Appendix A

RF Test Data for BT (Conducted Measurement)

Product Name: True wireless earbuds

Test Model: Happy Plugs Air 1 Zen

Environmental Conditions

Temperature:	25 ° C
Relative Humidity:	50%
ATM Pressure:	100.0 kPa
Test Engineer:	Carl Fu
Supervised by:	Li Huan

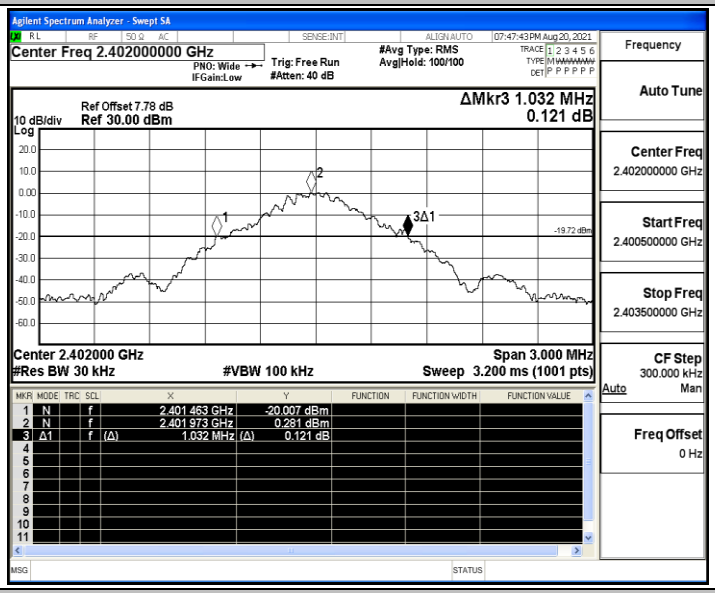
A.1 20dB Emission Bandwidth

Test Result

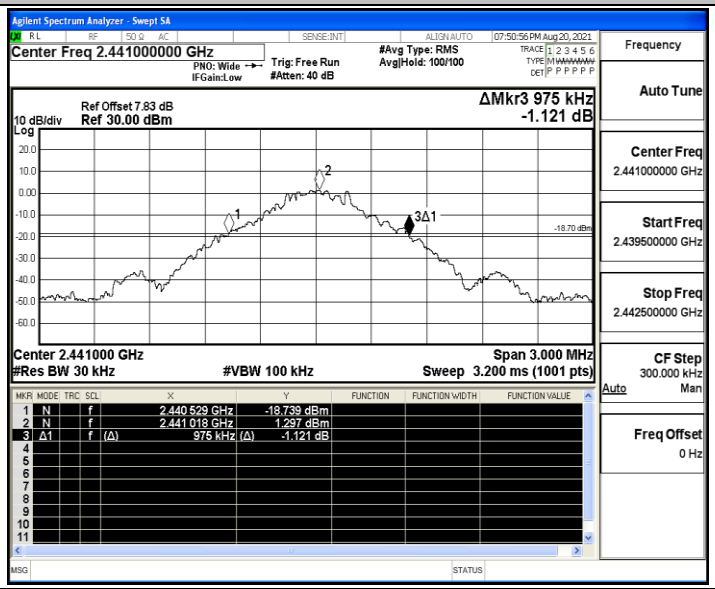
TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	1.032	2401.463	2402.495	---	PASS
		2441	0.975	2440.529	2441.504	---	PASS
		2480	1.035	2479.463	2480.498	---	PASS
2DH5	Ant1	2402	1.302	2401.358	2402.660	---	PASS
		2441	1.341	2440.328	2441.669	---	PASS
		2480	1.338	2479.328	2480.666	---	PASS
3DH5	Ant1	2402	1.308	2401.346	2402.654	---	PASS
		2441	1.293	2440.349	2441.642	---	PASS
		2480	1.317	2479.343	2480.660	---	PASS

Test Graphs

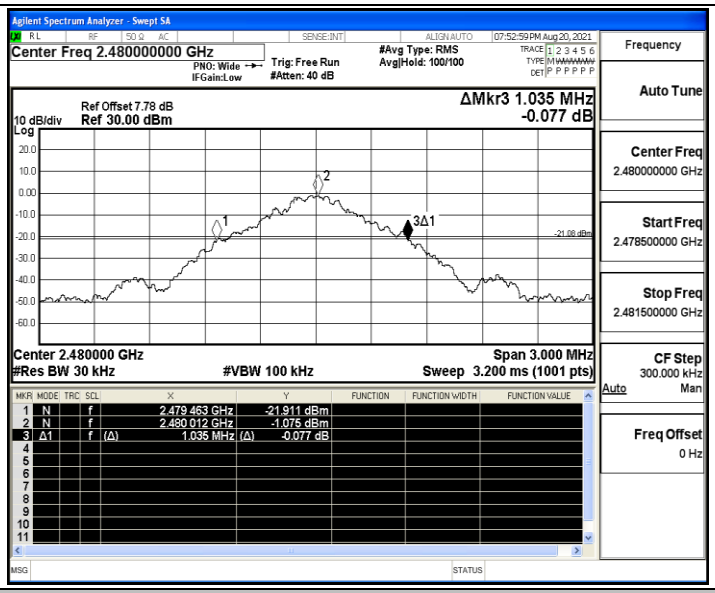
DH5_Ant1_2402



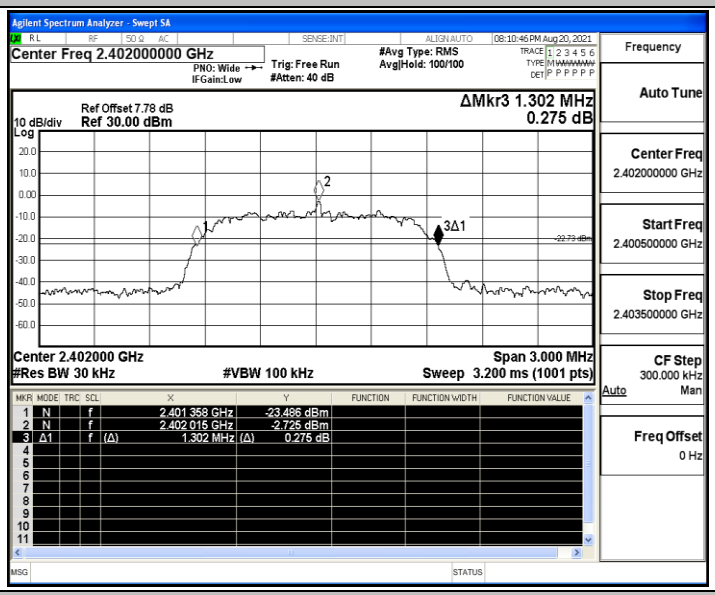
DH5_Ant1_2441



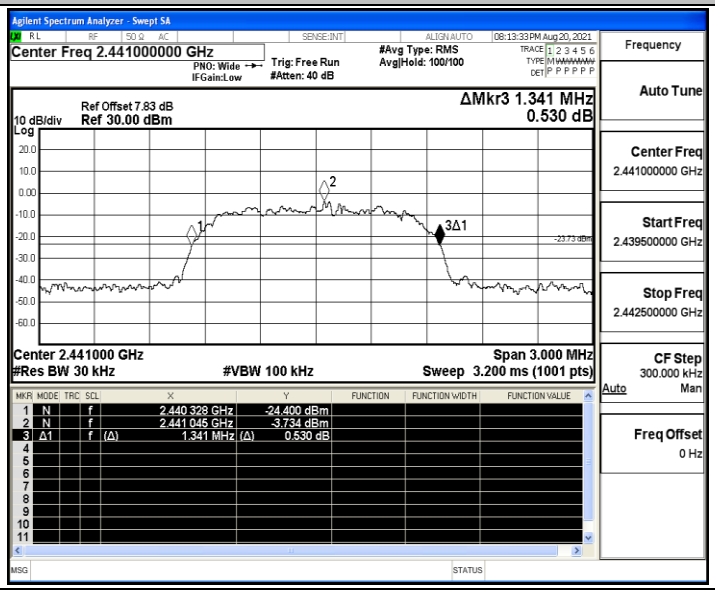
DH5_Ant1_2480



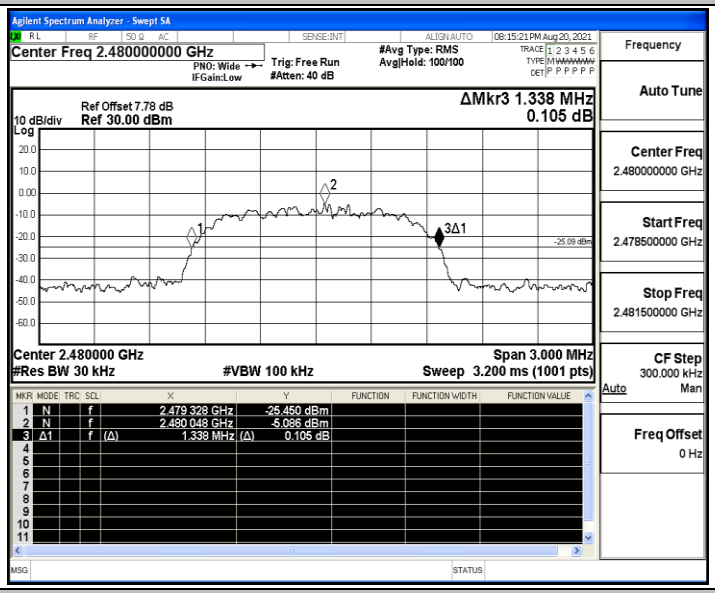
2DH5_Ant1_2402



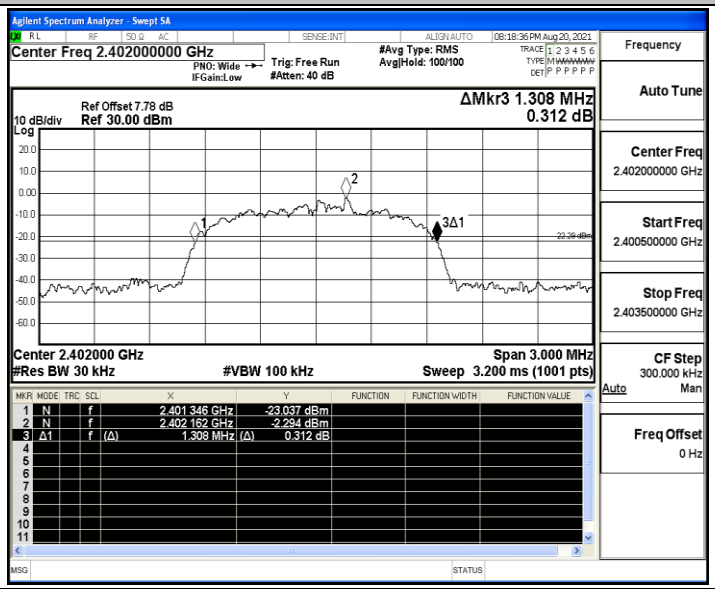
2DH5_Ant1_2441



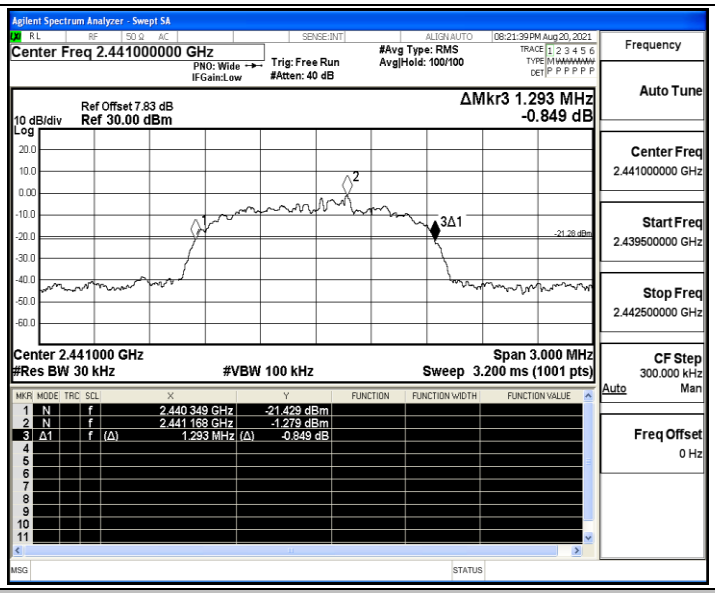
2DH5_Ant1_2480



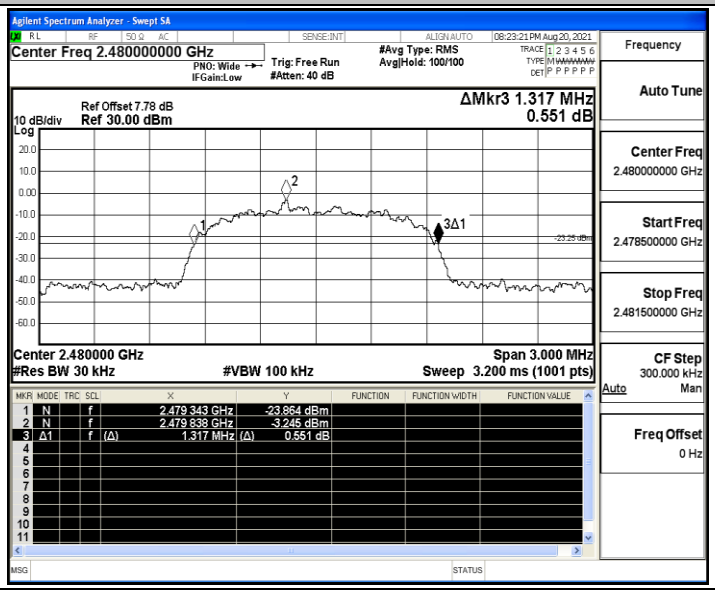
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



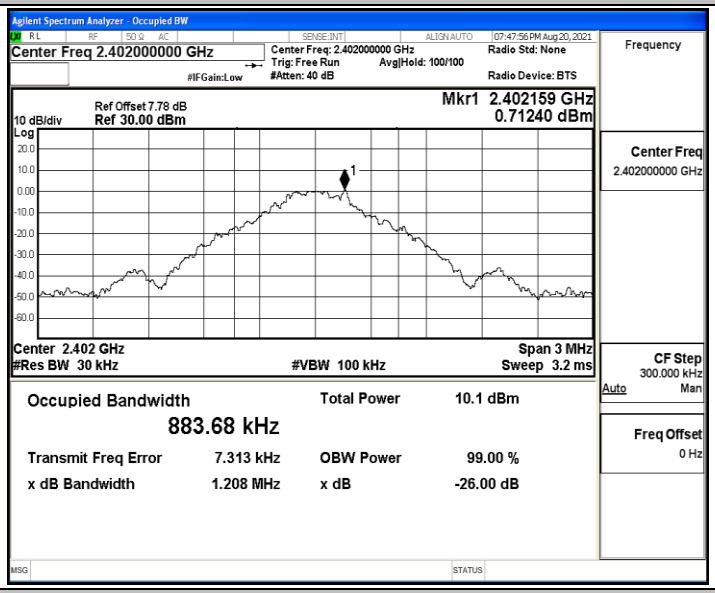
A.2 Occupied Channel Bandwidth

Test Result

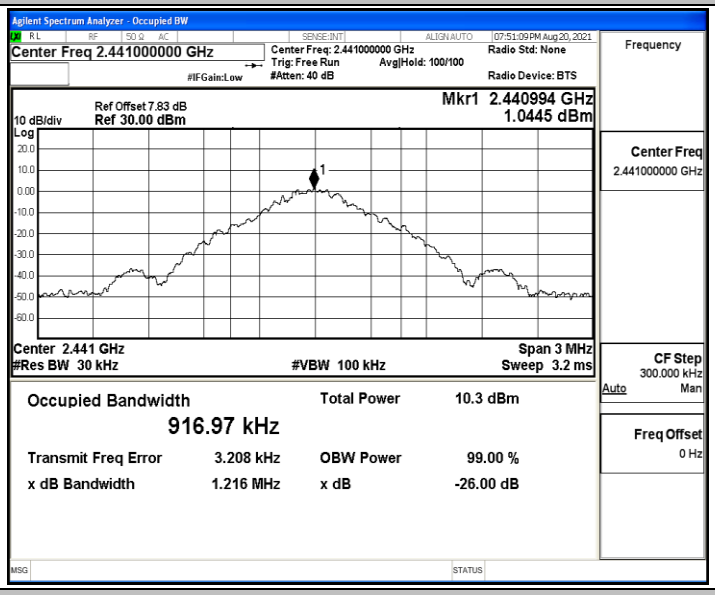
TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.88368	2401.565	2402.449	---	PASS
		2441	0.91697	2440.545	2441.462	---	PASS
		2480	0.92063	2479.544	2480.464	---	PASS
2DH5	Ant1	2402	1.1890	2401.406	2402.595	---	PASS
		2441	1.1730	2440.412	2441.585	---	PASS
		2480	1.1895	2479.405	2480.594	---	PASS
3DH5	Ant1	2402	1.1840	2401.410	2402.594	---	PASS
		2441	1.1896	2440.403	2441.593	---	PASS
		2480	1.2065	2479.394	2480.601	---	PASS

Test Graphs

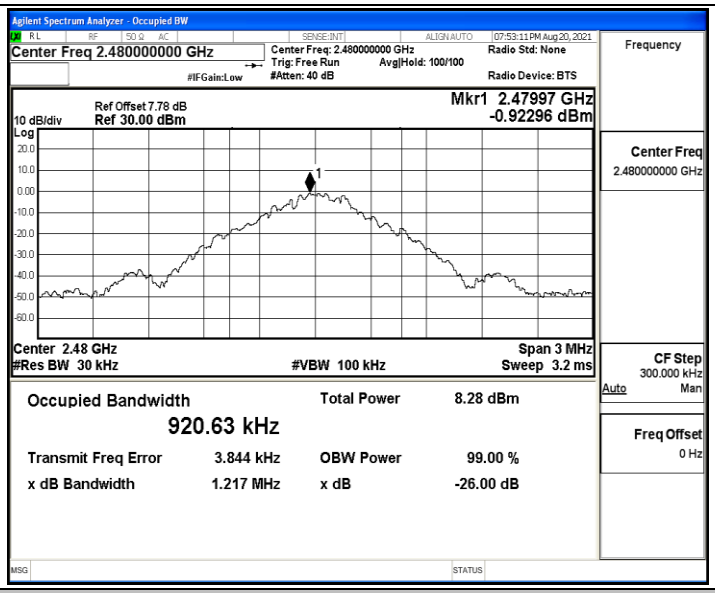
DH5_Ant1_2402



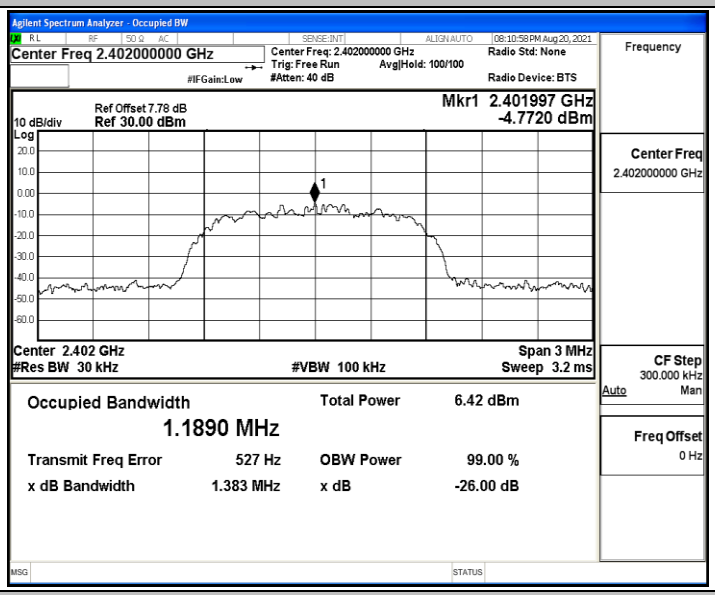
DH5_Ant1_2441



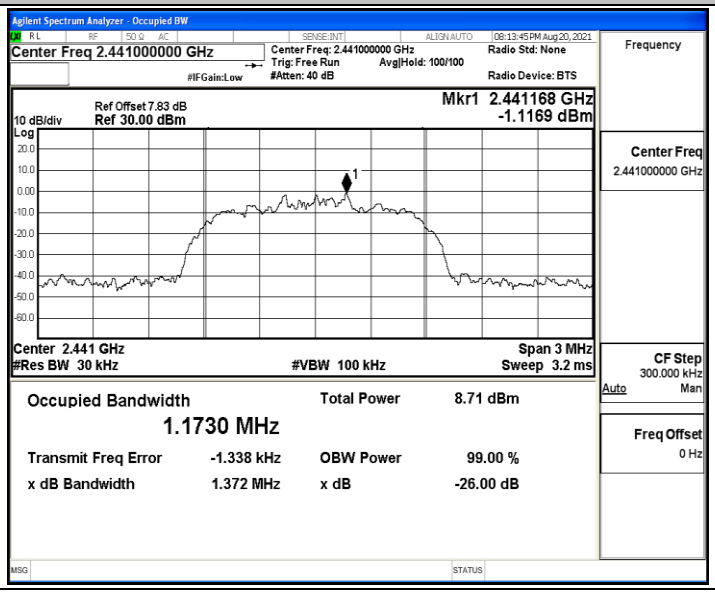
DH5_Ant1_2480



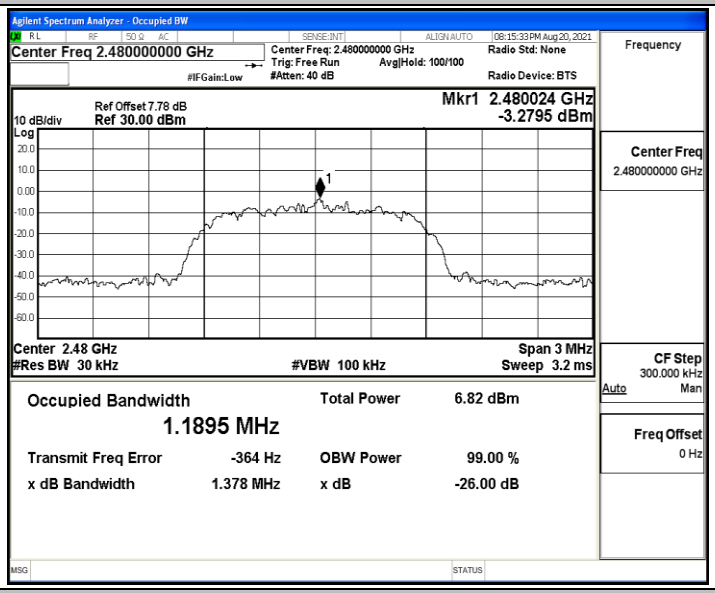
2DH5_Ant1_2402



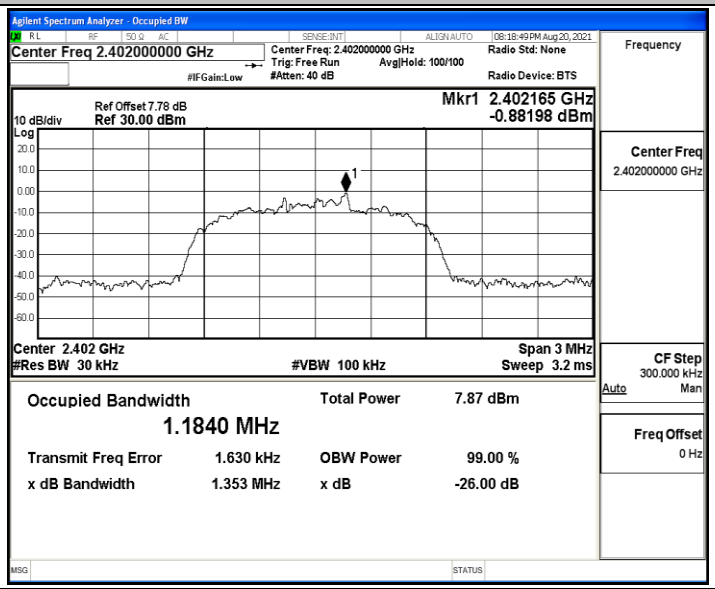
2DH5_Ant1_2441



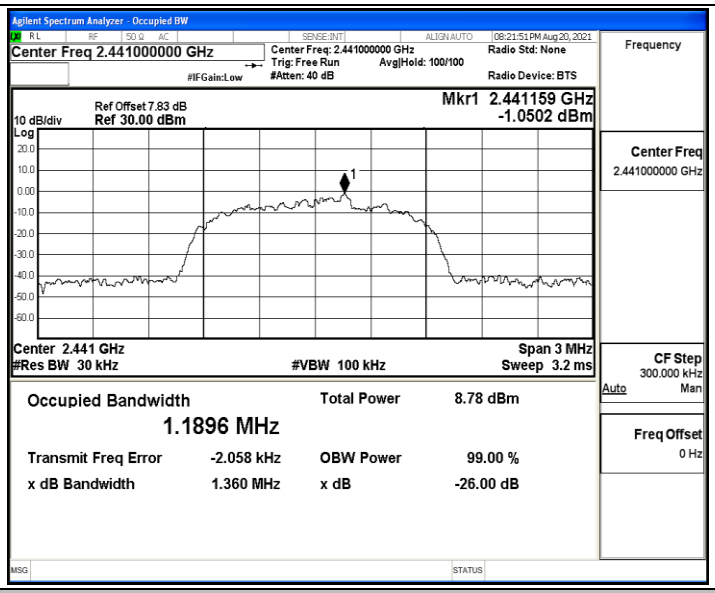
2DH5_Ant1_2480



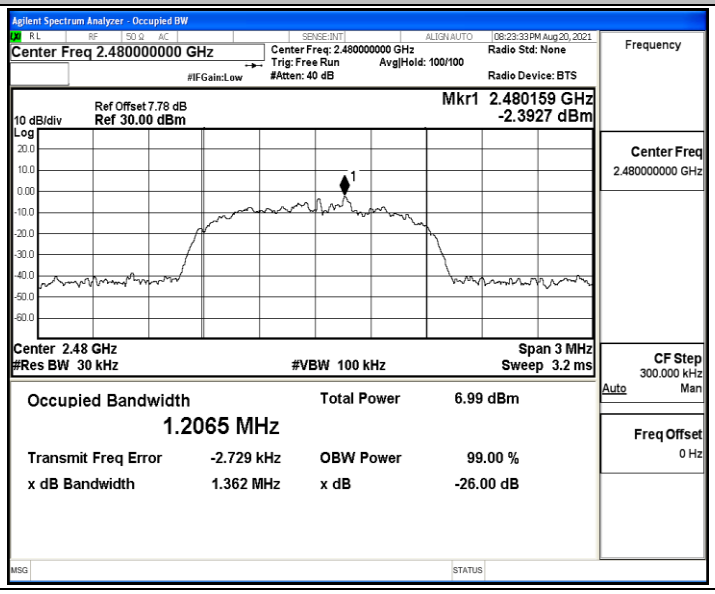
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



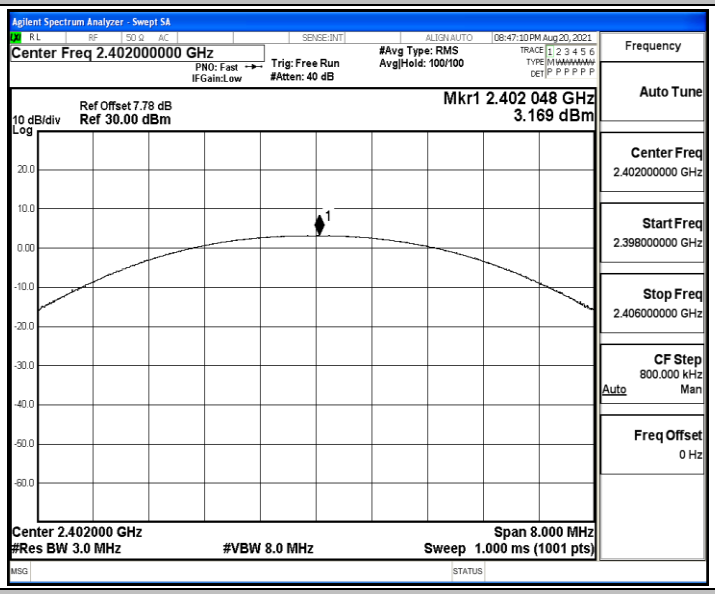
A.3 Maximum conducted output power

Test Result

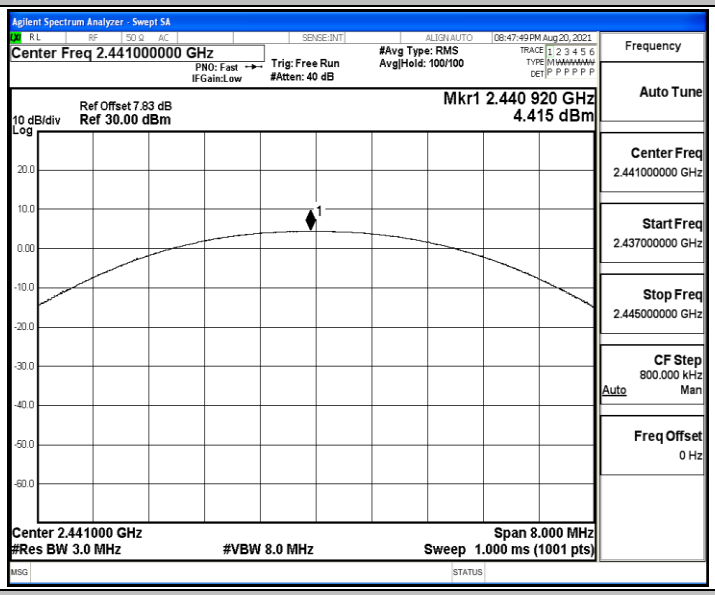
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	2402	3.17	≤20.97	PASS
		2441	4.42	≤20.97	PASS
		2480	2.9	≤20.97	PASS
2DH5	Ant1	2402	2.11	≤20.97	PASS
		2441	3.46	≤20.97	PASS
		2480	2	≤20.97	PASS
3DH5	Ant1	2402	2.55	≤20.97	PASS
		2441	1.74	≤20.97	PASS
		2480	2.3	≤20.97	PASS

Test Graphs

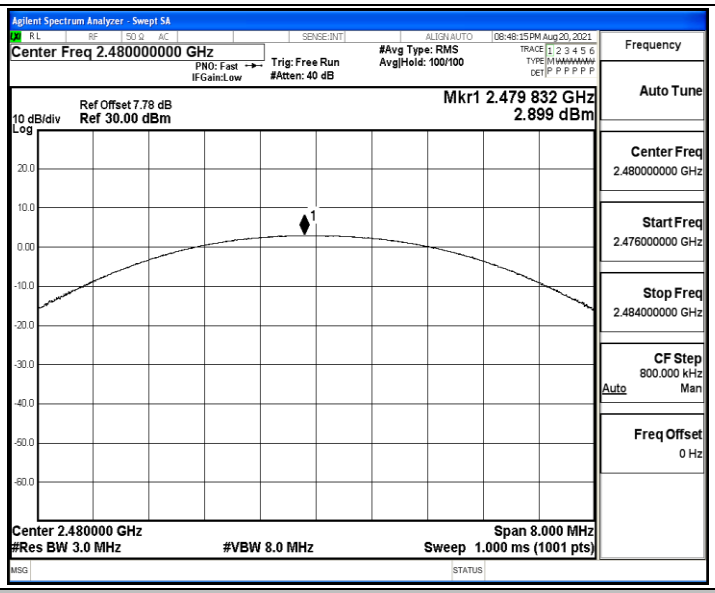
DH5_Ant1_2402



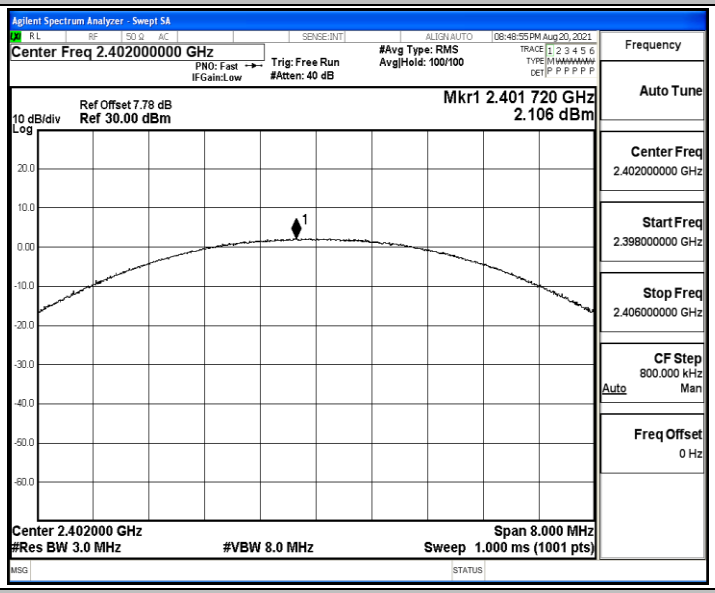
DH5_Ant1_2441



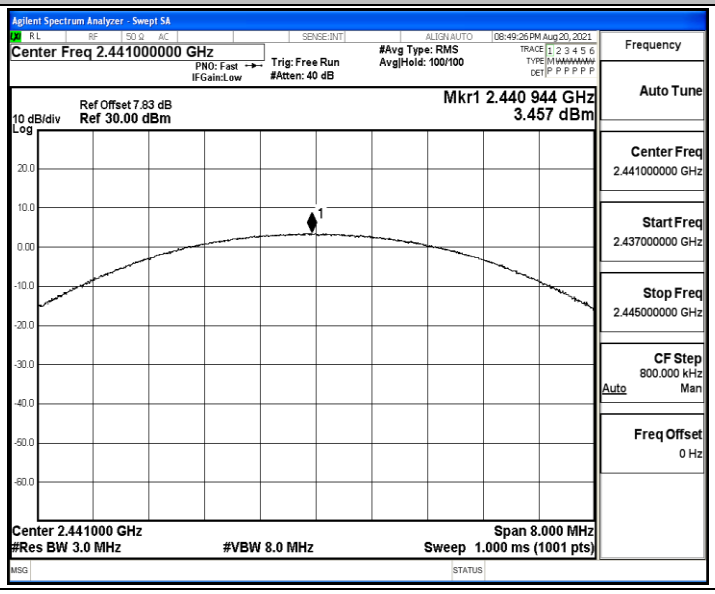
DH5_Ant1_2480



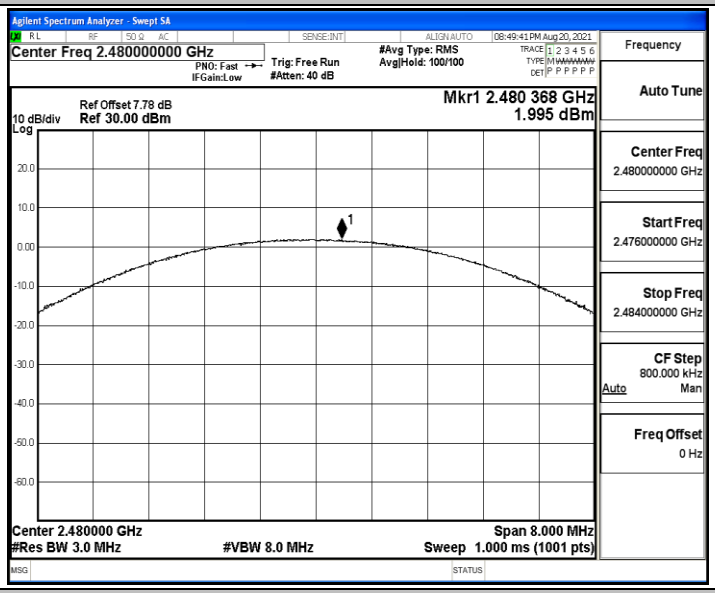
2DH5_Ant1_2402



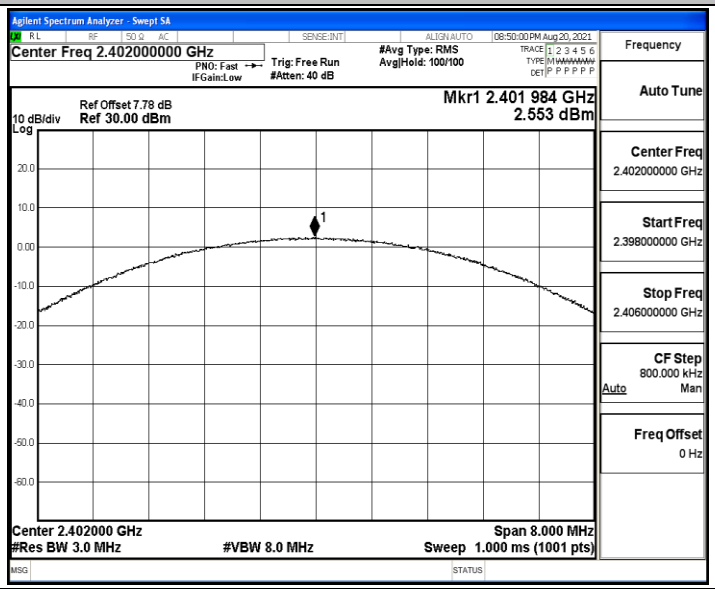
2DH5_Ant1_2441



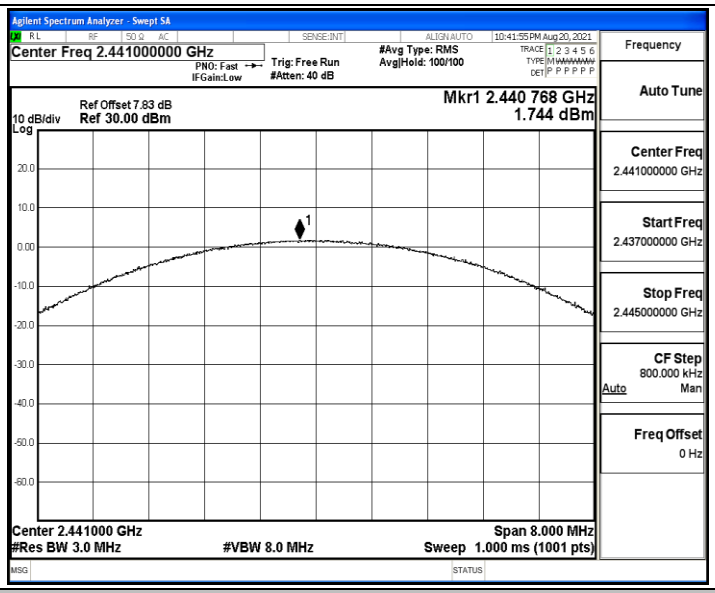
2DH5_Ant1_2480



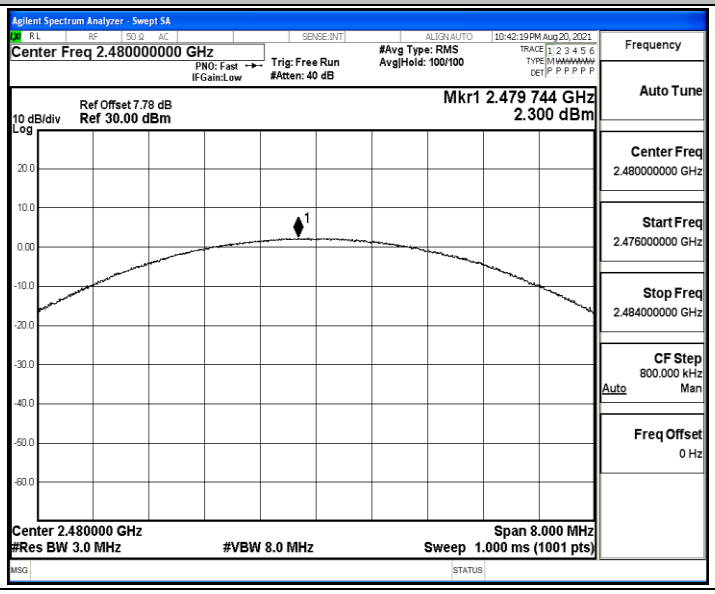
3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480



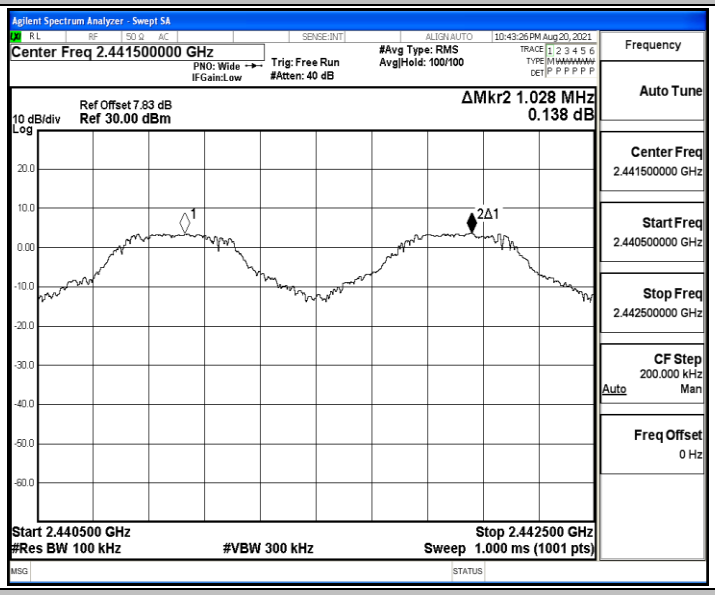
A.4 Carrier frequency separation

Test Result

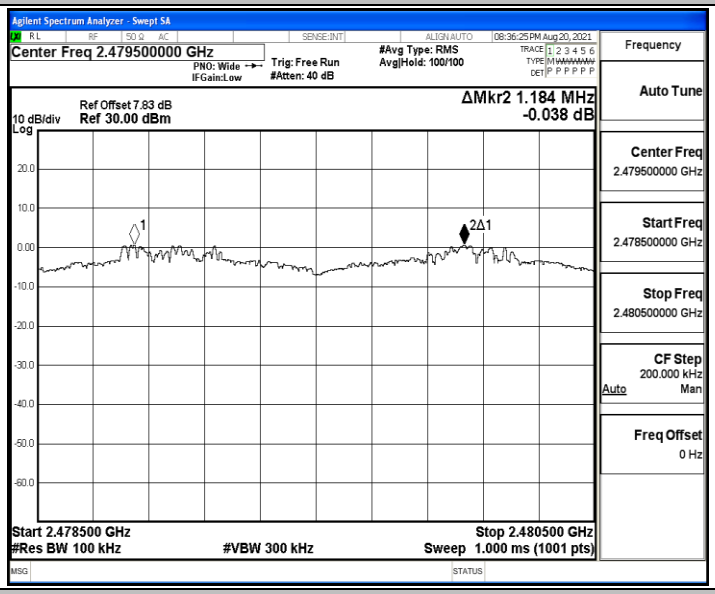
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	Hop	1.028	≥0.690	PASS
2DH5	Ant1	Hop	1.184	≥0.894	PASS
3DH5	Ant1	Hop	0.98	≥0.878	PASS

Test Graphs

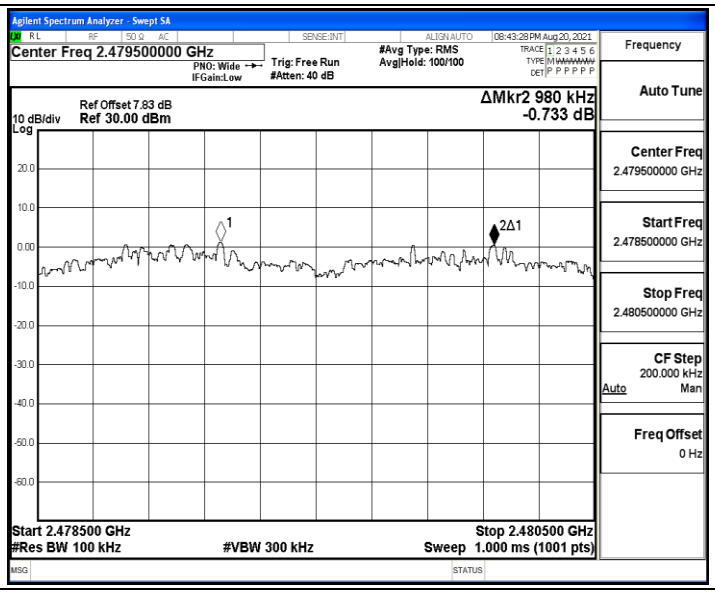
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop

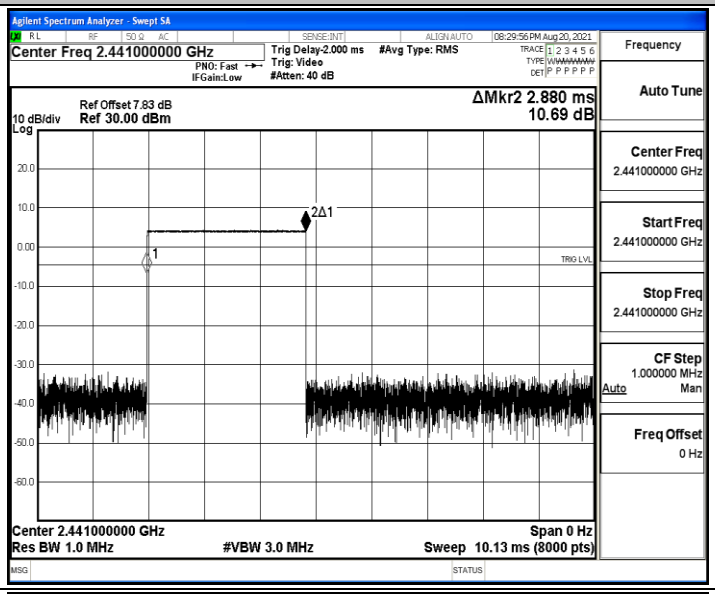
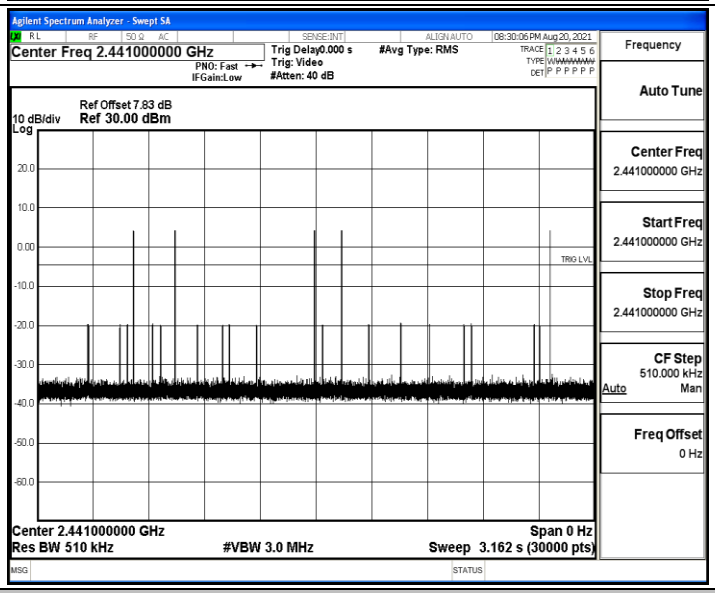

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.479500000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
08:43:28 PM Aug 20, 2021
Ref Offset 7.83 dB
10 dB/div Ref 30.00 dBm
Log
ΔMkr2 980 kHz
-0.733 dB
Start 2.478500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.480500 GHz
Sweep 1.000 ms (1001 pts)
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

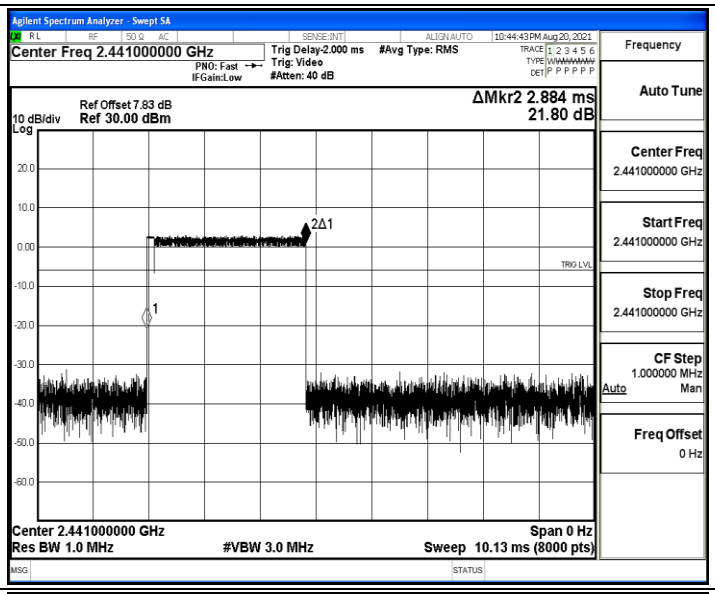
A.5 Time of occupancy

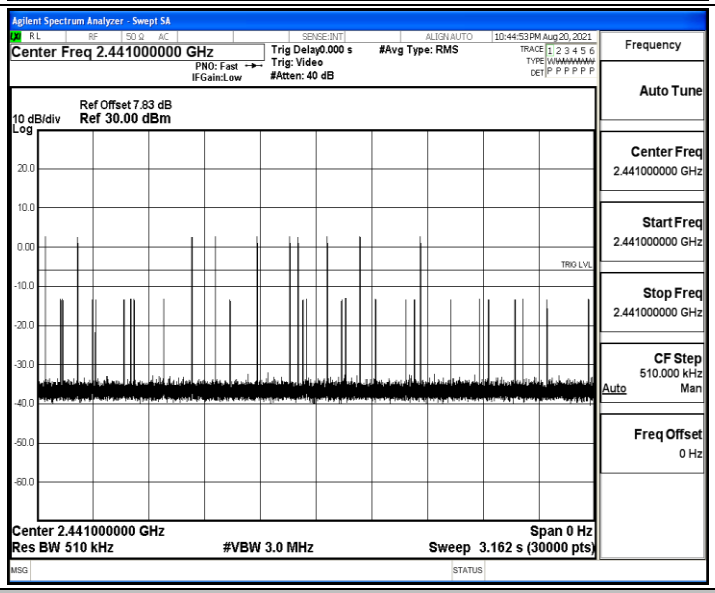
Test Result

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH5	Ant1	Hop	2.88	60	0.173	≤0.4	PASS
2DH5	Ant1	Hop	2.88	110	0.317	≤0.4	PASS
3DH5	Ant1	Hop	2.89	60	0.173	≤0.4	PASS

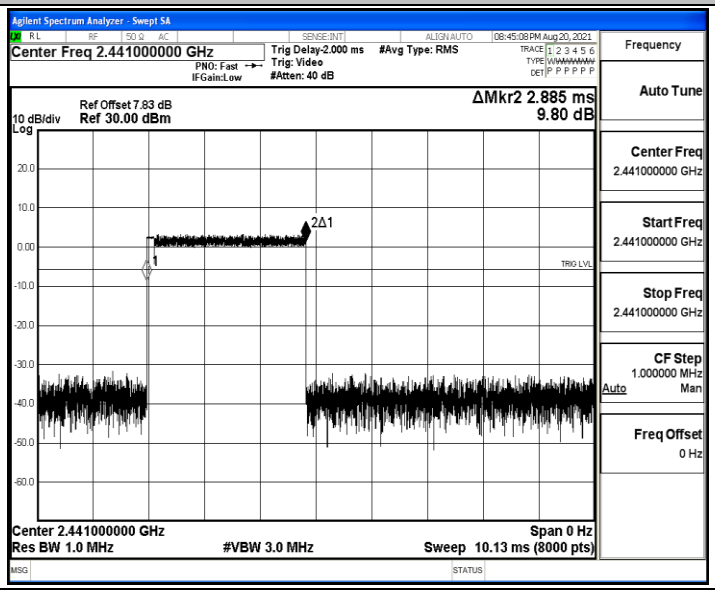
Test Graphs

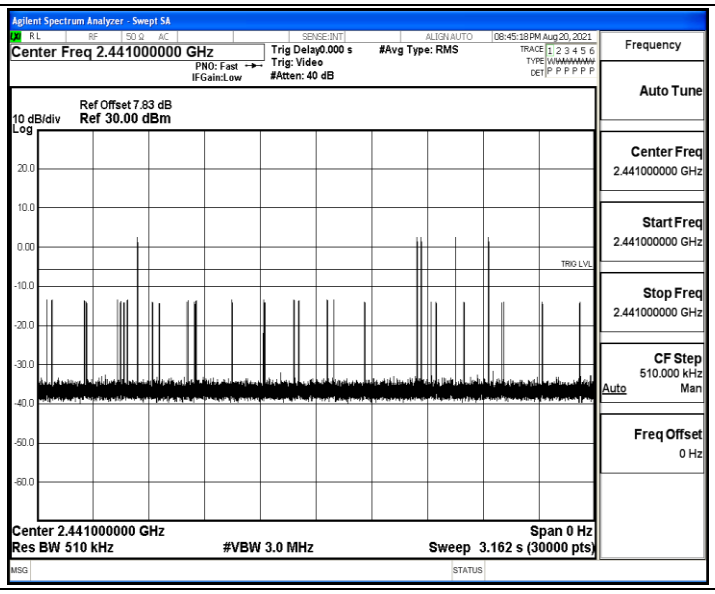
DH5_Ant1_Hop


2DH5_Ant1_Hop





3DH5_Ant1_Hop




Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
Trig Delay0.000 s
#Avg Type: RMS
PNO: Fast
IFGain:Low
Trig: Video
#Atten: 40 dB
08:45:18 PM Aug 20, 2021
Ref Offset 7.83 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
TRIG LVL
Center 2.441000000 GHz
Span 0 Hz
Res BW 510 kHz
#VBW 3.0 MHz
Sweep 3.162 s (30000 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.441000000 GHz
Stop Freq
2.441000000 GHz
CF Step
510.000 kHz
Auto
Man
Freq Offset
0 Hz

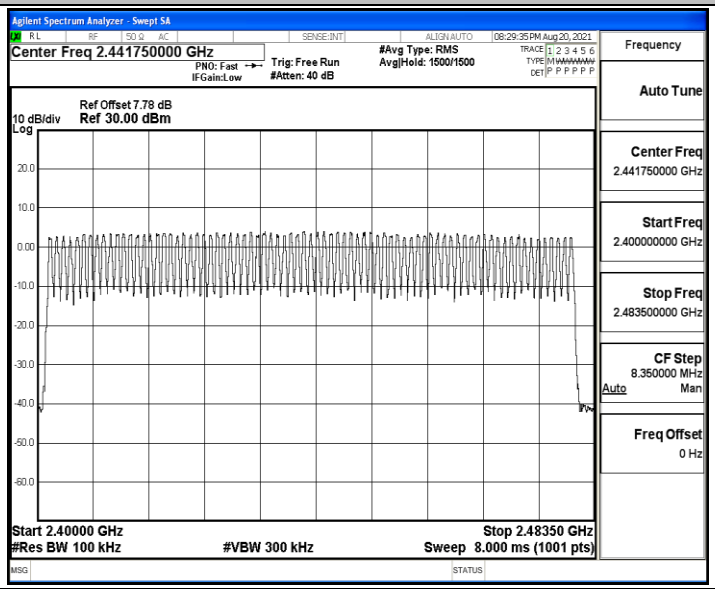
A.6 Number of hopping channels

Test Result

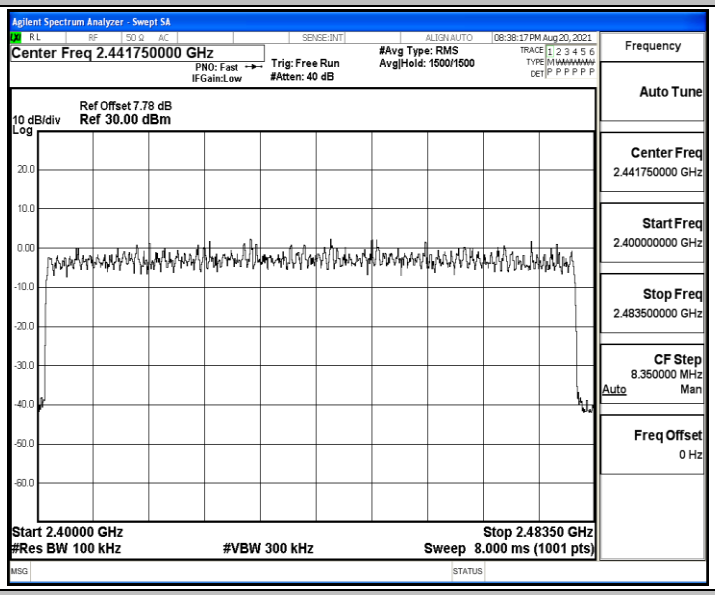
TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

Test Graphs

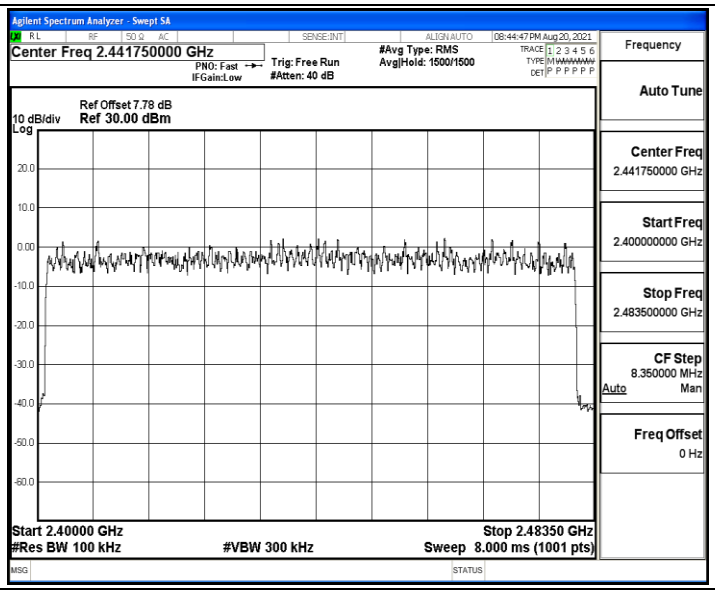
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 1500/1500
08:44:47 PM Aug 20, 2021
Ref Offset 7.78 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.441750000 GHz
Start Freq
2.400000000 GHz
Stop Freq
2.483500000 GHz
CF Step
8.350000 MHz
Auto
Man
Freq Offset
0 Hz

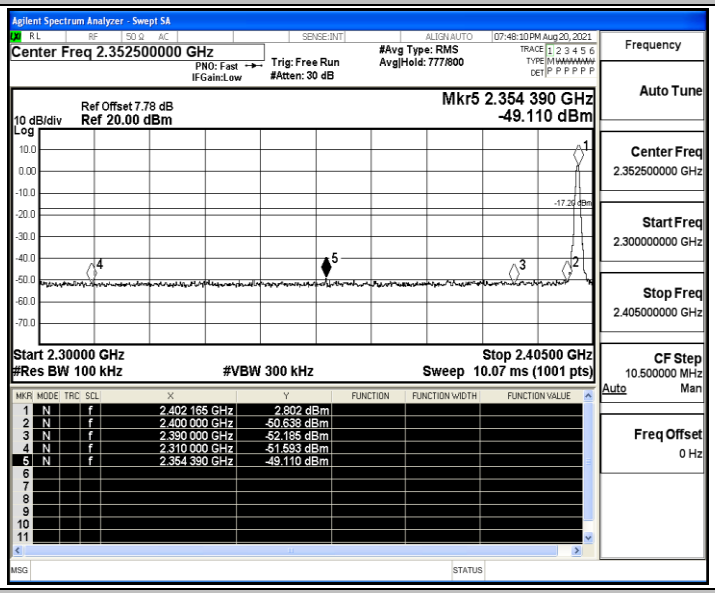
A.7 Band edge measurements

Test Result

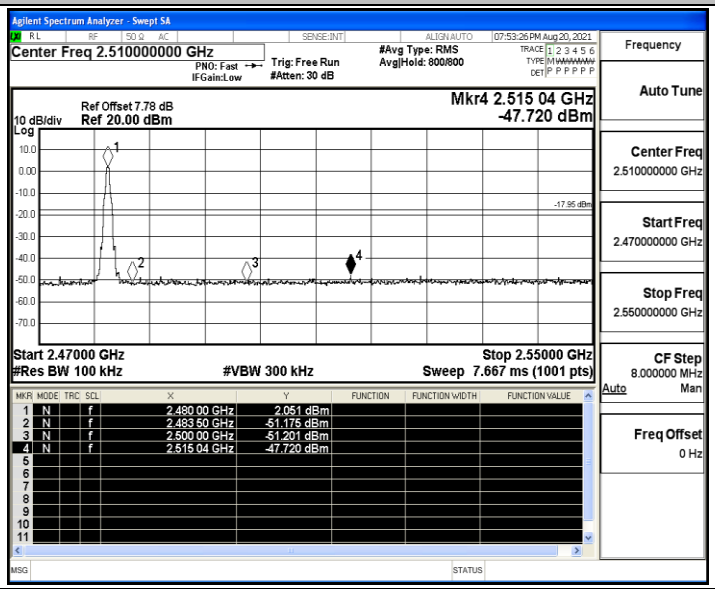
TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	2.80	-49.11	≤-17.2	PASS
		High	2480	2.05	-47.72	≤-17.95	PASS
		Low	Hop_2402	2.75	-49.13	≤-17.25	PASS
		High	Hop_2480	3.21	-48.55	≤-16.79	PASS
2DH5	Ant1	Low	2402	-0.24	-49.49	≤-20.24	PASS
		High	2480	0.75	-48.73	≤-19.25	PASS
		Low	Hop_2402	-1.55	-49.77	≤-21.55	PASS
		High	Hop_2480	1.71	-48.58	≤-18.29	PASS
3DH5	Ant1	Low	2402	0.87	-49.6	≤-19.13	PASS
		High	2480	1.28	-48.72	≤-18.72	PASS
		Low	Hop_2402	-1.72	-49.91	≤-21.72	PASS
		High	Hop_2480	0.86	-48.1	≤-19.14	PASS

Test Graphs

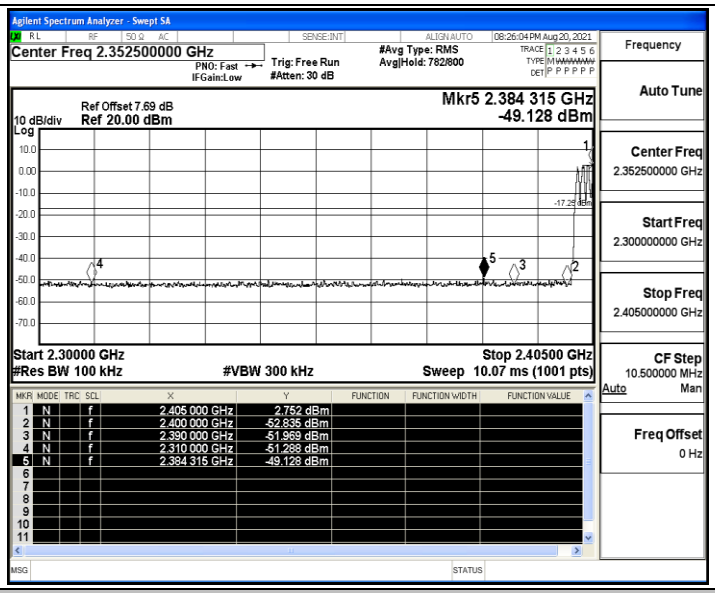
DH5_Ant1_Low_2402



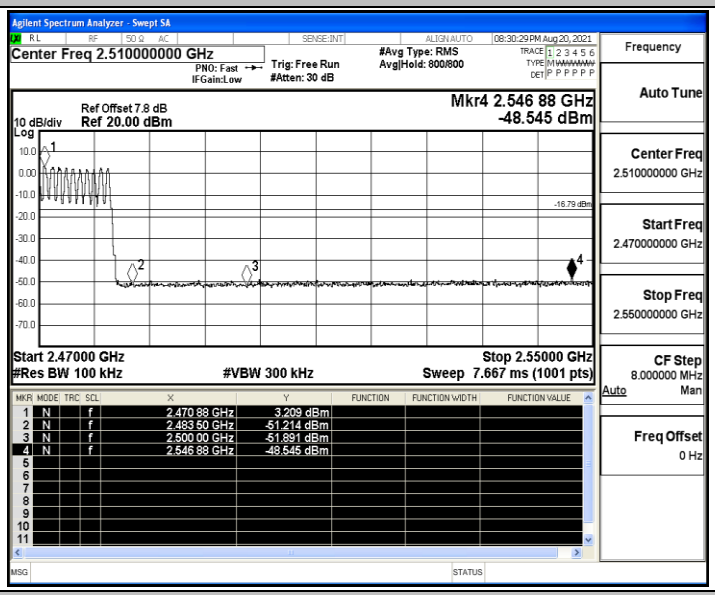
DH5_Ant1_High_2480



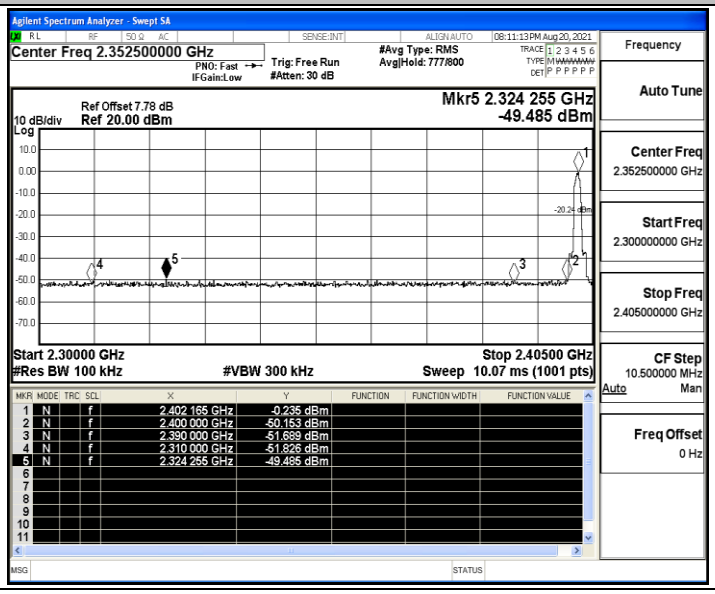
DH5_Ant1_Low_Hop_2402



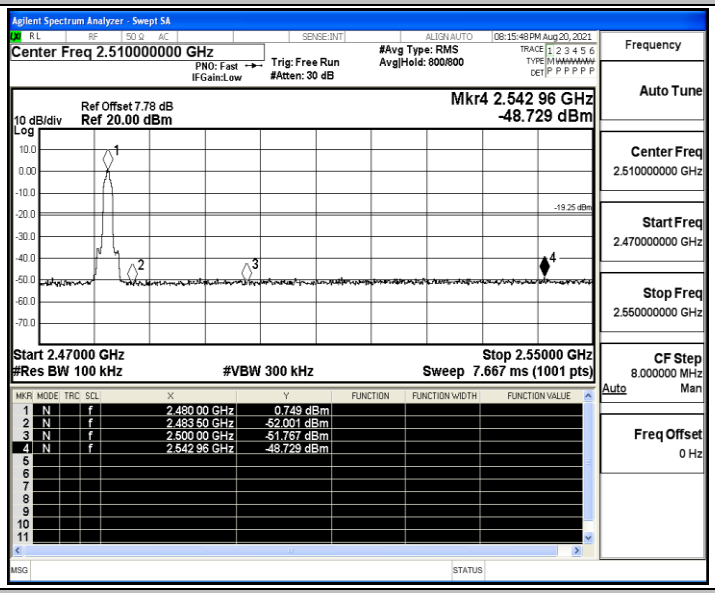
DH5_Ant1_High_Hop_2480



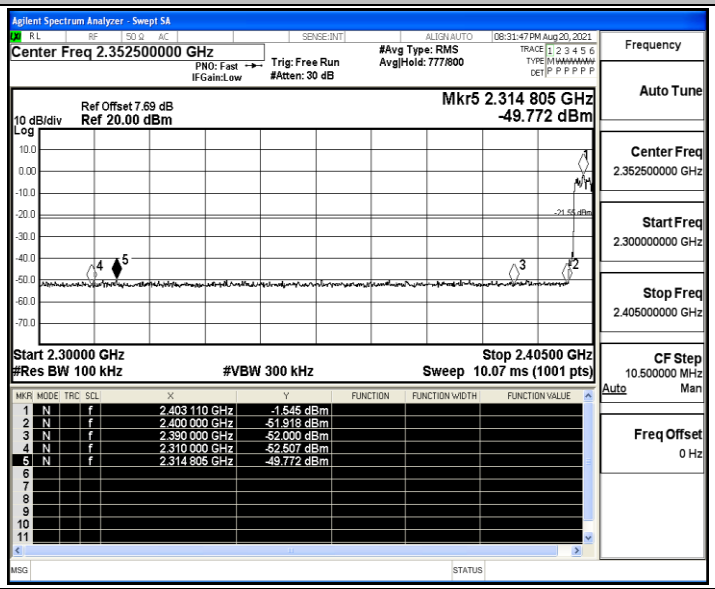
2DH5_Ant1_Low_2402



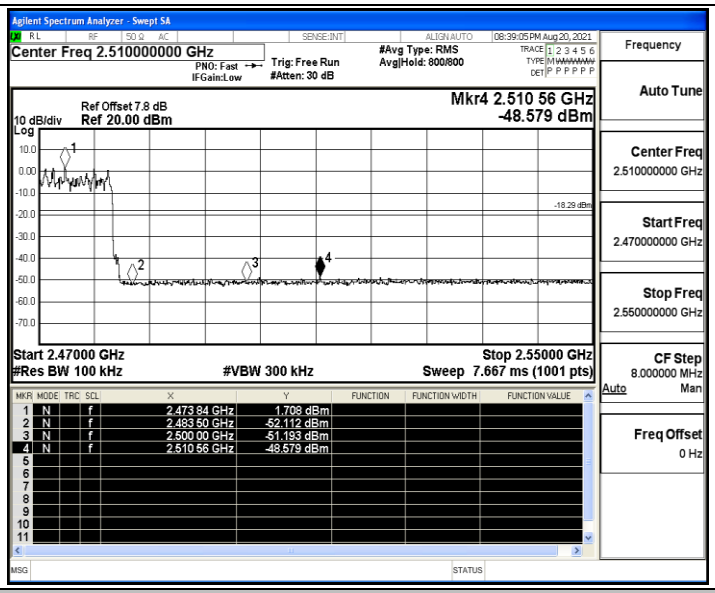
2DH5_Ant1_High_2480



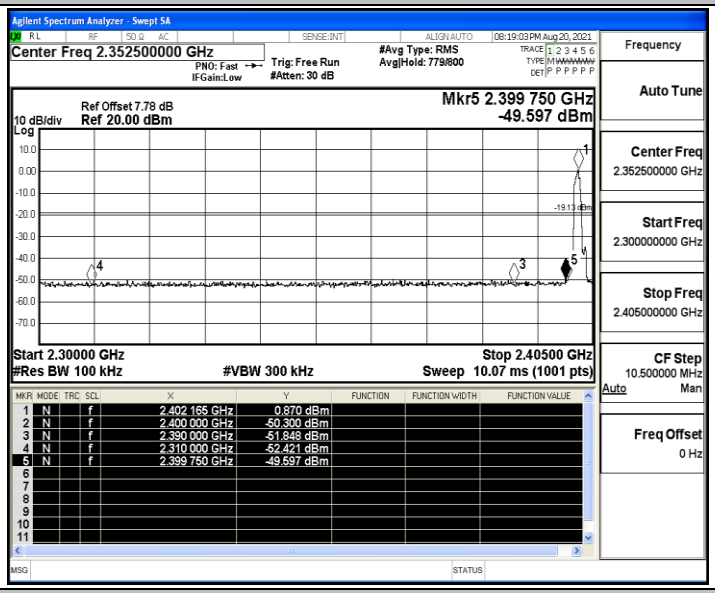
2DH5_Ant1_Low_Hop_2402



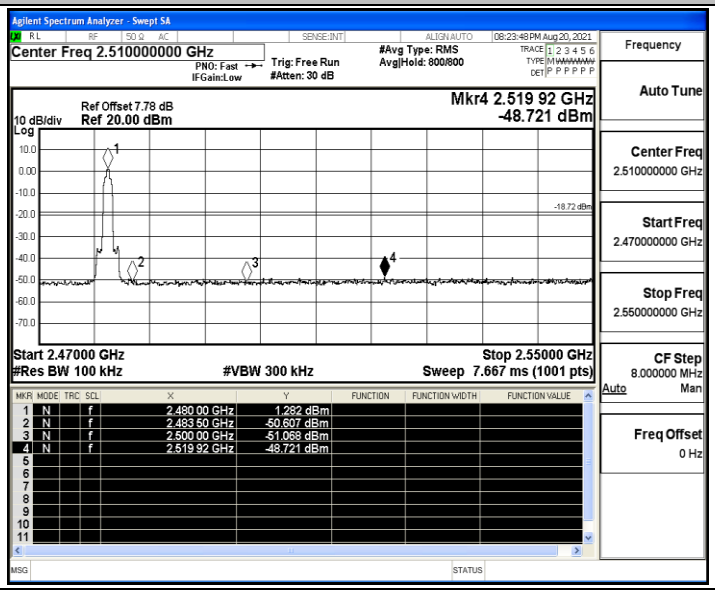
2DH5_Ant1_High_Hop_2480



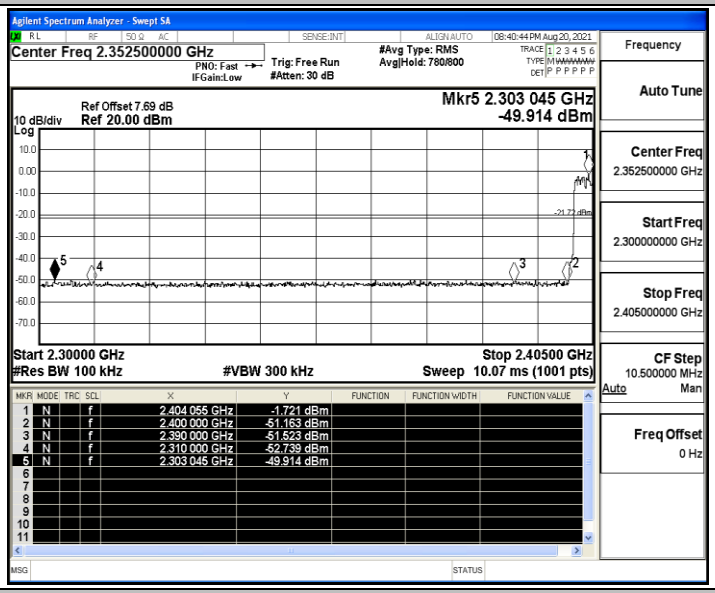
3DH5_Ant1_Low_2402



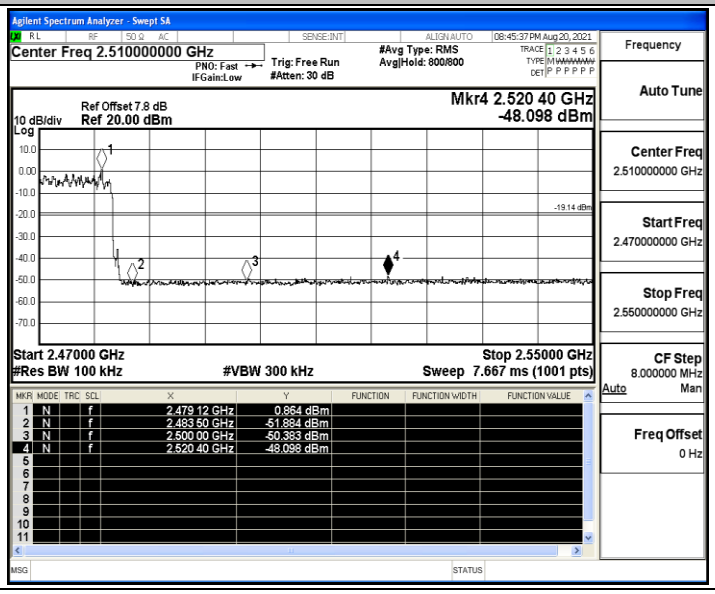
3DH5_Ant1_High_2480



3DH5_Ant1_Low_Hop_2402



3DH5_Ant1_High_Hop_2480



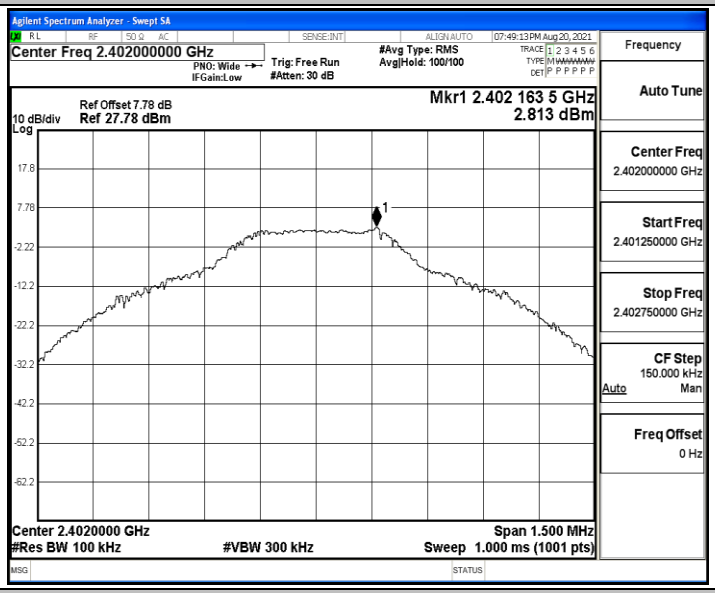
A.8 Conducted Spurious Emission

Test Result

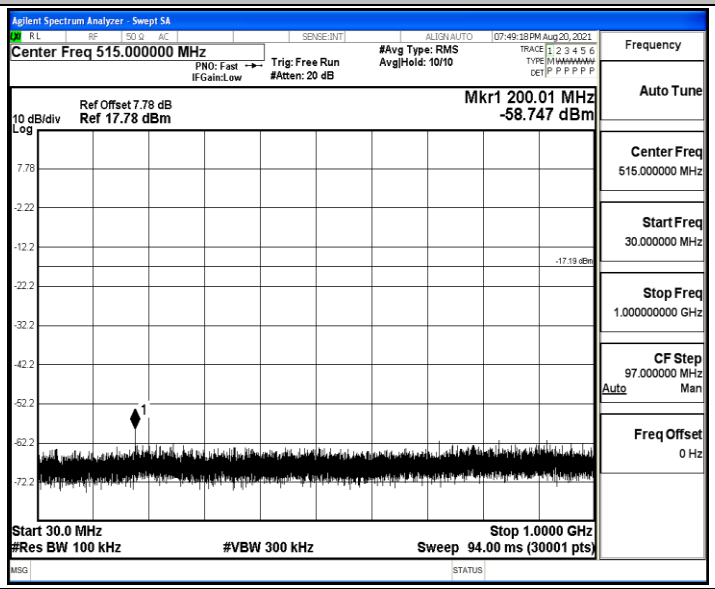
TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	2.81	2.81	---	PASS
			30~1000	2.81	-58.75	≤-17.19	PASS
			1000~26500	2.81	-47.56	≤-17.19	PASS
		2441	Reference	3.57	3.57	---	PASS
			30~1000	3.57	-59.26	≤-16.44	PASS
			1000~26500	3.57	-48.06	≤-16.44	PASS
		2480	Reference	1.33	1.33	---	PASS
			30~1000	1.33	-58.68	≤-18.67	PASS
			1000~26500	1.33	-46.71	≤-18.67	PASS
2DH5	Ant1	2402	Reference	0.90	0.90	---	PASS
			30~1000	0.90	-59.04	≤-19.1	PASS
			1000~26500	0.90	-47.55	≤-19.1	PASS
		2441	Reference	2.09	2.09	---	PASS
			30~1000	2.09	-59.36	≤-17.91	PASS
			1000~26500	2.09	-47.76	≤-17.91	PASS
		2480	Reference	-1.53	-1.53	---	PASS
			30~1000	-1.53	-57.76	≤-21.53	PASS
			1000~26500	-1.53	-47.67	≤-21.53	PASS
3DH5	Ant1	2402	Reference	1.25	1.25	---	PASS
			30~1000	1.25	-58.45	≤-18.75	PASS
			1000~26500	1.25	-47.88	≤-18.75	PASS
		2441	Reference	2.47	2.47	---	PASS
			30~1000	2.47	-58.66	≤-17.53	PASS
			1000~26500	2.47	-47.19	≤-17.53	PASS
		2480	Reference	0.30	0.30	---	PASS
			30~1000	0.30	-58.48	≤-19.7	PASS
			1000~26500	0.30	-47.52	≤-19.7	PASS

Test Graphs

DH5_Ant1_2402_0~Reference



DH5_Ant1_2402_30~1000



DH5_Ant1_2402_1000~26500