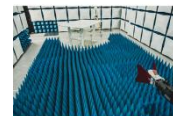




Element Washington DC LLC
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
<http://www.element.com>



DATA REFERENCE REPORT FCC PART 15.407 Narrowband UNII HDR

Applicant Name:

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

Date of Testing:

05/30/2022 - 9/13/2022

Test Site/Location:

Element Washington DC LLC, Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090026-16.BCG

FCC ID:

BCGA2761

APPLICANT:

Apple Inc.

Reference Model:

A2435

Variant Model:

A2761(A2762)

EUT Type:

Tablet Device

Frequency Range:

5162 – 5245MHz, 5733 – 5844MHz

Type of Modulation:

$\pi/4$ -DQPSK

FCC Classification:

Unlicensed National Information Infrastructure (UNII)

FCC Rule Part(s):

Part 15 Subpart E (15.407)

Test Procedure(s):

ANSI C63.10-2013, KDB 789033 D02 v02r01

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 789033 D02 v02r01. 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



FCC ID: BCGA2761	DATA REFERENCE REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 1 of 8

V 1.0 3/13/2021

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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two tablet models, A2435 and A2761 (A2762), with high degree of similarity, reference model FCC ID: BCGA2761 and variant model FCC ID: BCGA2761. The reference models support mmWave operations, while the variant models have the mmWave components/antennas removed. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC/ISED approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2435 / IC: 579C-A2435, while radiated and conducted spot-check verification has been performed on variant model **FCC ID: BCGA2761 / IC: 579C-A2761**. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

Equipment Class	Reference Model FCC ID	Reference Report	Report Title
NII	BCGA2435	1C2205090025-17.BCG	RF NB UNII HDR Test Report

Table 1-1. Reference Model Details

Spot-check verification are not applicable to this test report; therefore, all data for variant model FCC ID: BCGA2435 can be fully referenced from the reference model.

Reference model FCC ID: BCGA2435 test report has been included in Appendix A.

1.2 Element Washington DC LLC Test Location

These measurement tests were conducted at the Element Washington DC LLC 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

- Element Washinton DC LLC 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 Washington DC LLC facility is a registered (22831) test laboratory with the site description on file with ISED.

FCC ID: BCGA2761		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 3 of 8

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2761**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

- This Narrowband UNII module has been by manufacturer and the following were confirmed:
 - A) The hopping sequence is pseudorandom
 - B) 79 channels can be used at a time for hopping
 - C) The receiver input bandwidth equals the transmit bandwidth
 - D) The receiver hops in sequence with the transmit signal
 - E) Narrowband UNII can only hop within the same UNII band and cannot hop between bands

Test Device Serial No.: W7NCJD7FYQ, MN2XHWC32M, NHDWQV19RP

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, 802.11a/ax WIFI 6E, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT, NB UNII (1x, HDR4, HDR8)

Band 1	Band 3
Frequency (MHz)	Frequency (MHz)
5162	5733
:	:
5204	5789
:	:
5245	5844

Table 2-1. NB UNII HDR 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 U-NII Band 1 & U-NII Band 3. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of KDB 789033 D02 v02r01 and ANSI C63.10-2013. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

FCC ID: BCGA2761		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 4 of 8

Measured Duty Cycles		
Mode	Frequency (MHz)	Duty Cycle [%]
HDR4	5162 - 5245	100.0
	5733 - 5844	100.0
HDR8	5162 - 5245	100.0
	5733 - 5844	100.0

Table 2-2. Measured Duty Cycles

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	WiFi 2.4GHz	Bluetooth	NB UNII	WiFi 5GHz	WiFi 6GHz	LTE / FR1 NR
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	BDR, HDR4/8	802.11 a/n/ac/ax	802.11 a/ax	Ultra High Band
2a	Config 1	✓	✗	✗	✗	✗	✓
2a	Config 2	✗	✓	✗	✗	✗	✓
4a	Config 3	✓	✗	✓	✗	✗	✗
4a	Config 4	✗	✓	✗	✓	✗	✗

Table 2-3. Simultaneous Transmission Configurations

✓ = Support; ✗ = Not Support

Note:

All above simultaneous transmission configurations have been tested and the worst case configuration was found to be configuration 2 (BT and LTE) and reported in RF Bluetooth and RF Part 96 test reports.

Wi-Fi 2.4GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. For BT (2.4 GHz) in connected mode and Wi-Fi (2.4 GHz) – Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power. For BT (2.4 GHz) in disconnected mode and Wi-Fi (2.4 GHz) – BT will be using iPA only and Wi-Fi max power will not exceed minimum of (SAR max cap, Reg max cap) power.

FCC ID: BCGA2761	 DATA REFERENCE REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 5 of 8

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2.3 Antenna Description

Following antenna gain provided by manufacturer was used for testing.

Frequency [MHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4a
5162 – 5245	3.7	2.4
5733 – 5844	4.0	0.3

Table 2-4. Highest Antenna Gain

FCC ID: BCGA2761	 DATA REFERENCE REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 6 of 8

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3.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2761** is in tolerance with reference model FCC ID: BCGA2435 per FCC Approved Data Referencing Test Plan.

FCC ID: BCGA2761		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 7 of 8

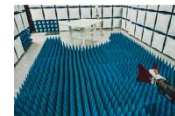
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4.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2205090025-17.BCG) from reference model FCC ID: BCGA2435 / IC: 579C-A2435, which includes referenced data results.

FCC ID: BCGA2761		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090026-16.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 8 of 8



MEASUREMENT REPORT

FCC PART 15.407 Narrowband UNII HDR

Applicant Name:

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

Date of Testing:

05/30/2022 - 9/13/2022

Test Site/Location:

Element Washington DC LLC, Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090025-17.BCG

FCC ID:

BCGA2435

APPLICANT:

Apple Inc.

Application Type:

Certification

Model/HVIN:

A2435

EUT Type:

Tablet Device

Frequency Range:

5162 – 5245MHz, 5733 – 5844MHz

Modulation Type:

$\pi/4$ DQPSK

FCC Classification:

Unlicensed National Information Infrastructure (UNII)

FCC Rule Part(s):

Part 15 Subpart E (15.407)

Test Procedure(s):

ANSI C63.10-2013, KDB 789033 D02 v02r01

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 789033 D02 v02r01. 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



FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 1 of 136

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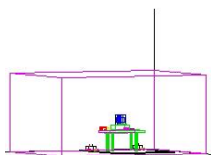
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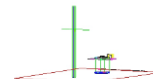
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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MEASUREMENT REPORT



UNII Band	Tx Frequency (MHz)	Mode	Power Scheme	SISO				TxBF					
				Antenna 5b		Antenna 4a		Antenna 5b		Antenna 4a		Summed	
				Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
1	5162 - 5245	HDR4	ePA	15.668	11.95	11.220	10.50	7.568	8.79	7.447	8.72	15.031	11.77
		HDR8	ePA	15.849	12.00	10.940	10.39	7.925	8.99	7.745	8.89	15.668	11.95
		HDR4	iPA	0.484	-3.15	0.630	-2.01	0.498	-3.03	0.583	-2.34	1.081	0.34
		HDR8	iPA	0.472	-3.26	0.631	-2.00	0.499	-3.02	0.607	-2.17	1.107	0.44
3	5733 - 5844	HDR4	ePA	24.491	13.89	11.092	10.45	24.266	13.85	10.814	10.34	35.075	15.45
		HDR8	ePA	22.909	13.60	10.495	10.21	23.878	13.78	10.351	10.15	34.198	15.34
		HDR4	iPA	0.697	-1.57	0.938	-0.28	0.685	-1.64	0.962	-0.17	1.648	2.17
		HDR8	iPA	0.708	-1.50	0.989	-0.05	0.708	-1.50	0.933	-0.30	1.641	2.15

FCC EUT Overview

FCC ID: BCGA2435			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device		Page 3 of 136

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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 Washington DC LLC Test Location

These measurement tests were conducted at the Element Washington DC LLC 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 Washington DC LLC located in Morgan Hill, CA 95037, 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 2041.02 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 Washington DC LLC facility is a registered (22831) test laboratory with the site description on file with ISED.

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 4 of 136

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2435**. The test data contained in this report pertains only to the emissions due to the EUT's Narrowband UNII transmitter.

- This Narrowband UNII module has been tested by manufacturer and the following were confirmed:
 - A) The hopping sequence is pseudorandom
 - B) 79 channels can be used at a time for hopping
 - C) The receiver input bandwidth equals the transmit bandwidth
 - D) The receiver hops in sequence with the transmit signal
 - E) Narrowband UNII can only hop within the same UNII band and cannot hop between bands

Test Device Serial No.: Q994673JFG, N6FT9Q03C0, JCF2GYG9FN, DLX218300CD1JXQ1C

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1/FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, 802.11a/ax WIFI 6E, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT, NB UNII (1x, HDR4, HDR8).

Band 1	Band 3
Frequency (MHz)	Frequency (MHz)
5162	5733
:	:
5204	5789
:	:
5245	5844

Table 2-1. NB UNII HDR Frequency of Operations

Notes:

This device is capable of operating in hopping and non-hopping mode. The EUT can hop between 79 different channels in the U-NII Band 1 & U-NII Band 3. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section B)2)b) of KDB 789033 D02 v02r01 and ANSI C63.10-2013. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 5 of 136

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Measured Duty Cycles		
Mode	Frequency (MHz)	Duty Cycle [%]
HDR4	5162 - 5245	100.0
	5733 - 5844	100.0
HDR8	5162 - 5245	100.0
	5733 - 5844	100.0

Table 2-2. Measured Duty Cycles

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	WiFi 2.4GHz	Bluetooth	NB UNII	WiFi 5GHz	WiFi 6GHz	LTE / FR1 NR
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	BDR, HDR4/8	802.11 a/n/ac/ax	802.11 a/ax	Ultra High Band
2a	Config 1	✓	✗	✗	✗	✗	✓
2a	Config 2	✗	✓	✗	✗	✗	✓
4a	Config 3	✓	✗	✓	✗	✗	✗
4a	Config 4	✗	✓	✗	✓	✗	✗

Table 2-3. Simultaneous Transmission Configurations

✓ = Support; ✗ = Not Support

Note:

All above simultaneous transmission configurations have been tested and the worst case configuration was found to be configuration 2 (BT and LTE) and reported in RF Bluetooth and RF Part 96 test reports.

Wi-Fi 2.4GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. For BT (2.4 GHz) in connected mode and Wi-Fi (2.4 GHz) – Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power. For BT (2.4 GHz) in disconnected mode and Wi-Fi (2.4 GHz) – BT will be using iPA only and Wi-Fi max power will not exceed minimum of (SAR max cap, Reg max cap) power.

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 6 of 136

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2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [MHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4a
5162 – 5245	3.7	2.4
5733 – 5844	4.0	0.3

Table 2-4. Highest Antenna Gain

See Appendix A for full antenna specs sheet.

2.4 Test Support Equipment

1	Apple MacBook Pro w/AC/DC Adapter	Model: A2141 Model: A2166	S/N: C02DV7VKMD6T S/N: N/A
2	Apple USB-C Cable	Model: Spartan	S/N: 000MKTR02U
3	USB-C Cable w/ AC Adapter	Model: A246 Model: A2305	S/N: N/A S/N: N/A
4	Apple Pencil	Model: N/A	S/N: GQXGSXBJKM9
5	DC Power Supply	Model: KPS3010D	S/N: N/A

Table 2-5. Test Support Equipment List

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 789033 D02 v02r01. 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, and 7.5 for antenna port conducted emissions test setups.

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, the following configuration were investigated,

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

2.6 Software and Firmware

The test was conducted with firmware version 20A8359 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 789033 D02 v02r01 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 65-6. 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 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 ground plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

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

Line conducted emissions test results are shown in Section 7.8. 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 used 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 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.

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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 Number
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	6/10/2022	Annual	6/10/2023	MY49430244
Agilent Technologies	N9020A	MXA Signal Analyzer	4/26/2022	Annual	4/26/2023	MY56470202
Anritsu	ML2496A	Power Meter	11/29/2021	Annual	11/29/2022	1840005
Anritsu	MA2411B	Pulse Power Sensor	11/30/2021	Annual	11/30/2022	1726261
Anritsu	MA2411B	Pulse Power Sensor	11/30/2021	Annual	11/30/2022	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	1/19/2022	Annual	1/19/2023	T058701-02
Com-Power Corporation	LIN-120A	Line Impedance Stabilization Network (LISN)	3/7/2022	Annual	3/7/2023	241296
ETS-Lindgren	3142E	Biconilog Antenna (26-6000MHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Horn Antenna (1-18GHz)	10/25/2021	Annual	10/25/2022	227597
Keysight Technology	N9040B	UXA Signal Analyzer	2/8/2022	Annual	2/8/2023	MY57212015
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz-6GHz)	1/6/2022	Annual	1/6/2023	102328
Rohde & Schwarz	ESW26	EMI Test Receiver	5/19/2022	Annual	5/19/2023	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/4/2022	Annual	3/4/2023	101619
Rohde & Schwarz	FSVA3044	Signal Analyzer (up to 44 GHz)	5/12/2022	Annual	5/12/2023	101098
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/3/2022	Annual	4/3/2023	100546
Rohde & Schwarz	TC-TA18	Cross-Polarized Antenna 400MHz-18GHz	1/25/2022	Annual	1/25/2023	101063
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz-18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz-40GHz)	4/18/2022	Annual	4/18/2023	100050

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: BCGA2435

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407	26dB Bandwidth	N/A	CONDUCTED	N/A	Section 7.2
15.407(e)	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
2.1049	Occupied Bandwidth	N/A		N/A	Section 7.2, 7.3
15.407 (a.1.iv), (a.3)	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a)		PASS	Section 7.4
15.407 (a.1.iv), (a.3)	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a)		PASS	Section 7.5
15.407(b.1), (4)	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b)	RADIATED	PASS	Section 7.6
15.205, 15.407(b.1), (4)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS	Section 7.6, 7.7
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	AC LINE CONDUCTED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

1. All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4. For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element “UNII Automation,” Version 7.0.
5. For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element “Chamber Automation,” Version 1.3.2.

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7.2 26dB & 99% Bandwidth Measurement – HDR

§2.1049; §15.407

Test Overview and Limit

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

The 26dB bandwidth is used to determine the conducted power limits.

Test Procedure Used

ANSI C63.10-2013 – Subclause 12.4

KDB 789033 D02 v02r01 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 26$. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. $VBW \geq 3 \times RBW$
4. Detector = Peak
5. Trace mode = max hold

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 antenna configurations and power schemes were investigated and only the worst case is reported.

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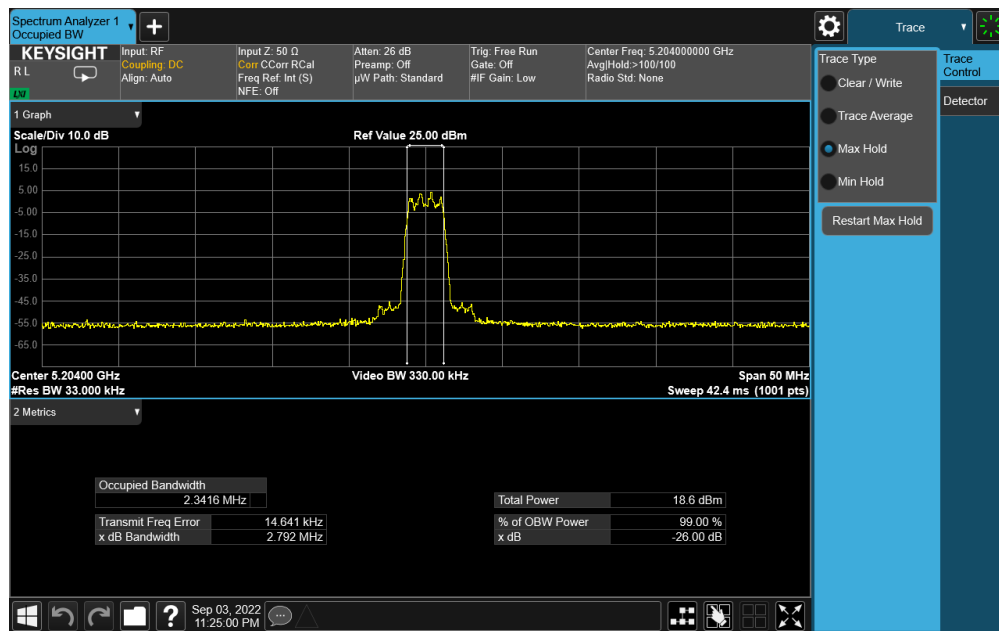
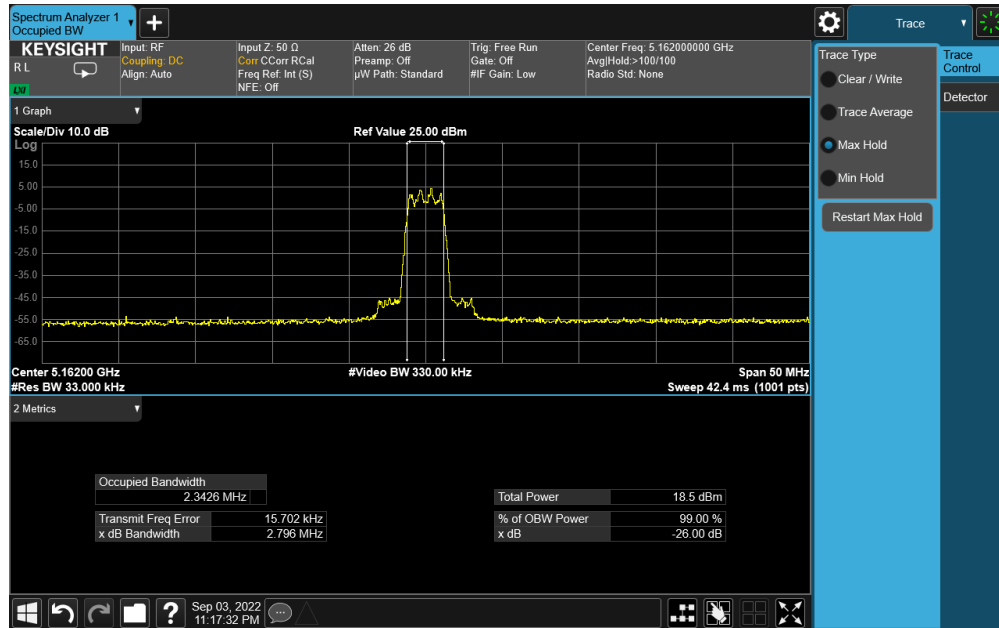
7.2.1 Antenna 5b 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	HDR4	ePA	2.343	2.796
	5204	HDR4	ePA	2.342	2.792
	5245	HDR4	ePA	2.339	2.791
	5162	HDR8	ePA	4.874	5.763
	5204	HDR8	ePA	4.873	5.760
	5245	HDR8	ePA	4.873	5.751

Table 7-2. Conducted BW Measurements Antenna 5b

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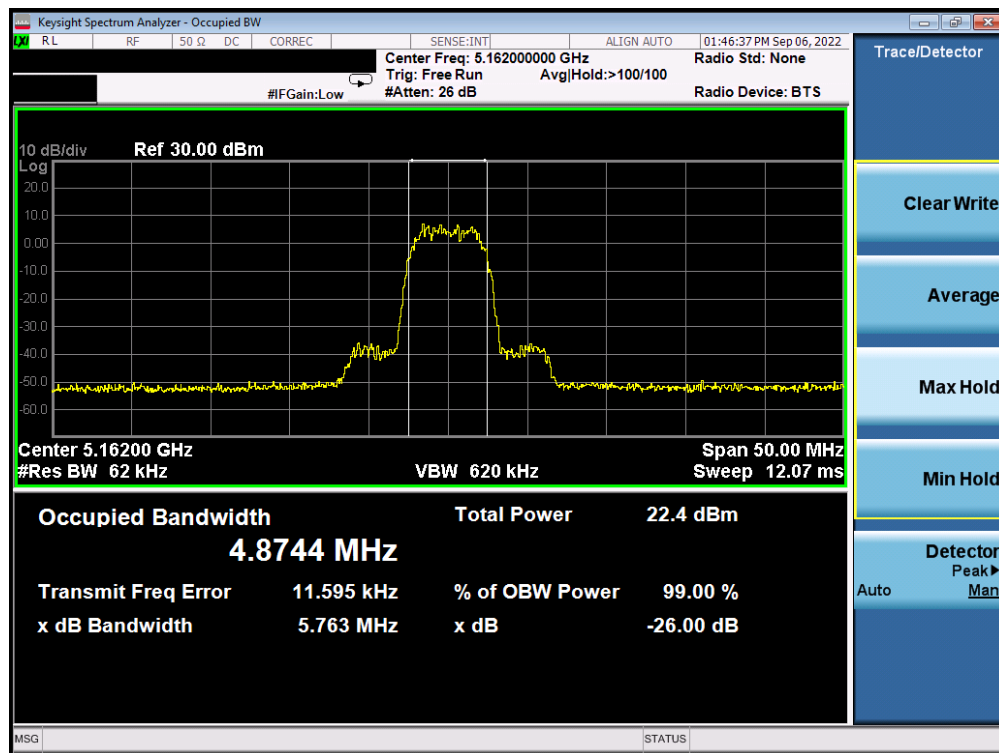
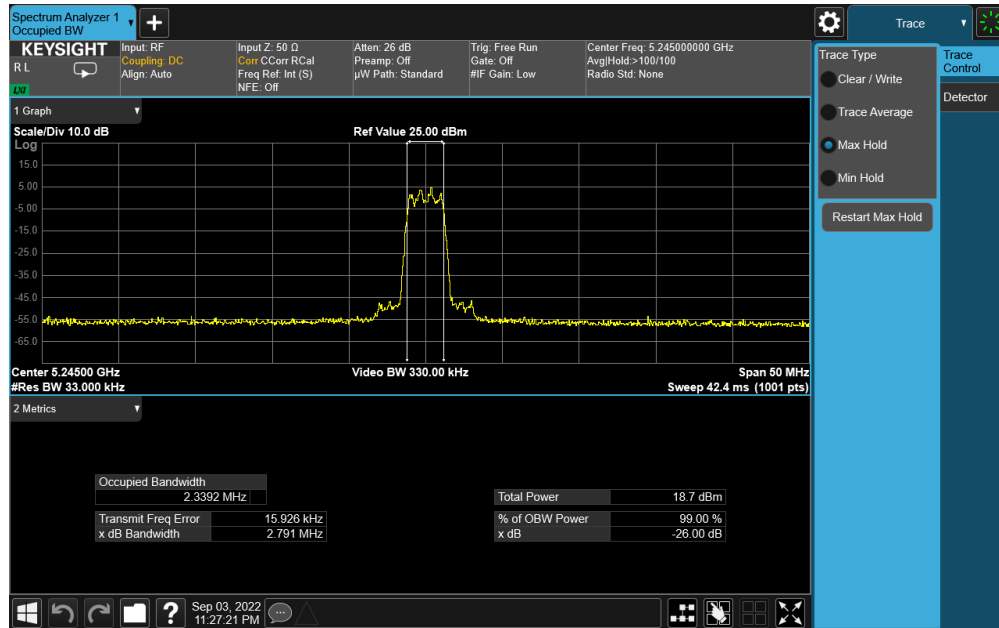
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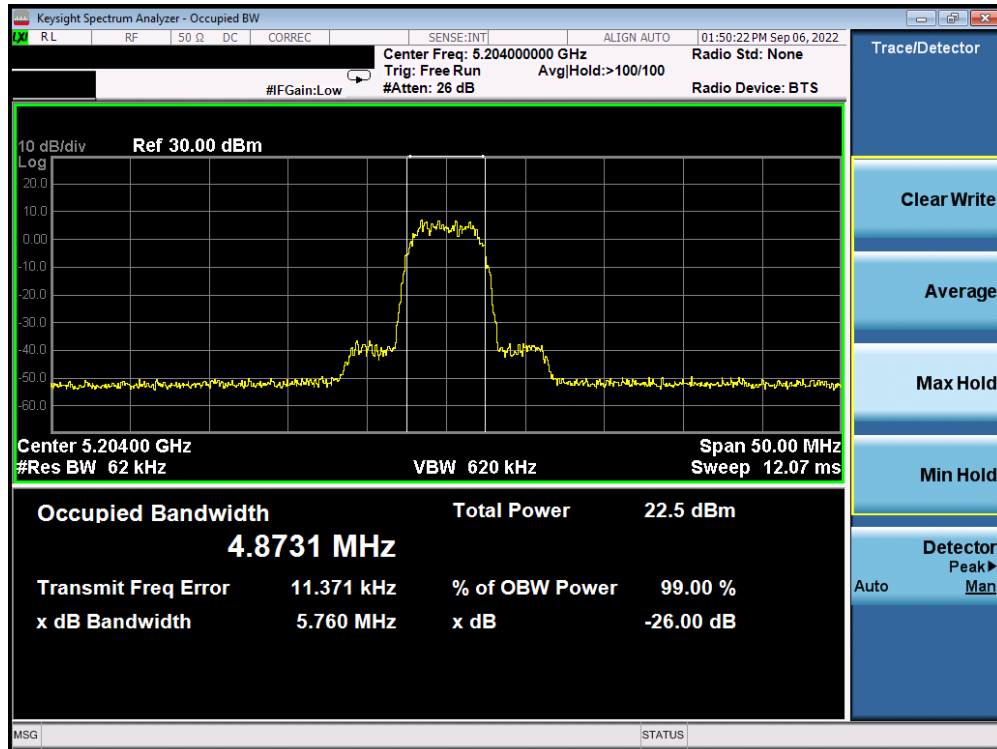
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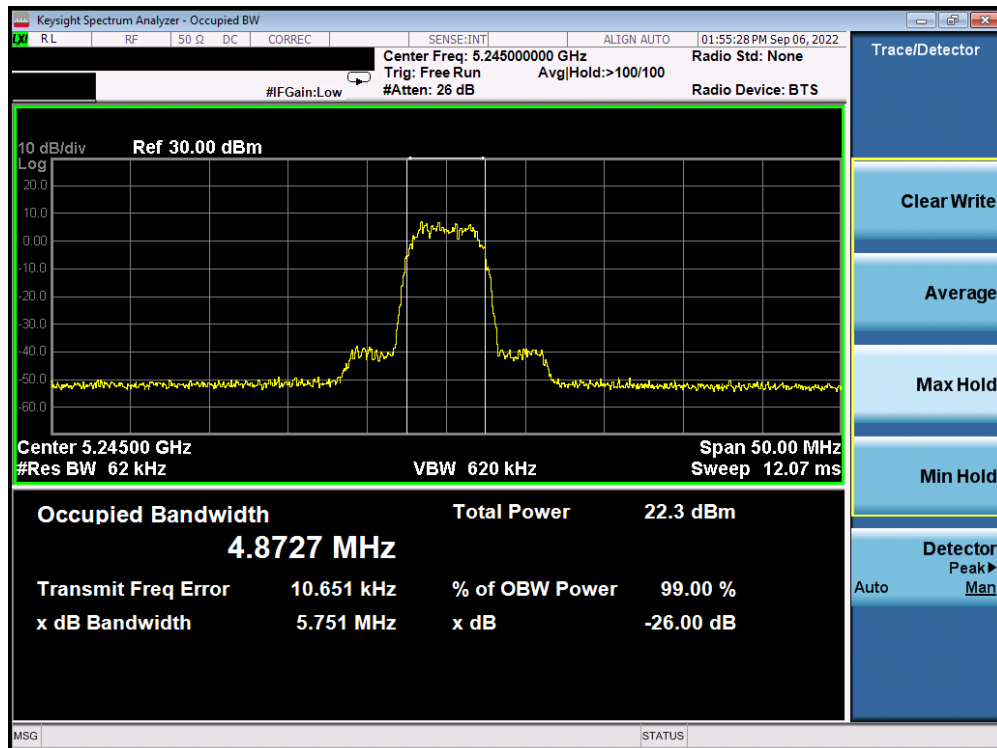
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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Plot 7-5. 26dB BW & 99% OBW Antenna 5b (HDR8, ePA, 5204MHz)



Plot 7-6. 26dB BW & 99% OBW Antenna 5b (HDR8, ePA, 5245MHz)

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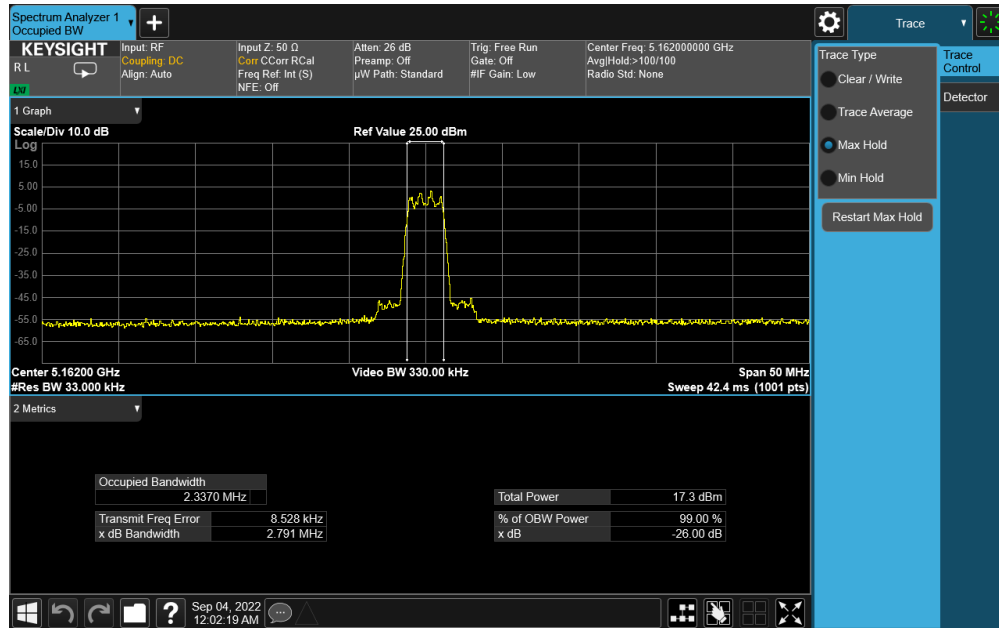
7.2.2 Antenna 4a 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Mode	Power Cheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	HDR4	ePA	2.337	2.791
	5204	HDR4	ePA	2.337	2.787
	5245	HDR4	ePA	2.336	2.790
	5162	HDR8	ePA	4.884	5.776
	5204	HDR8	ePA	4.884	5.771
	5245	HDR8	ePA	4.883	5.770

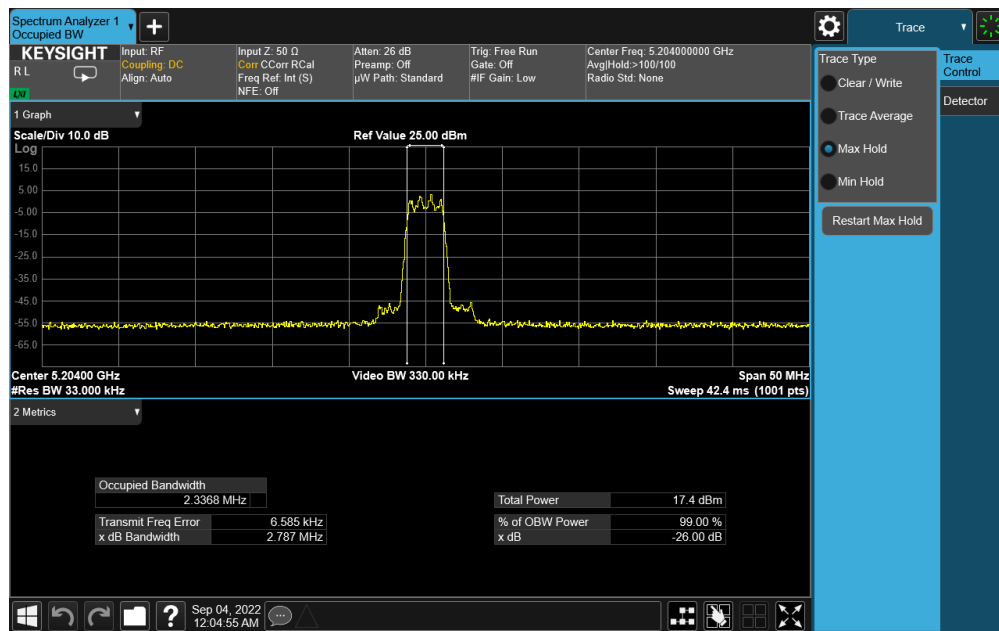
Table 7-3. Conducted BW Measurements Antenna 4a

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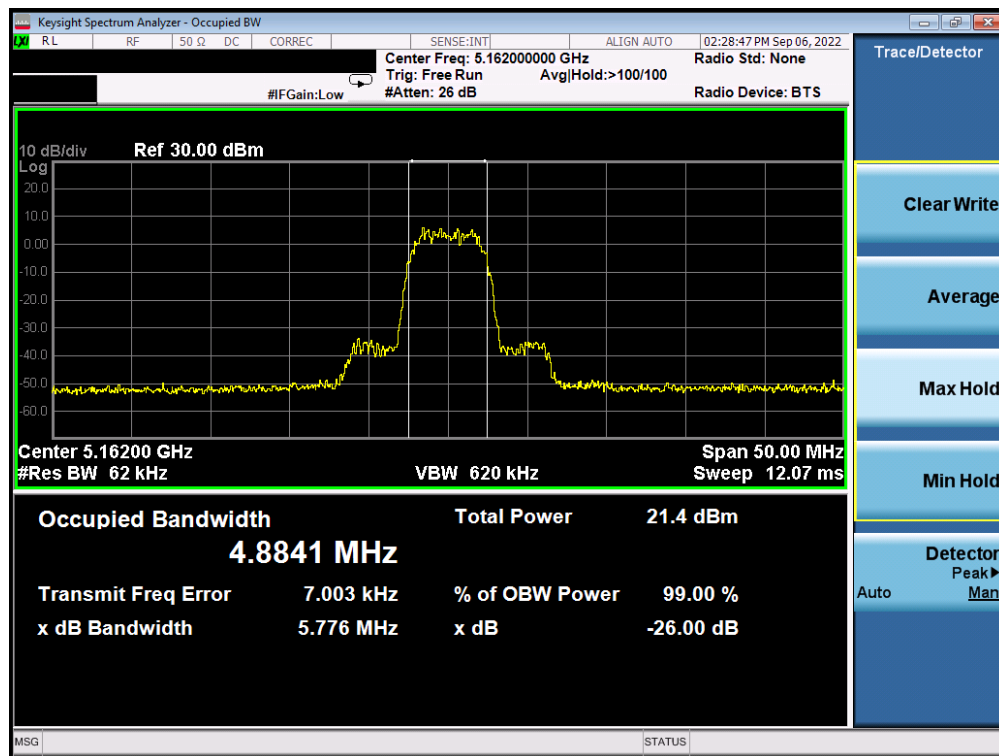
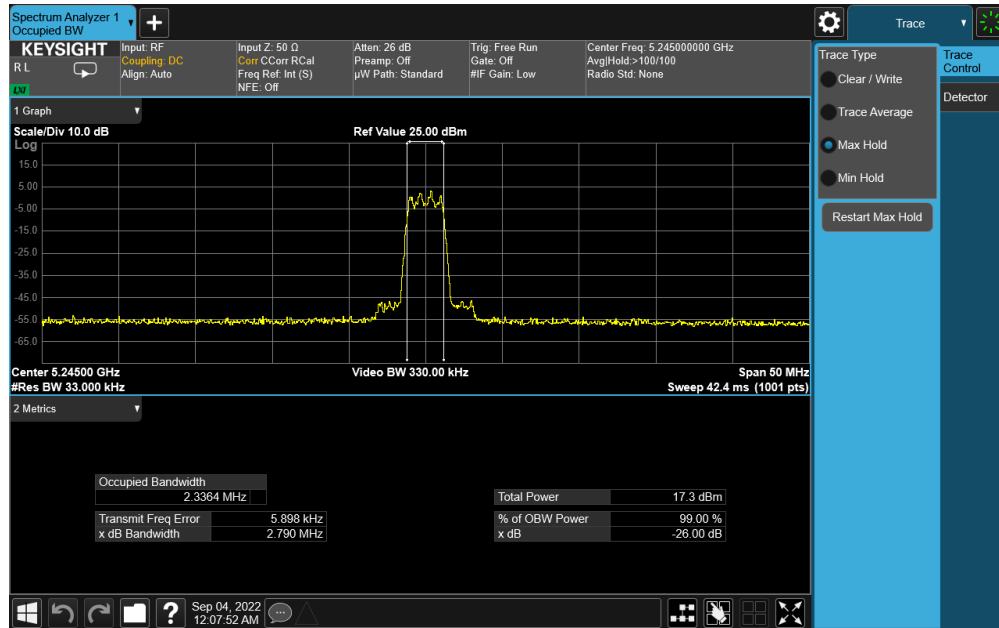


Plot 7-7. 26dB BW & 99% OBW Antenna 4a (HDR4, ePA, 5162MHz)

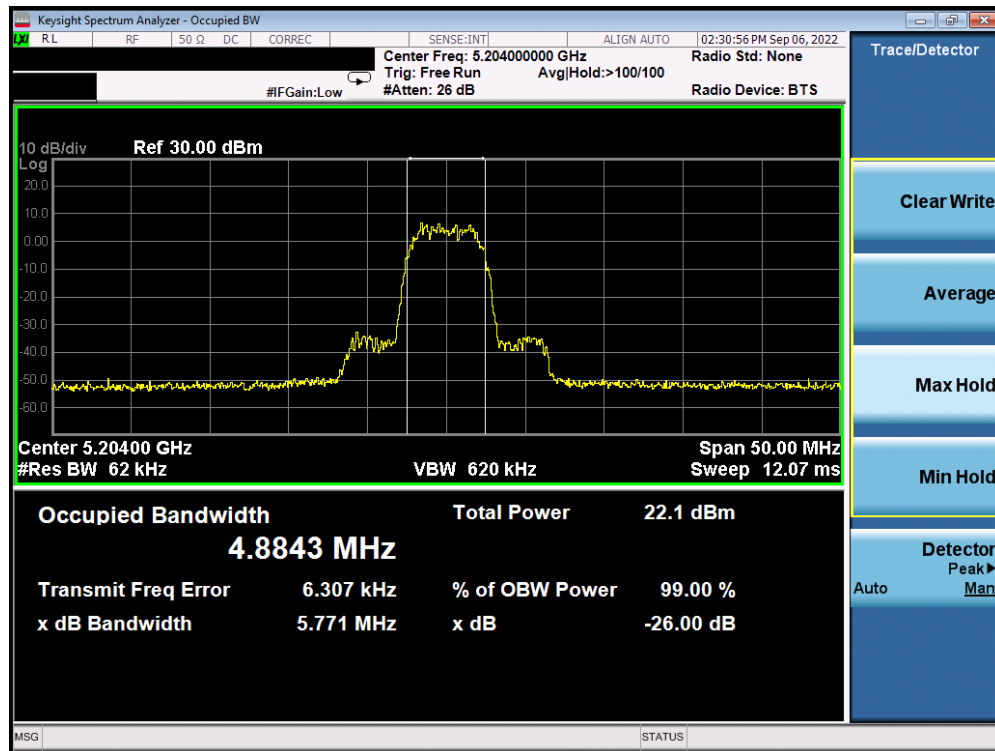


Plot 7-8. 26dB BW & 99% OBW Antenna 4a (HDR4, ePA, 5204MHz)

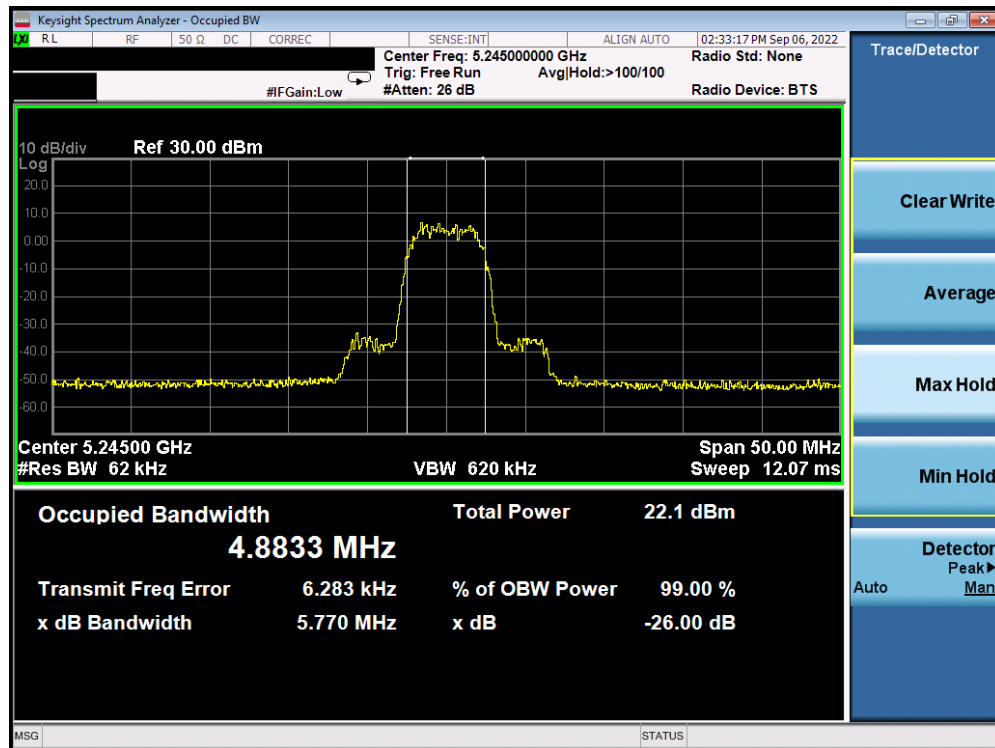
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Plot 7-11. 26dB BW & 99% OBW Antenna 4a (HDR8, ePA, 5204MHz)



Plot 7-12. 26dB BW & 99% OBW Antenna 4a (HDR8, ePA, 5245MHz)

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7.3 6dB & 99% Bandwidth Measurement – HDR

§2.1049; §15.407 (e)

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 antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 6dB bandwidth.

In the 5.725 – 5.850GHz band, the 6dB bandwidth must be ≥ 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Subclause 6.9.2
KDB 789033 D02 v02r01 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 6$. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100 kHz
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

Test Setup

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



Figure 7-2. Test Instrument & Measurement Setup

Test Notes

All antenna configurations and power schemes were investigated and only the worst case is reported.

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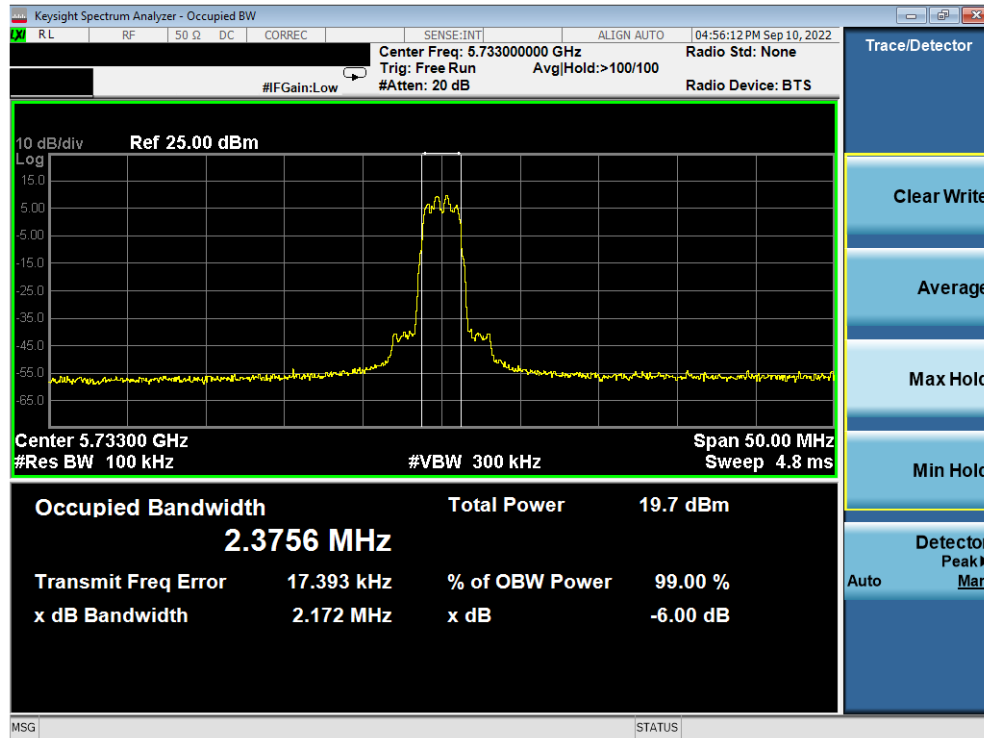
7.3.1 Antenna 5b 6dB & 99% Bandwidth Measurements

	Frequency [MHz]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	HDR4	ePA	2.376	2.172	0.50	Pass
	5789	HDR4	ePA	2.376	2.175	0.50	Pass
	5844	HDR4	ePA	2.377	2.164	0.50	Pass
	5733	HDR8	ePA	4.873	4.220	0.50	Pass
	5789	HDR8	ePA	4.872	4.221	0.50	Pass
	5844	HDR8	ePA	4.871	4.209	0.50	Pass

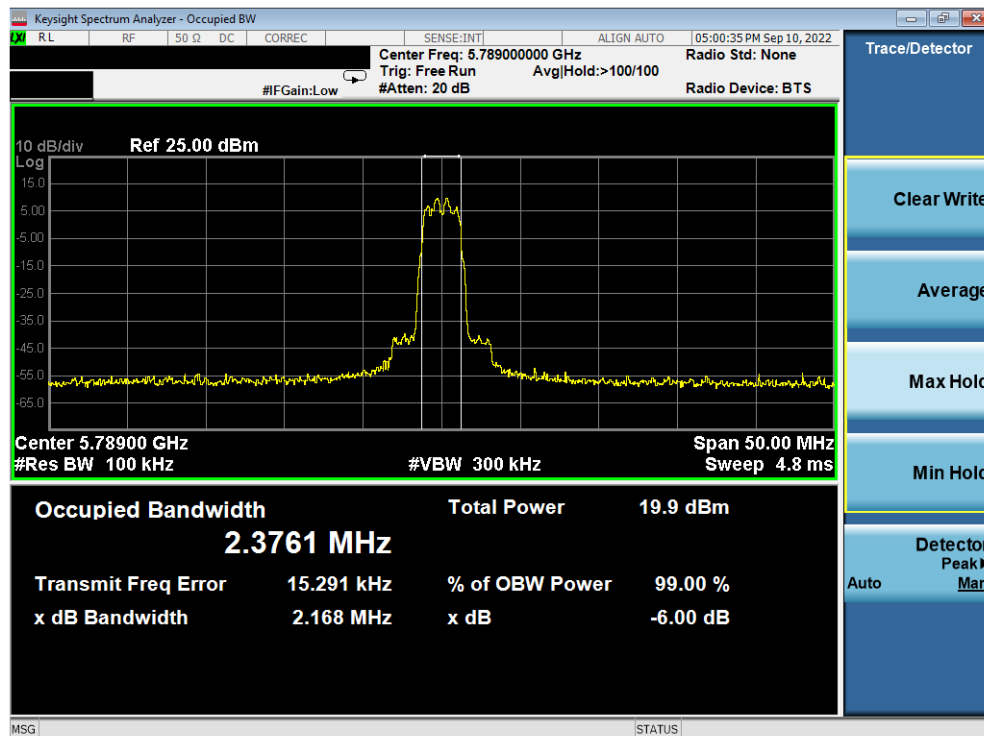
Table 7-4. Conducted BW Measurements

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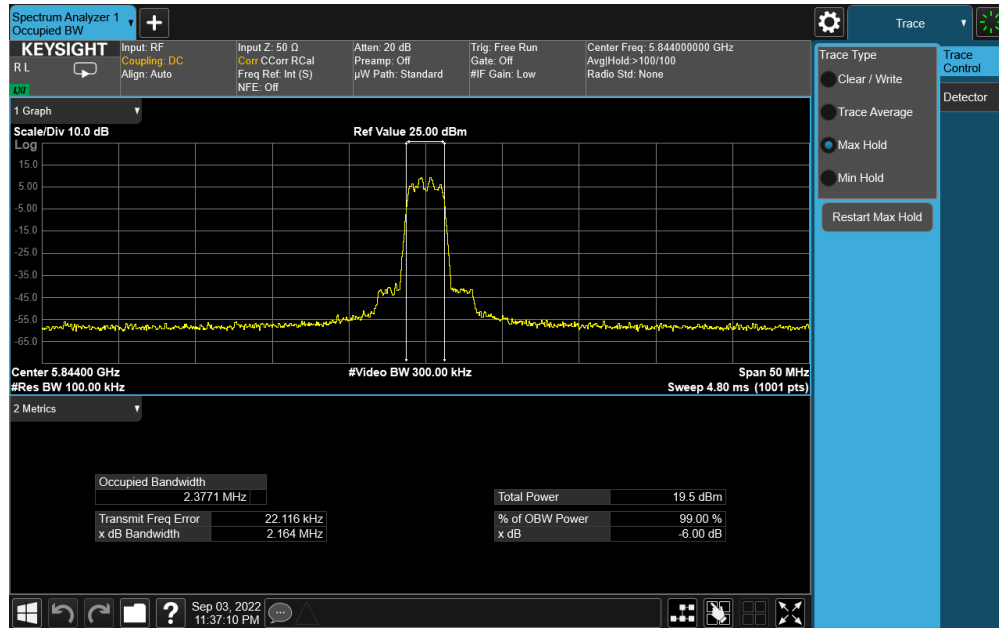


Plot 7-13. 6dB BW & 99% OBW Antenna 5b (HDR4, ePA, 5733MHz)

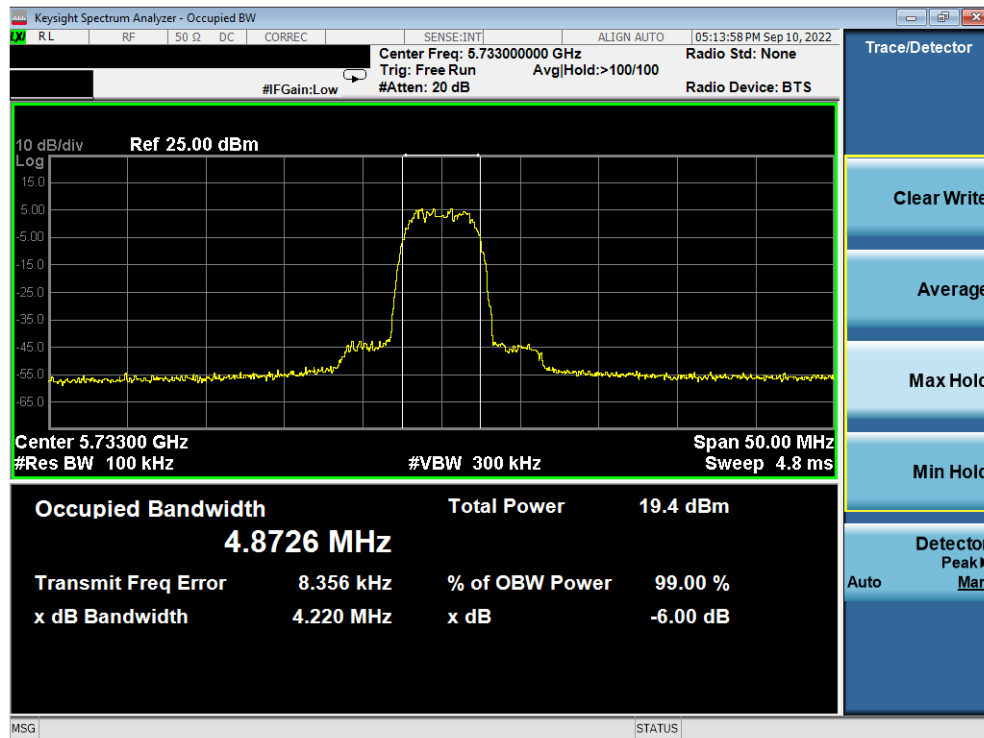


Plot 7-14. 6dB BW & 99% OBW Antenna 5b (HDR4, ePA, 5789MHz)

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Plot 7-15. 6dB BW & 99% OBW Antenna 5b (HDR4, ePA, 5844MHz)

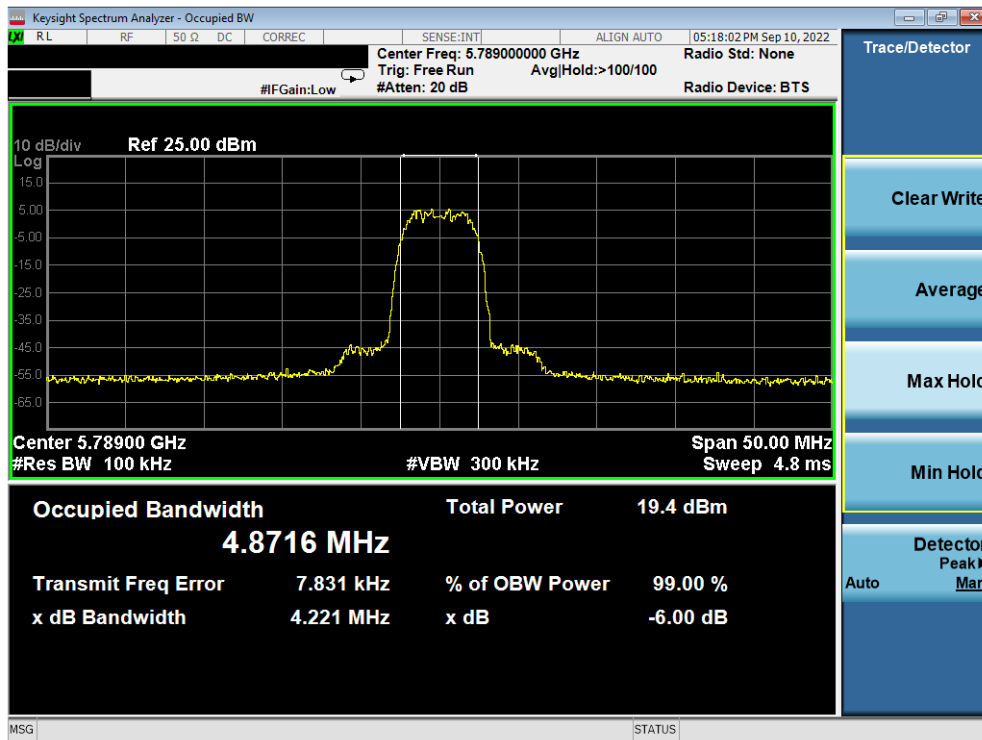


Plot 7-16. 6dB BW & 99% OBW Antenna 5b (HDR8, ePA, 5733MHz)

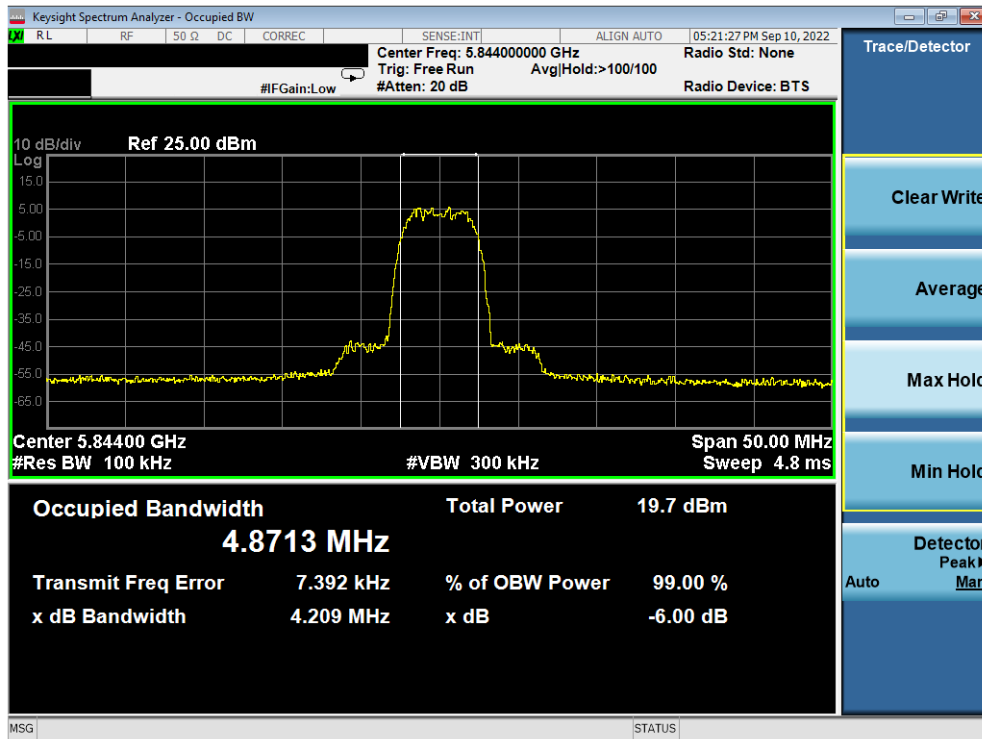
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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Plot 7-17. 6dB BW & 99% OBW Antenna 5b (HDR8, ePA, 5789MHz)



Plot 7-18. 6dB BW & 99% OBW Antenna 5b (HDR8, ePA, 5844MHz)

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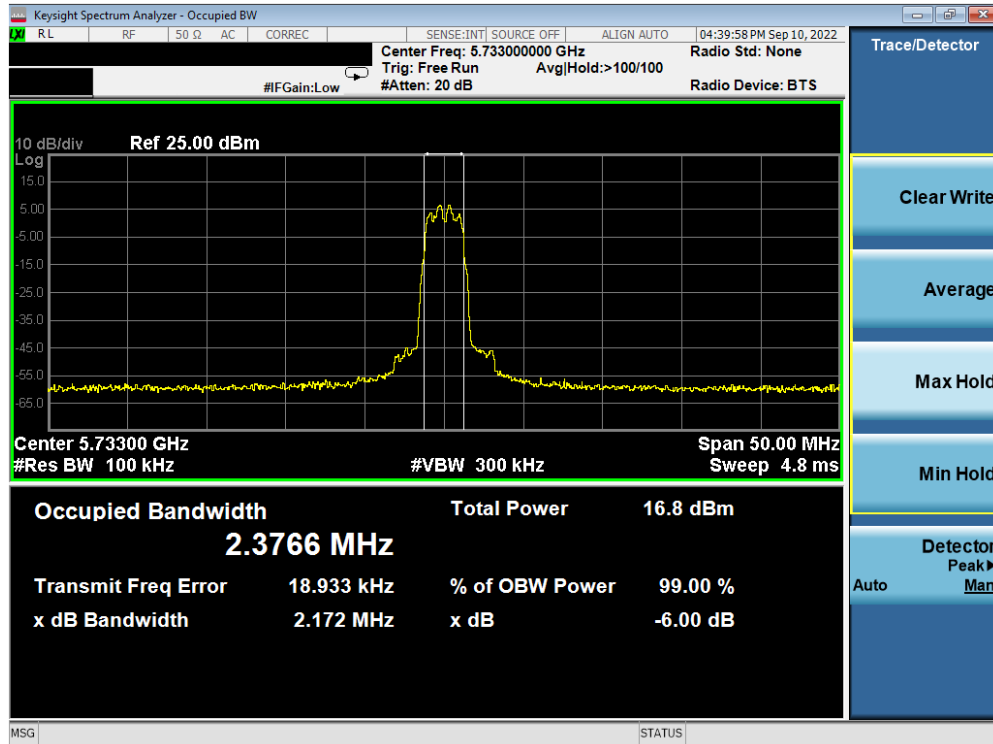
7.3.2 Antenna 4a 6dB & 99% Bandwidth Measurements

	Frequency [MHz]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	HDR4	ePA	2.377	2.172	0.50	Pass
	5789	HDR4	ePA	2.377	2.174	0.50	Pass
	5844	HDR4	ePA	2.376	2.164	0.50	Pass
	5745	HDR8	ePA	4.873	4.214	0.50	Pass
	5785	HDR8	ePA	4.875	4.212	0.50	Pass
	5825	HDR8	ePA	4.868	4.219	0.50	Pass

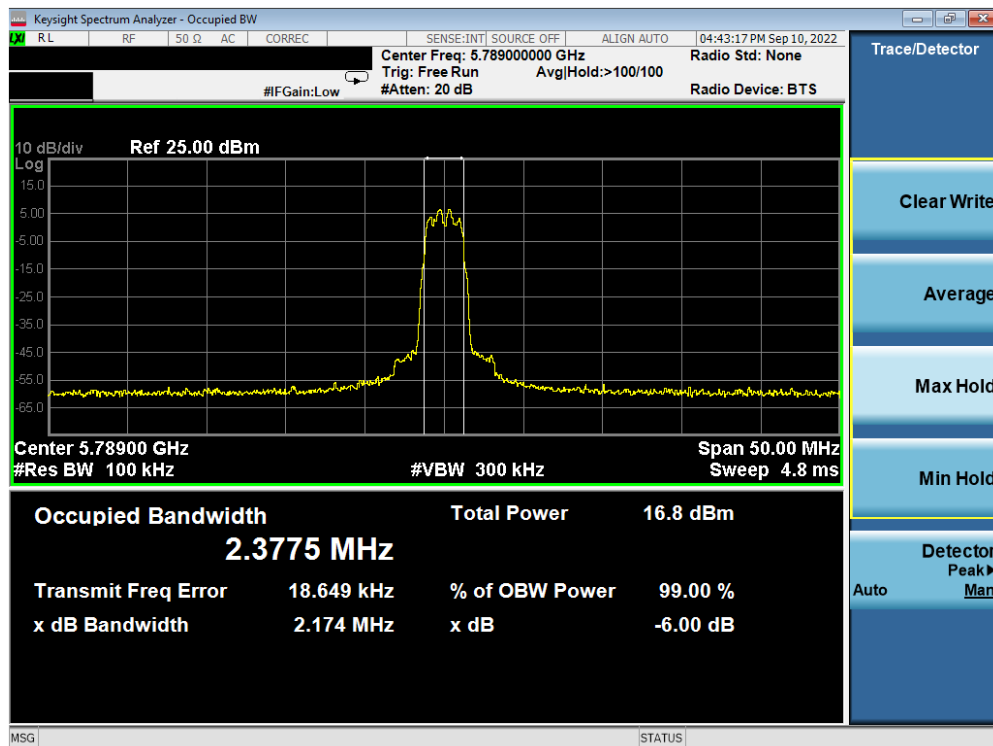
Table 7-5. Conducted BW Measurements

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Plot 7-19. 6dB BW & 99% OBW Antenna 4a (HDR4, ePA, 5733MHz)

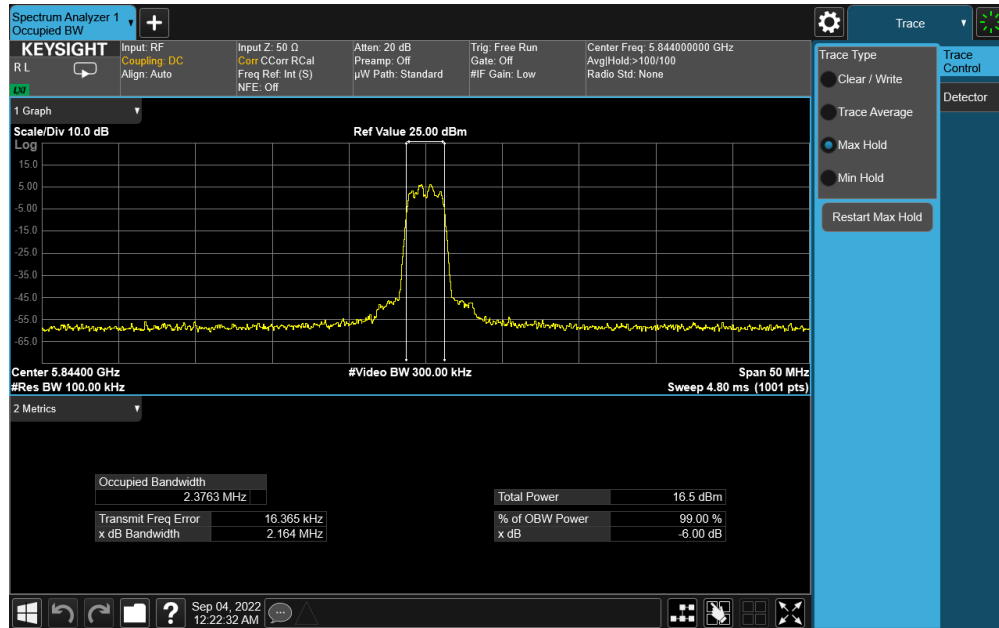


Plot 7-20. 6dB BW & 99% OBW Antenna 4a (HDR4, ePA, 5789MHz)

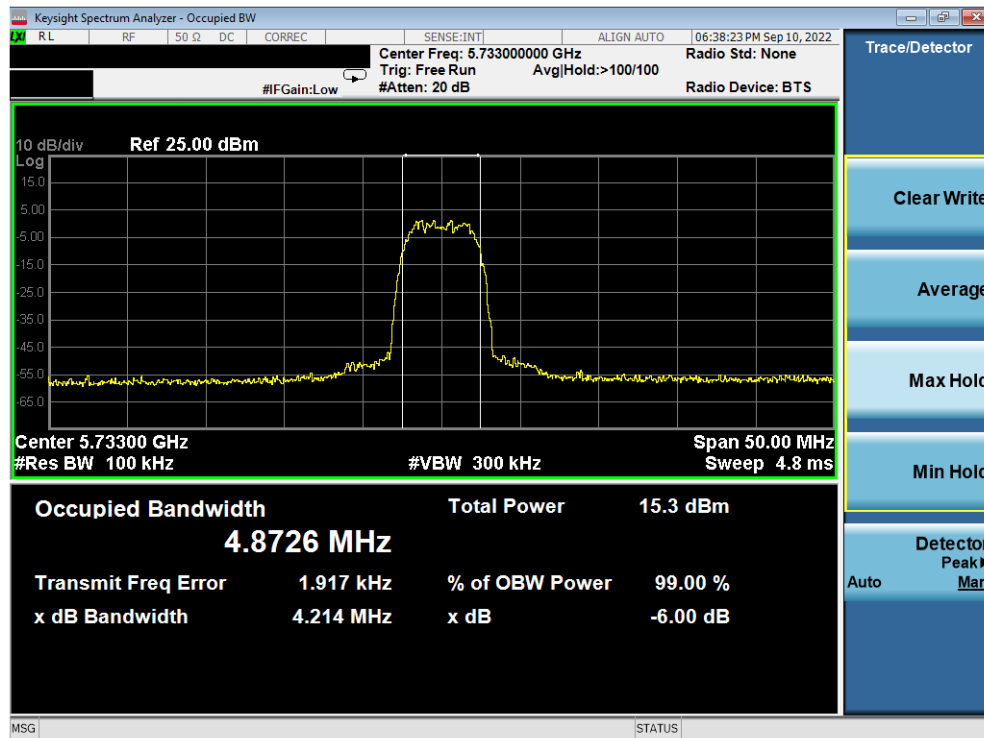
FCC ID: BCGA2435			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-21. 6dB BW & 99% OBW Antenna 4a (HDR4, ePA, 5844MHz)

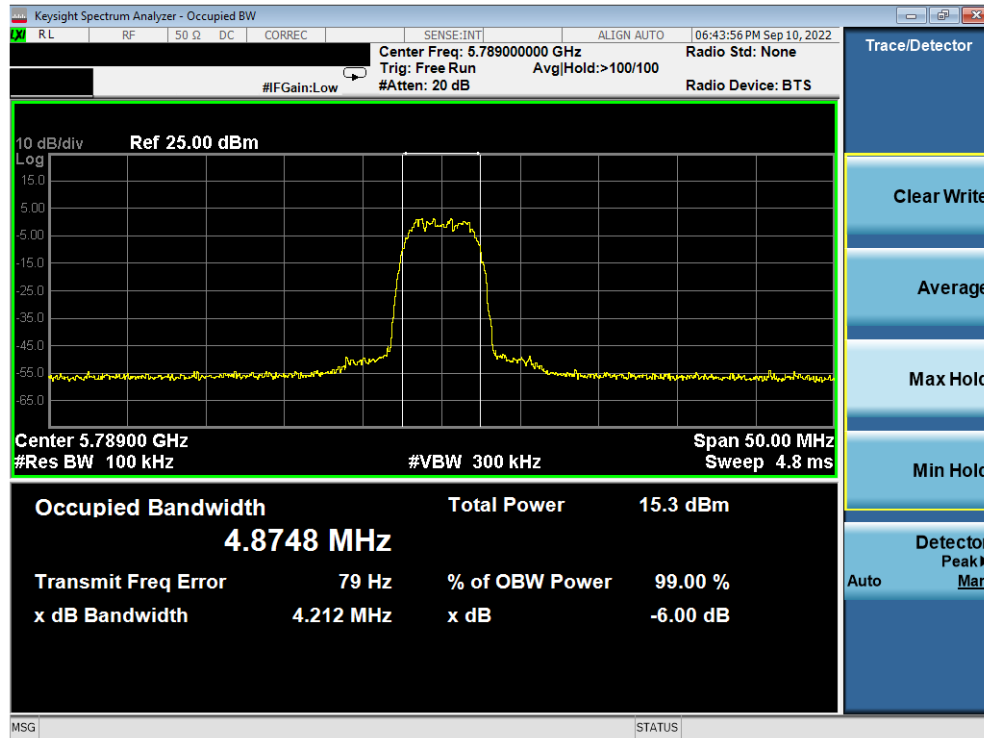


Plot 7-22. 6dB BW & 99% OBW Antenna 4a (HDR8, ePA, 5733MHz)

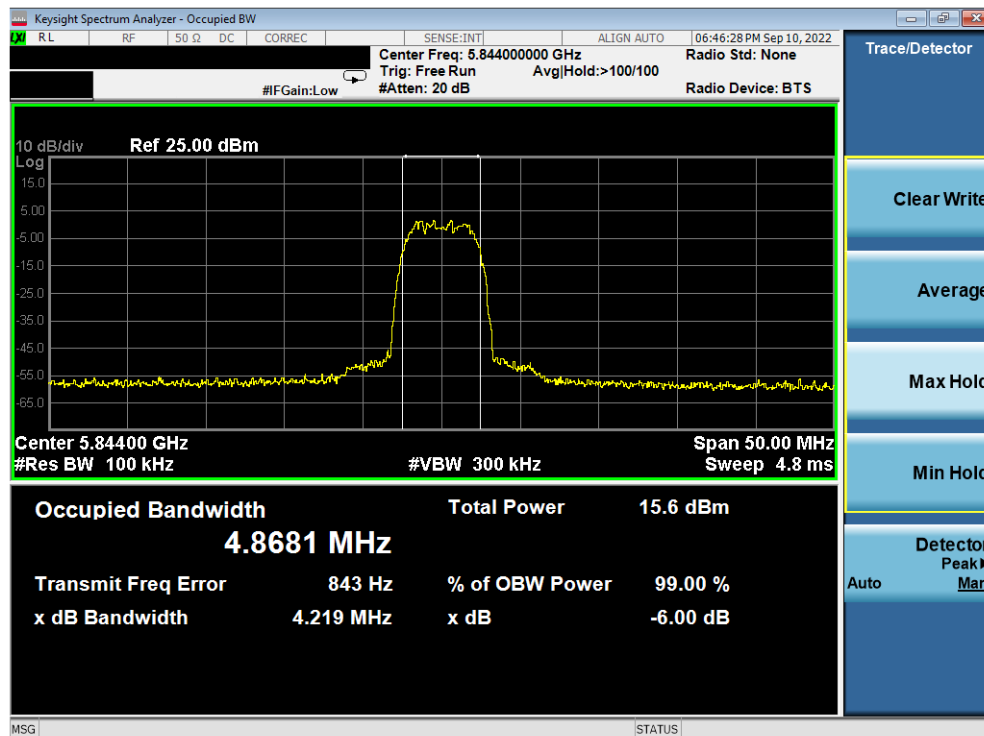
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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Plot 7-23. 6dB BW & 99% OBW Antenna 4a (HDR8, ePA, 5789MHz)



Plot 7-24. 6dB BW & 99% OBW Antenna 4a (HDR8, ePA, 5844MHz)

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7.4 Conducted Output Power – HDR

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3)

Test Overview and Limits

A transmitter antenna terminal of the EUT is connected to the input of an RF pulse power sensor. Measurement is made using a broadband average power meter while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. B is the 26dB BW per FCC 15.407.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm).

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm).

Test Procedure Used

ANSI C63.10-2013 – Subclause 12.3.3.2 Method PM-G
KDB 789033 D02 v02r01 – Section E)3)b) Method PM-G

Test Settings

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 7-3. Test Instrument & Measurement Setup

Test Notes

None

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7.4.1 Antenna 5b Conducted Output Power Measurements

Freq [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	HDR4	ePA	11.73	23.98	-12.25
5204	AVG	HDR4	ePA	11.95	23.98	-12.03
5245	AVG	HDR4	ePA	11.70	23.98	-12.28
5162	AVG	HDR4	iPA	-3.23	23.98	-27.21
5204	AVG	HDR4	iPA	-3.15	23.98	-27.13
5245	AVG	HDR4	iPA	-3.38	23.98	-27.36
5162	AVG	HDR8	ePA	12.00	23.98	-11.98
5204	AVG	HDR8	ePA	11.99	23.98	-11.99
5245	AVG	HDR8	ePA	11.97	23.98	-12.01
5162	AVG	HDR8	iPA	-3.38	23.98	-27.36
5204	AVG	HDR8	iPA	-3.28	23.98	-27.26
5245	AVG	HDR8	iPA	-3.26	23.98	-27.24
5733	AVG	HDR4	ePA	13.89	30.00	-16.11
5789	AVG	HDR4	ePA	13.85	30.00	-16.15
5844	AVG	HDR4	ePA	13.47	30.00	-16.53
5733	AVG	HDR4	iPA	-1.69	30.00	-31.69
5789	AVG	HDR4	iPA	-1.61	30.00	-31.61
5844	AVG	HDR4	iPA	-1.57	30.00	-31.57
5733	AVG	HDR8	ePA	13.60	30.00	-16.40
5789	AVG	HDR8	ePA	13.56	30.00	-16.44
5844	AVG	HDR8	ePA	13.52	30.00	-16.48
5733	AVG	HDR8	iPA	-1.65	30.00	-31.65
5789	AVG	HDR8	iPA	-1.50	30.00	-31.50
5844	AVG	HDR8	iPA	-1.51	30.00	-31.51

Table 7-6. FCC Antenna 5b Maximum Conducted Output Power

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.4.2 Antenna 4a Conducted Output Power Measurements

Freq [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	HDR4	ePA	10.15	23.98	-13.83
5204	AVG	HDR4	ePA	10.28	23.98	-13.70
5245	AVG	HDR4	ePA	10.50	23.98	-13.48
5162	AVG	HDR4	iPA	-2.01	23.98	-25.99
5204	AVG	HDR4	iPA	-2.04	23.98	-26.02
5245	AVG	HDR4	iPA	-2.15	23.98	-26.13
5162	AVG	HDR8	ePA	10.21	23.98	-13.77
5204	AVG	HDR8	ePA	10.39	23.98	-13.59
5245	AVG	HDR8	ePA	10.29	23.98	-13.69
5162	AVG	HDR8	iPA	-2.02	23.98	-26.00
5204	AVG	HDR8	iPA	-2.08	23.98	-26.06
5245	AVG	HDR8	iPA	-2.00	23.98	-25.98
5733	AVG	HDR4	ePA	10.31	30.00	-19.69
5789	AVG	HDR4	ePA	10.22	30.00	-19.78
5844	AVG	HDR4	ePA	10.45	30.00	-19.55
5733	AVG	HDR4	iPA	-0.28	30.00	-30.28
5789	AVG	HDR4	iPA	-0.43	30.00	-30.43
5844	AVG	HDR4	iPA	-0.36	30.00	-30.36
5733	AVG	HDR8	ePA	10.21	30.00	-19.79
5789	AVG	HDR8	ePA	10.12	30.00	-19.88
5844	AVG	HDR8	ePA	10.06	30.00	-19.94
5733	AVG	HDR8	iPA	-0.16	30.00	-30.16
5789	AVG	HDR8	iPA	-0.20	30.00	-30.20
5844	AVG	HDR8	iPA	-0.05	30.00	-30.05

Table 7-7. FCC Antenna 4a Maximum Conducted Output Power

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7.4.3 TxBF Conducted Output Power Measurements

Freq [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
				Antenna 5b	Antenna 4a	Summed		
5162	AVG	HDR4	ePA	8.61	8.88	11.76	23.98	-12.22
5204	AVG	HDR4	ePA	8.53	8.96	11.76	23.98	-12.22
5245	AVG	HDR4	ePA	8.79	8.72	11.77	23.98	-12.21
5162	AVG	HDR4	iPA	-3.03	-2.34	0.34	23.98	-23.64
5204	AVG	HDR4	iPA	-3.32	-2.22	0.28	23.98	-23.70
5245	AVG	HDR4	iPA	-3.39	-2.45	0.12	23.98	-23.86
5162	AVG	HDR8	ePA	8.89	8.76	11.84	23.98	-12.14
5204	AVG	HDR8	ePA	8.99	8.89	11.95	23.98	-12.03
5245	AVG	HDR8	ePA	8.59	8.51	11.56	23.98	-12.42
5162	AVG	HDR8	iPA	-3.00	-2.26	0.40	23.98	-23.58
5204	AVG	HDR8	iPA	-3.02	-2.17	0.44	23.98	-23.54
5245	AVG	HDR8	iPA	-3.26	-2.38	0.21	23.98	-23.77
5733	AVG	HDR4	ePA	13.85	10.34	15.45	30.00	-14.55
5789	AVG	HDR4	ePA	13.48	10.31	15.19	30.00	-14.81
5844	AVG	HDR4	ePA	13.40	10.49	15.19	30.00	-14.81
5733	AVG	HDR4	iPA	-1.64	-0.17	2.17	30.00	-27.83
5789	AVG	HDR4	iPA	-1.50	-0.56	2.01	30.00	-27.99
5844	AVG	HDR4	iPA	-1.70	-0.48	1.96	30.00	-28.04
5733	AVG	HDR8	ePA	13.78	10.15	15.34	30.00	-14.66
5789	AVG	HDR8	ePA	13.41	10.13	15.08	30.00	-14.92
5844	AVG	HDR8	ePA	13.56	10.20	15.21	30.00	-14.79
5733	AVG	HDR8	iPA	-1.97	-0.35	1.93	30.00	-28.07
5789	AVG	HDR8	iPA	-1.81	-0.39	1.97	30.00	-28.03
5844	AVG	HDR8	iPA	-1.50	-0.30	2.15	30.00	-27.85

Table 7-8. FCC TxBF Maximum Conducted Output Power

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Note:

Per ANSI C63.10-2013 and KDB 662911 v02r01 Section E1), the conducted powers at Antenna 5b and Antenna 4a 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 correlated 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.

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

Per ANSI C63.10-2013 Subclause 14.4.3, the uncorrelated 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.

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

Sample TxBF Calculation:

At 5162MHz, the average conducted power was measured to be 8.61 dBm for Antenna 5b and 8.88 dBm for Antenna 4a.

$$\text{Antenna 5b} + \text{Antenna 4a} = \text{TxBF}$$

$$(8.61 \text{ dBm} + 8.88 \text{ dBm}) = (7.261 \text{ mW} + 7.727 \text{ mW}) = 14.988 \text{ mW} = 11.76 \text{ dBm}$$

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7.5 Maximum Power Spectral Density – HDR

§15.407(a.1.iv) §15.407(a.3)

Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, was used to measure the power spectral density.

In the 5.15 – 5.25GHz band, the maximum permissible power spectral density is 11dBm/MHz.

In the 5.725 – 5.850GHz band, the maximum permissible power spectral density is 30dBm/500kHz.

Test Procedure Used

ANSI C63.10-2013 – Subclause 12.3.2.2

KDB 789033 D02 v02r01 – Section F

Test Settings

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points $\geq 2 \times (\text{span}/\text{RBW})$
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run for all modes
9. Trace was averaged over 100 sweeps
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

Test Setup

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



Figure 7-4. Test Instrument & Measurement Setup

Test Notes

None

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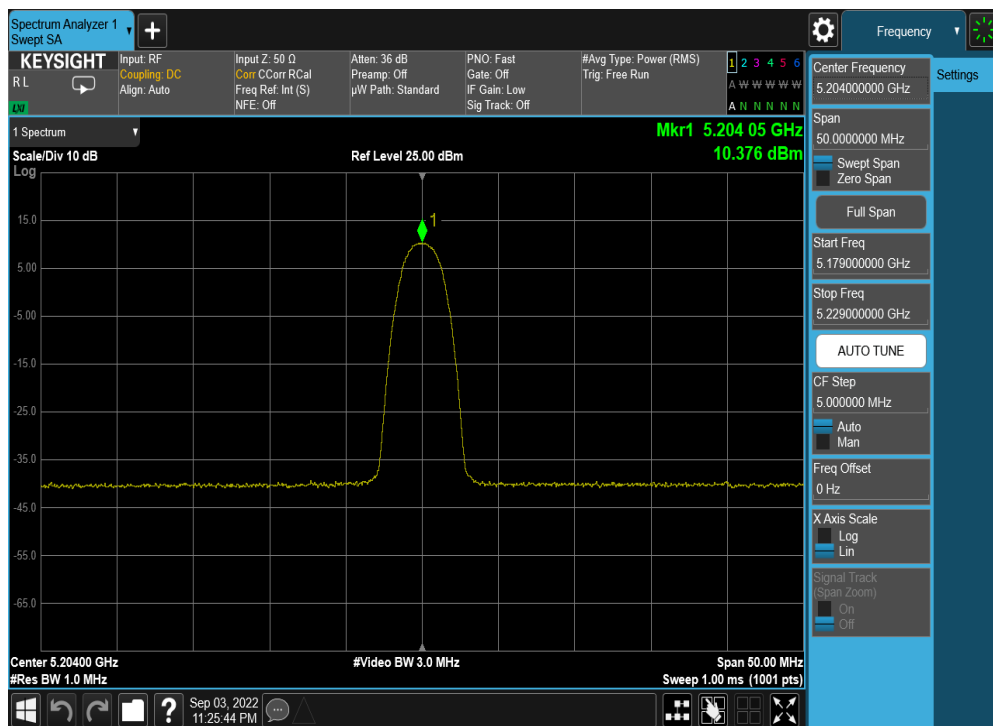
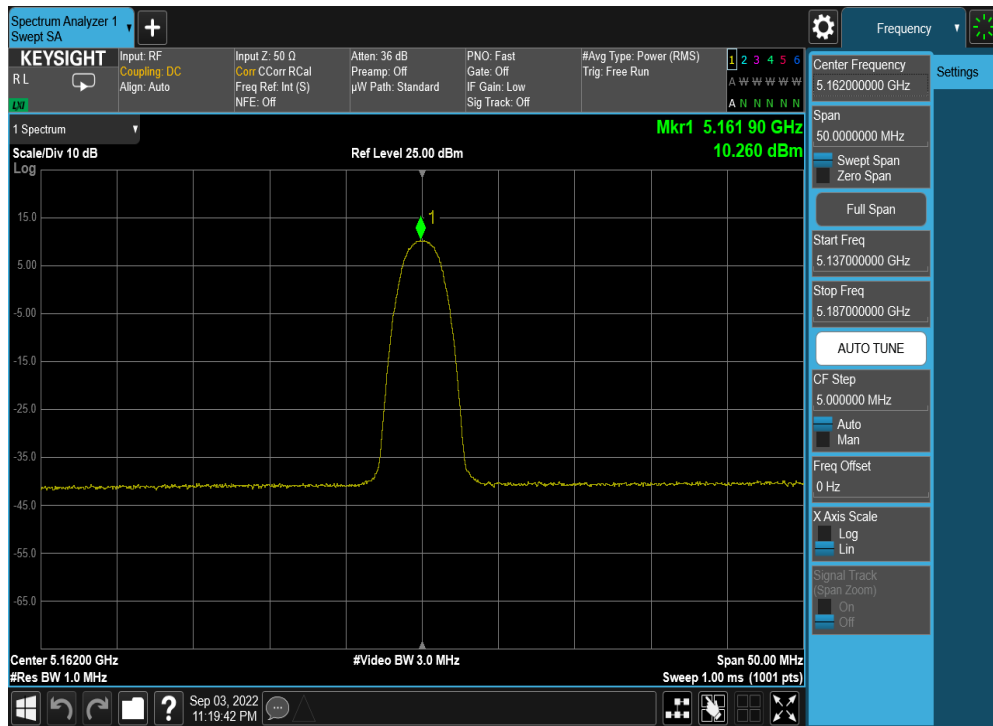
7.5.1 Antenna 5b Power Spectral Density Measurements

	Frequency [MHz]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	HDR4	ePA	10.26	11.0	-0.74
	5204	HDR4	ePA	10.38	11.0	-0.62
	5245	HDR4	ePA	9.91	11.0	-1.09
	5162	HDR8	ePA	9.86	11.0	-1.14
	5204	HDR8	ePA	10.43	11.0	-0.57
	5245	HDR8	ePA	10.54	11.0	-0.46
	5162	HDR4	iPA	-6.30	11.0	-17.30
	5204	HDR4	iPA	-6.12	11.0	-17.12
	5245	HDR4	iPA	-7.32	11.0	-18.32
	5162	HDR8	iPA	-4.62	11.0	-15.62
	5204	HDR8	iPA	-3.07	11.0	-14.07
	5245	HDR8	iPA	-3.33	11.0	-14.33

Table 7-9. Power Spectral Density Measurements

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 39 of 136

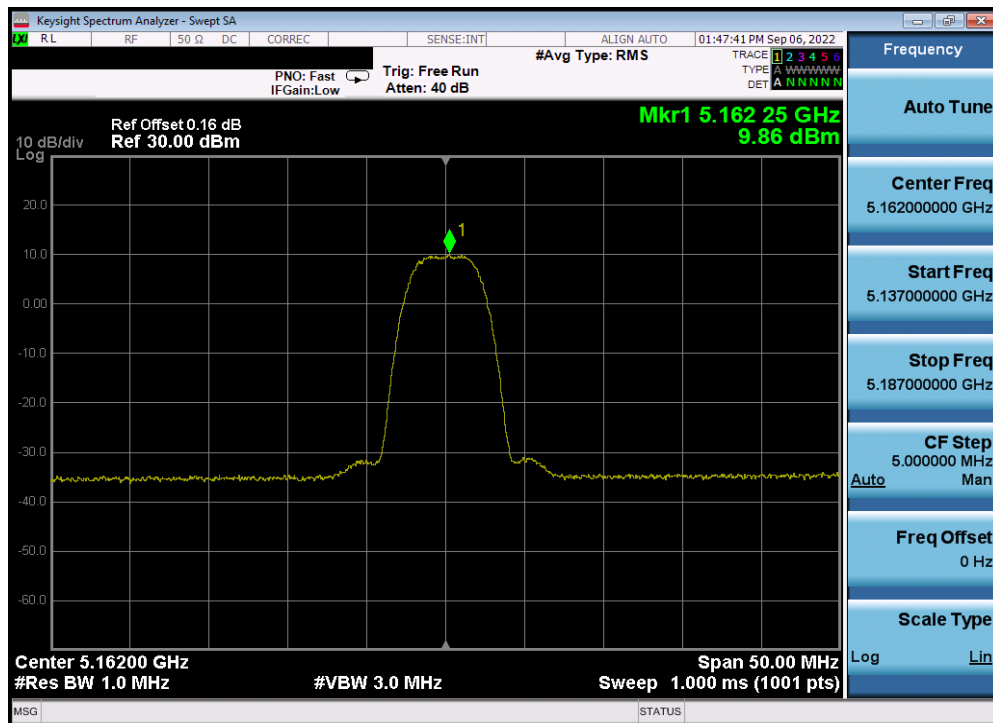
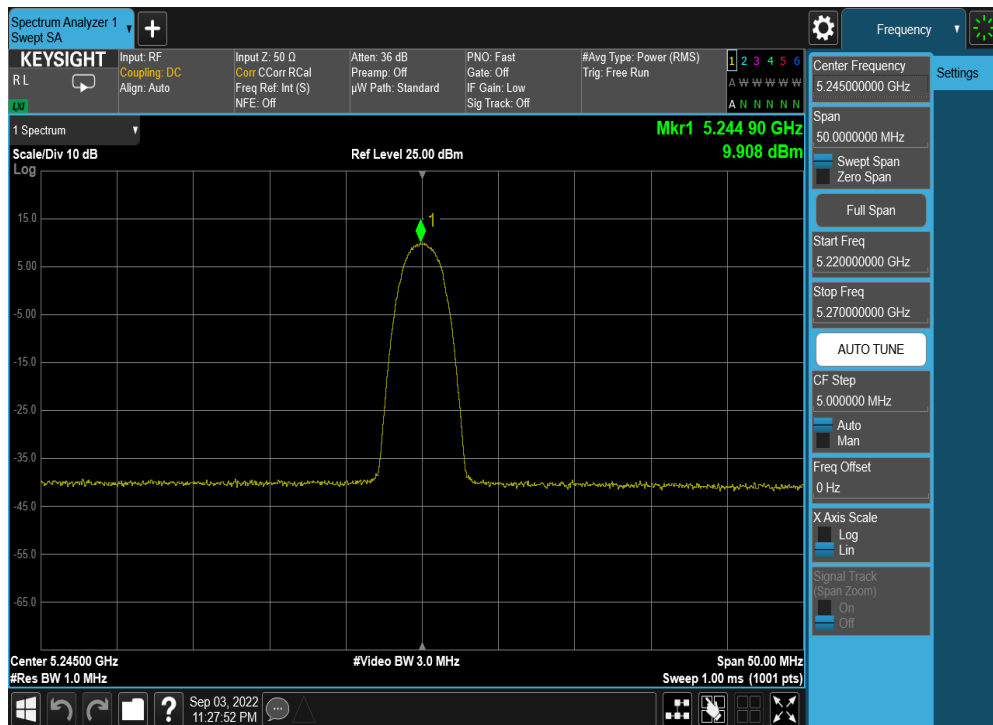
V 10.5 12/15/2021



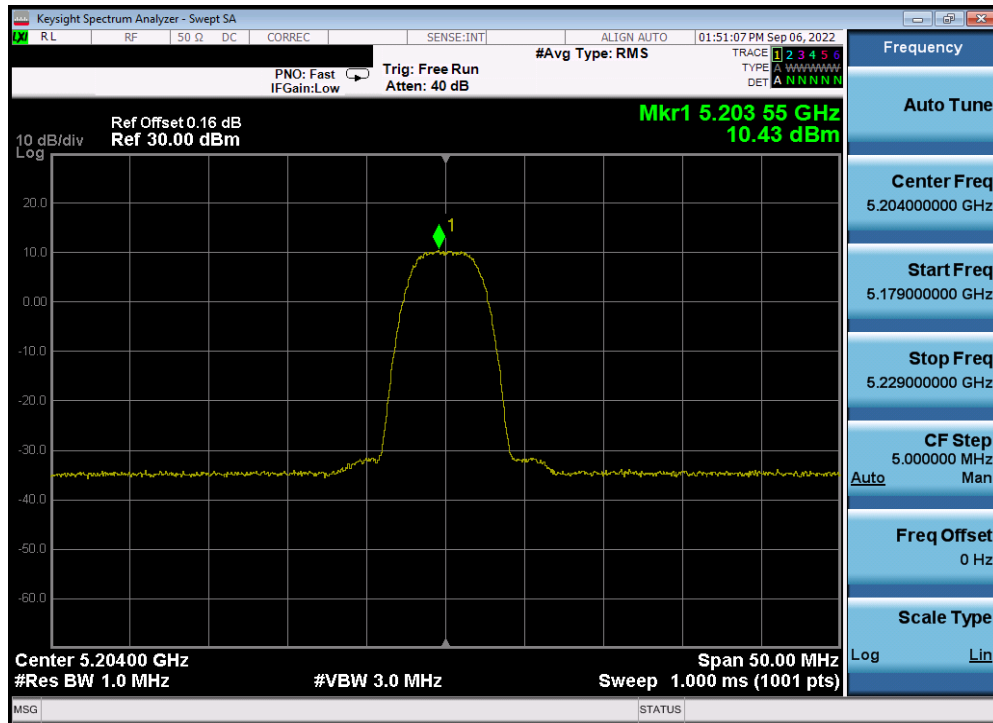
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 40 of 136

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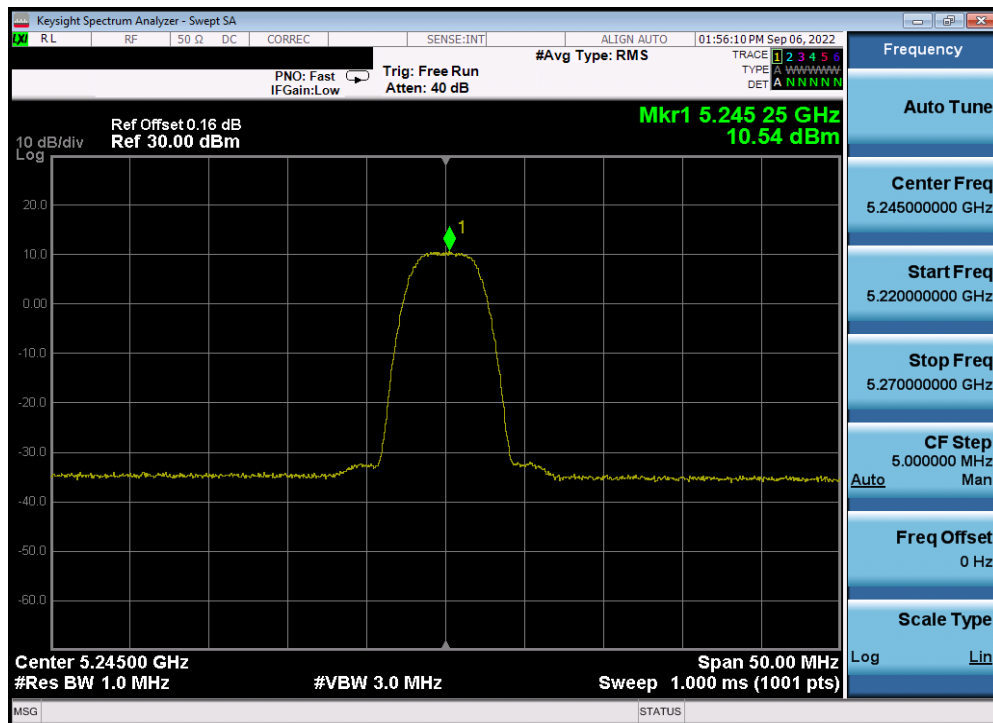
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FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 41 of 136

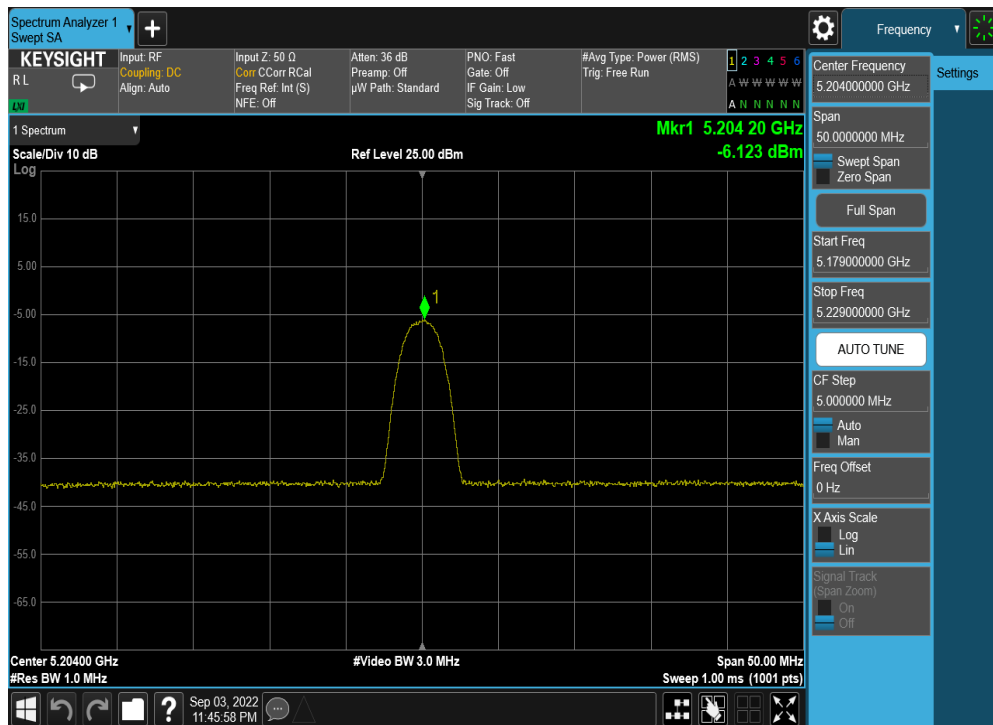
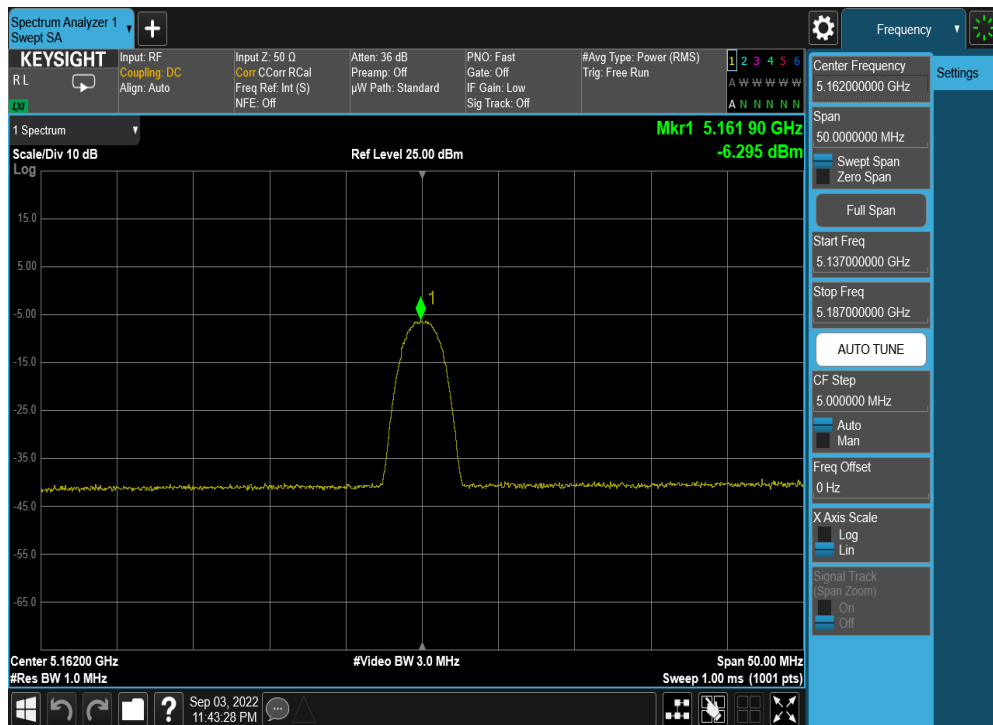


Plot 7-29. PSD Antenna 5b (HDR8, ePA, 5204MHz)



Plot 7-30. PSD Antenna 5b (HDR8, ePA, 5245MHz)

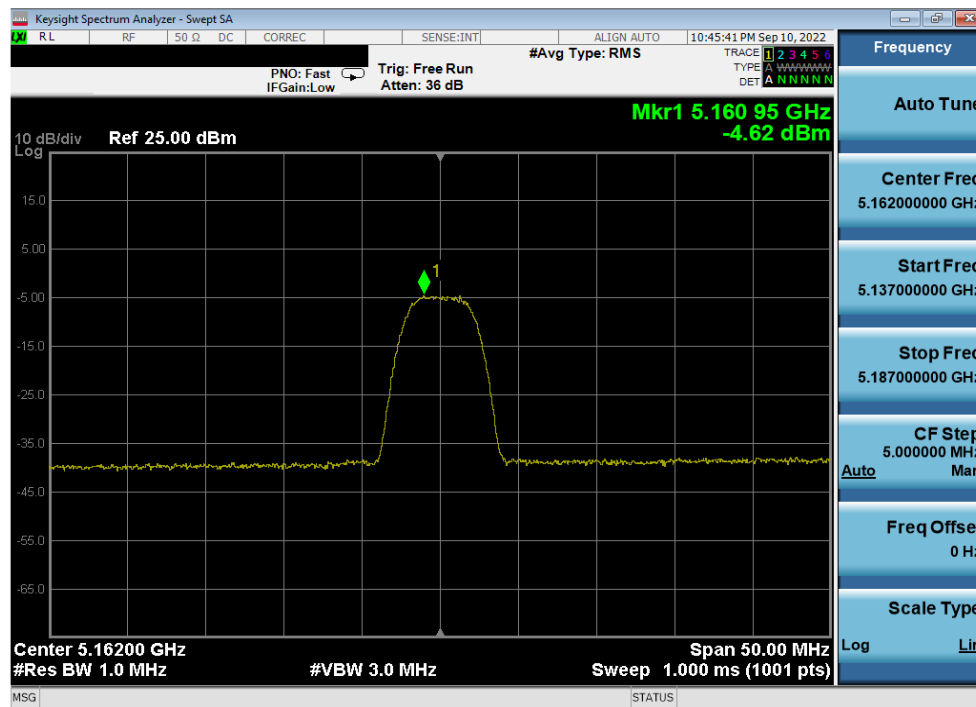
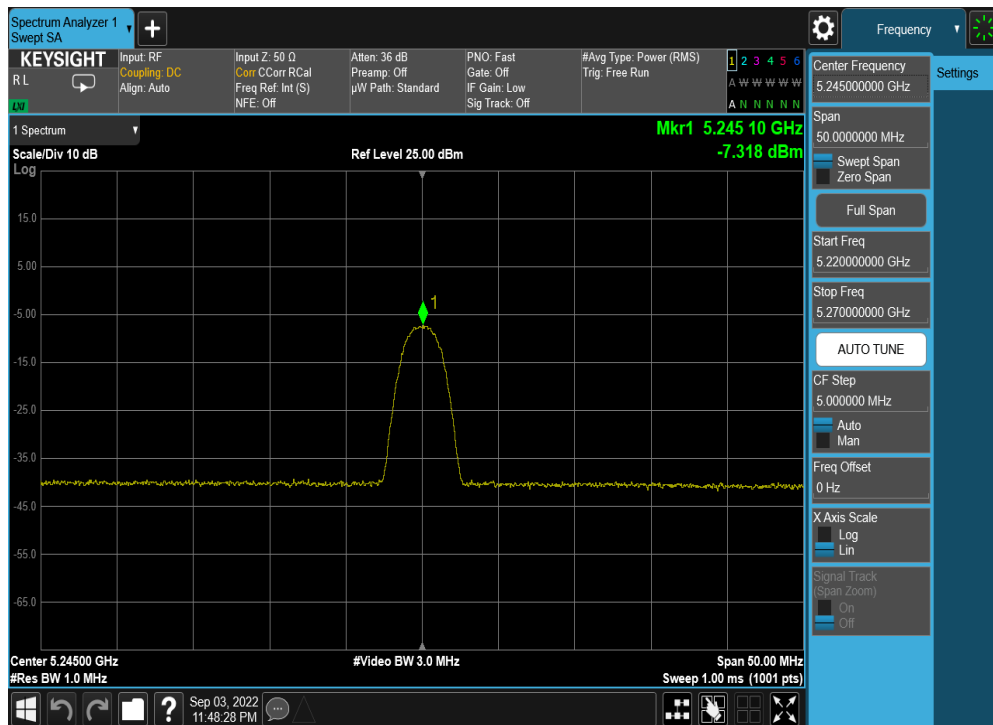
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 42 of 136



FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 43 of 136

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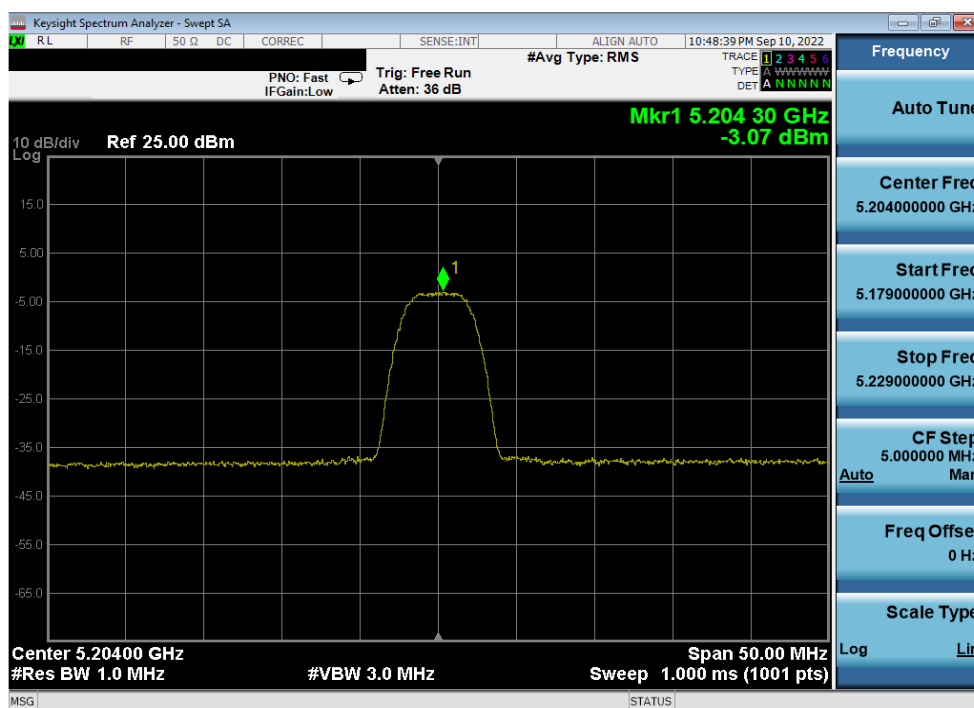
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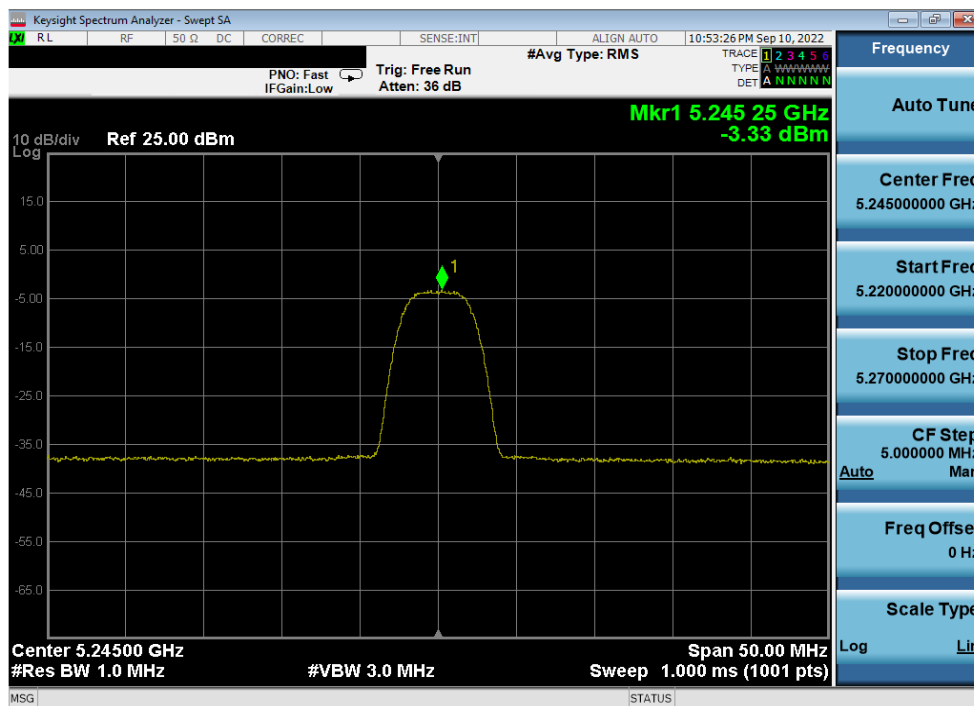
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 44 of 136

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Plot 7-35. PSD Antenna 5b (HDR8, iPA, 5204MHz)



Plot 7-36. PSD Antenna 5b (HDR8, iPA, 5245MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 45 of 136

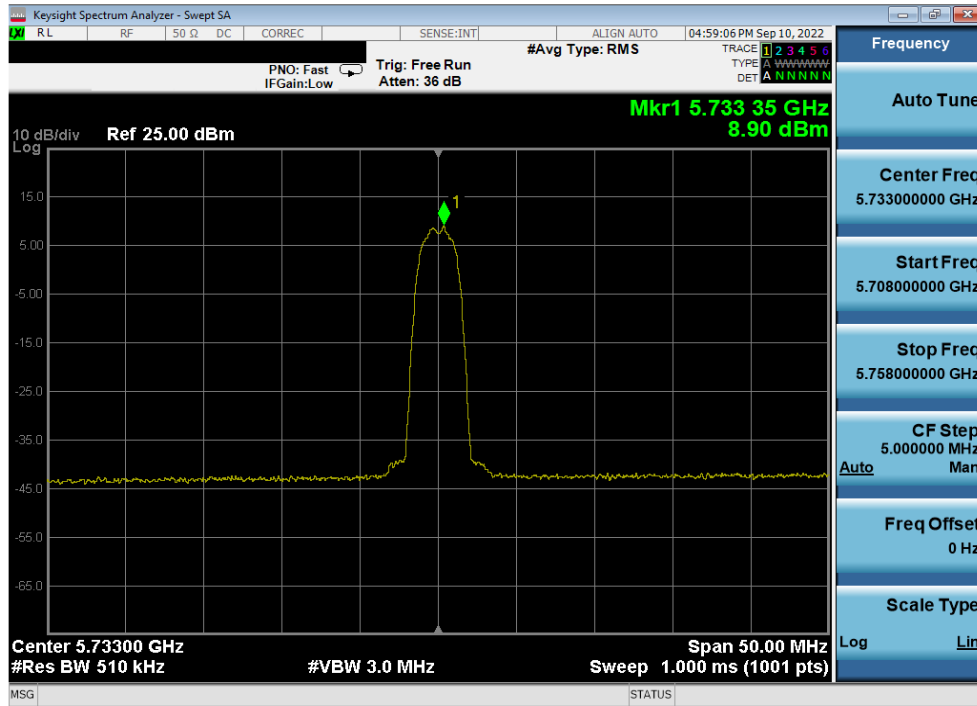
V 10.5 12/15/2021

	Frequency [MHz]	Mode	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	HDR4	ePA	8.90	30.0	-21.10
	5789	HDR4	ePA	8.47	30.0	-21.53
	5844	HDR4	ePA	9.15	30.0	-20.85
	5745	HDR8	ePA	4.98	30.0	-25.03
	5785	HDR8	ePA	4.44	30.0	-25.56
	5825	HDR8	ePA	5.15	30.0	-24.86
	5733	HDR4	iPA	-5.69	30.0	-35.69
	5789	HDR4	iPA	-5.59	30.0	-35.59
	5844	HDR4	iPA	-5.51	30.0	-35.51
	5745	HDR8	iPA	-8.47	30.0	-38.47
	5785	HDR8	iPA	-9.85	30.0	-39.85
	5825	HDR8	iPA	-9.60	30.0	-39.60

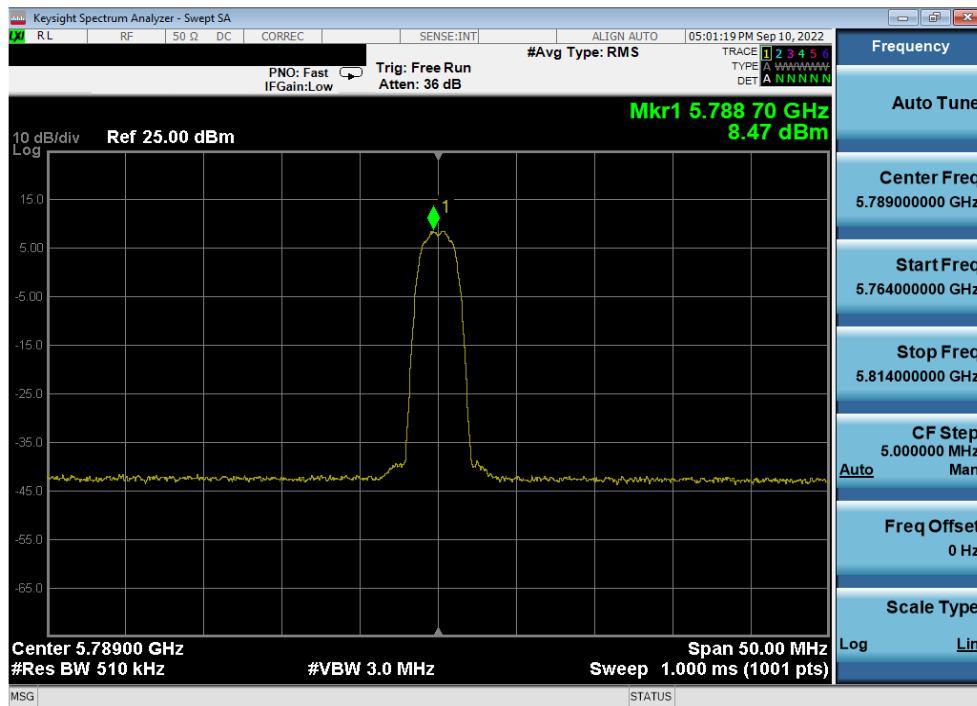
Table 7-10. Power Spectral Density Measurements

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 46 of 136

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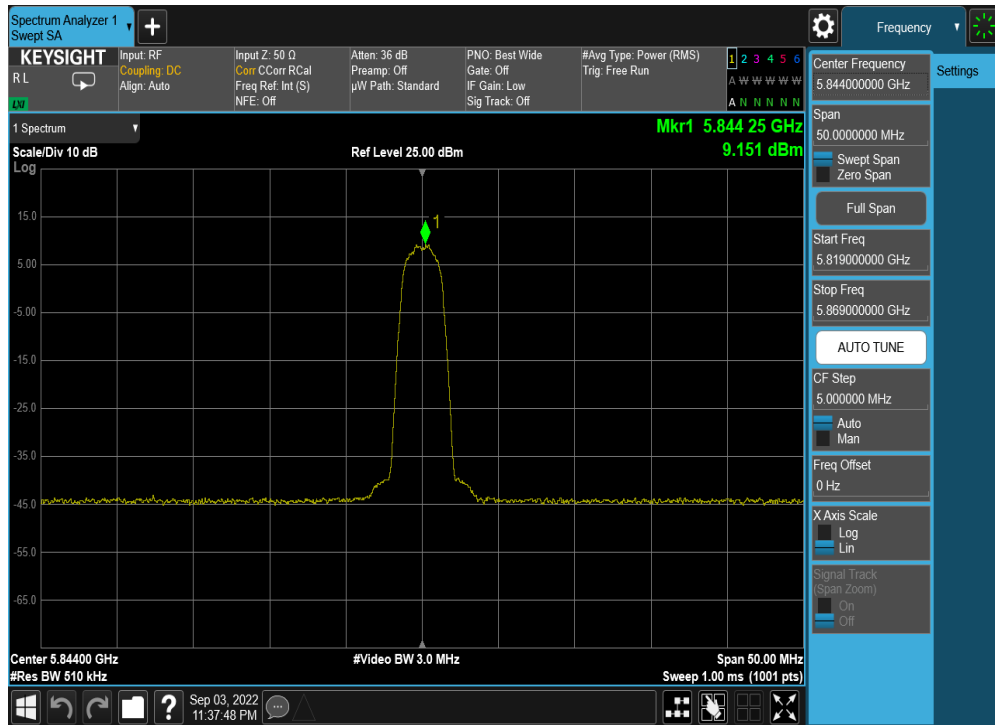
Plot 7-37. PSD Antenna 5b (HDR4, ePA, 5733MHz)



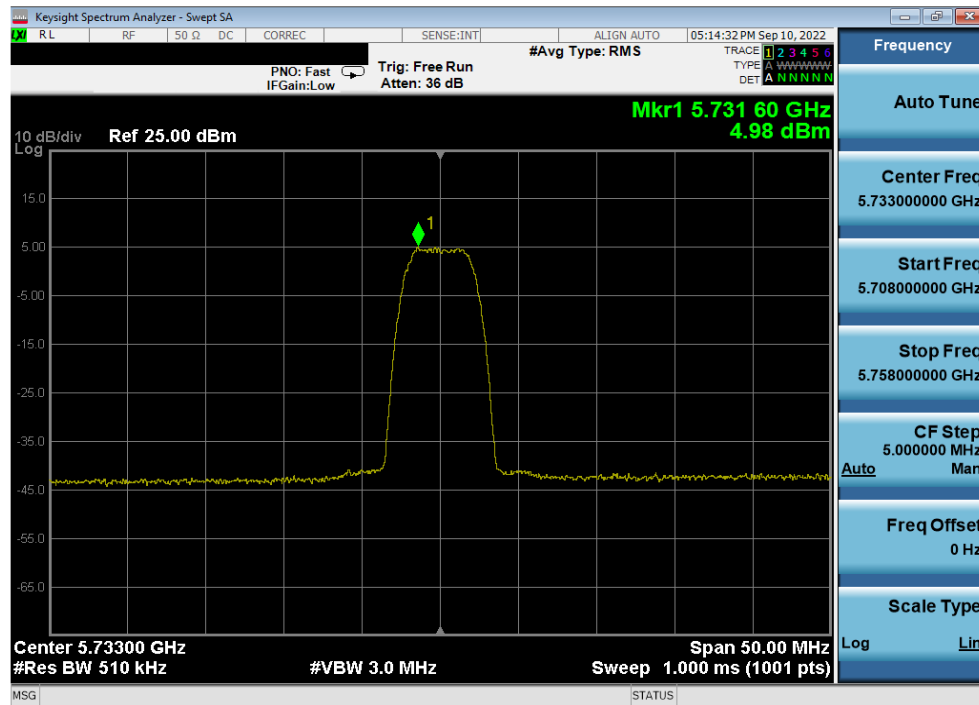
Plot 7-38. PSD Antenna 5b (HDR4, ePA, 5789MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 47 of 136

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Plot 7-39. PSD Antenna 5b (HDR4, ePA, 5844MHz)

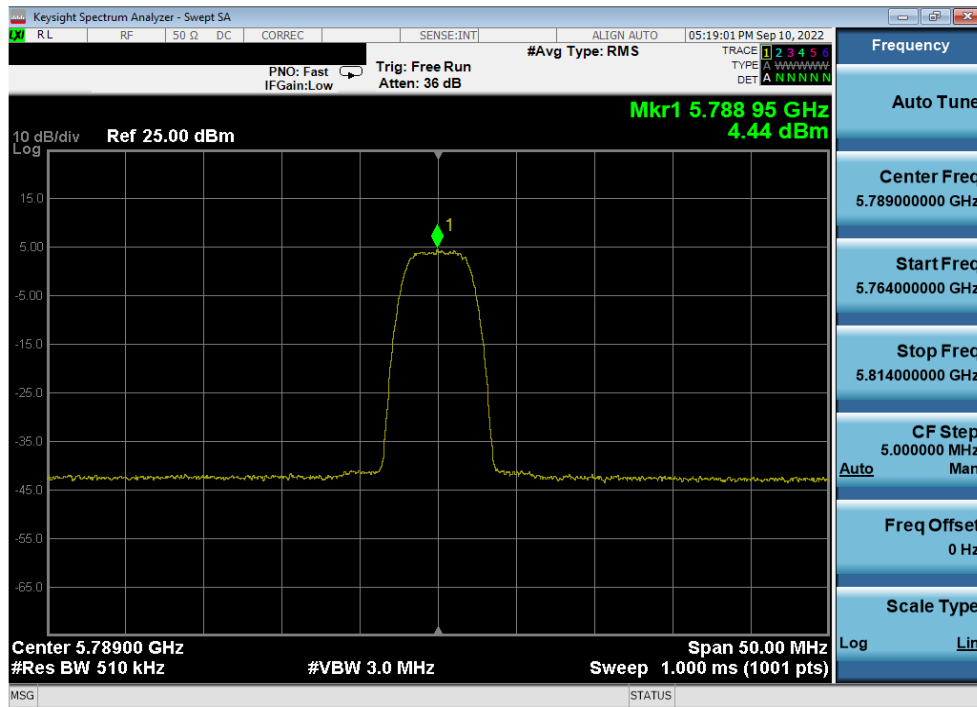


Plot 7-40. PSD Antenna 5b (HDR8, ePA, 5733MHz)

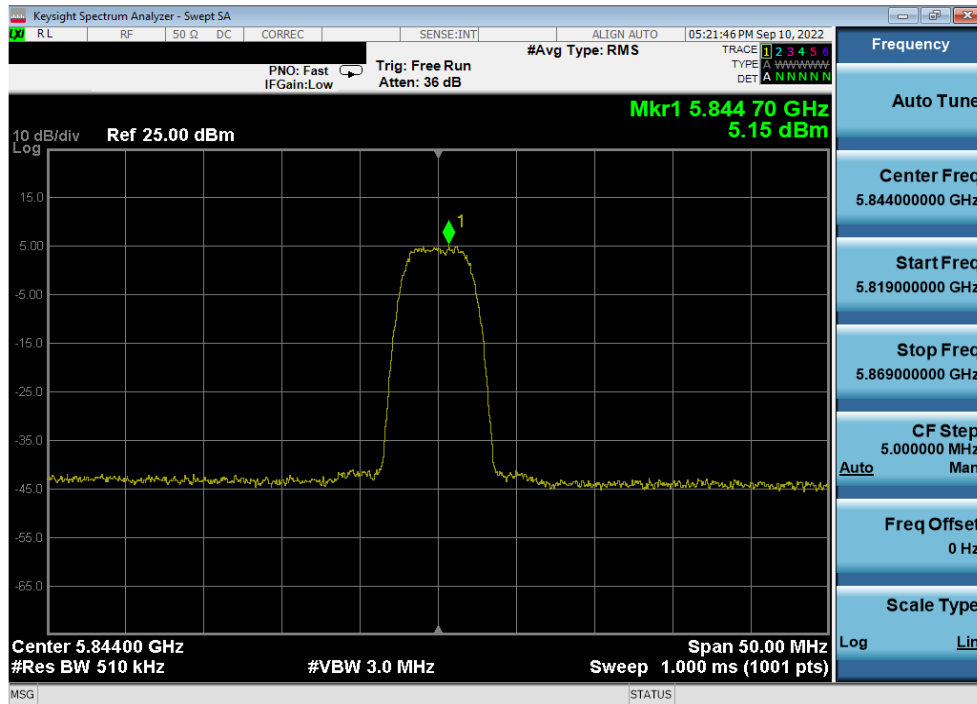
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 48 of 136

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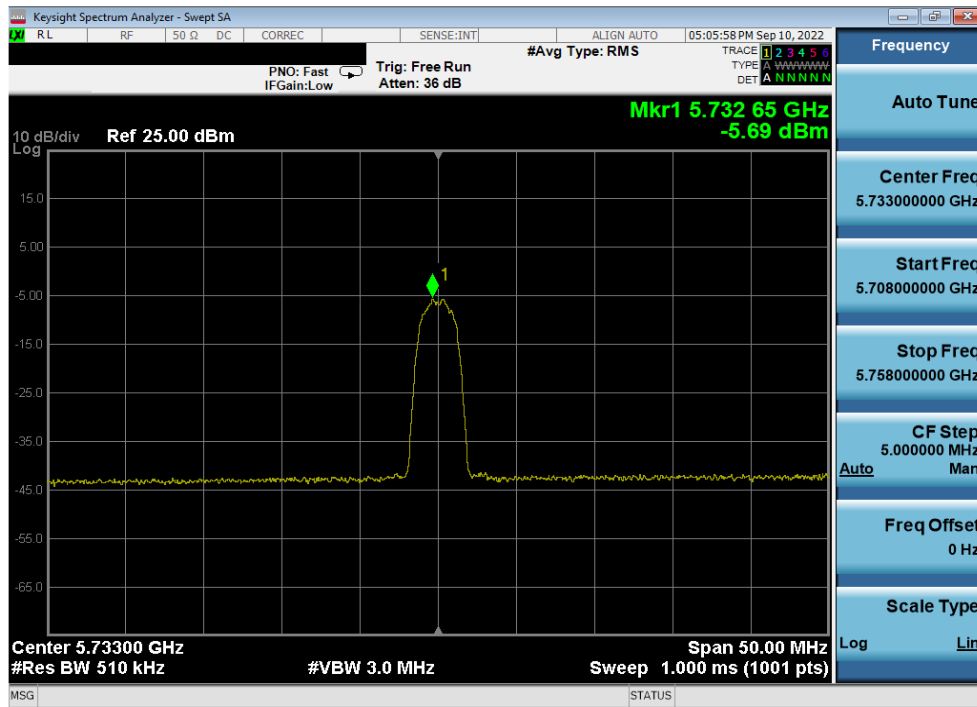


Plot 7-41. PSD Antenna 5b (HDR8, ePA, 5789MHz)

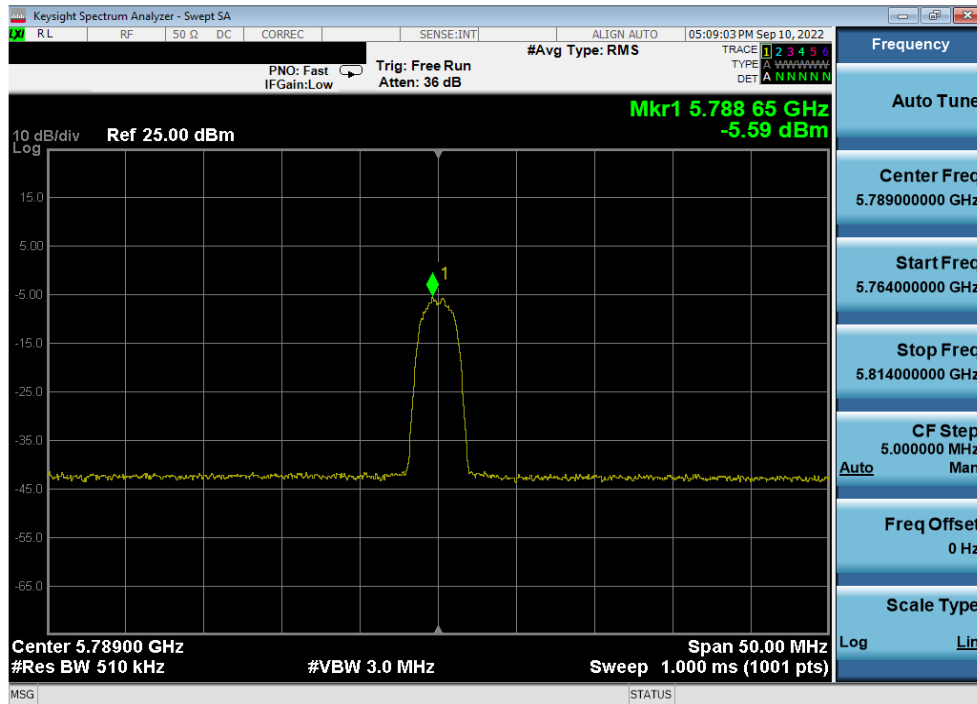


Plot 7-42. PSD Antenna 5b (HDR8, ePA, 5844MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 49 of 136



Plot 7-43. PSD Antenna 5b (HDR4, iPA, 5733MHz)

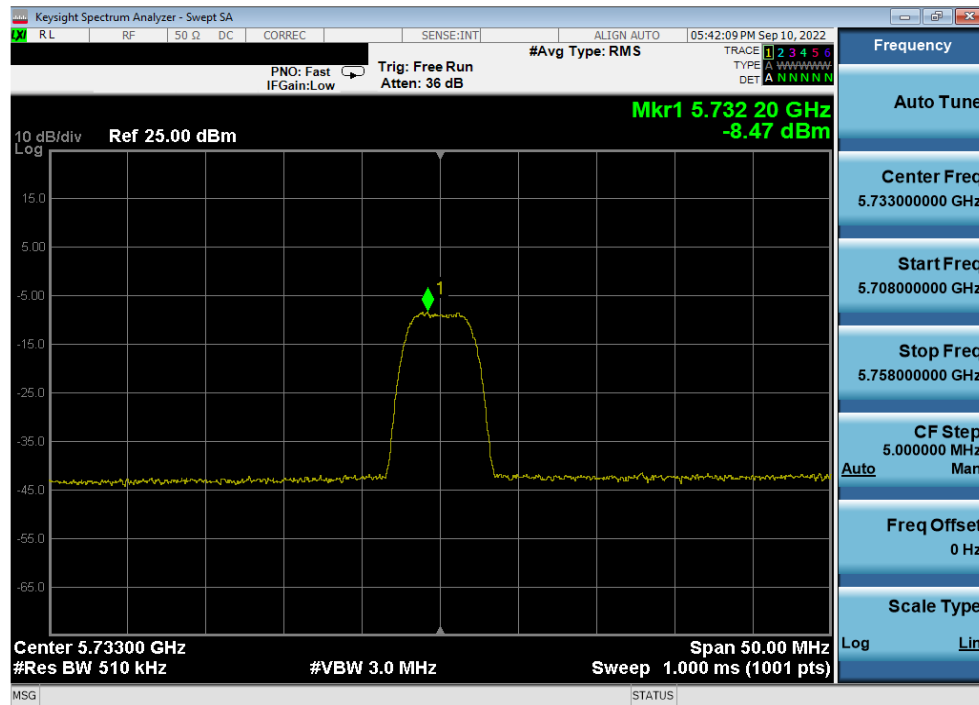
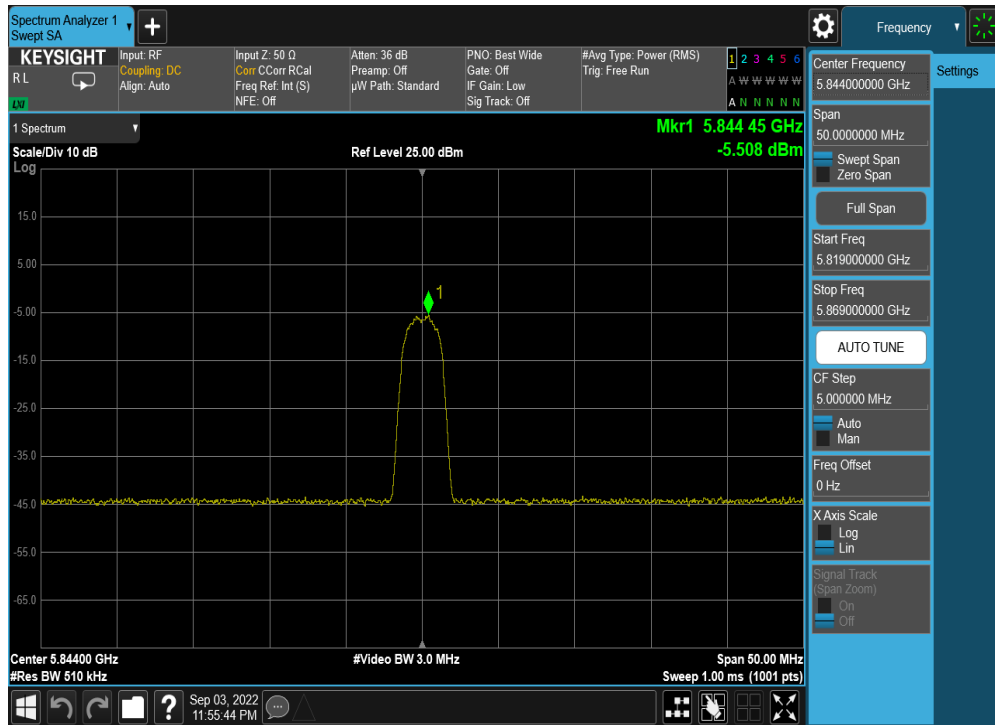


Plot 7-44. PSD Antenna 5b (HDR4, iPA, 5789MHz)

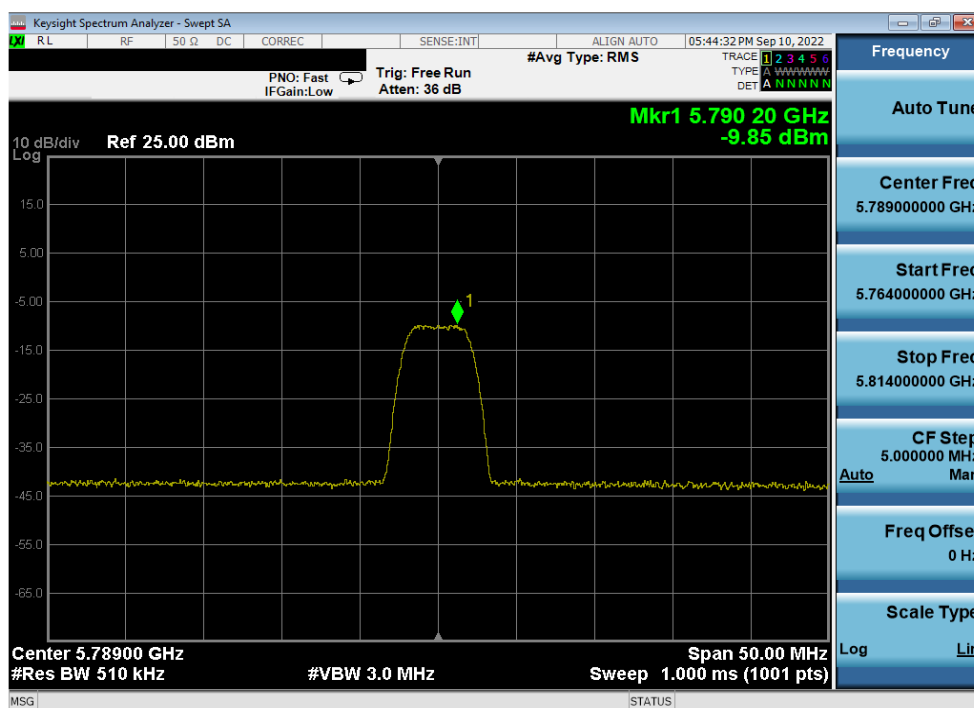
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 50 of 136

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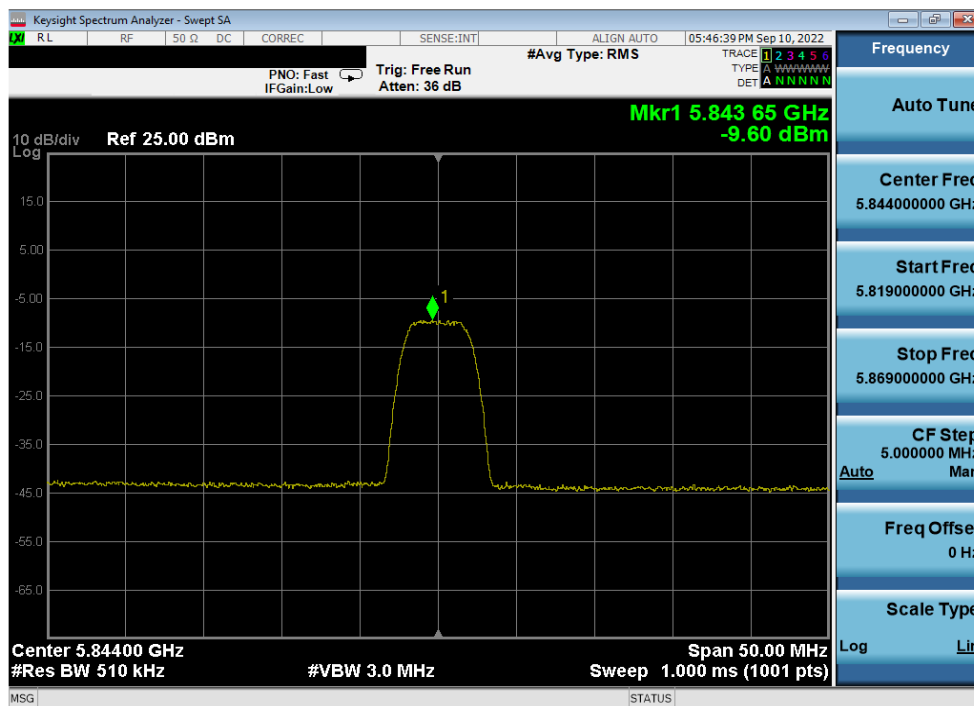
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Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 51 of 136



Plot 7-47. PSD Antenna 5b (HDR8, iPA, 5789MHz)



Plot 7-48. PSD Antenna 5b (HDR8, iPA, 5844MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 52 of 136

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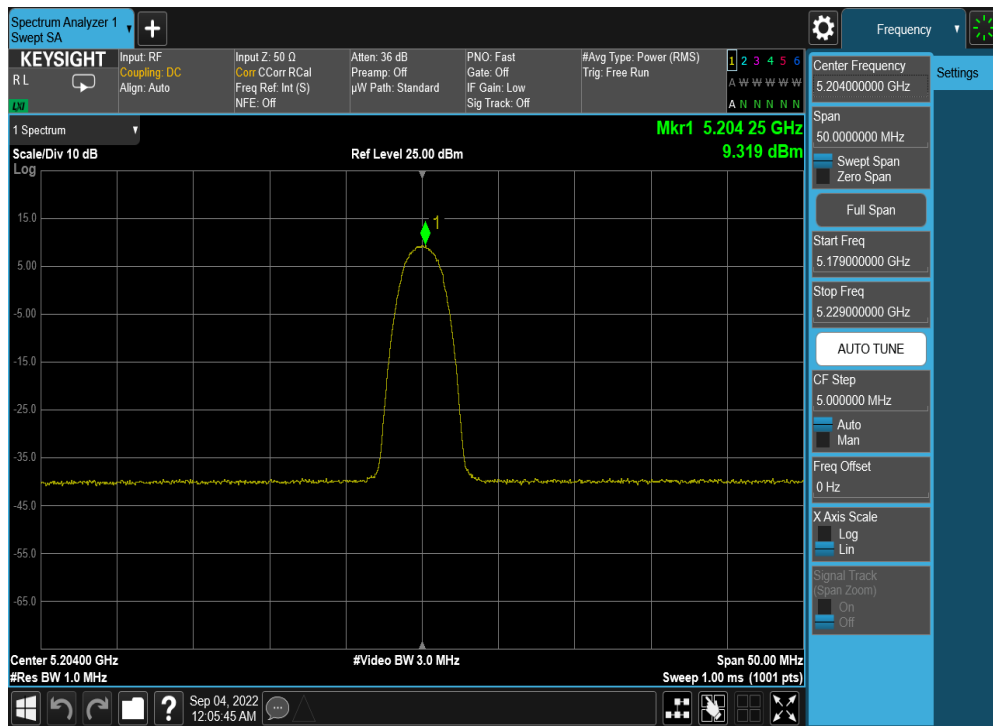
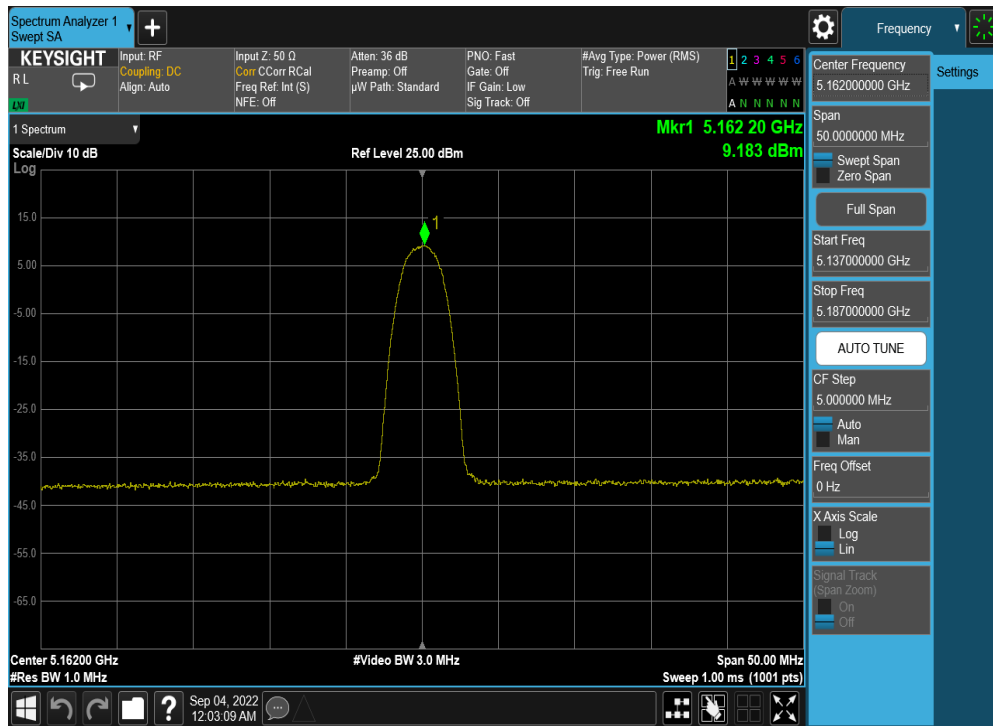
7.5.2 Antenna 4a Power Spectral Density Measurements

	Frequency [MHz]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	HDR4	ePA	9.18	11.0	-1.82
	5204	HDR4	ePA	9.32	11.0	-1.68
	5245	HDR4	ePA	8.68	11.0	-2.32
	5162	HDR8	ePA	9.69	11.0	-1.31
	5204	HDR8	ePA	10.07	11.0	-0.93
	5245	HDR8	ePA	10.52	11.0	-0.48
	5162	HDR4	iPA	-4.90	11.0	-15.90
	5204	HDR4	iPA	-5.04	11.0	-16.04
	5245	HDR4	iPA	-5.89	11.0	-16.89
	5162	HDR8	iPA	-4.15	11.0	-15.15
	5204	HDR8	iPA	-3.48	11.0	-14.48
	5245	HDR8	iPA	-3.92	11.0	-14.92

Table 7-11. Power Spectral Density Measurements

FCC ID: BCGA2435			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device		Page 53 of 136

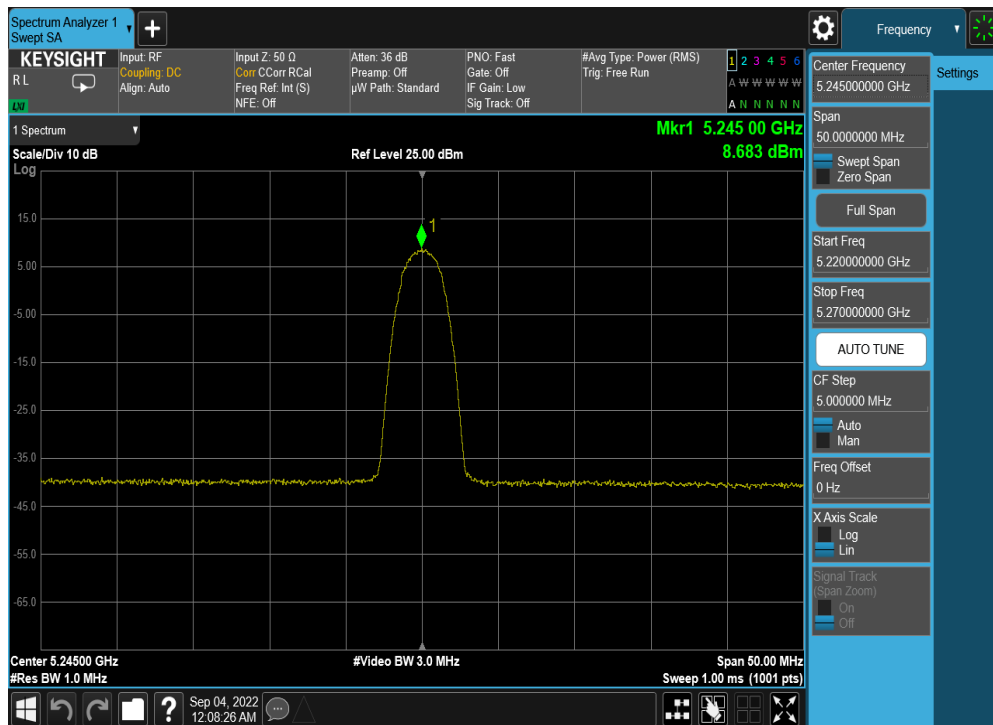
V 10.5 12/15/2021



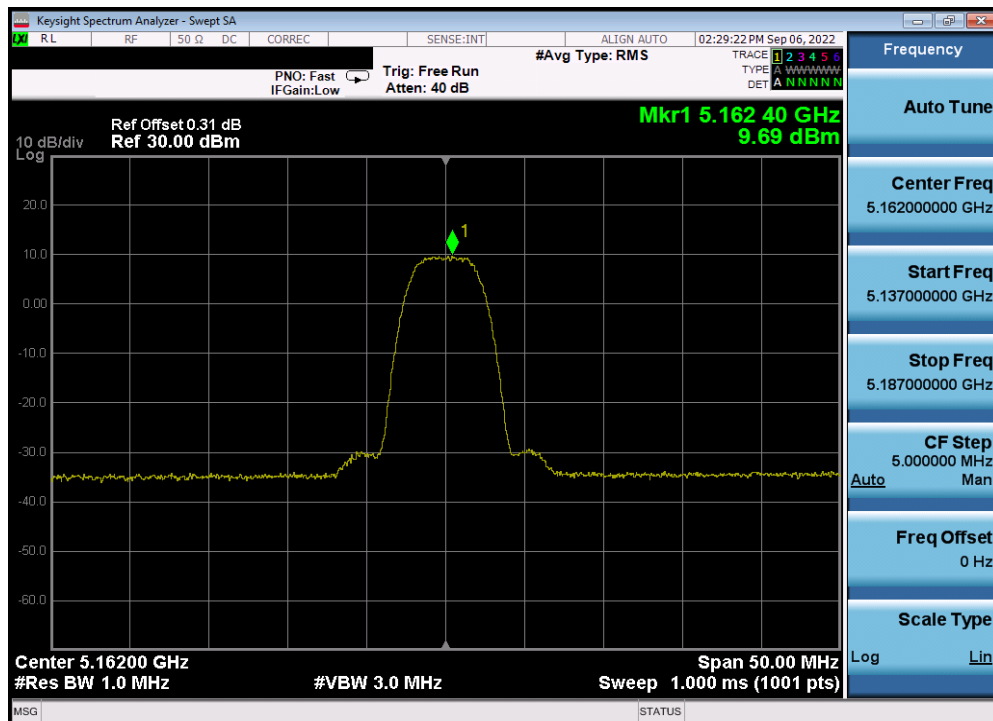
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 54 of 136

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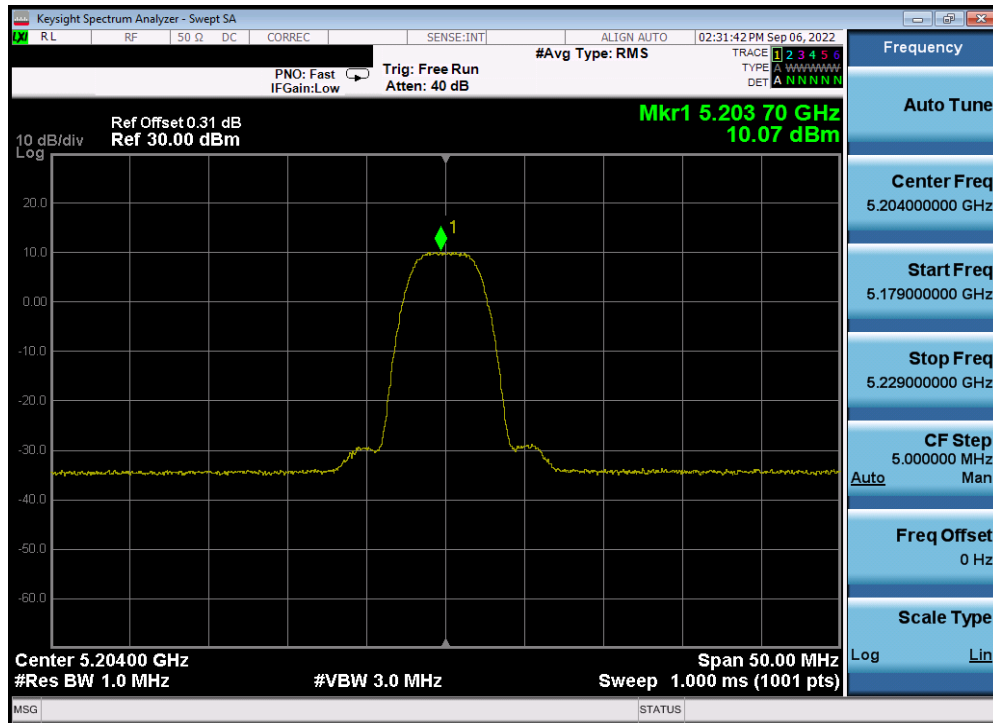


Plot 7-51. PSD Antenna 4a (HDR4, ePA, 5245MHz)

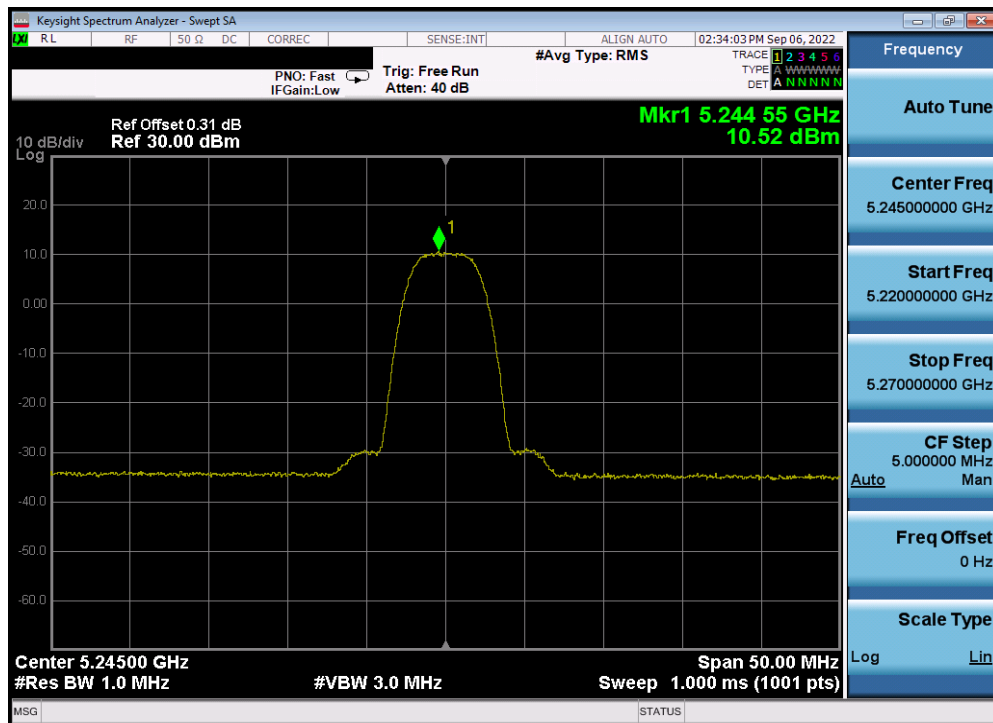


Plot 7-52. PSD Antenna 4a (HDR8, ePA, 5162MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 55 of 136



Plot 7-53. PSD Antenna 4a (HDR8, ePA, 5204MHz)

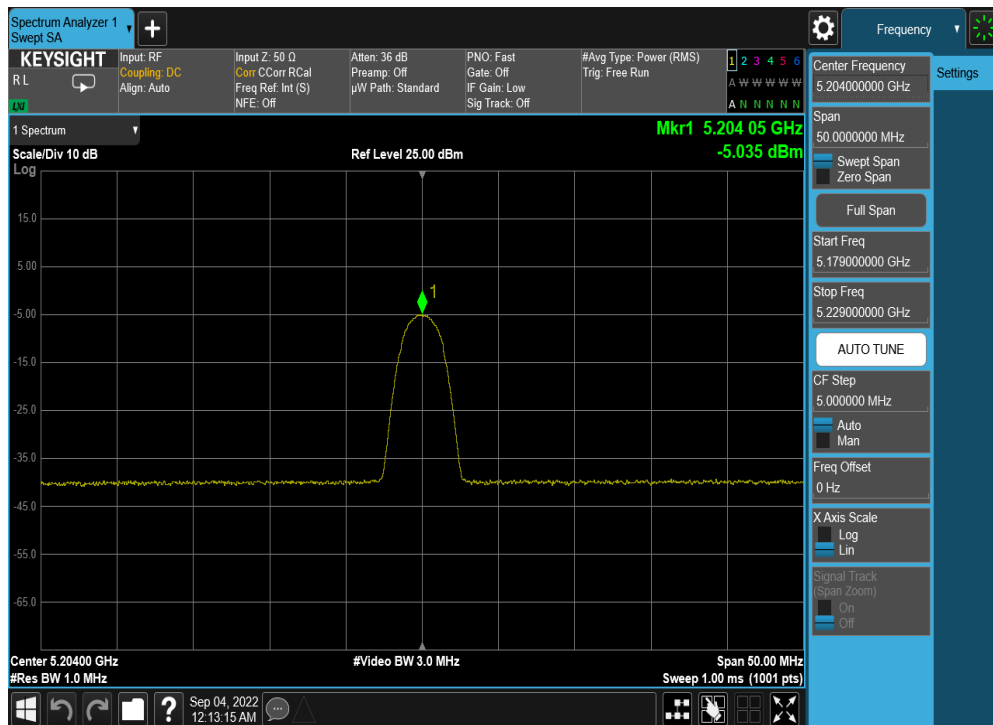
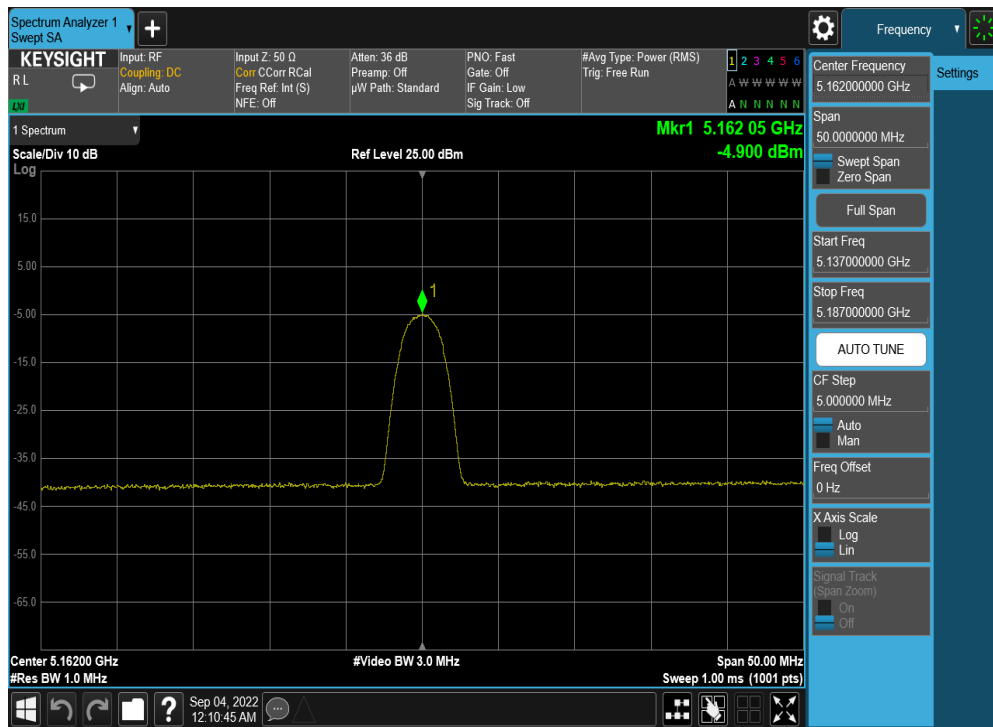


Plot 7-54. PSD Antenna 4a (HDR8, ePA, 5245MHz)

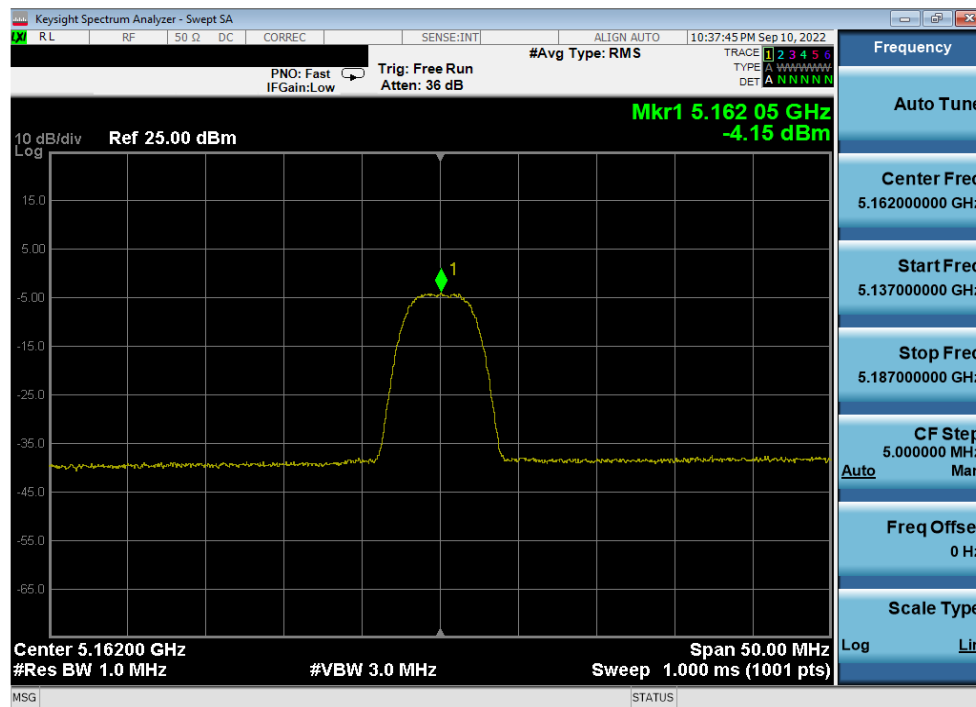
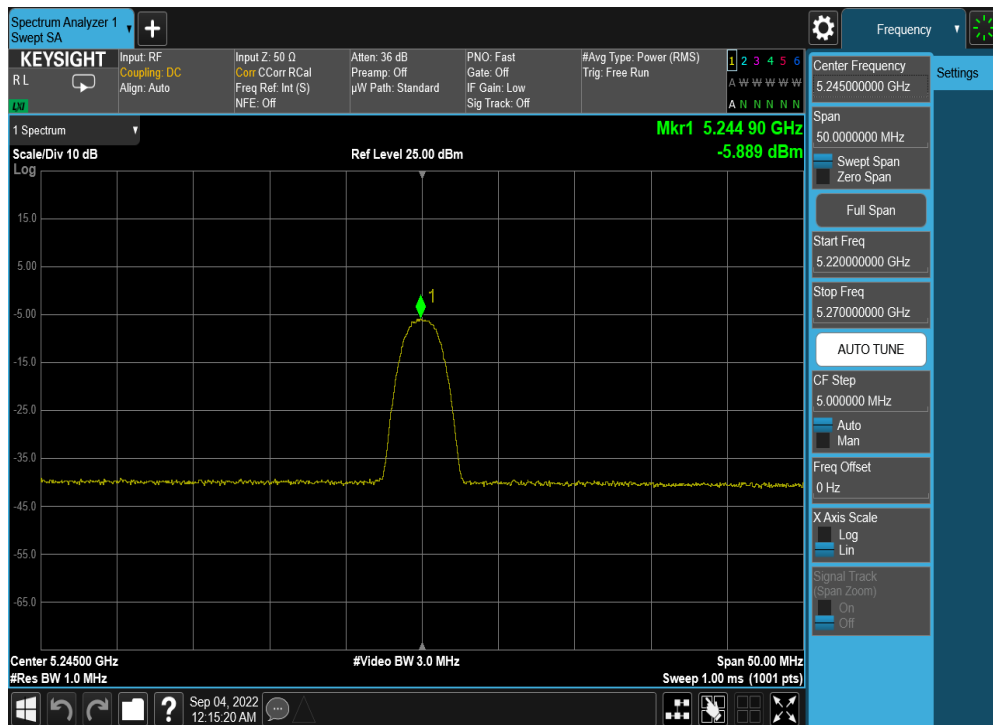
FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 56 of 136

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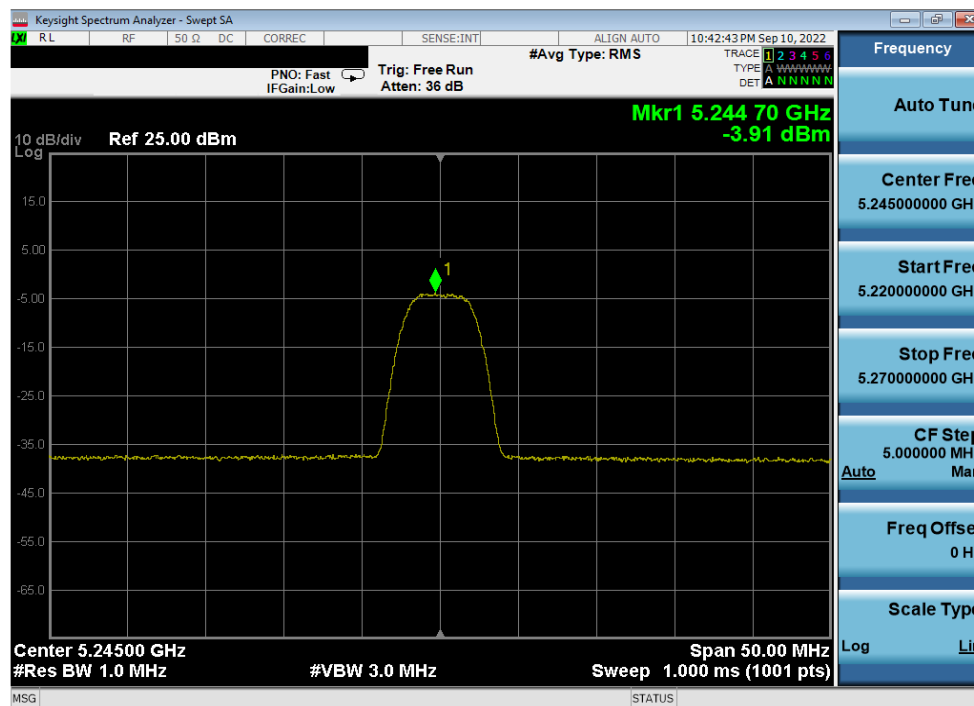
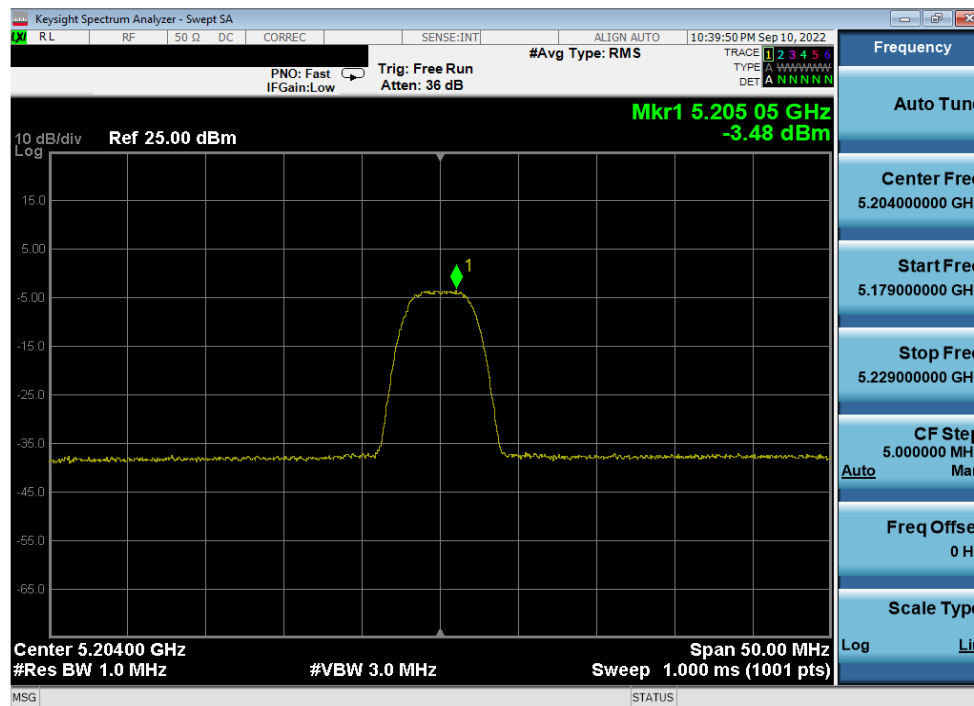
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 57 of 136



FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 58 of 136

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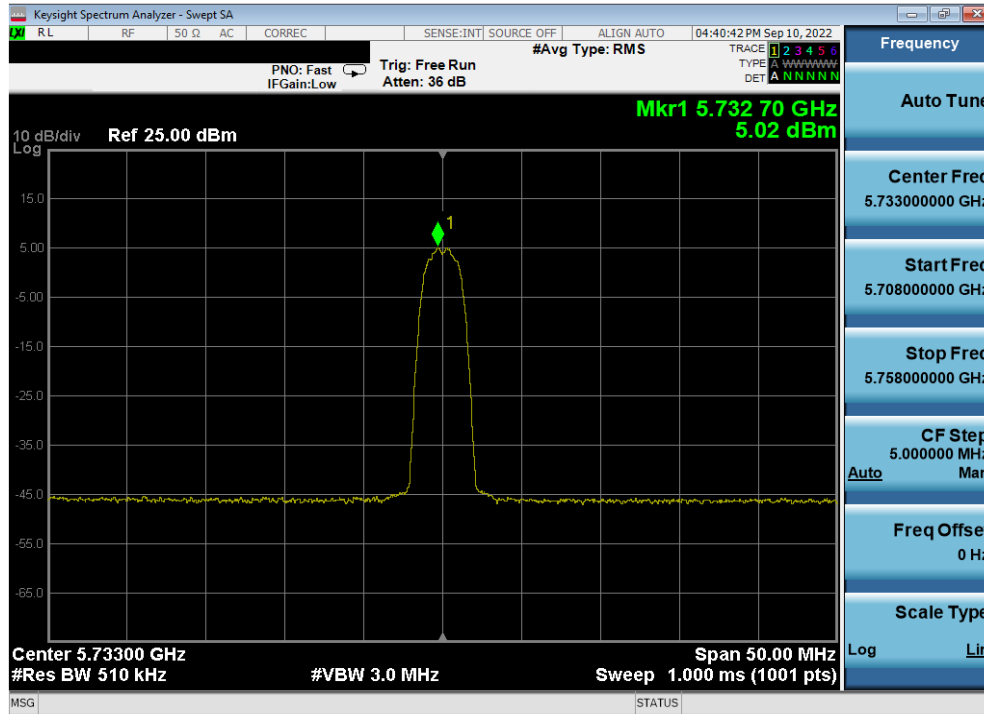


	Frequency [MHz]	Mode	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	HDR4	ePA	5.02	30.0	-24.99
	5789	HDR4	ePA	5.00	30.0	-25.01
	5844	HDR4	ePA	6.20	30.0	-23.80
	5745	HDR8	ePA	2.12	30.0	-27.88
	5785	HDR8	ePA	2.59	30.0	-27.41
	5825	HDR8	ePA	2.26	30.0	-27.74
	5733	HDR4	iPA	-5.40	30.0	-35.40
	5789	HDR4	iPA	-5.16	30.0	-35.16
	5844	HDR4	iPA	-4.93	30.0	-34.93
	5745	HDR8	iPA	-8.23	30.0	-38.23
	5785	HDR8	iPA	-8.51	30.0	-38.51
	5825	HDR8	iPA	-8.19	30.0	-38.19

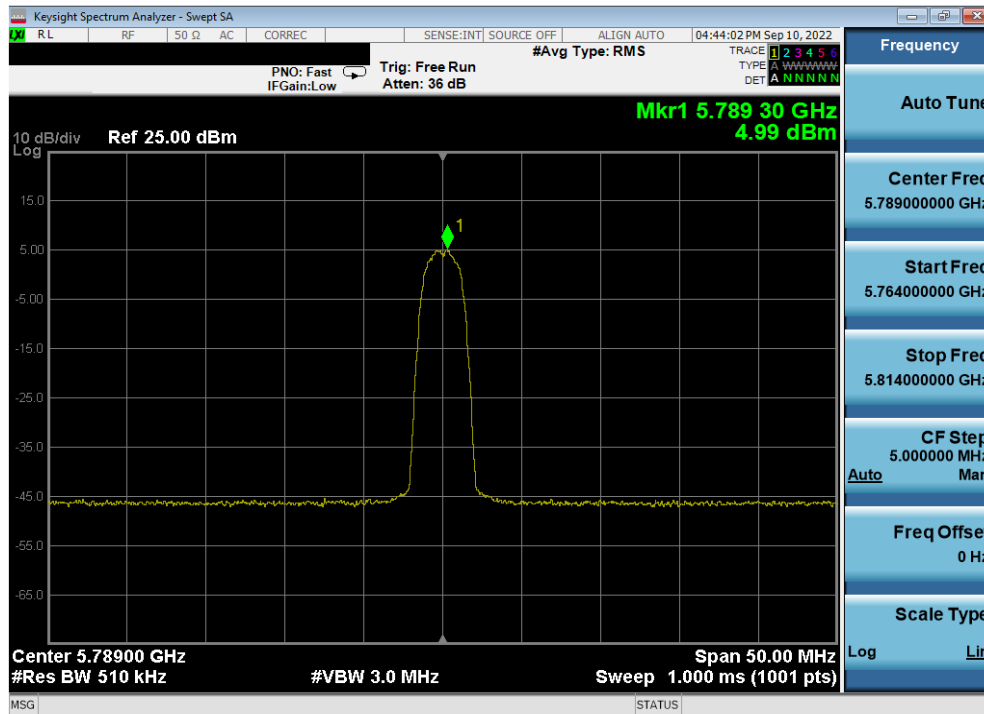
Table 7-12. Power Spectral Density Measurements

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 60 of 136

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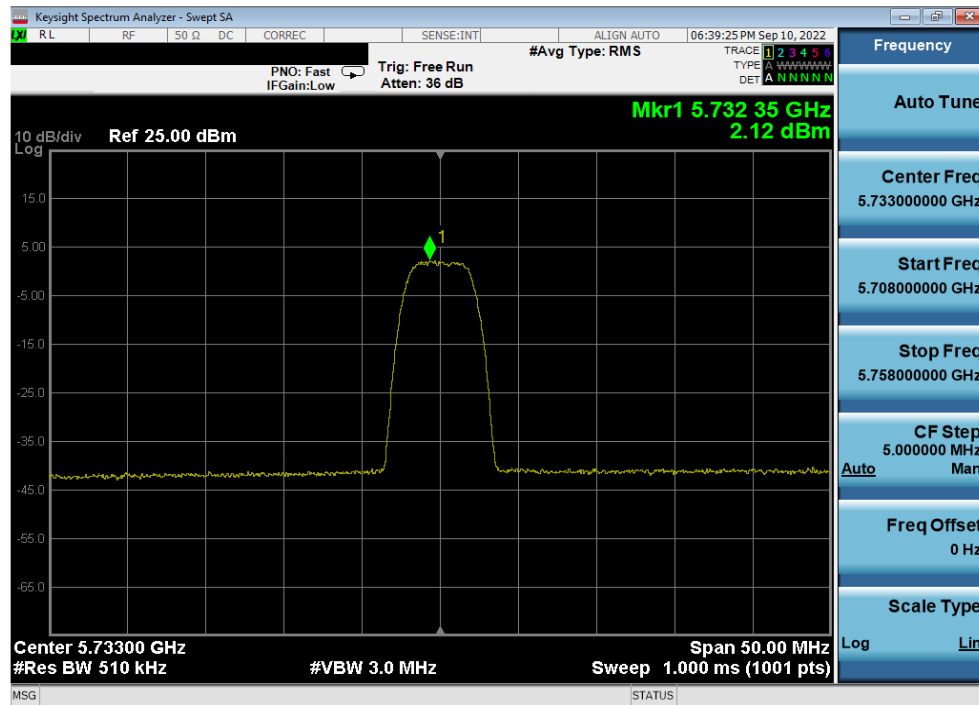
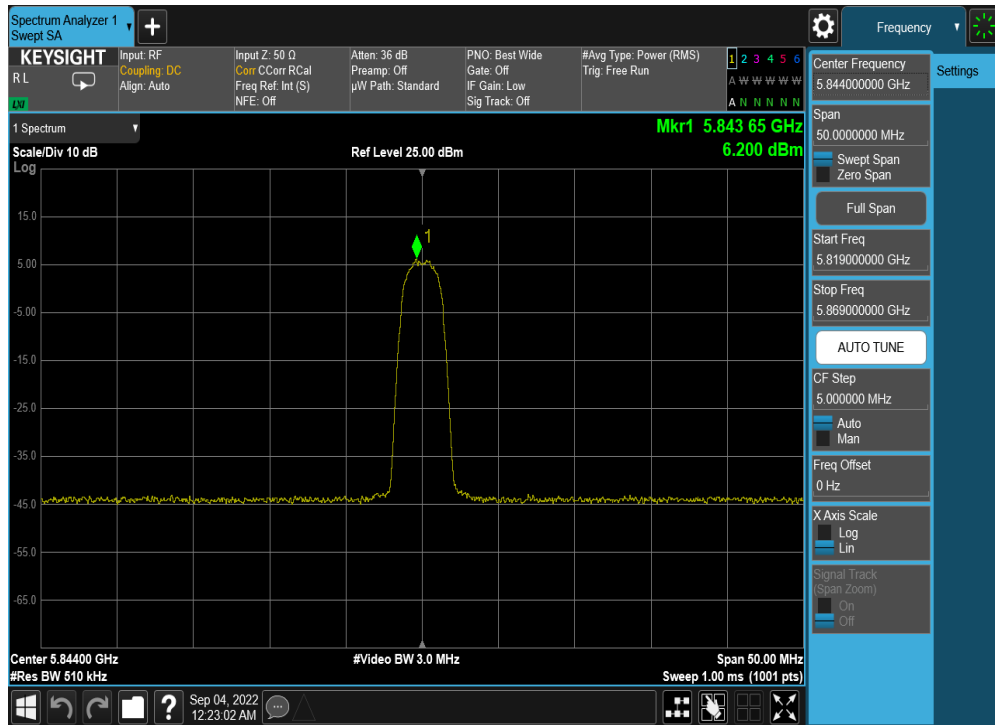


Plot 7-61. PSD Antenna 4a (HDR4,ePA, 5733MHz)

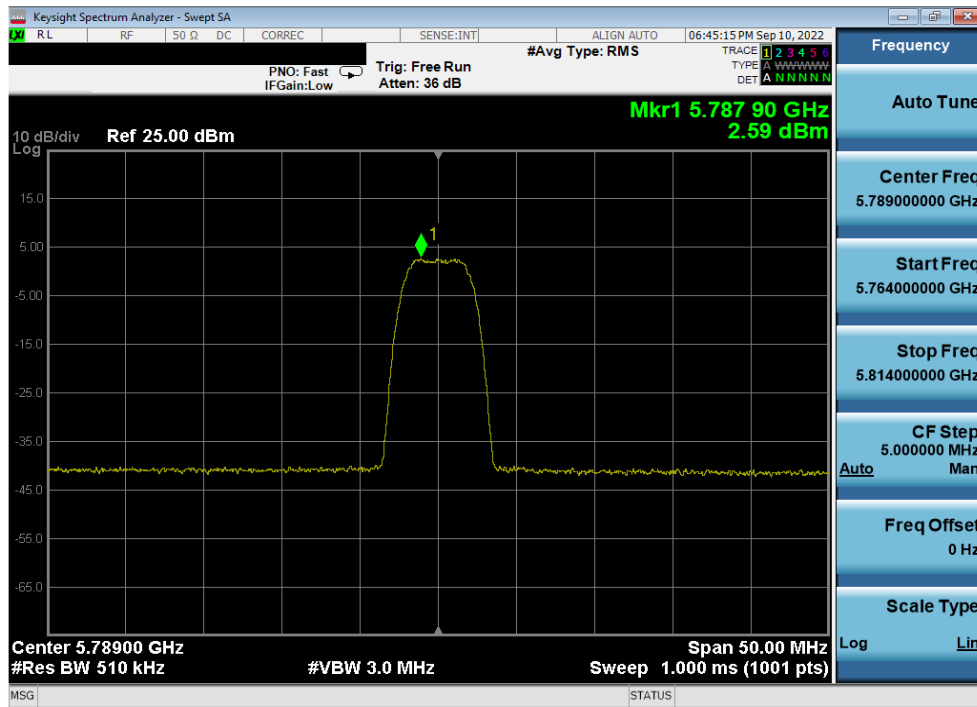


Plot 7-62. PSD Antenna 4a (HDR4, ePA, 5789MHz)

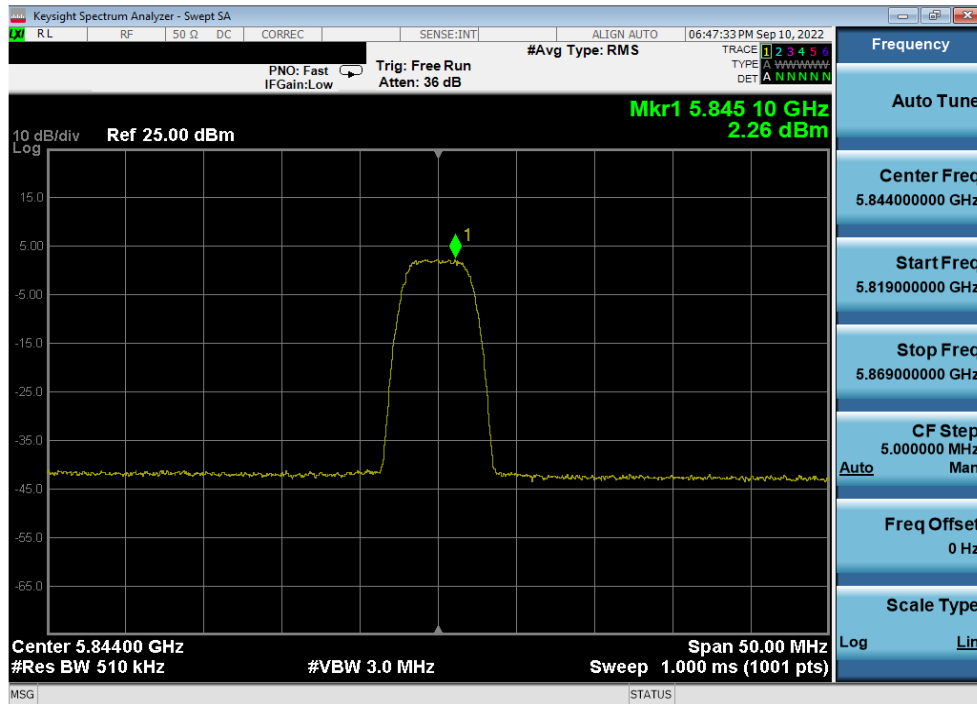
FCC ID: BCGA2435			MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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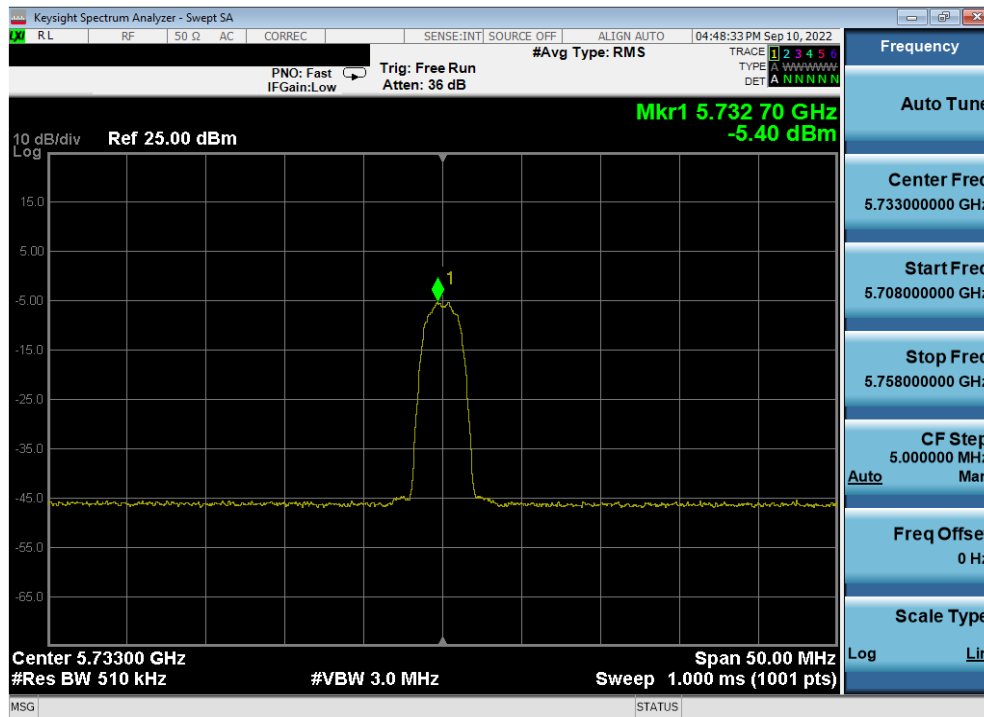


Plot 7-65. PSD Antenna 4a (HDR8, ePA, 5789MHz)

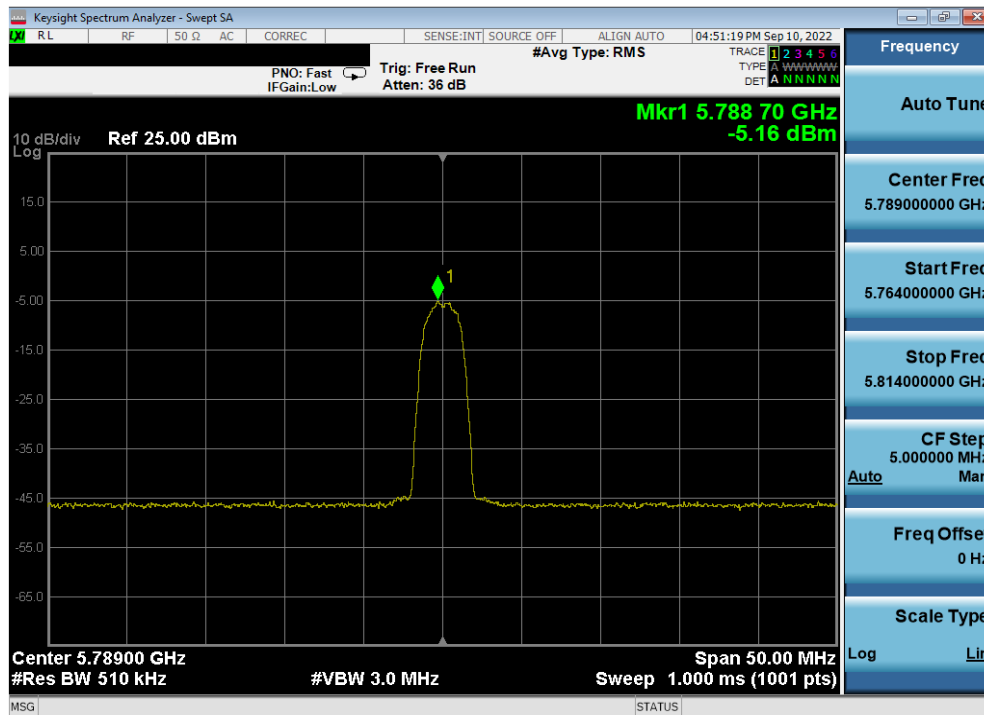


Plot 7-66. PSD Antenna 4a (HDR8, ePA, 5844MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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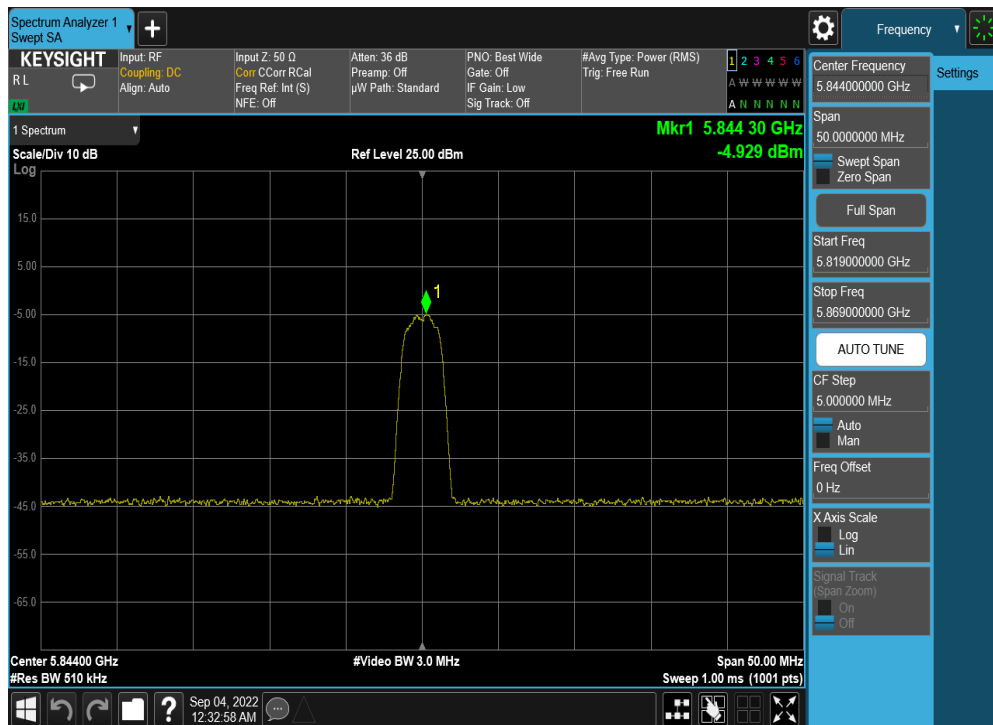


Plot 7-67. PSD Antenna 4a (HDR4, iPA, 5733MHz)

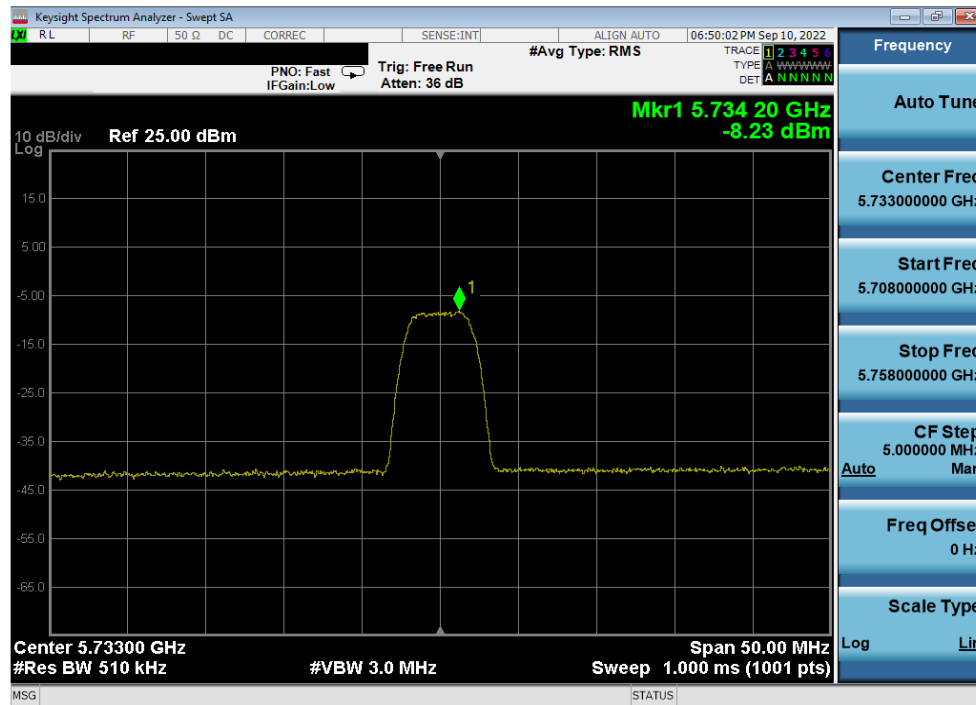


Plot 7-68. PSD Antenna 4a (HDR4, iPA, 5789MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 64 of 136

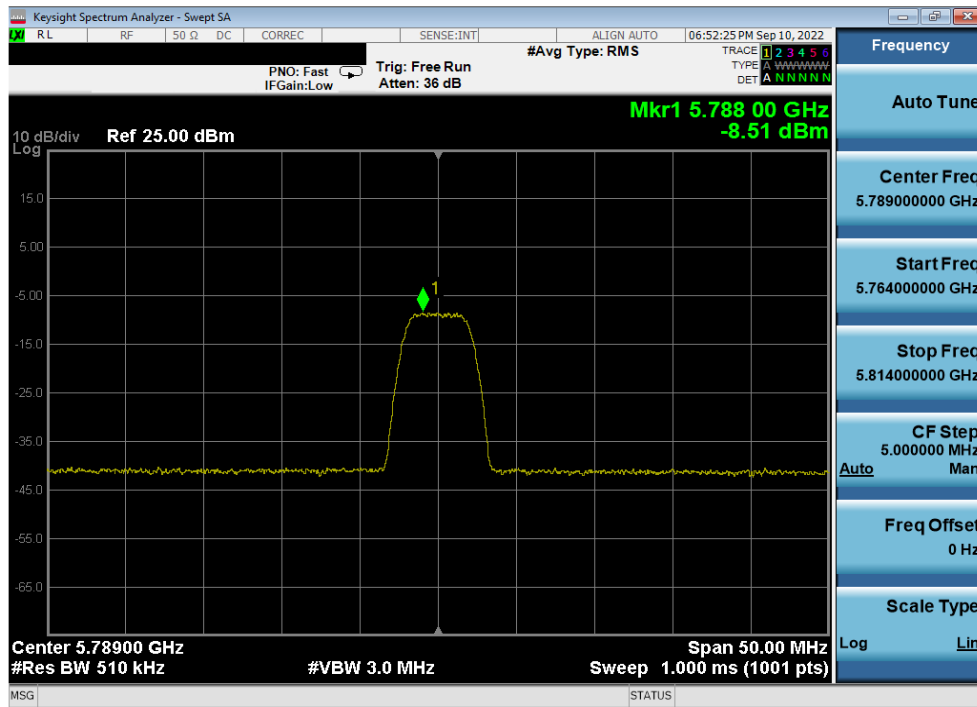


Plot 7-69. PSD Antenna 4a (HDR4, iPA, 5844MHz)

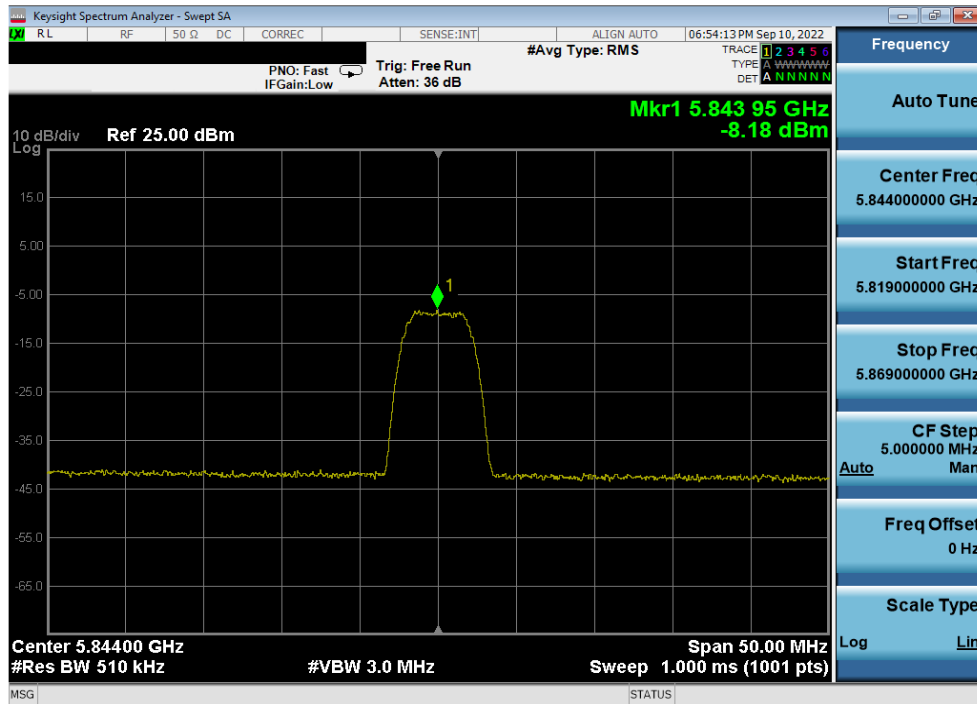


Plot 7-70. PSD Antenna 4a (HDR8, iPA, 5733MHz)

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 65 of 136



Plot 7-71. PSD Antenna 4a (HDR8, iPA, 5789MHz)



Plot 7-72. PSD Antenna 4a (HDR8, iPA, 5844MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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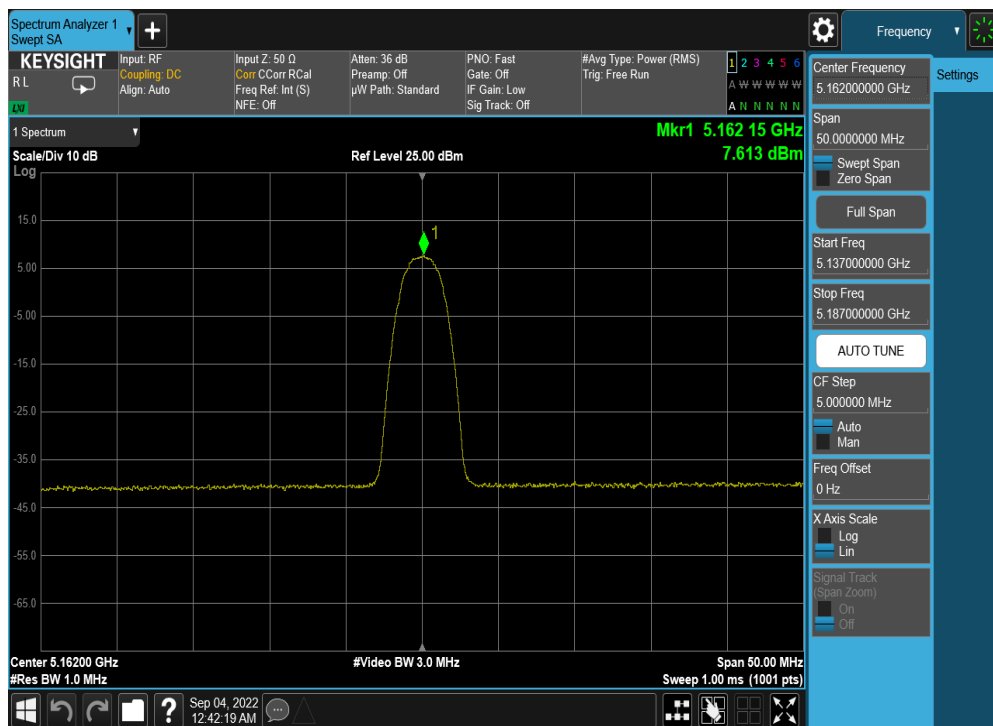
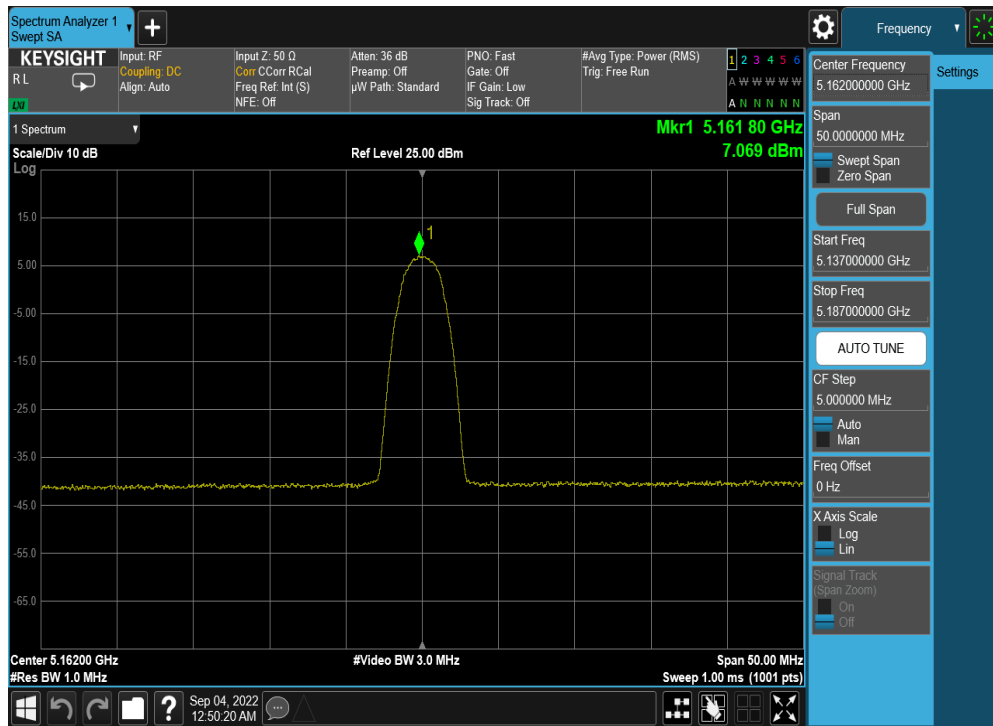
7.5.3 TxBF Power Spectral Density Measurements

	Frequency [MHz]	Mode	Power Scheme	Antenna 5b Power Density [dBm/MHz]	Antenna 4a Power Density [dBm/MHz]	Summed Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	HDR4	ePA	7.07	7.61	10.36	11.0	-0.64
	5204	HDR4	ePA	4.11	4.66	7.40	11.0	-3.60
	5245	HDR4	ePA	6.15	7.34	9.79	11.0	-1.21
	5162	HDR8	ePA	4.40	3.84	7.14	11.0	-3.86
	5204	HDR8	ePA	4.73	3.47	7.16	11.0	-3.84
	5245	HDR8	ePA	4.39	3.54	6.99	11.0	-4.01
	5162	HDR4	iPA	-3.41	-2.88	-0.13	11.0	-11.13
	5204	HDR4	iPA	-3.30	-2.89	-0.08	11.0	-11.08
	5245	HDR4	iPA	-6.10	-3.57	-1.65	11.0	-12.65
	5162	HDR8	iPA	-4.96	-6.52	-2.66	11.0	-13.66
	5204	HDR8	iPA	-4.25	-6.77	-2.32	11.0	-13.32
	5245	HDR8	iPA	-5.63	-7.23	-3.34	11.0	-14.34

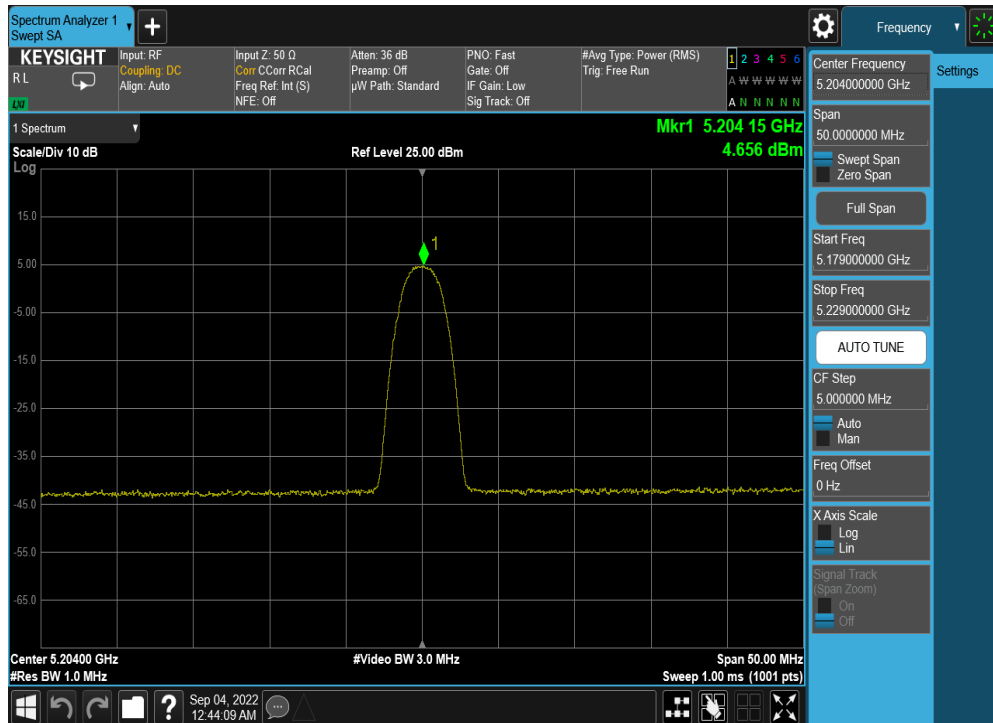
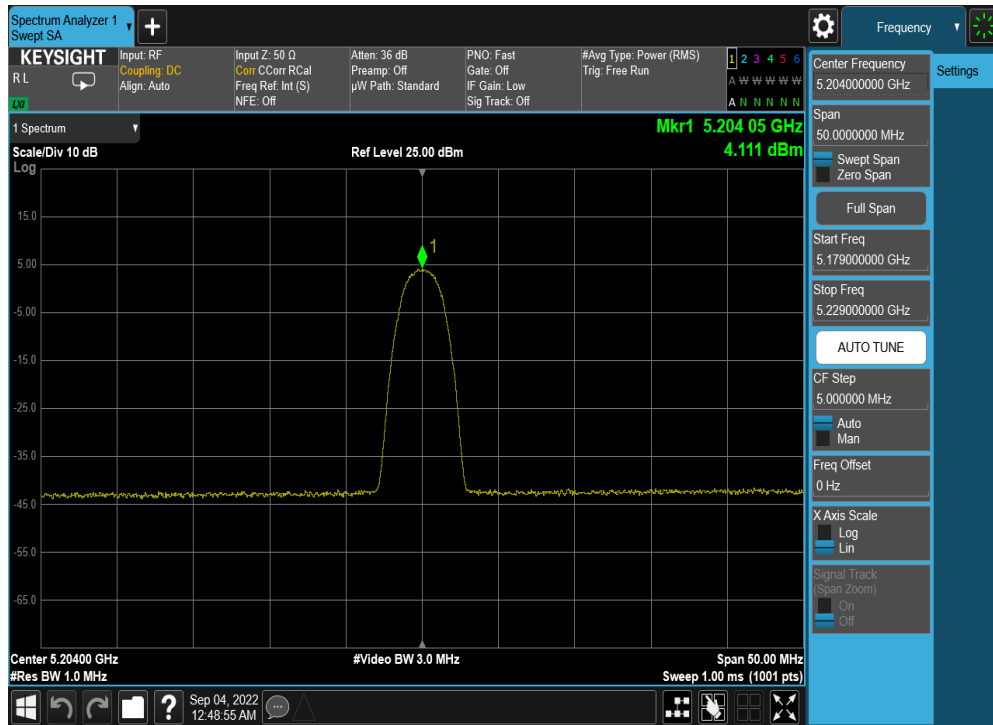
Table 7-13. Power Spectral Density Measurements

FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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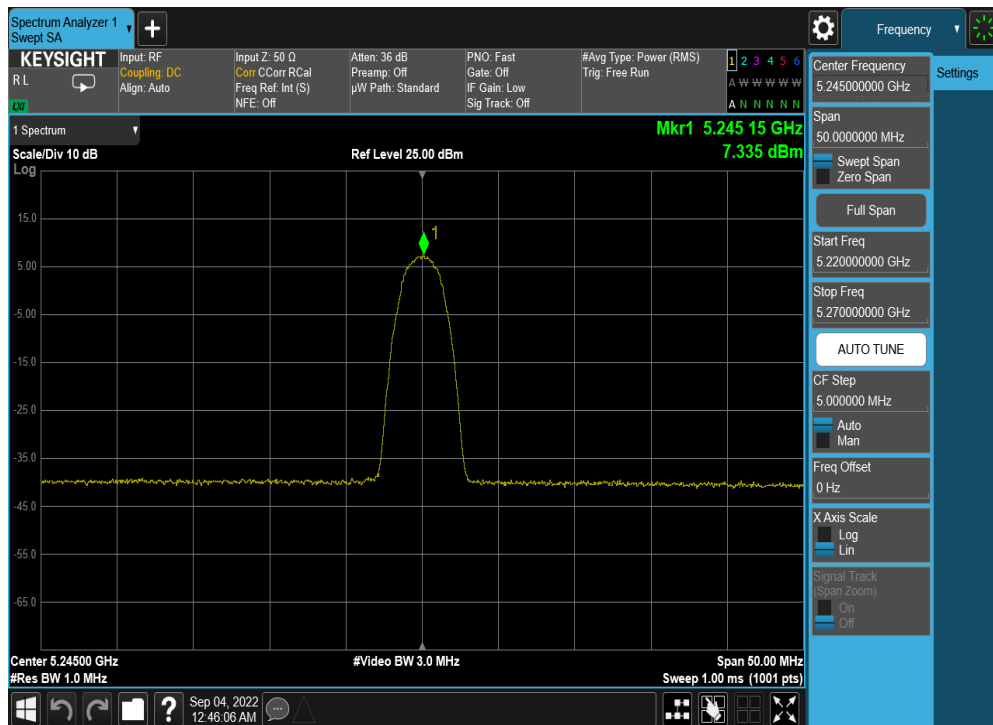
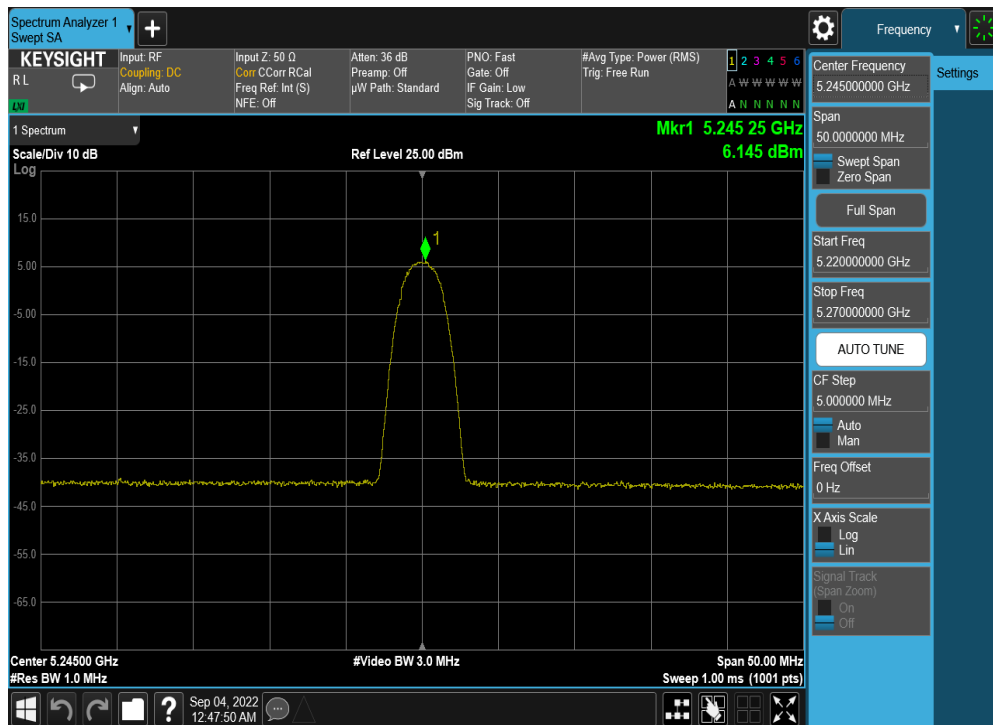
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1C2205090025-17.BCG	Test Dates: 05/30/2022 - 9/13/2022	EUT Type: Tablet Device	Page 68 of 136



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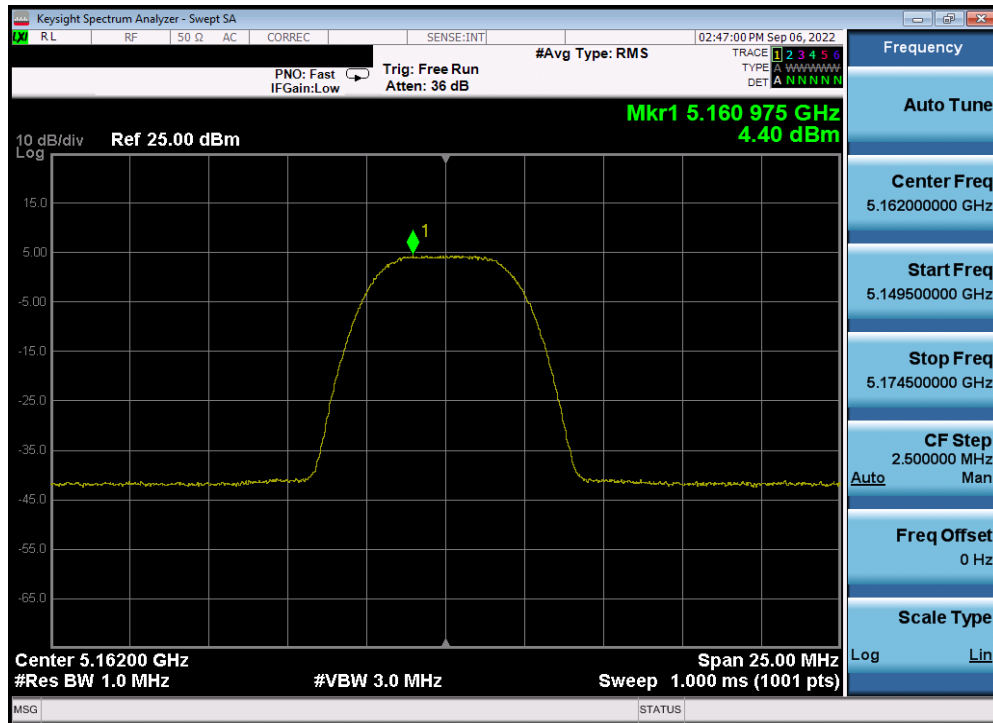
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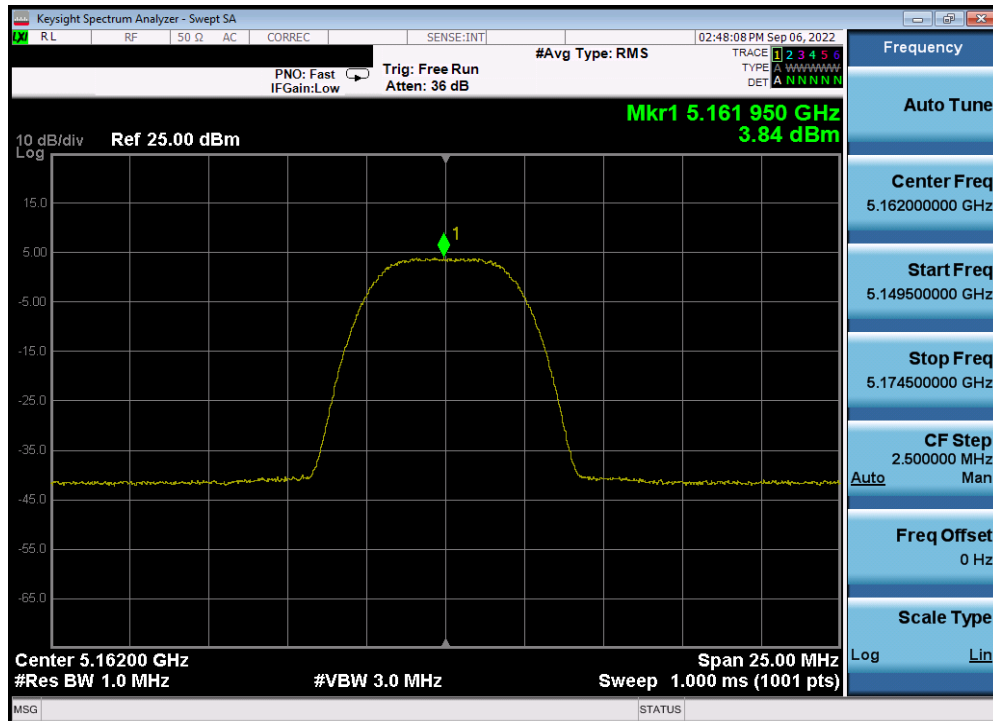
FCC ID: BCGA2435	 MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
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Plot 7-79. PSD TxBF Antenna 5b (HDR8, ePA, 5162MHz)



Plot 7-80. PSD TxBF Antenna 4a (HDR8, ePA, 5162MHz)

FCC ID: BCGA2435		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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