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MEASUREMENT REPORT
FCC PART 15.247 Bluetooth

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

Date of Testing:
03/26/2024 – 04/30/2024
Test Report Issue Date:
04/30/2024
Test Site/Location:
Element Lab. Yongin-Si, Gyeonggi-do, South Korea
Test Report Serial No.:
1M2403190019-03.A3L

FCC ID:	**A3LNP940XMA**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	NP940XMA
Additional Model:	NP944XMA
EUT Type:	Portable Computing Device
Max. RF Output Power:	59.347 mW (17.73 dBm) Peak Conducted
Frequency Range:	2402 – 2480MHz
Type of Modulation:	GFSK, π/4-DQPSK, 8DPSK
FCC Classification:	FCC Part 15 Spread Spectrum Transmitter (DSS)
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01 v05r02

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in ANSI C63.10-2013 (See Test Report). These measurements were performed with no deviation from the standards. 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.

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 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: A3LNP940XMA**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
  - A) The hopping sequence is pseudorandom
  - B) All channels are used equally on average
  - C) The receiver input bandwidth equals the transmit bandwidth
  - D) The receiver hops in sequence with the transmit signal
- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

Test Device Serial No.: 0358T, 0032M

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)
00	2402
:	:
39	2441
:	:
78	2480

Table 2-1. Frequency/ Channel Operations

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.

2.3 Antenna Description

The following antenna was used for the testing.

Frequency [GHz]	Antenna 1 Gain (dBi)	Antenna 2 Gain (dBi)	Directional Gain [dBi]
2.4	-1.81	-1.98	1.17

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. ANSI C63.10-2013 was also 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, 7.9 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, and 7.8 for antenna port conducted emissions test setups.

2.5 Software and Firmware

The test was conducted with firmware version REV 1.0 and software version Windows 11 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure 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 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by SY cooperation RF Enclosures. The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. 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 that 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 7.12. The EMI Receiver mode of the R&S ESW was used to perform AC line conducted emissions testing. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.20.01.

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 15ºC to 35ºC. 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 antennas 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). Measurement 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	CMW500	Wideband Radio Communication Tester	7/4/2023	Annual	7/3/2024	116851
Rohde & Schwarz	TS-PR1840	Preamplifier	7/6/2023	Annual	7/5/2024	100049
Rohde & Schwarz	ENV216	Two-Line V-Network	4/6/2024	Annual	4/5/2025	101319
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

Notes:

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: A3LNP940XMA

Method/System: Frequency Hopping Spread Spectrum (FHSS)

Number of Channels: 79

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(1)(iii)	RSS-247 [5.1(1)]	20dB Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
15.247(b)(1)	RSS-247 [5.4(2)]	Peak Transmitter Output Power	< 1 Watt if ≥ 75 non-overlapping channels used		PASS	Section 7.3
15.247(a)(1)	RSS-247 [5.1(2)]	Channel Separation	> 2/3 of 20 dB BW for systems with Output Power < 125mW		PASS	Section 7.5
15.247(a)(1)(iii)	RSS-247 [5.1(4)]	Number of Channels	> 15 Channels		PASS	Section 7.7
15.247(a)(1)(iii)	RSS-247 [5.1(4)]	Time of Occupancy	< 0.4 sec in 31.6 sec period		PASS	Section 7.6
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	Conducted > 20dBc		PASS	Section 7.4, Section 7.8
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-247 limits)	RADIATED	PASS	Section 7.9, Section 7.10, Section 7.11
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8] limits)	LINE CONDUCTED	PASS	Section 7.12

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates 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, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT 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, attenuators, and couplers.
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 “BT Auto,” Version 3.5.
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 “Chamber Automation,” Version 1.3.1.

7.2 20dB Bandwidth Measurement

§15.247 (a.1.iii); RSS-247 [5.1(1)]

Test Overview and Limit

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 20dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 20. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
5. Detector = Peak
6. Trace mode = max hold
7. Sweep = auto couple
8. The trace was allowed to stabilize

Test Setup

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

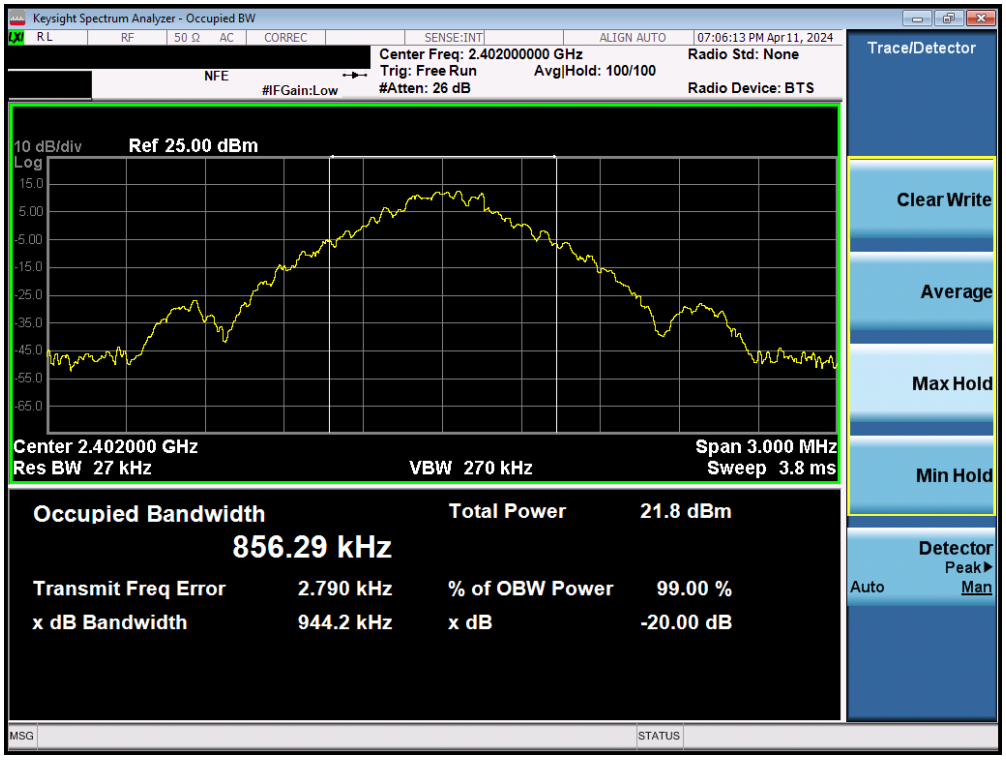
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

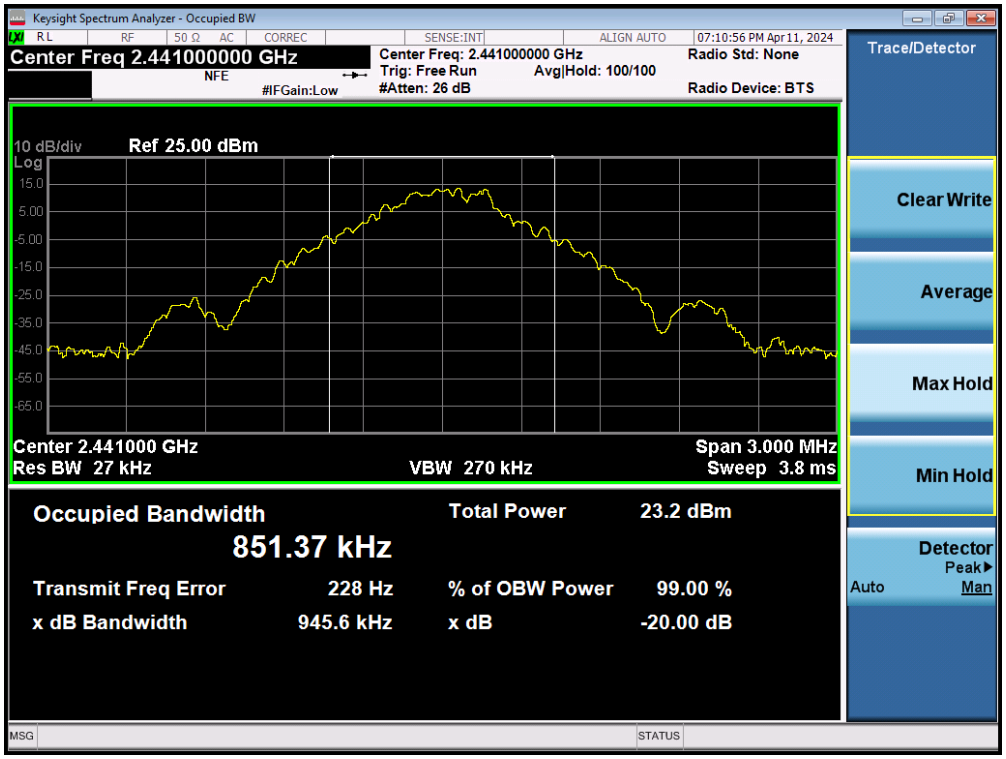
None

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	944.20
2441	1.0	GFSK	39	945.60
2480	1.0	GFSK	78	945.90
2402	2.0	π/4-DQPSK	0	1337.00
2441	2.0	π/4-DQPSK	39	1338.00
2480	2.0	π/4-DQPSK	78	1338.00
2402	3.0	8DPSK	0	1307.00
2441	3.0	8DPSK	39	1305.00
2480	3.0	8DPSK	78	1303.00

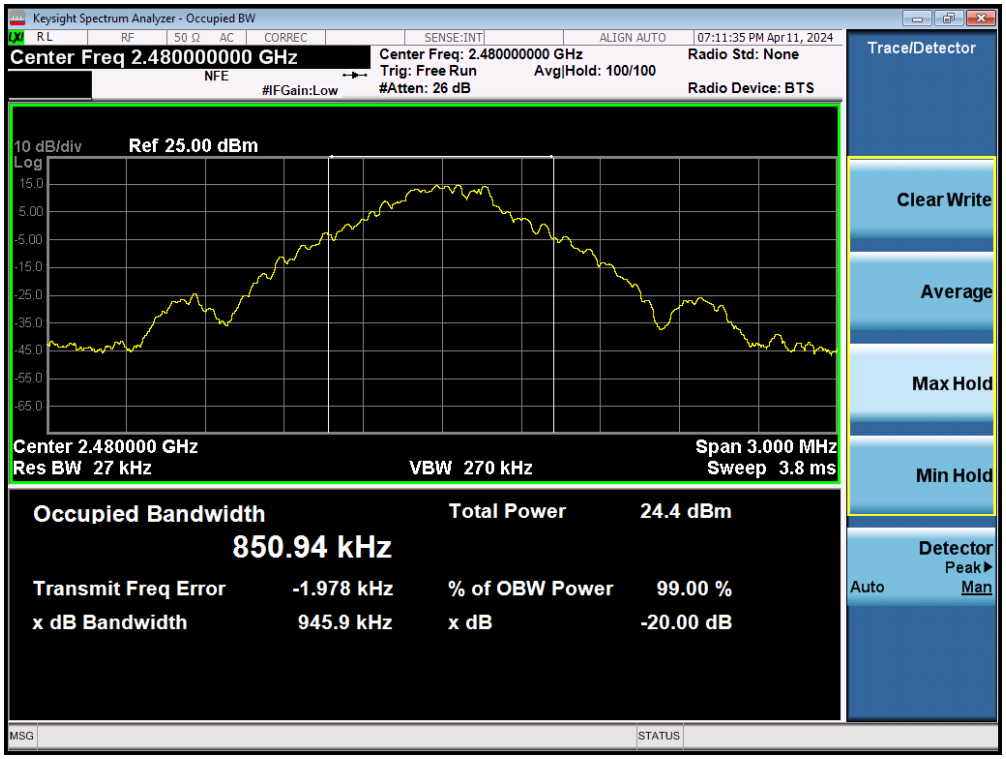
Table 7-2. Conducted 20dB Bandwidth Measurements – Ant1



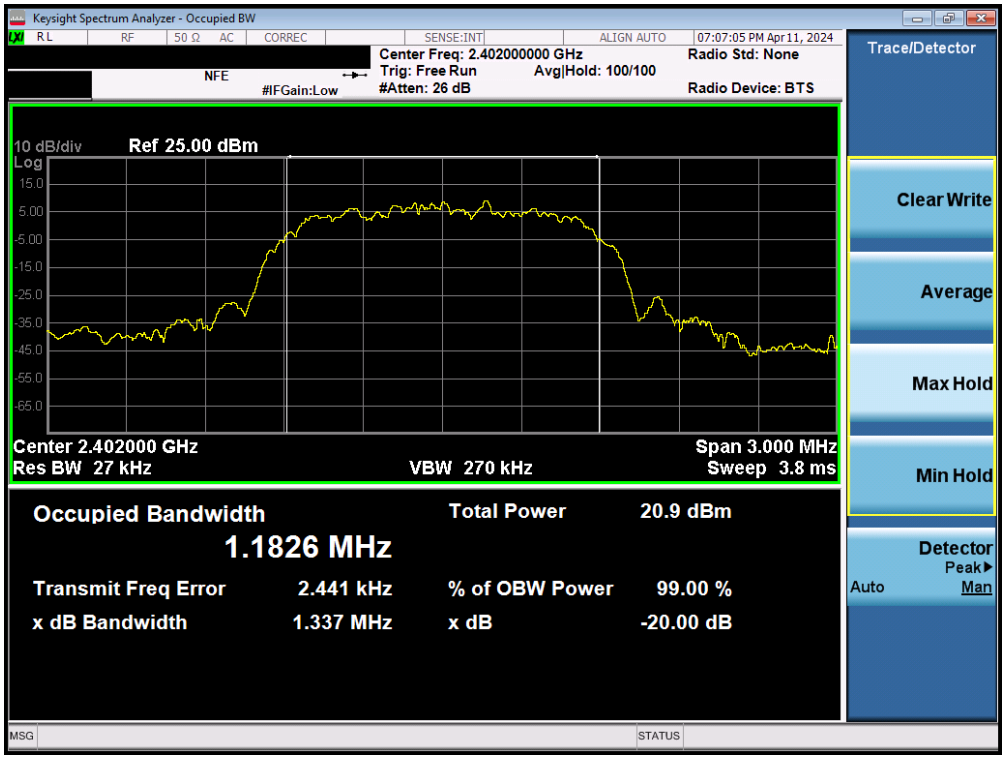
Plot 7-1. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Ant 1



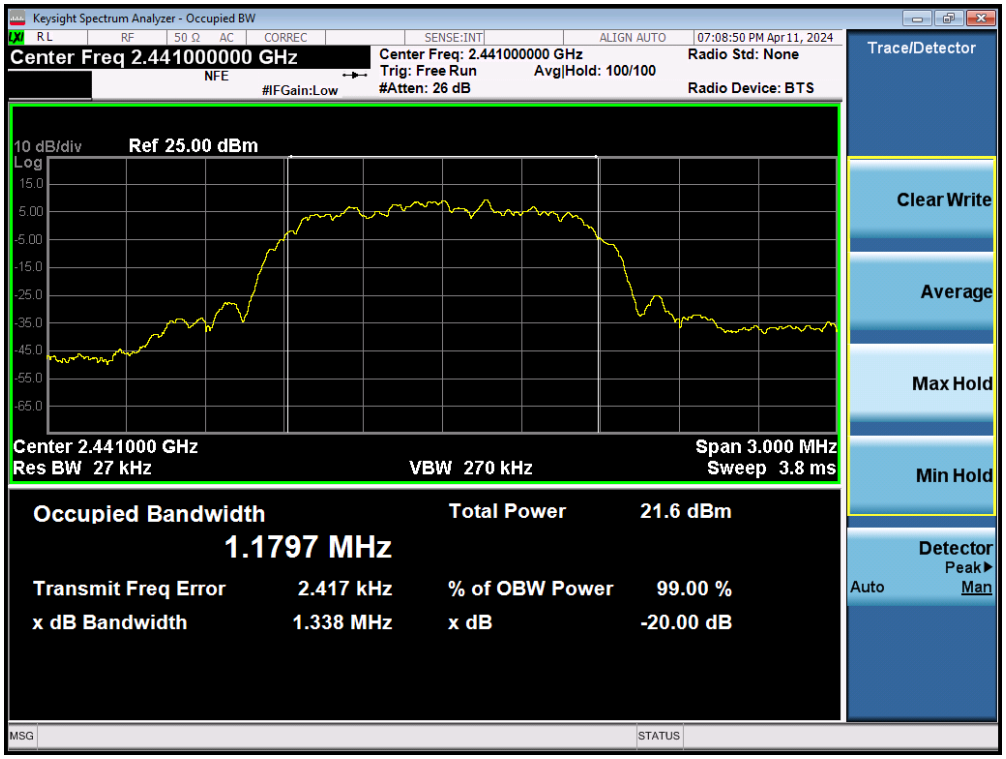
Plot 7-2. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Ant 1



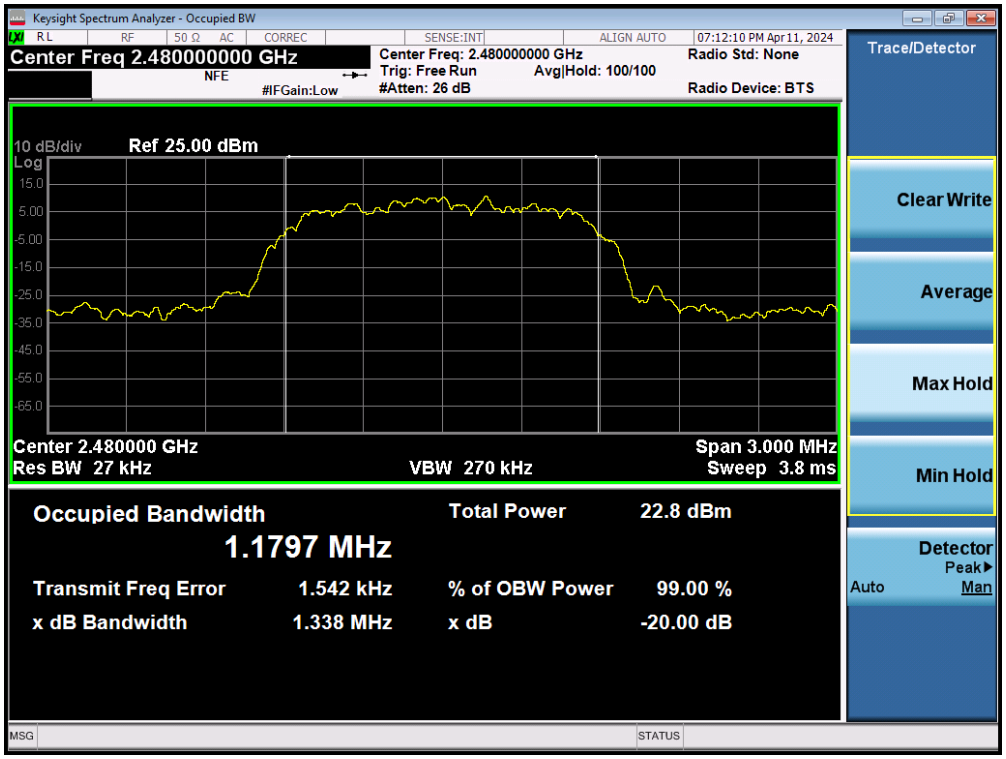
Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Ant 1



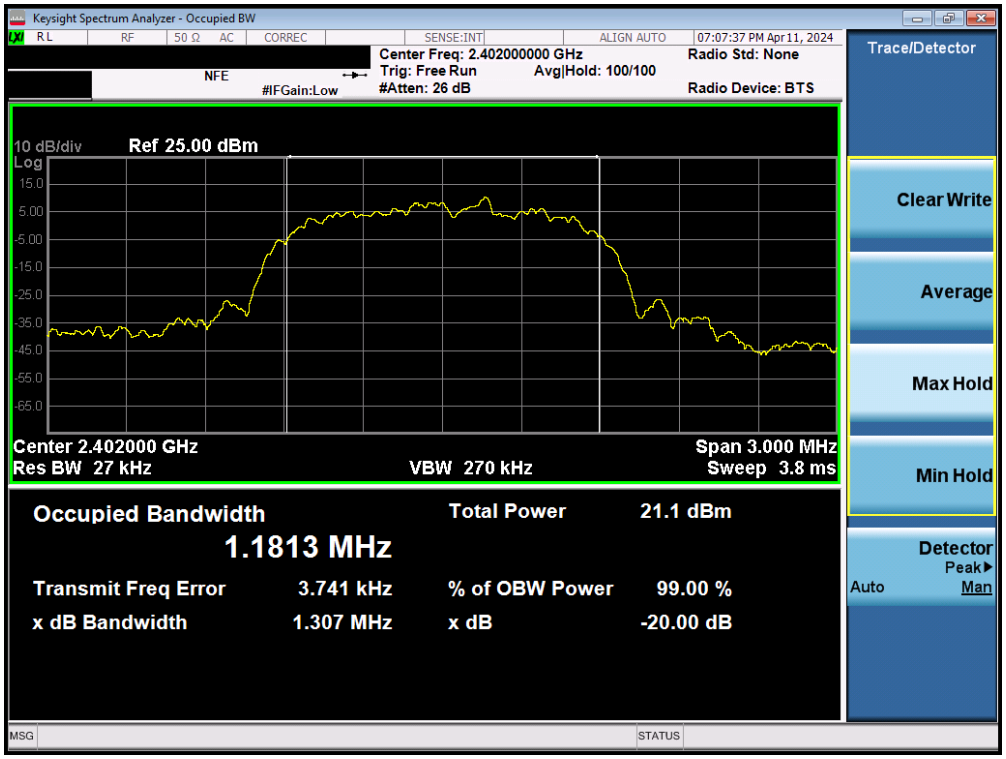
Plot 7-4. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Ant 1



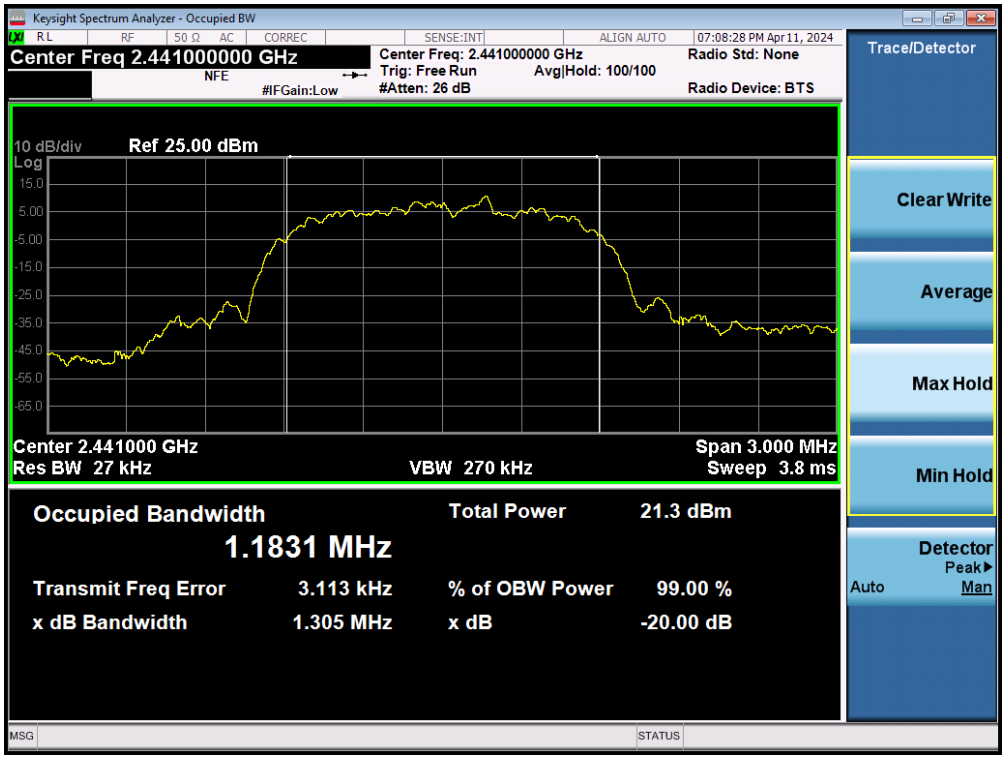
Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Ant 1



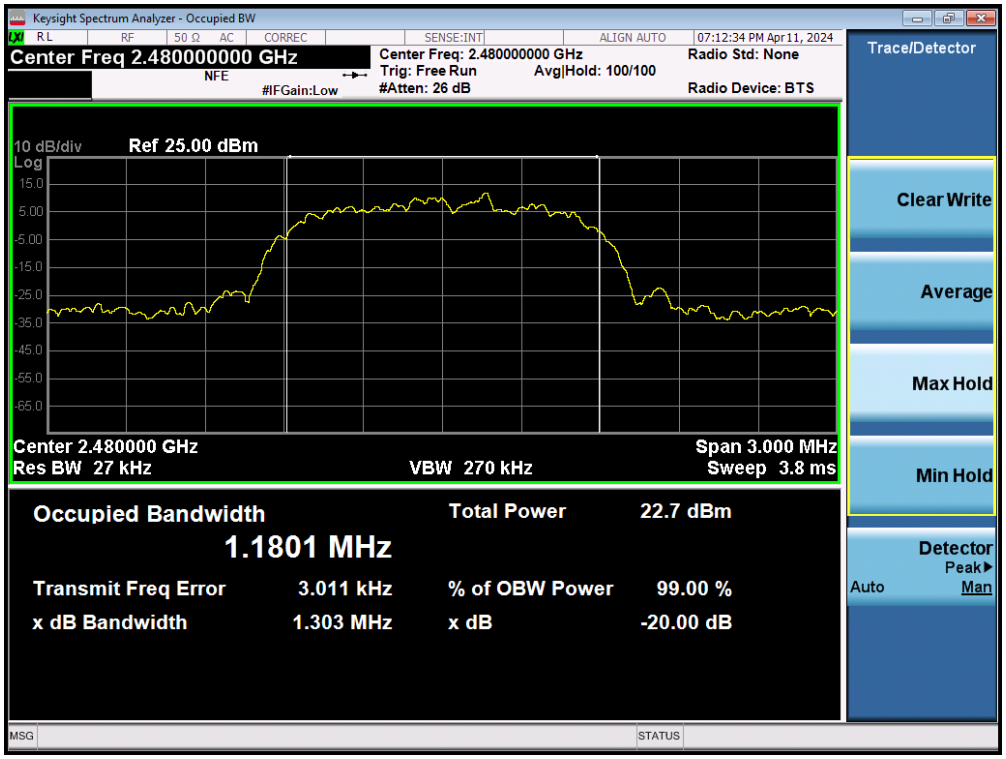
Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Ant 1



Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Ant 1



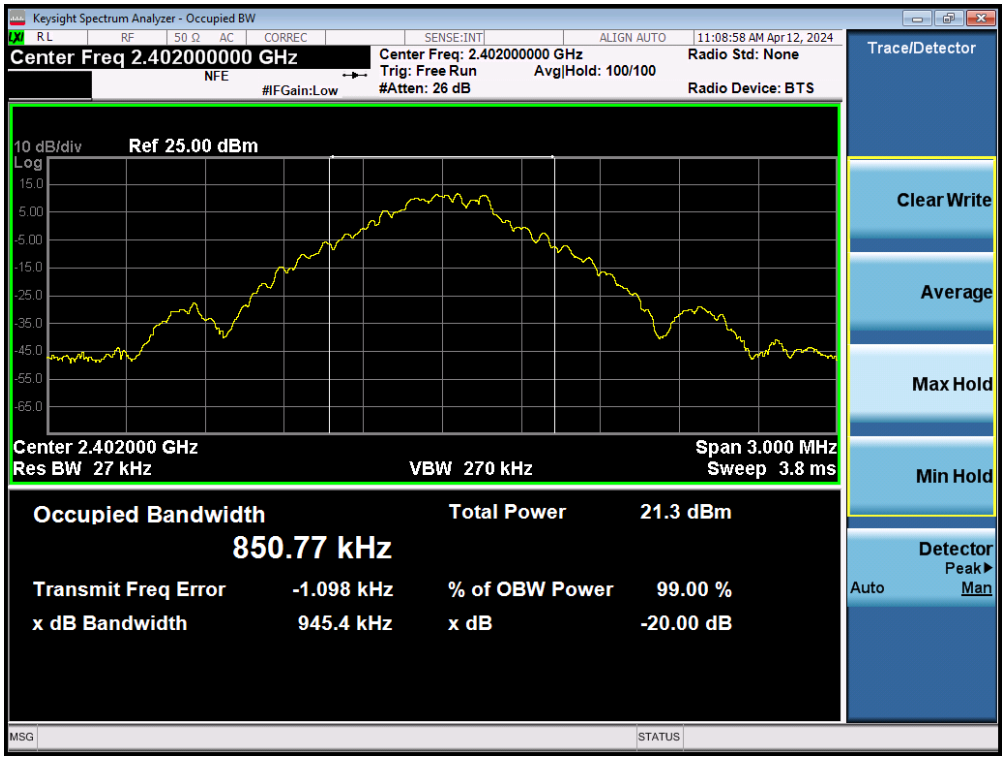
Plot 7-8. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Ant 1



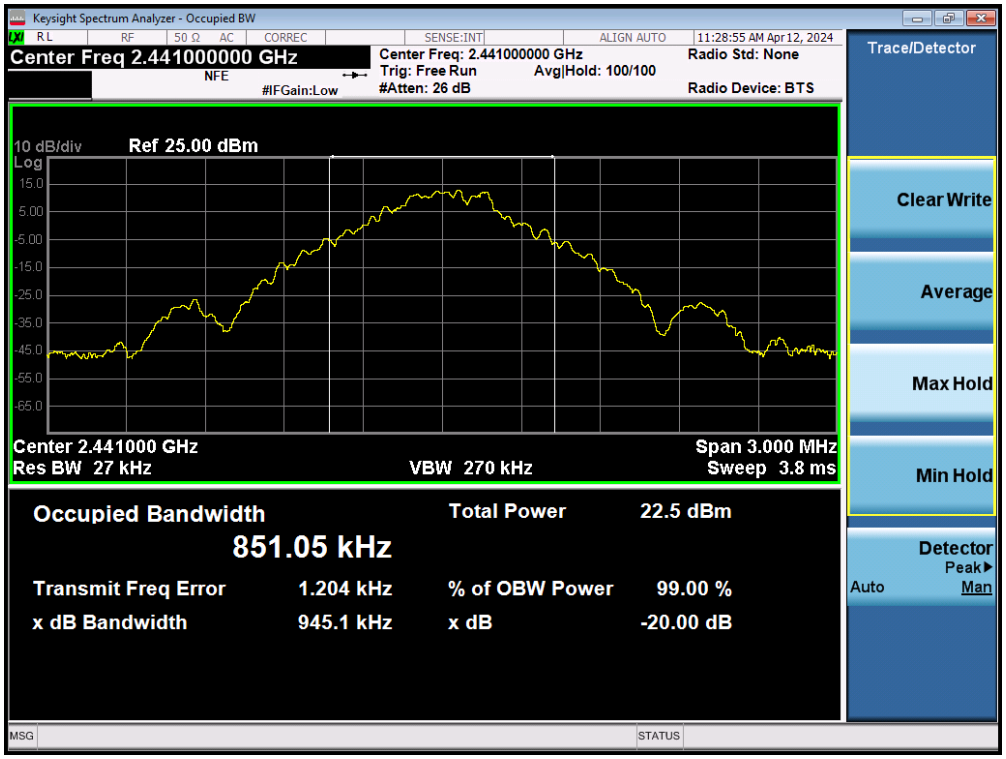
Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Ant 1

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	945.40
2441	1.0	GFSK	39	945.10
2480	1.0	GFSK	78	945.60
2402	2.0	π/4-DQPSK	0	1338.00
2441	2.0	π/4-DQPSK	39	1337.00
2480	2.0	π/4-DQPSK	78	1335.00
2402	3.0	8DPSK	0	1306.00
2441	3.0	8DPSK	39	1308.00
2480	3.0	8DPSK	78	1303.00

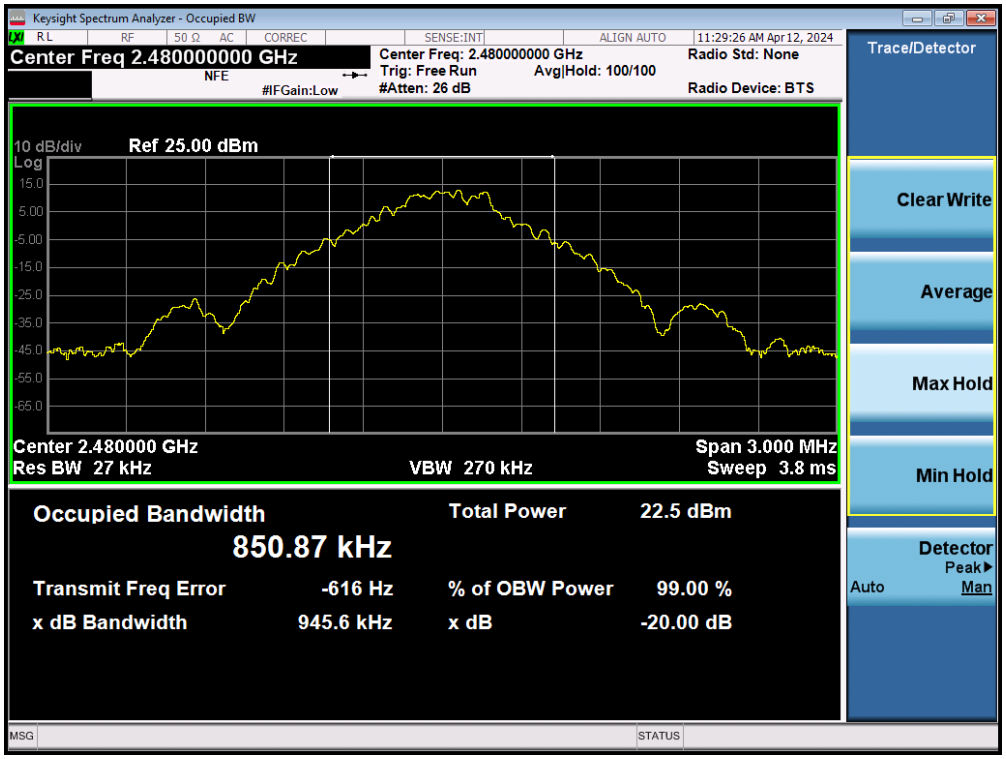
Table 7-3. Conducted 20dB Bandwidth Measurements – Ant 2



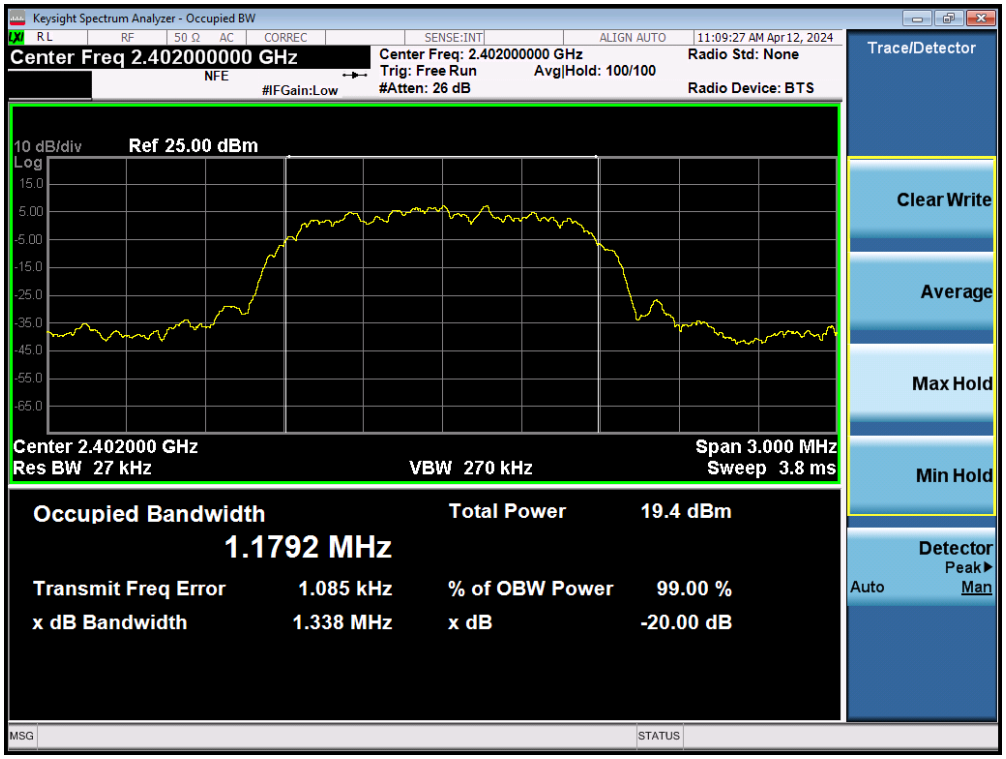
Plot 7-10. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Ant 2



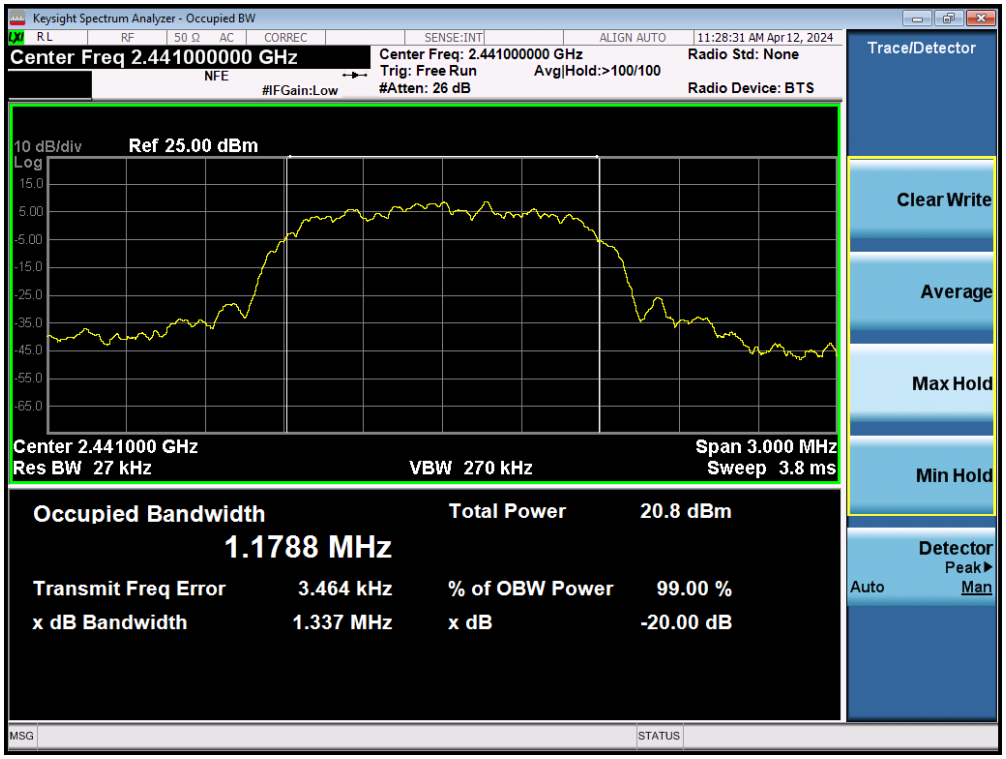
Plot 7-11. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Ant 2



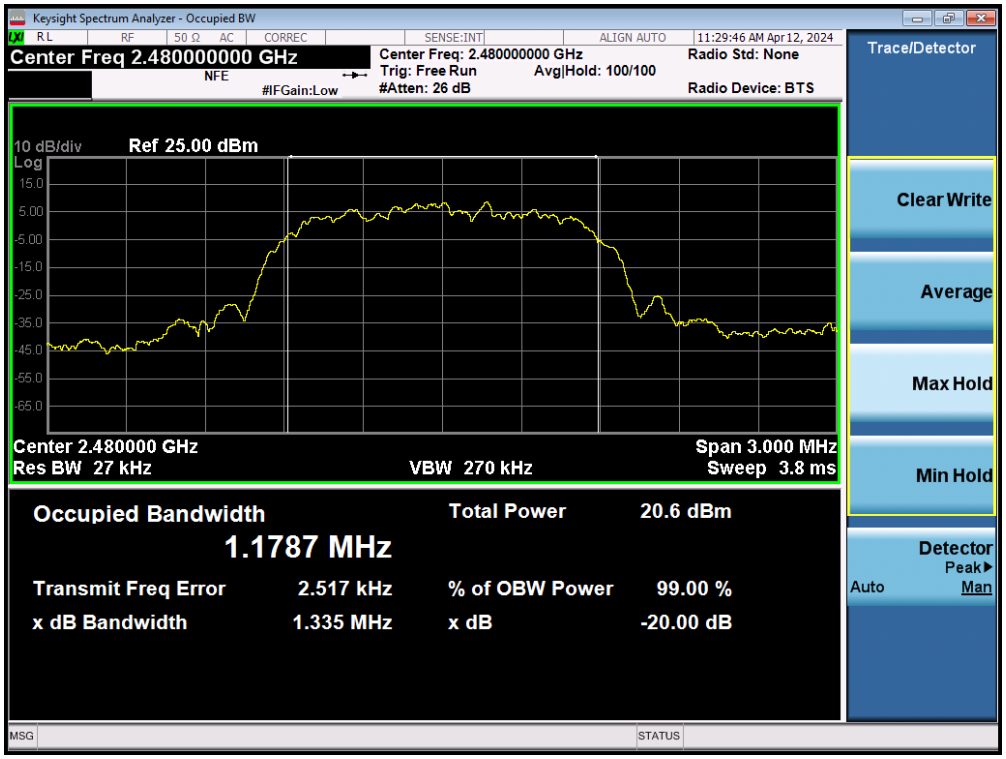
Plot 7-12. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Ant 2



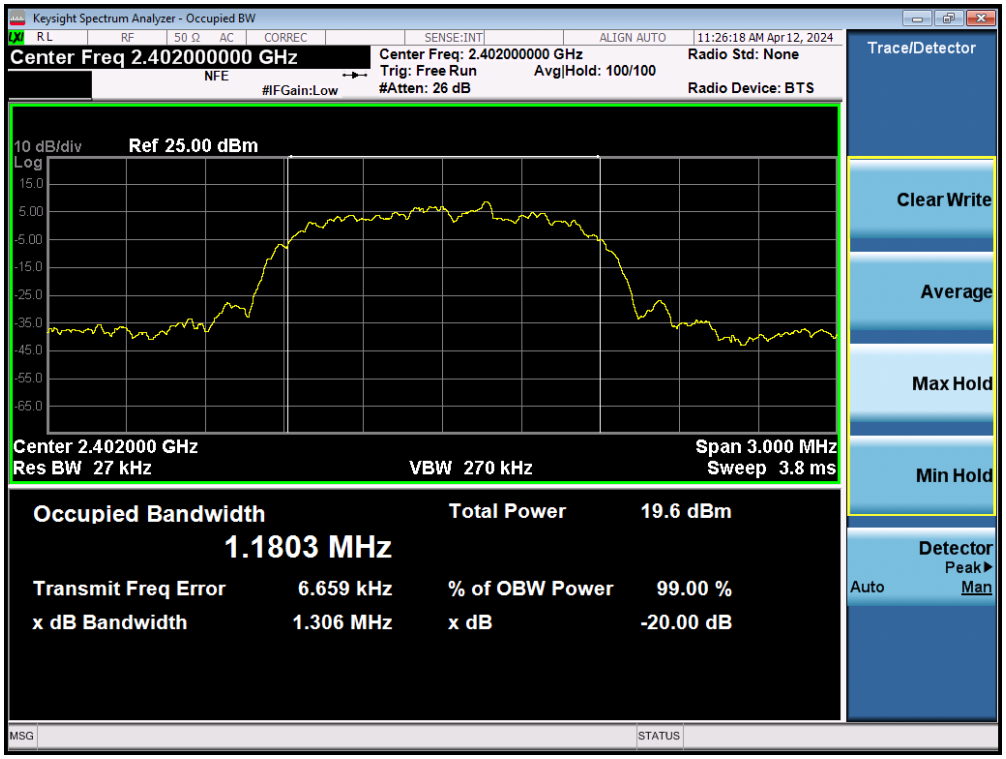
Plot 7-13. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Ant 2



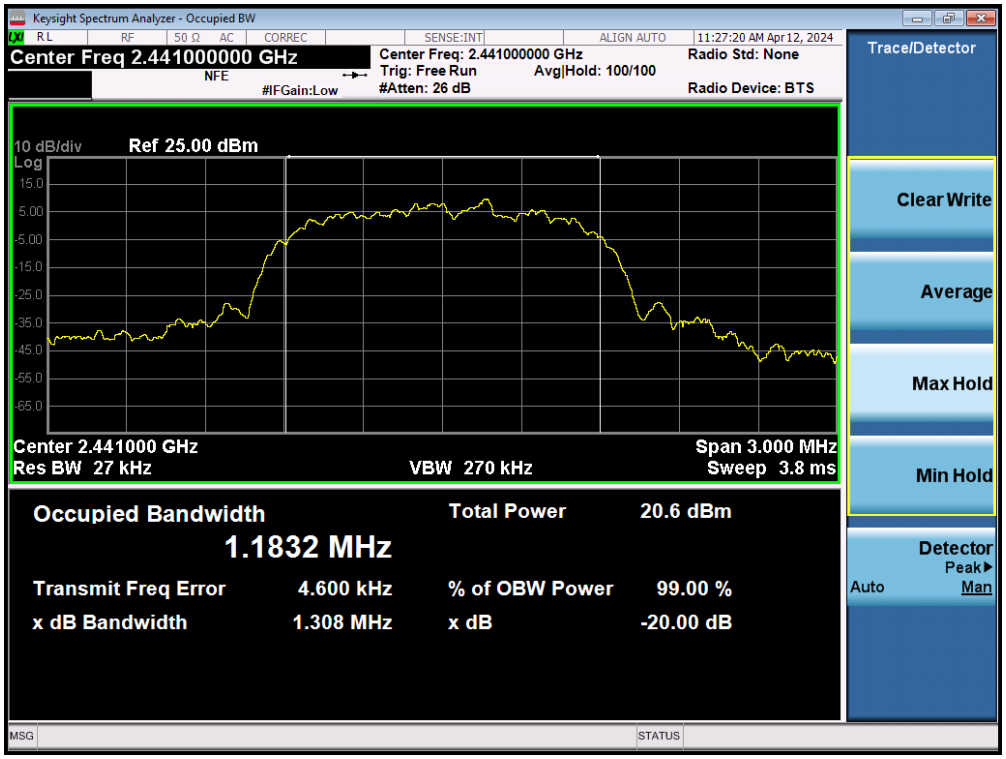
Plot 7-14. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Ant 2



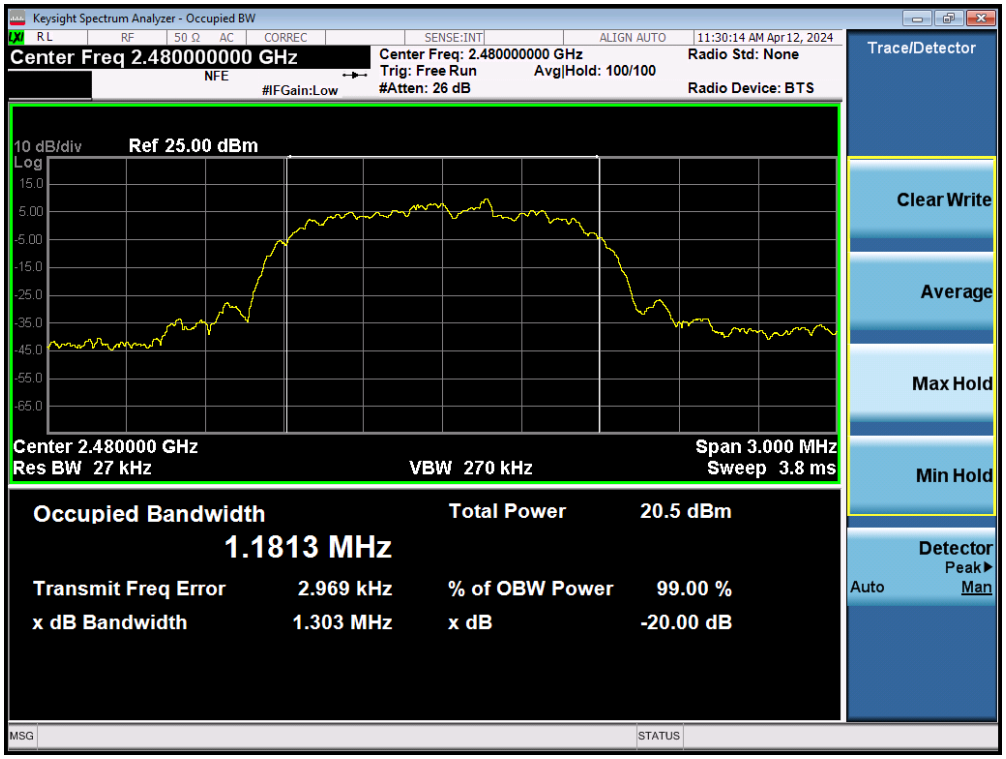
Plot 7-15. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Ant 2



Plot 7-16. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Ant 2



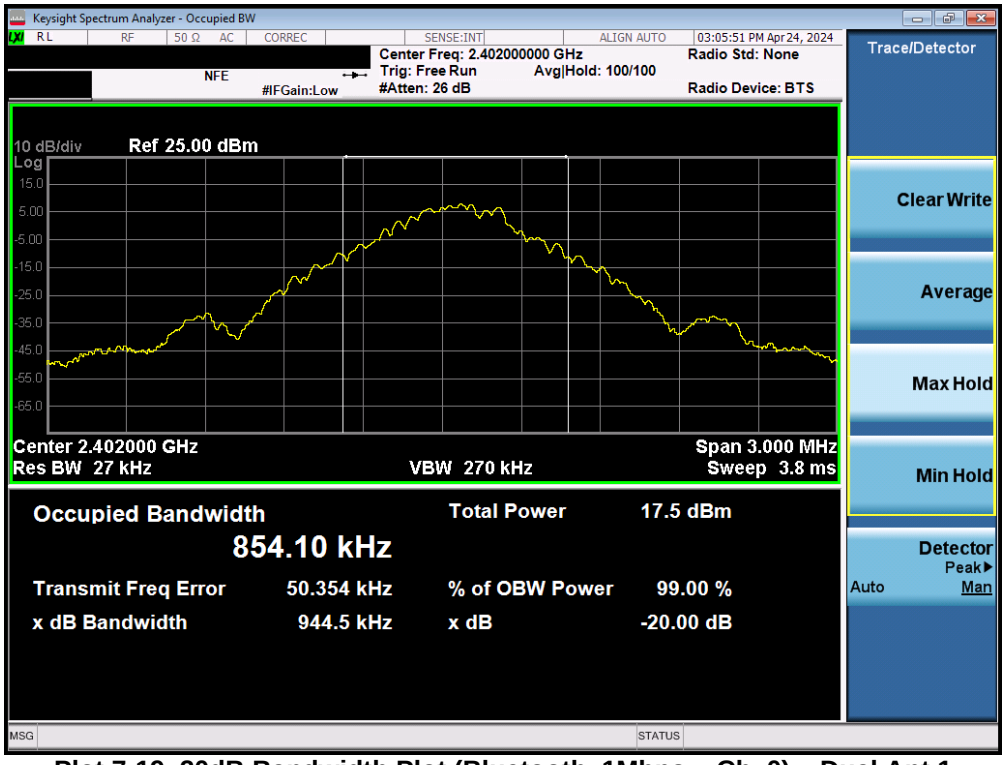
Plot 7-17. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Ant 2



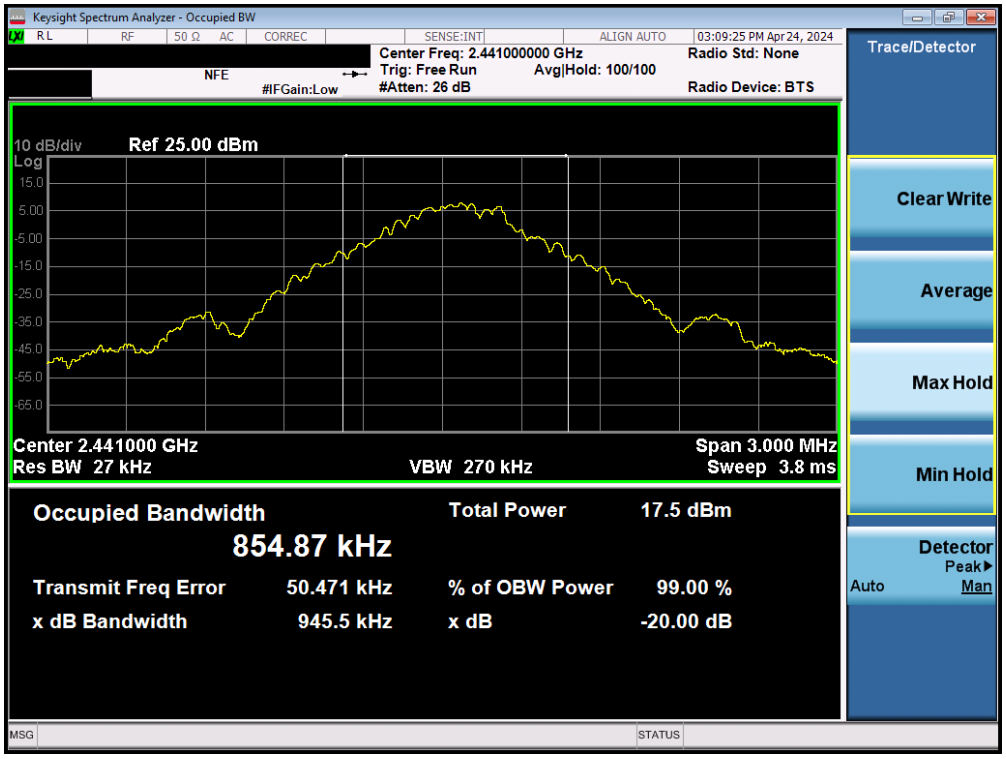
Plot 7-18. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Ant 2

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	944.50
2441	1.0	GFSK	39	945.50
2480	1.0	GFSK	78	944.30
2402	2.0	π/4-DQPSK	0	1322.00
2441	2.0	π/4-DQPSK	39	1321.00
2480	2.0	π/4-DQPSK	78	1322.00
2402	3.0	8DPSK	0	1302.00
2441	3.0	8DPSK	39	1301.00
2480	3.0	8DPSK	78	1302.00

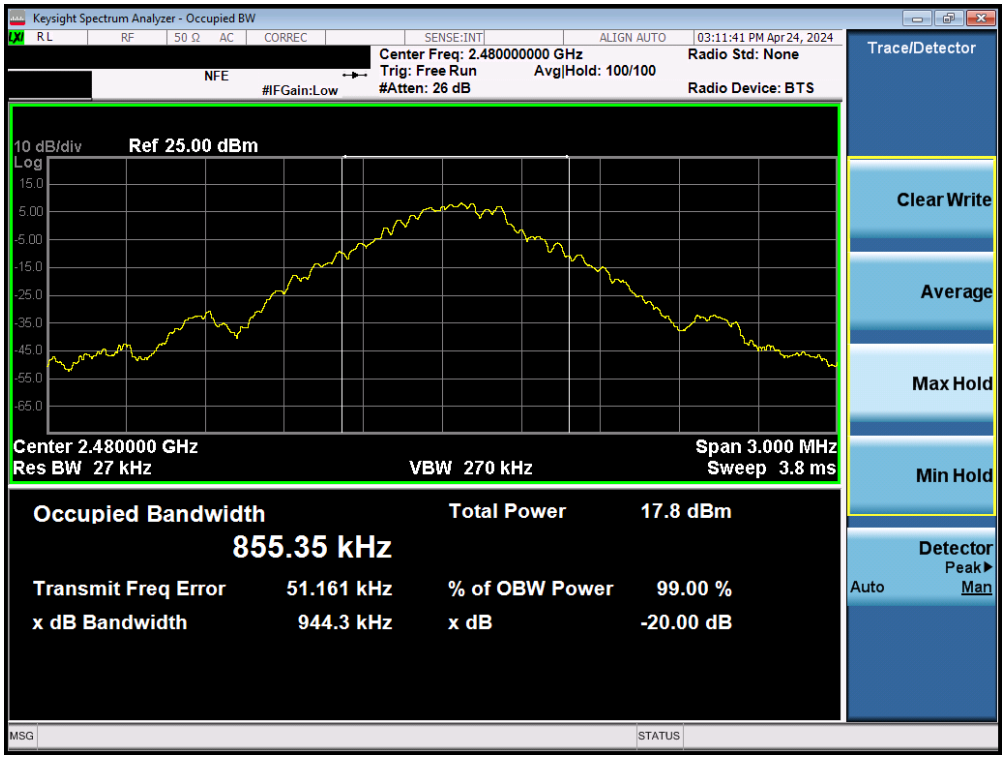
Table 7-4. Conducted 20dB Bandwidth Measurements – Dual Ant1



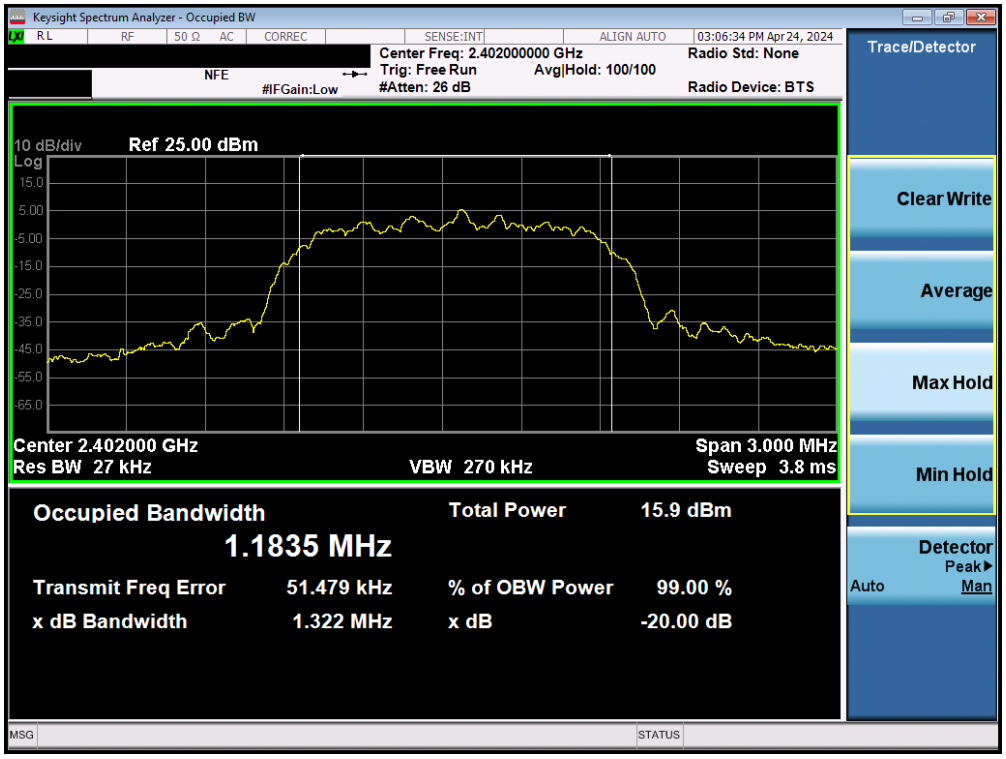
Plot 7-19. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Dual Ant 1



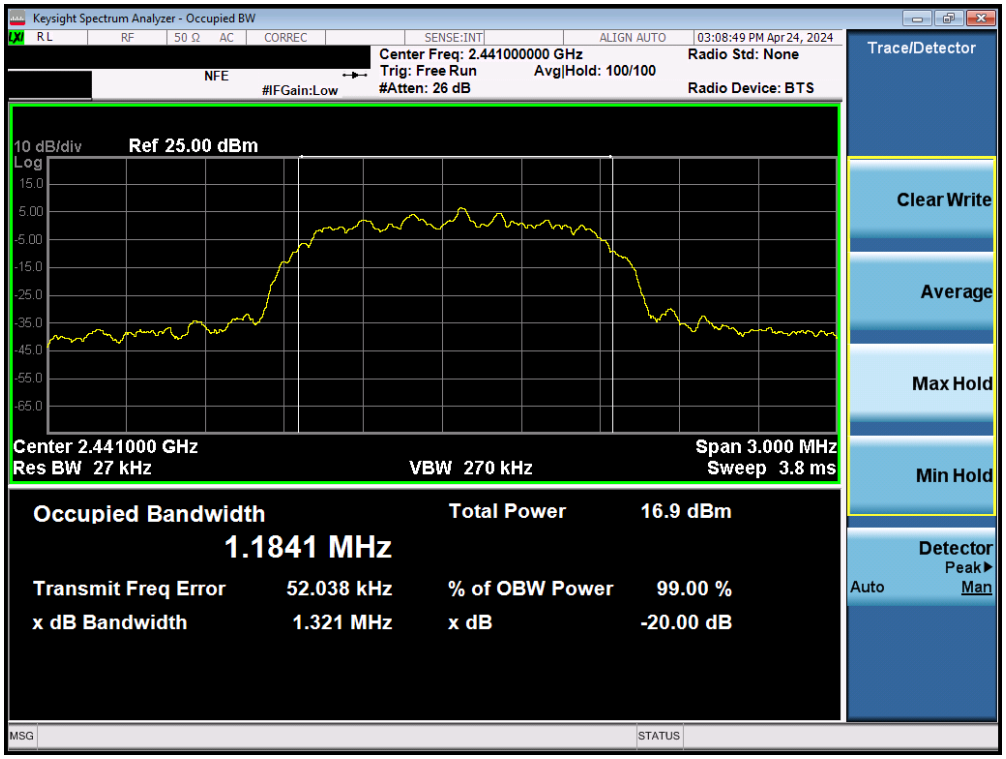
Plot 7-20. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Dual Ant 1



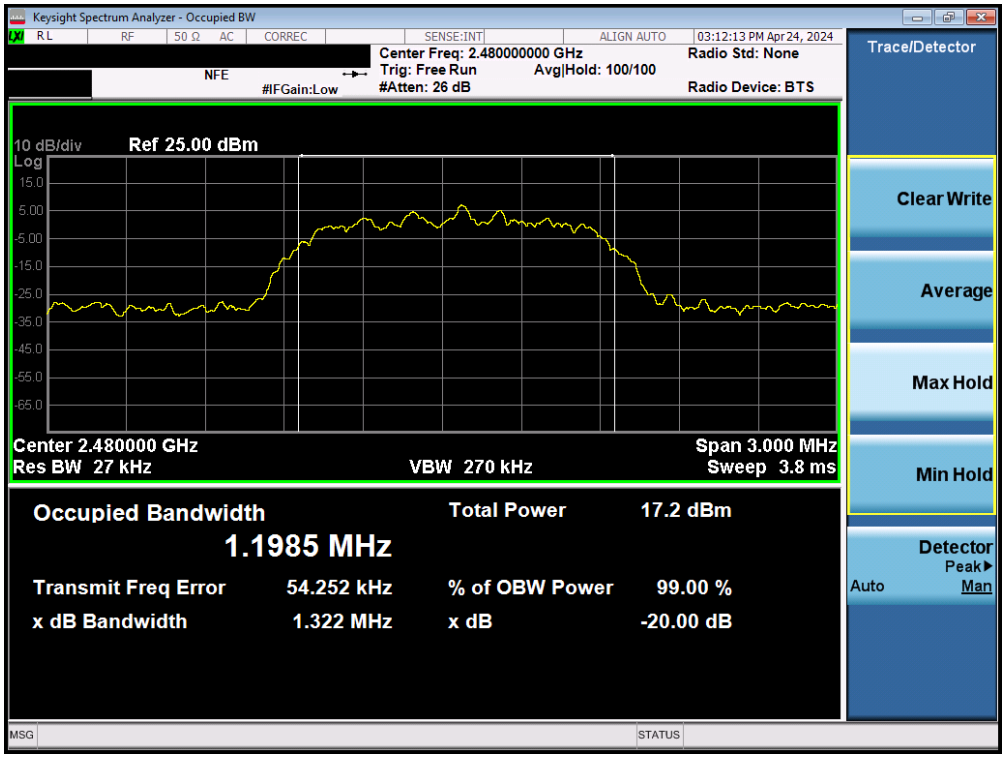
Plot 7-21. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Dual Ant 1



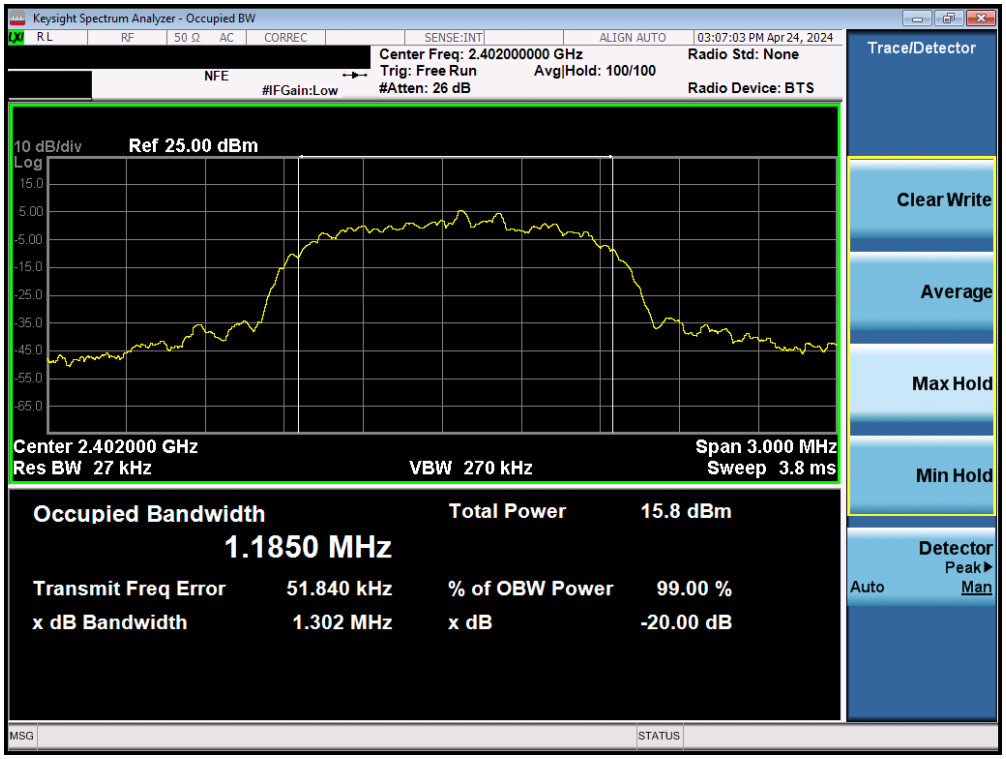
Plot 7-22. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Dual Ant 1



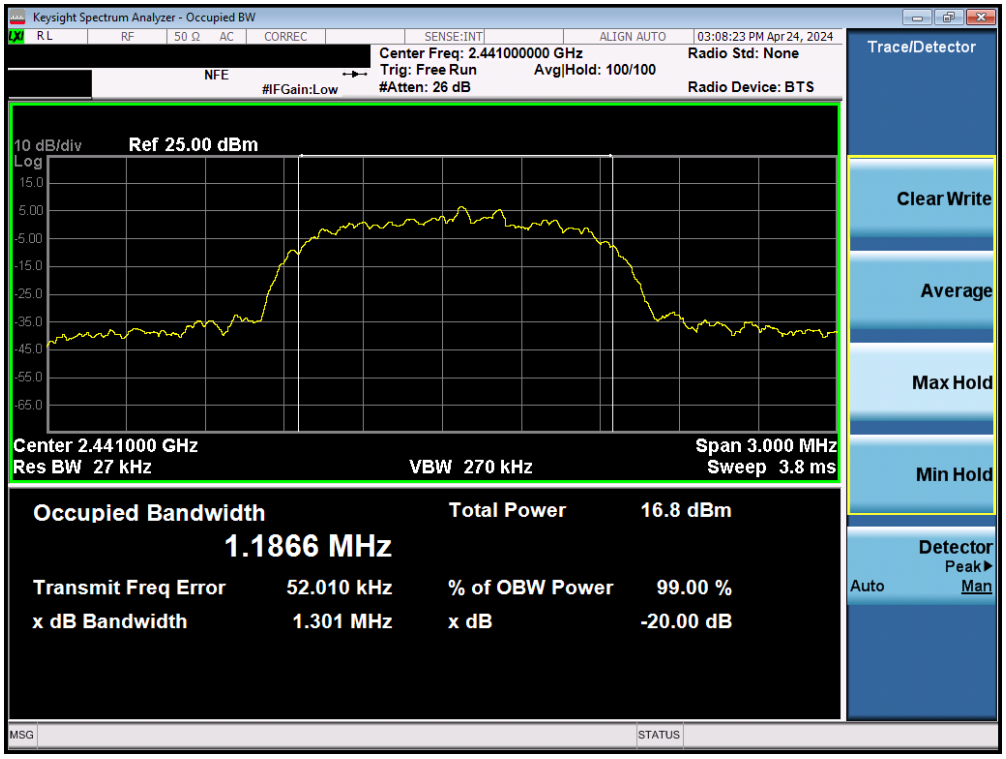
Plot 7-23. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Dual Ant 1



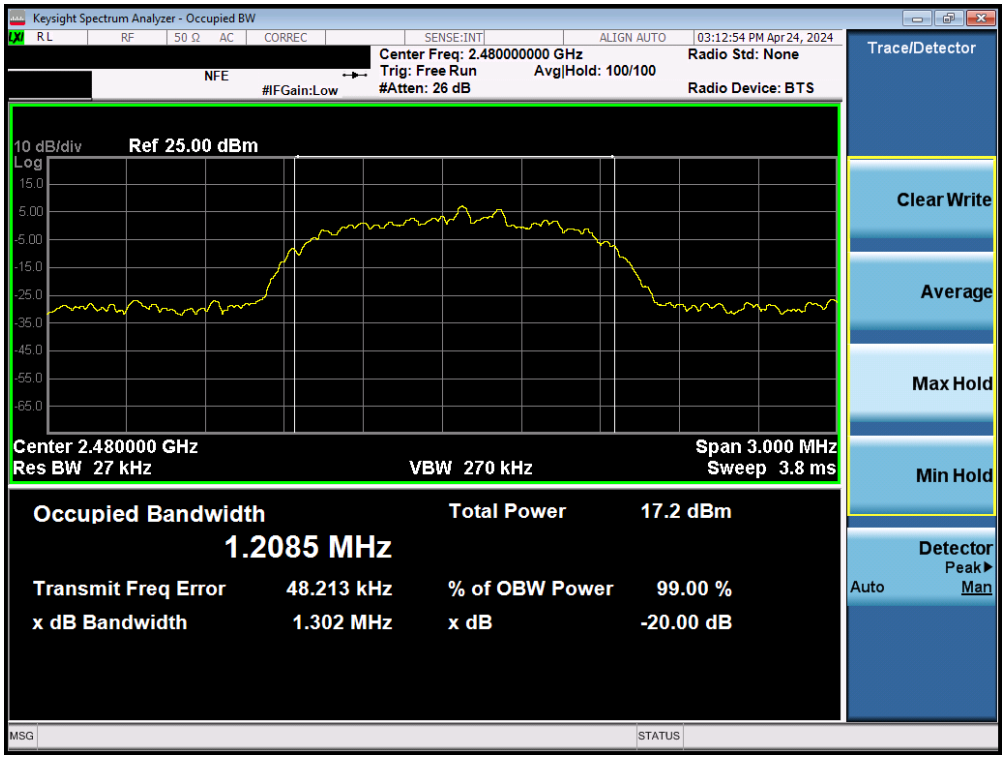
Plot 7-24. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Dual Ant 1



Plot 7-25. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Dual Ant 1



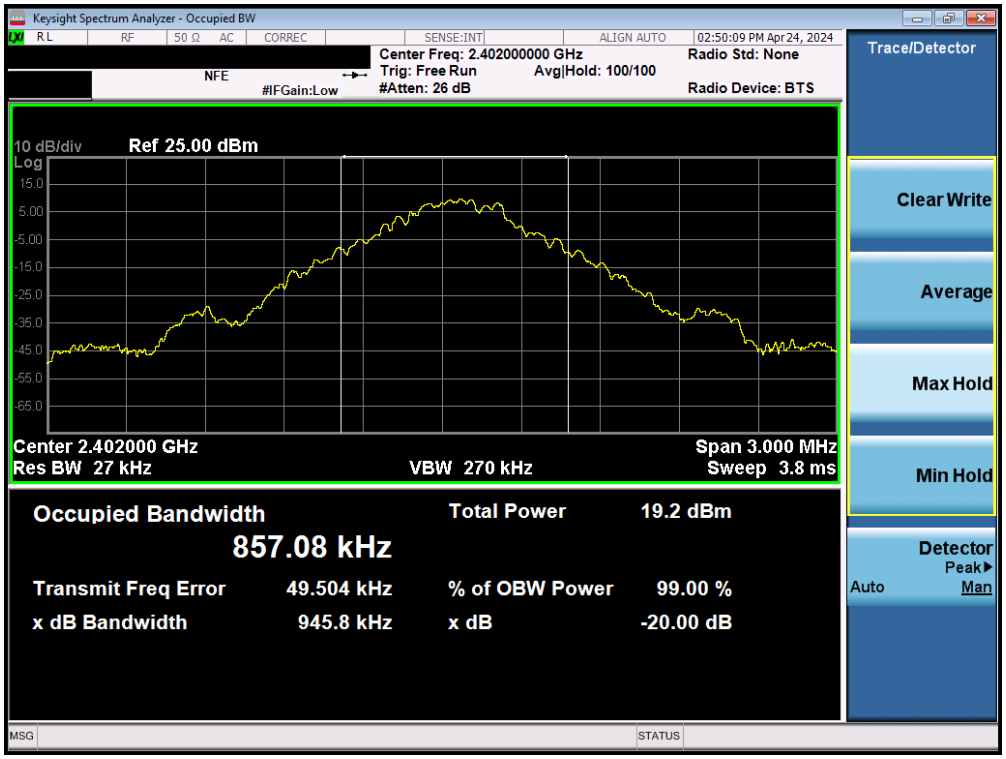
Plot 7-26. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Dual Ant 1



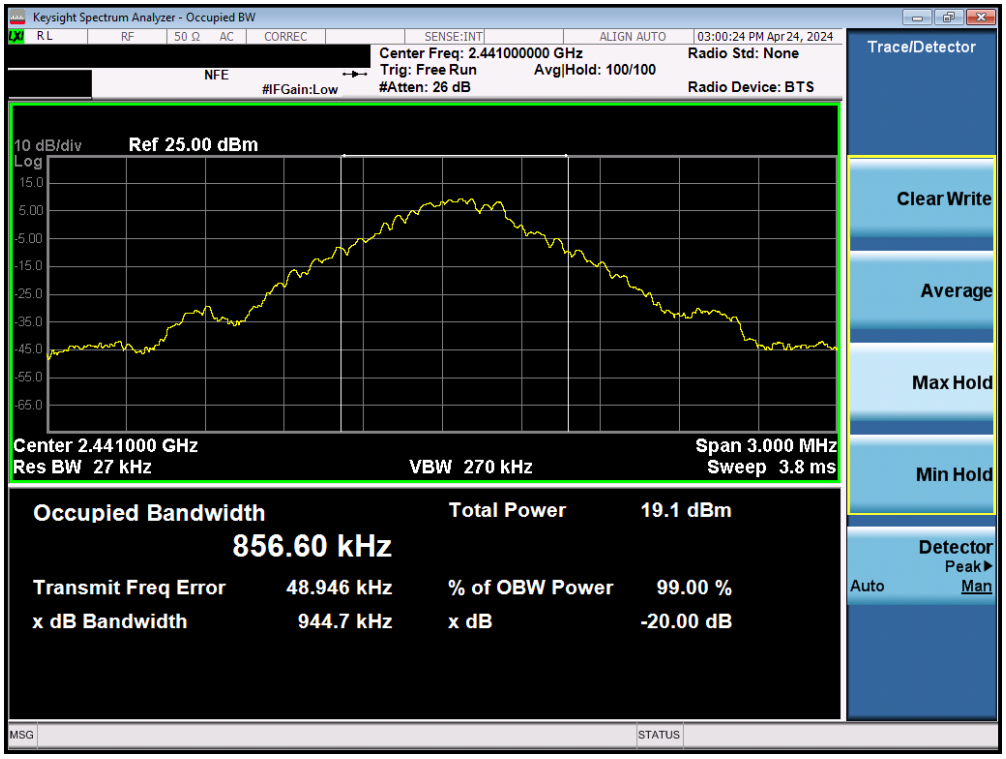
Plot 7-27. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Dual Ant 1

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	945.80
2441	1.0	GFSK	39	944.70
2480	1.0	GFSK	78	944.70
2402	2.0	π/4-DQPSK	0	1323.00
2441	2.0	π/4-DQPSK	39	1321.00
2480	2.0	π/4-DQPSK	78	1322.00
2402	3.0	8DPSK	0	1304.00
2441	3.0	8DPSK	39	1303.00
2480	3.0	8DPSK	78	1323.00

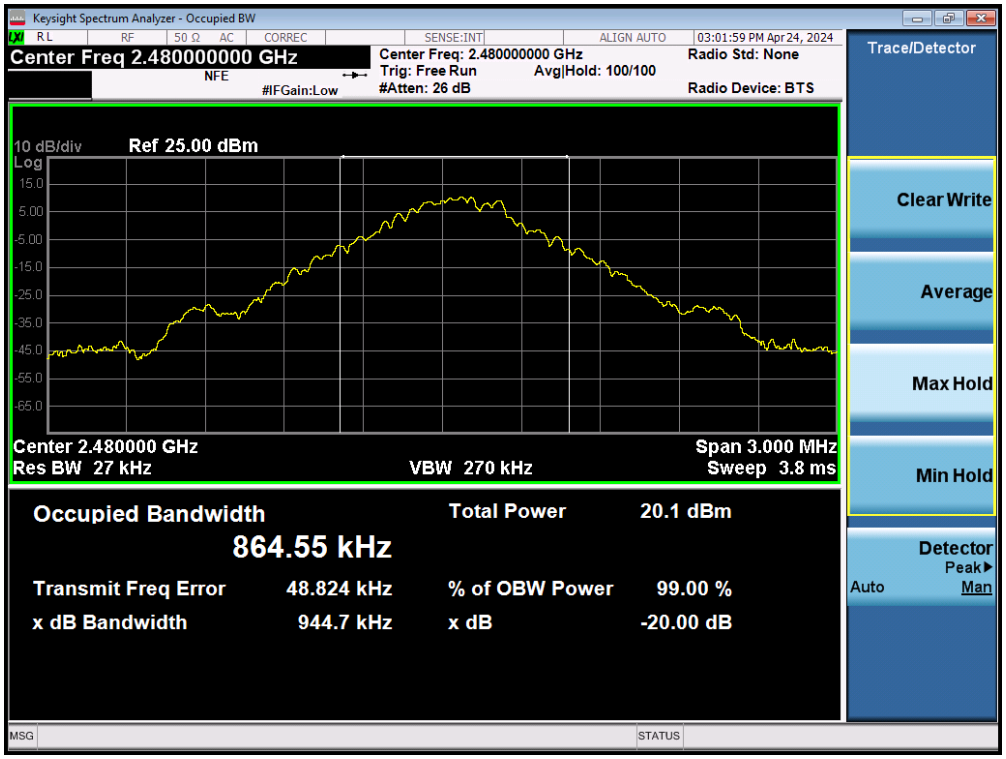
Table 7-5. Conducted 20dB Bandwidth Measurements – Dual Ant 2



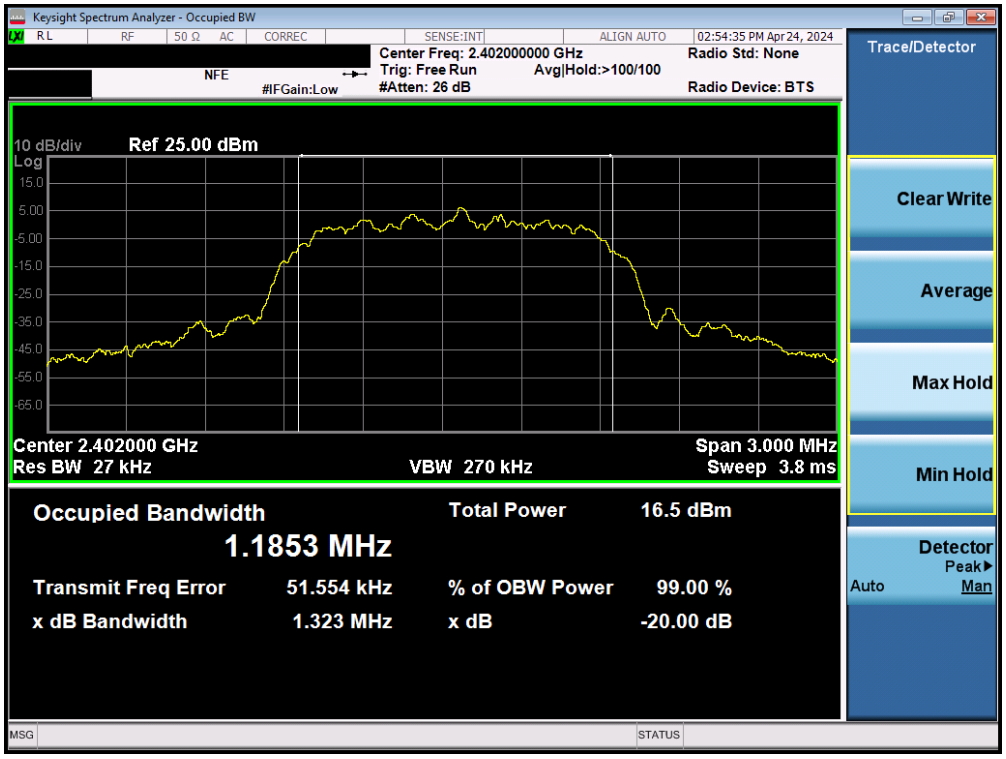
Plot 7-28. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Dual Ant 2



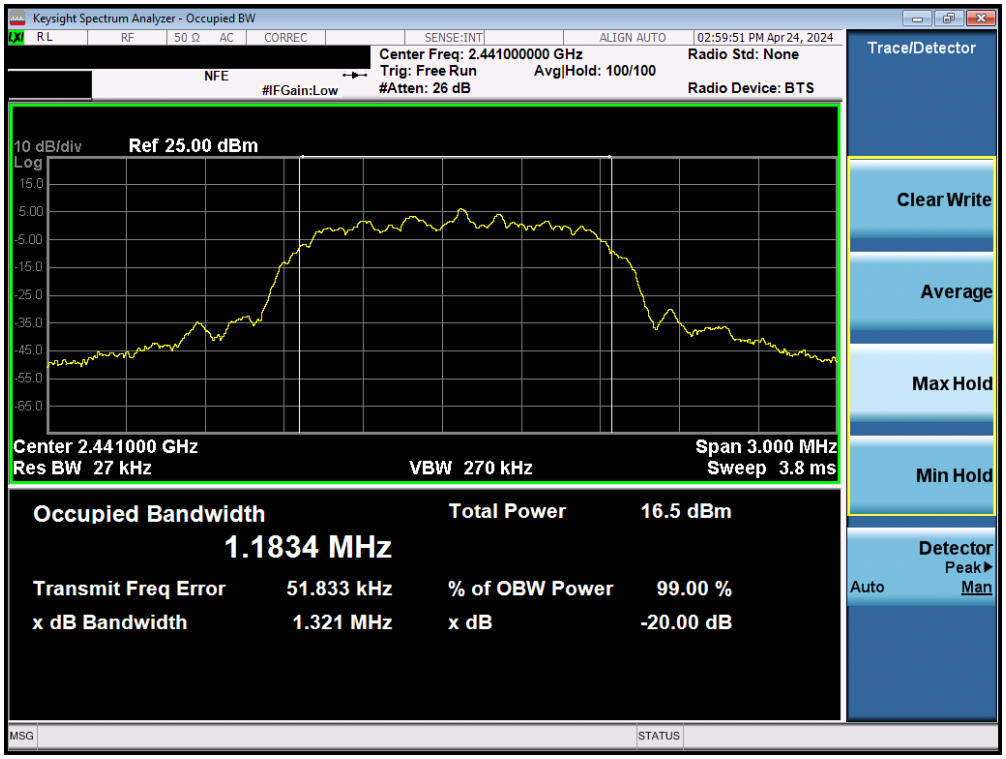
Plot 7-29. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Dual Ant 2



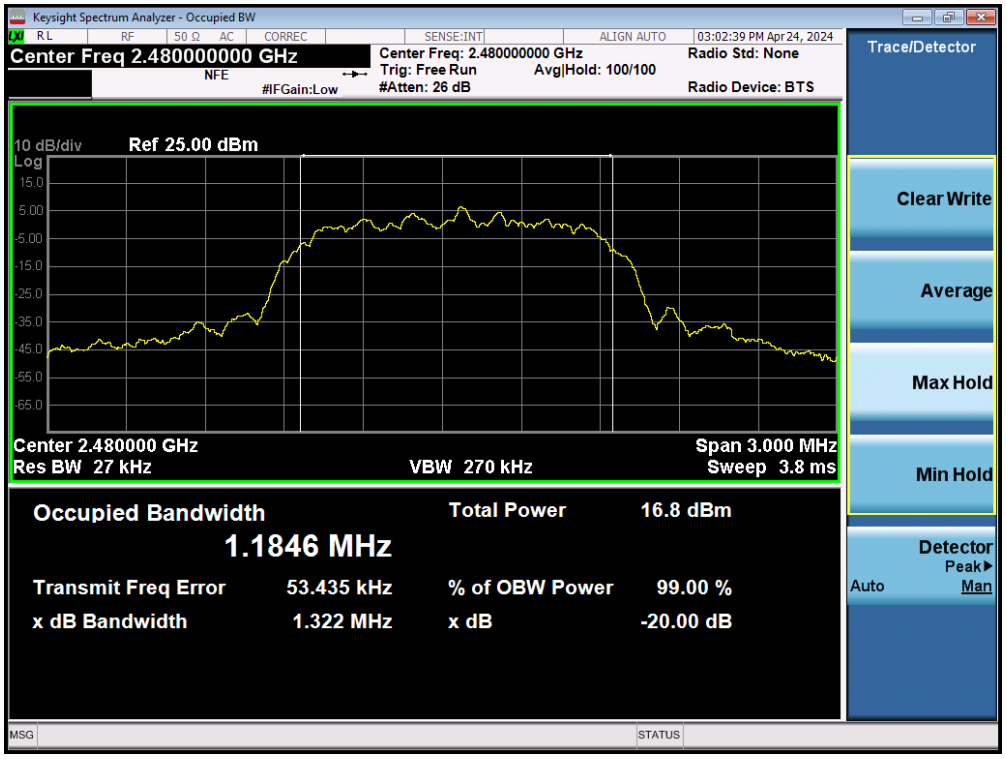
Plot 7-30. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Dual Ant 2



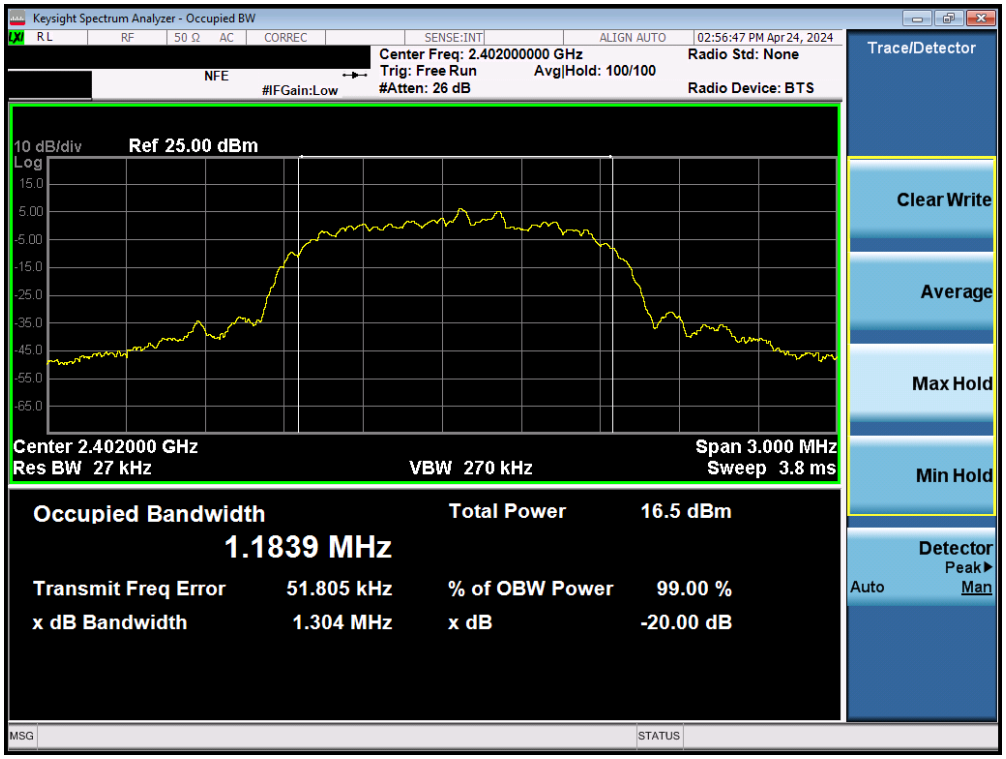
Plot 7-31. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Dual Ant 2



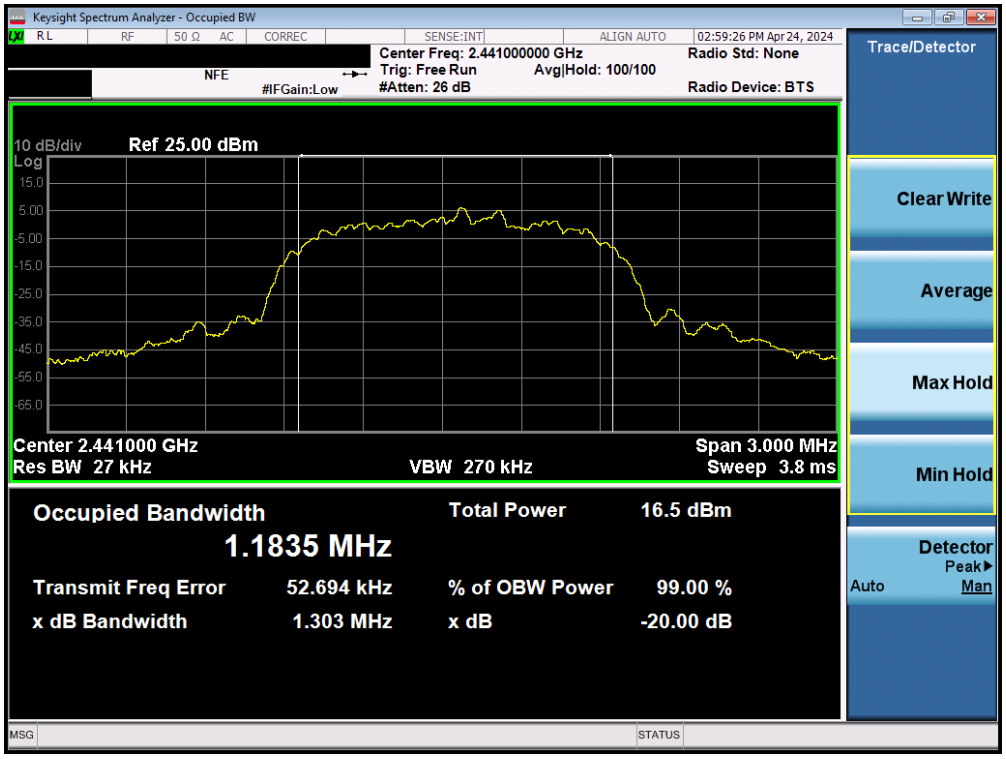
Plot 7-32. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Dual Ant 2



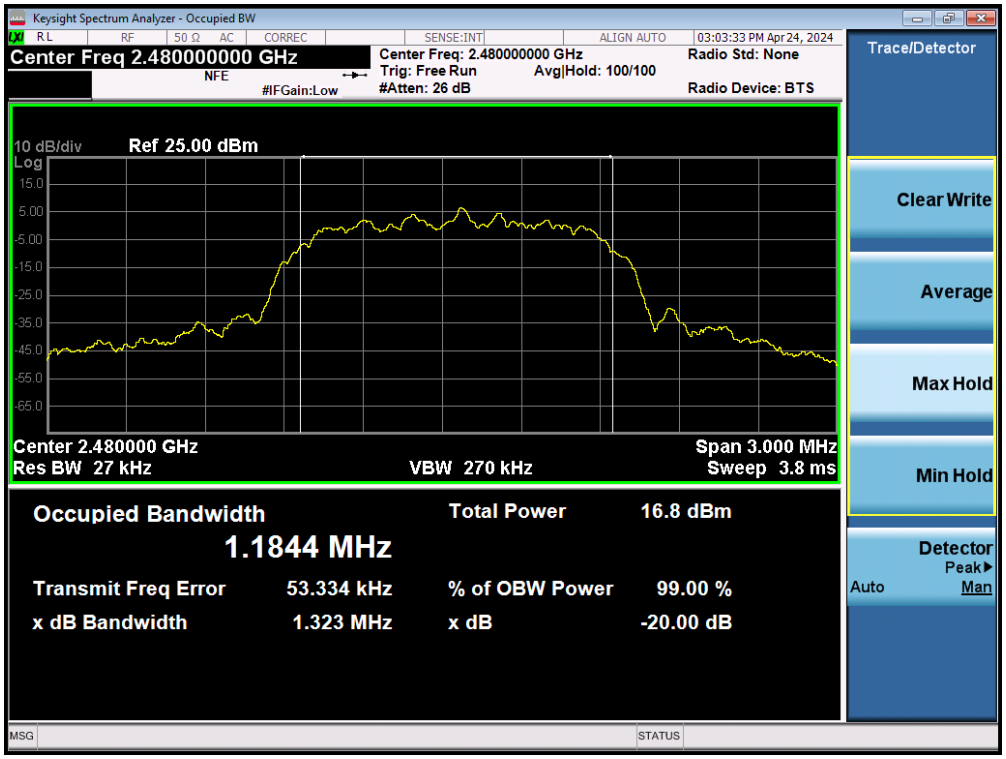
Plot 7-33. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Dual Ant 2



Plot 7-34. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Dual Ant 2



Plot 7-35. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Dual Ant 2



Plot 7-36. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Dual Ant 2

7.3 Output Power Measurement

§15.247 (b.1); RSS-247 [5.4(2)]

Test Overview and Limits

Measurement is made while the EUT is operating in non-hopping transmission mode. The powers shown below were measured using a spectrum analyzer with a Bluetooth signaling test set (Agilent Model: N4010A) used only to maintain a Bluetooth link with the EUT. Average power measurements are performed using the analyzer's "burst power" function with RBW = 3MHz. The burst power function triggers on a single set burst set to maximum power and measures the maximum average power on the on-time.

The maximum permissible output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.5
ANSI C63.10-2013 – Section 11.9.2.3.2 method AVGPM-G

Test Settings

Peak Power Measurement

1. Span = approximately 5x 20dB bandwidth, centered on hopping channel
2. RBW > 20dB bandwidth of emission being measured
3. VBW ≥ RBW
4. Sweep = auto
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

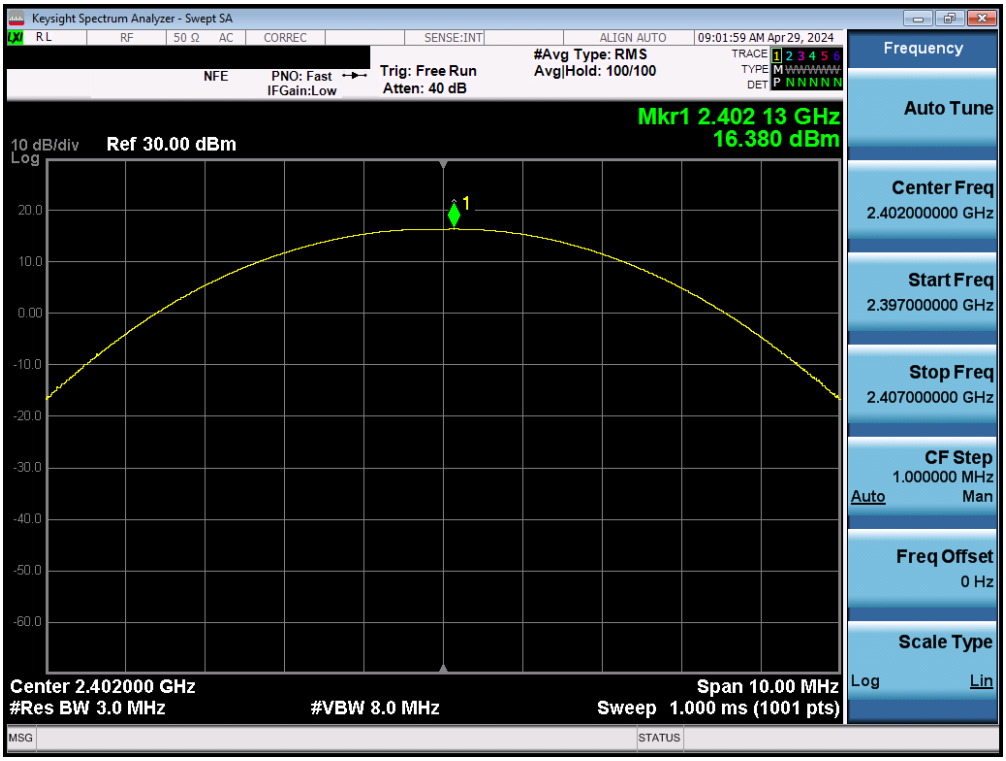
Note

Final results were obtained using calibrated couplers, attenuators, and cables. The following formula was used:

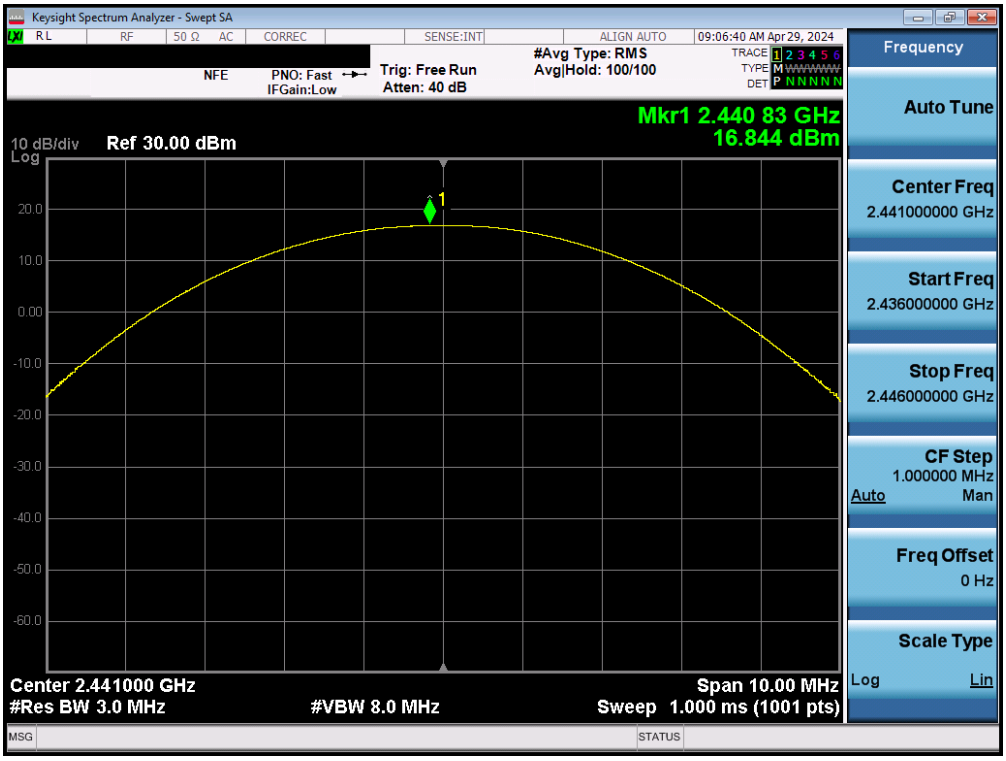
Output Power (dBm) = Raw Analyzer Level (dBm) + Cable Loss (dB) + Loss in Directional Coupler/Insertion Loss (dB)

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	16.38	43.451	16.12	40.935
2441	1.0	39	16.84	48.350	16.57	45.394
2480	1.0	78	17.39	54.828	17.10	51.333
2402	2.0	0	16.25	42.209	13.30	21.380
2441	2.0	39	16.64	46.121	13.79	23.922
2480	2.0	78	17.21	52.541	14.22	25.876
2402	3.0	0	16.91	49.046	13.23	21.052
2441	3.0	39	17.17	52.095	13.81	24.060
2480	3.0	78	17.50	56.221	14.15	25.990

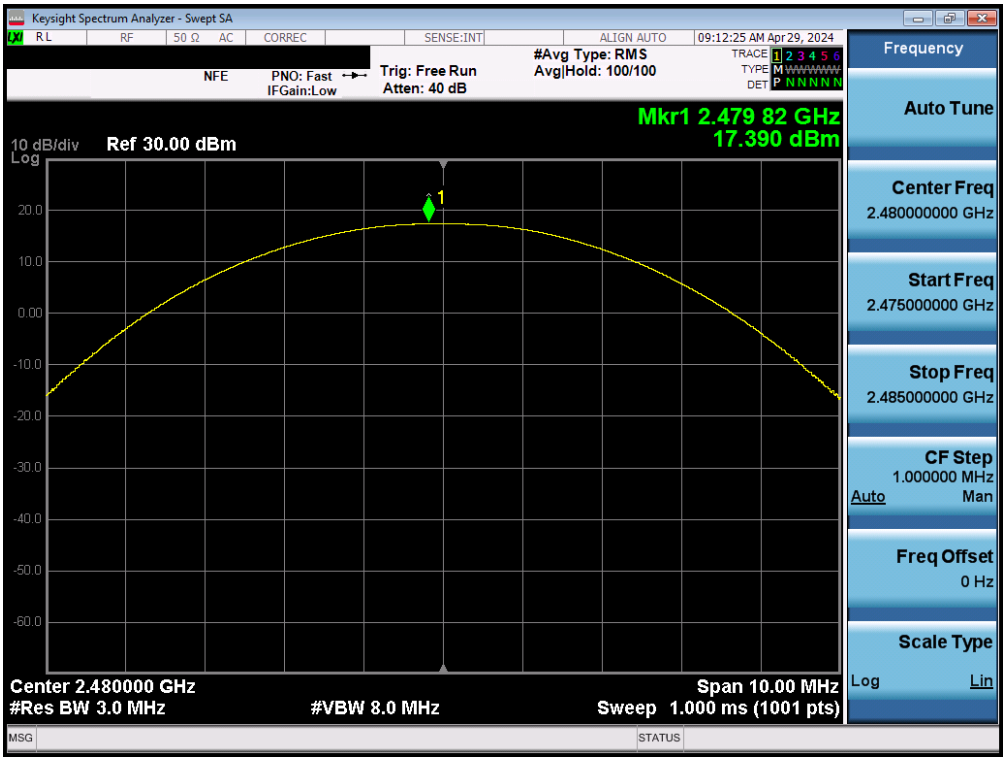
Table 7-6. Conducted Output Power Measurements – Ant 1



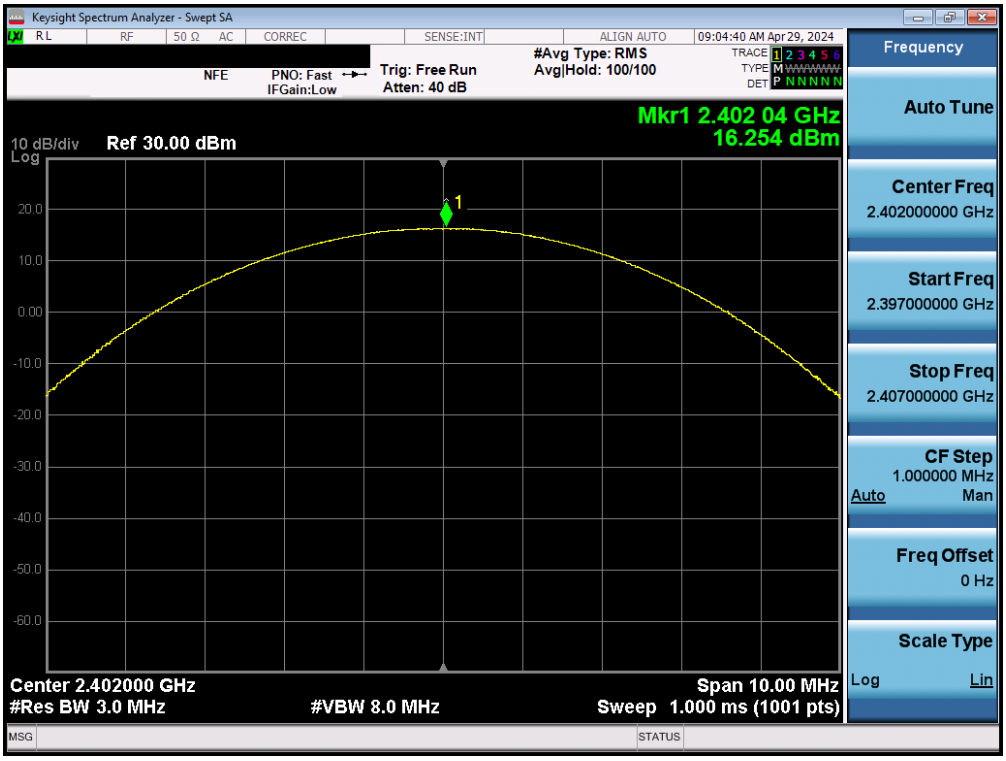
Plot 7-37. Peak Conducted Power (1Mbps – Ch. 0) – Ant 1



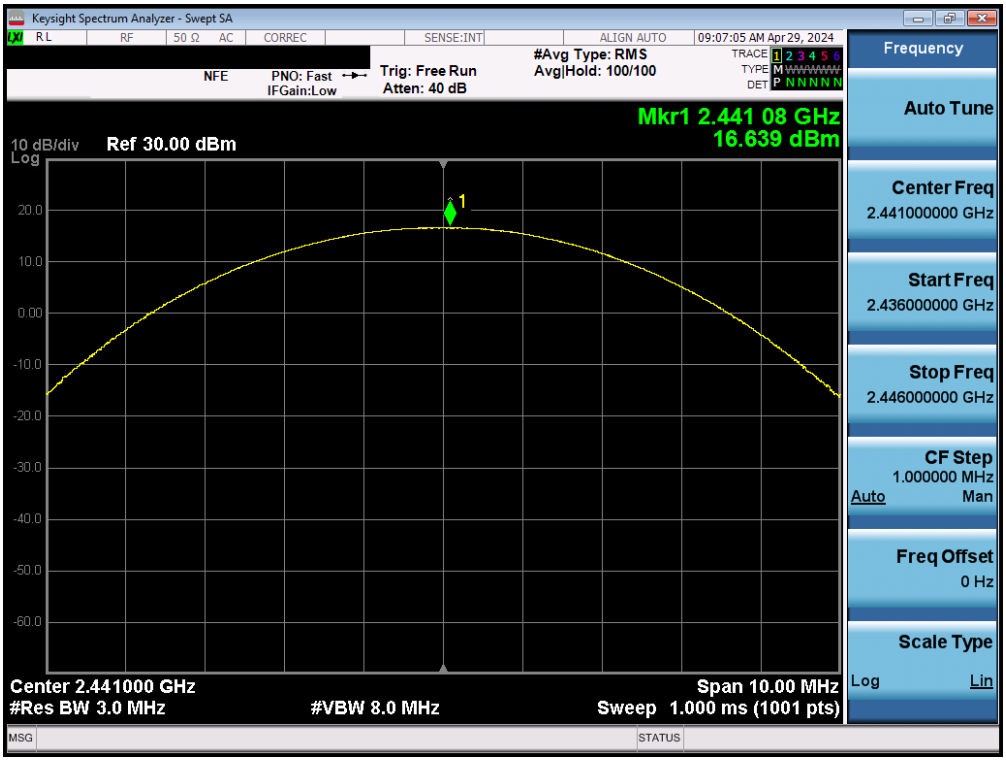
Plot 7-38. Peak Conducted Power (1Mbps – Ch. 39) – Ant 1



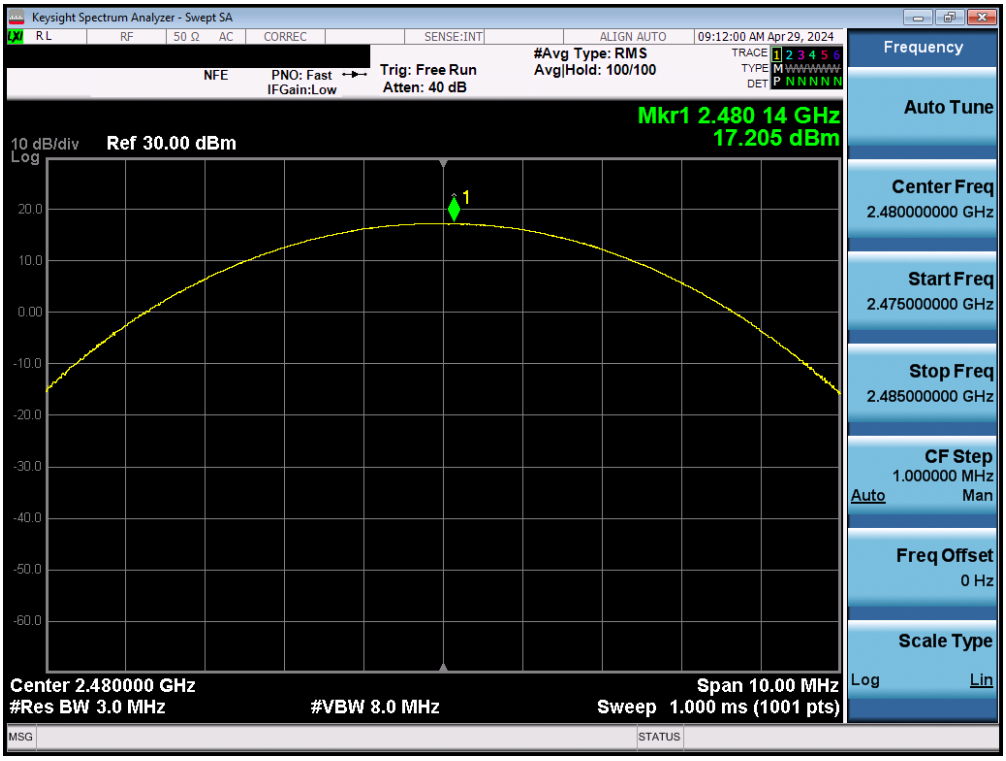
Plot 7-39. Peak Conducted Power (1Mbps – Ch. 78) – Ant 1



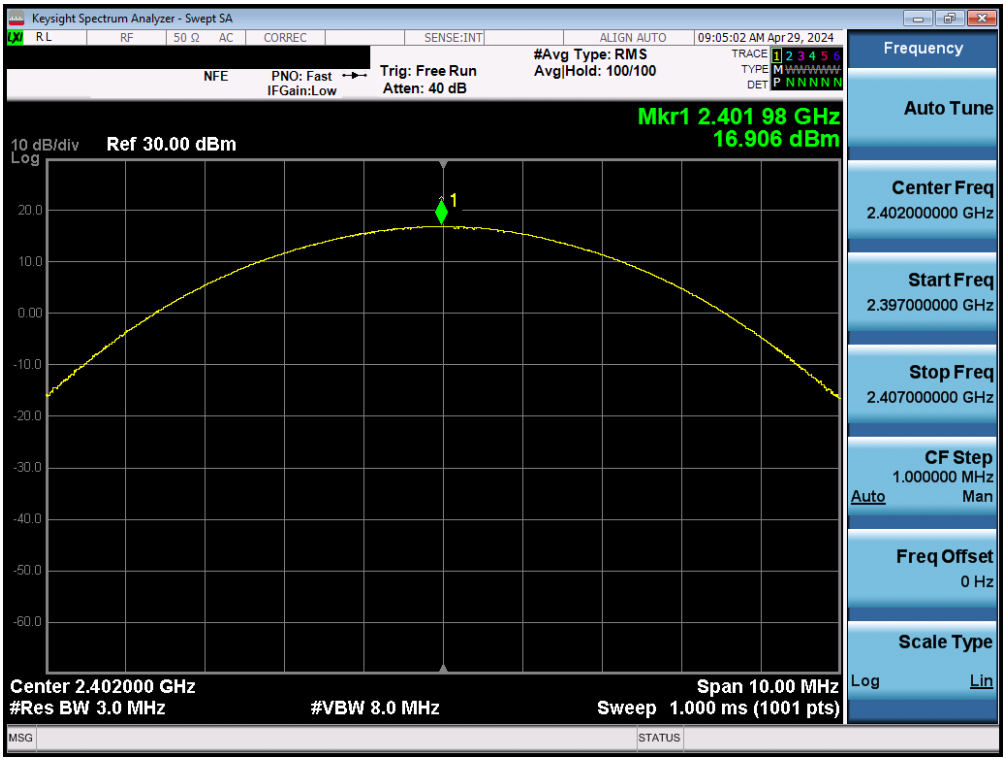
Plot 7-40. Peak Conducted Power (2Mbps – Ch. 0) – Ant 1



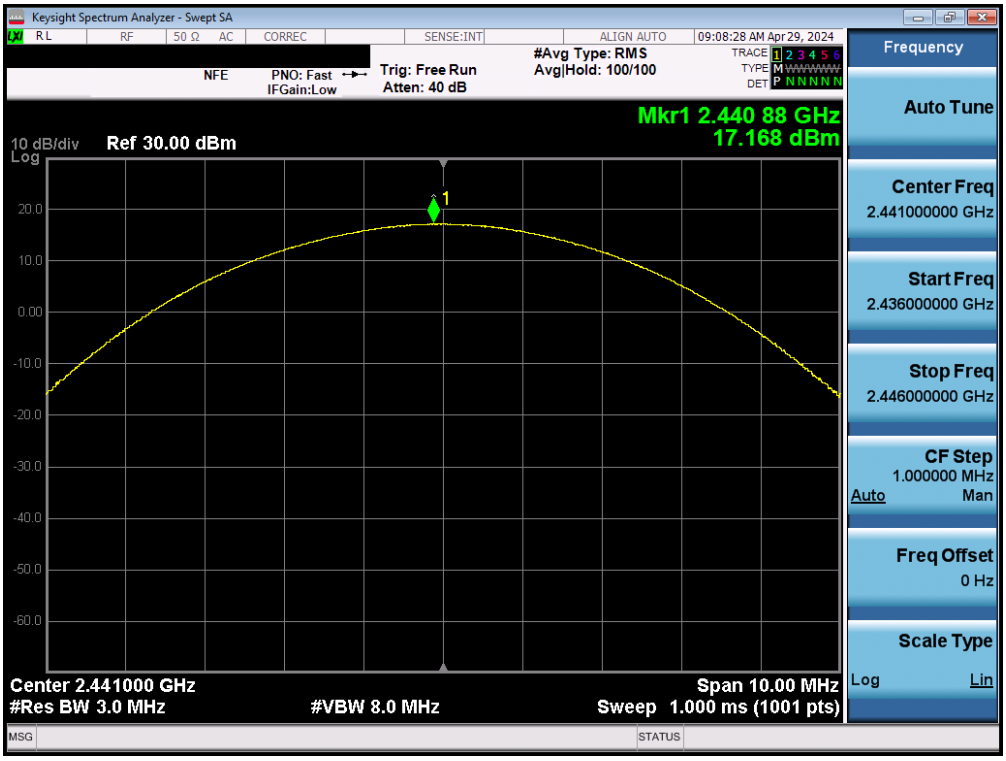
Plot 7-41. Peak Conducted Power (2Mbps – Ch. 39) – Ant 1



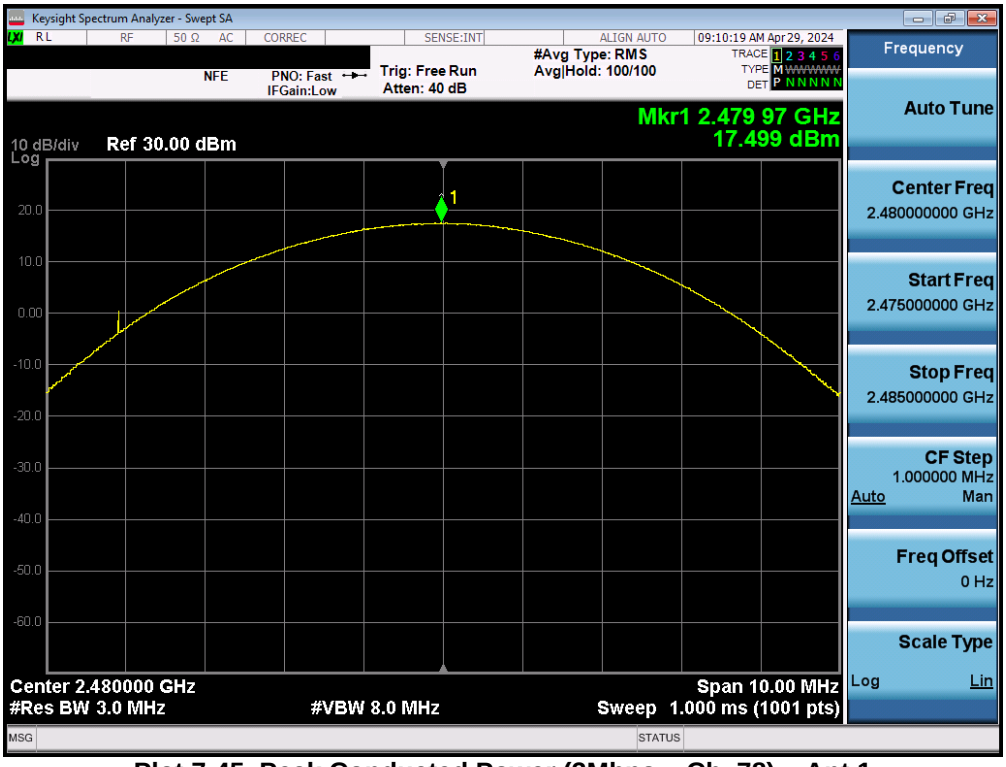
Plot 7-42. Peak Conducted Power (2Mbps – Ch. 78) – Ant 1



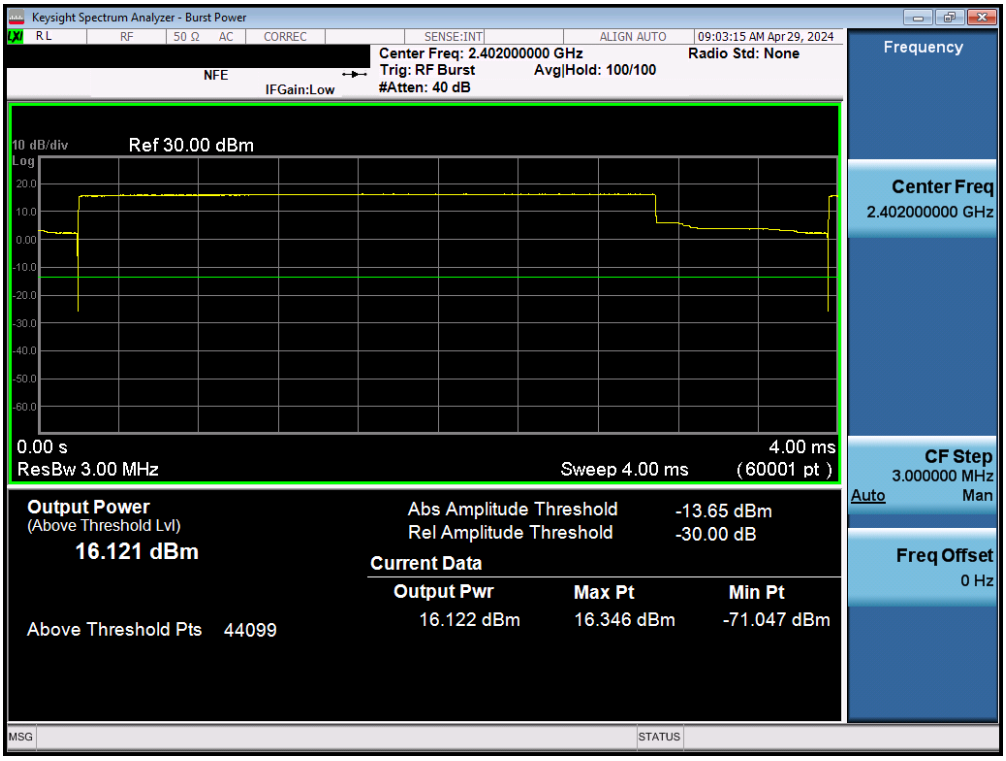
Plot 7-43. Peak Conducted Power (3Mbps – Ch. 0) – Ant 1



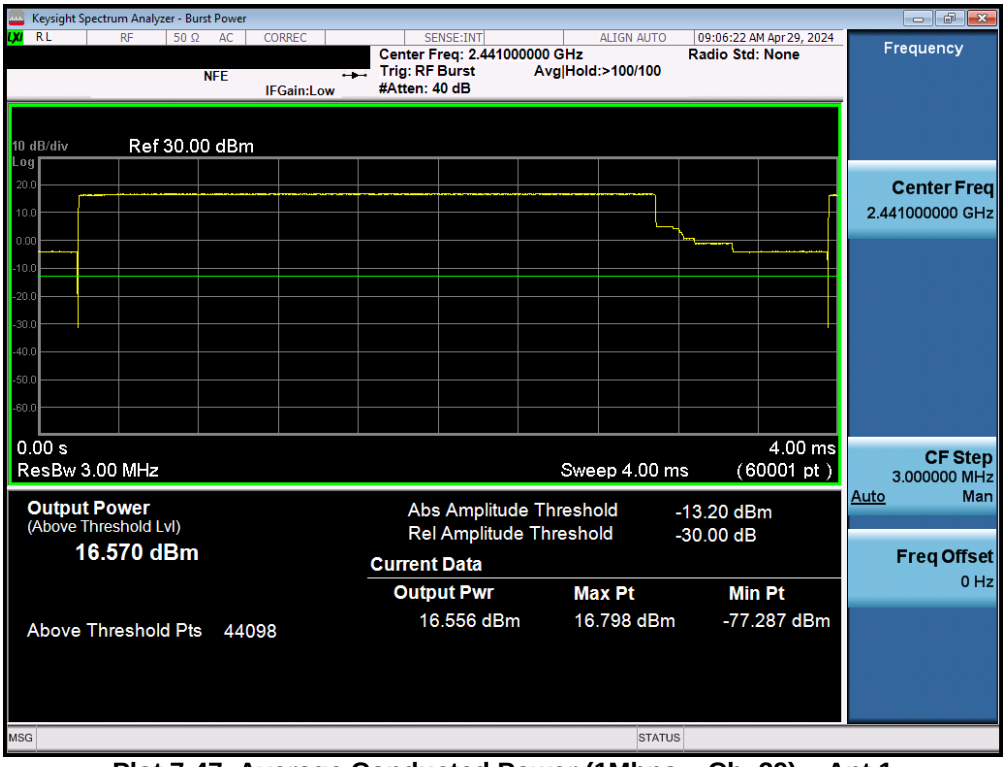
Plot 7-44. Peak Conducted Power (3Mbps – Ch. 39) – Ant 1



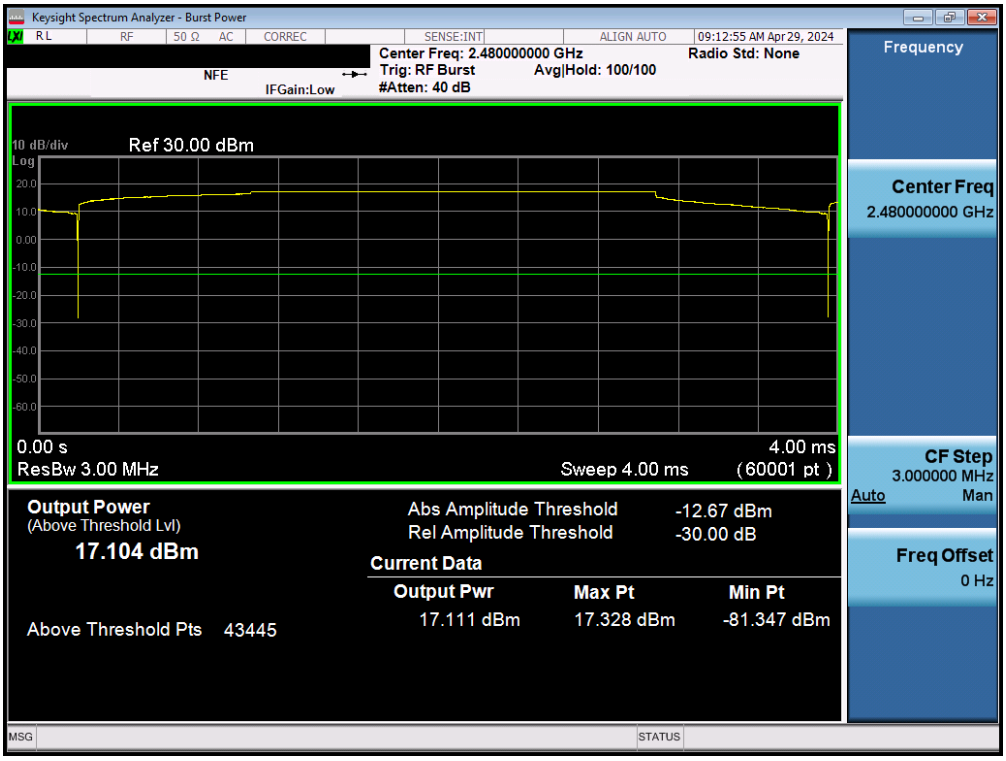
Plot 7-45. Peak Conducted Power (3Mbps – Ch. 78) – Ant 1



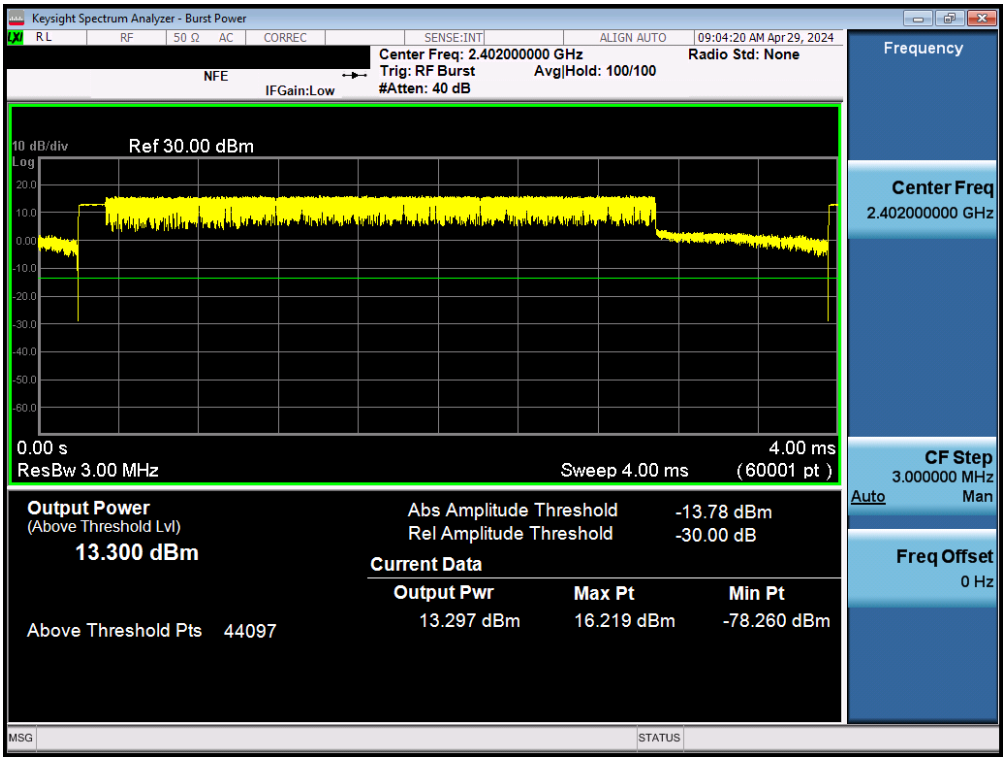
Plot 7-46. Average Conducted Power (1Mbps – Ch. 0) – Ant 1



Plot 7-47. Average Conducted Power (1Mbps – Ch. 39) – Ant 1



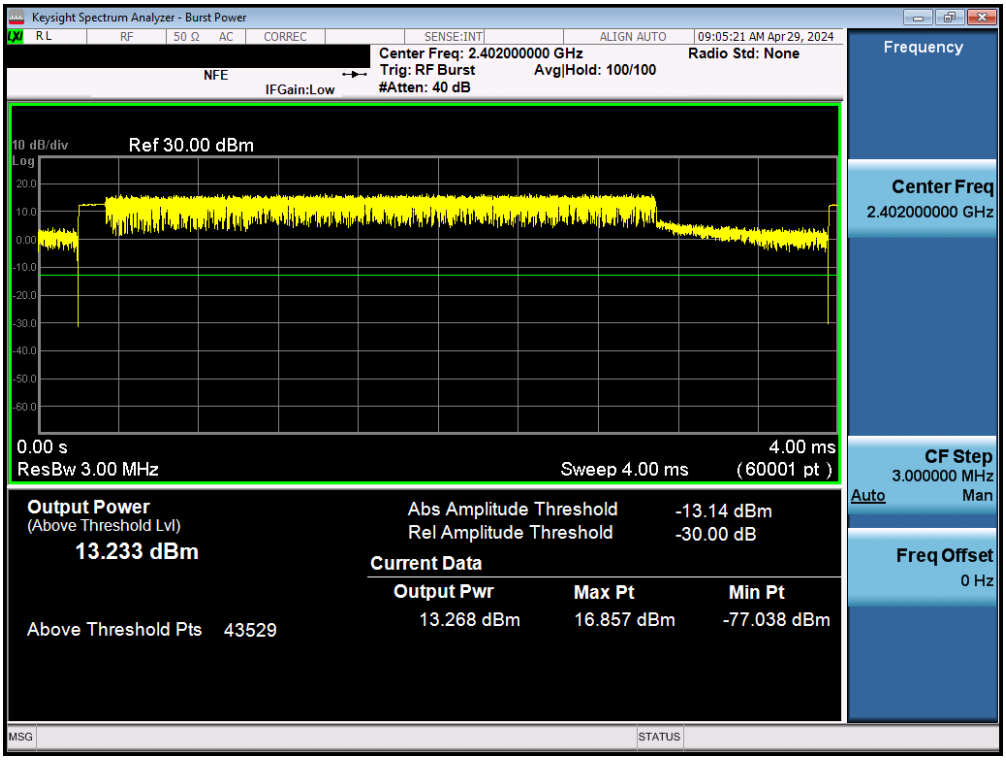
Plot 7-48. Average Conducted Power (1Mbps – Ch. 78) – Ant 1



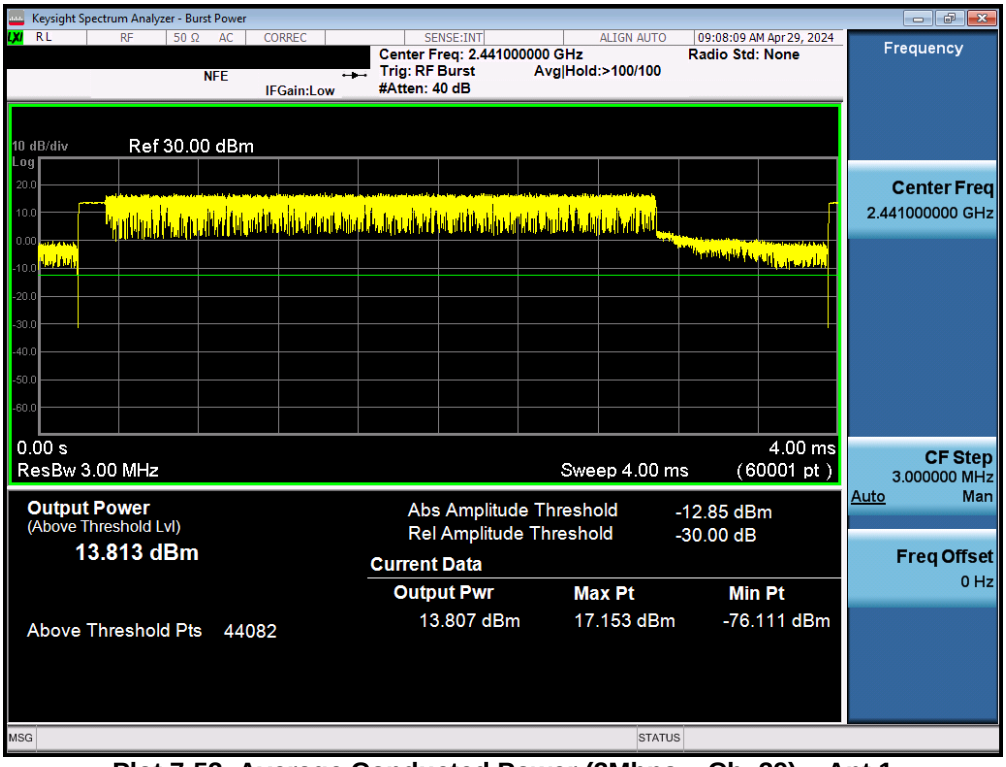
Plot 7-49. Average Conducted Power (2Mbps – Ch. 0) – Ant 1

Plot 7-50. Average Conducted Power (2Mbps – Ch. 39) – Ant 1

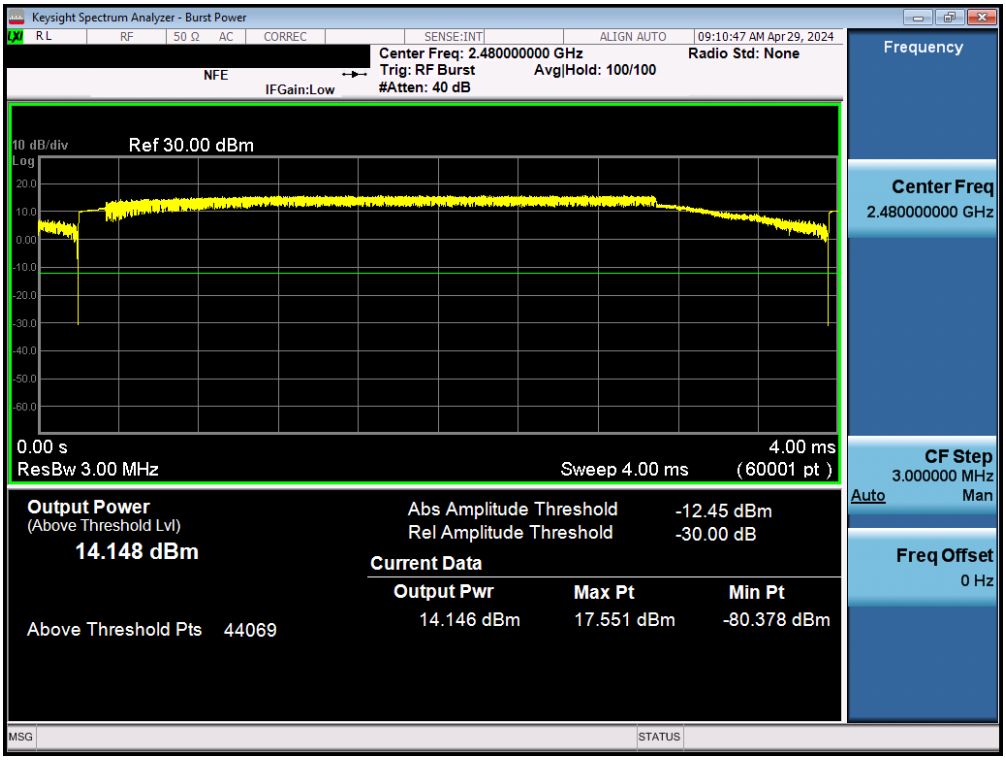
Plot 7-51. Average Conducted Power (2Mbps – Ch. 78) – Ant 1



Plot 7-52. Average Conducted Power (3Mbps – Ch. 0) – Ant 1



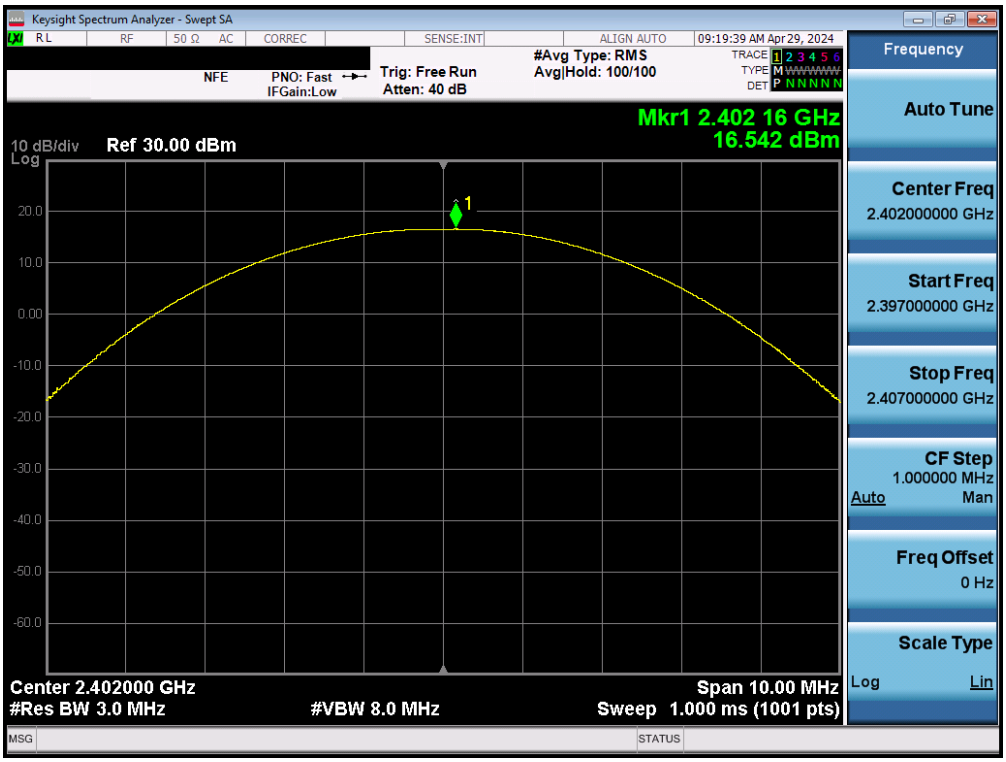
Plot 7-53. Average Conducted Power (3Mbps – Ch. 39) – Ant 1



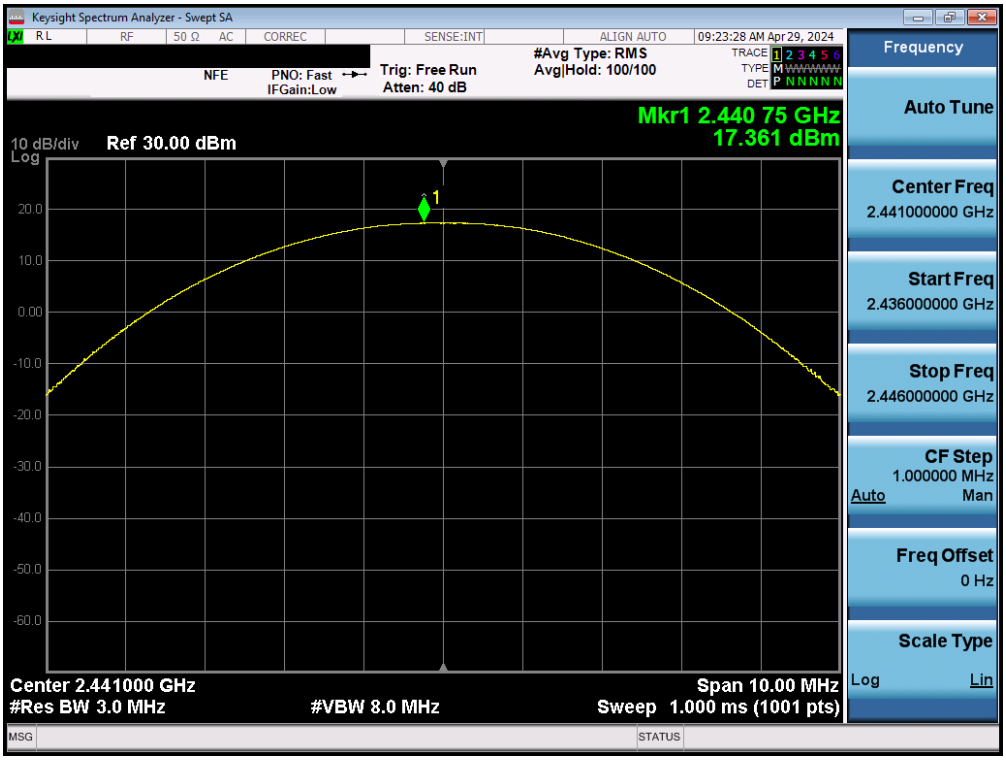
Plot 7-54. Average Conducted Power (3Mbps – Ch. 78) – Ant 1

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	16.54	45.102	16.26	42.218
2441	1.0	39	17.36	54.463	17.00	50.153
2480	1.0	78	17.34	54.188	17.00	50.130
2402	2.0	0	16.47	44.320	13.44	22.095
2441	2.0	39	16.98	49.843	14.21	26.339
2480	2.0	78	17.33	54.075	14.26	26.675
2402	3.0	0	16.97	49.774	13.49	22.310
2441	3.0	39	17.36	54.388	14.19	26.242
2480	3.0	78	17.73	59.347	14.29	26.860

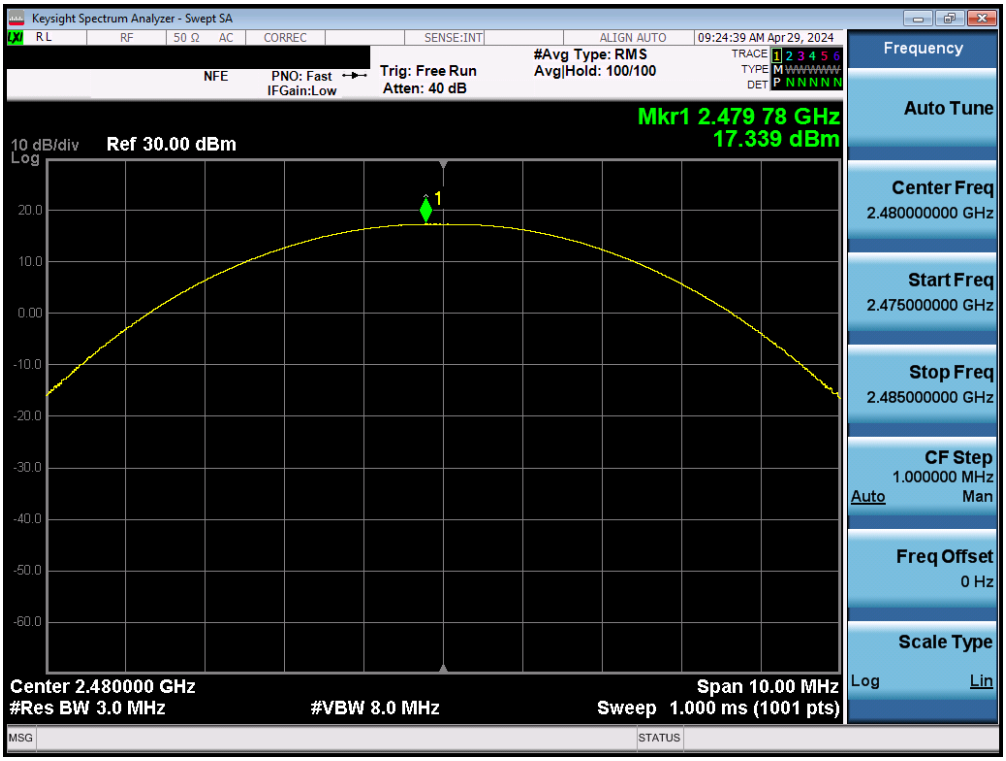
Table 7-7. Conducted Output Power Measurements – Ant 2



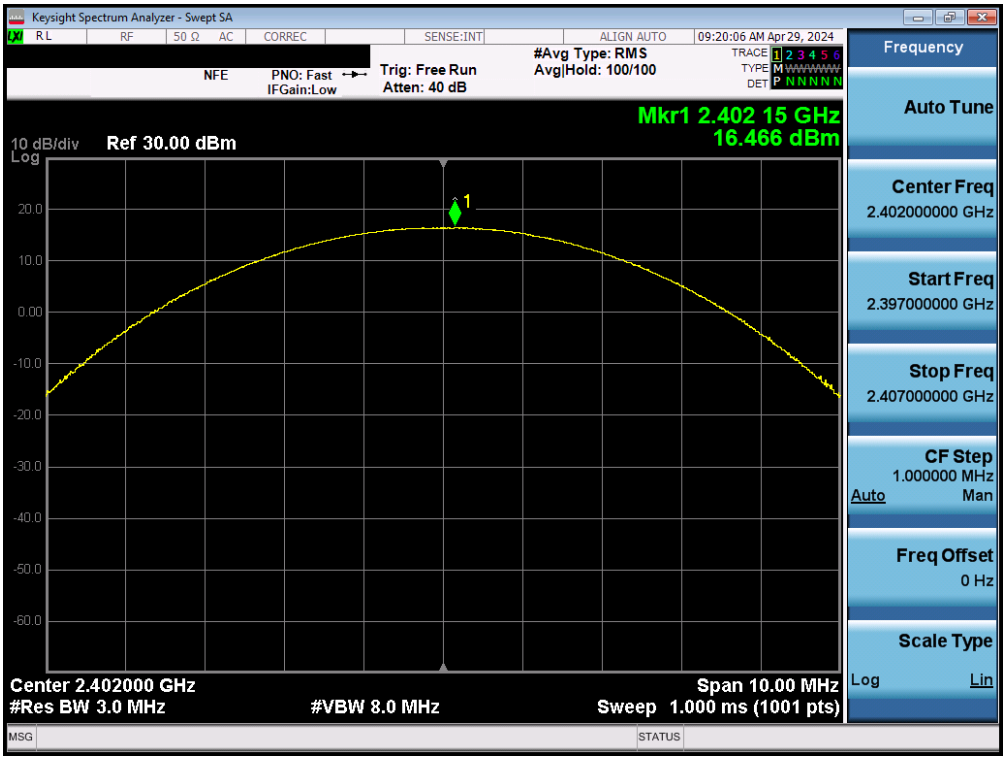
Plot 7-55. Peak Conducted Power (1Mbps – Ch. 0) – Ant 2



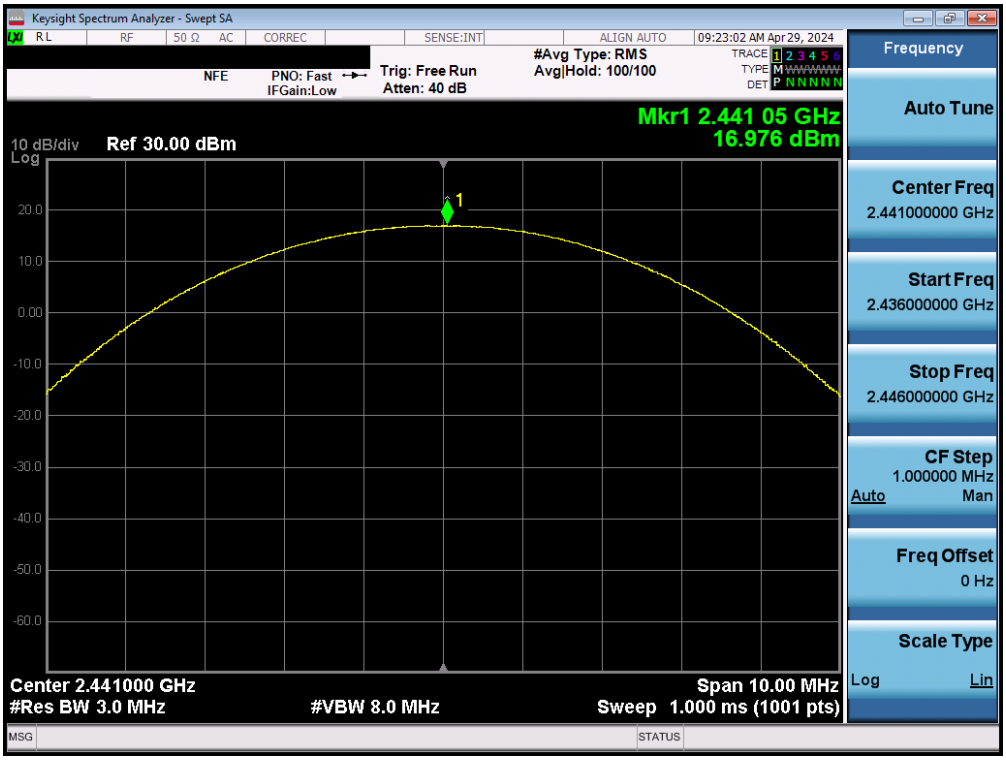
Plot 7-56. Peak Conducted Power (1Mbps – Ch. 39) – Ant 2



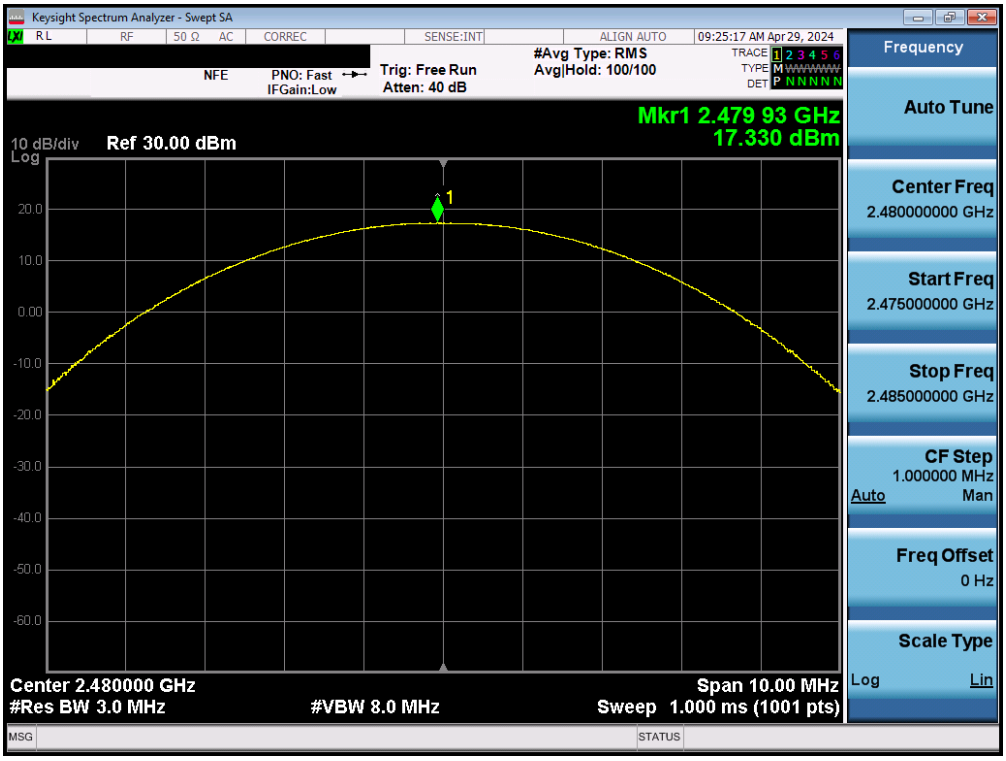
Plot 7-57. Peak Conducted Power (1Mbps – Ch. 78) – Ant 2



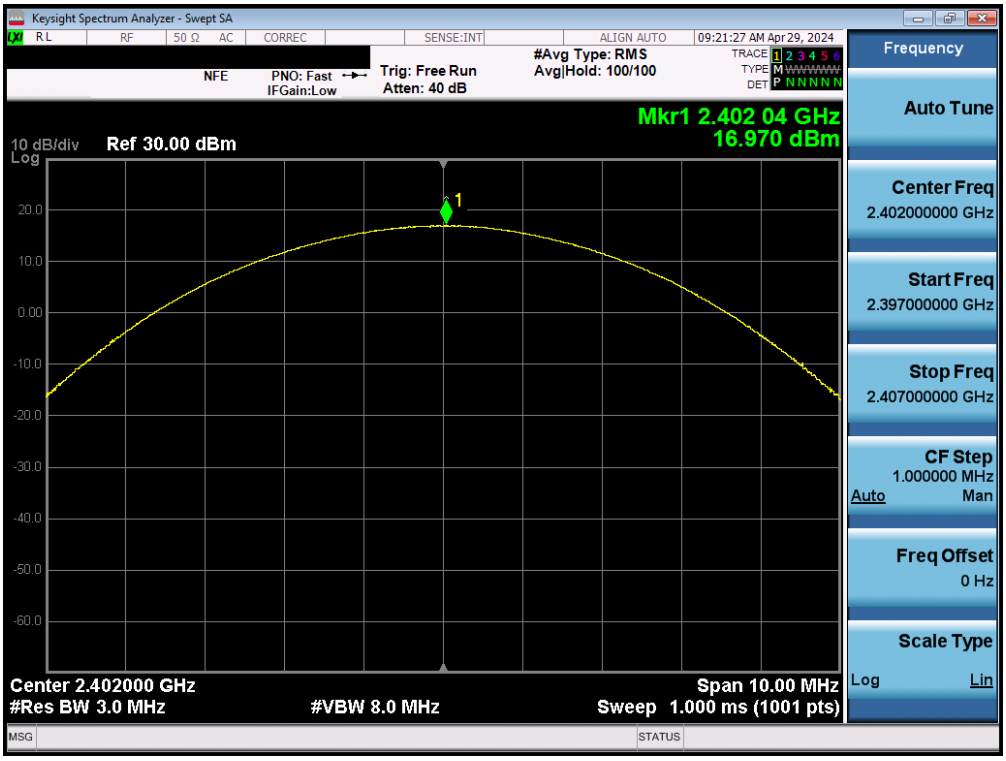
Plot 7-58. Peak Conducted Power (2Mbps – Ch. 0) – Ant 2



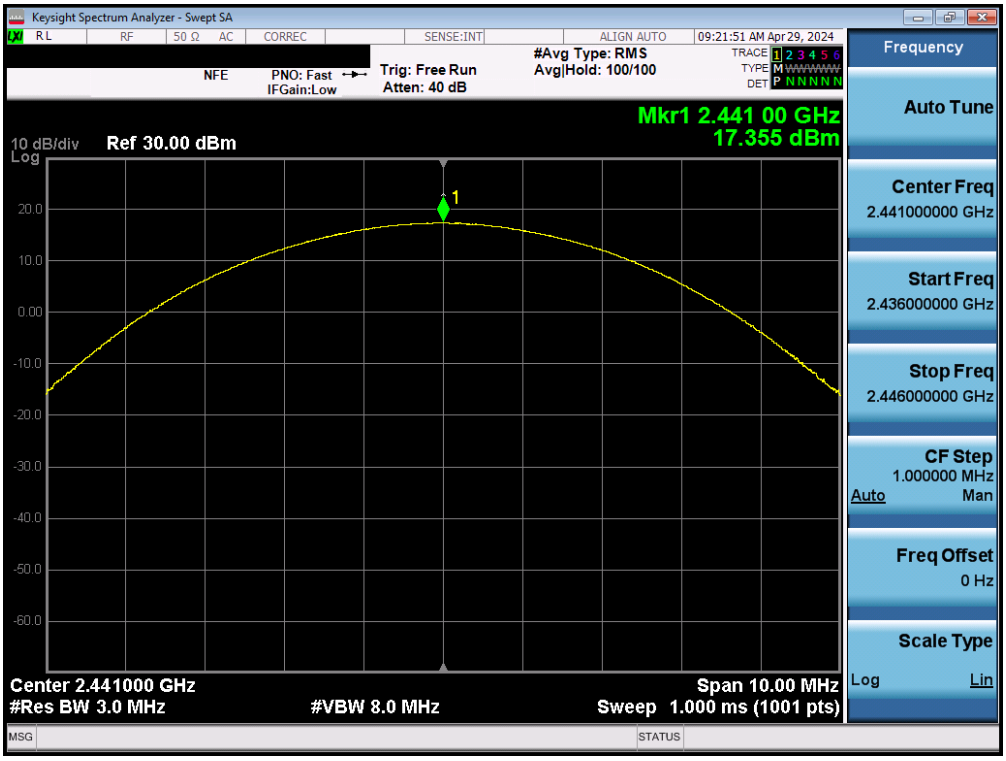
Plot 7-59. Peak Conducted Power (2Mbps – Ch. 39) – Ant 2



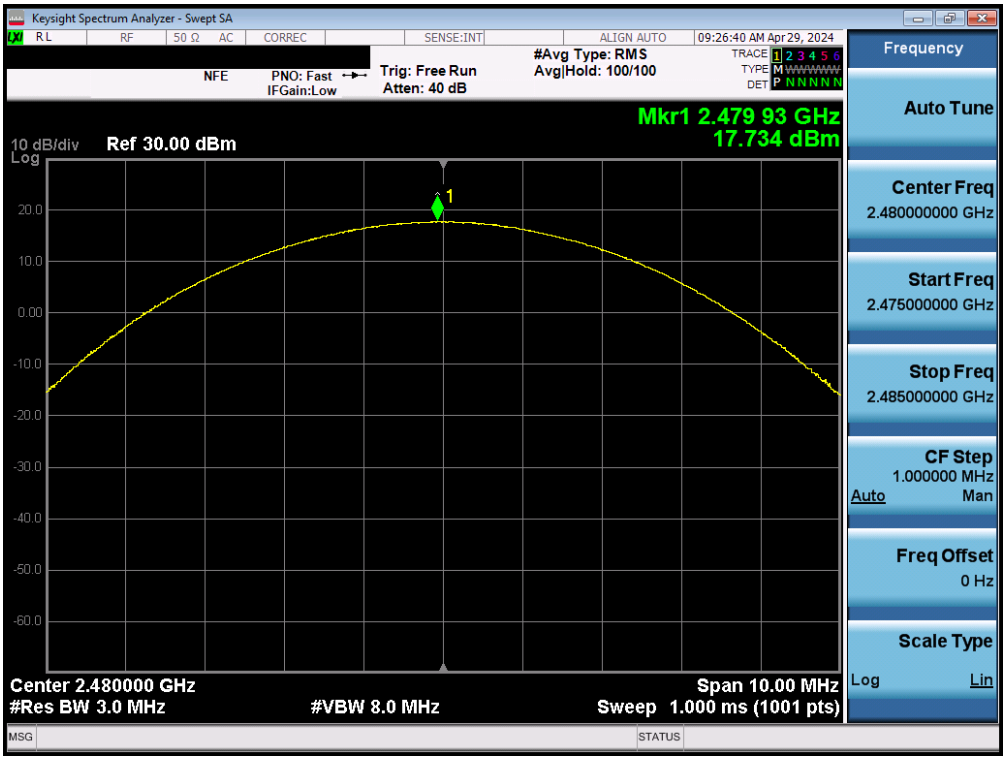
Plot 7-60. Peak Conducted Power (2Mbps – Ch. 78) – Ant 2



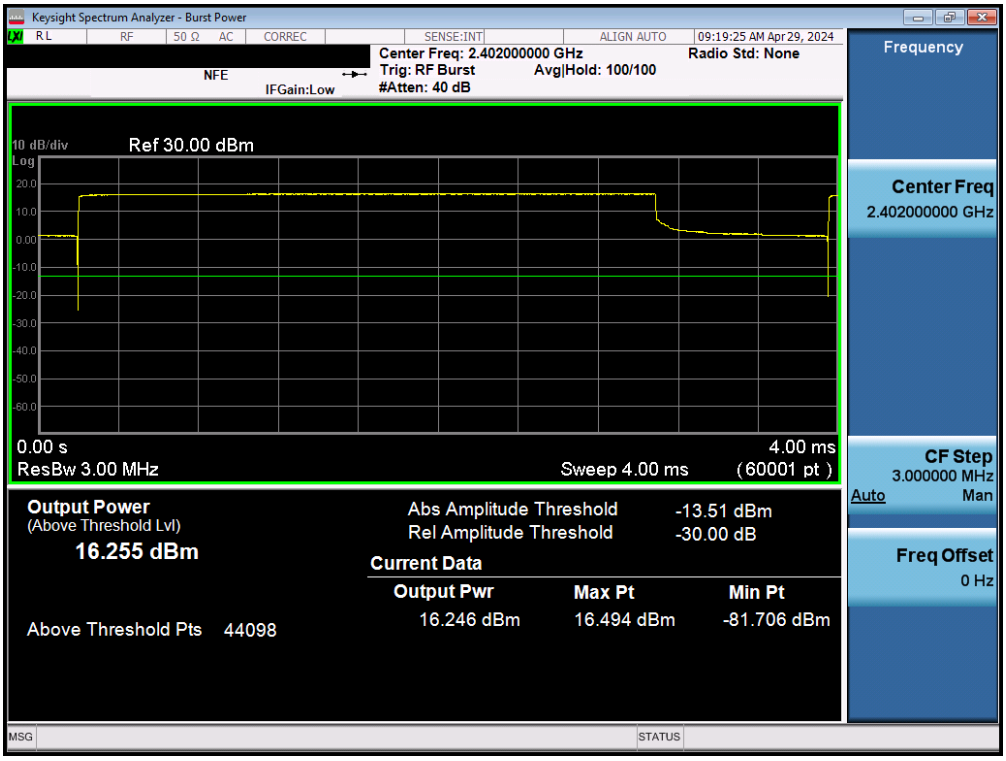
Plot 7-61. Peak Conducted Power (3Mbps – Ch. 0) – Ant 2



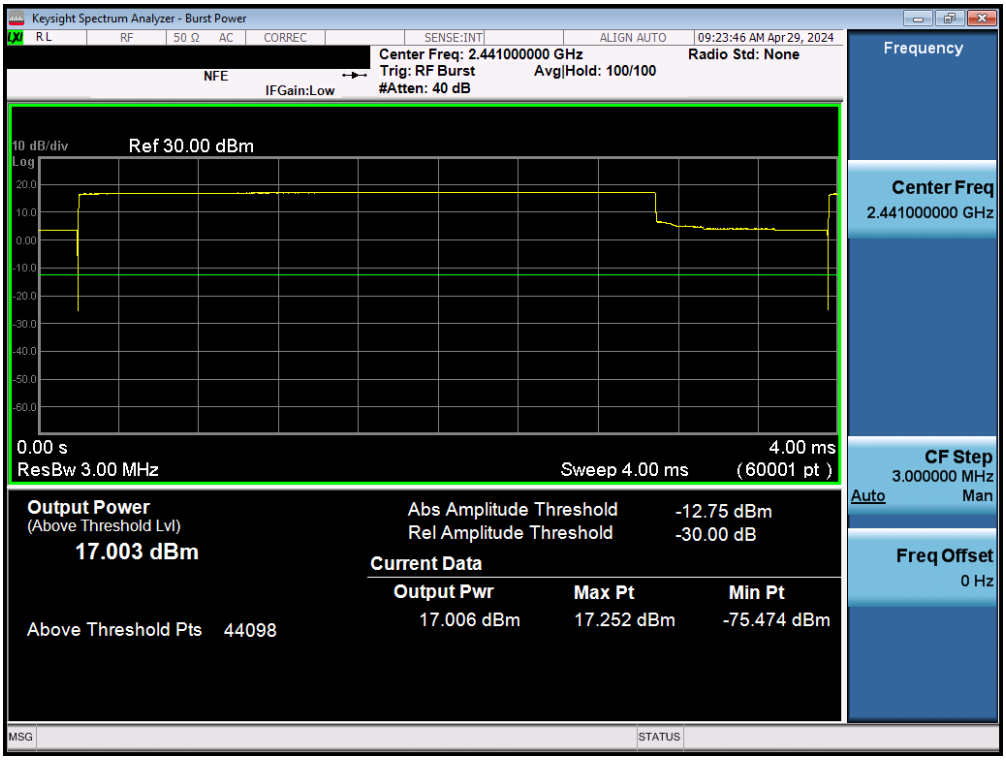
Plot 7-62. Peak Conducted Power (3Mbps – Ch. 39) – Ant 2



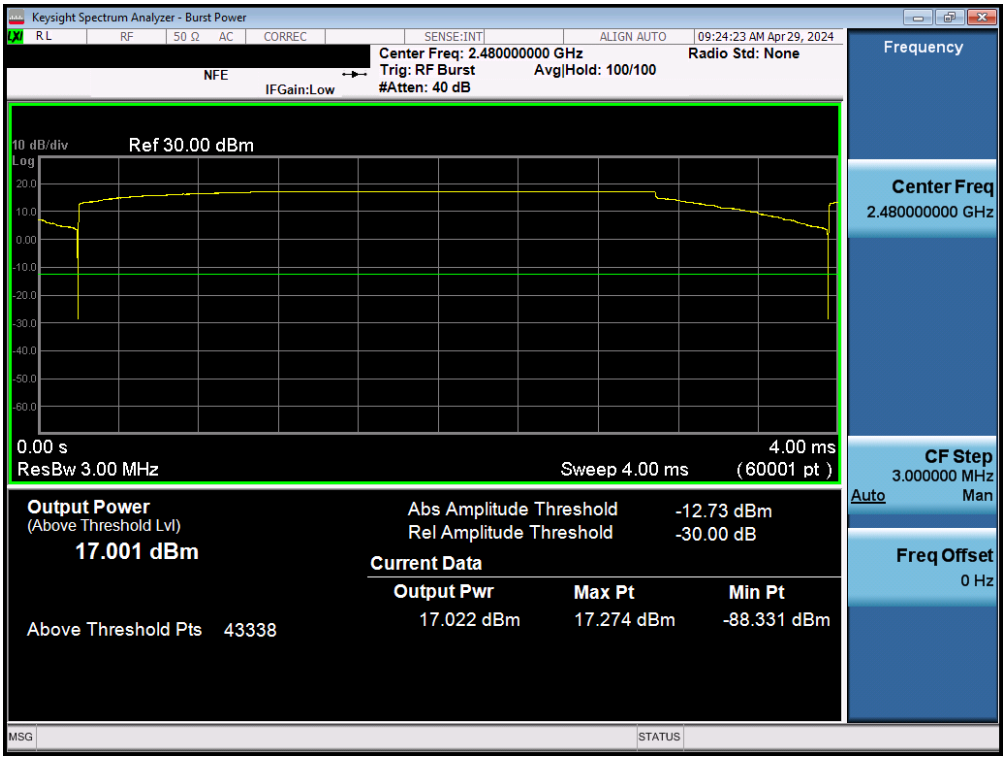
Plot 7-63. Peak Conducted Power (3Mbps – Ch. 78) – Ant 2



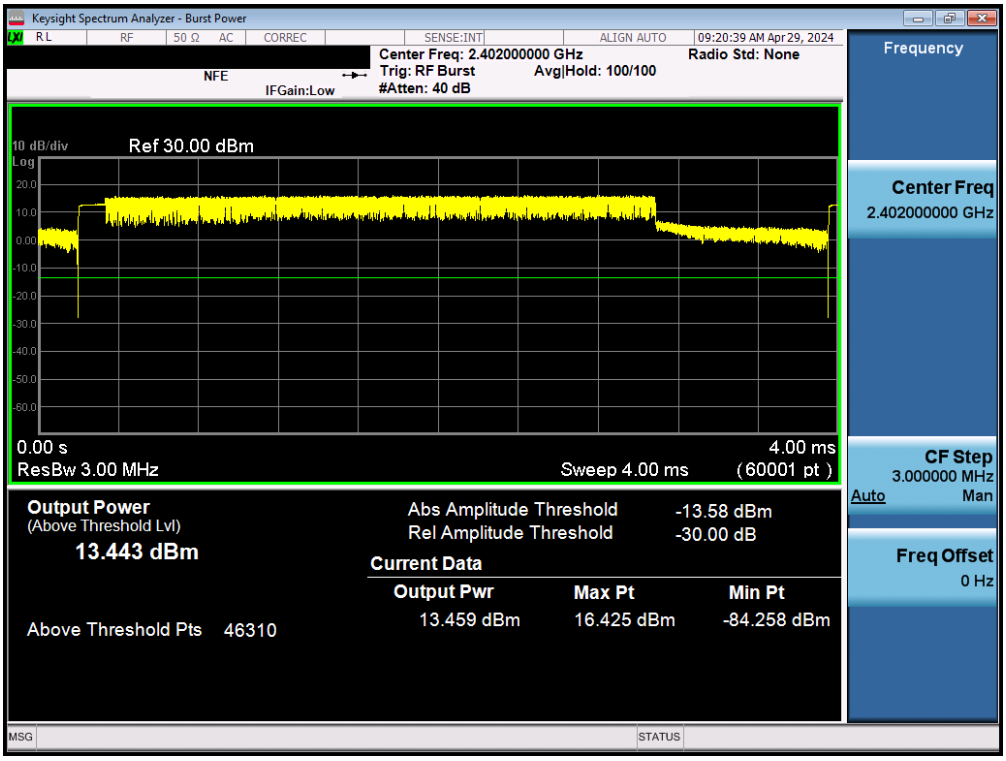
Plot 7-64. Average Conducted Power (1Mbps – Ch. 0) – Ant 2



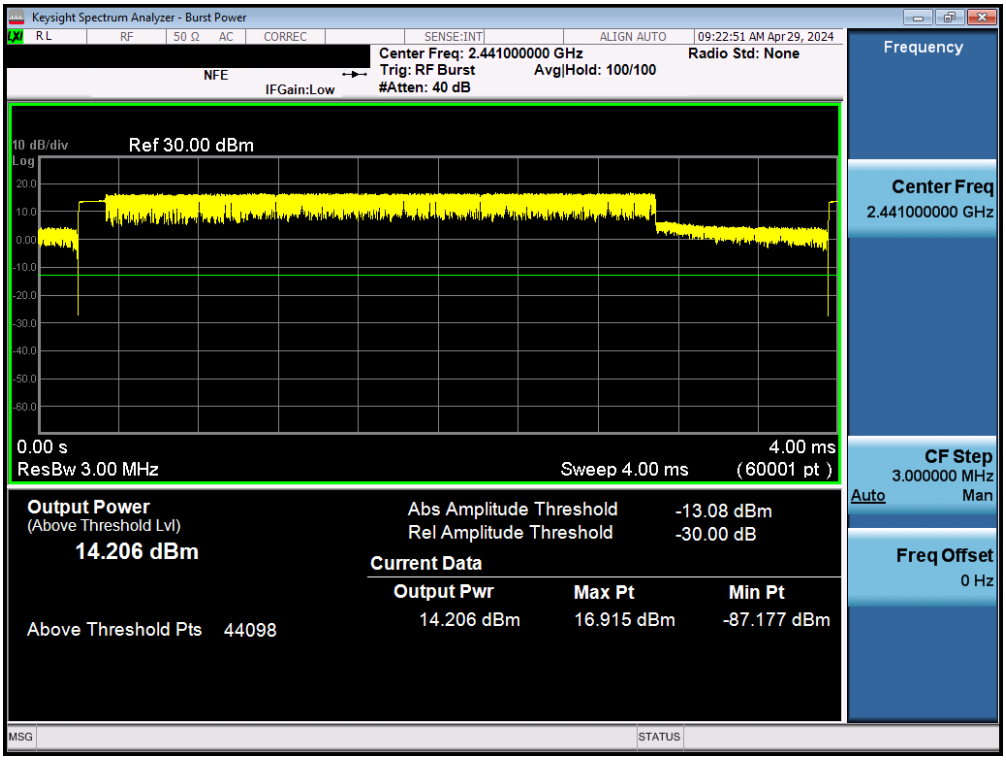
Plot 7-65. Average Conducted Power (1Mbps – Ch. 39) – Ant 2



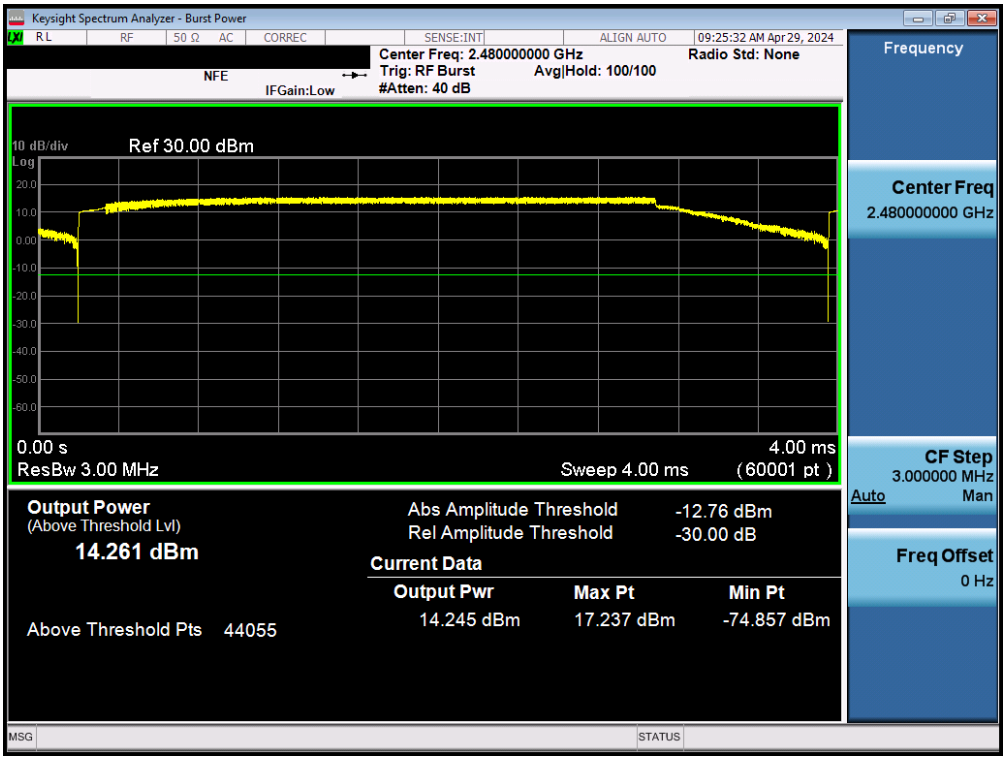
Plot 7-66. Average Conducted Power (1Mbps – Ch. 78) – Ant 2



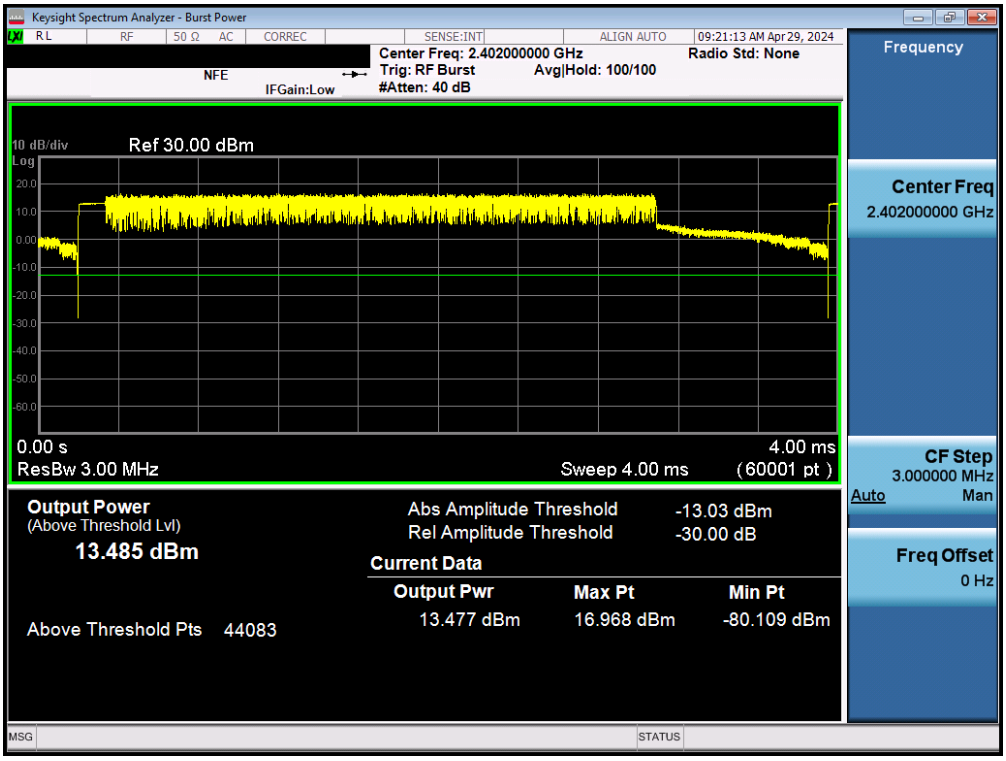
Plot 7-67. Average Conducted Power (2Mbps – Ch. 0) – Ant 2



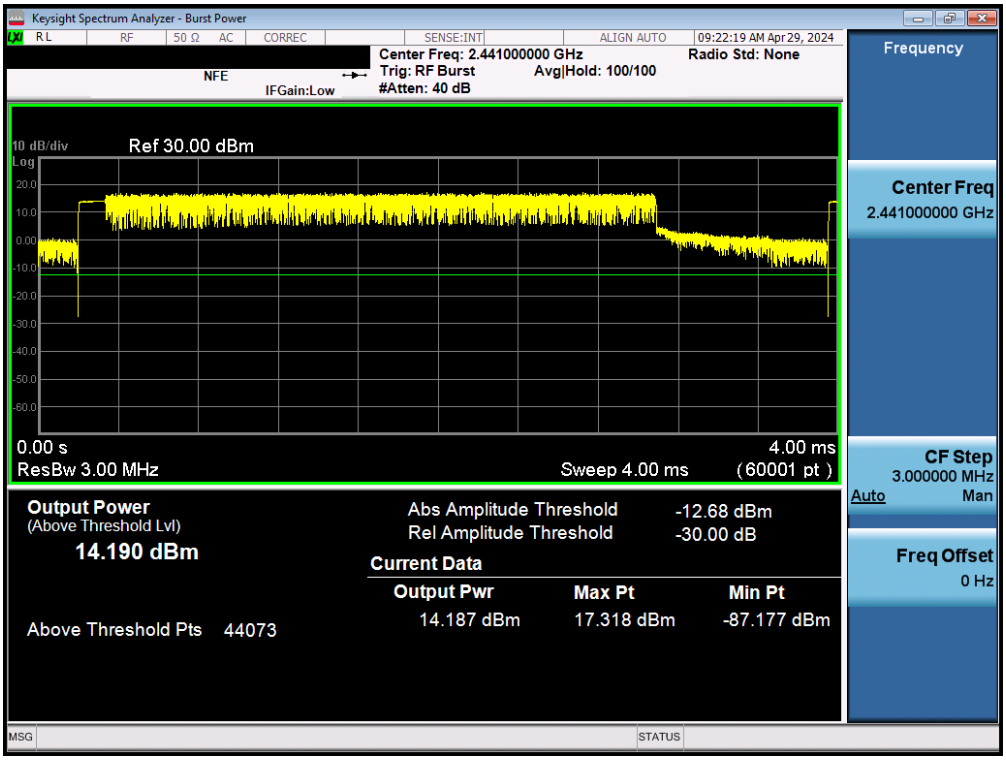
Plot 7-68. Average Conducted Power (2Mbps – Ch. 39) – Ant 2



Plot 7-69. Average Conducted Power (2Mbps – Ch. 78) – Ant 2



Plot 7-70. Average Conducted Power (3Mbps – Ch. 0) – Ant 2

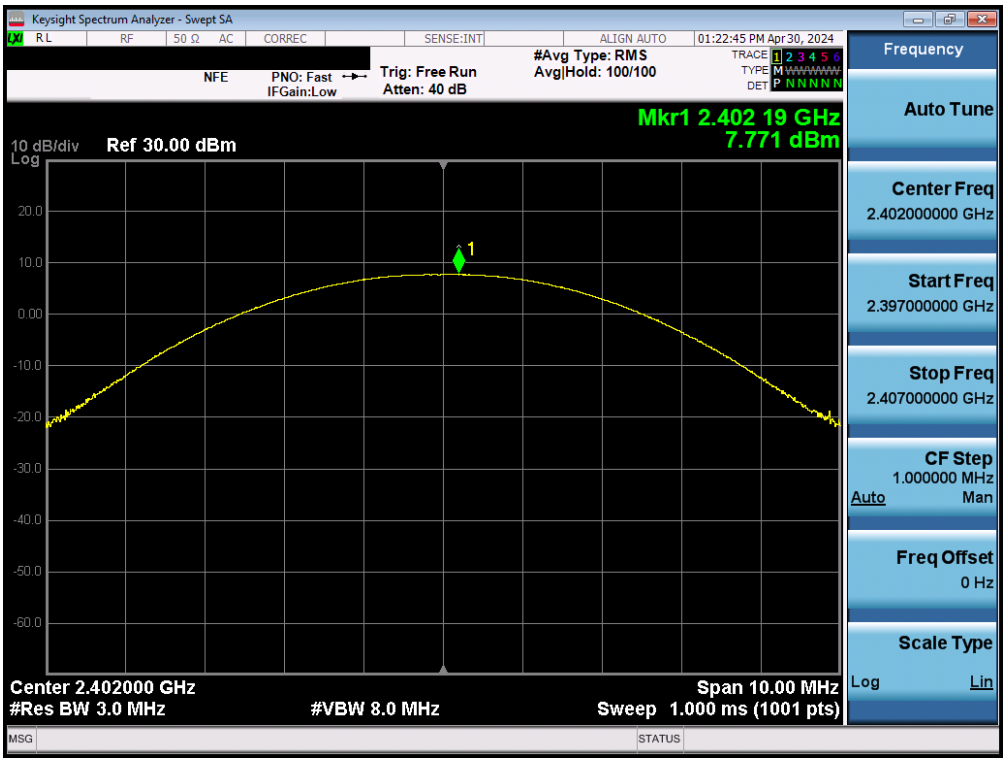


Plot 7-71. Average Conducted Power (3Mbps – Ch. 39) – Ant 2

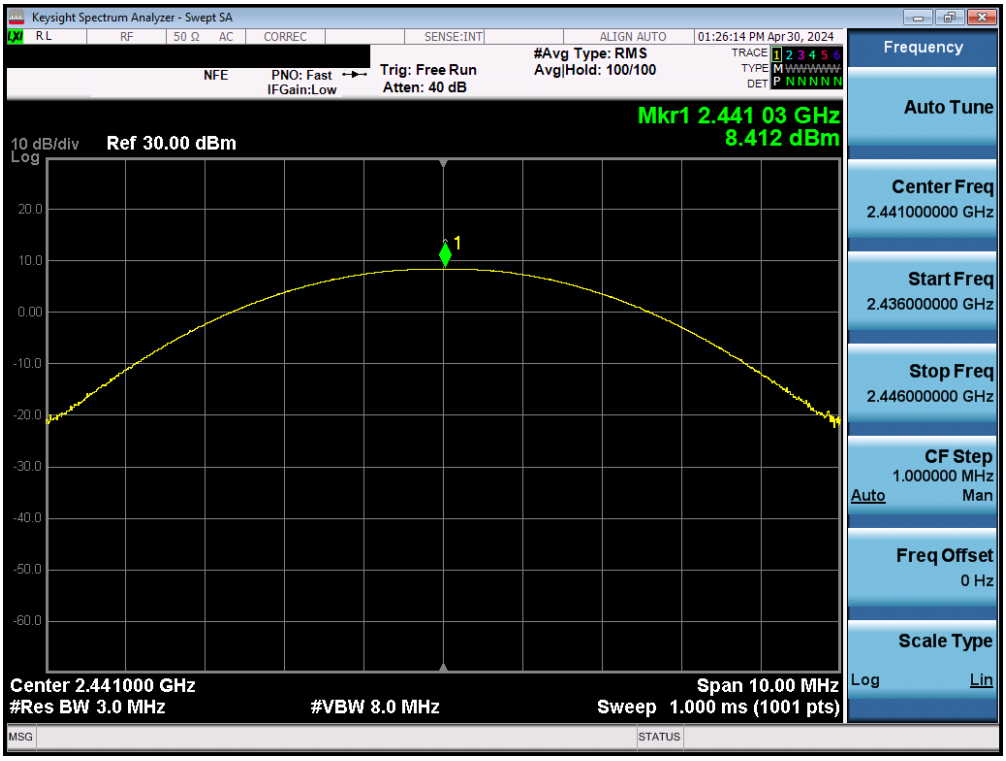
Plot 7-72. Average Conducted Power (3Mbps – Ch. 78) – Ant 2

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power Ant 1		Peak Conducted Power Ant 2		Avg Conducted Power Ant 1		Avg Conducted Power Ant 2		Peak Conducted Power MIMO		Avg Conducted Power MIMO	
			[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	7.77	5.985	12.65	18.391	7.47	5.580	12.42	17.458	13.87	24.376	13.62	23.038
2441	1.0	39	8.41	6.937	12.68	18.523	8.15	6.527	12.43	17.507	14.06	25.460	13.81	24.033
2480	1.0	78	8.93	7.813	13.41	21.928	8.69	7.396	13.21	20.922	14.73	29.741	14.52	28.318
2402	2.0	0	10.12	10.271	11.83	15.241	7.36	5.448	8.57	7.187	14.07	25.511	11.02	12.634
2441	2.0	39	10.81	12.056	11.78	15.063	8.08	6.420	9.19	8.298	14.33	27.119	11.68	14.718
2480	2.0	78	10.11	10.257	12.28	16.885	7.64	5.803	9.68	9.296	14.34	27.141	11.79	15.099
2402	3.0	0	10.66	11.633	12.53	17.902	7.37	5.455	8.56	7.175	14.70	29.535	11.01	12.630
2441	3.0	39	11.36	13.677	12.27	16.877	8.06	6.404	9.20	8.318	14.85	30.554	11.68	14.722
2480	3.0	78	10.52	11.275	12.69	18.557	7.64	5.806	9.68	9.281	14.75	29.831	11.79	15.087

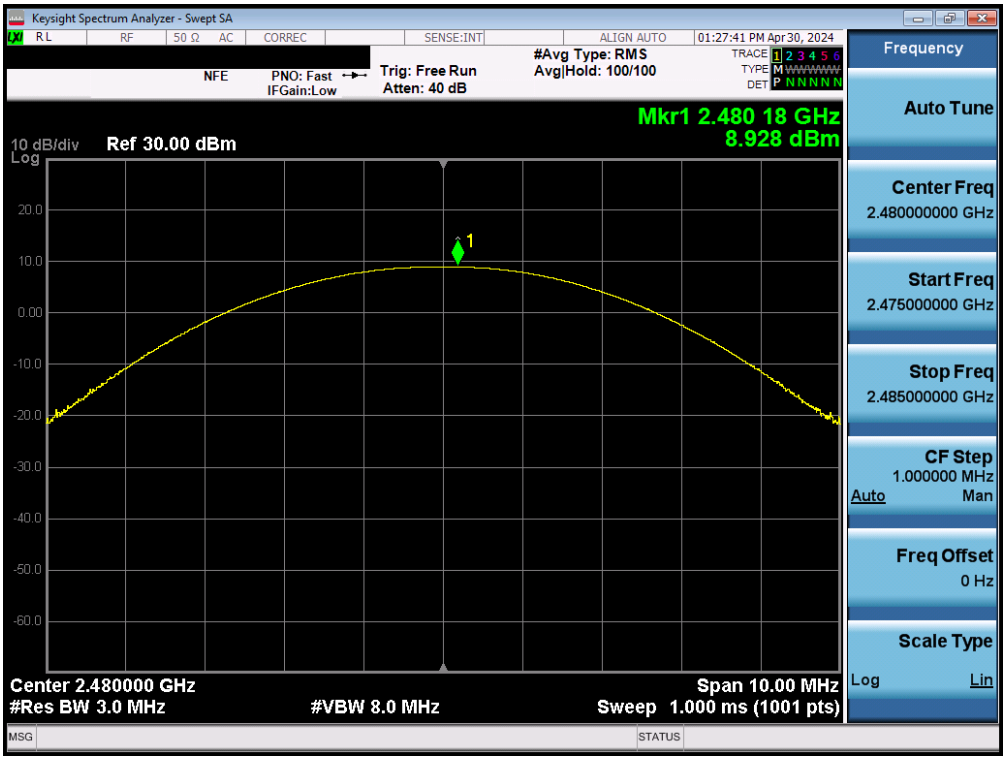
Table 7-8. Conducted Output Power Measurements – Dual Ant



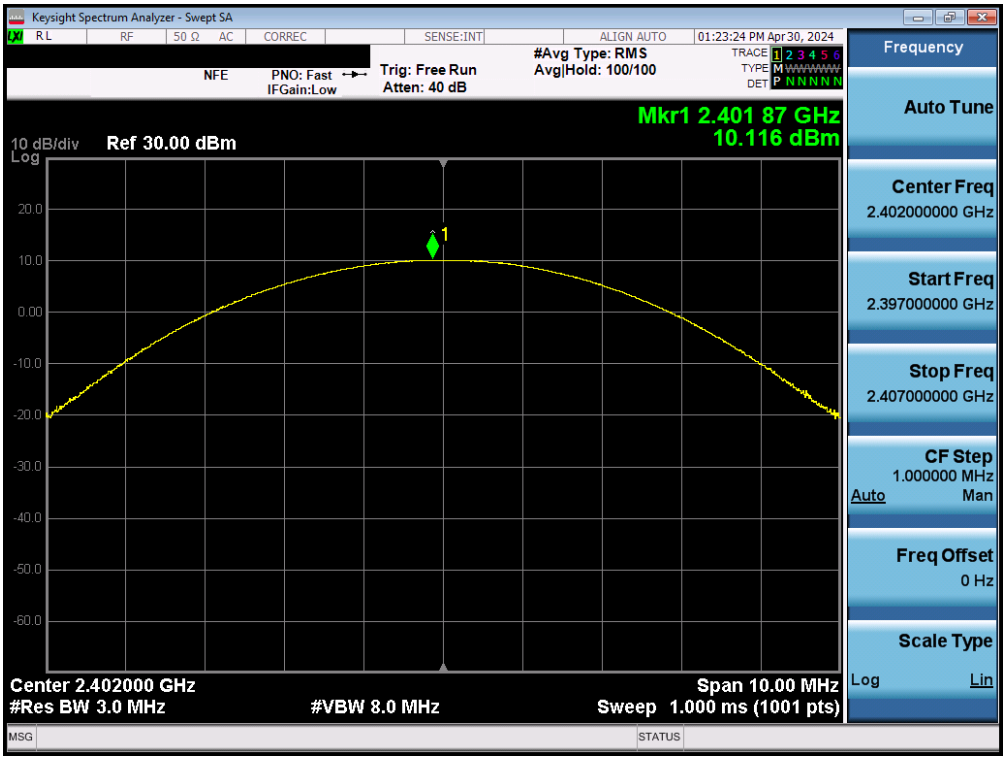
Plot 7-73. Peak Conducted Power (1Mbps – Ch. 0) – Dual Ant 1



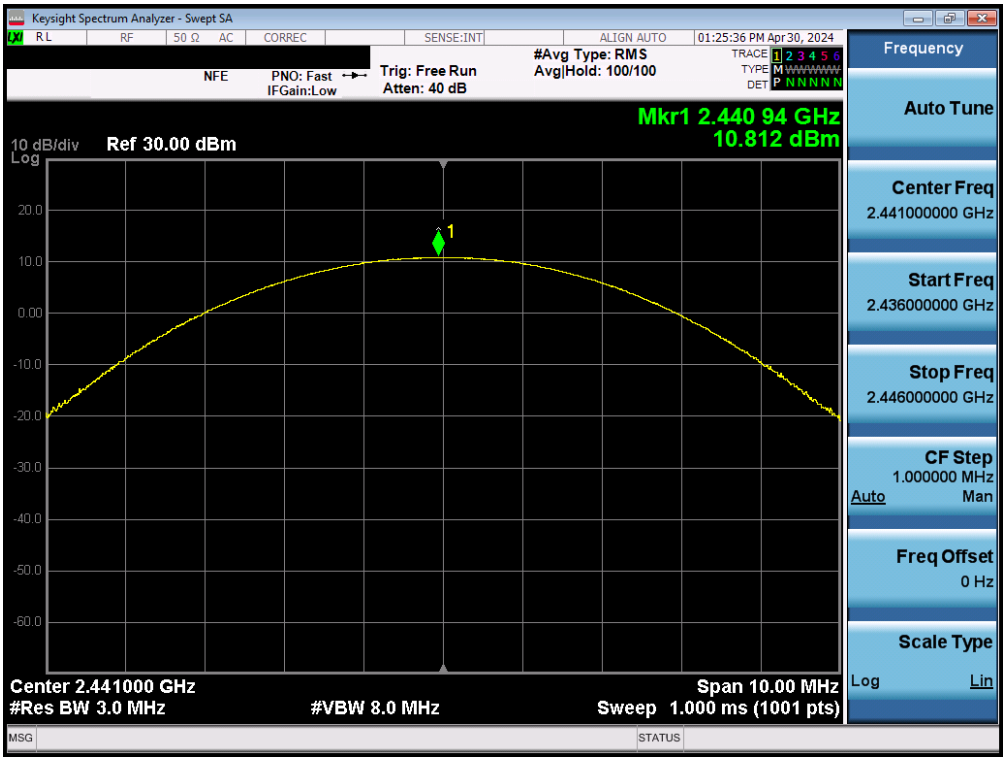
Plot 7-74. Peak Conducted Power (1Mbps – Ch. 39) – Dual Ant 1



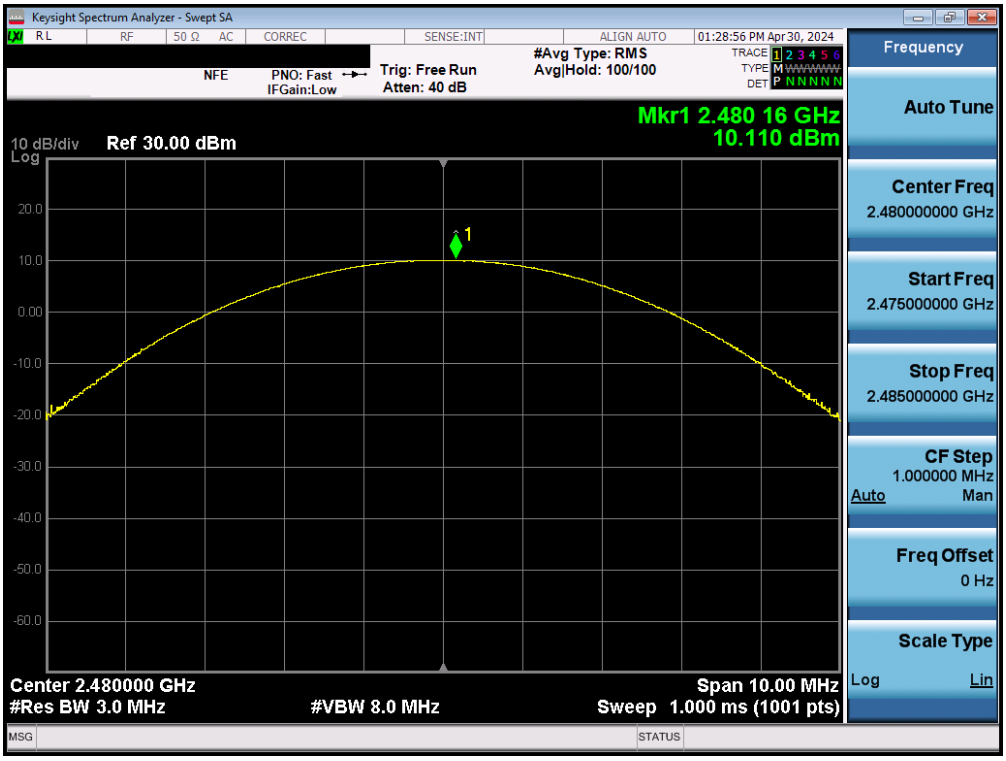
Plot 7-75. Peak Conducted Power (1Mbps – Ch. 78) – Dual Ant 1



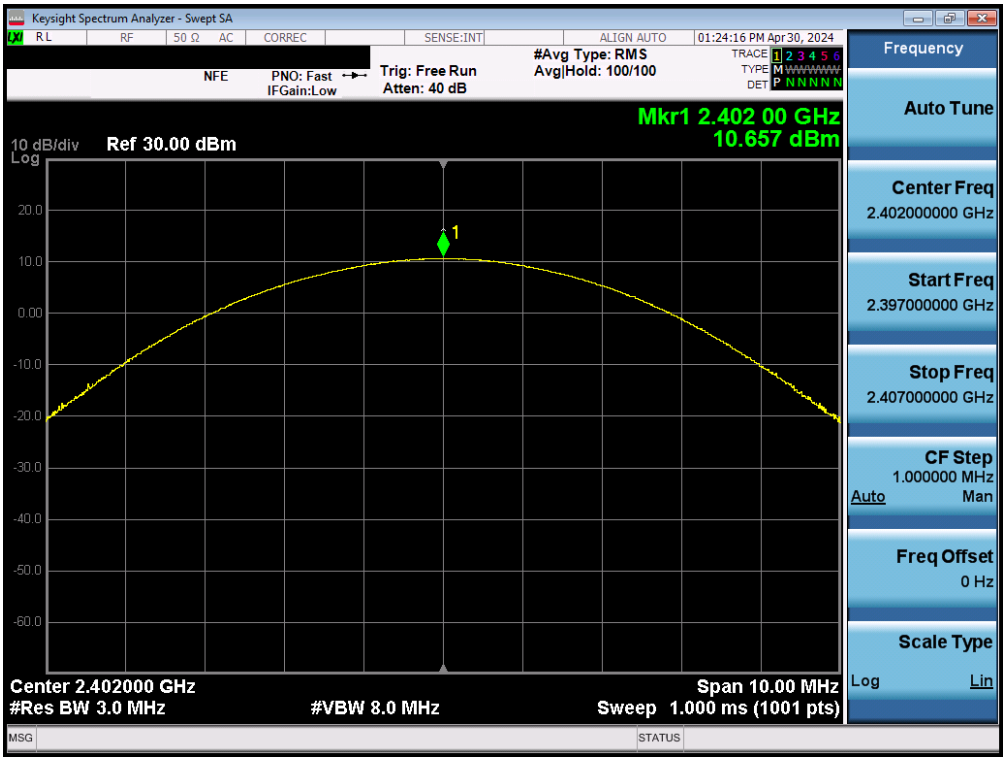
Plot 7-76. Peak Conducted Power (2Mbps – Ch. 0) – Dual Ant 1



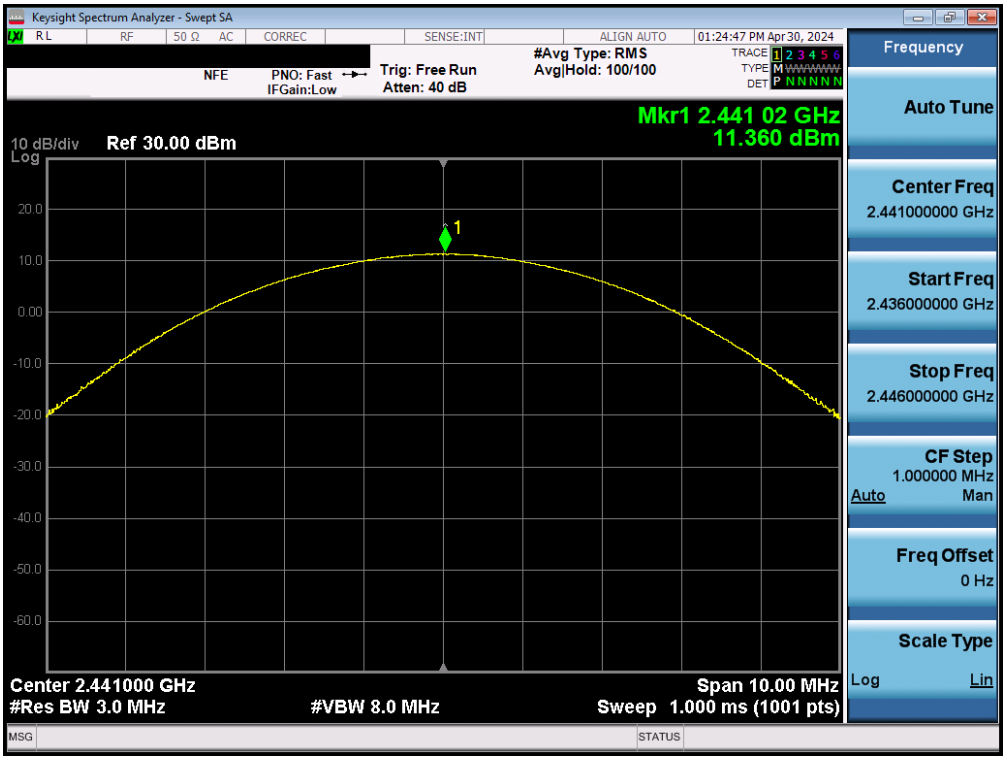
Plot 7-77. Peak Conducted Power (2Mbps – Ch. 39) – Dual Ant 1



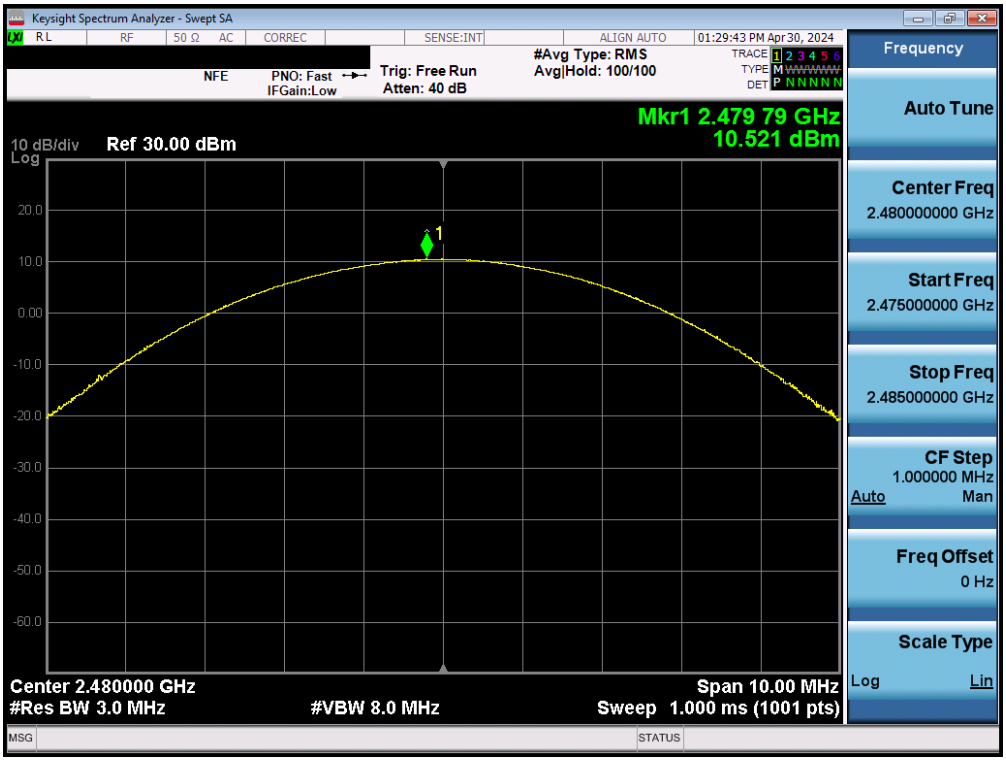
Plot 7-78. Peak Conducted Power (2Mbps – Ch. 78) – Dual Ant 1



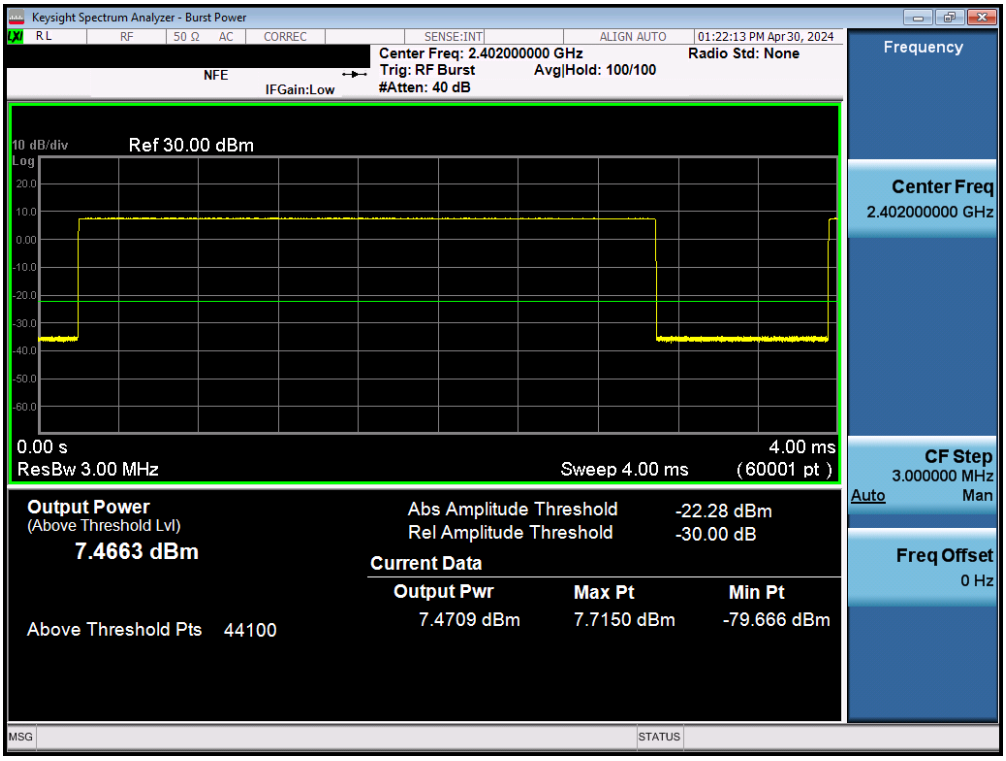
Plot 7-79. Peak Conducted Power (3Mbps – Ch. 0) – Dual Ant 1



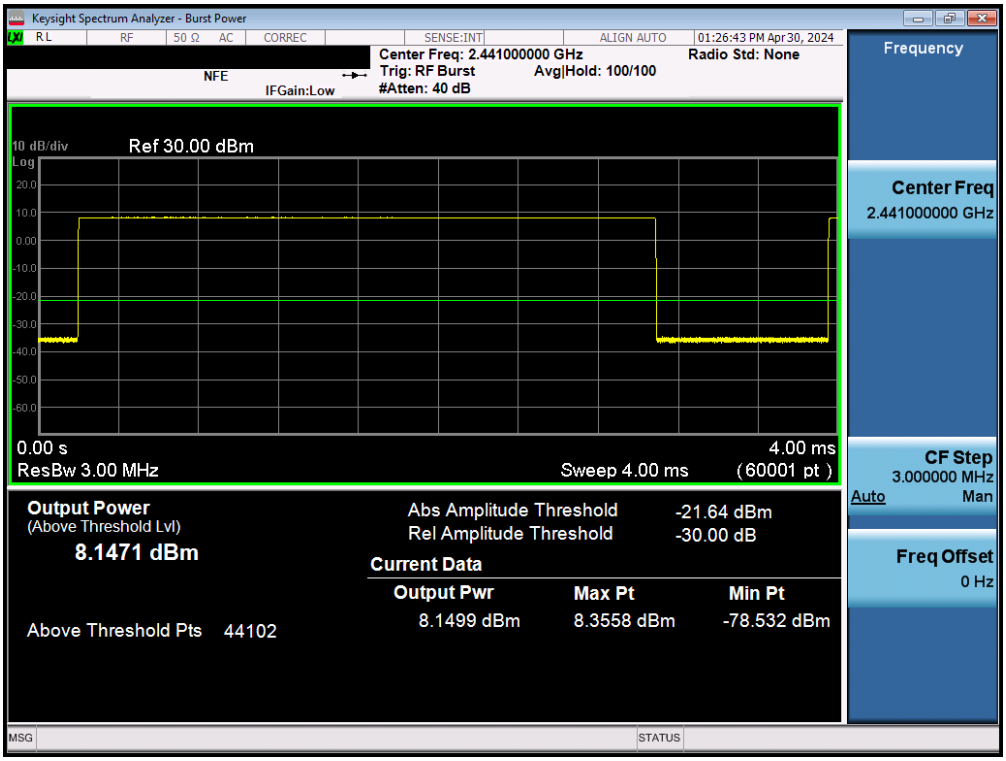
Plot 7-80. Peak Conducted Power (3Mbps – Ch. 39) – Dual Ant 1



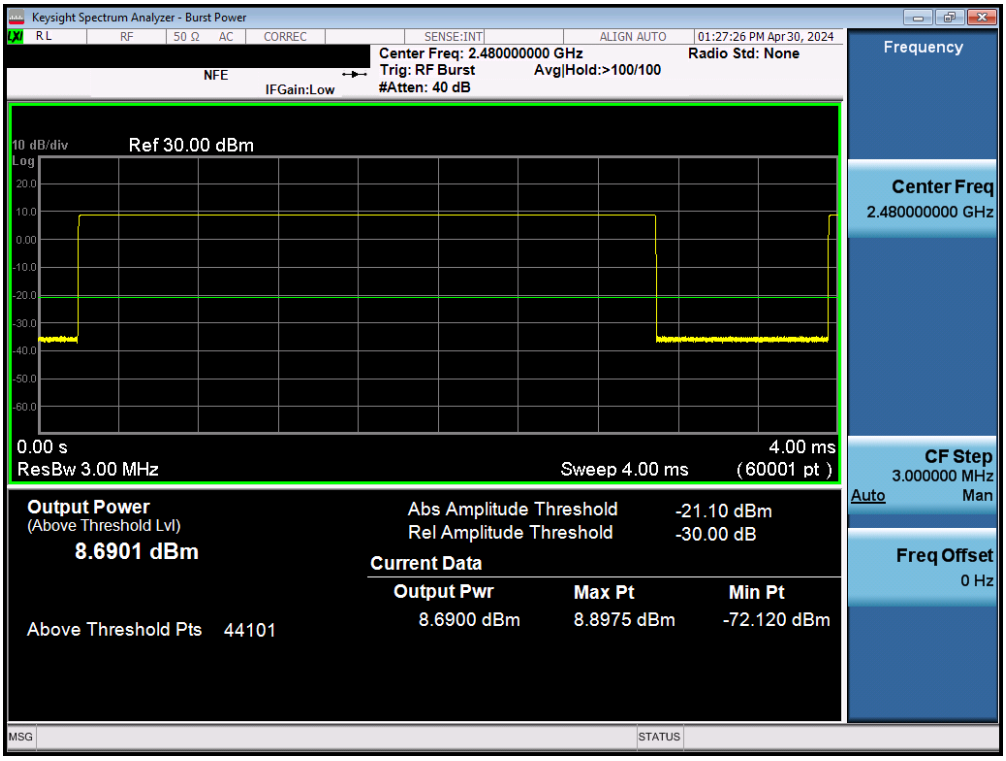
Plot 7-81. Peak Conducted Power (3Mbps – Ch. 78) – Dual Ant 1



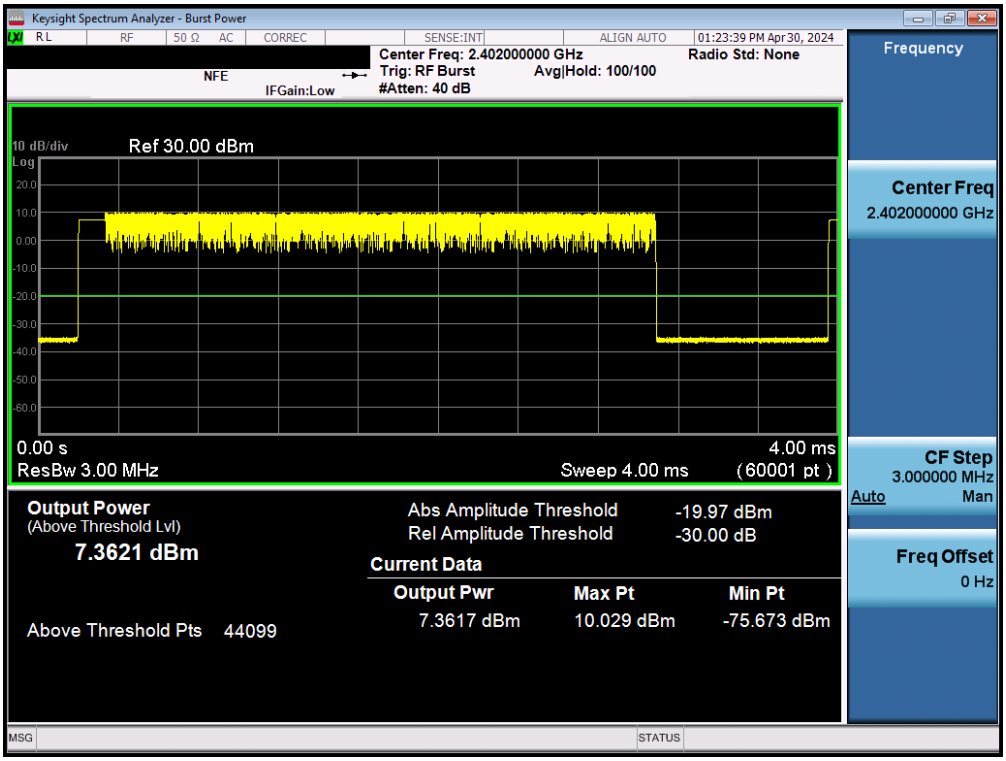
Plot 7-82. Average Conducted Power (1Mbps – Ch. 0) – Dual Ant 1



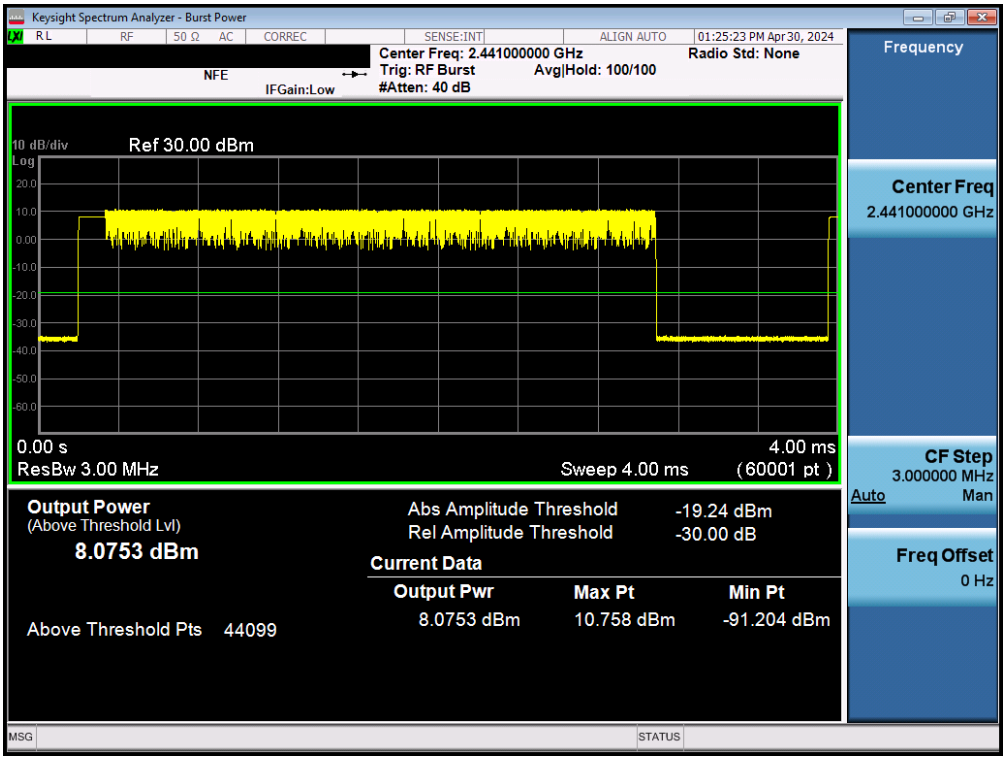
Plot 7-83. Average Conducted Power (1Mbps – Ch. 39) – Dual Ant 1



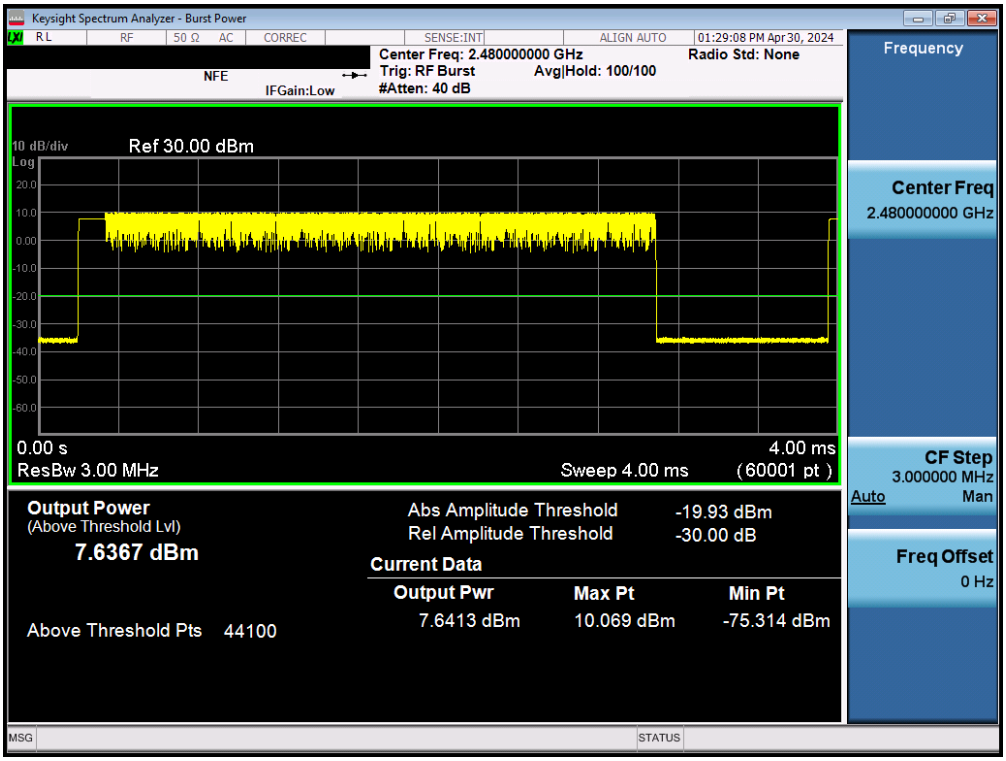
Plot 7-84. Average Conducted Power (1Mbps – Ch. 78) – Dual Ant 1



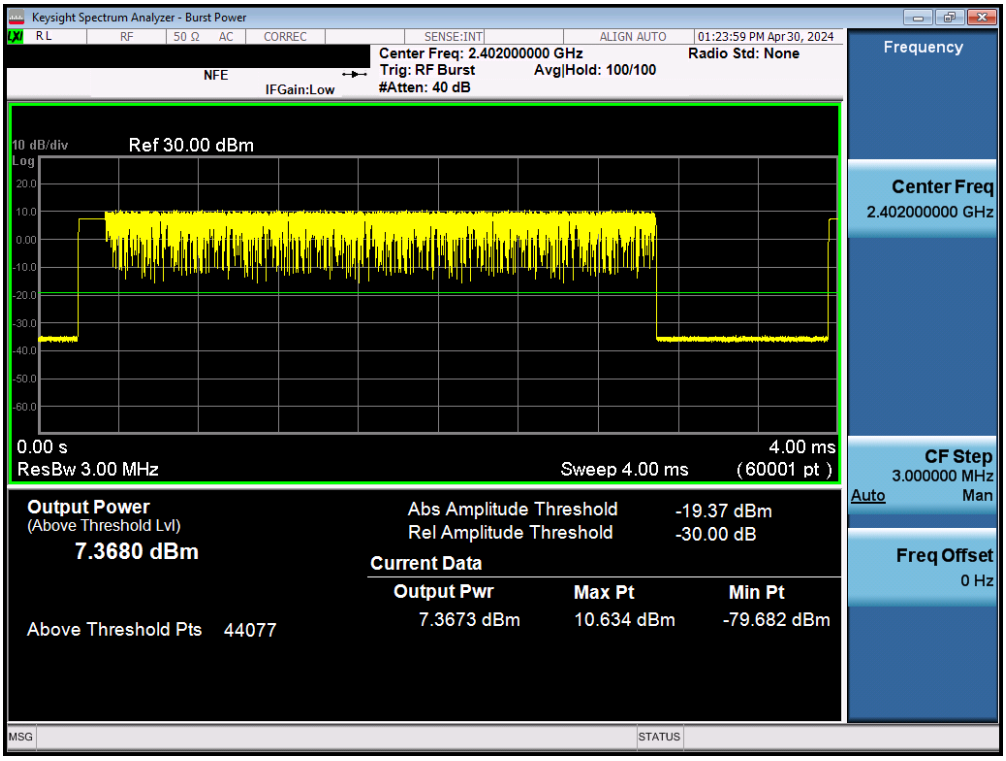
Plot 7-85. Average Conducted Power (2Mbps – Ch. 0) – Dual Ant 1



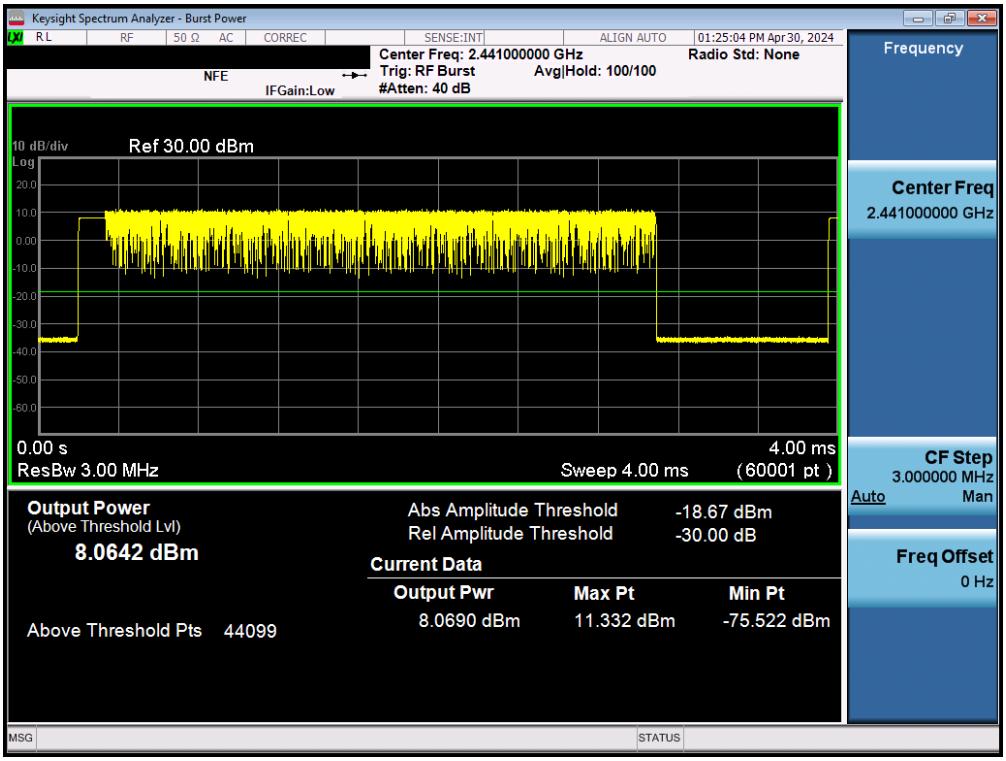
Plot 7-86. Average Conducted Power (2Mbps – Ch. 39) – Dual Ant 1



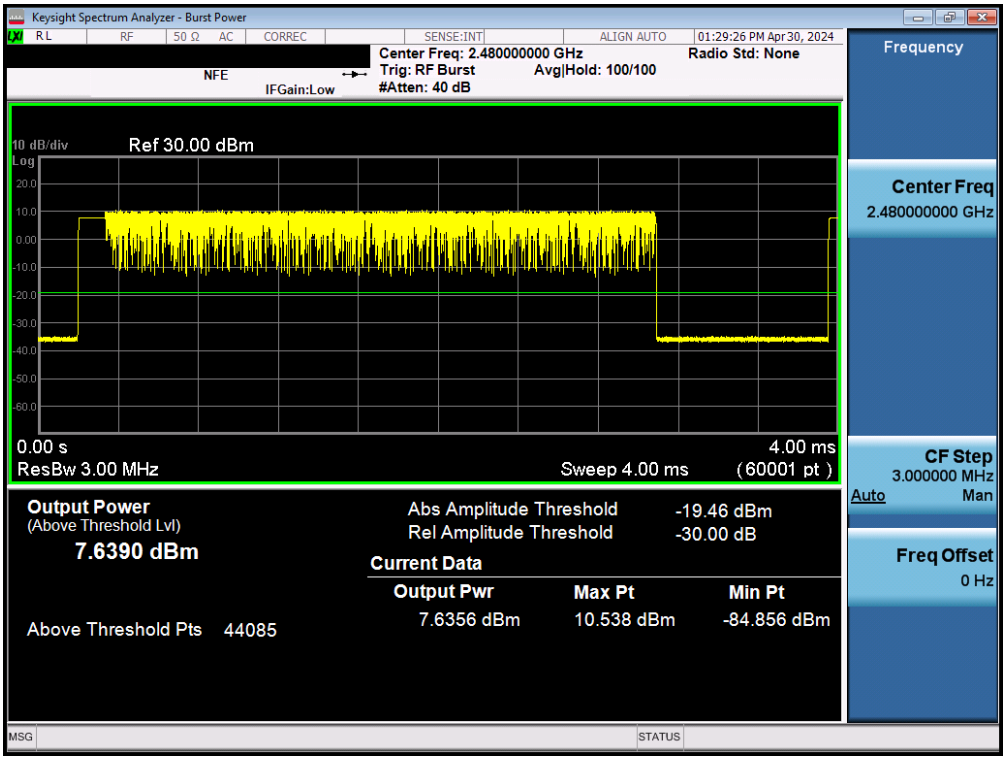
Plot 7-87. Average Conducted Power (2Mbps – Ch. 78) – Dual Ant 1



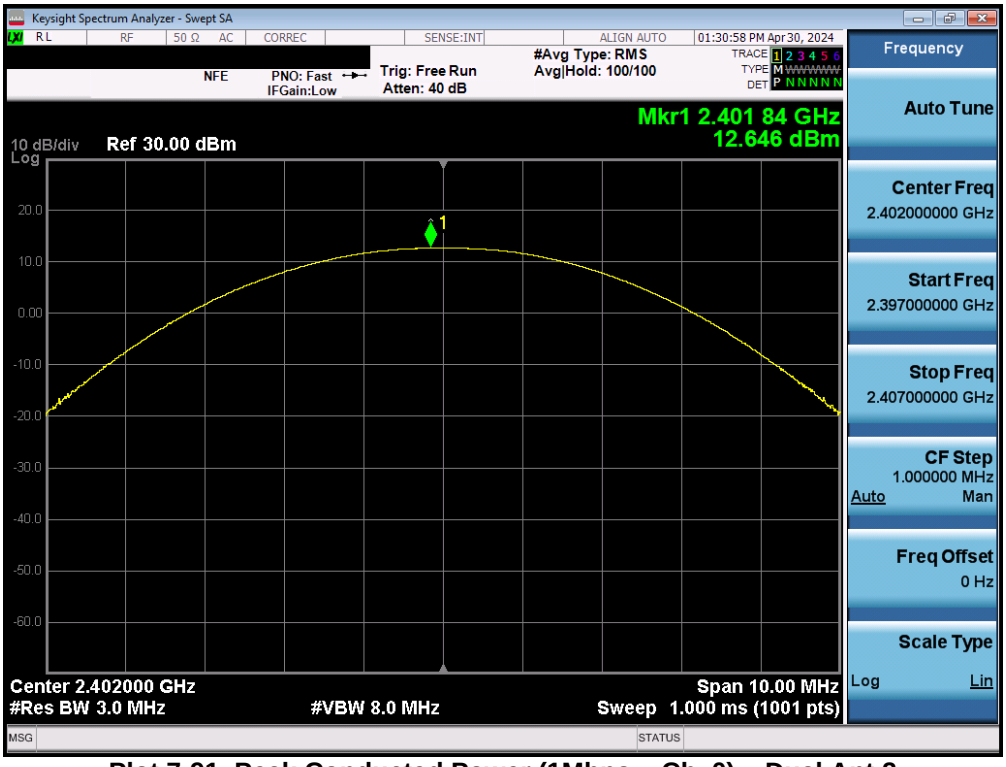
Plot 7-88. Average Conducted Power (3Mbps – Ch. 0) – Dual Ant 1



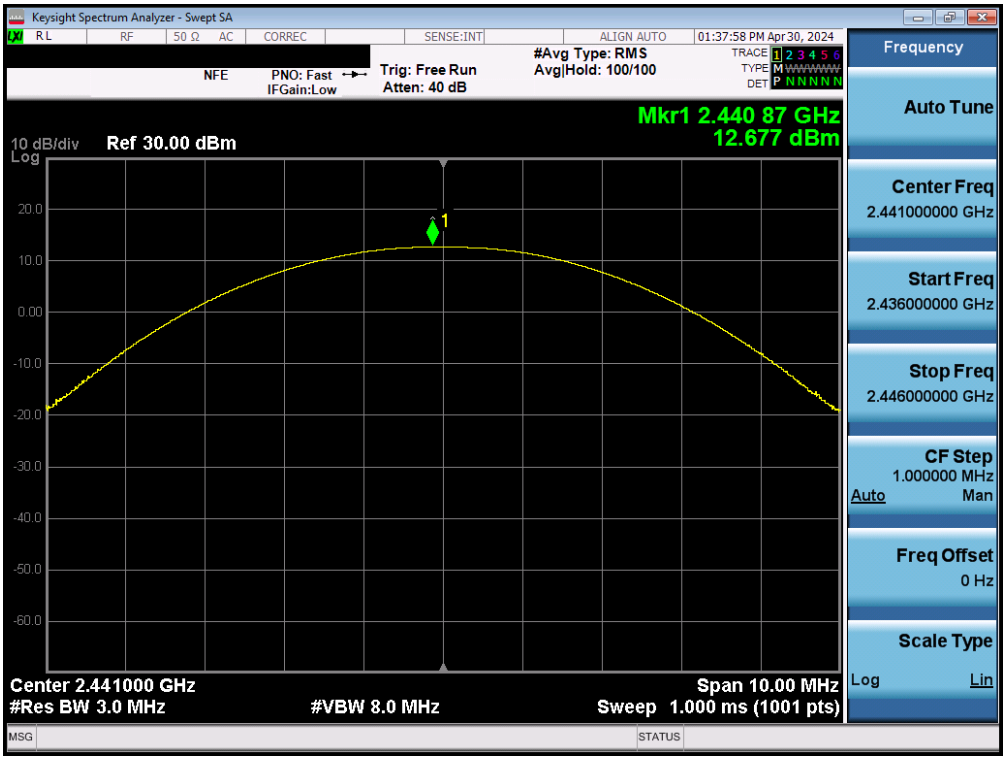
Plot 7-89. Average Conducted Power (3Mbps – Ch. 39) – Dual Ant 1



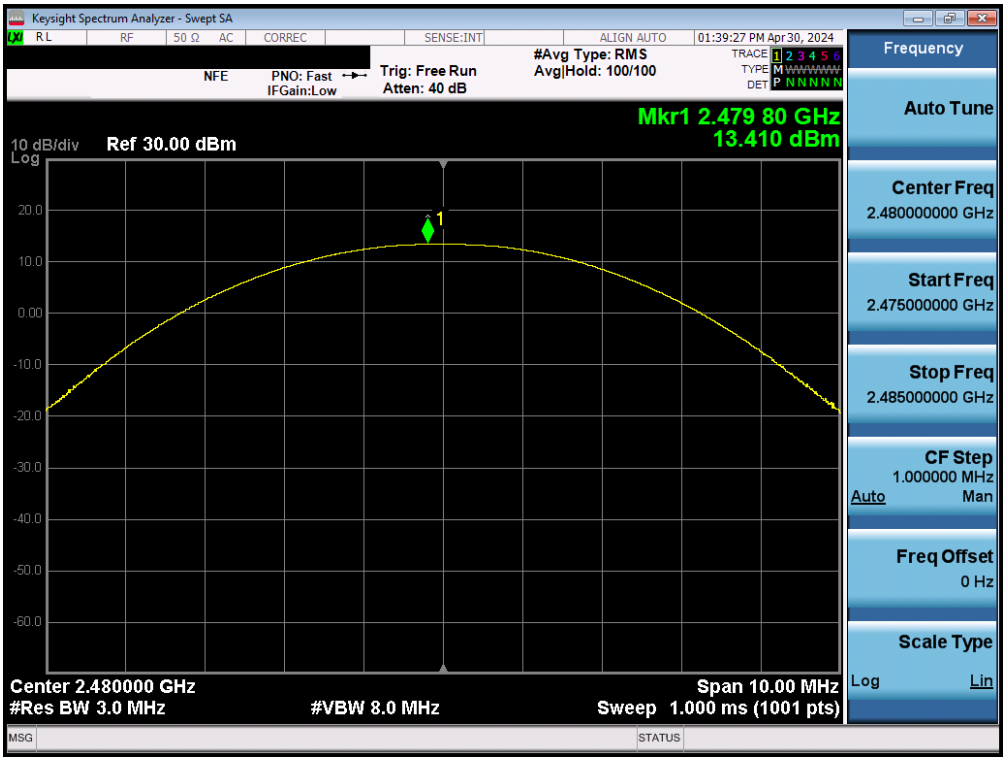
Plot 7-90. Average Conducted Power (3Mbps – Ch. 78) – Dual Ant 1



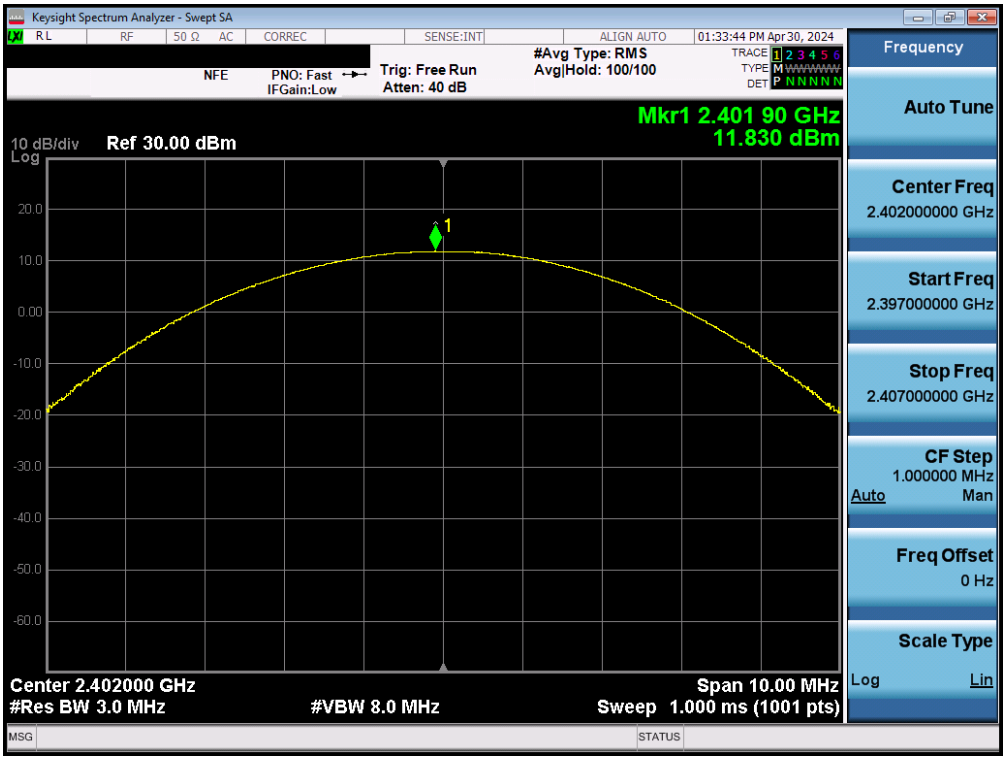
Plot 7-91. Peak Conducted Power (1Mbps – Ch. 0) – Dual Ant 2



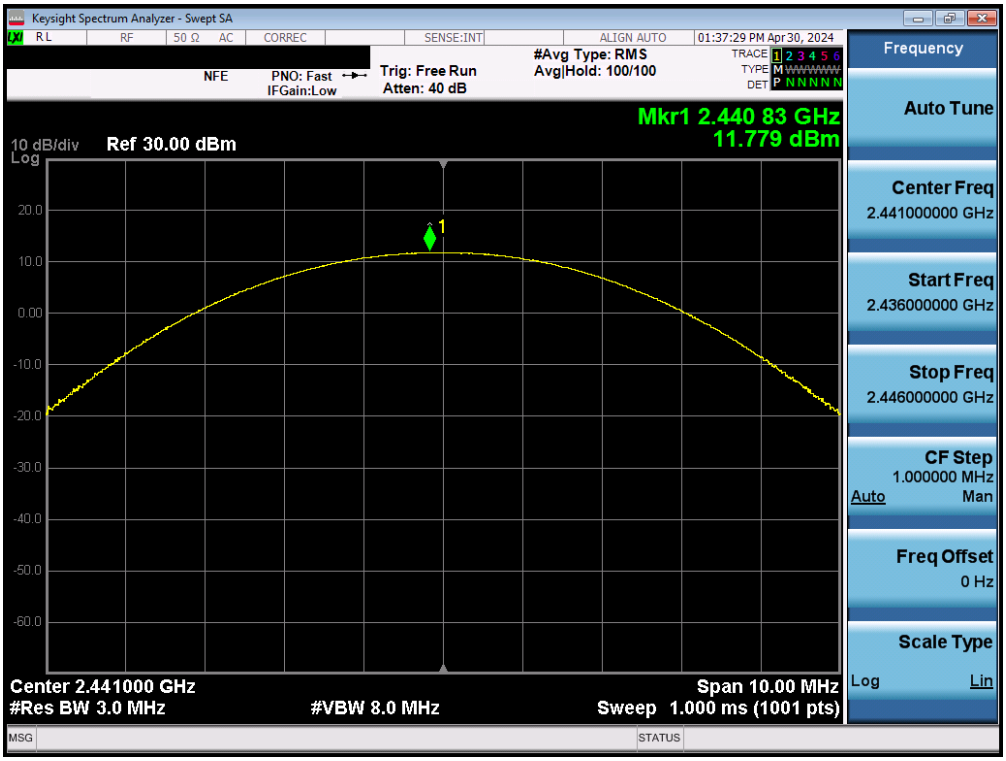
Plot 7-92. Peak Conducted Power (1Mbps – Ch. 39) – Dual Ant 2



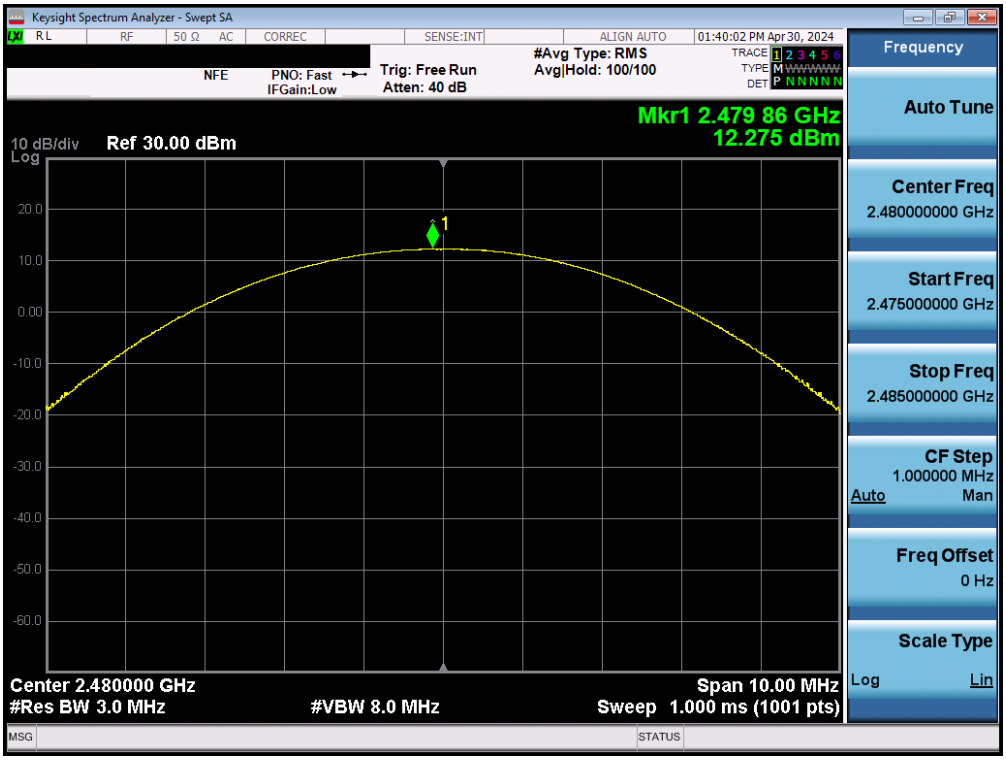
Plot 7-93. Peak Conducted Power (1Mbps – Ch. 78) – Dual Ant 2



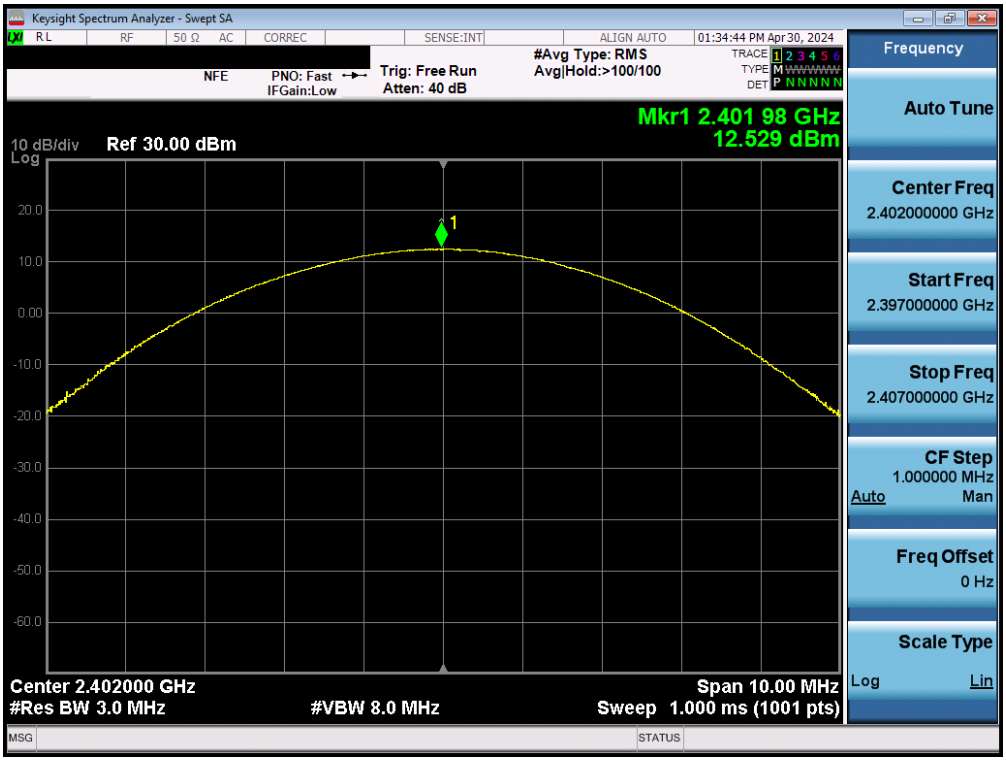
Plot 7-94. Peak Conducted Power (2Mbps – Ch. 0) – Dual Ant 2



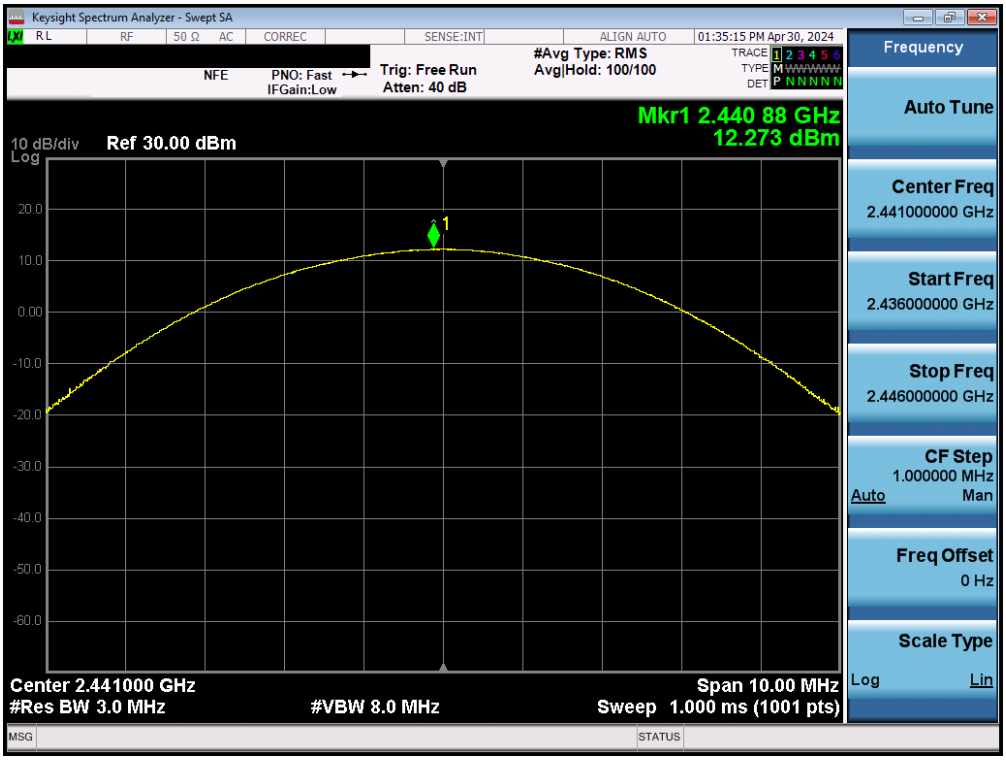
Plot 7-95. Peak Conducted Power (2Mbps – Ch. 39) – Dual Ant 2



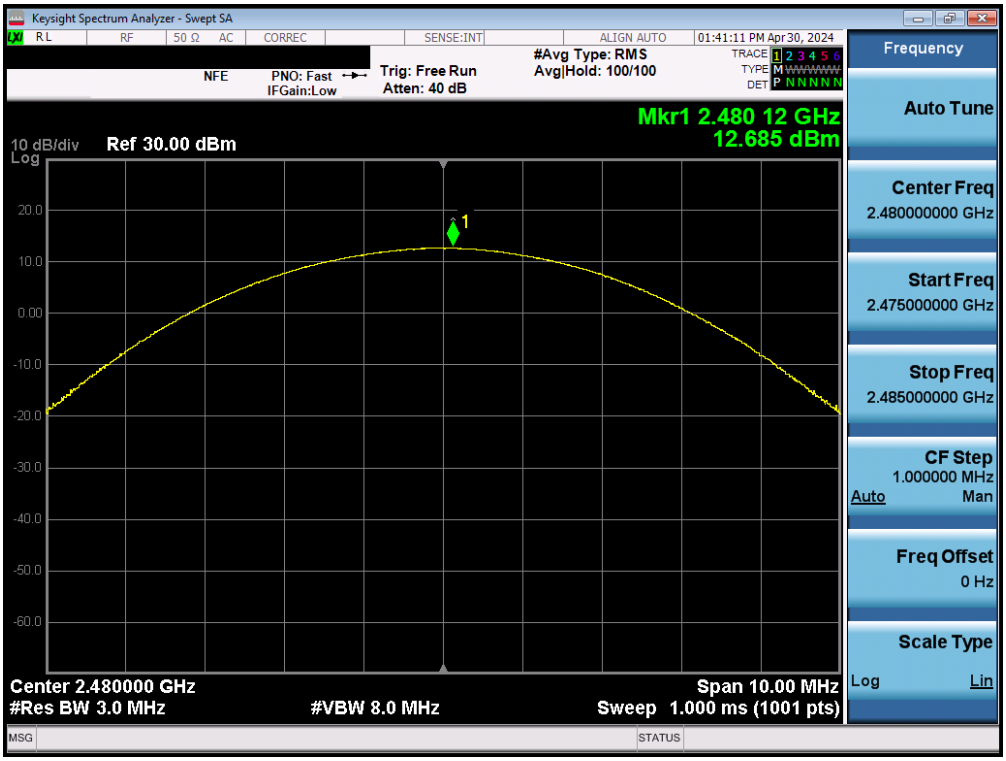
Plot 7-96. Peak Conducted Power (2Mbps – Ch. 78) – Dual Ant 2



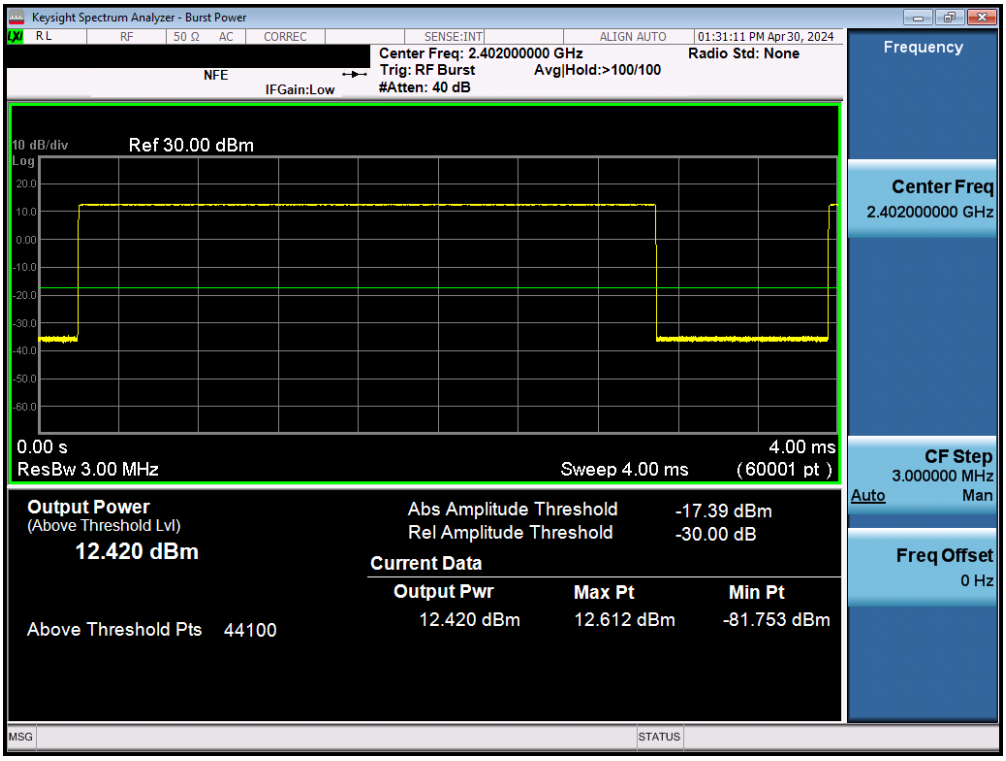
Plot 7-97. Peak Conducted Power (3Mbps – Ch. 0) – Dual Ant 2



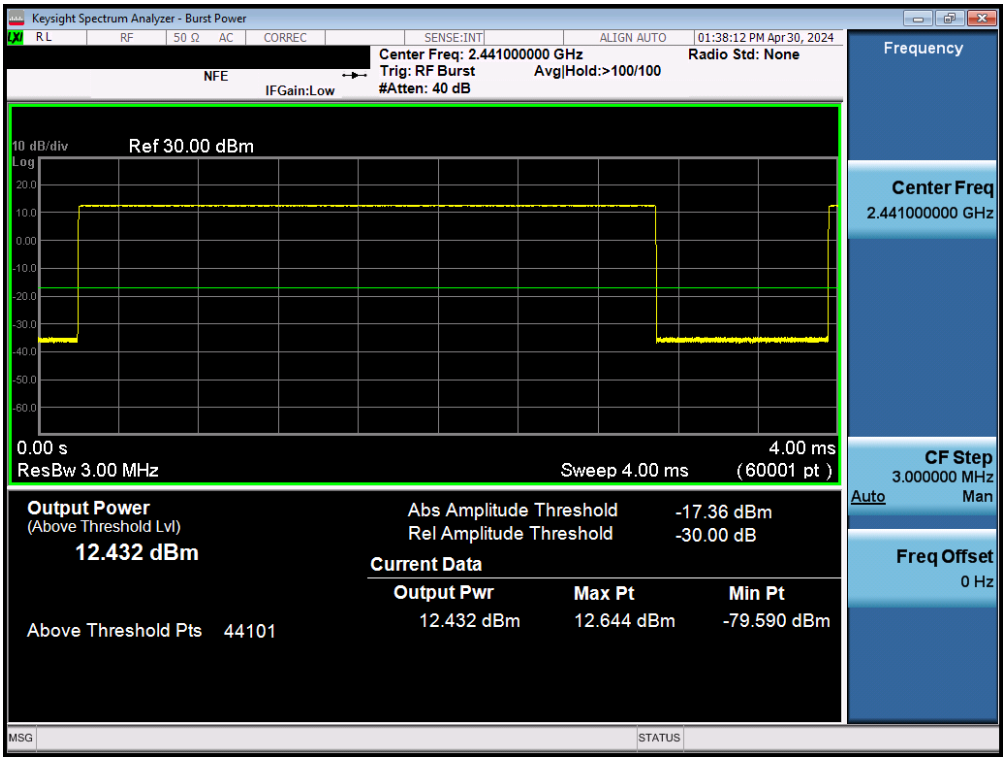
Plot 7-98. Peak Conducted Power (3Mbps – Ch. 39) – Dual Ant 2



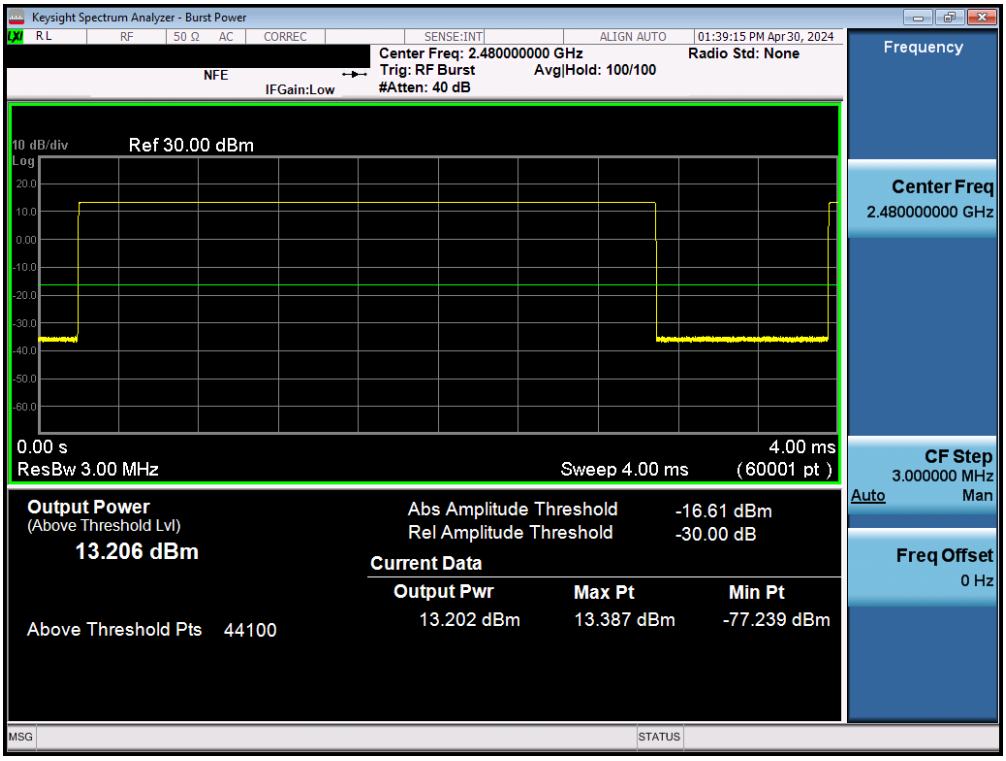
Plot 7-99. Peak Conducted Power (3Mbps – Ch. 78) – Dual Ant 2



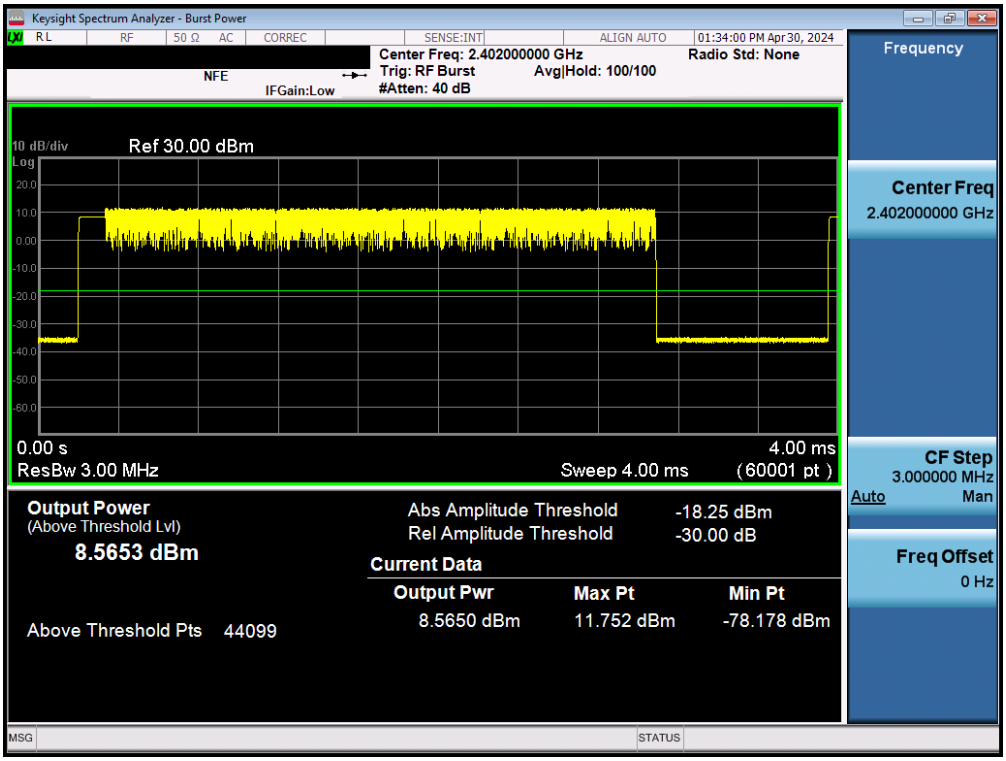
Plot 7-100. Average Conducted Power (1Mbps – Ch. 0) – Dual Ant 2



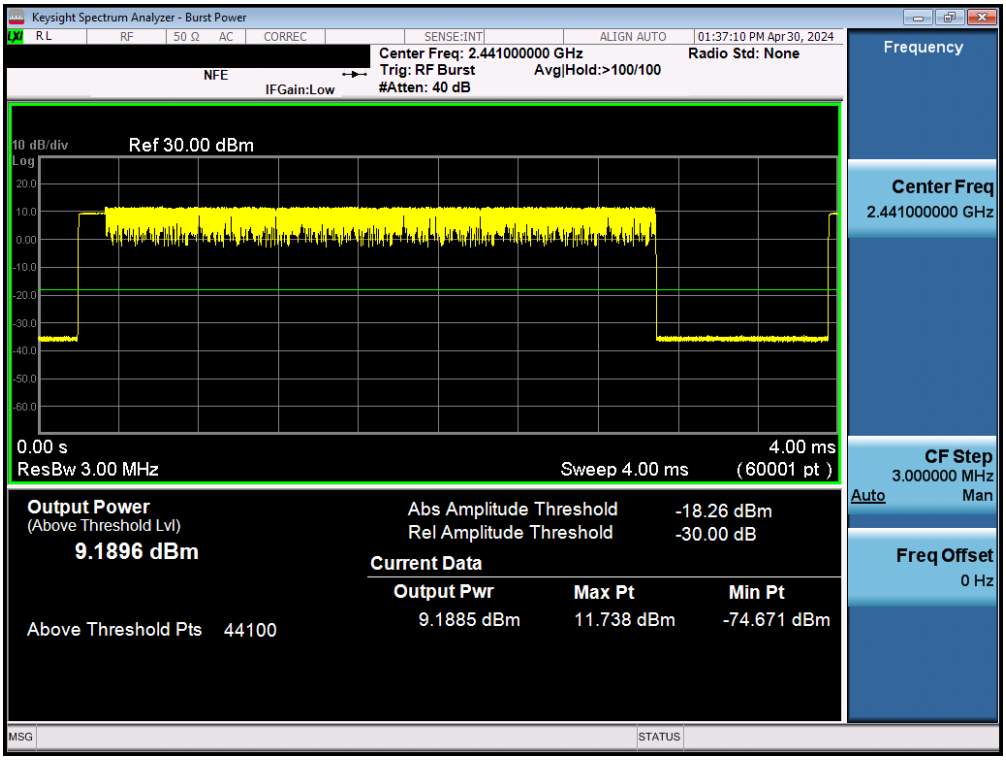
Plot 7-101. Average Conducted Power (1Mbps – Ch. 39) – Dual Ant 2



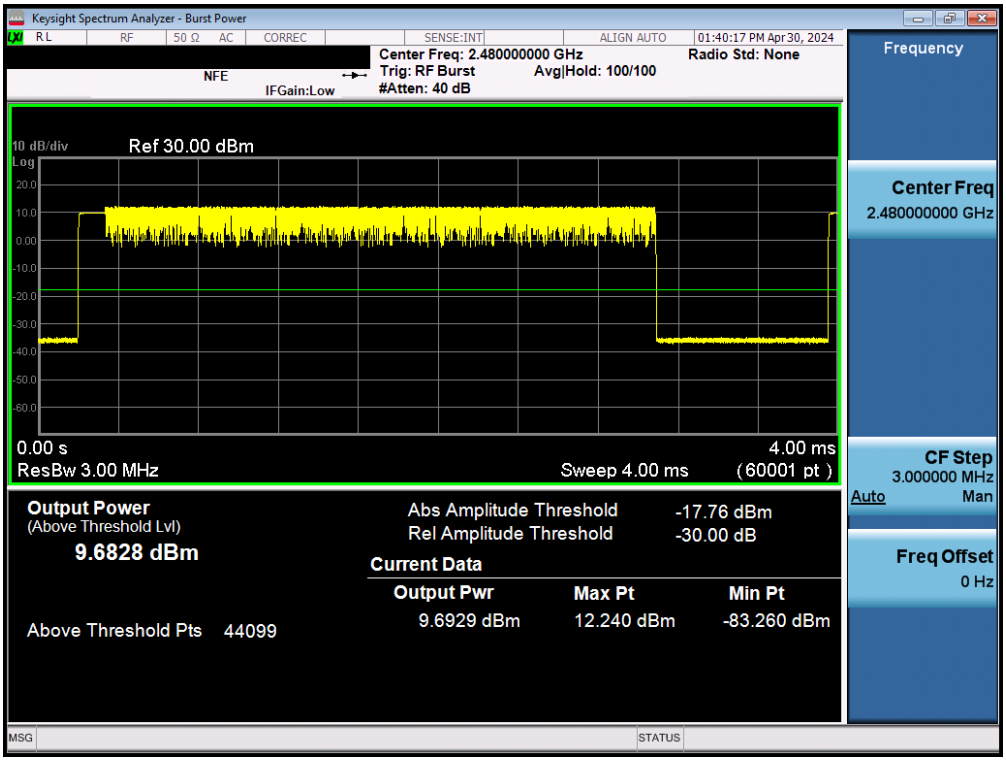
Plot 7-102. Average Conducted Power (1Mbps – Ch. 78) – Dual Ant 2



Plot 7-103. Average Conducted Power (2Mbps – Ch. 0) – Dual Ant 2



Plot 7-104. Average Conducted Power (2Mbps – Ch. 39) – Dual Ant 2



Plot 7-105. Average Conducted Power (2Mbps – Ch. 78) – Dual Ant 2