

Appendix B

RF Test Data for 2.4G WIFI (Conducted Measurement)

Product Name: Smart Hub+



Trade Mark: AMERICAN LIGHTING

Test Model: SPKPL-GTWY

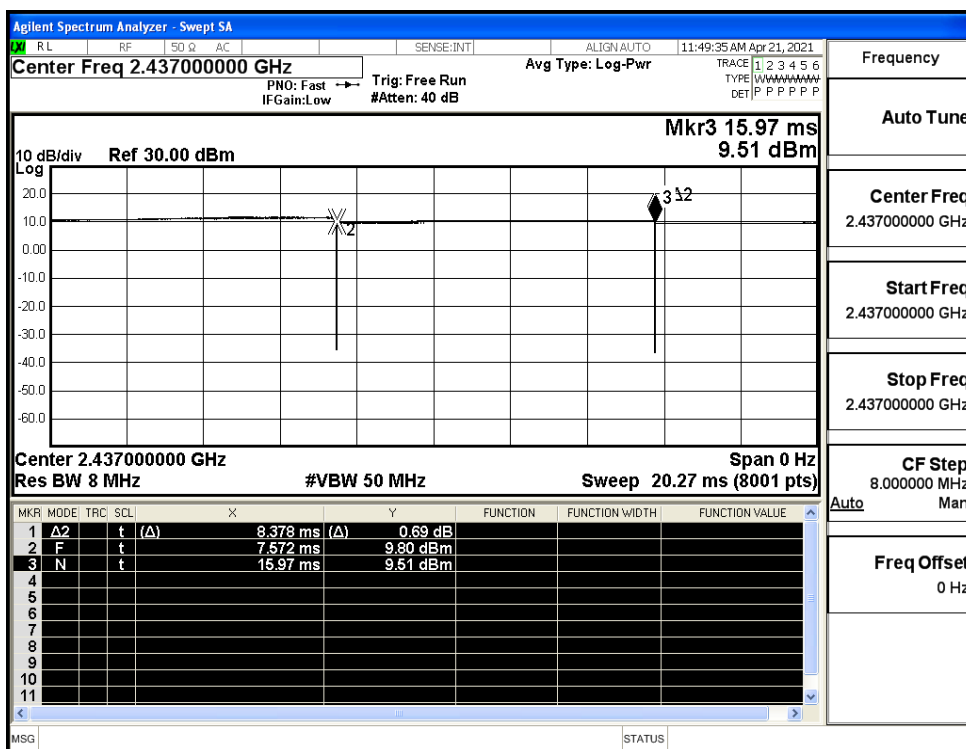
Environmental Conditions

Temperature:	24.6 ° C
Relative Humidity:	54.1%
ATM Pressure:	100.0 kPa
Test Engineer:	Kay Hu
Supervised by:	Li Huan

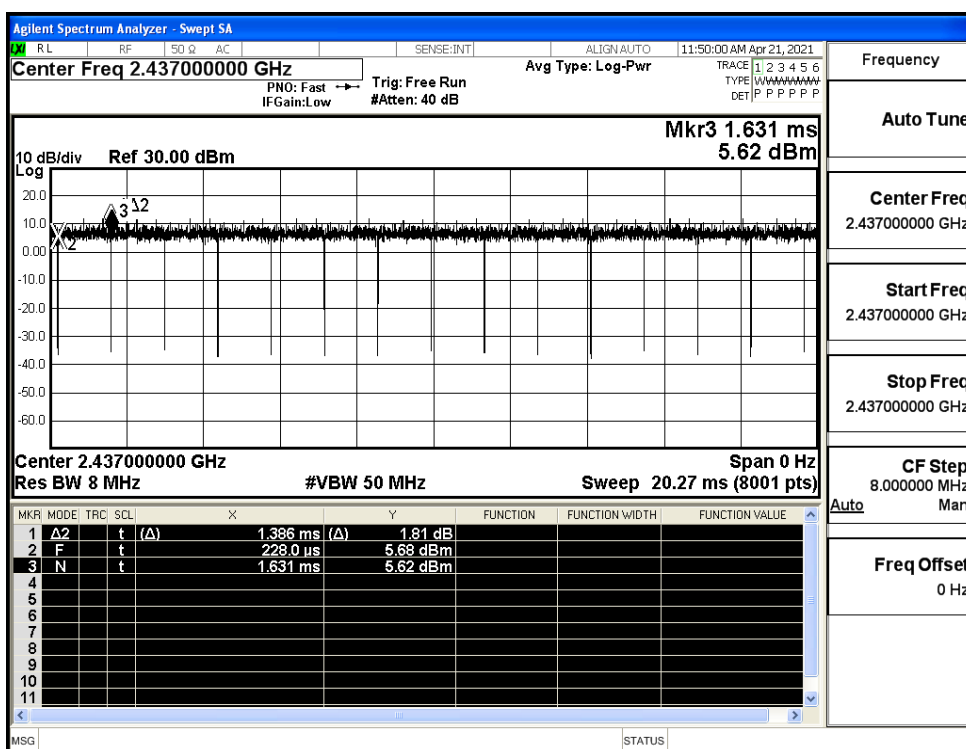
B.1 Duty Cycle

Test Mode	Test Channel	Ant	Duty Cycle[%]	Verdict
11B	2437	Ant1	99.76	PASS
11G	2437	Ant1	98.74	PASS
11N20SISO	2437	Ant1	98.46	PASS
11N40SISO	2437	Ant1	98.07	PASS

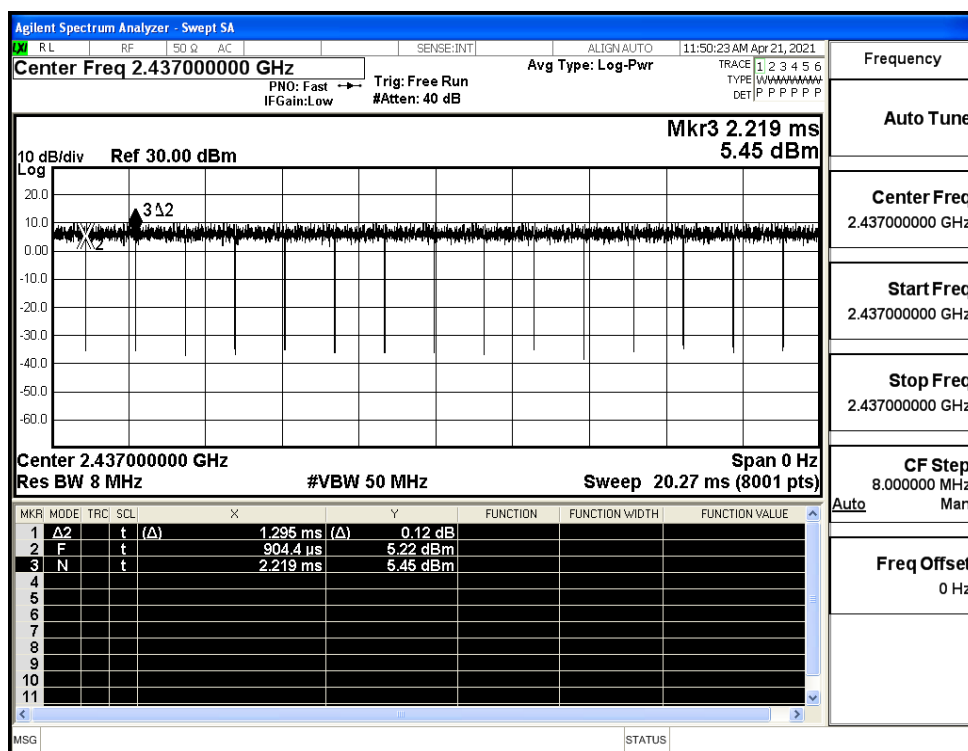
Duty Cycle_11B_2437_Ant1



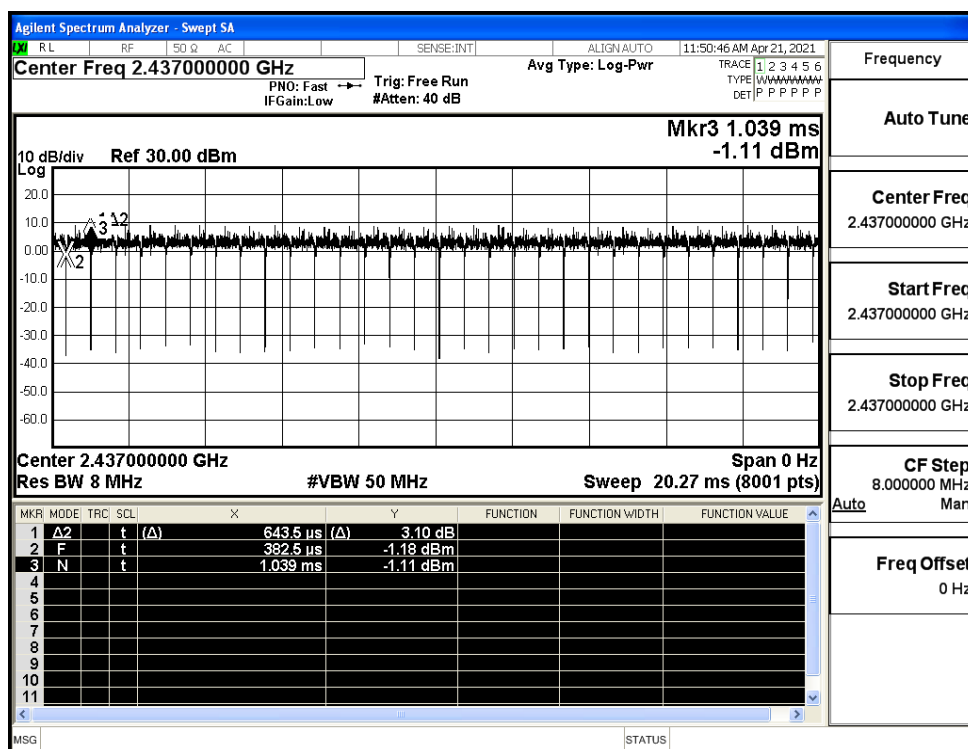
Duty Cycle_11G_2437_Ant1



Duty Cycle_11N20SISO_2437_Ant1



Duty Cycle_11N40SISO_2437_Ant1



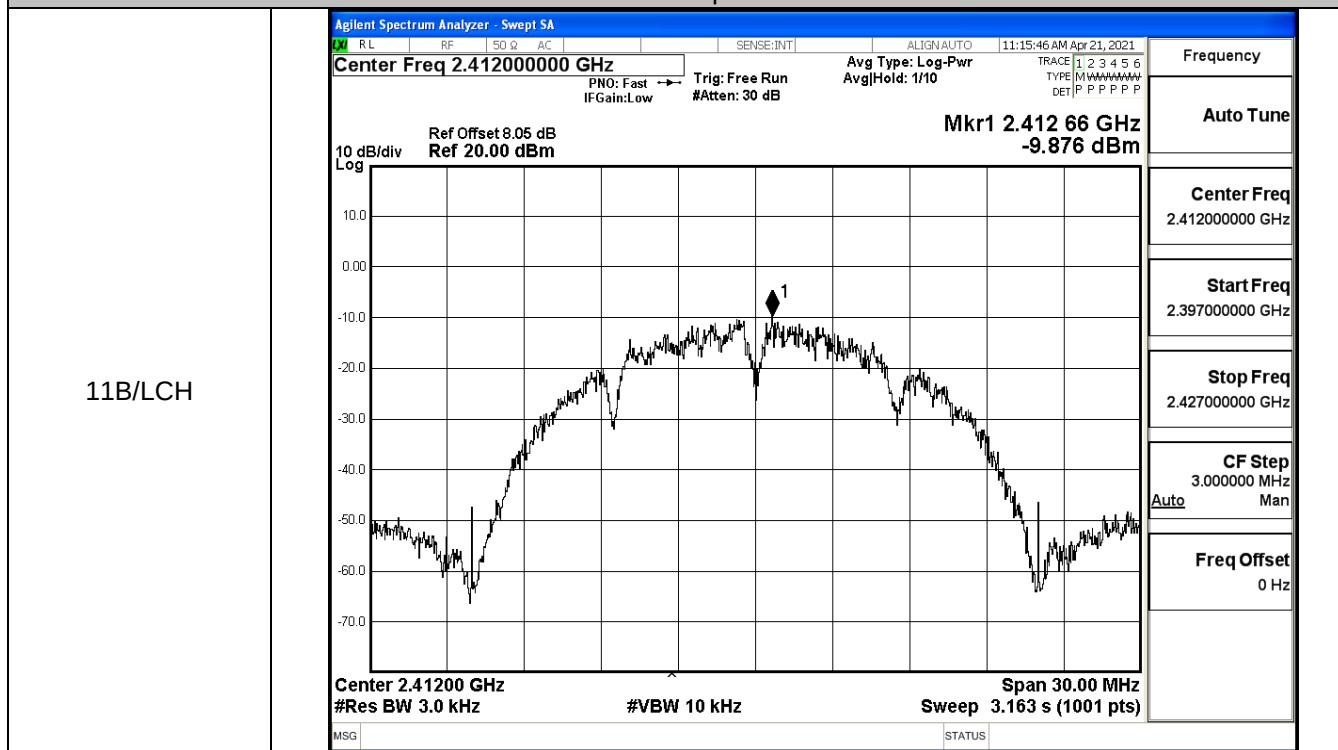
B.2 Maximum Conducted Output Power

Mode	Channel	Meas.Level [dBm]	Limit [dBm]	Verdict
11B	LCH	17.00	30	PASS
	MCH	17.66	30	PASS
	HCH	17.04	30	PASS
11G	LCH	16.26	30	PASS
	MCH	17.64	30	PASS
	HCH	16.74	30	PASS
11N20SISO	LCH	16.24	30	PASS
	MCH	17.39	30	PASS
	HCH	16.5	30	PASS
11N40SISO	LCH	16.59	30	PASS
	MCH	17.57	30	PASS
	HCH	16.56	30	PASS

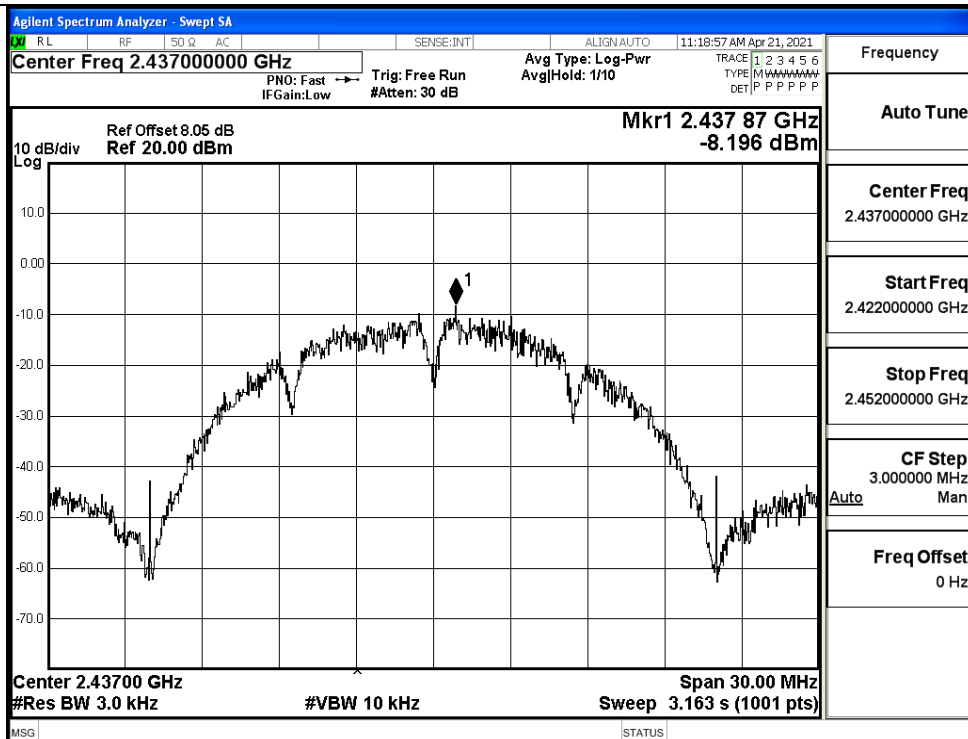
B.3 Maximum Power Spectral Density

Mode	Channel	Meas.Level [dBm/3KHz]	Limit [dBm/3KHz]	Verdict
11B	LCH	-9.876	8	PASS
	MCH	-8.196	8	PASS
	HCH	-9.959	8	PASS
11G	LCH	-16.157	8	PASS
	MCH	-15.206	8	PASS
	HCH	-16.142	8	PASS
11N20SISO	LCH	-15.202	8	PASS
	MCH	-14.592	8	PASS
	HCH	-16.145	8	PASS
11N40SISO	LCH	-16.216	8	PASS
	MCH	-16.393	8	PASS
	HCH	-18.625	8	PASS

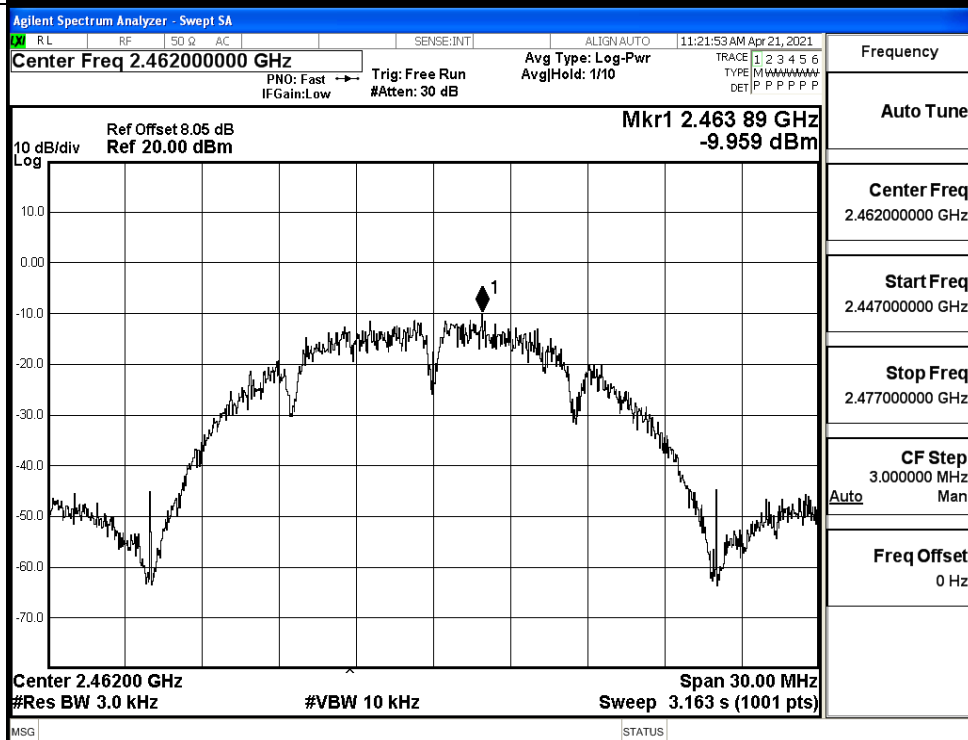
Test Graphs



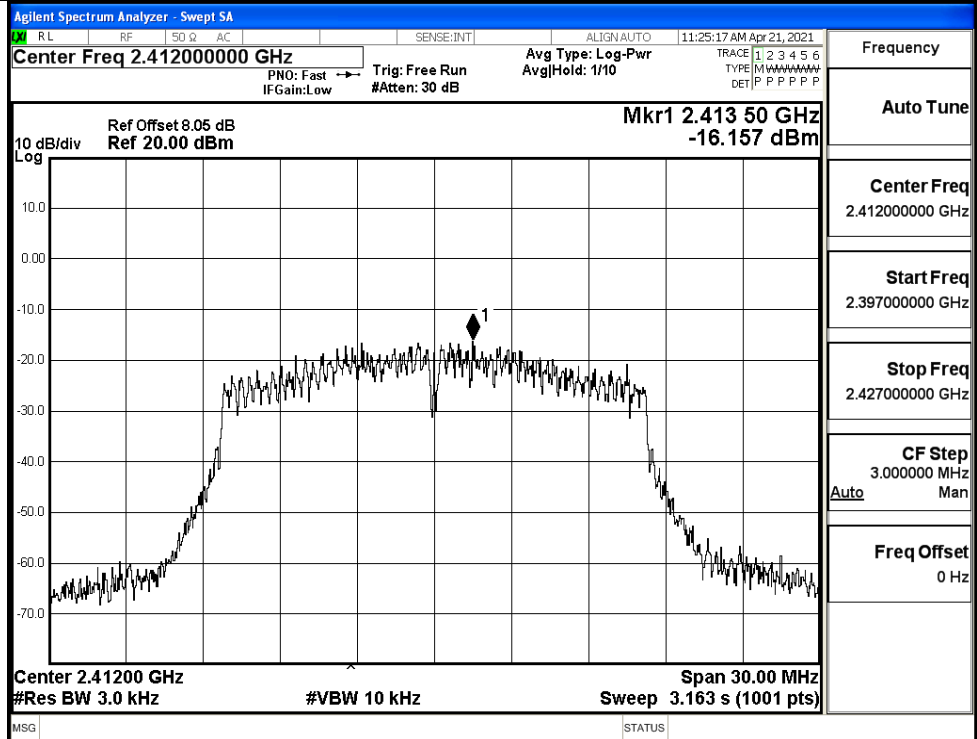
11B/MCH



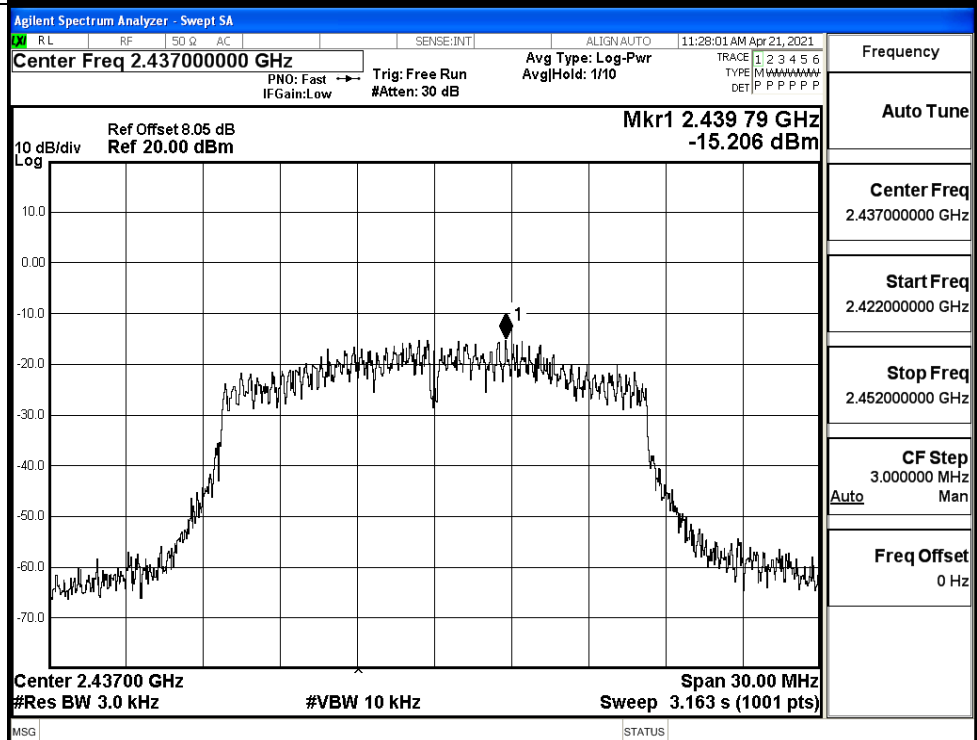
11B/HCH



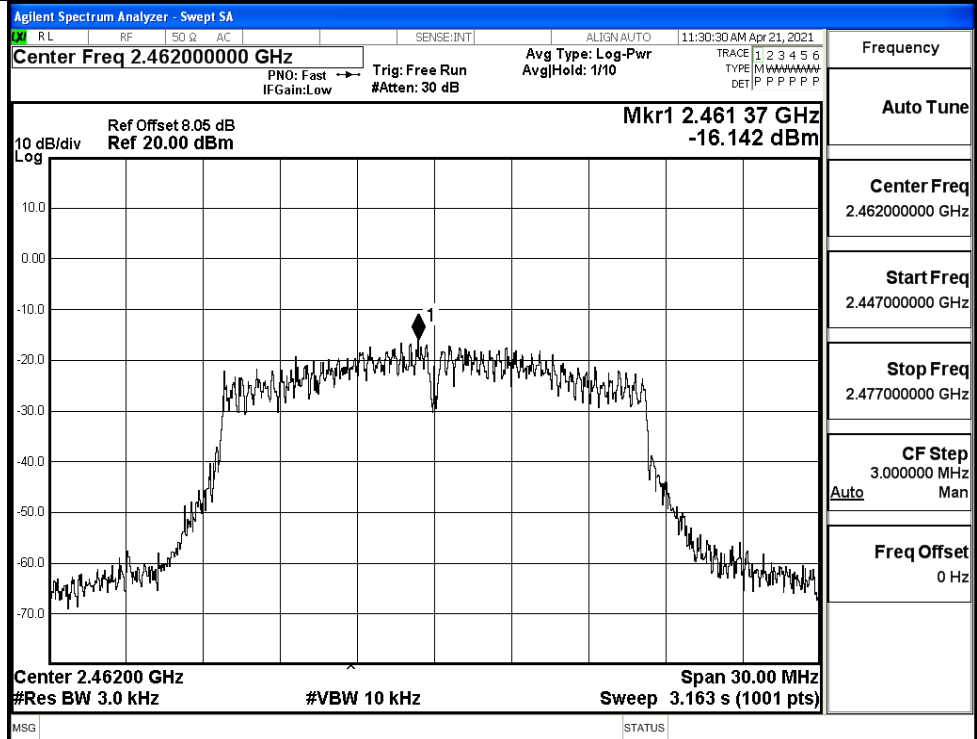
11G/LCH



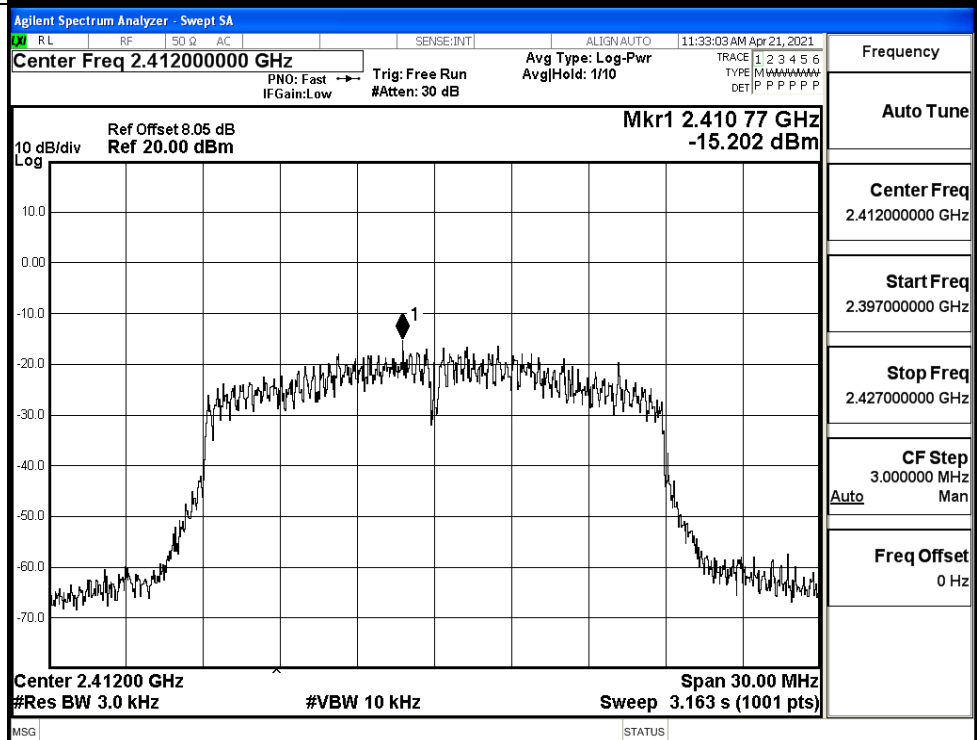
11G/MCH



11G/HCH



11N20SISO/LCH



Agilent Spectrum Analyzer - Swept SA

Center Freq 2.43700000 GHz

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

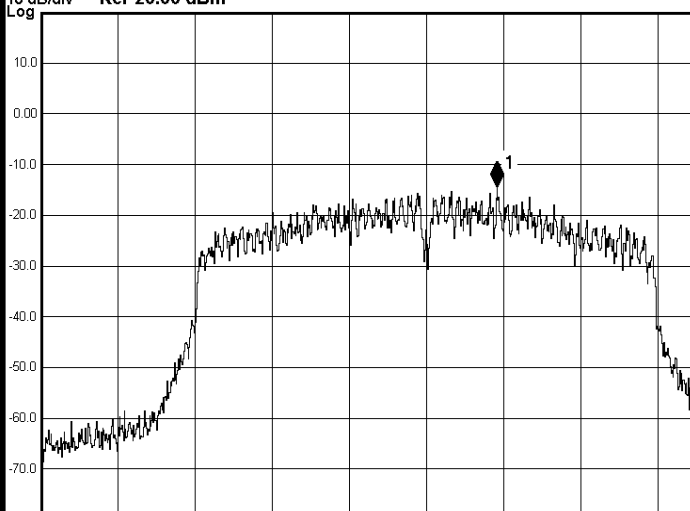
Avg Type: Log-Pwr
AvgHold: 1/10

11:36:09 AM Apr 21, 2021

10 dB/div
Log

Ref Offset 8.05 dB
Ref 20.00 dBm

Mkr1 2.439 76 GHz
-14.592 dBm



Center 2.43700 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Sweep 3.163 s (1001 pts)

Frequency
Auto Tune
Center Freq 2.437000000 GHz
Start Freq 2.422000000 GHz
Stop Freq 2.452000000 GHz
CF Step 3.000000 MHz Auto Man
Freq Offset 0 Hz

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.46200000 GHz

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

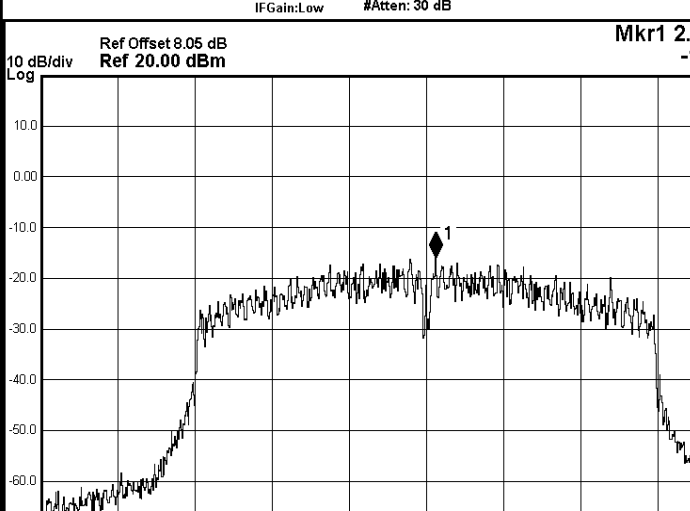
Avg Type: Log-Pwr
AvgHold: 1/10

11:38:20 AM Apr 21, 2021

10 dB/div
Log

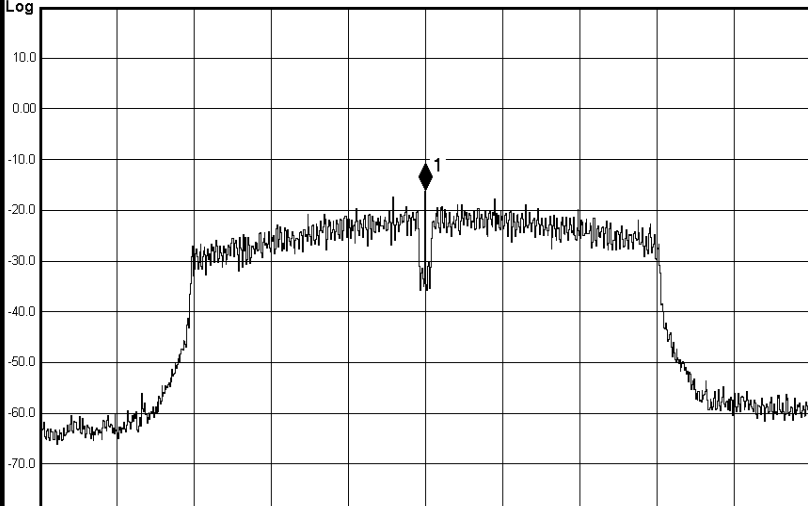
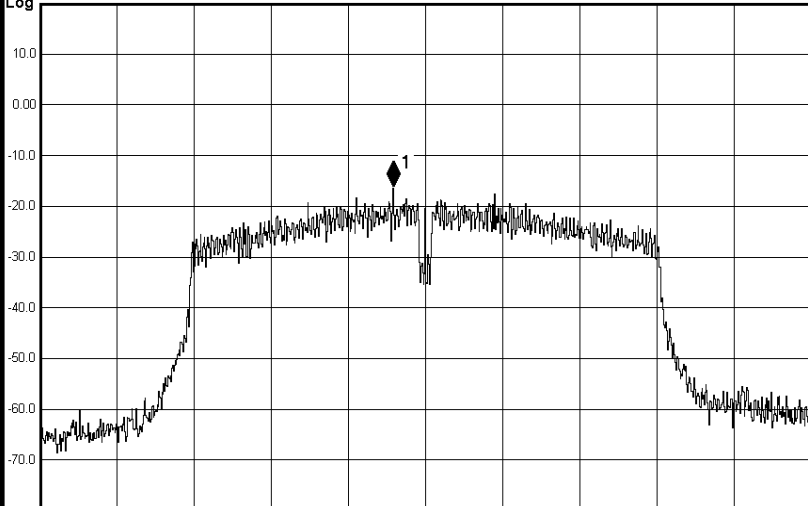
Ref Offset 8.05 dB
Ref 20.00 dBm

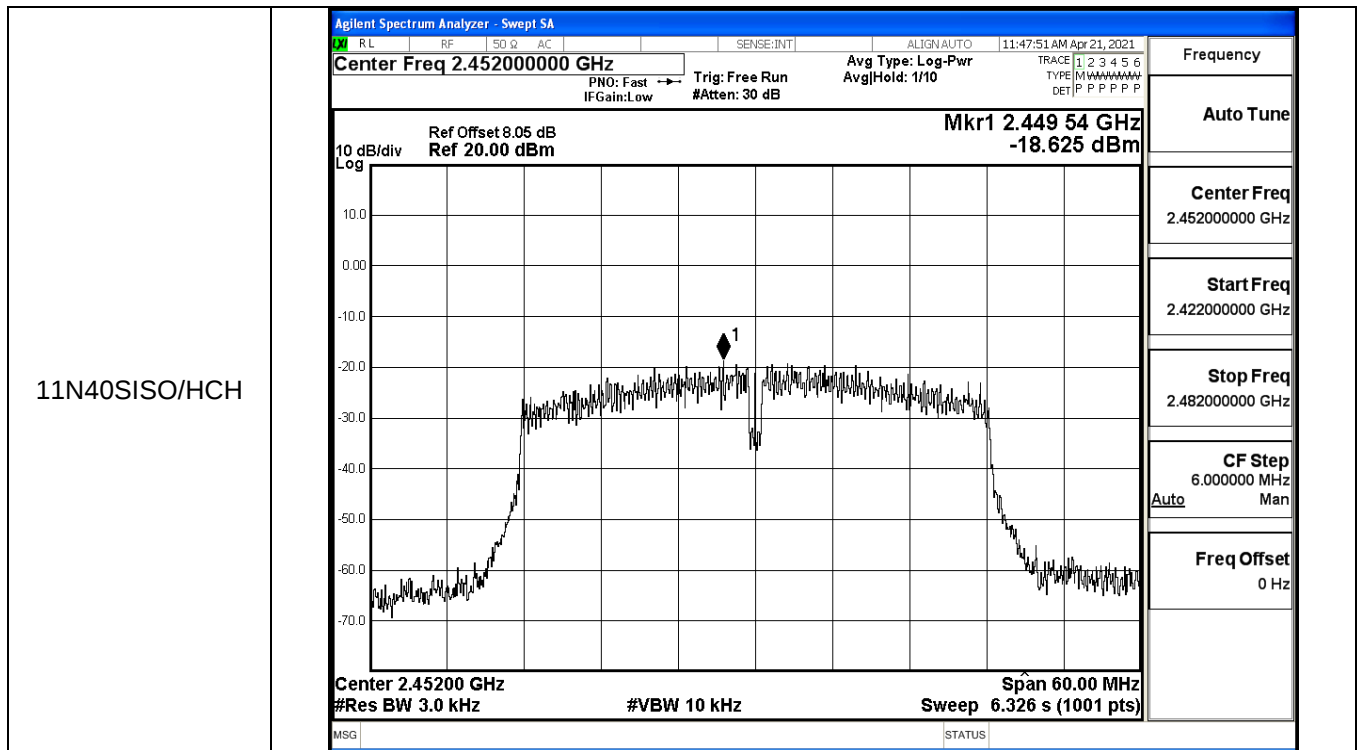
Mkr1 2.462 36 GHz
-16.145 dBm



Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Sweep 3.163 s (1001 pts)

Frequency
Auto Tune
Center Freq 2.462000000 GHz
Start Freq 2.447000000 GHz
Stop Freq 2.477000000 GHz
CF Step 3.000000 MHz Auto Man
Freq Offset 0 Hz

11N40SISO/LCH	Agilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC SENSE:INT ALIGN: AUTO 11:43:24 AM Apr 21, 2021 Center Freq 2.422000000 GHz PNO: Fast IF Gain: Low Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr AvgHold: 10/10 Ref Offset 8.05 dB Ref 20.00 dBm Mkr1 2.422 00 GHz -16.216 dBm  Center 2.42200 GHz #Res BW 3.0 kHz #VBW 10 kHz Span 60.00 MHz Sweep 6.326 s (1001 pts) Frequency Auto Tune Center Freq 2.422000000 GHz Start Freq 2.392000000 GHz Stop Freq 2.452000000 GHz CF Step 6.000000 MHz Auto Man Freq Offset 0 Hz
11N40SISO/MCH	Agilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC SENSE:INT ALIGN: AUTO 11:46:00 AM Apr 21, 2021 Center Freq 2.437000000 GHz PNO: Fast IF Gain: Low Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr AvgHold: 1/10 Ref Offset 8.05 dB Ref 20.00 dBm Mkr1 2.434 48 GHz -16.393 dBm  Center 2.43700 GHz #Res BW 3.0 kHz #VBW 10 kHz Span 60.00 MHz Sweep 6.326 s (1001 pts) Frequency Auto Tune Center Freq 2.437000000 GHz Start Freq 2.407000000 GHz Stop Freq 2.467000000 GHz CF Step 6.000000 MHz Auto Man Freq Offset 0 Hz

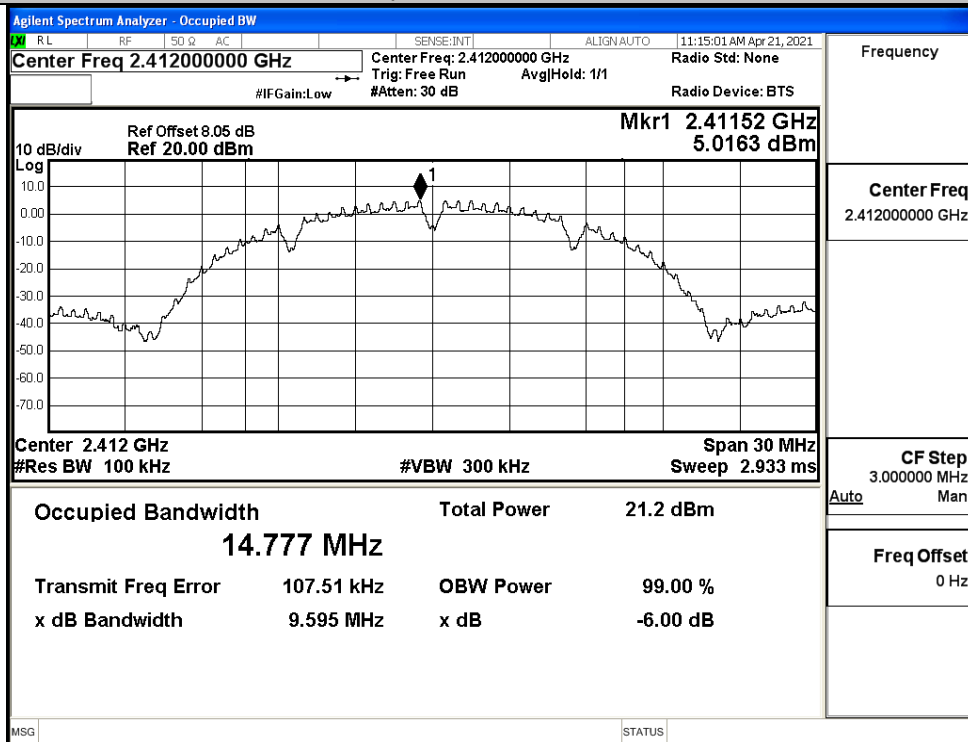


B.4 6dB Bandwidth

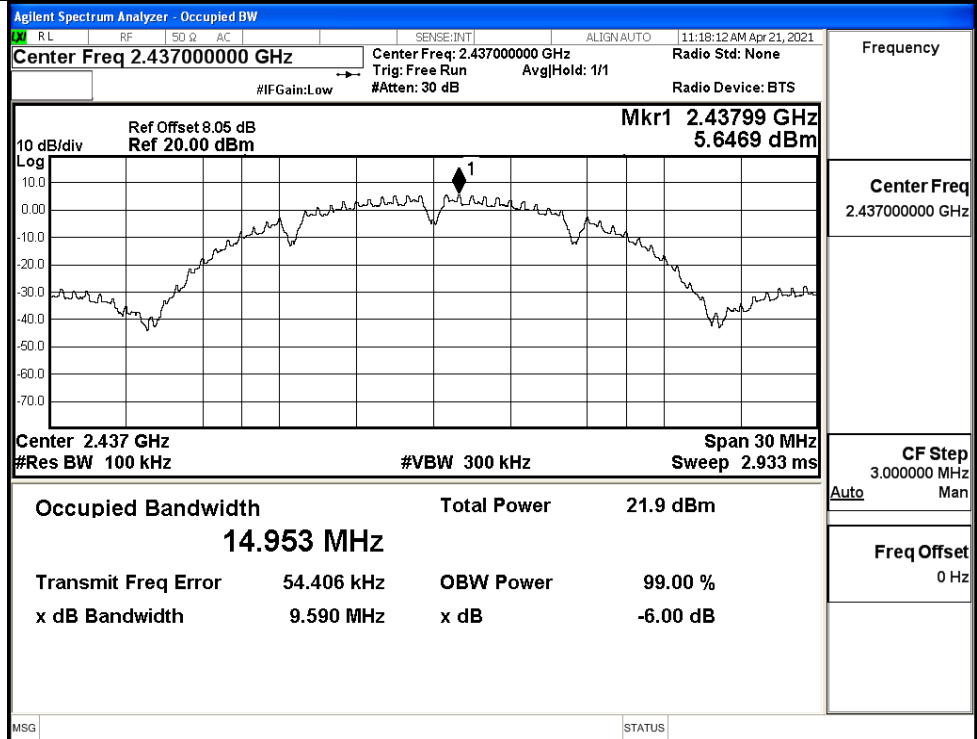
Mode	Channel	6dB Bandwidth [MHz]	Limit [MHz]	Verdict
11B	LCH	9.595	≥ 0.5	PASS
	MCH	9.590	≥ 0.5	PASS
	HCH	9.580	≥ 0.5	PASS
11G	LCH	10.10	≥ 0.5	PASS
	MCH	11.34	≥ 0.5	PASS
	HCH	12.58	≥ 0.5	PASS
11N20SISO	LCH	12.59	≥ 0.5	PASS
	MCH	15.05	≥ 0.5	PASS
	HCH	13.83	≥ 0.5	PASS
11N40SISO	LCH	31.37	≥ 0.5	PASS
	MCH	32.56	≥ 0.5	PASS
	HCH	33.77	≥ 0.5	PASS

Test Graphs

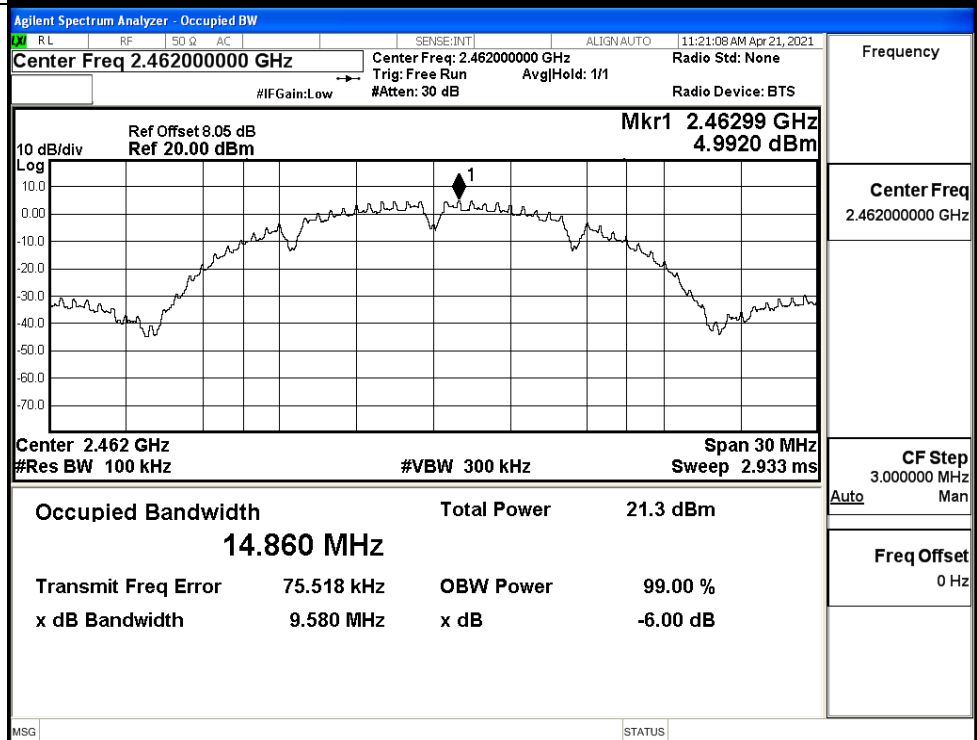
11B/LCH



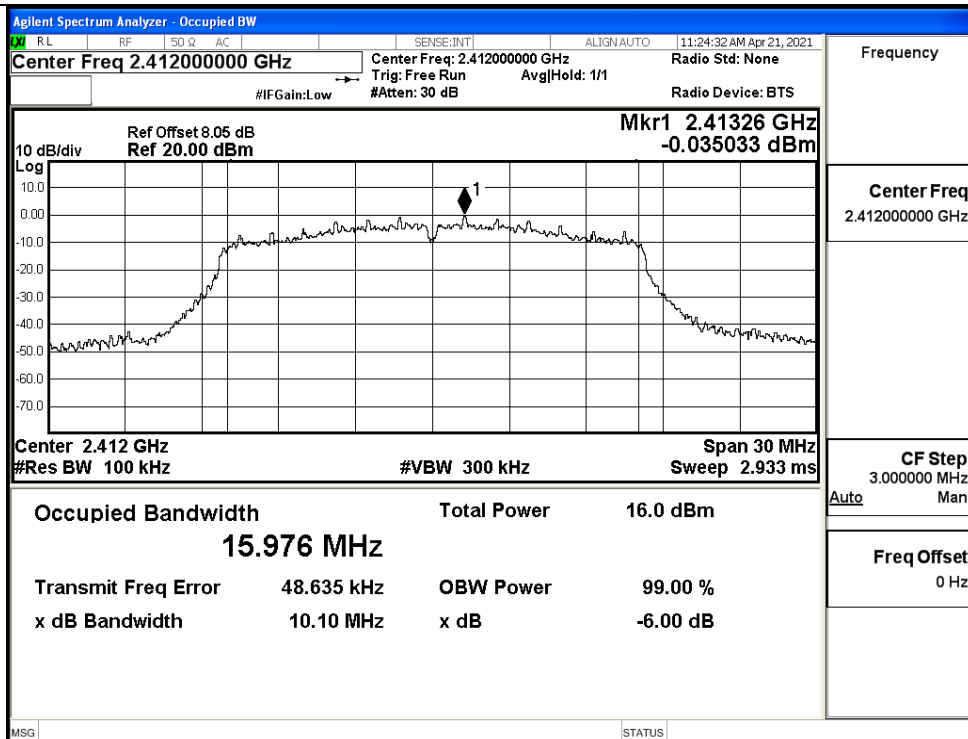
11B/MCH



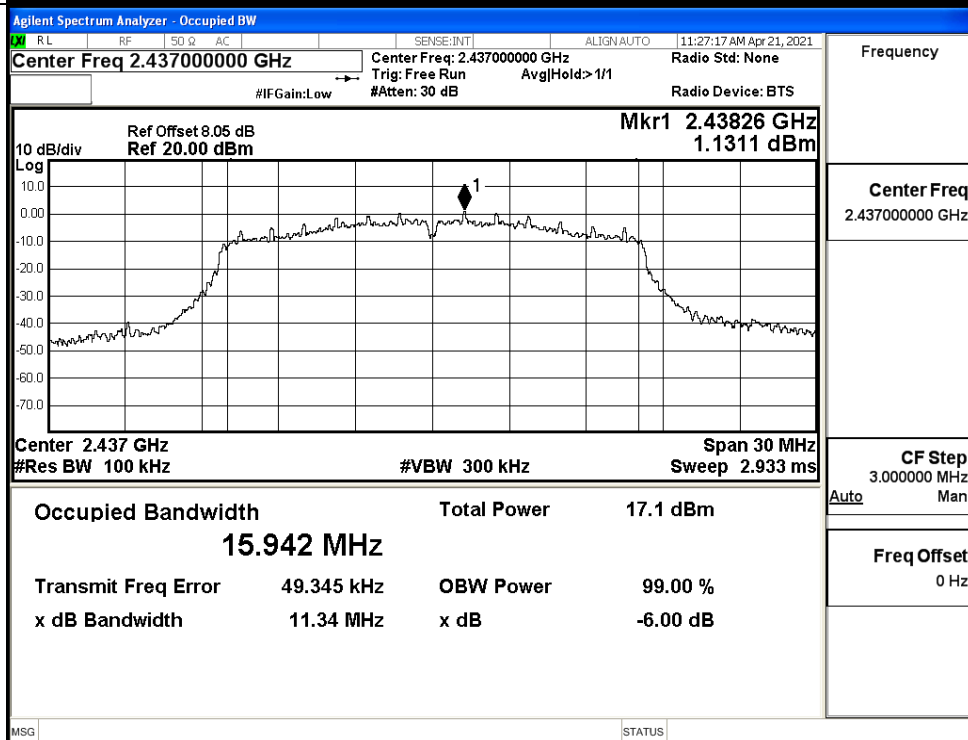
11B/HCH



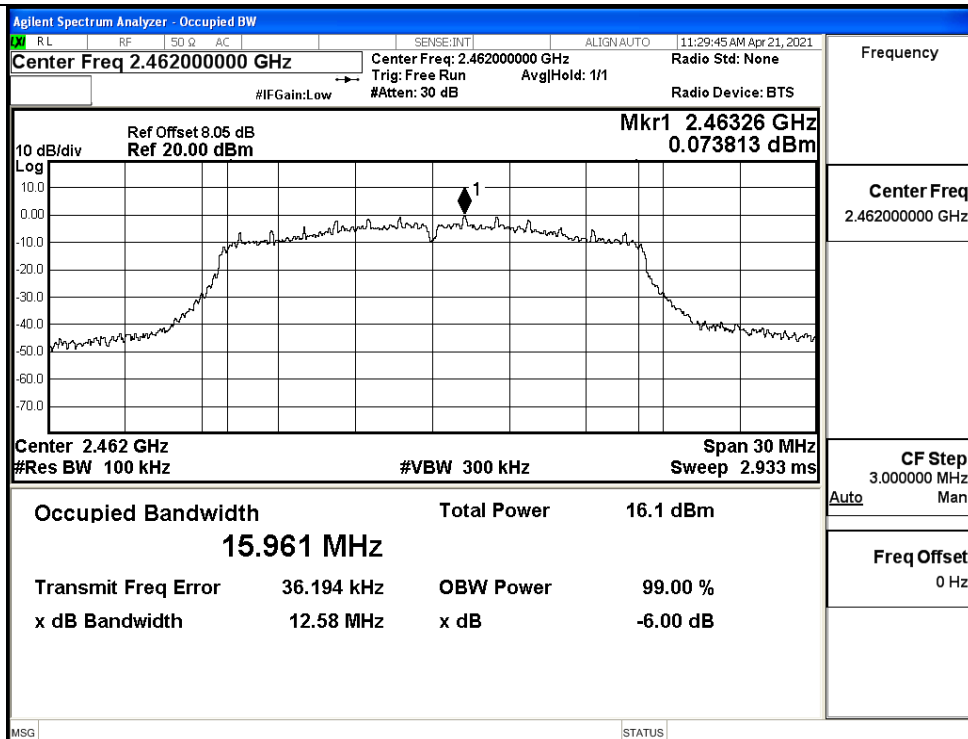
11G/LCH



11G/MCH



11G/HCH



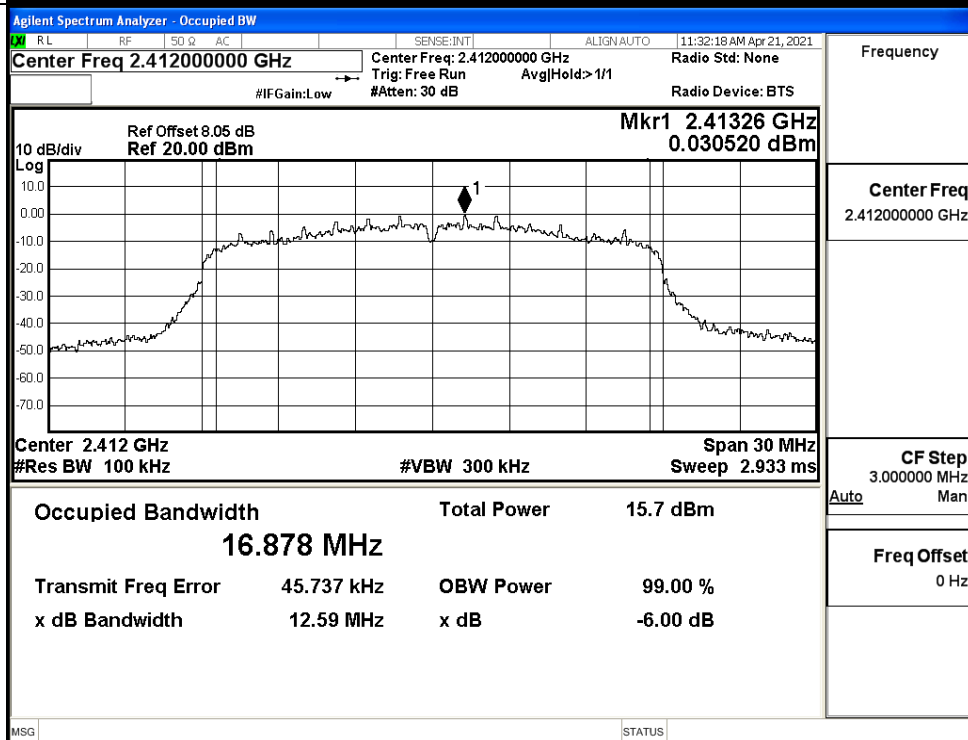
Frequency

Center Freq
2.46200000 GHz

CF Step
3.000000 MHz
Auto Man

Freq Offset
0 Hz

11N20SISO/LCH



Frequency

Center Freq
2.41200000 GHz

CF Step
3.000000 MHz
Auto Man

Freq Offset
0 Hz

Agilent Spectrum Analyzer - Occupied BW

RL

RF

50 Ω

AC

SENSE:INT

ALIGN: AUTO

11:35:24 AM Apr 21, 2021

Center Freq 2.437000000 GHz

Center Freq: 2.437000000 GHz

Trig: Free Run

Avg/Hold: 1/1

Radio Std: None

#IF Gain: Low

#Atten: 30 dB

Radio Device: BTS

Ref Offset 8.05 dB

Ref 20.00 dBm

Mkr1 2.43574 GHz

-0.037699 dBm

10 dB/div

Log

Center 2.437 GHz

Span 30 MHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 2.933 ms

Occupied Bandwidth

Total Power

16.7 dBm

16.838 MHz

Transmit Freq Error

24.012 kHz

OBW Power

99.00 %

x dB Bandwidth

15.05 MHz

x dB

-6.00 dB

MSG

STATUS

Frequency

Center Freq
2.437000000 GHz

CF Step
3.000000 MHz
Auto Man

Freq Offset
0 Hz

Agilent Spectrum Analyzer - Occupied BW

RL

RF

50 Ω

AC

SENSE:INT

ALIGN: AUTO

11:37:35 AM Apr 21, 2021

Center Freq 2.462000000 GHz

Center Freq: 2.462000000 GHz

Trig: Free Run

Avg/Hold: 1/1

Radio Std: None

#IF Gain: Low

#Atten: 30 dB

Radio Device: BTS

Ref Offset 8.05 dB

Ref 20.00 dBm

Mkr1 2.46329 GHz

-0.20900 dBm

10 dB/div

Log

Center 2.462 GHz

Span 30 MHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 2.933 ms

Occupied Bandwidth

Total Power

16.0 dBm

16.864 MHz

Transmit Freq Error

25.310 kHz

OBW Power

99.00 %

x dB Bandwidth

13.83 MHz

x dB

-6.00 dB

MSG

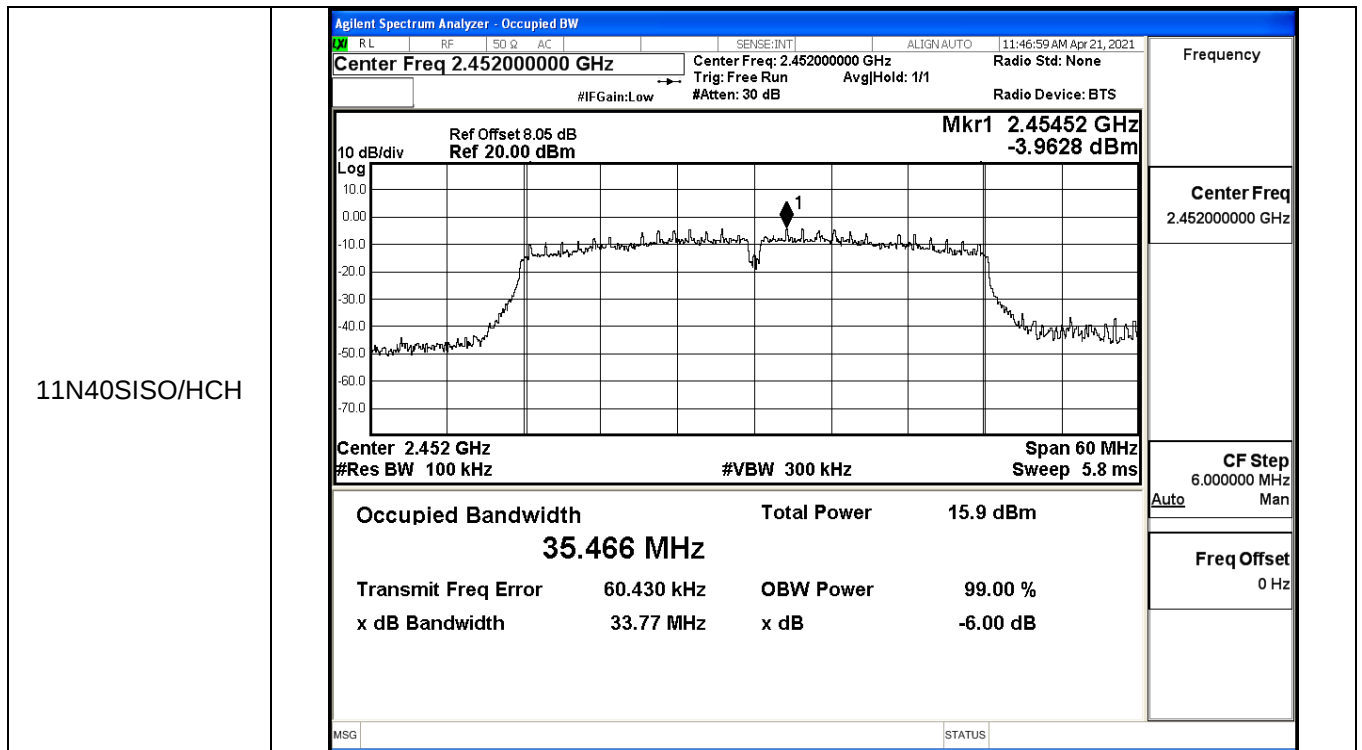
STATUS

Frequency

Center Freq
2.462000000 GHz

CF Step
3.000000 MHz
Auto Man

Freq Offset
0 Hz

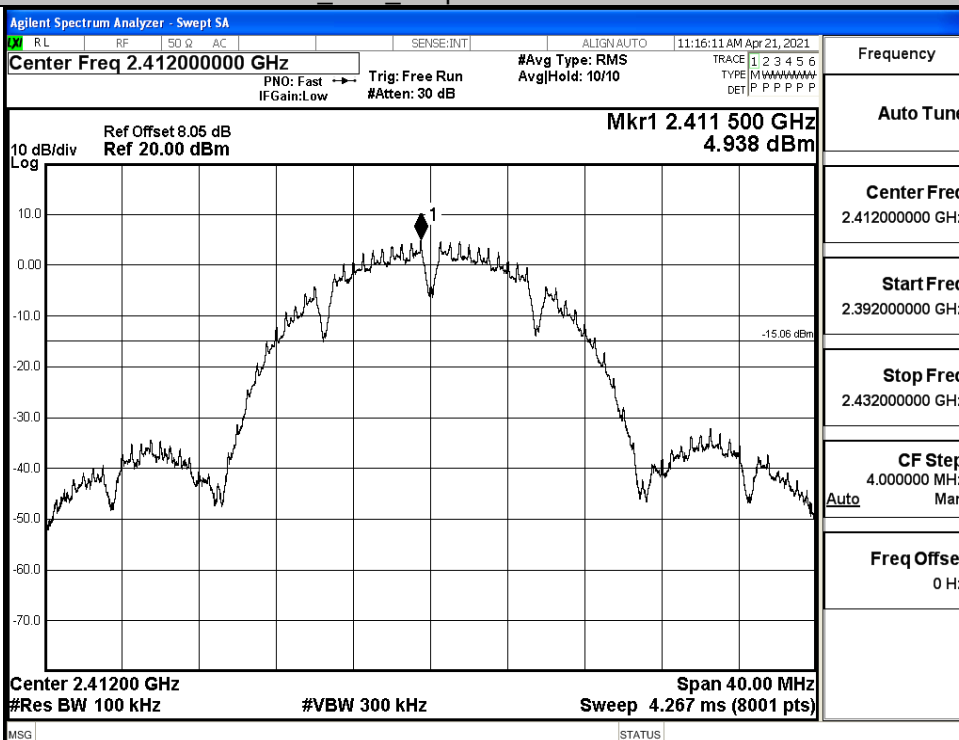


B.5 RF Conducted Spurious Emissions

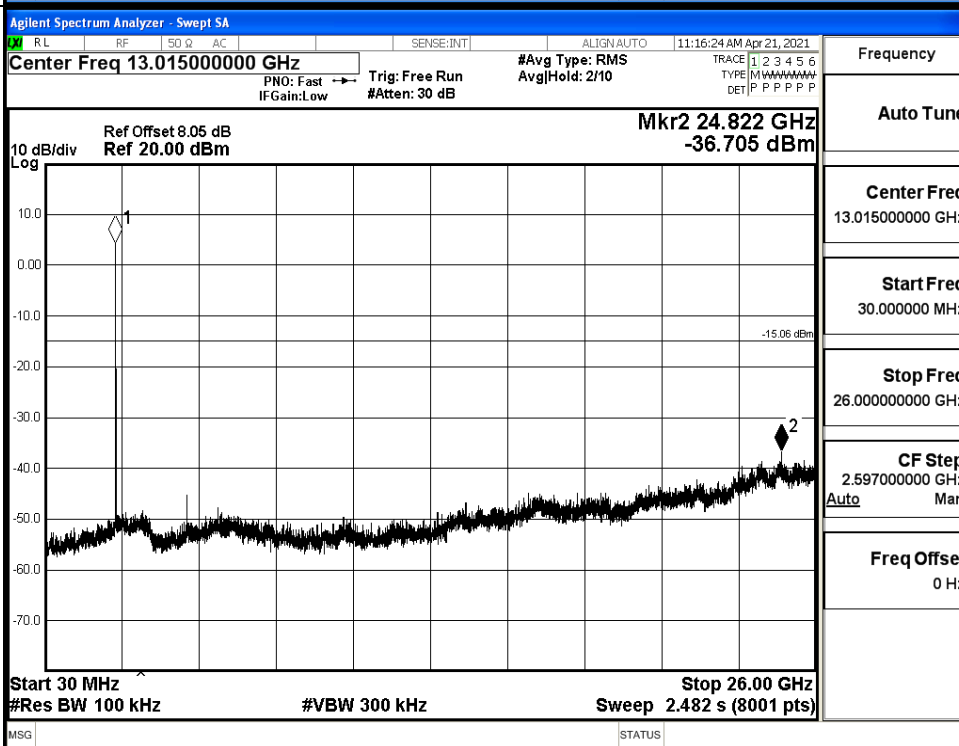
Mode	Channel	Pref [dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
11B	LCH	4.938	-36.705	-15.062	PASS
	MCH	5.398	-37.800	-14.602	PASS
	HCH	4.867	-38.520	-15.133	PASS
11G	LCH	-0.5	-37.921	-20.500	PASS
	MCH	0.128	-37.473	-19.872	PASS
	HCH	-0.088	-36.338	-20.088	PASS
11N20 SISO	LCH	-1.031	-38.124	-21.031	PASS
	MCH	0.695	-38.053	-19.305	PASS
	HCH	-0.317	-38.201	-20.317	PASS
11N40 SISO	LCH	-4.22	-37.937	-24.220	PASS
	MCH	-2.936	-38.015	-22.936	PASS
	HCH	-4.102	-36.996	-24.102	PASS

11B LCH Graphs

Pref/11B/LCH

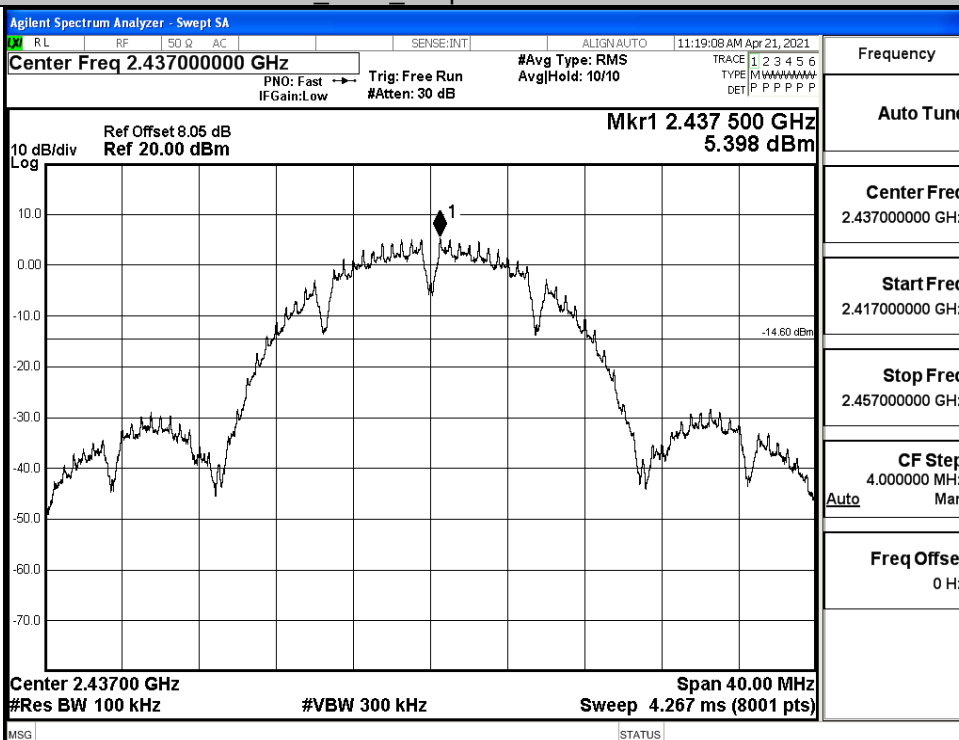


Puw/11B/LCH

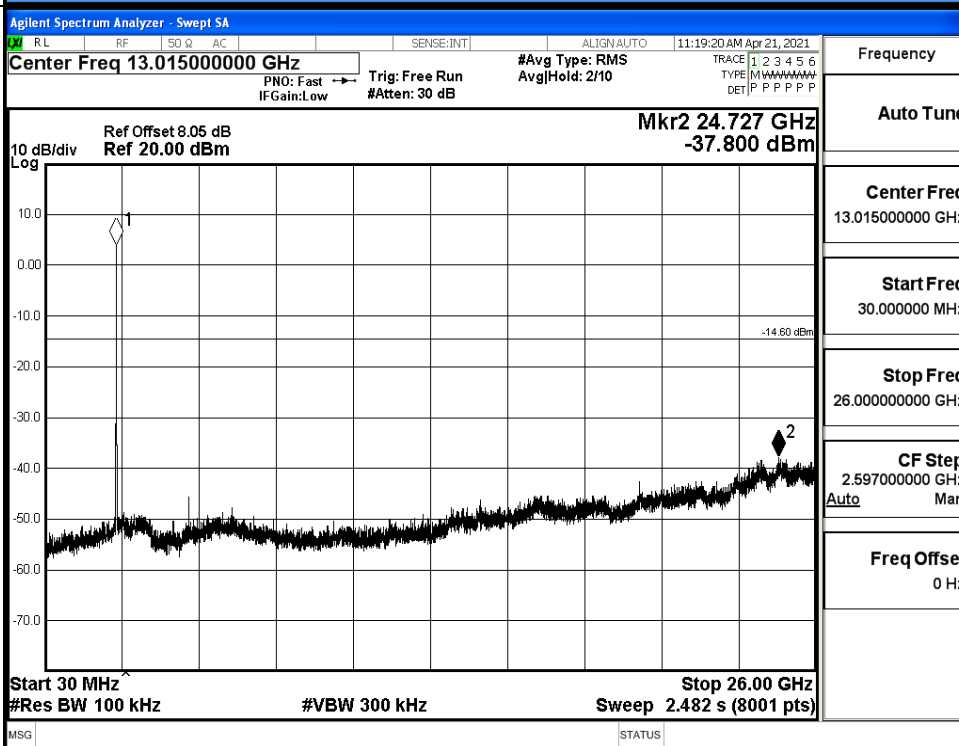


11B MCH Graphs

Pref/11B/MCH

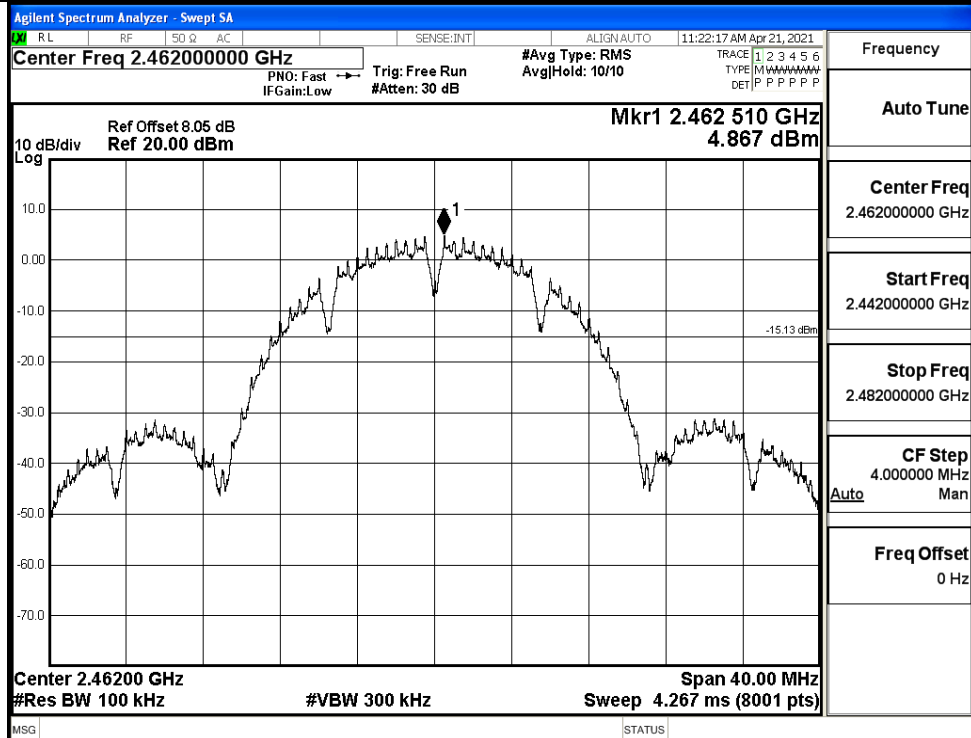


Puw/11B/MCH

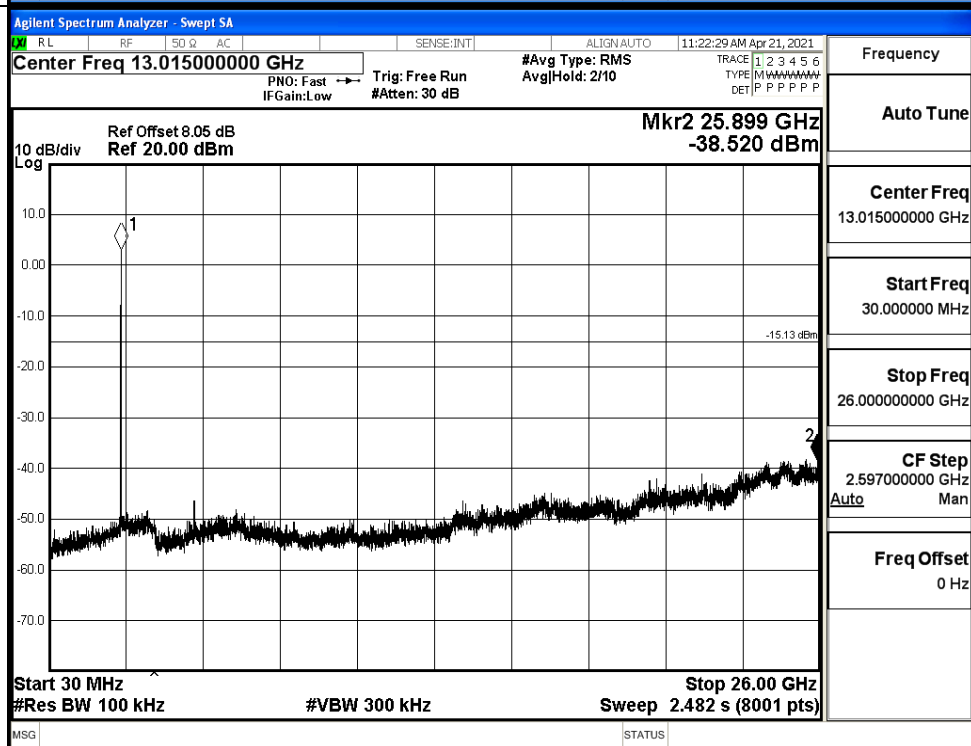


11B HCH Graphs

Pref/11B/HCH

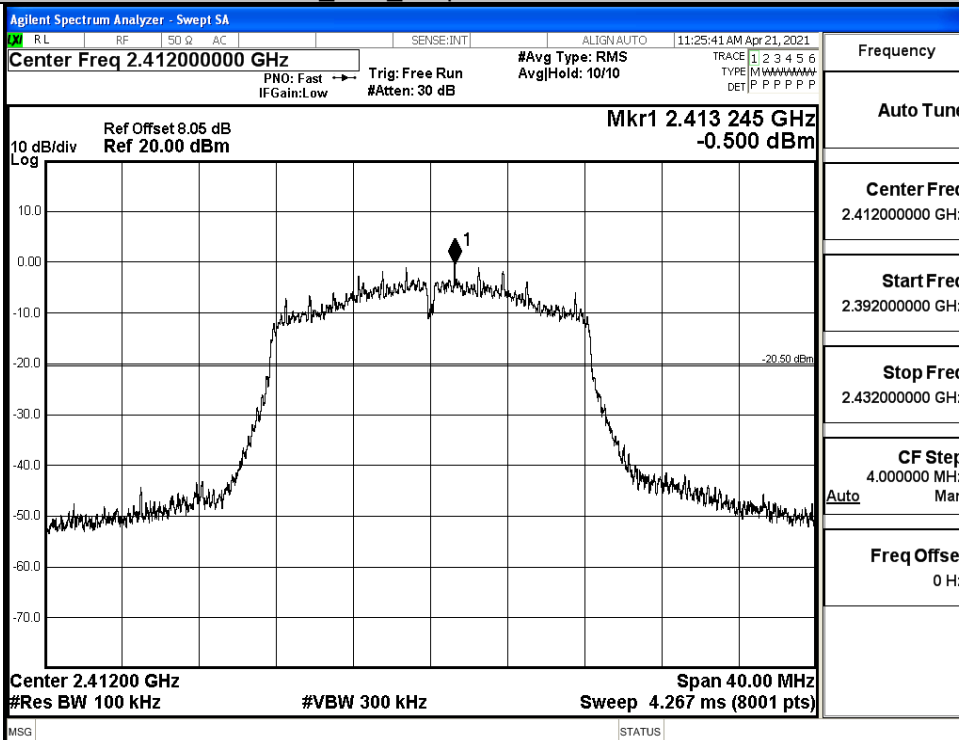


Puw/11B/HCH

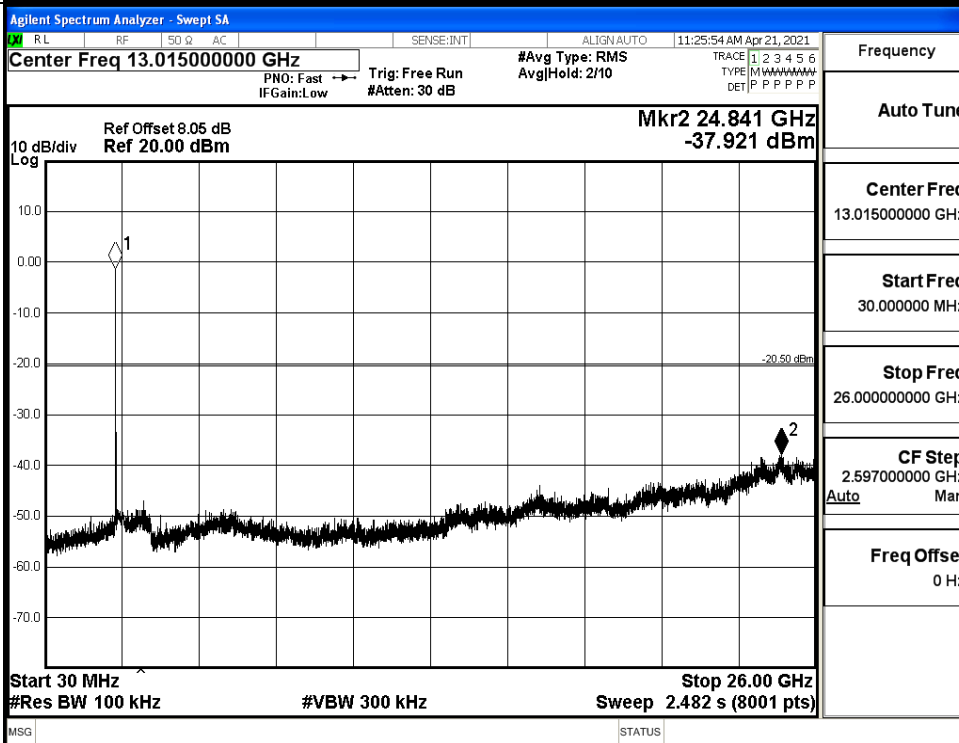


11G LCH Graphs

Pref/11G/LCH

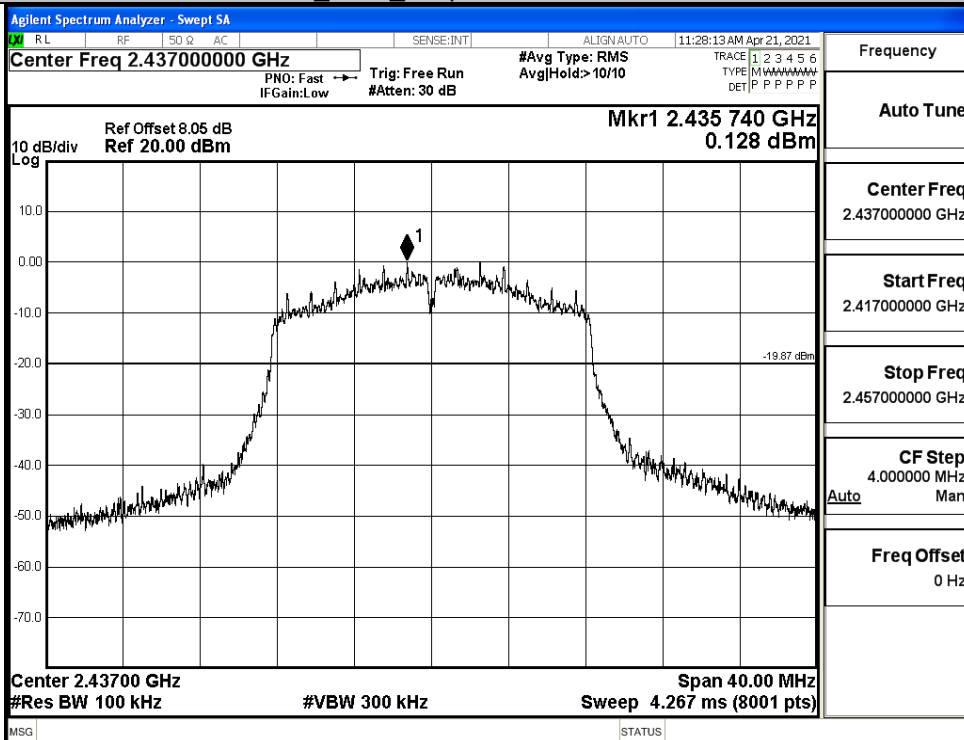


Puw/11G/LCH

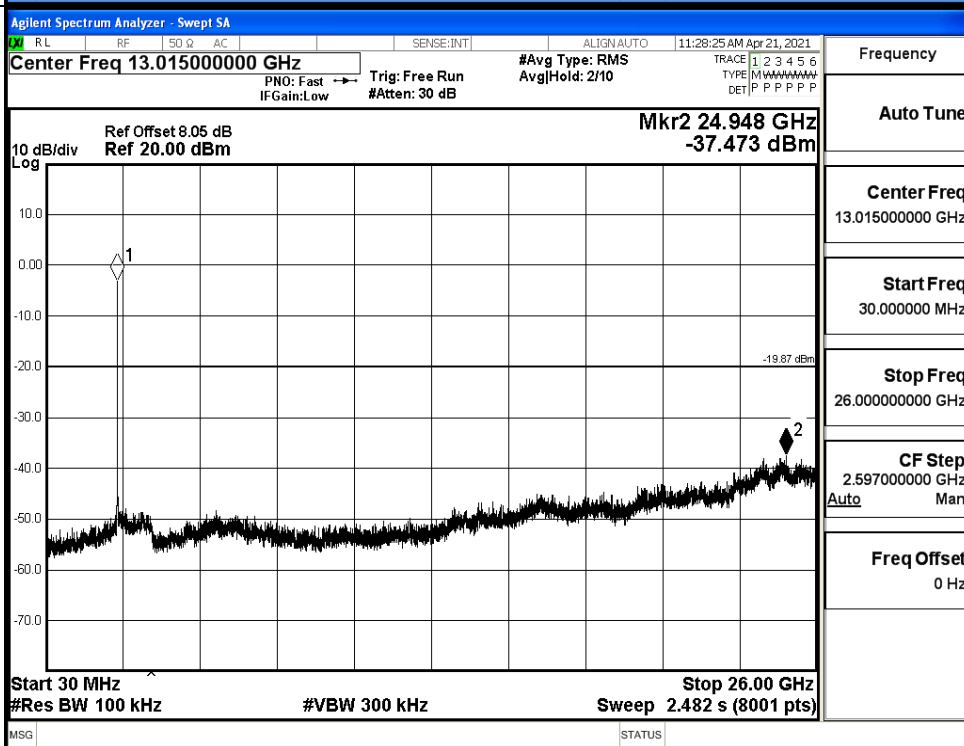


11G MCH Graphs

Pref/11G/MCH

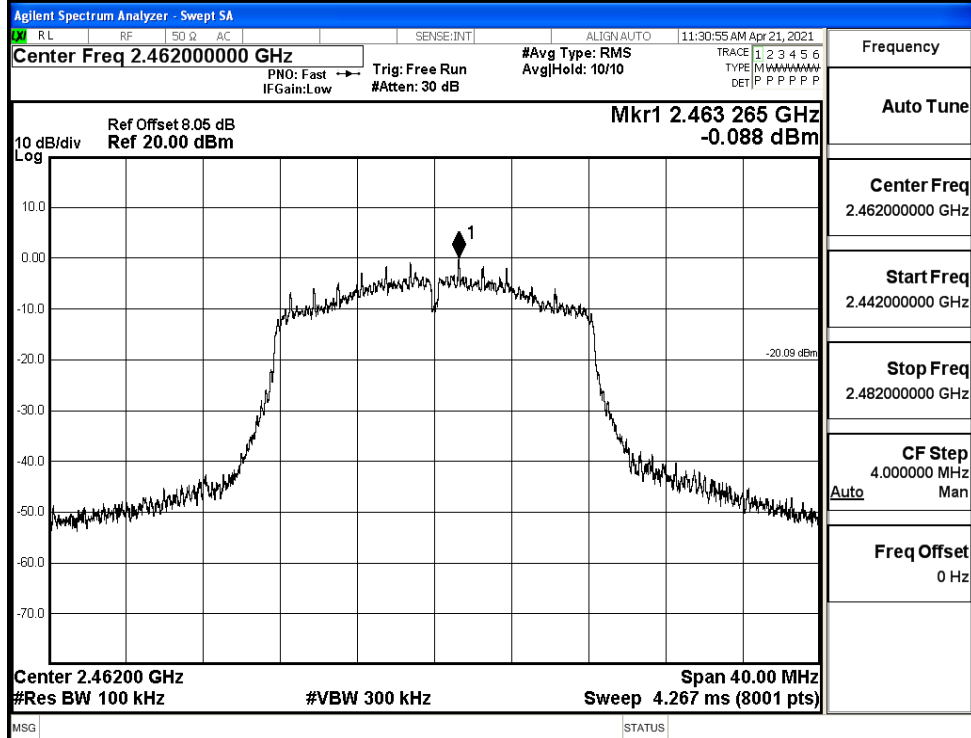


Puw/11G/MCH

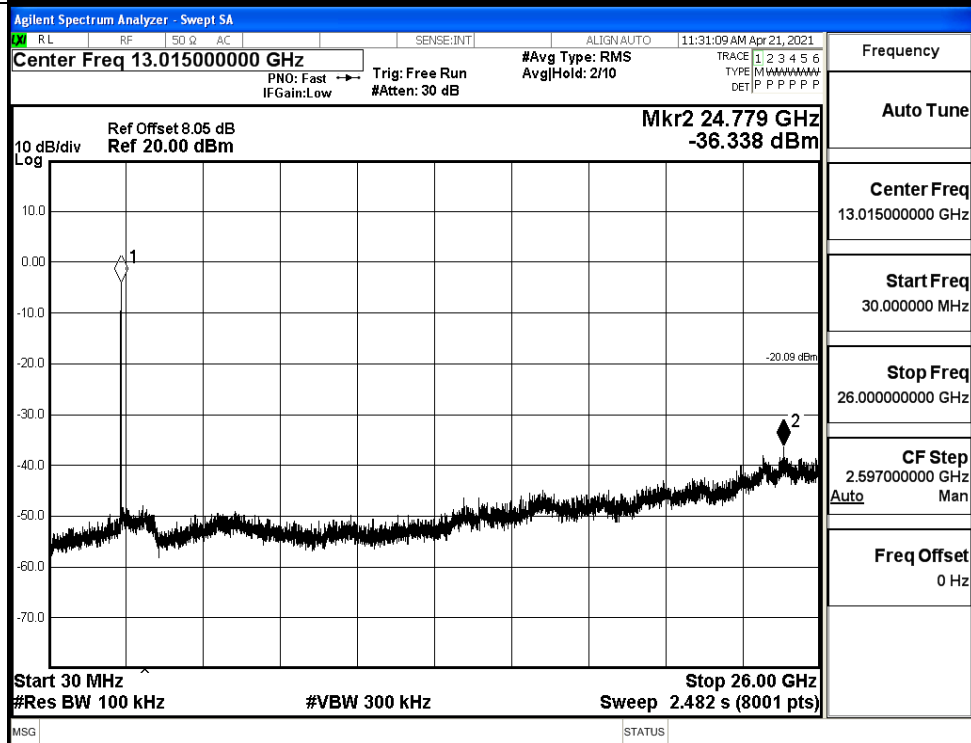


11G HCH Graphs

Pref/11G/HCH

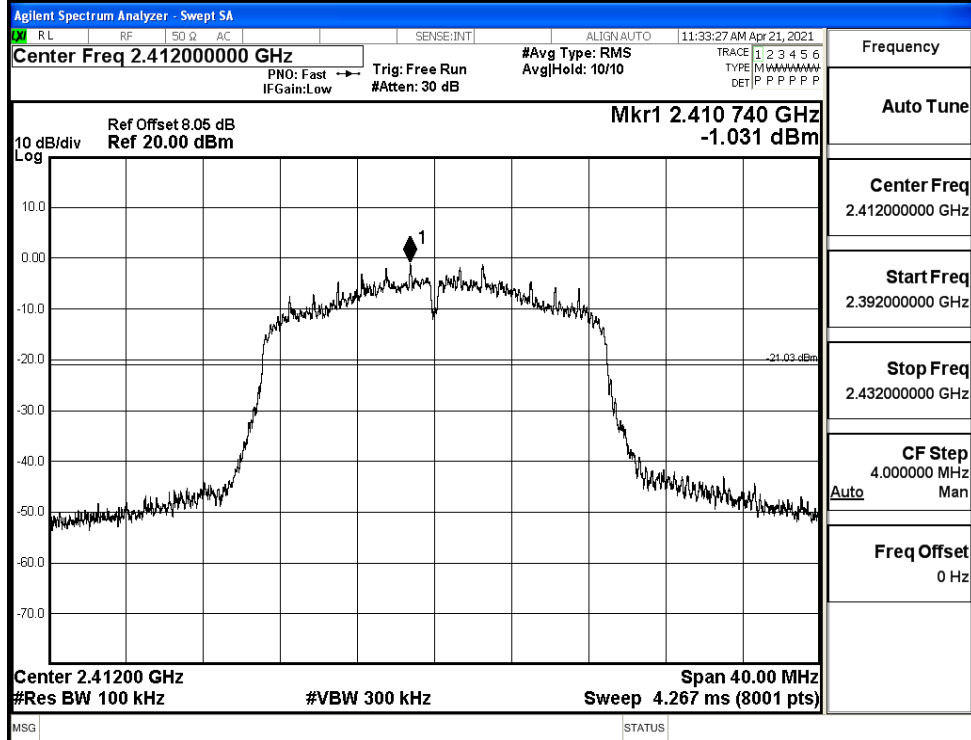


Puw/11G/HCH

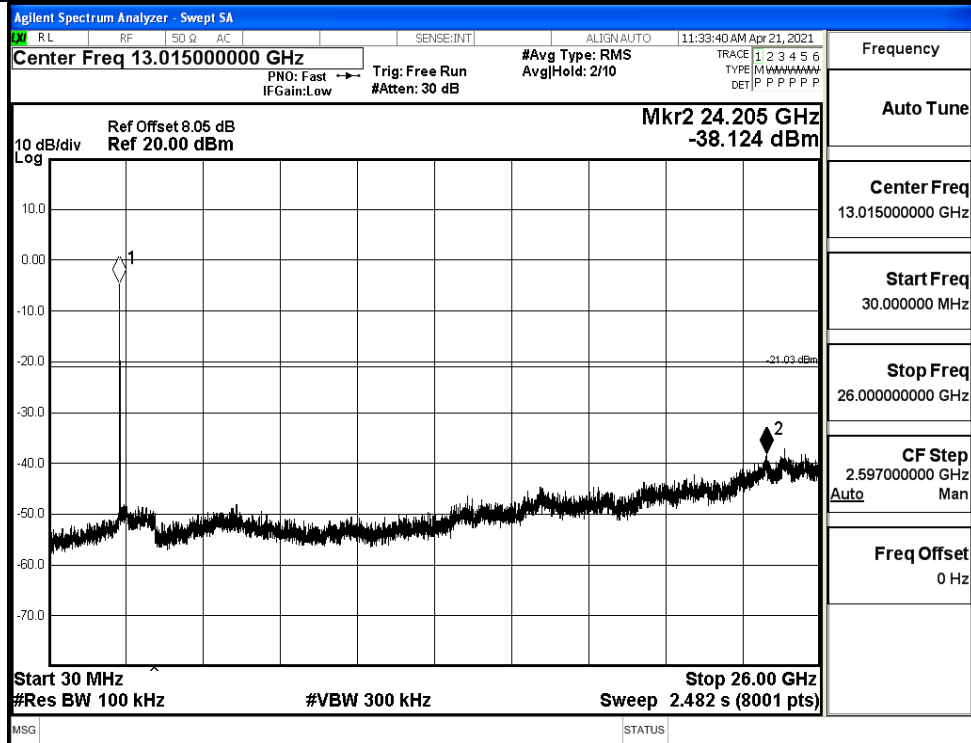


11N20SISO LCH Graphs

Pref/11N20SIS
O/LCH

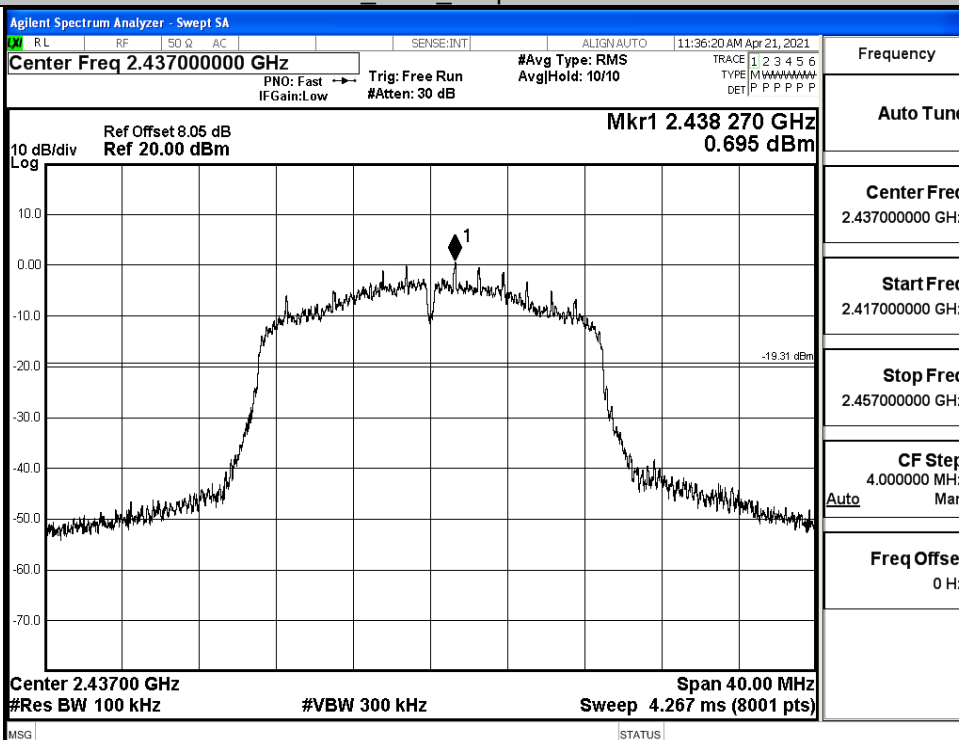


Puw/11N20
SISO/LCH

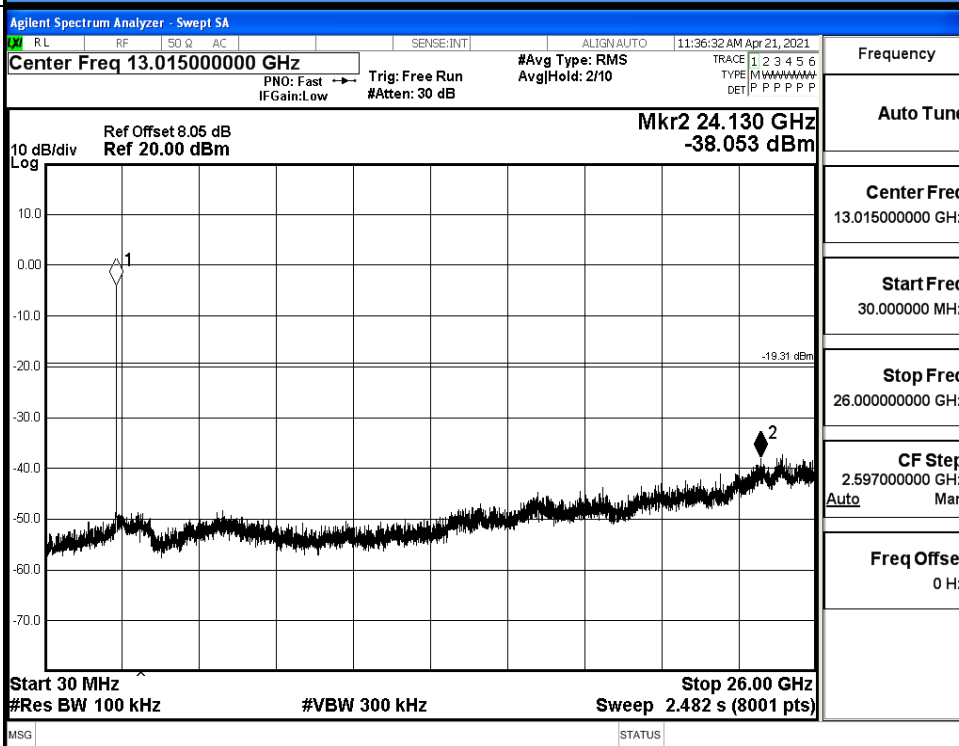


11N20SISO_MCH_Graphs

Pref/11N20
SISO/MCH

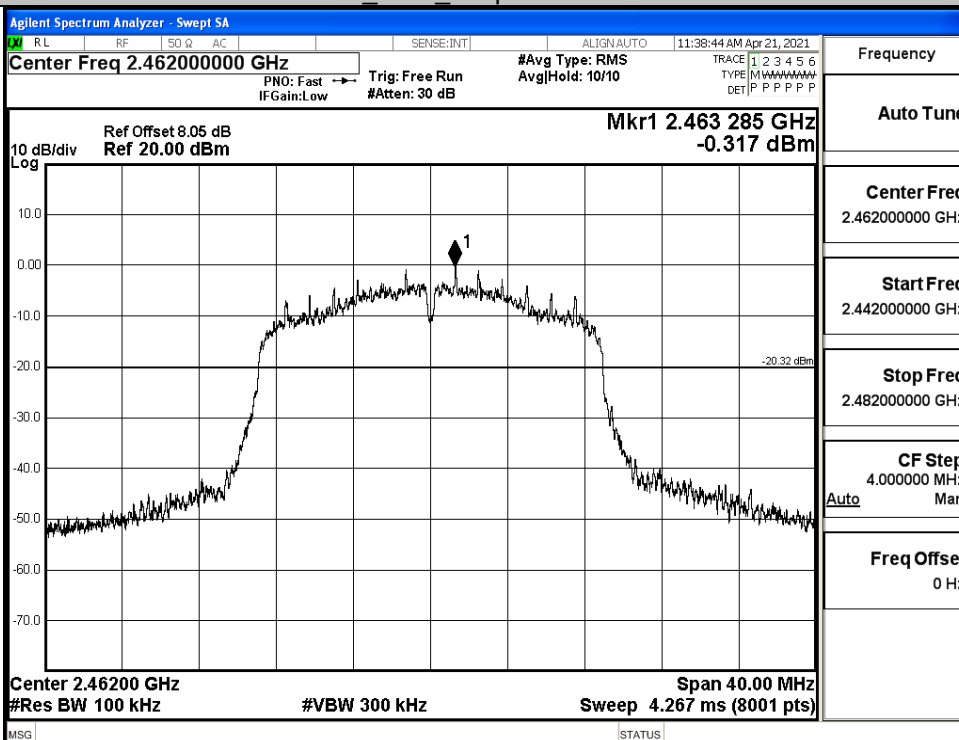


Puw/11N20
SISO/MCH

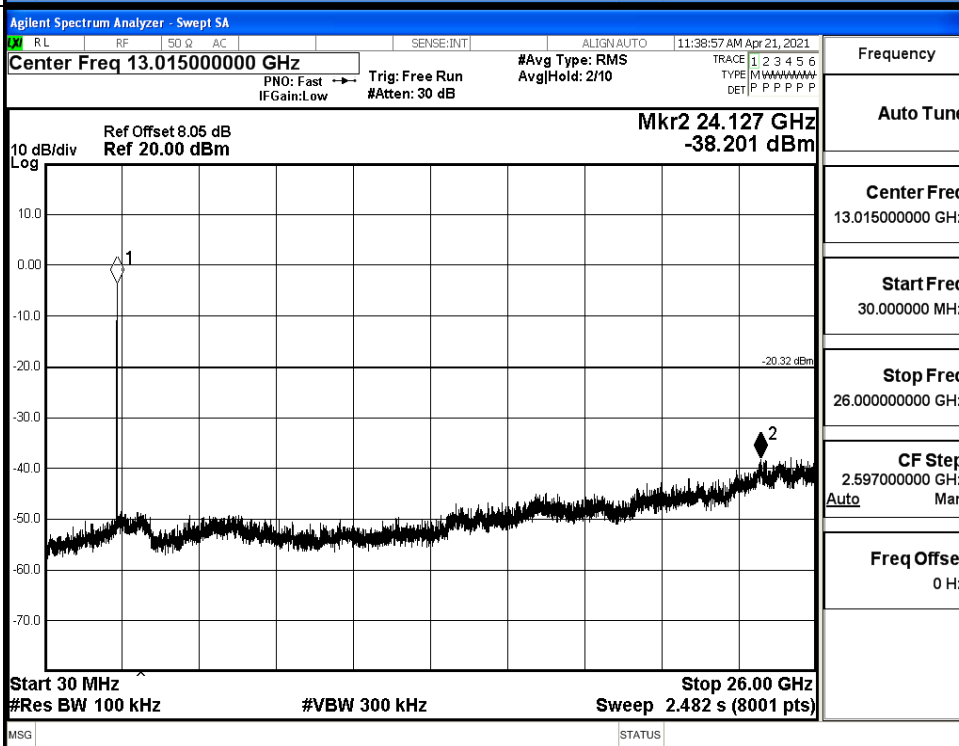


11N20SISO HCH Graphs

Pref/11N20
SISO/HCH

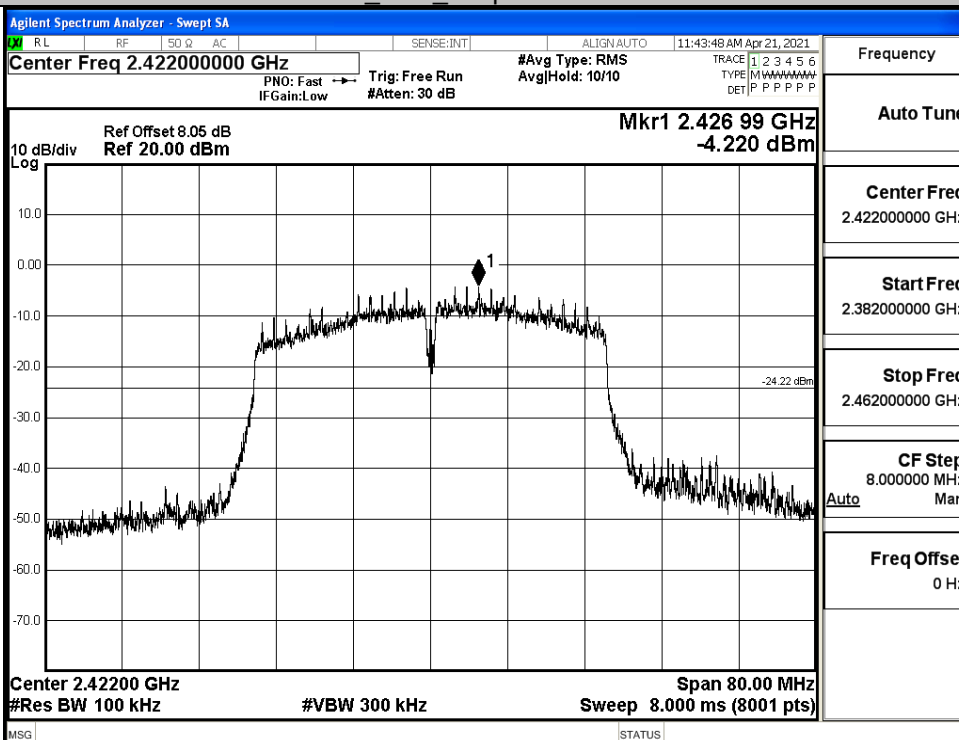


Puw/11N20
SISO/HCH

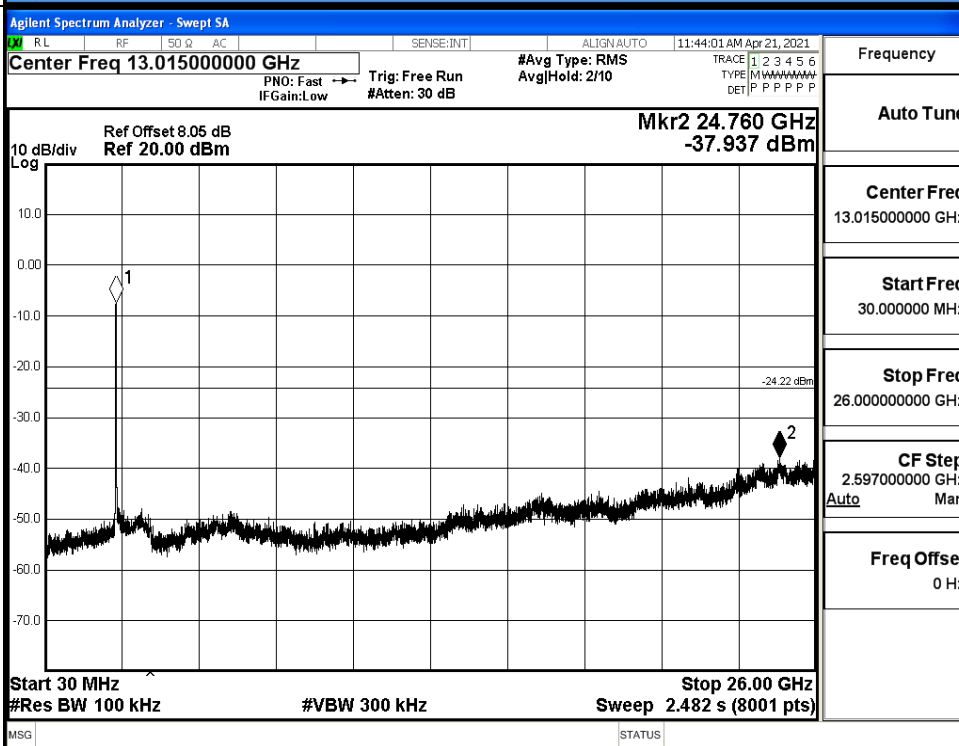


11N40SISO LCH Graphs

Pref/11N40
SISO/LCH

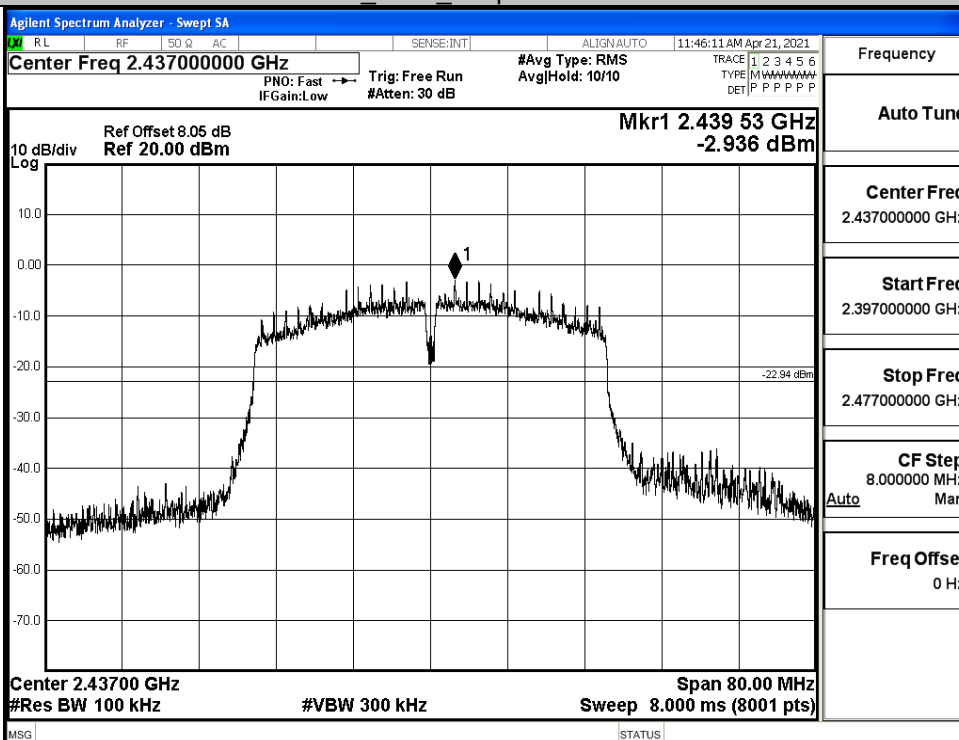


Puw/11N40
SISO/LCH

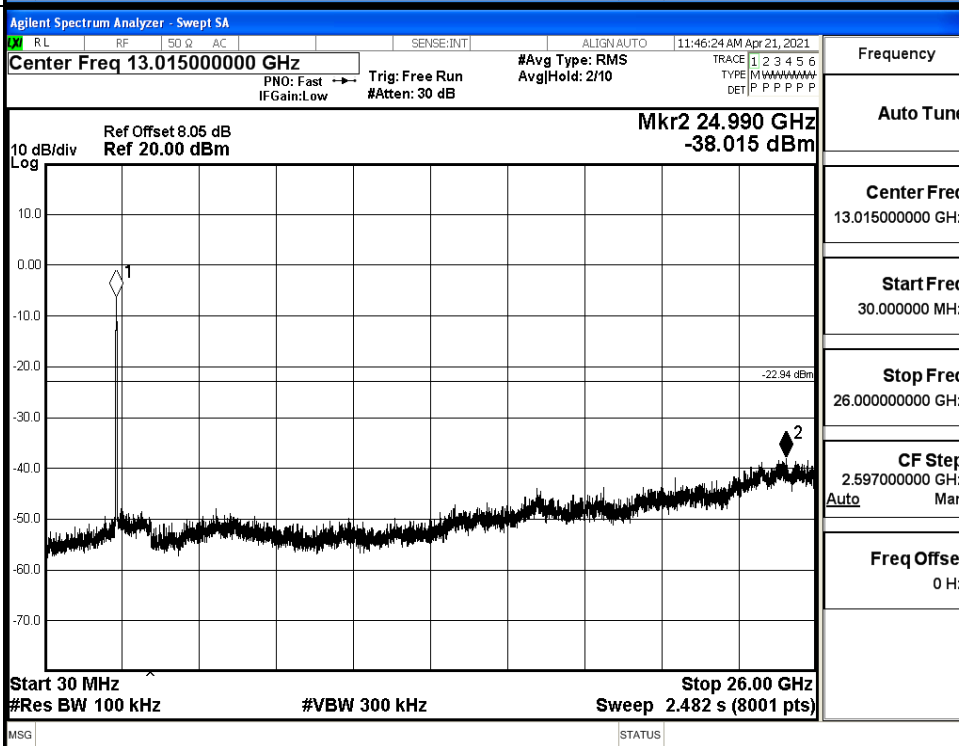


11N40SISO_MCH_Graphs

Pref/11N40
SISO/MCH

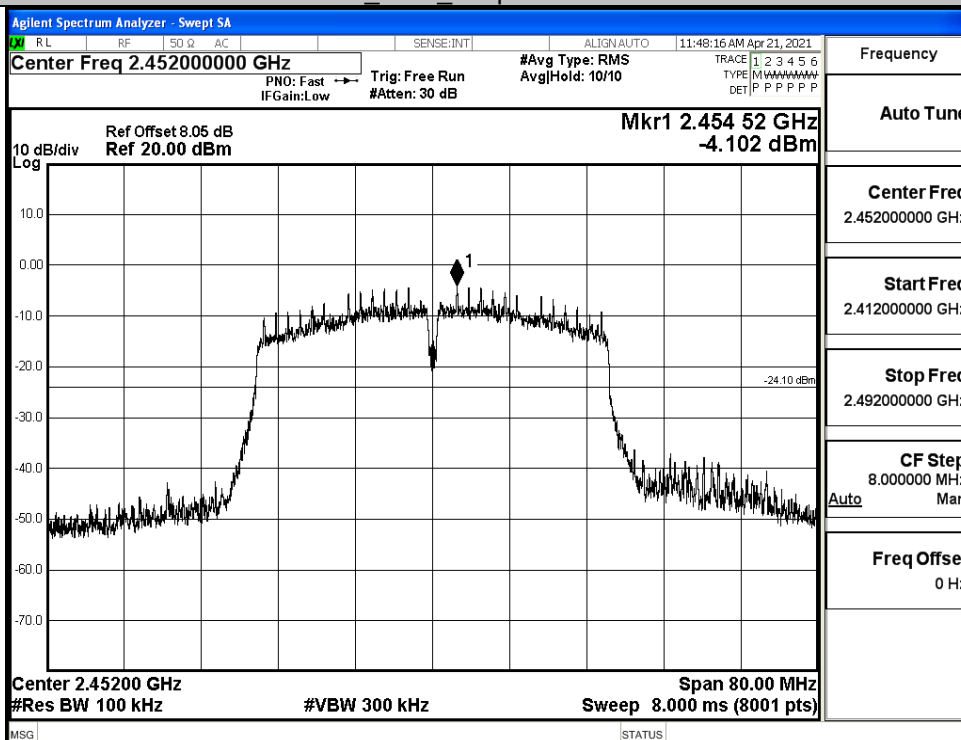


Puw/11N40
SISO/MCH

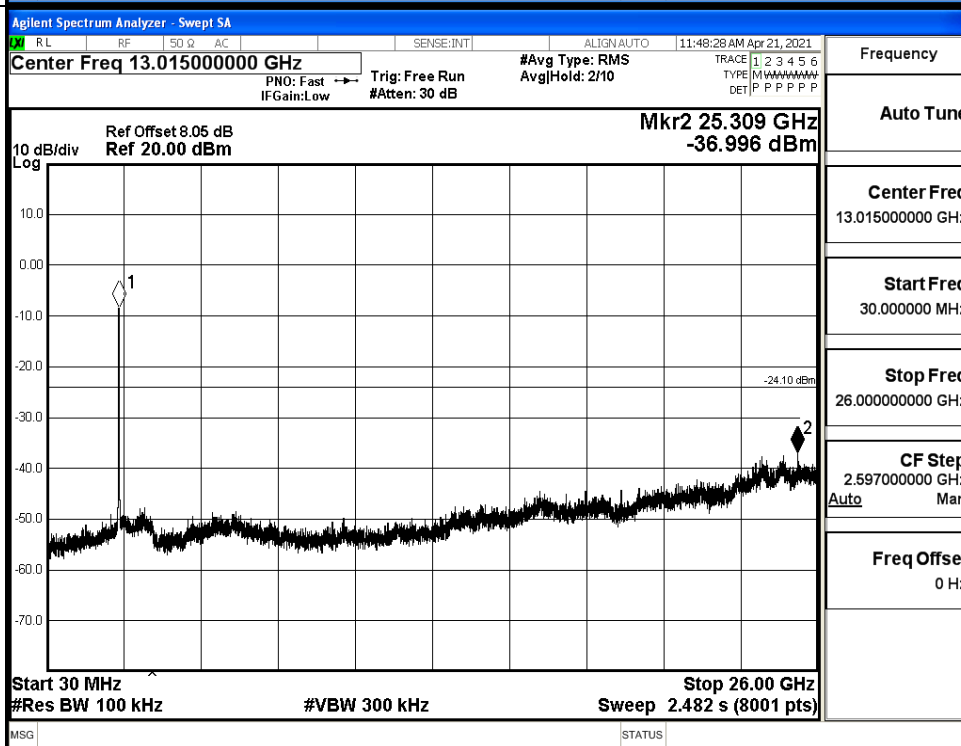


11N40SISO HCH Graphs

Pref/11N40
SISO/HCH



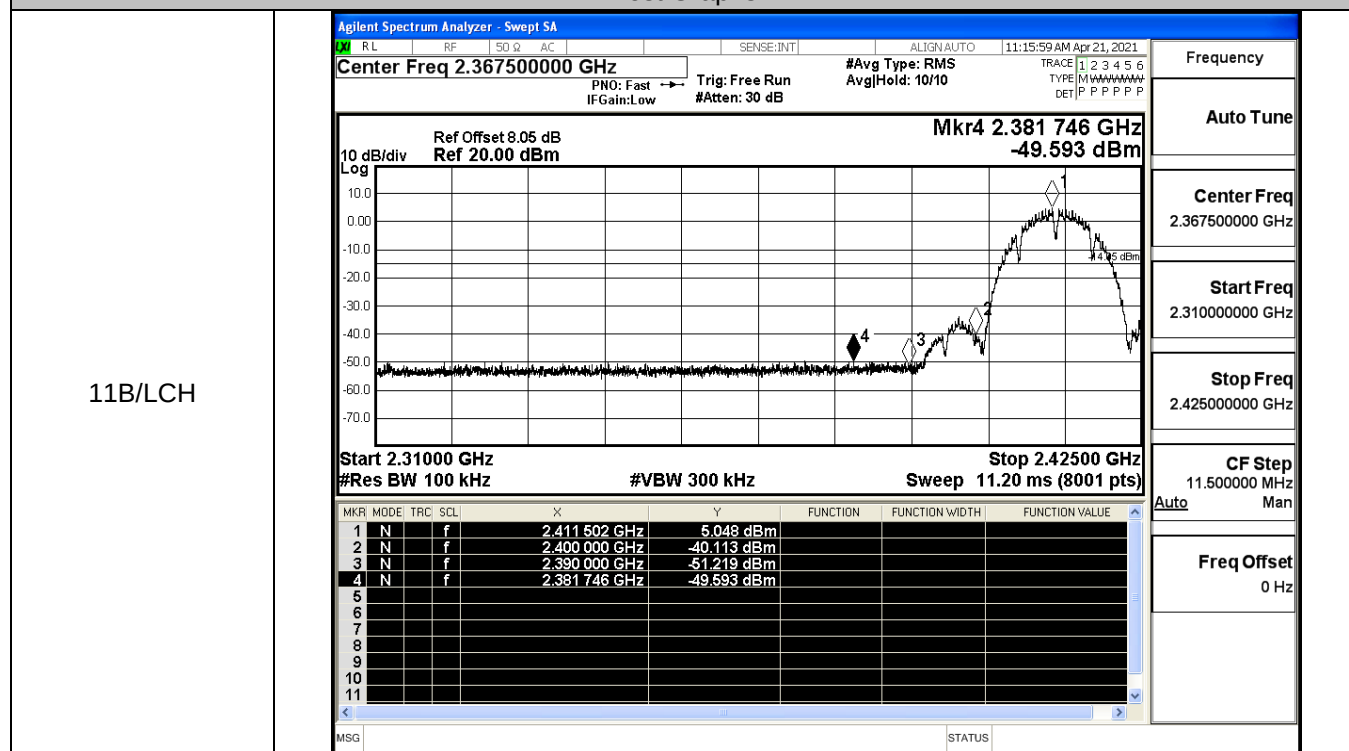
Puw/11N40
SISO/HCH



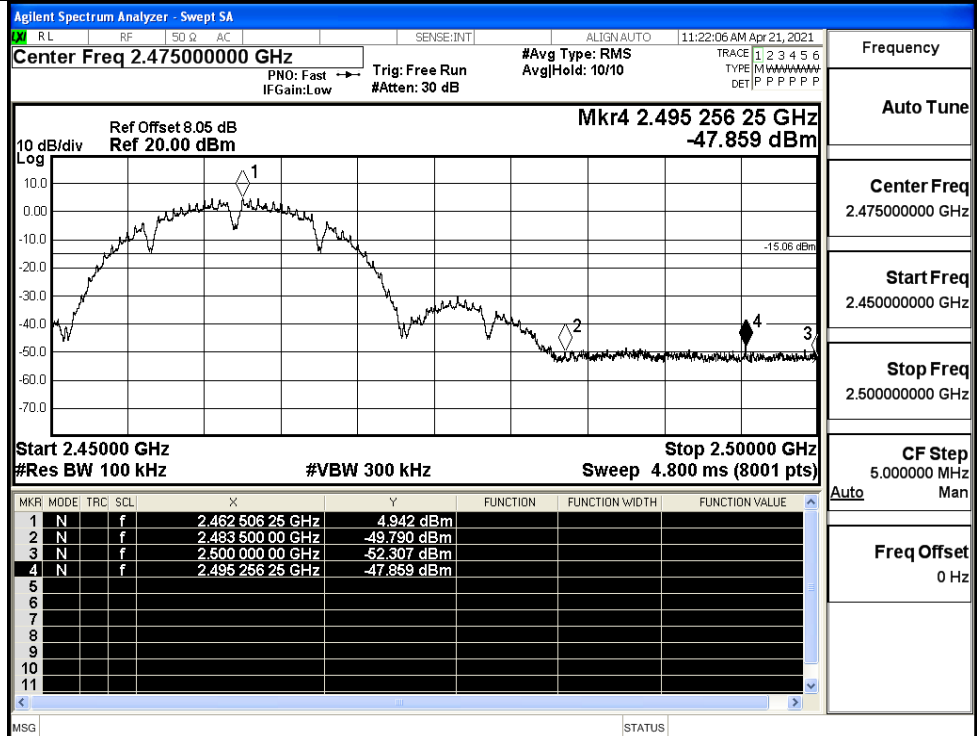
B.6 Band-edge for RF Conducted Emissions

Mode	Channel	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
11B	LCH	5.048	-49.593	-14.95	PASS
	HCH	4.942	-47.859	-15.06	PASS
11G	LCH	-0.313	-49.481	-20.31	PASS
	HCH	-0.894	-48.676	-20.89	PASS
11N20SISO	LCH	-0.283	-49.146	-20.28	PASS
	HCH	-0.630	-46.838	-20.63	PASS
11N40SISO	LCH	-4.305	-48.827	-24.31	PASS
	HCH	-4.251	-40.990	-24.25	PASS

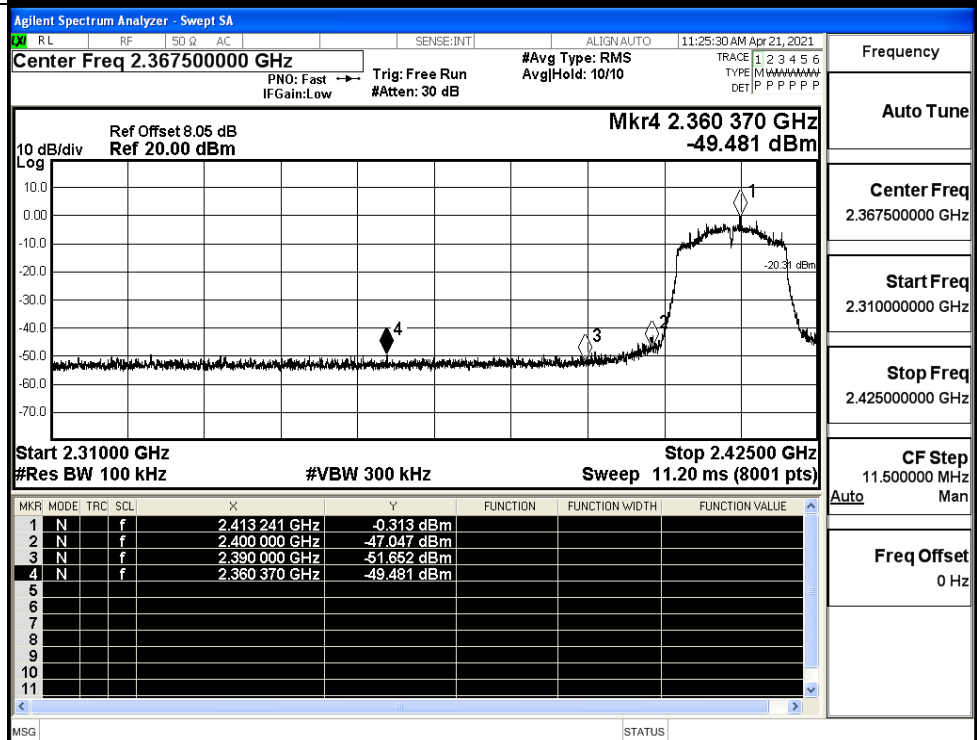
Test Graphs



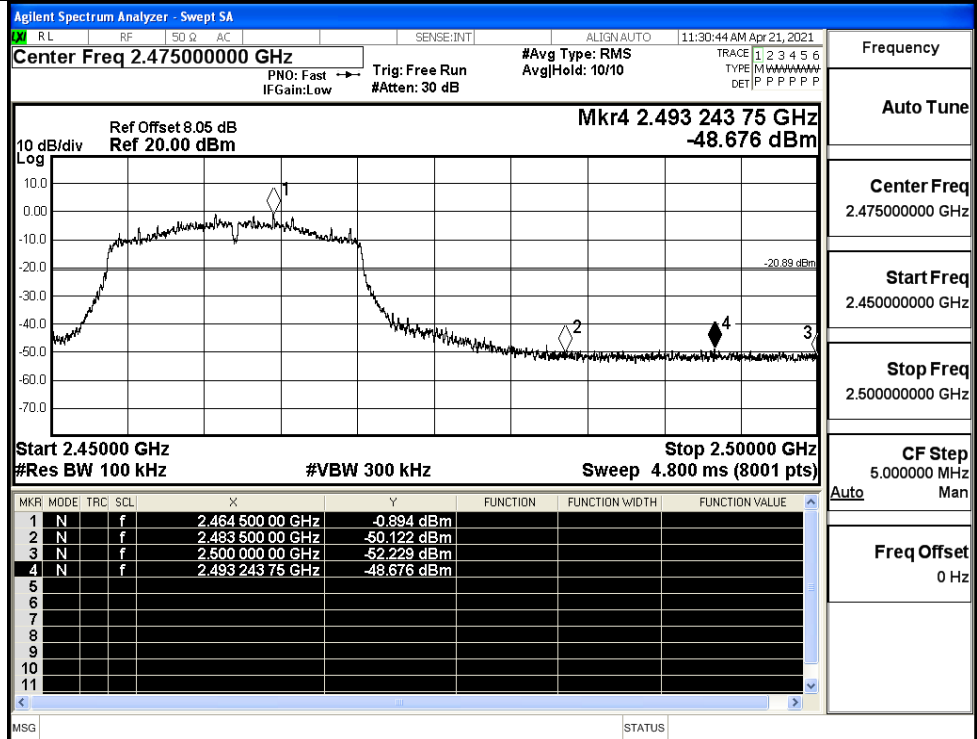
11B/HCH



11G/LCH



11G/HCH



Frequency

Auto Tune

Center Freq
2.475000000 GHz

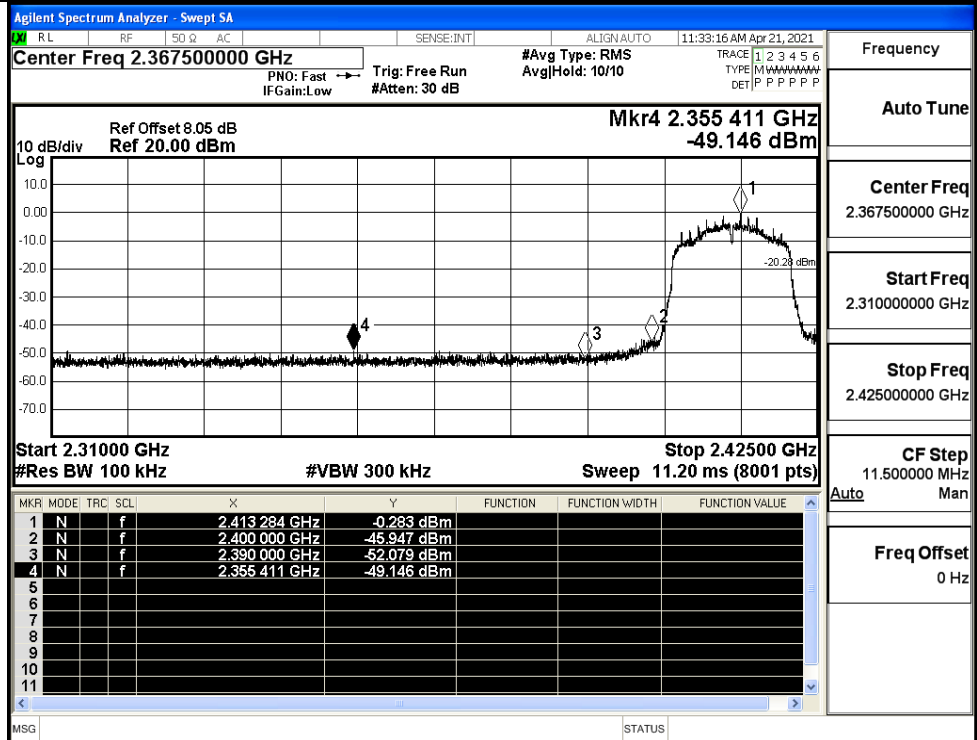
Start Freq
2.450000000 GHz

Stop Freq
2.500000000 GHz

CF Step
5.000000 MHz

Freq Offset
0 Hz

11N20SISO/LCH



Frequency

Auto Tune

Center Freq
2.367500000 GHz

Start Freq
2.310000000 GHz

Stop Freq
2.425000000 GHz

CF Step
11.500000 MHz

Freq Offset
0 Hz

11N20SISO/HCH

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.475000000 GHz

PNO: Fast → IF Gain: Low Trig: Free Run #Atten: 30 dB

#Avg Type: RMS Avg|Hold: 10/10

TRACE 1 2 3 4 5 6
TYPE [M W A W A W A W A W]
DET [P P P P P P P P]

Ref Offset 8.05 dB Ref 20.00 dBm

Mkr4 2.485 812 50 GHz -46.838 dBm

10 dB/div Log

Start 2.45000 GHz Stop 2.50000 GHz
#Res BW 100 kHz #VBW 300 kHz Sweep 4.800 ms (8001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N		f	2.463 237 50 GHz	-0.630 dBm			
2	N		f	2.483 500 00 GHz	-52.114 dBm			
3	N		f	2.500 000 00 GHz	-51.847 dBm			
4	N		f	2.485 812 50 GHz	-46.838 dBm			
5								
6								
7								
8								
9								
10								
11								

MSG STATUS

Frequency

Auto Tune

Center Freq
2.475000000 GHz

Start Freq
2.450000000 GHz

Stop Freq
2.500000000 GHz

CF Step
5.000000 MHz

Auto

Freq Offset
0 Hz

11N40SISO/LCH

Agilent Spectrum Analyzer - Swept SA

Center Freq 2.377500000 GHz

PNO: Fast → IF Gain: Low Trig: Free Run #Atten: 30 dB

#Avg Type: RMS Avg|Hold: 10/10

TRACE 1 2 3 4 5 6
TYPE [M W A W A W A W A W]
DET [P P P P P P P P]

Ref Offset 8.05 dB Ref 20.00 dBm

Mkr4 2.383 204 GHz -48.827 dBm

10 dB/div Log

Start 2.31000 GHz Stop 2.44500 GHz
#Res BW 100 kHz #VBW 300 kHz Sweep 13.33 ms (8001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N		f	2.426 994 GHz	-4.305 dBm			
2	N		f	2.400 000 GHz	-47.404 dBm			
3	N		f	2.390 000 GHz	-51.423 dBm			
4	N		f	2.383 204 GHz	-48.827 dBm			
5								
6								
7								
8								
9								
10								
11								

MSG STATUS

Frequency

Auto Tune

Center Freq
2.377500000 GHz

Start Freq
2.310000000 GHz

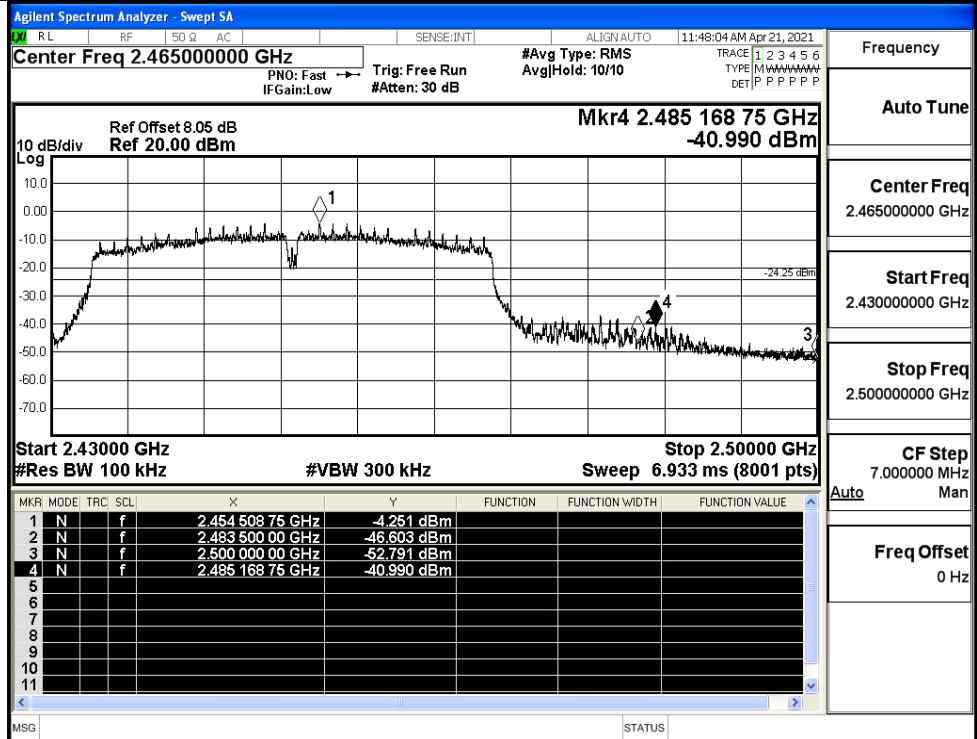
Stop Freq
2.445000000 GHz

CF Step
13.500000 MHz

Auto

Freq Offset
0 Hz

11N40SISO/HCH

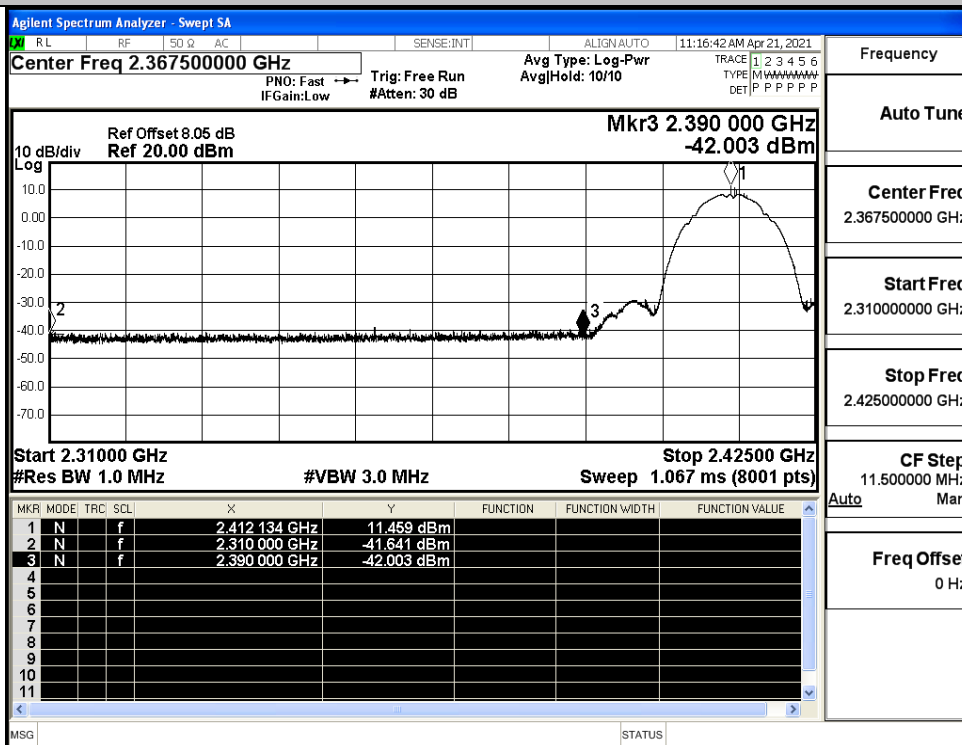


B.7 Restrict-band band-edge measurements

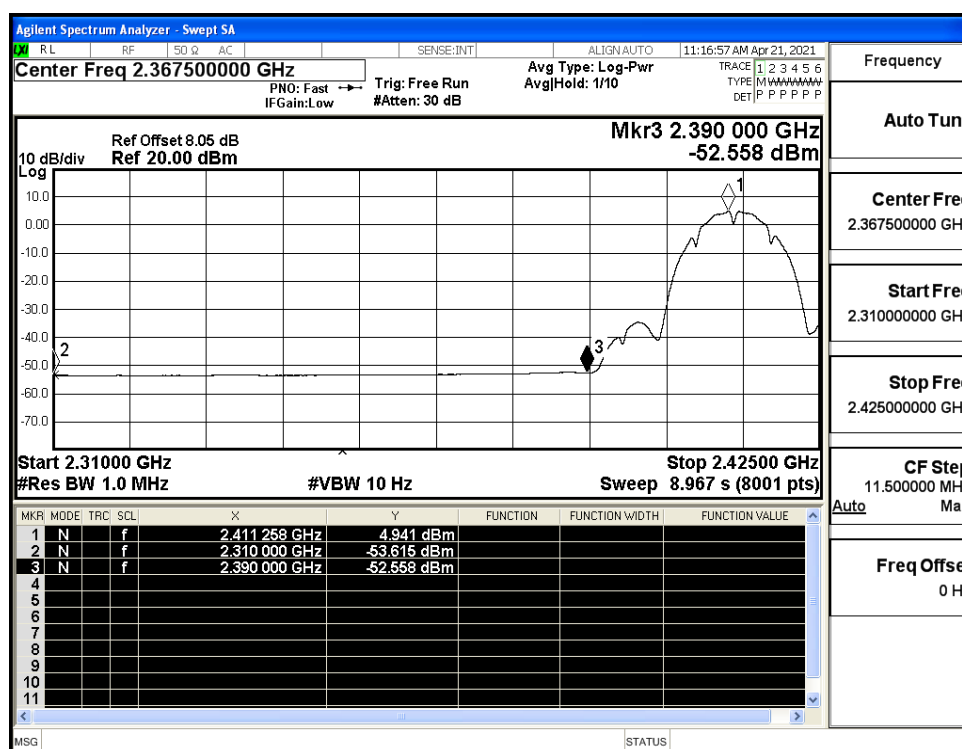
Test Mode	Test Channel	Ant	Freq.	Power [dBm]	Gain	Ground Factor	E [dBuV/m]	Detector	Limit [dBuV/m]	Verdict
11B	2412	Ant1	2310.0	-41.64	2.5	0	56.12	PEAK	74	PASS
	2412	Ant1	2310.0	-53.62	2.5	0	44.14	AV	54	PASS
	2412	Ant1	2390.0	-42.00	2.5	0	55.76	PEAK	74	PASS
	2412	Ant1	2390.0	-52.56	2.5	0	45.2	AV	54	PASS
	2462	Ant1	2483.5	-42.21	2.5	0	55.55	PEAK	74	PASS
	2462	Ant1	2483.5	-51.78	2.5	0	45.98	AV	54	PASS
	2462	Ant1	2500.0	-41.55	2.5	0	56.21	PEAK	74	PASS
	2462	Ant1	2500.0	-52.06	2.5	0	45.7	AV	54	PASS
11G	2412	Ant1	2310.0	-43.49	2.5	0	54.27	PEAK	74	PASS
	2412	Ant1	2310.0	-53.44	2.5	0	44.32	AV	54	PASS
	2412	Ant1	2390.0	-41.02	2.5	0	56.74	PEAK	74	PASS
	2412	Ant1	2390.0	-52.41	2.5	0	45.35	AV	54	PASS
	2462	Ant1	2483.5	-41.40	2.5	0	56.36	PEAK	74	PASS
	2462	Ant1	2483.5	-51.64	2.5	0	46.12	AV	54	PASS
	2462	Ant1	2500.0	-41.48	2.5	0	56.28	PEAK	74	PASS
	2462	Ant1	2500.0	-51.78	2.5	0	45.98	AV	54	PASS
11N20 SISO	2412	Ant1	2310.0	-43.52	2.5	0	54.24	PEAK	74	PASS
	2412	Ant1	2310.0	-53.45	2.5	0	44.31	AV	54	PASS
	2412	Ant1	2390.0	-42.59	2.5	0	55.17	PEAK	74	PASS
	2412	Ant1	2390.0	-52.43	2.5	0	45.33	AV	54	PASS
	2462	Ant1	2483.5	-41.31	2.5	0	56.45	PEAK	74	PASS
	2462	Ant1	2483.5	-51.61	2.5	0	46.15	AV	54	PASS
	2462	Ant1	2500.0	-39.80	2.5	0	57.96	PEAK	74	PASS
	2462	Ant1	2500.0	-51.78	2.5	0	45.98	AV	54	PASS
11N40 SISO	2422	Ant1	2310.0	-43.15	2.5	0	54.61	PEAK	74	PASS
	2422	Ant1	2310.0	-53.38	2.5	0	44.38	AV	54	PASS

	2422	Ant1	2390.0	-39.14	2.5	0	58.62	PEAK	74	PASS
	2422	Ant1	2390.0	-50.63	2.5	0	47.13	AV	54	PASS
	2452	Ant1	2483.5	-31.04	2.5	0	66.72	PEAK	74	PASS
	2452	Ant1	2483.5	-47.29	2.5	0	50.47	AV	54	PASS
	2452	Ant1	2500.0	-40.60	2.5	0	57.16	PEAK	74	PASS
	2452	Ant1	2500.0	-51.52	2.5	0	46.24	AV	54	PASS

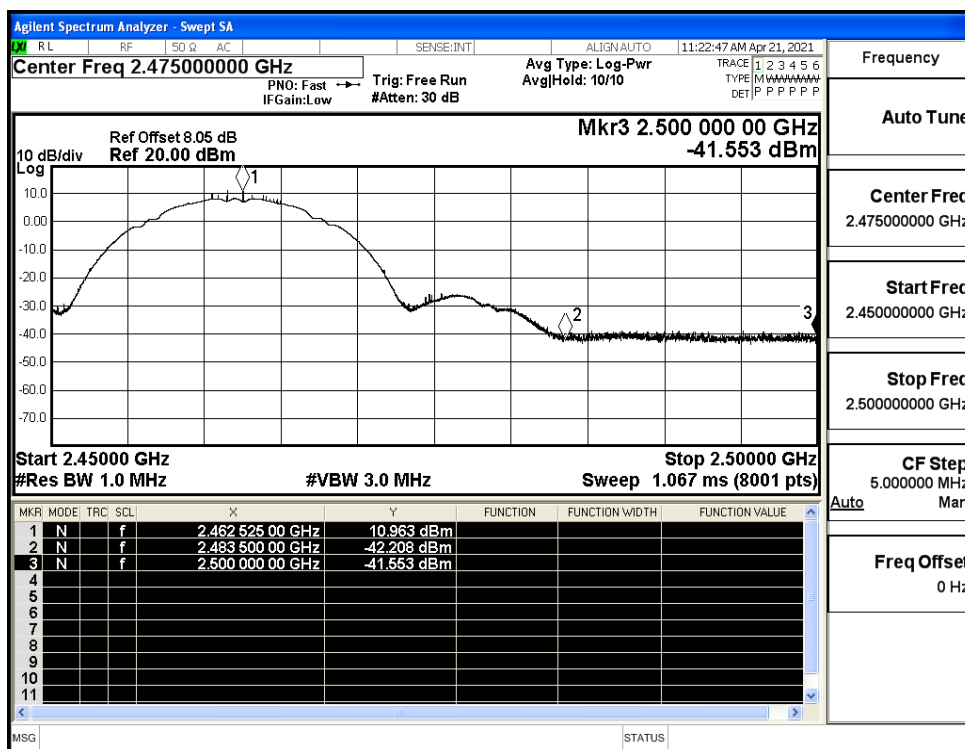
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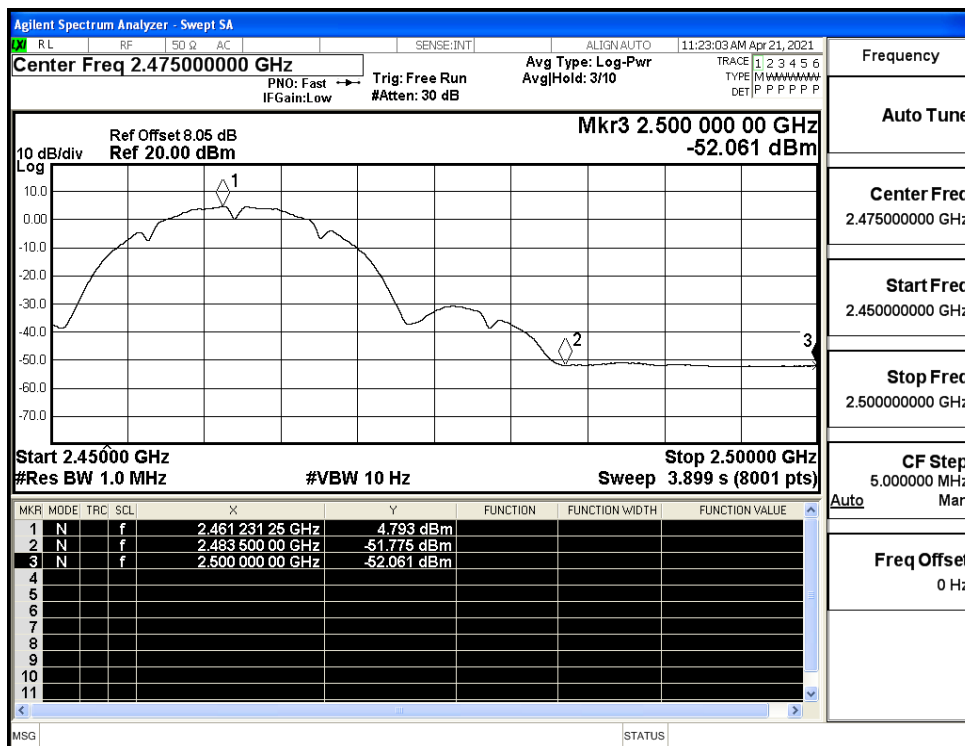
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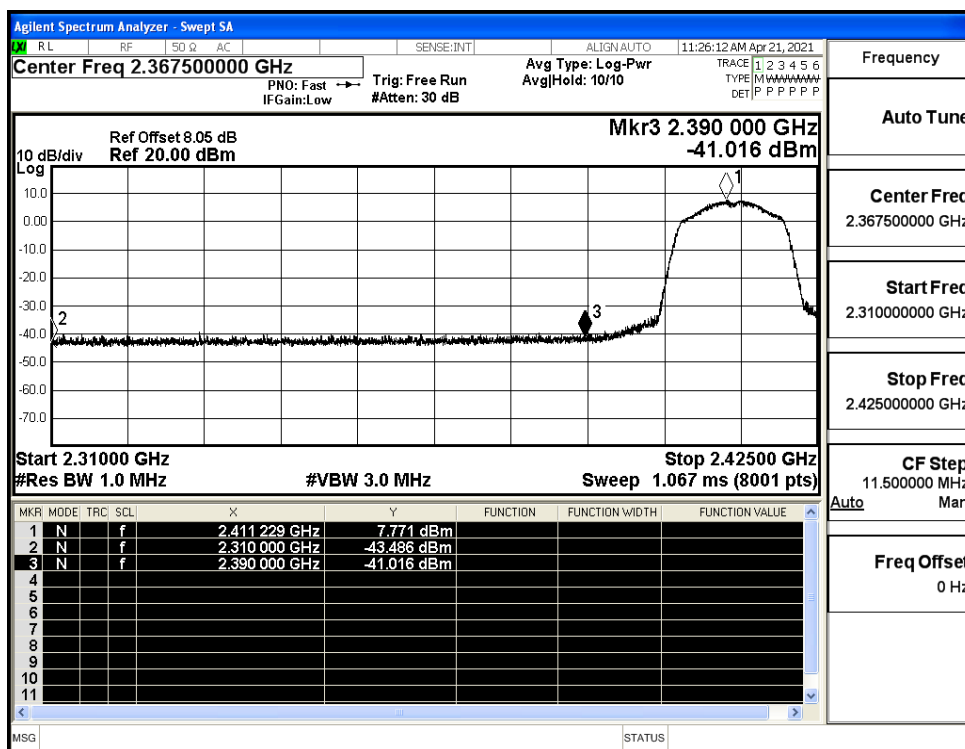
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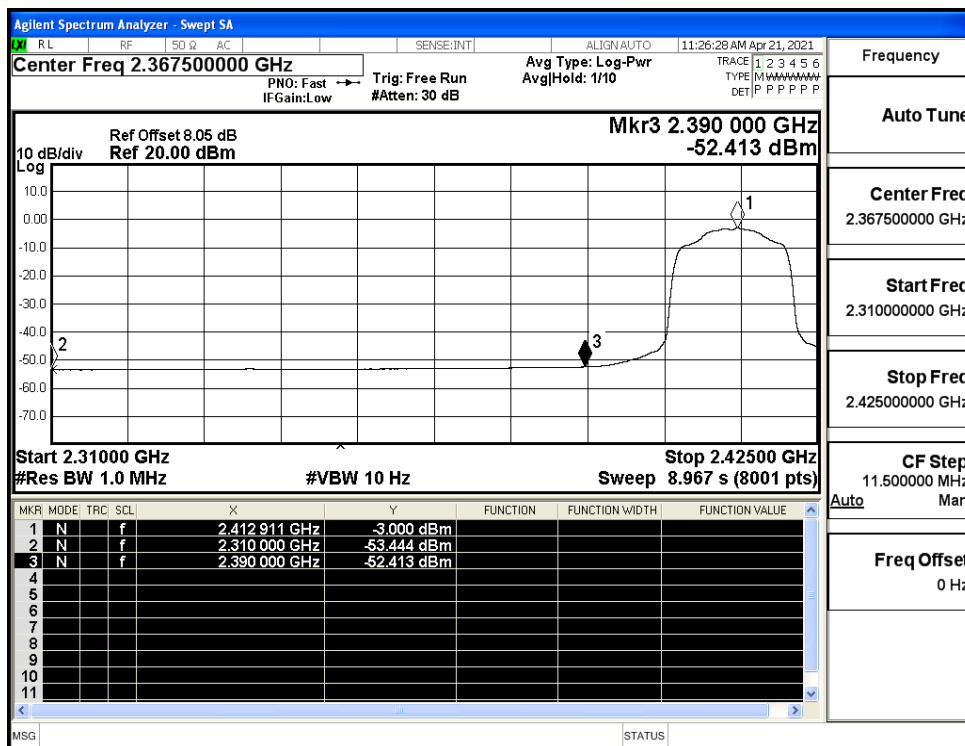
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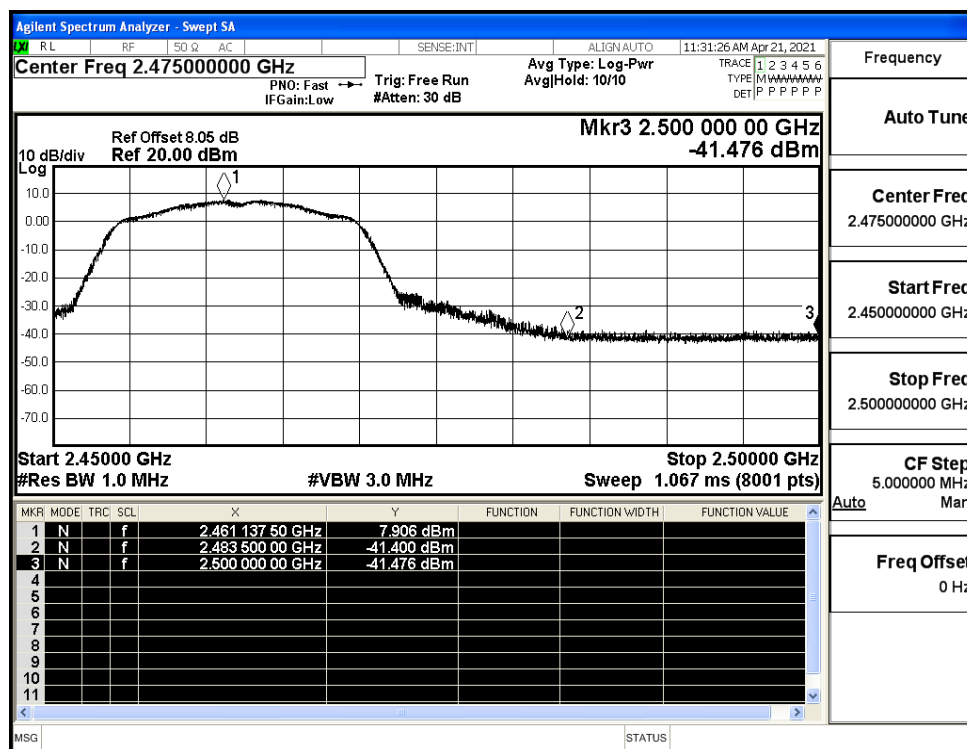
Restrict-band band-edge measurements_11G_2412_Ant1_PEAK



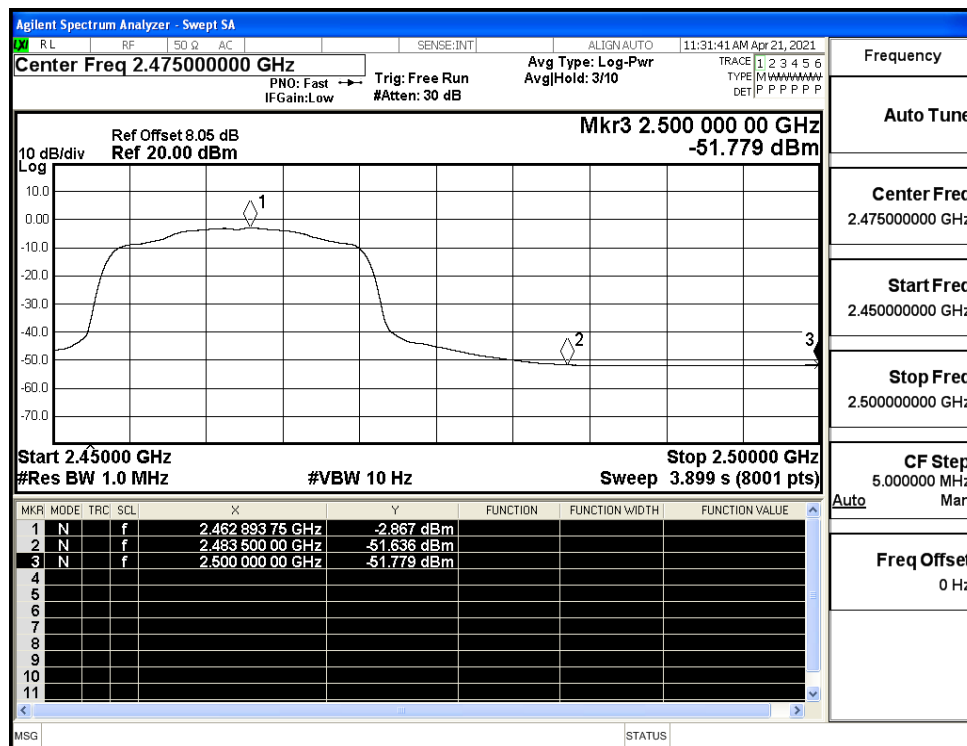
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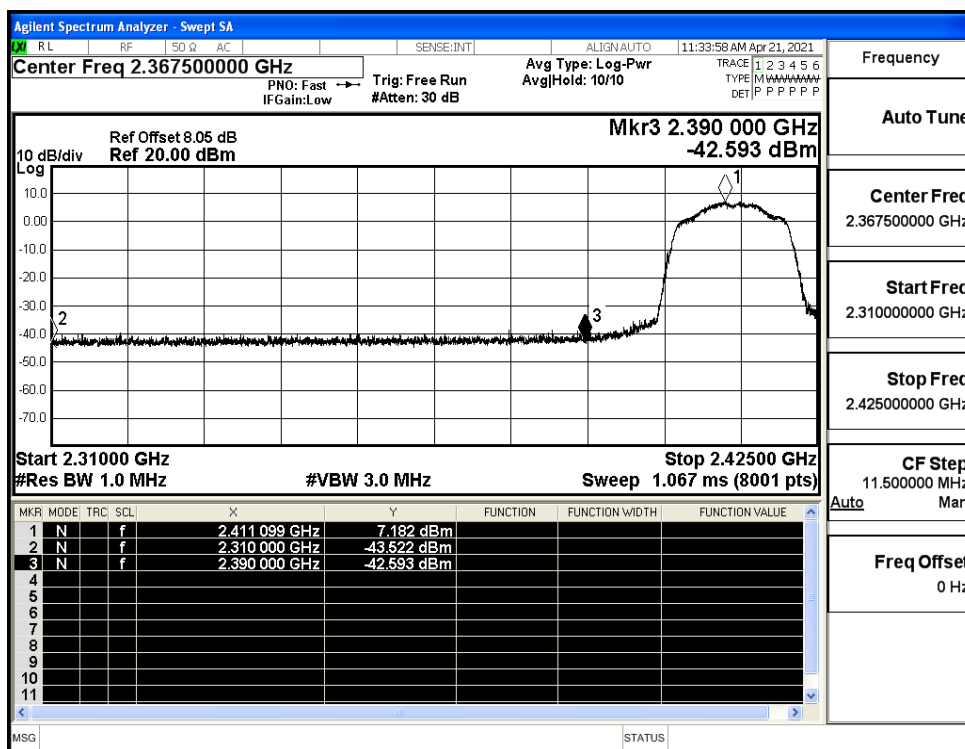
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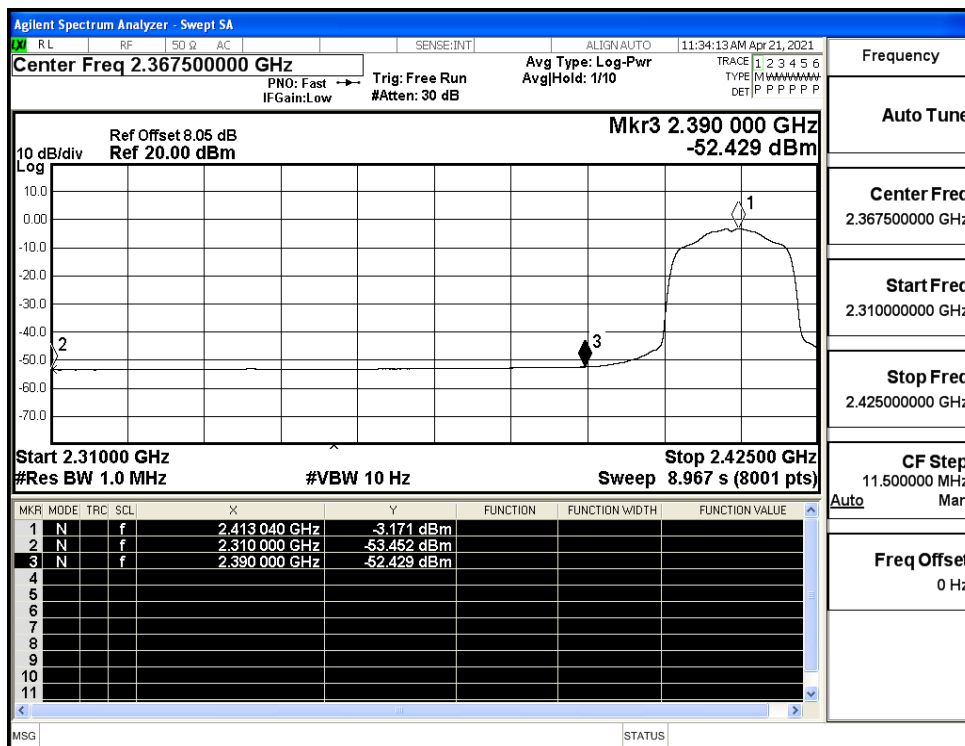
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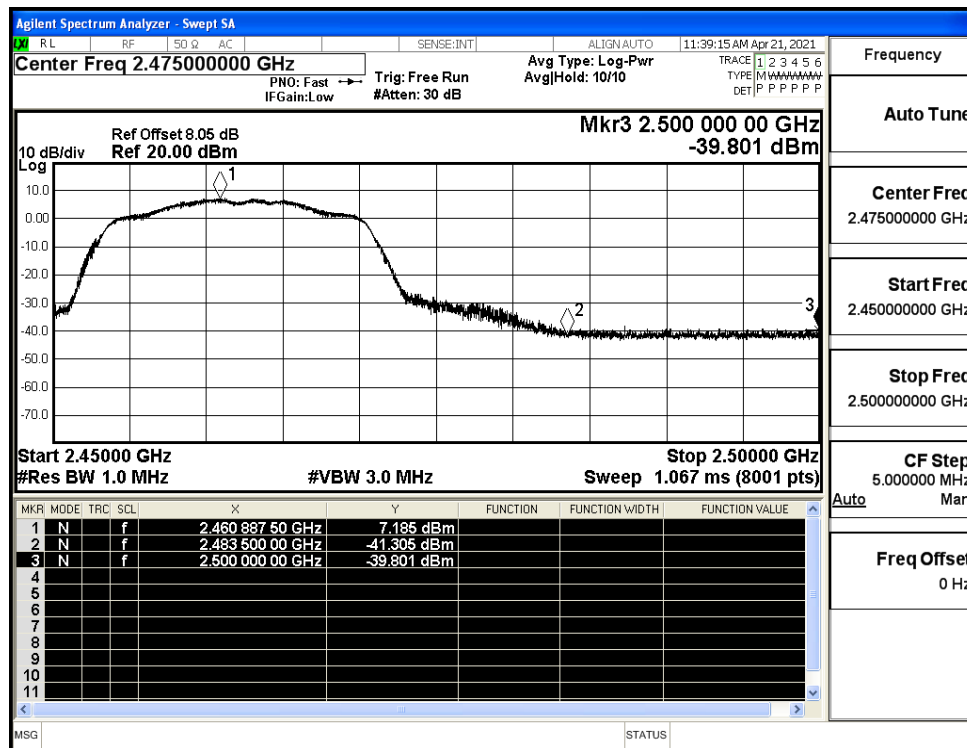
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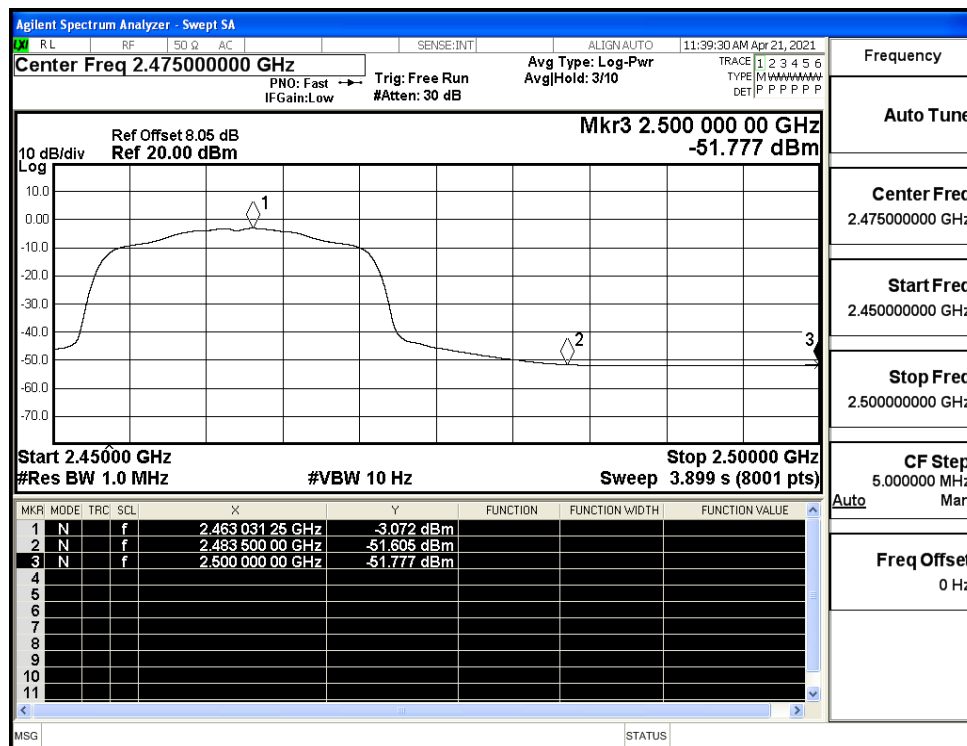
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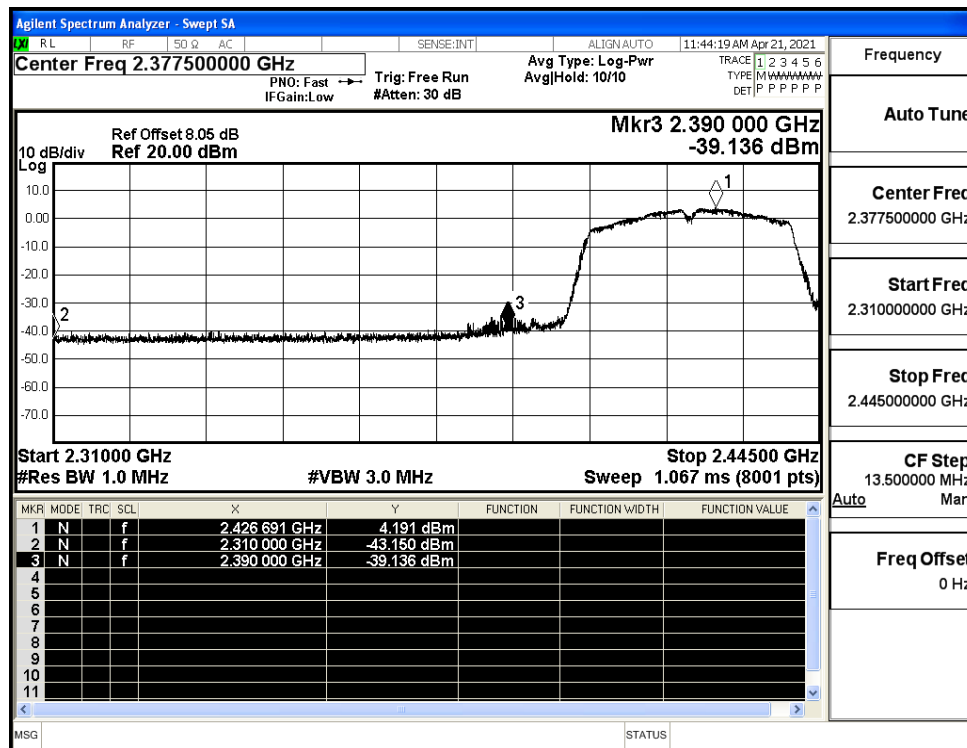
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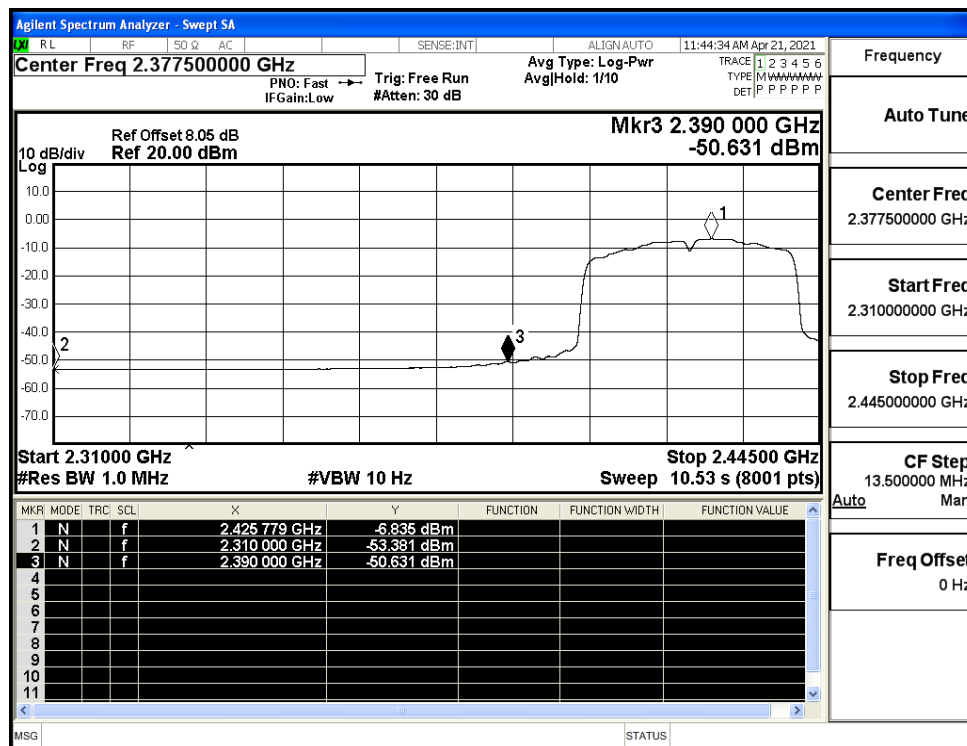
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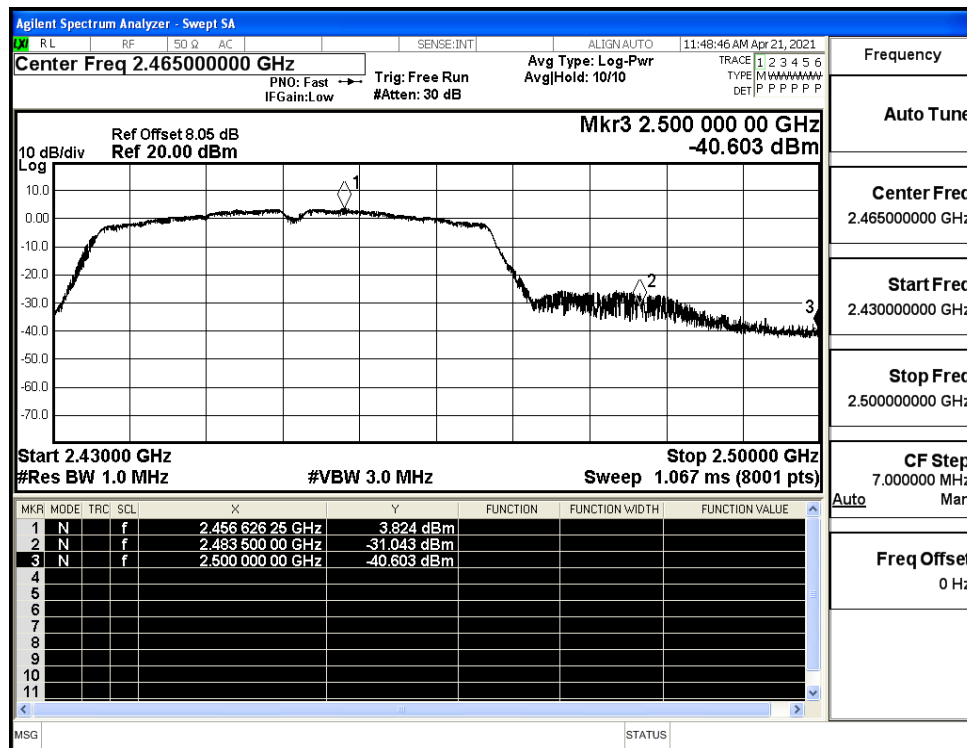
Restrict-band band-edge measurements_11N40SISO_2422_Ant1_PEAK



Restrict-band band-edge measurements_11N40SISO_2422_Ant1_AV



Restrict-band band-edge measurements_11N40SISO_2452_Ant1_PEAK



Restrict-band band-edge measurements_11N40SISO_2452_Ant1_AV

