

7.8 Conducted Spurious Emissions

§15.247 (d); RSS-247 [5.5]

Test Overview and Limit

Conducted out-of-band spurious emissions were investigated from 30MHz up to 25GHz to include the 10th harmonic of the fundamental transmit frequency. **The maximum permissible out-of-band emission level is 20 dBc.**

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.8

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz* (See note below)
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

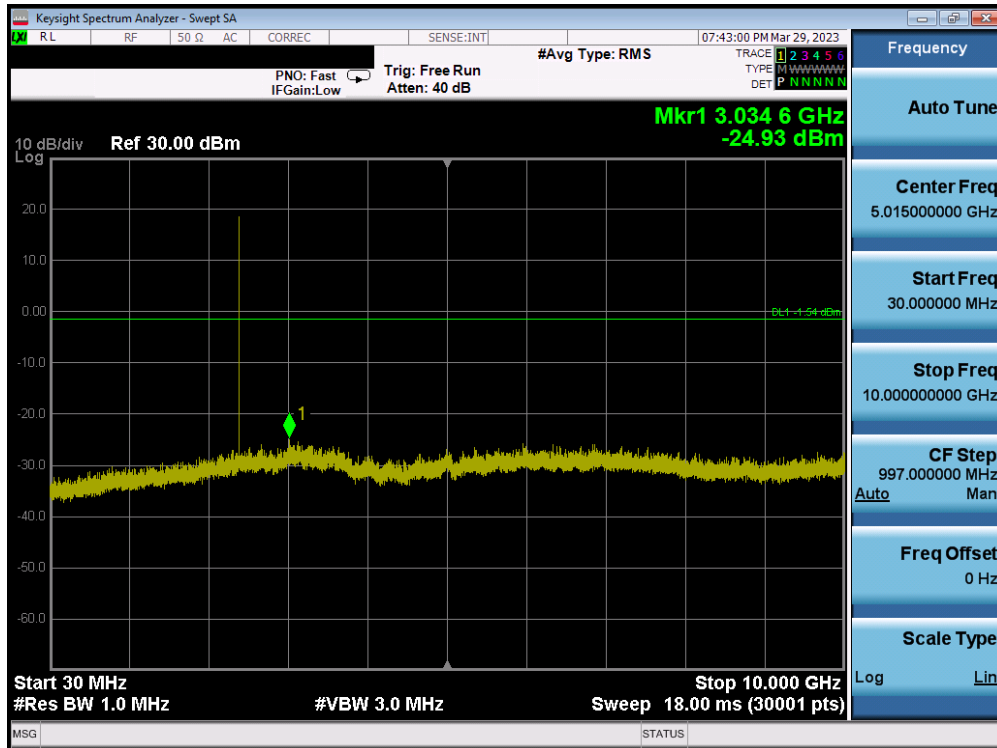


Figure 7-7. Test Instrument & Measurement Setup

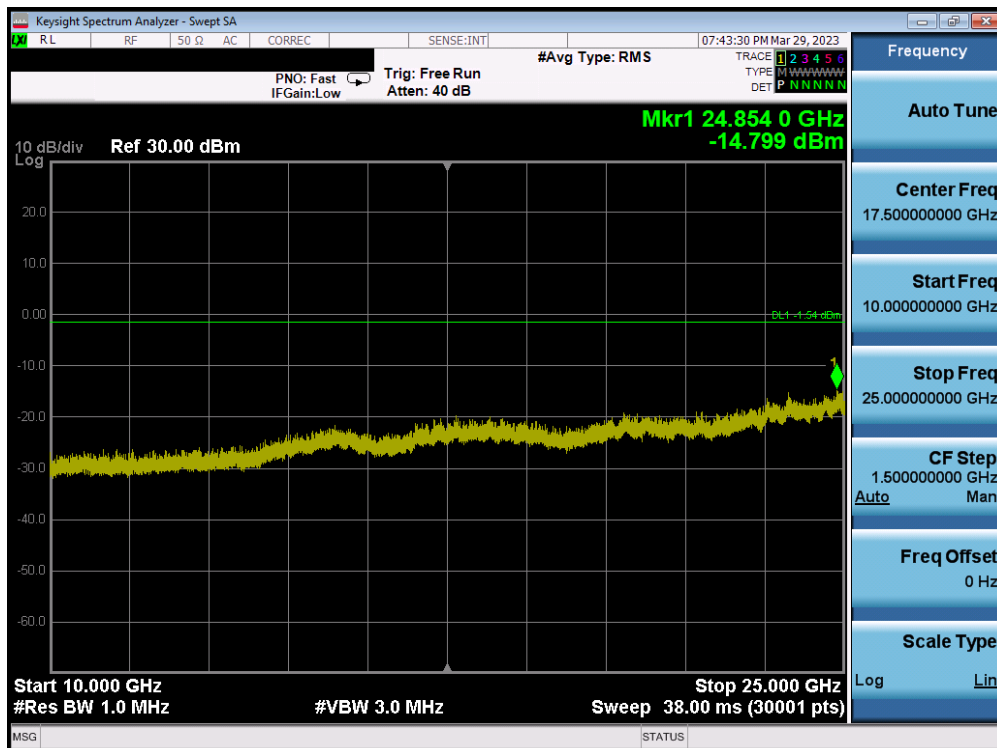
Test Notes

1. Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the traces in the following plots are measured with a 1MHz RBW to reduce test time, so the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.
2. The unit was tested with all possible mode and power schemes and only the highest emission is reported.

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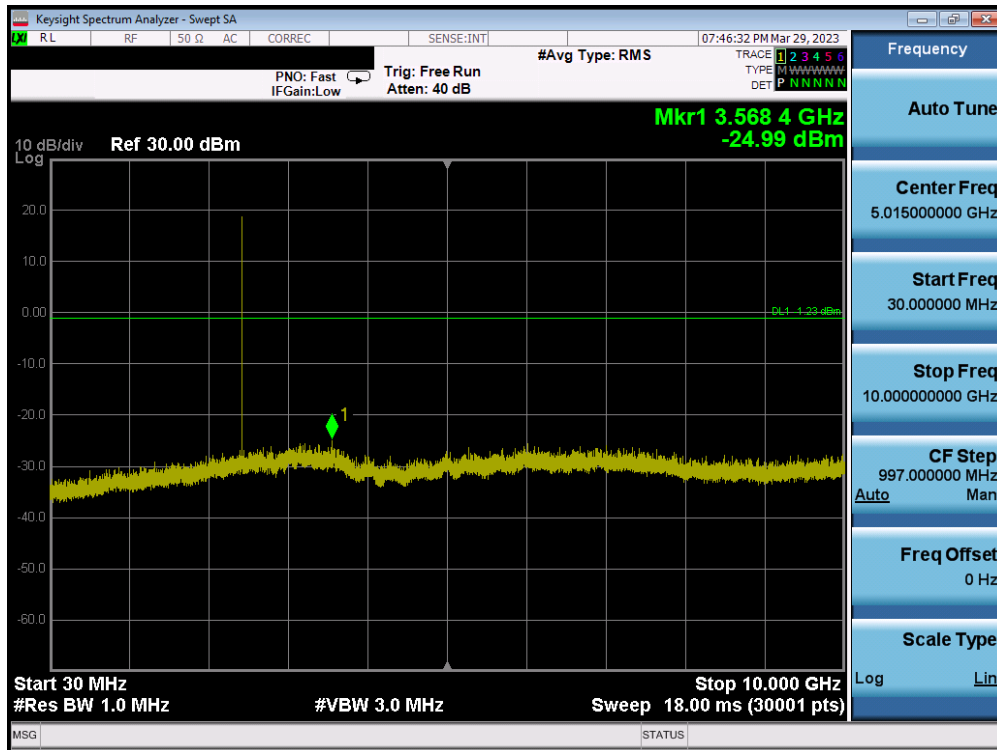


Plot 7-67. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA – Ch.0)

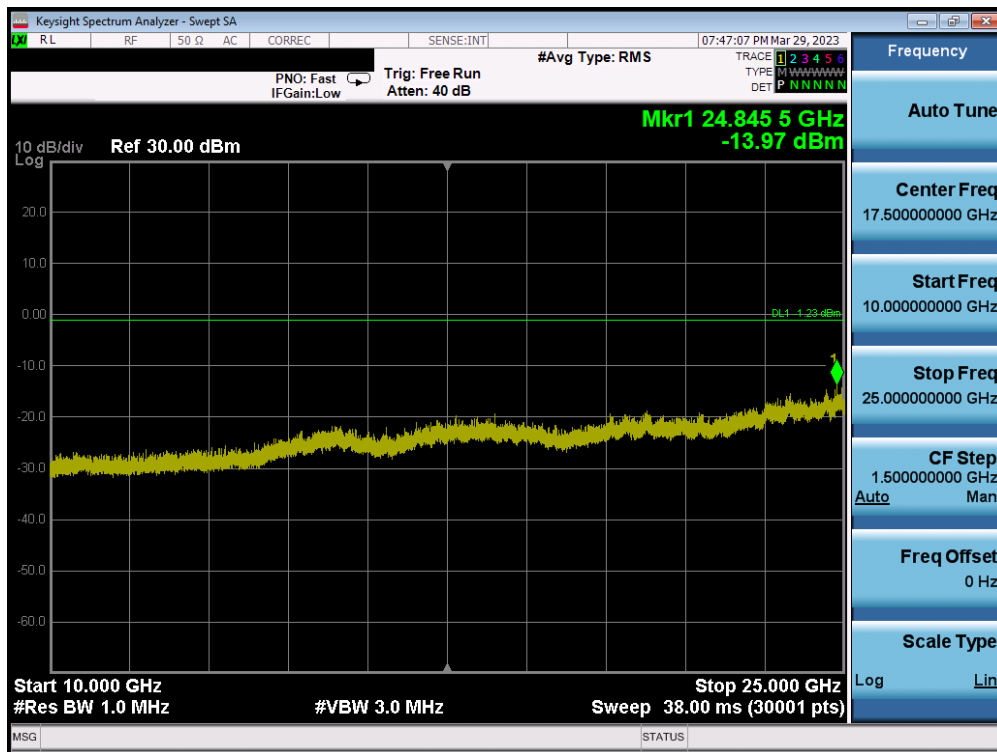


Plot 7-68. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA – Ch.0)

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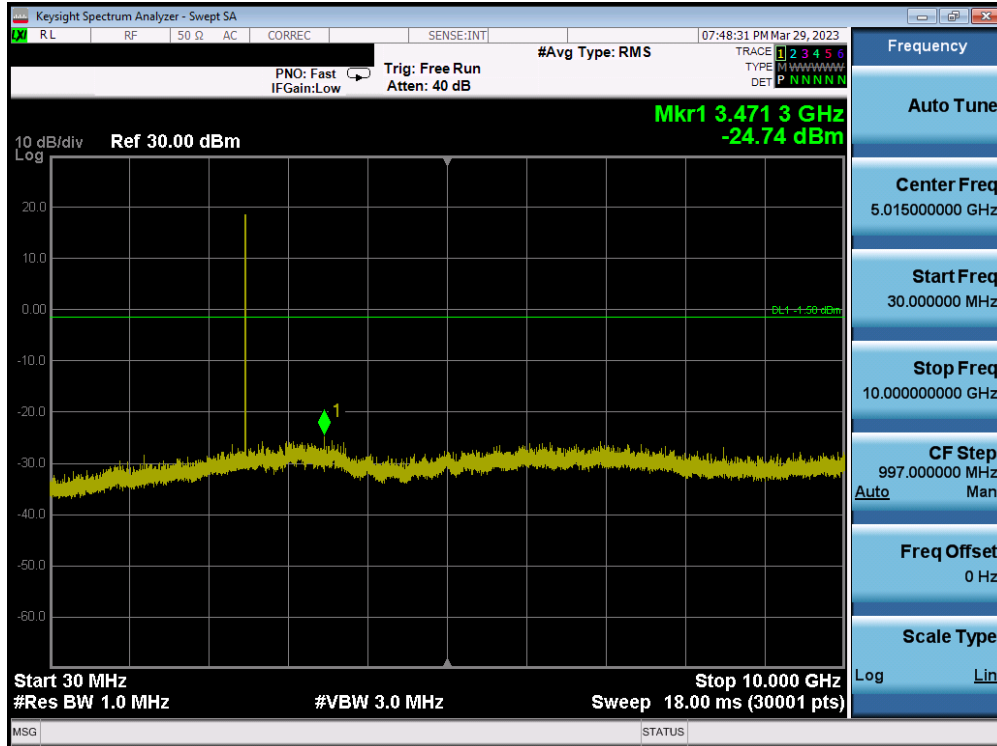


Plot 7-69. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA – Ch.39)

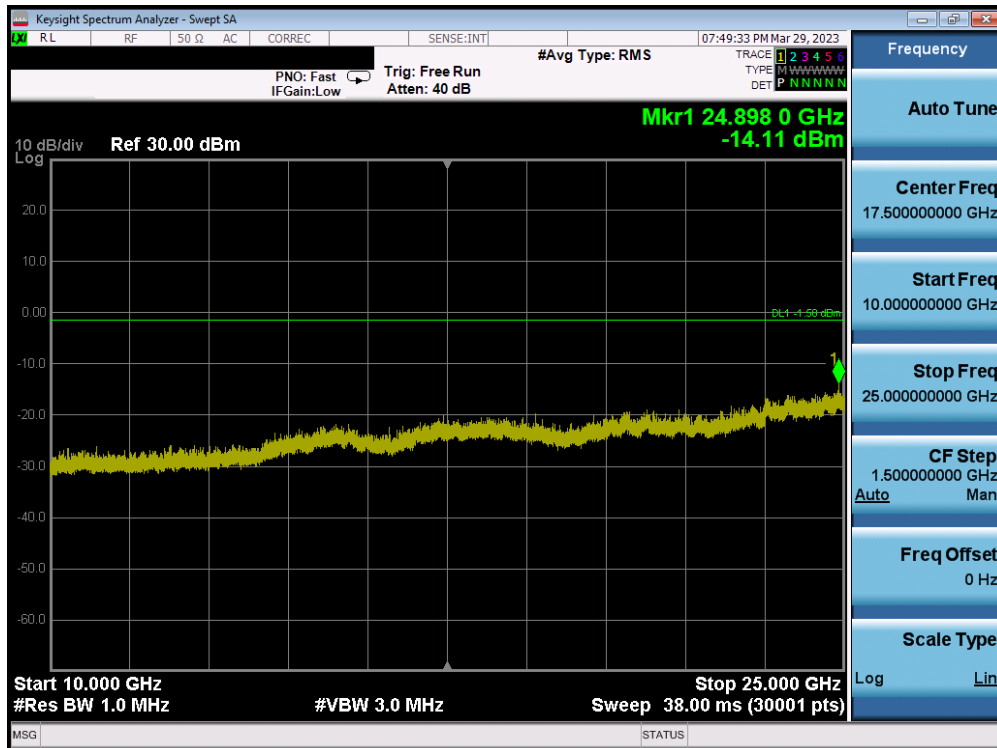


Plot 7-70. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA Ch.39)

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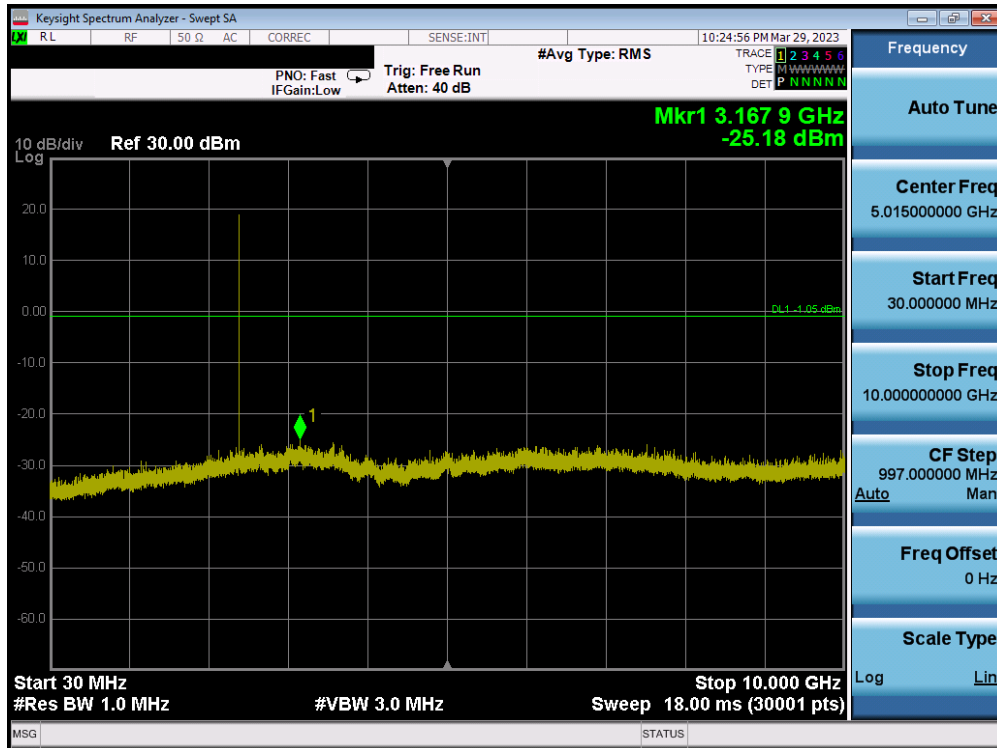


Plot 7-71. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA – Ch.78)

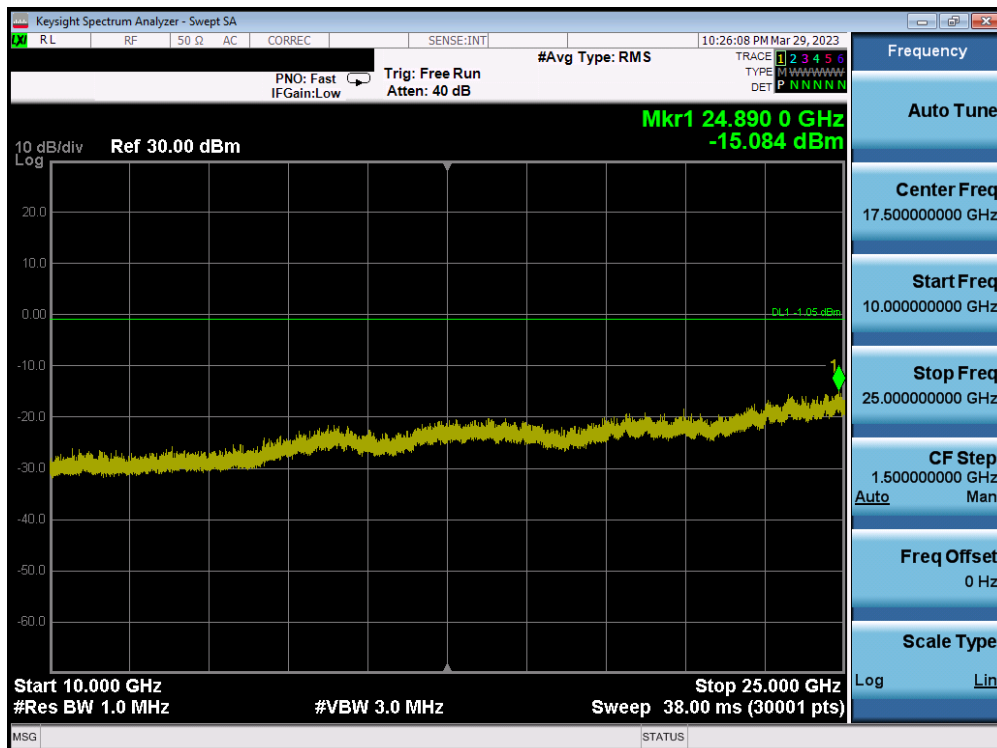


Plot 7-72. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA – Ch.78)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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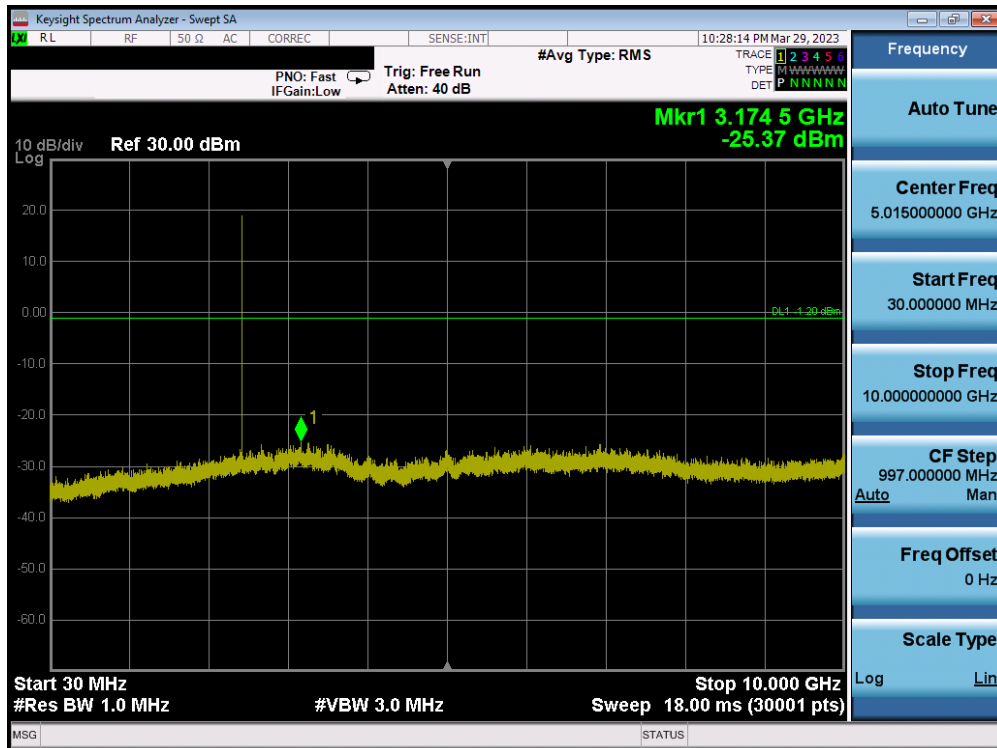


Plot 7-73. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.0)

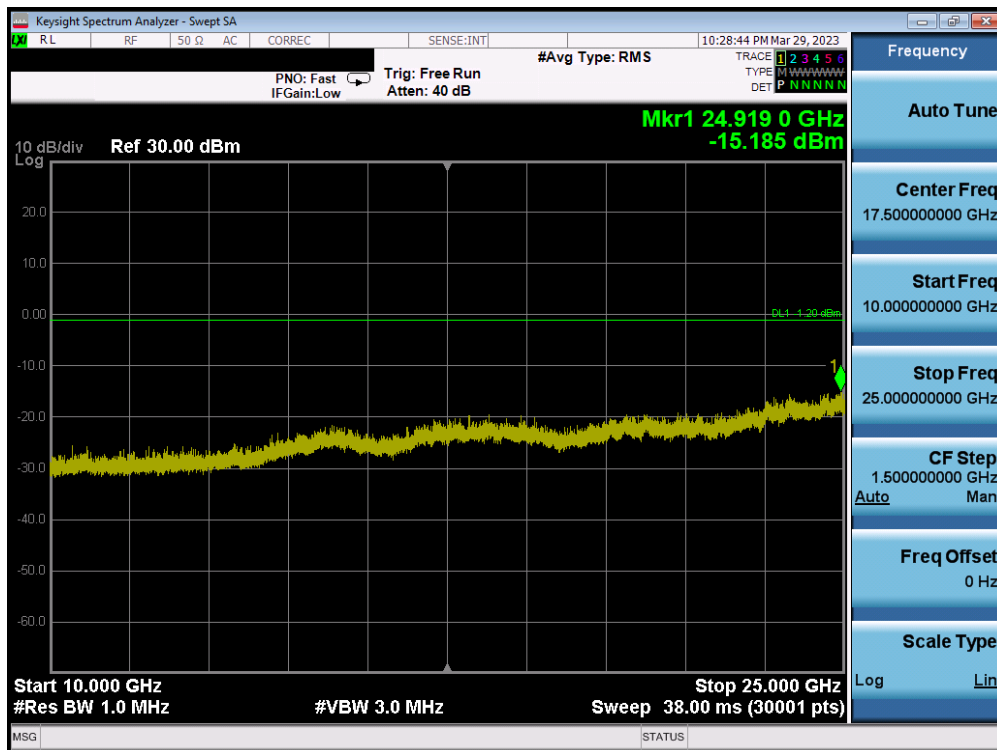


Plot 7-74. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.0)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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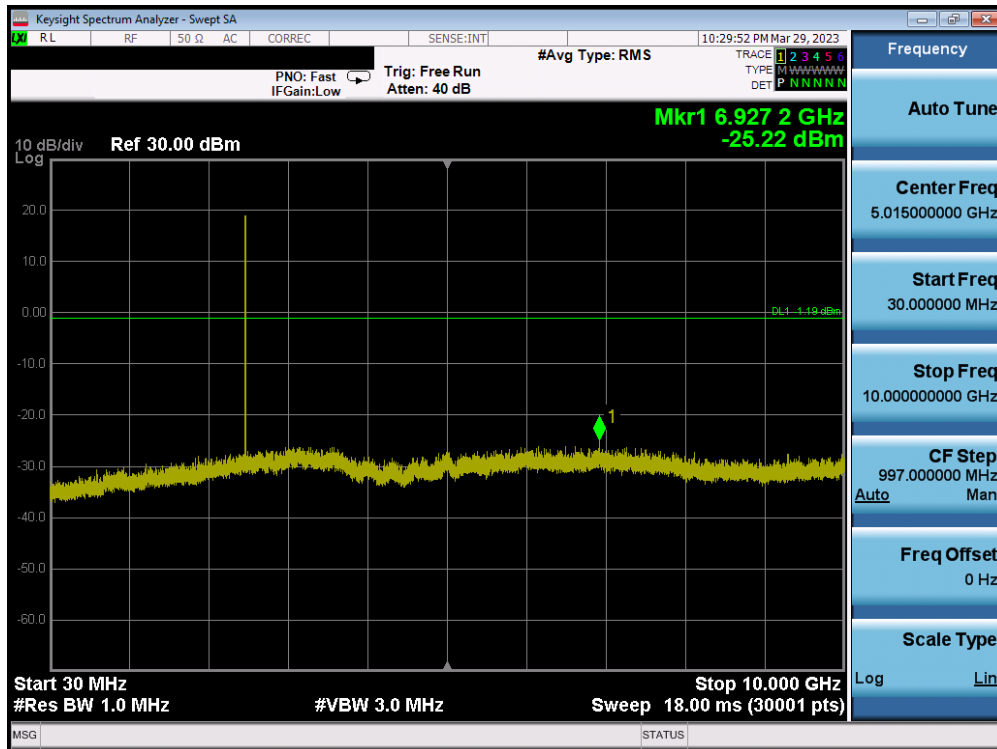


Plot 7-75. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.39)

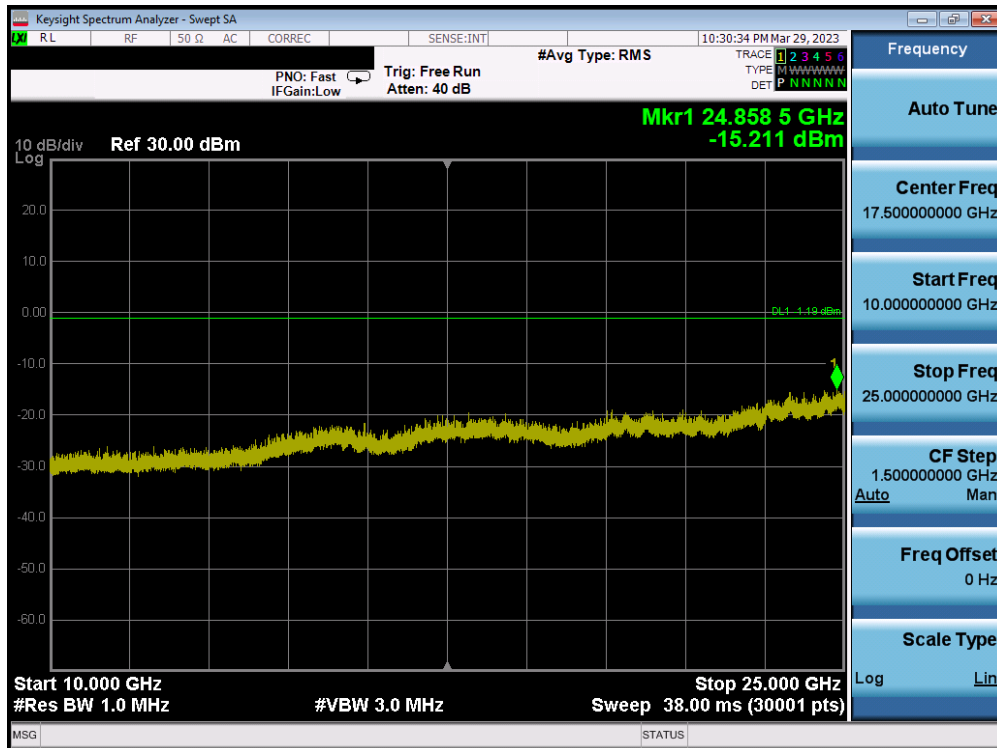


Plot 7-76. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA Ch.39)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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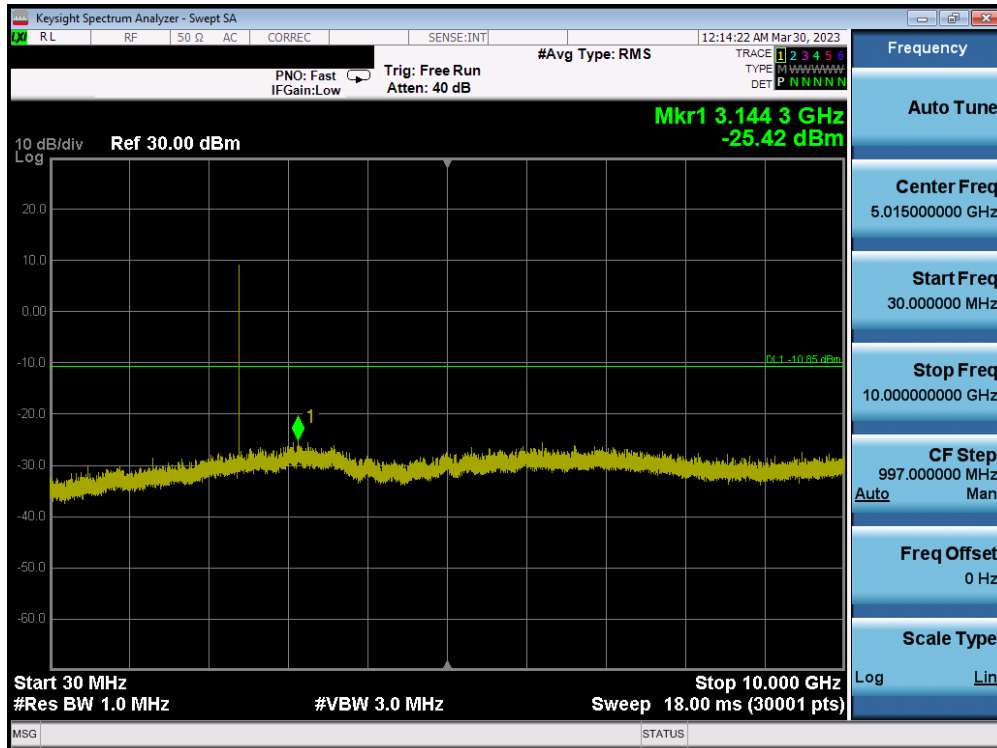


Plot 7-77. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.78)

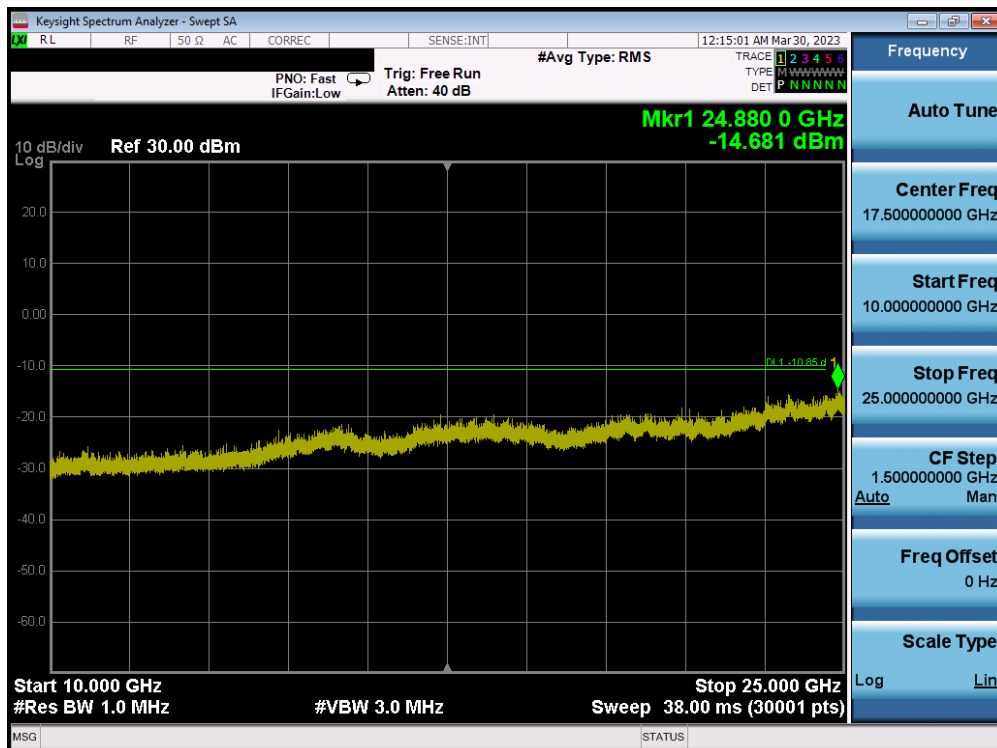


Plot 7-78. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.78)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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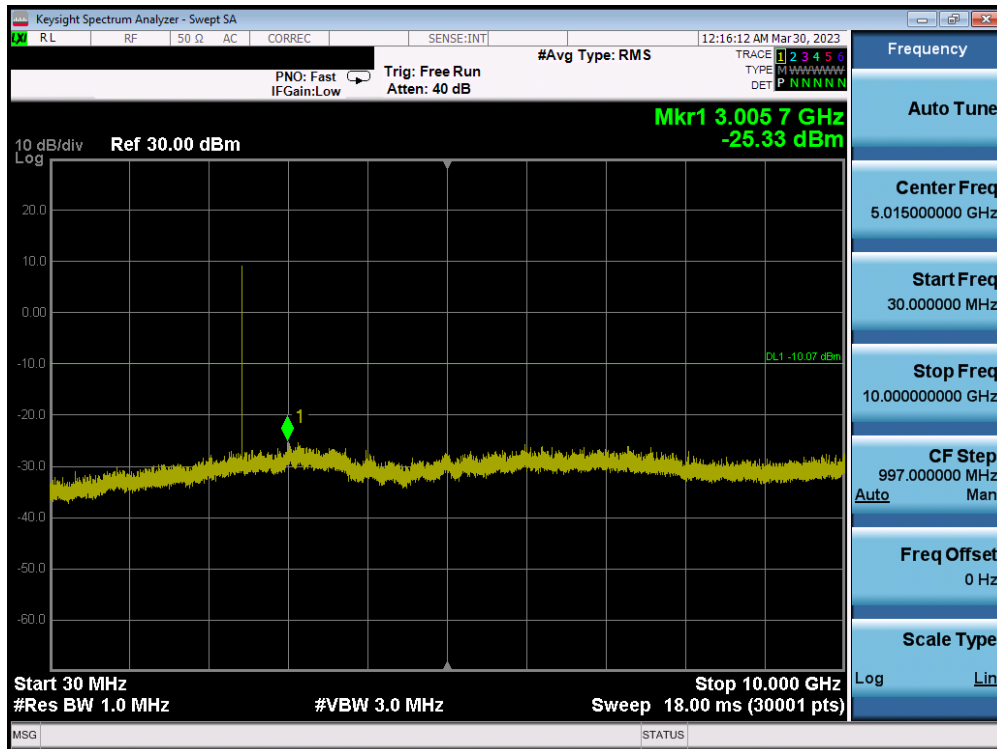


Plot 7-79. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA – Ch.0)

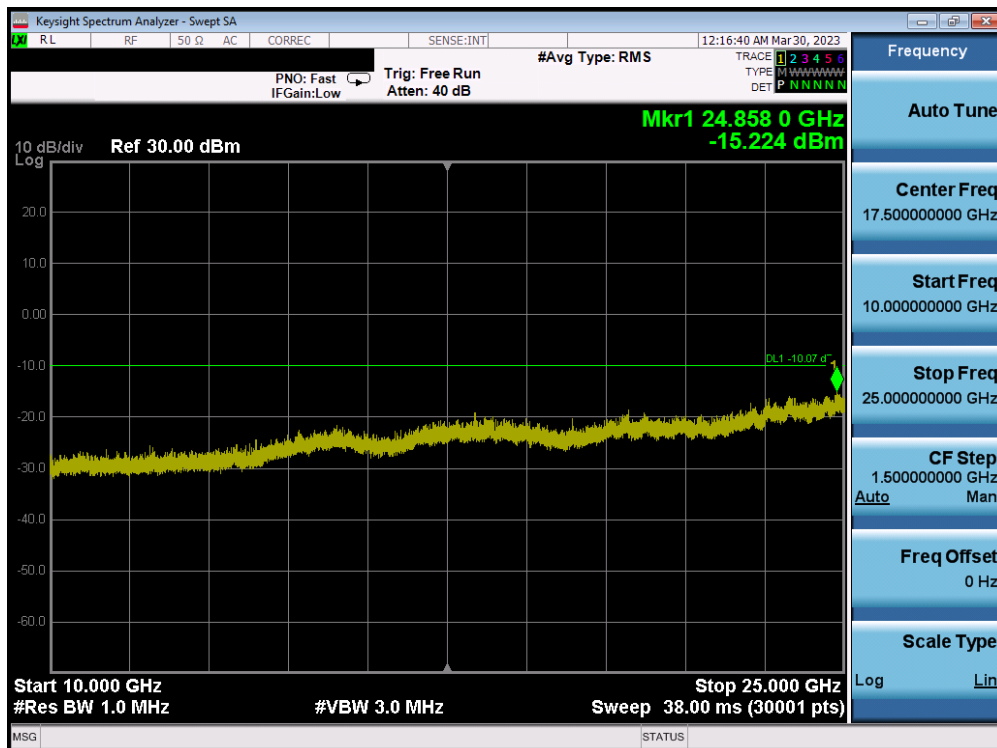


Plot 7-80. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA – Ch.0)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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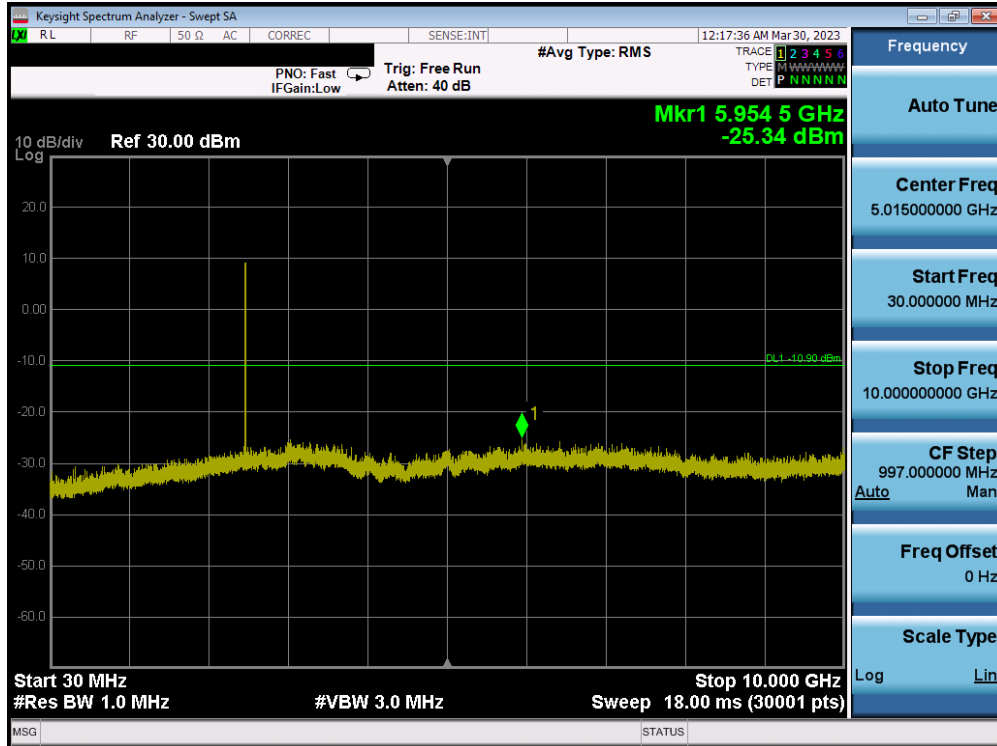


Plot 7-81. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA – Ch. 39)

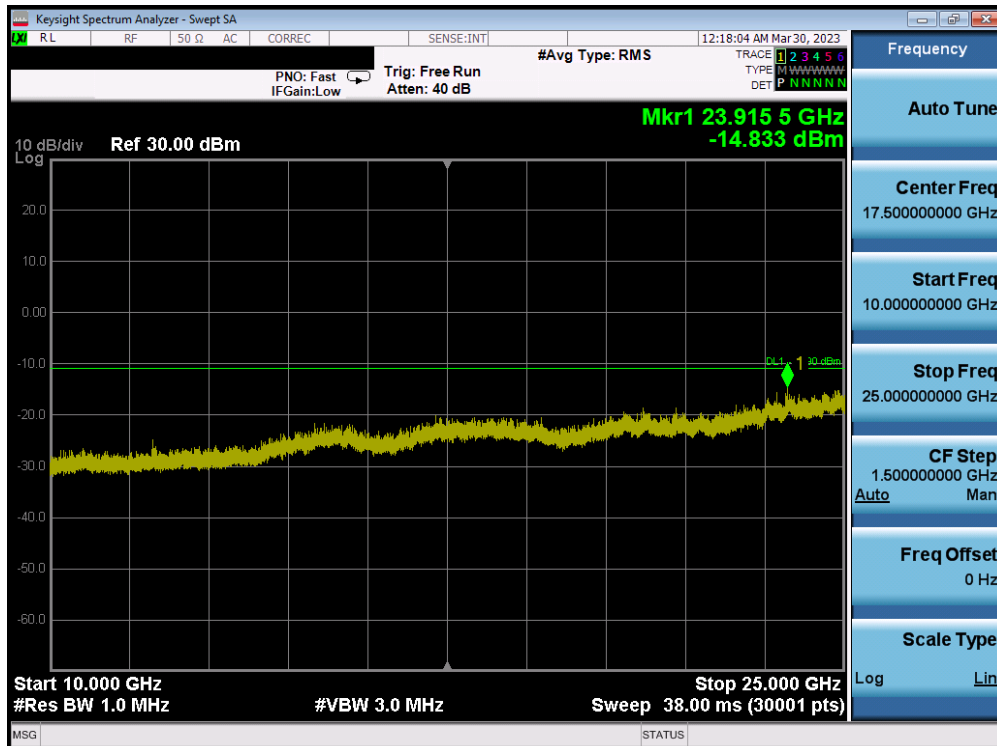


Plot 7-82. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA Ch. 39)

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Plot 7-83. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA – Ch. 78)



Plot 7-84. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA – Ch. 78)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.9 Radiated Spurious Emissions – Above 1GHz

§15.205 §15.209 §15.247 (d); 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 maximum power and at the appropriate frequencies. 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 7-16 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [$\mu\text{V/m}$]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-16. Radiated Limits

Test Procedure Used

ANSI C63.10-2013 – Section 6.6.4.3

Test Settings

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

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Test Setup

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

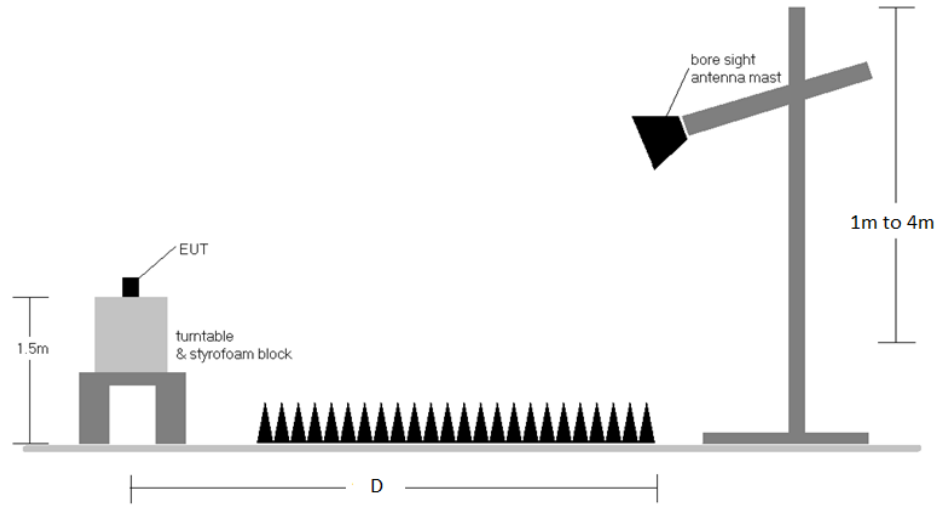


Figure 7-8. Radiated Test Setup >1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-16.
2. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested with its standard battery.
4. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.
5. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
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, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.
9. Average emissions were not reported since the duty cycle correction factor was greater than 20dB.

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Sample Calculation

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

Duty Cycle Correction Factor Calculation

- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = $1 / 133.33 \text{ hops/second} = 7.50 \text{ ms}$
- Time to cycle through all channels = $7.50 \times 20 \text{ channels} = 150 \text{ ms}$
- Number of times transmitter hits on one channel = $100 \text{ ms} / 150 \text{ ms} = 1 \text{ time(s)}$
- Worst case dwell time = 7.5 ms

Duty cycle correction factor = $20\log_{10}(7.5\text{ms}/100\text{ms}) = -22.5 \text{ dB}$

Average Emission Calculation

- Average Emission = Measured Peak Emissions $_{[dB\mu V/m]} - \text{Duty Cycle Correction Factor }_{[dB]}$

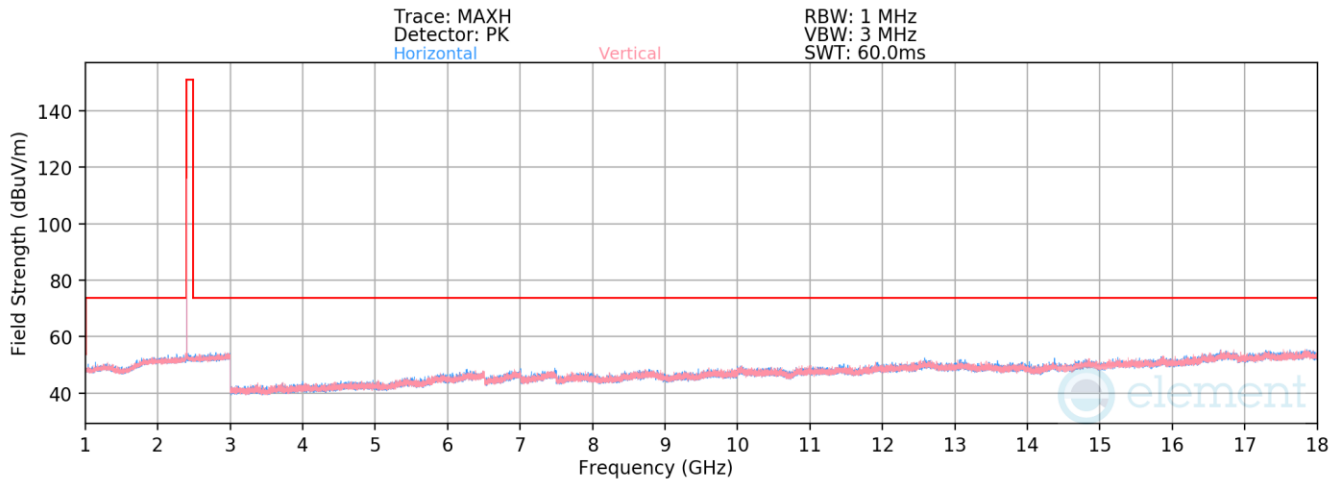
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Radiated Spurious Emission Measurements (1 – 18GHz)

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

Ant1



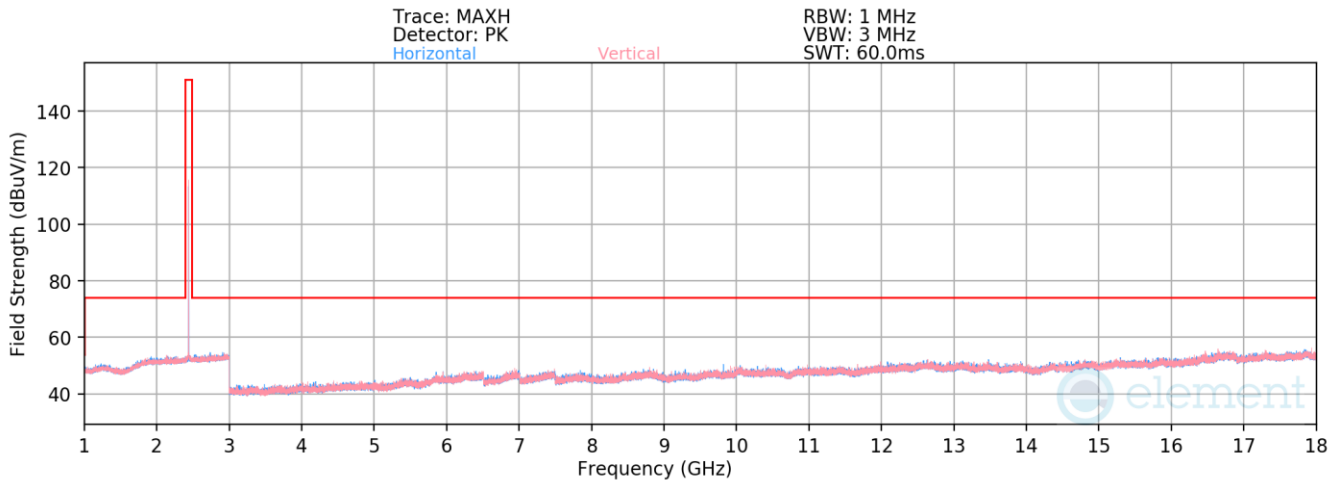
Plot 7-85. Radiated Spurious Emissions above 1GHz Ant1 (BT GFSK ePA – Ch.0)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz

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	Peak	V	160	194	-66.78	4.00	44.22	73.98	-29.76
12010.00	Peak	-	-	-	-68.88	12.75	50.87	73.98	-23.11

Table 7-17. Radiated Measurements Ant1

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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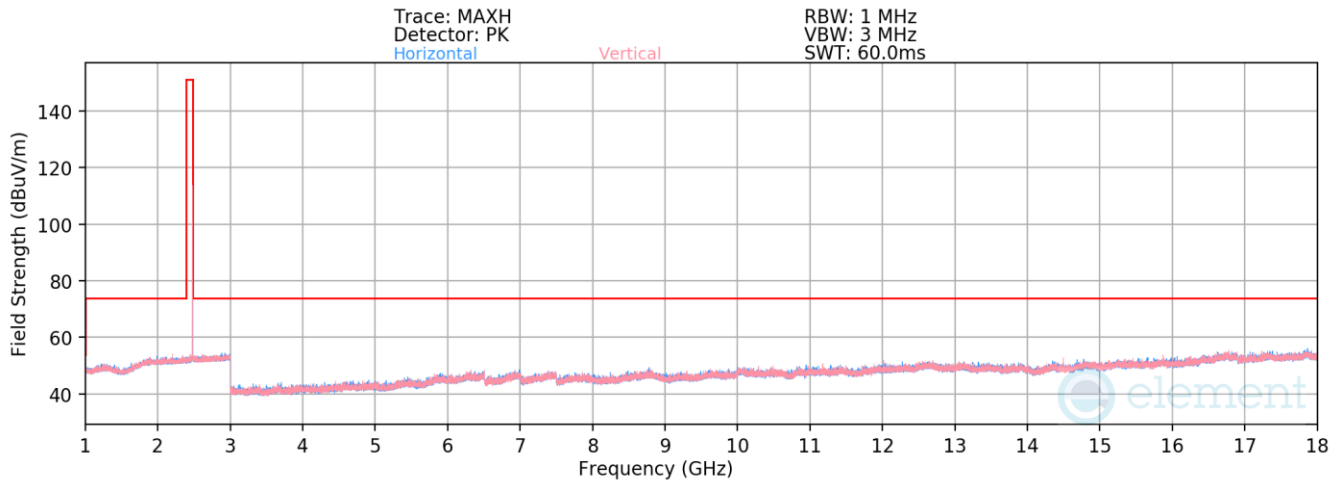
Plot 7-86. Radiated Spurious Emissions above 1GHz Ant1 (BT GFSK ePA – Ch.39)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
4882.00	Peak	V	235	191	-66.88	4.23	44.35	73.98	-29.63
7323.00	Peak	V	282	157	-67.91	8.72	47.81	73.98	-26.17
12205.00	Peak	V	-	-	-70.51	13.63	50.12	73.98	-23.86

Table 7-18. Radiated Measurements Ant1

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-87. Radiated Spurious Emissions above 1GHz Ant1 (BT GFSK ePA – Ch.78)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
4960.00	Peak	V	267	162	-66.85	4.42	44.57	73.98	-29.41
7440.00	Peak	V	221	124	-67.74	8.60	47.86	73.98	-26.12
12400.00	Peak	-	-	-	-69.93	13.30	50.37	73.98	-23.61

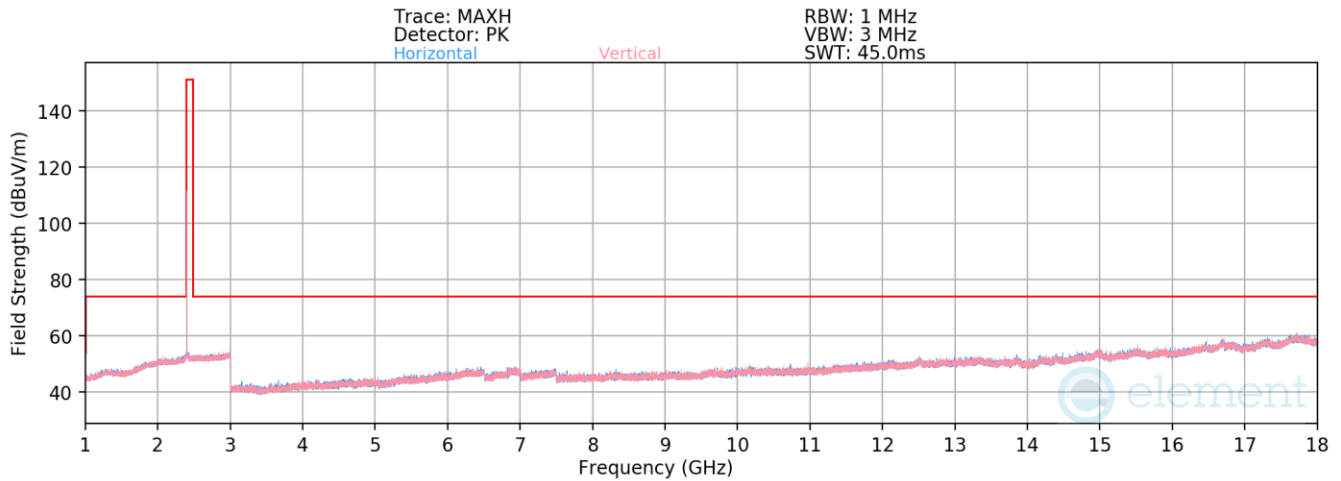
Table 7-19. Radiated Measurements Ant1

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Radiated Spurious Emission Measurements (1 – 18GHz)

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

Ant2



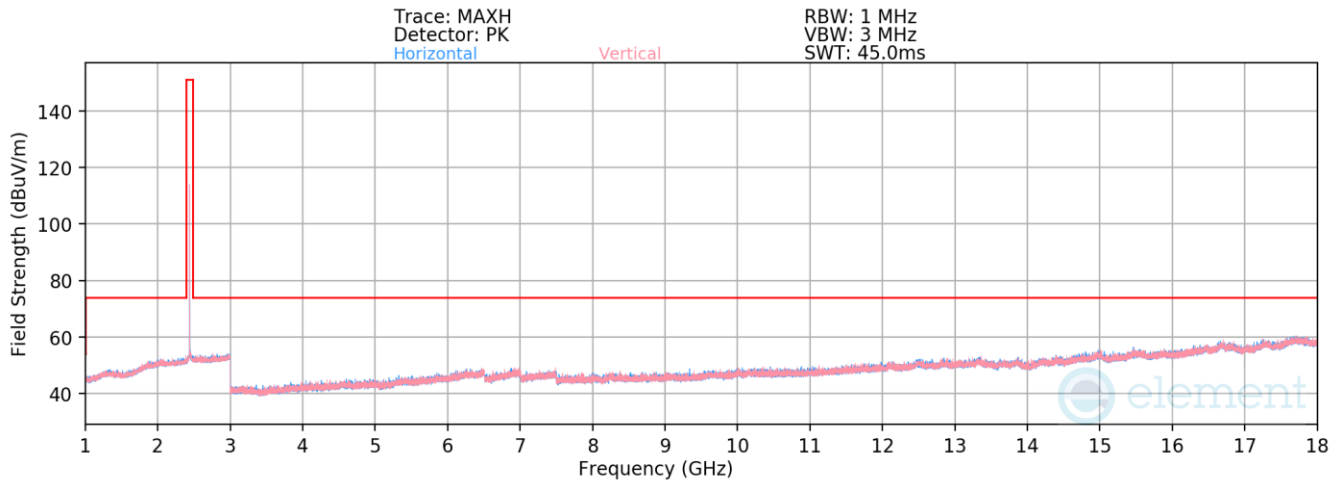
Plot 7-88. Radiated Spurious Emissions above 1GHz Ant2 (BT GFSK ePA – Ch.0)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz

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	Peak	H	264	200	-68.72	5.88	44.16	73.98	-29.82
12010.00	Peak	-	-	-	-72.63	14.68	49.05	73.98	-24.92

Table 7-20. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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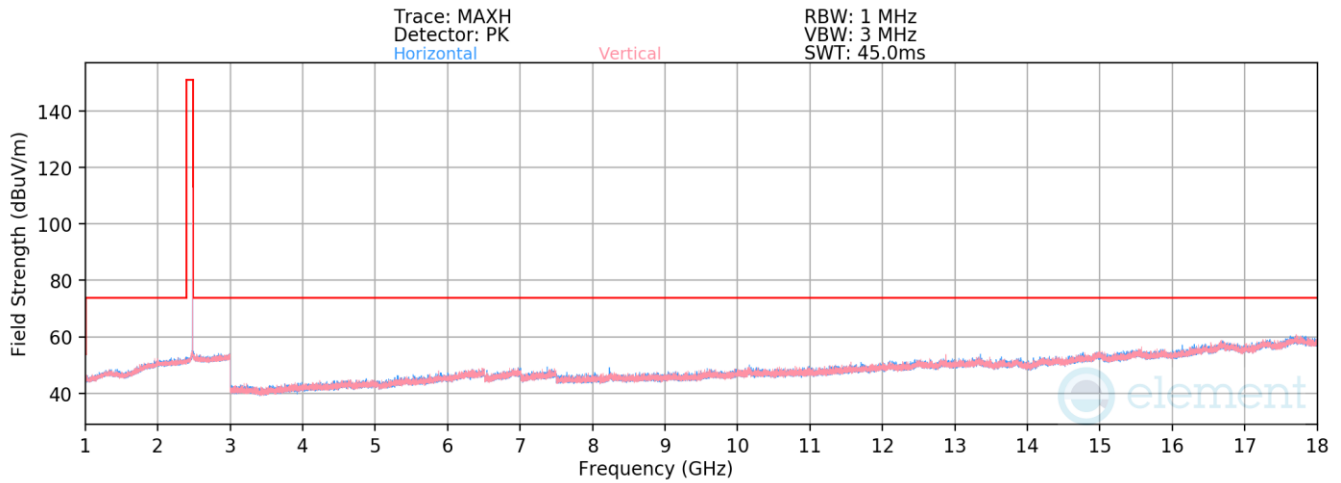
Plot 7-89. Radiated Spurious Emissions above 1GHz Ant2 (BT GFSK ePA – Ch.39)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
4882.00	Peak	-	-	-	-69.19	6.23	44.04	73.98	-29.94
7323.00	Peak	H	305	252	-67.60	9.95	49.35	73.98	-24.63
12205.00	Peak	-	-	-	-73.69	14.84	48.15	73.98	-25.83

Table 7-21. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-90. Radiated Spurious Emissions above 1GHz Ant2 (BT GFSK ePA – Ch.78)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz

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	Peak	-	-	-	-69.17	6.45	44.28	73.98	-29.70
7440.00	Peak	H	195	200	-68.12	9.93	48.81	73.98	-25.17
12400.00	Peak	-	-	-	-73.50	15.14	48.64	73.98	-25.34

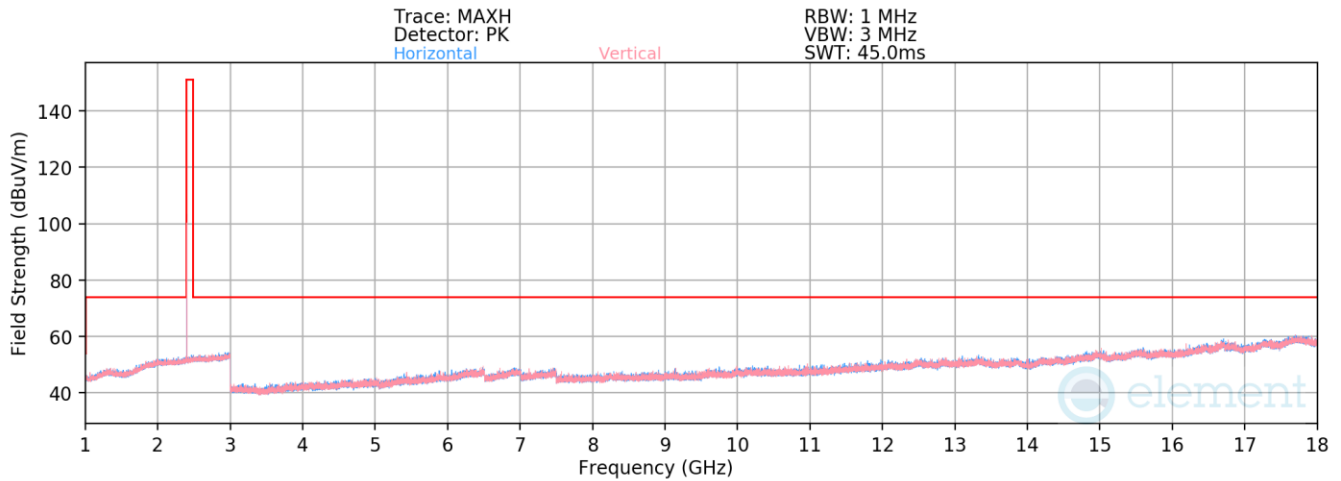
Table 7-22. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Radiated Spurious Emission Measurements (1 – 18GHz)

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

NB UNII_L



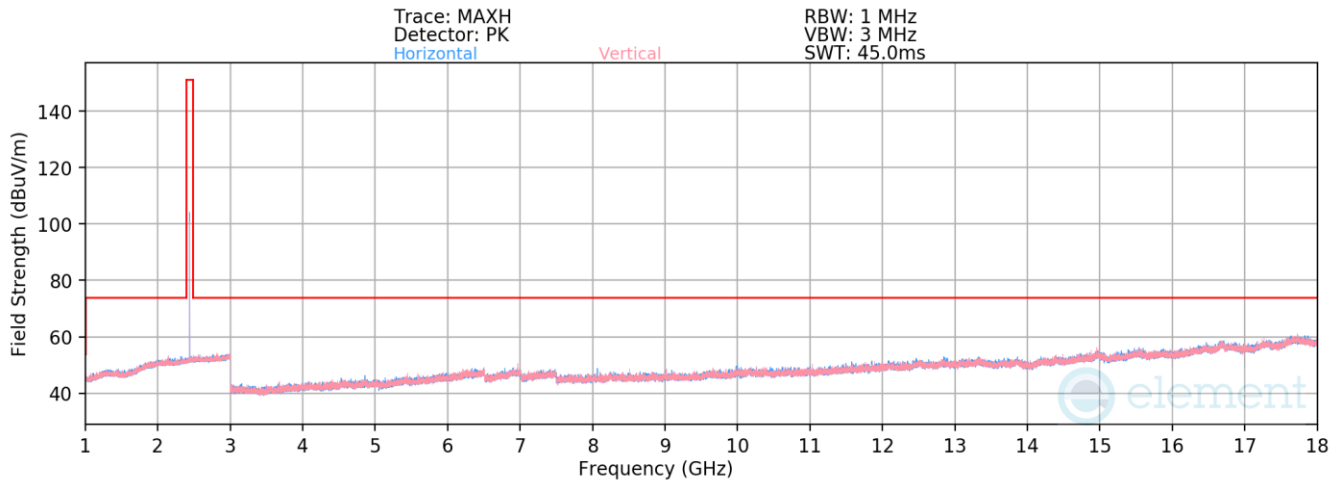
Plot 7-91. Radiated Spurious Emissions above 1GHz NB UNII_L (BT GFSK iPA – Ch.0)

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

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	Peak	H	-	-	-68.48	5.88	44.40	73.98	-29.58
12010.00	Peak	H	-	-	-72.80	14.68	48.88	73.98	-25.09

Table 7-23. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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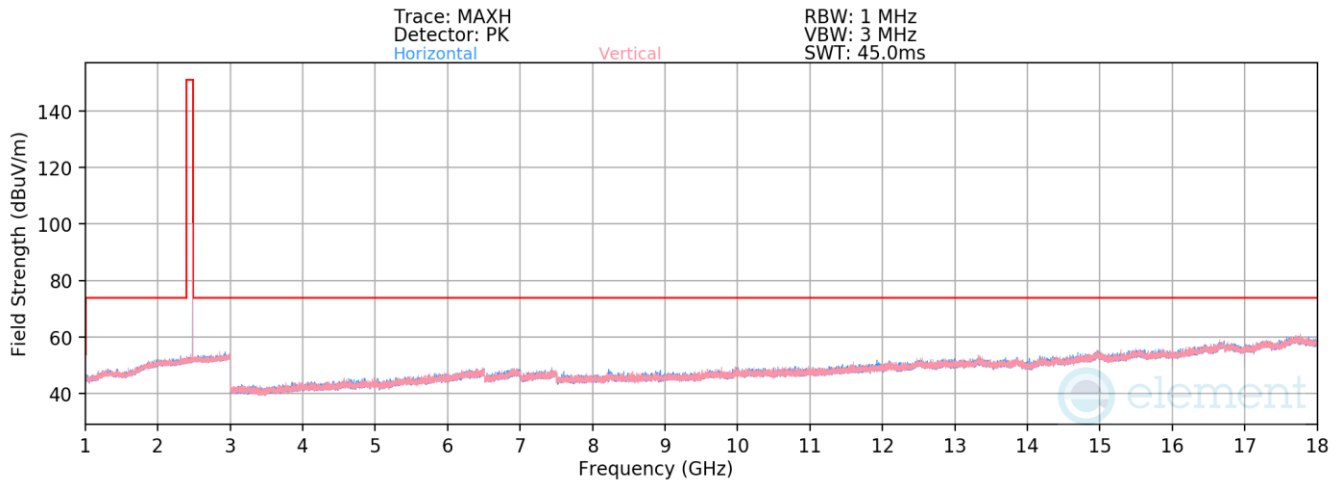
Plot 7-92. Radiated Spurious Emissions above 1GHz NB UNII_L (BT GFSK iPA – Ch.39)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme iPA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2441MHz

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]
4882.00	Peak	H	-	-	-68.47	6.23	44.76	73.98	-29.22
7323.00	Peak	H	-	-	-69.04	9.95	47.91	73.98	-26.07
12205.00	Peak	H	-	-	-73.48	14.84	48.36	73.98	-25.62

Table 7-24. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 86 of 108



Plot 7-93. Radiated Spurious Emissions above 1GHz NB UNII_L (BT GFSK iPA – Ch.78)

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

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	Peak	H	-	-	-69.64	6.45	43.81	73.98	-30.17
7440.00	Peak	H	-	-	-69.62	9.93	47.31	73.98	-26.67
12400.00	Peak	H	-	-	-74.29	15.14	47.85	73.98	-26.13

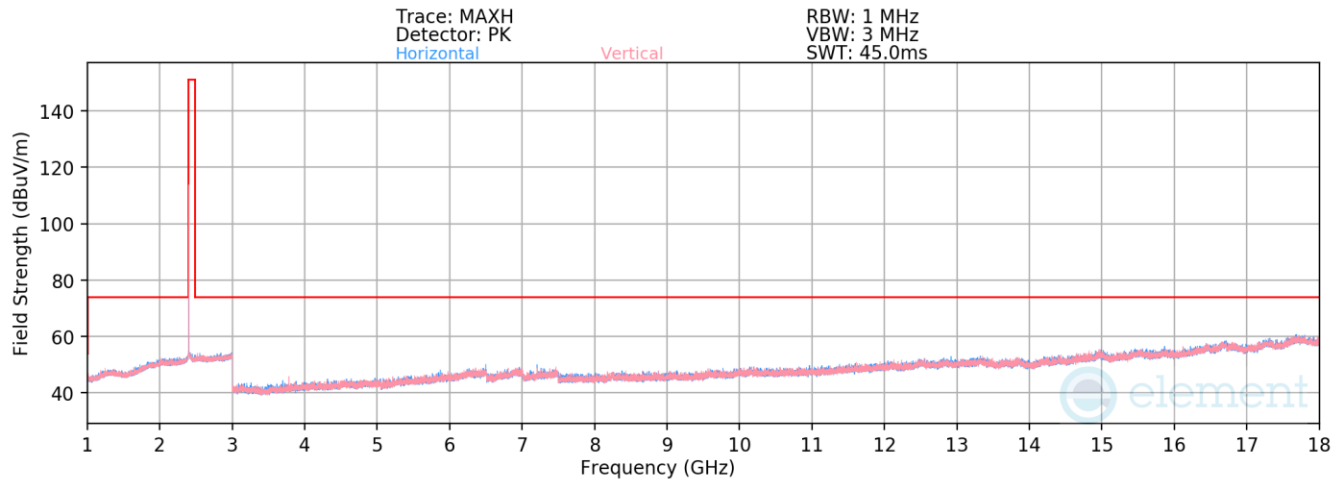
Table 7-25. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 87 of 108

Radiated Spurious Emission Measurements (1 – 18GHz)

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

TxBF



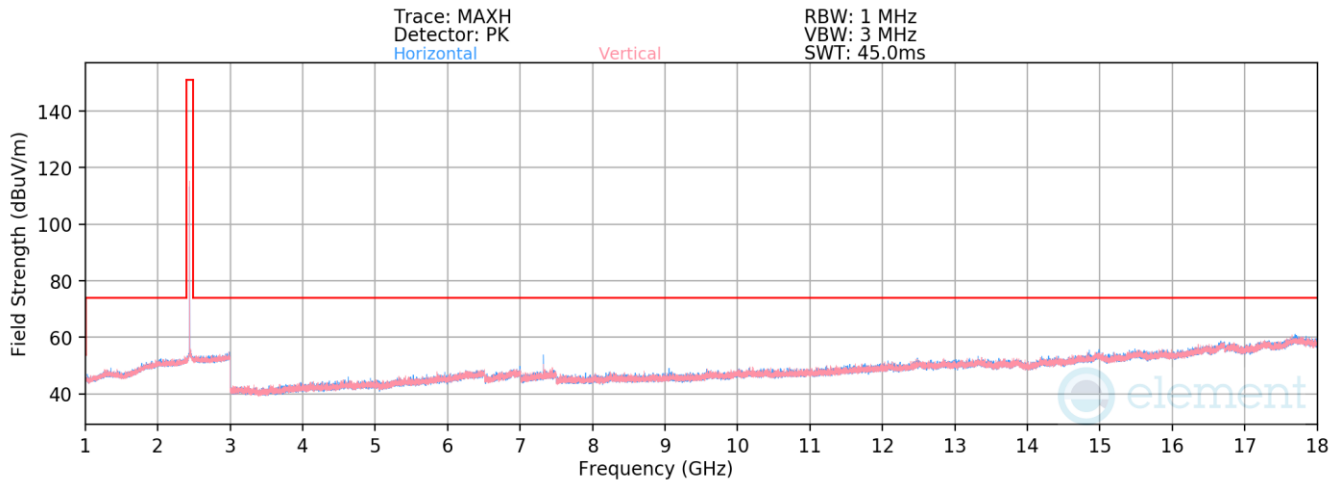
Plot 7-94. Radiated Spurious Emissions above 1GHz TxBF (BT GFSK ePA – Ch.0)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz

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	Peak	H	-	-	-68.83	5.88	44.05	73.98	-29.93
12010.00	Peak	H	-	-	-72.72	14.68	48.96	73.98	-25.01

Table 7-26. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 88 of 108



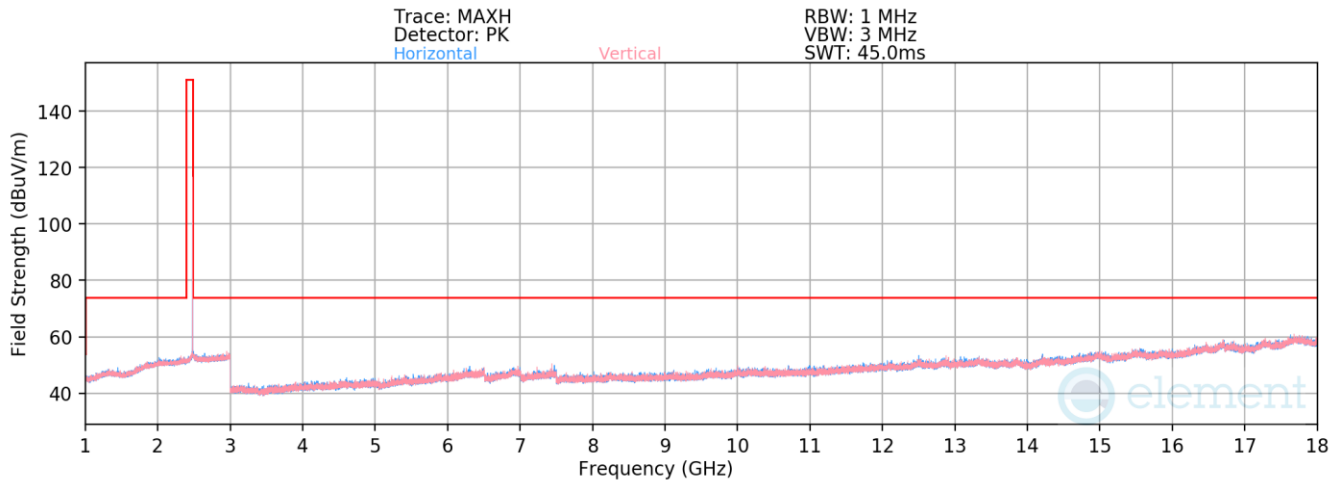
Plot 7-95. Radiated Spurious Emissions above 1GHz TxBF (BT GFSK ePA – Ch.39)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2441MHz

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]
4882.00	Peak	H	152	252	-68.69	6.23	44.54	73.98	-29.44
7323.00	Peak	H	278	253	-62.23	9.95	54.72	73.98	-19.26
12205.00	Peak	H	-	-	-73.43	14.84	48.41	73.98	-25.57

Table 7-27. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 89 of 108



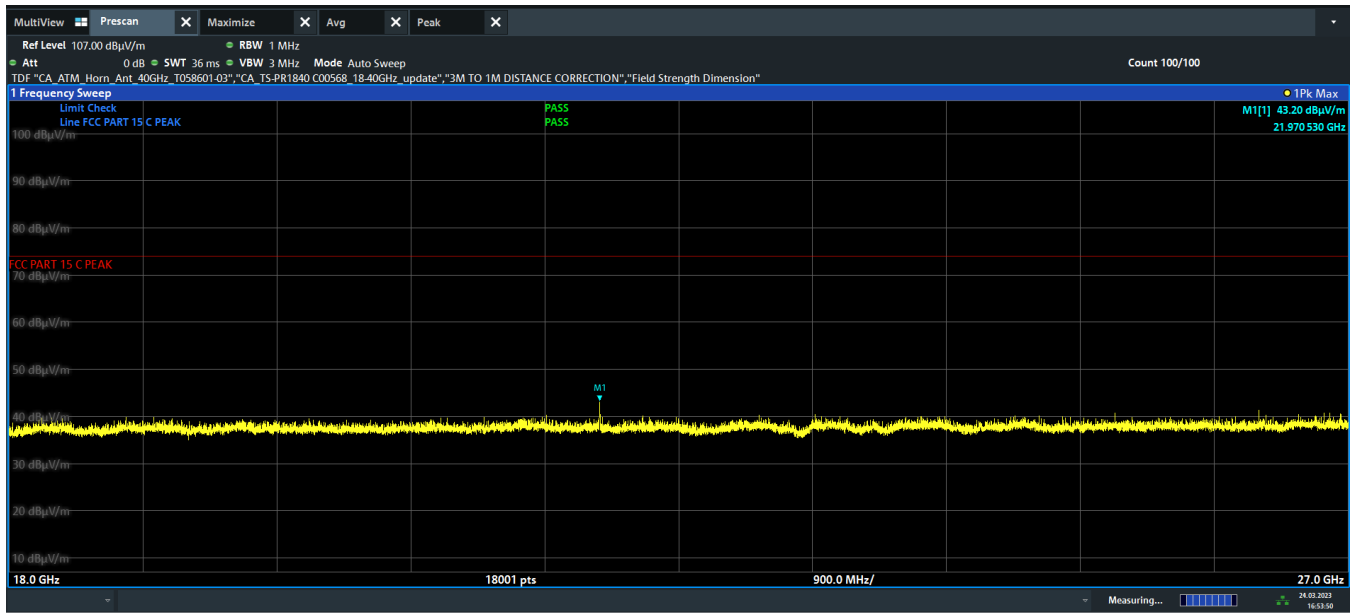
Plot 7-96. Radiated Spurious Emissions above 1GHz TxBF (BT GFSK ePA – Ch.78)

Bluetooth Mode: GFSK
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz

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	Peak	H	215	214	-68.78	6.45	44.67	73.98	-29.31
7440.00	Peak	H	305	248	-64.08	9.93	52.85	73.98	-21.13
12400.00	Peak	H	368	74	-74.56	15.14	47.58	73.98	-26.40

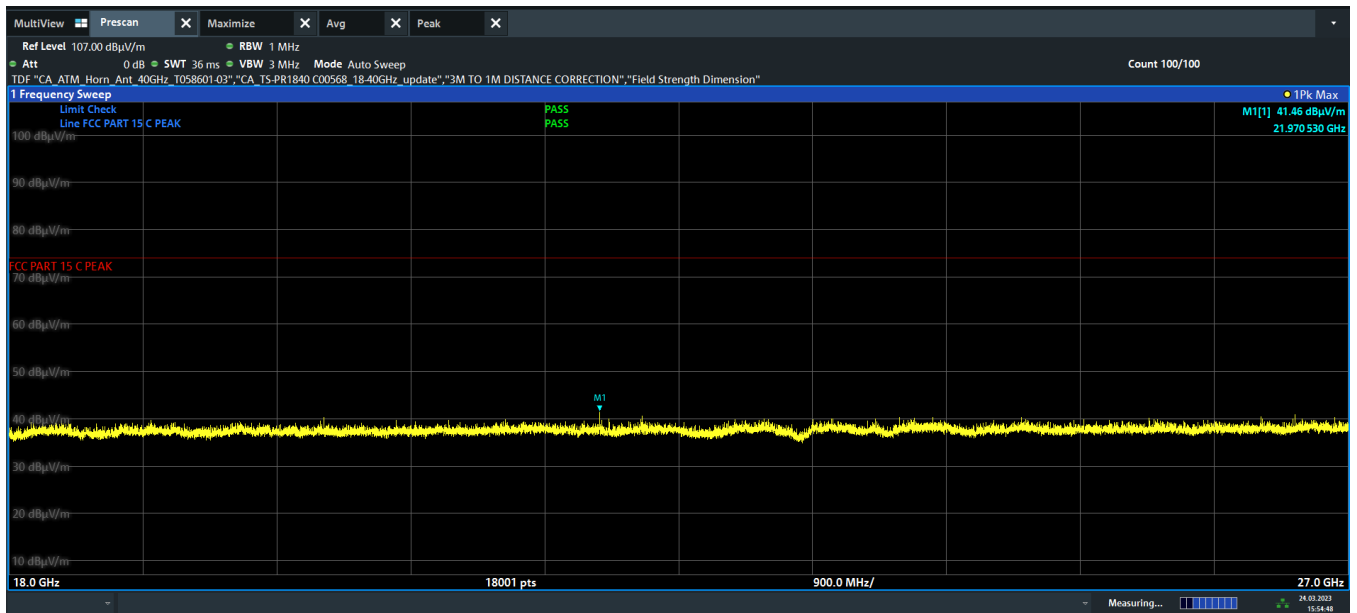
Table 7-28. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 90 of 108



16:53:50 24.03.2023

Plot 7-97. Radiated Spurious Emissions above 18GHz TxBF (BT GFSK ePA – Ch.39, Pol H)



15:54:49 24.03.2023

Plot 7-98. Radiated Spurious Emissions above 18GHz TxBF (BT GFSK ePA – Ch.39, Pol V)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 91 of 108

V 10.5 12/15/2021

7.9.1 Radiated Restricted Band Edge Measurements

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

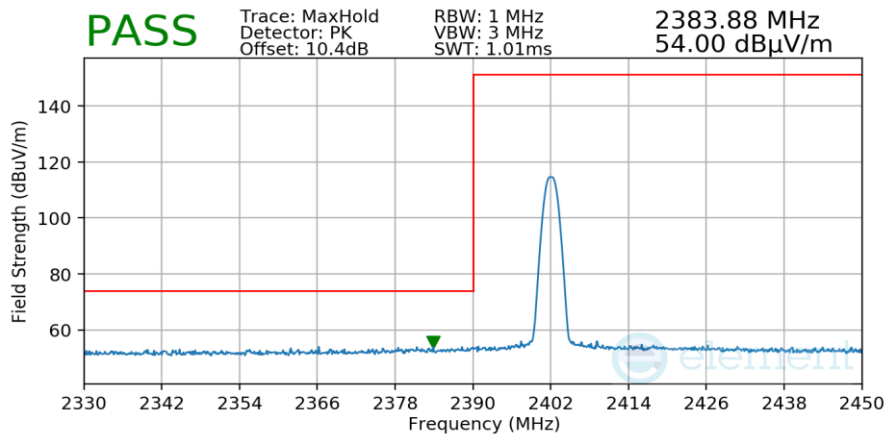
Ant1

Bluetooth Mode: GFSK

Power Scheme: ePA

Measurement Distance: 3 Meters

Operating Frequency: 2402MHz



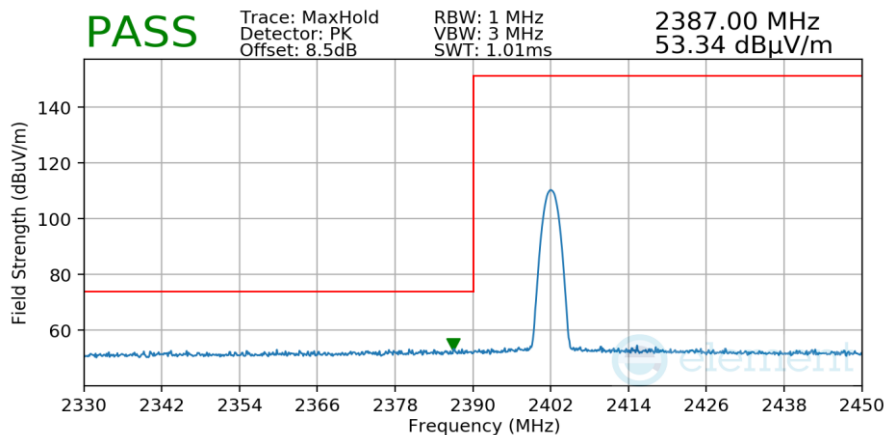
Plot 7-99. Radiated Restricted Lower Band Edge Measurement Ant1

Bluetooth Mode: 8DPSK

Power Scheme: ePA

Measurement Distance: 3 Meters

Operating Frequency: 2402MHz

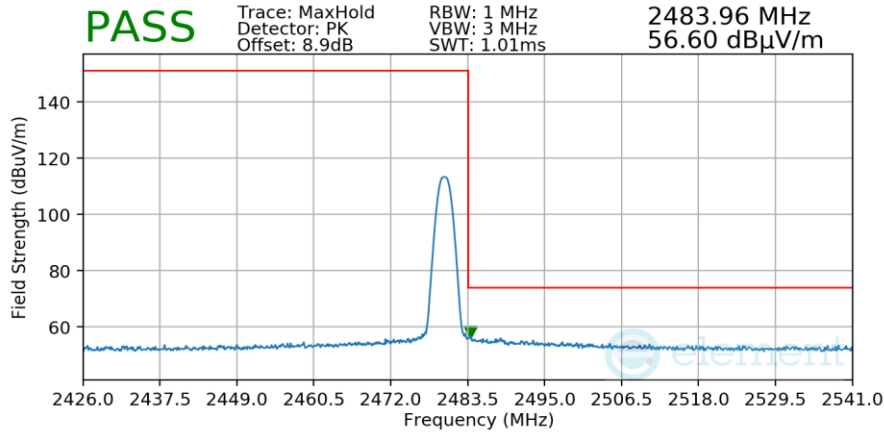


Plot 7-100. Radiated Restricted Lower Band Edge Measurement Ant1

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 92 of 108

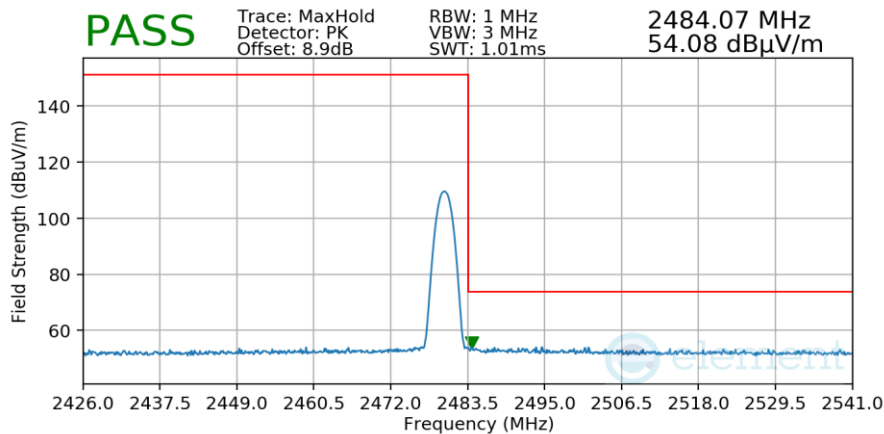
Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Bluetooth Mode: GFSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



Plot 7-101. Radiated Restricted Upper Band Edge Measurement Ant1

Bluetooth Mode: 8DPSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



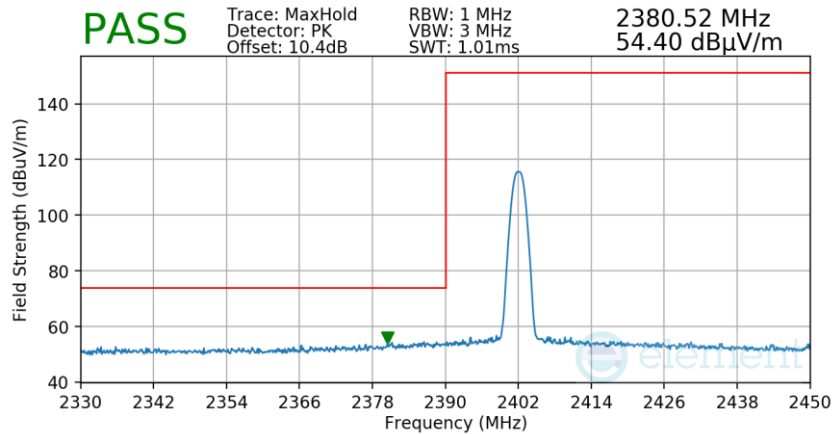
Plot 7-102. Radiated Restricted Upper Band Edge Measurement Ant1

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 93 of 108

Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

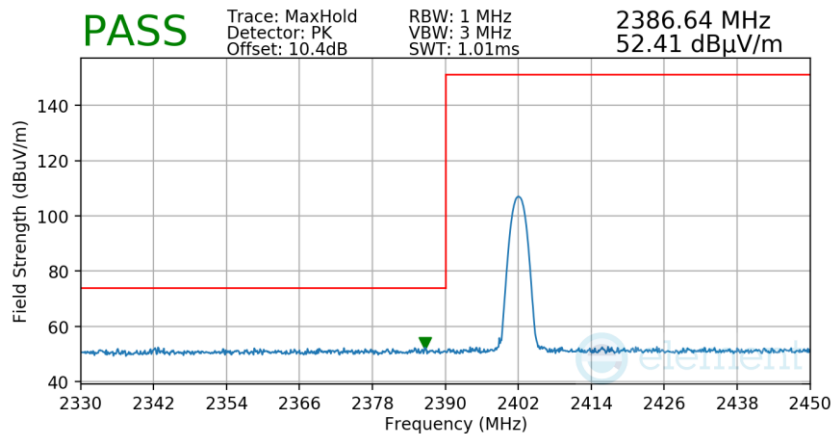
Ant2

Bluetooth Mode: GFSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz



Plot 7-103. Radiated Restricted Lower Band Edge Measurement Ant2

Bluetooth Mode: 8DPSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz

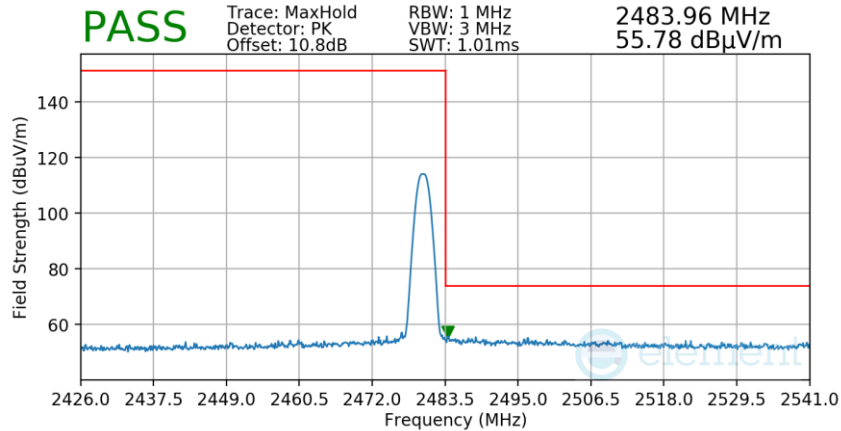


Plot 7-104. Radiated Restricted Lower Band Edge Measurement Ant2

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 94 of 108

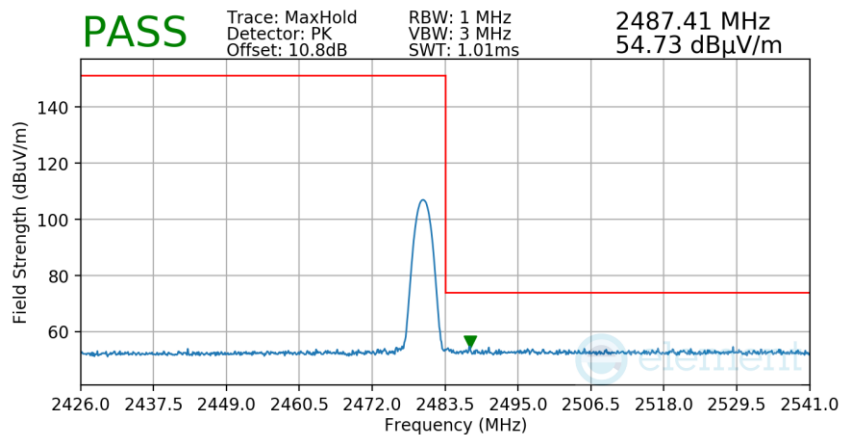
Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Bluetooth Mode: GFSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



Plot 7-105. Radiated Restricted Upper Band Edge Measurement Ant2

Bluetooth Mode: 8DPSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



Plot 7-106. Radiated Restricted Upper Band Edge Measurement Ant2

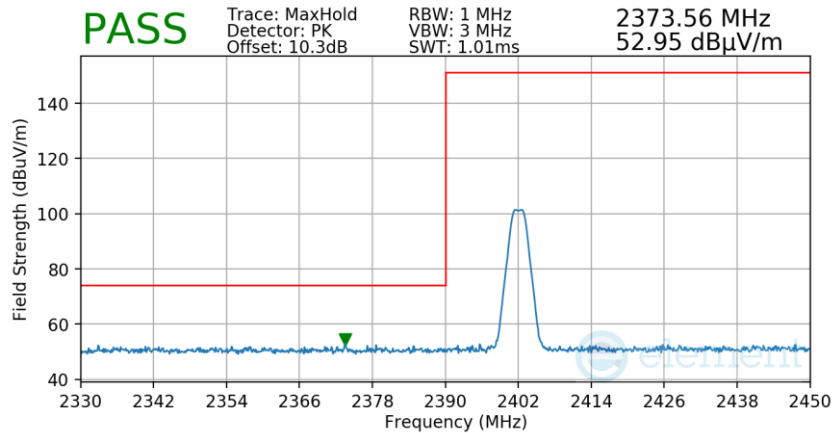
FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 95 of 108



Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

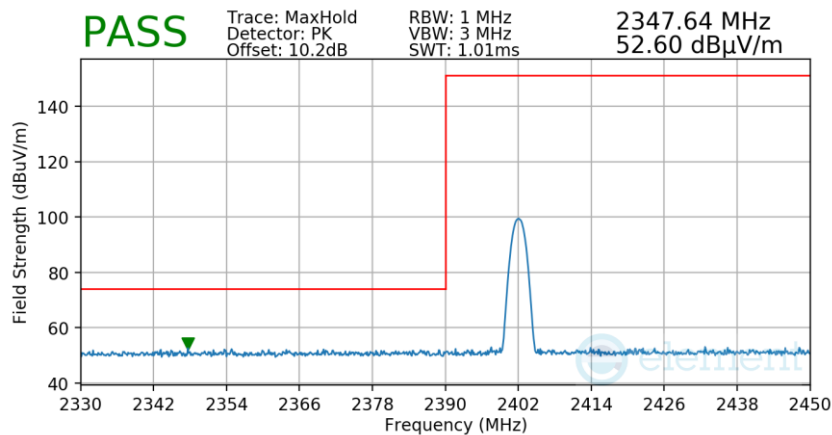
NB UNII_L

Bluetooth Mode: GFSK
 Power Scheme: iPA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz



Plot 7-107. Radiated Restricted Lower Band Edge Measurement NB UNII_L

Bluetooth Mode: 8DPSK
 Power Scheme: iPA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz



Plot 7-108. Radiated Restricted Lower Band Edge Measurement NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 96 of 108

Radiated Restricted Band Edge Measurements

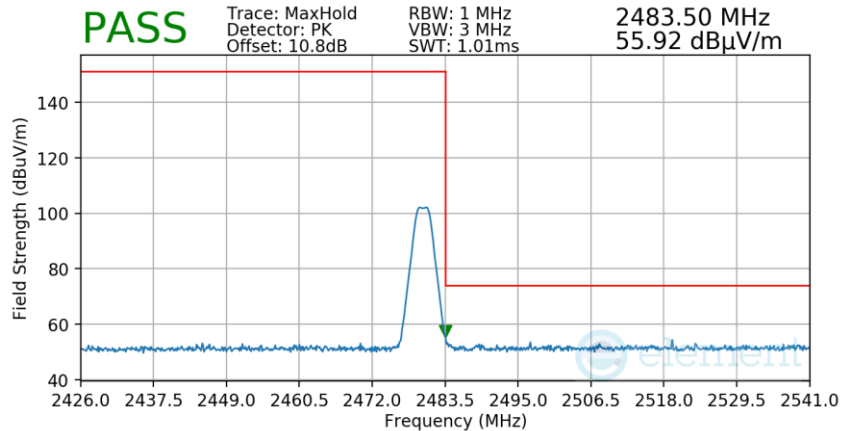
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Bluetooth Mode: GFSK

Power Scheme: iPA

Measurement Distance: 3 Meters

Operating Frequency: 2480MHz



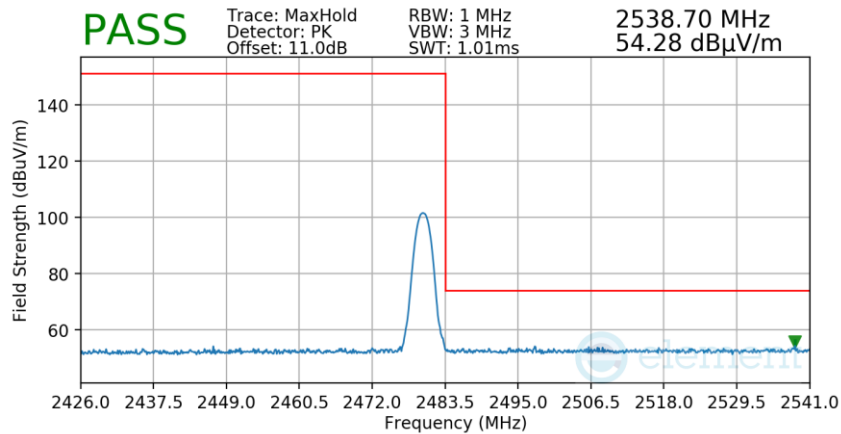
Plot 7-109. Radiated Restricted Upper Band Edge Measurement NB UNII_L

Bluetooth Mode: 8DPSK

Power Scheme: iPA

Measurement Distance: 3 Meters

Operating Frequency: 2480MHz



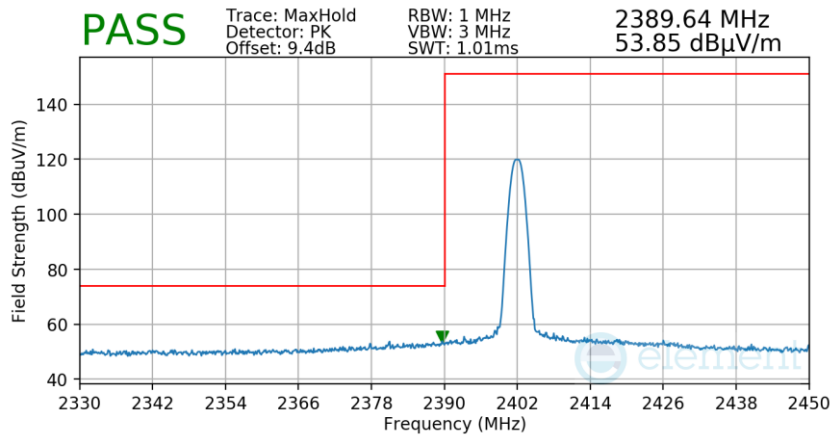
Plot 7-110. Radiated Restricted Upper Band Edge Measurement NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 97 of 108

Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

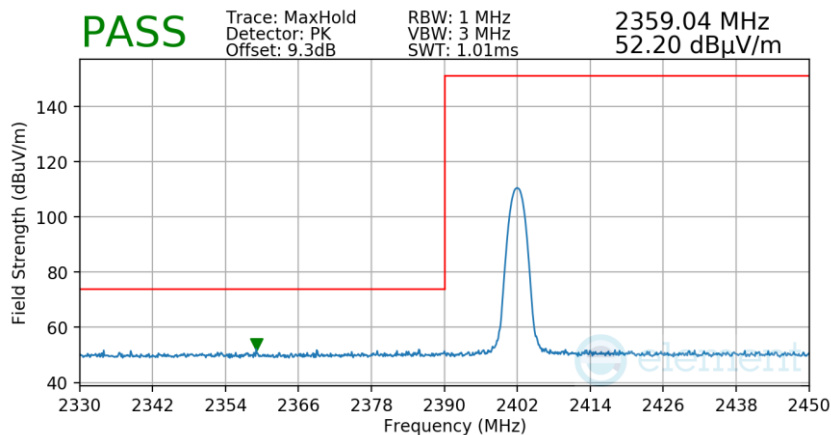
TxBF

Bluetooth Mode: GFSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz



Plot 7-111. Radiated Restricted Lower Band Edge Measurement TxBF

Bluetooth Mode: 8DPSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2402MHz

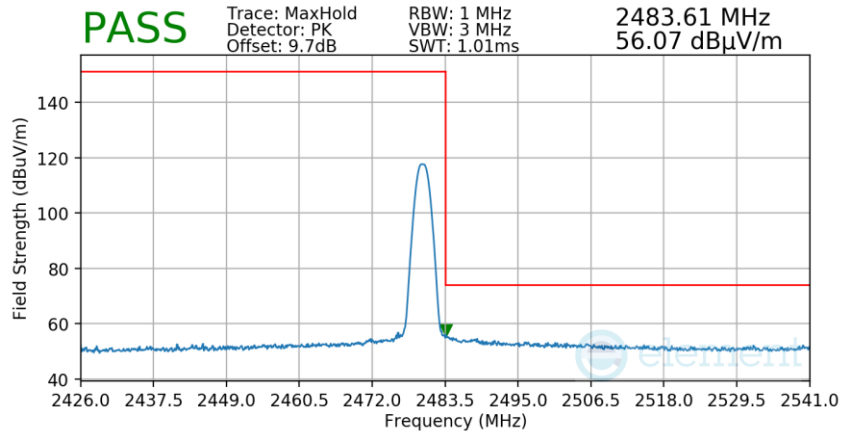


Plot 7-112. Radiated Restricted Lower Band Edge Measurement TxBF

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 98 of 108

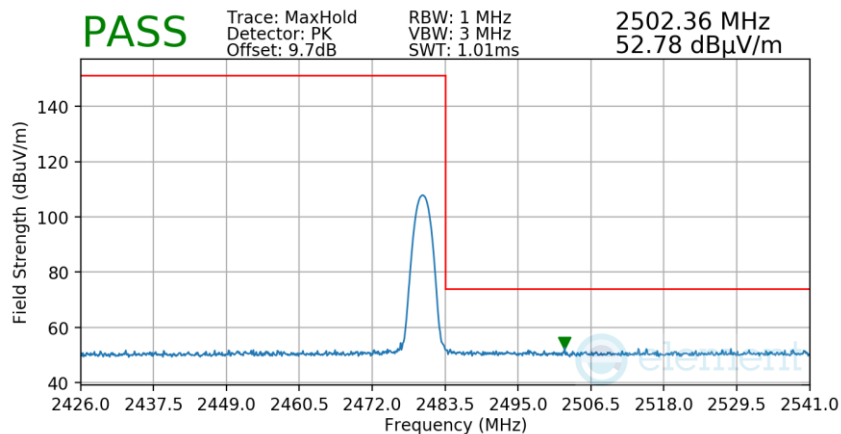
Radiated Restricted Band Edge Measurements
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Bluetooth Mode: GFSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



Plot 7-113. Radiated Restricted Upper Band Edge Measurement TxBF

Bluetooth Mode: 8DPSK
 Power Scheme: ePA
 Measurement Distance: 3 Meters
 Operating Frequency: 2480MHz



Plot 7-114. Radiated Restricted Upper Band Edge Measurement TxBF

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-01.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 99 of 108

7.10 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 7-29 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μ V/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 7-29. 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

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Setup

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

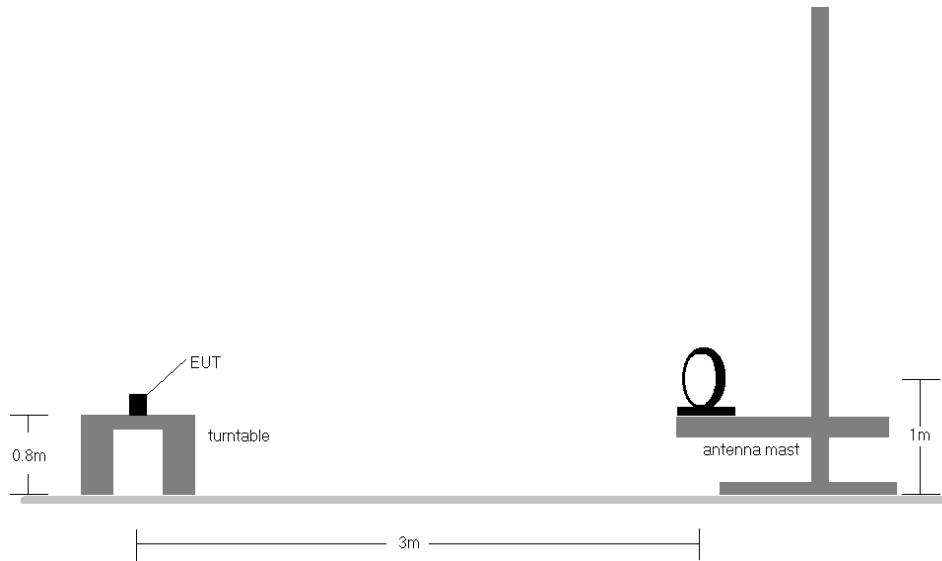


Figure 7-9. Radiated Test Setup < 30MHz

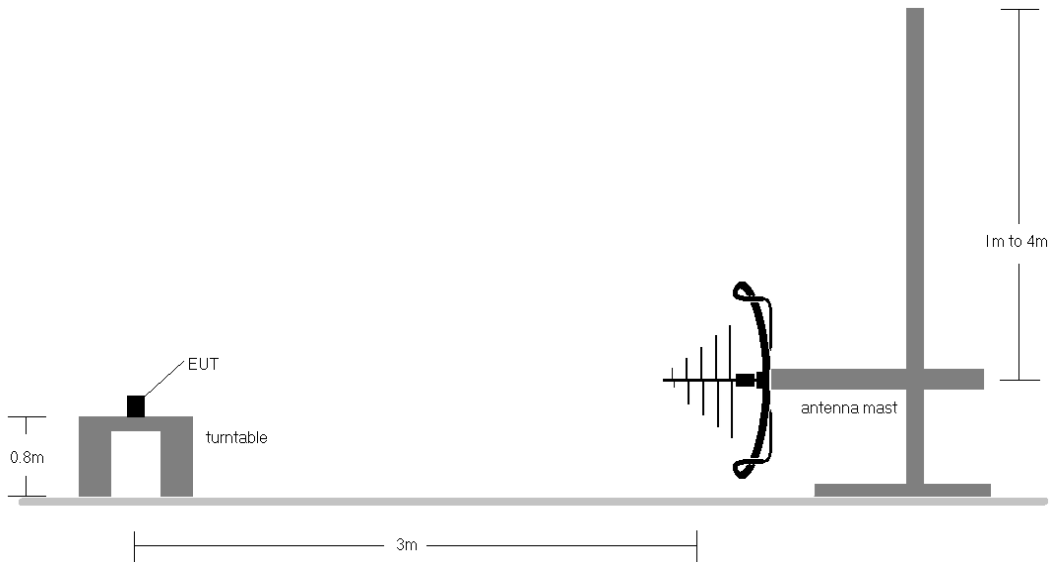


Figure 7-10. Radiated Test Setup < 1GHz

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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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 7-29.
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 to USB-C Power Pack to Magnetic Charging Cable
 - b. EUT powered by host PC via USB-C Power Pack to Magnetic Charging Cable

Sample Calculations

Determining Spurious Emissions Levels

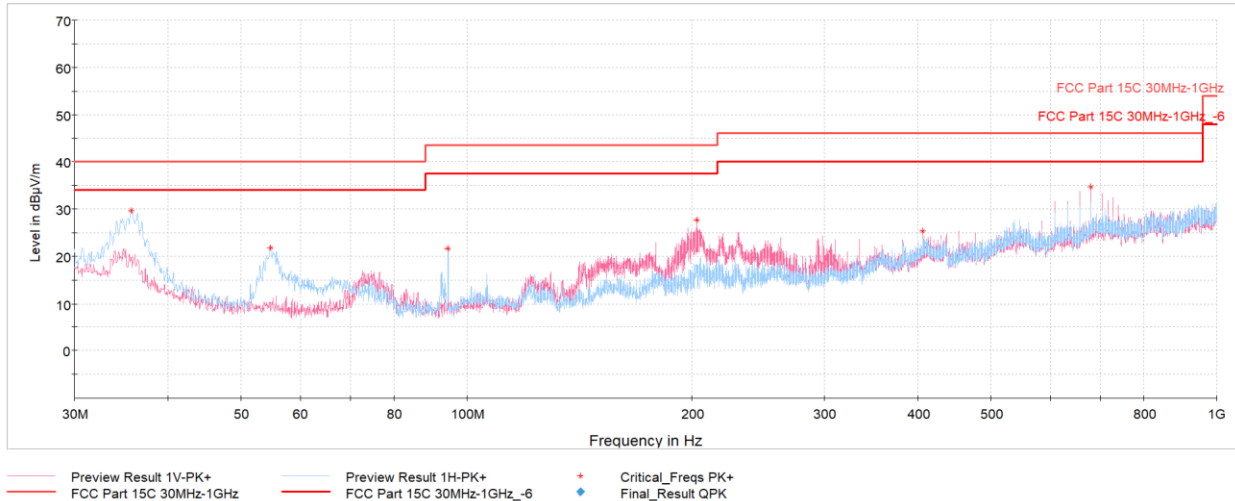
- Field Strength Level $_{[dB_{\mu V/m}]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$ – Preamplifier Gain $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB_{\mu V/m}]}$ – Limit $_{[dB_{\mu V/m}]}$

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Radiated Spurious Emissions Measurements (Below 1GHz) §15.209; RSS-Gen [8.9]

TxBF



Plot 7-115. Radiated Spurious Emissions Below 1GHz TxBF (GFSK ePA – Ch.39, 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]
35.72	Max Peak	H	100	17	-65.56	-11.72	29.72	40.00	-10.28
54.83	Max Peak	H	100	300	-67.07	-18.18	21.75	40.00	-18.25
94.46	Max Peak	H	200	243	-68.26	-17.08	21.66	43.52	-21.86
202.85	Max Peak	V	100	288	-66.66	-12.74	27.60	43.52	-15.92
405.63	Max Peak	V	100	151	-76.22	-5.52	25.26	46.02	-20.76
680.14	Max Peak	V	100	281	-73.13	0.87	34.74	46.02	-11.28

Table 7-30. Radiated Spurious Emissions Below 1GHz TxBF (GFSK ePA – Ch.39, with AC/DC Adapter)

FCC ID: BCGA2117 IC: 579C-A2117	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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7.11 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 (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-31. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

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

Average Measurements

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

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Test Setup

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

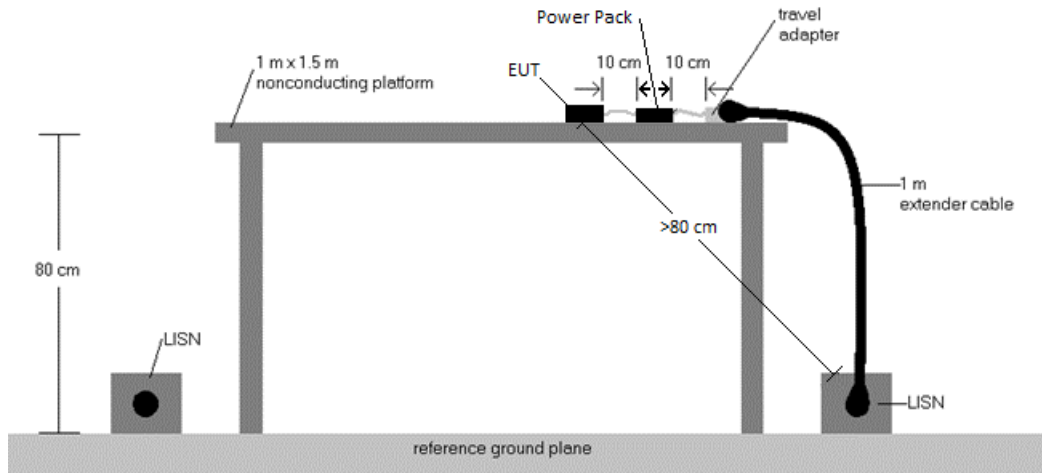


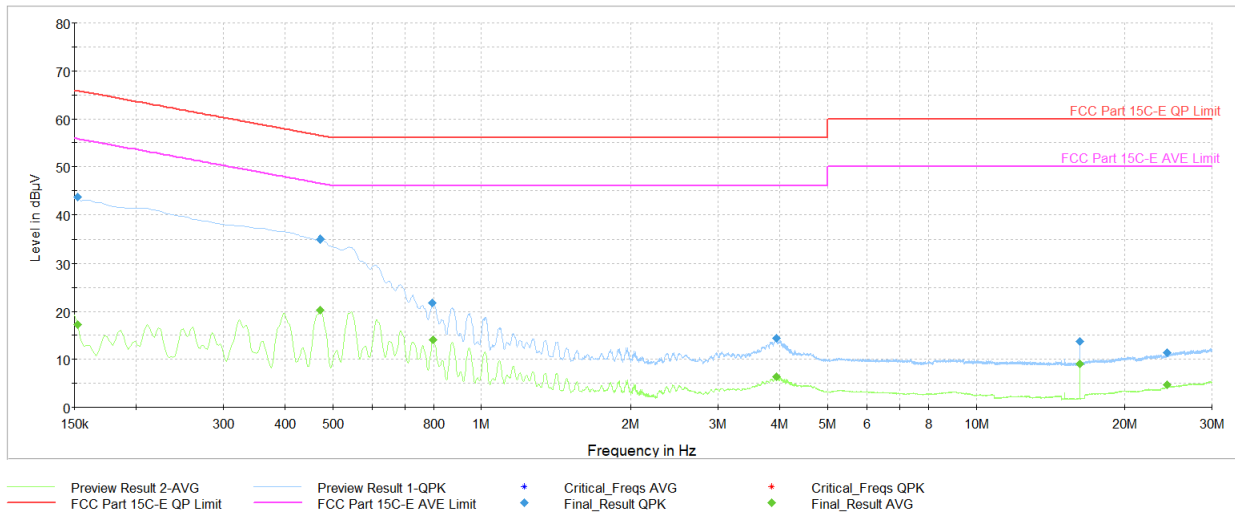
Figure 7-11. Test Instrument & Measurement Setup

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 Power Pack to Magnetic Charging Cable
 - b. EUT powered by host PC via USB-C Power Pack to Magnetic Charging Cable
3. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen (8.8).
4. $\text{Corr. (dB)} = \text{Cable loss (dB)} + \text{LISN insertion factor (dB)}$
5. $\text{QP/AV Level (dB}\mu\text{V)} = \text{QP/AV Analyzer/Receiver Level (dB}\mu\text{V)} + \text{Correction Factor (dB)}$
6. $\text{Margin (dB)} = \text{QP/AV Level (dB}\mu\text{V)} - \text{QP/AV Limit (dB}\mu\text{V)}$
7. Traces shown in plot are made using a quasi peak and average detectors.
8. Deviations to the Specifications: None.

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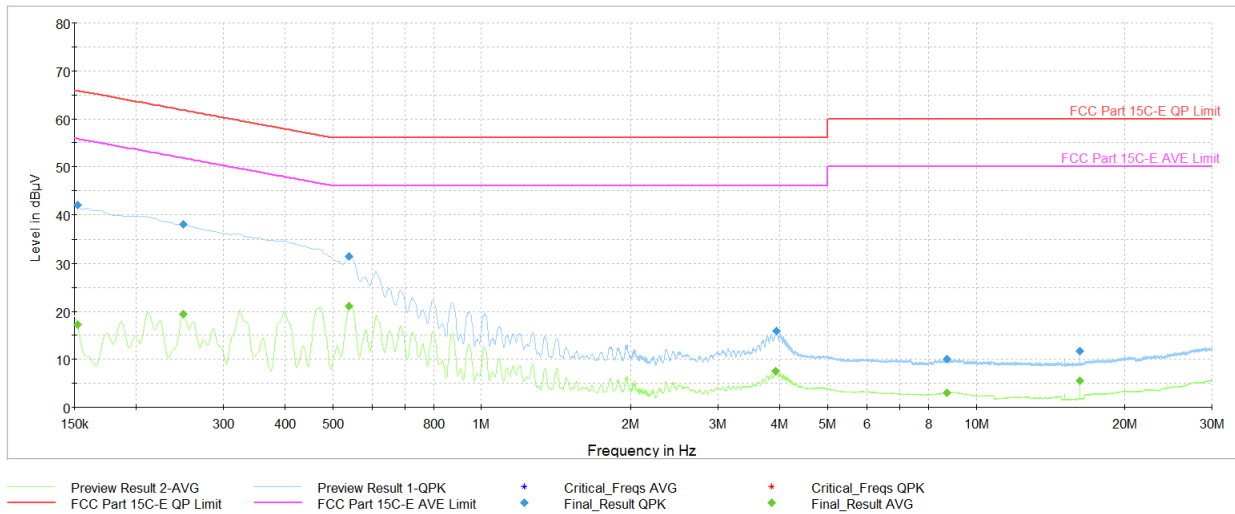


Plot 7-116. AC Line-Conducted Test Plot TxBF (L1, GFSK ePA – Ch.39, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.152	FINAL	—	17.25	55.88	-38.63	L1	GND
0.152	FINAL	43.6	—	65.88	-22.24	L1	GND
0.472	FINAL	—	20.24	46.48	-26.24	L1	GND
0.472	FINAL	35.0	—	56.48	-21.44	L1	GND
0.796	FINAL	21.7	—	56.00	-34.27	L1	GND
0.798	FINAL	—	14.09	46.00	-31.91	L1	GND
3.937	FINAL	—	6.34	46.00	-39.66	L1	GND
3.941	FINAL	14.4	—	56.00	-41.56	L1	GND
16.208	FINAL	13.8	—	60.00	-46.20	L1	GND
16.208	FINAL	—	9.10	50.00	-40.90	L1	GND
24.311	FINAL	—	4.72	50.00	-45.28	L1	GND
24.311	FINAL	11.4	—	60.00	-48.65	L1	GND

Table 7-32. AC Line-Conducted Test Data TxBF (L1, GFSK ePA – Ch.39, with AC/DC Adapter)

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Plot 7-117. AC Line-Conducted Test Plot TxBF (N, GFSK ePA – Ch.39, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.152	FINAL	—	17.27	55.88	-38.61	N	GND
0.152	FINAL	41.9	—	65.88	-23.95	N	GND
0.249	FINAL	—	19.37	51.79	-32.42	N	GND
0.249	FINAL	38.0	—	61.79	-23.76	N	GND
0.539	FINAL	—	21.04	46.00	-24.96	N	GND
0.539	FINAL	31.5	—	56.00	-24.50	N	GND
3.928	FINAL	—	7.48	46.00	-38.52	N	GND
3.944	FINAL	15.9	—	56.00	-40.14	N	GND
8.711	FINAL	10.0	—	60.00	-50.02	N	GND
8.711	FINAL	—	2.94	50.00	-47.06	N	GND
16.211	FINAL	—	5.52	50.00	-44.48	N	GND
16.211	FINAL	11.7	—	60.00	-48.30	N	GND

Table 7-33. AC Line-Conducted Test Data TxBF (N, GFSK ePA – Ch.39, with AC/DC Adapter)

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Head Mounted Device FCC ID: BCGA2117 and IC: 579C-A2117** 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.

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