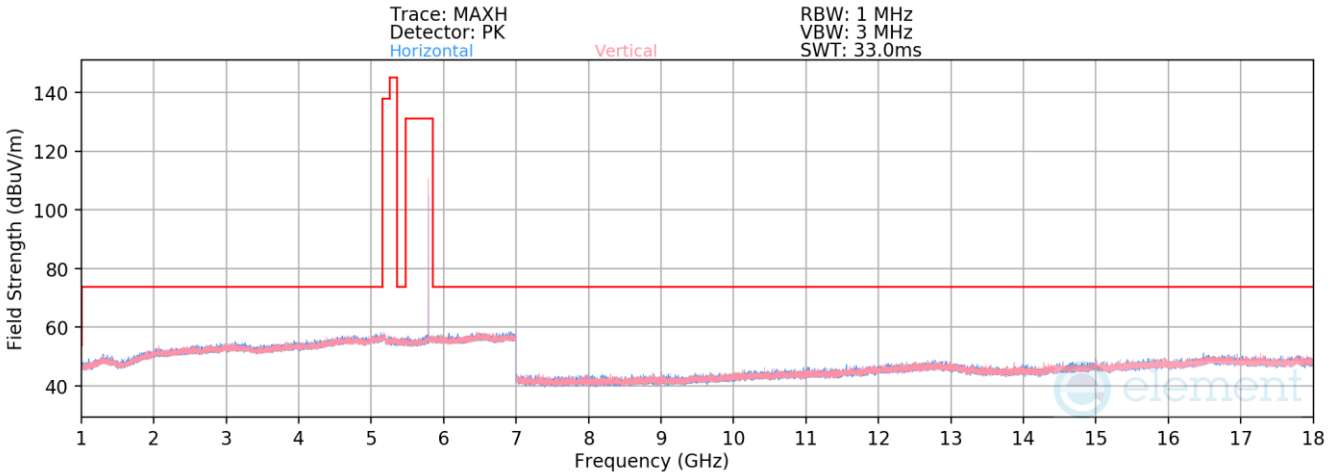


Plot 7-121. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5733MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5733MHz

	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]
*	11466.00	Average	V	-	-	-79.65	7.47	34.82	53.98	-19.16
*	11466.00	Peak	V	-	-	-67.62	7.47	46.85	73.98	-27.13
	17199.00	Peak	V	-	-	-71.50	14.96	50.46	68.20	-17.74

Table 7-50. Radiated Spurious Emissions Measurements TxBF

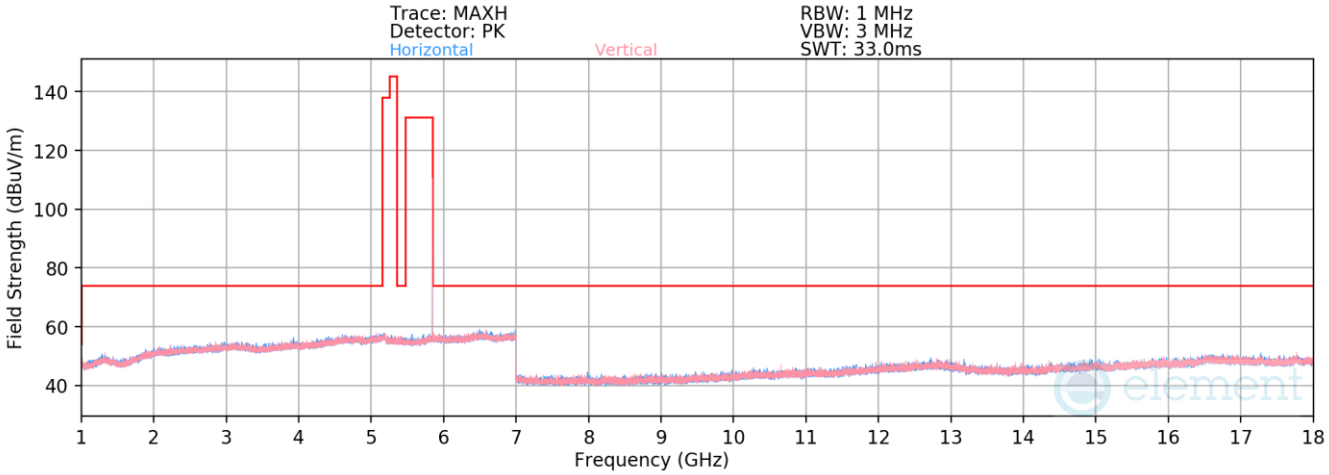


Plot 7-122. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5789MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5789MHz

	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]
*	11578.00	Average	V	-	-	-79.35	7.44	35.09	53.98	-18.89
*	11578.00	Peak	V	-	-	-68.01	7.44	46.43	73.98	-27.55
	17367.00	Peak	V	-	-	-71.49	14.88	50.39	68.20	-17.81

Table 7-51. Radiated Spurious Emissions Measurements TxBF



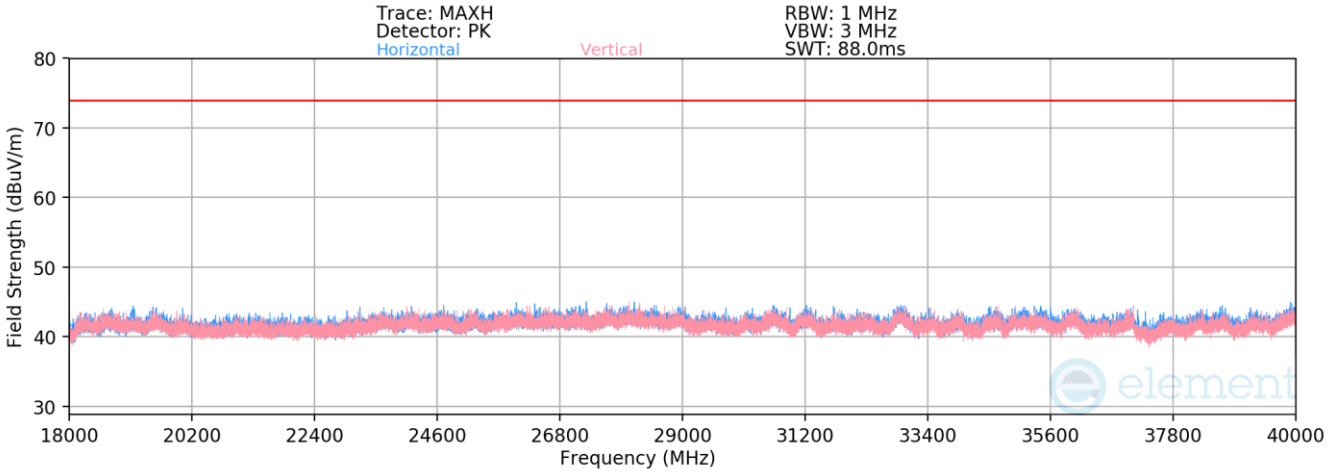
Plot 7-123. Radiated Spurious Emissions 1-18GHz TxBF (BDR GFSK ePA – 5844MHz)

Mode:	BDR
Data Rate:	1Mbps
Power Scheme:	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	5844MHz

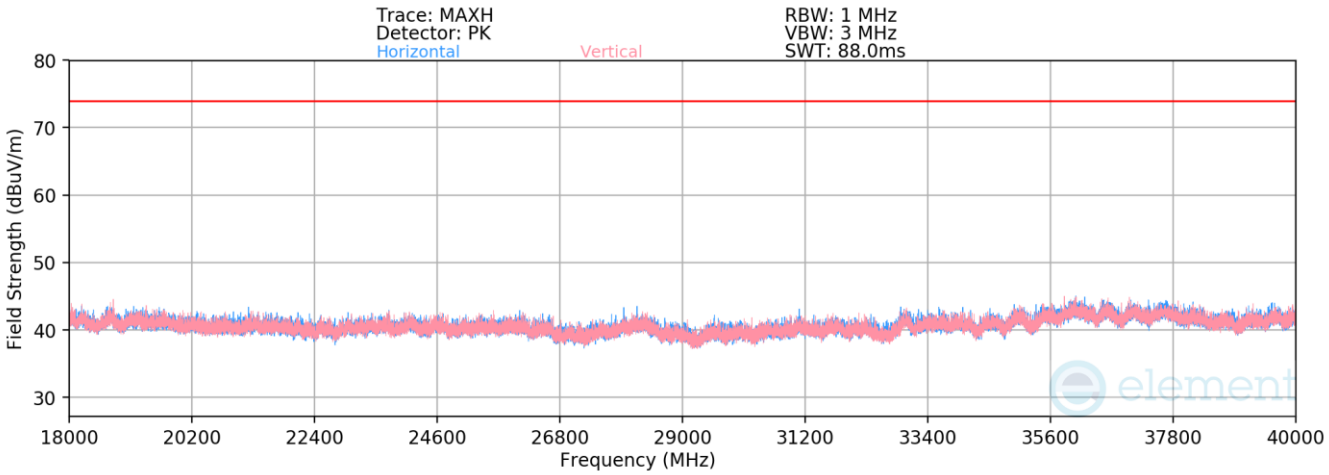
	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11688.00	Average	V	-	-	-79.28	7.86	35.58	53.98	-18.40
*	11688.00	Peak	V	-	-	-68.17	7.86	46.69	73.98	-27.29
	17532.00	Peak	V	-	-	-71.89	15.50	50.61	68.20	-17.59

Table 7-52. Radiated Spurious Emissions Measurements TxBF

Radiated Spurious Emissions Measurements (Above 18GHz)



Plot 7-124. Radiated Spurious Emissions Above 18GHz TxBF (BDR GFSK ePA – 5204MHz)



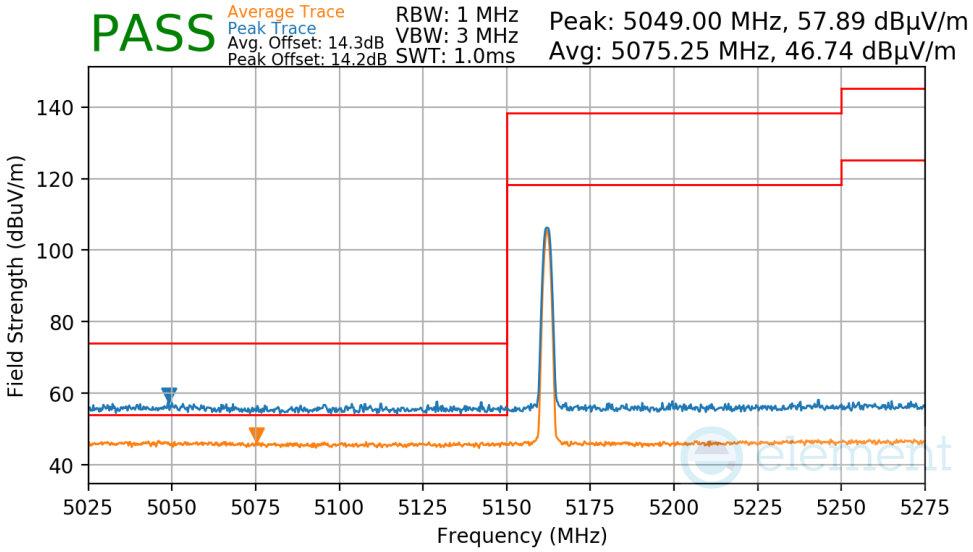
Plot 7-125. Radiated Spurious Emissions Above 18GHz TxBF (BDR GFSK ePA – 5789MHz)

7.6.1 Radiated Band Edge Measurements

§15.407(b.1) §15.205 §15.209; RSS-Gen [8.9]

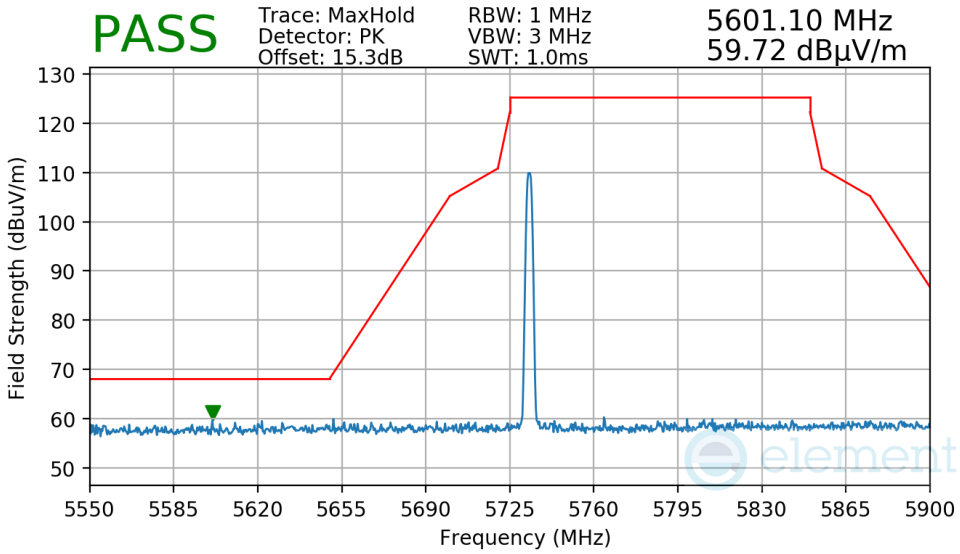
Antenna WF7a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5162MHz



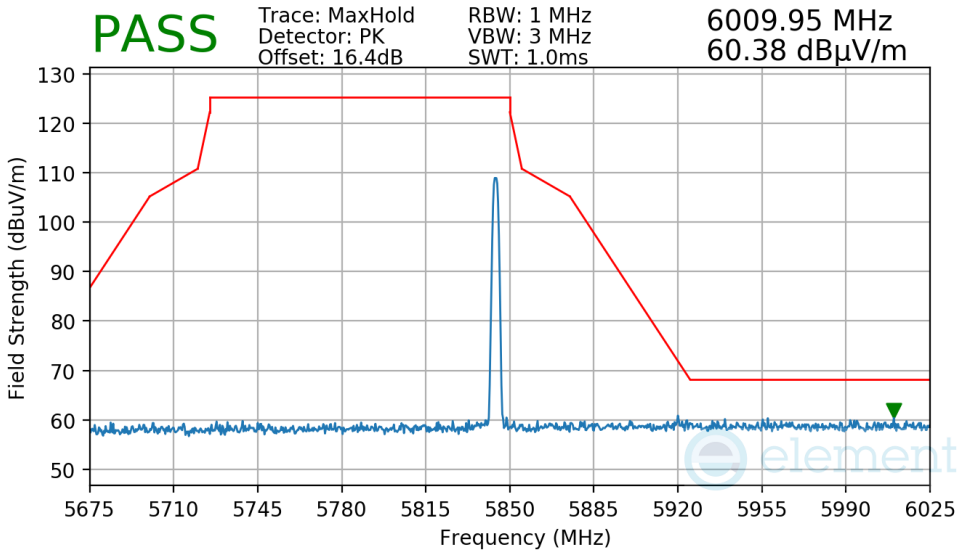
Plot 7-126. Radiated Lower Band Edge Measurement Antenna WF7a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5733MHz



Plot 7-127. Radiated Lower Band Edge Measurement Antenna WF7a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5844MHz



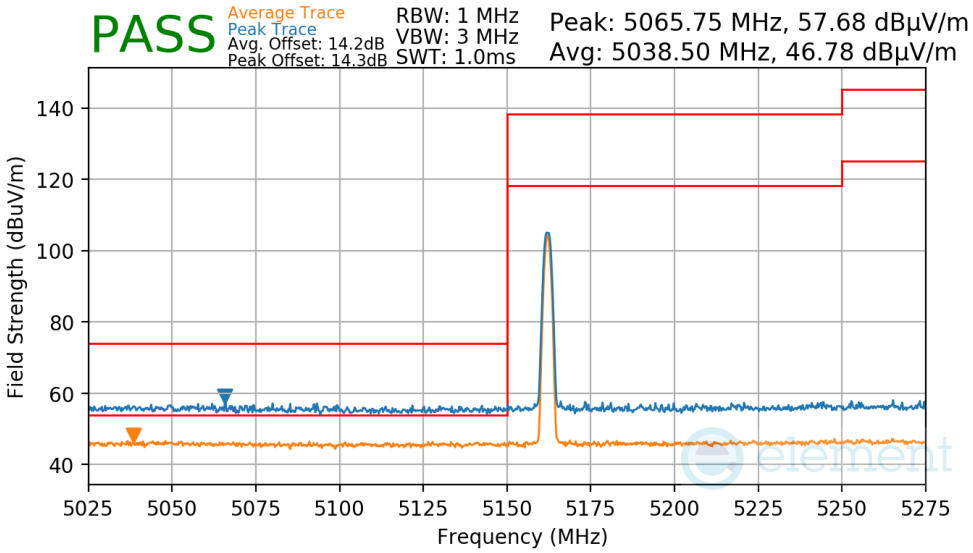
Plot 7-128. Radiated Upper Band Edge Measurement Antenna WF7a

Radiated Band Edge Measurements

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

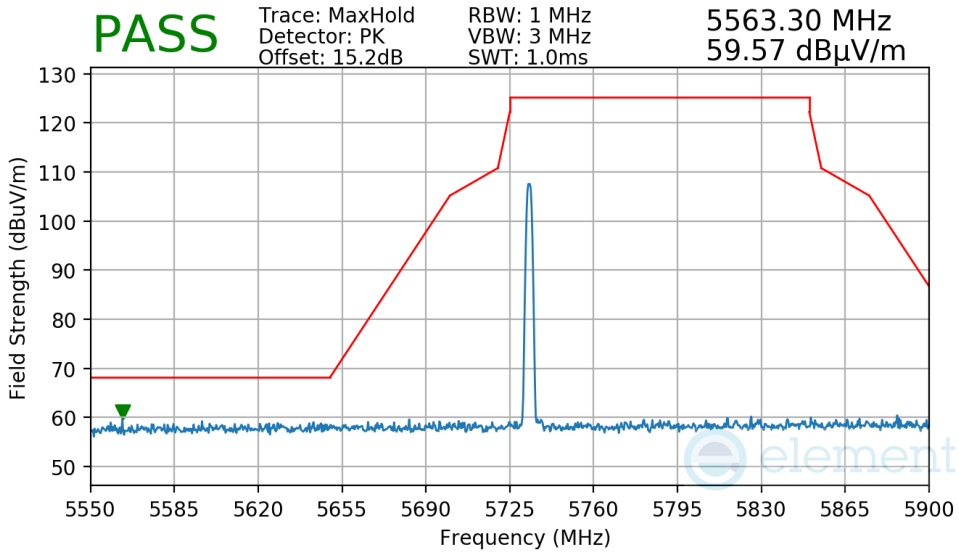
Antenna WF2a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5162MHz



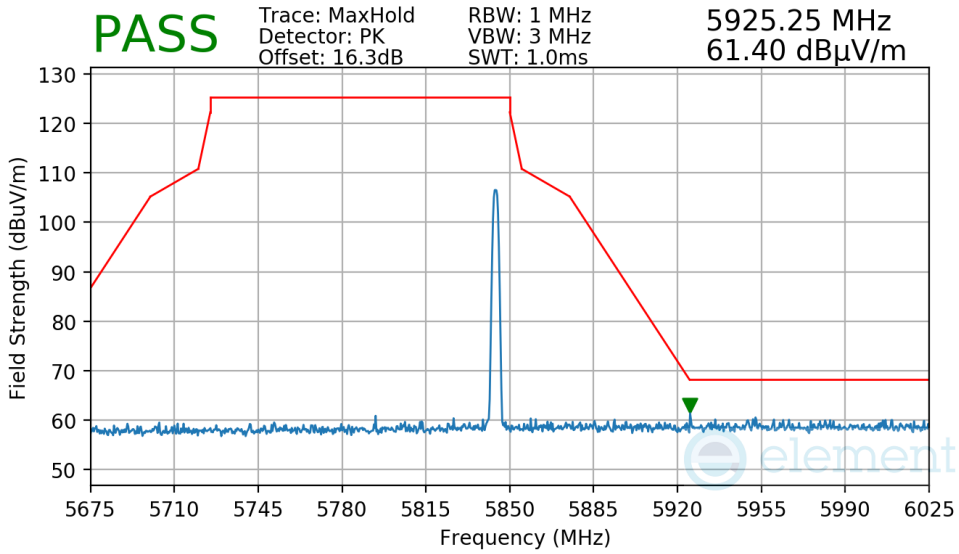
Plot 7-129. Radiated Lower Band Edge Measurement Antenna WF2a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5733MHz



Plot 7-130. Radiated Lower Band Edge Measurement Antenna WF2a

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5844MHz



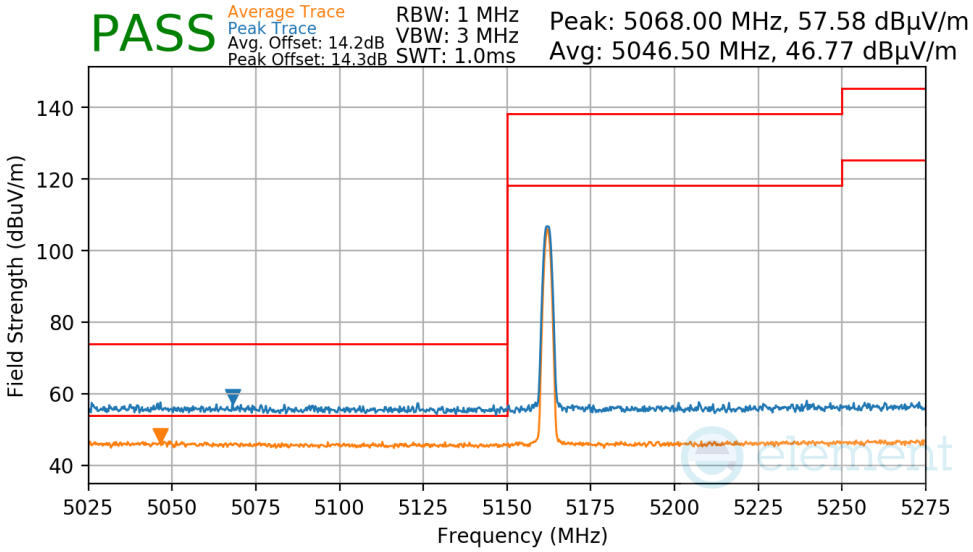
Plot 7-131. Radiated Upper Band Edge Measurement Antenna WF2a

Radiated Band Edge Measurements

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

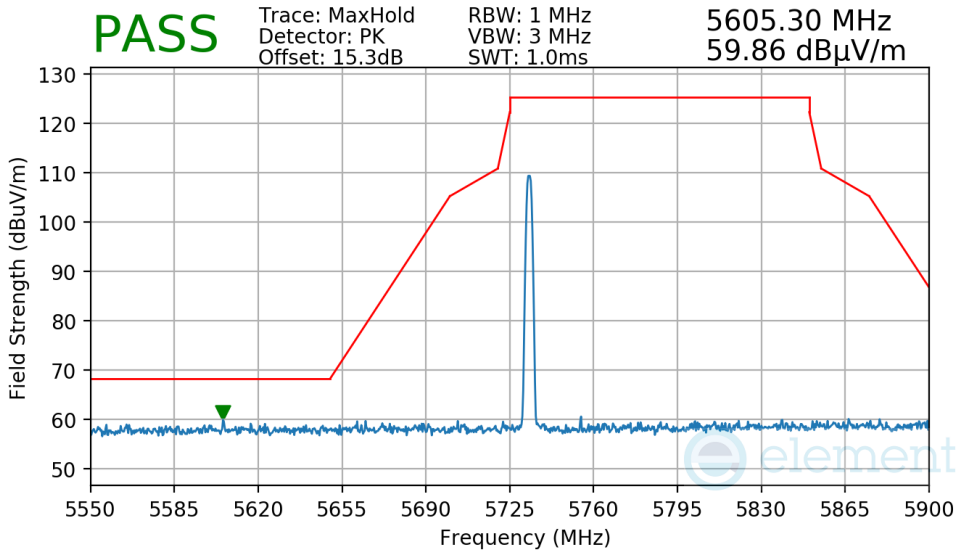
Antenna WF7b

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5162MHz



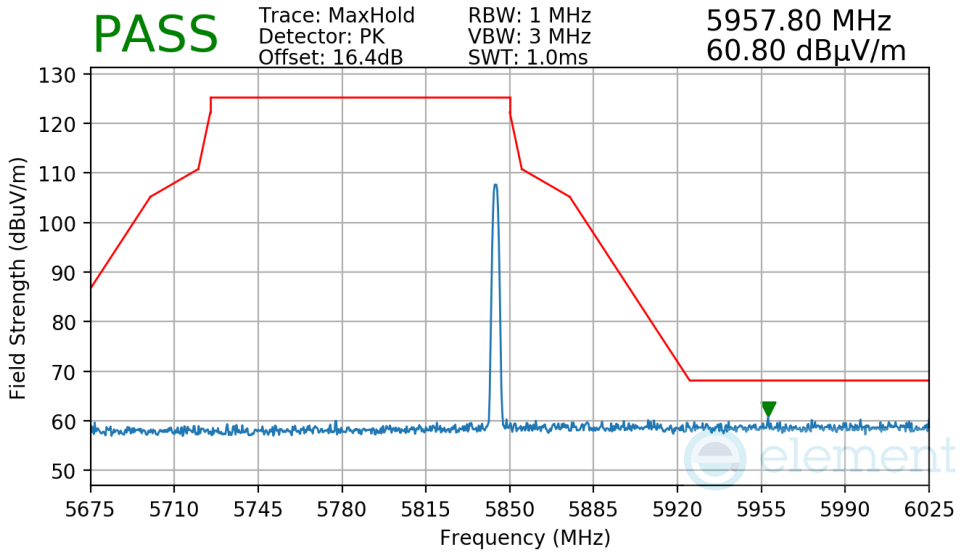
Plot 7-132. Radiated Lower Band Edge Measurement Antenna WF7b

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5733MHz



Plot 7-133. Radiated Lower Band Edge Measurement Antenna WF7b

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5844MHz



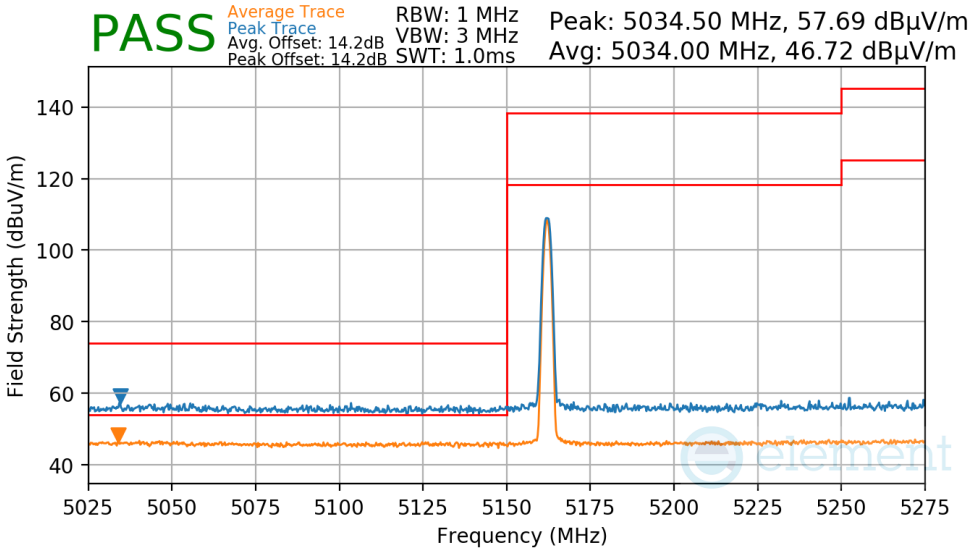
Plot 7-134. Radiated Upper Band Edge Measurement Antenna WF7b

Radiated Band Edge Measurements

§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

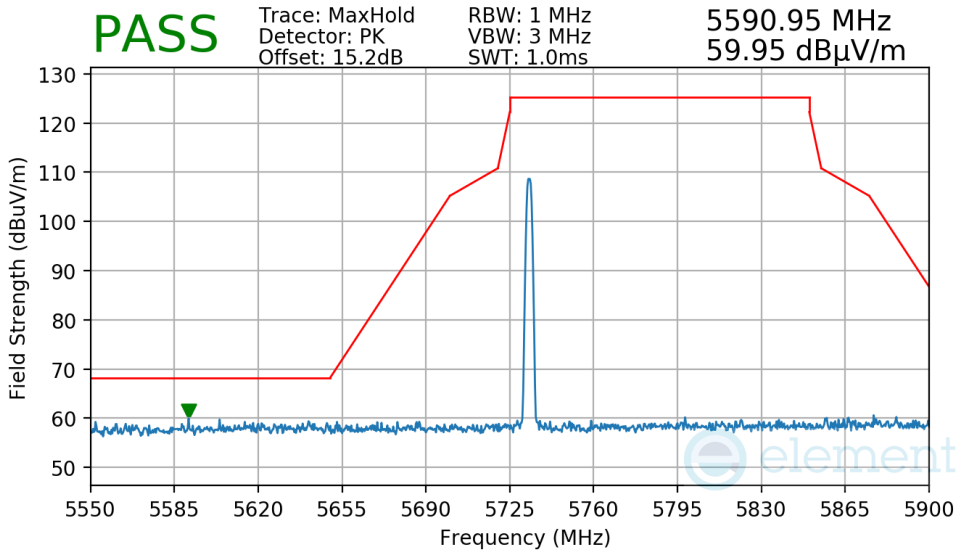
TxBF

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5162MHz



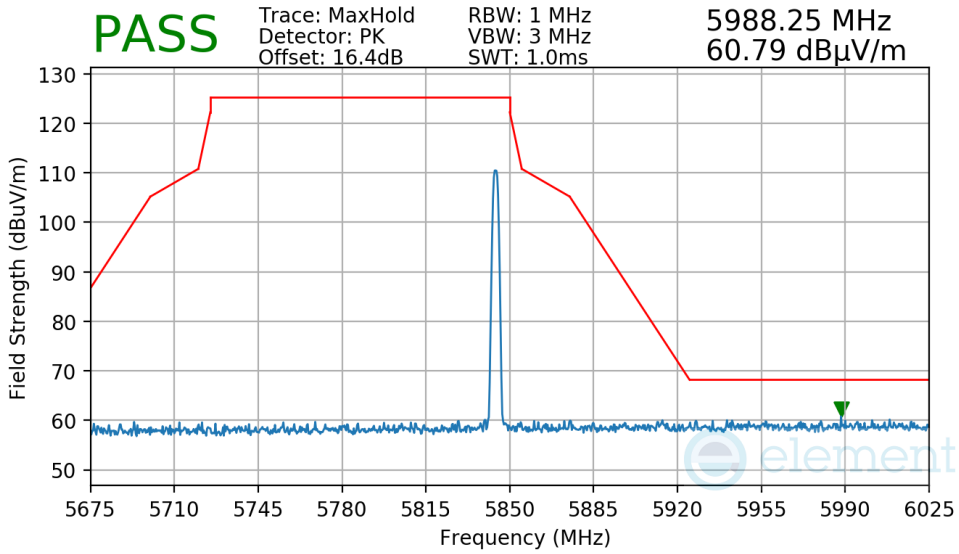
Plot 7-135. Radiated Lower Band Edge Measurement TxBF

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5733MHz



Plot 7-136. Radiated Lower Band Edge Measurement TxBF

Mode:	BDR
Power Scheme:	ePA
Measurement Distance:	3 Meters
Operating Frequency:	5844MHz



Plot 7-137. Radiated Upper Band Edge Measurement TxBF

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 7-53 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 7-53. 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.

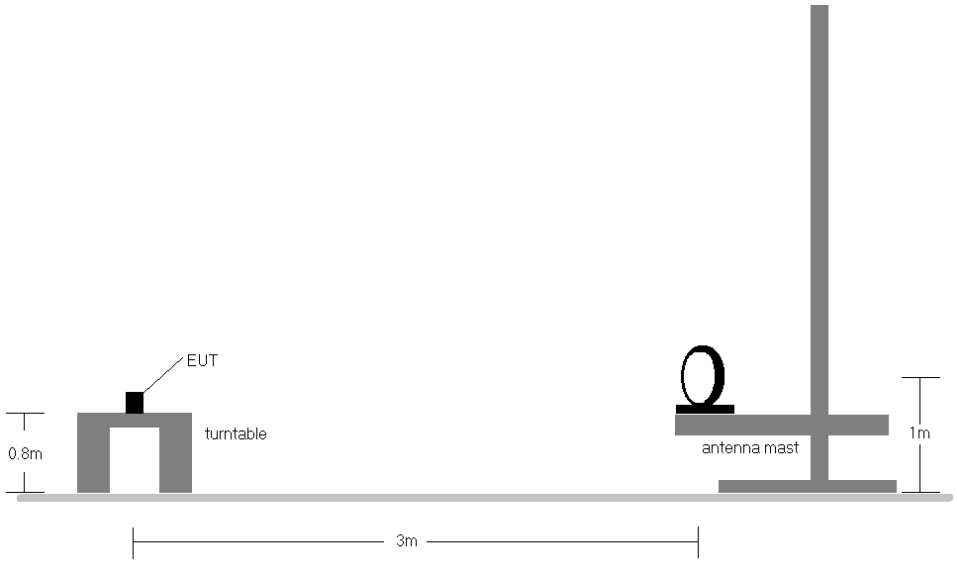


Figure 7-6. Radiated Test Setup < 30MHz

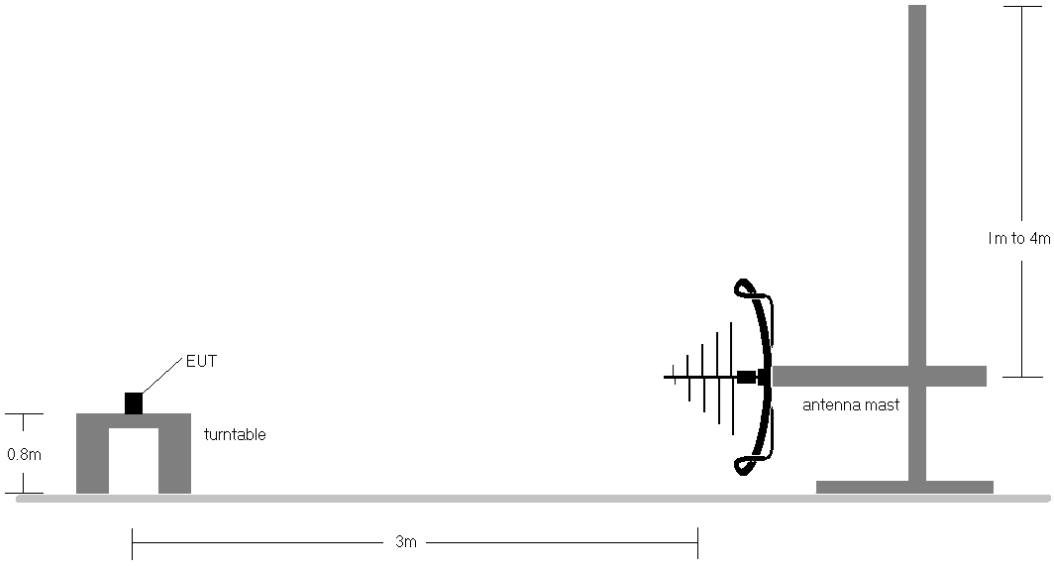


Figure 7-7. Radiated Test Setup < 1GHz

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 7-53.
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 for emissions 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 to USB-C cable with wire charger
    b. EUT powered by host PC via USB-C cable with wire charger

Sample Calculations

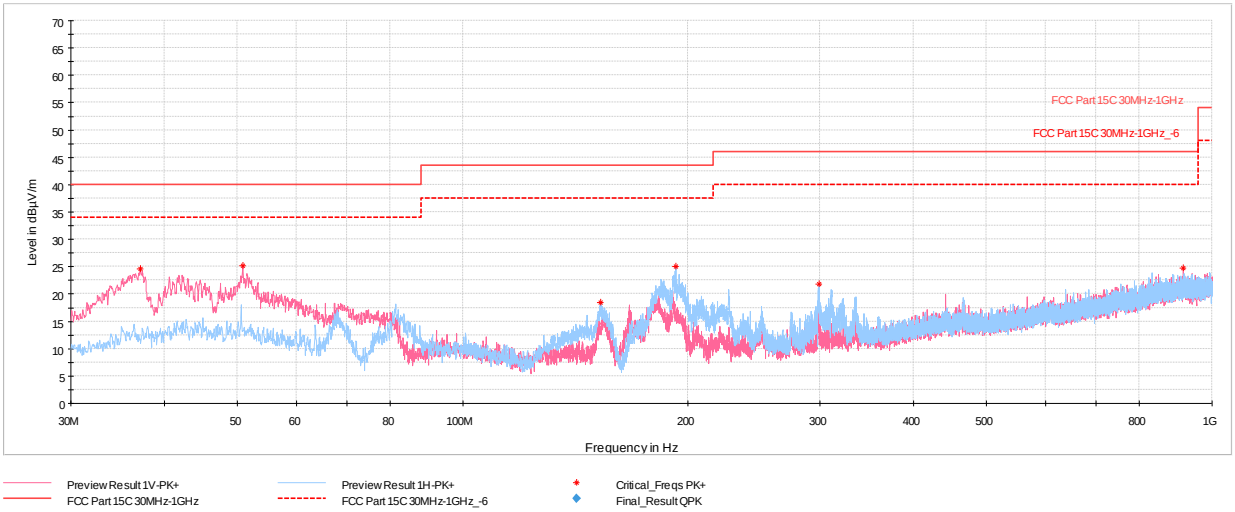
Determining Spurious Emissions Levels

- 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 (Below 1GHz)

§15.209; RSS-Gen [8.9]

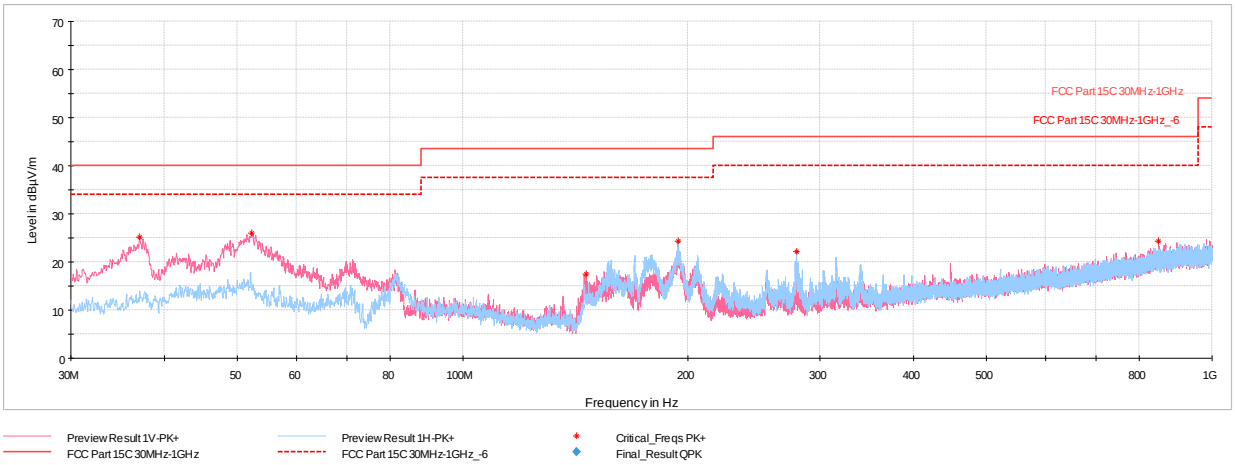
TxBF



Plot 7-138. Radiated Spurious Emissions Below 1GHz TxBF (BDR GFSK ePA – 5204MHz), 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]
37.13	Max-Peak	V	100	0	-67.20	-15.20	24.60	40.00	-15.40
50.90	Max-Peak	V	100	282	-68.68	-13.13	25.19	40.00	-14.81
152.66	Max-Peak	H	200	207	-68.44	-20.07	18.49	43.52	-25.03
192.43	Max-Peak	H	200	230	-64.68	-17.21	25.11	43.52	-18.41
299.03	Max-Peak	H	100	275	-70.55	-14.61	21.84	46.02	-24.18
914.98	Max-Peak	V	100	14	-79.51	-2.72	24.77	46.02	-21.25

Table 7-54. Radiated Spurious Emissions Below 1GHz TxBF (BDR GFSK ePA – 5204MHz), with AC/DC Adapter



Plot 7-139. Radiated Spurious Emissions Below 1GHz TxBF (BDR GFSK ePA – 5789MHz), 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	352	-66.66	-15.22	25.12	40.00	-14.88
52.31	Max-Peak	V	100	262	-67.85	-13.21	25.94	40.00	-14.06
146.25	Max-Peak	V	100	340	-68.97	-20.50	17.53	43.52	-25.99
193.83	Max-Peak	H	200	0	-65.63	-16.98	24.39	43.52	-19.13
278.81	Max-Peak	H	100	123	-69.77	-15.05	22.18	46.02	-23.84
848.83	Max-Peak	V	200	210	-79.46	-3.21	24.33	46.02	-21.69

Table 7-55. Radiated Spurious Emissions Below 1GHz TxBF (BDR GFSK ePA – 5789MHz), with AC/DC Adapter

7.8 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. All data rates and modes were investigated for AC Line conducted spurious emissions.

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 7-56. 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.

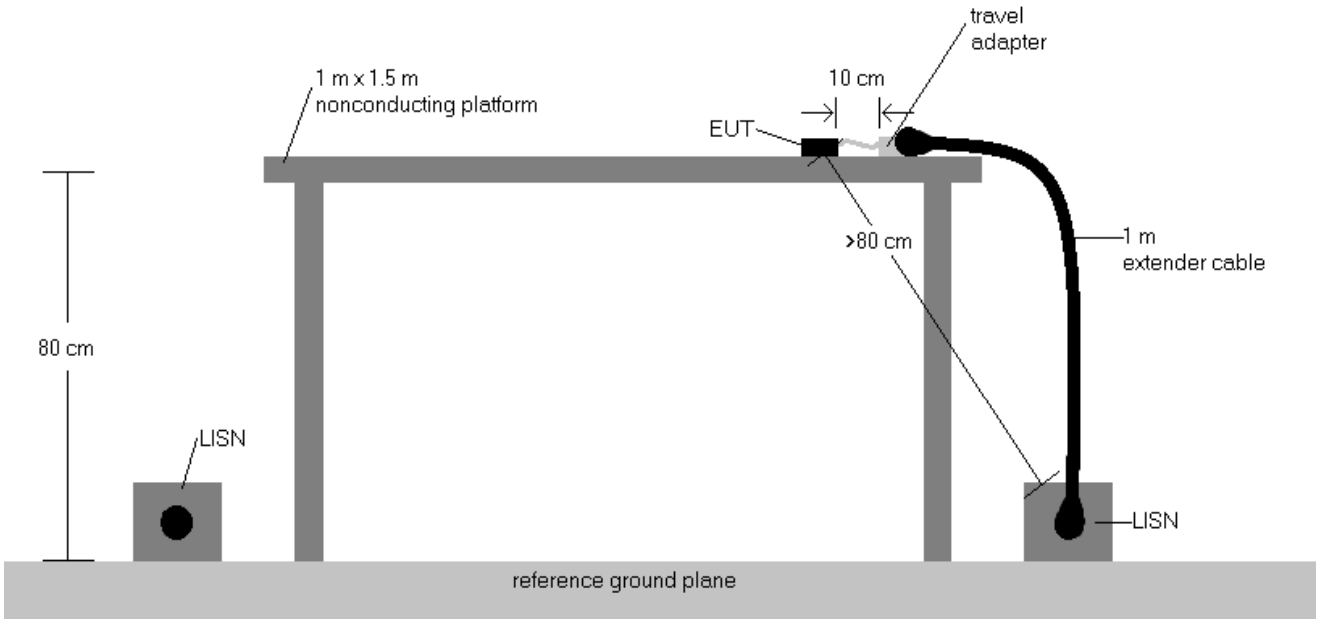
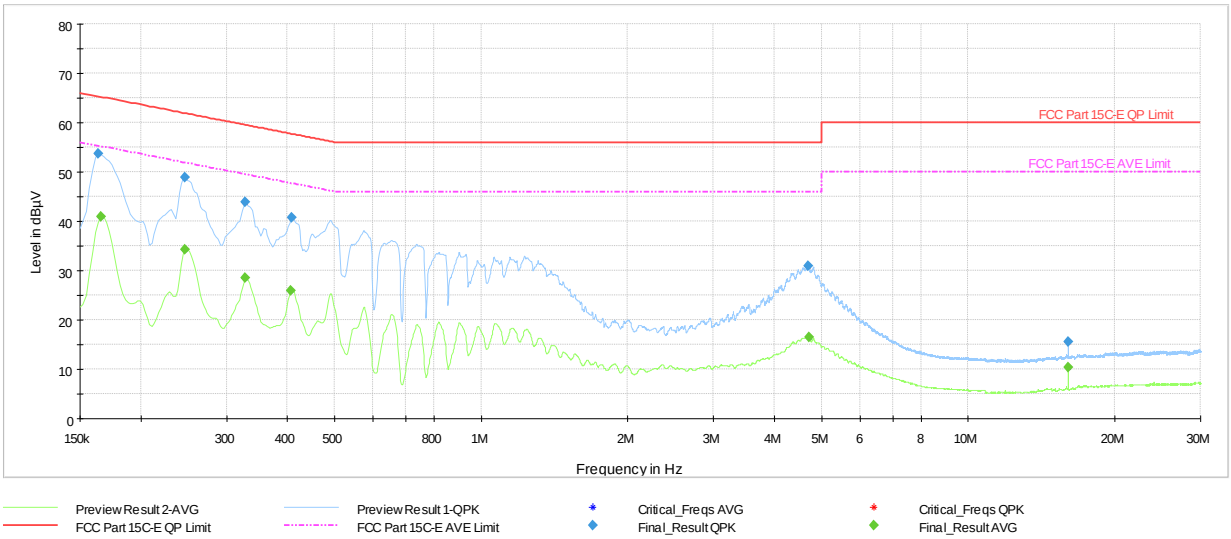


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

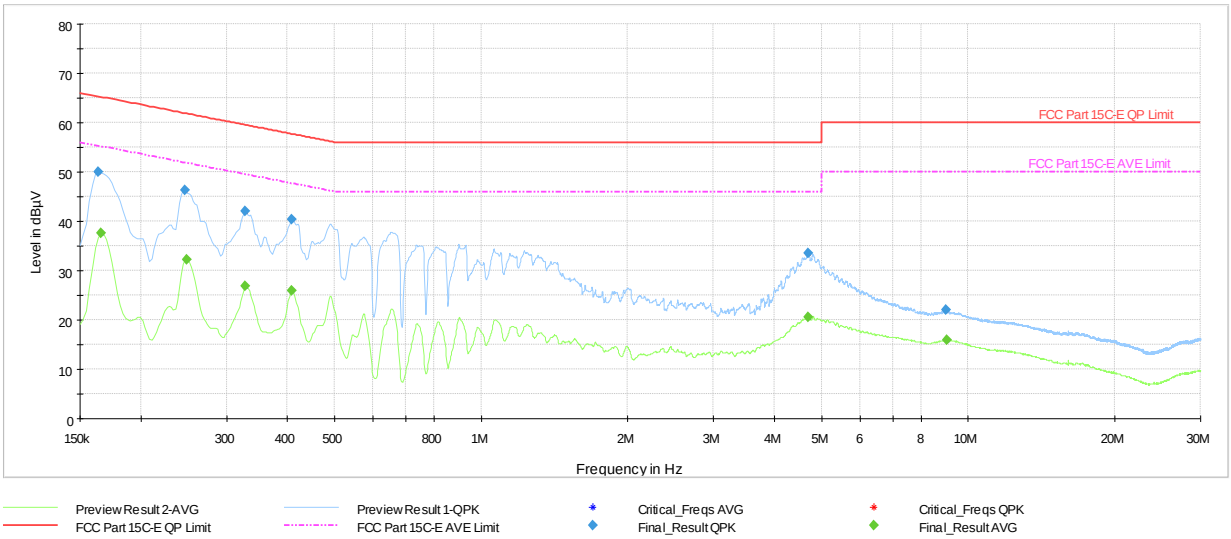
1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
2. Both configurations below were investigated, and the worst case has been reported.
    a. EUT powered by AC/DC adaptor to USB-C 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.
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.



Plot 7-140. AC Line Conducted Plot TxBF (BDR GFSK ePA – 5204MHz) (L1) with AC/DC Adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.164	FINAL	53.7	—	65.28	-11.61	L1	GND
0.166	FINAL	—	40.94	55.17	-14.23	L1	GND
0.247	FINAL	—	34.33	51.87	-17.54	L1	GND
0.247	FINAL	48.9	—	61.87	-12.97	L1	GND
0.328	FINAL	—	28.47	49.51	-21.04	L1	GND
0.328	FINAL	43.8	—	59.51	-15.67	L1	GND
0.407	FINAL	—	25.90	47.72	-21.82	L1	GND
0.409	FINAL	40.7	—	57.67	-16.95	L1	GND
4.700	FINAL	31.0	—	56.00	-25.02	L1	GND
4.706	FINAL	—	16.39	46.00	-29.61	L1	GND
16.055	FINAL	—	10.43	50.00	-39.57	L1	GND
16.055	FINAL	15.7	—	60.00	-44.35	L1	GND

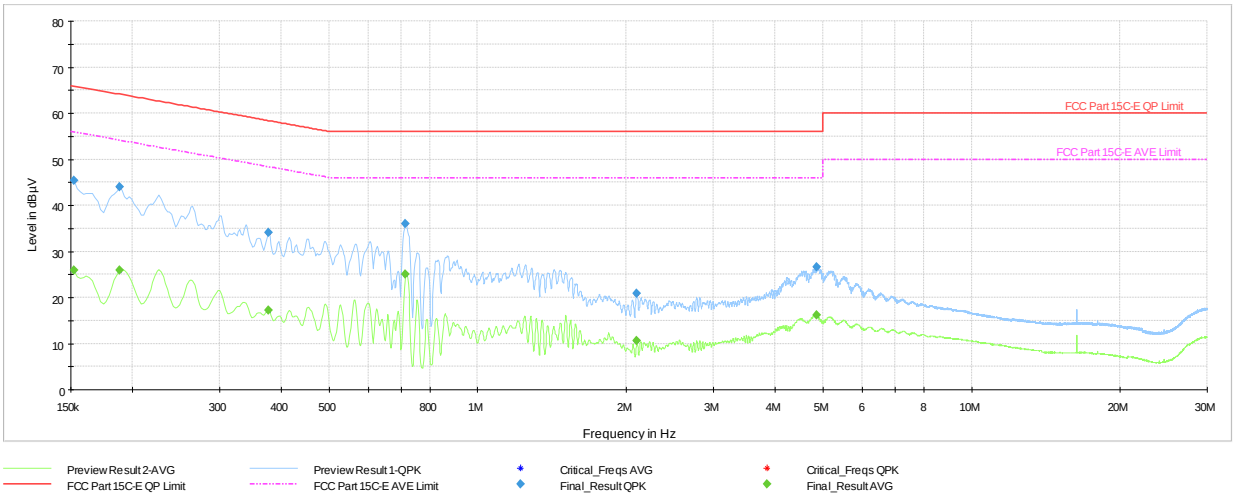
Table 7-57. AC Line Conducted Data TxBF (BDR GFSK ePA – 5204MHz) (L1) with AC/DC Adapter



Plot 7-141. AC Line Conducted Plot TxBF (BDR GFSK ePA – 5204MHz) (N) with AC/DC Adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.164	FINAL	50.1	—	65.28	-15.21	N	GND
0.166	FINAL	—	37.60	55.17	-17.57	N	GND
0.247	FINAL	46.3	—	61.87	-15.59	N	GND
0.249	FINAL	—	32.16	51.79	-19.63	N	GND
0.328	FINAL	42.1	—	59.51	-17.43	N	GND
0.328	FINAL	—	26.89	49.51	-22.62	N	GND
0.409	FINAL	40.4	—	57.67	-17.29	N	GND
0.409	FINAL	—	25.84	47.67	-21.84	N	GND
4.686	FINAL	—	20.49	46.00	-25.51	N	GND
4.697	FINAL	33.4	—	56.00	-22.57	N	GND
9.015	FINAL	22.0	—	60.00	-37.97	N	GND
9.024	FINAL	—	15.92	50.00	-34.08	N	GND

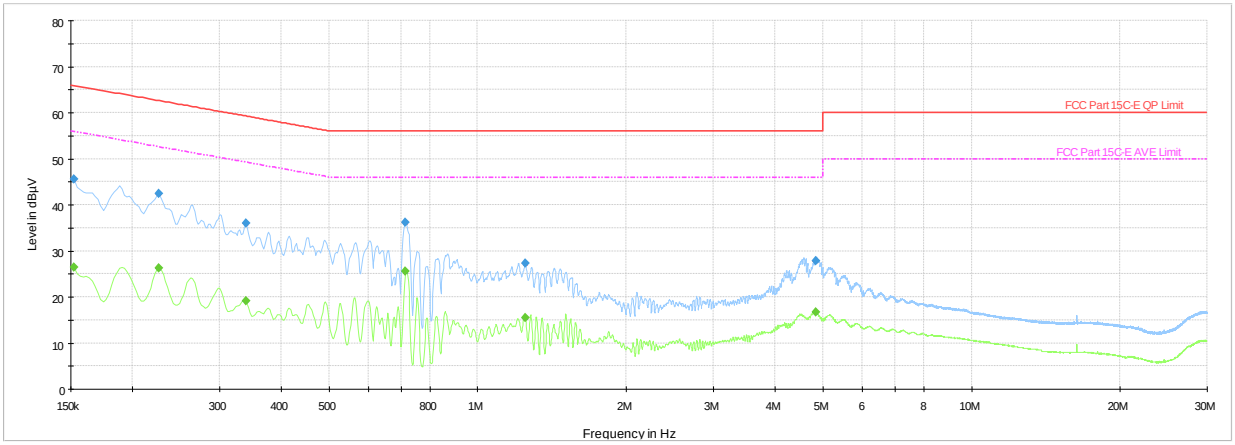
Table 7-58. AC Line Conducted TxBF (BDR GFSK ePA – 5204MHz) (N) with AC/DC Adapter



Plot 7-142. AC Line Conducted Plot TxBF (BDR GFSK ePA – 5789MHz) (L1) with AC/DC Adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.152	FINAL	—	25.85	55.88	-30.03	L1	GND
0.152	FINAL	45.4	—	65.88	-20.44	L1	GND
0.188	FINAL	—	25.88	54.11	-28.23	L1	GND
0.188	FINAL	44.0	—	64.11	-20.14	L1	GND
0.377	FINAL	—	17.22	48.34	-31.12	L1	GND
0.377	FINAL	34.0	—	58.34	-24.31	L1	GND
0.715	FINAL	35.9	—	56.00	-20.07	L1	GND
0.715	FINAL	—	25.05	46.00	-20.95	L1	GND
2.101	FINAL	20.8	—	56.00	-35.20	L1	GND
2.101	FINAL	—	10.67	46.00	-35.33	L1	GND
4.853	FINAL	—	16.14	46.00	-29.86	L1	GND
4.853	FINAL	26.6	—	56.00	-29.39	L1	GND

Table 7-59. AC Line Conducted Data TxBF (BDR GFSK ePA – 5789MHz) (L1) with AC/DC Adapter



Plot 7-143. AC Line Conducted Plot (BDR GFSK ePA – 5789MHz) (N) with AC/DC Adapter

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.152	FINAL	—	26.41	55.88	-29.46	N	GND
0.152	FINAL	45.6	—	65.88	-20.32	N	GND
0.227	FINAL	—	26.34	52.58	-26.24	N	GND
0.227	FINAL	42.5	—	62.58	-20.08	N	GND
0.339	FINAL	—	19.11	49.23	-30.12	N	GND
0.339	FINAL	36.0	—	59.23	-23.27	N	GND
0.715	FINAL	36.2	—	56.00	-19.84	N	GND
0.715	FINAL	—	25.49	46.00	-20.51	N	GND
1.250	FINAL	27.3	—	56.00	-28.68	N	GND
1.250	FINAL	—	15.51	46.00	-30.49	N	GND
4.846	FINAL	—	16.75	46.00	-29.25	N	GND
4.846	FINAL	27.8	—	56.00	-28.21	N	GND

Table 7-60. AC Line Conducted (BDR GFSK ePA – 5789MHz) (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: BCGA2898 , IC: 579C-A2898** 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.