

FCC/ISED Test Report

Prepared for: HerdDogg, Inc.

Address: 612 Seward Ave.,
Seward, NE 68434

Product: HerdDogg Welfare Tag

Test Report No: R20240524-00-E1 **Rev:** A

Approved by:


Fox Lane,
EMC Test Engineer

DATE: January 2, 2025

Total Pages: 43

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REVISION PAGE

Rev. No.	Date	Description
0	22 October 2024	Issued by FLane Reviewed by KVepuri Prepared by FLane
A	2 January 2025	Included setup diagram in radiated emissions section, Added emission range statement, Corrected figure labeling – FL

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1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

FCC Part 15.247

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISSED RSS-Gen, Issue 5
- (3) ISSED RSS-247, Issue 3

APPLIED STANDARDS AND REGULATIONS		
Standard Section	Test Type	Result
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(b)(3) RSS-247 Issue 3 Section 5.4(d)	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 3 Section 5.2 (a)	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 3 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(e) RSS-247 Issue 3 Section 5.2 (b)	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 3 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	NA – Battery Powered Device



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2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

Client	HerdDogg, Inc.
EUT	HerdDogg Welfare Tag
Model	HerdDogg Welfare Tag
IC	33208-1129
FCC ID	2BF8K1129
EUT Received	16 September 2024
EUT Tested	16 September 2024
Serial No.	001 Radiated Unit (Lab assigned SN) 002 Radiated Unit (Lab assigned SN) 003 Conducted Unit (Lab assigned SN)
Operating Band	2400 – 2483.5 MHz
Device Type	☒ GMSK ☐ GFSK ☐ BT BR ☐ BT EDR 2MB ☐ BT EDR 3MB ☐ 802.11x
Power Supply / Voltage	3VDC Internal Battery

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

GMSK Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

2.3 DESCRIPTION OF SUPPORT UNITS

None

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3.0 LABORATORY AND GENERAL TEST DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number: 1953.01
FCC Accredited Test Site Designation No: US1060
Industry Canada Test Site Registration No: 4294A
NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of $35 \pm 4\%$
Temperature of $22 \pm 3^\circ$ Celsius



3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Fox Lane	Test Engineer	Testing and Report
2	Ethan Schmidt	Test Engineer	Report

Notes: All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

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3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	July 17, 2024	July 18, 2026
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 18, 2023	July 17, 2025
SunAR RF Motion	JB1	A091418-1	July 17, 2024	July 17, 2025
EMCO Horn Antenna	3117	29616	June 12, 2024	June 12, 2025
ETS Red Preamplifier (Orange)*	3115-PA	00218576	January 22, 2024	January 22, 2026
Agilent Preamp*	87405A	3207A01475	May 2, 2024	May 2, 2026
Trilithic High Pass Filter*	6HC330	23042	June 5, 2023	June 5, 2025
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	June 5, 2023	June 5, 2025
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	May 15, 2024	May 15, 2027
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 22, 2024	May 22, 2026
RF Cables (3m Ant. to Control room Bulkhead)	MFR-57500	1E3874	June 5, 2023	June 5, 2025
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEEBH2	June 5, 2023	June 5, 2025
TDK Emissions Lab Software	V11.25	700307	NA	NA

*Internal Characterization

Notes:

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

Conducted – ☒

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

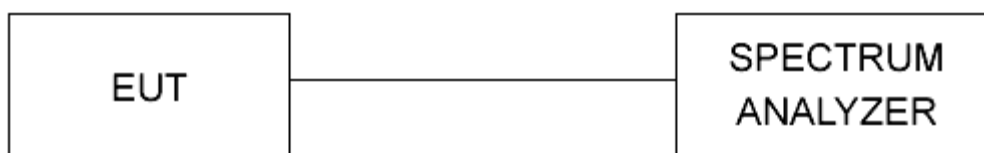


Figure 1 - Bandwidth Measurements Test Setup

Radiated ☒

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

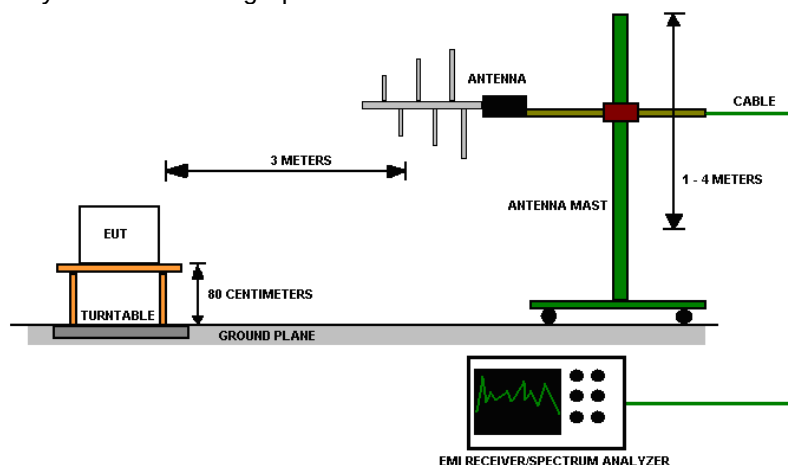


Figure 2 - Radiated Emissions Test Setup



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4.0 RESULTS**DTS Radio Measurements**

CHANNEL	Mode	Occupied BW (kHz)	6 dB BW (kHz)	PSD (dBm)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	RESULT
Low	BLE 1MB	1061.10	726.40	-5.007	7.671	5.849	PASS
Mid	BLE 1MB	1060.10	724.30	-4.42	7.571	5.716	PASS
High	BLE 1MB	1063.90	740.30	-4.429	7.550	5.689	PASS
Low	BLE 2MB	2063.10	1288.00	-8.345	7.717	5.912	PASS
Mid	BLE 2MB	2085.30	1225.00	-7.07	7.637	5.804	PASS
High	BLE 2MB	2059.50	1182.00	-7.504	7.596	5.749	PASS

Occupied Bandwidth = N/A; 6dB Bandwidth Limit = N/A

Peak Output Power Limit = 30dBm; PSD Limit = 8dBm

Unrestricted Band-Edge

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBm)	Relative Fundamental (dBm)	Delta (dB)	Min Delta (dB)	Result
Low	BLE 1MB	2400.00	60.21	114.04	53.83	20.00	PASS
Low	BLE 2MB	2400.00	81.70	113.62	31.92	20.00	PASS
High	BLE 1MB	2483.50	52.61	113.84	61.23	20.00	PASS
High	BLE 2MB	2483.50	57.74	113.42	55.67	20.00	PASS

Peak Restricted Band-Edge

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin	Result
Low	BLE 1MB	2390.00	55.19	Peak	73.98	18.79	PASS
Low	BLE 2MB	2390.00	55.14	Peak	73.98	18.84	PASS
High	BLE 1MB	2483.50	58.83	Peak	73.98	15.15	PASS
High	BLE 2MB	2483.50	62.94	Peak	73.98	11.04	PASS

*Limit shown is the peak limit taken from FCC Part 15.209

Average Restricted Band-Edge

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin	Result
Low	BLE 1MB	2390.00	43.03	Average	53.98	10.95	PASS
Low	BLE 2MB	2390.00	43.75	Average	53.98	10.23	PASS
High	BLE 1MB	2483.50	46.89	Average	53.98	7.09	PASS
High	BLE 2MB	2483.50	52.74	Average	53.98	1.24	PASS

*Limit shown is the average limit taken from FCC Part 15.209



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4.1 OUTPUT POWER

Test Method: All measurements were performed using section 11.9.1.1 from ANSI C63.10-2020.

Limits of power measurements:

For FCC Part 15.247 Device:

The maximum allowed output power is 30 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the output power plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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4.2 BANDWIDTH

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of bandwidth measurements:

For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational purpose only. The 6dB bandwidth of the signal must be greater than 500 kHz.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the bandwidth plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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4.3 DUTY CYCLE

Test Method:

Test software utilized >98% duty cycle and all tests were run with >98% duty cycle. Duty cycle correction was not applied to any of the measurements.

4.4 RADIATED EMISSIONS

Test Method: ANSI C63.10-2013, Section 6.5, 6.6

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH ($\mu\text{V/m}$)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level ($\text{dB}\mu\text{V/m}$) = $20 * \log * \text{Emission level } (\mu\text{V/m})$.
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.



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Test procedures:

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10-meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise, the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

Test setup:

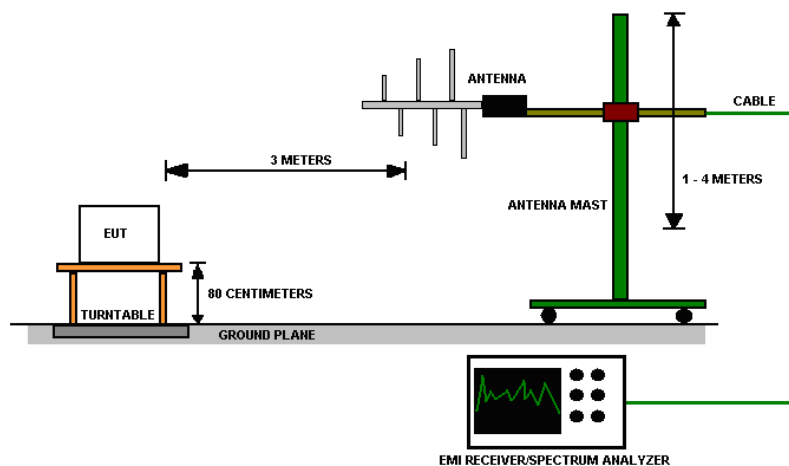


Figure 3 - Radiated Emissions Test Setup

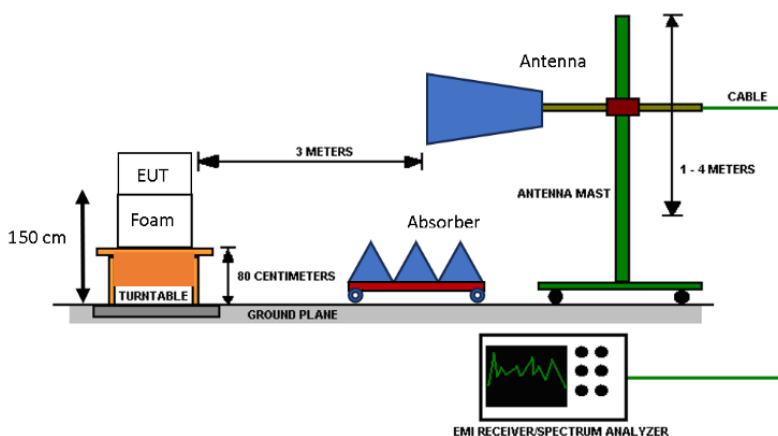


Figure 4 - Radiated Emissions Test Setup

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.

Test results:

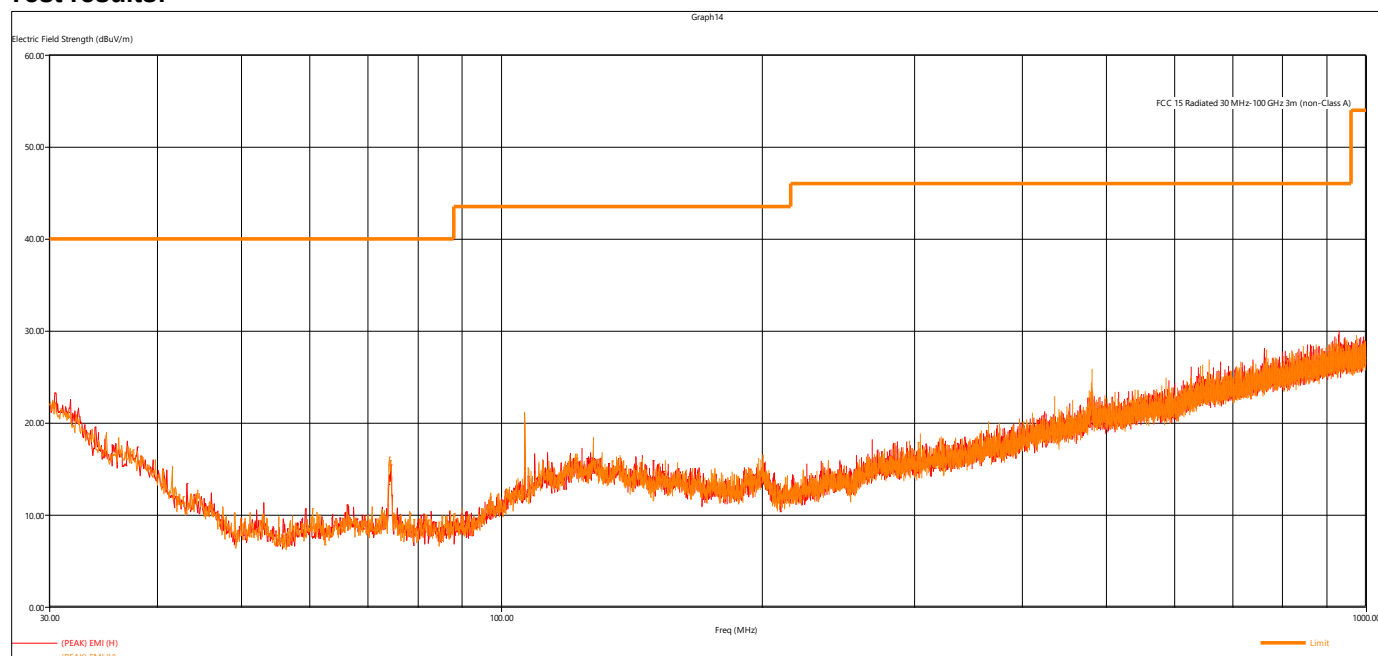


Figure 5 - Radiated Emissions Plot, 30MHz – 1GHz

All other emissions were found to be at least 10dB below applicable limit and were not tabulated
Worst-case orientation and modulations were investigated.

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level



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Peak Measurements, GMSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.			
4960.504000	50.23	73.98	23.75	320.00	191.00	H	High	BLE 1MB
7439.046000	53.34	73.98	20.64	261.25	240.00	H	High	BLE 1MB
12399.154000	53.93	73.98	20.05	253.67	0.00	H	High	BLE 1MB
7440.812000	56.31	73.98	17.67	265.97	244.75	V	High	BLE 1MB
4879.534000	51.40	73.98	22.58	284.89	195.75	H	Mid	BLE 1MB
7319.682000	55.74	73.98	18.24	516.65	328.50	H	Mid	BLE 1MB
7320.666000	55.82	73.98	18.16	453.19	324.00	H	Mid	BLE 1MB
12198.716000	55.37	73.98	18.61	326.98	340.50	H	Mid	BLE 1MB
4804.144000	47.82	73.98	26.16	360.35	353.50	H	Low	BLE 1MB
12008.592000	57.89	73.98	16.09	147.04	345.25	H	Low	BLE 1MB
12011.486000	57.82	73.98	16.16	329.79	341.50	H	Low	BLE 1MB
4881.008000	50.48	73.98	23.50	358.32	187.50	H	Mid	BLE 2MB
7318.238000	54.76	73.98	19.22	498.14	323.75	H	Mid	BLE 2MB
7321.568000	56.58	73.98	17.40	451.82	330.75	H	Mid	BLE 2MB
12202.290000	54.34	73.98	19.64	411.70	344.25	H	Mid	BLE 2MB
12397.518000	54.02	73.98	19.96	353.13	359.00	H	High	BLE 2MB
4959.128000	48.60	73.98	25.38	306.02	198.50	V	High	BLE 2MB
7441.572000	56.07	73.98	17.91	266.32	240.25	V	High	BLE 2MB
12007.802000	59.10	73.98	14.88	114.68	328.25	H	Low	BLE 2MB
12012.674000	59.07	73.98	14.91	134.20	330.50	H	Low	BLE 2MB

Emissions up to the 10th harmonic, 25GHz, were investigated

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

All other measurements were found to be at least 6 dB below the limit.



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Average Measurements, GMSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.			
4960.504000	42.47	53.98	11.51	320.00	191.00	H	High	BLE 1MB
7439.046000	43.25	53.98	10.73	261.25	240.00	H	High	BLE 1MB
12399.154000	43.22	53.98	10.76	253.67	0.00	H	High	BLE 1MB
7440.812000	47.74	53.98	6.24	265.97	244.75	V	High	BLE 1MB
4879.534000	43.98	53.98	10.00	284.89	195.75	H	Mid	BLE 1MB
7319.682000	47.82	53.98	6.16	516.65	328.50	H	Mid	BLE 1MB
7320.666000	47.80	53.98	6.18	453.19	324.00	H	Mid	BLE 1MB
12198.716000	45.43	53.98	8.55	326.98	340.50	H	Mid	BLE 1MB
4804.144000	41.01	53.98	12.97	360.35	353.50	H	Low	BLE 1MB
12008.592000	47.51	53.98	6.47	147.04	345.25	H	Low	BLE 1MB
12011.486000	47.34	53.98	6.64	329.79	341.50	H	Low	BLE 1MB
4881.008000	41.64	53.98	12.34	358.32	187.50	H	Mid	BLE 2MB
7318.238000	44.34	53.98	9.64	498.14	323.75	H	Mid	BLE 2MB
7321.568000	46.56	53.98	7.42	451.82	330.75	H	Mid	BLE 2MB
12202.290000	44.14	53.98	9.84	411.70	344.25	H	Mid	BLE 2MB
12397.518000	41.13	53.98	12.85	353.13	359.00	H	High	BLE 2MB
4959.128000	39.23	53.98	14.75	306.02	198.50	V	High	BLE 2MB
7441.572000	46.42	53.98	7.56	266.32	240.25	V	High	BLE 2MB
12007.802000	49.95	53.98	4.03	114.68	328.25	H	Low	BLE 2MB
12012.674000	47.88	53.98	6.10	134.20	330.50	H	Low	BLE 2MB

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

All other measurements were found to be at least 6 dB below the limit.

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4.5 BAND EDGES

Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, Section 11.12.2.5.2. Details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of band-edge measurements:

For FCC Part 15.247 Device:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

Test procedures:

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the band edge plots can be found in Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
3. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209.
4. Tabulated data is listed in section 4.0.



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4.6 CONDUCTED SPURIOUS EMISSIONS

Test Method:

ANSI C63.10-2013, Section 6.7

Limits of spurious emissions:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Test procedures:

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 30dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:

None.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Note that the limit shown on the plots does not apply. It is a line for reference

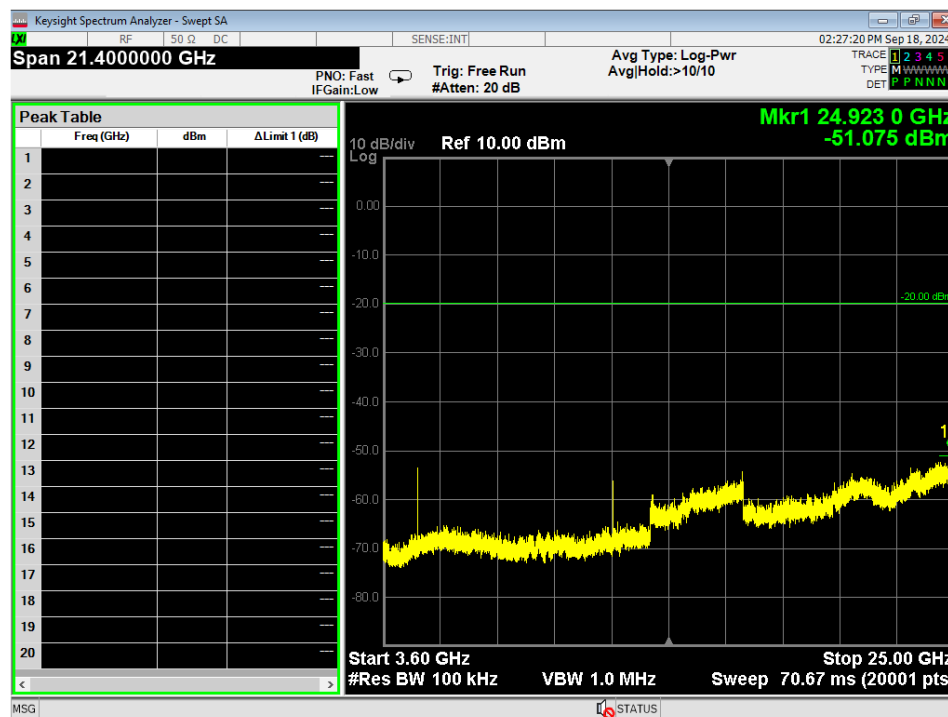


Figure 8 - Conducted Emissions Plot, GMSK 1MB, 3.6GHz – 25GHz, Mid

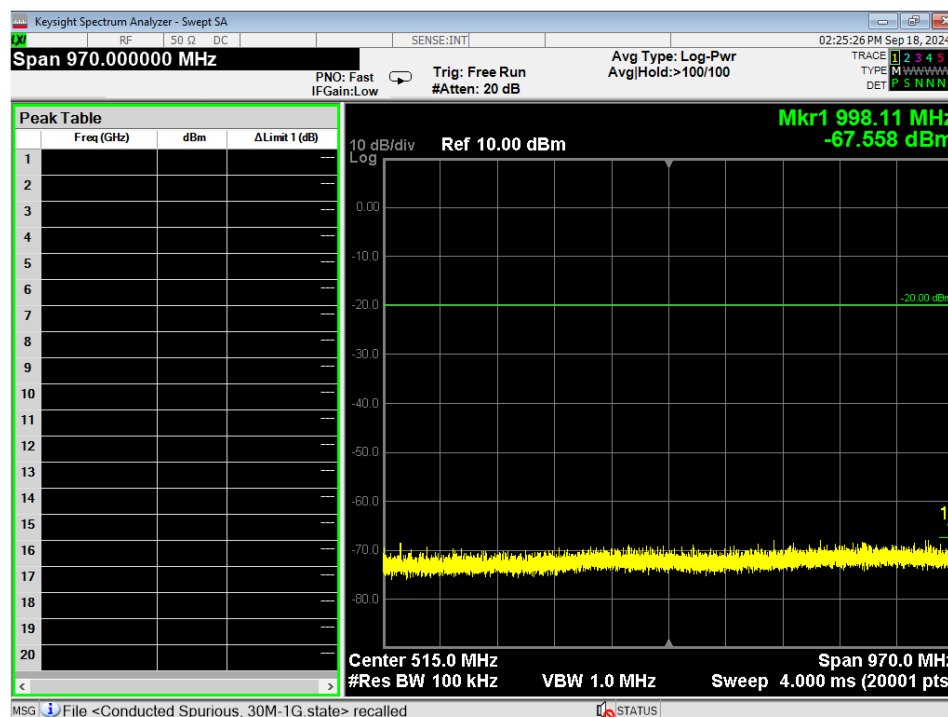


Figure 9 - Conducted Emissions Plot, GMSK 2MB, 30MHz – 1GHz, Mid

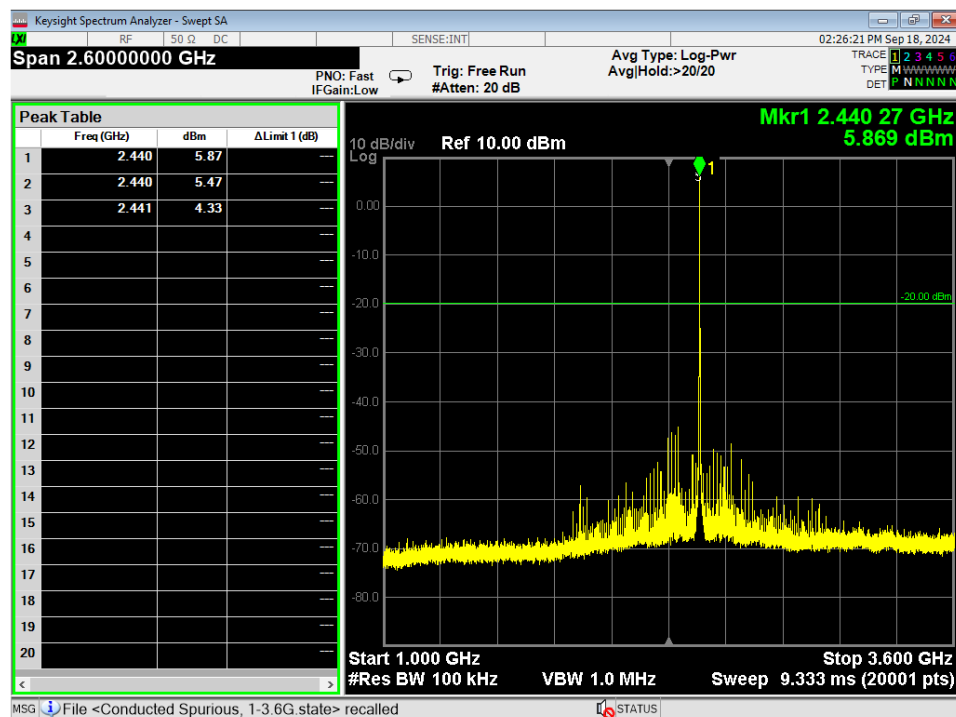


Figure 10 - Conducted Emissions Plot, GMSK 2MB, 1GHz – 3.6GHz, Mid

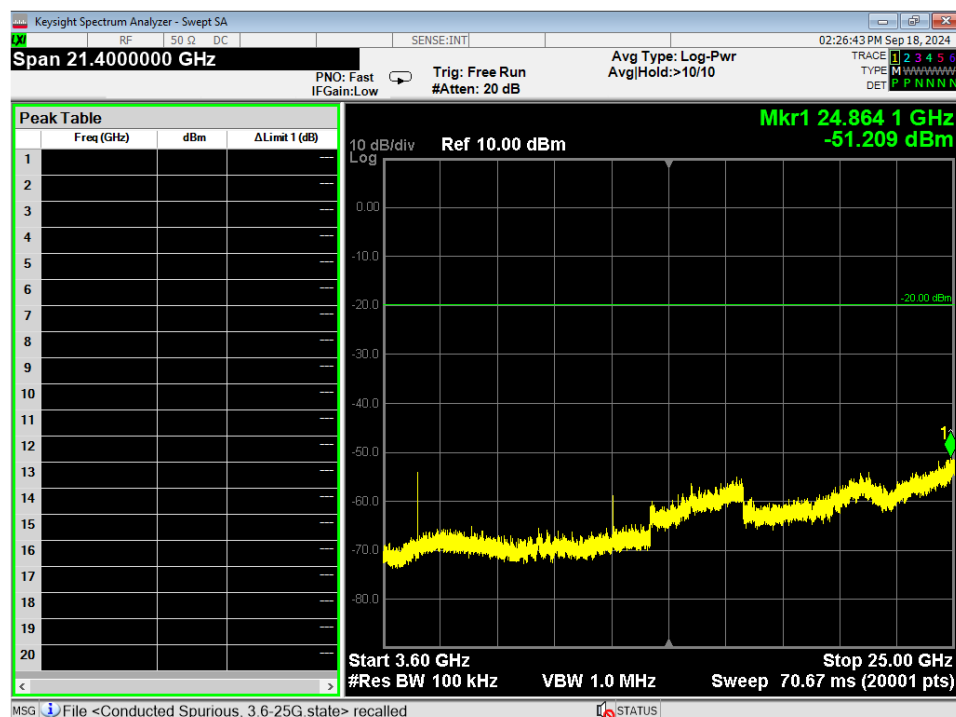


Figure 11 - Conducted Emissions Plot, GMSK 2MB, 3.6GHz – 25GHz, Mid



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4.7 POWER SPECTRAL DENSITY

Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of power measurements:

For FCC Part 15.247 Device:

The maximum PSD allowed is 8 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the Power Spectral Density (PSD) plots can be found in Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.

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APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

FS = Field Strength
 RA = Receiver Amplitude
 AF = Antenna Factor
 CF = Cable Attenuation Factor
 AG = Amplifier Gain
 AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB μ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB μ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

AV is calculated by taking the $20 \cdot \log(T_{\text{on}}/100)$ where T_{on} is the maximum transmission time in any 100ms window.

EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

$$\begin{aligned}
 \text{EIRP (Watts)} &= [\text{Field Strength (V/m)} \times \text{antenna distance (m)}]^2 / 30 \\
 \text{Power (watts)} &= 10^{[\text{Power (dBm)}]/10} / 1000 \\
 \text{Voltage (dB}\mu\text{V)} &= \text{Power (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)} \\
 \text{Field Strength (V/m)} &= 10^{[\text{Field Strength (dB}\mu\text{V/m)} / 20] / 10^6} \\
 \text{Gain} &= 1 \text{ (numeric gain for isotropic radiator)} \\
 \text{Conversion from 3m field strength to EIRP (d=3):}
 \end{aligned}$$

$$\text{EIRP} = [FS(\text{V/m}) \times d^2]/30 = FS [0.3] \quad \text{for } d = 3$$

$$\text{EIRP(dBm)} = FS(\text{dB}\mu\text{V/m}) - 10(\log 10^9) + 10\log[0.3] = FS(\text{dB}\mu\text{V/m}) - 95.23$$

$10\log(10^9)$ is the conversion from micro to milli.



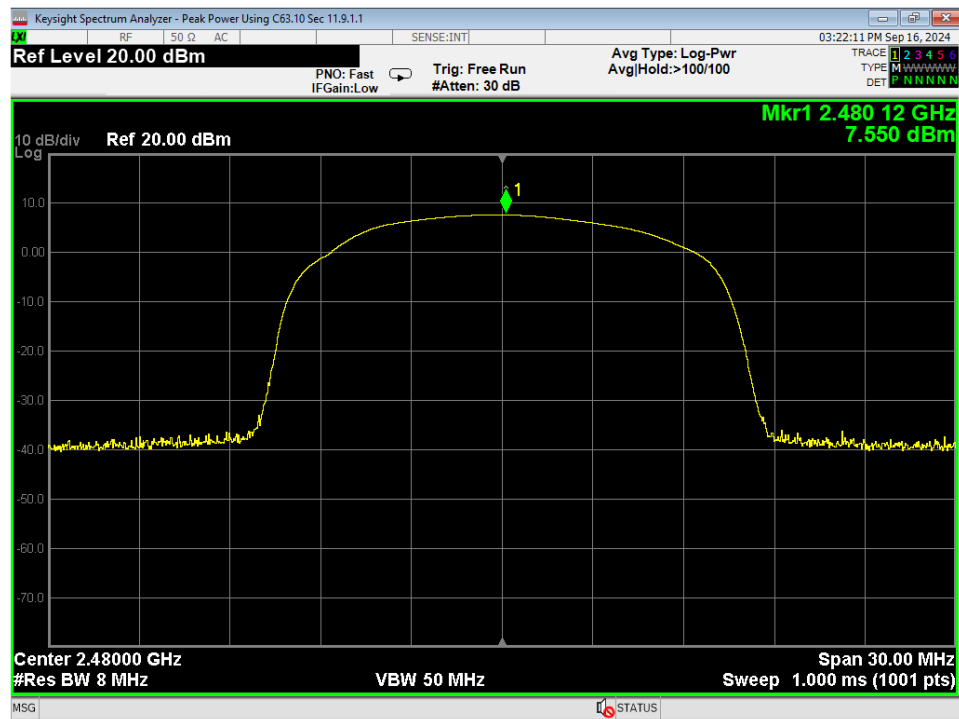
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APPENDIX B – MEASUREMENT UNCERTAINTY

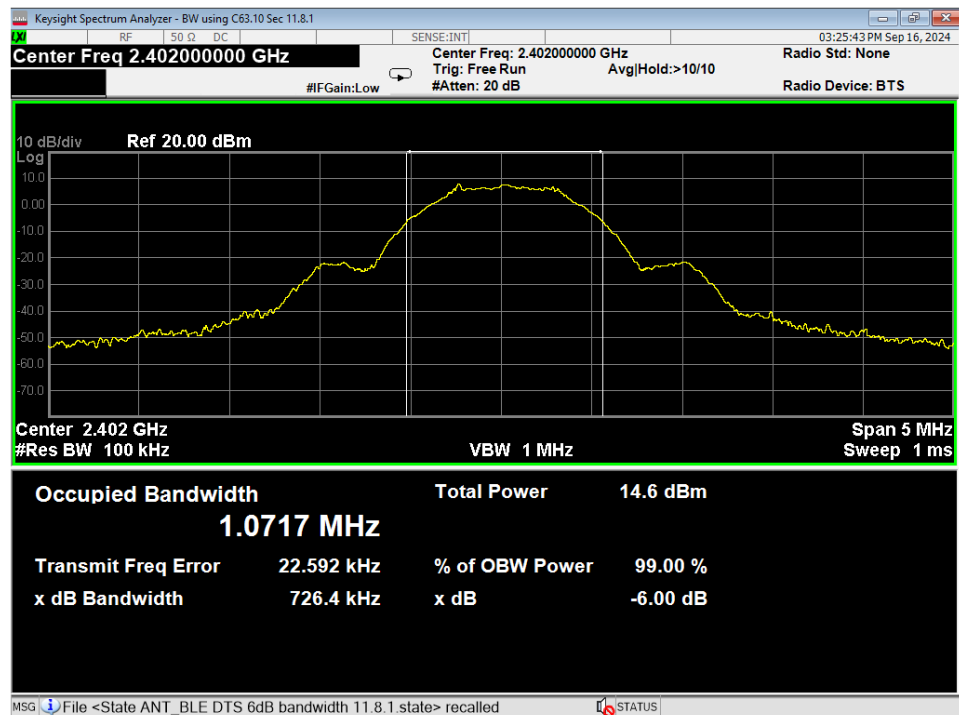
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08
Emissions limits, conducted	30MHz – 18GHz	±3.03

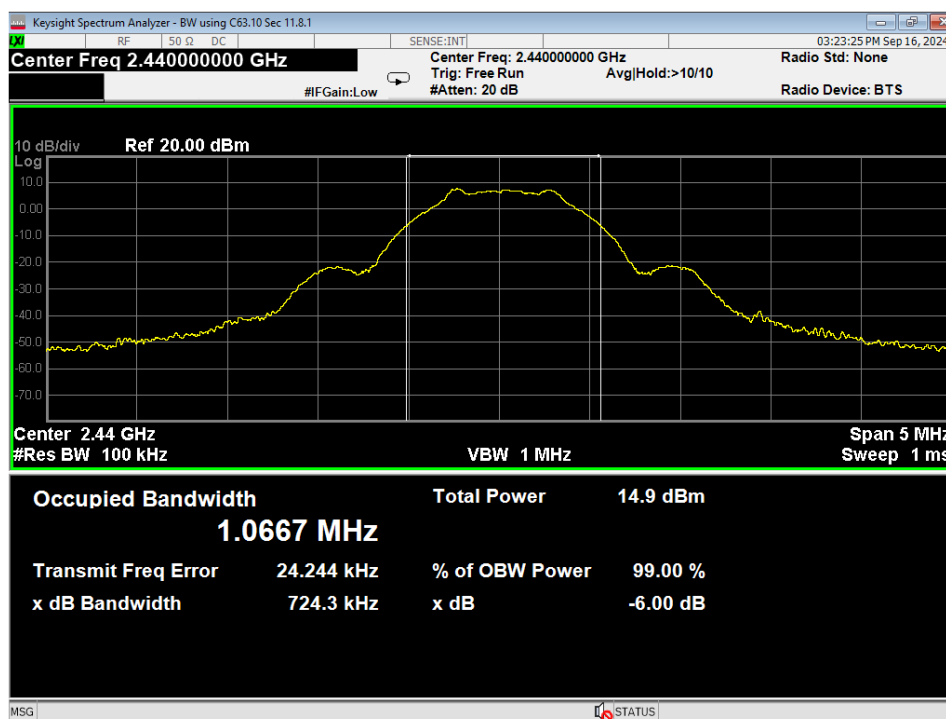
Expanded uncertainty values are calculated to a confidence level of 95%.



03 Peak Power, High Channel, BLE 1MB



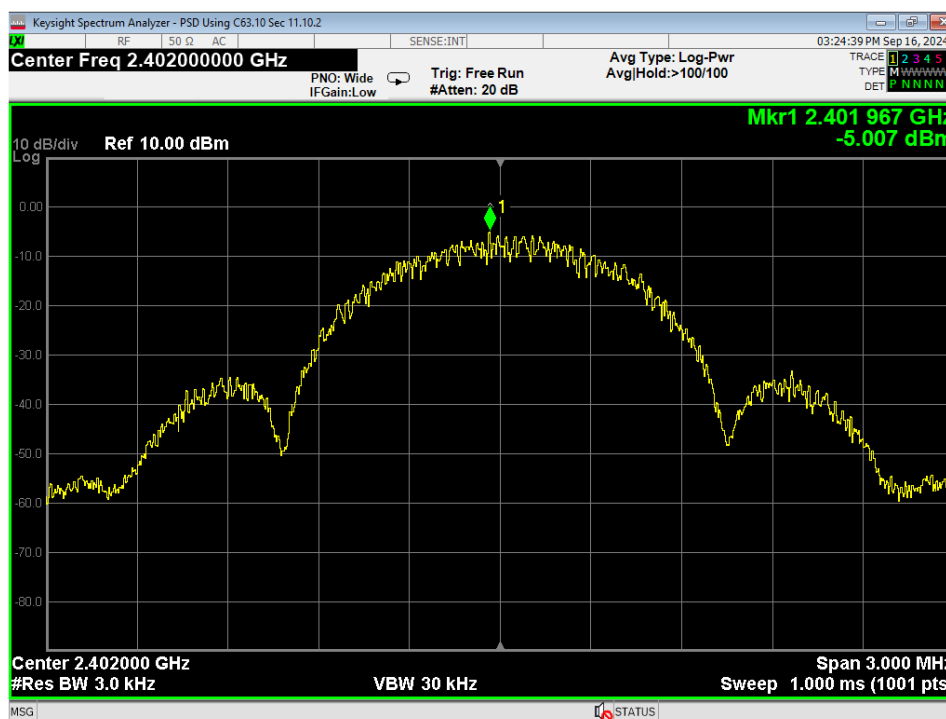
04 6dB Bandwidth, Low Channel, BLE 1MB



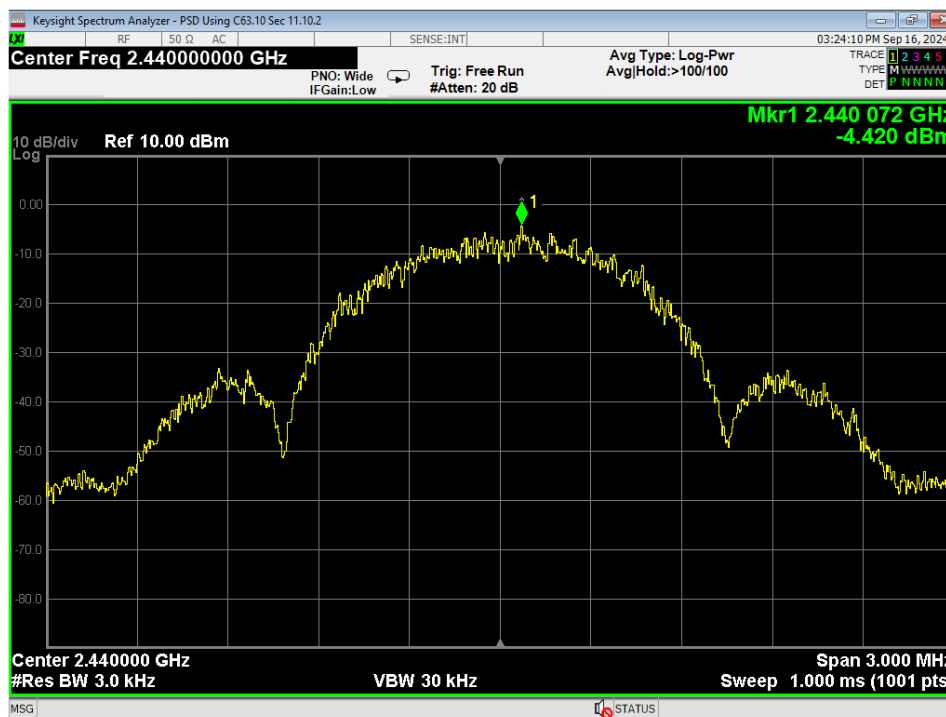
05 6dB Bandwidth, Mid Channel, BLE 1MB



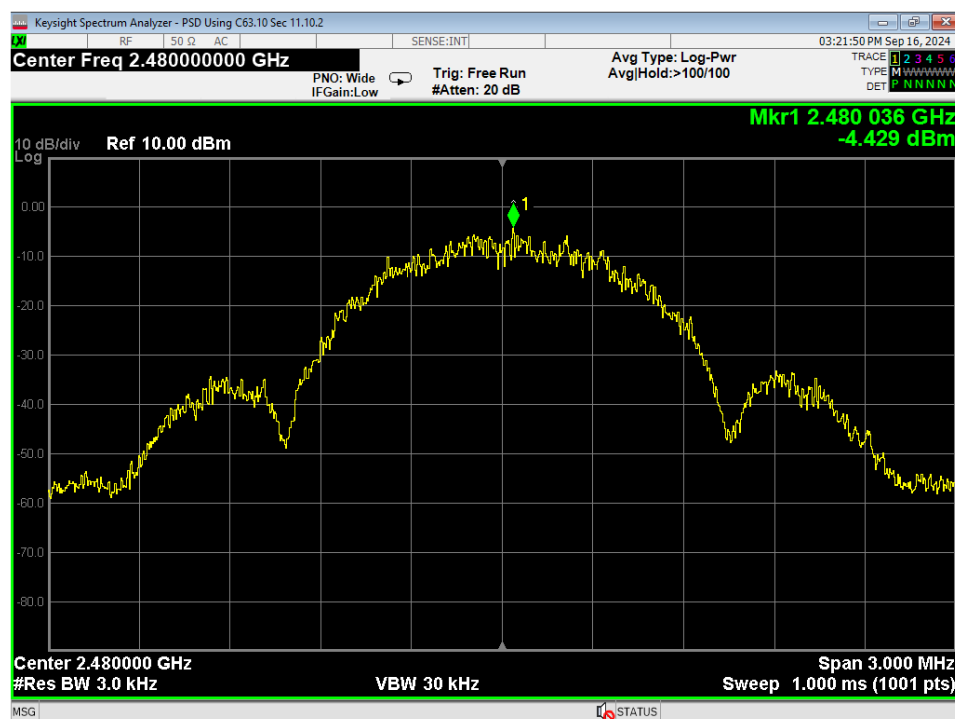
06 6dB Bandwidth, High Channel, BLE 1MB



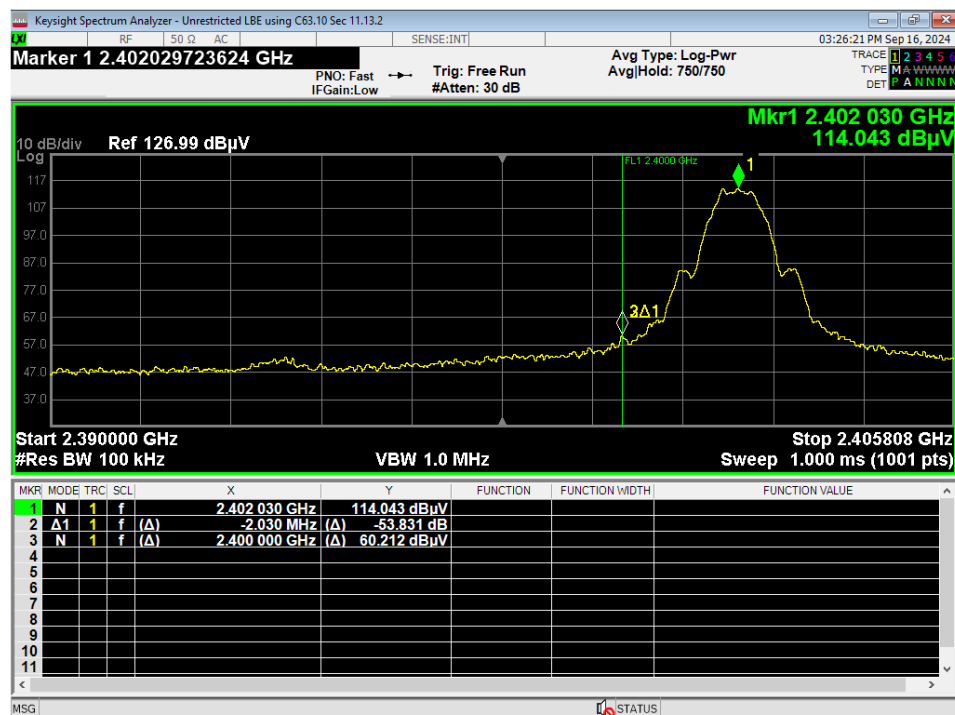
07 PSD, Low Channel, BLE 1MB



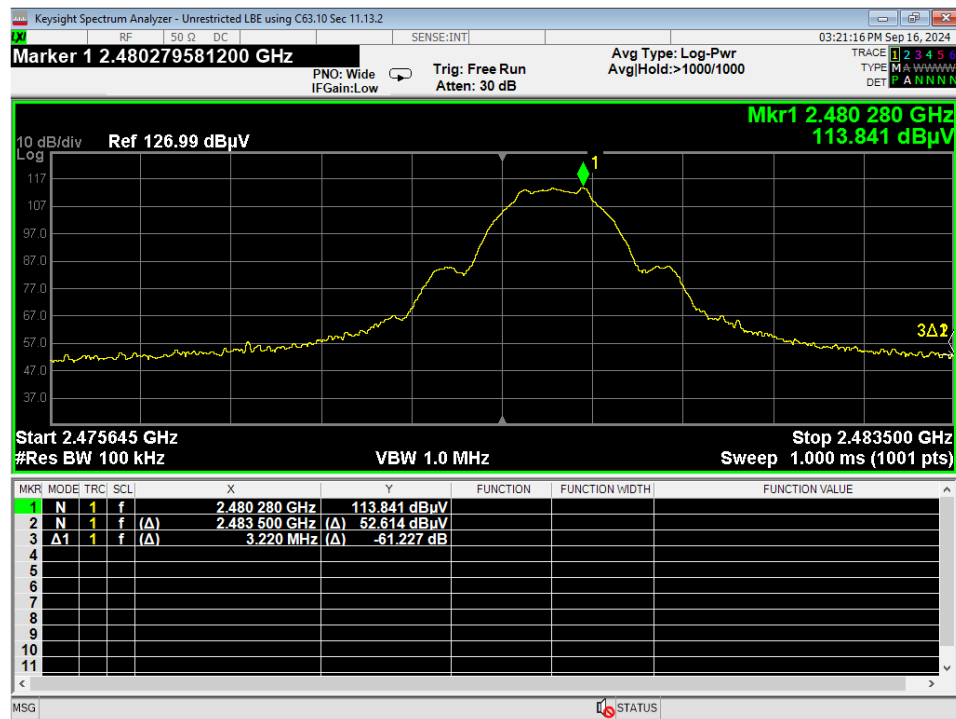
08 PSD, Mid Channel, BLE 1MB



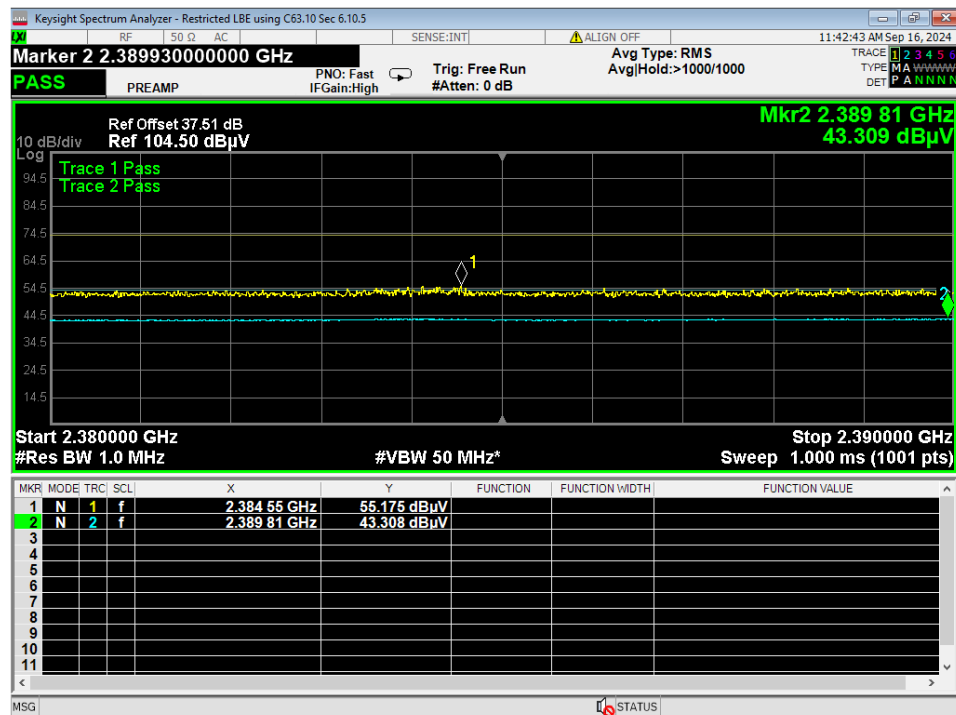
09 PSD, High Channel, BLE 1MB



10 LBE Unrestricted, BLE 1MB

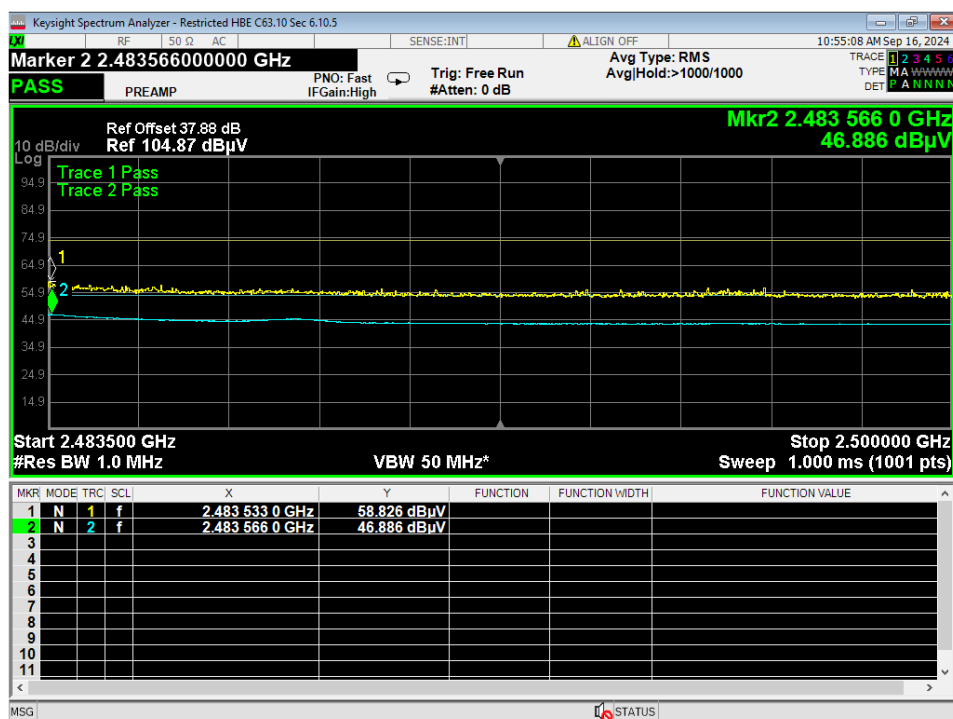


11 HBE Unrestricted, BLE 1MB

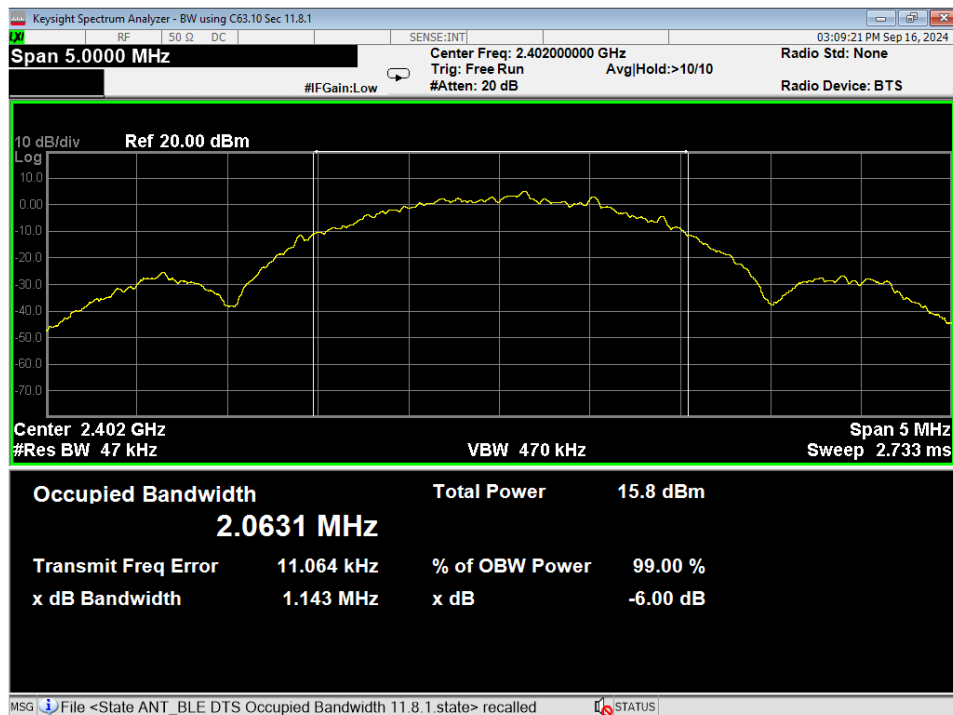


12 LBE Restricted, BLE 1MB

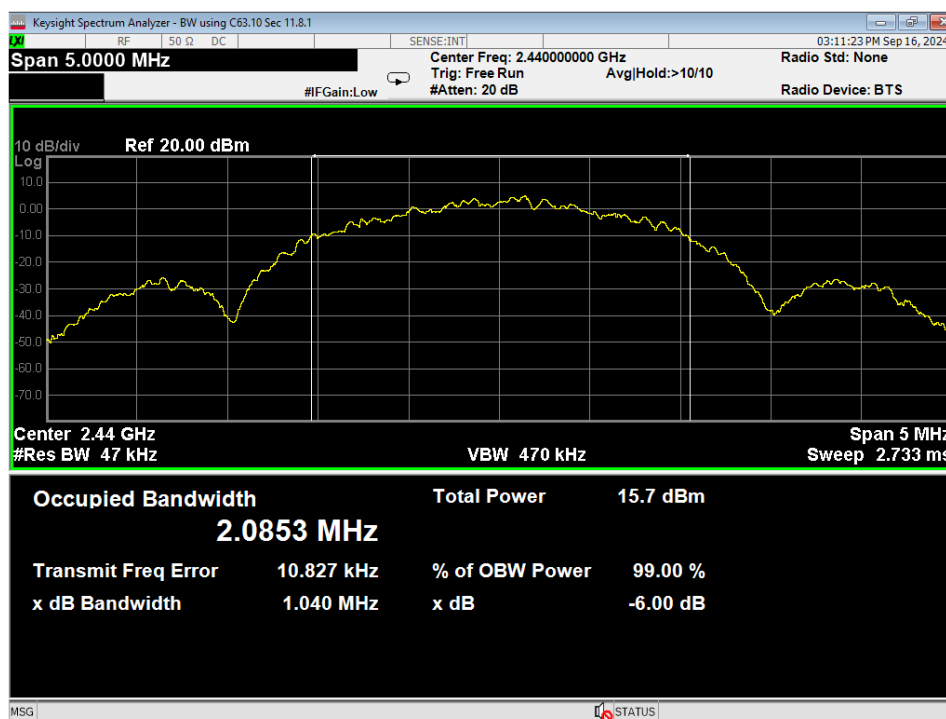
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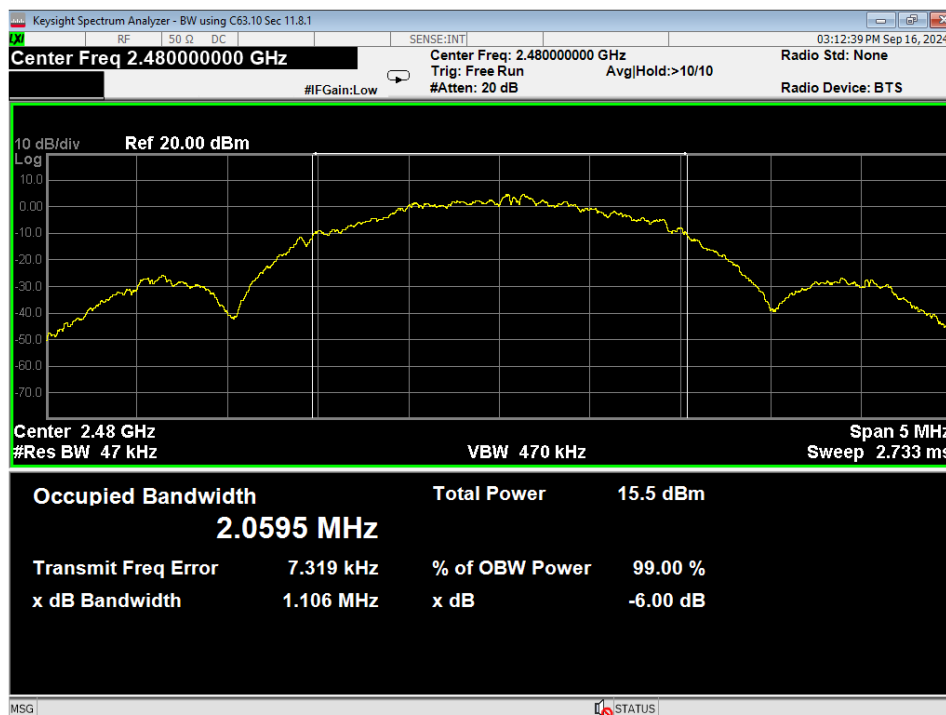
13 HBE Restricted, BLE 1MB



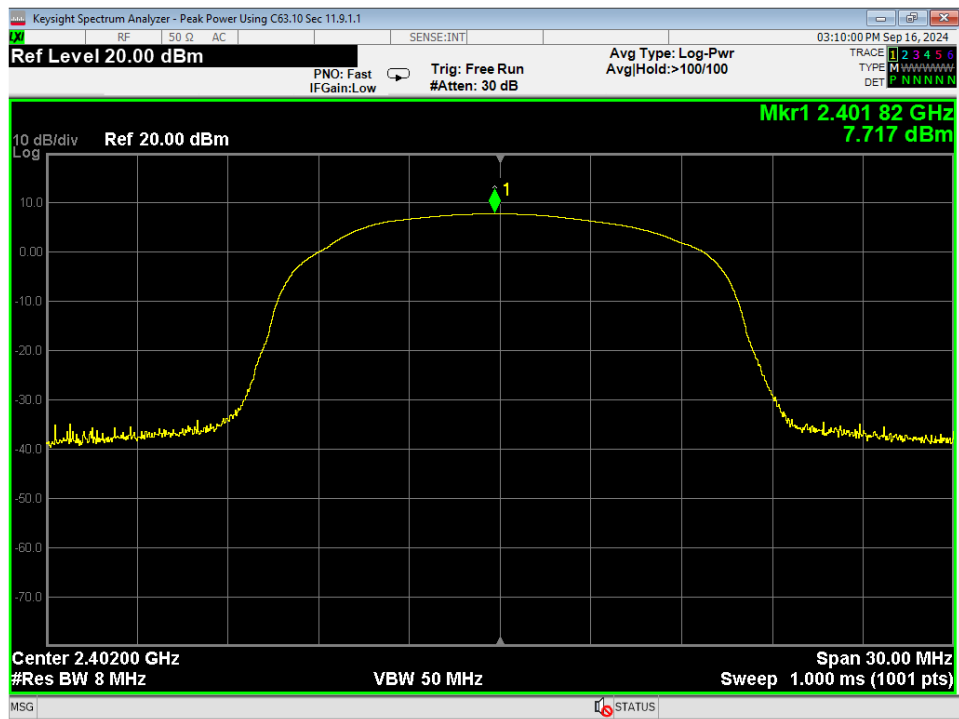
14 Occupied Bandwidth, Low Channel, BLE 1MB



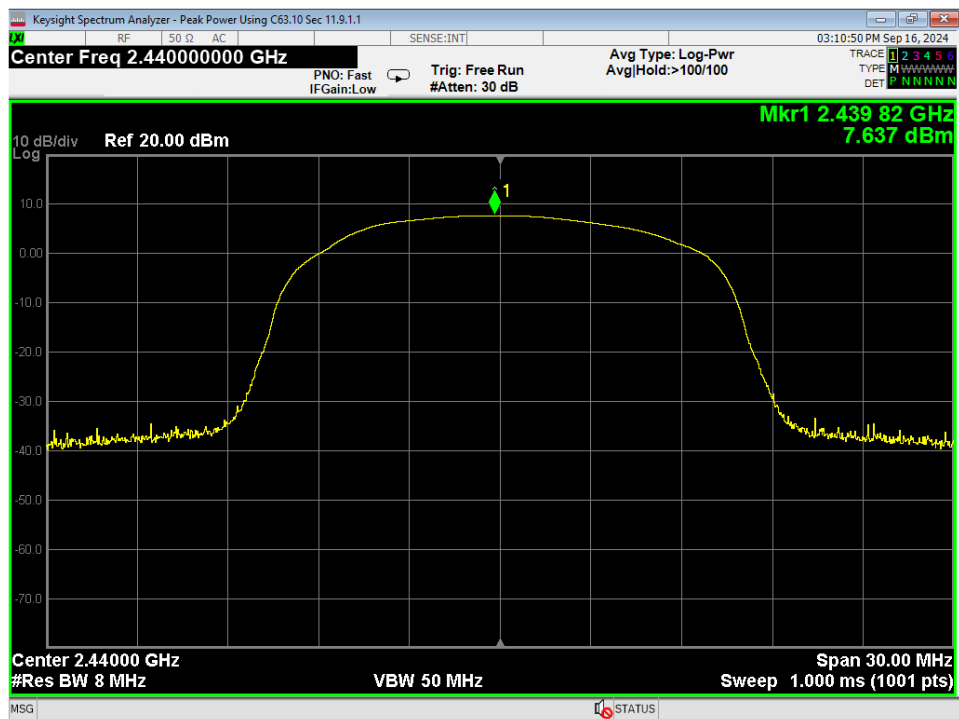
15 Occupied Bandwidth, Mid Channel, BLE 1MB



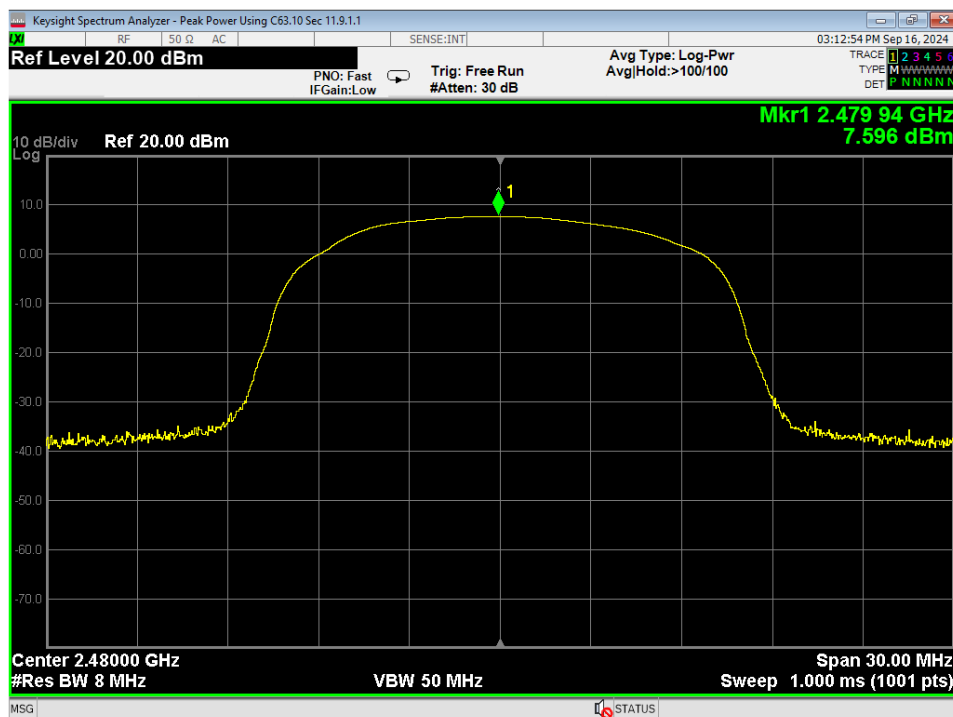
16 Occupied Bandwidth, High Channel, BLE 1MB



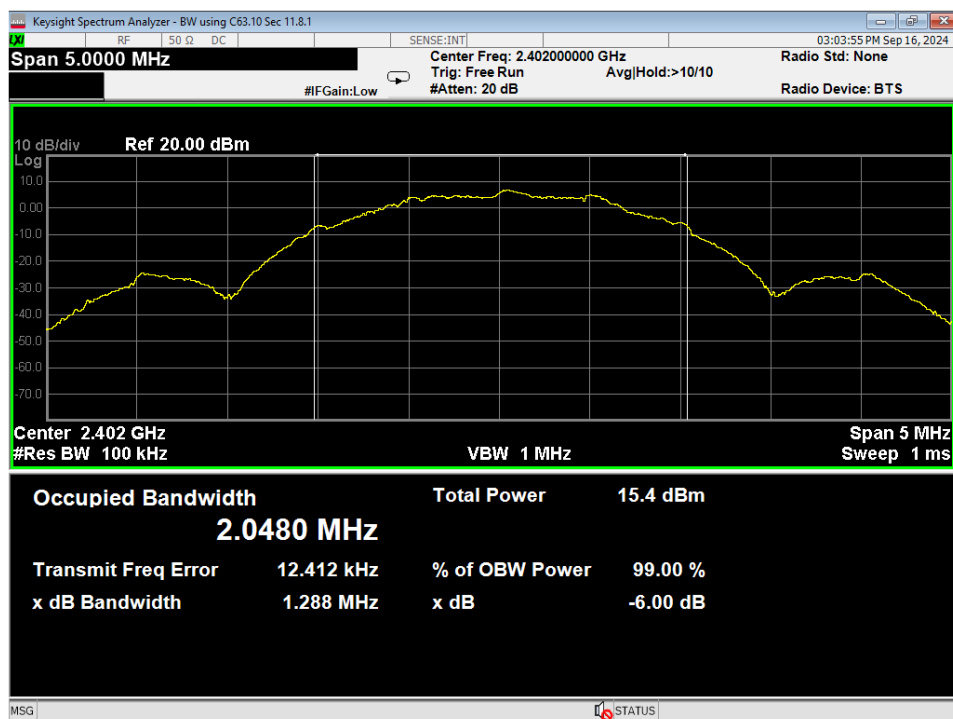
17 Peak Power, Low Channel, BLE 2MB



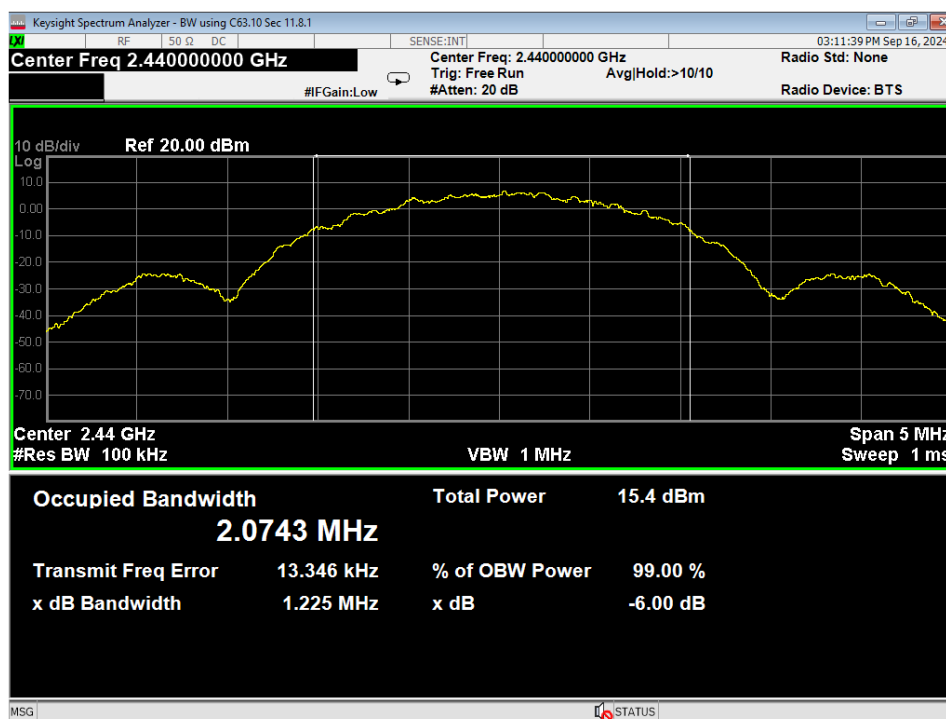
18 Peak Power, Mid Channel, BLE 2MB



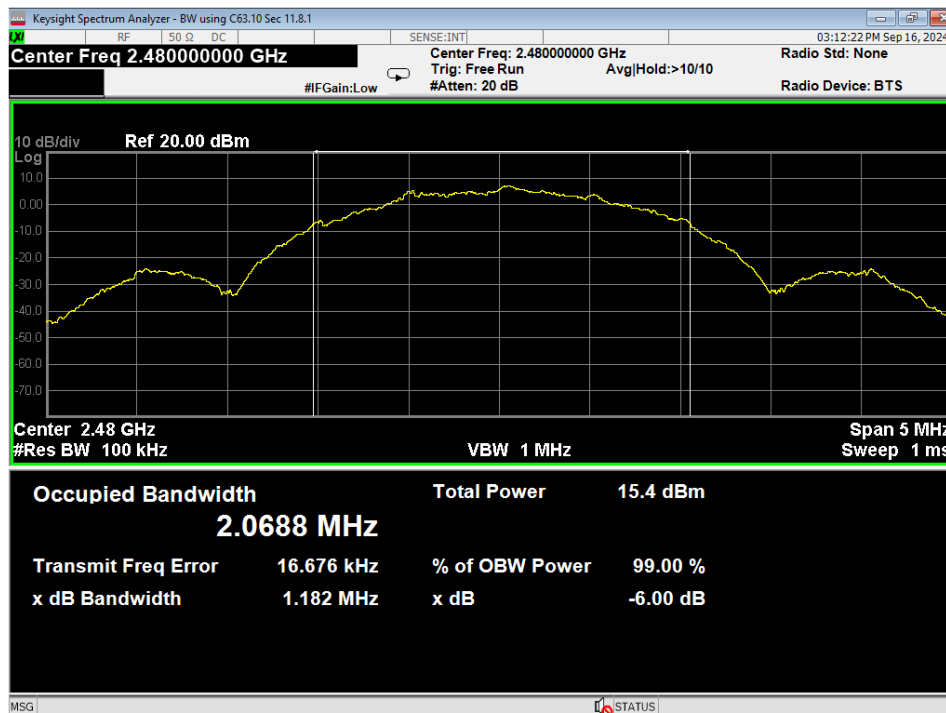
19 Peak Power, High Channel, BLE 2MB



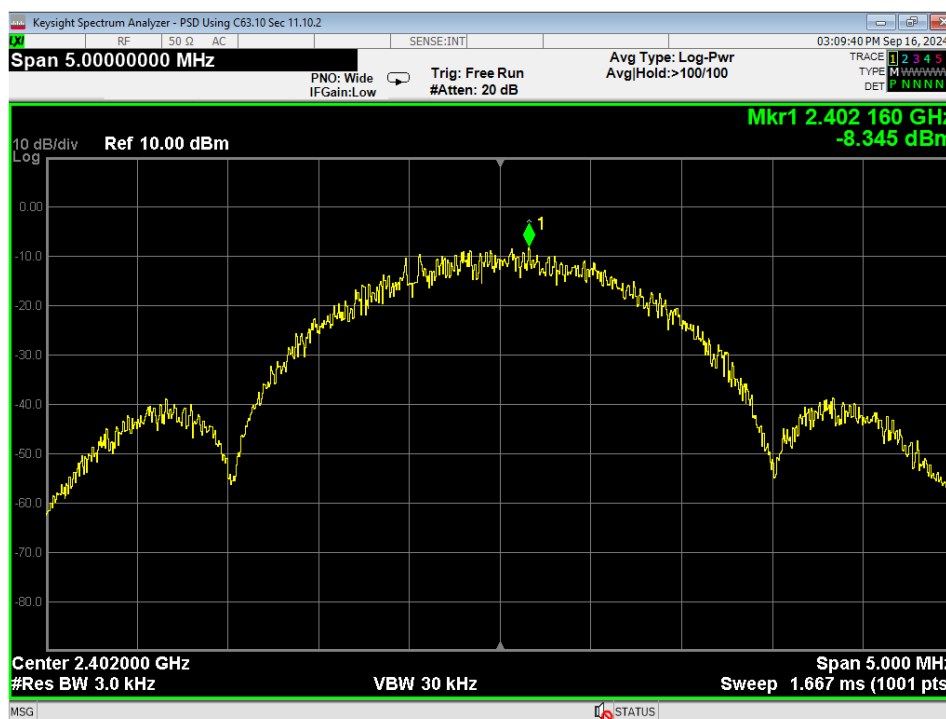
20 6dB Bandwidth, Low Channel, BLE 2MB



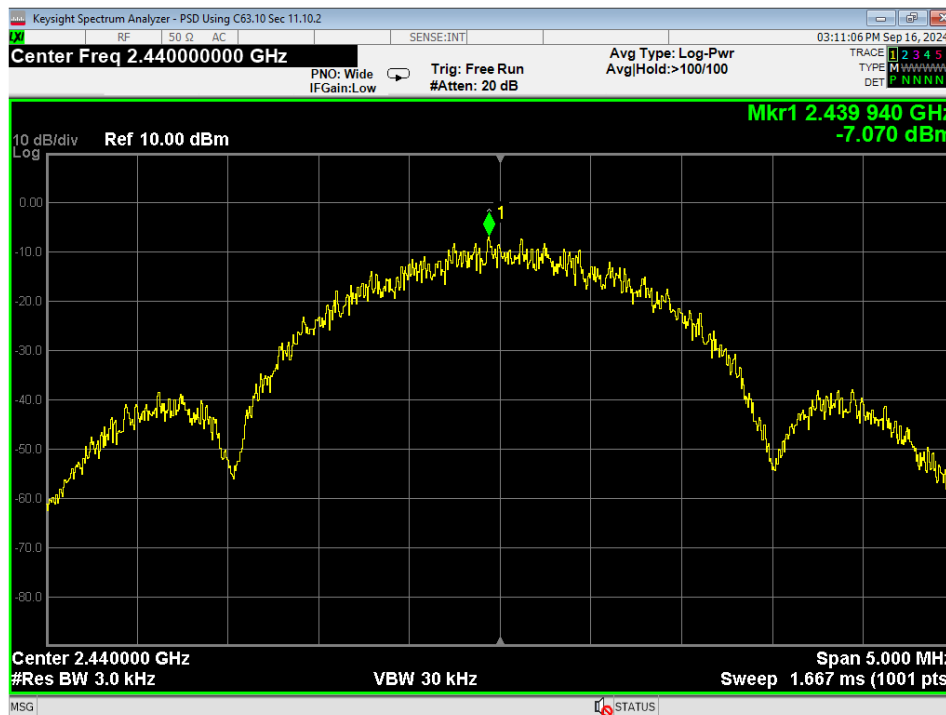
21 dB Bandwidth, Mid Channel, BLE 2MB



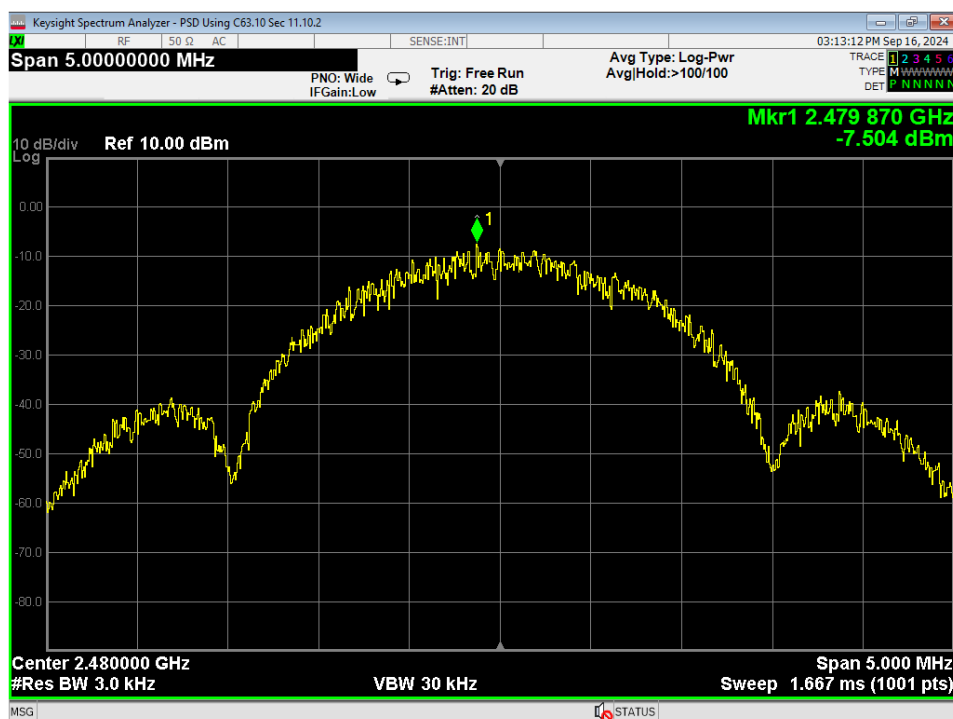
22 dB Bandwidth, High Channel, BLE 2MB



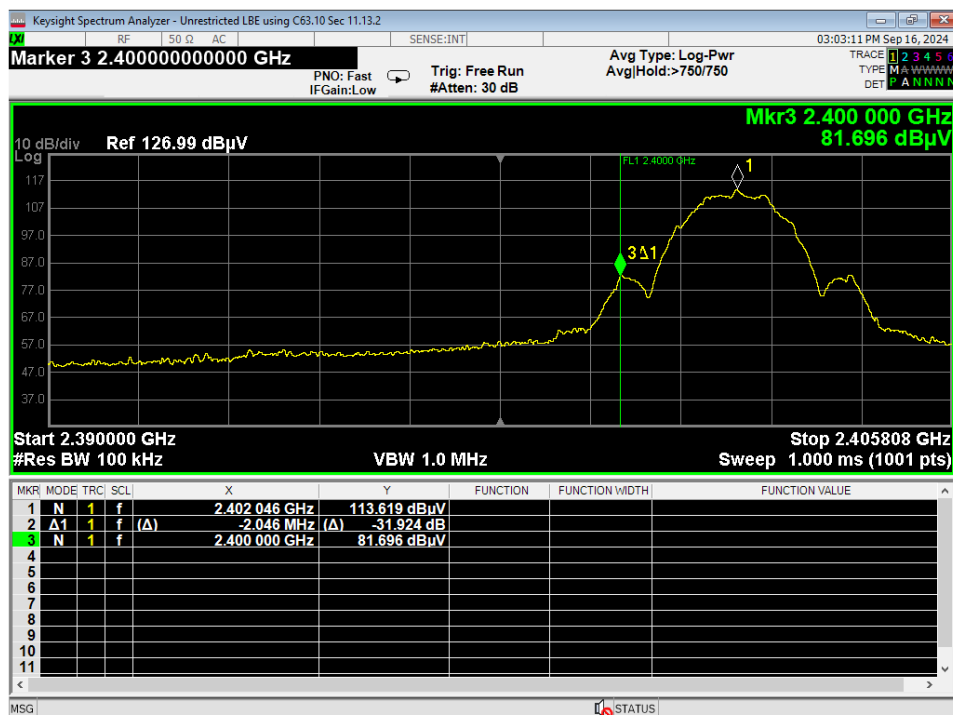
23 PSD, Low Channel, BLE 2MB



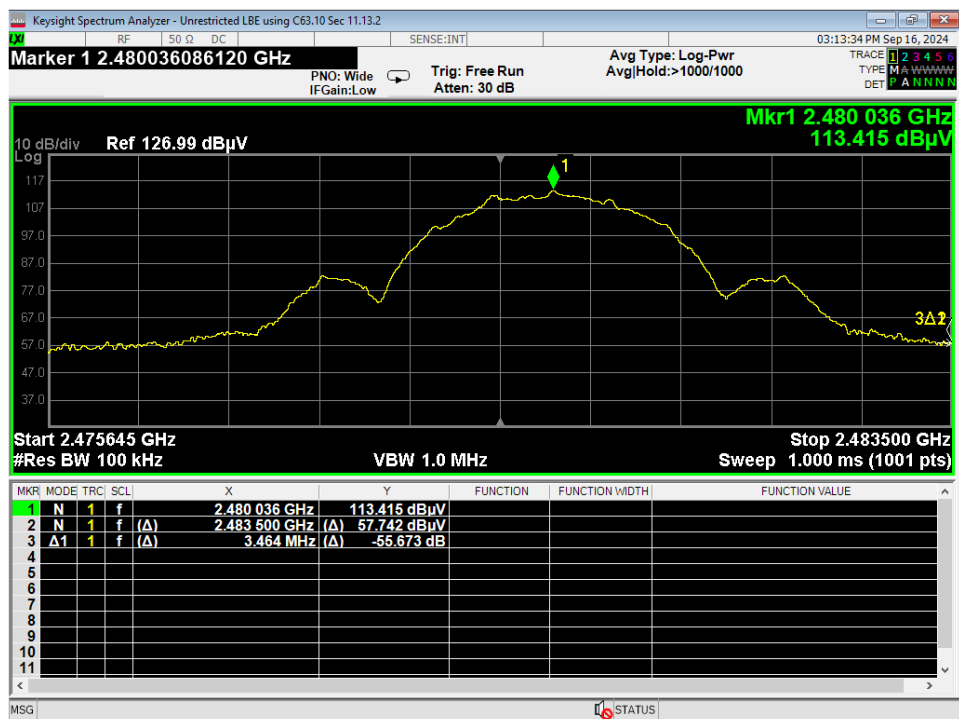
24 PSD, Mid Channel, BLE 2MB



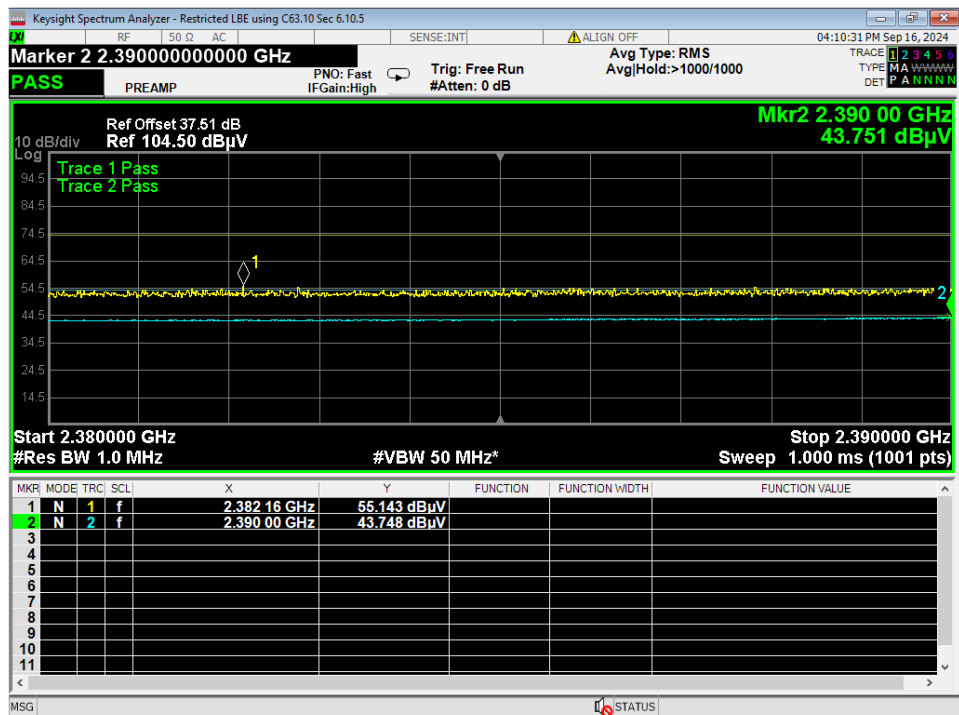
25 PSD, High Channel, BLE 2MB



26 LBE Unrestricted, BLE 2MB

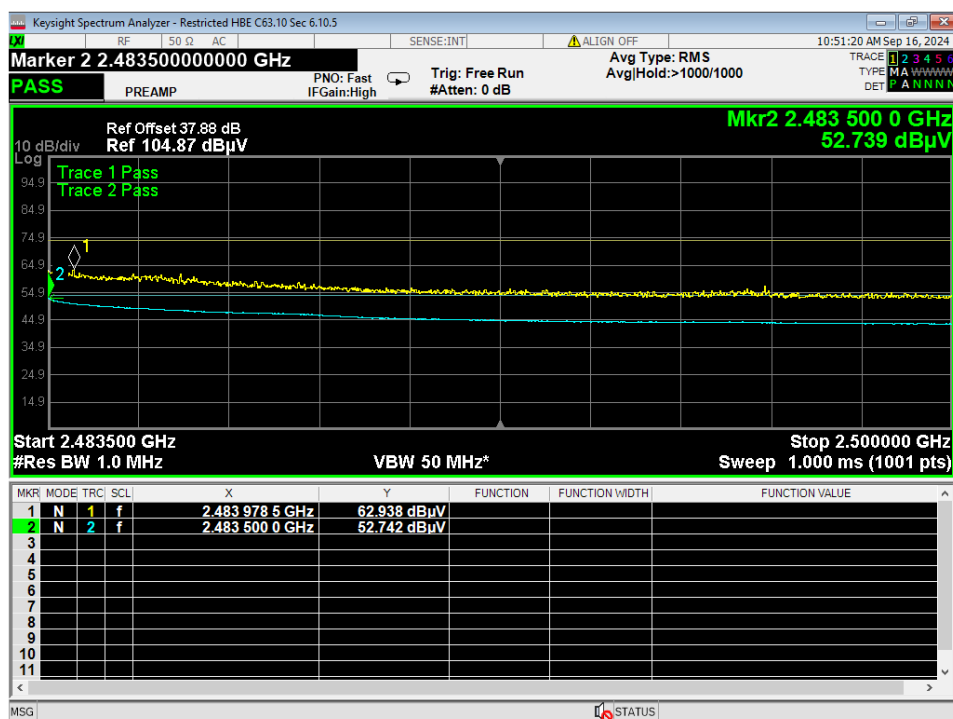


27 HBE Unrestricted, BLE 2MB

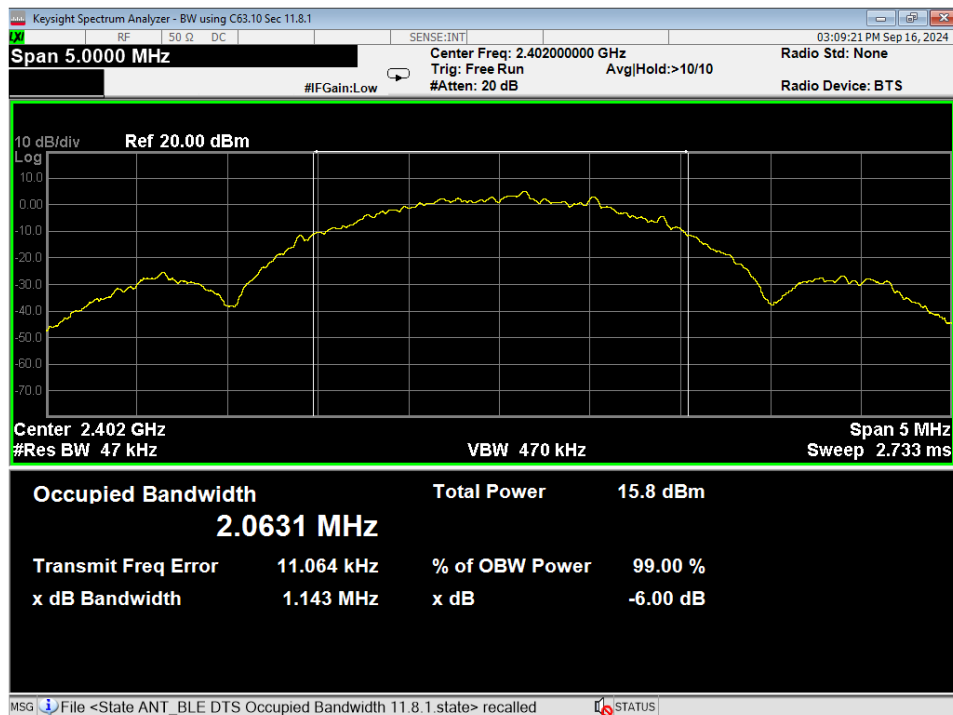


28 LBE Restricted, BLE 2MB

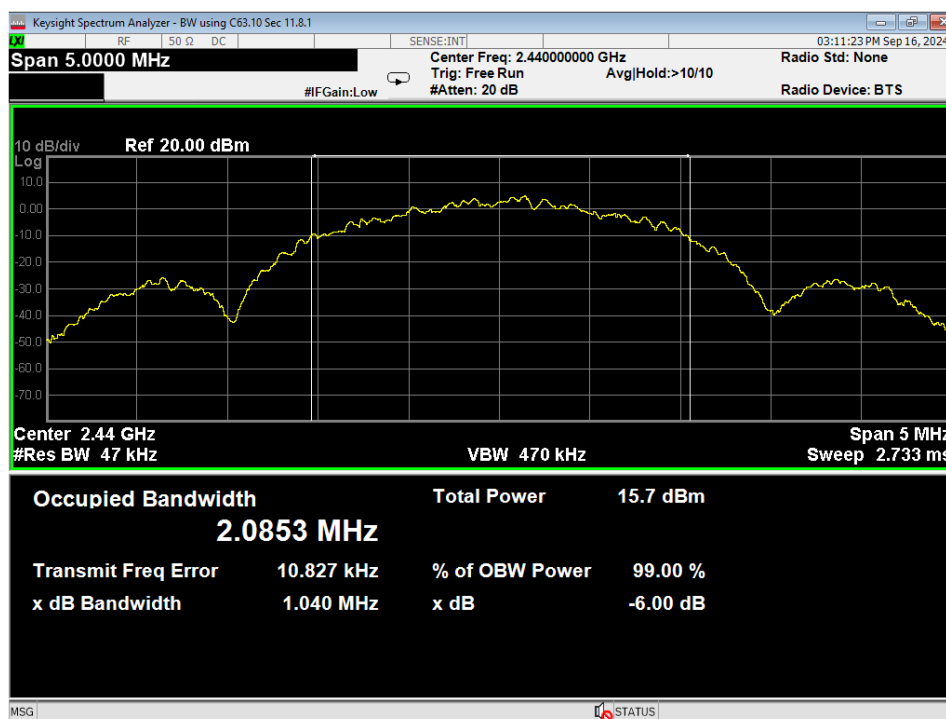
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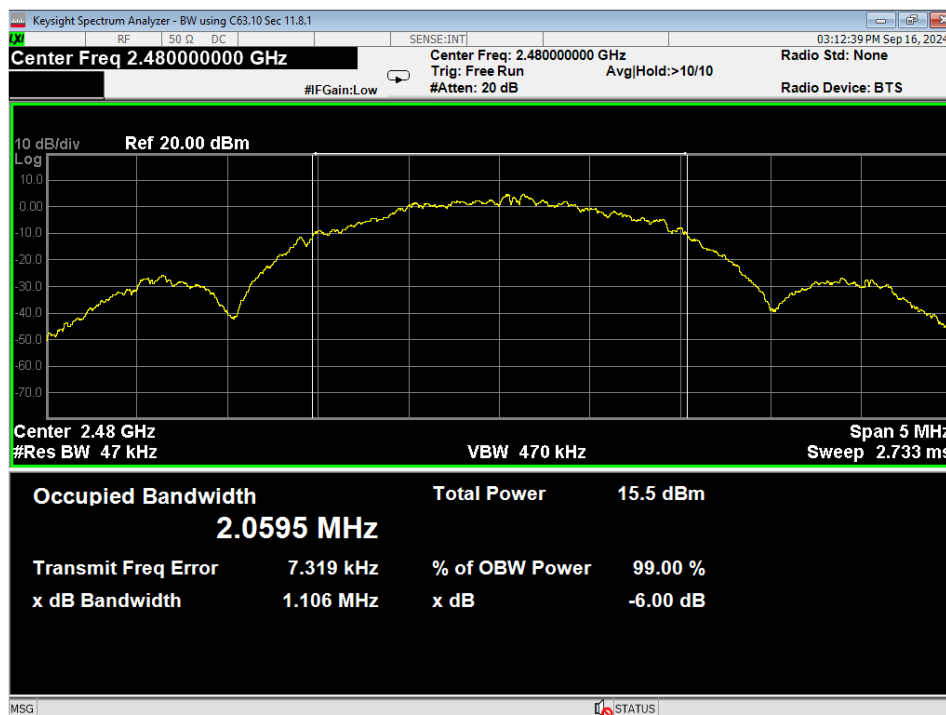
29 HBE Restricted, BLE 2MB



30 Occupied Bandwidth, Low Channel, BLE 2MB



31 Occupied Bandwidth, Mid Channel, BLE 2MB



32 Occupied Bandwidth, High Channel, BLE 2MB



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