



## Appendix A

### RF Test Data for BT V5.0(DSS) (Conducted Measurement)

Product Name: Ellis Bluetooth® Headphones

Trade Mark: Gemline

Test Model: 101127-001B

#### Environmental Conditions

Temperature:	21.6 ° C
Relative Humidity:	52.7%
ATM Pressure:	100.0 kPa
Test Engineer:	Ken He
Supervised by:	Li Huan

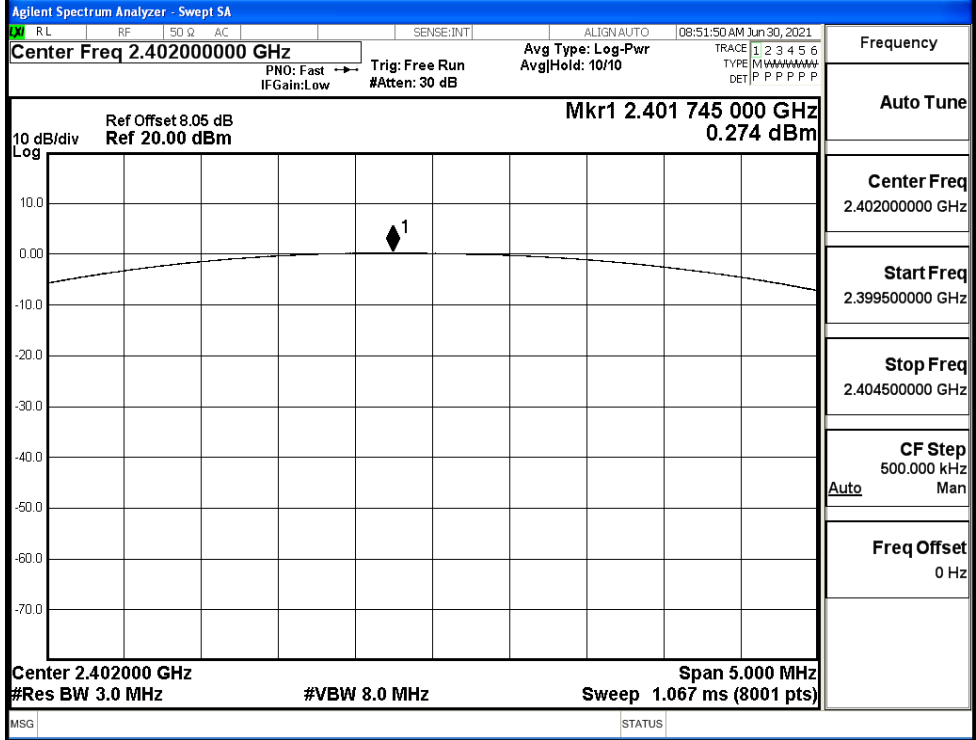
#### A.1 Maxmum Conducted Peak Output Power

Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	0.274	21	PASS
	MCH	0.545	21	PASS
	HCH	0.278	21	PASS
$\pi/4$ DQPSK	LCH	0.937	21	PASS
	MCH	1.153	21	PASS
	HCH	0.927	21	PASS



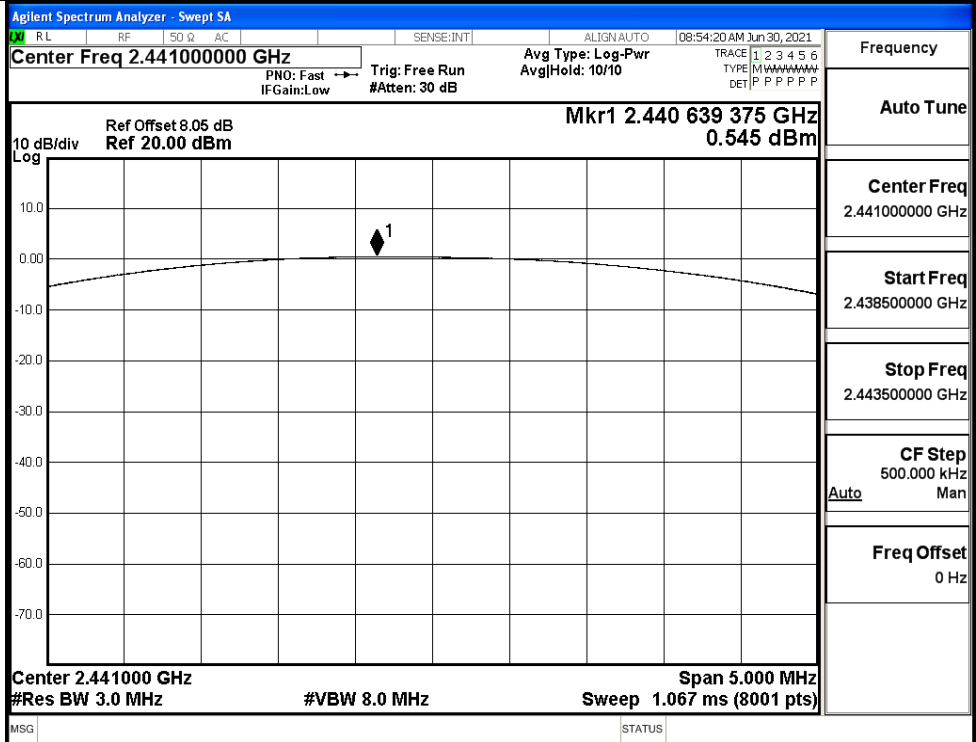
Test Graphs

GFSK/LCH

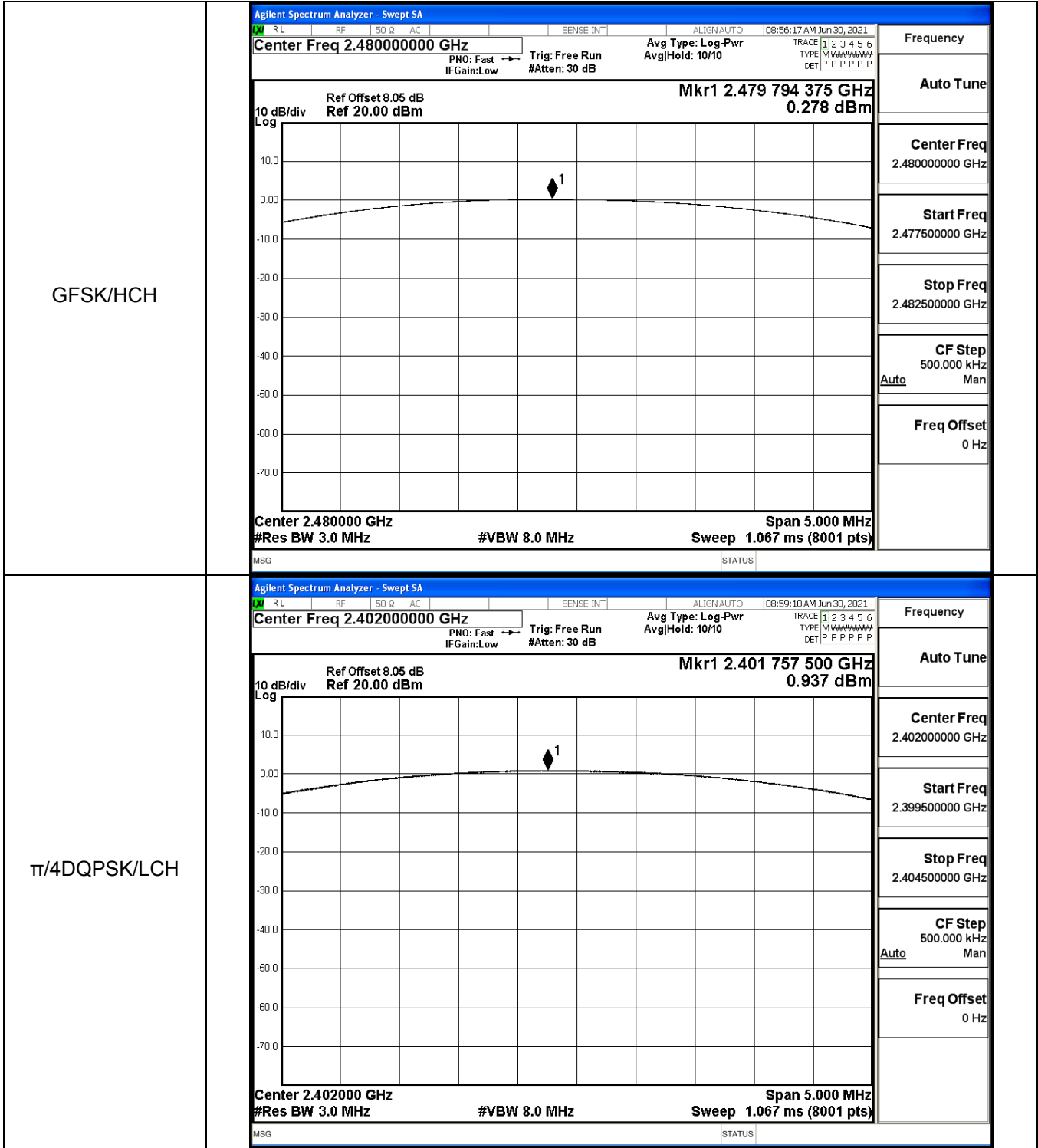


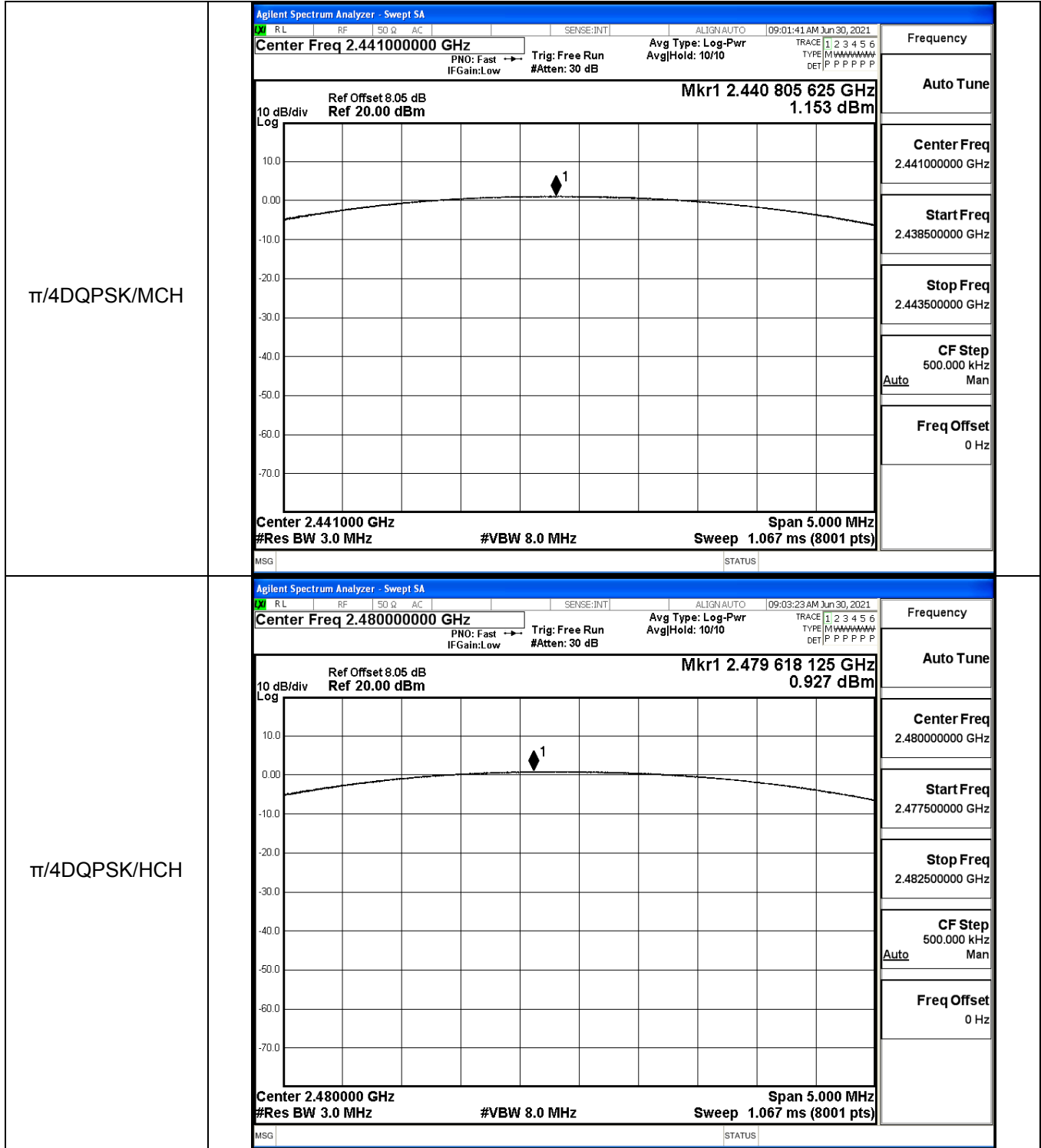
Frequency
Auto Tune
Center Freq 2.402000000 GHz
Start Freq 2.399500000 GHz
Stop Freq 2.404500000 GHz
CF Step 500.000 kHz Auto Man
Freq Offset 0 Hz

GFSK/MCH



Frequency
Auto Tune
Center Freq 2.441000000 GHz
Start Freq 2.438500000 GHz
Stop Freq 2.443500000 GHz
CF Step 500.000 kHz Auto Man
Freq Offset 0 Hz

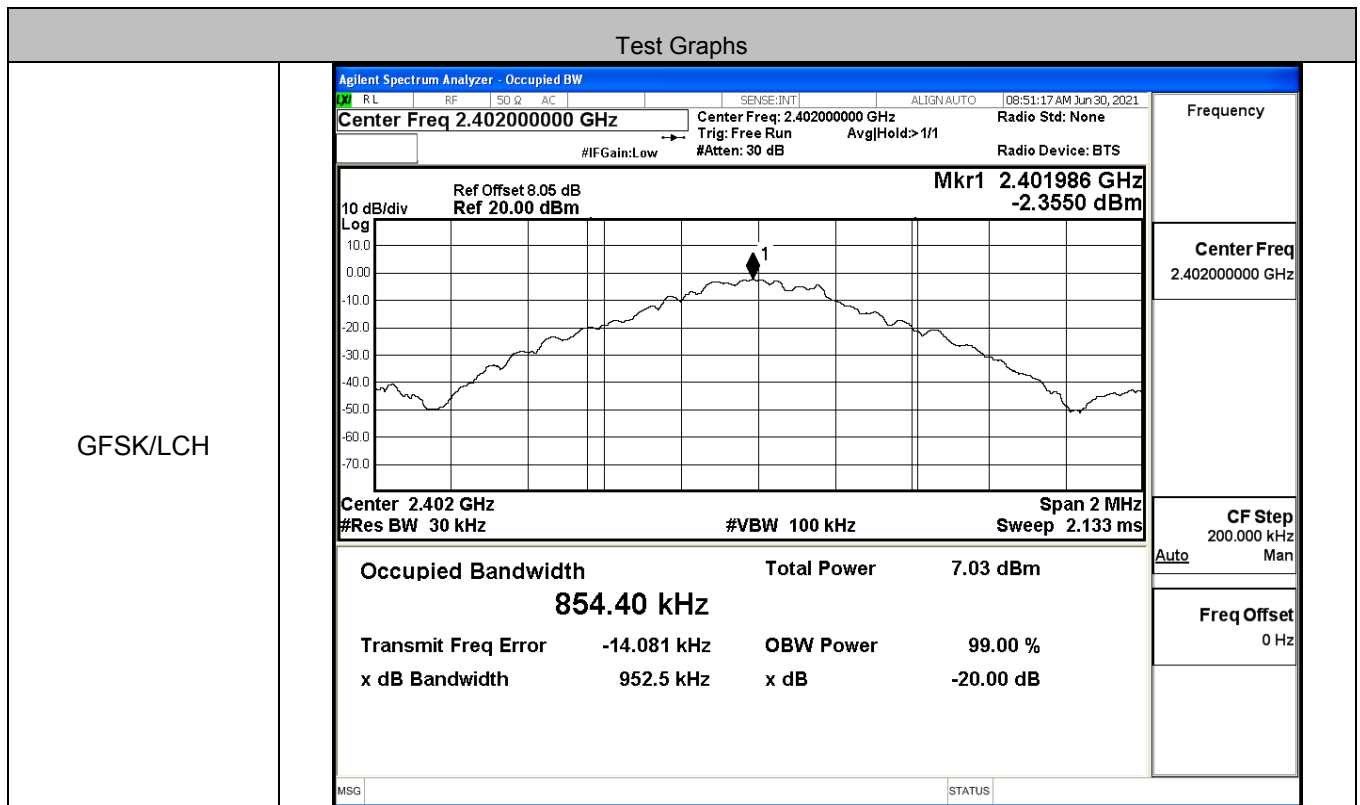






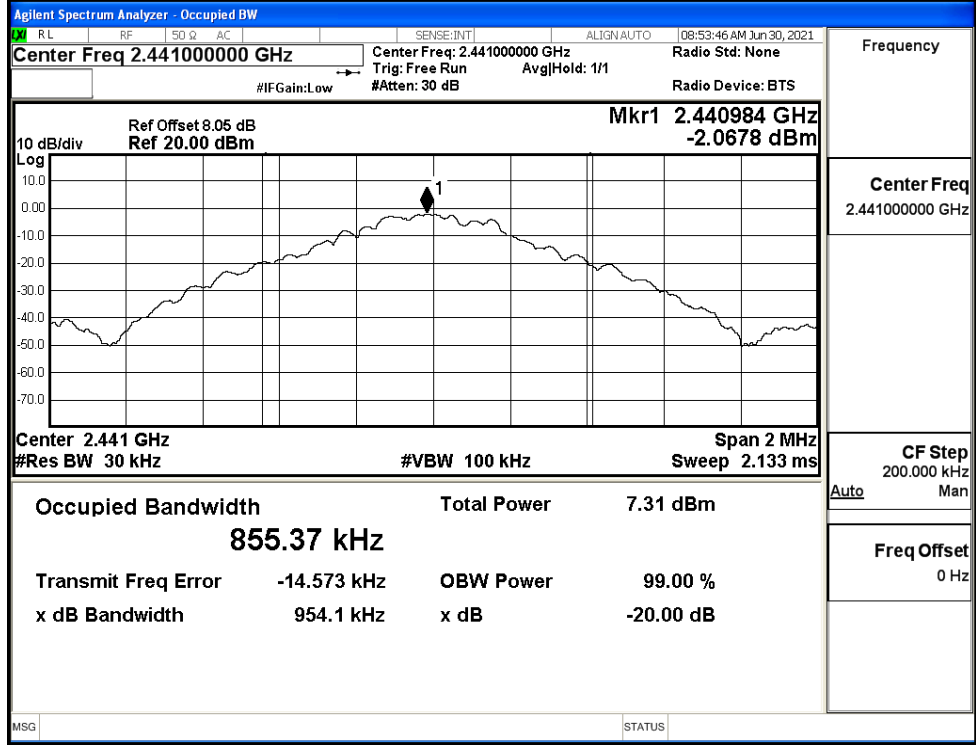
### A.2 20dB Bandwidth

Mode	Channel.	20dB Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.9525	Not Specified	PASS
	MCH	0.9541	Not Specified	PASS
	HCH	0.9535	Not Specified	PASS
$\pi/4$ DQPSK	LCH	1.315	Not Specified	PASS
	MCH	1.316	Not Specified	PASS
	HCH	1.315	Not Specified	PASS

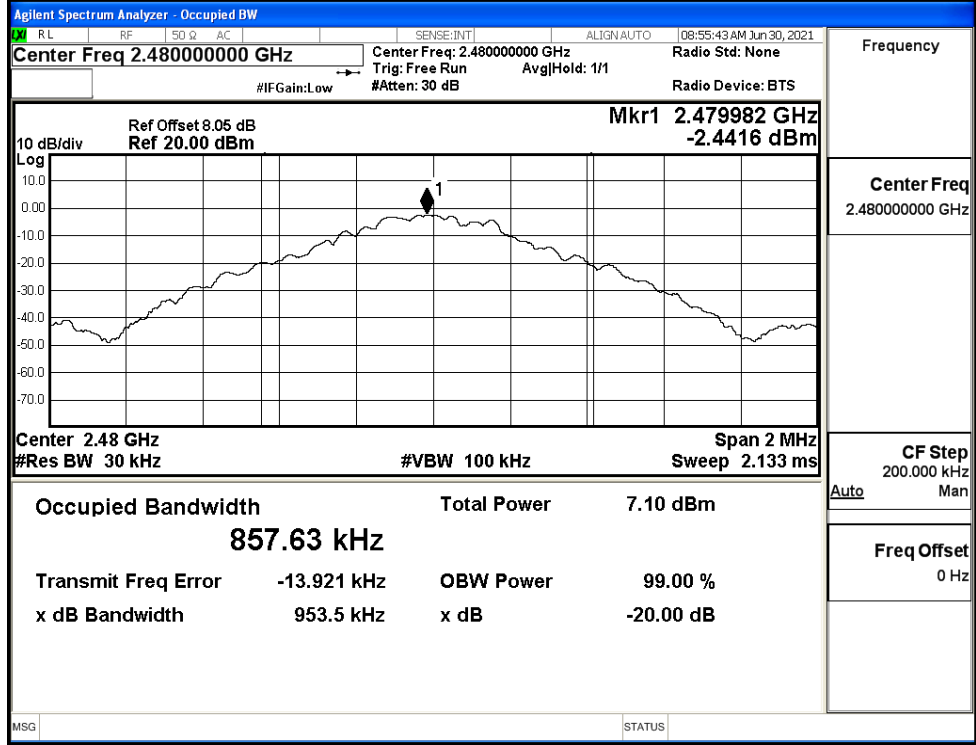




GFSK/MCH



GFSK/HCH

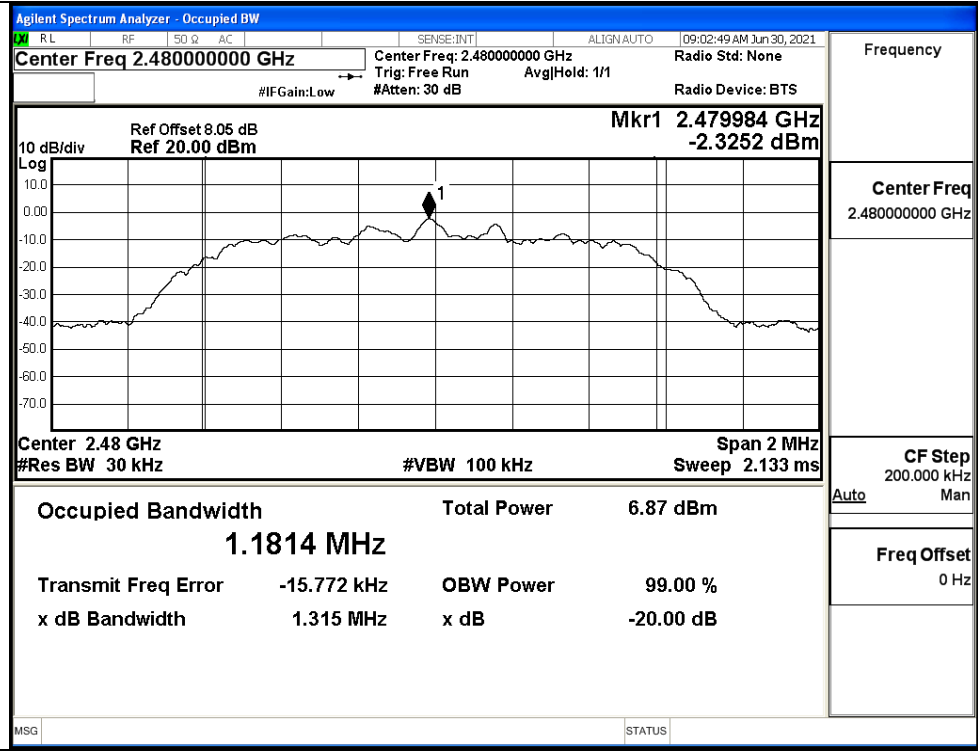




<p style="text-align: center;">π/4DQPSK/LCH</p>	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.40200000 GHz</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p>Mkr1 2.40199 GHz -2.6667 dBm</p> <p>Center 2.402 GHz #Res BW 30 kHz</p> <p>Span 2 MHz Sweep 2.133 ms</p> <p>#VBW 100 kHz</p> <p>Occupied Bandwidth 1.1792 MHz</p> <p>Total Power 6.78 dBm</p> <p>Transmit Freq Error -15.205 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.315 MHz</p> <p>x dB -20.00 dB</p>	<p>Frequency</p> <p>Center Freq 2.40200000 GHz</p> <p>CF Step 200.000 kHz</p> <p>Freq Offset 0 Hz</p>
<p style="text-align: center;">π/4DQPSK/MCH</p>	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.44100000 GHz</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p>Mkr1 2.440982 GHz -2.2890 dBm</p> <p>Center 2.441 GHz #Res BW 30 kHz</p> <p>Span 2 MHz Sweep 2.133 ms</p> <p>#VBW 100 kHz</p> <p>Occupied Bandwidth 1.1816 MHz</p> <p>Total Power 7.05 dBm</p> <p>Transmit Freq Error -15.068 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.316 MHz</p> <p>x dB -20.00 dB</p>	<p>Frequency</p> <p>Center Freq 2.44100000 GHz</p> <p>CF Step 200.000 kHz</p> <p>Freq Offset 0 Hz</p>



$\pi/4$ DQPSK/HCH

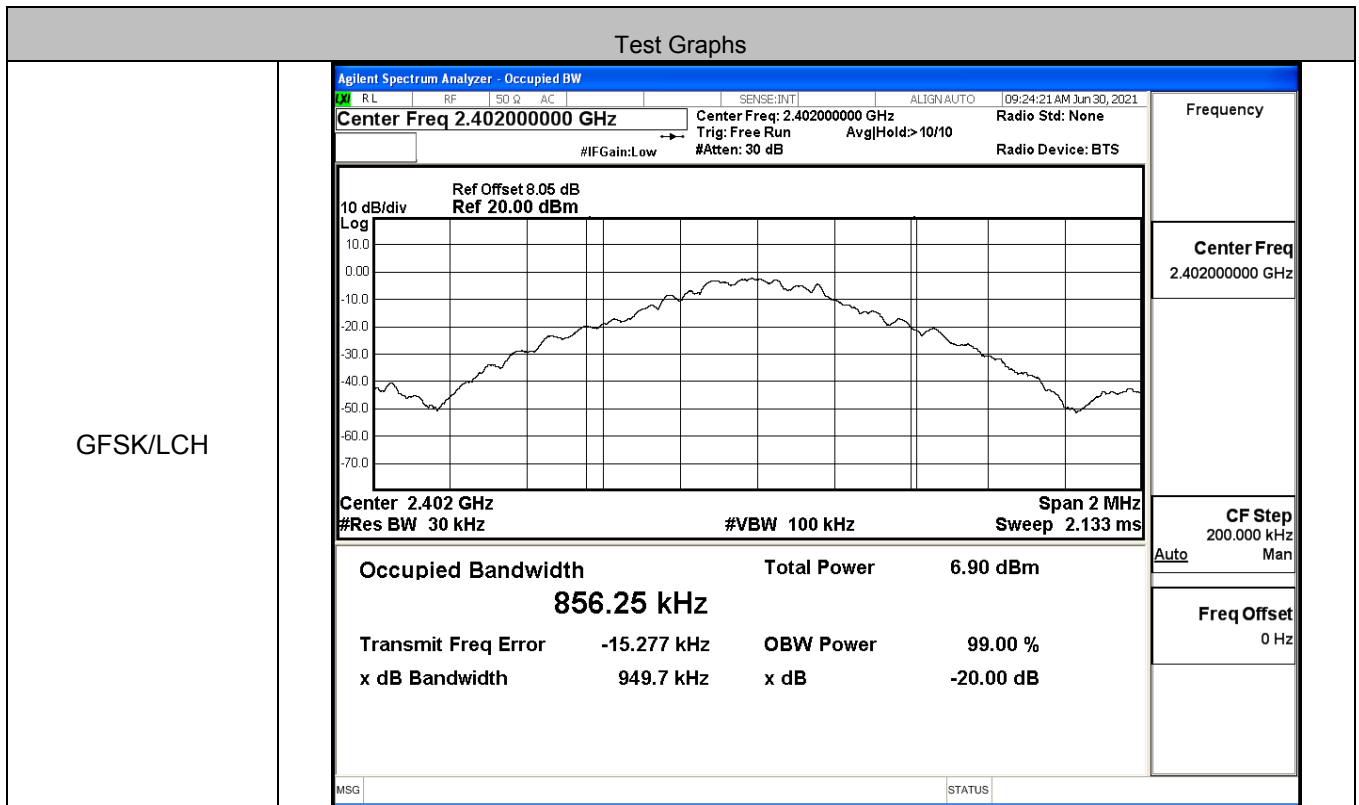






### A.2 Occupied Bandwidth

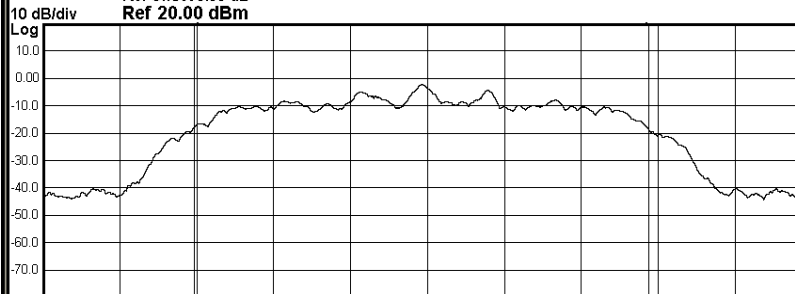
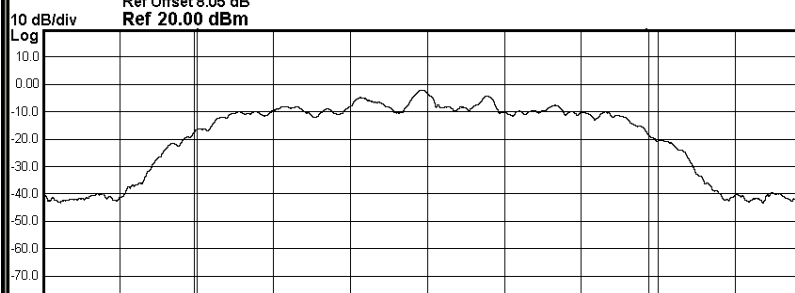
Mode	Channel.	Occupied Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.85625	Not Specified	PASS
	MCH	0.85455	Not Specified	PASS
	HCH	0.85541	Not Specified	PASS
π/4DQPSK	LCH	1.1789	Not Specified	PASS
	MCH	1.1793	Not Specified	PASS
	HCH	1.1838	Not Specified	PASS





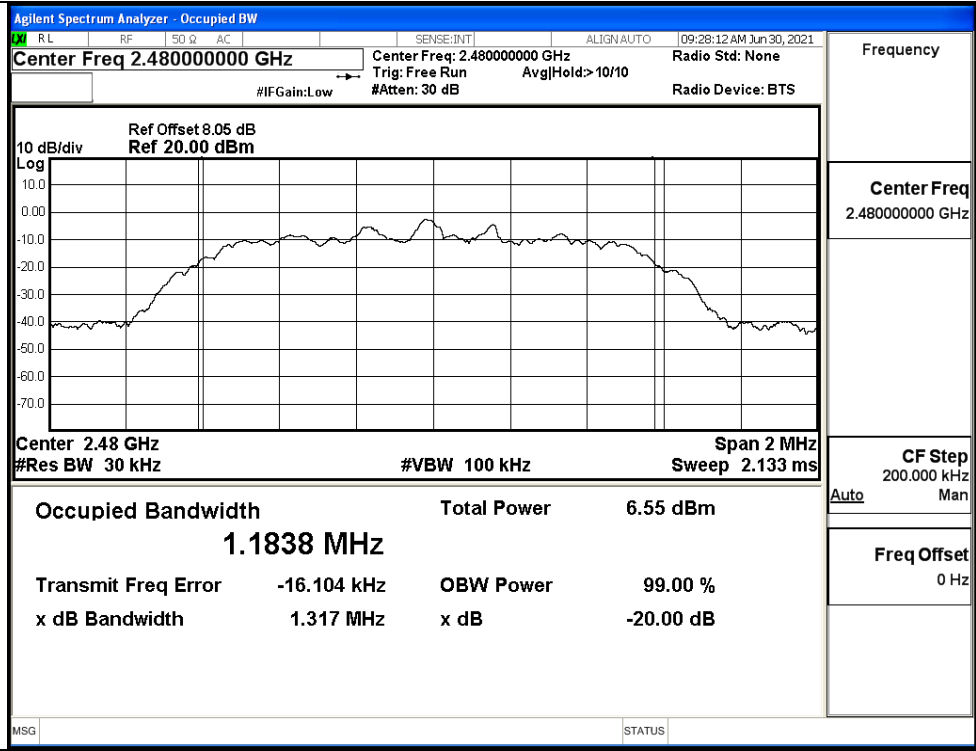
<p style="text-align: center;">GFSK/MCH</p>	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.441000000 GHz</p> <p>Occupied Bandwidth: 854.55 kHz</p> <p>Total Power: 7.25 dBm</p> <p>Transmit Freq Error: -15.263 kHz</p> <p>x dB Bandwidth: 951.3 kHz</p>	<p>Frequency</p> <p>Center Freq 2.441000000 GHz</p> <p>CF Step 200.000 kHz</p> <p>Freq Offset 0 Hz</p>
<p style="text-align: center;">GFSK/HCH</p>	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.480000000 GHz</p> <p>Occupied Bandwidth: 855.41 kHz</p> <p>Total Power: 6.99 dBm</p> <p>Transmit Freq Error: -14.718 kHz</p> <p>x dB Bandwidth: 951.2 kHz</p>	<p>Frequency</p> <p>Center Freq 2.480000000 GHz</p> <p>CF Step 200.000 kHz</p> <p>Freq Offset 0 Hz</p>



<p style="text-align: center;">π/4DQPSK/LCH</p>	<div style="border: 1px solid black; padding: 5px;"> <p style="font-size: small; margin: 0;">Agilent Spectrum Analyzer - Occupied BW</p> <p style="font-size: x-small; margin: 0;"> <span style="border: 1px solid black; padding: 1px;">RL</span> <span style="border: 1px solid black; padding: 1px;">RF</span> <span style="border: 1px solid black; padding: 1px;">50 Ω</span> <span style="border: 1px solid black; padding: 1px;">AC</span> <span style="margin-left: 20px;">SENSE:INT</span> <span style="margin-left: 20px;">ALIGN:AUTO</span> <span style="float: right;">09:26:29 AM Jun 30, 2021</span> </p> <p style="margin: 0;"> <span style="font-weight: bold;">Center Freq 2.40200000 GHz</span> <span style="margin-left: 20px;">Center Freq: 2.40200000 GHz</span> <span style="margin-left: 20px;">Radio Std: None</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Trig: Free Run</span> <span style="margin-left: 20px;">Avg Hold: 10/10</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">#IFGain:Low</span> <span style="margin-left: 20px;">#Atten: 30 dB</span> <span style="float: right;">Radio Device: BTS</span> </p> <hr/> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Ref Offset 8.05 dB</span> <span style="margin-left: 20px;">Ref 20.00 dBm</span> </p>  <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Center 2.402 GHz</span> <span style="margin-left: 20px;">Span 2 MHz</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">#Res BW 30 kHz</span> <span style="margin-left: 20px;">#VBW 100 kHz</span> <span style="float: right;">Sweep 2.133 ms</span> </p> <table border="0" style="width: 100%; font-size: small;"> <tr> <td style="width: 33%;">Occupied Bandwidth</td> <td style="width: 33%;">Total Power</td> <td style="width: 33%;">6.73 dBm</td> </tr> <tr> <td style="text-align: center;"><b>1.1789 MHz</b></td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-15.195 kHz</td> <td>OBW Power 99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.309 MHz</td> <td>x dB -20.00 dB</td> </tr> </table> <p style="font-size: x-small; margin: 0;">MSG <span style="float: right;">STATUS</span></p> </div>	Occupied Bandwidth	Total Power	6.73 dBm	<b>1.1789 MHz</b>			Transmit Freq Error	-15.195 kHz	OBW Power 99.00 %	x dB Bandwidth	1.309 MHz	x dB -20.00 dB	<p style="text-align: center;">Frequency</p> <p style="text-align: center;">Center Freq 2.40200000 GHz</p> <p style="text-align: center;">CF Step 200.000 kHz Auto Man</p> <p style="text-align: center;">Freq Offset 0 Hz</p>
	Occupied Bandwidth	Total Power	6.73 dBm											
<b>1.1789 MHz</b>														
Transmit Freq Error	-15.195 kHz	OBW Power 99.00 %												
x dB Bandwidth	1.309 MHz	x dB -20.00 dB												
<p style="text-align: center;">π/4DQPSK/MCH</p>	<div style="border: 1px solid black; padding: 5px;"> <p style="font-size: small; margin: 0;">Agilent Spectrum Analyzer - Occupied BW</p> <p style="font-size: x-small; margin: 0;"> <span style="border: 1px solid black; padding: 1px;">RL</span> <span style="border: 1px solid black; padding: 1px;">RF</span> <span style="border: 1px solid black; padding: 1px;">50 Ω</span> <span style="border: 1px solid black; padding: 1px;">AC</span> <span style="margin-left: 20px;">SENSE:INT</span> <span style="margin-left: 20px;">ALIGN:AUTO</span> <span style="float: right;">09:27:23 AM Jun 30, 2021</span> </p> <p style="margin: 0;"> <span style="font-weight: bold;">Center Freq 2.44100000 GHz</span> <span style="margin-left: 20px;">Center Freq: 2.44100000 GHz</span> <span style="margin-left: 20px;">Radio Std: None</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Trig: Free Run</span> <span style="margin-left: 20px;">Avg Hold: 10/10</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">#IFGain:Low</span> <span style="margin-left: 20px;">#Atten: 30 dB</span> <span style="float: right;">Radio Device: BTS</span> </p> <hr/> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Ref Offset 8.05 dB</span> <span style="margin-left: 20px;">Ref 20.00 dBm</span> </p>  <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">Center 2.441 GHz</span> <span style="margin-left: 20px;">Span 2 MHz</span> </p> <p style="font-size: x-small; margin: 0;"> <span style="margin-left: 20px;">#Res BW 30 kHz</span> <span style="margin-left: 20px;">#VBW 100 kHz</span> <span style="float: right;">Sweep 2.133 ms</span> </p> <table border="0" style="width: 100%; font-size: small;"> <tr> <td style="width: 33%;">Occupied Bandwidth</td> <td style="width: 33%;">Total Power</td> <td style="width: 33%;">7.04 dBm</td> </tr> <tr> <td style="text-align: center;"><b>1.1793 MHz</b></td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-15.314 kHz</td> <td>OBW Power 99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.310 MHz</td> <td>x dB -20.00 dB</td> </tr> </table> <p style="font-size: x-small; margin: 0;">MSG <span style="float: right;">STATUS</span></p> </div>	Occupied Bandwidth	Total Power	7.04 dBm	<b>1.1793 MHz</b>			Transmit Freq Error	-15.314 kHz	OBW Power 99.00 %	x dB Bandwidth	1.310 MHz	x dB -20.00 dB	<p style="text-align: center;">Frequency</p> <p style="text-align: center;">Center Freq 2.44100000 GHz</p> <p style="text-align: center;">CF Step 200.000 kHz Auto Man</p> <p style="text-align: center;">Freq Offset 0 Hz</p>
Occupied Bandwidth	Total Power	7.04 dBm												
<b>1.1793 MHz</b>														
Transmit Freq Error	-15.314 kHz	OBW Power 99.00 %												
x dB Bandwidth	1.310 MHz	x dB -20.00 dB												



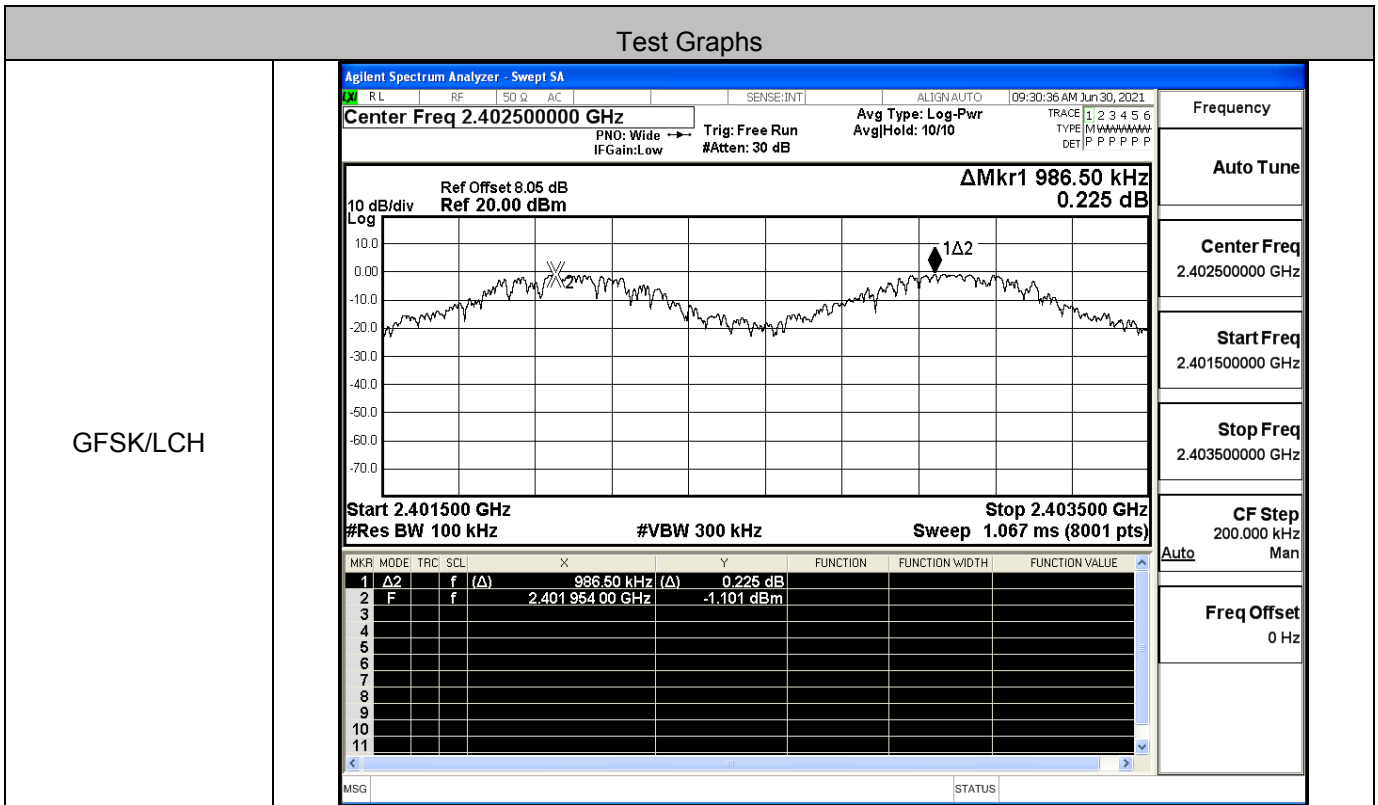
$\pi/4$ DQPSK/HCH





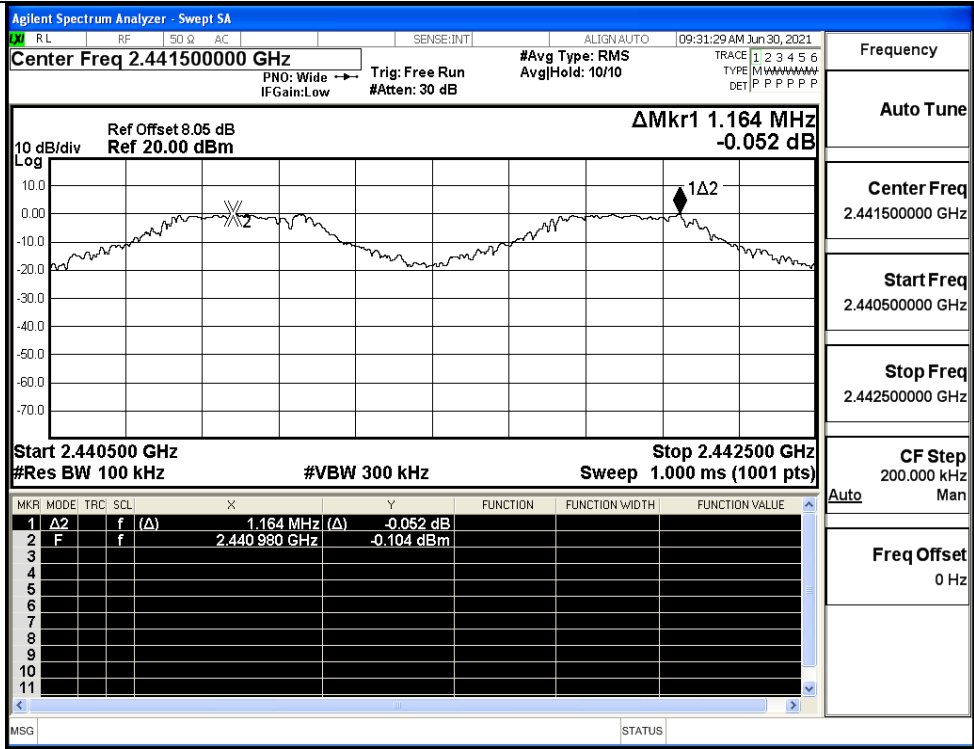
### A.3 Carrier Frequency Separation

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.986	0.636	PASS
	MCH	1.164	0.636	PASS
	HCH	0.946	0.636	PASS
π/4DQPSK	LCH	1.122	0.877	PASS
	MCH	0.966	0.877	PASS
	HCH	1.164	0.877	PASS

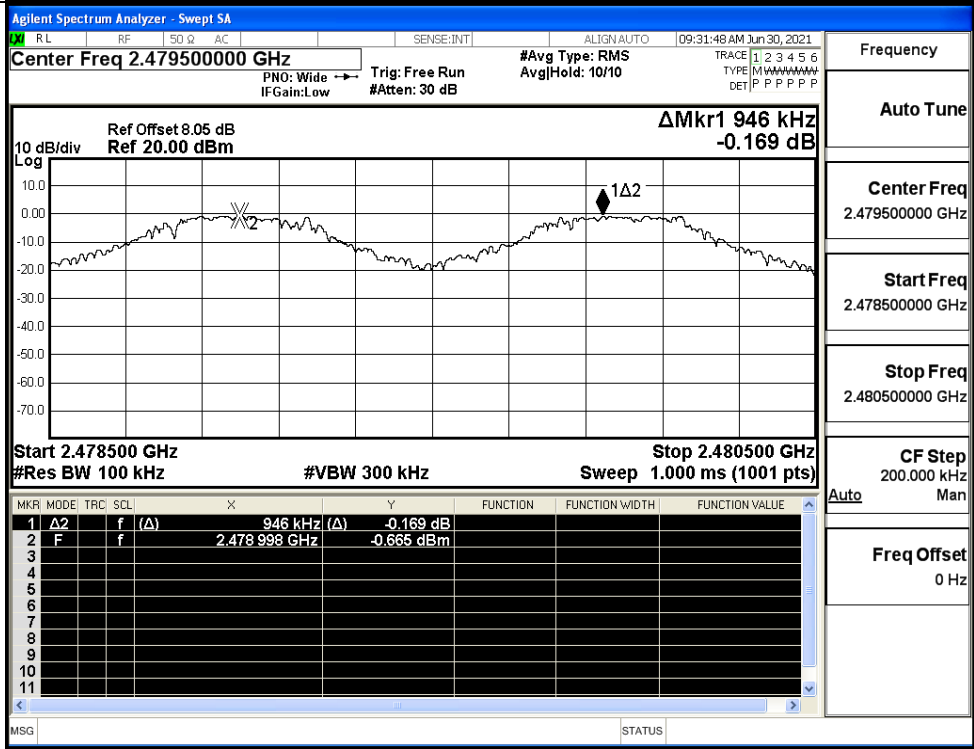




GFSK/MCH

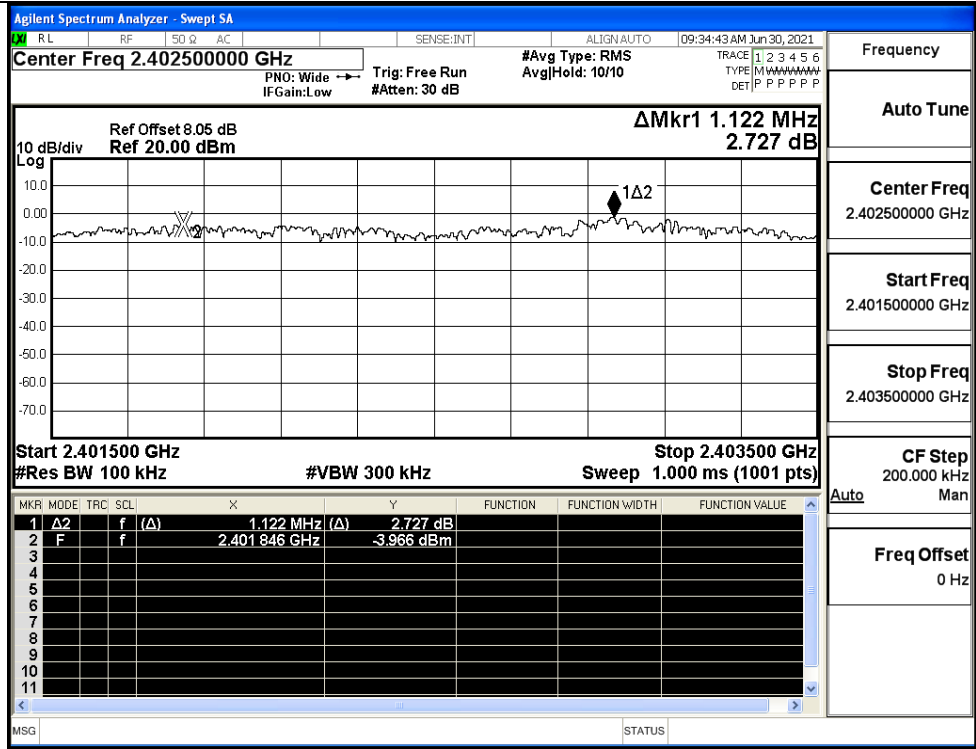


GFSK/HCH

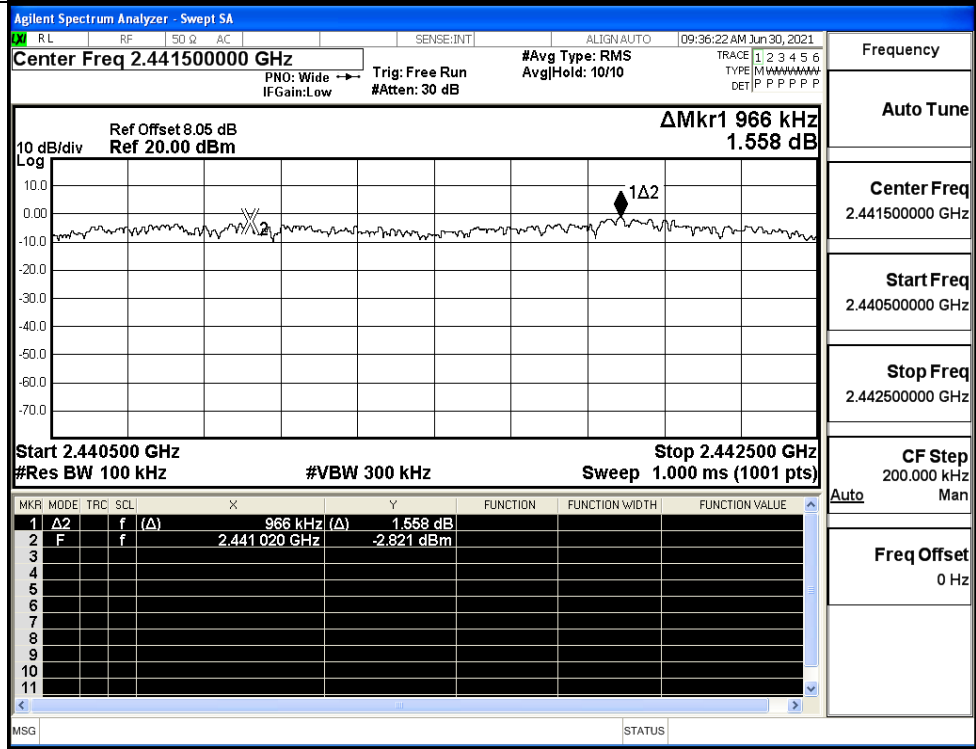




$\pi/4$ DQPSK/LCH



$\pi/4$ DQPSK/MCH





π/4DQPSK/HCH

Agilent Spectrum Analyzer - Swept SA

RL RF SQ Q AC SENSE:INT ALIGN AUTO 09:36:45 AM Jun 30, 2021

**Center Freq 2.479500000 GHz**
#Avg Type: RMS  
AvgHold: 10/10

PNO: Wide → Trig: Free Run #Atten: 30 dB  
 IFGain:Low

Ref Offset 8.05 dB **ΔMkr1 1.164 MHz**  
-0.368 dB

10 dB/div Log

Start 2.478500 GHz #Res BW 100 kHz #VBW 300 kHz Stop 2.480500 GHz Sweep 1.000 ms (1001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	Δ2	f	(Δ)	1.164 MHz (Δ)	-0.368 dB			
2	F	f	(Δ)	2.478 810 GHz	-0.737 dBm			
3								
4								
5								
6								
7								
8								
9								
10								
11								

MSG STATUS

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





### 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

GFSK/Hop

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.441750000 GHz

Ref Offset 8.05 dB Ref 20.00 dBm

$\Delta$ Mkr1 77.791 MHz -0.515 dB

Start 2.40000 GHz Stop 2.48350 GHz

#Res BW 100 kHz #VBW 300 kHz Sweep 8.000 ms (8001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	$\Delta$ 2	f	( $\Delta$ )	77.791 MHz ( $\Delta$ )	-0.515 dB			
2	F	f		2.402150 GHz	-0.278 dBm			

Frequency: 2.441750000 GHz

Auto Tune

Center Freq: 2.441750000 GHz

Start Freq: 2.400000000 GHz

Stop Freq: 2.483500000 GHz

CF Step: 8.350000 MHz

Freq Offset: 0 Hz

$\pi/4$ DQPSK/Hop

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.441750000 GHz

Ref Offset 8.05 dB Ref 20.00 dBm

$\Delta$ Mkr1 77.843 MHz 0.152 dB

Start 2.40000 GHz Stop 2.48350 GHz

#Res BW 100 kHz #VBW 300 kHz Sweep 8.000 ms (8001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	$\Delta$ 2	f	( $\Delta$ )	77.843 MHz ( $\Delta$ )	0.152 dB			
2	F	f		2.402161 GHz	-0.783 dBm			

Frequency: 2.441750000 GHz

Auto Tune

Center Freq: 2.441750000 GHz

Start Freq: 2.400000000 GHz

Stop Freq: 2.483500000 GHz

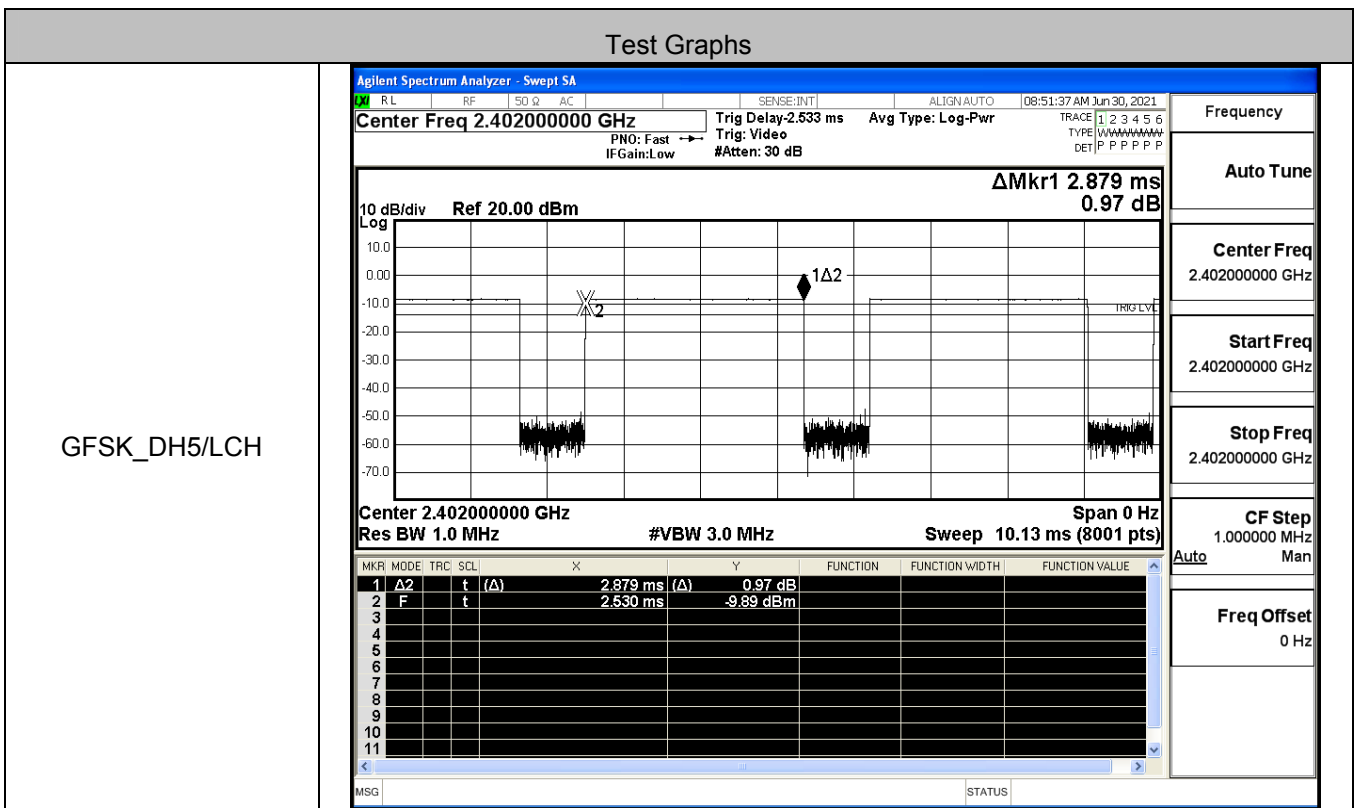
CF Step: 8.350000 MHz

Freq Offset: 0 Hz



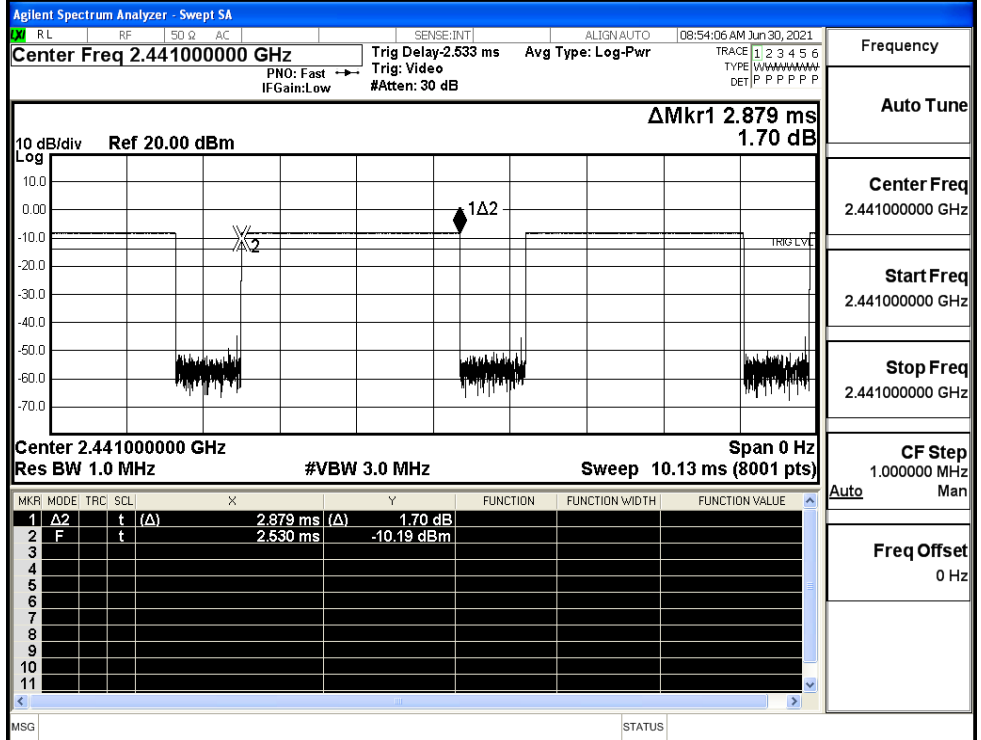
### A.5 Dwell Time

Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit [s]	Verdict
GFSK	DH5	LCH	2.88	106.7	0.307	0.4	PASS
	DH5	MCH	2.88	106.7	0.307	0.4	PASS
	DH5	HCH	2.88	106.7	0.307	0.4	PASS
$\pi/4$ DQPSK	2DH5	LCH	2.88	106.7	0.307	0.4	PASS
	2DH5	MCH	2.88	106.7	0.308	0.4	PASS
	2DH5	HCH	2.88	106.7	0.307	0.4	PASS

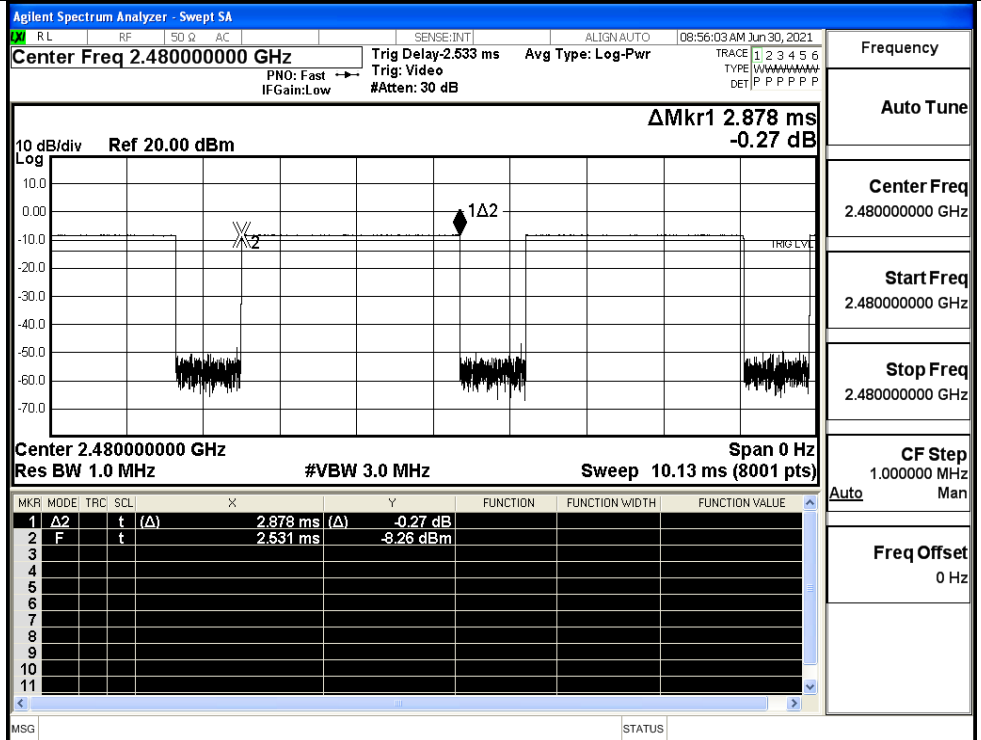




GFSK\_DH5/MCH

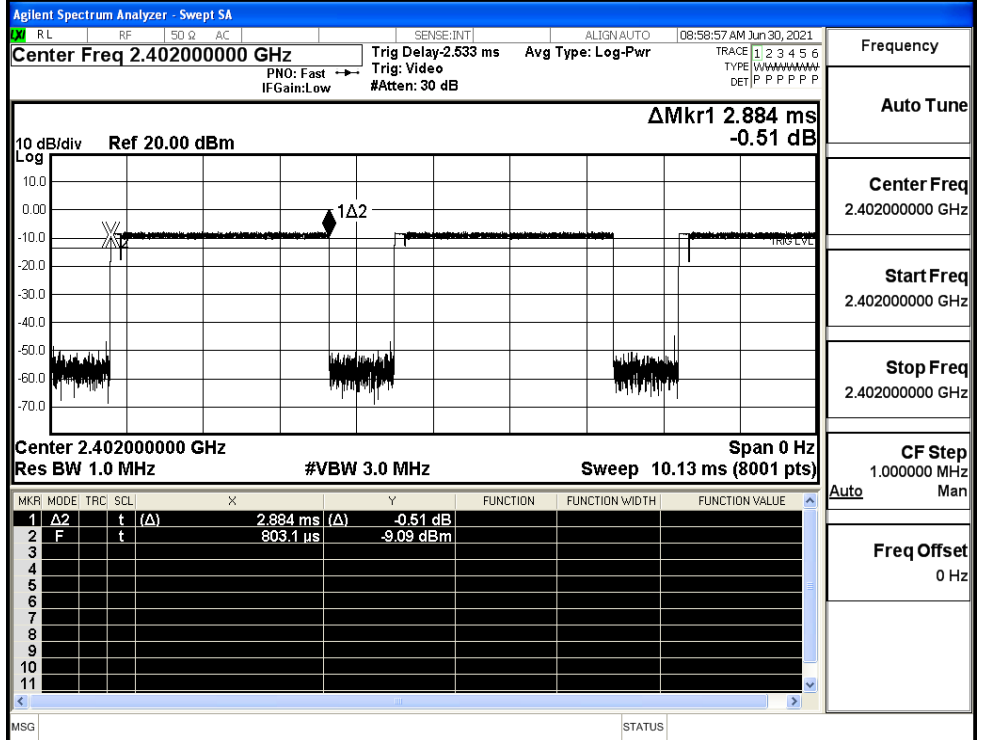


GFSK\_DH5/HCH

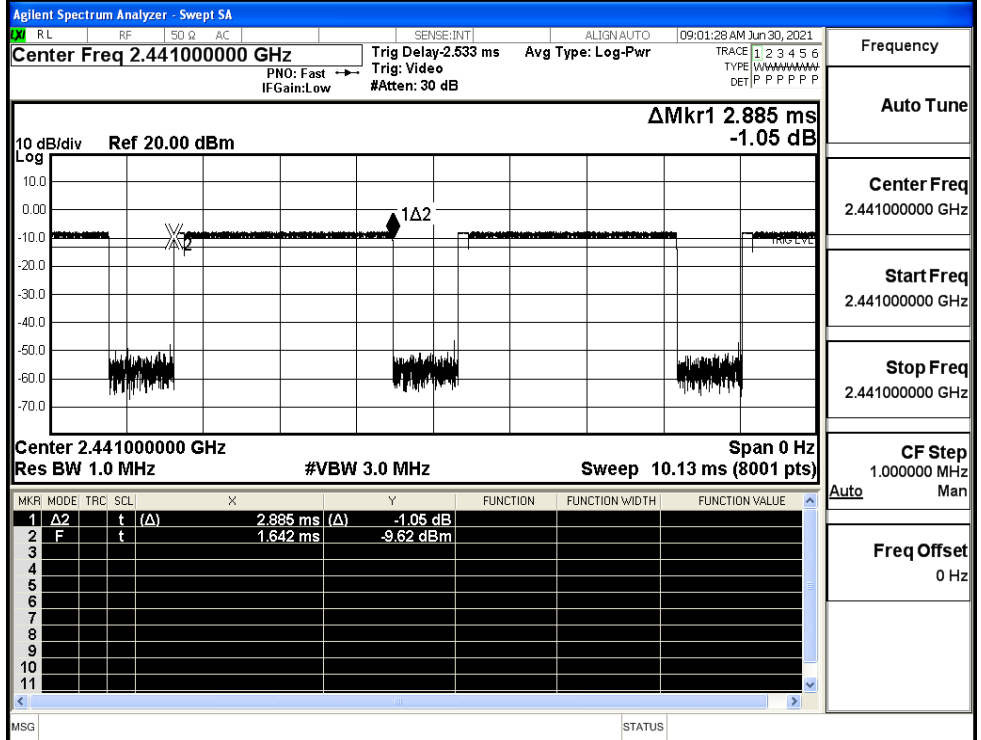




$\pi$ /4DQPSK  
\_2DH5/LCH

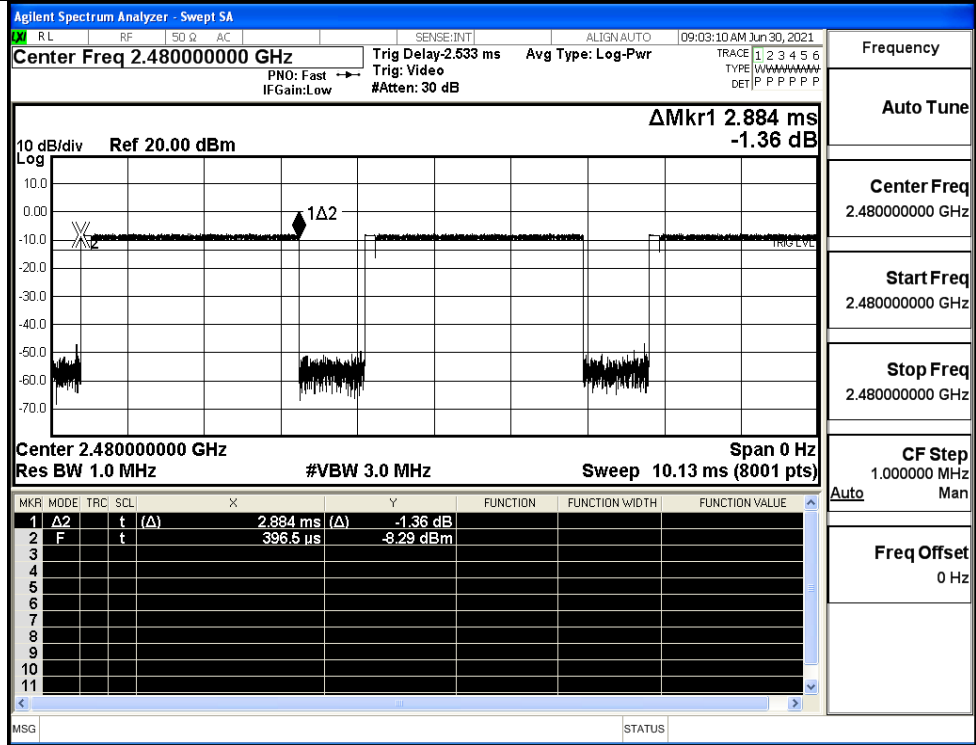


$\pi$ /4DQPSK  
\_2DH5/MCH





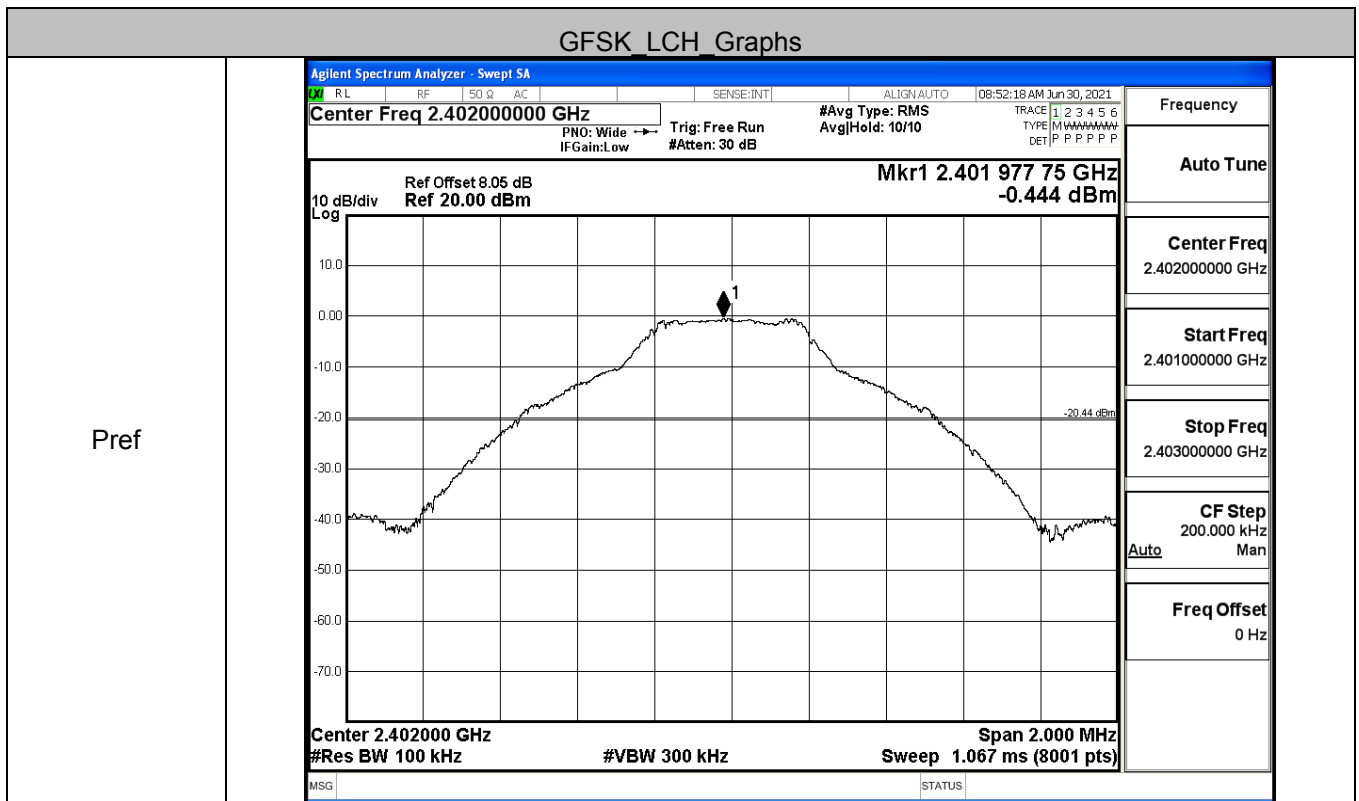
$\pi/4$ DQPSK  
\_2DH5/HCH

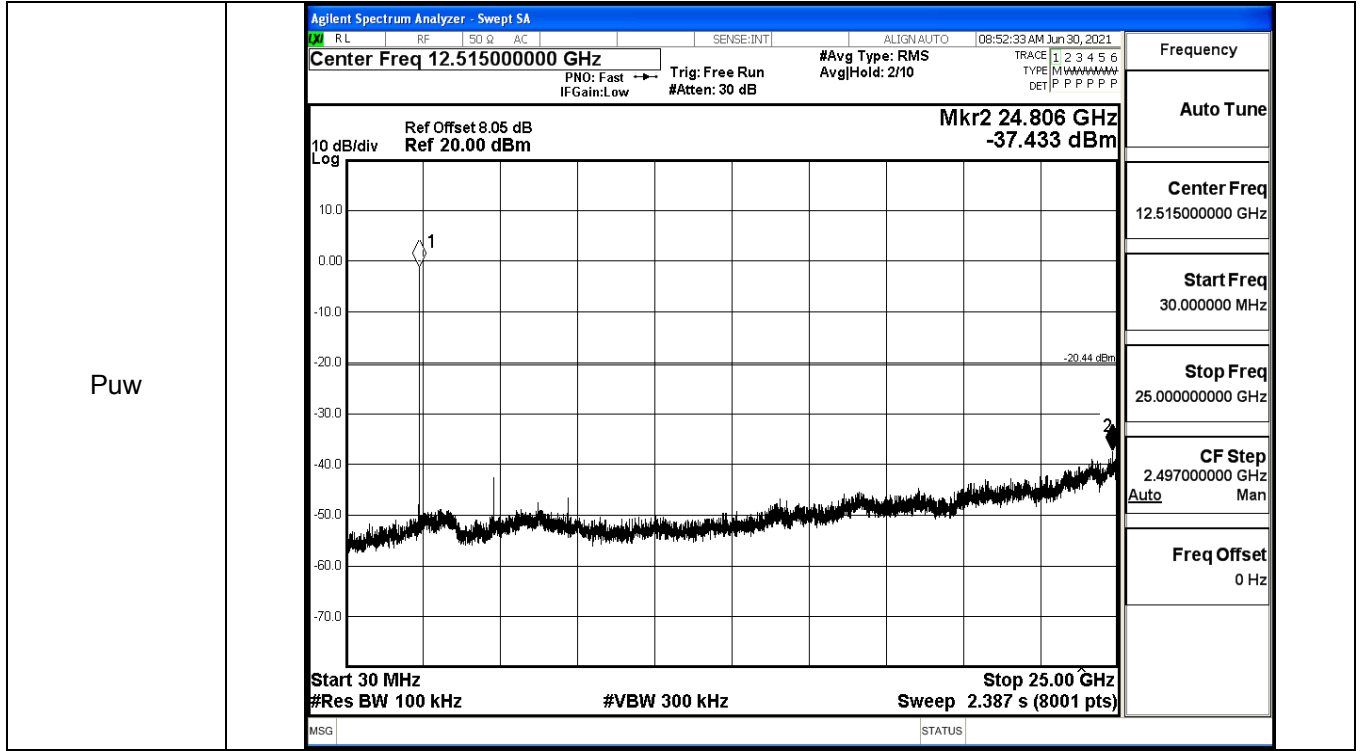




### A.6 RF Conducted Spurious Emissions

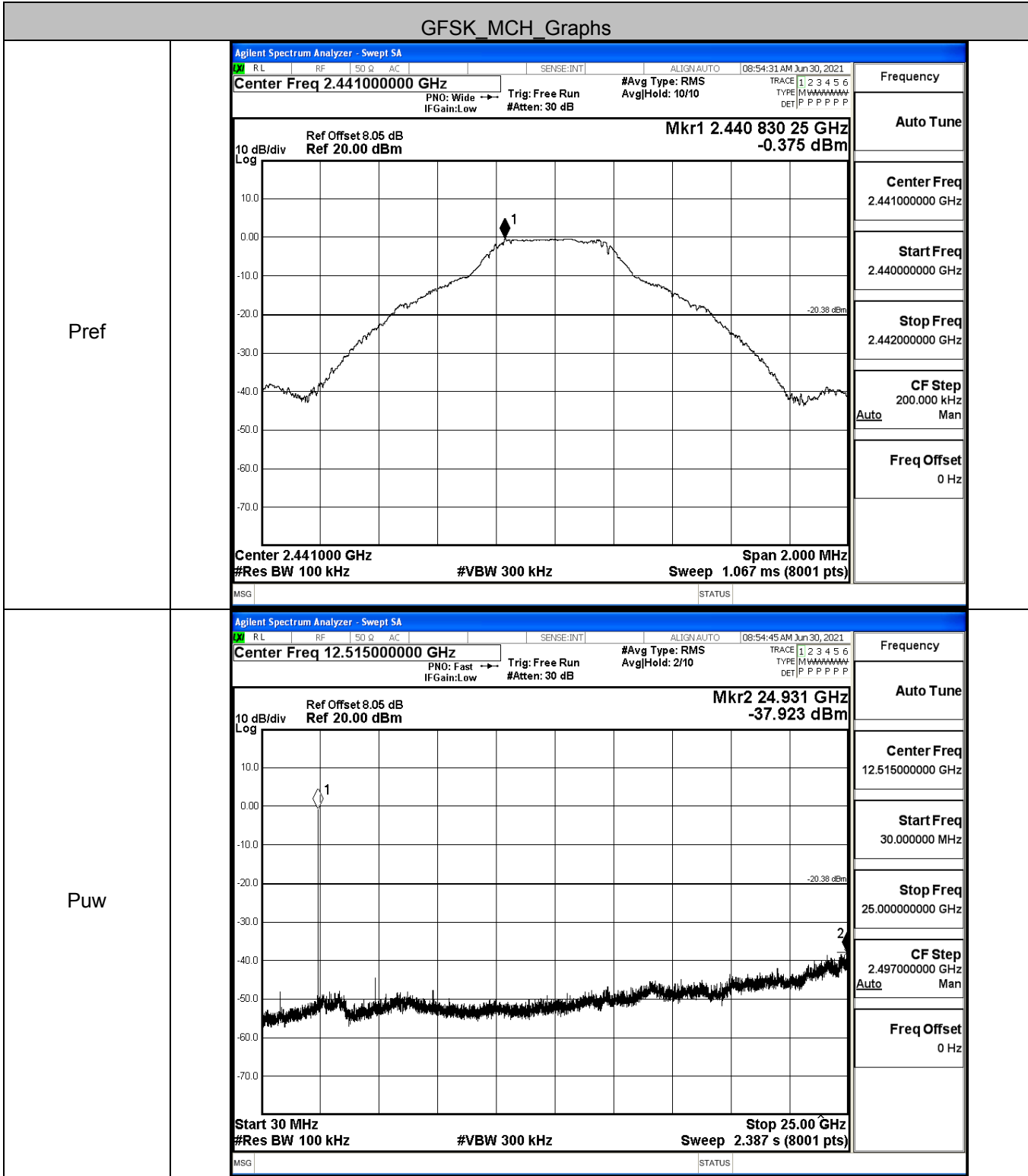
Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	-0.444	-37.433	-20.444	PASS
	MCH	-0.375	-37.923	-20.375	PASS
	HCH	-0.6	-37.967	-20.600	PASS
$\pi/4$ DQPSK	LCH	-0.538	-38.379	-20.538	PASS
	MCH	0.026	-38.319	-19.974	PASS
	HCH	-0.514	-38.472	-20.514	PASS







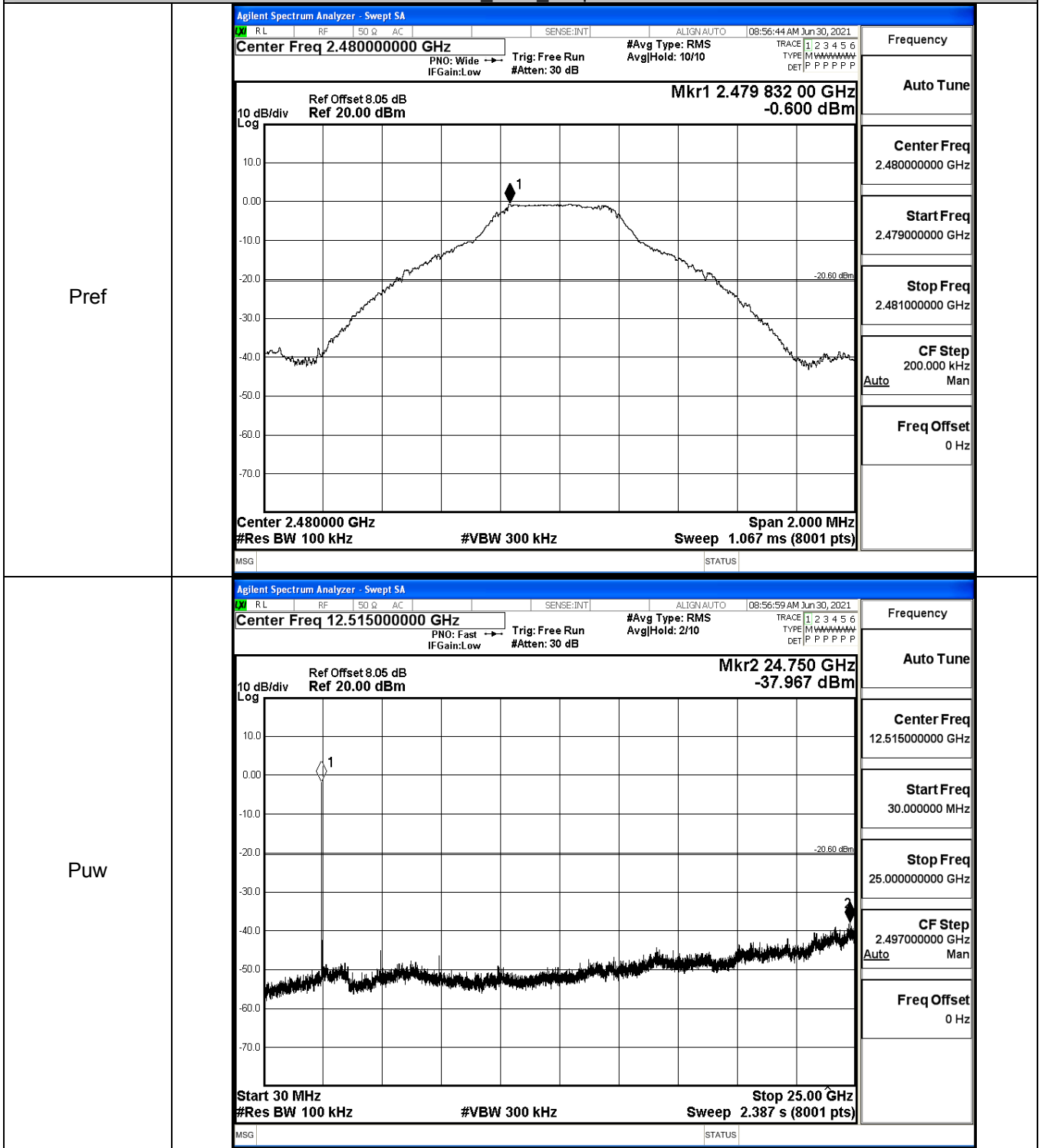
GFSK\_MCH\_Graphs





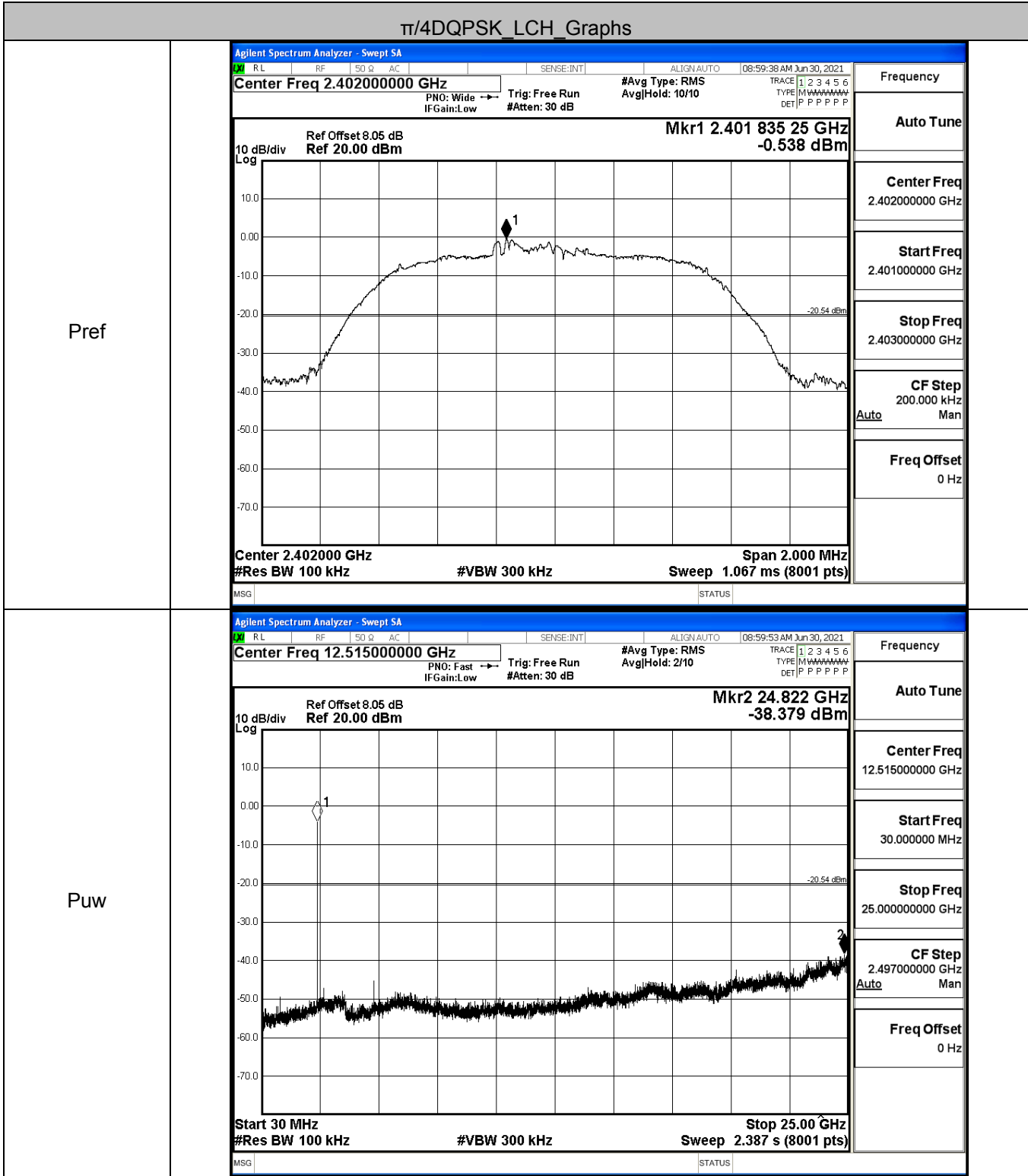


### GFSK\_HCH\_Graphs



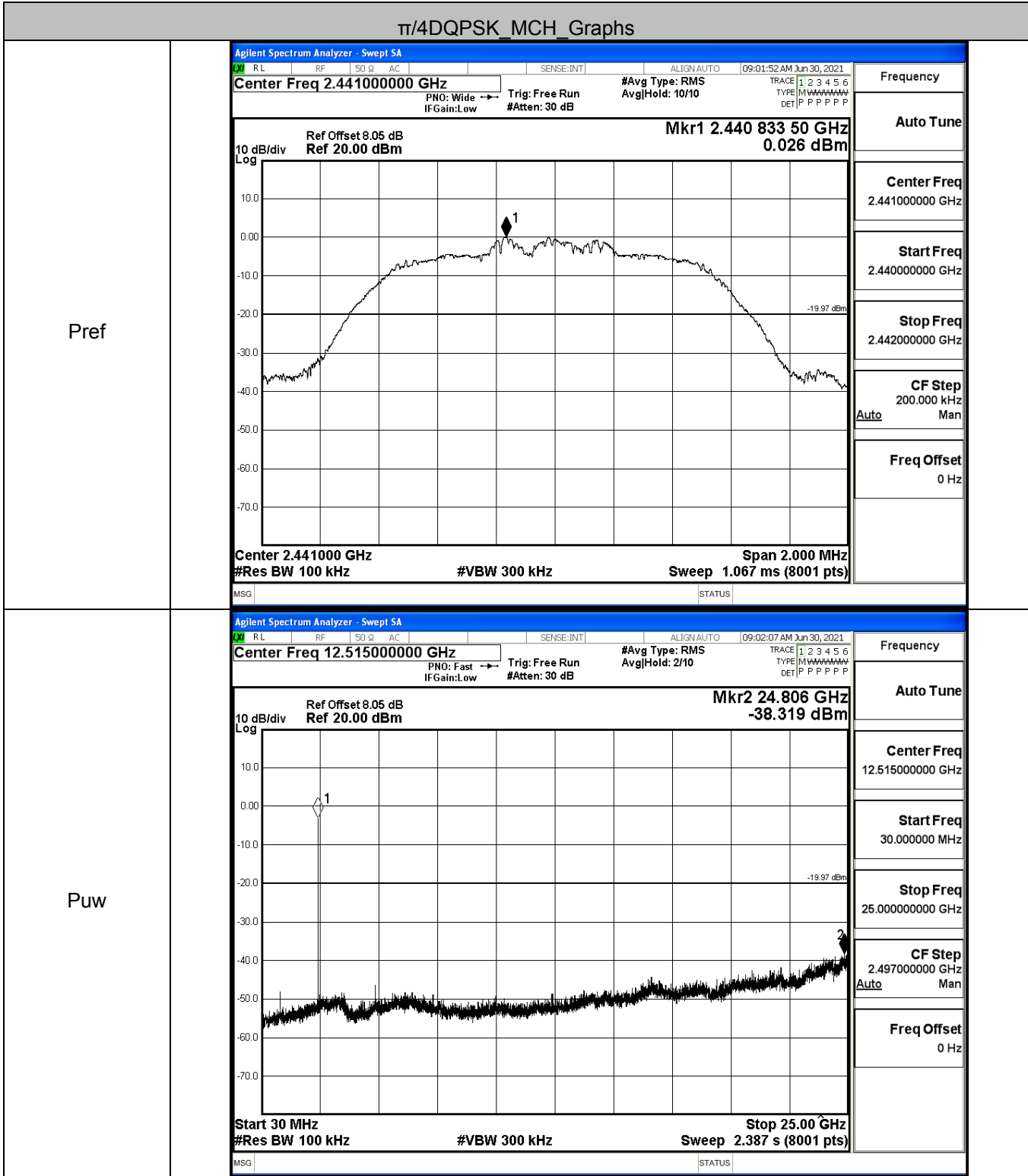


$\pi/4$ DQPSK\_LCH\_Graphs



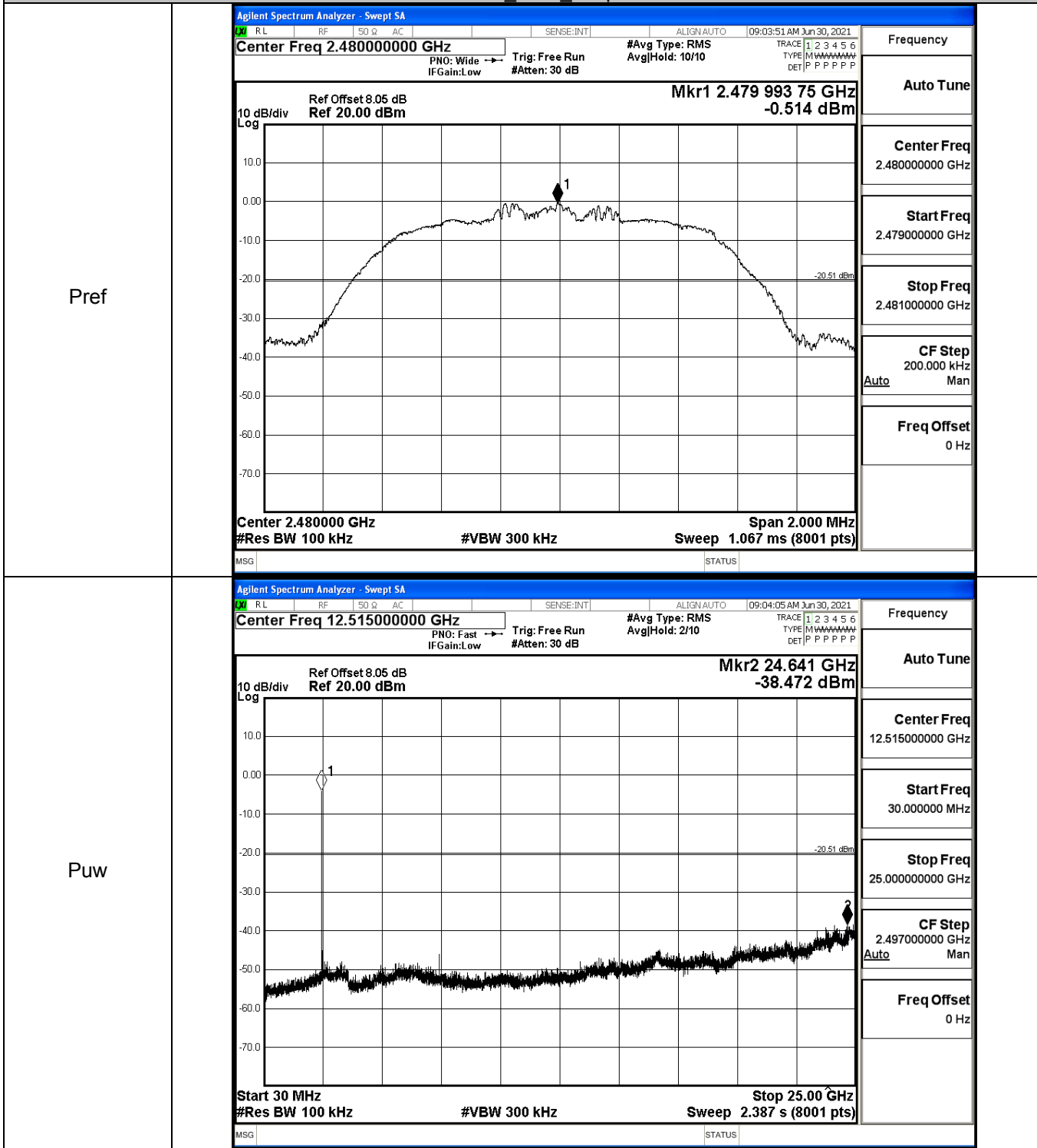


$\pi/4$ DQPSK\_MCH\_Graphs





$\pi/4$ DQPSK\_HCH\_Graphs





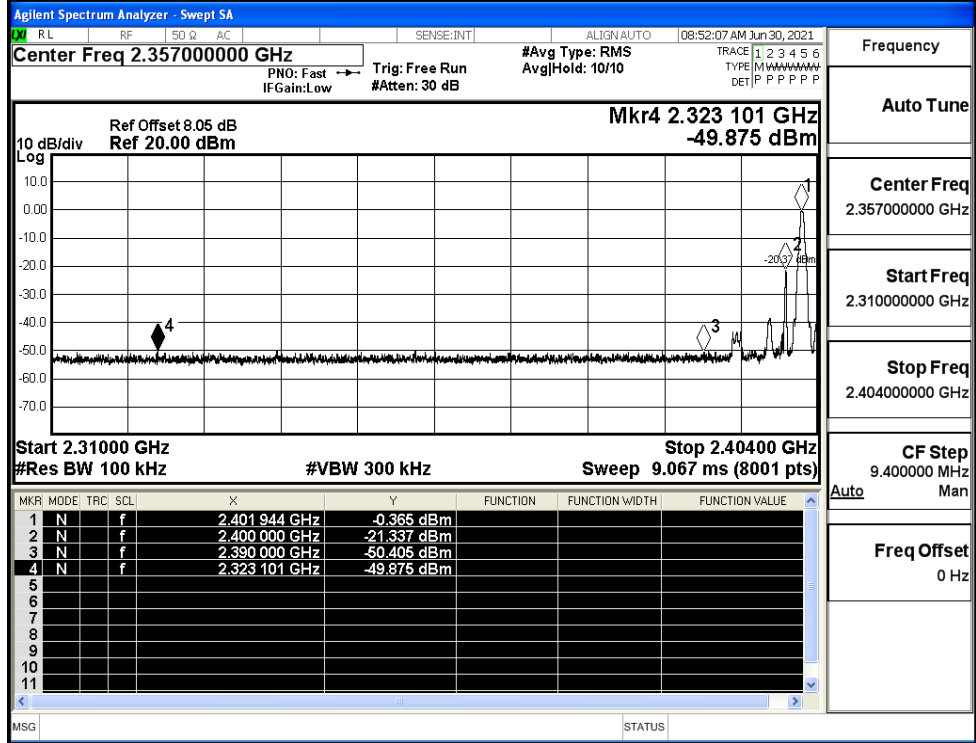
## A.7 Band-edge for RF Conducted Emissions

Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	-0.365	Off	-49.875	-20.37	PASS
			-0.180	On	-49.534	-20.18	PASS
	HCH	2480	-0.358	Off	-48.198	-20.36	PASS
			-0.064	On	-48.859	-20.06	PASS
$\pi/4$ DQPSK	LCH	2402	-0.755	Off	-50.074	-20.76	PASS
			-0.050	On	-48.904	-20.05	PASS
	HCH	2480	-0.343	Off	-48.069	-20.34	PASS
			0.226	On	-47.830	-19.77	PASS

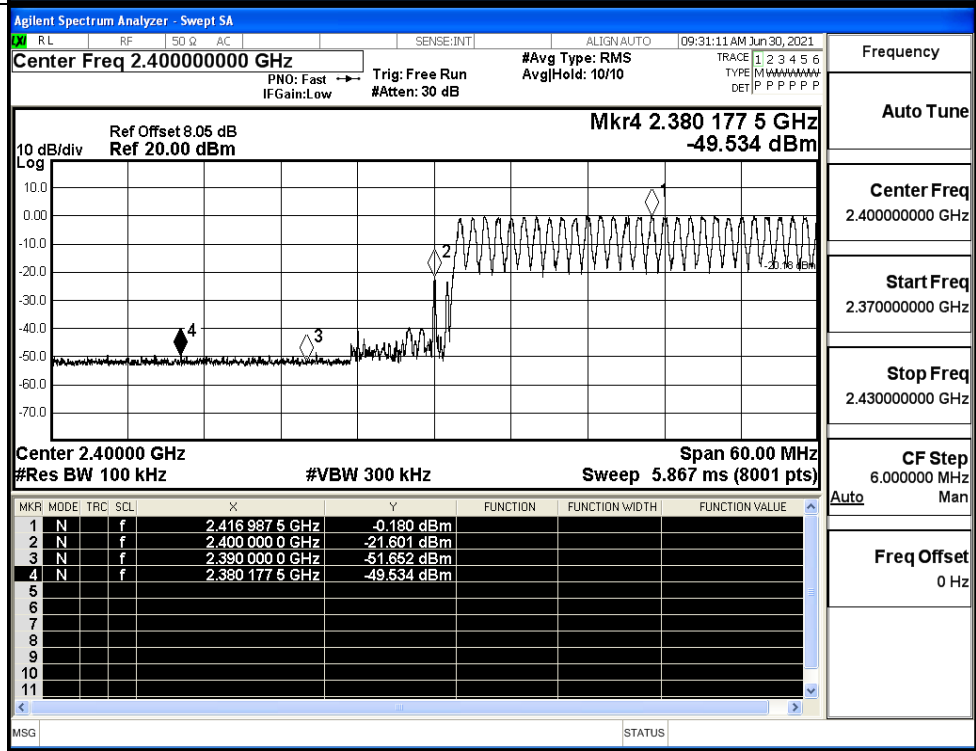


Test Graphs

GFSK/LCH/No Hop

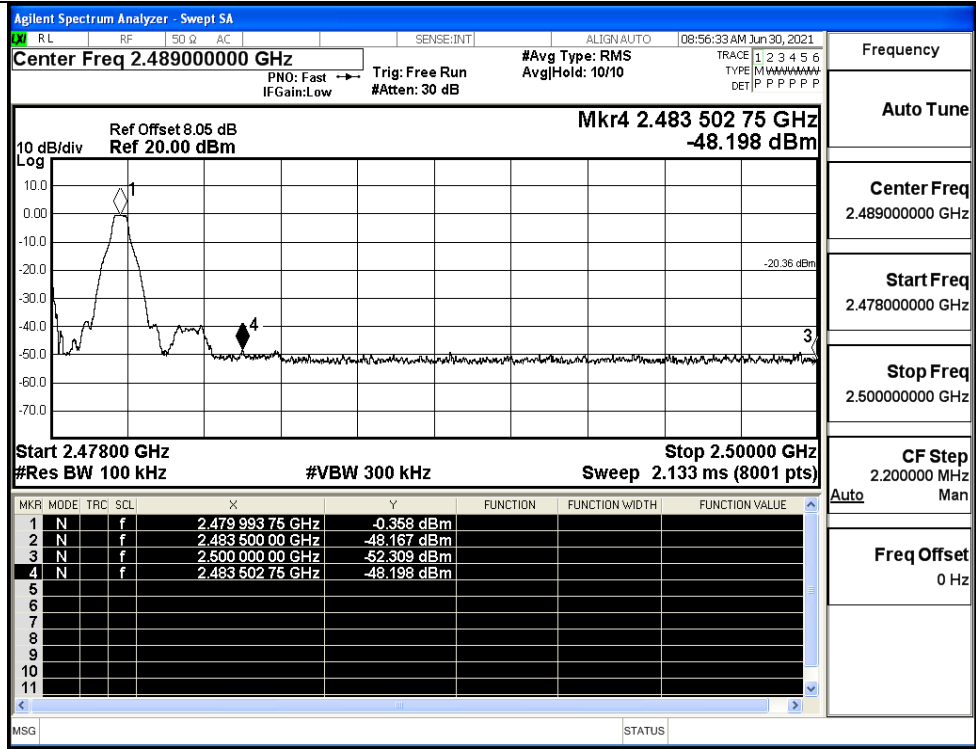


GFSK/LCH/Hop

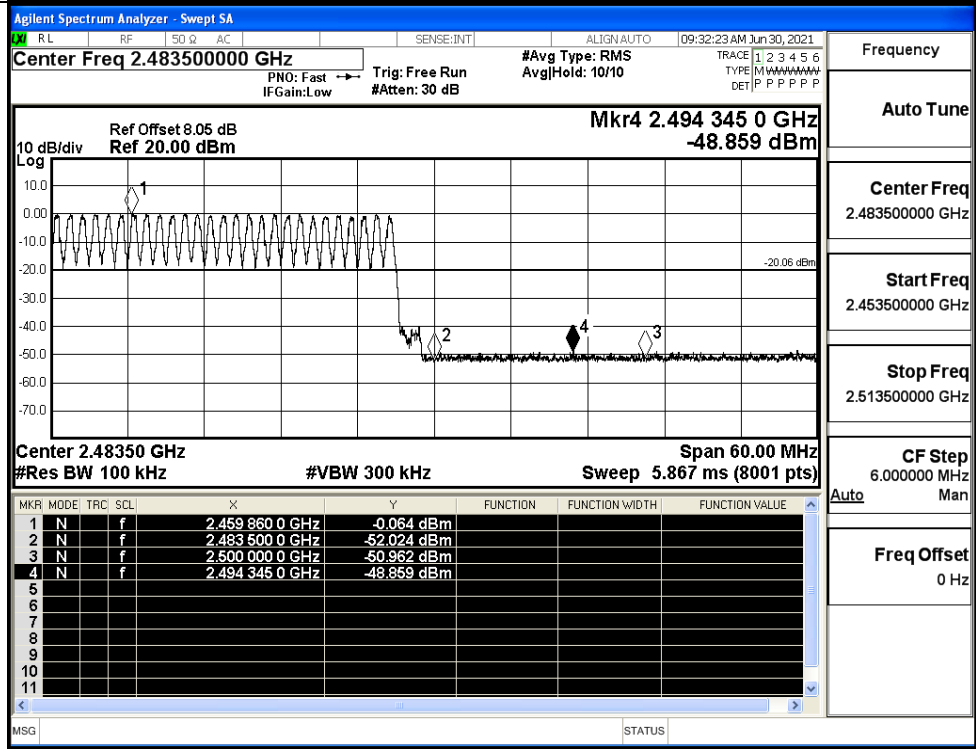




GFSK/HCH/No Hop

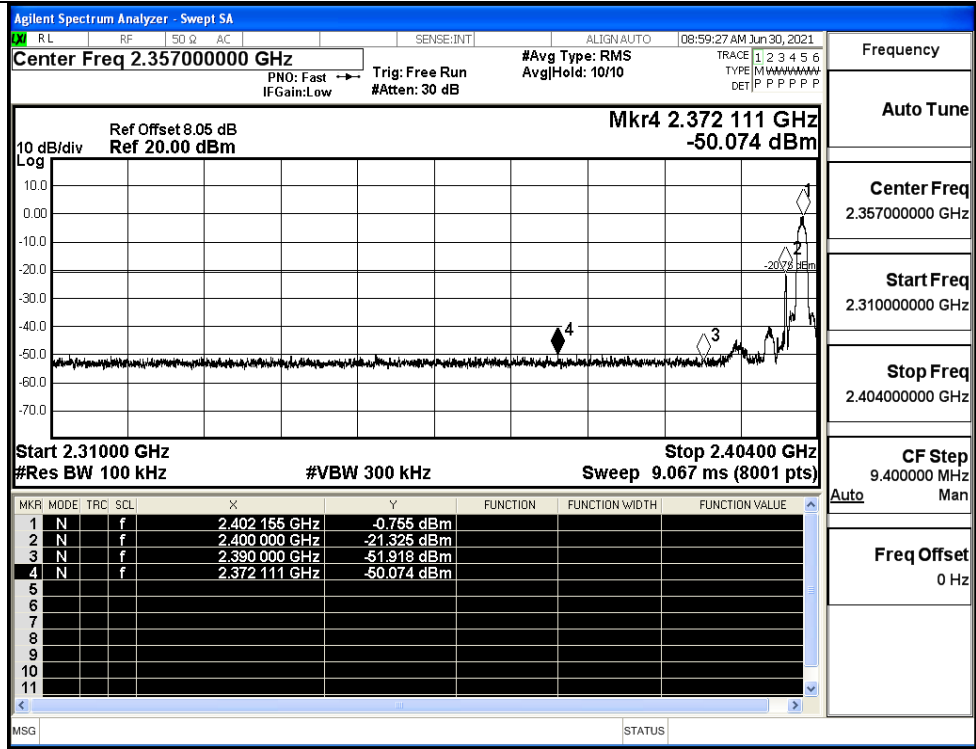


GFSK/HCH/Hop

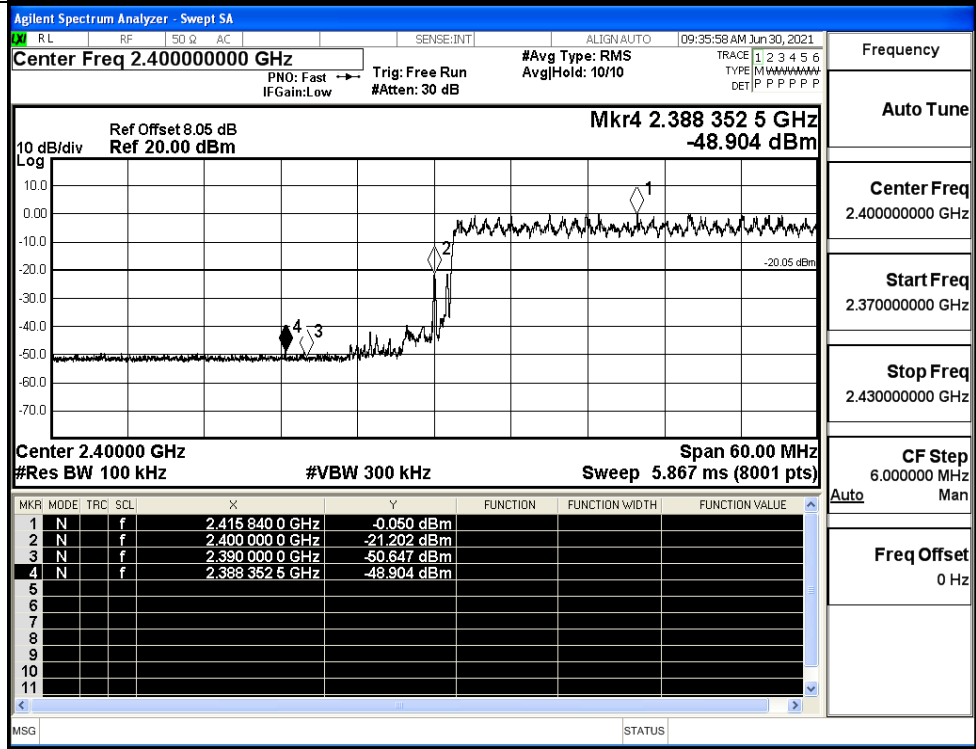




$\pi/4$ DQPSK/LCH/No Hop



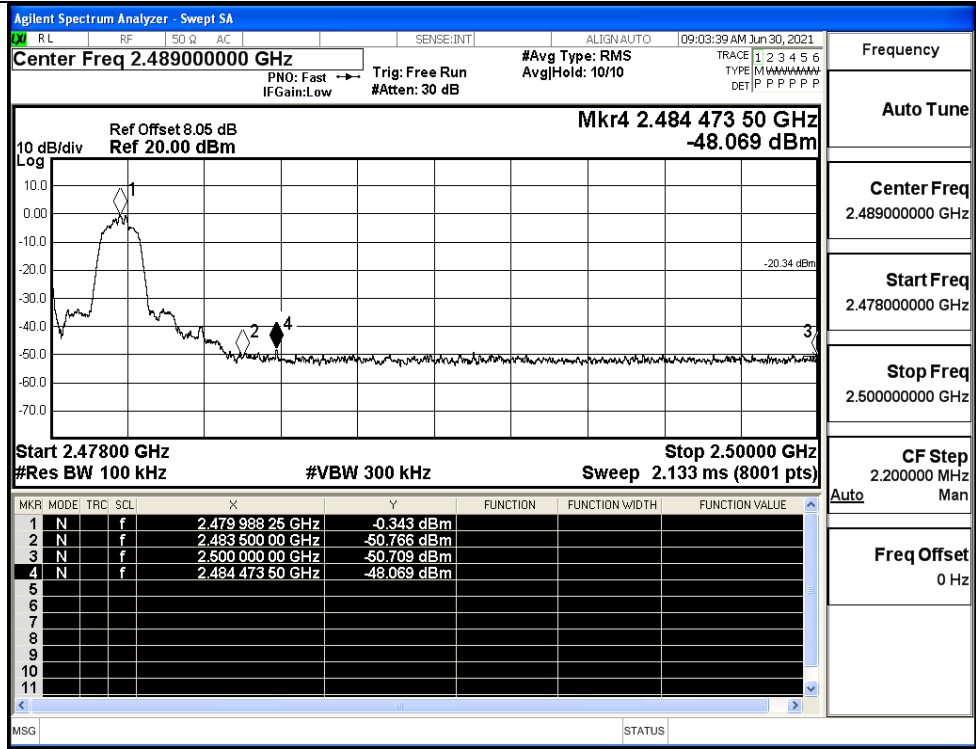
$\pi/4$ DQPSK/LCH/Hop



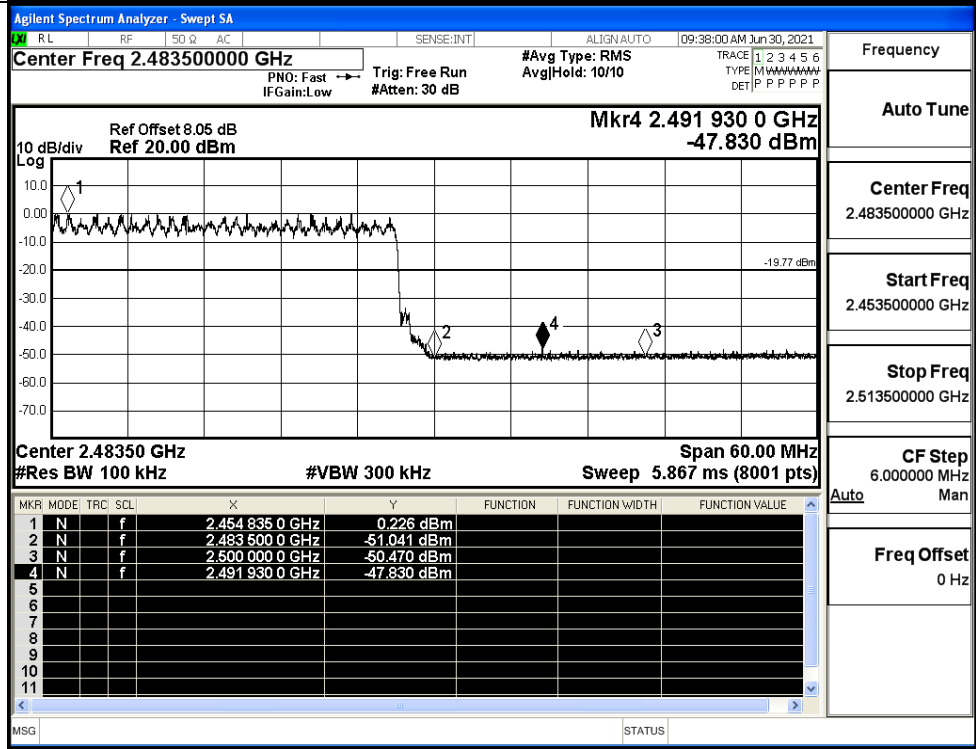




$\pi/4$ DQPSK/HCH/No Hop



$\pi/4$ DQPSK/HCH/Hop



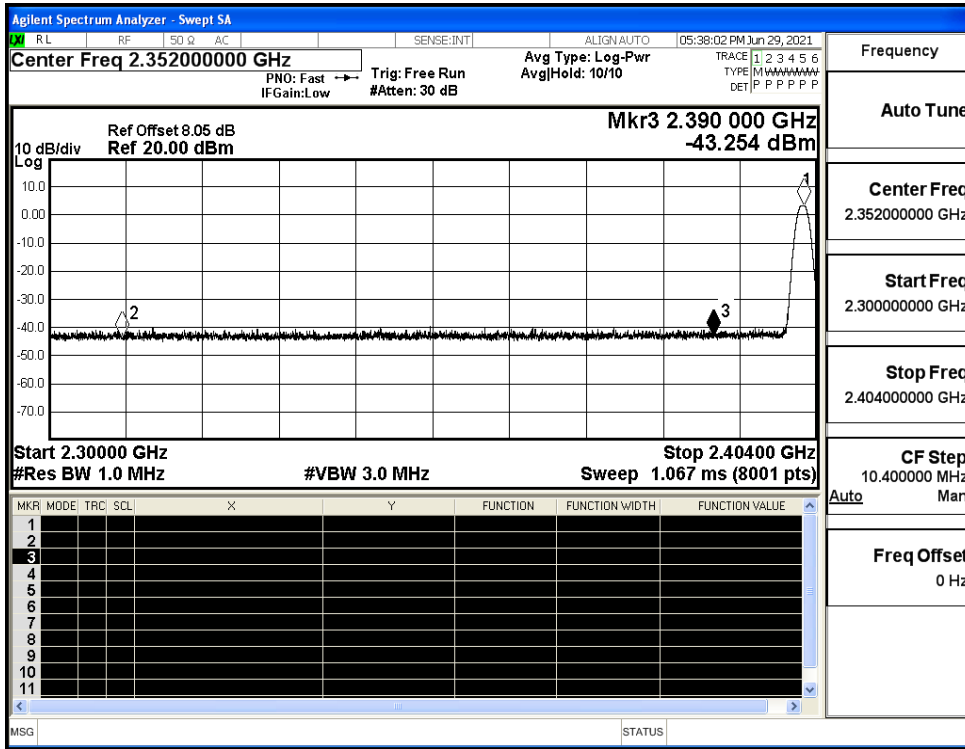


## A.8 Restrict-band band-edge measurements

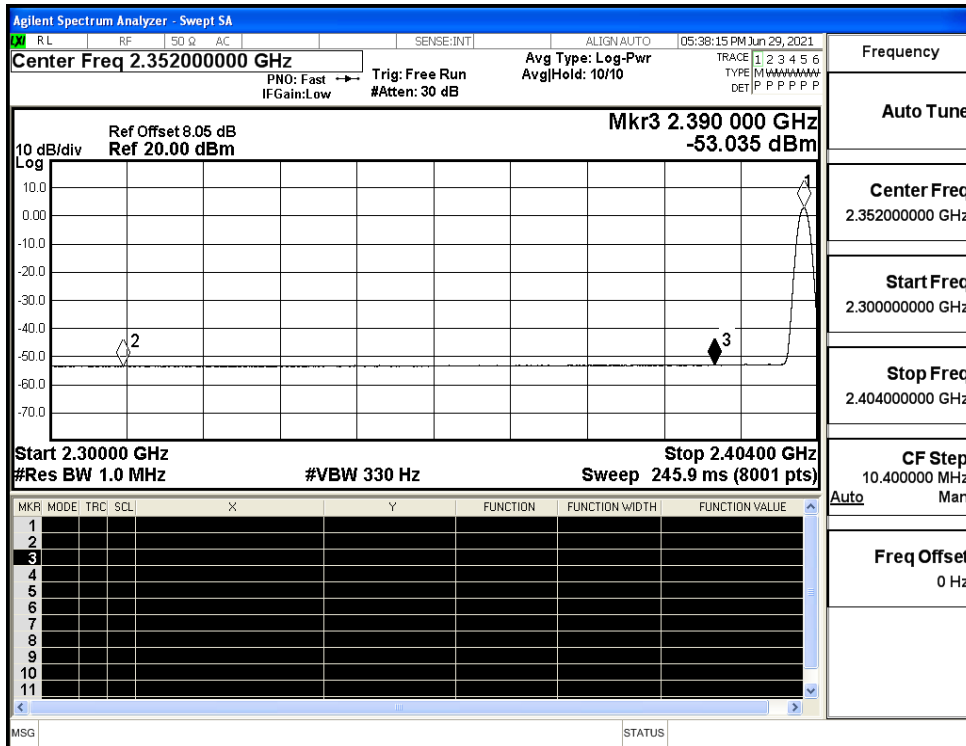
Test Mode	Hopping	Freq.	Power [dBm]	Gain	Ground Factor	E [dBUV/m]	Detector	Limit [dBUV/m]	Verdict
GFSK	Off	2310.0	-43.72	2.0	0	53.51	PEAK	74	PASS
	Off	2310.0	-53.42	2.0	0	43.81	AV	54	PASS
	Off	2390.0	-43.25	2.0	0	53.98	PEAK	74	PASS
	Off	2390.0	-53.04	2.0	0	44.19	AV	54	PASS
	Off	2483.5	-42.35	2.0	0	54.88	PEAK	74	PASS
	Off	2483.5	-52.48	2.0	0	44.75	AV	54	PASS
	Off	2500.0	-41.41	2.0	0	55.82	PEAK	74	PASS
	Off	2500.0	-52.41	2.0	0	44.82	AV	54	PASS
$\pi/4$ DQPSK	Off	2310.0	-43.26	2.0	0	53.97	PEAK	74	PASS
	Off	2310.0	-53.46	2.0	0	43.77	AV	54	PASS
	Off	2390.0	-42.18	2.0	0	55.05	PEAK	74	PASS
	Off	2390.0	-53.06	2.0	0	44.17	AV	54	PASS
	Off	2483.5	-42.45	2.0	0	54.78	PEAK	74	PASS
	Off	2483.5	-52.35	2.0	0	44.88	AV	54	PASS
	Off	2500.0	-41.10	2.0	0	56.13	PEAK	74	PASS
	Off	2500.0	-52.36	2.0	0	44.87	AV	54	PASS



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

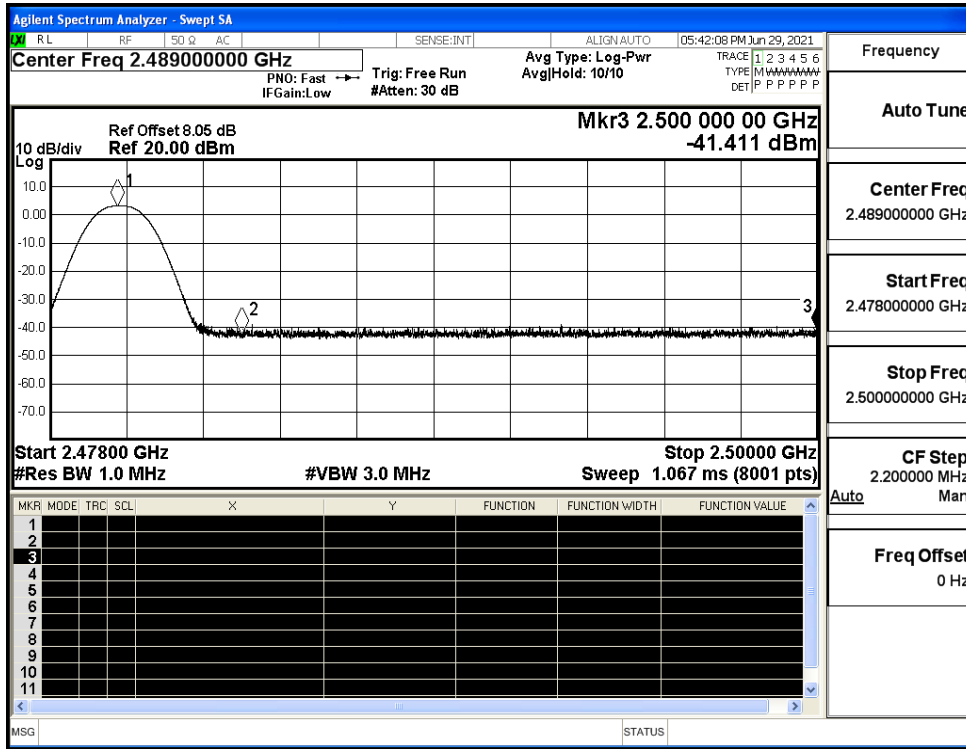


Restrict-band band-edge measurements\_Hopping Off\_GFSK\_Average (Low Channel)

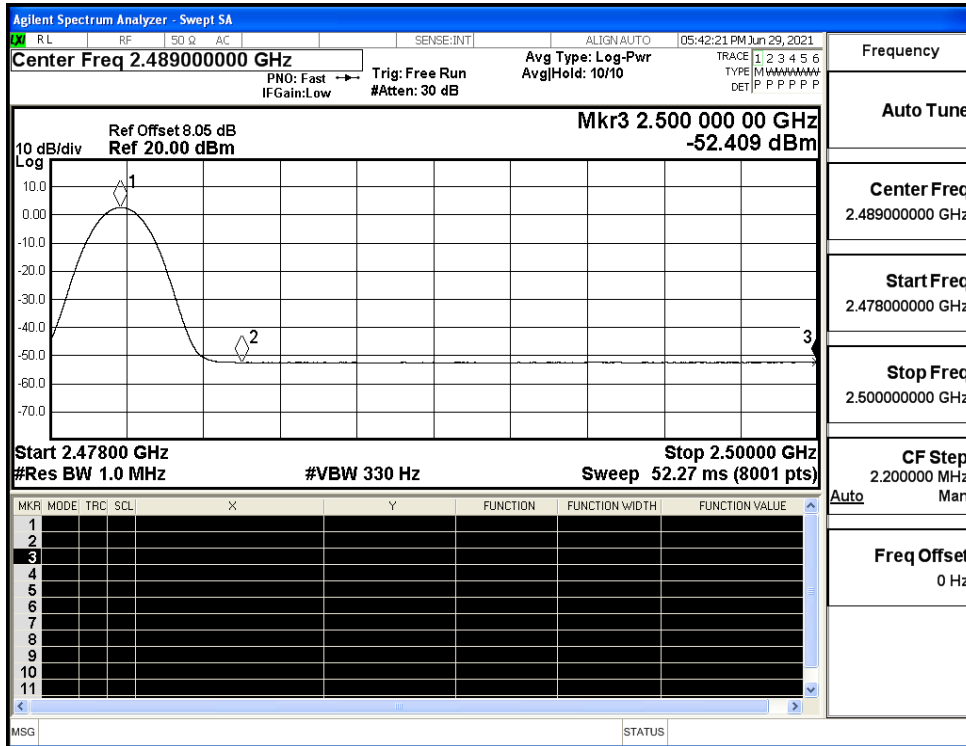




Restrict-band band-edge measurements\_Hopping Off\_ GFSK\_PEAK (High Channel)

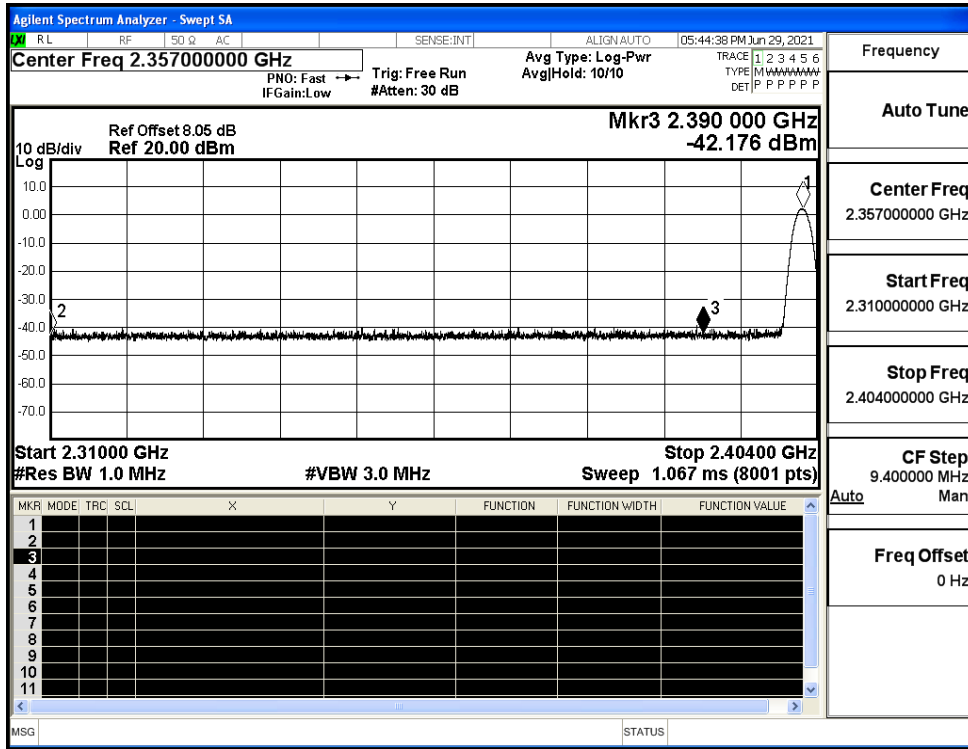


Restrict-band band-edge measurements\_Hopping Off\_ GFSK\_Average (High Channel)

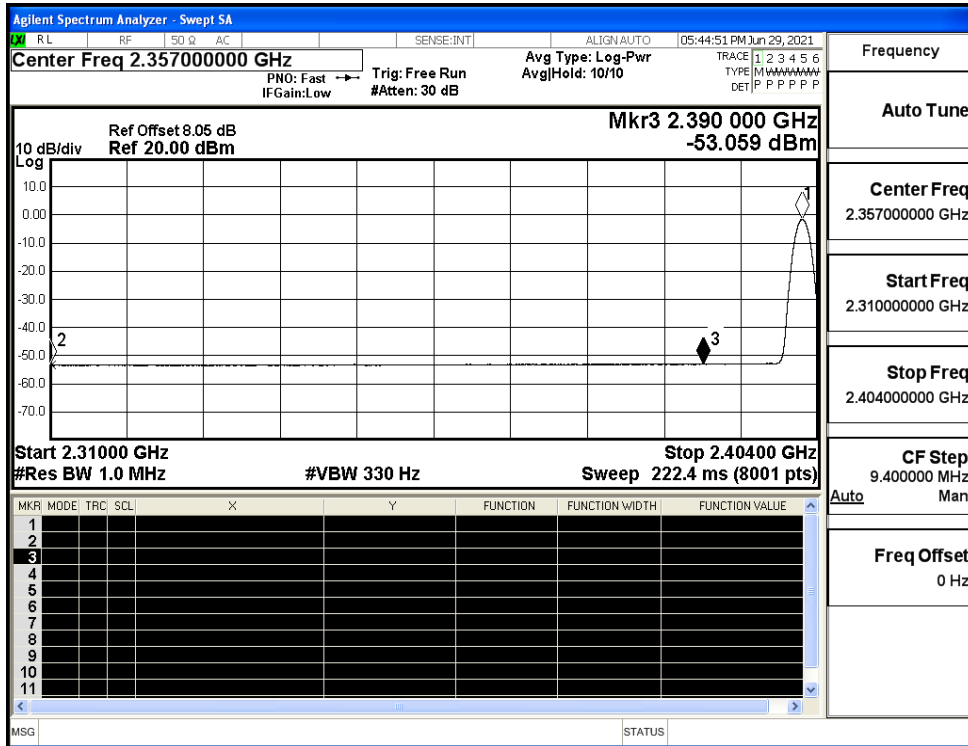




Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_PEAK (Low Channel)

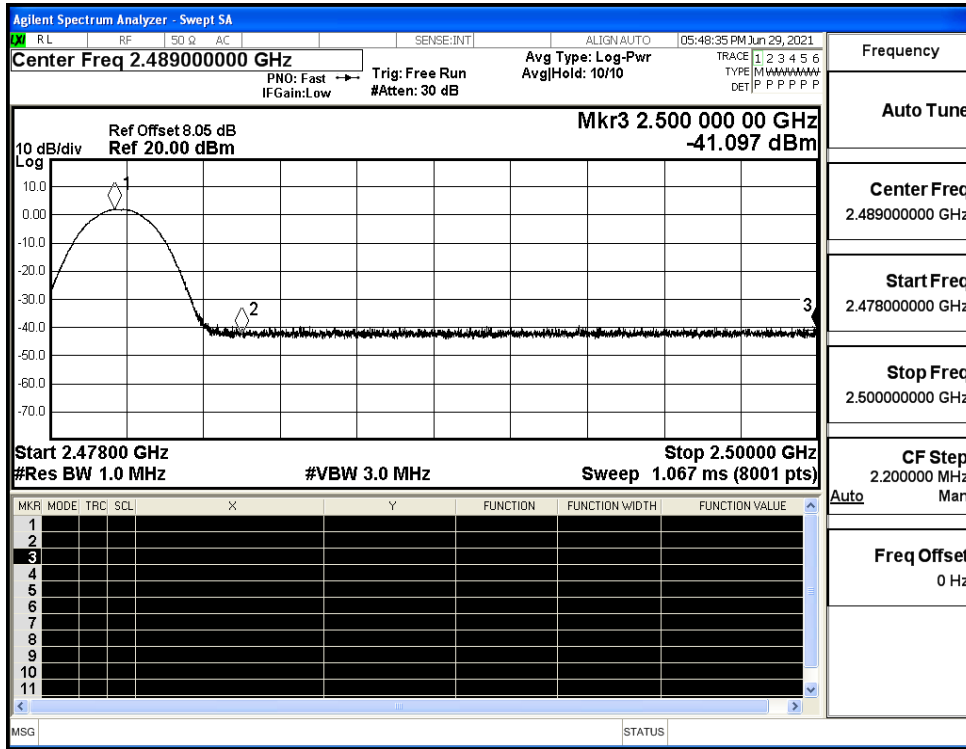


Restrict-band band-edge measurements\_Hopping Off\_π/4-DQPSK\_Average (Low Channel)





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)

