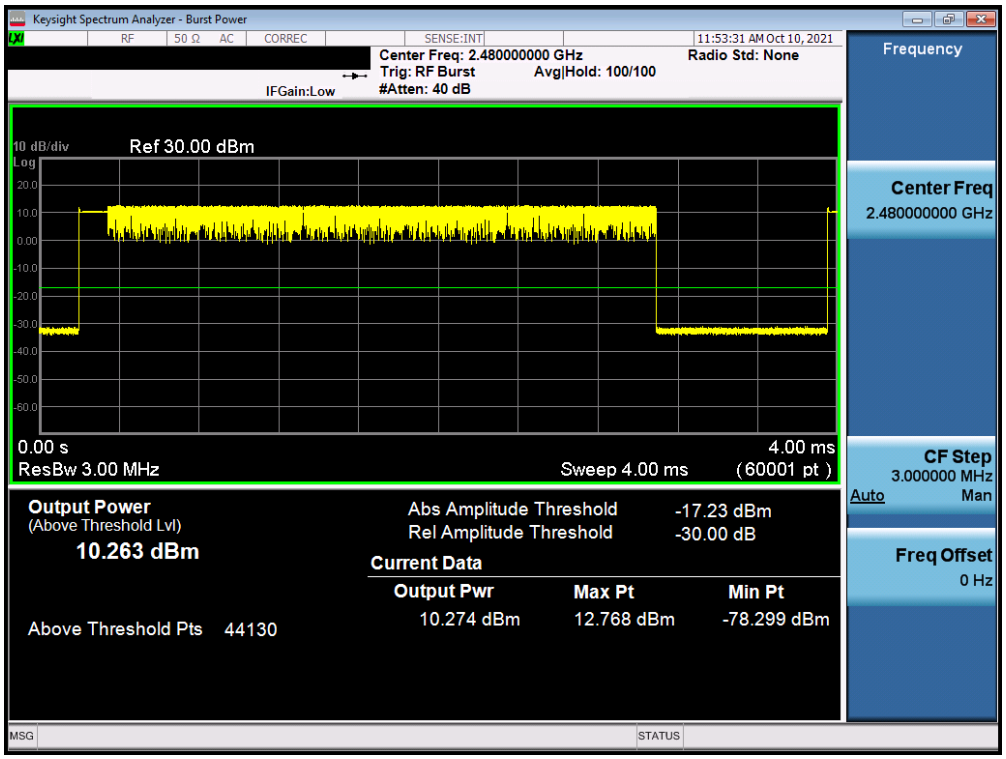
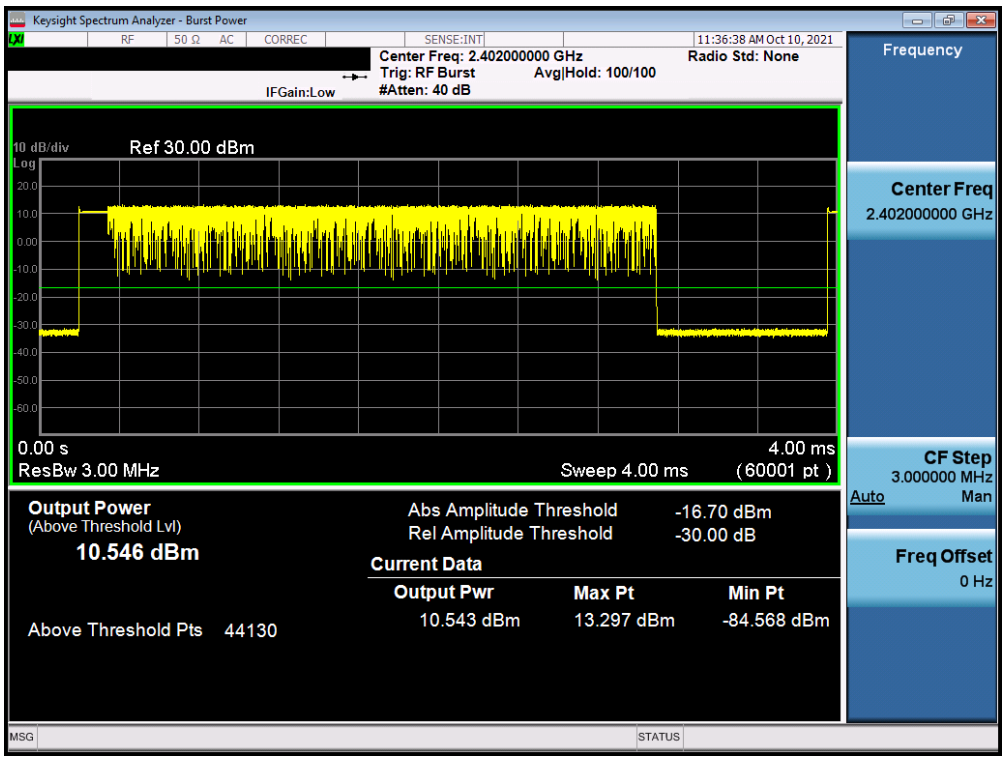
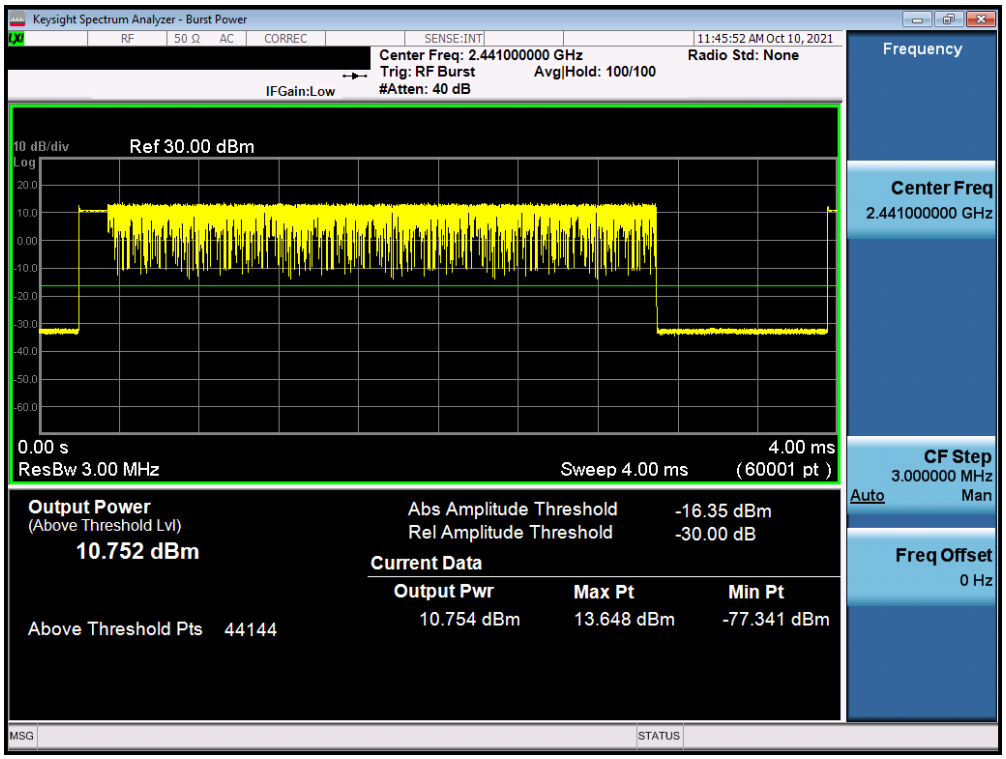


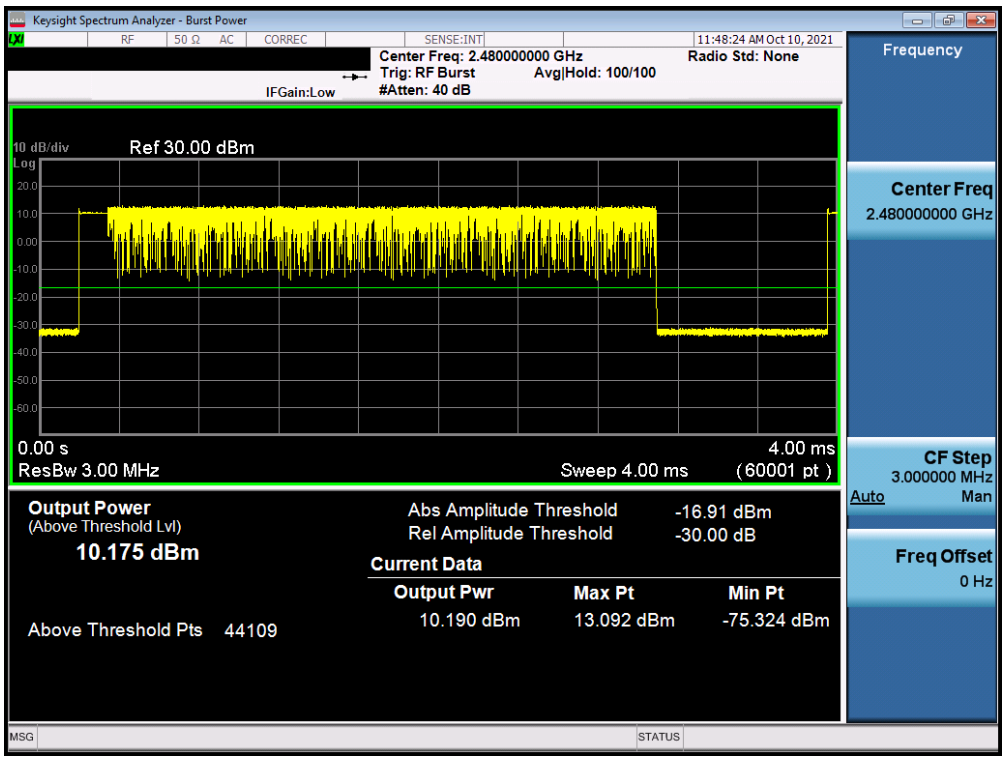
Plot 7-105. Dual Bluetooth Average Conducted Power (2Mbps – Ch. 78) Antenna 1 iPA



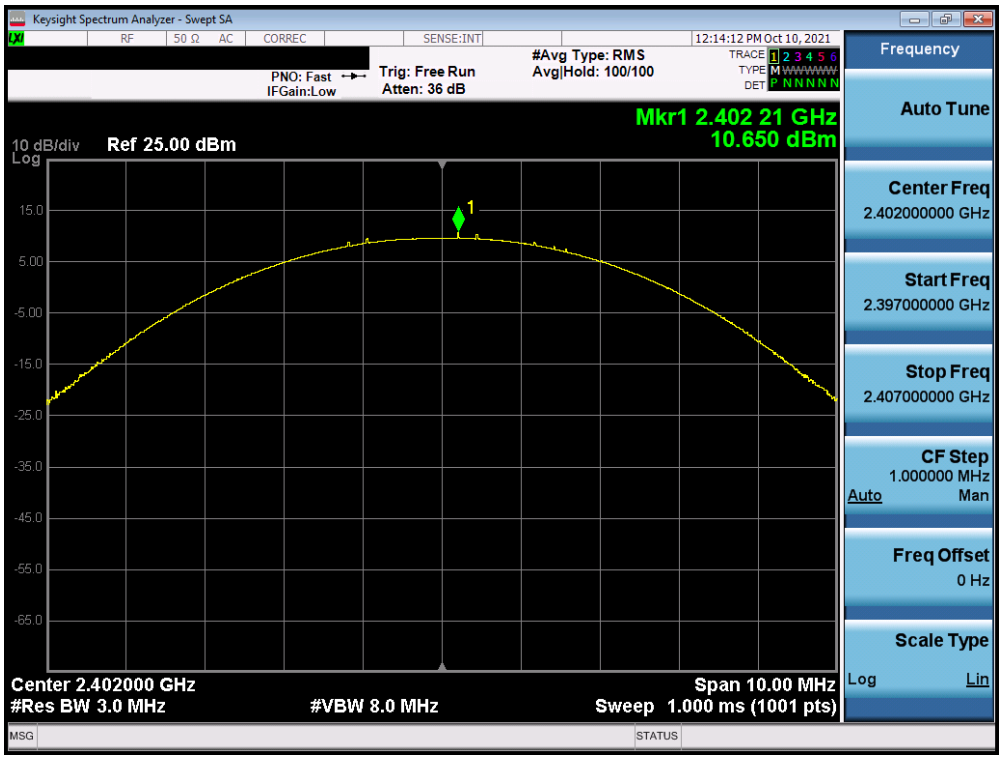
Plot 7-106. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 0) Antenna 1 iPA



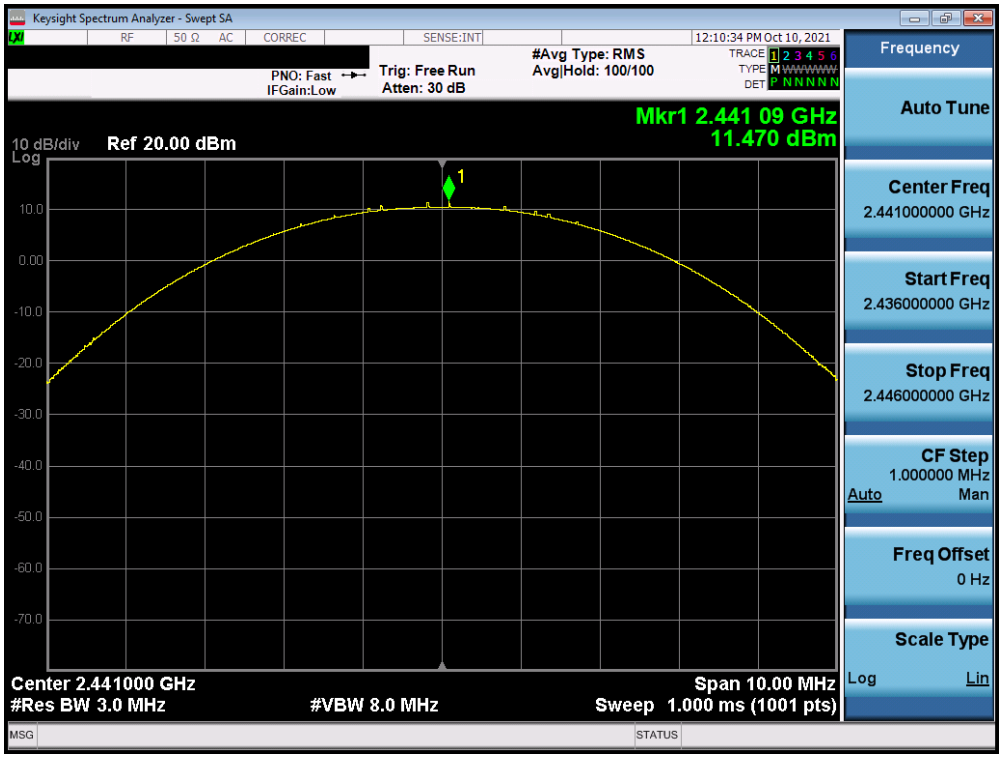
Plot 7-107. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 39) Antenna 1 iPA



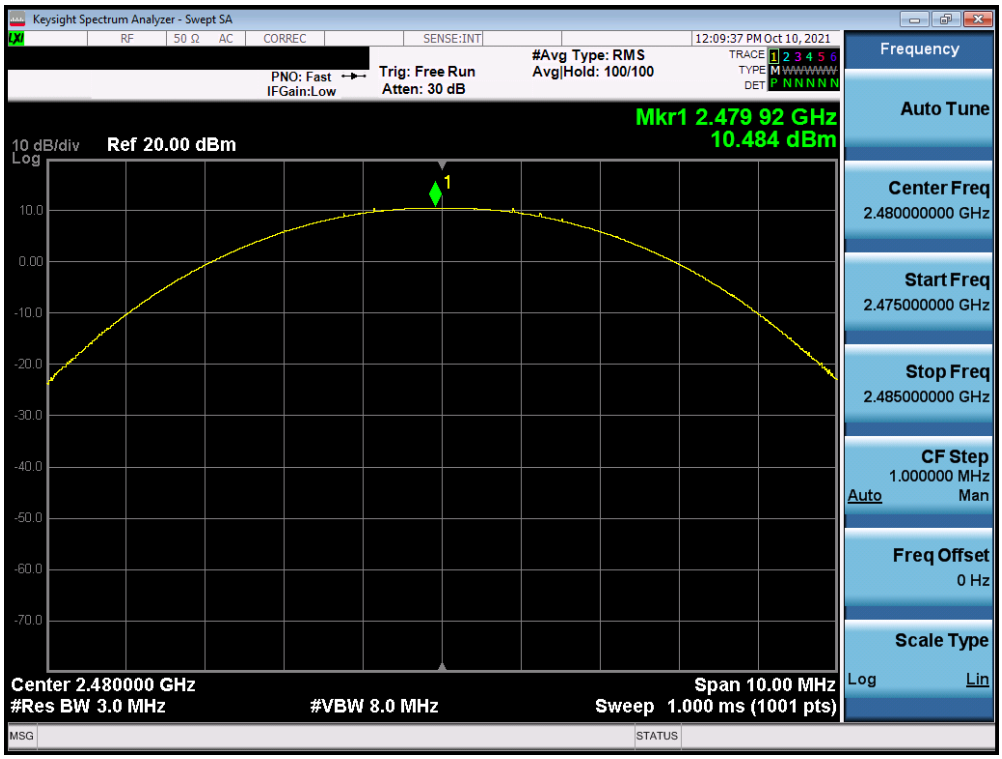
Plot 7-108. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 78) Antenna 1 iPA



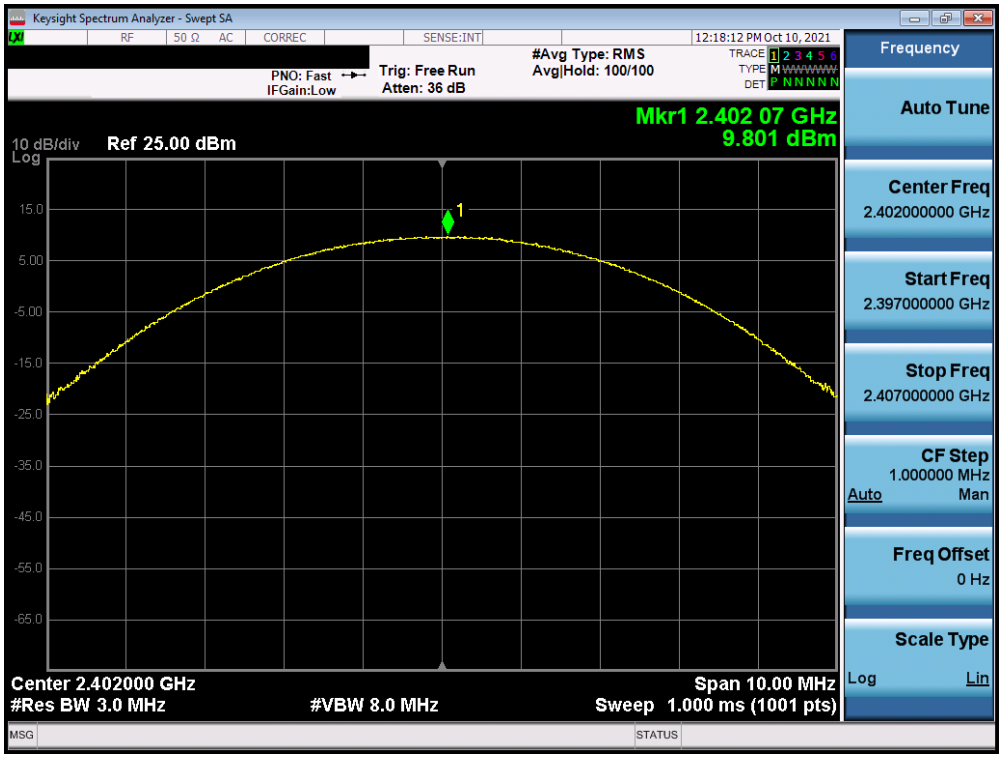
Plot 7-109. Dual Bluetooth Peak Conducted Power (1Mbps – Ch. 0) Antenna 2 iPA



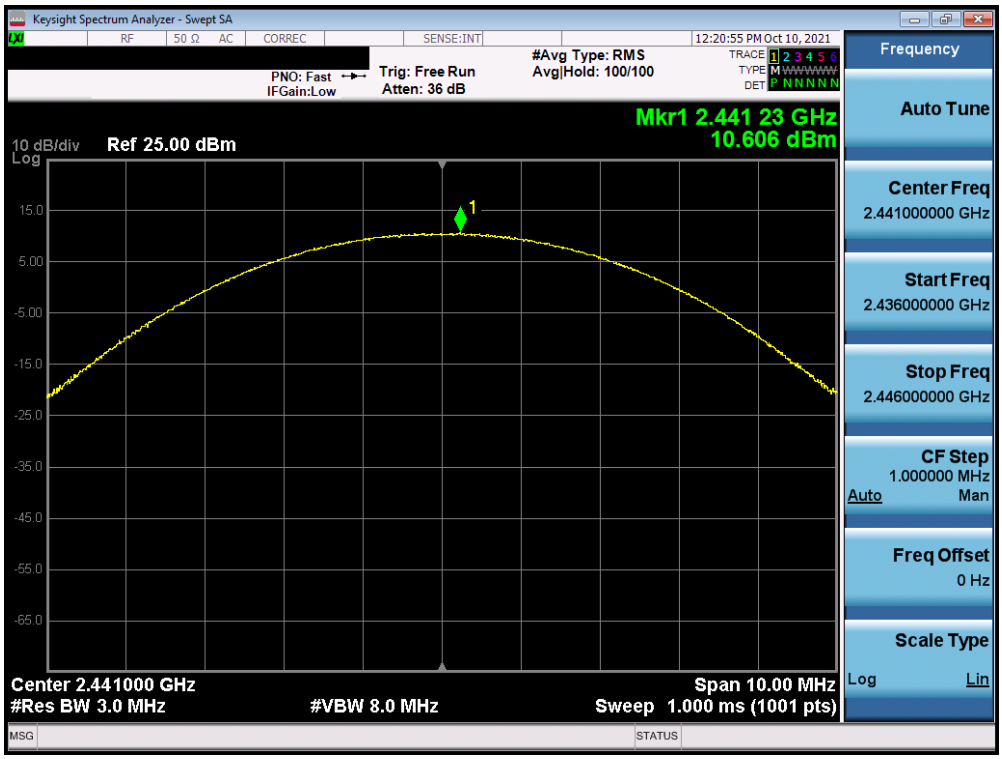
Plot 7-110. Dual Bluetooth Peak Conducted Power (1Mbps – Ch. 39) Antenna 2 iPA



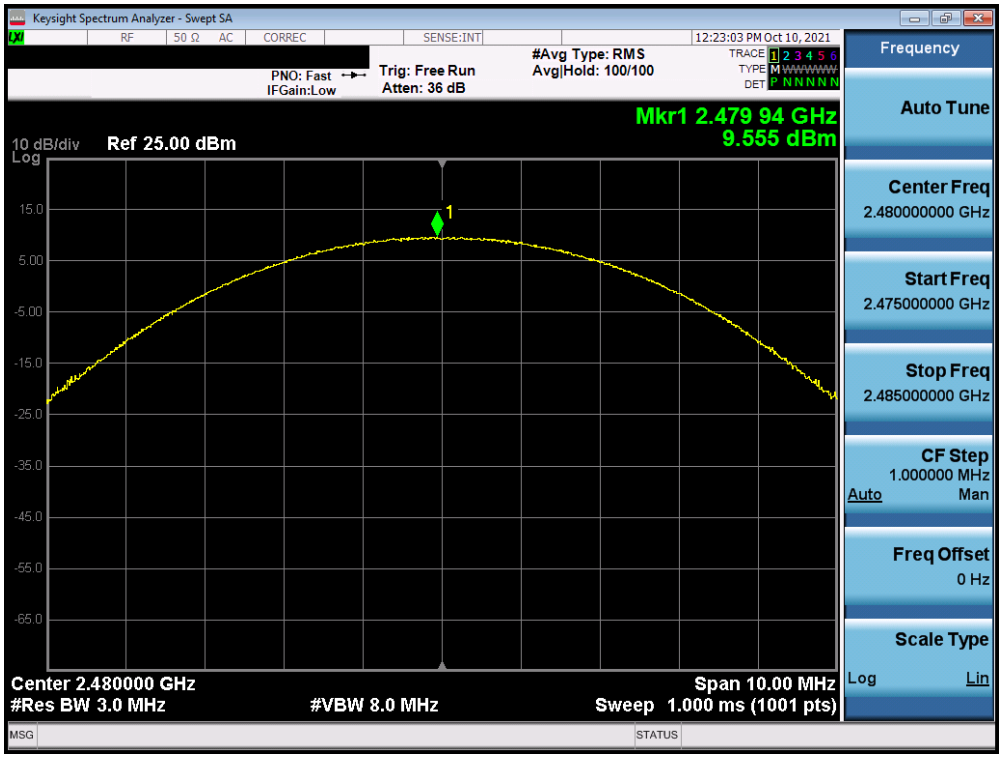
Plot 7-111. Dual Bluetooth Peak Conducted Power (1Mbps – Ch. 78) Antenna 2 iPA



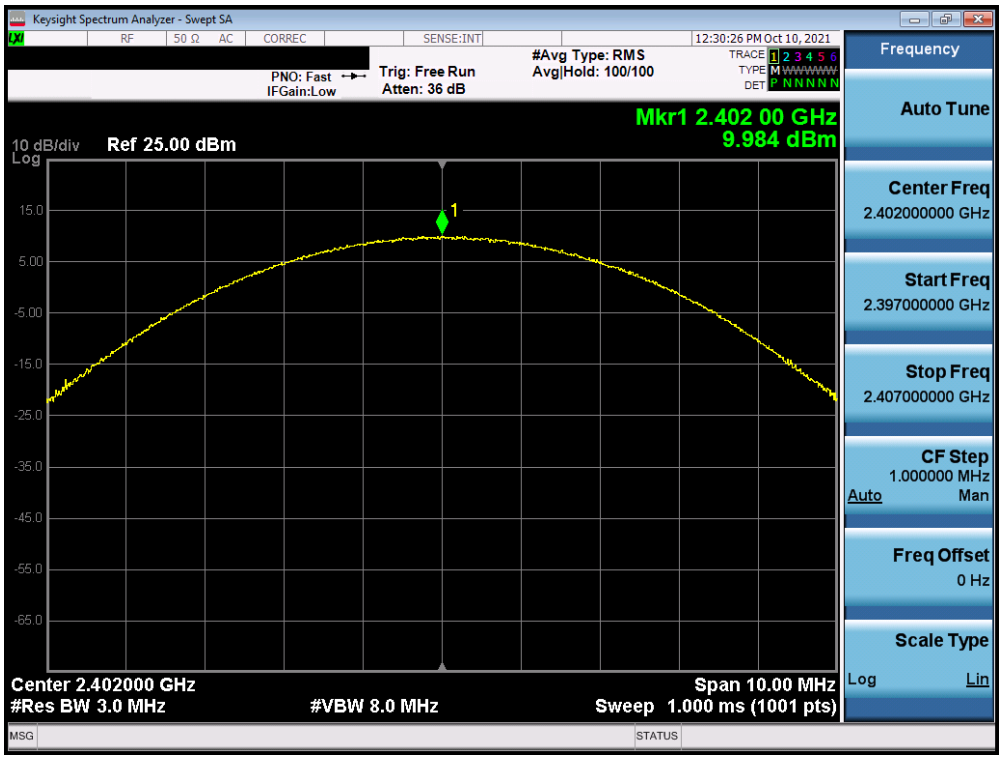
Plot 7-112. Dual Bluetooth Peak Conducted Power (2Mbps – Ch. 0) Antenna 2 iPA



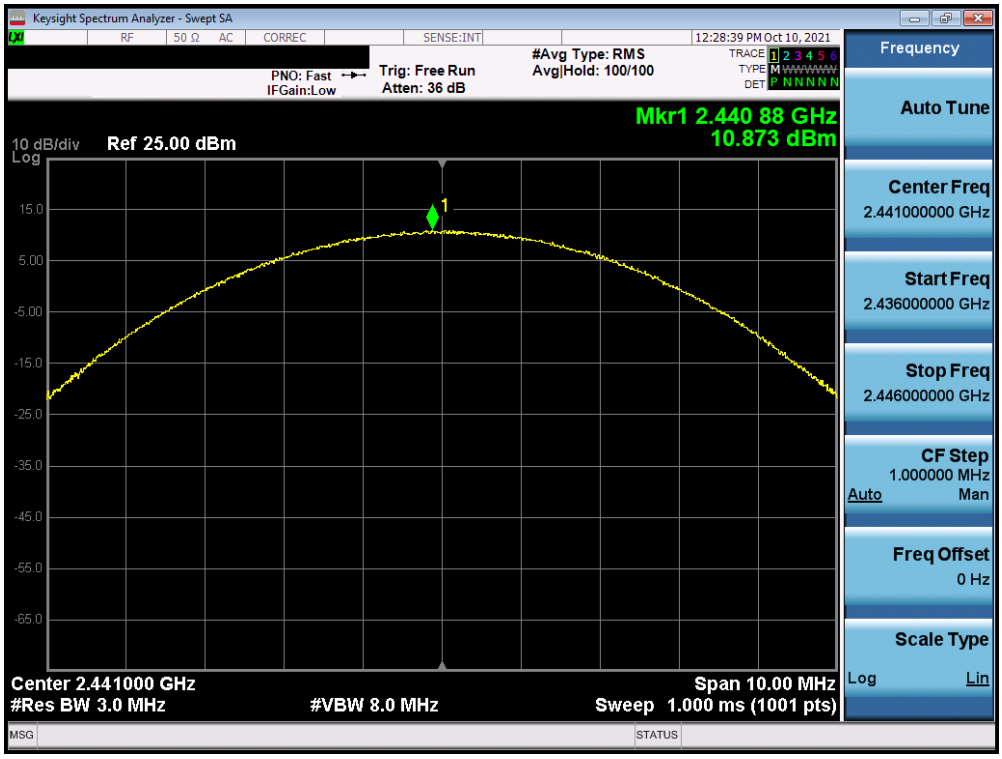
Plot 7-113. Dual Bluetooth Peak Conducted Power (2Mbps – Ch. 39) Antenna 2 iPA



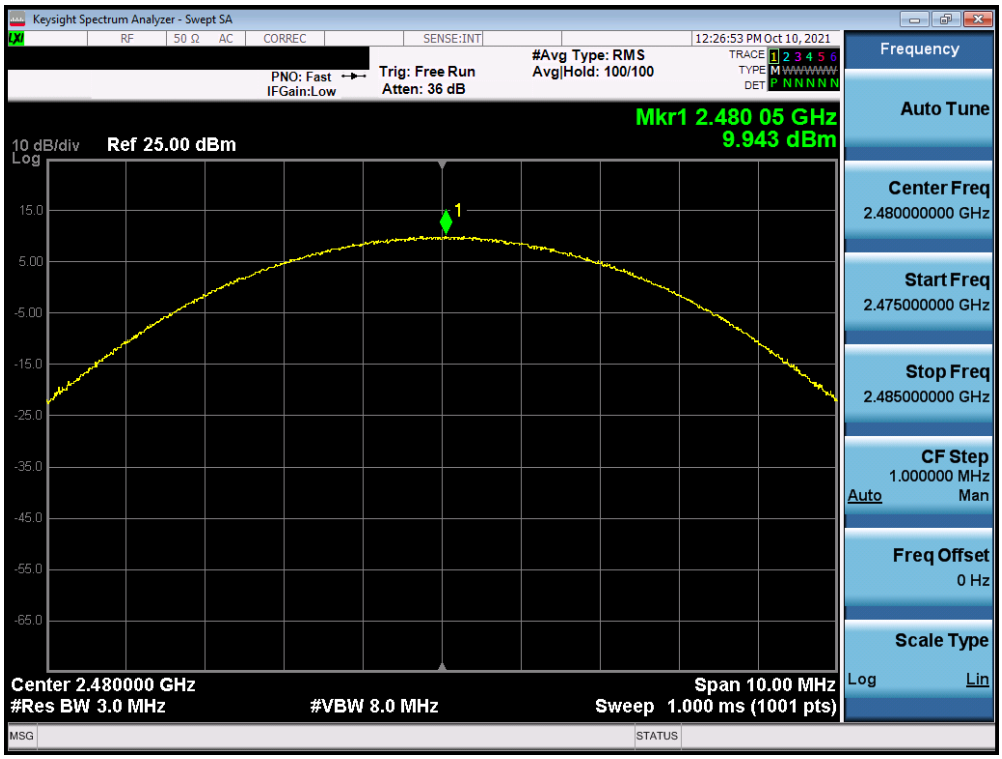
Plot 7-114. Dual Bluetooth Peak Conducted Power (2Mbps – Ch. 78) Antenna 2 iPA



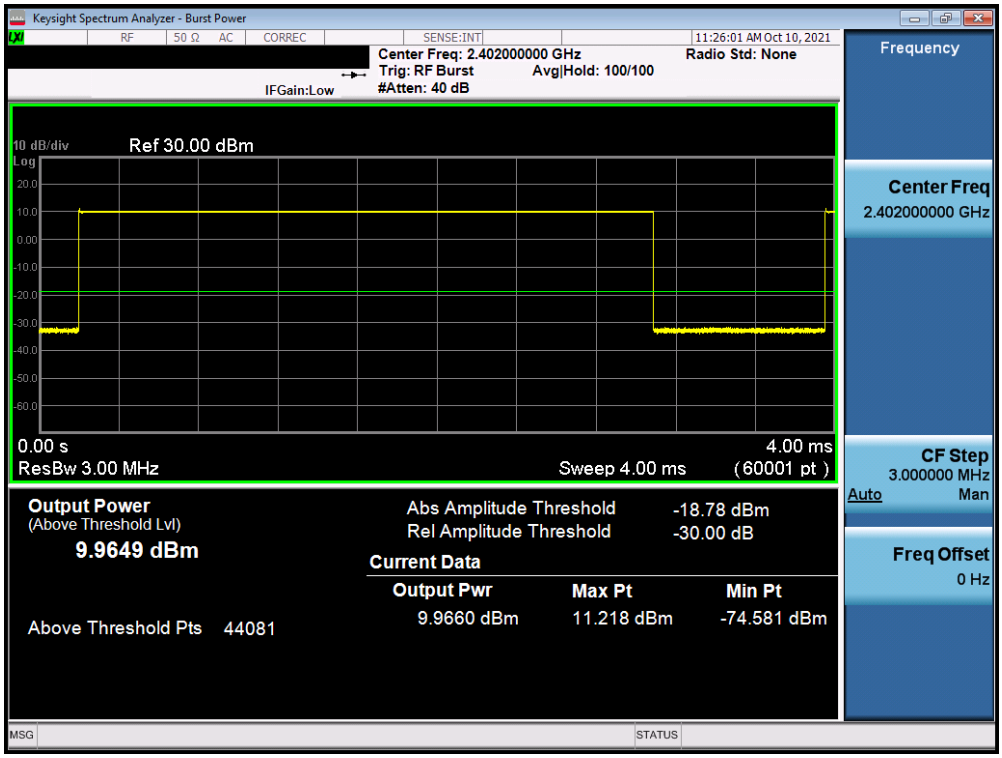
Plot 7-115. Dual Bluetooth Peak Conducted Power (3Mbps – Ch. 0) Antenna 2 iPA



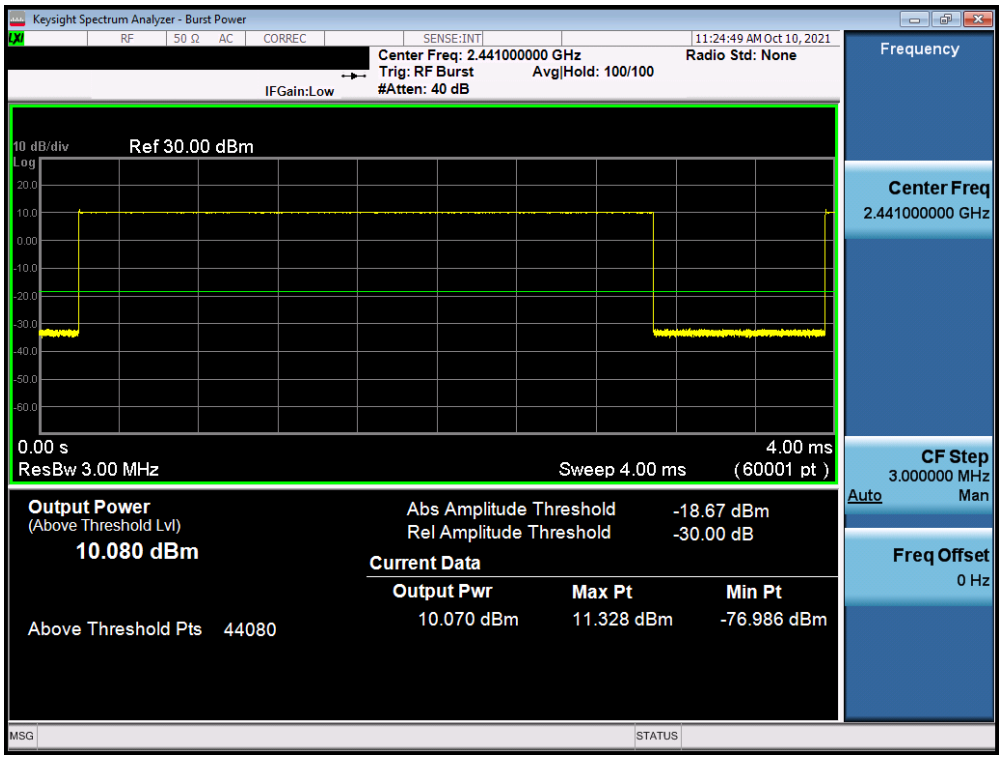
Plot 7-116. Dual Bluetooth Peak Conducted Power (3Mbps – Ch. 39) Antenna 2 iPA



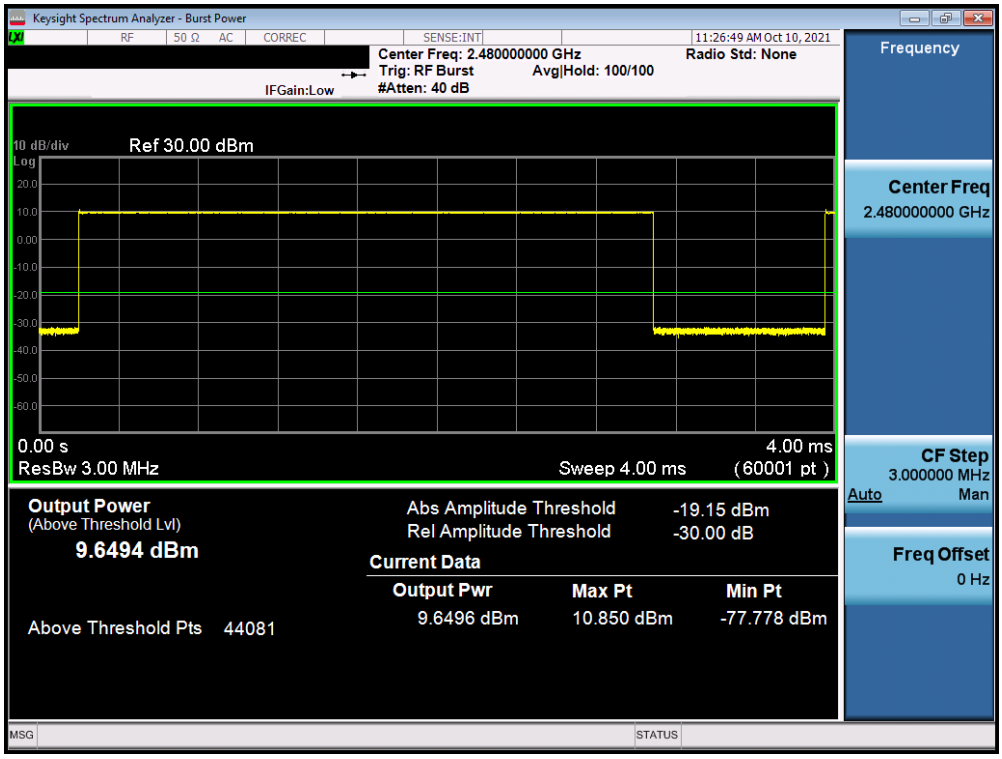
Plot 7-117. Dual Bluetooth Peak Conducted Power (3Mbps – Ch. 78) Antenna 2 iPA



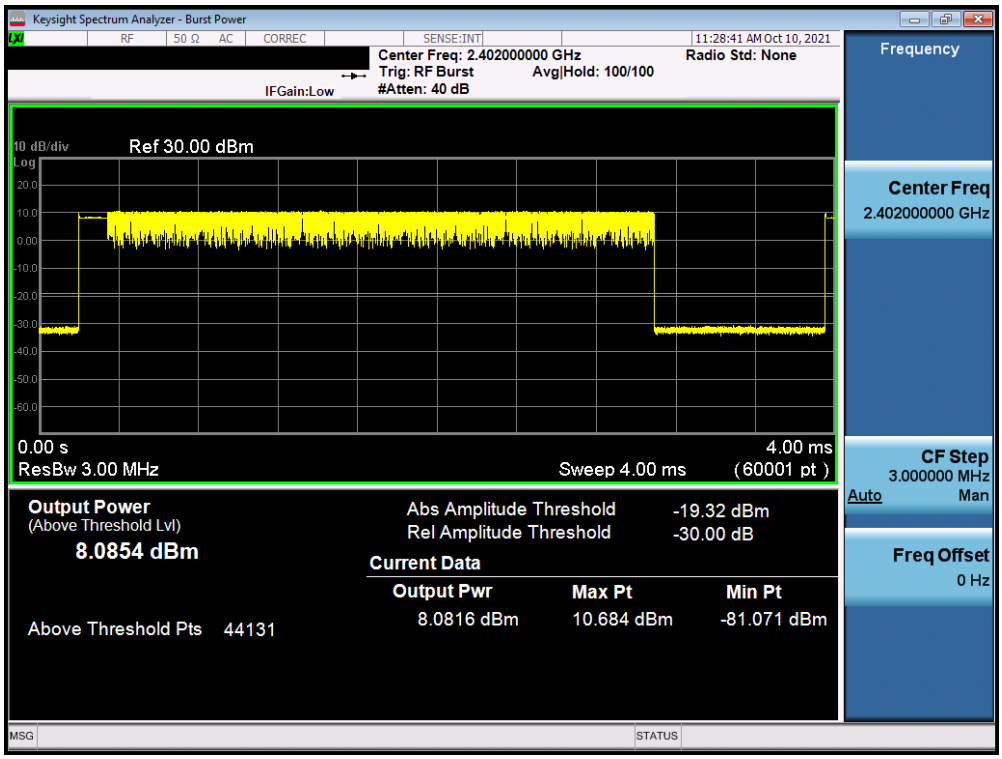
Plot 7-118. Dual Bluetooth Average Conducted Power (1Mbps – Ch. 0) Antenna 2 iPA



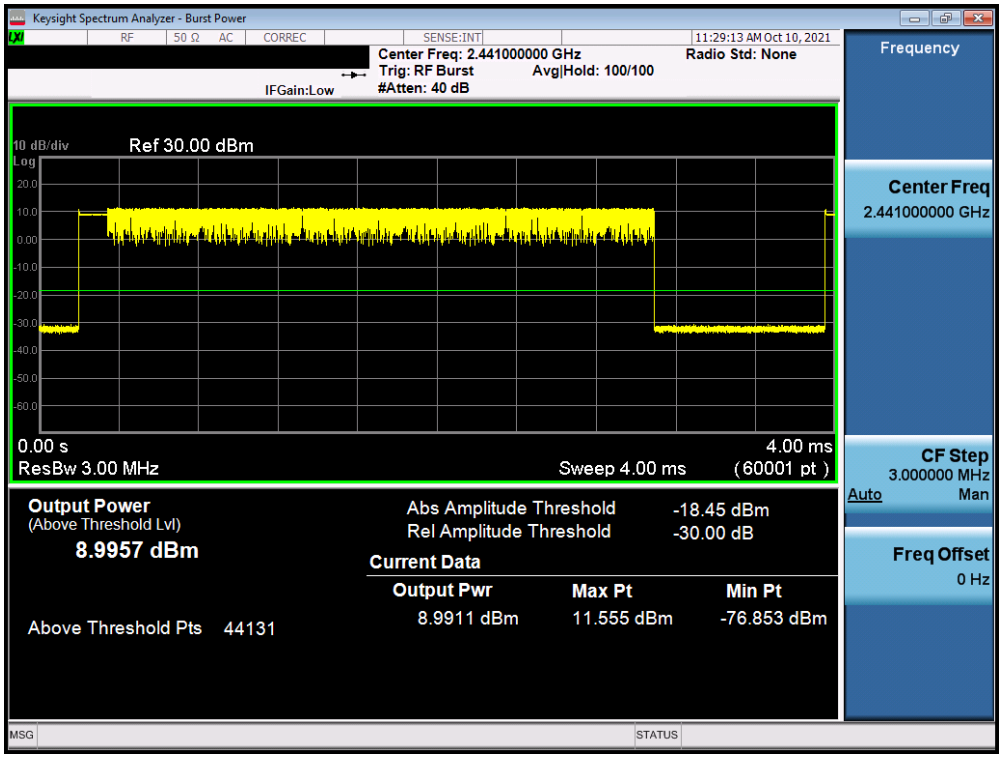
Plot 7-119. Dual Bluetooth Average Conducted Power (1Mbps – Ch. 39) Antenna 2 iPA



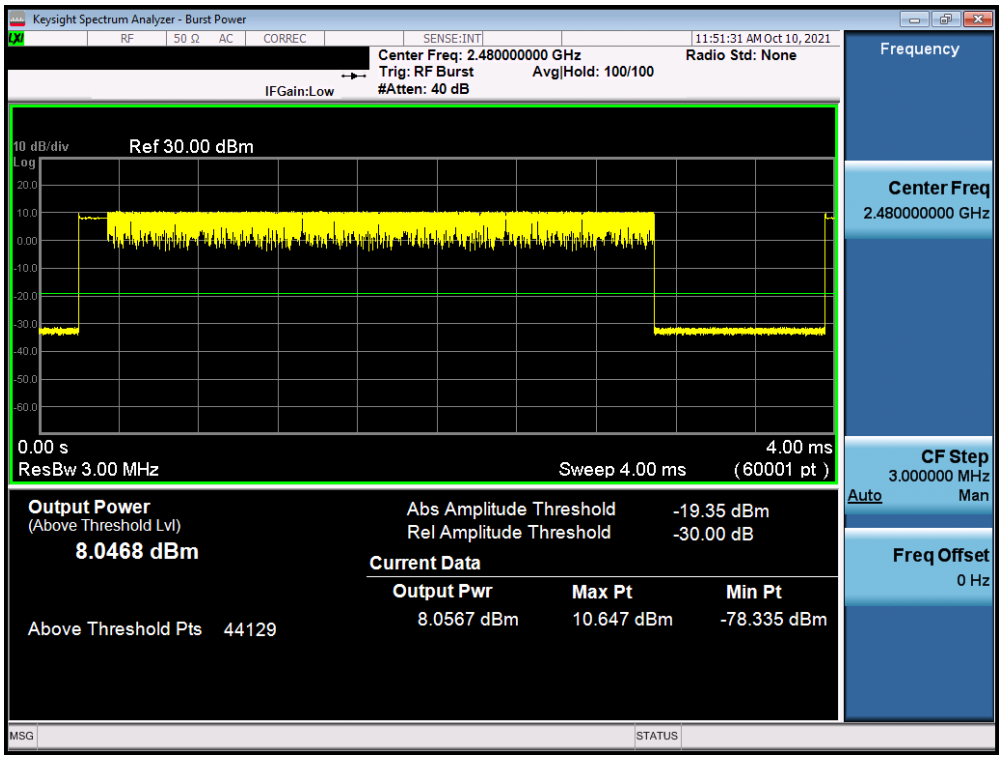
Plot 7-120. Dual Bluetooth Average Conducted Power (1Mbps – Ch. 78) Antenna 2 iPA



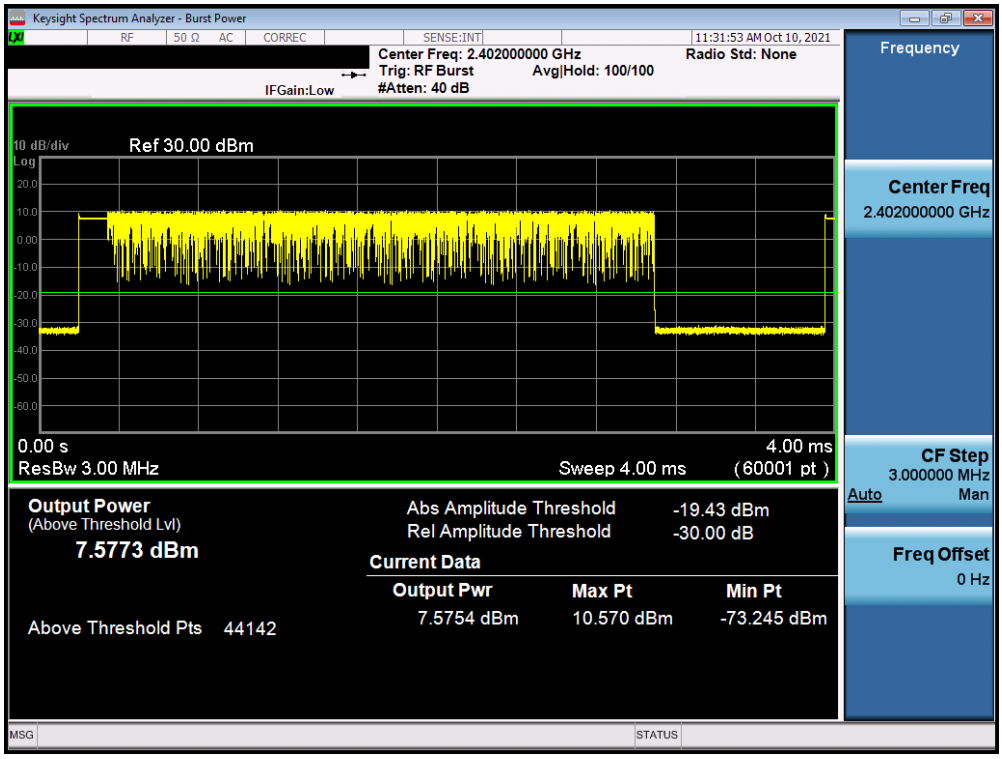
Plot 7-121. Dual Bluetooth Average Conducted Power (2Mbps – Ch. 0) Antenna 2 iPA



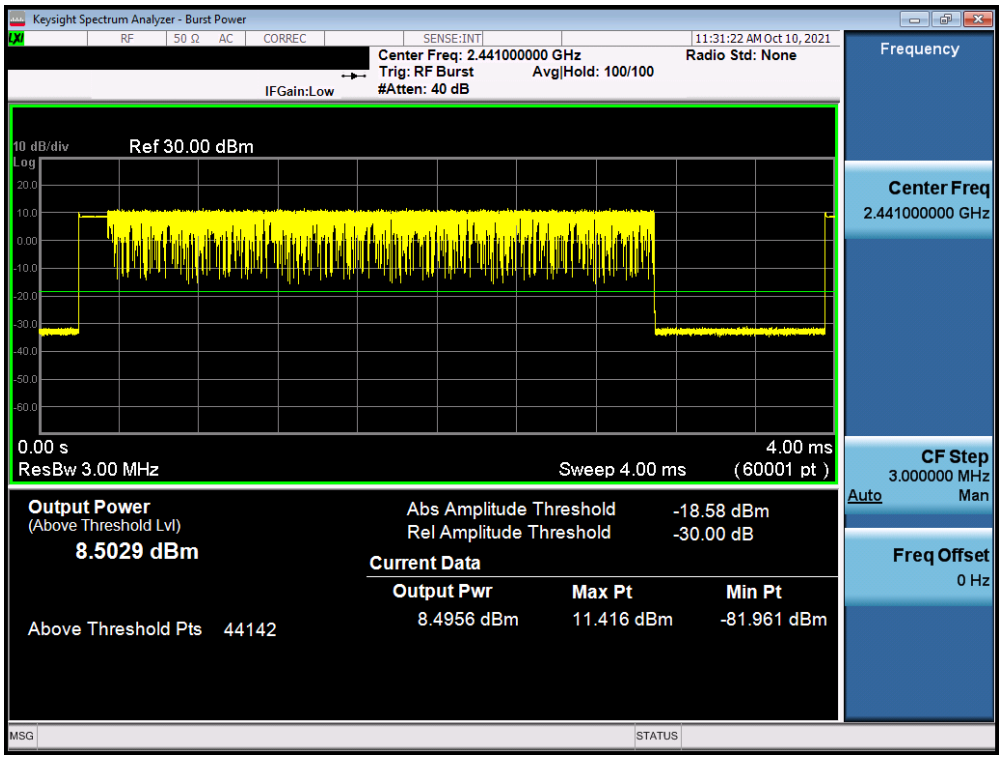
Plot 7-122. Dual Bluetooth Average Conducted Power (2Mbps – Ch. 39) Antenna 2 iPA



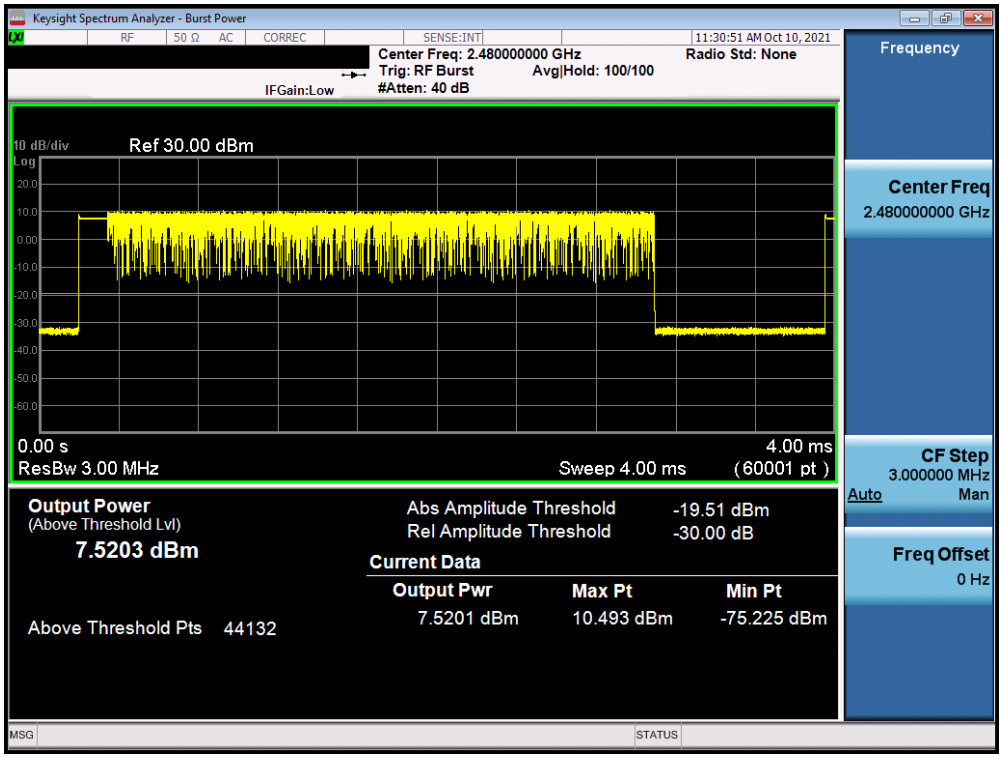
Plot 7-123. Dual Bluetooth Average Conducted Power (2Mbps – Ch. 78) Antenna 2 iPA



Plot 7-124. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 0) Antenna 2 iPA



Plot 7-125. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 39) Antenna 2 iPA



Plot 7-126. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 79) Antenna 2 iPA

7.4 Conducted Authorized Band Edge

§15.247 (d); RSS-247 [5.5]

Test Overview and Limits

EUT operates in hopping and non-hopping transmission mode. Measurement is taken at the highest point located outside of the emission bandwidth. ***The maximum permissible out-of-band emission level is 20 dBc.***

Test Procedure Used

ANSI C63.10-2013 – Section 6.10.4

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

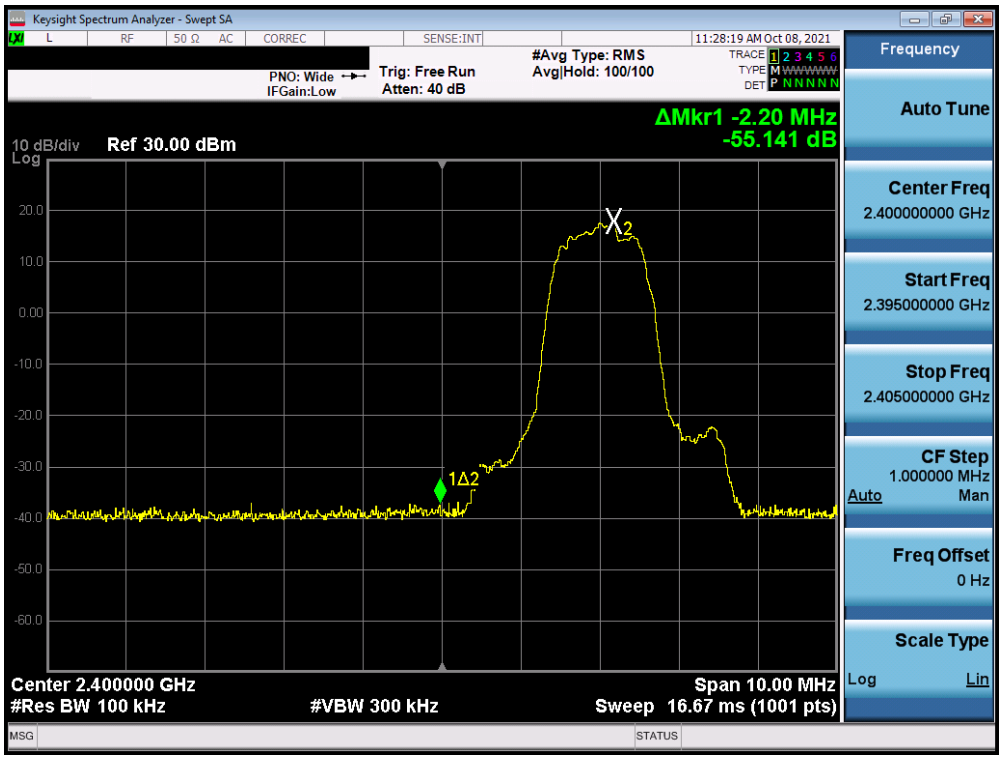
Test Setup

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

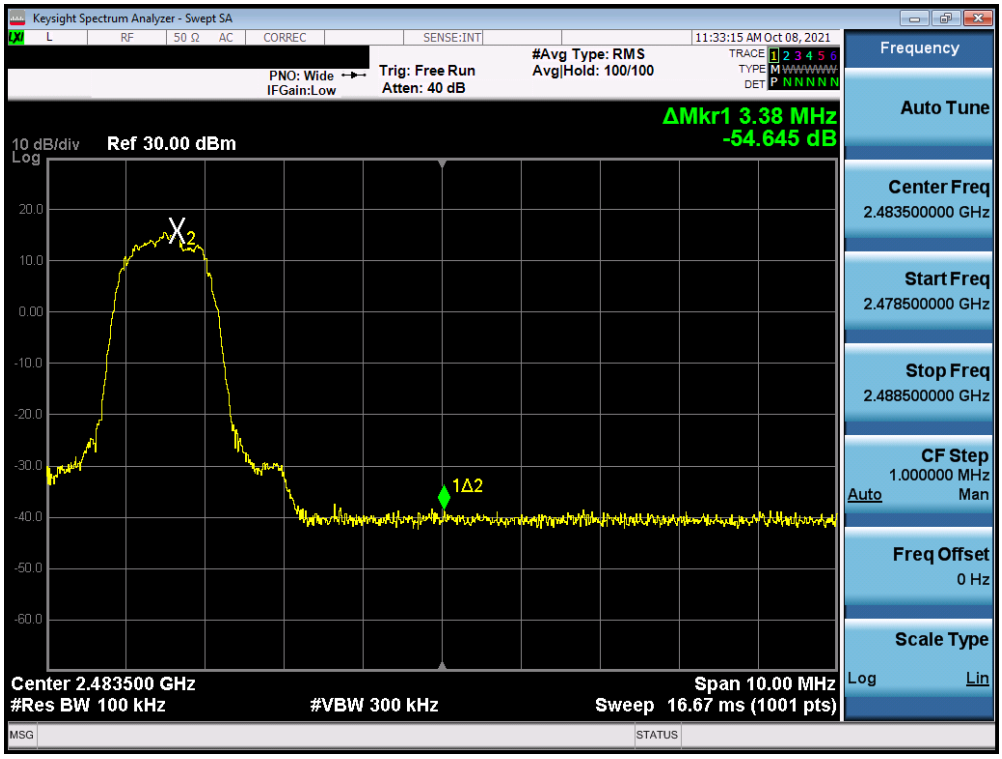
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

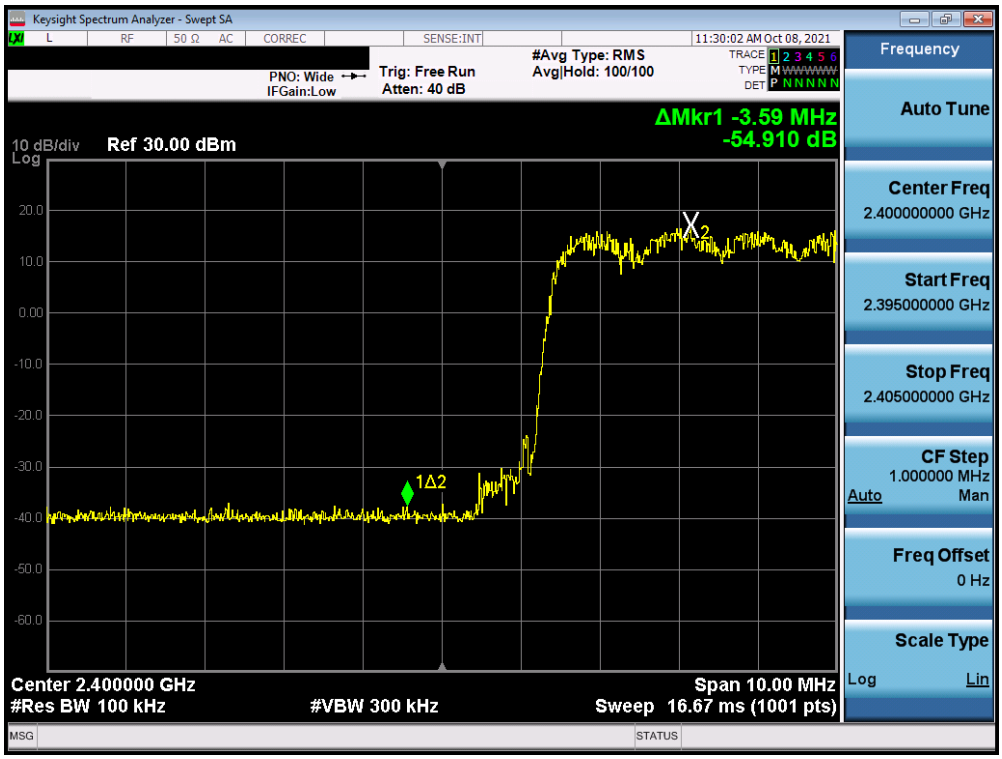
Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the worst case emissions are shown below.



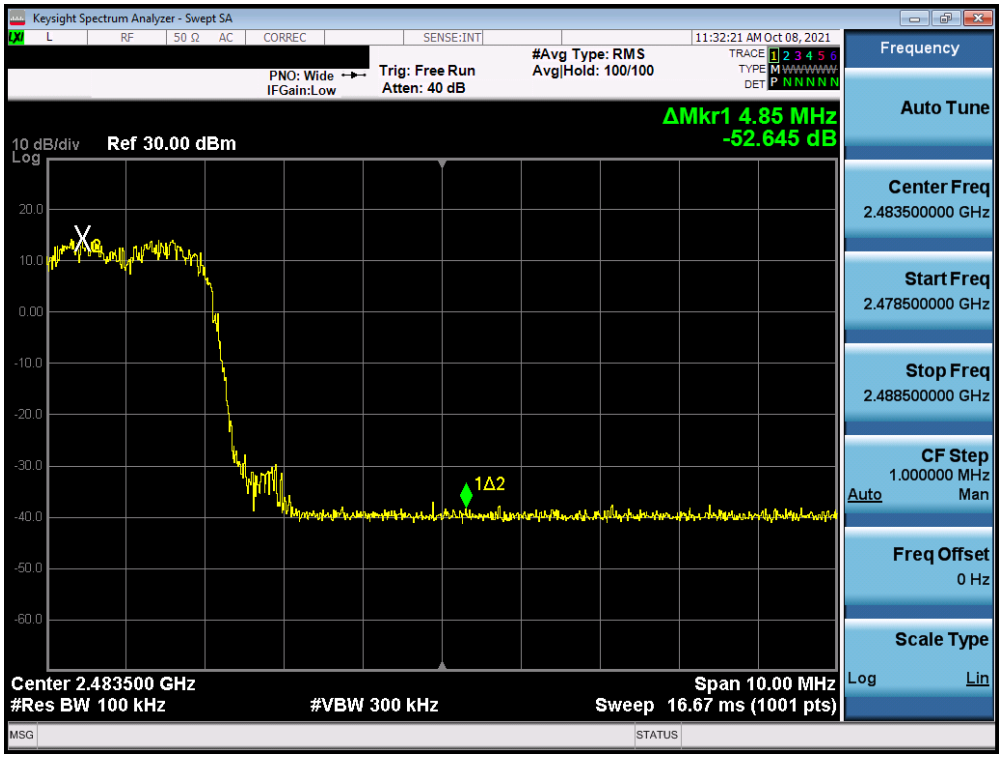
Plot 7-127. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps– Ch. 0) Antenna 1



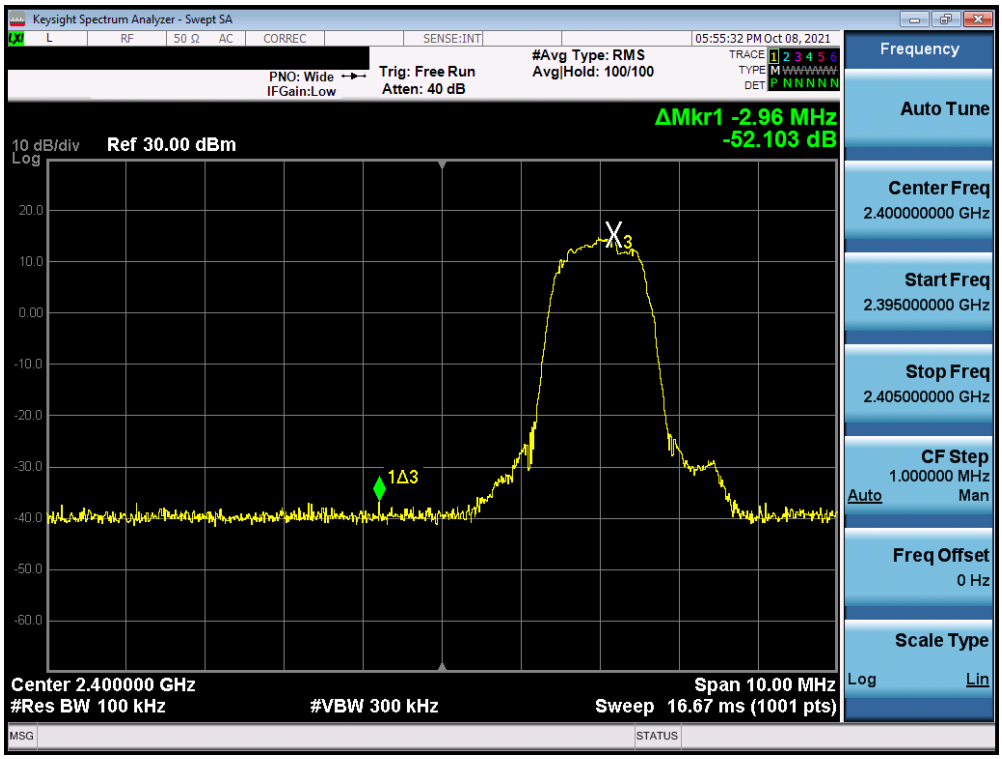
Plot 7-128. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps– Ch. 78) Antenna 1



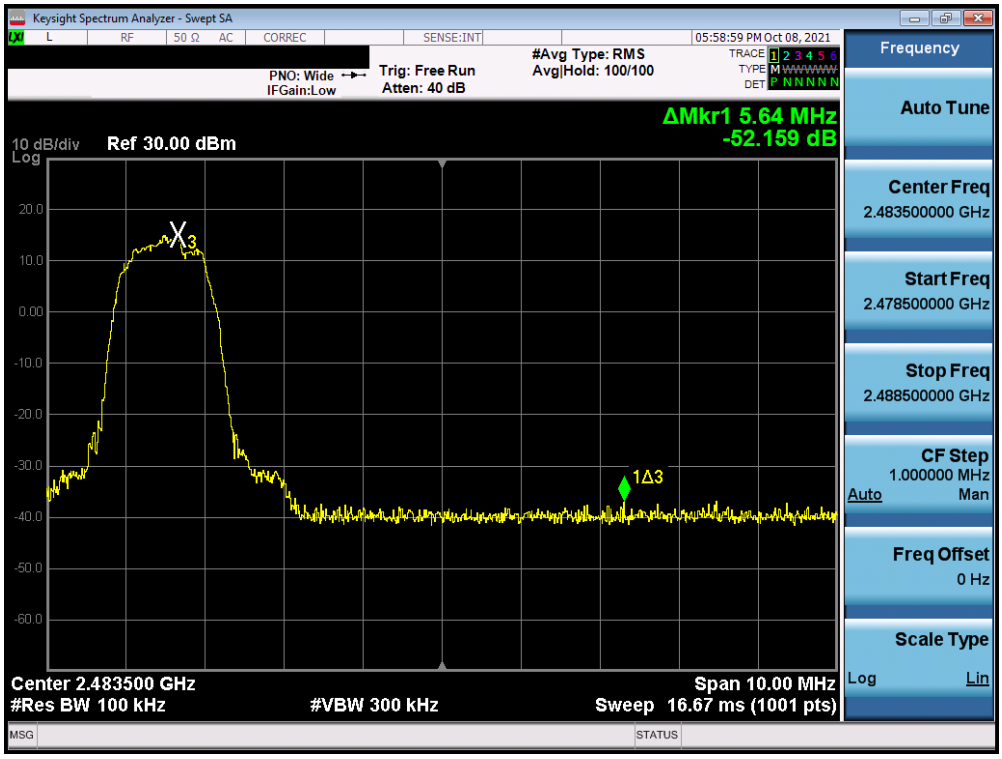
Plot 7-129. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps– Ch. 0) Antenna 1



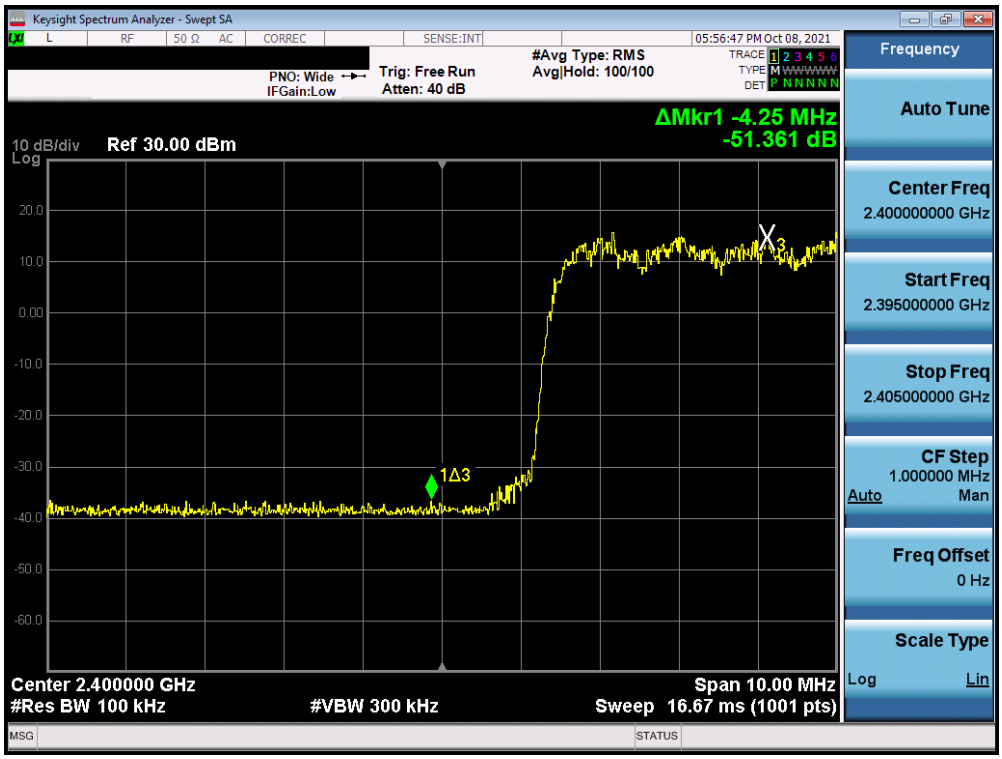
Plot 7-130. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps– Ch. 78) Antenna 1



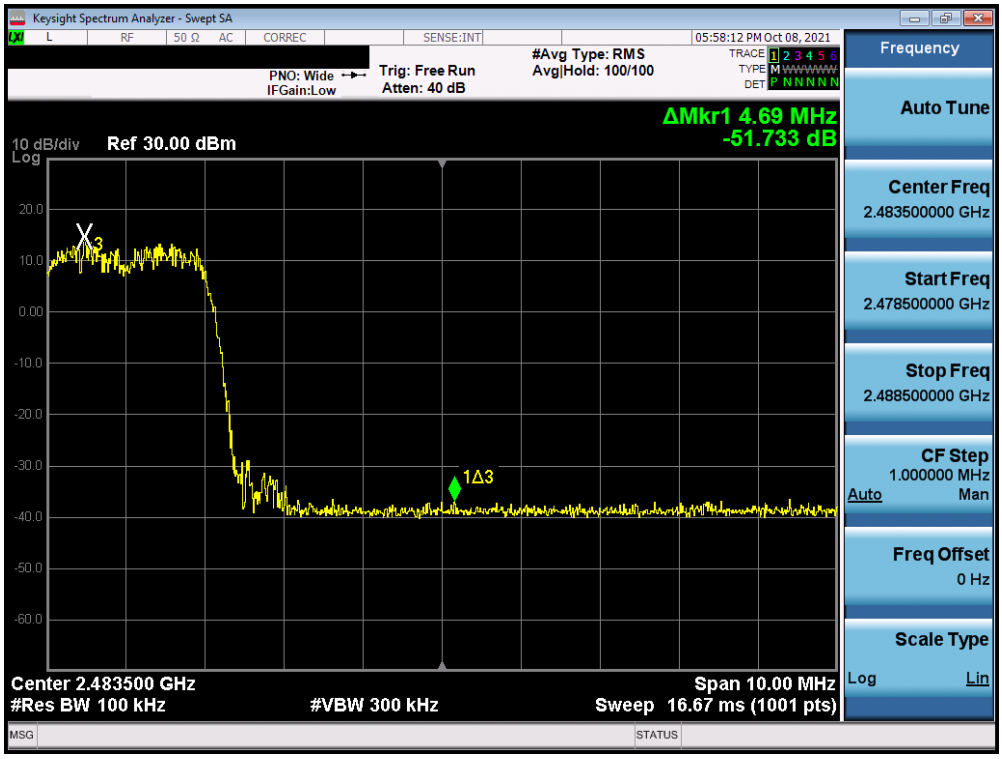
Plot 7-131. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps– Ch. 0) Antenna 2



Plot 7-132. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps– Ch. 78) Antenna 2



Plot 7-133. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps– Ch. 0) Antenna 2



Plot 7-134. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps– Ch. 78) Antenna 2

7.5 Carrier Frequency Separation

§15.247(a)(1); RSS-247 [5.1(b)]

Test Overview and Limit

Measurement is made with EUT operating in hopping mode. ***The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.***

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.2

Test Settings

1. Span = Wide enough to capture peaks of two adjacent channels
2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
3. VBW ≥ RBW
4. Sweep = Auto
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize.
8. Marker-delta function used to determine separation between peaks of the adjacent channels

Test Setup

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

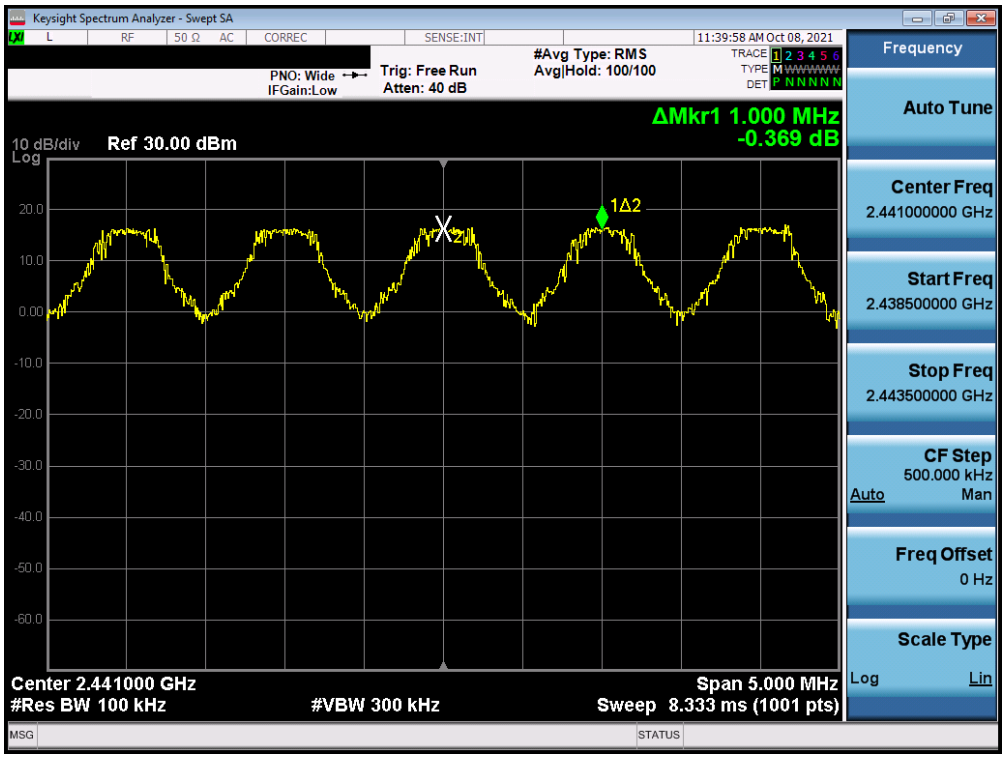
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

1. The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.
2. All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported.

Frequency [MHz]	Data Rate [Mbps]	Modulation	Power Scheme	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	ePA	0	0.663
2441	1.0	GFSK	ePA	39	0.627
2480	1.0	GFSK	ePA	78	0.625
2402	2.0	π/4-DQPSK	ePA	0	0.895
2441	2.0	π/4-DQPSK	ePA	39	0.881
2480	2.0	π/4-DQPSK	ePA	78	0.886
2402	3.0	8DPSK	ePA	0	0.868
2441	3.0	8DPSK	ePA	39	0.873
2480	3.0	8DPSK	ePA	78	0.865

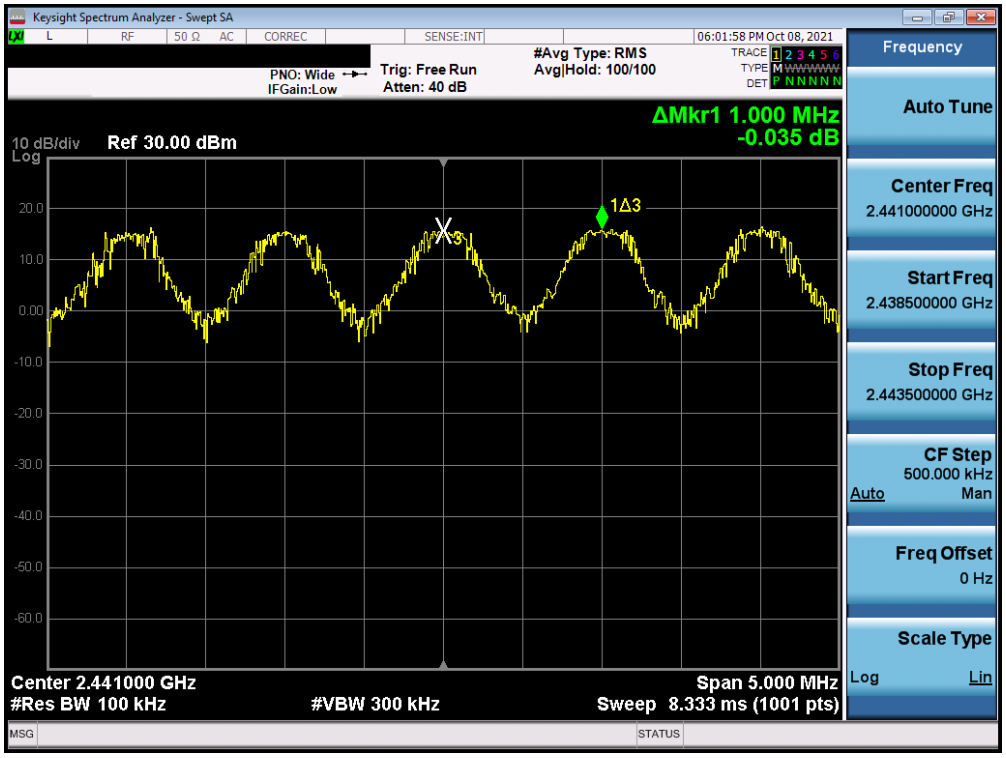
Table 7-8. Minimum Channel Separation – Antenna 1



Plot 7-135. Channel Spacing Plot (Bluetooth) – Antenna 1

Frequency [MHz]	Data Rate [Mbps]	Modulation	Power Scheme	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	ePA	0	0.681
2441	1.0	GFSK	ePA	39	0.668
2480	1.0	GFSK	ePA	78	0.662
2402	2.0	π/4-DQPSK	ePA	0	0.881
2441	2.0	π/4-DQPSK	ePA	39	0.882
2480	2.0	π/4-DQPSK	ePA	78	0.891
2402	3.0	8DPSK	ePA	0	0.874
2441	3.0	8DPSK	ePA	39	0.881
2480	3.0	8DPSK	ePA	78	0.872

Table 7-9. Minimum Channel Separation – Antenna 2



Plot 7-136. Channel Spacing Plot (Bluetooth) – Antenna 2

7.6 Time of Occupancy

§15.247(a)(1)(iii); RSS-247 [5.1(d)]

Test Overview and Limit

Measurement is made while EUT is operating in hopping mode with the spectrum analyzer set to zero span. ***The maximum permissible time of occupancy is 400 ms within a period of 400ms multiplied by the number of hopping channels employed.***

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.4

Test Settings

1. Span = zero span, centered on a hopping channel
2. RBW ≤ channel spacing and >> 1/T, where T is expected dwell time per channel
3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
5. Detector = peak
6. Trace mode = max hold
7. Marker-delta function used to determine transmit time per hop

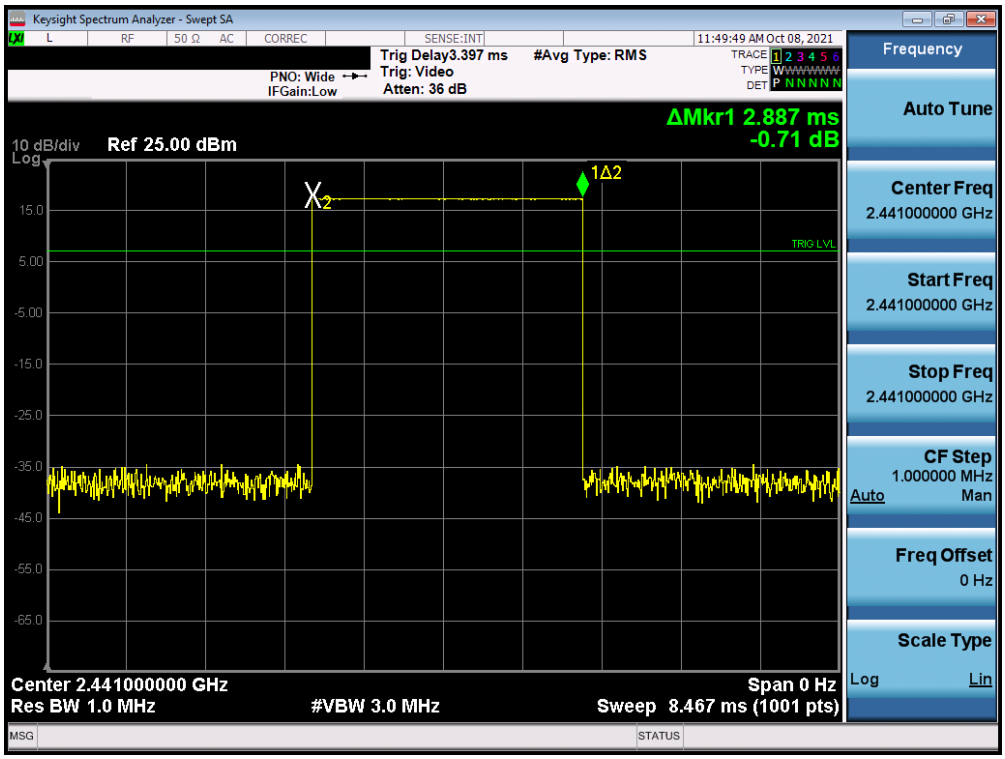
Test Setup

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

Figure 7-5. Test Instrument & Measurement Setup

Test Notes

All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported



Plot 7-137. Time of Occupancy Plot (Bluetooth) -Antenna 1

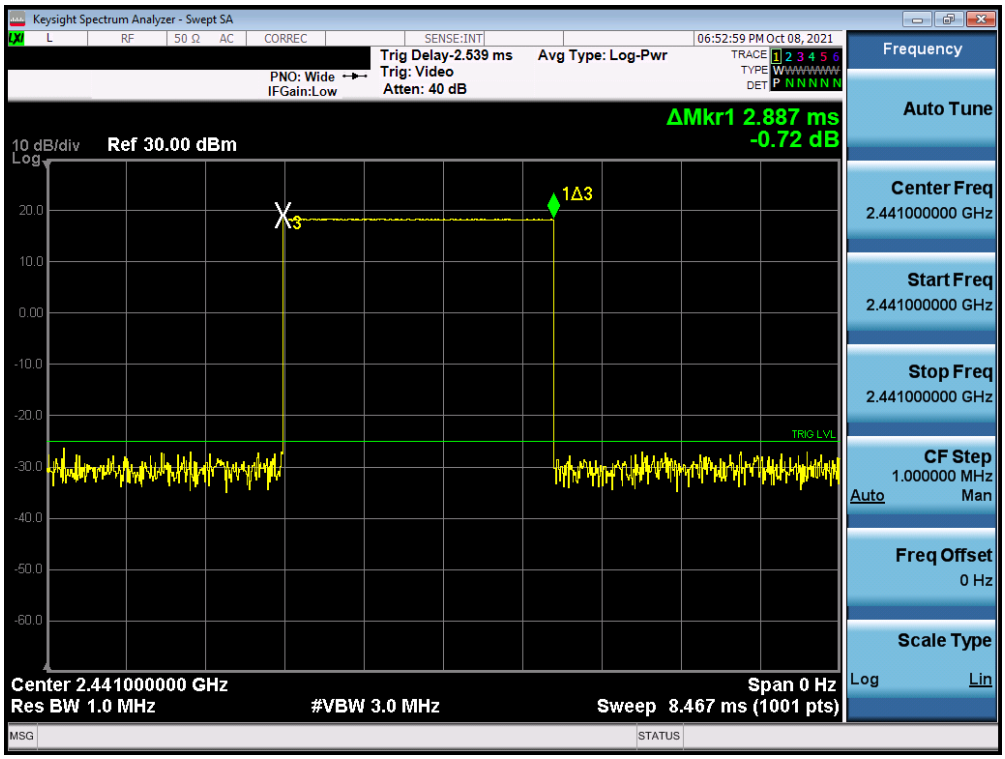
Bluetooth time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/BDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.887 ms/channel = 307.96 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- 53.34 hops x 2.887 ms/channel = 153.99 ms (worst case dwell time for one channel in AFH mode)



Plot 7-138. Time of Occupancy Plot (Bluetooth) -Antenna 2

Bluetooth time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/BDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.887 ms/channel = 307.96 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- 53.34 hops x 2.887 ms/channel = 153.99 ms (worst case dwell time for one channel in AFH mode)

7.7 Number of Hopping Channels

§15.247 (a.1.iii); RSS-247 [5.1(d)]

Test Overview and Limit

Measurement is made while EUT is operating in hopping mode. ***This frequency hopping system must employ a minimum of 15 hopping channels.***

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.3

Test Settings

1. Span = frequency of band of operation (divided into two plots)
2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
3. VBW ≥ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Setup

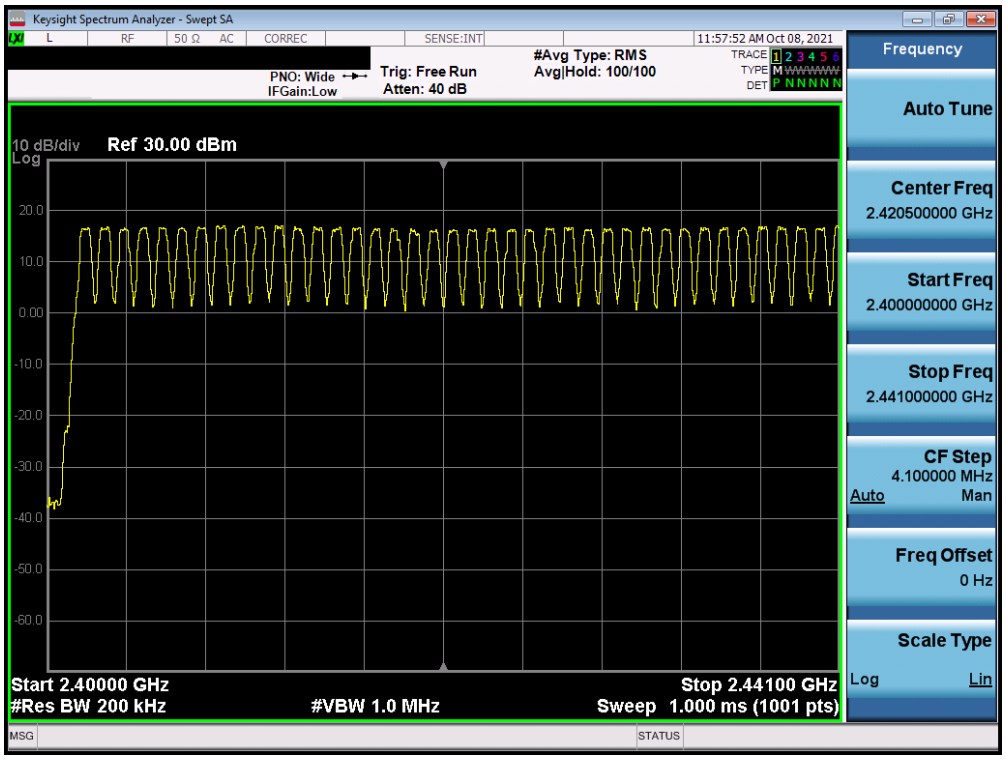
The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-6. Test Instrument & Measurement Setup

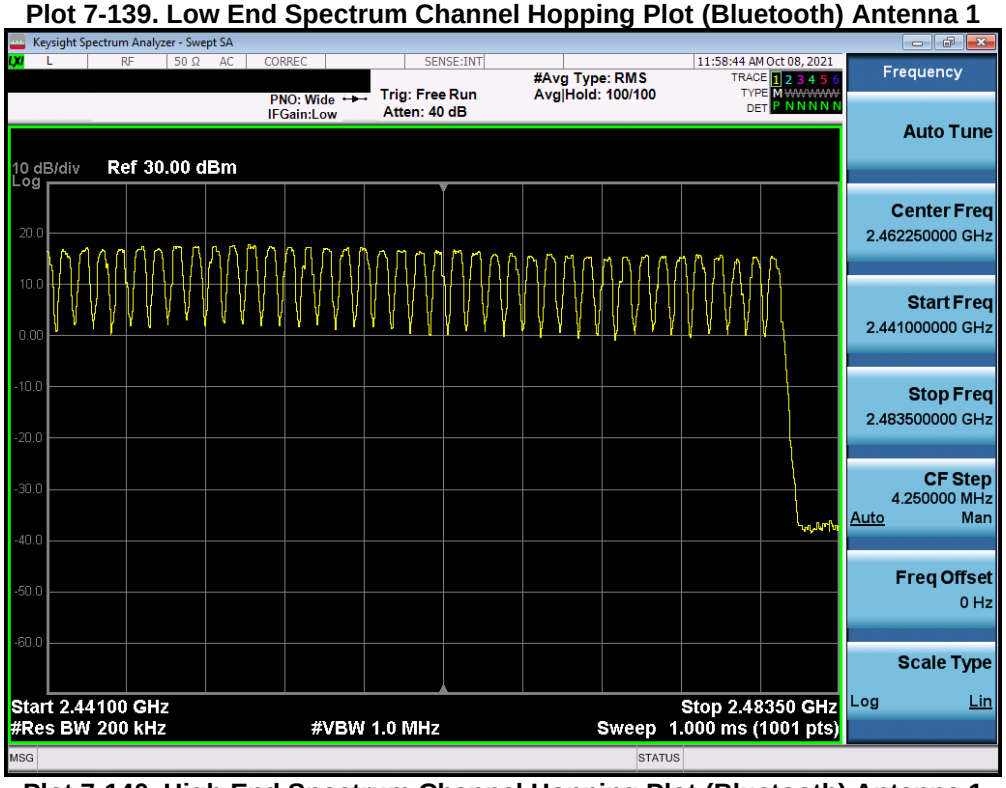
Test Notes

1. The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.

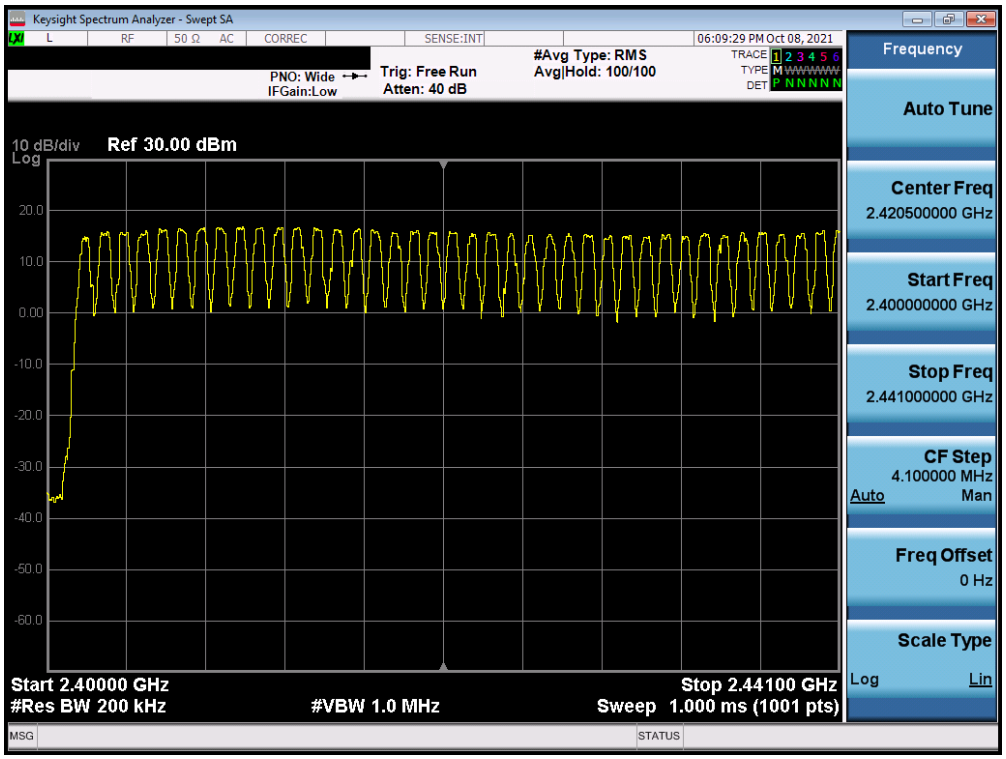
2. All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported.



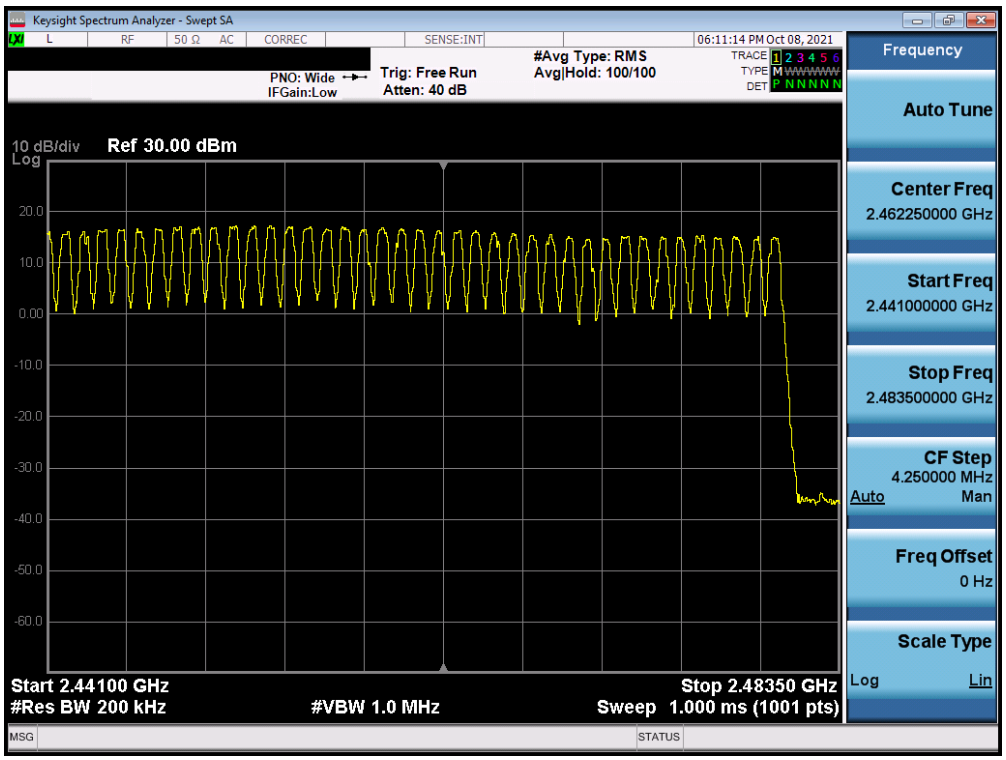
Plot 7-139. Low End Spectrum Channel Hopping Plot (Bluetooth) Antenna 1



Plot 7-140. High End Spectrum Channel Hopping Plot (Bluetooth) Antenna 1



Plot 7-141. Low End Spectrum Channel Hopping Plot (Bluetooth) Antenna 2



Plot 7-142. High End Spectrum Channel Hopping Plot (Bluetooth) Antenna 2

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

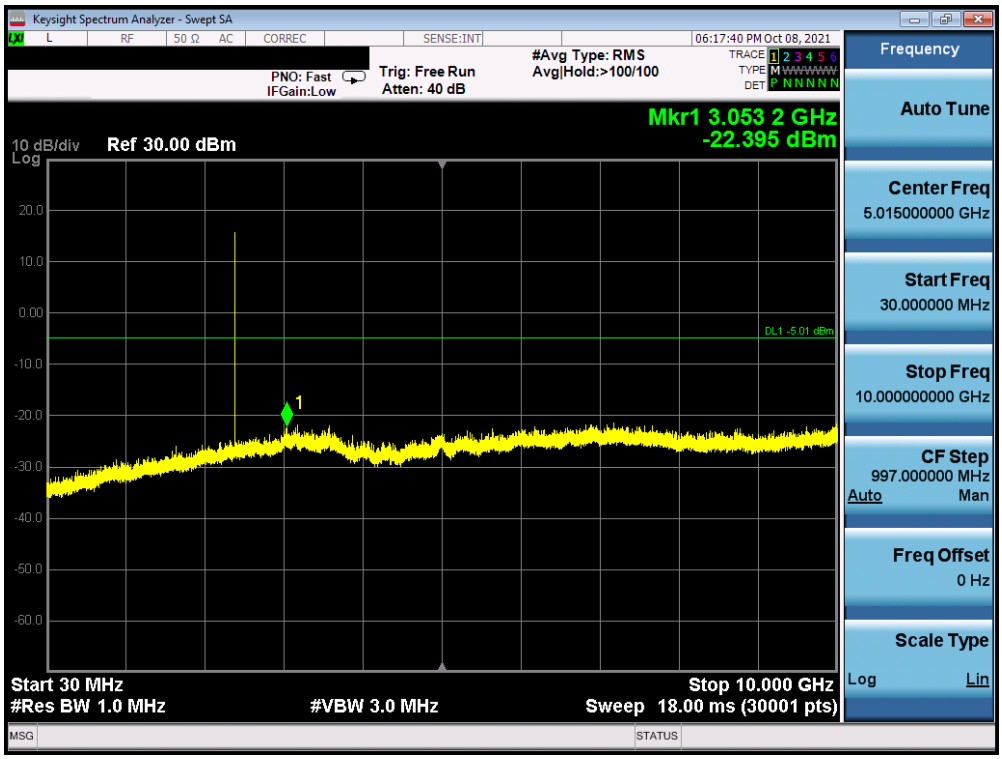
Test Setup

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

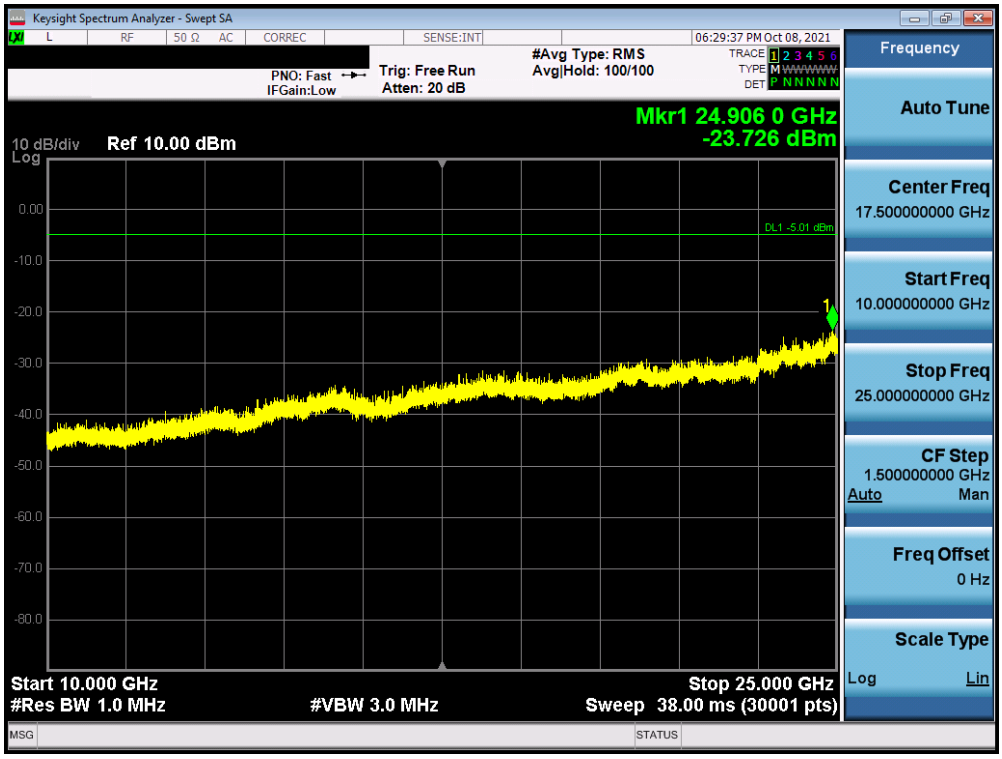
Figure 7-7. Test Instrument & Measurement Setup

Test Notes

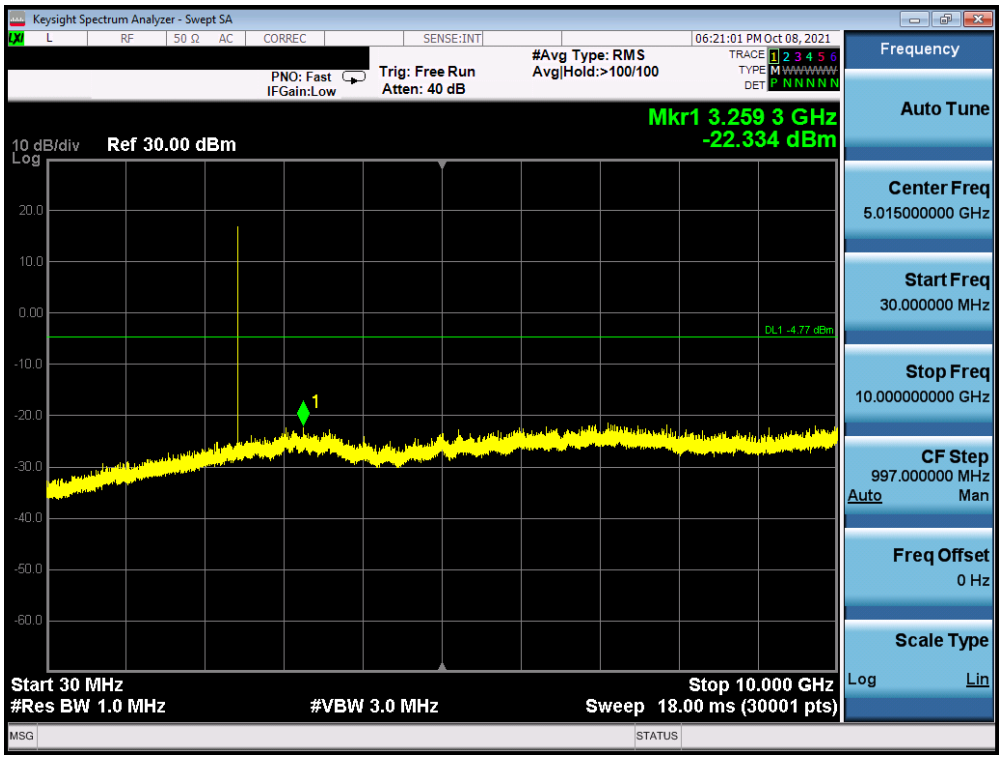
1. Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, 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. All supported modulation and power schemes have been tested on the unit and only worst-case configuration is reported



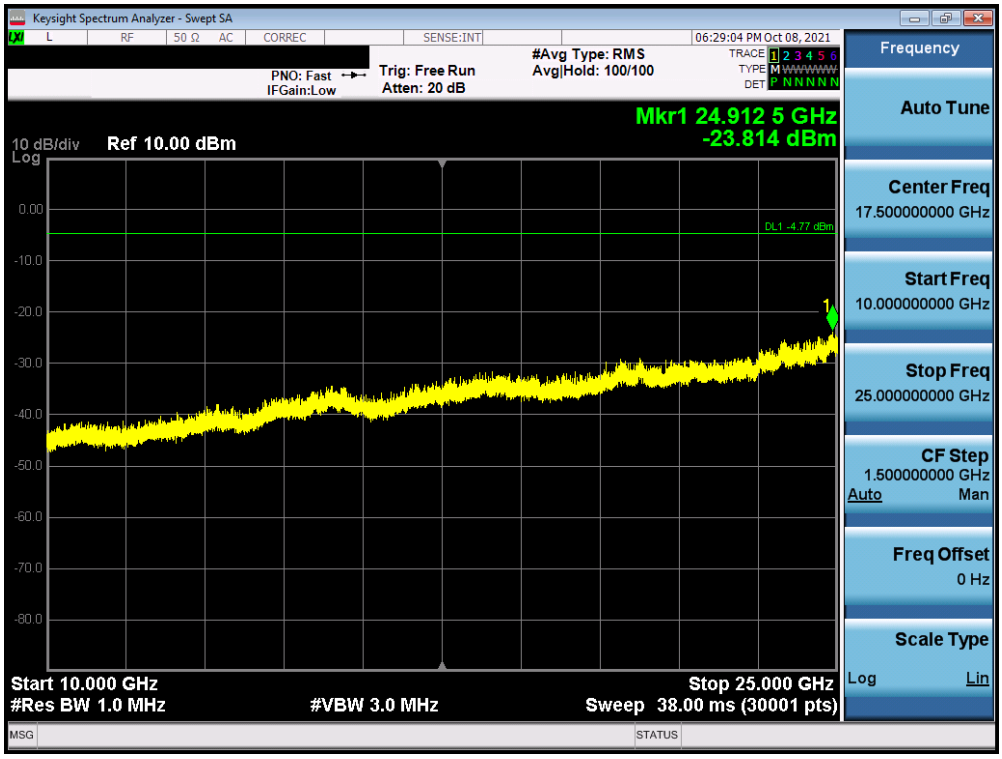
Plot 7-143. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 0) Antenna 1



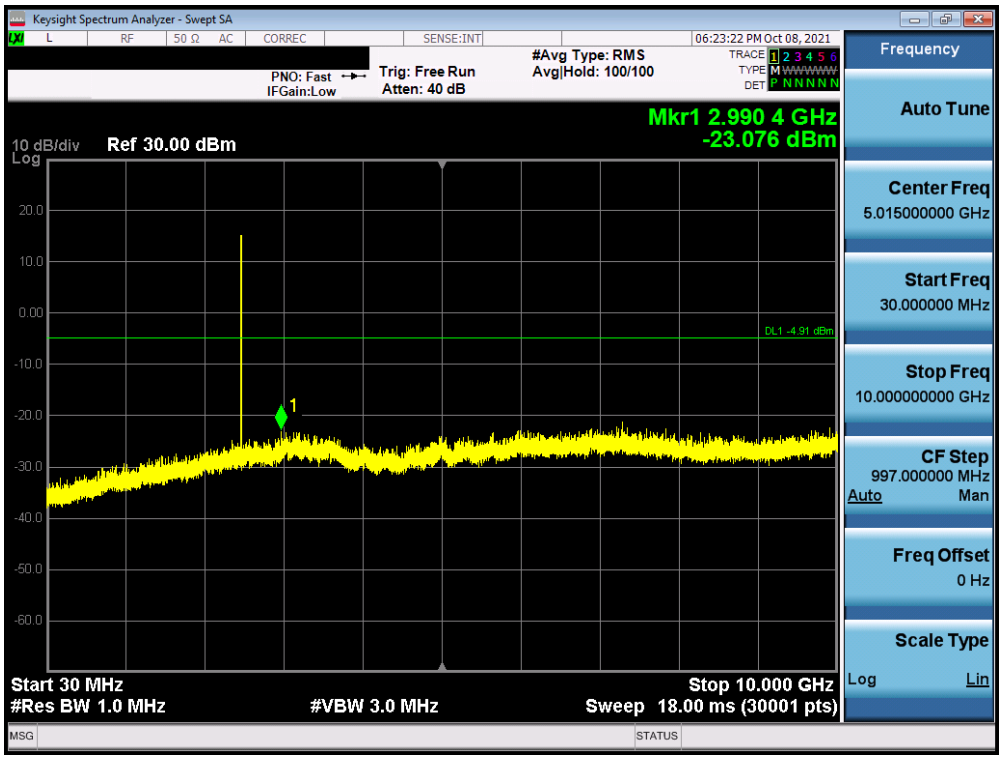
Plot 7-144. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 0) Antenna 1



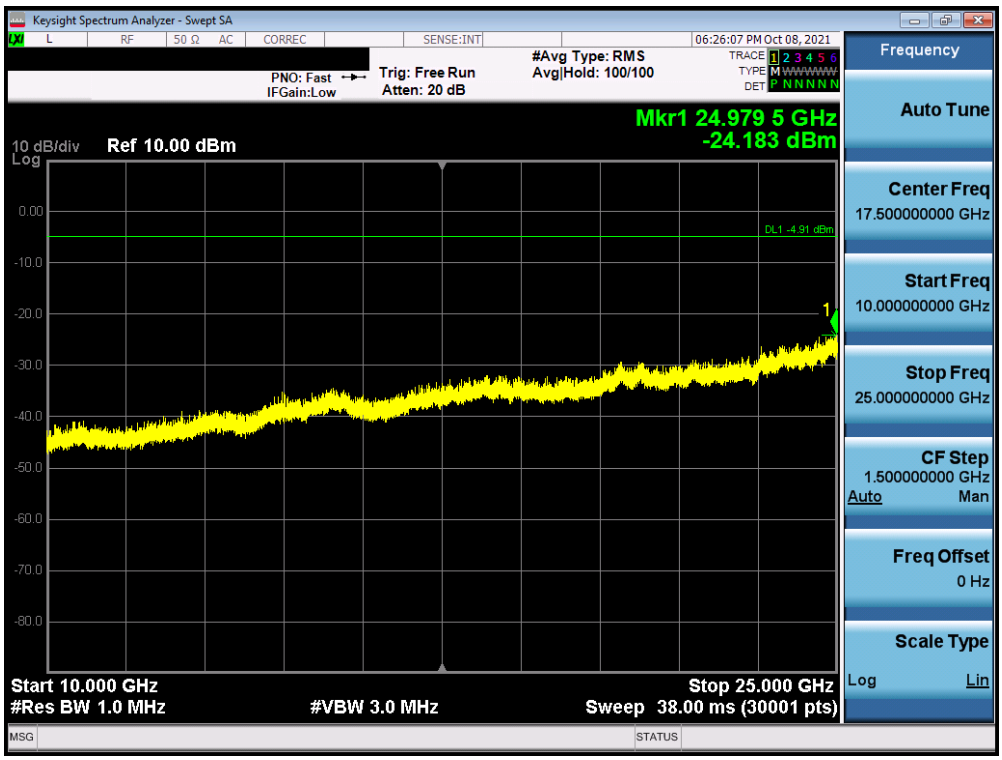
Plot 7-145. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 39) Antenna 1



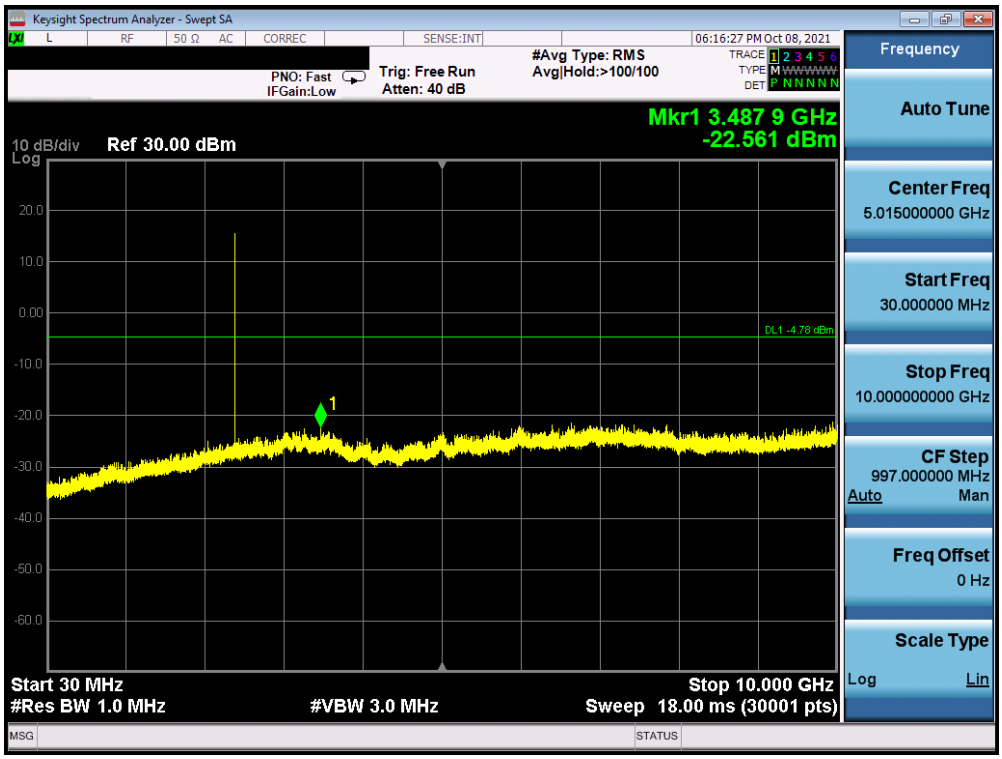
Plot 7-146. Conducted Spurious Plot (Bluetooth, 1MbpsCh. 39) Antenna 1



Plot 7-147. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 78) Antenna 1

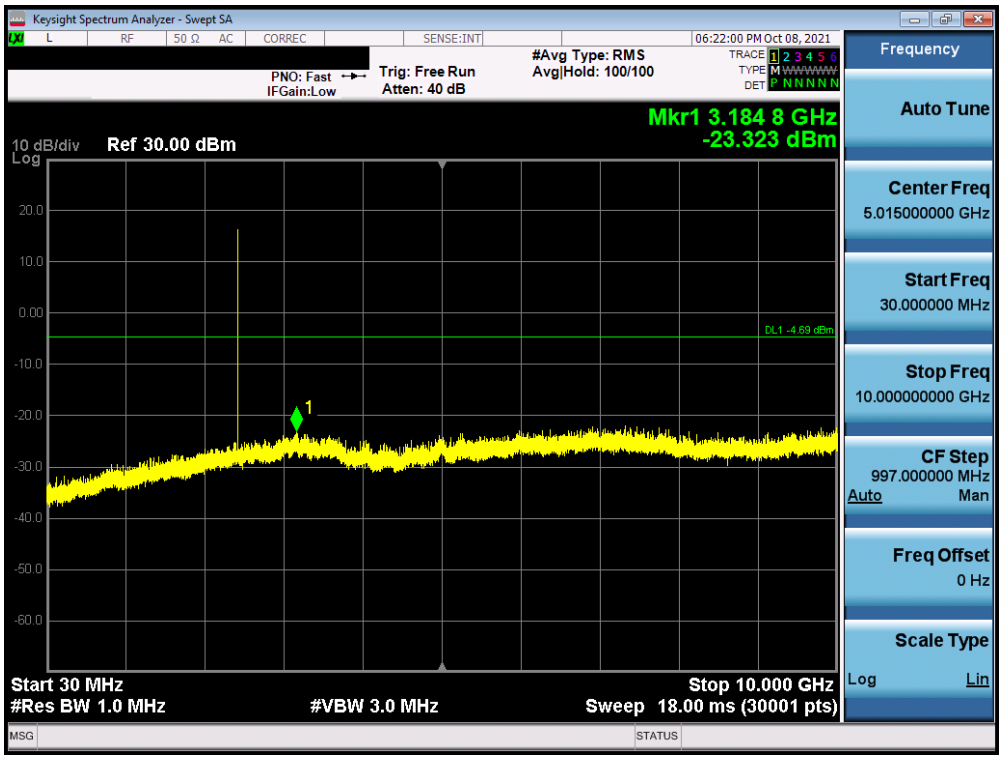


Plot 7-148. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 78) Antenna 1

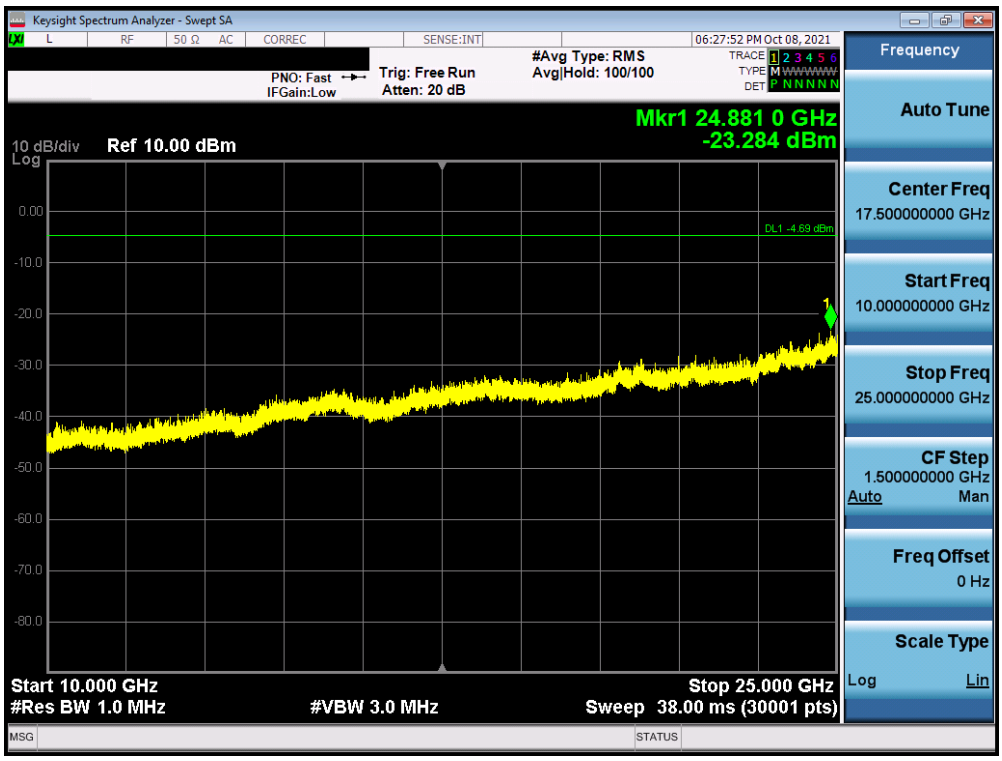


Plot 7-149. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 0) Antenna 2

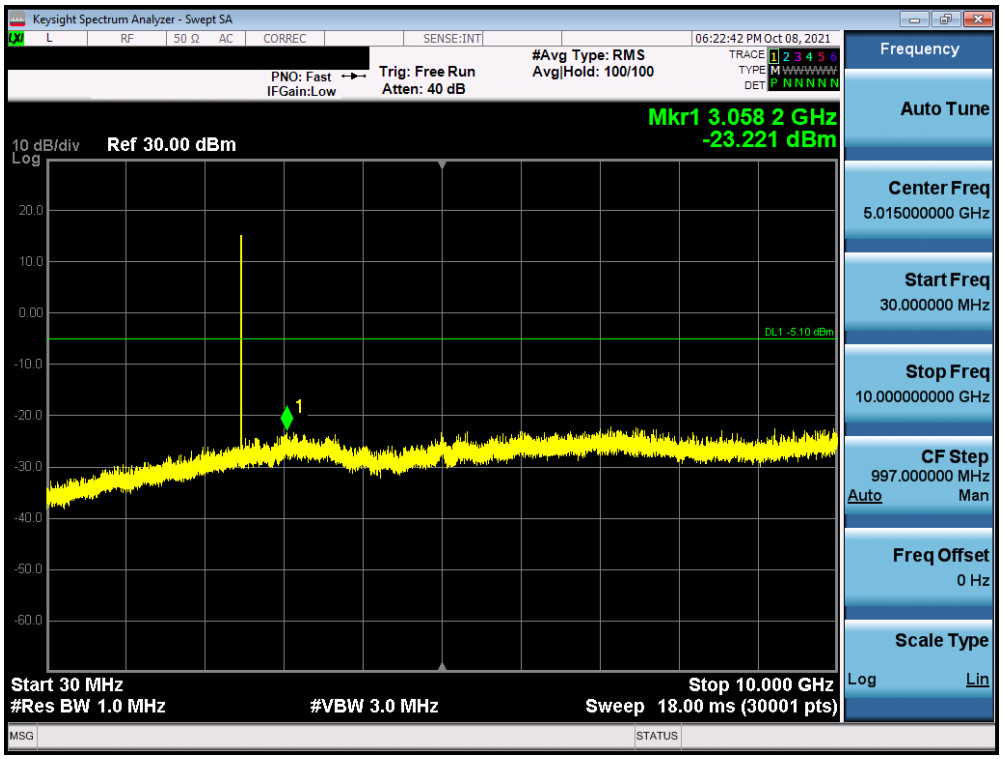
Plot 7-150. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 0) Antenna 2



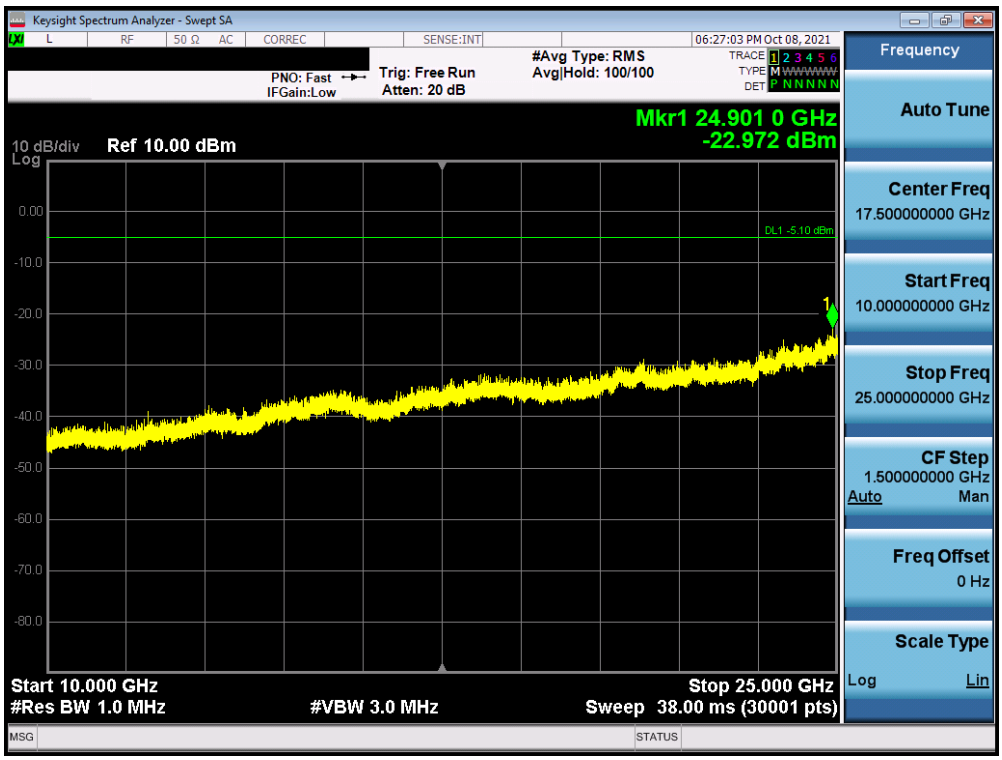
Plot 7-151. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 39) Antenna 2



Plot 7-152. Conducted Spurious Plot (Bluetooth, 1MbpsCh. 39) Antenna 2



Plot 7-153. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 78) Antenna 2



Plot 7-154. Conducted Spurious Plot (Bluetooth, 1Mbps– Ch. 78) Antenna 2

7.9 Radiated Spurious Emissions Measurements – 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 7-10 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-10. 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

Test Setup

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

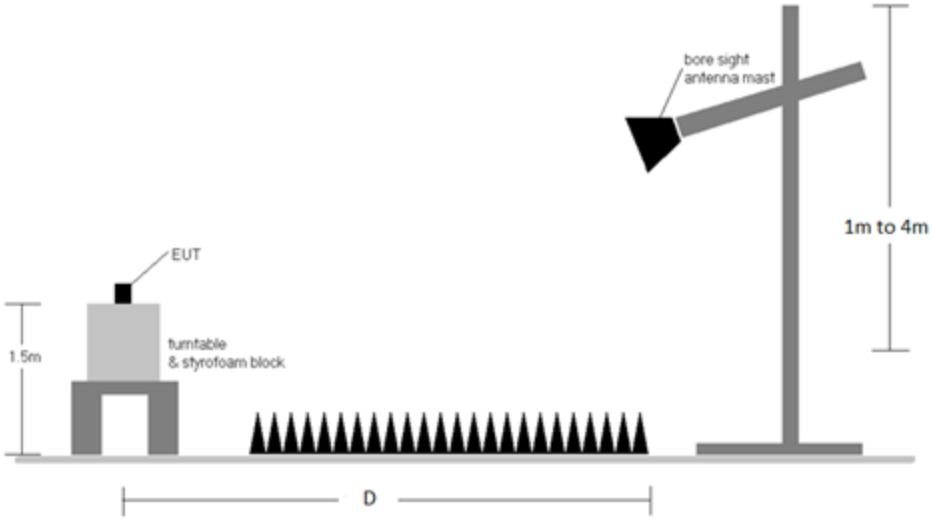


Figure 7-8. Radiated Test Setup >1GHz

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 7-10.
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. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
7. Average emissions were not reported since the duty cycle correction factor was greater than 20dB.
8. 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.
9. All supported modulation and power schemes have been tested on the unit and only the worst-case configuration is reported

Sample Calculation

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

Duty Cycle Correction Factor Calculation

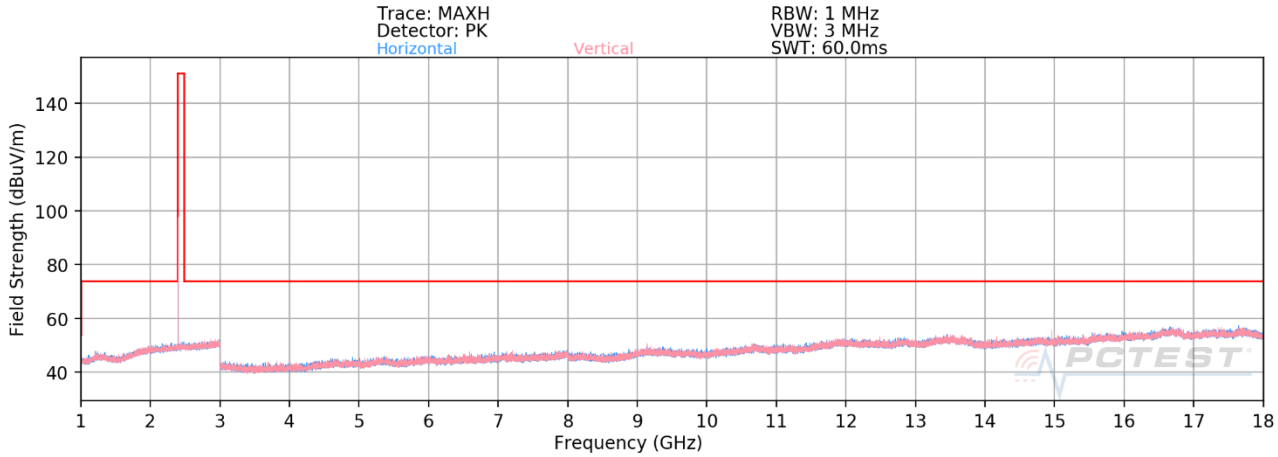
- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = 20log10(7.5ms/100ms) = -22.5 dB

Average Emission Calculation

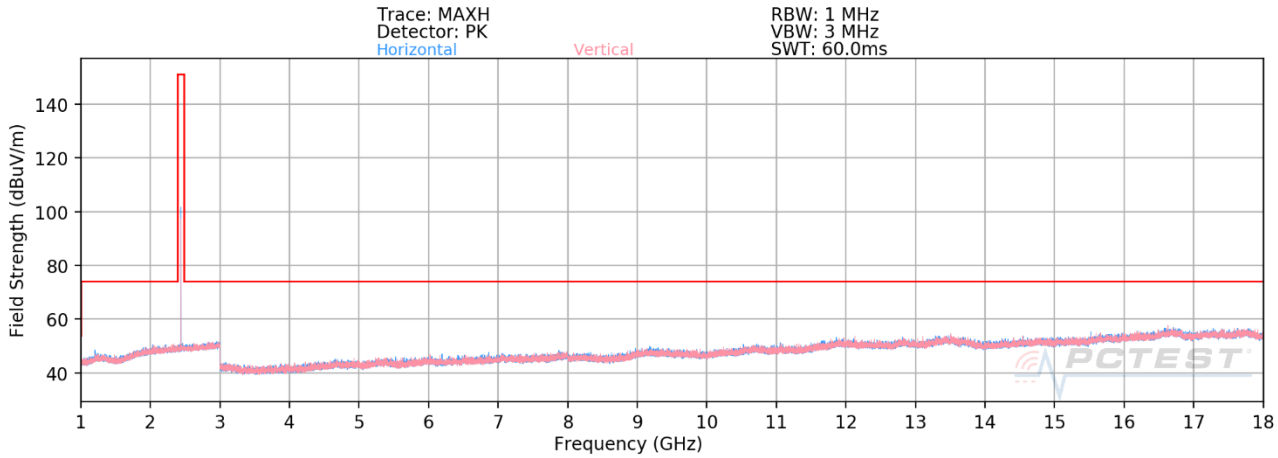
- Average Emission = Measured Peak Emissions [dBμV/m] – Duty Cycle Correction Factor [dB]

Radiated Spurious Emission Measurements (1 – 18GHz)

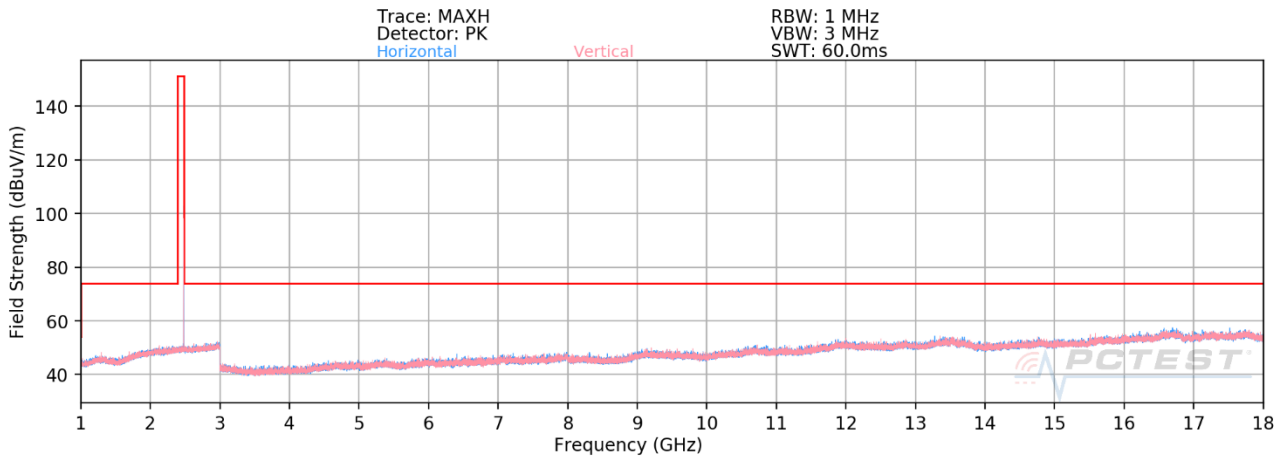
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]



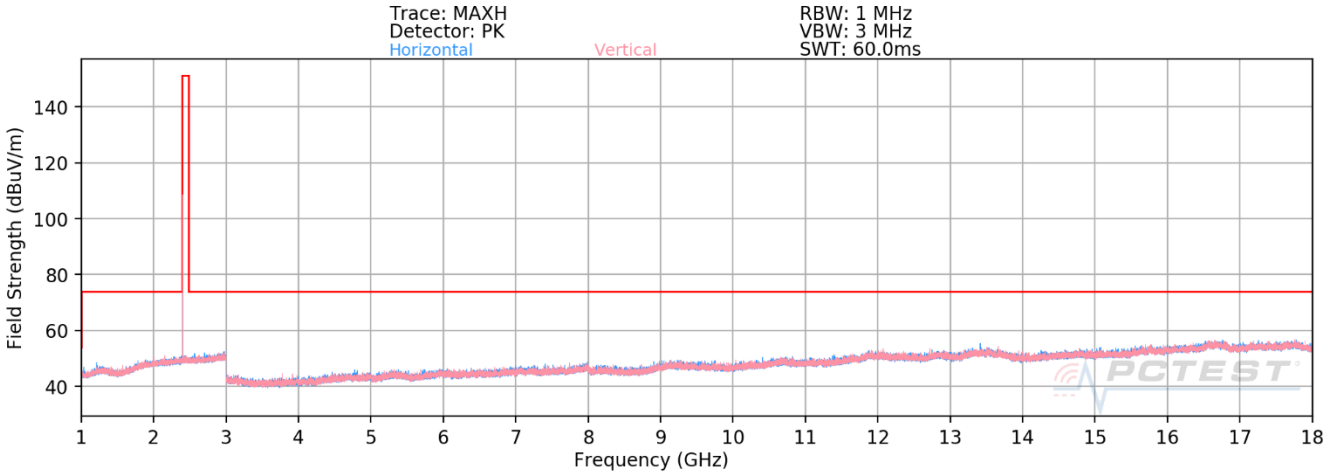
Plot 7-155. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 0) Antenna 1



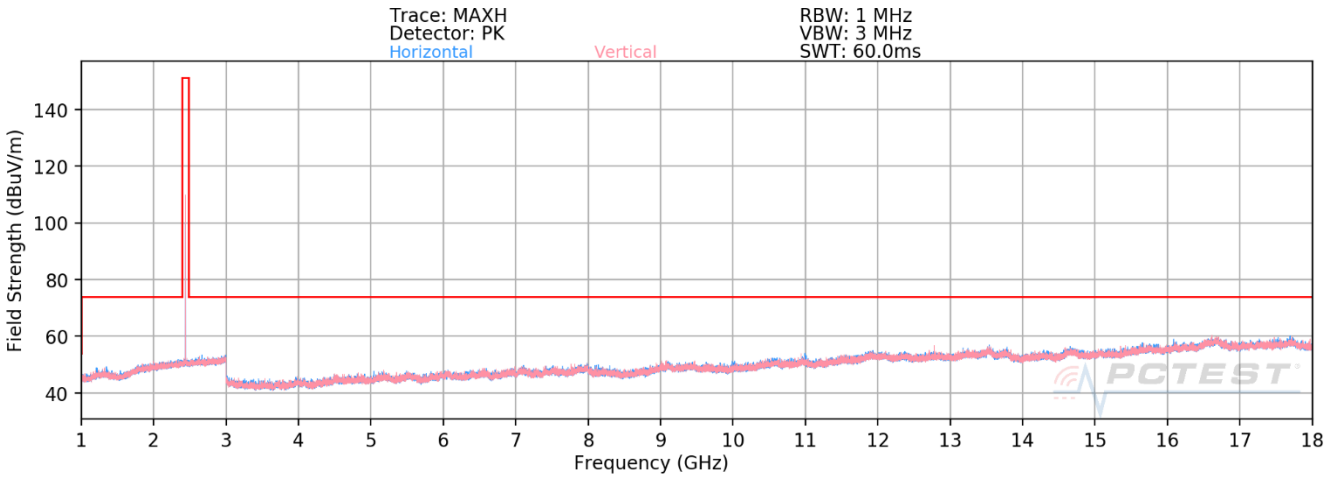
Plot7-156. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 39) Antenna 1



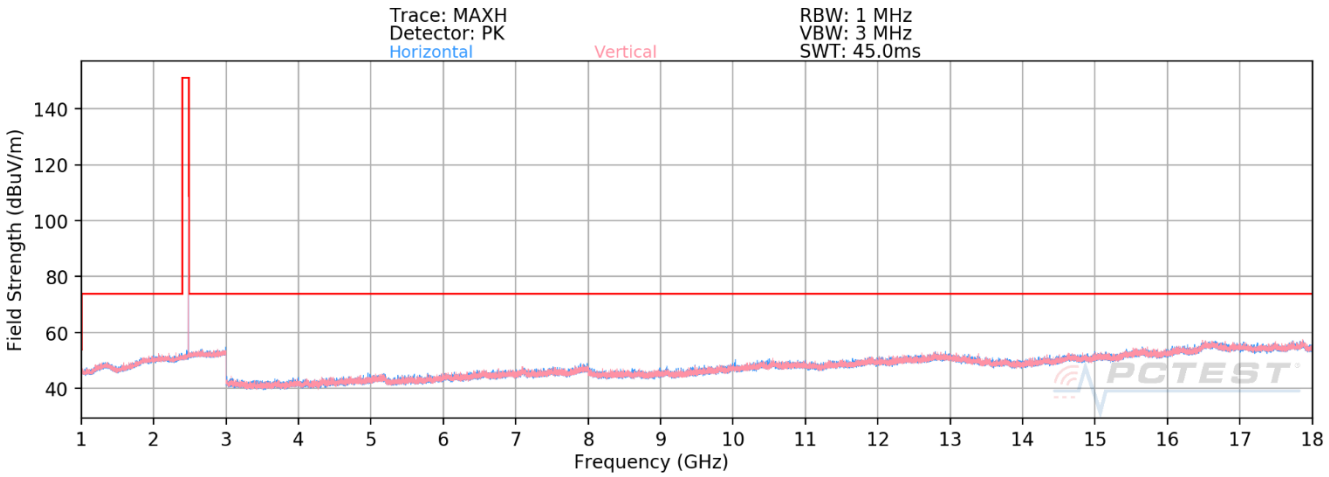
Plot 7-157. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 78) Antenna 1



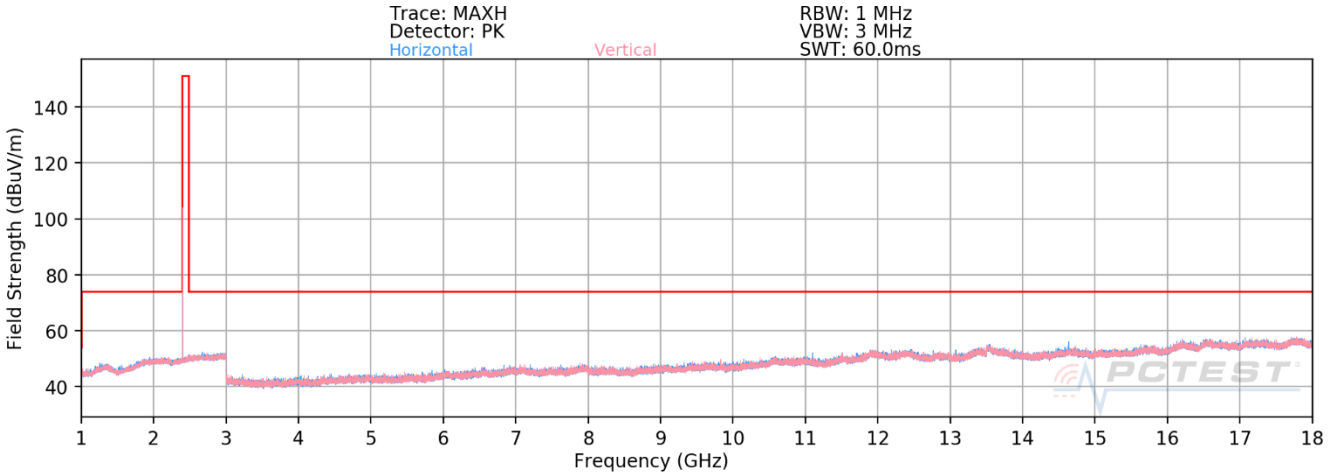
Plot 7-158. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 0) Antenna 2



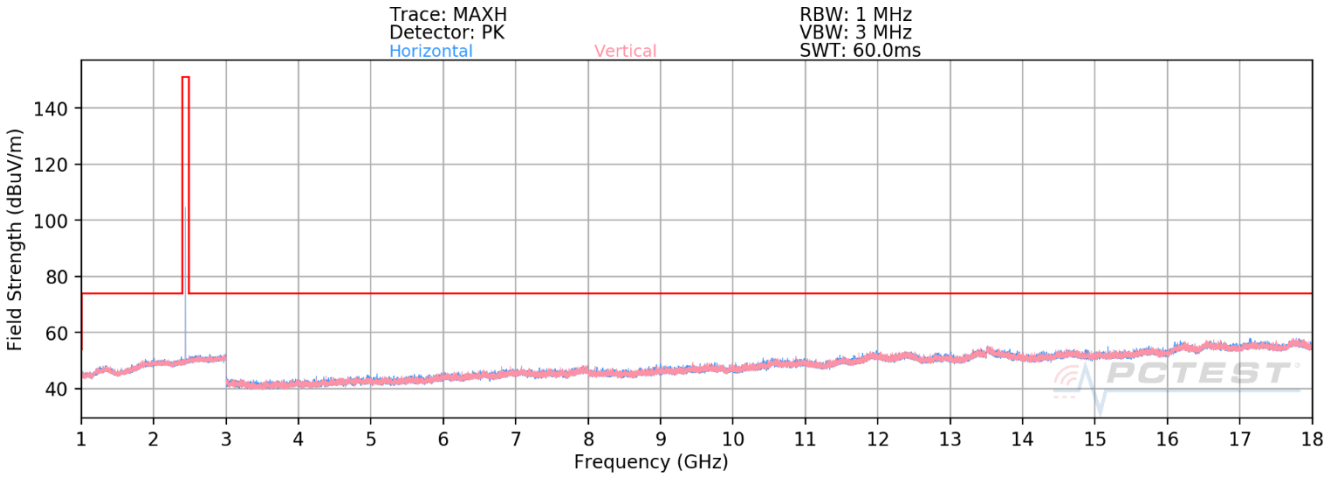
Plot7-159. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 39) Antenna 2



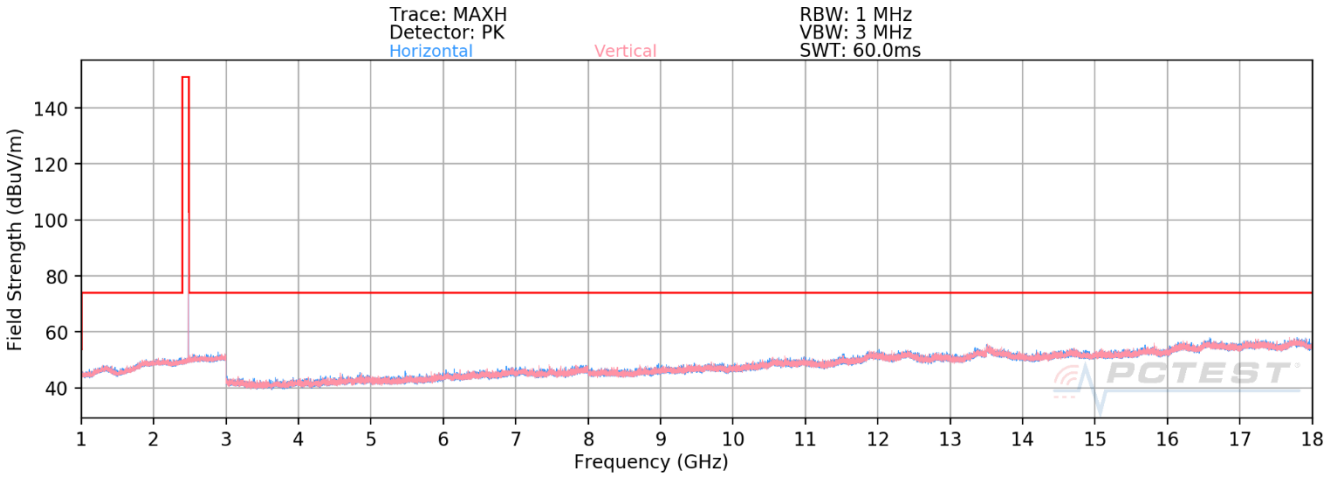
Plot 7-160. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 78) Antenna 2



Plot 7-161. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 0) Dual



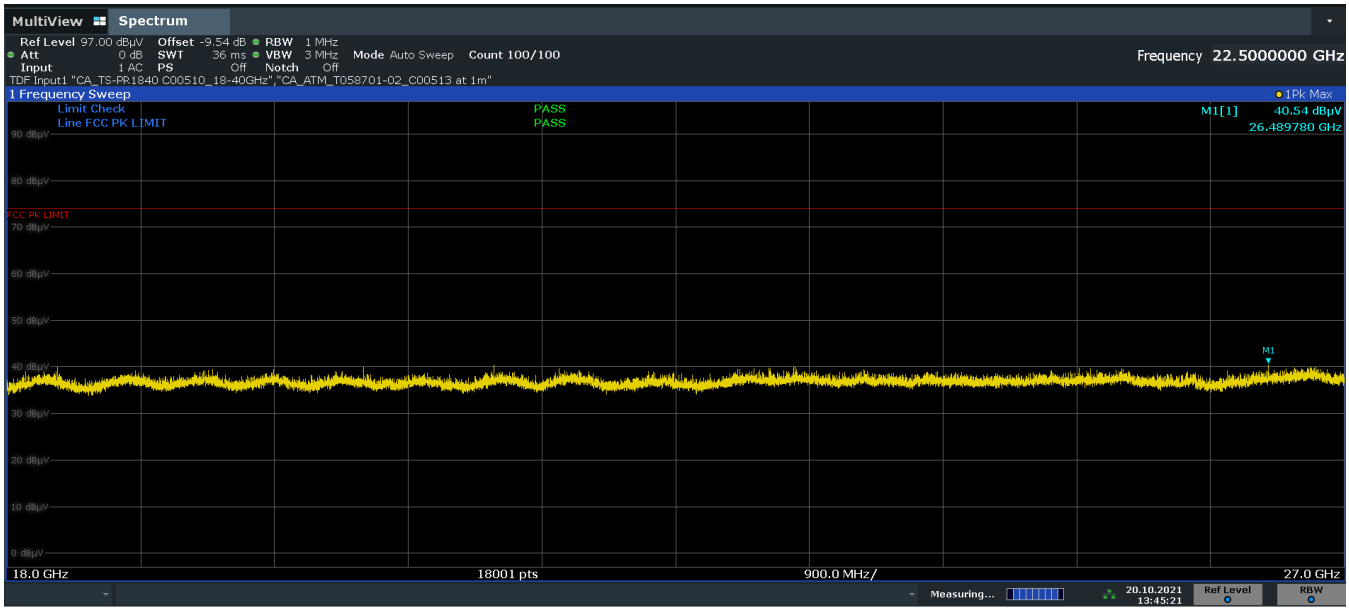
Plot7-162. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 39) Dual



Plot 7-163. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 78) Dual

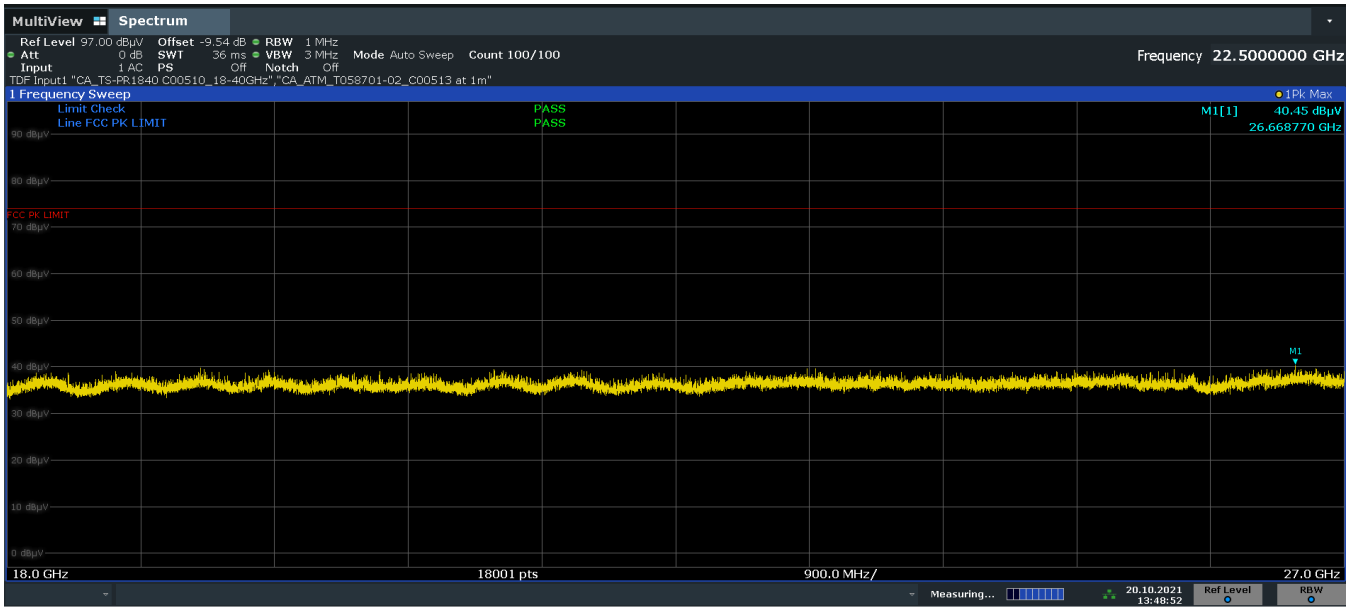
Radiated Spurious Emissions Measurements (Above 18GHz)

§15.209; RSS-Gen [8.9]



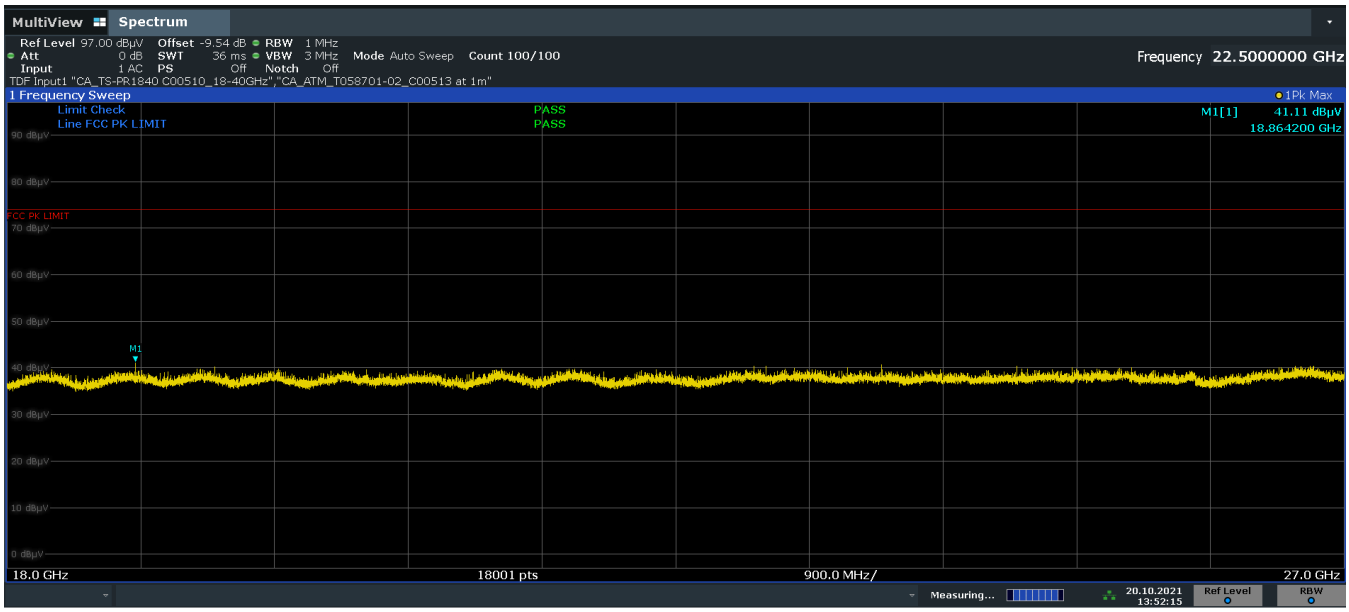
13:45:22 20.10.2021

Plot 7-164. Radiated Spurious Emissions above 18GHz (Bluetooth, 1Mbps– Ch. 0) Antenna 1 – Pol. H



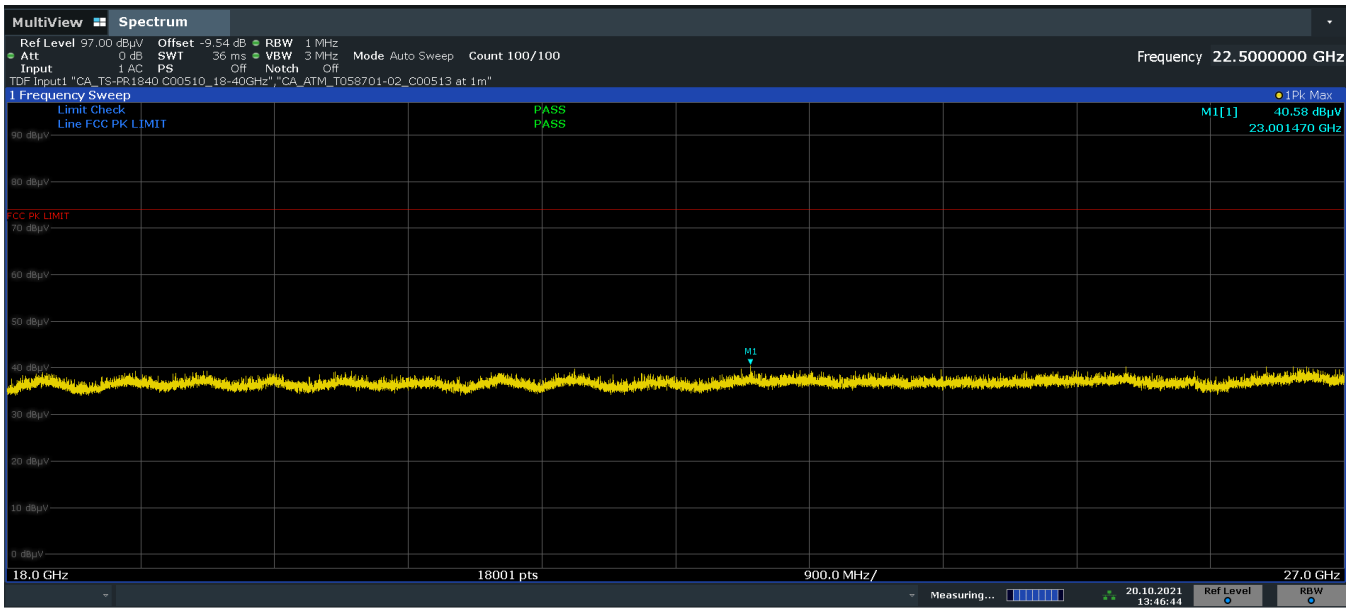
13:48:53 20.10.2021

Plot 7-165. Radiated Spurious Emissions above 18GHz (Bluetooth, 1Mbps– Ch. 0) Antenna 1 – Pol. V



13:52:16 20.10.2021

Plot 7-166. Radiated Spurious Emissions above 18GHz (Bluetooth, 1Mbps– Ch. 78) Dual – Pol. H



13:46:45 20.10.2021

Plot 7-167. Radiated Spurious Emissions above 18GHz (Bluetooth, 1Mbps– Ch. 78) Dual – Pol. V

Worst Case Mode	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	H	233	278	-78.71	6.55	-22.50	12.34	53.98	-41.64
4804.00	H	233	278	-68.75	6.55	0.00	44.80	73.98	-29.18
12010.00	H	-	-	-82.35	16.03	0.00	40.68	53.98	-13.30
12010.00	H	-	-	-71.63	16.03	0.00	51.40	73.98	-22.58

Table 7-11. Radiated Emission Measurements Antenna 1

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2441MHz
Channel:	39

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	H	244	266	-79.67	6.87	-22.50	11.70	53.98	-42.28
4882.00	H	244	266	-68.68	6.87	0.00	45.19	73.98	-28.79
7323.00	H	-	-	-81.82	9.92	0.00	35.10	53.98	-18.88
7323.00	H	-	-	-72.49	9.92	0.00	44.43	73.98	-29.55
12205.00	H	-	-	-82.66	16.32	0.00	40.66	53.98	-13.32
12205.00	H	-	-	-71.42	16.32	0.00	51.90	73.98	-22.08

Table 7-12. Radiated Emission Measurements Antenna 1

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	H	239	269	-80.10	6.96	-22.50	11.36	53.98	-42.62
4960.00	H	239	269	-69.72	6.96	0.00	44.24	73.98	-29.74
7440.00	H	-	-	-82.36	10.39	0.00	35.03	53.98	-18.95
7440.00	H	-	-	-71.85	10.39	0.00	45.54	73.98	-28.44
12400.00	H	-	-	-83.58	16.20	0.00	39.62	53.98	-14.36
12400.00	H	-	-	-72.56	16.20	0.00	50.64	73.98	-23.34

Table 7-13. Radiated Emission Measurements Antenna 1

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	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	Avg	H	-	-	-81.26	7.71	33.45	53.98	-20.53
4804.00	Peak	H	-	-	-69.81	7.71	44.90	73.98	-29.08
12010.00	Avg	H	-	-	-83.69	17.55	40.86	53.98	-13.12
12010.00	Peak	H	-	-	-72.47	17.55	52.08	73.98	-21.90

Table 7-14. Radiated Emission Measurements Antenna 1 with WCP

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	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	Avg	H	-	-	-76.84	6.55	36.71	53.98	-17.27
4804.00	Peak	H	-	-	-65.95	6.55	47.60	73.98	-26.38
12010.00	Avg	H	-	-	-82.41	16.03	40.62	53.98	-13.36
12010.00	Peak	H	-	-	-71.89	16.03	51.14	73.98	-22.84

Table 7-15. Radiated Emission Measurements Antenna 2

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2441MHz
Channel:	39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	H	192	357	-79.60	6.87	-22.50	11.77	53.98	-42.21
4882.00	Peak	H	192	357	-68.52	6.87	0.00	45.35	73.98	-28.63
7323.00	Avg	H	-	-	-81.83	9.92	0.00	35.09	53.98	-18.89
7323.00	Peak	H	-	-	-70.76	9.92	0.00	46.16	73.98	-27.82
12205.00	Avg	H	-	-	-82.70	16.32	0.00	40.62	53.98	-13.36
12205.00	Peak	H	-	-	-71.81	16.32	0.00	51.51	73.98	-22.47

Table 7-16. Radiated Emission Measurements Antenna 2

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	H	184	3	-78.31	6.96	-22.50	13.15	53.98	-40.83
4960.00	Peak	H	184	3	-69.30	6.96	0.00	44.66	73.98	-29.32
7440.00	Avg	H	-	-	-82.45	10.39	0.00	34.94	53.98	-19.04
7440.00	Peak	H	-	-	-71.27	10.39	0.00	46.12	73.98	-27.86
12400.00	Avg	H	-	-	-83.11	16.20	0.00	40.09	53.98	-13.89
12400.00	Peak	H	-	-	-72.23	16.20	0.00	50.97	73.98	-23.01

Table 7-17. Radiated Emission Measurements Antenna 2

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	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	Avg	V	-	-	-82.10	7.71	32.61	53.98	-21.37
4804.00	Peak	V	-	-	-70.81	7.71	43.90	73.98	-30.08
12010.00	Avg	V	-	-	-85.05	17.55	39.50	53.98	-14.48
12010.00	Peak	V	-	-	-73.82	17.55	50.73	73.98	-23.25

Table 7-18. Radiated Emission Measurements Dual

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2441MHz
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]
4882.00	Avg	V	-	-	-82.01	8.03	33.02	53.98	-20.96
4882.00	Peak	V	-	-	-70.63	8.03	44.40	73.98	-29.58
7323.00	Avg	V	-	-	-83.79	11.43	34.64	53.98	-19.34
7323.00	Peak	V	-	-	-72.77	11.43	45.66	73.98	-28.32
12205.00	Avg	V	-	-	-84.10	17.79	40.69	53.98	-13.29
12205.00	Peak	V	-	-	-72.68	17.79	52.11	73.98	-21.87

Table 7-19. Radiated Emission Measurements Dual

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

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	Avg	V	-	-	-81.81	7.89	33.08	53.98	-20.90
4960.00	Peak	V	-	-	-70.45	7.89	44.44	73.98	-29.54
7440.00	Avg	V	-	-	-84.45	12.38	34.93	53.98	-19.05
7440.00	Peak	V	-	-	-72.86	12.38	46.52	73.98	-27.46
12400.00	Avg	V	-	-	-84.80	18.27	40.47	53.98	-13.51
12400.00	Peak	V	-	-	-73.93	18.27	51.34	73.98	-22.64

Table 7-20. Radiated Emission Measurements Dual

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

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	Avg	V	-	-	-81.32	7.89	33.57	53.98	-20.41
4960.00	Peak	V	-	-	-70.24	7.89	44.65	73.98	-29.33
7440.00	Avg	V	-	-	-83.62	12.38	35.76	53.98	-18.22
7440.00	Peak	V	-	-	-72.44	12.38	46.94	73.98	-27.04
12400.00	Avg	V	-	-	-84.06	18.27	41.21	53.98	-12.77
12400.00	Peak	V	-	-	-72.47	18.27	52.80	73.98	-21.18

Table 7-21. Radiated Emission Measurements Dual with WCP

7.10 Radiated Restricted Band Edge Measurements

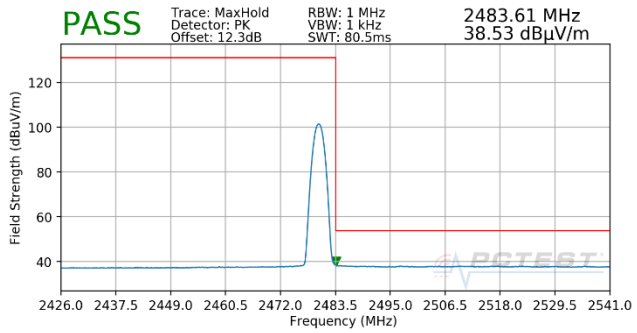
§15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction factor (DCCF).

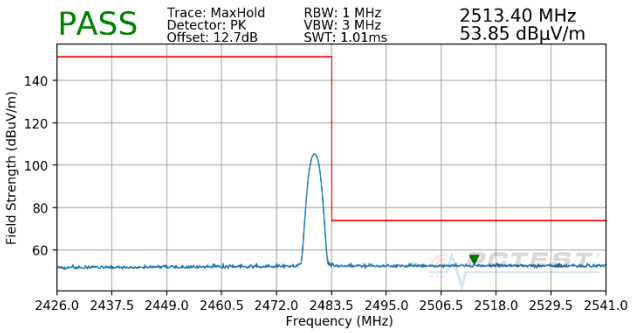
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

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

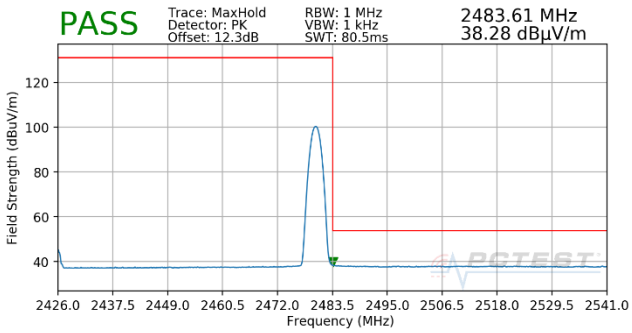
Worst Case Mode:	Bluetooth
Worst Case Data Rate:	3 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



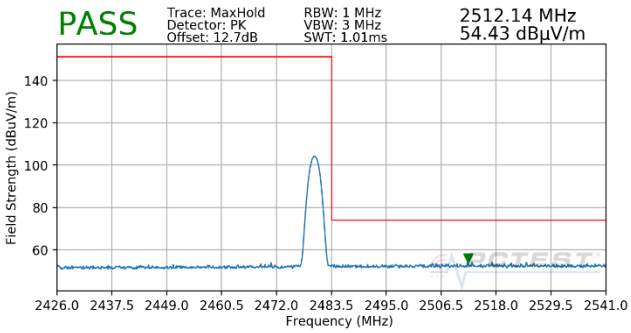
Plot 7-168. Radiated Restricted Upper Band Edge Measurement (Average) – Antenna 1



Plot 7-169. Radiated Restricted Upper Band Edge Measurement (Peak) – Antenna 1

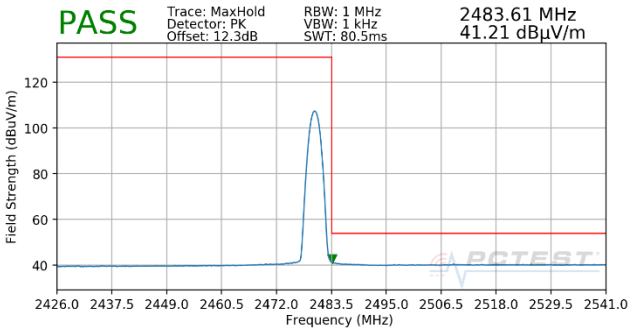


Plot 7-170. Radiated Restricted Upper Band Edge Measurement with WCP (Average) – Antenna 1

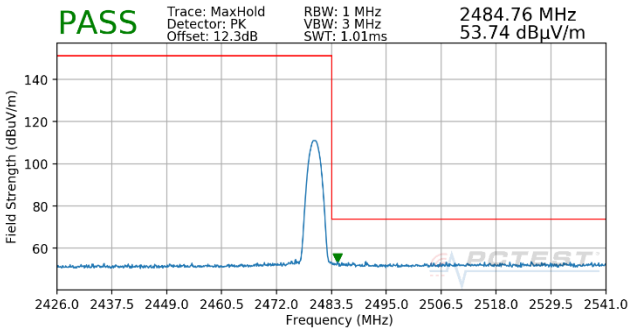


Plot 7-171. Radiated Restricted Upper Band Edge Measurement with WCP (Peak) – Antenna 1

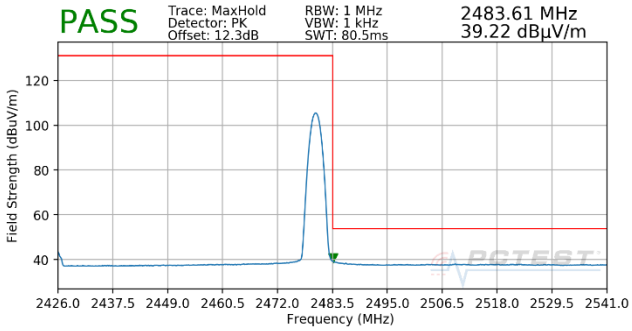
Worst Case Mode:	Bluetooth
Worst Case Data Rate:	2 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



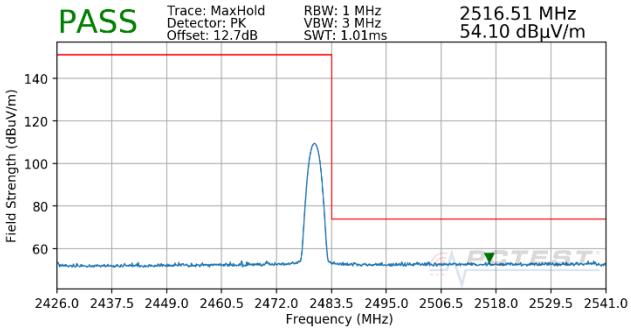
Plot 7-172. Radiated Restricted Upper Band Edge Measurement (Average) – Antenna 2



Plot 7-173. Radiated Restricted Upper Band Edge Measurement (Peak) – Antenna 2

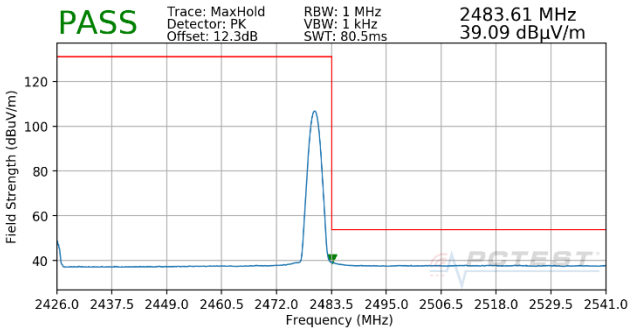


Plot 7-174. Radiated Restricted Upper Band Edge Measurement with WCP (Average) – Antenna 2

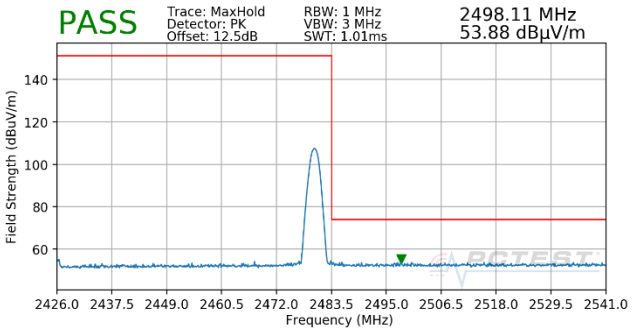


Plot 7-175. Radiated Restricted Upper Band Edge Measurement with WCP (Peak) – Antenna 2

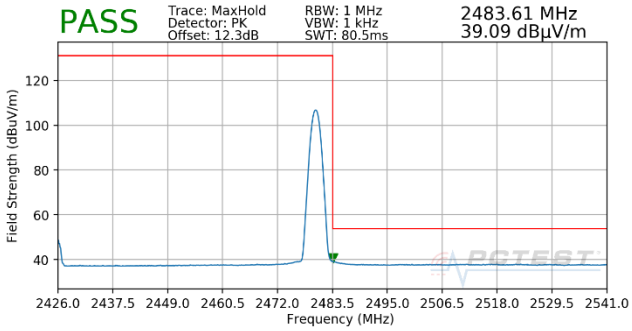
Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



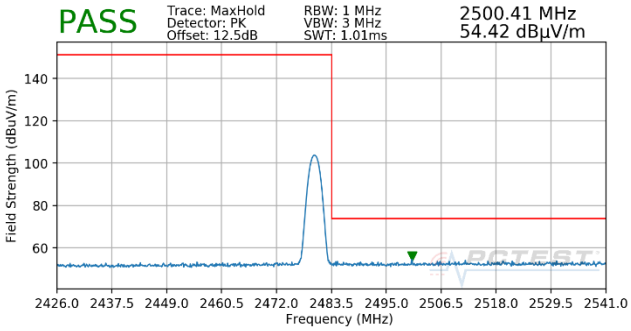
Plot 7-176. Radiated Restricted Upper Band Edge Measurement (Average) – Dual



Plot 7-177. Radiated Restricted Upper Band Edge Measurement (Peak) – Dual



Plot 7-178. Radiated Restricted Upper Band Edge Measurement with WCP (Average) – Dual



Plot 7-179. Radiated Restricted Upper Band Edge Measurement with WCP (Peak) – Dual

7.11 Radiated Spurious Emissions Measurements – 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 7-22 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 7-22. 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.

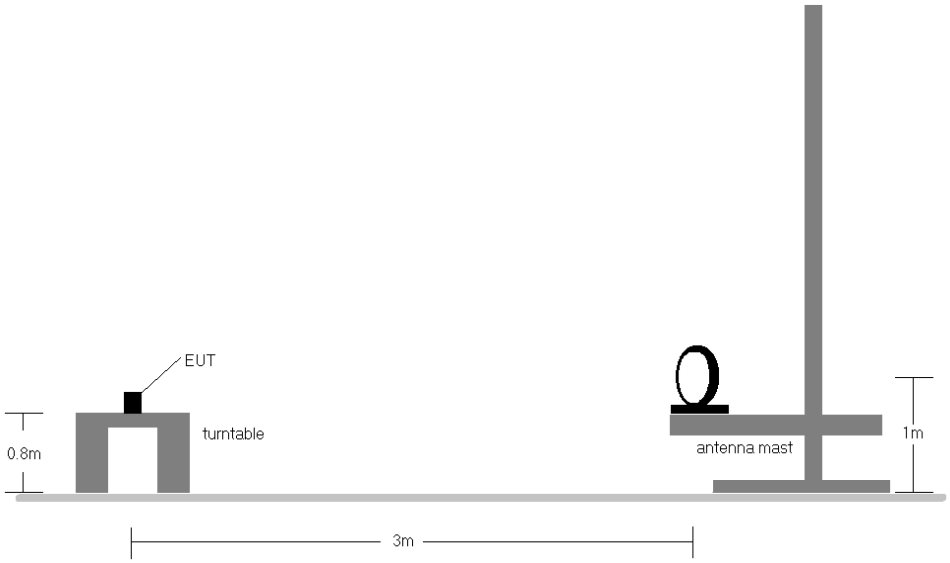


Figure 7-9. Radiated Test Setup < 30Mhz

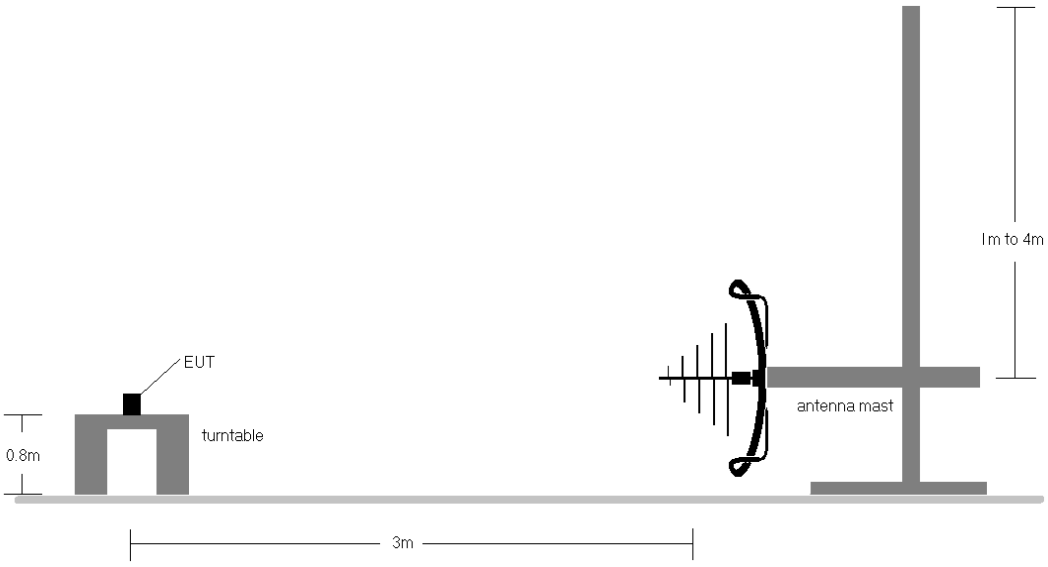


Figure 7-10. Radiated Test Setup < 1GHz

Test Notes

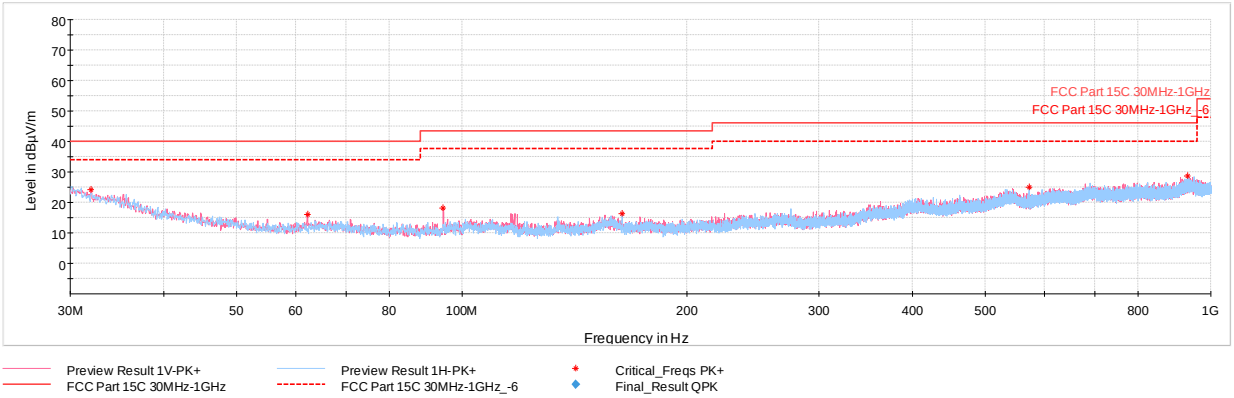
1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-10.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes. For below 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 and power schemes have been tested on the unit and only the worst-case configuration is reported.

Sample Calculation

- Field Strength Level [dBμV/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 [dBμV/m] – Limit [dBμV/m]

Radiated Spurious Emissions Measurements (Below 1GHz)

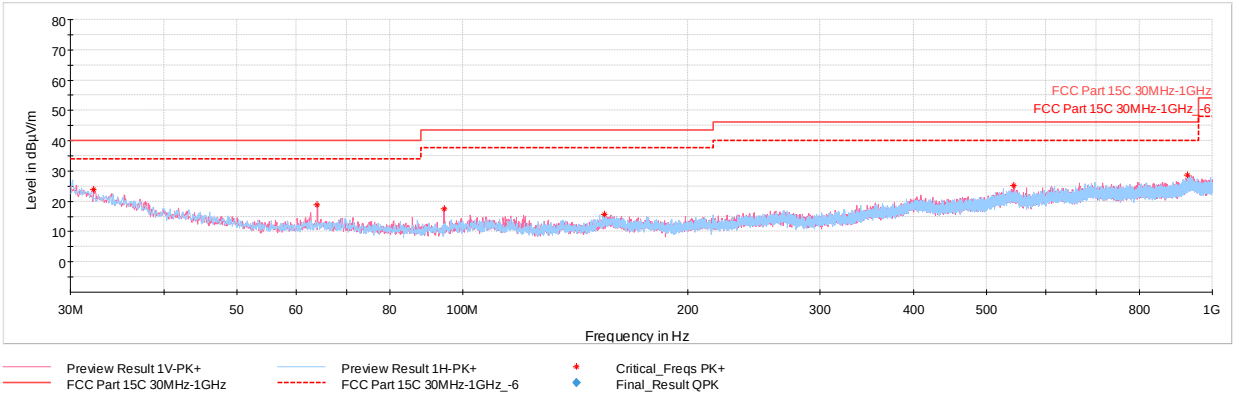
§15.209; RSS-Gen [8.9]



Plot 7-180. Radiated Spurious Plot Below 1GHz - Antenna 1

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]
31.99	Max- Peak	V	100	236	-69.64	-13.18	24.18	40.00	-15.82
62.20	Max- Peak	V	250	268	-70.14	-20.71	16.15	40.00	-23.85
94.46	Max- Peak	V	100	91	-68.49	-20.42	18.09	43.52	-25.43
163.67	Max- Peak	H	100	13	-73.79	-16.88	16.33	43.52	-27.19
571.55	Max- Peak	H	100	21	-76.14	-5.81	25.05	46.02	-20.97
930.40	Max- Peak	H	100	277	-78.69	0.37	28.68	46.02	-17.34

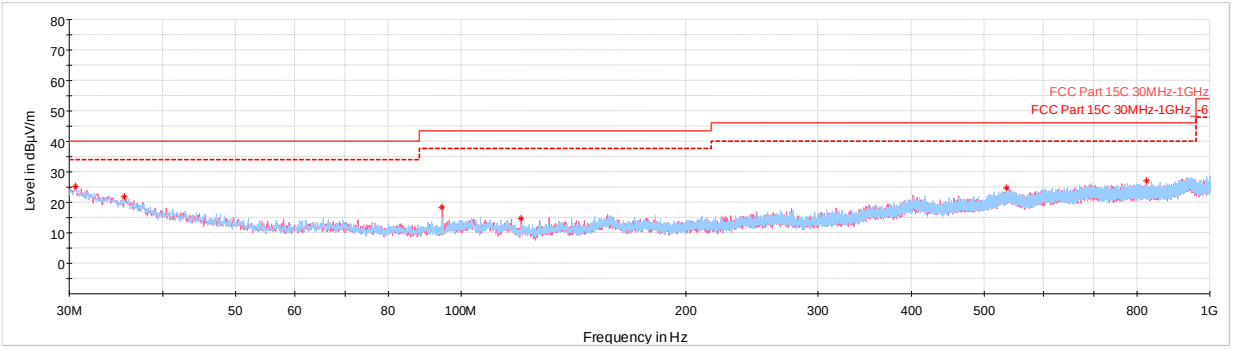
Table 7-23. Radiated Spurious Emissions Below 1GHz - Antenna 1



Plot 7-181. Radiated Spurious Plot Below 1GHz - Antenna 2

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]
32.23	Max- Peak	V	250	125	-69.83	-13.37	23.80	40.00	-16.20
64.05	Max- Peak	V	100	45	-67.65	-20.60	18.75	40.00	-21.25
94.51	Max- Peak	V	100	237	-69.08	-20.39	17.53	43.52	-25.99
154.79	Max- Peak	H	250	125	-75.40	-16.00	15.60	43.52	-27.92
543.81	Max- Peak	V	100	75	-77.42	-4.37	25.21	46.02	-20.81
927.64	Max- Peak	H	100	180	-78.66	0.23	28.57	46.02	-17.45

Table 7-24. Radiated Spurious Emissions Below 1GHz - Antenna 2



Plot 7-182. Radiated Spurious Plot Below 1GHz - Dual

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]
30.63	Max- Peak	V	250	43	-69.60	-12.03	25.37	40.00	-14.63
35.53	Max- Peak	H	250	18	-70.62	-14.50	21.88	40.00	-18.12
94.46	Max- Peak	V	100	16	-68.24	-20.42	18.34	43.52	-25.18
120.40	Max- Peak	V	100	22	-72.74	-19.51	14.75	43.52	-28.77
535.95	Max- Peak	H	100	293	-77.72	-4.54	24.74	46.02	-21.28
822.78	Max- Peak	V	250	160	-78.13	-1.71	27.16	46.02	-18.86

Table 7-25. Radiated Spurious Emissions Below 1GHz - Dual

7.12 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 7-26. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

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

Average Measurements

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

Test Setup

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

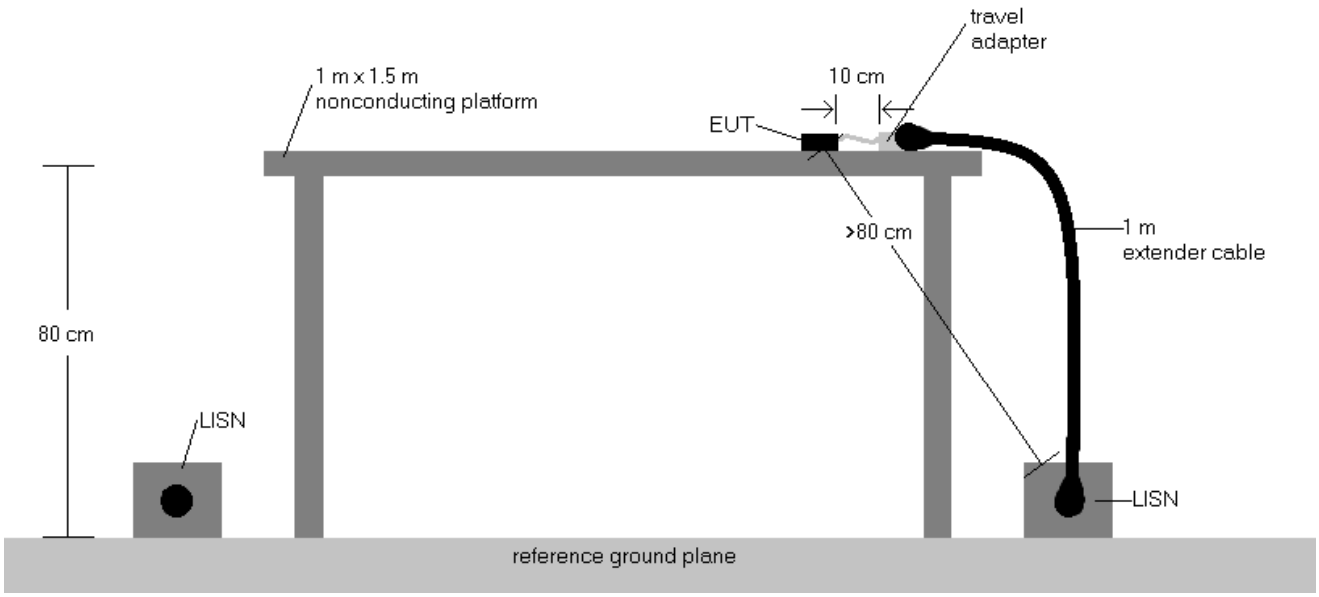
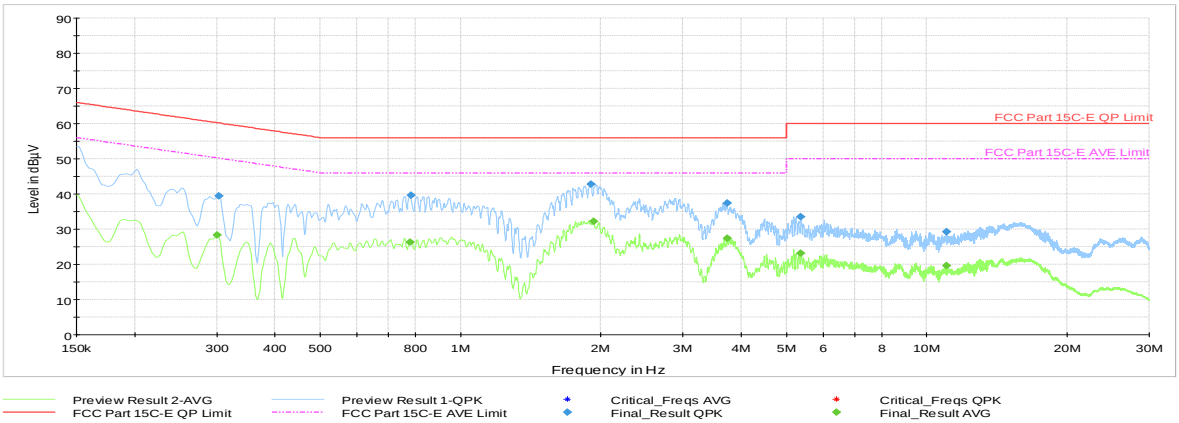


Figure 7-11. Test Instrument & Measurement Setup

Test Notes

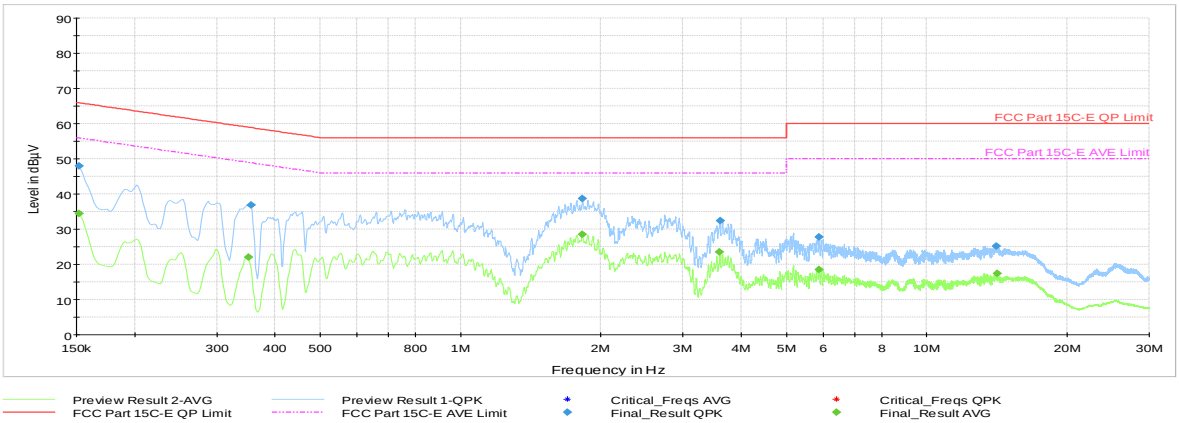
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Level (dBμV) – QP/AV Limit (dBμV)
6. Traces shown in plot are made using quasi-peak and average detectors.
7. Deviations to the Specifications: None.



Plot 7-183. AC Line-Conducted Emissions (L1)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.301	FINAL	—	28.31	50.22	-21.91	L1	GND
0.303	FINAL	39.5	—	60.16	-20.63	L1	GND
0.780	FINAL	—	26.29	46.00	-19.71	L1	GND
0.782	FINAL	39.5	—	56.00	-16.46	L1	GND
1.901	FINAL	42.8	—	56.00	-13.20	L1	GND
1.928	FINAL	—	32.18	46.00	-13.82	L1	GND
3.725	FINAL	37.4	—	56.00	-18.63	L1	GND
3.728	FINAL	—	27.39	46.00	-18.61	L1	GND
5.370	FINAL	—	23.17	50.00	-26.83	L1	GND
5.370	FINAL	33.6	—	60.00	-26.44	L1	GND
11.038	FINAL	—	19.65	50.00	-30.35	L1	GND
11.045	FINAL	29.3	—	60.00	-30.69	L1	GND

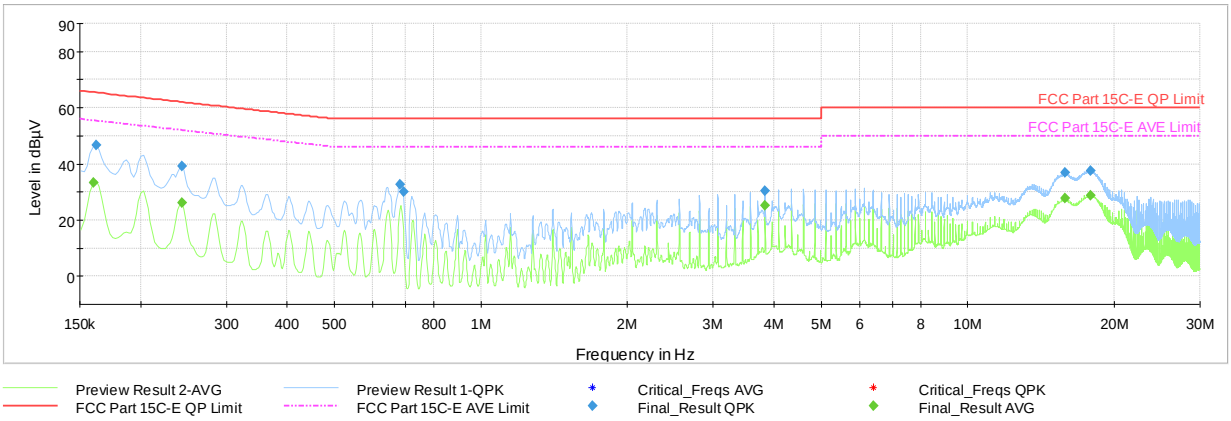
Table 7-27. AC Line-Conducted Emissions Data (L1)



Plot 7-184. AC Line-Conducted Emissions (N)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.152	FINAL	48.0	—	65.88	-17.90	N	GND
0.152	FINAL	—	34.37	55.88	-21.51	N	GND
0.350	FINAL	—	22.09	48.96	-26.86	N	GND
0.355	FINAL	36.8	—	58.85	-22.08	N	GND
1.826	FINAL	—	28.56	46.00	-17.44	N	GND
1.826	FINAL	38.6	—	56.00	-17.36	N	GND
3.595	FINAL	—	23.48	46.00	-22.52	N	GND
3.604	FINAL	32.4	—	56.00	-23.56	N	GND
5.881	FINAL	—	18.48	50.00	-31.52	N	GND
5.883	FINAL	27.9	—	60.00	-32.15	N	GND
14.082	FINAL	25.2	—	60.00	-34.85	N	GND
14.138	FINAL	—	17.32	50.00	-32.68	N	GND

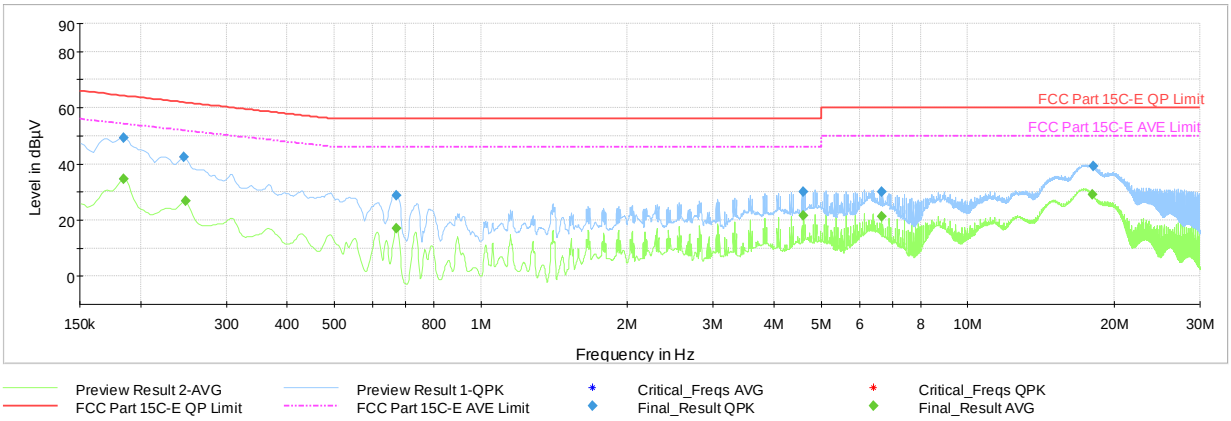
Table 7-28. AC Line-Conducted Emissions Data (N)



Plot 7-185. AC Line-Conducted Emissions (L1) with WCP

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.160	FINAL	—	33.36	55.48	-22.12	L1	GND
0.162	FINAL	46.8	—	65.36	-18.58	L1	GND
0.243	FINAL	—	26.13	51.99	-25.86	L1	GND
0.243	FINAL	39.2	—	61.99	-22.82	L1	GND
0.682	FINAL	32.8	—	56.00	-23.22	L1	GND
0.693	FINAL	30.2	—	56.00	-25.83	L1	GND
3.834	FINAL	—	25.05	46.00	-20.95	L1	GND
3.834	FINAL	30.3	—	56.00	-25.67	L1	GND
15.845	FINAL	—	27.77	50.00	-22.23	L1	GND
15.845	FINAL	36.9	—	60.00	-23.12	L1	GND
17.888	FINAL	—	28.66	50.00	-21.34	L1	GND
17.890	FINAL	37.5	—	60.00	-22.54	L1	GND

Table 7-29. AC Line-Conducted Emissions Data (L1) with WCP



Plot 7-186. AC Line-Conducted Emissions (N) with WCP

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.185	FINAL	—	34.74	54.28	-19.54	N	GND
0.185	FINAL	49.4	—	64.28	-14.92	N	GND
0.245	FINAL	42.5	—	61.92	-19.37	N	GND
0.248	FINAL	—	26.69	51.84	-25.15	N	GND
0.671	FINAL	—	17.10	46.00	-28.90	N	GND
0.671	FINAL	28.7	—	56.00	-27.27	N	GND
4.601	FINAL	29.9	—	56.00	-26.09	N	GND
4.601	FINAL	—	21.69	46.00	-24.31	N	GND
6.644	FINAL	30.0	—	60.00	-30.00	N	GND
6.644	FINAL	—	21.23	50.00	-28.77	N	GND
18.029	FINAL	—	29.22	50.00	-20.78	N	GND
18.144	FINAL	39.3	—	60.00	-20.69	N	GND

Table 7-30. AC Line-Conducted Emissions Data (N) with WCP

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMS908U** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.