ELEMENT WASHINGTON DC LLC
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MEASUREMENT REPORT
Bluetooth (Low Energy)

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

Date of Testing:
09/03/24 - 10/25/2024
Test Report Issue Date:
11/15/2024
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2408260066-11.A3L

FCC ID:	**A3LSMS936B**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-S936B/DS
Additional Model(s):	SM-S936B
EUT Type:	Portable Handset
Max. RF Output Power:	68.976 mW (18.39 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 558074 D01 v05r02, KDB 648474 D03 v01r04

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 and KDB 558074 D01 v05r02. Test results reported herein relate only to the item(s) tested.

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.

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

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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 laboratory located at 7185 Oakland Mills Road, Columbia, MD 21046. 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 lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under U.S. and Canada Mutual Recognition Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMS936B**. 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. Typical Bluetooth operation is covered under the DSS report found with this application.

Test Device Serial No.: N/A

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, 850/1900 GSM/GPRS/EDGE Multi-Band LTE, MultiBand 5G NR (FR1 and FR2), 802.11b/g/n/ac/ax/be WLAN, 802.11a/n/ac/ax/be UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), Wireless Power Transfer, UWB

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

Table 2-1. Frequency / Channel Operations

2.3 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna-1 Gain [dBi]	Antenna-2 Gain [dBi]	Directional Gain [dBi]
2.4	-1.72	-4.06	0.20

Table 2-2. Antenna Peak Gain

Note: This device is capable of operating in hopping and non-hopping mode. The EUT can hop between 79 different channels in the 2400 – 2483.5MHz band.

2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 0, and 7.6 for antenna port conducted emissions test setups.

There are two vendors of the WiFi/Bluetooth radio modules, variant 1 and variant 2. Both radio modules have the same mechanical outline, same on-board antenna matching circuit, identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. The worst case configuration was found between the two variants. The EUT was also investigated with and without charger.

The emissions below 1GHz and above 18GHz were tested with the highest transmitting power channel and the worst case configuration.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report. The worst orientation was found to be Y-orientation (landscape).

For AC line conducted and radiated test below 1GHz, following configuration were investigated and EUT powered by AC/DC was the worst case.

- EUT powered by AC/DC adaptor via USB cable with wire charger
- EUT powered by host PC via USB cable with wire charger

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model NQ-WC-06 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

2.5 Software and Firmware

The test was conducted with software/firmware version S936USQU0AXI3 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) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT.

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

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that those cables were not draped over the second LISN.

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 RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.11. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

3.3 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 v01r01.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°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	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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
-	WL25-1	Conducted Cable Set (25GHz)	4/2/2024	Annual	4/2/2025	WL25-1
-	WL25-2	Conducted Cable Set (25GHz)	4/2/2024	Annual	4/2/2025	WL25-2
-	WL40-1	Conducted Cable Set (40GHz)	4/2/2024	Annual	4/2/2025	WL40-1
-	AP1-002	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	AP1-002
-	ETS-001	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	ETS-001
-	ETS-002	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	ETS-002
-	MD 1M 18-40	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	MD 1M 18-40
Anritsu	MA24408A	Microwave Peak Power Sensor	5/21/2024	Annual	5/21/2025	11675
Anritsu	MA24408A	Microwave Peak Power Sensor	4/10/2024	Annual	4/10/2025	12798
ETS-Lindgren	3116C	Horn Antenna (18-40GHz)	2/27/2023	Biennial	2/27/2025	218893
Rohde & Schwarz	TC-TA18	Vivaldi Antenna	2/23/2023	Biennial	2/23/2025	26040036
Rohde & Schwarz	FSW26	Signal and Spectrum Analyzer (26.5GHz)	3/8/2024	Annual	3/8/2025	103187
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	9/25/2023	Annual	9/25/2024	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/11/2023	Annual	9/11/2024	100348
Rohde & Schwarz	ESW44	EMI Test Receiver (44GHz)	4/5/2024	Annual	4/5/2025	101716
Pasternak	NMLC-2	EMI Test Receiver (2Hz to 44GHz)	4/2/2024	Annual	4/2/2025	NMLC-2
Rohde & Schwarz	ENV216	Two-Line V-Network	1/31/2023	Biennial	1/31/2025	101379
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	4/9/2024	Annual	4/9/2025	MY52350166
Keysight Technologies	N9020A	MXA Signal Analyzer	4/11/2024	Annual	4/11/2025	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer	2/29/2024	Annual	3/1/2025	MY55410501
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	9/19/2024	Annual	9/19/2025	MY57141001
Sunol	JB6	JB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816
Sunol	JB5	Bi-Log Antenna (20M-5GHz)	9/11/2024	Biennial	9/11/2026	A051107
Rohde & Schwarz	SMW200A	Vector Signal Generator	4/4/2024	Annual	4/4/2025	109456

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: A3LSMS936B

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]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 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, 7.9
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	Section 7.11

Table 7-1. Summary of Test Results

Notes:

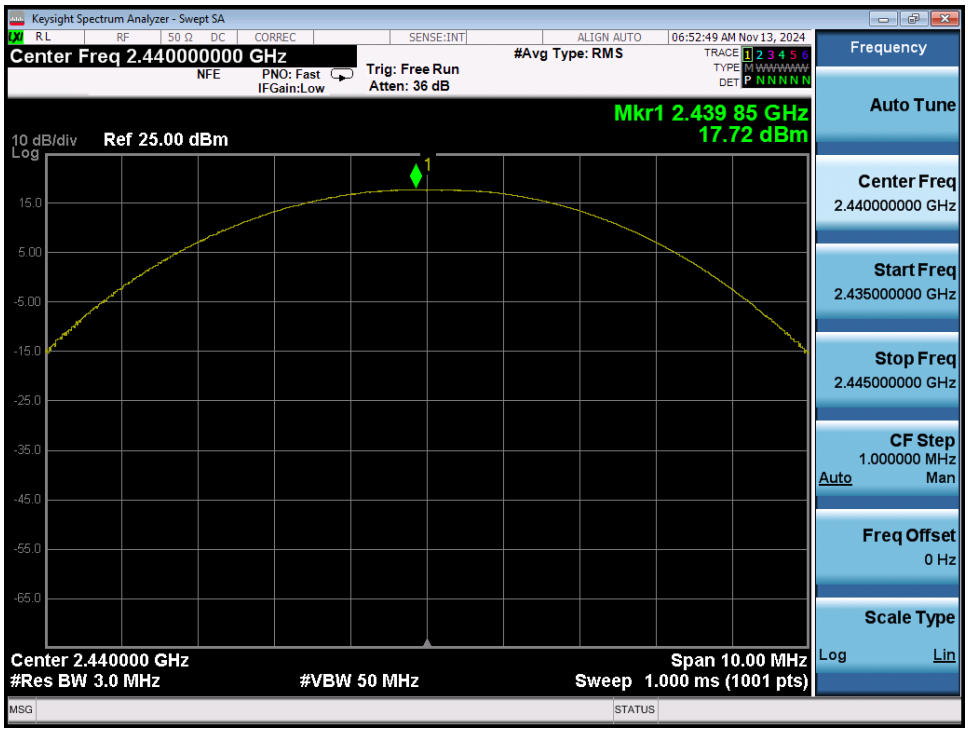
1. All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the 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 PCTEST "Bluetooth LE Automation," Version 3.6.
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 PCTEST "Chamber Automation," Version 1.3.1.
6. Data was leveraged from model SM-S938U for the certification of SM-S938B/DS. See Table 7-2 for spot-check results.

FCC Rules	Test Item	Test Case	Units	Limit	Reference Model: SM-S936U	Variant Model: SM-S936B	Deviation (dB)	Max Deviation (dB)	Pass/Fail
15.247(b)(3)	Conducted Output Power	Ant2 Ch.19 - 1 Mbps - Peak	dBm	N/A	18.11	17.72	0.39	1	PASS
15.209	Radiated Spurious Emissions	SISO Ant1 Ch.19 - Average - 4880 MHz	dBm	53.98	49.35	49.12	0.23	3	PASS
15.209	Radiated Band Edge Emissions	SISO Ant1 Ch.39 - Average	dBm	53.98	44.32	41.52	2.8	3	PASS

Table 7-2. Summary of Spot-Checks

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2440	1 Mbps	19	LE	17.72	59.156

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

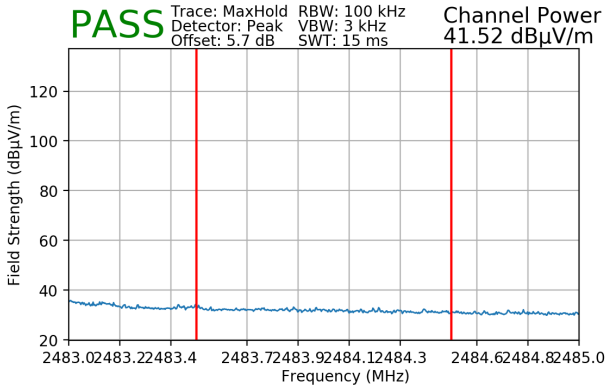


Plot 7-1. Conducted Peak Power Measurement (Spot-check)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4880.00	Avg	H	132	277	-61.00	3.12	0.00	49.12	53.98	-4.85

Table 7-4. Radiated Measurements MIMO (Spot-check)

Bluetooth Mode:	LE
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	39
Bluetooth Mode:	LE



Plot 7-2. Radiated Restricted Upper Band Edge Measurement (Average)

1. Each spot check test on the EUT was performed using the same procedure and setting that were used to perform the test on the corresponding reference device.
2. All test cases were performed to verify the variant EUT is still in compliance with the spot checked results to the reference device and was performed using the guidance of ANSI C63.10-2013.

7.2 6dB Bandwidth Measurement – Bluetooth (LE)

§15.247(a.2); RSS-247 [5.2]

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
KDB 558074 D01 v05r02 – Section 8.2

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.

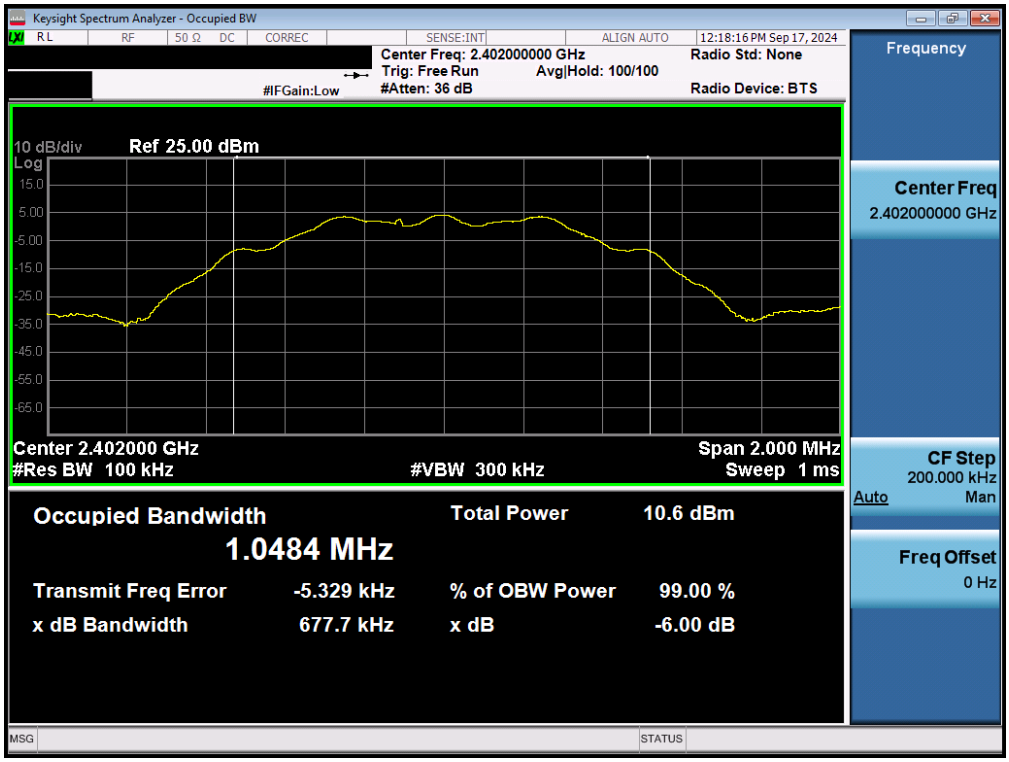
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	125 kbps	0	LE	677.7	500	Pass
2440	125 kbps	19	LE	680.5	500	Pass
2480	125 kbps	39	LE	682.6	500	Pass
2402	500 kbps	0	LE	674.3	500	Pass
2440	500 kbps	19	LE	662.0	500	Pass
2480	500 kbps	39	LE	669.6	500	Pass
2402	1 Mbps	0	LE	658.3	500	Pass
2440	1 Mbps	19	LE	649.6	500	Pass
2480	1 Mbps	39	LE	658.7	500	Pass
2402	2 Mbps	0	LE	1153.0	500	Pass
2440	2 Mbps	19	LE	1110.0	500	Pass
2480	2 Mbps	39	LE	1142.0	500	Pass

Table 7-5. Conducted Bandwidth Measurements – Ant 1



Plot 7-3. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 1

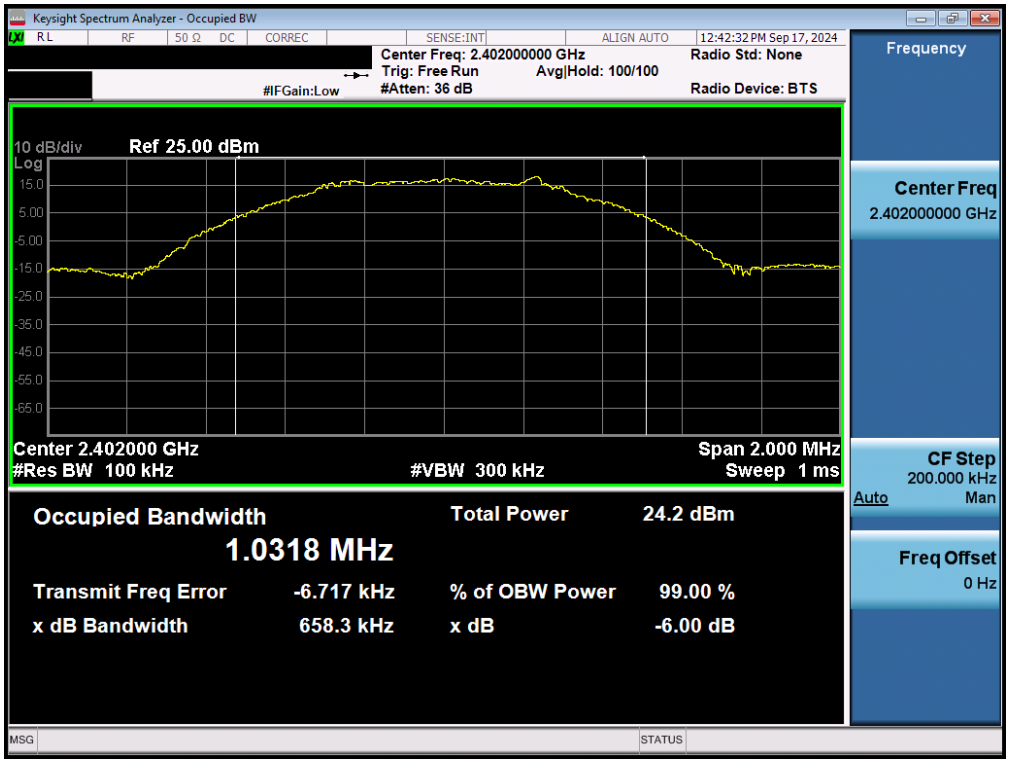
Plot 7-4. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 1

Plot 7-5. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 1

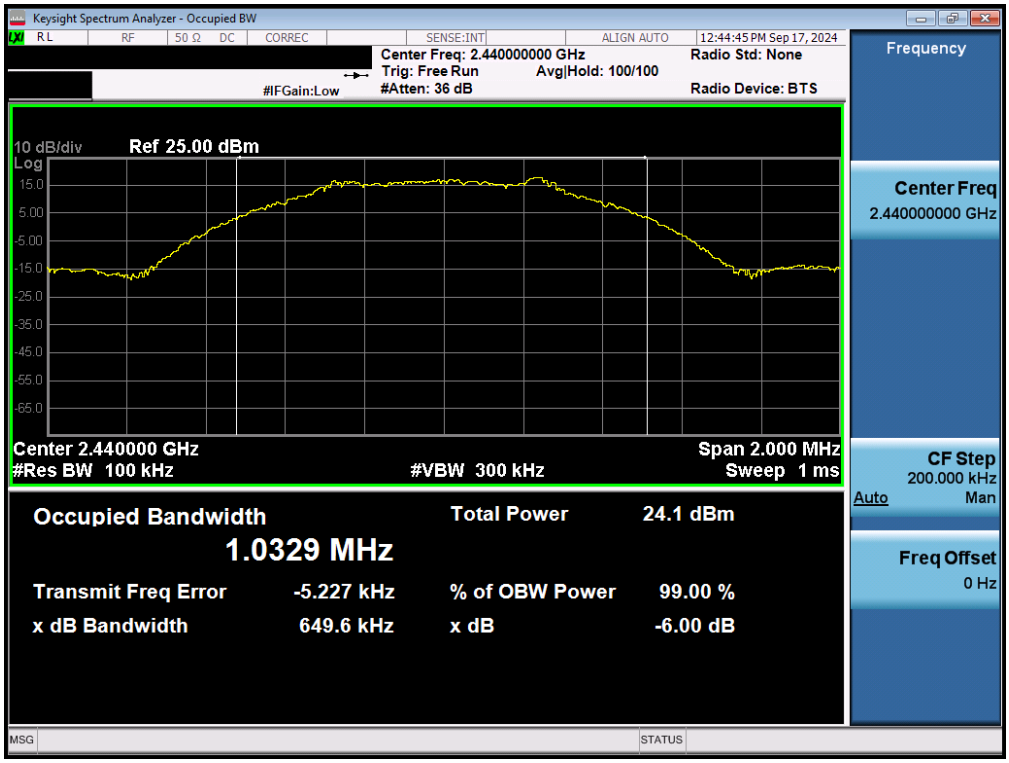
Plot 7-6. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 1

Plot 7-7. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 1

Plot 7-8. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 1

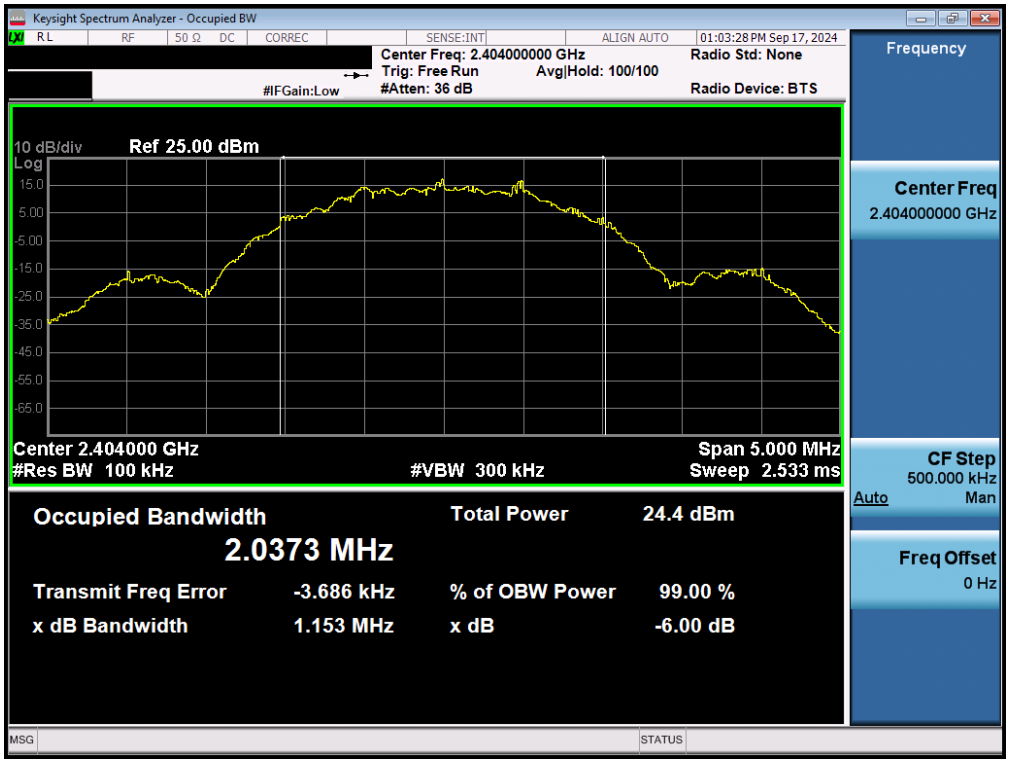


Plot 7-9. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant 1

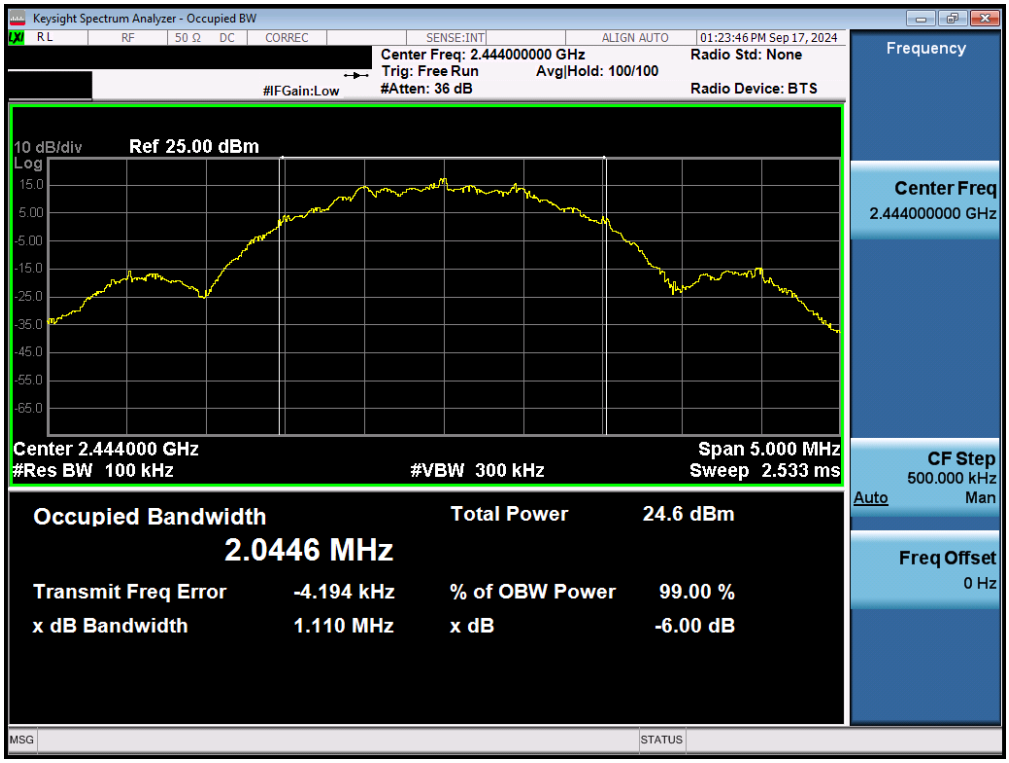


Plot 7-10. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant 1

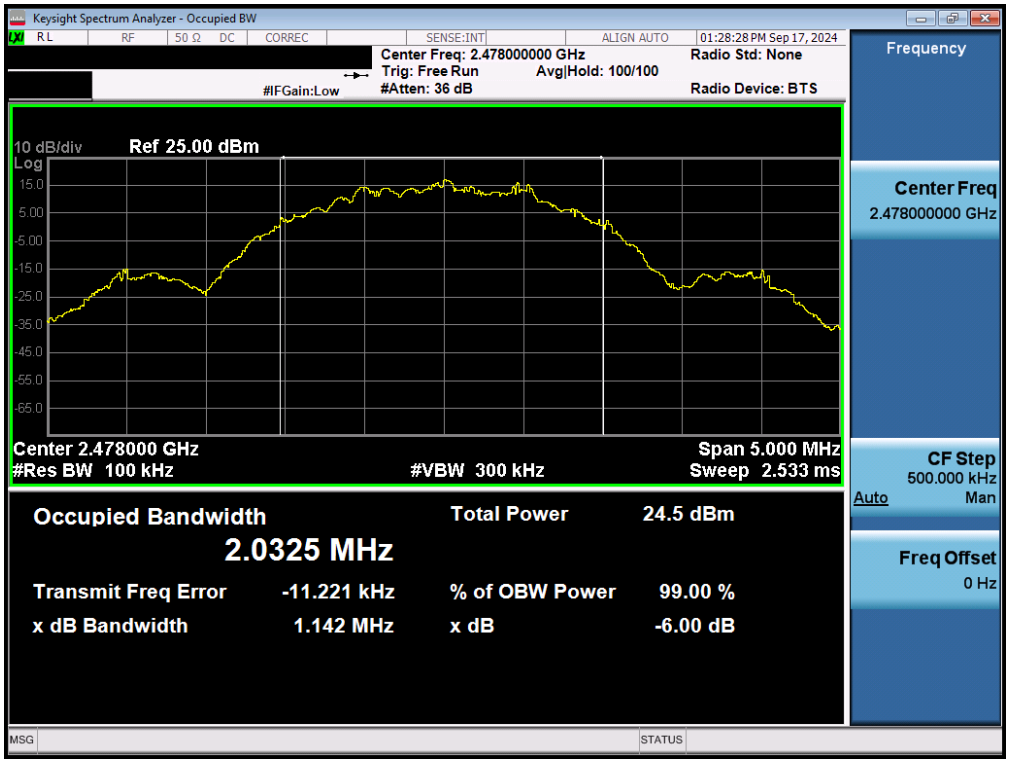
Plot 7-11. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant 1



Plot 7-12. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant 1



Plot 7-13. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant 1



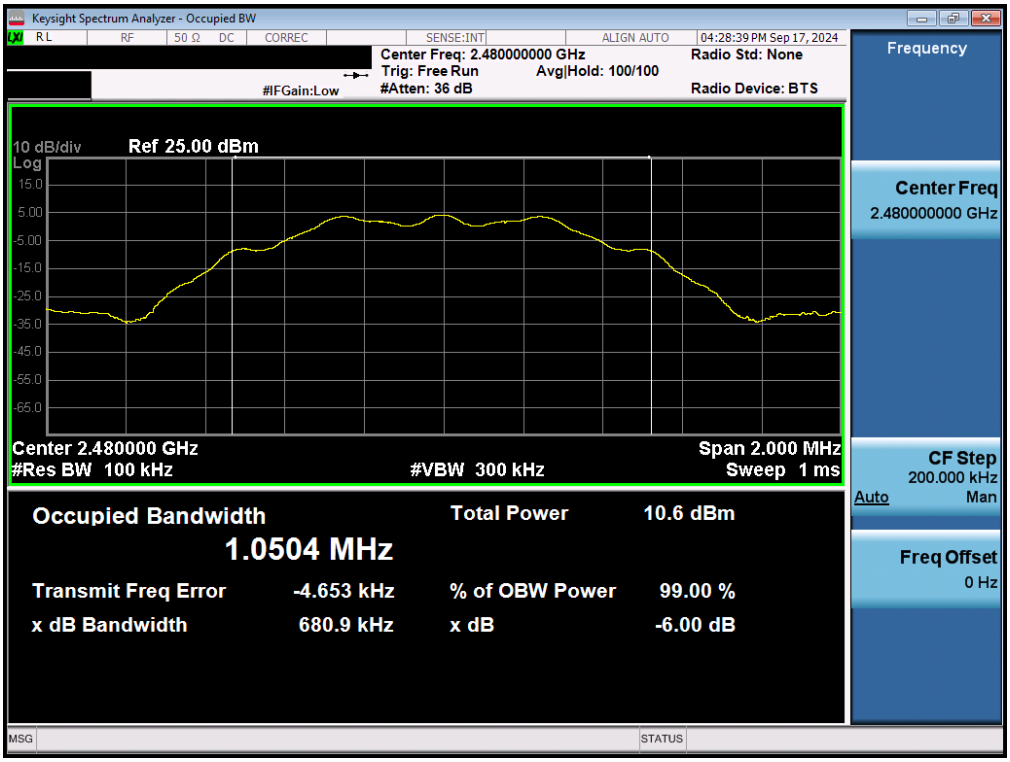
Plot 7-14. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant 1

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	125 kbps	0	LE	679.9	500	Pass
2440	125 kbps	19	LE	677.6	500	Pass
2480	125 kbps	39	LE	680.9	500	Pass
2402	500 kbps	0	LE	683.0	500	Pass
2440	500 kbps	19	LE	657.7	500	Pass
2480	500 kbps	39	LE	654.8	500	Pass
2402	1 Mbps	0	LE	663.0	500	Pass
2440	1 Mbps	19	LE	678.6	500	Pass
2480	1 Mbps	39	LE	721.0	500	Pass
2404	2 Mbps	0	LE	1145.0	500	Pass
2444	2 Mbps	19	LE	1131.0	500	Pass
2480	2 Mbps	39	LE	1131.0	500	Pass

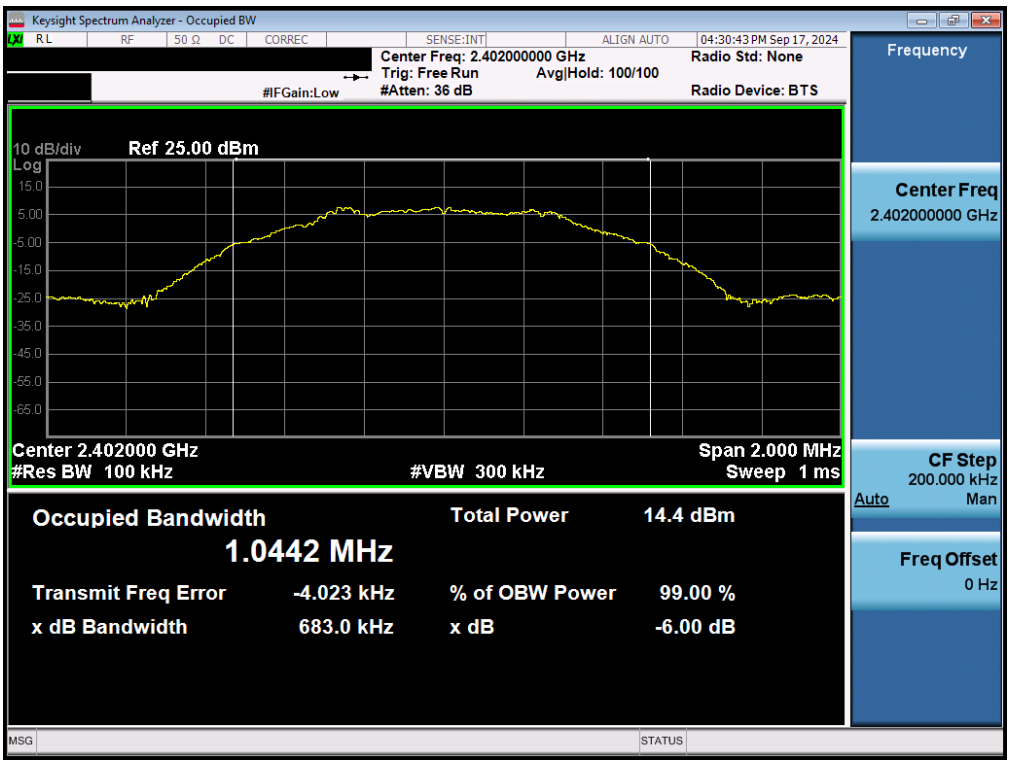
Table 7-6. Conducted Bandwidth Measurements – Ant 2

Plot 7-15. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 2

Plot 7-16. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 2



Plot 7-17. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 2

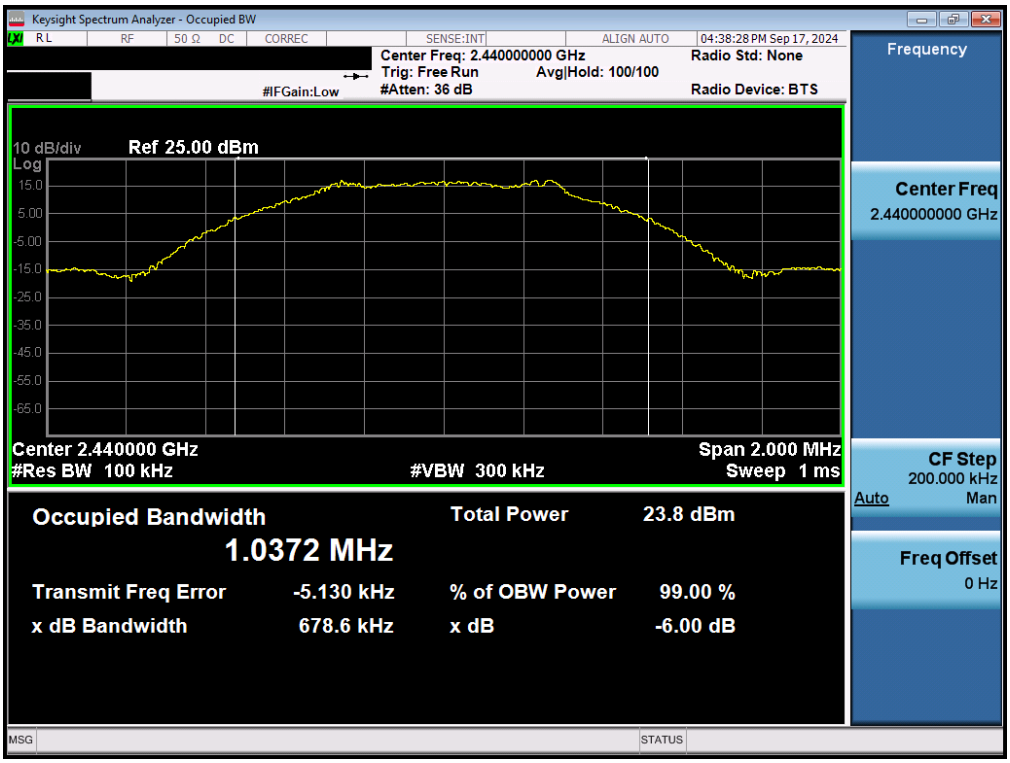


Plot 7-18. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 2

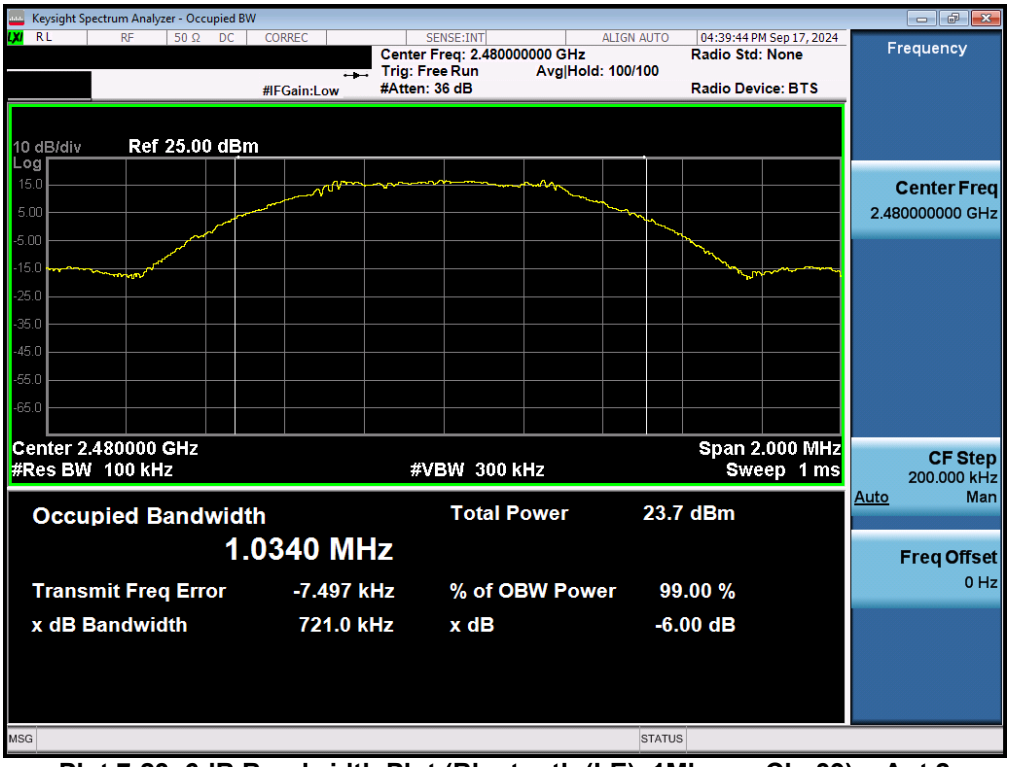
Plot 7-19. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 2

Plot 7-20. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 2

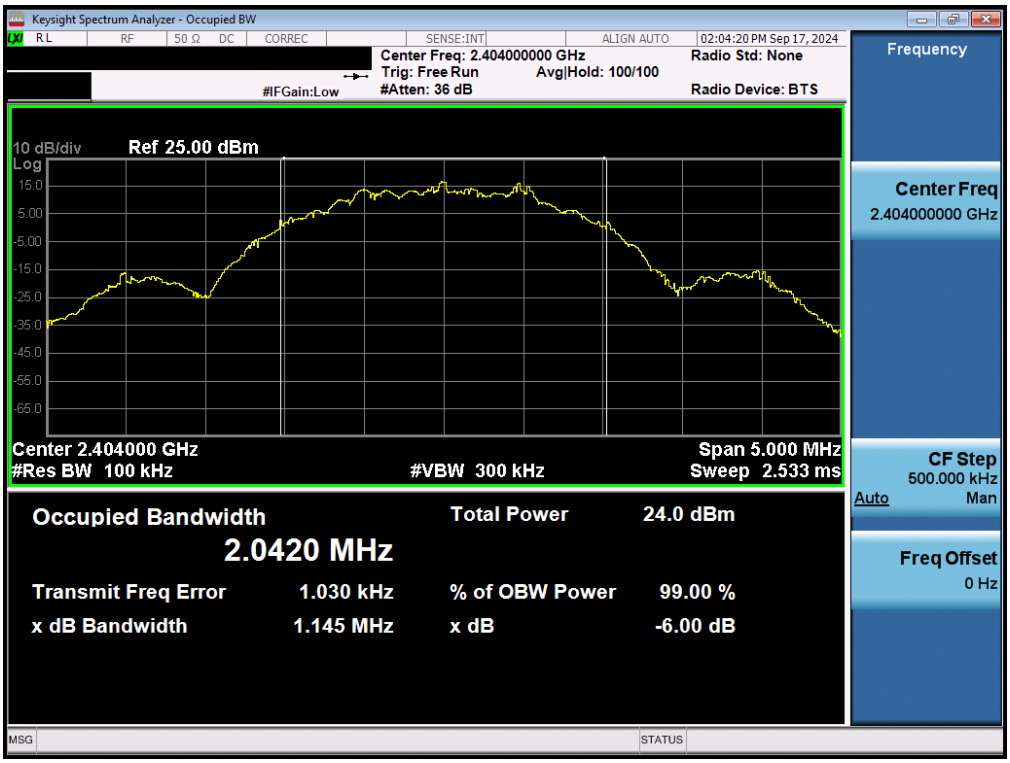
Plot 7-21. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant 2



Plot 7-22. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant 2

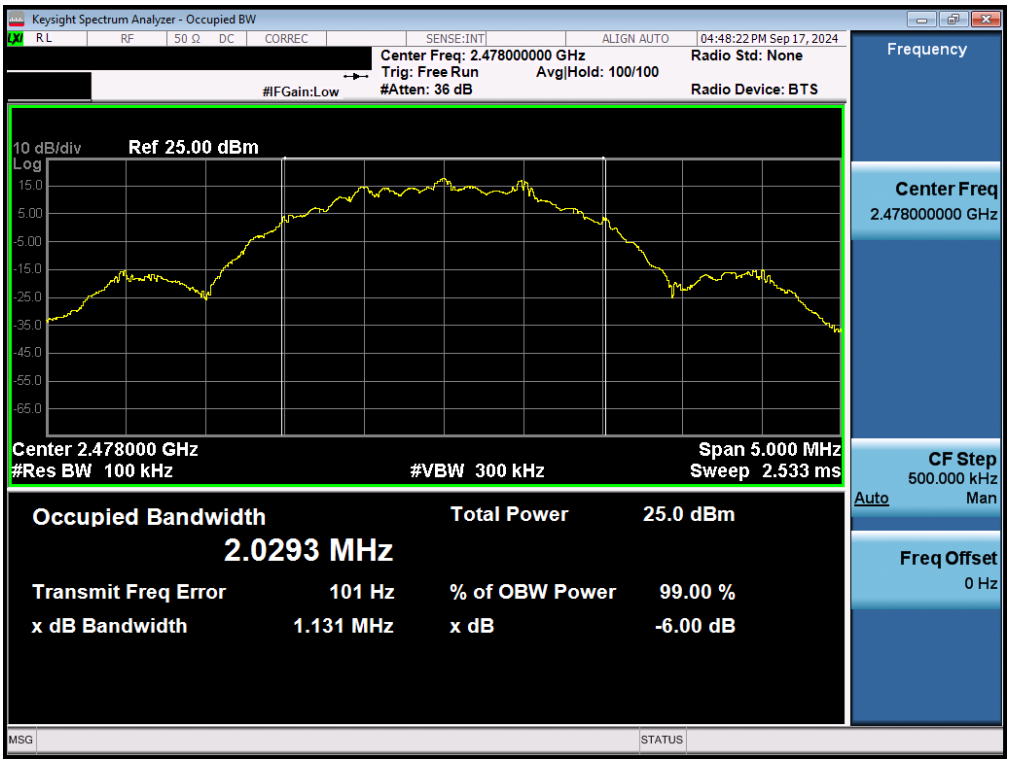


Plot 7-23. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant 2



Plot 7-24. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant 2

Plot 7-25. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant 2

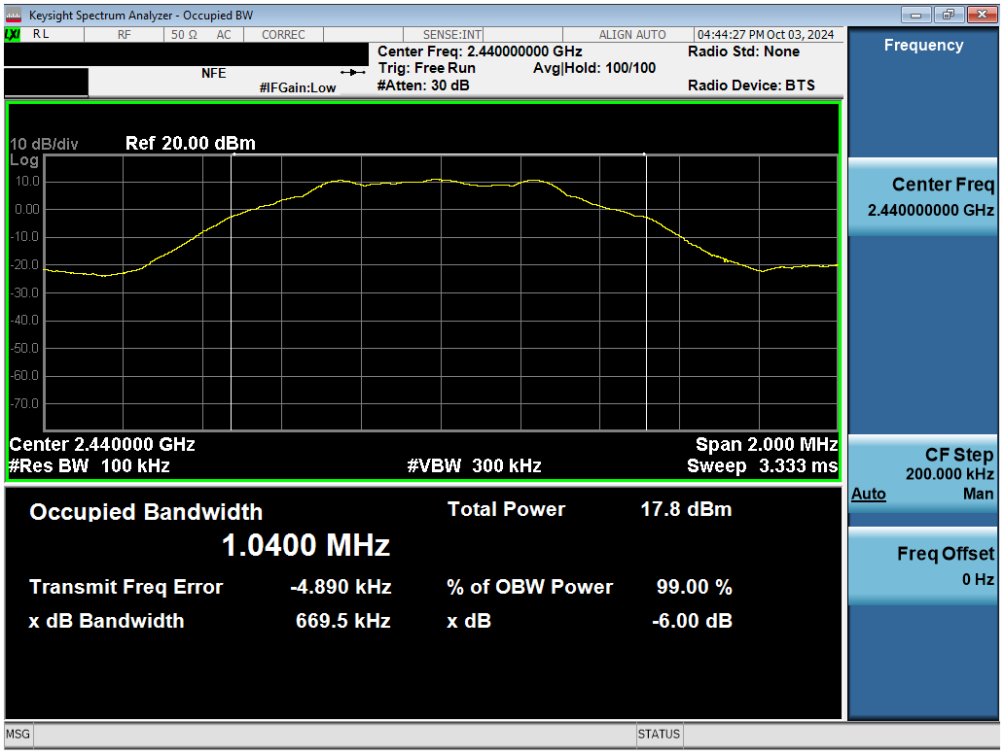


Plot 7-26. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant 2

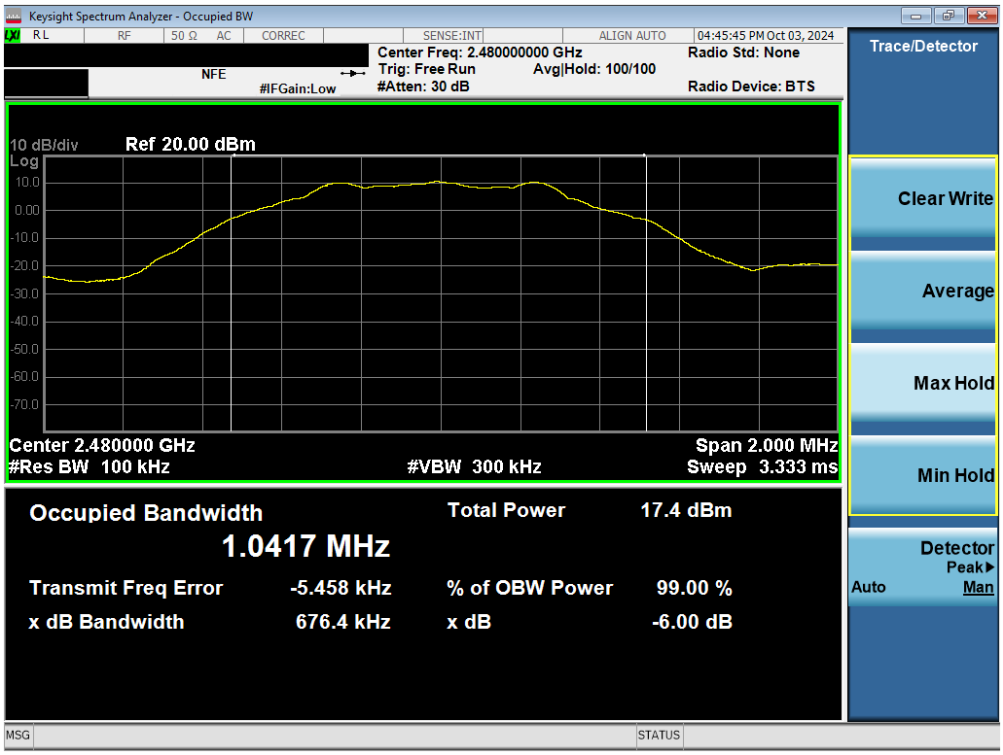
Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	677.3	500	Pass
2440	1 Mbps	19	LE	669.5	500	Pass
2480	1 Mbps	39	LE	676.4	500	Pass
2404	2 Mbps	1	LE	1144.0	500	Pass
2444	2 Mbps	19	LE	1142.0	500	Pass
2480	2 Mbps	38	LE	1138.0	500	Pass

Table 7-7. Conducted Bandwidth Measurements – Dual Ant 1

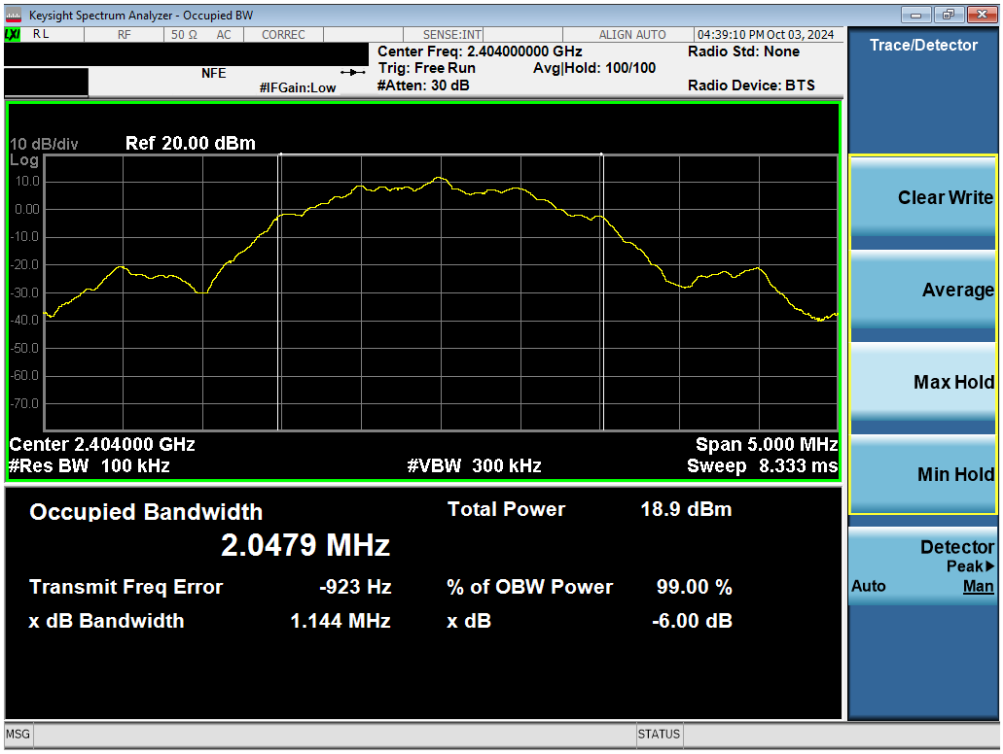
Plot 7-27. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Dual Ant 1



Plot 7-28. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant 1



Plot 7-29. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant 1



Plot 7-30. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 1) – Dual Ant 1

Plot 7-31. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant 1

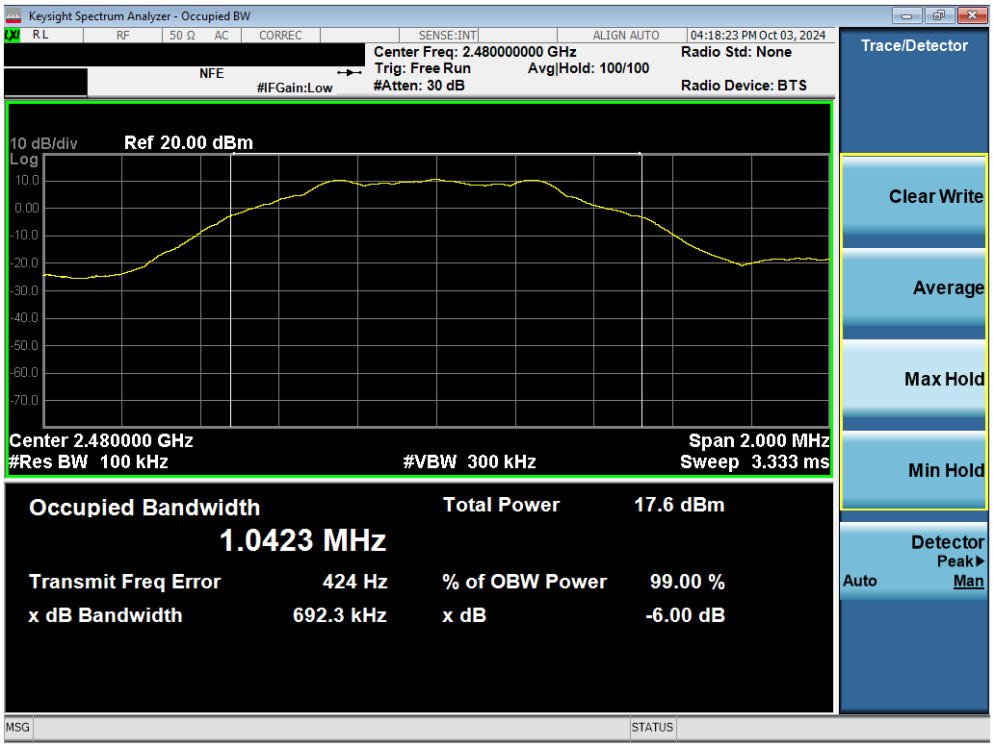
Plot 7-32. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 38) – Dual Ant 1

Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	687.8	500	Pass
2440	1 Mbps	19	LE	667.8	500	Pass
2480	1 Mbps	39	LE	692.3	500	Pass
2404	2 Mbps	1	LE	1146.0	500	Pass
2444	2 Mbps	19	LE	1136.0	500	Pass
2480	2 Mbps	38	LE	1145.0	500	Pass

Table 7-8. Conducted Bandwidth Measurements – Dual Ant 2

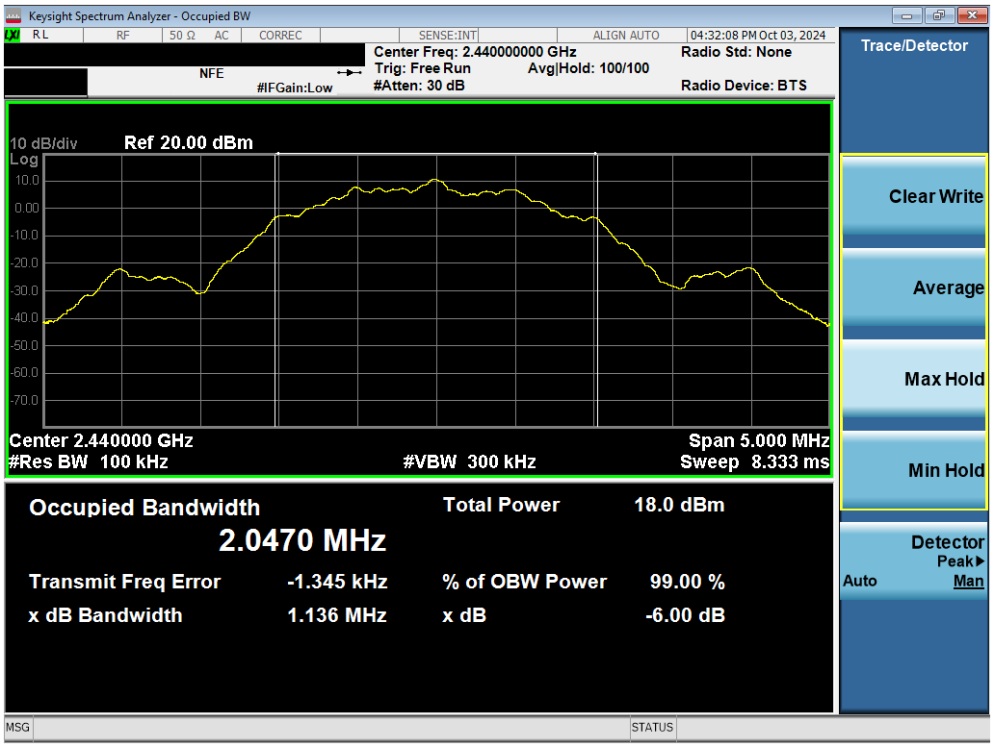
Plot 7-33. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 1) – Dual Ant 2

Plot 7-34. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Dual Ant 2



Plot 7-35. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Dual Ant 2

Plot 7-36. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 1) – Dual Ant 2



Plot 7-37. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Dual Ant 2

Plot 7-38. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 38) – Dual Ant 2

7.3 Output Power Measurement – Bluetooth (LE)

§15.247(b.3); RSS-247 [5.4(4)]

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.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.1
KDB 558074 D01 v05r02 – Section 8.3.1.1

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.

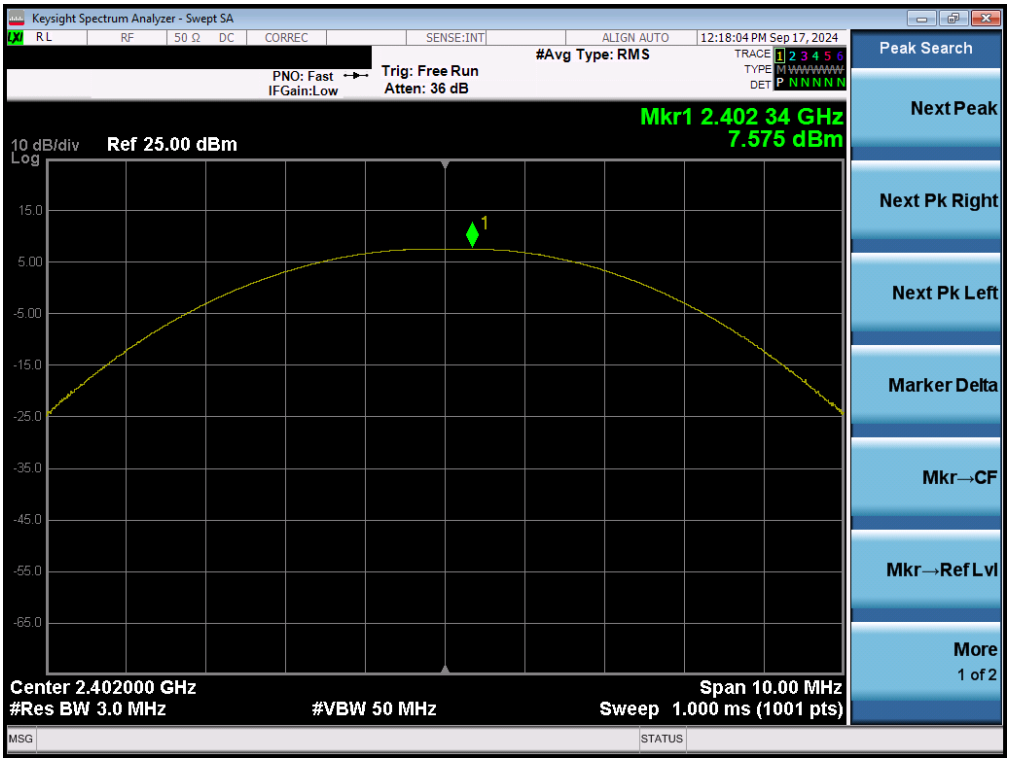
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

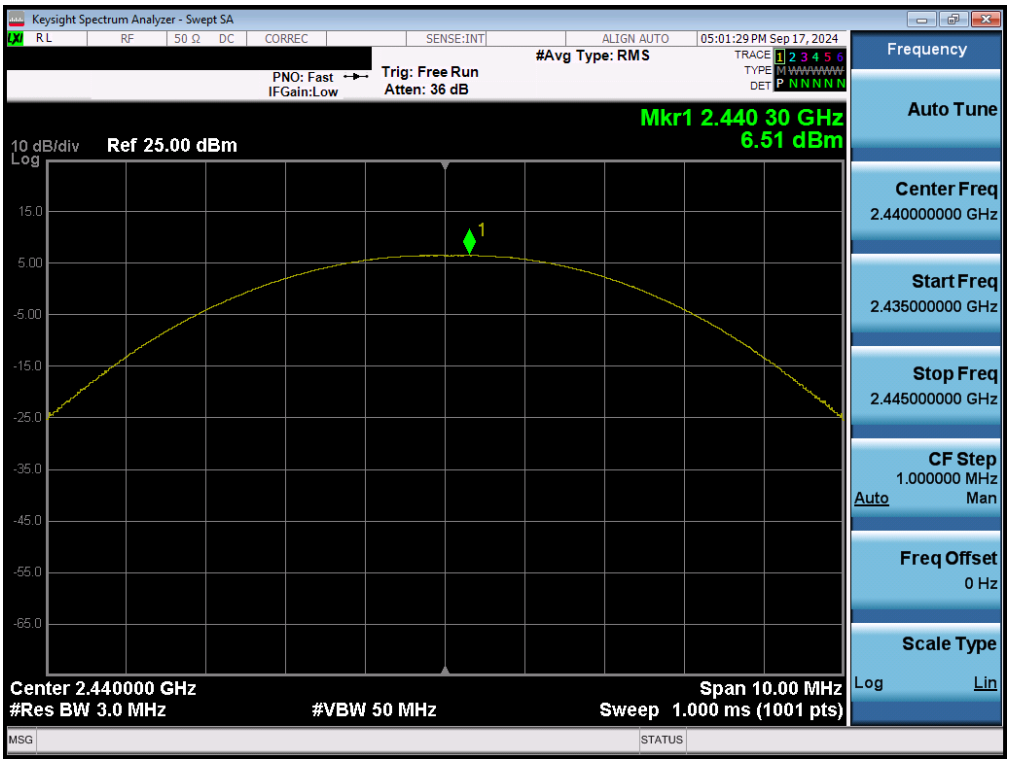
None

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2402	125 kbps	0	LE	7.58	5.721
2440	125 kbps	19	LE	6.51	4.475
2480	125 kbps	39	LE	5.96	3.947
2402	500 kbps	0	LE	7.51	5.642
2440	500 kbps	19	LE	6.57	4.539
2480	500 kbps	39	LE	5.97	3.954
2402	1 Mbps	0	LE	18.39	68.976
2440	1 Mbps	19	LE	18.11	64.670
2480	1 Mbps	39	LE	17.65	58.170
2402	2 Mbps	0	LE	17.93	62.087
2440	2 Mbps	19	LE	18.10	64.506
2480	2 Mbps	39	LE	17.94	62.259

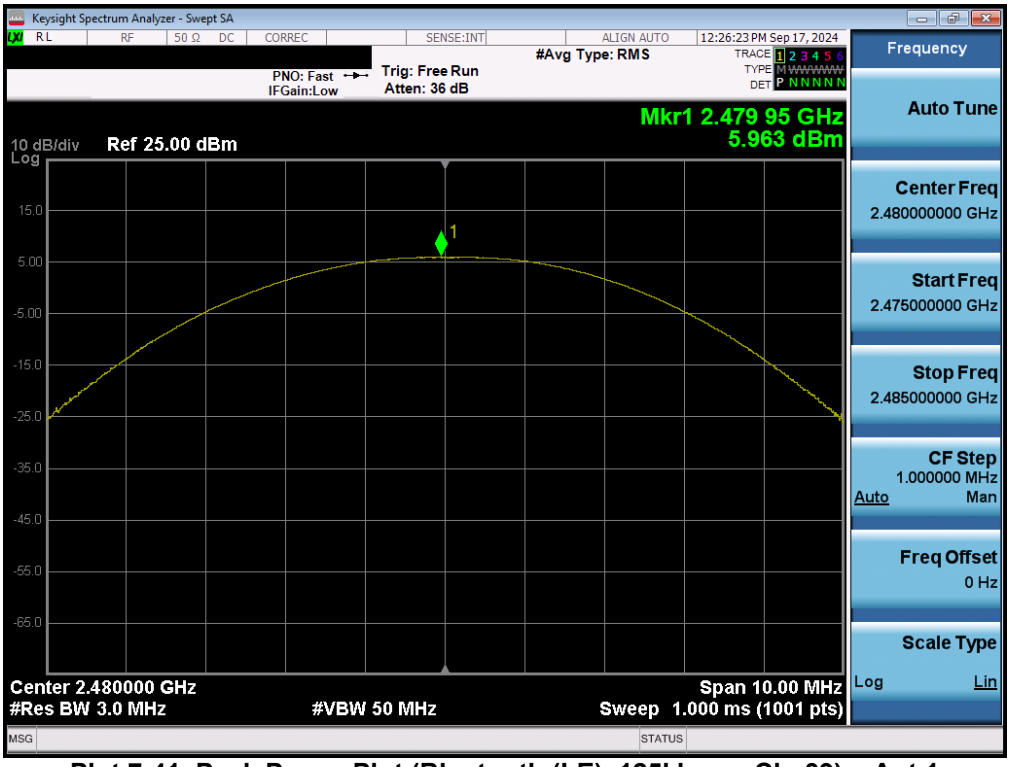
Table 7-9. Conducted Output Power Measurements (Bluetooth (LE)) – Ant 1



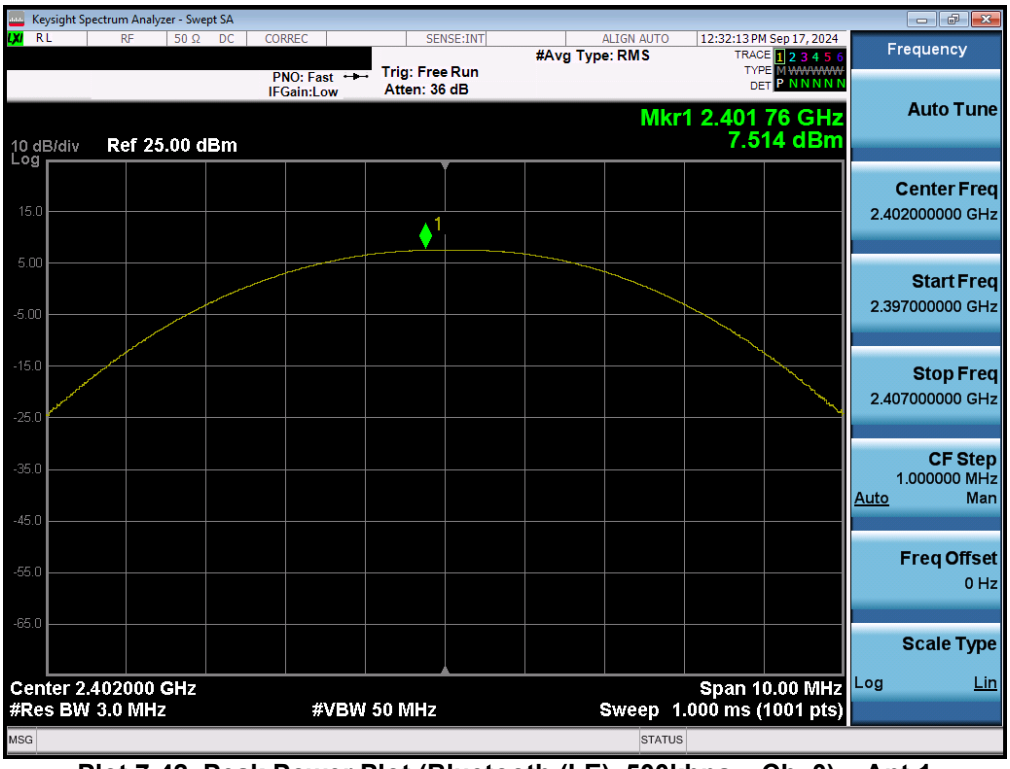
Plot 7-39. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 1



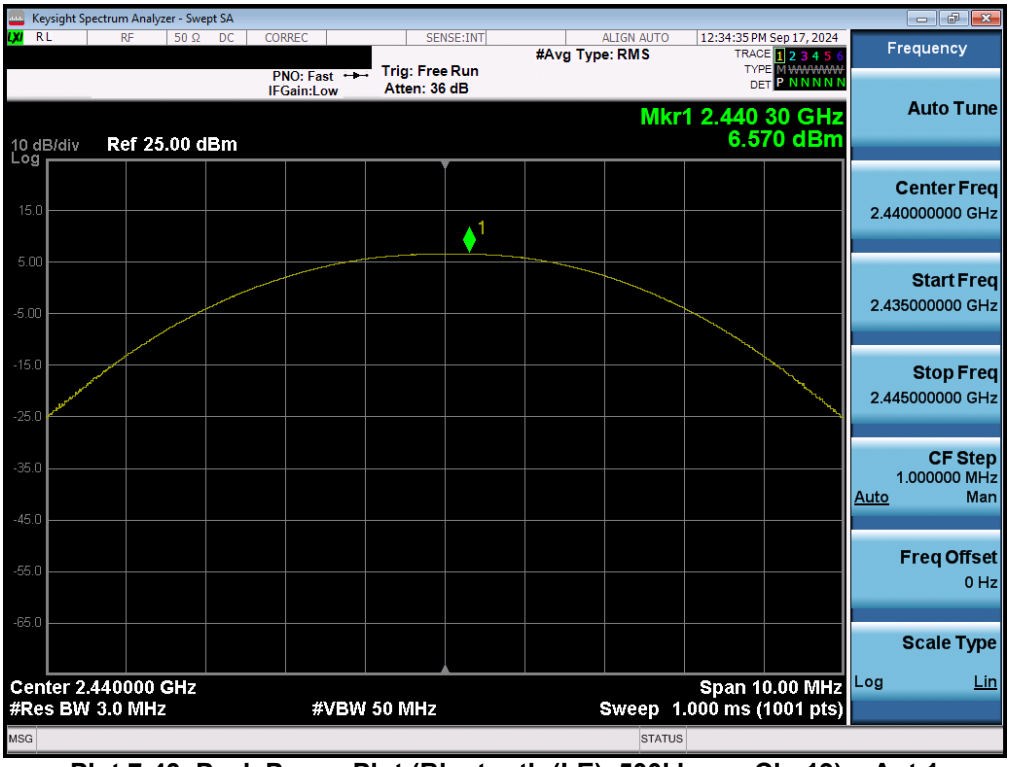
Plot 7-40. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 1



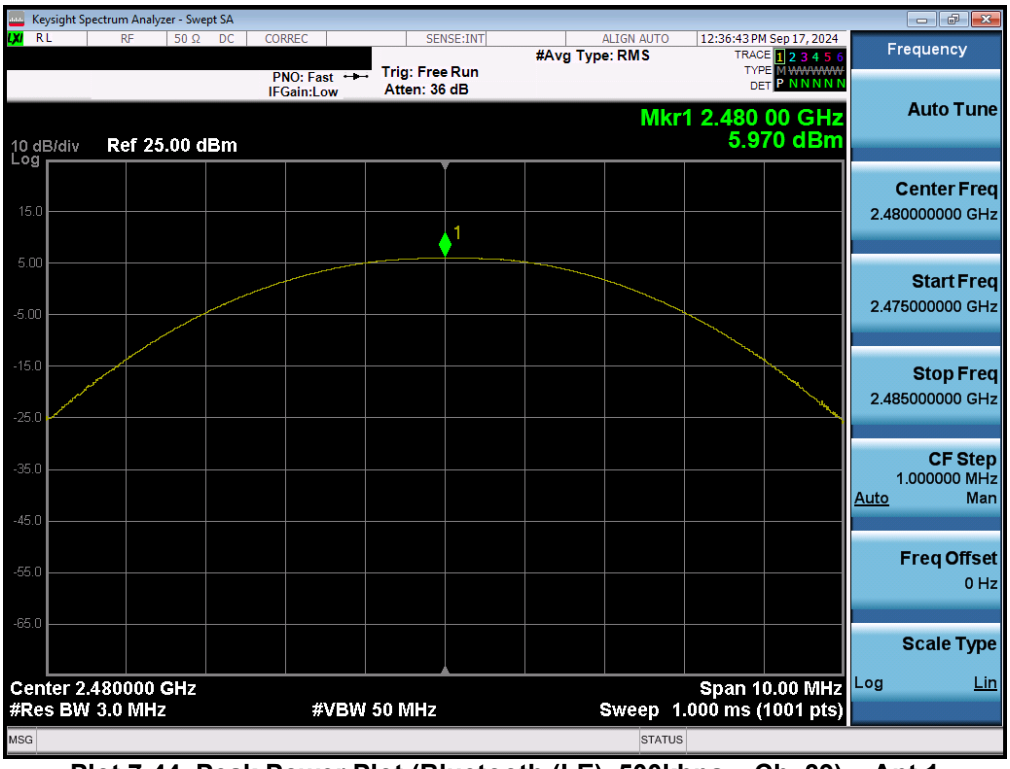
Plot 7-41. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 1



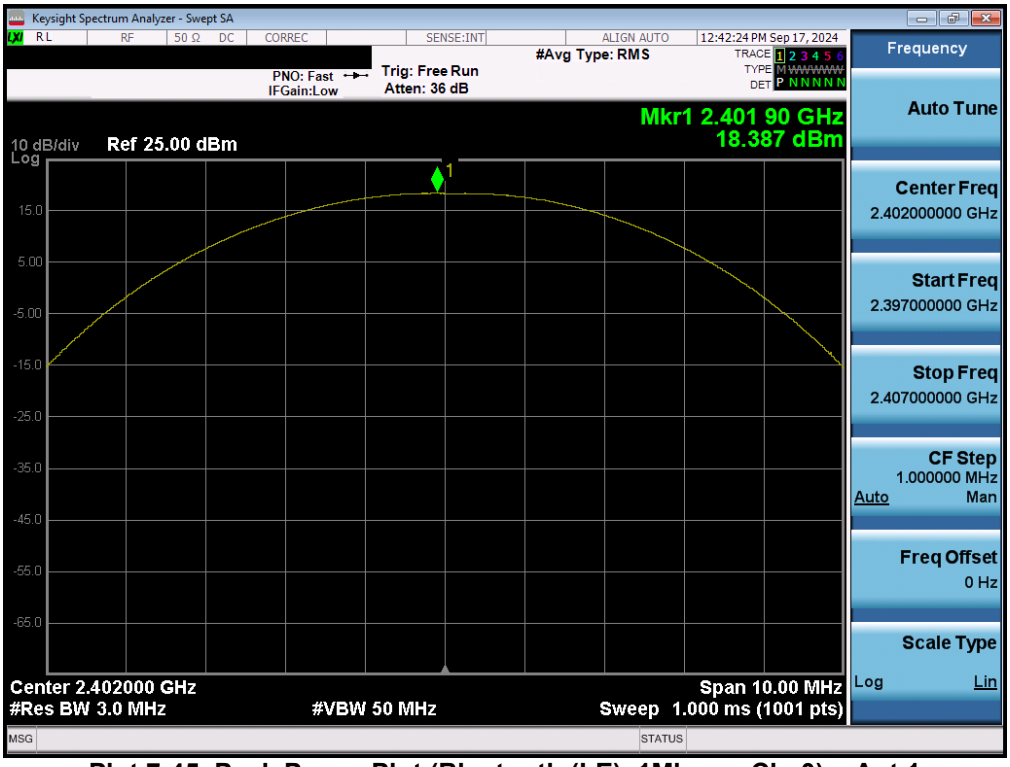
Plot 7-42. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 1



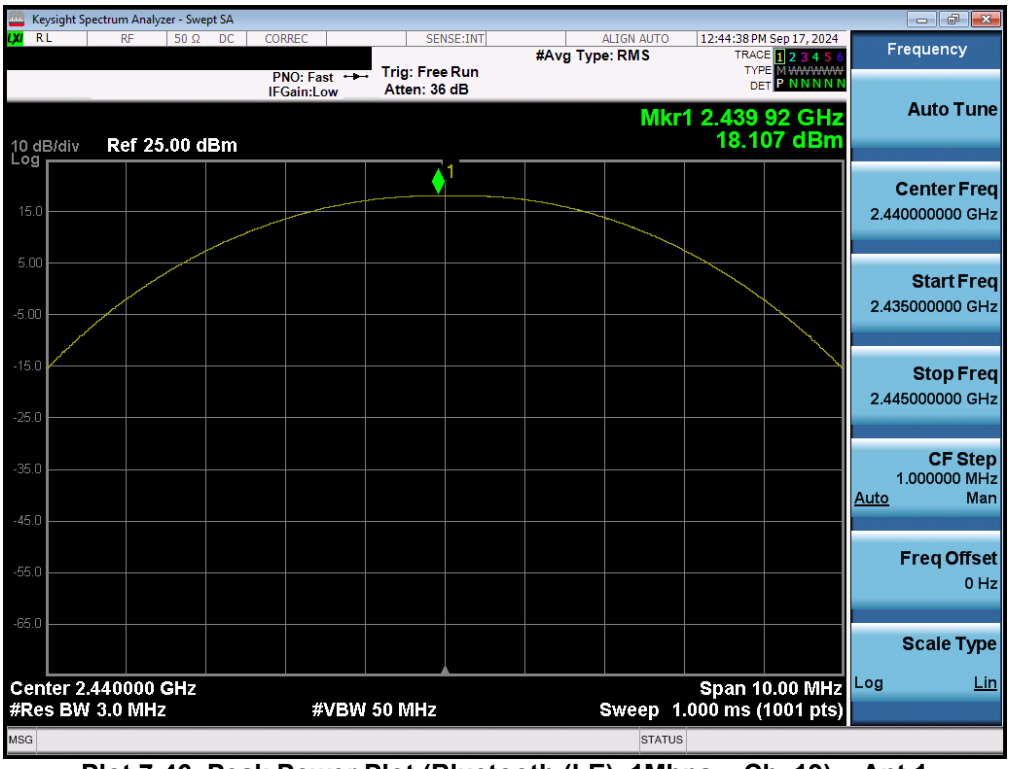
Plot 7-43. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 1



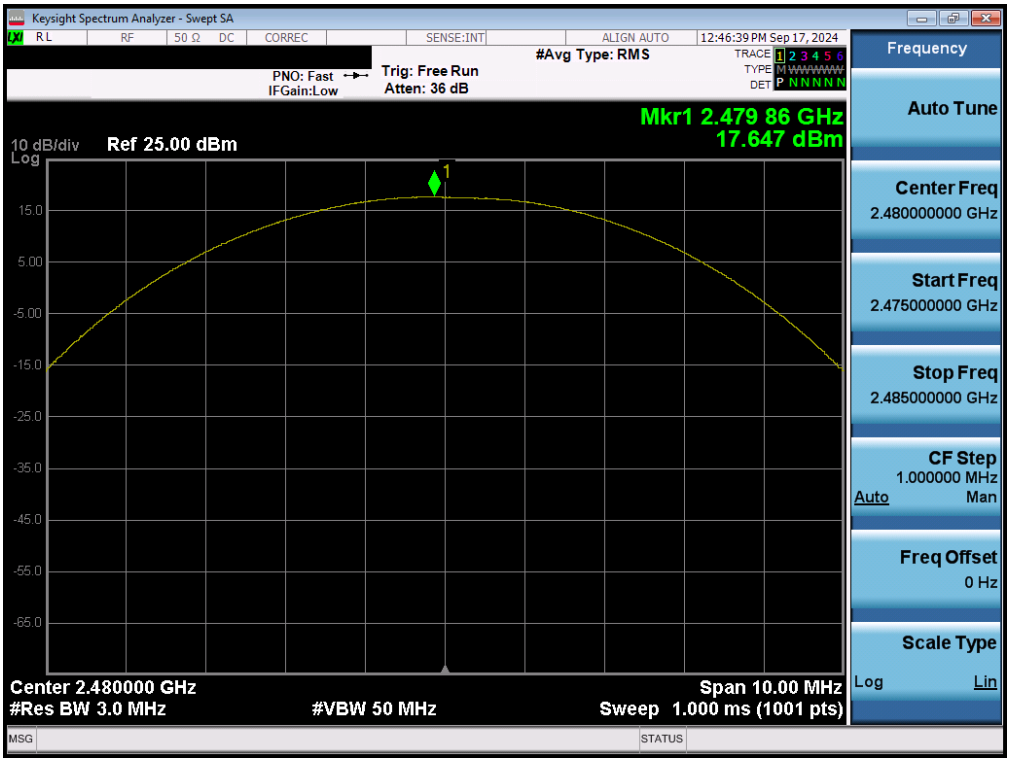
Plot 7-44. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 1



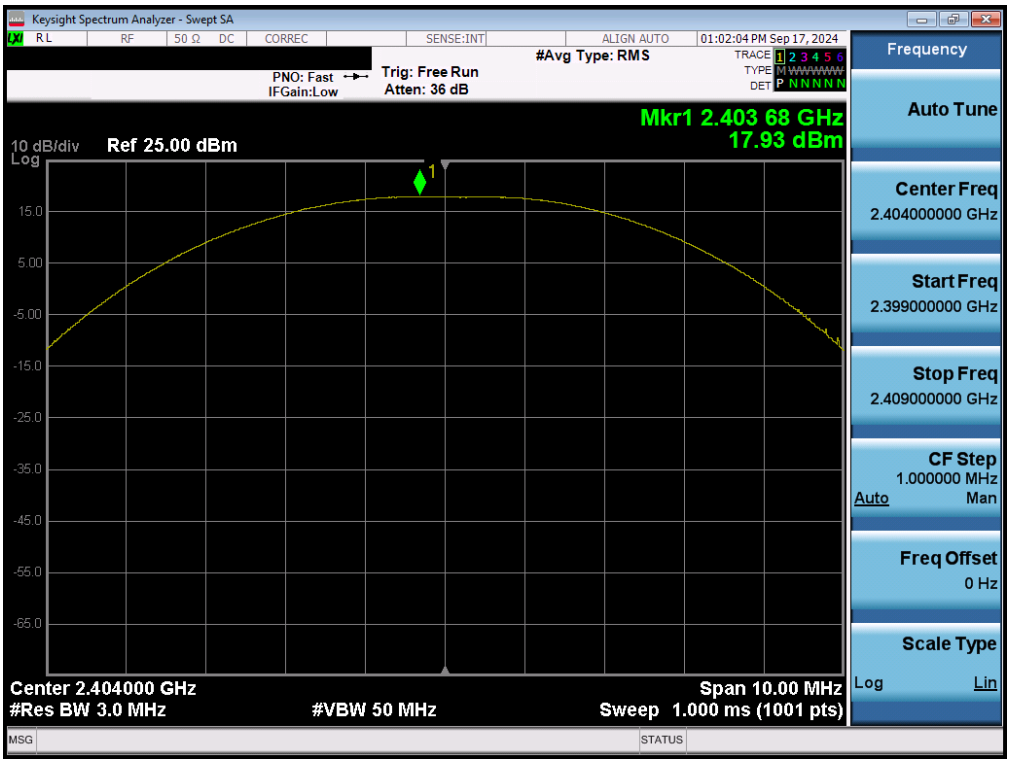
Plot 7-45. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant 1



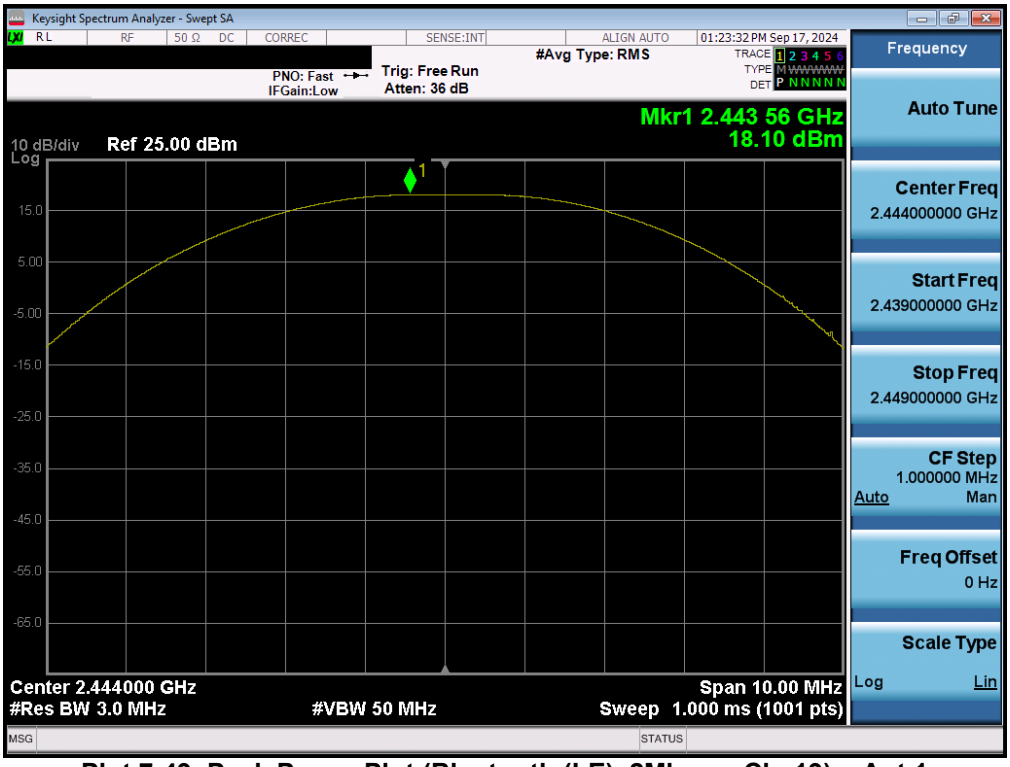
Plot 7-46. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant 1



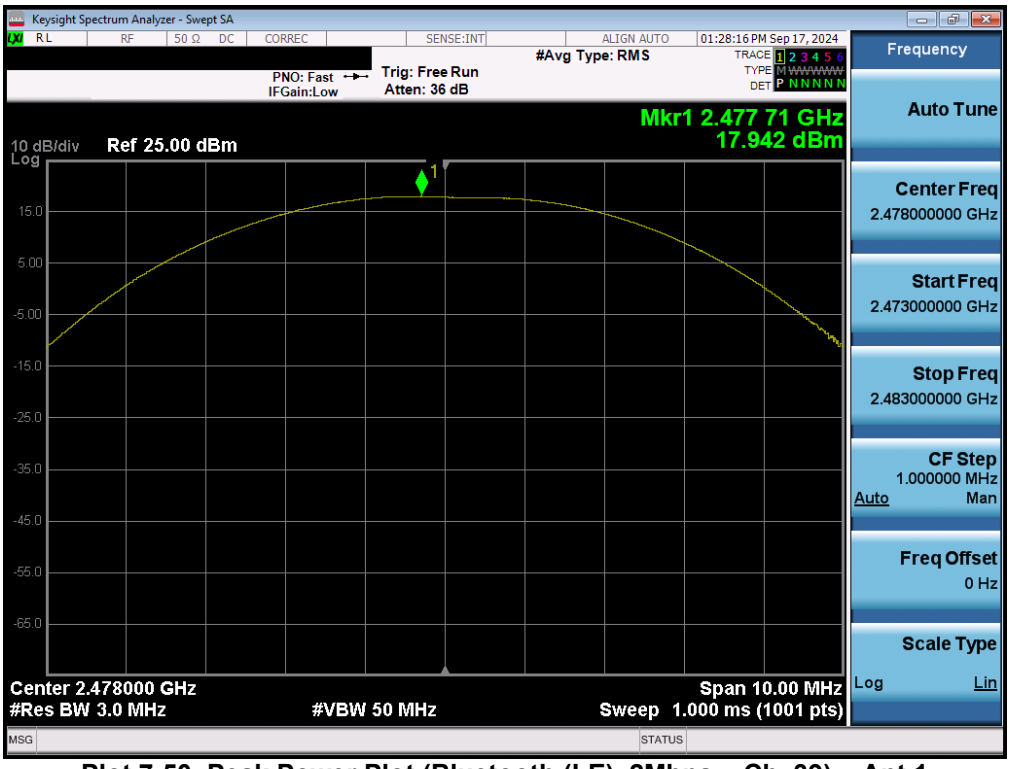
Plot 7-47. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant 1



Plot 7-48. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant 1



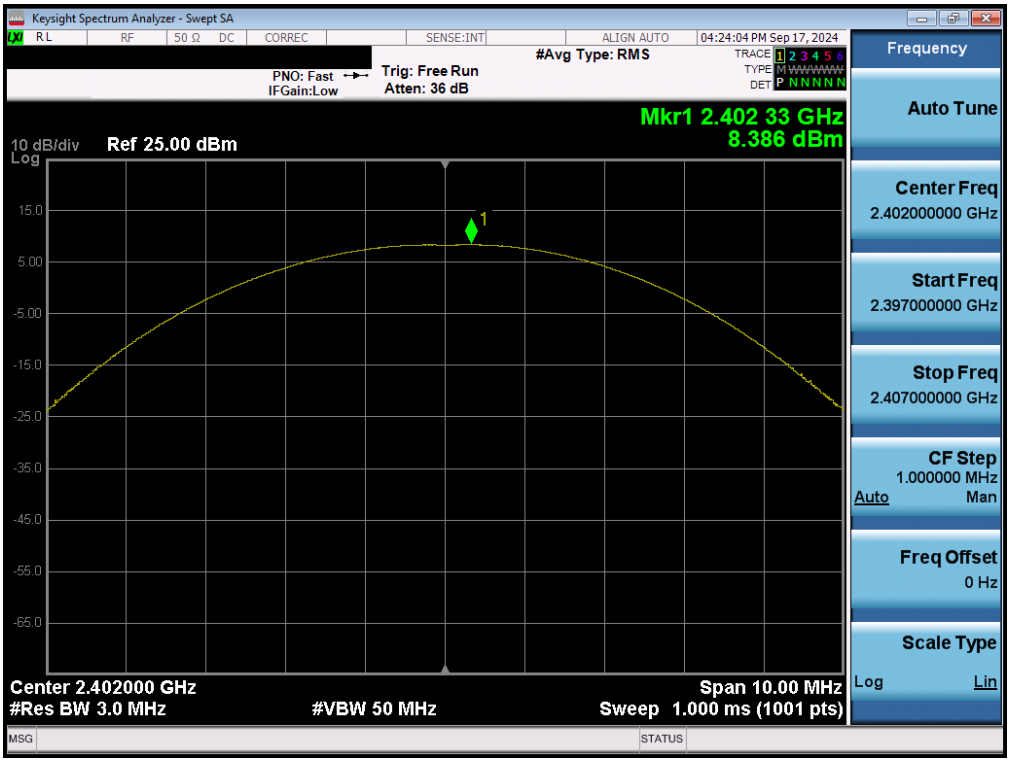
Plot 7-49. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant 1



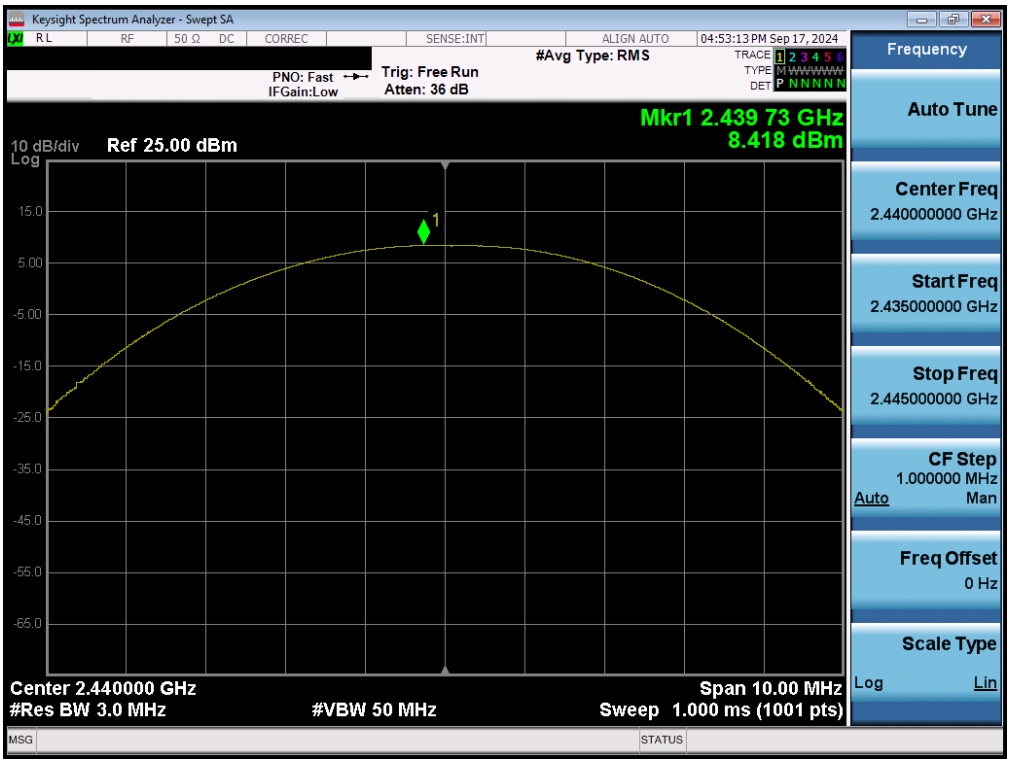
Plot 7-50. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant 1

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power	
				[dBm]	[mW]
2402	125 kbps	0	LE	8.39	6.896
2440	125 kbps	19	LE	8.42	6.947
2480	125 kbps	39	LE	7.64	5.805
2402	500 kbps	0	LE	8.45	6.997
2440	500 kbps	19	LE	8.43	6.968
2480	500 kbps	39	LE	7.67	5.844
2402	1 Mbps	0	LE	17.11	51.416
2440	1 Mbps	19	LE	18.02	63.329
2480	1 Mbps	39	LE	17.89	61.489
2404	2 Mbps	0	LE	17.19	52.336
2444	2 Mbps	19	LE	17.65	58.237
2480	2 Mbps	39	LE	18.28	67.251

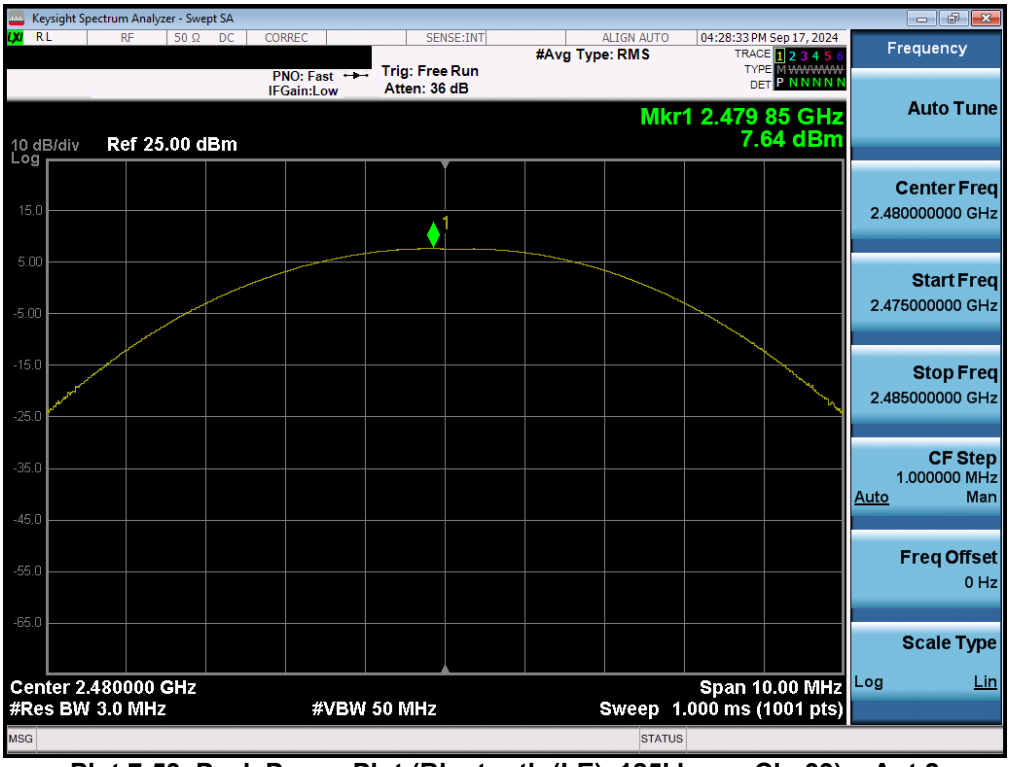
Table 7-10. Conducted Output Power Measurements (Bluetooth (LE)) – Ant 2



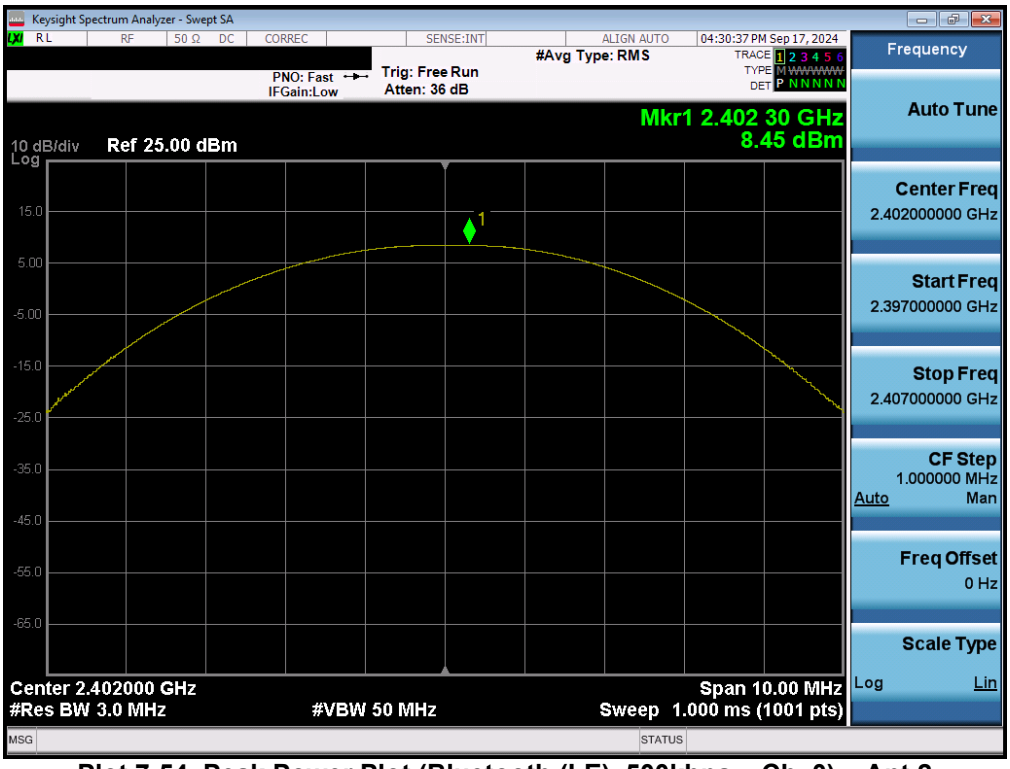
Plot 7-51. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 2



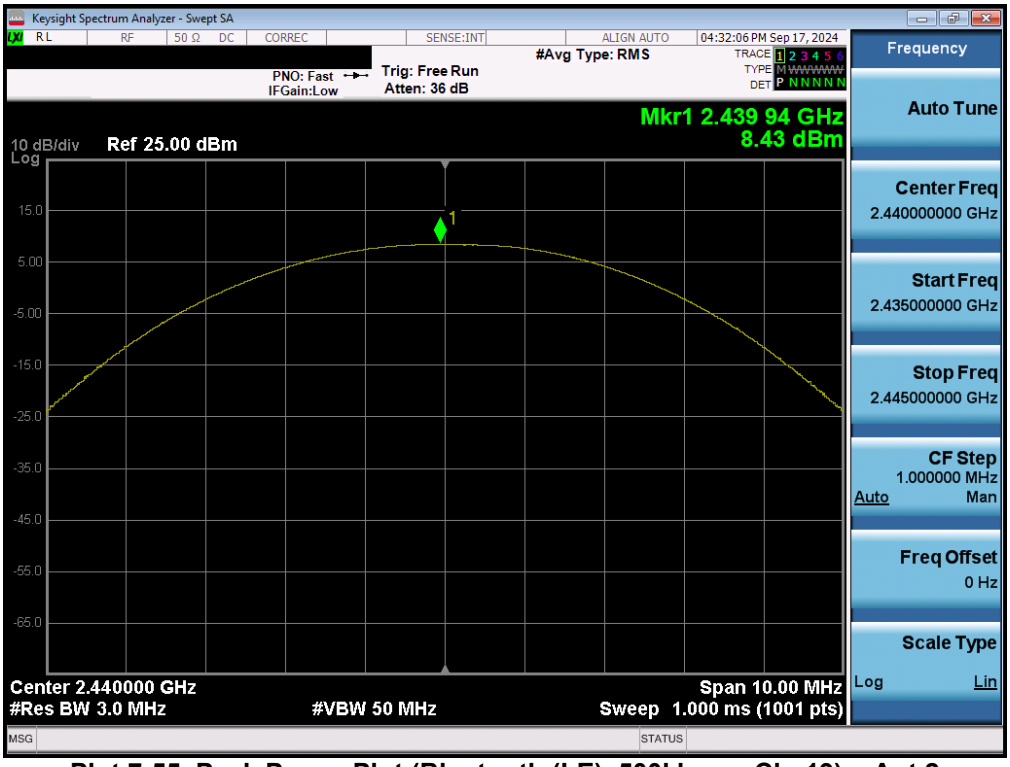
Plot 7-52. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 2



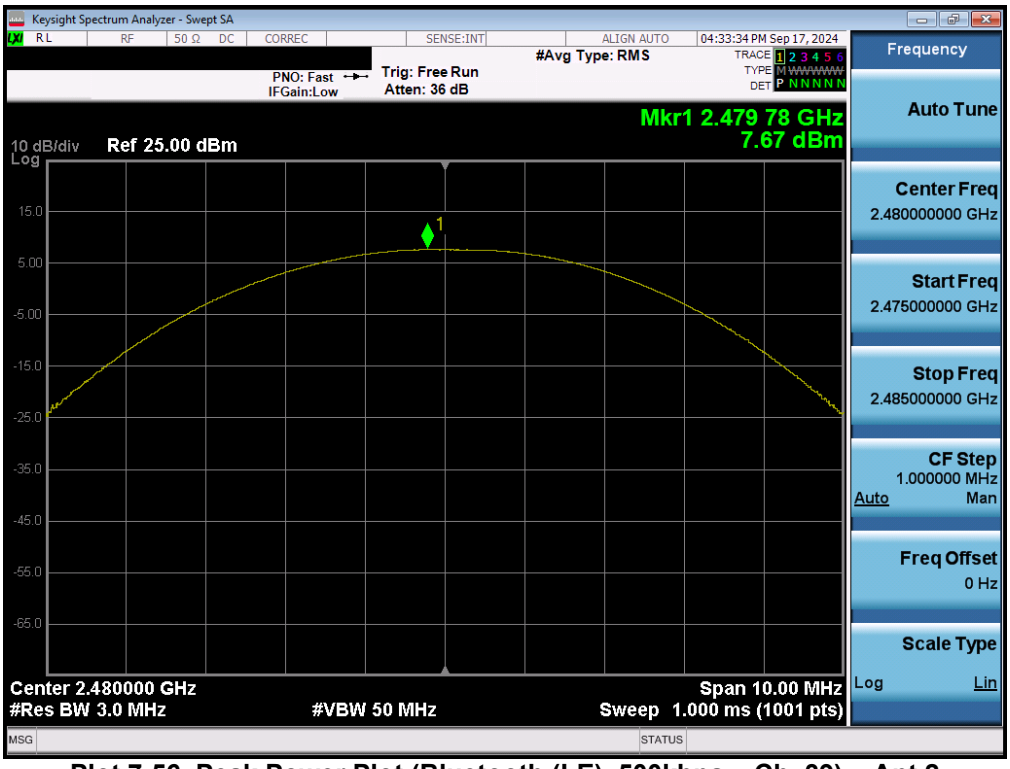
Plot 7-53. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 2



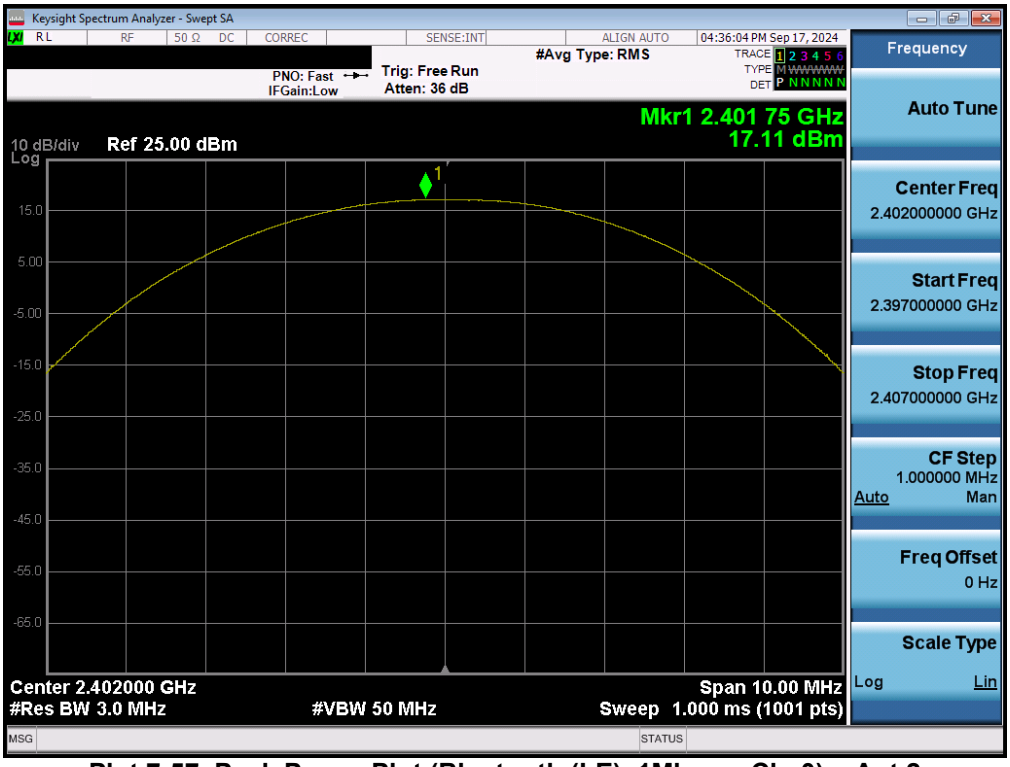
Plot 7-54. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 2



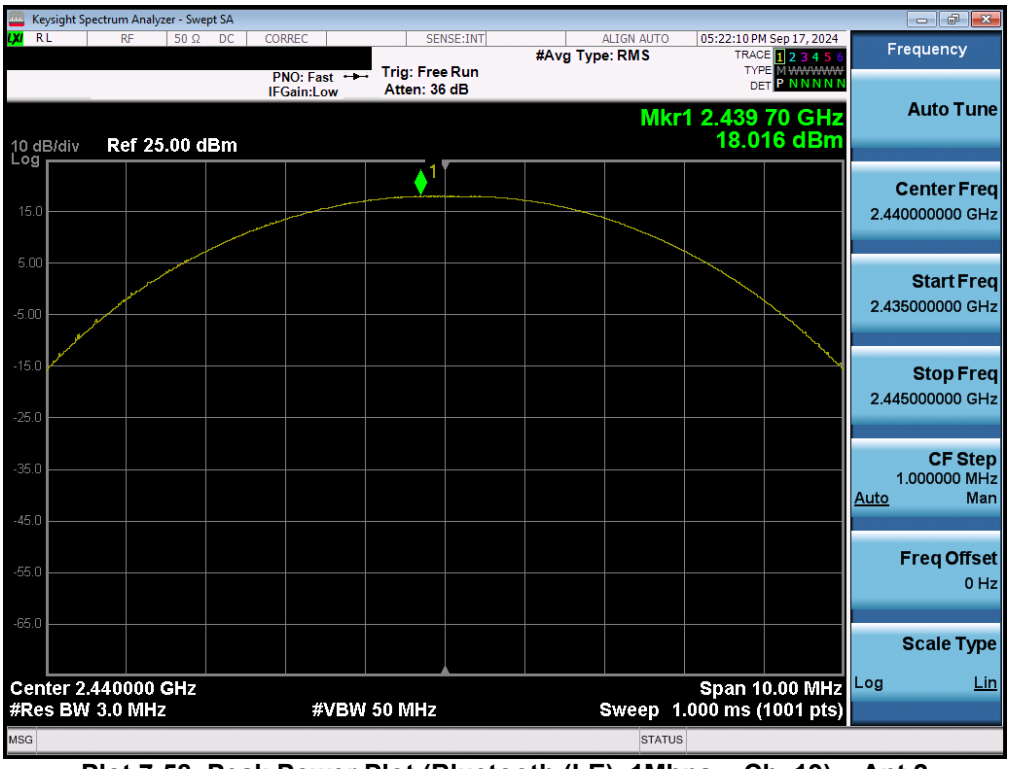
Plot 7-55. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 2



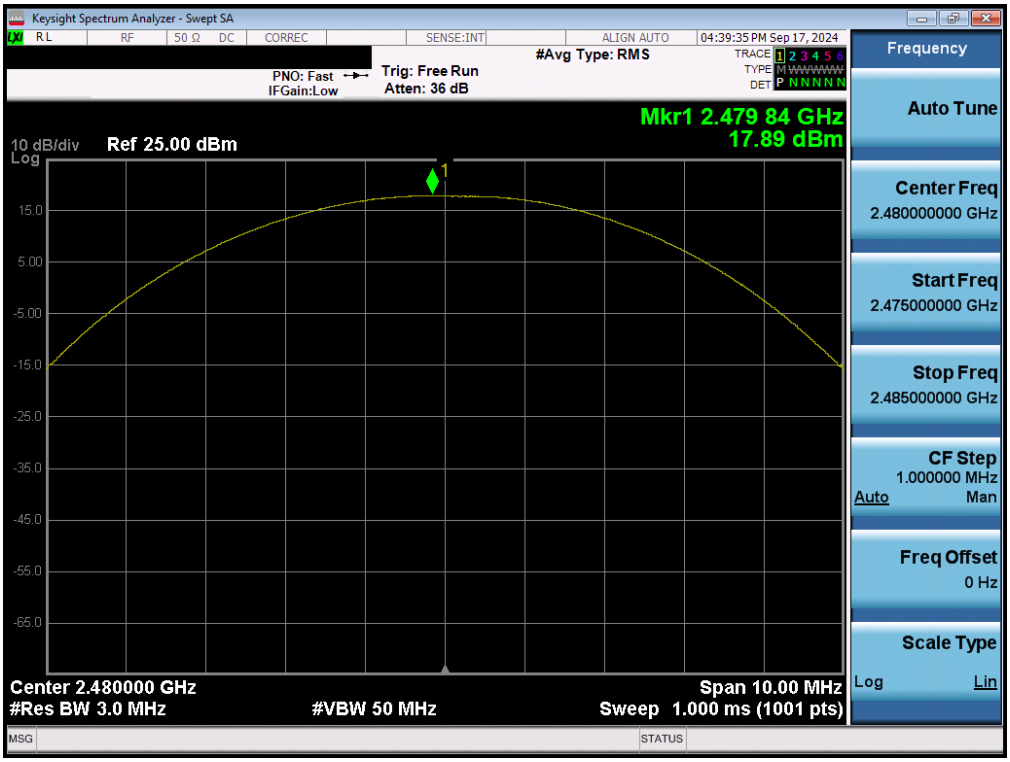
Plot 7-56. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 2



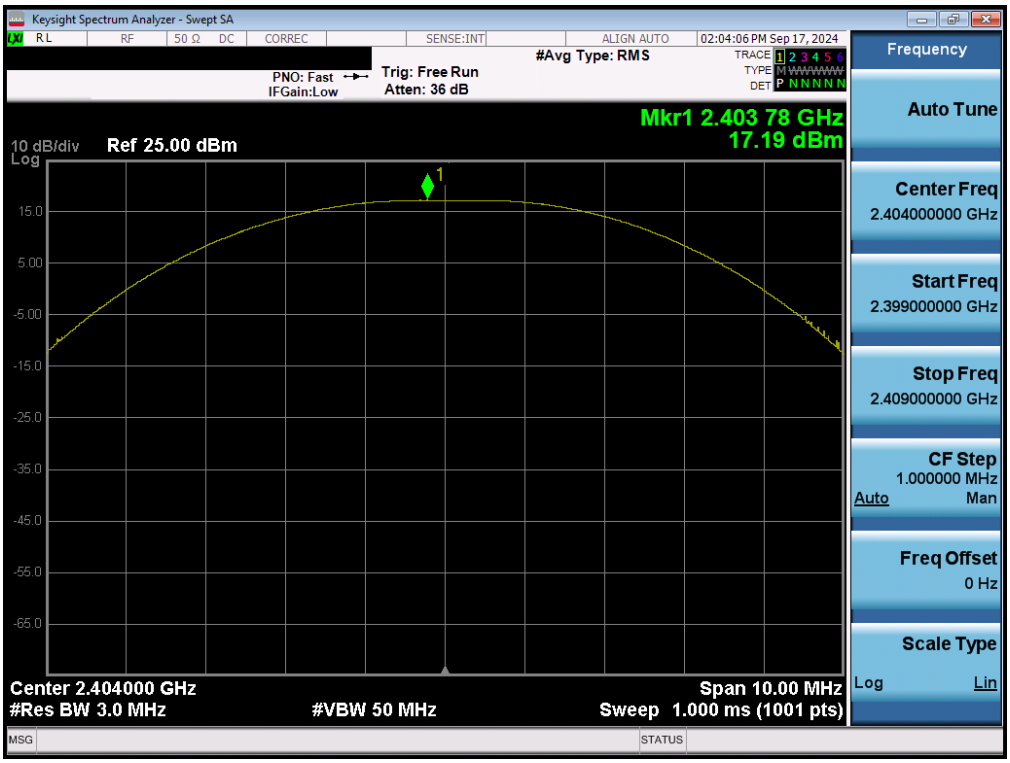
Plot 7-57. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant 2



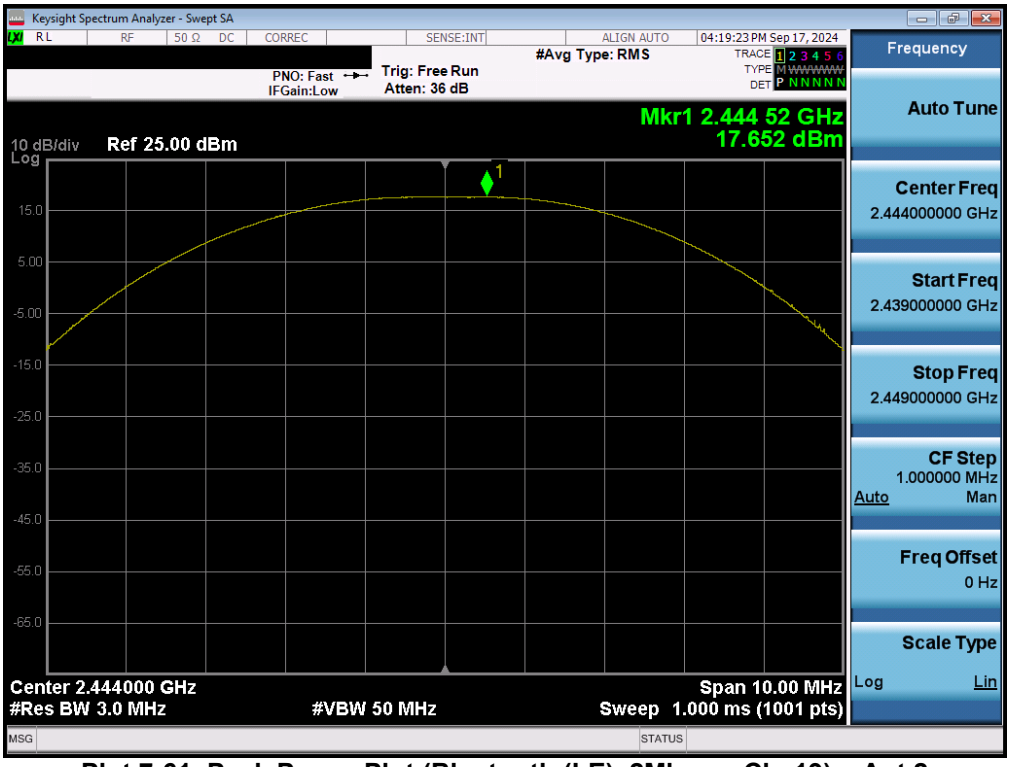
Plot 7-58. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant 2



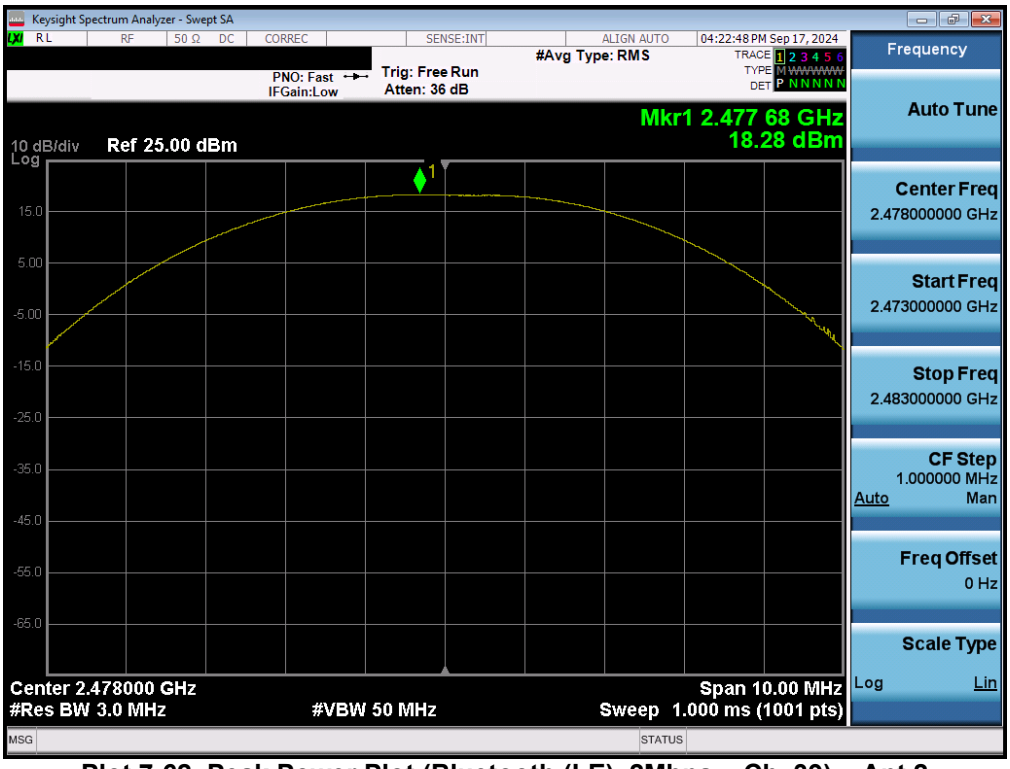
Plot 7-59. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant 2



Plot 7-60. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant 2



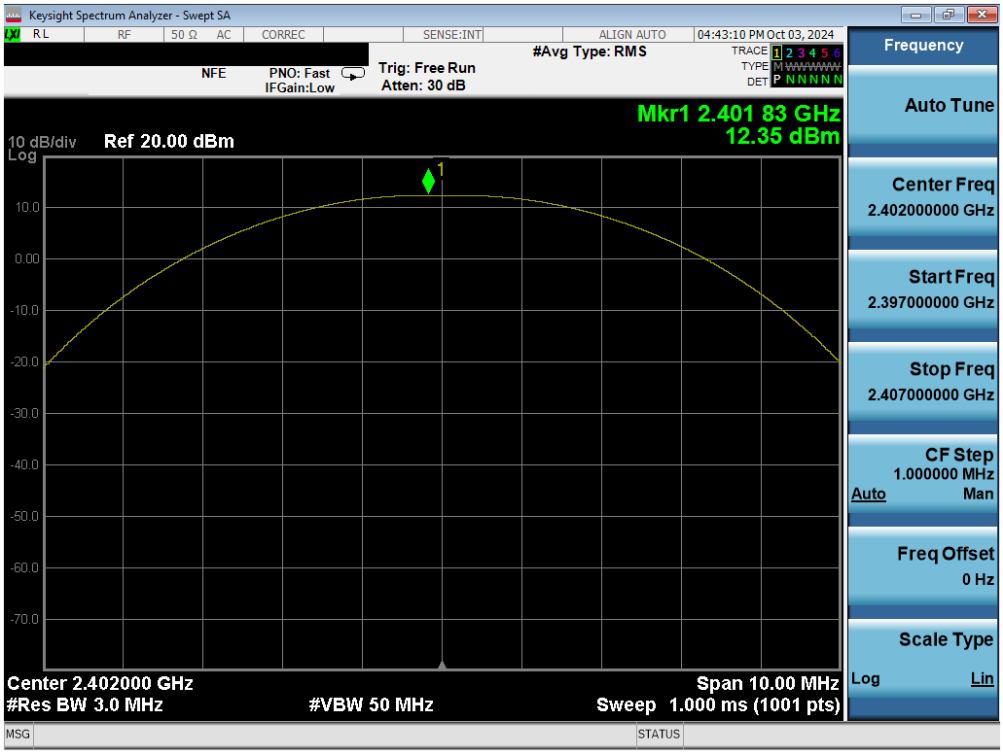
Plot 7-61. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant 2



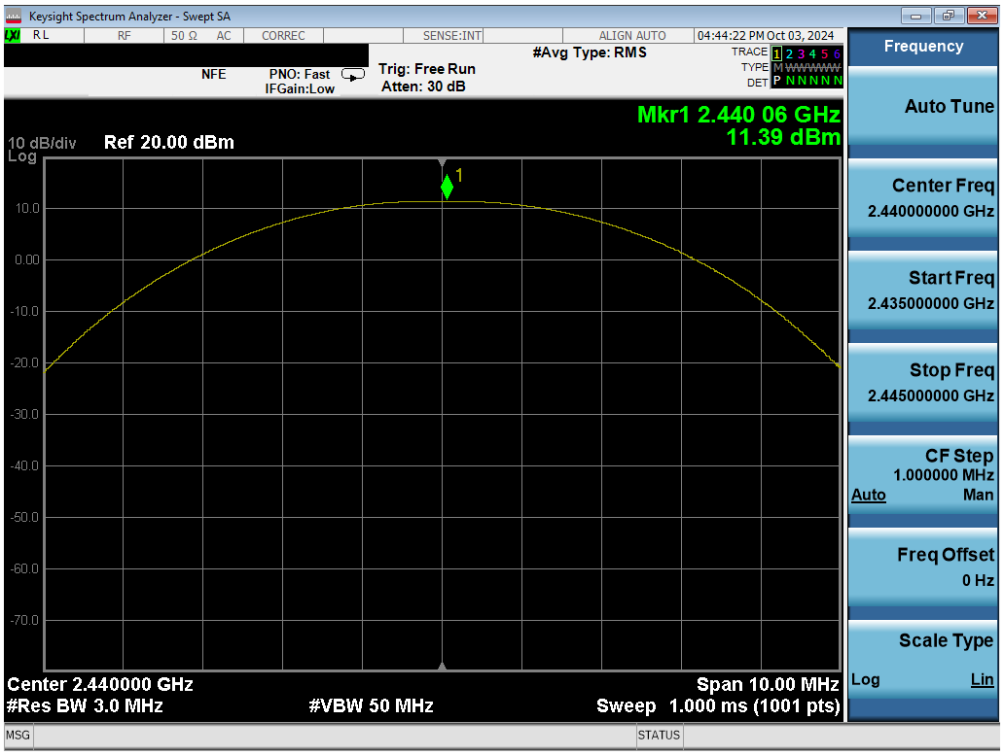
Plot 7-62. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant 2

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	12.35	17.179	11.92	15.560	15.15	32.739
2440	1 Mbps	19	LE	11.39	13.772	11.67	14.689	14.54	28.461
2480	1 Mbps	39	LE	10.98	12.531	11.22	13.243	14.11	25.775
2404	2 Mbps	1	LE	11.99	15.812	11.04	12.706	14.55	28.518
2444	2 Mbps	19	LE	11.24	13.305	11.37	13.709	14.32	27.013
2480	2 Mbps	38	LE	10.96	12.474	10.45	11.092	13.72	23.566

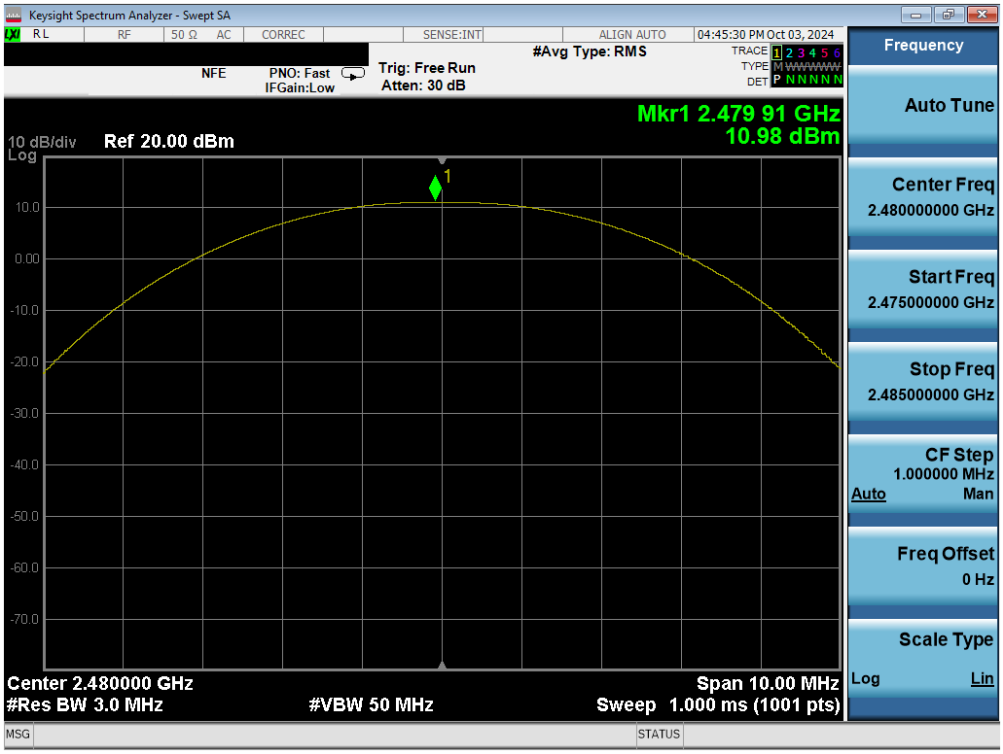
Table 7-11. Conducted Output Power Measurements (Bluetooth (LE)) – Dual



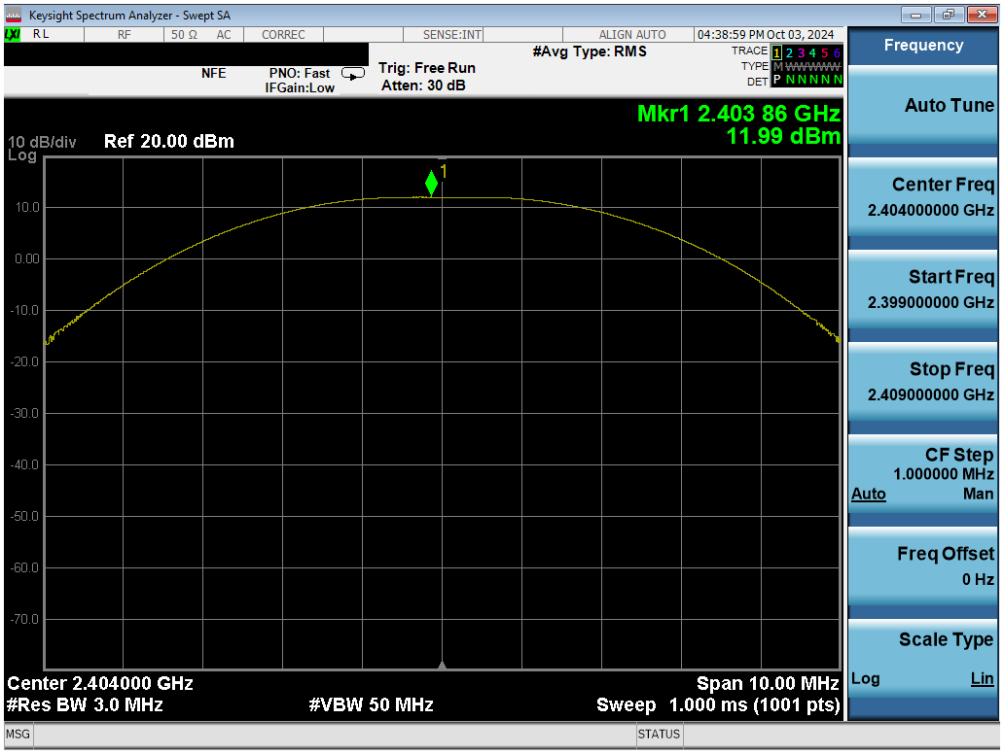
Plot 7-63. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Daul Ant 1



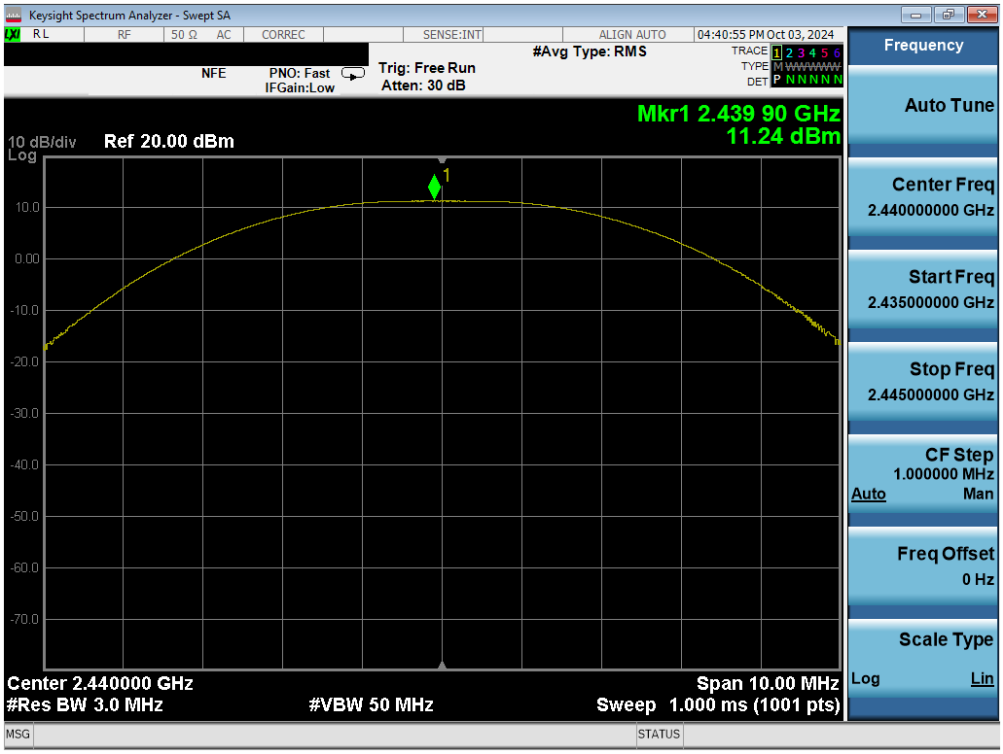
Plot 7-64. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Daul Ant 1



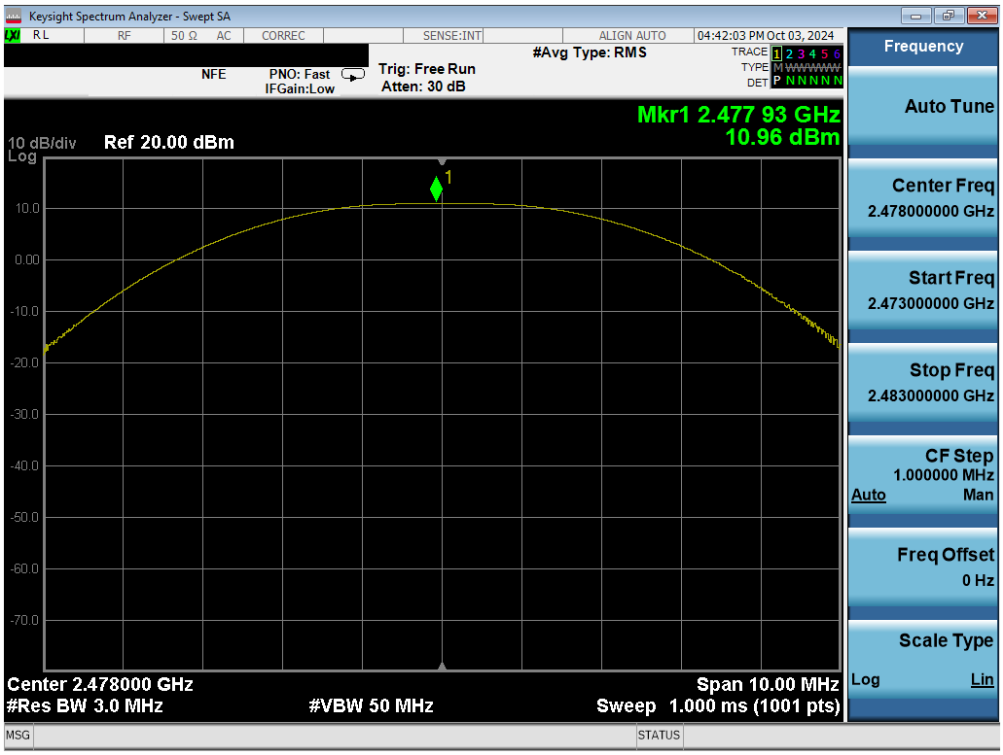
Plot 7-65. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Daul Ant 1



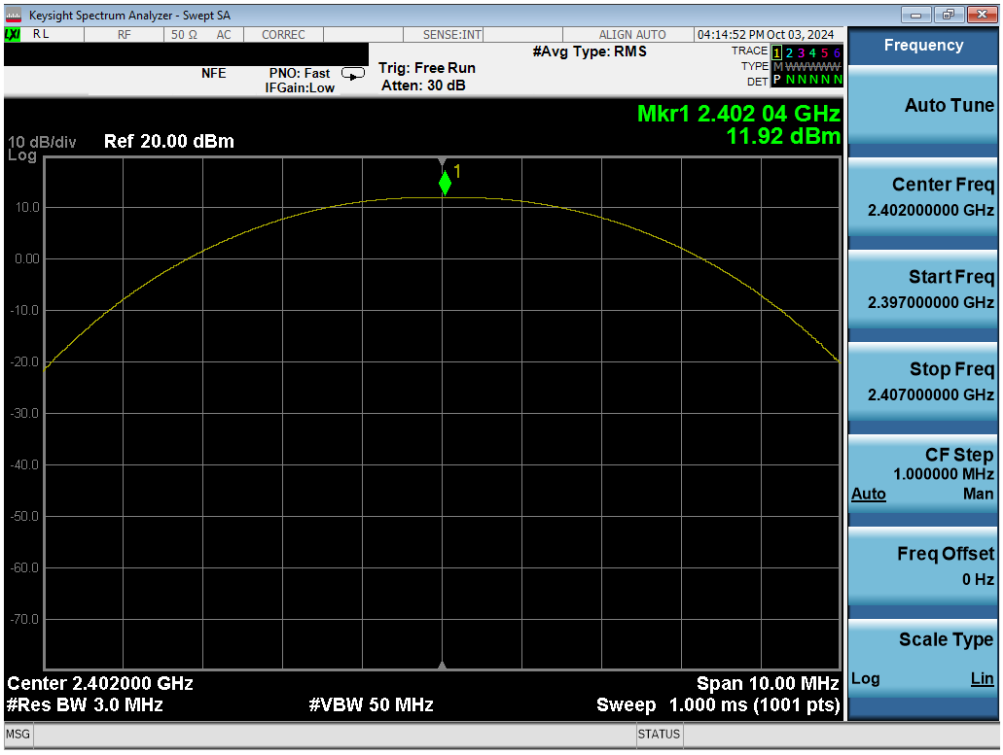
Plot 7-66. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Daul Ant 1



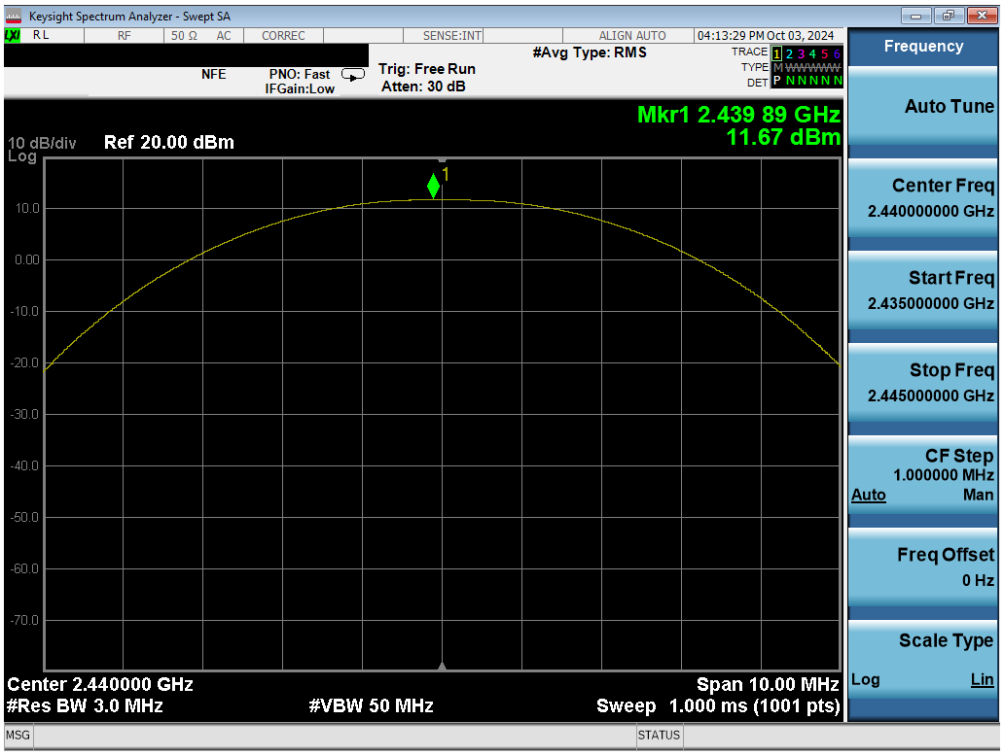
Plot 7-67. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Daul Ant 1



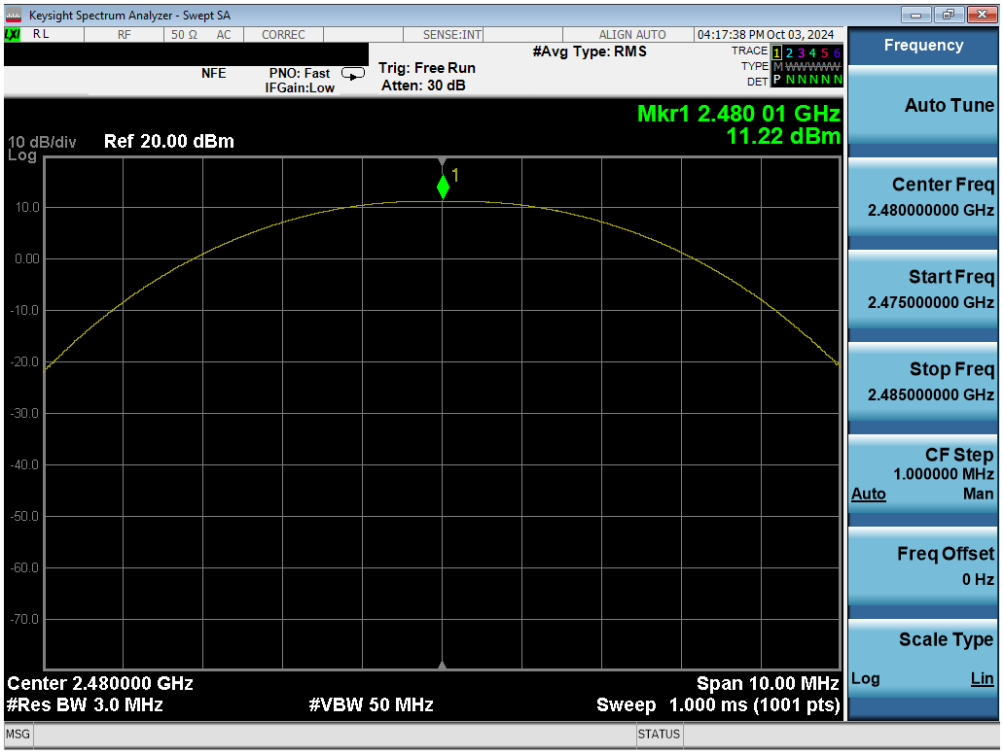
Plot 7-68. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Daul Ant 1



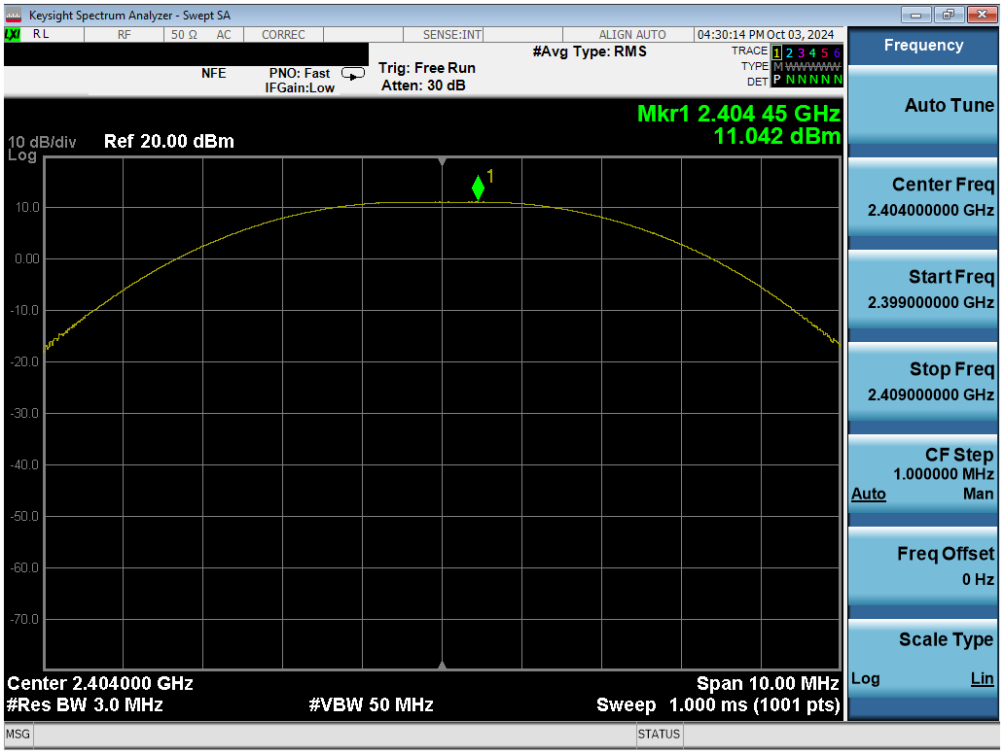
Plot 7-69. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Daul Ant 2



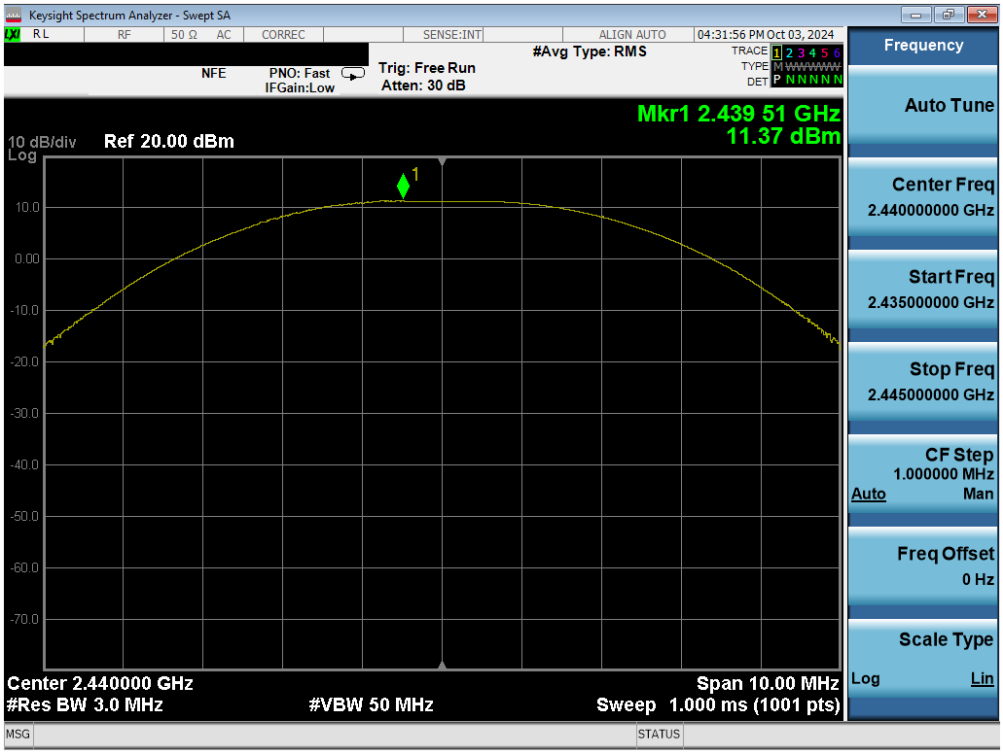
Plot 7-70. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Daul Ant 2



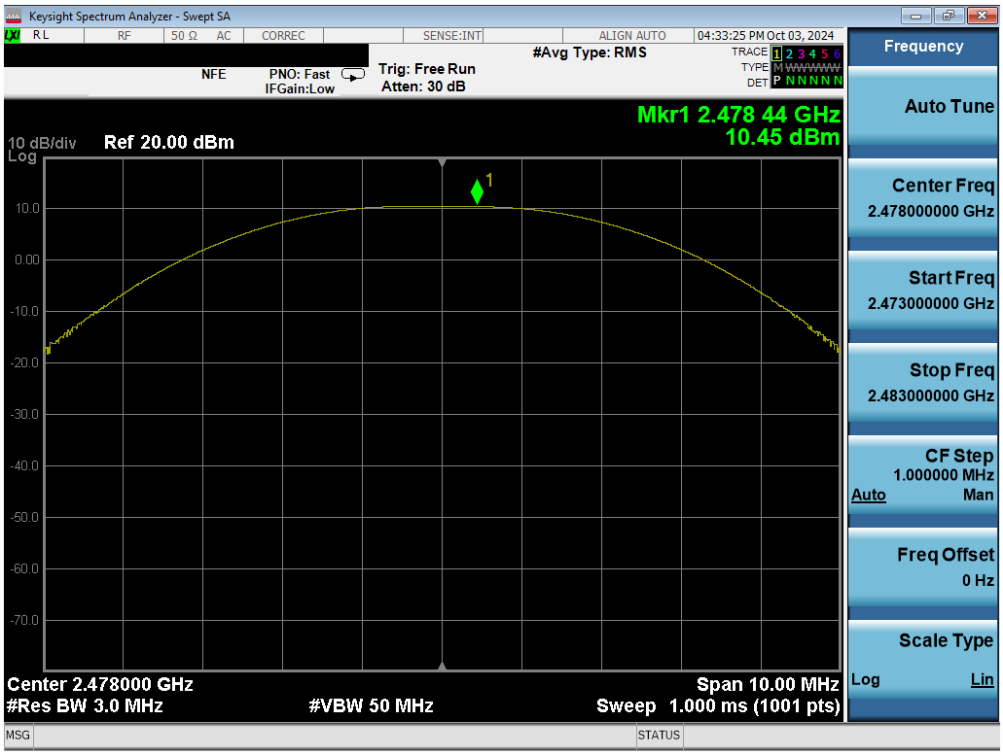
Plot 7-71. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Daul Ant 2



Plot 7-72. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Daul Ant 2



Plot 7-73. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Daul Ant 2



Plot 7-74. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Daul Ant 2

7.4 Power Spectral Density – Bluetooth (LE)

§15.247(e); RSS-247 [5.2]

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
KDB 558074 D01 v05r02 – Section 8.4 DTS Maximum Power Spectral Density level in the fundamental emission

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.

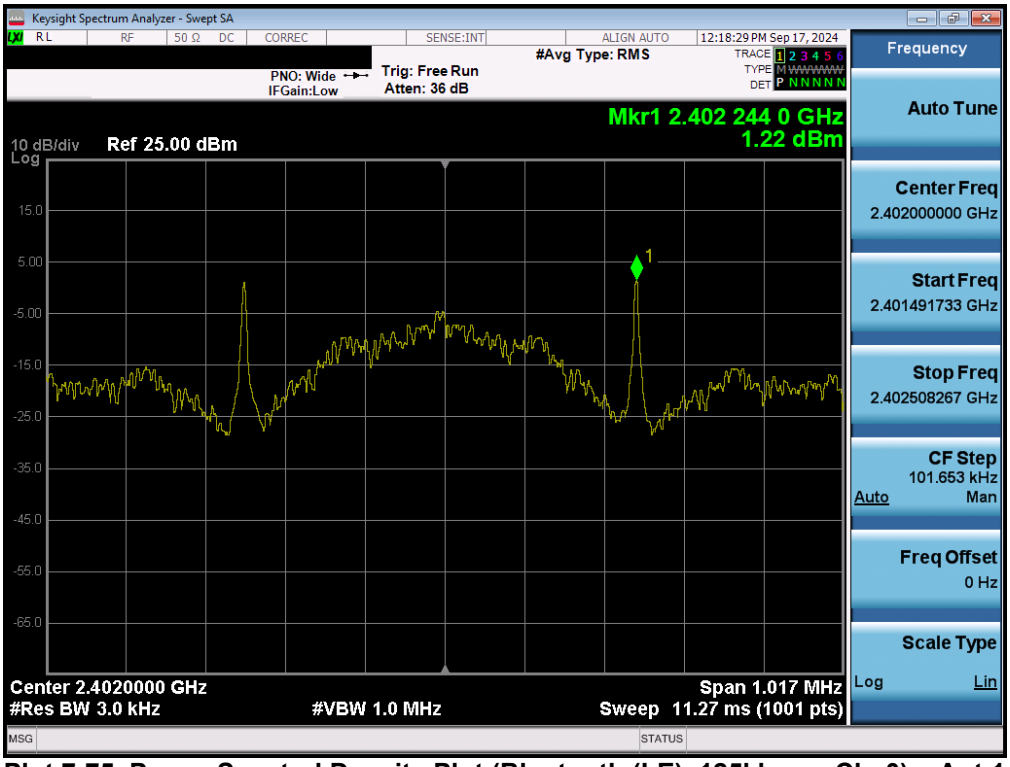
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

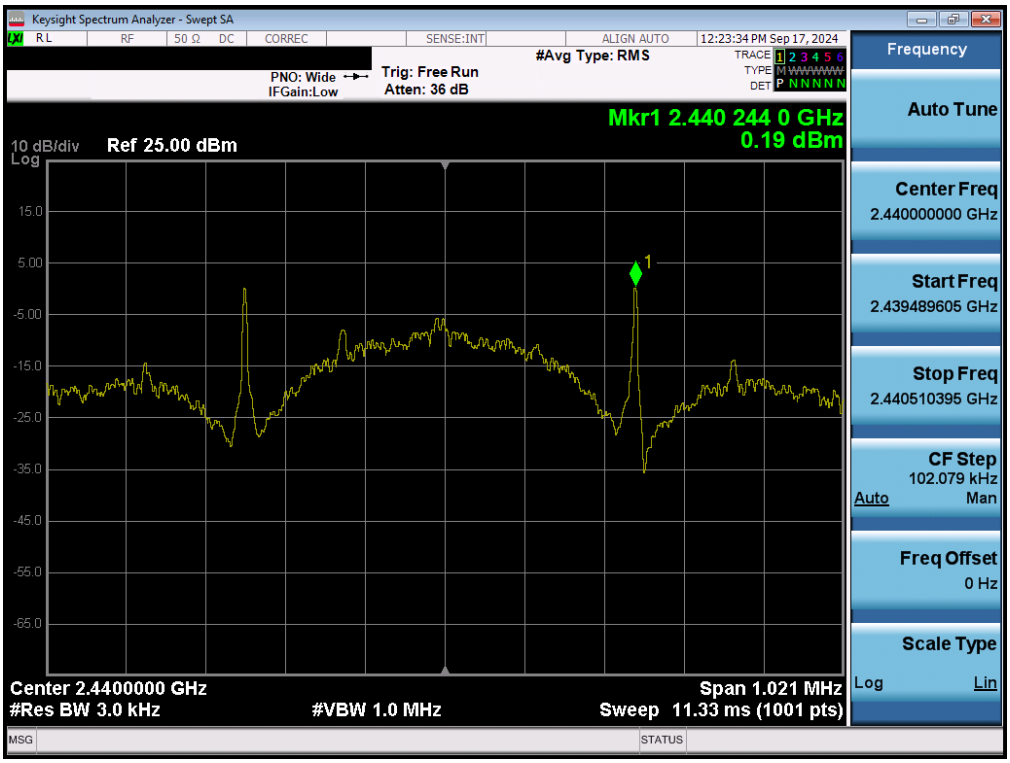
None

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	1.22	8.0	-6.78
2440	125 kbps	19	LE	0.19	8.0	-7.81
2480	125 kbps	39	LE	-0.41	8.0	-8.41
2402	500 kbps	0	LE	0.91	8.0	-7.09
2440	500 kbps	19	LE	-0.09	8.0	-8.09
2480	500 kbps	39	LE	-0.55	8.0	-8.55
2402	1 Mbps	0	LE	2.03	8.0	-5.97
2440	1 Mbps	19	LE	1.82	8.0	-6.18
2480	1 Mbps	39	LE	0.96	8.0	-7.04
2402	2 Mbps	0	LE	-1.63	8.0	-9.63
2440	2 Mbps	19	LE	-1.48	8.0	-9.48
2480	2 Mbps	39	LE	-1.66	8.0	-9.66

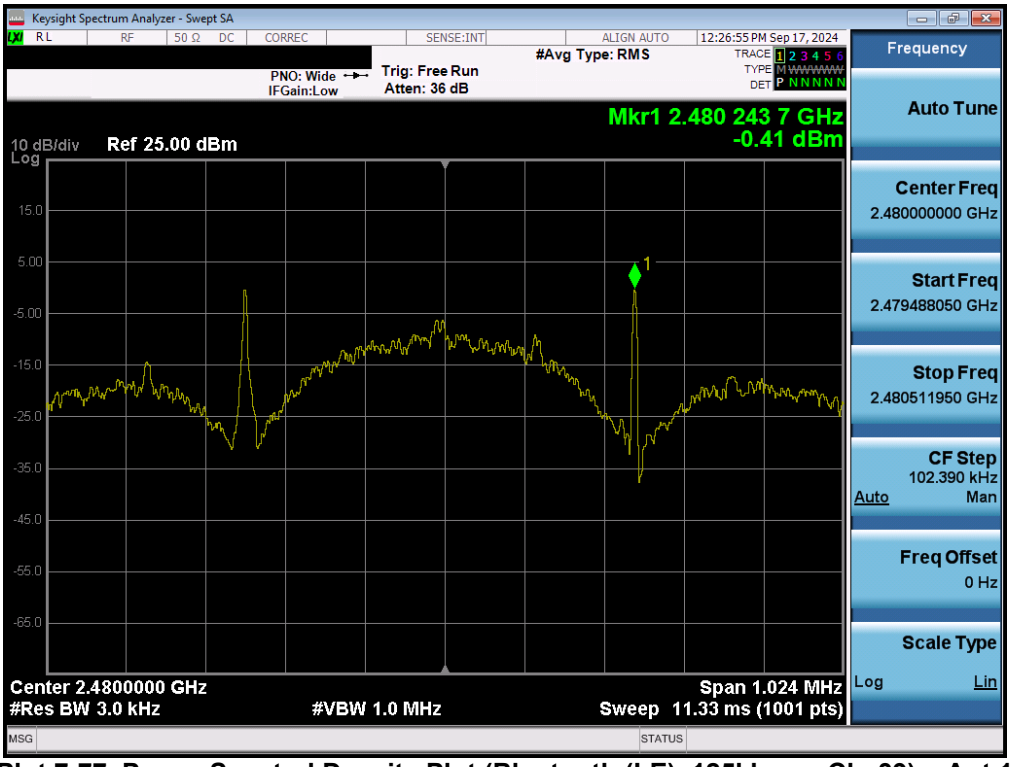
Table 7-12. Conducted Power Density Measurements – Ant 1



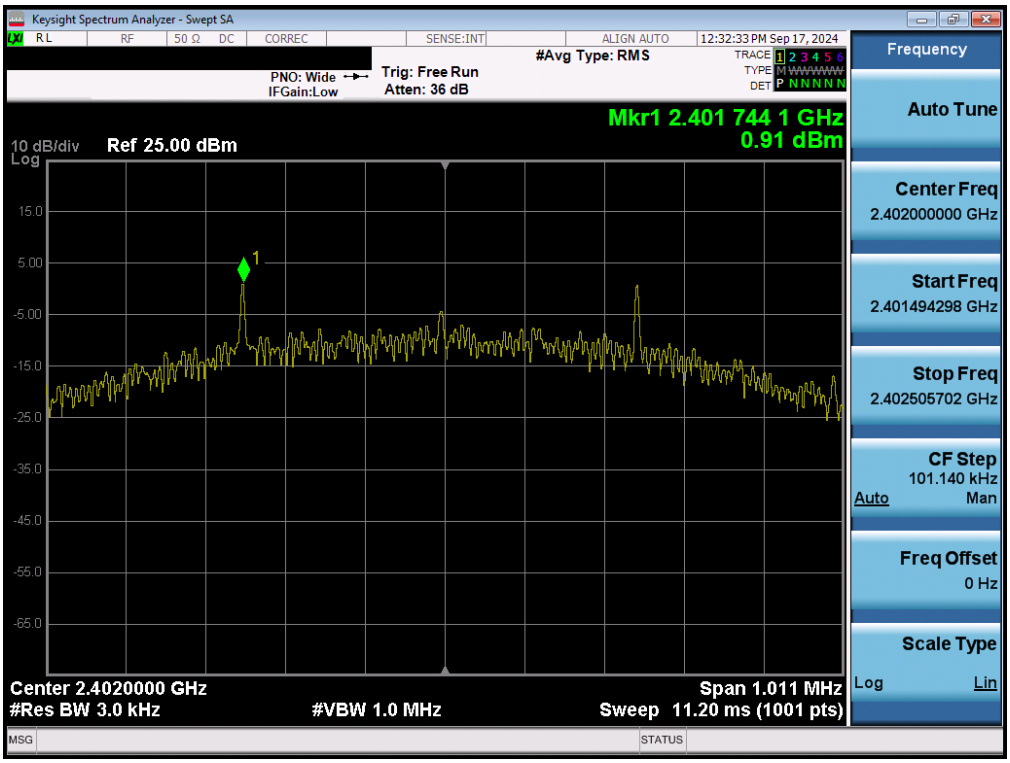
Plot 7-75. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 1



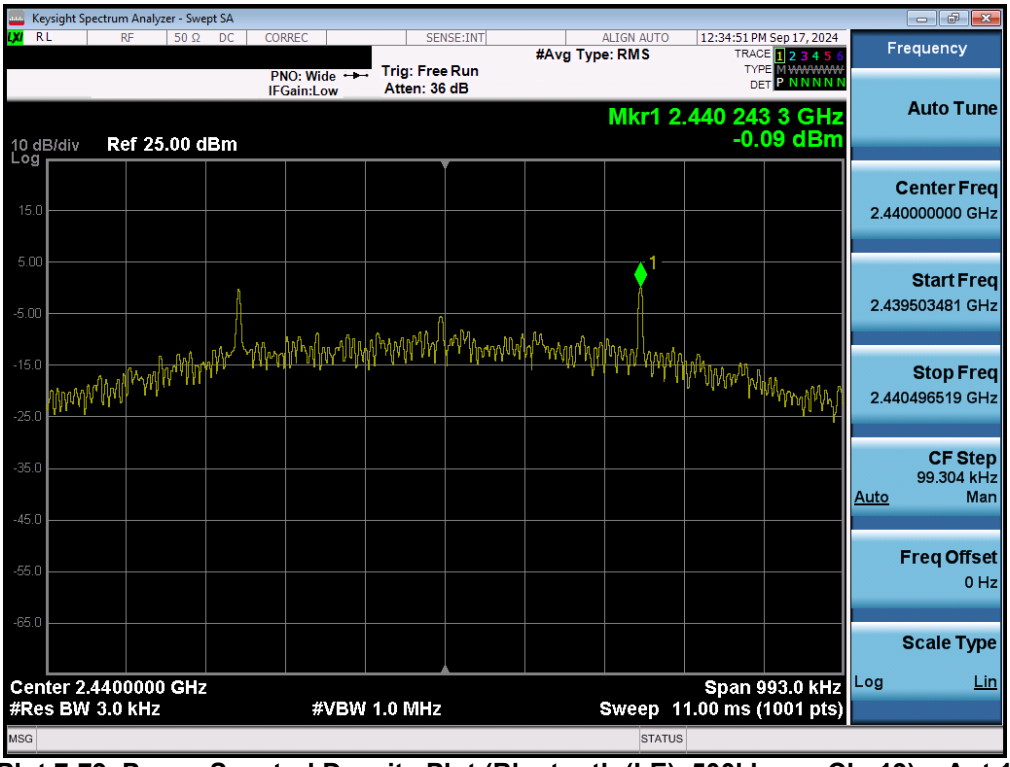
Plot 7-76. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 1



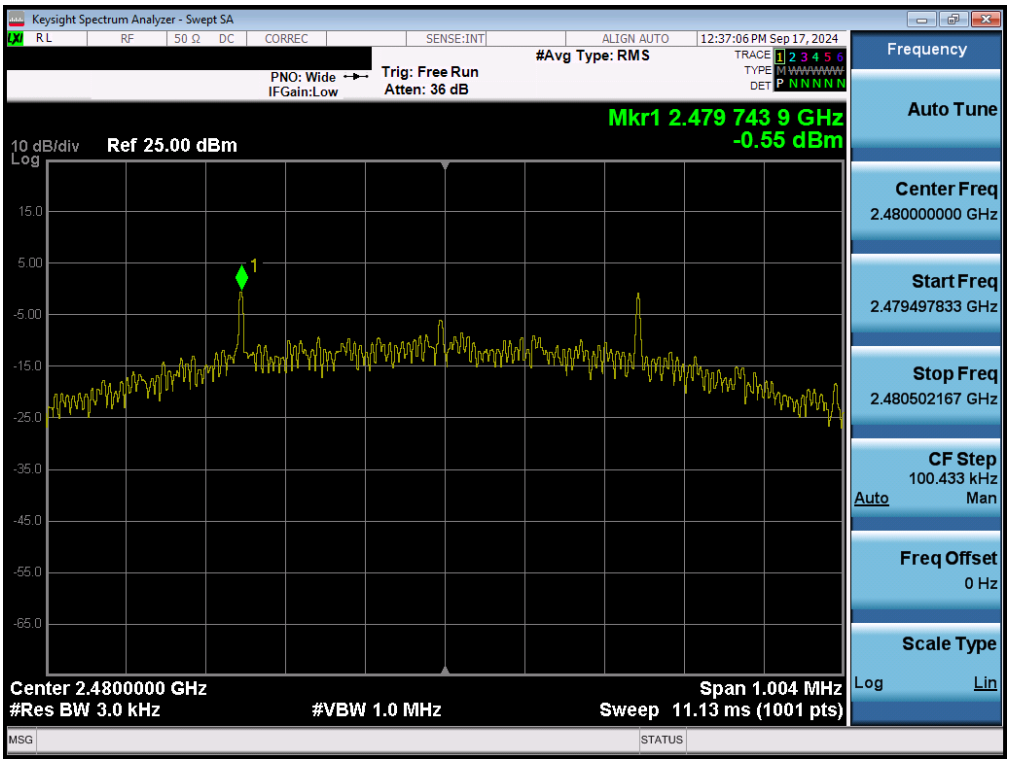
Plot 7-77. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 1



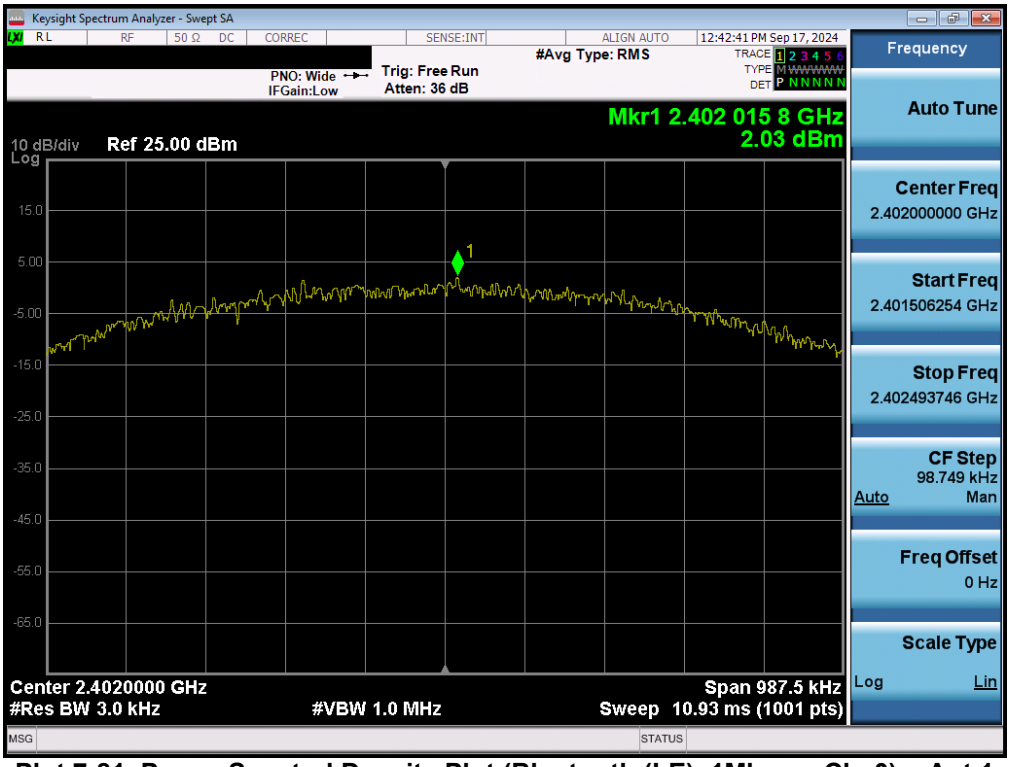
Plot 7-78. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 1



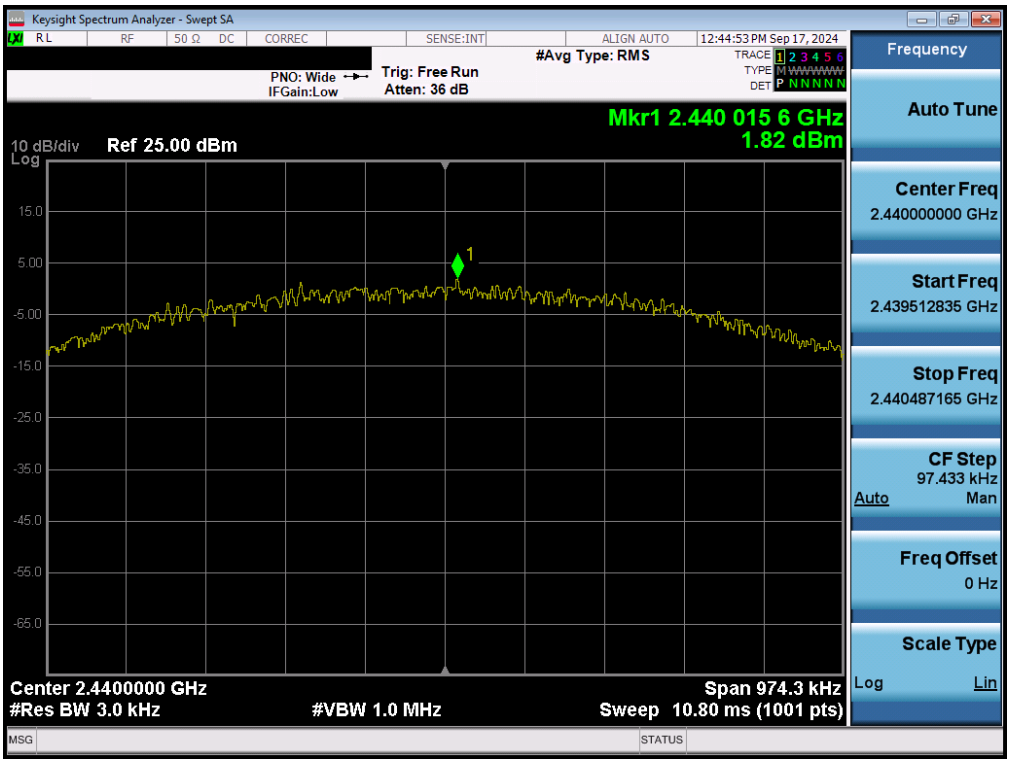
Plot 7-79. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 1



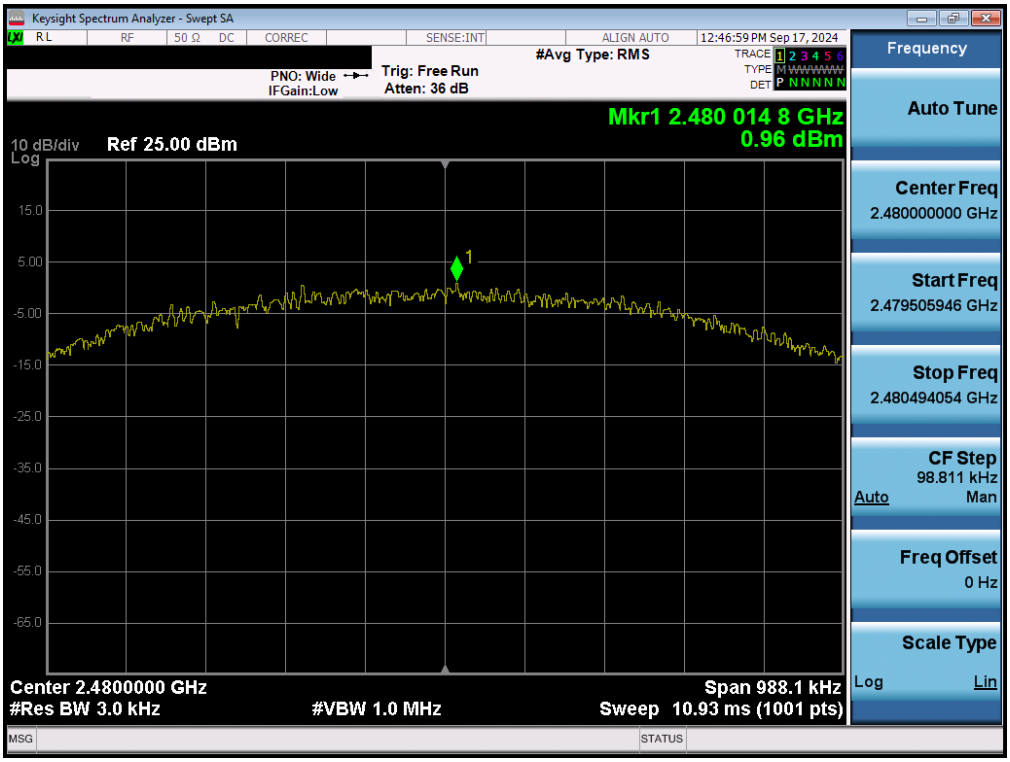
Plot 7-80. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 1



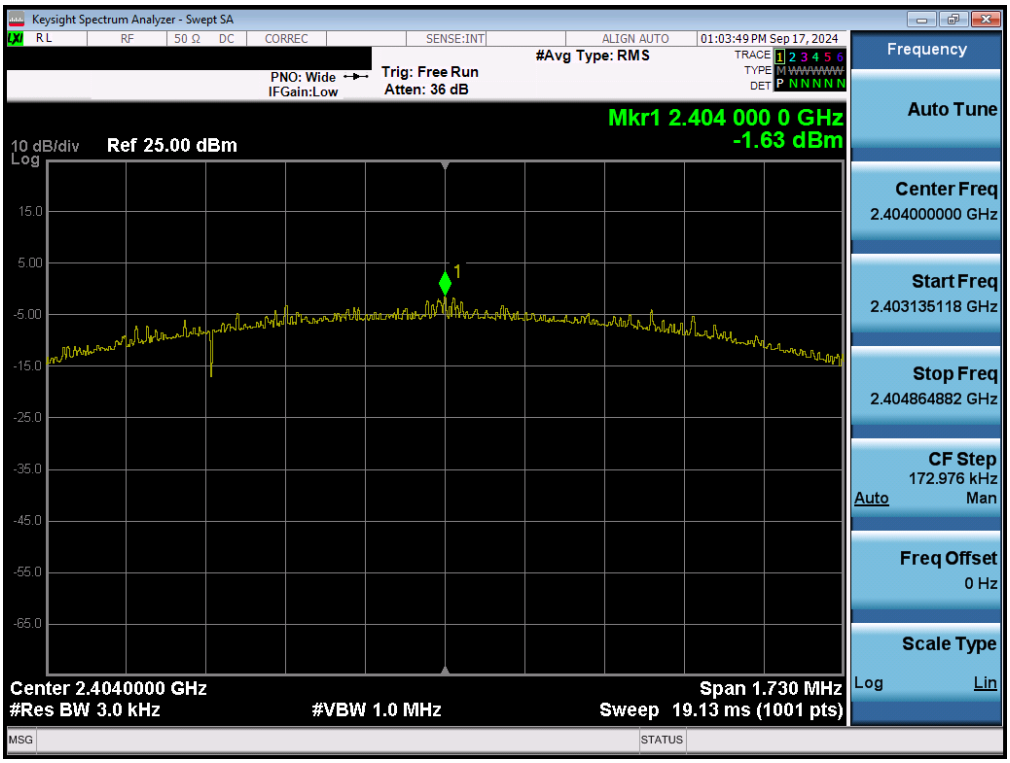
Plot 7-81. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Ant 1



Plot 7-82. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Ant 1

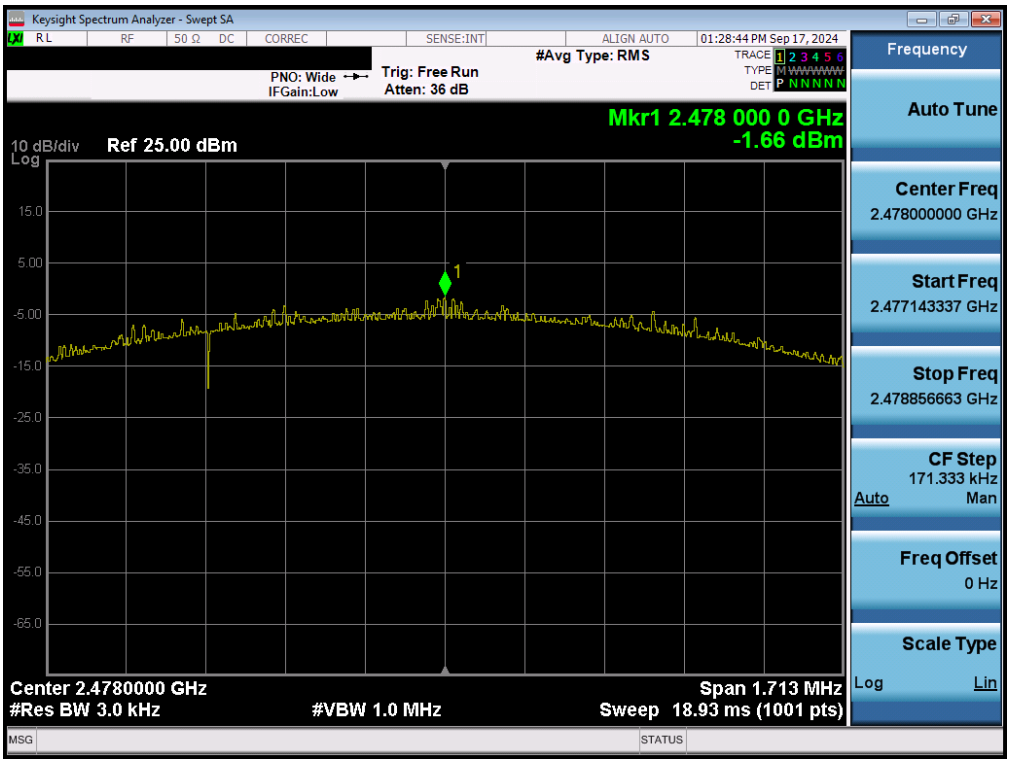


Plot 7-83. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Ant 1



Plot 7-84. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Ant 1

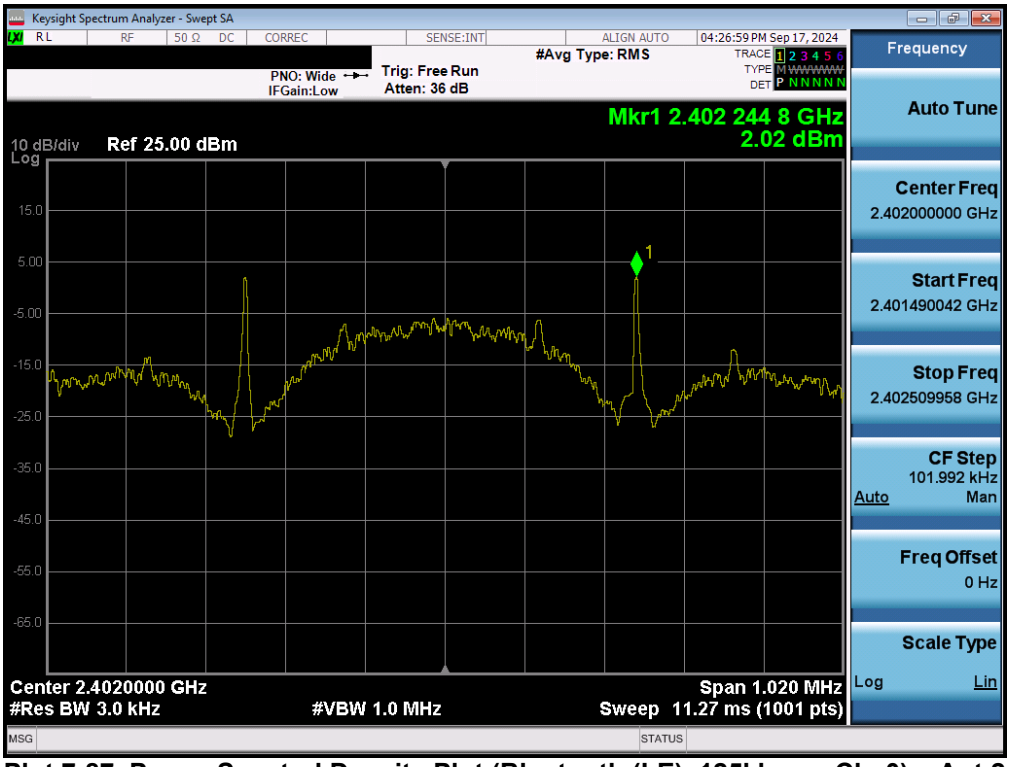
Plot 7-85. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Ant 1



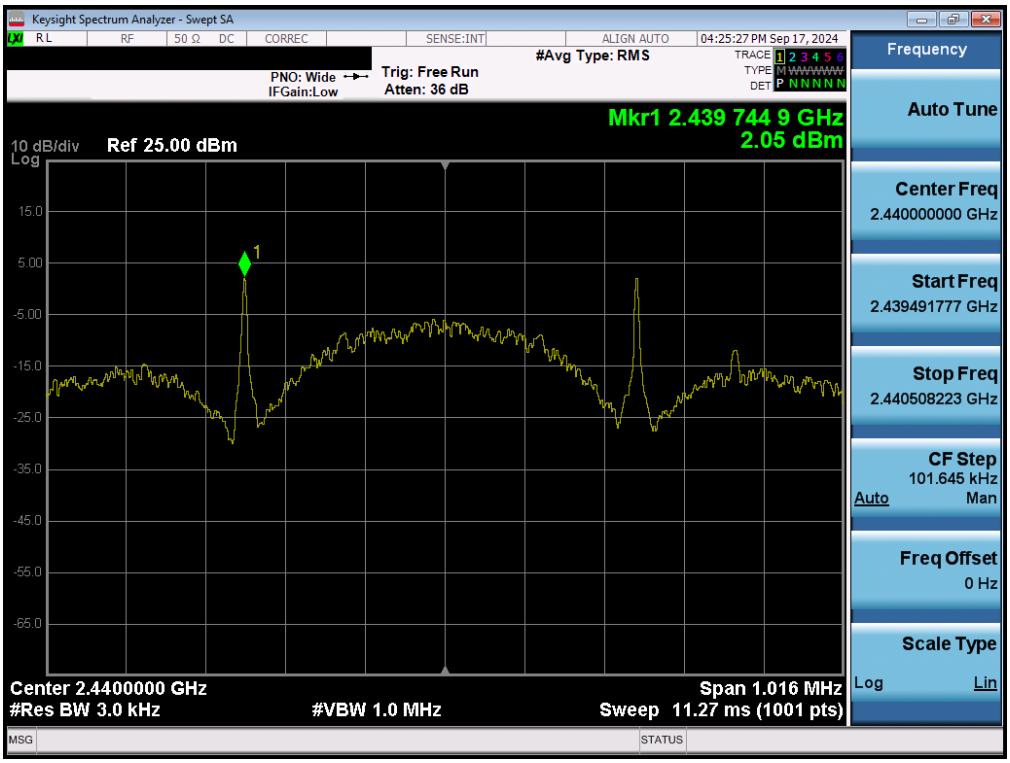
Plot 7-86. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Ant 1

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	2.02	8.0	-5.98
2440	125 kbps	19	LE	2.05	8.0	-5.95
2480	125 kbps	39	LE	1.28	8.0	-6.72
2402	500 kbps	0	LE	1.78	8.0	-6.22
2440	500 kbps	19	LE	1.90	8.0	-6.11
2480	500 kbps	39	LE	1.13	8.0	-6.87
2402	1 Mbps	0	LE	0.59	8.0	-7.41
2440	1 Mbps	19	LE	1.53	8.0	-6.47
2480	1 Mbps	39	LE	1.30	8.0	-6.70
2404	2 Mbps	0	LE	-2.13	8.0	-10.13
2444	2 Mbps	19	LE	-2.13	8.0	-10.13
2480	2 Mbps	39	LE	-1.22	8.0	-9.22

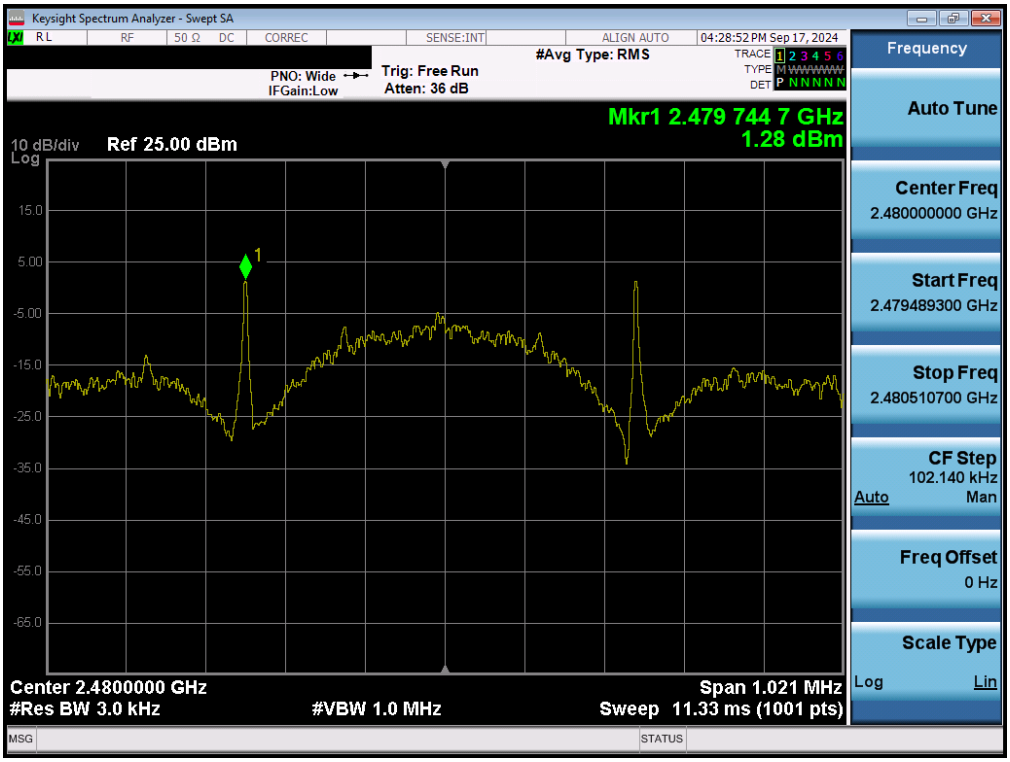
Table 7-13. Conducted Power Density Measurements – Ant 2



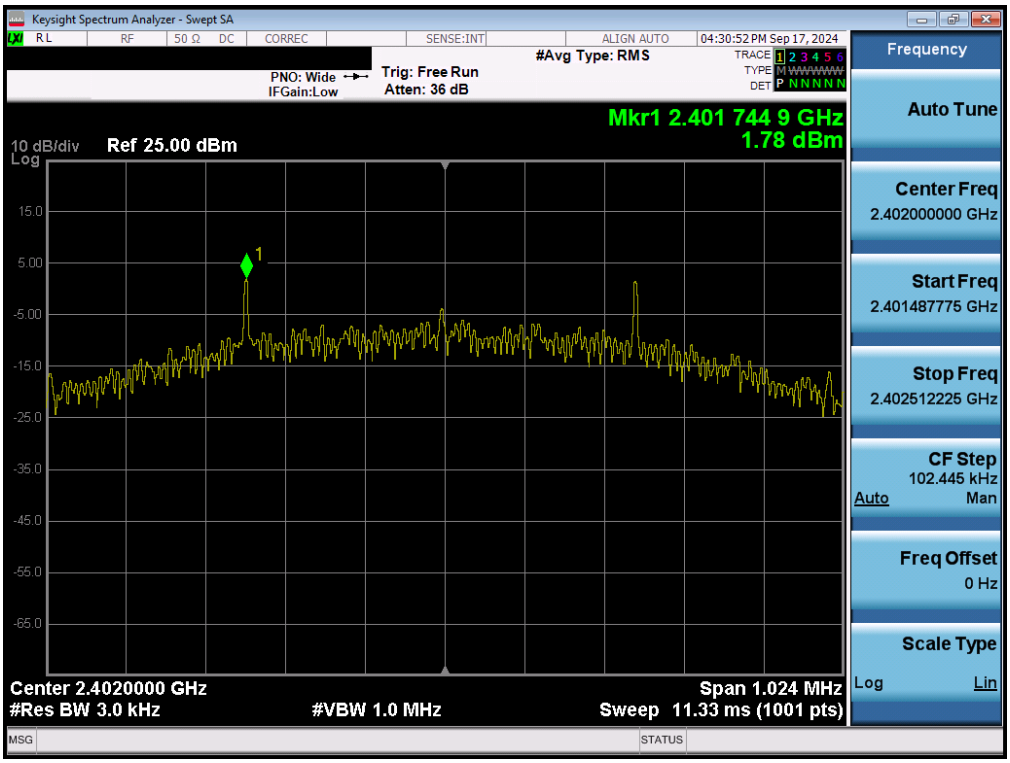
Plot 7-87. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 0) – Ant 2



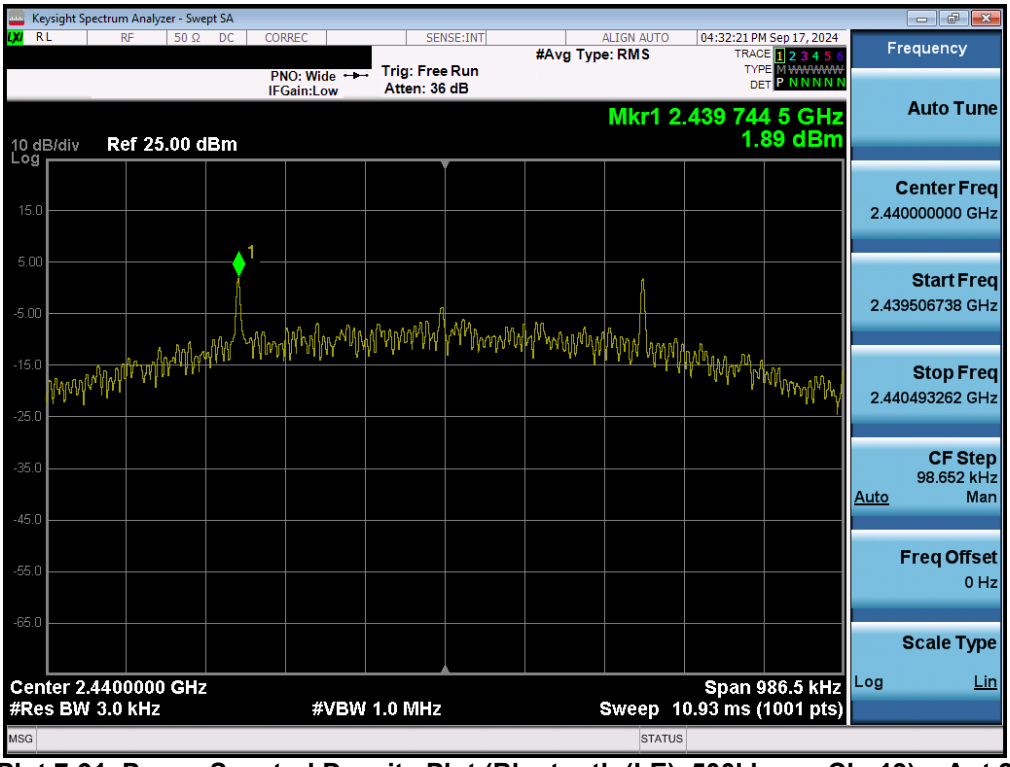
Plot 7-88. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 19) – Ant 2



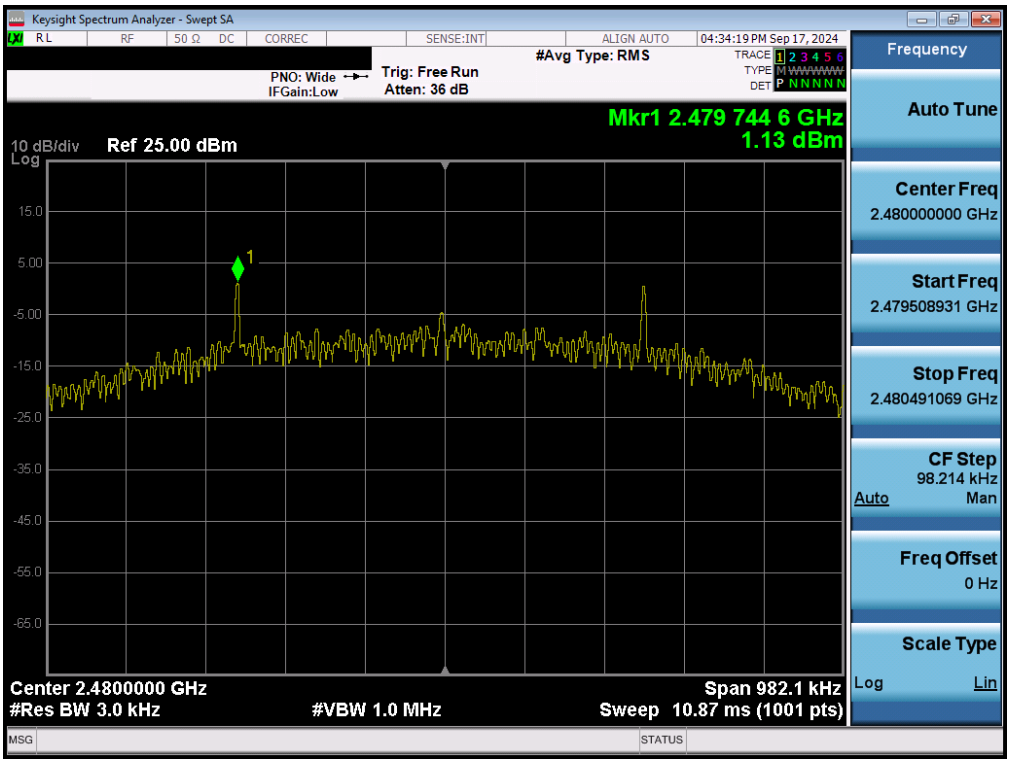
Plot 7-89. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 39) – Ant 2



Plot 7-90. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 0) – Ant 2



Plot 7-91. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 19) – Ant 2



Plot 7-92. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 39) – Ant 2