5.5 CARRIER FREQUENCIES SEPARATION

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(1)
RSS-247 Issue 2, Section 5.1(b)

Test Method: ANSI C63.10-2013 Section 7.8.2

Limit: Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

a) Span: Wide enough to capture the peaks of two adjacent channels.
b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.
h) Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left Ear

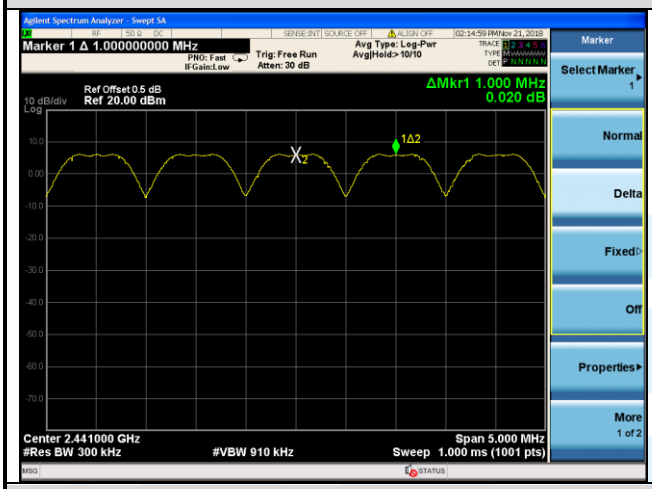
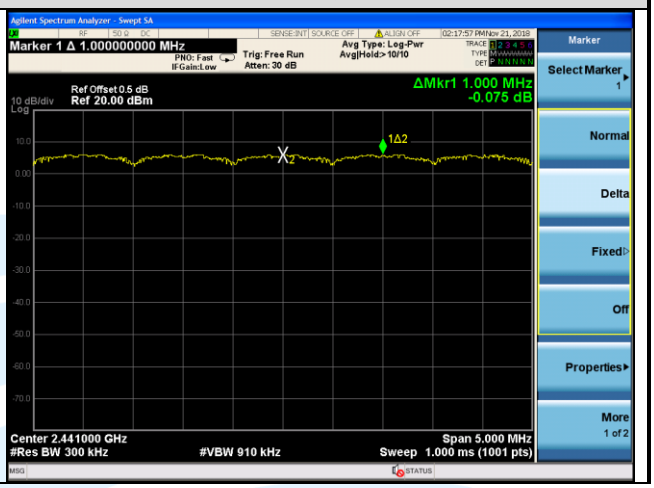
Type of Modulation	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)
	Channel 39	Channel 39
GFSK	1.000	0.638
π/4 DQPSK	1.000	0.849
8DPSK	1.000	0.871
Note: The minimum limit is two-third 20 dB bandwidth.		

Right Ear

Type of Modulation	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)
	Channel 39	Channel 39
GFSK	1.000	0.638
π/4 DQPSK	1.000	0.890
8DPSK	1.000	0.845
Note: The minimum limit is two-third 20 dB bandwidth.		

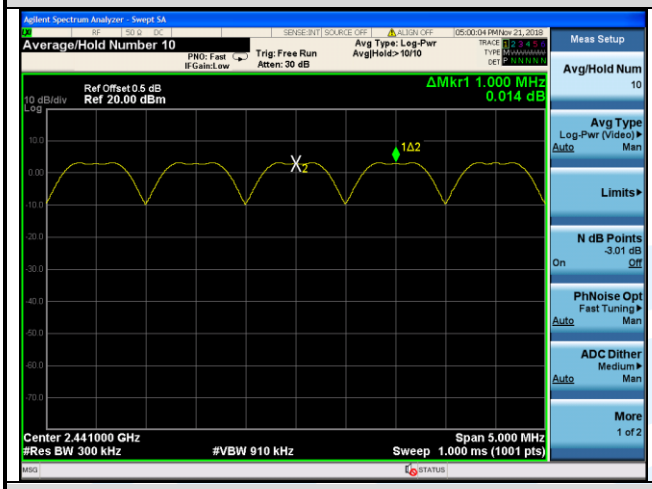
The test plots as follows:

Left Ear

GFSK	π/4 DQPSK
	

8DPSK

Right Ear

GFSK	π/4 DQPSK
	

8DPSK

5.6 NUMBER OF HOPPING CHANNEL

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247(b)(1)
RSS-247 Issue 2, Section 5.1(d)

Test Method: ANSI C63.10-2013 Section 7.8.3

Limit: Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
c) VBW ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left Ear

Type of Modulation	Number of Hopping Channel
GFSK	79
π /4 DQPSK	79
8DPSK	79

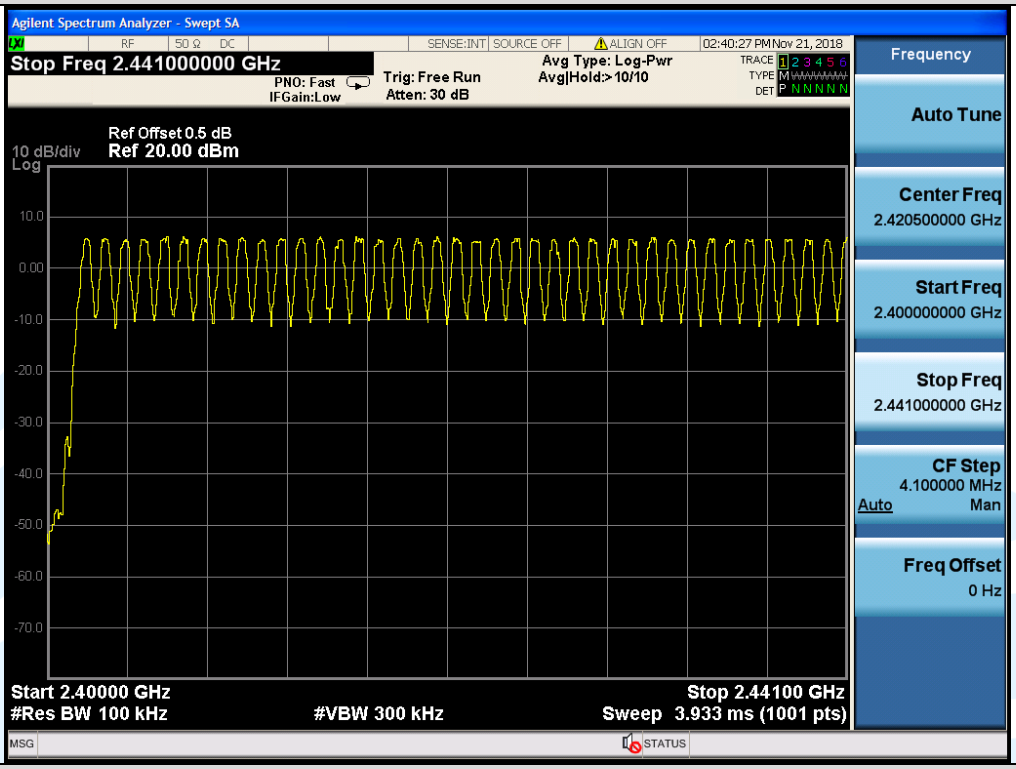
Right Ear

Type of Modulation	Number of Hopping Channel
GFSK	79
π /4 DQPSK	79
8DPSK	79

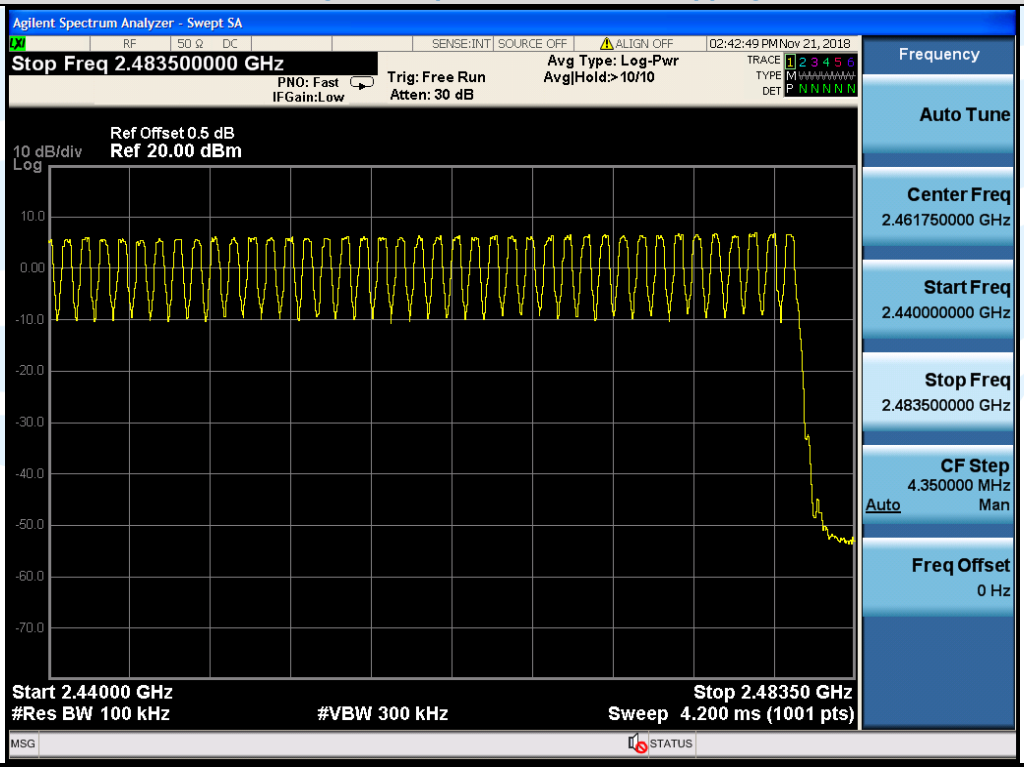
The test plots as follows:

Left Ear

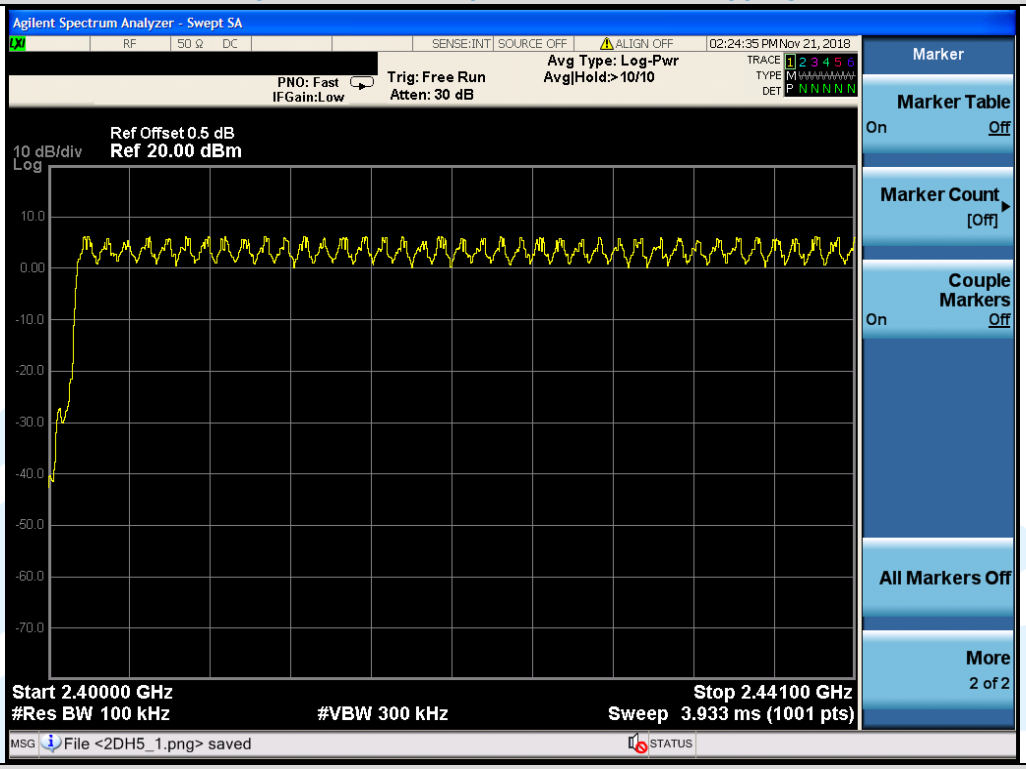
GFSK_Low End Spectrum Channel Hopping Plot



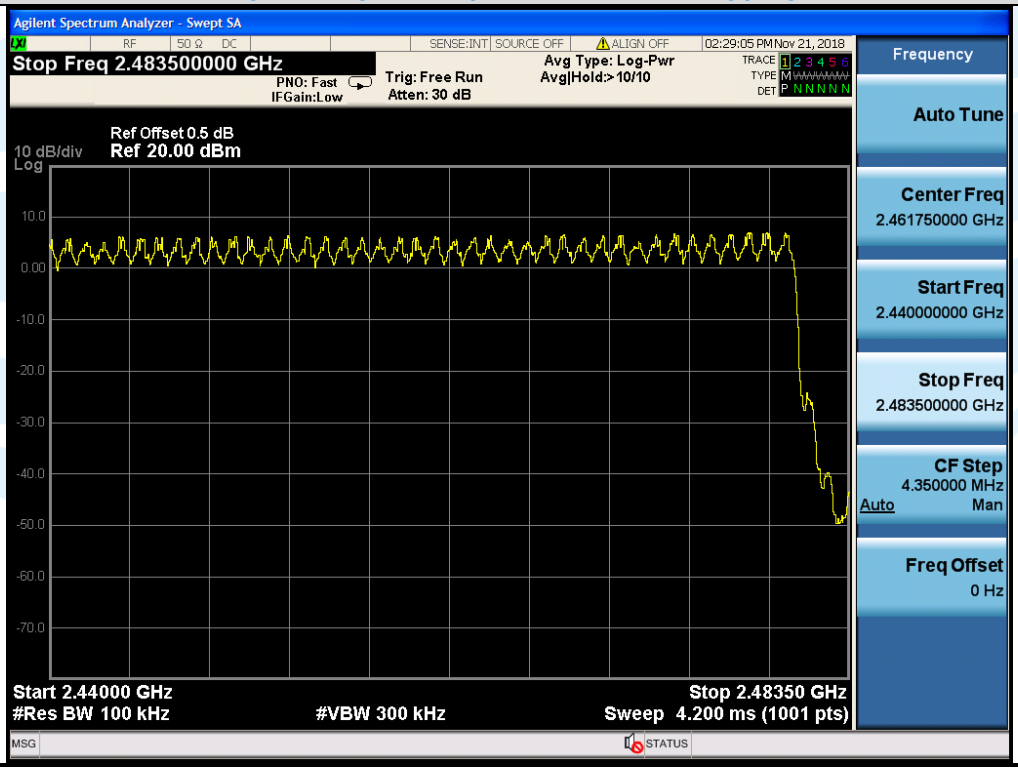
GFSK_High End Spectrum Channel Hopping Plot

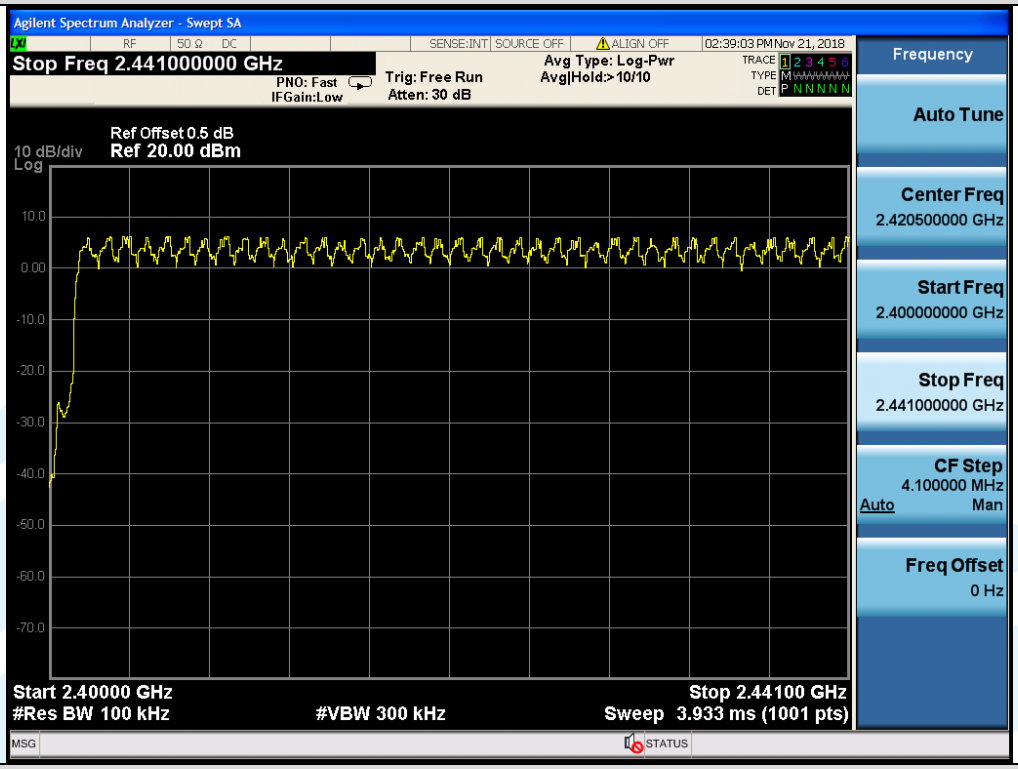


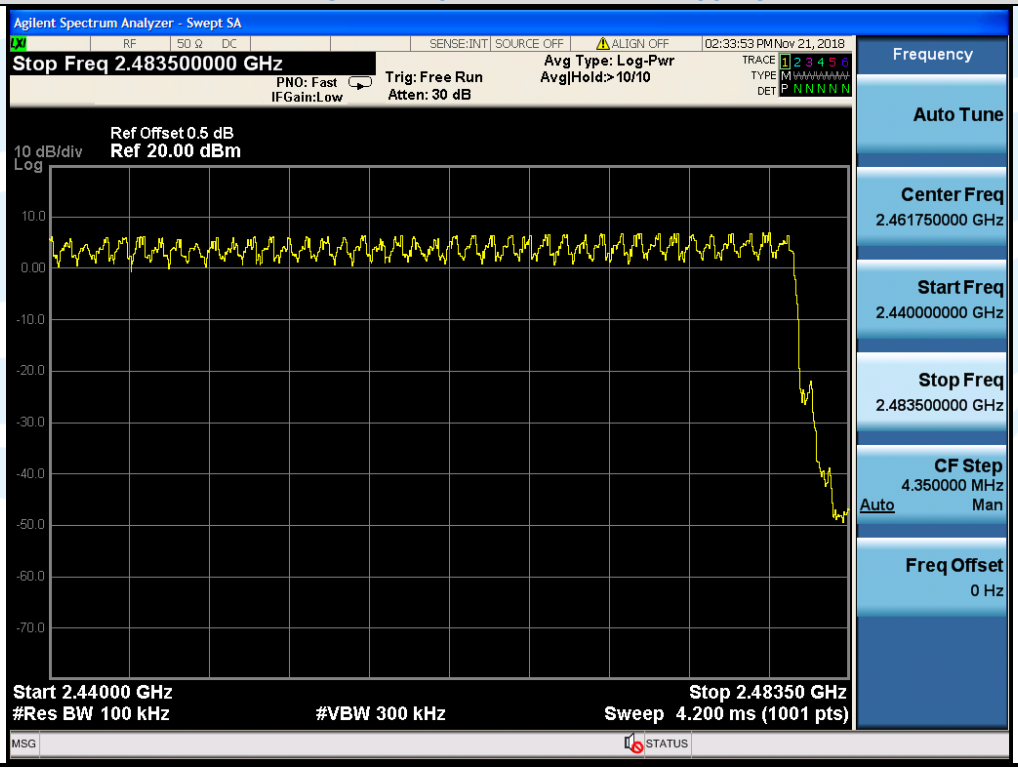
π /4 DQPSK_Low End Spectrum Channel Hopping Plot



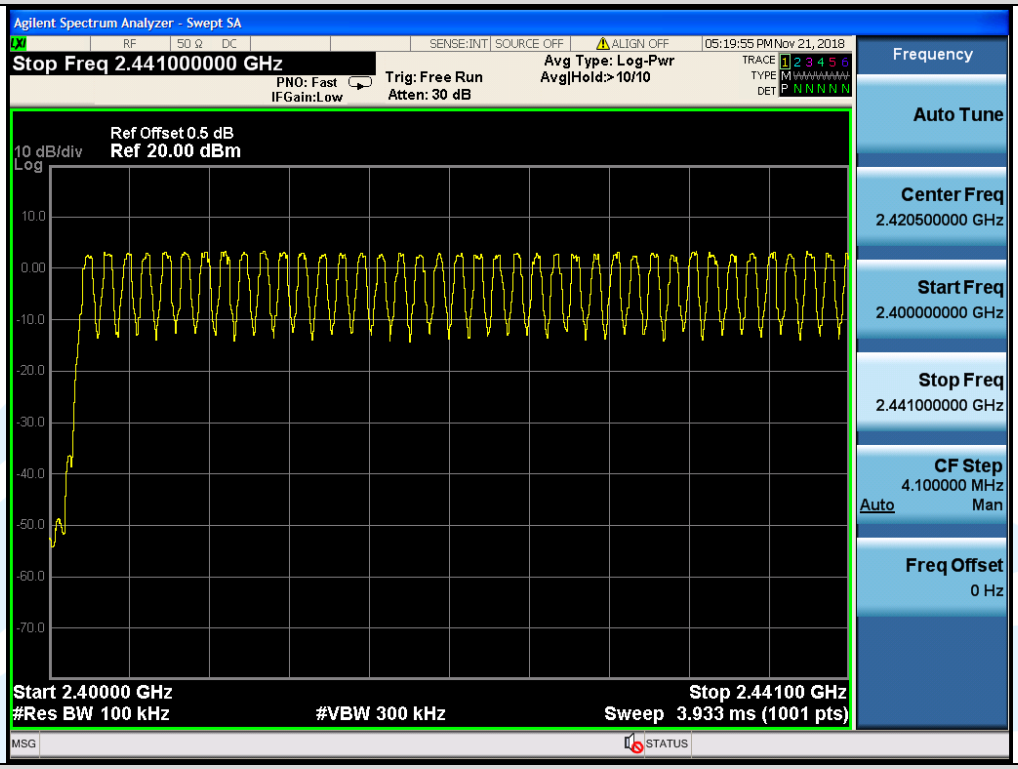
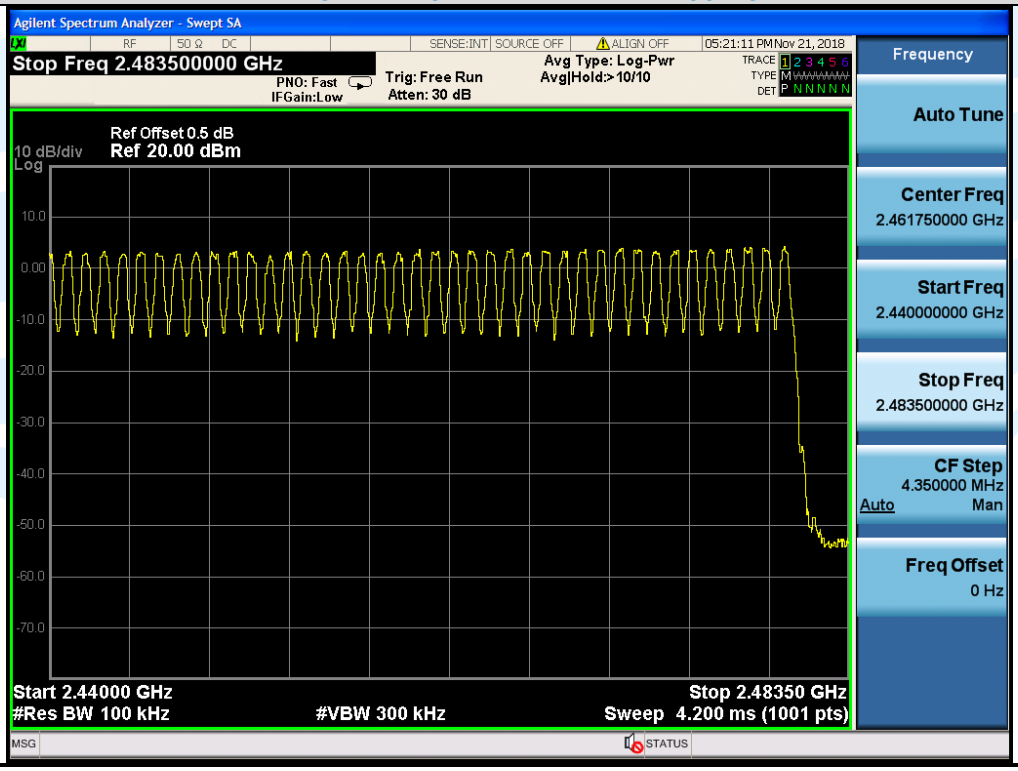
π /4 DQPSK_High End Spectrum Channel Hopping Plot



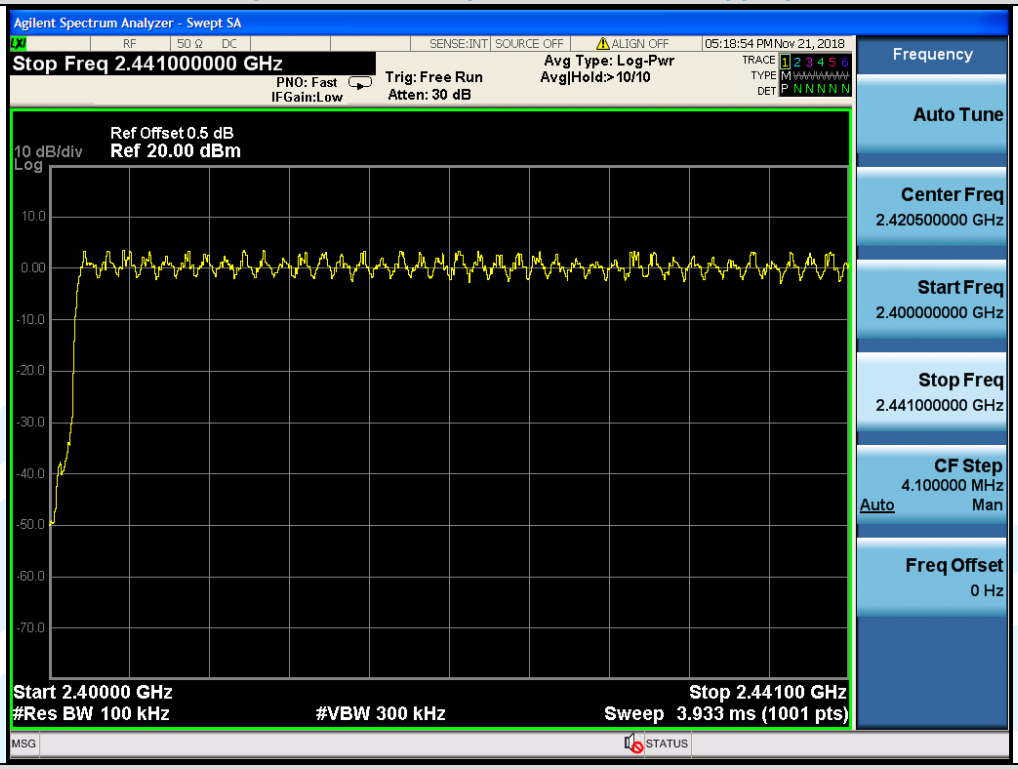
8DPSK_Low End Spectrum Channel Hopping Plot


8DPSK_High End Spectrum Channel Hopping Plot


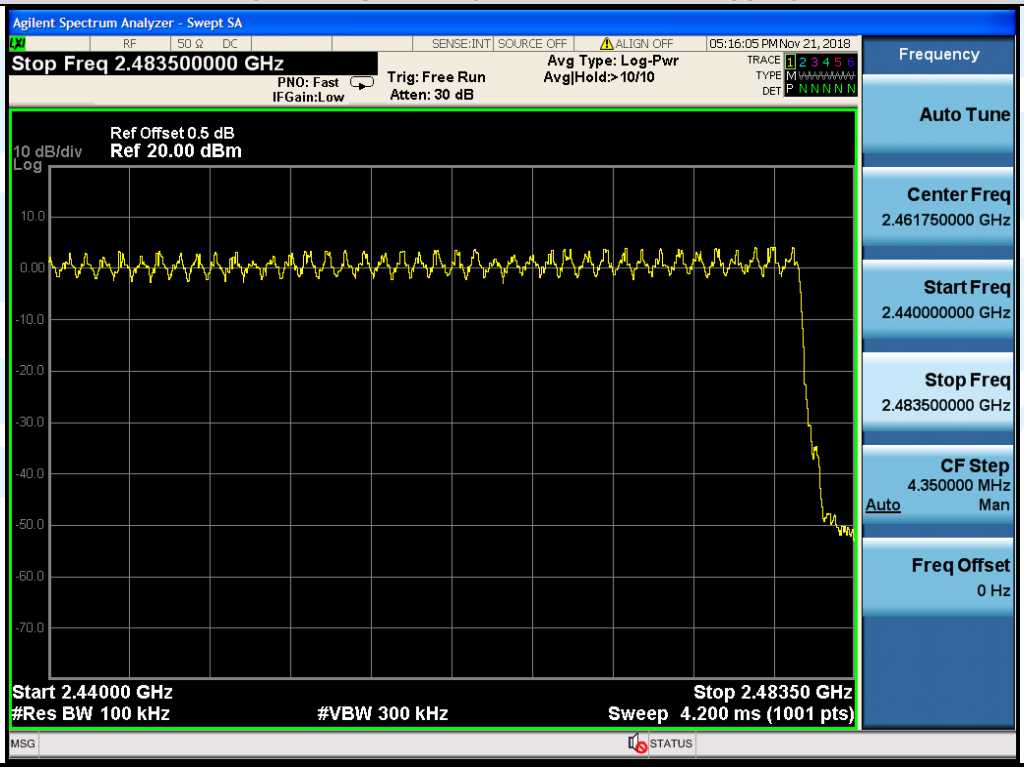
Right Ear

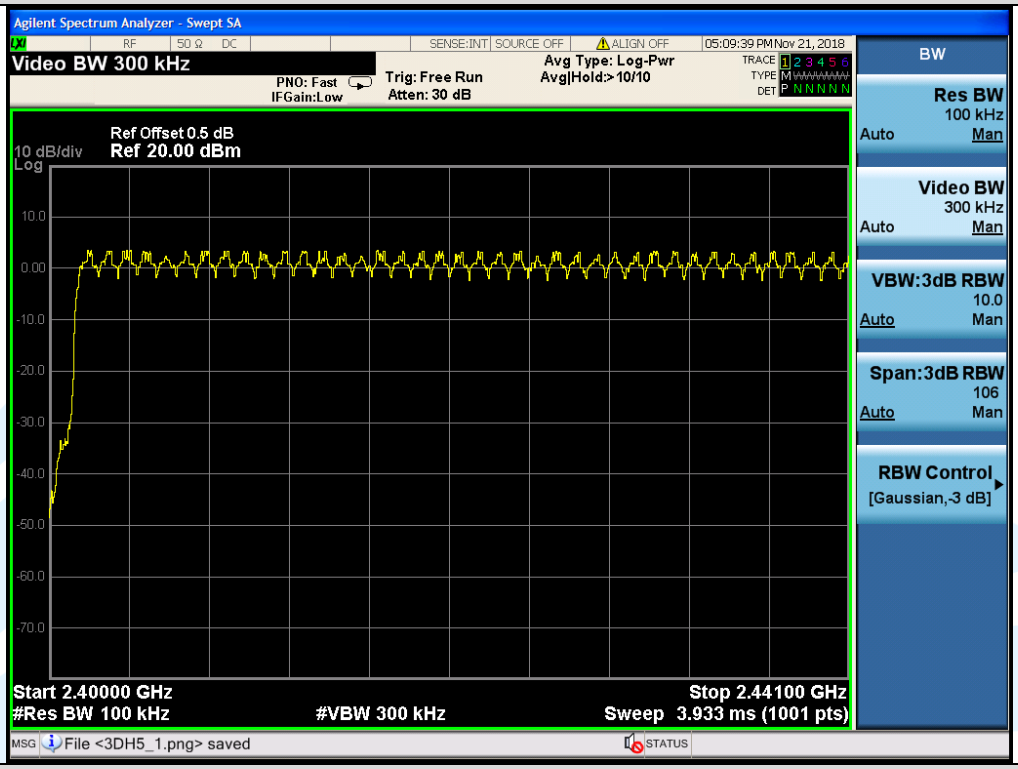
GFSK_Low End Spectrum Channel Hopping Plot

GFSK_High End Spectrum Channel Hopping Plot


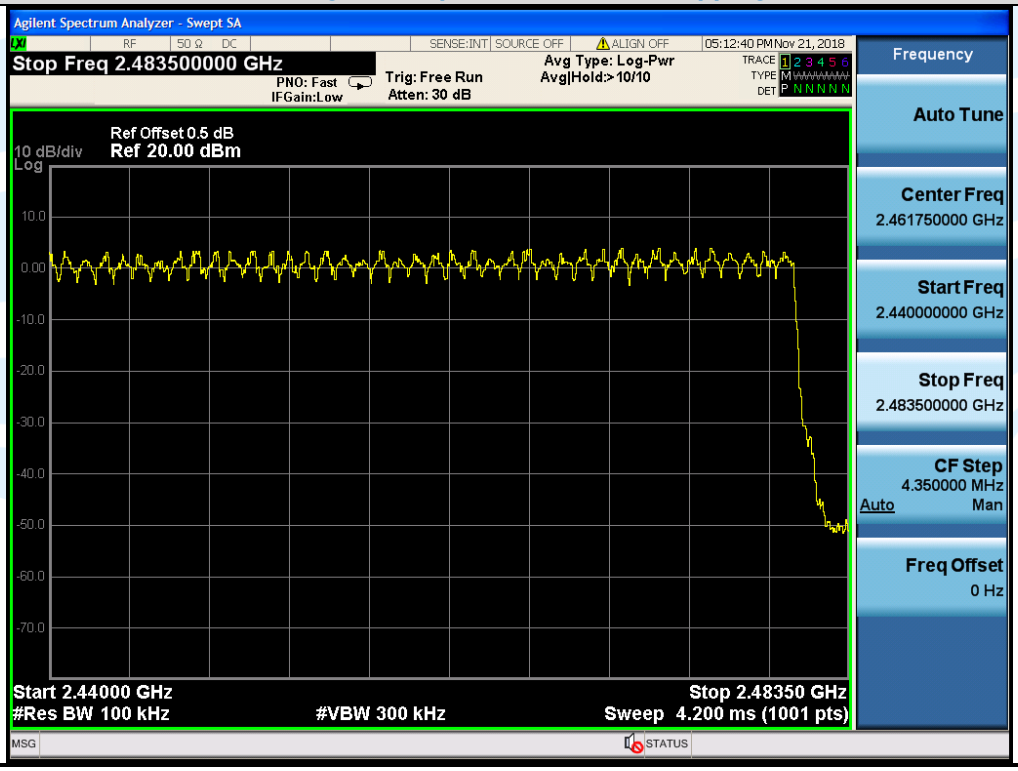
π /4 DQPSK_Low End Spectrum Channel Hopping Plot



π /4 DQPSK_High End Spectrum Channel Hopping Plot



8DPSK_Low End Spectrum Channel Hopping Plot


8DPSK_High End Spectrum Channel Hopping Plot


5.7 DWELL TIME

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247(a)(1)
RSS-247 Issue 2, Section 5.1(d)

Test Method: ANSI C63.10-2013 Section 7.8.4

Limit: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

a) Span = zero span, centered on a hopping channel
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep = As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function = peak
e) Trace = max hold
f) Use the marker-delta function to determine the dwell time

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left Ear

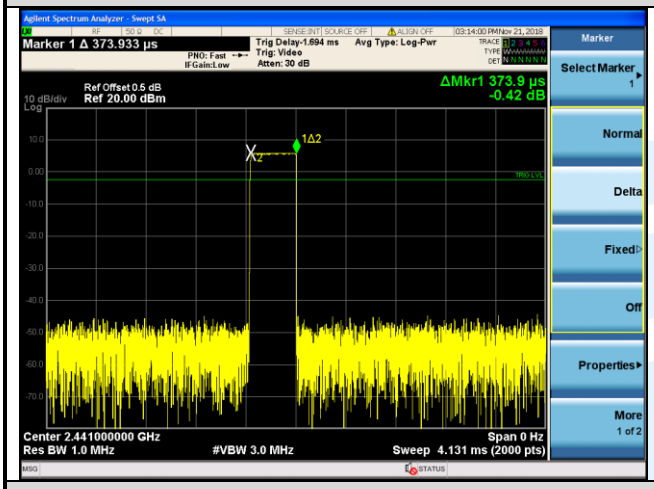
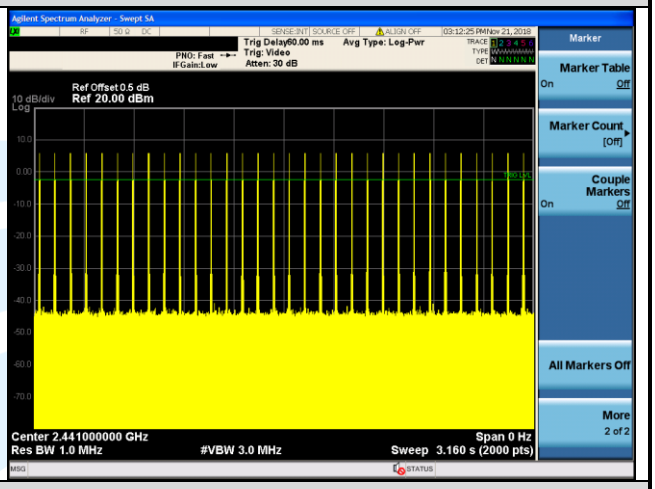
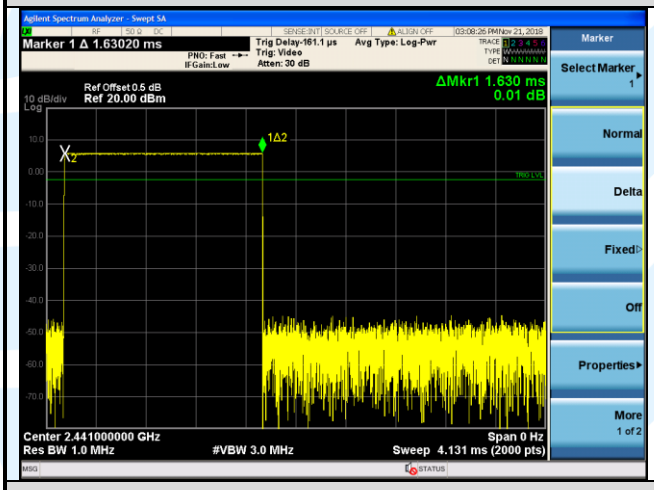
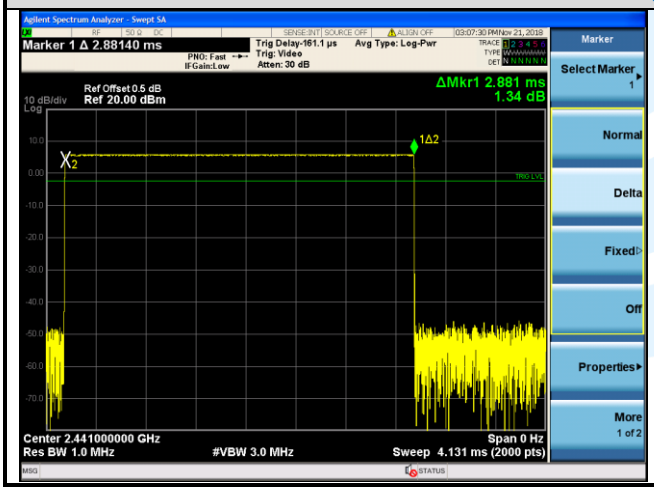
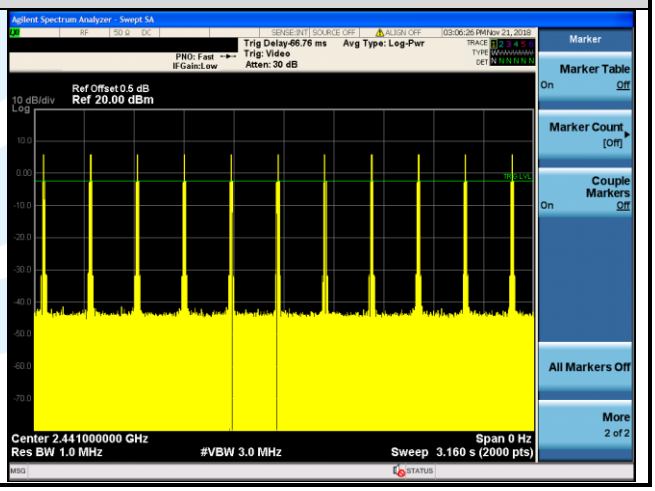
Type of Modulation	Test Frequency	Packet	Pulse Width	Number of Pulses in 3.16 seconds	Dwell Time	Limit
			ms		ms	ms
GFSK	2441MHz	1-DH1	0.374	32.000	119.65	< 400
		1-DH3	1.630	16.000	260.80	< 400
		1-DH5	2.881	11.000	316.91	< 400
π/4 DQPSK	2441MHz	2-DH1	0.388	32.000	124.03	< 400
		2-DH3	1.639	16.000	262.24	< 400
		2-DH5	2.888	11.000	**317.68**	< 400
8DPSK	2441MHz	3-DH1	0.388	32.000	124.03	< 400
		3-DH3	1.633	16.000	261.28	< 400
		3-DH5	2.888	11.000	**317.68**	< 400

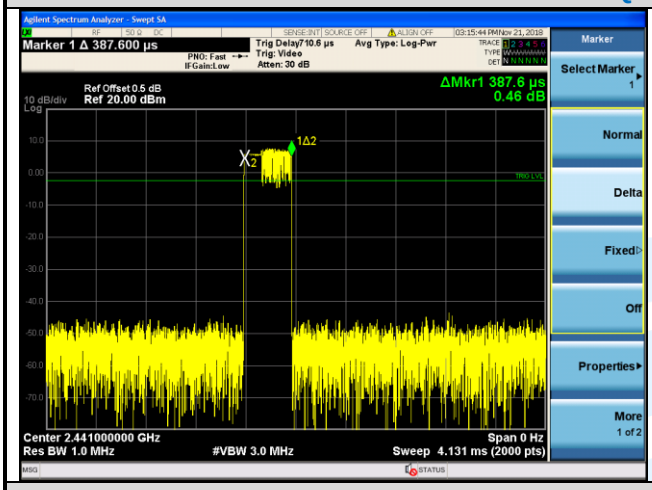
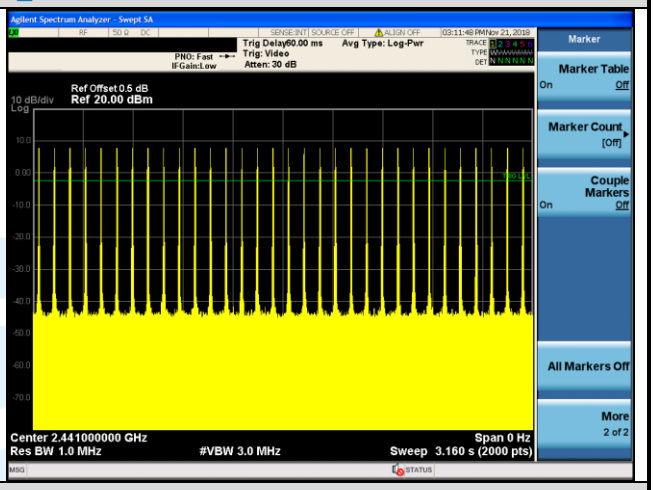
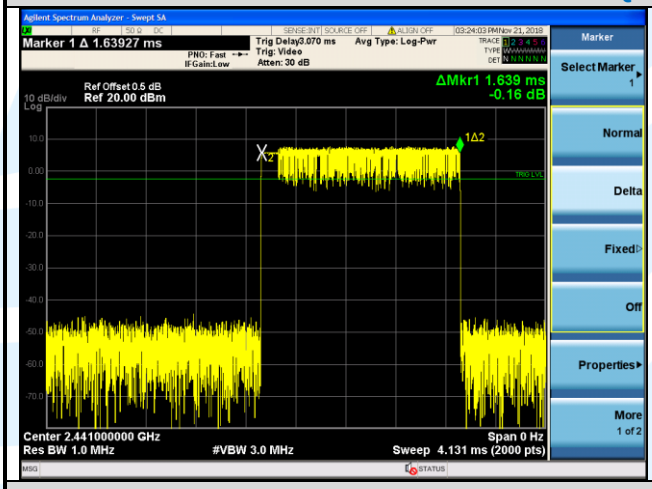
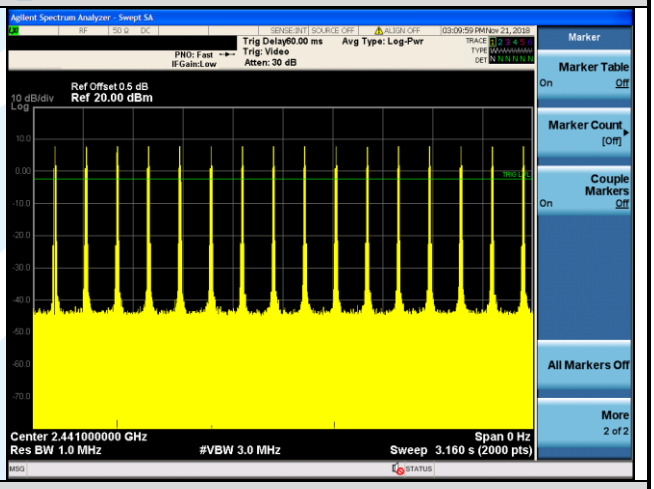
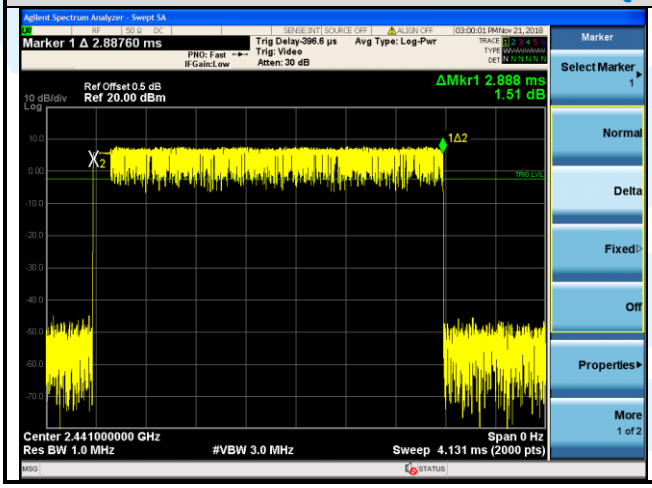
Right Ear

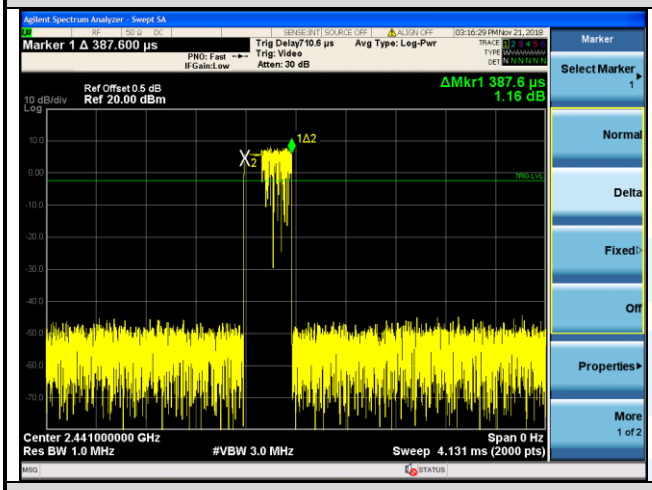
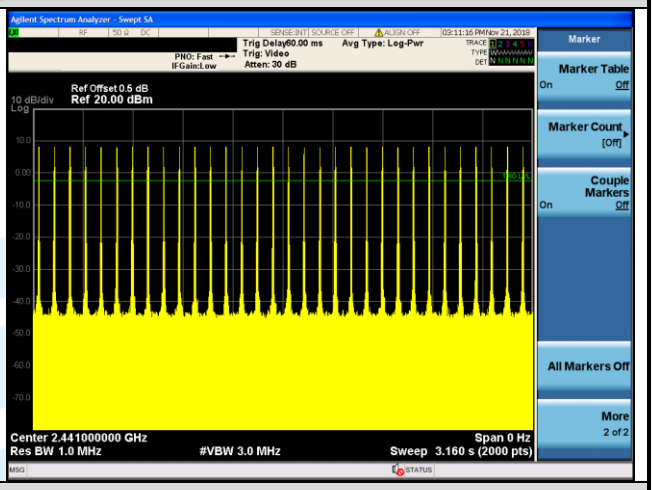
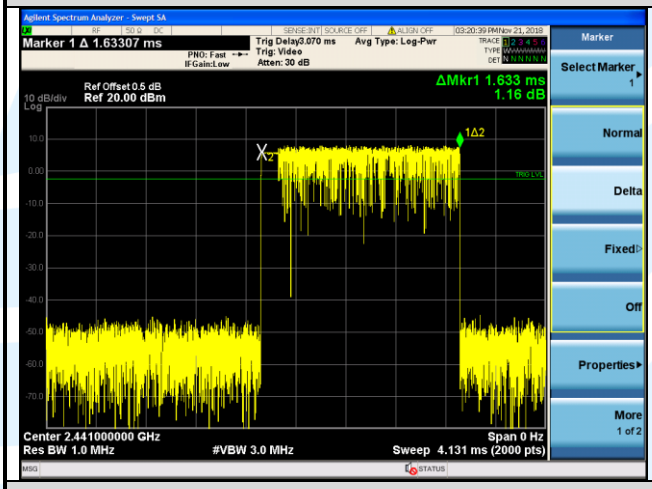
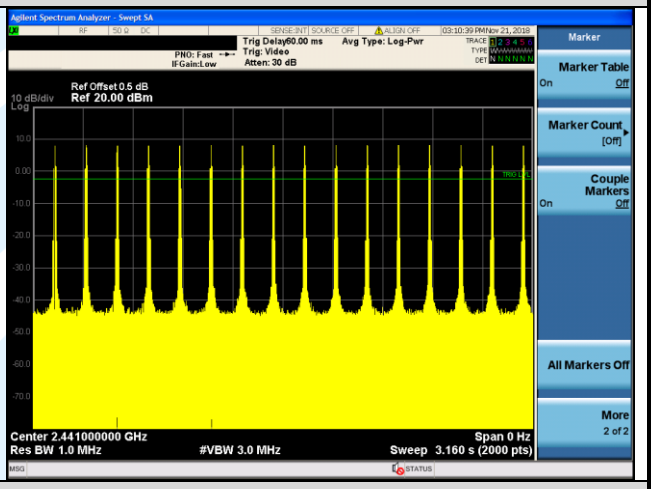
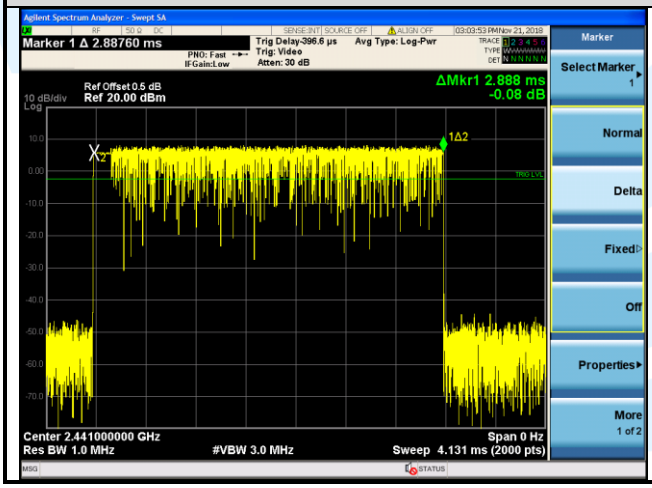
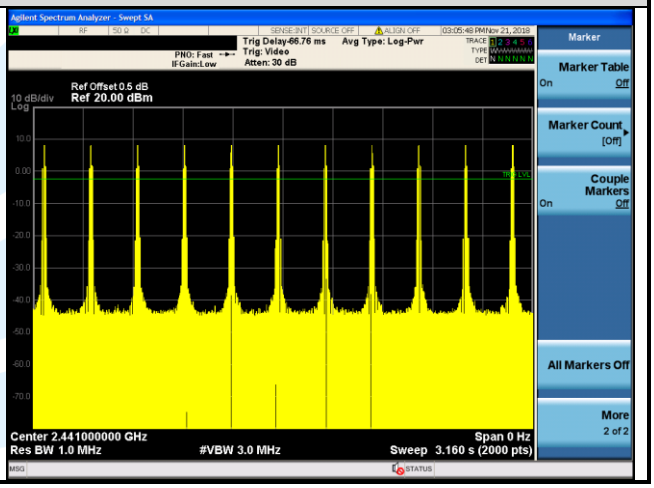
Type of Modulation	Test Frequency	Packet	Pulse Width	Number of Pulses in 3.16 seconds	Dwell Time	Limit
			ms		ms	ms
GFSK	2441MHz	1-DH1	0.374	32.000	119.71	< 400
		1-DH3	1.633	16.000	261.28	< 400
		1-DH5	2.879	11.000	316.69	< 400
π/4 DQPSK	2441MHz	2-DH1	0.384	32.000	123.01	< 400
		2-DH3	1.637	16.000	261.92	< 400
		2-DH5	2.886	11.000	**317.46**	< 400
8DPSK	2441MHz	3-DH1	0.387	32.000	123.68	< 400
		3-DH3	1.638	16.000	262.08	< 400
		3-DH5	2.883	11.000	317.13	< 400

The test plots as follows:

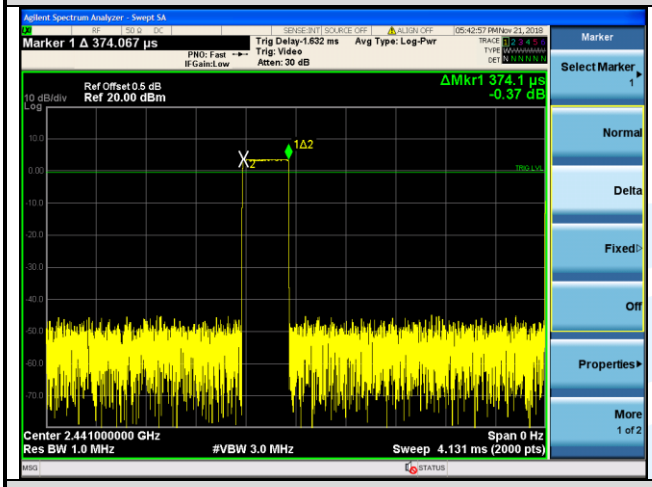
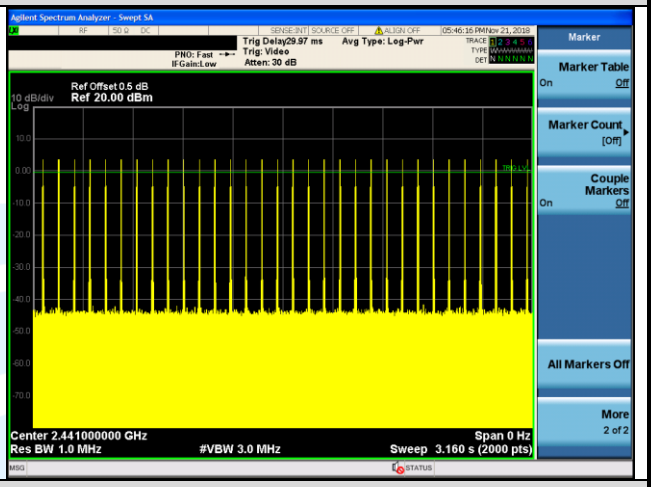
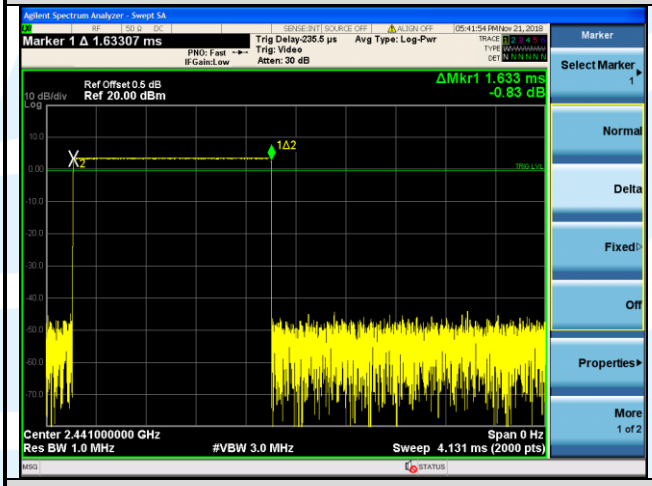
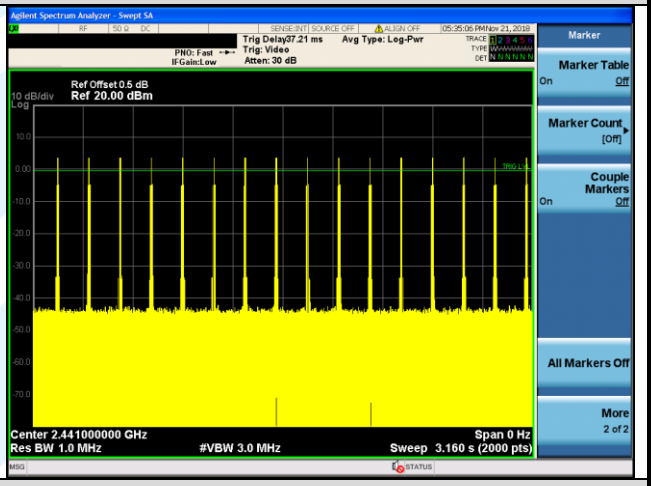
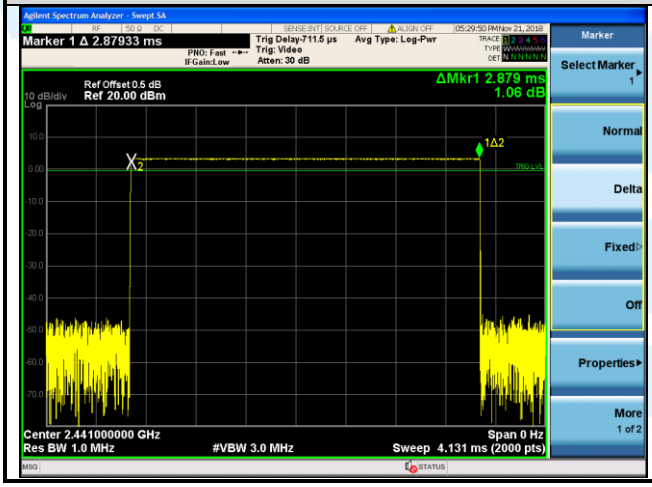
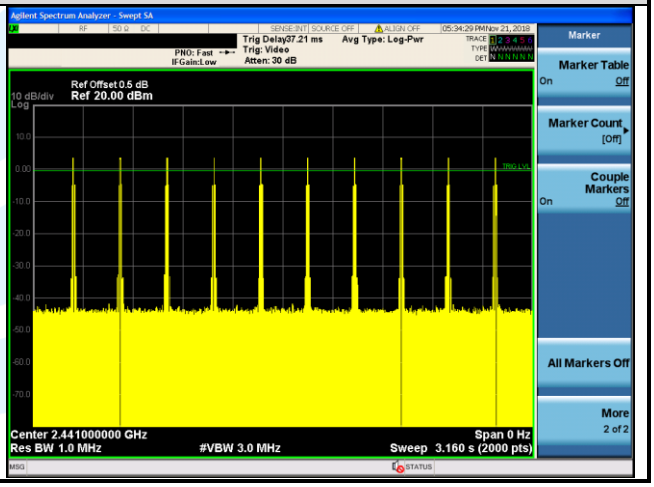
Left Ear

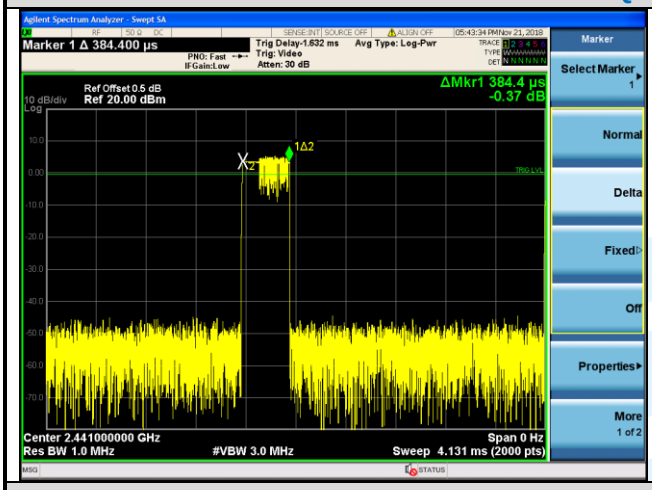
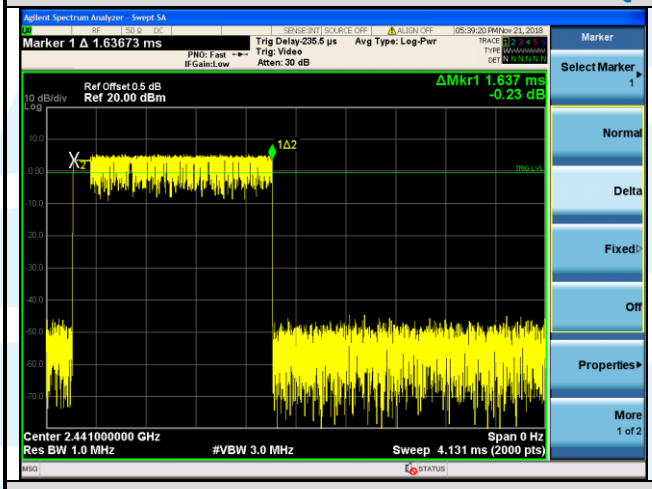
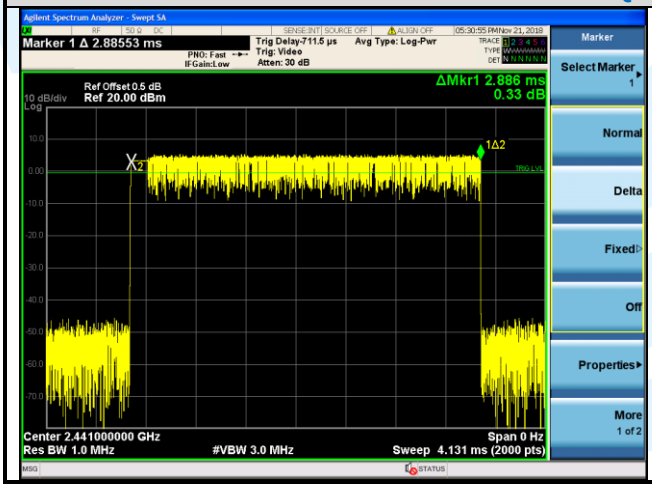
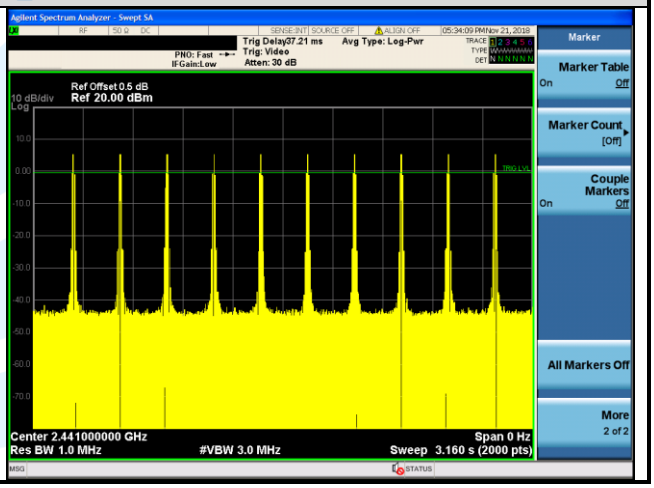
Pulse Width	Number of Pulses in 3.16 Seconds
GFSK_1-DH1	
	
GFSK_1-DH3	
	
GFSK_1-DH5	
	

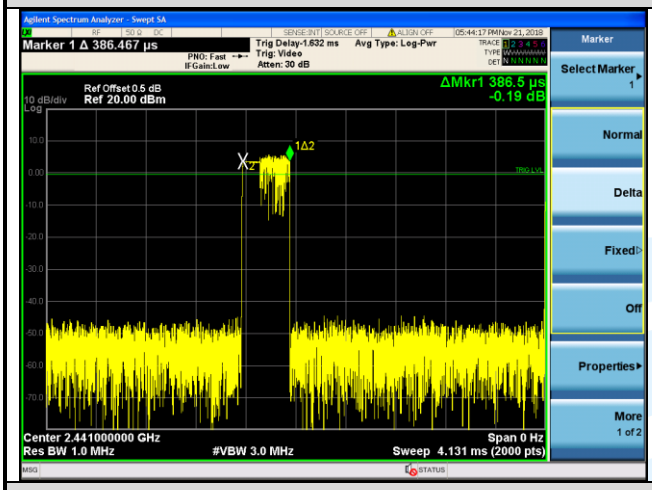
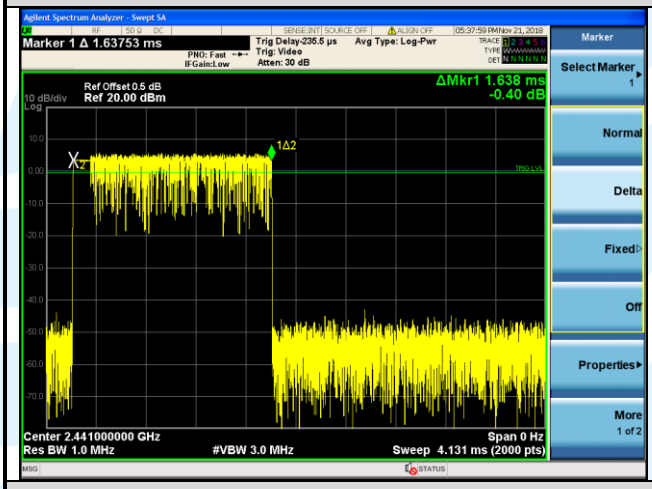
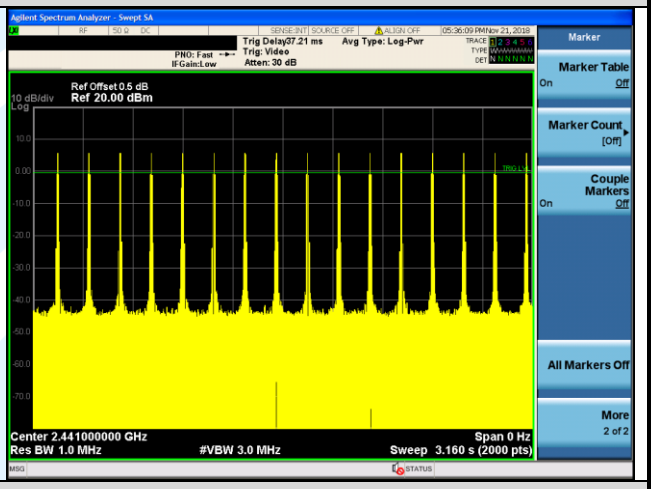
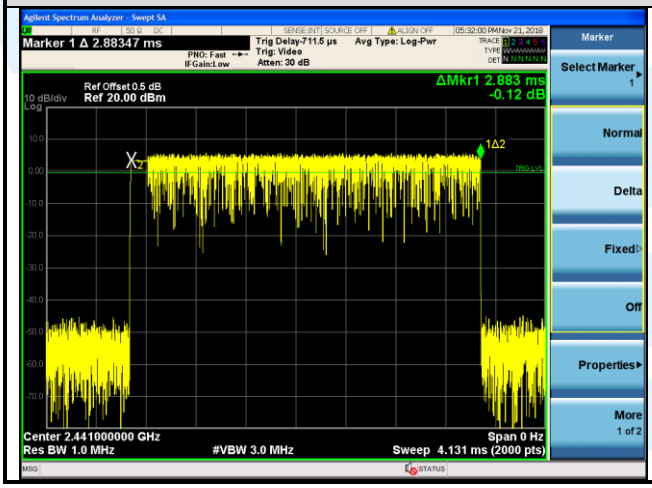
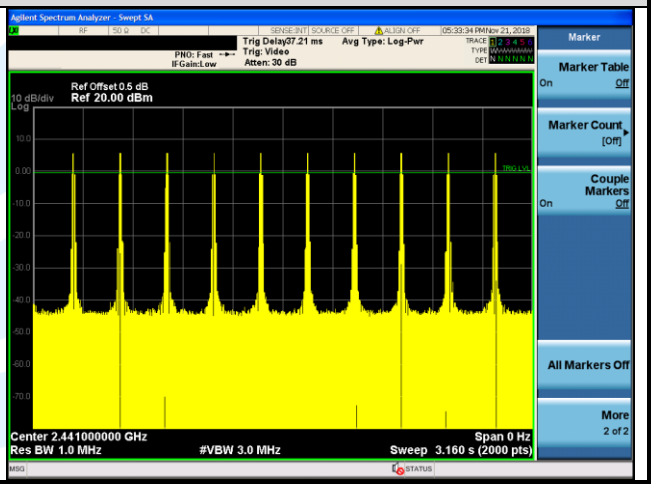
Pulse Width	Number of Pulses in 3.16 Seconds
π /4DQPSK_2-DH1	
	
π /4DQPSK_2-DH3	
	
π /4DQPSK_2-DH5	
	

Pulse Width	Number of Pulses in 3.16 Seconds
8DPSK_3-DH1	
	
8DPSK_3-DH3	
	
8DPSK_3-DH5	
	

Right Ear

Pulse Width	Number of Pulses in 3.16 Seconds
GFSK_1-DH1	
	
GFSK_1-DH3	
	
GFSK_1-DH5	
	

Pulse Width	Number of Pulses in 3.16 Seconds
π /4DQPSK_2-DH1	
	
π /4DQPSK_2-DH3	
	
π /4DQPSK_2-DH5	
	

Pulse Width	Number of Pulses in 3.16 Seconds
8DPSK_3-DH1	
	
8DPSK_3-DH3	
	
8DPSK_3-DH5	
	

5.8 CONDUCTED OUT OF BAND EMISSION

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247(d)
RSS-247 Issue 2, Section 5.5

Test Method: ANSI C63.10-2013 Section 6.10.4 & Section 7.8.8

Limit: In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

Step 1:Measurement Procedure REF

a) Set instrument center frequency to 2400 MHz or 2483.5 MHz.
b) Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Sweep points ≥ 2 x Span/RBW
h) Trace mode = max hold.
i) Allow the trace to stabilize.
j) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

Step 2:Measurement Procedure OOBE

a) Set RBW = 100 kHz.
b) Set VBW ≥ 300 kHz.
c) Detector = peak.
d) Sweep = auto couple.
e) Trace Mode = max hold.
f) Allow trace to fully stabilize.
g) Use the peak marker function to determine the maximum amplitude level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

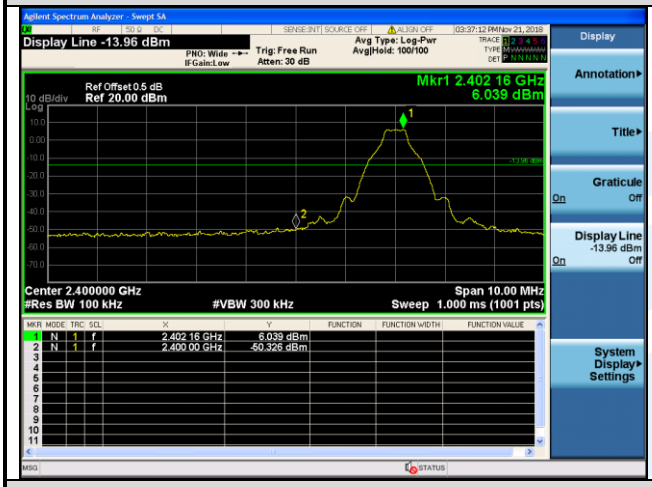
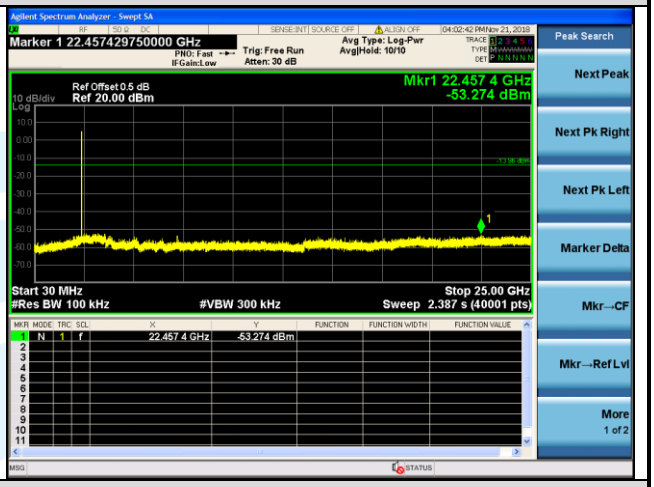
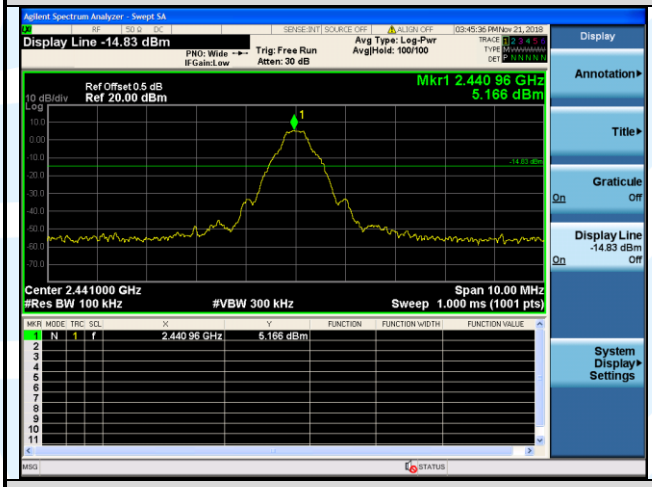
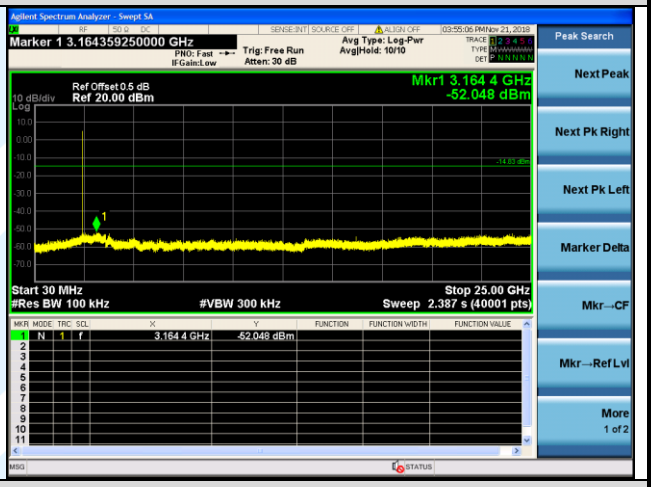
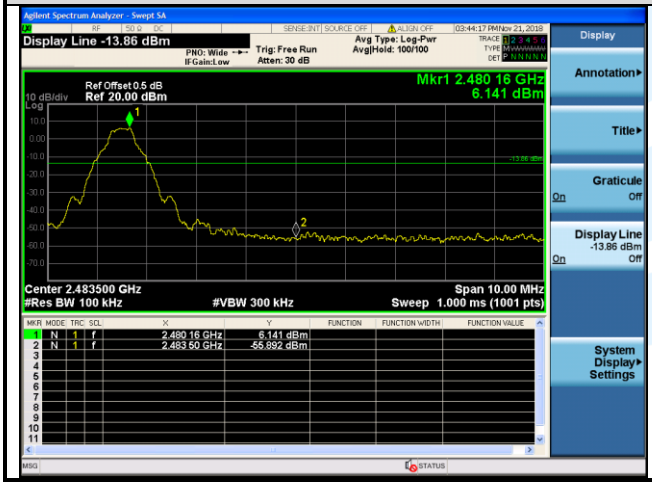
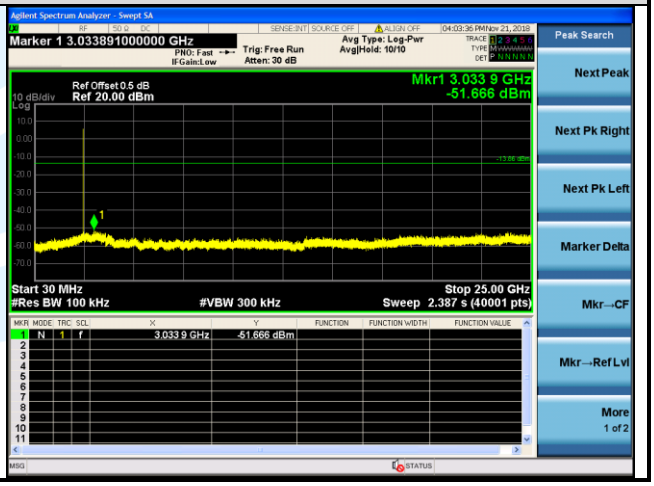
Test Mode: Hopping Frequencies Transmitter mode

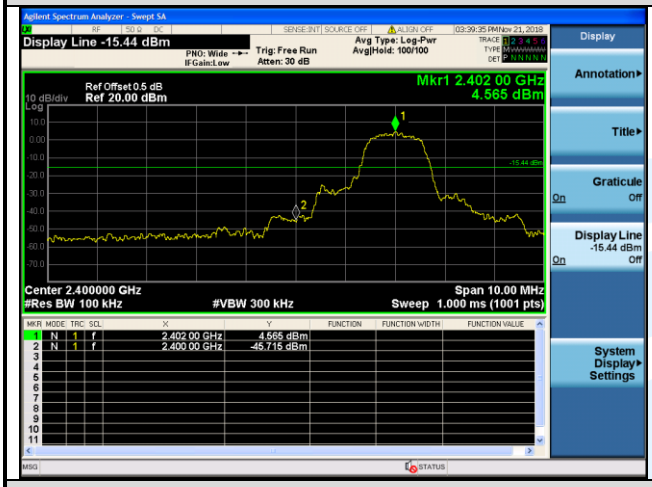
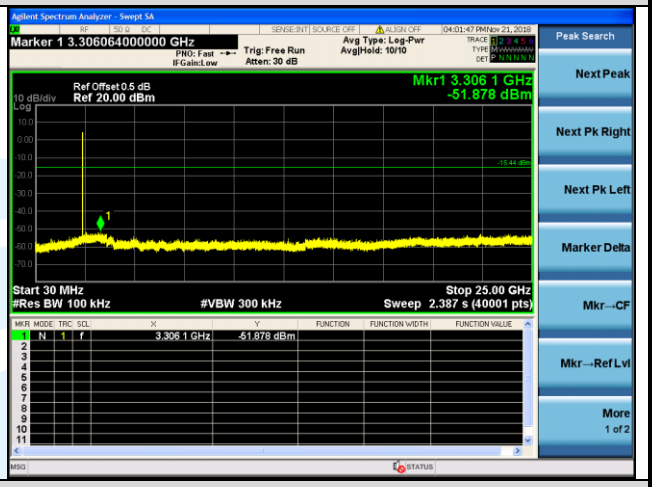
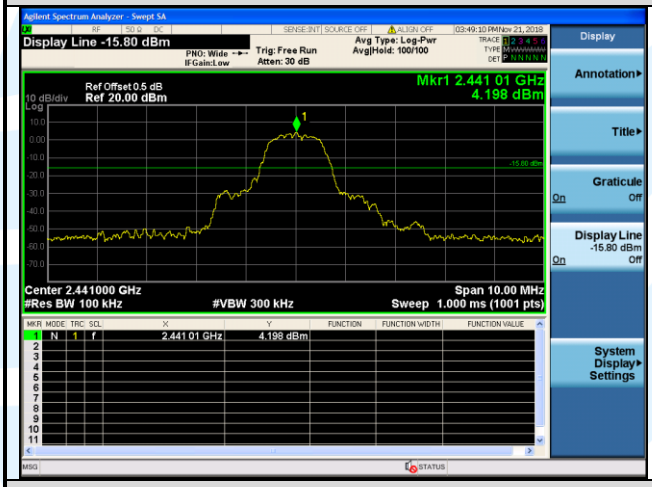
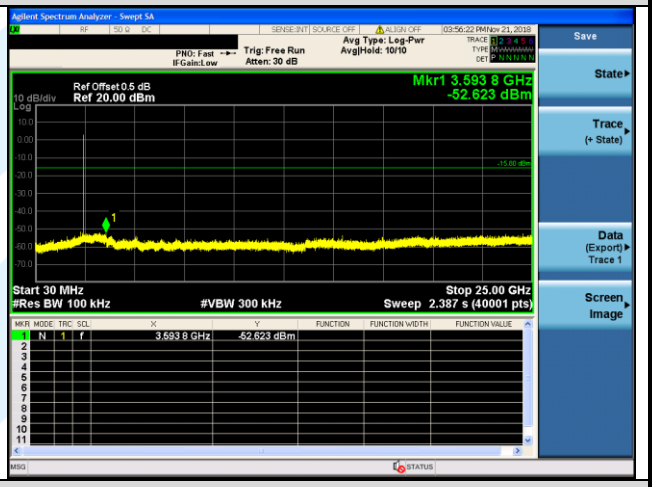
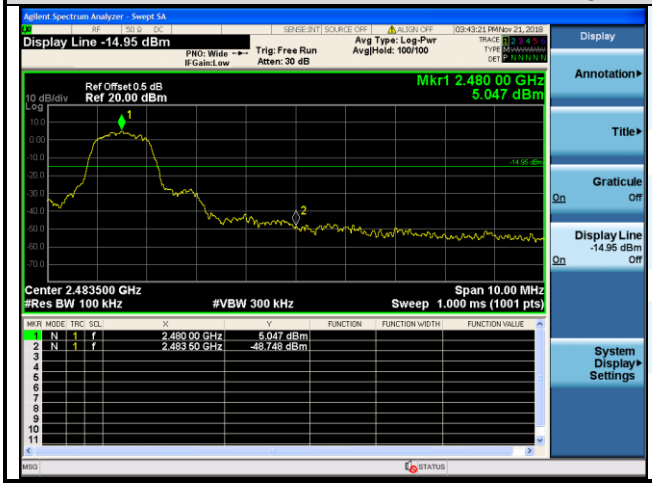
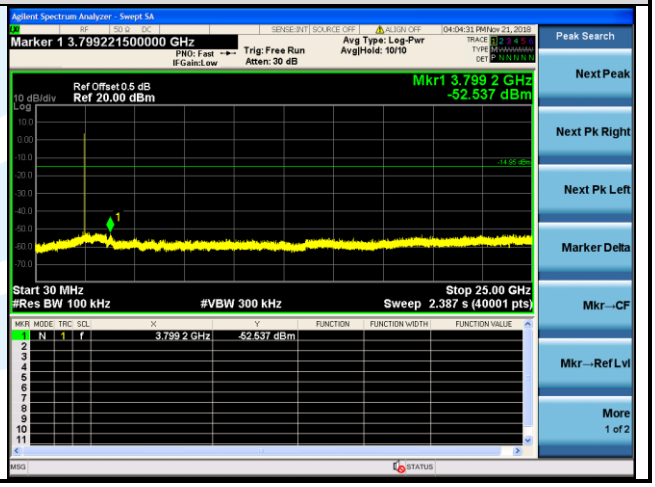
Test Results: Pass

Test Data:

The test plots as follows:

Left Ear

GFSK	
In-Band Reference Level	**Out of Band Emission**
Lowest Channel	
	
Middle Channel	
	
Highest Channel	
	

π/4DQPSK	
In-Band Reference Level	**Out of Band Emission**
Lowest Channel	
	
Middle Channel	
	
Highest Channel