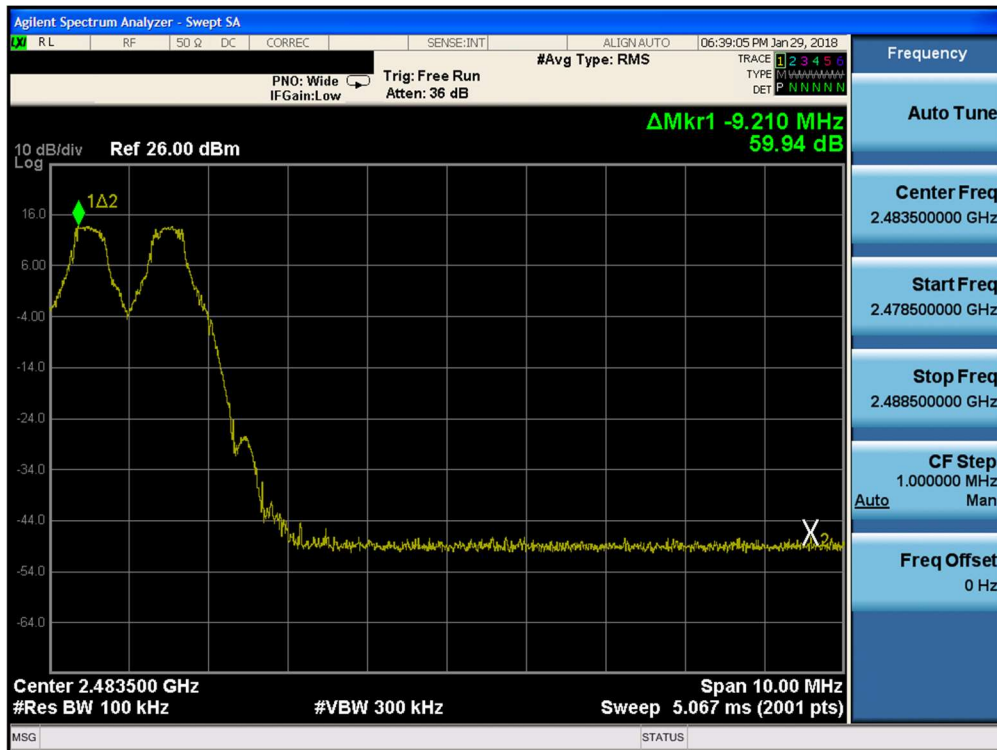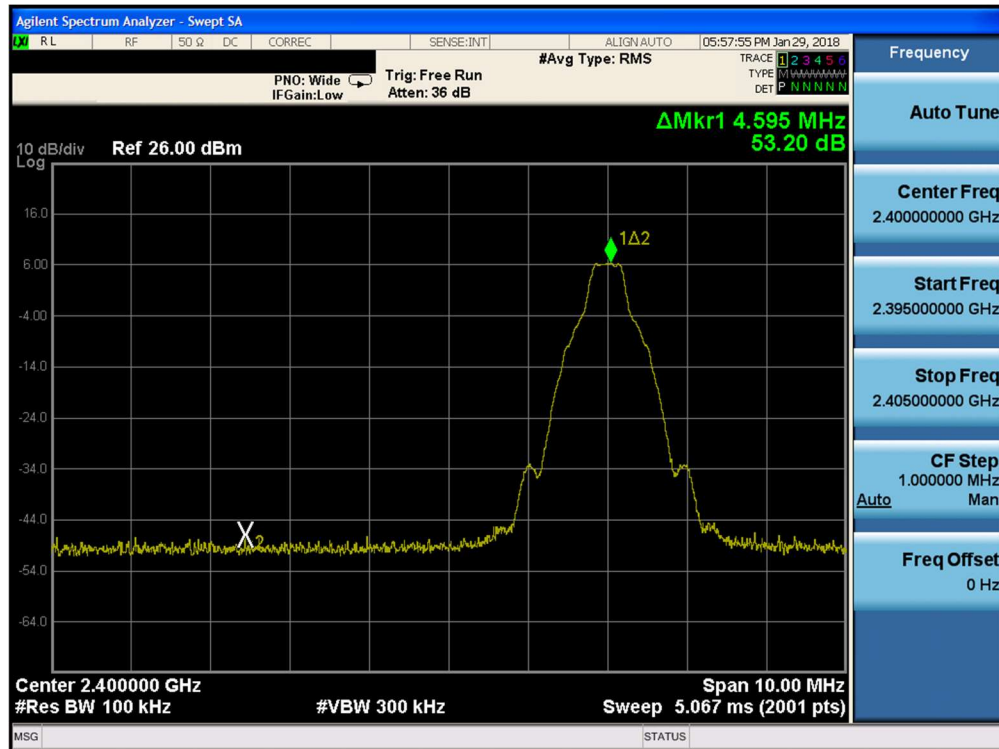**Plot 7-27. Band Edge Plot (Bluetooth with Hopping Enabled, GFSK, ePA - Ch.0)**

Plot 7-28. Band Edge Plot (Bluetooth with Hopping Enabled, GFSK, ePA – Ch.78)

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Plot 7-29. Band Edge Plot (Bluetooth with Hopping Disabled, GFSK, iPA – Ch. 0)

Plot 7-30. Band Edge Plot (Bluetooth with Hopping Disabled, GFSK, iPA – Ch.78)

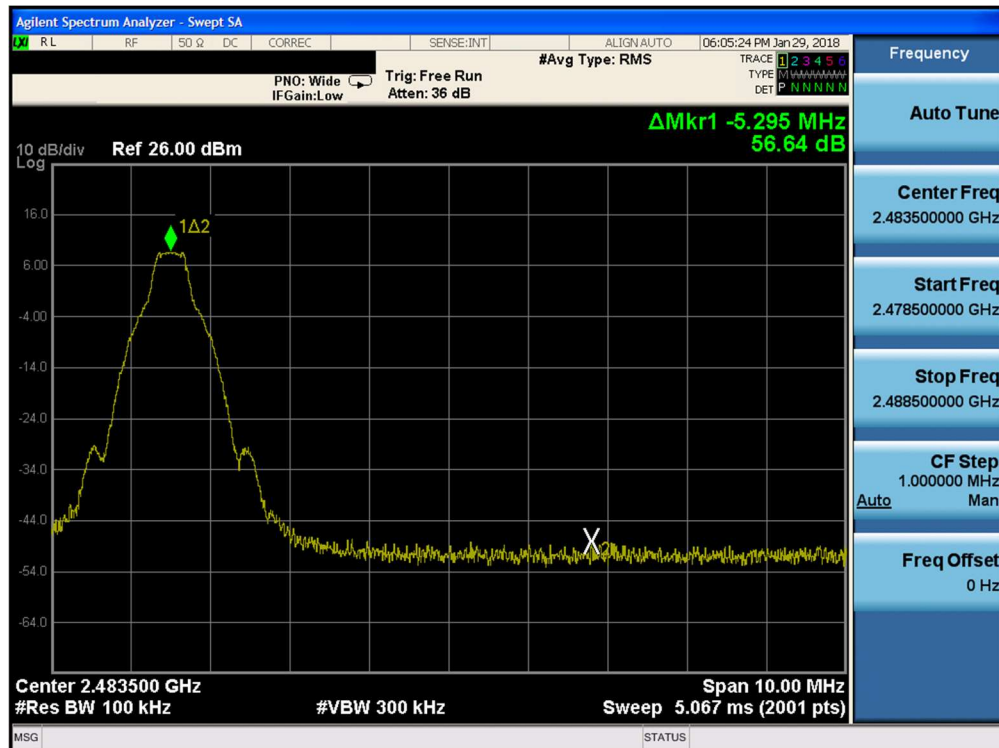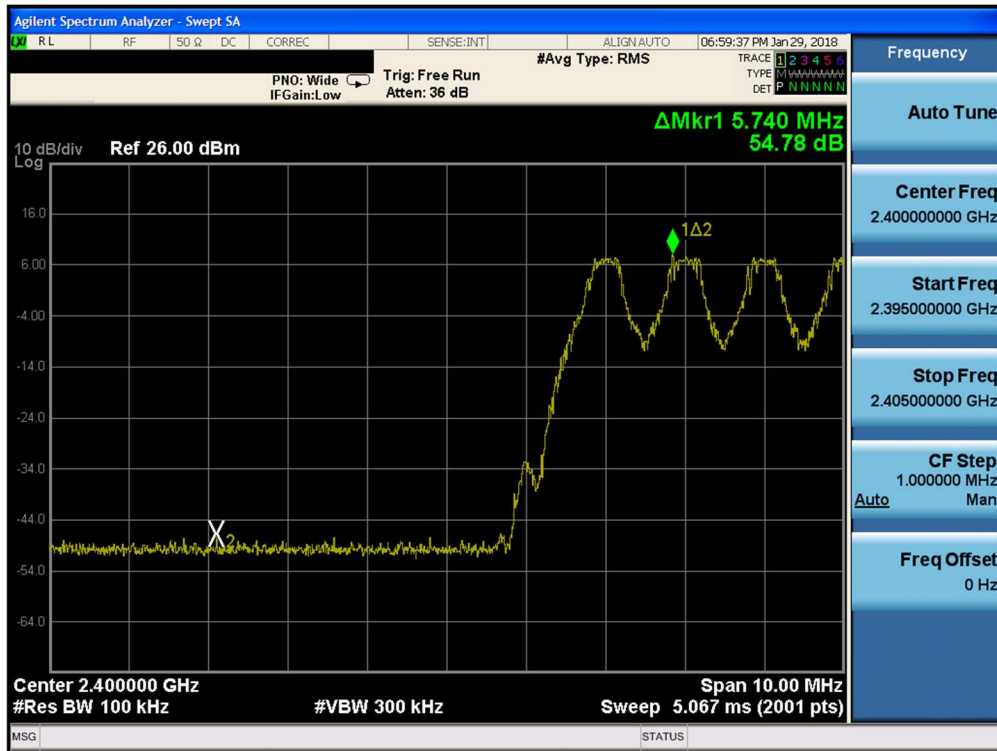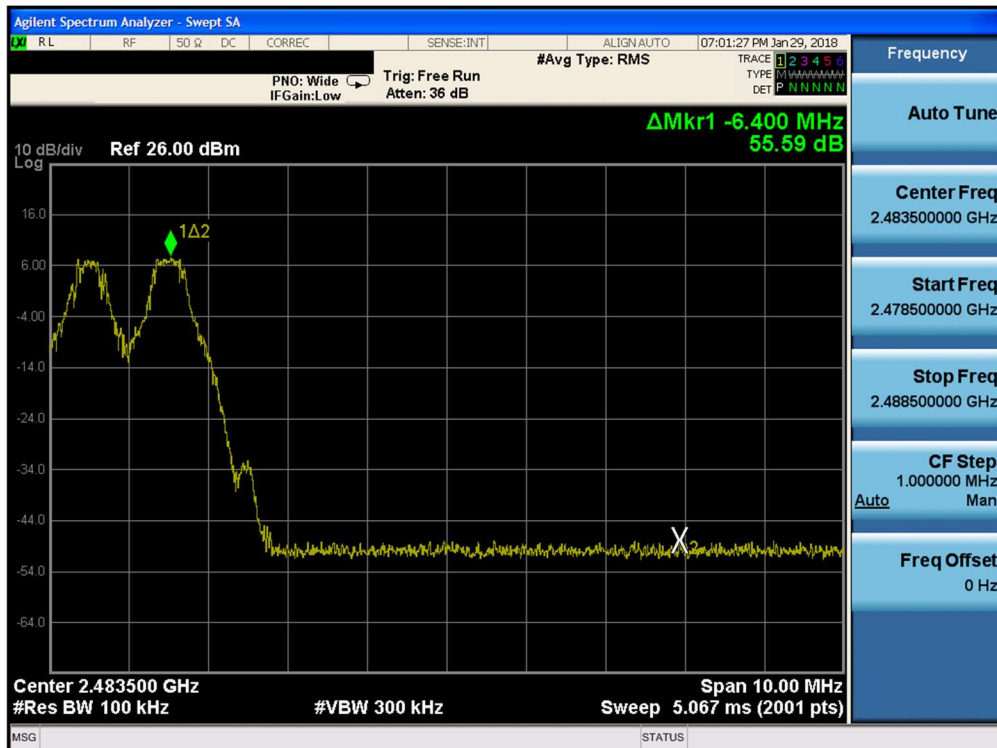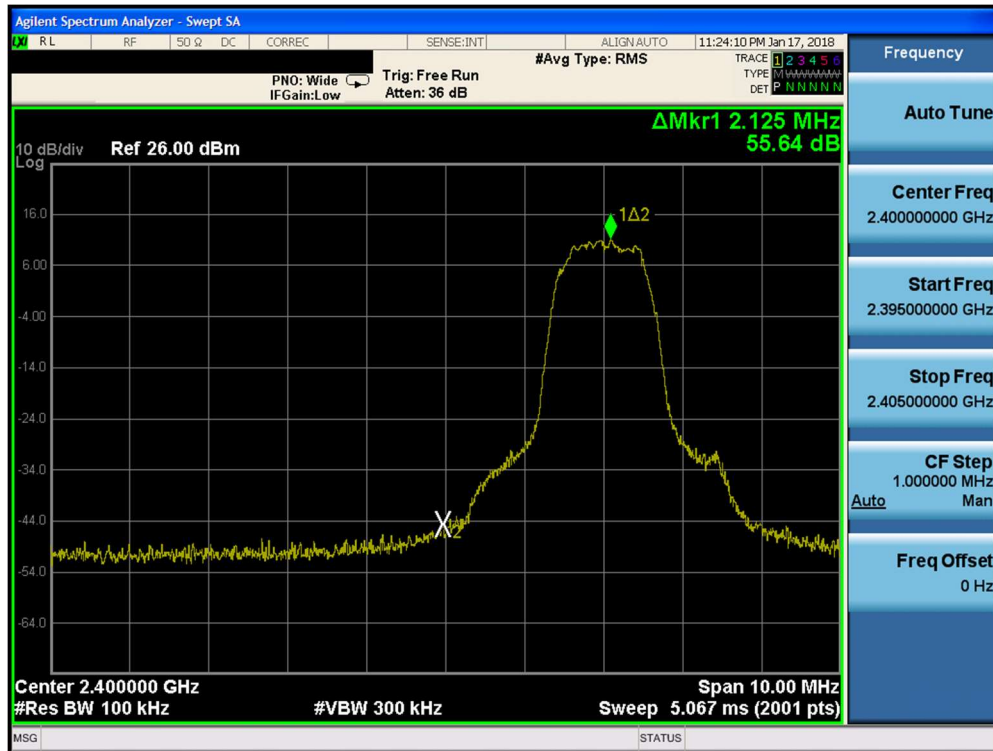**Plot 7-31. Band Edge Plot (Bluetooth with Hopping Enabled, GFSK, iPA - Ch.0)**

Plot 7-32. Band Edge Plot (Bluetooth with Hopping Enabled, GFSK, iPA – Ch.78)

Plot 7-33. Band Edge Plot (Bluetooth with Hopping Disabled, 8DPSK, ePA – Ch. 0)

Plot 7-34. Band Edge Plot (Bluetooth with Hopping Disabled, 8DPSK, ePA – Ch. 78)

Plot 7-35. Band Edge Plot (Bluetooth with Hopping Enabled, 8DPSK, ePA - Ch.0)

Plot 7-36. Band Edge Plot (Bluetooth with Hopping Enabled, 8DPSK, ePA – Ch.78)

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Plot 7-37. Band Edge Plot (Bluetooth with Hopping Disabled, 8DPSK, iPA – Ch. 0)
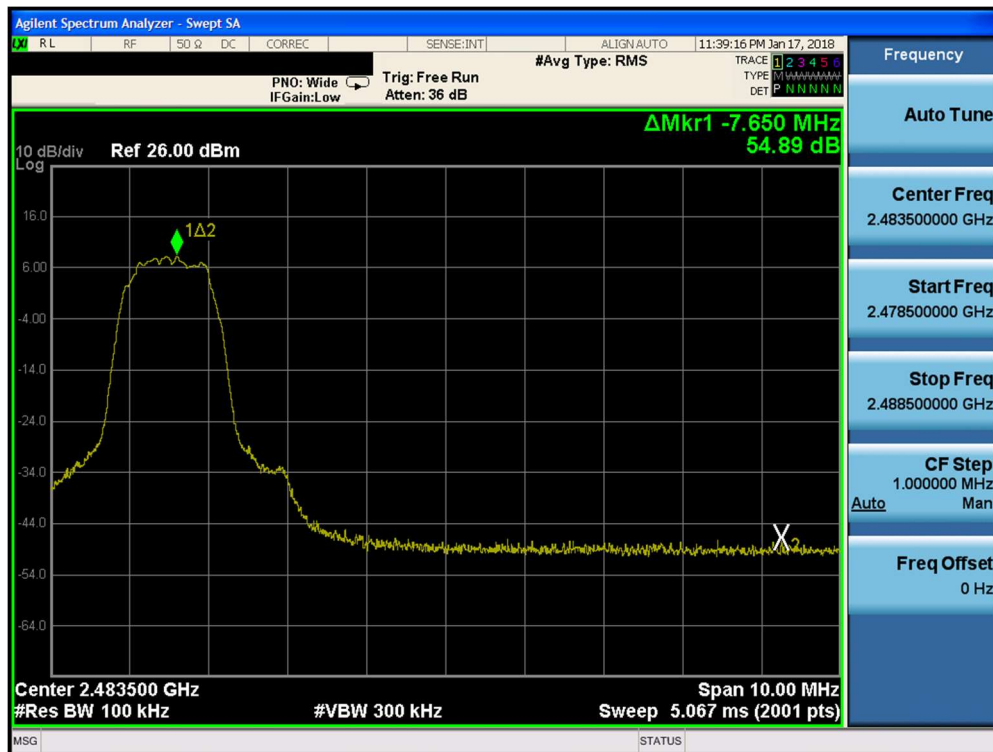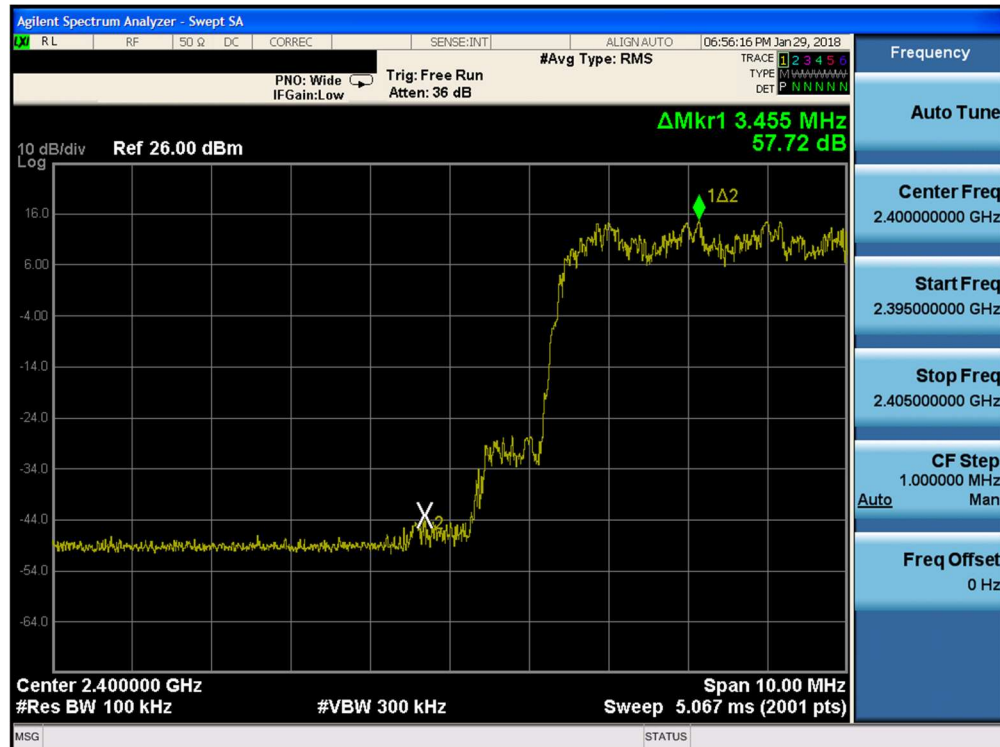

Plot 7-38. Band Edge Plot (Bluetooth with Hopping Disabled, 8DPSK, iPA – Ch. 78)

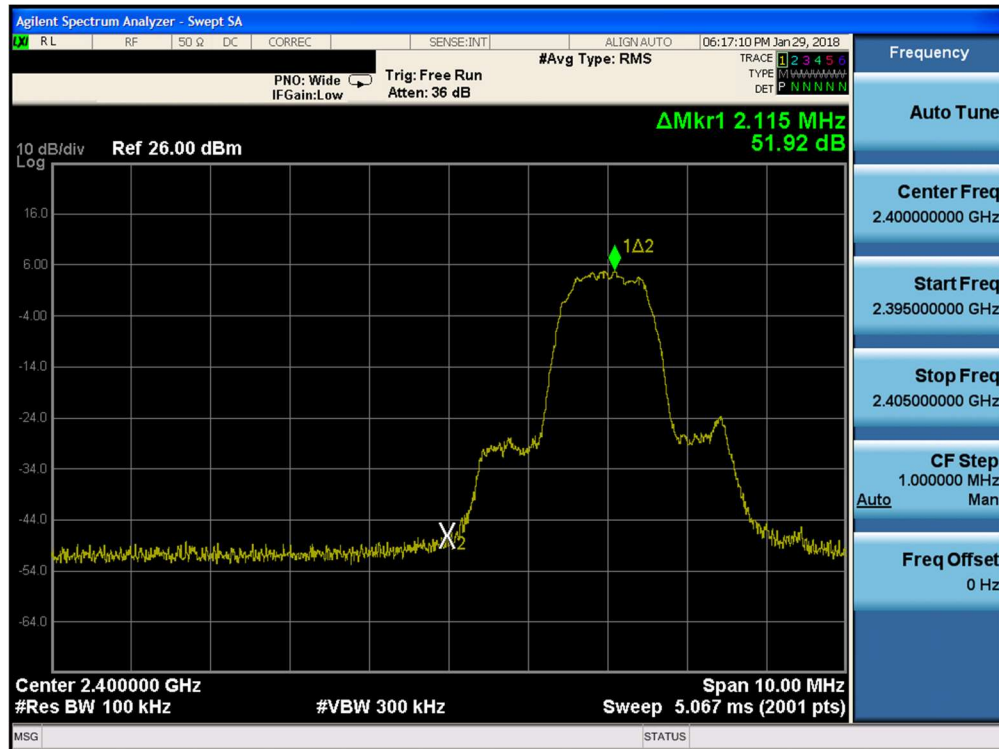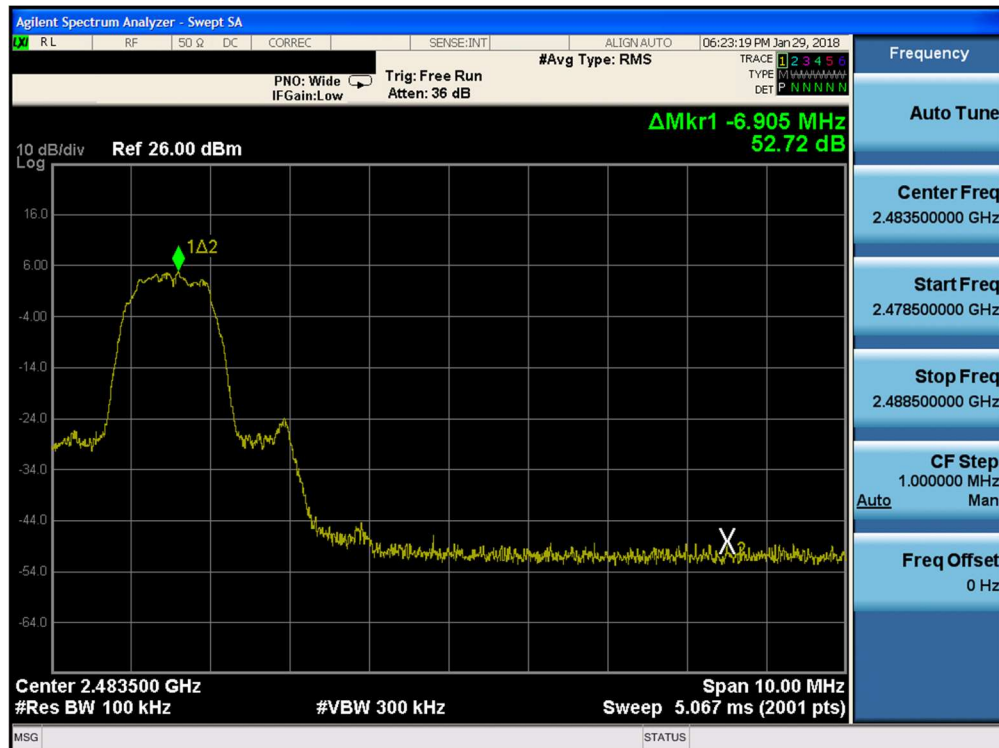| FCC ID: BCGA1954		MEASUREMENT REPORT (CERTIFICATION)	Approved by:
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Plot 7-39. Band Edge Plot (Bluetooth with Hopping Enabled, 8DPSK, iPA - Ch.0)
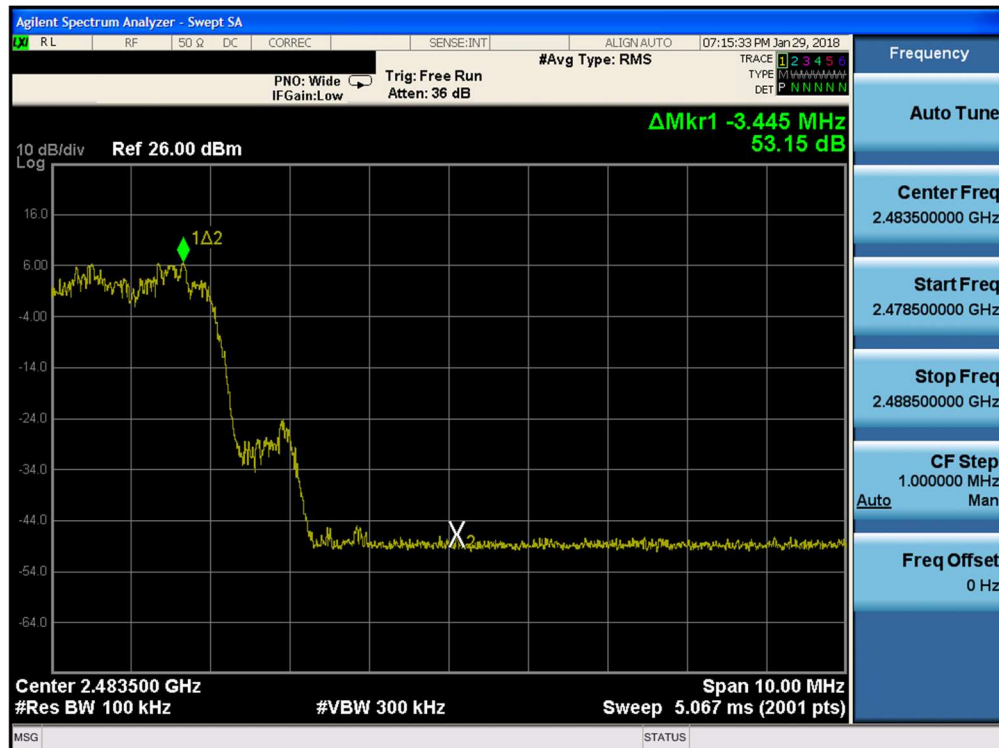
Plot 7-40. Band Edge Plot (Bluetooth with Hopping Enabled, 8DPSK, iPA – Ch.78)

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7.5   Carrier Frequency Separation
§15.247 (a.1); RSS-247 [5.1(c)]

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 7-5. Test Instrument & Measurement Setup

Test Notes

The EUT complies with the minimum channel separation requirement when it is operating in GFSK mode using 79 channels and when operating in AFH mode using 20 channels.
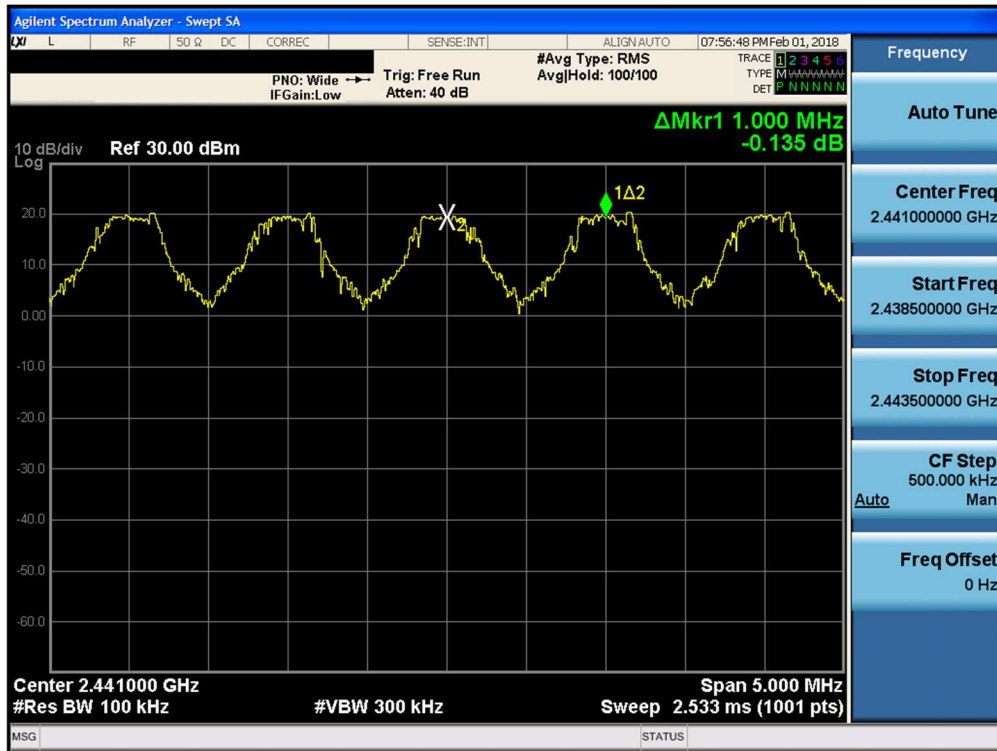
FCC ID: BCGA1954		**MEASUREMENT REPORT (CERTIFICATION)**	**Approved by:** Quality Manager
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Frequency [MHz]	Modulation	Power Scheme	Channel No.	Min. Channel Separation [MHz]
2441	GFSK	ePA	39	0.135
2441	GFSK	iPA	39	0.194
2441	8DPSK	ePA	39	0.489
2441	8DPSK	iPA	39	0.246

Table 7-5. Minimum Channel Separation

Plot 7-41. Channel Spacing Plot (Bluetooth, GFSK, ePA)
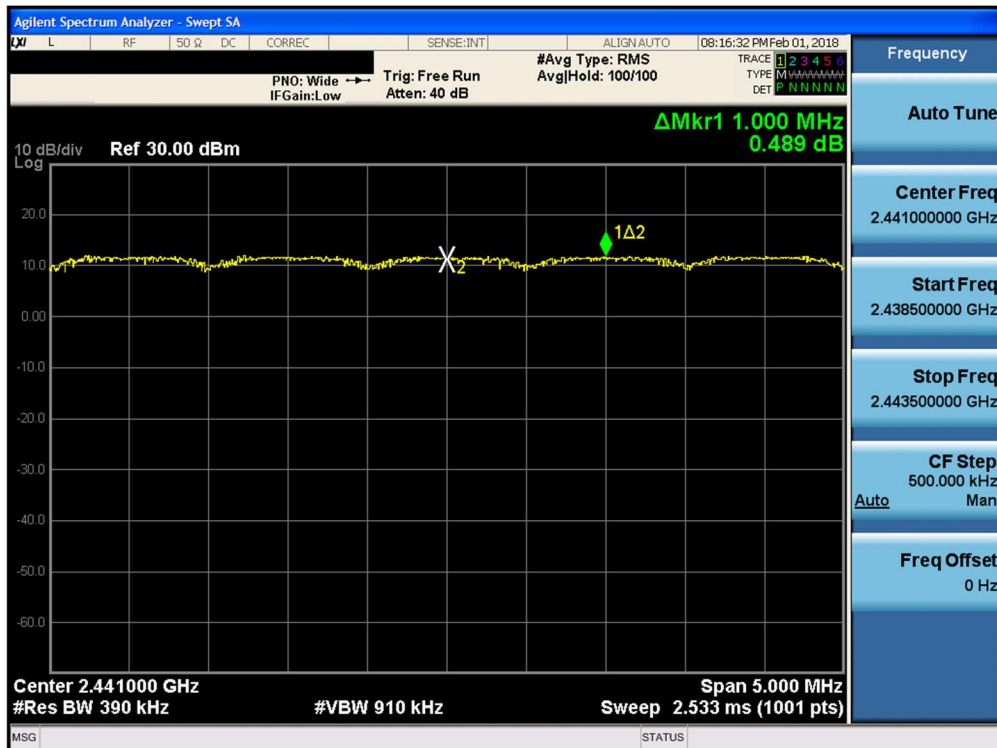
Plot 7-42. Channel Spacing Plot (Bluetooth, 8DPSK, ePA)

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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

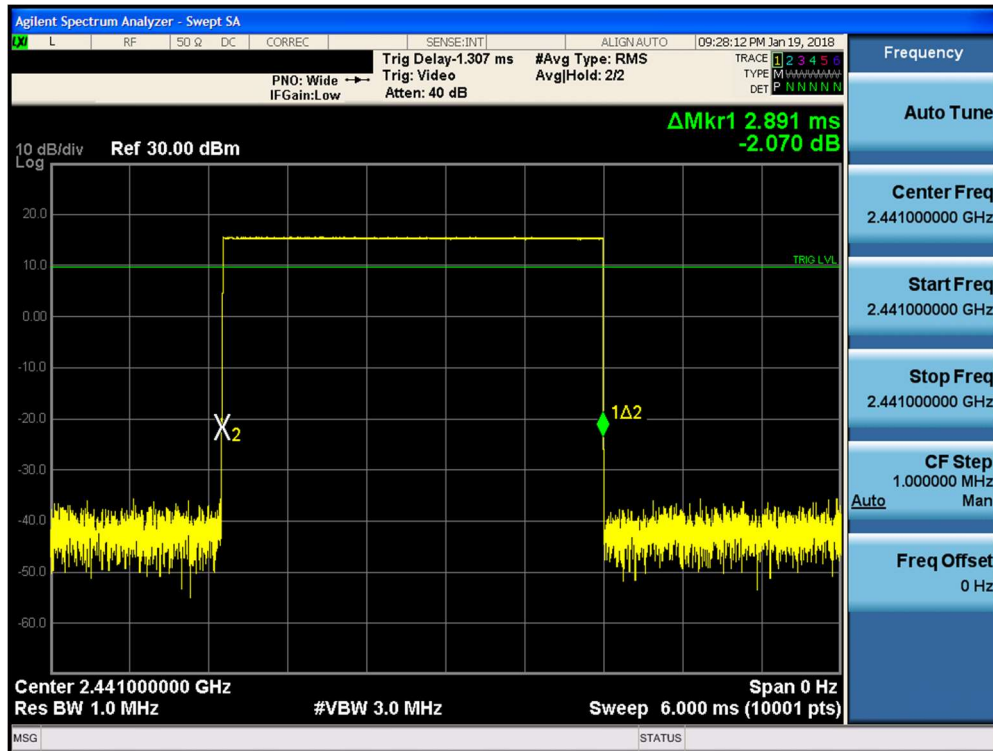The EUT and measurement equipment were set up as shown in the diagram below.

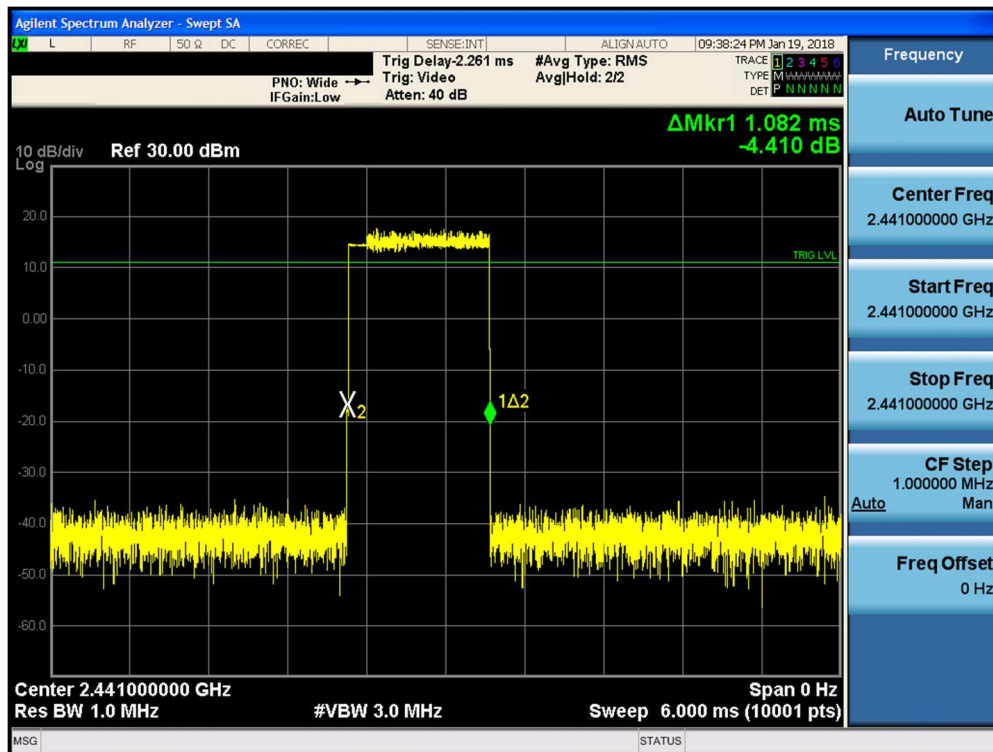**Figure 7-6. Test Instrument & Measurement Setup**

Test Notes

None

Plot 7-43. Time of Occupancy Plot (Bluetooth, GFSK, ePA)

Plot 7-44. Time of Occupancy Plot (Bluetooth, 8DPSK, ePA)

Bluetooth Time of Occupancy Calculation

Typically, Bluetooth GFSK mode has a channel hopping rate of 1600 hops/s. Since GFSK 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

- o   400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- o   Worst case BT has 266.67 hops/second (for GFSK modes with DH5 operation)
- o   266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- o   3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- o   106.67 hops x 2.891 ms/channel = 308.38 ms (worst case dwell time for one channel in GFSK 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

- o   400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- o   Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- o   133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- o   6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- o   53.34 hops x 2.891ms/channel = 154.21 ms (worst case dwell time for one channel in AFH mode)

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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

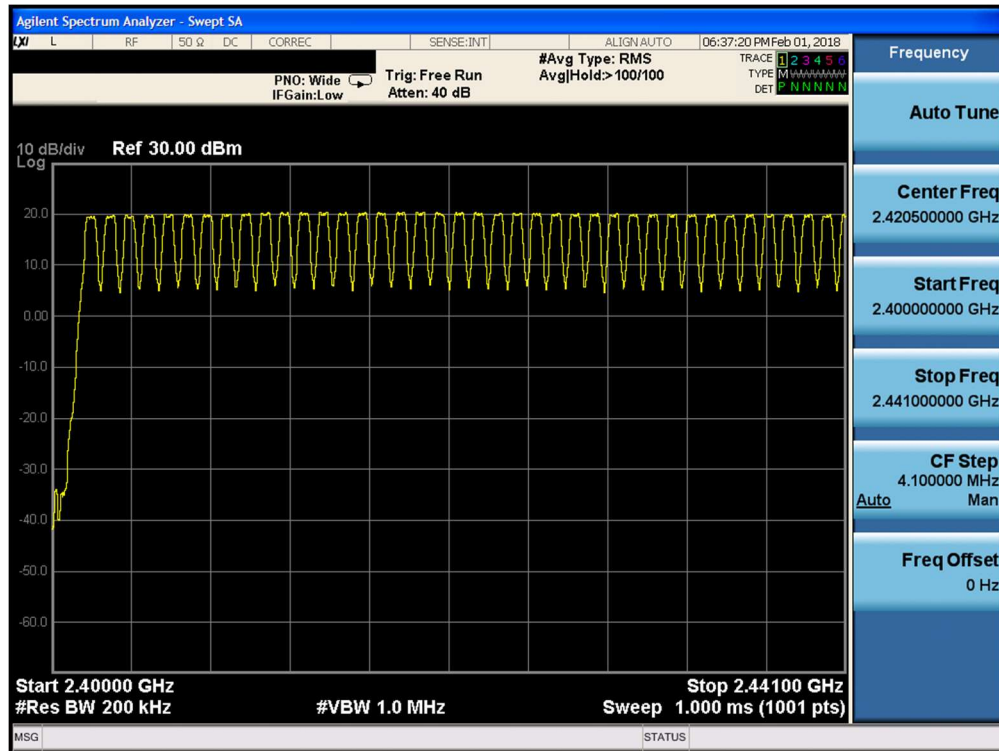The EUT and measurement equipment were set up as shown in the diagram below.


Figure 7-7. Test Instrument & Measurement Setup

Test Notes

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.

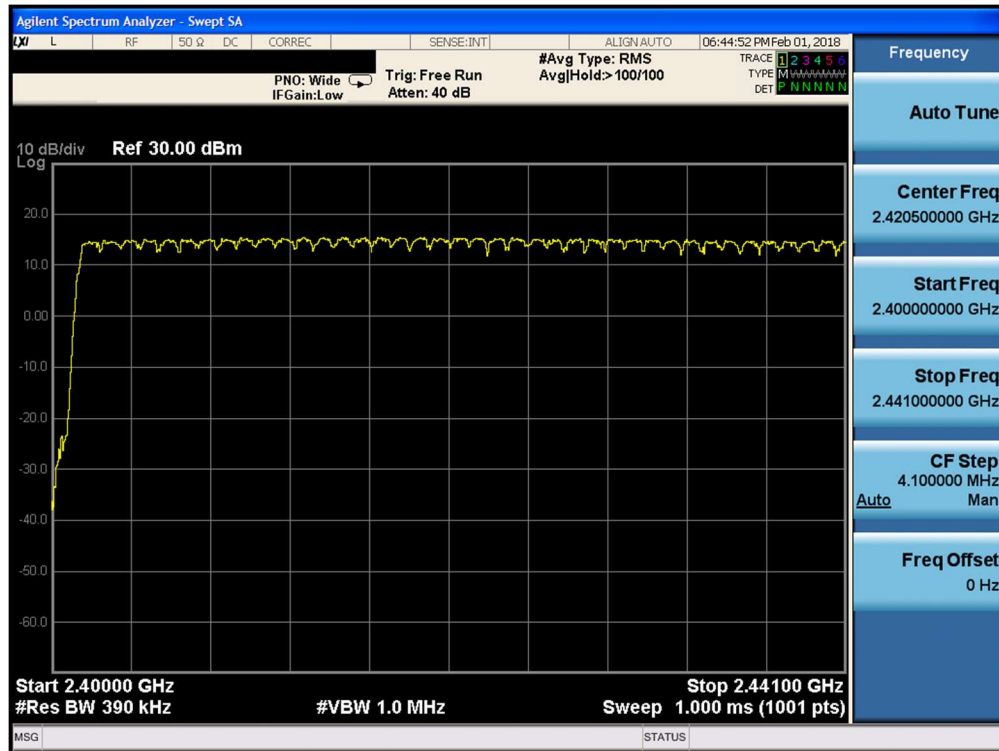| FCC ID: BCGA1954	![PCTEST logo]	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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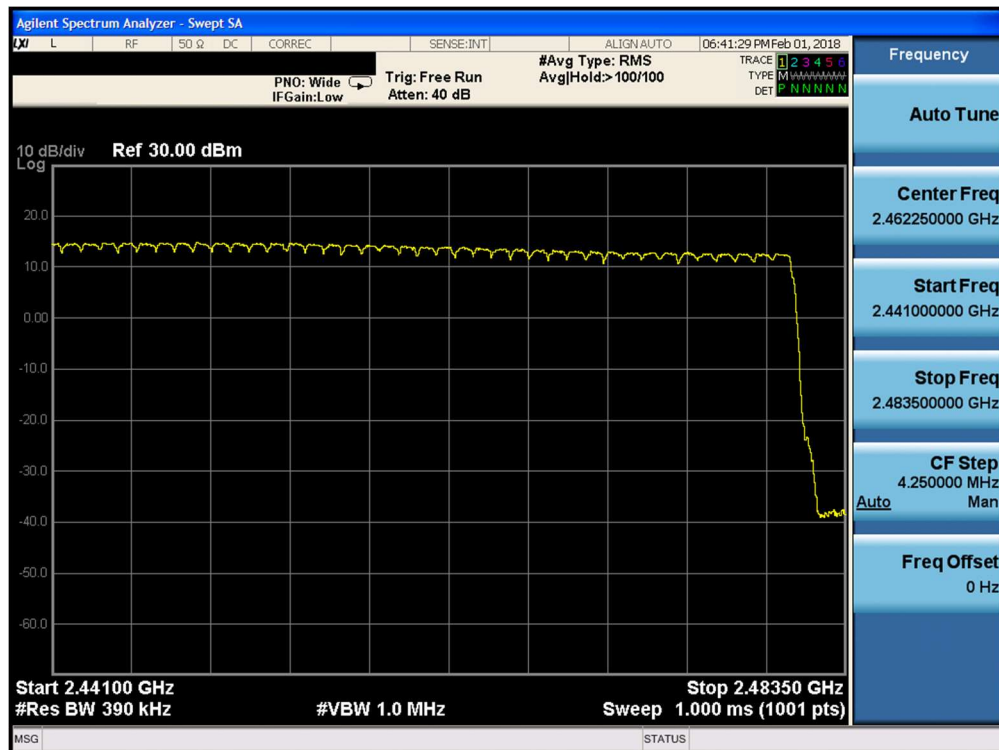**Plot 7-45. Low End Spectrum Channel Hopping Plot (Bluetooth, GFSK, ePA)**
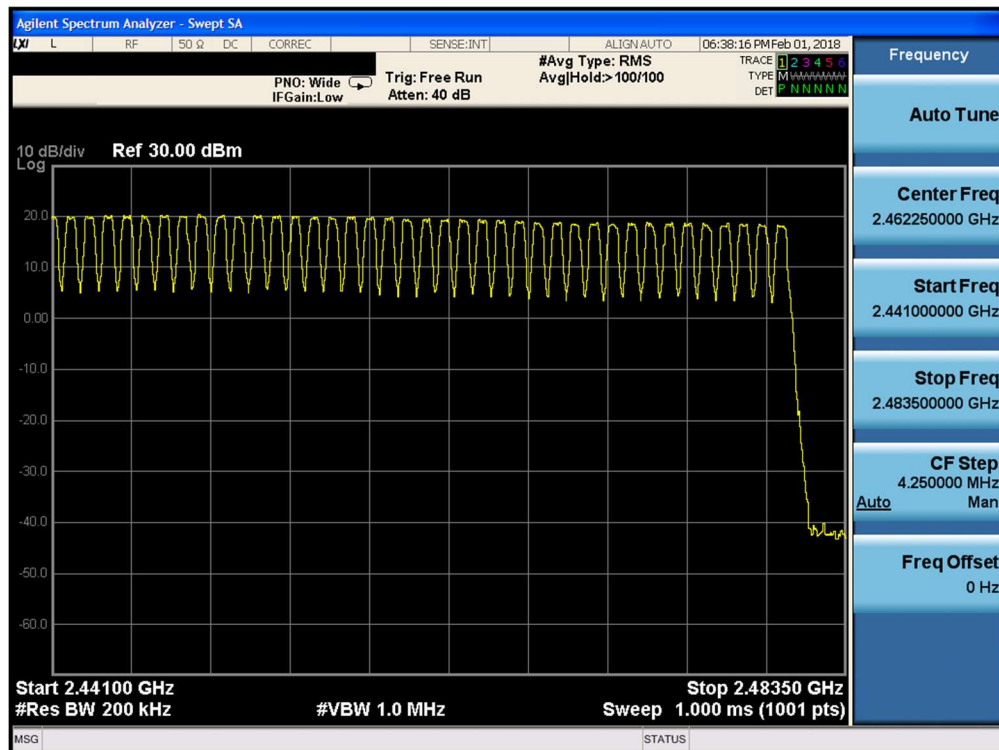
Plot 7-46. High End Spectrum Channel Hopping Plot (Bluetooth, GFSK, ePA)

Plot 7-47. Low End Spectrum Channel Hopping Plot (Bluetooth, 8DPSK, ePA)

Plot 7-48. High End Spectrum Channel Hopping Plot (Bluetooth, 8DPSK, ePA)

FCC ID: BCGA1954	![PCTEST logo]	**MEASUREMENT REPORT (CERTIFICATION)**	**Approved by:** Quality Manager
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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

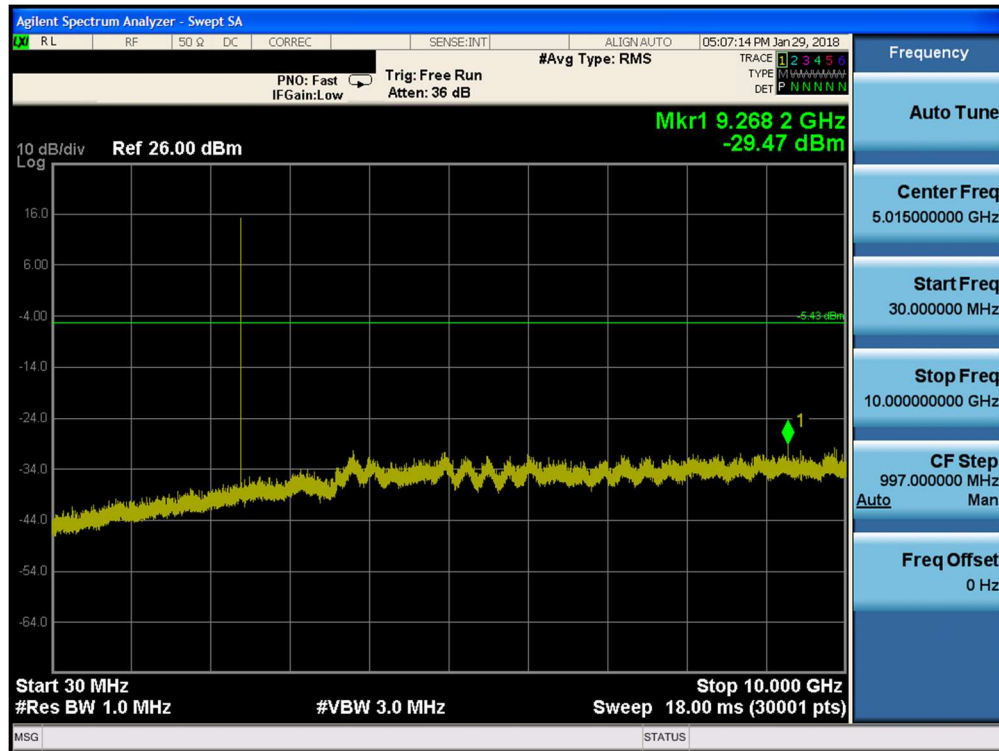The EUT and measurement equipment were set up as shown in the diagram below.

**Figure 7-8. Test Instrument & Measurement Setup**

Test Notes

Out-of-band conducted spurious emissions were investigated for all data rates. 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.

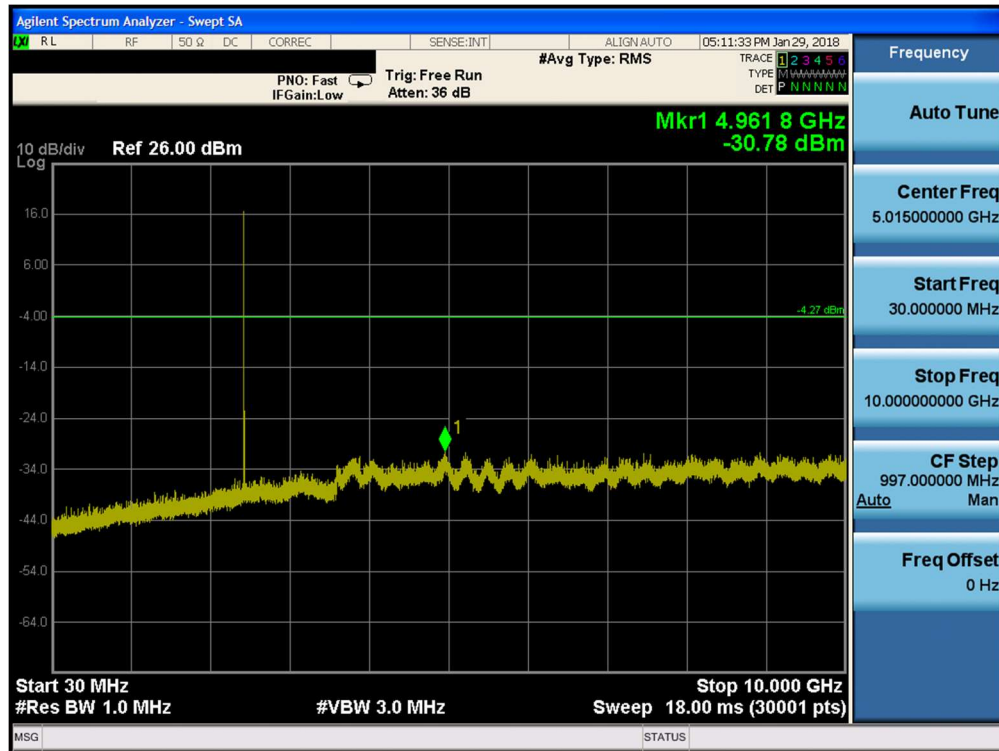| **FCC ID:** BCGA1954	![PCTEST logo]	**MEASUREMENT REPORT (CERTIFICATION)**	**Approved by:** Quality Manager
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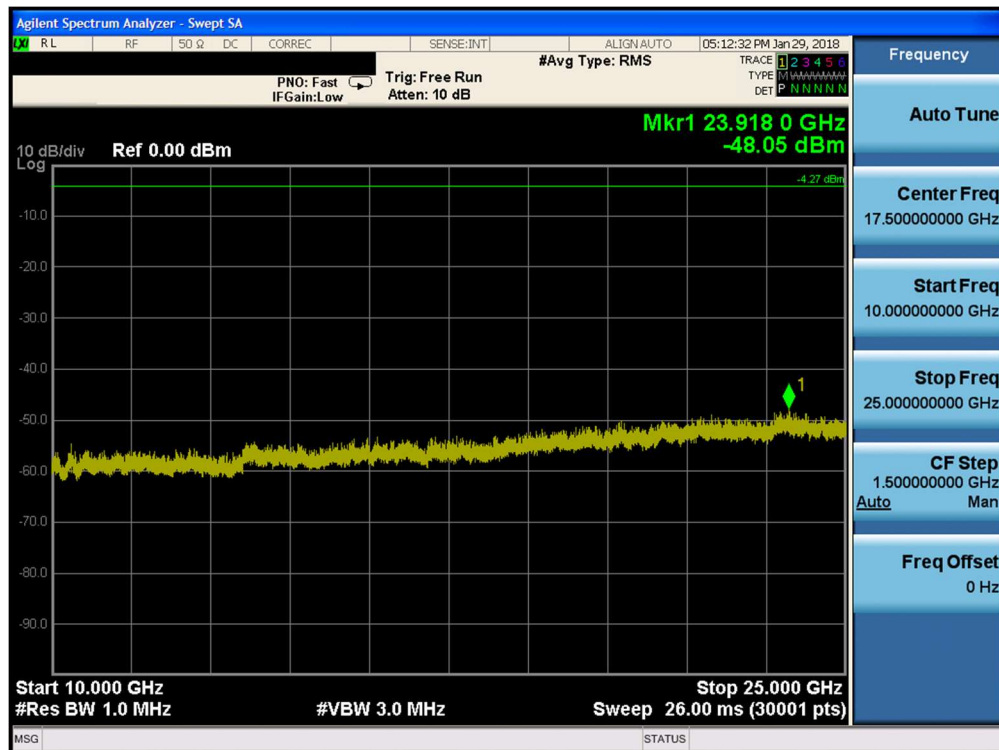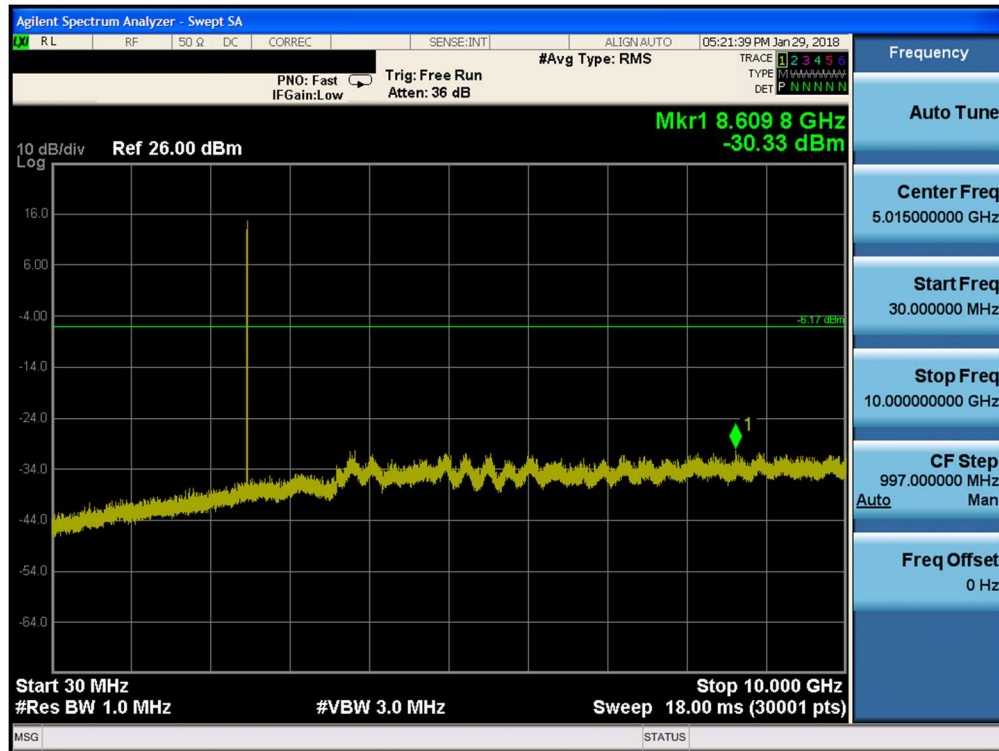**Plot 7-49. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 0)**
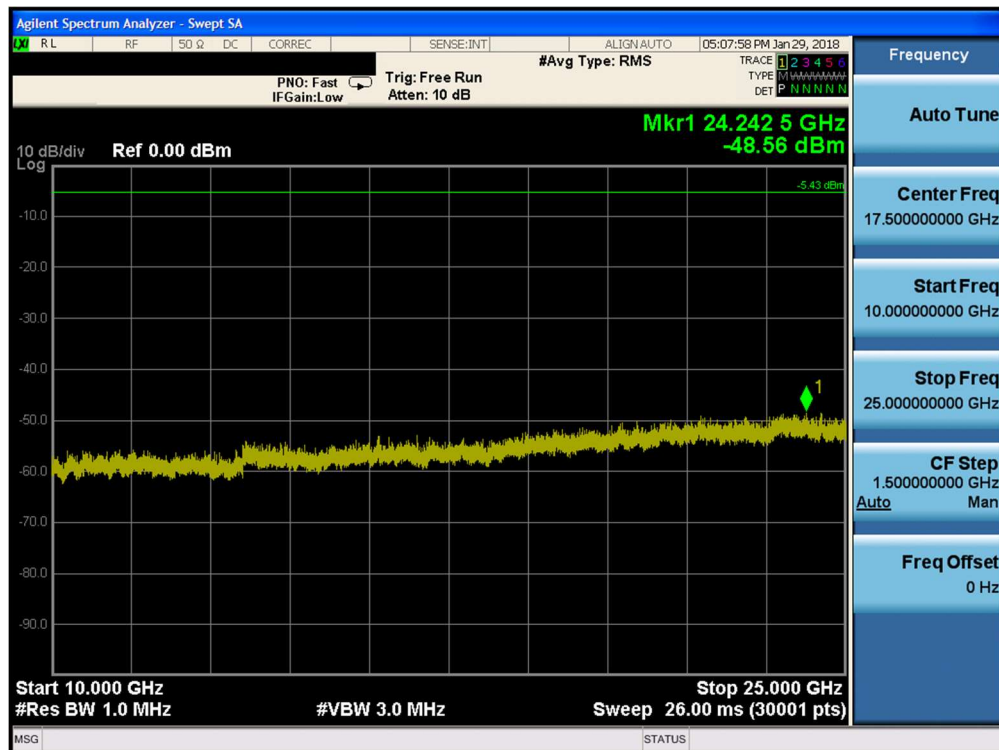
Plot 7-50. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 0)

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Plot 7-51. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 39)

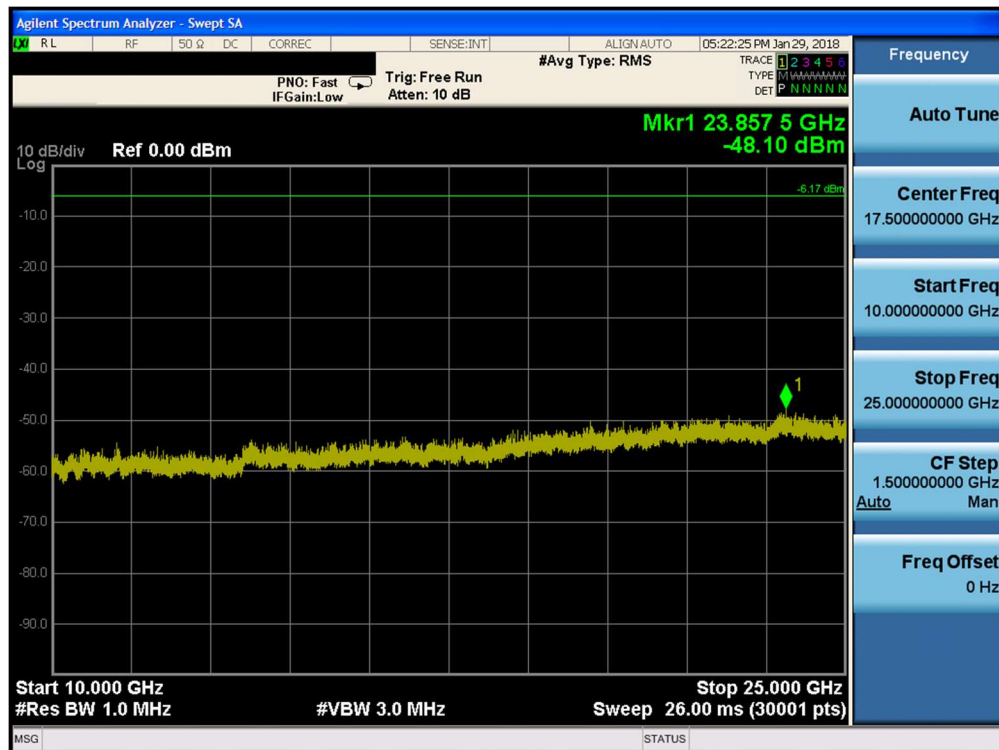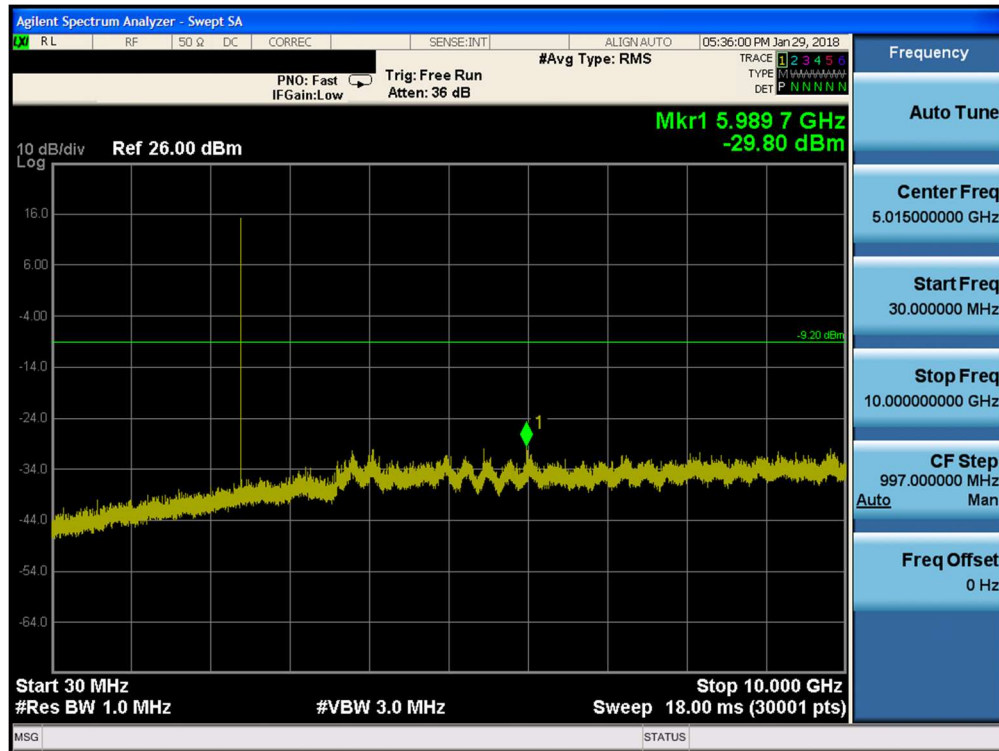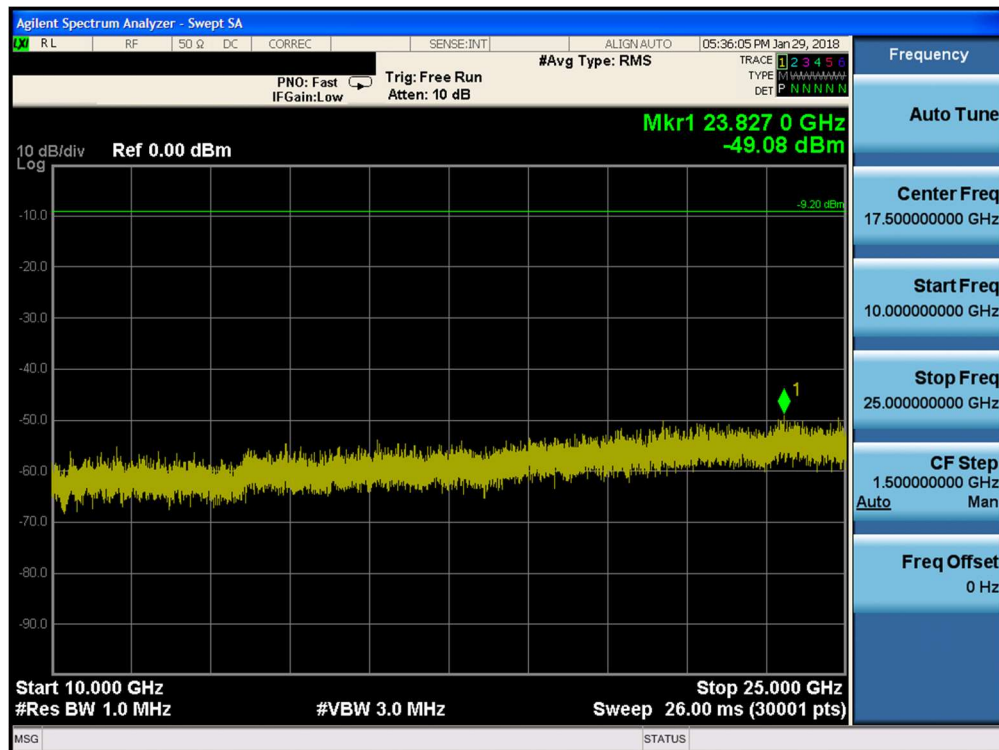**Plot 7-52. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 39)**

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Plot 7-53. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 78)

Plot 7-54. Conducted Spurious Plot (Bluetooth, GFSK, ePA – Ch. 78)

Plot 7-55. Conducted Spurious Plot (Bluetooth, 8DPSK, ePA – Ch. 0)

Plot 7-56. Conducted Spurious Plot (Bluetooth, 8DPSK, ePA – Ch. 0)