

FCC Appendix RF Test Data for BLE

FCC ID : 2ADOE-PHPLUS2

Company : Industrial Test Systems, Inc.

EUT : Water quality tester

Model Number : PHPLUS2

Report No. : CTA26040901001

Reviewed By : Eric Wang

Appendix A: DTS Bandwidth

Test Result

TestMode	Antenna	Freq(MHz)	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.640	2401.696	2402.336	0.5	PASS
		2440	0.640	2439.696	2440.336	0.5	PASS
		2480	0.636	2479.700	2480.336	0.5	PASS

Agilent Spectrum Analyzer - Sweep SA

Center Freq 2.40200000 GHz

Ref Offset 0.4 dB
Ref 30.00 dBm

Trig: Free Run
#Atten: 40 dB

#Avg Type: RMS
Avg/Hold: 100/100

Trace 1 2 3 4 5 6 7 8 9 10 11

TYPE: MATH:MMMM
DET: P P P P P

Frequency

Auto Tune

Center Freq
2.40200000 GHz

Start Freq
2.40000000 GHz

Stop Freq
2.40400000 GHz

CF Step
400.000 kHz
Auto Man

Freq Offset
0 Hz

Span 4.000 MHz
Sweep 1.000 ms (1001 pts)

#Res BW 100 kHz
#VBW 300 kHz

Log

10 dB/div

20.0

10.0

0.00

-10.0

-20.0

-30.0

-40.0

-50.0

-60.0

1

2

3Δ1

ΔMkr3 640 kHz
0.288 dB

-0.34 dB

MKR	MODE	TRIG	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.401696 GHz	-9.222 dBm			
2	N	1	f	2.402020 GHz	-3.338 dBm			
3	Δ1	1	f (Δ)	640 kHz (Δ)	0.288 dB			

MSG

STATUS

BLE_1M_Ant1_2402

Agilent Spectrum Analyzer - Sweep SA

Center Freq 2.44000000 GHz

Ref Offset 0.4 dB
Ref 30.00 dBm

Trig: Free Run
#Atten: 40 dB

#Avg Type: RMS
Avg/Hold: 100/100

Trace 1 2 3 4 5 6 7 8 9 10 11

TYPE: MATH:MMMM
DET: P P P P P

Frequency

Auto Tune

Center Freq
2.44000000 GHz

Start Freq
2.43800000 GHz

Stop Freq
2.44200000 GHz

CF Step
400.000 kHz
Auto Man

Freq Offset
0 Hz

Span 4.000 MHz
Sweep 1.000 ms (1001 pts)

#Res BW 100 kHz
#VBW 300 kHz

Log

10 dB/div

20.0

10.0

0.00

-10.0

-20.0

-30.0

-40.0

-50.0

-60.0

1

2

3Δ1

ΔMkr3 640 kHz
0.010 dB

-0.67 dB

MKR	MODE	TRIG	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.439696 GHz	-9.560 dBm			
2	N	1	f	2.440024 GHz	-3.668 dBm			
3	Δ1	1	f (Δ)	640 kHz (Δ)	0.010 dB			

MSG

STATUS

BLE_1M_Ant1_2440

Agilent Spectrum Analyzer - Sweep SA

Center Freq 2.48000000 GHz

Ref Offset 0.4 dB
Ref 30.00 dBm

Trig: Free Run
#Atten: 40 dB

#Avg Type: RMS
Avg/Hold: 100/100

Trace 1 2 3 4 5 6 7 8 9 10 11

TYPE: MATH:MMMM
DET: P P P P P

Frequency

Auto Tune

Center Freq
2.48000000 GHz

Start Freq
2.47800000 GHz

Stop Freq
2.48200000 GHz

CF Step
400.000 kHz
Auto Man

Freq Offset
0 Hz

Span 4.000 MHz
Sweep 1.000 ms (1001 pts)

#Res BW 100 kHz
#VBW 300 kHz

Log

10 dB/div

20.0

10.0

0.00

-10.0

-20.0

-30.0

-40.0

-50.0

-60.0

1

2

3Δ1

ΔMkr3 640 kHz
0.010 dB

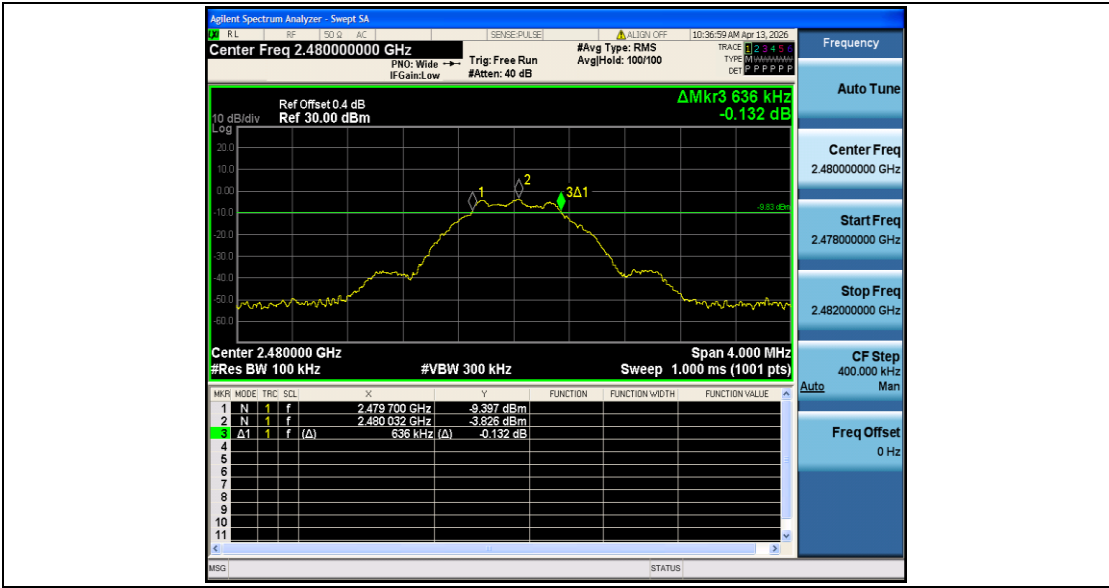
-0.67 dB

MKR	MODE	TRIG	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.479696 GHz	-9.560 dBm			
2	N	1	f	2.480024 GHz	-3.668 dBm			
3	Δ1	1	f (Δ)	640 kHz (Δ)	0.010 dB			

MSG

STATUS

BLE_1M_Ant1_2480

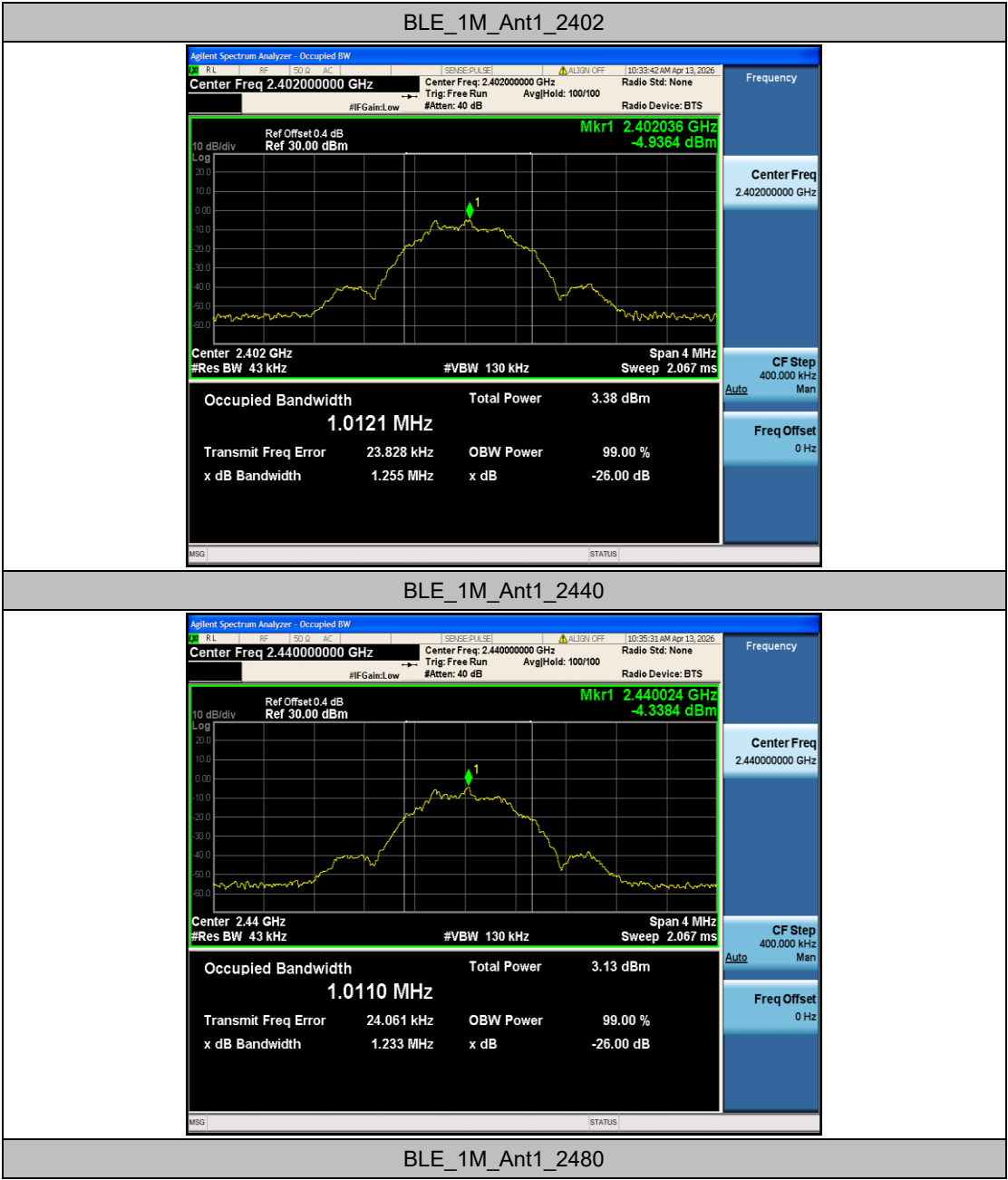


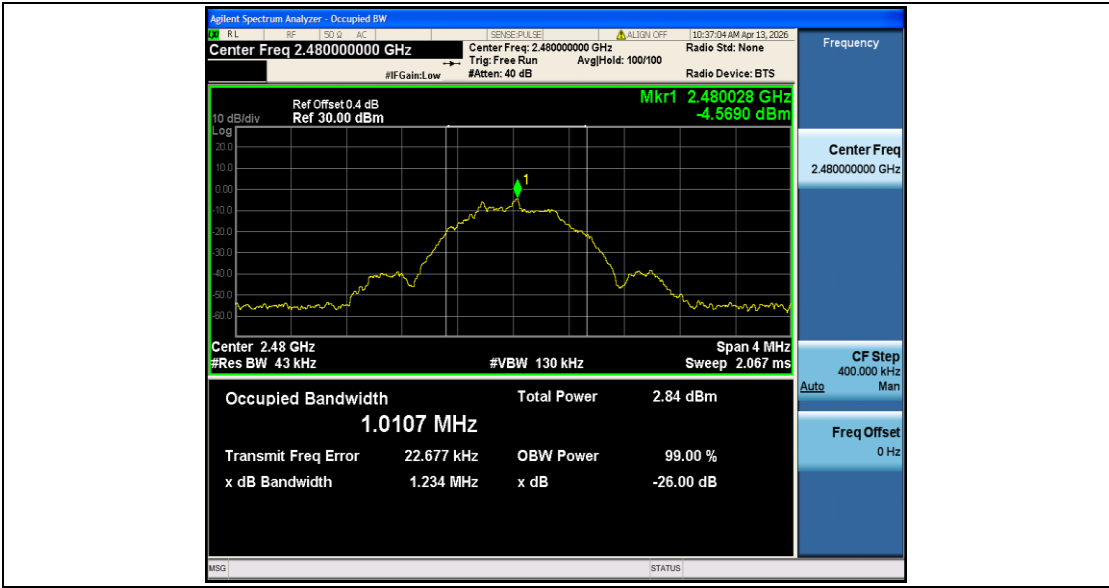
Appendix B: Occupied Channel Bandwidth

Test Result

TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0121	2401.5178	2402.5299	---	---
		2440	1.0110	2439.5186	2440.5296	---	---
		2480	1.0107	2479.5173	2480.5280	---	---

Test Graphs





Appendix C: Maximum conducted output power

Test Result Peak

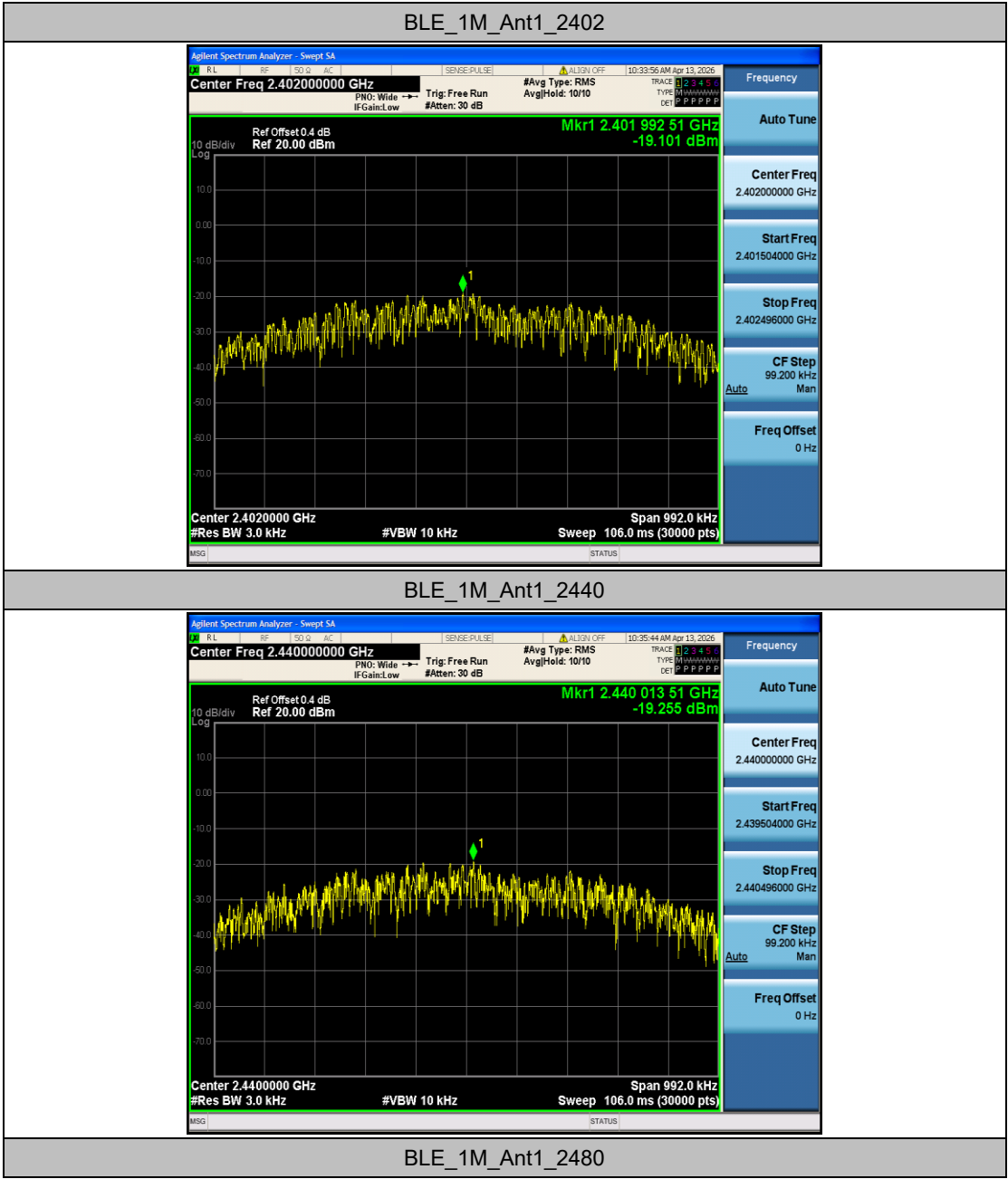
TestMode	Antenna	Freq(MHz)	Conducted Peak Power[dBm]	Conducted Limit[dBm]	Verdict
BLE_1M	Ant1	2402	-3.26	≤30	PASS
		2440	-3.58	≤30	PASS
		2480	-3.71	≤30	PASS

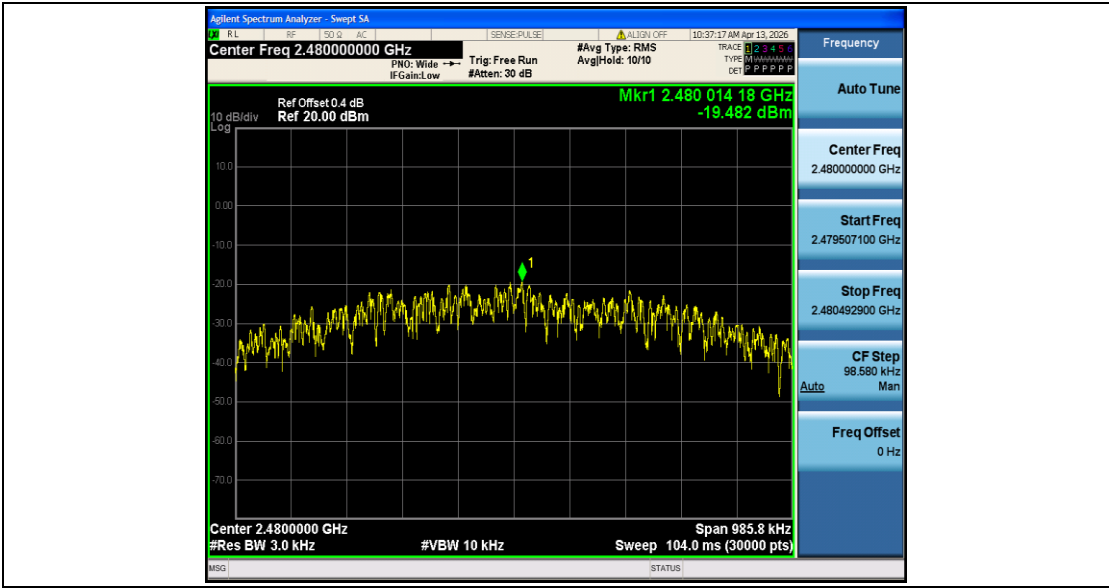
Appendix D: Maximum power spectral density

Test Result

TestMode	Antenna	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-19.10	≤8.00	PASS
		2440	-19.26	≤8.00	PASS
		2480	-19.48	≤8.00	PASS

Test Graphs



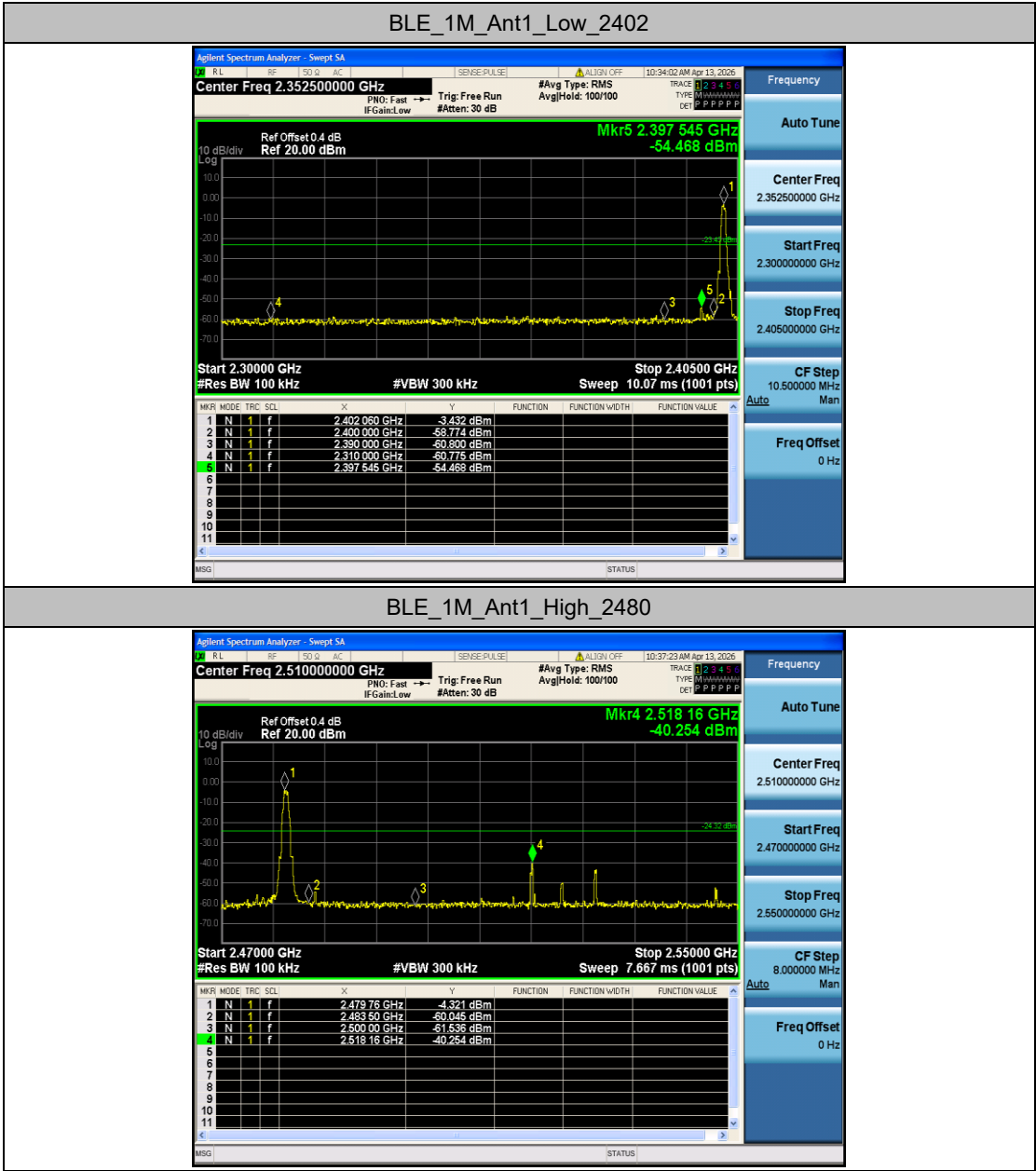


Appendix E: Band edge measurements

Test Result

TestMode	Antenna	Channel	Freq(MHz)	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	-3.43	-54.47	≤-23.43	PASS
		High	2480	-4.32	-40.25	≤-24.32	PASS

Test Graphs

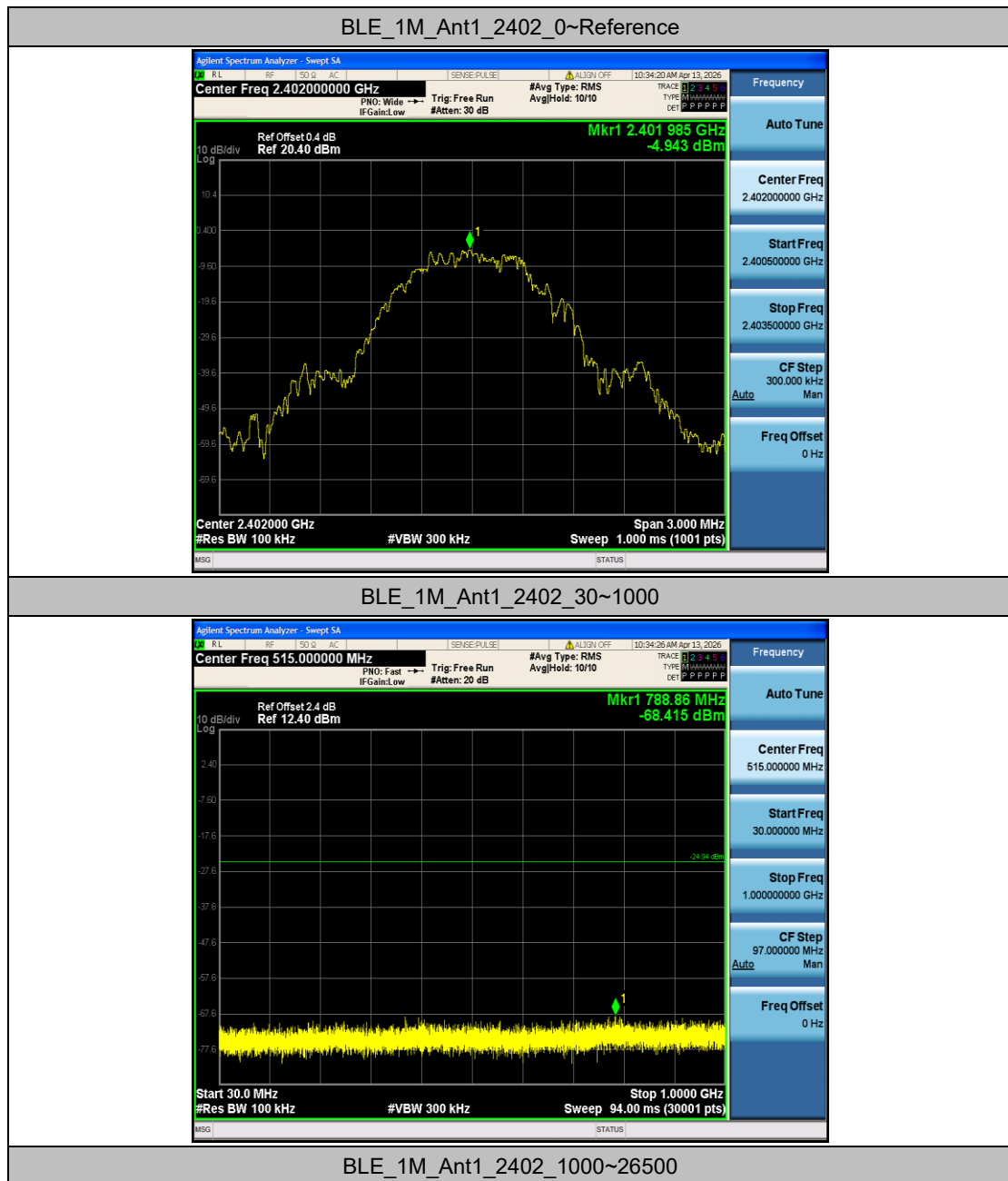


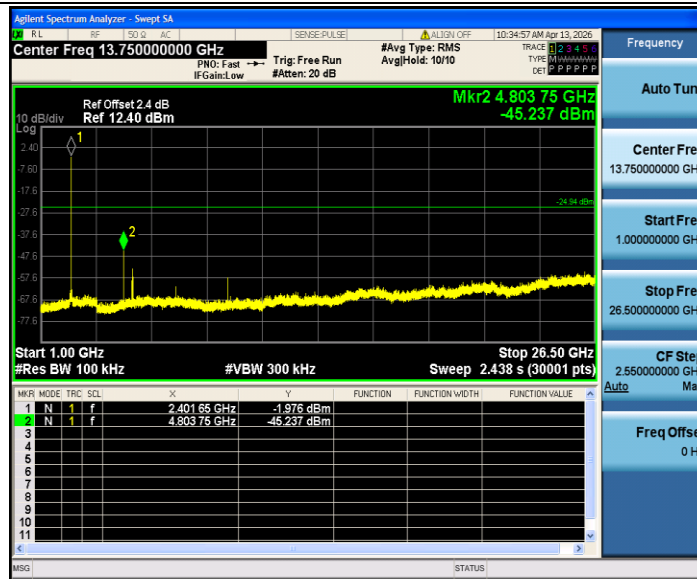
Appendix F: Conducted Spurious Emission

Test Result

TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	Reference	-4.94	-4.94	---	PASS
			30~1000	-4.94	-68.42	≤-24.94	PASS
			1000~26500	-4.94	-45.24	≤-24.94	PASS
		2440	Reference	-4.56	-4.56	---	PASS
			30~1000	-4.56	-68.14	≤-24.56	PASS
			1000~26500	-4.56	-47.49	≤-24.56	PASS
		2480	Reference	-4.27	-4.27	---	PASS
			30~1000	-4.27	-67.55	≤-24.27	PASS
			1000~26500	-4.27	-47.53	≤-24.27	PASS

Test Graphs

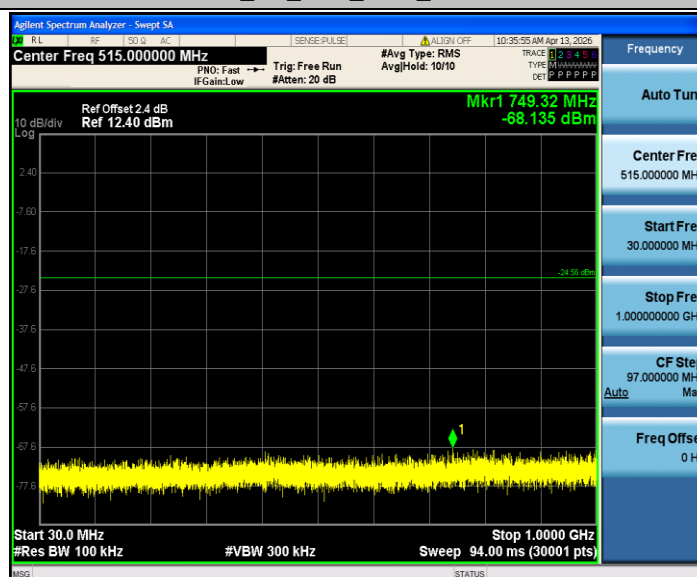




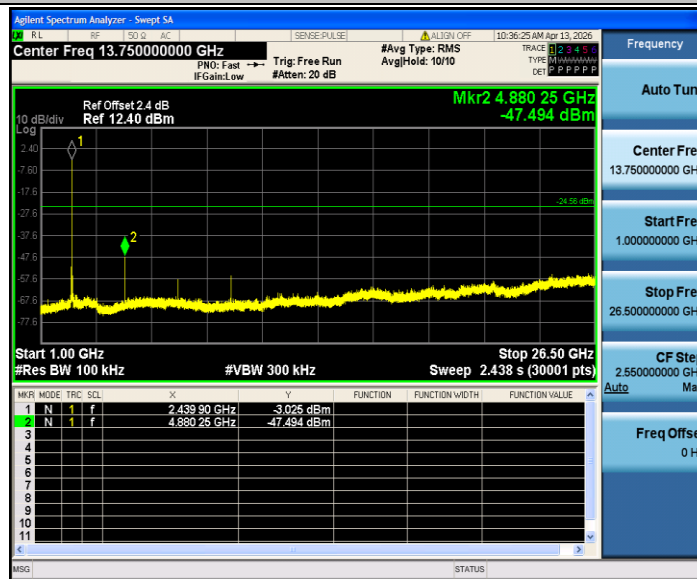
BLE_1M_Ant1_2440_0~Reference



BLE_1M_Ant1_2440_30~1000



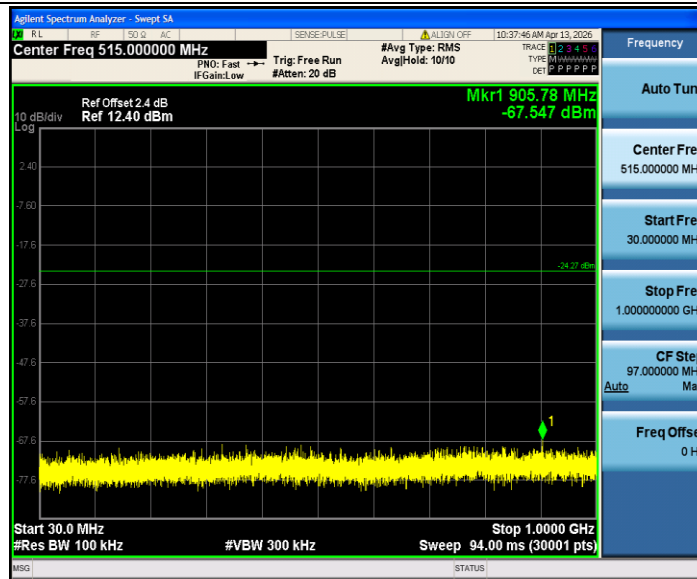
BLE_1M_Ant1_2440_1000~26500



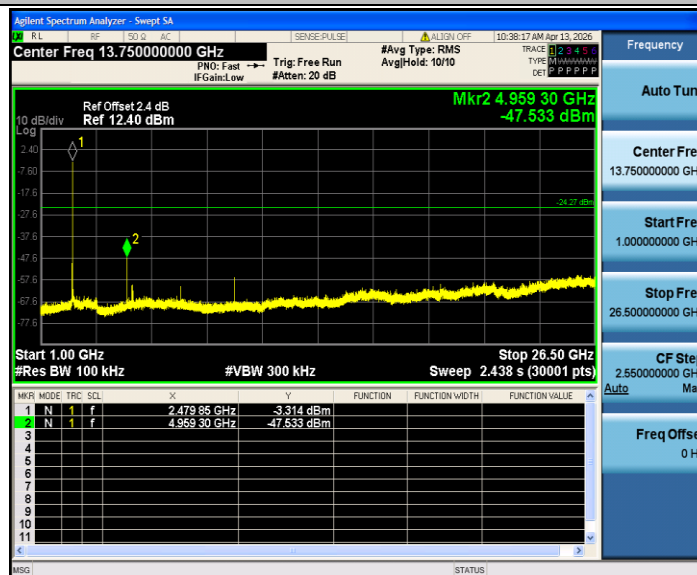
BLE_1M_Ant1_2480_0~Reference



BLE_1M_Ant1_2480_30~1000



BLE_1M_Ant1_2480_1000~26500

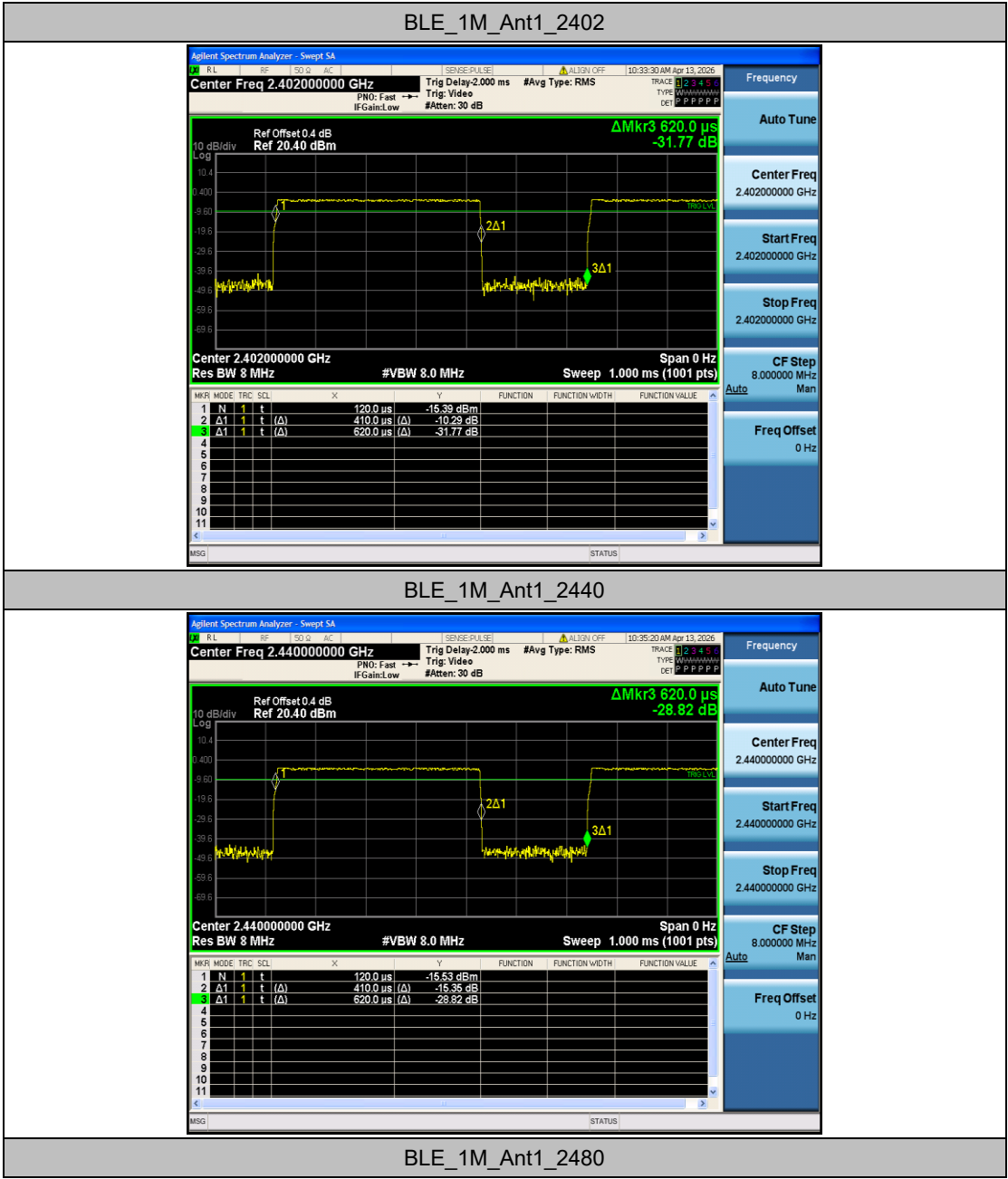


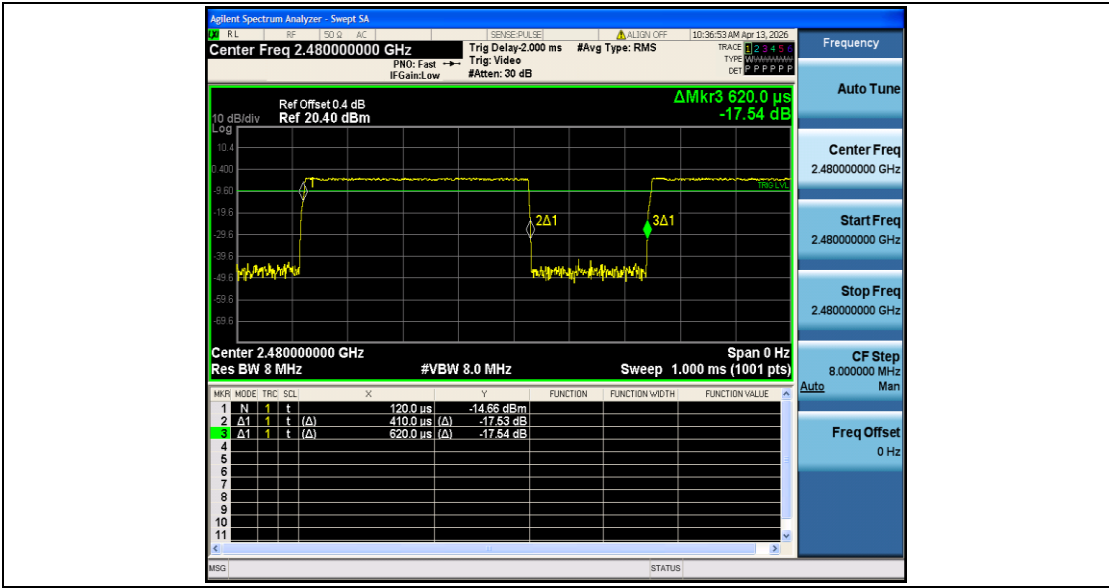
Appendix G: Duty Cycle

Test Result

TestMode	Antenna	Freq(MHz)	ON Time [ms]	Period [ms]	X	DC [%]	xFactor	Limit	Verdict
BLE_1M	Ant1	2402	0.41	0.62	0.6613	66.13	1.80	---	---
		2440	0.41	0.62	0.6613	66.13	1.80	---	---
		2480	0.41	0.62	0.6613	66.13	1.80	---	---

Test Graphs





Appendix H: Emissions in Restricted Bands

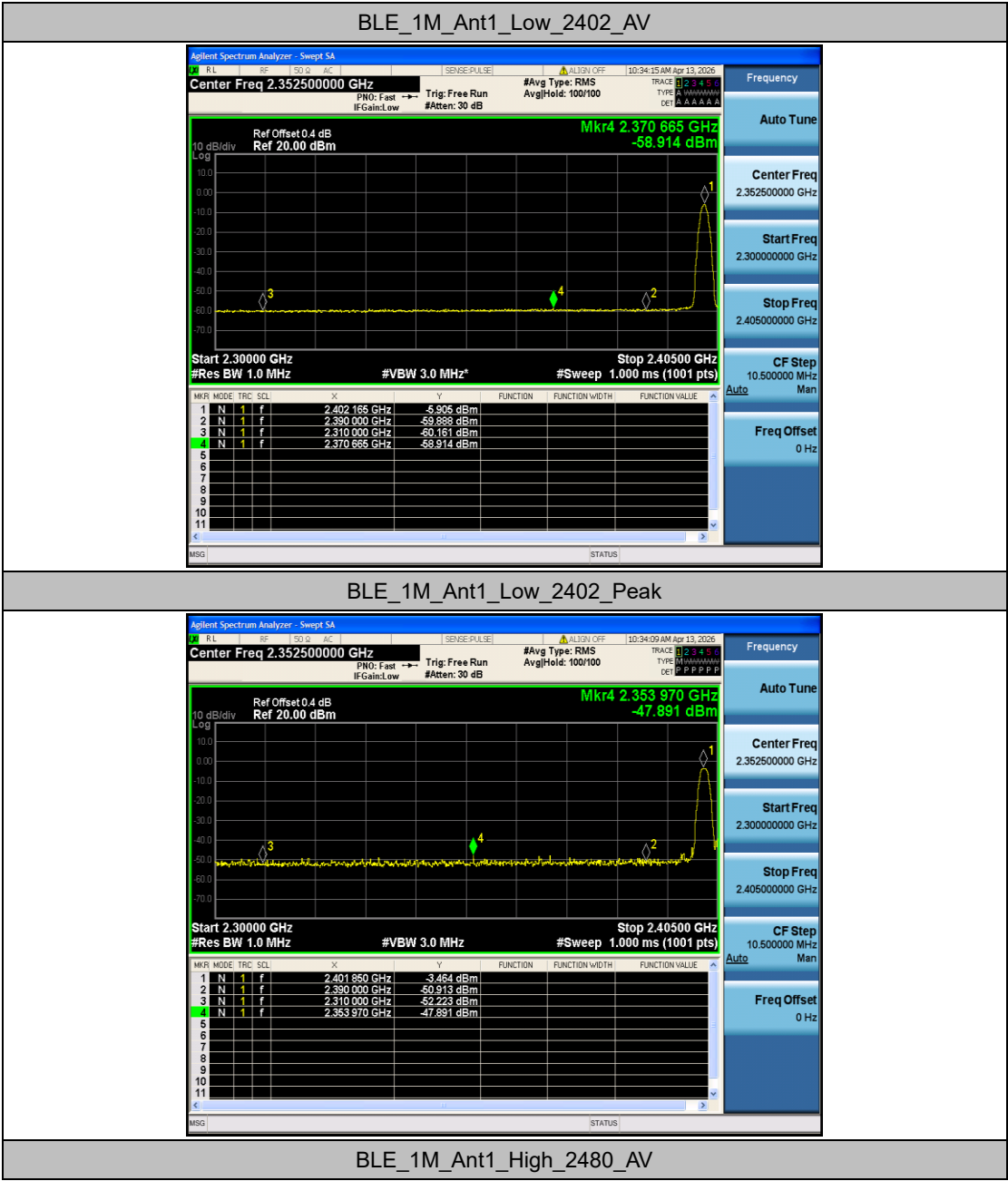
Test Result

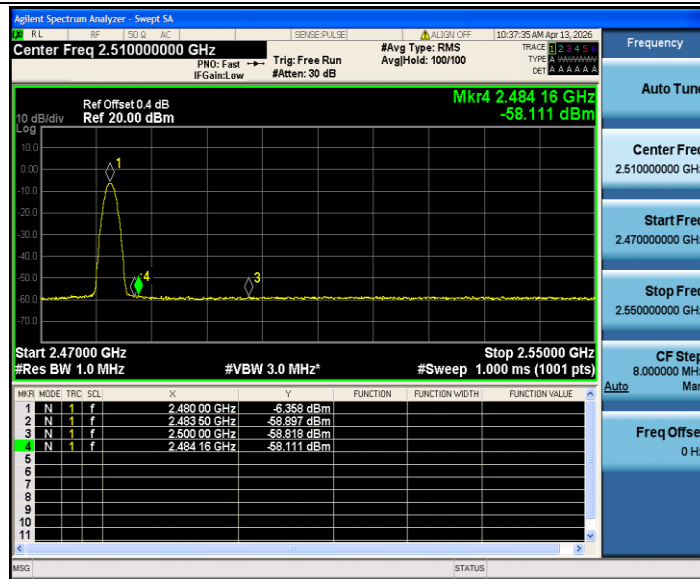
TestMode	Antenna	ChName	Freq(MHz)	Detector	Freq [MHz]	Result [dBm]	Gain [dB]	DC Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Verdict
BLE_1M	Ant1	Low	2402	AV	2310.000	-60.16	2.99	1.80	39.83	≤54	PASS
				AV	2370.665	-58.91	2.99	1.80	41.08	≤54	PASS
				AV	2390.000	-59.89	2.99	1.80	40.1	≤54	PASS
				Peak	2310.000	-52.22	2.99	0.00	45.97	≤74	PASS
				Peak	2353.970	-47.89	2.99	0.00	50.3	≤74	PASS
				Peak	2390.000	-50.91	2.99	0.00	47.28	≤74	PASS
		High	2480	AV	2483.500	-58.9	2.99	1.80	41.09	≤54	PASS
				AV	2484.160	-58.11	2.99	1.80	41.88	≤54	PASS
				AV	2500.000	-58.82	2.99	1.80	41.17	≤54	PASS
				Peak	2483.500	-50.63	2.99	0.00	47.56	≤74	PASS
				Peak	2488.320	-48.59	2.99	0.00	49.6	≤74	PASS
				Peak	2500.000	-51.65	2.99	0.00	46.54	≤74	PASS

Note:

The limit in dBm for average detector is conversion from 54dBuV/m, according to 15.209(a). The limit in dBm for peak detector is 20dB above the limit of average detector in dBm.

Test Graphs





BLE_1M_Ant1_High_2480_Peak

