

**MEASUREMENT REPORT**  
**FCC PART 15.247 / ISED RSS-247 Bluetooth (HDR)**

**Applicant Name:**

Apple Inc.  
One Apple Park Way  
Cupertino, CA 95014  
United States

**Date of Testing:**

2/10/2023 - 5/5/2023

**Test Report Issue Date:**

11/29/2023

**Test Site/Location:**

Element Materials Technology Morgan Hill, CA, USA

**Test Report Serial No.:**

1C2302130007-03.BCG

<b>FCC ID:</b>	<b>BCGA2117</b>
<b>IC:</b>	<b>579C-A2117</b>
<b>APPLICANT:</b>	<b>Apple Inc.</b>

**Application Type:**

Certification

**Model/HVIN:**

A2117

**EUT Type:**

Head Mounted Device

**Max. RF Output Power:**

49.091 mW (16.91 dBm) Peak Conducted

**Frequency Range:**

2404 – 2476MHz

**FCC Classification:**

Digital Transmission System (DTS)

**FCC Rule Part(s):**

Part 15 Subpart C (15.247)

**ISED Specification:**

RSS-247 Issue 3

**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 was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 558074 D01 v05r02. Test results reported herein relate only to the item(s) tested.

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



RJ Ortanez

Executive Vice President



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<b>Test Report S/N:</b> 1C2302130007-03.BCG	<b>Test Dates:</b> 2/10/2023 - 5/5/2023	<b>EUT Type:</b> Head Mounted Device	Page 1 of 124

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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 Materials Technology Morgan Hill Test Location

These measurement tests were conducted at the Element Materials Technology Morgan Hill facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

## 1.3 Test Facility / Accreditations

**Measurements were performed at Element Materials Technology located in Morgan Hill, CA 95037, U.S.A.**

- Element Materials Technology Morgan Hill is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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 Materials Technology Morgan Hill facility is a registered (22831) 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)

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## 2.0 PRODUCT INFORMATION

### 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Head Mounted Device FCC ID: BCGA2117, IC: 579C-A2117**. The data found in this test report was taken with the EUT operating in Bluetooth HDR mode. While in HDR mode, the Bluetooth transmitter hops pseudo-randomly between 73 channels.

**Test Device Serial No.:** GPG3017001F20N78X, PYVWK6LLC6, WFGF7D9H60, MHP0XYH0XK, HP14K0WJ0Q

### 2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), NB UNII (1x, LE1M, LE2M, HDR4, HDR8, HDRp4, HDRp8)

This device supports BT Beamforming

Ch.	Frequency (MHz)
01	2404
:	:
38	2441
:	:
73	2476

**Table 2-1. Bluetooth HDR Frequency / Channel Operations**

**Note:** This device is capable of operating in hopping and non-hopping mode. The EUT can hop between 73 different channels in the 2400 – 2483.5MHz band.

Measured Duty Cycles					
HDR Mode		Duty Cycle [%]			
		Ant1	Ant2	NB UNII_L	TxBF (Ant1 + Ant2)
4M	ePA	100.0	100.0	-	100.0
	iPA	100.0	100.0	100.0	100.0
8M	ePA	100.0	100.0	-	100.0
	iPA	100.0	100.0	100.0	100.0

**Table 2-2. Measured Duty Cycles**

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This device supports simultaneous transmission operations. The table below shows all configurations possible.

Simultaneous Tx Config	Ant1			Ant2			NB UNII_L		NB UNII_R
	WLAN 2.4G 802.11 b/g/n/ax	BT 2.4G BDR, EDR, HDR4/8, LE1M/2M, HDRp4/p8	WIFI 5G 802.11 a/n/ac/ax	WLAN 2.4G 802.11 b/g/n/ax	BT 2.4G BDR, EDR, HDR4/8, LE1M/2M, HDRp4/p8	WIFI 5G 802.11 a/n/ac/ax	BT 2.4G BDR, EDR, HDR4/8, LE1M/2M, HDRp4/p8	NB_UNII 5G BDR, HDR4/8, LE1M/2M, HDRp4/p8	NB_UNII 5G BDR, HDR4/8, LE1M/2M, HDRp4/p8
Config 1	✓	✗	✓	✗	✗	✗	✗	✓	✓
Config 2	✗	✗	✗	✓	✗	✓	✗	✓	✓
Config 3	✗	✓	✓	✗	✗	✗	✗	✓	✓
Config 4	✗	✓	✗	✗	✗	✓	✗	✓	✓
Config 5	✗	✓	✓	✗	✓	✗	✗	✗	✗
Config 6	✗	✓	✗	✗	✓	✓	✗	✗	✗
Config 7	✓	✗	✓	✗	✗	✗	✓	✓	✓
Config 8	✓	✗	✗	✗	✗	✓	✓	✓	✓
Config 9	✓	✗	✓	✗	✓	✗	✗	✗	✗
Config 10	✓	✗	✗	✗	✓	✓	✗	✗	✗
Config 11	✓	✗	✓	✓	✗	✓	✗	✗	✗
Config 12	✗	✓	✓	✗	✗	✓	✗	✗	✗
Config 13	✓	✗	✓	✗	✗	✓	✓	✗	✗

**Table 2-3. Simultaneous Transmission Configurations**

✓ = Support; ✗ = Not Support

**Note:**

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 7 and reported in UNII OFDM, Bluetooth LE, NB UNII LE and WLAN test reports.

### 2.3 Antenna Description

The following antenna gains provided by the manufacturer were used for testing.


Frequency [MHz]	Antenna Gain (dBi)		
	Ant1	Ant2	NB UNII_L
2404 - 2476	1.6	-1.0	-3.7

**Table 2-4. Highest Antenna Gain**

### 2.4 Test Support Equipment

1	Apple Macbook Pro w/ AD/DC Adapter	Model: A2289 Model: A2164	S/N: C02DV7V/GMD6T S/N: N/A
2	Apple USB-C Cable	Model: Spartan	S/N: 000MKTR02U
3	Right Temple Left Temple Headband	Model: N/A Model: N/A Model: N/A	S/N: HTFGR70005J000020R S/N: HTFGR40004A00002GY S/N: GKNGNC0001H0000215
4	Light Seal Light Seal Padding	Model: N/A Model: N/A	S/N: GKNGQF000RX00003KB S/N: GKNGQ8001RD00002XA
5	EUT Power Pack	Model: N/A	S/N: HTFGQW0009800001MV

**Table 2-5. Test Support Equipment List**

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## 2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

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

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

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.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and the worst case was reported.

- EUT powered by AC/DC adaptor to USB-C Power Pack to Magnetic Charging Cable
- EUT powered by host PC via USB-C Power Pack to Magnetic Charging Cable

## 2.6 Software and Firmware

The test was conducted with firmware version 20.1.467.5718 installed on the EUT.

## 2.7 EMI Suppression Device(s)/Modifications

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

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## 3.0 DESCRIPTION OF TESTS

### 3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT.

**Deviation from measurement procedure.....None**

### 3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 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 EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (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 7.10. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

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### 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.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

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.

### 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).

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## 4.0 ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

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

**Conclusion:**

The EUT complies with the requirement of §15.203.

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## 5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. 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 ( $\pm$ dB)
Conducted Bench Top Measurements	1.77
Line Conducted Disturbance	2.70
Radiated Disturbance (<30MHz)	4.38
Radiated Disturbance (30MHz - 1GHz)	4.75
Radiated Disturbance (1 - 18GHz)	5.20
Radiated Disturbance (>18GHz)	4.72

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## 6.0 TEST EQUIPMENT CALIBRATION DATA

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

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial #
Agilent	N9020A	MXA Signal Analyzer	4/26/2022	Annual	4/26/2023	MY56470202
Anritsu	MA2411B	Pulse Power Sensor	5/19/2022	Annual	5/19/2023	1911106
Anritsu	ML2496A	Power Meter	10/17/2022	Annual	10/17/2023	2002005
ETS-Lindgren	3117	Double Ridged Guide Horn Antenna (1-18 GHz)	5/24/2022	Annual	5/24/2023	240049
Keysight Technologies	N9030A	PXA Signal Analyzer	6/10/2022	Annual	6/10/2023	MY49430244
Rohde & Schwarz	180-442A-KF	Horn (Small)	3/6/2023	Annual	3/6/2024	T058701-2
Rohde & Schwarz	ENV216	Two-Line V-Network	3/30/2023	Annual	3/30/2024	101364
Rohde & Schwarz	FSVA3044	Signal Analyzer 44GHz	5/12/2022	Annual	5/12/2023	101098
Rohde & Schwarz	FSW43	Signal and Spectrum Analyzer 2Hz to 43GHz	5/19/2022	Annual	5/19/2023	104093
Rohde & Schwarz	FSW67	Signal and Spectrum Analyzer (2Hz-67GHz)	4/21/2022	Annual	4/21/2023	101366
Rohde & Schwarz	HFH-2Z2	9kHz - 30MHz Loop Antenna	4/13/2022	Annual	4/13/2023	100546
Rohde & Schwarz	TS-PR1	Preamplifier - Antenna System; 30MHz - 1GHz	4/18/2022	Annual	4/18/2023	102081
Rohde & Schwarz	TS-PR18	Pre Amplifier 1-18GHz	3/3/2023	Annual	3/3/2024	102130
Rohde & Schwarz	TS-PR1840	Pre Amplifier 18-40GHz	4/18/2022	Annual	4/18/2023	100050
Schwarzbeck	VULB9162	Biconilog Antenna - (30MHz-6GHz)	7/27/2022	Annual	7/27/2023	121034

**Table 6-1. Test Equipment List**

**Note:**

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

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## 7.0 TEST RESULTS

### 7.1 Summary

Company Name: Apple Inc.  
 FCC ID: BCGA2117  
 IC: 579C-A2117  
 FCC Classification: Digital Transmission System (DTS)  
 Number of Channels: 73

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A		N/A	Section 7.2
15.247(b)(3)	RSS-247 [5.4(d)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	RADIATED	PASS	Sections 7.7, 7.7.1, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	AC LINE CONDUCTED	PASS	Section 7.9

**Table 7-1. Summary of Test Results**

#### Notes:

- All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
- The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
- For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "HDR Automation," Version 4.0.
- For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 2.0.

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## 7.2 Bandwidth Measurement – Bluetooth (HDR)

§2.1049; §15.247(a.2); RSS-247 [5.2]; RSS-Gen [6.7]

### Test Overview and Limit

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

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

***The minimum permissible 6dB bandwidth is 500 kHz.***

### Test Procedure Used

ANSI C63.10-2013 – Subclause 11.8.2 Option 2  
 KDB 558074 D01 v05r02 – Section 8.2  
 RSS-Gen [6.7]

### Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 99% occupied bandwidth and the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW  $\geq$  3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

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**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**

All supported modulation, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.

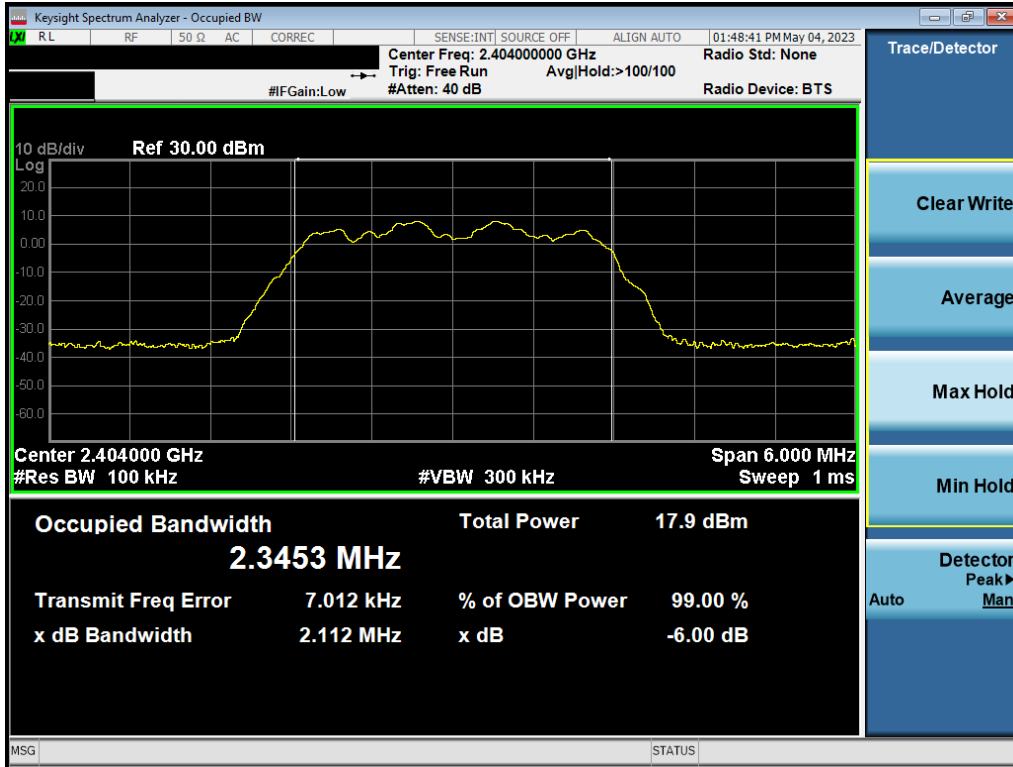
<b>FCC ID:</b> BCGA2117 <b>IC:</b> 579C-A2117	 <b>MEASUREMENT REPORT (CERTIFICATION)</b>		<b>Approved by:</b> Technical Manager
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**Ant1**

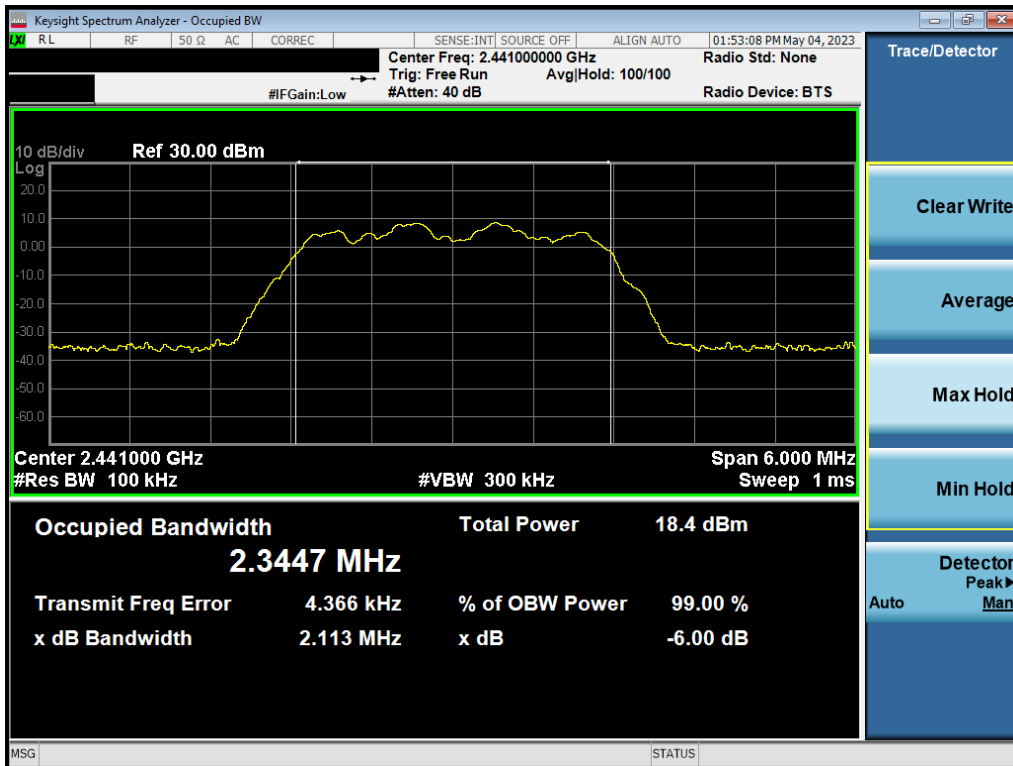
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured 99% Occupied Bandwidth [kHz]	Measured 6dB Bandwidth [kHz]	Minimum 6dB Bandwidth [kHz]	Pass / Fail
2404	4.0	ePA	1	2345.3	2111.7	500	Pass
2441	4.0	ePA	38	2344.7	2112.7	500	Pass
2476	4.0	ePA	73	2345.0	2112.3	500	Pass
2404	8.0	ePA	1	4712.4	4073.2	500	Pass
2441	8.0	ePA	38	4704.0	4071.1	500	Pass
2476	8.0	ePA	73	4701.0	4072.1	500	Pass

**Table 7-2. 6dB BW & 99% OBW Measurements Ant1**

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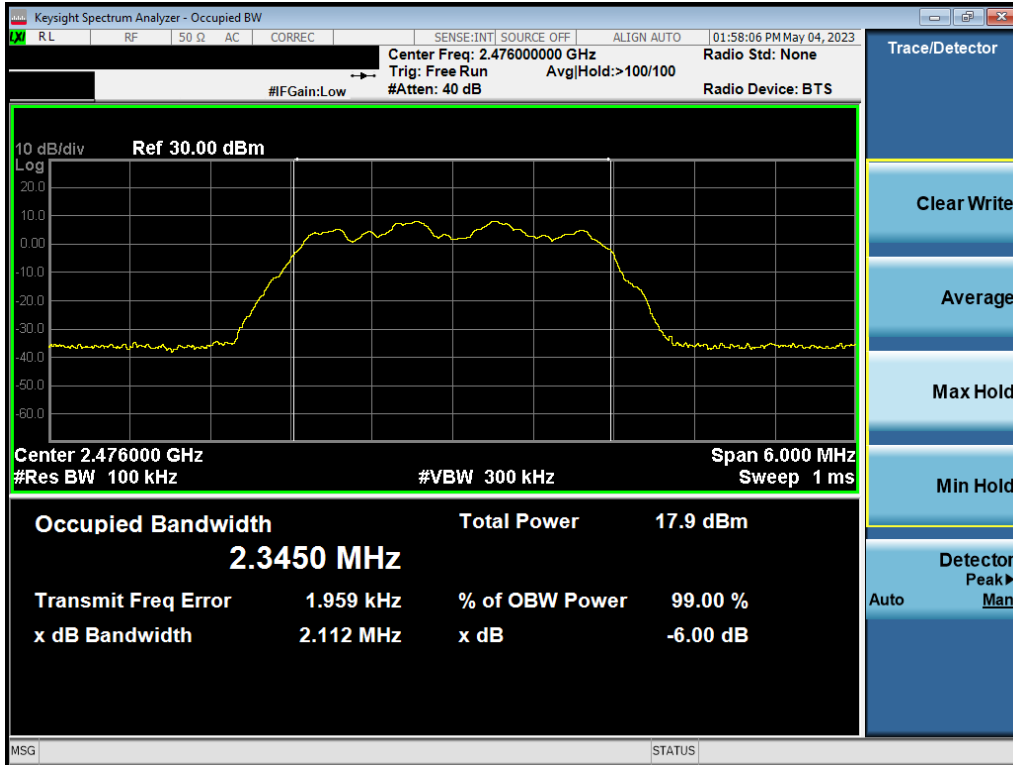
Plot 7-1. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)



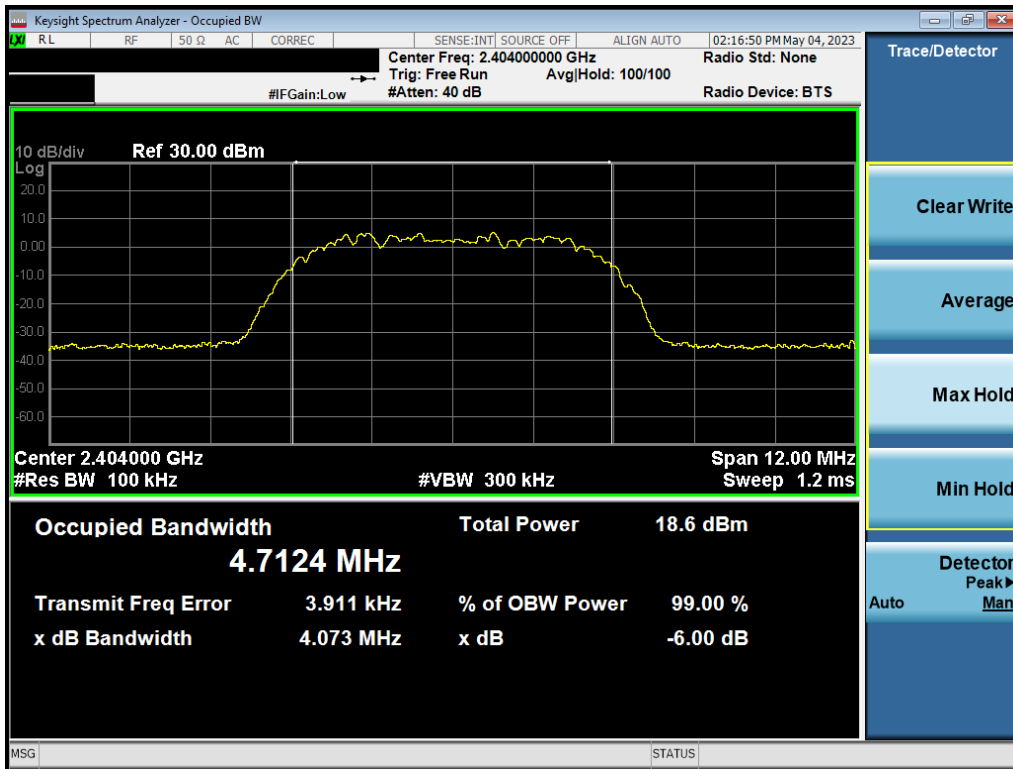
Plot 7-2. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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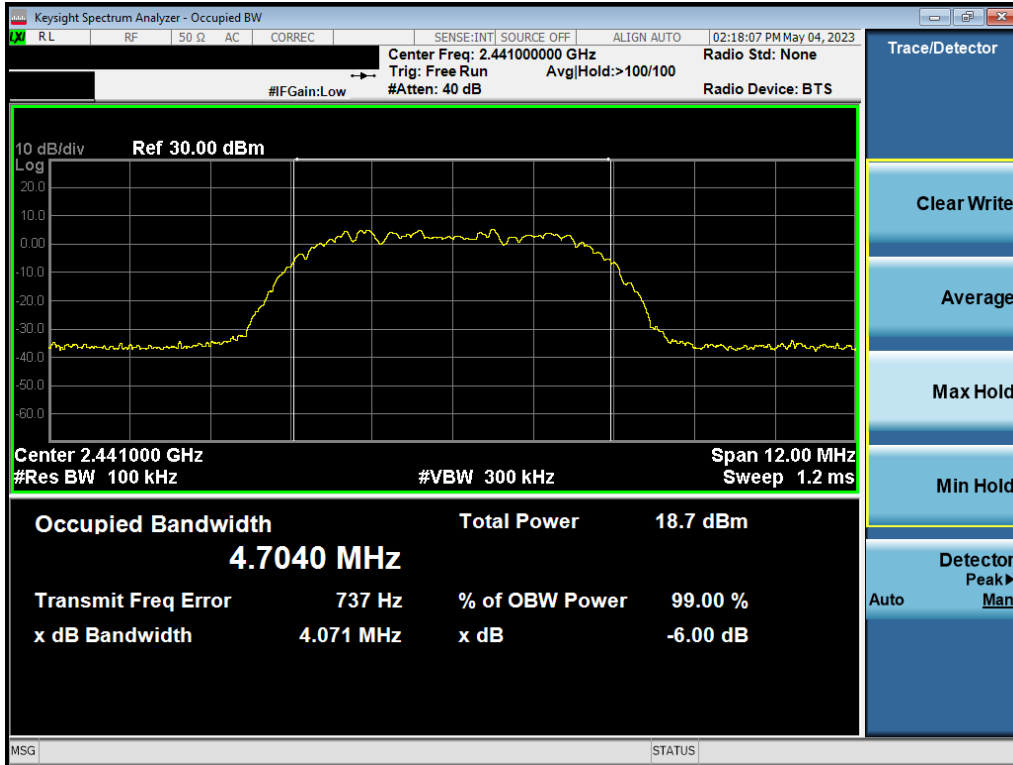


Plot 7-3. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

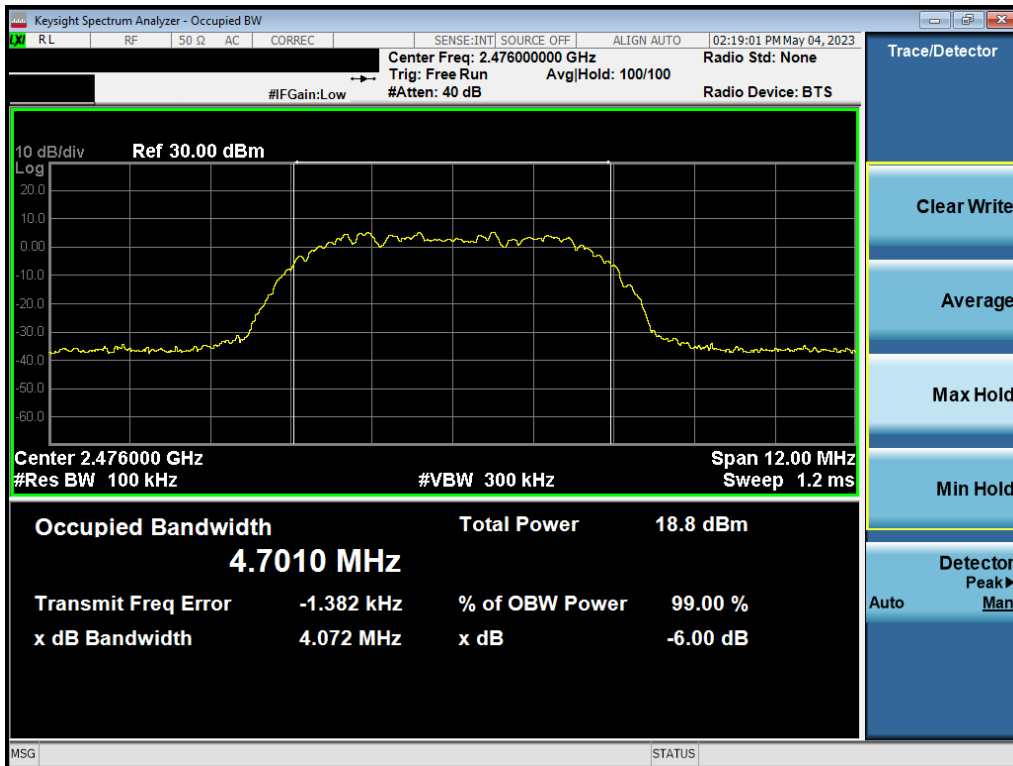


Plot 7-4. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-5. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 38)




Plot 7-6. 6dB BW & 99% OBW Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 73)

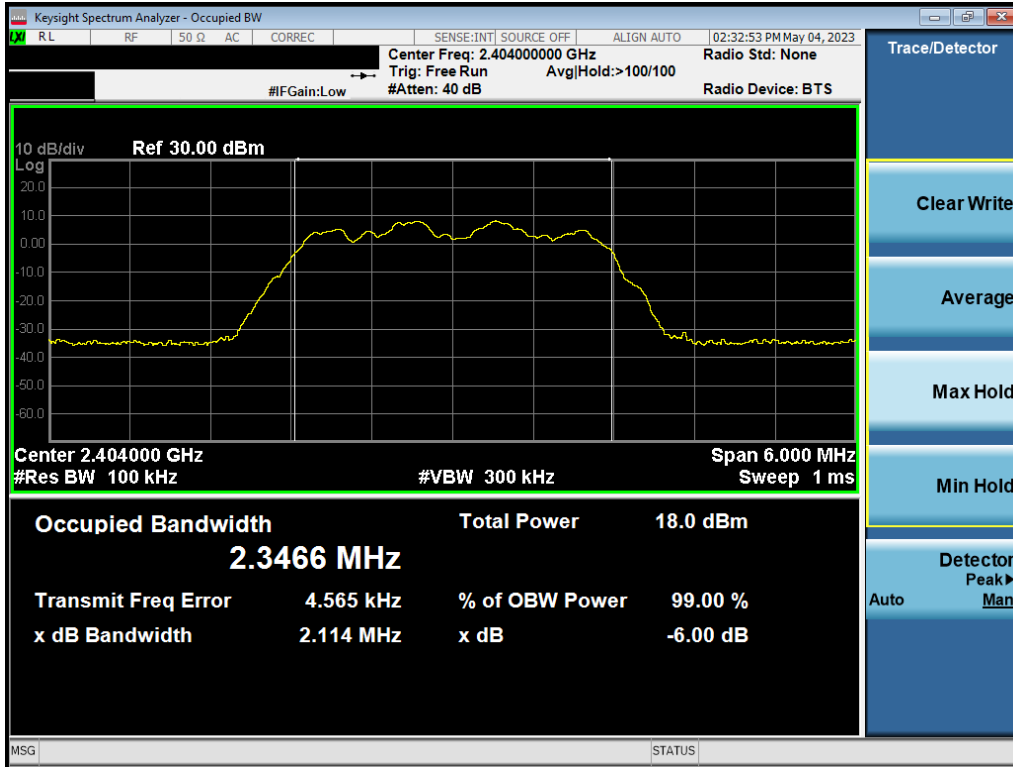
FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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**Ant2**

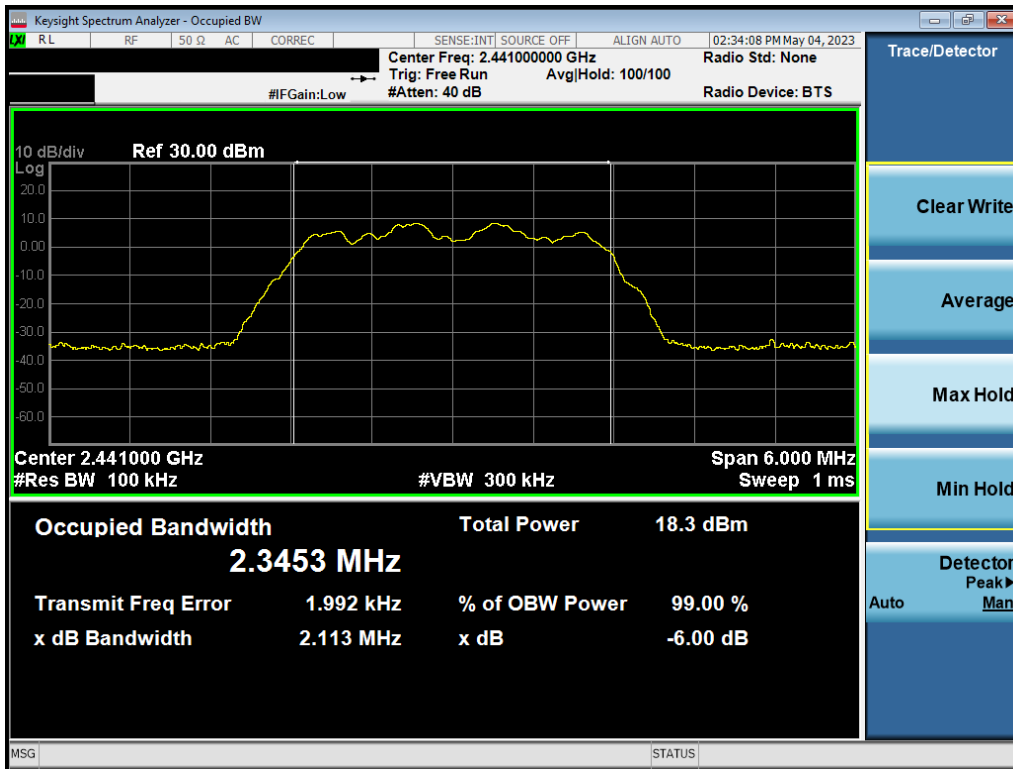
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured 99% Occupied Bandwidth [kHz]	Measured 6dB Bandwidth [kHz]	Minimum 6dB Bandwidth [kHz]	Pass / Fail
2404	4.0	ePA	1	2346.6	2113.7	500	Pass
2441	4.0	ePA	38	2345.3	2113.3	500	Pass
2476	4.0	ePA	73	2344.7	2113.0	500	Pass
2404	8.0	ePA	1	4707.9	4071.9	500	Pass
2441	8.0	ePA	38	4710.1	4074.1	500	Pass
2476	8.0	ePA	73	4702.4	4074.4	500	Pass

**Table 7-3. 6dB BW & 99% OBW Measurements Ant2**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
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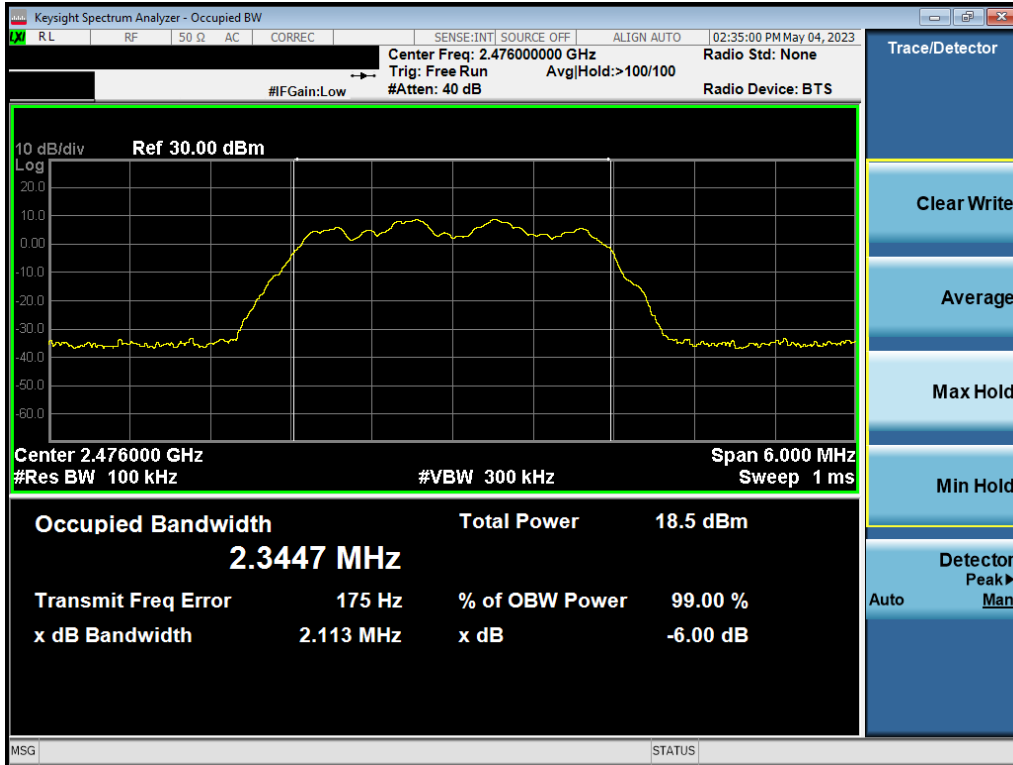


Plot 7-7. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)

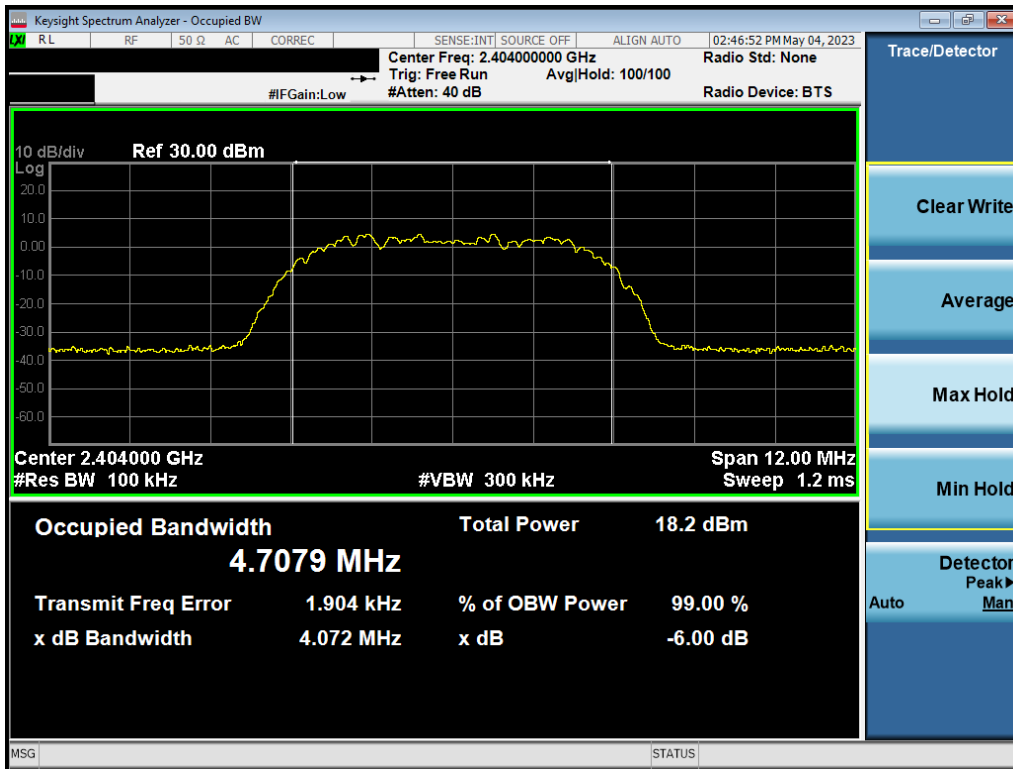


Plot 7-8. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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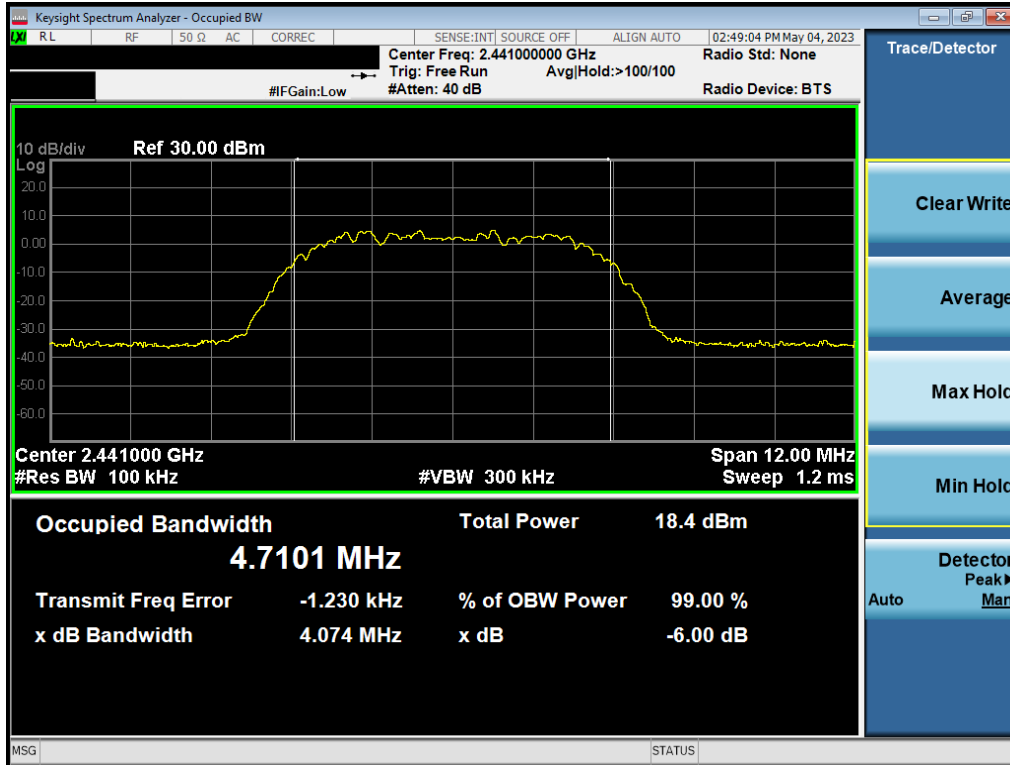


Plot 7-9. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

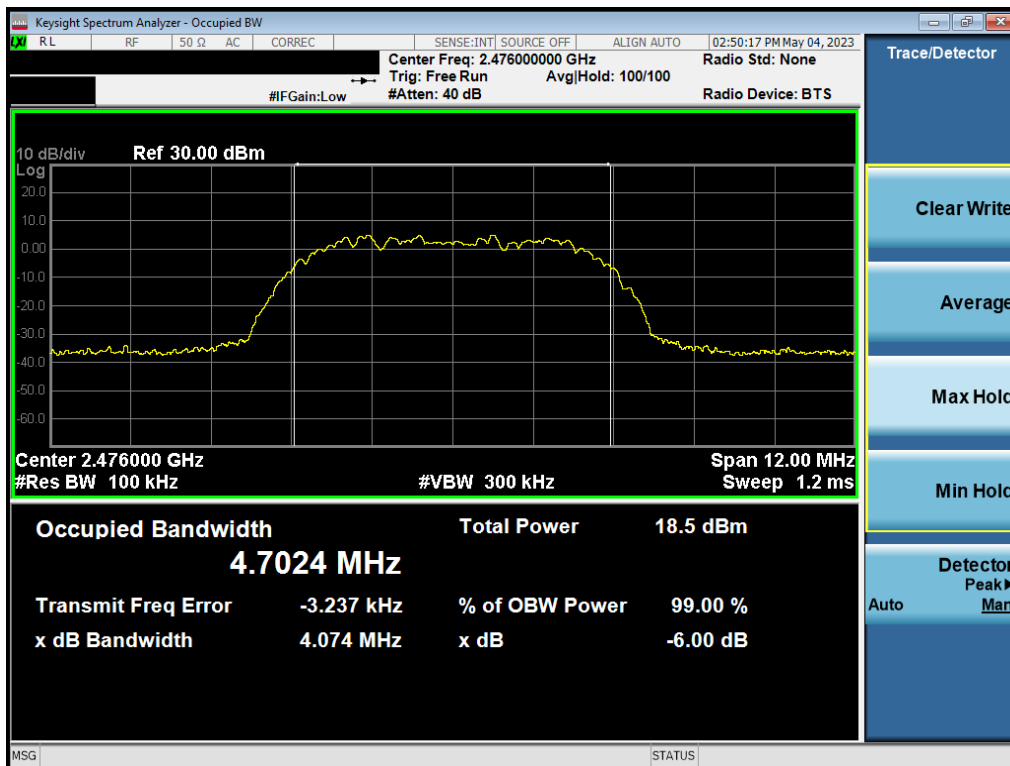


Plot 7-10. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-11. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 38)



Plot 7-12. 6dB BW & 99% OBW Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 73)

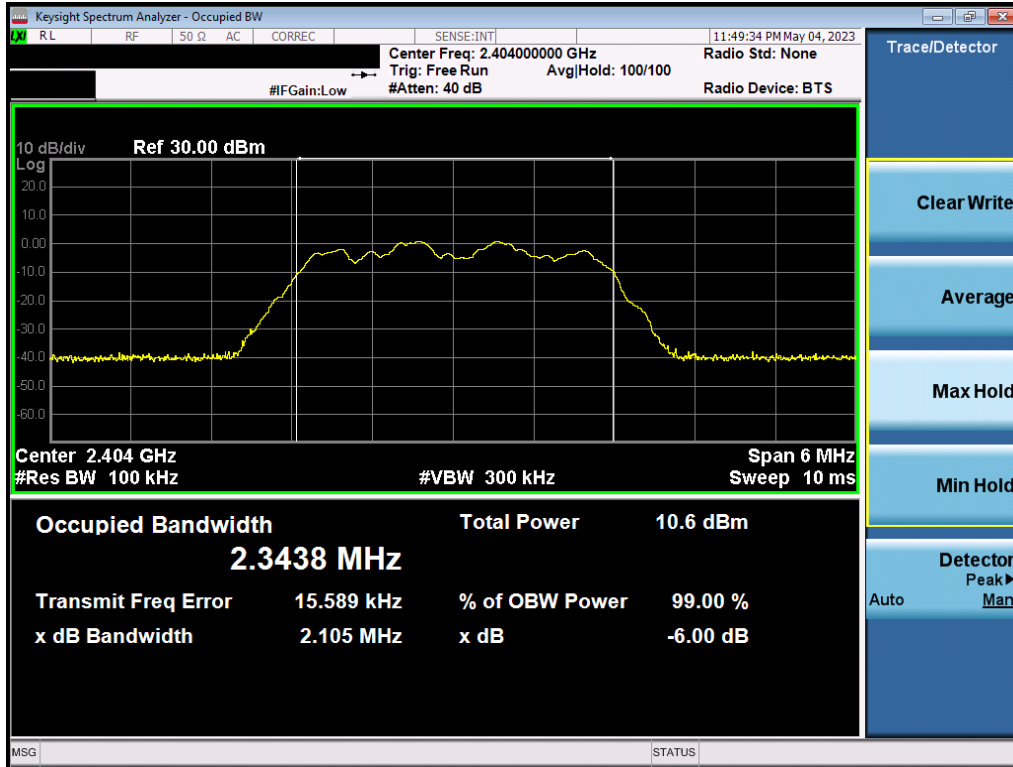
FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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**NB UNII\_L**

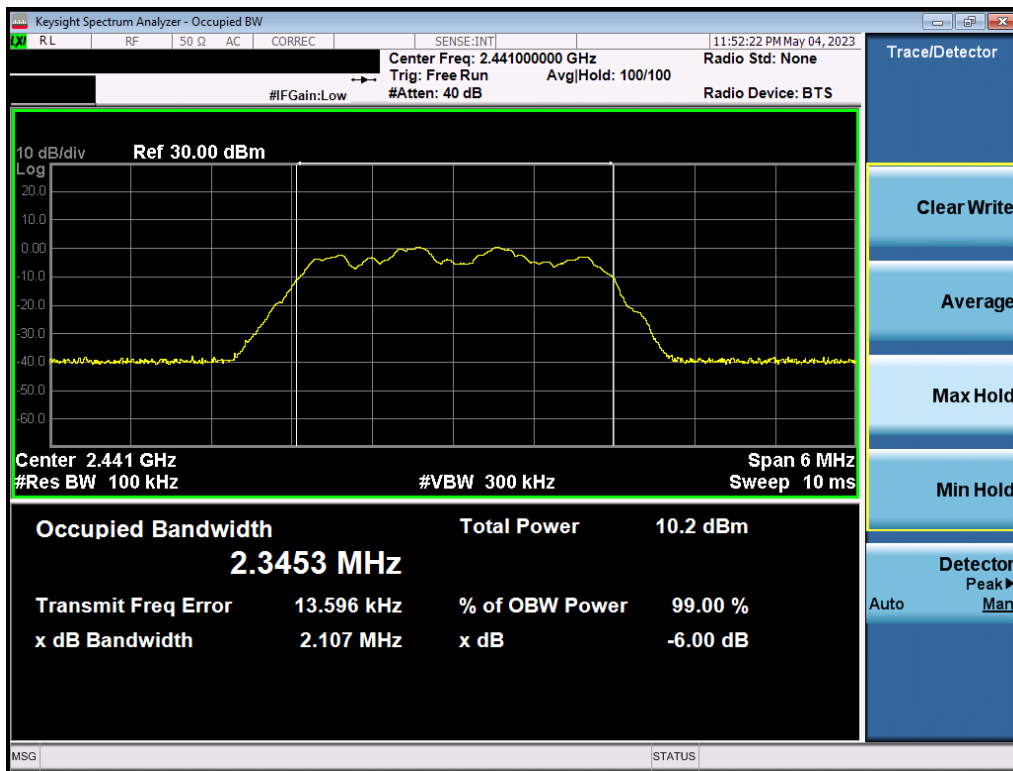
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured 99% Occupied Bandwidth [kHz]	Measured 6dB Bandwidth [kHz]	Minimum 6dB Bandwidth [kHz]	Pass / Fail
2404	4.0	iPA	1	2343.8	2105.4	500	Pass
2441	4.0	iPA	38	2345.3	2106.9	500	Pass
2476	4.0	iPA	73	2344.8	2107.5	500	Pass
2404	8.0	iPA	1	4758.2	4158.8	500	Pass
2441	8.0	iPA	38	4738.6	4157.3	500	Pass
2476	8.0	iPA	73	4742.5	4155.8	500	Pass

**Table 7-4. 6dB BW & 99% OBW Measurements NB UNII\_L**

<b>FCC ID:</b> BCGA2117 <b>IC:</b> 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
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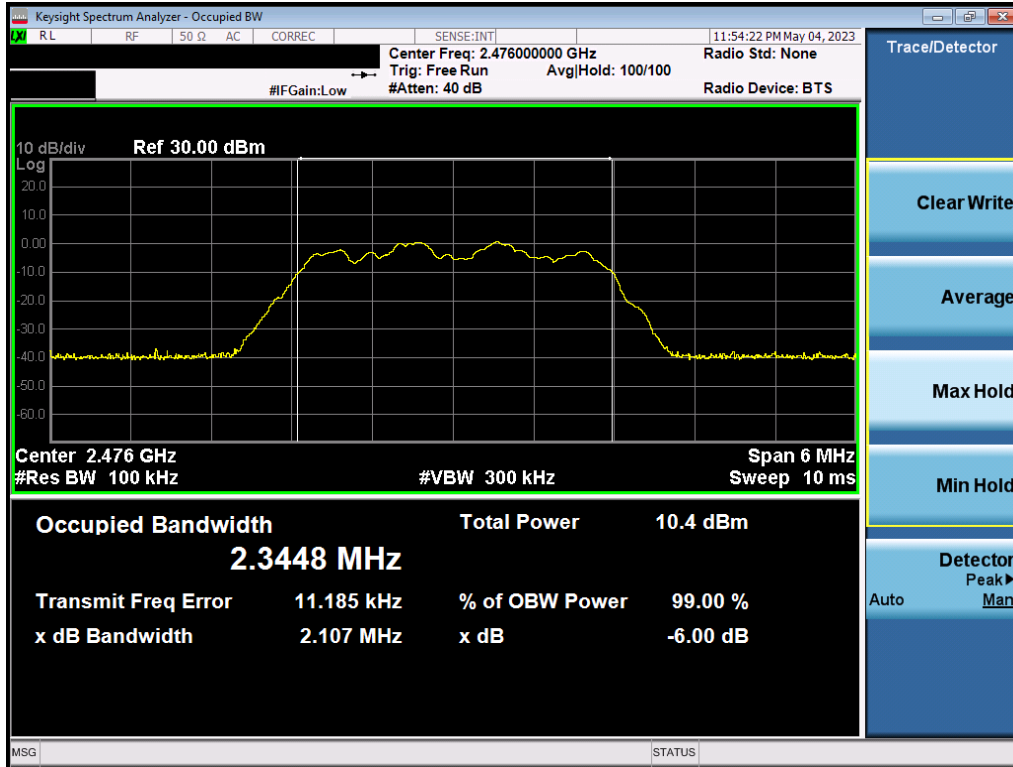
Plot 7-13. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)



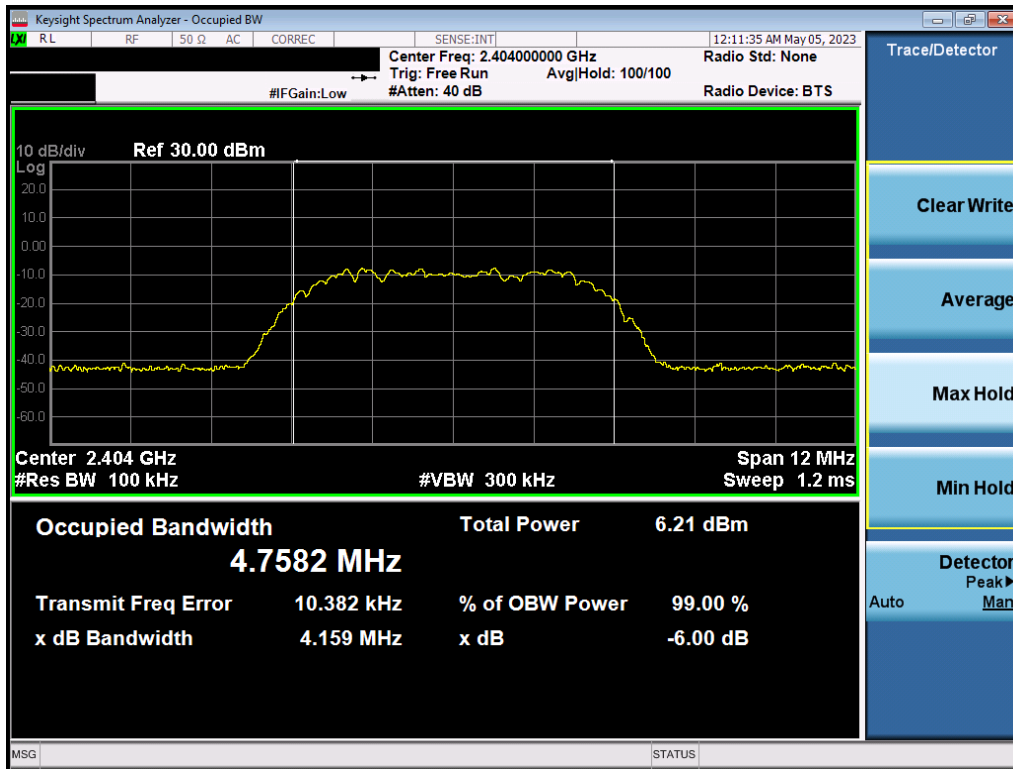
Plot 7-14. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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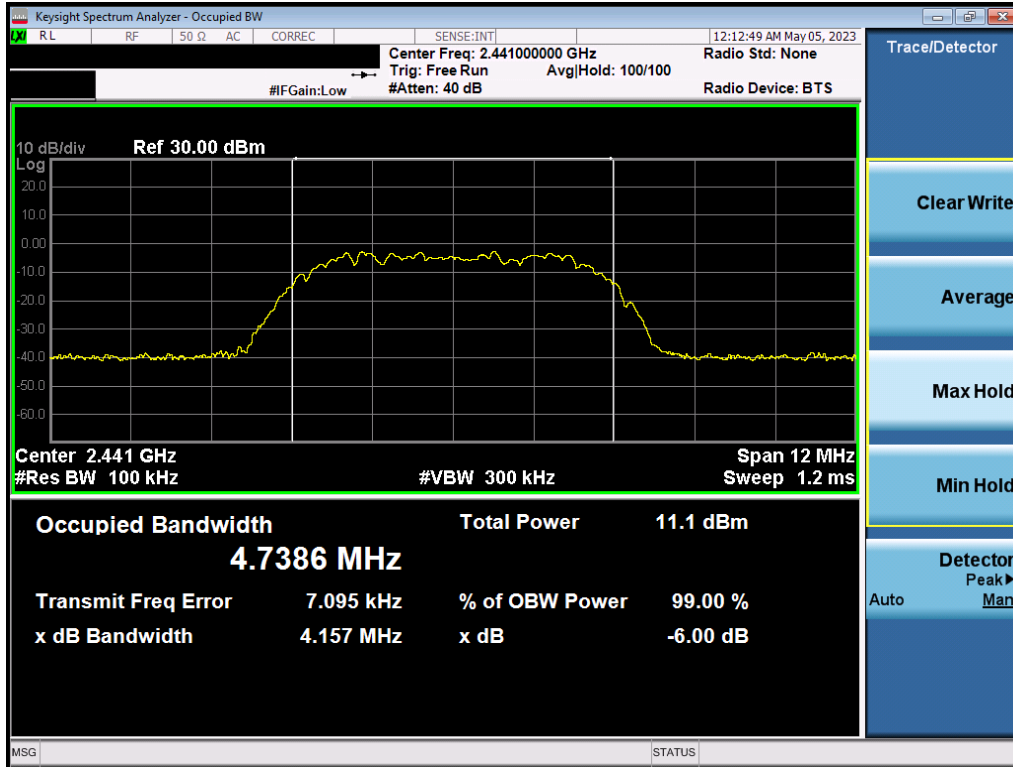


Plot 7-15. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 73)

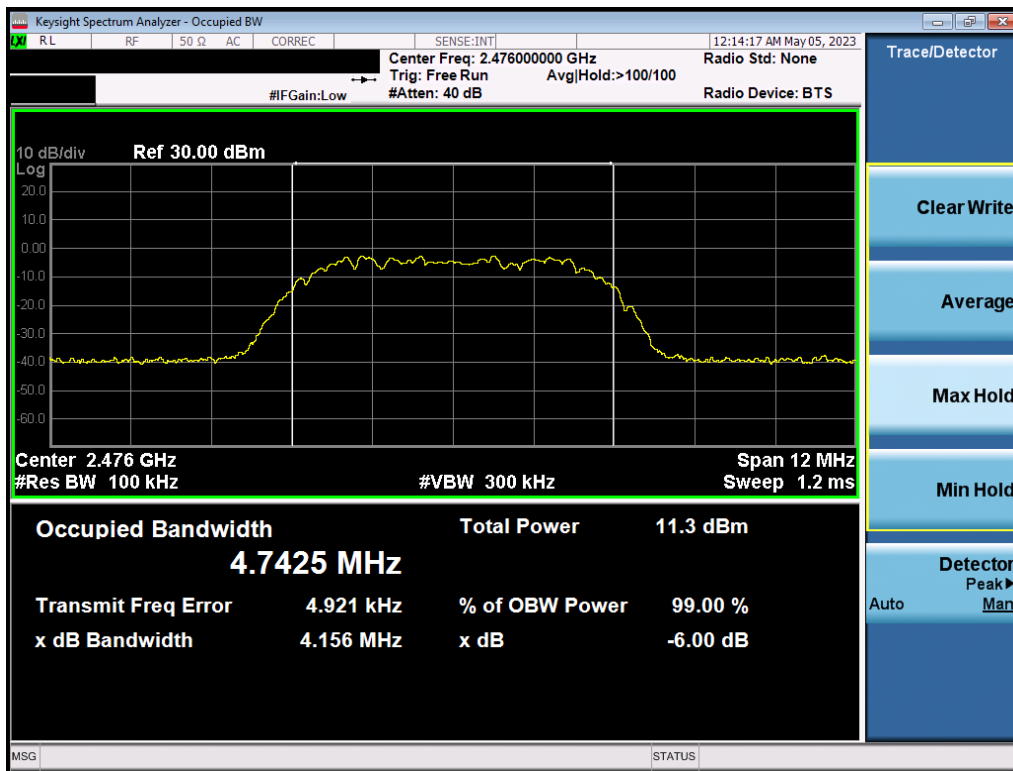


Plot 7-16. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-17. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 38)



Plot 7-18. 6dB BW & 99% OBW Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 73)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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### 7.3 Output Power Measurement – Bluetooth (HDR)

**§15.247(b.3); RSS-247 [5.4(d)]**

#### Test Overview and Limits

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

**The maximum peak conducted output power of digital modulation systems operating in the 2400-2483.5 MHz band is 1 Watt.**

**The conducted output power limit on paragraph above is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.**

**For DTSs employing digital modulation techniques operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.**

#### Test Procedure Used

ANSI C63.10-2013 – Subclause 11.9.1.3  
 ANSI C63.10-2013 – Subclause 11.9.2.3.2  
 KDB 558074 D01 v05r02 – Section 8.3.1.3, 8.3.2.3  
 ANSI C63.10-2013 – Subclause 14.2 Measure-and-Sum Technique  
 KDB 662911 D01 v02r01 – Section E)1) Measure-and-Sum Technique

#### Test Settings

##### Method PKPM1 (Peak Power Measurement)

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

##### Method AVGPM-G (Average Power Measurement)

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

#### Test Setup

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



**Figure 7-2. Test Instrument & Measurement Setup for Peak and Average Power Measurement**

#### Test Notes

None

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V 10.5 12/15/2021


### 7.3.1 Peak Output Power Measurement – Bluetooth (HDR)

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Peak Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	ePA	1	12.80	19.055	30.00	-17.20	1.60	14.40	36.02	-21.62
2441	4.0	ePA	38	13.11	20.464	30.00	-16.89	1.60	14.71	36.02	-21.31
2476	4.0	ePA	73	12.77	18.923	30.00	-17.23	1.60	14.37	36.02	-21.65
2404	4.0	iPA	1	7.06	5.082	30.00	-22.94	1.60	8.66	36.02	-27.36
2441	4.0	iPA	38	7.01	5.023	30.00	-22.99	1.60	8.61	36.02	-27.41
2476	4.0	iPA	73	7.08	5.105	30.00	-22.92	1.60	8.68	36.02	-27.34
2404	8.0	ePA	1	13.80	23.988	30.00	-16.20	1.60	15.40	36.02	-20.62
2441	8.0	ePA	38	13.81	24.044	30.00	-16.19	1.60	15.41	36.02	-20.61
2476	8.0	ePA	73	13.66	23.227	30.00	-16.34	1.60	15.26	36.02	-20.76
2404	8.0	iPA	1	7.86	6.109	30.00	-22.14	1.60	9.46	36.02	-26.56
2441	8.0	iPA	38	7.82	6.053	30.00	-22.18	1.60	9.42	36.02	-26.60
2476	8.0	iPA	73	7.42	5.521	30.00	-22.58	1.60	9.02	36.02	-27.00

**Table 7-5. Peak Conducted Output Power Measurements Ant1 (Bluetooth HDR)**

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Peak Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	ePA	1	12.89	19.454	30.00	-17.11	-1.00	11.89	36.02	-24.13
2441	4.0	ePA	38	13.03	20.091	30.00	-16.97	-1.00	12.03	36.02	-23.99
2476	4.0	ePA	73	13.05	20.184	30.00	-16.95	-1.00	12.05	36.02	-23.97
2404	4.0	iPA	1	6.67	4.645	30.00	-23.33	-1.00	5.67	36.02	-30.35
2441	4.0	iPA	38	6.88	4.875	30.00	-23.12	-1.00	5.88	36.02	-30.14
2476	4.0	iPA	73	6.99	5.000	30.00	-23.01	-1.00	5.99	36.02	-30.03
2404	8.0	ePA	1	13.64	23.121	30.00	-16.36	-1.00	12.64	36.02	-23.38
2441	8.0	ePA	38	13.60	22.909	30.00	-16.40	-1.00	12.60	36.02	-23.42
2476	8.0	ePA	73	13.66	23.227	30.00	-16.34	-1.00	12.66	36.02	-23.36
2404	8.0	iPA	1	7.46	5.572	30.00	-22.54	-1.00	6.46	36.02	-29.56
2441	8.0	iPA	38	7.68	5.861	30.00	-22.32	-1.00	6.68	36.02	-29.34
2476	8.0	iPA	73	7.81	6.039	30.00	-22.19	-1.00	6.81	36.02	-29.21

**Table 7-6. Peak Conducted Output Power Measurements Ant2 (Bluetooth HDR)**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
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Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Peak Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	iPA	1	7.06	5.082	30.00	-22.94	-3.70	3.36	36.02	-32.66
2441	4.0	iPA	38	6.90	4.898	30.00	-23.10	-3.70	3.20	36.02	-32.82
2476	4.0	iPA	73	7.05	5.070	30.00	-22.95	-3.70	3.35	36.02	-32.67
2404	8.0	iPA	1	7.90	6.166	30.00	-22.10	-3.70	4.20	36.02	-31.82
2441	8.0	iPA	38	7.87	6.124	30.00	-22.13	-3.70	4.17	36.02	-31.85
2476	8.0	iPA	73	7.68	5.861	30.00	-22.32	-3.70	3.98	36.02	-32.04

**Table 7-7. Peak Conducted Output Power Measurements NB UNII\_L (Bluetooth HDR)**

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Peak Conducted Power						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				Ant1		Ant2		Summed							
				[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]						
2404	4.0	ePA	1	12.83	19.187	12.89	19.454	15.87	38.637	30.00	-14.13	3.41	19.28	36.02	-16.74
2441	4.0	ePA	38	12.82	19.143	13.02	20.045	15.93	39.174	30.00	-14.07	3.41	19.34	36.02	-16.68
2476	4.0	ePA	73	12.99	19.907	13.08	20.324	16.05	40.272	30.00	-13.95	3.41	19.46	36.02	-16.56
2404	4.0	iPA	1	7.79	6.012	7.52	5.649	10.67	11.668	30.00	-19.33	3.41	14.08	36.02	-21.94
2441	4.0	iPA	38	7.44	5.546	7.39	5.483	10.43	11.041	30.00	-19.57	3.41	13.84	36.02	-22.18
2476	4.0	iPA	73	7.81	6.039	7.63	5.794	10.73	11.830	30.00	-19.27	3.41	14.14	36.02	-21.88
2404	8.0	ePA	1	13.99	25.061	13.80	23.988	16.91	49.091	30.00	-13.09	3.41	20.32	36.02	-15.70
2441	8.0	ePA	38	13.59	22.856	13.91	24.604	16.76	47.424	30.00	-13.24	3.41	20.17	36.02	-15.85
2476	8.0	ePA	73	13.56	22.699	13.98	25.003	16.79	47.753	30.00	-13.21	3.41	20.20	36.02	-15.82
2404	8.0	iPA	1	7.78	5.998	7.52	5.649	10.66	11.641	30.00	-19.34	3.41	14.07	36.02	-21.95
2441	8.0	iPA	38	7.43	5.534	7.36	5.445	10.41	10.990	30.00	-19.59	3.41	13.82	36.02	-22.20
2476	8.0	iPA	73	7.81	6.039	7.62	5.781	10.73	11.830	30.00	-19.27	3.41	14.14	36.02	-21.88

**Table 7-8. Peak Conducted Output Power Measurements TxBF (Bluetooth HDR)**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 29 of 124

### 7.3.2 Average Output Power Measurement – Bluetooth (HDR)

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Average Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	ePA	1	10.12	10.280	30.00	-19.88	1.60	11.72	36.02	-24.30
2441	4.0	ePA	38	10.44	11.066	30.00	-19.56	1.60	12.04	36.02	-23.98
2476	4.0	ePA	73	10.11	10.257	30.00	-19.89	1.60	11.71	36.02	-24.31
2404	4.0	iPA	1	4.43	2.773	30.00	-25.57	1.60	6.03	36.02	-29.99
2441	4.0	iPA	38	4.38	2.742	30.00	-25.62	1.60	5.98	36.02	-30.04
2476	4.0	iPA	73	4.48	2.805	30.00	-25.52	1.60	6.08	36.02	-29.94
2404	8.0	ePA	1	10.32	10.765	30.00	-19.68	1.60	11.92	36.02	-24.10
2441	8.0	ePA	38	10.35	10.839	30.00	-19.65	1.60	11.95	36.02	-24.07
2476	8.0	ePA	73	10.24	10.568	30.00	-19.76	1.60	11.84	36.02	-24.18
2404	8.0	iPA	1	4.48	2.805	30.00	-25.52	1.60	6.08	36.02	-29.94
2441	8.0	iPA	38	4.43	2.773	30.00	-25.57	1.60	6.03	36.02	-29.99
2476	8.0	iPA	73	4.05	2.541	30.00	-25.95	1.60	5.65	36.02	-30.37

**Table 7-9. Average Conducted Output Power Measurements Ant1 (Bluetooth HDR)**

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Average Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	ePA	1	10.18	10.423	30.00	-19.82	-1.00	9.18	36.02	-26.84
2441	4.0	ePA	38	10.32	10.765	30.00	-19.68	-1.00	9.32	36.02	-26.70
2476	4.0	ePA	73	10.34	10.814	30.00	-19.66	-1.00	9.34	36.02	-26.68
2404	4.0	iPA	1	4.04	2.535	30.00	-25.96	-1.00	3.04	36.02	-32.98
2441	4.0	iPA	38	4.24	2.655	30.00	-25.76	-1.00	3.24	36.02	-32.78
2476	4.0	iPA	73	4.36	2.729	30.00	-25.64	-1.00	3.36	36.02	-32.66
2404	8.0	ePA	1	10.12	10.280	30.00	-19.88	-1.00	9.12	36.02	-26.90
2441	8.0	ePA	38	10.09	10.209	30.00	-19.91	-1.00	9.09	36.02	-26.93
2476	8.0	ePA	73	10.15	10.351	30.00	-19.85	-1.00	9.15	36.02	-26.87
2404	8.0	iPA	1	4.05	2.541	30.00	-25.95	-1.00	3.05	36.02	-32.97
2441	8.0	iPA	38	4.28	2.679	30.00	-25.72	-1.00	3.28	36.02	-32.74
2476	8.0	iPA	73	4.41	2.761	30.00	-25.59	-1.00	3.41	36.02	-32.61

**Table 7-10. Average Conducted Output Power Measurements Ant2 (Bluetooth HDR)**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
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Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Average Conducted Power		Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				[dBm]	[mW]						
2404	4.0	iPA	1	4.42	2.767	30.00	-25.58	-3.70	0.72	36.02	-35.30
2441	4.0	iPA	38	4.27	2.673	30.00	-25.73	-3.70	0.57	36.02	-35.45
2476	4.0	iPA	73	4.44	2.780	30.00	-25.56	-3.70	0.74	36.02	-35.28
2404	8.0	iPA	1	4.49	2.812	30.00	-25.51	-3.70	0.79	36.02	-35.23
2441	8.0	iPA	38	4.48	2.805	30.00	-25.52	-3.70	0.78	36.02	-35.24
2476	8.0	iPA	73	4.31	2.698	30.00	-25.69	-3.70	0.61	36.02	-35.41

**Table 7-11. Average Conducted Output Power Measurements NB UNII\_L (Bluetooth HDR)**

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Average Conducted Power						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	EIRP Margin [dB]
				Ant1		Ant2		Summed							
				[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]						
2404	4.0	ePA	1	10.15	10.351	10.19	10.447	13.18	20.797	30.00	-16.82	3.41	16.59	36.02	-19.43
2441	4.0	ePA	38	10.16	10.375	10.31	10.740	13.25	21.135	30.00	-16.75	3.41	16.66	36.02	-19.36
2476	4.0	ePA	73	10.32	10.765	10.37	10.889	13.36	21.677	30.00	-16.64	3.41	16.77	36.02	-19.25
2404	4.0	iPA	1	4.43	2.773	4.12	2.582	7.29	5.358	30.00	-22.71	3.41	10.70	36.02	-25.32
2441	4.0	iPA	38	4.07	2.553	4.02	2.523	7.06	5.082	30.00	-22.94	3.41	10.47	36.02	-25.55
2476	4.0	iPA	73	4.47	2.799	4.25	2.661	7.37	5.458	30.00	-22.63	3.41	10.78	36.02	-25.24
2404	8.0	ePA	1	10.49	11.194	10.32	10.765	13.42	21.979	30.00	-16.58	3.41	16.83	36.02	-19.19
2441	8.0	ePA	38	10.13	10.304	10.43	11.041	13.29	21.330	30.00	-16.71	3.41	16.70	36.02	-19.32
2476	8.0	ePA	73	10.12	10.280	10.50	11.220	13.32	21.478	30.00	-16.68	3.41	16.73	36.02	-19.29
2404	8.0	iPA	1	4.40	2.754	4.11	2.576	7.27	5.333	30.00	-22.73	3.41	10.68	36.02	-25.34
2441	8.0	iPA	38	4.07	2.553	4.00	2.512	7.05	5.070	30.00	-22.95	3.41	10.46	36.02	-25.56
2476	8.0	iPA	73	4.47	2.799	4.24	2.655	7.37	5.458	30.00	-22.63	3.41	10.78	36.02	-25.24

**Table 7-12. Average Conducted Output Power Measurements TxBF (Bluetooth HDR)**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
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**Note:**

Per ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)1), the conducted powers at Antenna 1 and Antenna 2 were first measured separately during TxBF transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.10-2013 Subclause 14.4.3, the directional gain is calculated using the following formula, where  $G_N$  is the gain of the nth antenna and  $N_{ANT}$ , the total number of antennas used.

$$\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$

**Sample TxBF Calculation:**

At 2404MHz the average conducted output power was measured to be 10.15 dBm for Antenna 1 and 10.19 dBm for Antenna 2.

$$\text{Antenna 1} + \text{Antenna 2} = \text{TxBF}$$

$$(10.15\text{dBm} + 10.19 \text{ dBm}) = (10.35 \text{ mW} + 10.45 \text{ mW}) = 20.80 \text{ mW} = 13.18 \text{ dBm}$$

**Sample e.i.r.p. Calculation:**

At 2404MHz, the average conducted output power was calculated to be 13.18 dBm with directional gain of 3.41 dBi.

$$\text{e.i.r.p. (dBm)} = \text{Conducted Power (dBm)} + \text{Ant gain (dBi)}$$

$$13.18 \text{ dBm} + 3.41 \text{ dBi} = 16.59 \text{ dBm}$$

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## 7.4 Power Spectral Density – Bluetooth (HDR)

§15.247(e); RSS-247 [5.2]

### Test Overview and Limit

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

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

### Test Procedure Used

ANSI C63.10-2013 – Subclause 11.10.2 Method PKPSD

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

ANSI C63.10-2013 – Subclause 14.3.2.2 Measure-and-Sum Technique

KDB 662911 D01 v02r01 – Section E)2) Measure-and-Sum Technique

### Test Settings

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

### Test Setup

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



**Figure 7-3. Test Instrument & Measurement Setup**

### Test Notes

None

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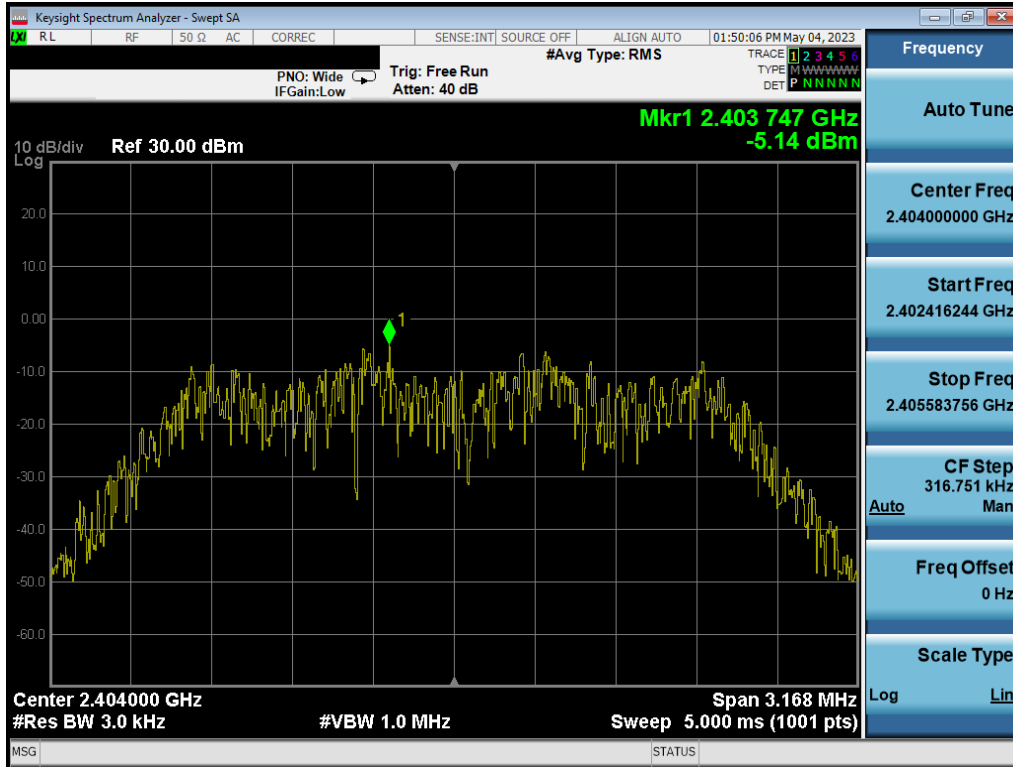
V 10.5 12/15/2021

**Ant1**

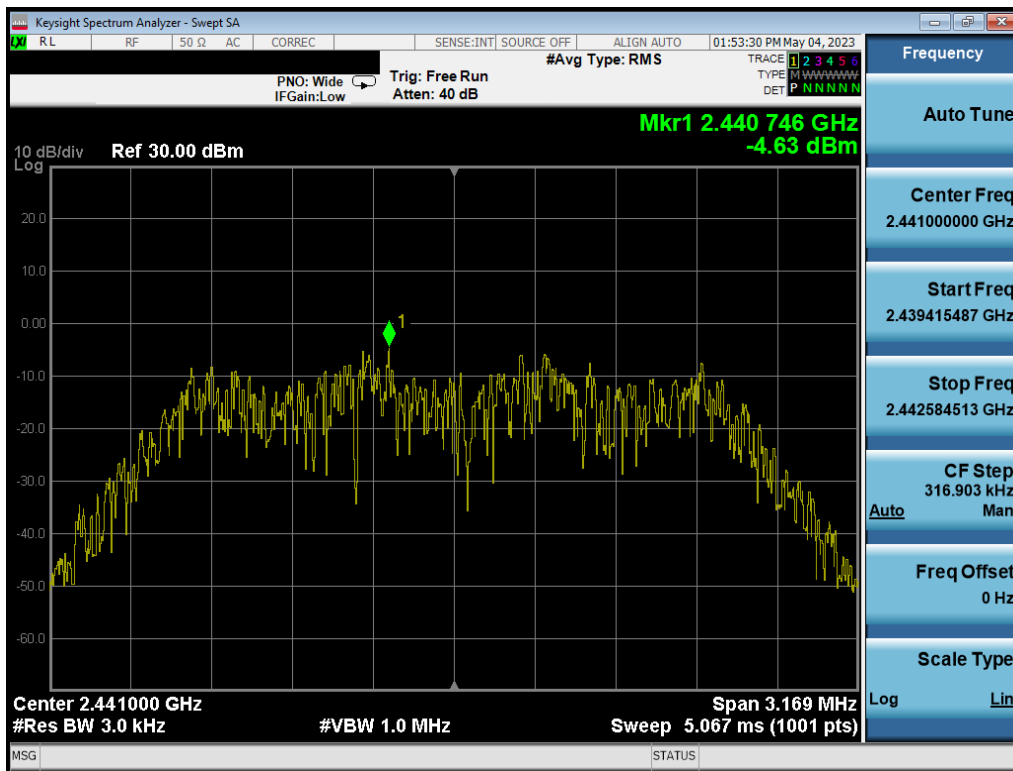
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2404	4.0	ePA	1	-5.14	8.0	-13.14
2441	4.0	ePA	38	-4.63	8.0	-12.63
2476	4.0	ePA	73	-5.14	8.0	-13.14
2404	4.0	iPA	1	-10.28	8.0	-18.28
2441	4.0	iPA	38	-10.39	8.0	-18.39
2476	4.0	iPA	73	-10.30	8.0	-18.30
2404	8.0	ePA	1	-7.33	8.0	-15.33
2441	8.0	ePA	38	-7.19	8.0	-15.19
2476	8.0	ePA	73	-7.05	8.0	-15.05
2404	8.0	iPA	1	-12.83	8.0	-20.83
2441	8.0	iPA	38	-12.83	8.0	-20.83
2476	8.0	iPA	73	-13.32	8.0	-21.32

**Table 7-13. Conducted Power Density Measurements Ant1**

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
<b>Test Report S/N:</b> 1C2302130007-03.BCG	<b>Test Dates:</b> 2/10/2023 - 5/5/2023	<b>EUT Type:</b> Head Mounted Device	Page 34 of 124

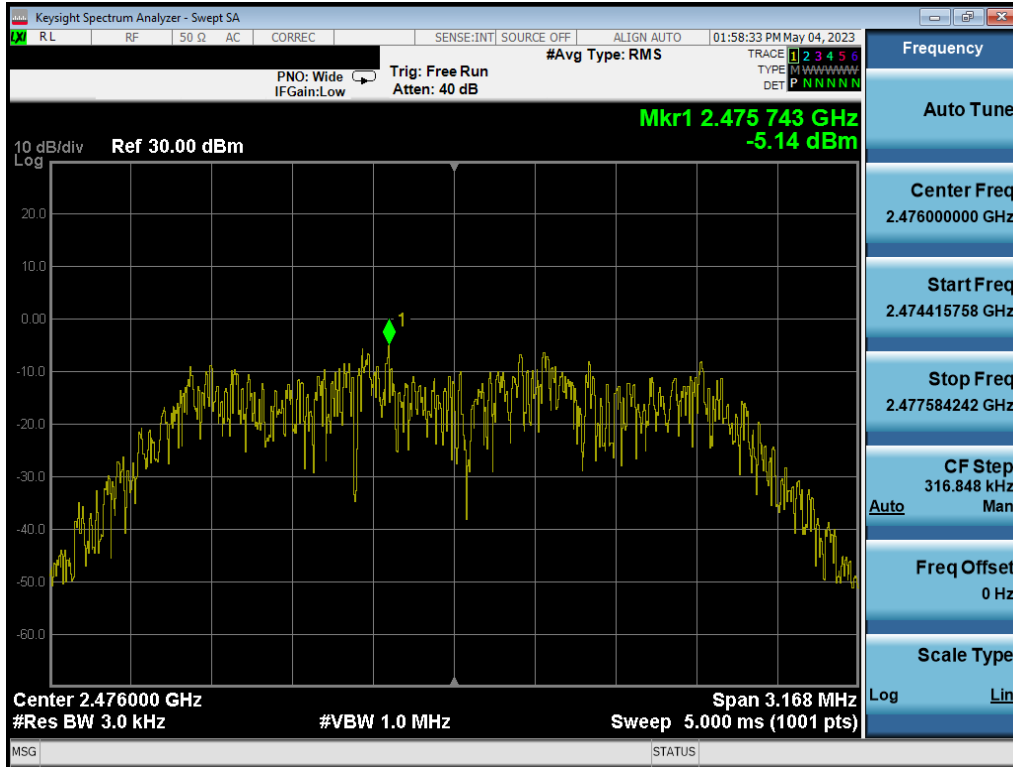


Plot 7-19. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)

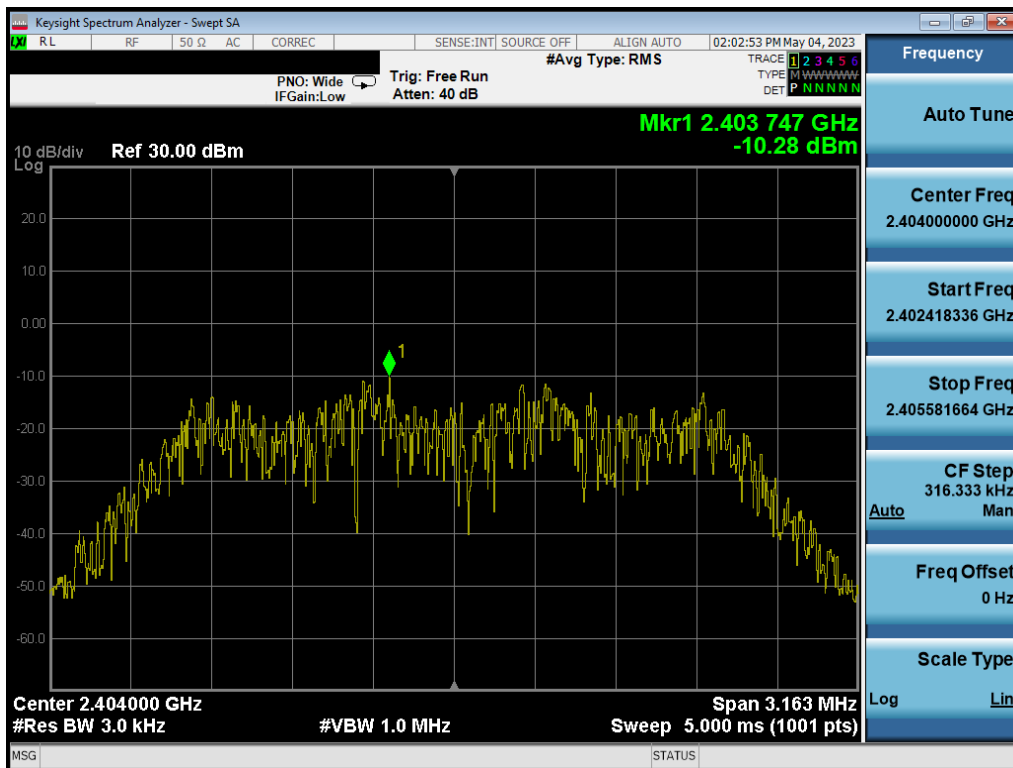


Plot 7-20. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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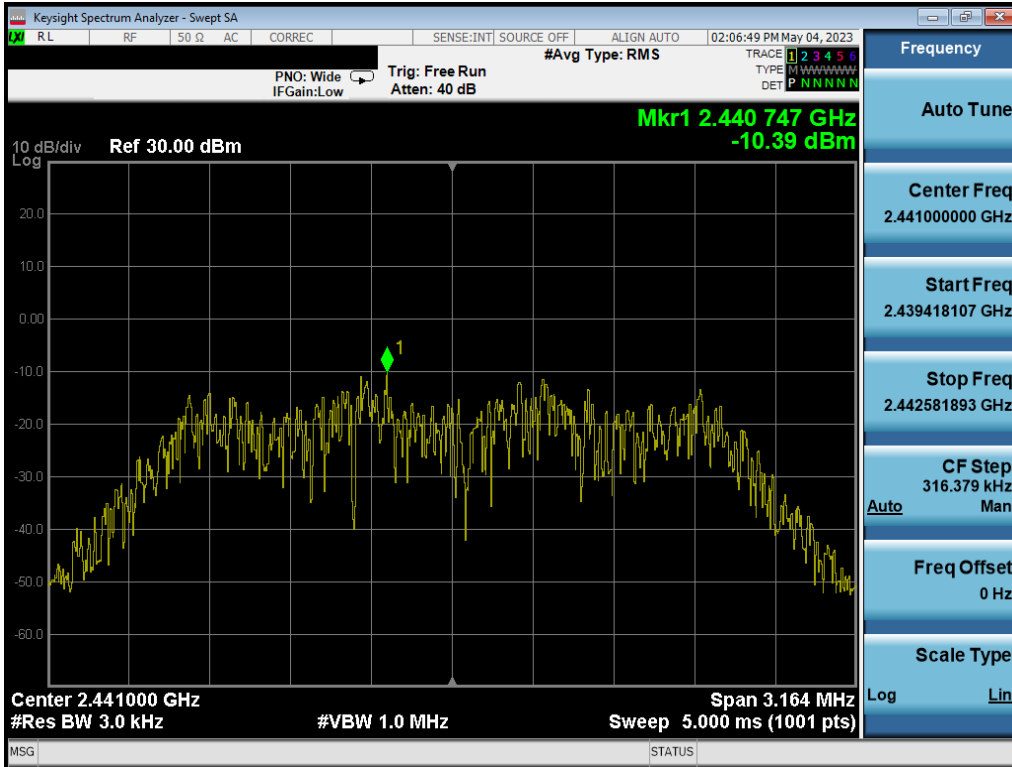


Plot 7-21. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

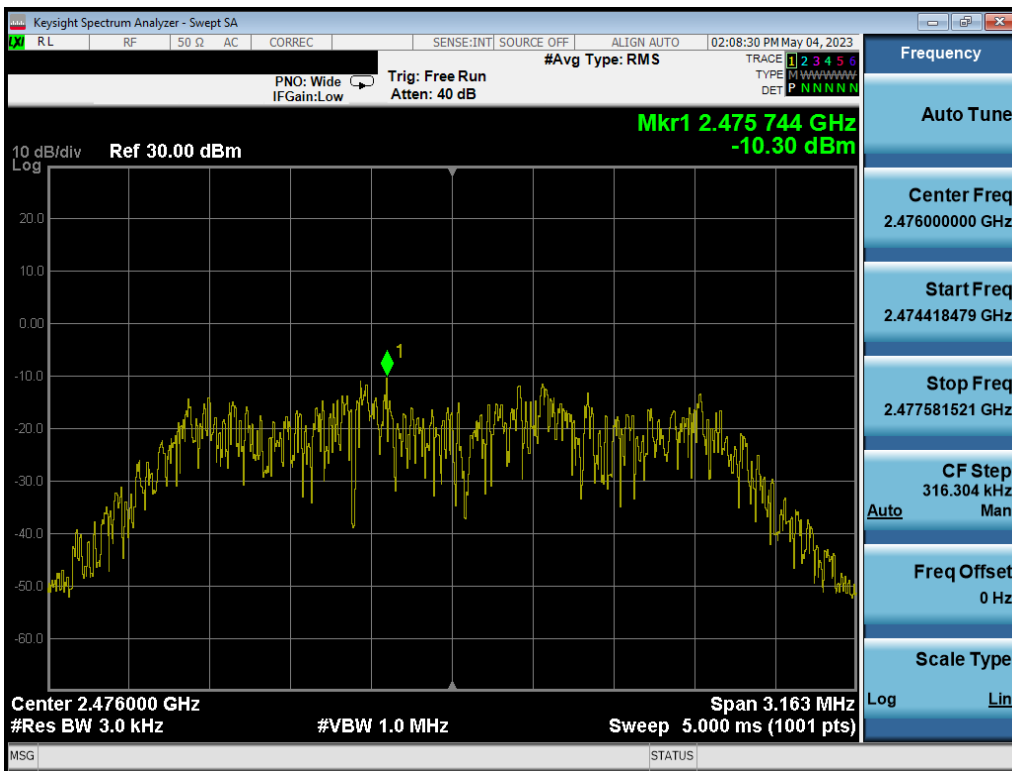


Plot 7-22. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)


FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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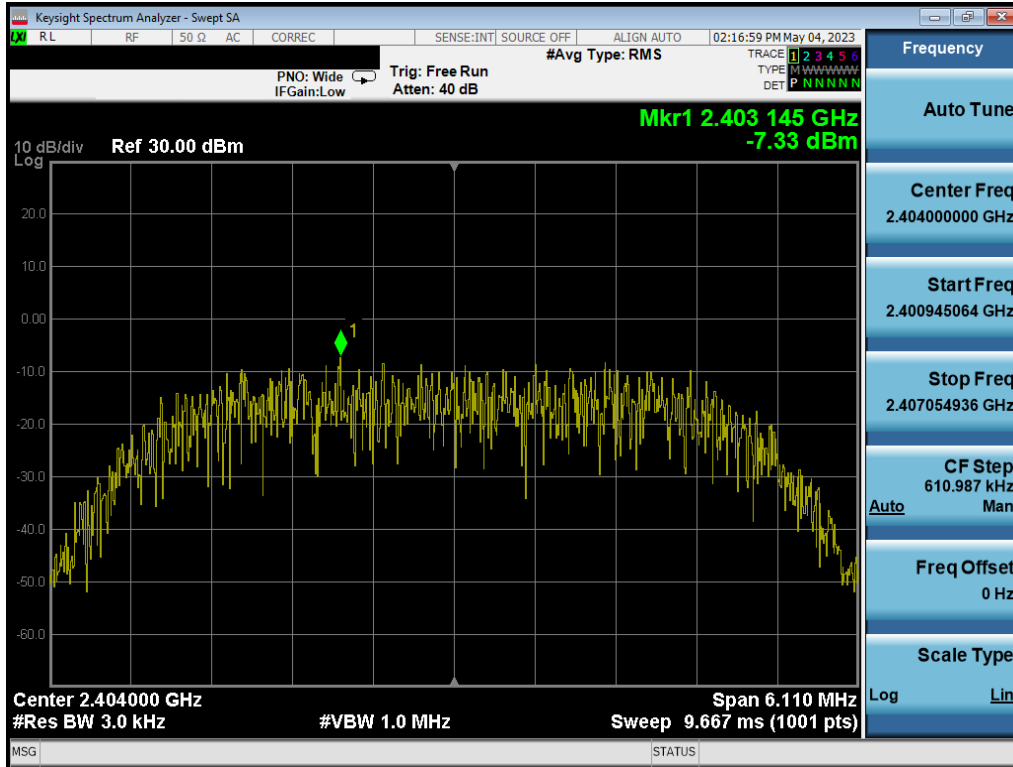


Plot 7-23. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)

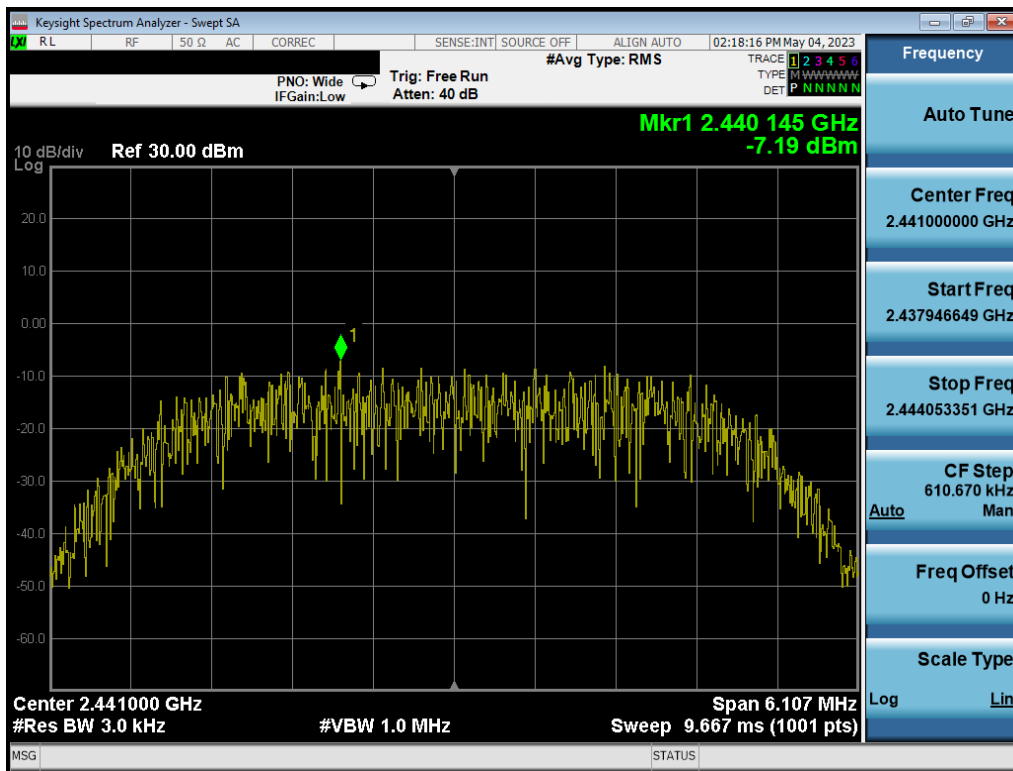


Plot 7-24. Power Spectral Density Plot Ant1 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 73)

FCC ID: BCGA2117 IC: 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	Approved by: Technical Manager
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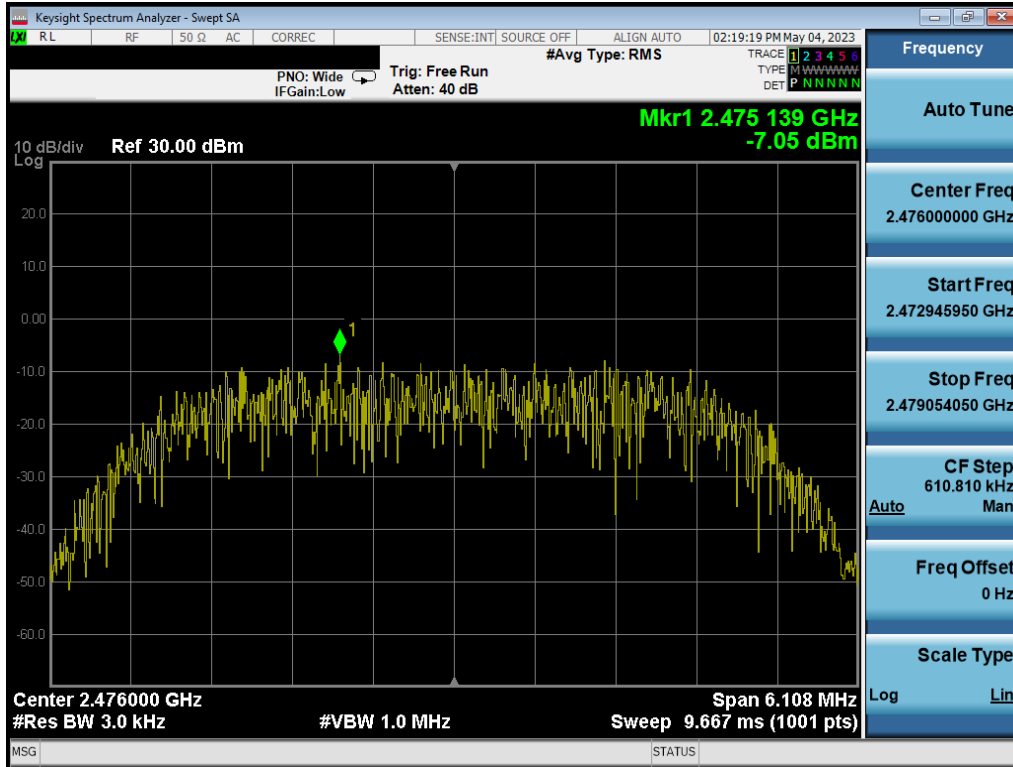


Plot 7-25. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 1)

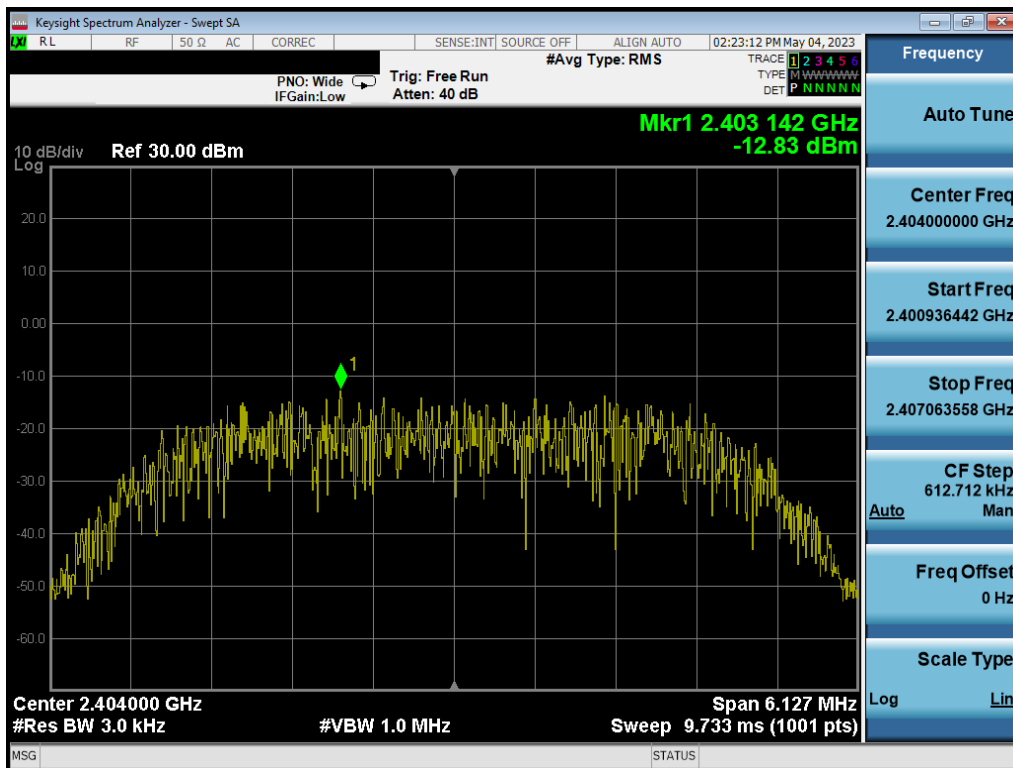


Plot 7-26. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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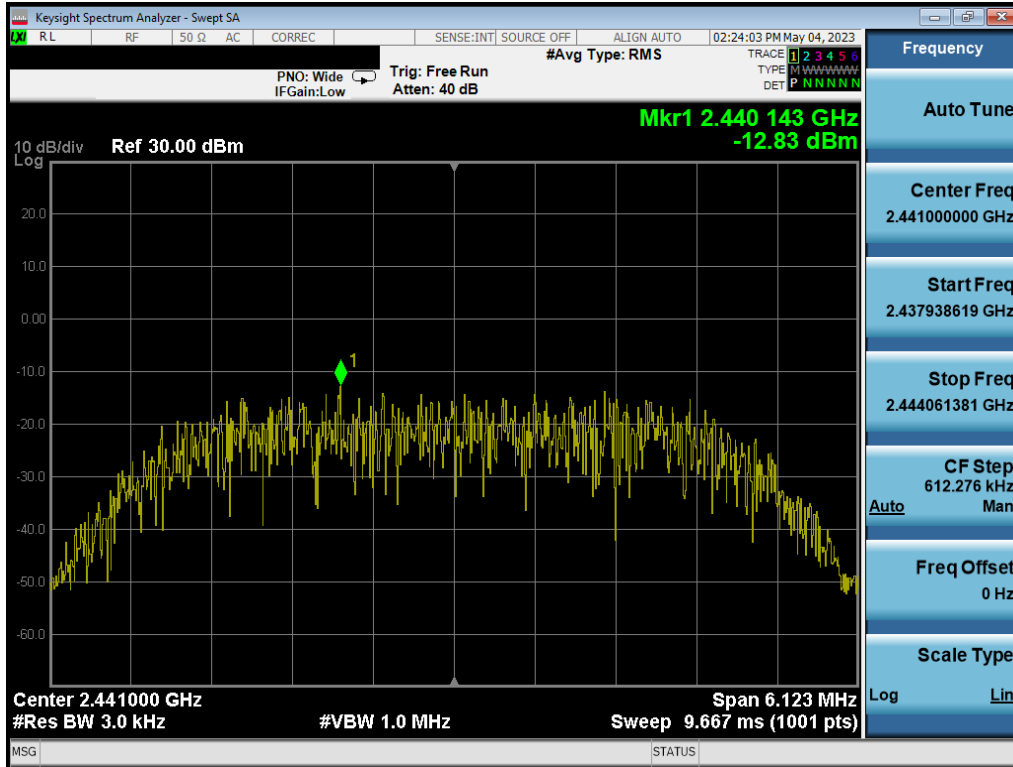


Plot 7-27. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 73)

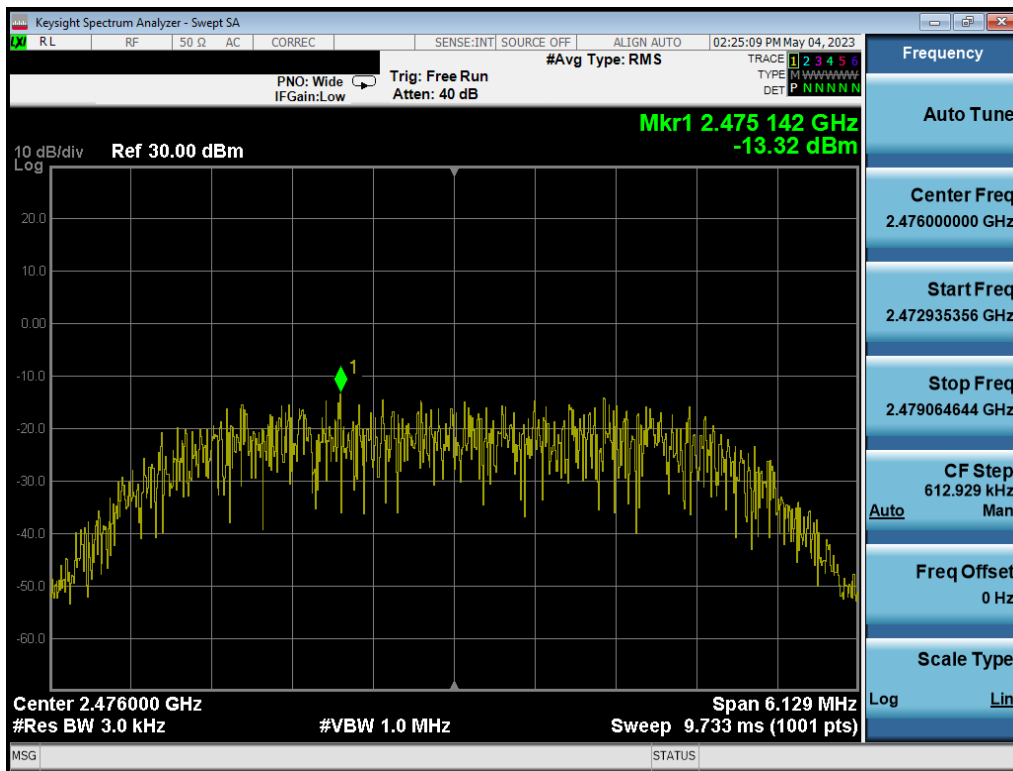


Plot 7-28. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-29. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 38)



Plot 7-30. Power Spectral Density Plot Ant1 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 73)


FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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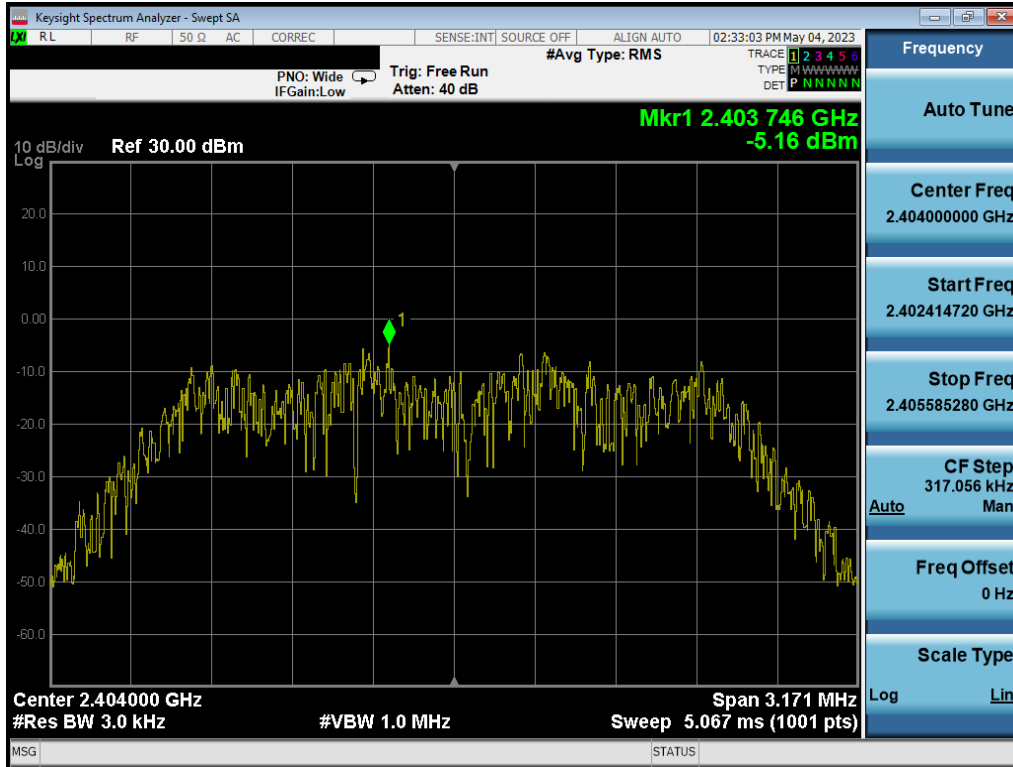


Ant2

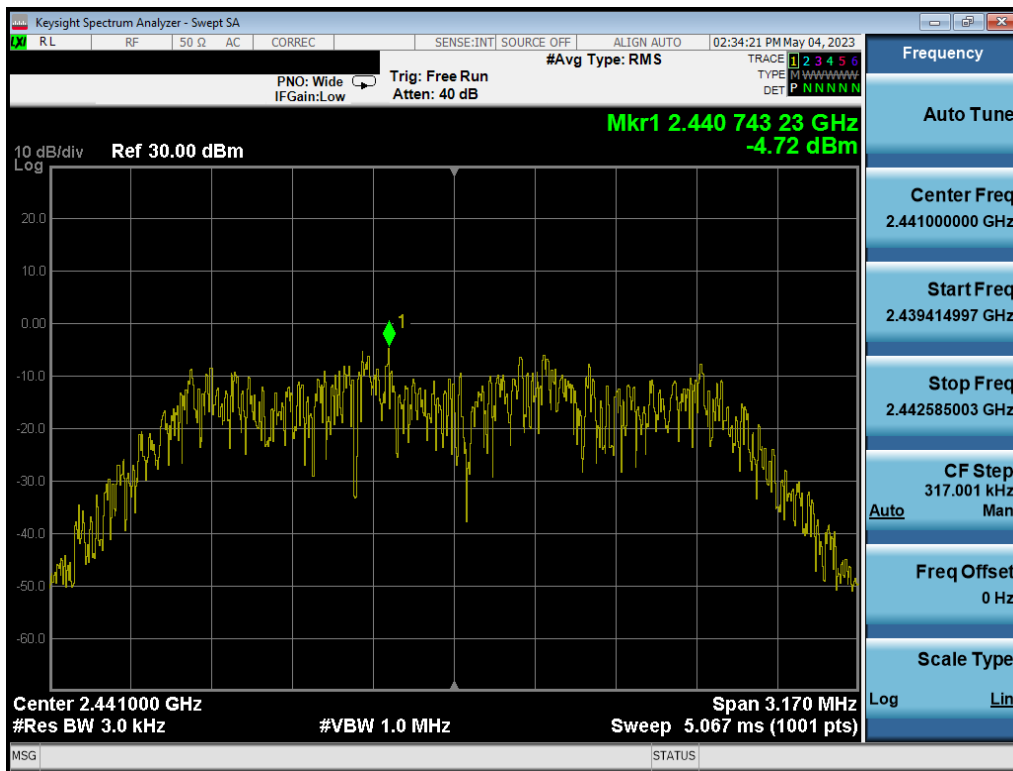
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2404	4.0	ePA	1	-5.16	8.0	-13.16
2441	4.0	ePA	38	-4.72	8.0	-12.72
2476	4.0	ePA	73	-4.44	8.0	-12.44
2404	4.0	iPA	1	-10.75	8.0	-18.75
2441	4.0	iPA	38	-10.84	8.0	-18.84
2476	4.0	iPA	73	-10.70	8.0	-18.70
2404	8.0	ePA	1	-7.71	8.0	-15.71
2441	8.0	ePA	38	-7.53	8.0	-15.53
2476	8.0	ePA	73	-7.26	8.0	-15.26
2404	8.0	iPA	1	-13.03	8.0	-21.03
2441	8.0	iPA	38	-13.26	8.0	-21.26
2476	8.0	iPA	73	-13.13	8.0	-21.13

Table 7-14. Conducted Power Density Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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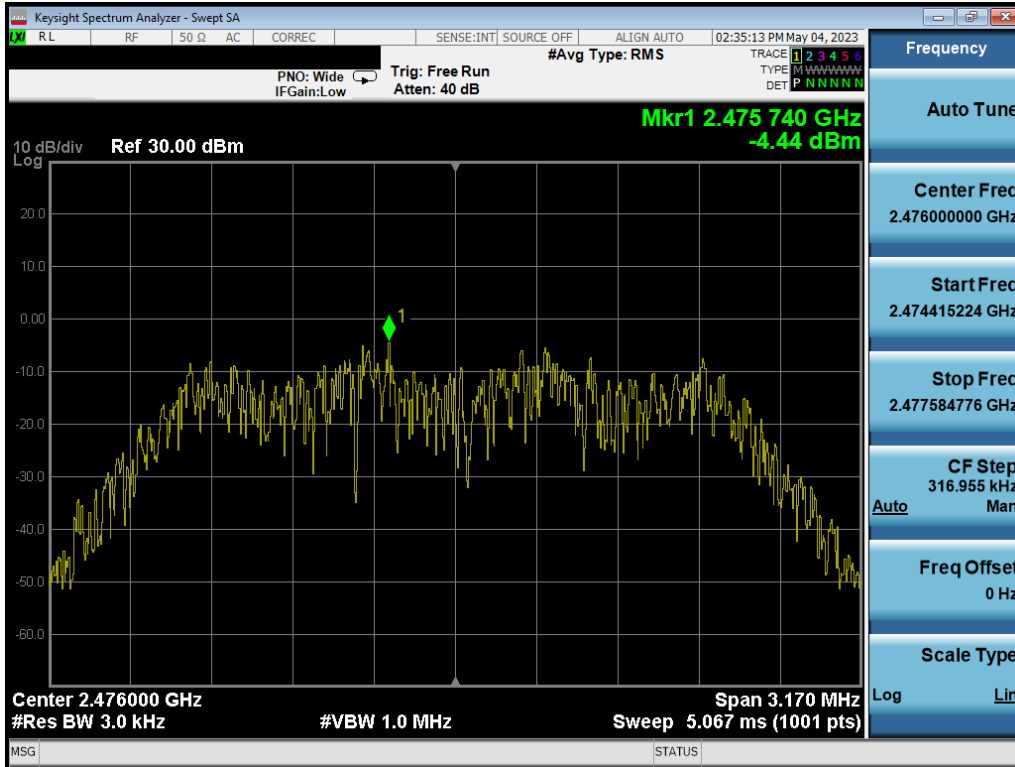


Plot 7-31. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)

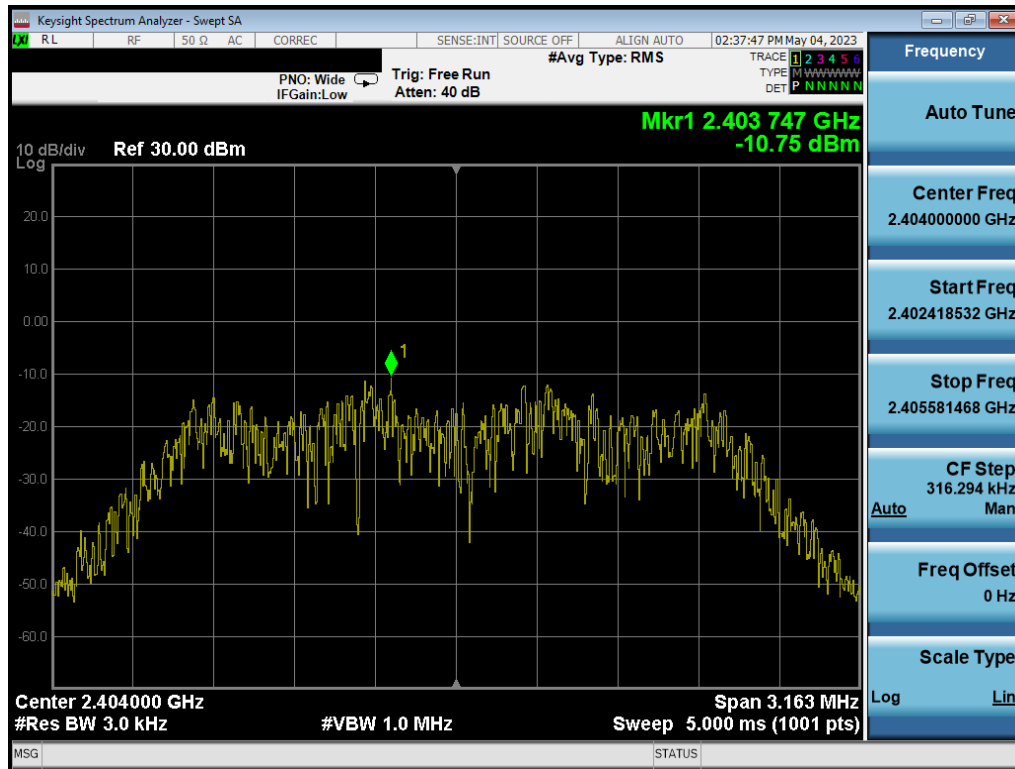


Plot 7-32. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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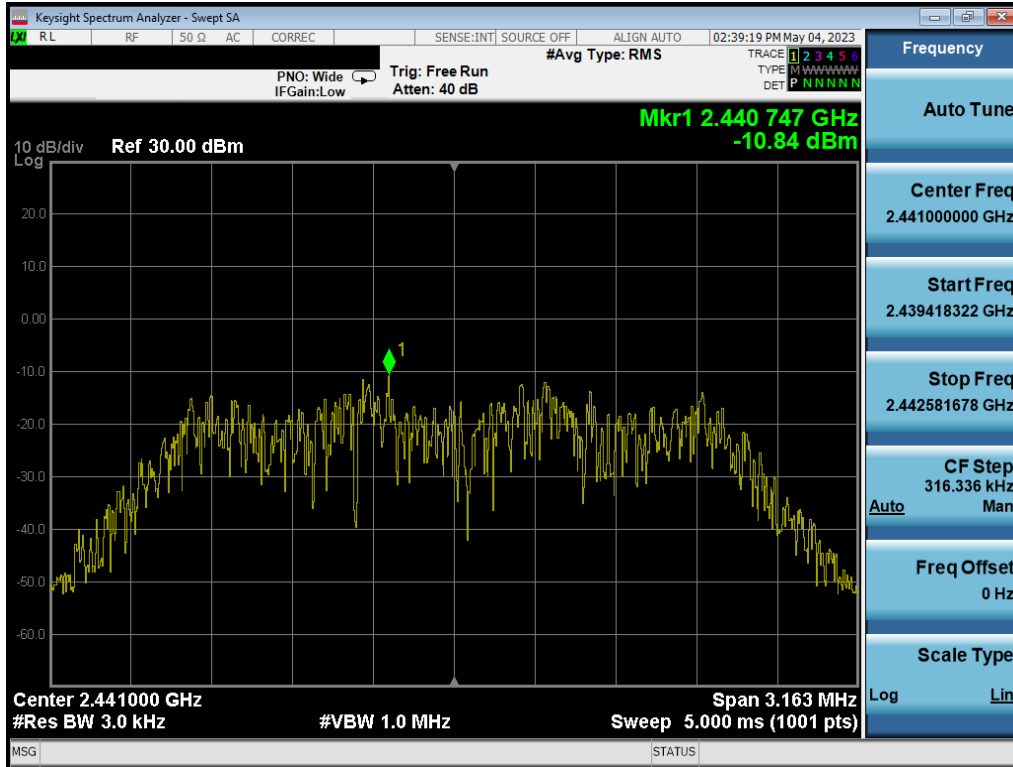


Plot 7-33. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

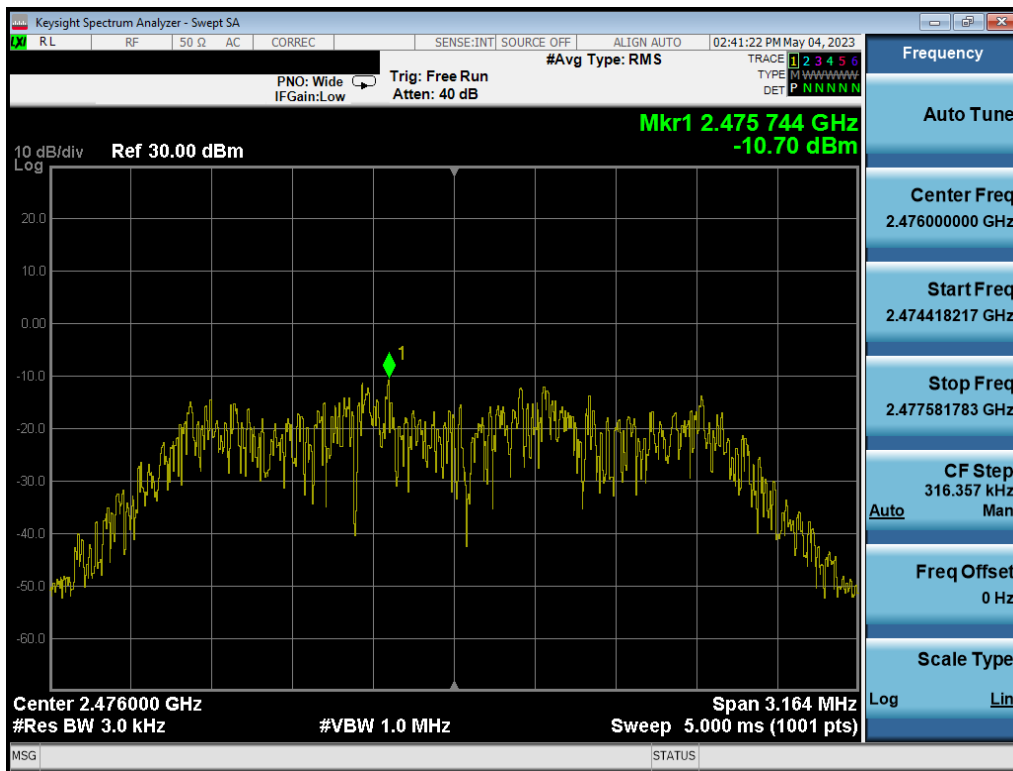


Plot 7-34. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 43 of 124

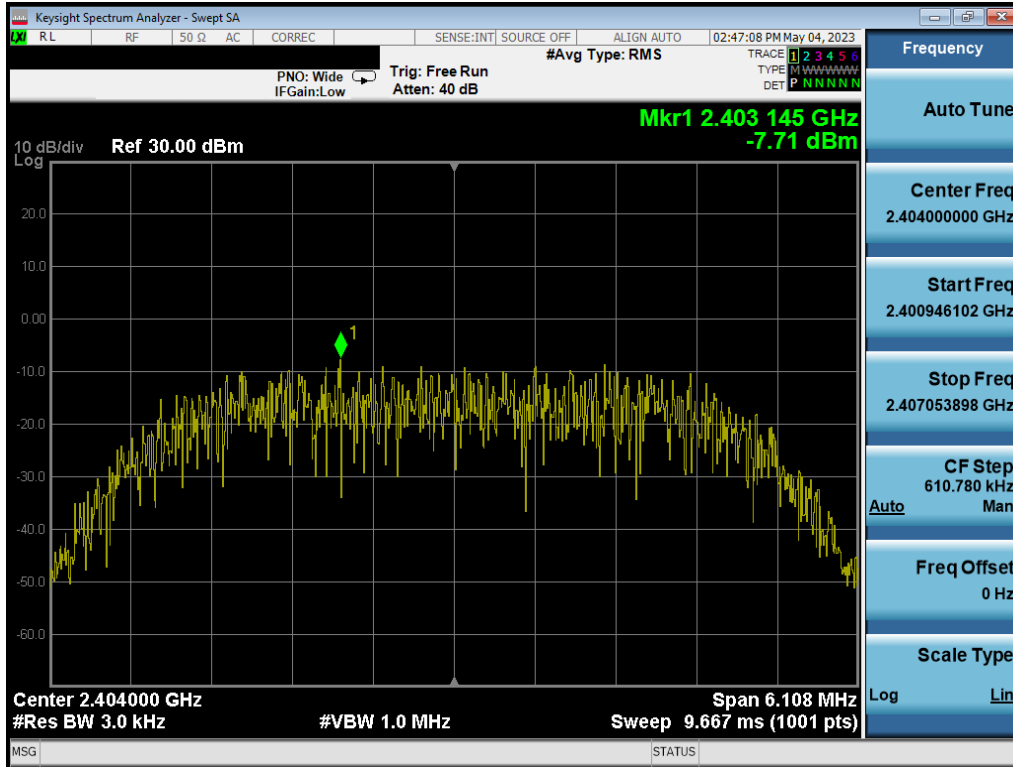


Plot 7-35. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)

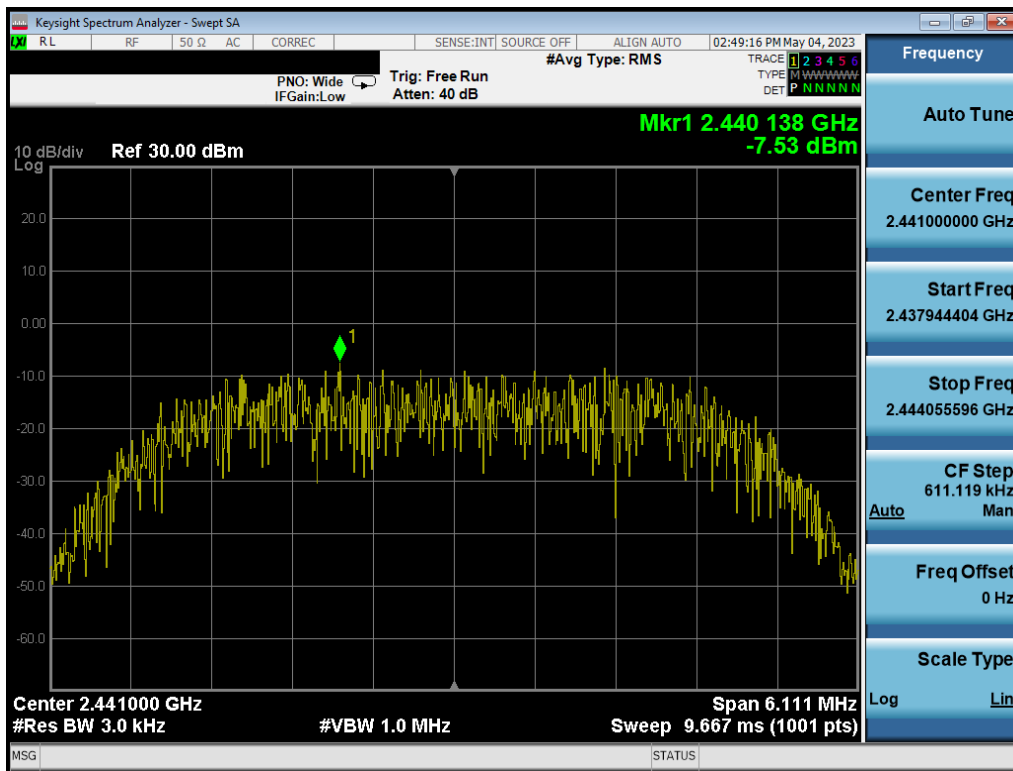


Plot 7-36. Power Spectral Density Plot Ant2 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 73)


FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 44 of 124

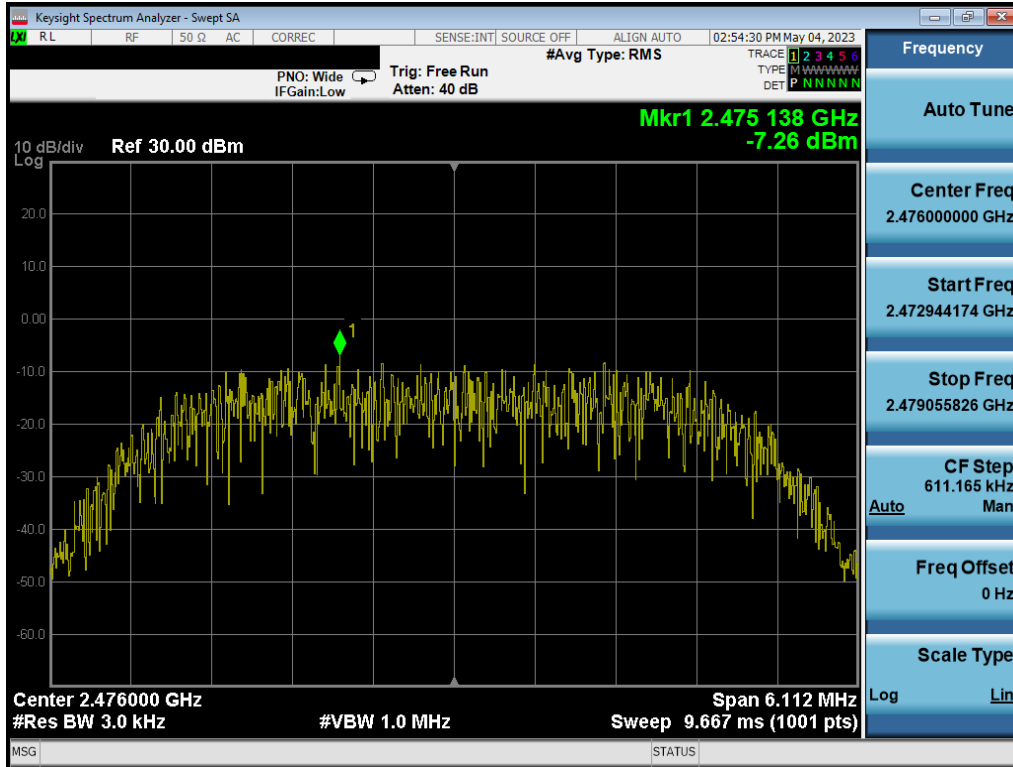


Plot 7-37. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 1)

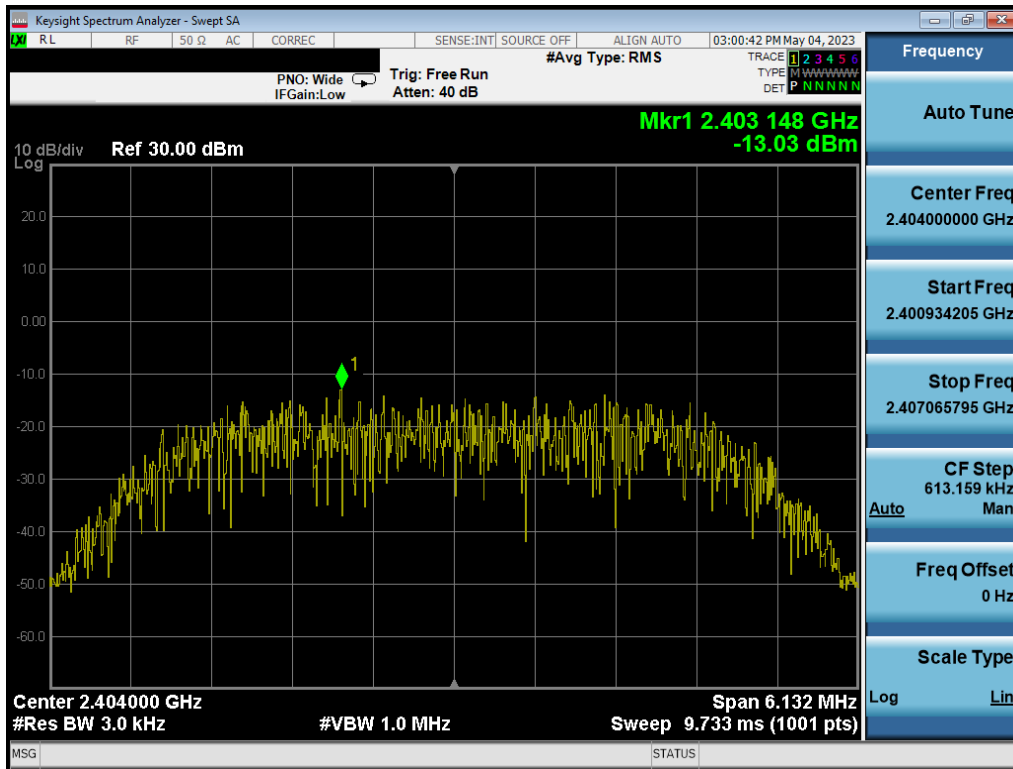


Plot 7-38. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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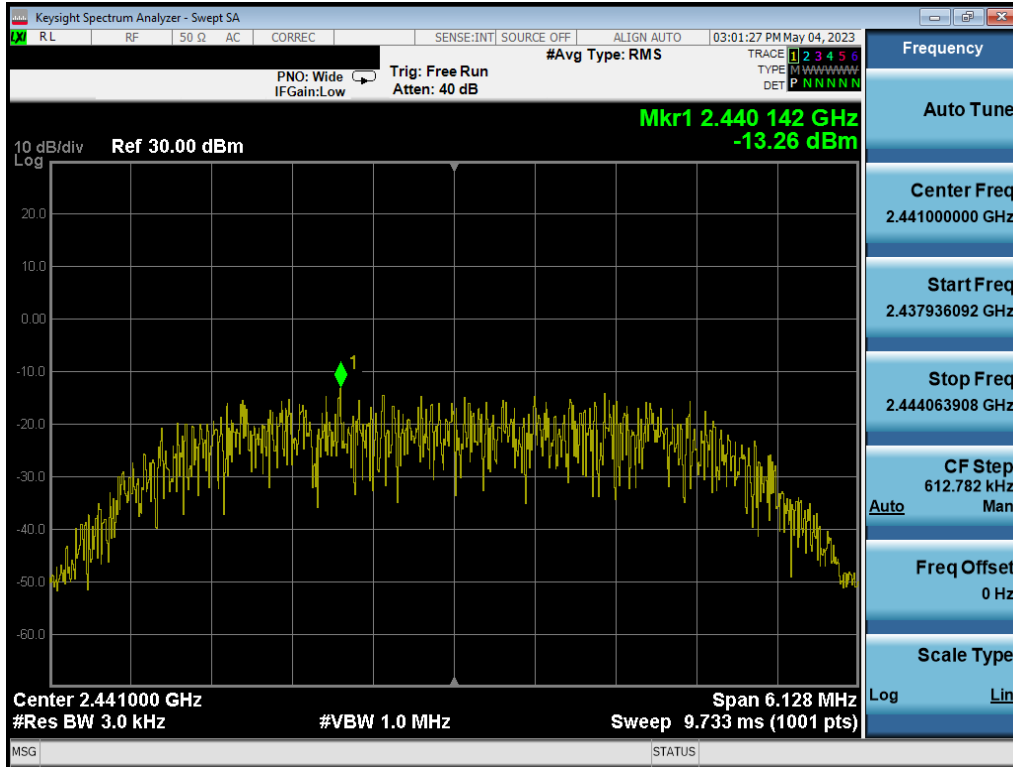


Plot 7-39. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, ePA – Ch. 73)

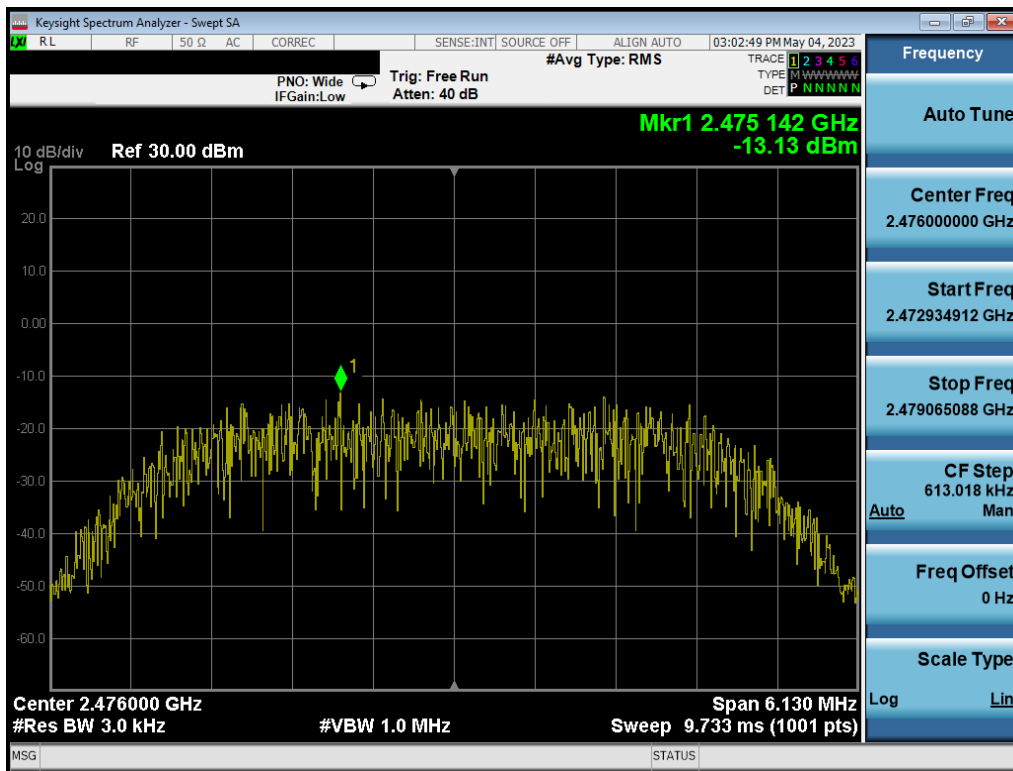


Plot 7-40. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 1)


FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-41. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 38)



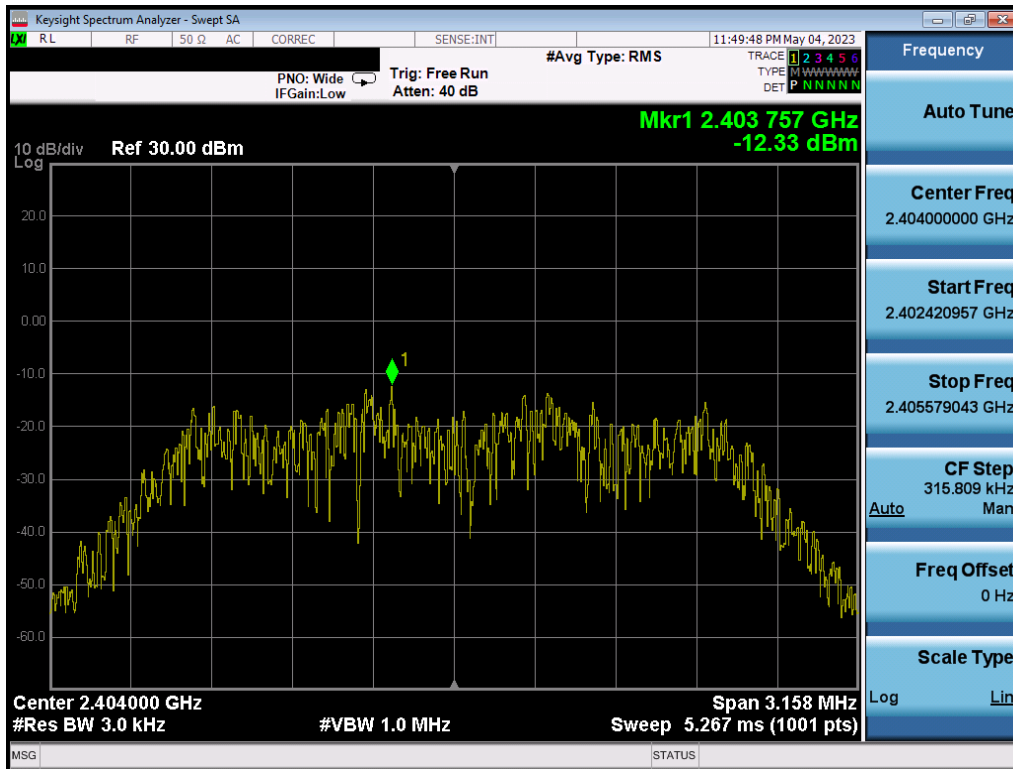
Plot 7-42. Power Spectral Density Plot Ant2 (Bluetooth (HDR8), 8Mbps, iPA – Ch. 73)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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NB UNII\_L

Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2404	4.0	iPA	1	-12.33	8.0	-20.33
2441	4.0	iPA	38	-12.74	8.0	-20.74
2476	4.0	iPA	73	-12.63	8.0	-20.63
2404	8.0	iPA	1	-14.80	8.0	-22.80
2441	8.0	iPA	38	-15.23	8.0	-23.23
2476	8.0	iPA	73	-15.06	8.0	-23.06

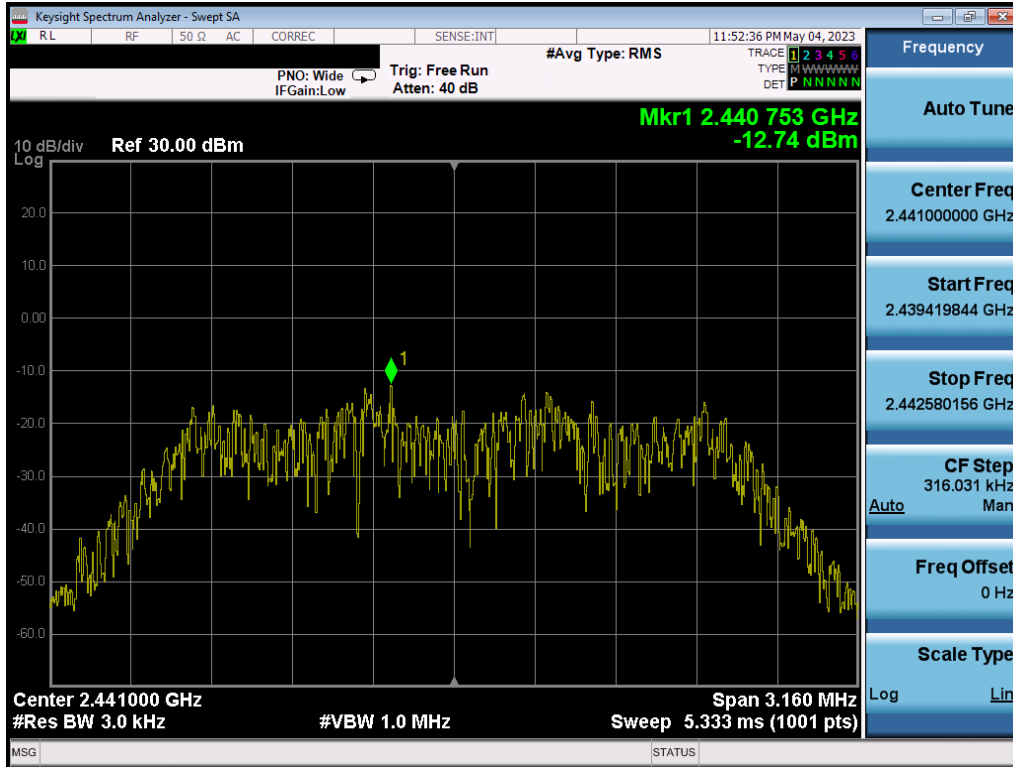
Table 7-15. Conducted Power Density Measurements NB UNII\_L



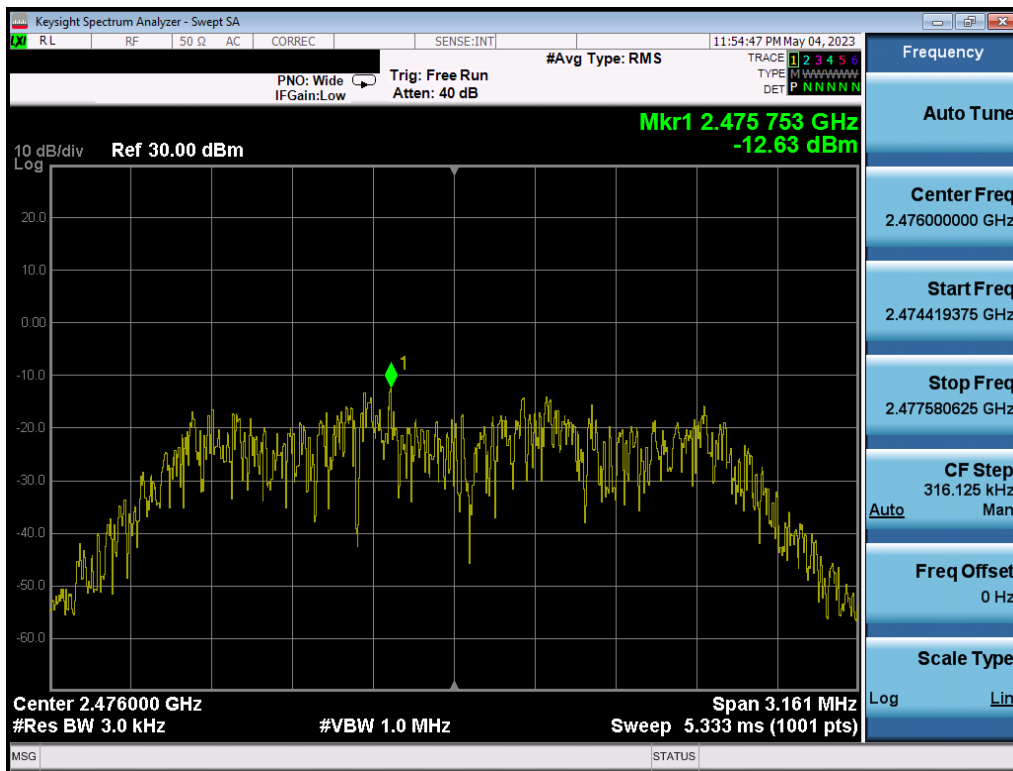
Plot 7-43. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 48 of 124



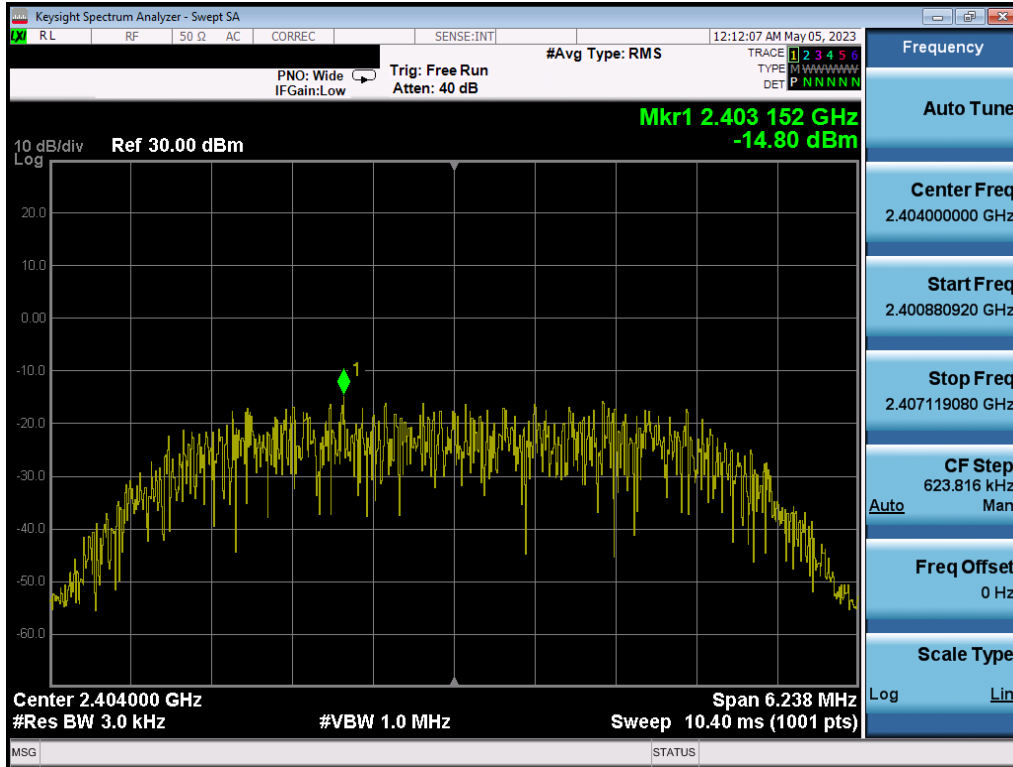


Plot 7-44. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)

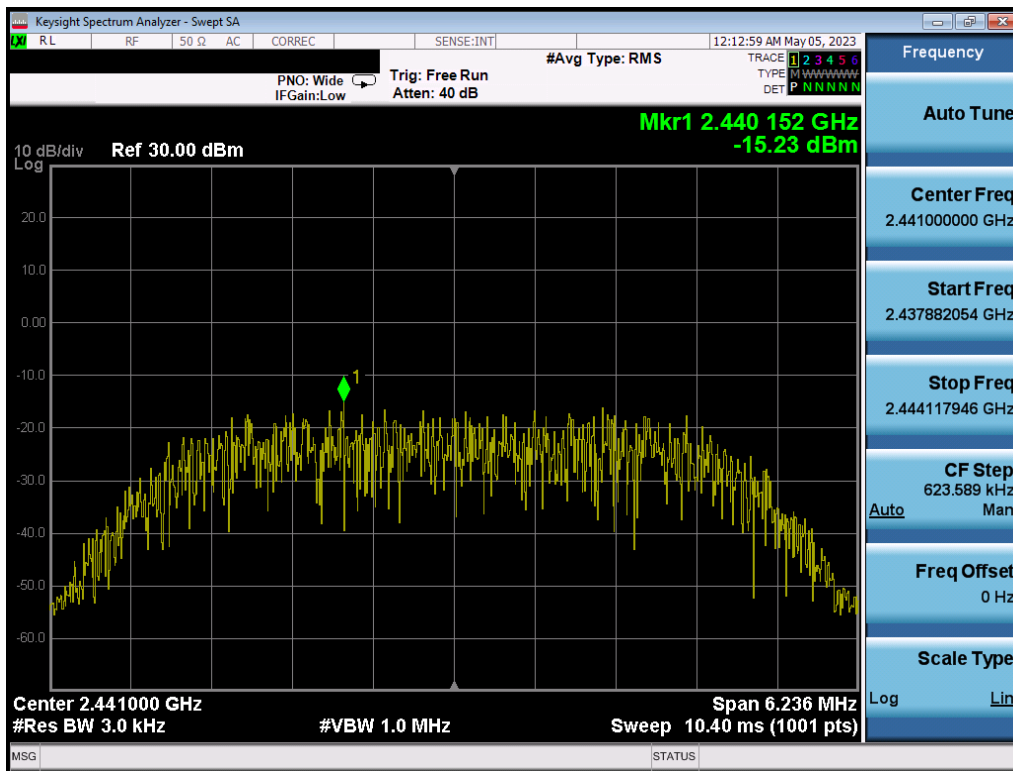


Plot 7-45. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR4), 4Mbps, iPA – Ch. 73)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 49 of 124

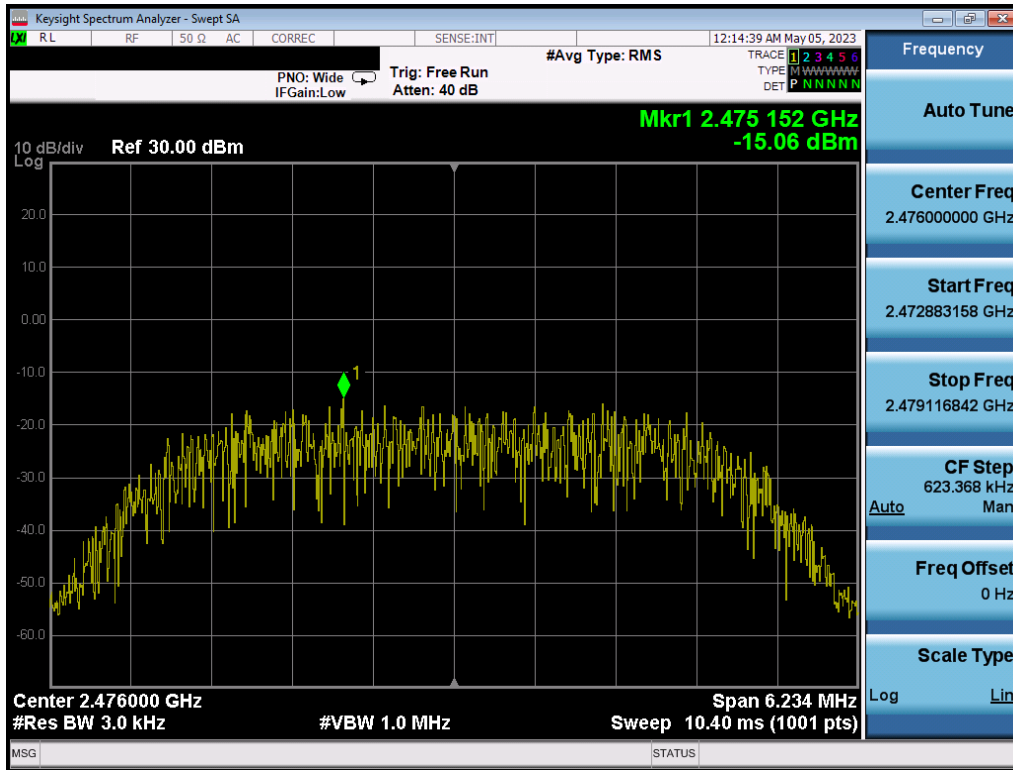


Plot 7-46. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 1)



Plot 7-47. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 50 of 124



Plot 7-48. Power Spectral Density Plot NB UNII\_L (Bluetooth (HDR8), 8Mbps, iPA – Ch. 73)

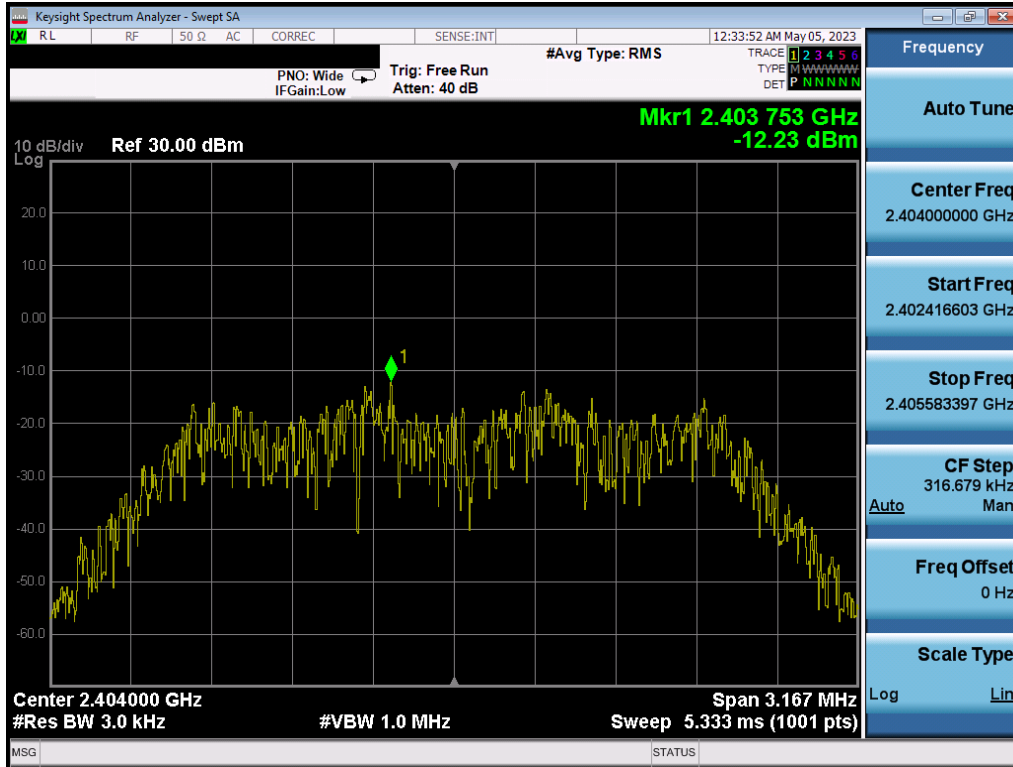
<b>FCC ID:</b> BCGA2117 <b>IC:</b> 579C-A2117		<b>MEASUREMENT REPORT (CERTIFICATION)</b>	<b>Approved by:</b> Technical Manager
<b>Test Report S/N:</b> 1C2302130007-03.BCG	<b>Test Dates:</b> 2/10/2023 - 5/5/2023	<b>EUT Type:</b> Head Mounted Device	Page 51 of 124

**TxBF**

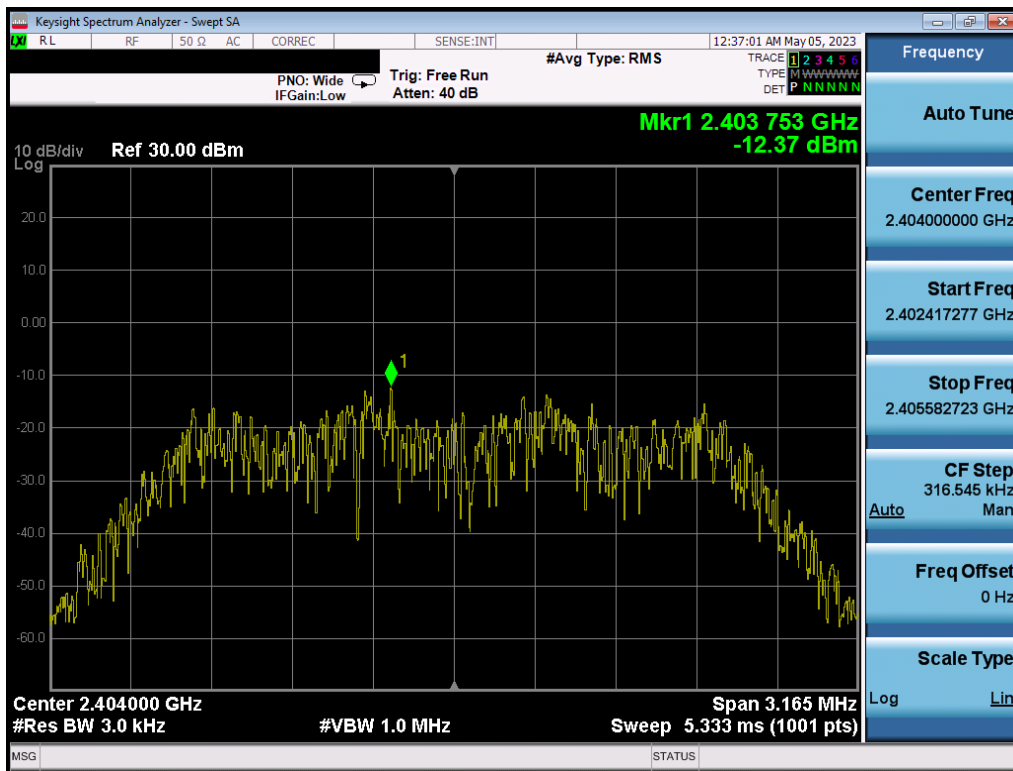
Frequency [MHz]	Data Rate [Mbps]	Power Scheme	Channel No.	Measured Power Spectral Density [dBm / 3kHz]			Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
				Ant1	Ant2	Summed		
2404	4.0	ePA	1	-12.23	-12.37	-9.29	8.0	-17.29
2441	4.0	ePA	38	-13.00	-12.26	-9.60	8.0	-17.60
2476	4.0	ePA	73	-12.08	-11.84	-8.95	8.0	-16.95
2404	4.0	iPA	1	-11.91	-12.32	-9.10	8.0	-17.10
2441	4.0	iPA	38	-12.67	-12.92	-9.78	8.0	-17.78
2476	4.0	iPA	73	-12.27	-12.26	-9.25	8.0	-17.25
2404	8.0	ePA	1	-9.48	-9.06	-6.26	8.0	-14.26
2441	8.0	ePA	38	-9.12	-8.16	-5.61	8.0	-13.61
2476	8.0	ePA	73	-9.18	-8.82	-5.98	8.0	-13.98
2404	8.0	iPA	1	-14.40	-14.80	-11.59	8.0	-19.59
2441	8.0	iPA	38	-16.84	-15.36	-13.03	8.0	-21.03
2476	8.0	iPA	73	-14.69	-14.44	-11.56	8.0	-19.56

**Table 7-16. Conducted Power Density Measurements TxBF**

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 52 of 124

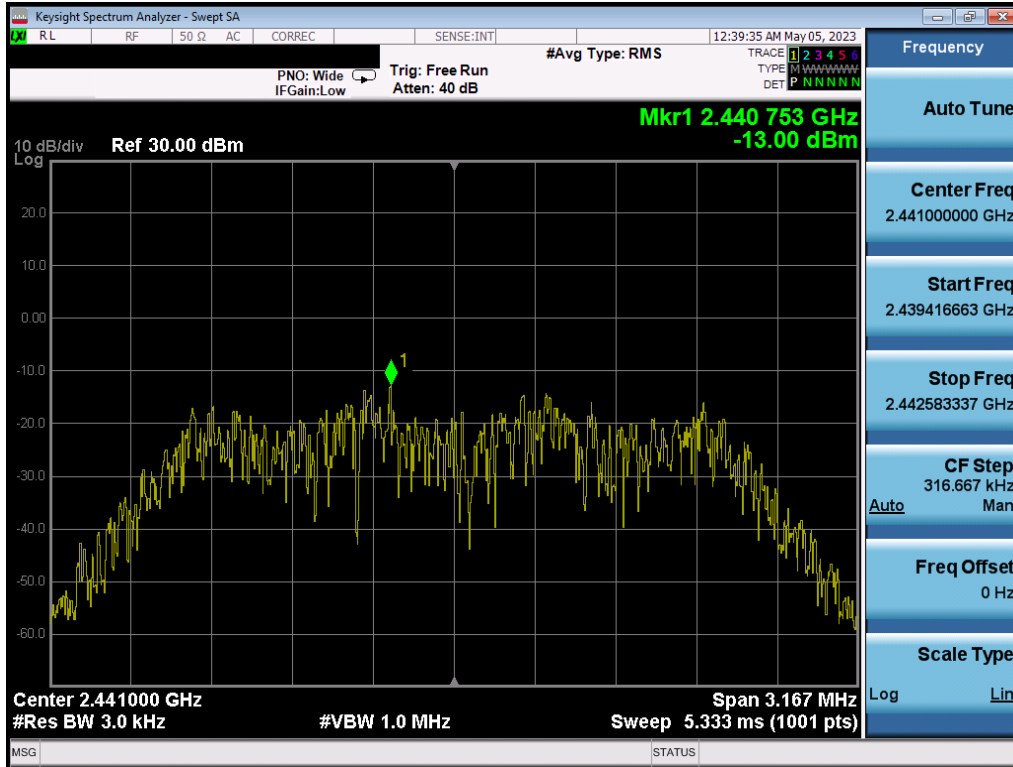


Plot 7-49. Power Spectral Density Plot TxBF Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)

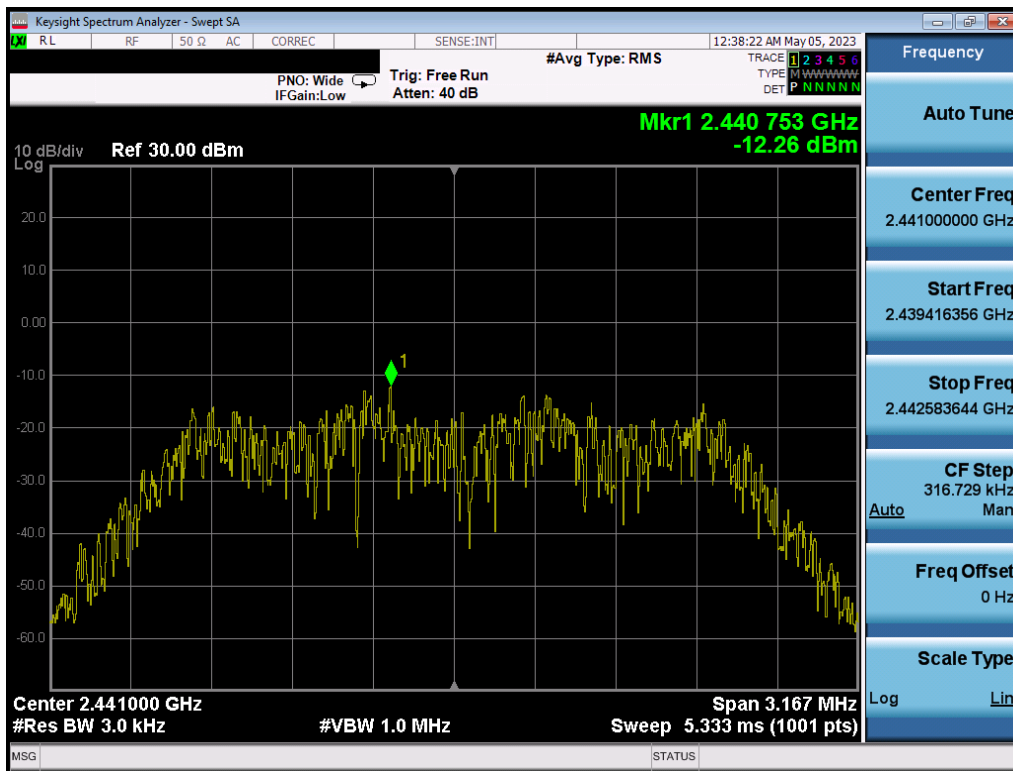


Plot 7-50. Power Spectral Density Plot TxBF Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 53 of 124

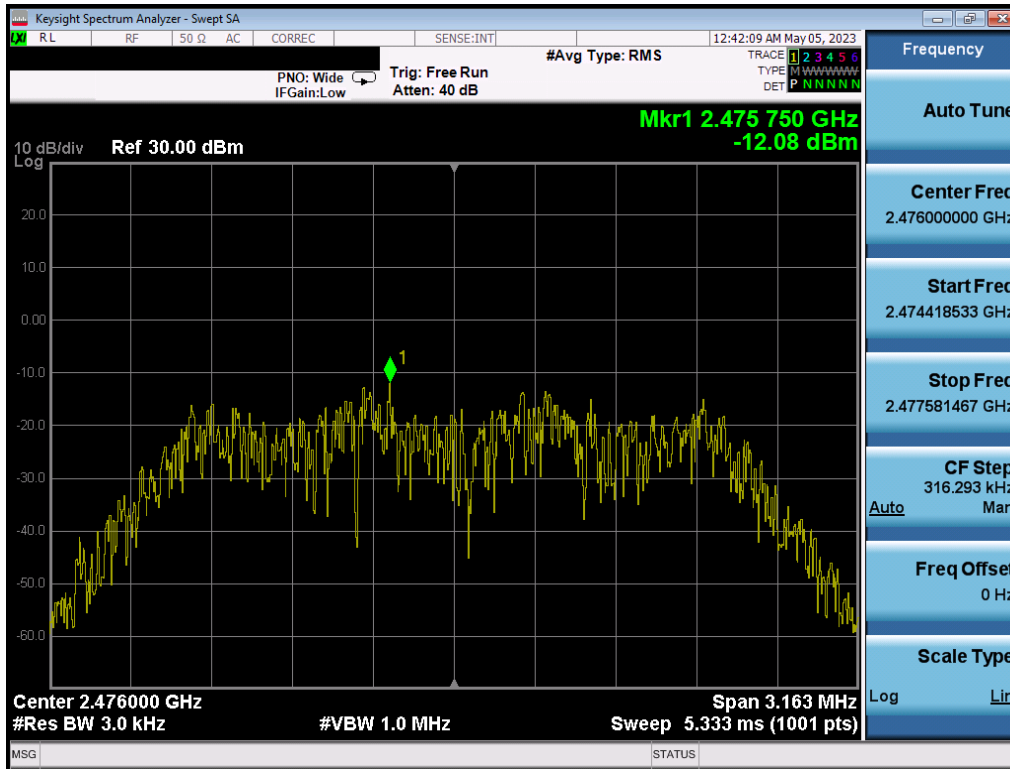


Plot 7-51. Power Spectral Density Plot Tx BF Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

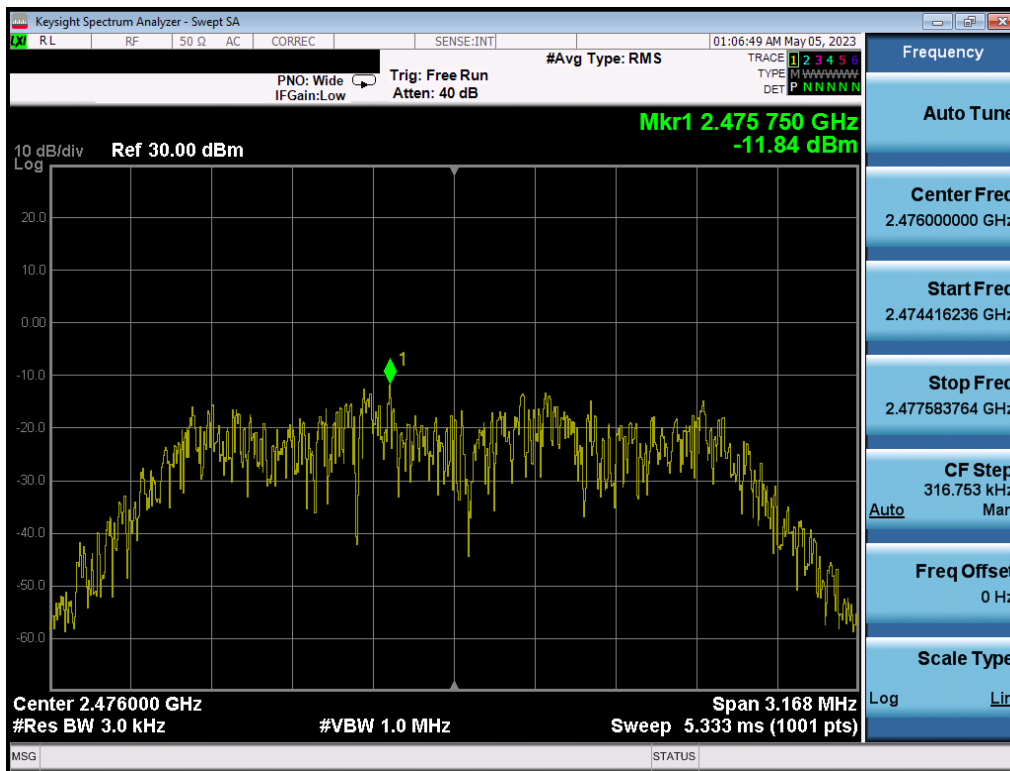


Plot 7-52. Power Spectral Density Plot Tx BF Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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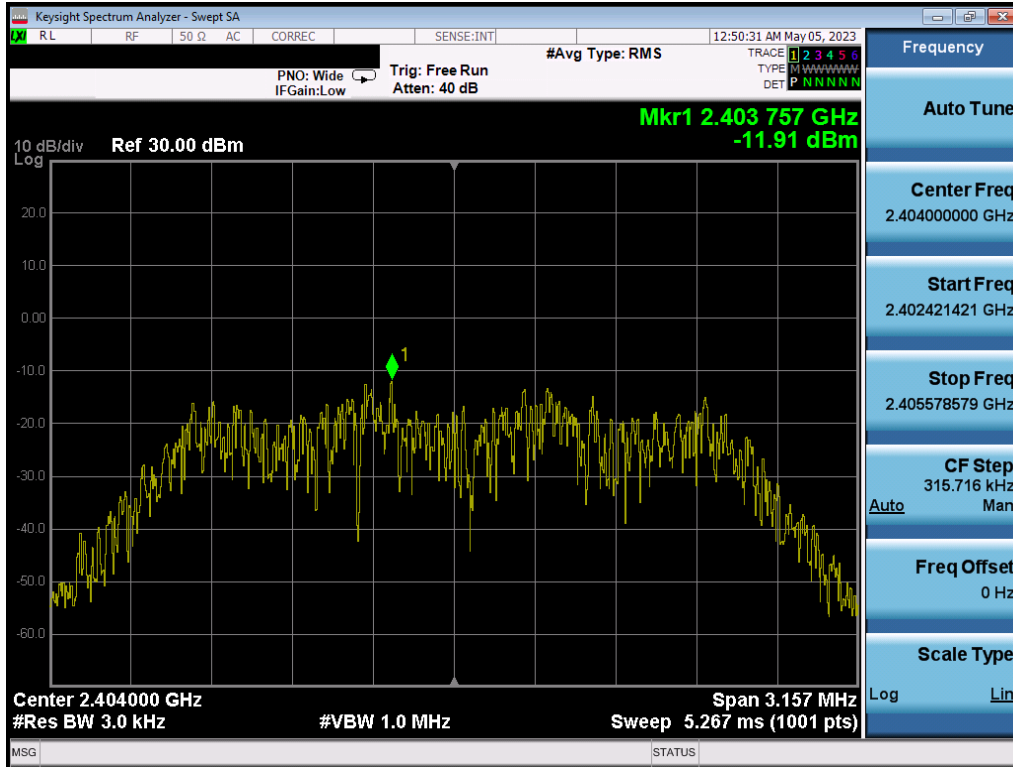


Plot 7-53. Power Spectral Density Plot Tx BF Ant1 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

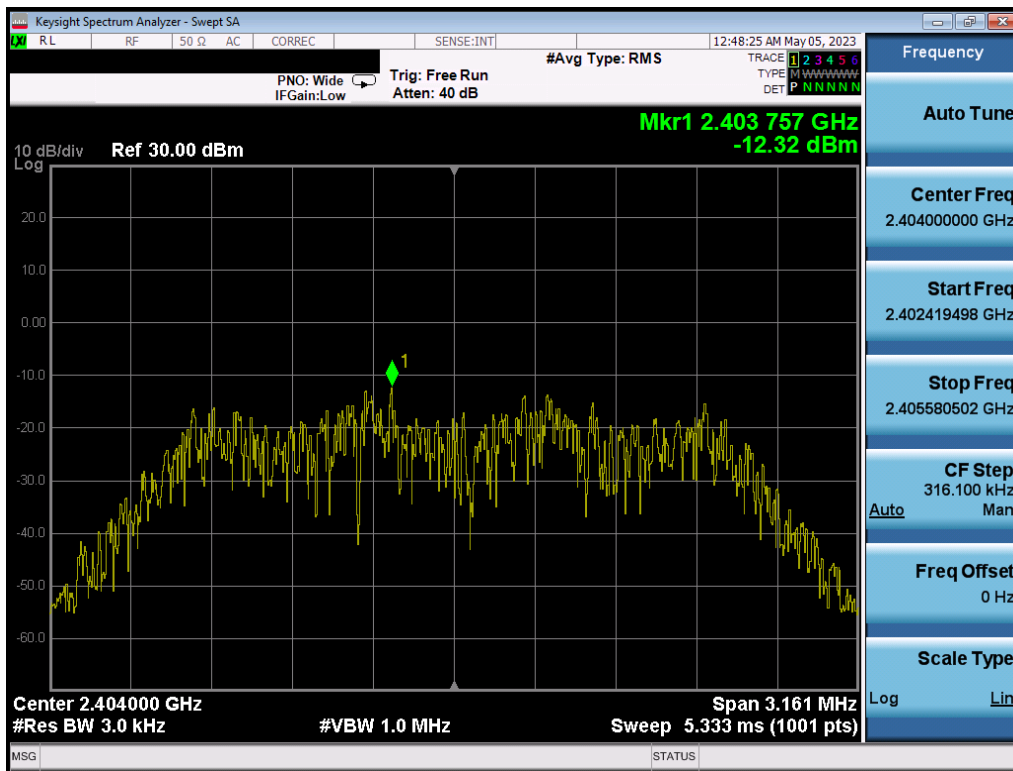


Plot 7-54. Power Spectral Density Plot Tx BF Ant2 (Bluetooth (HDR4), 4Mbps, ePA – Ch. 73)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 55 of 124



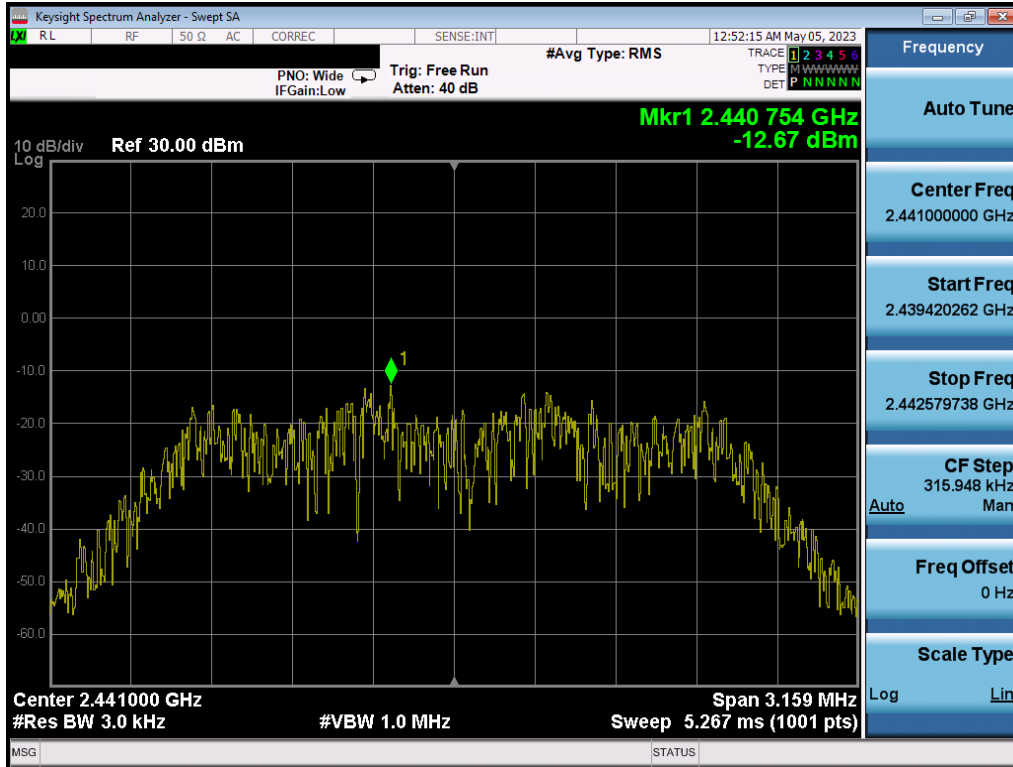
Plot 7-55. Power Spectral Density Plot TxBF Ant1 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)



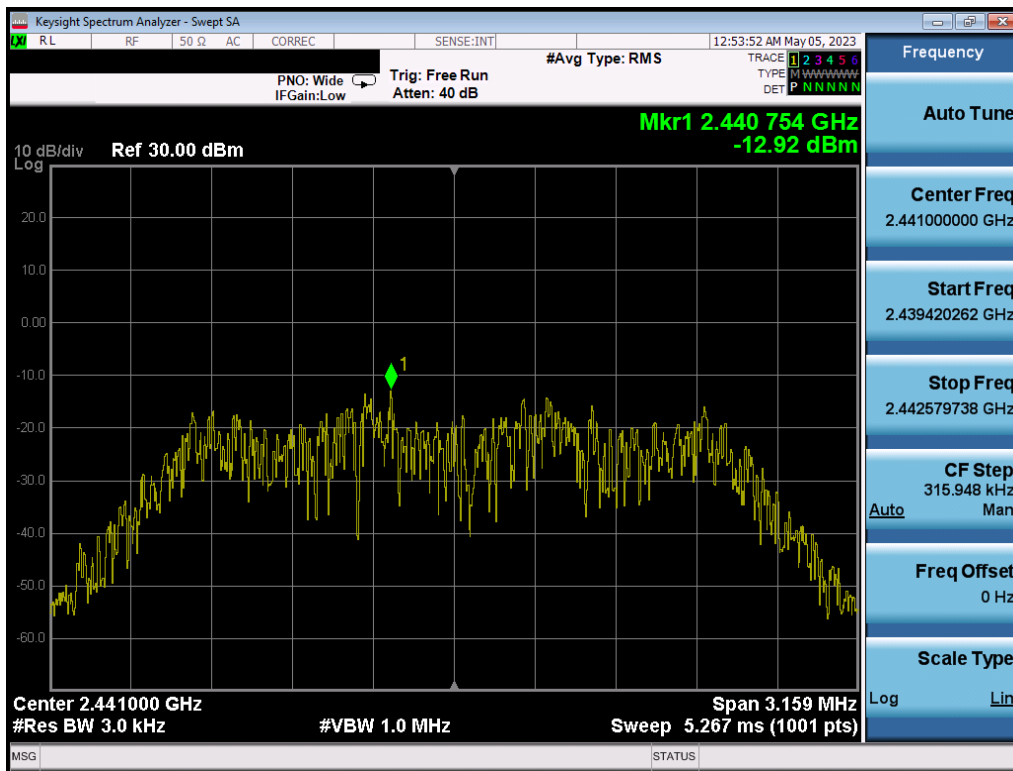
Plot 7-56. Power Spectral Density Plot TxBF Ant2 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 1)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-57. Power Spectral Density Plot TxBF Ant1 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)



Plot 7-58. Power Spectral Density Plot TxBF Ant2 (Bluetooth (HDR4), 4Mbps, iPA – Ch. 38)

FCC ID: BCGA2117 IC: 579C-A2117		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2302130007-03.BCG	Test Dates: 2/10/2023 - 5/5/2023	EUT Type: Head Mounted Device	Page 57 of 124