



Element Washington DC LLC

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DATA REFERENCE REPORT FCC PART 15.247 Narrowband UNII BDR

Applicant Name:

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

Date of Testing:

07/21/2022-9/27/2022

Test Site/Location:

Element Washington DC LLC, Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090029-15.BCG

FCC ID:	BCGA2437
APPLICANT:	Apple Inc.

Reference Model:

A2764

Variant Model:

A2437(A2766)

EUT Type:

Tablet Device

Frequency Range:

5162 – 5245MHz, 5733 – 5844MHz

Type of Modulation:

GFSK

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. 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 Ortiz

Executive Vice President



FCC ID: BCGA2437		DATA REFERENCE REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090029-15.BCG	Test Dates: 07/21/2022-9/27/2022	EUT Type: Tablet Device	Page 1 of 17

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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two tablet models, A2764 and A2437 (A2766), with high degree of similarity, reference model FCC ID: BCGA2764 and variant model **FCC ID: BCGA2437**. 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 approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2764, while radiated and conducted spot-check verification has been performed on variant model **FCC ID: BCGA2437**. 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	BCGA2764	1C2205090028-16.BCG	RF NB UNII BDR Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCGA2764 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 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.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2437**. 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 confirmed the following:
 - The hopping sequence is pseudorandom
 - 79 channels can be used at a time for hopping
 - The receiver input bandwidth equals the transmit bandwidth
 - The receiver hops in sequence with the transmit signal
 - Narrowband UNII can only hop within the same UNII band and cannot hop between bands

Test Device Serial No.: VT04VPHP2V, HHQXGQDW0V

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), NB UNII (1x, HDR4, HDR8), WPT

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

Table 2-1. NB UNII BDR Frequency / Channel Operations

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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:

Measured Duty Cycles							
Band	Mode		Duty Cycle [%]				
			Antenna 5b	Antenna 4a	TxBF		
UNII-1	GFSK	ePA	100	100	100		
		iPA	100	100	100		
UNII-3		ePA	100	100	100		
		iPA	100	100	100		

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

Notes:

1. All of the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 2 and reported in the RF Bluetooth and RF Part 96 test report.
2. Wi-Fi 2.4 GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. Specific 2.4 GHz Wi-Fi antenna that can only transmit simultaneously with 2.4 GHz Bluetooth antenna is listed in the SAR test report. 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.

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2.3 Antenna Description

Following antenna gain provided by manufacturer was used for testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4a
5.162 – 5.245	1.4	0.4
5.733 – 5.844	2.1	-1.3

Table 2-4. Highest Antenna Gain

2.4 Test Support Equipment

Test Support Equipment List					
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

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions. See Sections 7.2 for radiated emissions test setups.

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

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.

Per FCC Approved Data Referencing Test Plan, spot-check measurements have been conducted and reported. NB UNII (BDR) Spot-check Test Plan can be referred to below Table 2-6.

Technology	Test Case	FCC ID: BCGA2437	
		Mode	Channel
NB UNII	Radiated Spurious Emissions	Max Power Only ePA: GFSK	M

Table 2-6. FCC Approved Data Referencing Test Plan

Output powers were measured and confirmed to be consistent between Reference and Variant models prior to testing.

2.6 Software and Firmware

The test was conducted with firmware version 20A8359 installed in 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 Evaluations 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 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, 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.

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3.3 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 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

Notes:

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

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7.0 TEST RESULTS (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2437

FCC Classification: Unlicensed National Information Infrastructure (UNII)

Technology	Test Configurations					Reference Model		Variant Model		Delta	
	Test Description	Data Rate [Mbps]	Power Scheme	Channel Frequency [MHz]	Measurement Frequency [MHz]	FCC ID: BCGA2764	FCC ID: BCGA2437				
						Peak [dB μ V/m]	Average [dB μ V/m]	Peak [dB μ V/m]	Average [dB μ V/m]	Peak [dB]	Average [dB]
NB UNII	Radiated Spurious Emissions	1.0	ePA	5204	15612	54.35	42.91	53.70	43.09	0.65	-0.18
		1.0	ePA	5789	17367	56.62	-	58.41	-	-1.79	-

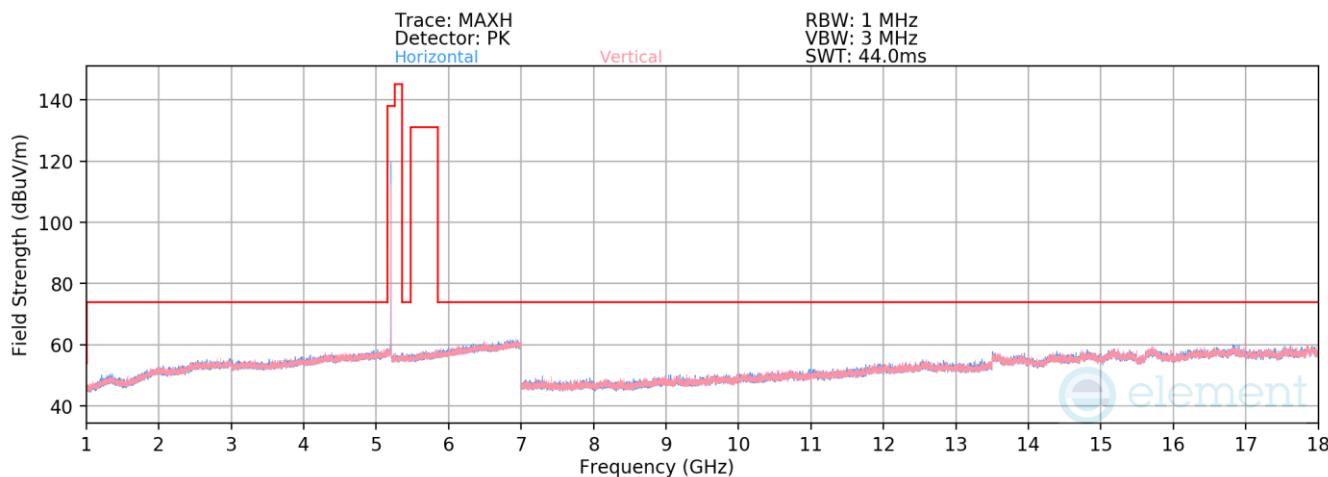
Table 7-1. Worst Case Spot-Check Results

Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC Approved Data Referencing Test Plan

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7.2 Radiated Spurious Emissions – Above 1GHz

§15.205 §15.209 §15.407(b); RSS-Gen [8.9]



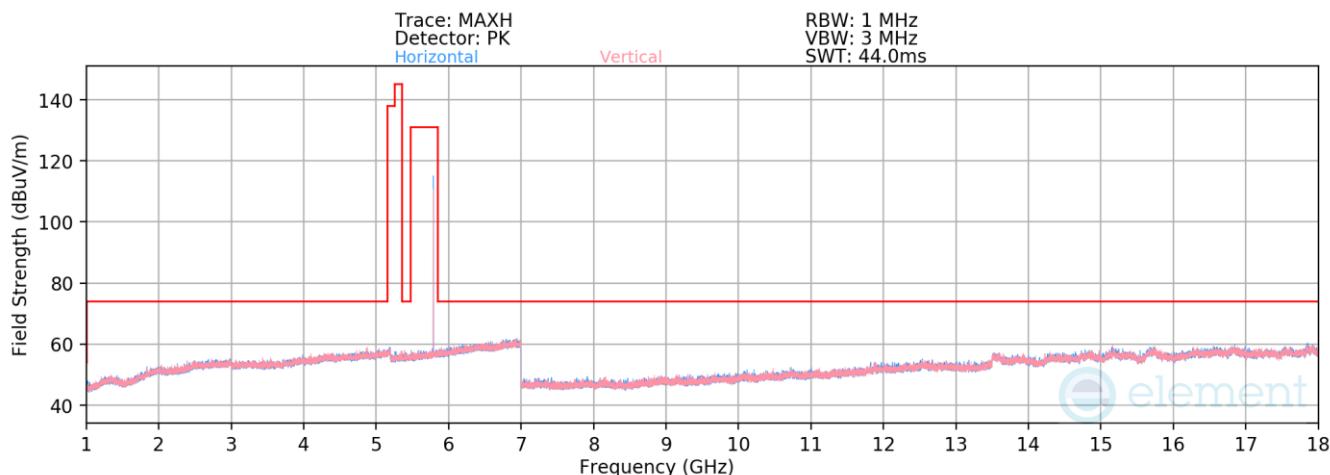
Plot 7-1. Radiated Spurious Emissions Above 1GHz TxBF (BT GFSK ePA – 5204MHz)

Bluetooth Mode: GFSK
 Worst Case Data Rate 1 Mbps
 Power Scheme ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 5204MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
10408.00	Peak	H	-	-	-74.34	14.02	48.66	68.20	-19.54
* 15612.00	Average	H	-	-	-84.17	18.06	43.09	53.98	-10.89
* 15612.00	Peak	H	-	-	-73.37	18.06	53.70	73.98	-20.28

Table 7-2. Radiated Measurements, TxBF

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Plot 7-2. Radiated Spurious Emissions Above 1GHz TxBF (BT GFSK ePA – 5789MHz)

Bluetooth Mode: GFSK
 Worst Case Data Rate 1 Mbps
 Power Scheme ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 5789MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
* 11578.00	Average	H	-	-	-83.26	16.48	40.22	53.98	-13.76
* 11578.00	Peak	H	-	-	-72.33	16.48	51.47	73.98	-22.51
17367.00	Peak	H	-	-	-72.35	23.30	58.41	68.20	-9.79

Table 7-3. Radiated Measurements, TxBF

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8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2437** is in tolerance with reference model FCC ID: BCGA2764 per FCC Approved Data Referencing Test Plan.

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9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2205090028-16.BCG) from reference model FCC ID: BCGA2764, which includes referenced data results.

FCC ID: BCGA2437	DATA REFERENCE REPORT (CERTIFICATION)		Approved by: Technical Manager
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V 1.0 3/13/2021

**MEASUREMENT REPORT**
FCC PART 15.407 Narrowband UNII BDR**Applicant Name:**

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

Date of Testing:

7/21/2022-9/27/2022

Test Site/Location:

Element Washington DC LLC, Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090028-16.BCG

FCC ID:	BCGA2764
APPLICANT:	Apple Inc.

Application Type:

Certification

Model/HVIN:

A2764

EUT Type:

Tablet Device

Frequency Range:

5162 – 5245MHz, 5733 – 5844MHz

Modulation Type:

GFSK

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 Ortiz
Executive Vice President

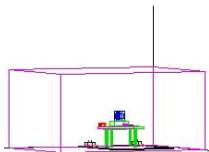


FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 1 of 100

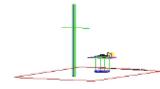
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MEASUREMENT REPORT



UNII Band	Tx Frequency (MHz)	Mode	Power Scheme	SISO				TxBF				Summed	
				Antenna 5b		Antenna 4a		Antenna 5b		Antenna 4a		Max. Power (mW)	Max. Power (dBm)
				Max. Power (mW)	Max. Power (dBm)								
1	5162 - 5245	GFSK	ePA	10.000	10.00	9.683	9.86	4.966	6.96	4.819	6.83	9.795	9.91
		GFSK	iPA	2.218	3.46	2.716	4.34	2.158	3.34	2.685	4.29	4.842	6.85
3	5733 - 5844	GFSK	ePA	60.534	17.82	12.190	10.86	62.517	17.96	12.388	10.93	74.989	18.75
		GFSK	iPA	3.141	4.97	3.972	5.99	3.133	4.96	3.936	5.95	6.982	8.44

FCC EUT Overview

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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V 10.5 12/15/2021

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.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2764**. 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.: Q26GK4Q9C7, M34YQC3PX6, LJFR9N4G07, DLX2237005M22Y21Z

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 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), NB UNII (1x, HDR4, HDR8), WPT.

This device supports BT Beamforming.

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

Table 2-1. NB UNII BDR Frequency / Channel 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 B2(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:

Measured Duty Cycles						
Band	Mode	Duty Cycle [%]				
		Antenna 5b	Antenna 4a	TxBF		
UNII-1	GFSK	ePA	100.0	100.0	100.0	
		iPA	100.0	100.0	100.0	
UNII-3		ePA	100.0	100.0	100.0	
		iPA	100.0	100.0	100.0	

Table 2-2. Measured Duty Cycles

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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:

1. All of the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 2 and reported in the RF Bluetooth and RF Part 96 test report.
2. Wi-Fi 2.4 GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. Specific 2.4 GHz Wi-Fi antenna that can only transmit simultaneously with 2.4 GHz Bluetooth antenna is listed in the SAR test report. 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.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 5b	Antenna 4a
5.162 – 5.245	1.4	0.4
5.733 – 5.844	2.1	-1.3

Table 2-4. Highest Antenna Gain

2.4 Test Support Equipment

Test Support Equipment List				
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

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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, and 7.5 for antenna port conducted emissions test setups.

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

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 EUT powered by AC/DC was the worst case.

- 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: BCGA2764

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; 15.209	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 – BDR

[\\$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

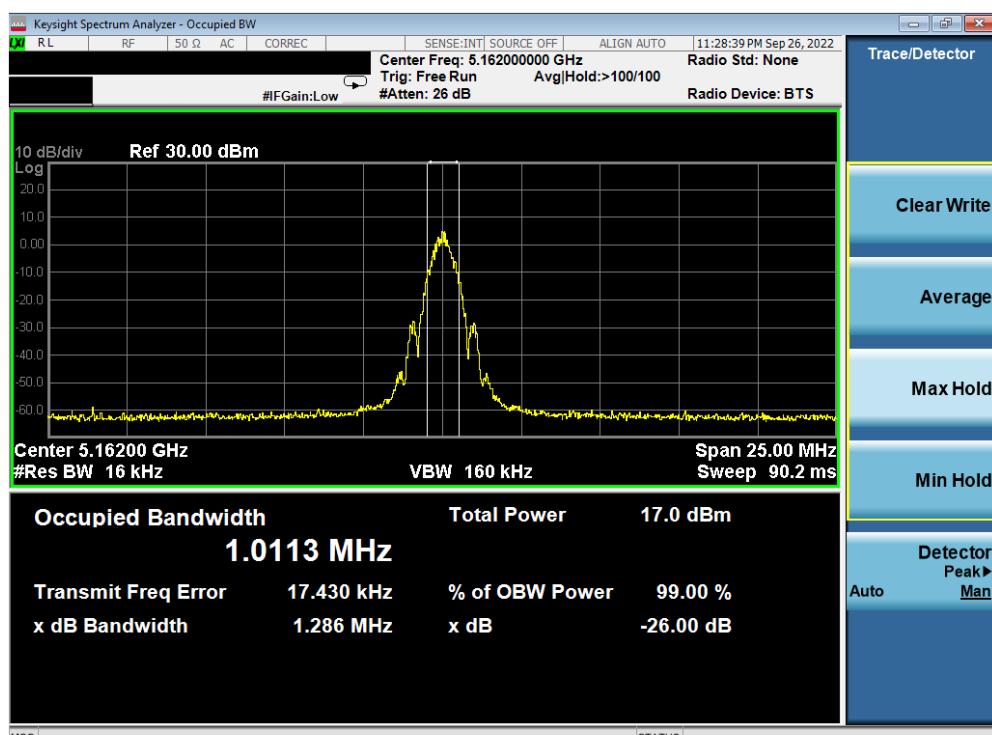
All antenna configs and power schemes were investigated and only the worst case is reported.

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 5b 26dB & 99% Bandwidth Measurements

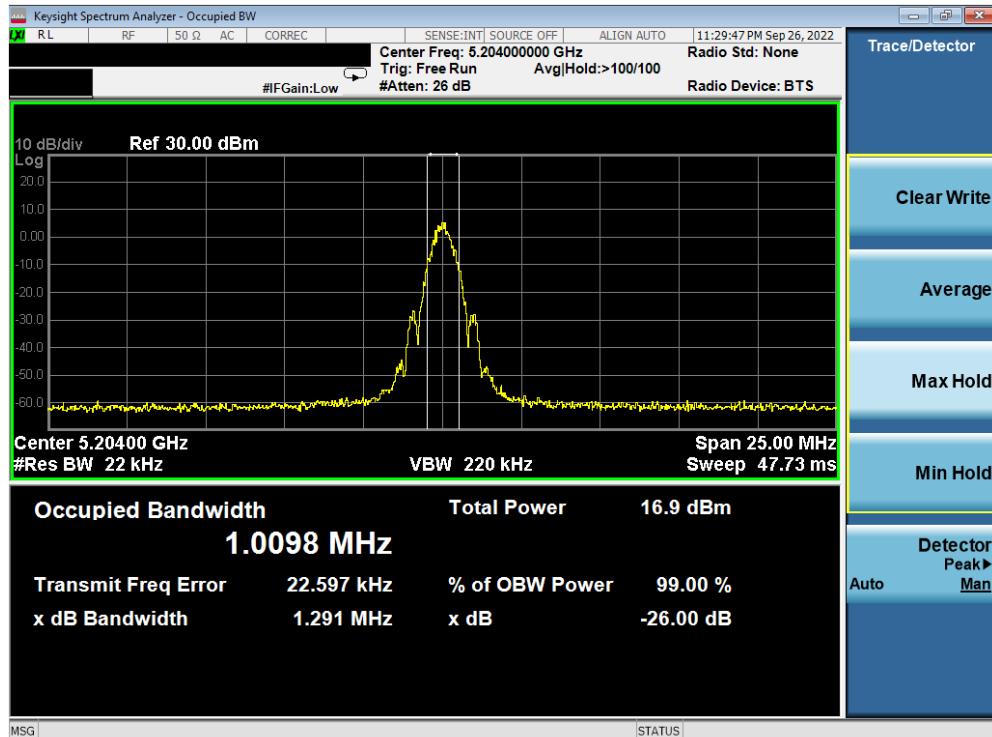
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	GFSK	1	ePA	1.0113	1.2860
	5204	GFSK	1	ePA	1.0098	1.2910
	5245	GFSK	1	ePA	1.0053	1.2890

Table 7-2. Conducted BW Measurements Antenna 5b

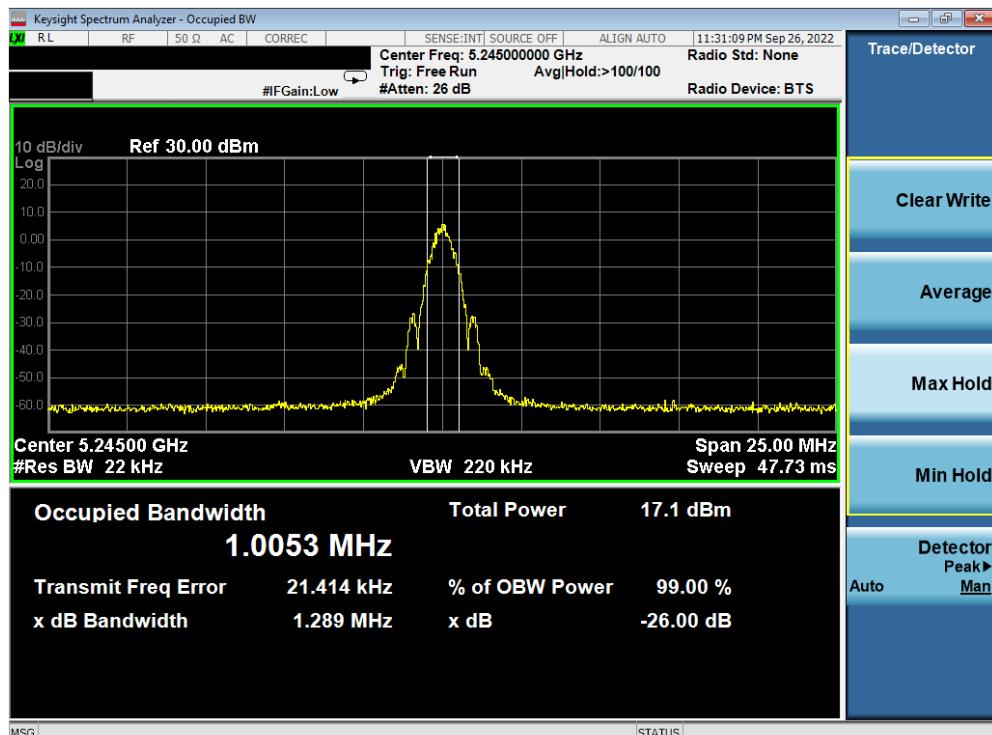


Plot 7-1. 26dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5162MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-2. 26dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5204MHz)



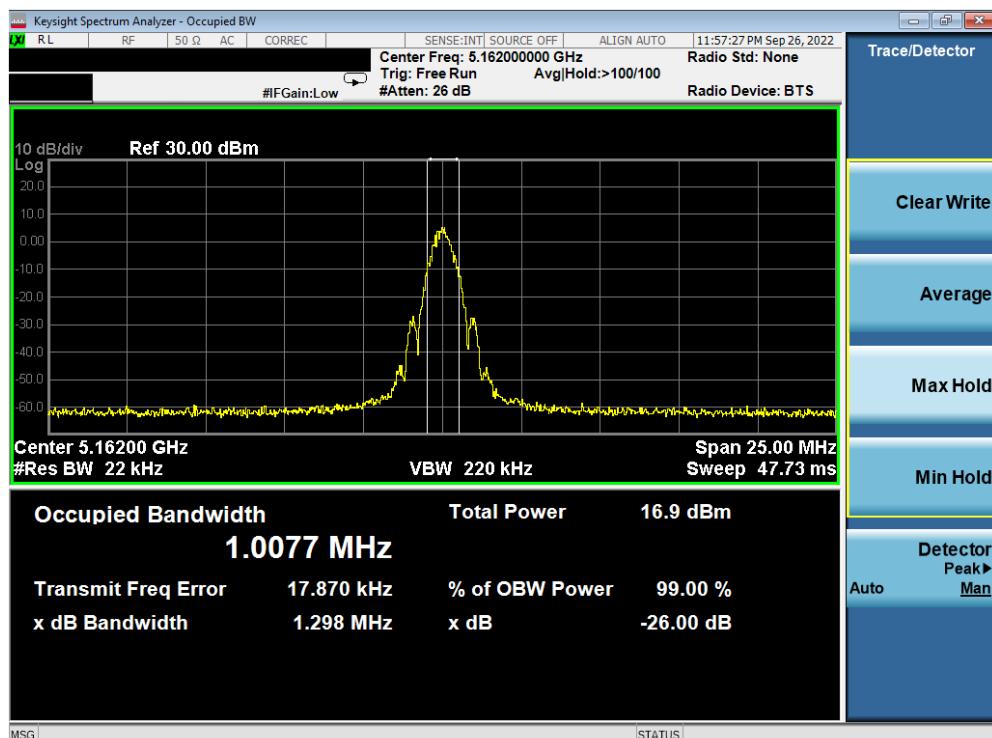
Plot 7-3. 26dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5245MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Antenna 4a 26dB & 99% Bandwidth Measurements

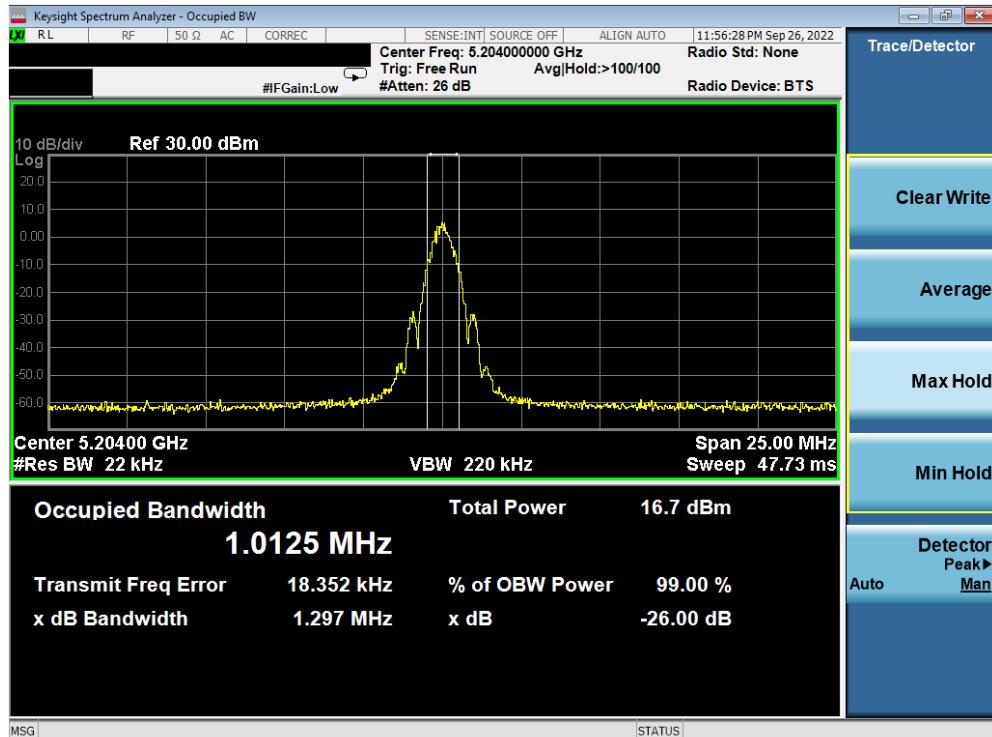
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	GFSK	1	ePA	1.0077	1.2980
	5204	GFSK	1	ePA	1.0125	1.2970
	5245	GFSK	1	ePA	1.0147	1.2990

Table 7-3. Conducted BW Measurements Antenna 4a

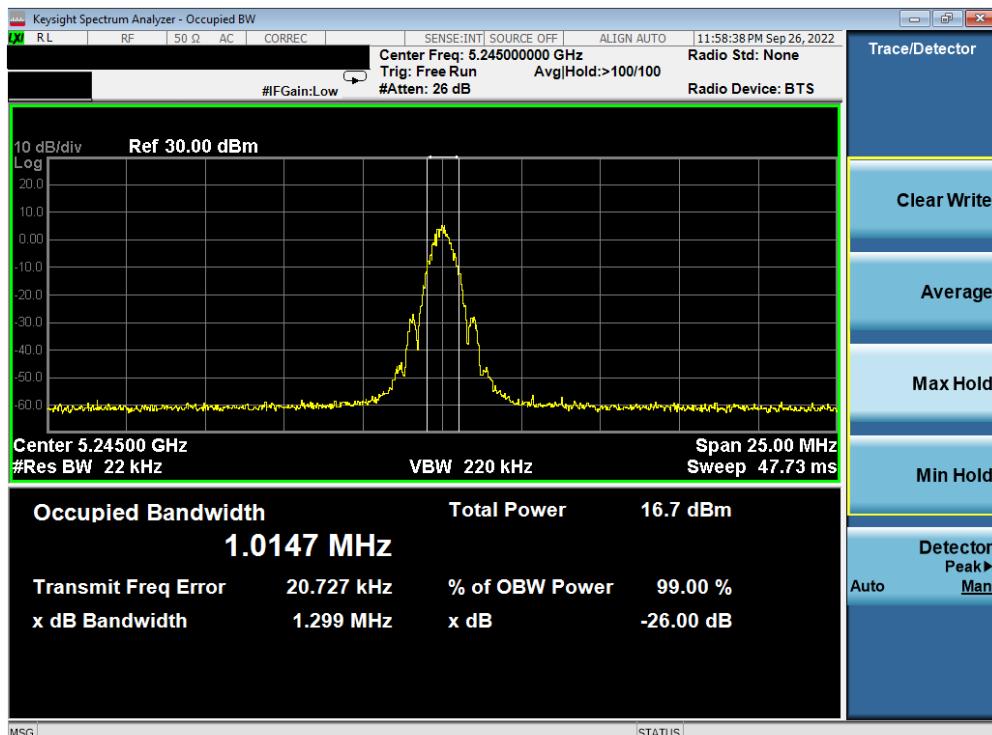


Plot 7-4. 26dB BW & 99% OBW Antenna 4a (BDR GFSK – 5162MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-5. 26dB BW & 99% OBW Antenna 4a (BDR GFSK, ePA – 5204MHz)



Plot 7-6. 26dB BW & 99% OBW Antenna 4a (BDR GFSK, ePA – 5245MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 18 of 100

7.3 6dB & 99% Bandwidth Measurement – BDR

§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

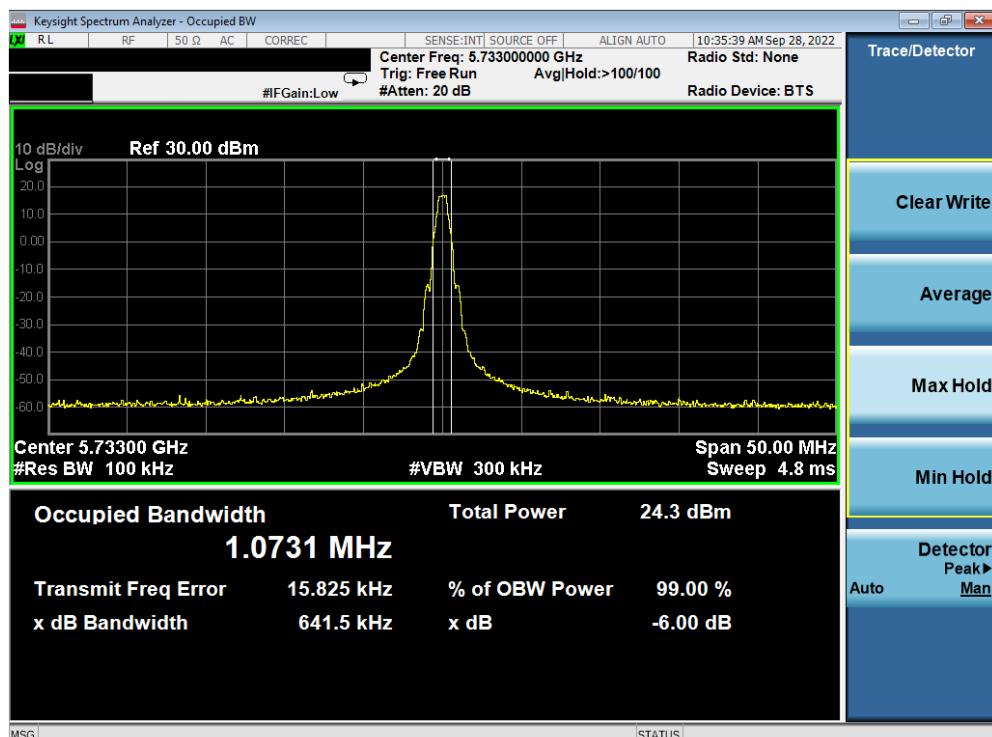
All antenna configurations and power schemes were investigated and only the worst case is reported.

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.3.1 Antenna 5b 6dB & 99% Bandwidth Measurements

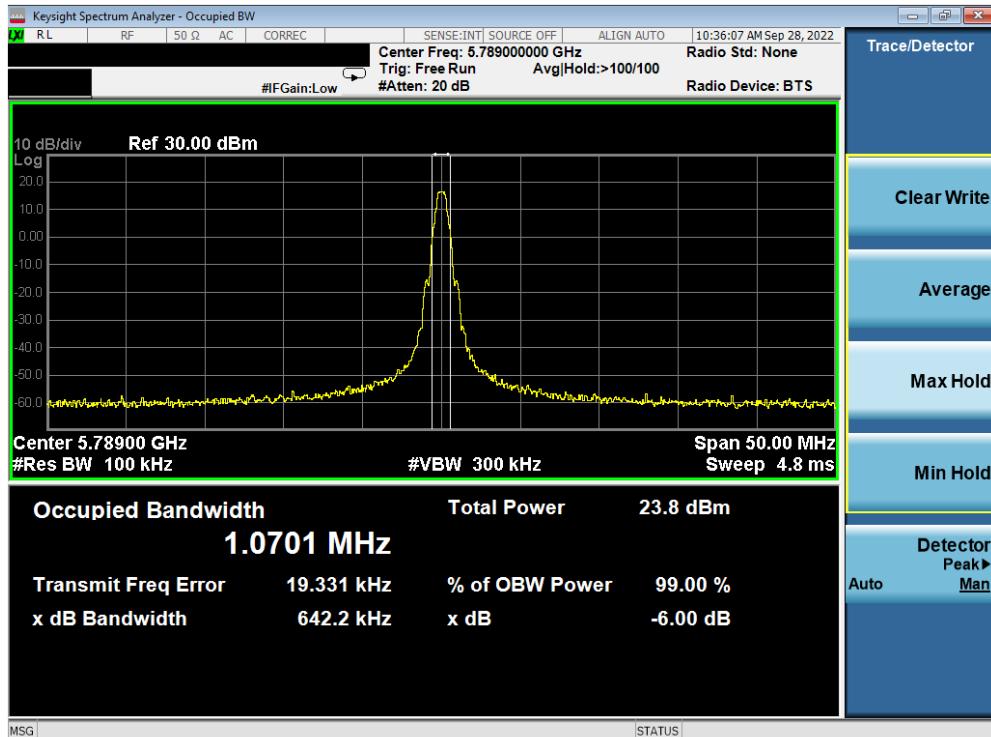
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	GFSK	1	ePA	1.0731	0.6415	0.500	Pass
	5789	GFSK	1	ePA	1.0701	0.6422	0.500	Pass
	5844	GFSK	1	ePA	1.0731	0.6396	0.500	Pass

Table 7-4. Conducted BW Measurements Antenna 5b

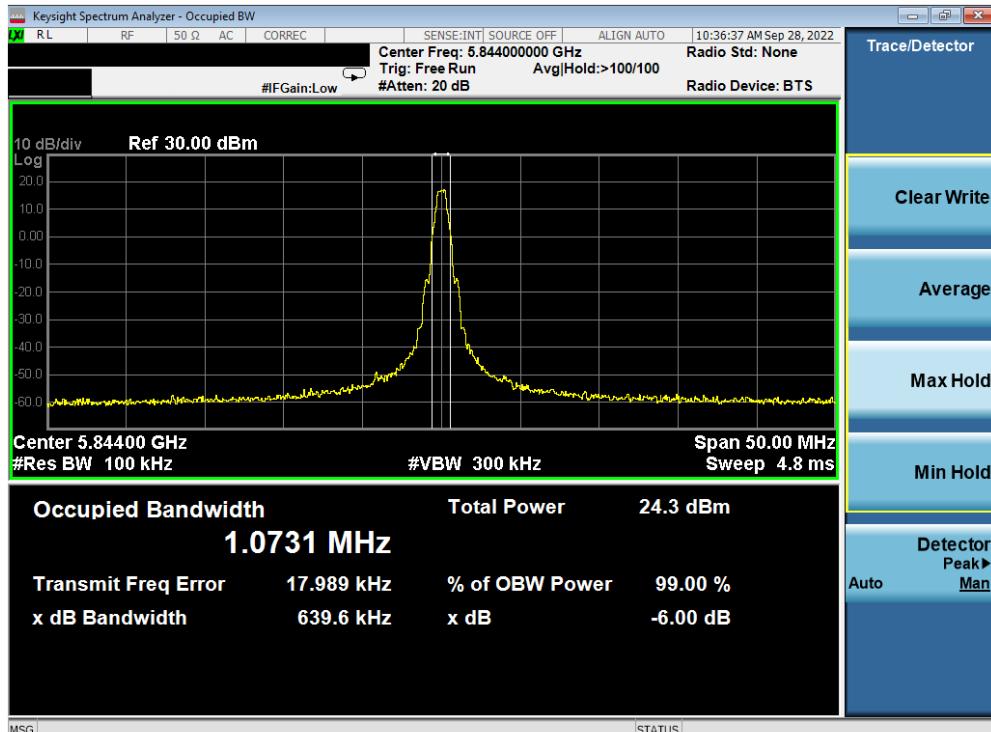


Plot 7-7. 6dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-8. 6dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5789MHz)



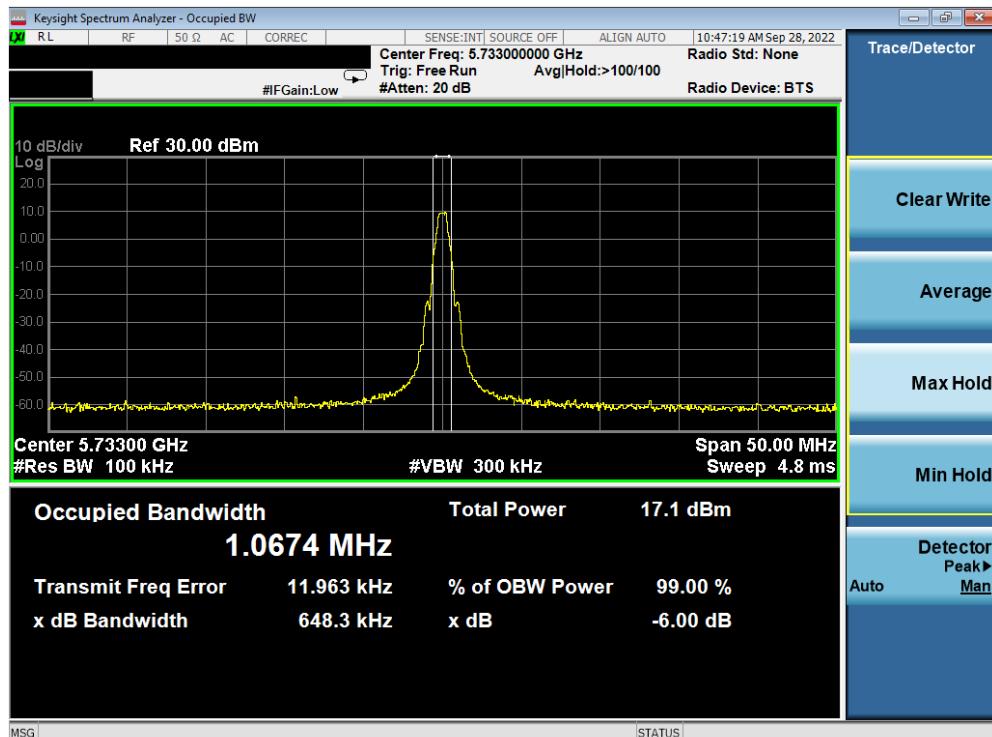
Plot 7-9. 6dB BW & 99% OBW Antenna 5b (BDR GFSK, ePA – 5844MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 21 of 100

7.3.2 Antenna 4a 6dB & 99% Bandwidth Measurements

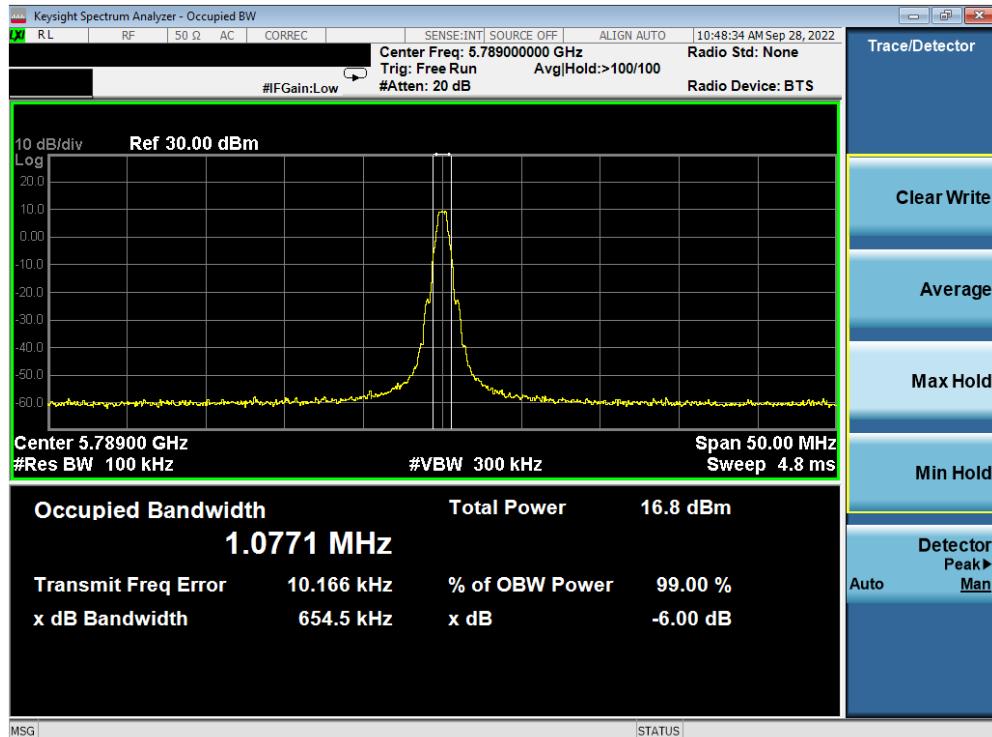
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	GFSK	1	ePA	1.0674	0.6483	0.500	Pass
	5789	GFSK	1	ePA	1.0771	0.6545	0.500	Pass
	5844	GFSK	1	ePA	1.0746	0.6596	0.500	Pass

Table 7-5. Conducted BW Measurements Antenna 4a

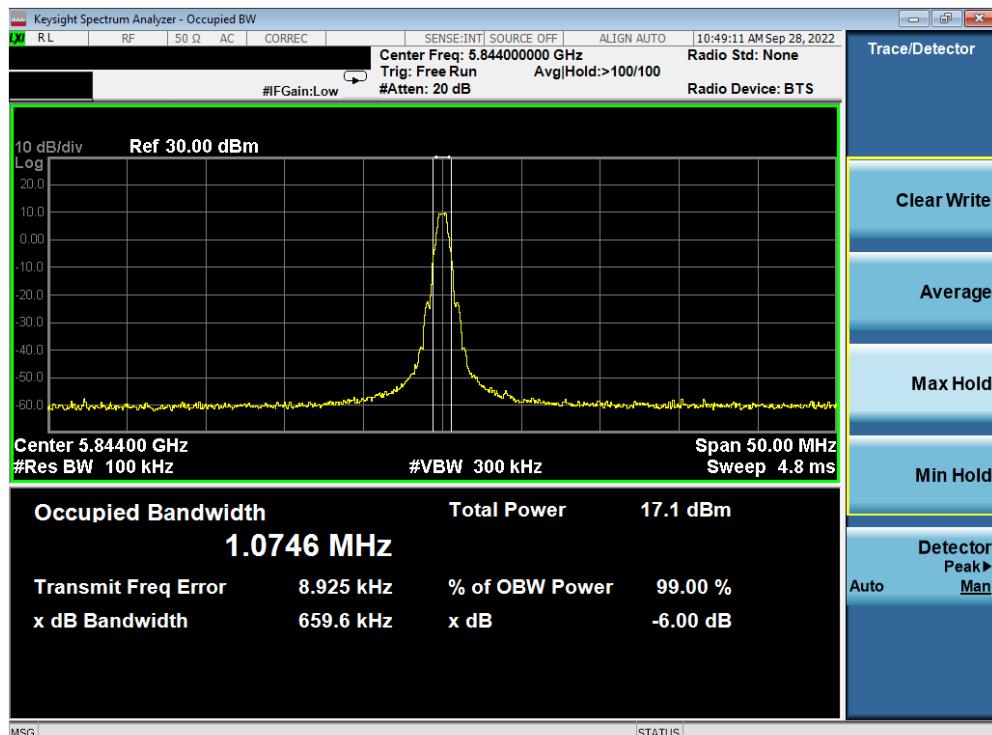


Plot 7-10. 6dB BW & 99% OBW Antenna 4a (BDR GFSK, ePA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-11. 6dB BW & 99% OBW Antenna 4a (BDR GFSK, ePA – 5789MHz)



Plot 7-12. 6dB BW & 99% OBW Antenna 4a (BDR GFSK, ePA – 5844MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 23 of 100

7.4 Conducted Output Power and Max EIRP Measurement – BDR

§15.407(a.1.iv) §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

ANSI C63.10-2013 – Subclause 14.2 Measure-and-Sum Technique

KDB 662911 v02r01 – Section E)1) Measure-and-Sum Technique

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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Antenna 5b Conducted Output Power Measurements

Freq [MHz]	Detector	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	ePA	9.76	23.98	-14.22
5204	AVG	ePA	9.73	23.98	-14.25
5245	AVG	ePA	10.00	23.98	-13.98
5162	AVG	iPA	3.46	23.98	-20.52
5204	AVG	iPA	3.43	23.98	-20.55
5245	AVG	iPA	3.44	23.98	-20.54
5733	AVG	ePA	17.65	30.00	-12.35
5789	AVG	ePA	17.78	30.00	-12.22
5844	AVG	ePA	17.82	30.00	-12.18
5733	AVG	iPA	4.58	30.00	-25.42
5789	AVG	iPA	4.70	30.00	-25.30
5844	AVG	iPA	4.97	30.00	-25.03

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

Antenna 4a Conducted Output Power Measurements

Freq [MHz]	Detector	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	ePA	9.57	23.98	-14.41
5204	AVG	ePA	9.77	23.98	-14.21
5245	AVG	ePA	9.86	23.98	-14.12
5162	AVG	iPA	4.26	23.98	-19.72
5204	AVG	iPA	4.34	23.98	-19.64
5245	AVG	iPA	4.23	23.98	-19.75
5733	AVG	ePA	10.86	30.00	-19.14
5789	AVG	ePA	10.77	30.00	-19.23
5844	AVG	ePA	10.67	30.00	-19.33
5733	AVG	iPA	5.99	30.00	-24.01
5789	AVG	iPA	5.79	30.00	-24.21
5844	AVG	iPA	5.72	30.00	-24.28

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

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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TxBF Conducted Output Power Measurements

Freq [MHz]	Detector	Power Scheme	Conducted Powers [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			Antenna 5b	Antenna 4a	Summed		
5162	AVG	ePA	6.82	6.63	9.74	23.98	-14.24
5204	AVG	ePA	6.79	6.80	9.81	23.98	-14.17
5245	AVG	ePA	6.96	6.83	9.91	23.98	-14.07
5162	AVG	iPA	3.14	4.13	6.67	23.98	-17.31
5204	AVG	iPA	3.28	4.28	6.82	23.98	-17.16
5245	AVG	iPA	3.34	4.29	6.85	23.98	-17.13
5733	AVG	ePA	17.96	10.93	18.75	30.00	-11.25
5789	AVG	ePA	17.62	10.75	18.43	30.00	-11.57
5844	AVG	ePA	17.65	10.52	18.42	30.00	-11.58
5733	AVG	iPA	4.84	5.95	8.44	30.00	-21.56
5789	AVG	iPA	4.58	5.60	8.13	30.00	-21.87
5844	AVG	iPA	4.96	5.56	8.28	30.00	-21.72

Table 7-8. FCC TxBF Maximum Conducted Output Power

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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V 10.5 12/15/2021

**Note:**

Per ANSI C63.10-2013 and KDB 662911 v02r01 Section E)1), 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 output power was measured to be 6.82 dBm for Antenna 5b and 6.63 dBm for Antenna 4a.

Antenna 5b + Antenna 4a = TxBF

$$(6.82 \text{ dBm} + 6.63 \text{ dBm}) = (4.808 \text{ mW} + 4.603 \text{ mW}) = 9.411 \text{ mW} = 9.74 \text{ dBm}$$

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.5 Maximum Power Spectral Density – BDR

§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

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

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

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

FCC ID: BCGA2764	 element		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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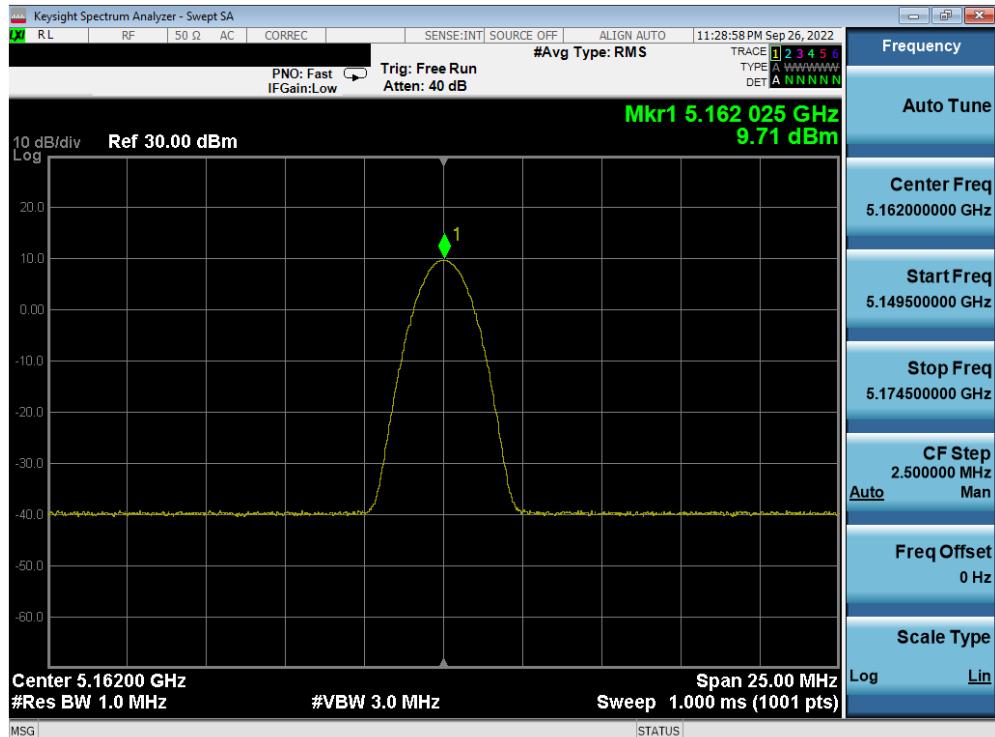


Antenna 5b Power Spectral Density Measurements

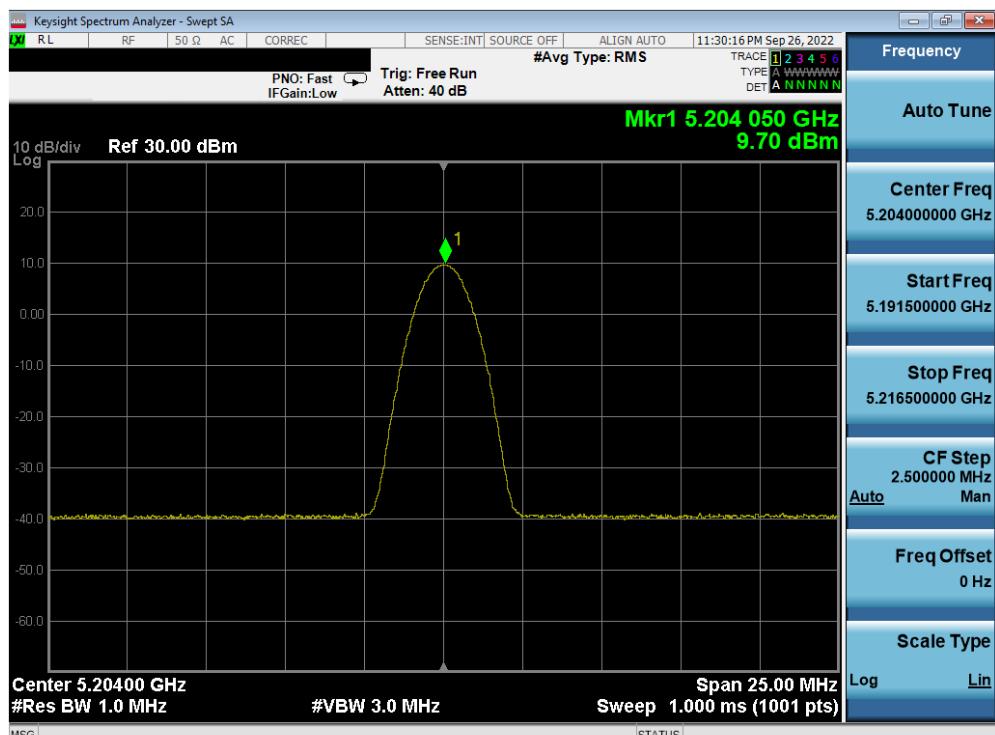
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	GFSK	1	ePA	9.71	11.0	-1.29
	5204	GFSK	1	ePA	9.70	11.0	-1.30
	5245	GFSK	1	ePA	9.81	11.0	-1.19
	5162	GFSK	1	iPA	3.24	11.0	-7.76
	5204	GFSK	1	iPA	2.98	11.0	-8.02
	5245	GFSK	1	iPA	3.16	11.0	-7.84

Table 7-9. Power Spectral Density Measurements Antenna 5b

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 29 of 100

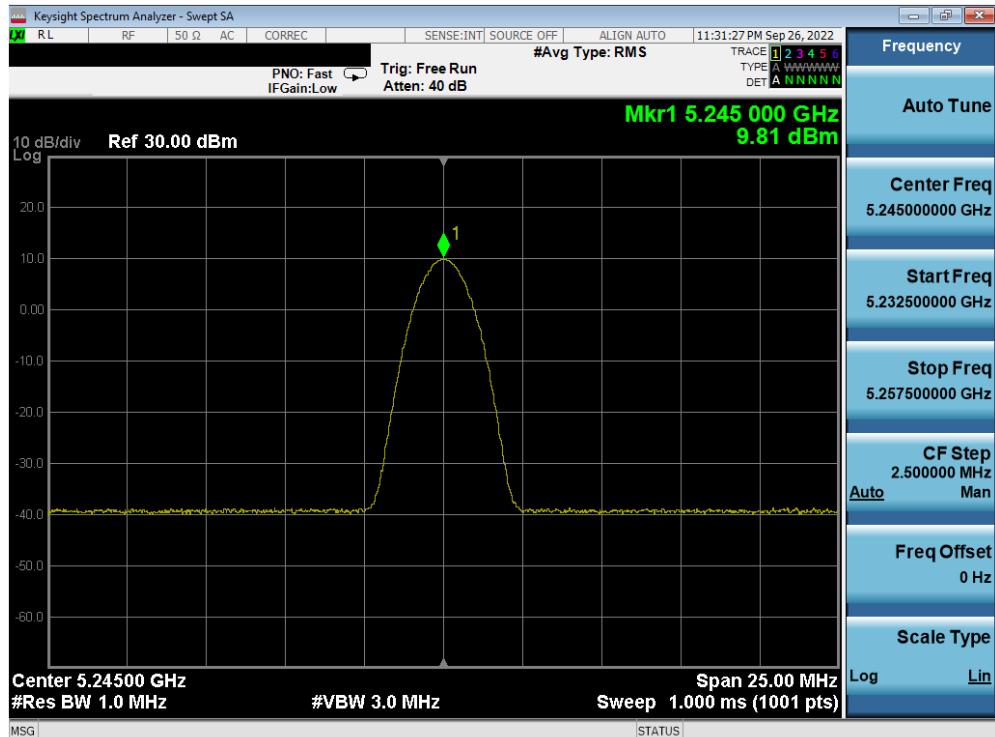


Plot 7-13. PSD Antenna 5b (BDR GFSK, ePA, – 5162MHz)

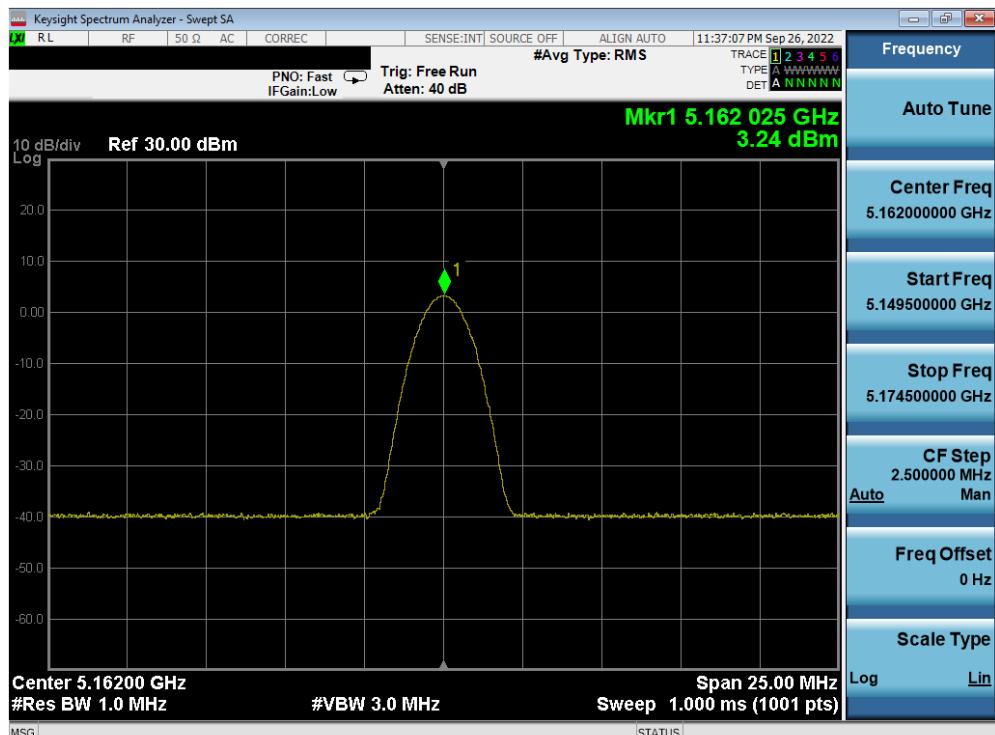


Plot 7-14. PSD Antenna 5b (BDR GFSK, ePA – 5204MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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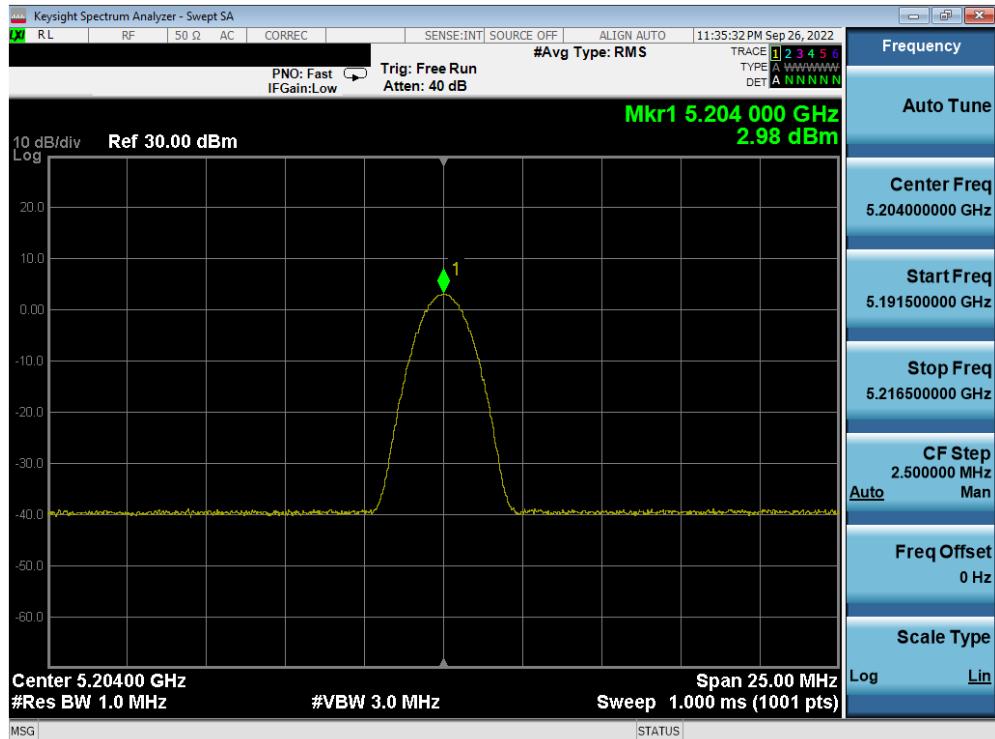


Plot 7-15. PSD Antenna 5b (BDR GFSK, ePA – 5245MHz)

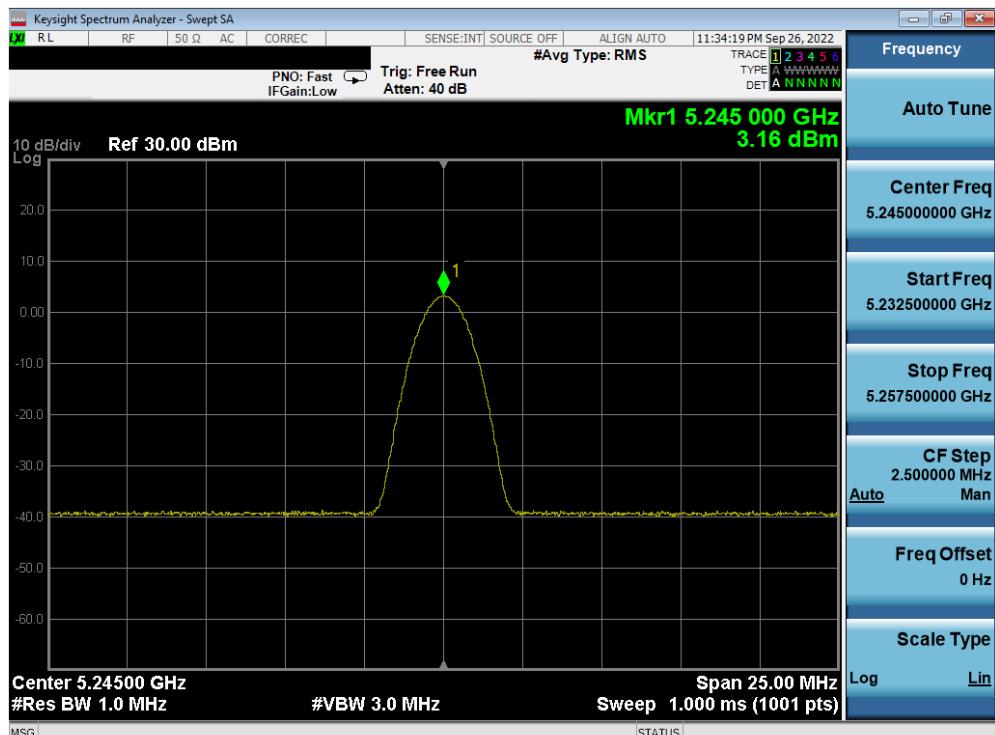


Plot 7-16. PSD Antenna 5b (BDR GFSK, iPA – 5162MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 31 of 100



Plot 7-17. PSD Antenna 5b (BDR GFSK, iPA, – 5204MHz)



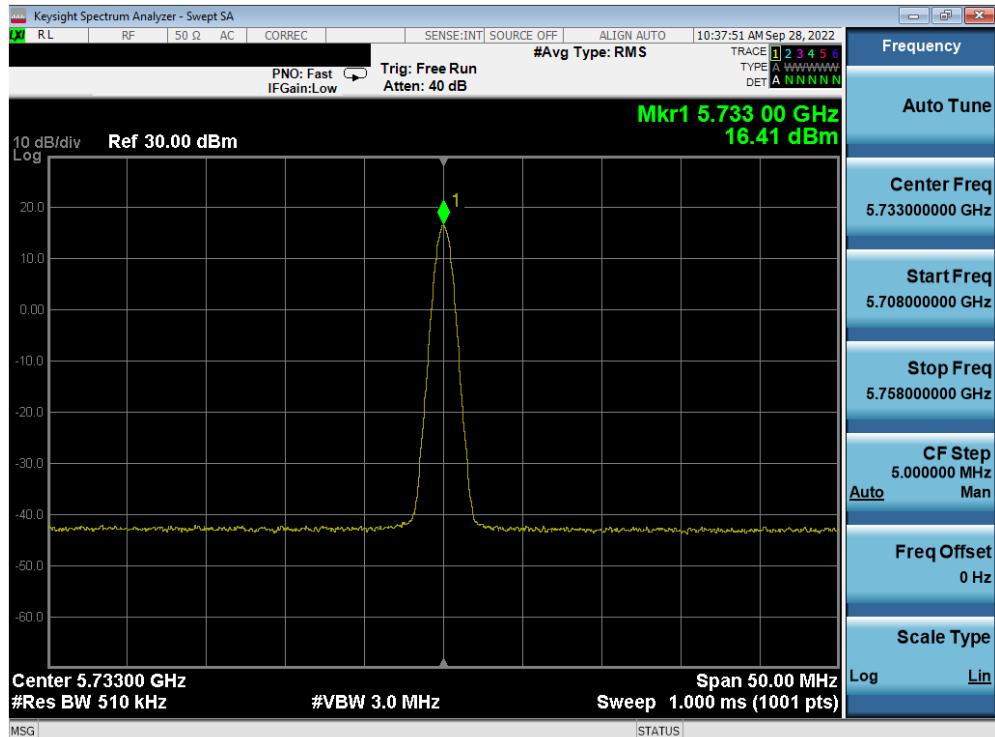
Plot 7-18. PSD Antenna 5b (BDR GFSK, iPA – 5245MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 32 of 100

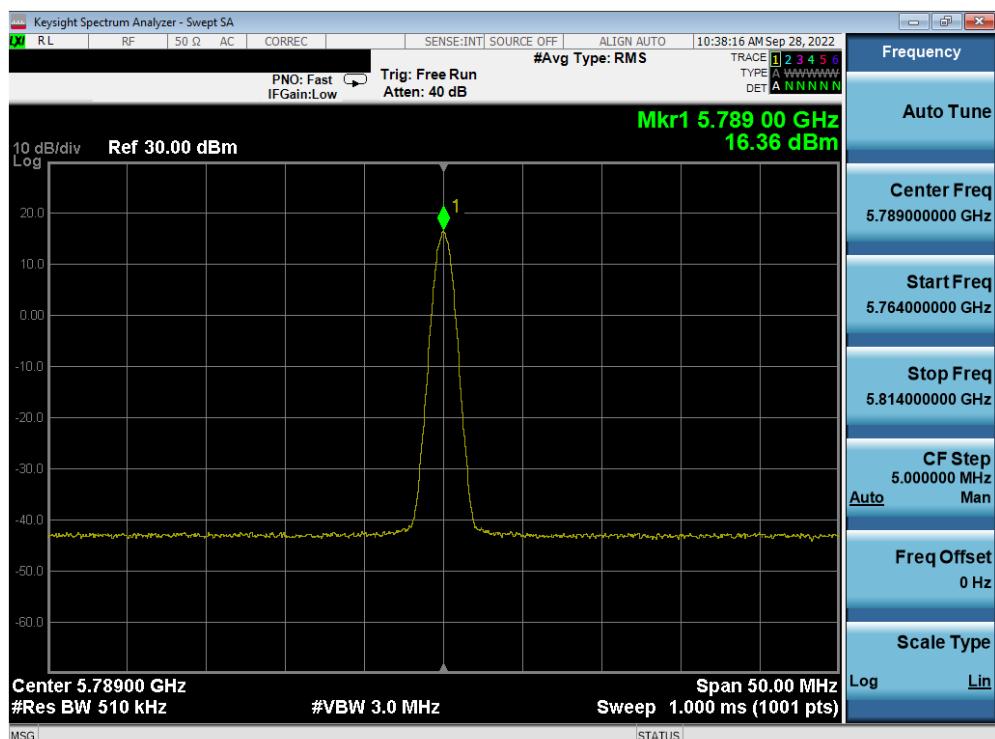
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	GFSK	1	ePA	16.41	30.0	-13.59
	5789	GFSK	1	ePA	16.36	30.0	-13.64
	5844	GFSK	1	ePA	16.61	30.0	-13.39
	5733	GFSK	1	iPA	3.37	30.0	-26.63
	5789	GFSK	1	iPA	3.16	30.0	-26.84
	5844	GFSK	1	iPA	3.72	30.0	-26.28

Table 7-10. Power Spectral Density Measurements Antenna 5b

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 33 of 100

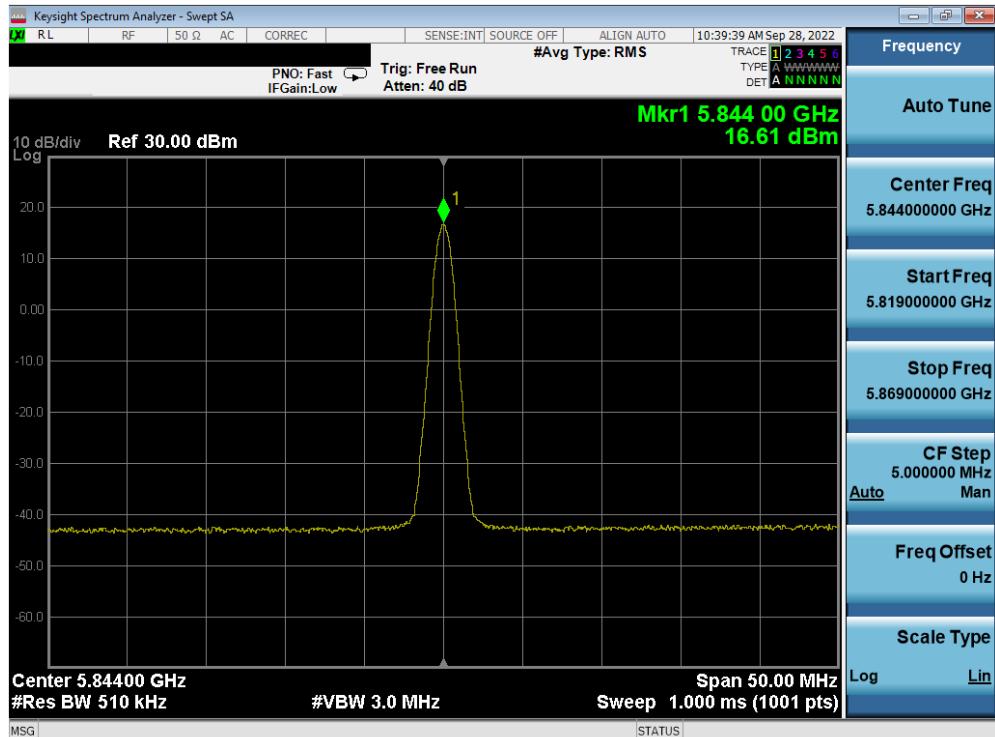


Plot 7-19. PSD Antenna 5b (BDR GFSK, ePA – 5733MHz)

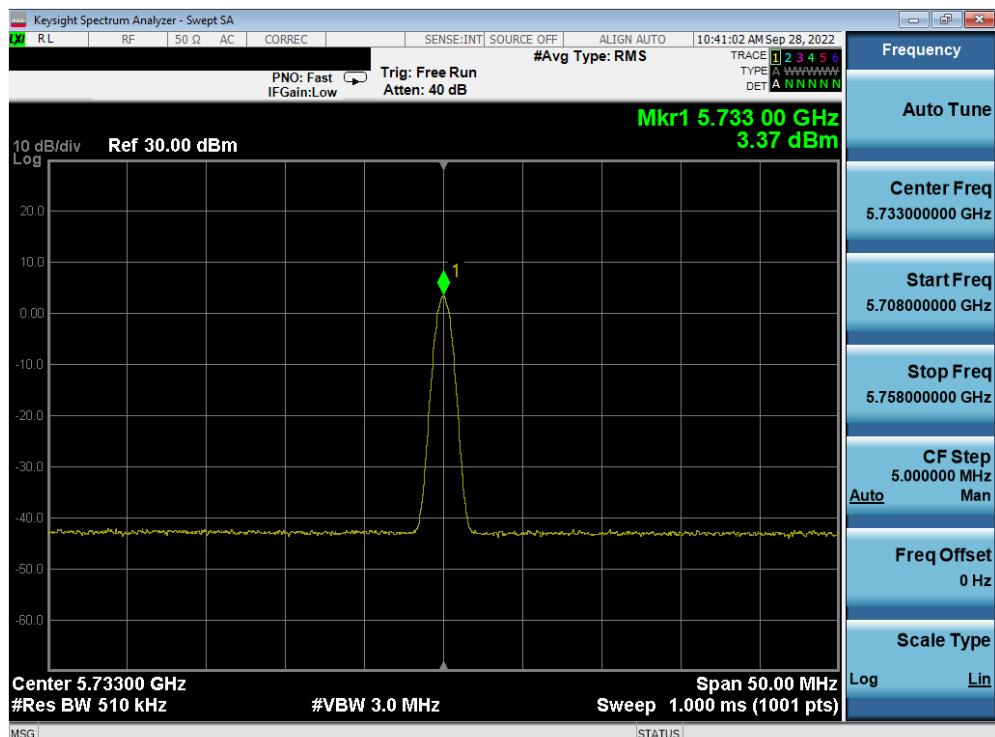


Plot 7-20. PSD Antenna 5b (BDR GFSK, ePA – 5789MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 34 of 100

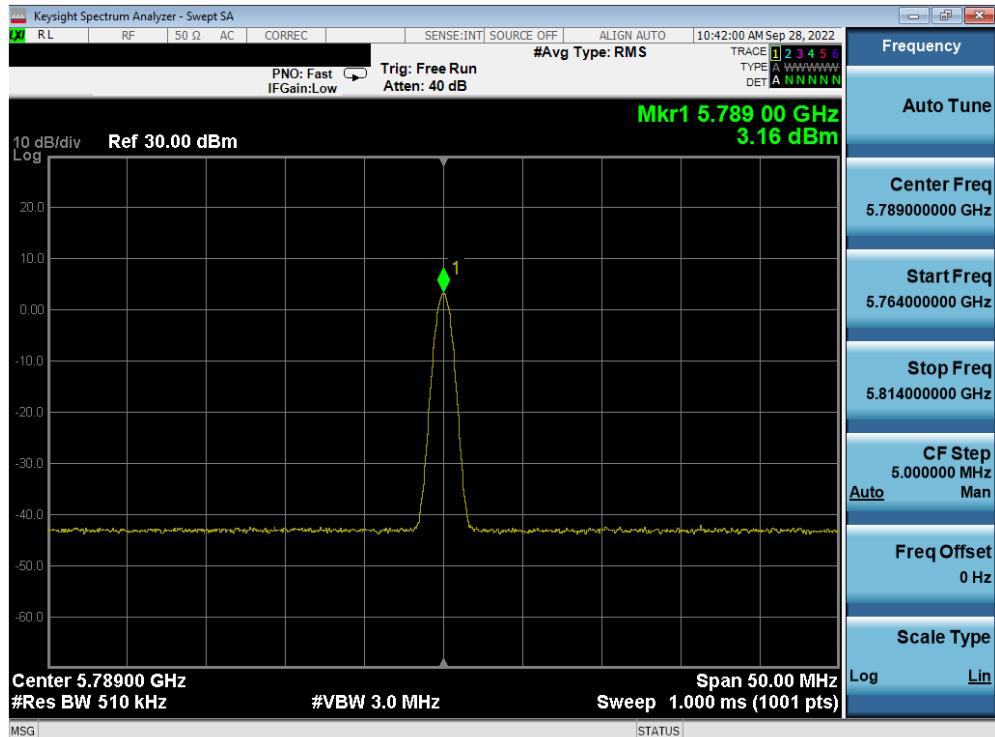


Plot 7-21. PSD Antenna 5b (BDR GFSK, ePA – 5844MHz)

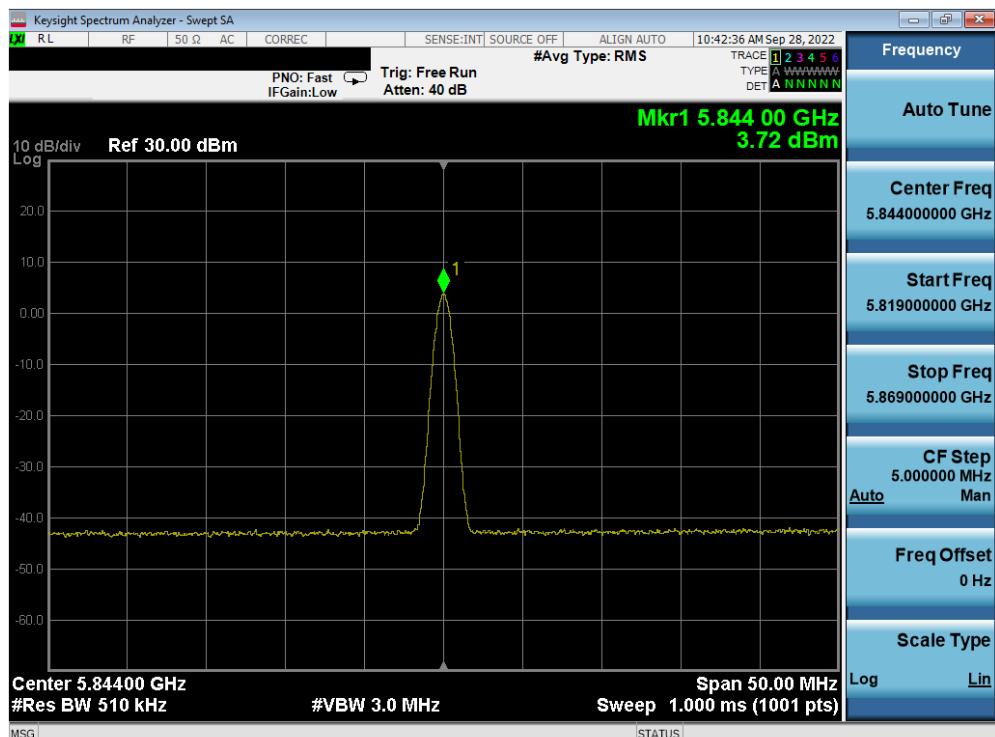


Plot 7-22. PSD Antenna 5b (BDR GFSK, iPA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 35 of 100



Plot 7-23. PSD Antenna 5b (BDR GFSK, iPA – 5789MHz)



Plot 7-24. PSD Antenna 5b (BDR GFSK, iPA – 5844MHz)

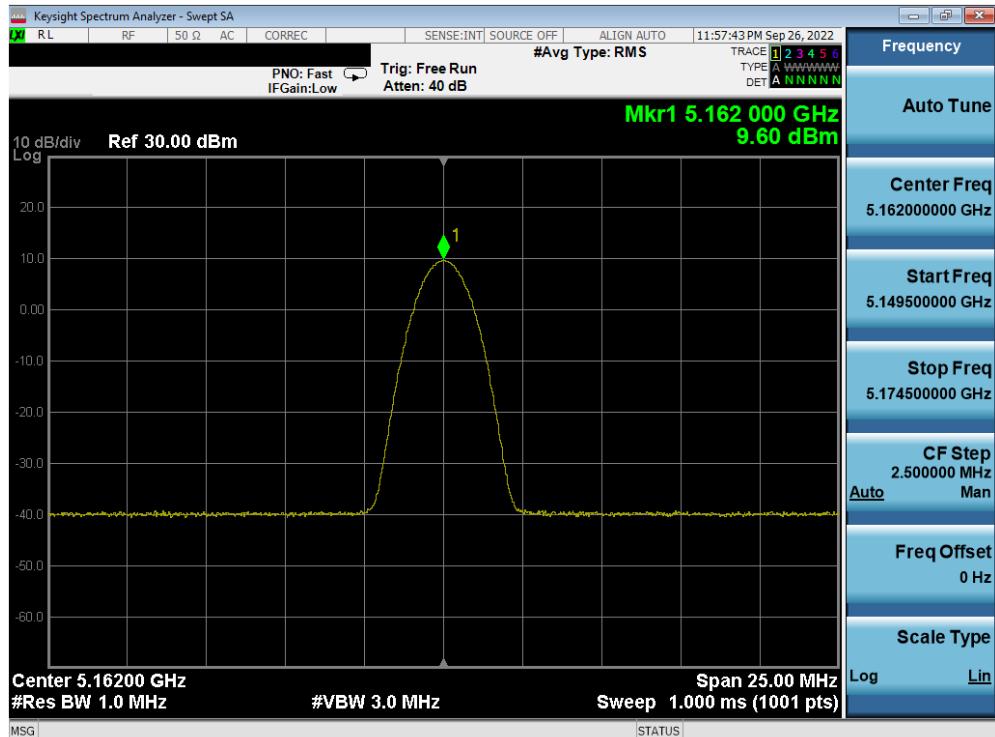
FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 36 of 100

Antenna 4a Power Spectral Density Measurements

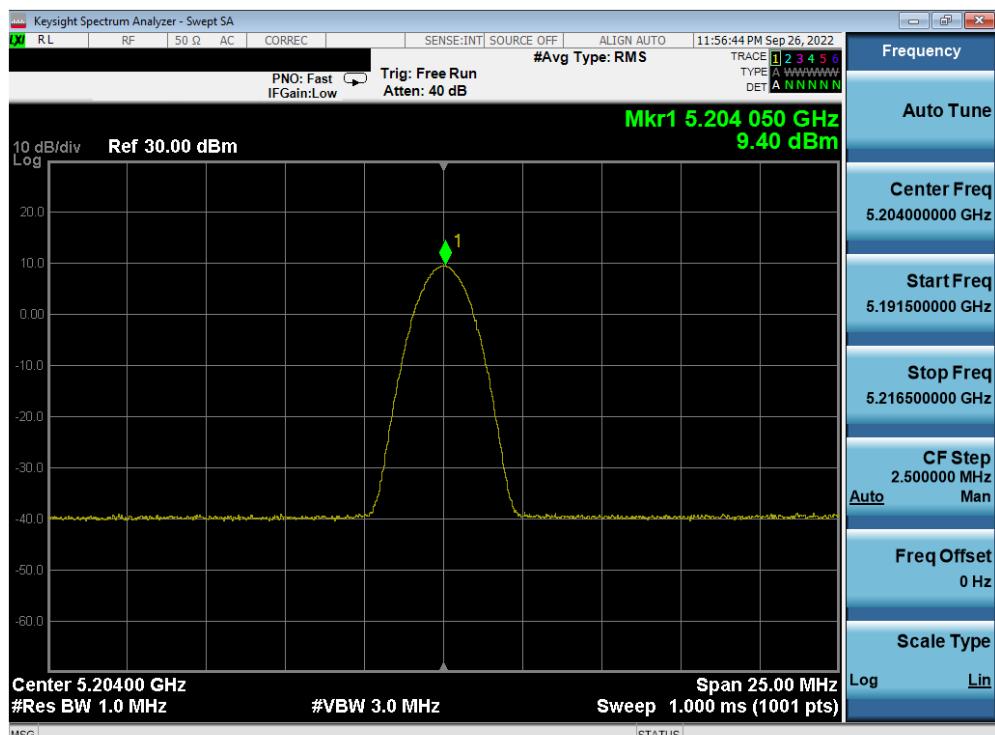
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	GFSK	1	ePA	9.60	11.0	-1.40
	5204	GFSK	1	ePA	9.40	11.0	-1.60
	5245	GFSK	1	ePA	9.47	11.0	-1.53
	5162	GFSK	1	iPA	4.03	11.0	-6.97
	5204	GFSK	1	iPA	3.82	11.0	-7.18
	5245	GFSK	1	iPA	3.80	11.0	-7.20

Table 7-11. Power Spectral Density Measurements Antenna 4a

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 37 of 100

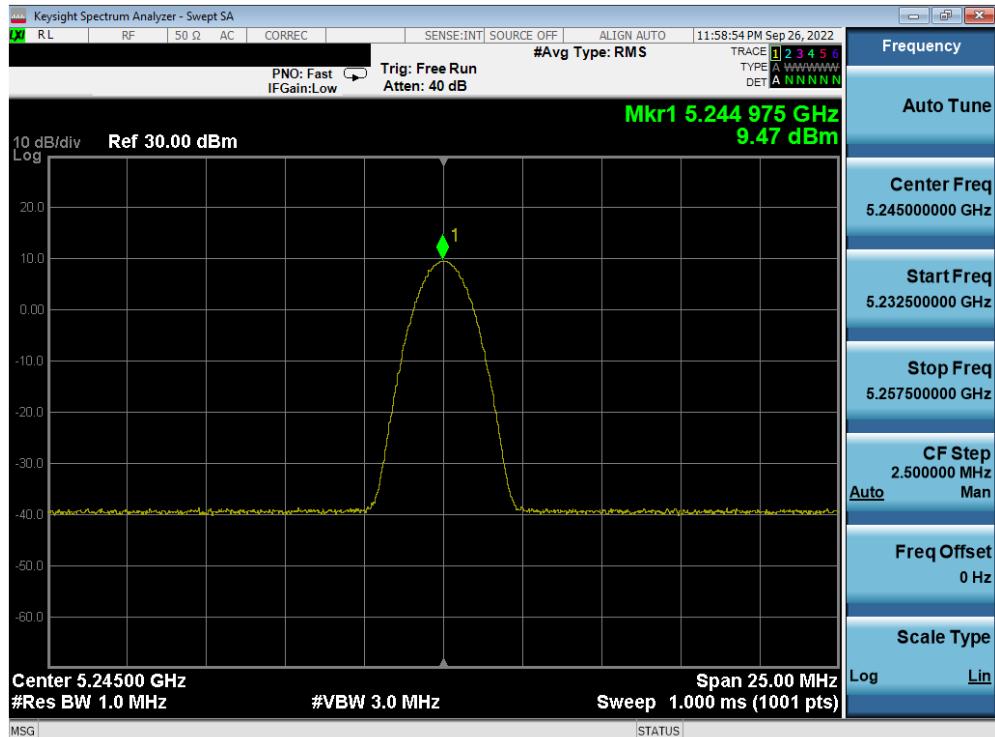


Plot 7-25. PSD Antenna 4a (BDR GFSK, ePA – 5162MHz)

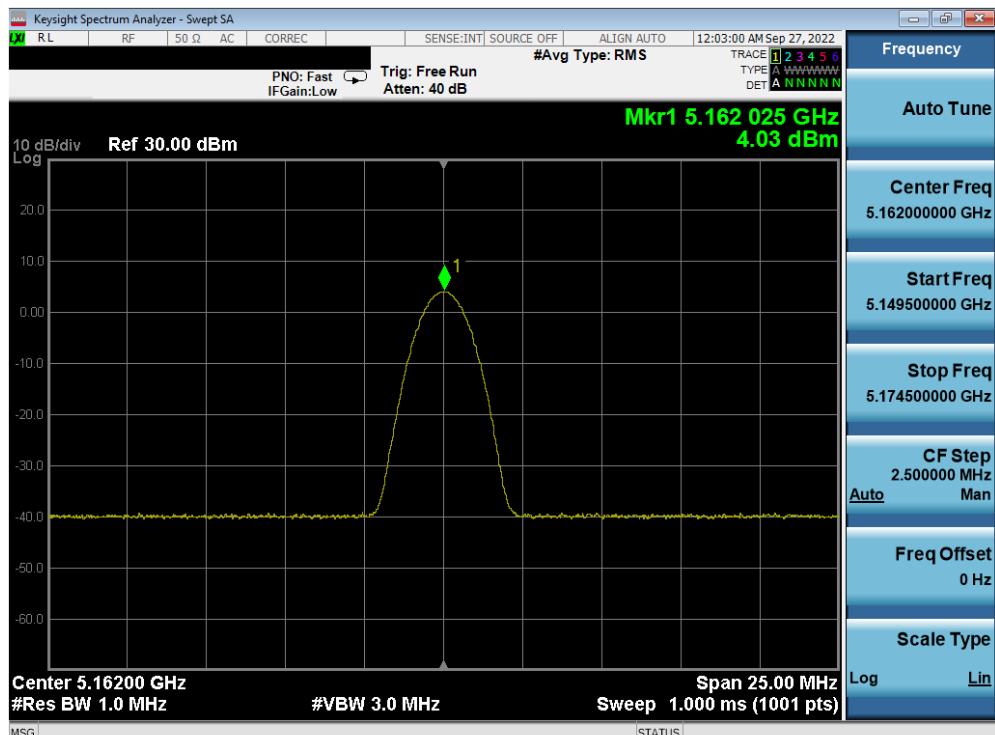


Plot 7-26. PSD Antenna 4a (BDR GFSK, ePA – 5204MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 38 of 100

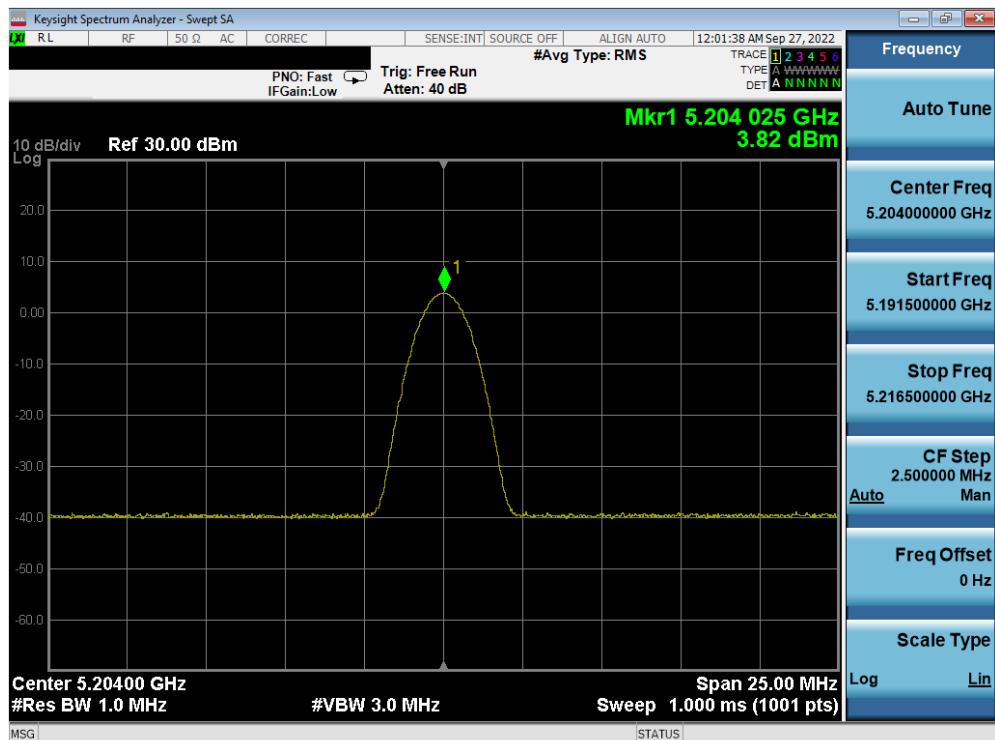


Plot 7-27. PSD Antenna 4a (BDR GFSK, ePA – 5245MHz)

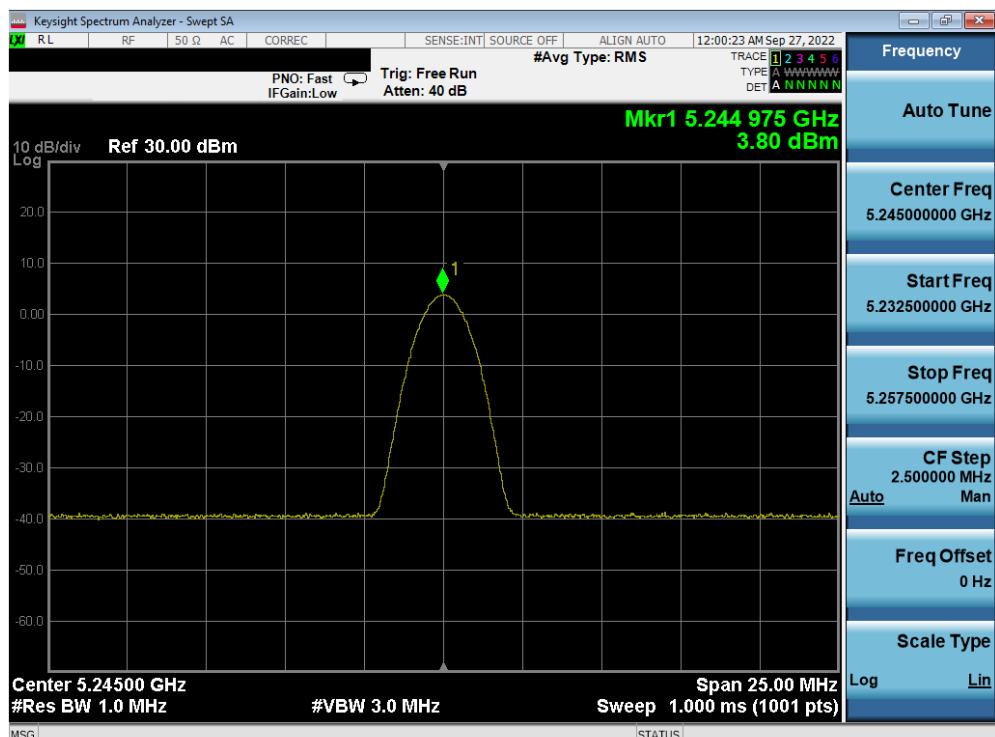


Plot 7-28. PSD Antenna 4a (BDR GFSK, iPA – 5162MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 39 of 100



Plot 7-29. PSD Antenna 4a (BDR GFSK, iPA – 5204MHz)



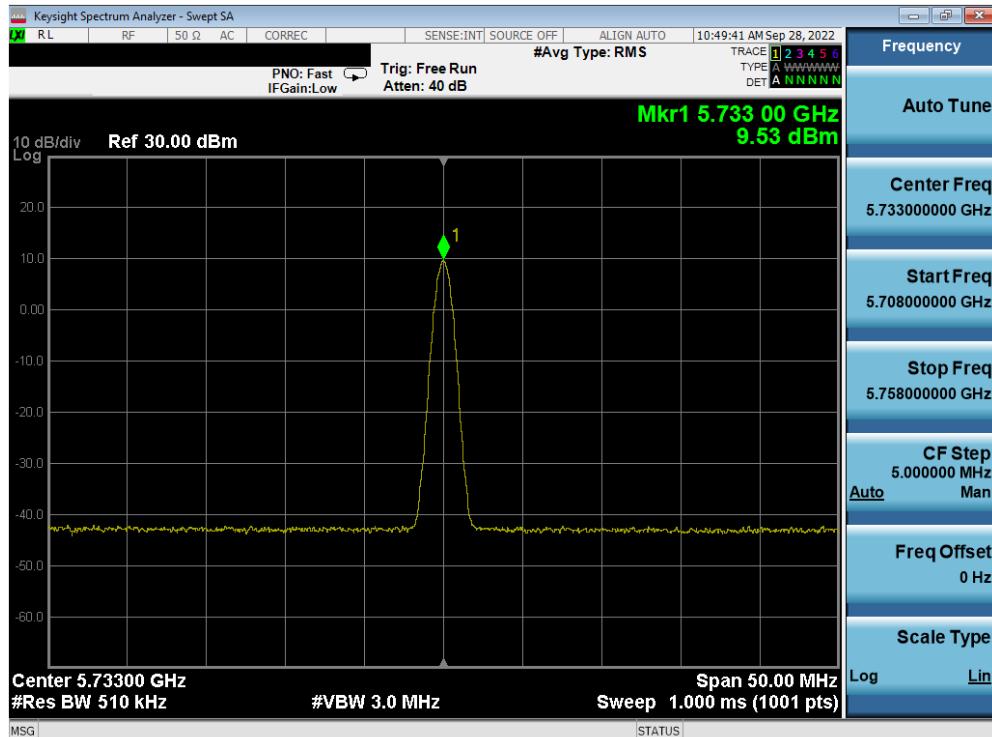
Plot 7-30. PSD Antenna 4a (BDR GFSK, iPA – 5245MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 40 of 100

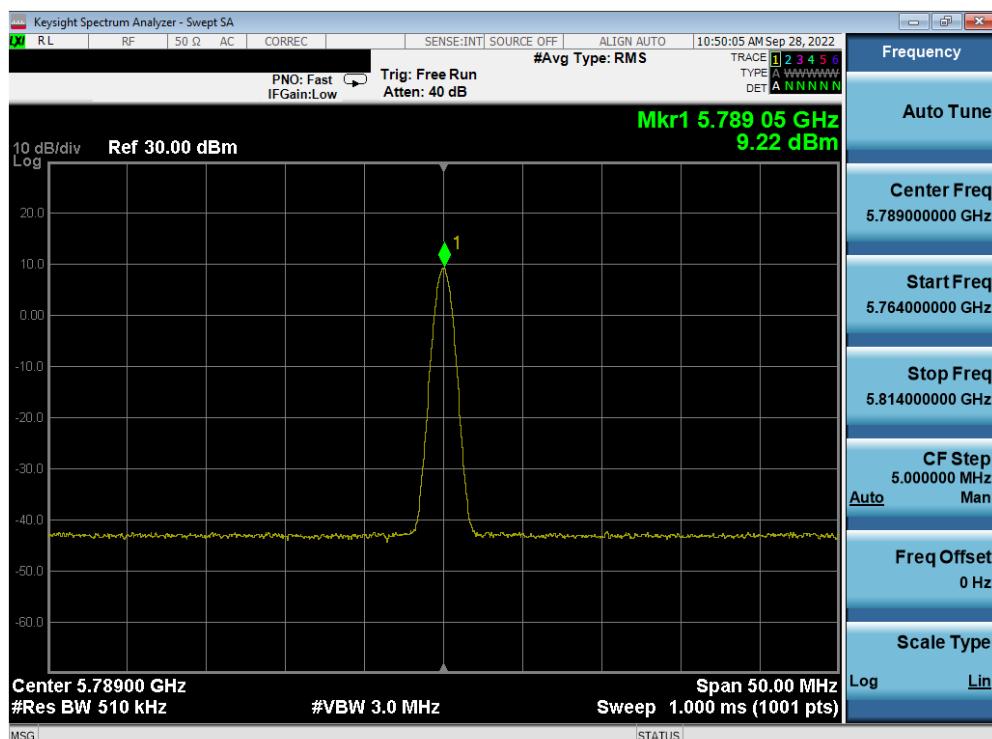
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	GFSK	1	ePA	9.53	30.0	-20.47
	5789	GFSK	1	ePA	9.22	30.0	-20.78
	5844	GFSK	1	ePA	9.46	30.0	-20.54
	5733	GFSK	1	iPA	4.28	30.0	-25.72
	5789	GFSK	1	iPA	4.02	30.0	-25.98
	5844	GFSK	1	iPA	4.63	30.0	-25.37

Table 7-12. Power Spectral Density Measurements Antenna 4a

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 41 of 100

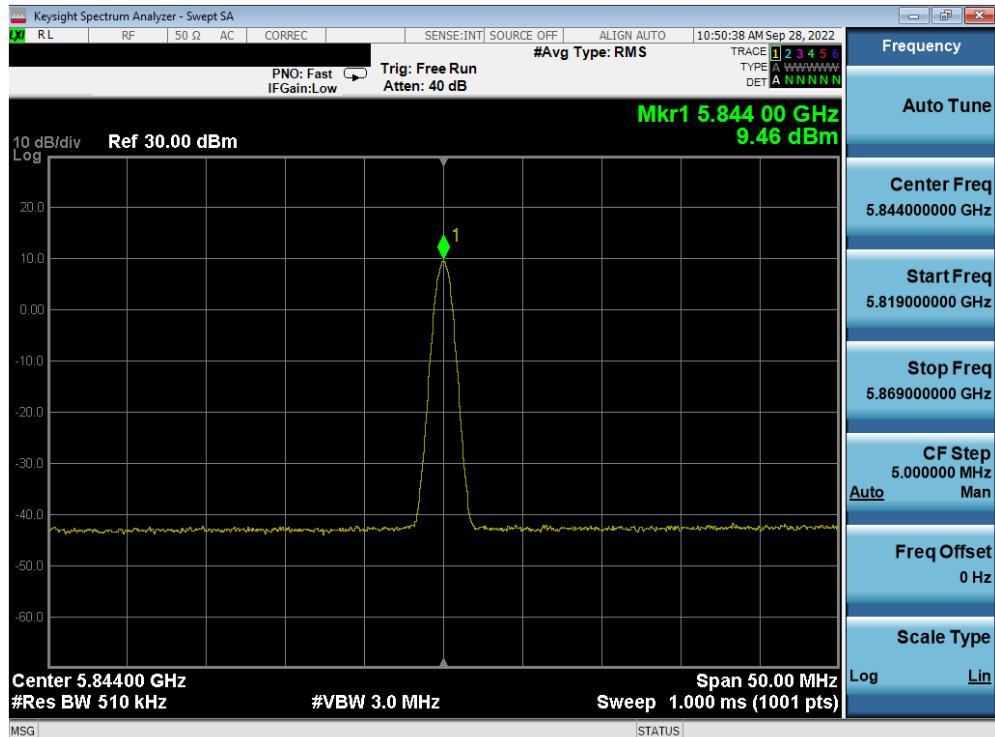


Plot 7-31. PSD Antenna 4a (BDR GFSK, ePA – 5733MHz)

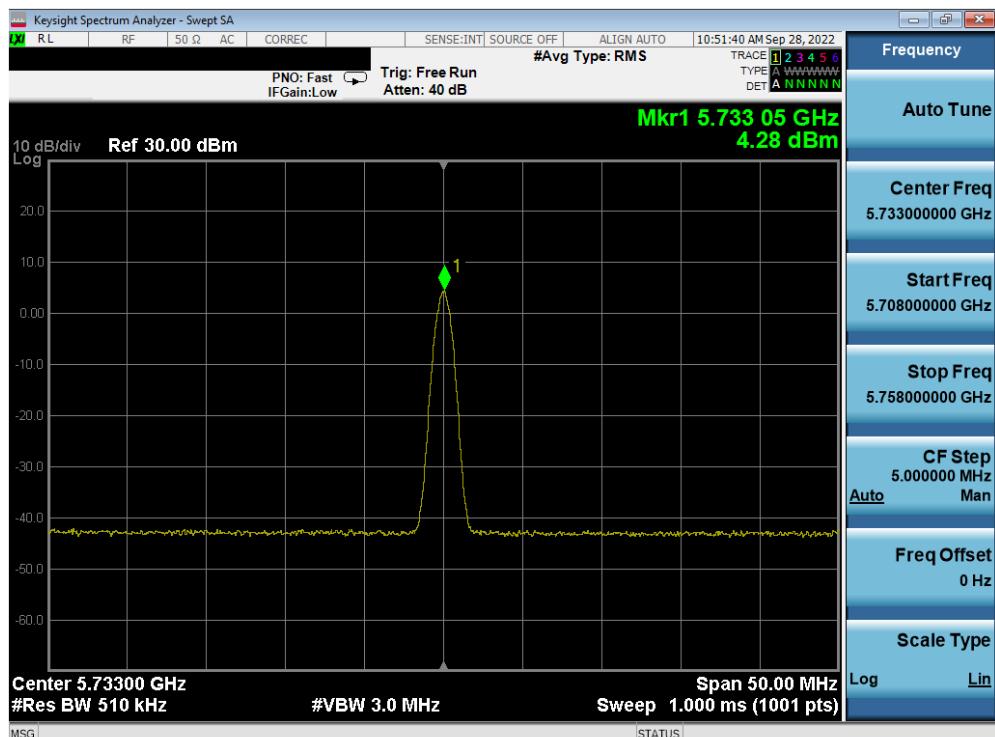


Plot 7-32. PSD Antenna 4a (BDR GFSK, ePA – 5789MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 42 of 100

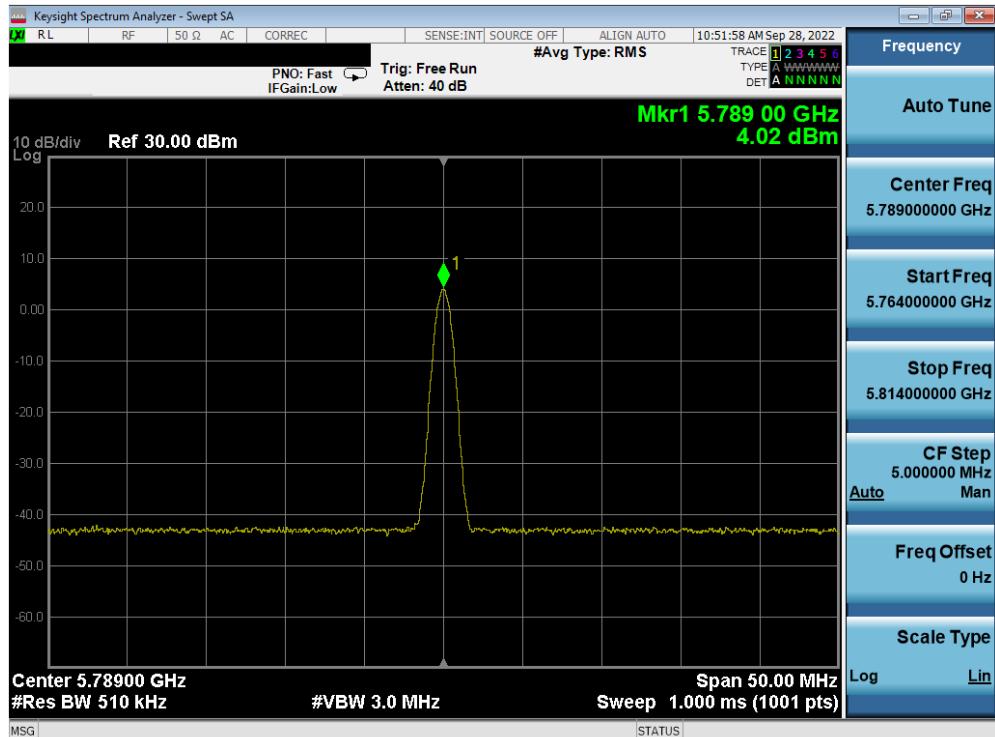


Plot 7-33. PSD Antenna 4a (BDR GFSK, ePA – 5844MHz)

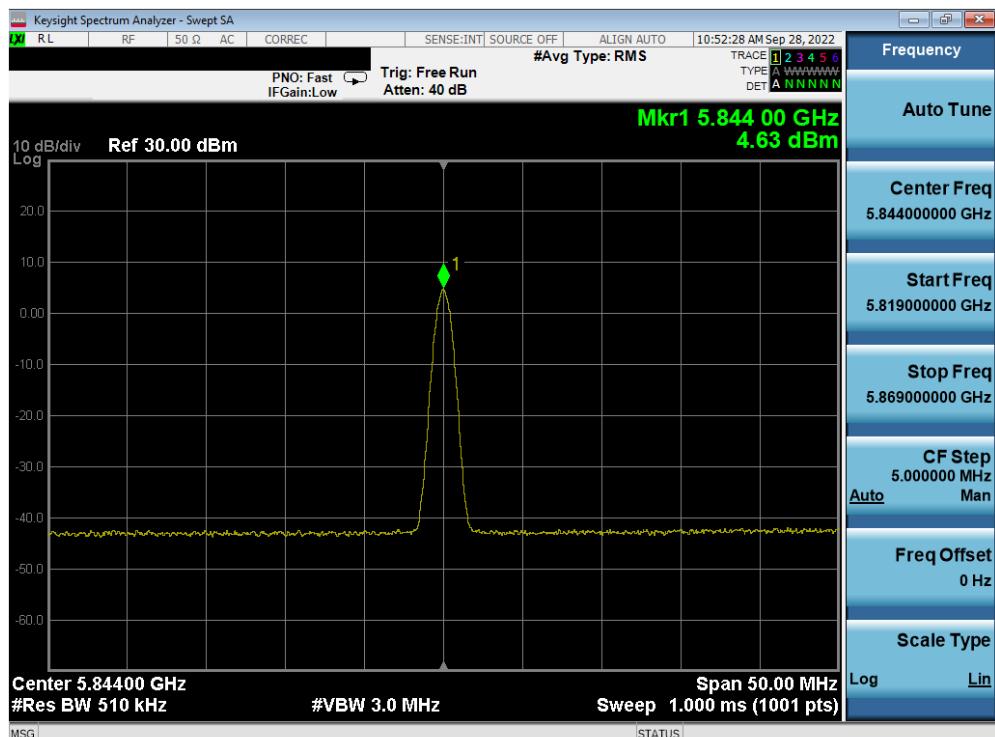


Plot 7-34. PSD Antenna 4a (BDR GFSK, iPA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 43 of 100



Plot 7-35. PSD Antenna 4a (BDR GFSK, iPA – 5789MHz)



Plot 7-36. PSD Antenna 4a (BDR GFSK, iPA – 5844MHz)

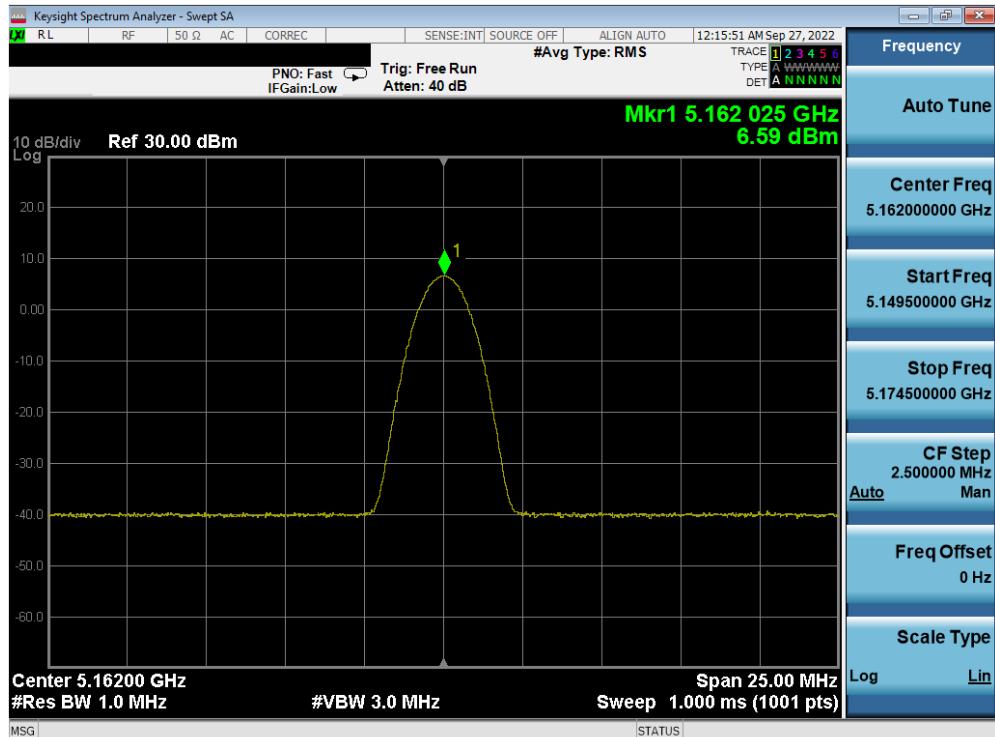
FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 44 of 100

TxBF Power Spectral Density Measurements

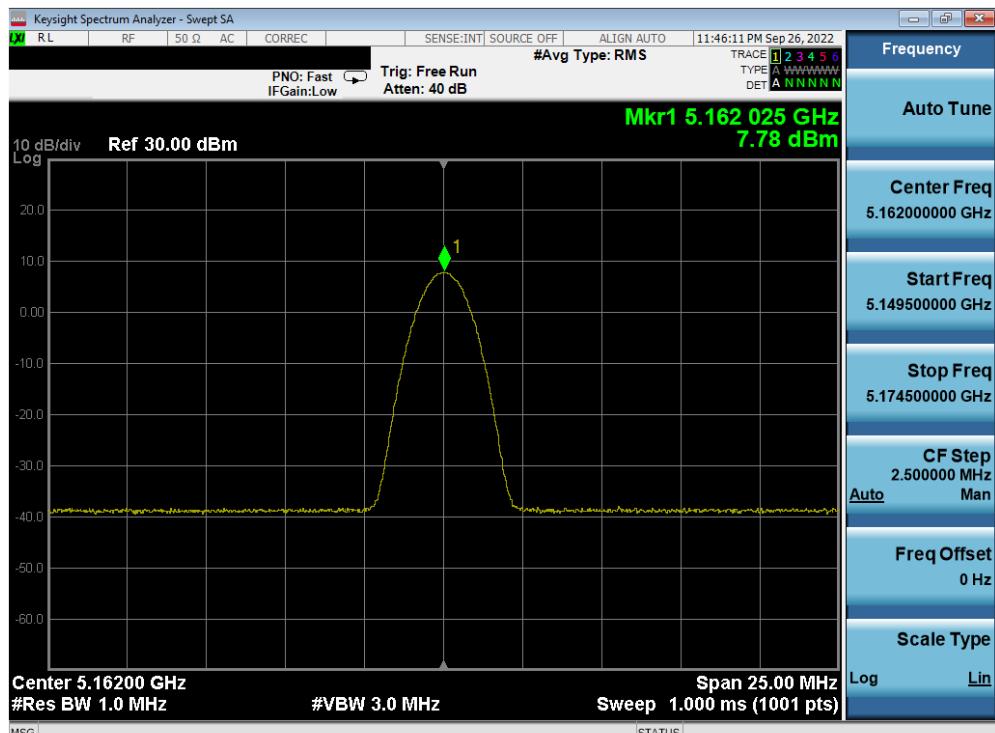
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Antenna 5b Power Density [dBm/MHz]	Antenna 4a Power Density [dBm/MHz]	Summed Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	GFSK	1	ePA	6.59	7.78	10.24	11.0	-0.76
	5204	GFSK	1	ePA	6.55	7.60	10.12	11.0	-0.88
	5245	GFSK	1	ePA	6.73	7.43	10.10	11.0	-0.90
	5162	GFSK	1	iPA	3.16	4.09	6.66	11.0	-4.34
	5204	GFSK	1	iPA	3.03	3.90	6.50	11.0	-4.50
	5245	GFSK	1	iPA	3.10	3.72	6.43	11.0	-4.57

Table 7-13. Power Spectral Density Measurements TxBF

FCC ID: BCGA2764	 element MEASUREMENT REPORT (CERTIFICATION)			Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 45 of 100	

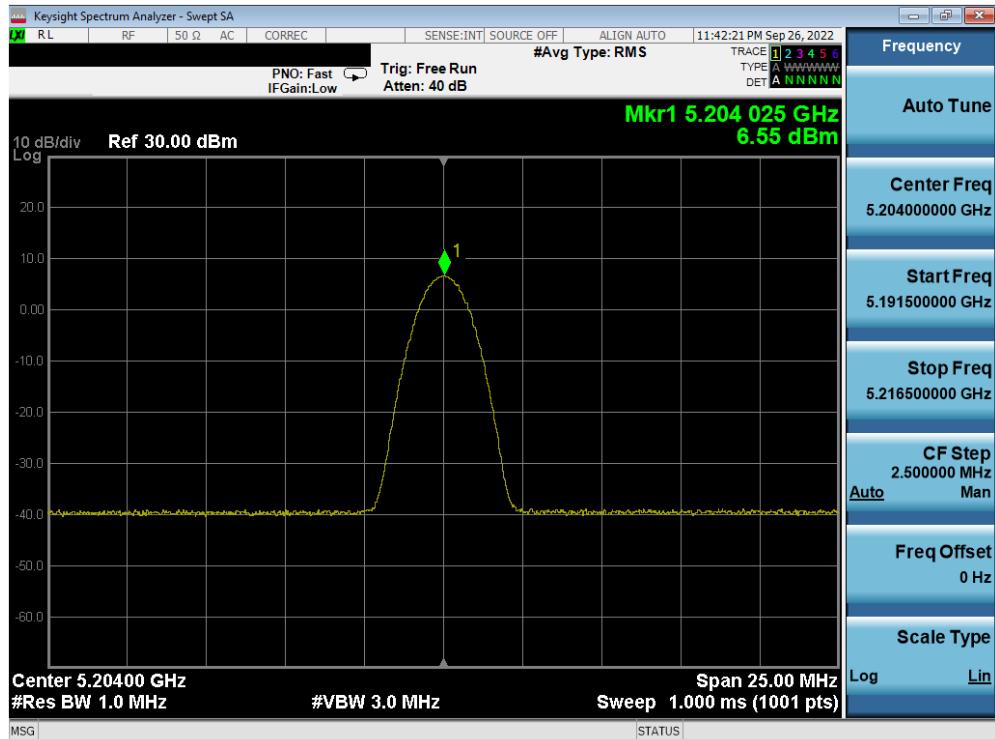


Plot 7-37. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5162MHz)

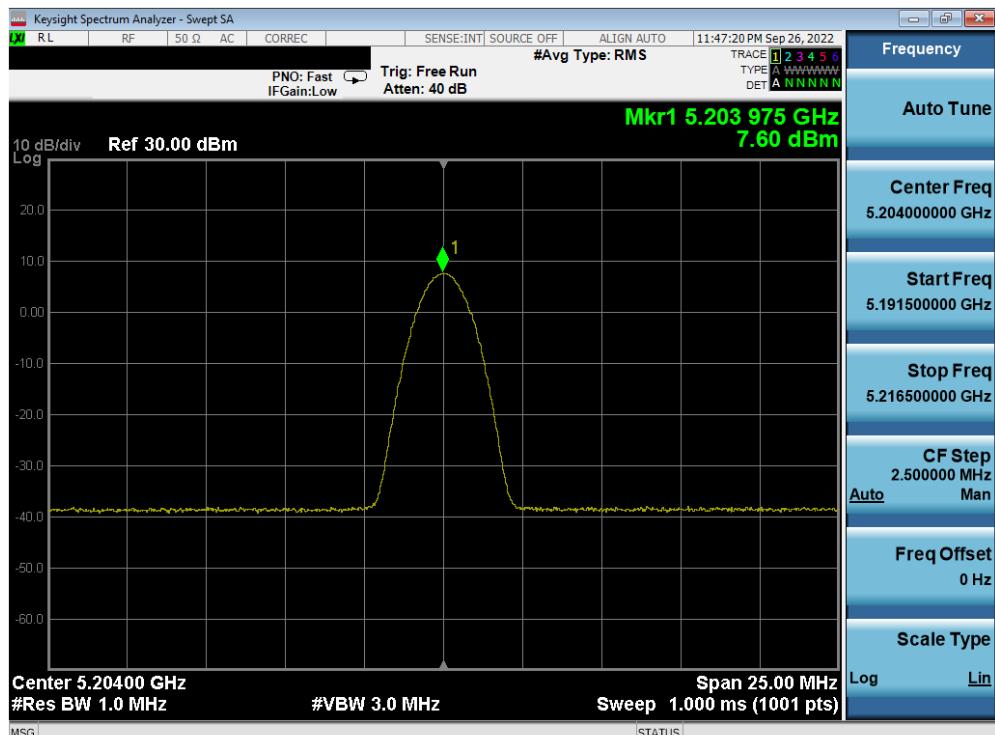


Plot 7-38. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5162MHz)

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 46 of 100

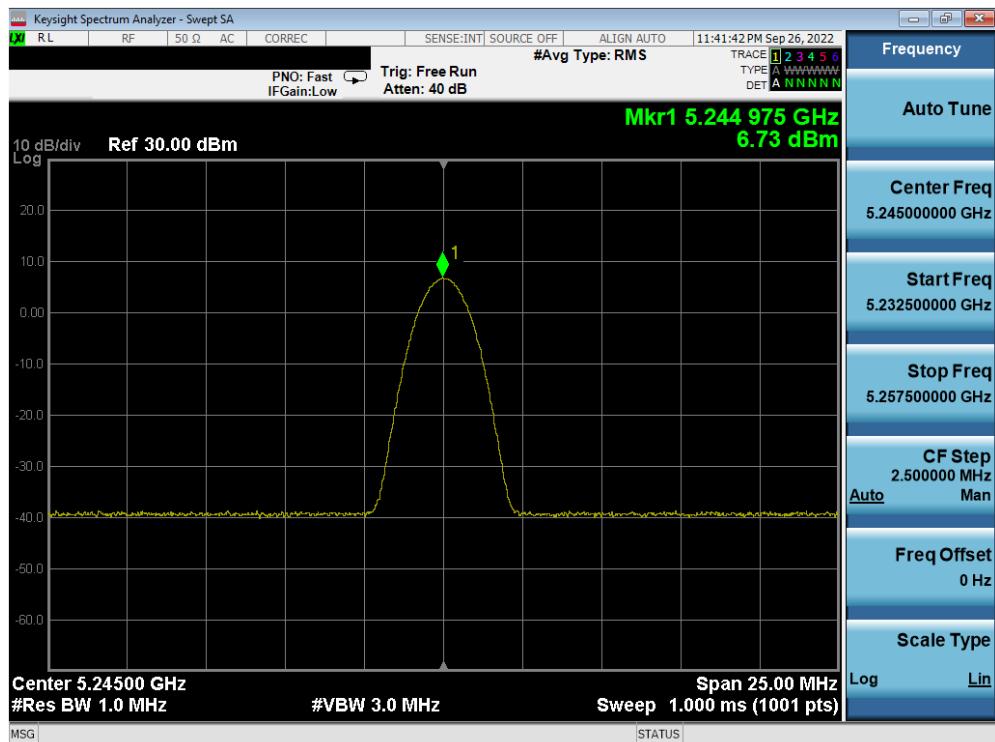


Plot 7-39. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5204MHz)

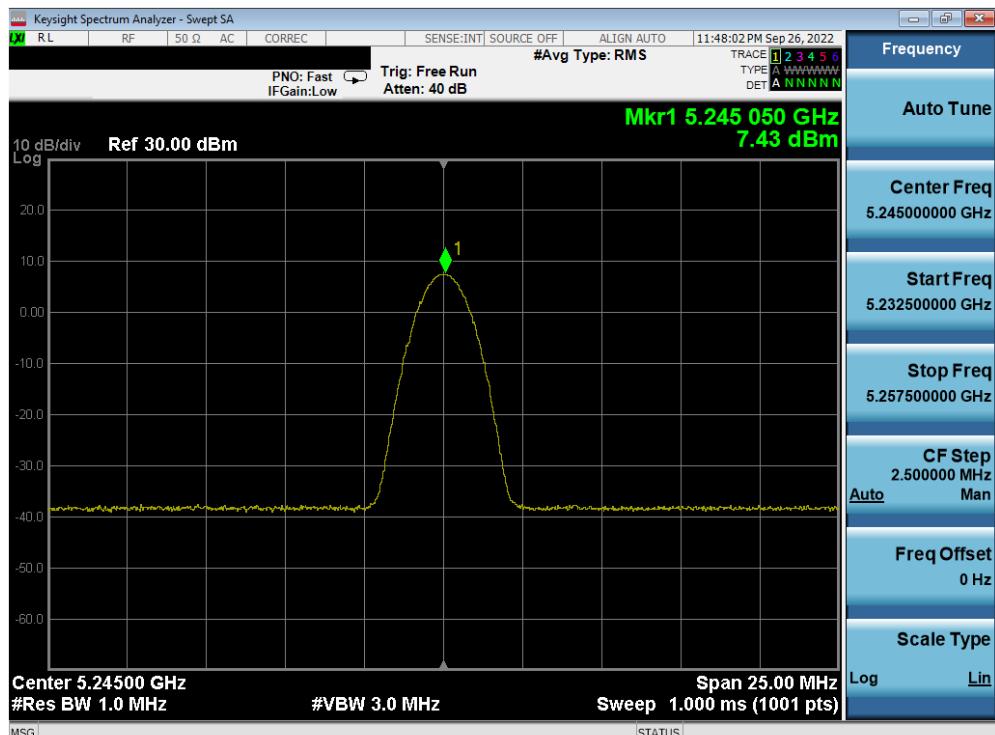


Plot 7-40. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5204MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 47 of 100

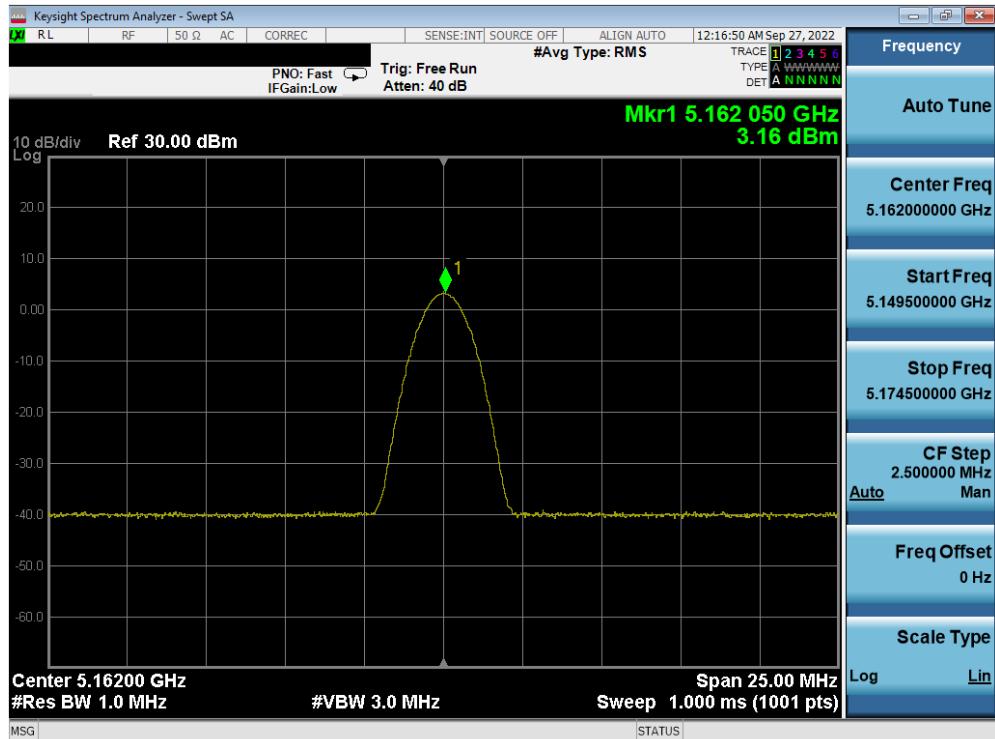


Plot 7-41. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5245MHz)

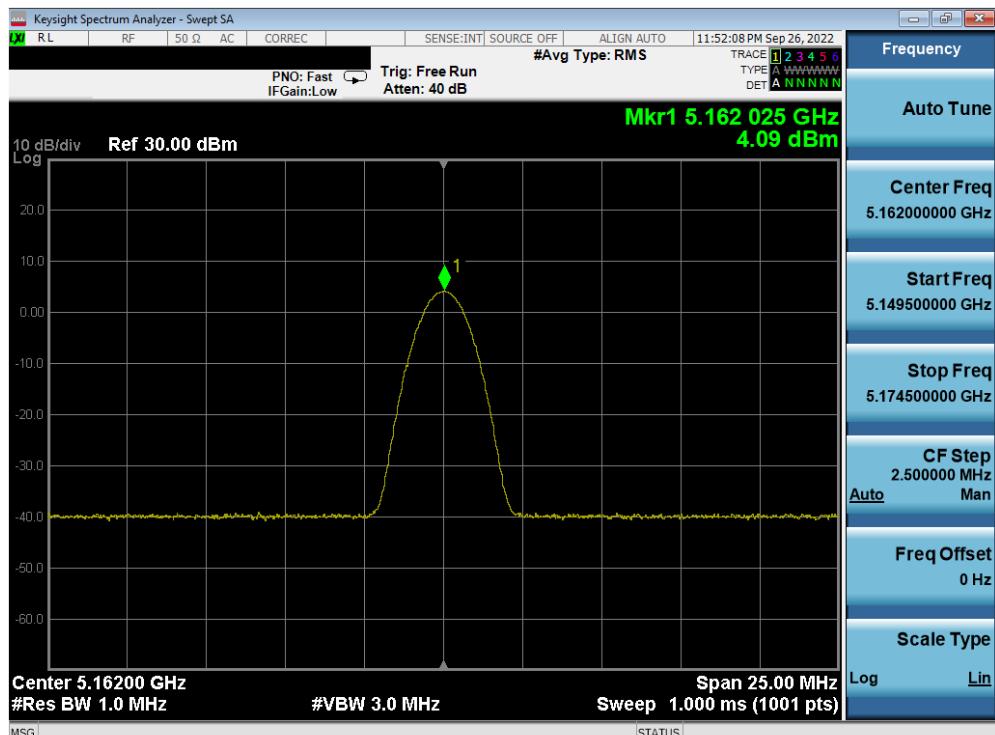


Plot 7-42. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5245MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 48 of 100

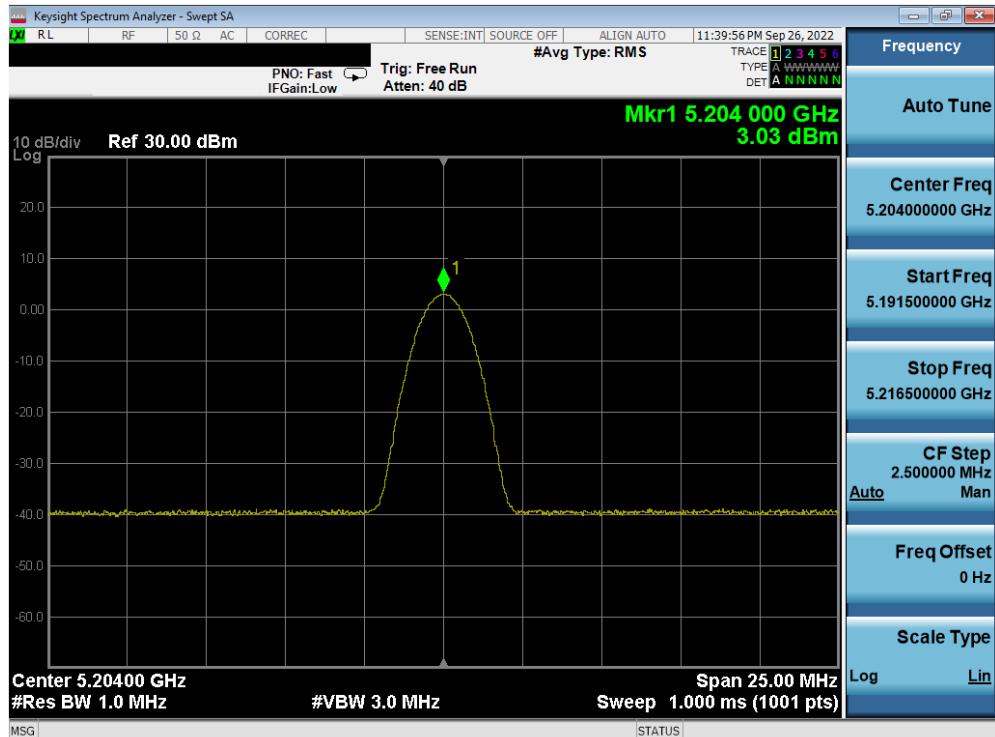


Plot 7-43. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5162MHz)

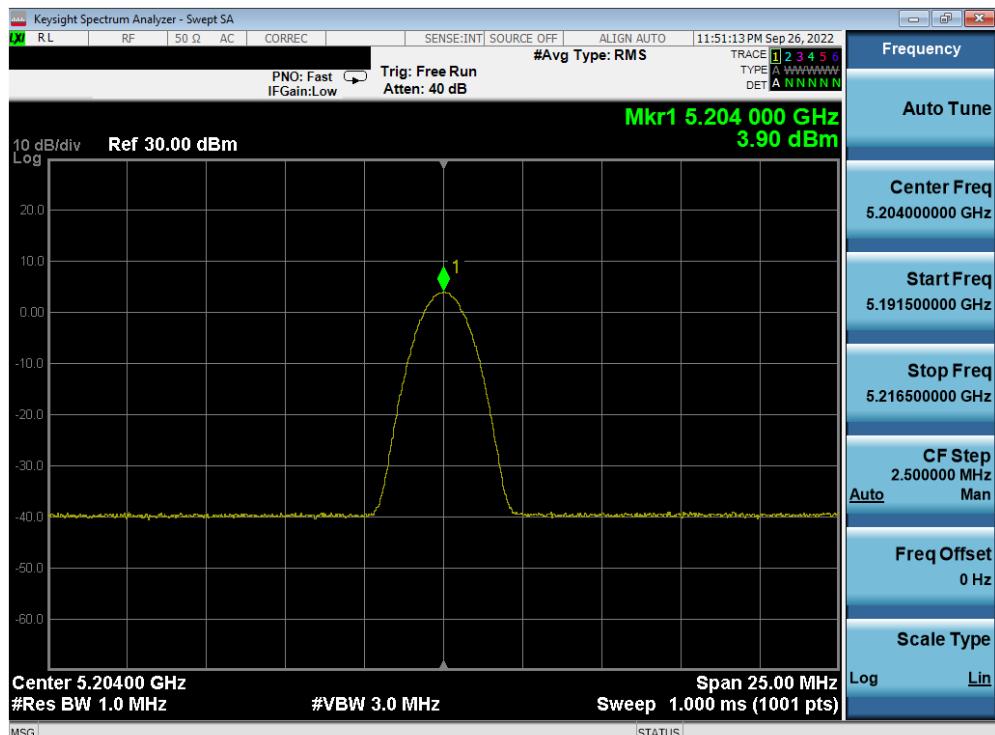


Plot 7-44. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5162MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 49 of 100

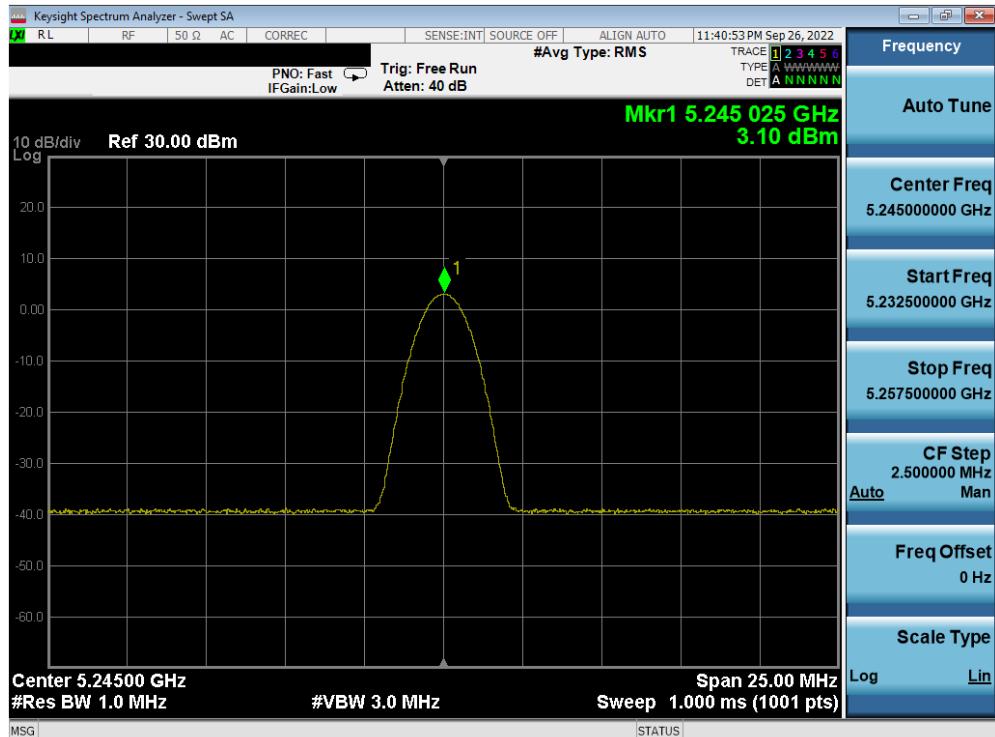


Plot 7-45. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5204MHz)

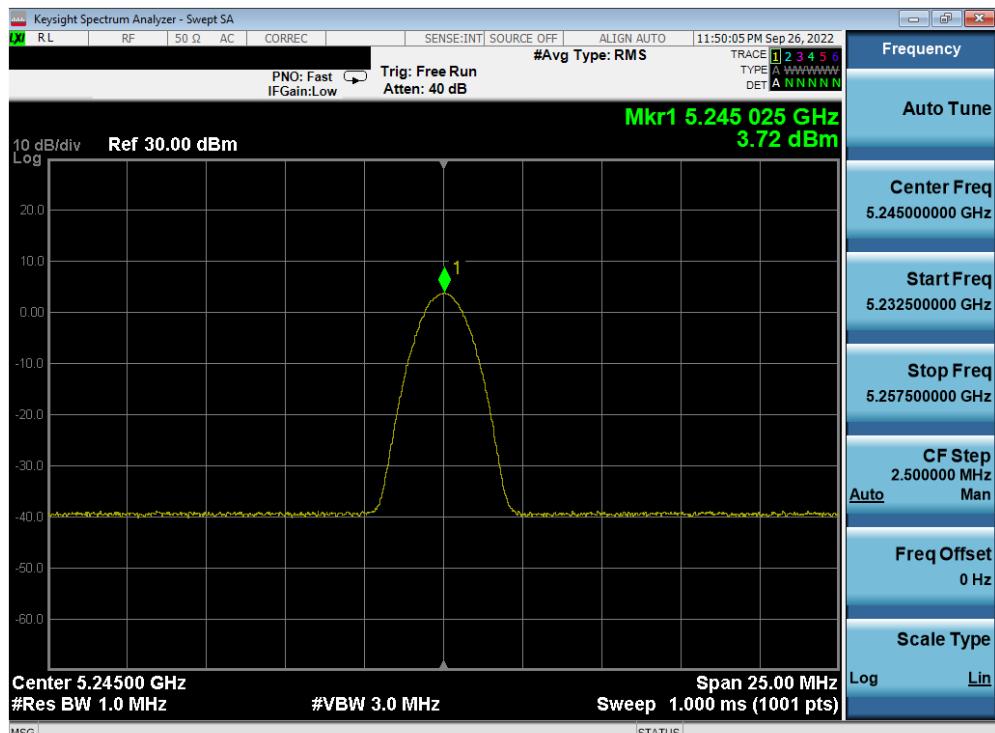


Plot 7-46. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5204MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 50 of 100



Plot 7-47. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5245MHz)



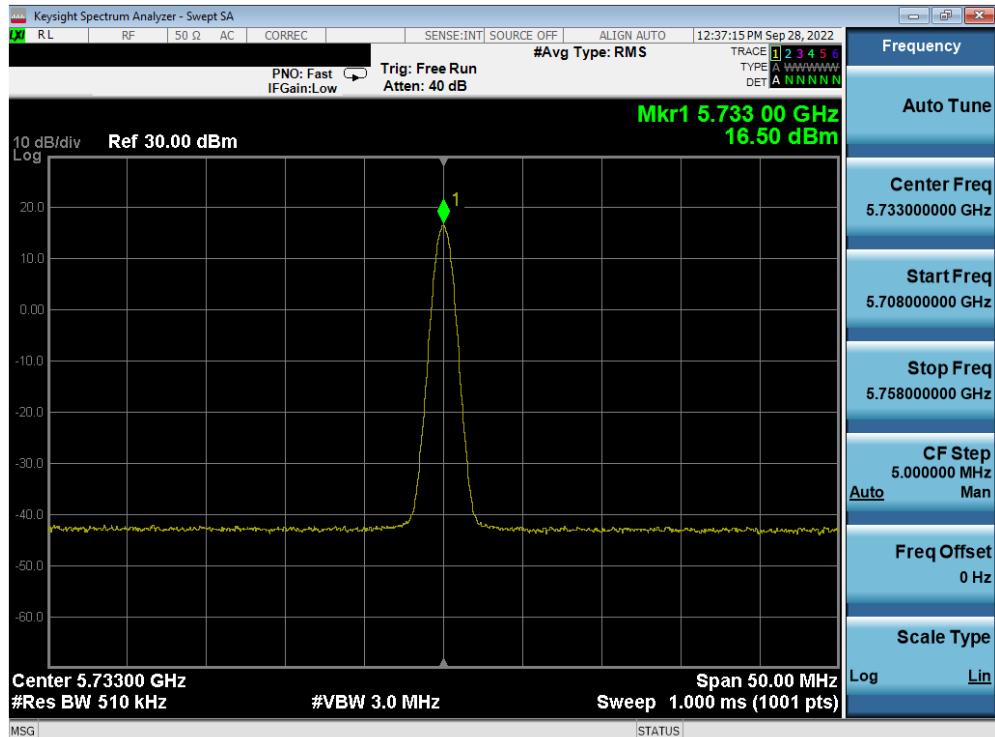
Plot 7-48. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5245MHz)

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 51 of 100

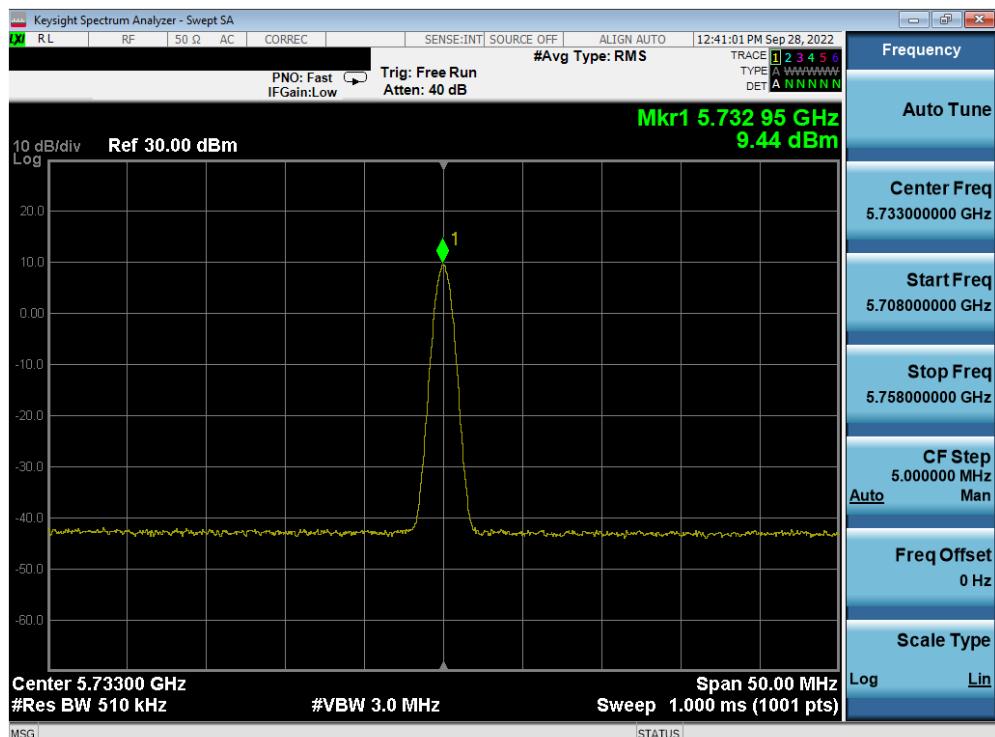
	Frequency [MHz]	Mode	Data Rate [Mbps]	Power Scheme	Antenna 5b Power Density [dBm/500kHz]	Antenna 4a Power Density [dBm/500kHz]	Summed Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	GFSK	1	ePA	16.50	9.44	17.28	30.0	-12.72
	5789	GFSK	1	ePA	16.32	9.00	17.06	30.0	-12.94
	5844	GFSK	1	ePA	16.96	9.32	17.65	30.0	-12.35
	5733	GFSK	1	iPA	3.21	4.05	6.66	30.0	-23.34
	5789	GFSK	1	iPA	3.16	3.91	6.56	30.0	-23.44
	5844	GFSK	1	iPA	3.49	4.26	6.90	30.0	-23.10

Table 7-14. Power Spectral Density Measurements TxBF

FCC ID: BCGA2764	 element MEASUREMENT REPORT (CERTIFICATION)			Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 52 of 100	

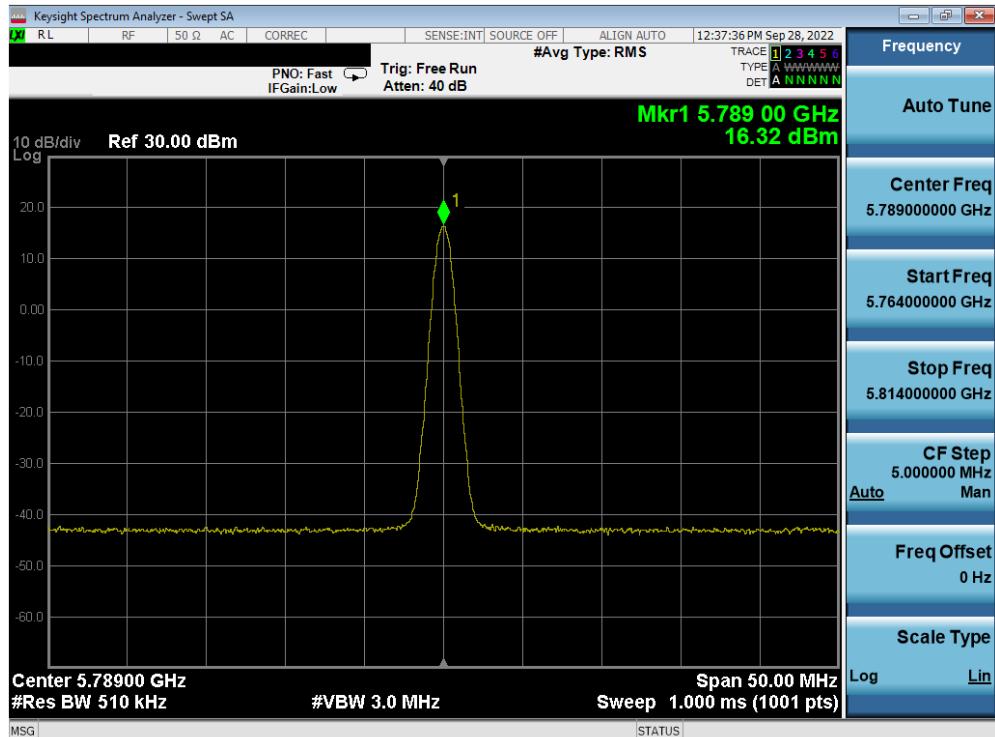


Plot 7-49. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5733MHz)

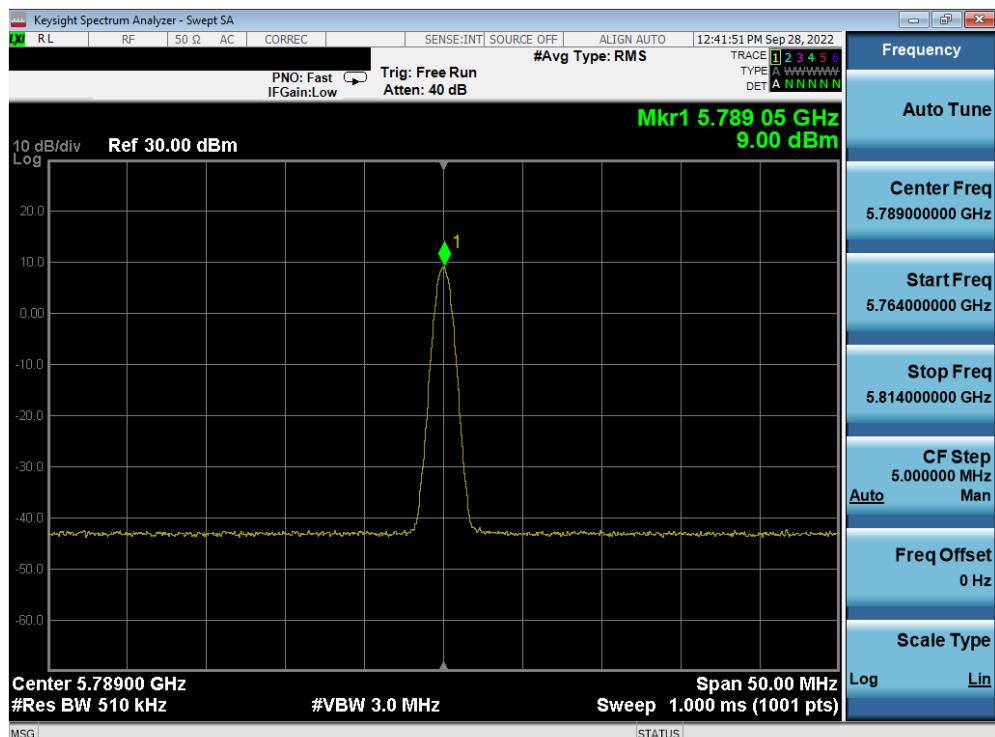


Plot 7-50. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 53 of 100

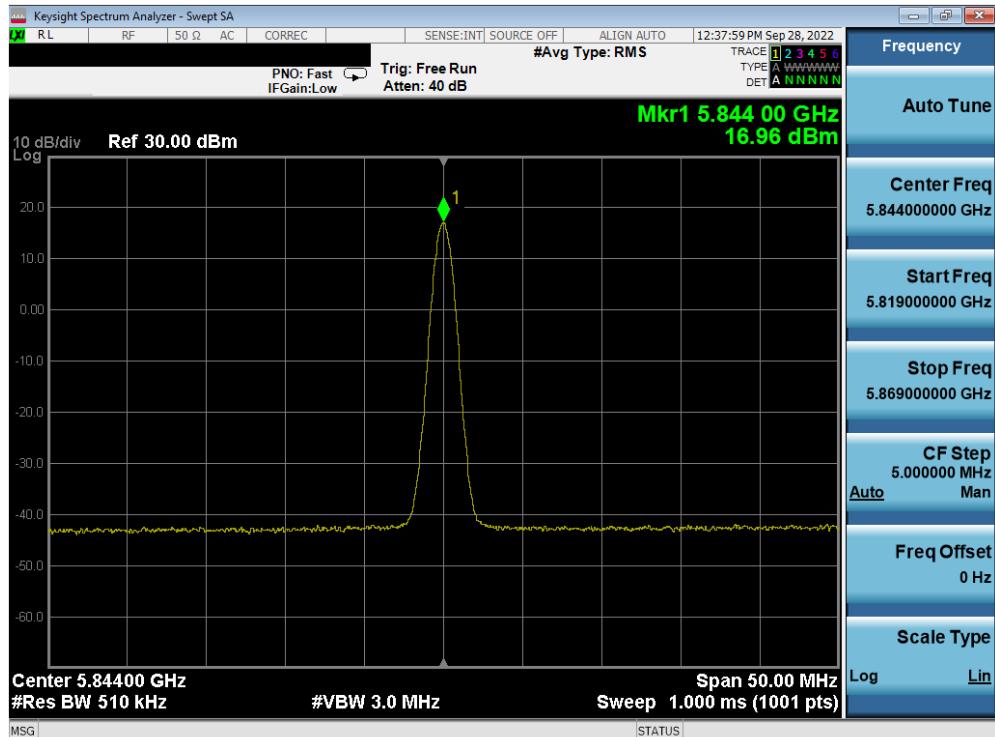


Plot 7-51. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5789MHz)

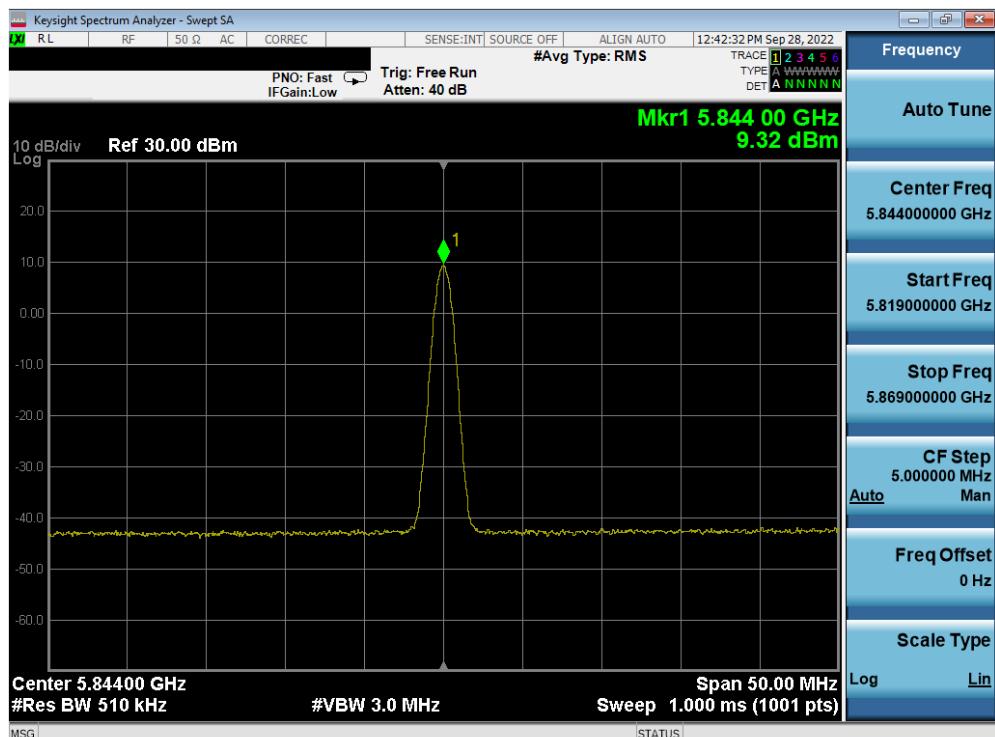


Plot 7-52. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5789MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 54 of 100

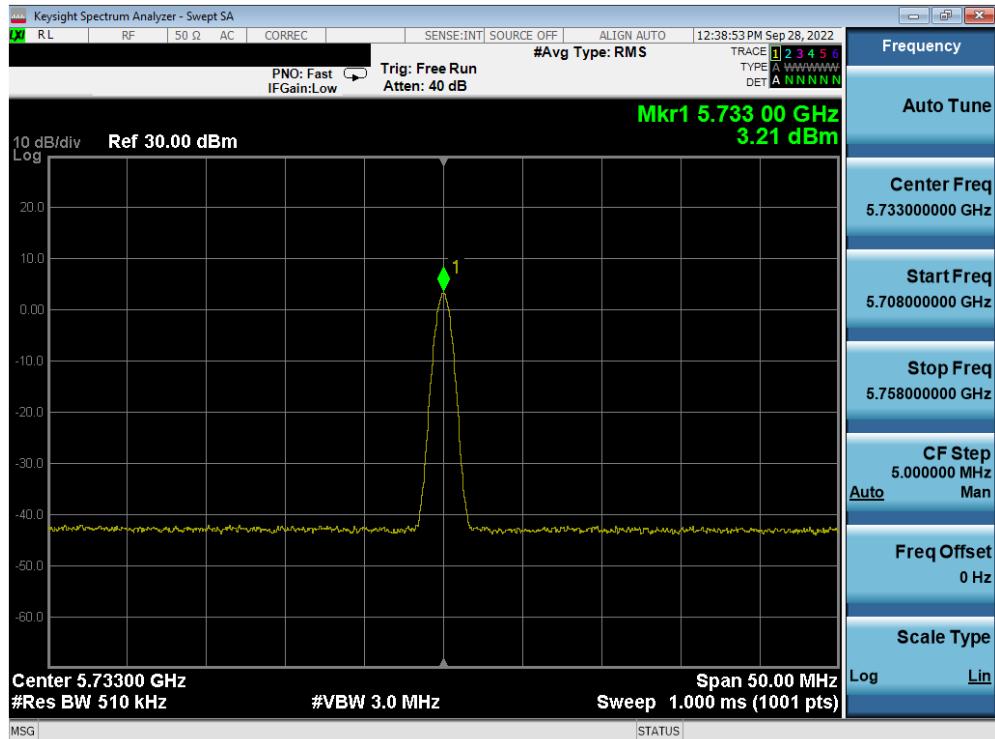


Plot 7-53. PSD TxBF Antenna 5b (BDR GFSK, ePA – 5844MHz)

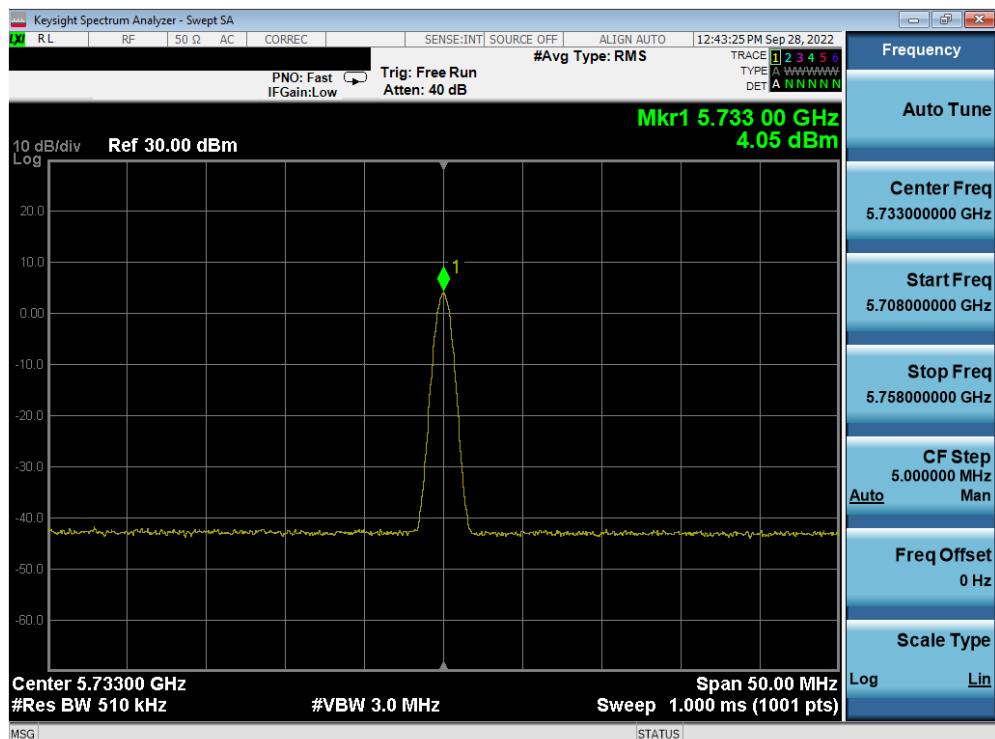


Plot 7-54. PSD TxBF Antenna 4a (BDR GFSK, ePA – 5844MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 55 of 100

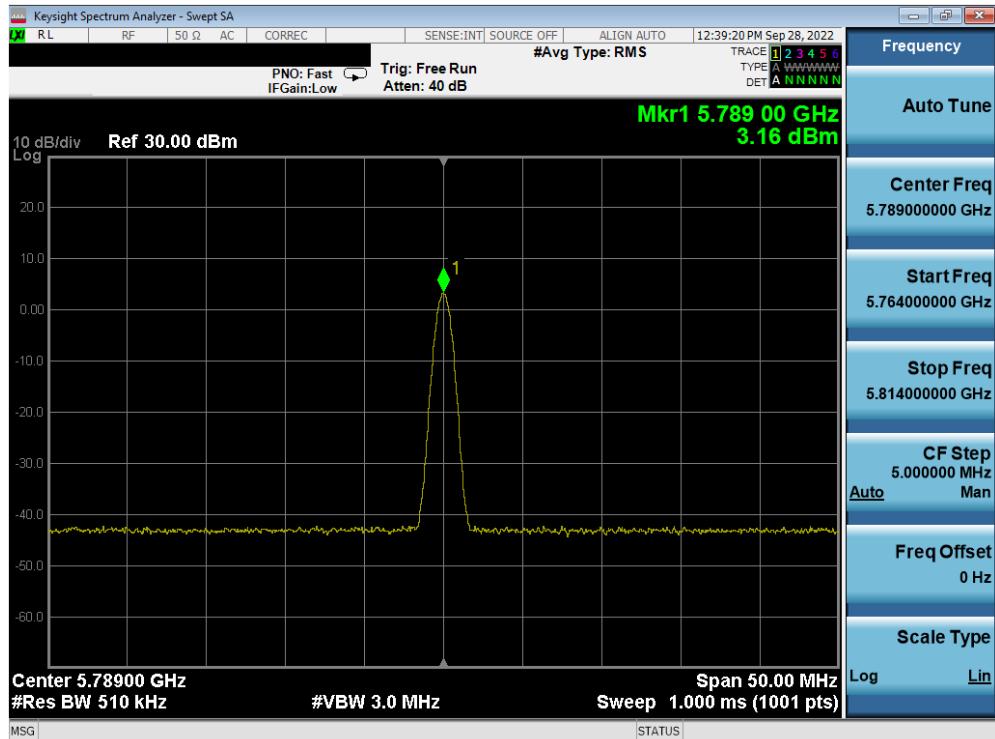


Plot 7-55. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5733MHz)

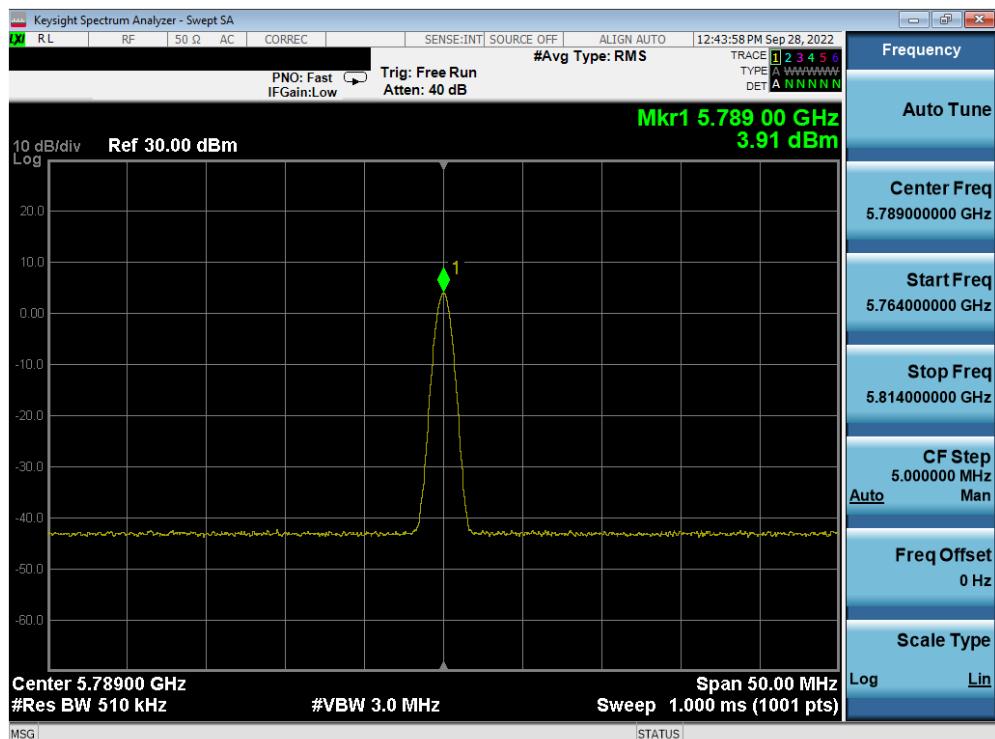


Plot 7-56. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5733MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 56 of 100

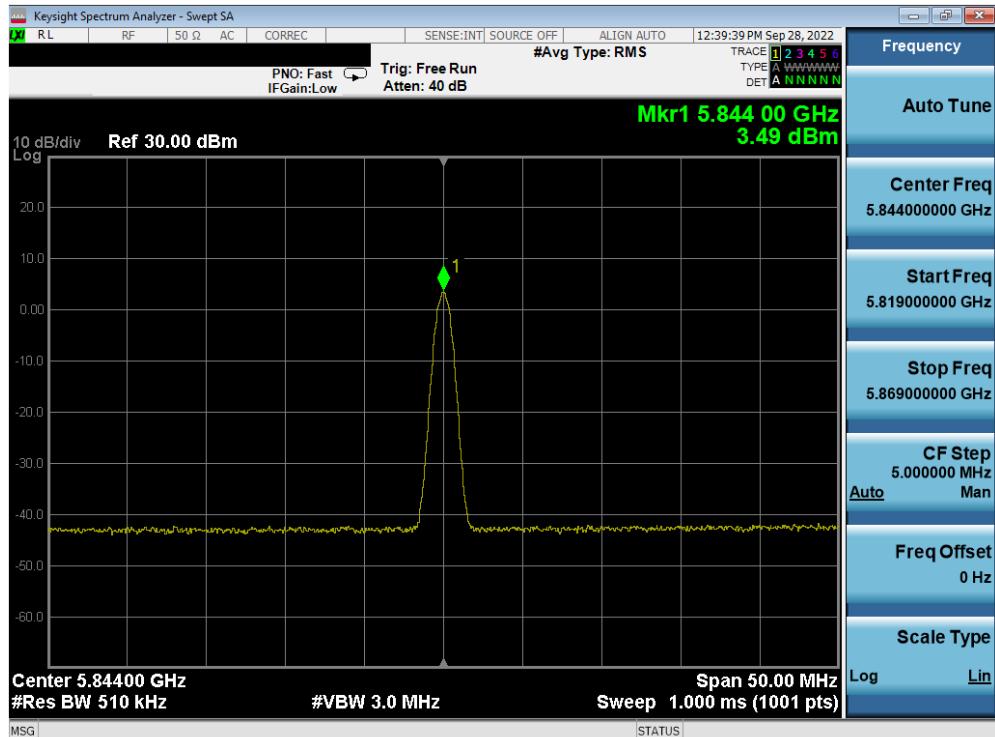


Plot 7-57. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5789MHz)

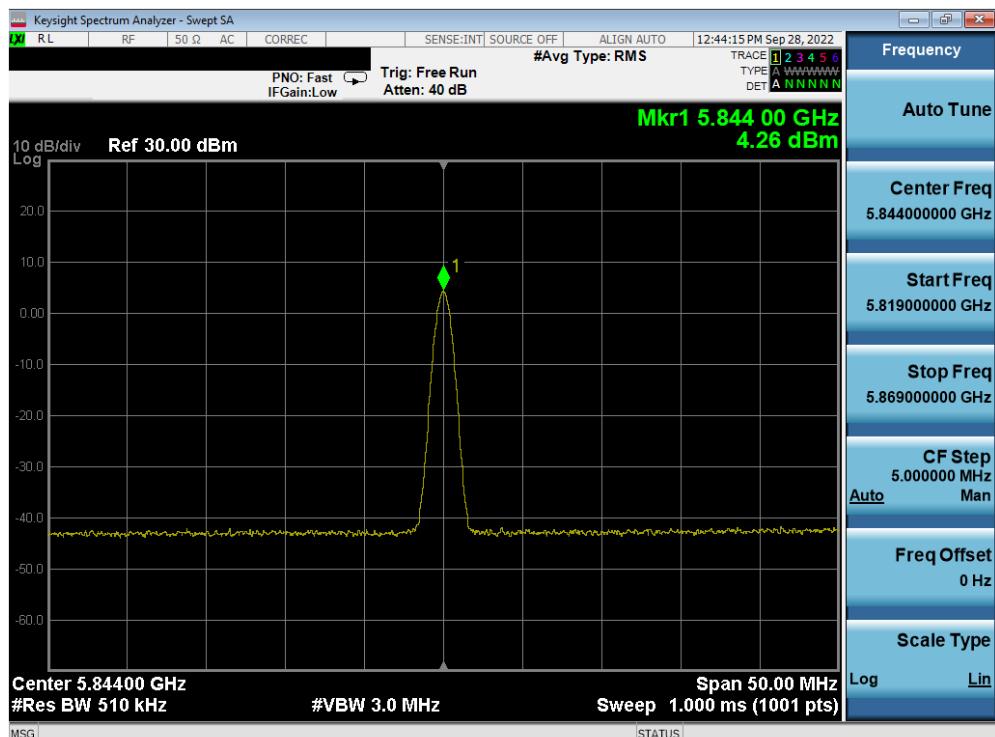


Plot 7-58. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5789MHz)

FCC ID: BCGA2764	 element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 57 of 100



Plot 7-59. PSD TxBF Antenna 5b (BDR GFSK, iPA – 5844MHz)



Plot 7-60. PSD TxBF Antenna 4a (BDR GFSK, iPA – 5844MHz)

FCC ID: BCGA2764		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N: 1C2205090028-16.BCG	Test Dates: 7/21/2022-9/27/2022	EUT Type: Tablet Device	Page 58 of 100

**Note:**

Per ANSI C63.10-2013 Subclause 14.3.2.2 and KDB 662911 v02r01 Section E(2), the power spectral density 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.

Sample TxBF Calculation:

Assuming the average conducted power spectral density was measured to be 6.59 dBm for Antenna 5b and 7.78 dBm for Antenna 4a.

Antenna 5b + Antenna 4a = TxBF

$$(6.59 \text{ dBm} + 7.78 \text{ dBm}) = (4.560 \text{ mW} + 5.998 \text{ mW}) = 10.558 \text{ mW} = 10.24 \text{ dBm}$$

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7.6 Radiated Spurious Emission – Above 1GHz

§15.407(b) §15.205 §15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna 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. All channels and power schemes were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.25 GHz band shall not exceed an EIRP of -27 dBm/MHz.

For transmitters operating in the 5.725 – 5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-15 per Section 15.209.

Frequency	Field Strength [μ V/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-15. Radiated Limits

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Test Procedures Used

ANSI C63.10-2013 – Subclauses 12.7.7.2, 12.7.6, 12.7.5
 KDB 789033 D02 v02r01 – Section G

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be $\geq 2 \times \text{span}/\text{RBW}$)
6. Averaging type = power (RMS)
7. Sweep time = auto couple
8. Trace was averaged over 100 sweeps

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Setup

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

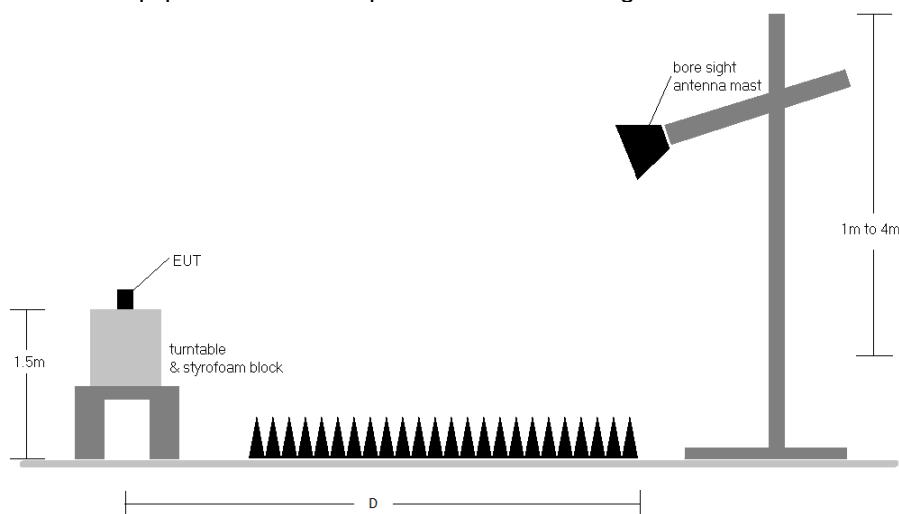


Figure 7-5. Test Instrument & Measurement Setup

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Test Notes

1. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 are below the limit shown in Table 7-15.
2. All spurious emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-15. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -27dBm/MHz. At a distance of 3 meters, the field strength limit in dB μ V/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dB μ V/m.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas.
6. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The “-” shown in the following RSE tables are used to denote a noise floor measurement.
8. All supported modulation, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level [dB μ V/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB] – Preamplifier Gain [dB]
- Margin [dB] = Field Strength Level [dB μ V/m] – Limit [dB μ V/m]

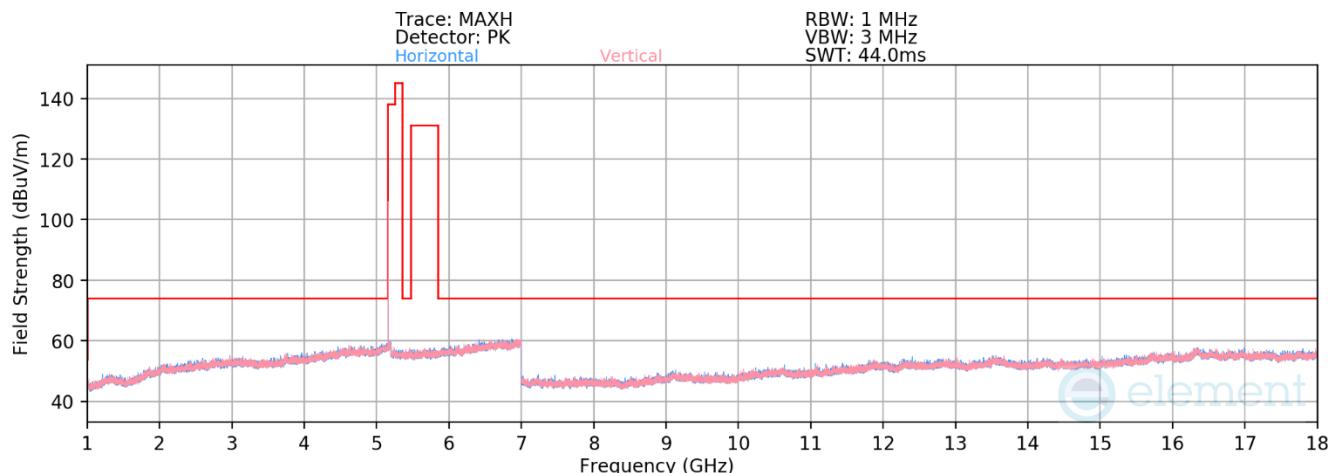
Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.6.4 was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + \text{Attenuator}) - \text{Preamplifier Gain}$$

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7.6.1 Antenna 5b Radiated Spurious Emission



Plot 7-61. RSE 1-18GHz Antenna 5b (BDR GFSK ePA – 5162MHz)

Mode: BDR
 Data Rate: 1Mbps
 Power Scheme: ePA
 Distance of Measurements: 3 Meters
 Operating Frequency: 5162MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
10324.00	Peak	H	-	-	-71.25	14.80	50.55	68.20	-17.65
* 15486.00	Average	H	-	-	-84.12	20.16	43.04	53.98	-10.94
* 15486.00	Peak	H	-	-	-71.52	20.16	55.64	73.98	-18.34

Table 7-16. Radiated Measurements Antenna 5b

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