

Appendix A

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

Product Name: Bluetooth mechanical keyboard

Trade Mark: keychron

Test Model: keychron K1

FCC ID: 2ASF4-KS

Environmental Conditions

Temperature:	22.1 ° C
Relative Humidity:	50%
ATM Pressure:	100.0 kPa
Test Engineer:	Gary Qian
Supervised by:	Eden Hu

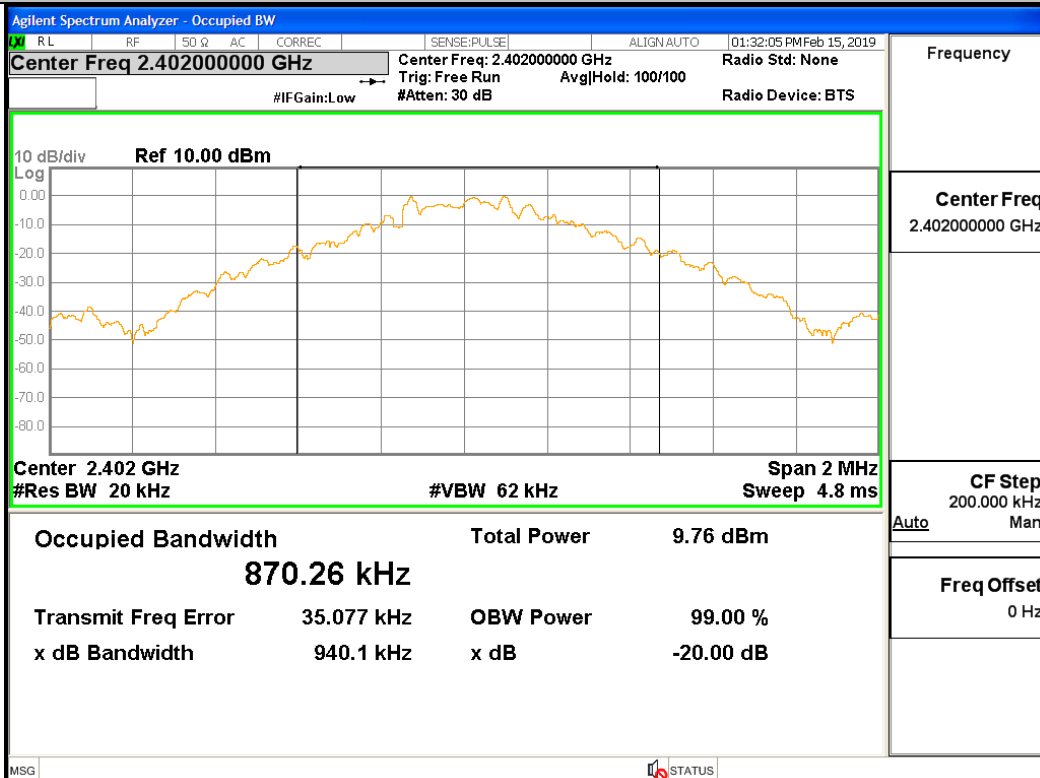
A.1 20 dB Bandwidth

Mode	Channel.	20dB Bandwidth [MHz]	Limit(MHz)	Verdict
GFSK	LCH	0.940	Not Specified	PASS
GFSK	MCH	0.948	Not Specified	PASS
GFSK	HCH	0.944	Not Specified	PASS
$\pi/4$ DQPSK	LCH	1.336	Not Specified	PASS
$\pi/4$ DQPSK	MCH	1.344	Not Specified	PASS
$\pi/4$ DQPSK	HCH	1.330	Not Specified	PASS
8DPSK	LCH	1.272	Not Specified	PASS
8DPSK	MCH	1.326	Not Specified	PASS
8DPSK	HCH	1.269	Not Specified	PASS

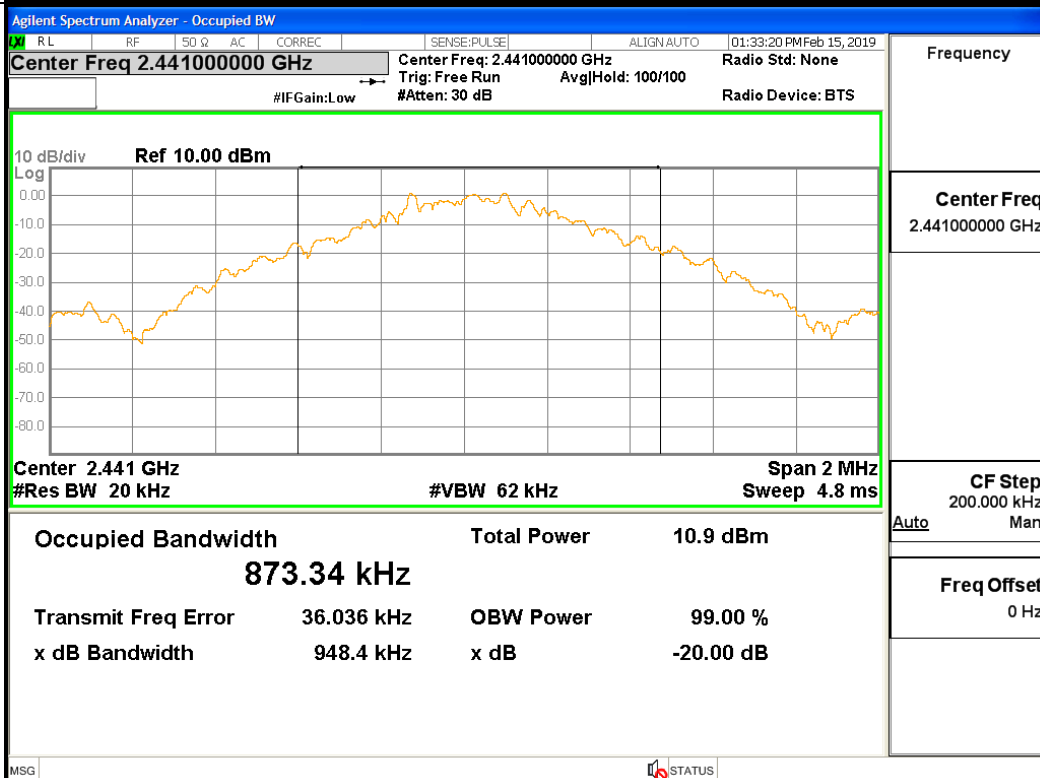
Test Graph

Graphs

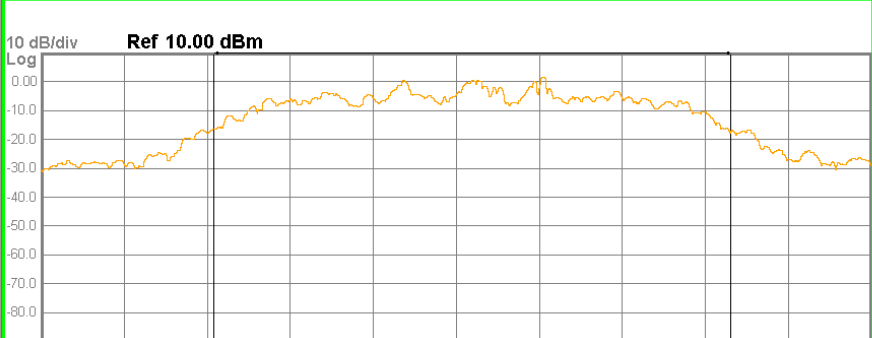
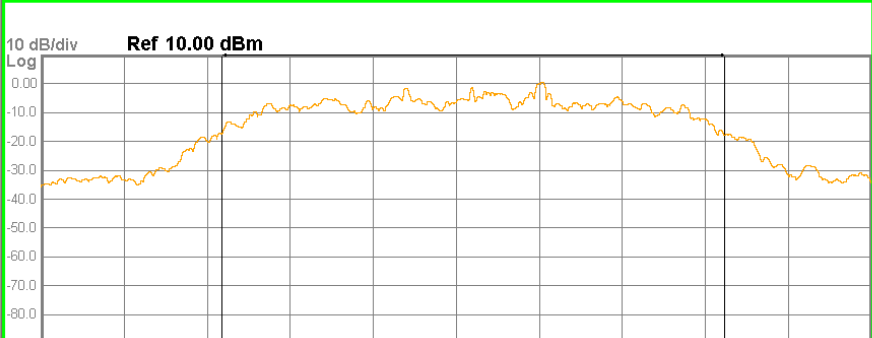
GFSK/LCH



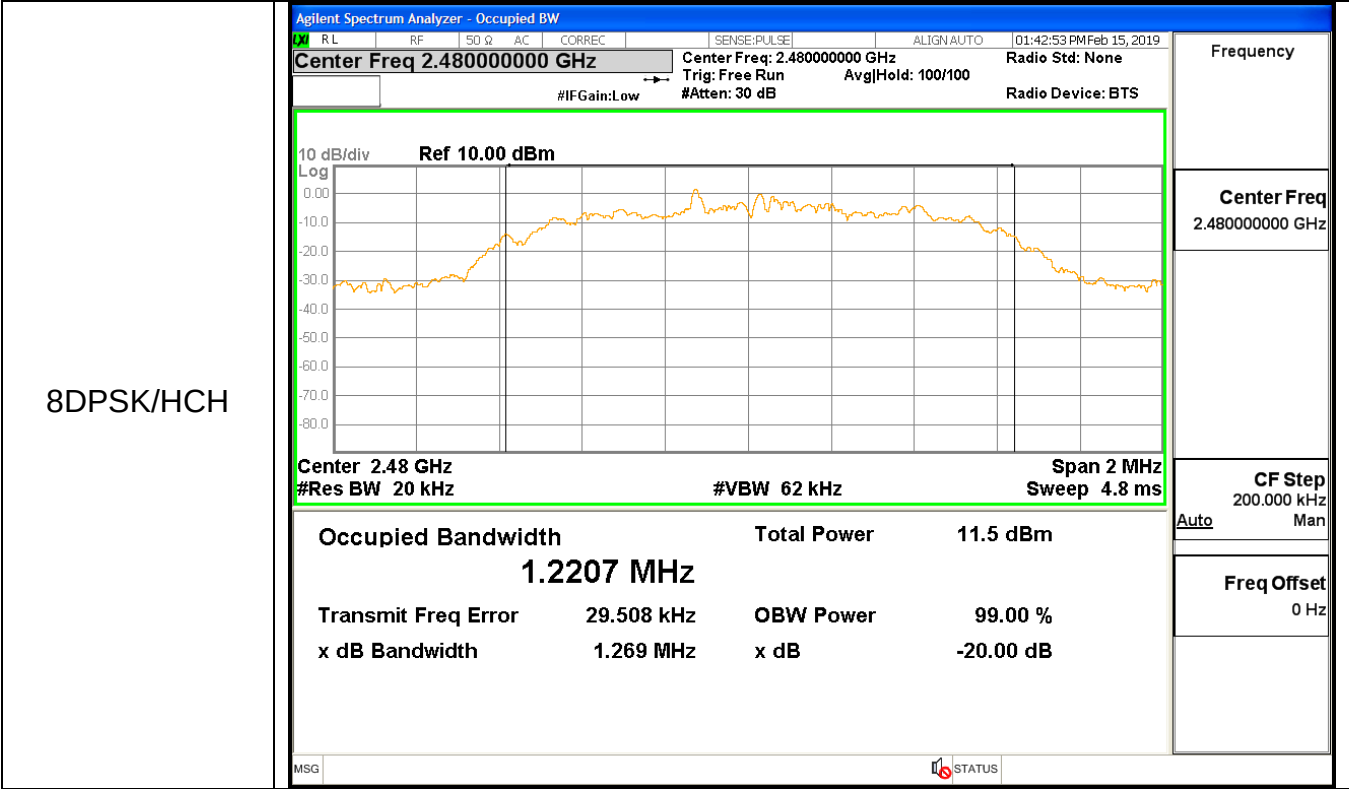
GFSK/MCH

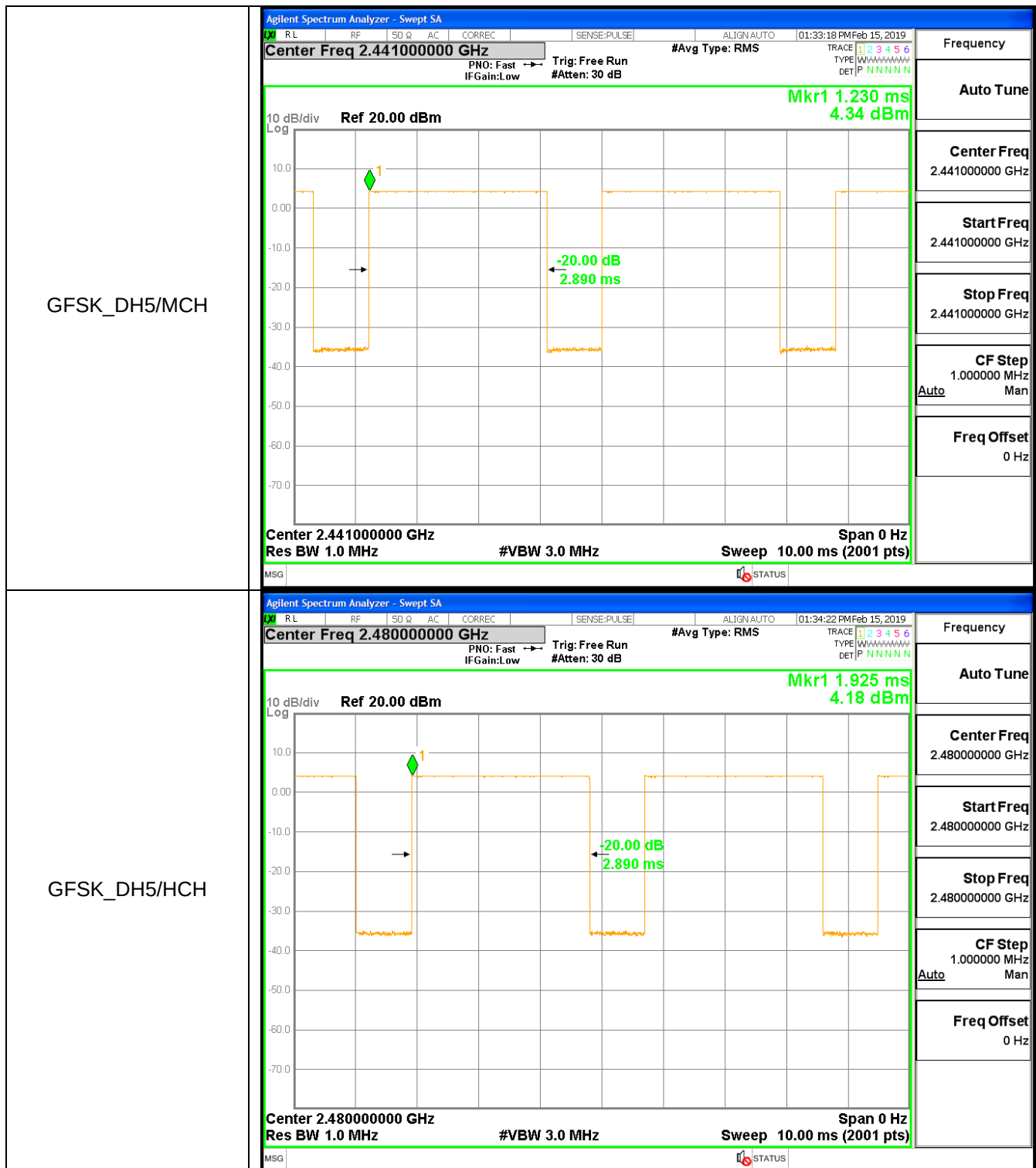


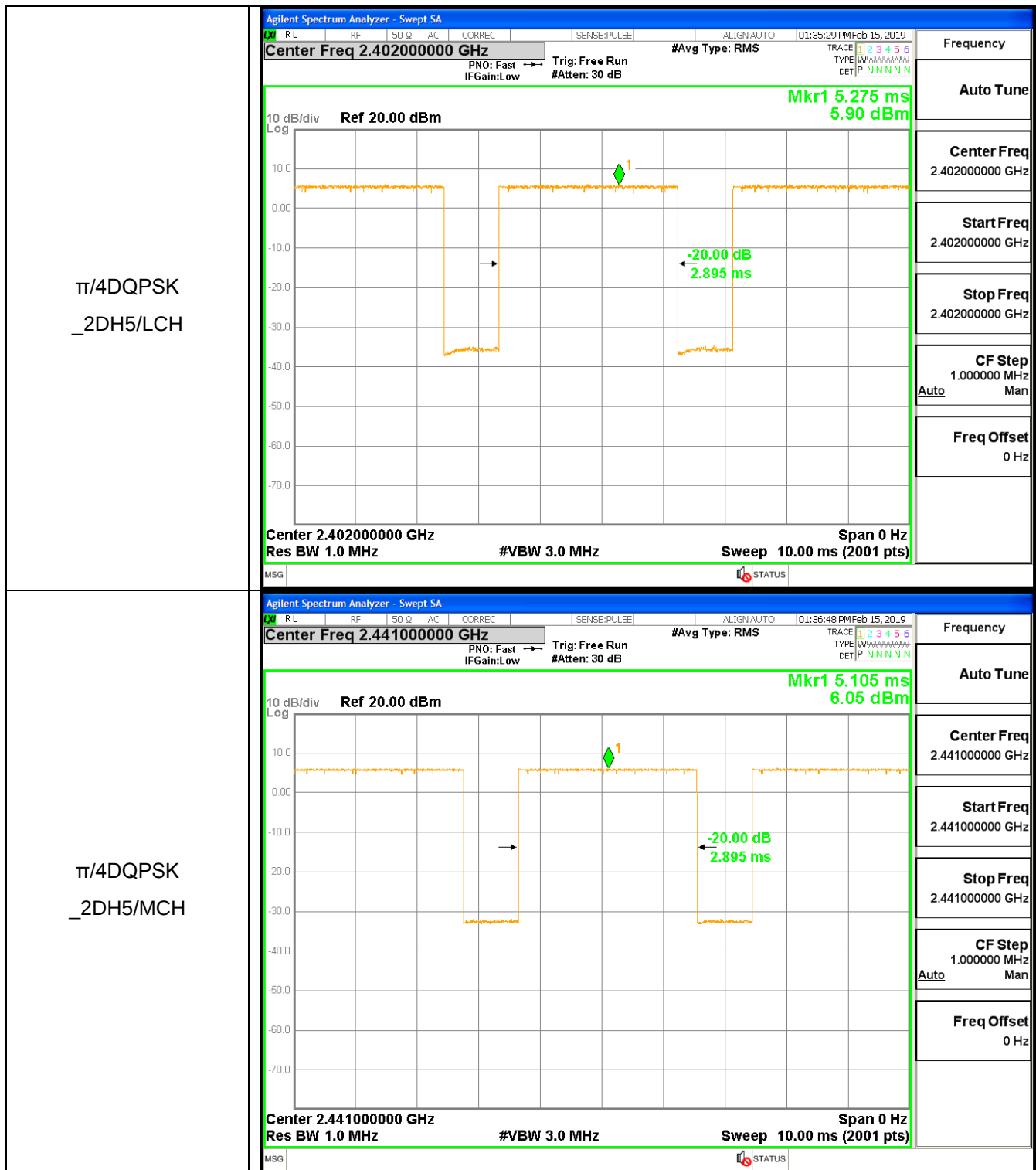
GFSK/HCH	Agilent Spectrum Analyzer - Occupied BW RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN: AUTO 01:34:25 PM Feb 15, 2019 Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Radio Std: None Trig: Free Run AvgHold: 100/100 #IFGain: Low #Atten: 30 dB Radio Device: BTS Center 2.48 GHz Span 2 MHz #Res BW 20 kHz #VBW 62 kHz Sweep 4.8 ms <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>10.5 dBm</td> </tr> <tr> <td>884.96 kHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>40.094 kHz</td> <td>OBW Power</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>943.8 kHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-20.00 dB</td> </tr> </table>	Occupied Bandwidth	Total Power	10.5 dBm	884.96 kHz			Transmit Freq Error	40.094 kHz	OBW Power			99.00 %	x dB Bandwidth	943.8 kHz	x dB			-20.00 dB	Frequency Center Freq 2.480000000 GHz CF Step 200.000 kHz Auto Man Freq Offset 0 Hz
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π/4DQPSK/LCH	Agilent Spectrum Analyzer - Occupied BW RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN: AUTO 01:35:32 PM Feb 15, 2019 Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Radio Std: None Trig: Free Run AvgHold: 100/100 #IFGain: Low #Atten: 30 dB Radio Device: BTS Center 2.402 GHz Span 2 MHz #Res BW 20 kHz #VBW 62 kHz Sweep 4.8 ms <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>11.4 dBm</td> </tr> <tr> <td>1.2314 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>43.457 kHz</td> <td>OBW Power</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.336 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-20.00 dB</td> </tr> </table>	Occupied Bandwidth	Total Power	11.4 dBm	1.2314 MHz			Transmit Freq Error	43.457 kHz	OBW Power			99.00 %	x dB Bandwidth	1.336 MHz	x dB			-20.00 dB	Frequency Center Freq 2.402000000 GHz CF Step 200.000 kHz Auto Man Freq Offset 0 Hz
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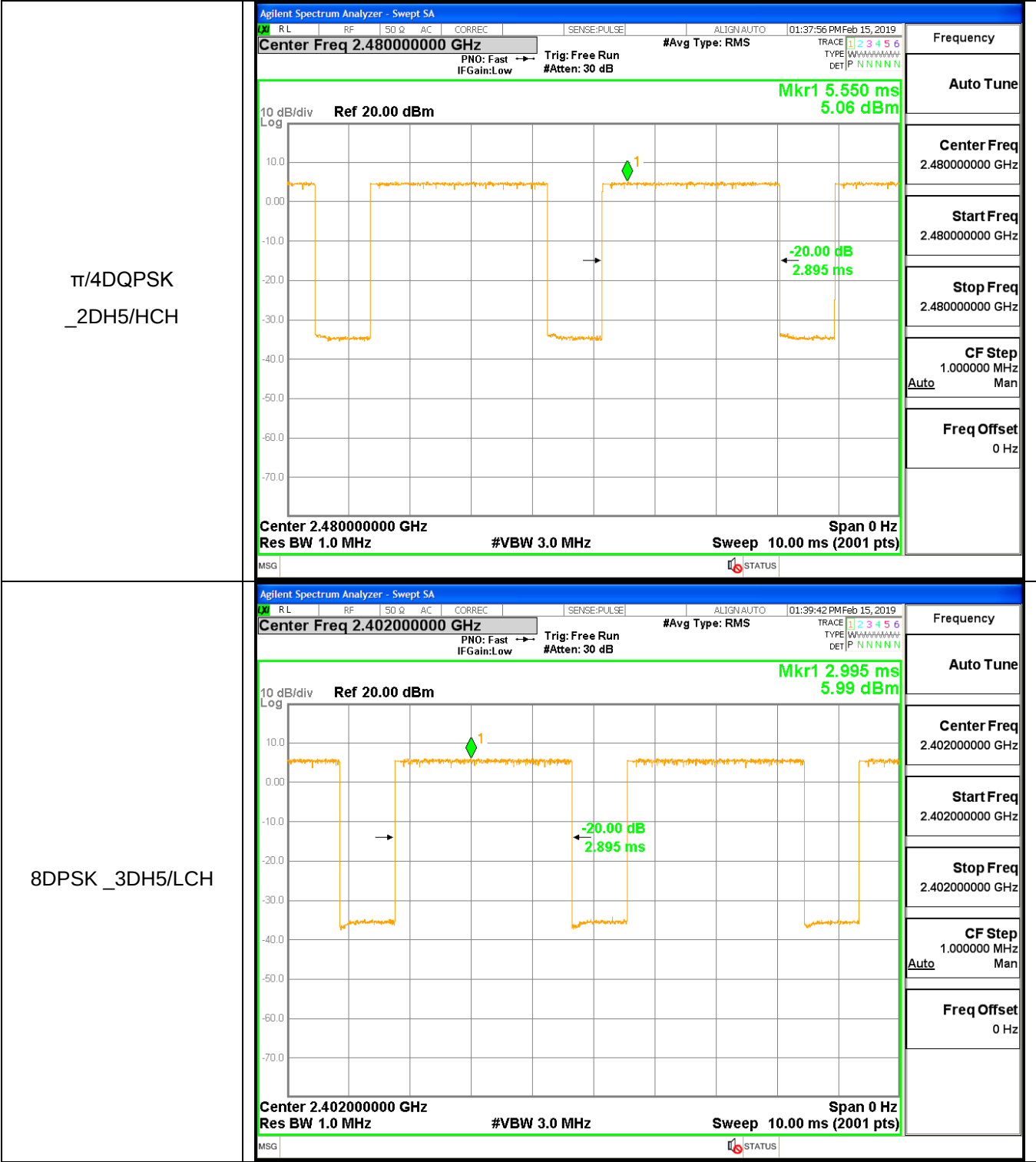
π/4DQPSK/MCH	Agilent Spectrum Analyzer - Occupied BW RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN AUTO 01:36:51 PM Feb 15, 2019 Center Freq 2.441000000 GHz Center Freq: 2.441000000 GHz Radio Std: None #IFGain:Low #Atten: 30 dB AvgHold: 100/100 Radio Device: BTS  Center 2.441 GHz Span 2 MHz #Res BW 20 kHz #VBW 62 kHz Sweep 4.8 ms Occupied Bandwidth 1.2382 MHz Total Power 12.5 dBm Transmit Freq Error 39.836 kHz OBW Power 99.00 % x dB Bandwidth 1.344 MHz x dB -20.00 dB MSG STATUS	Frequency Center Freq 2.441000000 GHz CF Step 200.000 kHz Auto Man Freq Offset 0 Hz
π/4DQPSK/HCH	Agilent Spectrum Analyzer - Occupied BW RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN AUTO 01:38:00 PM Feb 15, 2019 Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Radio Std: None #IFGain:Low #Atten: 30 dB AvgHold: 100/100 Radio Device: BTS  Center 2.48 GHz Span 2 MHz #Res BW 20 kHz #VBW 62 kHz Sweep 4.8 ms Occupied Bandwidth 1.2059 MHz Total Power 10.9 dBm Transmit Freq Error 41.969 kHz OBW Power 99.00 % x dB Bandwidth 1.330 MHz x dB -20.00 dB MSG STATUS	Frequency Center Freq 2.480000000 GHz CF Step 200.000 kHz Auto Man Freq Offset 0 Hz

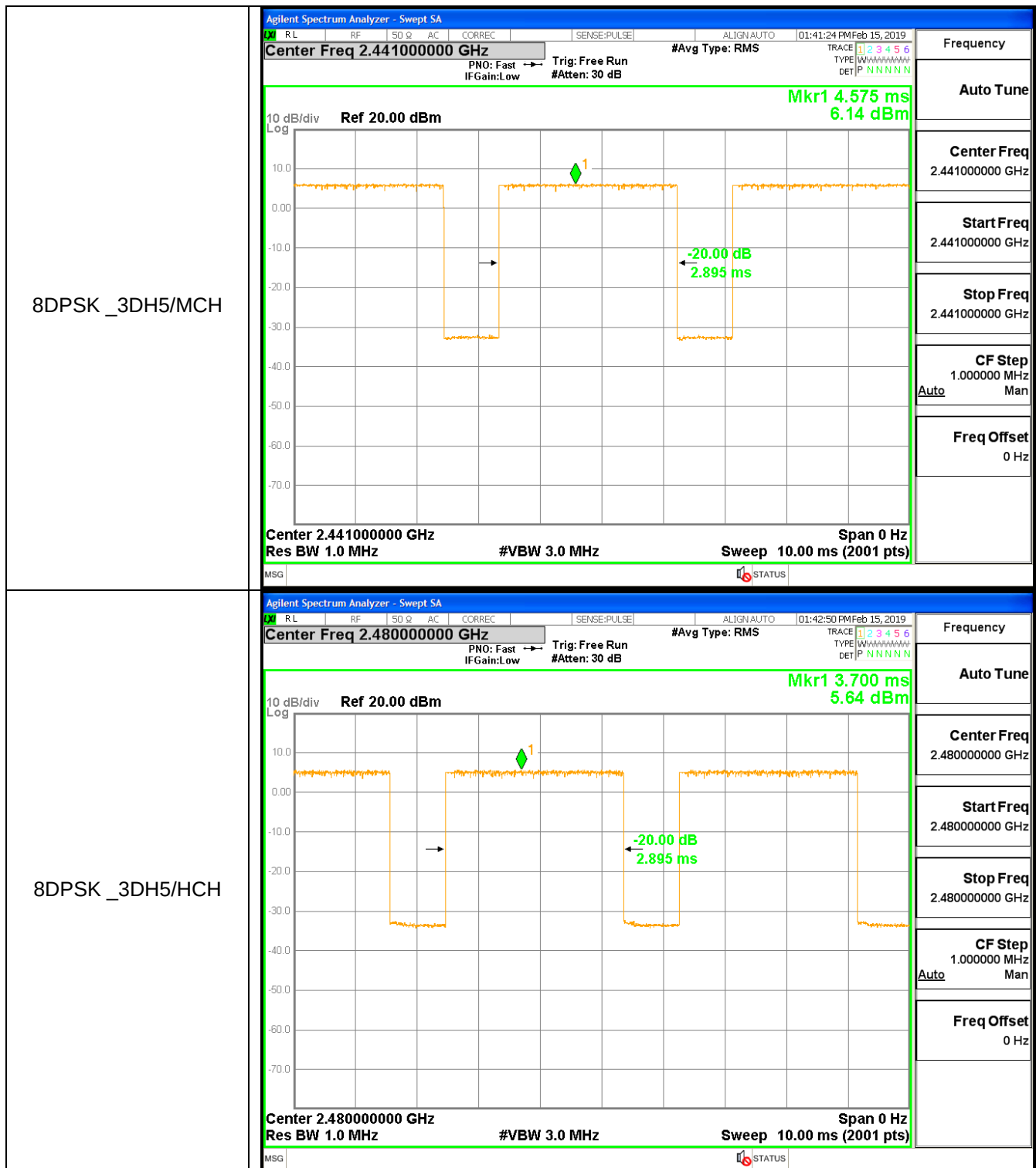










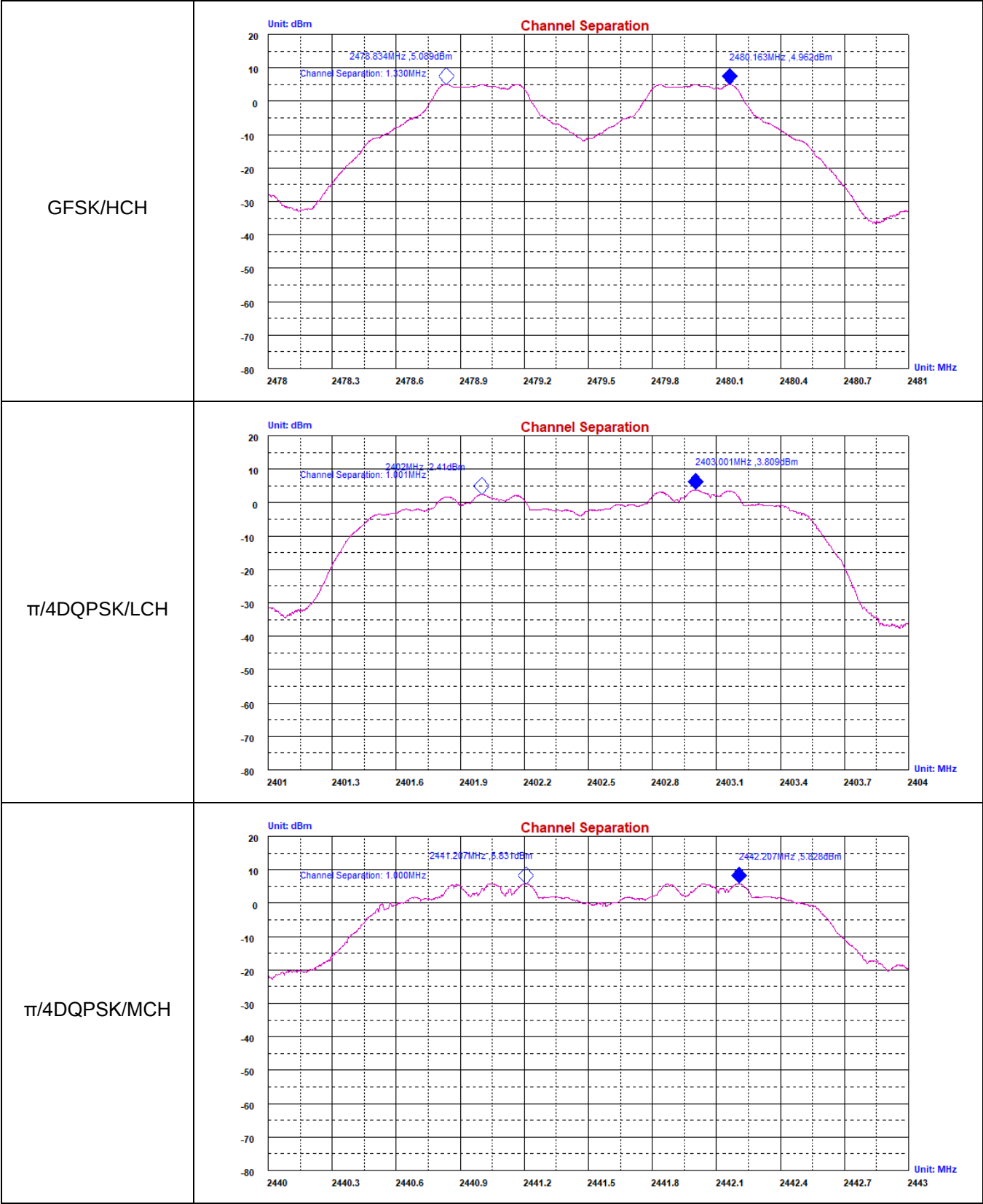


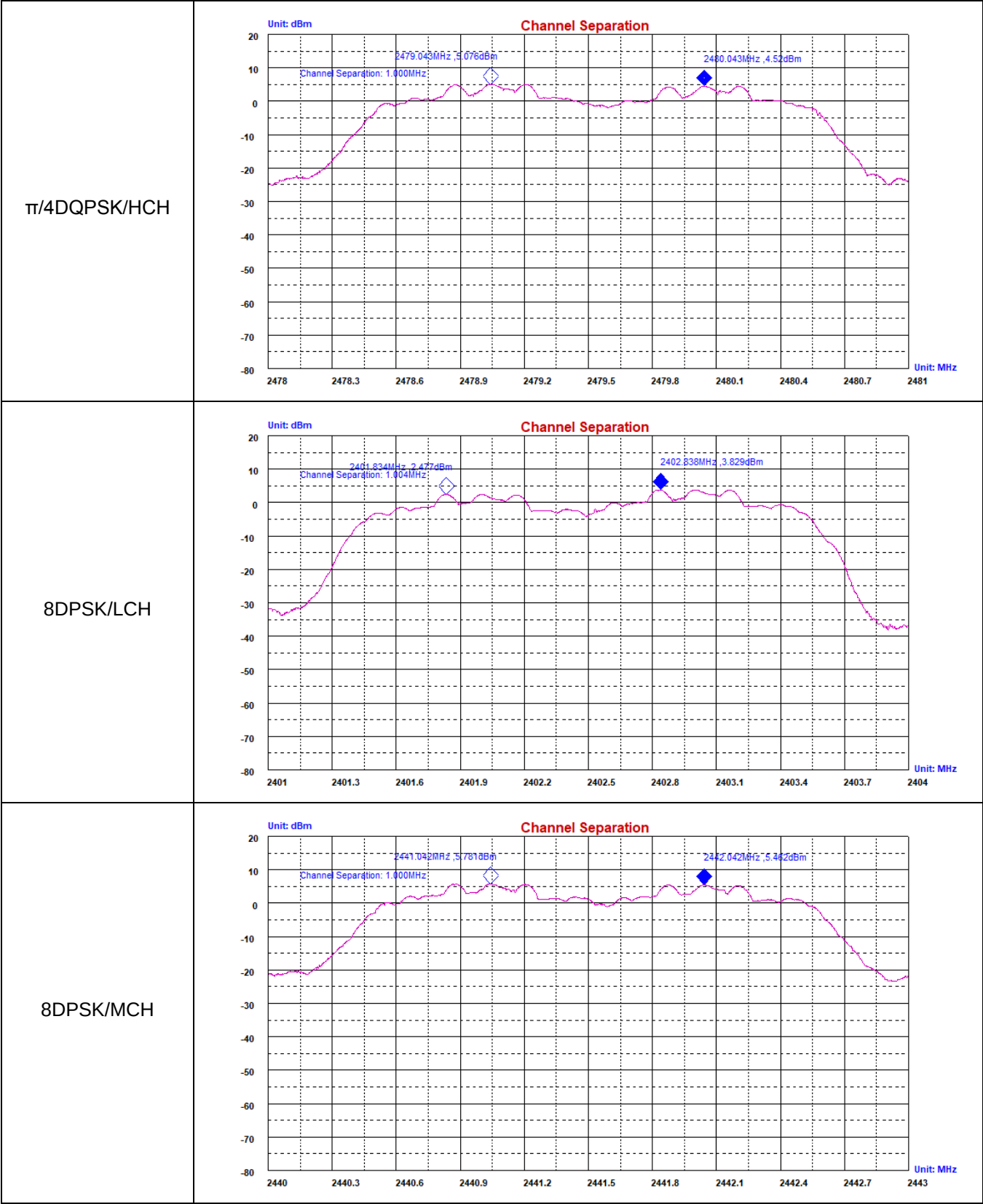
A.3 Carrier Frequency Separation

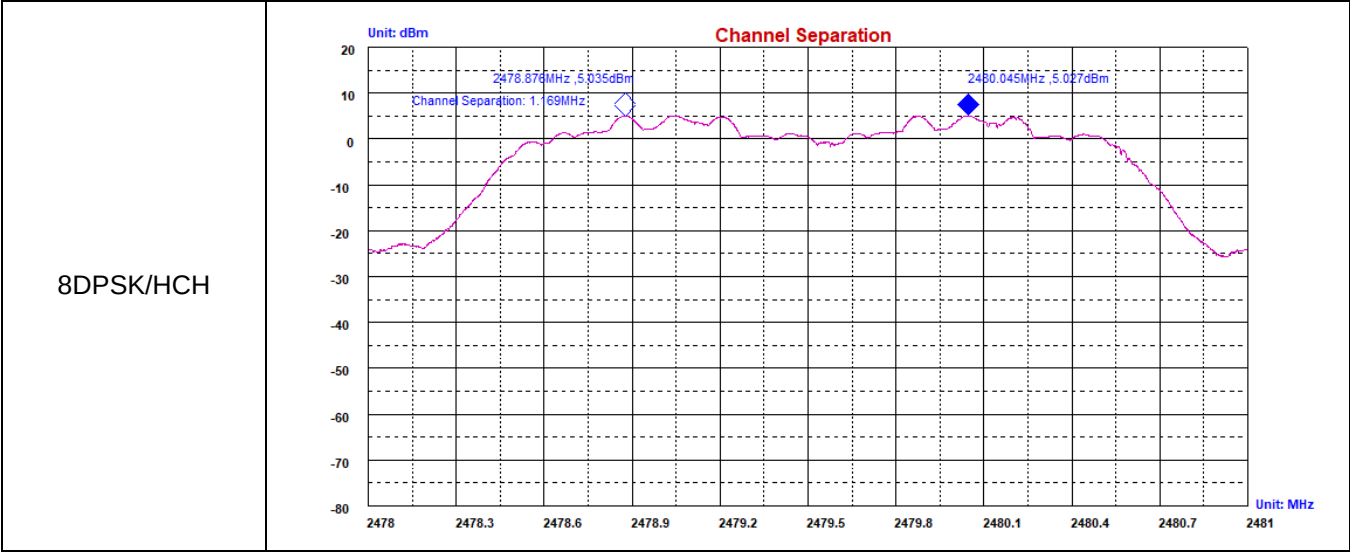
Mode	Channel.	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	1.003	0.642	PASS
GFSK	MCH	1.000	0.625	PASS
GFSK	HCH	1.330	0.643	PASS
$\pi/4$ DQPSK	LCH	1.001	0.889	PASS
$\pi/4$ DQPSK	MCH	1.000	0.899	PASS
$\pi/4$ DQPSK	HCH	1.000	0.899	PASS
8DPSK	LCH	1.004	0.885	PASS
8DPSK	MCH	1.000	0.896	PASS
8DPSK	HCH	1.169	0.895	PASS

Test Graph





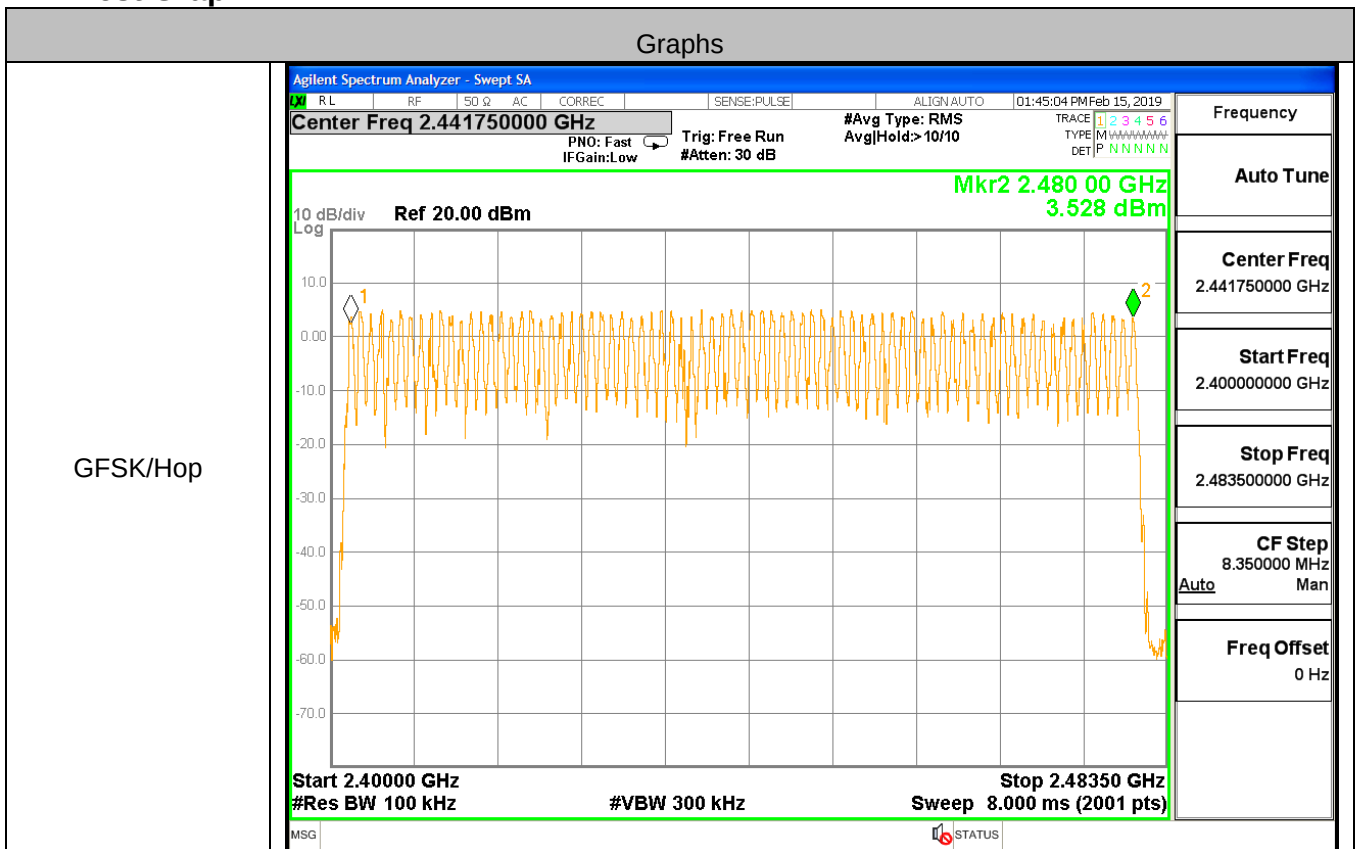


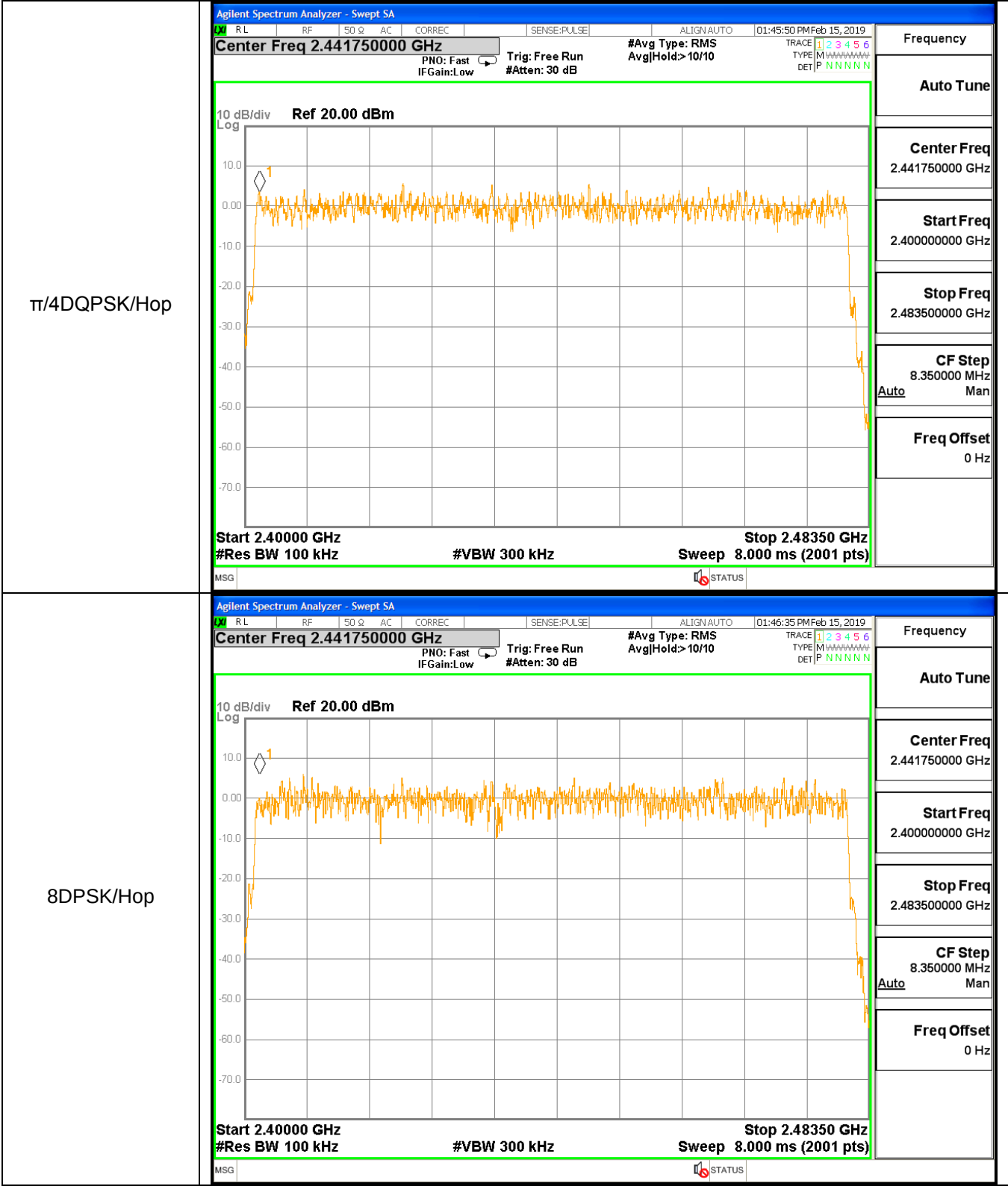


A.4 Hopping Channel Number

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 Graph

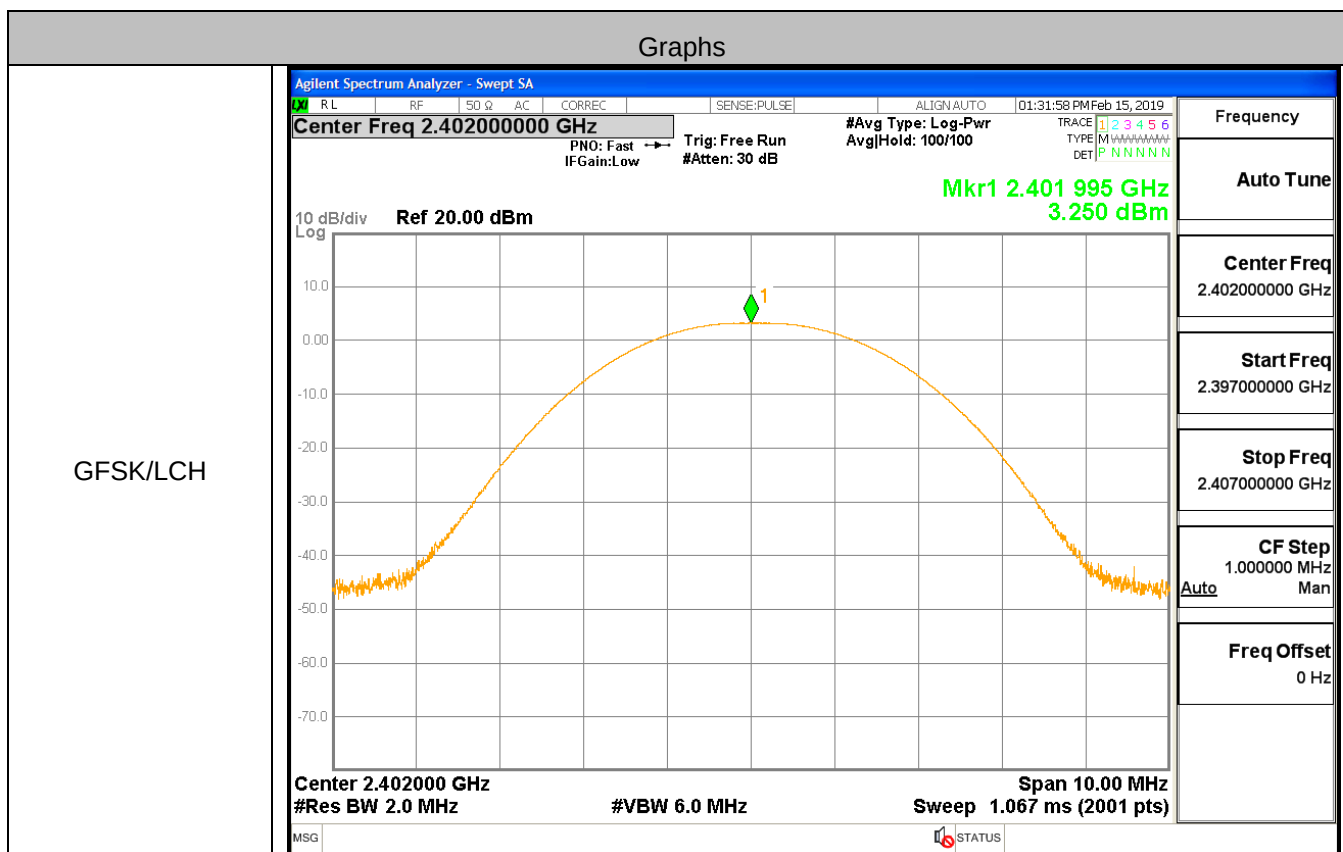


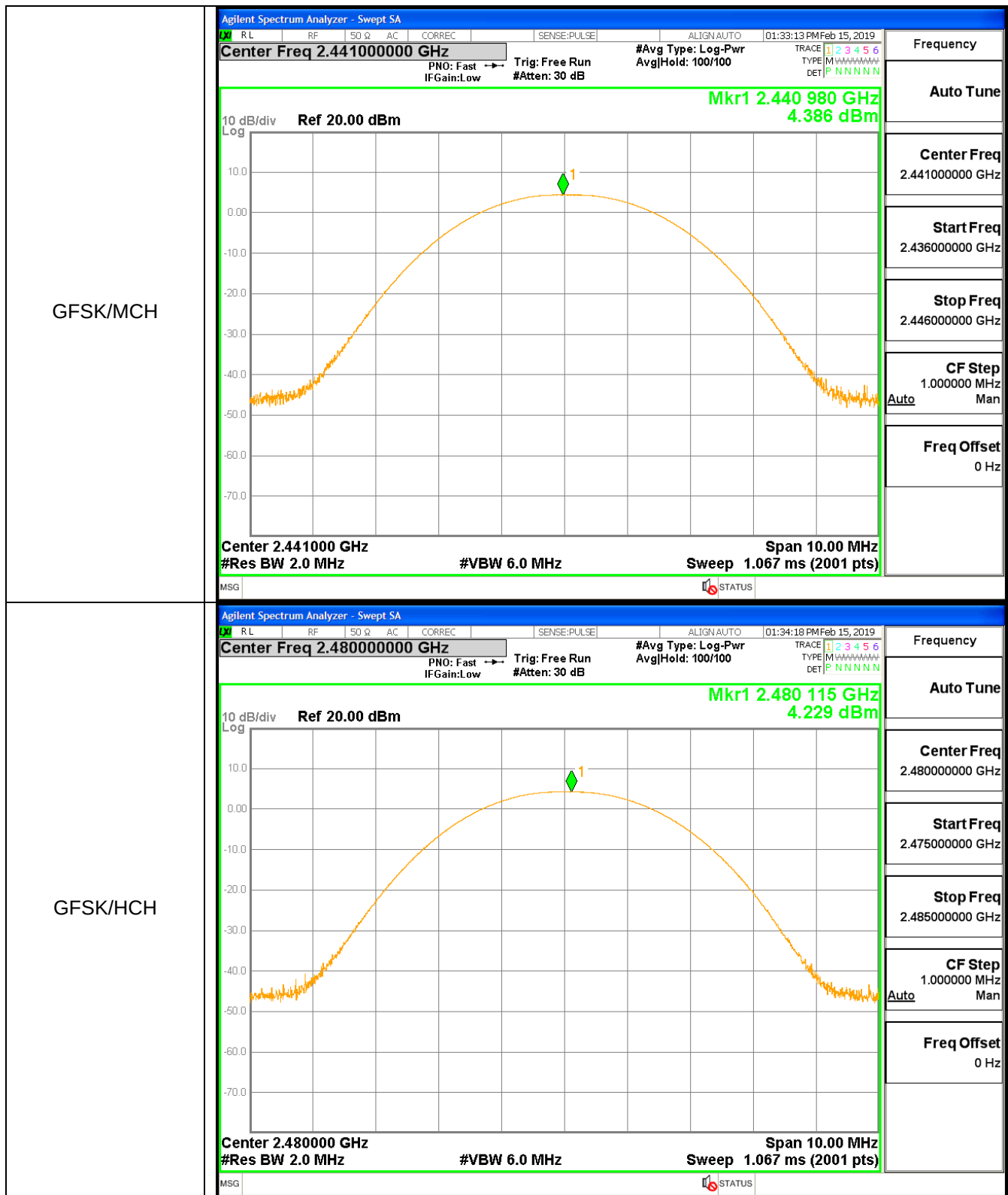


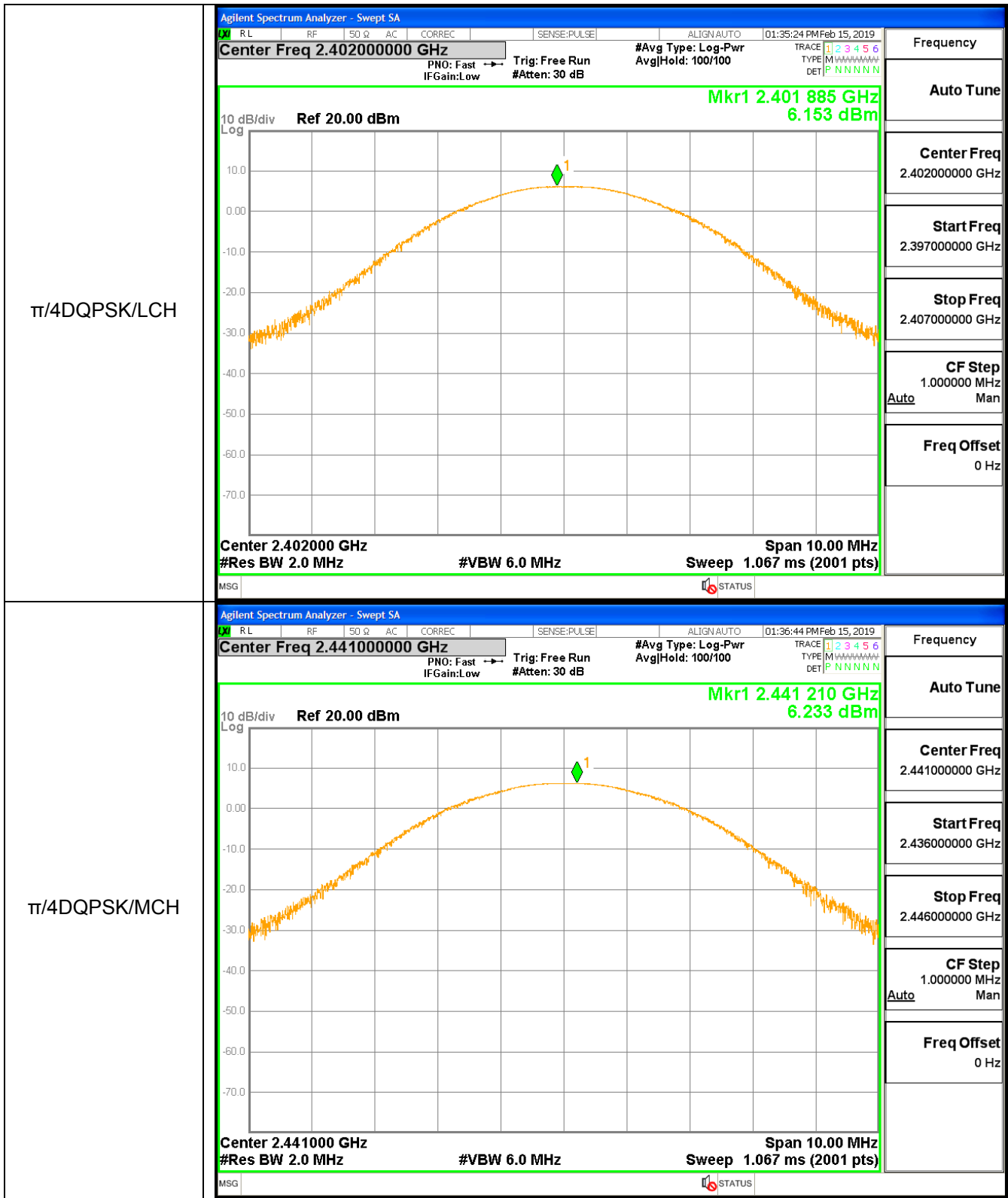
A.5 Conducted Peak Output Power

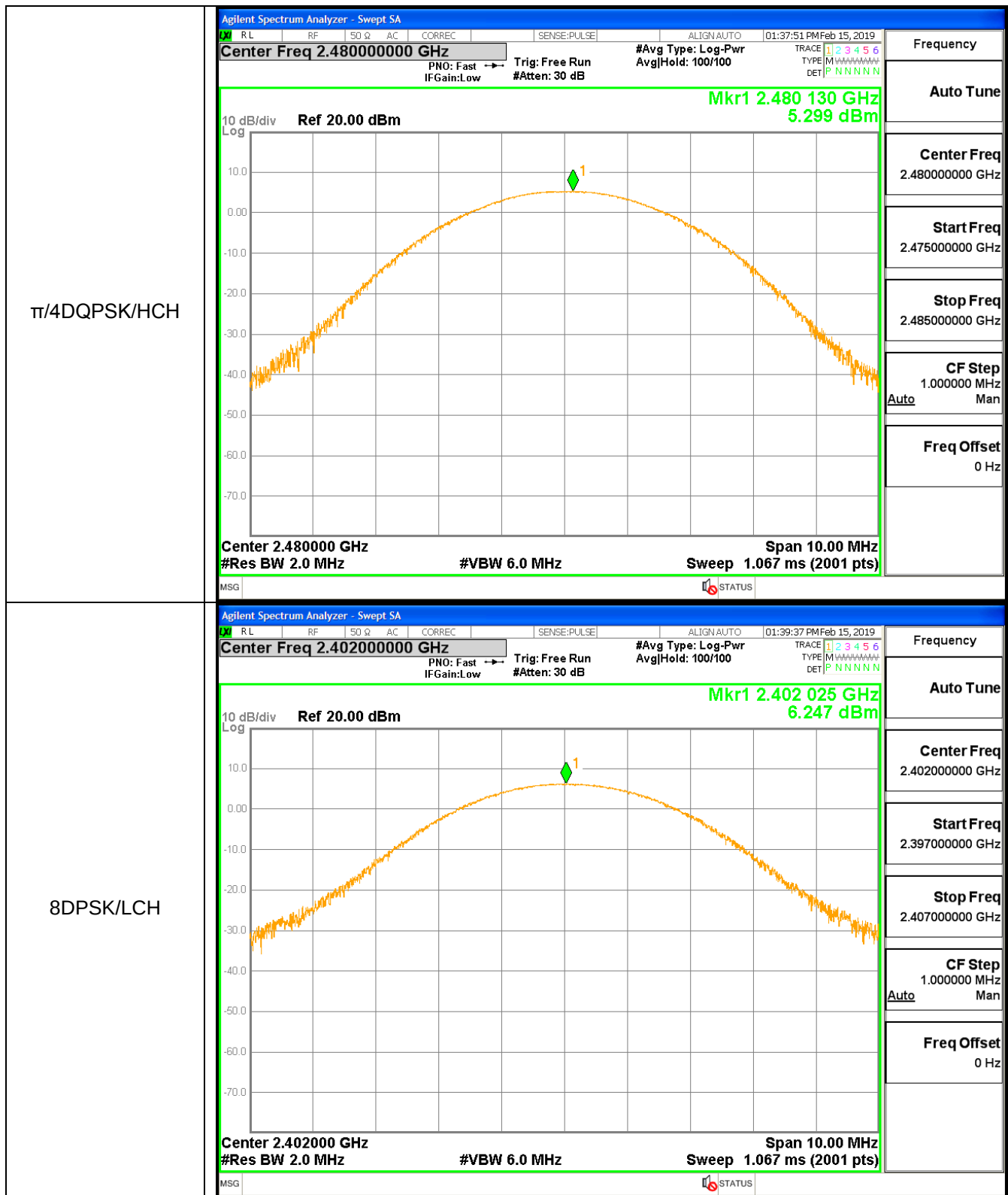
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	3.250	21	PASS
GFSK	MCH	4.386	21	PASS
GFSK	HCH	4.229	21	PASS
$\pi/4$ DQPSK	LCH	6.153	21	PASS
$\pi/4$ DQPSK	MCH	6.233	21	PASS
$\pi/4$ DQPSK	HCH	5.299	21	PASS
8DPSK	LCH	6.247	21	PASS
8DPSK	MCH	6.291	21	PASS
8DPSK	HCH	5.799	21	PASS

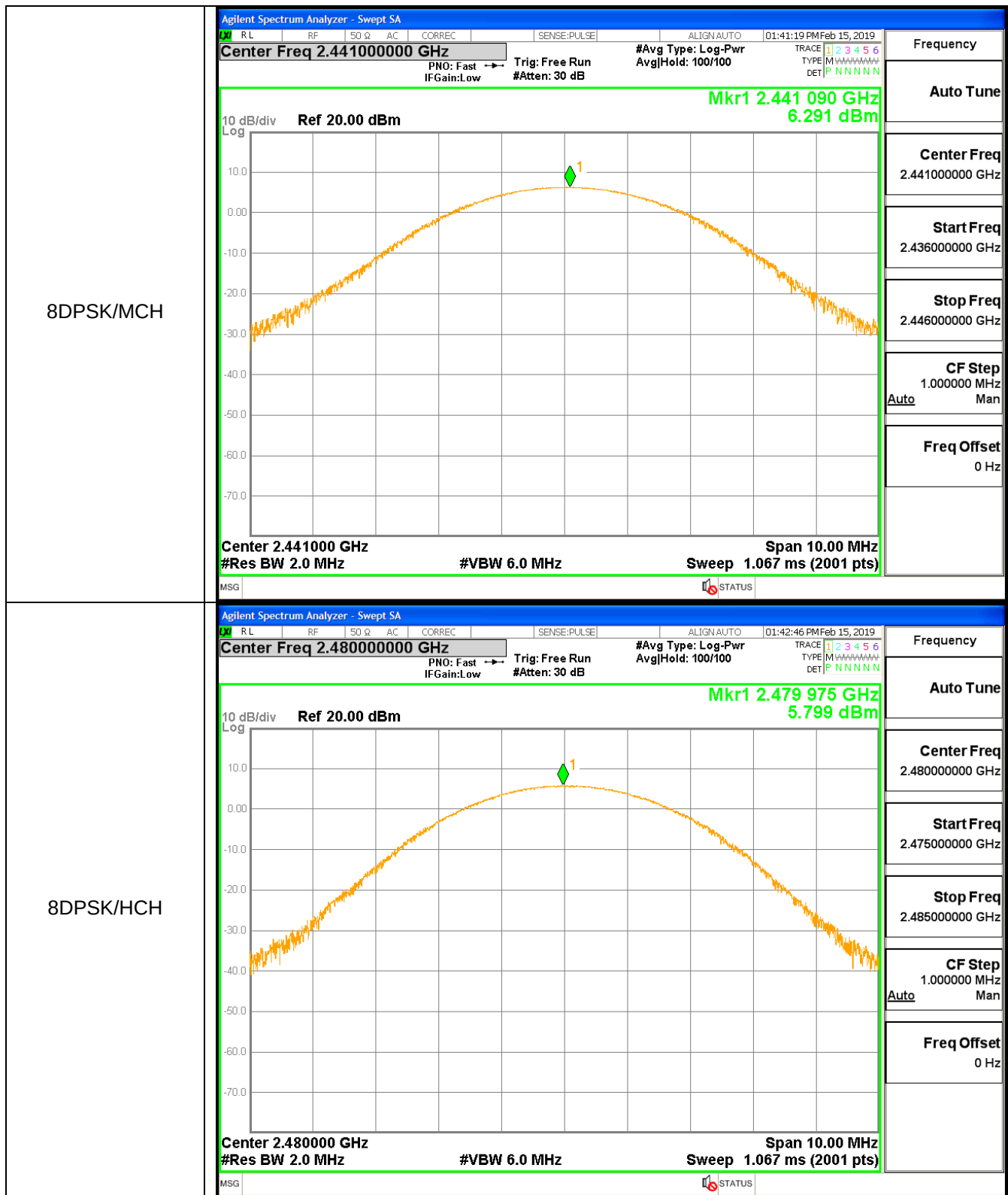
Test Graph







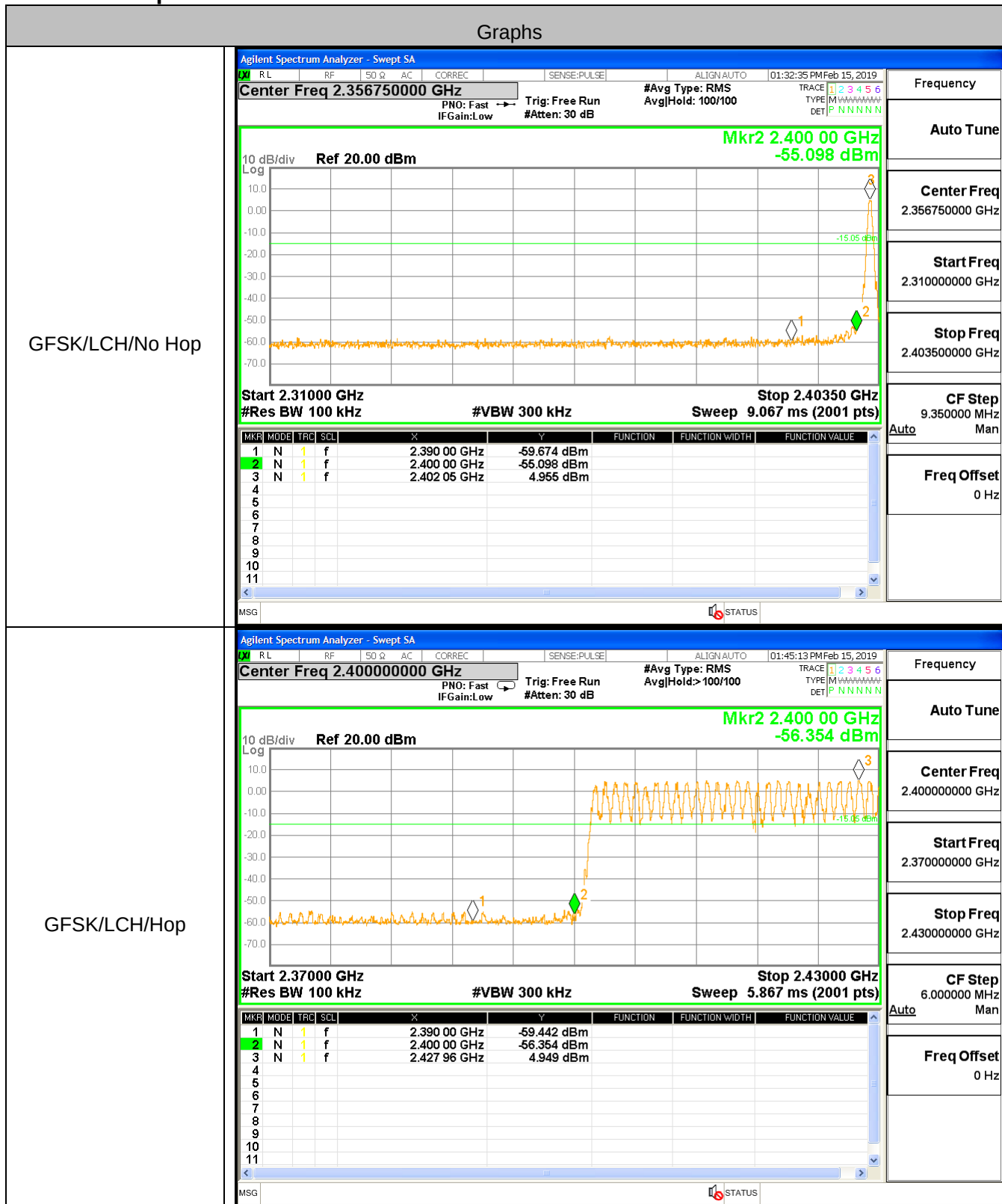




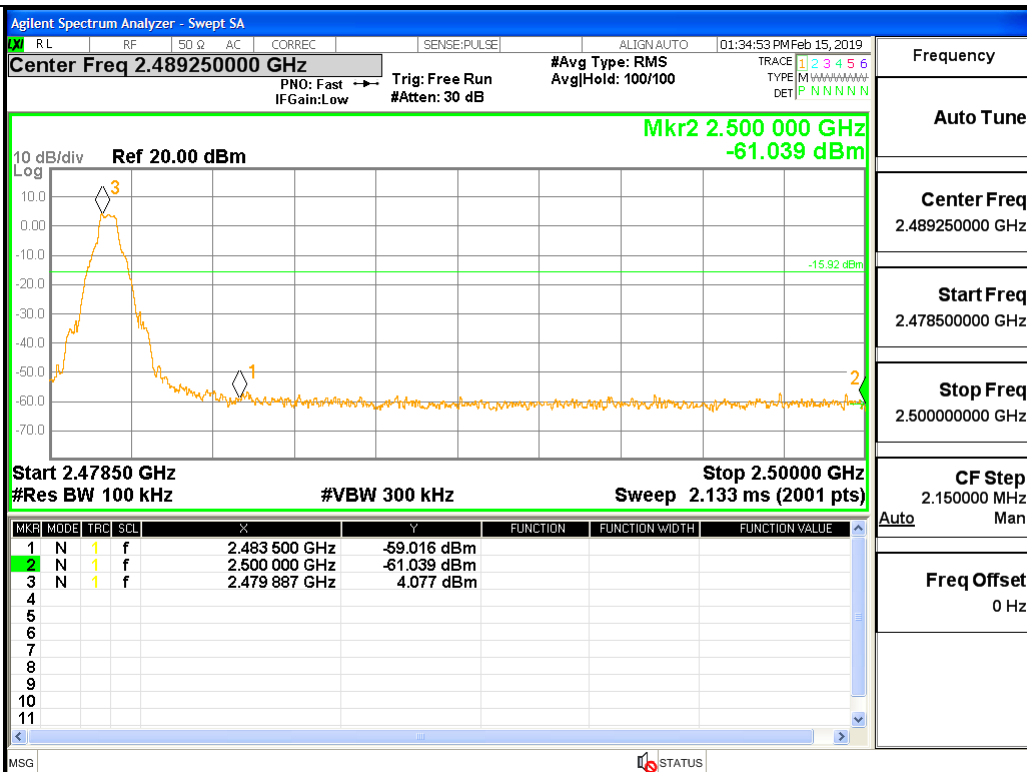
A.6 Band-edge for RF Conducted Emissions

Type	Carrier Frequency(MHz)	Frequency(MHz)	Carrier Frequency Power [dBm]	Bandedge Peak(dBm)	Upper limit(dBm)	Conclusion
1DH5	2402	2390	4.96	-59.67	-15.05	Pass
1DH5	2402	2400	4.96	-55.1	-15.05	Pass
1DH5-Hopping	2402	2390	4.95	-59.44	-15.05	Pass
1DH5-Hopping	2402	2400	4.95	-56.35	-15.05	Pass
1DH5	2480	2483.5	4.08	-59.02	-15.92	Pass
1DH5	2480	2500	4.08	-61.04	-15.92	Pass
1DH5-Hopping	2480	2483.5	4.78	-60.27	-15.22	Pass
1DH5-Hopping	2480	2500	4.78	-55.78	-15.22	Pass
2DH5	2402	2390	5.75	-61.05	-14.26	Pass
2DH5	2402	2400	5.75	-33.74	-14.26	Pass
2DH5-Hopping	2480	2483.5	5.36	-56.63	-14.64	Pass
2DH5-Hopping	2480	2500	5.36	-59.48	-14.64	Pass
2DH5	2480	2483.5	4.56	-53.34	-15.44	Pass
2DH5	2480	2500	4.56	-61.83	-15.44	Pass
2DH5-Hopping	2402	2390	3.62	-59.55	-16.38	Pass
2DH5-Hopping	2402	2400	3.62	-39.94	-16.38	Pass
3DH5	2402	2390	5.14	-61.91	-14.87	Pass
3DH5	2402	2400	5.14	-35.03	-14.87	Pass
3DH5-Hopping	2402	2390	4.66	-59.34	-15.34	Pass
3DH5-Hopping	2402	2400	4.66	-38.58	-15.34	Pass
3DH5	2480	2483.5	4.99	-50.34	-15.01	Pass
3DH5	2480	2500	4.99	-60.78	-15.01	Pass
3DH5-Hopping	2480	2483.5	4.99	-57.73	-15.01	Pass
3DH5-Hopping	2480	2500	4.99	-59.46	-15.01	Pass

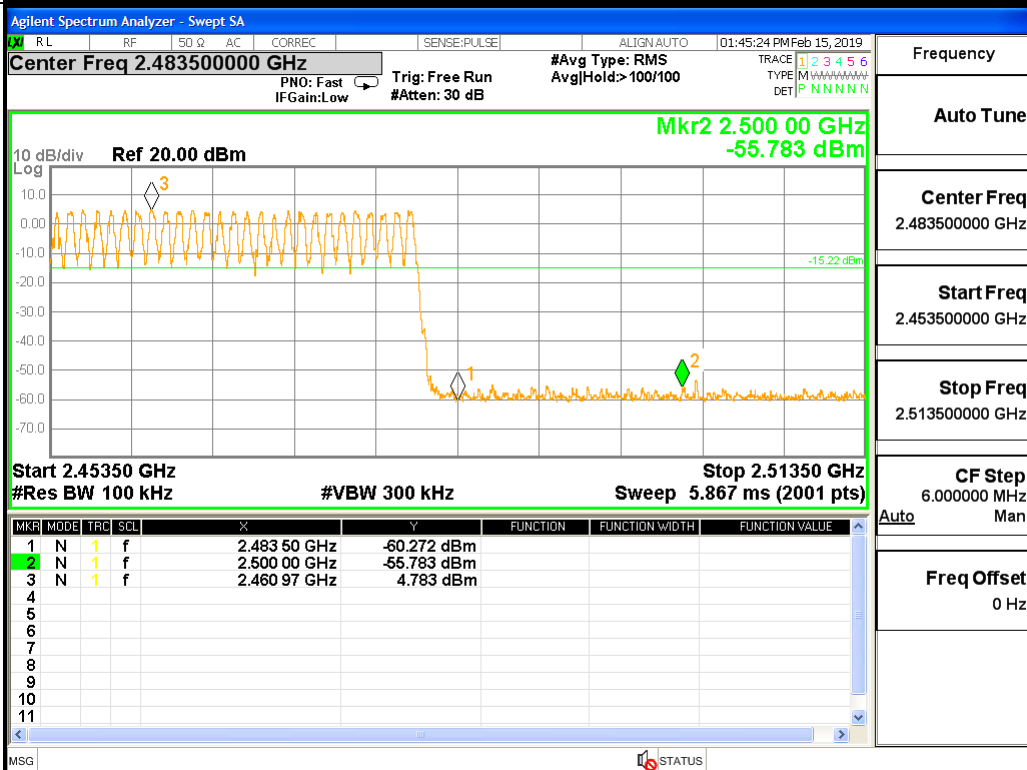
Test Graph

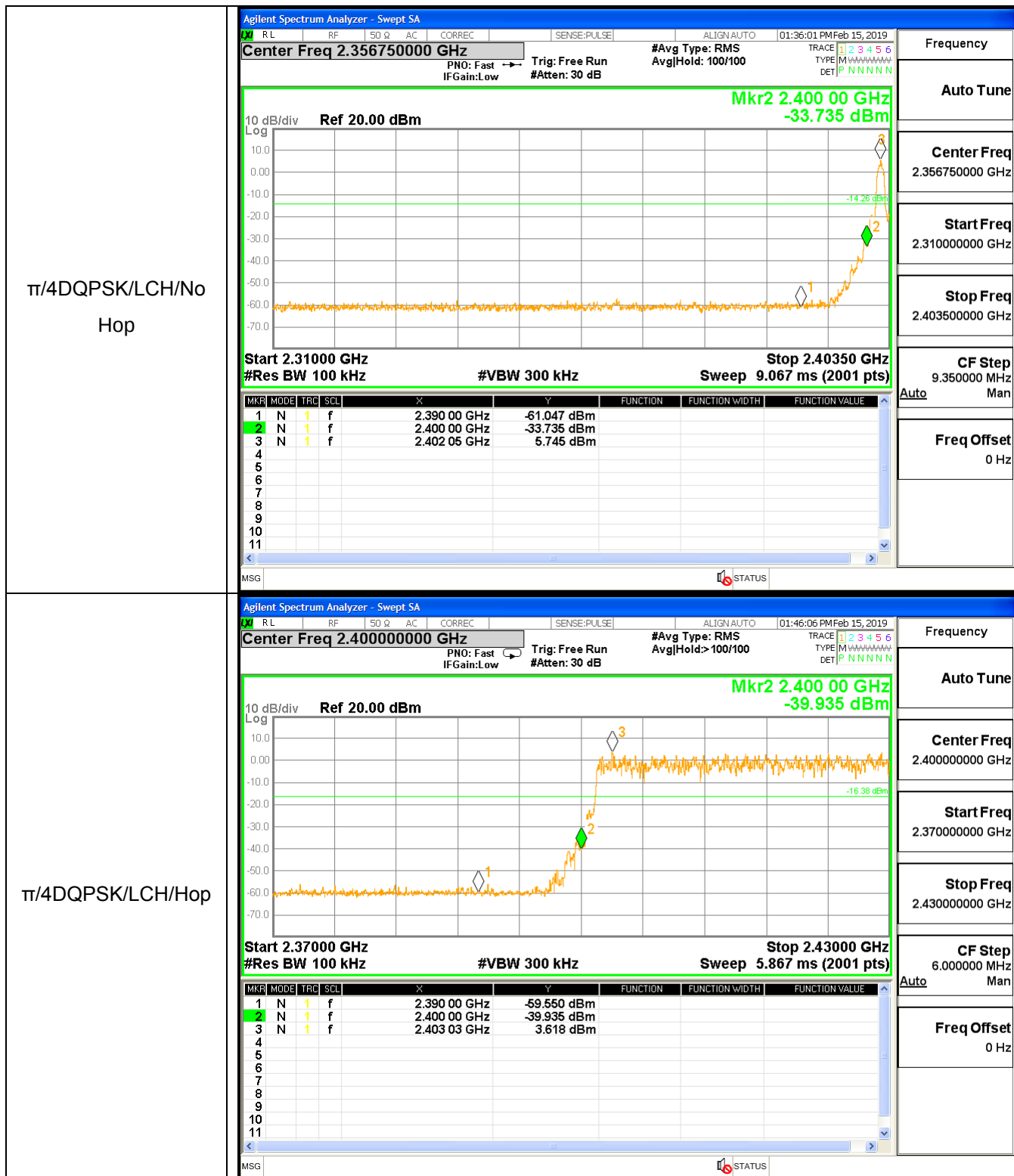


GFSK/HCH/No Hop



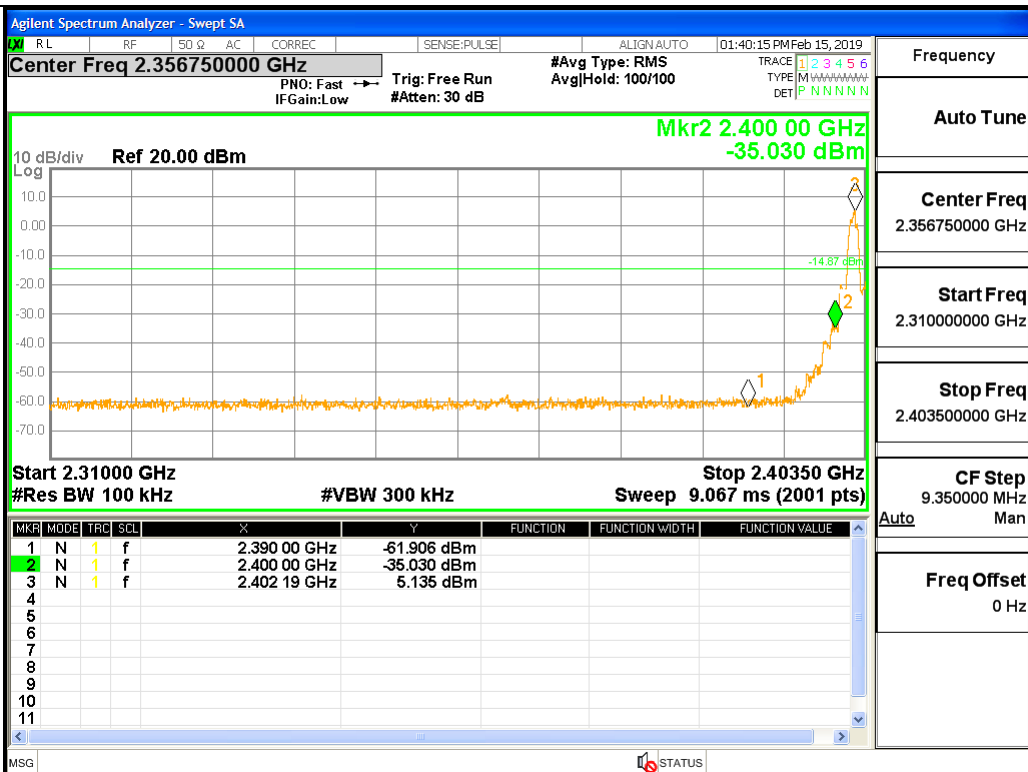
GFSK/HCH/Hop



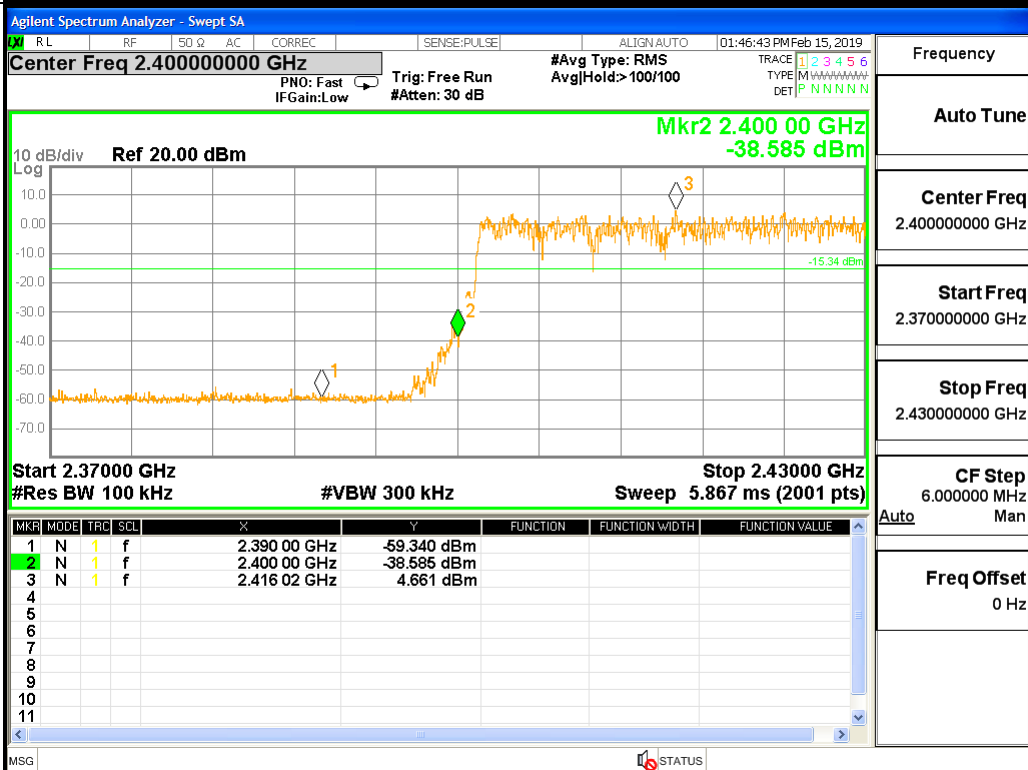


π/4DQPSK/HCH/No Hop	Agilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN:AUTO 01:38:29 PM Feb 15, 2019 Center Freq 2.489250000 GHz PN0: Fast IFGain:Low Trig: Free Run #Atten: 30 dB #Avg Type: RMS Avg Hold: 100/100 TRACE 1 2 3 4 5 6 TYPE M W W W W W W W DET P N N N N N N Frequency Auto Tune Center Freq 2.489250000 GHz Start Freq 2.478500000 GHz Stop Freq 2.500000000 GHz CF Step 2.150000 MHz Auto Man Freq Offset 0 Hz 10 dB/div Log Ref 20.00 dBm Mkr2 2.500 000 GHz -61.826 dBm -15.44 dBm Start 2.47850 GHz #Res BW 100 kHz #VBW 300 kHz Stop 2.50000 GHz Sweep 2.133 ms (2001 pts) <table><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><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2.483 500 GHz</td><td>-53.338 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>2.500 000 GHz</td><td>-61.826 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>f</td><td>2.480 059 GHz</td><td>4.559 dBm</td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>11</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> MSG STATUS	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2.483 500 GHz	-53.338 dBm				2	N	1	f	2.500 000 GHz	-61.826 dBm				3	N	1	f	2.480 059 GHz	4.559 dBm				4									5									6									7									8									9									10									11								
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π/4DQPSK/HCH/Hop	Agilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC CORREC SENSE:PULSE ALIGN:AUTO 01:45:58 PM Feb 15, 2019 Center Freq 2.483500000 GHz PN0: Fast IFGain:Low Trig: Free Run #Atten: 30 dB #Avg Type: RMS Avg Hold> 100/100 TRACE 1 2 3 4 5 6 TYPE M W W W W W W W DET P N N N N N N Frequency 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 10 dB/div Log Ref 20.00 dBm Mkr2 2.500 00 GHz -59.479 dBm -14.64 dBm Start 2.45350 GHz #Res BW 100 kHz #VBW 300 kHz Stop 2.51350 GHz Sweep 5.867 ms (2001 pts) <table><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><tr><td>1</td><td>N</td><td>1</td><td>f</td><td>2.483 50 GHz</td><td>-56.630 dBm</td><td></td><td></td><td></td></tr><tr><td>2</td><td>N</td><td>1</td><td>f</td><td>2.500 00 GHz</td><td>-59.479 dBm</td><td></td><td></td><td></td></tr><tr><td>3</td><td>N</td><td>1</td><td>f</td><td>2.455 06 GHz</td><td>5.357 dBm</td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>11</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> MSG STATUS	MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	N	1	f	2.483 50 GHz	-56.630 dBm				2	N	1	f	2.500 00 GHz	-59.479 dBm				3	N	1	f	2.455 06 GHz	5.357 dBm				4									5									6									7									8									9									10									11								
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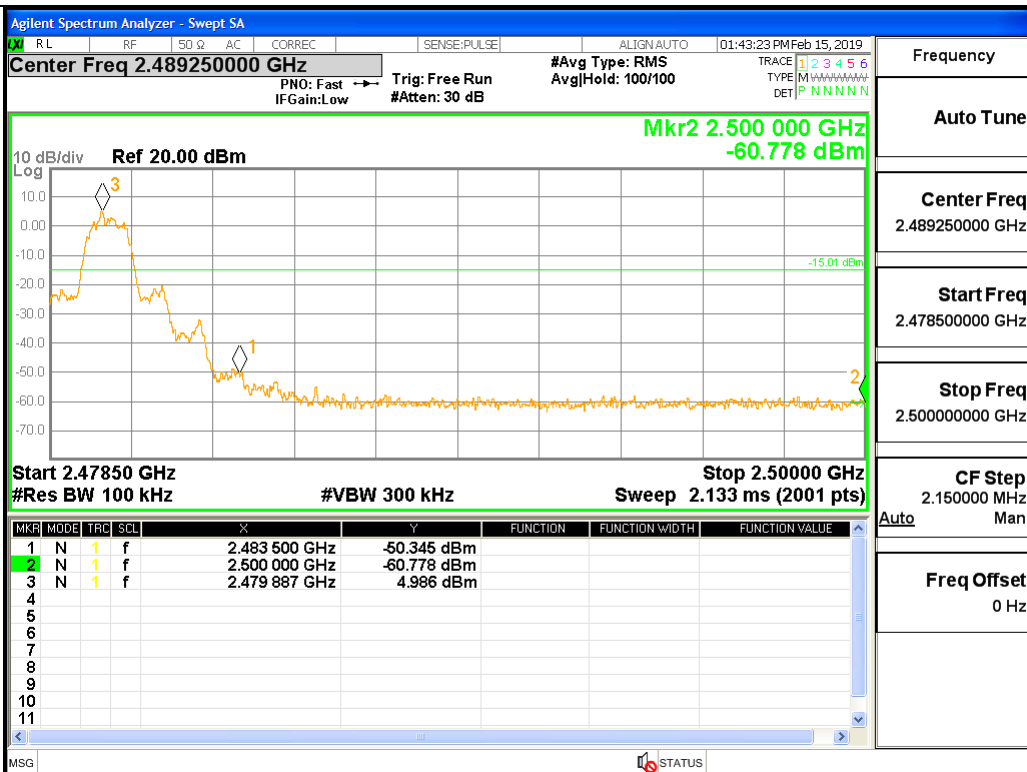
8DPSK/LCH/No Hop



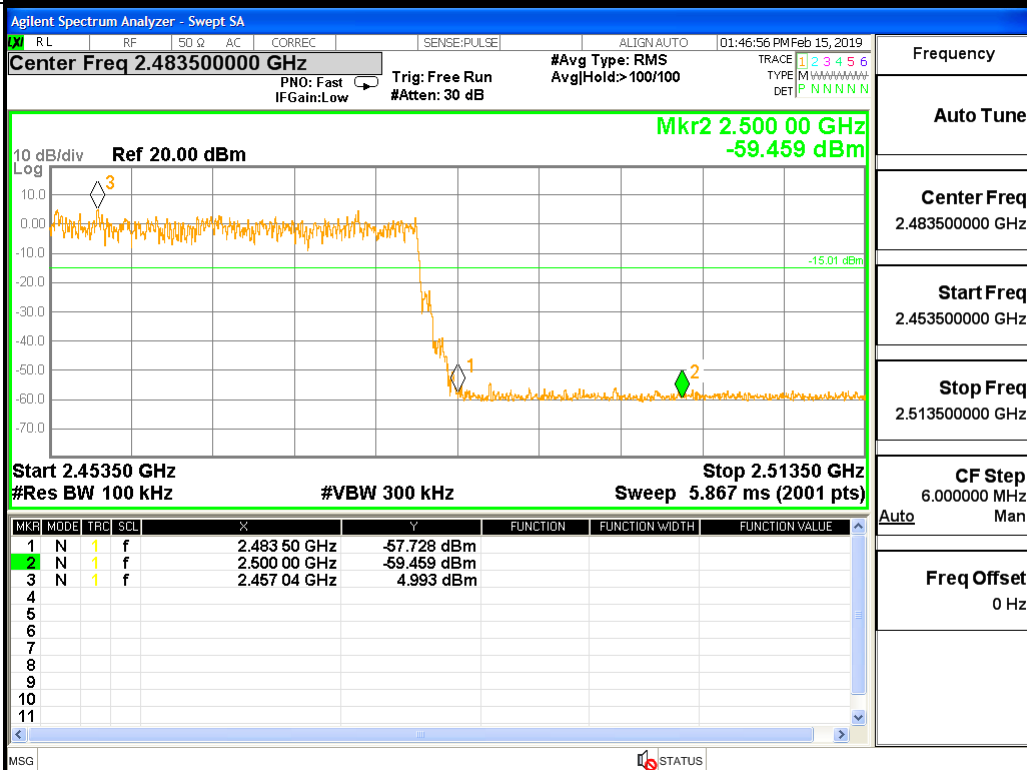
8DPSK/LCH/Hop



8DPSK/HCH/No Hop

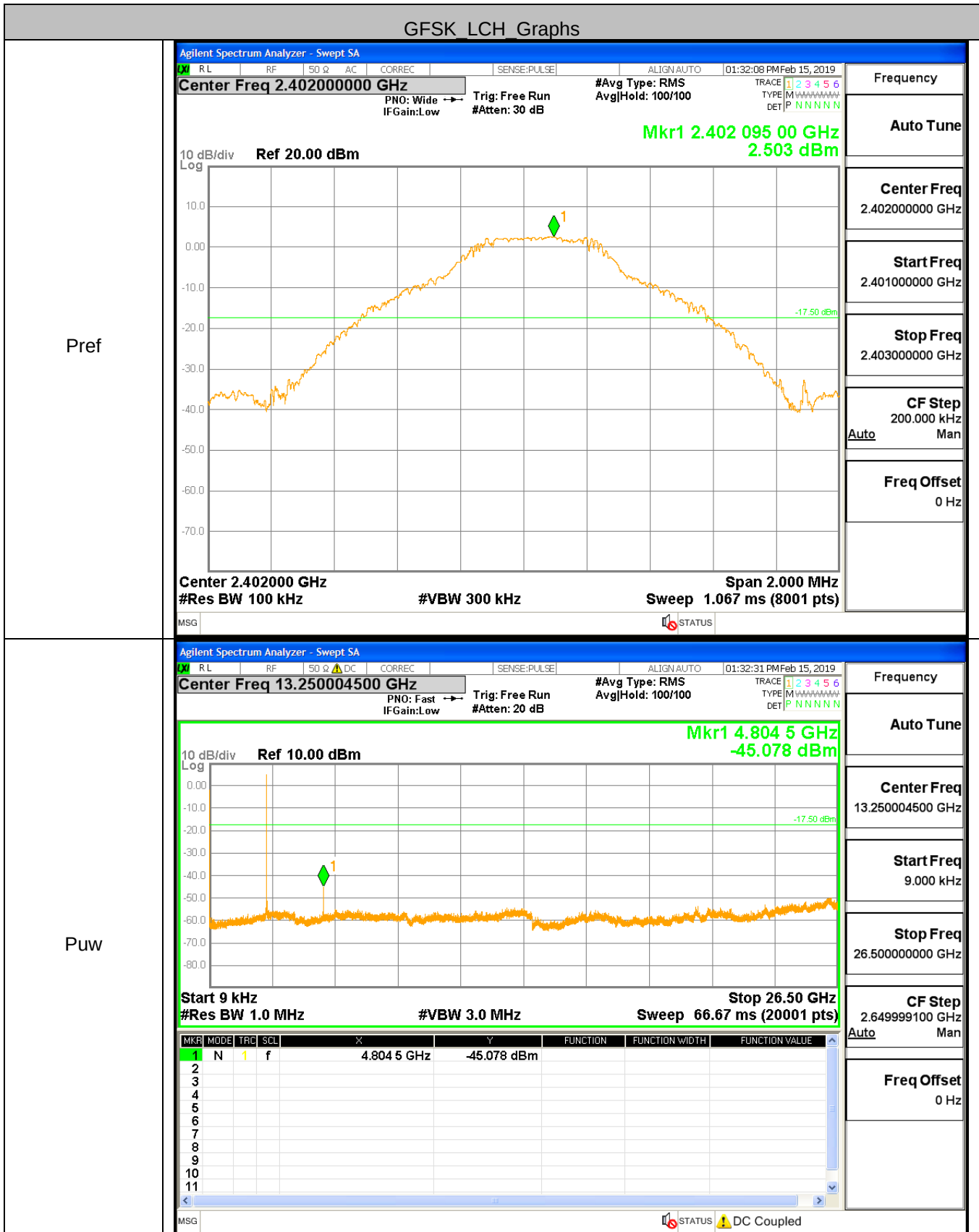


8DPSK/HCH/Hop

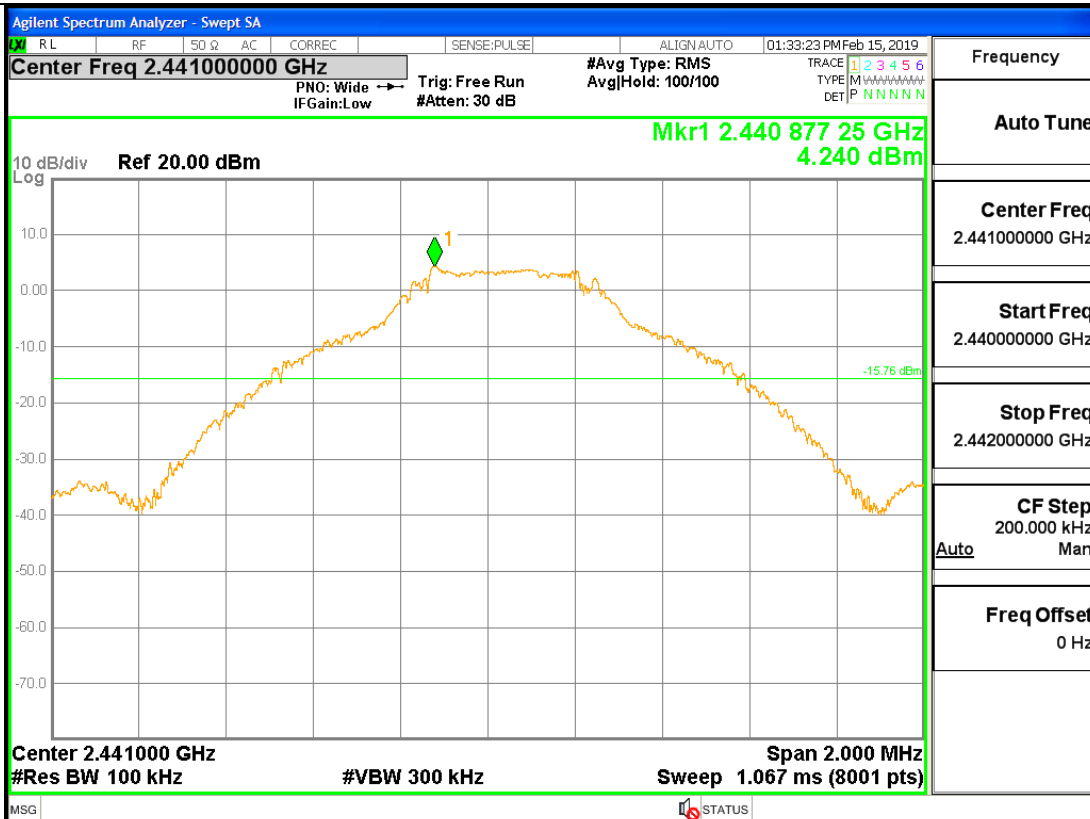


A.7 RF Conducted Spurious Emissions

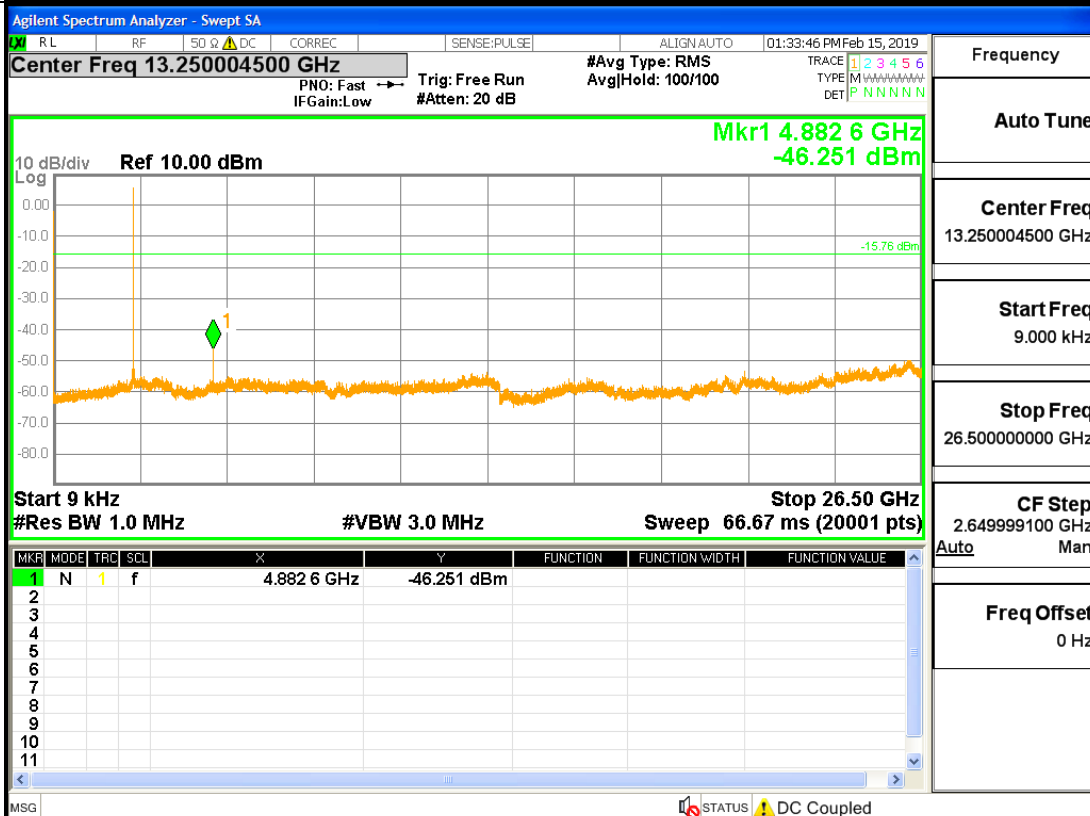
Test Graph



Pref

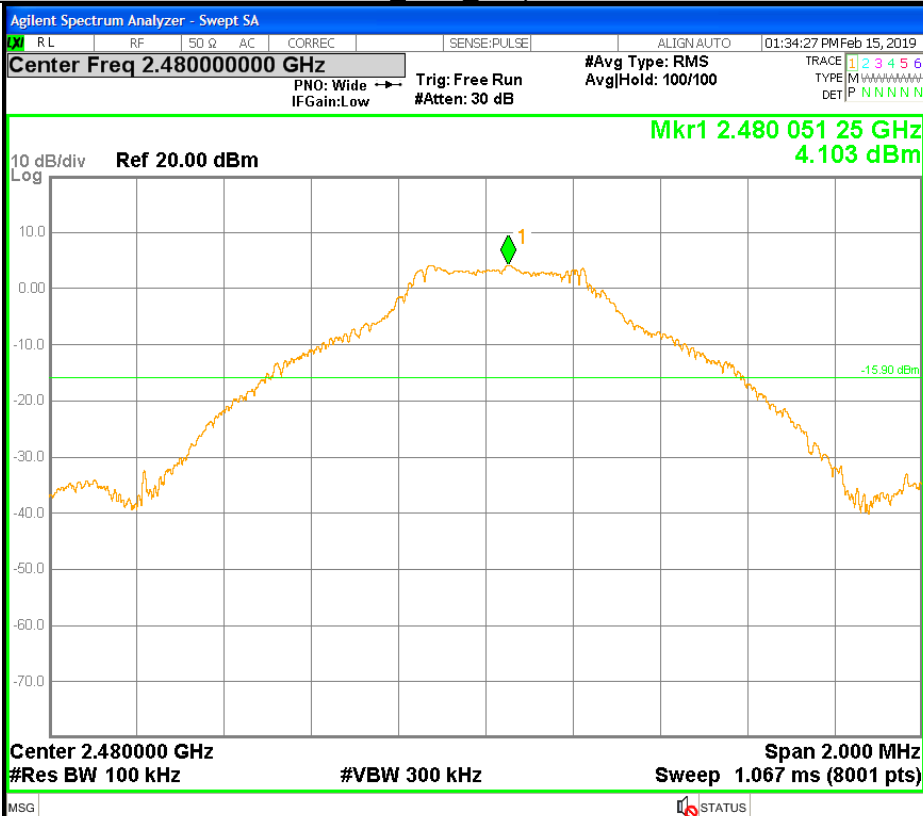


Puw

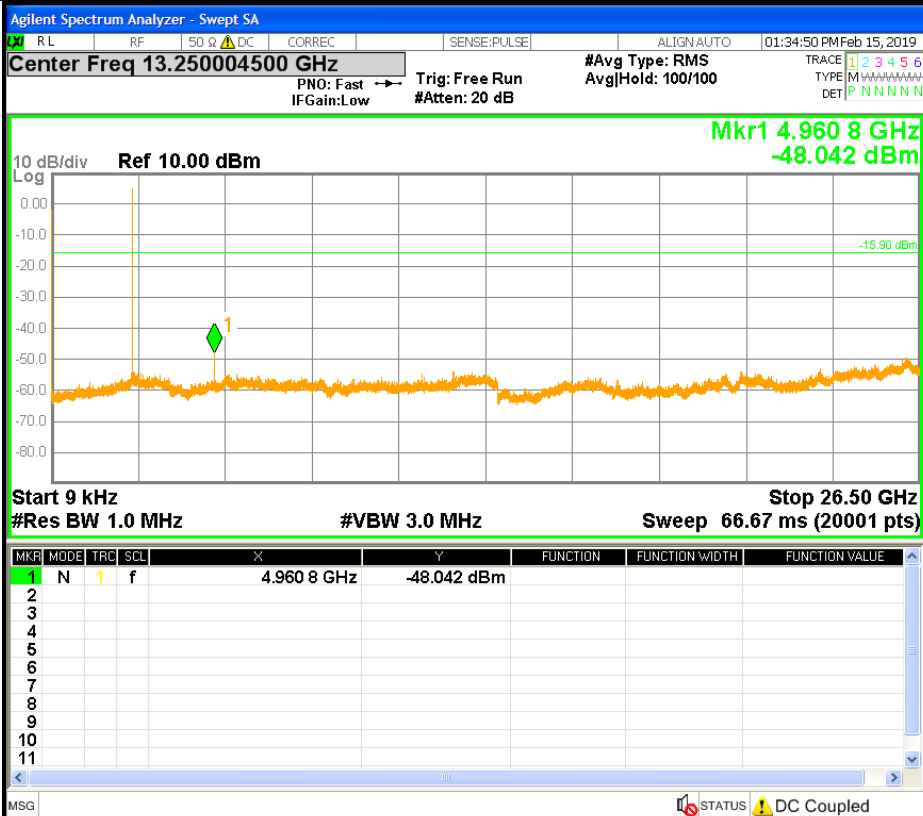


GFSK HCH Graphs

Pref

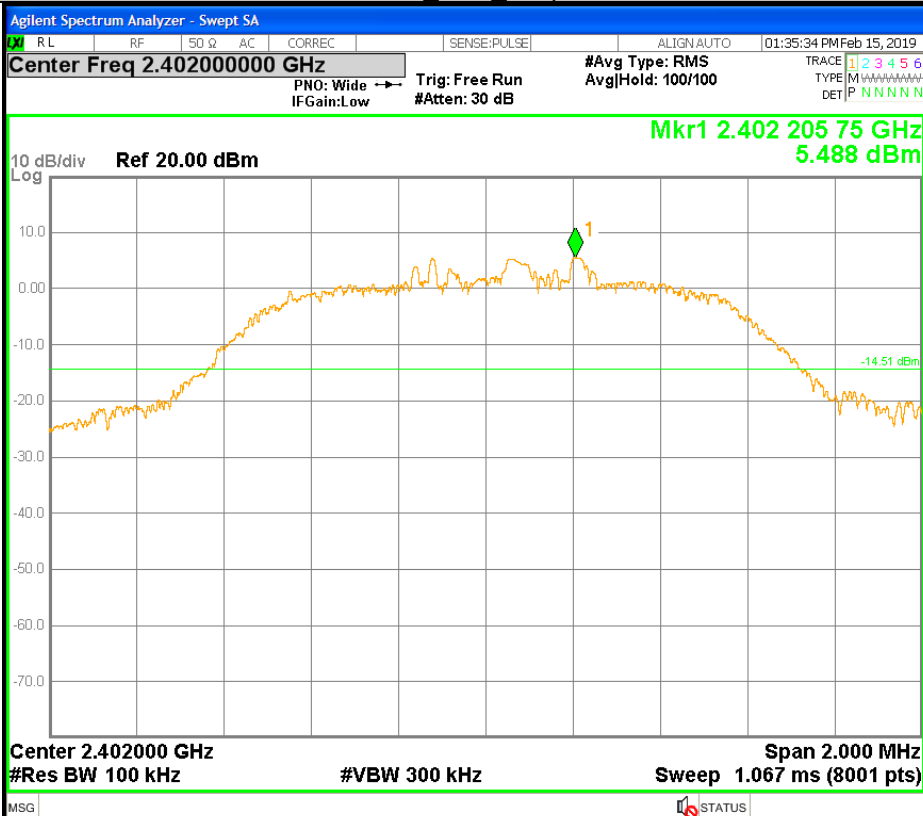


Puw

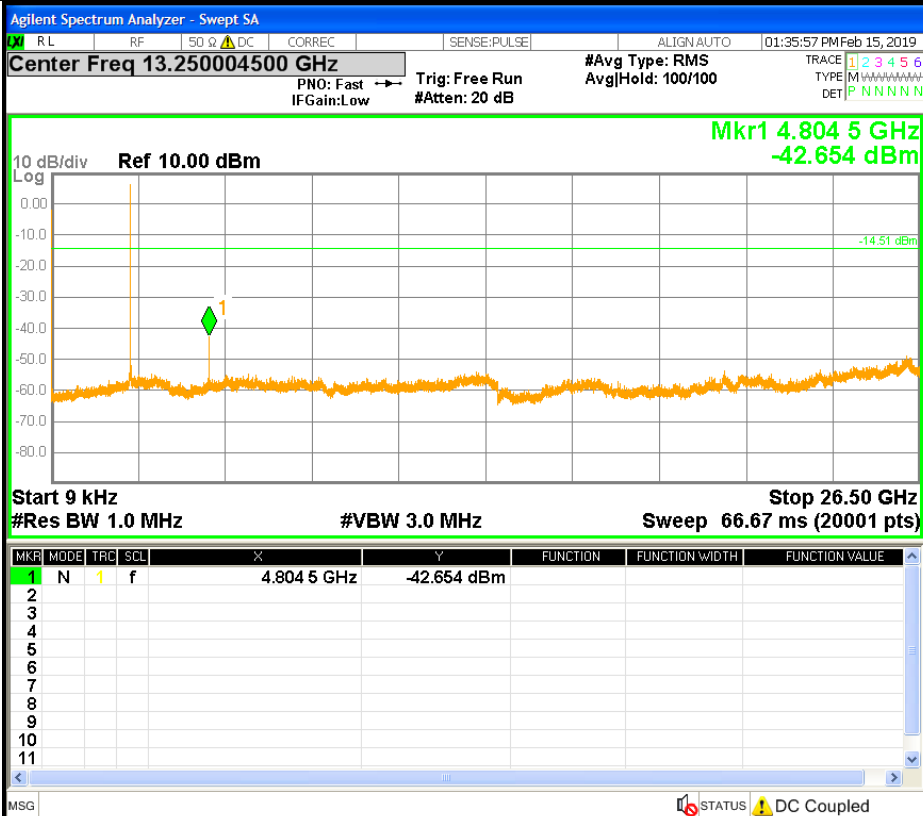


$\pi/4$ DQPSK LCH Graphs

Pref

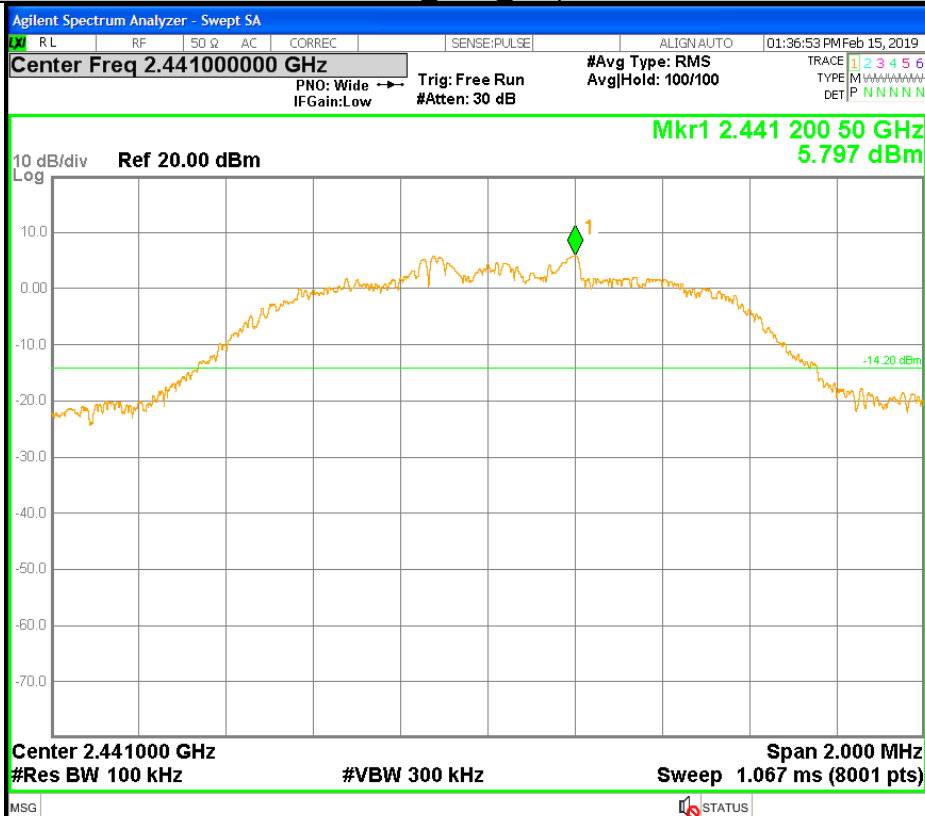


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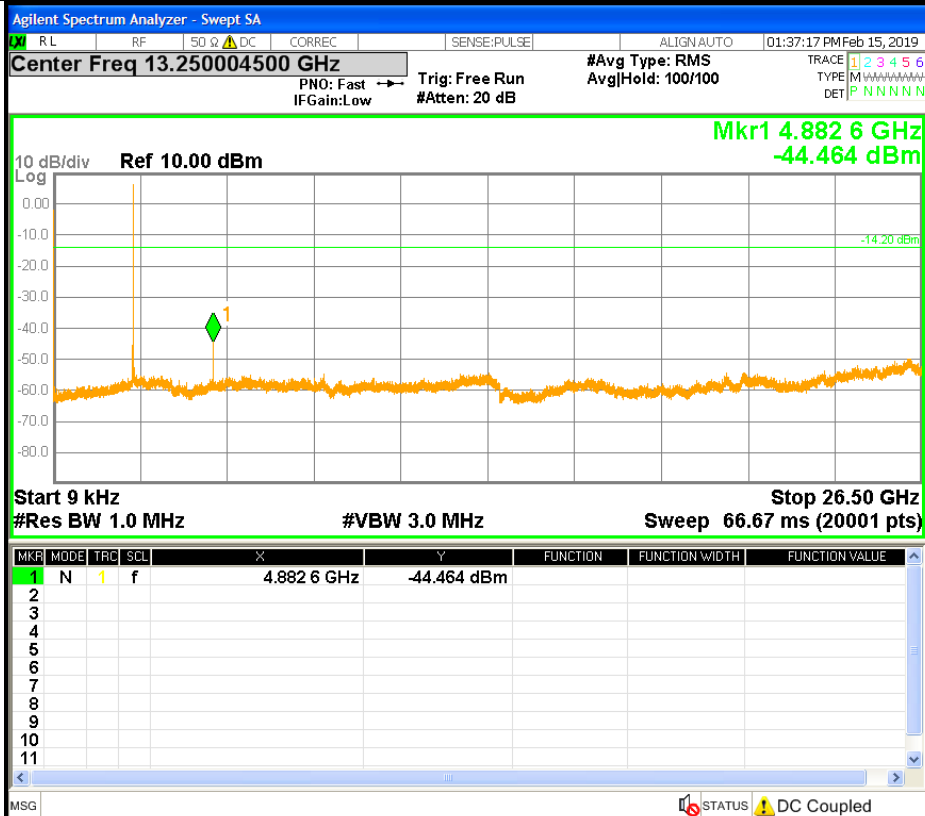
$\pi/4$ DQPSK MCH Graphs

Pref



Frequency
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Center Freq 2.441000000 GHz
Start Freq 2.440000000 GHz
Stop Freq 2.442000000 GHz
CF Step 200.000 kHz Auto Man
Freq Offset 0 Hz

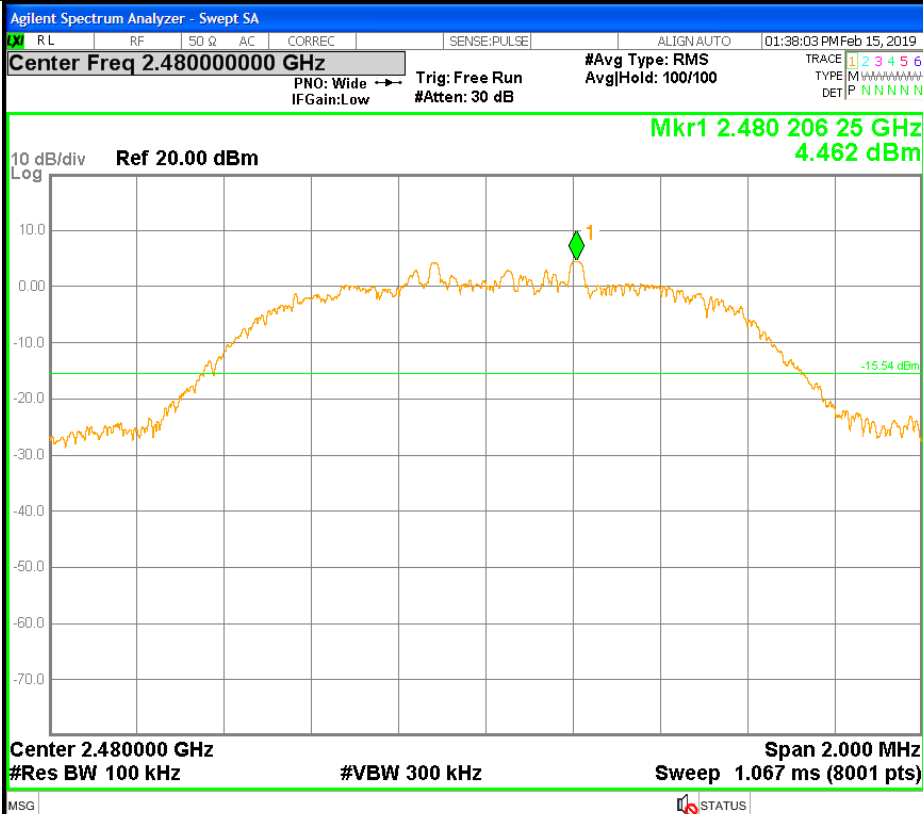
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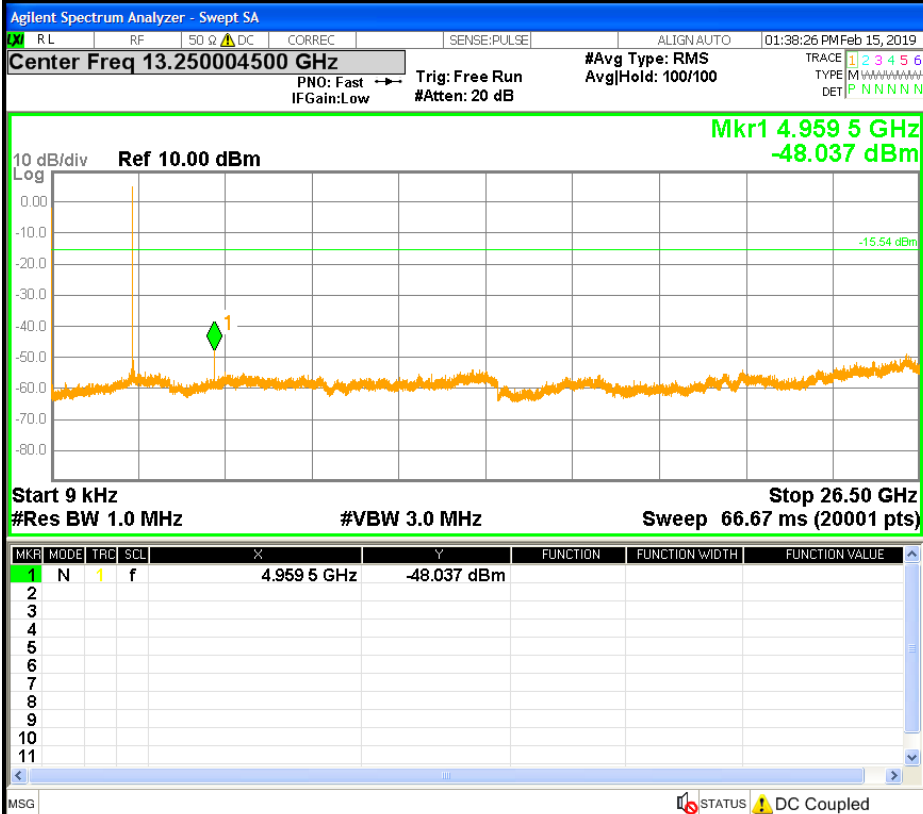
Frequency
Auto Tune
Center Freq 13.250004500 GHz
Start Freq 9.000 kHz
Stop Freq 26.500000000 GHz
CF Step 2.649999100 GHz Auto Man
Freq Offset 0 Hz

$\pi/4$ DQPSK HCH Graphs

Pref

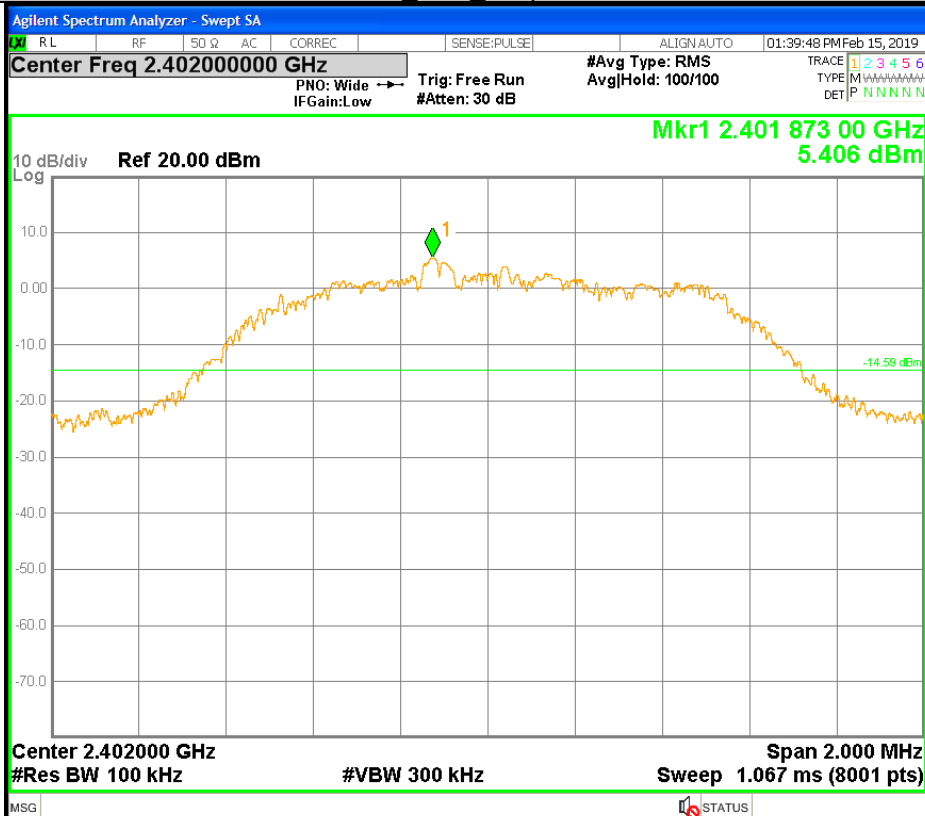


Puw

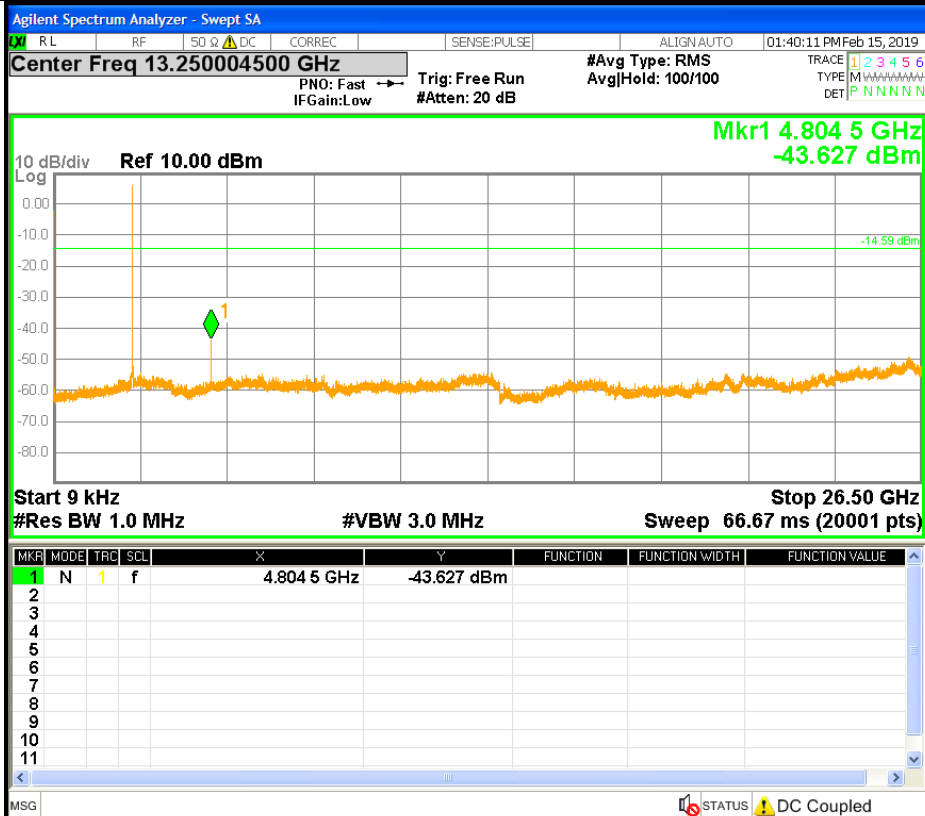


8DPSK LCH Graphs

Pref

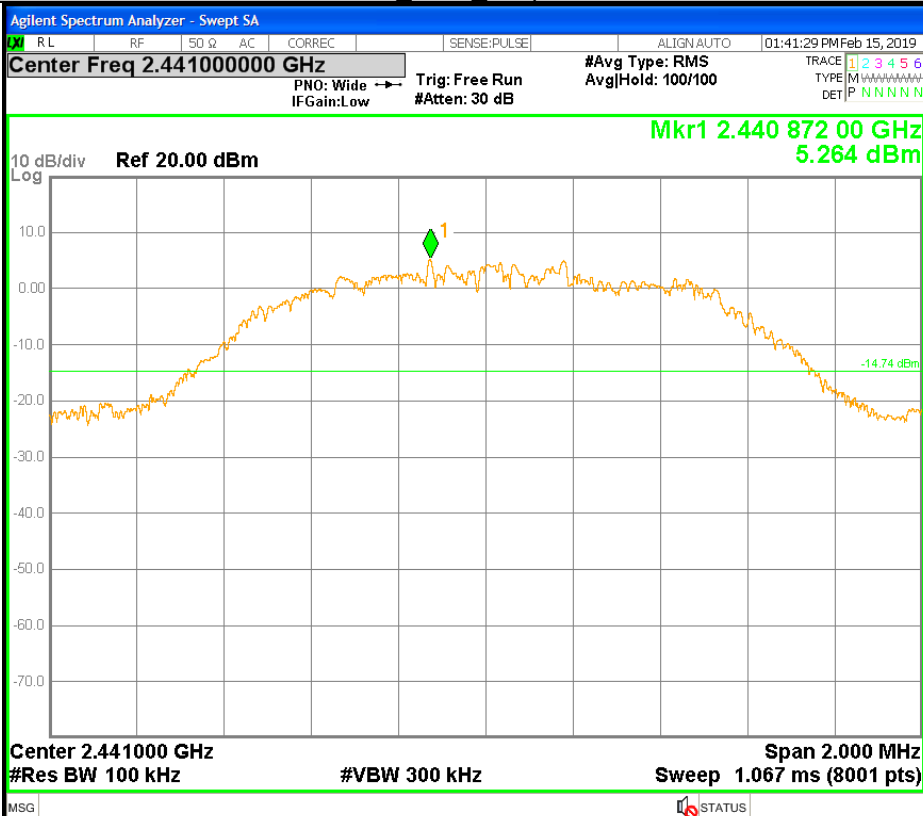


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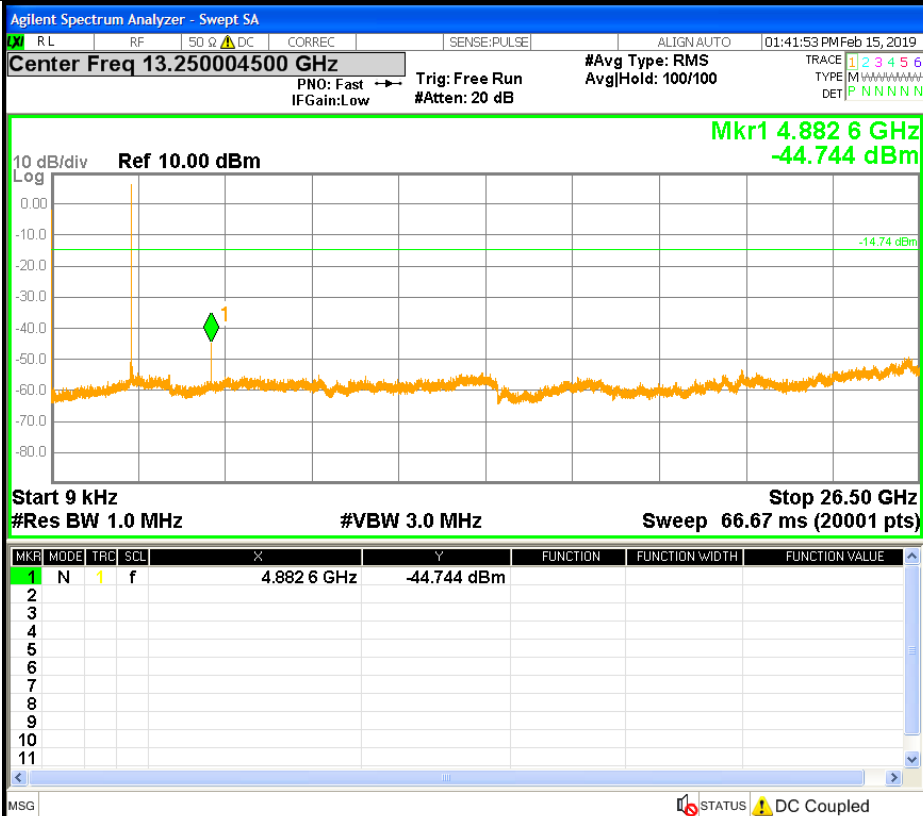


8DPSK MCH Graphs

Pref

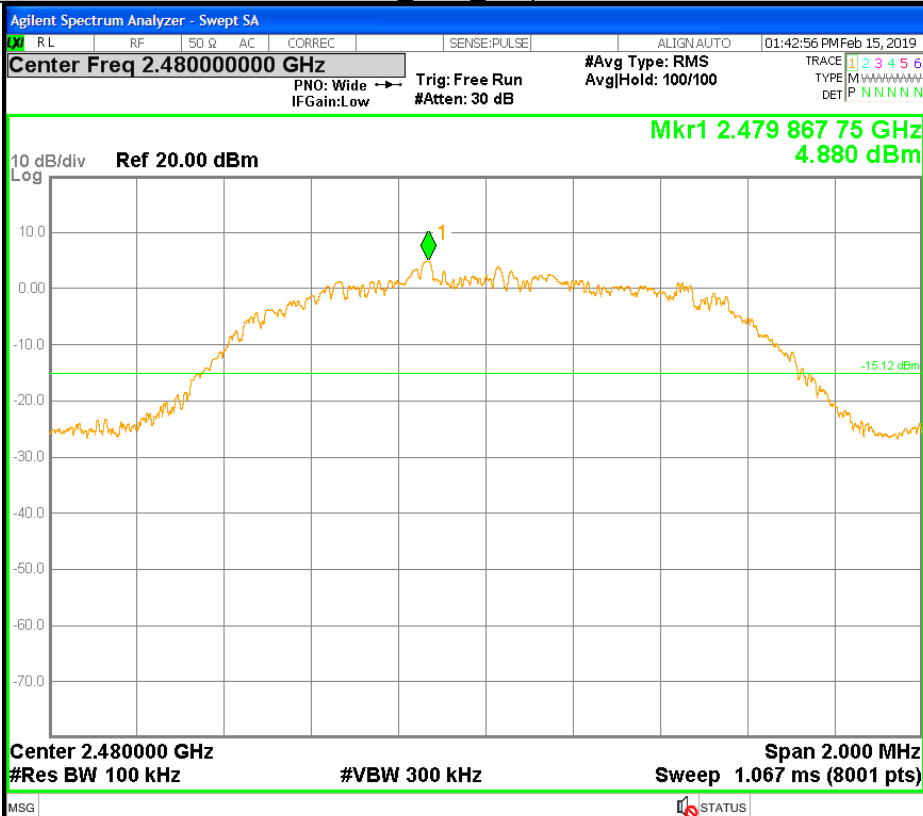


Puw

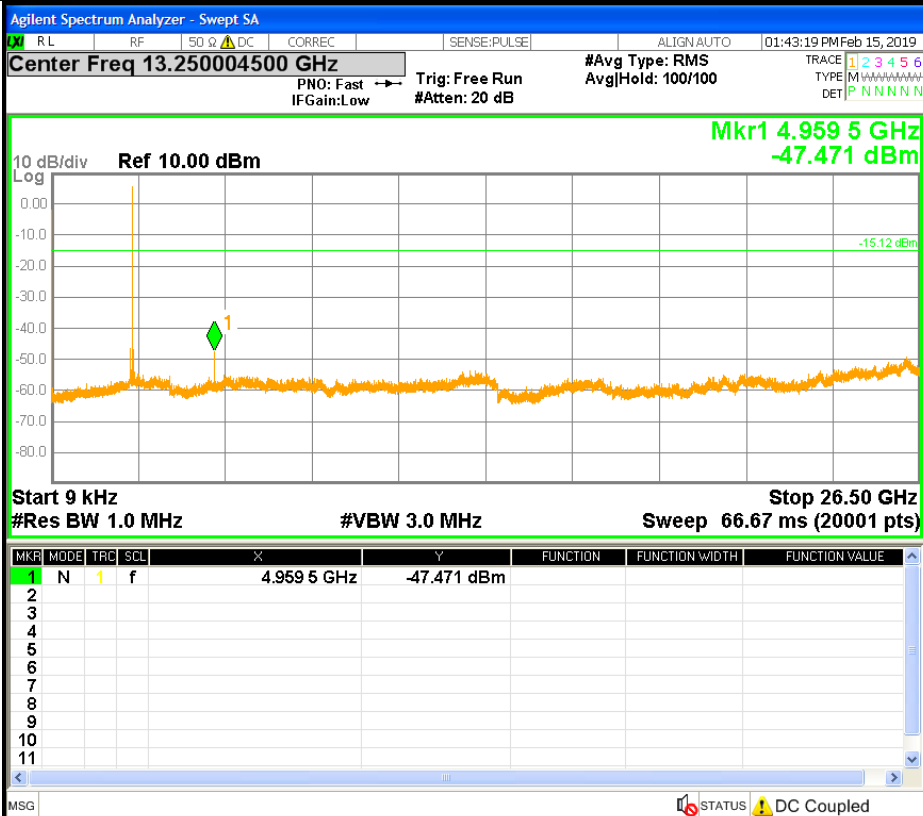


8DPSK HCH Graphs

Pref



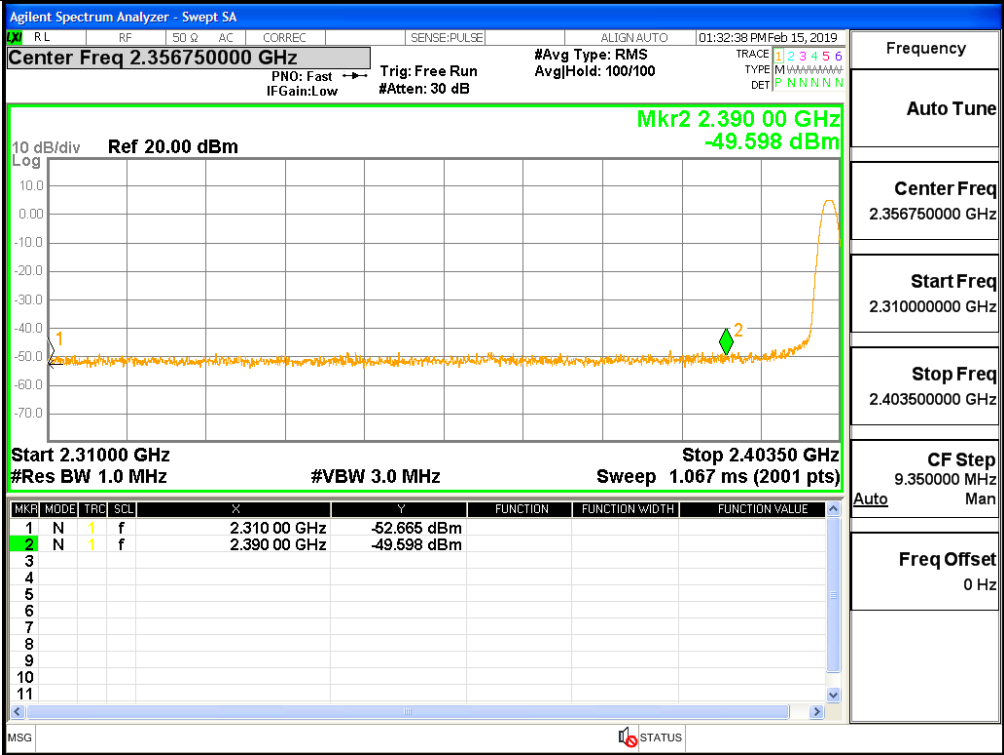
Puw



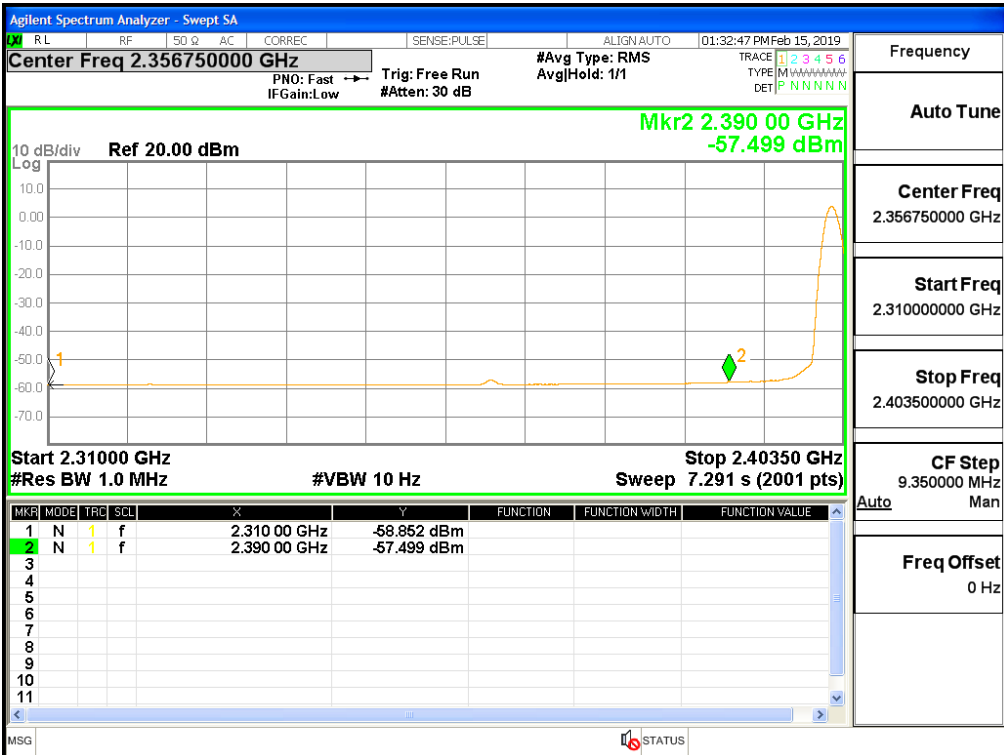
A.8 Restrict-band band-edge measurements

Type	Carrier Frequency (MHz)	Frequency(MHz)	Gain	Ground Factor	Peak Value(dBm)	E [dBuV/m]	Limit [dBuV/m]	Average Value(dBm)	E [dBuV/m]	Limit [dBuV/m]	Conclusion
1DH5	2402	2310	2.00	0.00	-52.66	44.54	74	-58.85	38.35	54	Pass
1DH5	2402	2390	2.00	0.00	-49.6	47.6	74	-57.5	39.7	54	Pass
1DH5	2480	2483.5	2.00	0.00	-47.99	49.21	74	-53.5	43.7	54	Pass
1DH5	2480	2500	2.00	0.00	-50.43	46.77	74	-57.89	39.31	54	Pass
2DH5	2402	2310	2.00	0.00	-51.72	45.48	74	-58.82	38.38	54	Pass
2DH5	2402	2390	2.00	0.00	-51.41	45.79	74	-58.03	39.17	54	Pass
2DH5	2480	2483.5	2.00	0.00	-39	58.2	74	-48.72	48.48	54	Pass
2DH5	2480	2500	2.00	0.00	-51.88	45.32	74	-57.87	39.33	54	Pass
3DH5	2402	2310	2.00	0.00	-50.28	46.92	74	-58.86	38.34	54	Pass
3DH5	2402	2390	2.00	0.00	-52.46	44.74	74	-57.94	39.26	54	Pass
3DH5	2480	2483.5	2.00	0.00	-37.76	59.44	74	-46.66	50.54	54	Pass
3DH5	2480	2500	2.00	0.00	-49.54	47.66	74	-57.92	39.28	54	Pass

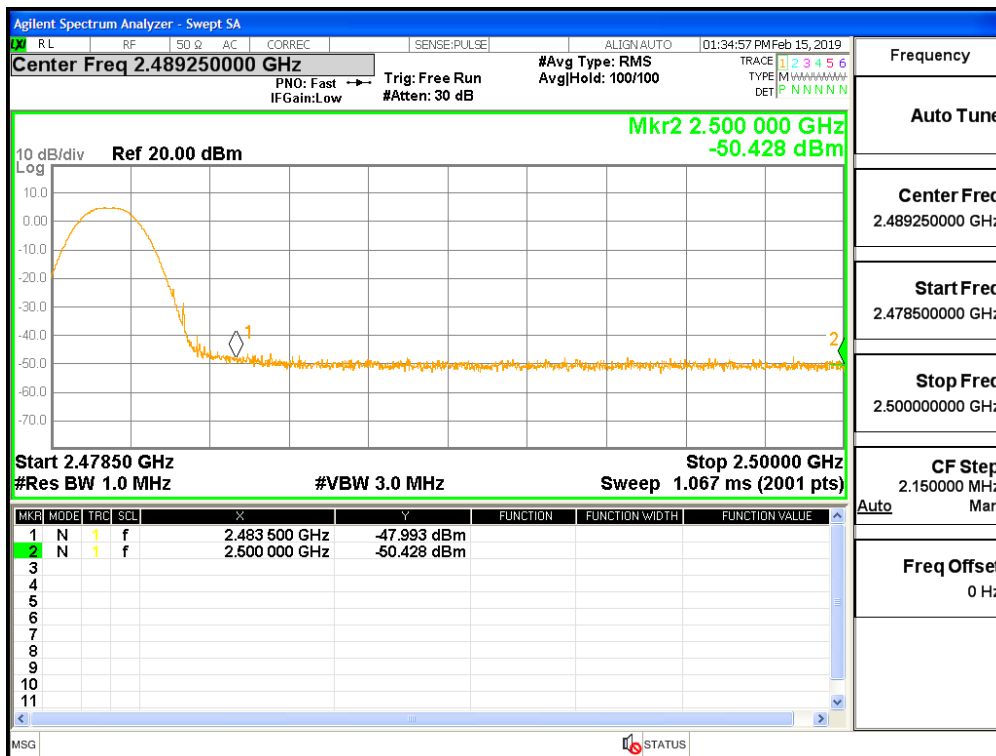
Restrict-band band-edge measurements_2402_PEAK_DH5



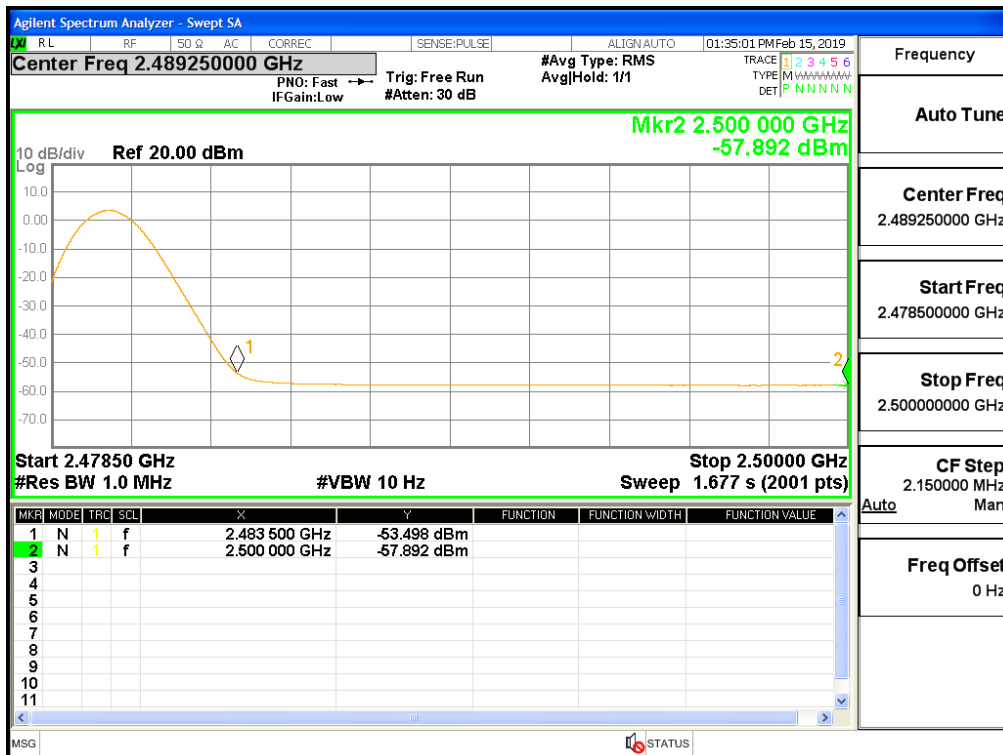
Restrict-band band-edge measurements_2402_AV_DH5



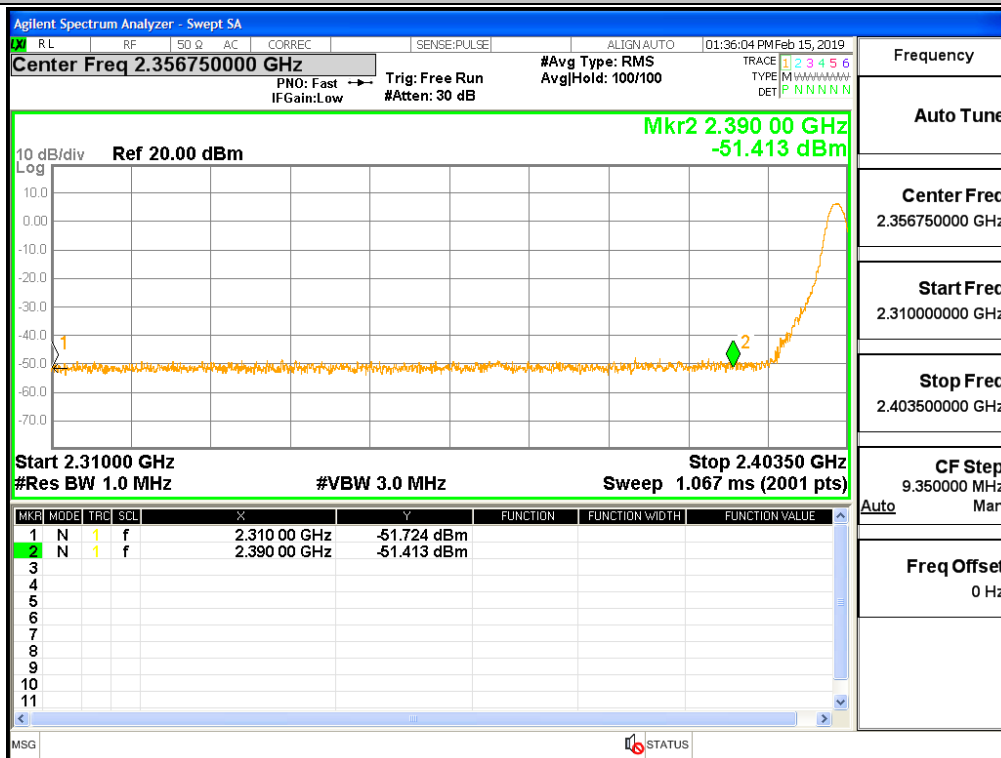
Restrict-band band-edge measurements_2480_PEAK_DH5



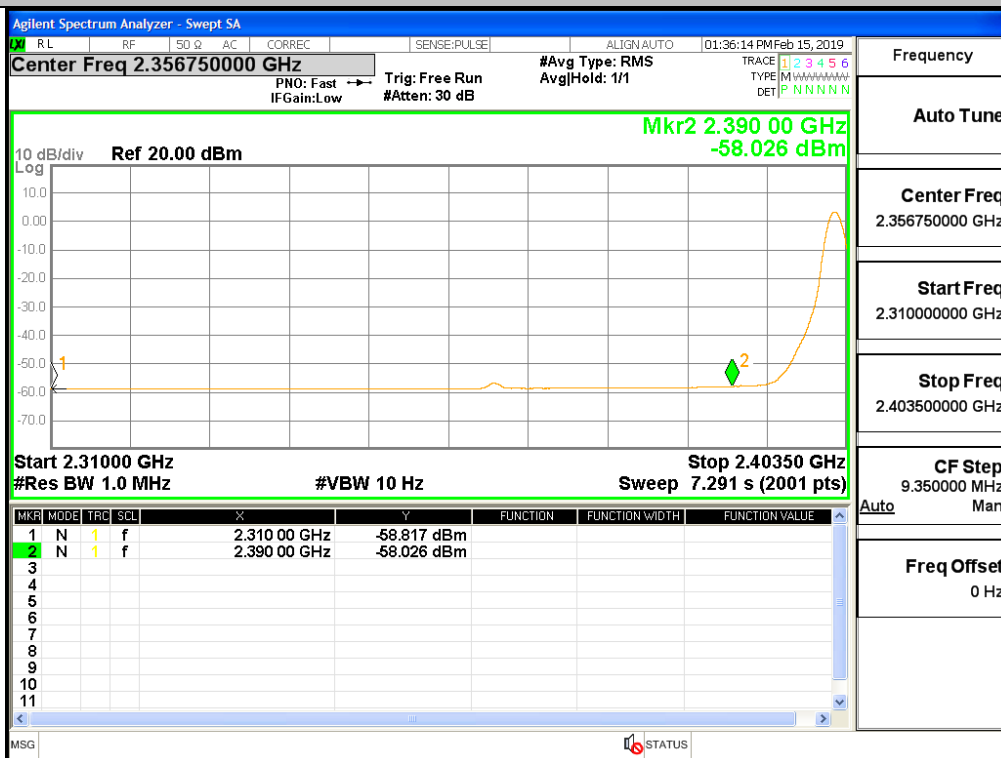
Restrict-band band-edge measurements_2480_AV_DH5



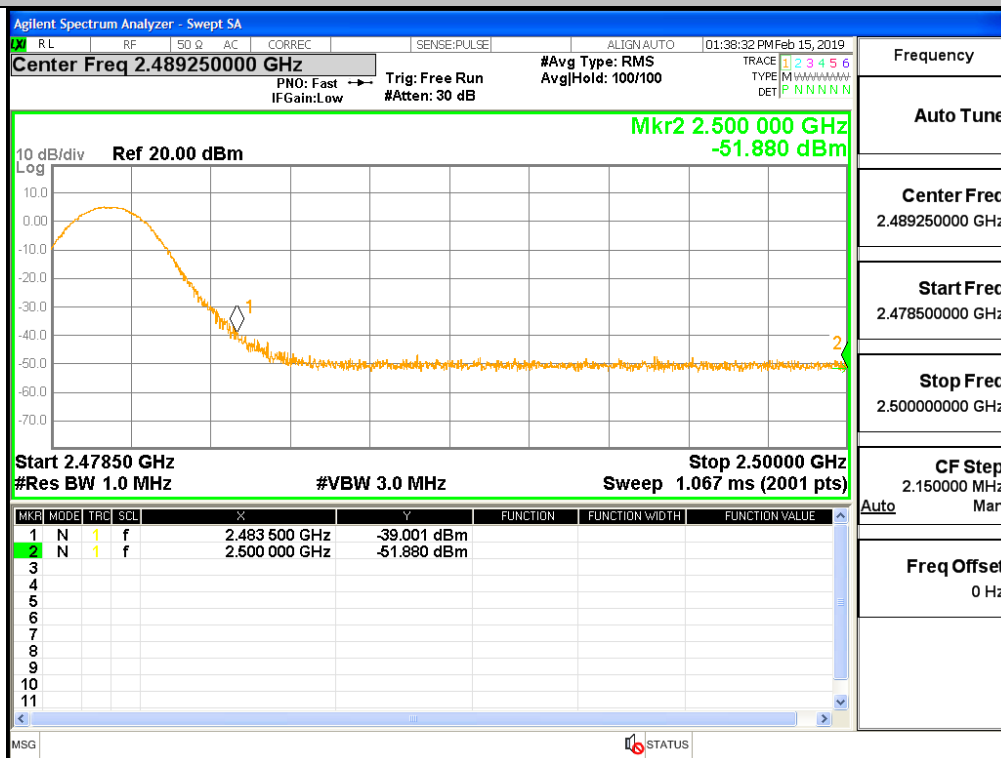
Restrict-band band-edge measurements_2402_PEAK_2DH5



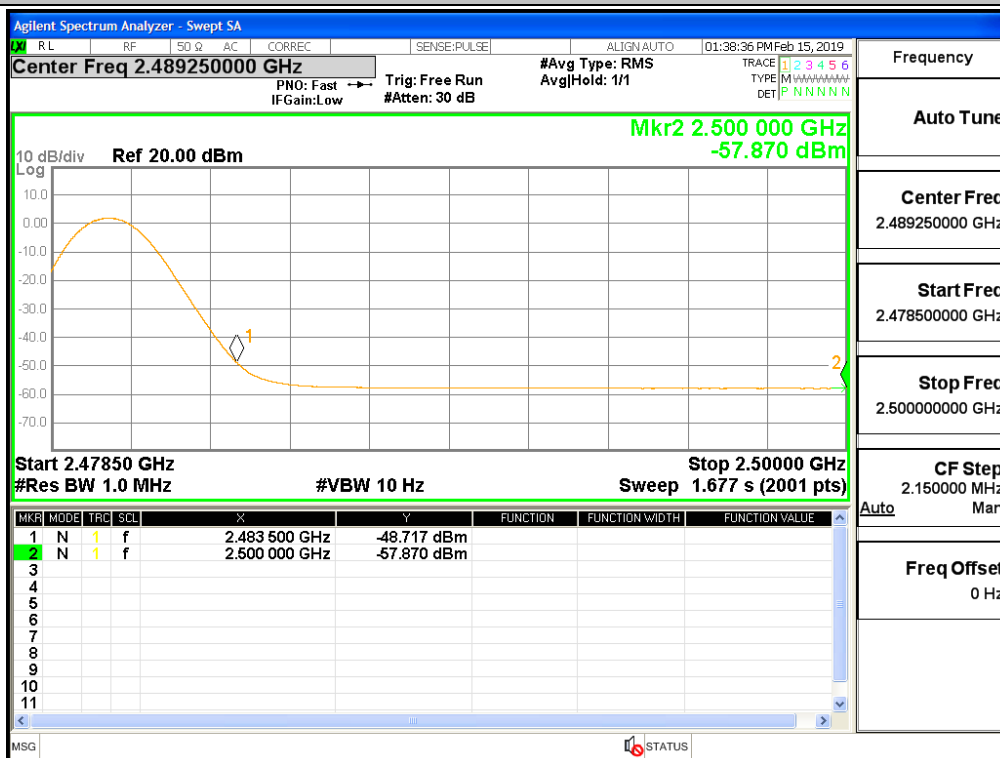
Restrict-band band-edge measurements_2402_AV_2DH5



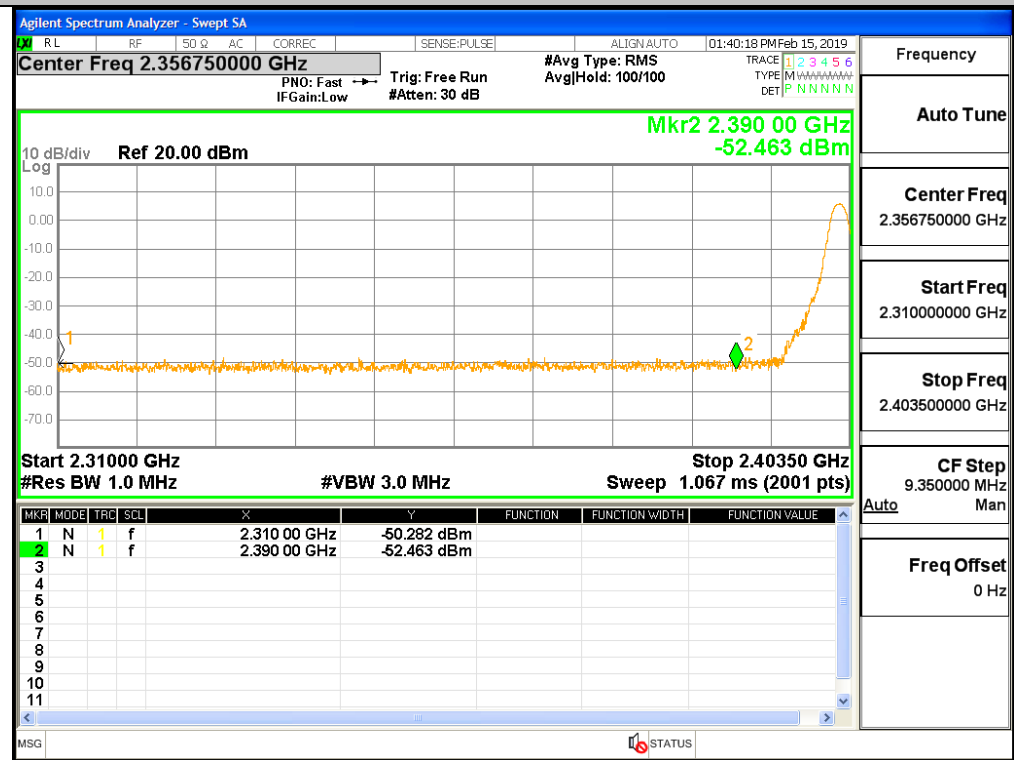
Restrict-band band-edge measurements_2480_PEAK_2DH5



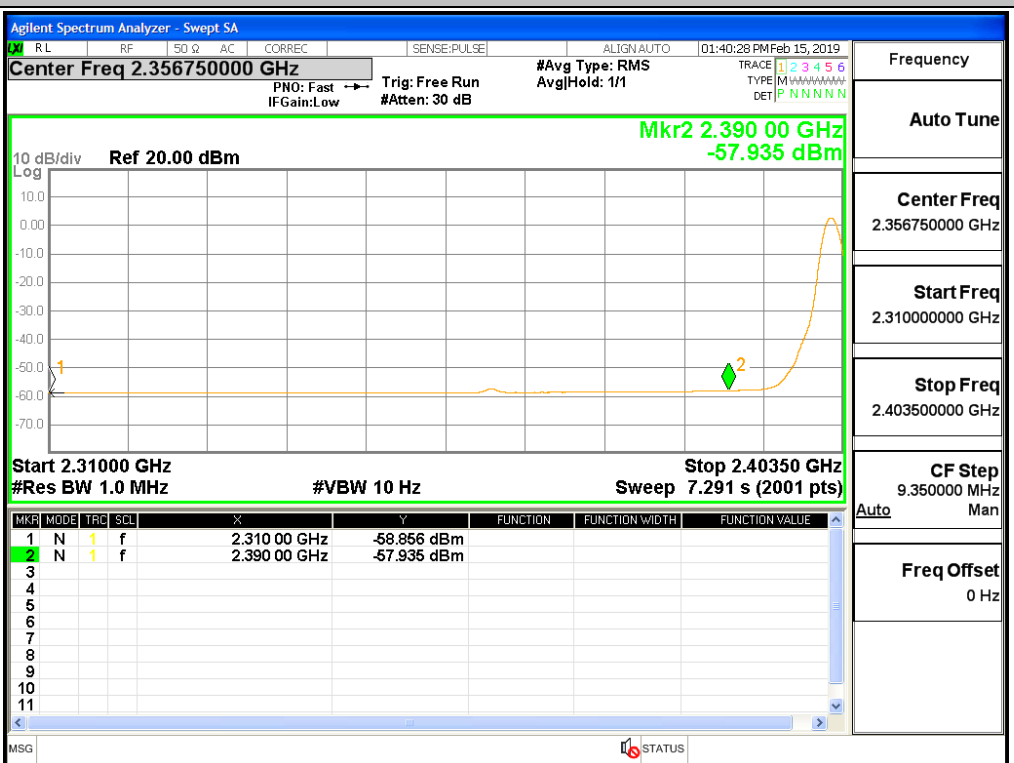
Restrict-band band-edge measurements_2480_AV_2DH5



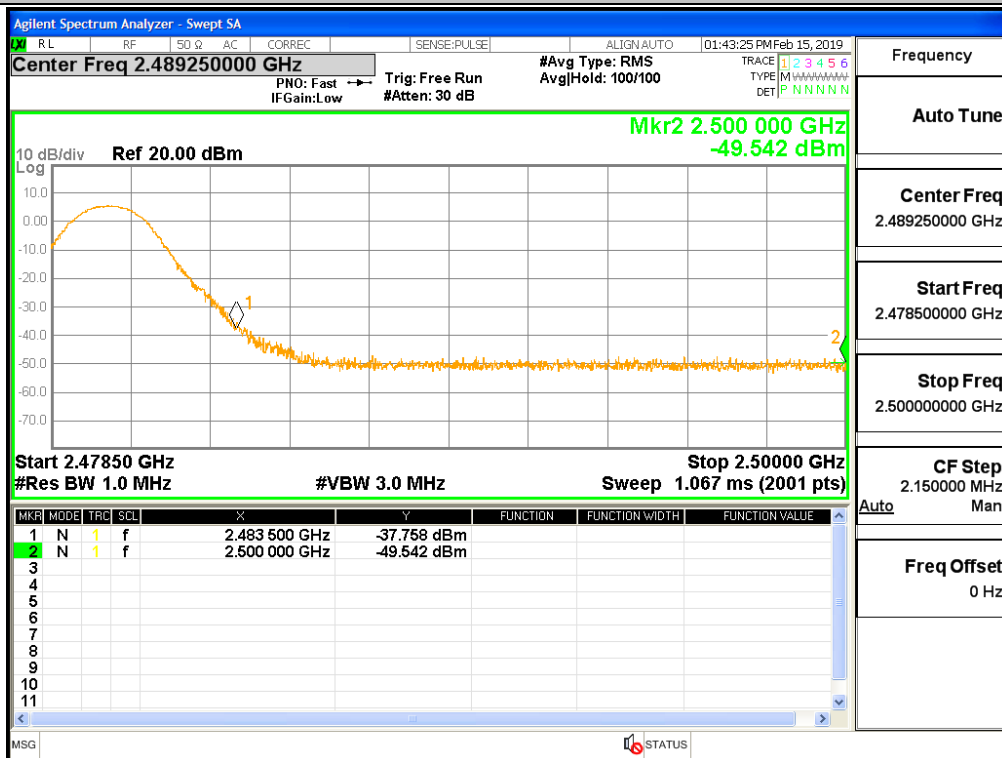
Restrict-band band-edge measurements_2402_PEAK_3DH5



Restrict-band band-edge measurements_2402_AV_3DH5



Restrict-band band-edge measurements_2480_PEAK_3DH5



Restrict-band band-edge measurements_2480_AV_3DH5

