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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:
09/03/2024 - 10/25/2024
Test Report Issue Date:
10/28/2024
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2408260069-11.A3L

FCC ID:	**A3LSMS938B**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-S938B/DS
Additional Model:	SM-S938B
EUT Type:	Portable Handset
Max. RF Output Power:	105.439 mW (20.23 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, KDB 648474 D03 v01r045, KDB 484596 v02r02 D01

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

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 the 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: A3LSMS938B**. 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.: 0568M, 0304M, 0298M, 0073M, 0076M, 0111M, 0108M, 0131M, 0079M, 0066M, 0835M, 0823M, 0630R, 0635R

2.2 Device Capabilities

This device contains the following capabilities:

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

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 Antenna Gain (dBi)
2.4	-1.39	-3.33	0.70

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, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 0, 7.6, 7.7, and 7.8 for antenna port conducted emissions test setups. The worst case radiated emissions data is shown in this report.

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

π/4-DQPSK has been investigated and confirmed as not the worst case.

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) FCC ID: 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 S938USQUOAXJ3 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 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 the 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 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 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	1.13
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). 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
-	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

Notes:

1. 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.

2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMS938B

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:

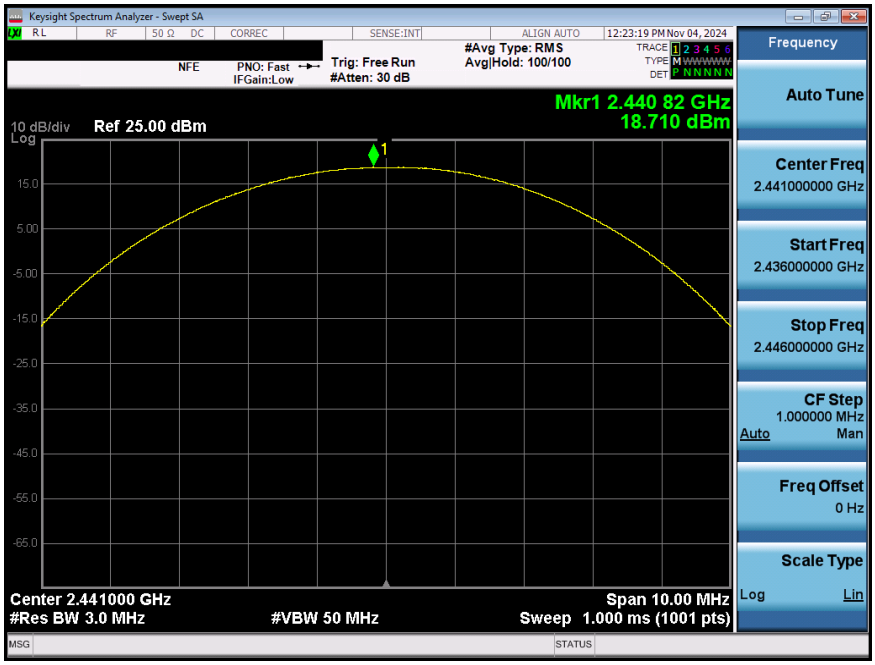
1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the 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 PCTEST "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 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-S938U	Variant Model: SM-S938B	Deviation (dB)	Max Deviation (dB)	Pass/Fail
15.247(b)(1)	Conducted Output Power	SISO Ant 1 Ch.39 - Peak	dBm	N/A	19.16	18.71	-0.45	1	PASS
15.209	Radiated Spurious Emissions	Dual Ch.0 - Average	dBm	53.98	32.84	33.68	0.84	3	PASS
15.209	Radiated Band Edge Emissions	SISO Ant1 Ch.78 - Average	dBm	53.98	46.23	47.77	1.54	3	PASS

Table 7-2. Summary of Spot-Checks

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power	
			[dBm]	[mW]
2441	1.0	39	18.71	74.302

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

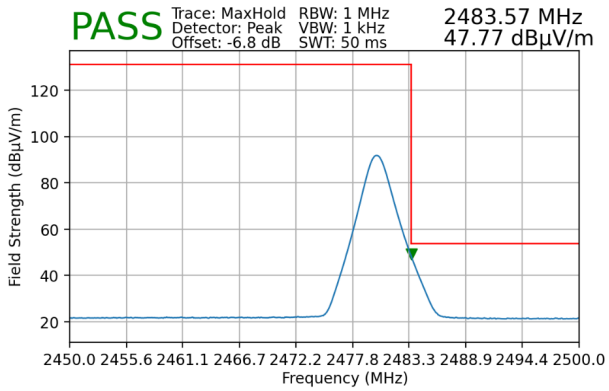


Plot 7-1. Conducted Peak Power Measurement (Spot-check)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Dist. Corr. Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	H	-	-	-75.98	2.66	0.00	0.00	33.68	53.98	-20.30

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

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



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 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.

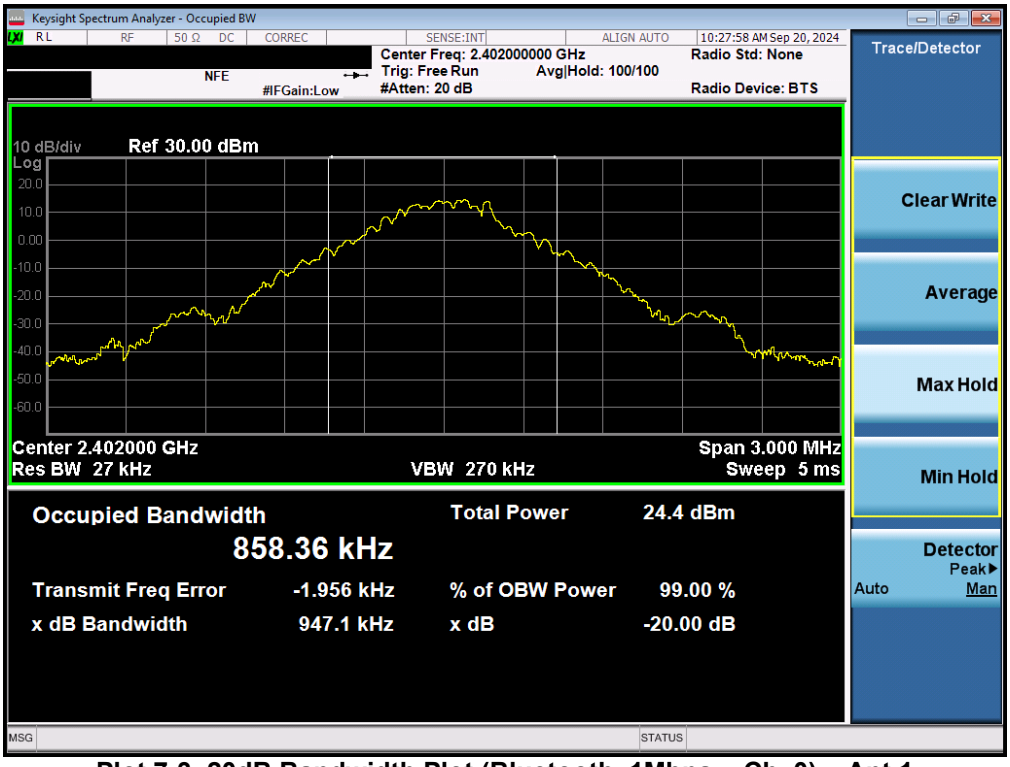
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

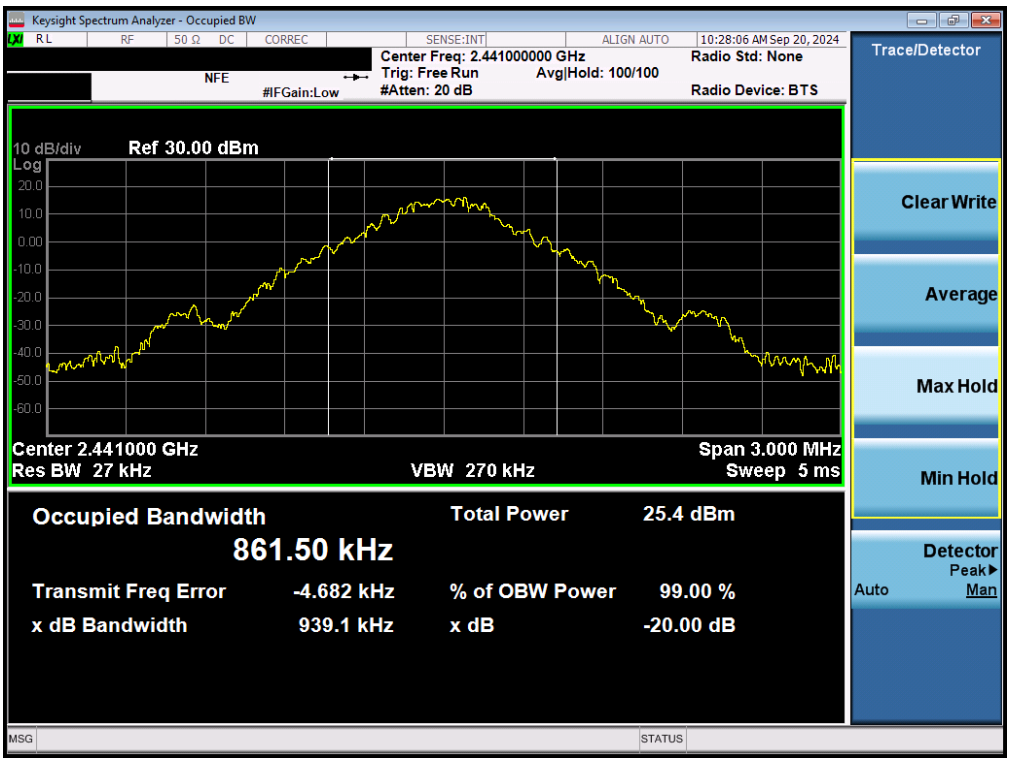
None

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	947.1
2441	1.0	GFSK	39	939.1
2480	1.0	GFSK	78	944.6
2402	2.0	π/4-DQPSK	0	1293
2441	2.0	π/4-DQPSK	39	1314
2480	2.0	π/4-DQPSK	78	1296
2402	3.0	8DPSK	0	1326
2441	3.0	8DPSK	39	1287
2480	3.0	8DPSK	78	1320

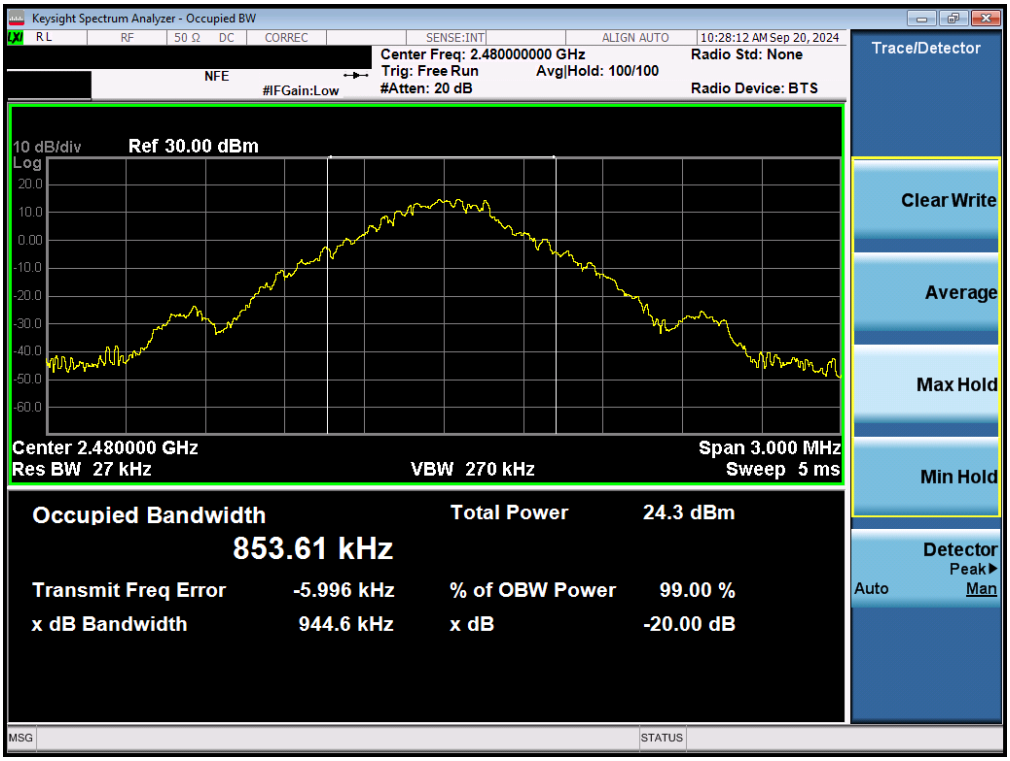
Table 7-5. Conducted 20dB Bandwidth Measurements – Ant 1



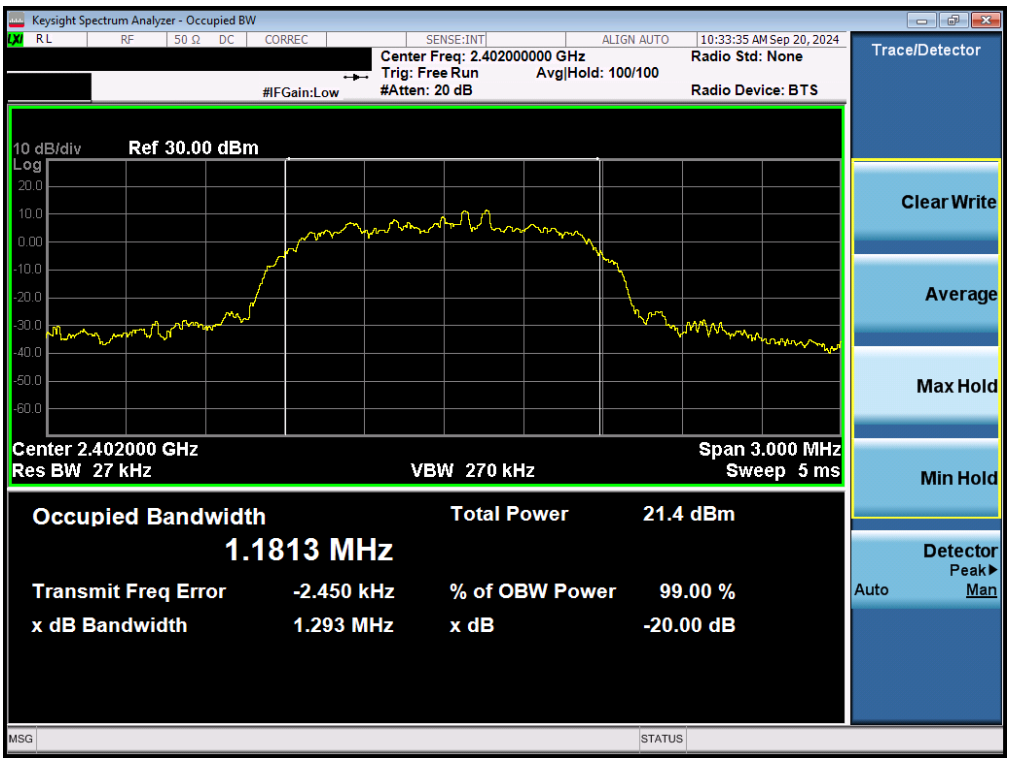
Plot 7-3. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Ant 1



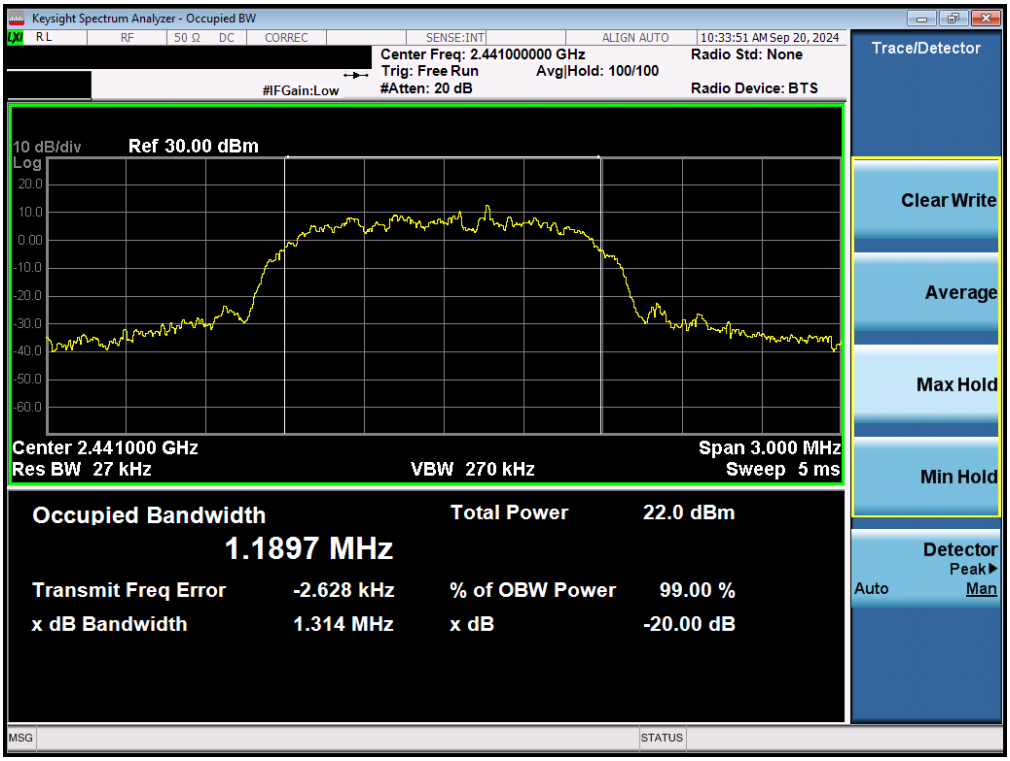
Plot 7-4. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Ant 1



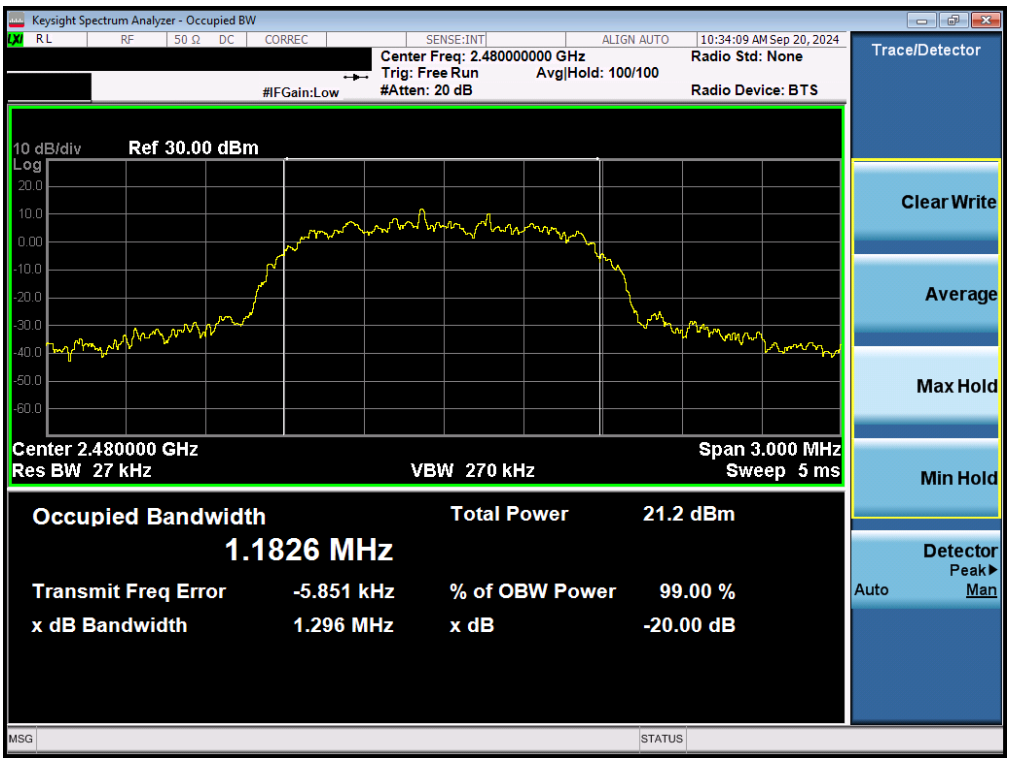
Plot 7-5. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Ant 1



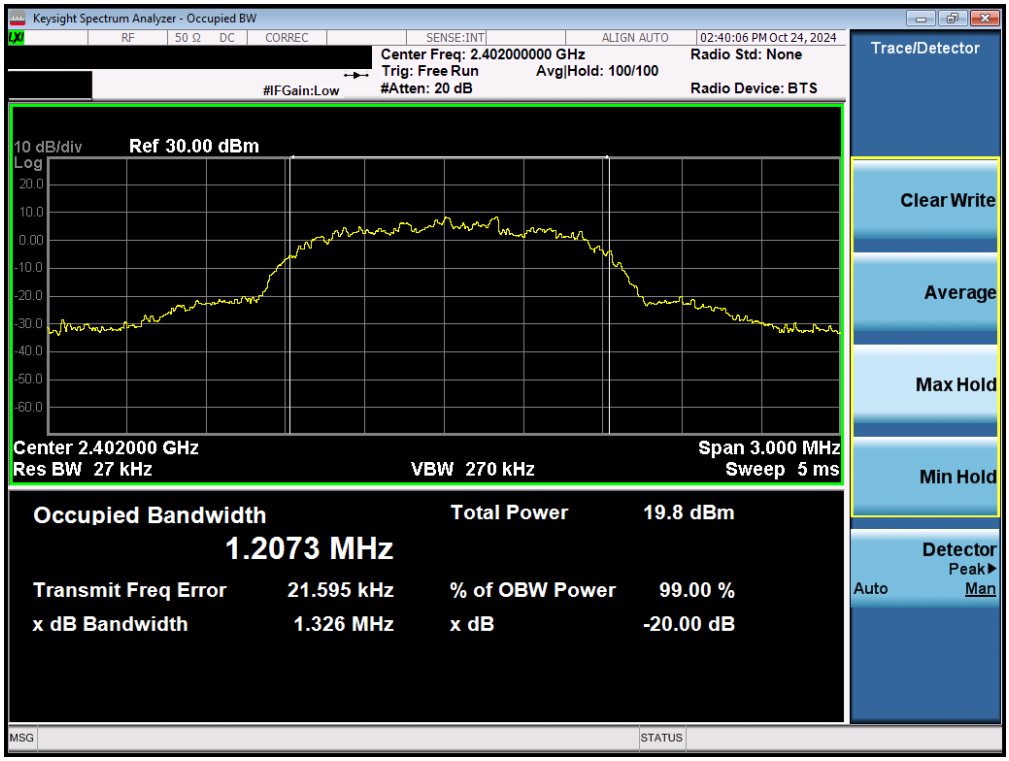
Plot 7-6. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Ant 1



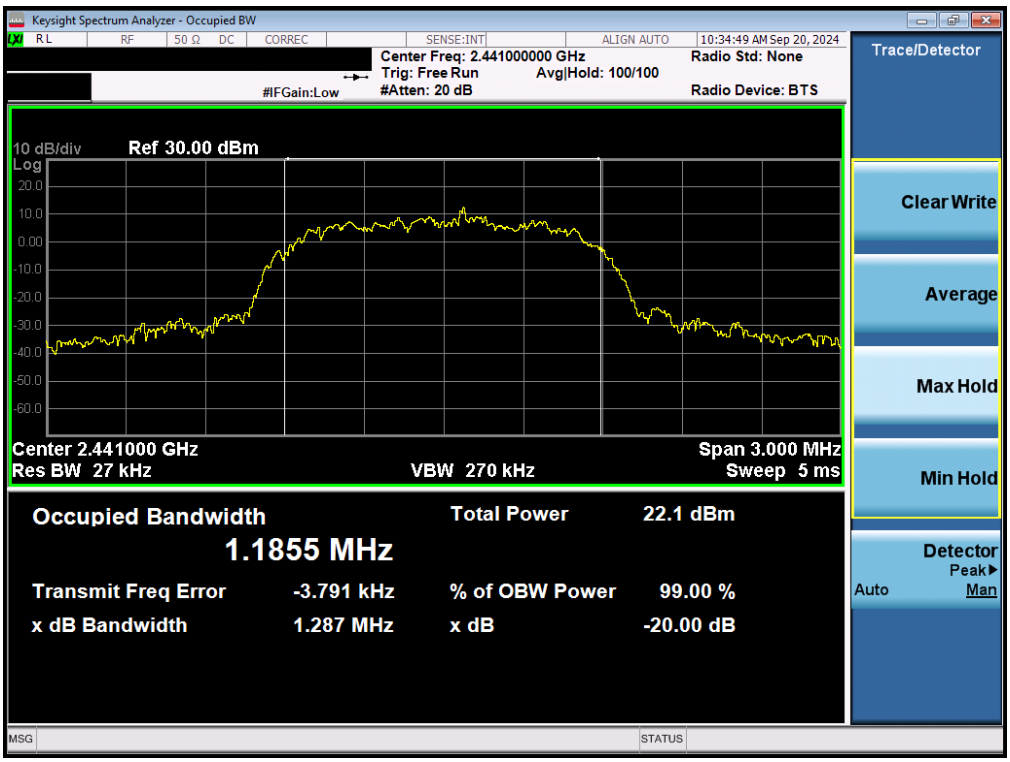
Plot 7-7. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Ant 1



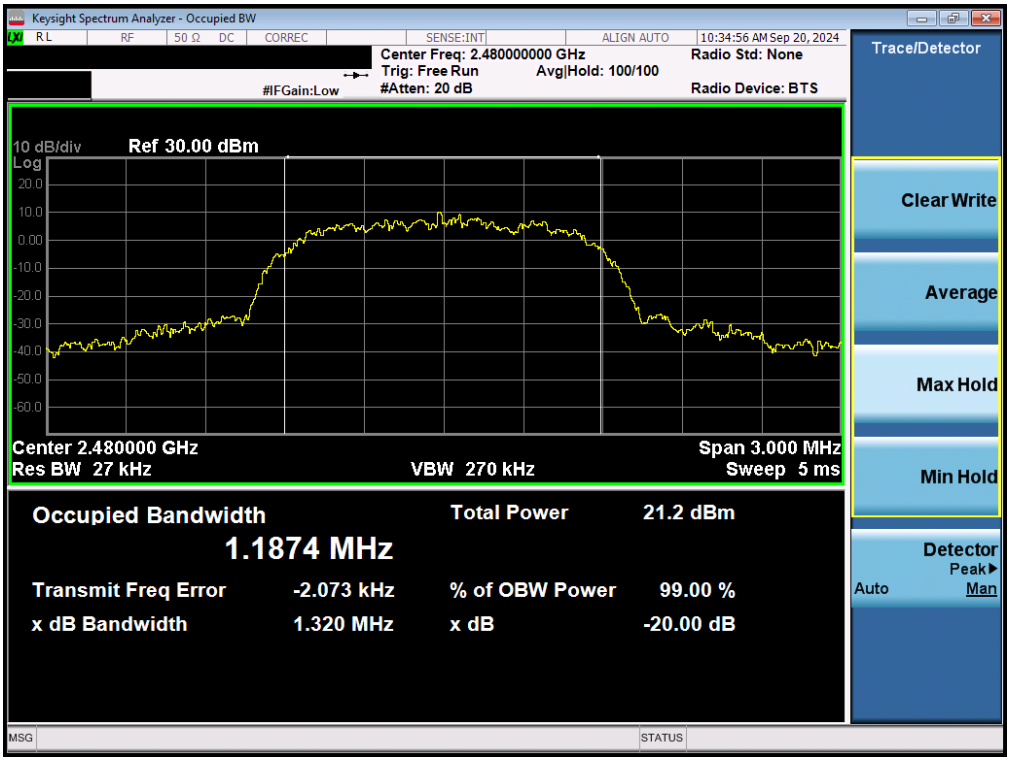
Plot 7-8. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Ant 1



Plot 7-9. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Ant 1



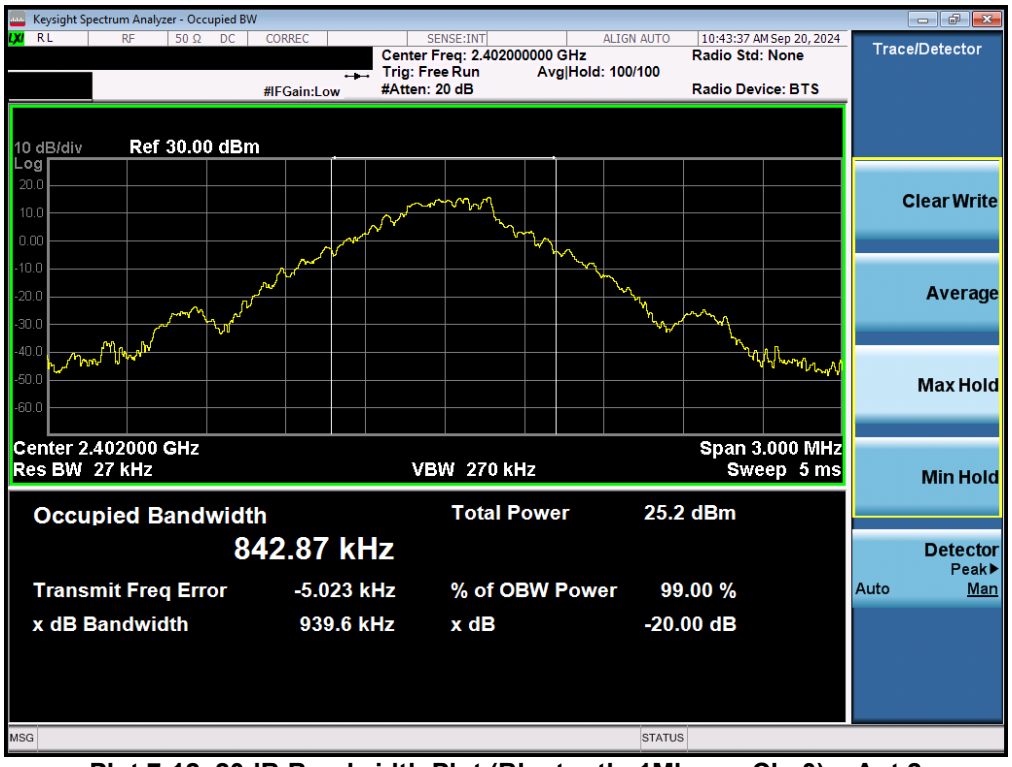
Plot 7-10. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Ant 1



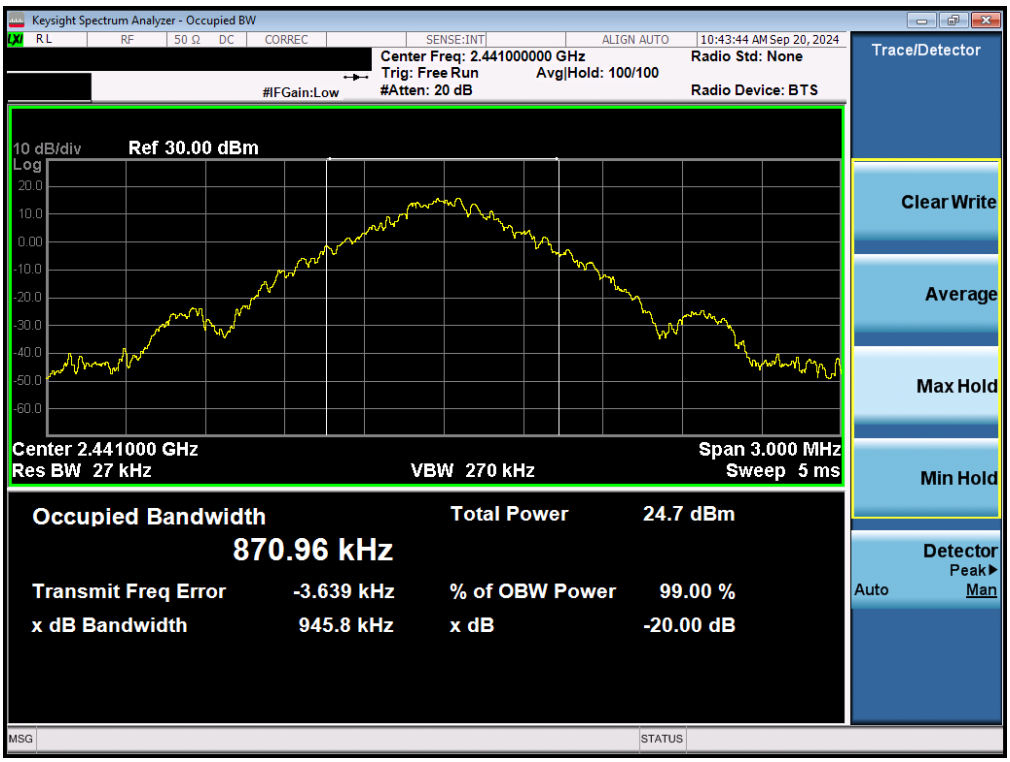
Plot 7-11. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Ant 1

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	939.6
2441	1.0	GFSK	39	945.8
2480	1.0	GFSK	78	899.2
2402	2.0	π/4-DQPSK	0	1321
2441	2.0	π/4-DQPSK	39	1315
2480	2.0	π/4-DQPSK	78	1313
2402	3.0	8DPSK	0	1345
2441	3.0	8DPSK	39	1339
2480	3.0	8DPSK	78	1289

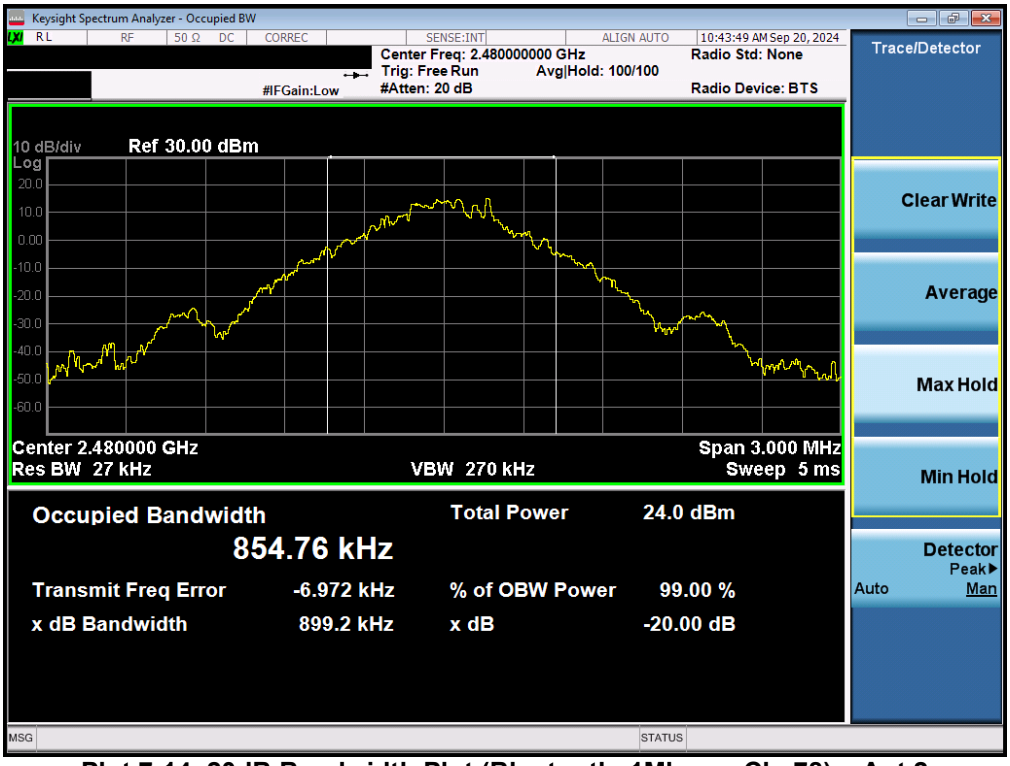
Table 7-6. Conducted 20dB Bandwidth Measurements – Ant 2



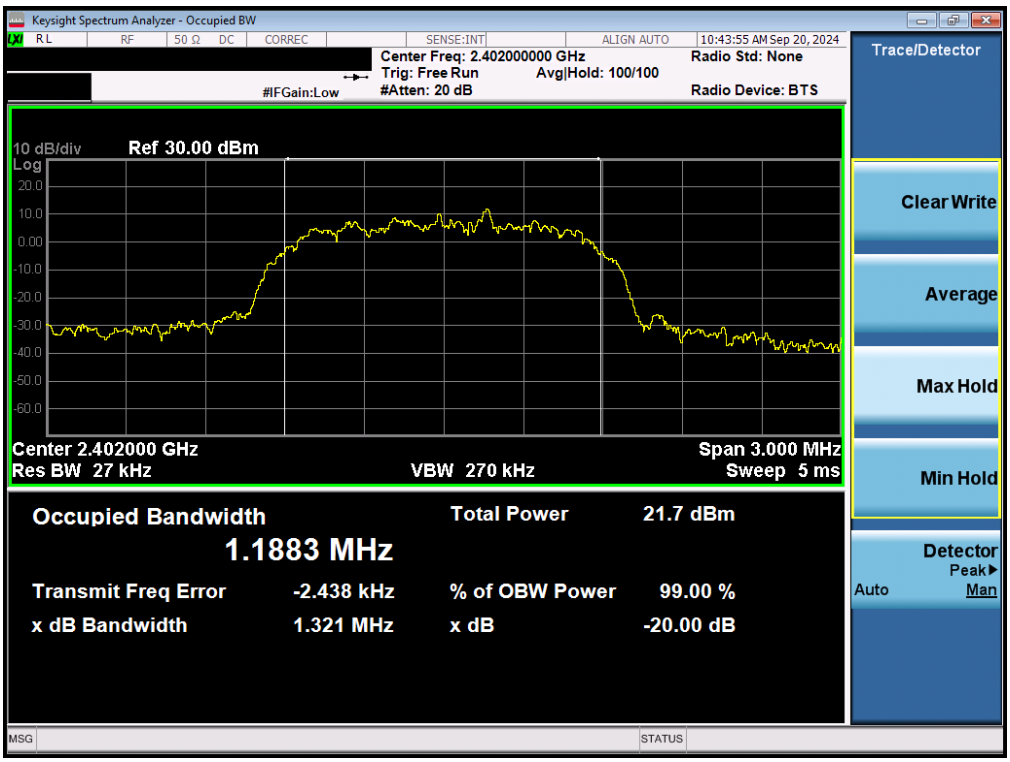
Plot 7-12. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Ant 2



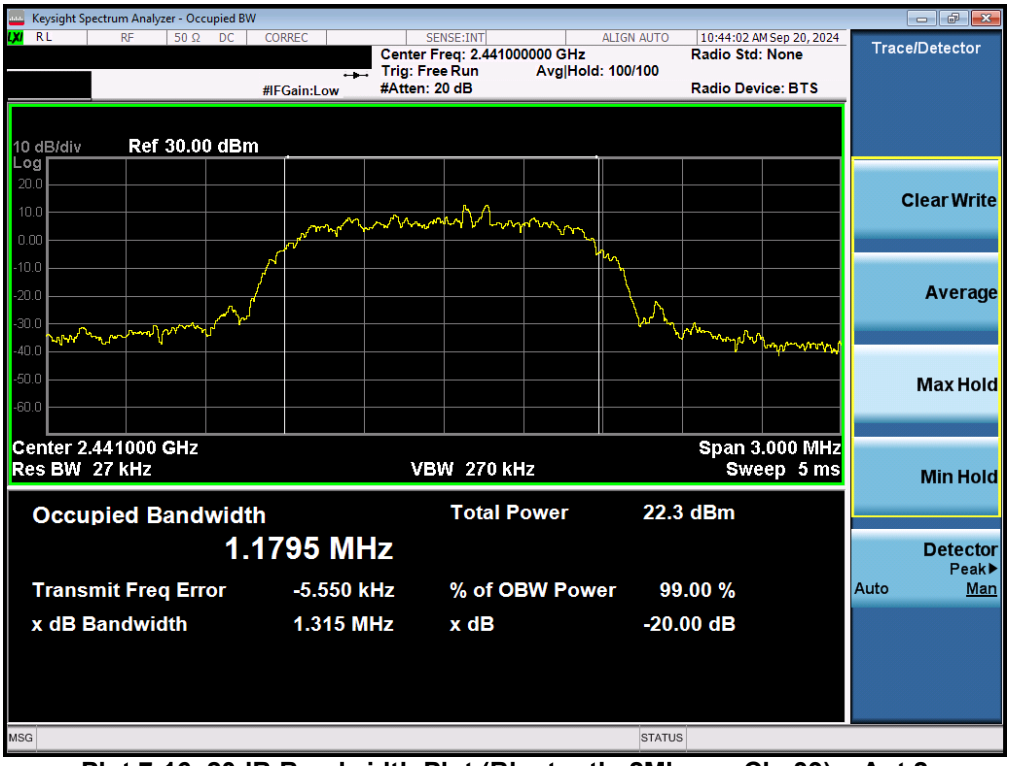
Plot 7-13. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Ant 2



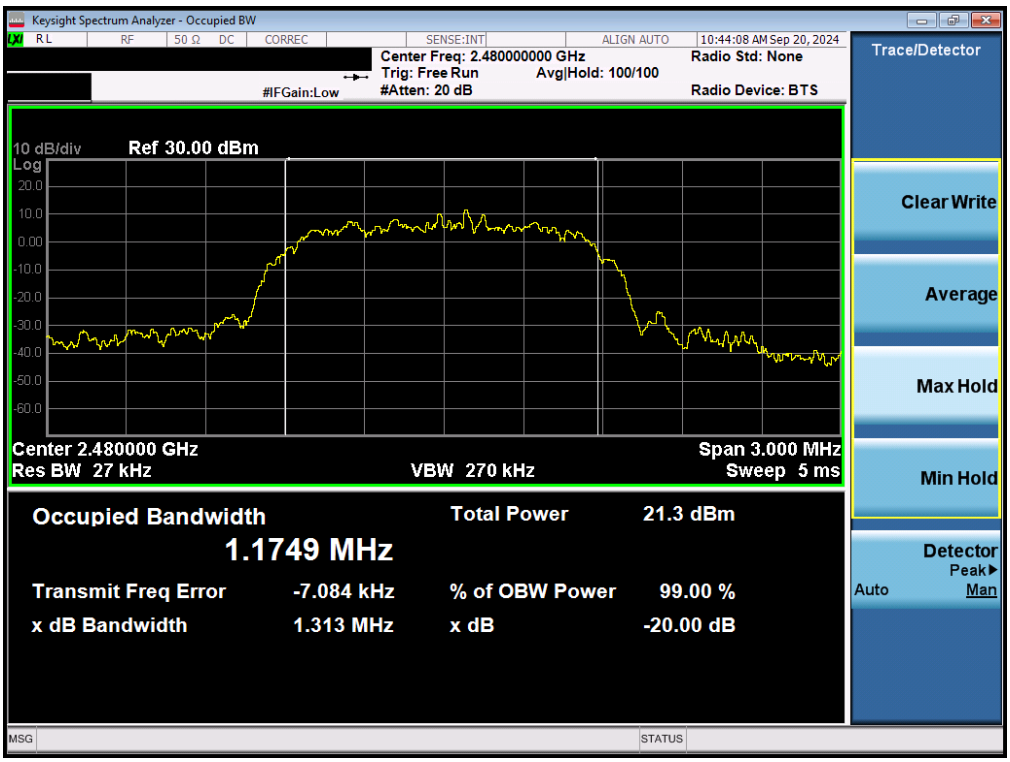
Plot 7-14. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Ant 2



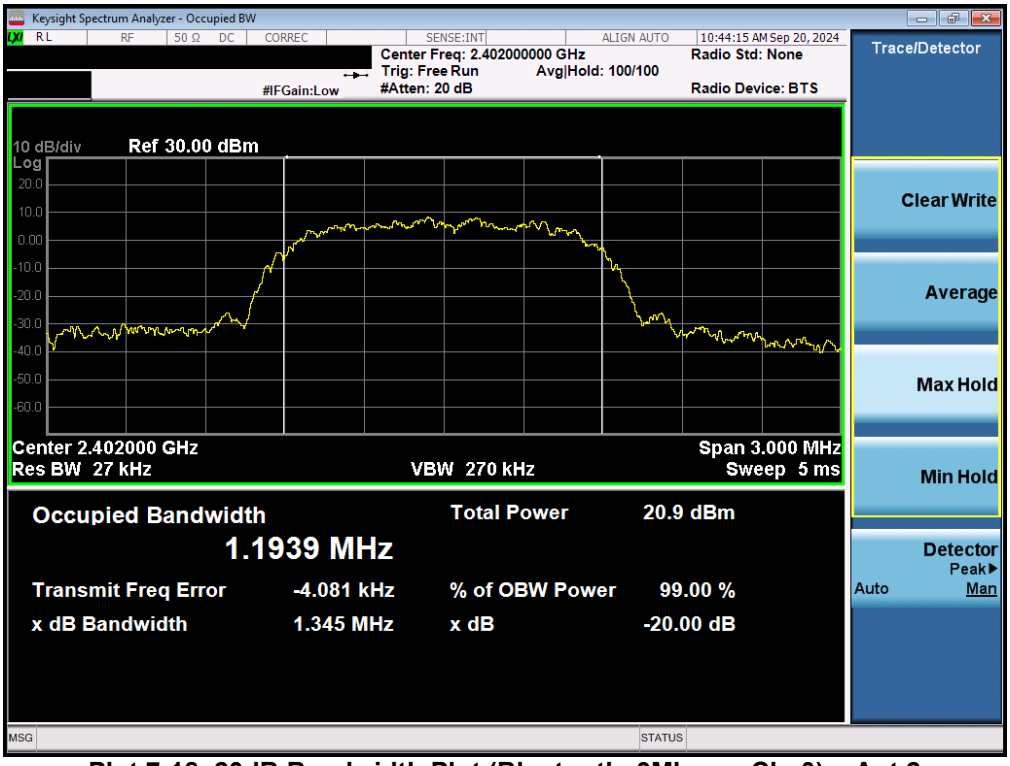
Plot 7-15. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Ant 2



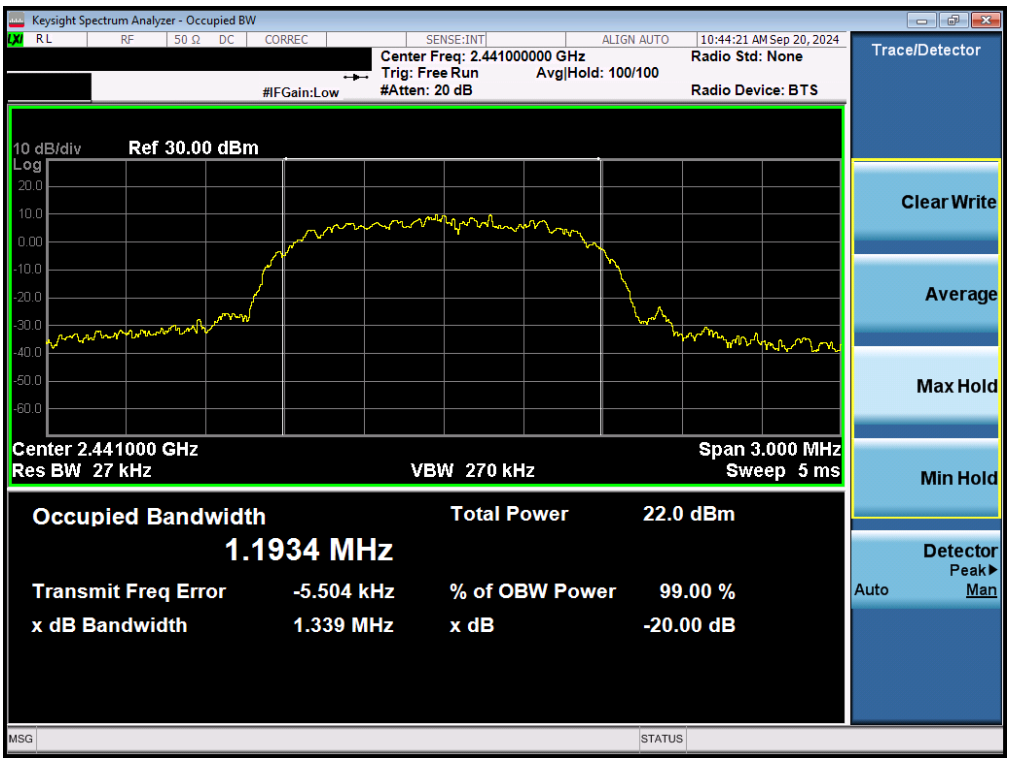
Plot 7-16. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Ant 2



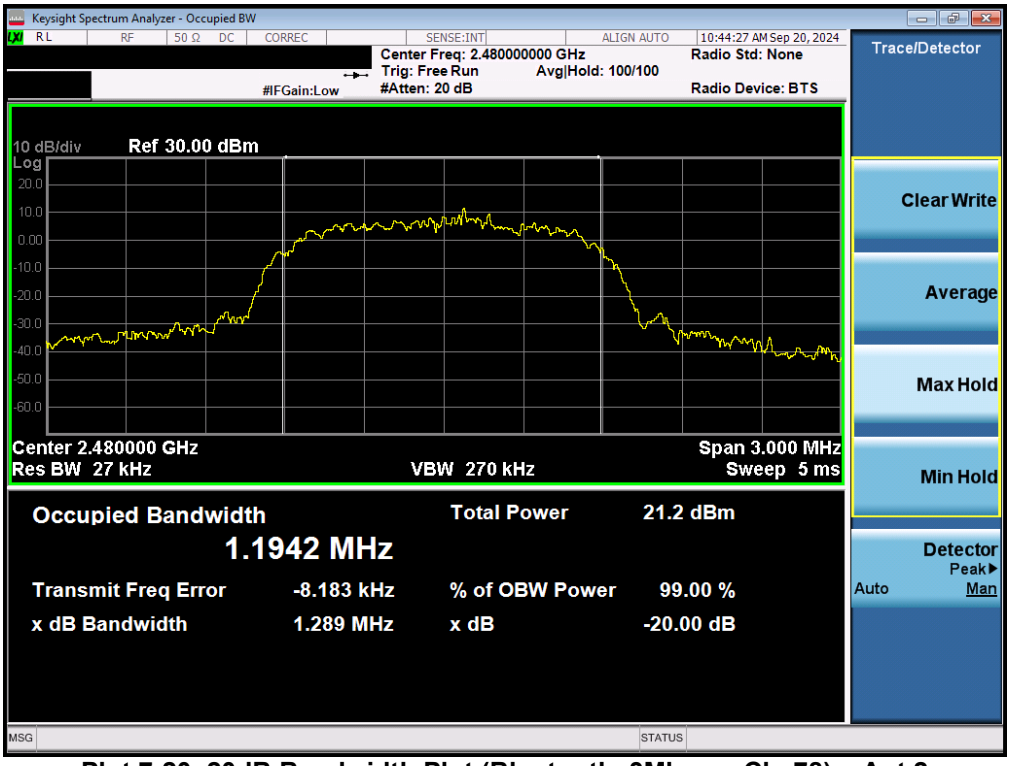
Plot 7-17. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Ant 2



Plot 7-18. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Ant 2



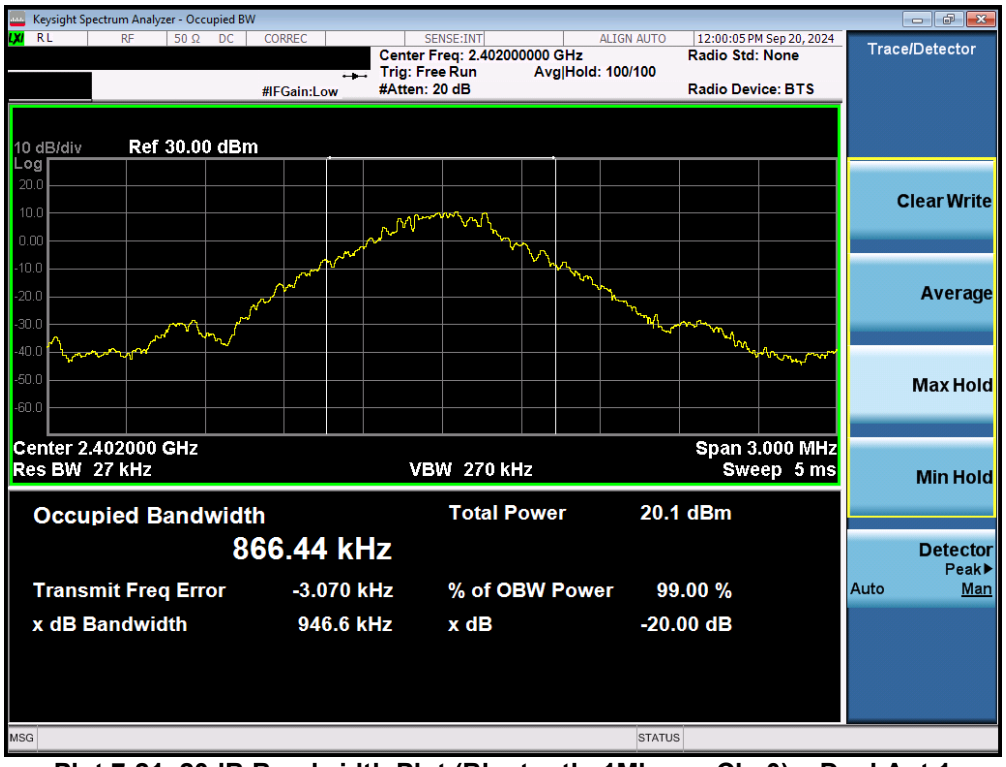
Plot 7-19. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Ant 2



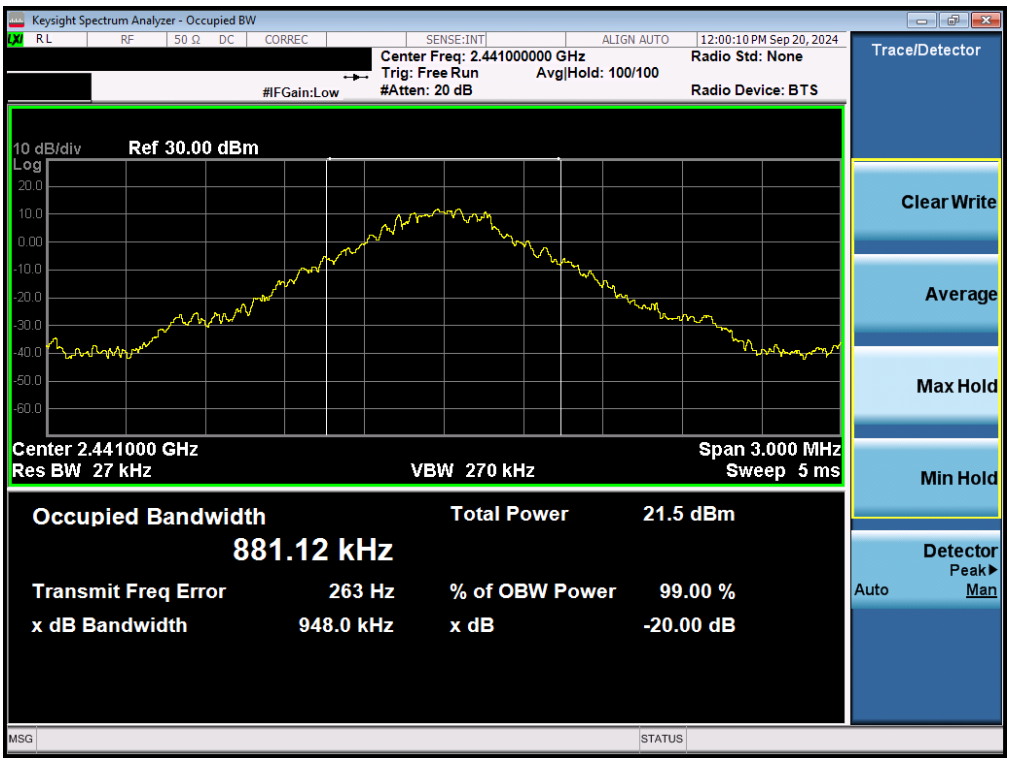
Plot 7-20. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Ant 2

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	946.60
2441	1.0	GFSK	39	948.00
2480	1.0	GFSK	78	938.90
2402	2.0	π/4-DQPSK	0	1332.00
2441	2.0	π/4-DQPSK	39	1331.00
2480	2.0	π/4-DQPSK	78	1329.00
2402	3.0	8DPSK	0	1327.00
2441	3.0	8DPSK	39	1335.00
2480	3.0	8DPSK	78	1307.00

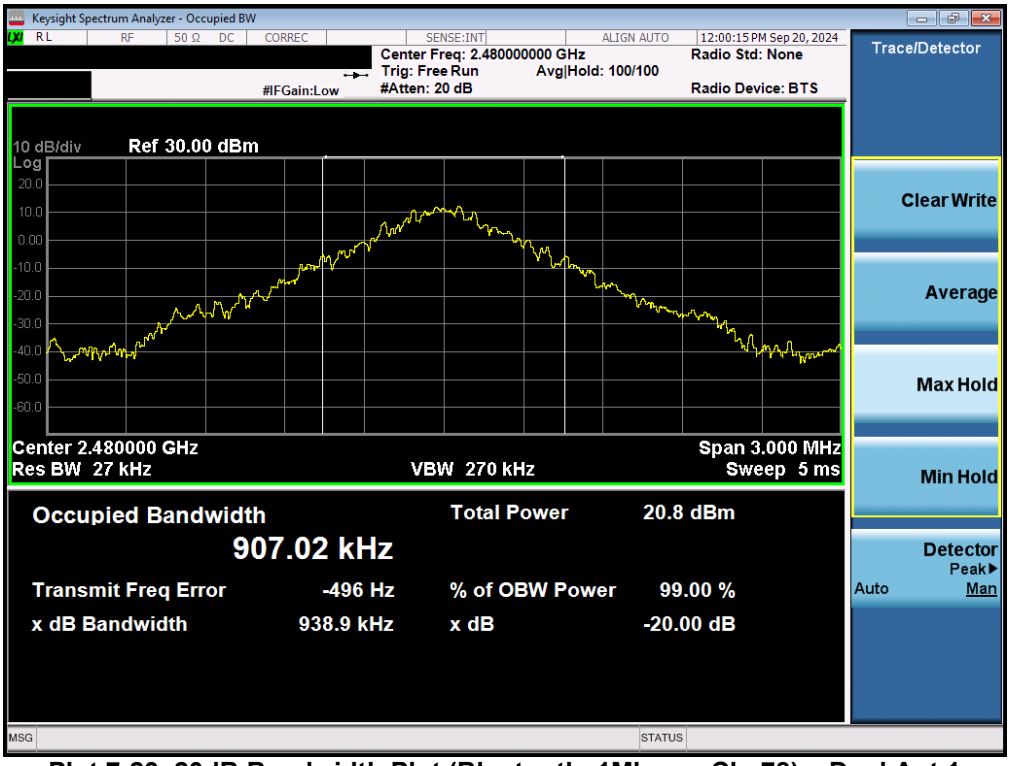
Table 7-7. Conducted 20dB Bandwidth Measurements – Dual Ant 1



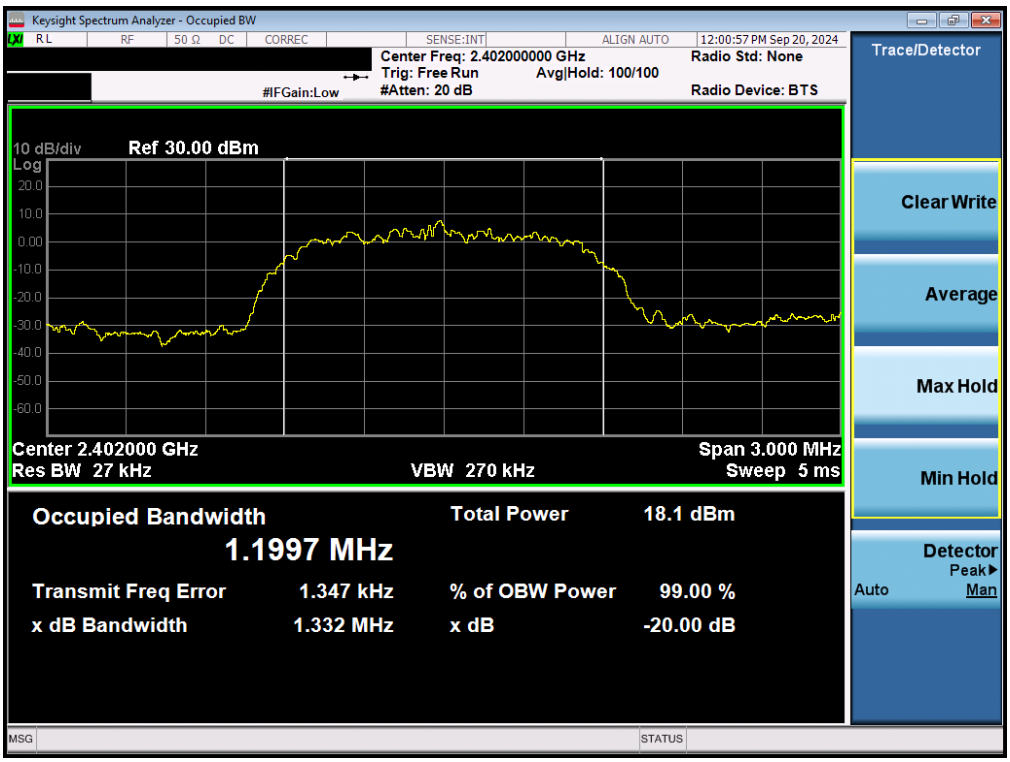
Plot 7-21. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Dual Ant 1



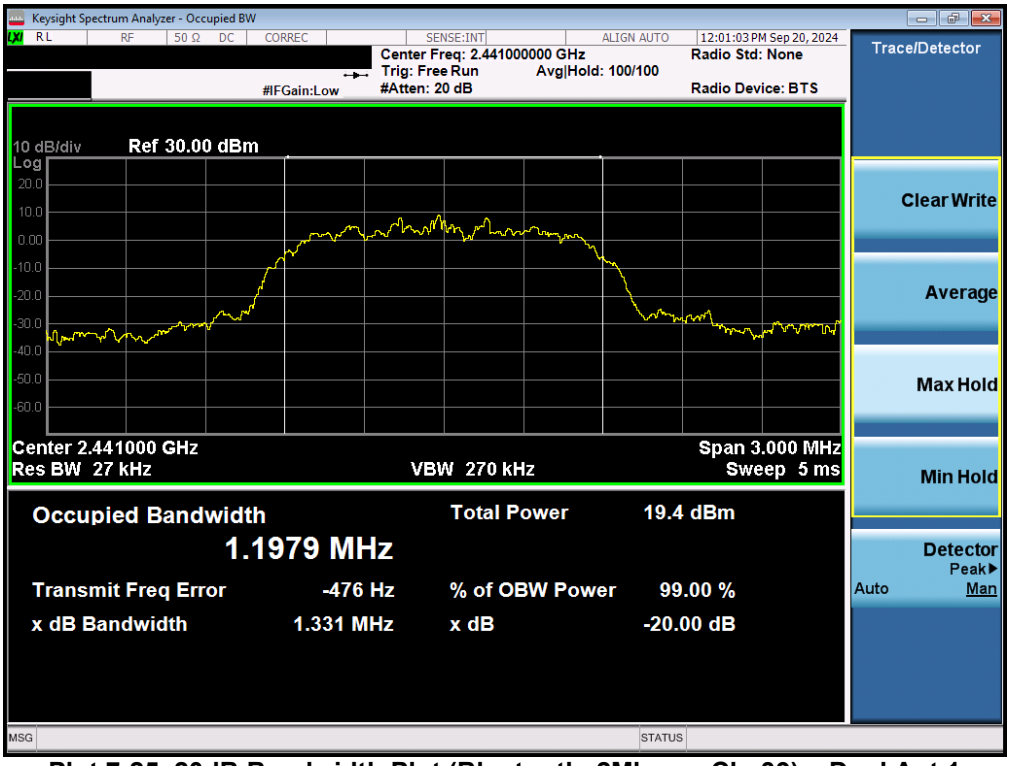
Plot 7-22. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Dual Ant 1



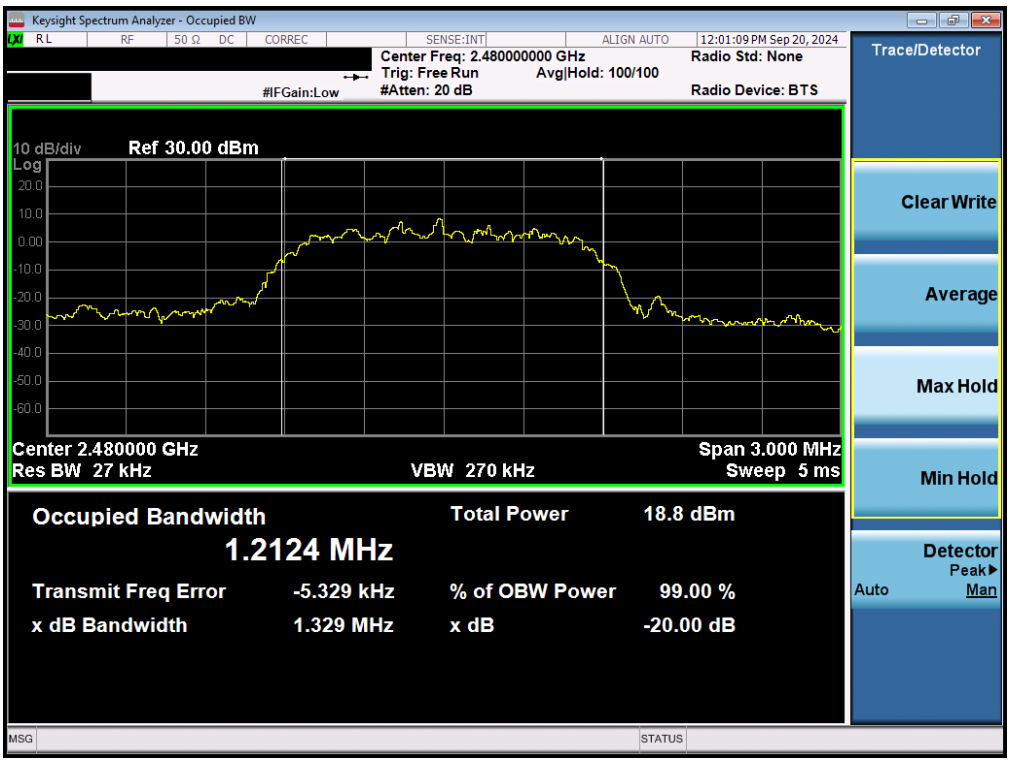
Plot 7-23. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Dual Ant 1



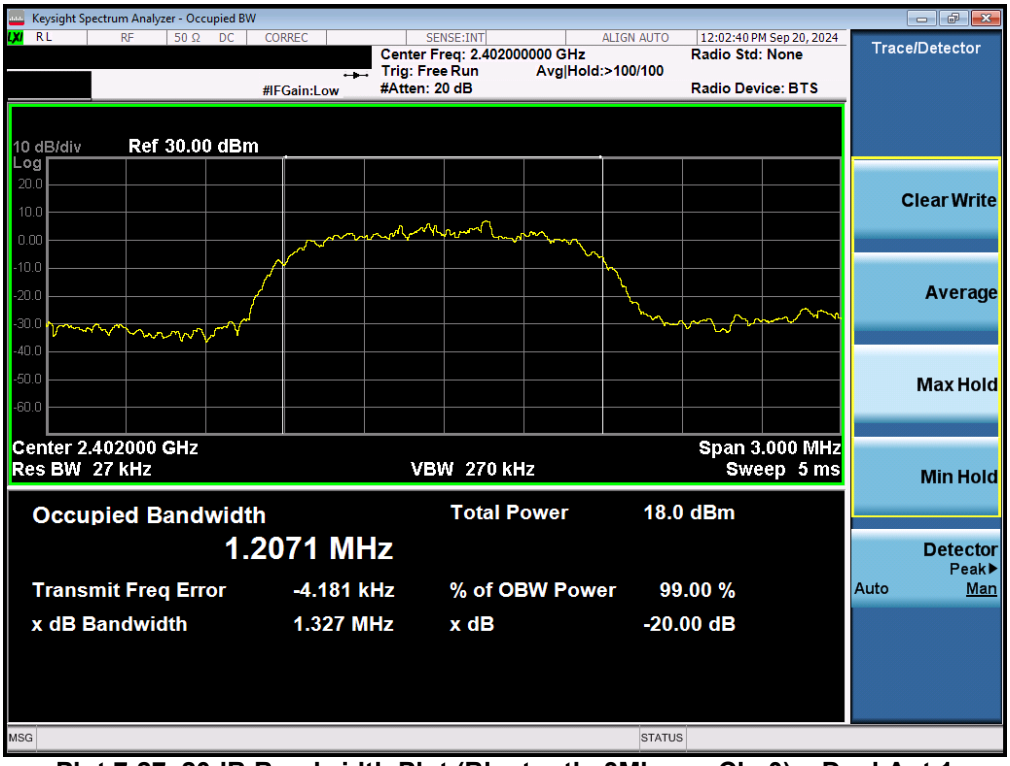
Plot 7-24. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Dual Ant 1



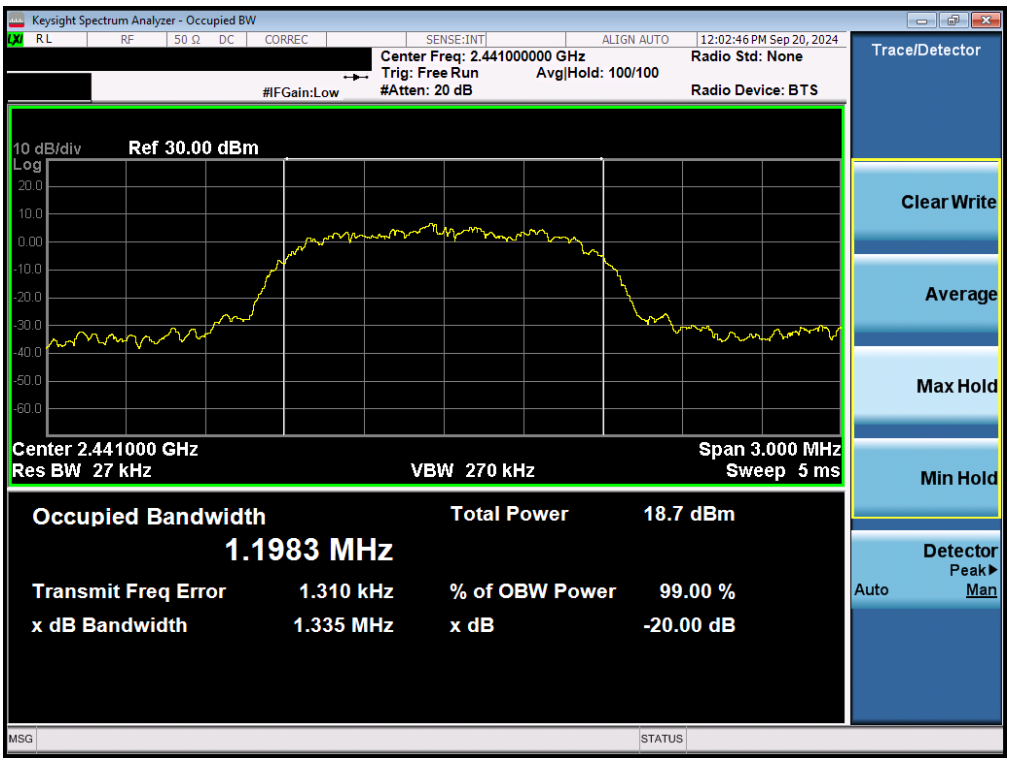
Plot 7-25. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Dual Ant 1



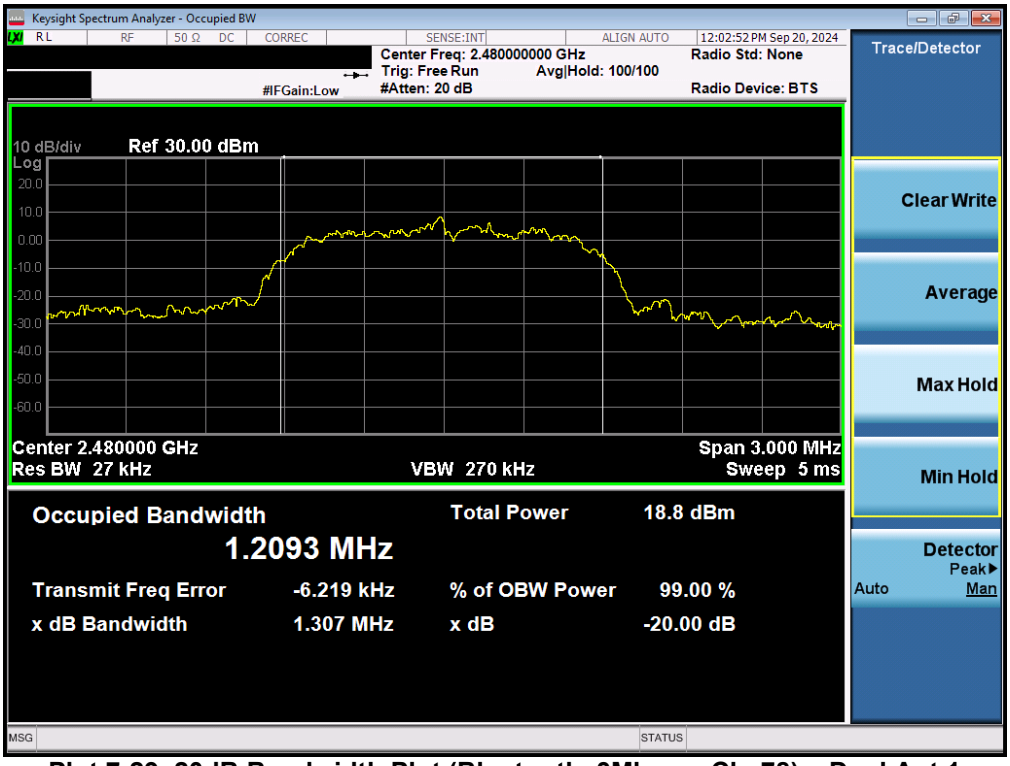
Plot 7-26. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Dual Ant 1



Plot 7-27. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Dual Ant 1



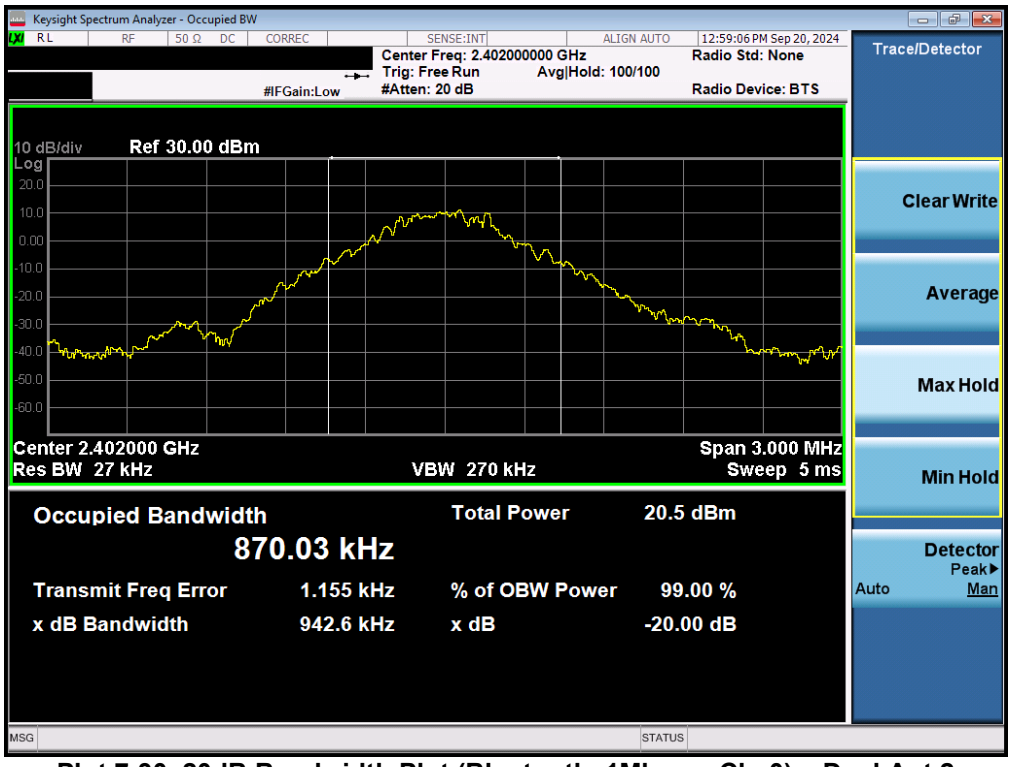
Plot 7-28. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Dual Ant 1



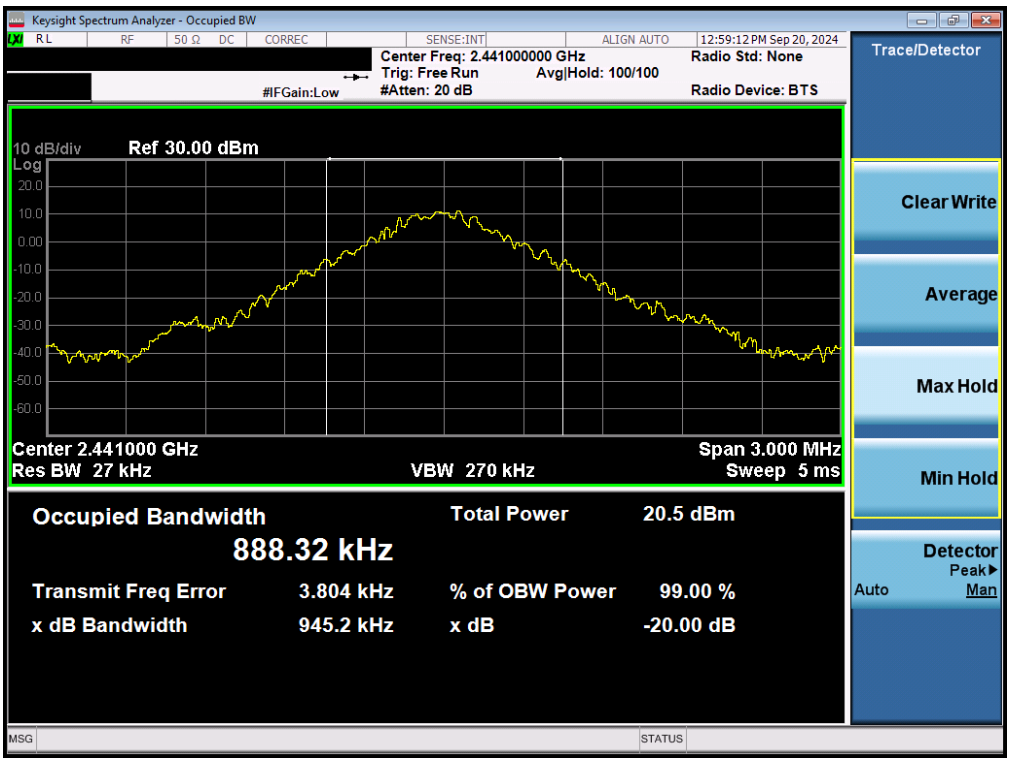
Plot 7-29. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 78) – Dual Ant 1

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	20dB Bandwidth Test Results [kHz]
2402	1.0	GFSK	0	942.6
2441	1.0	GFSK	39	945.2
2480	1.0	GFSK	78	983.9
2402	2.0	π/4-DQPSK	0	1342
2441	2.0	π/4-DQPSK	39	1355
2480	2.0	π/4-DQPSK	78	1344
2402	3.0	8DPSK	0	1335
2441	3.0	8DPSK	39	1328
2480	3.0	8DPSK	78	1323

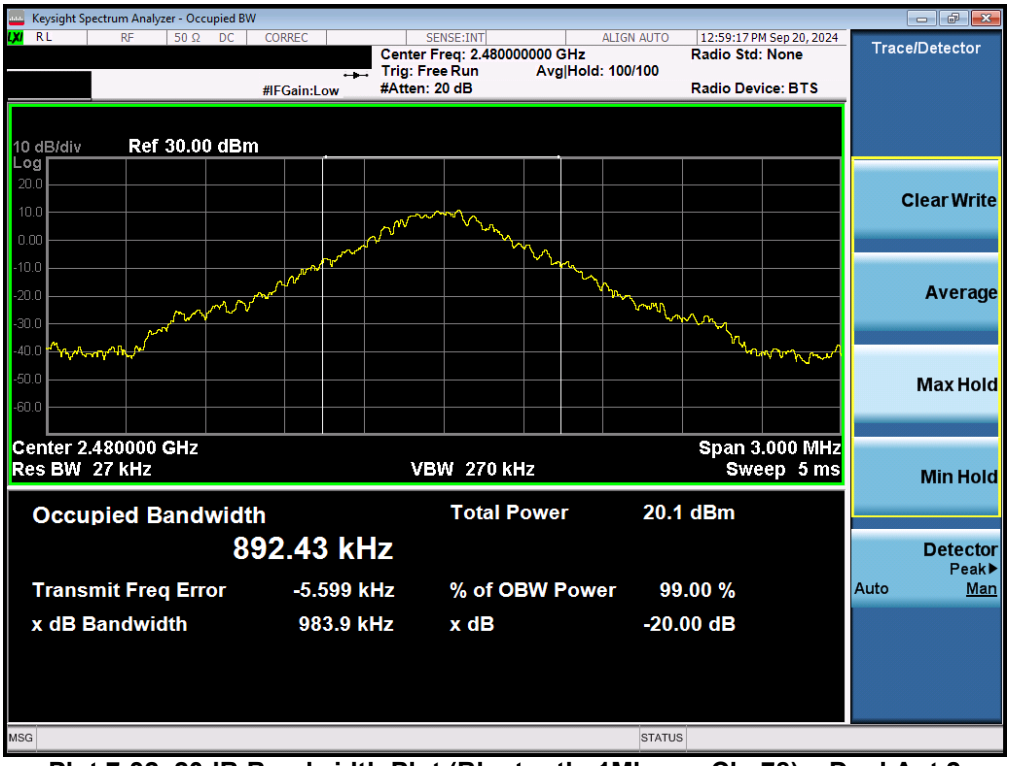
Table 7-8. Conducted 20dB Bandwidth Measurements – Dual Ant 2



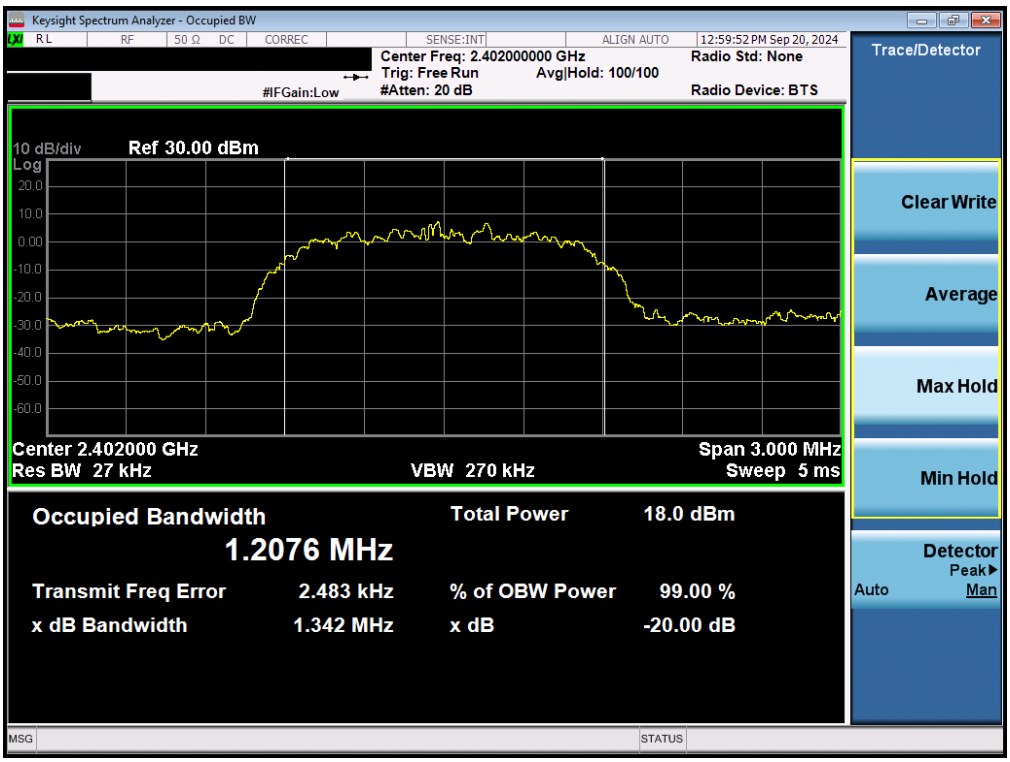
Plot 7-30. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 0) – Dual Ant 2



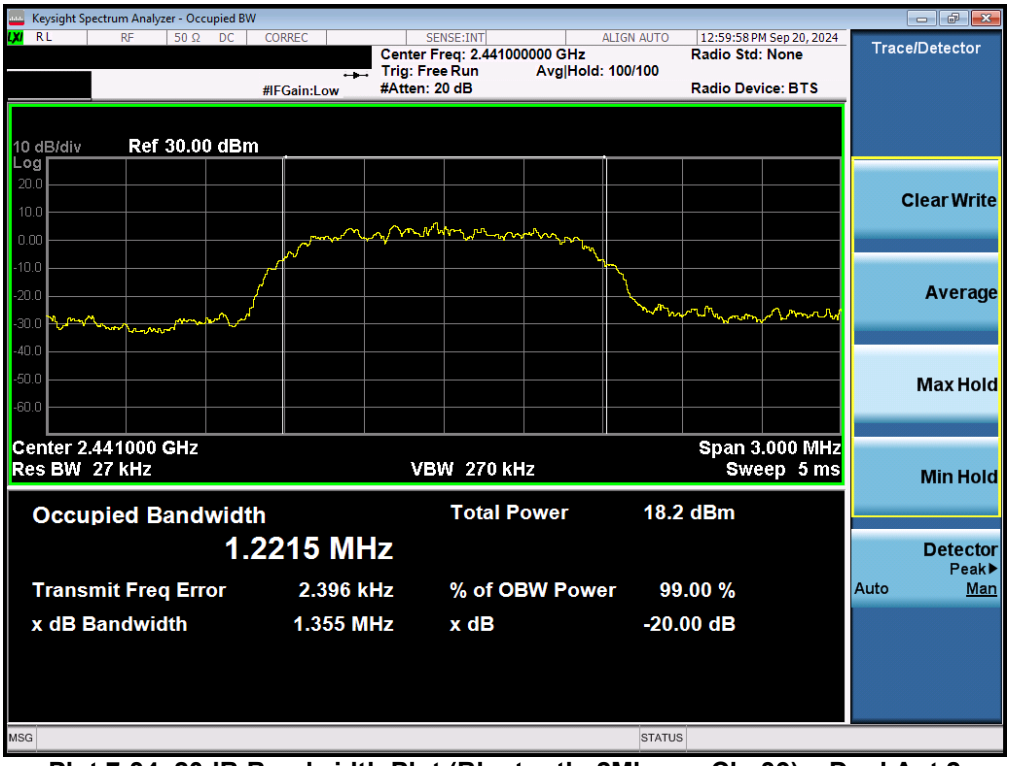
Plot 7-31. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 39) – Dual Ant 2



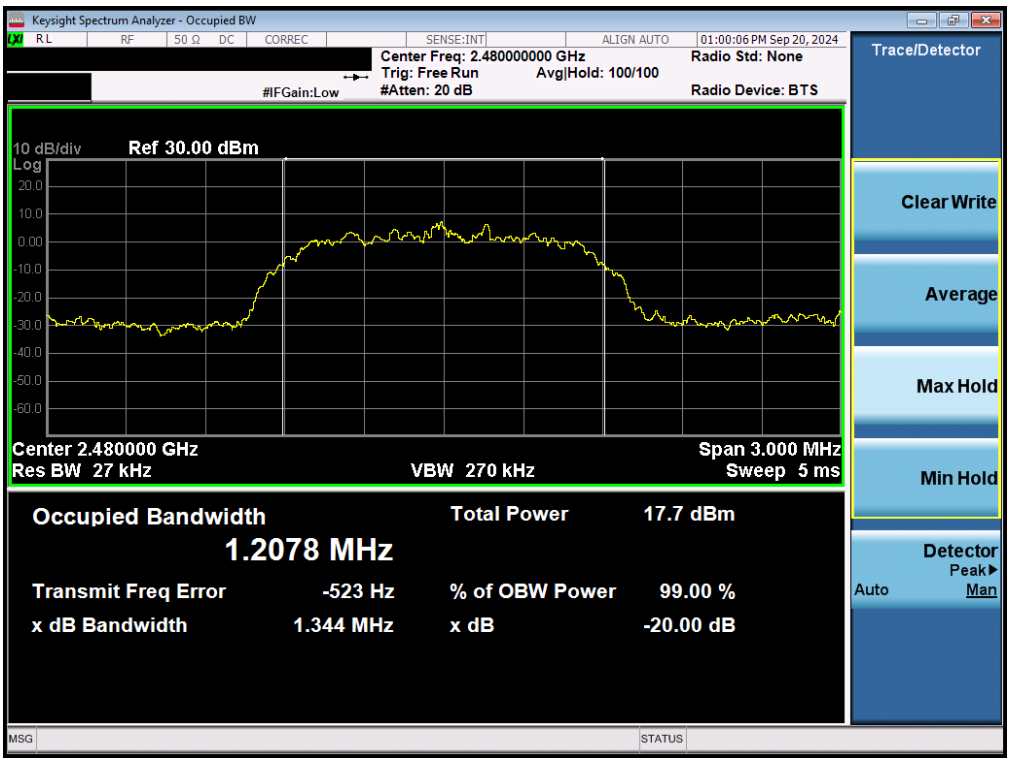
Plot 7-32. 20dB Bandwidth Plot (Bluetooth, 1Mbps – Ch. 78) – Dual Ant 2



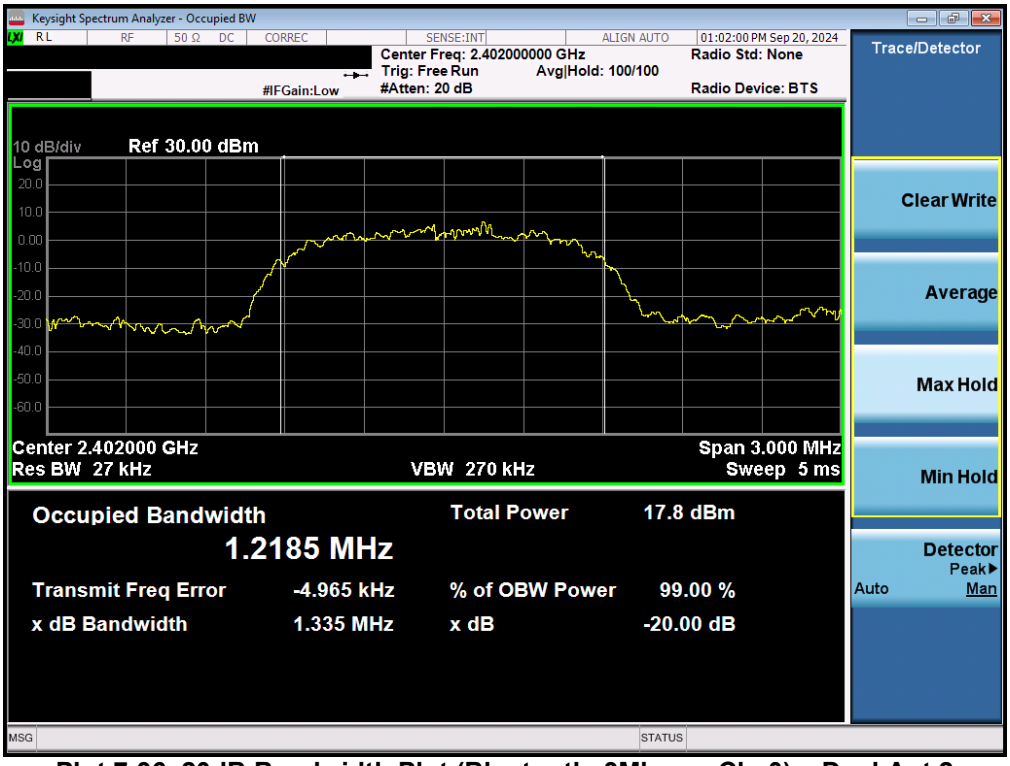
Plot 7-33. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 0) – Dual Ant 2



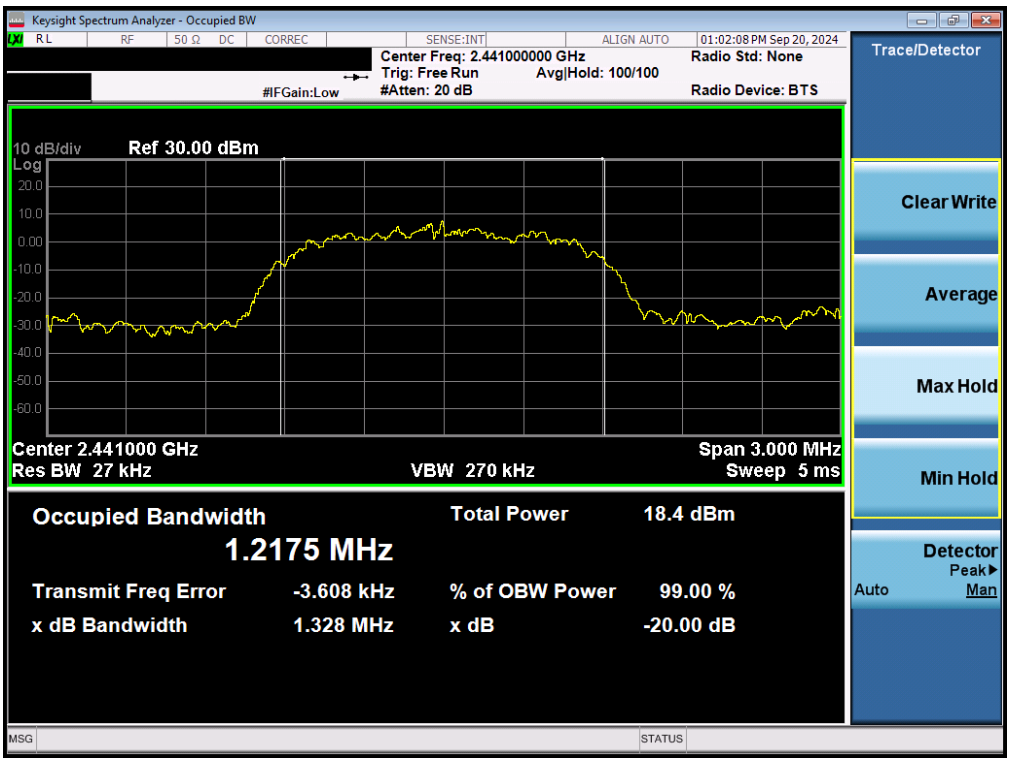
Plot 7-34. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 39) – Dual Ant 2



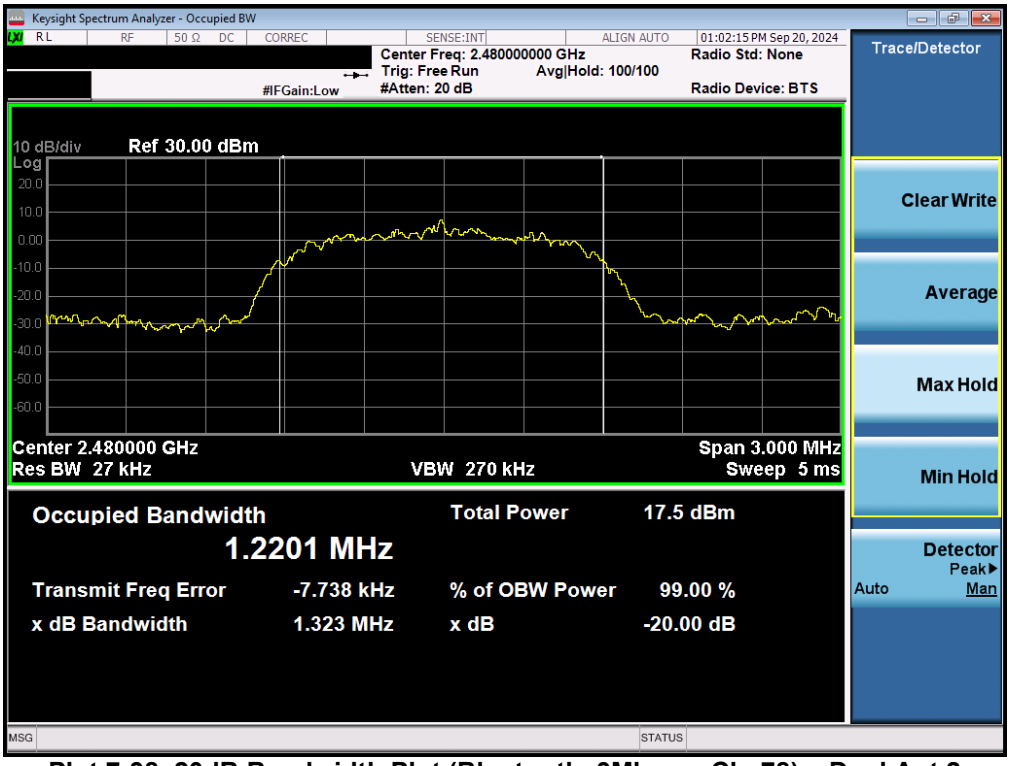
Plot 7-35. 20dB Bandwidth Plot (Bluetooth, 2Mbps – Ch. 78) – Dual Ant 2



Plot 7-36. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 0) – Dual Ant 2



Plot 7-37. 20dB Bandwidth Plot (Bluetooth, 3Mbps – Ch. 39) – Dual Ant 2



Plot 7-38. 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

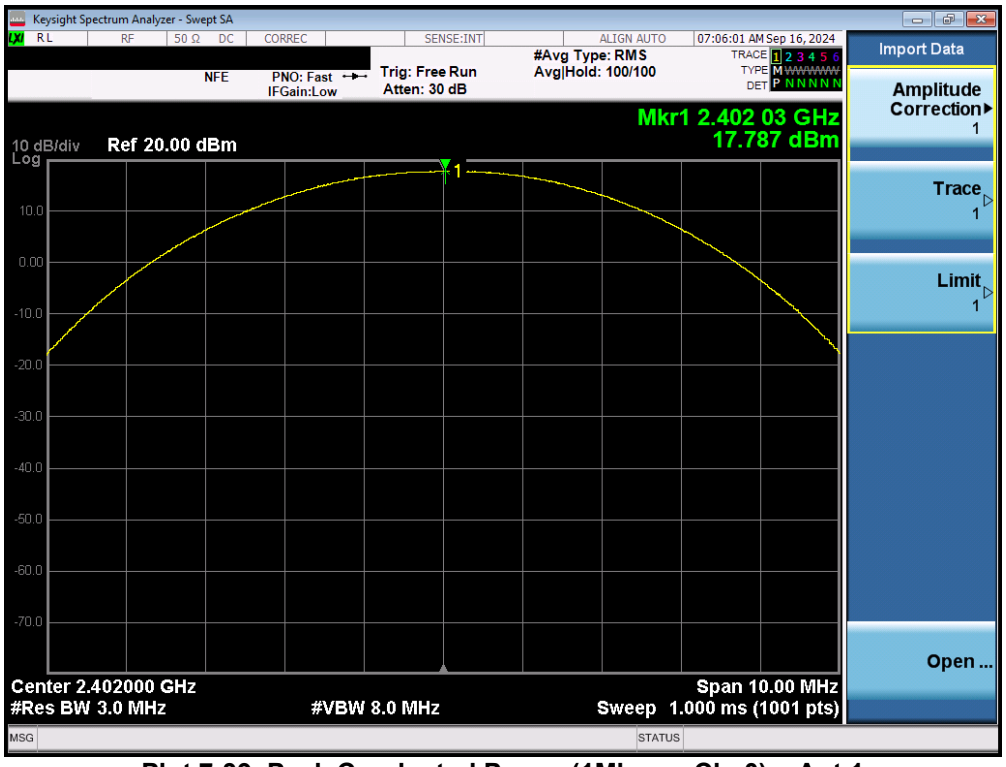
Note

This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 1Mbps. The EUT was tested for the average power with a broadband power meter for reporting purposes only. Final results were obtained using calibrated couplers, attenuators and cables. The following formula was used:

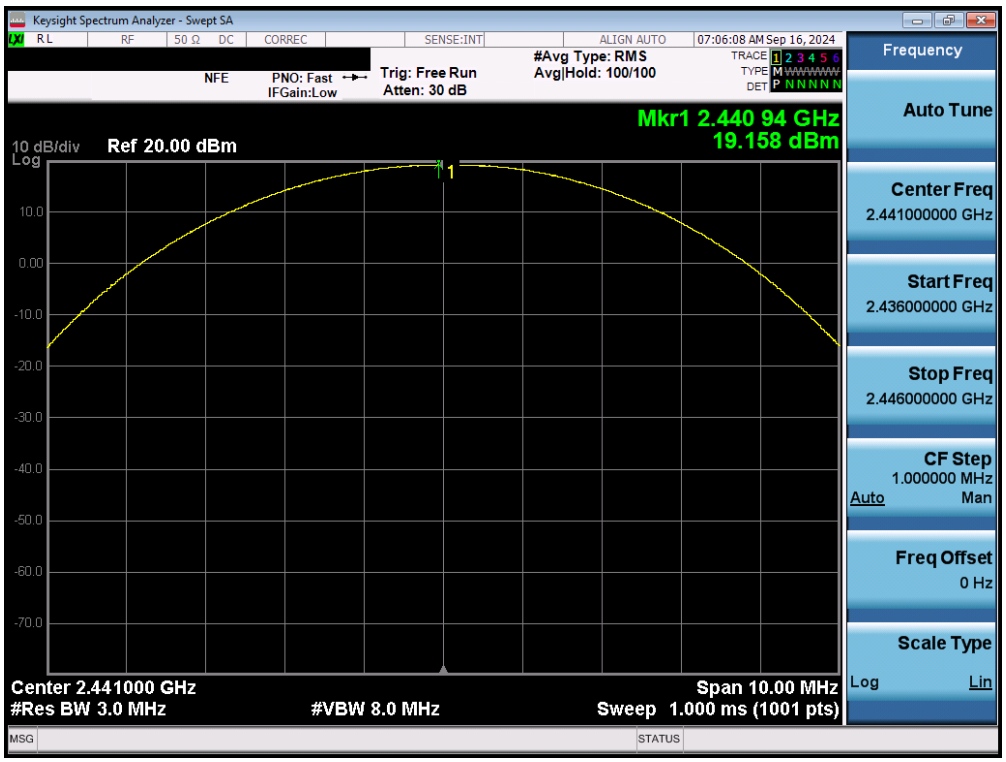
Output Power (dBm) = Raw Analyzer Level (dBm) + Cable Loss (dB) + Loss in Directional Coupler/Insertion Loss (dB)

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	Peak Conducted Power		Avg Conducted Power	
				[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	0	17.79	60.076	17.10	51.227
2441	1.0	GFSK	39	19.16	82.376	18.64	73.182
2480	1.0	GFSK	78	18.43	69.663	17.75	59.574
2402	2.0	π/4-DQPSK	0	16.58	45.478	13.79	23.920
2441	2.0	π/4-DQPSK	39	18.67	73.604	15.71	37.238
2480	2.0	π/4-DQPSK	78	17.78	59.924	14.88	30.780
2402	3.0	8DPSK	0	17.47	55.860	14.25	26.620
2441	3.0	8DPSK	39	18.89	77.482	15.83	38.255
2480	3.0	8DPSK	78	17.92	61.887	14.71	29.592

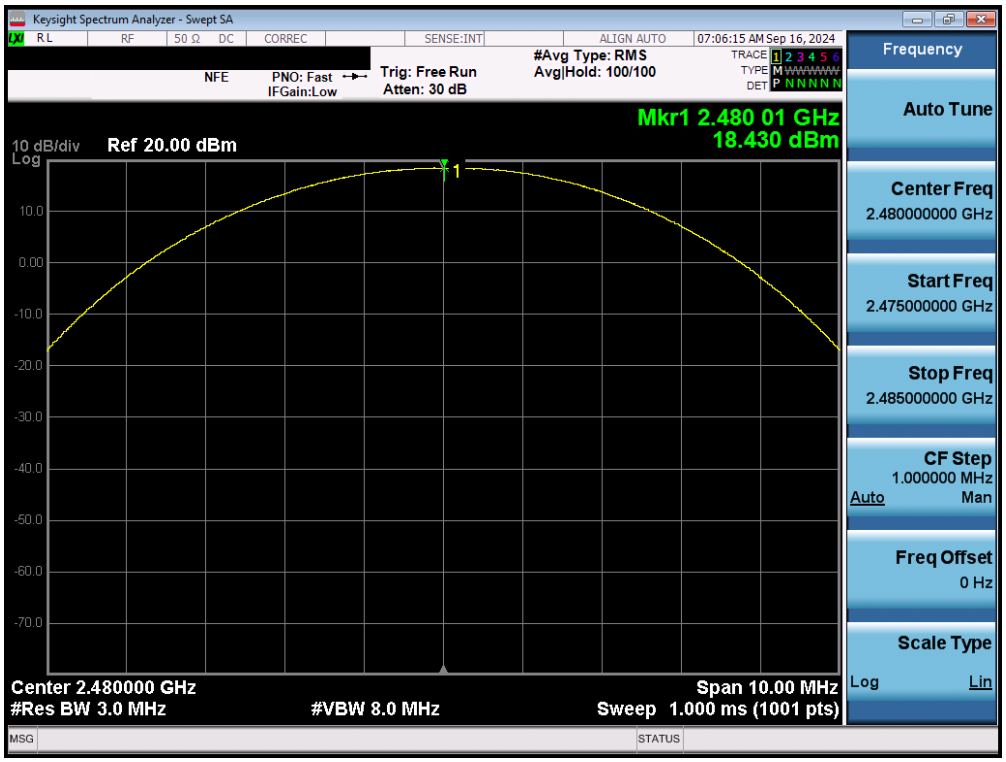
Table 7-9. Conducted Output Power Measurements – Ant 1



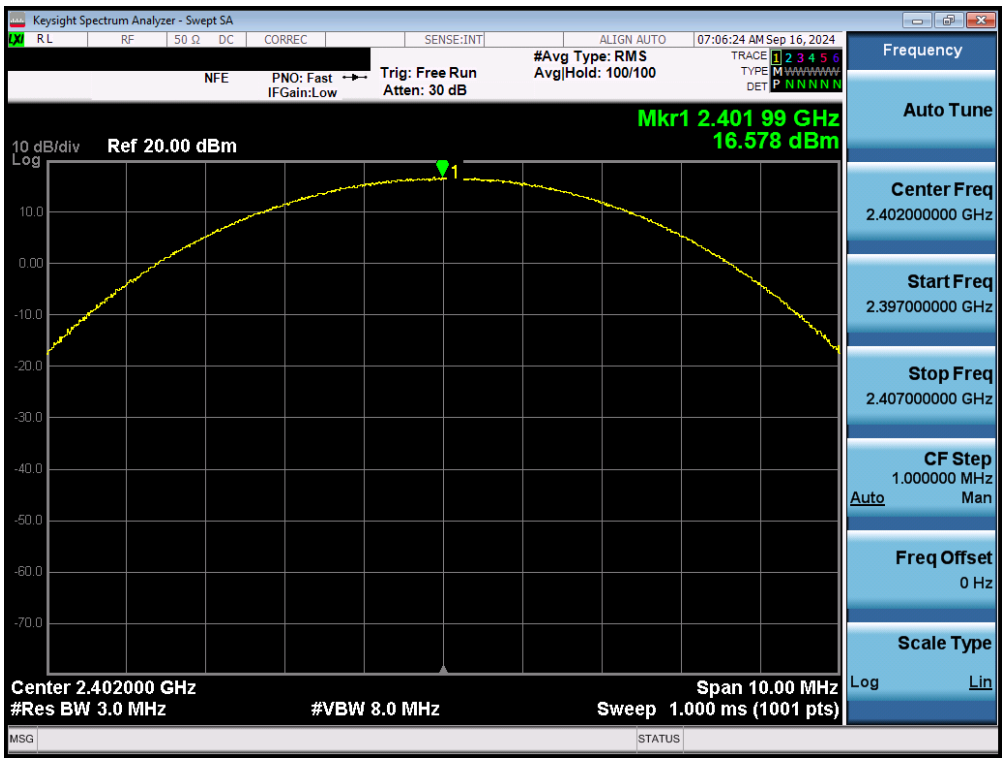
Plot 7-39. Peak Conducted Power (1Mbps – Ch. 0) – Ant 1



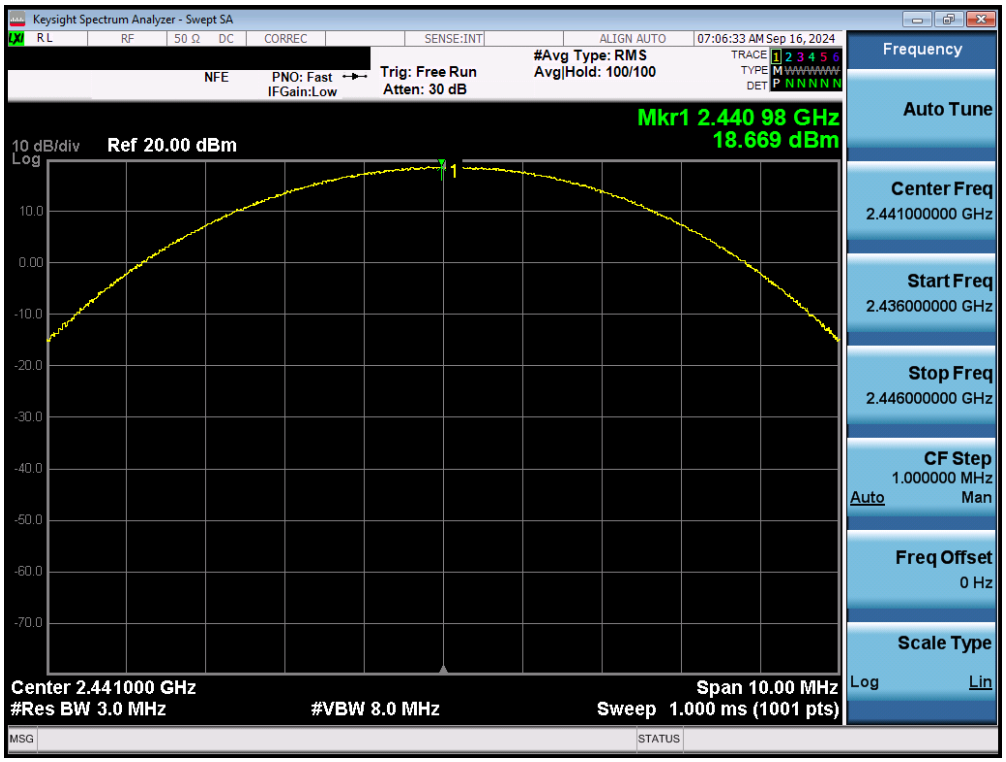
Plot 7-40. Peak Conducted Power (1Mbps – Ch. 39) – Ant 1



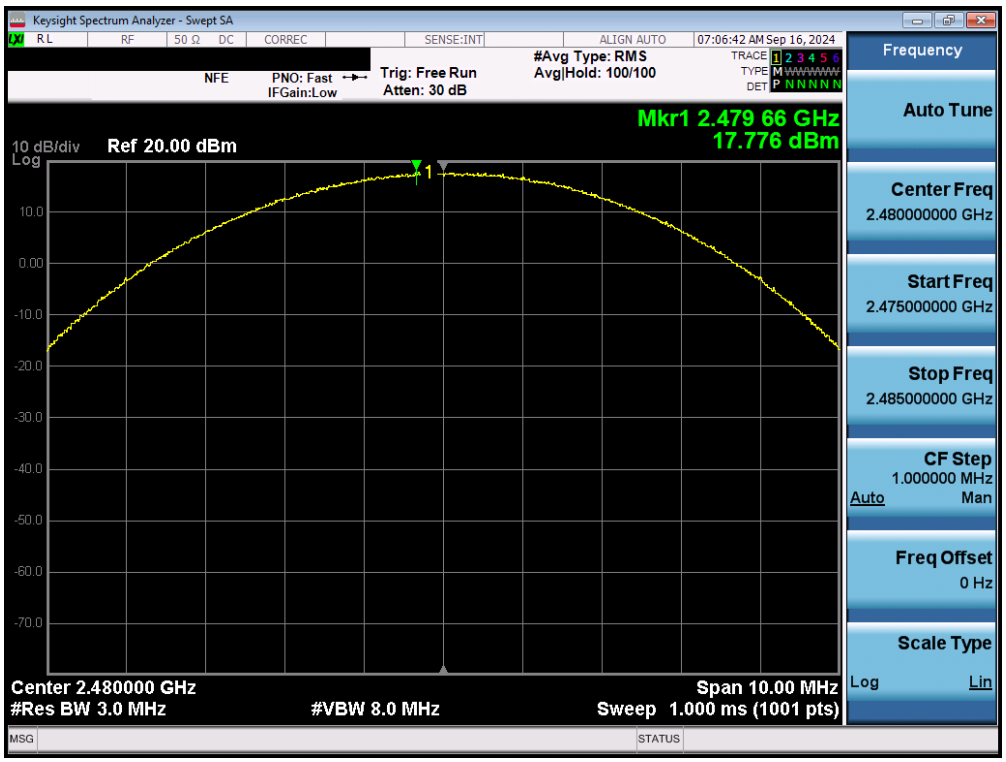
Plot 7-41. Peak Conducted Power (1Mbps – Ch. 78) – Ant 1



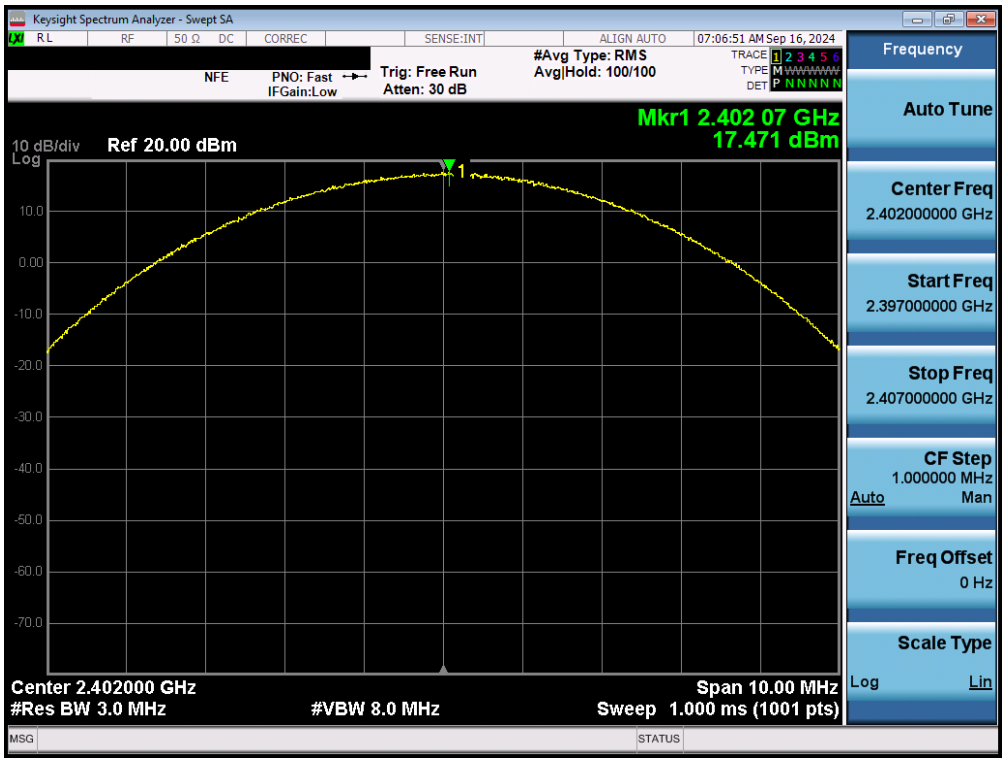
Plot 7-42. Peak Conducted Power (2Mbps – Ch. 0) – Ant 1



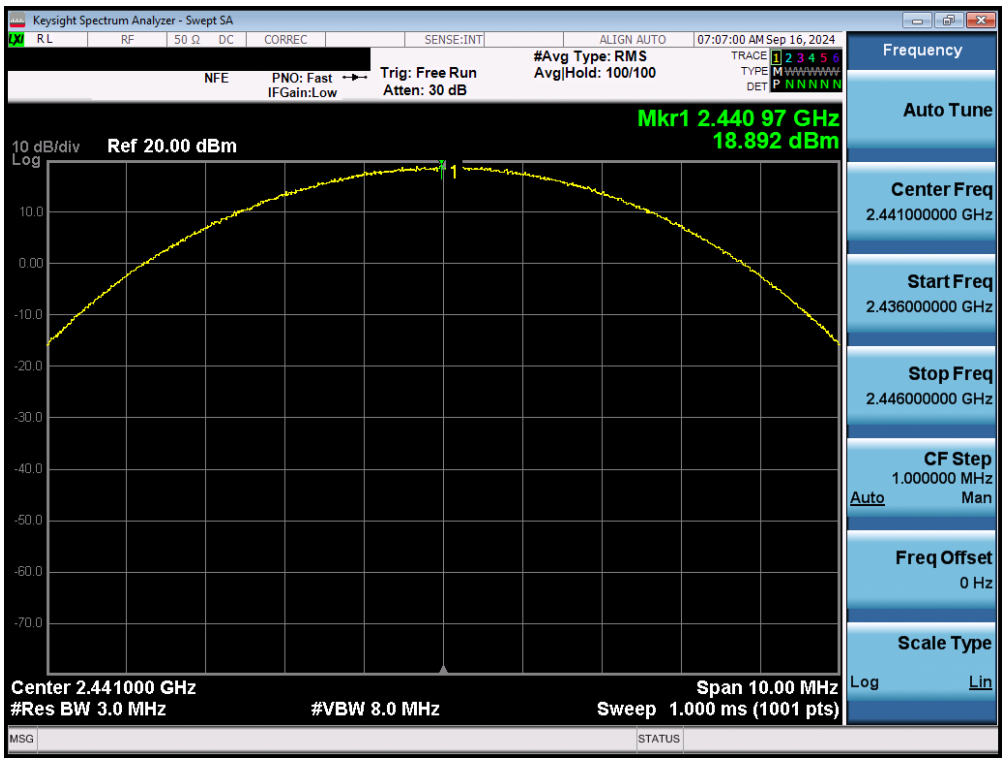
Plot 7-43. Peak Conducted Power (2Mbps – Ch. 39) – Ant 1



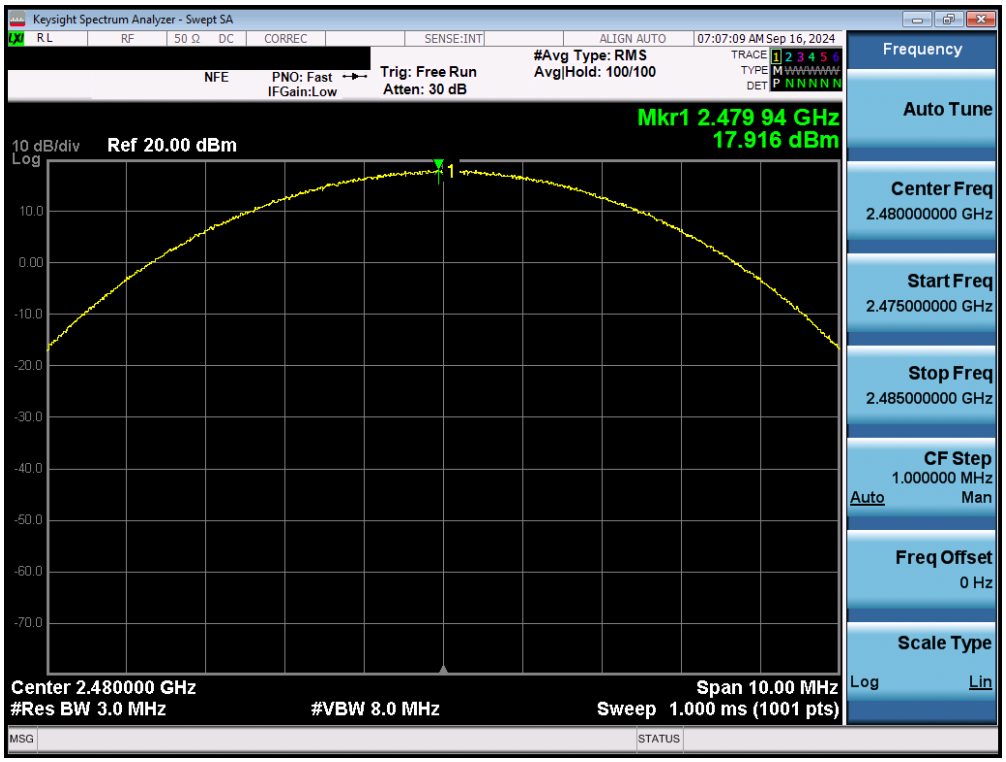
Plot 7-44. Peak Conducted Power (2Mbps – Ch. 78) – Ant 1



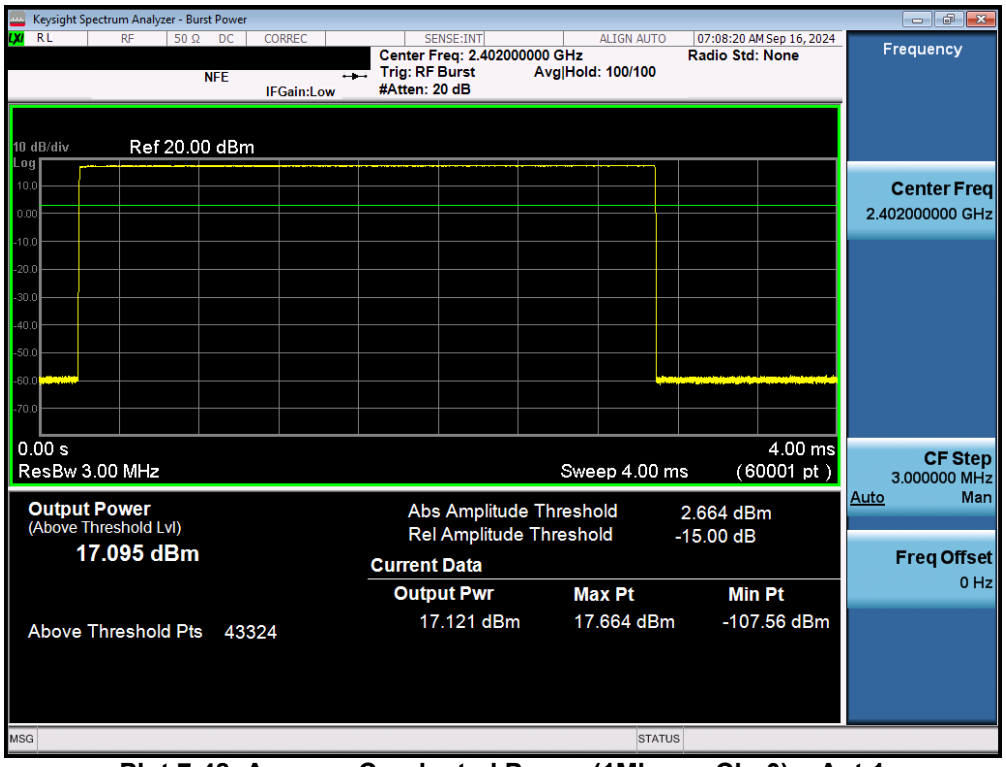
Plot 7-45. Peak Conducted Power (3Mbps – Ch. 0) – Ant 1



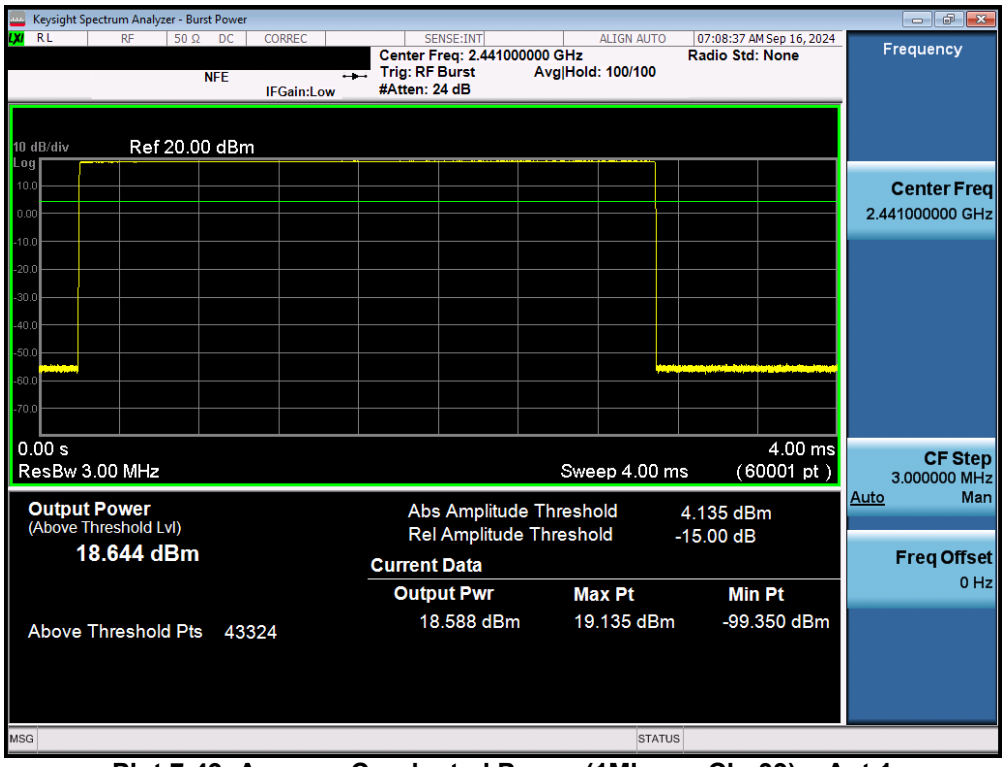
Plot 7-46. Peak Conducted Power (3Mbps – Ch. 39) – Ant 1



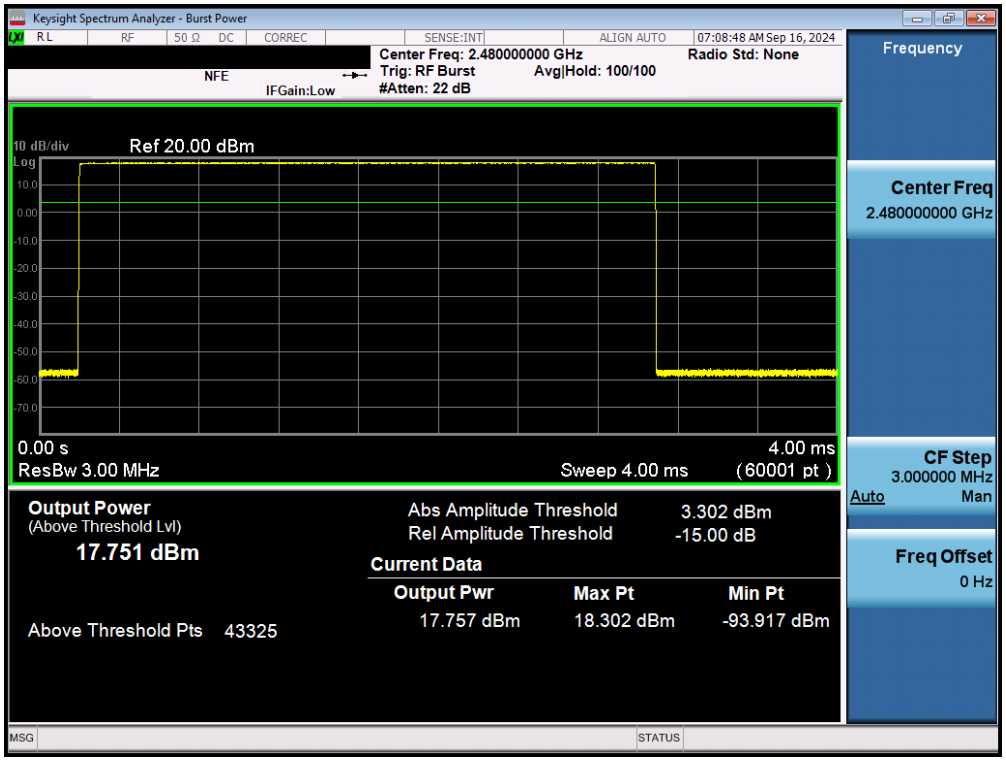
Plot 7-47. Peak Conducted Power (3Mbps – Ch. 78) – Ant 1



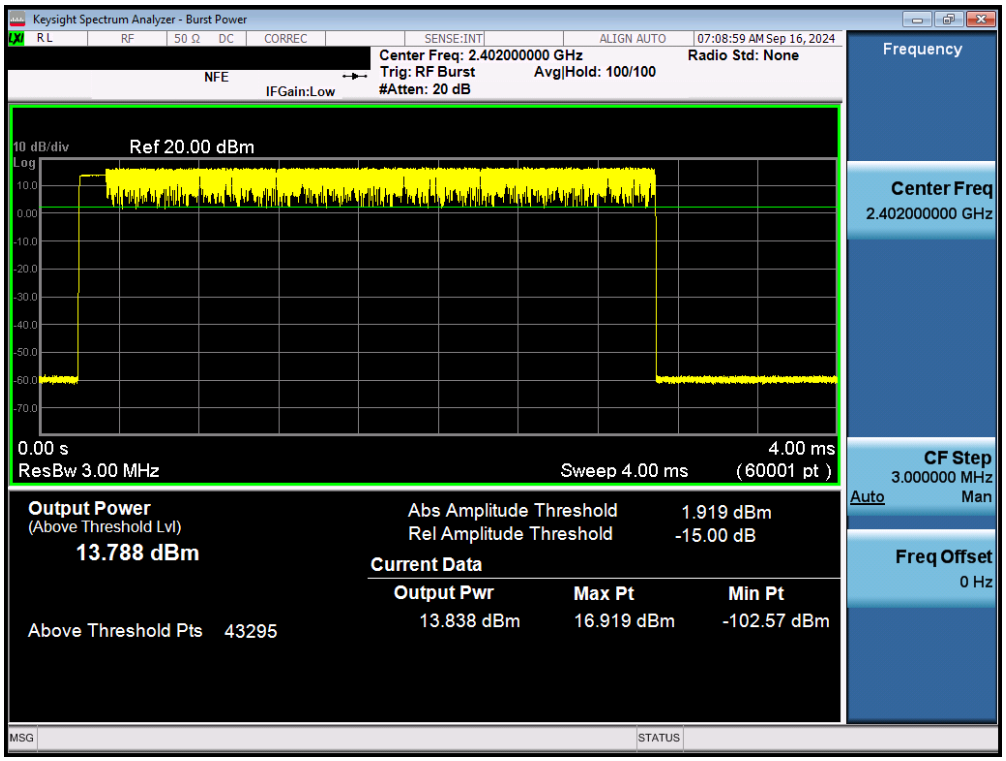
Plot 7-48. Average Conducted Power (1Mbps – Ch. 0) – Ant 1



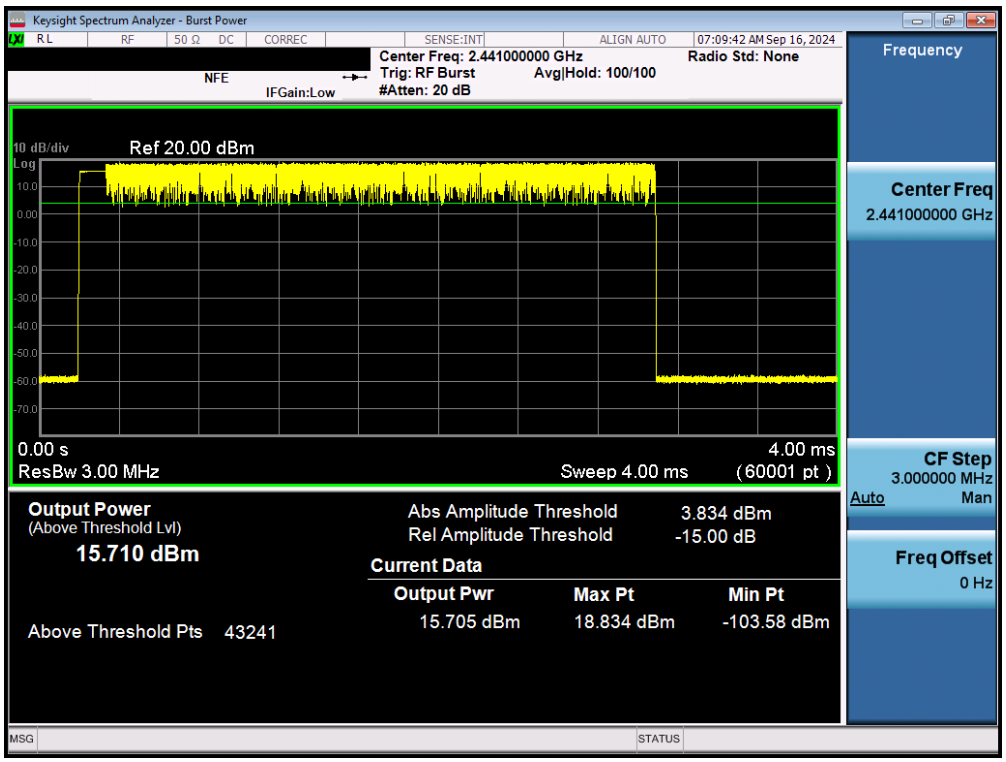
Plot 7-49. Average Conducted Power (1Mbps – Ch. 39) – Ant 1



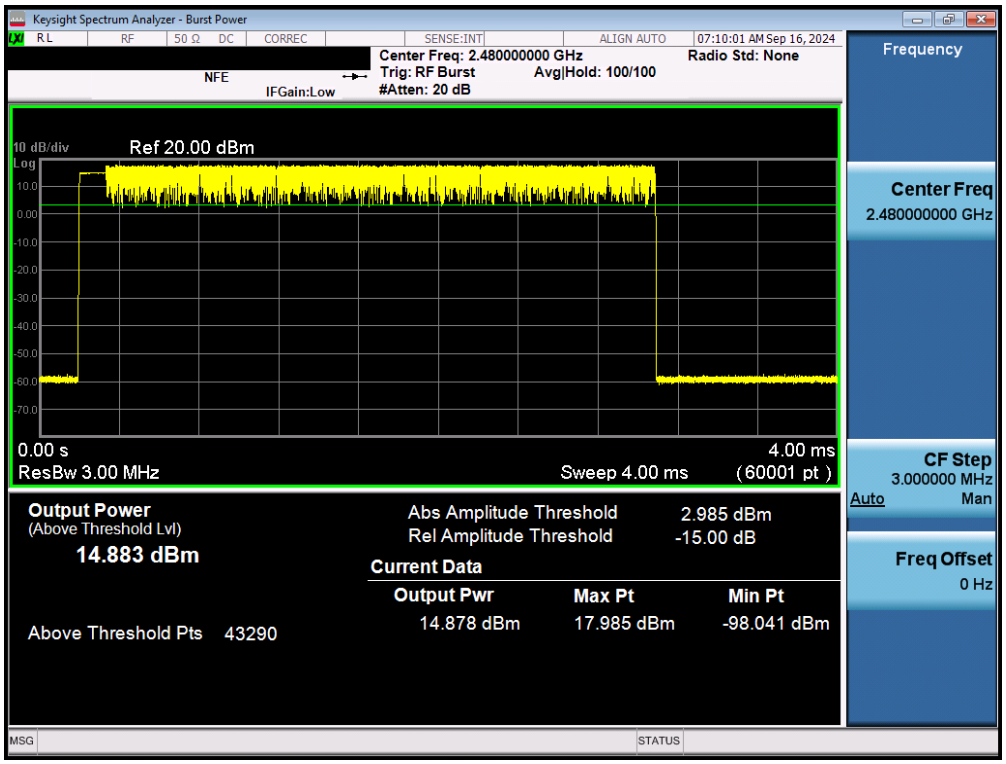
Plot 7-50. Average Conducted Power (1Mbps – Ch. 78) – Ant 1



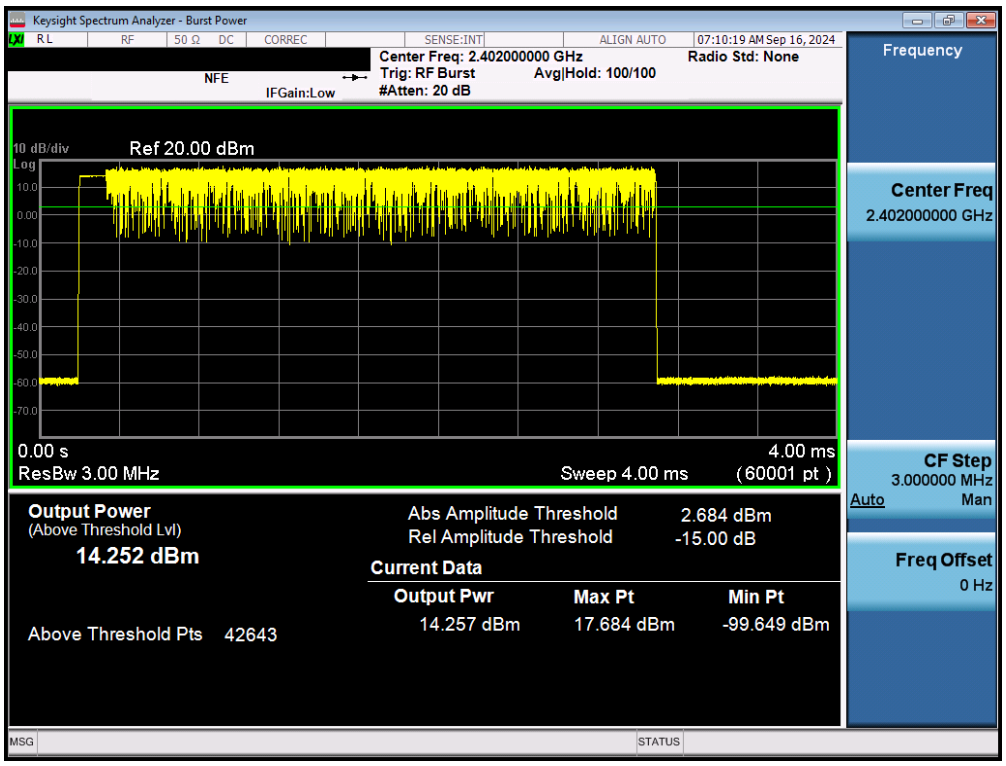
Plot 7-51. Average Conducted Power (2Mbps – Ch. 0) – Ant 1



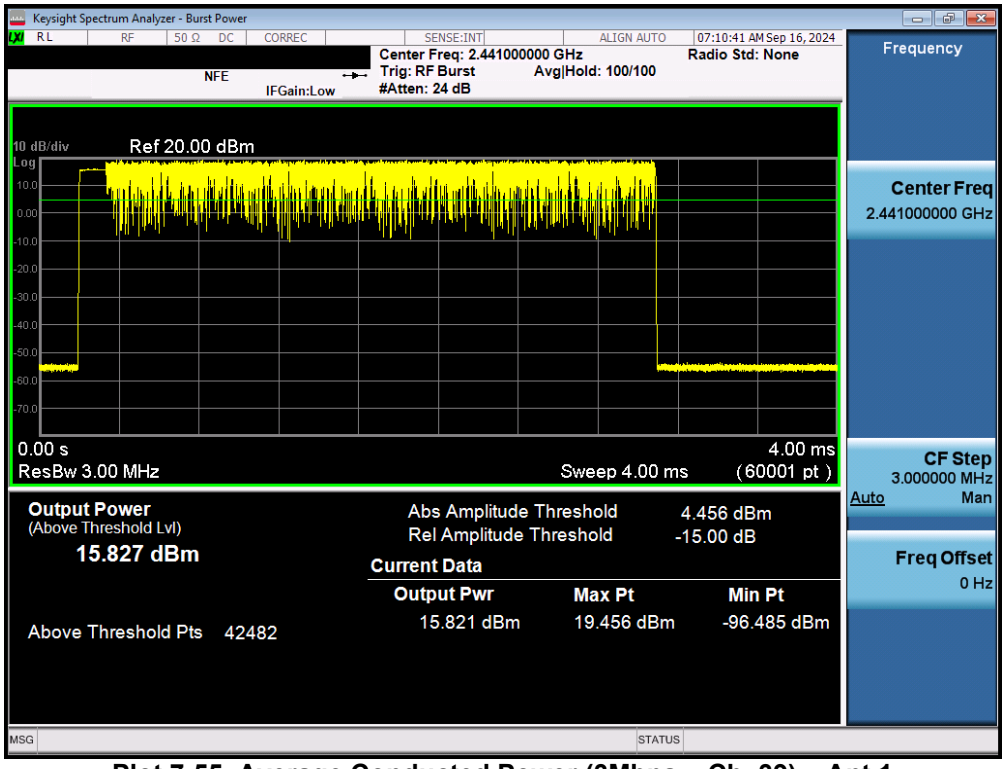
Plot 7-52. Average Conducted Power (2Mbps – Ch. 39) – Ant 1



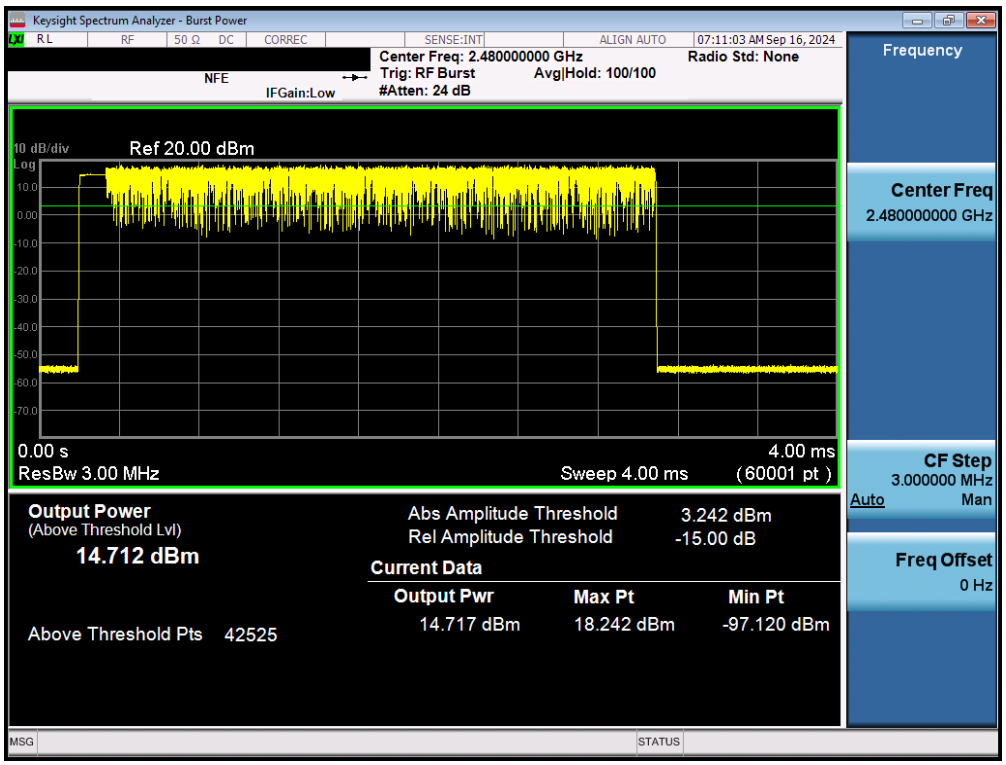
Plot 7-53. Average Conducted Power (2Mbps – Ch. 78) – Ant 1



Plot 7-54. Average Conducted Power (3Mbps – Ch. 0) – Ant 1



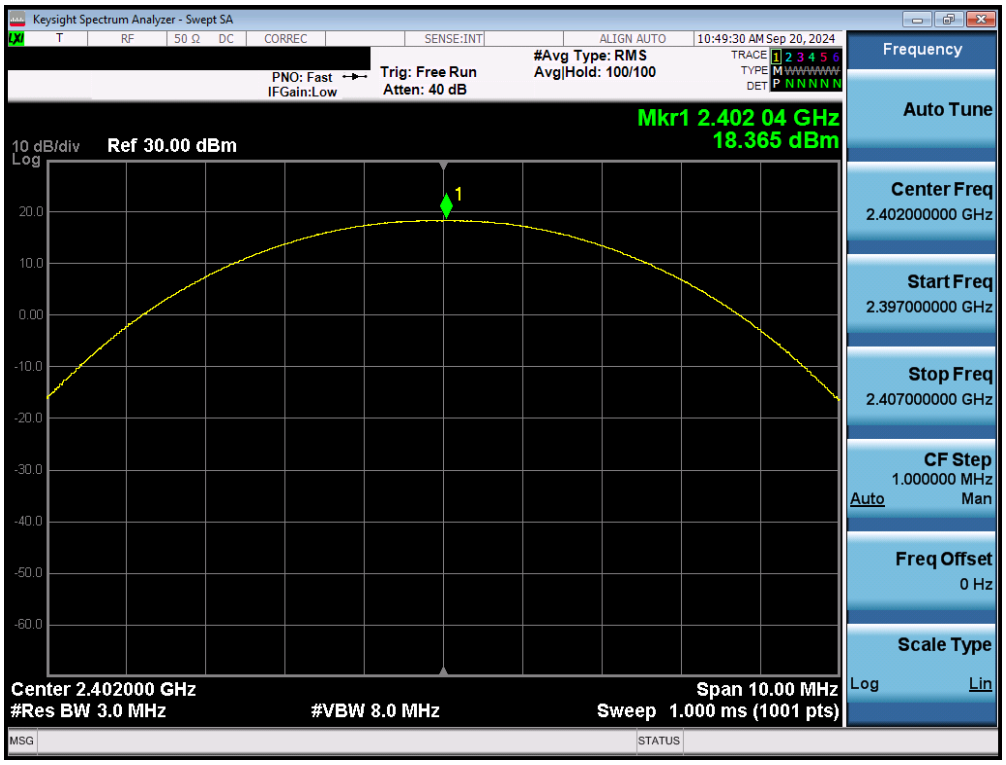
Plot 7-55. Average Conducted Power (3Mbps – Ch. 39) – Ant 1



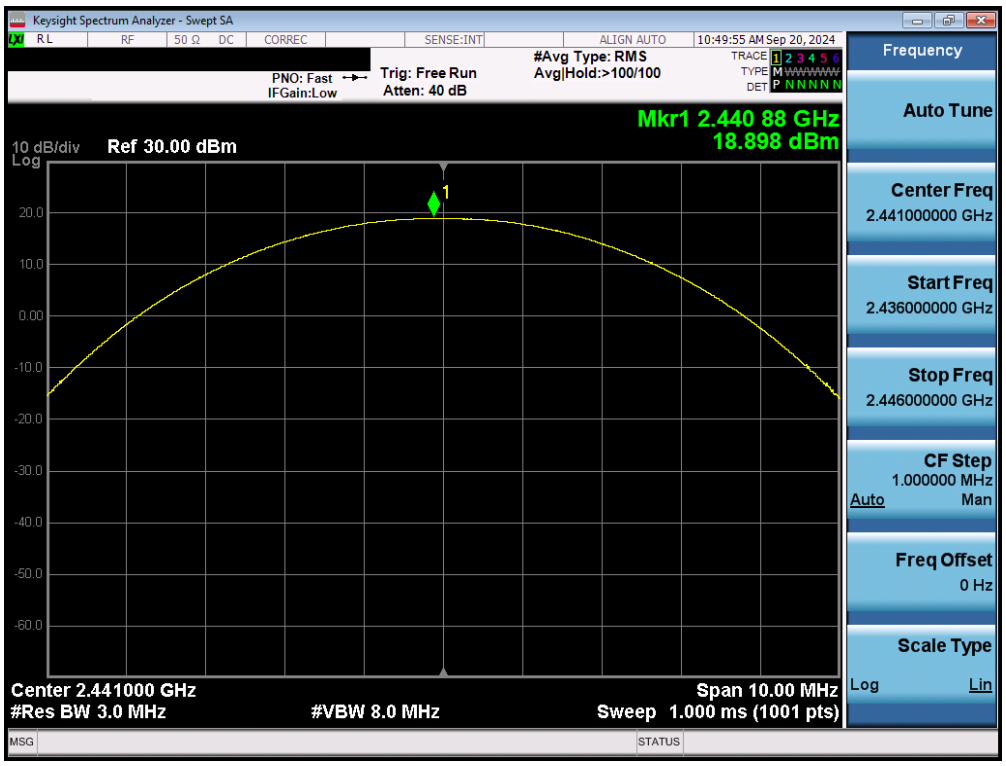
Plot 7-56. Average Conducted Power (3Mbps – Ch. 78) – Ant 1

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	Peak Conducted Power		Avg Conducted Power	
				[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	0	18.37	68.628	18.09	64.408
2441	1.0	GFSK	39	18.90	77.589	18.68	73.723
2480	1.0	GFSK	78	17.85	60.954	17.74	59.425
2402	2.0	π/4-DQPSK	0	17.79	60.104	15.06	32.055
2441	2.0	π/4-DQPSK	39	19.64	91.939	15.58	36.126
2480	2.0	π/4-DQPSK	78	17.65	58.251	14.46	27.954
2402	3.0	8DPSK	0	18.36	68.501	15.14	32.695
2441	3.0	8DPSK	39	20.23	105.439	15.55	35.917
2480	3.0	8DPSK	78	18.00	63.096	14.54	28.467

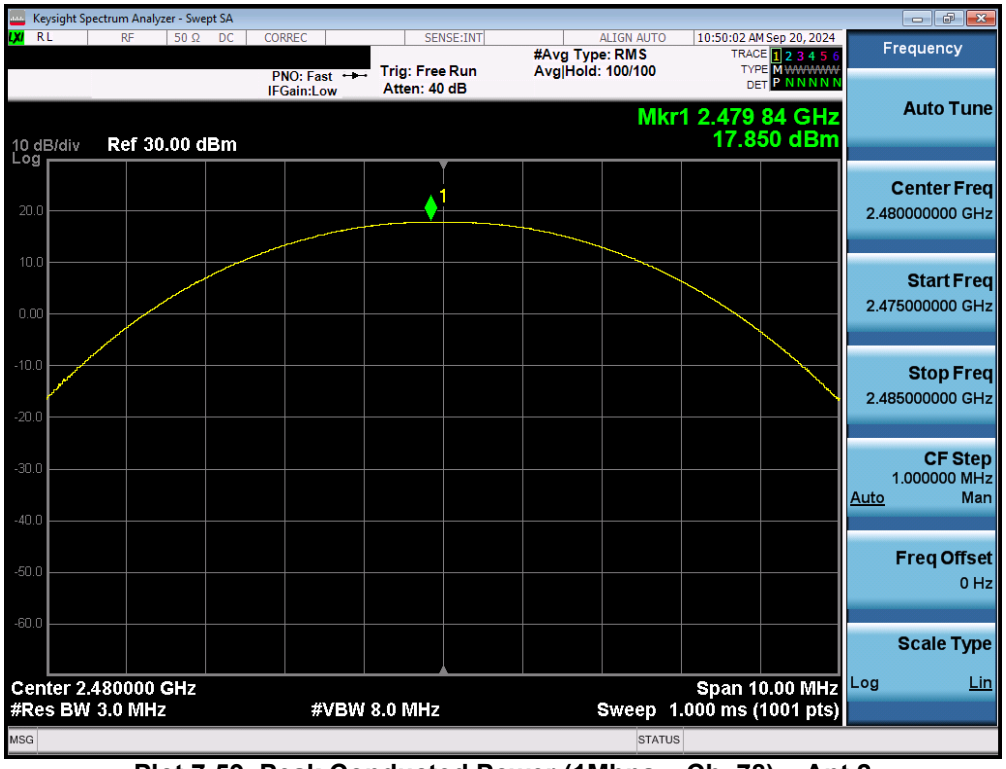
Table 7-10. Conducted Output Power Measurements – Ant 2



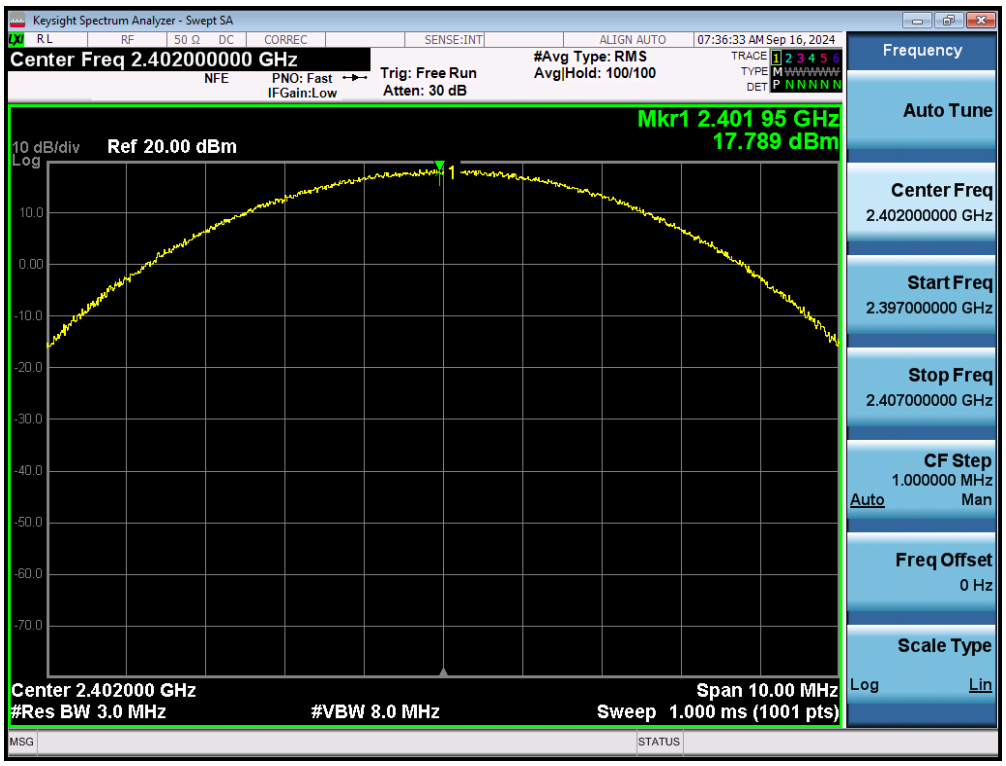
Plot 7-57. Peak Conducted Power (1Mbps – Ch. 0) – Ant 2



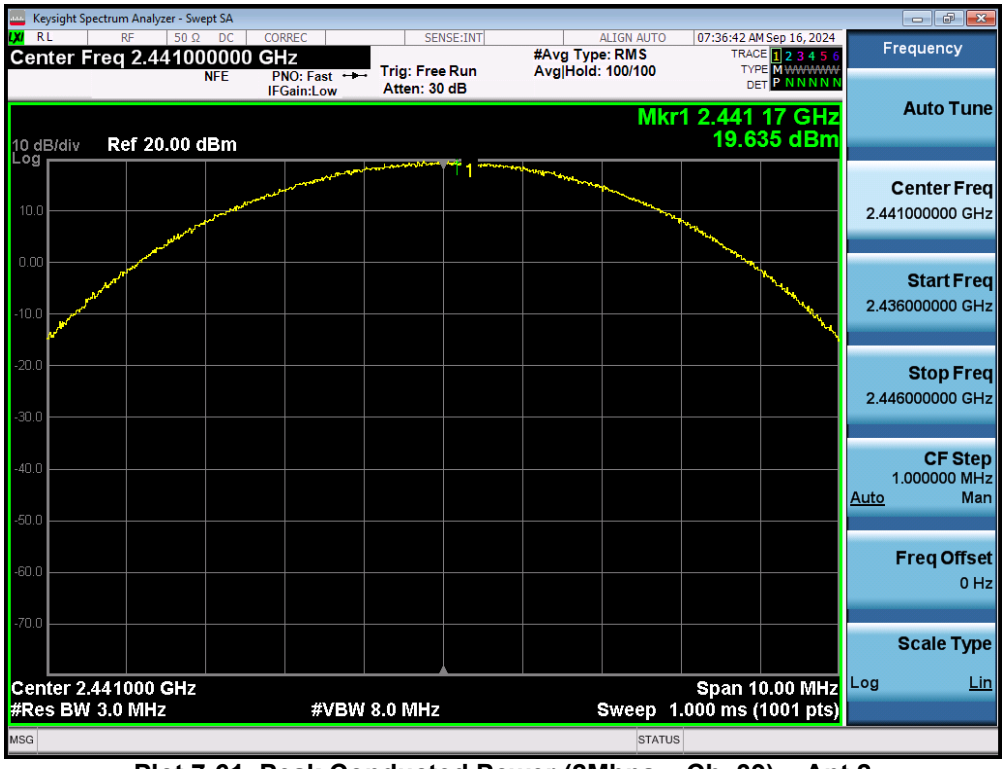
Plot 7-58. Peak Conducted Power (1Mbps – Ch. 39) – Ant 2



Plot 7-59. Peak Conducted Power (1Mbps – Ch. 78) – Ant 2

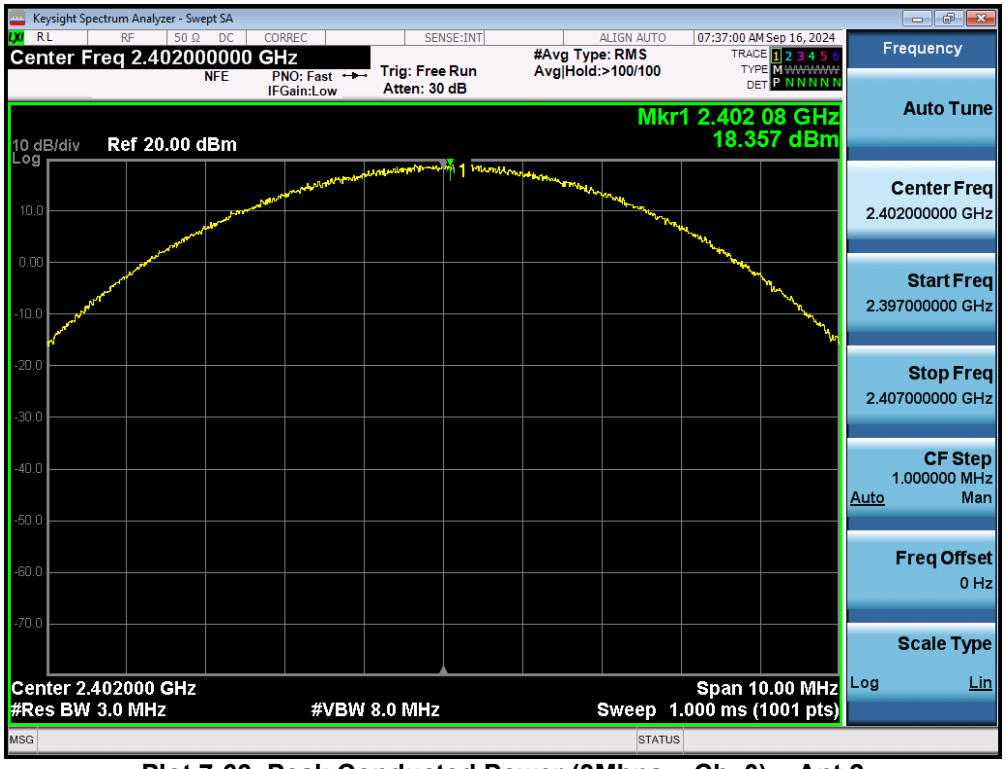


Plot 7-60. Peak Conducted Power (2Mbps – Ch. 0) – Ant 2

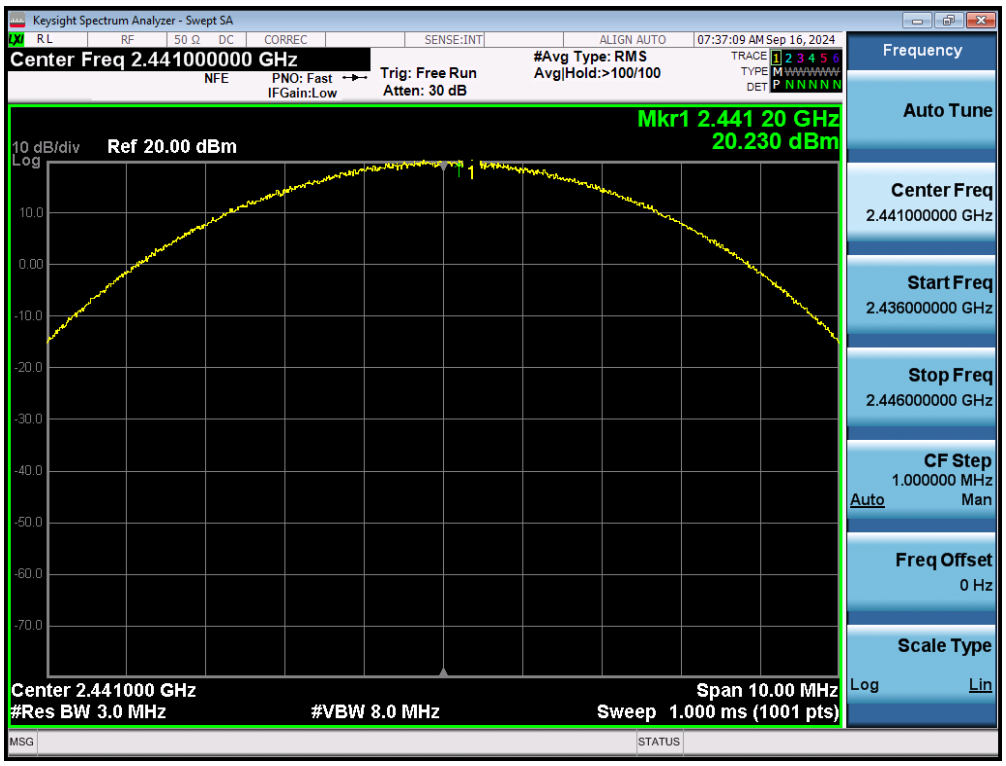


Plot 7-61. Peak Conducted Power (2Mbps – Ch. 39) – Ant 2

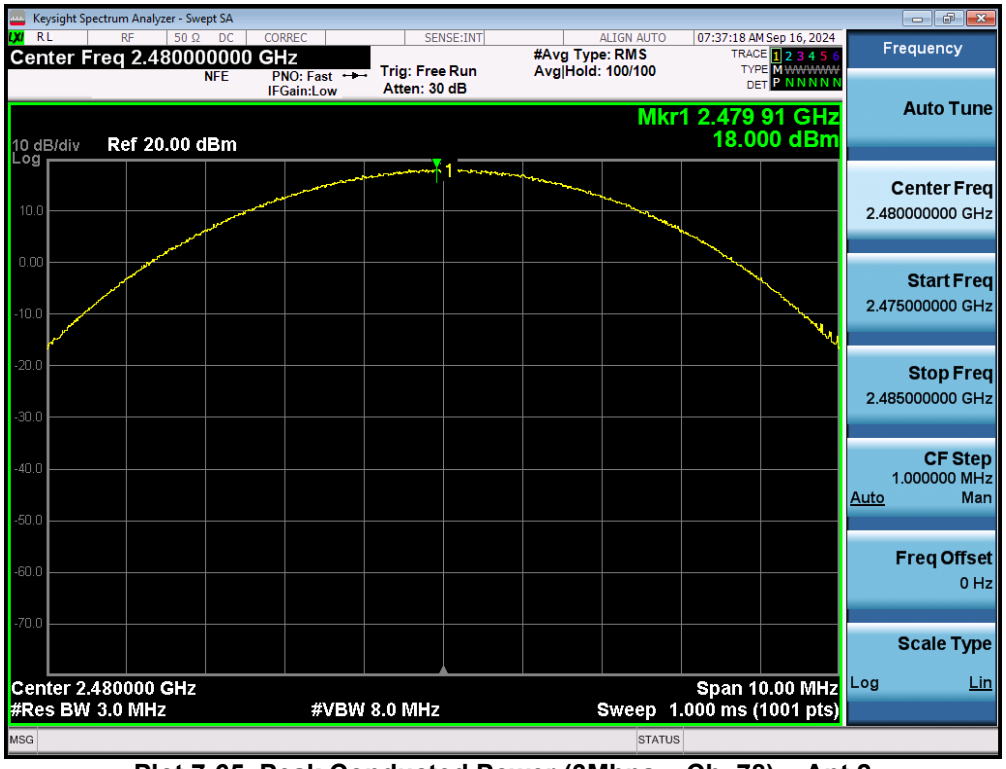
Plot 7-62. Peak Conducted Power (2Mbps – Ch. 78) – Ant 2



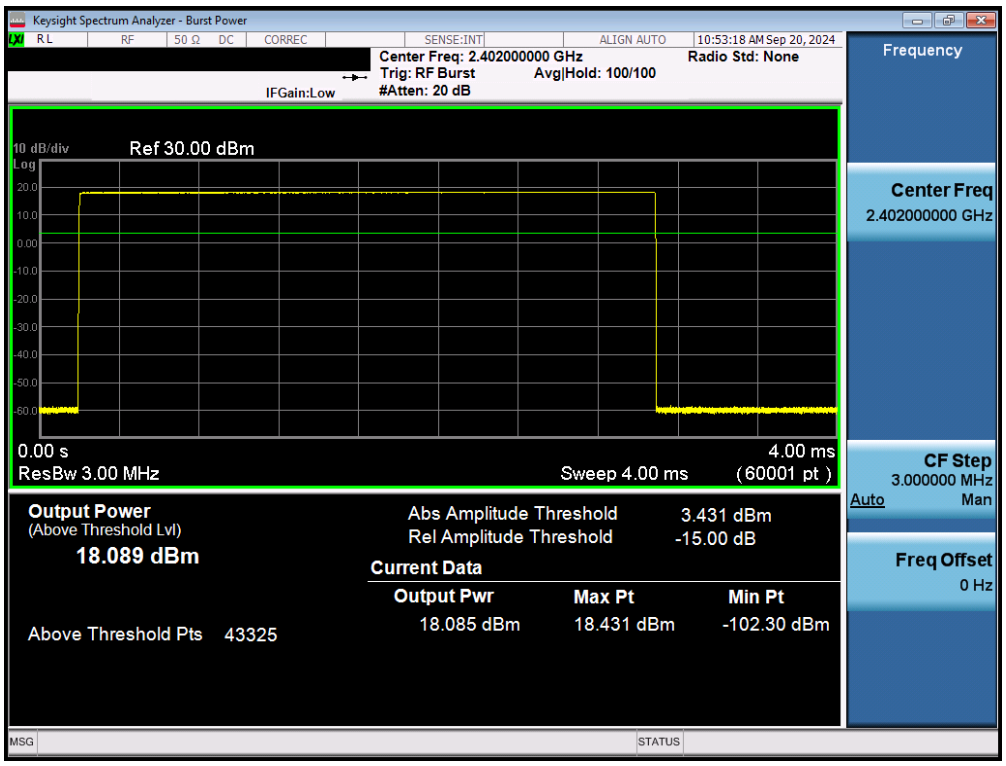
Plot 7-63. Peak Conducted Power (3Mbps – Ch. 0) – Ant 2



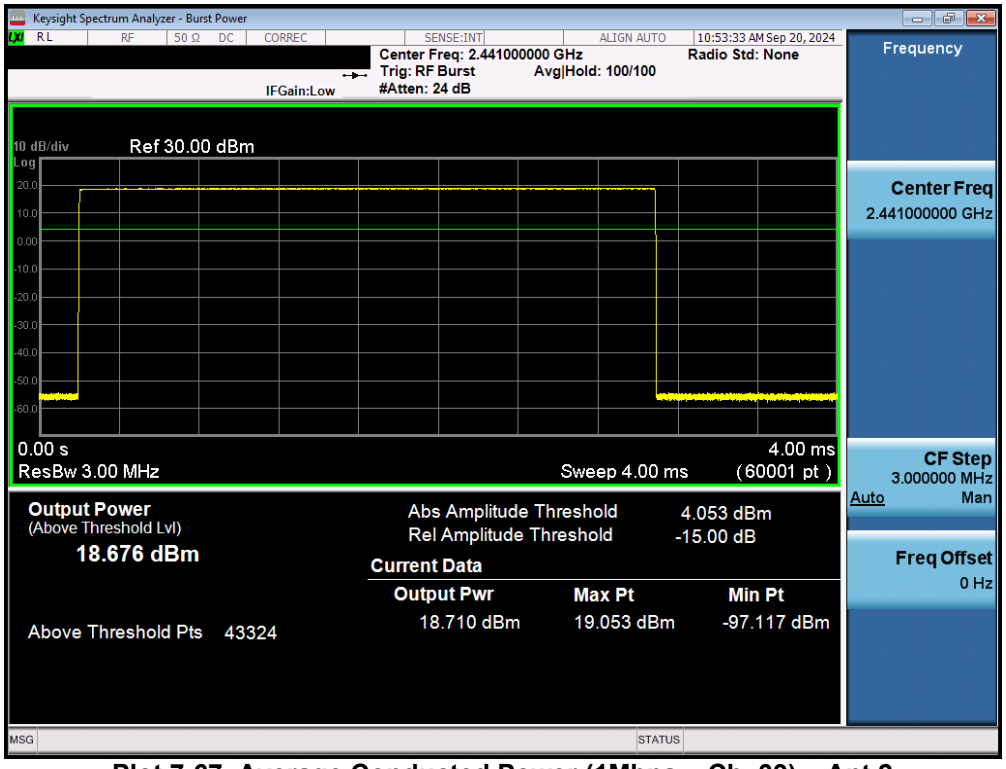
Plot 7-64. Peak Conducted Power (3Mbps – Ch. 39) – Ant 2



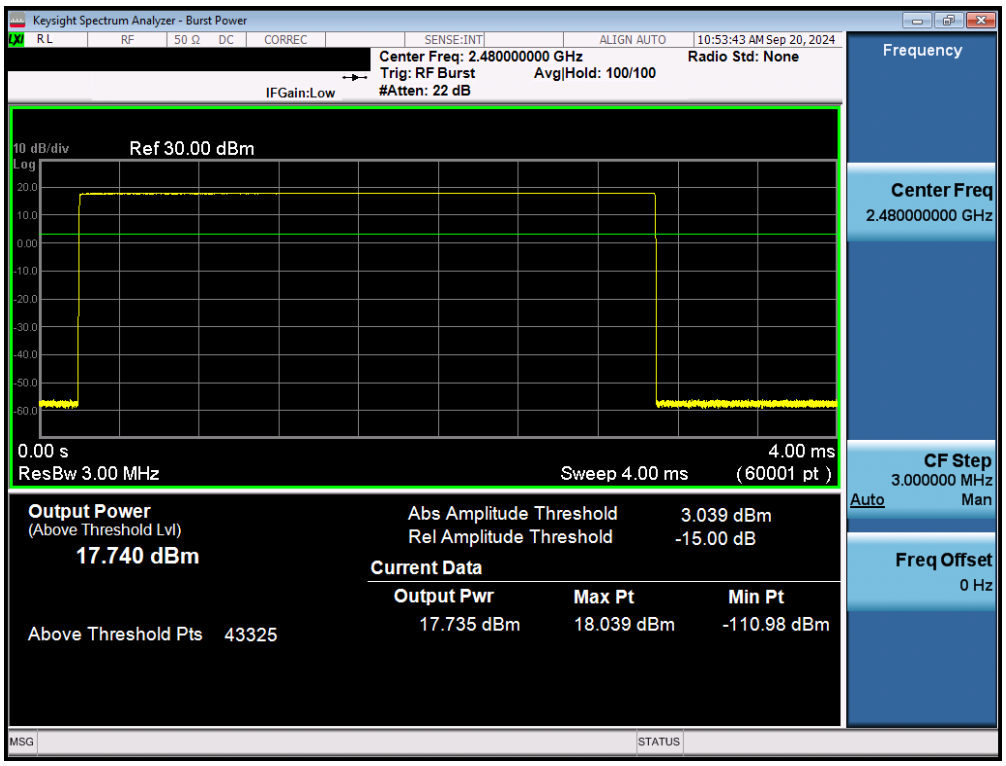
Plot 7-65. Peak Conducted Power (3Mbps – Ch. 78) – Ant 2



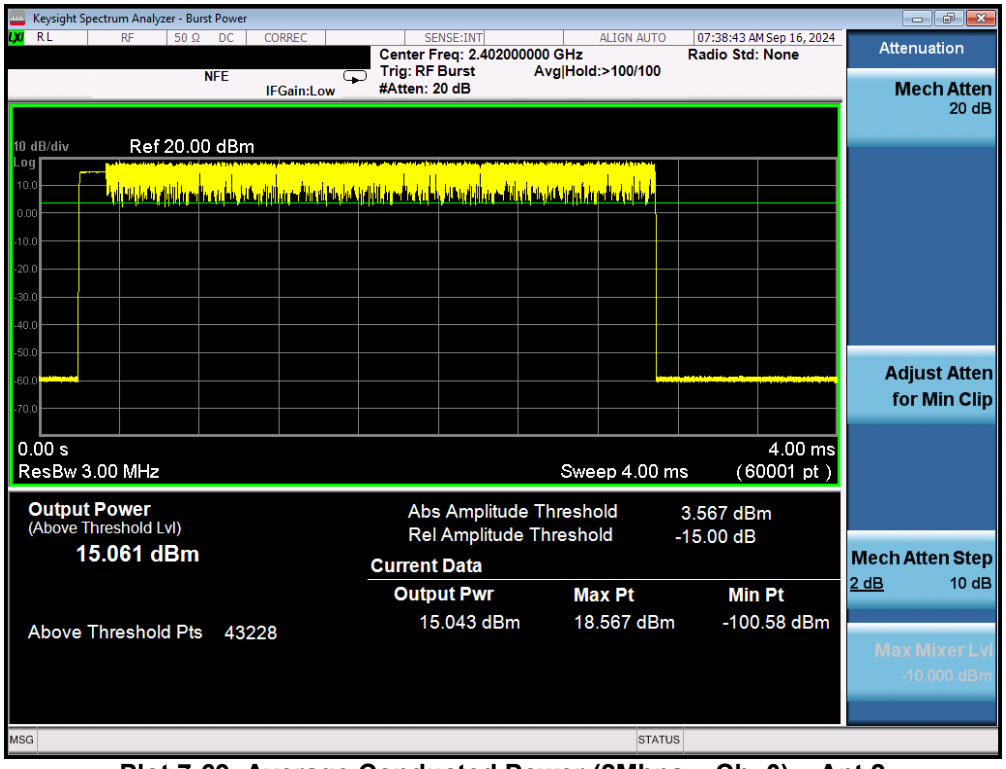
Plot 7-66. Average Conducted Power (1Mbps – Ch. 0) – Ant 2



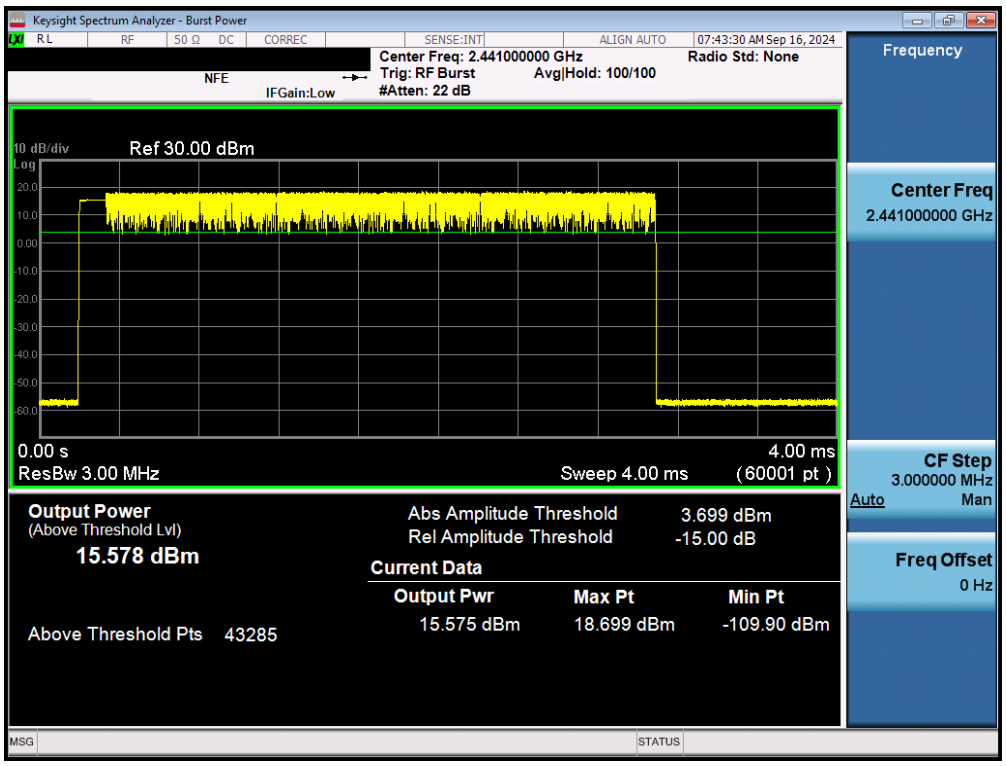
Plot 7-67. Average Conducted Power (1Mbps – Ch. 39) – Ant 2



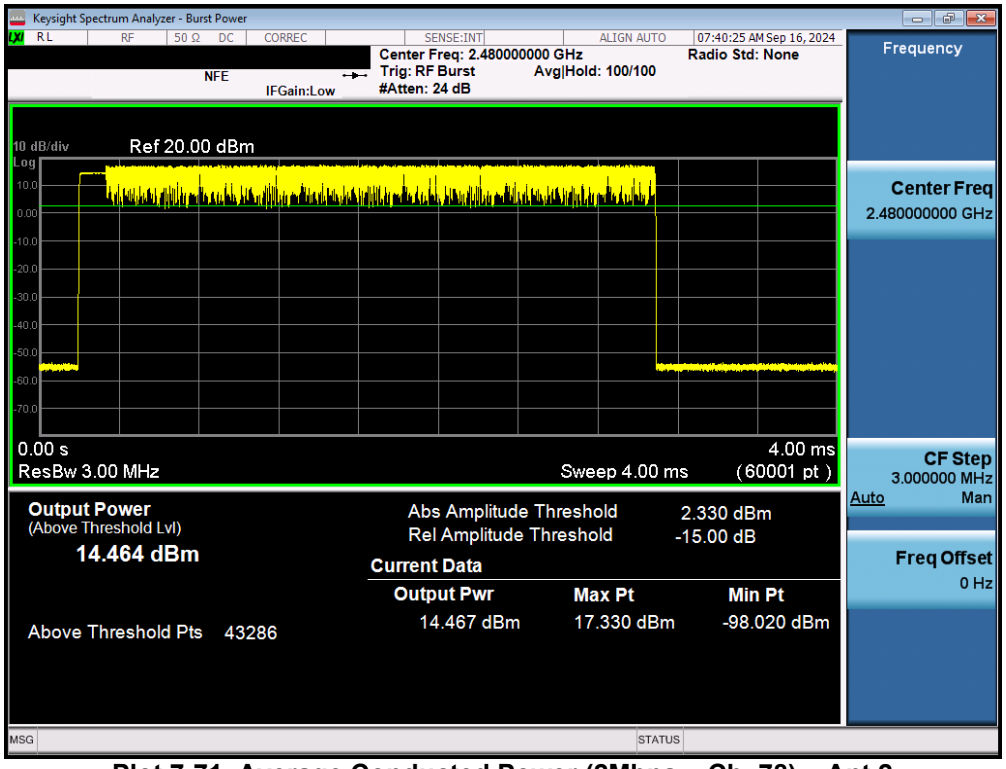
Plot 7-68. Average Conducted Power (1Mbps – Ch. 78) – Ant 2



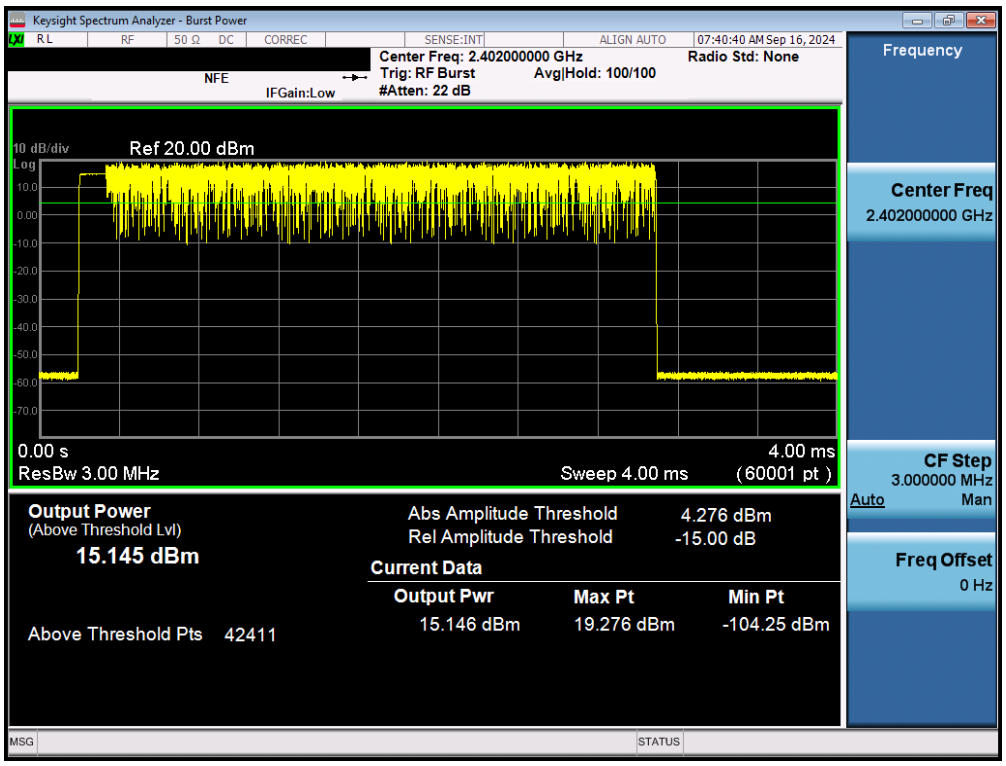
Plot 7-69. Average Conducted Power (2Mbps – Ch. 0) – Ant 2



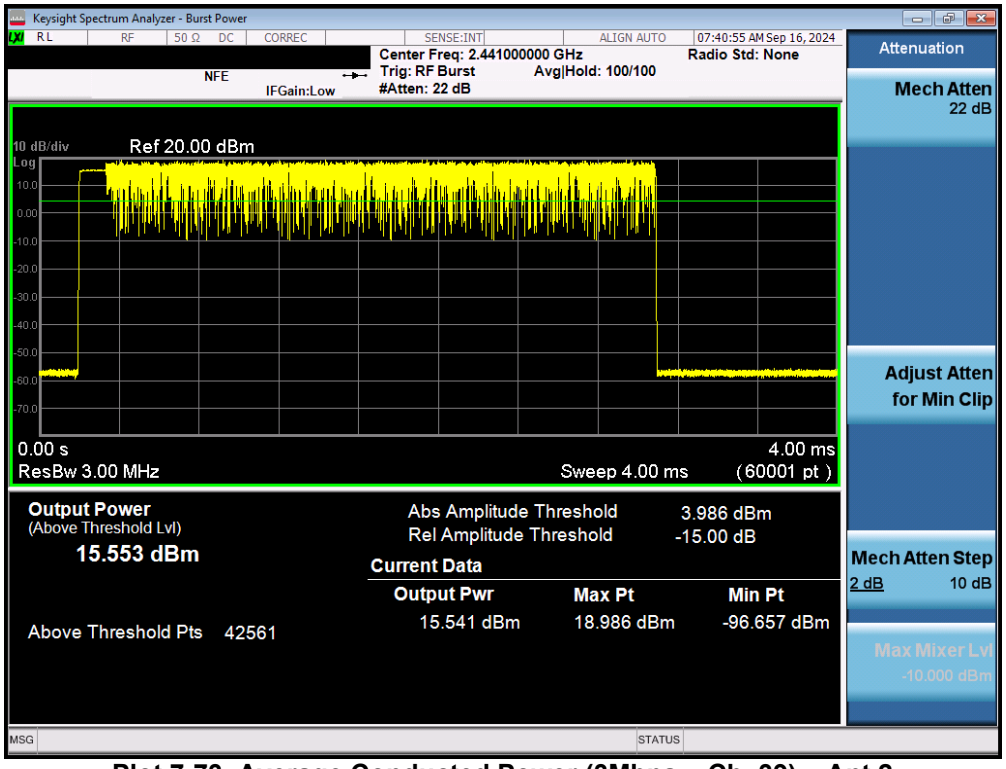
Plot 7-70. Average Conducted Power (2Mbps – Ch. 39) – Ant 2



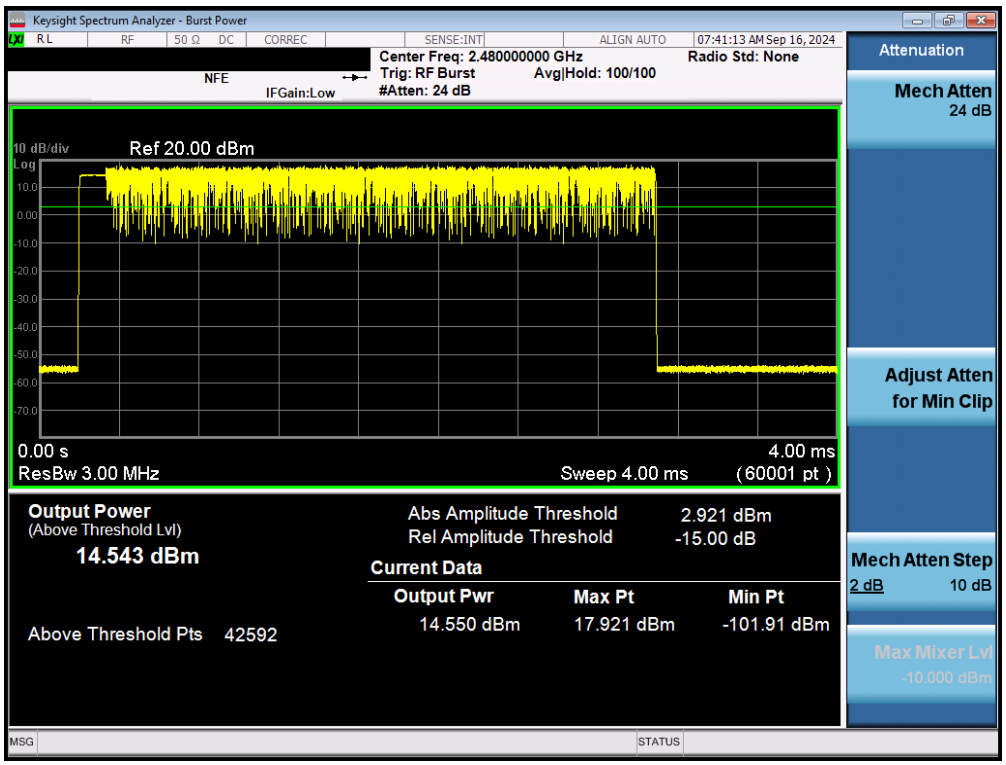
Plot 7-71. Average Conducted Power (2Mbps – Ch. 78) – Ant 2



Plot 7-72. Average Conducted Power (3Mbps – Ch. 0) – Ant 2



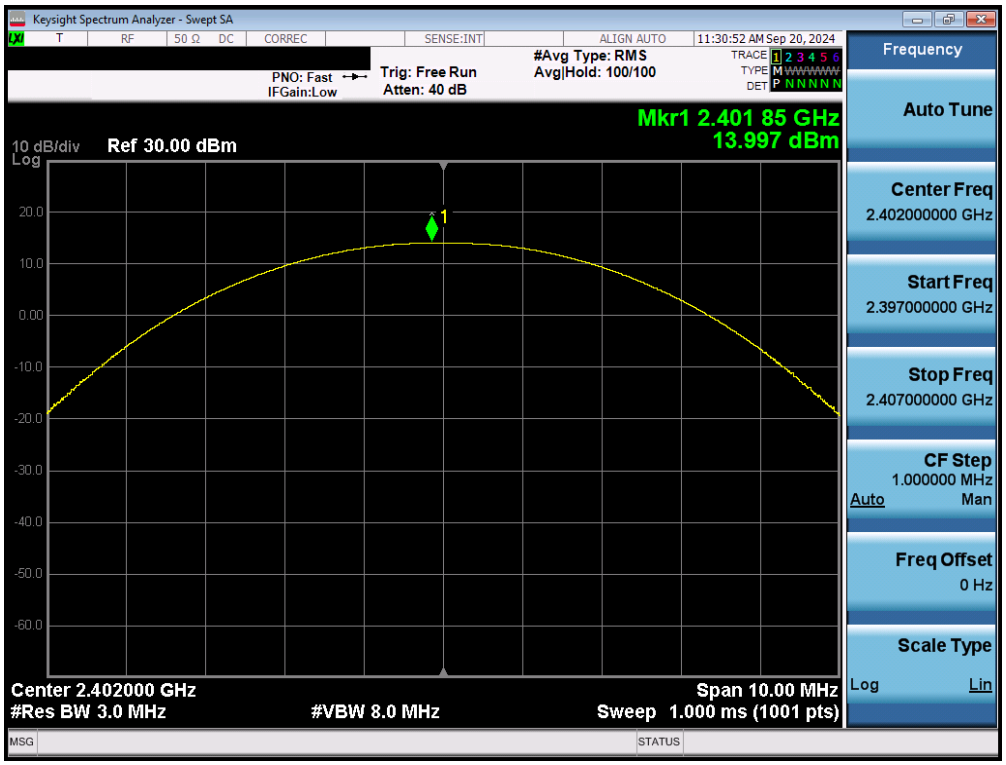
Plot 7-73. Average Conducted Power (3Mbps – Ch. 39) – Ant 2



Plot 7-74. Average Conducted Power (3Mbps – Ch. 78) – Ant 2

Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	ANT1 Peak Conducted Power		ANT1 Avg Conducted Power		ANT2 Peak Conducted Power		ANT2 Avg Conducted Power		Dual Peak Conducted Power		Dual Avg Conducted Power	
				[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	0	14.00	25.102	13.80	23.991	14.28	26.792	14.14	25.956	17.15	51.893	16.99	49.947
2441	1.0	GFSK	39	15.30	33.892	15.15	32.756	14.44	27.765	14.33	27.087	17.90	61.657	17.77	59.843
2480	1.0	GFSK	78	15.16	32.787	14.50	28.186	13.92	24.643	13.89	24.497	17.59	57.430	17.22	52.683
2402	2.0	π/4-DQPSK	0	13.55	22.626	10.94	12.415	13.21	20.960	11.25	13.348	16.39	43.586	14.11	25.762
2441	2.0	π/4-DQPSK	39	14.58	28.714	12.27	16.865	13.65	23.185	11.66	14.652	17.15	51.899	14.99	31.517
2480	2.0	π/4-DQPSK	78	13.68	23.356	11.69	14.750	12.89	19.454	10.91	12.342	16.32	42.810	14.33	27.091
2402	3.0	8DPSK	0	13.76	23.763	10.90	12.296	13.44	22.075	11.05	12.728	16.61	45.838	13.98	25.024
2441	3.0	8DPSK	39	14.86	30.627	12.32	17.059	13.84	24.205	11.70	14.783	17.39	54.831	15.03	31.841
2480	3.0	8DPSK	78	14.35	27.252	11.75	14.966	13.13	20.554	10.80	12.031	16.79	47.806	14.31	26.997

Table 7-11. Conducted Output Power Measurements – Dual



Plot 7-75. Peak Conducted Power (1Mbps – Ch. 0) – Dual Ant 1