

## Appendix A

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

Product Name: HyperGear True Wireless Earbuds

Trade Mark: HyperGear

Test Model: 15165

#### Environmental Conditions

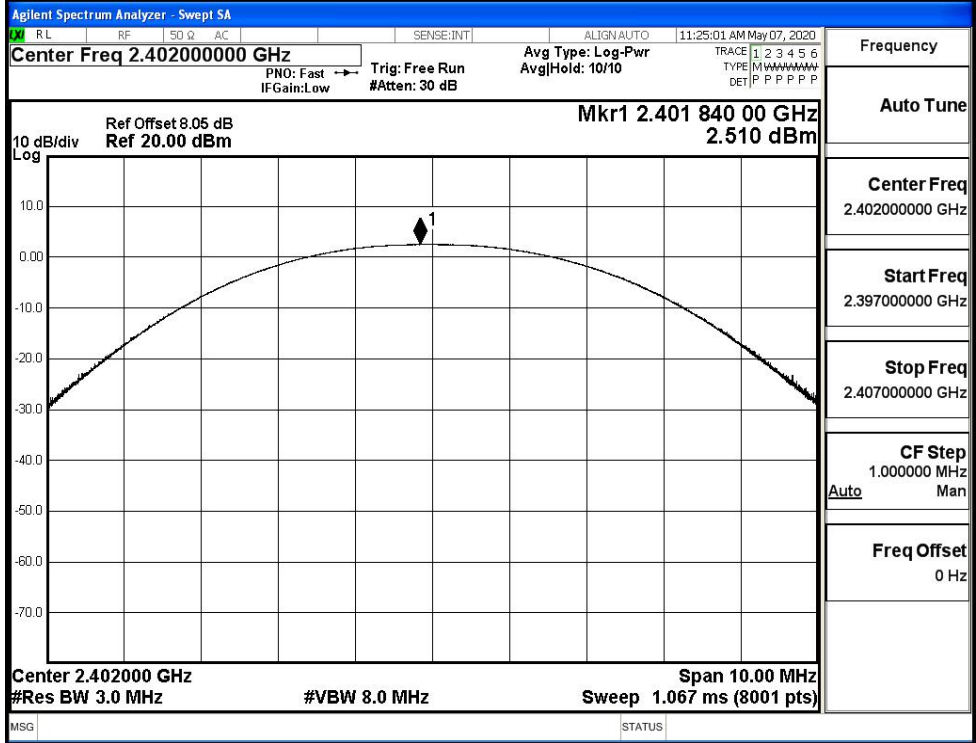
Temperature:	23.7 ° C
Relative Humidity:	54.5%
ATM Pressure:	100.0 kPa
Test Engineer:	Diamond Lu
Supervised by:	Li Huan

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

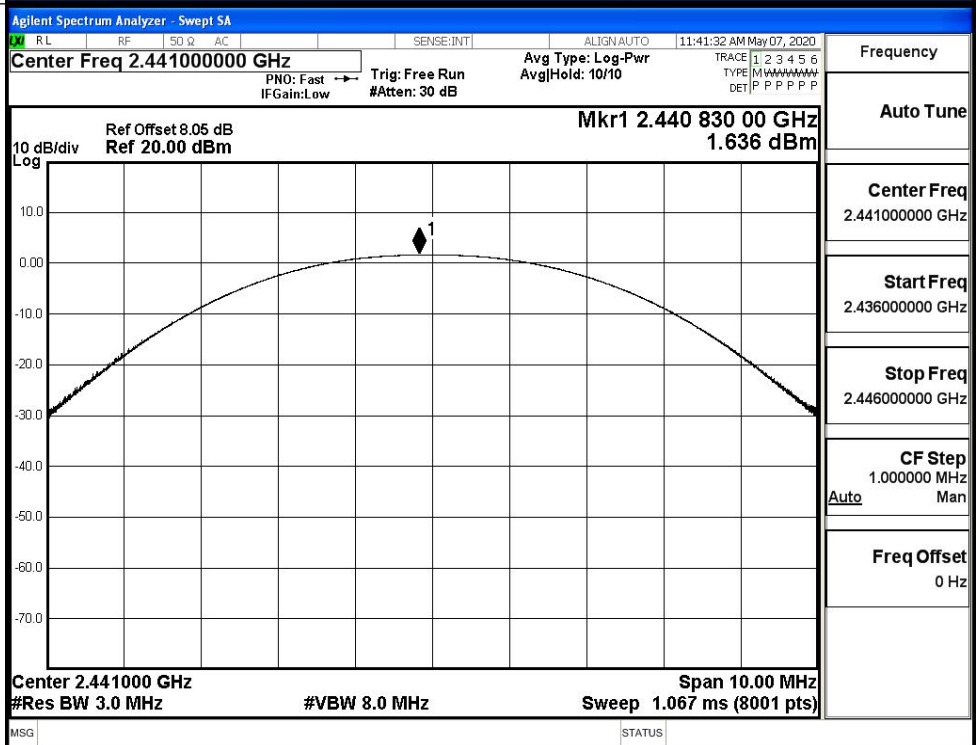
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2.510	21	PASS
	MCH	1.636	21	PASS
	HCH	0.767	21	PASS
$\pi/4$ DQPSK	LCH	2.957	21	PASS
	MCH	2.178	21	PASS
	HCH	1.444	21	PASS
8DPSK	LCH	3.469	21	PASS
	MCH	2.709	21	PASS
	HCH	1.923	21	PASS

Test Graphs

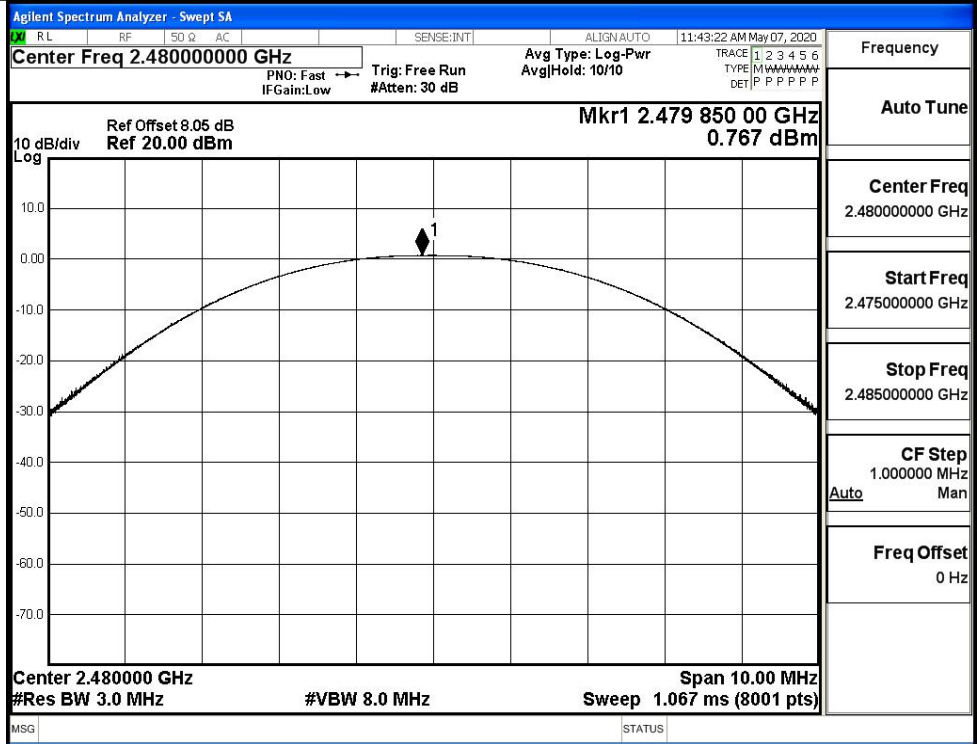
GFSK/LCH



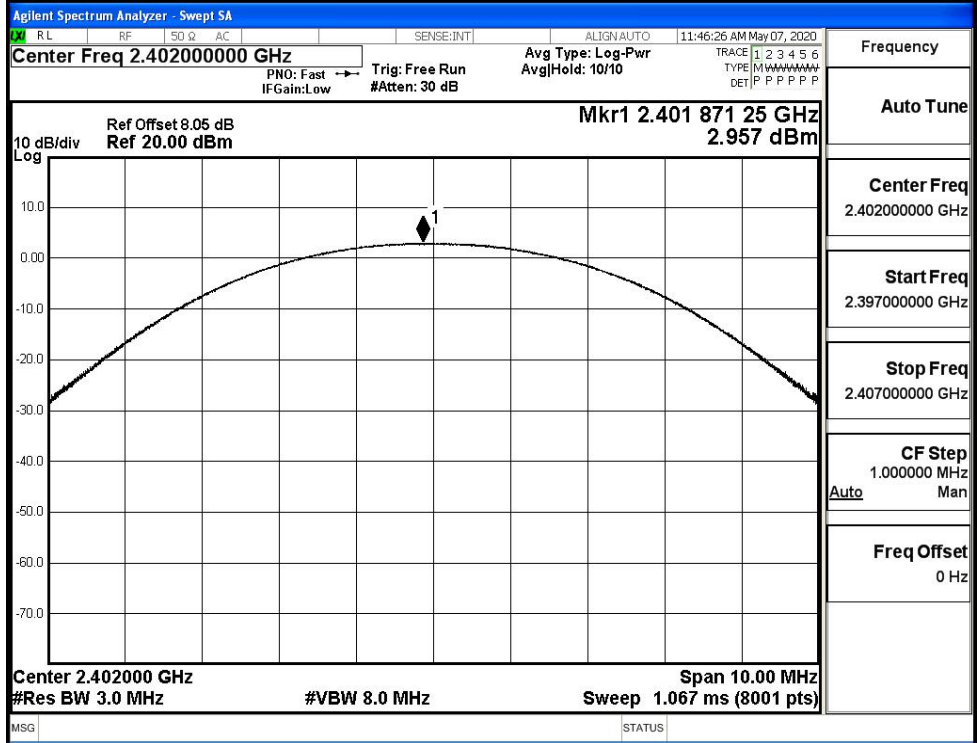
GFSK/MCH



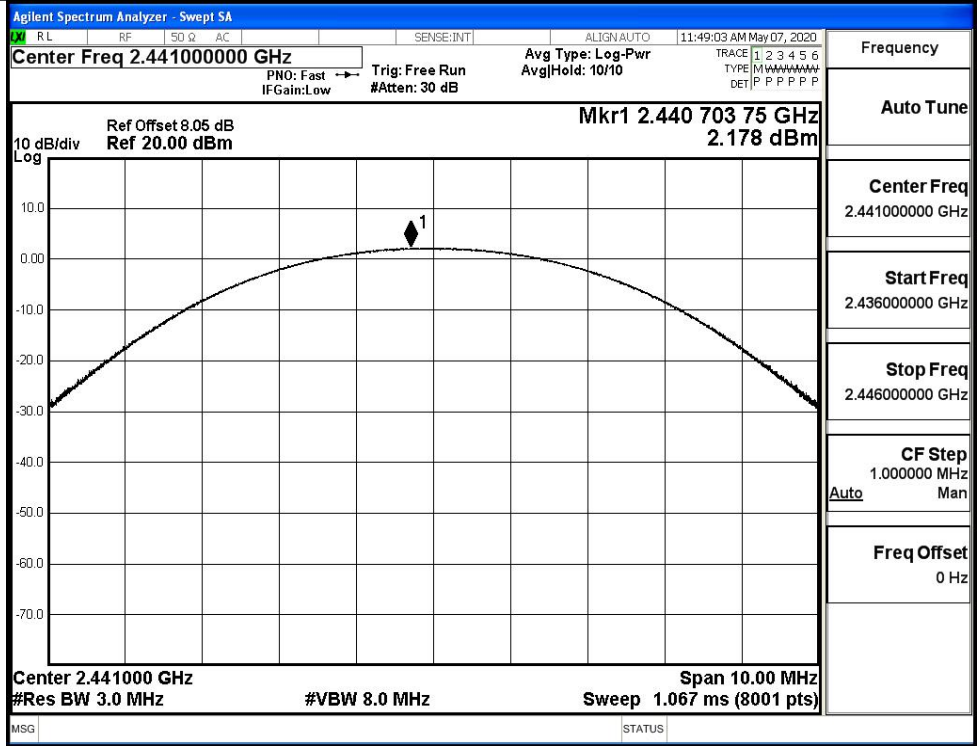
GFSK/HCH



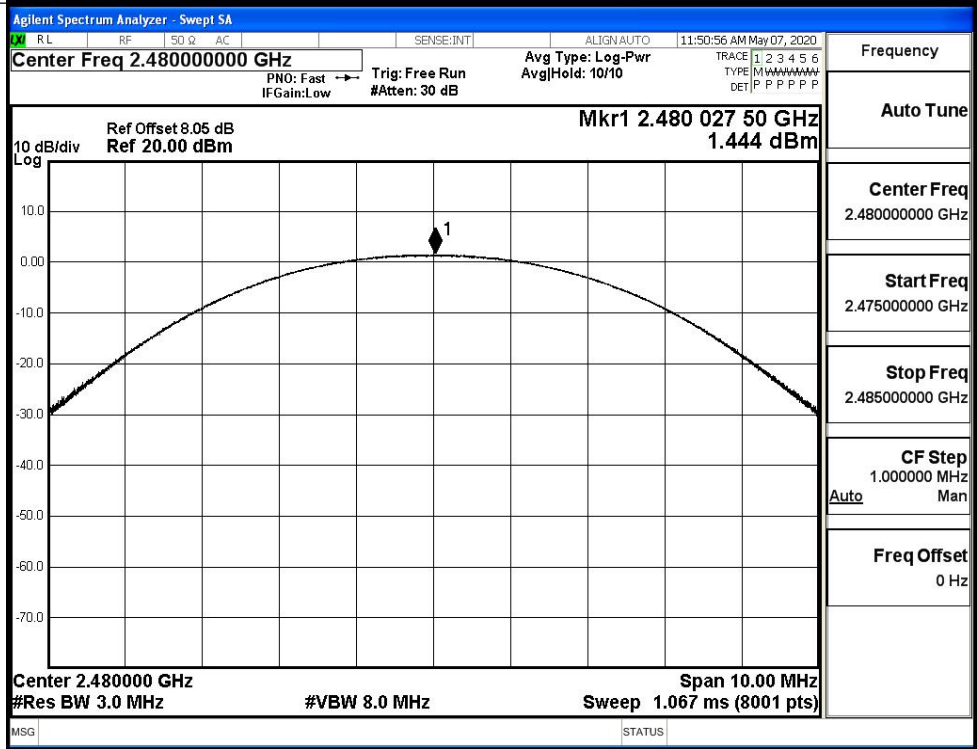
$\pi$ /4DQPSK/LCH



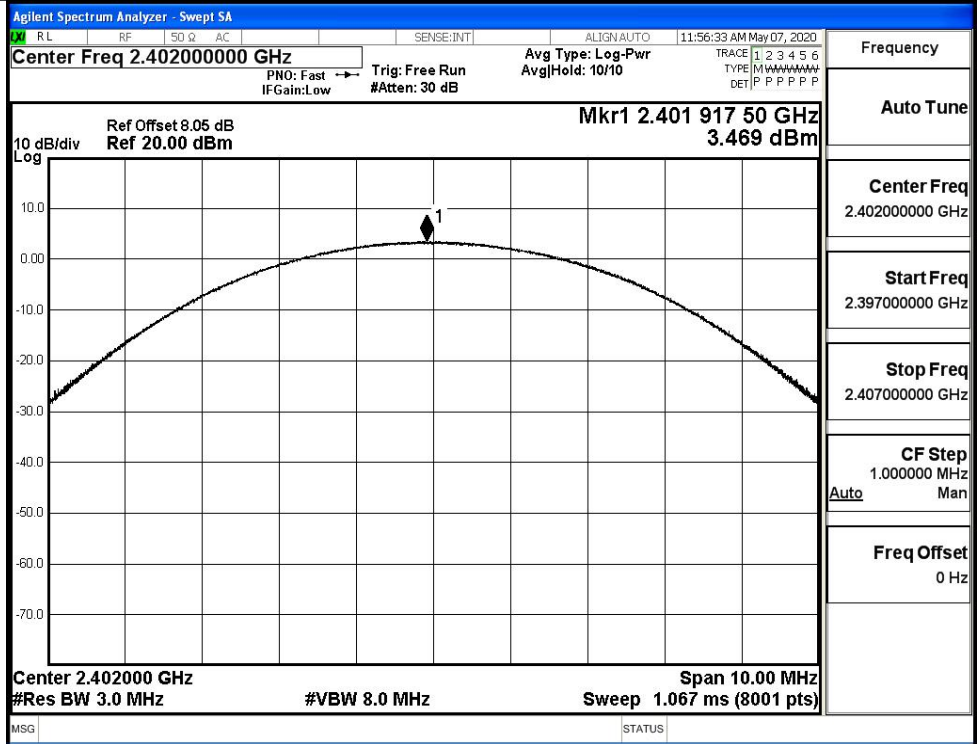
$\pi/4$ DQPSK/MCH



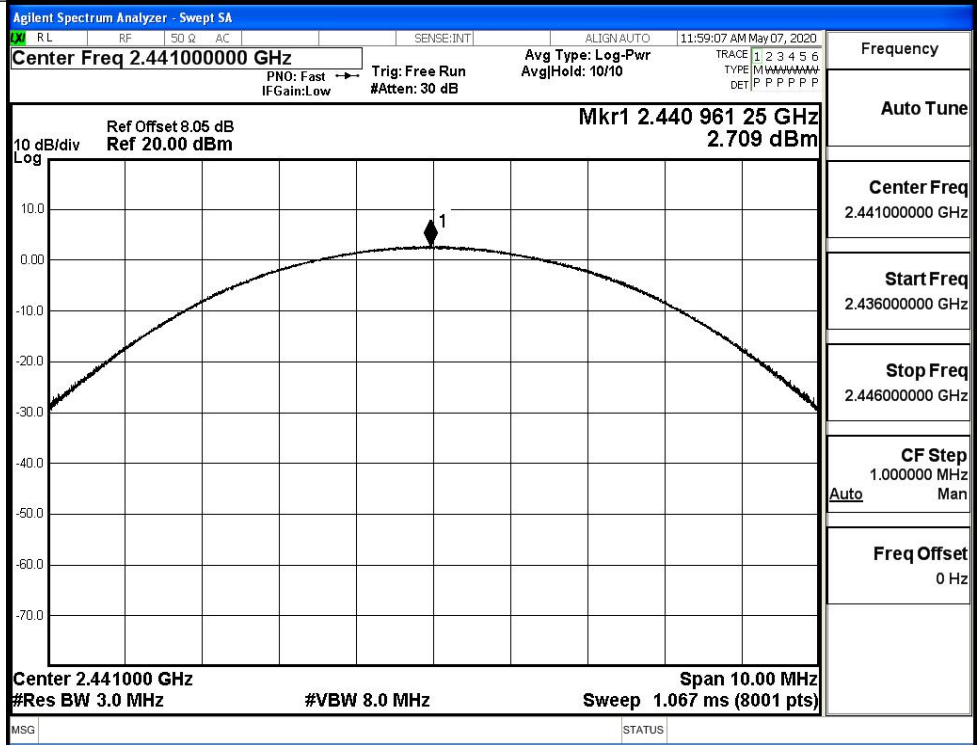
$\pi/4$ DQPSK/HCH



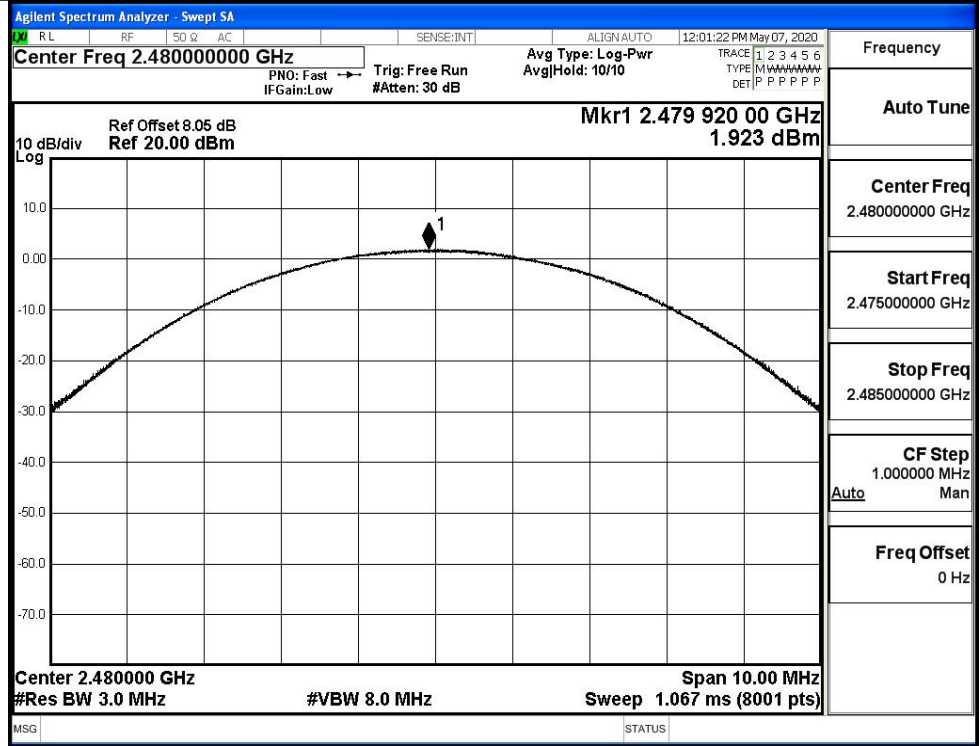
8DPSK/LCH



8DPSK/MCH

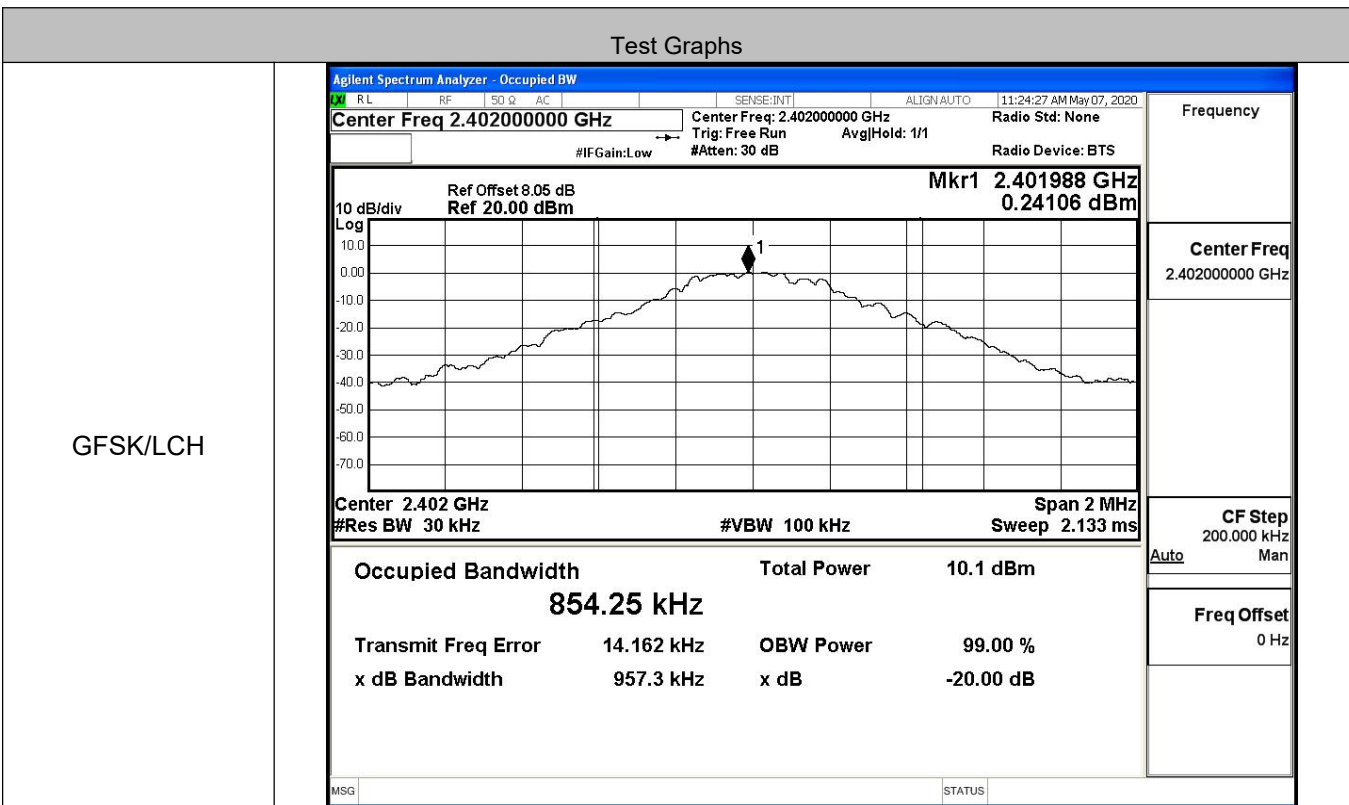


8DPSK/HCH

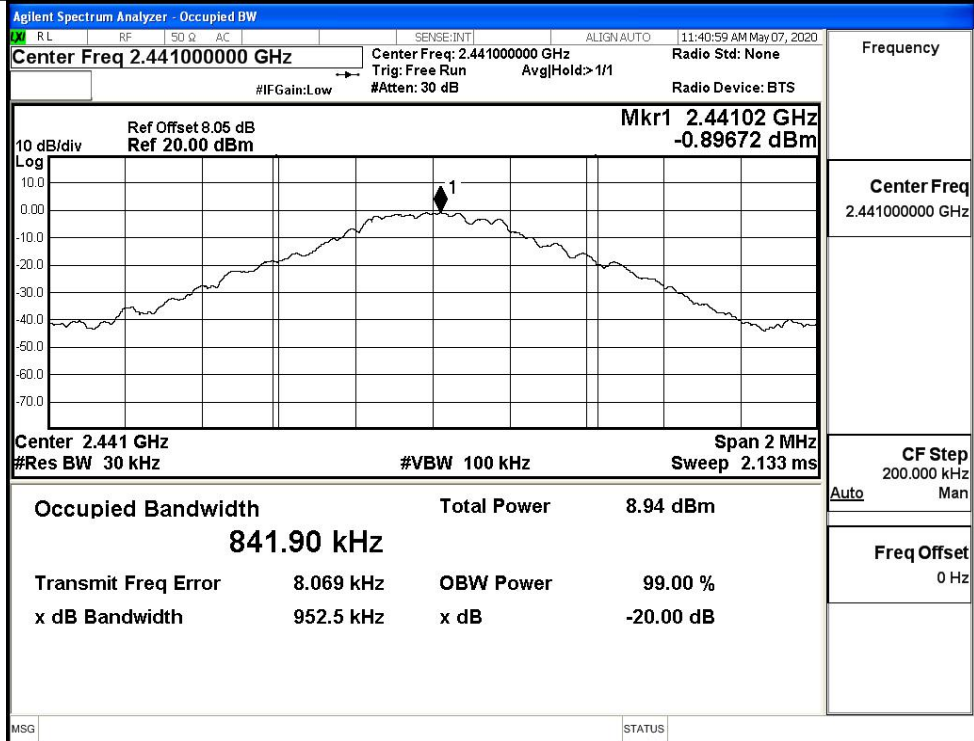


**A.2 20dB Bandwidth**

Mode	Channel.	20dB Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.9573	Not Specified	PASS
	MCH	0.9525	Not Specified	PASS
	HCH	0.9542	Not Specified	PASS
$\pi/4$ DQPSK	LCH	1.322	Not Specified	PASS
	MCH	1.319	Not Specified	PASS
	HCH	1.314	Not Specified	PASS
8DPSK	LCH	1.311	Not Specified	PASS
	MCH	1.310	Not Specified	PASS
	HCH	1.309	Not Specified	PASS



GFSK/MCH



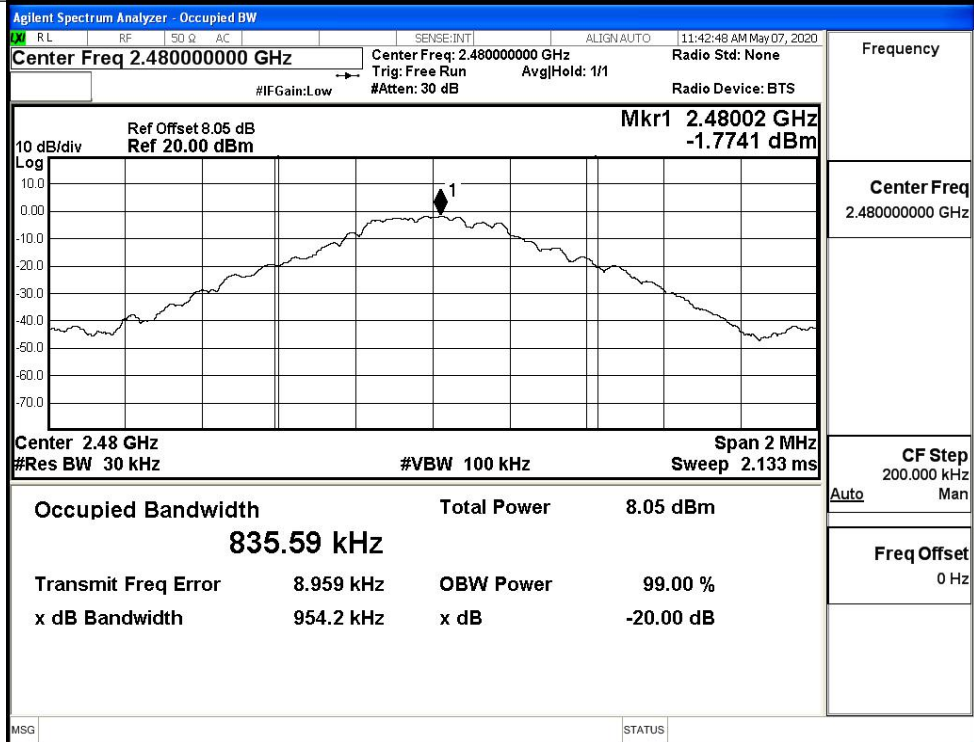
Frequency

Center Freq  
2.441000000 GHz

CF Step  
200.000 kHz

Freq Offset  
0 Hz

GFSK/HCH



Frequency

Center Freq  
2.480000000 GHz

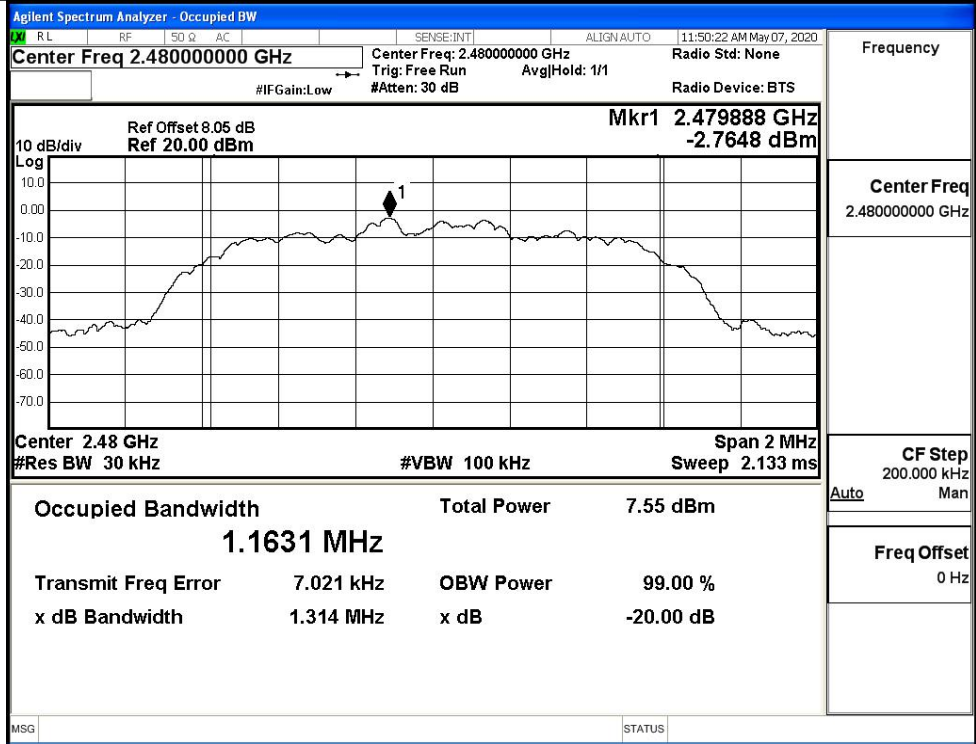
CF Step  
200.000 kHz

Freq Offset  
0 Hz

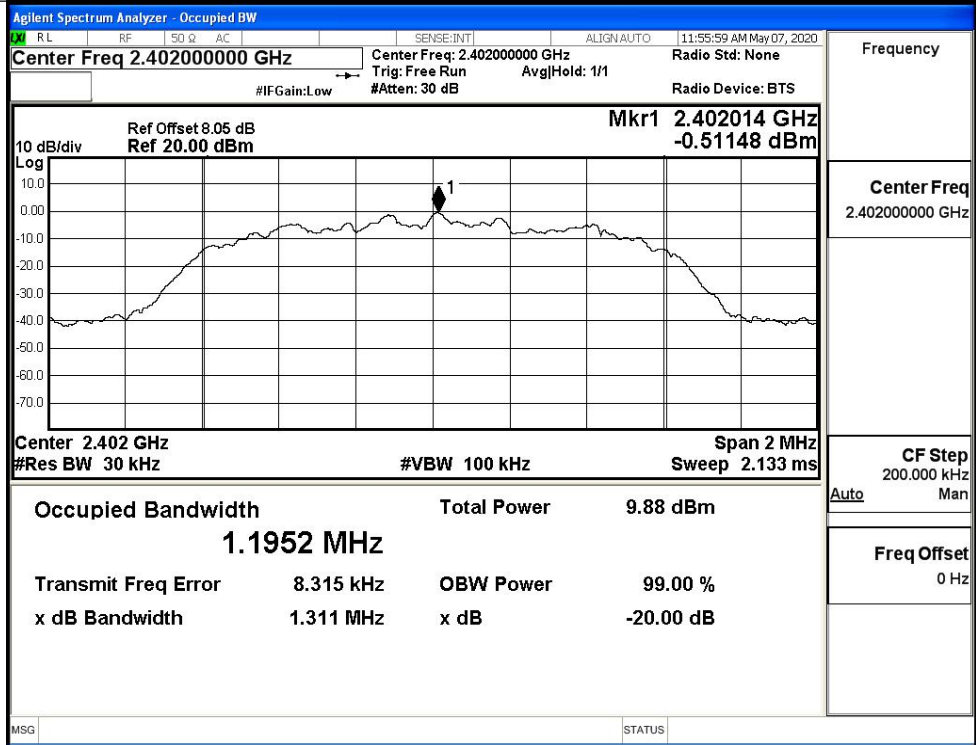


<p style="text-align: center;">π/4DQPSK/LCH</p>	<p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.40200000 GHz</p> <p>Center Freq: 2.40200000 GHz Trig: Free Run AvgHold: 1/1</p> <p>Radio Std: None Radio Device: BTS</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p>Mkr1 2.401882 GHz -1.3317 dBm</p> <p>Center 2.402 GHz #Res BW 30 kHz</p> <p>#VBW 100 kHz</p> <p>Span 2 MHz Sweep 2.133 ms</p> <p>Occupied Bandwidth 1.1682 MHz</p> <p>Total Power 9.16 dBm</p> <p>Transmit Freq Error 7.374 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.322 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>Center Freq: 2.44100000 GHz Trig: Free Run AvgHold: &gt;1/1</p> <p>Radio Std: None Radio Device: BTS</p> <p>Ref Offset 8.05 dB Ref 20.00 dBm</p> <p>Mkr1 2.440882 GHz -2.1137 dBm</p> <p>Center 2.441 GHz #Res BW 30 kHz</p> <p>#VBW 100 kHz</p> <p>Span 2 MHz Sweep 2.133 ms</p> <p>Occupied Bandwidth 1.1669 MHz</p> <p>Total Power 8.26 dBm</p> <p>Transmit Freq Error 7.374 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.319 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>

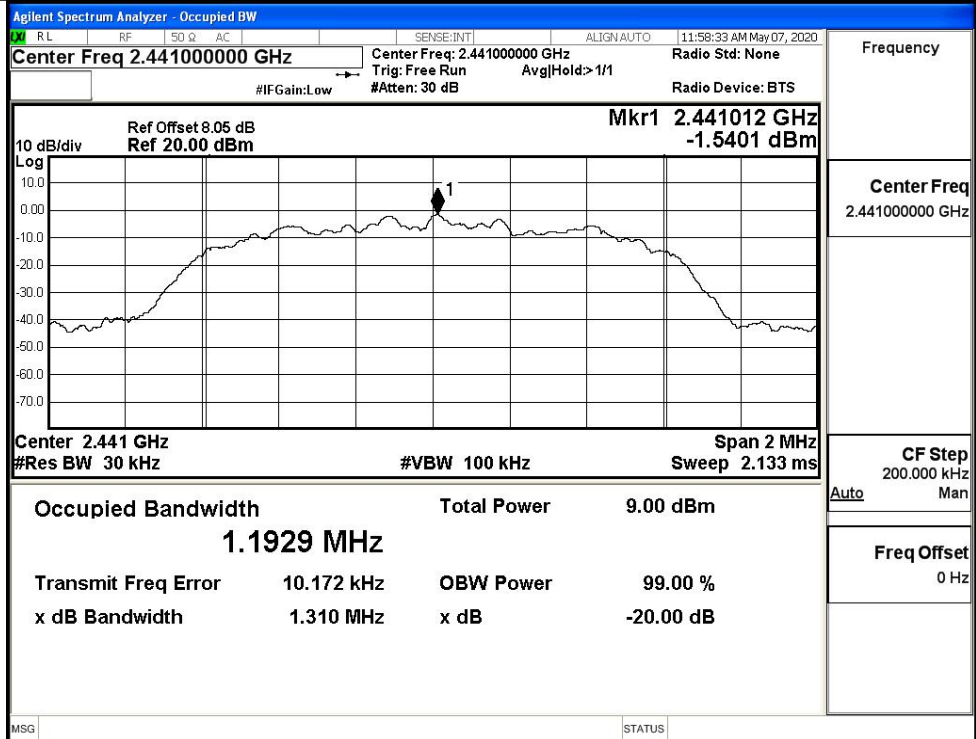
$\pi/4$ DQPSK/HCH



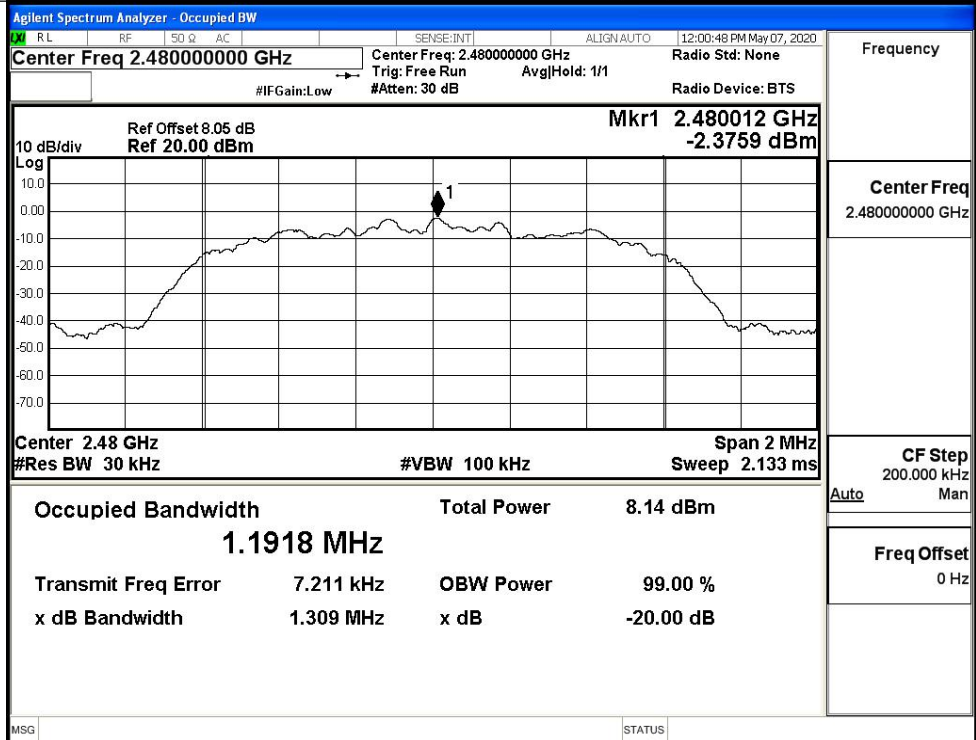
8DPSK/LCH



8DPSK/MCH



8DPSK/HCH



### A.3 Carrier Frequency Separation

Mode	Channel	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.917	0.638	PASS
	MCH	1.032	0.638	PASS
	HCH	1.192	0.638	PASS
π/4DQPSK	LCH	0.904	0.881	PASS
	MCH	1.200	0.881	PASS
	HCH	1.032	0.881	PASS
8DPSK	LCH	1.166	0.874	PASS
	MCH	1.356	0.874	PASS
	HCH	0.926	0.874	PASS

**Test Graphs**

GFSK/LCH

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.402500000 GHz

Ref Offset 8.05 dB  
Ref 20.00 dBm

ΔMkr1 917.00 kHz  
0.194 dBm

Start 2.401500 GHz  
#Res BW 100 kHz

Stop 2.403500 GHz  
#VBW 300 kHz  
Sweep 1.067 ms (8001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	Δ2	f	(Δ)	917.00 kHz (Δ)	0.194 dBm			
2	F	f		2.40195125 GHz	1.685 dBm			
3								
4								
5								
6								
7								
8								
9								
10								
11								

Frequency

Auto Tune

Center Freq  
2.402500000 GHz

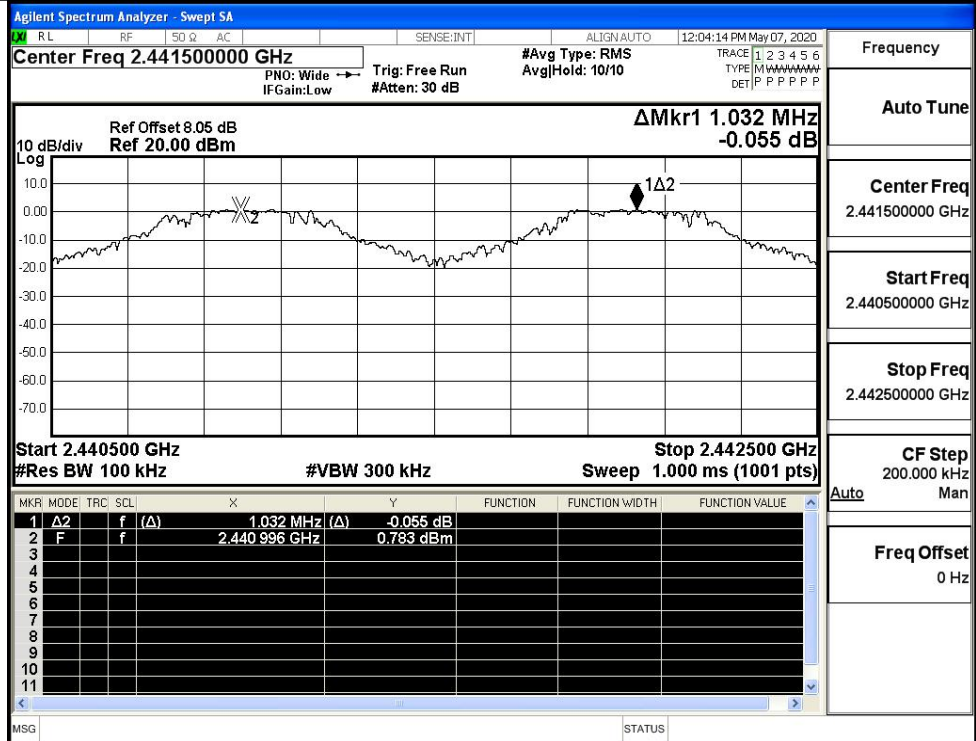
Start Freq  
2.401500000 GHz

Stop Freq  
2.403500000 GHz

CF Step  
200.000 kHz  
Auto Man

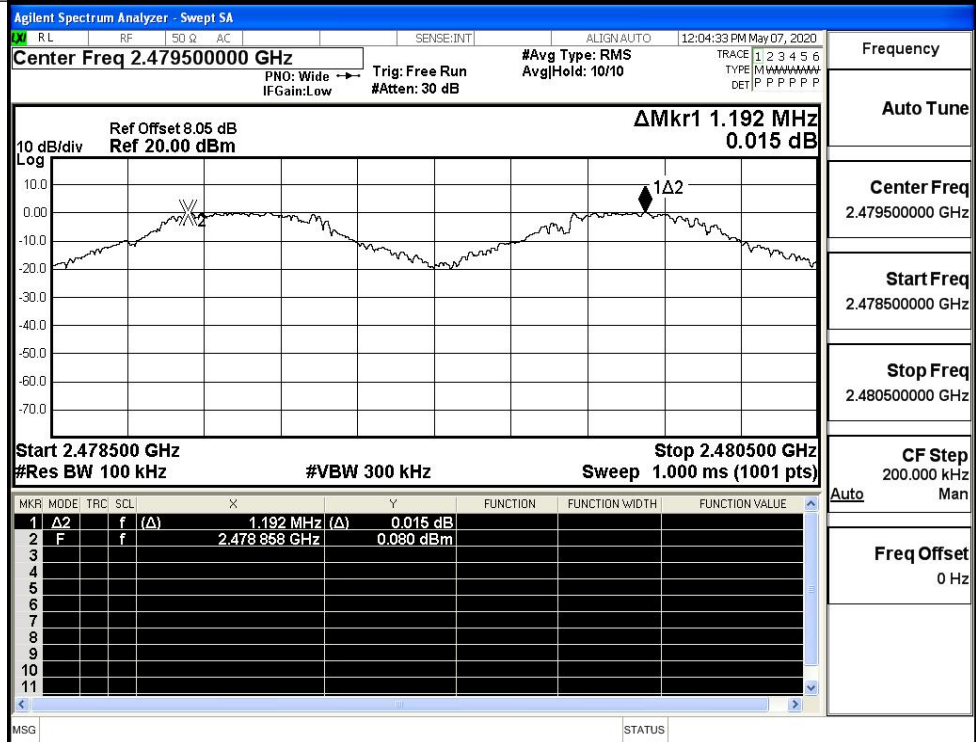
Freq Offset  
0 Hz

GFSK/MCH



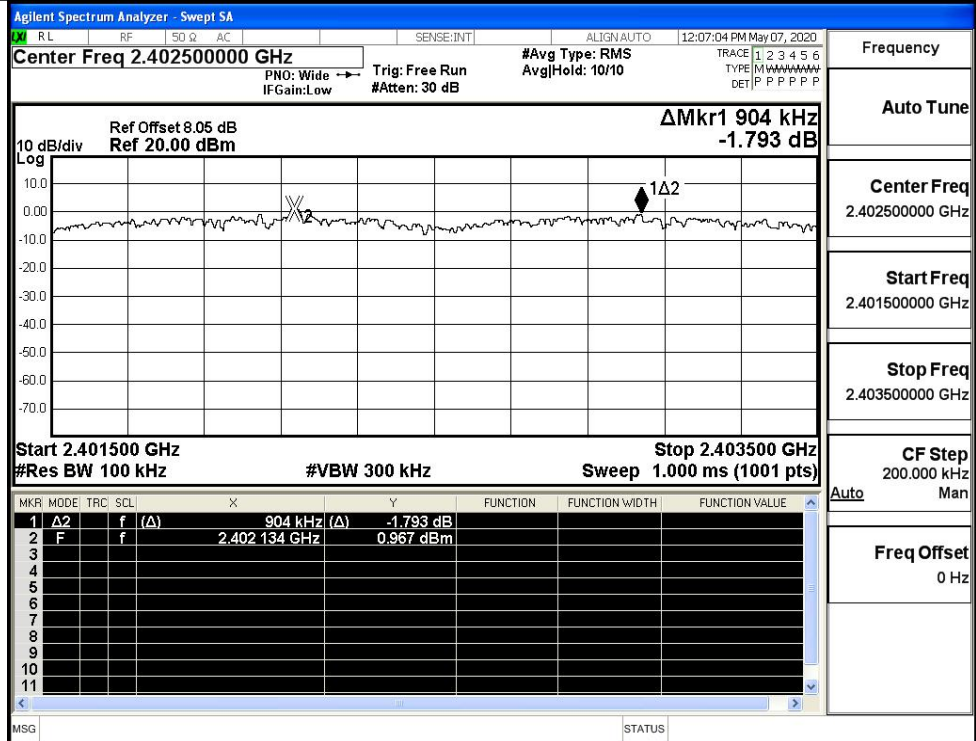
Frequency  
Auto Tune  
Center Freq  
2.441500000 GHz  
Start Freq  
2.440500000 GHz  
Stop Freq  
2.442500000 GHz  
CF Step  
200.000 kHz  
Auto Man  
Freq Offset  
0 Hz

GFSK/HCH

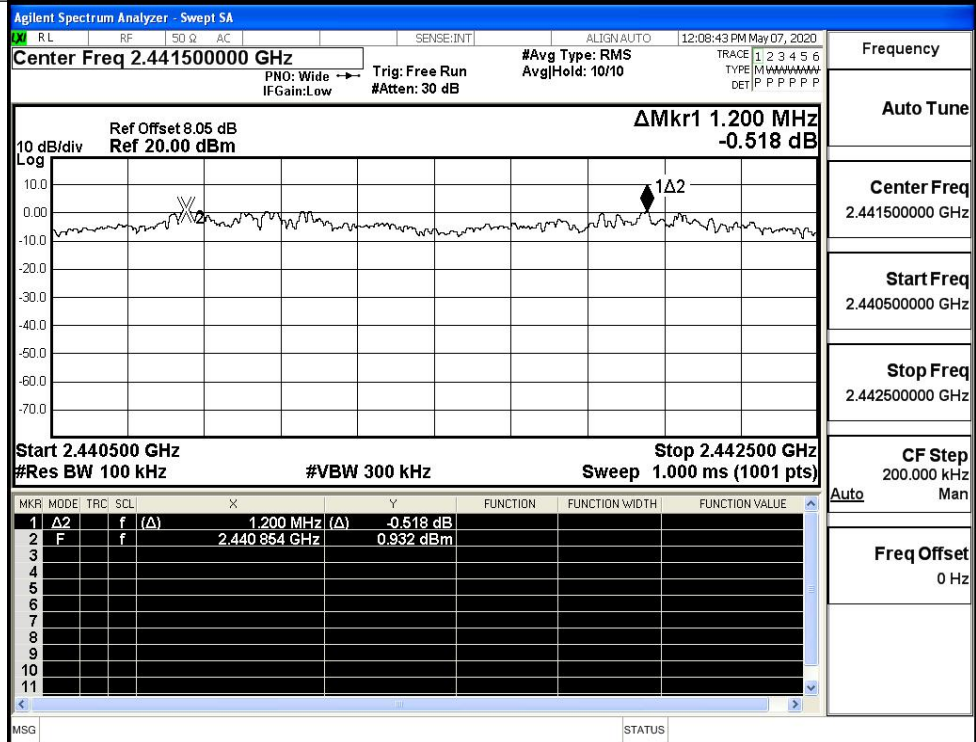


Frequency  
Auto Tune  
Center Freq  
2.479500000 GHz  
Start Freq  
2.478500000 GHz  
Stop Freq  
2.480500000 GHz  
CF Step  
200.000 kHz  
Auto Man  
Freq Offset  
0 Hz

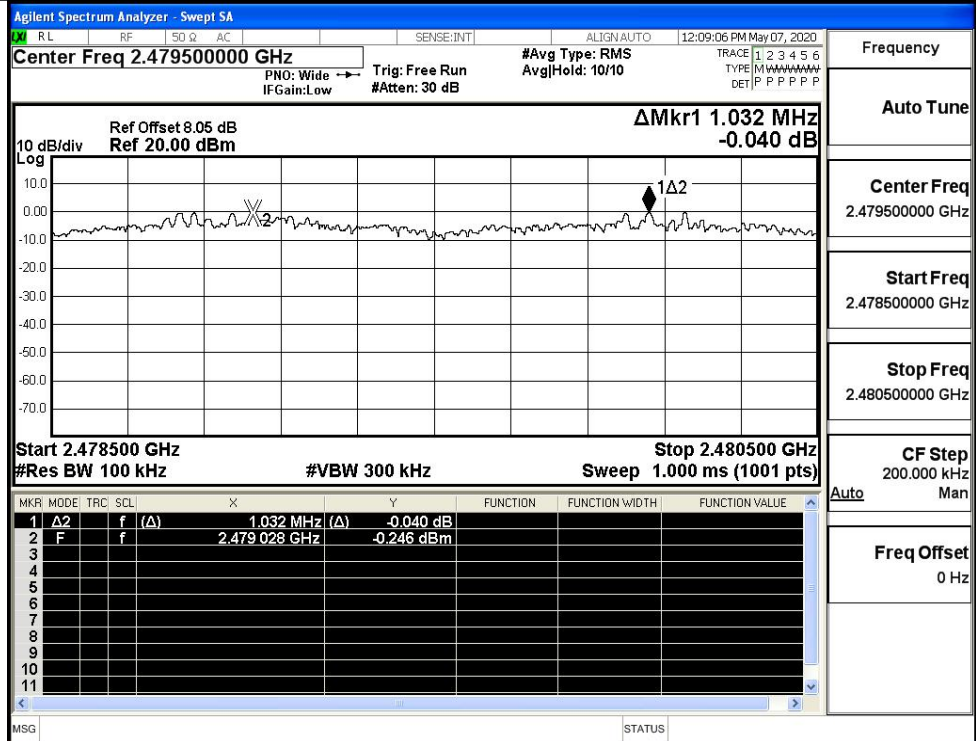
$\pi/4$ DQPSK/LCH



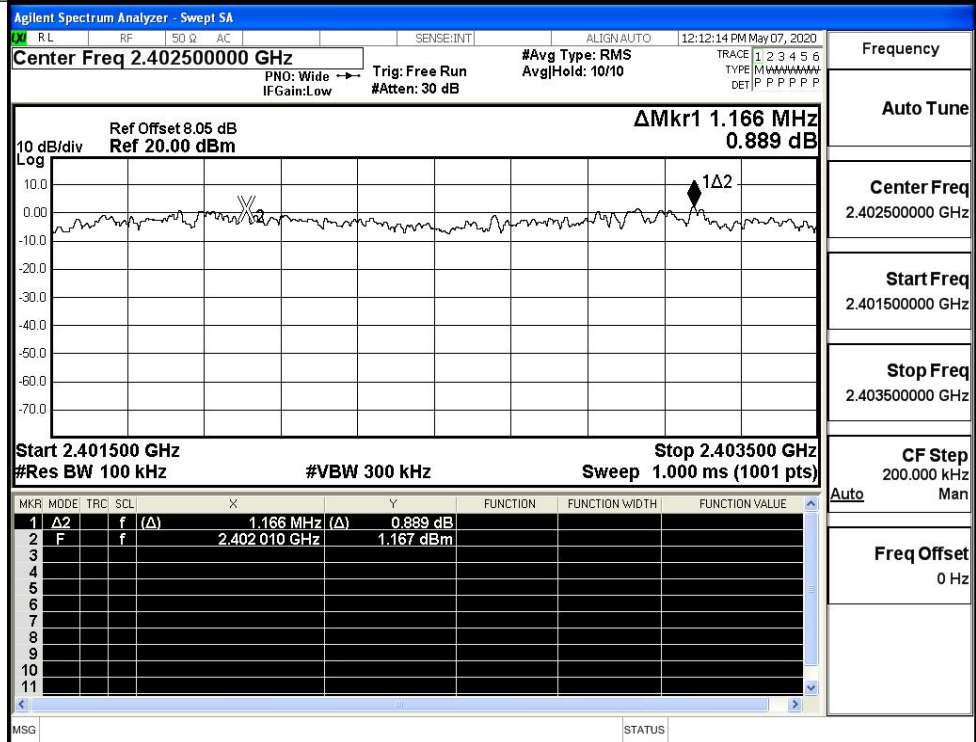
$\pi/4$ DQPSK/MCH



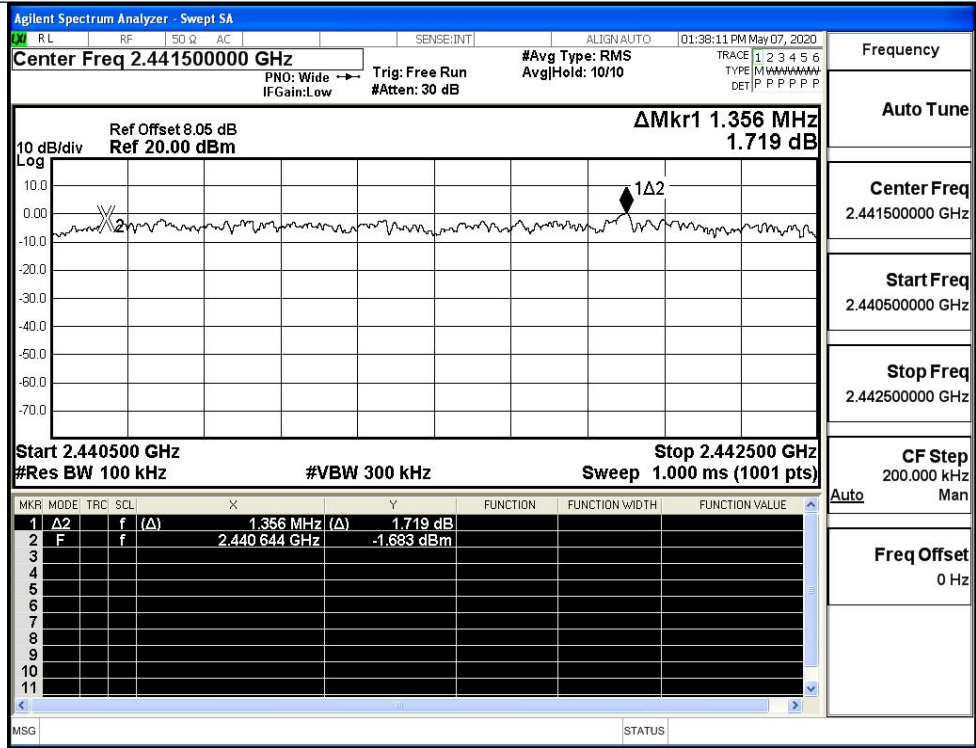
π/4DQPSK/HCH



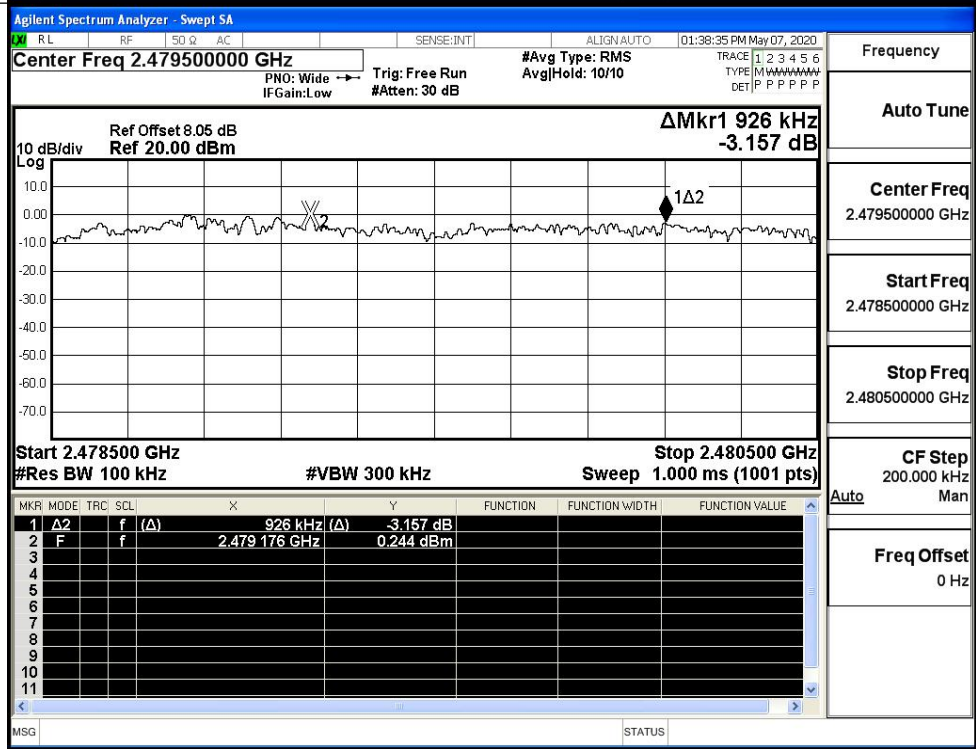
8DPSK/LCH



8DPSK/MCH



8DPSK/HCH





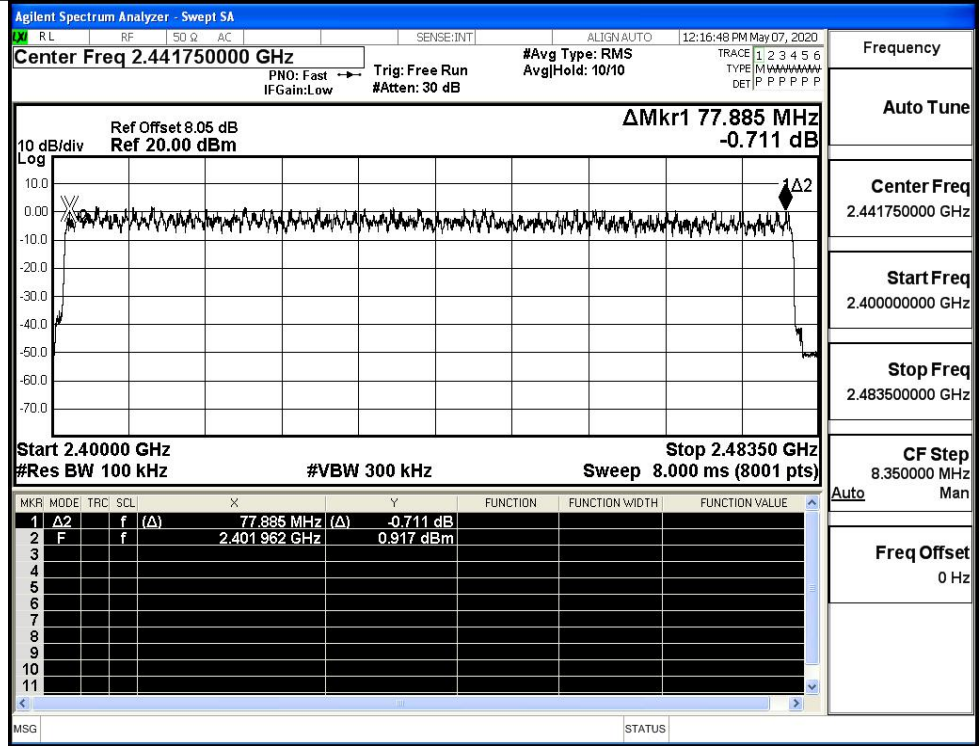
### A.4 Hopping Channel Number

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

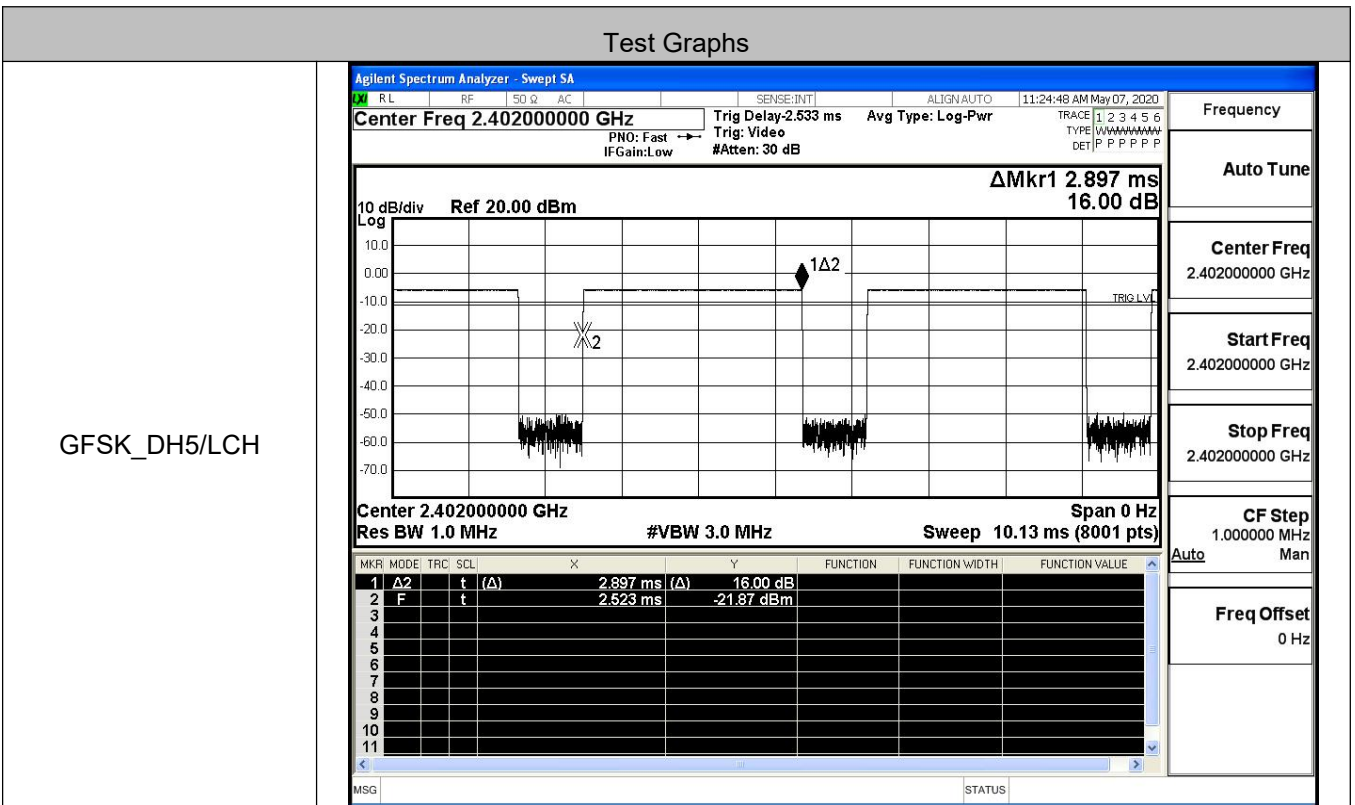
<p>GFSK/Hop</p>	<p>Agilent Spectrum Analyzer - Swept SA                  Center Freq 2.441750000 GHz                  Ref Offset 8.05 dB Ref 20.00 dBm                  ΔMkr1 78.187 MHz -2.228 dB                  Start 2.40000 GHz Stop 2.48350 GHz                  #Res BW 100 kHz #VBW 300 kHz Sweep 8.000 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>Δ2</td> <td>f</td> <td>(Δ)</td> <td>78.187 MHz (Δ)</td> <td>-2.228 dB</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>F</td> <td>f</td> <td></td> <td>2.401879 GHz</td> <td>2.063 dBm</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	Δ2	f	(Δ)	78.187 MHz (Δ)	-2.228 dB				2	F	f		2.401879 GHz	2.063 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 Man</p> <p>Freq Offset 0 Hz</p>
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																					
1	Δ2	f	(Δ)	78.187 MHz (Δ)	-2.228 dB																								
2	F	f		2.401879 GHz	2.063 dBm																								
<p><math>\pi/4</math>DQPSK/Hop</p>	<p>Agilent Spectrum Analyzer - Swept SA                  Center Freq 2.441750000 GHz                  Ref Offset 8.05 dB Ref 20.00 dBm                  ΔMkr1 78.125 MHz -5.248 dB                  Start 2.40000 GHz Stop 2.48350 GHz                  #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>Δ2</td> <td>f</td> <td>(Δ)</td> <td>78.125 MHz (Δ)</td> <td>-5.248 dB</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>F</td> <td>f</td> <td></td> <td>2.402025 GHz</td> <td>1.836 dBm</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	Δ2	f	(Δ)	78.125 MHz (Δ)	-5.248 dB				2	F	f		2.402025 GHz	1.836 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 Man</p> <p>Freq Offset 0 Hz</p>
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																					
1	Δ2	f	(Δ)	78.125 MHz (Δ)	-5.248 dB																								
2	F	f		2.402025 GHz	1.836 dBm																								

8DPSK/Hop

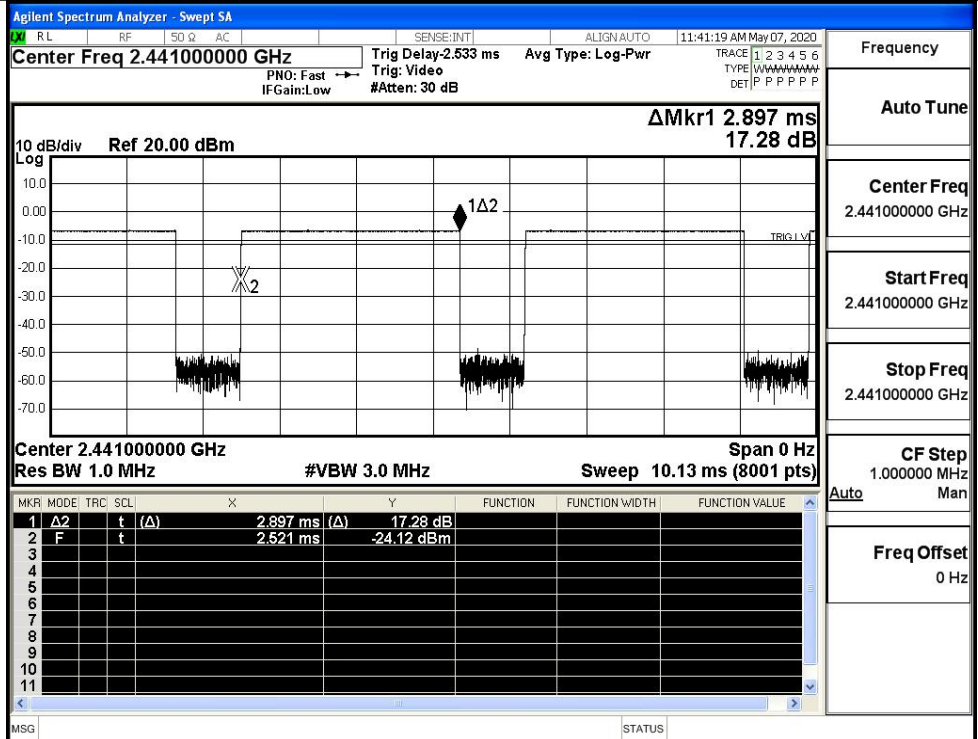


**A.5 Dwell Time**

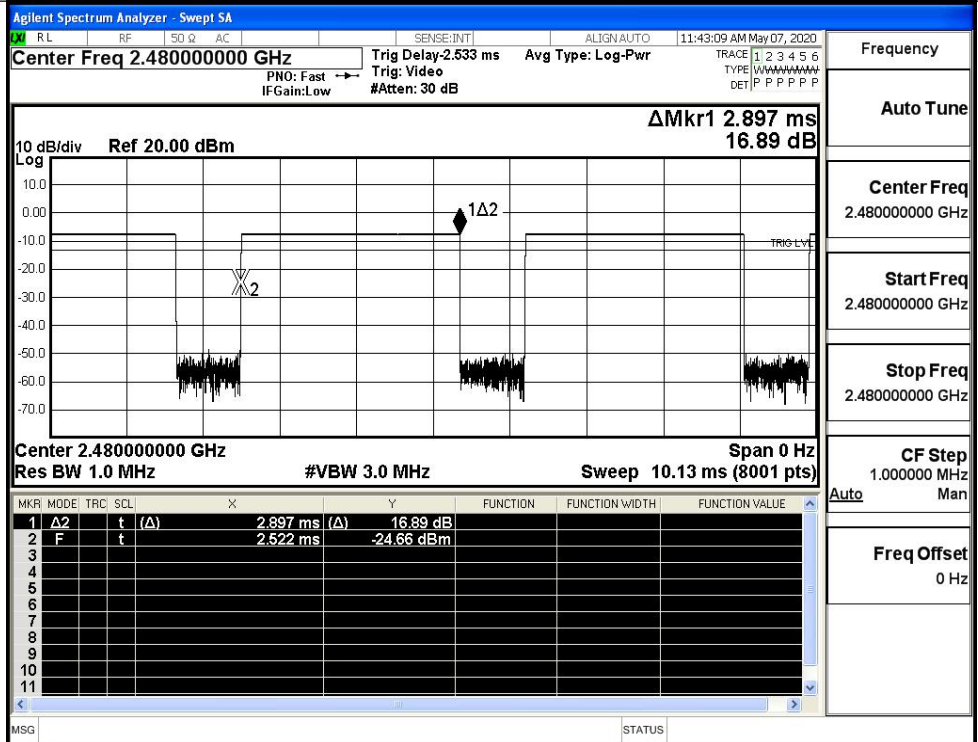
Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit [s]	Verdict
GFSK	DH5	LCH	2.9	106.7	0.309	0.4	PASS
	DH5	MCH	2.9	106.7	0.309	0.4	PASS
	DH5	HCH	2.9	106.7	0.309	0.4	PASS
π/4DQPSK	2DH5	LCH	2.9	106.7	0.309	0.4	PASS
	2DH5	MCH	2.9	106.7	0.309	0.4	PASS
	2DH5	HCH	2.9	106.7	0.309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



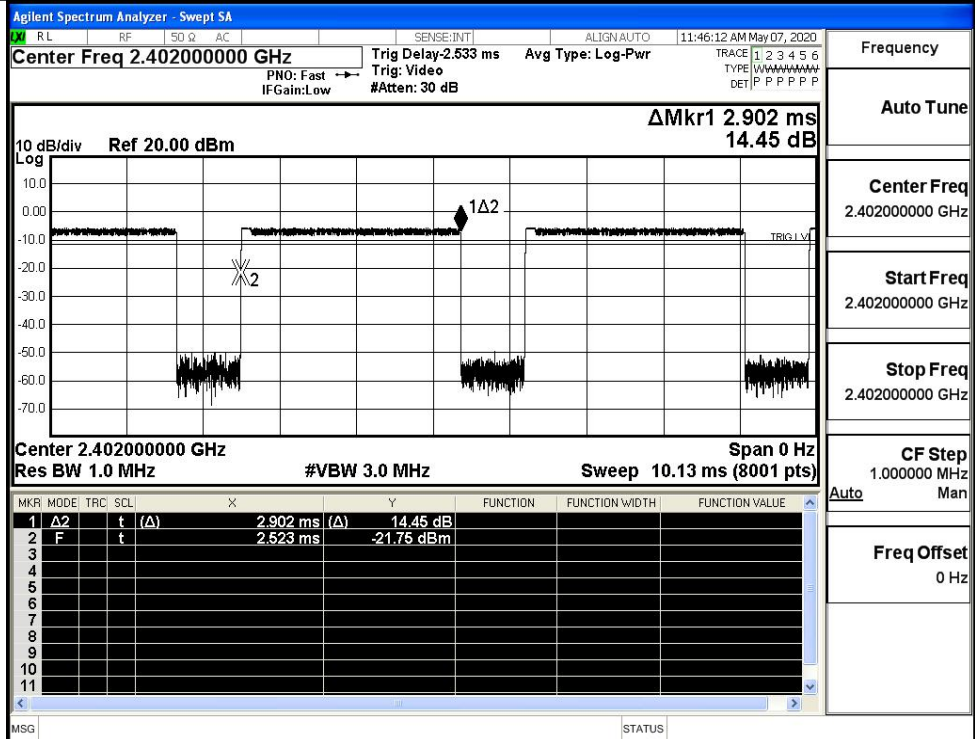
GFSK\_DH5/MCH



GFSK\_DH5/HCH

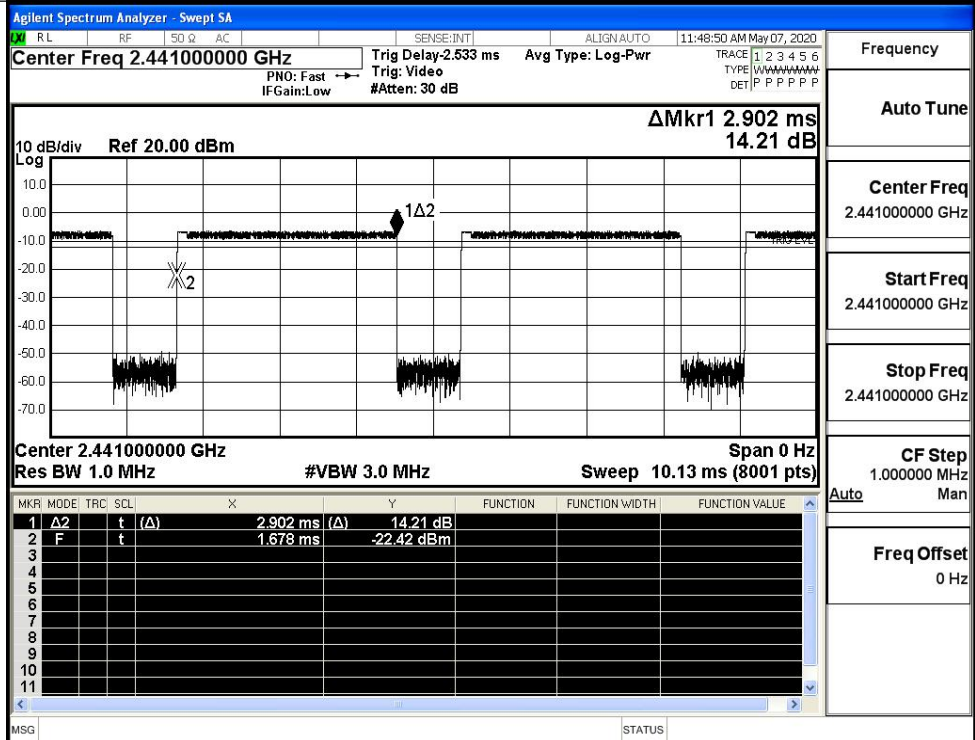


$\pi/4$ DQPSK  
\_2DH5/LCH



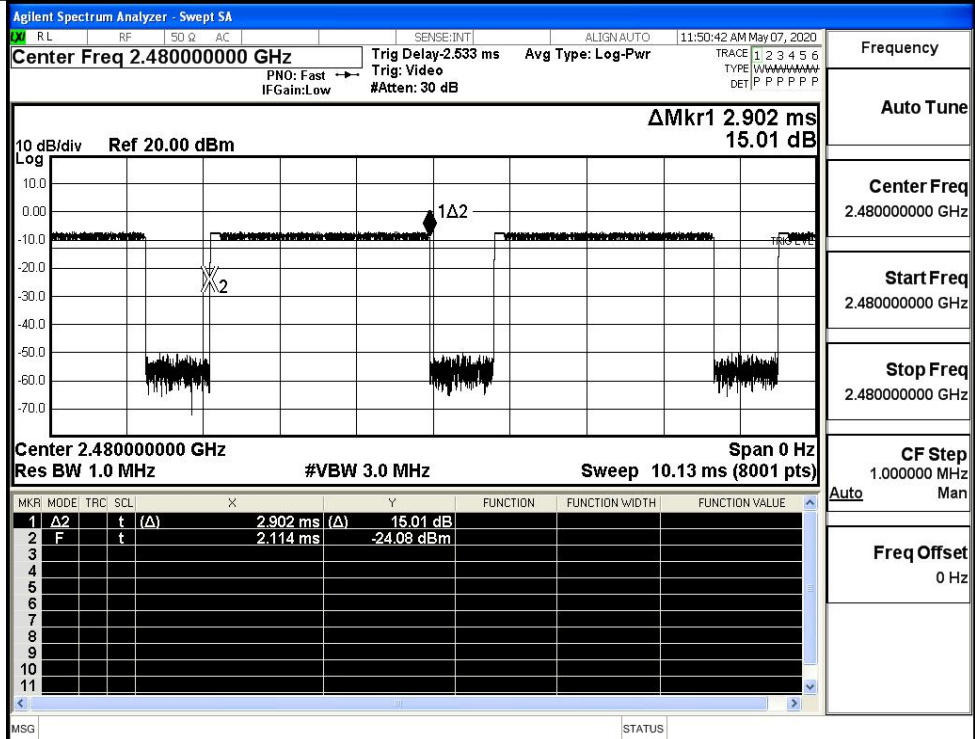
Frequency	2.402000000 GHz
Auto Tune	
Center Freq	2.402000000 GHz
Start Freq	2.402000000 GHz
Stop Freq	2.402000000 GHz
CF Step	1.000000 MHz
Freq Offset	0 Hz

$\pi/4$ DQPSK  
\_2DH5/MCH



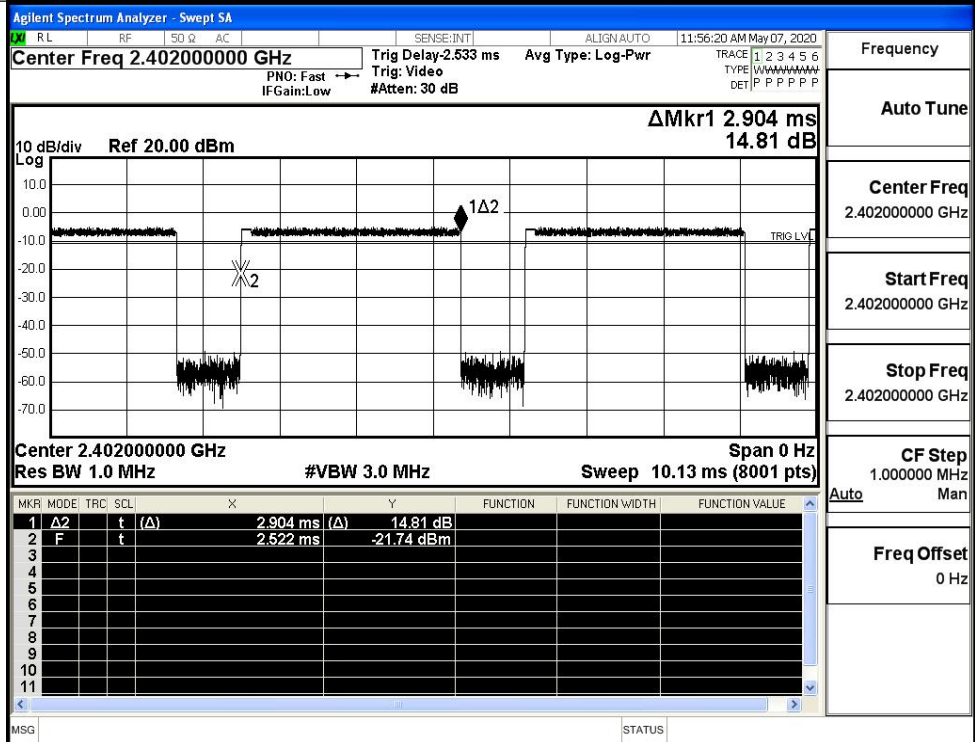
Frequency	2.441000000 GHz
Auto Tune	
Center Freq	2.441000000 GHz
Start Freq	2.441000000 GHz
Stop Freq	2.441000000 GHz
CF Step	1.000000 MHz
Freq Offset	0 Hz

$\pi/4$ DQPSK  
\_2DH5/HCH



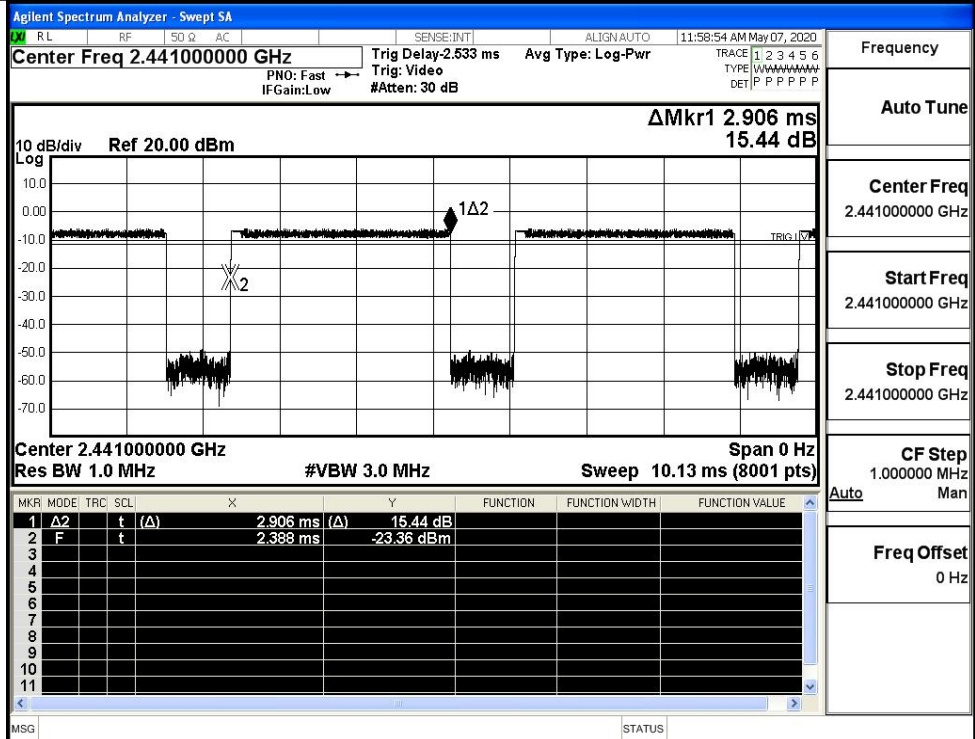
Frequency	2.48000000 GHz
Auto Tune	
Center Freq	2.48000000 GHz
Start Freq	2.48000000 GHz
Stop Freq	2.48000000 GHz
CF Step	1.000000 MHz
Auto Man	
Freq Offset	0 Hz

8DPSK\_3DH5/LCH



Frequency	2.40200000 GHz
Auto Tune	
Center Freq	2.40200000 GHz
Start Freq	2.40200000 GHz
Stop Freq	2.40200000 GHz
CF Step	1.000000 MHz
Auto Man	
Freq Offset	0 Hz

8DPSK\_3DH5/MCH



8DPSK\_3DH5/HCH

