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MEASUREMENT REPORT
FCC PART 15.247 Bluetooth (Low Energy)

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
03/26/2024 – 05/02/2024
Test Report Issue Date:
05/02/2024
Test Site/Location:
Element Lab. Yongin-Si, Gyeonggi-do, South Korea
Test Report Serial No.:
1M2401250007-10-R1.A3L

FCC ID:	**A3LNP960XMA**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	NP960XMA
Additional Model(s):	NP960XMB, NP964XMA, NP964XMB
EUT Type:	Portable Computing Devcie
Max. RF Output Power:	49.900 mW (16.98 dBm) Peak Conducted
Frequency Range:	2402 – 2480MHz
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C(15.247)
Test Procedure(s):	ANSI C63.10-2013, KDB 484596 D01 v02r03

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1M2401250007-10-R1.A3L) supersedes and replaces the previously issued test report (S/N: 1M2401250007-10.A3L) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Prepared by

Reviewed by

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Test Location

These measurement tests were conducted at the Element Suwon Laboratory located at 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954, South Korea. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology Suwon, Ltd. located in Yongin-si, Gyeonggi-do, 16954, South Korea.

- Element Materials Technology Suwon, Ltd. is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation(A2LA) with Certificate number 2041.04 for Specific Absorption Rate (SAR), and Electromagnetic Compatibility (EMC) & Telecommunications testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology Suwon, Ltd. facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of ISED: 26168

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Computing Device FCC ID: A3LNP960XMA**. The data found in this test report was taken with the EUT operating in Bluetooth low energy mode. While in low energy mode, the Bluetooth transmitter hops pseudo-randomly between 40 channels, three of which are "advertising channels". When the transmitter is hopping only between the three advertising channels, the EUT does not fall under the category of a "hopper" as defined in 15.247(a)(iii) which states that a "frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels." As operation on only the advertising channels does not qualify the EUT as a hopper, the EUT is certified as a DTS device in this mode. The data found in this report is representative of the device when it transmits on its advertising channels.

Test Device Serial No.: 0791F, 1105D

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n/ax/be WLAN, 802.11a/n/ac/ax/be UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE)

Ch.	Frequency (MHz)
0	2402
:	:
19	2440
:	:
39	2480

Table 2-1. Frequency / Channel Operations

2.3 Antenna Description

This device is only used with its integral antennas as shown in the documentation of this filing. The antenna gains for this device are as shown in the table below:

Frequency [GHz]	Antenna 1 Gain (dBi)	Antenna 2 Gain (dBi)	Directional Gain (dBi)
2.4	-1.62	-1.82	1.29

Table 2-2. Antenna Peak Gain

2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing. See Section 7.7, 7.8, 7.9 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

2.5 Software and Firmware

The test was conducted with firmware version REV0.1 and software version Windows 11 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT**.**

Deviation from measurement procedure…….....None

3.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01.

3.3 Environmental Conditions

The temperature is controlled within range of 15^{o}C to 35^{o}C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna(s) of the EUT are **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.37
Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	3.94
Radiated Disturbance (>1GHz)	4.75
Radiated Disturbance (>18GHz)	4.84

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	N9030A	PXA Signal Analyzer	7/6/2023	Annual	7/3/2024	MY49432391
Antritsu	S820E	Cable and Antenna Analyzer	7/4/2023	Annual	7/3/2024	1839097
Antritsu	TOSLKF50A-40	Calibration Kit	N/A	-	N/A	1825024
Com-Power	AL-130R	Active Loop Antenna	10/21/2022	Biennial	10/20/2024	10160045
Fairview Microwave	FM2CP1122-10	Coupler	7/4/2023	Annual	7/3/2024	1946
Keysight Technologies	N9030B	PXA Signal Analyzer	7/4/2023	Annual	7/3/2024	MY57143276
Mini-Circuits	BW-N10W5+	Attenuator	1/11/2024	Annual	1/10/2025	TEMPNO.01-151
NARDA	180-442A-KF	Horn Antenna (Small)	1/16/2024	Annual	1/15/2025	T058701-03
Rohde & Schwarz	TS-PR1840	Preamplifier	7/6/2023	Annual	7/5/2024	100049
Rohde & Schwarz	ESW43	EMI TEST Receiver	7/5/2023	Annual	7/4/2024	101761
Rohde & Schwarz	TS-SFUNIT-Rx	Shielded Filter Unit	1/11/2024	Annual	1/10/2025	102151
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	6/1/2023	Biennial	5/31/2025	9162-217
Sunol Sciences	DRH-118	Horn Antenna	1/26/2023	Biennial	1/25/2025	A102416-1

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LNP960XMA

FCC Classification: Digital Transmission System (DTS)

Number of Channels: 40

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2(a)]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(d)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2(b)]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Sections 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	RADIATED	PASS	Sections 7.7, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (FSS-Gen[8.8])	LINE CONDUCTED	PASS	Sections 7.9

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4. For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Bluetooth LE Automation," Version .
5. For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version .

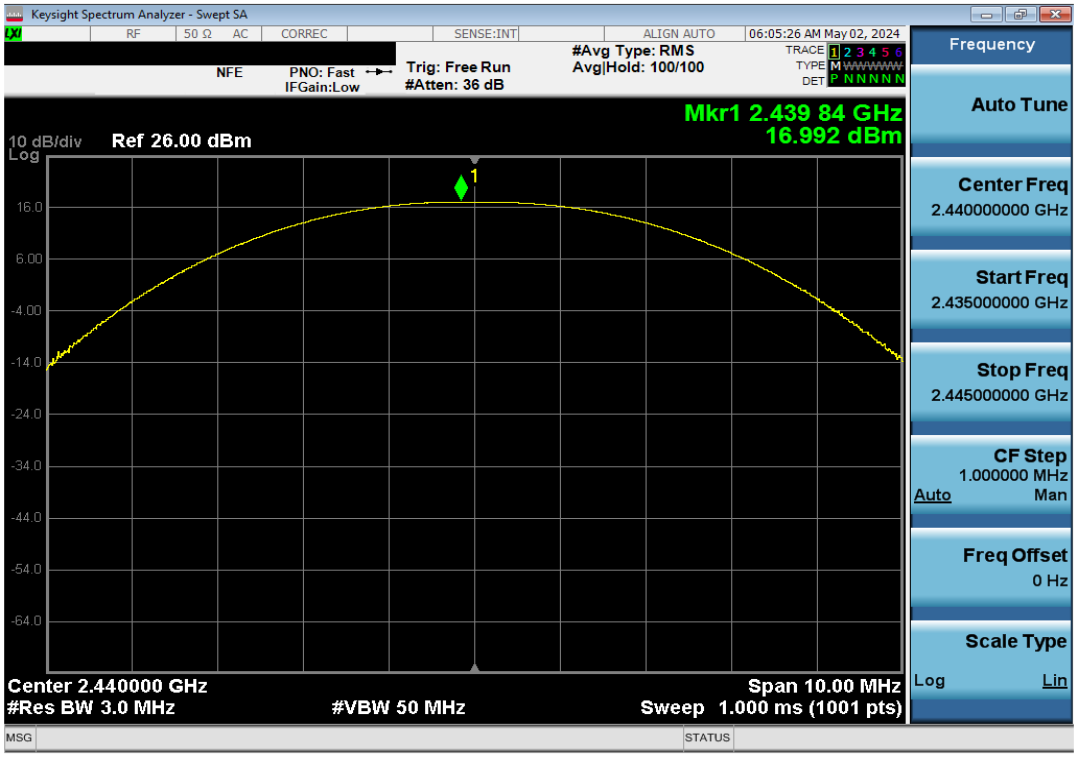
6) Data was leveraged from Model NP960XMA for the certification of NP960XMB. See Table 7-2 for spot-check results.

FCC Rules	Test Item	Test Case	Units	Limit	Reference Model: NP960XMA	Variant Model: NP960XMB	Deviation	Max Deviation	Pass/Fail
15.247(b)(3)	Conducted Output Power	1 Mbps, Ch.19, Ant1	dBm	N/A	16.98	16.99	0.01	3	PASS

Table 7-2. Summary of Spot-checks Results

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2440	1 Mbps	19	LE	16.99	50.003

Table 7-3. Conducted Output Power Measurements (Spot-check)



Plot 7-1. Peak Conducted Power Plot (Spot-check, 1Mbps – Ch. 19))

7.2 6dB Bandwidth Measurement – Bluetooth (LE)

§15.247(a)(2); RSS-247 [5.2(a)]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

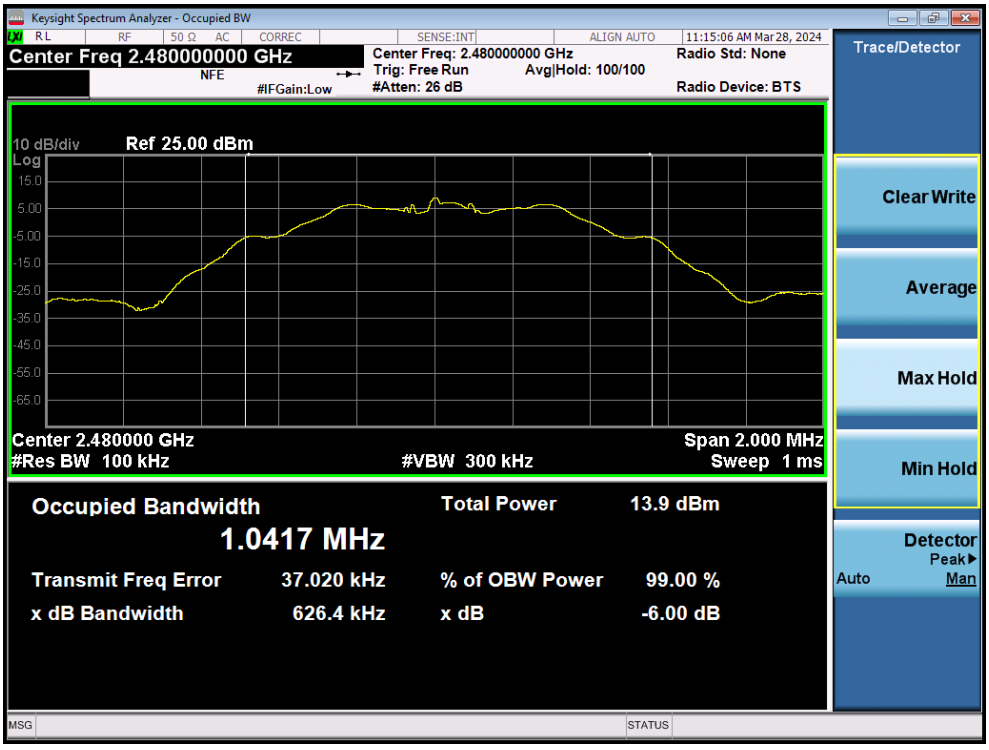
None

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	125 kbps	0	LE	607.0	500	Pass
2440	125 kbps	19	LE	605.7	500	Pass
2480	125 kbps	39	LE	626.4	500	Pass
2402	500 kbps	0	LE	662.0	500	Pass
2440	500 kbps	19	LE	659.7	500	Pass
2480	500 kbps	39	LE	658.8	500	Pass
2402	1 Mbps	0	LE	663.7	500	Pass
2440	1 Mbps	19	LE	666.0	500	Pass
2480	1 Mbps	39	LE	664.3	500	Pass
2402	2 Mbps	0	LE	1156.0	500	Pass
2440	2 Mbps	19	LE	1158.0	500	Pass
2480	2 Mbps	39	LE	1161.0	500	Pass

Table 7-4. Conducted Bandwidth Measurements – Ant1

Plot 7-2. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 0 – Ant1)

Plot 7-3. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 19 – Ant1)

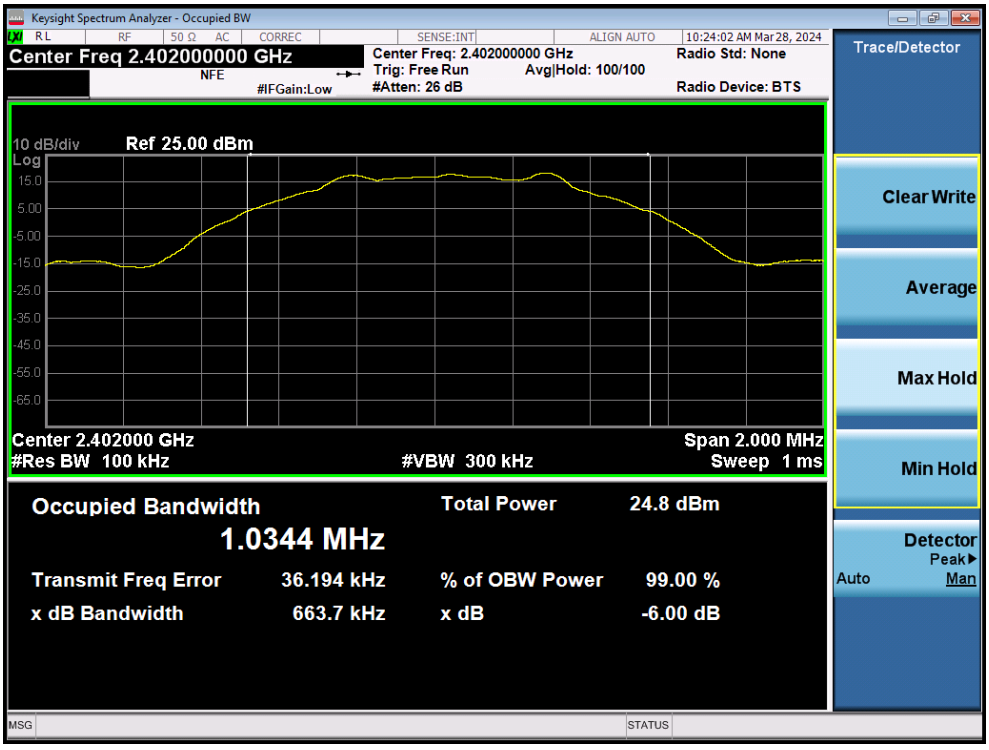


Plot 7-4. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 39 – Ant1)

Plot 7-5. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 0 – Ant1)

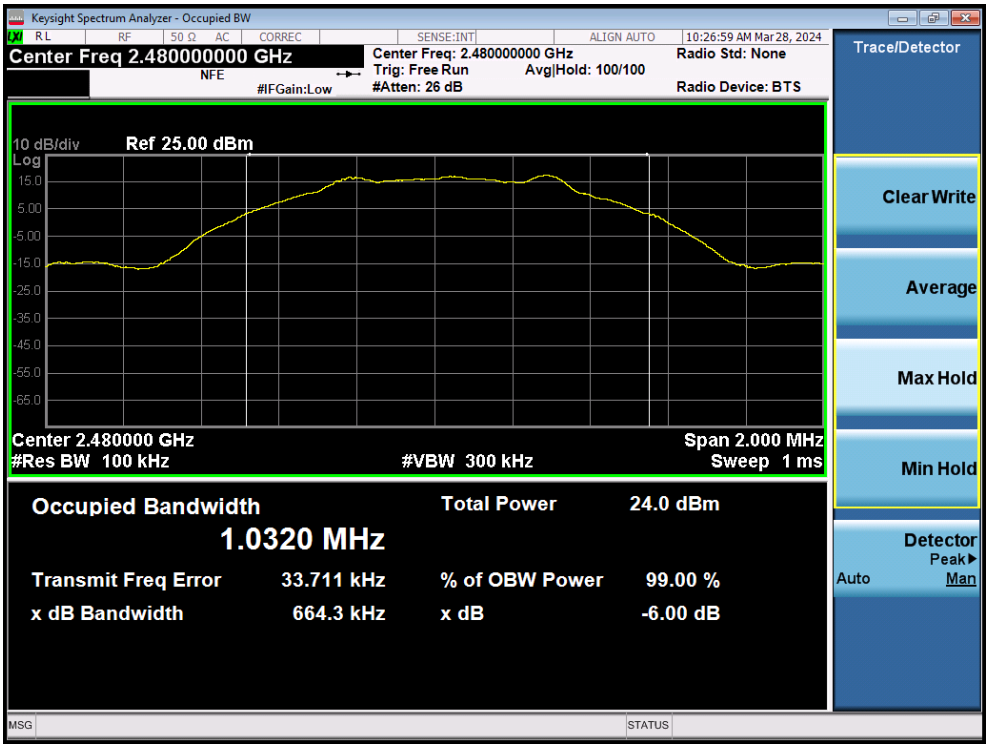
Plot 7-6. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 19 – Ant1)

Plot 7-7. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 39 – Ant1)

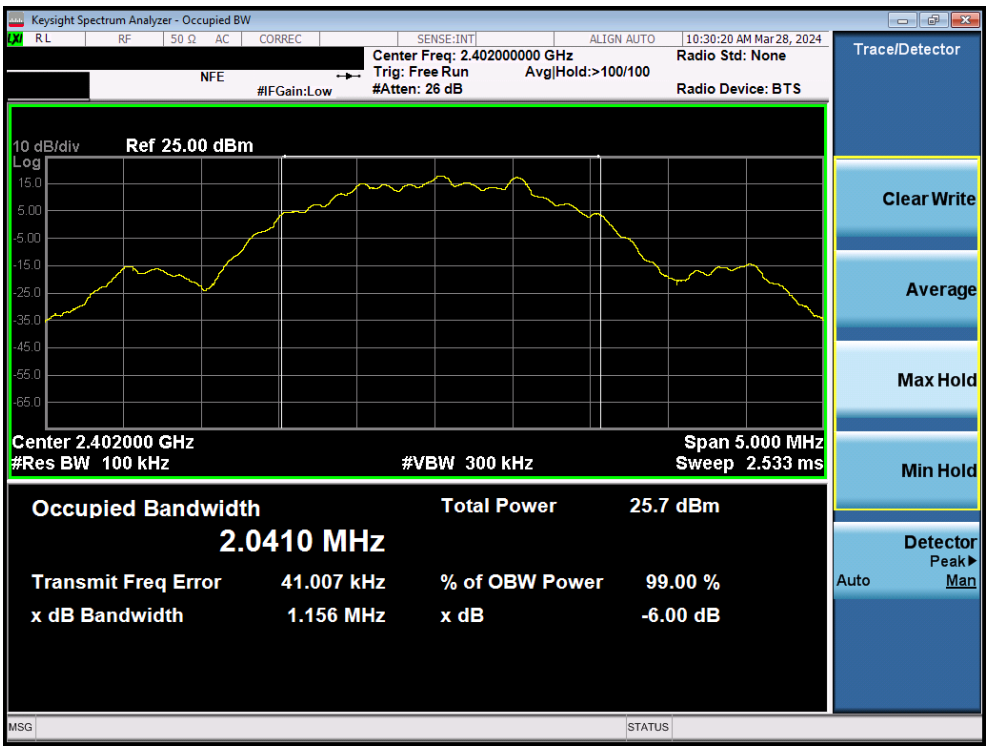


Plot 7-8. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0 – Ant1)

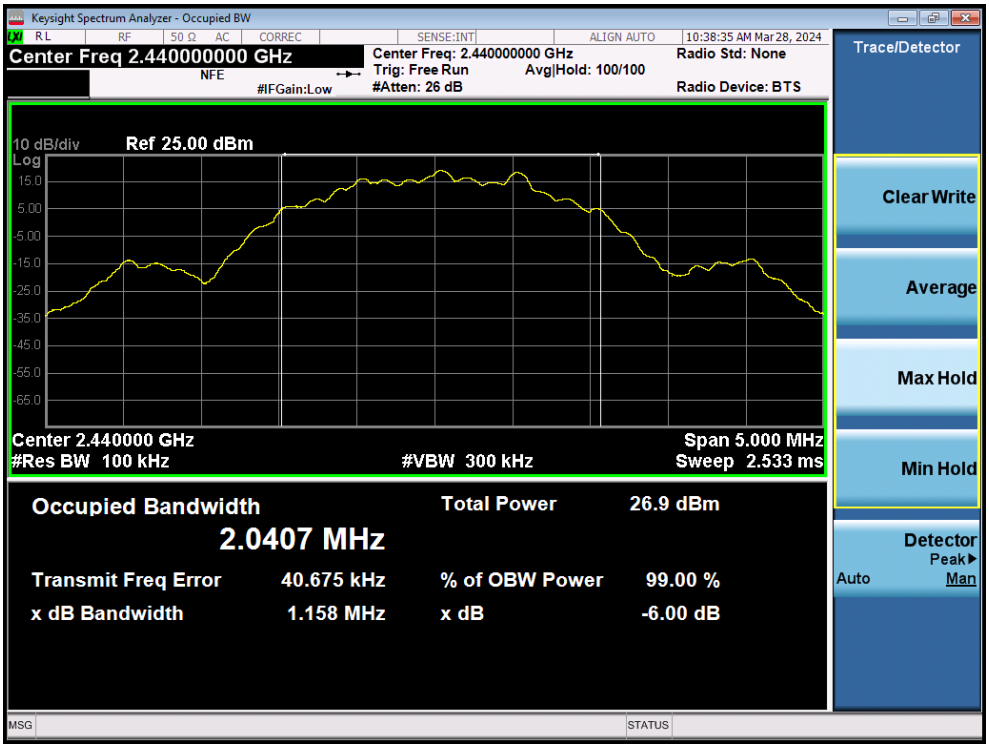
Plot 7-9. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19 – Ant1)



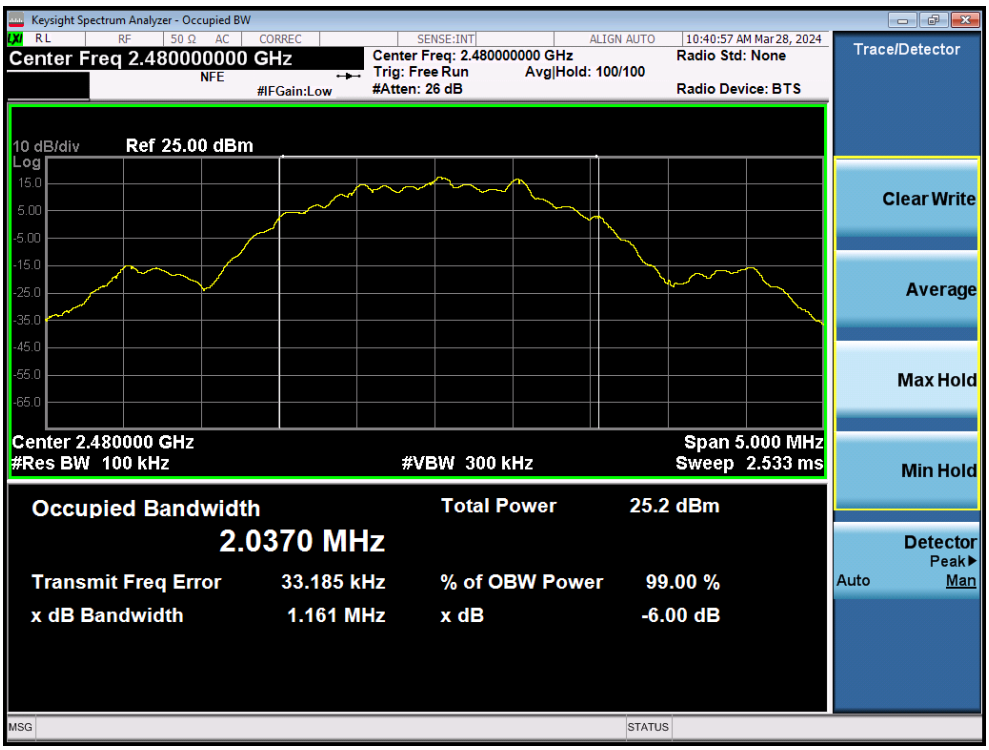
Plot 7-10. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39 – Ant1)



Plot 7-11. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0 – Ant1)



Plot 7-12. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19 – Ant1)



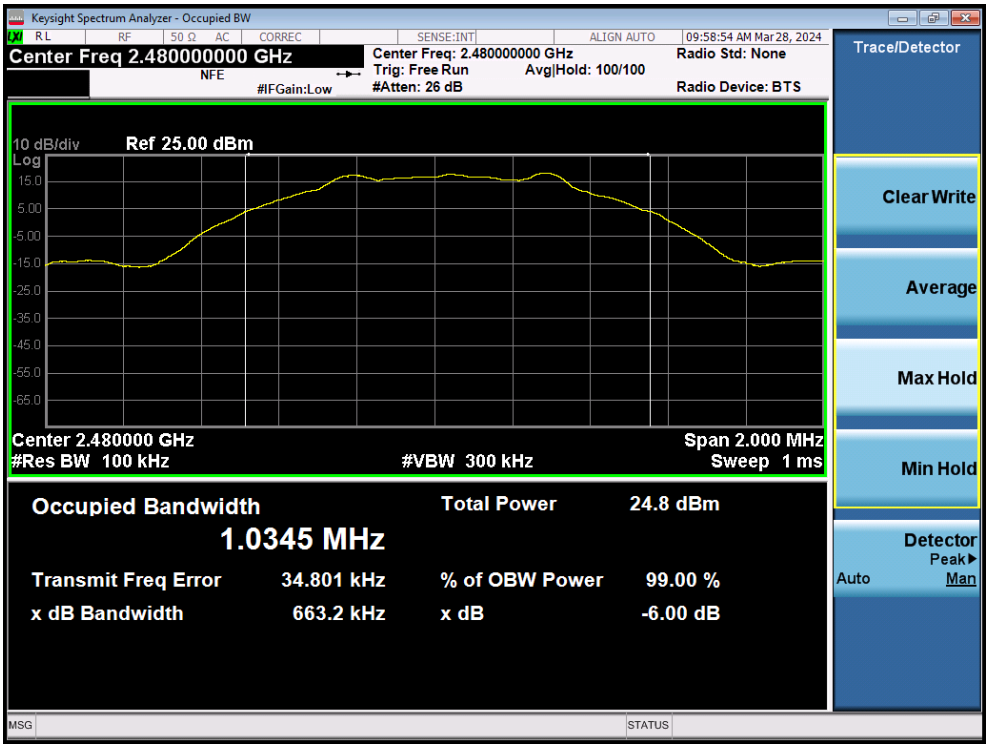
Plot 7-13. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39 – Ant1)

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	663.0	500	Pass
2440	1 Mbps	19	LE	663.4	500	Pass
2480	1 Mbps	39	LE	663.2	500	Pass
2402	2 Mbps	0	LE	1156.0	500	Pass
2440	2 Mbps	19	LE	1162.0	500	Pass
2480	2 Mbps	39	LE	1157.0	500	Pass

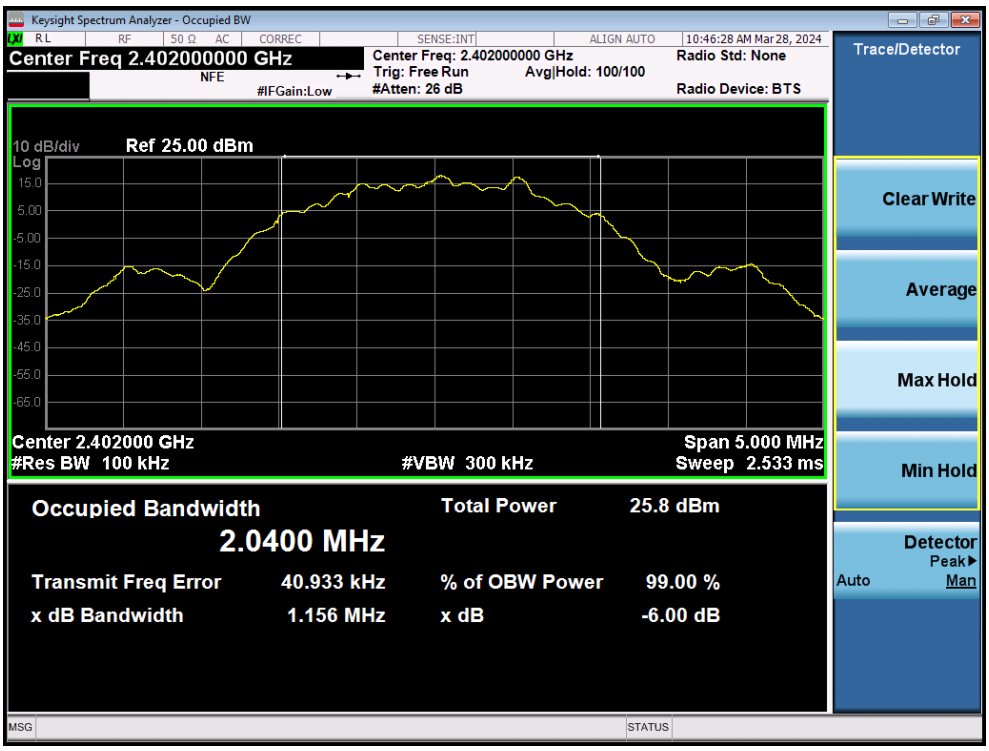
Table 7-5. Conducted Bandwidth Measurements – Ant2

Plot 7-14. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0 – Ant2)

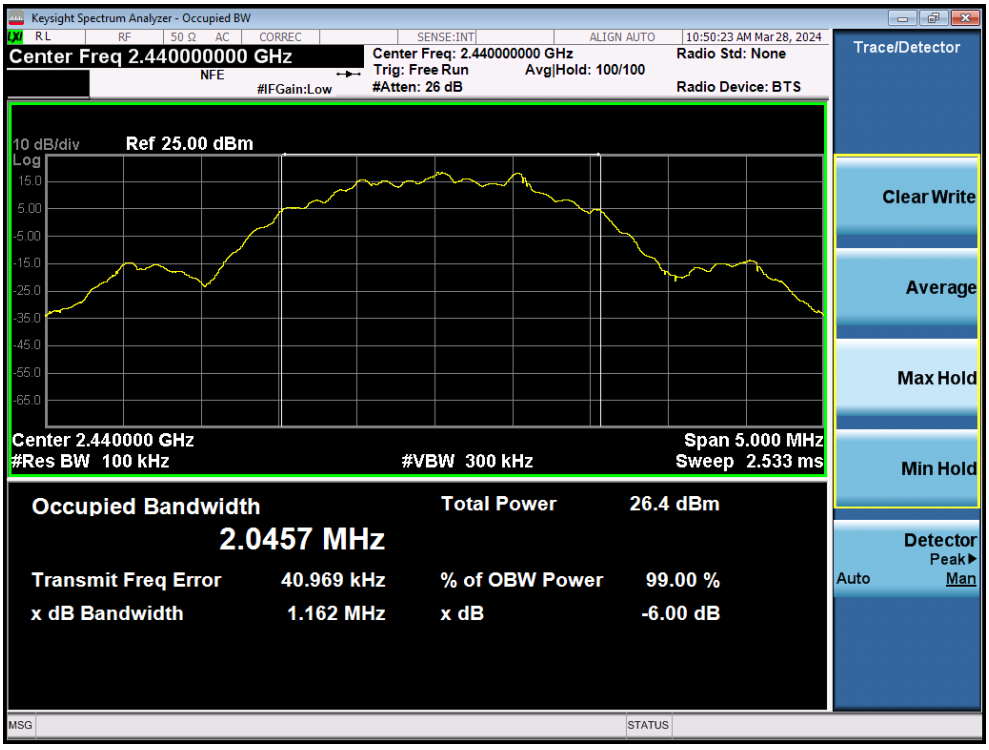
Plot 7-15. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19 – Ant2)



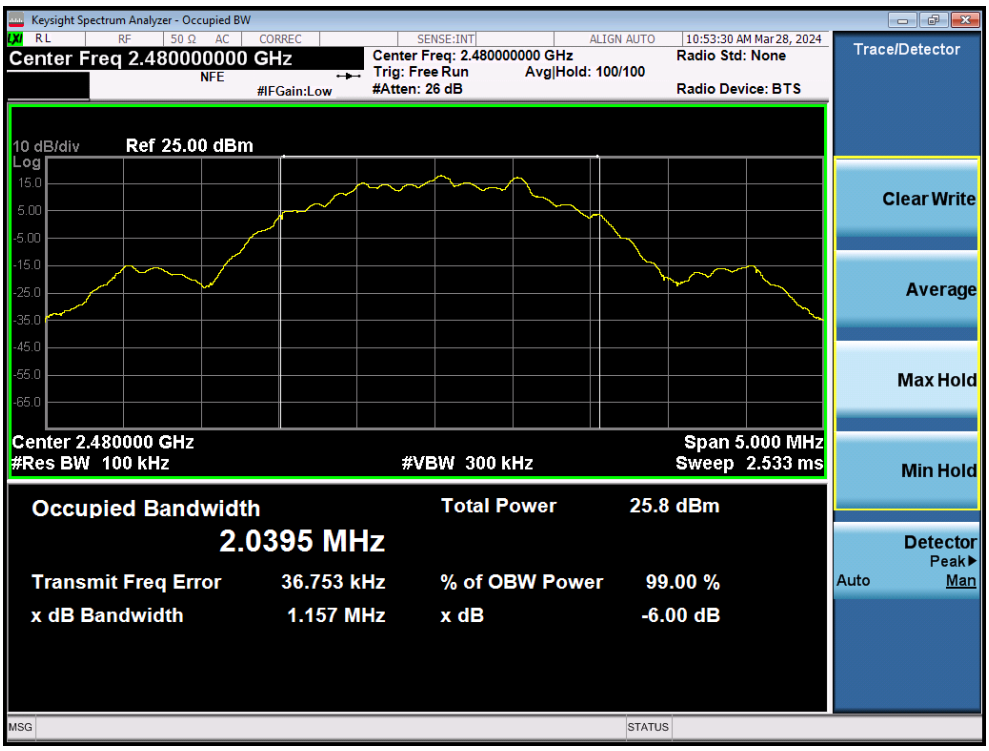
Plot 7-16. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39 – Ant2)



Plot 7-17. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0 – Ant2)



Plot 7-18. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19 – Ant2)



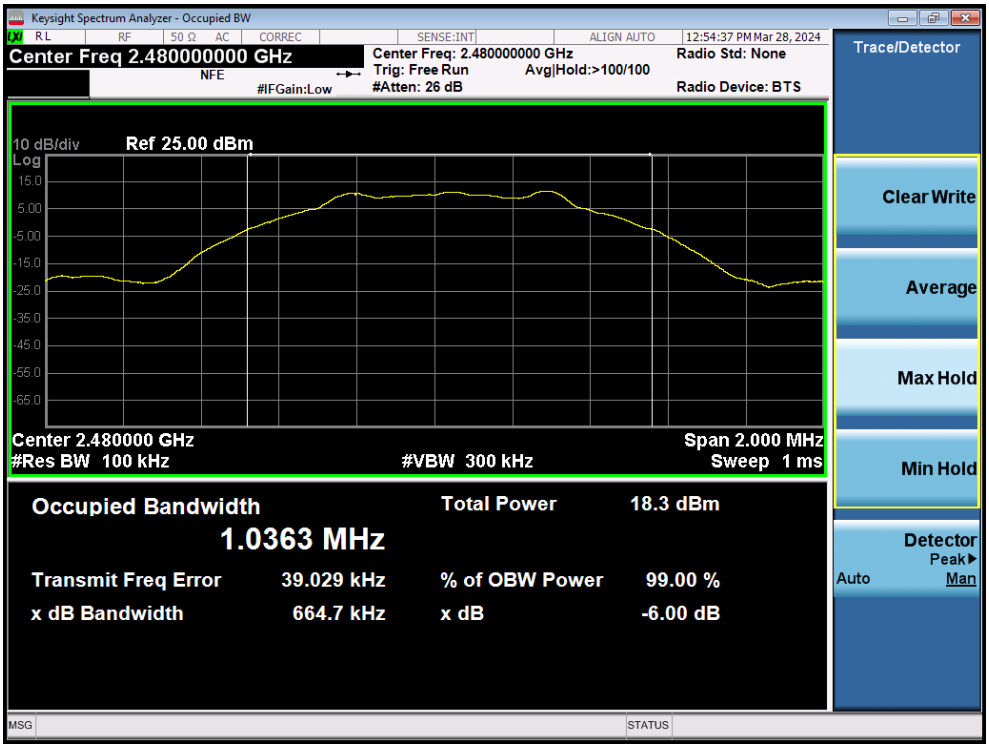
Plot 7-19. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39 – Ant2)

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	663.9	500	Pass
2440	1 Mbps	19	LE	665.3	500	Pass
2480	1 Mbps	39	LE	664.7	500	Pass
2402	2 Mbps	0	LE	1147.0	500	Pass
2440	2 Mbps	19	LE	1144.0	500	Pass
2480	2 Mbps	39	LE	1149.0	500	Pass

Table 7-6. Conducted Bandwidth Measurements – Dual Ant1

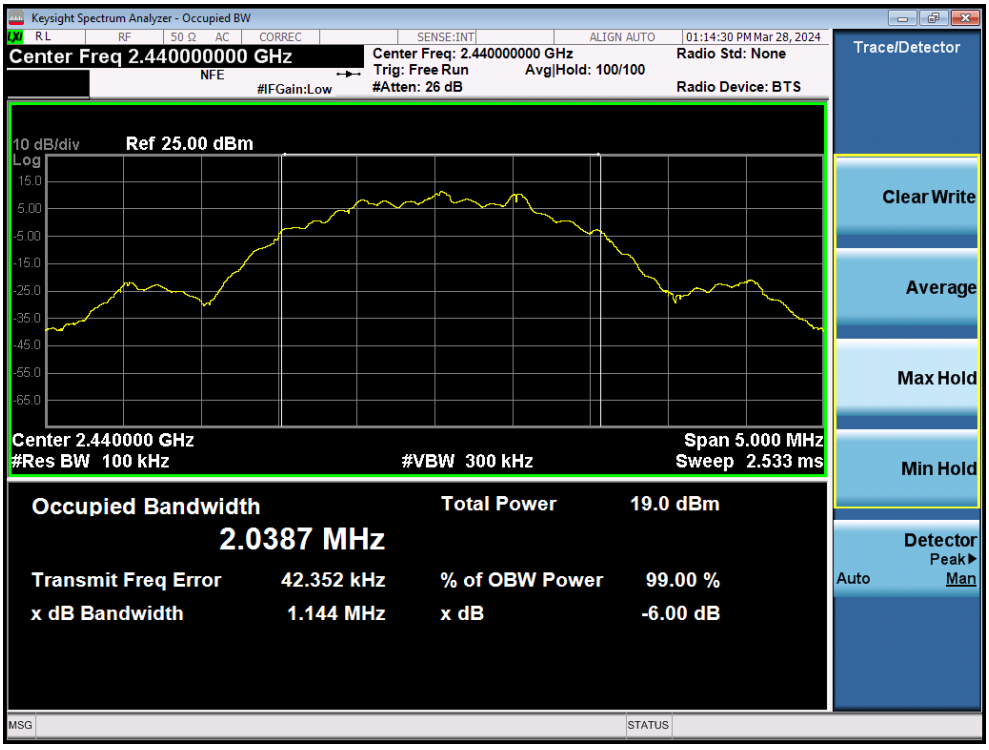
Plot 7-20. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0 – Dual Ant1)

Plot 7-21. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19 – Dual Ant1)



Plot 7-22. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39 – Dual Ant1)

Plot 7-23. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0 – Dual Ant1)

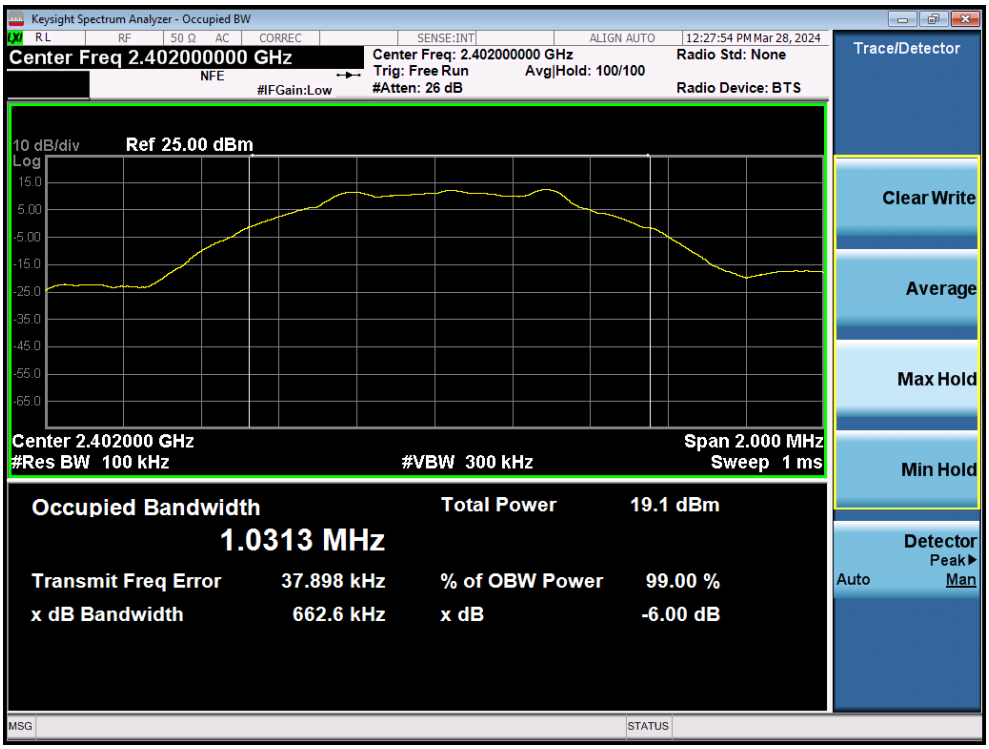


Plot 7-24. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19 – Dual Ant1)

Plot 7-25. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39 – Dual Ant1)

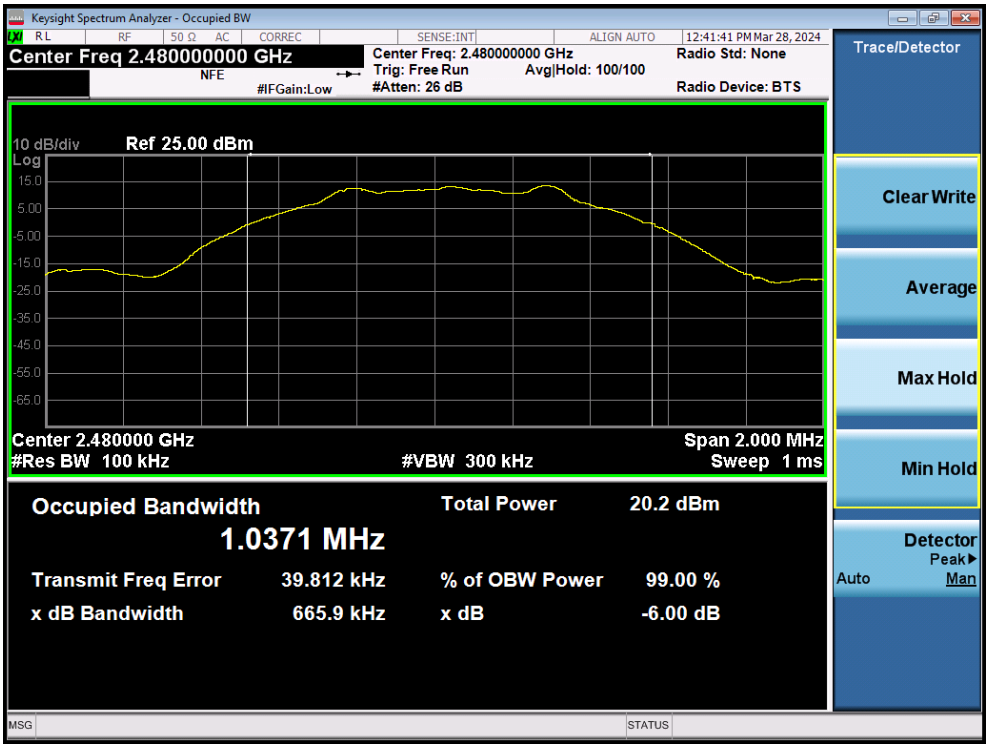
Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	662.6	500	Pass
2440	1 Mbps	19	LE	666.6	500	Pass
2480	1 Mbps	39	LE	665.9	500	Pass
2402	2 Mbps	0	LE	1139.0	500	Pass
2440	2 Mbps	19	LE	1150.0	500	Pass
2480	2 Mbps	39	LE	1146.0	500	Pass

Table 7-7. Conducted Bandwidth Measurements – Dual Ant2



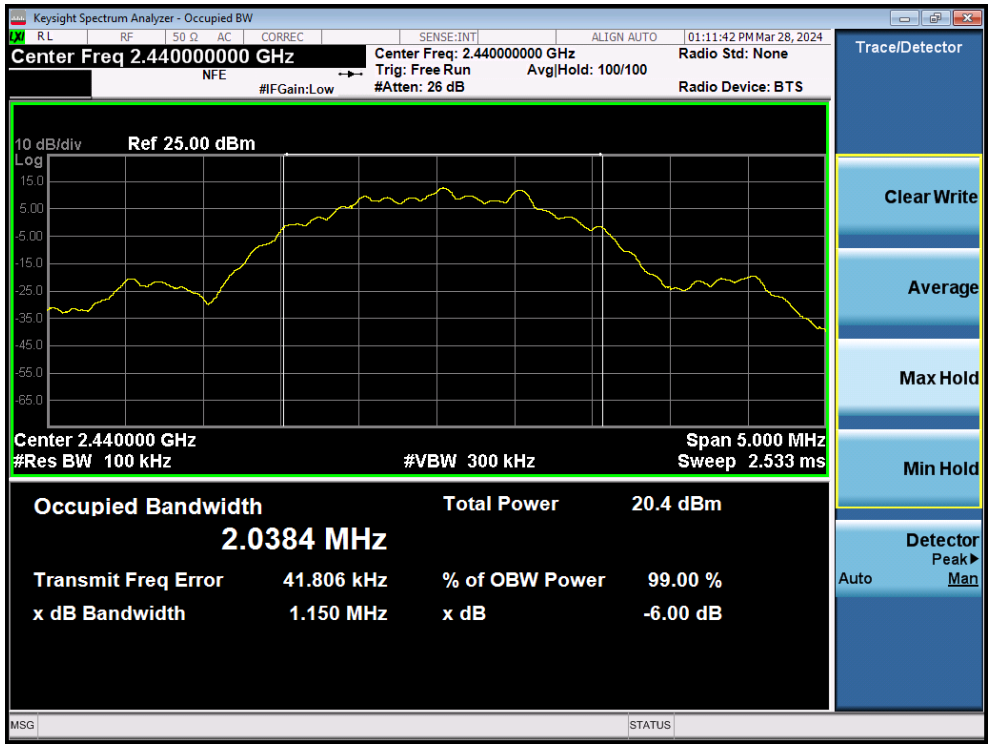
Plot 7-26. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0 – Dual Ant2)

Plot 7-27. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19 – Dual Ant2)

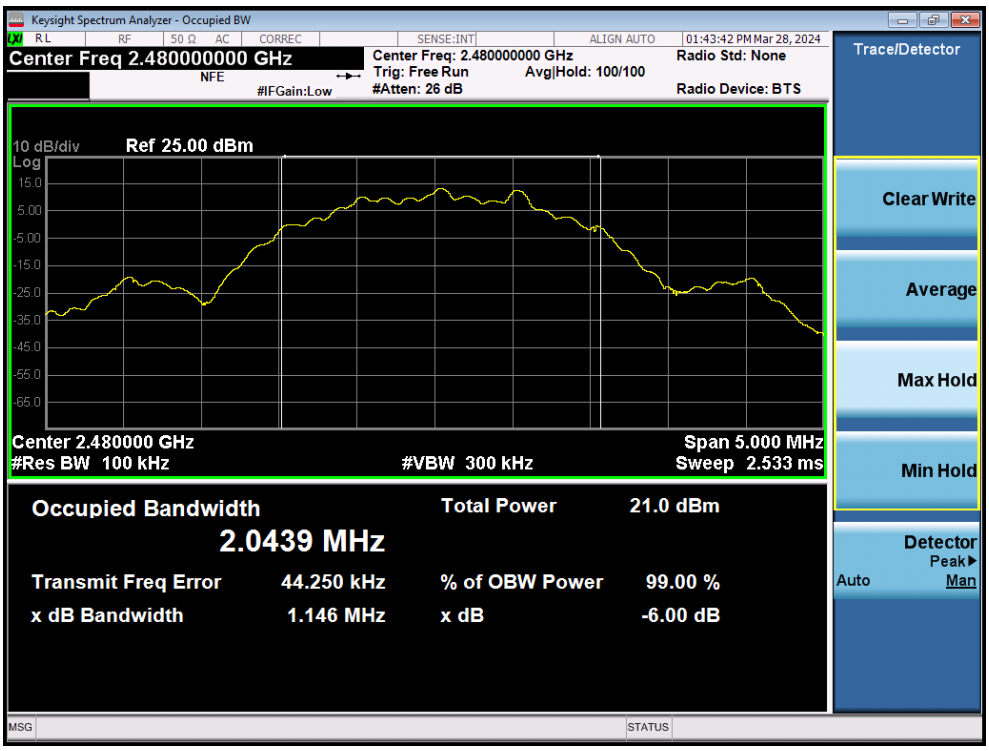


Plot 7-28. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39 – Dual Ant2)

Plot 7-29. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0 – Dual Ant2)



Plot 7-30. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19 – Dual Ant2)



Plot 7-31. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39 – Dual Ant2)

7.3 Output Power Measurement – Bluetooth (LE)

§15.247(b)(3); RSS-247 [5.4(d)]

Test Overview and Limits

The transmitter antenna terminal of the EUT is connected to the input of a spectrum analyzer. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt. The maximum permissible e i r p per RSS-247 is 4 Watts.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.1

Test Settings

1. RBW = 3MHz
2. VBW = 50MHz
3. Span ≥ 3 x RBW
4. Sweep = auto couple
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

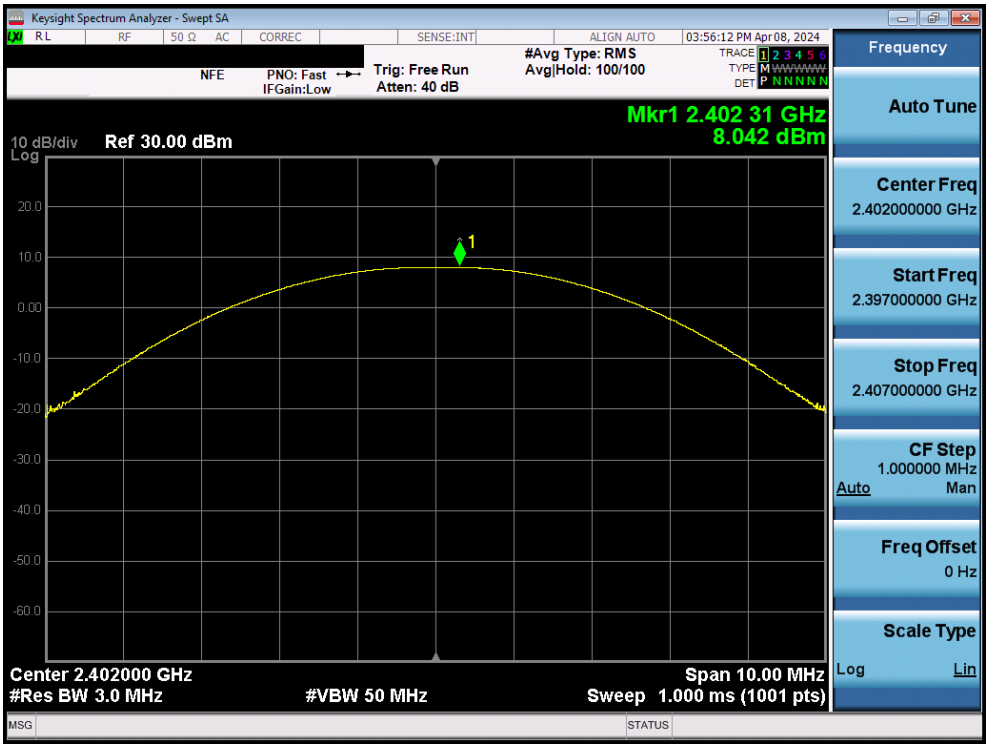
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

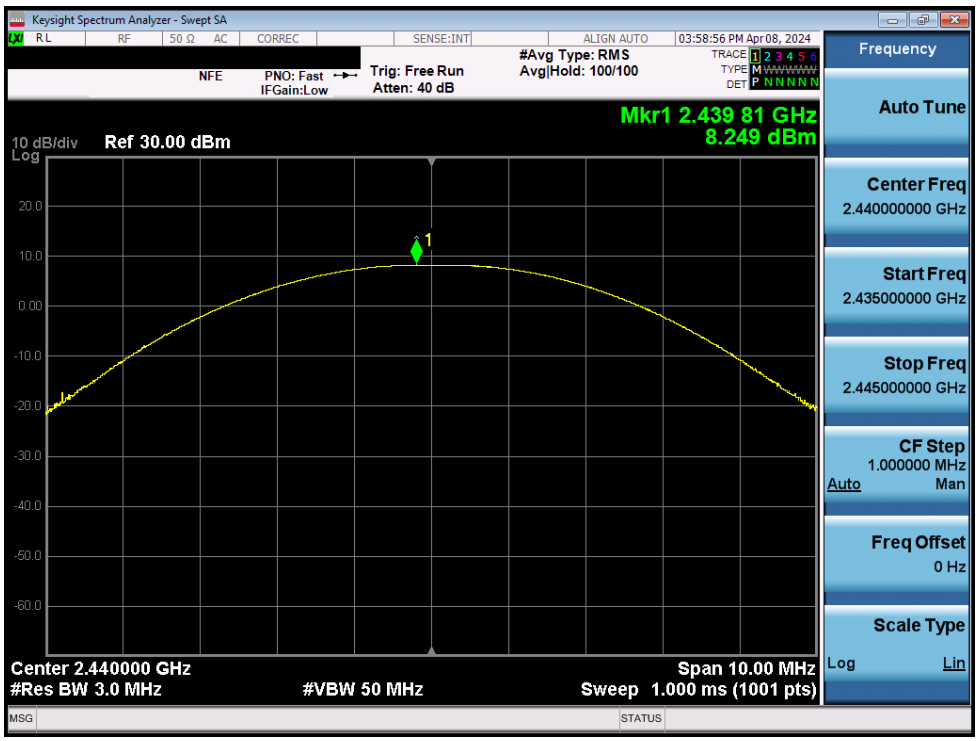
None

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2402	125 kbps	0	LE	8.04	6.371
2440	125 kbps	19	LE	8.25	6.682
2480	125 kbps	39	LE	7.63	5.797
2402	500 kbps	0	LE	8.04	6.368
2440	500 kbps	19	LE	8.25	6.690
2480	500 kbps	39	LE	7.65	5.820
2402	1 Mbps	0	LE	15.97	39.518
2440	1 Mbps	19	LE	16.98	49.900
2480	1 Mbps	39	LE	15.84	38.327
2402	2 Mbps	0	LE	15.74	37.506
2440	2 Mbps	19	LE	16.91	49.034
2480	2 Mbps	39	LE	15.49	35.432

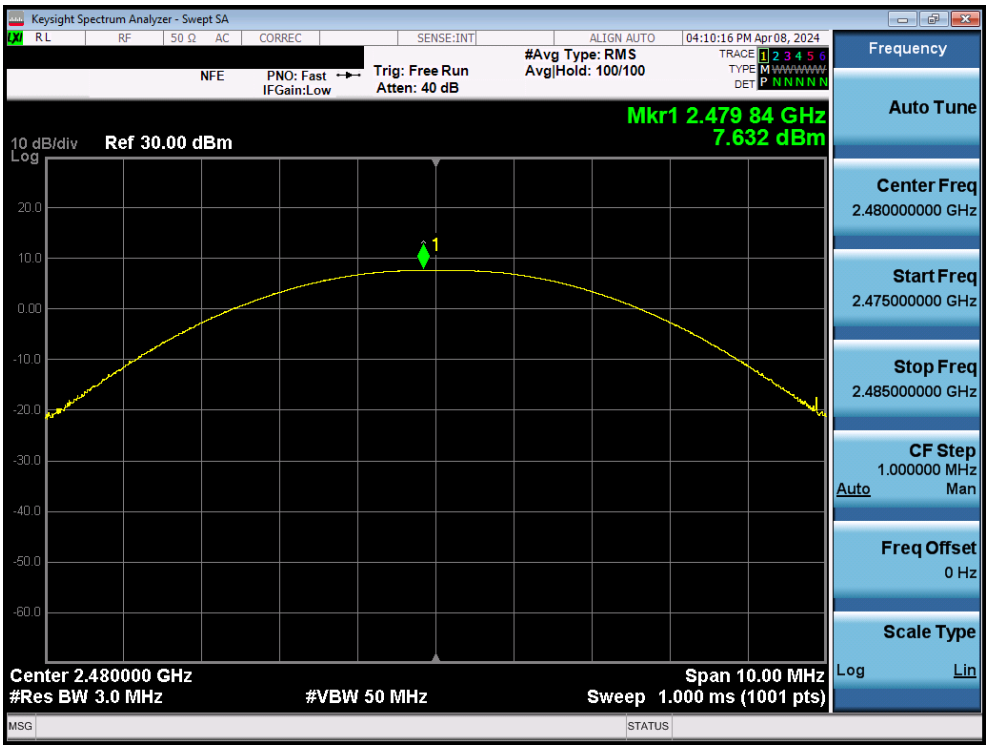
Table 7-8. Conducted Output Power Measurements (Bluetooth (LE)) – Ant1



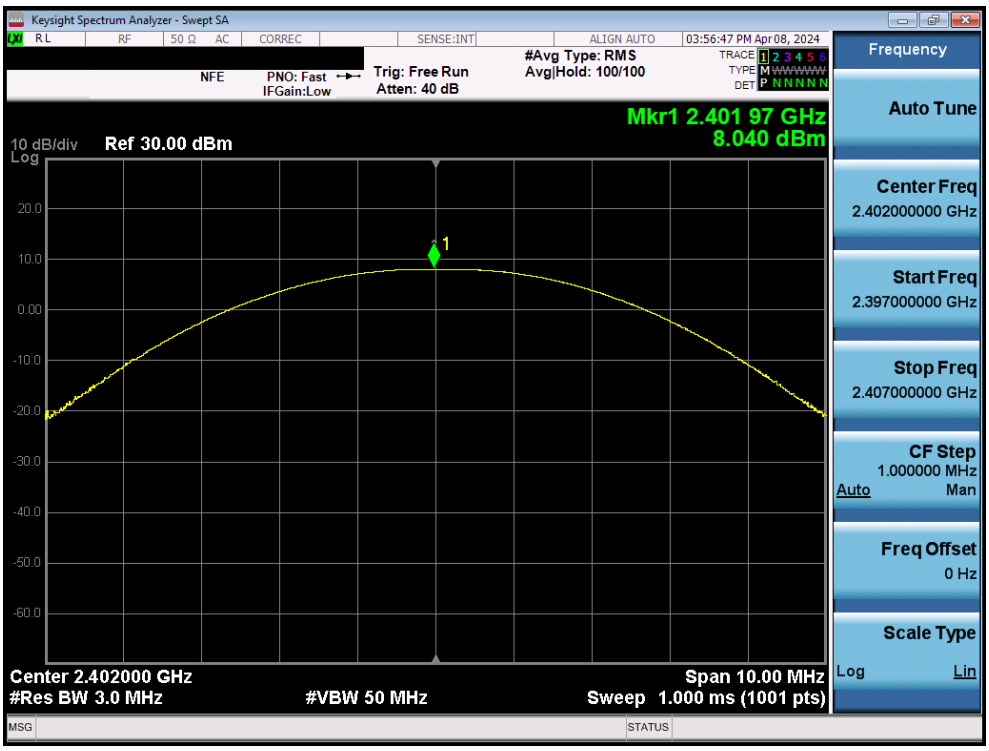
Plot 7-32. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant1



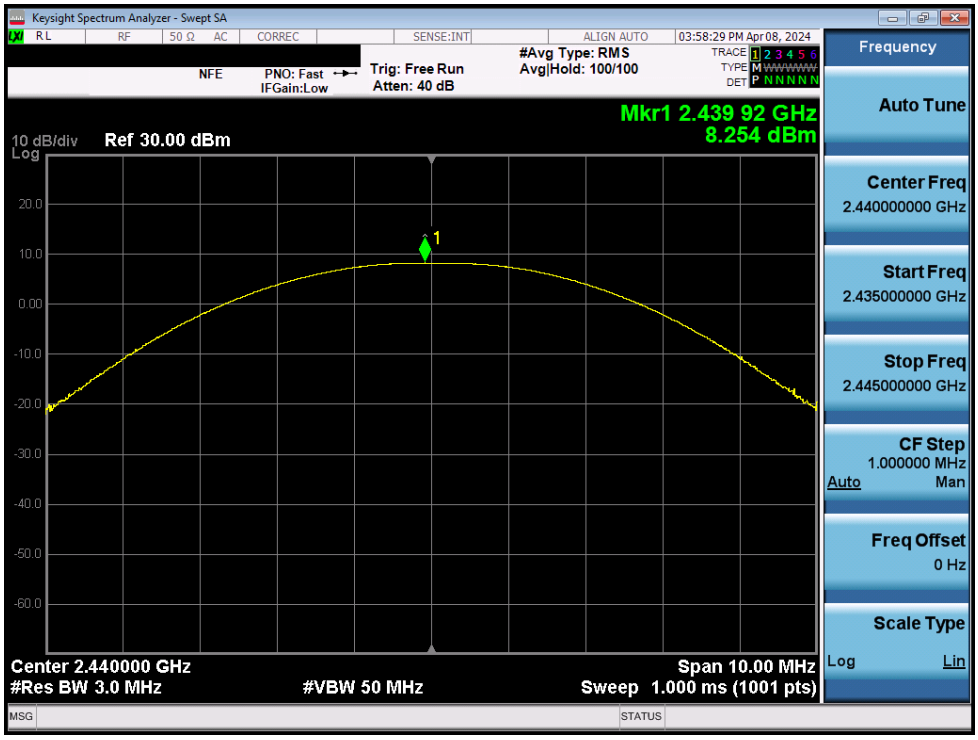
Plot 7-33. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant1



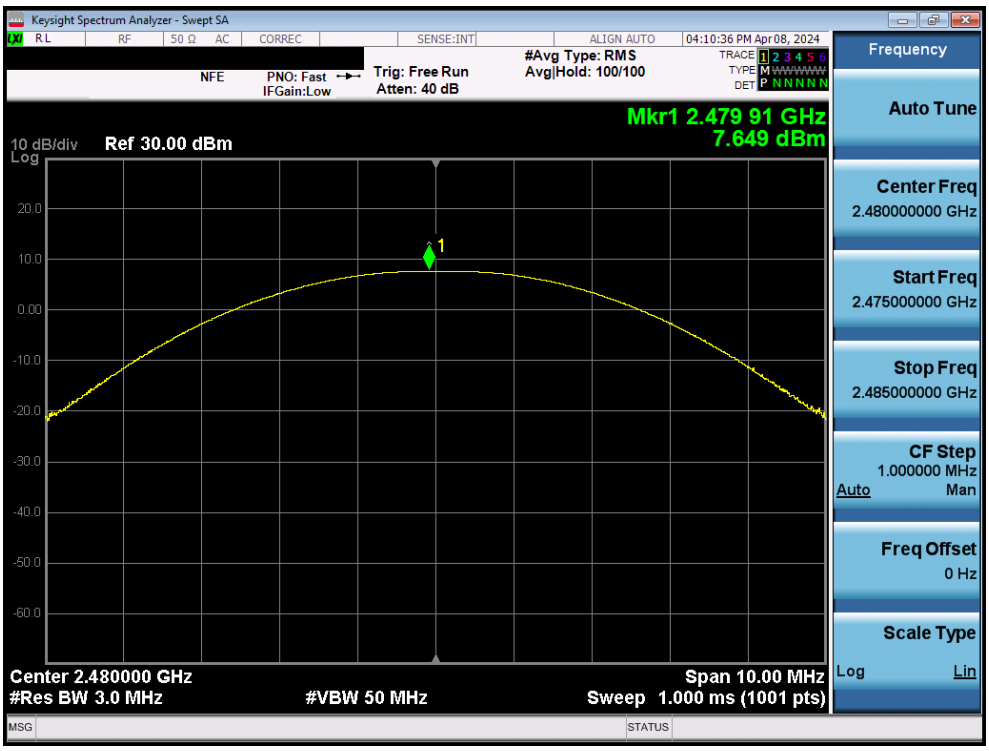
Plot 7-34. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant1



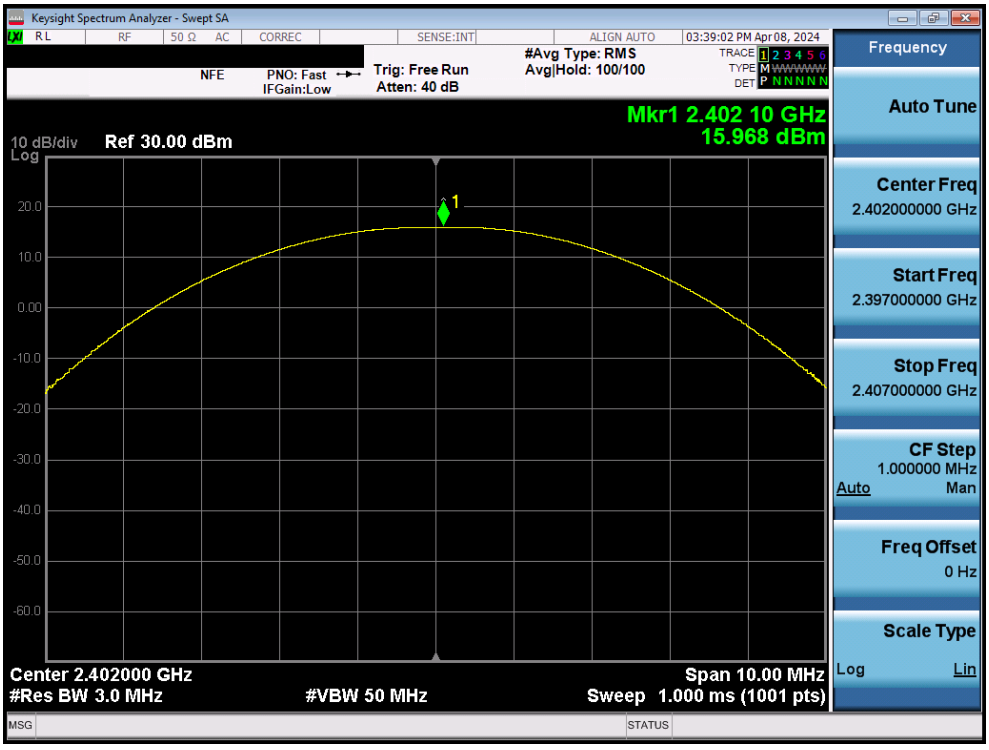
Plot 7-35. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant1



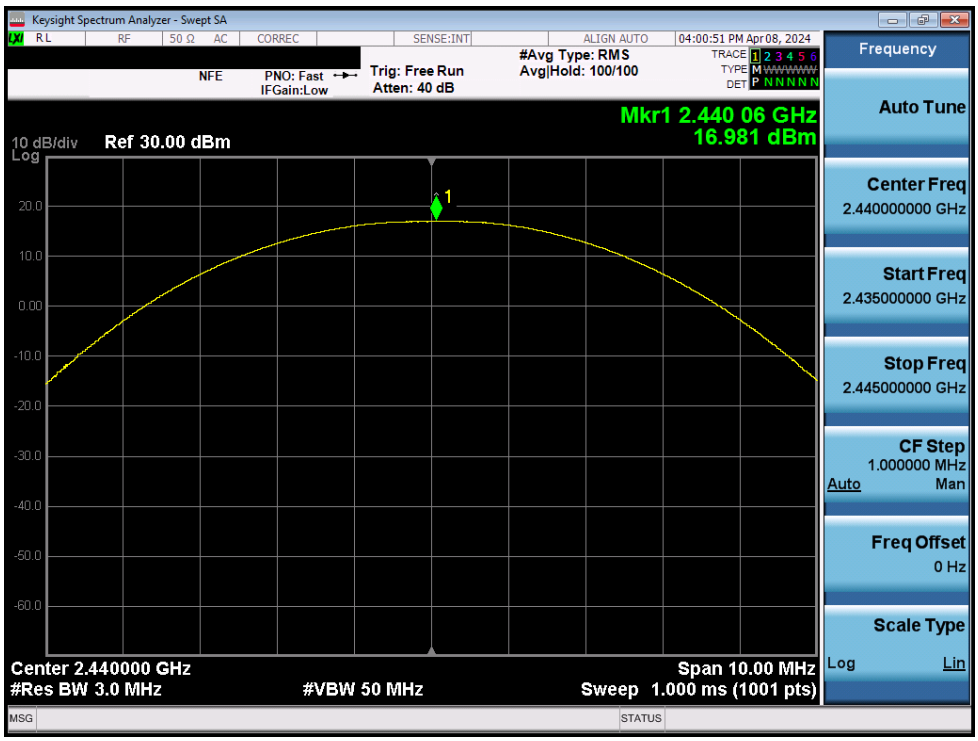
Plot 7-36. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant1



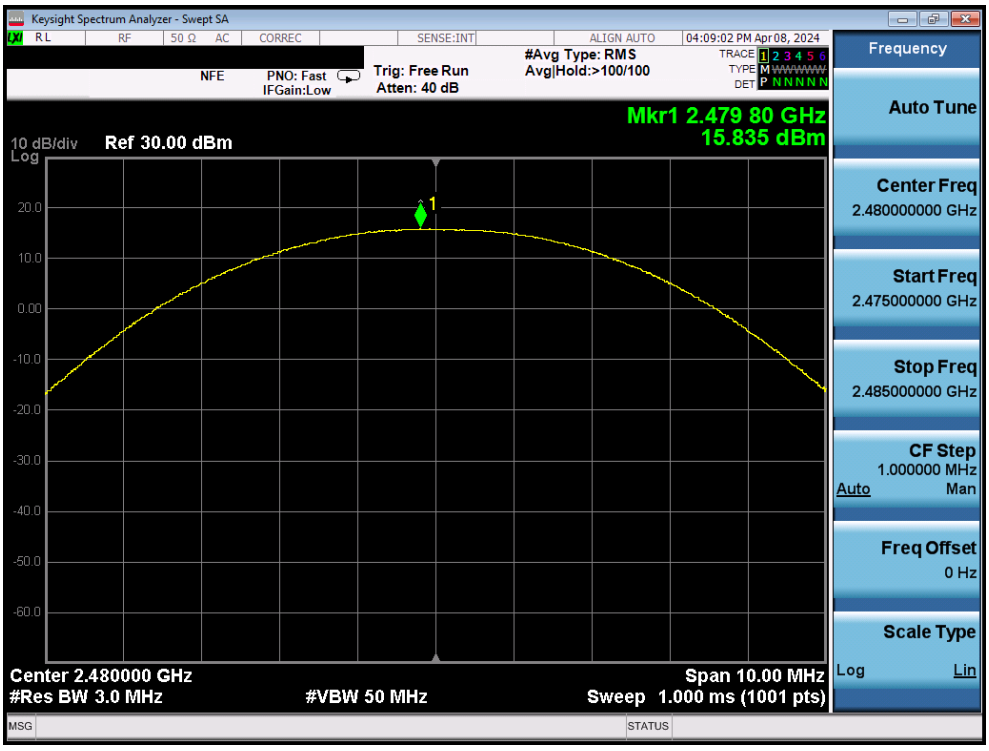
Plot 7-37. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant1



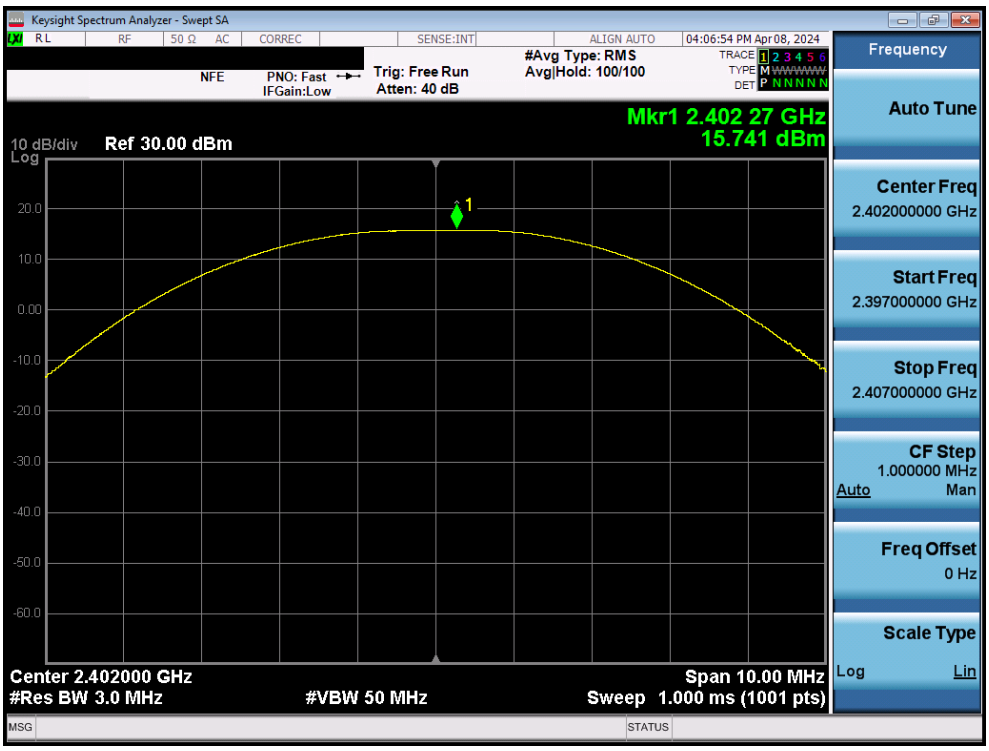
Plot 7-38. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant1



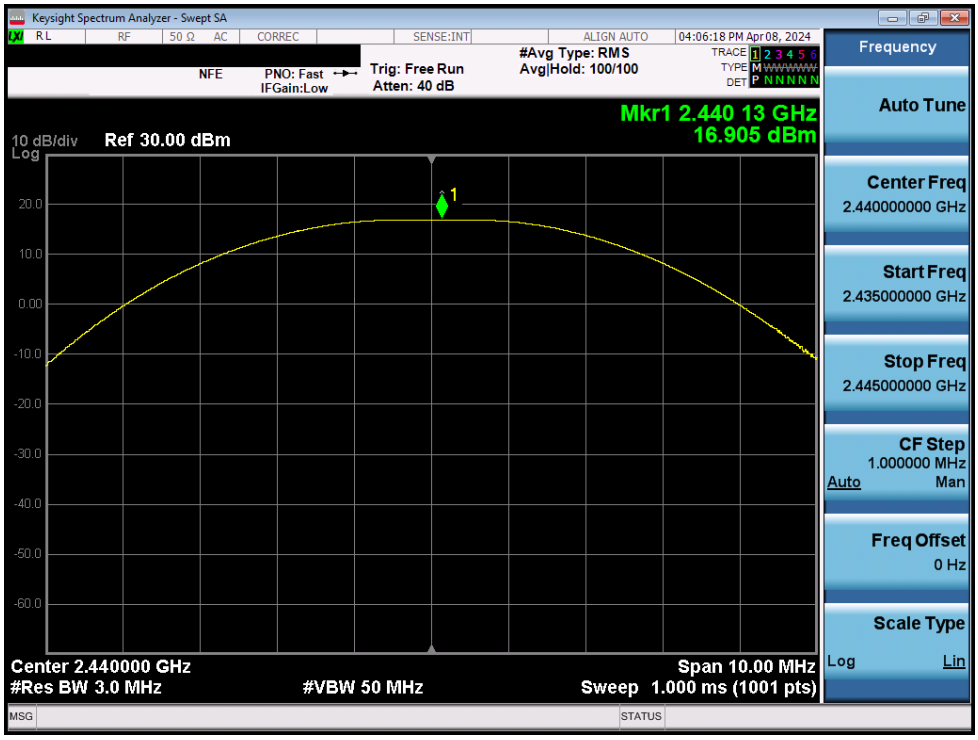
Plot 7-39. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant1



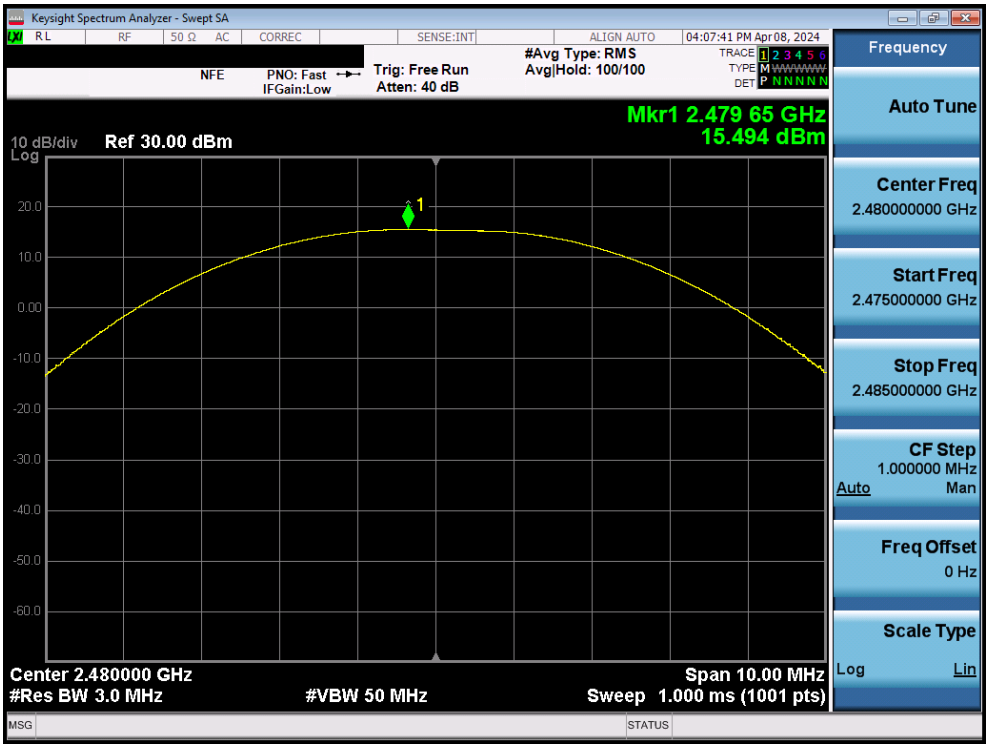
Plot 7-40. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant1



Plot 7-41. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant1



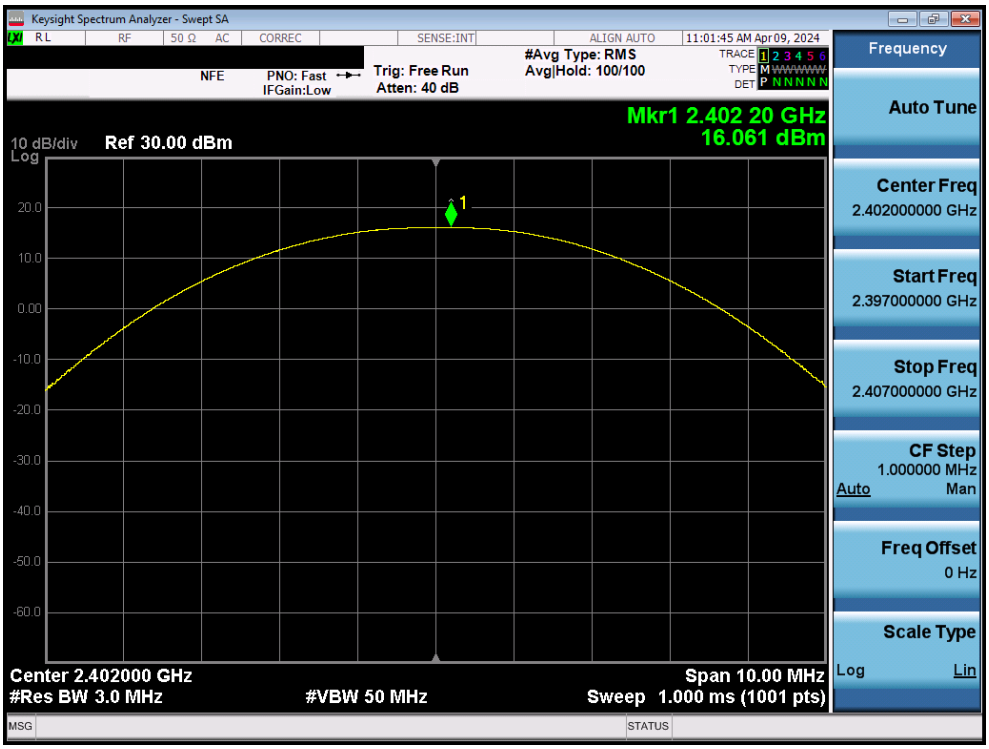
Plot 7-42. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant1



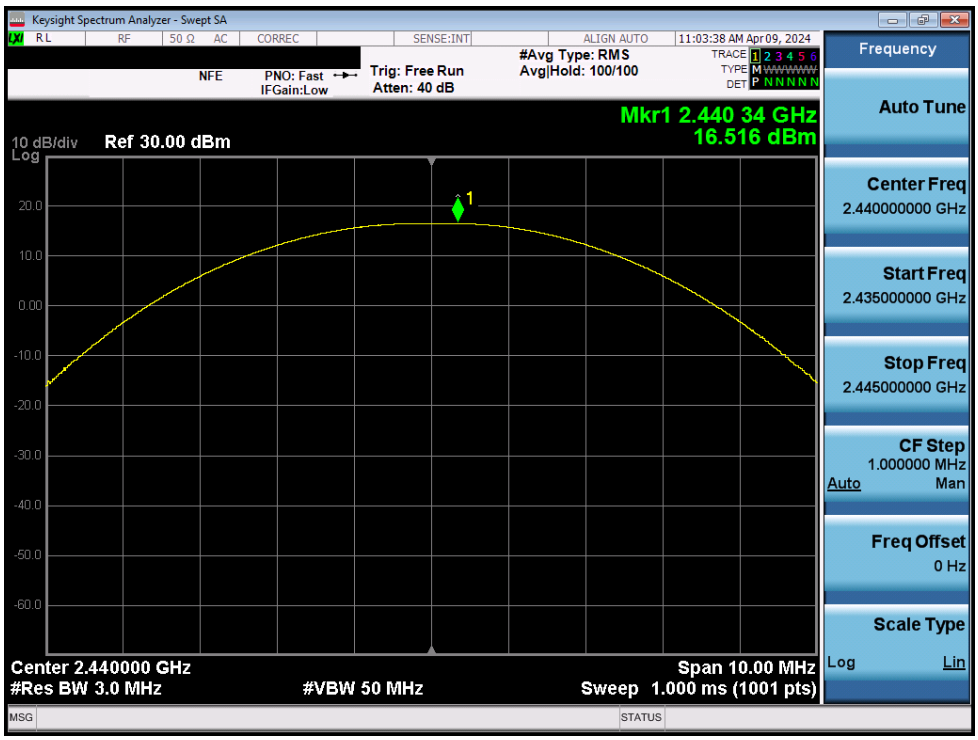
Plot 7-43. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant1

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2402	1 Mbps	0	LE	16.06	40.374
2440	1 Mbps	19	LE	16.52	44.833
2480	1 Mbps	39	LE	16.07	40.476
2402	2 Mbps	0	LE	15.97	39.546
2440	2 Mbps	19	LE	16.50	44.648
2480	2 Mbps	39	LE	16.02	40.022

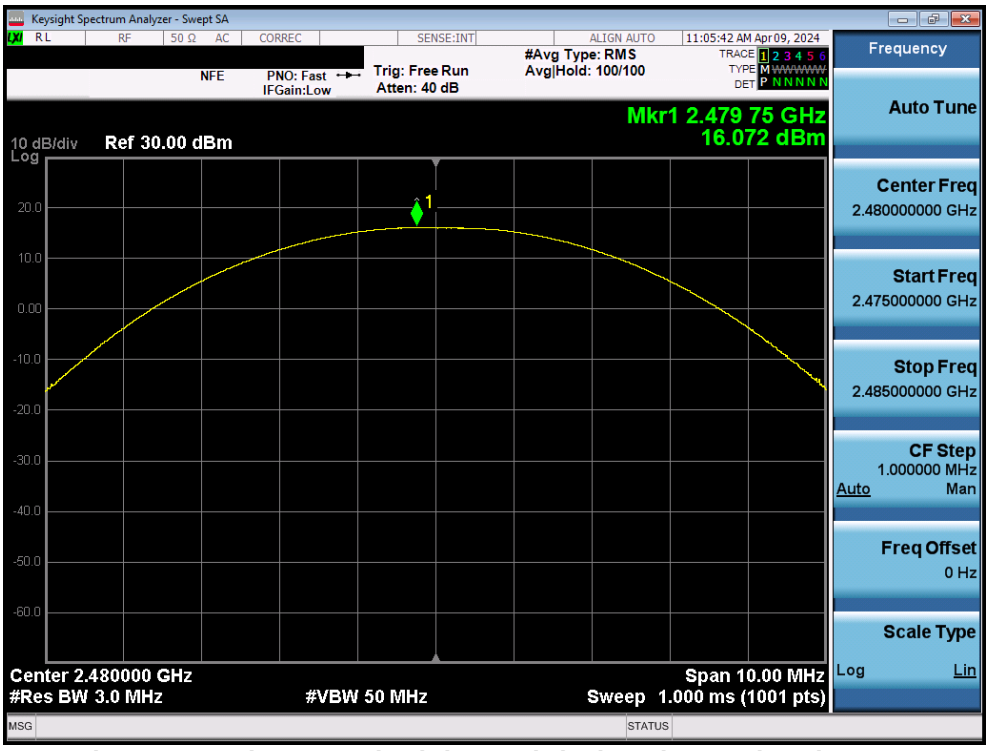
Table 7-9. Conducted Output Power Measurements (Bluetooth (LE)) – Ant2



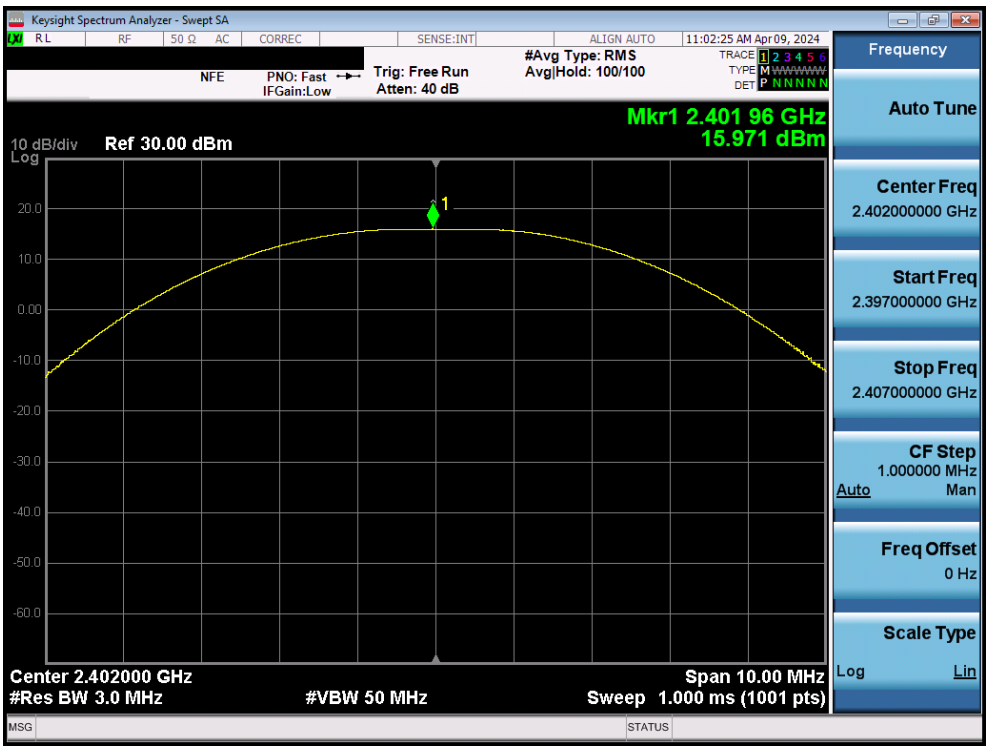
Plot 7-44. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant2



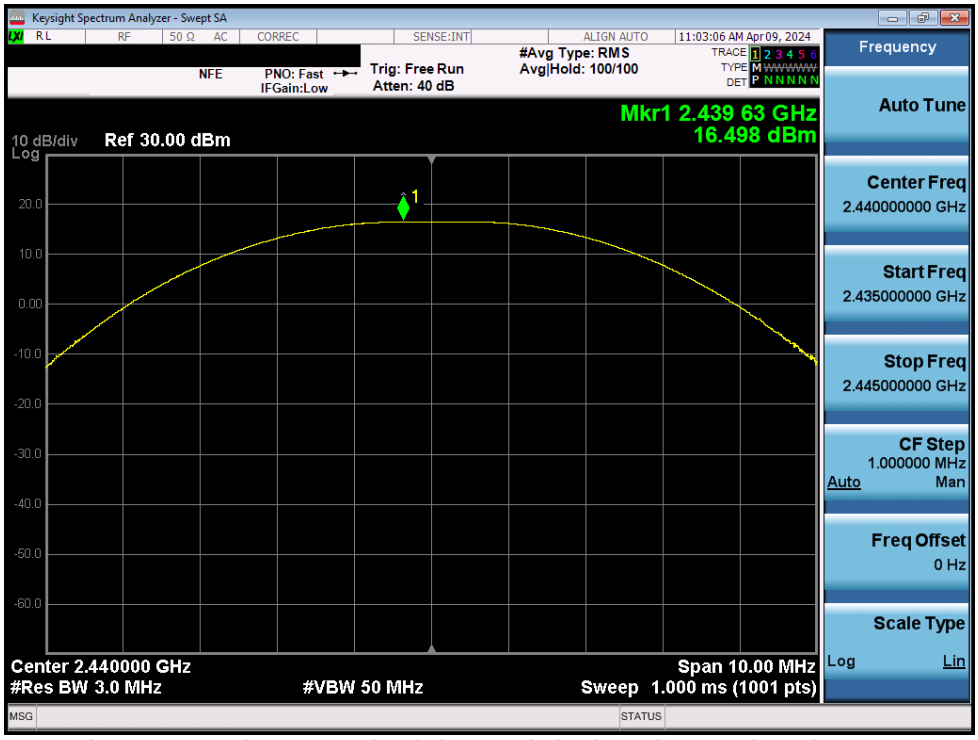
Plot 7-45. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant2



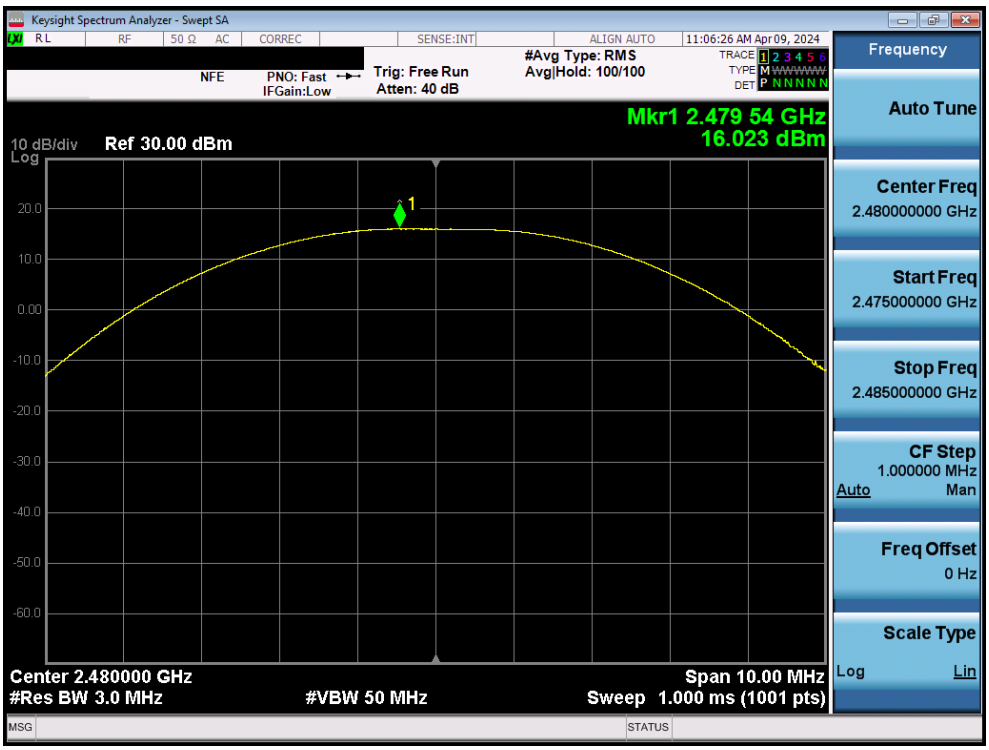
Plot 7-46. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant2



Plot 7-47. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant2



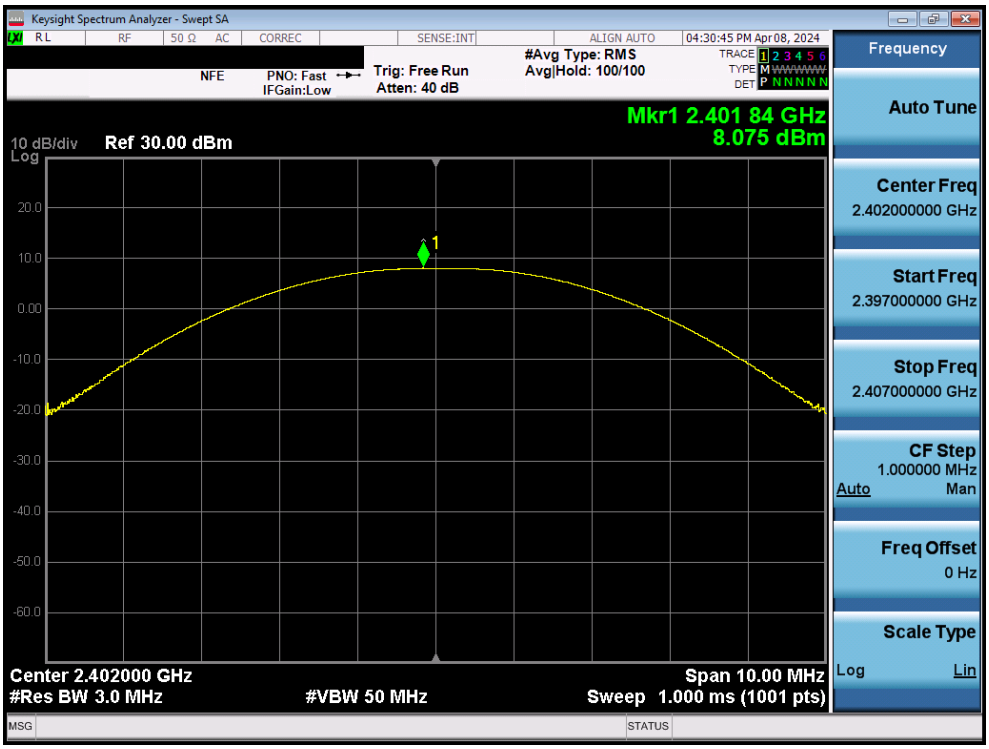
Plot 7-48. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant2



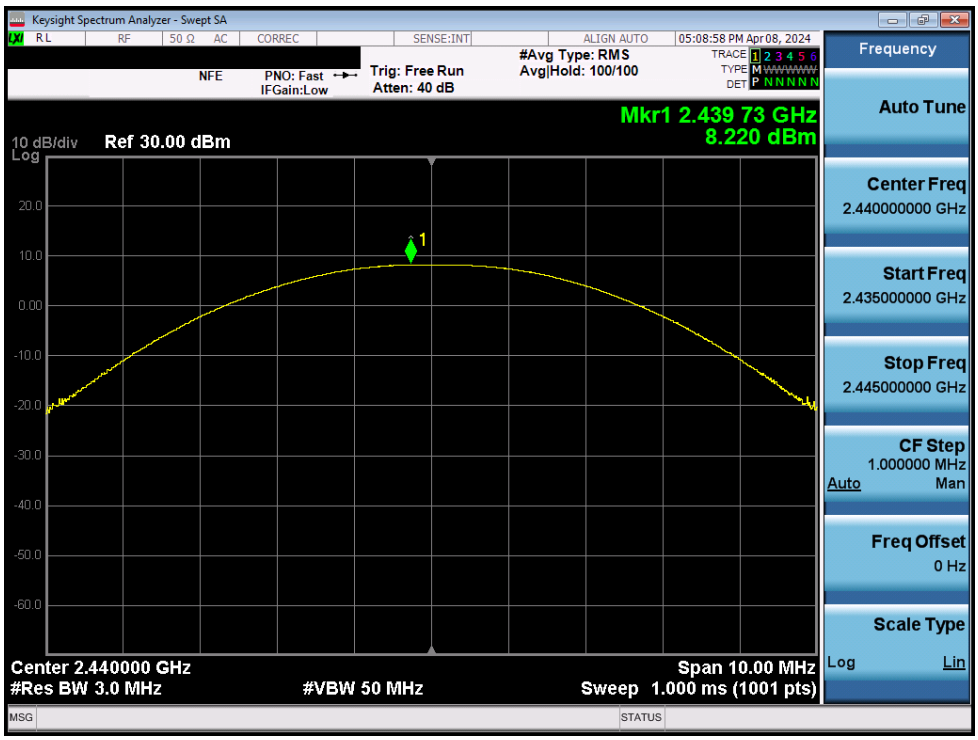
Plot 7-49. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant2

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Ant1 Peak Conducted Power		Ant2 Peak Conducted Power		Dual Peak Conducted Power	
				[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]
2402	1 Mbps	0	LE	8.08	6.419	6.09	4.062	10.20	10.481
2440	1 Mbps	19	LE	8.22	6.637	6.57	4.538	10.48	11.176
2480	1 Mbps	39	LE	7.72	5.916	5.62	3.649	9.81	9.565
2402	2 Mbps	0	LE	8.08	6.425	5.99	3.973	10.17	10.398
2440	2 Mbps	19	LE	8.30	6.759	6.43	4.395	10.47	11.155
2480	2 Mbps	39	LE	7.78	5.998	5.50	3.551	9.80	9.549

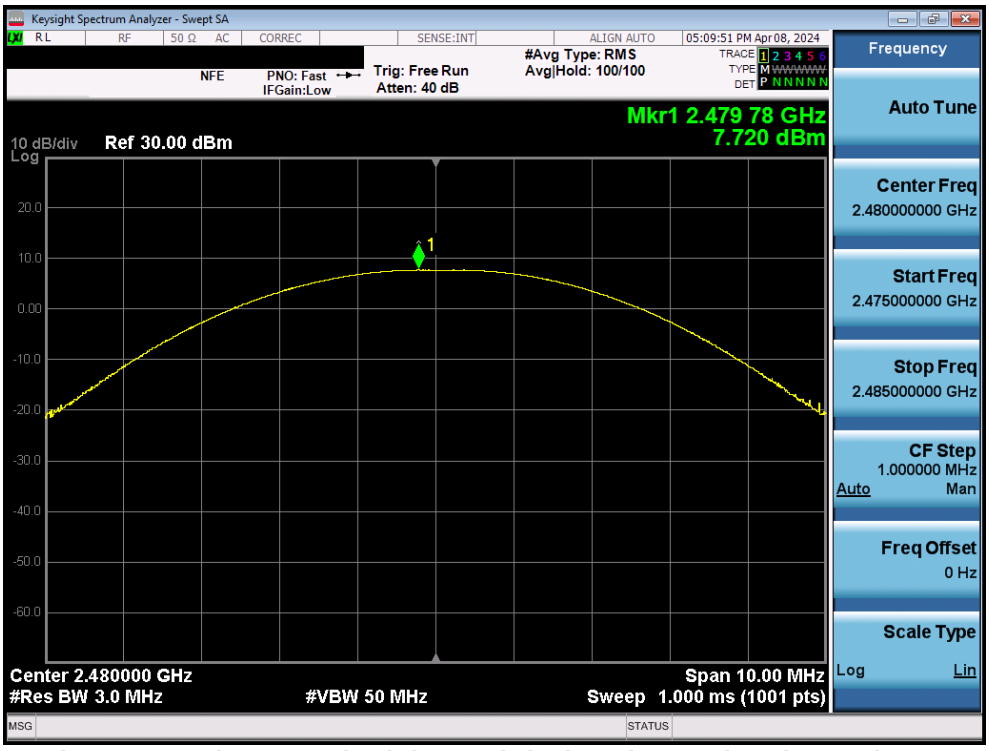
Table 7-10. Conducted Output Power Measurements (Bluetooth (LE)) – Dual



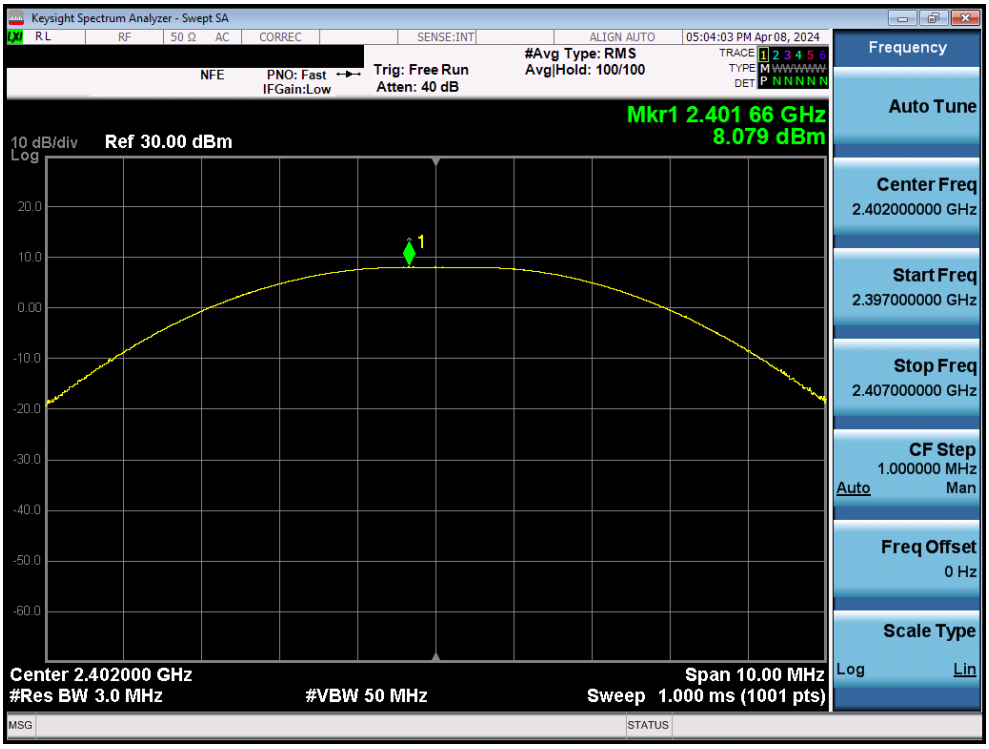
Plot 7-50. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Dual Ant1



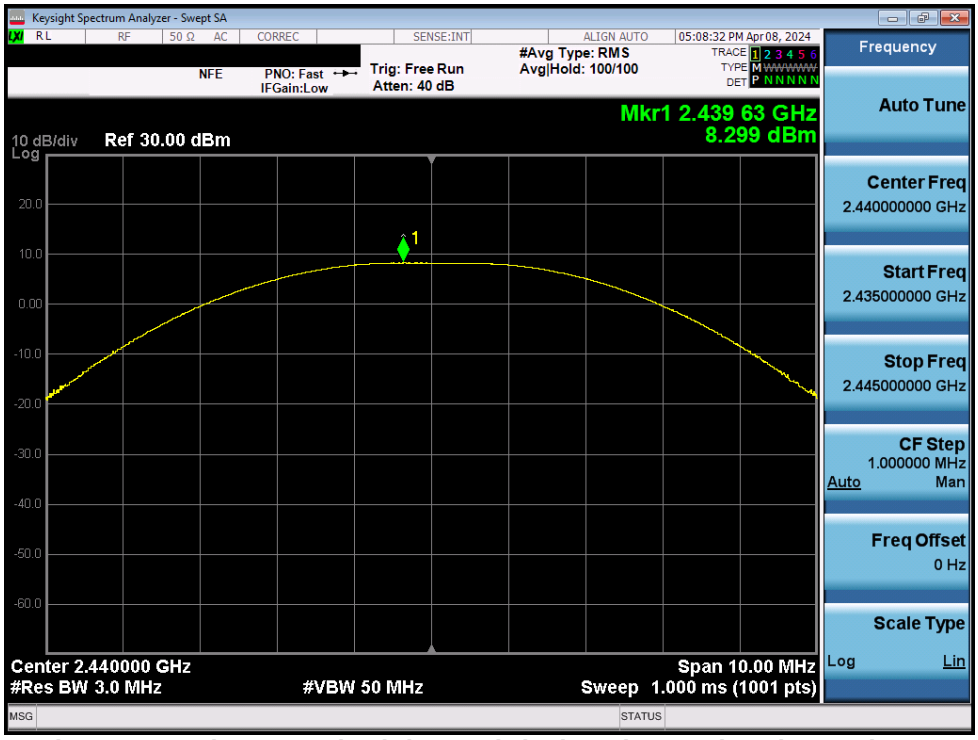
Plot 7-51. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant1



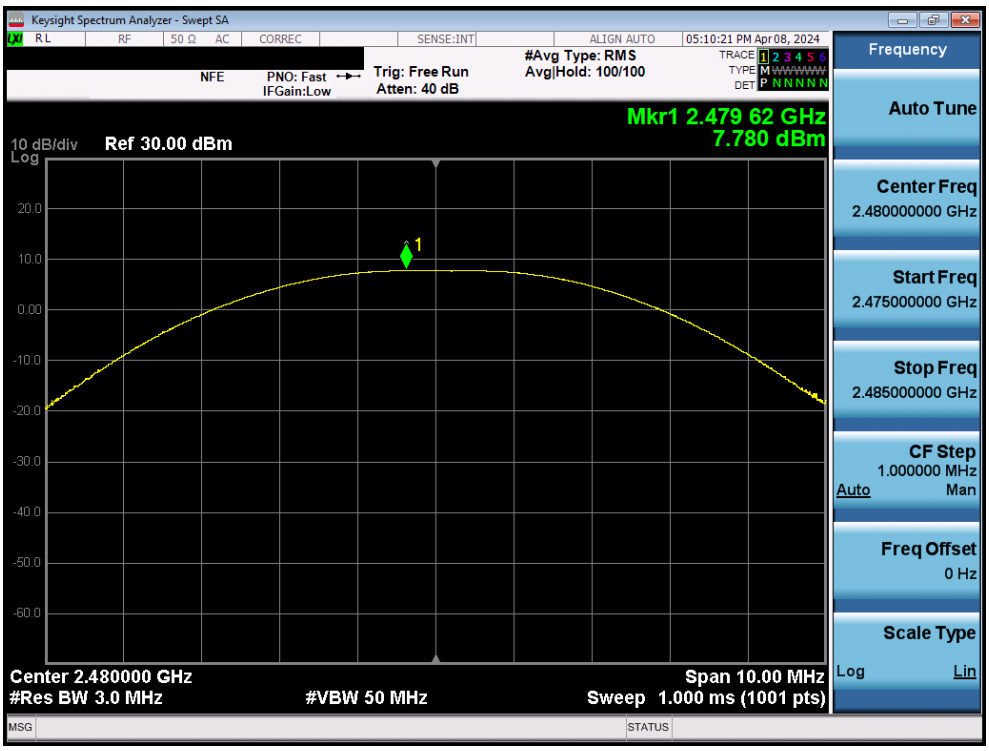
Plot 7-52. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant1



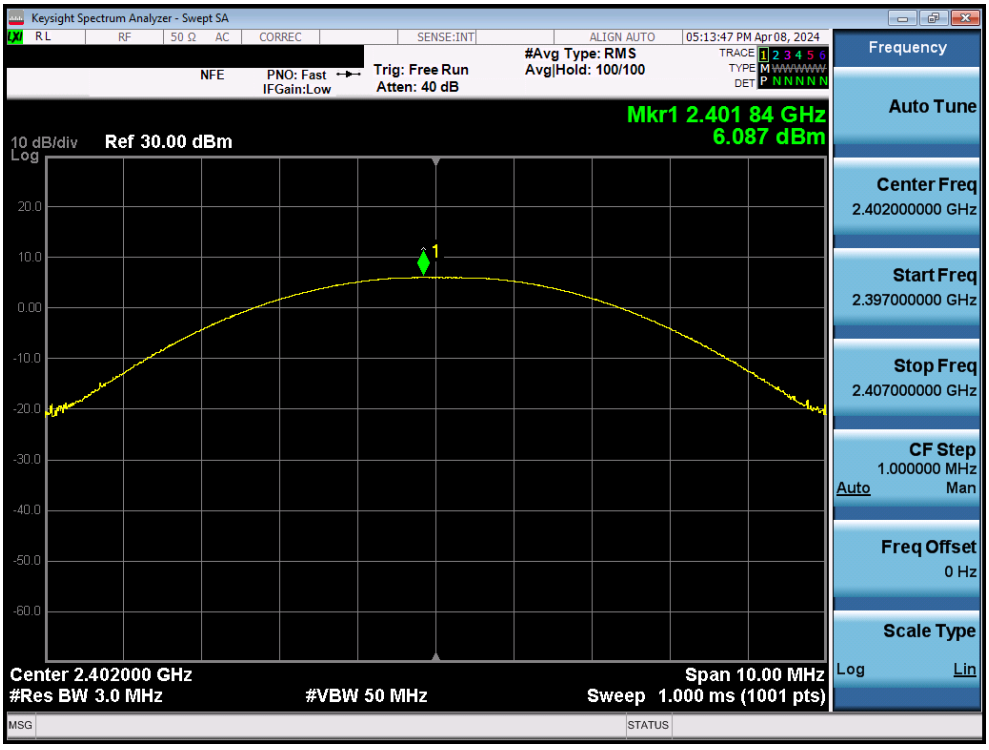
Plot 7-53. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Dual Ant1



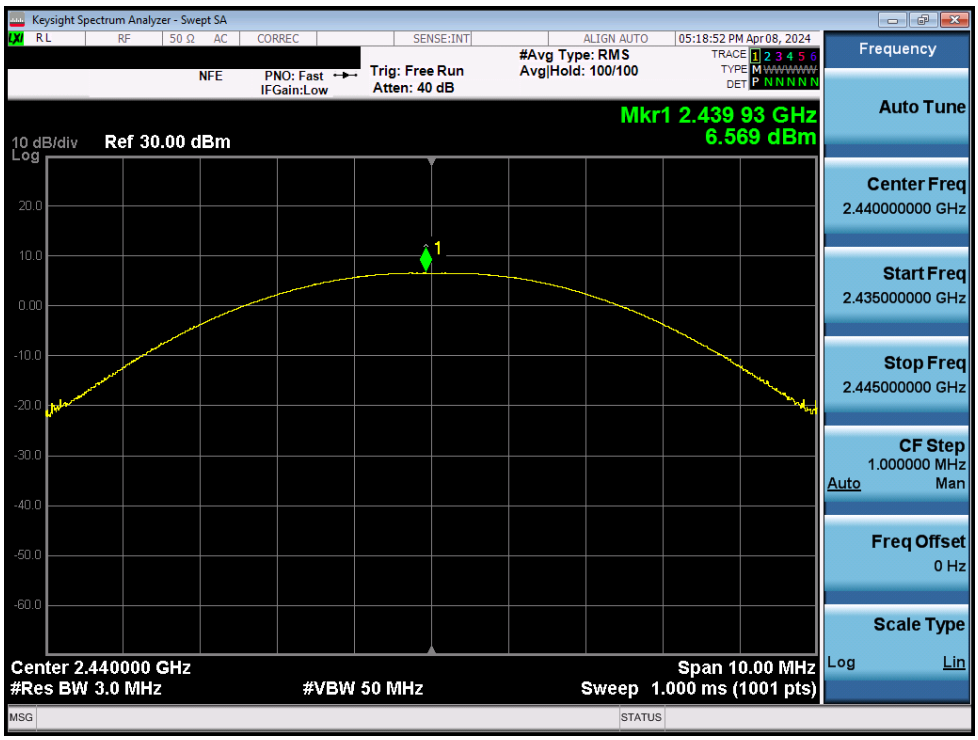
Plot 7-54. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant1



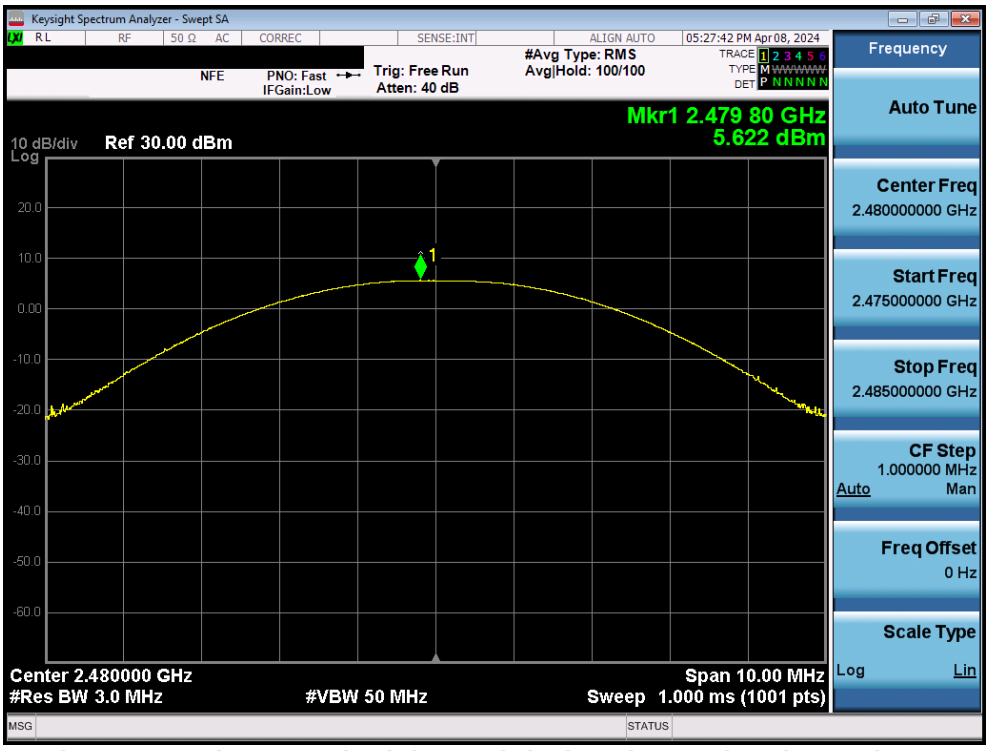
Plot 7-55. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Dual Ant1



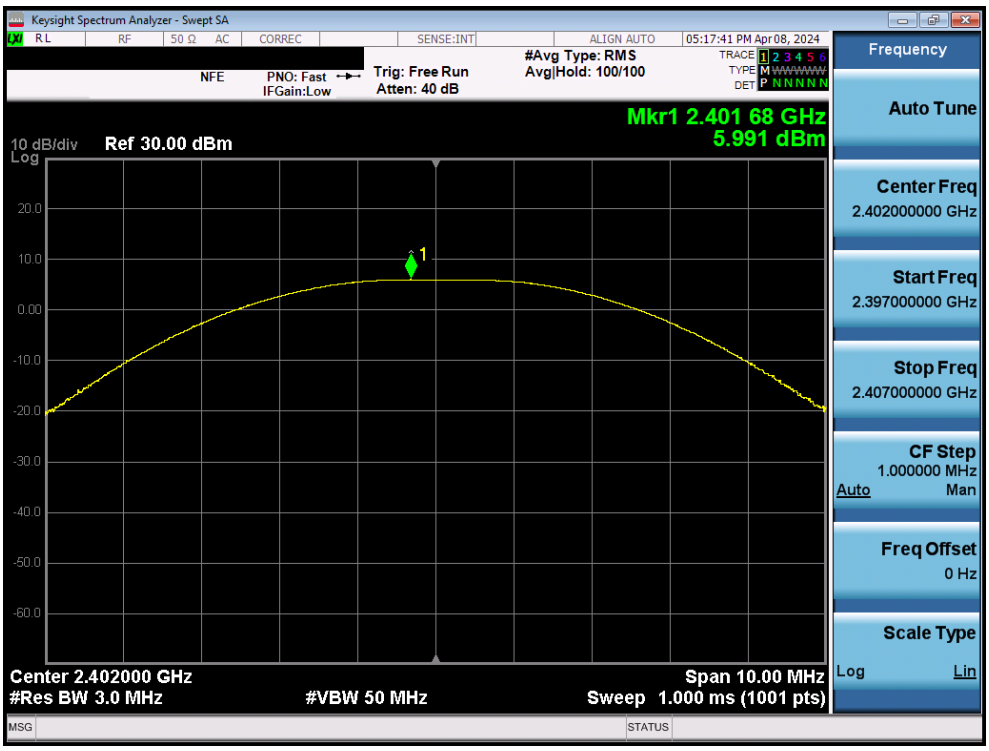
Plot 7-56. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Dual Ant2



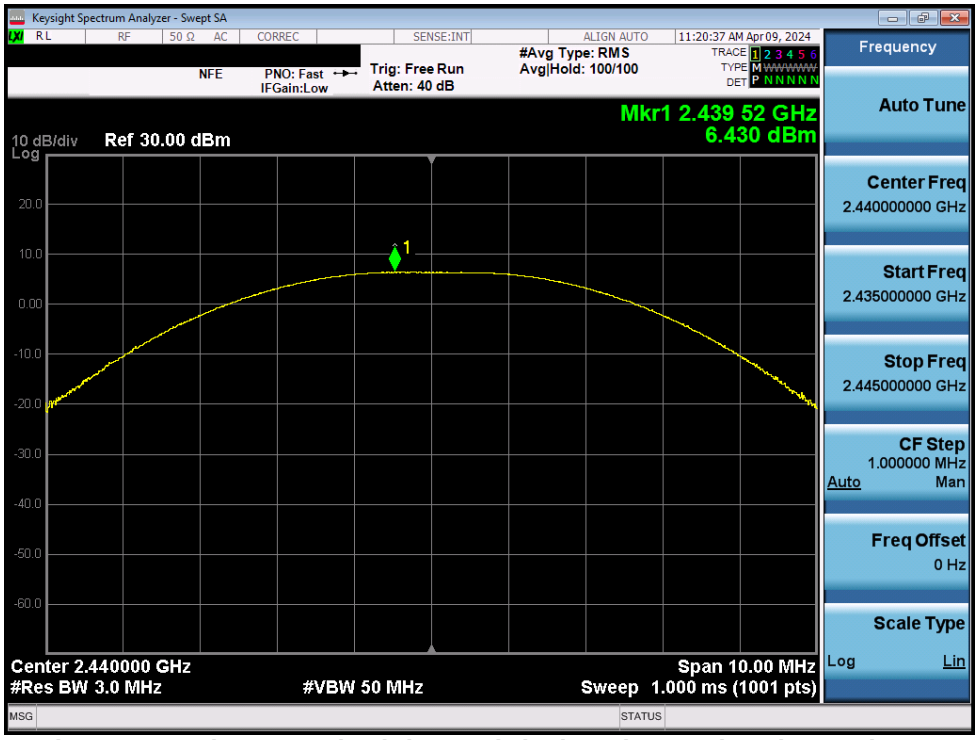
Plot 7-57. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant2



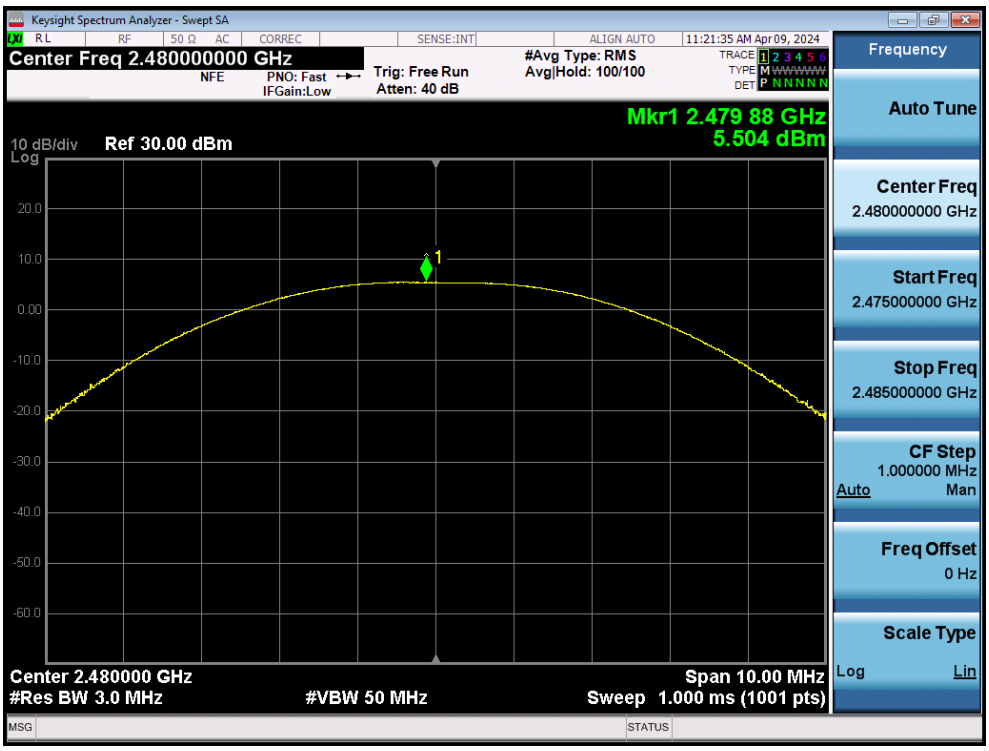
Plot 7-58. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant2



Plot 7-59. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Dual Ant2



Plot 7-60. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant2



Plot 7-61. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Dual Ant2

7.4 Power Spectral Density – Bluetooth (LE)

§15.247(e); RSS-247 [5.2(b)]

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Section 11.10.2 Method PKPSD

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

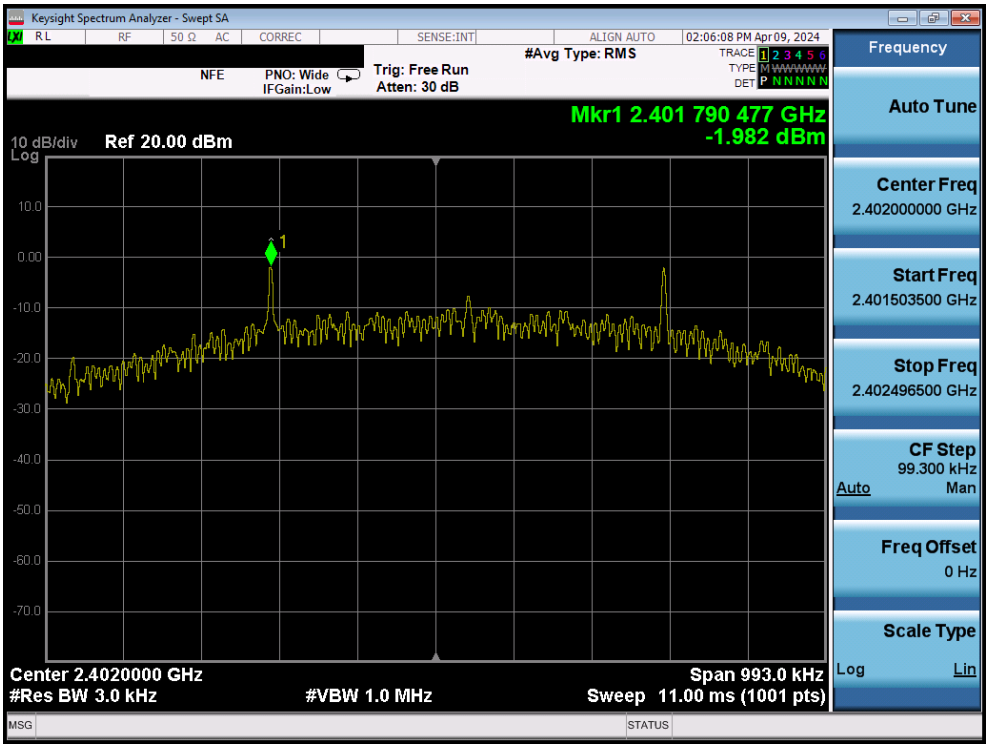
Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	125 kbps	0	LE	-1.79	8.0	-9.79
2440	125 kbps	19	LE	-1.62	8.0	-9.62
2480	125 kbps	39	LE	-2.58	8.0	-10.58
2402	500 kbps	0	LE	-1.98	8.0	-9.98
2440	500 kbps	19	LE	-1.78	8.0	-9.78
2480	500 kbps	39	LE	-2.74	8.0	-10.74
2402	1 Mbps	0	LE	0.15	8.0	-7.85
2440	1 Mbps	19	LE	1.32	8.0	-6.68
2480	1 Mbps	39	LE	-0.45	8.0	-8.45
2402	2 Mbps	0	LE	-2.95	8.0	-10.95
2440	2 Mbps	19	LE	-1.81	8.0	-9.81
2480	2 Mbps	39	LE	-3.23	8.0	-11.23

Table 7-11. Conducted Power Density Measurements – Ant1

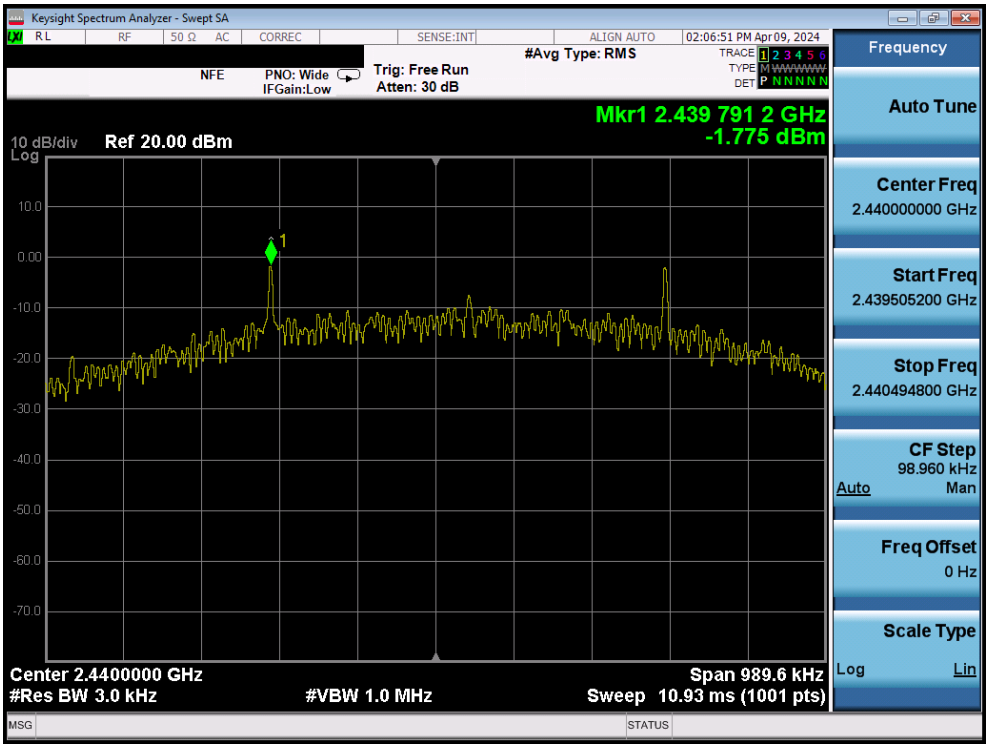
Plot 7-62. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant1

Plot 7-63. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant1

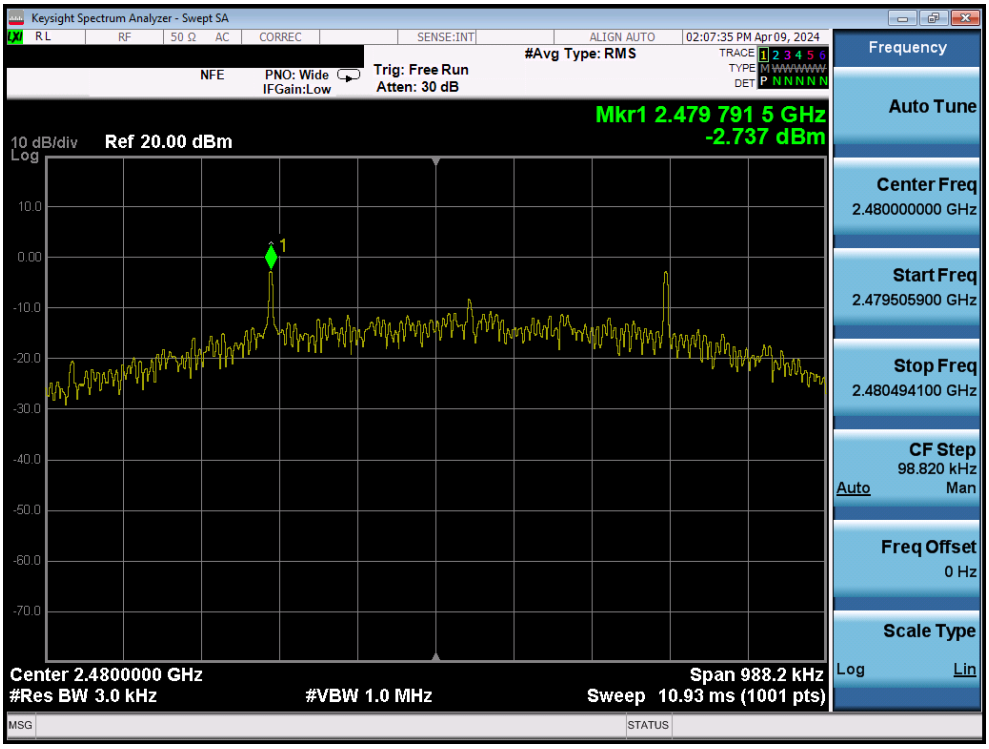
Plot 7-64. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant1



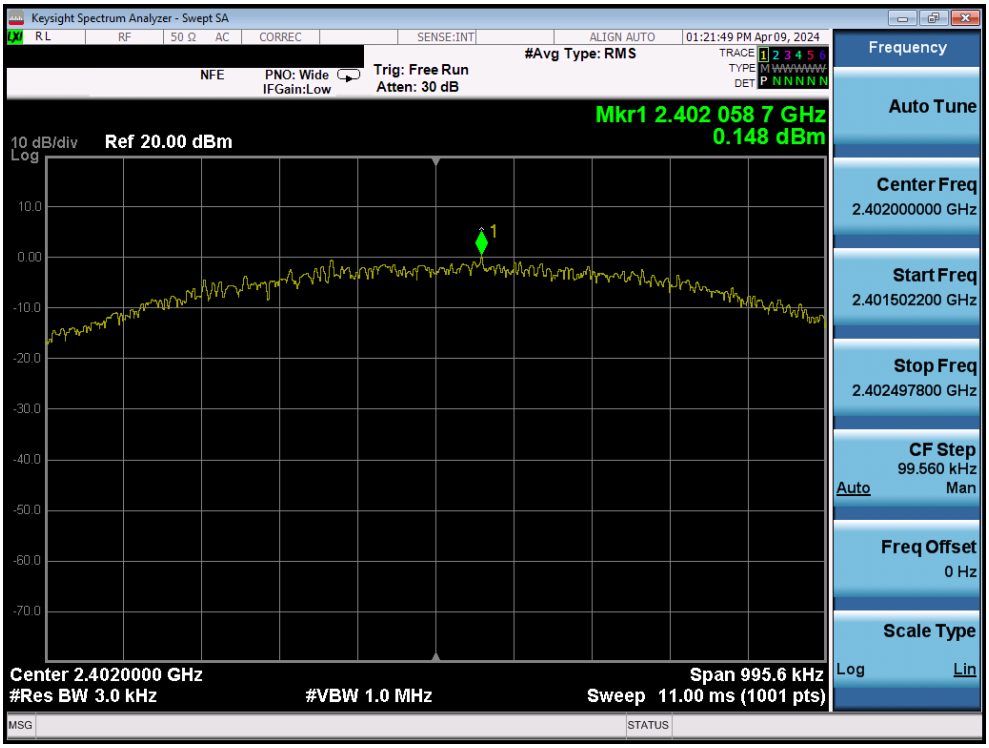
Plot 7-65. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant1



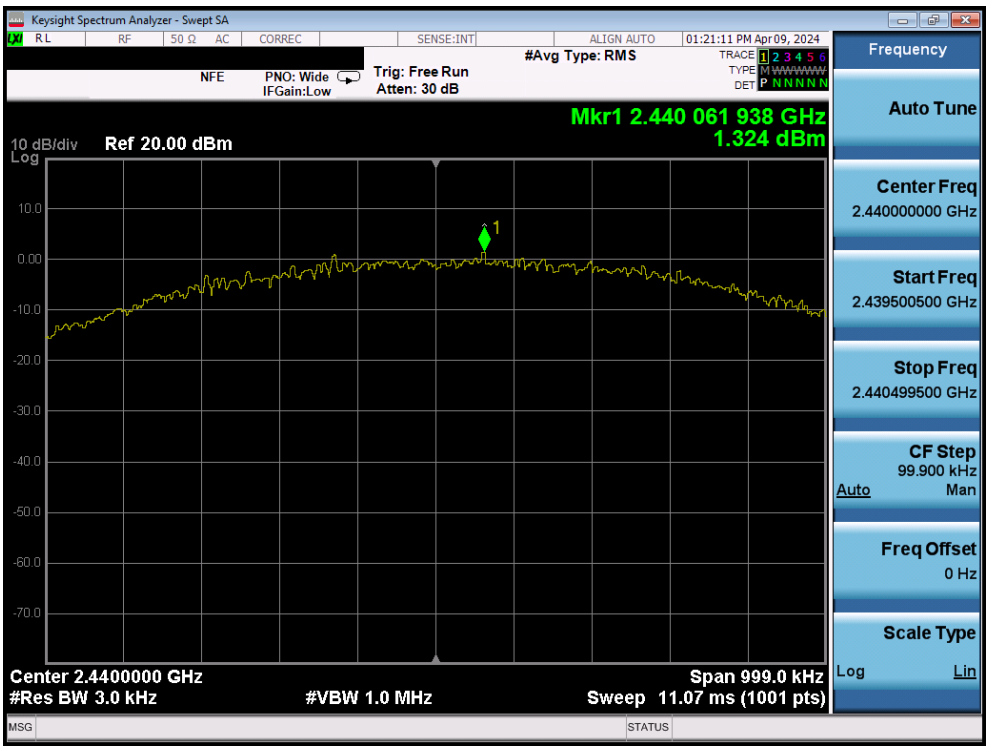
Plot 7-66. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant1



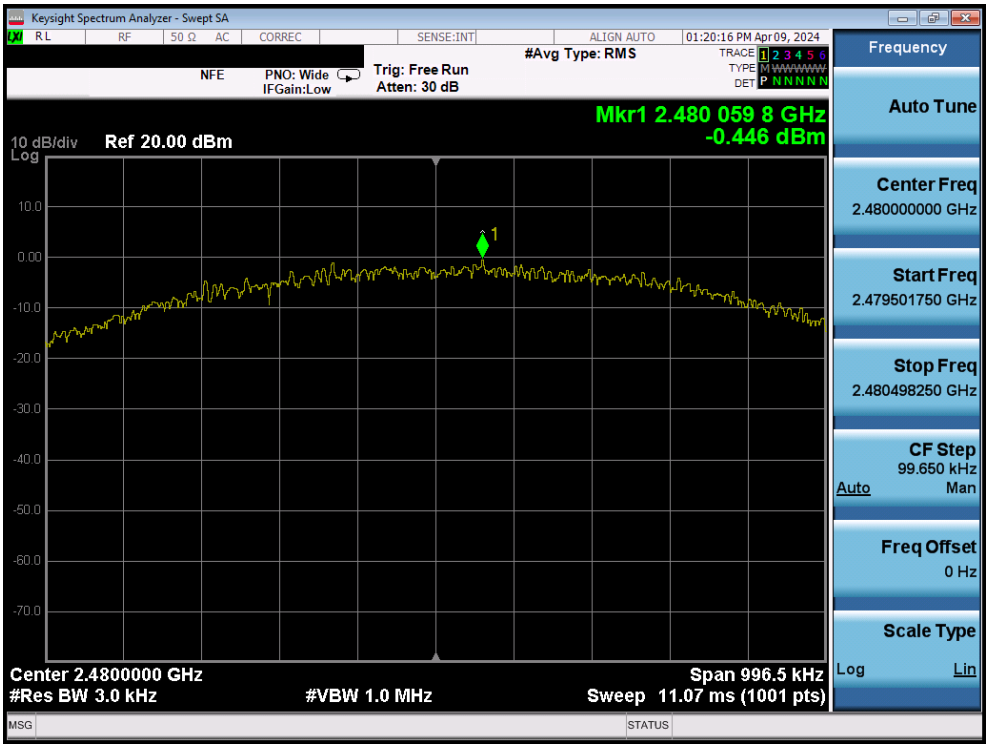
Plot 7-67. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant1



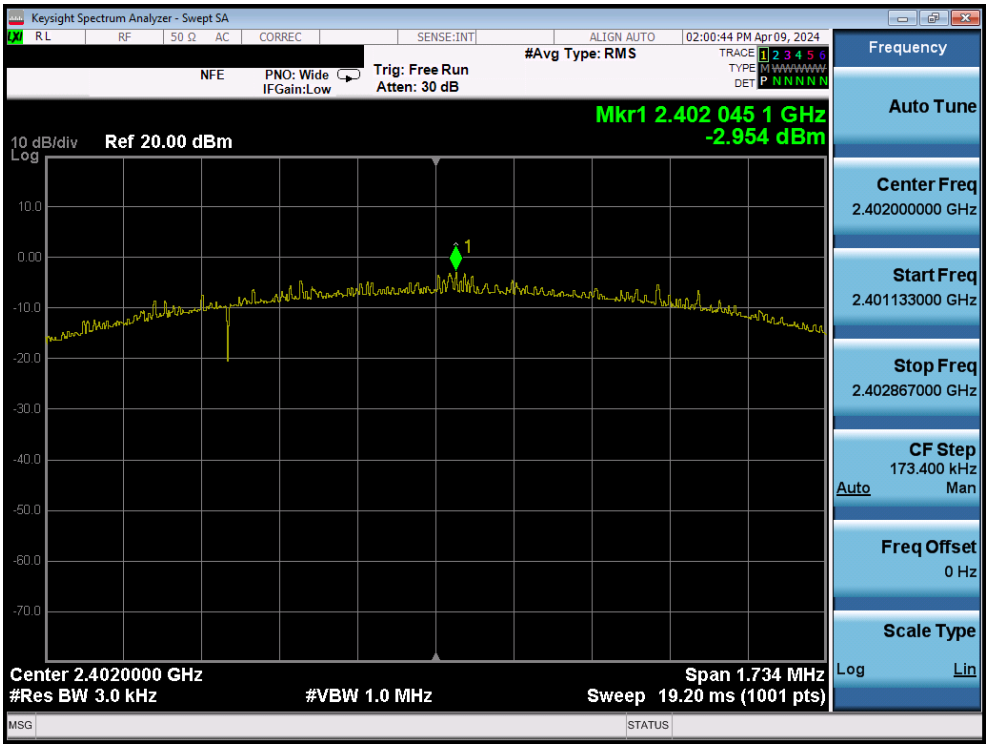
Plot 7-68. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant1



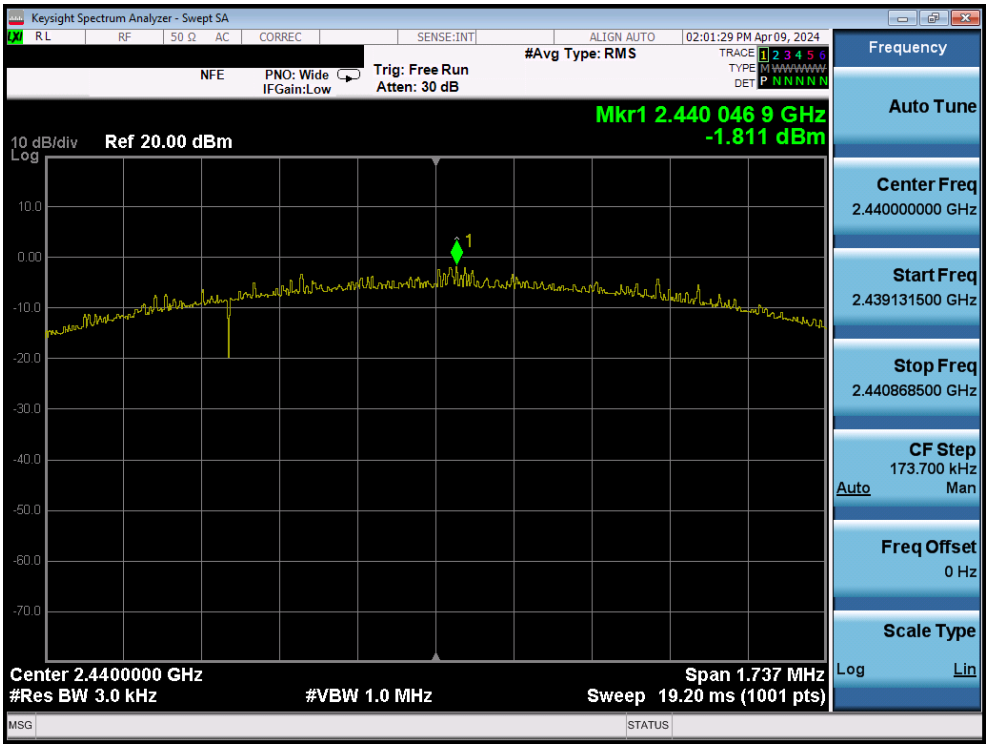
Plot 7-69. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant1



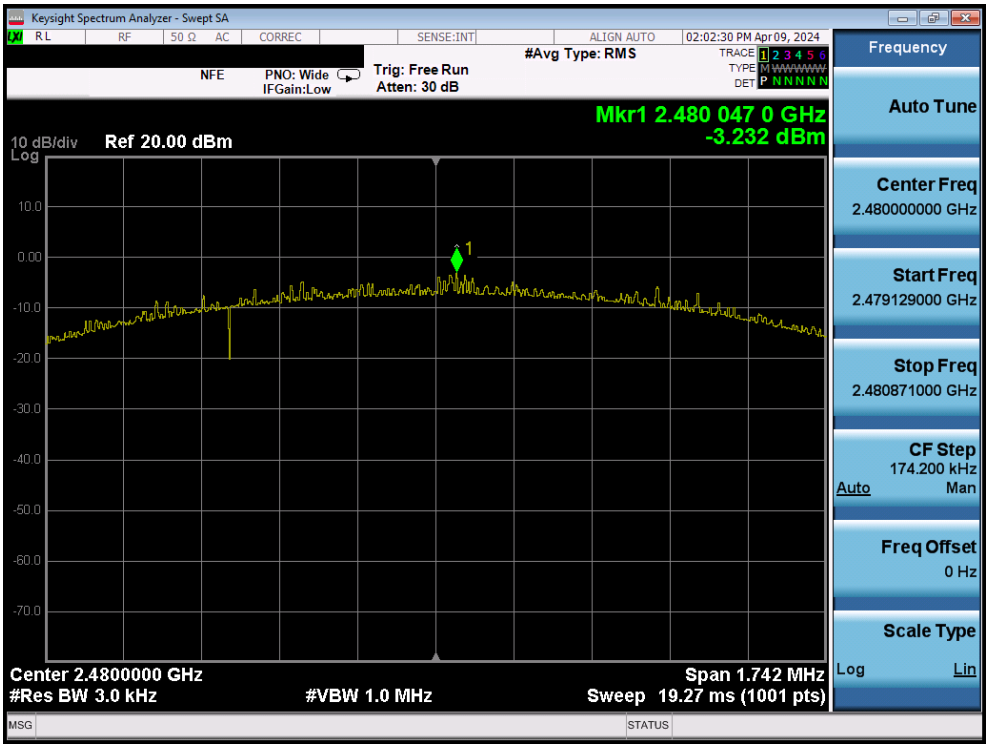
Plot 7-70. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant1



Plot 7-71. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant1



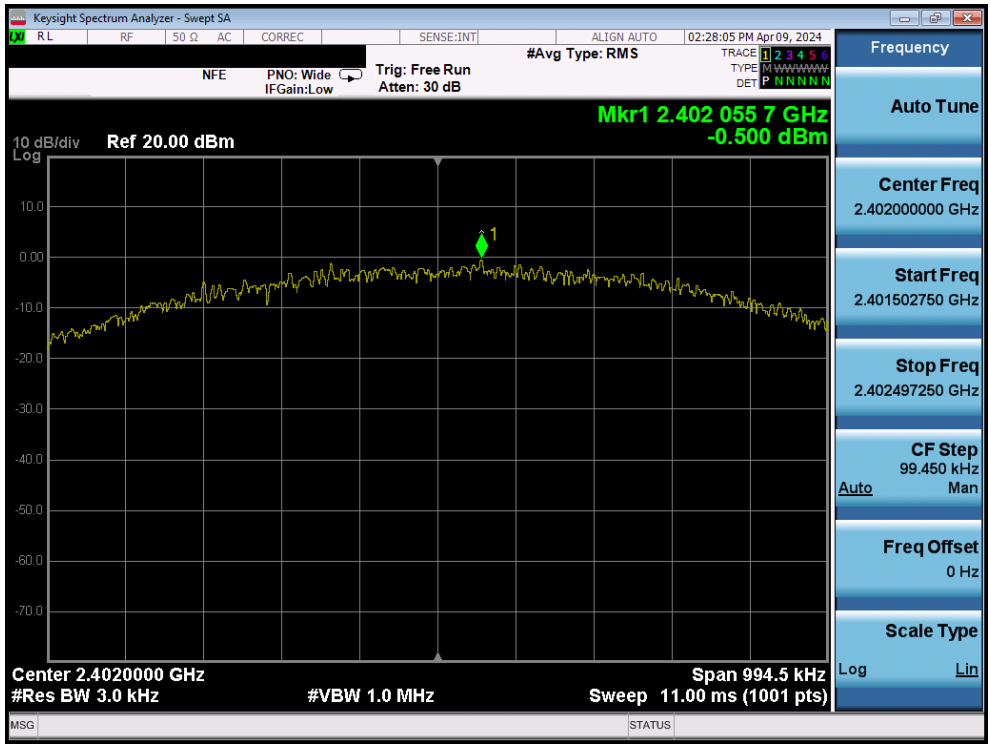
Plot 7-72. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant1



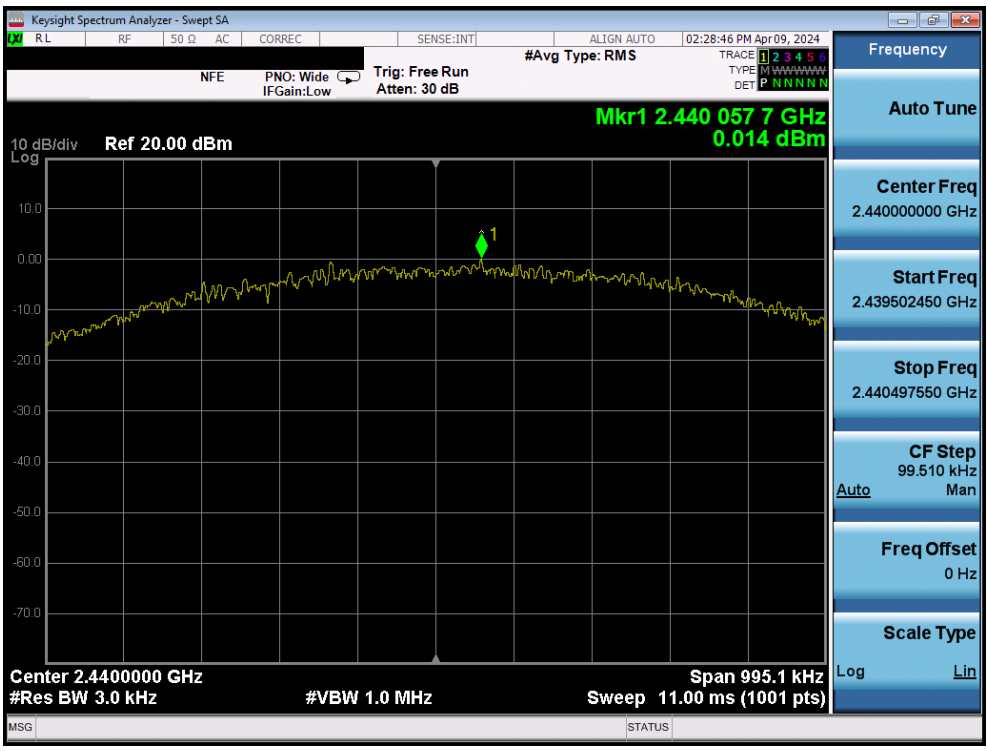
Plot 7-73. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant1

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	1 Mbps	0	LE	-0.50	8.0	-8.39
2440	1 Mbps	19	LE	0.01	8.0	-7.99
2480	1 Mbps	39	LE	-0.39	8.0	-8.50
2402	2 Mbps	0	LE	-3.53	8.0	-11.53
2440	2 Mbps	19	LE	-2.99	8.0	-10.99
2480	2 Mbps	39	LE	-3.37	8.0	-11.37

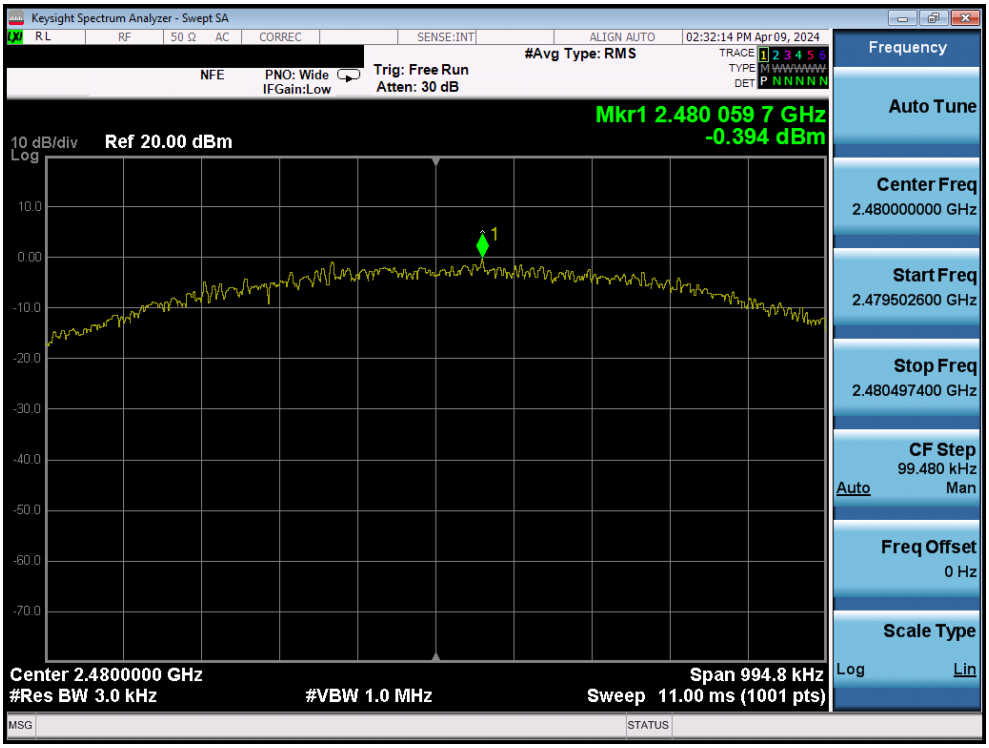
Table 7-12. Conducted Power Density Measurements – Ant2



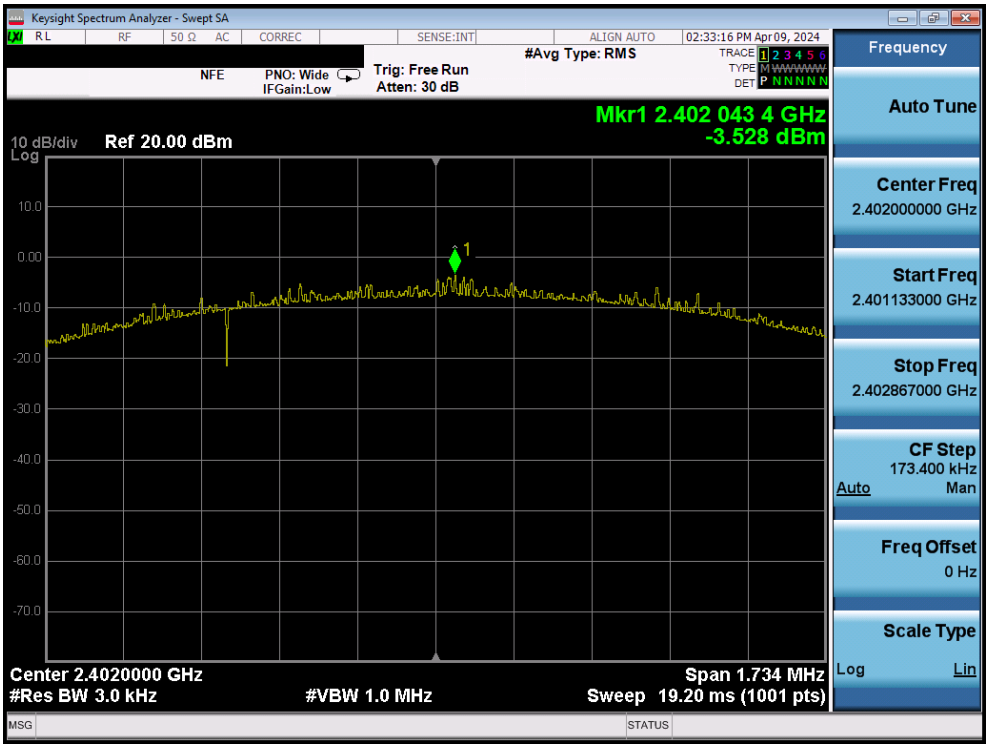
Plot 7-74. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant2



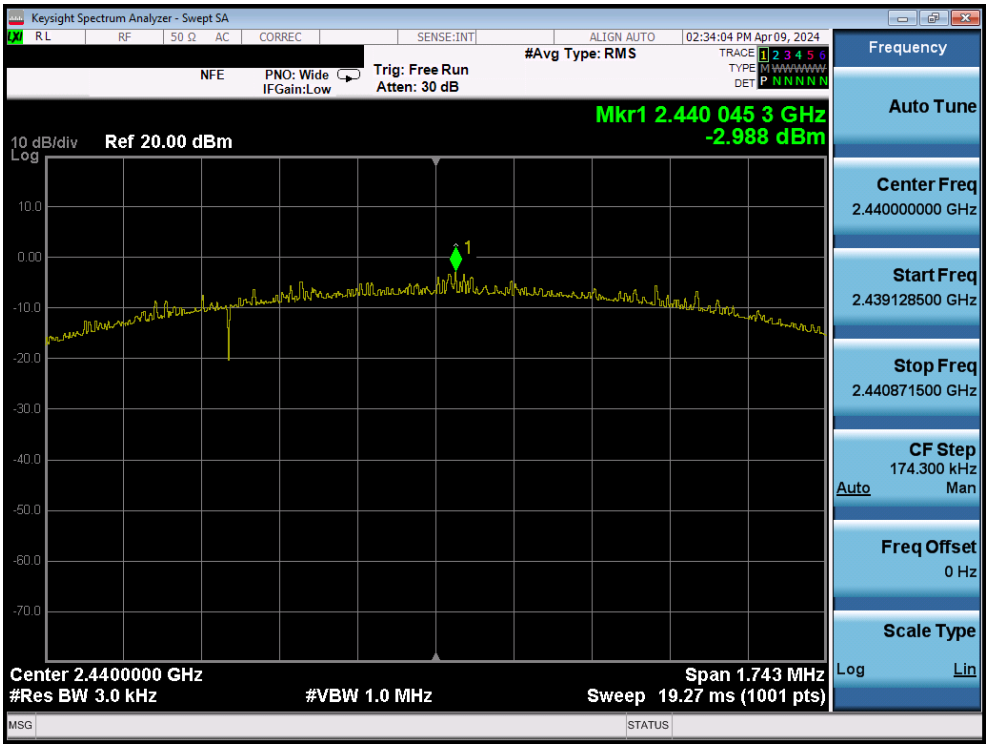
Plot 7-75. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant2



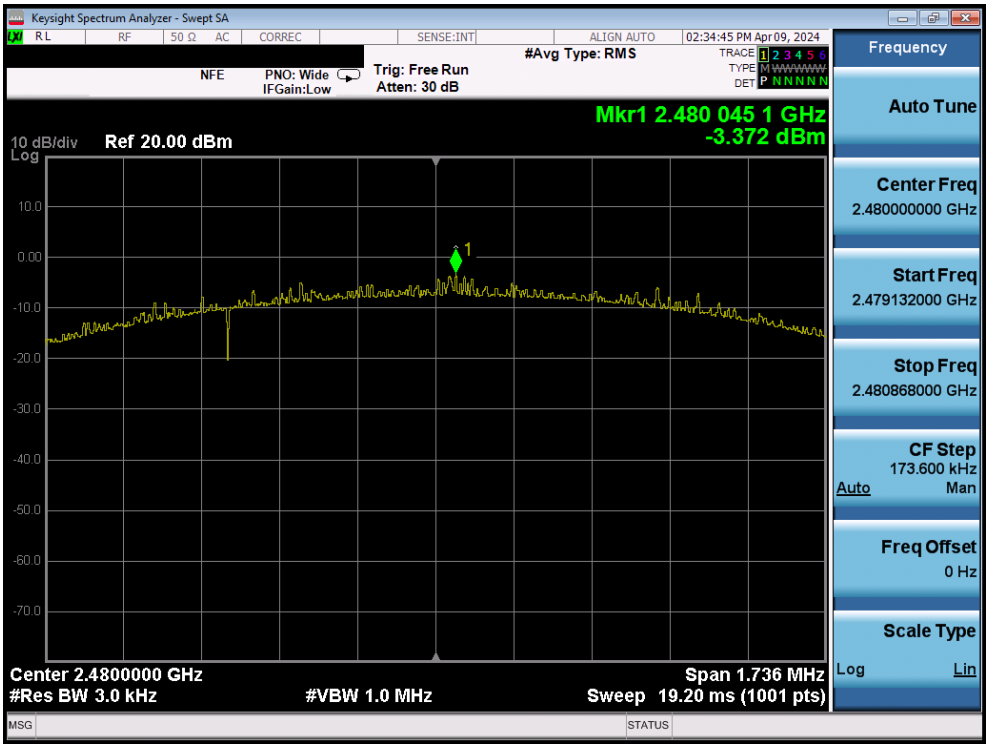
Plot 7-76. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant2



Plot 7-77. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant2



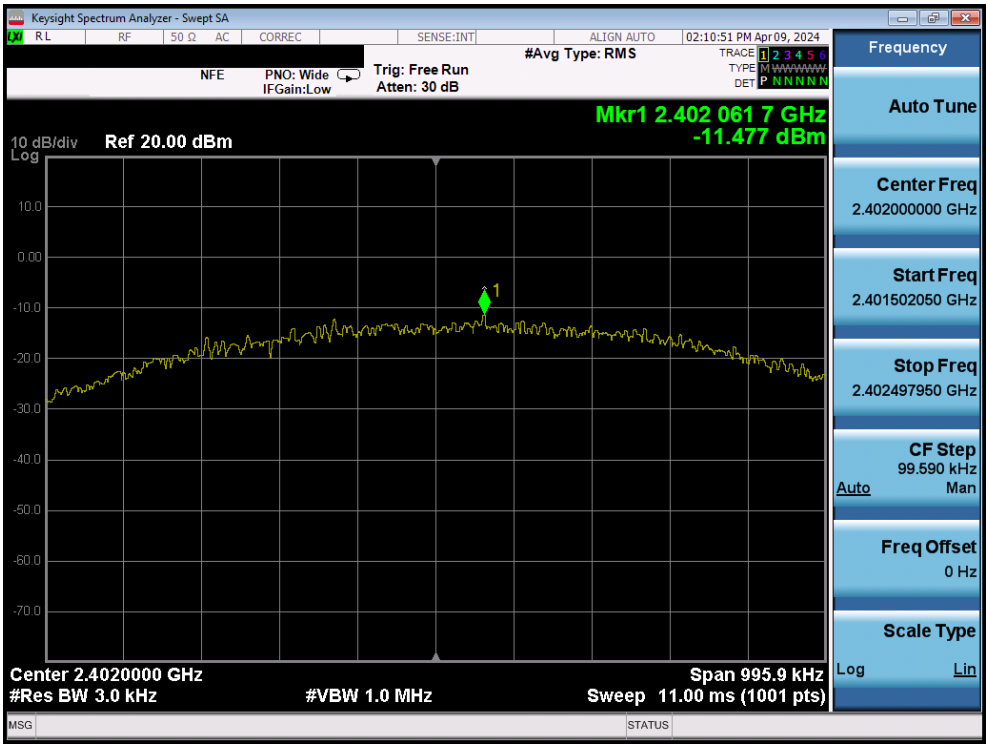
Plot 7-78. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant2



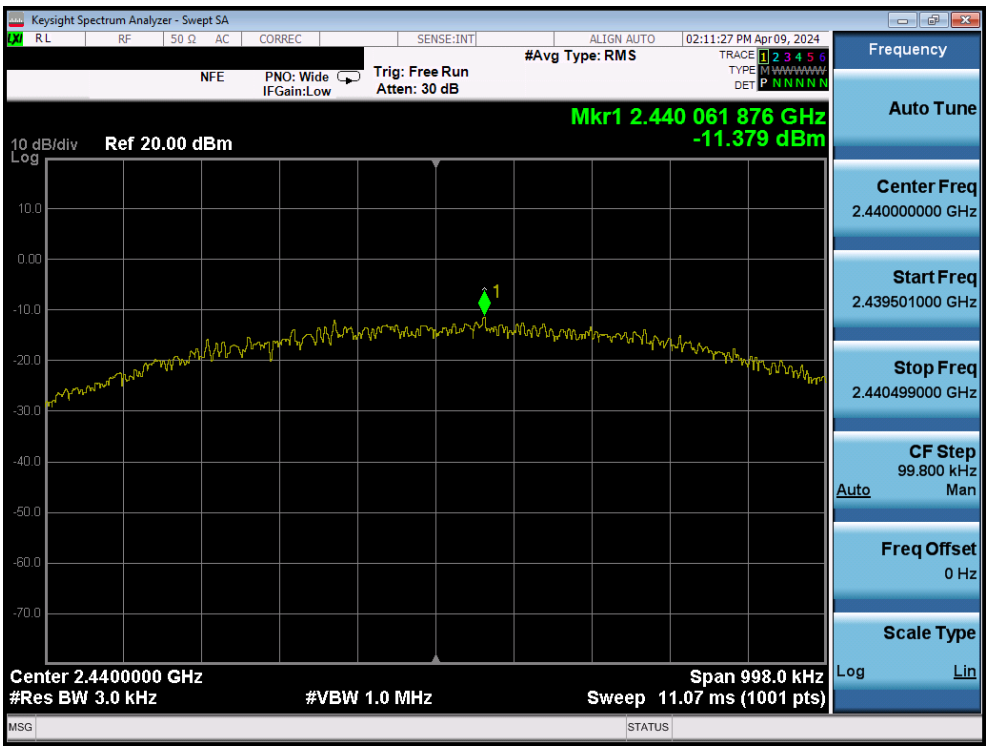
Plot 7-79. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant2

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Permissible Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	1 Mbps	0	LE	-11.48	-10.29	-7.83	8.0	-15.83
2440	1 Mbps	19	LE	-11.38	-9.70	-7.45	8.0	-15.45
2480	1 Mbps	39	LE	-12.20	-10.64	-8.34	8.0	-16.34
2402	2 Mbps	0	LE	-14.54	-13.46	-10.96	8.0	-18.96
2440	2 Mbps	19	LE	-14.38	-12.83	-10.52	8.0	-18.52
2480	2 Mbps	39	LE	-15.24	-13.86	-11.48	8.0	-19.48

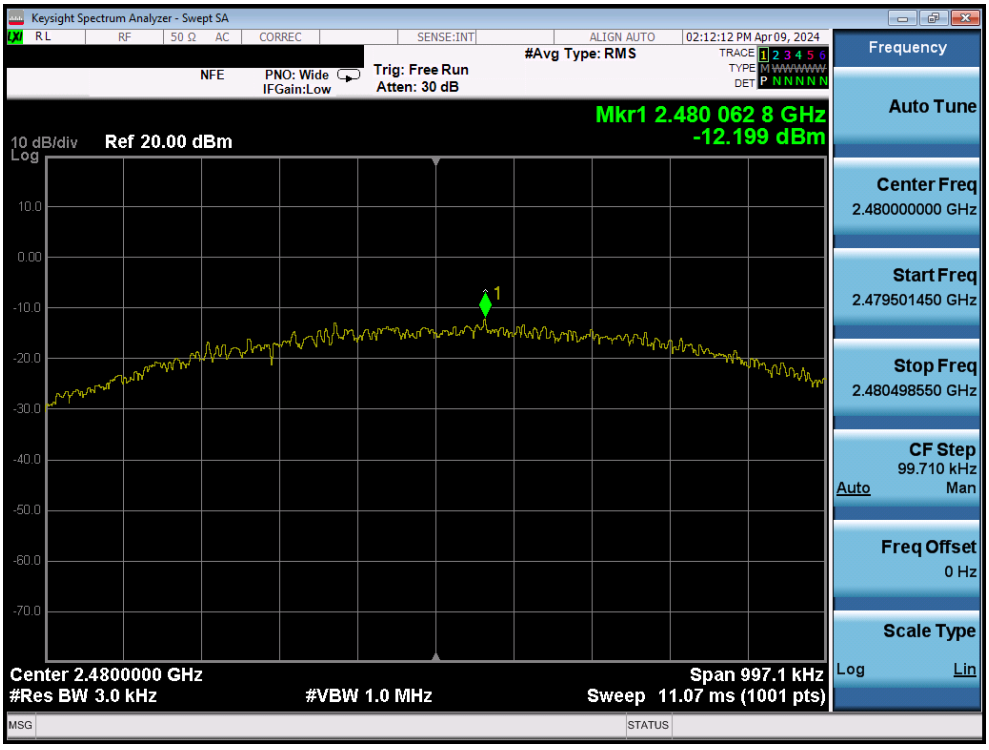
Table 7-13. Conducted Power Density Measurements – Dual



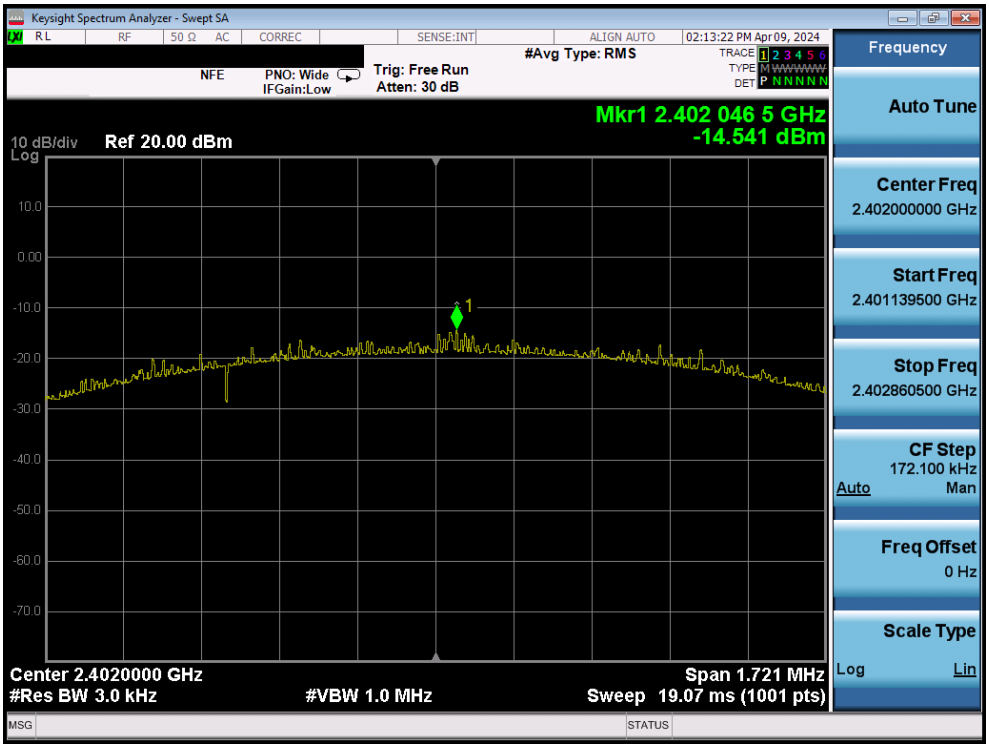
Plot 7-80. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Dual Ant1



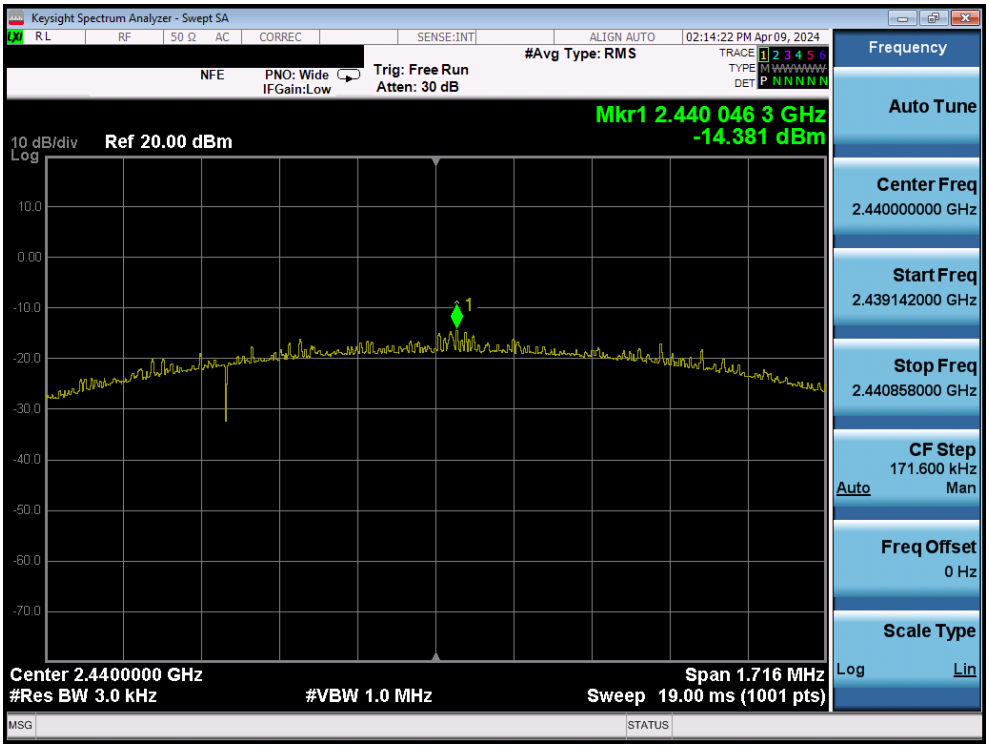
Plot 7-81. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant1



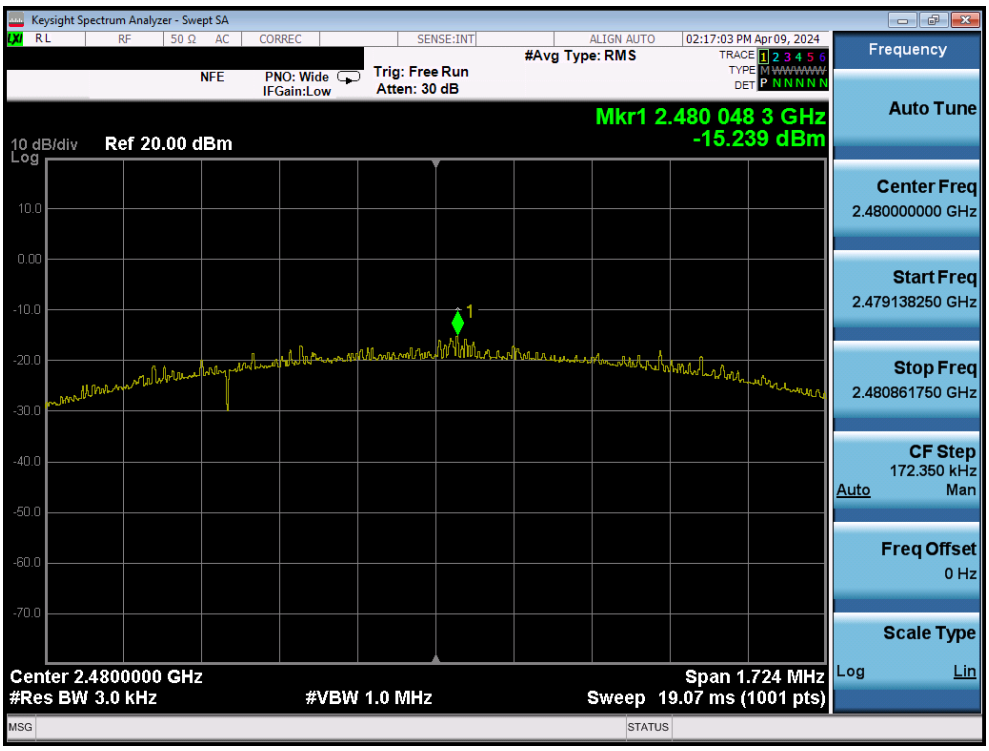
Plot 7-82. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant1



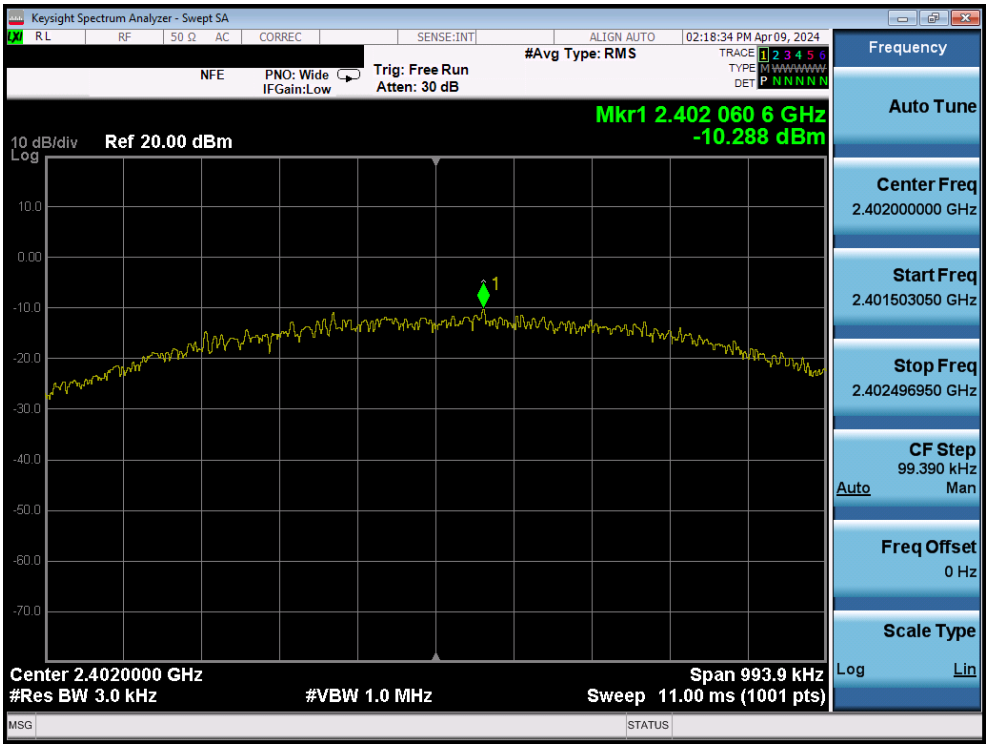
Plot 7-83. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Dual Ant1



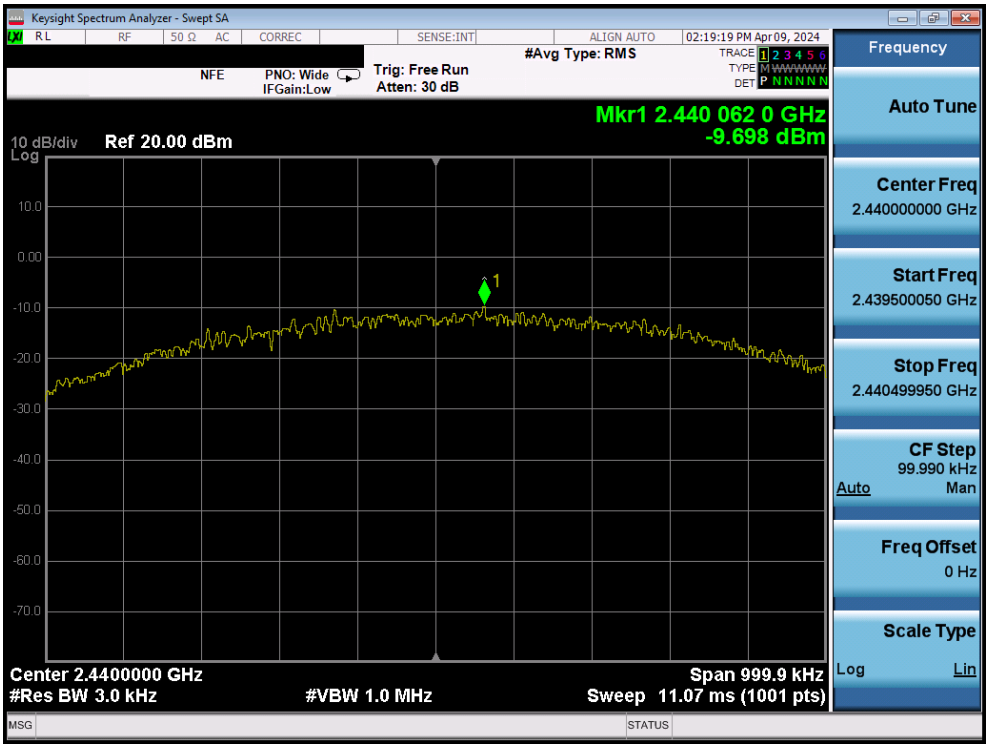
Plot 7-84. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant1



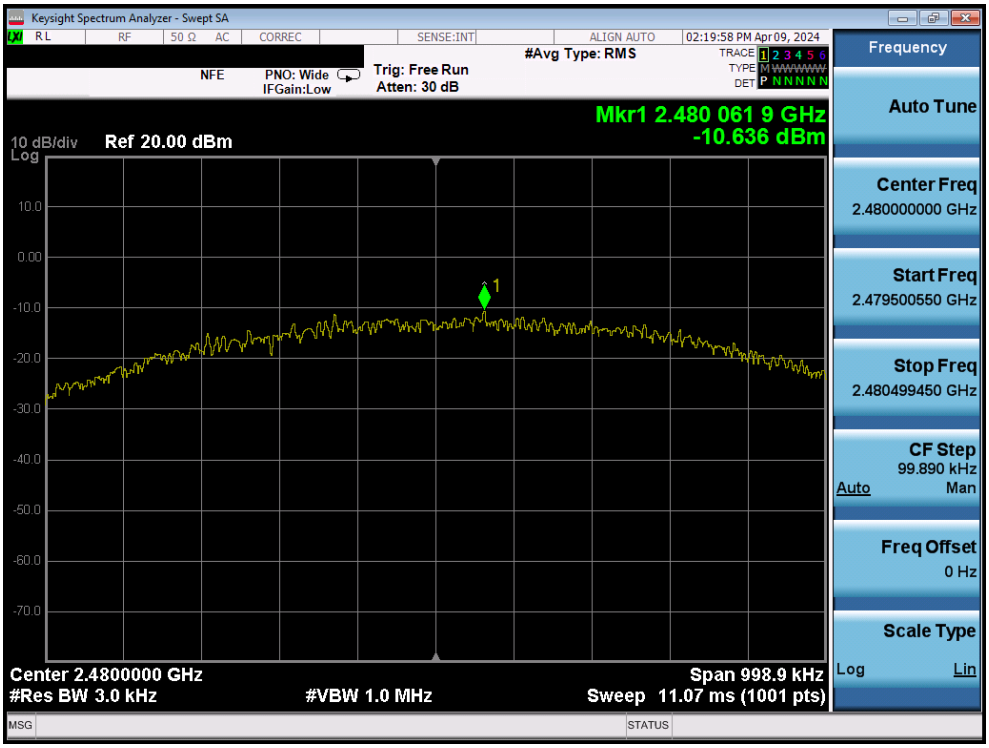
Plot 7-85. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Dual Ant1



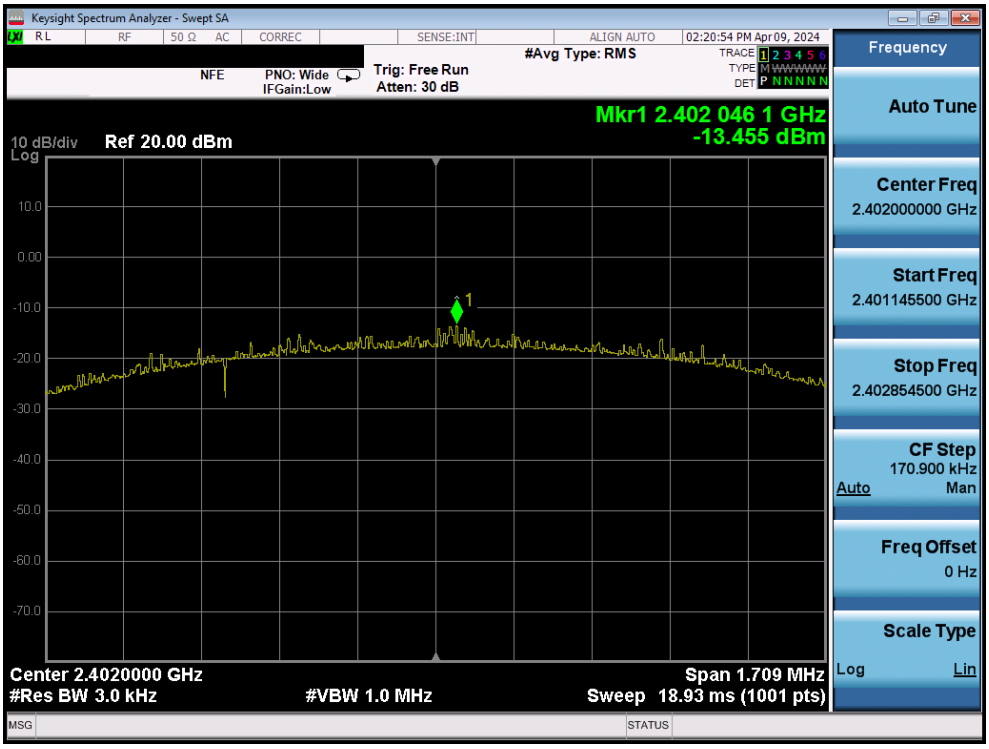
Plot 7-86. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Dual Ant2



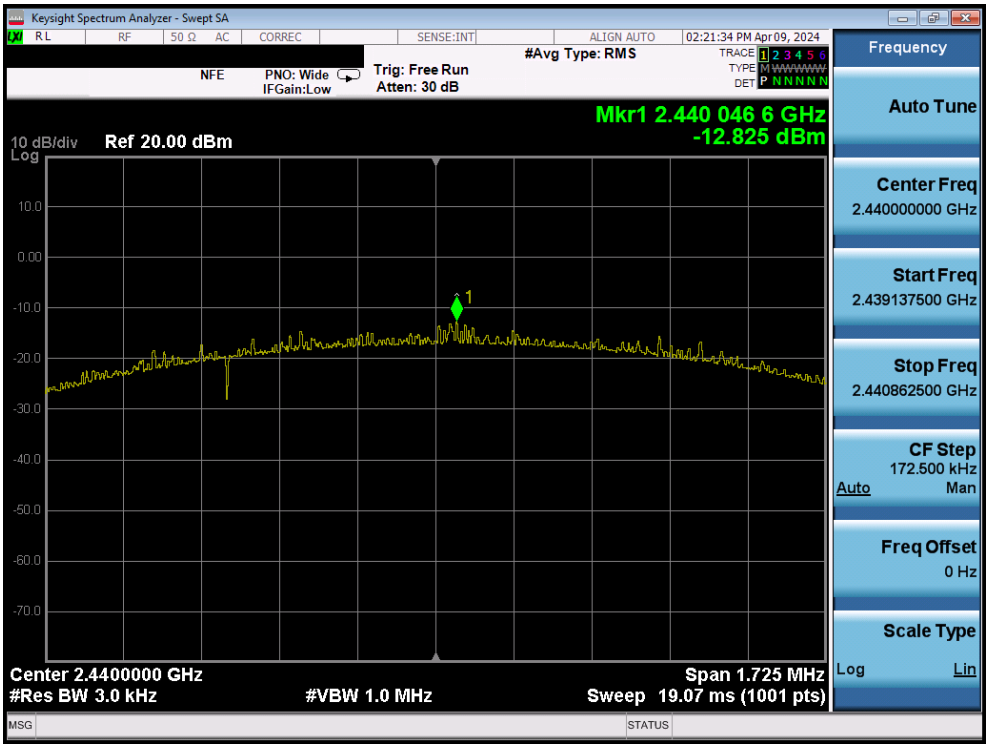
Plot 7-87. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant2



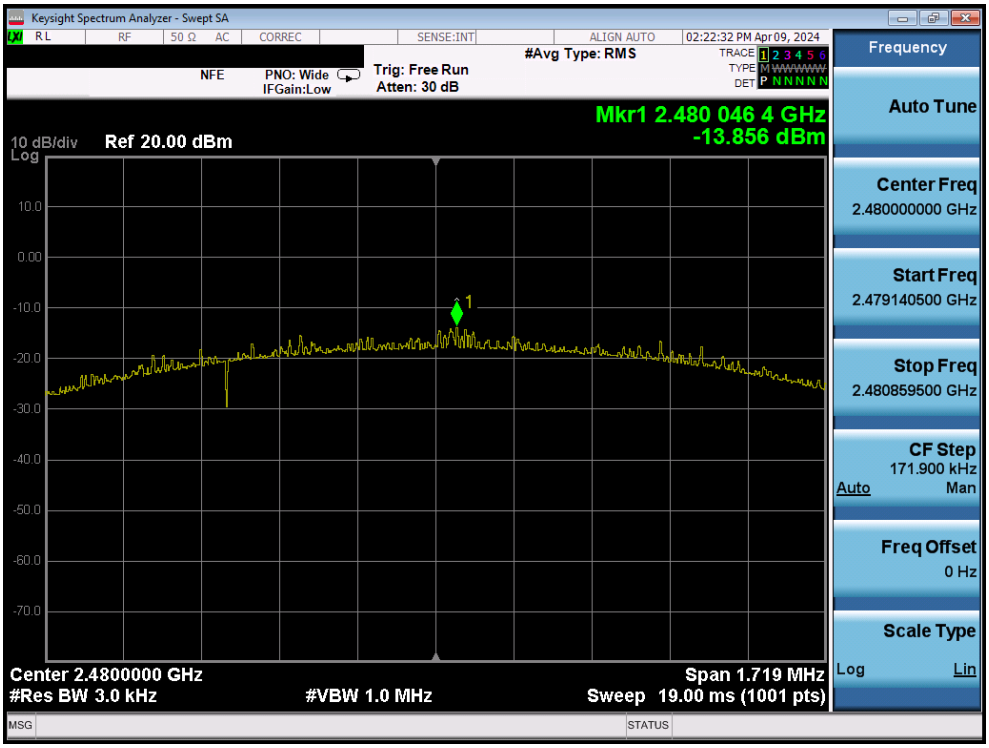
Plot 7-88. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant2



Plot 7-89. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Dual Ant2



Plot 7-90. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant2



Plot 7-91. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Dual Ant2

7.5 Conducted Emissions at the Band Edge

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

For the following out of band conducted spurious emissions plots at the band edge, the EUT was set to transmit at maximum power with the largest packet size available. These settings produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

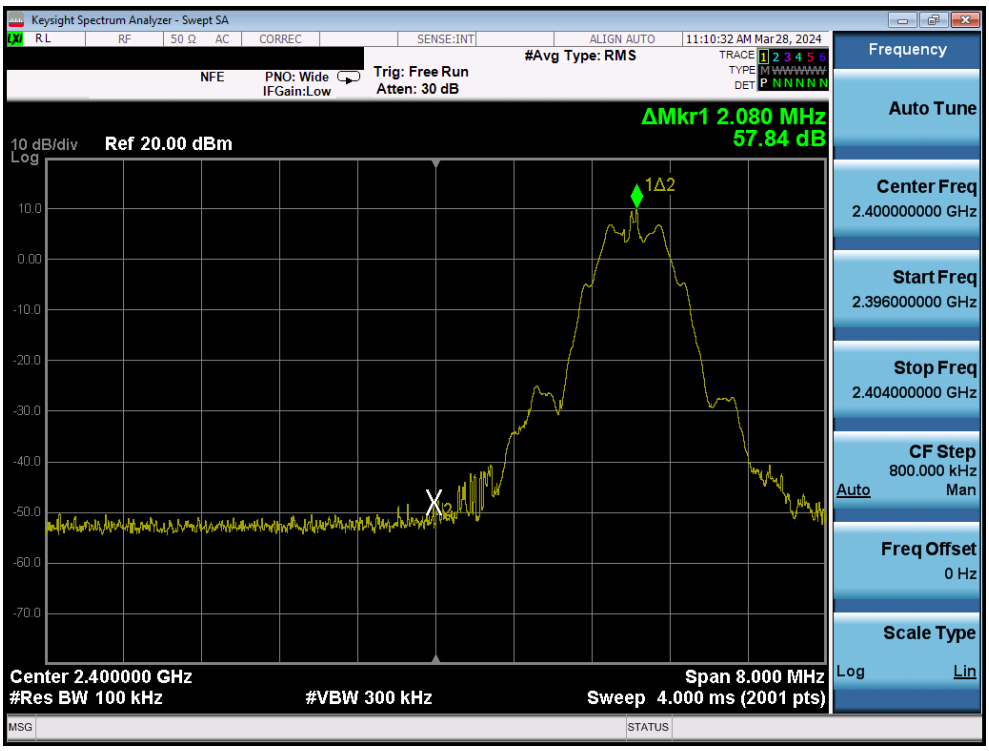
Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

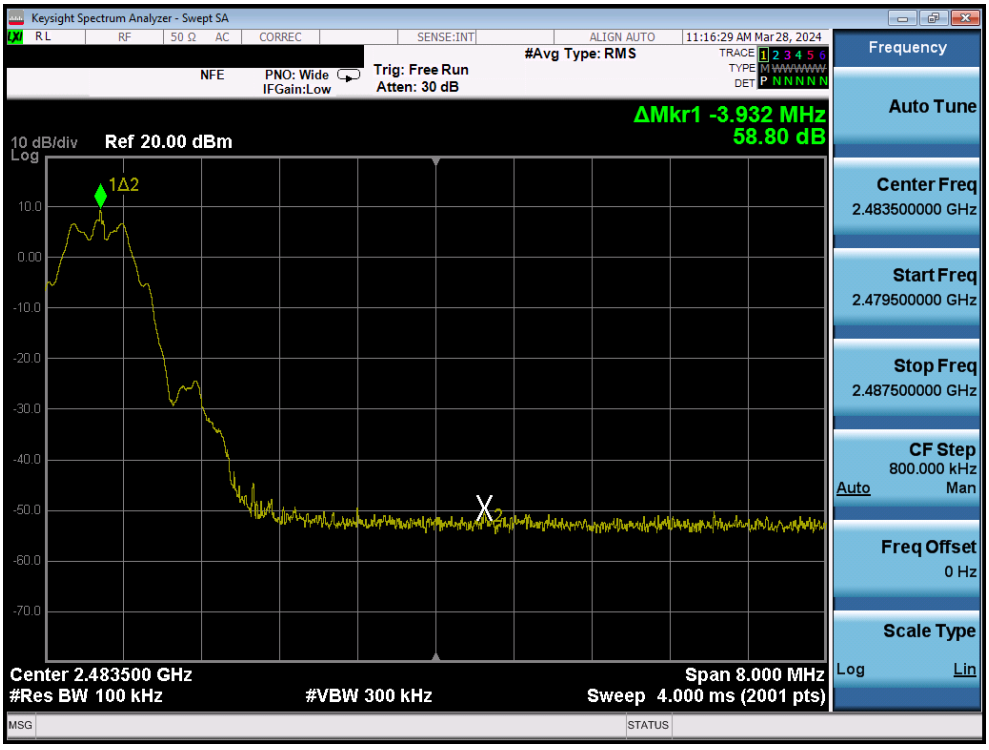
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

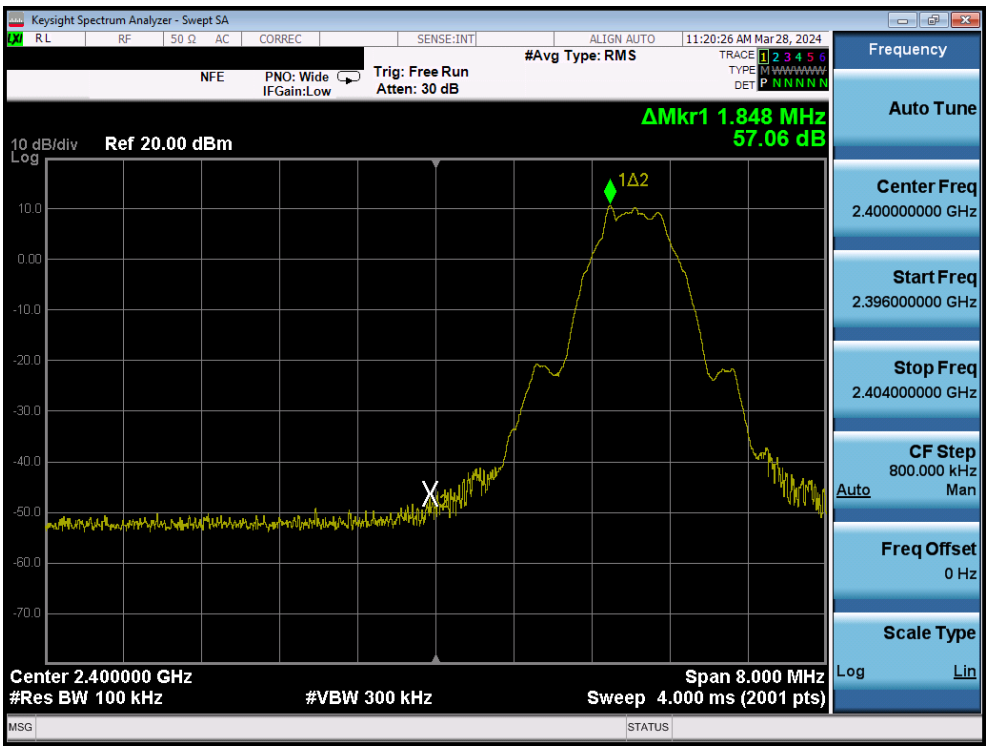
None



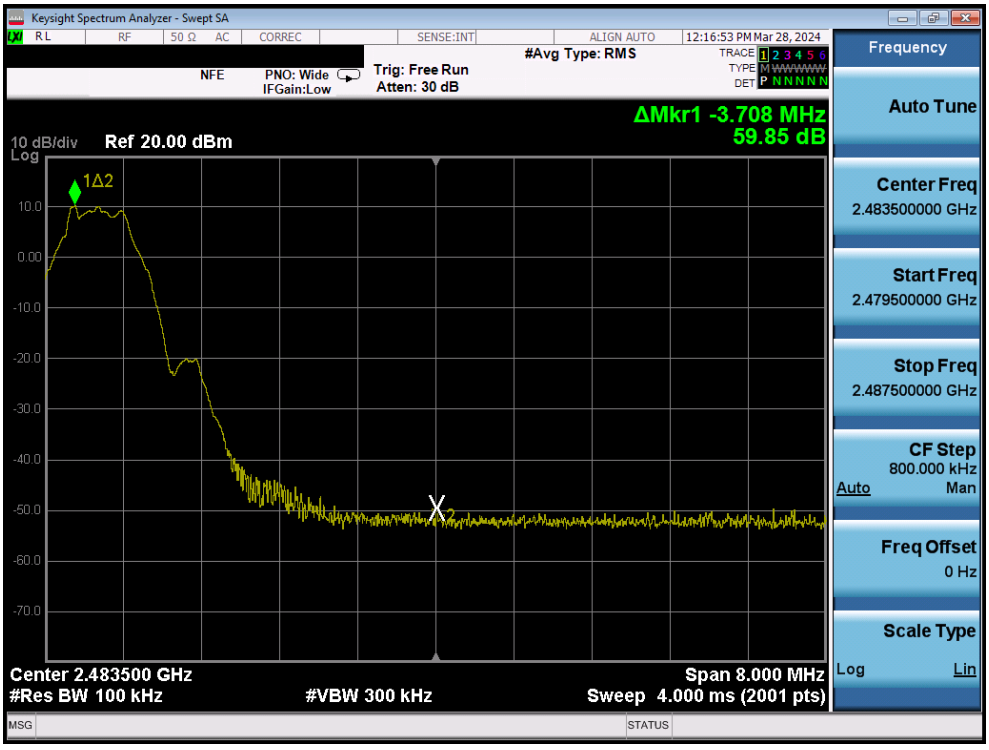
Plot 7-92. Band Edge Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant1



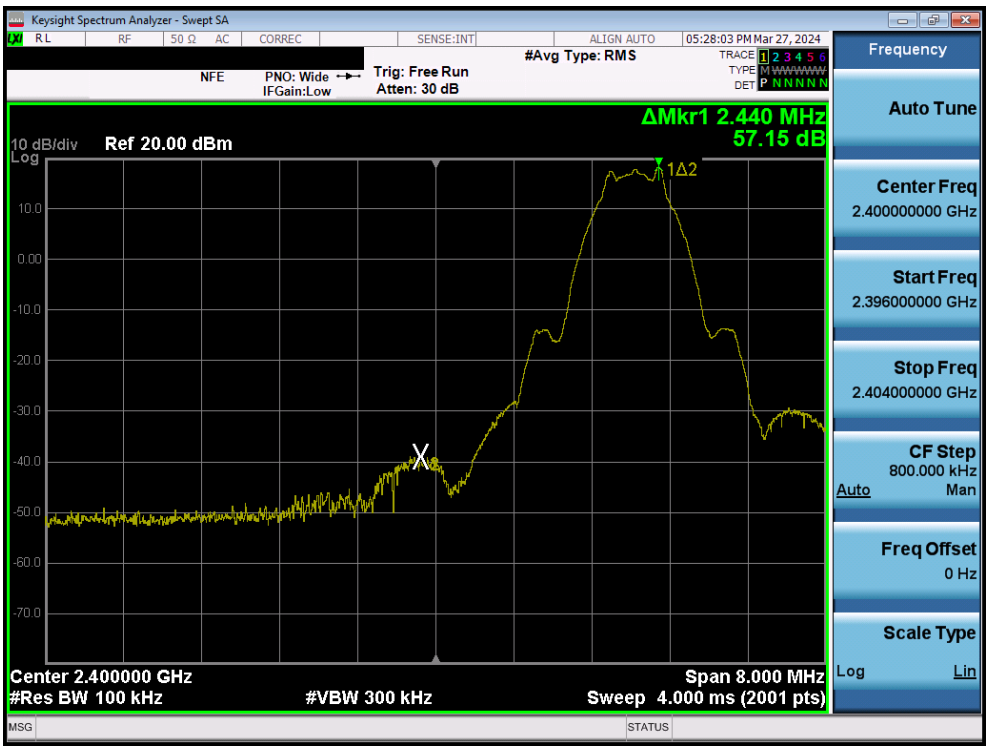
Plot 7-93. Band Edge Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant1



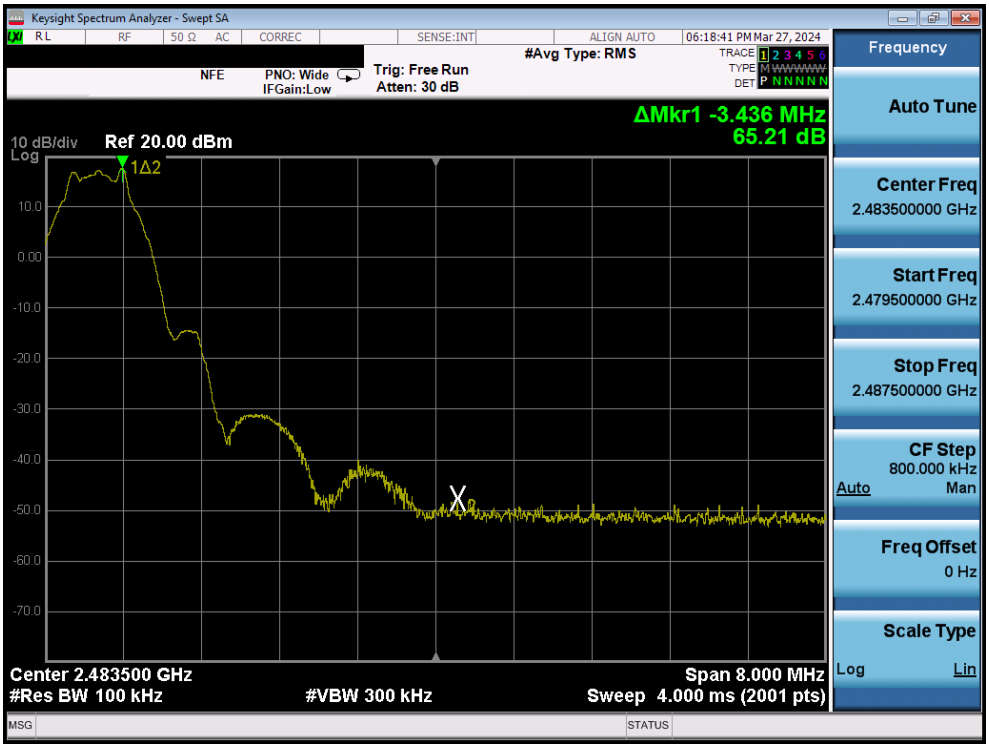
Plot 7-94. Band Edge Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant1



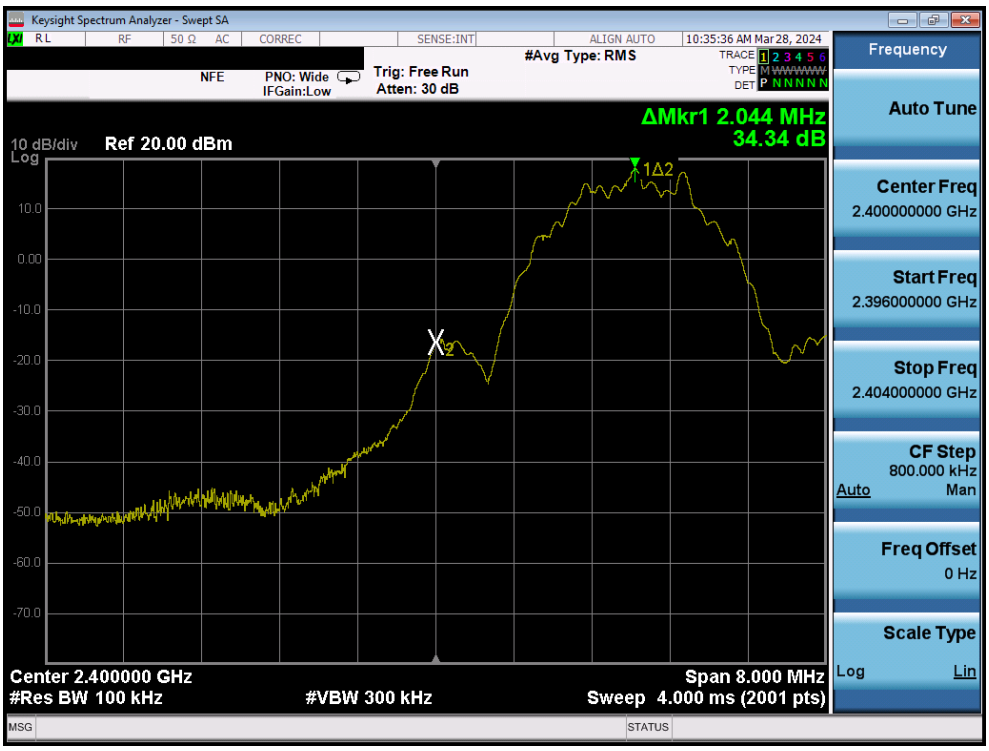
Plot 7-95. Band Edge Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant1



Plot 7-96. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant1



Plot 7-97. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant1



Plot 7-98. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant1

Plot 7-99. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant1