

## Appendix A

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

Product Name: True Wireless Earbuds

Trade Mark: Energizer

Test Model: UB2605

#### Environmental Conditions

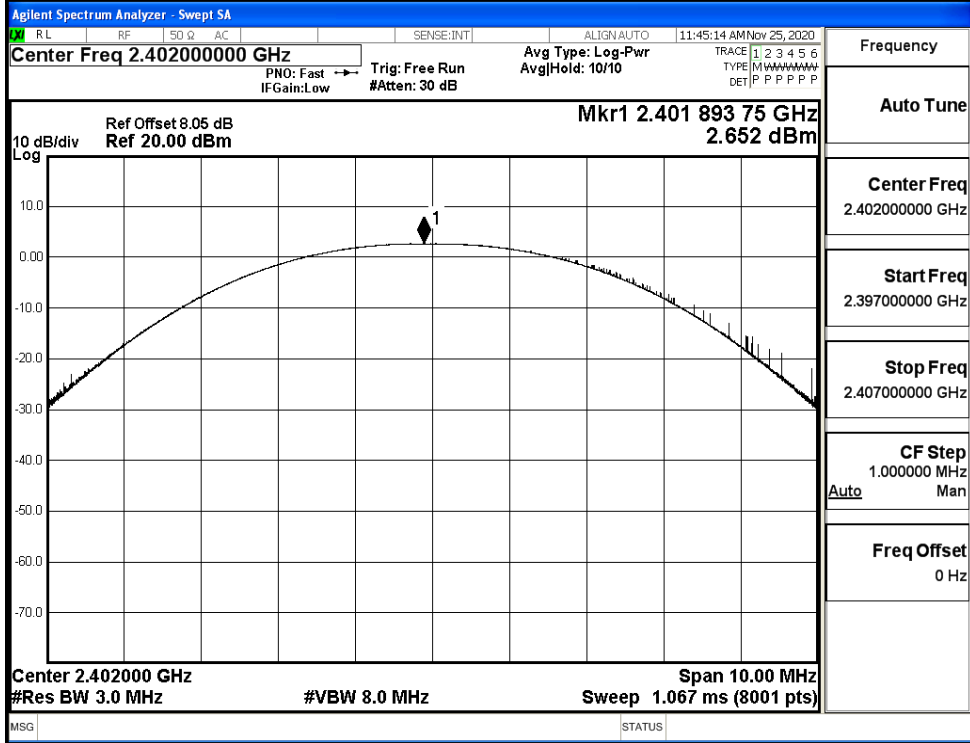
Temperature:	22.5° C
Relative Humidity:	53.1%
ATM Pressure:	100.0 kPa
Test Engineer:	Kay Hu
Supervised by:	Li Huan

#### A.1 Maxmum Conducted Peak Output Power

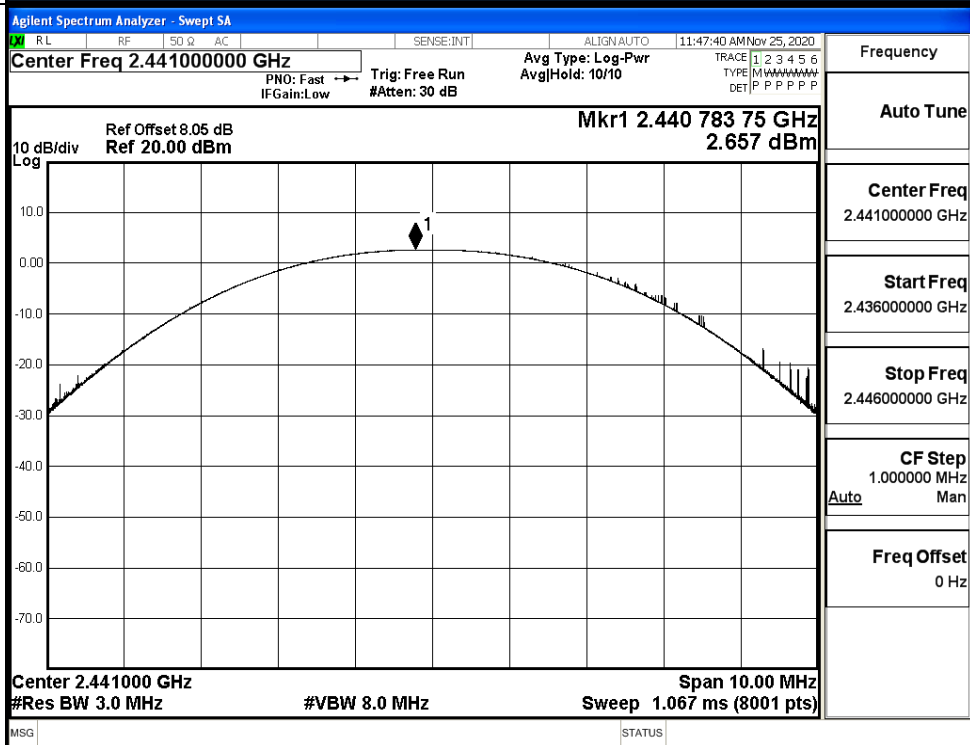
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2.652	30	PASS
	MCH	2.657	30	PASS
	HCH	2.136	30	PASS
$\pi/4$ DQPSK	LCH	2.651	21	PASS
	MCH	2.599	21	PASS
	HCH	2.101	21	PASS
8DPSK	LCH	2.559	21	PASS
	MCH	2.628	21	PASS
	HCH	2.134	21	PASS

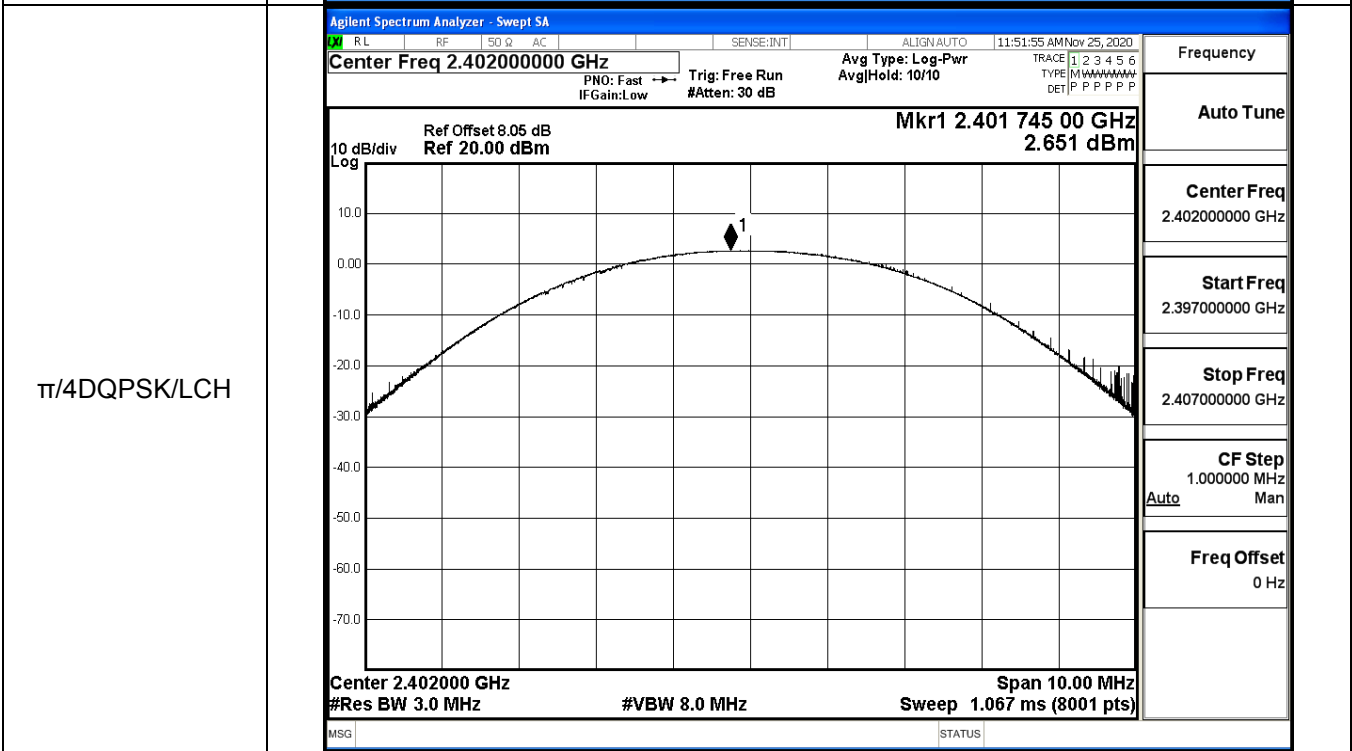
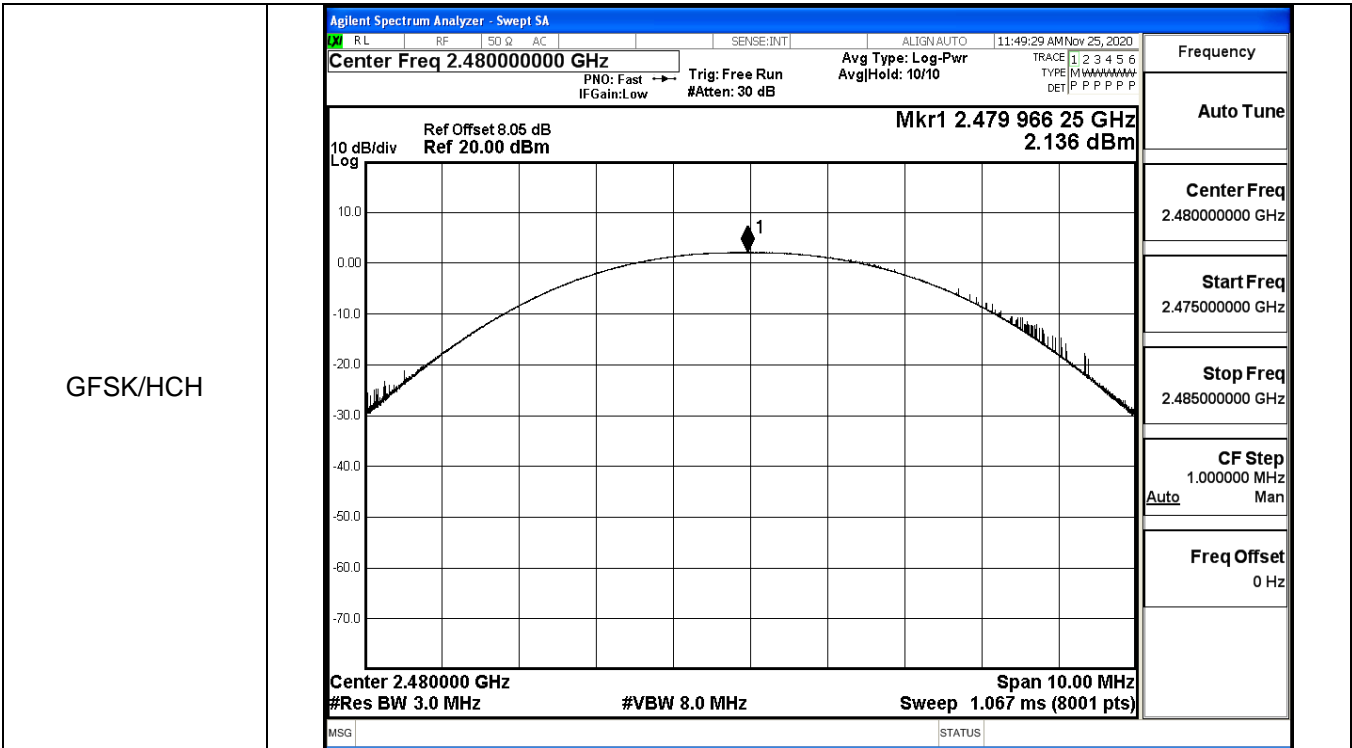
Test Graphs

GFSK/LCH

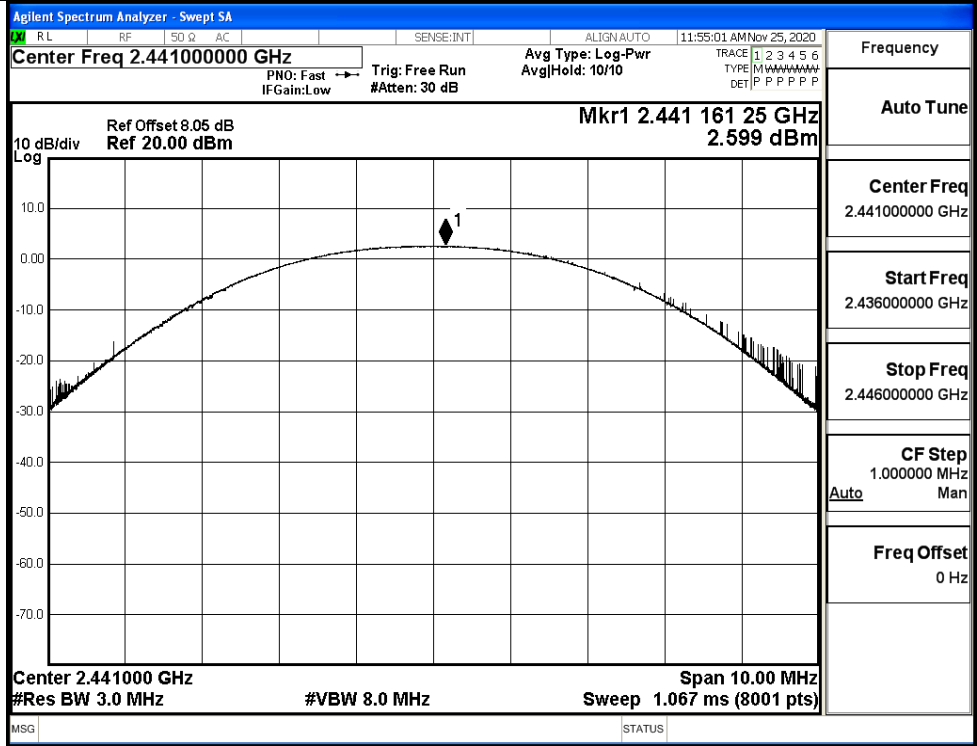


GFSK/MCH

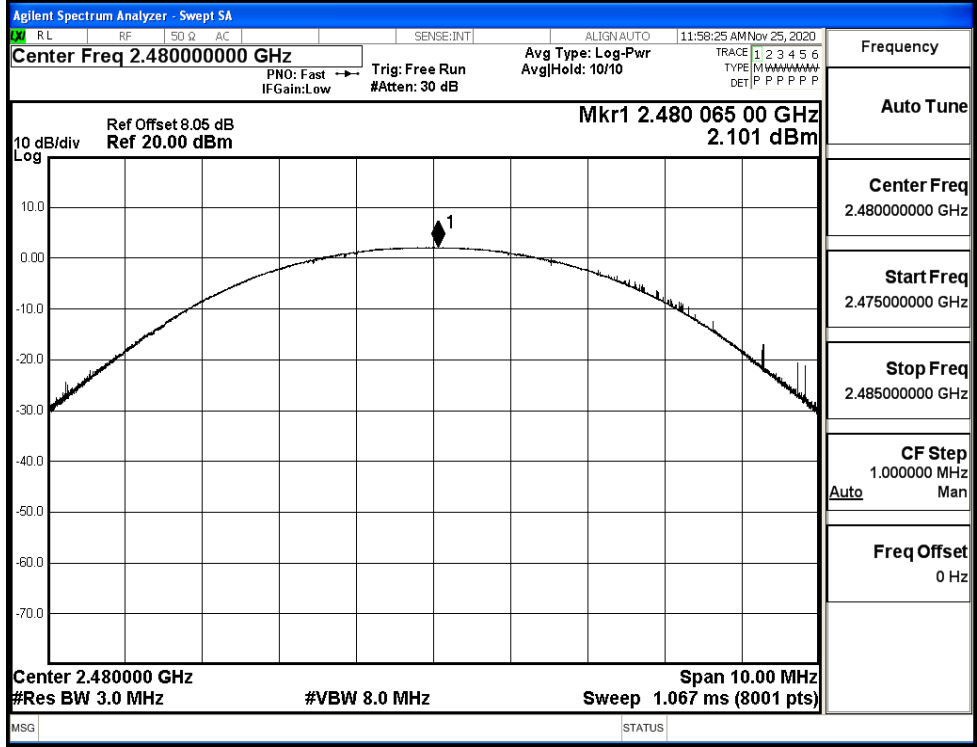


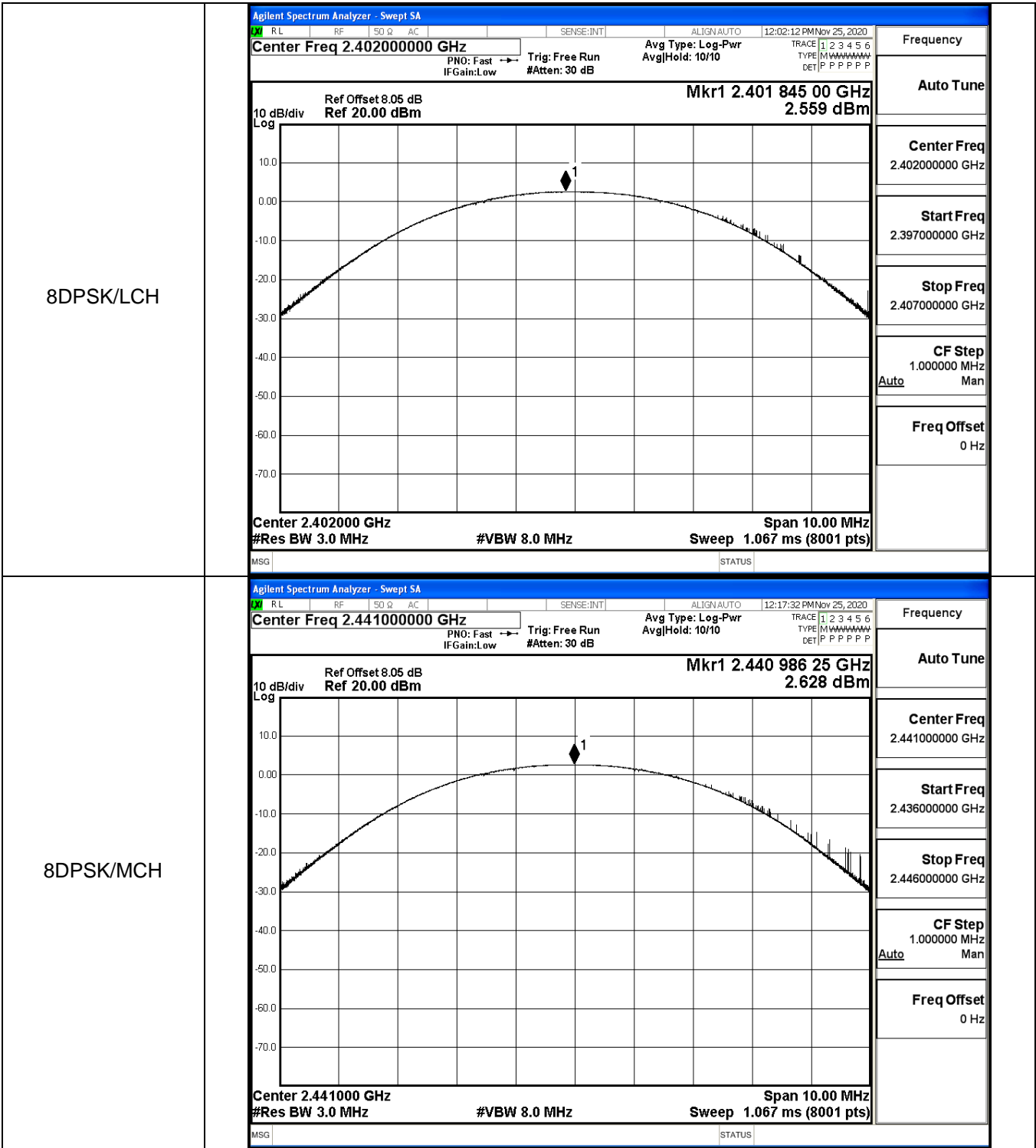


$\pi/4$ DQPSK/MCH

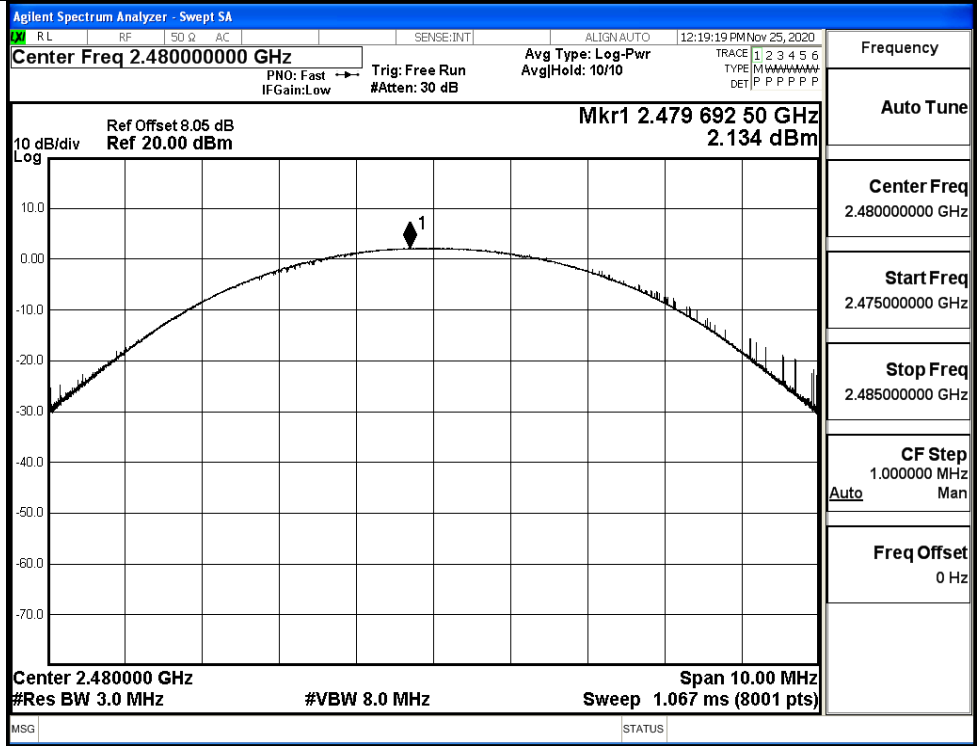


$\pi/4$ DQPSK/HCH



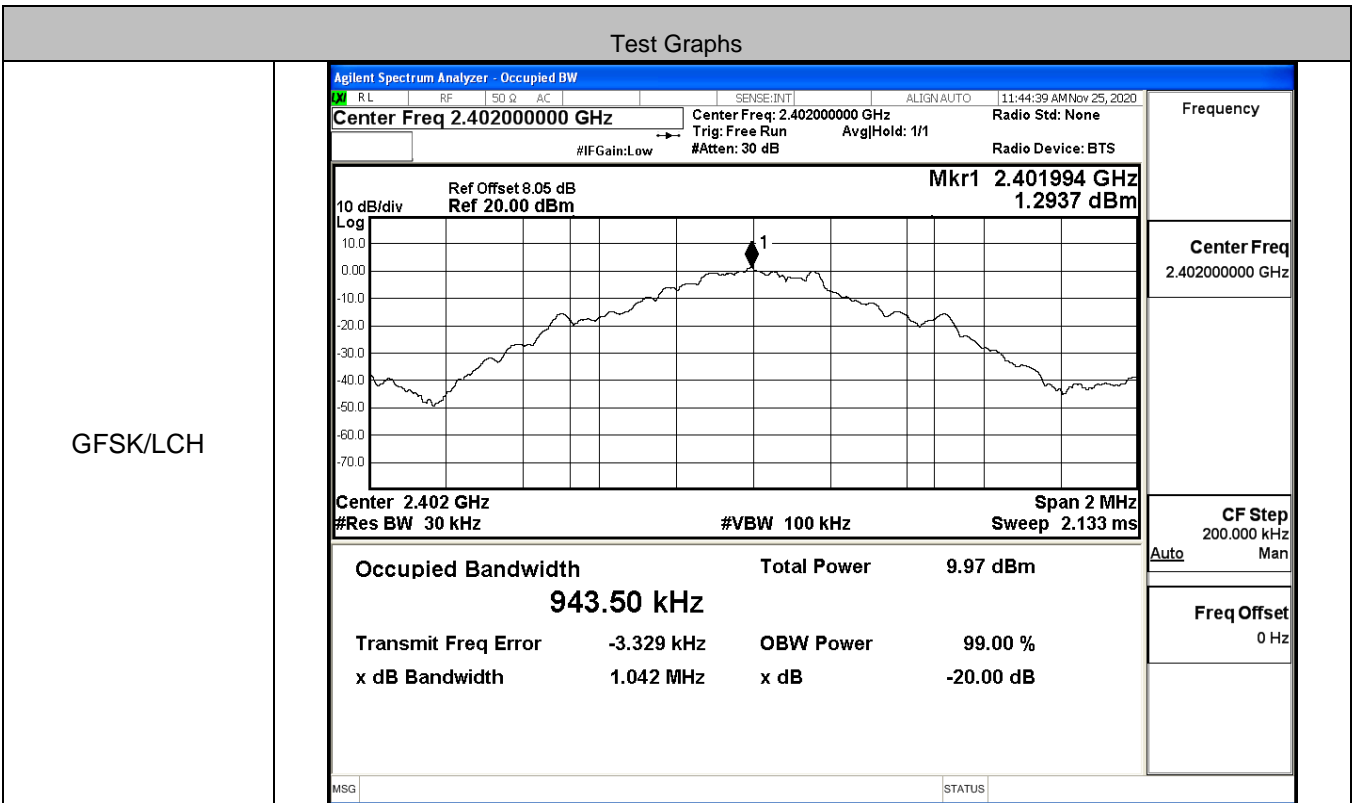


8DPSK/HCH

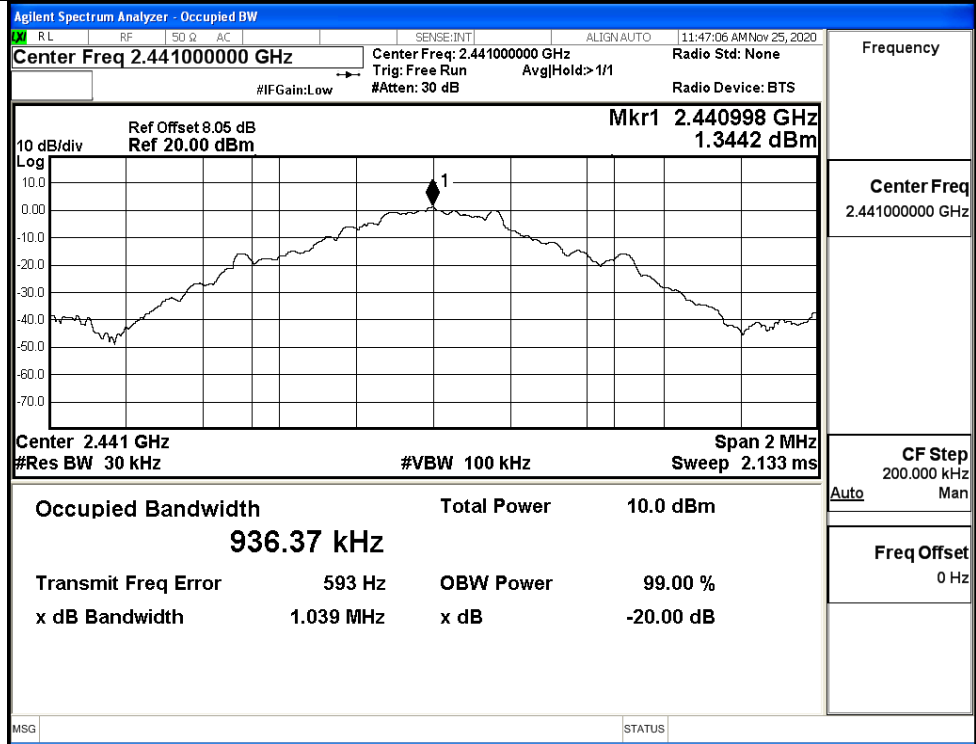


**A.2 20dB Bandwidth**

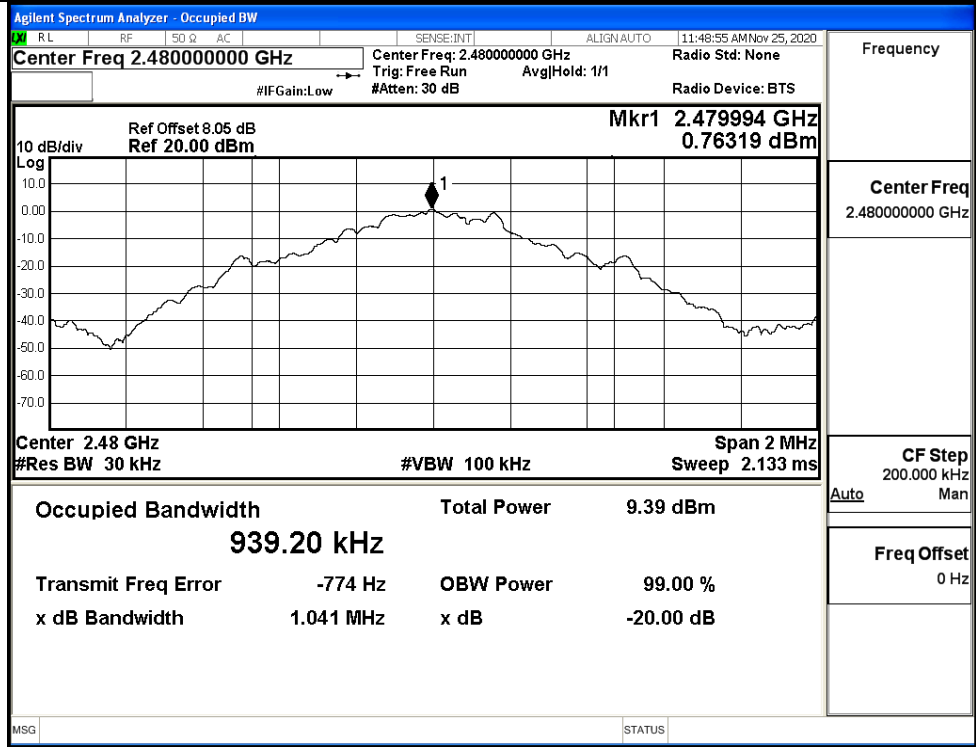
Mode	Channel.	20dB Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	1.042	Not Specified	PASS
	MCH	1.039	Not Specified	PASS
	HCH	1.041	Not Specified	PASS
$\pi/4$ DQPSK	LCH	1.202	Not Specified	PASS
	MCH	1.192	Not Specified	PASS
	HCH	1.192	Not Specified	PASS
8DPSK	LCH	1.248	Not Specified	PASS
	MCH	1.243	Not Specified	PASS
	HCH	1.201	Not Specified	PASS



GFSK/MCH

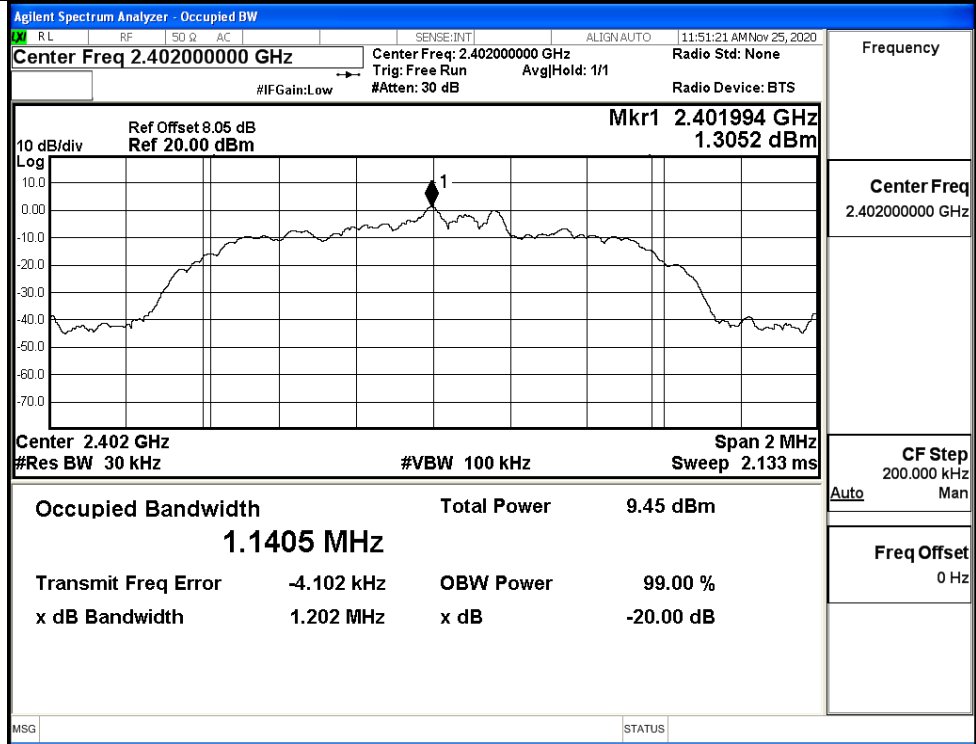


GFSK/HCH

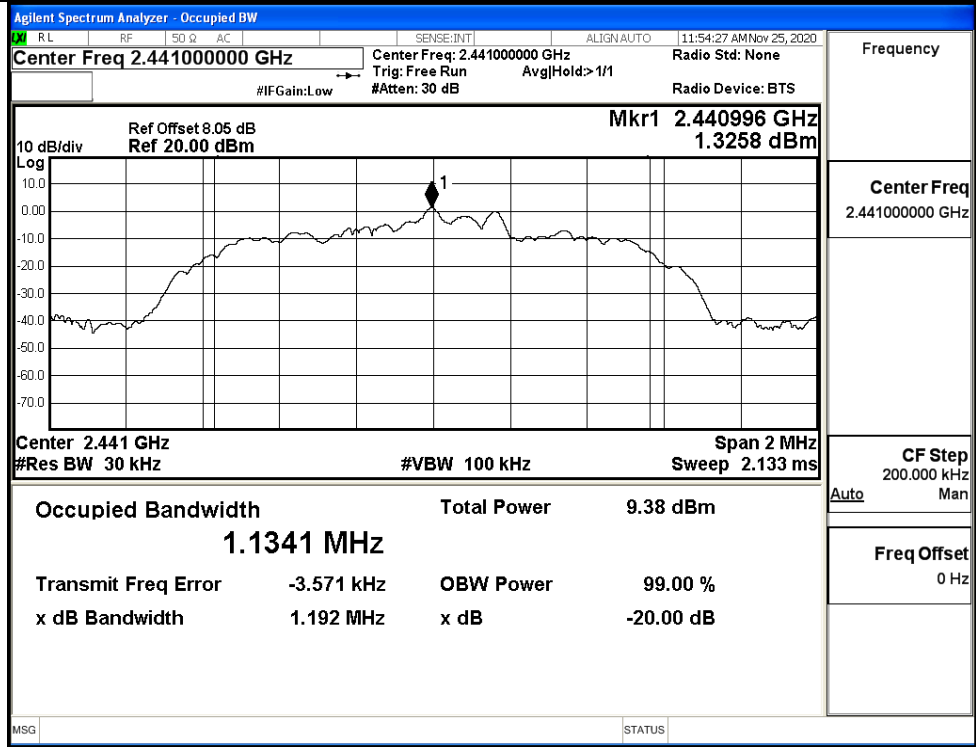




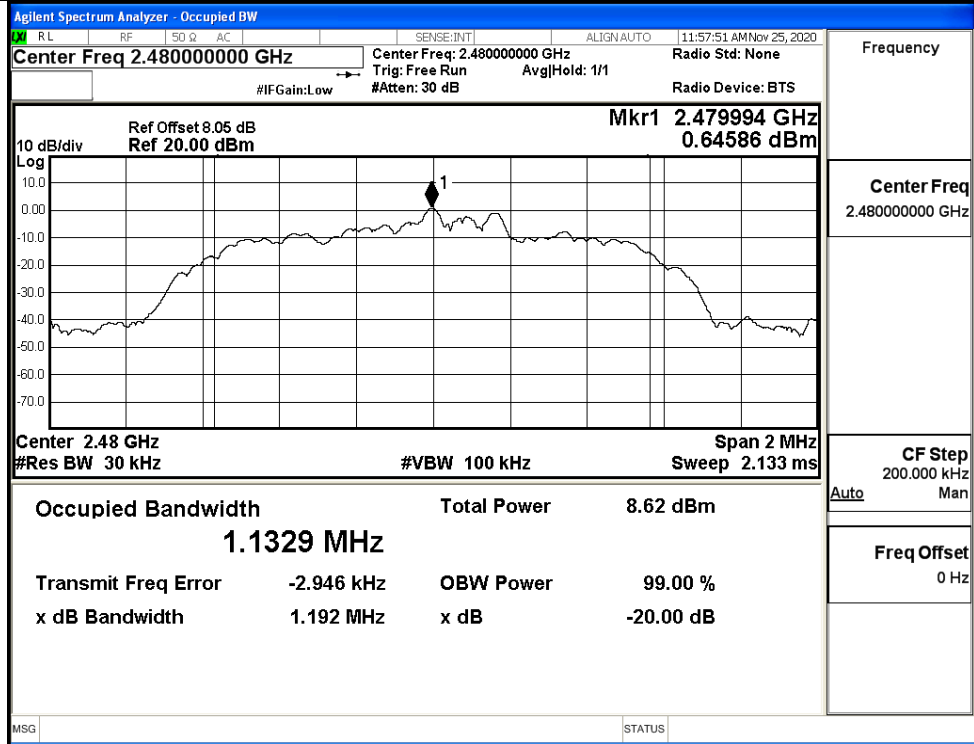
$\pi/4$ DQPSK/LCH



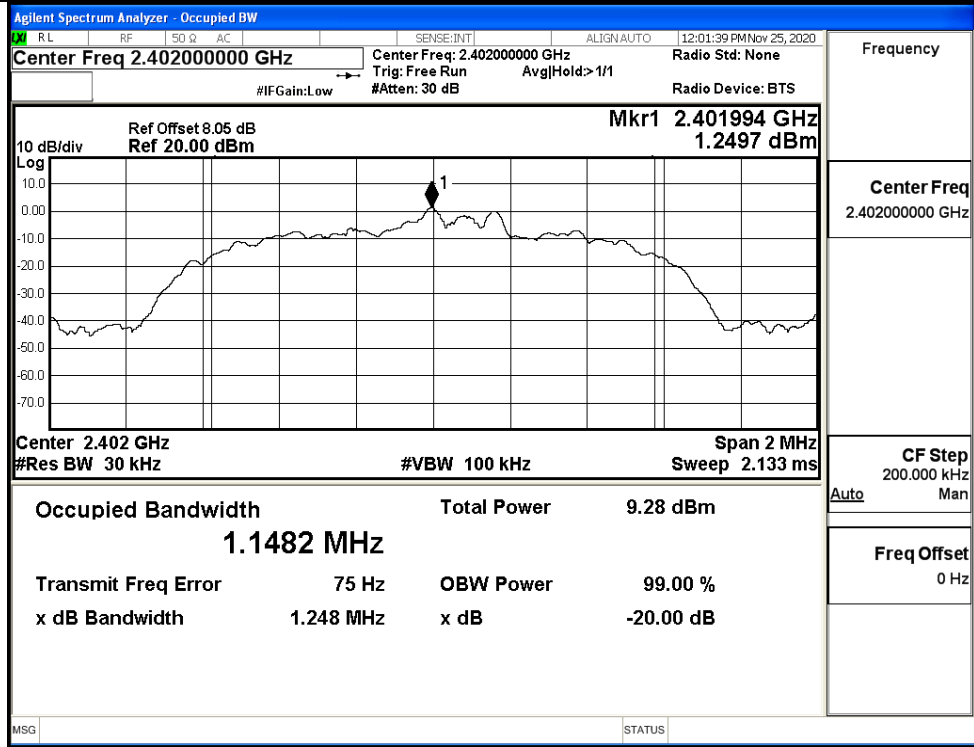
$\pi/4$ DQPSK/MCH



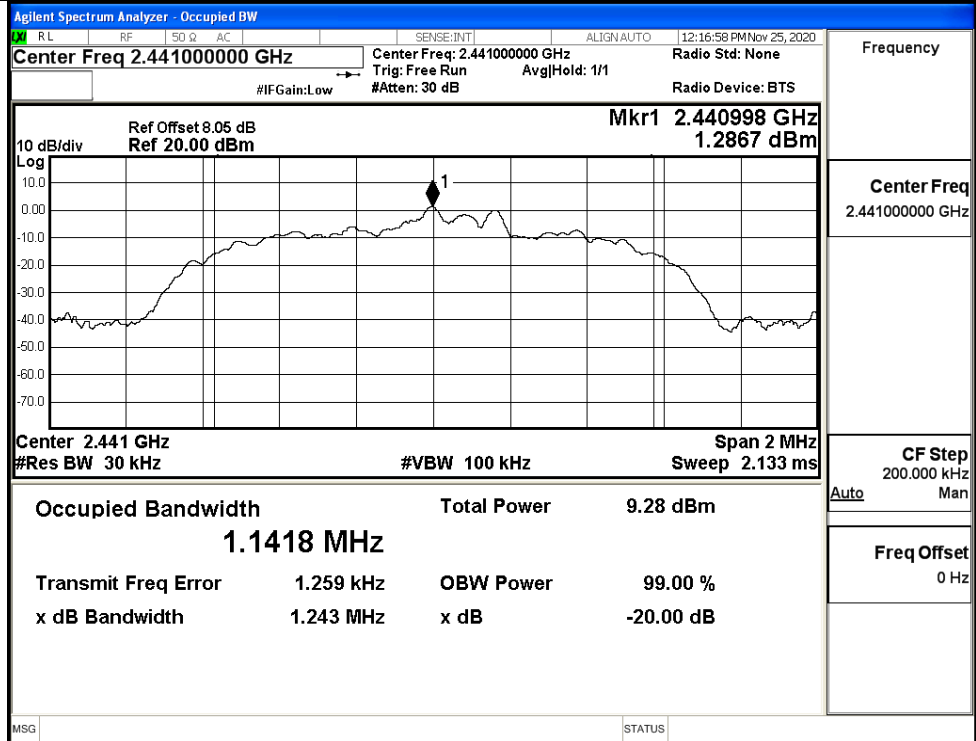
$\pi/4$ DQPSK/HCH



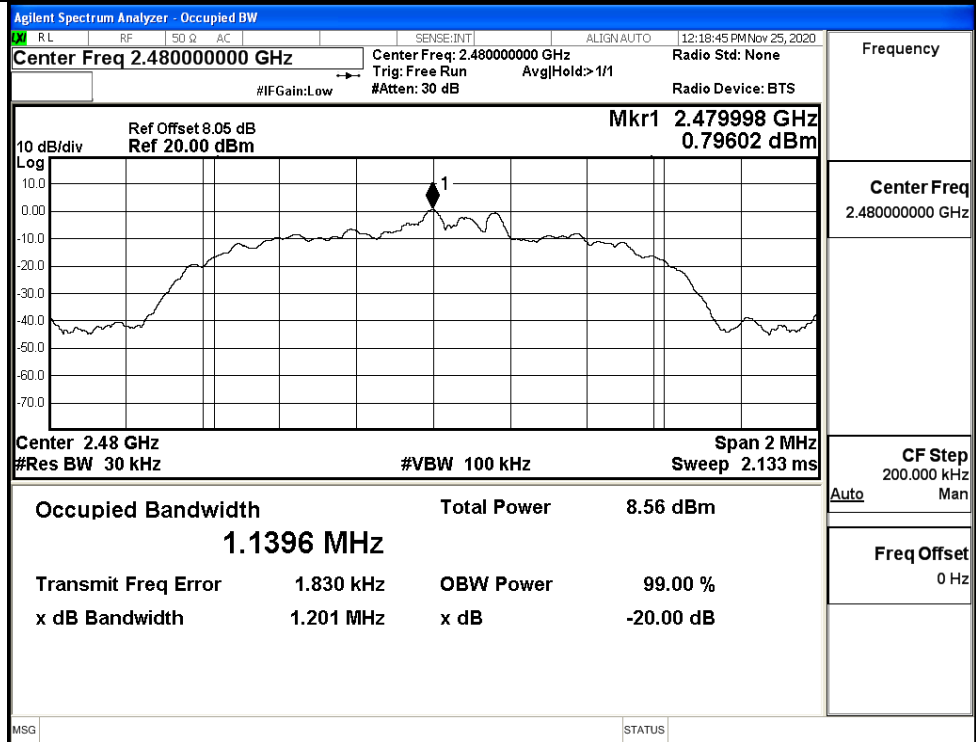
8DPSK/LCH



8DPSK/MCH

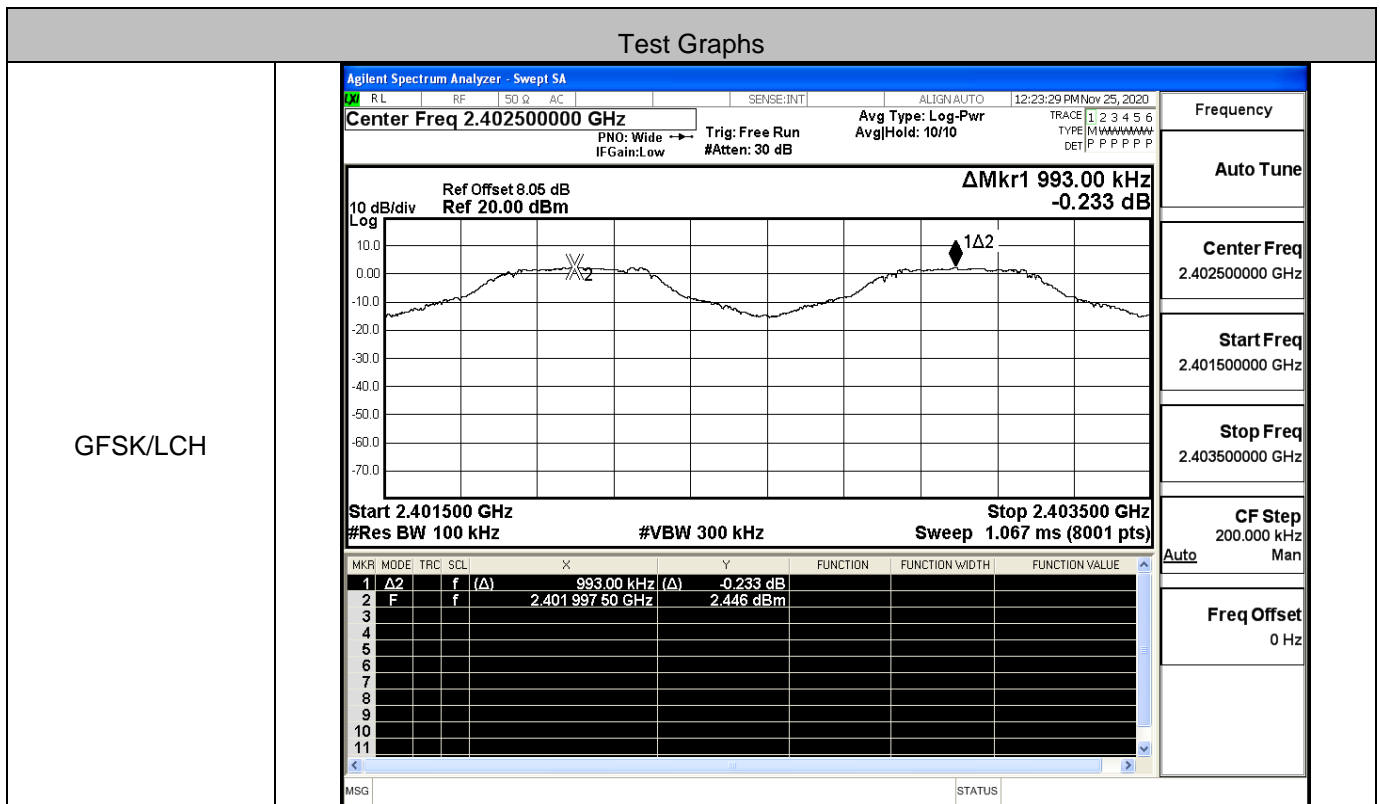


8DPSK/HCH

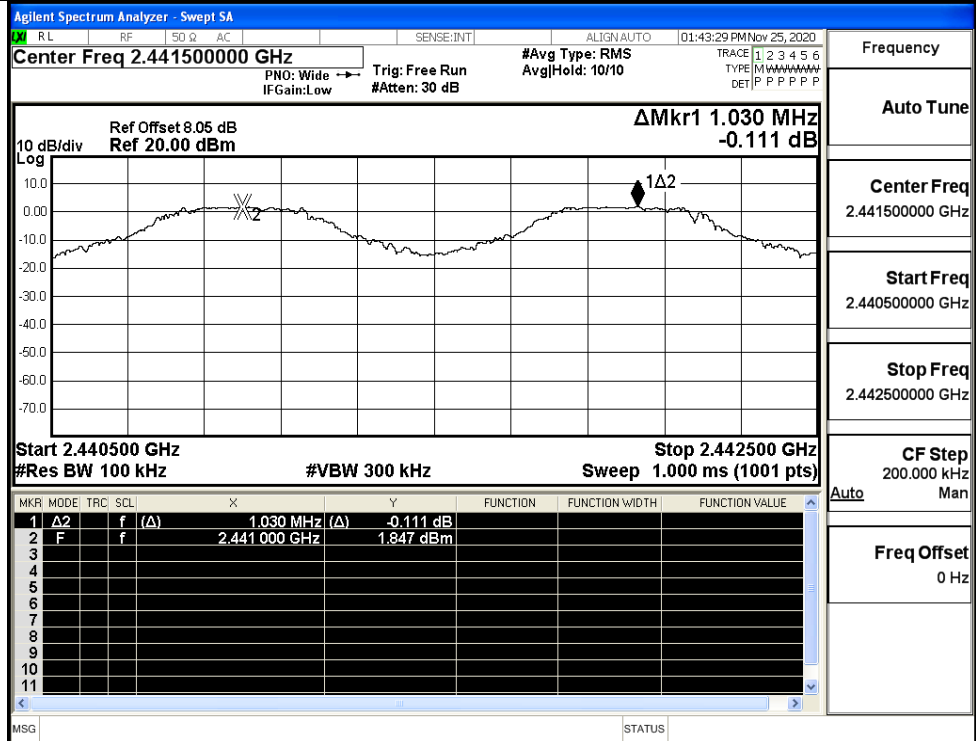


### A.3 Carrier Frequency Separation

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.993	0.695	PASS
	MCH	1.030	0.695	PASS
	HCH	1.052	0.695	PASS
π/4DQPSK	LCH	1.162	0.801	PASS
	MCH	0.964	0.801	PASS
	HCH	1.002	0.801	PASS
8DPSK	LCH	1.002	0.832	PASS
	MCH	1.306	0.832	PASS
	HCH	0.932	0.832	PASS

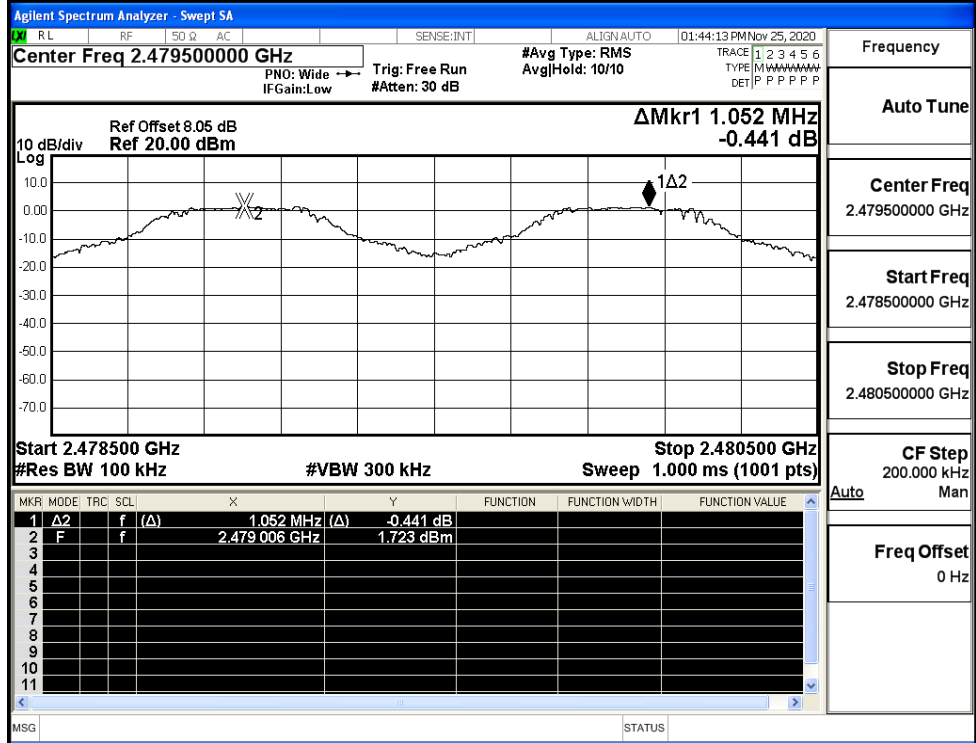


GFSK/MCH



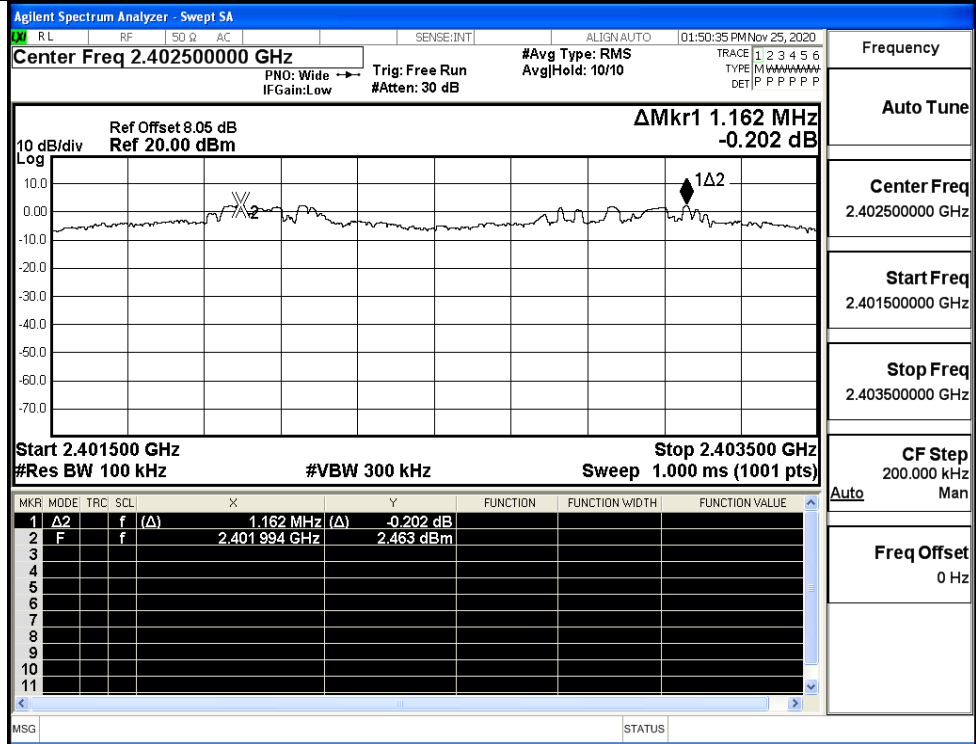
Frequency  
Auto Tune  
Center Freq  
2.441500000 GHz  
Start Freq  
2.440500000 GHz  
Stop Freq  
2.442500000 GHz  
CF Step  
200.000 kHz  
Auto  
Man  
Freq Offset  
0 Hz

GFSK/HCH



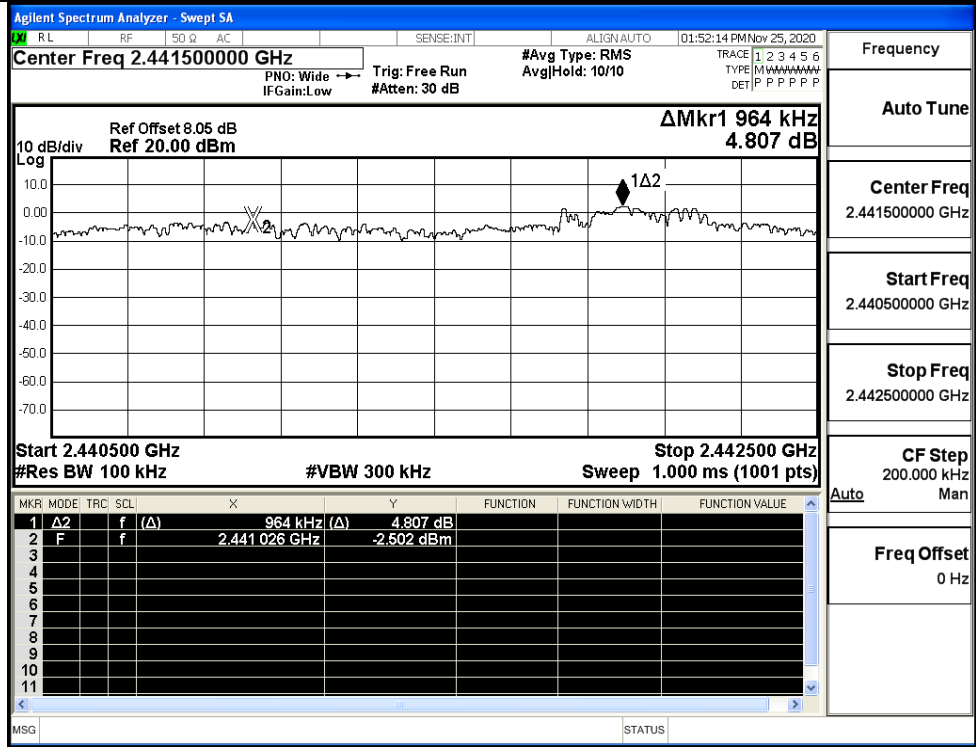
Frequency  
Auto Tune  
Center Freq  
2.479500000 GHz  
Start Freq  
2.478500000 GHz  
Stop Freq  
2.480500000 GHz  
CF Step  
200.000 kHz  
Auto  
Man  
Freq Offset  
0 Hz

$\pi/4$ DQPSK/LCH



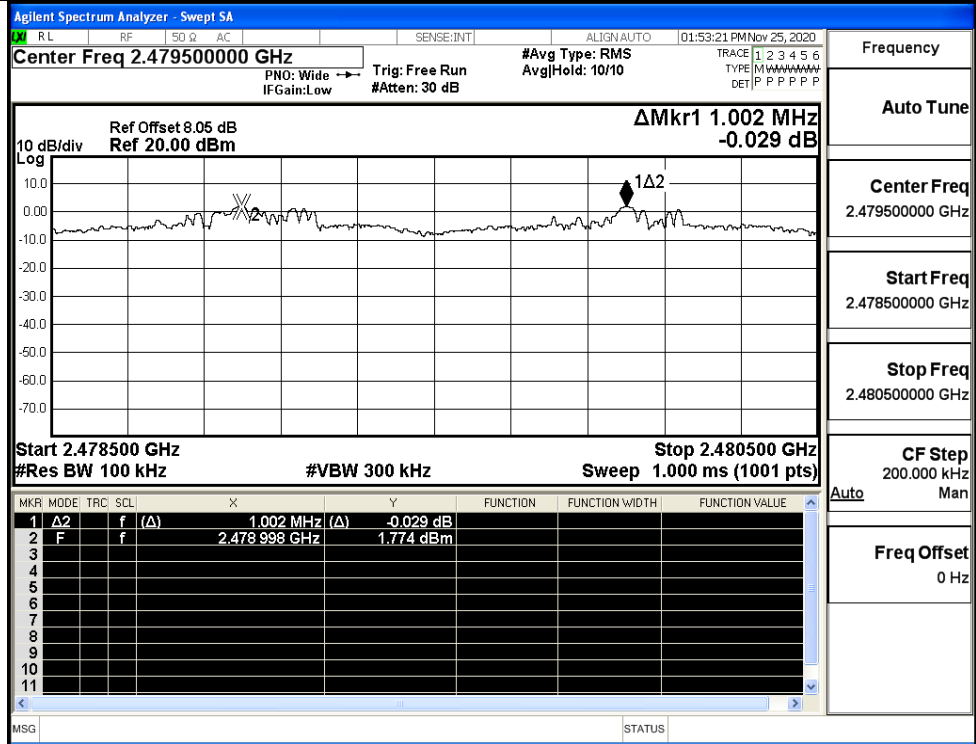
Frequency	2.402500000 GHz
Auto Tune	
Center Freq	2.402500000 GHz
Start Freq	2.401500000 GHz
Stop Freq	2.403500000 GHz
CF Step	200.000 kHz
Auto	Man
Freq Offset	0 Hz

$\pi/4$ DQPSK/MCH



Frequency	2.441500000 GHz
Auto Tune	
Center Freq	2.441500000 GHz
Start Freq	2.440500000 GHz
Stop Freq	2.442500000 GHz
CF Step	200.000 kHz
Auto	Man
Freq Offset	0 Hz

π/4DQPSK/HCH



Frequency

Auto Tune

Center Freq  
2.479500000 GHz

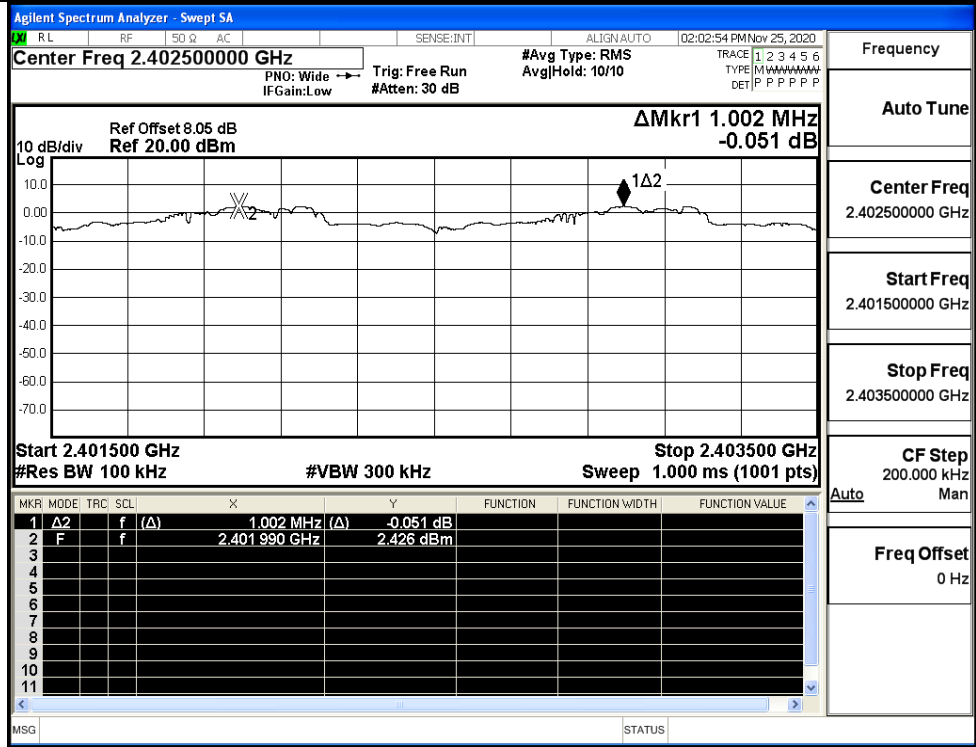
Start Freq  
2.478500000 GHz

Stop Freq  
2.480500000 GHz

CF Step  
200.000 kHz  
Auto Man

Freq Offset  
0 Hz

8DPSK/LCH



Frequency

Auto Tune

Center Freq  
2.402500000 GHz

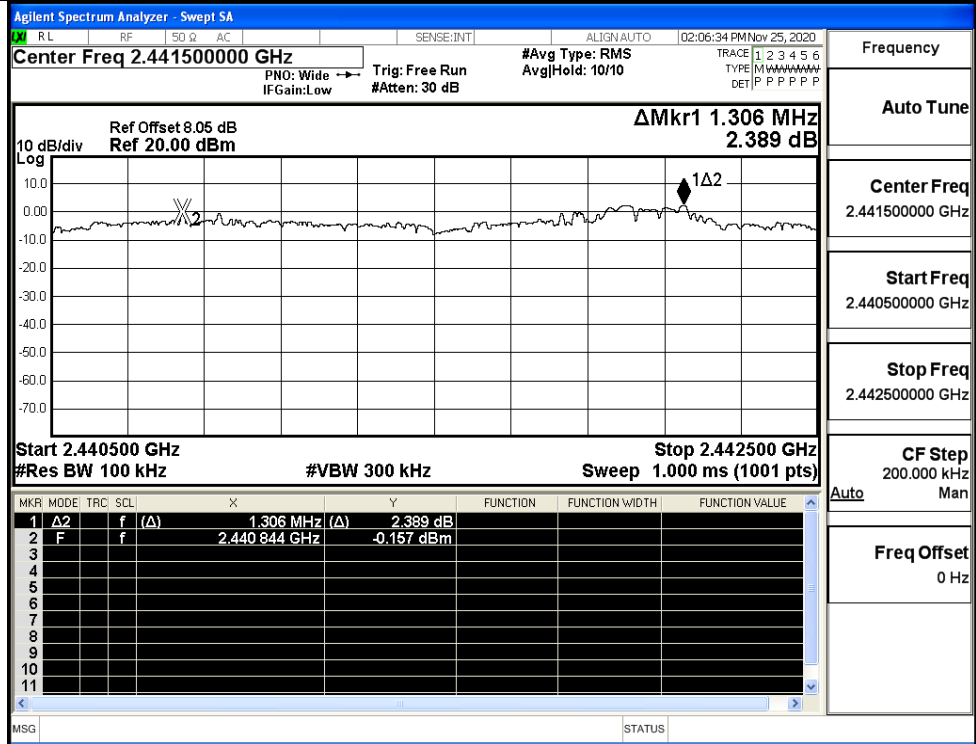
Start Freq  
2.401500000 GHz

Stop Freq  
2.403500000 GHz

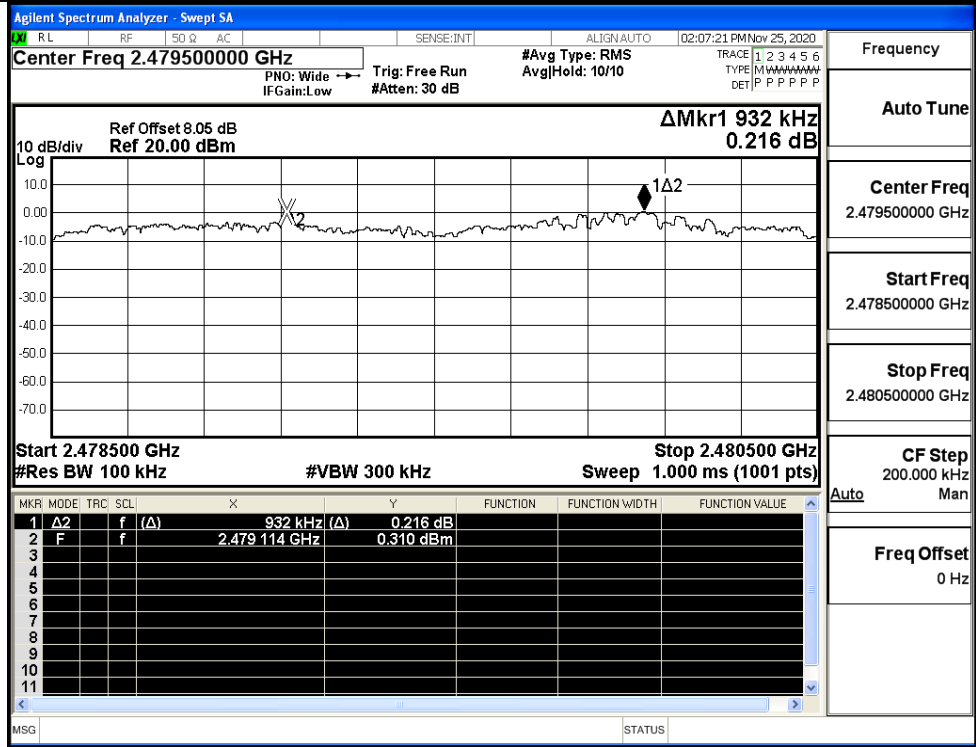
CF Step  
200.000 kHz  
Auto Man

Freq Offset  
0 Hz

8DPSK/MCH



8DPSK/HCH





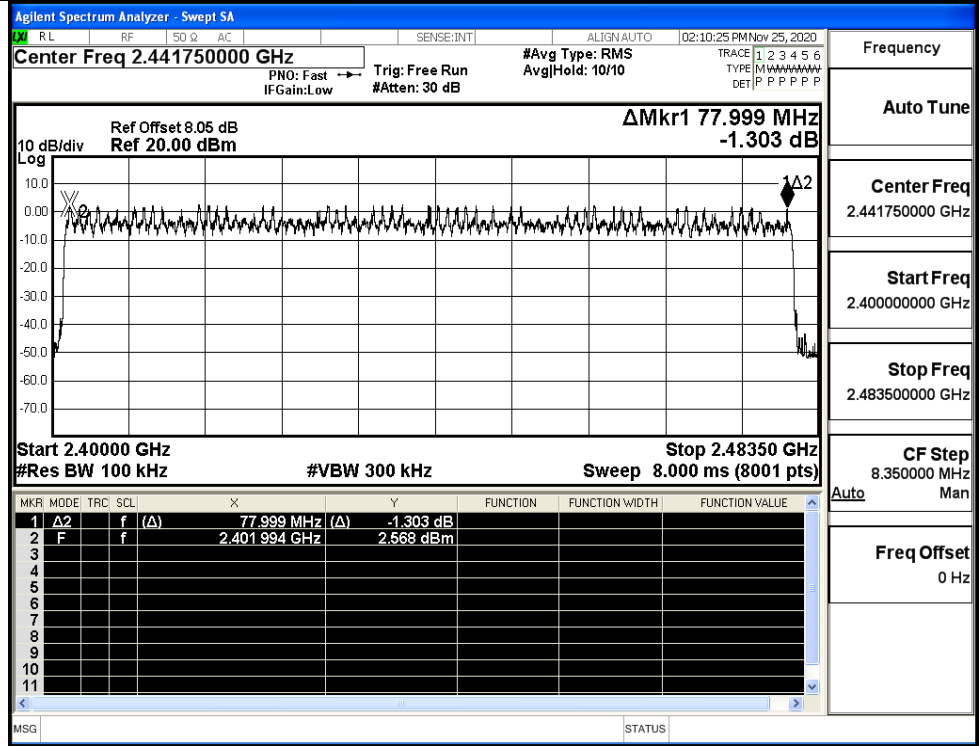
### A.4 Hopping Channel Number

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

#### Test Graphs

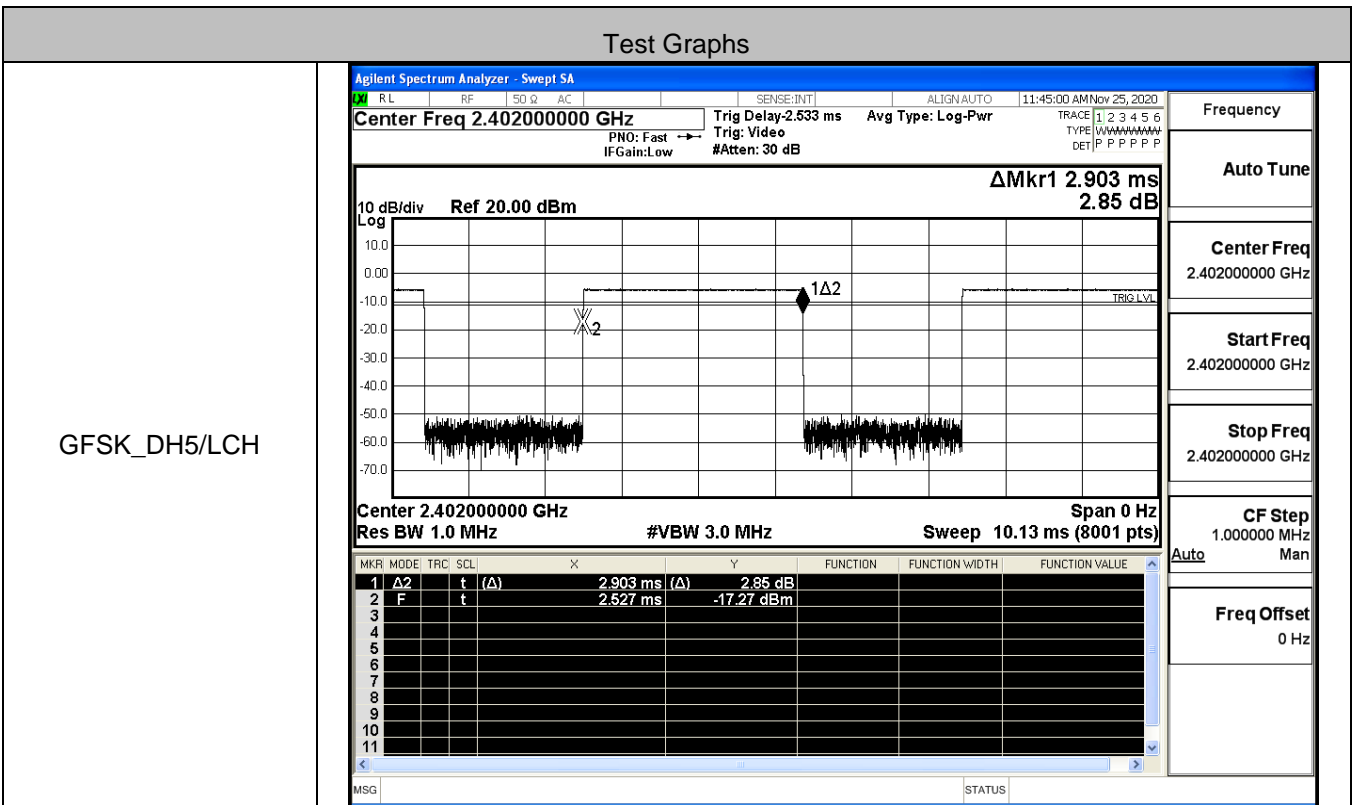
<p>GFSK/Hop</p>	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Center Freq 2.441750000 GHz</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p><math>\Delta</math>Mkr1 77.989 MHz -0.257 dB</p> <p>Start 2.40000 GHz Stop 2.48350 GHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 8.000 ms (8001 pts)</p> <table border="1"> <thead> <tr> <th>MKR</th> <th>MODE</th> <th>TRC</th> <th>SCL</th> <th>X</th> <th>Y</th> <th>FUNCTION</th> <th>FUNCTION WIDTH</th> <th>FUNCTION VALUE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><math>\Delta</math>2</td> <td>f</td> <td>(<math>\Delta</math>)</td> <td>77.989 MHz (<math>\Delta</math>)</td> <td>-0.257 dB</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>F</td> <td>f</td> <td>(<math>\Delta</math>)</td> <td>2.402004 GHz</td> <td>1.954 dBm</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	$\Delta$ 2	f	( $\Delta$ )	77.989 MHz ( $\Delta$ )	-0.257 dB				2	F	f	( $\Delta$ )	2.402004 GHz	1.954 dBm				<p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 2.441750000 GHz</p> <p>Start Freq 2.400000000 GHz</p> <p>Stop Freq 2.483500000 GHz</p> <p>CF Step 8.350000 MHz</p> <p>Freq Offset 0 Hz</p>
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																					
1	$\Delta$ 2	f	( $\Delta$ )	77.989 MHz ( $\Delta$ )	-0.257 dB																								
2	F	f	( $\Delta$ )	2.402004 GHz	1.954 dBm																								
<p><math>\pi/4</math>DQPSK/Hop</p>	<p>Agilent Spectrum Analyzer - Swept SA</p> <p>Center Freq 2.441750000 GHz</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p><math>\Delta</math>Mkr1 77.853 MHz -0.654 dB</p> <p>Start 2.40000 GHz Stop 2.48350 GHz</p> <p>#Res BW 100 kHz #VBW 300 kHz Sweep 8.000 ms (8001 pts)</p> <table border="1"> <thead> <tr> <th>MKR</th> <th>MODE</th> <th>TRC</th> <th>SCL</th> <th>X</th> <th>Y</th> <th>FUNCTION</th> <th>FUNCTION WIDTH</th> <th>FUNCTION VALUE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><math>\Delta</math>2</td> <td>f</td> <td>(<math>\Delta</math>)</td> <td>77.853 MHz (<math>\Delta</math>)</td> <td>-0.654 dB</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>F</td> <td>f</td> <td>(<math>\Delta</math>)</td> <td>2.402150 GHz</td> <td>2.383 dBm</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	$\Delta$ 2	f	( $\Delta$ )	77.853 MHz ( $\Delta$ )	-0.654 dB				2	F	f	( $\Delta$ )	2.402150 GHz	2.383 dBm				<p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 2.441750000 GHz</p> <p>Start Freq 2.400000000 GHz</p> <p>Stop Freq 2.483500000 GHz</p> <p>CF Step 8.350000 MHz</p> <p>Freq Offset 0 Hz</p>
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																					
1	$\Delta$ 2	f	( $\Delta$ )	77.853 MHz ( $\Delta$ )	-0.654 dB																								
2	F	f	( $\Delta$ )	2.402150 GHz	2.383 dBm																								

8DPSK/Hop

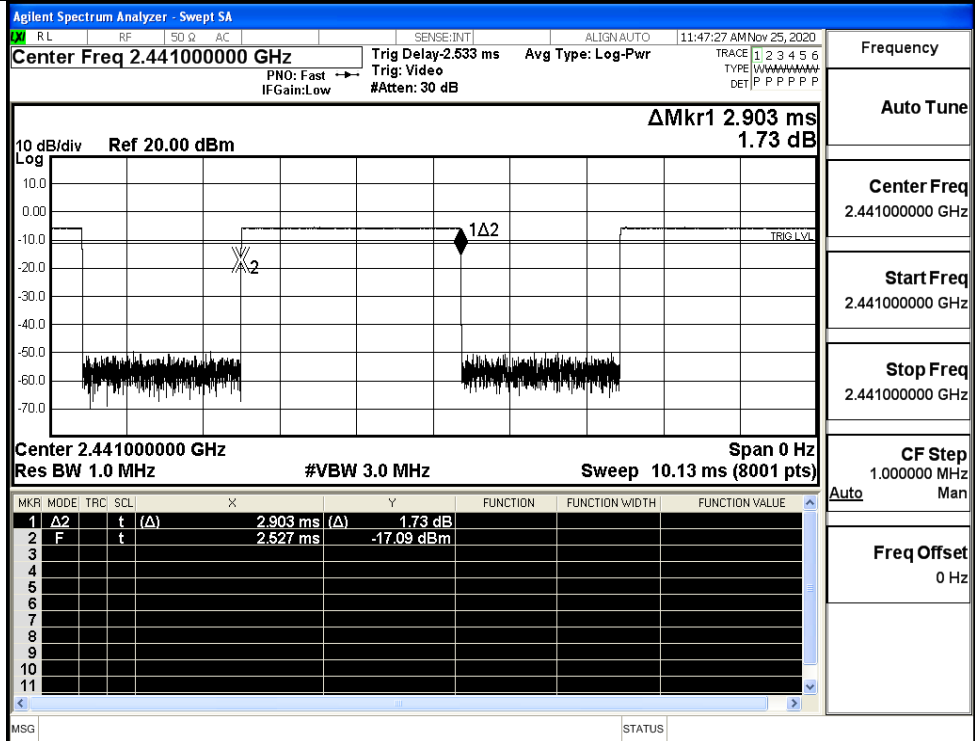


A.5 Dwell Time

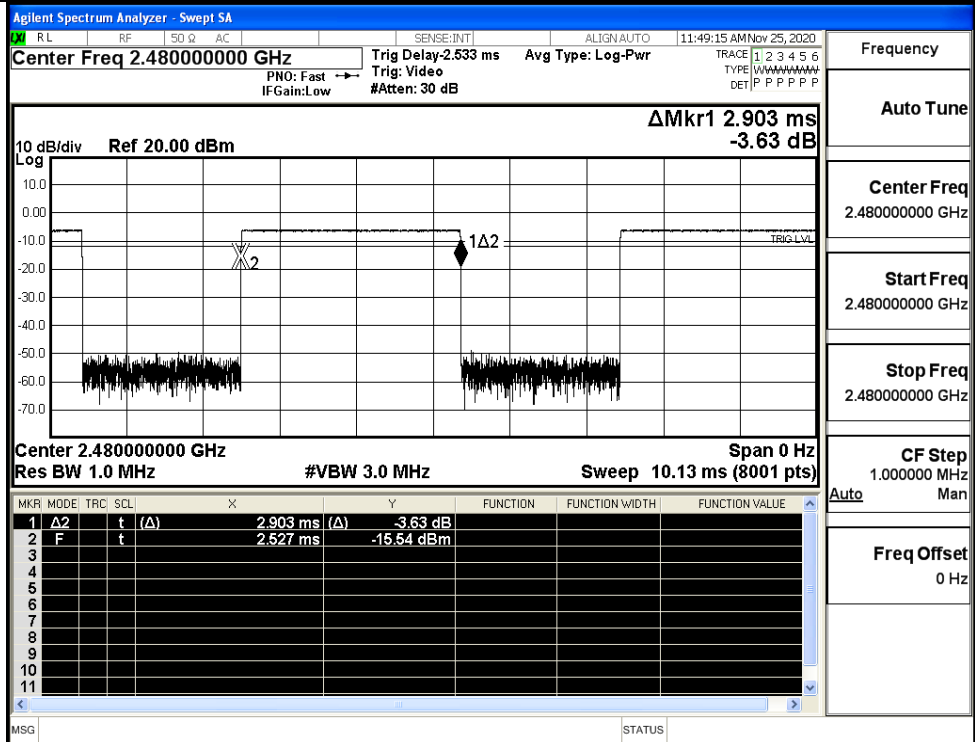
Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit [s]	Verdict
GFSK	DH5	LCH	2.9	106.7	0.309	0.4	PASS
	DH5	MCH	2.9	106.7	0.309	0.4	PASS
	DH5	HCH	2.9	106.7	0.309	0.4	PASS
π/4DQPSK	2DH5	LCH	2.9	106.7	0.31	0.4	PASS
	2DH5	MCH	2.9	106.7	0.31	0.4	PASS
	2DH5	HCH	2.9	106.7	0.31	0.4	PASS
8DPSK	3DH5	LCH	2.9	106.7	0.31	0.4	PASS
	3DH5	MCH	2.9	106.7	0.31	0.4	PASS
	3DH5	HCH	2.9	106.7	0.31	0.4	PASS



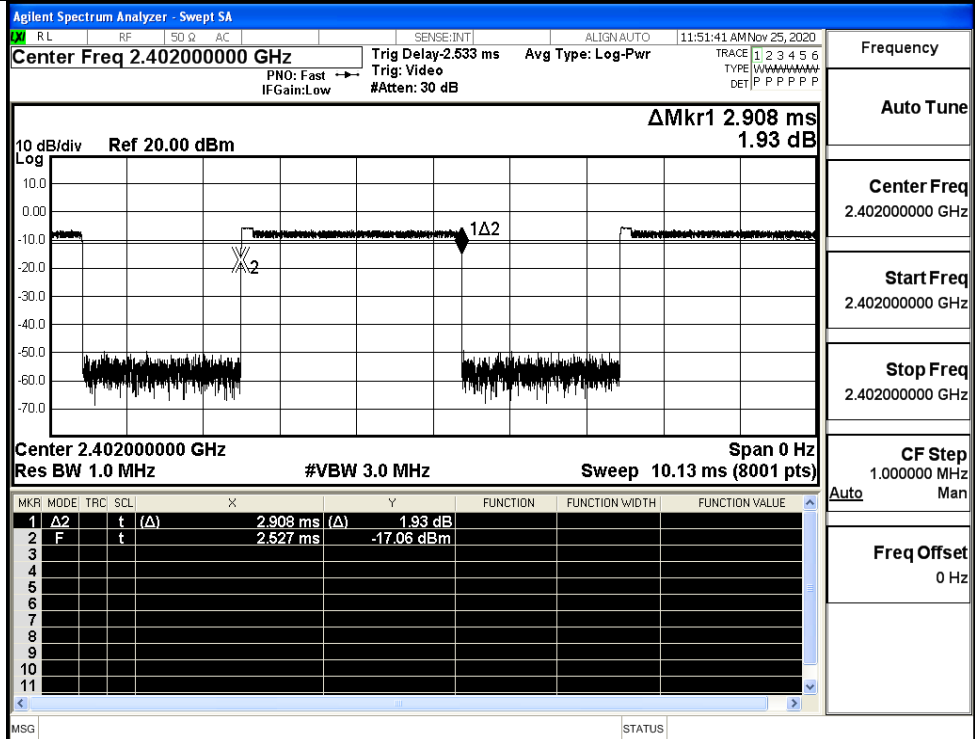
GFSK\_DH5/MCH



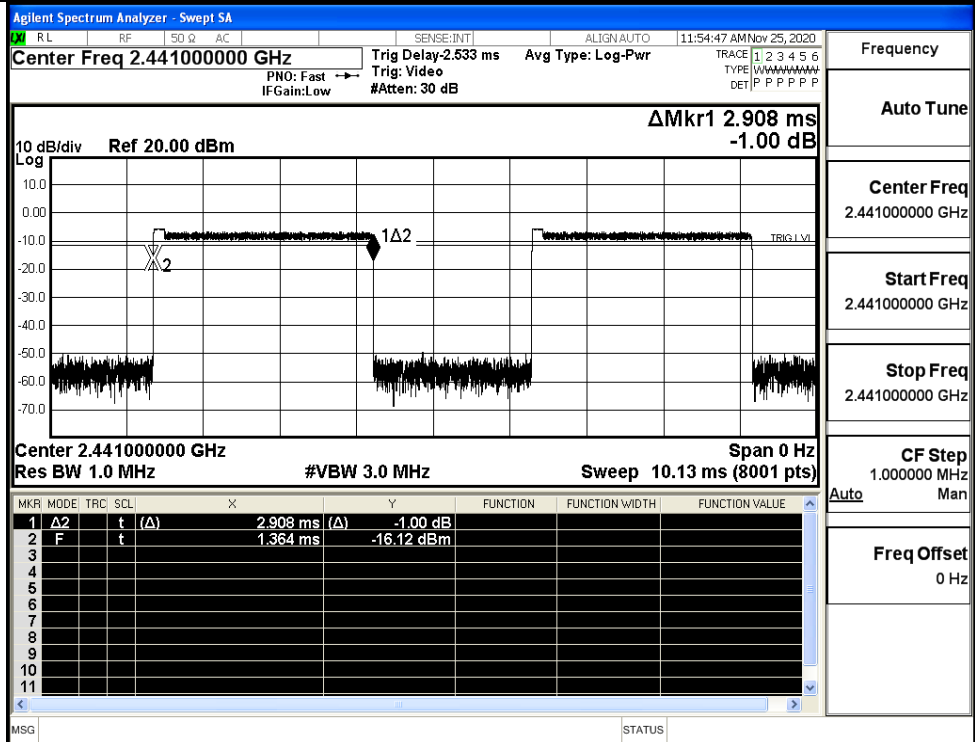
GFSK\_DH5/HCH



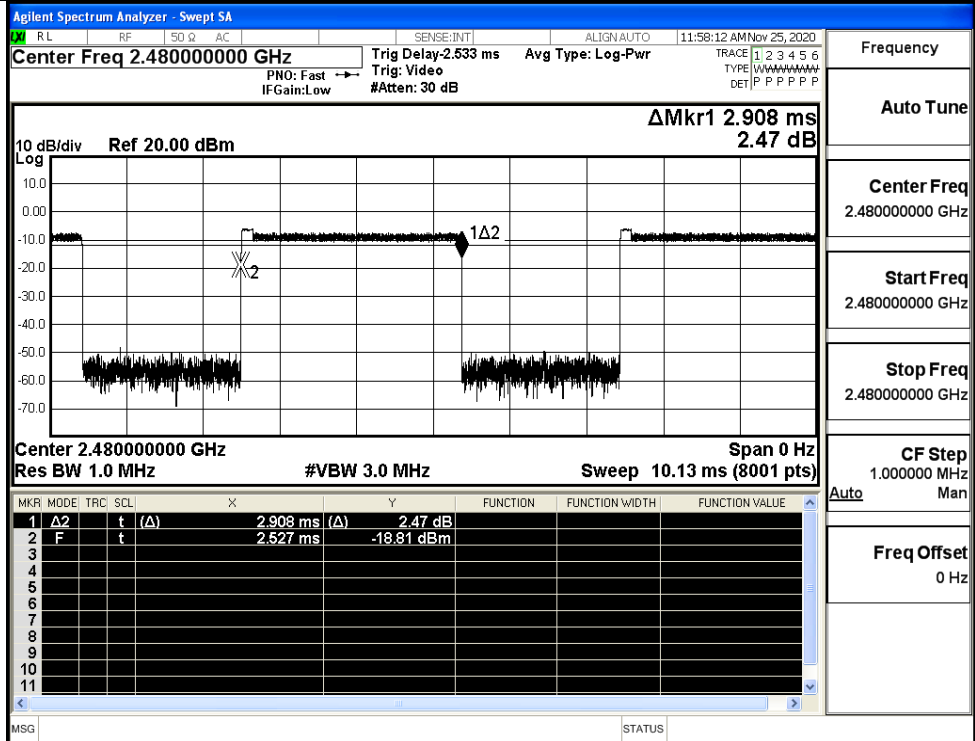
$\pi/4$ DQPSK  
\_2DH5/LCH



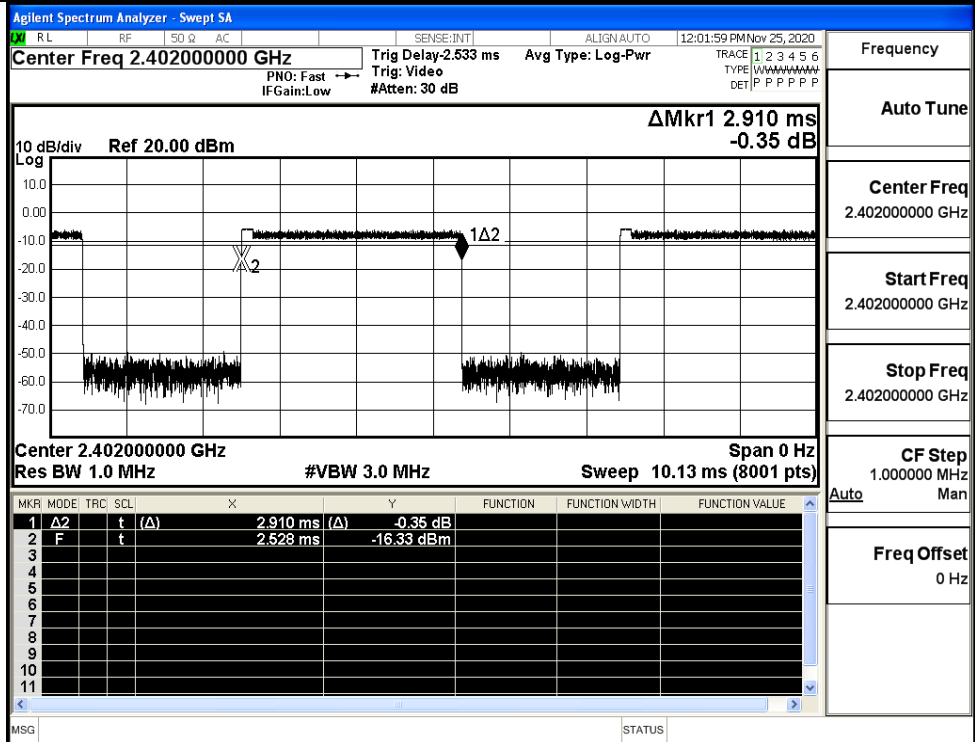
$\pi/4$ DQPSK  
\_2DH5/MCH



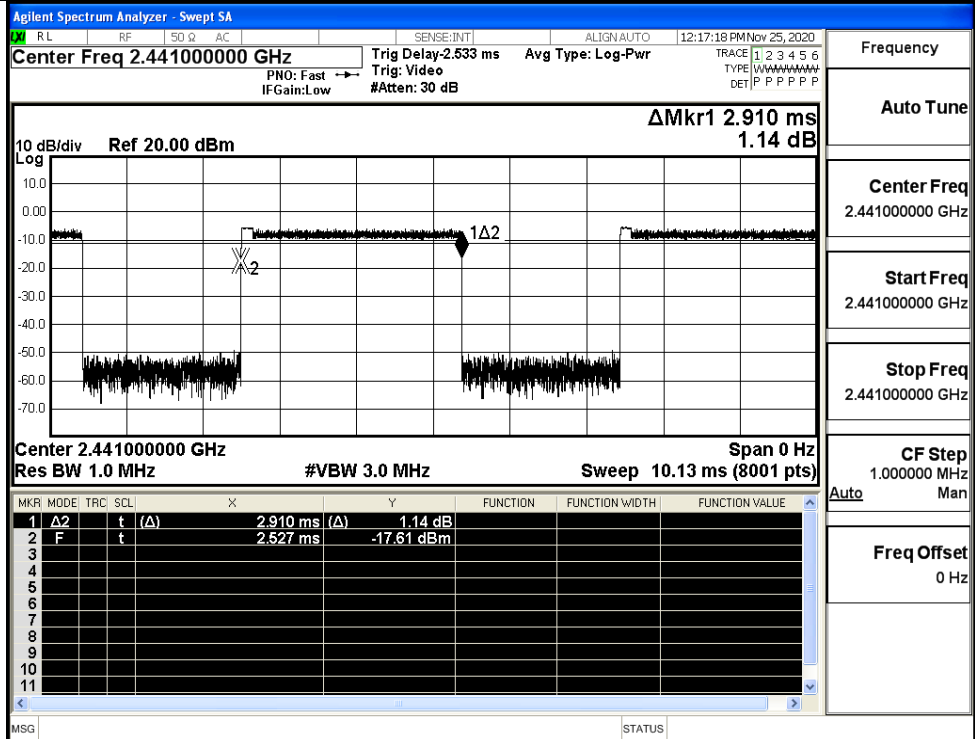
$\pi/4$ DQPSK  
\_2DH5/HCH



8DPSK\_3DH5/LCH



8DPSK\_3DH5/MCH



Frequency

Auto Tune

Center Freq  
2.441000000 GHz

Start Freq  
2.441000000 GHz

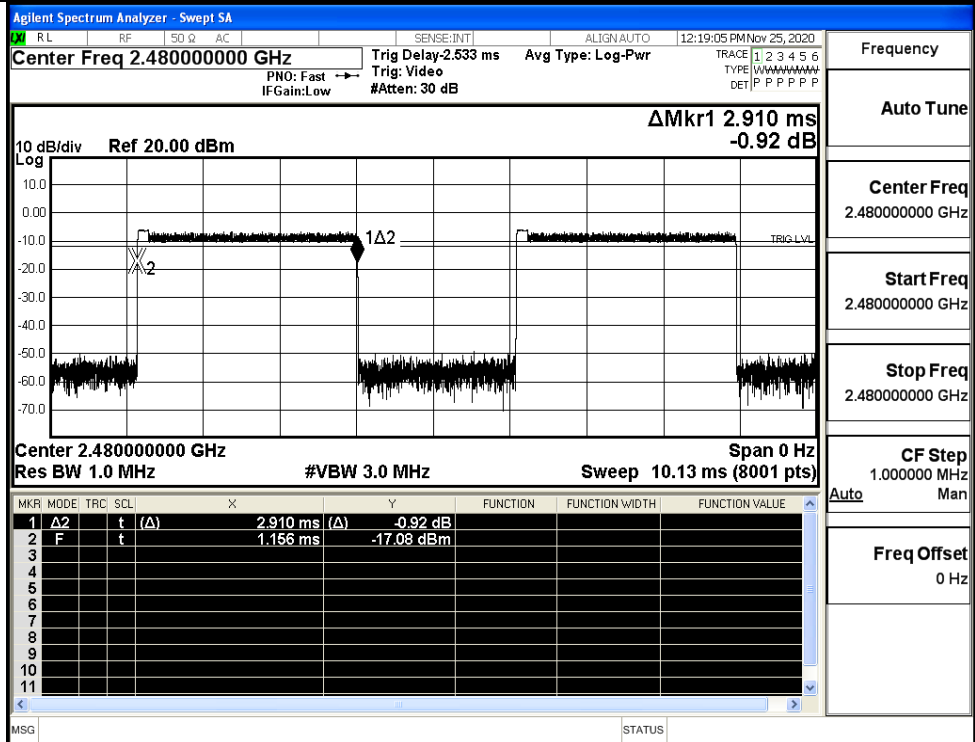
Stop Freq  
2.441000000 GHz

CF Step  
1.000000 MHz

Auto Man

Freq Offset  
0 Hz

8DPSK\_3DH5/HCH



Frequency

Auto Tune

Center Freq  
2.480000000 GHz

Start Freq  
2.480000000 GHz

Stop Freq  
2.480000000 GHz

CF Step  
1.000000 MHz

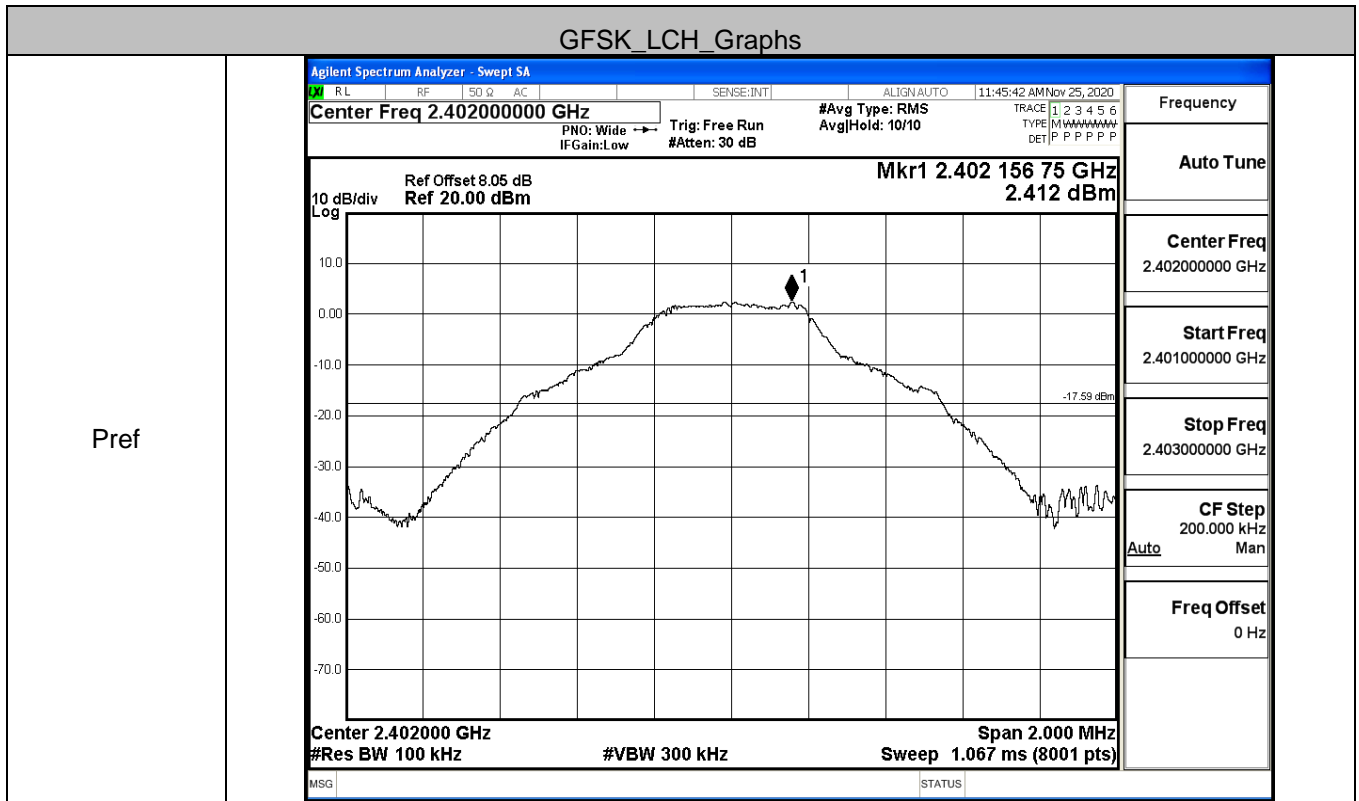
Auto Man

Freq Offset  
0 Hz

### A.6 RF Conducted Spurious Emissions

Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2.412	-37.969	-17.588	PASS
	MCH	2.315	-36.841	-17.685	PASS
	HCH	1.82	-38.142	-18.180	PASS
$\pi$ /4DQPSK	LCH	2.409	-37.153	-17.591	PASS
	MCH	2.315	-36.474	-17.685	PASS
	HCH	1.579	-37.071	-18.421	PASS
8DPSK	LCH	2.349	-37.575	-17.651	PASS
	MCH	2.378	-38.092	-17.622	PASS
	HCH	1.833	-37.549	-18.167	PASS

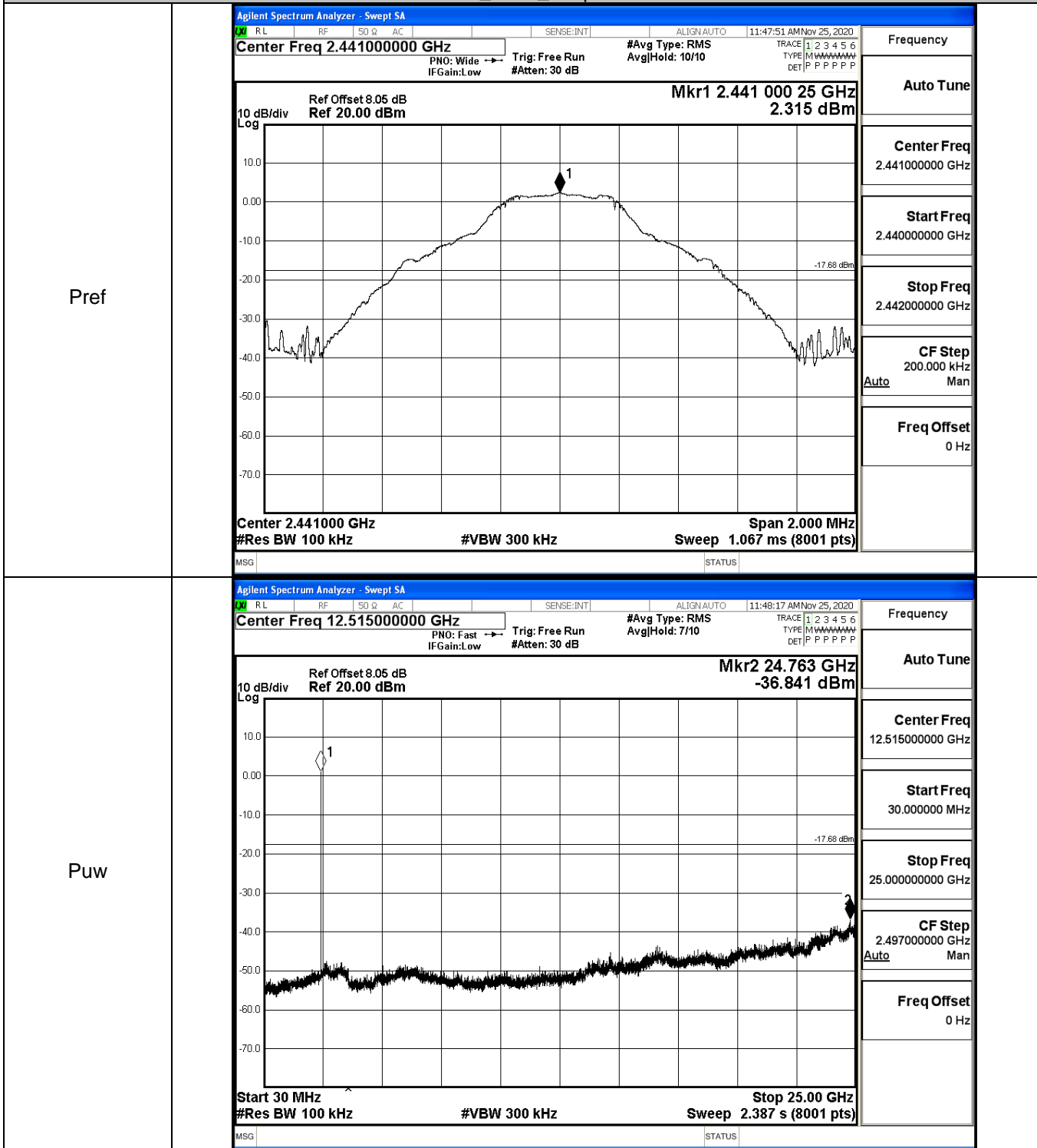
GFSK\_LCH\_Graphs



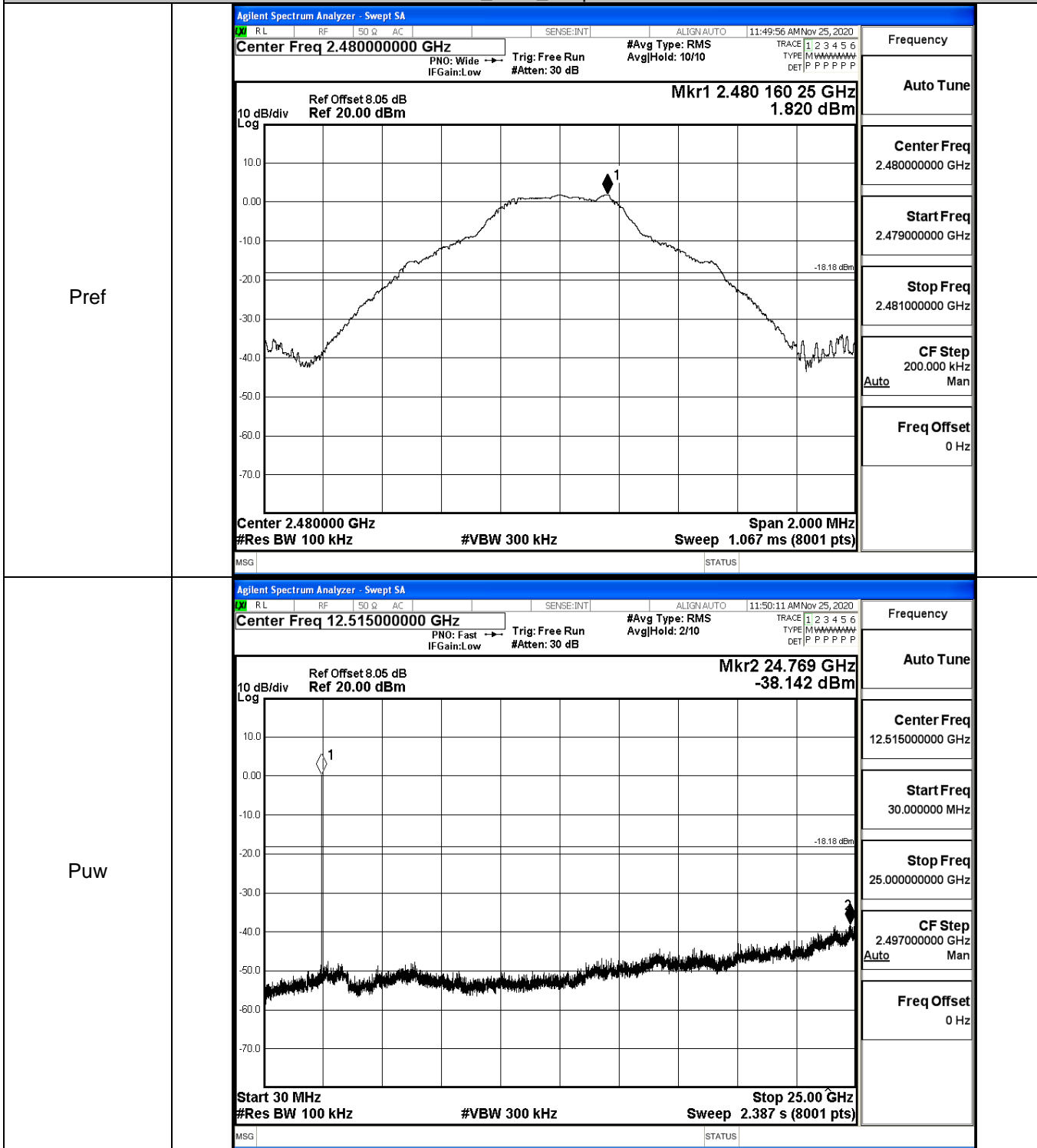




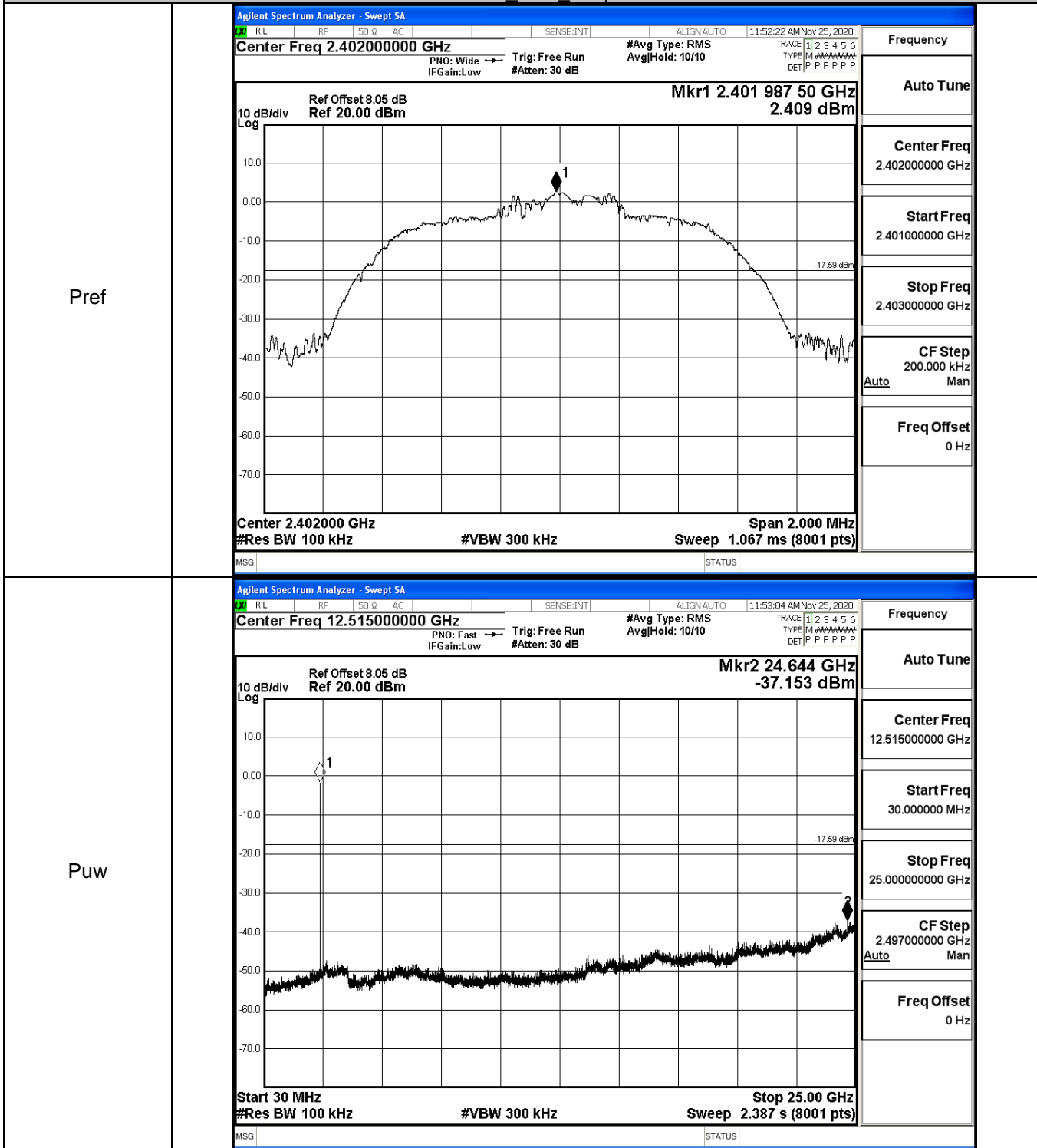
GFSK\_MCH\_Graphs



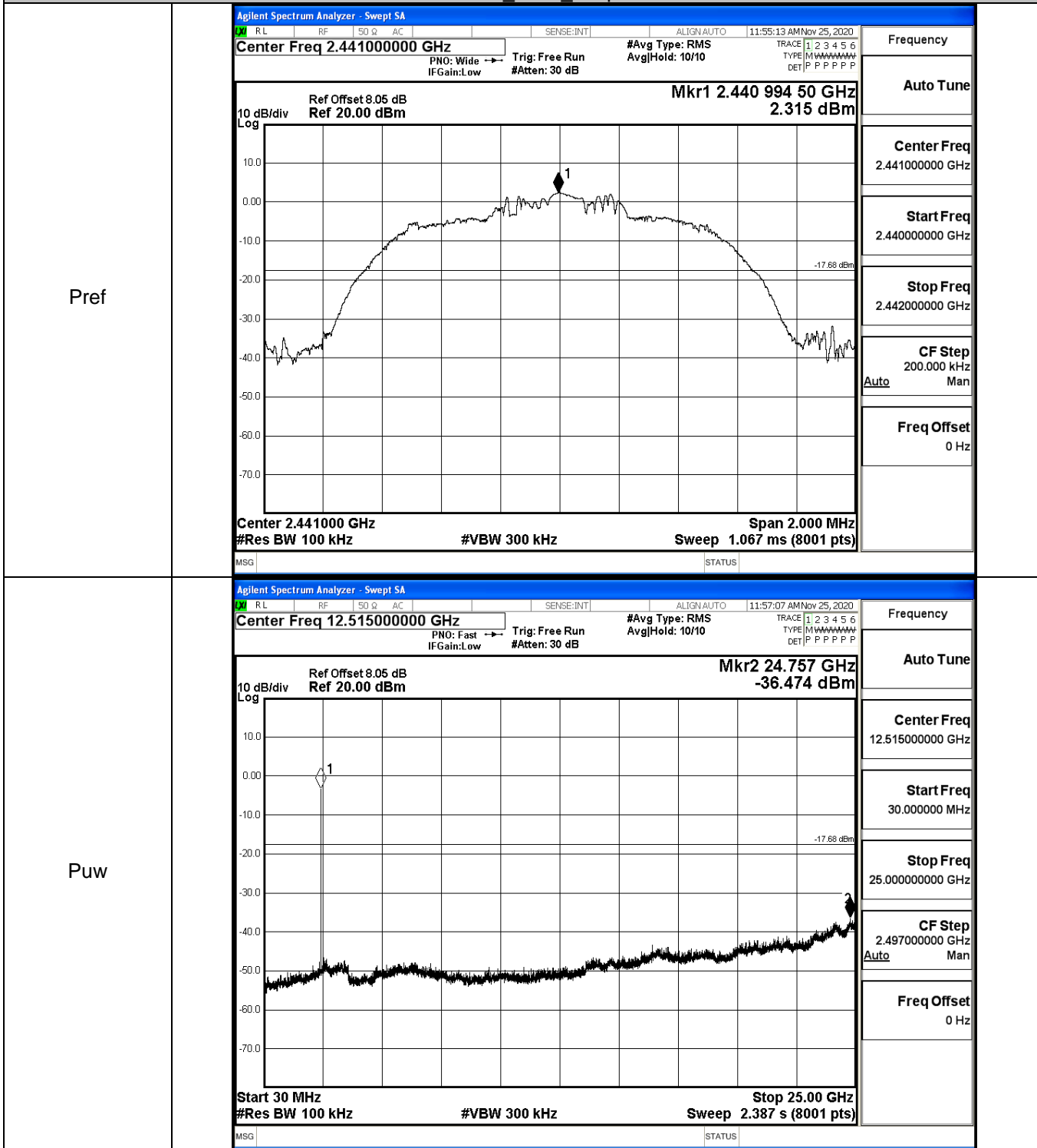
GFSK\_HCH\_Graphs



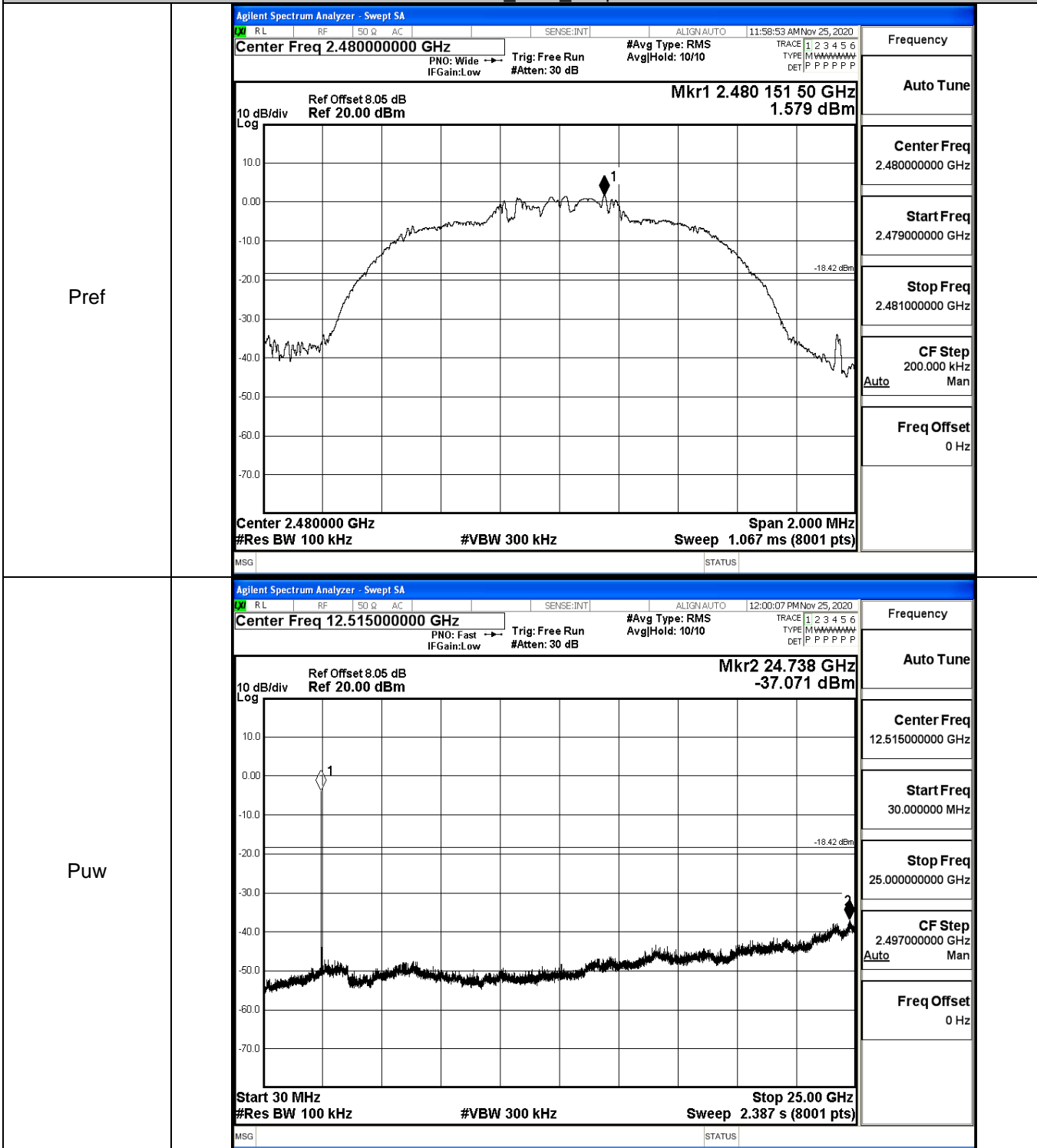
$\pi/4$ DQPSK\_LCH\_Graphs



$\pi/4$ DQPSK\_MCH\_Graphs

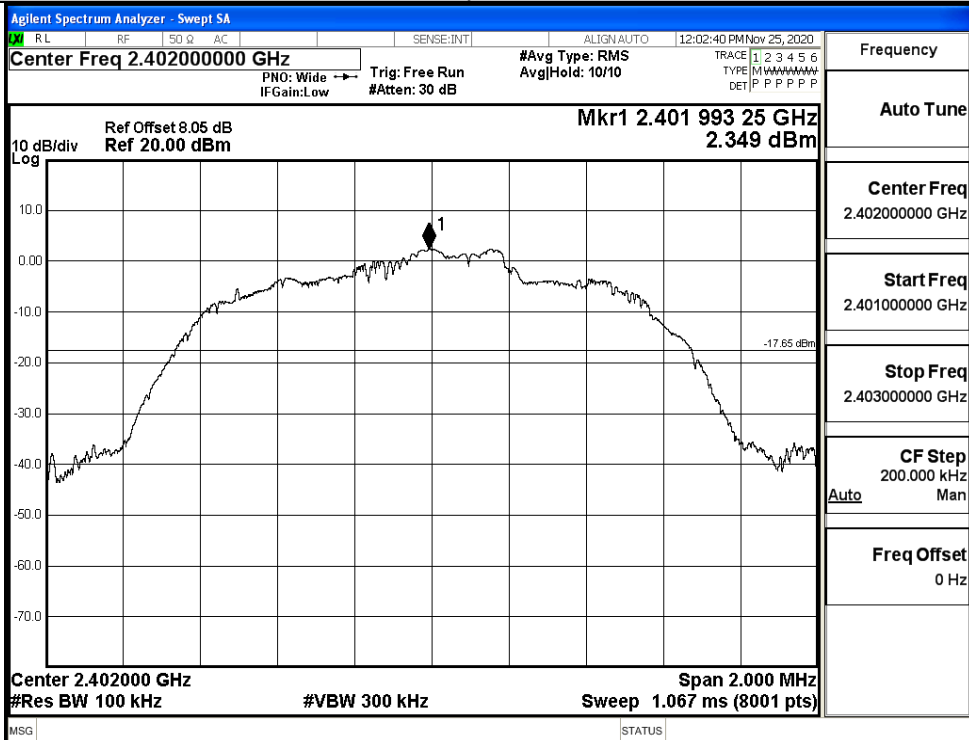


$\pi/4$ DQPSK\_HCH\_Graphs

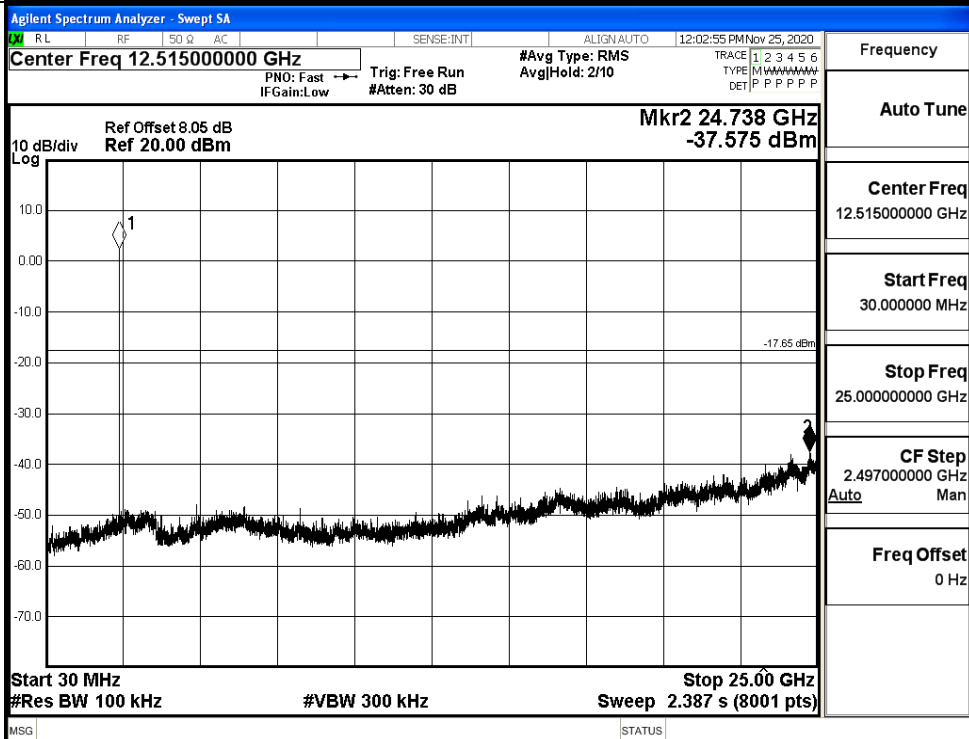


8DPSK\_LCH\_Graphs

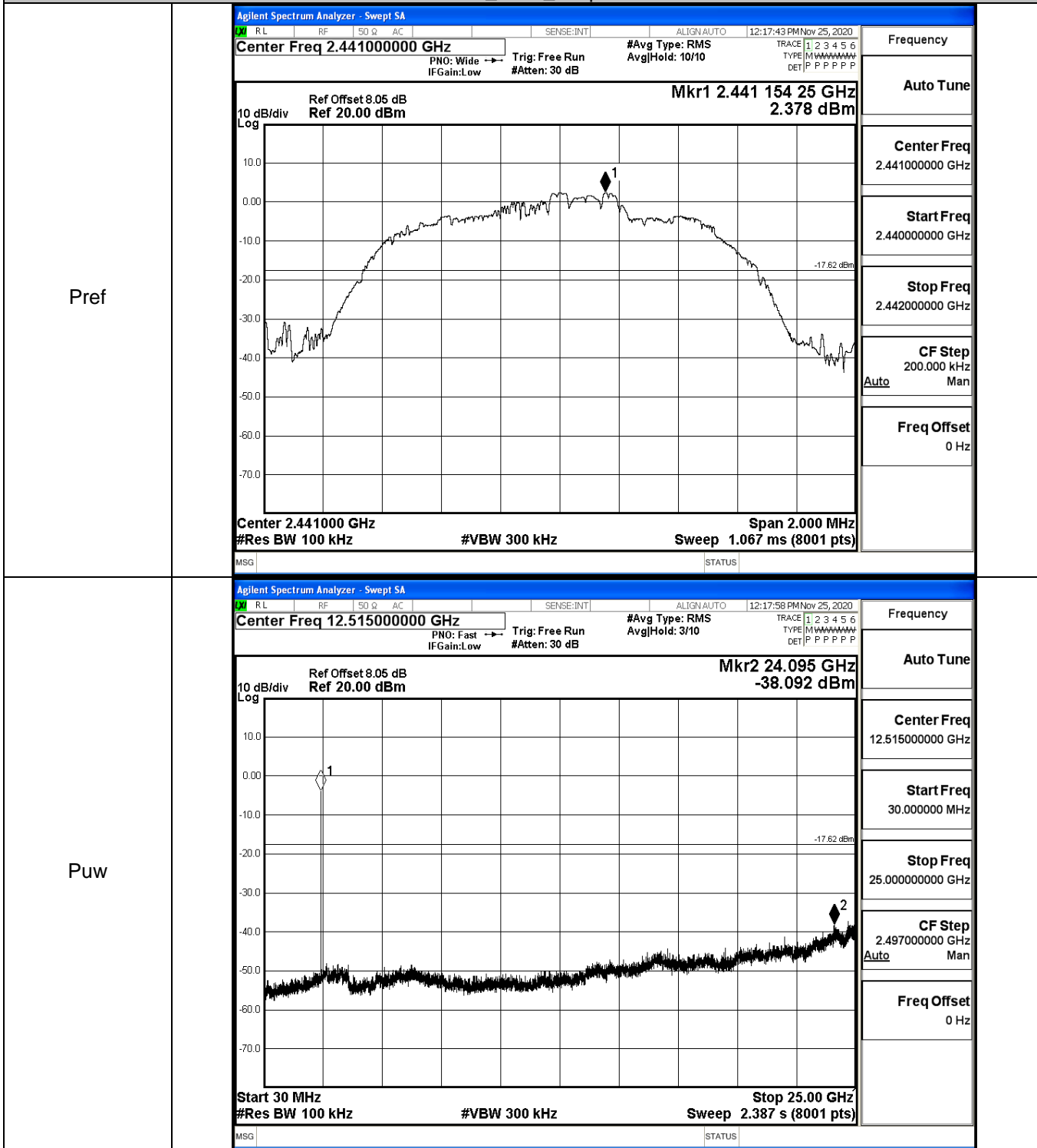
Pref



Puw

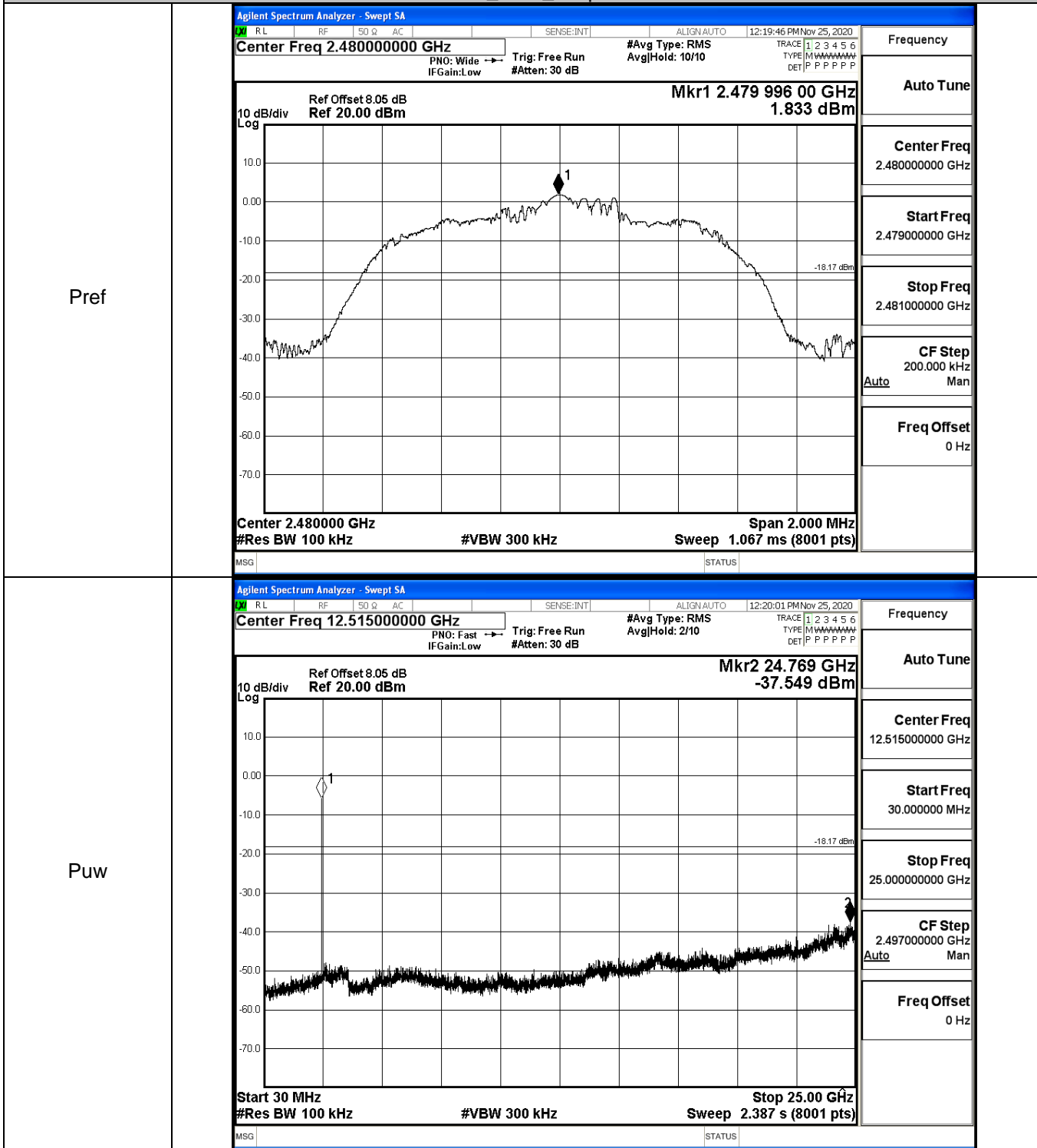


8DPSK\_MCH\_Graphs





8DPSK\_HCH\_Graphs

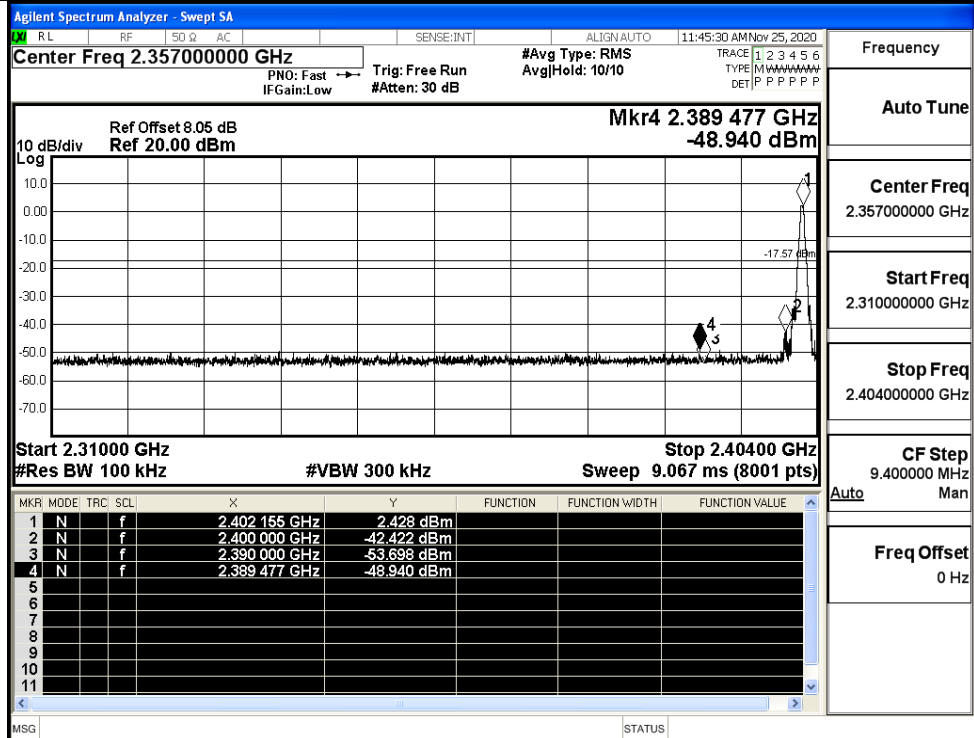


## A.7 Band-edge for RF Conducted Emissions

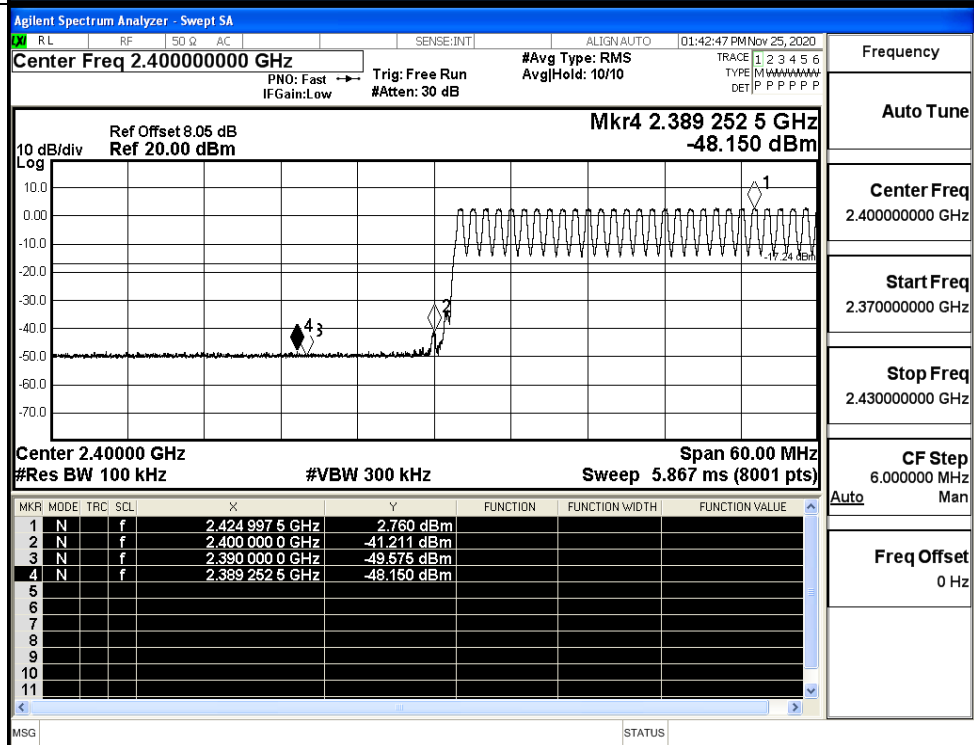
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	2.428	Off	-48.940	-17.57	PASS
			2.760	On	-48.150	-17.24	PASS
	HCH	2480	1.879	Off	-48.894	-18.12	PASS
			2.349	On	-47.876	-17.65	PASS
$\pi/4$ DQPSK	LCH	2402	1.290	Off	-49.790	-18.71	PASS
			2.620	On	-48.936	-17.38	PASS
	HCH	2480	1.784	Off	-48.514	-18.22	PASS
			2.202	On	-48.497	-17.8	PASS
8DPSK	LCH	2402	2.408	Off	-49.311	-17.59	PASS
			2.525	On	-48.084	-17.48	PASS
	HCH	2480	1.891	Off	-48.969	-18.11	PASS
			1.923	On	-48.736	-18.08	PASS

Test Graphs

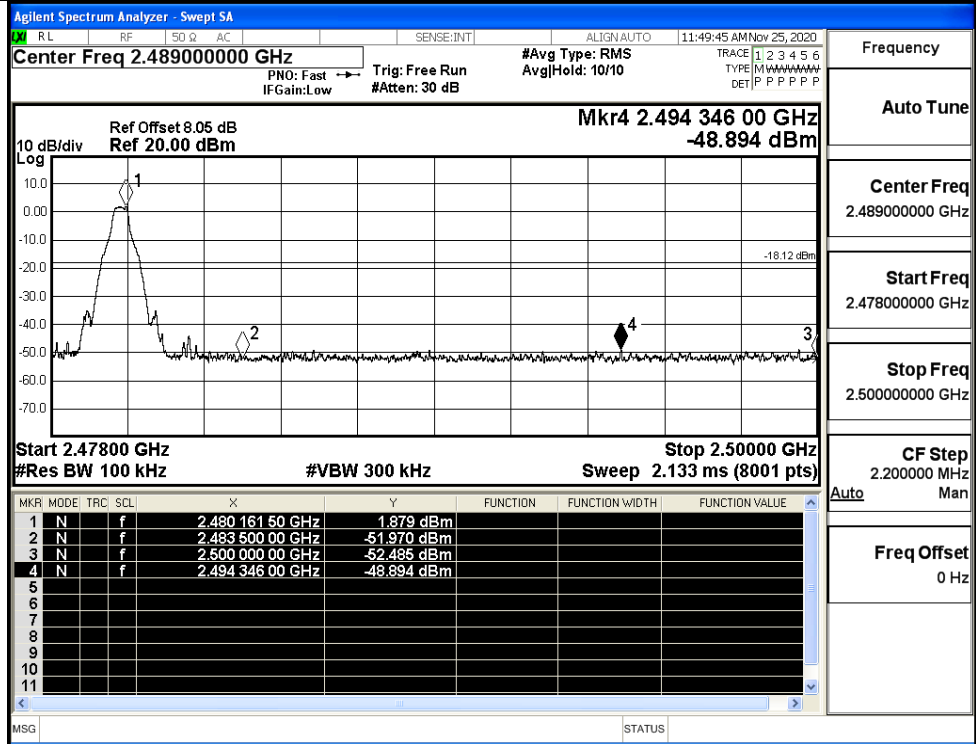
GFSK/LCH/No Hop



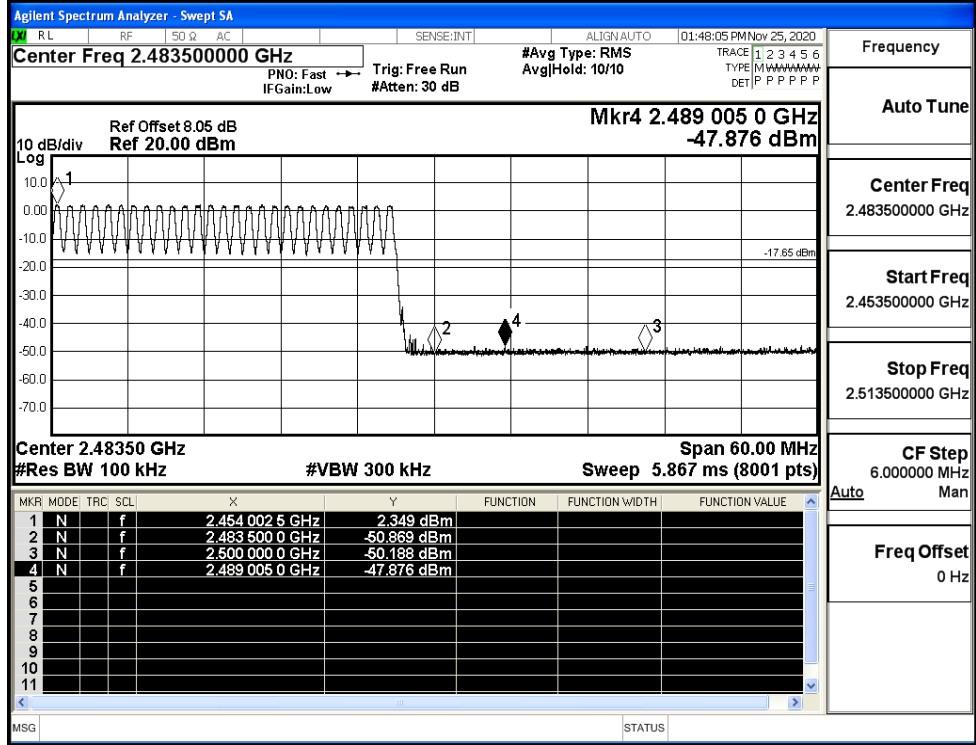
GFSK/LCH/Hop



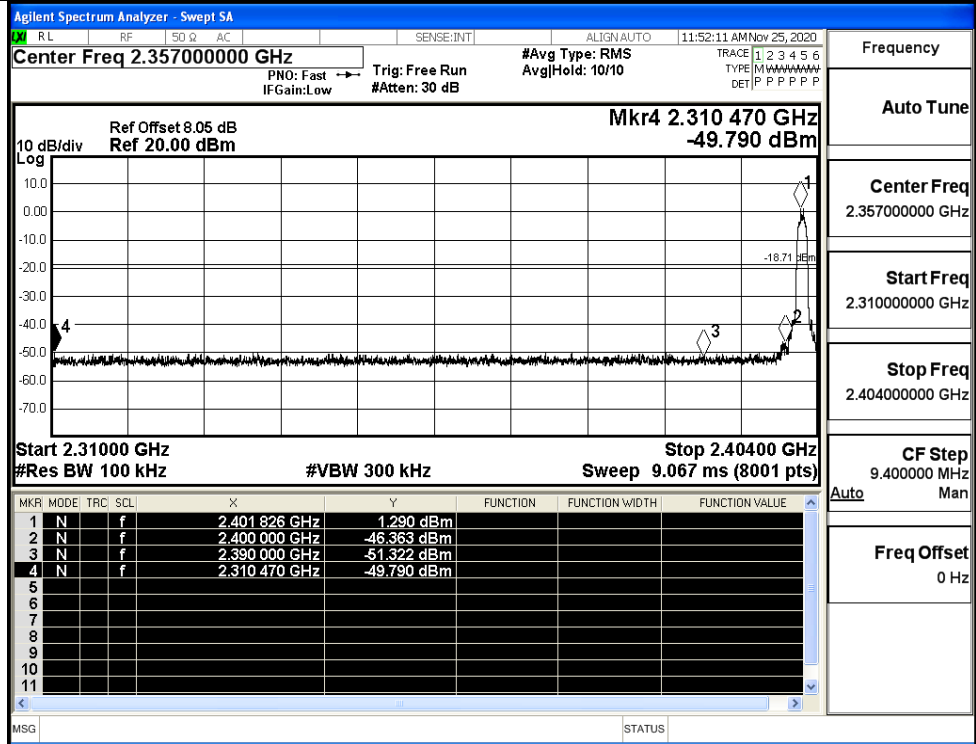
GFSK/HCH/No Hop



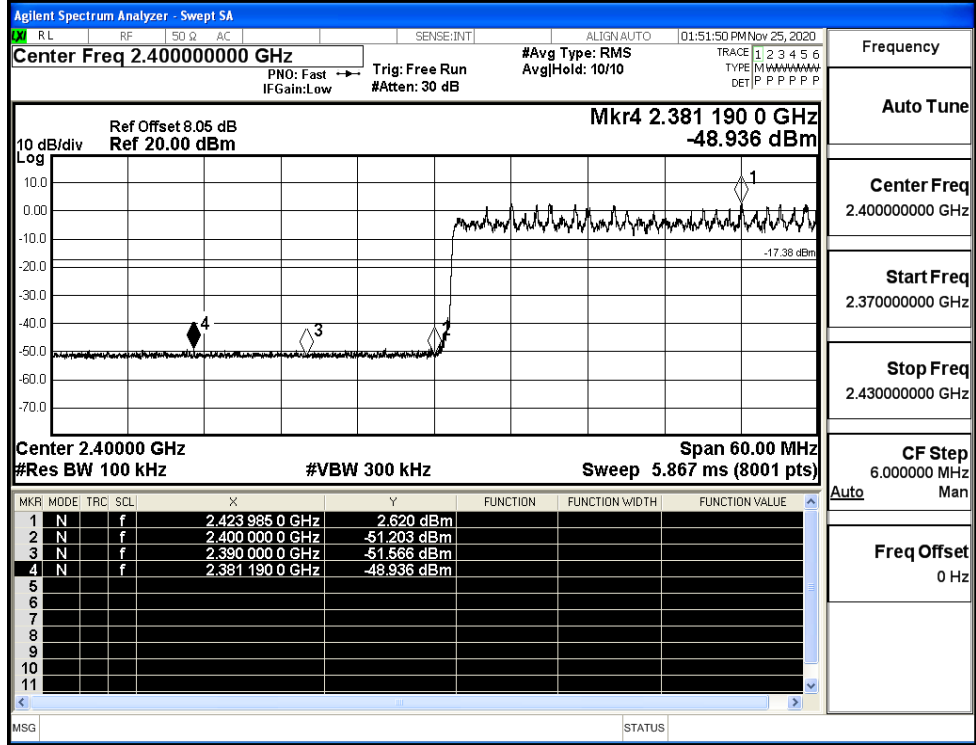
GFSK/HCH/Hop



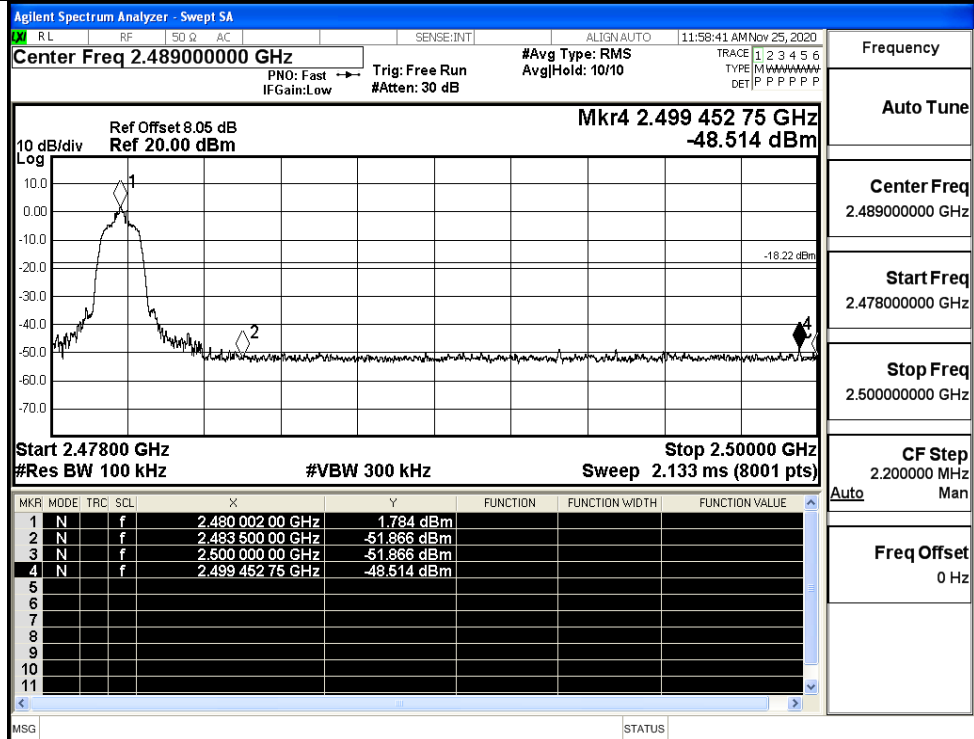
$\pi/4$ DQPSK/LCH/No  
Hop



$\pi/4$ DQPSK/LCH/Hop

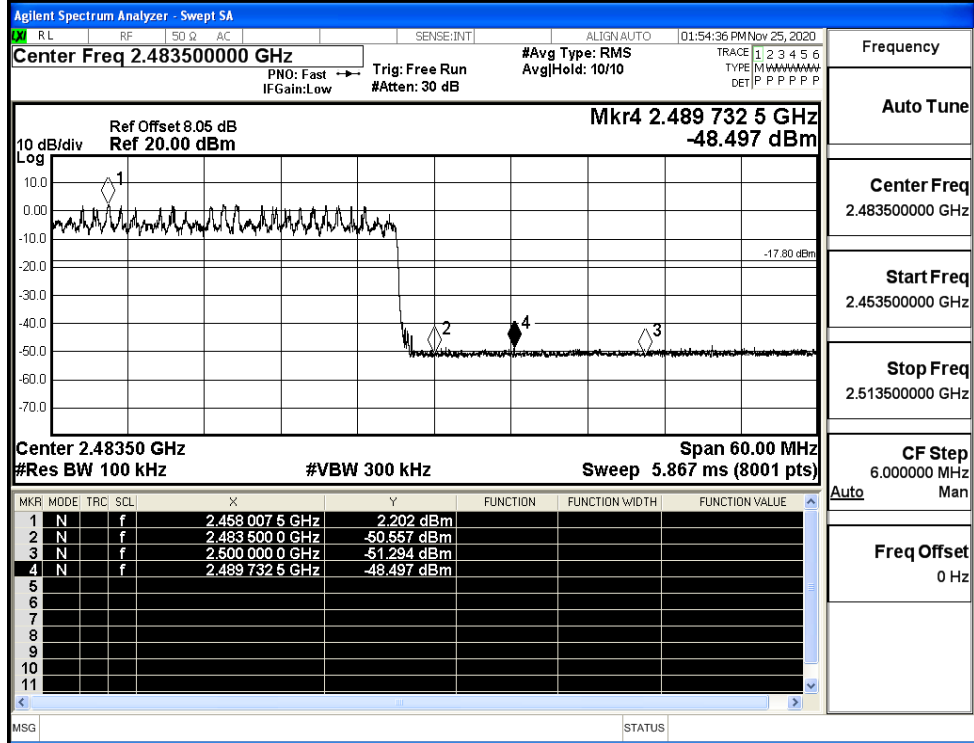


$\pi$ /4DQPSK/HCH/No  
Hop



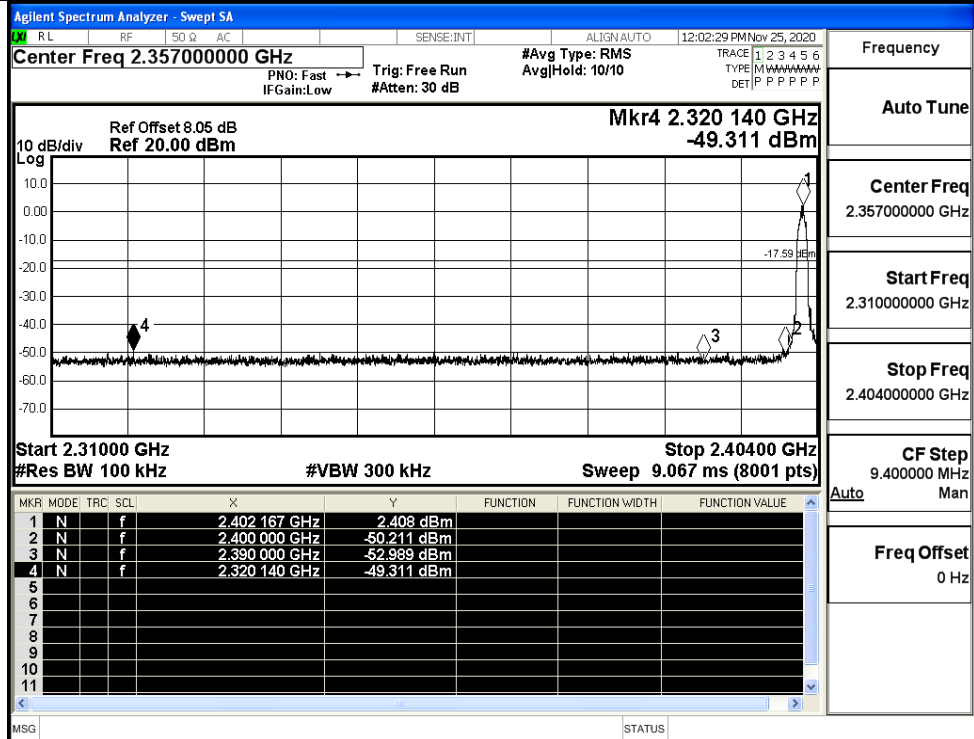
Frequency  
Auto Tune  
Center Freq  
2.489000000 GHz  
Start Freq  
2.478000000 GHz  
Stop Freq  
2.500000000 GHz  
CF Step  
2.200000 MHz  
Auto Man  
Freq Offset  
0 Hz

$\pi$ /4DQPSK/HCH/Hop



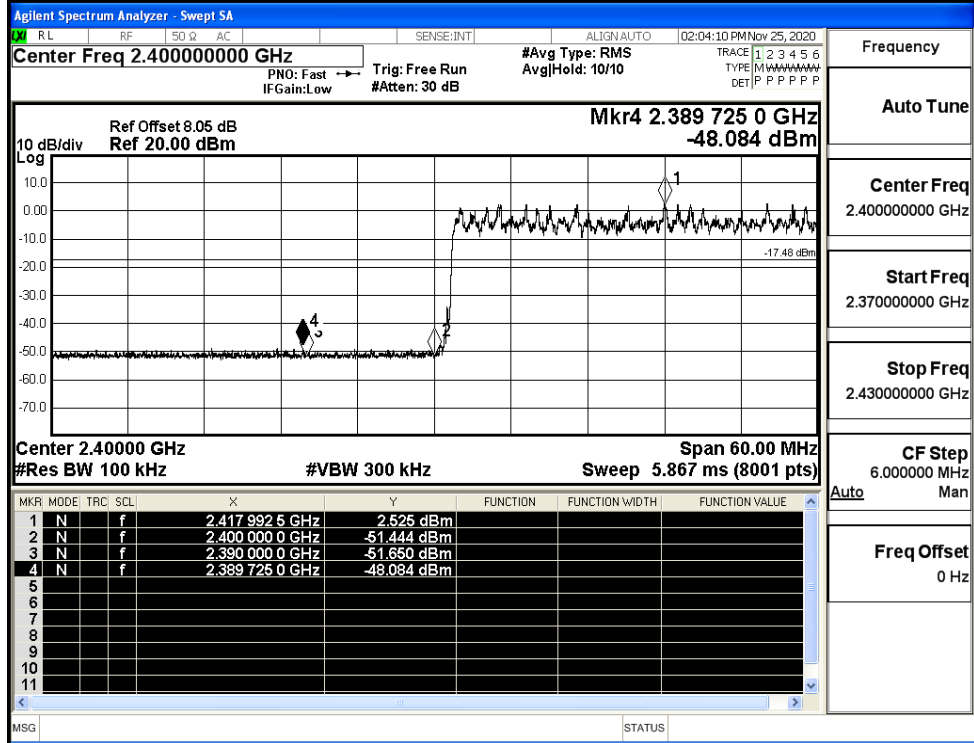
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Auto Tune  
Center Freq  
2.483500000 GHz  
Start Freq  
2.453500000 GHz  
Stop Freq  
2.513500000 GHz  
CF Step  
6.000000 MHz  
Auto Man  
Freq Offset  
0 Hz

8DPSK/LCH/No Hop



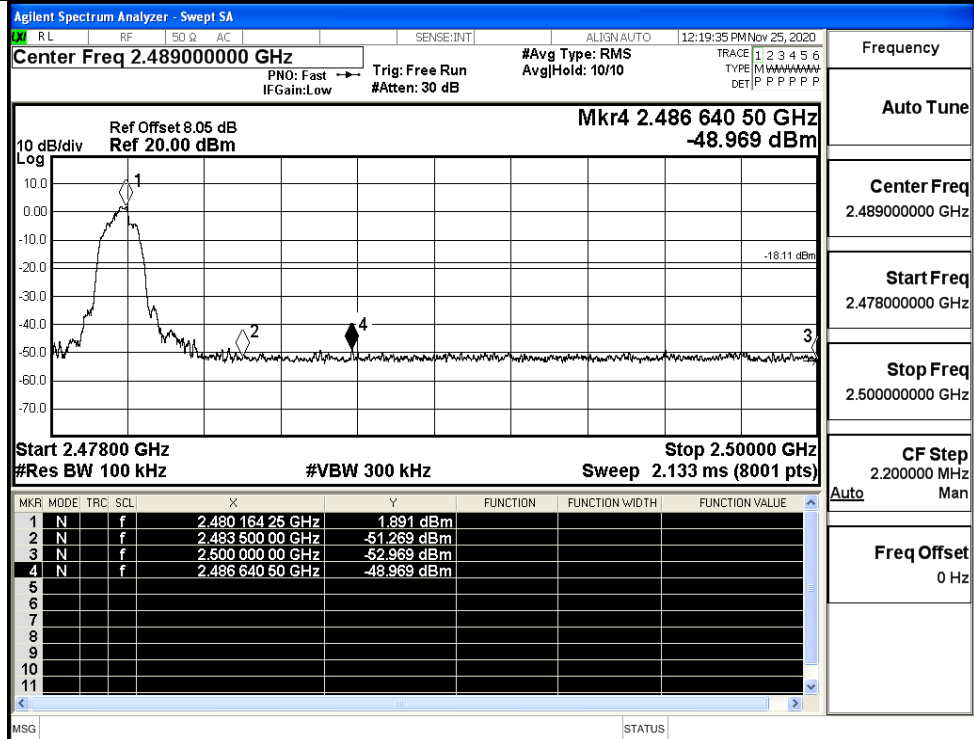
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Auto Tune  
Center Freq  
2.357000000 GHz  
Start Freq  
2.310000000 GHz  
Stop Freq  
2.404000000 GHz  
CF Step  
9.400000 MHz  
Freq Offset  
0 Hz

8DPSK/LCH/Hop



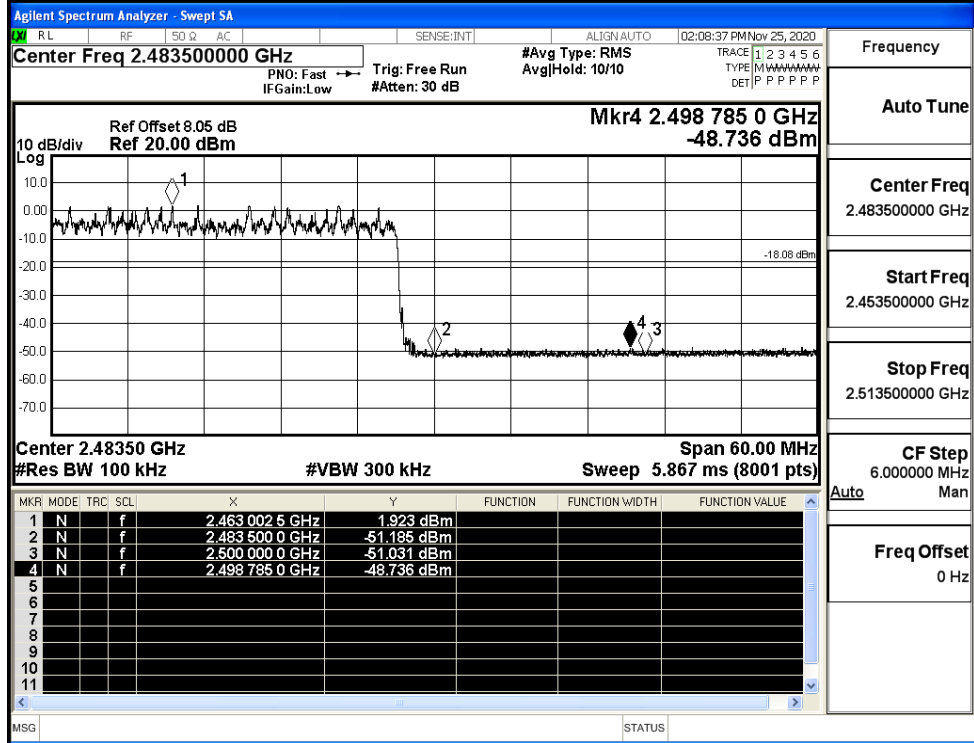
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Auto Tune  
Center Freq  
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Start Freq  
2.370000000 GHz  
Stop Freq  
2.430000000 GHz  
CF Step  
6.000000 MHz  
Freq Offset  
0 Hz

8DPSK/HCH/No Hop



Frequency  
Auto Tune  
Center Freq  
2.489000000 GHz  
Start Freq  
2.478000000 GHz  
Stop Freq  
2.500000000 GHz  
CF Step  
2.200000 MHz  
Auto Man  
Freq Offset  
0 Hz

8DPSK/HCH/Hop



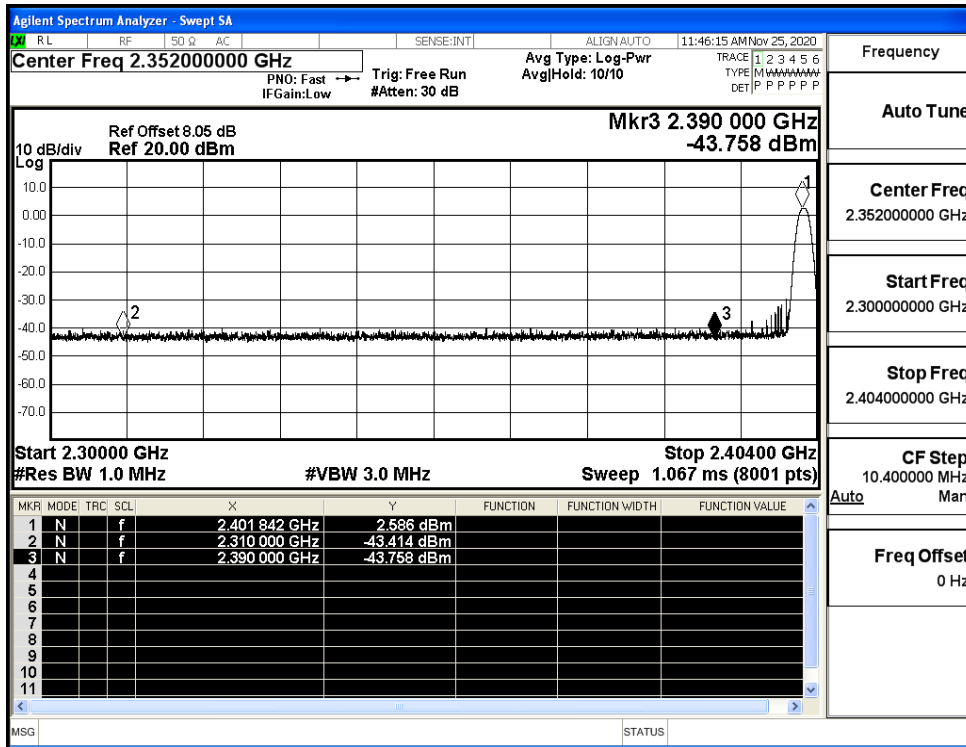
Frequency  
Auto Tune  
Center Freq  
2.483500000 GHz  
Start Freq  
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Stop Freq  
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CF Step  
6.000000 MHz  
Auto Man  
Freq Offset  
0 Hz



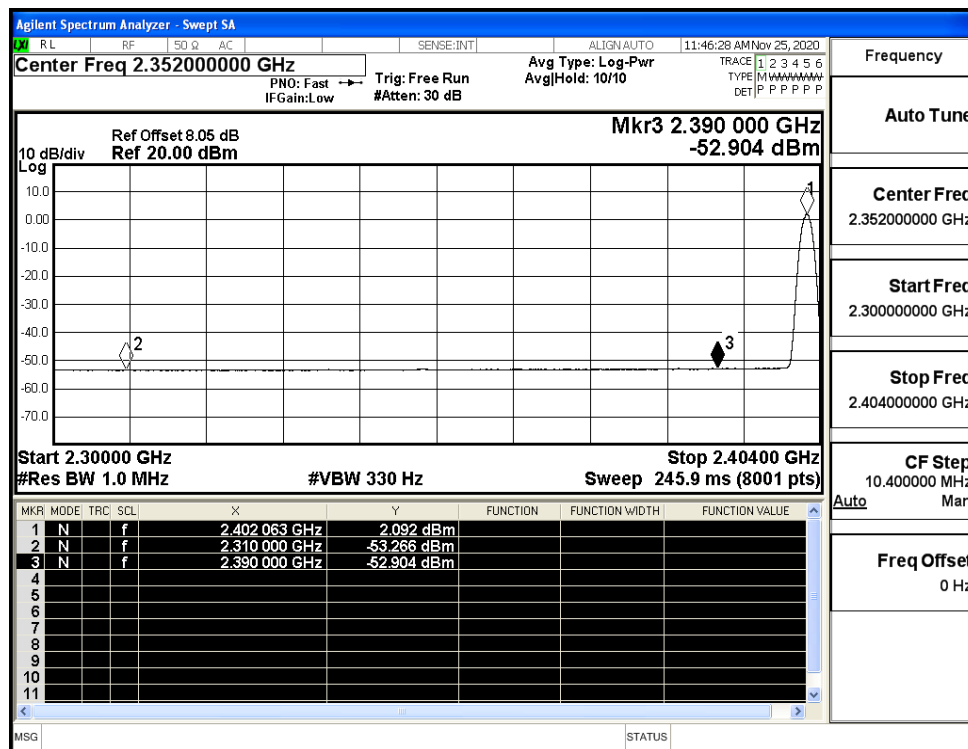
## A.8 Restrict-band band-edge measurements

Test Mode	Hopping	Freq.	Power [dBm]	Gain	Ground Factor	E [dBuV/m]	Detector	Limit [dBuV/m]	Verdict
GFSK	Off	2310.0	-43.41	2.5	0	54.35	PEAK	74	PASS
	Off	2310.0	-53.27	2.5	0	44.49	AV	54	PASS
	Off	2390.0	-43.76	2.5	0	54.00	PEAK	74	PASS
	Off	2390.0	-52.90	2.5	0	44.86	AV	54	PASS
	Off	2483.5	-42.76	2.5	0	55.00	PEAK	74	PASS
	Off	2483.5	-52.38	2.5	0	45.38	AV	54	PASS
	Off	2500.0	-41.90	2.5	0	55.86	PEAK	74	PASS
	Off	2500.0	-52.43	2.5	0	45.33	AV	54	PASS
$\pi/4$ DQPSK	Off	2310.0	-43.99	2.5	0	53.77	PEAK	74	PASS
	Off	2310.0	-53.29	2.5	0	44.47	AV	54	PASS
	Off	2390.0	-43.06	2.5	0	54.70	PEAK	74	PASS
	Off	2390.0	-53.00	2.5	0	44.76	AV	54	PASS
	Off	2483.5	-42.84	2.5	0	54.92	PEAK	74	PASS
	Off	2483.5	-52.40	2.5	0	45.36	AV	54	PASS
	Off	2500.0	-41.99	2.5	0	55.77	PEAK	74	PASS
	Off	2500.0	-52.42	2.5	0	45.34	AV	54	PASS
8DPSK	Off	2310.0	-43.15	2.5	0	54.61	PEAK	74	PASS
	Off	2310.0	-53.33	2.5	0	44.43	AV	54	PASS
	Off	2390.0	-43.46	2.5	0	54.30	PEAK	74	PASS
	Off	2390.0	-52.94	2.5	0	44.82	AV	54	PASS
	Off	2483.5	-34.47	2.5	0	63.29	PEAK	74	PASS
	Off	2483.5	-52.37	2.5	0	45.39	AV	54	PASS
	Off	2500.0	-42.21	2.5	0	55.55	PEAK	74	PASS
	Off	2500.0	-52.44	2.5	0	45.32	AV	54	PASS

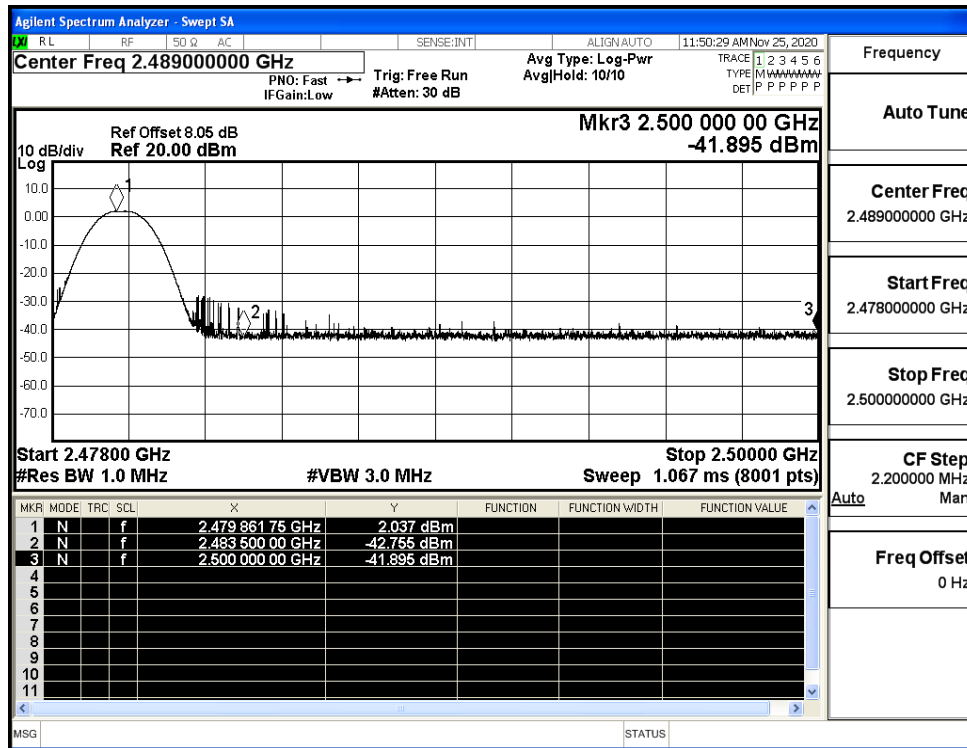
Restrict-band band-edge measurements\_Hopping Off\_GFSK\_PEAK (Low Channel)



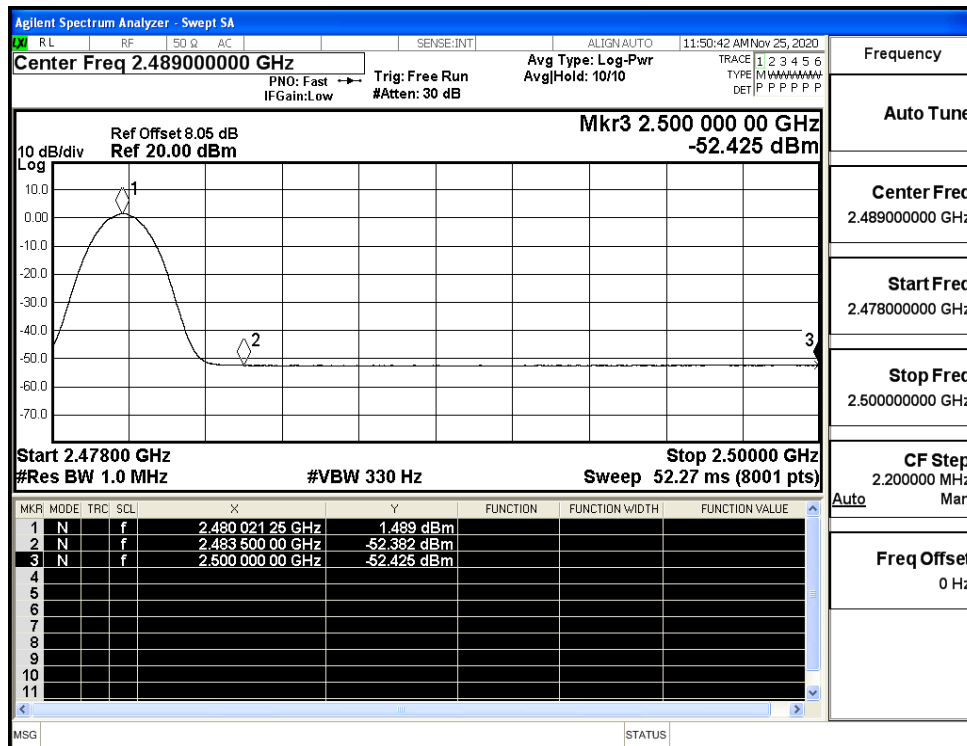
Restrict-band band-edge measurements\_Hopping Off\_GFSK\_Average (Low Channel)



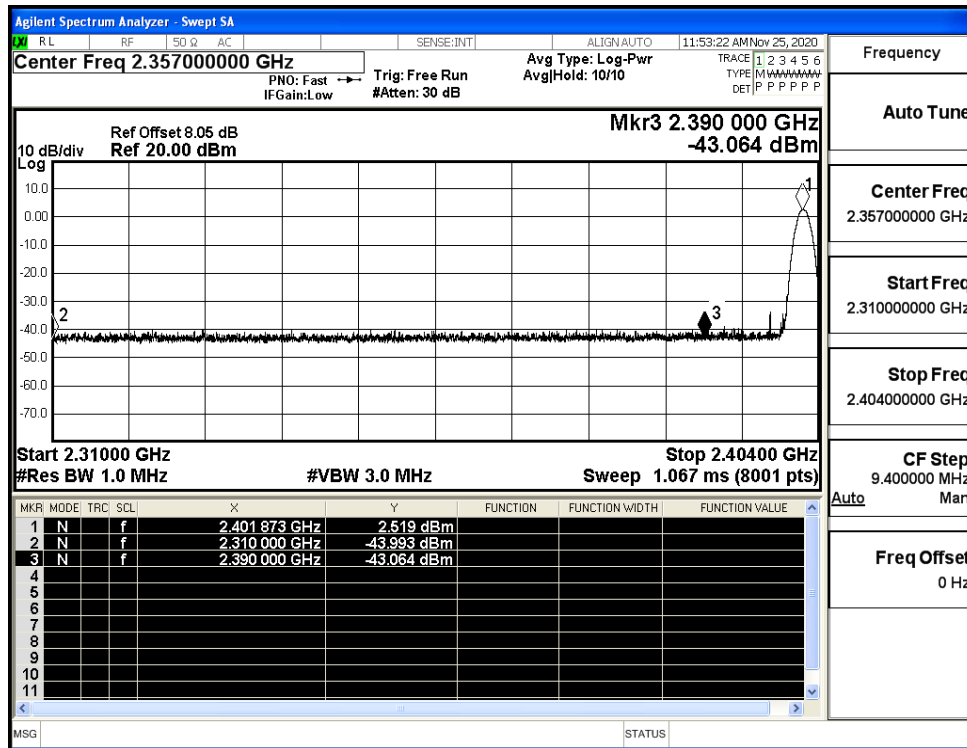
Restrict-band band-edge measurements\_Hopping Off\_GFSK\_PEAK (High Channel)



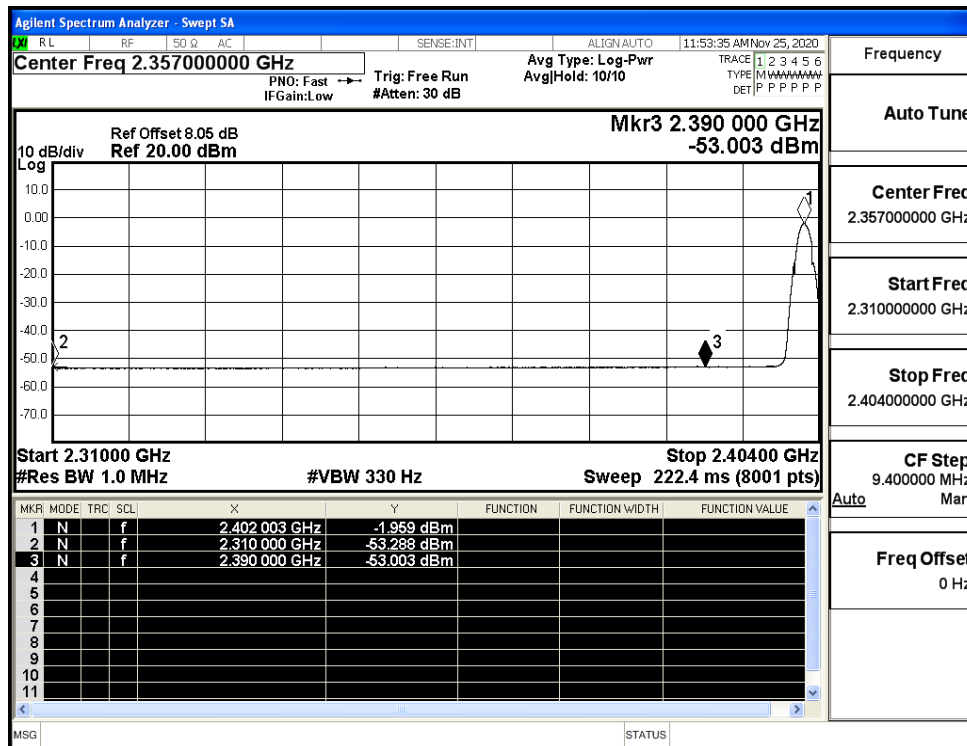
Restrict-band band-edge measurements\_Hopping Off\_GFSK\_Average (High Channel)



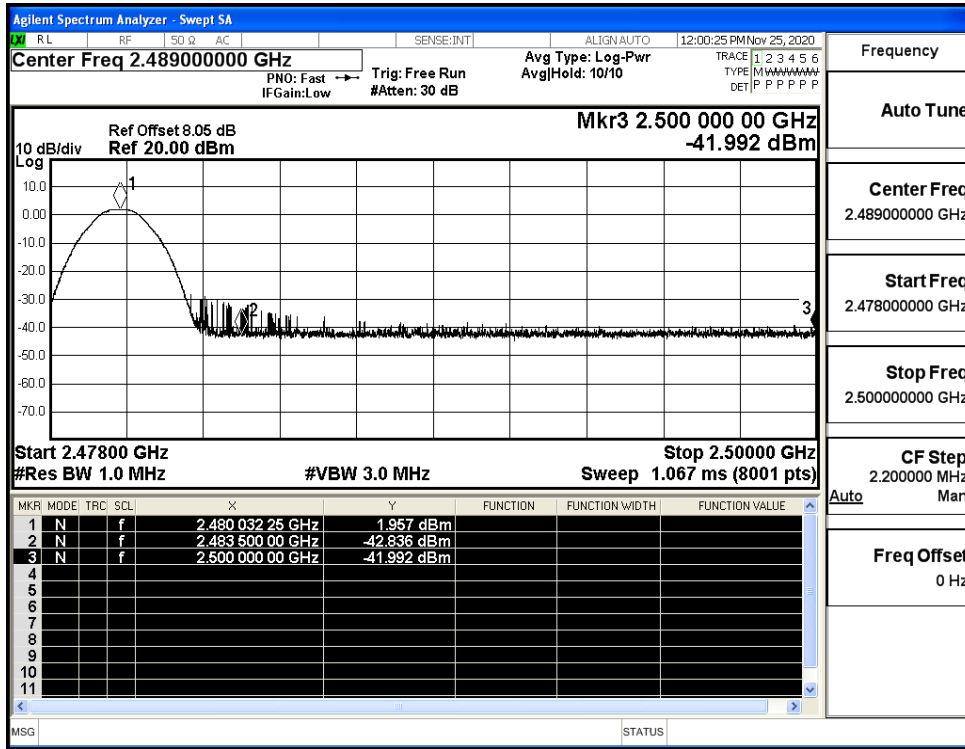
Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_PEAK (Low Channel)



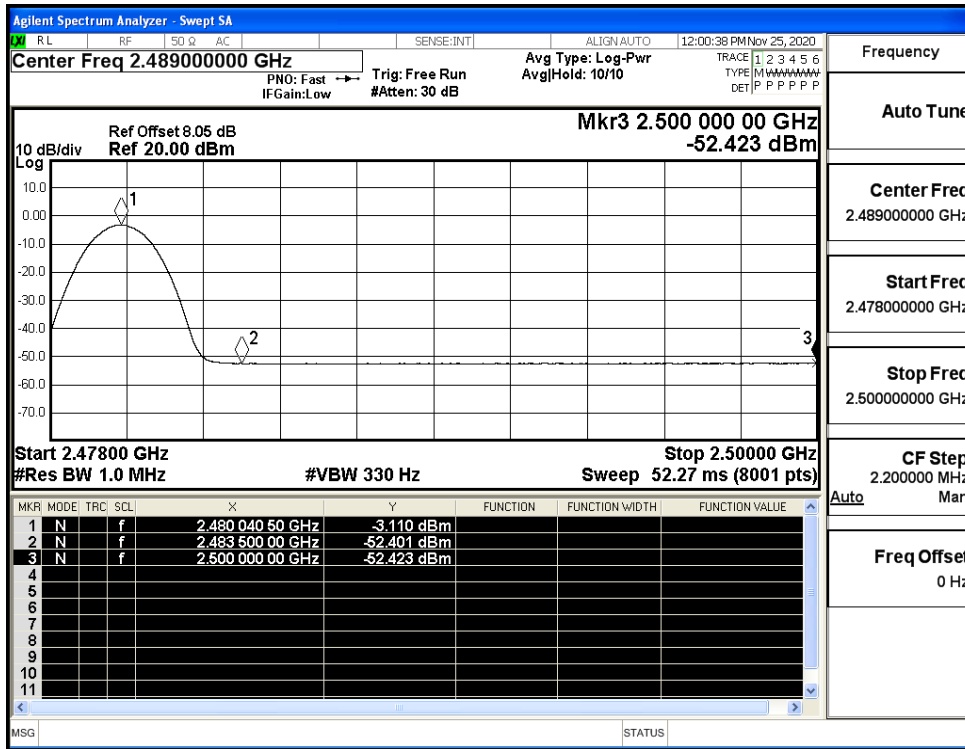
Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_Average (Low Channel)



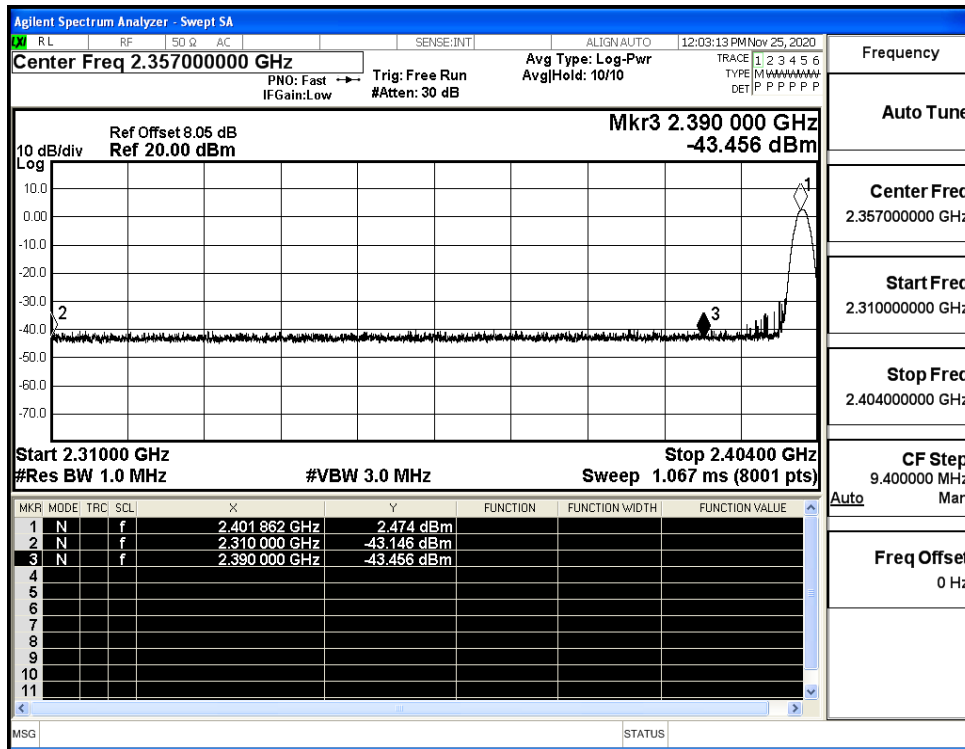
Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_PEAK (High Channel)



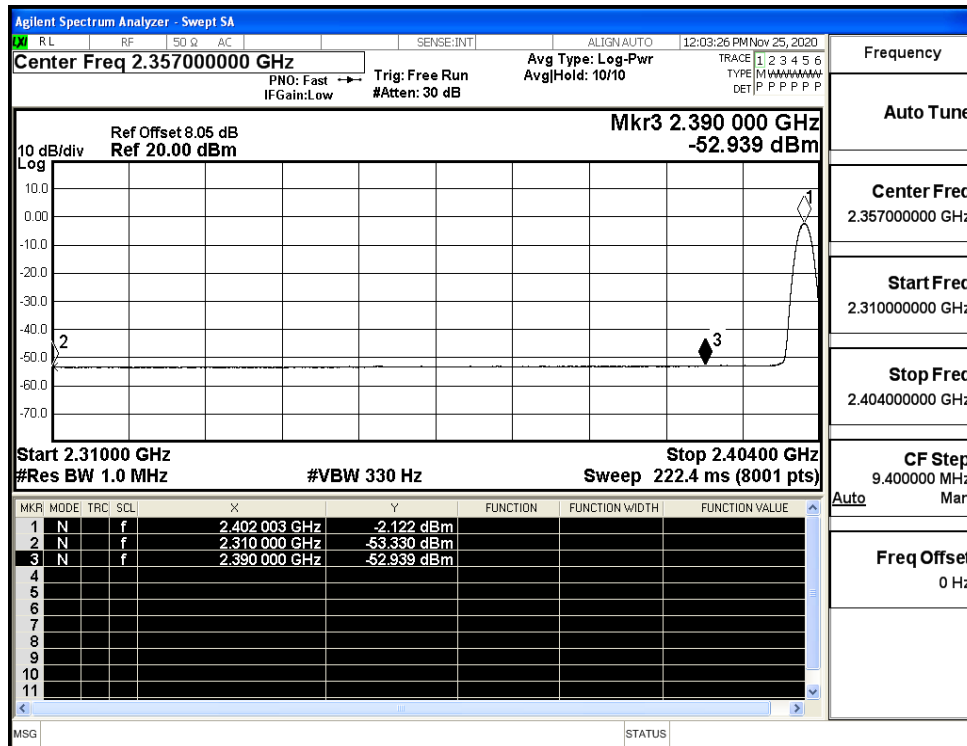
Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_Average (High Channel)



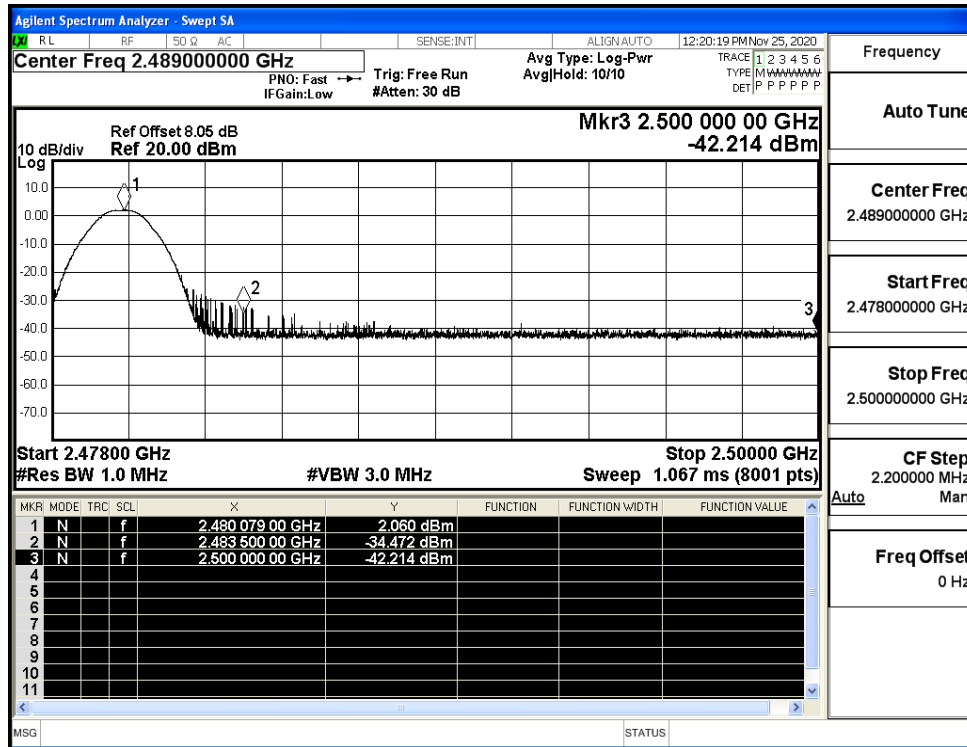
Restrict-band band-edge measurements\_Hopping Off\_8DPSK\_PEAK (Low Channel)



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)

