

Appendix A

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

Product Name: TRUE WIRELESS EARBUDS

Trade Mark: Happy Plugs

Test Model: Happy Plugs Air 1

Environmental Conditions

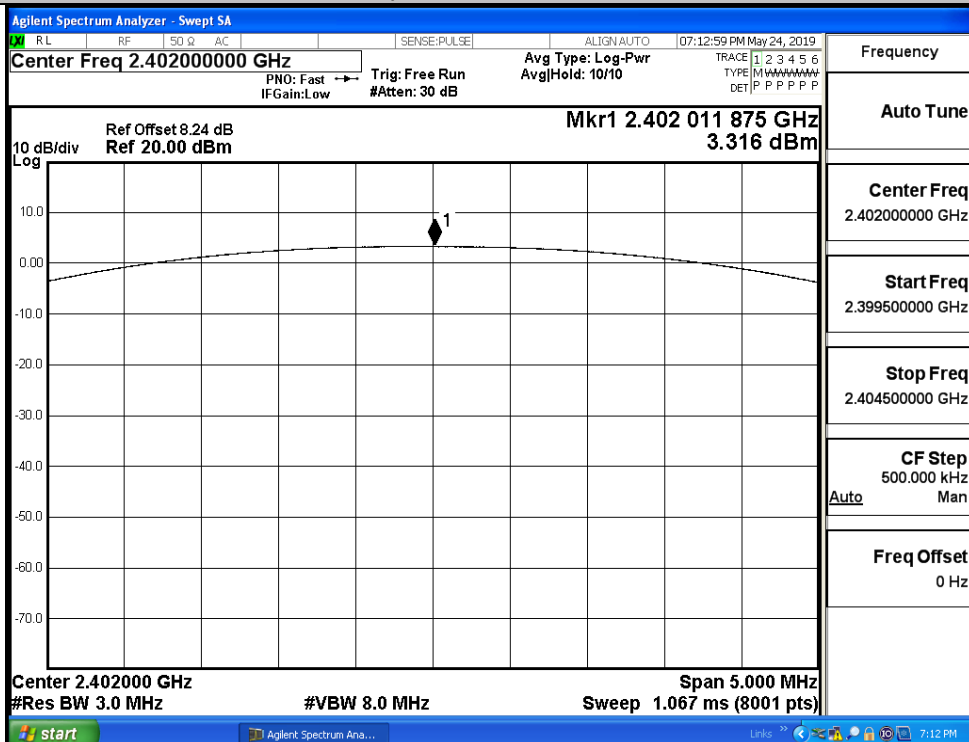
Temperature:	23.1 ° C
Relative Humidity:	53.4%
ATM Pressure:	100.0 kPa
Test Engineer:	David.Luo
Supervised by:	Tom.Liu

A.1 Maximum Conducted Peak Output Power

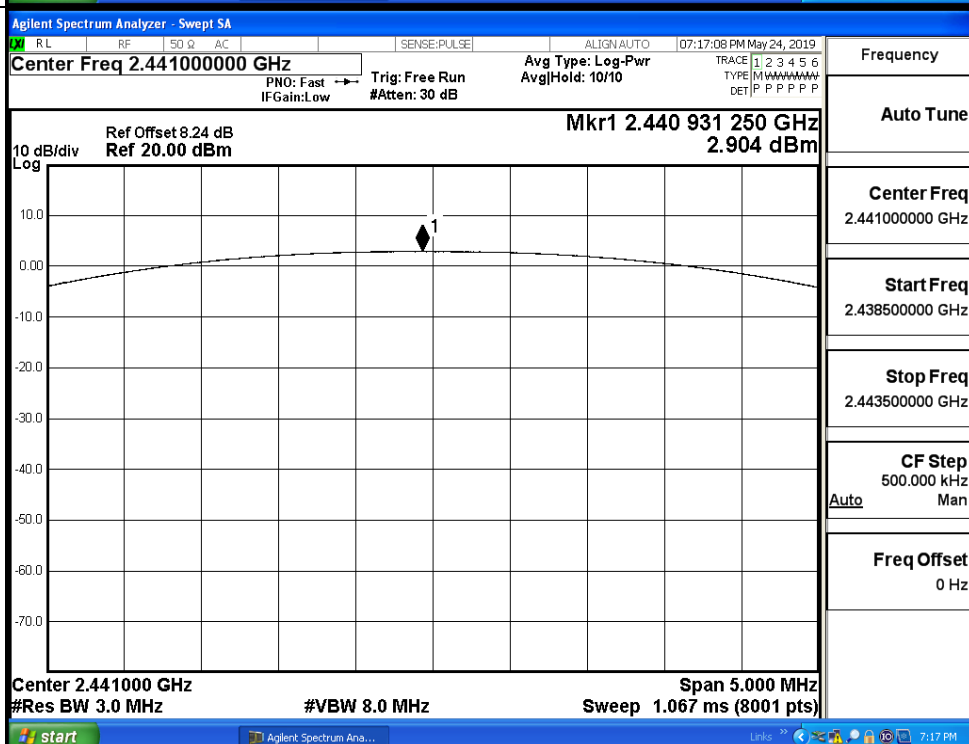
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	3.316	21	PASS
	MCH	2.904	21	PASS
	HCH	0.357	21	PASS
$\pi/4$ DQPSK	LCH	5.074	21	PASS
	MCH	4.092	21	PASS
	HCH	2.934	21	PASS
8DPSK	LCH	5.244	21	PASS
	MCH	4.334	21	PASS
	HCH	3.341	21	PASS

Test Graphs

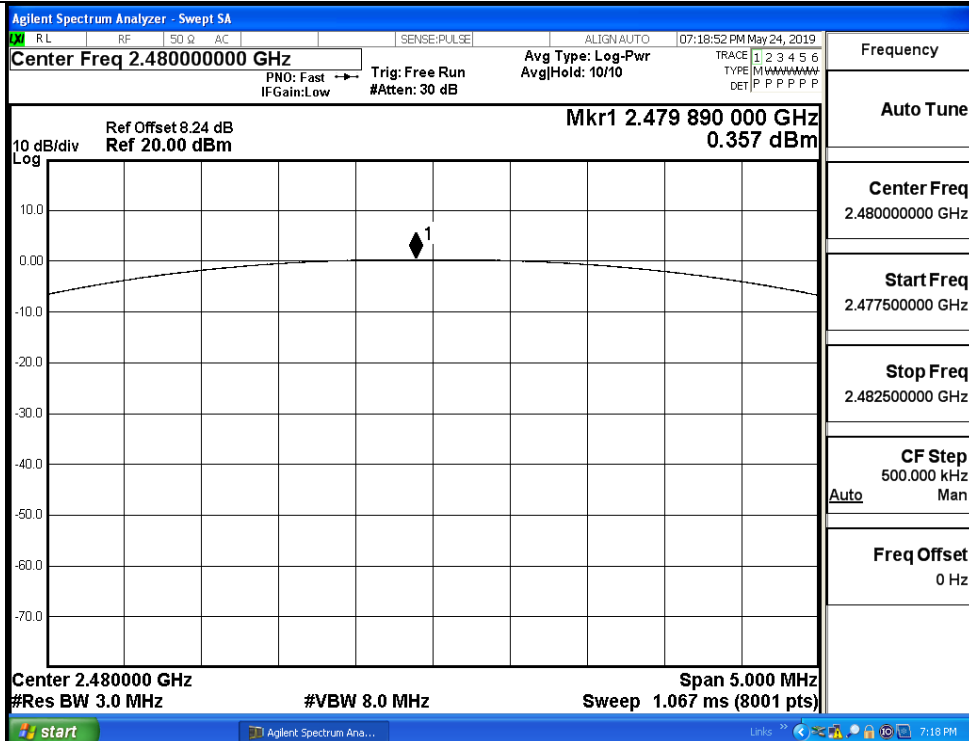
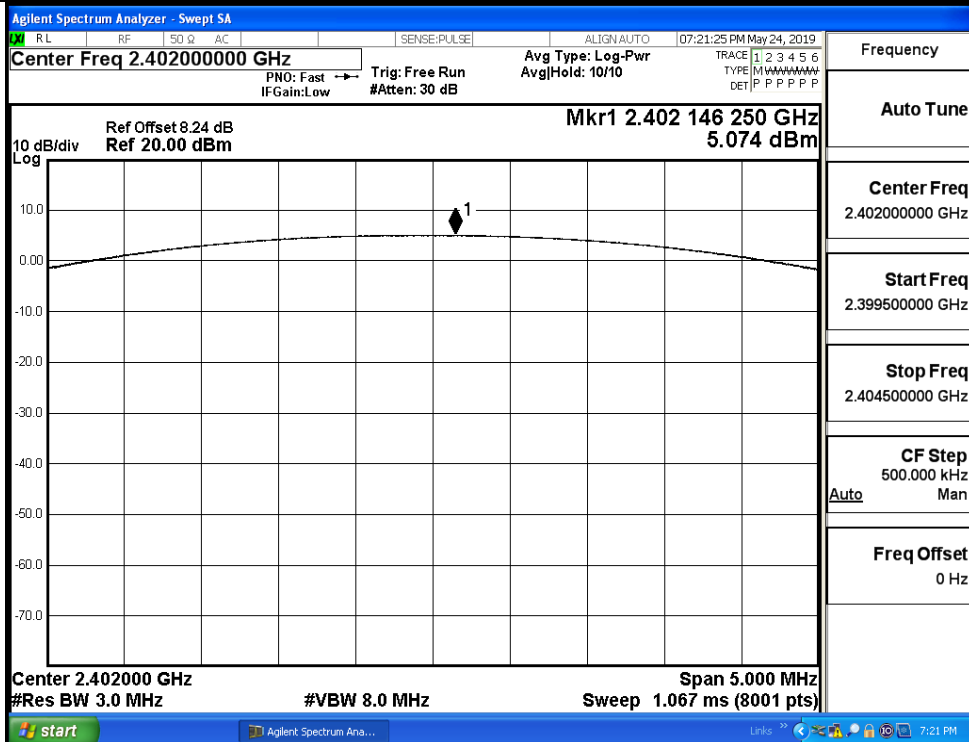
GFSK/LCH

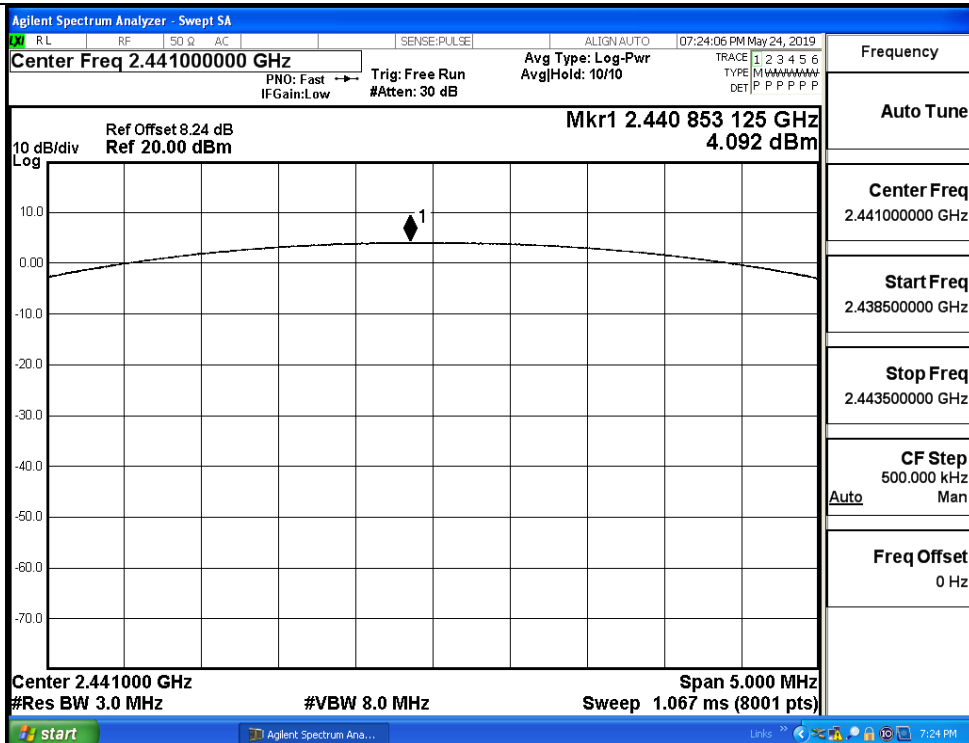
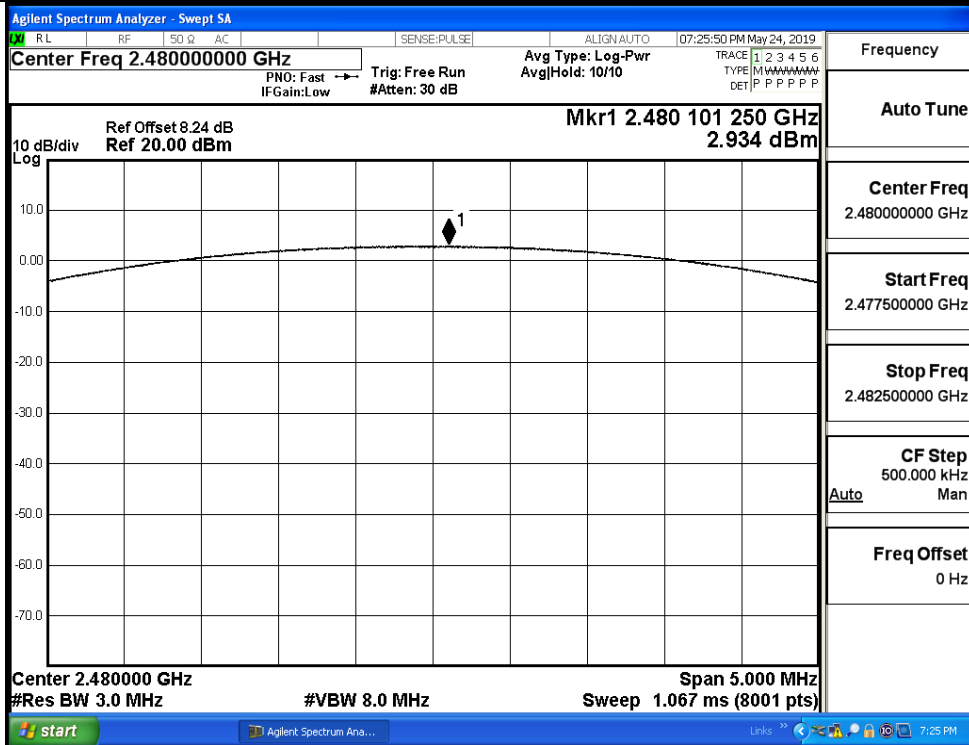


GFSK/MCH

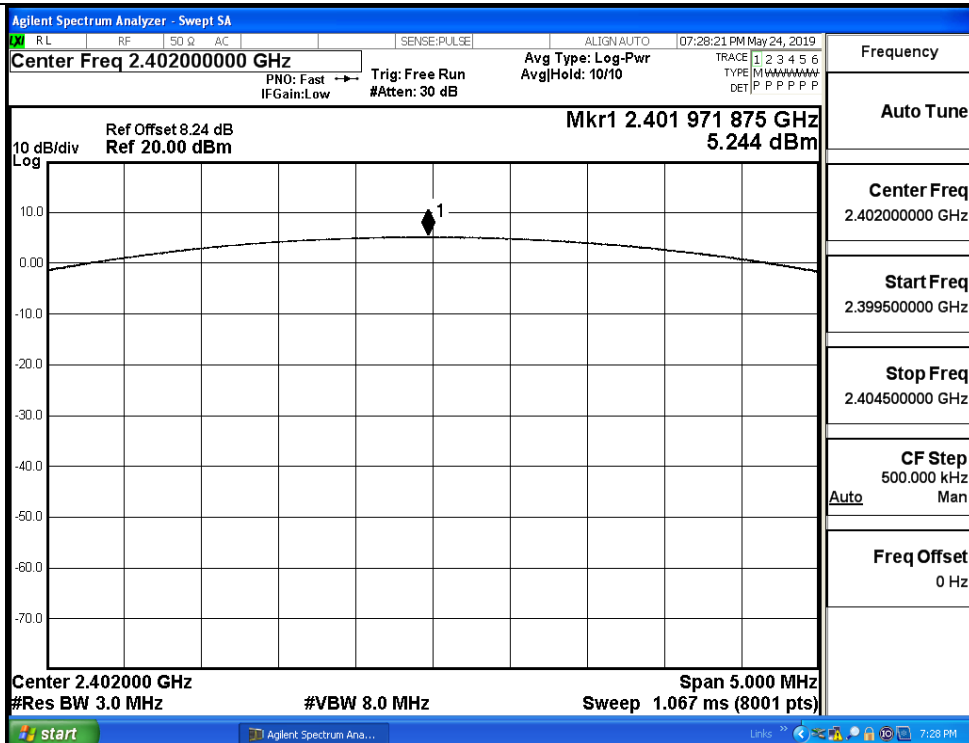


GFSK/HCH

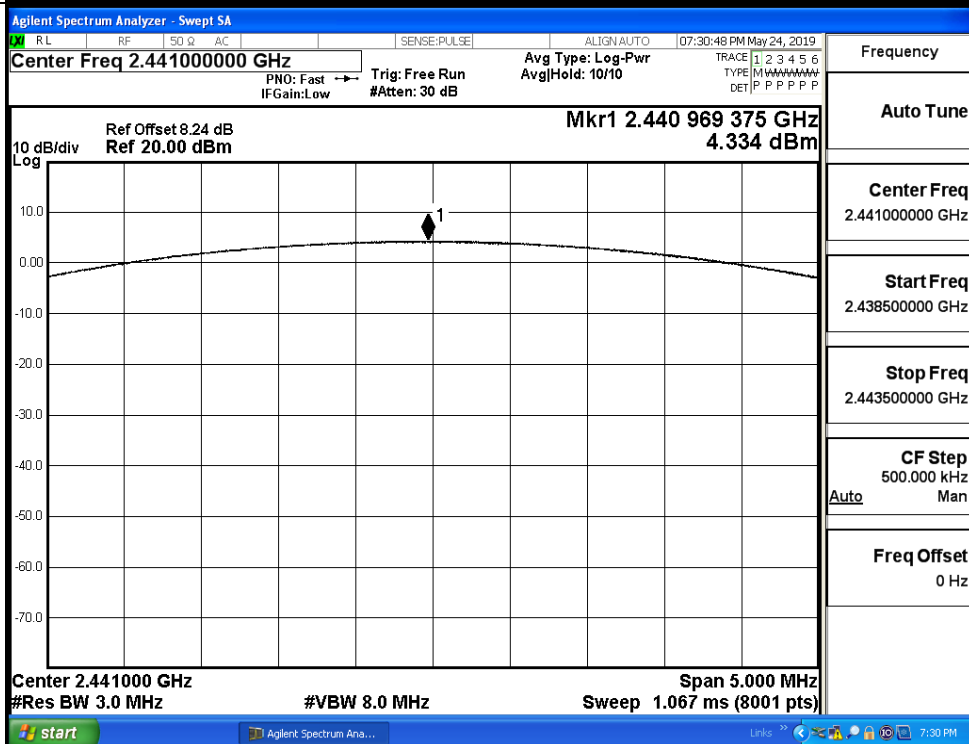
 π /4DQPSK/LCH

$\pi/4$ DQPSK/MCH $\pi/4$ DQPSK/HCH

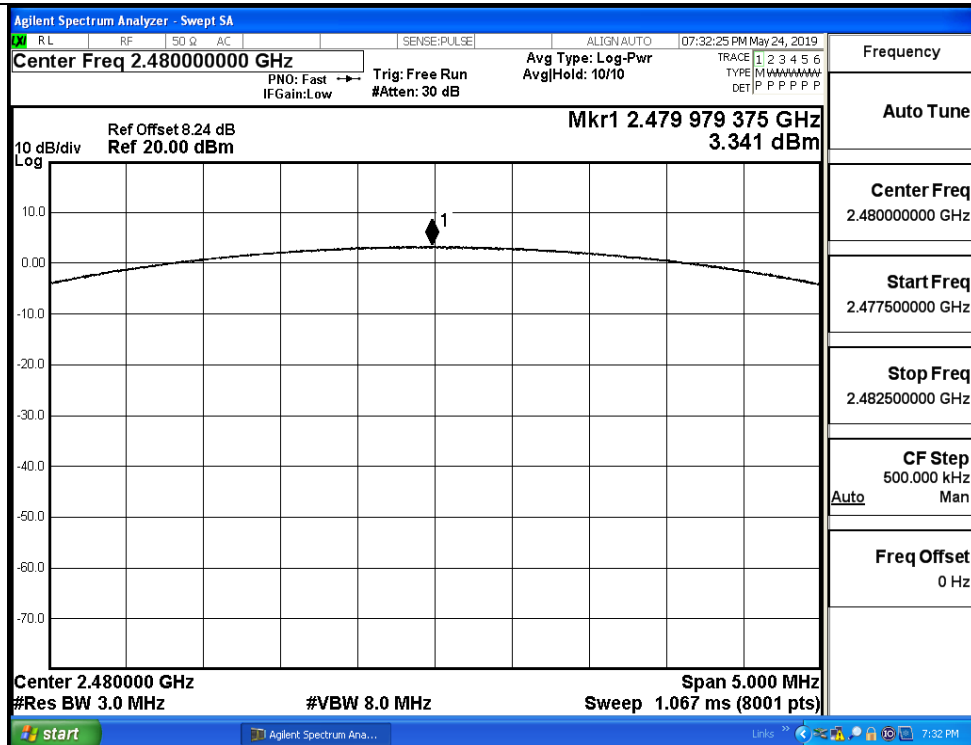
8DPSK/LCH



8DPSK/MCH



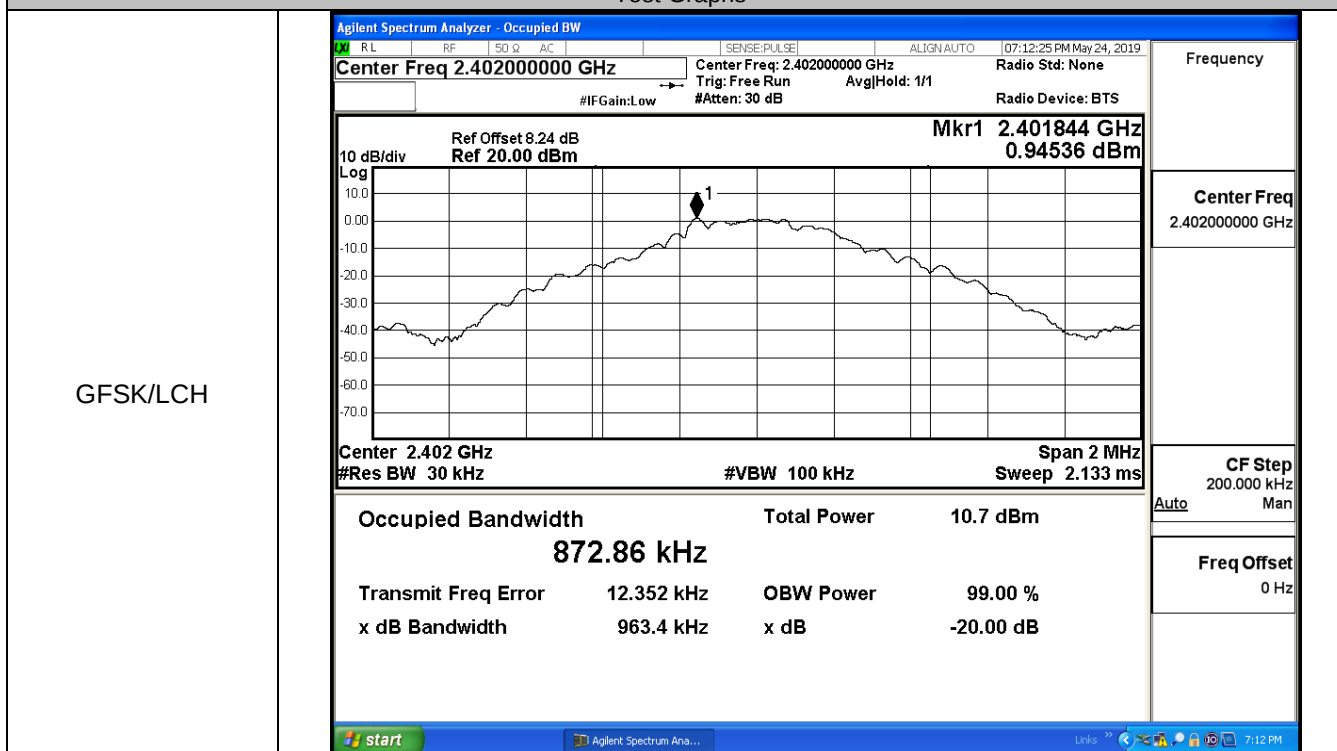
8DPSK/HCH



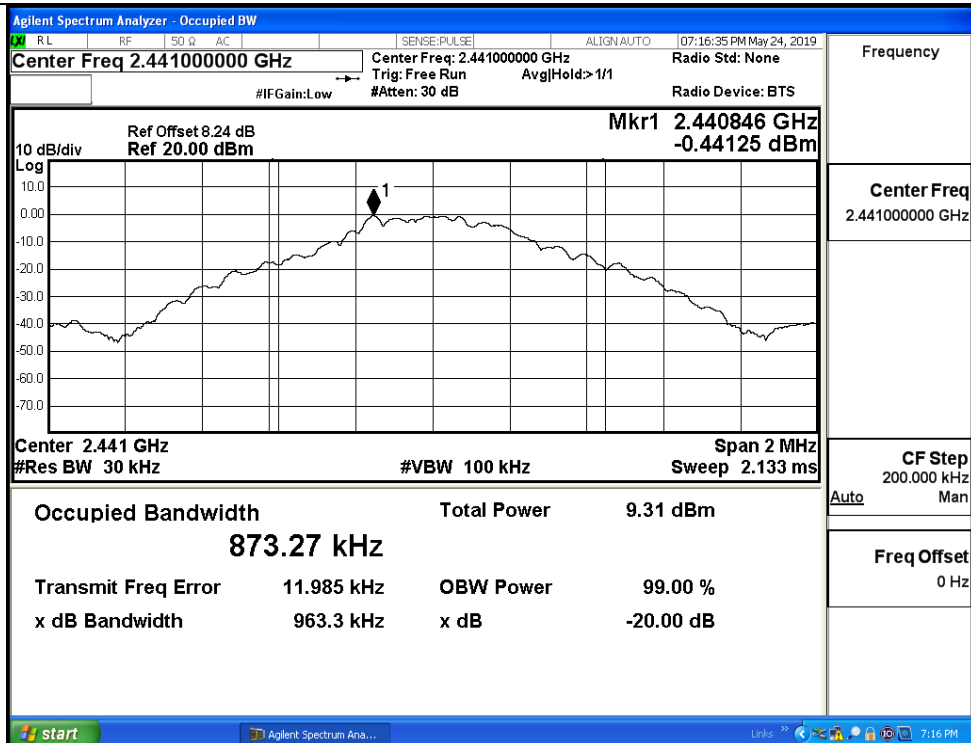
A.2 99% and 20dB Bandwidth

Mode	Channel.	99% Bandwidth [MHz]	20dB Bandwidth [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.87286	0.9634	Not Specified	PASS
	MCH	0.87327	0.9633	Not Specified	PASS
	HCH	0.87287	0.9630	Not Specified	PASS
π /4DQPSK	LCH	1.1919	1.316	Not Specified	PASS
	MCH	1.1739	1.311	Not Specified	PASS
	HCH	1.1661	1.286	Not Specified	PASS
8DPSK	LCH	1.2089	1.313	Not Specified	PASS
	MCH	1.1991	1.310	Not Specified	PASS
	HCH	1.1825	1.306	Not Specified	PASS

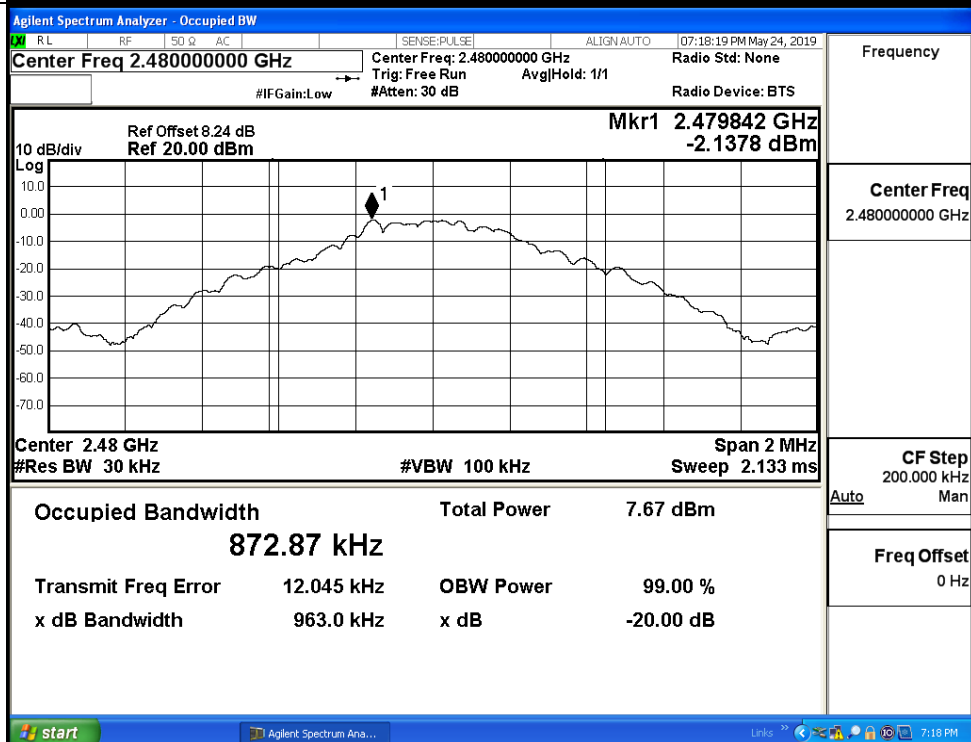
Test Graphs

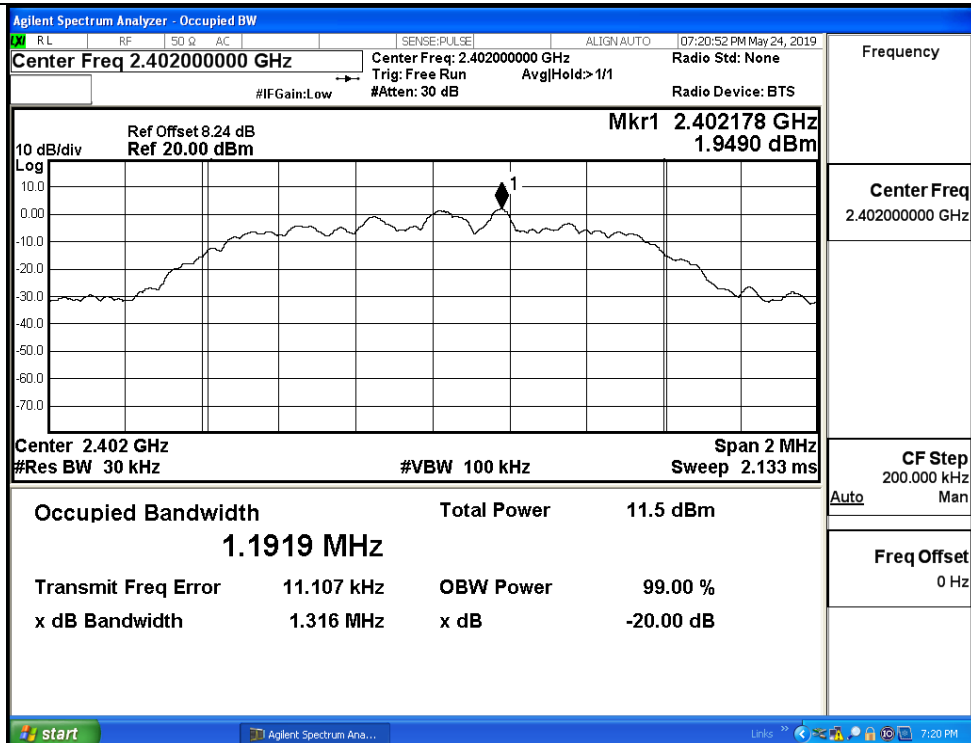
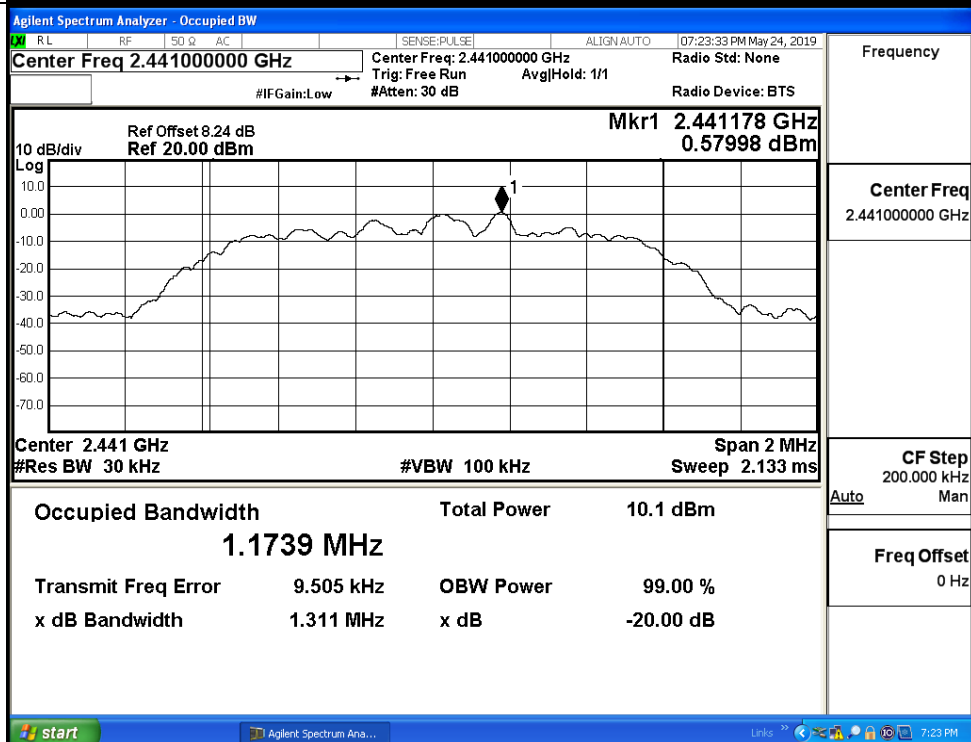


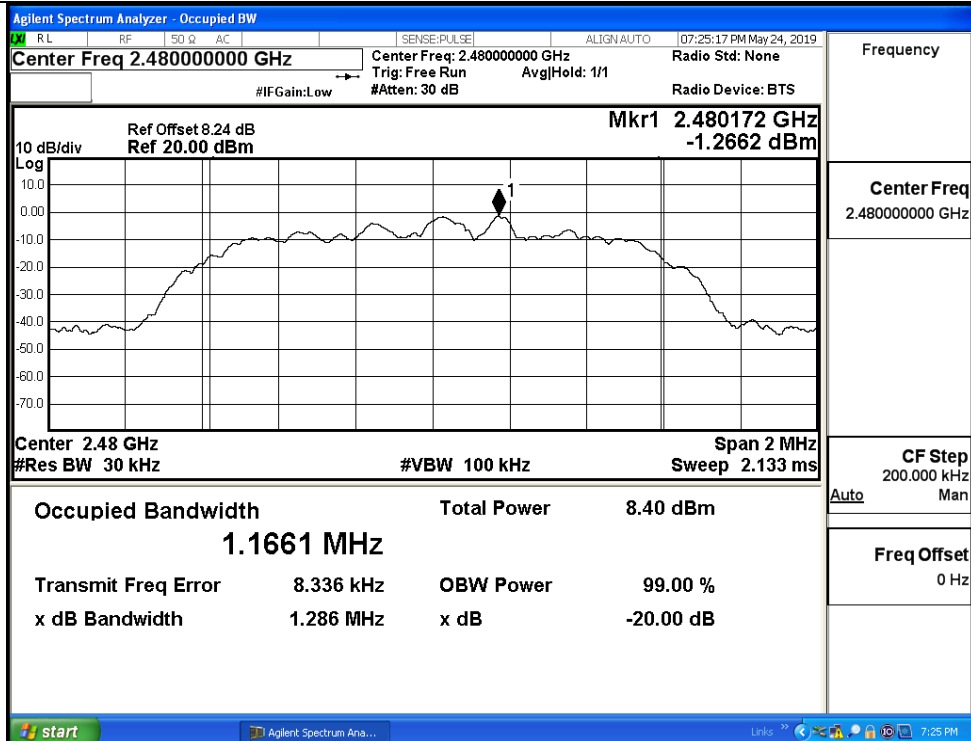
GFSK/MCH



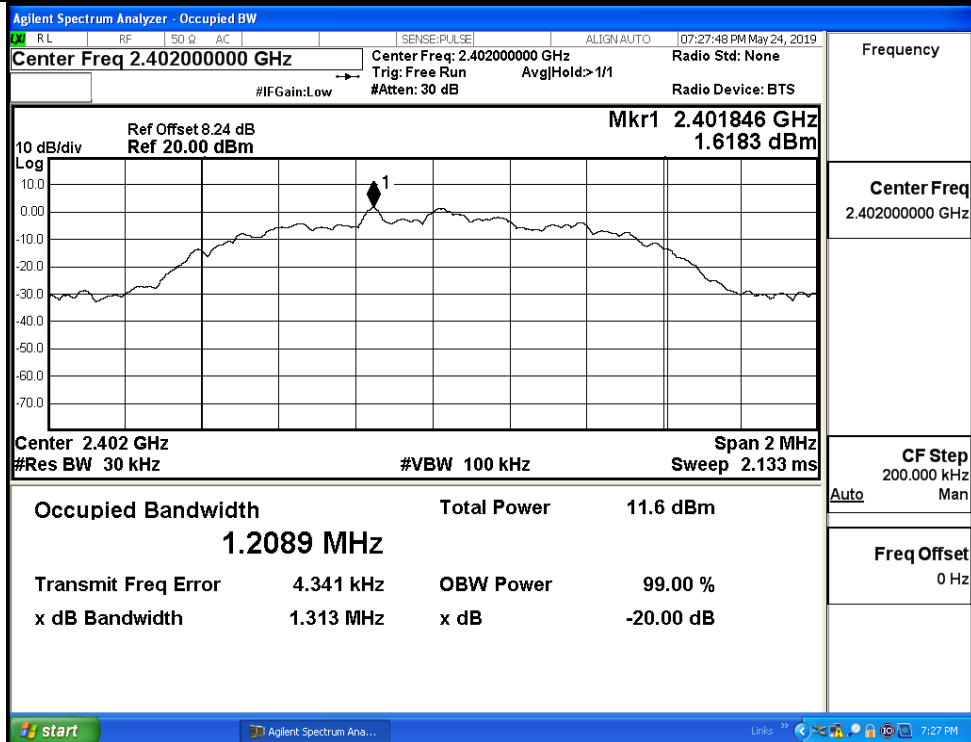
GFSK/HCH



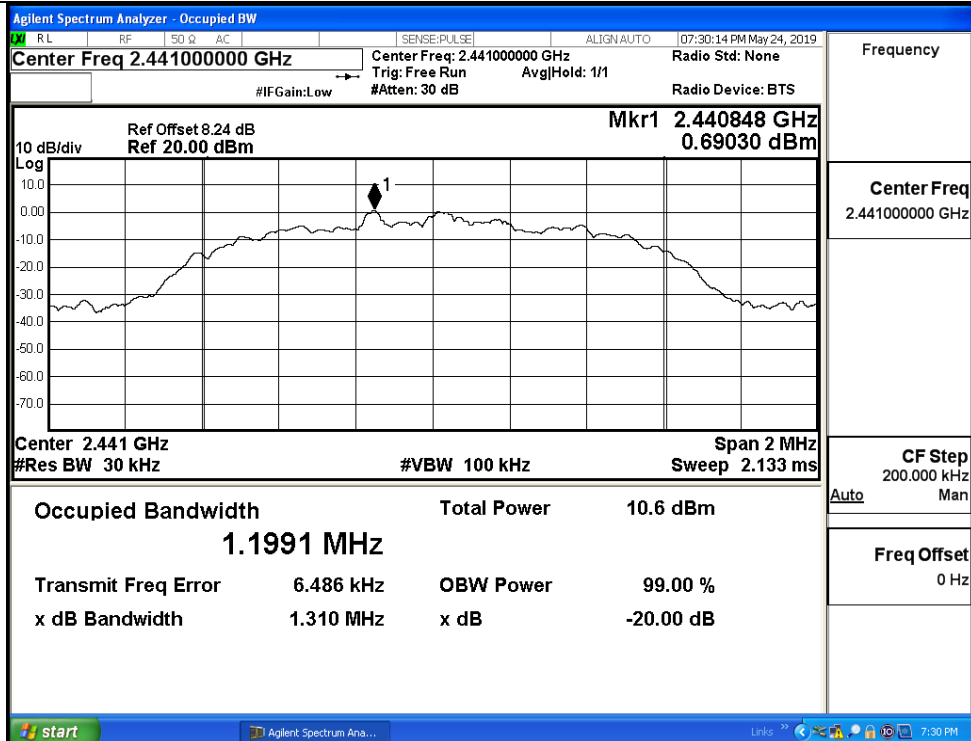
$\pi/4$ DQPSK/LCH $\pi/4$ DQPSK/MCH

$\pi/4$ DQPSK/HCH

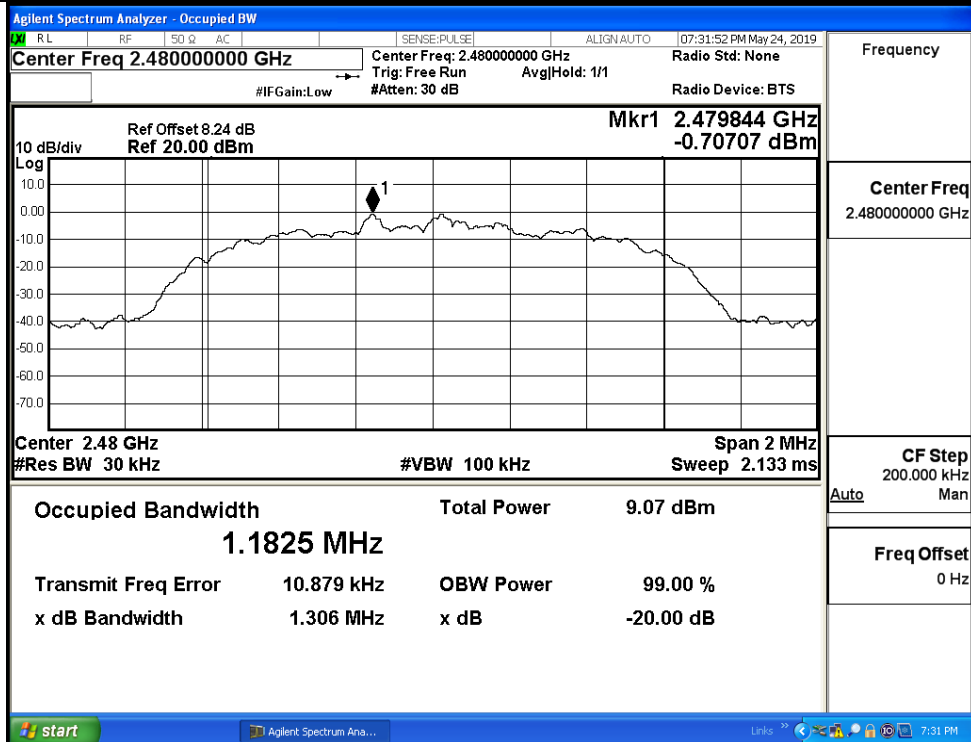
8DPSK/LCH



8DPSK/MCH



8DPSK/HCH

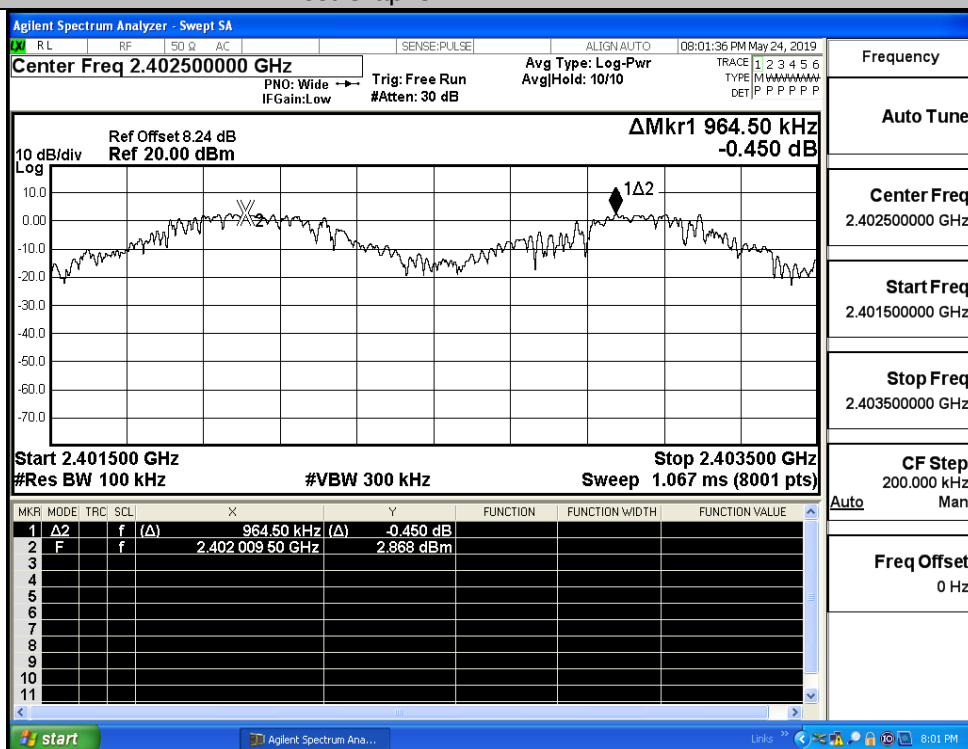


A.3 Carrier Frequency Separation

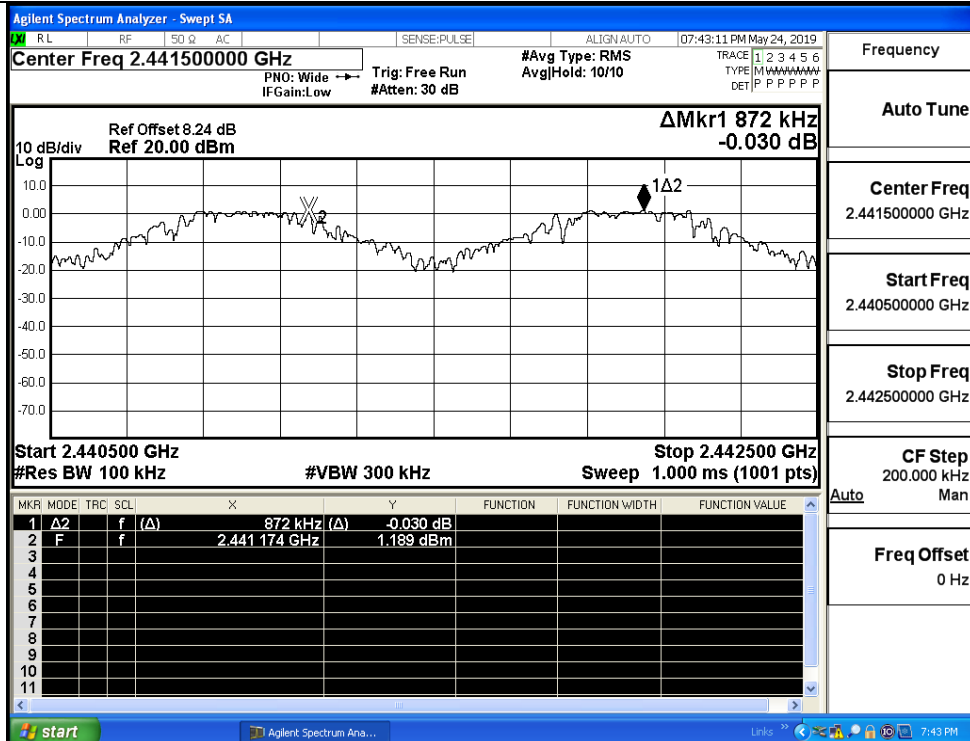
Mode	Channel.	Carrier Frequency Separation [MHz]	Limit [MHz]	Verdict
GFSK	LCH	0.965	0.642	PASS
	MCH	0.872	0.642	PASS
	HCH	1.160	0.642	PASS
$\pi/4$ DQPSK	LCH	1.192	0.877	PASS
	MCH	1.116	0.877	PASS
	HCH	1.078	0.877	PASS
8DPSK	LCH	1.080	0.875	PASS
	MCH	1.186	0.875	PASS
	HCH	0.934	0.875	PASS

Test Graphs

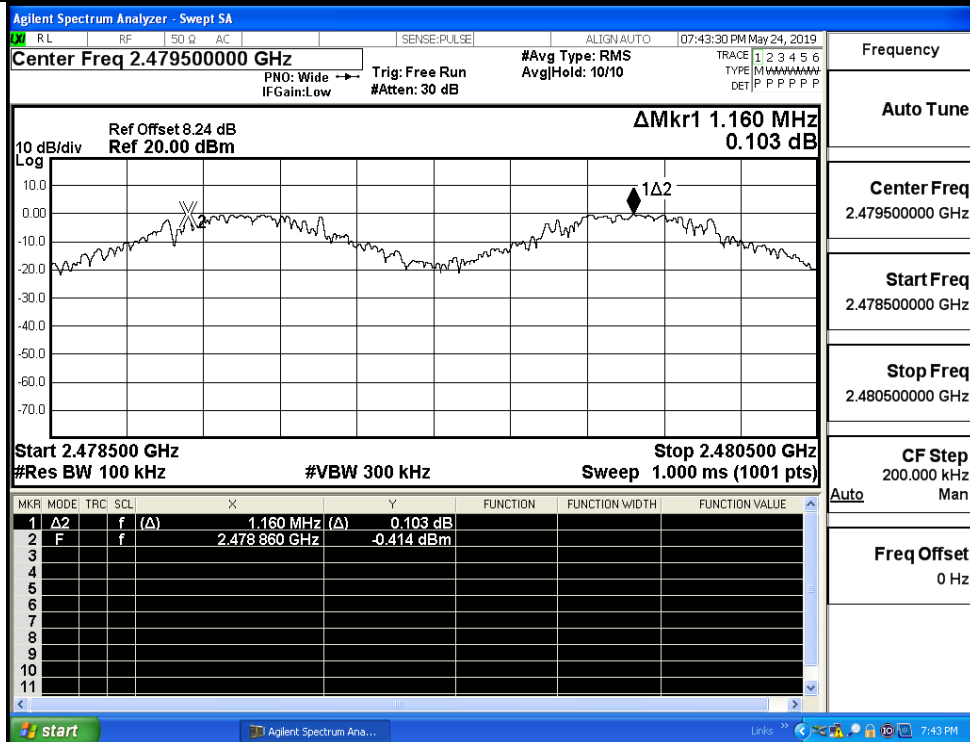
GFSK/LCH

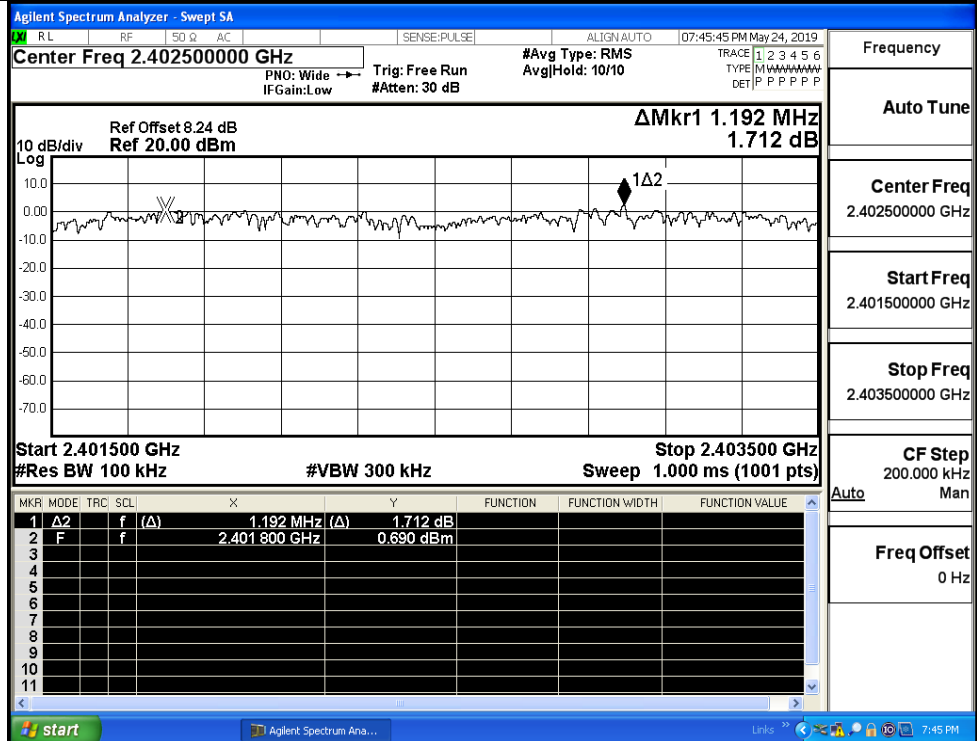
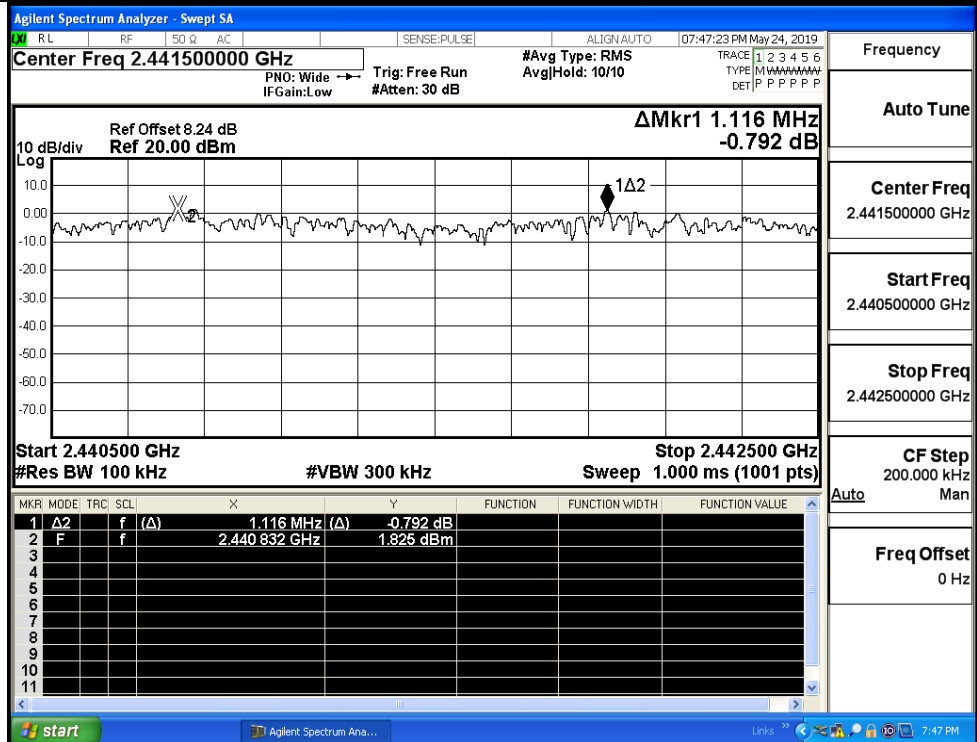


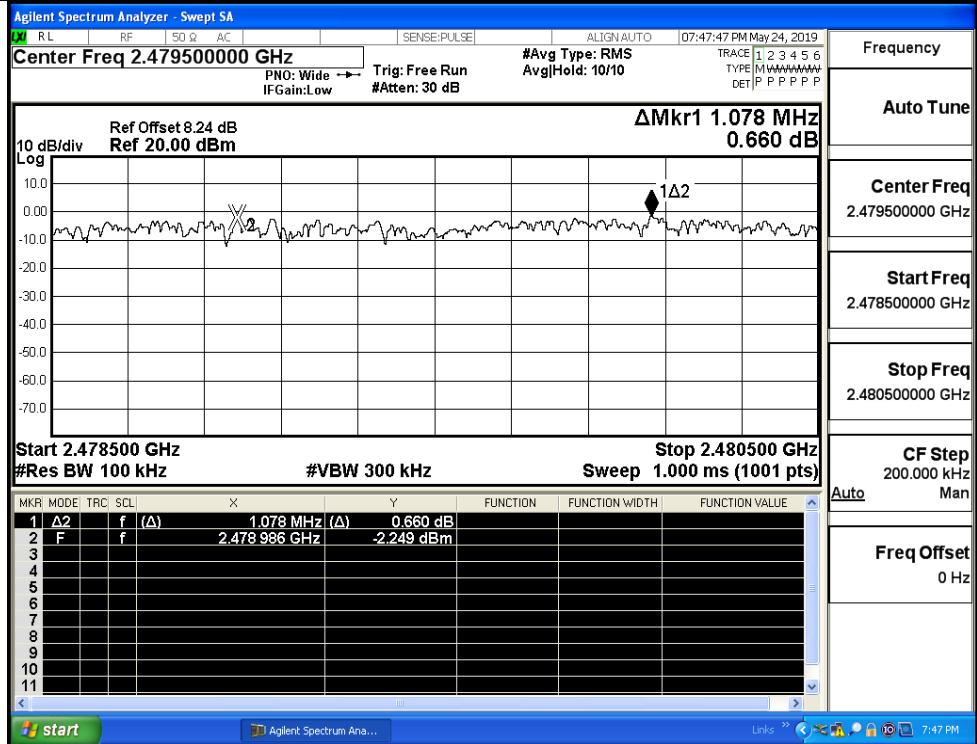
GFSK/MCH



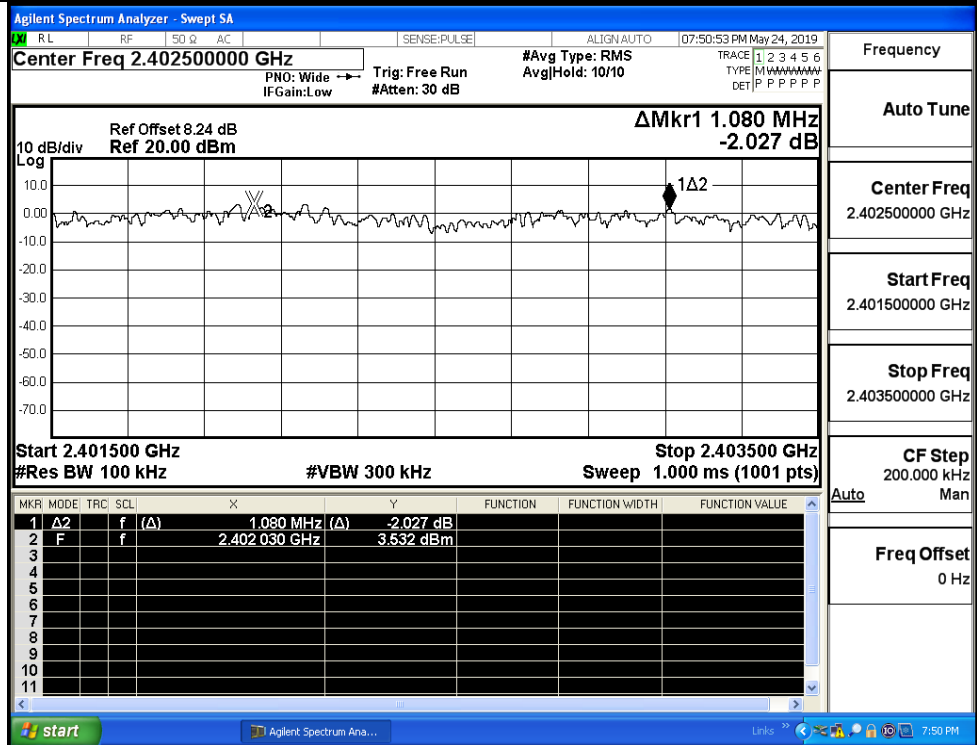
GFSK/HCH



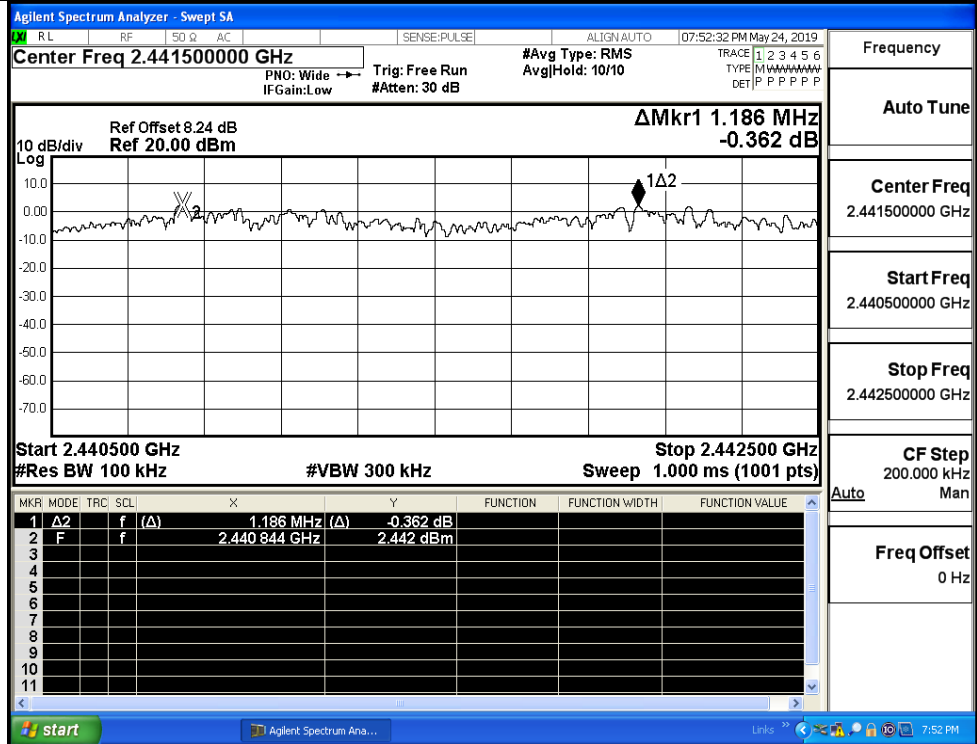
$\pi/4$ DQPSK/LCH $\pi/4$ DQPSK/MCH

$\pi/4$ DQPSK/HCH

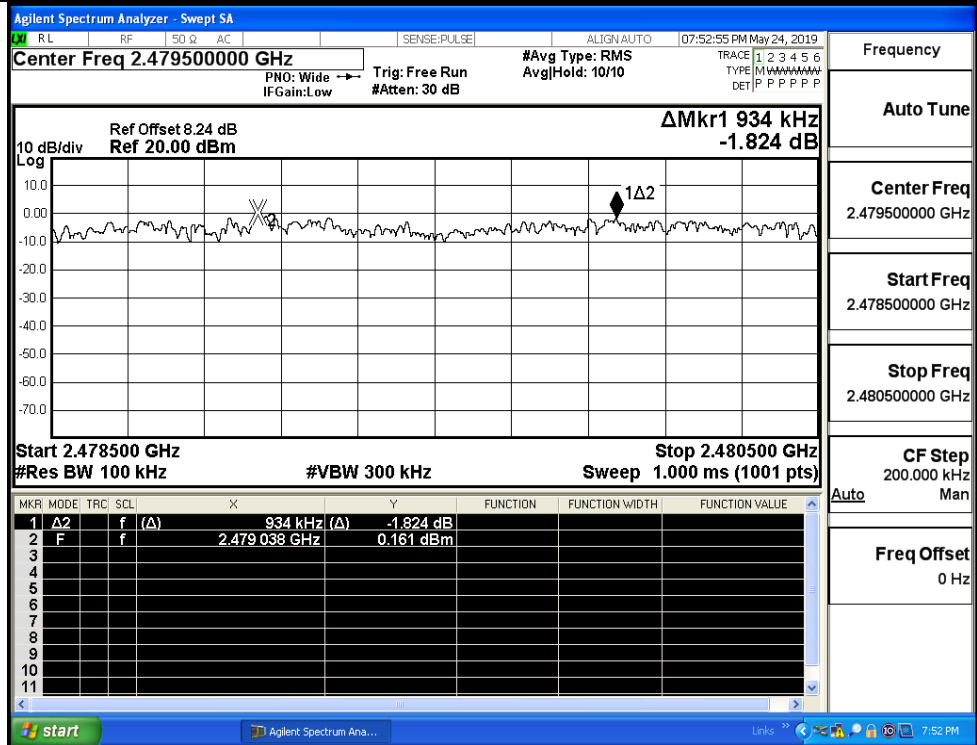
8DPSK/LCH



8DPSK/MCH



8DPSK/HCH

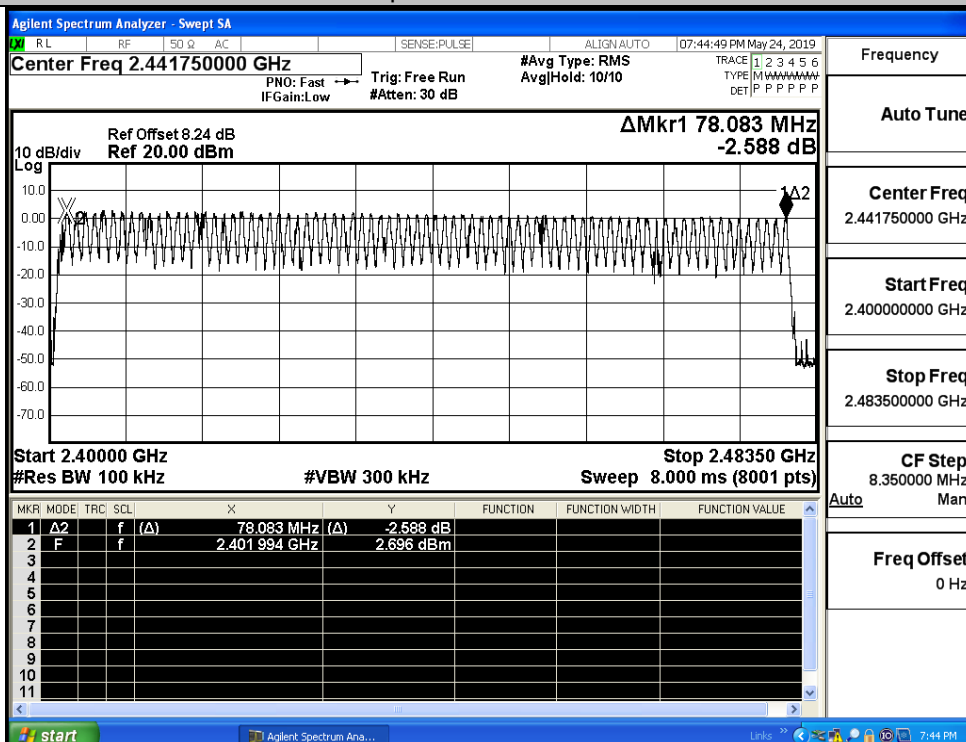
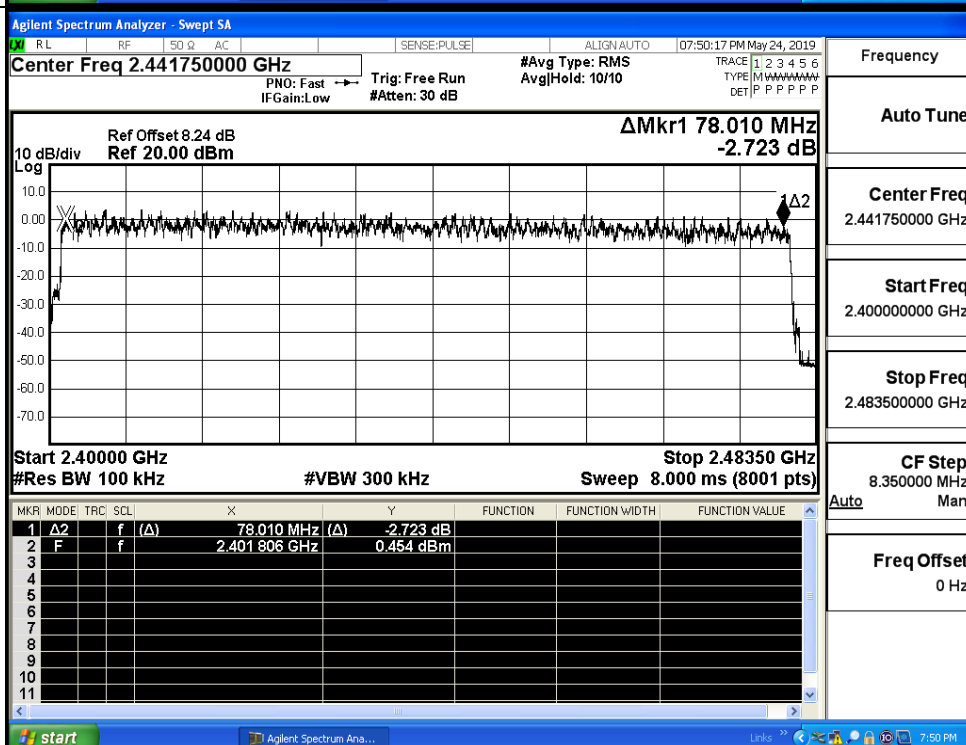


A.4 Hopping Channel Number

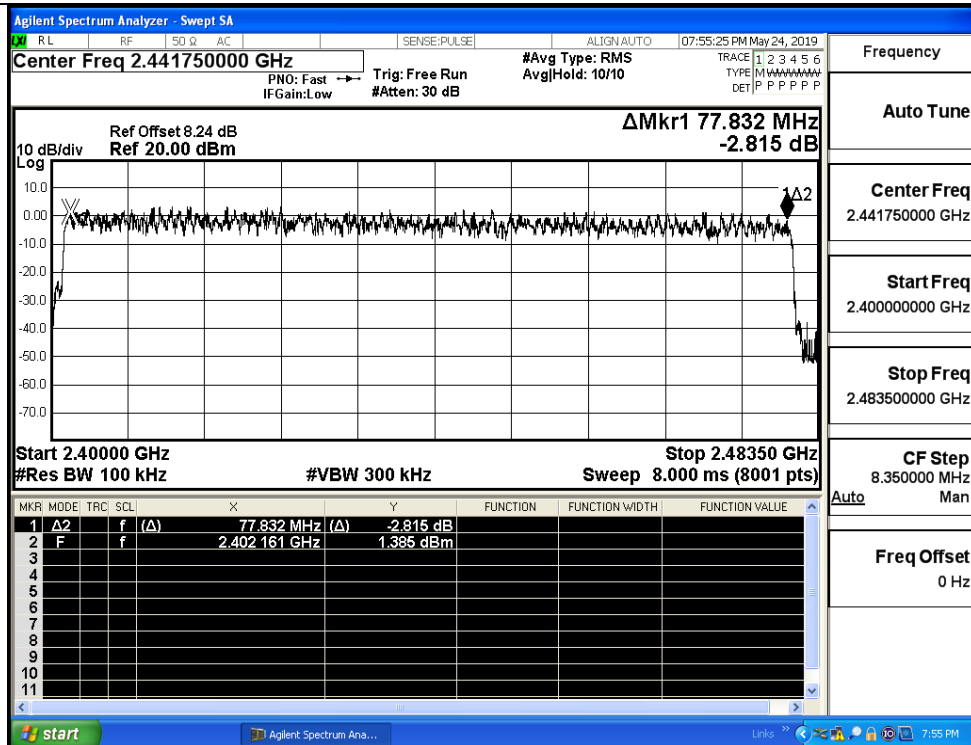
Mode	Channel.	Number of Hopping Channel [N]	Limit [N]	Verdict
GFSK	Hop	79	≥ 15	PASS
$\pi/4$ DQPSK	Hop	79	≥ 15	PASS
8DPSK	Hop	79	≥ 15	PASS

Test Graphs

GFSK/Hop

 $\pi/4$ DQPSK/Hop

8DPSK/Hop

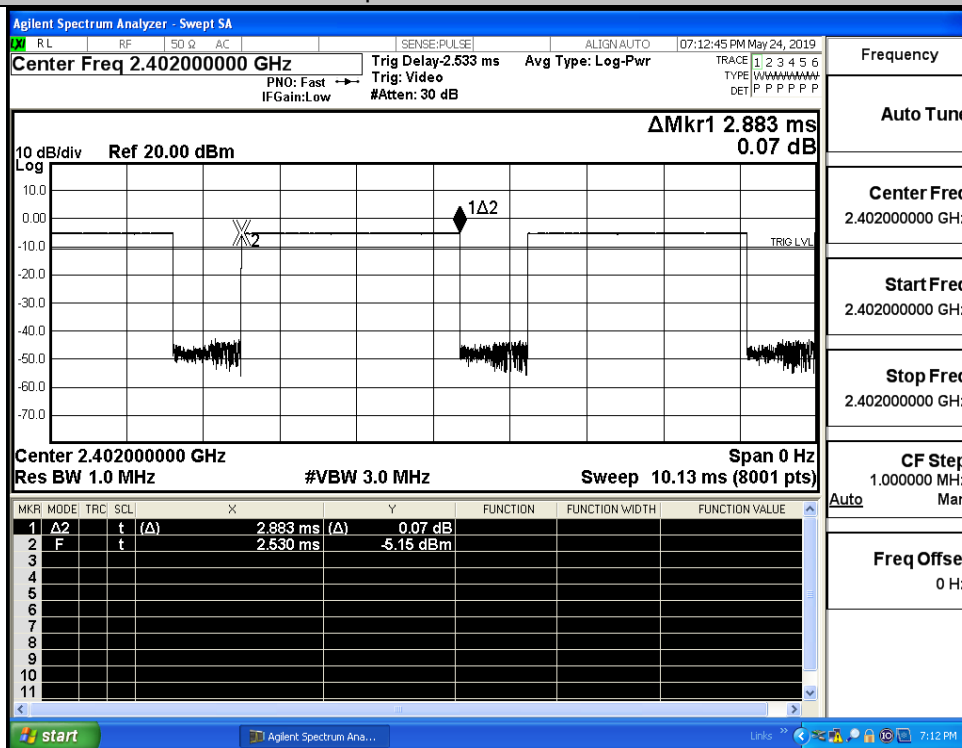


A.5 Dwell Time

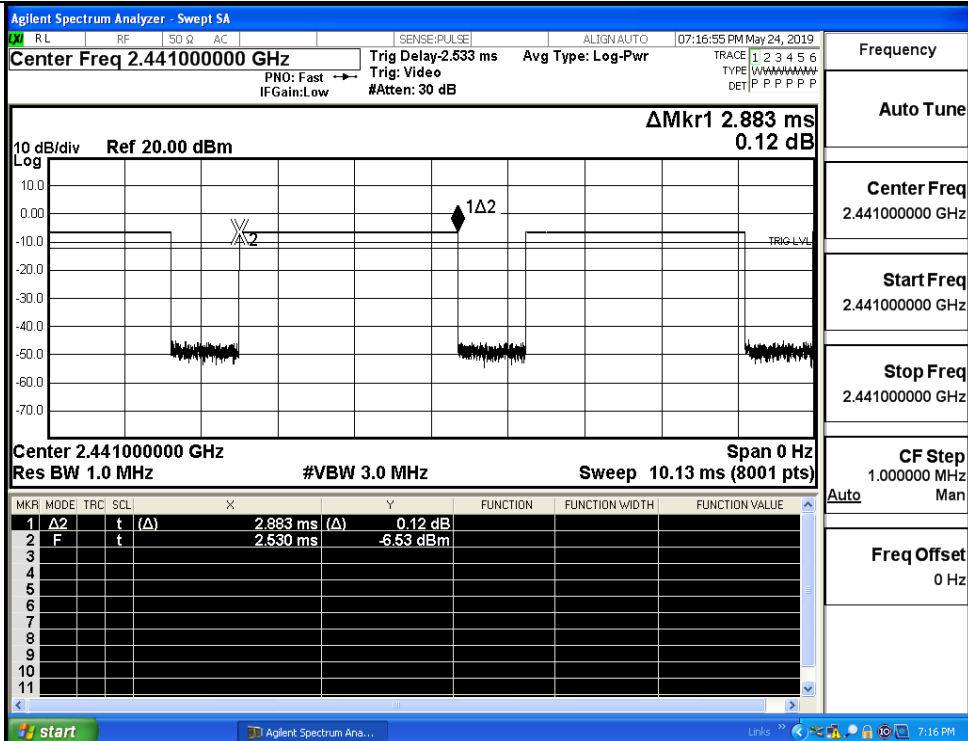
Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit [s]	Verdict
GFSK	DH5	LCH	2.88	106.7	0.307	0.4	PASS
	DH5	MCH	2.88	106.7	0.307	0.4	PASS
	DH5	HCH	2.88	106.7	0.307	0.4	PASS
$\pi/4$ DQPSK	2DH5	LCH	2.88	106.7	0.308	0.4	PASS
	2DH5	MCH	2.88	106.7	0.308	0.4	PASS
	2DH5	HCH	2.88	106.7	0.308	0.4	PASS
8DPSK	3DH5	LCH	2.89	106.7	0.308	0.4	PASS
	3DH5	MCH	2.89	106.7	0.308	0.4	PASS
	3DH5	HCH	2.89	106.7	0.308	0.4	PASS

Test Graphs

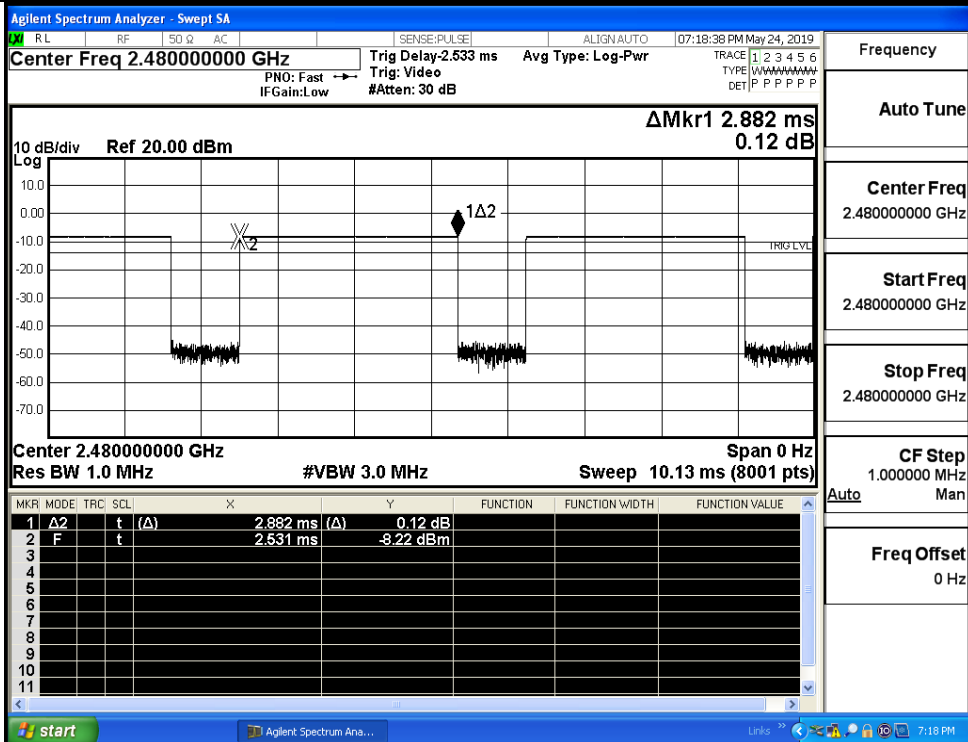
GFSK_DH5/LCH



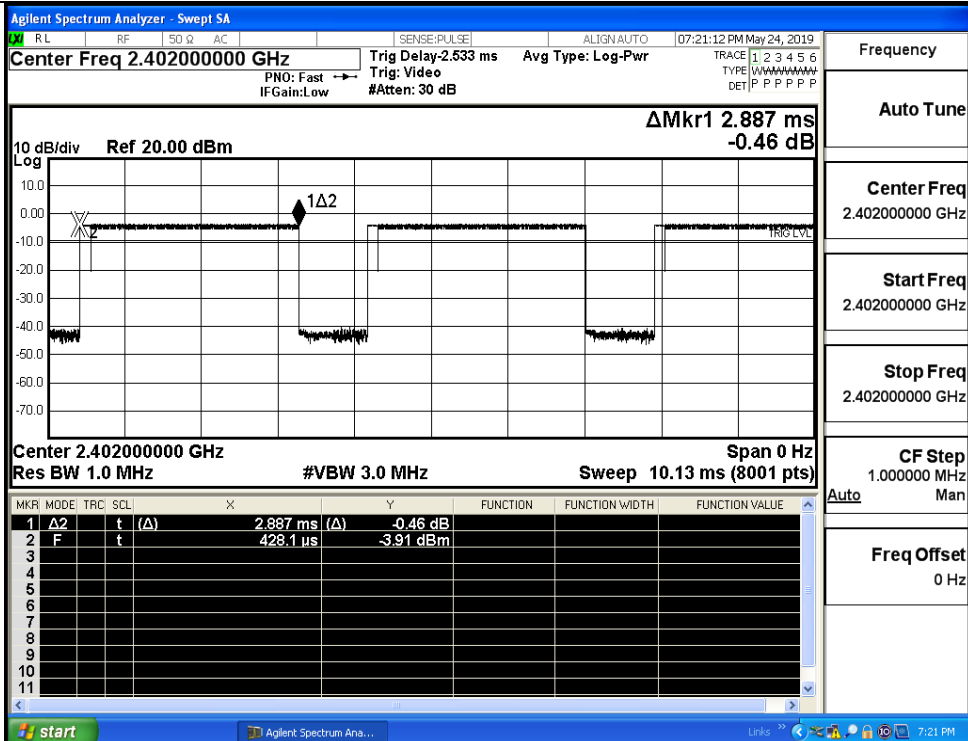
GFSK_DH5/MCH



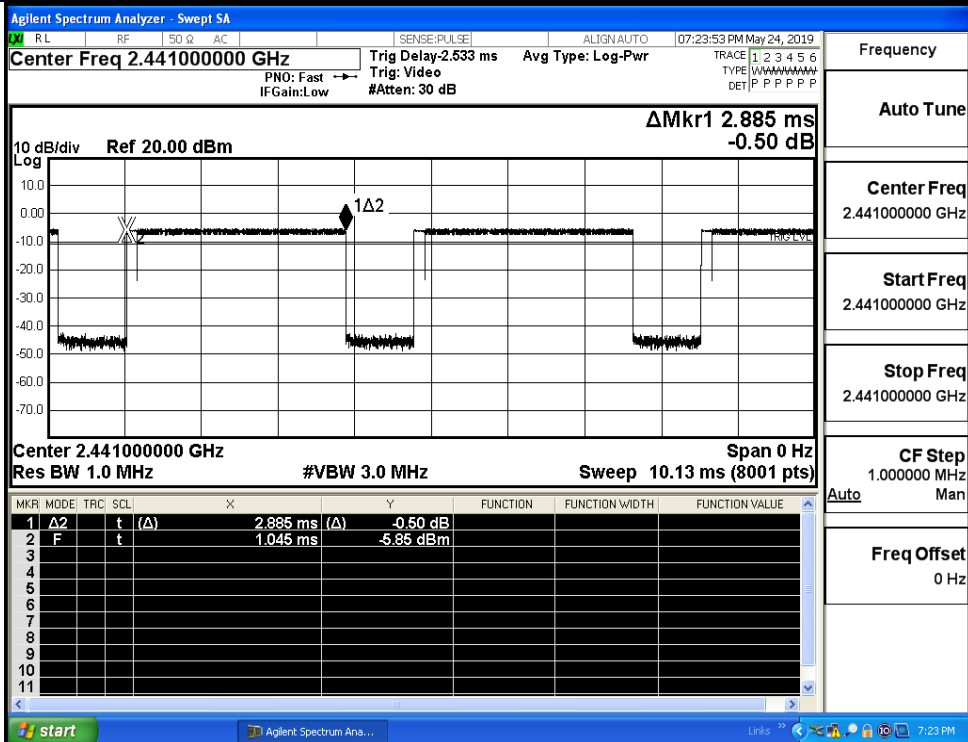
GFSK_DH5/HCH



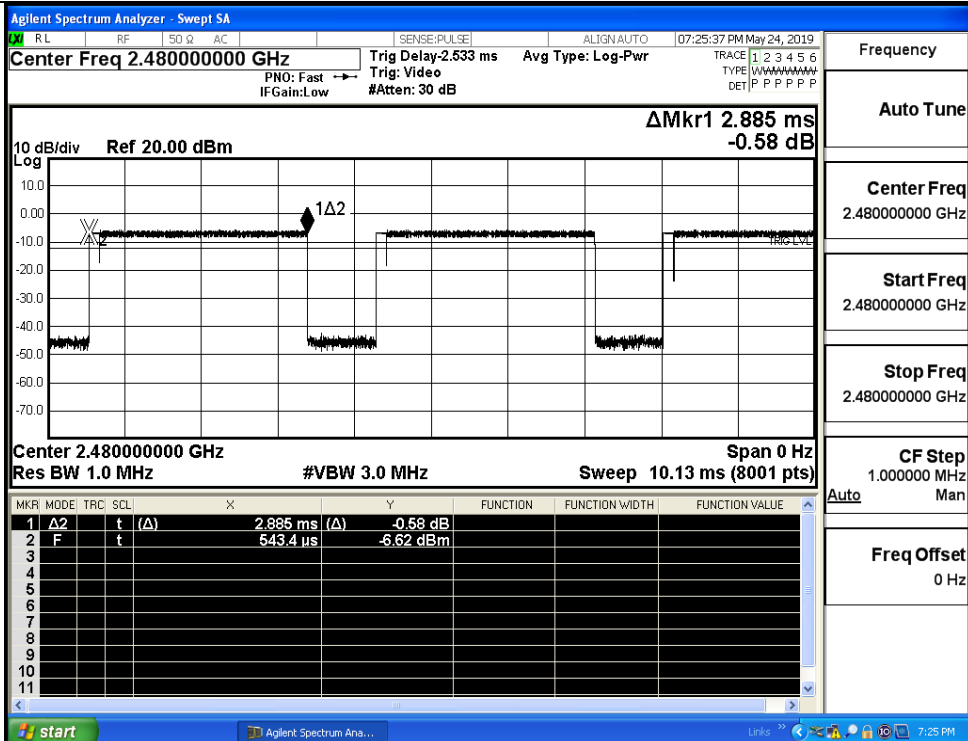
$\pi/4$ DQPSK
_2DH5/LCH



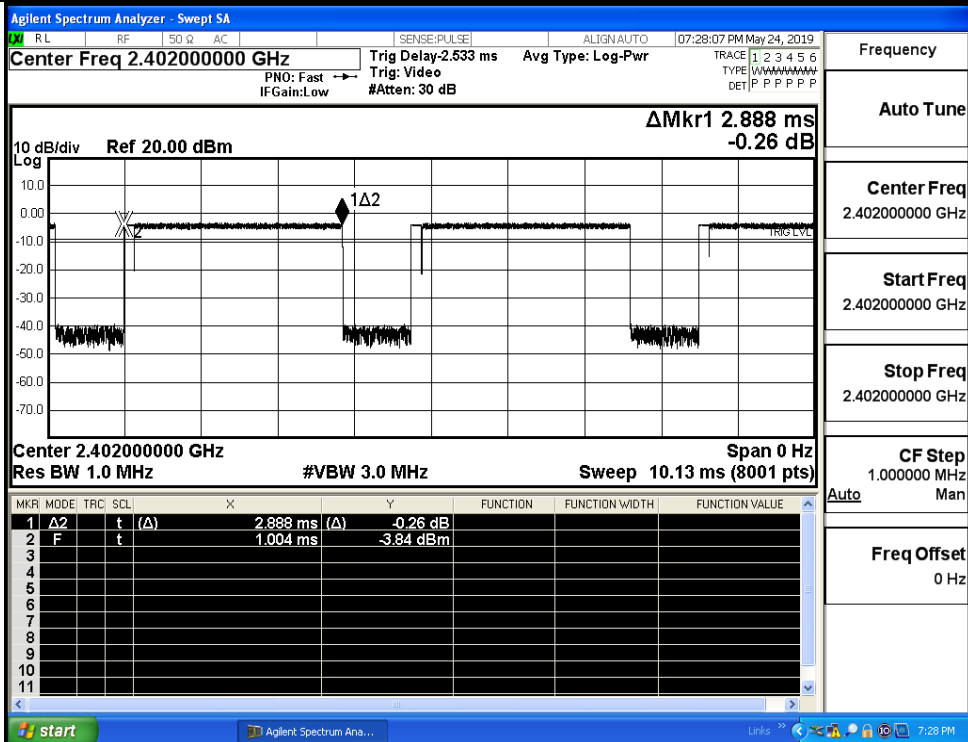
$\pi/4$ DQPSK
_2DH5/MCH



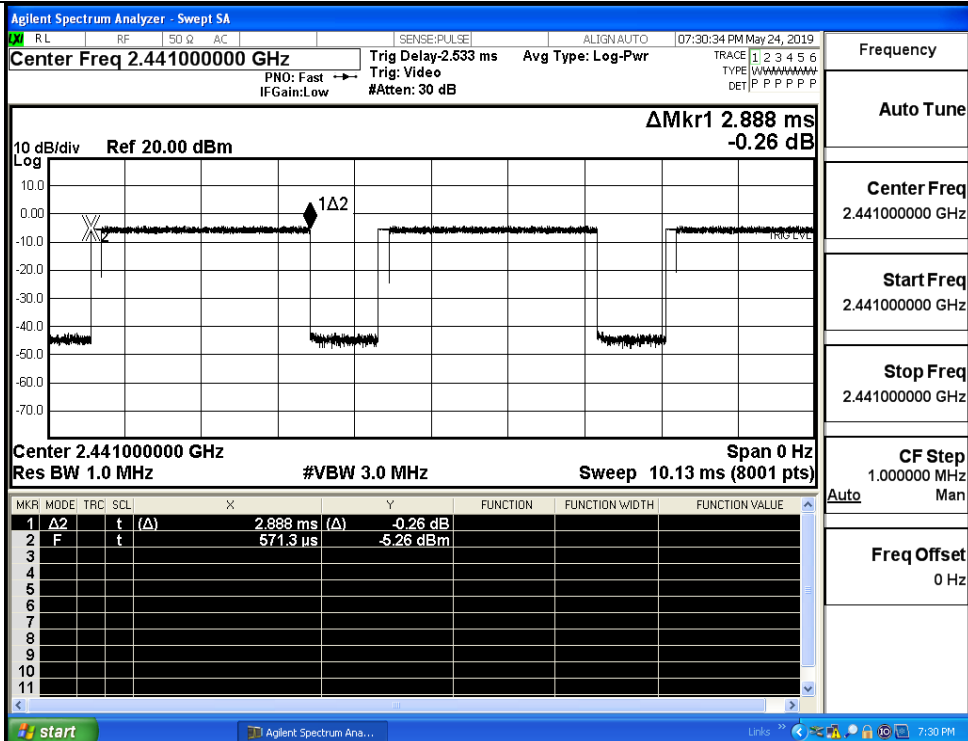
$\pi/4$ DQPSK
_2DH5/HCH



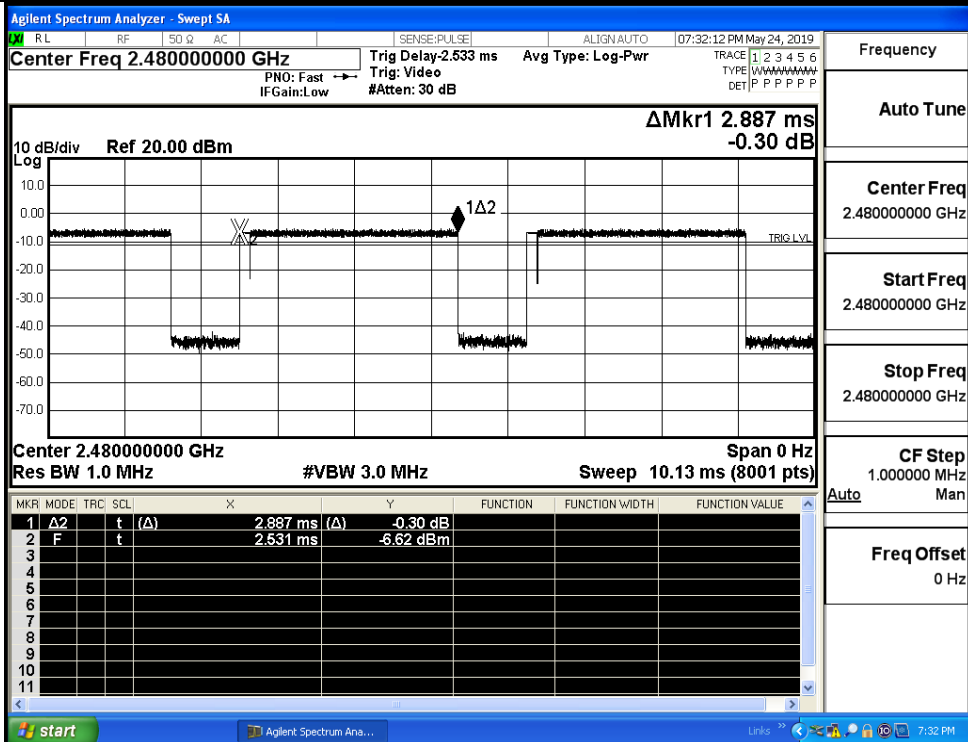
8DPSK _3DH5/LCH



8DPSK_3DH5/MCH



8DPSK_3DH5/HCH

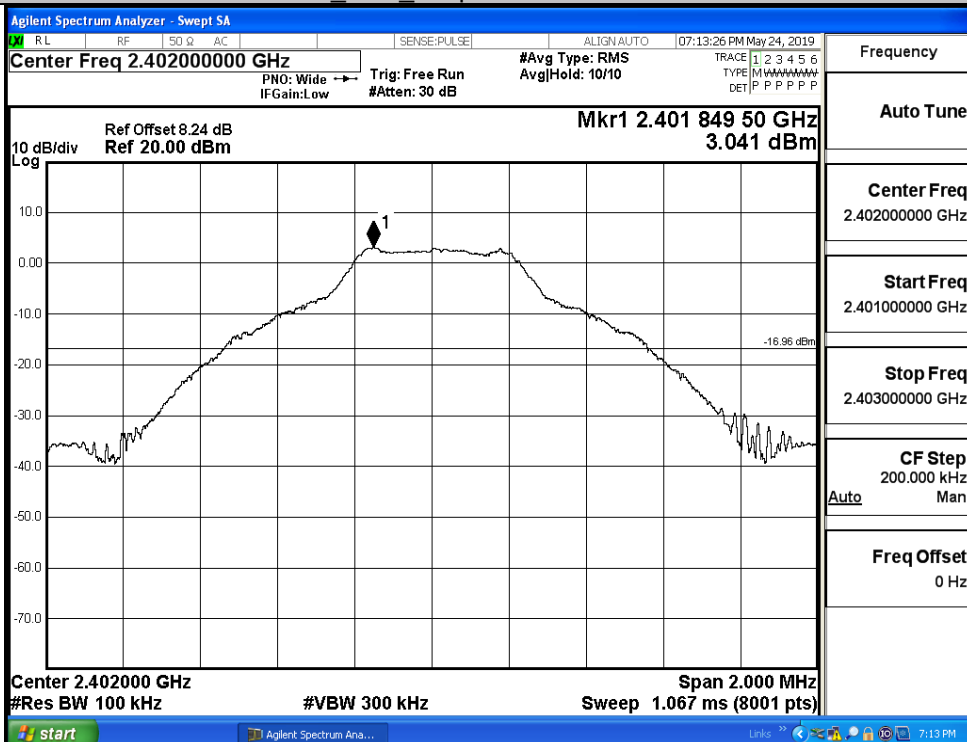


A.6 RF Conducted Spurious Emissions

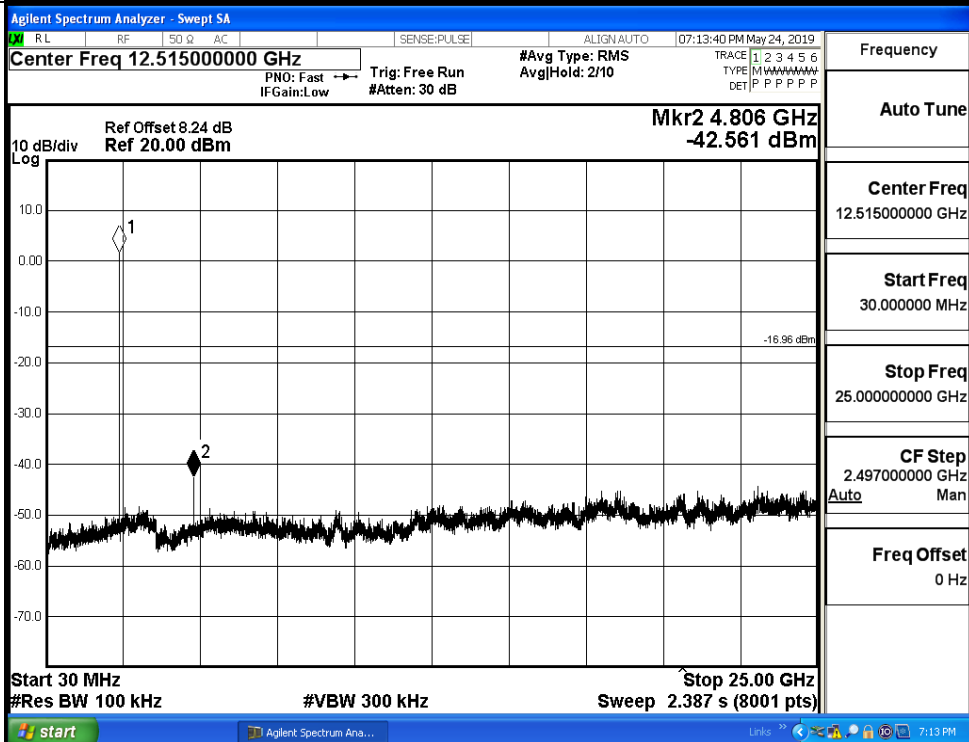
Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	3.041	-42.561	-16.959	PASS
	MCH	1.655	-43.970	-18.345	PASS
	HCH	1.194	-44.810	-18.806	PASS
$\pi/4$ DQPSK	LCH	4.302	-43.438	-15.698	PASS
	MCH	3.031	-44.157	-16.969	PASS
	HCH	1.574	-44.432	-18.426	PASS
8DPSK	LCH	4.058	-45.167	-15.942	PASS
	MCH	2.979	-45.239	-17.021	PASS
	HCH	1.594	-44.942	-18.406	PASS

GFSK LCH Graphs

Pref

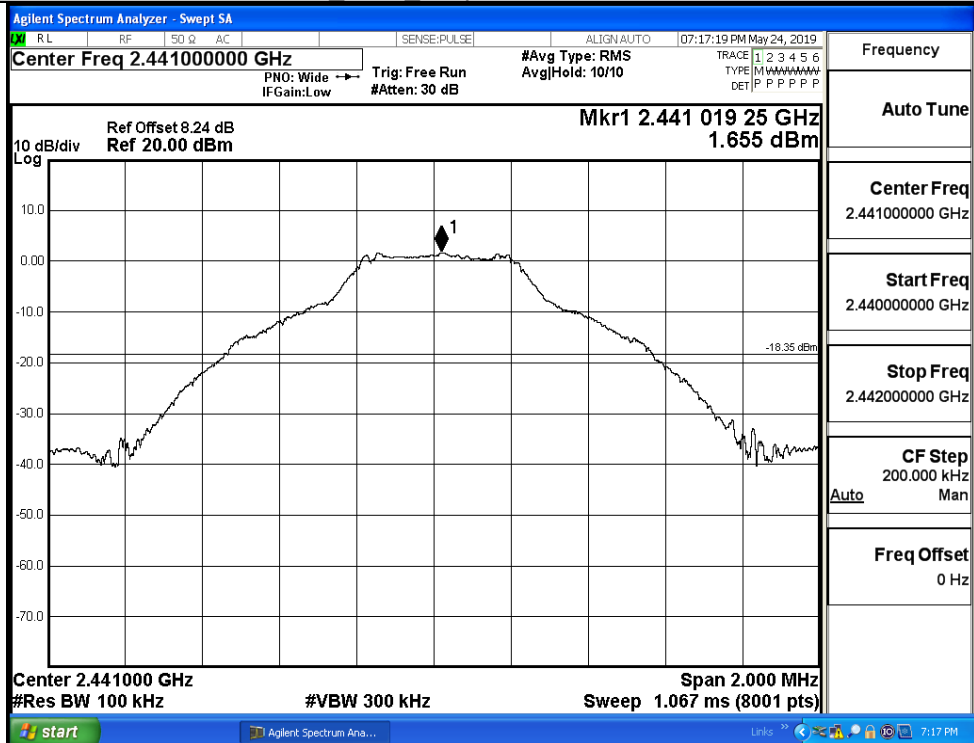


Puw

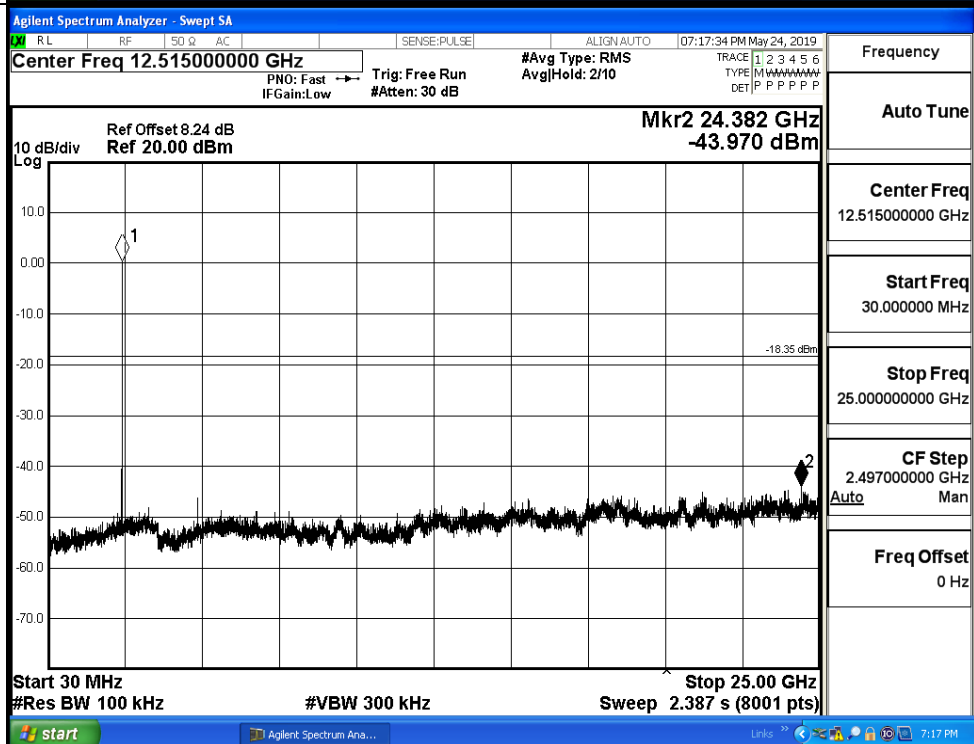


GFSK_MCH_Graphs

Pref

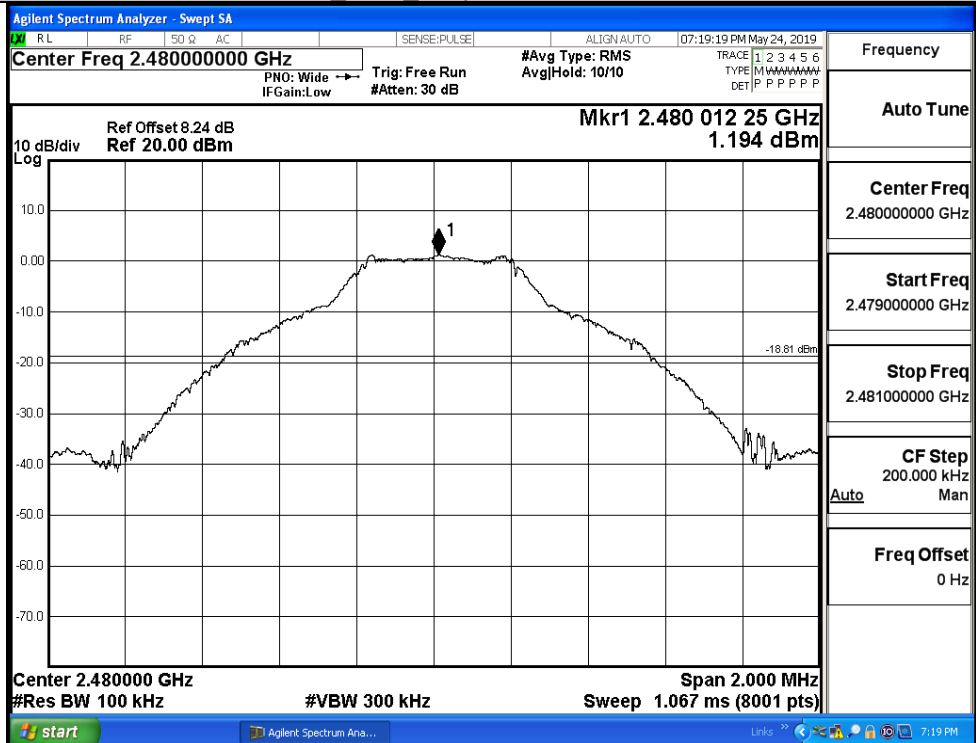


Puw

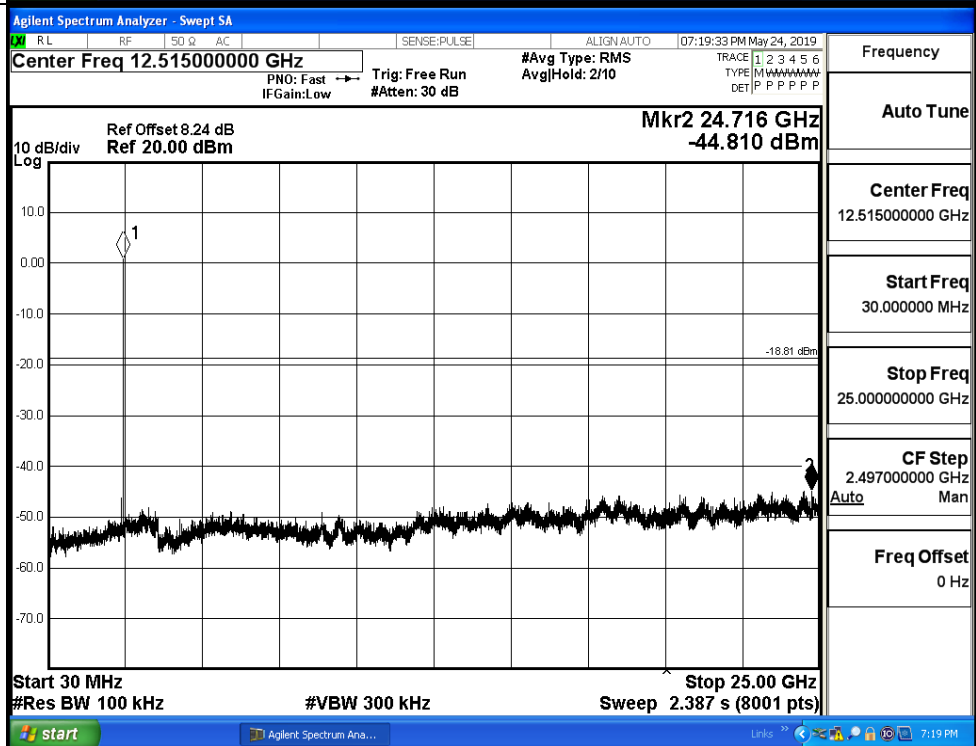


GFSK_HCH_Graphs

Pref

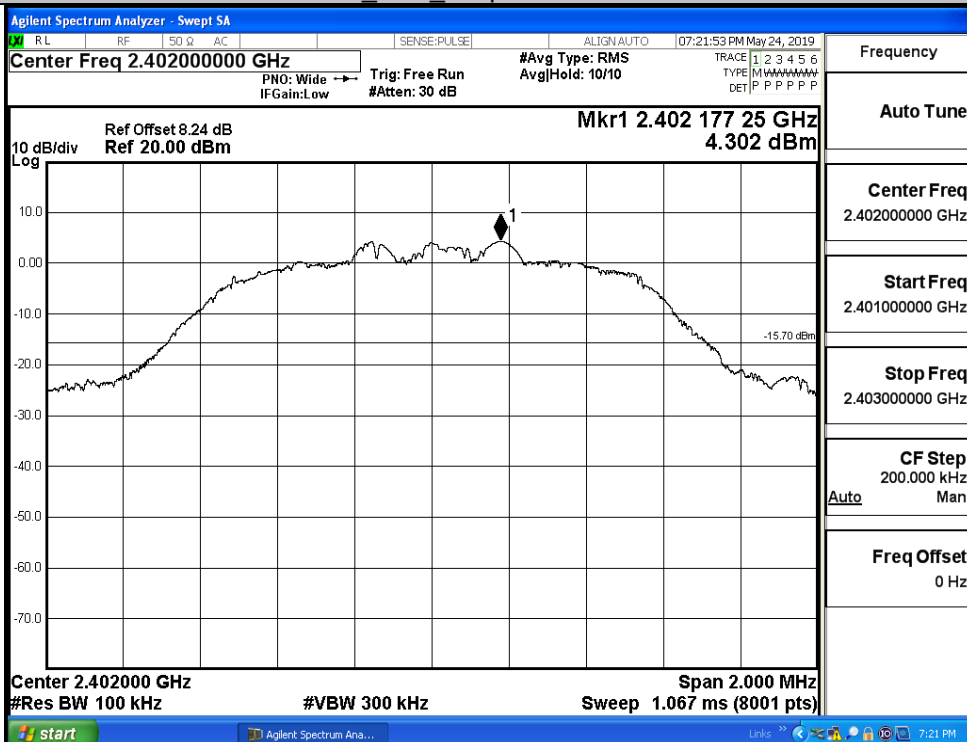


Puw

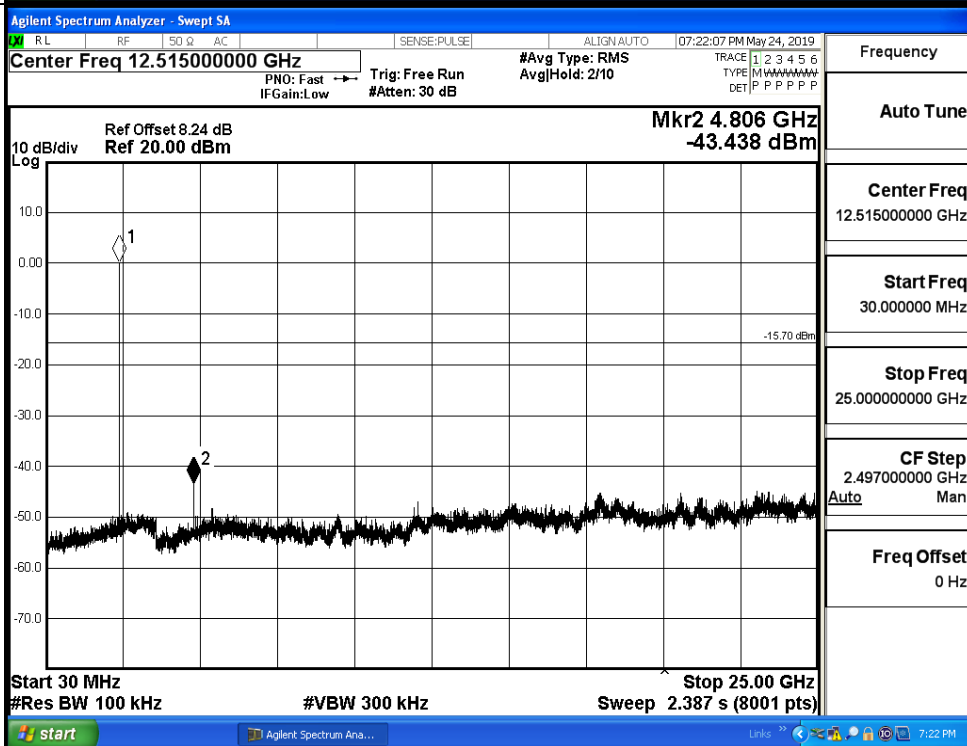


$\pi/4$ DQPSK LCH_Graphs

Pref

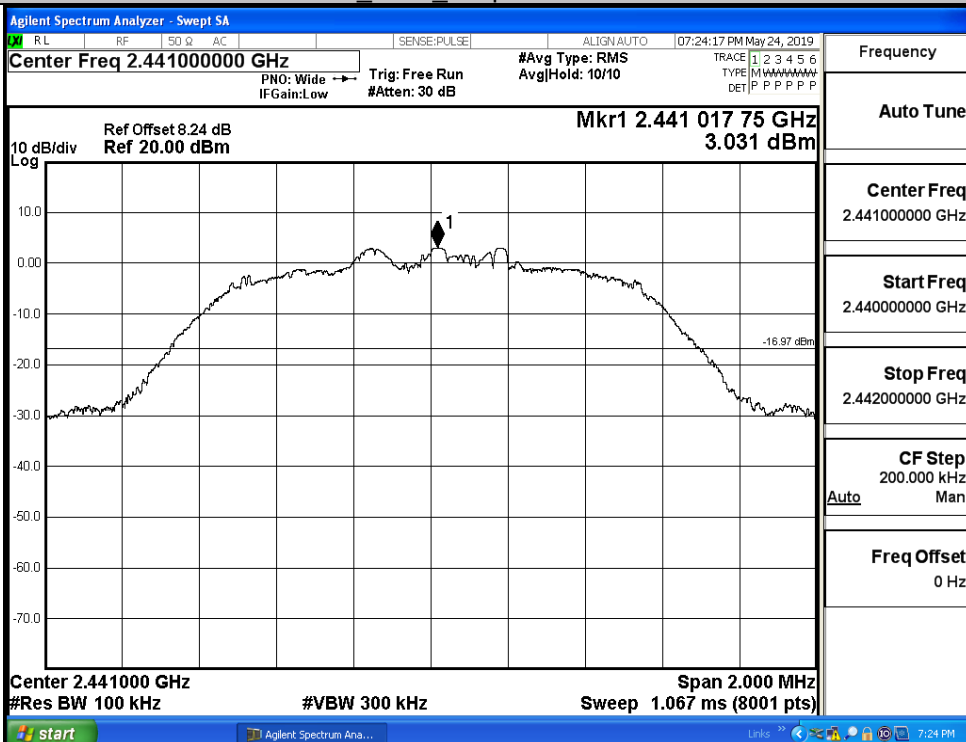


Puw

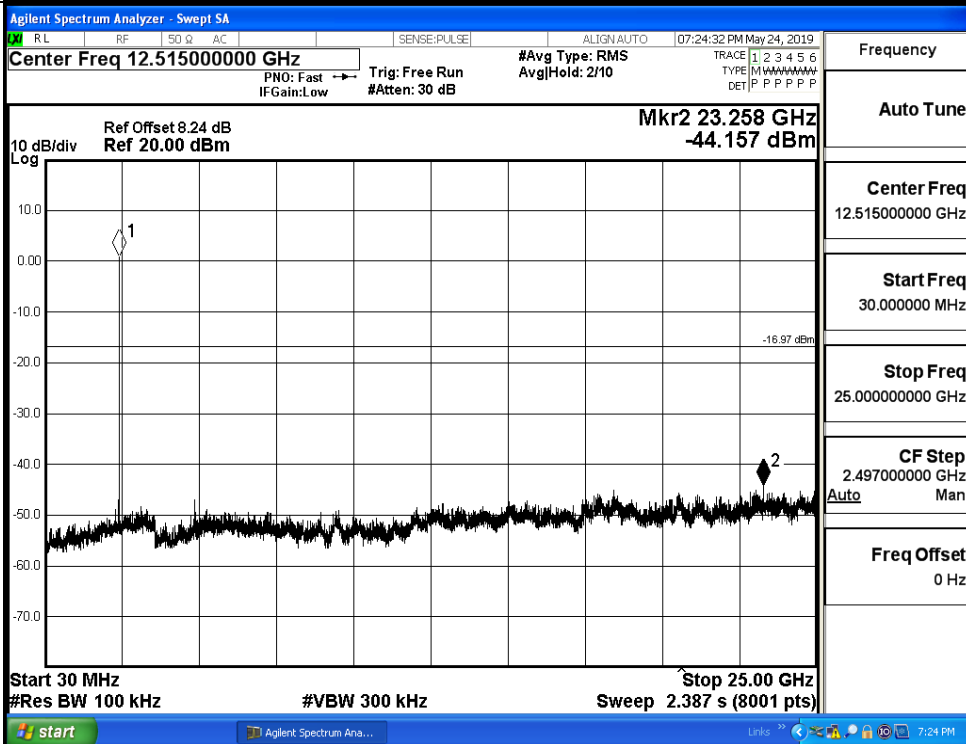


$\pi/4$ DQPSK_MCH_Graphs

Pref

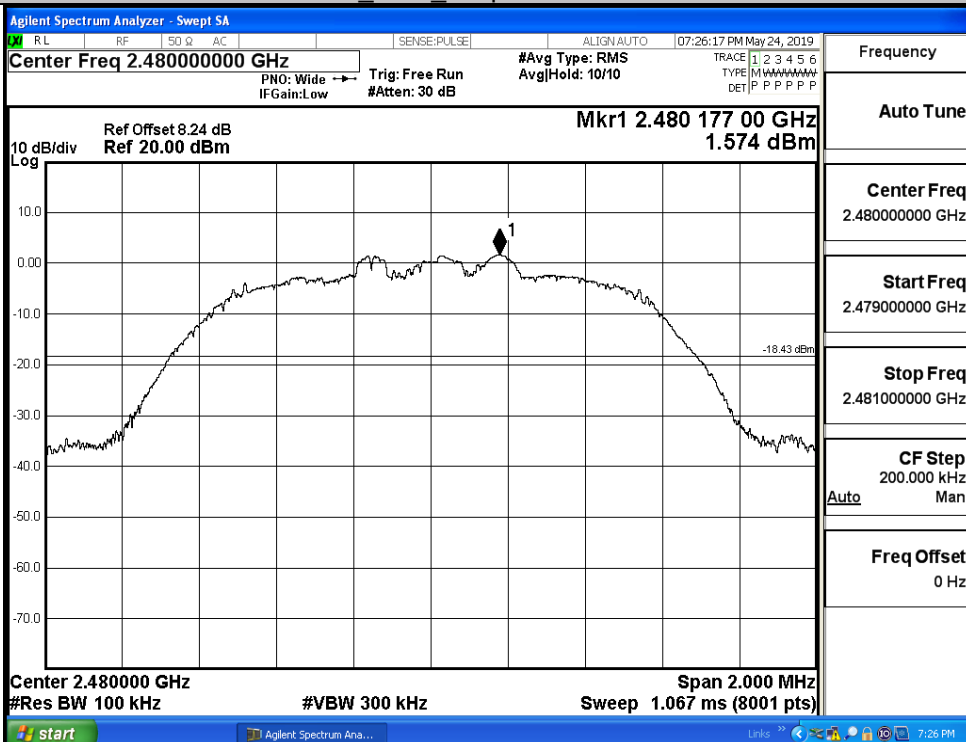


Puw

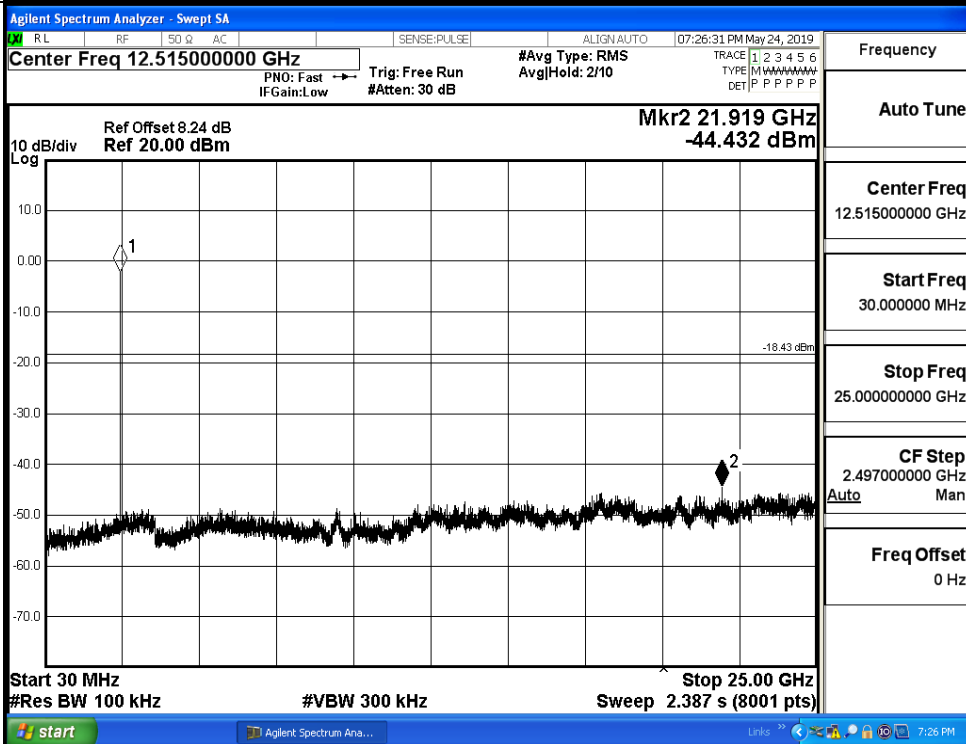


$\pi/4$ DQPSK_HCH_Graphs

Pref

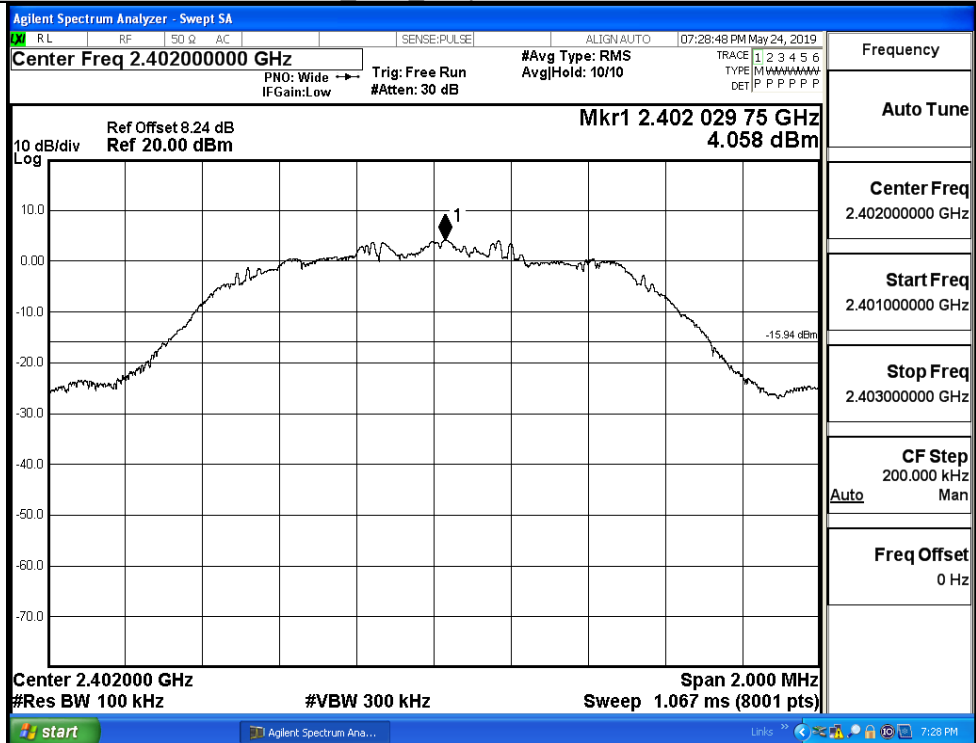


Puw

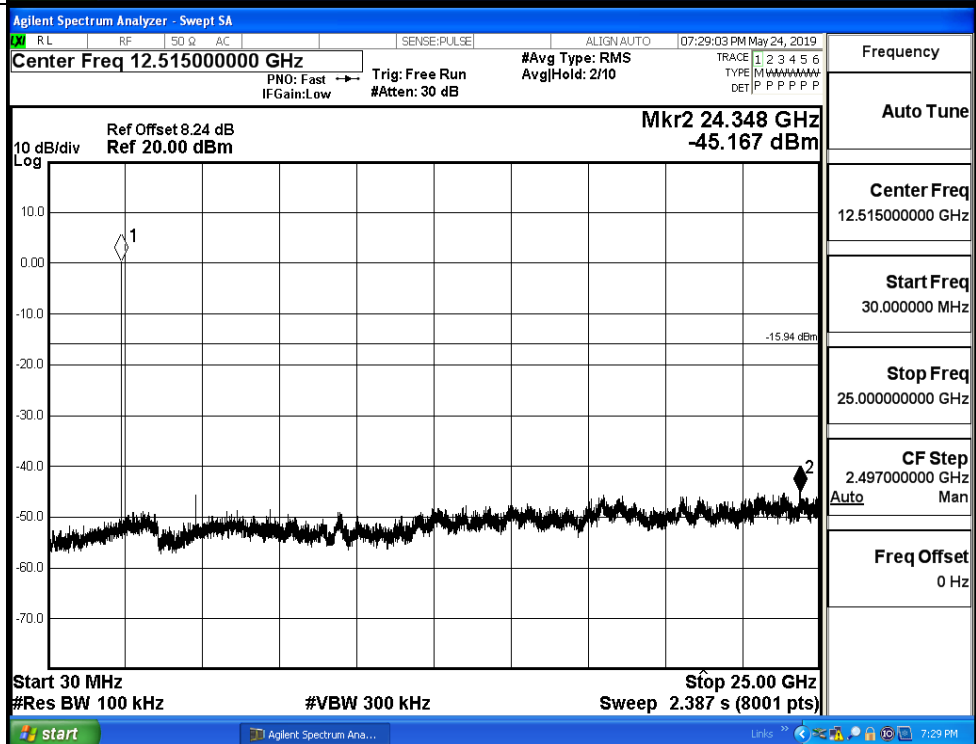


8DPSK_LCH_Graphs

Pref

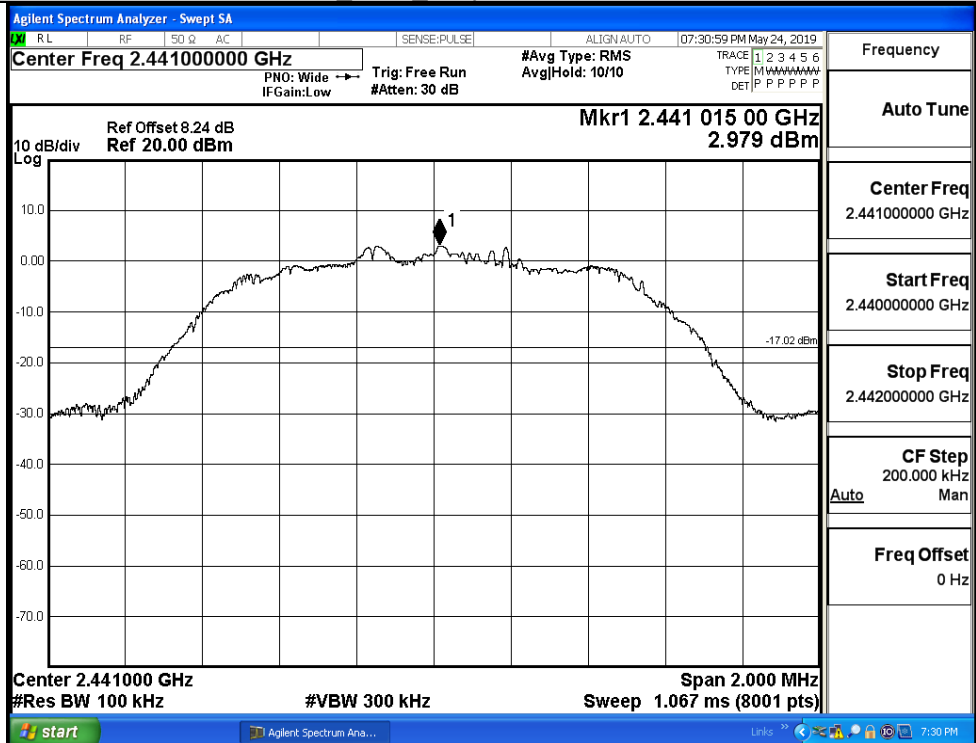


Puw

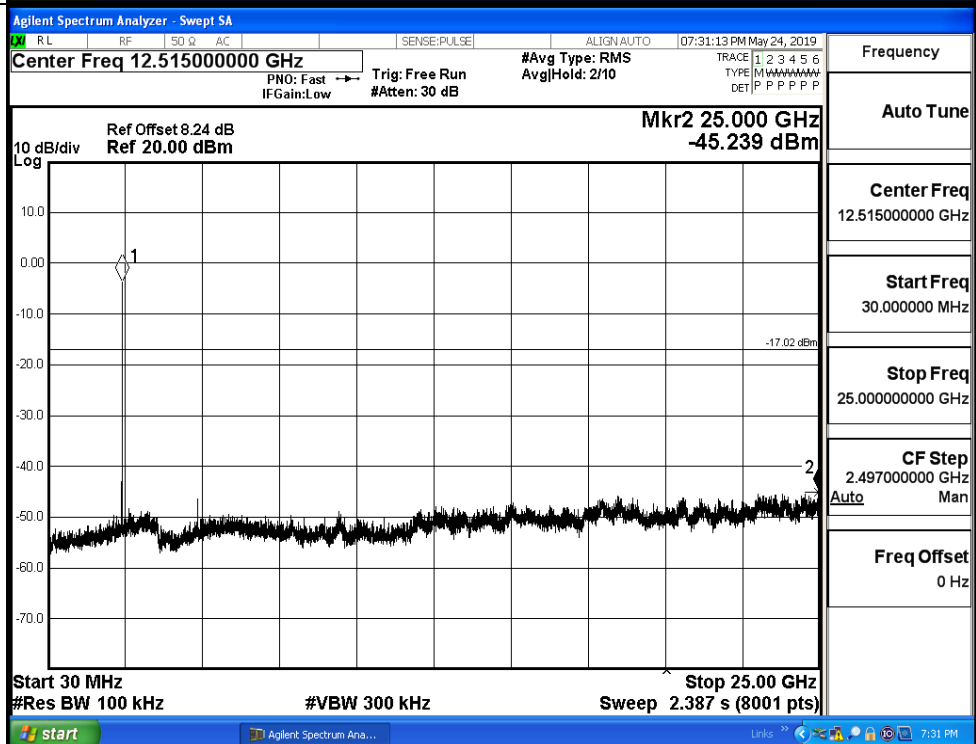


8DPSK_MCH_Graphs

Pref

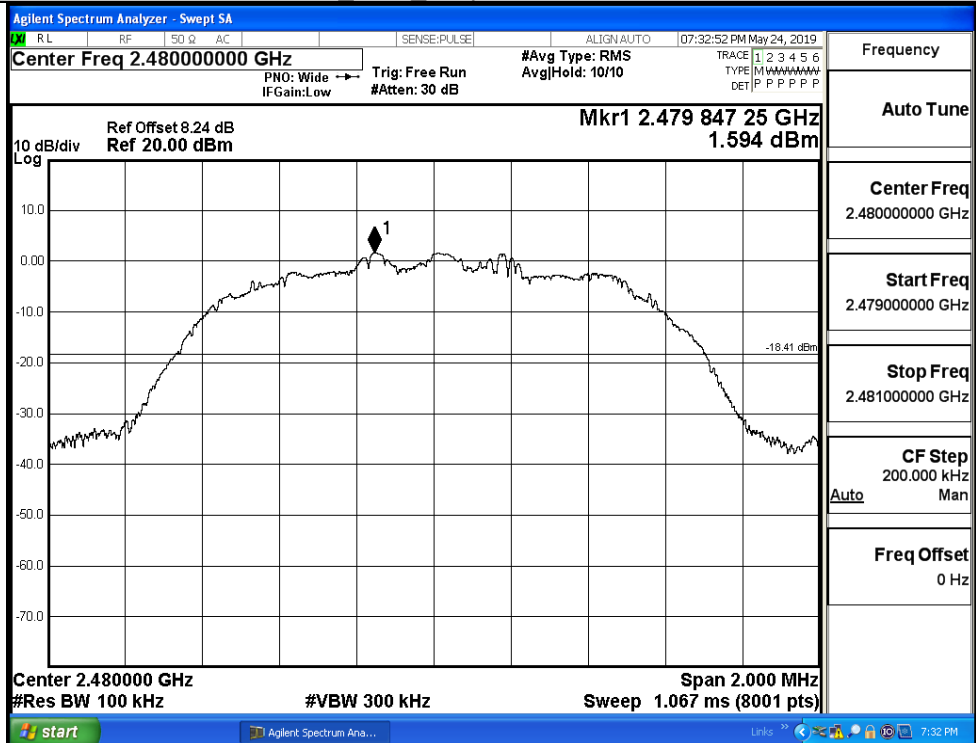


Puw

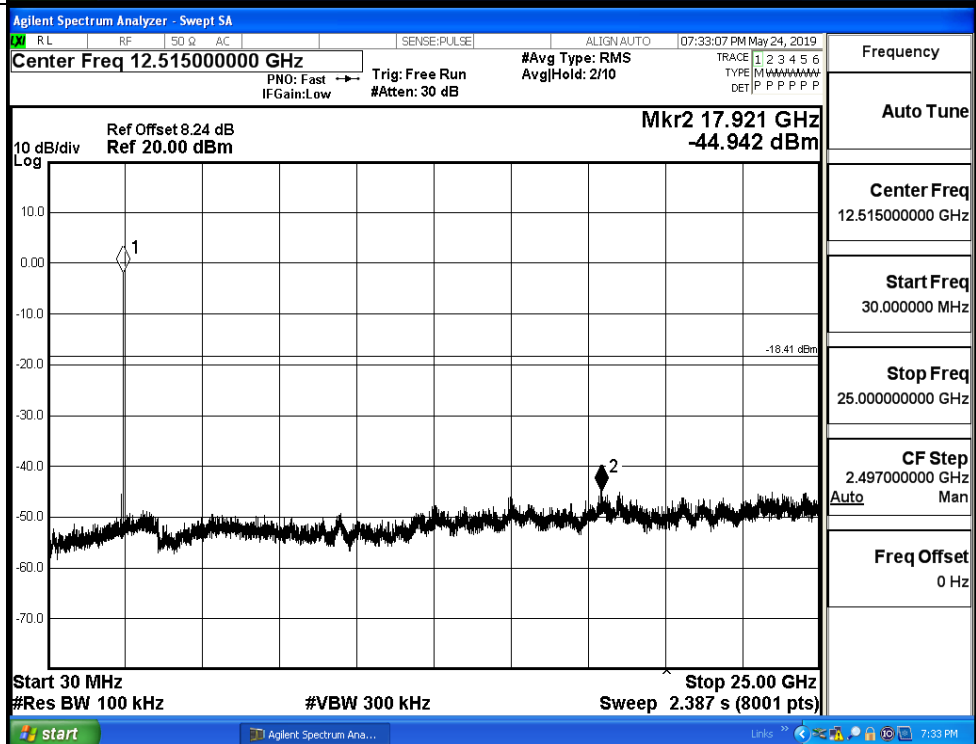


8DPSK_HCH_Graphs

Pref



Puw

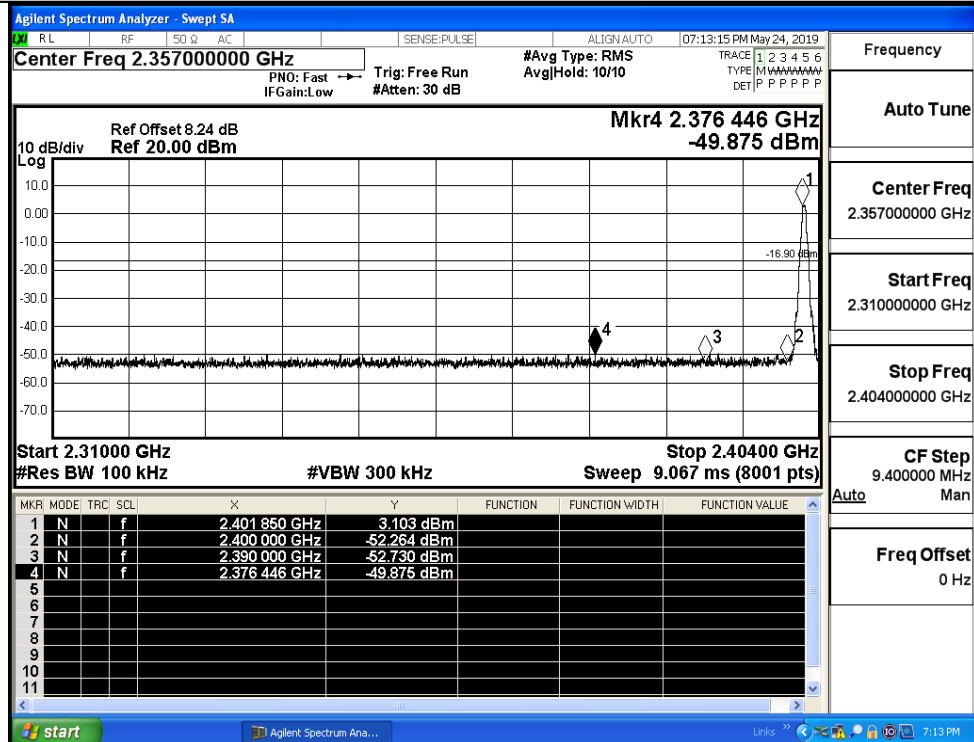


A.7 Band-edge for RF Conducted Emissions

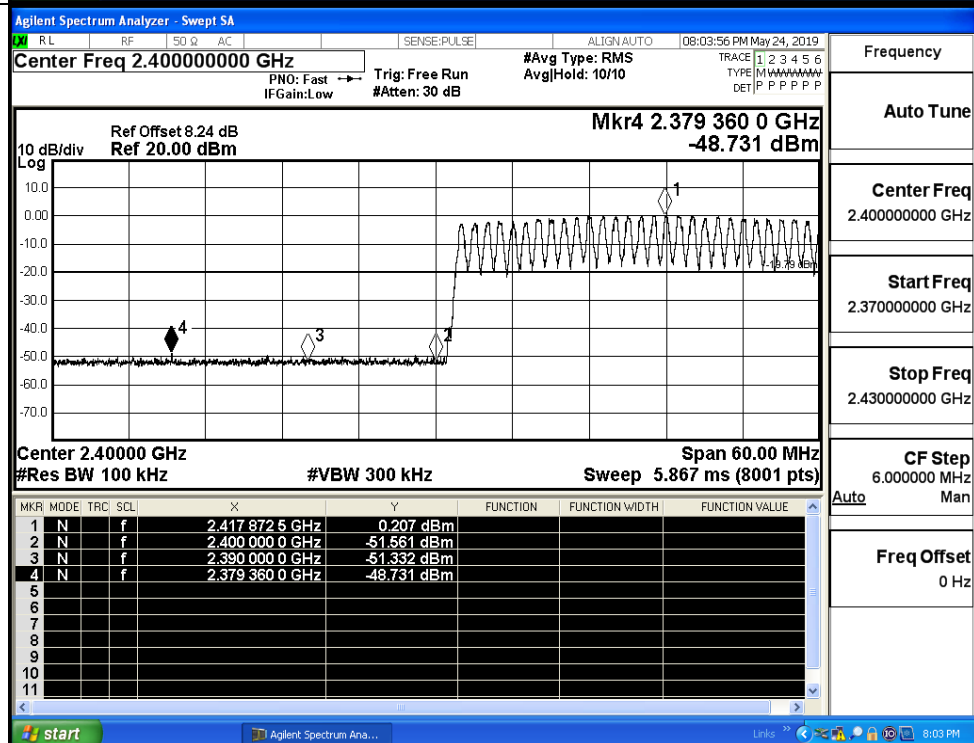
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	3.103	Off	-49.875	-16.9	PASS
			0.207	On	-48.731	-19.79	PASS
	HCH	2480	1.263	Off	-49.074	-18.74	PASS
			0.890	On	-46.612	-19.11	PASS
$\pi/4$ DQPSK	LCH	2402	4.317	Off	-49.645	-15.68	PASS
			-1.264	On	-49.320	-21.26	PASS
	HCH	2480	1.635	Off	-49.657	-18.37	PASS
			1.830	On	-44.595	-18.17	PASS
8DPSK	LCH	2402	4.500	Off	-49.869	-15.5	PASS
			-1.170	On	-48.708	-21.17	PASS
	HCH	2480	1.657	Off	-49.964	-18.34	PASS
			1.780	On	-46.874	-18.22	PASS

Test Graphs

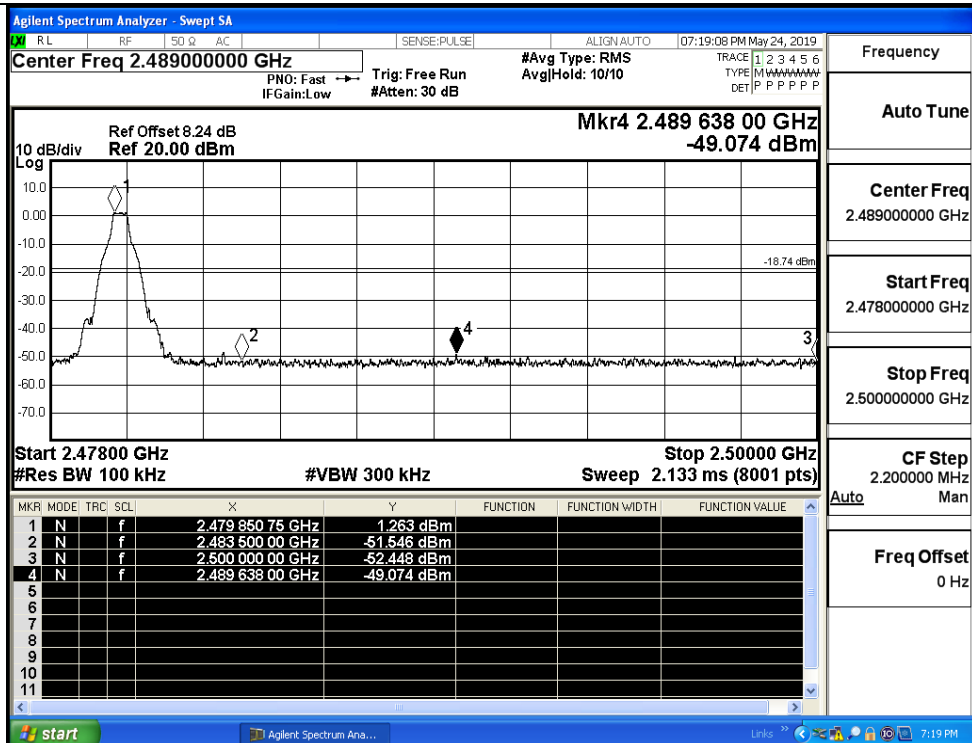
GFSK/LCH/No Hop



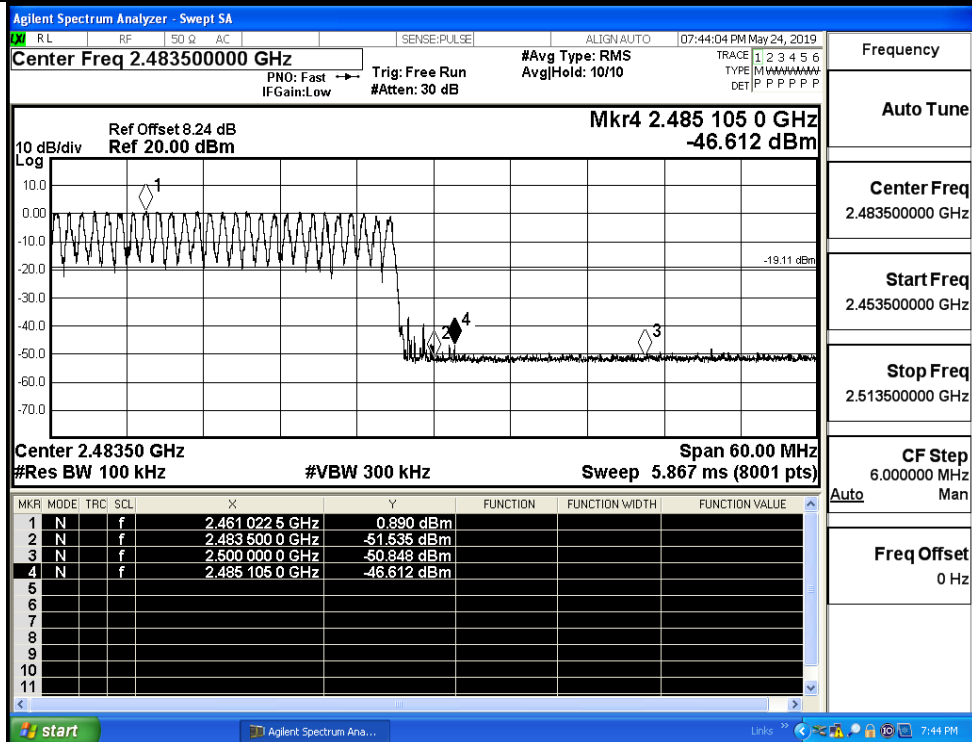
GFSK/LCH/Hop



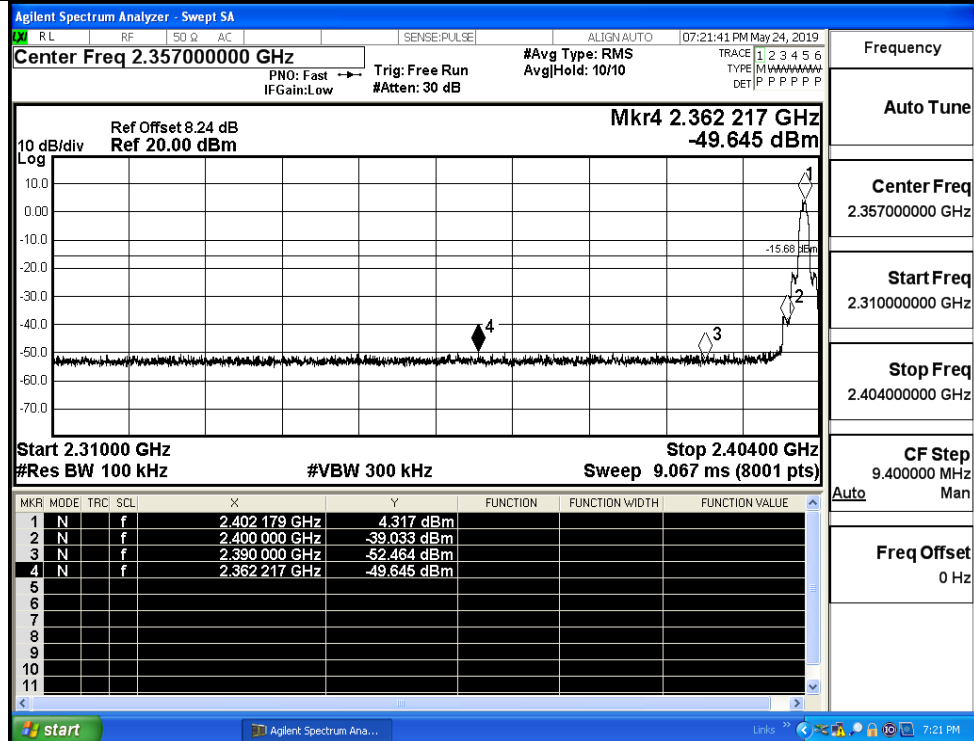
GFSK/HCH/No Hop



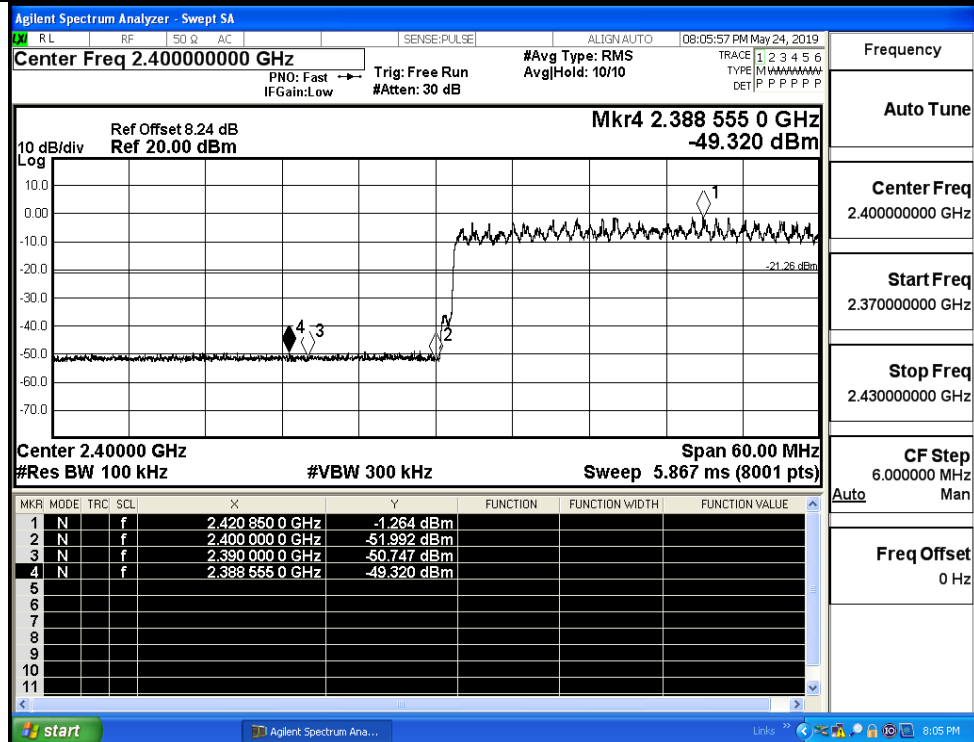
GFSK/HCH/Hop



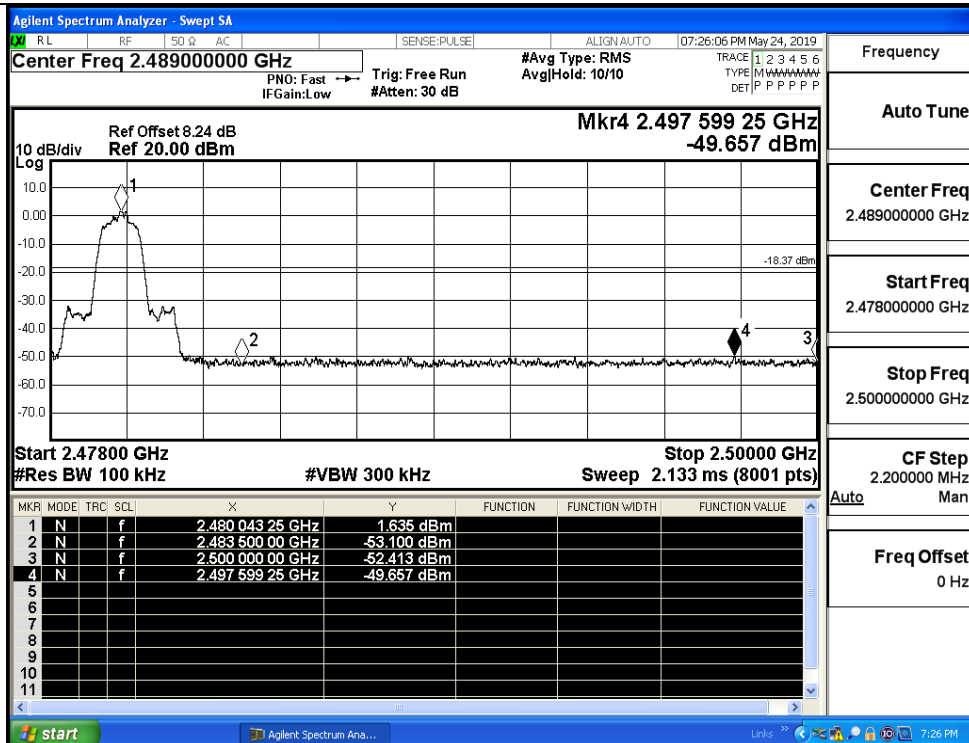
$\pi/4$ DQPSK/LCH/No
Hop



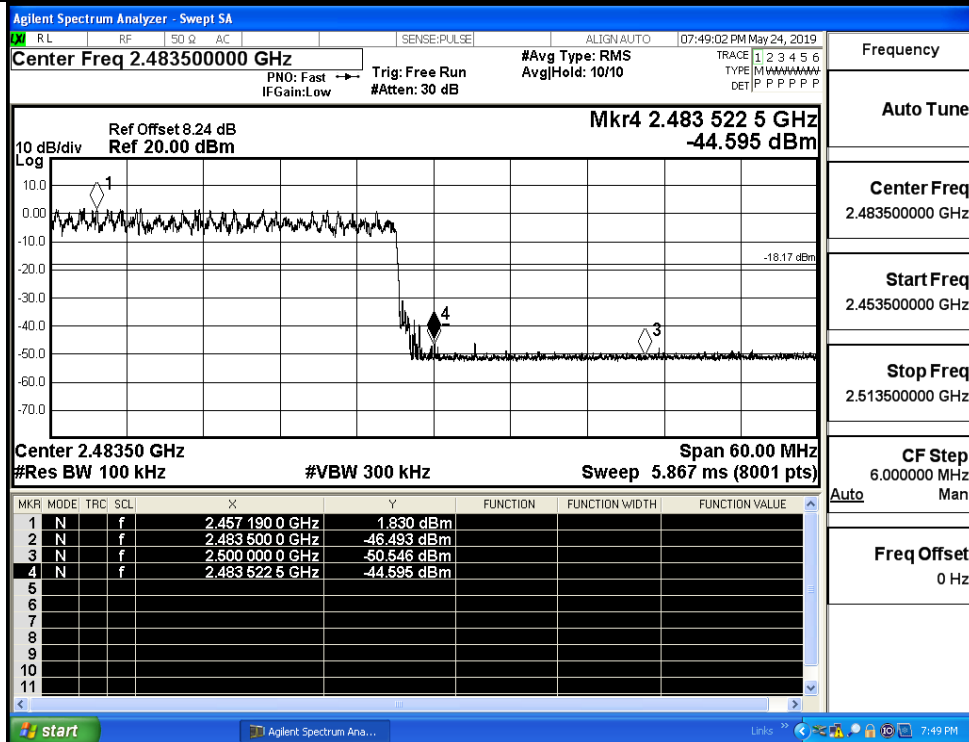
$\pi/4$ DQPSK/LCH/Hop



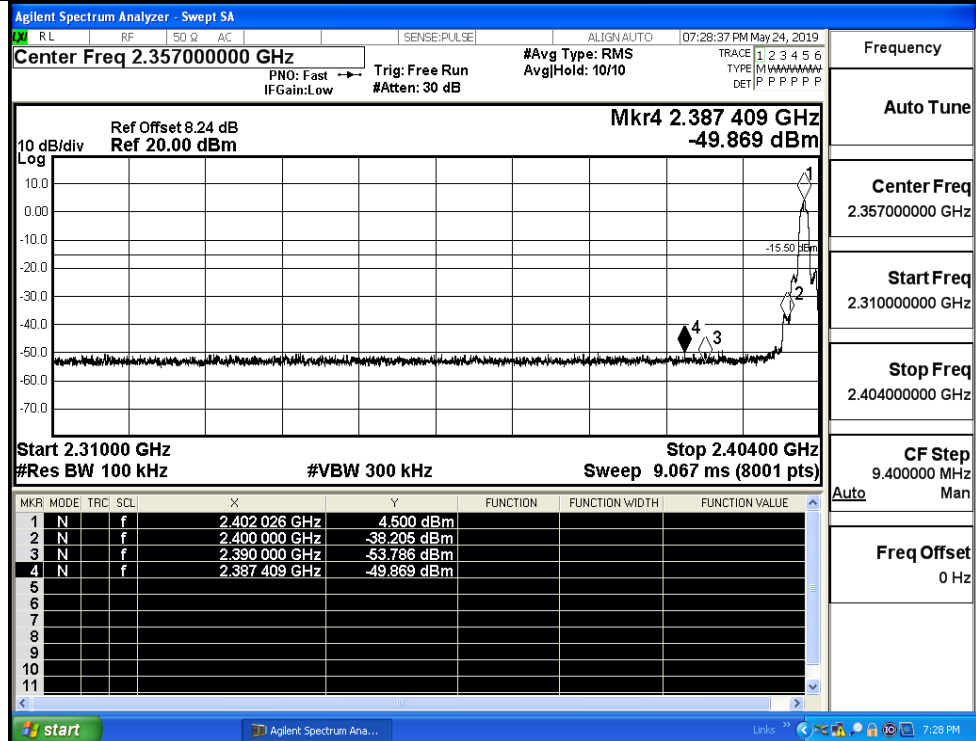
$\pi/4$ DQPSK/HCH/No
Hop



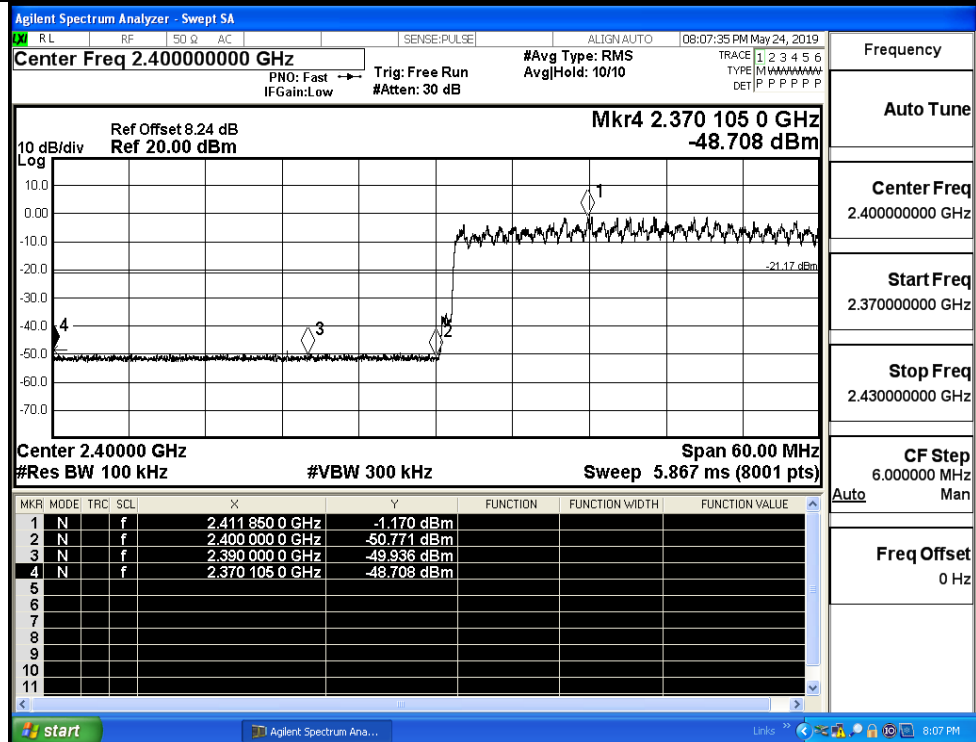
$\pi/4$ DQPSK/HCH/Hop



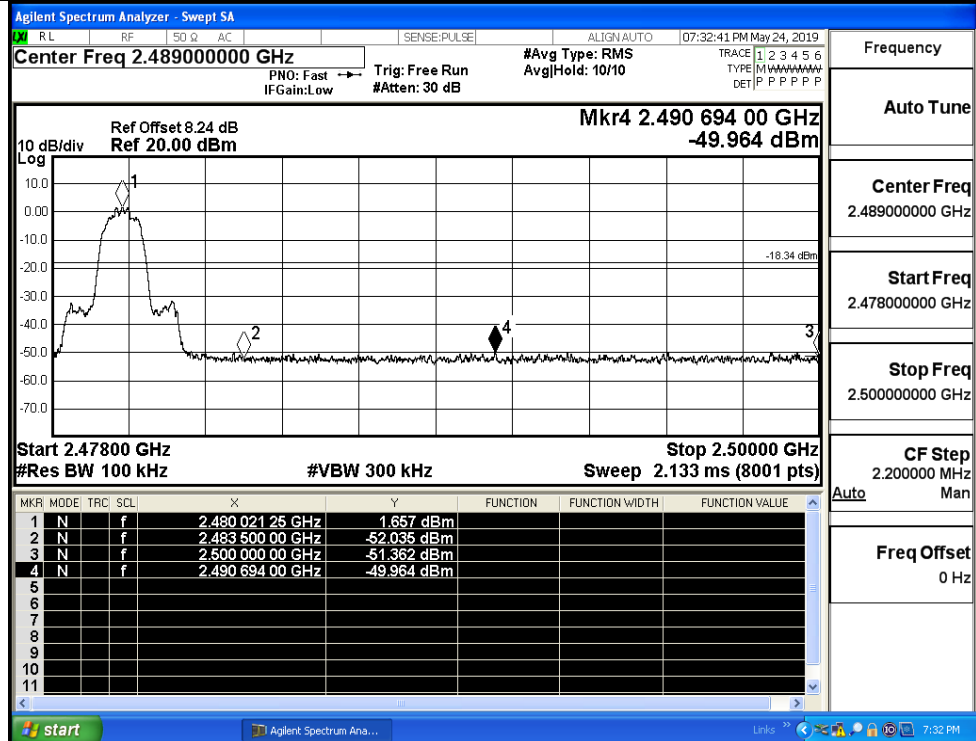
8DPSK/LCH/No Hop



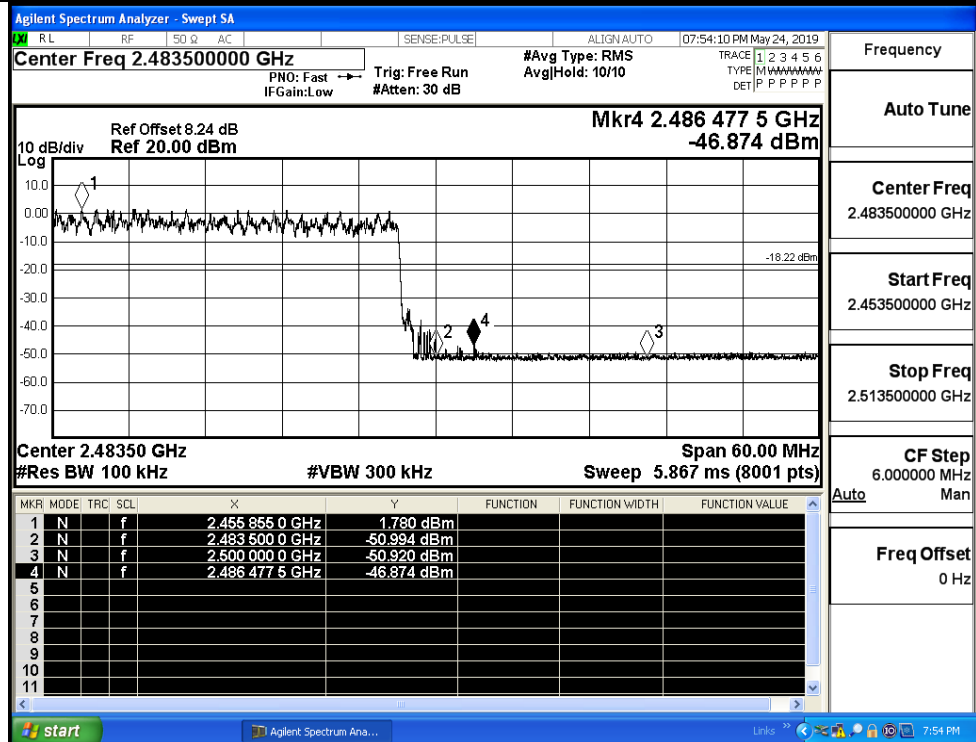
8DPSK/LCH/Hop



8DPSK/HCH/No Hop



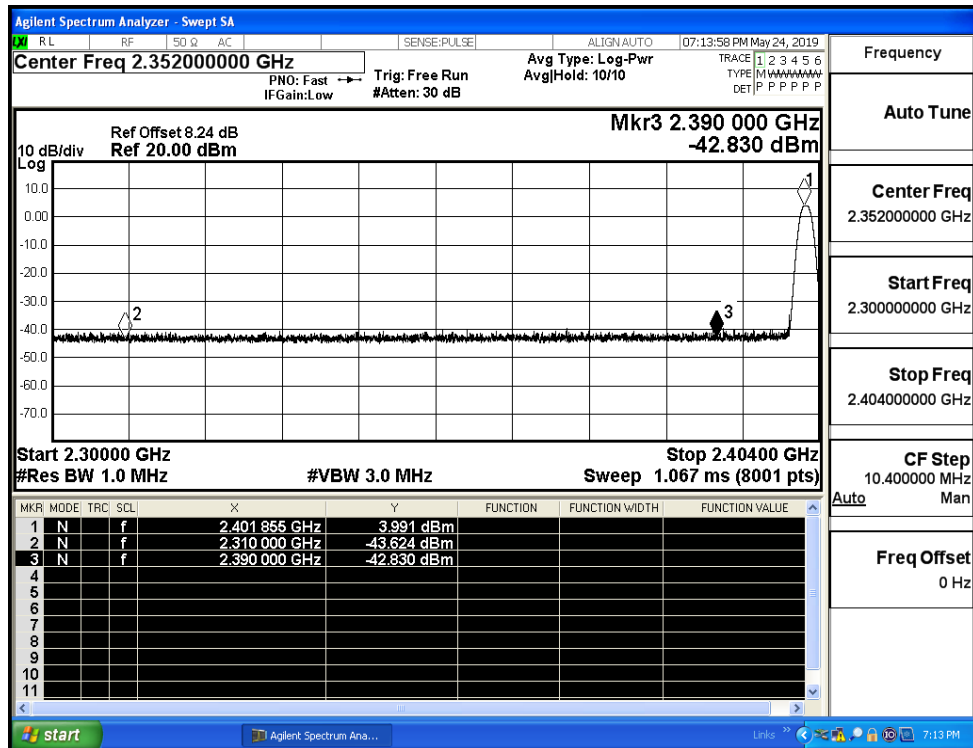
8DPSK/HCH/Hop



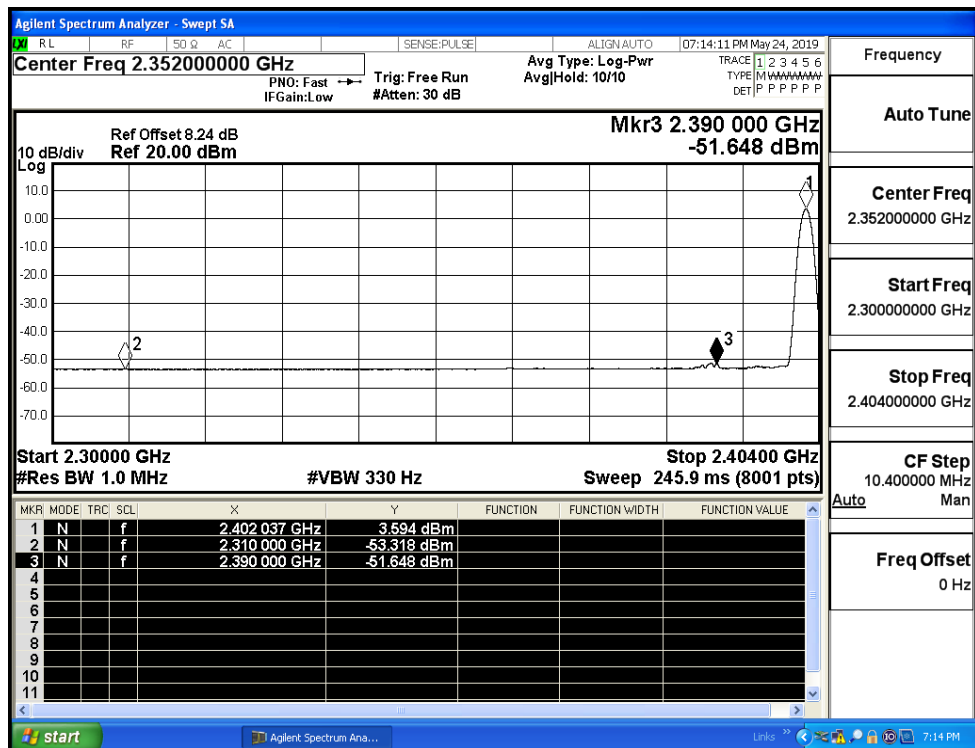
A.8 Restrict-band band-edge measurements

Test Mode	Hopping	Freq.	Power [dBm]	Gain	Ground Factor	E [dBuV/m]	Detector	Limit [dBuV/m]	Verdict
GFSK	Off	2310.0	-43.62	2.0	0	53.63	PEAK	74	PASS
	Off	2310.0	-53.32	2.0	0	43.94	AV	54	PASS
	Off	2390.0	-42.83	2.0	0	54.43	PEAK	74	PASS
	Off	2390.0	-51.65	2.0	0	45.61	AV	54	PASS
	Off	2483.5	-43.47	2.0	0	53.79	PEAK	74	PASS
	Off	2483.5	-52.66	2.0	0	44.60	AV	54	PASS
	Off	2500.0	-43.42	2.0	0	53.83	PEAK	74	PASS
	Off	2500.0	-52.77	2.0	0	44.49	AV	54	PASS
$\pi/4$ DQPSK	Off	2310.0	-43.19	2.0	0	54.07	PEAK	74	PASS
	Off	2310.0	-53.44	2.0	0	43.82	AV	54	PASS
	Off	2390.0	-43.01	2.0	0	54.24	PEAK	74	PASS
	Off	2390.0	-53.20	2.0	0	44.05	AV	54	PASS
	Off	2483.5	-42.16	2.0	0	55.09	PEAK	74	PASS
	Off	2483.5	-52.65	2.0	0	44.61	AV	54	PASS
	Off	2500.0	-42.58	2.0	0	54.68	PEAK	74	PASS
	Off	2500.0	-52.72	2.0	0	44.54	AV	54	PASS
8DPSK	Off	2310.0	-43.01	2.0	0	54.25	PEAK	74	PASS
	Off	2310.0	-53.45	2.0	0	43.81	AV	54	PASS
	Off	2390.0	-41.89	2.0	0	55.37	PEAK	74	PASS
	Off	2390.0	-52.92	2.0	0	44.33	AV	54	PASS
	Off	2483.5	-42.73	2.0	0	54.53	PEAK	74	PASS
	Off	2483.5	-52.71	2.0	0	44.55	AV	54	PASS
	Off	2500.0	-43.36	2.0	0	53.90	PEAK	74	PASS
	Off	2500.0	-52.85	2.0	0	44.40	AV	54	PASS

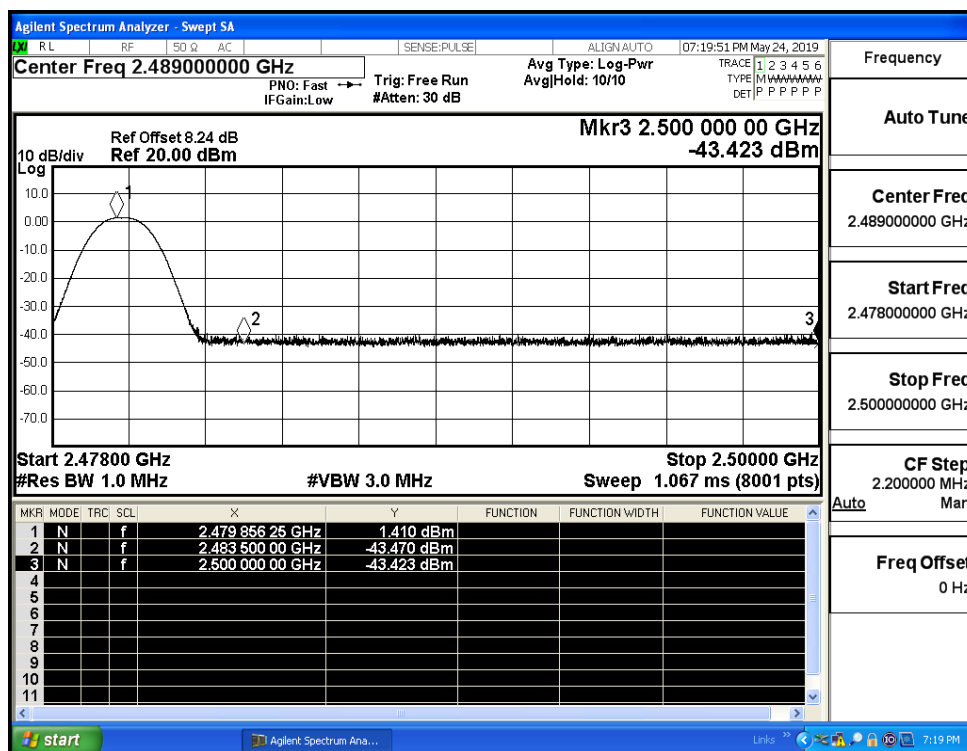
Restrict-band band-edge measurements_Hopping Off_GFSK_PEAK (Low Channel)



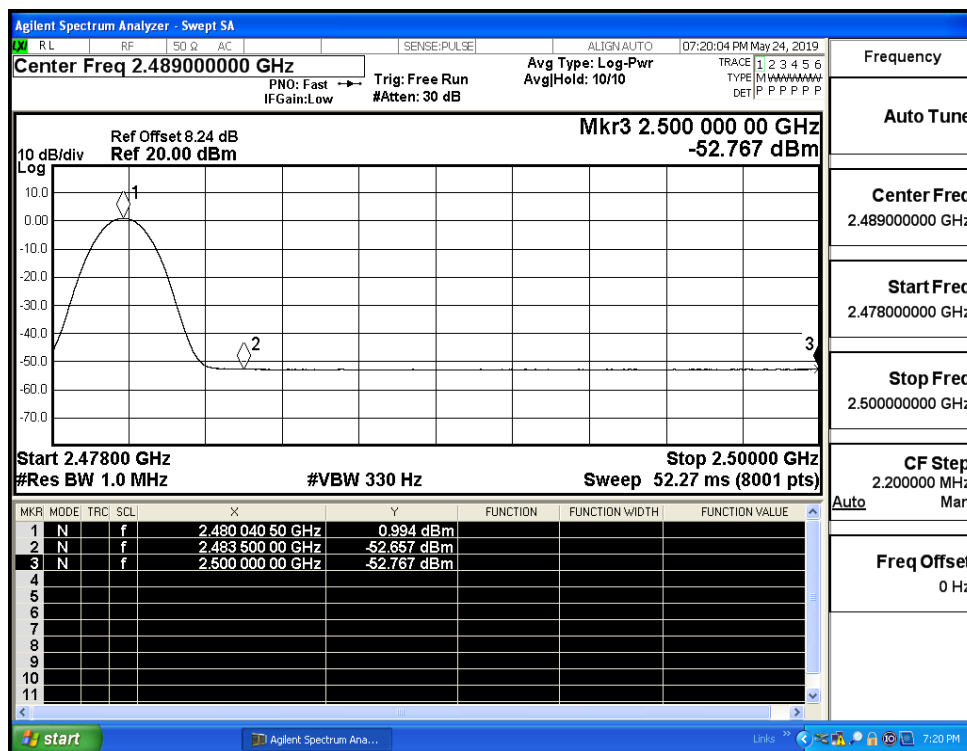
Restrict-band band-edge measurements_Hopping Off_GFSK_Average (Low Channel)

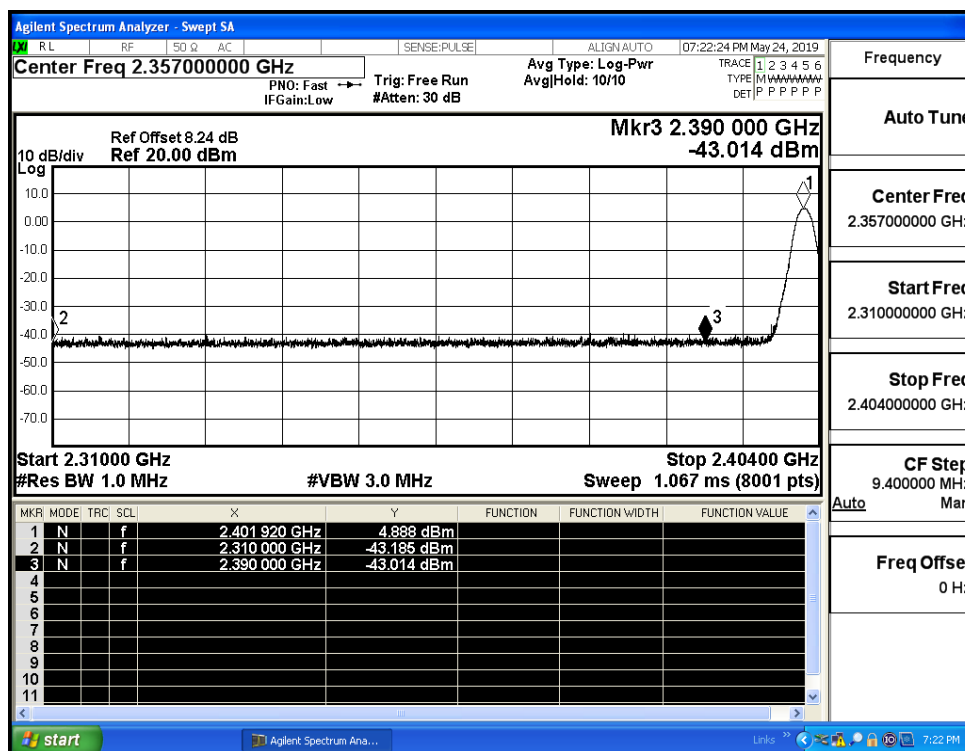
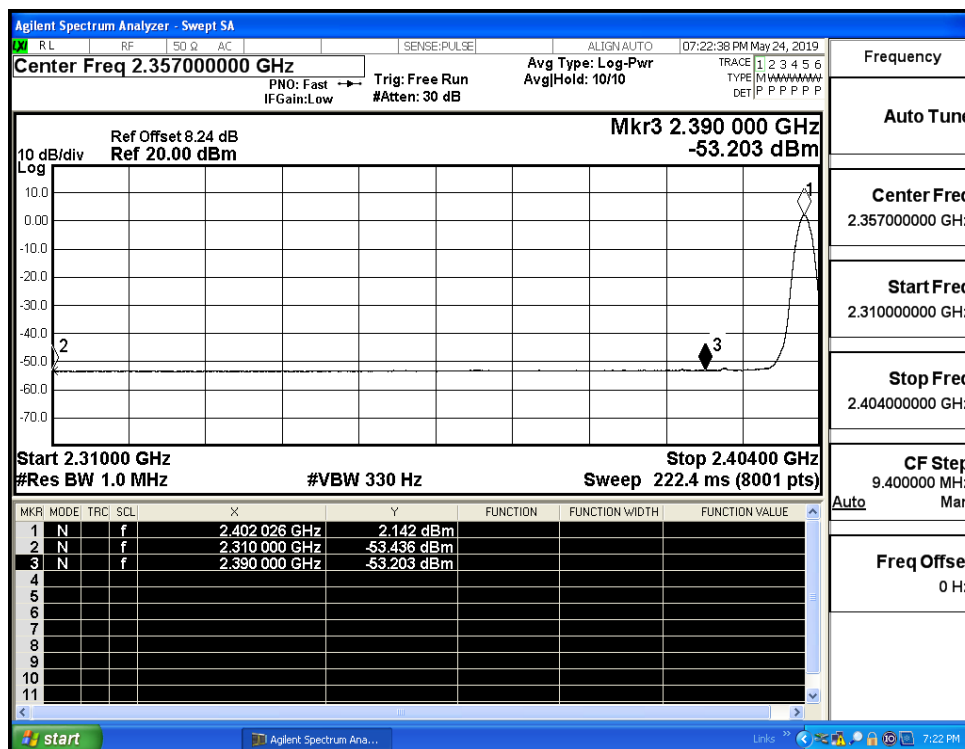


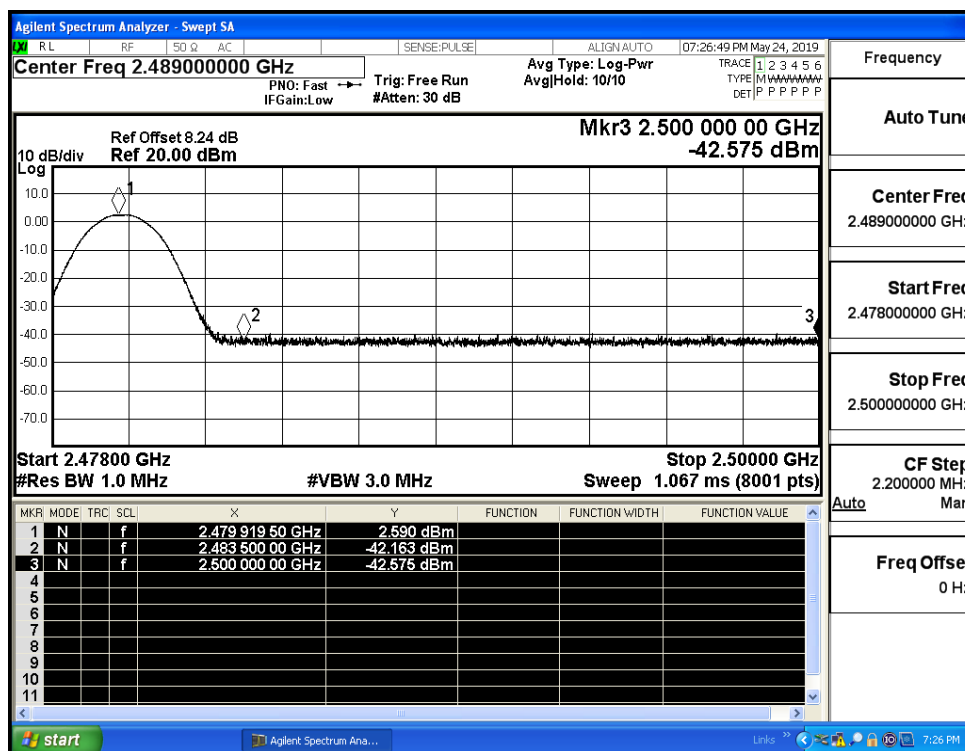
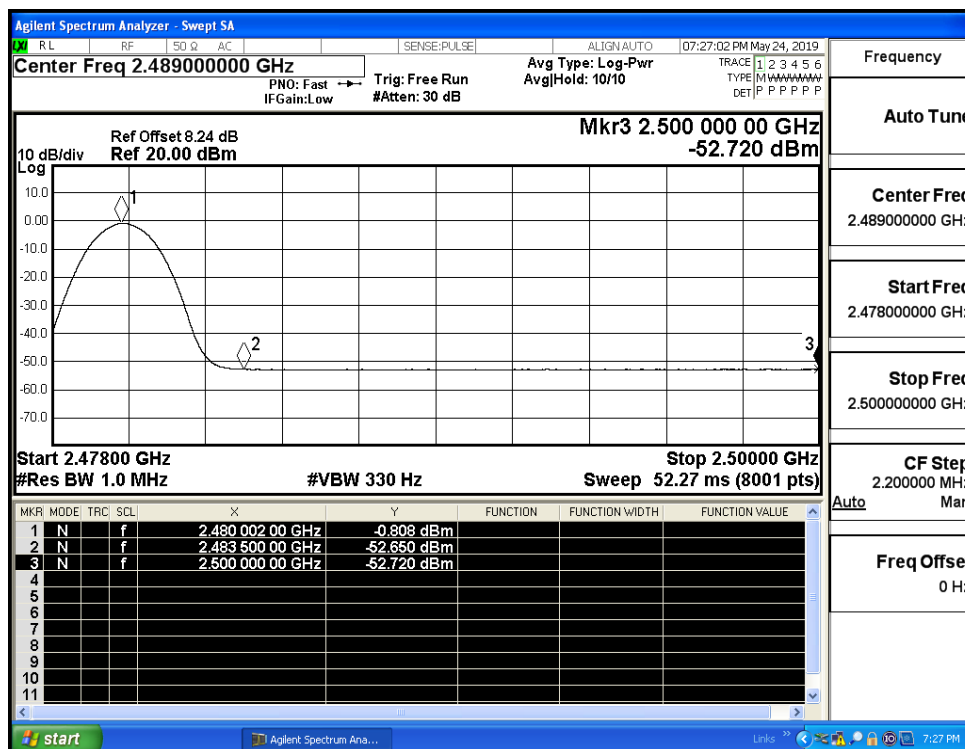
Restrict-band band-edge measurements_Hopping Off_GFSK_PEAK (High Channel)



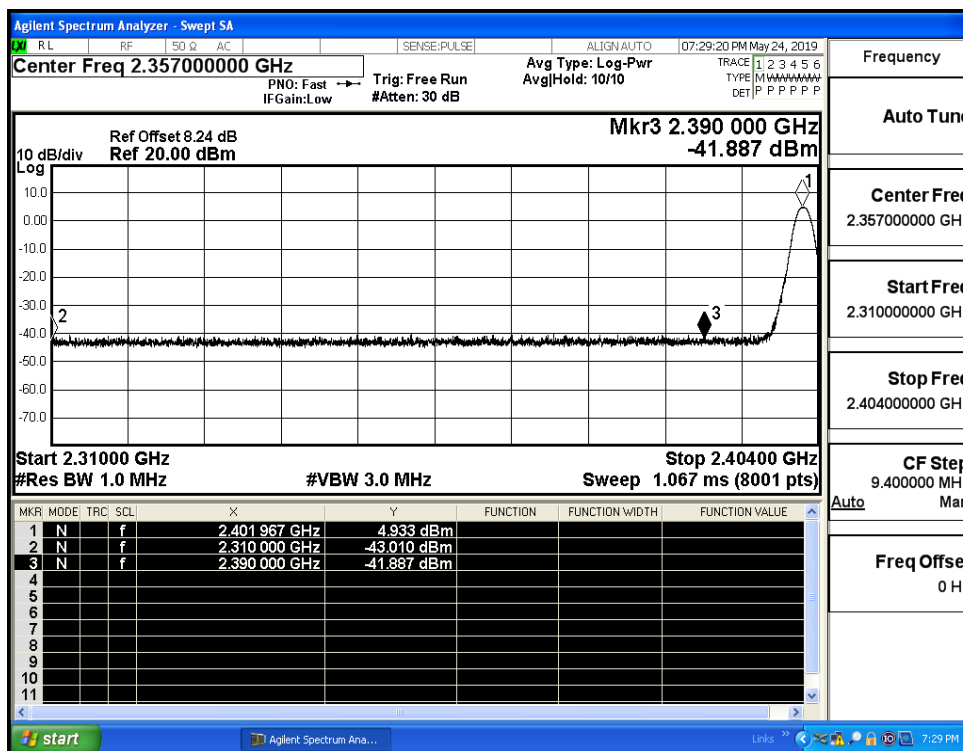
Restrict-band band-edge measurements_Hopping Off_GFSK_Average (High Channel)



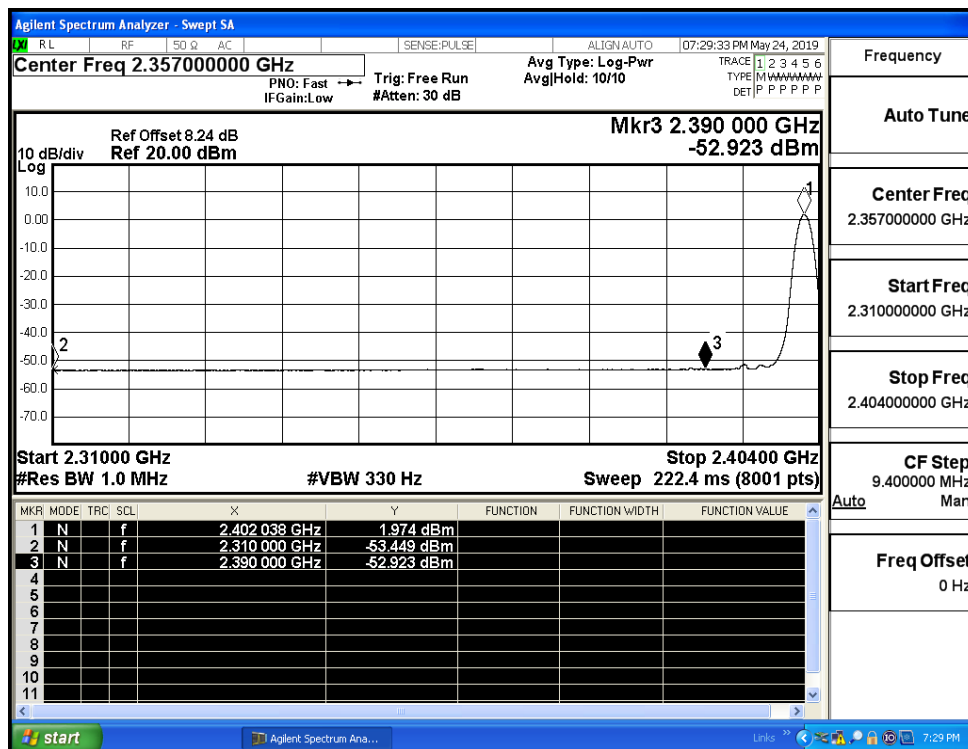
Restrict-band band-edge measurements_Hopping Off $\pi/4$ -DQPSK_PEAK (Low Channel)Restrict-band band-edge measurements_Hopping Off $\pi/4$ -DQPSK_Average (Low Channel)

Restrict-band band-edge measurements_Hopping Off $\pi/4$ -DQPSK_PEAK (High Channel)Restrict-band band-edge measurements_Hopping Off $\pi/4$ -DQPSK_Average (High Channel)

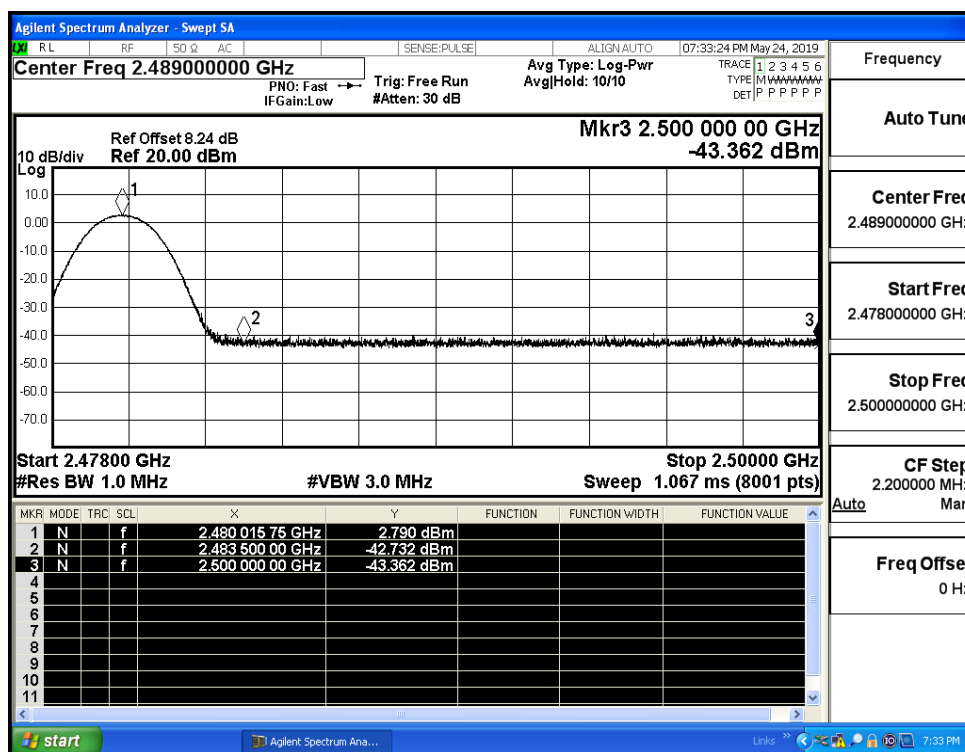
Restrict-band band-edge measurements_Hopping Off_8DPSK_PEAK (Low Channel)



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)

