Appendix A

RF Test Data for BT V5.0(BDR/EDR) (Conducted Measurement)

Product Name: Optima TWS Earbud w/Wireless Charging case

Trade Mark: Gemline

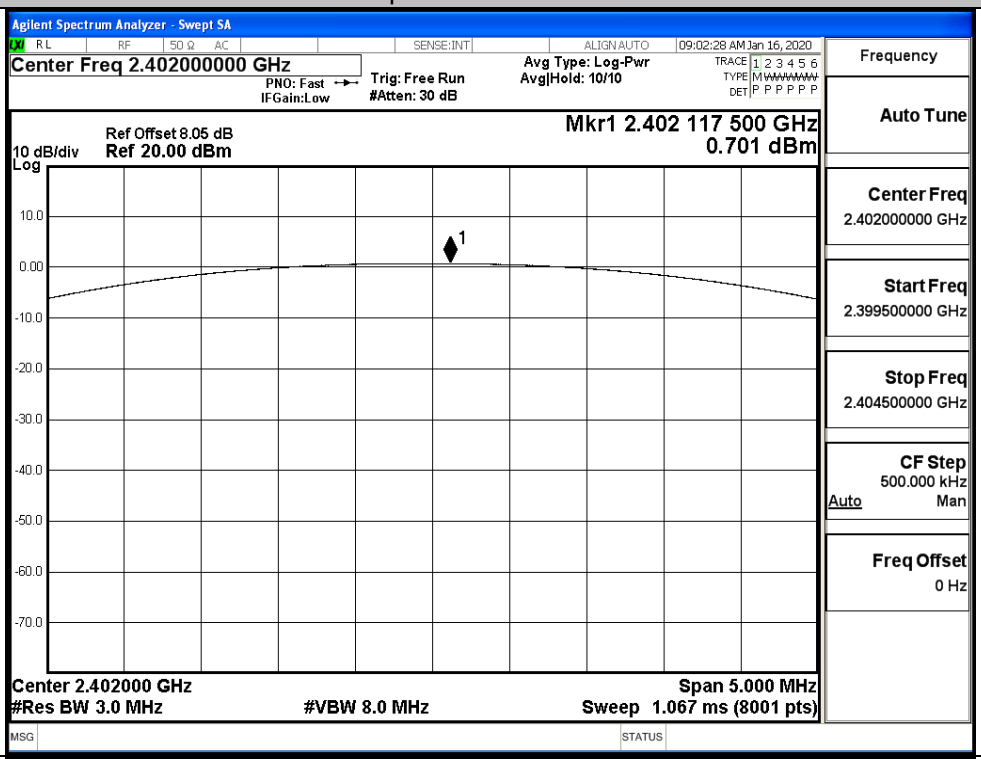
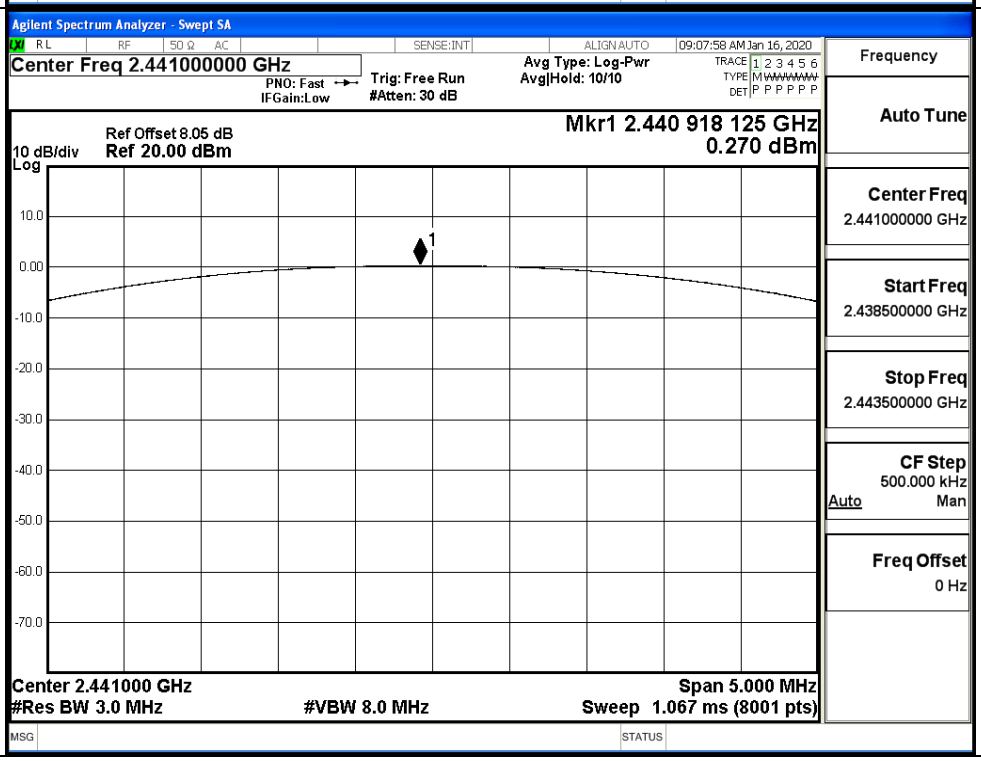
Test Model: 100565-001B

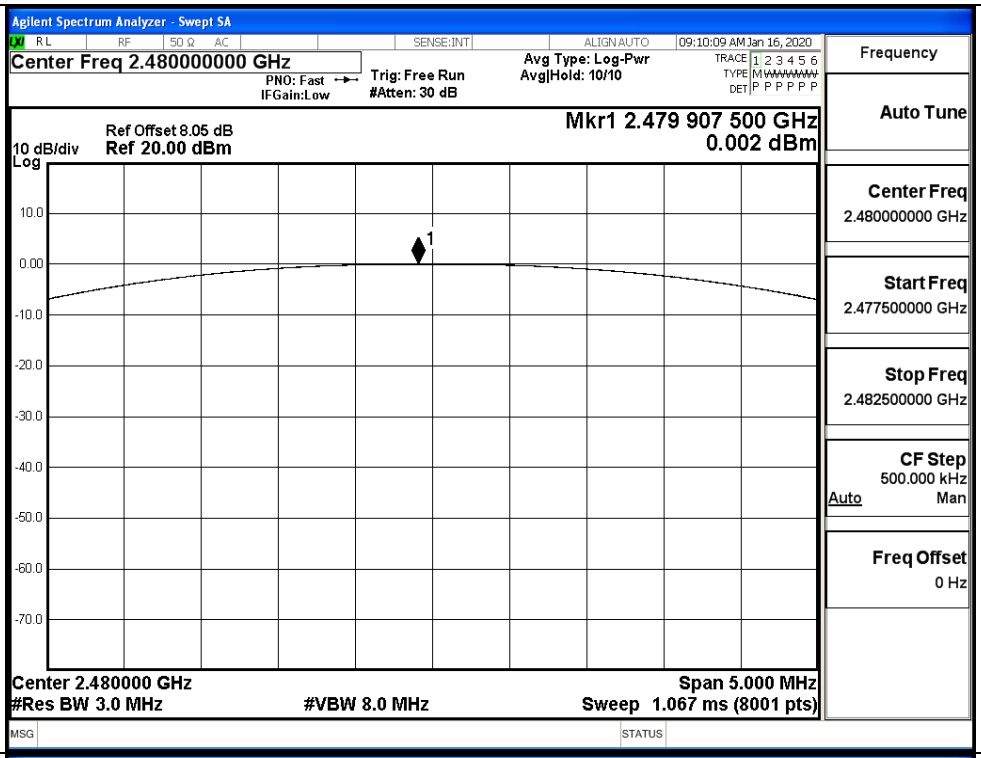
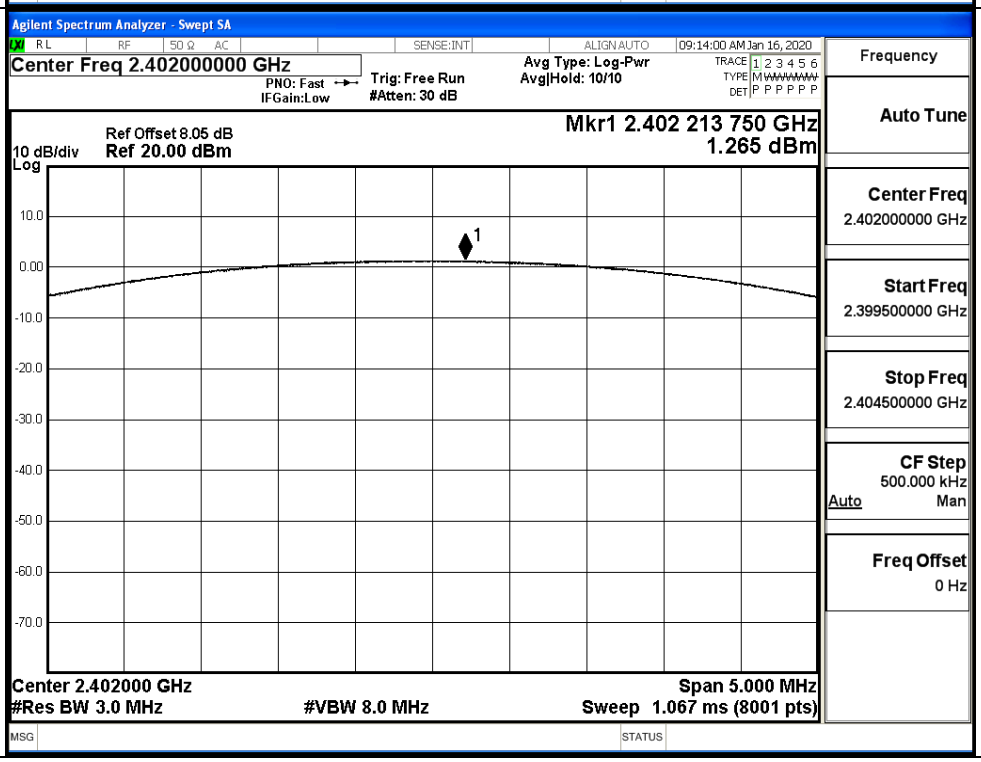
Environmental Conditions

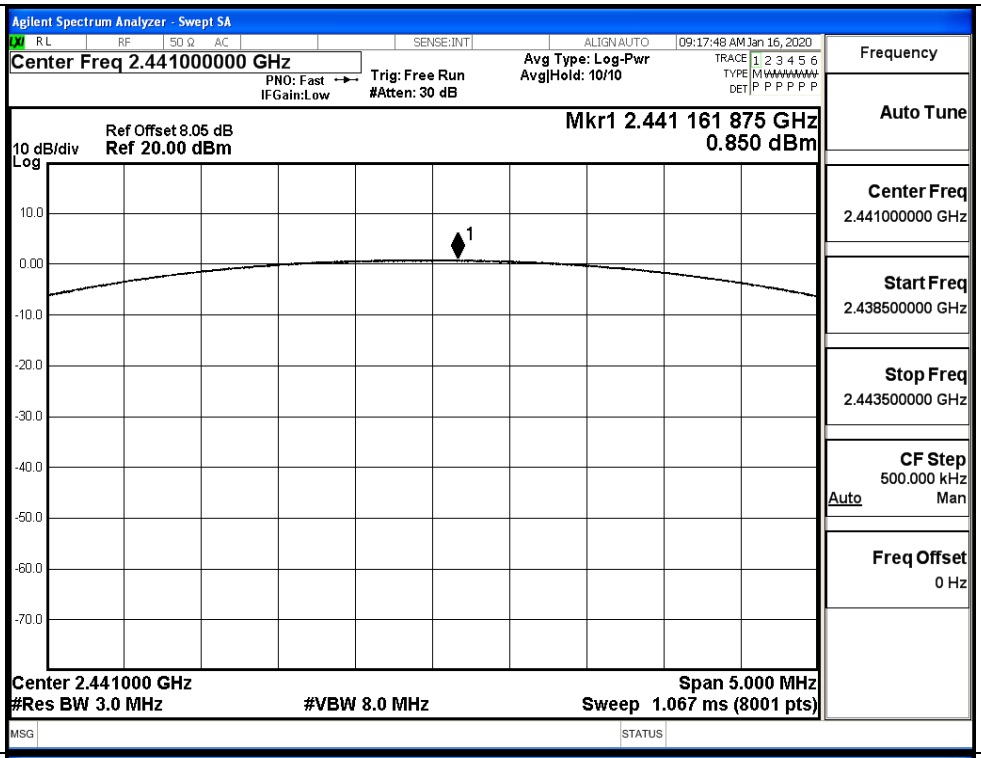
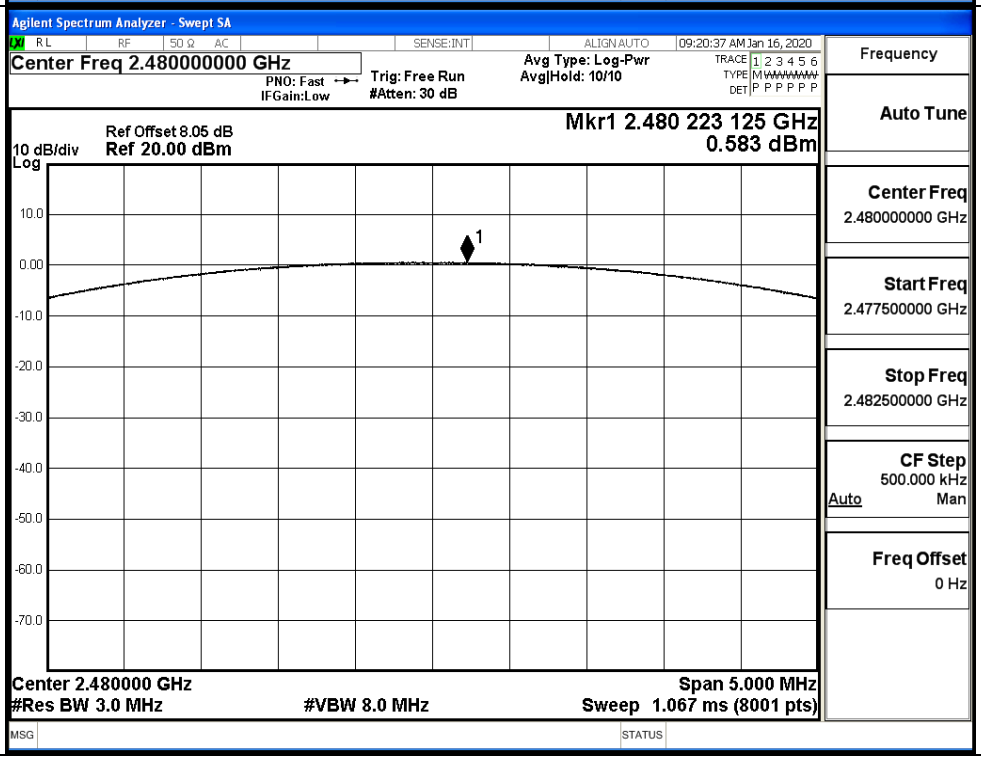
Temperature:	22.8°C
Relative Humidity:	53.4%
ATM Pressure:	100.0 kPa
Test Engineer:	Alisa Huang
Supervised by:	Li Huan

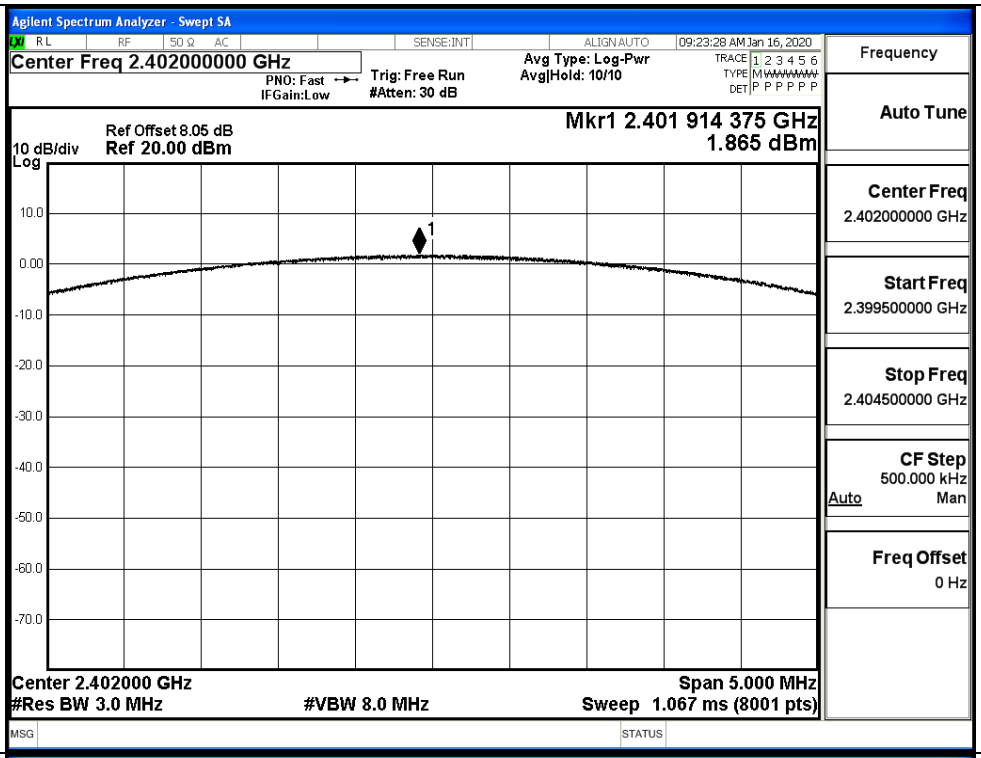
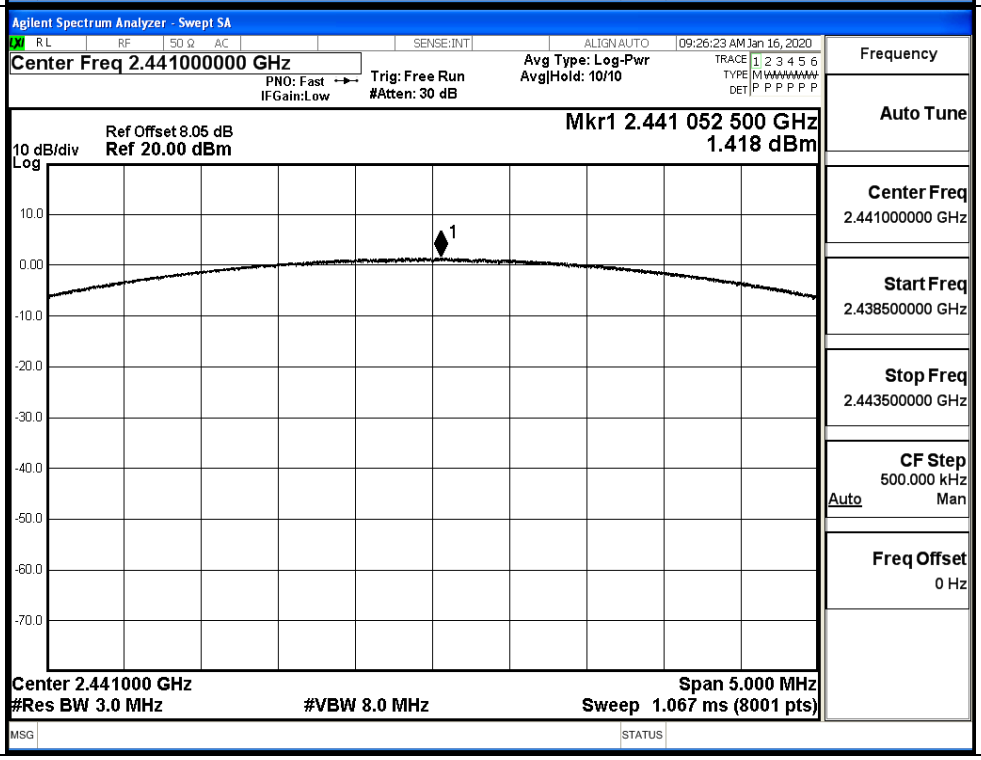
A.1 Maxmum Conducted Peak Output Power

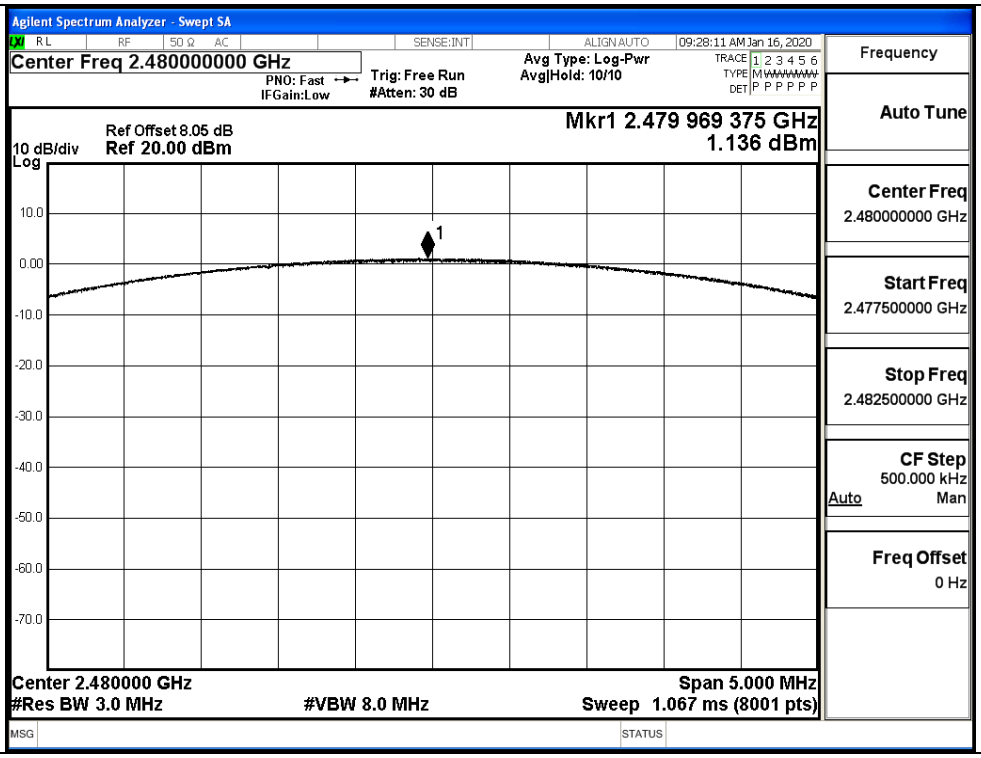
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	0.701	21	PASS
	MCH	0.270	21	PASS
	HCH	0.002	21	PASS
π/4DQPSK	LCH	1.265	21	PASS
	MCH	0.850	21	PASS
	HCH	0.583	21	PASS
8DPSK	LCH	1.865	21	PASS
	MCH	1.418	21	PASS
	HCH	1.136	21	PASS

Test Graphs		
GFSK/LCH		
GFSK/MCH		

GFSK/HCH		
π/4DQPSK/LCH		

π/4DQPSK/MCH		
π/4DQPSK/HCH		

8DPSK/LCH		
8DPSK/MCH		

8DPSK/HCH	

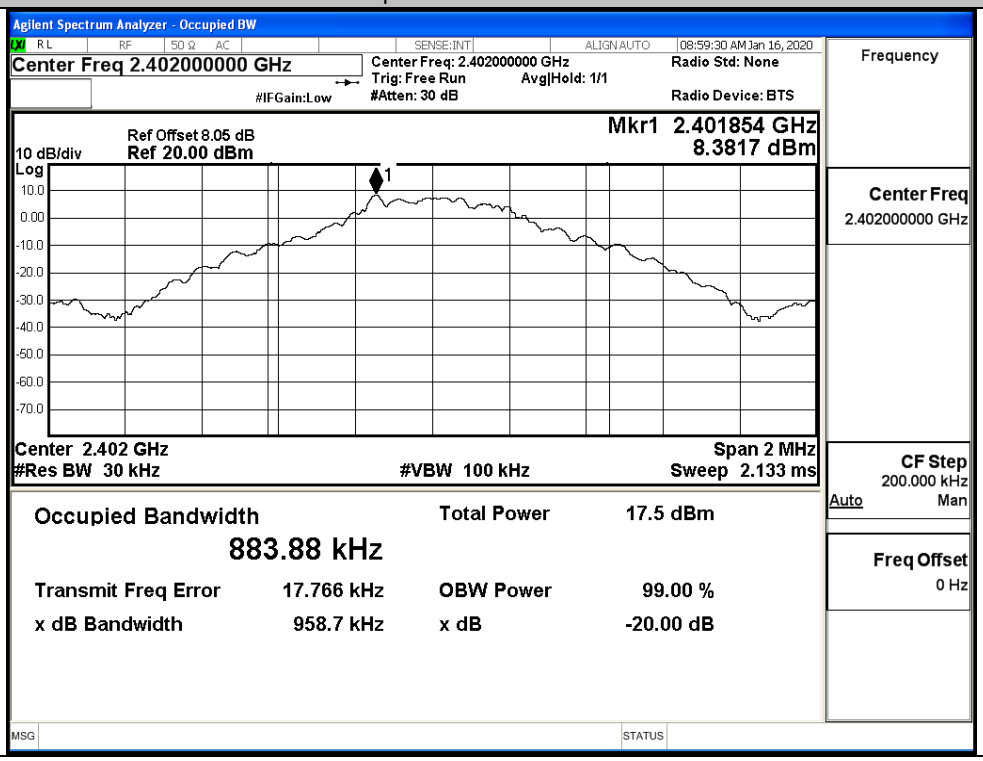
Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
09:28:11 AM Jan 16, 2020
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 8.05 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.479 969 375 GHz
1.136 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.480000 GHz
#Res BW 3.0 MHz
#VBW 8.0 MHz
Span 5.000 MHz
Sweep 1.067 ms (8001 pts)
MSG
STATUS
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.477500000 GHz
Stop Freq
2.482500000 GHz
CF Step
500.000 kHz
Auto
Man
Freq Offset
0 Hz

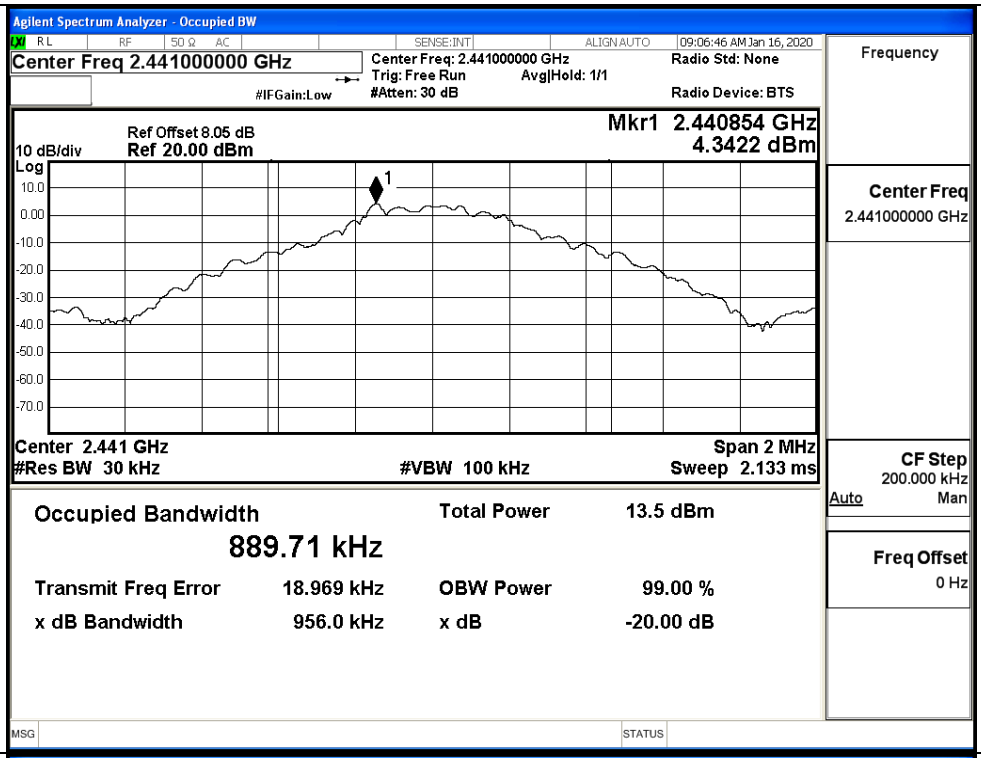
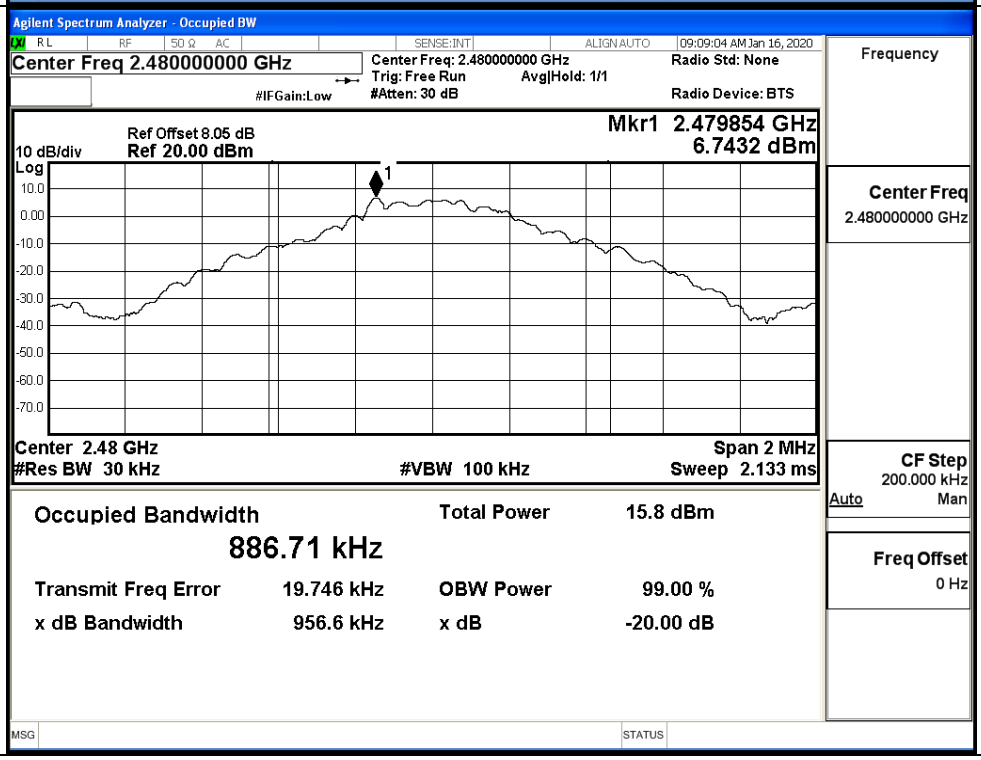
A.2 20dB Bandwidth

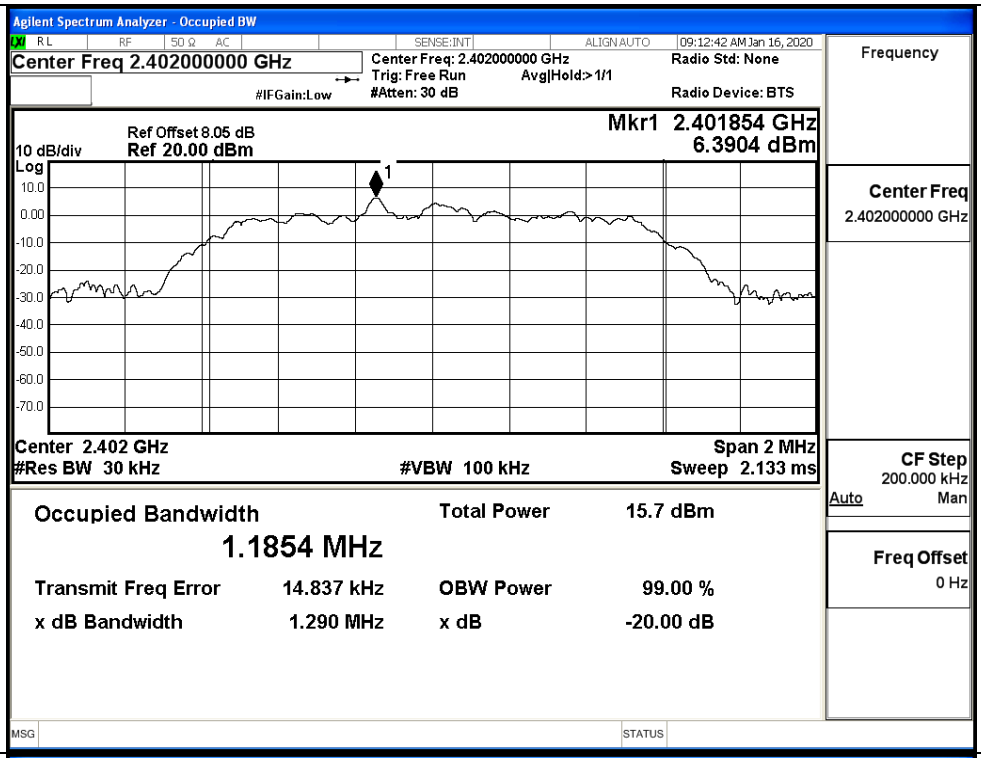
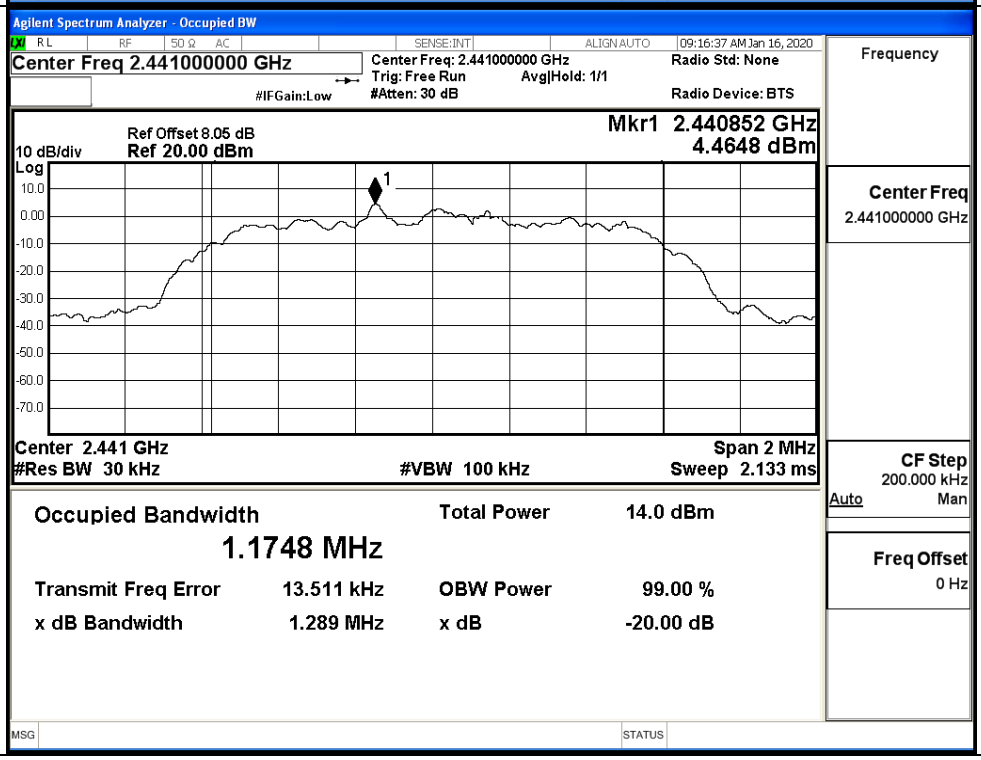
Mode	Channel.	20dB Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.9587	Not Specified	PASS
	MCH	0.9560	Not Specified	PASS
	HCH	0.9566	Not Specified	PASS
π/4DQPSK	LCH	1.290	Not Specified	PASS
	MCH	1.289	Not Specified	PASS
	HCH	1.290	Not Specified	PASS
8DPSK	LCH	1.304	Not Specified	PASS
	MCH	1.303	Not Specified	PASS
	HCH	1.302	Not Specified	PASS

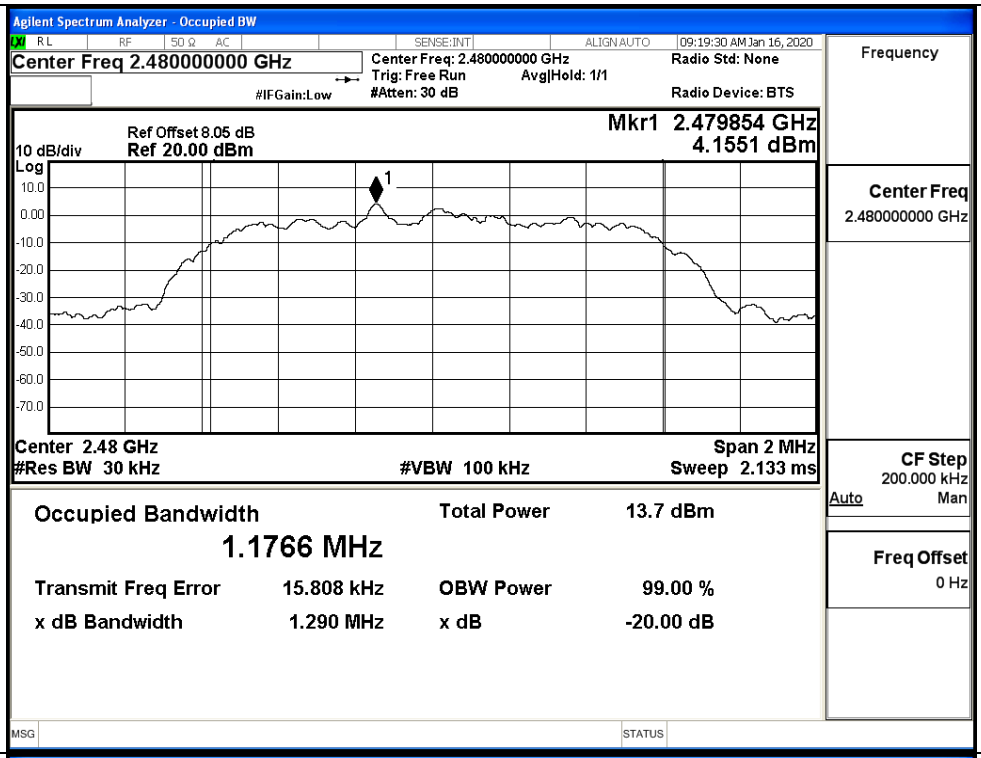
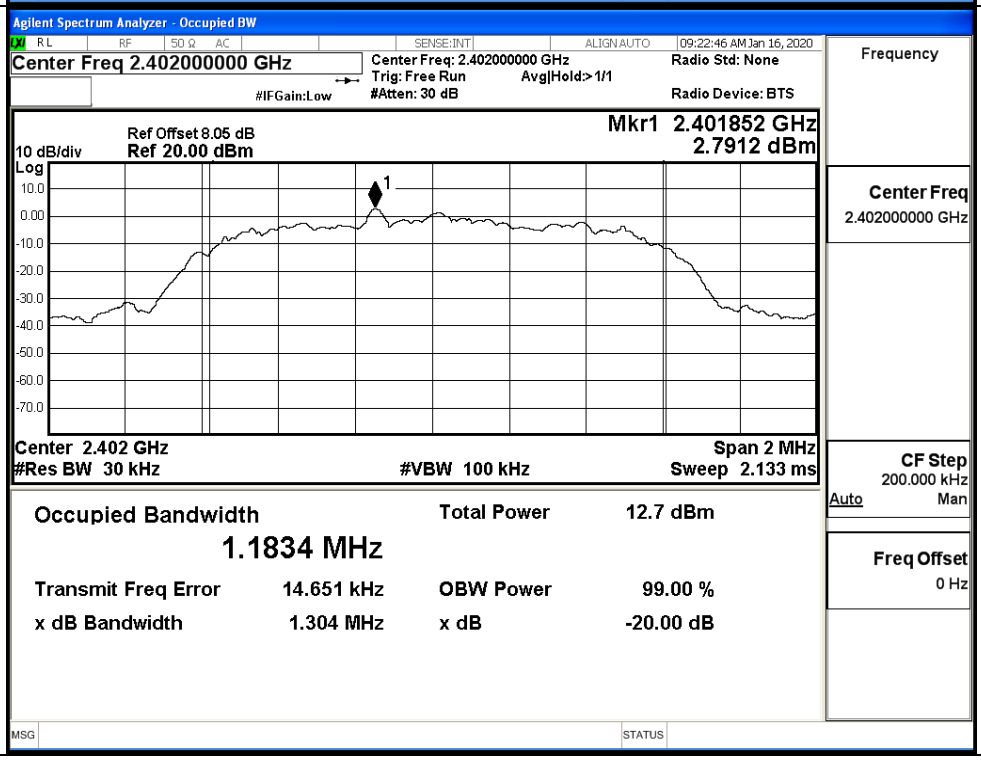
Test Graphs

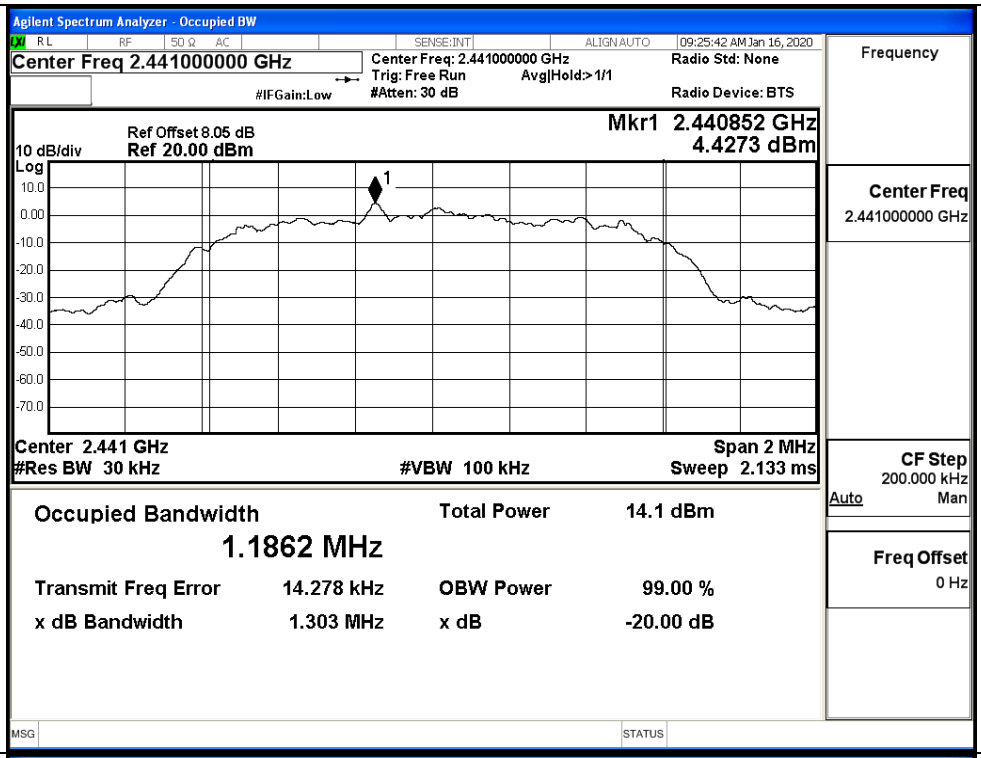
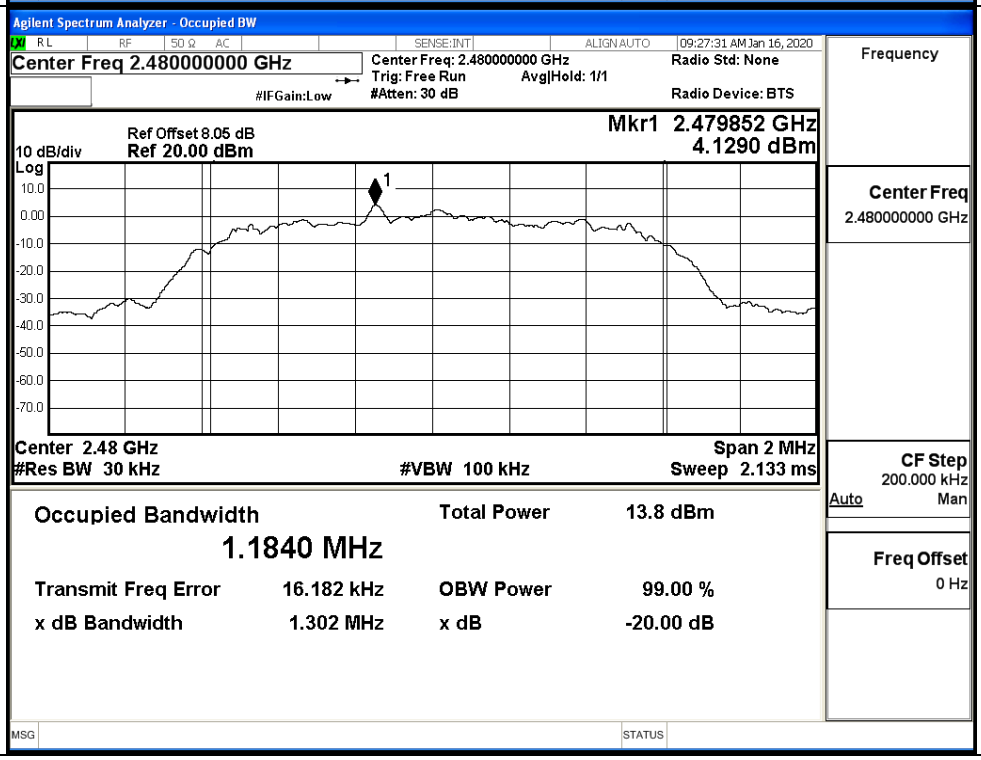
GFSK/LCH



GFSK/MCH	
GFSK/HCH	

π/4DQPSK/LCH	
π/4DQPSK/MCH	

π/4DQPSK/HCH	
8DPSK/LCH	

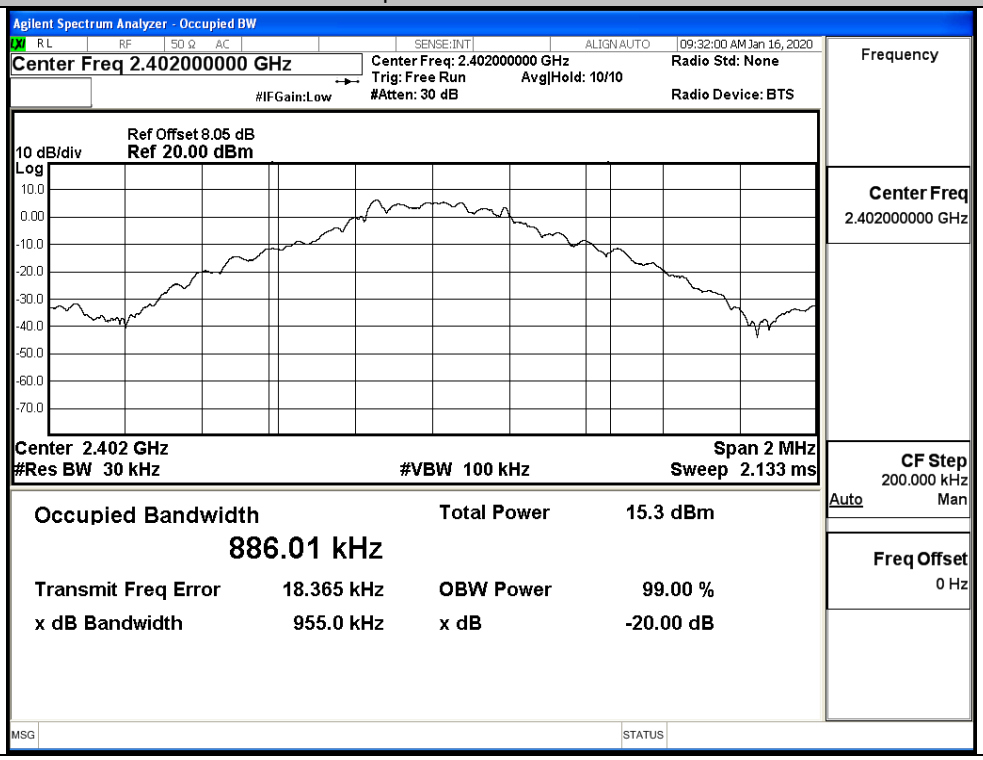
8DPSK/MCH	
8DPSK/HCH	

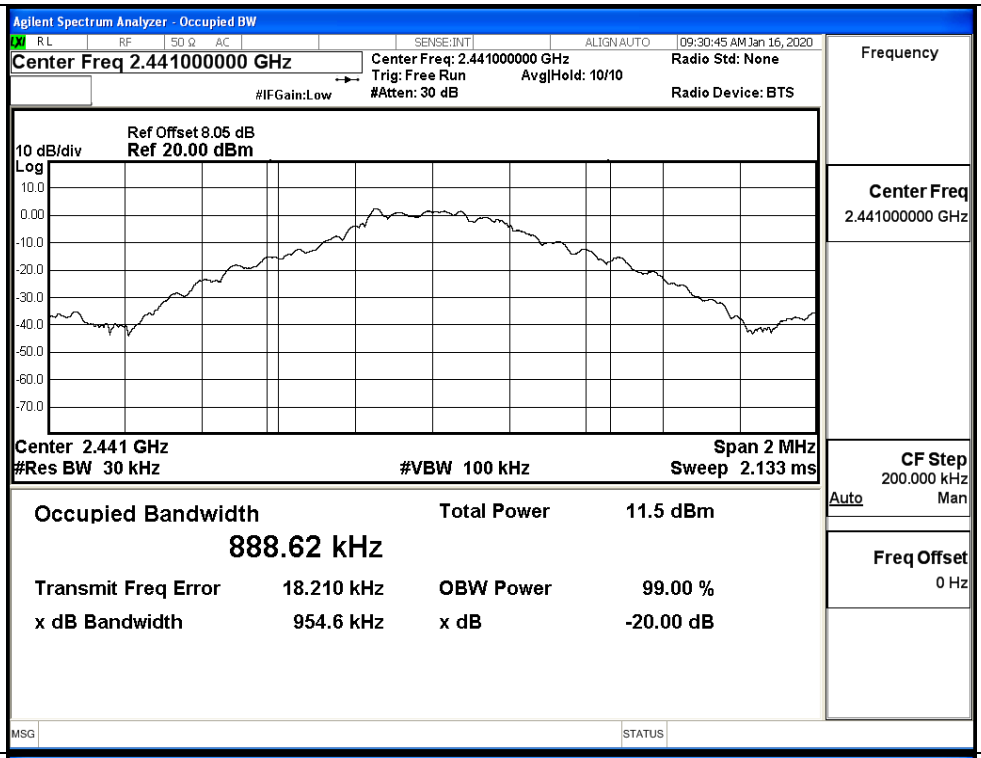
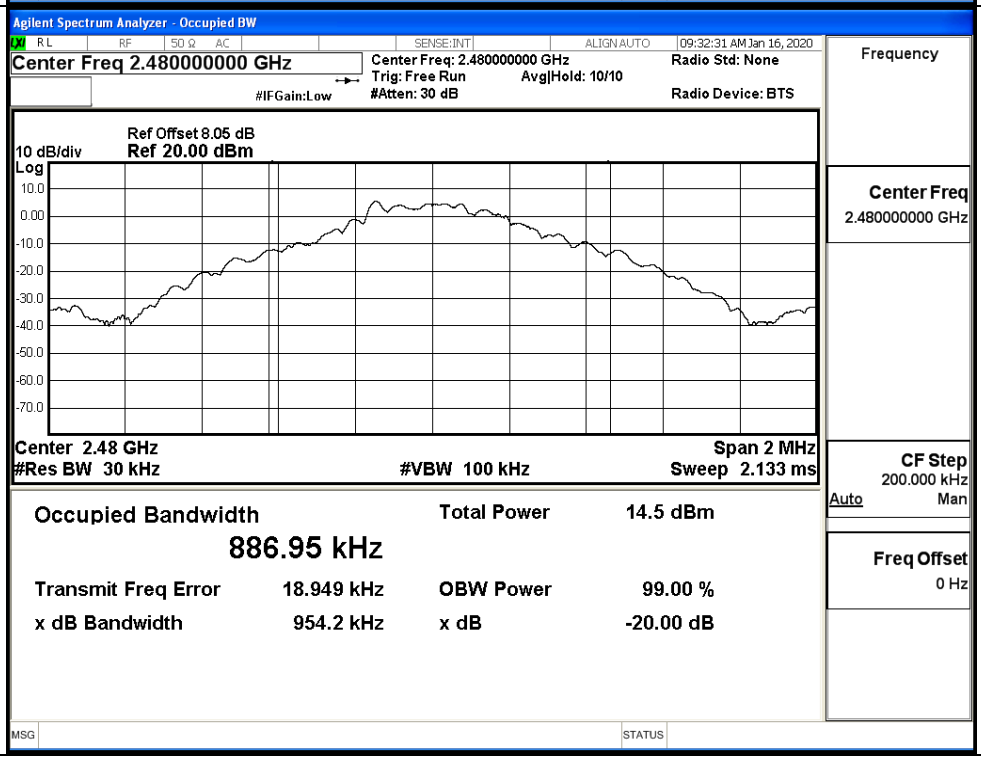
A.3 Occupied Bandwidth

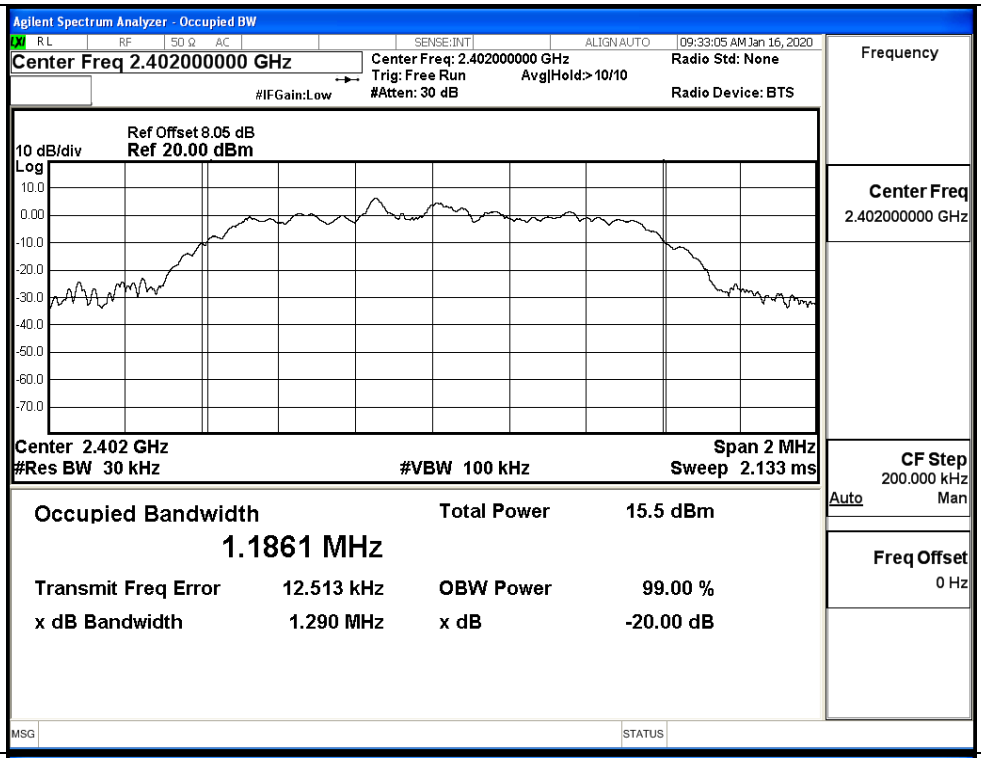
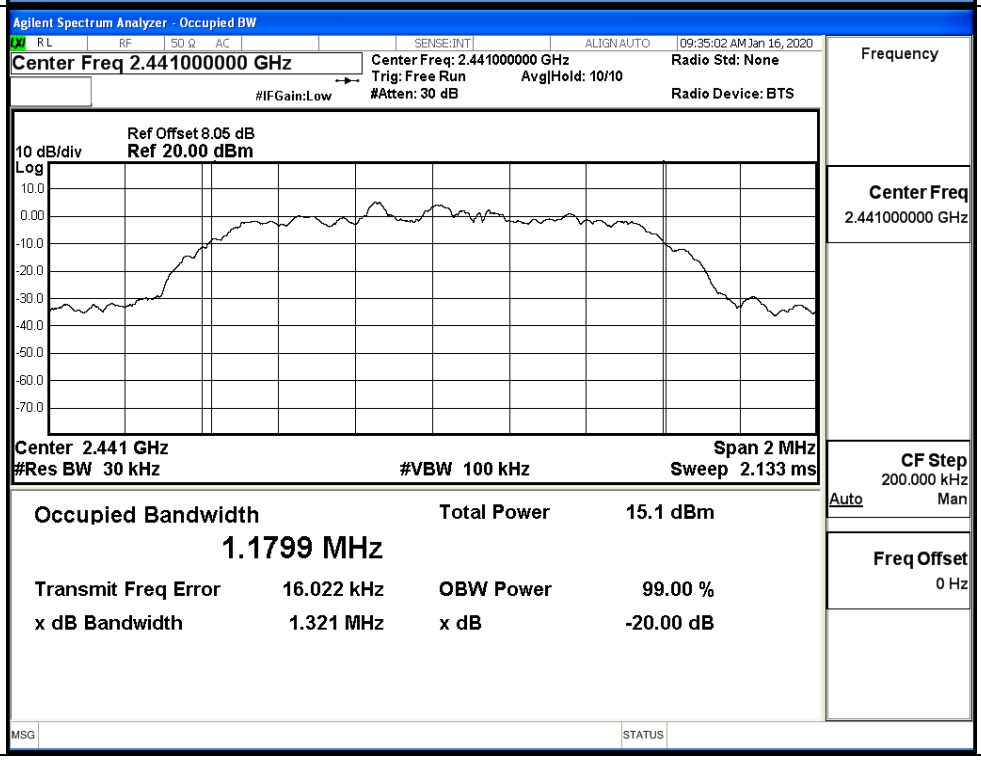
Mode	Channel.	Occupied Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.88601	Not Specified	PASS
	MCH	0.88862	Not Specified	PASS
	HCH	0.88695	Not Specified	PASS
π/4DQPSK	LCH	1.1861	Not Specified	PASS
	MCH	1.1799	Not Specified	PASS
	HCH	1.1801	Not Specified	PASS
8DPSK	LCH	1.1919	Not Specified	PASS
	MCH	1.1887	Not Specified	PASS
	HCH	1.1889	Not Specified	PASS

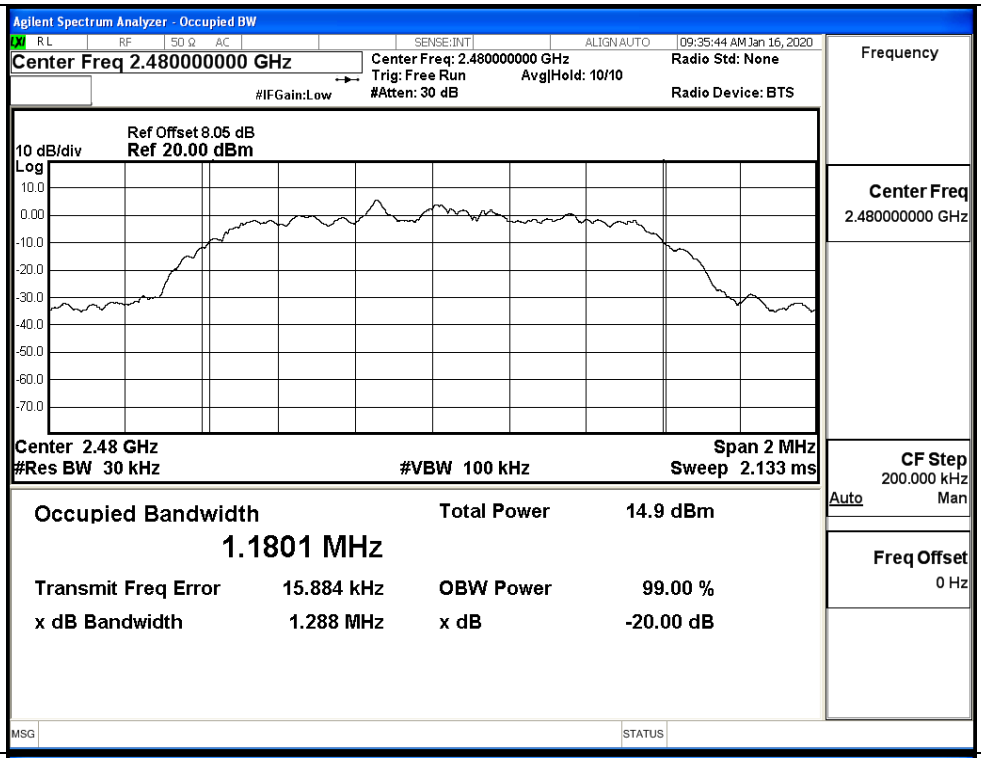
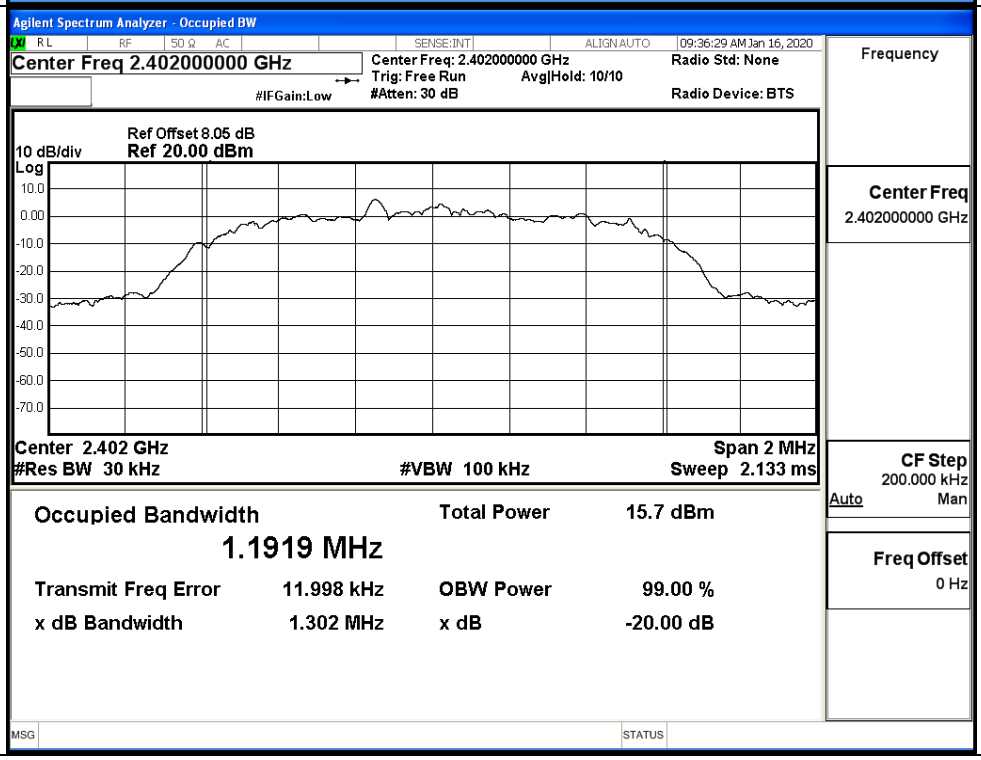
Test Graphs

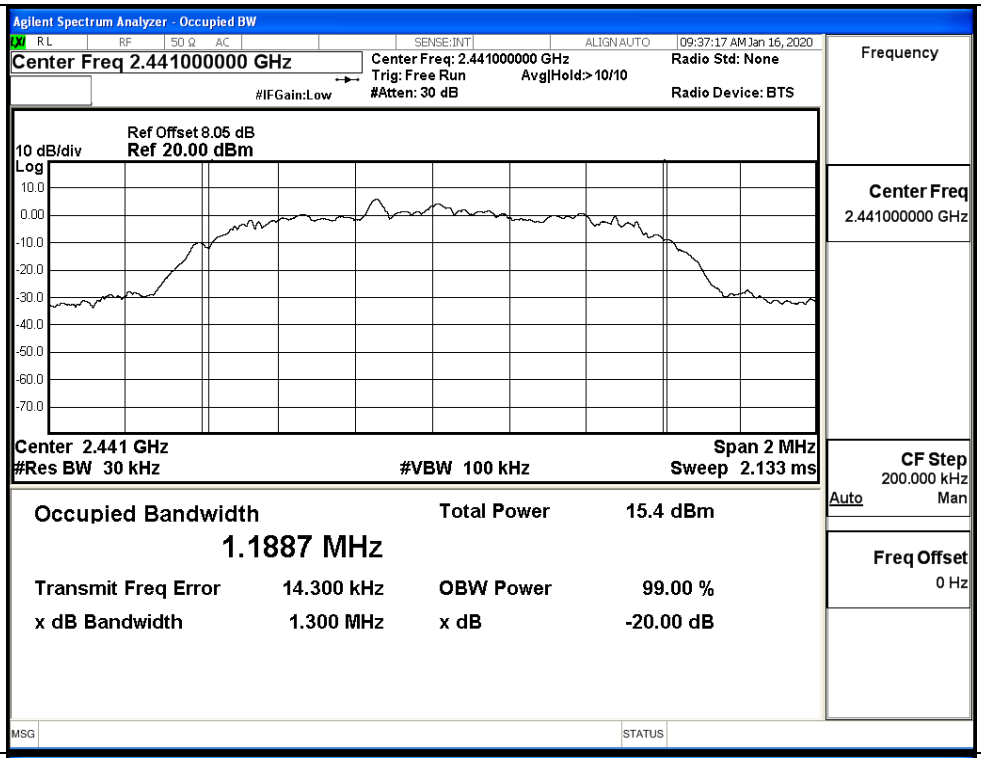
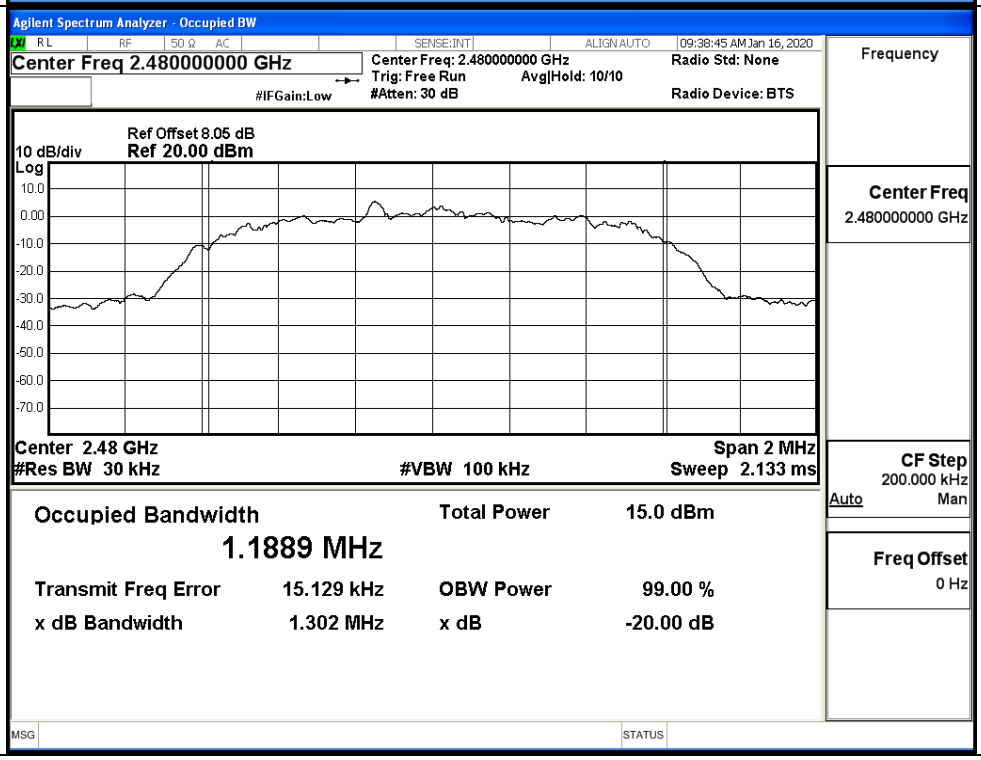
GFSK/LCH



GFSK/MCH	
GFSK/HCH	

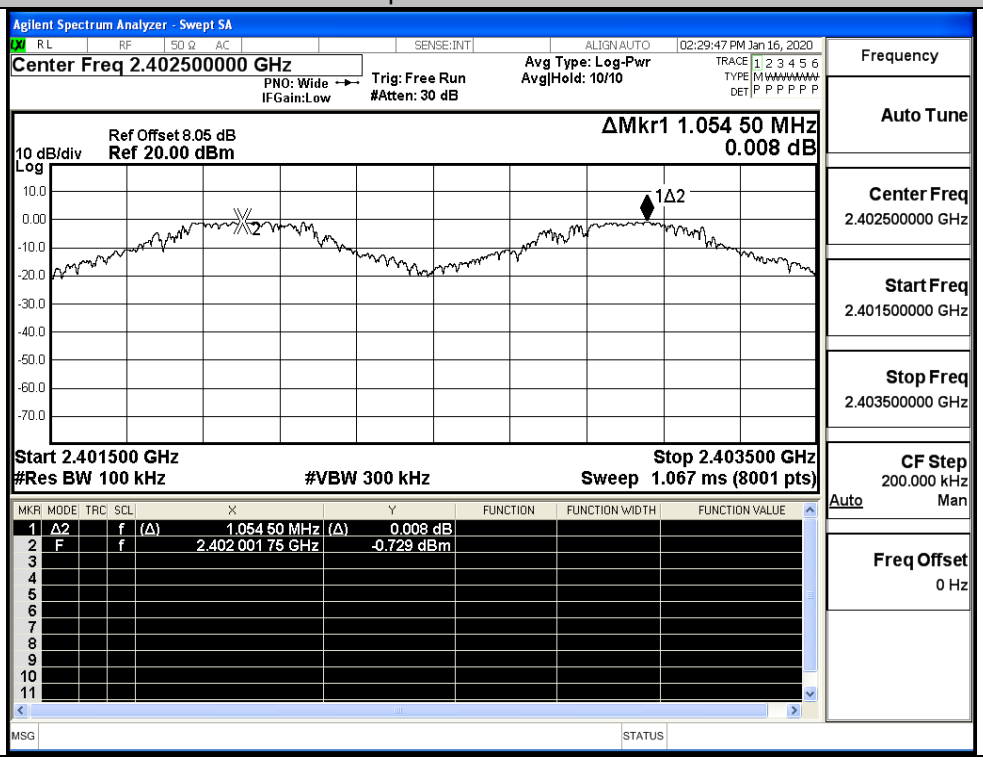
π/4DQPSK/LCH	
π/4DQPSK/MCH	

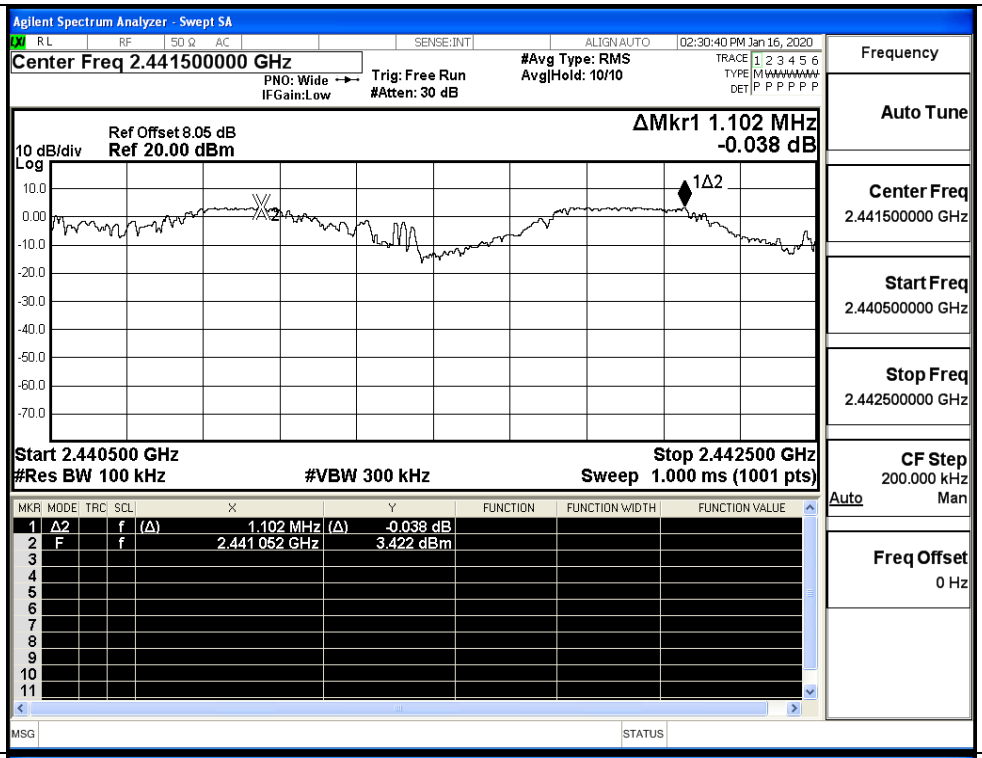
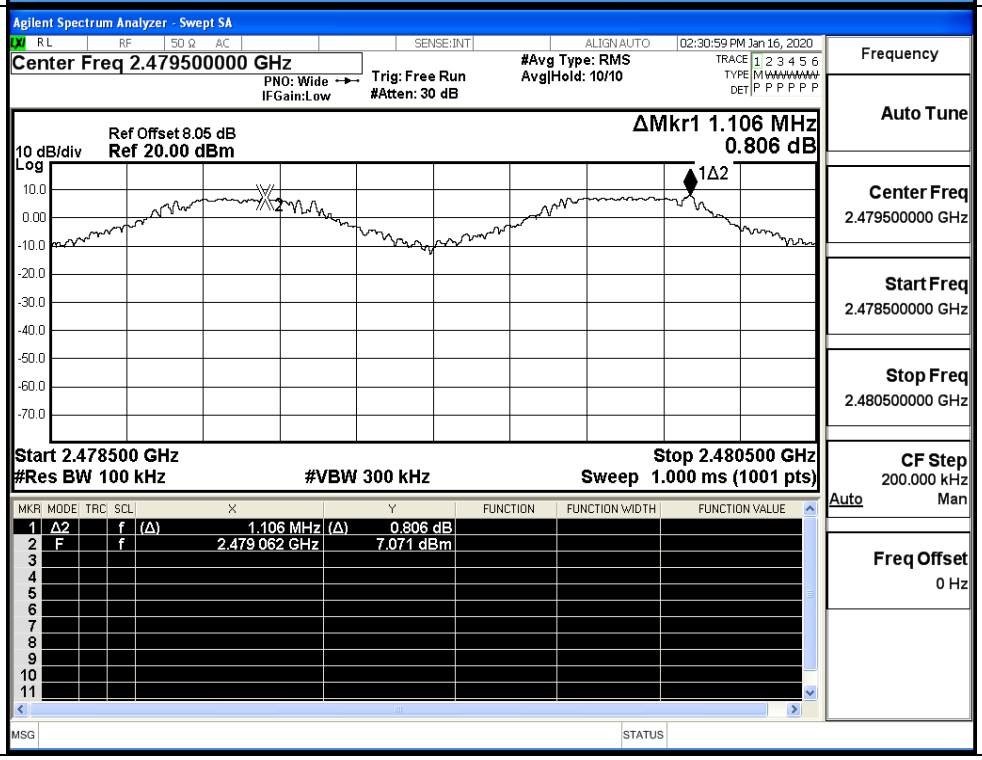
π/4DQPSK/HCH	
8DPSK/LCH	

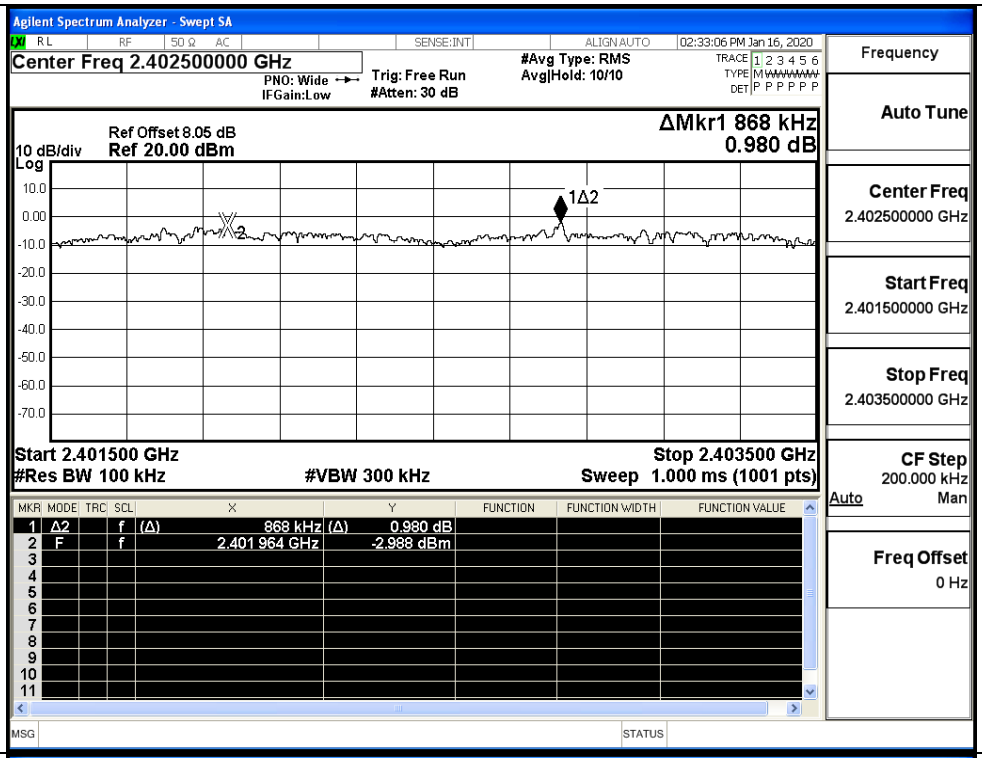
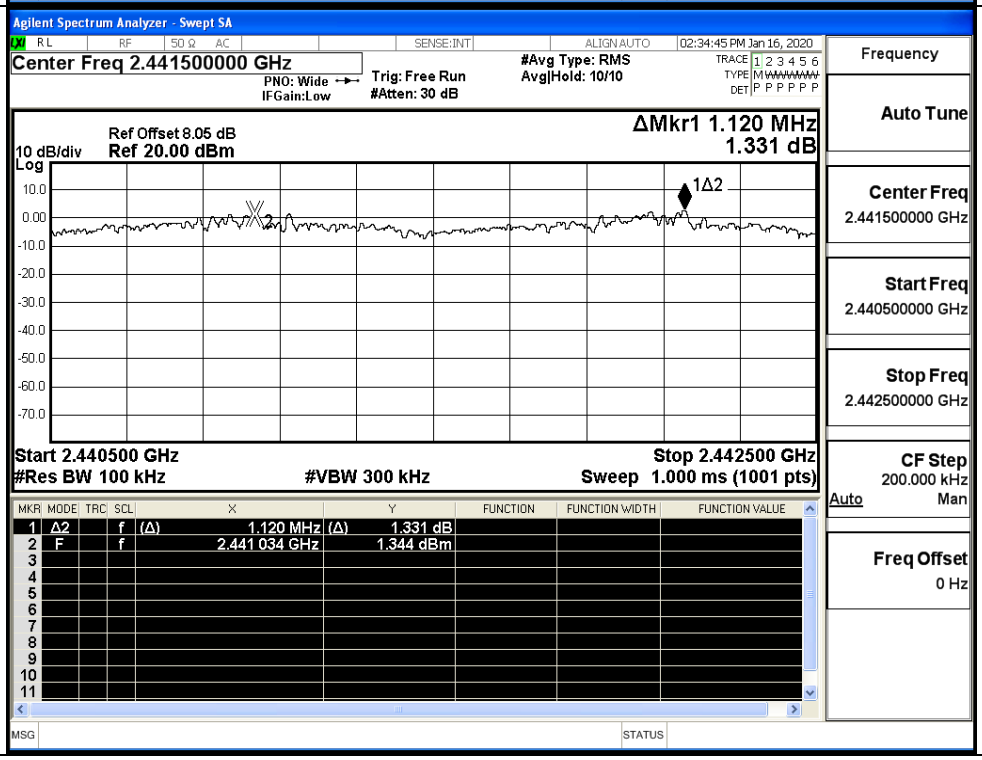
8DPSK/MCH	
8DPSK/HCH	

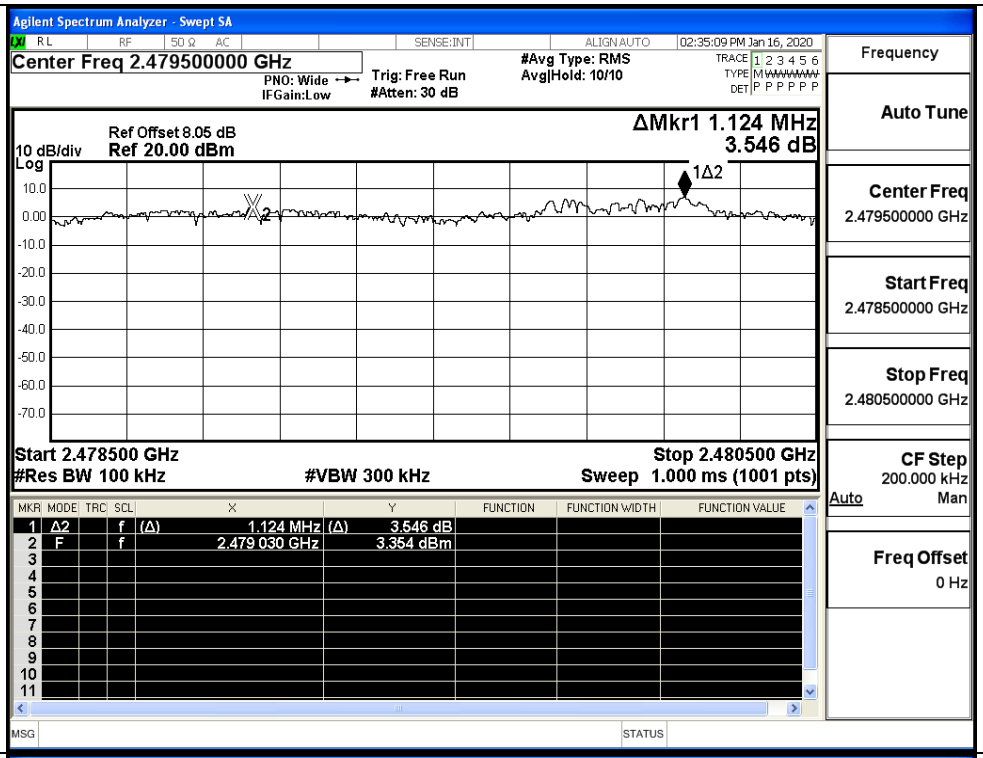
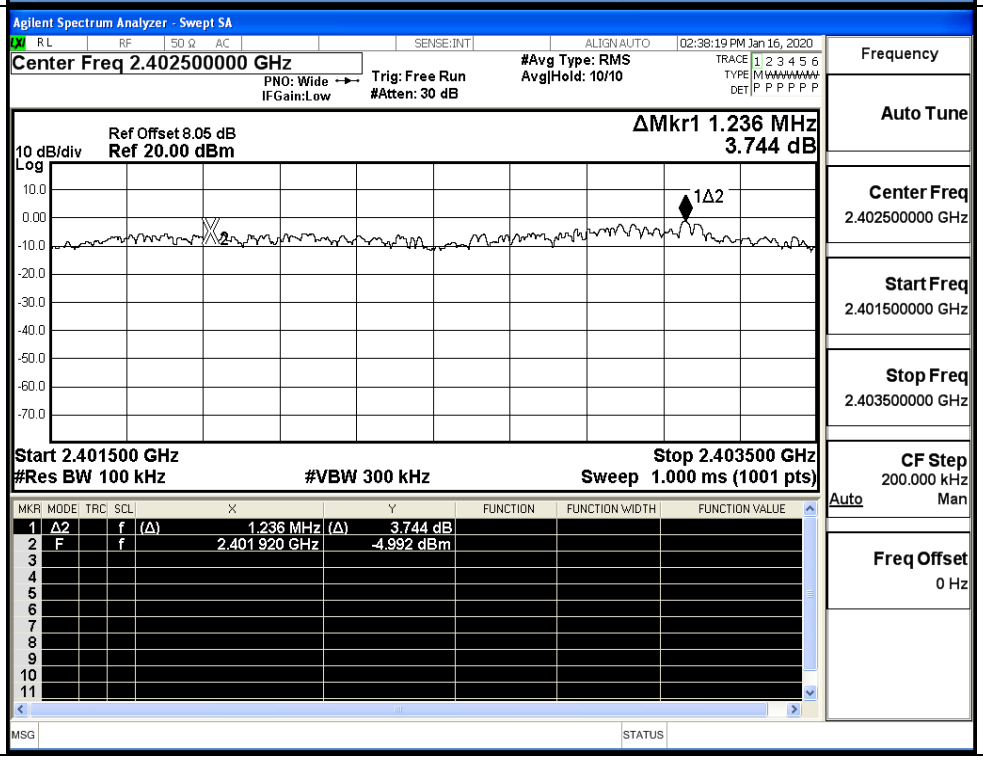
A.4 Carrier Frequency Separation

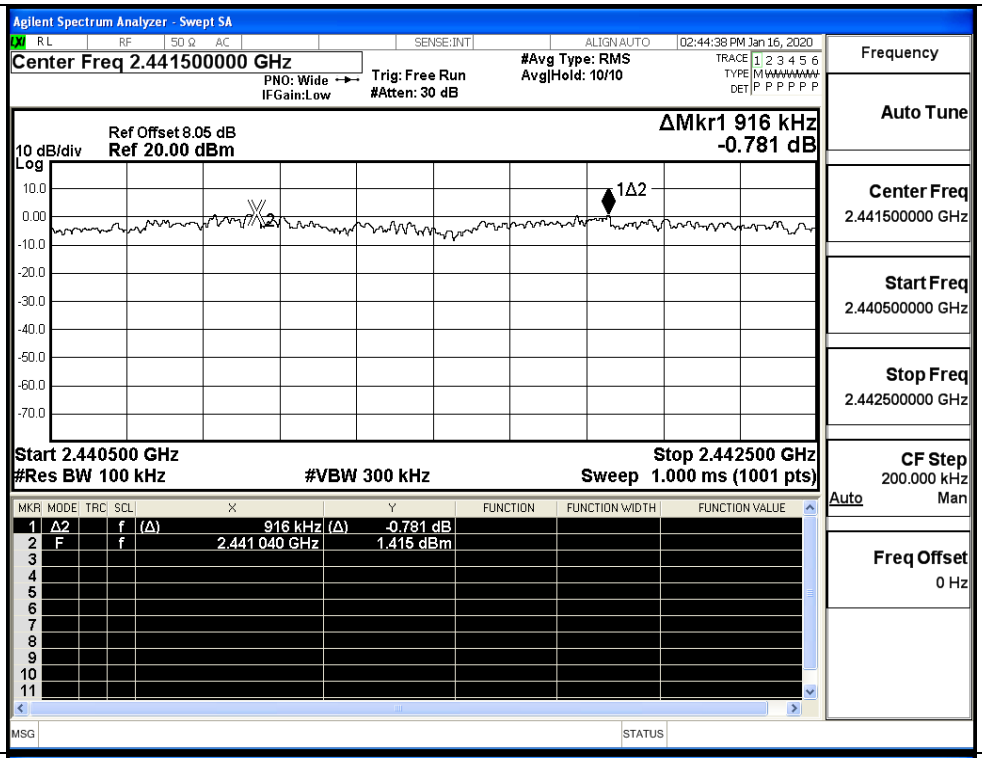
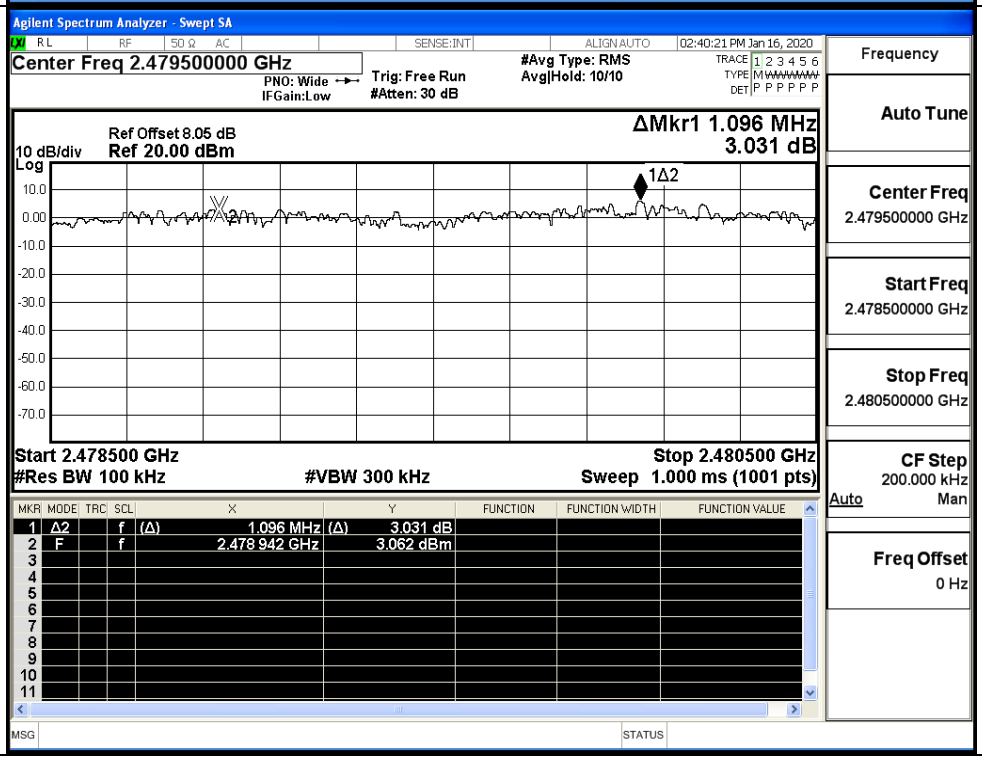
Mode	Channel.	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	1.055	0.639	PASS
	MCH	1.102	0.639	PASS
	HCH	1.106	0.639	PASS
π/4DQPSK	LCH	0.868	0.860	PASS
	MCH	1.120	0.860	PASS
	HCH	1.124	0.860	PASS
8DPSK	LCH	1.236	0.869	PASS
	MCH	0.916	0.869	PASS
	HCH	1.096	0.869	PASS

Test Graphs	
GFSK/LCH	

GFSK/MCH	
GFSK/HCH	

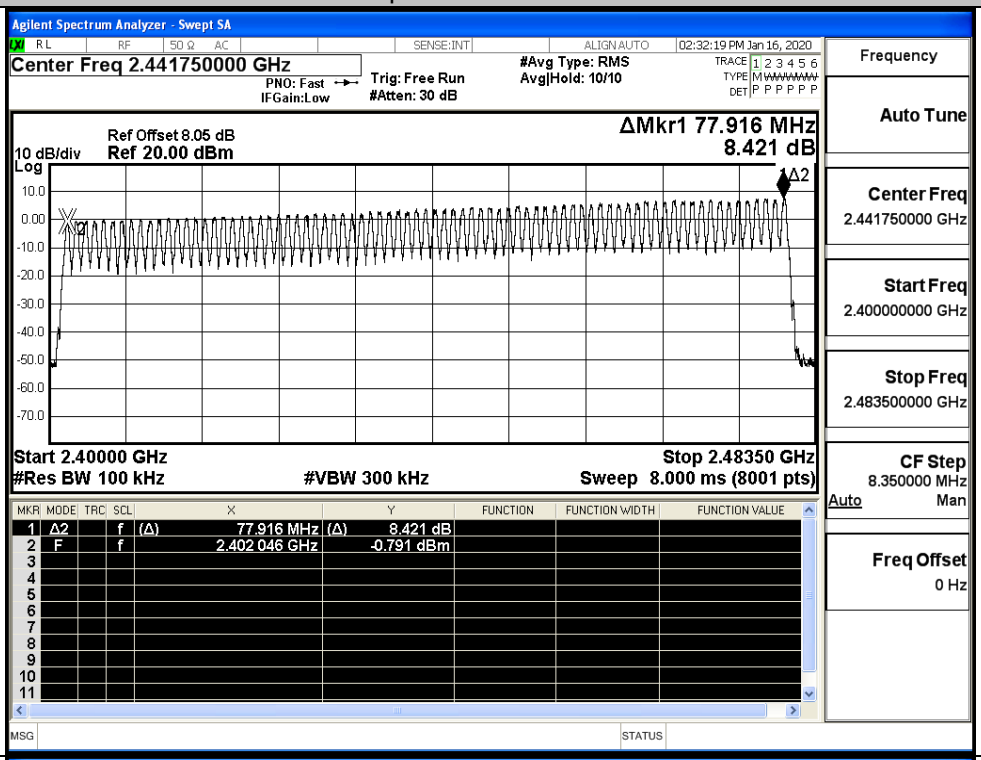
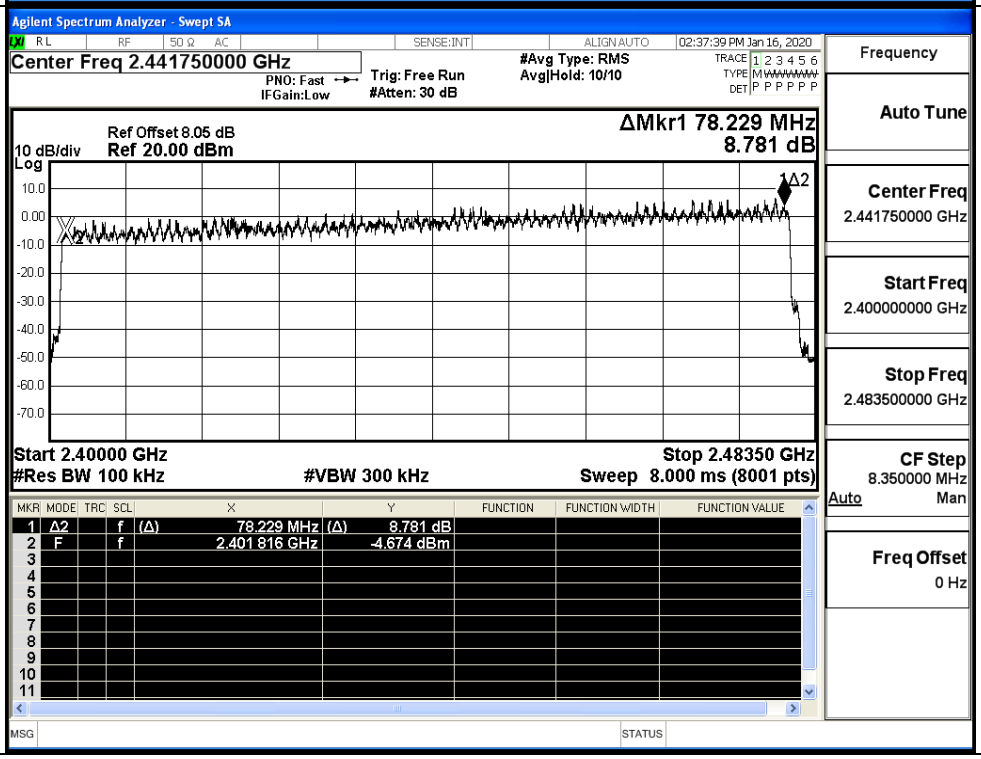
π/4DQPSK/LCH	
π/4DQPSK/MCH	

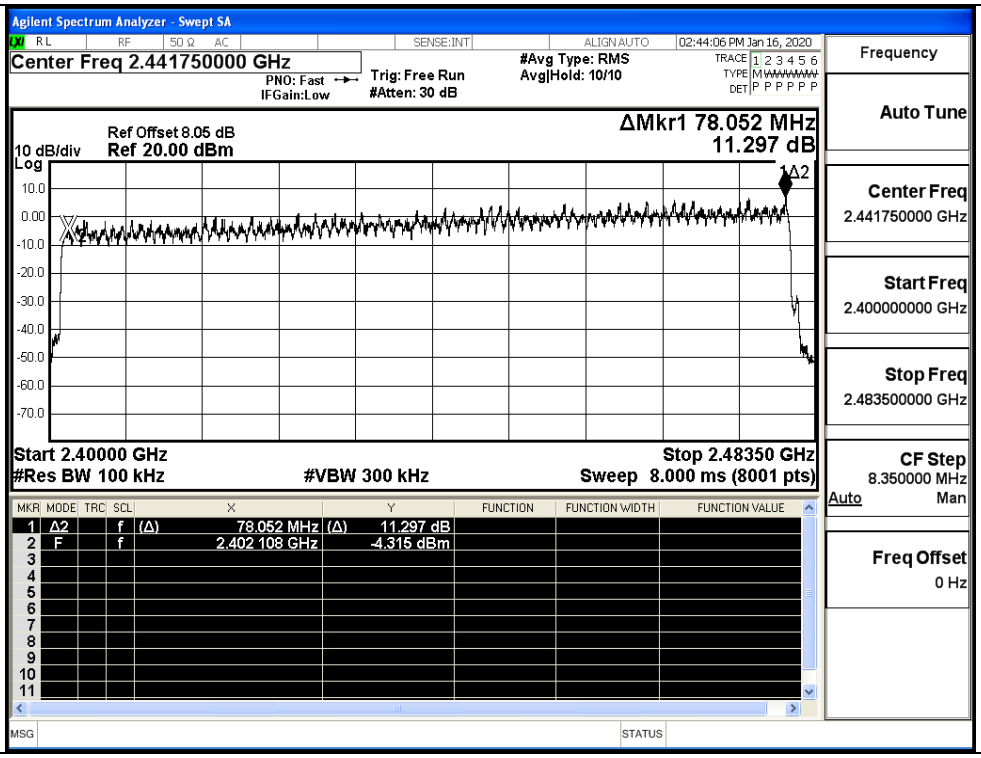
π/4DQPSK/HCH	
8DPSK/LCH	

8DPSK/MCH	
8DPSK/HCH	

A.5 Hopping Channel Number

Mode	Channel.	Number of Hopping Channel [N]	Limit [N]	Verdict
GFSK	Hop	79	>=15	PASS
π/4DQPSK	Hop	79	>=15	PASS
8DPSK	Hop	79	>=15	PASS

Test Graphs	
GFSK/Hop	
π/4DQPSK/Hop	

8DPSK/Hop	

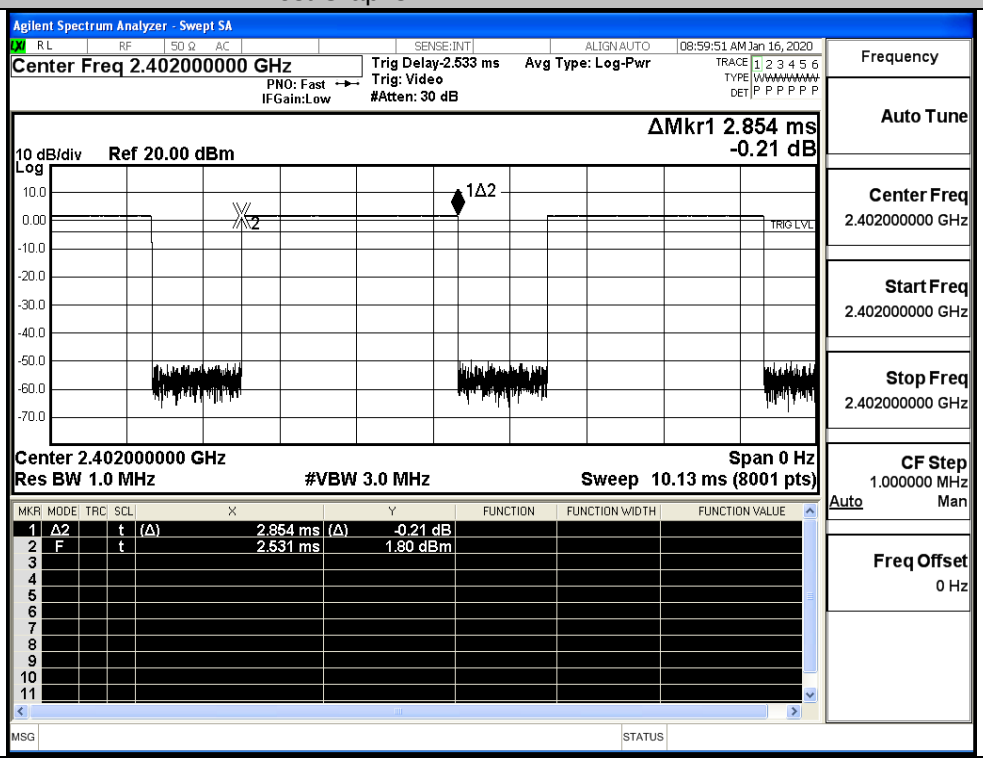
Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 10/10
02:44:06 PM Jan 16, 2020
Ref Offset 8.05 dB
10 dB/div
Ref 20.00 dBm
Log
ΔMkr1 78.052 MHz
11.297 dB
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (8001 pts)
1 Δ2 f (Δ) 78.052 MHz (Δ) 11.297 dB
2 F f 2.402 108 GHz -4.315 dBm
Frequency
Auto Tune
Center Freq
2.441750000 GHz
Start Freq
2.400000000 GHz
Stop Freq
2.483500000 GHz
CF Step
8.350000 MHz
Auto
Man
Freq Offset
0 Hz

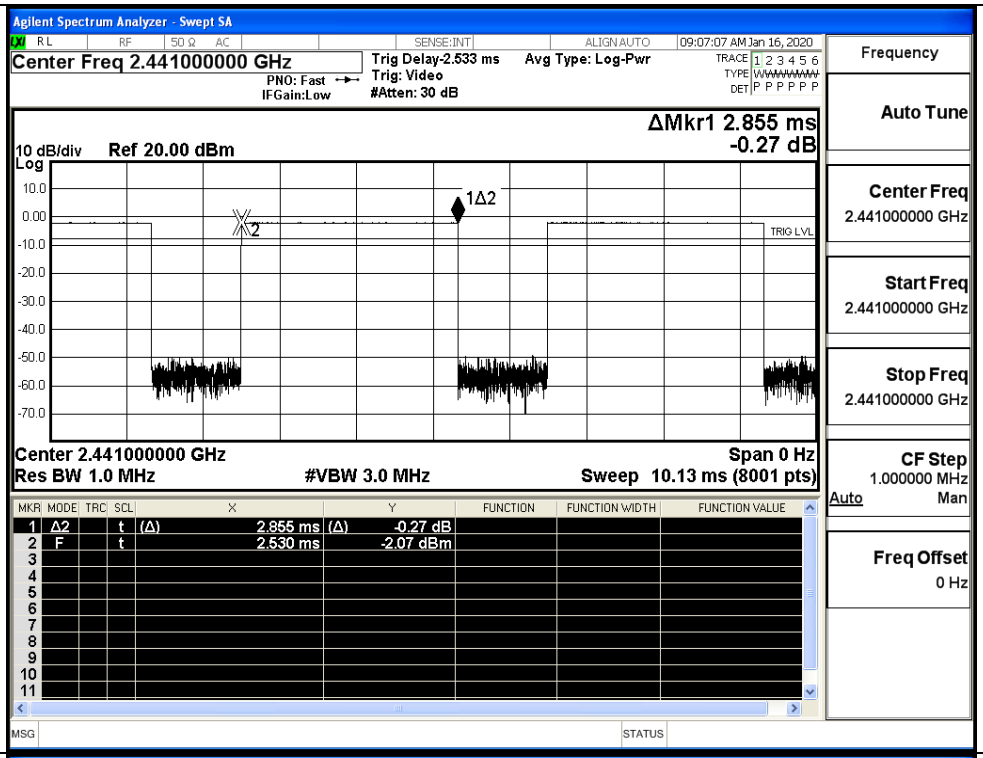
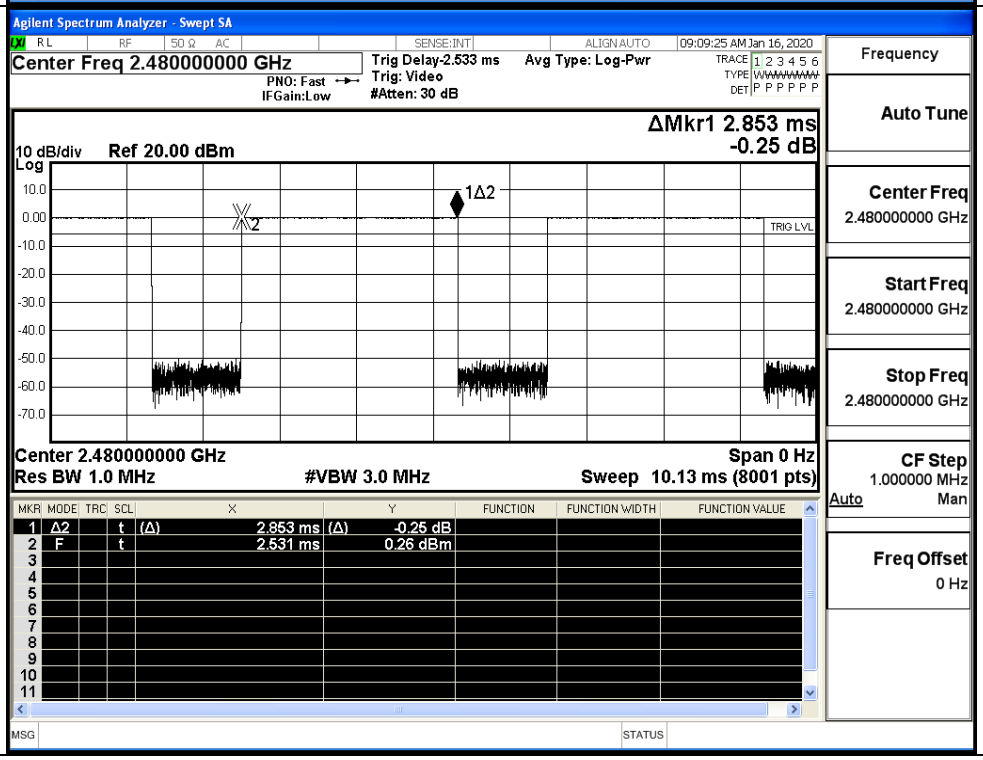
A.6 Dwell Time

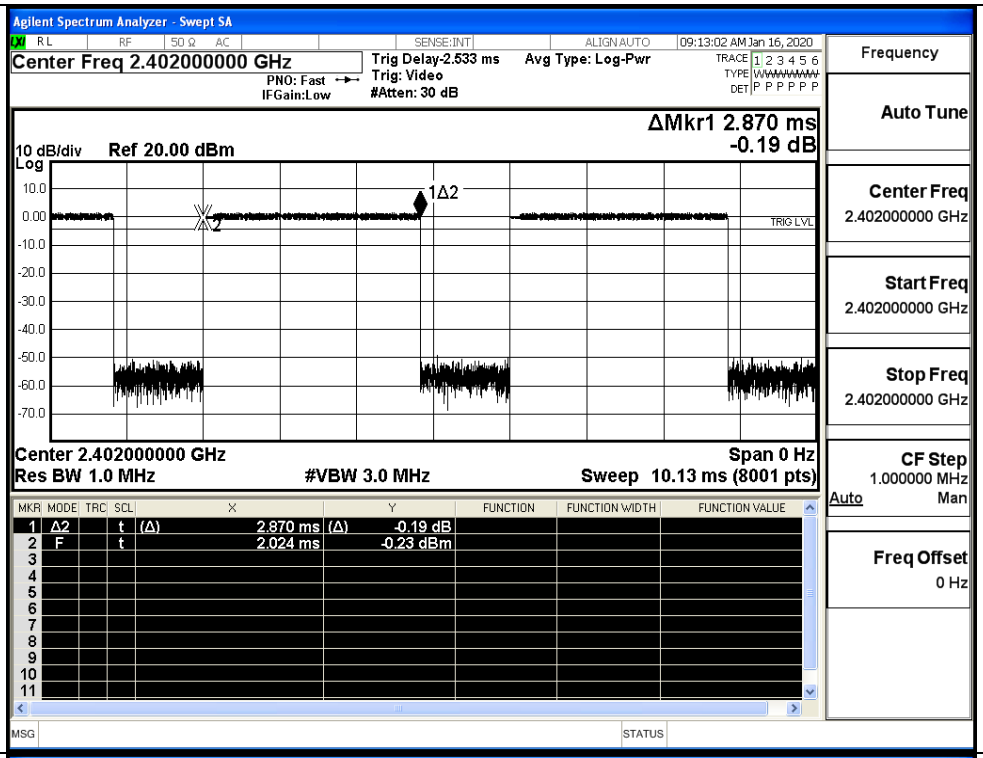
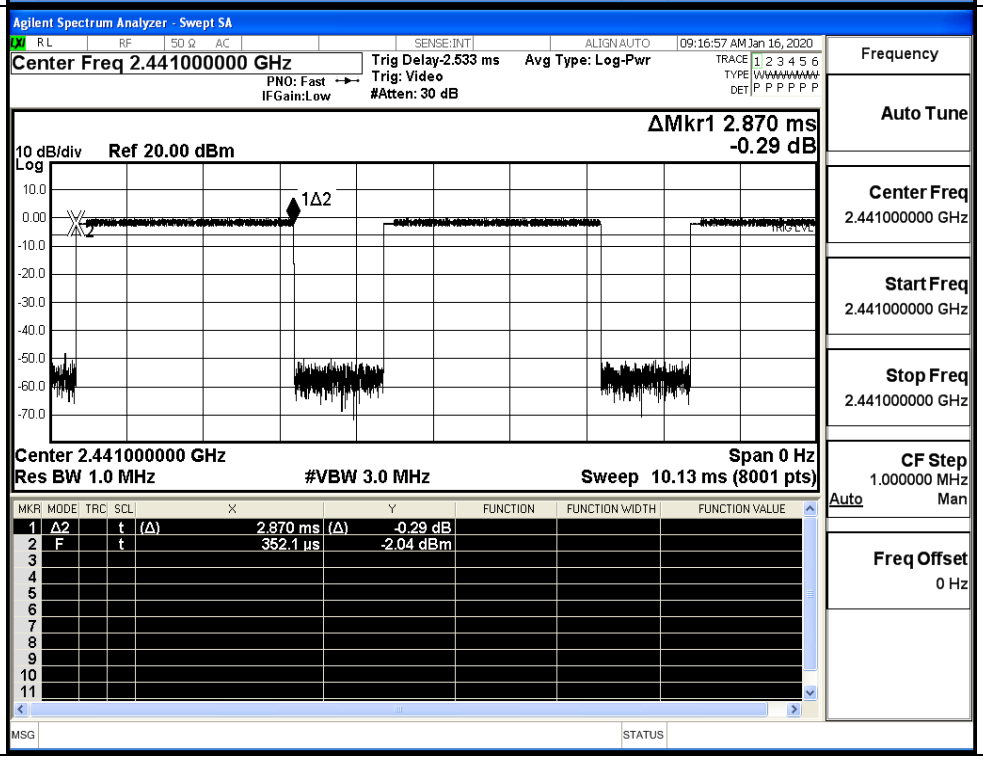
Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit [s]	Verdict
GFSK	DH5	LCH	2.85	106.7	0.304	0.4	PASS
	DH5	MCH	2.86	106.7	0.305	0.4	PASS
	DH5	HCH	2.85	106.7	0.304	0.4	PASS
π/4DQPSK	2DH5	LCH	2.87	106.7	0.306	0.4	PASS
	2DH5	MCH	2.87	106.7	0.306	0.4	PASS
	2DH5	HCH	2.87	106.7	0.306	0.4	PASS
8DPSK	3DH5	LCH	2.87	106.7	0.306	0.4	PASS
	3DH5	MCH	2.87	106.7	0.306	0.4	PASS
	3DH5	HCH	2.87	106.7	0.306	0.4	PASS

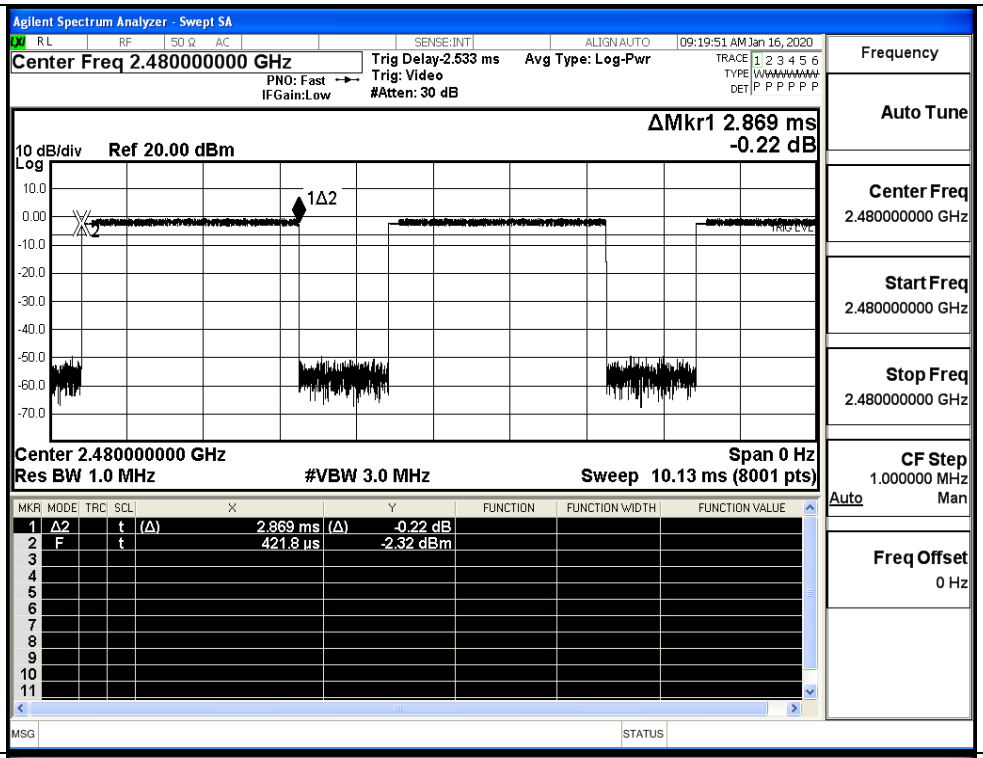
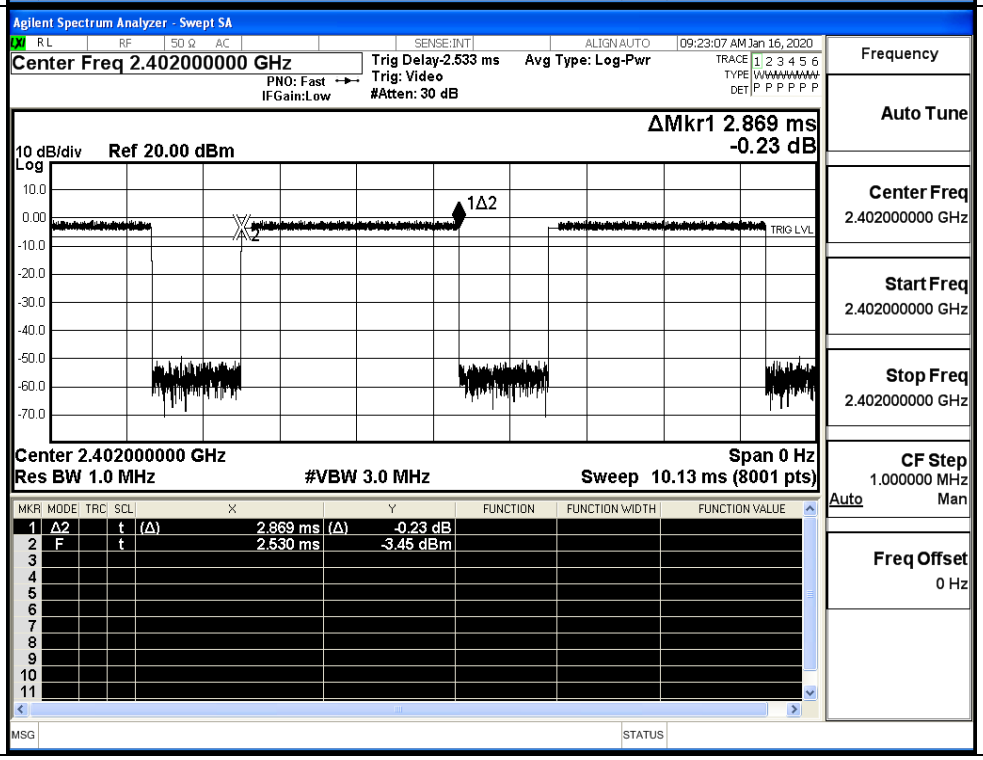
Test Graphs

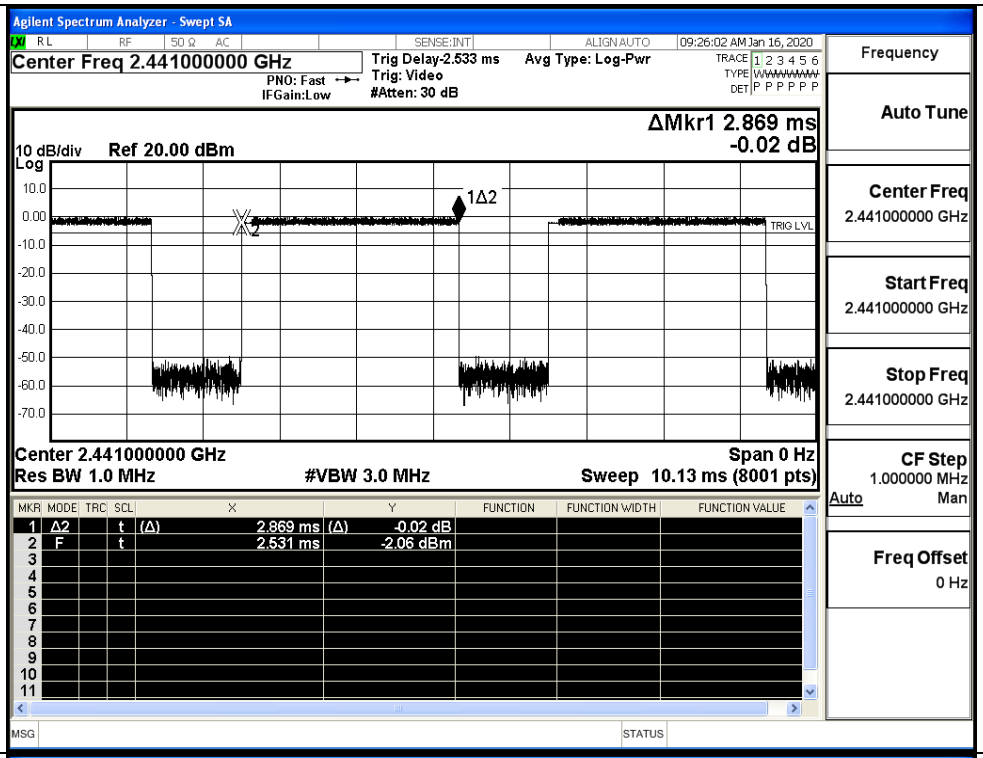
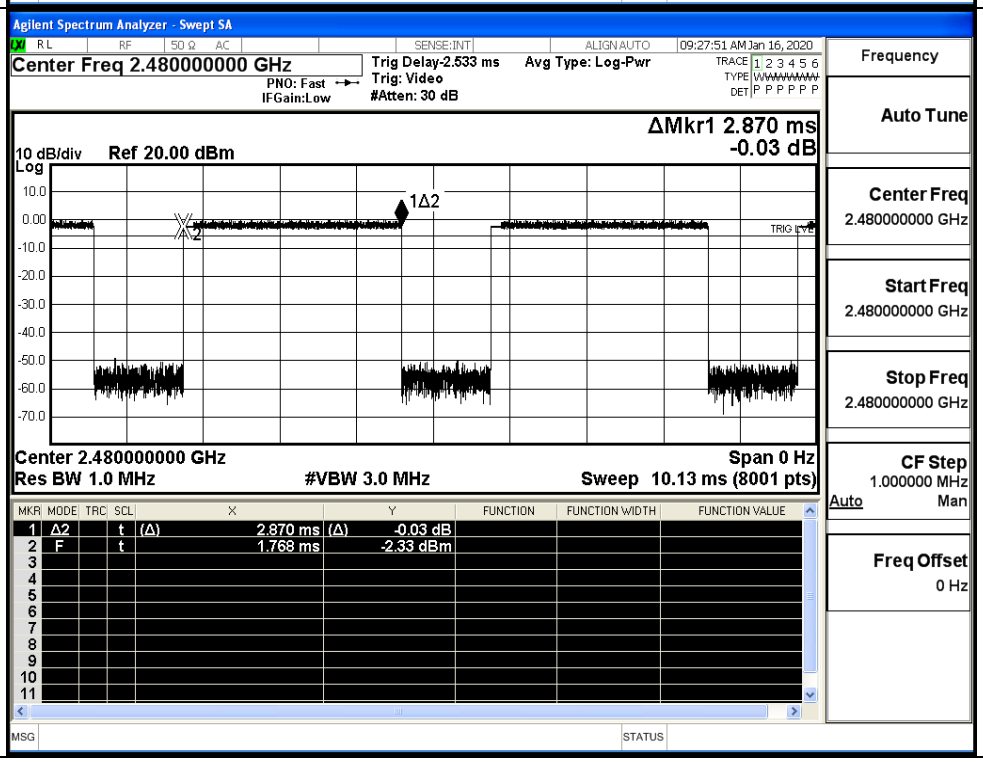
GFSK_DH5/LCH



GFSK_DH5/MCH	
GFSK_DH5/HCH	

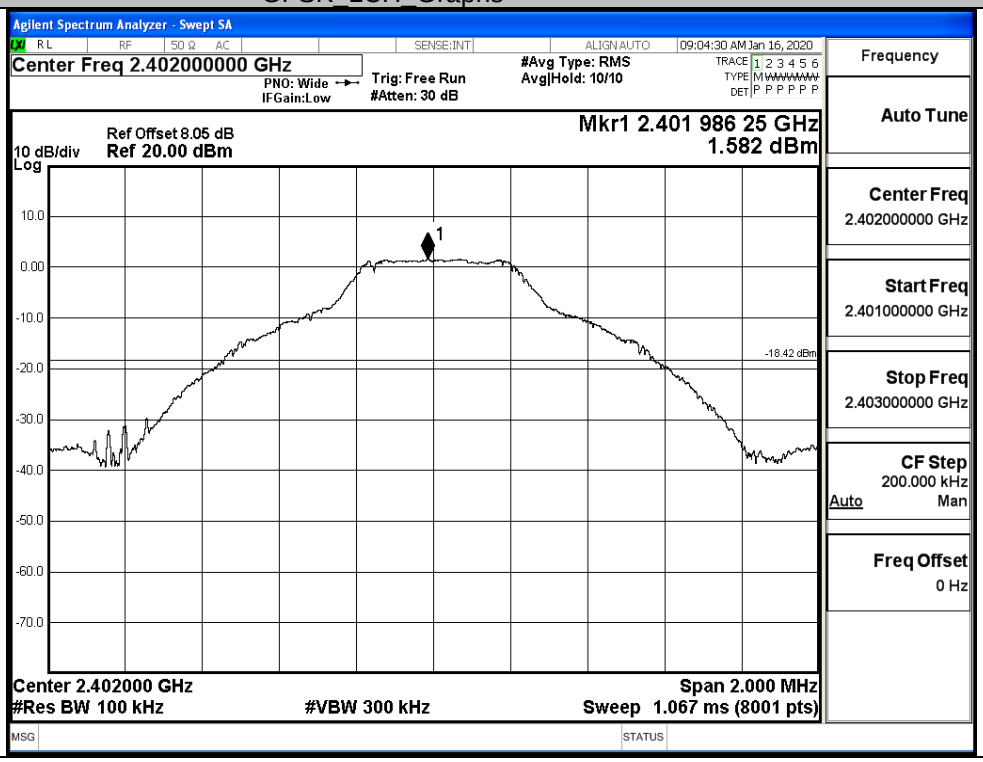
π/4DQPSK _2DH5/LCH	
π/4DQPSK _2DH5/MCH	

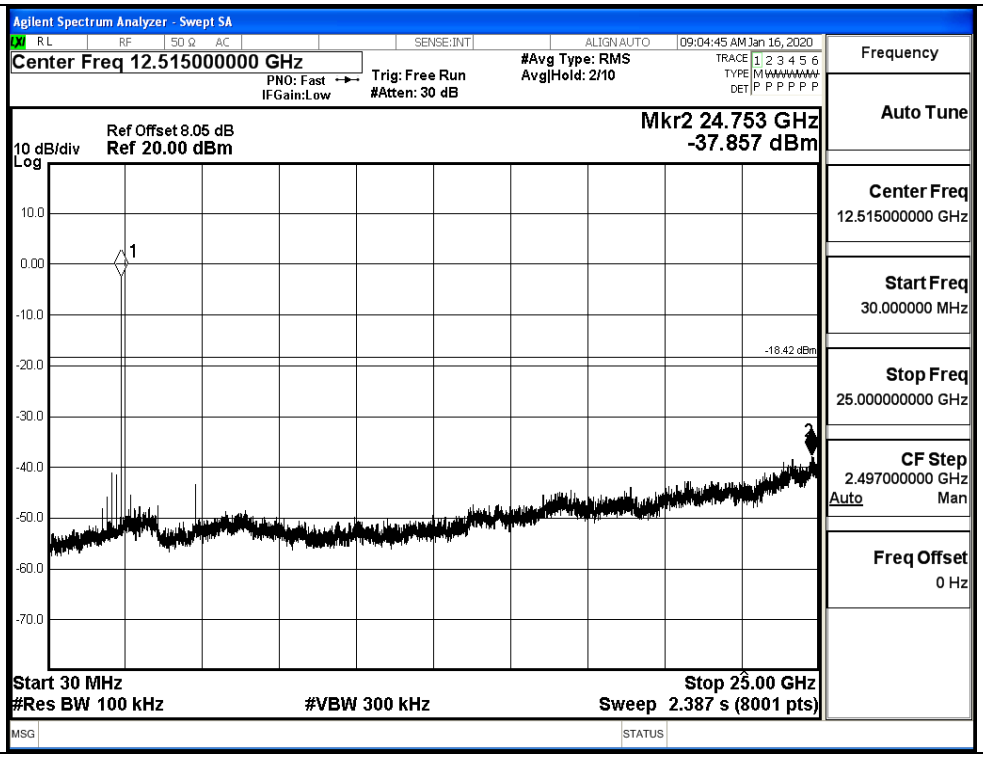
π/4DQPSK _2DH5/HCH	
8DPSK _3DH5/LCH	

8DPSK _3DH5/MCH	
8DPSK _3DH5/HCH	

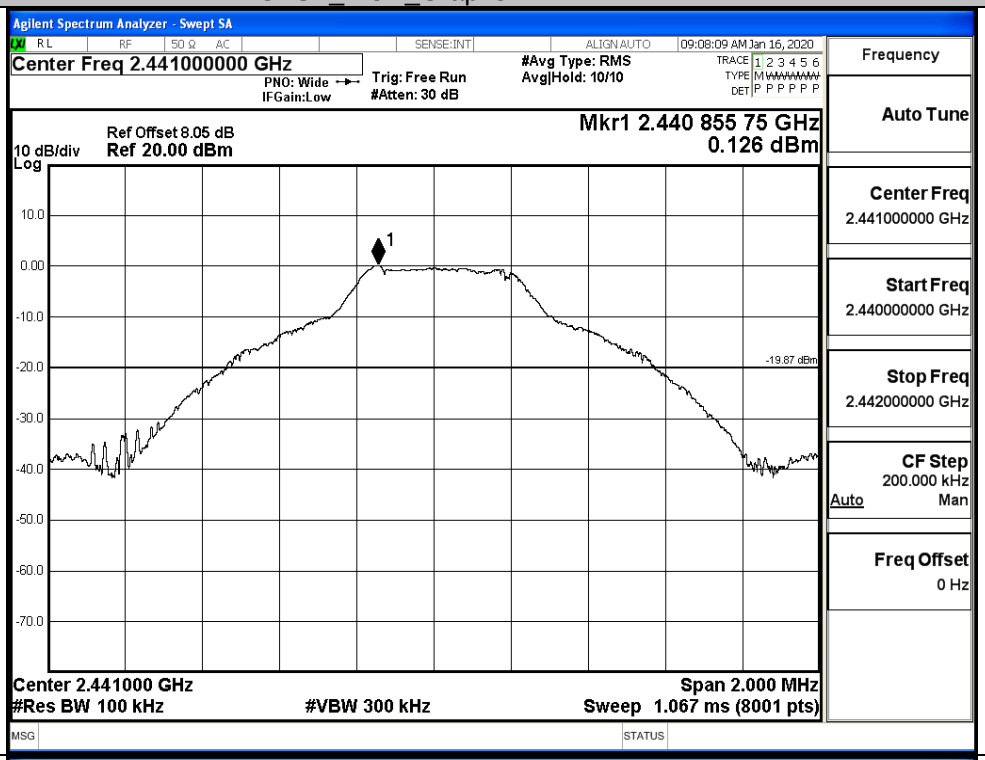
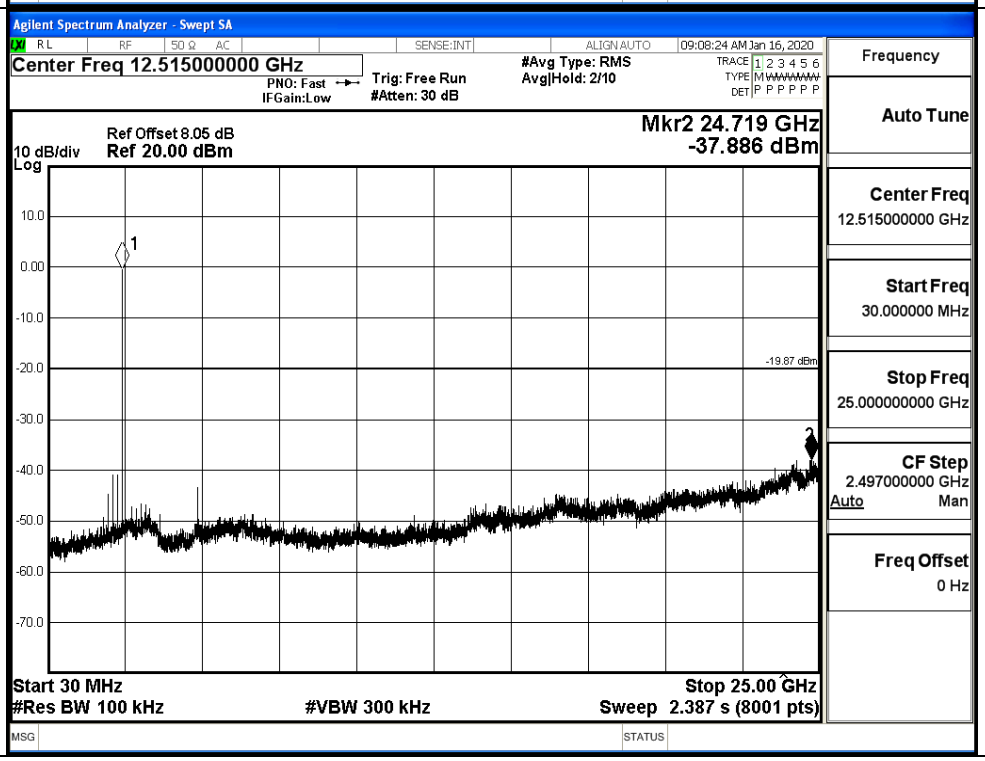
A.7 RF Conducted Spurious Emissions

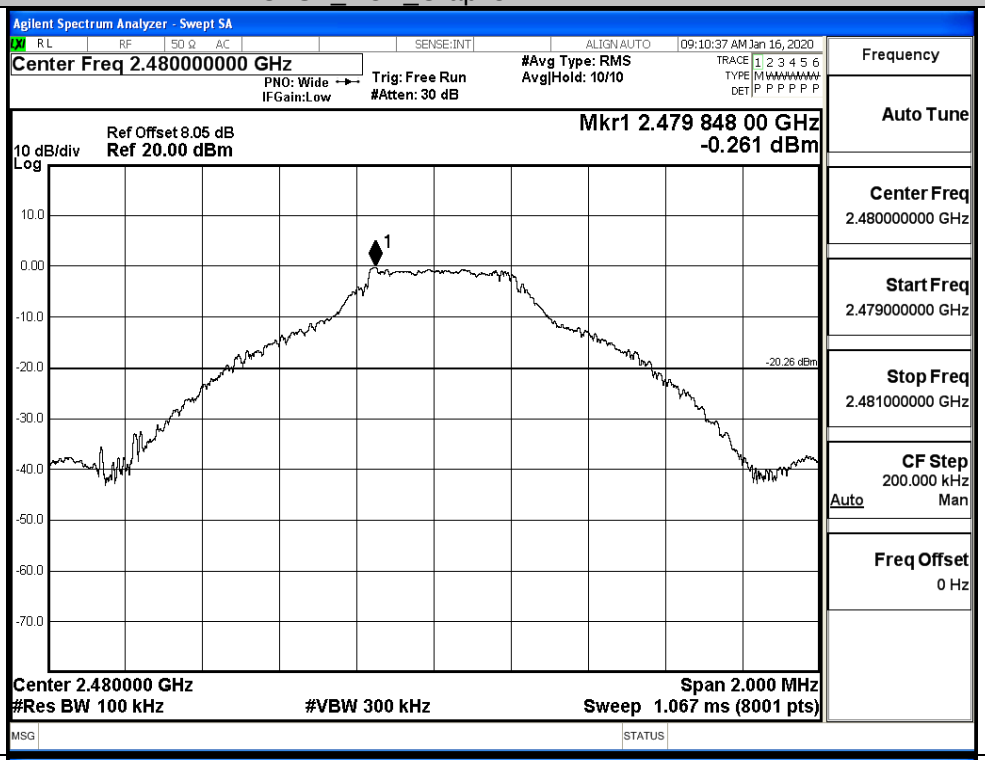
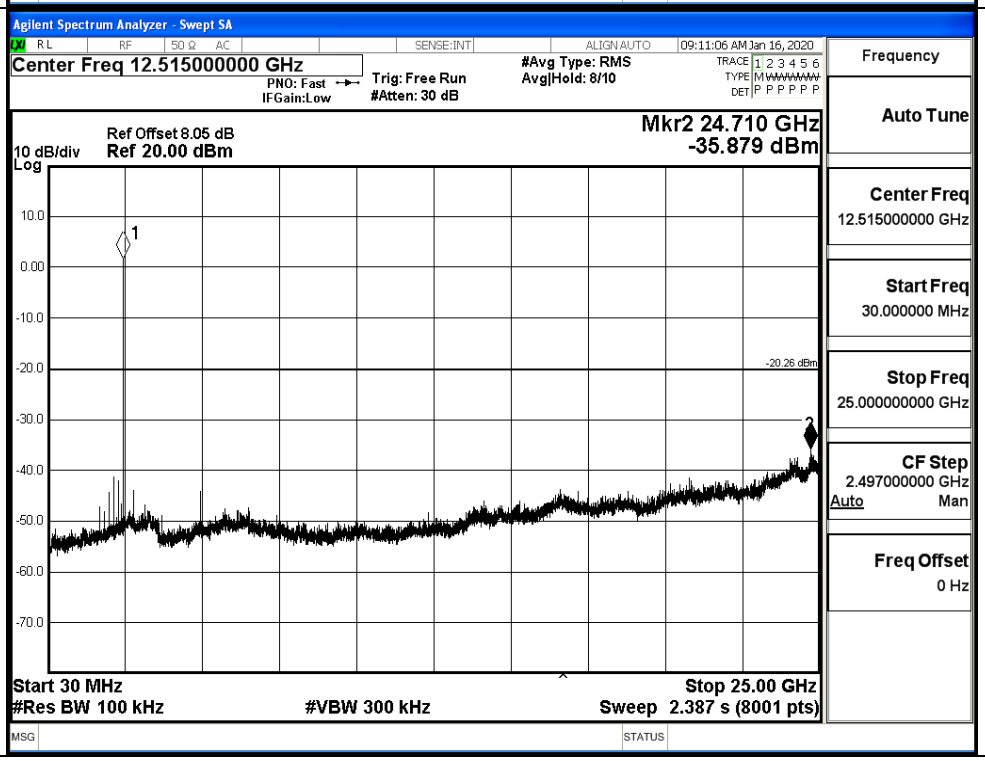
Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	1.582	-37.857	-18.418	PASS
	MCH	0.126	-37.886	-19.874	PASS
	HCH	-0.261	-35.879	-20.261	PASS
π/4DQPSK	LCH	3.487	-37.457	-16.513	PASS
	MCH	-1.706	-37.573	-21.706	PASS
	HCH	-2.179	-37.551	-22.179	PASS
8DPSK	LCH	4.6	-37.665	-15.400	PASS
	MCH	-1.809	-37.491	-21.809	PASS
	HCH	-1.996	-37.514	-21.996	PASS

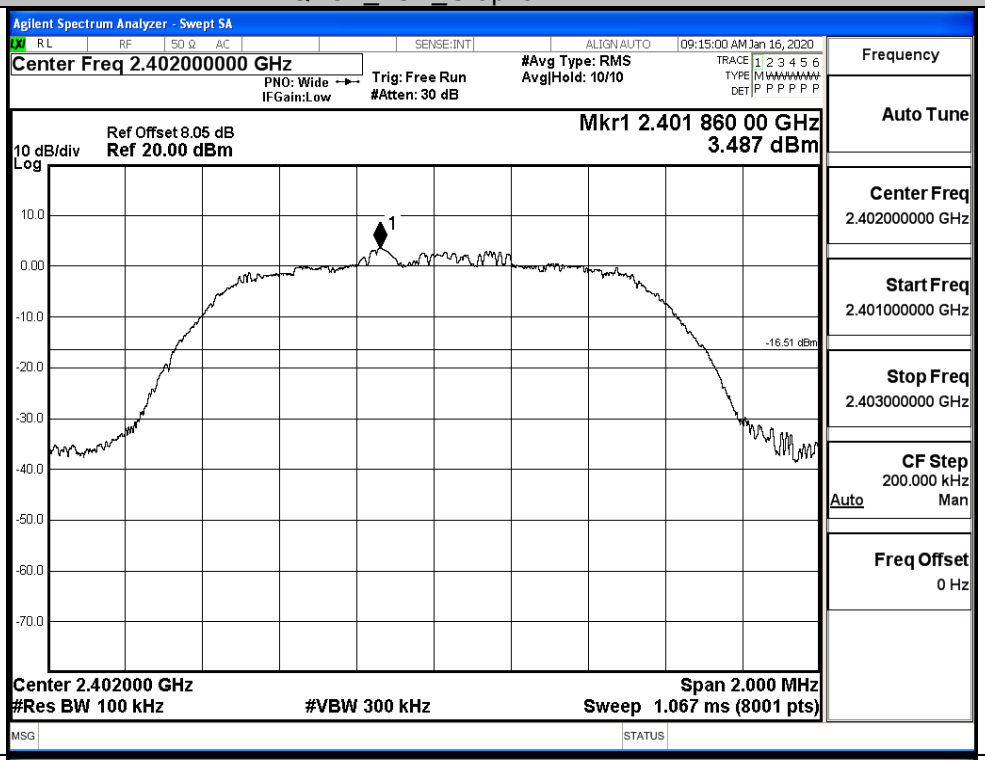
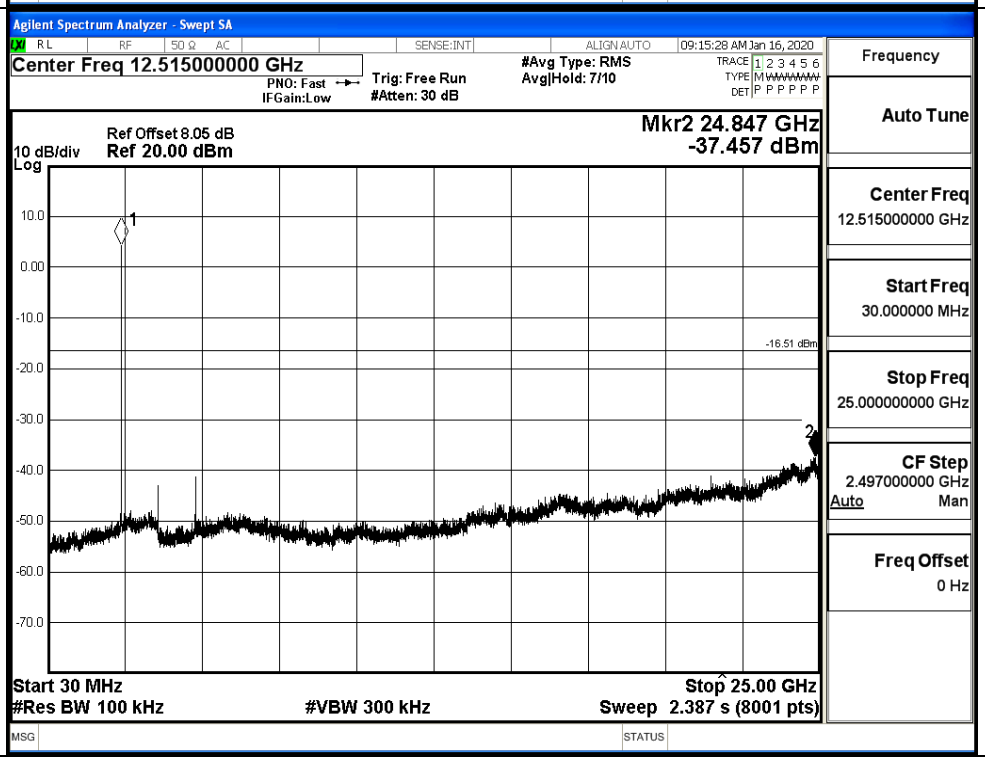
GFSK_LCH_Graphs	
Pref	

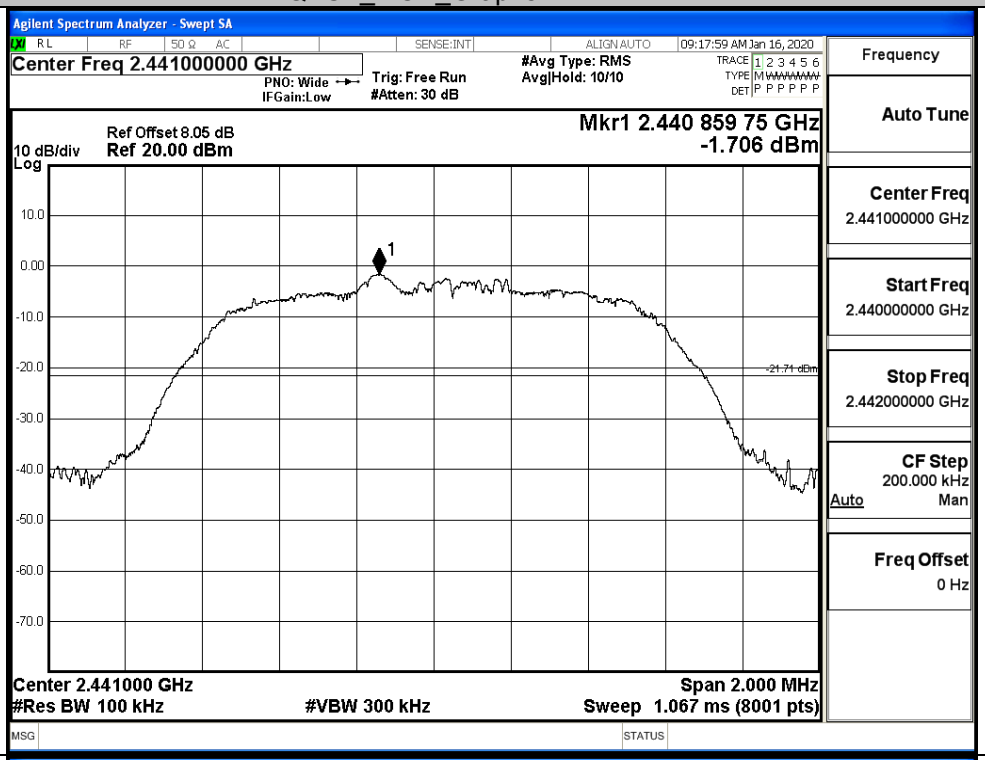
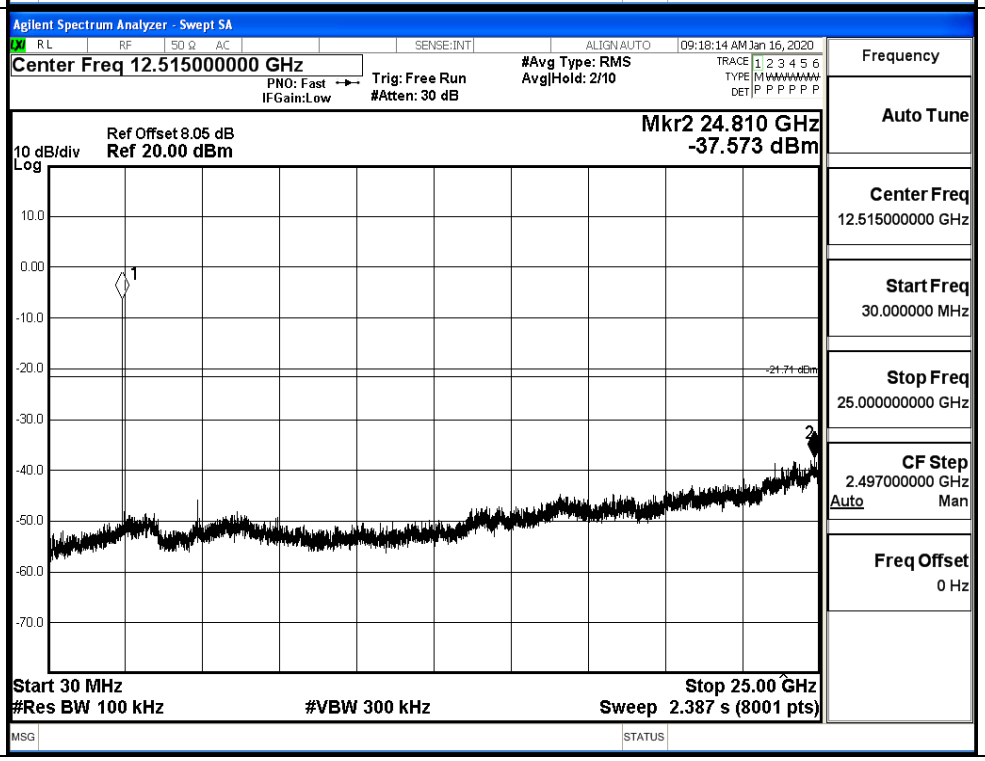
Puw		

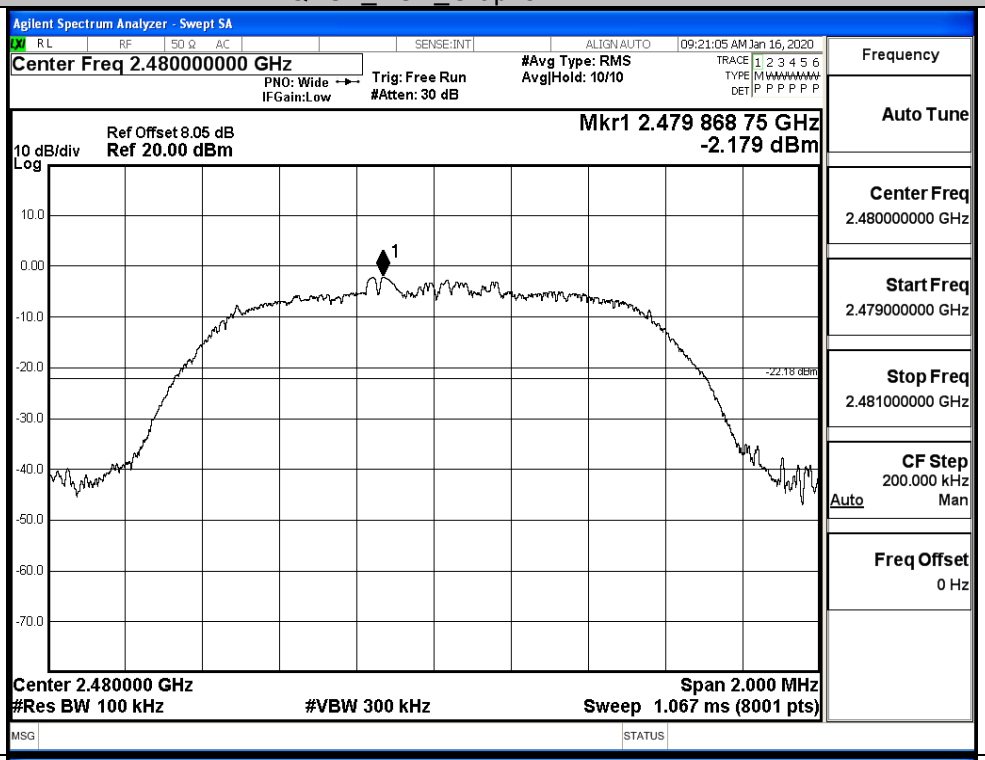
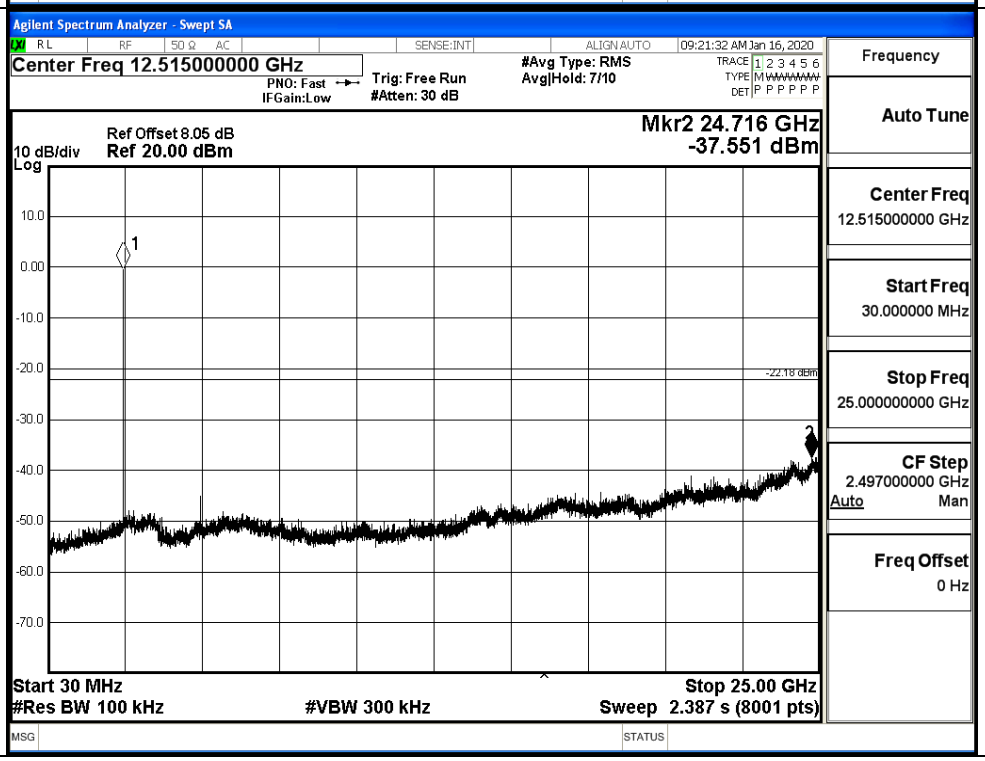
Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
09:04:45 AM Jan 16, 2020
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 2/10
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 8.05 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr2 24.753 GHz
-37.857 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-18.42 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.387 s (8001 pts)
Frequency
Auto Tune
Center Freq
12.515000000 GHz
Start Freq
30.000000 MHz
Stop Freq
25.000000000 GHz
CF Step
2.497000000 GHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

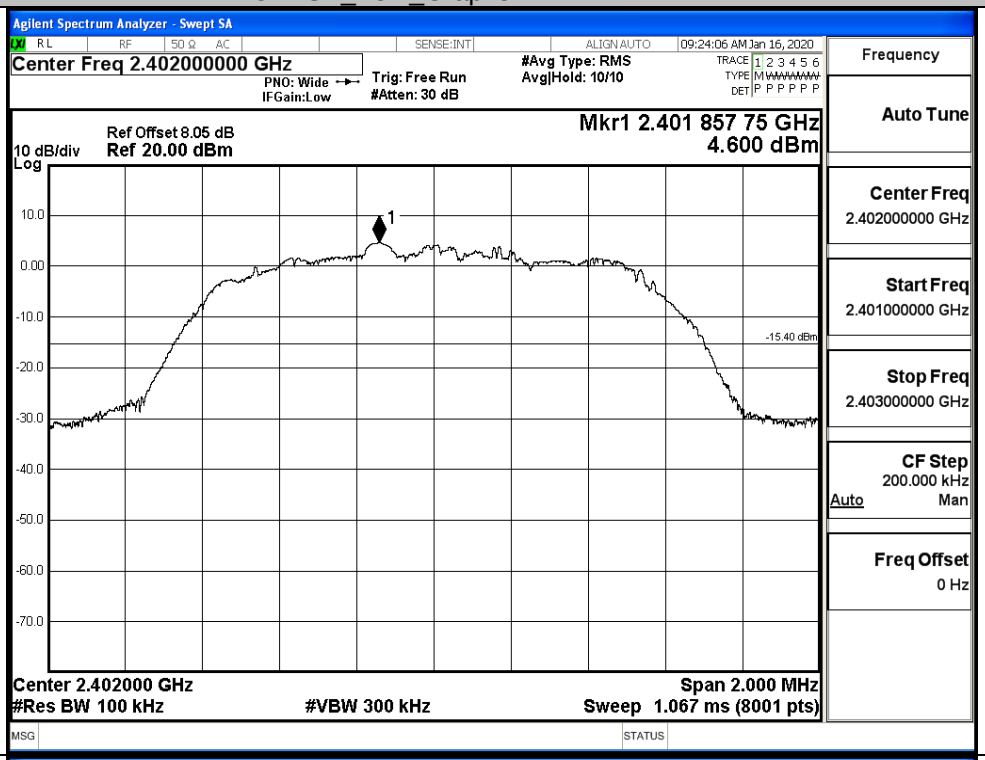
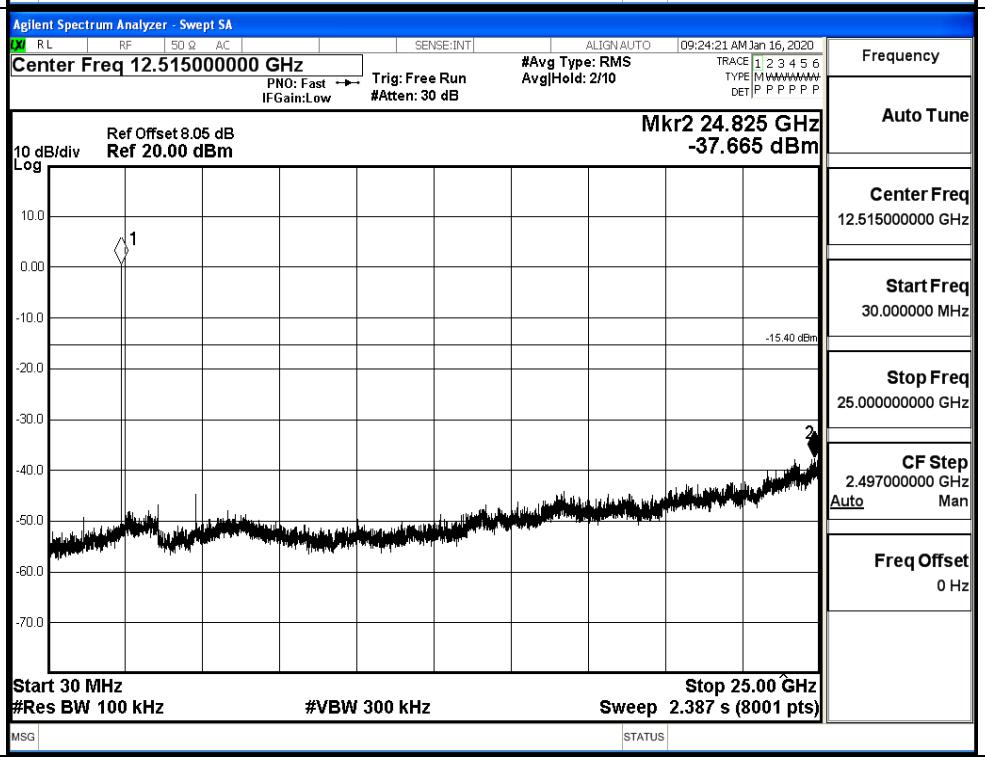
GFSK_MCH_Graphs			
Pref			
Puw			

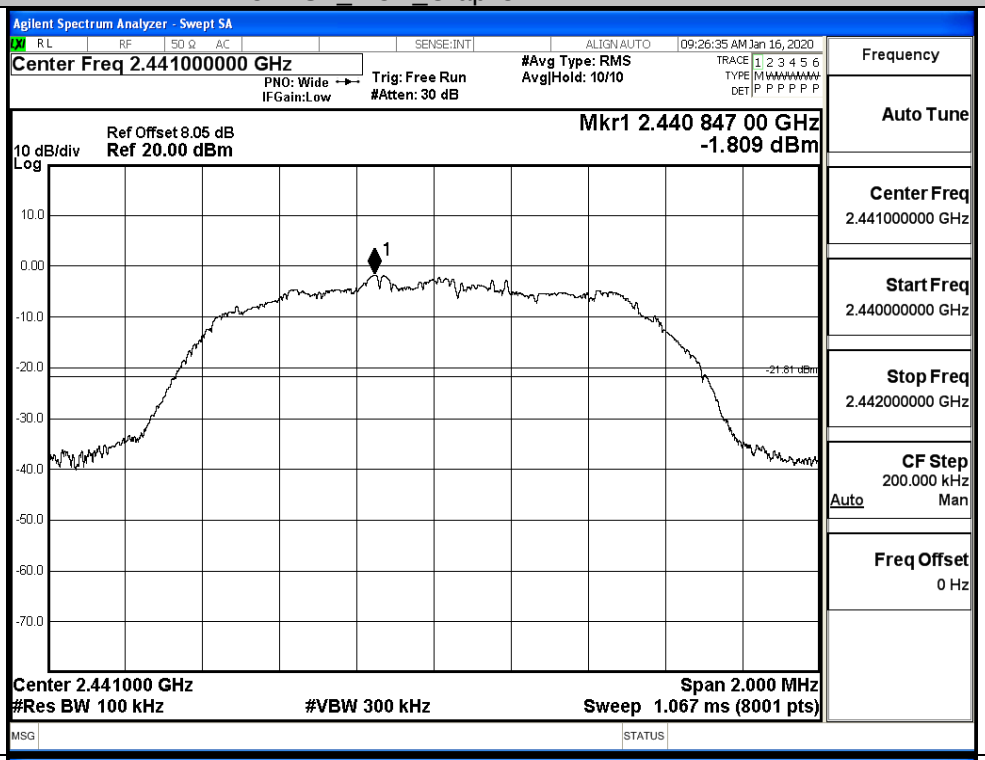
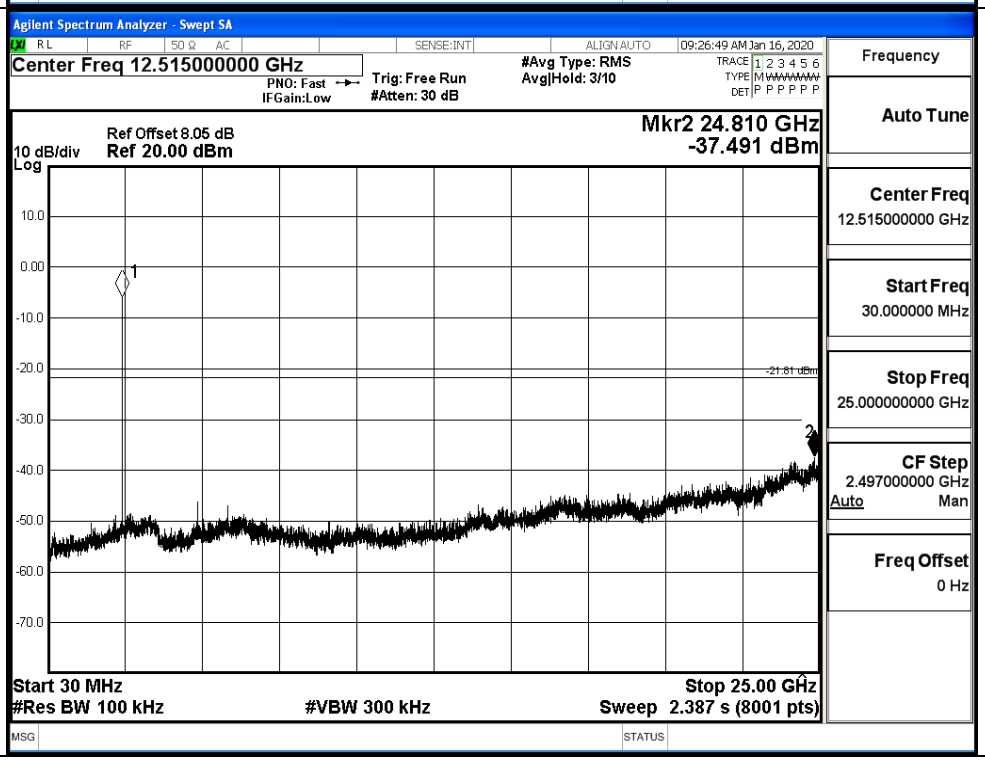
GFSK_HCH_Graphs			
Pref			
Puw			

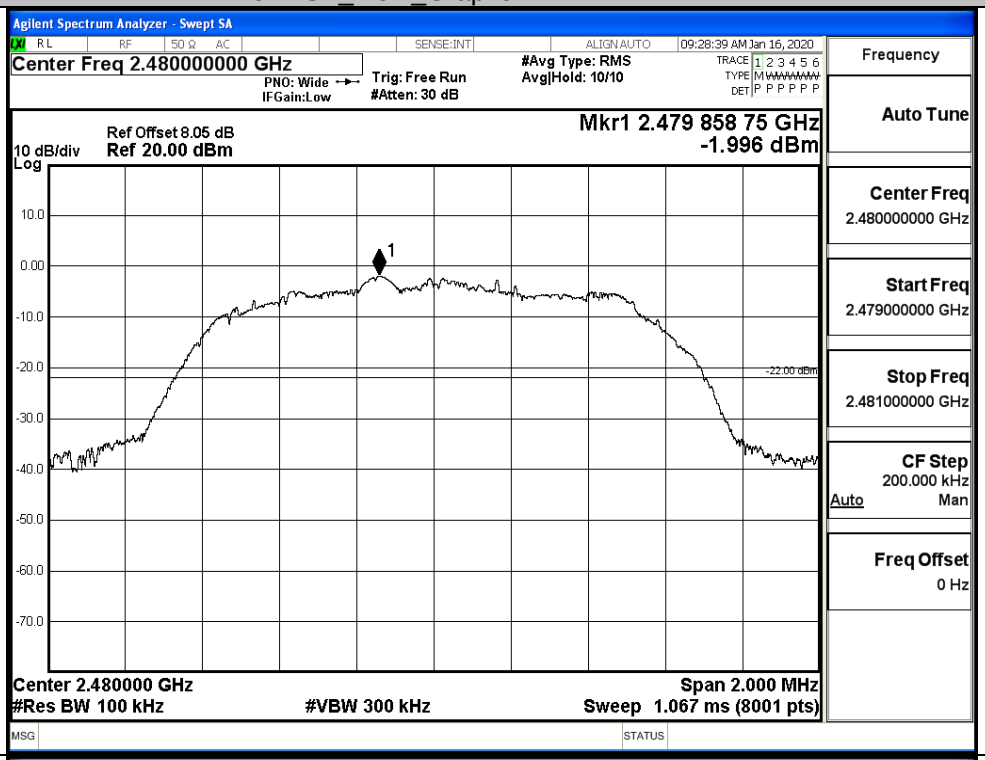
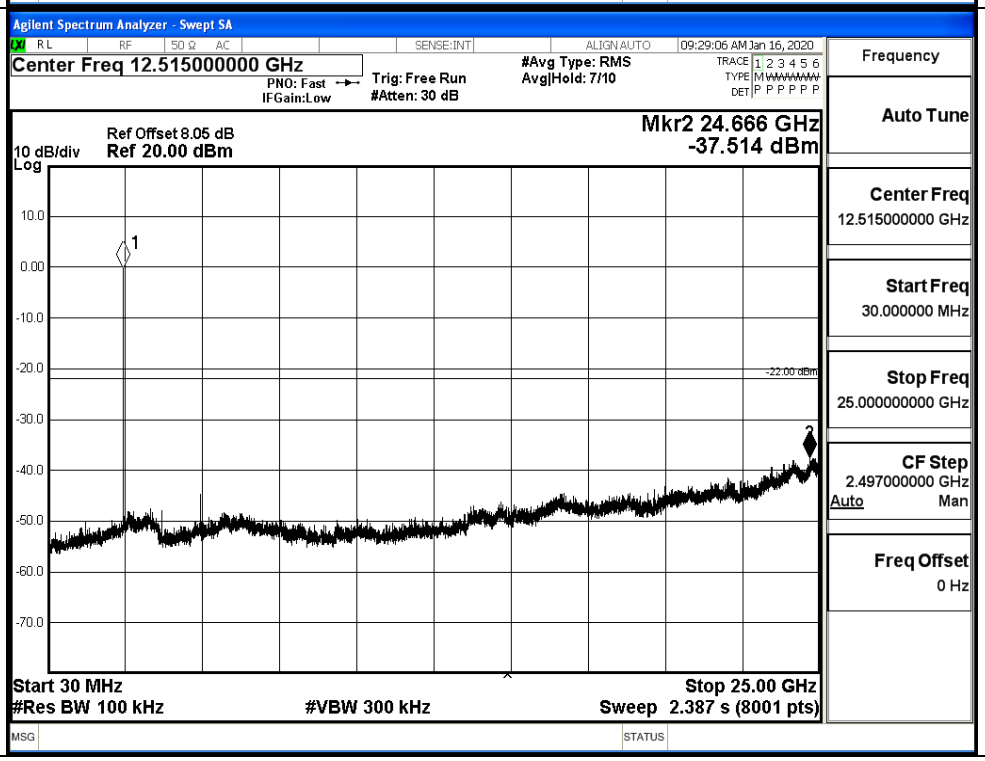
π/4DQPSK_LCH_Graphs		
Pref		
Puw		

π/4DQPSK_MCH_Graphs			
Pref		
Puw		

π/4DQPSK_HCH_Graphs		
Pref		
Puw		

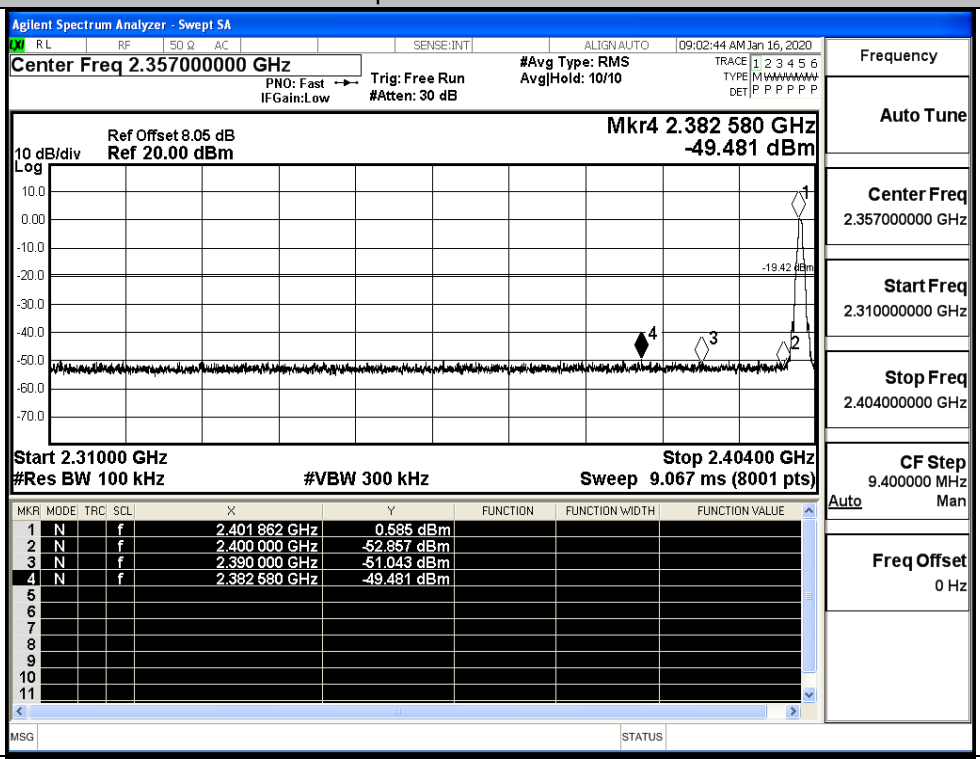
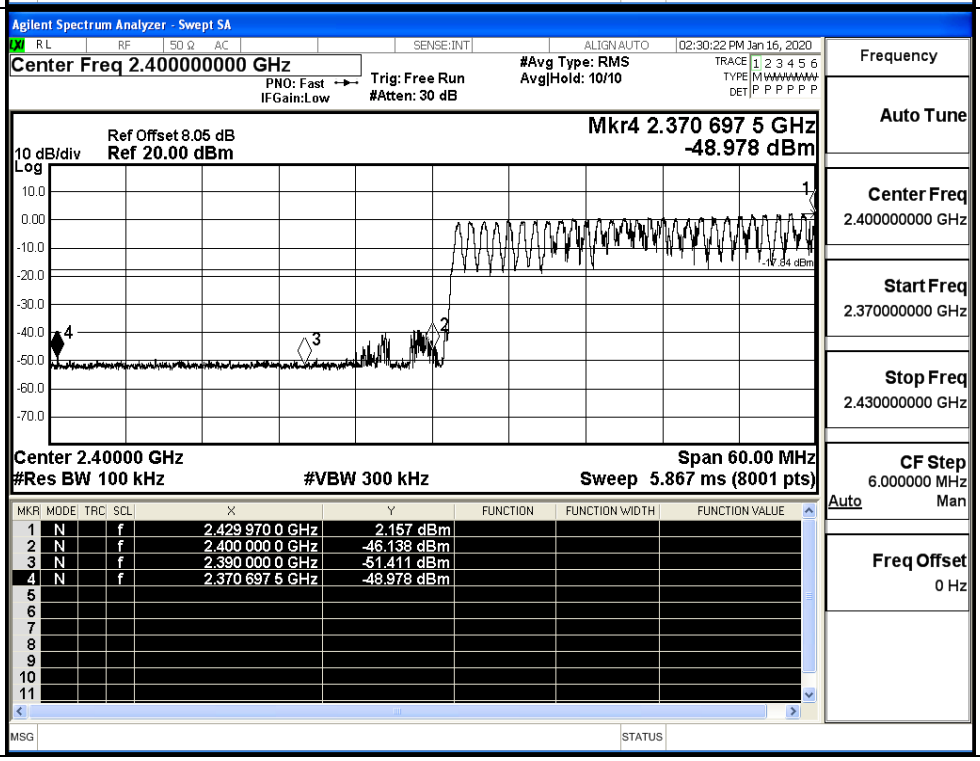
8DPSK_LCH_Graphs			
Pref			
Puw			

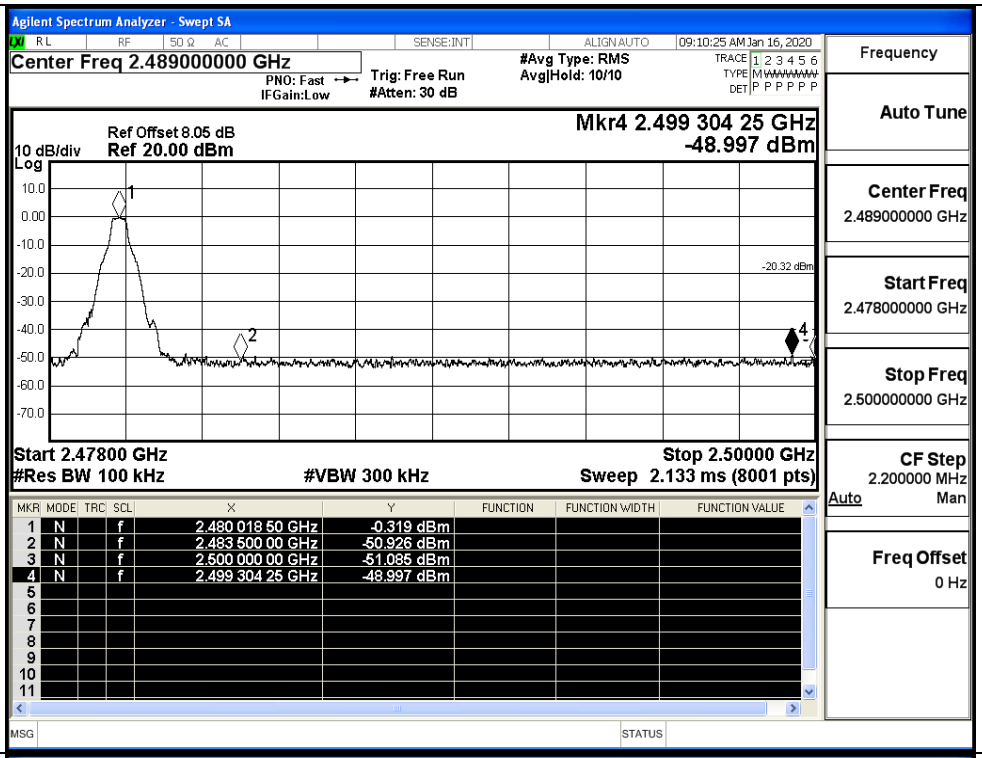
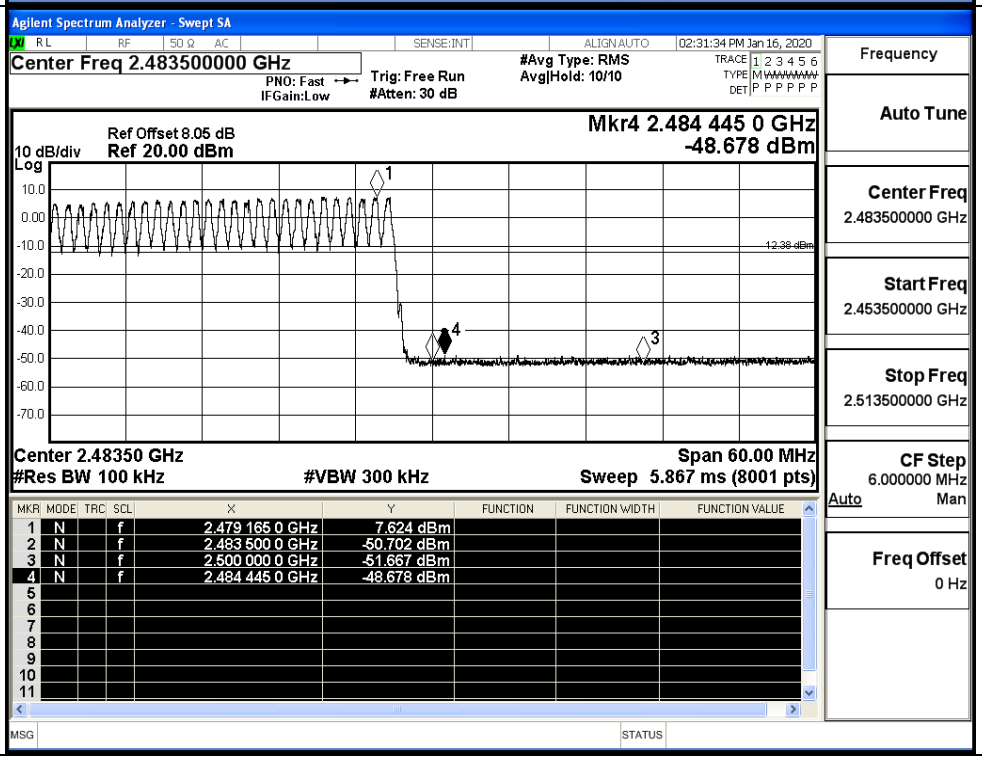
8DPSK_MCH_Graphs			
Pref			
Puw			

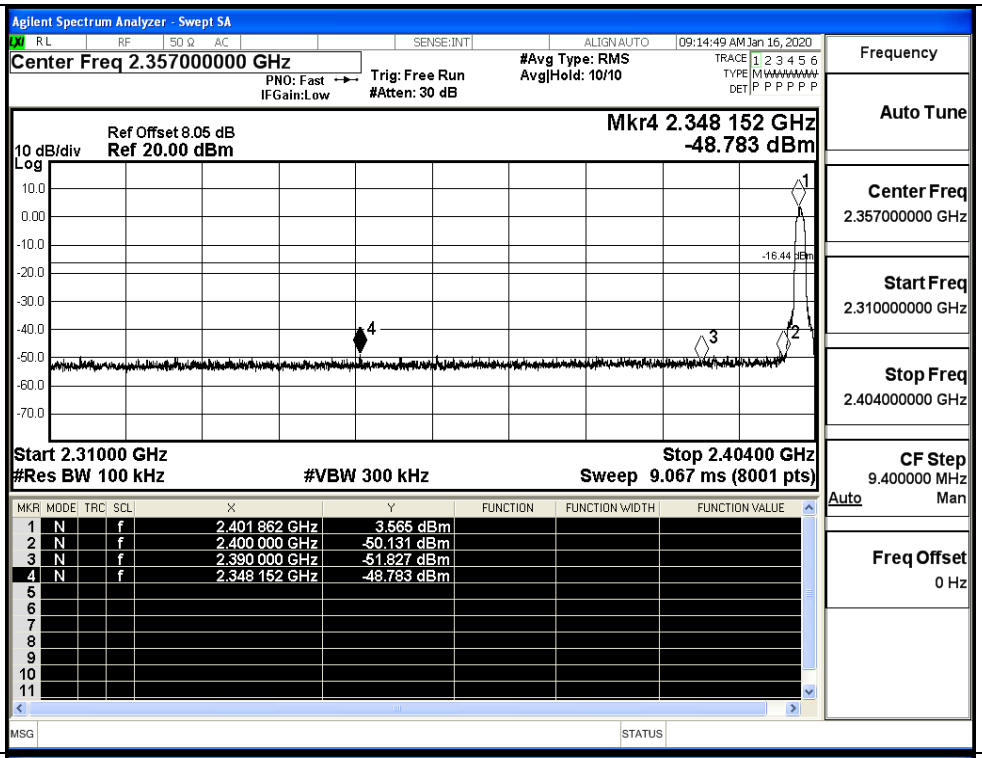
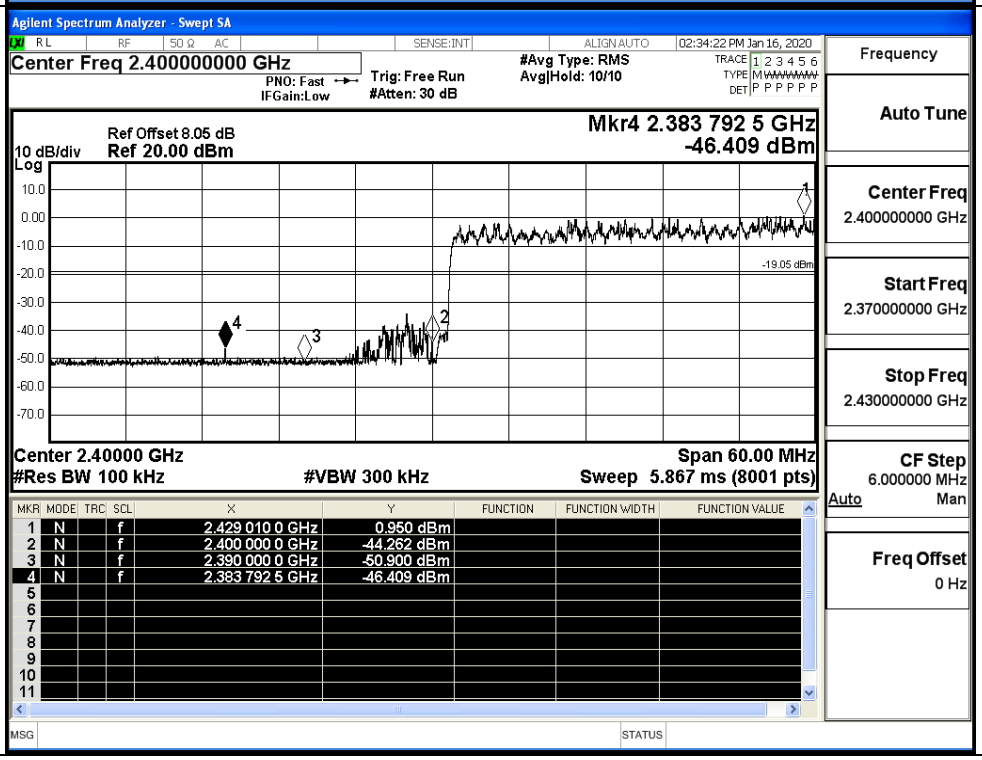
8DPSK_HCH_Graphs		
Pref		
Puw		

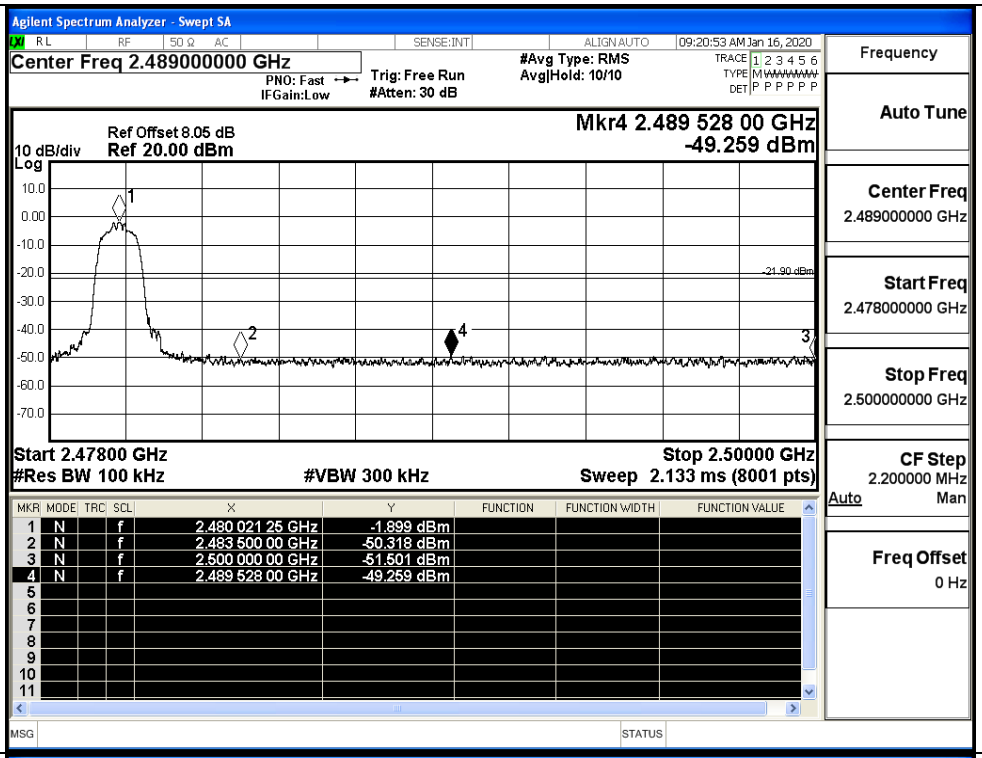
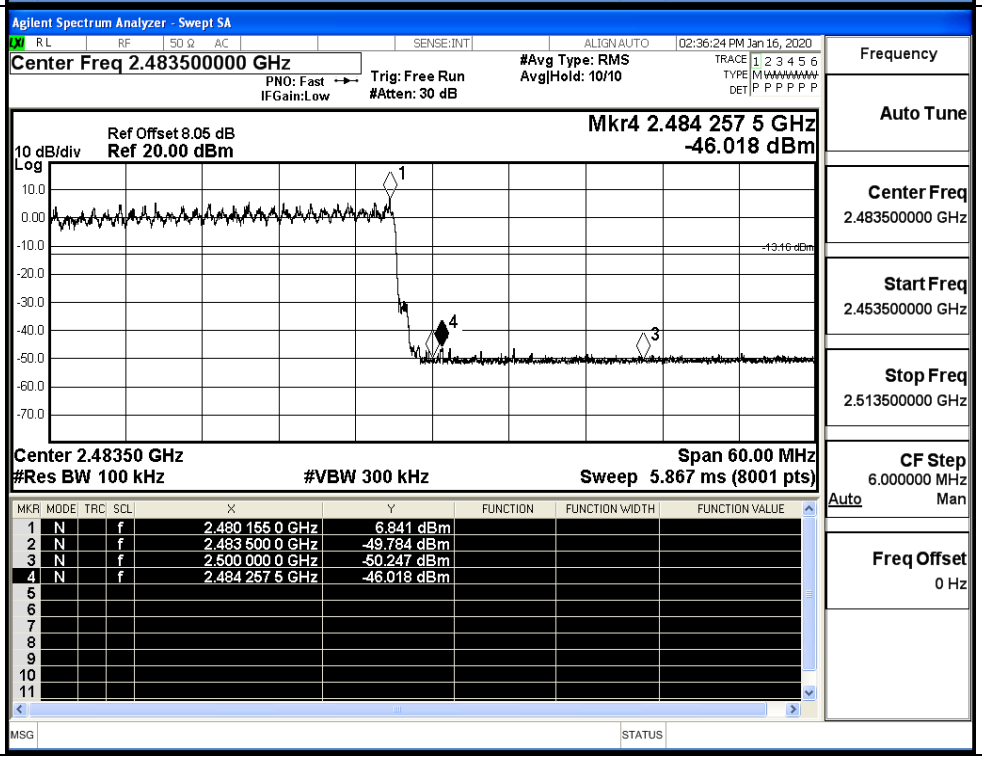
A.8 Band-edge for RF Conducted Emissions

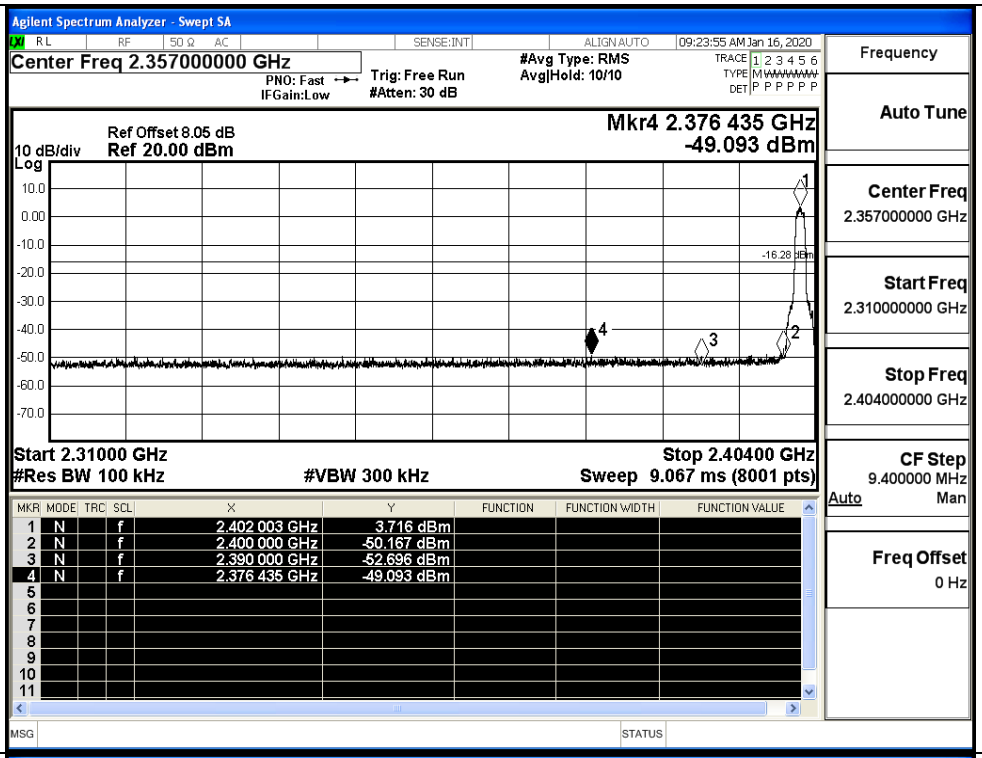
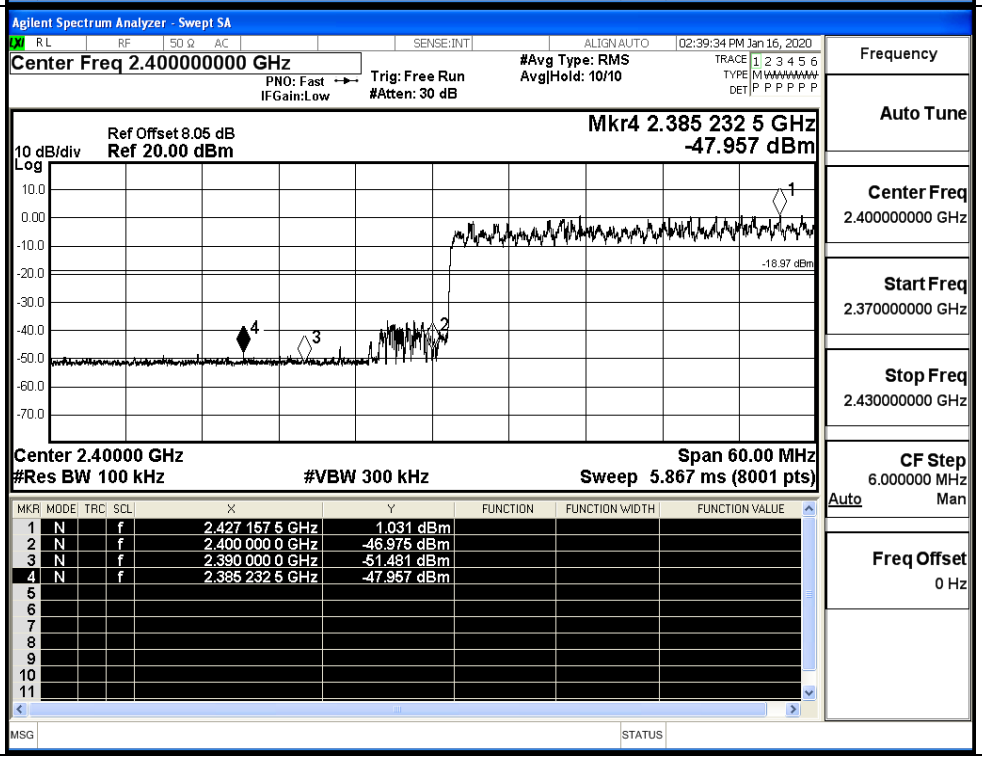
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	0.585	Off	-49.481	-19.42	PASS
			2.157	On	-48.978	-17.84	PASS
	HCH	2480	-0.319	Off	-48.997	-20.32	PASS
			7.624	On	-48.678	-12.38	PASS
π/4DQPSK	LCH	2402	3.565	Off	-48.783	-16.44	PASS
			0.950	On	-46.409	-19.05	PASS
	HCH	2480	-1.899	Off	-49.259	-21.9	PASS
			6.841	On	-46.018	-13.16	PASS
8DPSK	LCH	2402	3.716	Off	-49.093	-16.28	PASS
			1.031	On	-47.957	-18.97	PASS
	HCH	2480	-1.969	Off	-48.912	-21.97	PASS
			6.376	On	-37.886	-13.62	PASS

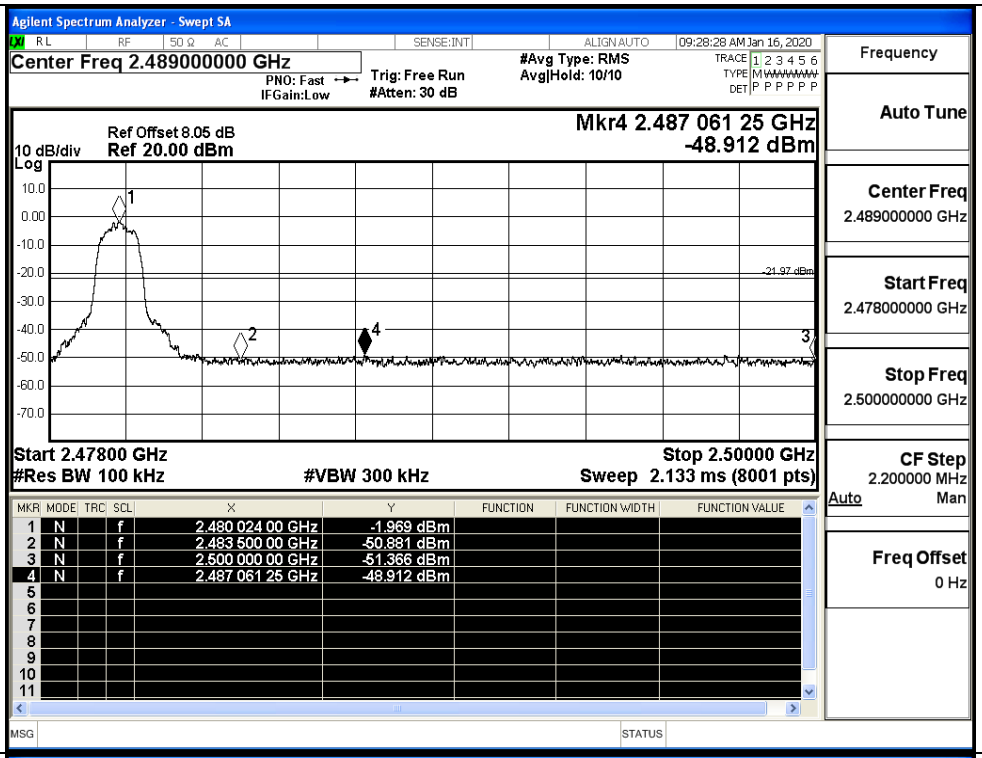
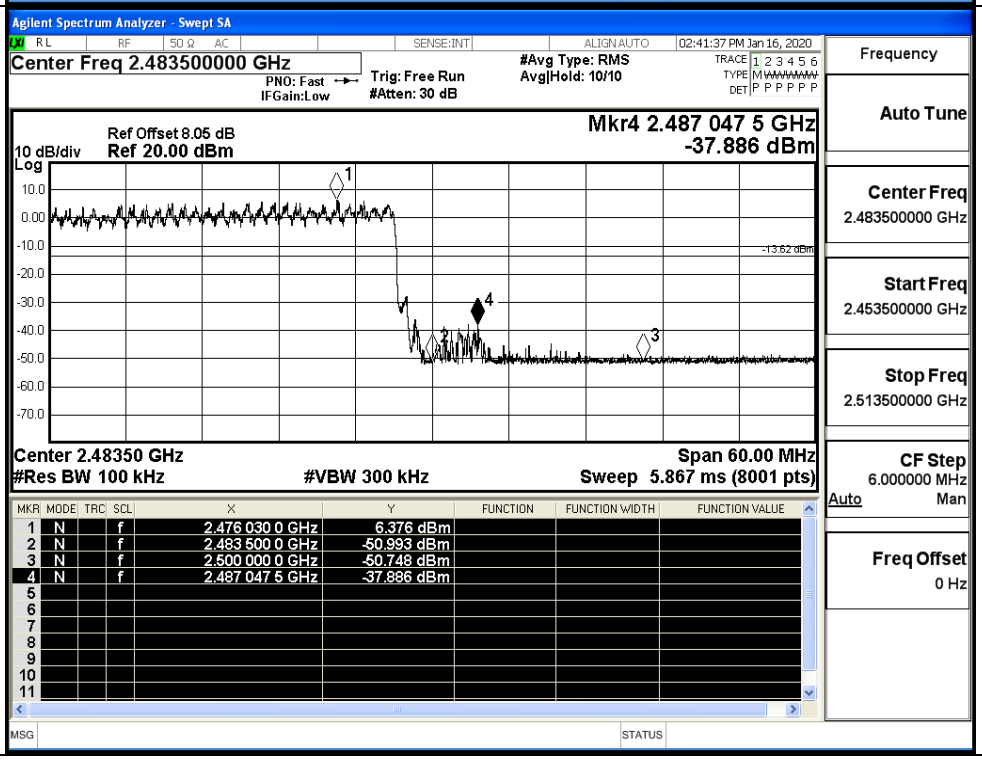
Test Graphs	
GFSK/LCH/No Hop	
GFSK/LCH/Hop	

GFSK/HCH/No Hop	
GFSK/HCH/Hop	

π/4DQPSK/LCH/No Hop	
π/4DQPSK/LCH/Hop	

π/4DQPSK/HCH/No Hop	
π/4DQPSK/HCH/Hop	

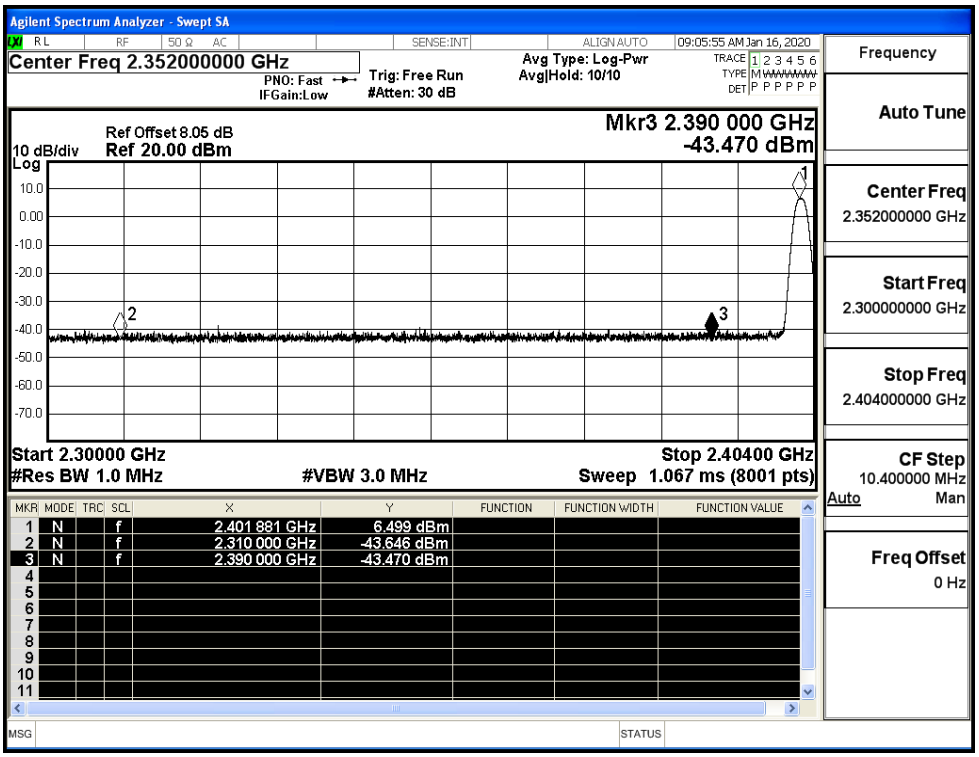
8DPSK/LCH/No Hop	
8DPSK/LCH/Hop	

8DPSK/HCH/No Hop	
8DPSK/HCH/Hop	

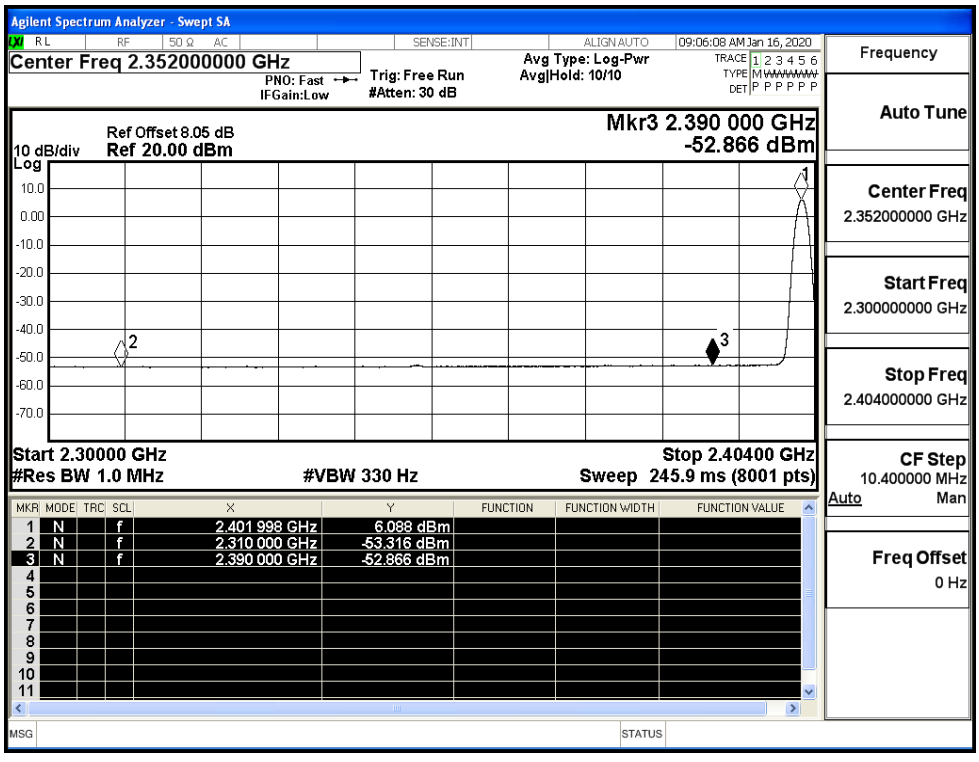
A.9 Restrict-band band-edge measurements

Test Mode	Hopping	Freq.	Power [dBm]	Gain	Ground Factor	E [dBuV/m]	Detector	Limit [dBuV/m]	Verdict
GFSK	Off	2310.0	-43.65	2.0	0	52.11	PEAK	74	PASS
	Off	2310.0	-53.32	2.0	0	42.44	AV	54	PASS
	Off	2390.0	-43.47	2.0	0	52.29	PEAK	74	PASS
	Off	2390.0	-52.87	2.0	0	42.89	AV	54	PASS
	Off	2483.5	-40.70	2.0	0	55.06	PEAK	74	PASS
	Off	2483.5	-52.46	2.0	0	43.30	AV	54	PASS
	Off	2500.0	-43.12	2.0	0	52.64	PEAK	74	PASS
	Off	2500.0	-52.37	2.0	0	43.39	AV	54	PASS
π/4DQPSK	Off	2310.0	-43.69	2.0	0	52.07	PEAK	74	PASS
	Off	2310.0	-53.14	2.0	0	42.62	AV	54	PASS
	Off	2390.0	-42.39	2.0	0	53.37	PEAK	74	PASS
	Off	2390.0	-51.54	2.0	0	44.22	AV	54	PASS
	Off	2483.5	-40.07	2.0	0	55.69	PEAK	74	PASS
	Off	2483.5	-51.36	2.0	0	44.40	AV	54	PASS
	Off	2500.0	-42.64	2.0	0	53.12	PEAK	74	PASS
	Off	2500.0	-51.74	2.0	0	44.02	AV	54	PASS
8DPSK	Off	2310.0	-41.49	2.0	0	54.27	PEAK	74	PASS
	Off	2310.0	-53.28	2.0	0	42.48	AV	54	PASS
	Off	2390.0	-40.93	2.0	0	54.83	PEAK	74	PASS
	Off	2390.0	-51.50	2.0	0	44.26	AV	54	PASS
	Off	2483.5	-39.83	2.0	0	55.93	PEAK	74	PASS
	Off	2483.5	-51.13	2.0	0	44.63	AV	54	PASS
	Off	2500.0	-41.42	2.0	0	54.34	PEAK	74	PASS
	Off	2500.0	-51.61	2.0	0	44.15	AV	54	PASS

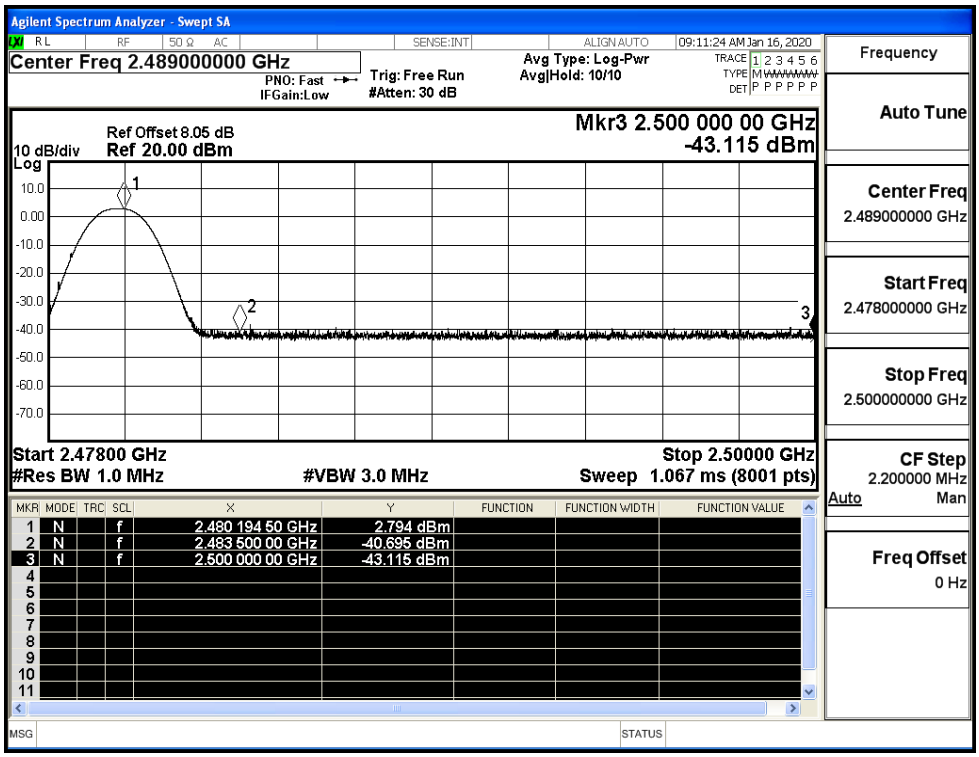
Restrict-band band-edge measurements_Hopping Off_ GFSK_PEAK (Low Channel)



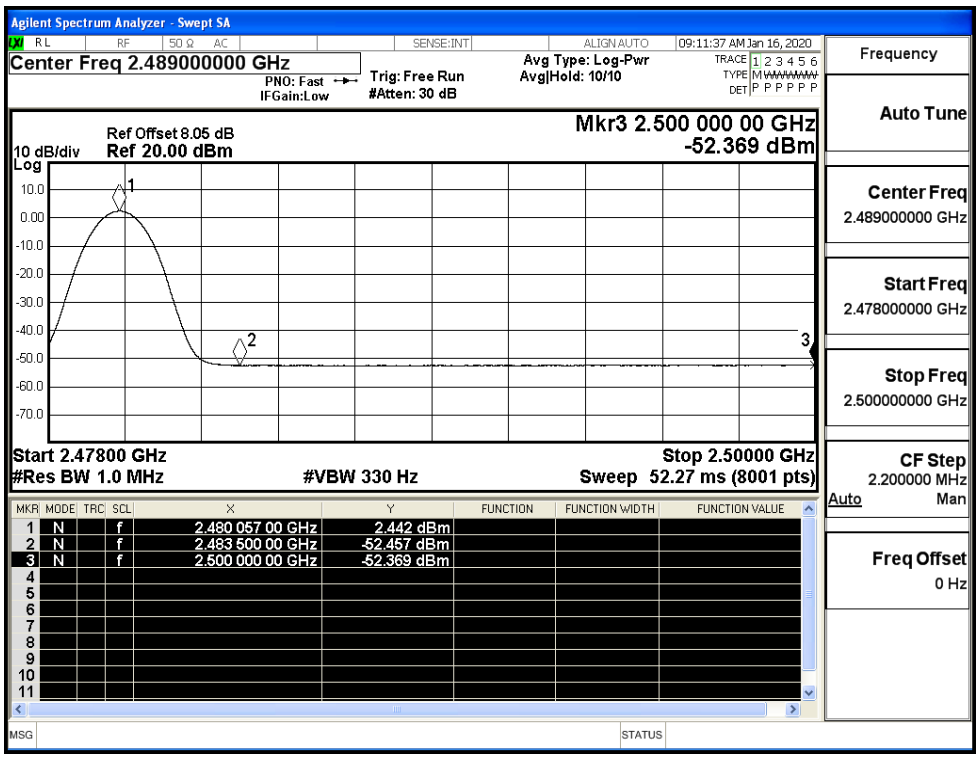
Restrict-band band-edge measurements_Hopping Off_ GFSK_Average (Low Channel)



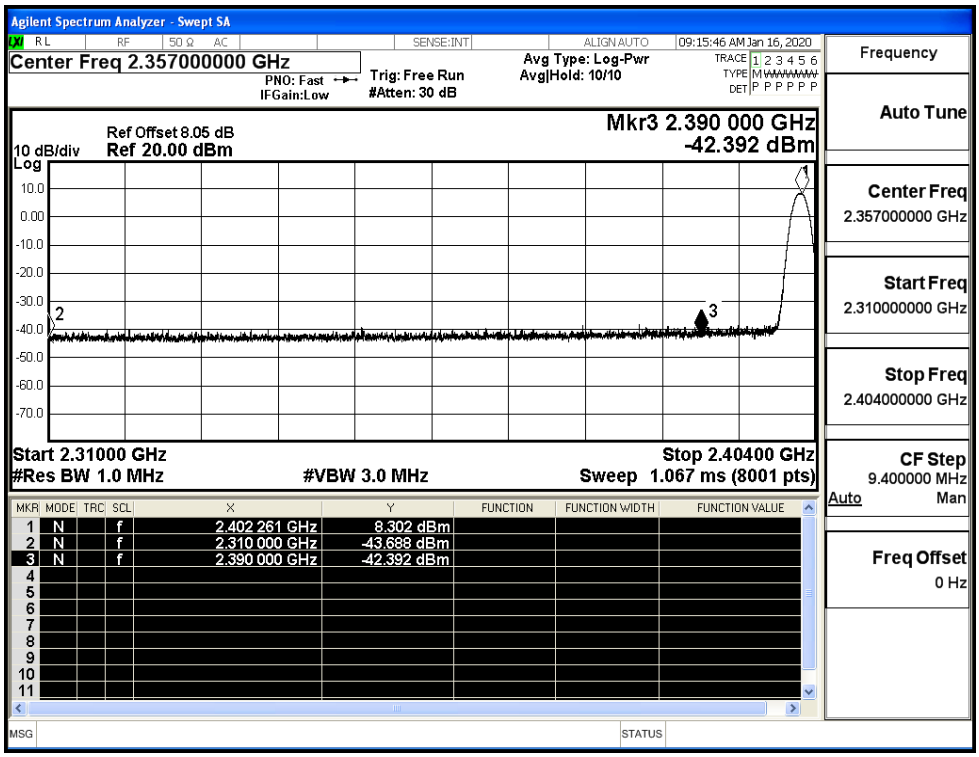
Restrict-band band-edge measurements_Hopping Off_ GFSK_PEAK (High Channel)



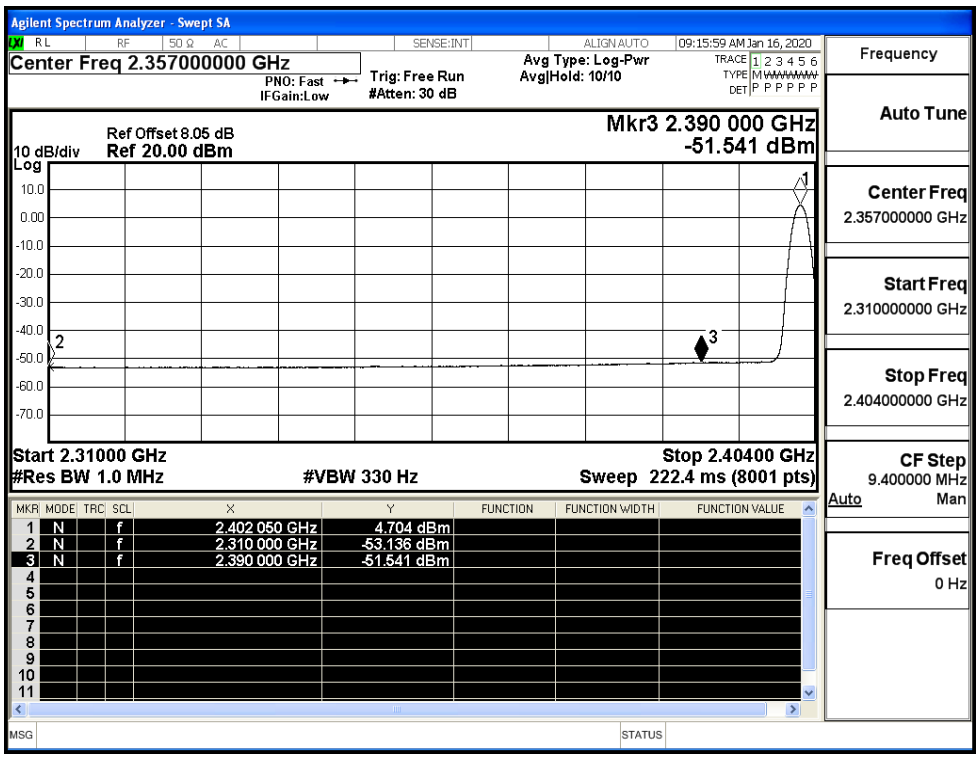
Restrict-band band-edge measurements_Hopping Off_ GFSK_Average (High Channel)



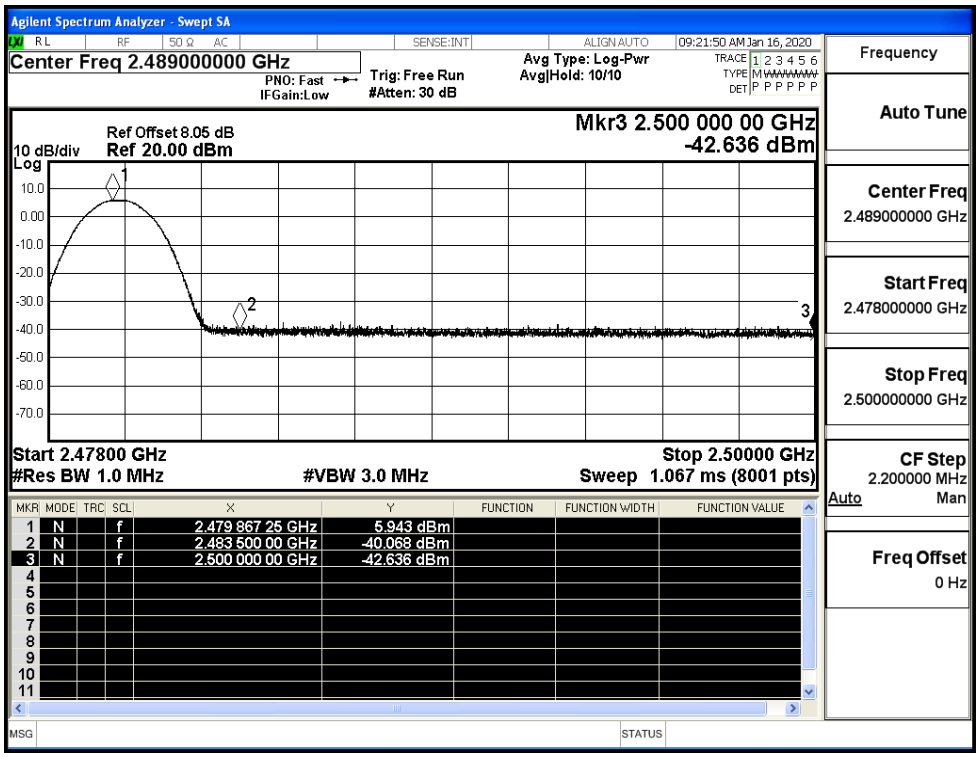
Restrict-band band-edge measurements_Hopping Off_π/4-DQPSK_PEAK (Low Channel)



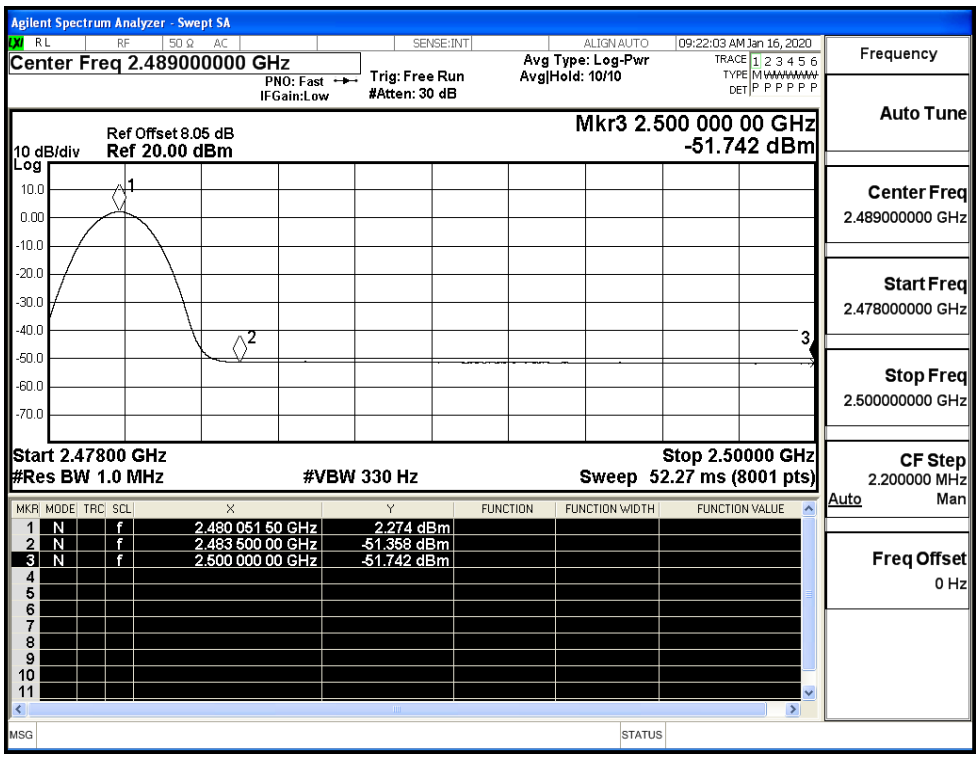
Restrict-band band-edge measurements_Hopping Off_π/4-DQPSK_Average (Low Channel)



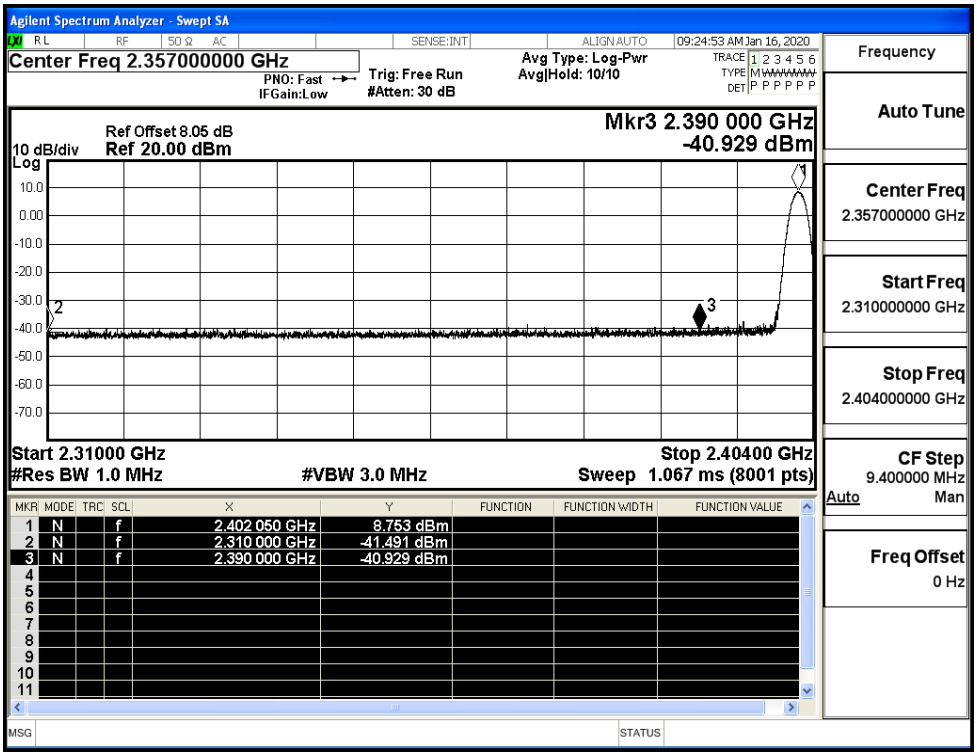
Restrict-band band-edge measurements_Hopping Off_π/4-DQPSK_PEAK (High Channel)



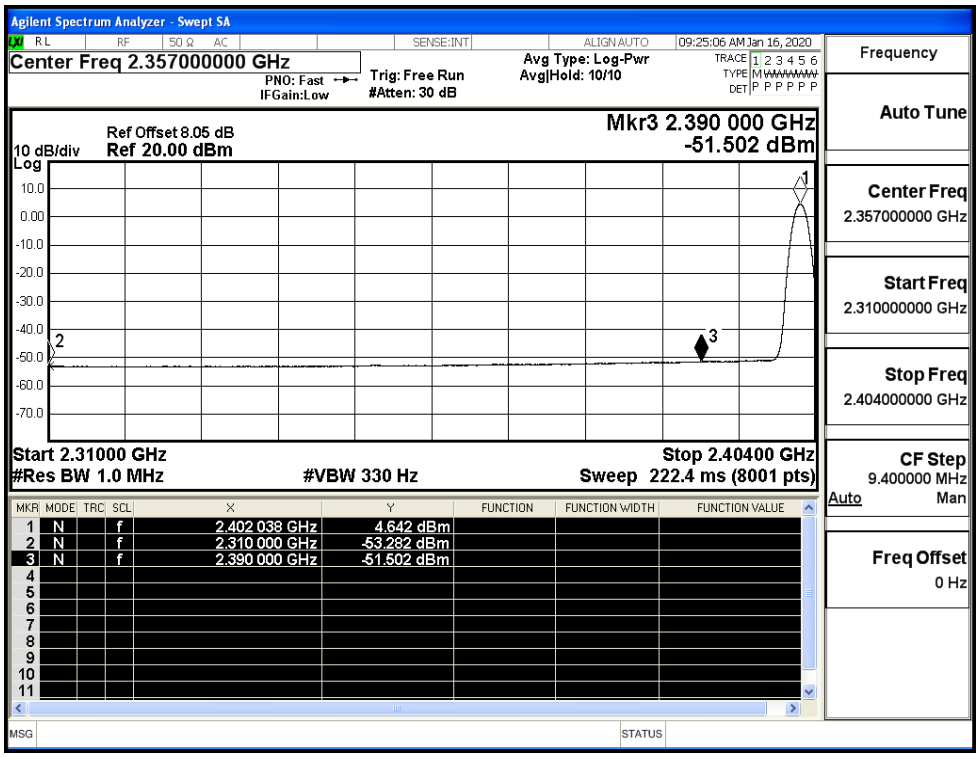
Restrict-band band-edge measurements_Hopping Off_π/4-DQPSK_Average (High Channel)



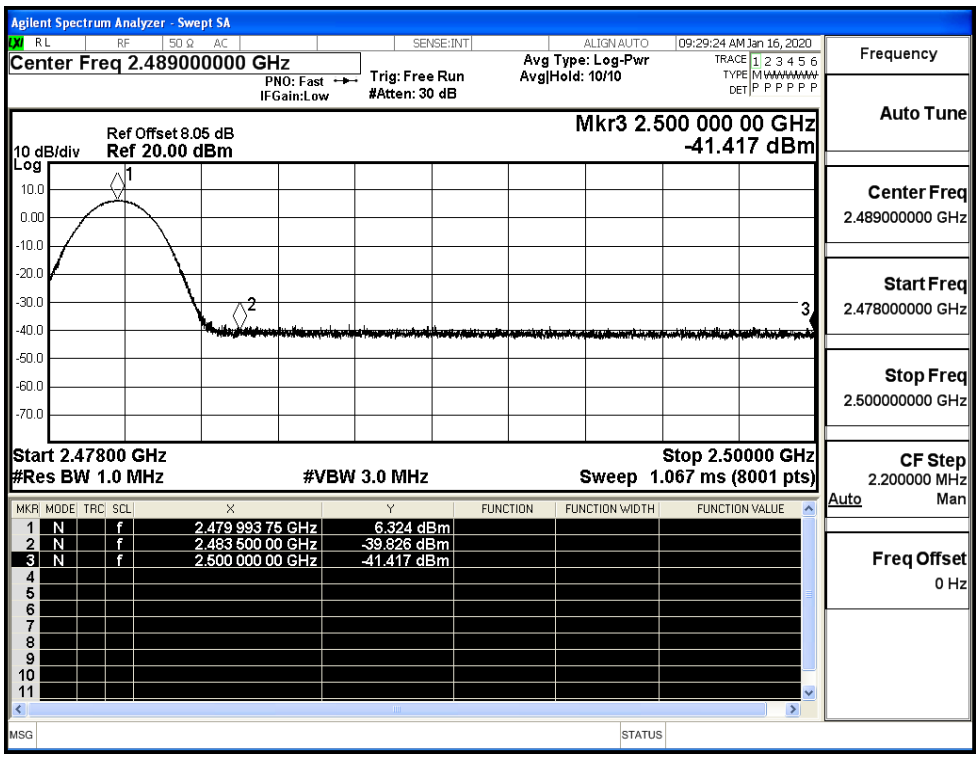
Restrict-band band-edge measurements_Hopping Off_8DPSK_PEAK (Low Channel)



Restrict-band band-edge measurements_Hopping Off_8DPSK_Average (Low Channel)



Restrict-band band-edge measurements_Hopping Off_8DPSK_PEAK (High Channel)



Restrict-band band-edge measurements_Hopping Off_8DPSK_Average (High Channel)