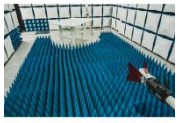
Element Materials Technology
(formerly PCTEST)
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 408.538.5600
http://www.element.com



MEASUREMENT REPORT
FCC PART 15.407 / ISED RSS-247 Narrowband UNII HDR

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

Date of Testing:
11/29/2023 - 3/5/2024
Test Report Issue Date:
3/22/2024
Test Site/Location:
Element Materials Technology Morgan Hill, CA, USA
Test Report Serial No.:
1C2311270063-09.BCG

FCC ID:	**BCGA2902**
IC:	**579C-A2902**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2902
EUT Type:	Tablet Device
Frequency Range:	5162 – 5245MHz, 5733 – 5844MHz
Modulation Type:	π/4 DPQSK
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-247 Issue 3
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.

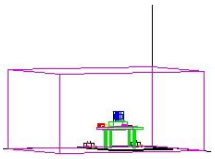
RJ Ortanez
Executive Vice President

Prepared by: WKR0000010551

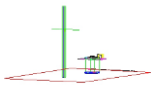
Reviewed by: WKR0000005805

ACCREDITED
CERT #2041.02

TABLE OF CONTENTS



MEASUREMENT REPORT



UNII Band	Tx Frequency [MHz]	Mode	Power Scheme	SISO				TXBF					
				Antenna WF8		Antenna WF7a		Antenna WF8		Antenna WF7a		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	16.89	12.28	14.64	11.65	8.64	9.37	8.85	9.47	17.50	12.43
		HDR8	ePA	17.15	12.34	14.29	11.55	15.76	11.98	14.14	11.51	29.92	14.76
		HDR4	iPA	1.73	2.38	1.38	1.40	1.62	2.11	1.42	1.52	3.04	4.83
		HDR8	iPA	1.72	2.37	1.40	1.46	1.66	2.21	1.38	1.41	3.05	4.84
3	5733 - 5844	HDR4	ePA	15.58	11.93	15.51	11.91	14.26	11.54	14.21	11.53	28.44	14.54
		HDR8	ePA	16.18	12.09	14.50	11.61	15.60	11.93	13.09	11.17	28.71	14.58
		HDR4	iPA	1.45	1.62	1.56	1.94	1.46	1.65	1.47	1.69	2.94	4.68
		HDR8	iPA	1.41	1.50	1.58	1.98	1.41	1.48	1.45	1.63	2.86	4.57

FCC EUT Overview

UNII Band	Tx Frequency [MHz]	Mode	Power Scheme	SISO				TXBF					
				Antenna WF8		Antenna WF7a		Antenna WF8		Antenna WF7a		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	9.74	9.89	6.88	8.38	2.37	3.75	1.75	2.44	4.13	6.16
		HDR8	ePA	16.48	12.17	12.50	10.97	4.44	6.47	3.04	4.83	7.48	8.74
		HDR4	iPA	1.73	2.38	1.38	1.40	1.62	2.11	1.42	1.52	3.04	4.83
		HDR8	iPA	1.72	2.37	1.40	1.46	1.66	2.21	1.38	1.41	3.05	4.84
3	5733 - 5844	HDR4	ePA	15.58	11.93	15.51	11.91	15.52	11.91	13.62	11.34	29.11	14.64
		HDR8	ePA	16.18	12.09	14.50	11.61	15.72	11.97	13.48	11.30	29.17	14.65
		HDR4	iPA	1.45	1.62	1.56	1.94	1.47	1.68	1.49	1.72	2.96	4.71
		HDR8	iPA	1.41	1.50	1.58	1.98	1.42	1.52	1.46	1.63	2.88	4.59

ISED EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Materials Technology Test Location

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

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology.

- Element Materials Technology is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Materials Technology facility is a registered (22831) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB# US0110) for ISED Canada as designed by NIST under the U.S. and Canada Mutual Recognition Agreements (MRAs)

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2902, IC: 579C-A2902**. 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.: CWF7TCY9J3, HJQ6KDT73J, YYW2W9H5YX, VNPP6G99NN, DLXH09000190000DHV

2.2 Device Capabilities

This device contains the following capabilities:

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), 802.15.4, 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 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:

Measured Duty Cycles			
Band	Mode		Duty Cycle [%]
UNII-1	HDR4	ePA	100.0
		iPA	100.0
UNII-3	HDR4	ePA	100.0
		iPA	100.0
UNII-1	HDR8	ePA	100.0
		iPA	100.0
UNII-3	HDR8	ePA	100.0
		iPA	100.0

Table 2-2. Measured Duty Cycles

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

Antenna	Simultaneous Tx Config	Wifi 2GHz	Bluetooth	Thread	Wifi 5GHz	Wifi 6GHz	NB UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	802.15.4	802.11 a/n/ac/ax	802.11 a/ax	BDR, HDR4/8
WF8	Config 1	✓	✗	✗	✗	✗	✓
WF8	Config 2	✗	✓	✗	✓	✗	✗
WF8	Config 3	✗	✓	✗	✗	✓	✗
WF8	Config 4	✗	✗	✓	✓	✗	✗
WF8	Config 5	✗	✗	✓	✗	✓	✗

Table 2-3. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All of the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 2 and reported in Bluetooth and UNII RF test reports.

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 (2.4GHz) in connected mode and Wi-Fi (2.4GHz) – Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power. For BT (2.4GHz) in disconnected mode and Wi-Fi (2.4GHz) – BT will be using iPA only and Wi-Fi max power will not exceed minimum of (SAR max cap, Reg max cap) power. Bluetooth can simultaneously transmit with IEEE 802.11a/n/ac/ax 5/6 GHz on separate antenna.

2.3 Antenna Description

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

Frequency [MHz]	Antenna Gain (dBi)	
	Antenna WF8	Antenna WF7a
5162 - 5245	1.3	2.9
5733 – 5844	5.0	2.1

Table 2-4. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro	Model:	A2141	S/N:	C02H604EQ05D
	w/AC/DC Adapter	Model:	A2166	S/N:	C4H042705ZNPM0WA6
2	Apple USB-C Cable	Model:	Spartan	S/N:	GXK1336018XKTR024
3	USB-C Cable	Model:	A246C	S/N:	DWH80115BK826GV19
	w/ AC Adapter	Model:	A2305	S/N:	C4H95160004PF4F4V
4	Apple Pencil	Model:	A2538	S/N:	KJ26TCFXJW
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-5. Test Support Equipment List

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 configurations were investigated and EUT powered by AC/DC adaptor was the worst case.

- EUT powered by AC/DC adaptor to 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 21E8197 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.

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.

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 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

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

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. 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 (±dB)
Conducted Bench Top Measurements	2.07
AC Line Conducted Disturbance	1.91
Radiated Disturbance (<30MHz)	4.12
Radiated Disturbance (30MHz - 1GHz)	4.85
Radiated Disturbance (1 - 18GHz)	5.08
Radiated Disturbance (>18GHz)	4.59

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 with 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	6/21/2023	Annual	6/21/2024	MY49430244
Anritsu	ML2496A	Power Meter	4/4/2023	Annual	4/4/2024	1840005
Anritsu	MA2411B	Pulse Power Sensor	8/22/2023	Annual	8/22/2024	1726262
Anritsu	MA2411B	Pulse Power Sensor	4/5/2023	Annual	4/5/2024	1726261
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/30/2023	Annual	3/30/2024	00218555
Keysight Technology	N9040B	UXA Signal Analyzer	3/10/2023	Annual	3/10/2024	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/31/2023	Annual	8/31/2024	100052
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/11/2023	Annual	5/11/2024	101619
Rohde & Schwarz	ESW44	EMI Test Receiver	6/6/2023	Annual	6/6/2024	101668
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	6/22/2023	Annual	6/22/2024	102356
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/2/2023	Annual	6/2/2024	100050
Rohde & Schwarz	HFH2-Z2	Loop Antenna	5/1/2023	Annual	5/1/2024	100519
Rohde & Schwarz	ENV216	Two-Line V-Network	6/8/2023	Annual	6/8/2024	192052
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	4/17/2023	Annual	4/17/2024	00304

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.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2902

IC: 579C-A2902

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407	RSS-Gen [6.7]	26dB Bandwidth	N/A	CONDUCTED	N/A	Section 7.2
15.407(e)	RSS-Gen [6.7]	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A		N/A	Section 7.2, 7.3
15.407 (a.1.iv), (a.3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a.1.iv), (a.3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(b.1), (4)	RSS-247 [6.2]	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])	RADIATED	PASS	Section 7.6
15.205, 15.407(b.1), (4)	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.6
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8]) 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 3.0.

7.2 26dB & 99% Bandwidth Measurement – HDR

§2.1049; §15.407; RSS-Gen [6.7]

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 x 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

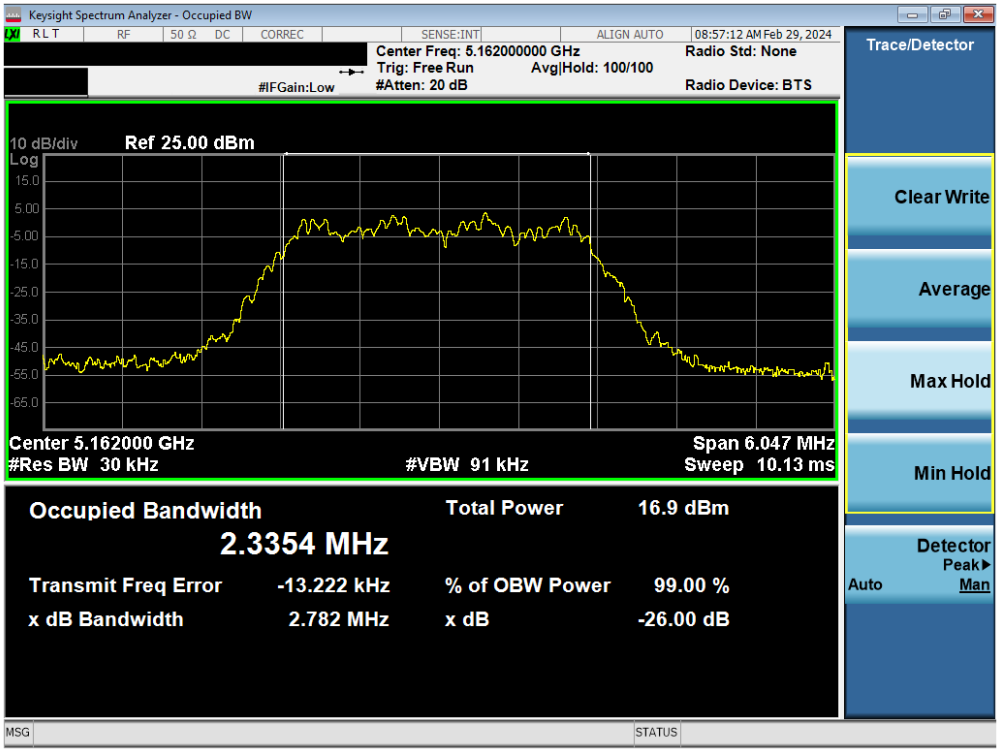
Test Notes

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

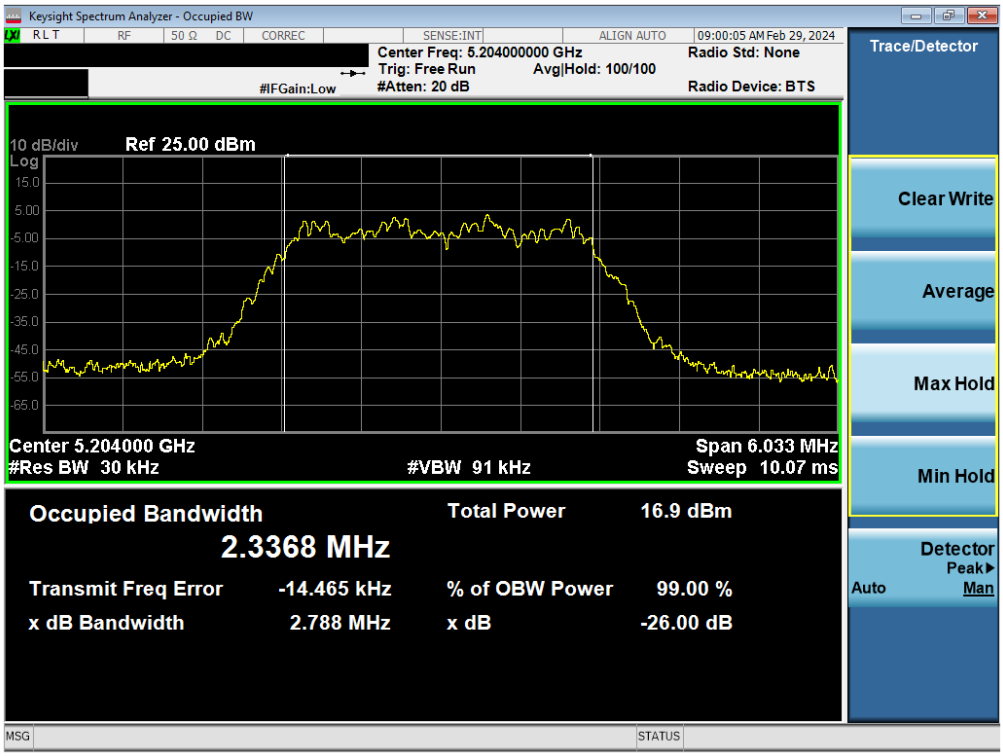
7.2.1 Antenna WF8 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	4.0	HDR4	ePA	2.3354	2.7824
	5204	4.0	HDR4	ePA	2.3368	2.7881
	5245	4.0	HDR4	ePA	2.3354	2.7865
	5162	8.0	HDR8	ePA	4.8514	5.6679
	5204	8.0	HDR8	ePA	4.8500	5.6597
	5245	8.0	HDR8	ePA	4.8496	5.6633

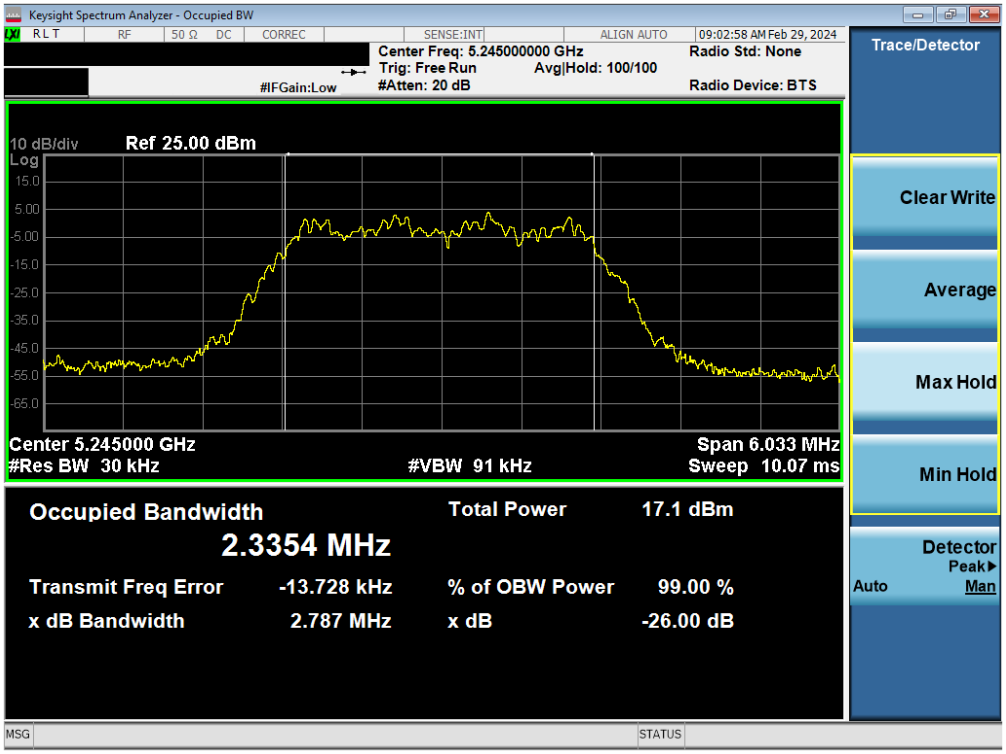
Table 7-2. Conducted BW Measurements Antenna WF8



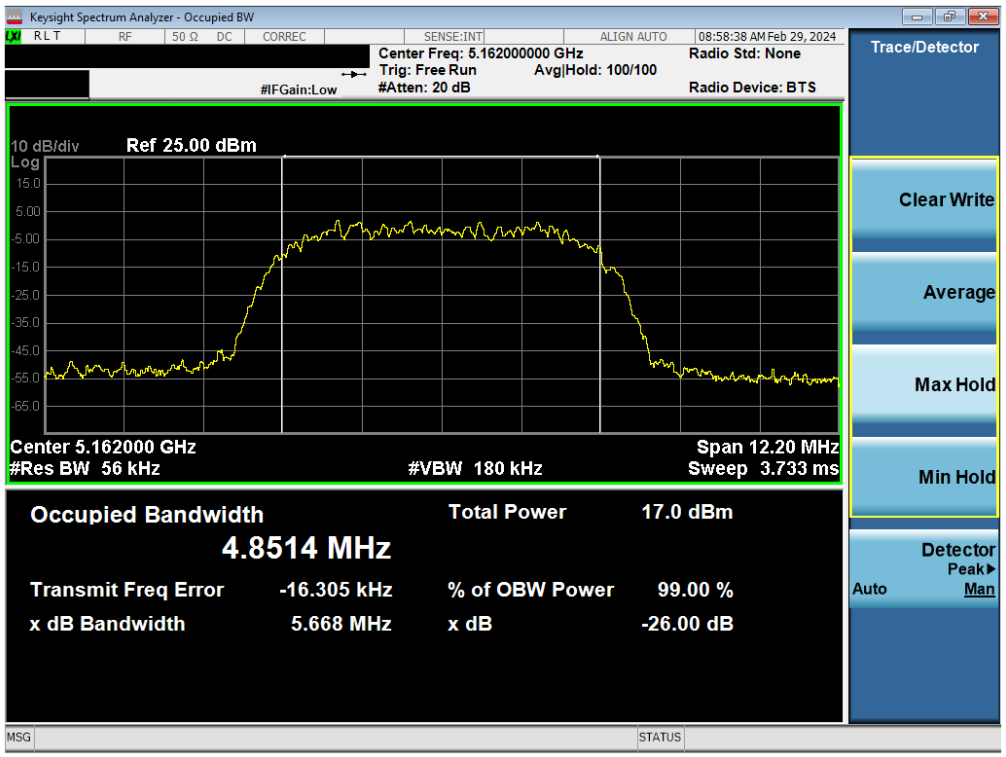
Plot 7-1. 26dB BW & 99% OBW Antenna WF8 (HDR4, ePA– 5162MHz)



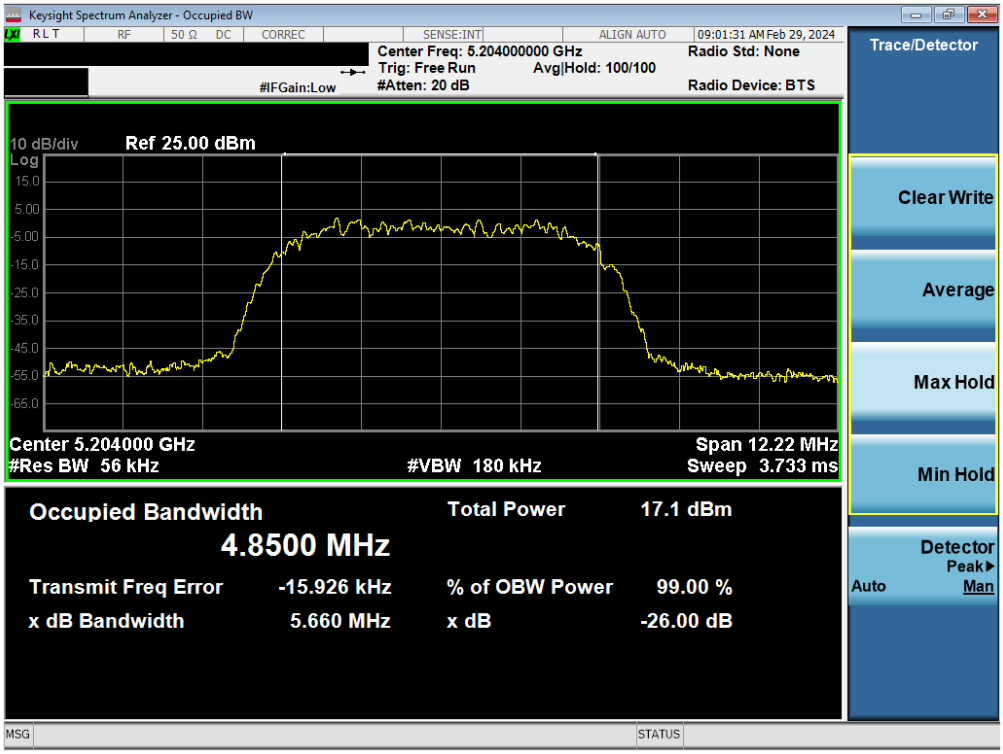
Plot 7-2. 26dB BW & 99% OBW Antenna WF8 (HDR4, ePA– 5204MHz)



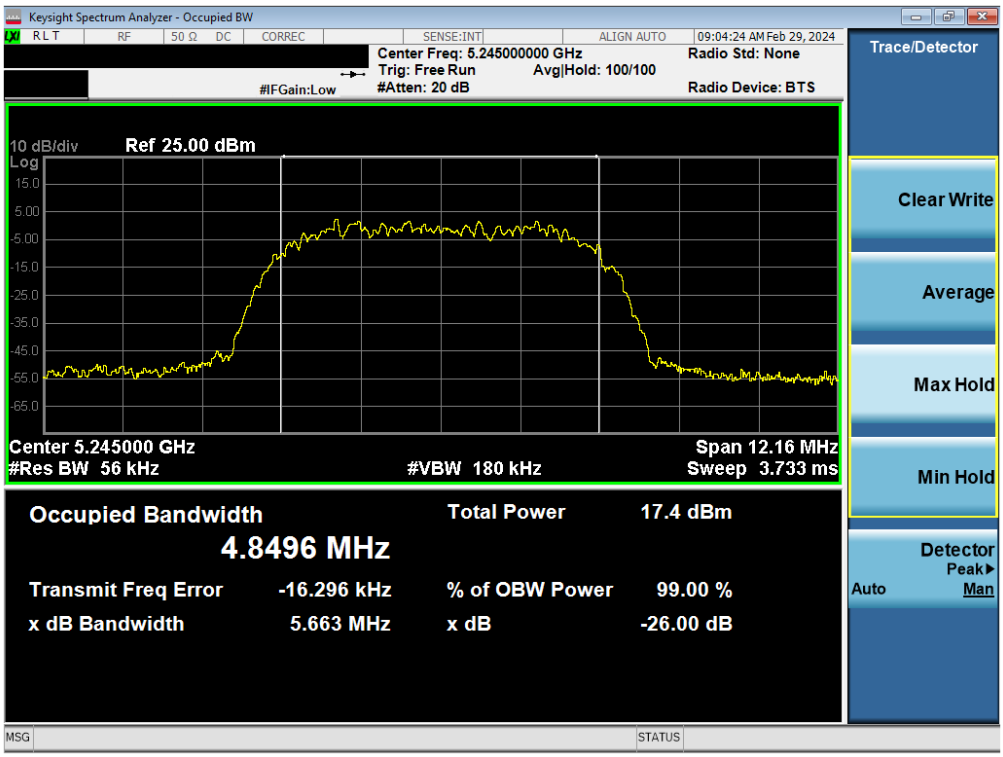
Plot 7-3. 26dB BW & 99% OBW Antenna WF8 (HDR4, ePA – 5245MHz)



Plot 7-4. 26dB BW & 99% OBW Antenna WF8 (HDR8, ePA– 5162MHz)



Plot 7-5. 26dB BW & 99% OBW Antenna WF8 (HDR8, ePA– 5204MHz)

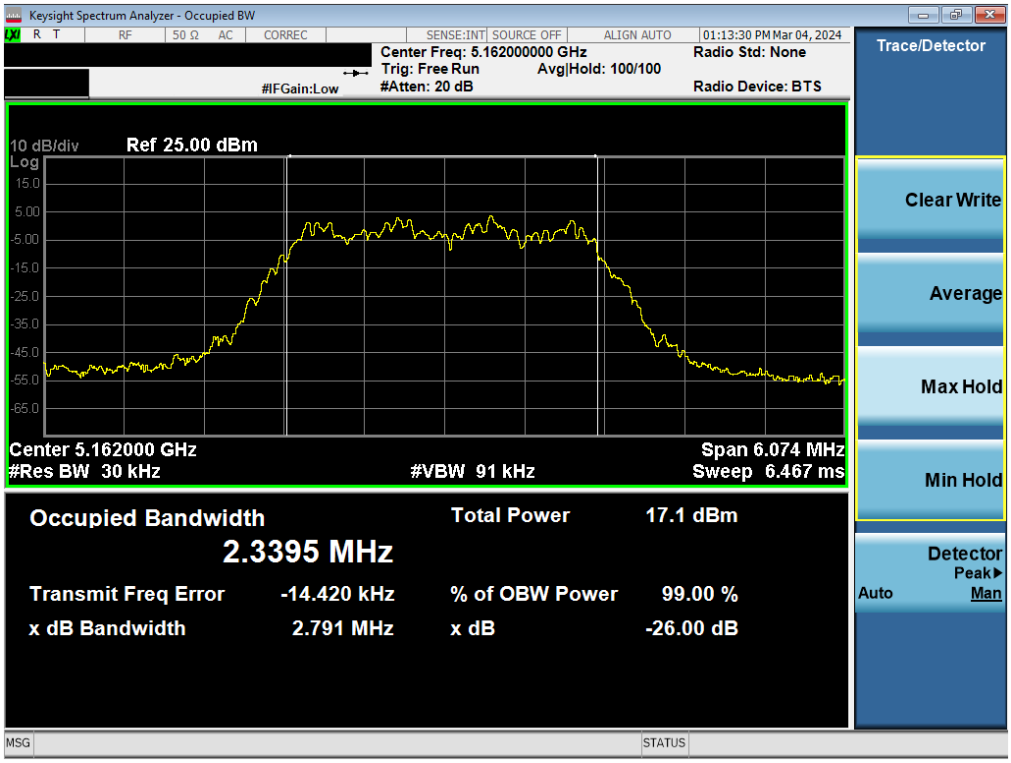


Plot 7-6. 26dB BW & 99% OBW Antenna WF8 (HDR8, ePA – 5245MHz)

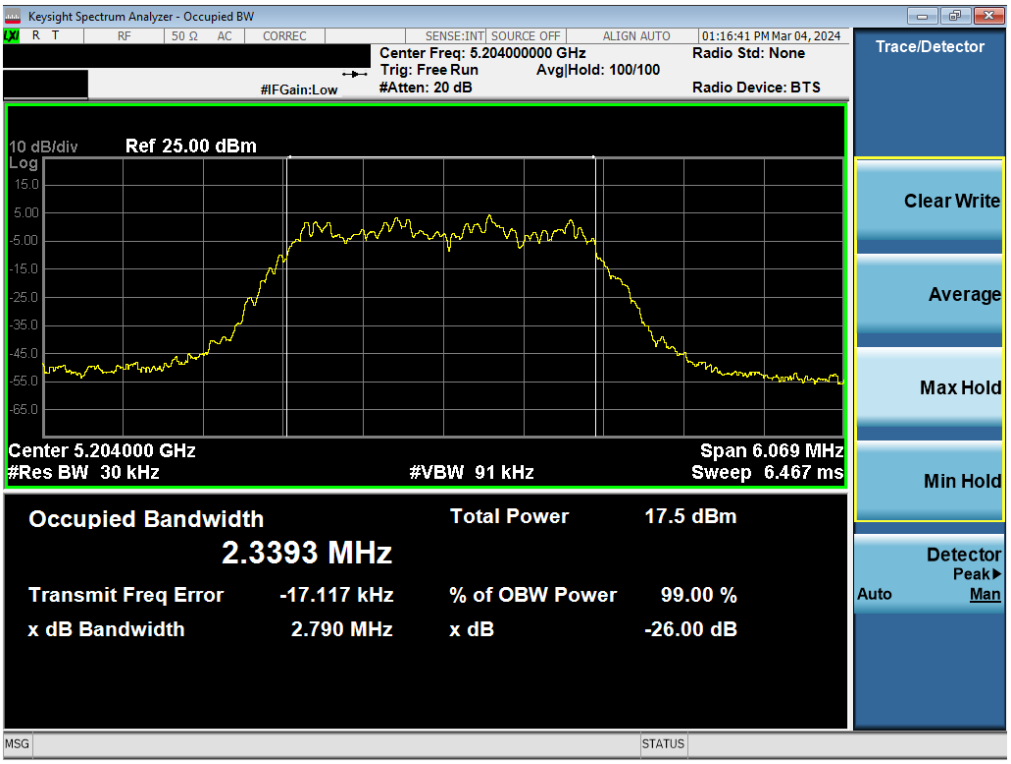
7.2.2 Antenna WF7a 26dB & 99% Bandwidth Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 26dB Bandwidth [MHz]
Band 1	5162	4.0	HDR4	ePA	2.3395	2.7906
	5204	4.0	HDR4	ePA	2.3393	2.7898
	5245	4.0	HDR4	ePA	2.3407	2.7895
	5162	8.0	HDR8	ePA	4.8529	5.6733
	5204	8.0	HDR8	ePA	4.8532	5.6946
	5245	8.0	HDR8	ePA	4.8533	5.6915

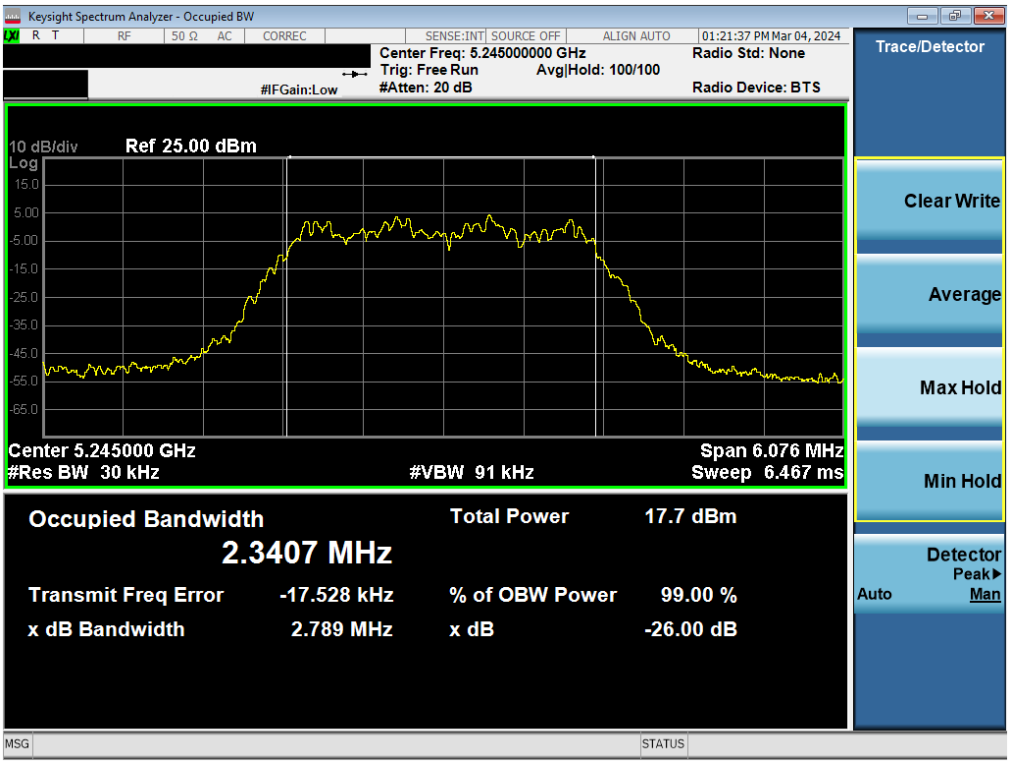
Table 7-3. Conducted BW Measurements Antenna WF7a



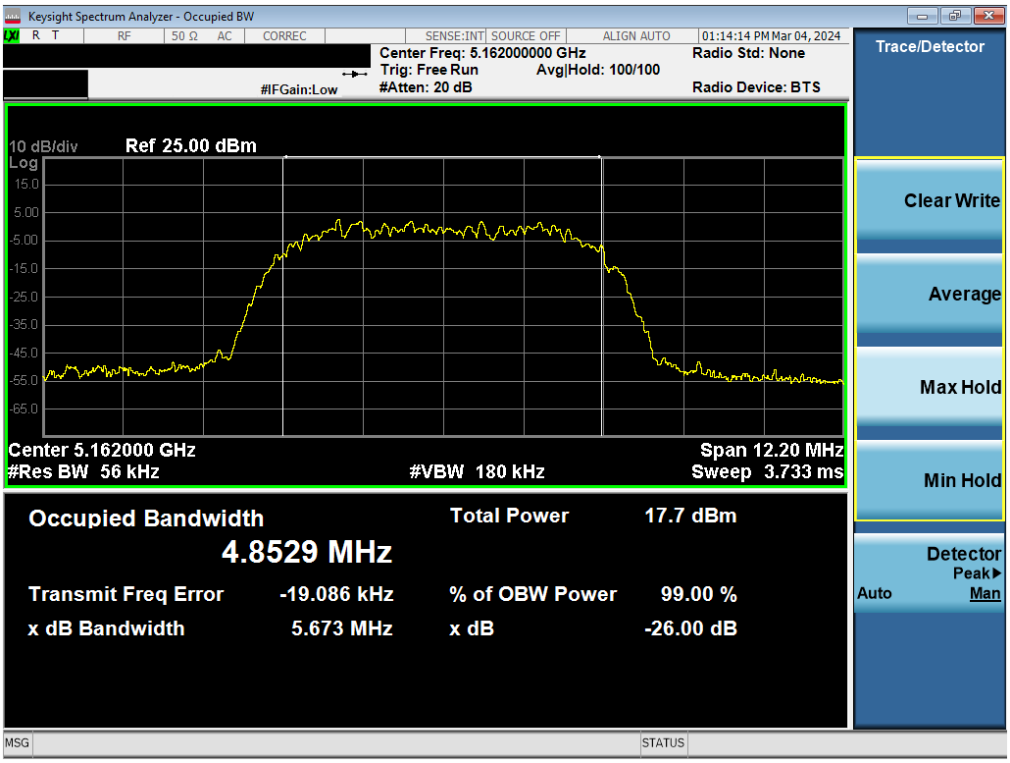
Plot 7-7. 26dB BW & 99% OBW Antenna WF7a (HDR4, ePA– 5162MHz)



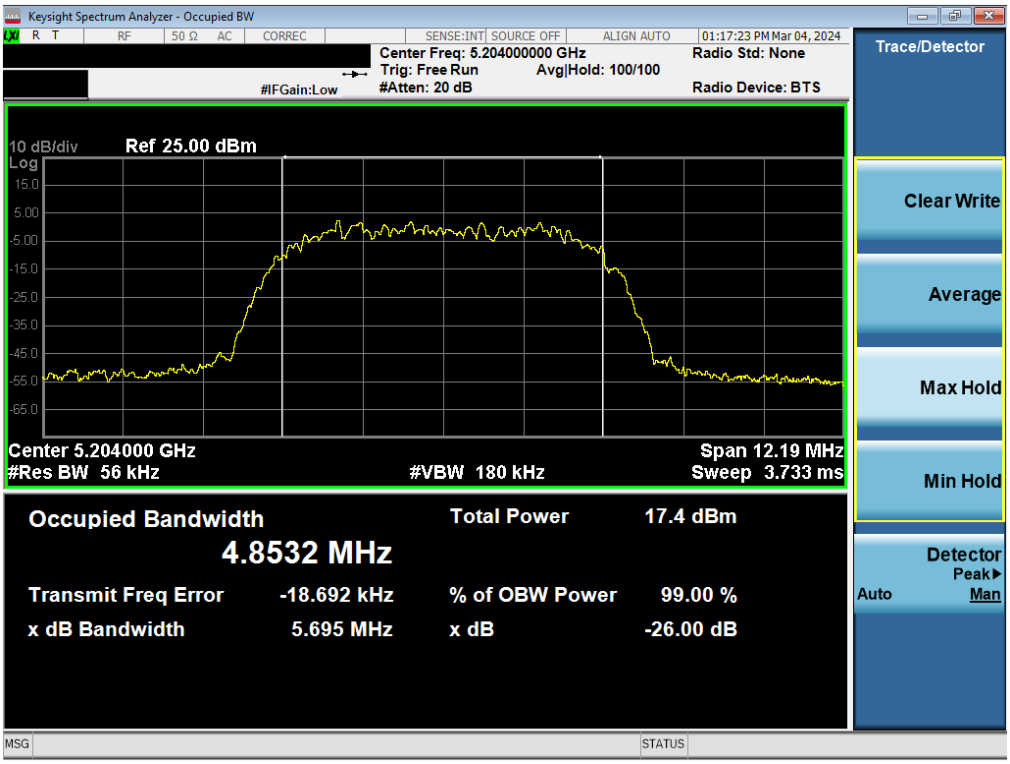
Plot 7-8. 26dB BW & 99% OBW Antenna WF7a (HDR4, ePA– 5204MHz)



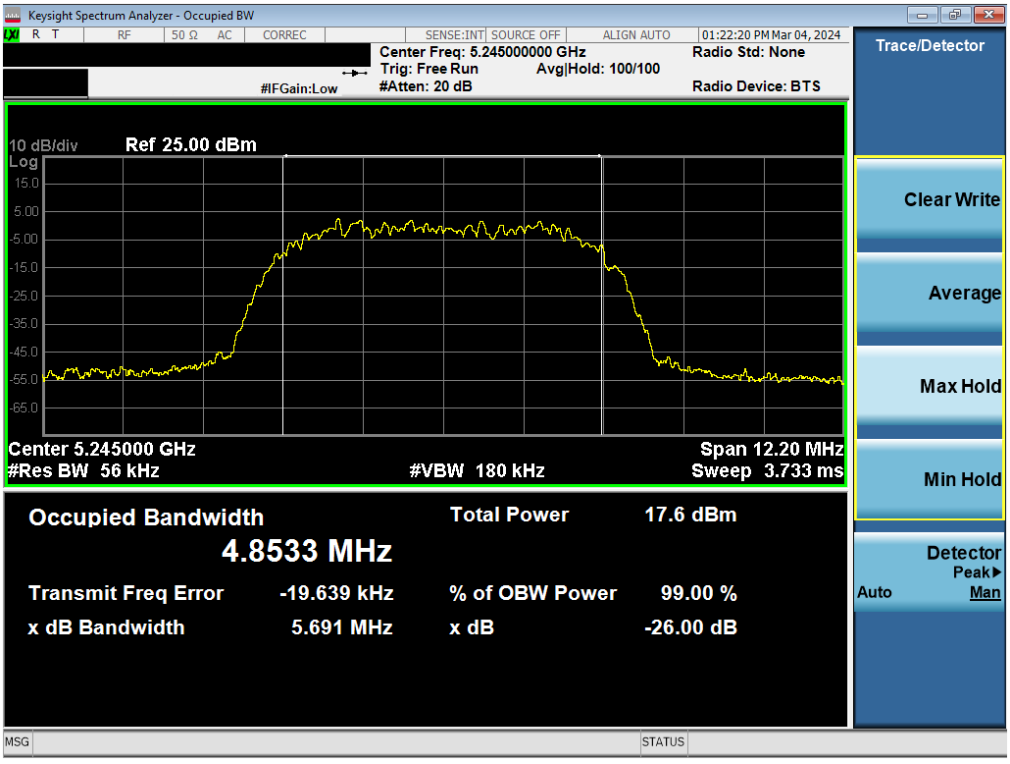
Plot 7-9. 26dB BW & 99% OBW Antenna WF7a (HDR4, ePA– 5245MHz)



Plot 7-10. 26dB BW & 99% OBW Antenna WF7a (HDR8, ePA– 5162MHz)



Plot 7-11. 26dB BW & 99% OBW Antenna WF7a (HDR8, ePA– 5204MHz)



Plot 7-12. 26dB BW & 99% OBW Antenna WF7a (HDR8, ePA– 5245MHz)

7.3 6dB & 99% Bandwidth Measurement – HDR

§2.1049; §15.407 (e); RSS-Gen [6.7]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the 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 ≥ 3 x 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

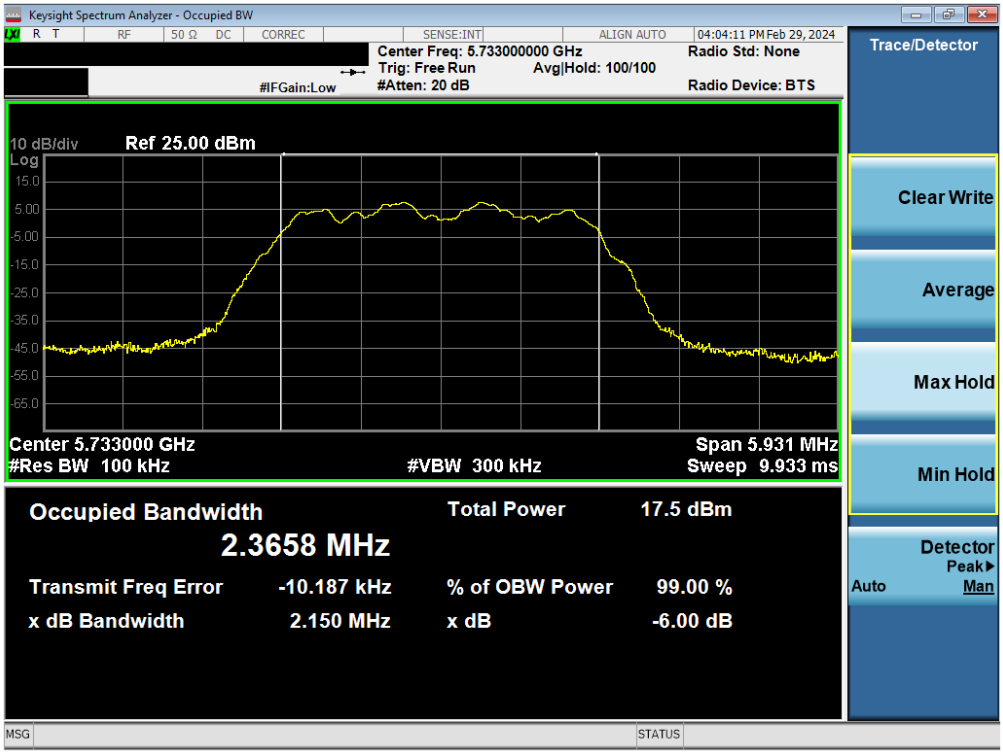
Test Notes

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

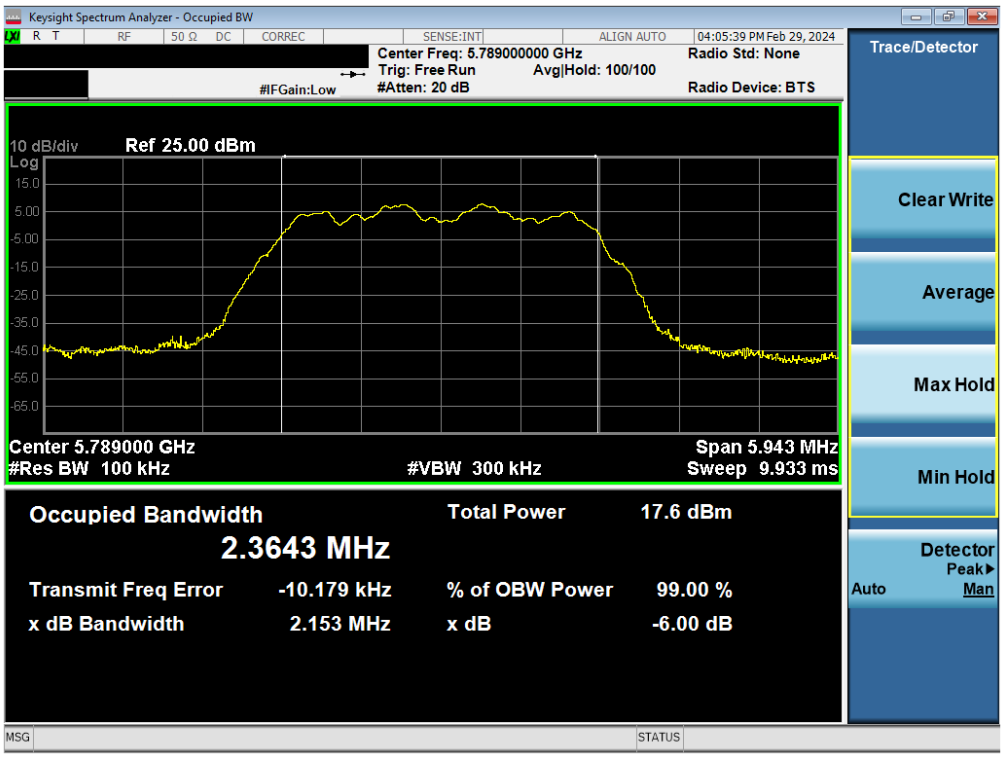
7.3.1 Antenna WF8 6dB & 99% Bandwidth Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	4.0	HDR4	ePA	2.3658	2.1499	0.50	Pass
	5789	4.0	HDR4	ePA	2.3643	2.1534	0.50	Pass
	5844	4.0	HDR4	ePA	2.3661	2.1561	0.50	Pass
	5733	8.0	HDR8	ePA	4.8492	4.1779	0.50	Pass
	5789	8.0	HDR8	ePA	4.8523	4.1783	0.50	Pass
	5844	8.0	HDR8	ePA	4.8515	4.1771	0.50	Pass

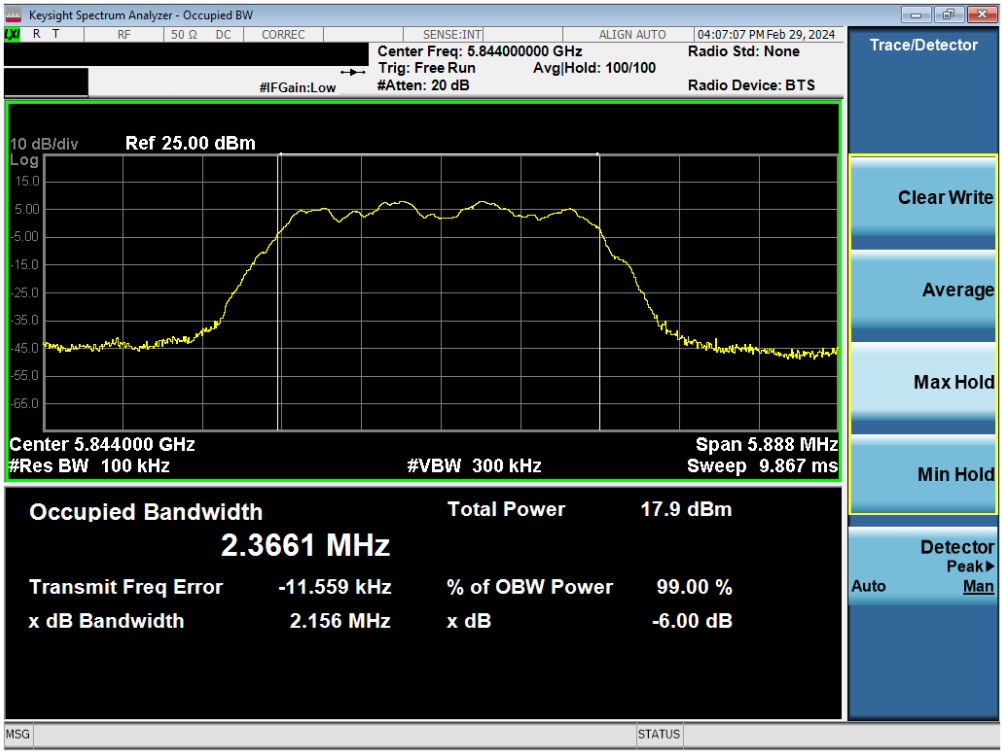
Table 7-4. Conducted BW Measurements Antenna WF8



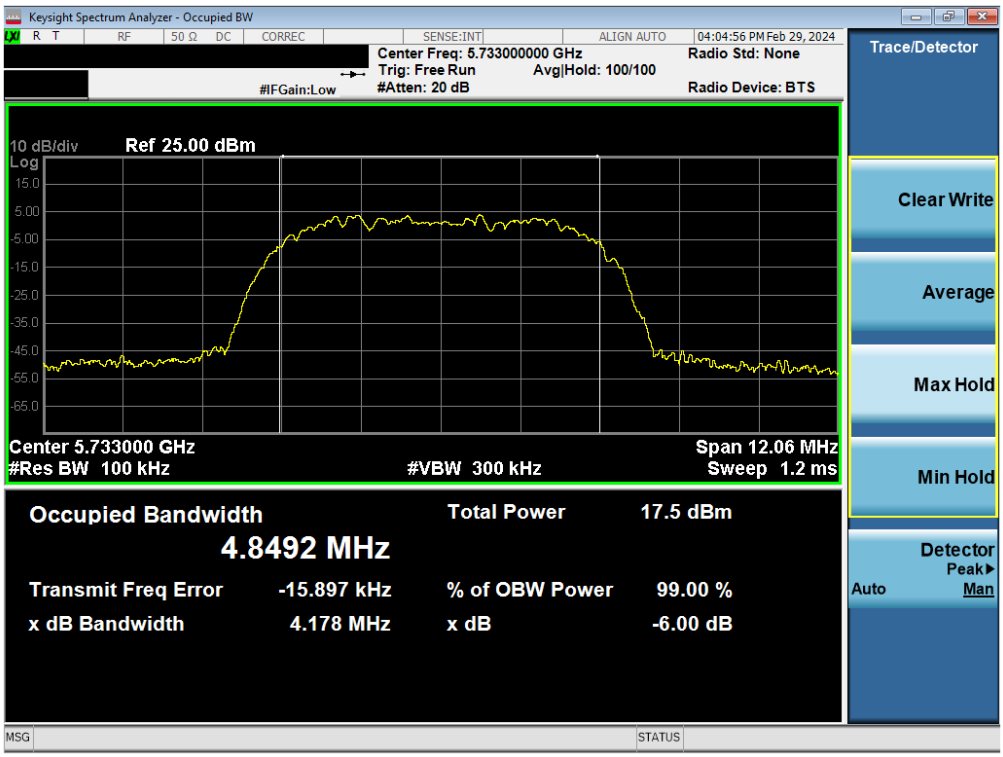
Plot 7-13. 6dB BW & 99% OBW Antenna WF8 (HDR4, ePA, 5733MHz)



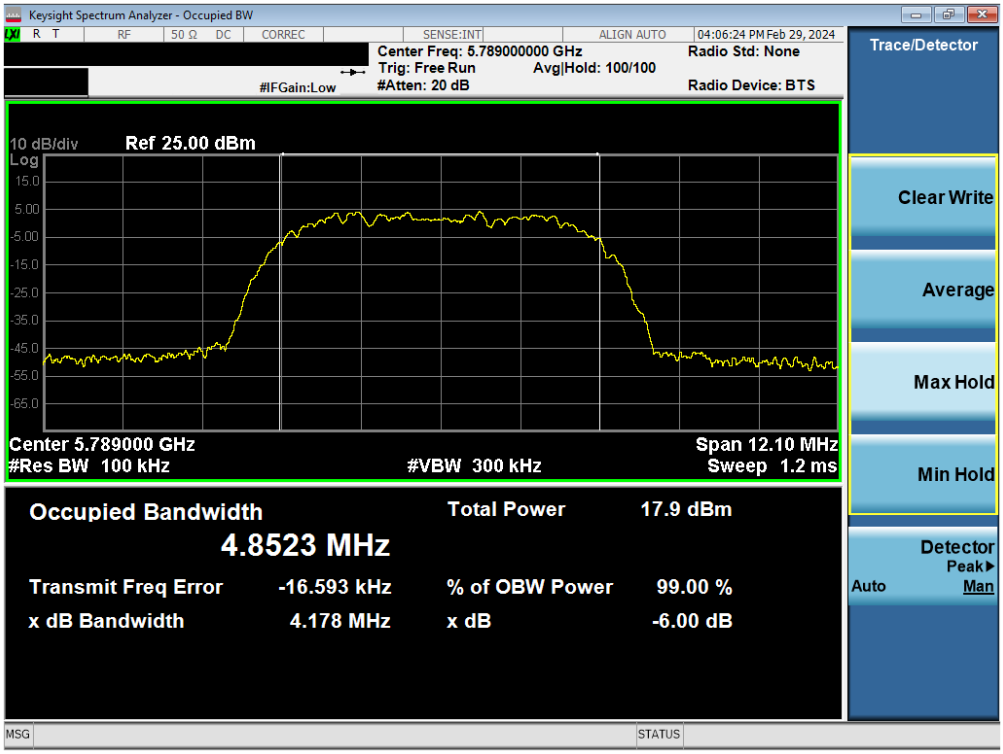
Plot 7-14. 6dB BW & 99% OBW Antenna WF8 (HDR4, ePA, 5789MHz)



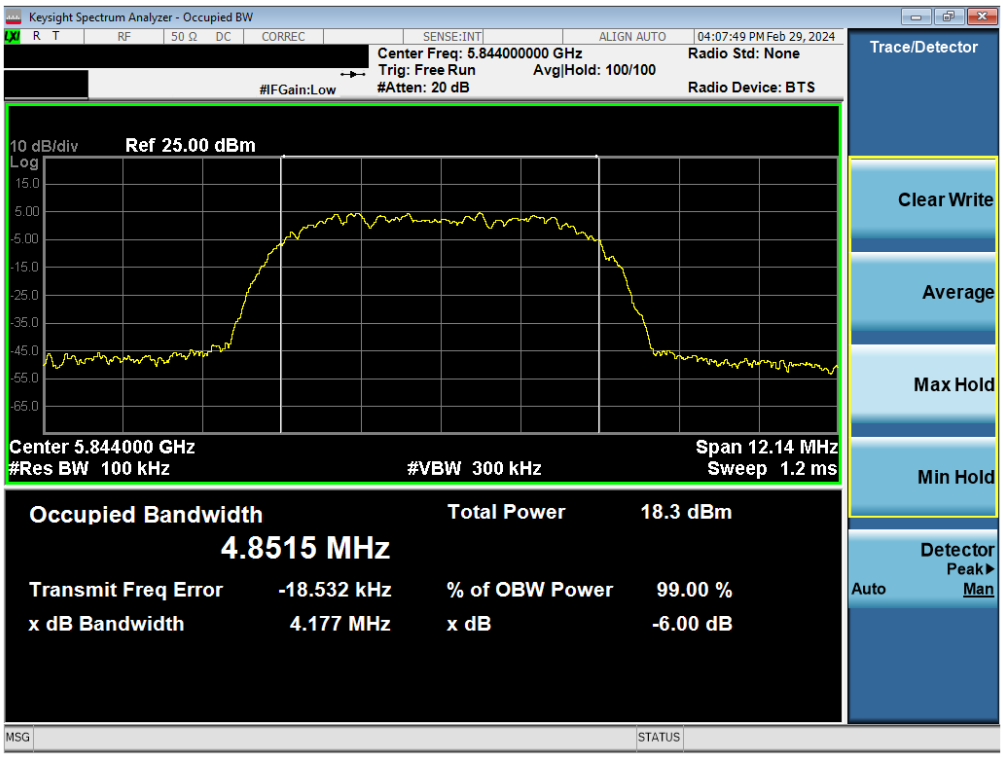
Plot 7-15. 6dB BW & 99% OBW Antenna WF8 (HDR4, ePA, 5844MHz)



Plot 7-16. 6dB BW & 99% OBW Antenna WF8 (HDR8, ePA, 5733MHz)



Plot 7-17. 6dB BW & 99% OBW Antenna WF8 (HDR8, ePA, 5789MHz)

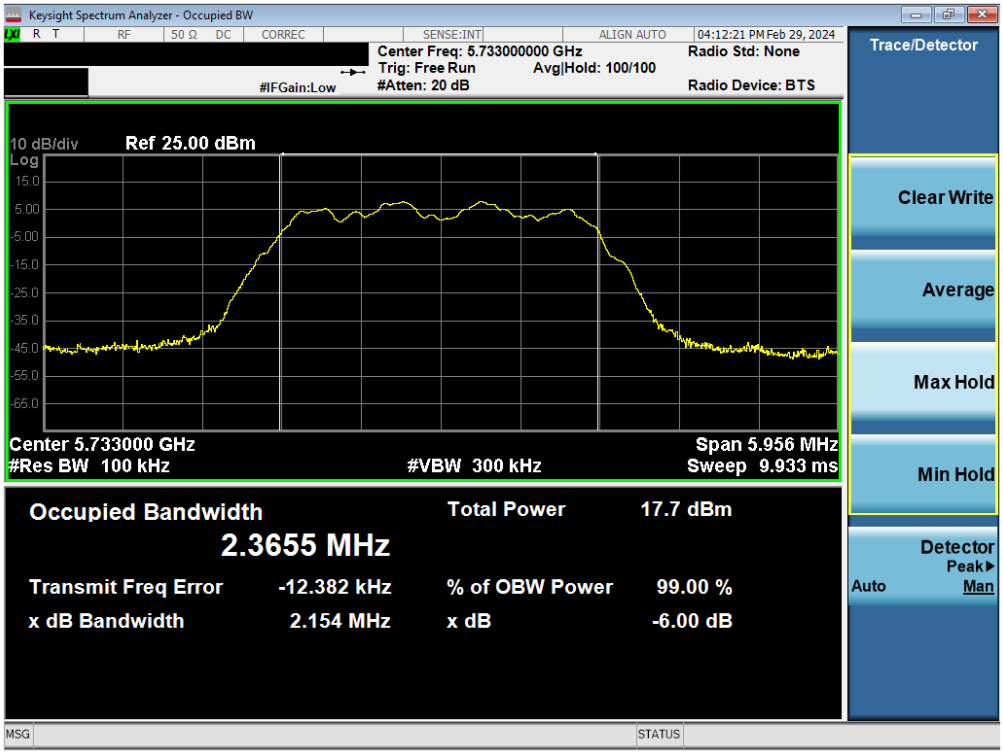


Plot 7-18. 6dB BW & 99% OBW Antenna WF8 (HDR8, ePA, 5844MHz)

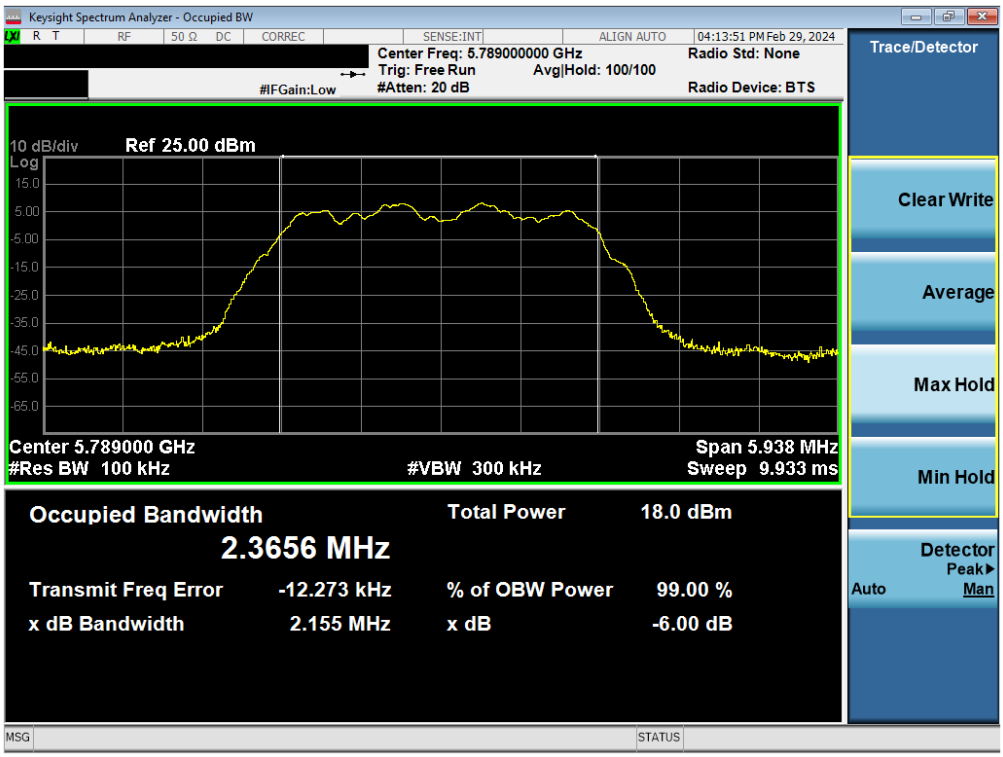
7.3.2 Antenna WF7a 6dB & 99% Bandwidth Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass / Fail
Band 3	5733	4.0	HDR4	ePA	2.3655	2.1539	0.50	Pass
	5789	4.0	HDR4	ePA	2.3656	2.1548	0.50	Pass
	5844	4.0	HDR4	ePA	2.3673	2.1555	0.50	Pass
	5733	8.0	HDR8	ePA	4.8537	4.1844	0.50	Pass
	5789	8.0	HDR8	ePA	4.8549	4.1840	0.50	Pass
	5844	8.0	HDR8	ePA	4.8492	4.1786	0.50	Pass

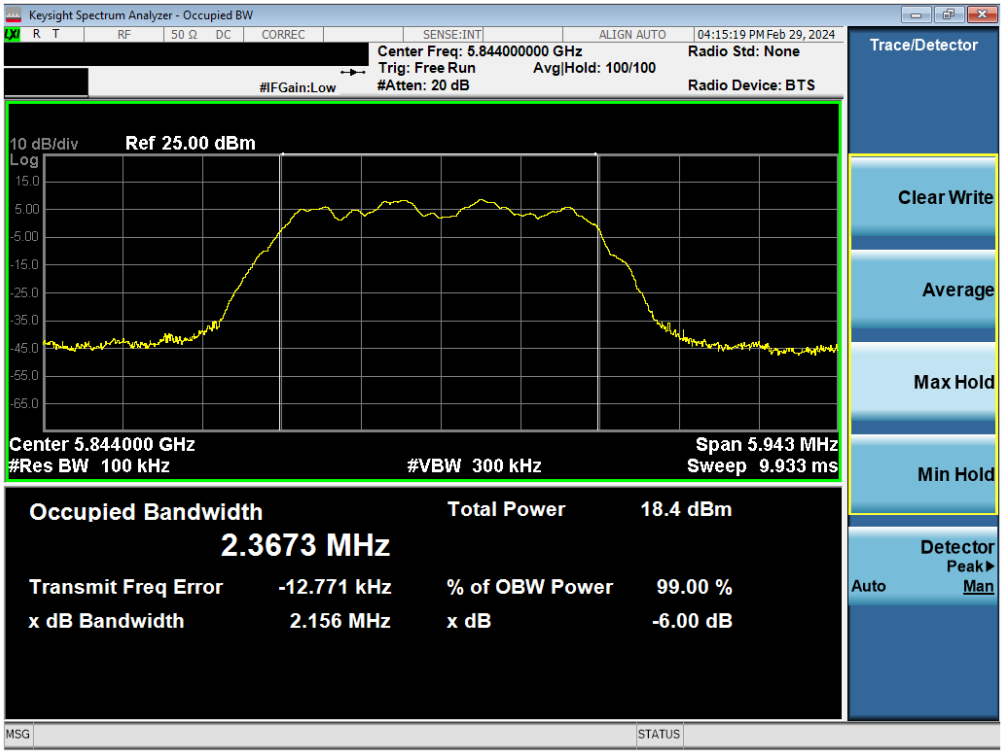
Table 7-5. Conducted BW Measurements Antenna WF7a



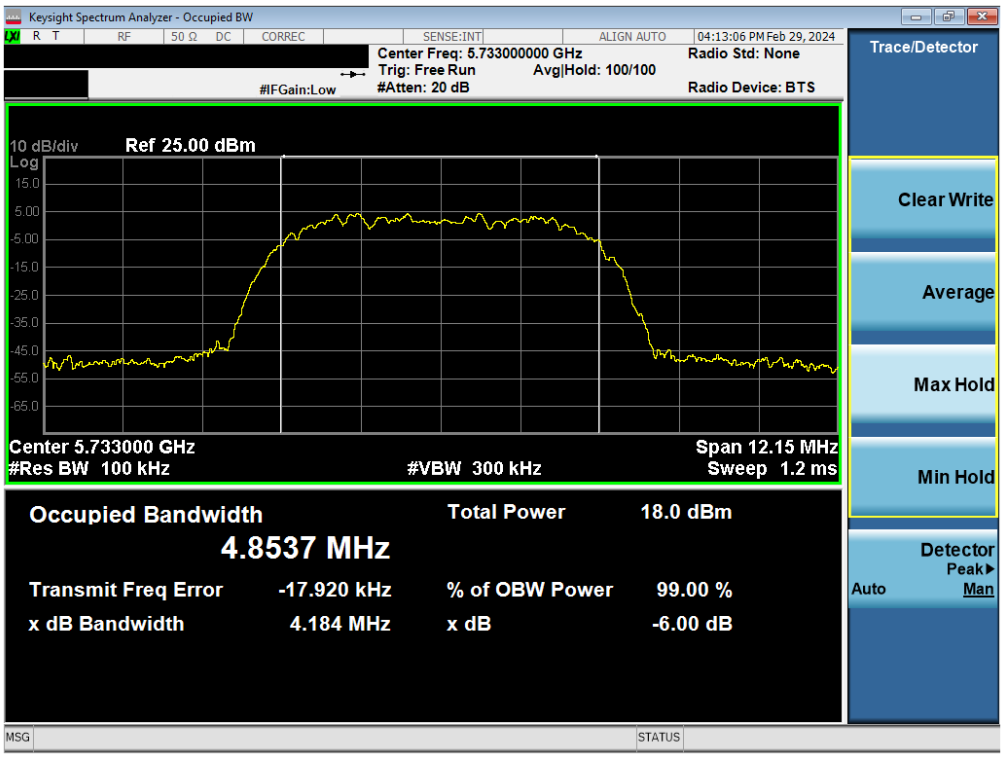
Plot 7-19. 6dB BW & 99% OBW Antenna WF7a (HDR4, ePA, 5733MHz)



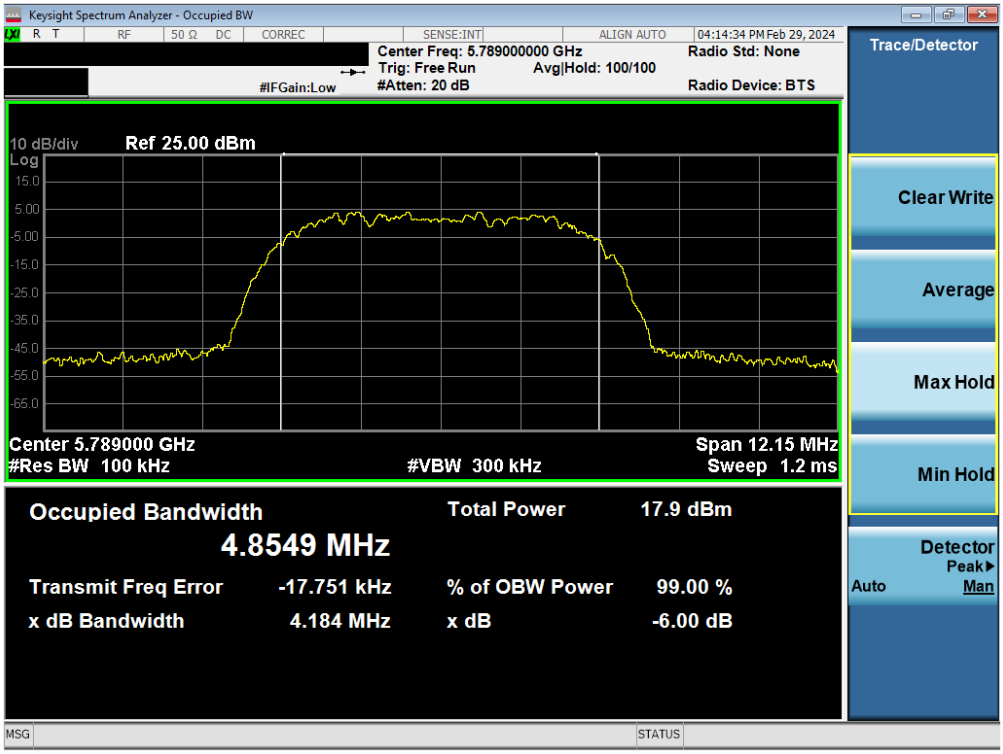
Plot 7-20. 6dB BW & 99% OBW Antenna WF7a (HDR4, ePA, 5789MHz)



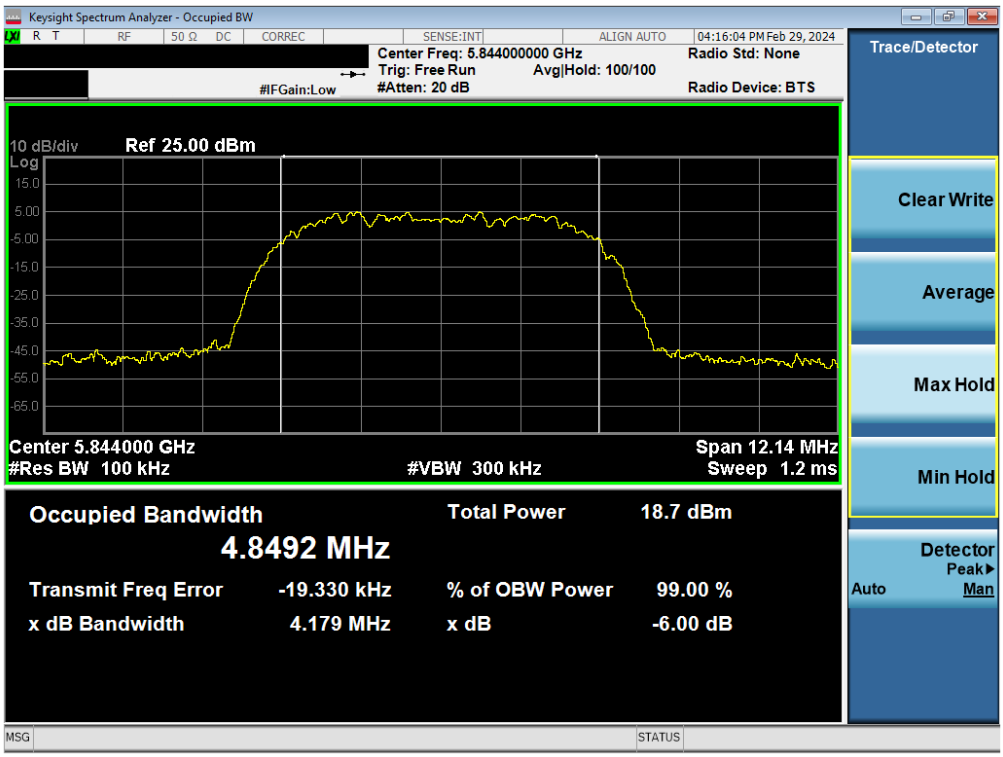
Plot 7-21. 6dB BW & 99% OBW Antenna WF7a (HDR4, ePA, 5844MHz)



Plot 7-22. 6dB BW & 99% OBW Antenna WF7a (HDR8, ePA, 5733MHz)



Plot 7-23. 6dB BW & 99% OBW Antenna WF7a (HDR8, ePA, 5789MHz)



Plot 7-24. 6dB BW & 99% OBW Antenna WF7a (HDR8, ePA, 5844MHz)

7.4 Conducted Output Power and Max EIRP Measurement – HDR

§15.407(a.1.iv) §15.407(a.3); RSS-247 [6.2]

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). The maximum e.i.r.p. shall not exceed the lesser of 200 mW or 10 + 10log$_{10}$B dBm.

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm). The maximum e.i.r.p. is 36 dBm.

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

7.4.1 Conducted Output Power Measurements

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	HDR4	ePA	12.28	23.98	-11.70
5204	AVG	HDR4	ePA	12.16	23.98	-11.82
5245	AVG	HDR4	ePA	12.20	23.98	-11.78
5162	AVG	HDR4	iPA	1.94	23.98	-22.04
5204	AVG	HDR4	iPA	2.30	23.98	-21.68
5245	AVG	HDR4	iPA	2.38	23.98	-21.60
5162	AVG	HDR8	ePA	12.12	23.98	-11.86
5204	AVG	HDR8	ePA	12.24	23.98	-11.74
5245	AVG	HDR8	ePA	12.34	23.98	-11.64
5162	AVG	HDR8	iPA	1.97	23.98	-22.01
5204	AVG	HDR8	iPA	2.37	23.98	-21.61
5245	AVG	HDR8	iPA	2.25	23.98	-21.73
5733	AVG	HDR4	ePA	11.91	30.00	-18.09
5789	AVG	HDR4	ePA	11.67	30.00	-18.33
5844	AVG	HDR4	ePA	11.93	30.00	-18.07
5733	AVG	HDR4	iPA	1.46	30.00	-28.54
5789	AVG	HDR4	iPA	1.62	30.00	-28.38
5844	AVG	HDR4	iPA	1.58	30.00	-28.42
5733	AVG	HDR8	ePA	11.82	30.00	-18.18
5789	AVG	HDR8	ePA	12.05	30.00	-17.95
5844	AVG	HDR8	ePA	12.09	30.00	-17.91
5733	AVG	HDR8	iPA	1.50	30.00	-28.51
5789	AVG	HDR8	iPA	1.45	30.00	-28.55
5844	AVG	HDR8	iPA	1.19	30.00	-28.81

Table 7-6. Antenna WF8 FCC Maximum Conducted Output Power

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p [dBm]	Max e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
5162	AVG	HDR4	ePA	9.89	-	-	1.30	11.19	13.68	-2.49
5204	AVG	HDR4	ePA	9.62	-	-	1.30	10.92	13.68	-2.75
5245	AVG	HDR4	ePA	9.73	-	-	1.30	11.03	13.68	-2.65
5162	AVG	HDR4	iPA	1.94	-	-	1.30	3.24	13.68	-10.44
5204	AVG	HDR4	iPA	2.30	-	-	1.30	3.60	13.68	-10.08
5245	AVG	HDR4	iPA	2.38	-	-	1.30	3.68	13.68	-10.00
5162	AVG	HDR8	ePA	12.17	-	-	1.30	13.47	16.86	-3.39
5204	AVG	HDR8	ePA	11.97	-	-	1.30	13.27	16.86	-3.59
5245	AVG	HDR8	ePA	12.16	-	-	1.30	13.46	16.86	-3.40
5162	AVG	HDR8	iPA	1.97	-	-	1.30	3.27	16.86	-13.58
5204	AVG	HDR8	iPA	2.37	-	-	1.30	3.67	16.86	-13.19
5245	AVG	HDR8	iPA	2.25	-	-	1.30	3.55	16.86	-13.31
5733	AVG	HDR4	ePA	11.91	30.00	-18.09	5.00	16.91	-	-
5789	AVG	HDR4	ePA	11.67	30.00	-18.33	5.00	16.67	-	-
5844	AVG	HDR4	ePA	11.93	30.00	-18.07	5.00	16.93	-	-
5733	AVG	HDR4	iPA	1.46	30.00	-28.54	5.00	6.46	-	-
5789	AVG	HDR4	iPA	1.62	30.00	-28.38	5.00	6.62	-	-
5844	AVG	HDR4	iPA	1.58	30.00	-28.42	5.00	6.58	-	-
5733	AVG	HDR8	ePA	11.82	30.00	-18.18	5.00	16.82	-	-
5789	AVG	HDR8	ePA	12.05	30.00	-17.95	5.00	17.05	-	-
5844	AVG	HDR8	ePA	12.09	30.00	-17.91	5.00	17.09	-	-
5733	AVG	HDR8	iPA	1.50	30.00	-28.51	5.00	6.50	-	-
5789	AVG	HDR8	iPA	1.45	30.00	-28.55	5.00	6.45	-	-
5844	AVG	HDR8	iPA	1.19	30.00	-28.81	5.00	6.19	-	-

Table 7-7. Antenna WF8 ISED Maximum Conducted Output Power

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
5162	AVG	HDR4	ePA	11.36	23.98	-12.62
5204	AVG	HDR4	ePA	11.50	23.98	-12.49
5245	AVG	HDR4	ePA	11.65	23.98	-12.33
5162	AVG	HDR4	iPA	1.12	23.98	-22.87
5204	AVG	HDR4	iPA	1.40	23.98	-22.59
5245	AVG	HDR4	iPA	1.37	23.98	-22.61
5162	AVG	HDR8	ePA	11.13	23.98	-12.86
5204	AVG	HDR8	ePA	11.55	23.98	-12.43
5245	AVG	HDR8	ePA	11.55	23.98	-12.43
5162	AVG	HDR8	iPA	1.26	23.98	-22.72
5204	AVG	HDR8	iPA	1.46	23.98	-22.52
5245	AVG	HDR8	iPA	1.42	23.98	-22.57
5733	AVG	HDR4	ePA	11.70	30.00	-18.30
5789	AVG	HDR4	ePA	11.91	30.00	-18.10
5844	AVG	HDR4	ePA	11.72	30.00	-18.29
5733	AVG	HDR4	iPA	1.43	30.00	-28.57
5789	AVG	HDR4	iPA	1.45	30.00	-28.55
5844	AVG	HDR4	iPA	1.94	30.00	-28.06
5733	AVG	HDR8	ePA	11.15	30.00	-18.85
5789	AVG	HDR8	ePA	11.61	30.00	-18.39
5844	AVG	HDR8	ePA	11.21	30.00	-18.79
5733	AVG	HDR8	iPA	1.48	30.00	-28.52
5789	AVG	HDR8	iPA	1.51	30.00	-28.49
5844	AVG	HDR8	iPA	1.98	30.00	-28.02

Table 7-8. Antenna WF7a FCC Maximum Conducted Output Power

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p [dBm]	Max e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
5162	AVG	HDR4	ePA	8.37	-	-	2.90	11.27	13.68	-2.41
5204	AVG	HDR4	ePA	8.16	-	-	2.90	11.06	13.68	-2.62
5245	AVG	HDR4	ePA	8.38	-	-	2.90	11.28	13.68	-2.40
5162	AVG	HDR4	iPA	1.12	-	-	2.90	4.02	13.68	-9.66
5204	AVG	HDR4	iPA	1.40	-	-	2.90	4.30	13.68	-9.38
5245	AVG	HDR4	iPA	1.37	-	-	2.90	4.27	13.68	-9.40
5162	AVG	HDR8	ePA	10.94	-	-	2.90	13.84	16.86	-3.02
5204	AVG	HDR8	ePA	10.91	-	-	2.90	13.81	16.86	-3.05
5245	AVG	HDR8	ePA	10.97	-	-	2.90	13.87	16.86	-2.99
5162	AVG	HDR8	iPA	1.26	-	-	2.90	4.16	16.86	-12.70
5204	AVG	HDR8	iPA	1.46	-	-	2.90	4.36	16.86	-12.50
5245	AVG	HDR8	iPA	1.42	-	-	2.90	4.32	16.86	-12.54
5733	AVG	HDR4	ePA	11.70	30.00	-18.30	2.10	13.80	-	-
5789	AVG	HDR4	ePA	11.91	30.00	-18.10	2.10	14.01	-	-
5844	AVG	HDR4	ePA	11.72	30.00	-18.29	2.10	13.82	-	-
5733	AVG	HDR4	iPA	0.86	30.00	-29.14	2.10	2.96	-	-
5789	AVG	HDR4	iPA	1.67	30.00	-28.33	2.10	3.77	-	-
5844	AVG	HDR4	iPA	1.94	30.00	-28.06	2.10	4.04	-	-
5733	AVG	HDR8	ePA	11.15	30.00	-18.85	2.10	13.25	-	-
5789	AVG	HDR8	ePA	11.61	30.00	-18.39	2.10	13.71	-	-
5844	AVG	HDR8	ePA	11.21	30.00	-18.79	2.10	13.31	-	-
5733	AVG	HDR8	iPA	0.89	30.00	-29.11	2.10	2.99	-	-
5789	AVG	HDR8	iPA	1.20	30.00	-28.80	2.10	3.30	-	-
5844	AVG	HDR8	iPA	1.98	30.00	-28.02	2.10	4.08	-	-

Table 7-9. Antenna WF7a ISED Maximum Conducted Output Power

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
				Antenna WF8	Antenna WF7a	Summed		
5162	AVG	HDR4	ePA	9.33	9.32	12.34	23.98	-11.64
5204	AVG	HDR4	ePA	9.49	9.03	12.27	23.98	-11.71
5245	AVG	HDR4	ePA	9.37	9.47	12.43	23.98	-11.55
5162	AVG	HDR4	iPA	1.80	1.08	4.46	23.98	-19.52
5204	AVG	HDR4	iPA	2.11	1.52	4.83	23.98	-19.15
5245	AVG	HDR4	iPA	2.25	1.25	4.79	23.98	-19.19
5162	AVG	HDR8	ePA	11.93	11.17	14.58	23.98	-9.40
5204	AVG	HDR8	ePA	11.98	11.51	14.76	23.98	-9.22
5245	AVG	HDR8	ePA	11.62	11.62	14.63	23.98	-9.35
5162	AVG	HDR8	iPA	1.86	1.27	4.58	23.98	-19.40
5204	AVG	HDR8	iPA	2.19	1.35	4.80	23.98	-19.18
5245	AVG	HDR8	iPA	2.21	1.41	4.84	23.98	-19.14
5733	AVG	HDR4	ePA	11.54	11.53	14.54	30.00	-15.46
5789	AVG	HDR4	ePA	11.64	11.36	14.51	30.00	-15.49
5844	AVG	HDR4	ePA	11.55	11.34	14.46	30.00	-15.54
5733	AVG	HDR4	iPA	1.61	1.45	4.54	30.00	-25.46
5789	AVG	HDR4	iPA	1.39	1.54	4.48	30.00	-25.52
5844	AVG	HDR4	iPA	1.65	1.69	4.68	30.00	-25.32
5733	AVG	HDR8	ePA	11.70	11.01	14.38	30.00	-15.62
5789	AVG	HDR8	ePA	11.60	11.34	14.49	30.00	-15.51
5844	AVG	HDR8	ePA	11.83	11.30	14.58	30.00	-15.42
5733	AVG	HDR8	iPA	1.23	1.42	4.34	30.00	-25.66
5789	AVG	HDR8	iPA	1.46	1.60	4.54	30.00	-25.46
5844	AVG	HDR8	iPA	1.48	1.63	4.57	30.00	-25.43

Table 7-10. TxBF FCC Maximum Conducted Output Power

Frequency [MHz]	Detector	Mode	Power Scheme	Conducted Powers [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p [dBm]	Max e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
				Antenna WF8	Antenna WF7a	Summed						
5162	AVG	HDR4	ePA	3.68	2.29	6.05	-	-	5.15	11.20	13.68	-2.48
5204	AVG	HDR4	ePA	3.54	2.20	5.93	-	-	5.15	11.08	13.68	-2.60
5245	AVG	HDR4	ePA	3.75	2.44	6.16	-	-	5.15	11.31	13.68	-2.37
5162	AVG	HDR4	iPA	1.80	1.08	4.46	-	-	5.15	9.61	13.68	-4.07
5204	AVG	HDR4	iPA	2.11	1.52	4.83	-	-	5.15	9.98	13.68	-3.70
5245	AVG	HDR4	iPA	2.25	1.25	4.79	-	-	5.15	9.94	13.68	-3.74
5162	AVG	HDR8	ePA	6.47	4.83	8.74	-	-	5.15	13.89	16.86	-2.97
5204	AVG	HDR8	ePA	6.39	4.83	8.69	-	-	5.15	13.84	16.86	-3.02
5245	AVG	HDR8	ePA	6.42	4.65	8.63	-	-	5.15	13.78	16.86	-3.08
5162	AVG	HDR8	iPA	1.86	1.27	4.58	-	-	5.15	9.73	16.86	-7.13
5204	AVG	HDR8	iPA	2.19	1.35	4.80	-	-	5.15	9.95	16.86	-6.91
5245	AVG	HDR8	iPA	2.21	1.41	4.84	-	-	5.15	9.99	16.86	-6.87
5733	AVG	HDR4	ePA	11.61	11.53	14.58	30.00	-15.42	6.68	21.26	-	-
5789	AVG	HDR4	ePA	11.72	11.36	14.55	30.00	-15.45	6.68	21.23	-	-
5844	AVG	HDR4	ePA	11.91	11.34	14.64	30.00	-15.36	6.68	21.32	-	-
5733	AVG	HDR4	iPA	1.27	0.89	4.09	30.00	-25.91	6.68	10.77	-	-
5789	AVG	HDR4	iPA	1.55	1.19	4.38	30.00	-25.62	6.68	11.06	-	-
5844	AVG	HDR4	iPA	1.68	1.72	4.71	30.00	-25.29	6.68	11.39	-	-
5733	AVG	HDR8	ePA	11.62	11.01	14.33	30.00	-15.67	6.68	21.01	-	-
5789	AVG	HDR8	ePA	11.59	11.34	14.48	30.00	-15.52	6.68	21.16	-	-
5844	AVG	HDR8	ePA	11.97	11.30	14.65	30.00	-15.35	6.68	21.33	-	-
5733	AVG	HDR8	iPA	1.41	0.96	4.20	30.00	-25.80	6.68	10.88	-	-
5789	AVG	HDR8	iPA	1.37	1.28	4.34	30.00	-25.66	6.68	11.02	-	-
5844	AVG	HDR8	iPA	1.52	1.63	4.59	30.00	-25.41	6.68	11.27	-	-

Table 7-11. TxBF ISED Maximum Conducted Output Power

Note:

Per ANSI C63.10-2013 and KDB 662911 v02r01 Section E)1), the conducted powers at and 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 Section 14.4.3, the directional gain is calculated using the following formula, where G_N is the gain of the nth antenna and N_{ANT}, the total number of antennas used.

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}] \text{ dBi}$$

Per ANSI C63.10-2013 Section 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.

$$\text{Directional gain} = 10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10}) / N_{ANT}] \text{ dBi}$$

Sample Tx BF Calculation:

At 5162MHz, the average conducted output power was measured to be 3.68 dBm for Antenna WF8 and 2.29 dBm for Antenna WF7a.

Antenna WF8 + Antenna WF7a = TxBF

(3.68dBm + 2.29dBm) = (2.333mW + 1.694mW) = 4.027mW = 6.05dBm

Sample e.i.r.p. Calculation:

At 5162MHz, the average conducted output power was measured to be 6.05 dBm with an Antenna gain of 5.15 dBi.

e.i.r.p. (dBm) = Conducted Power (dBm) + Ant gain (dBi)

6.05 dBm + 5.15 dBi = 11.20 dBm

7.5 Maximum Power Spectral Density – HDR

§15.407(a.1.iv) §15.407(a.3); RSS-247 [6.2]

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 for U-NII 1, 500kHz for U-NII 3
4. VBW ≥ 3MHz for U-NII 1, ≥ 3 x RBW for U-NII 3
5. Number of sweep points ≥ 2 x (span/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

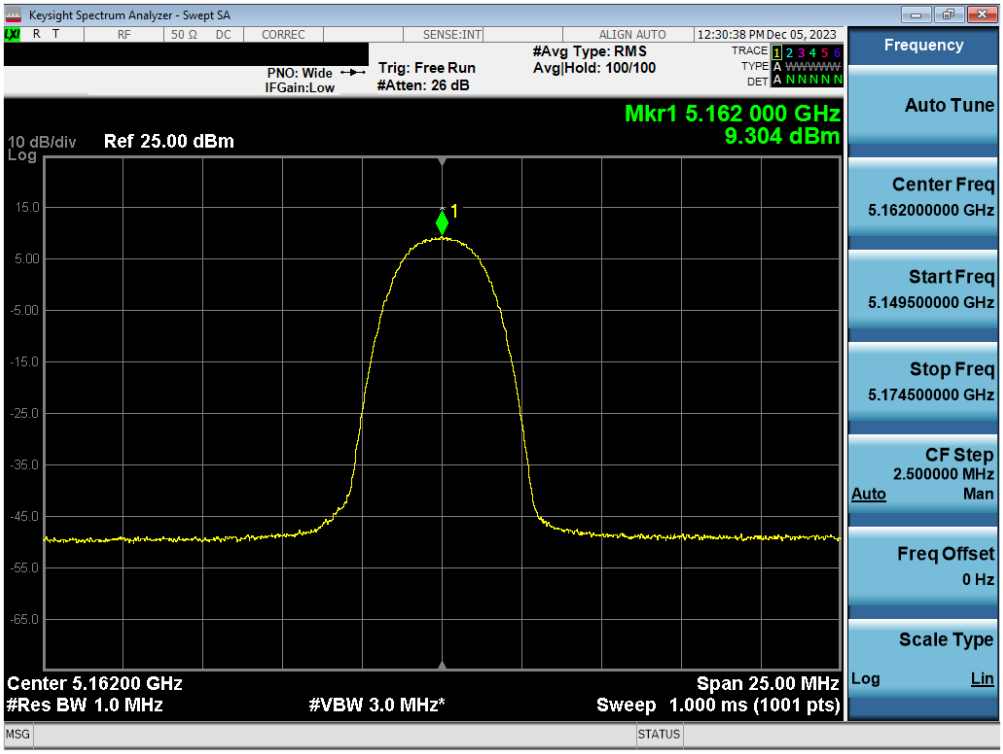
7.5.1 Antenna WF8 Power Spectral Density Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	4.0	HDR4	ePA	9.30	11.00	-1.70
	5204	4.0	HDR4	ePA	9.61	11.00	-1.39
	5245	4.0	HDR4	ePA	9.29	11.00	-1.71
	5162	4.0	HDR4	iPA	-0.55	11.00	-11.55
	5204	4.0	HDR4	iPA	-0.11	11.00	-11.11
	5245	4.0	HDR4	iPA	-0.19	11.00	-11.19
	5162	8.0	HDR8	ePA	6.47	11.00	-4.53
	5204	8.0	HDR8	ePA	7.08	11.00	-3.92
	5245	8.0	HDR8	ePA	7.01	11.00	-3.99
	5162	8.0	HDR8	iPA	-3.12	11.00	-14.12
	5204	8.0	HDR8	iPA	-2.79	11.00	-13.79
	5245	8.0	HDR8	iPA	-2.91	11.00	-13.91

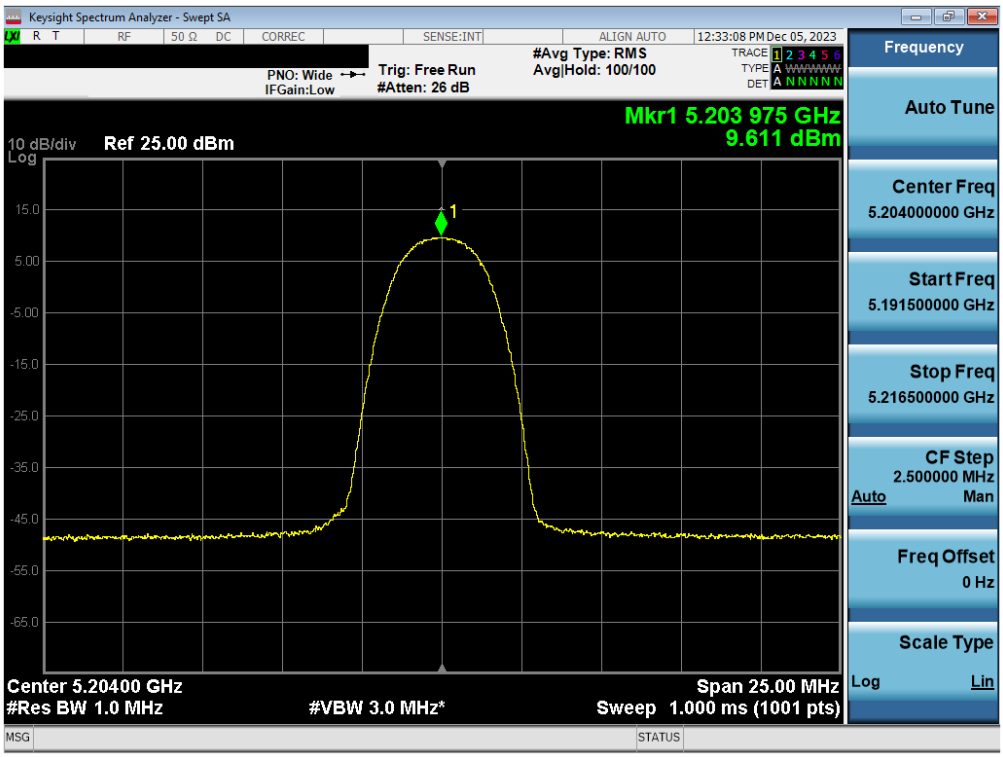
Table 7-12. FCC Power Spectral Density Measurements Antenna WF8

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p. Power Density [dBm/MHz]	ISED Max e.i.r.p. Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	4.0	HDR4	ePA	6.93	1.30	8.23	10.00	-1.77
	5204	4.0	HDR4	ePA	6.80	1.30	8.10	10.00	-1.90
	5245	4.0	HDR4	ePA	6.46	1.30	7.76	10.00	-2.24
	5162	4.0	HDR4	iPA	-0.55	1.30	0.75	10.00	-9.25
	5204	4.0	HDR4	iPA	-0.11	1.30	1.19	10.00	-8.81
	5245	4.0	HDR4	iPA	-0.19	1.30	1.11	10.00	-8.89
	5162	8.0	HDR8	ePA	6.47	1.30	7.77	10.00	-2.23
	5204	8.0	HDR8	ePA	7.08	1.30	8.38	10.00	-1.62
	5245	8.0	HDR8	ePA	7.01	1.30	8.31	10.00	-1.69
	5162	8.0	HDR8	iPA	-3.12	1.30	-1.82	10.00	-11.82
	5204	8.0	HDR8	iPA	-2.79	1.30	-1.49	10.00	-11.49
	5245	8.0	HDR8	iPA	-2.91	1.30	-1.61	10.00	-11.61

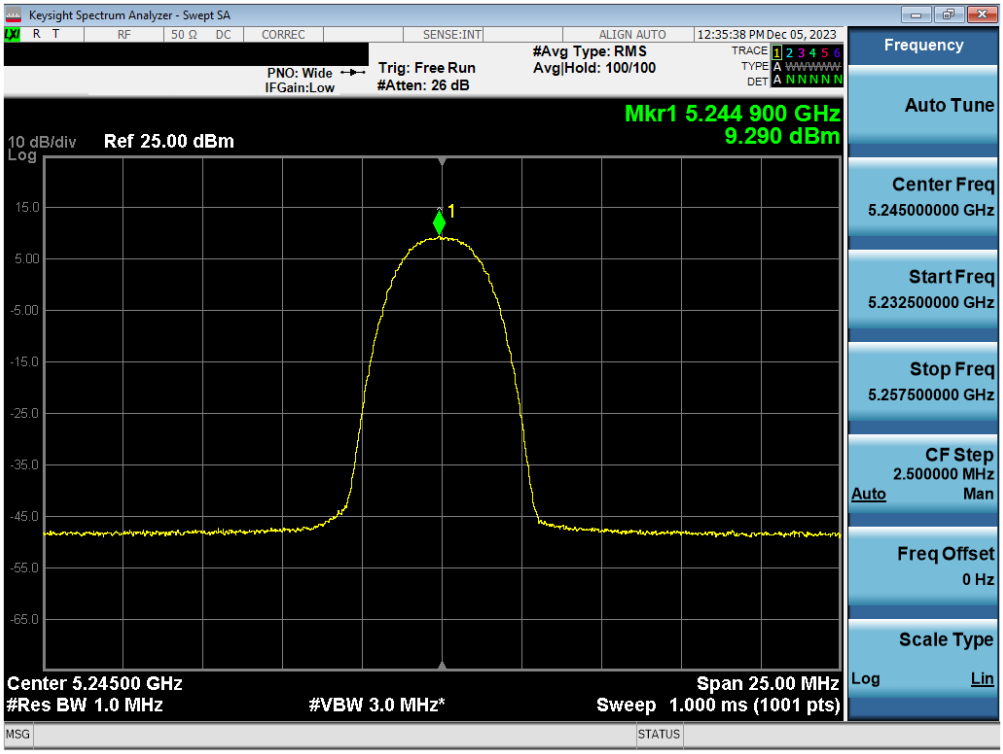
Table 7-13. ISED Power Spectral Density Measurements Antenna WF8



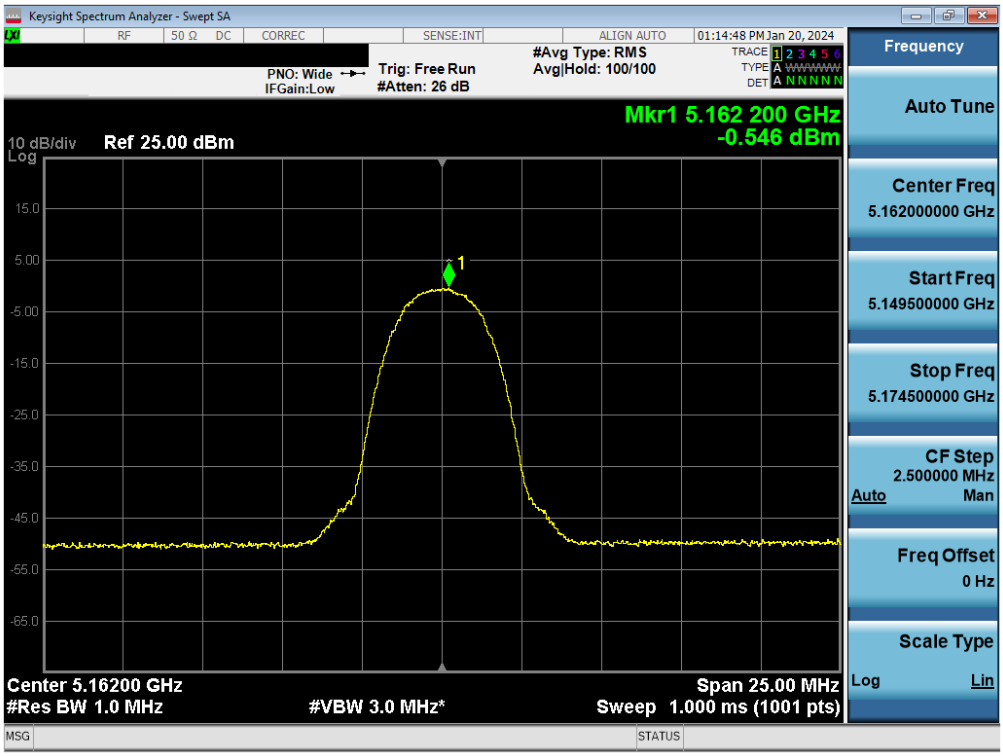
Plot 7-25. FCC PSD Antenna WF8 (HDR4, ePA – 5162MHz)



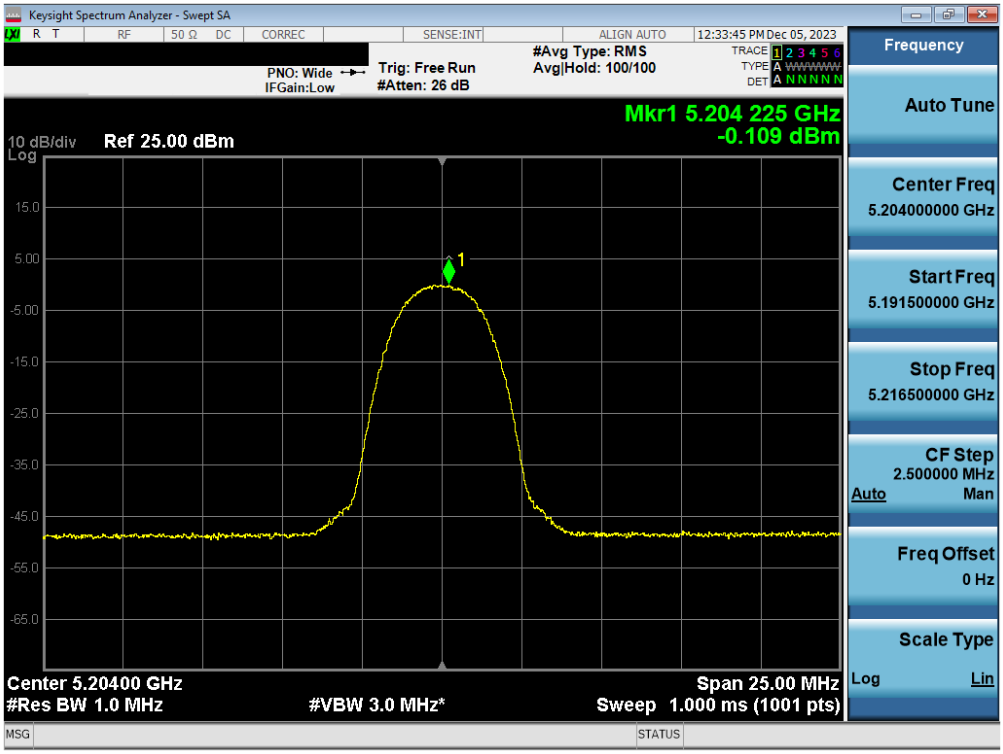
Plot 7-26. FCC PSD Antenna WF8 (HDR4, ePA – 5204MHz)



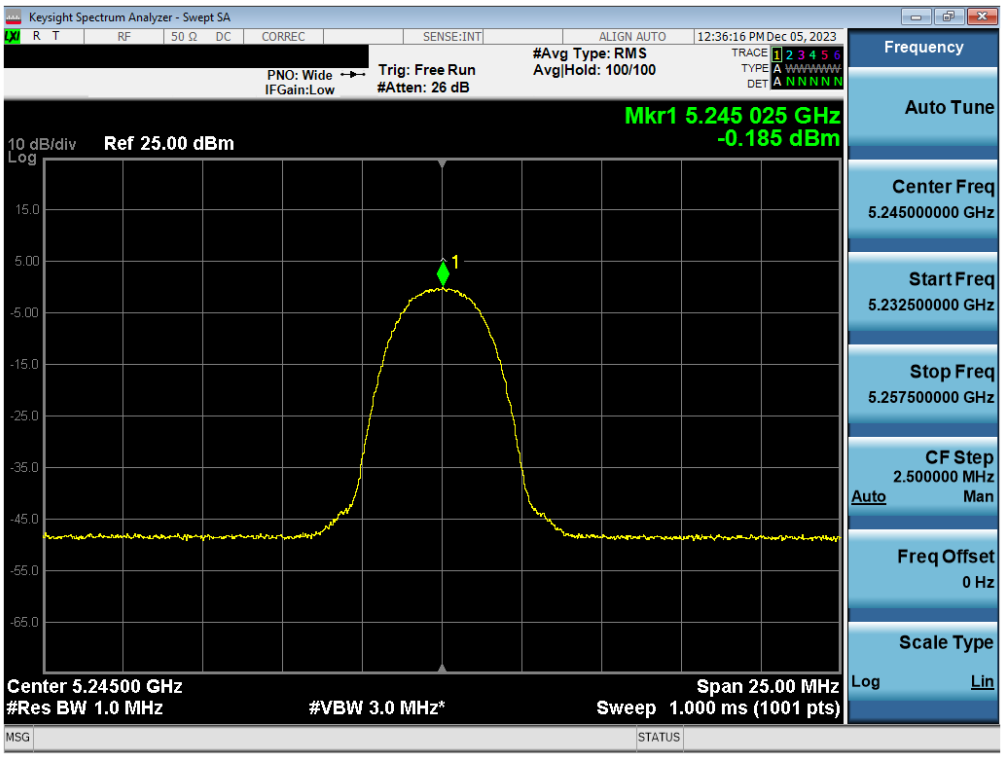
Plot 7-27. FCC PSD Antenna WF8 (HDR4, ePA– 5245MHz)



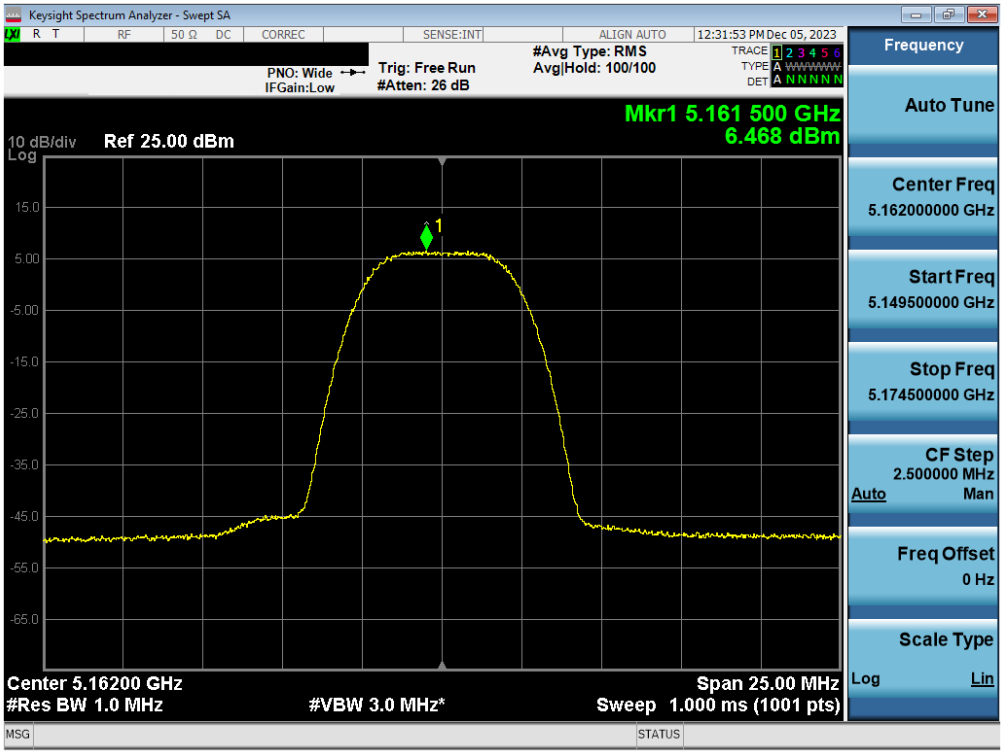
Plot 7-28. FCC/ISED PSD Antenna WF8 (HDR4, iPA – 5162MHz)



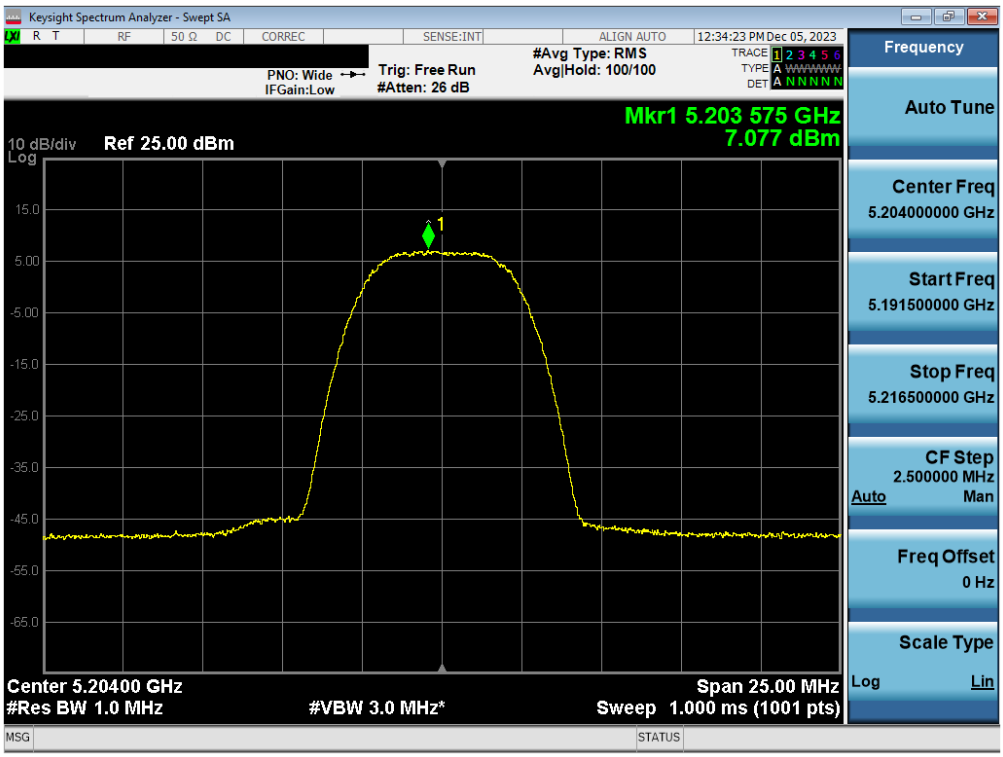
Plot 7-29. FCC/ISED PSD Antenna WF8 (HDR4, iPA – 5204MHz)



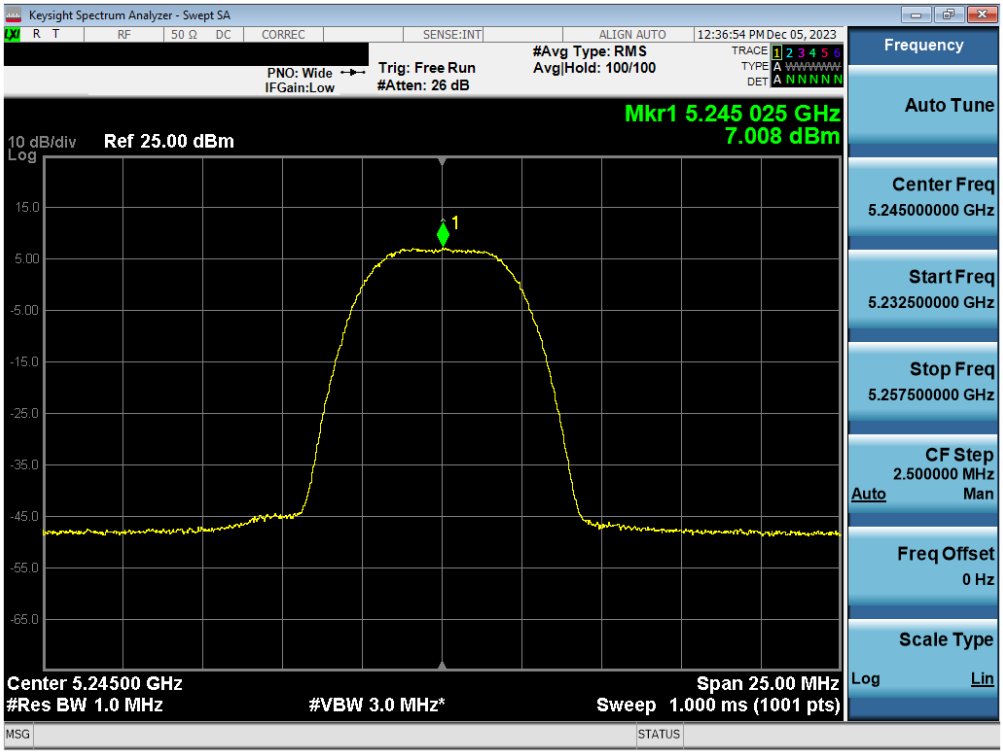
Plot 7-30. FCC/ISED PSD Antenna WF8 (HDR4, iPA– 5245MHz)



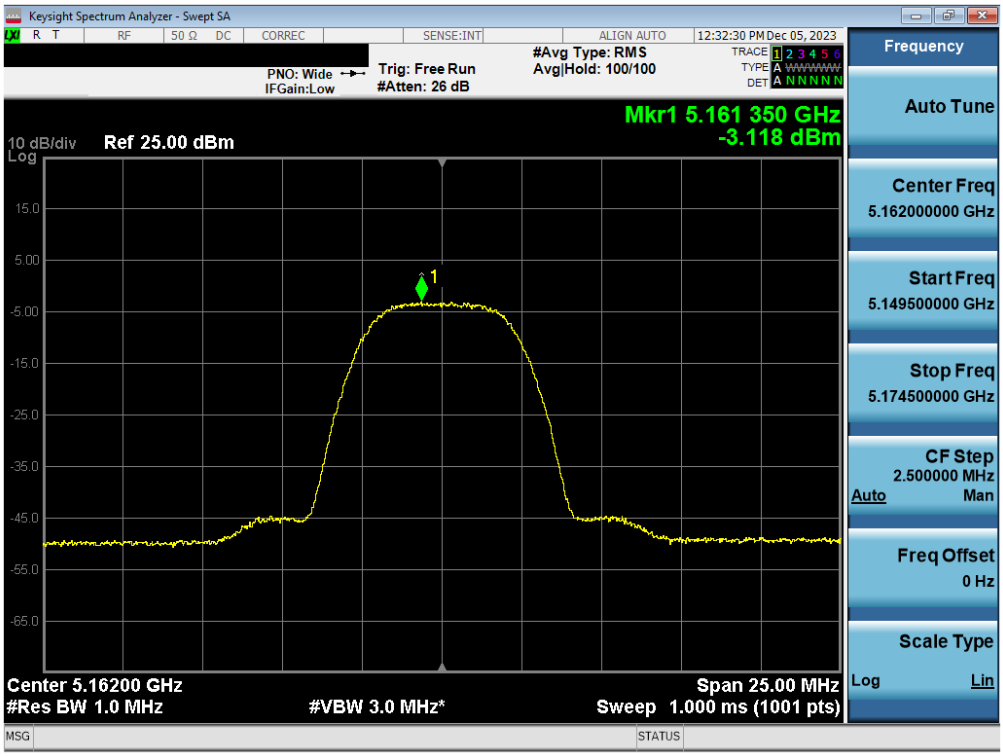
Plot 7-31. FCC/ISED PSD Antenna WF8 (HDR8, ePA – 5162MHz)



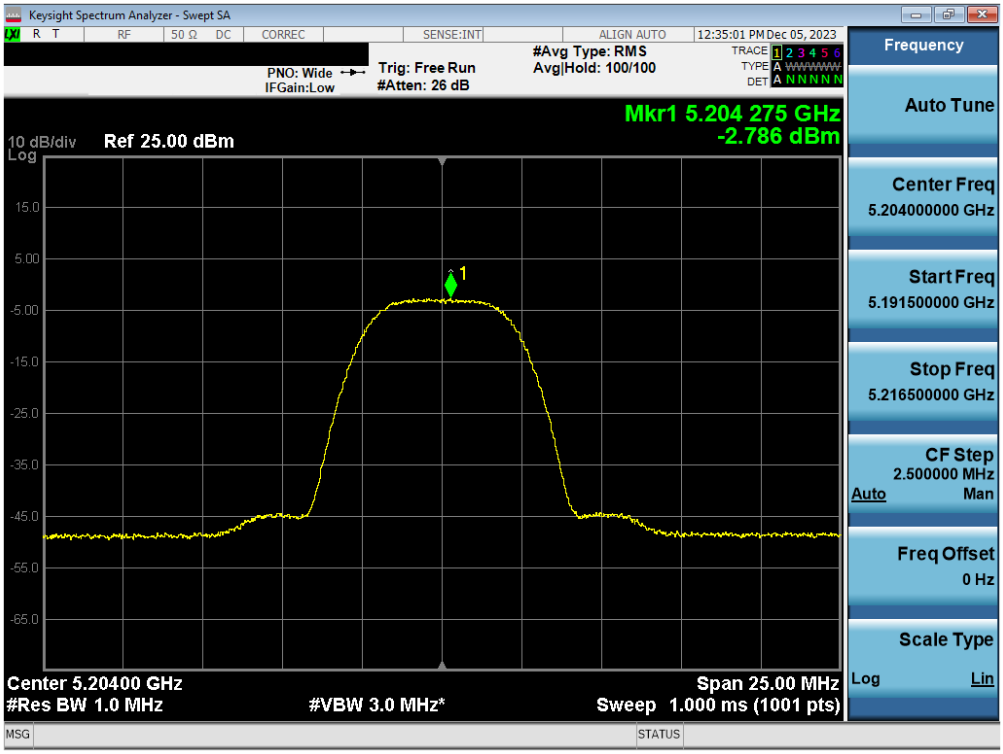
Plot 7-32. FCC/ISED PSD Antenna WF8 (HDR8, ePA – 5204MHz)



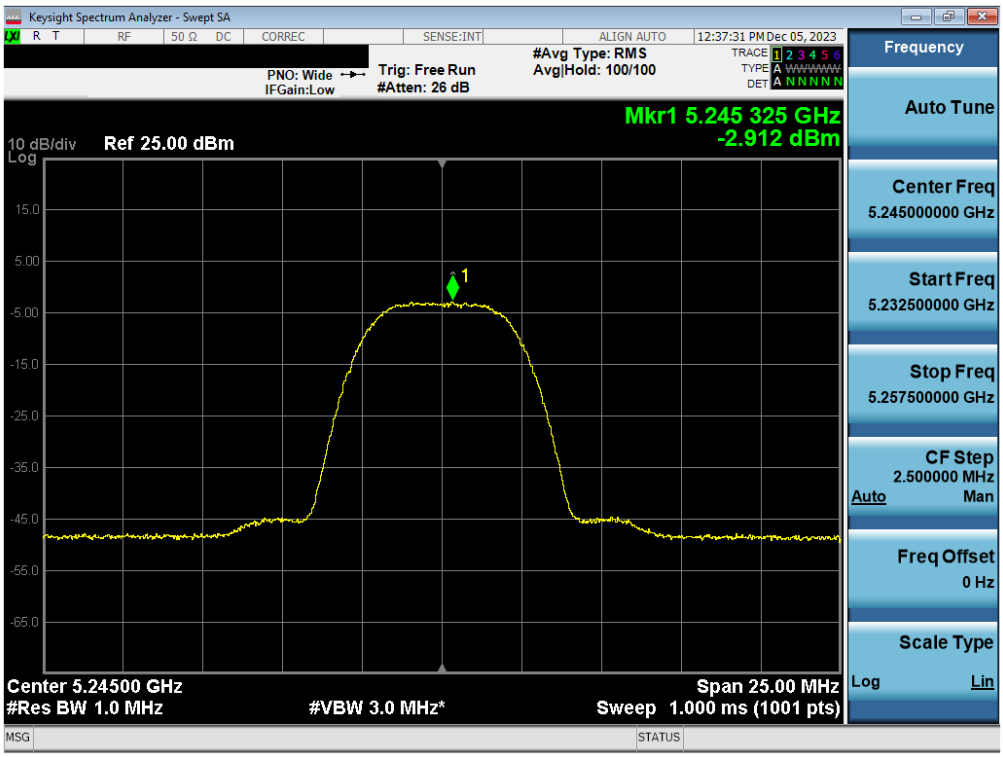
Plot 7-33. FCC/ISED PSD Antenna WF8 (HDR8, ePA– 5245MHz)



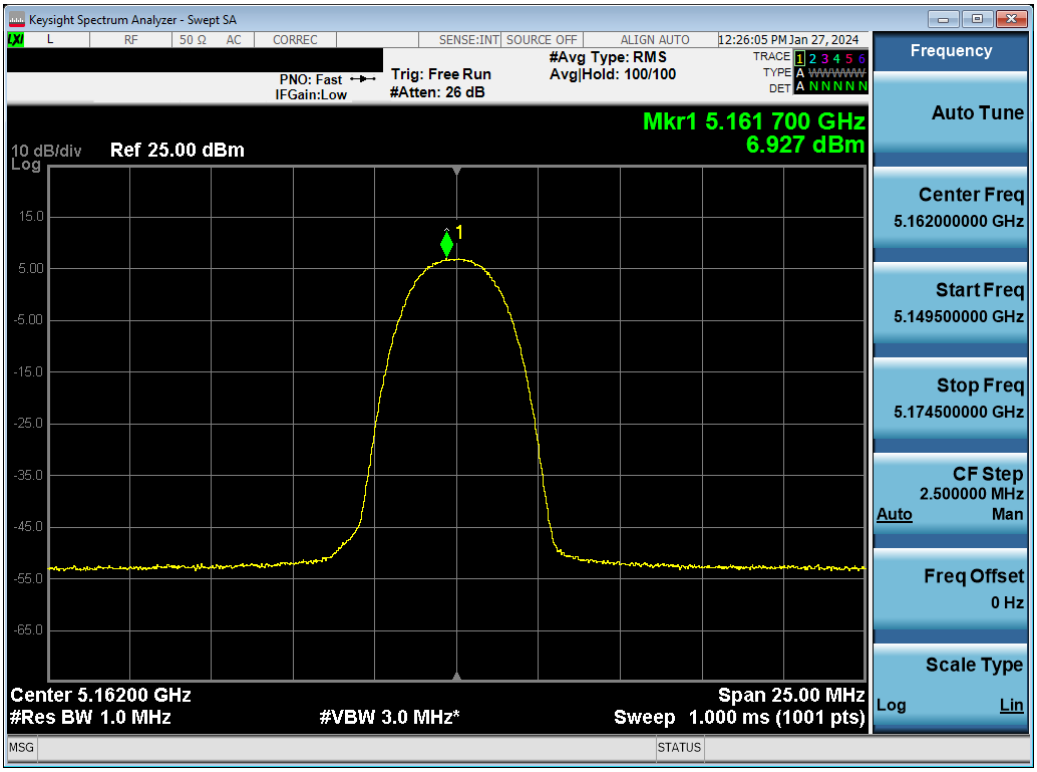
Plot 7-34. FCC/ISED PSD Antenna WF8 (HDR8, iPA – 5162MHz)



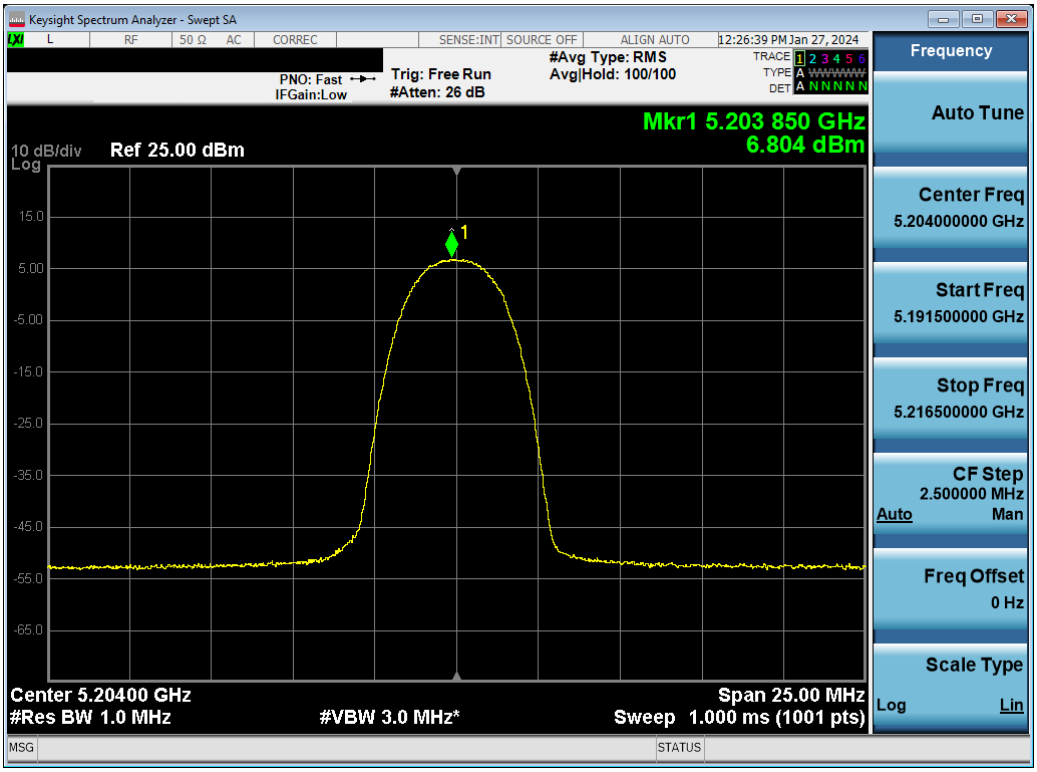
Plot 7-35. FCC/ISED PSD Antenna WF8 (HDR8, iPA – 5204MHz)



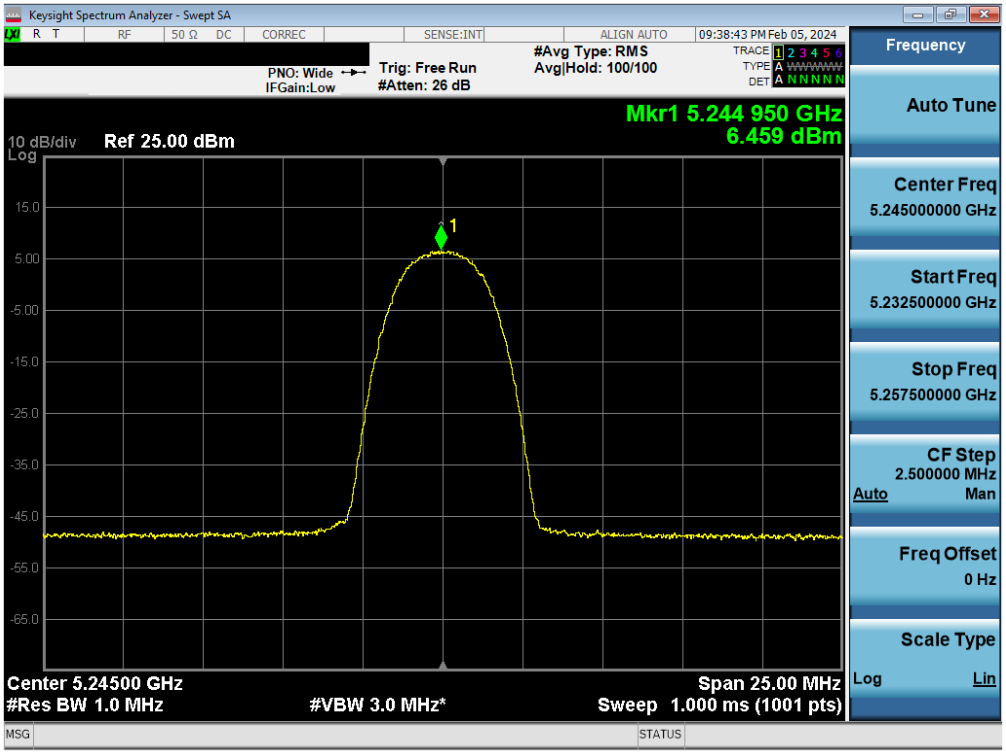
Plot 7-36. FCC/ISED PSD Antenna WF8 (HDR8, iPA– 5245MHz)



Plot 7-37. ISED PSD Antenna WF8 (HDR4, ePA – 5162MHz)



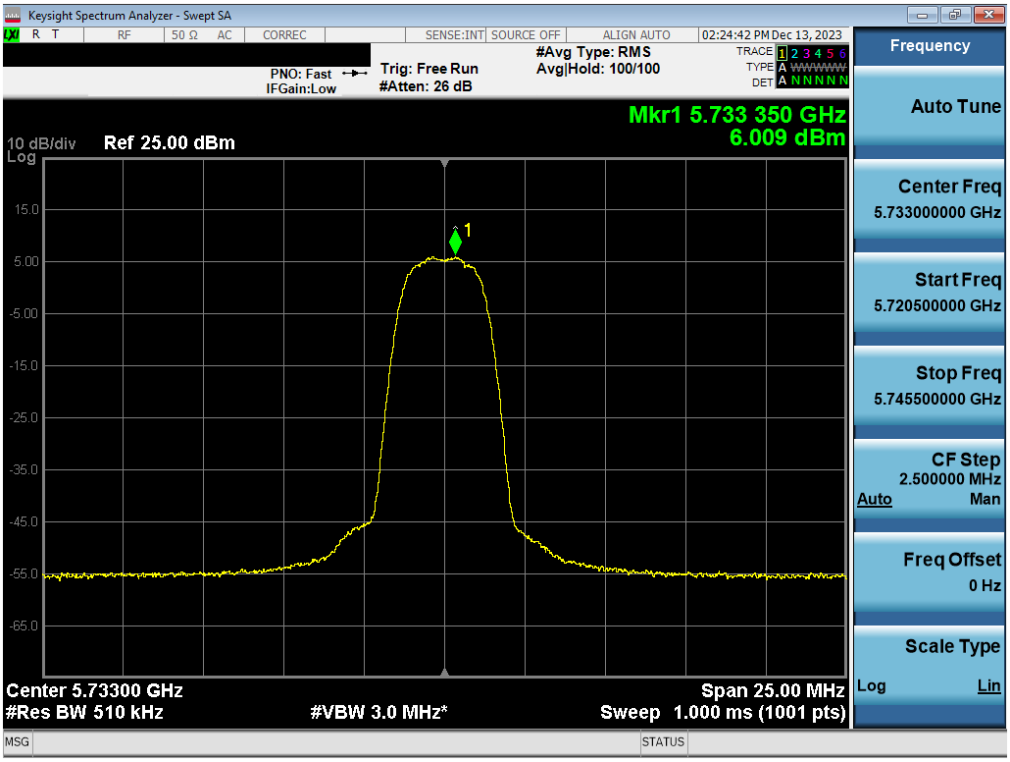
Plot 7-38. ISED PSD Antenna WF8 (HDR4, ePA – 5204MHz)



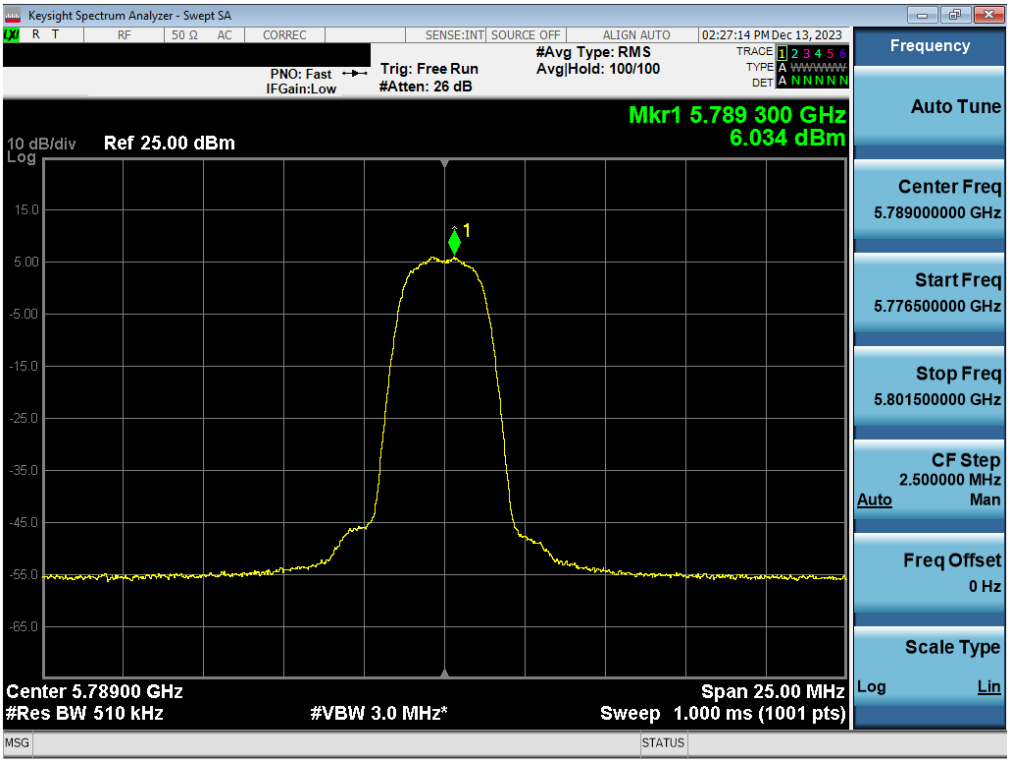
Plot 7-39. ISED PSD Antenna WF8 (HDR4, ePA– 5245MHz)

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	4.0	HDR4	ePA	6.01	30.00	-23.99
	5789	4.0	HDR4	ePA	6.03	30.00	-23.97
	5844	4.0	HDR4	ePA	6.46	30.00	-23.54
	5733	4.0	HDR4	iPA	-3.58	30.00	-33.58
	5789	4.0	HDR4	iPA	-3.59	30.00	-33.59
	5844	4.0	HDR4	iPA	-3.24	30.00	-33.24
	5733	8.0	HDR8	ePA	3.54	30.00	-26.46
	5789	8.0	HDR8	ePA	3.02	30.00	-26.98
	5844	8.0	HDR8	ePA	3.51	30.00	-26.50
	5733	8.0	HDR8	iPA	-6.56	30.00	-36.56
	5789	8.0	HDR8	iPA	-6.48	30.00	-36.48
	5844	8.0	HDR8	iPA	-6.56	30.00	-36.56

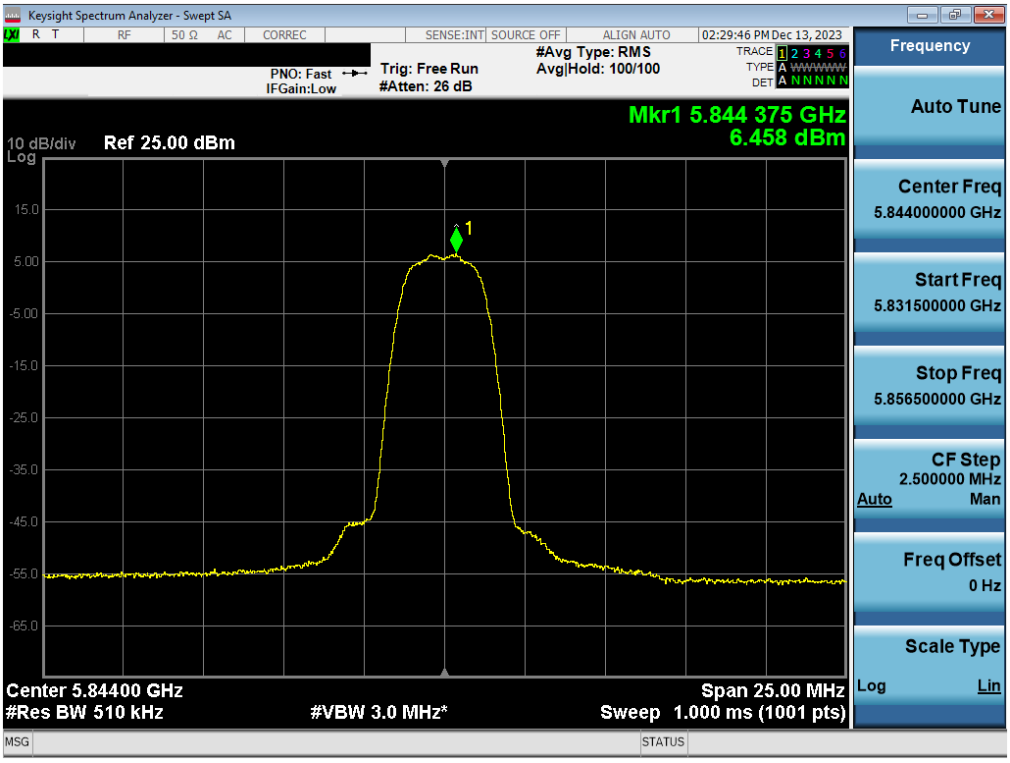
Table 7-14. Power Spectral Density Measurements Antenna WF8



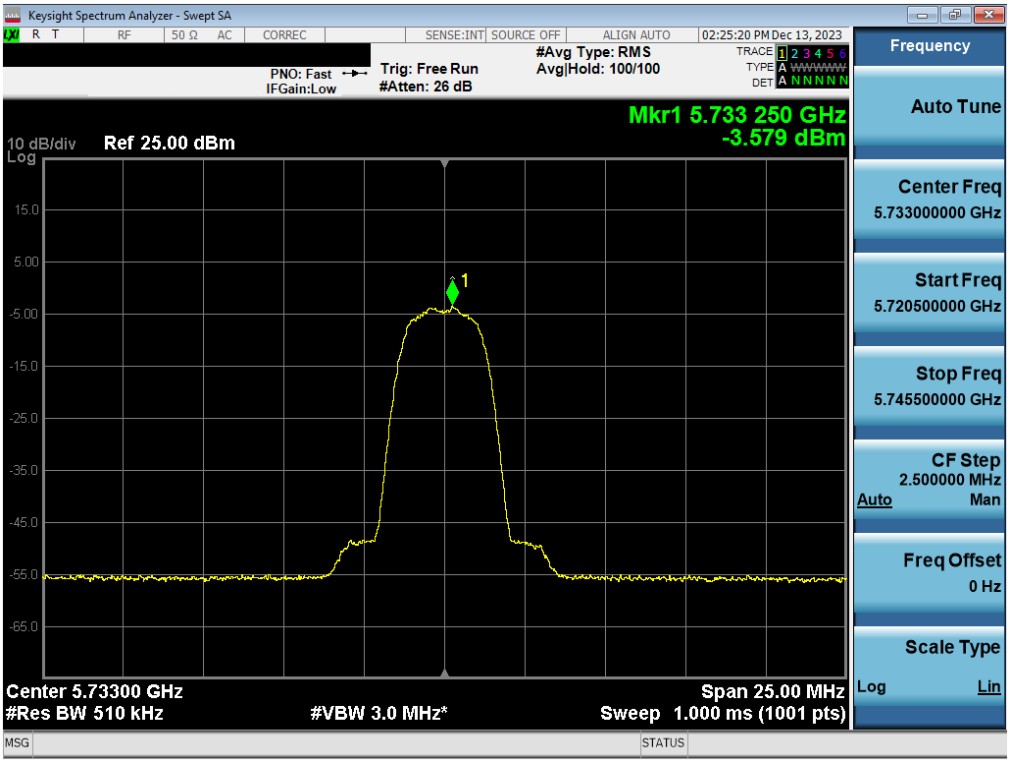
Plot 7-40. PSD Antenna WF8 (HDR4, ePA 5733MHz)



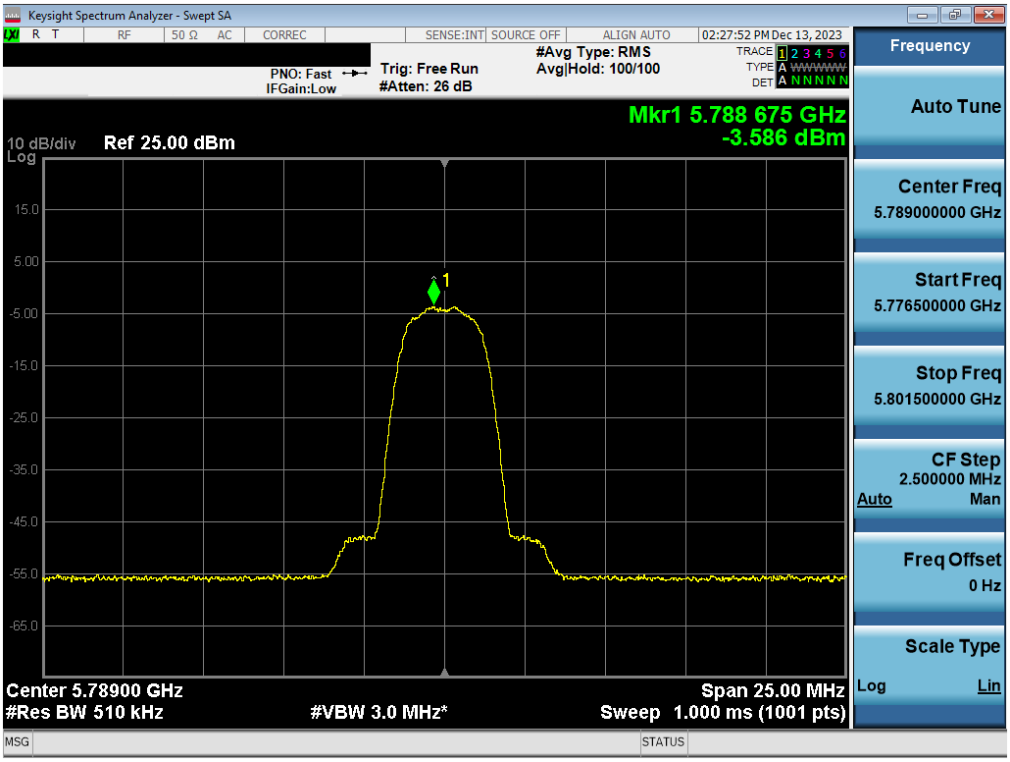
Plot 7-41. PSD Antenna WF8 (HDR4, ePA 5789MHz)



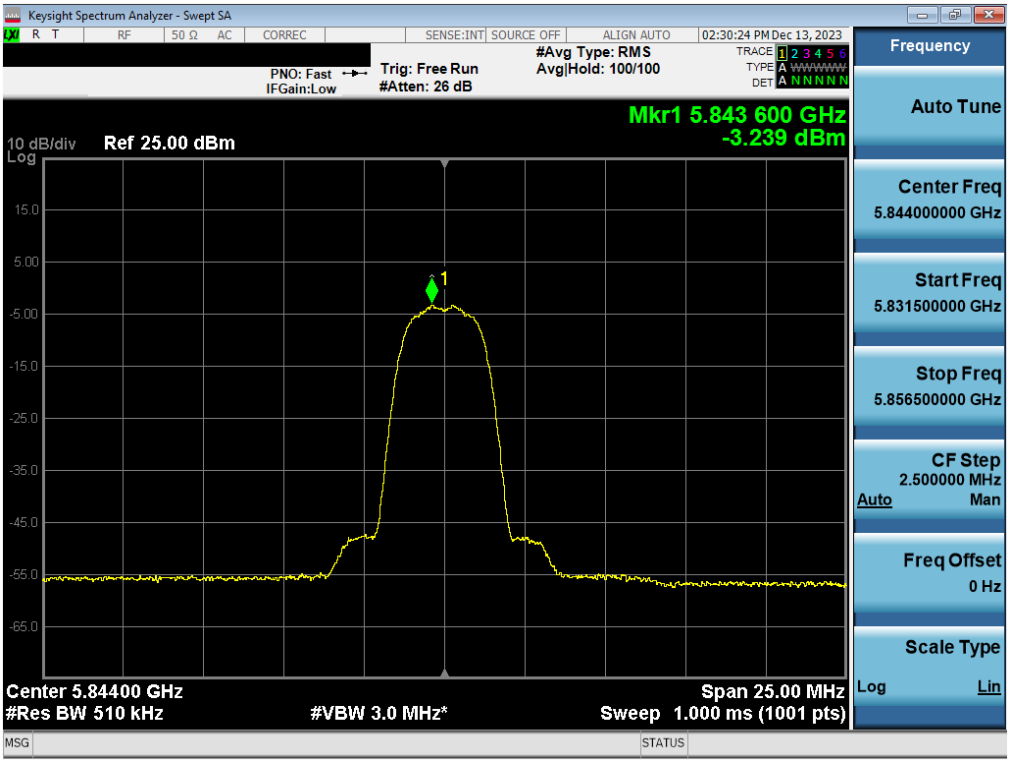
Plot 7-42. PSD Antenna WF8 (HDR4, ePA 5844MHz)



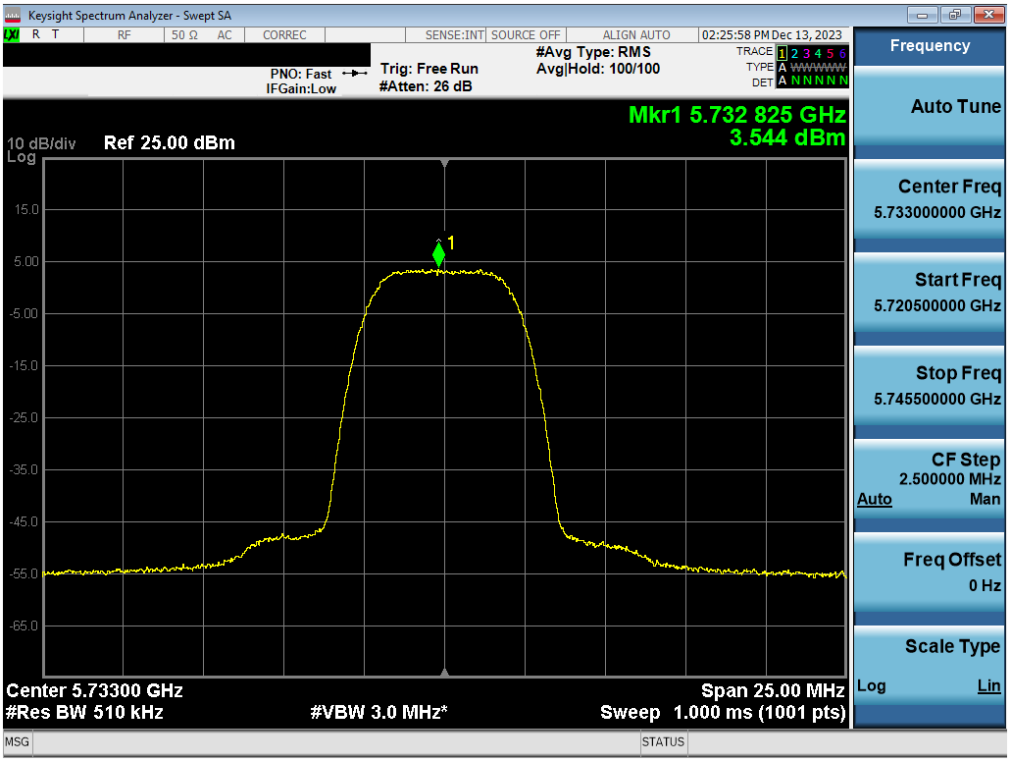
Plot 7-43. PSD Antenna WF8 (HDR4, iPA 5733MHz)



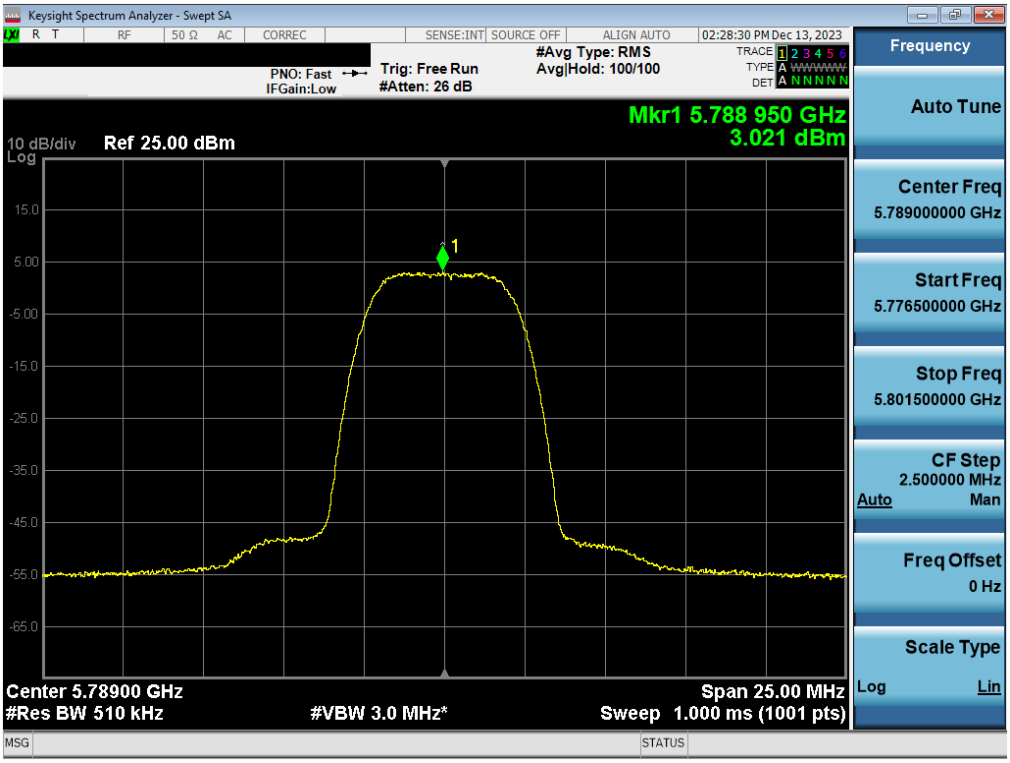
Plot 7-44. PSD Antenna WF8 (HDR4, iPA 5789MHz)



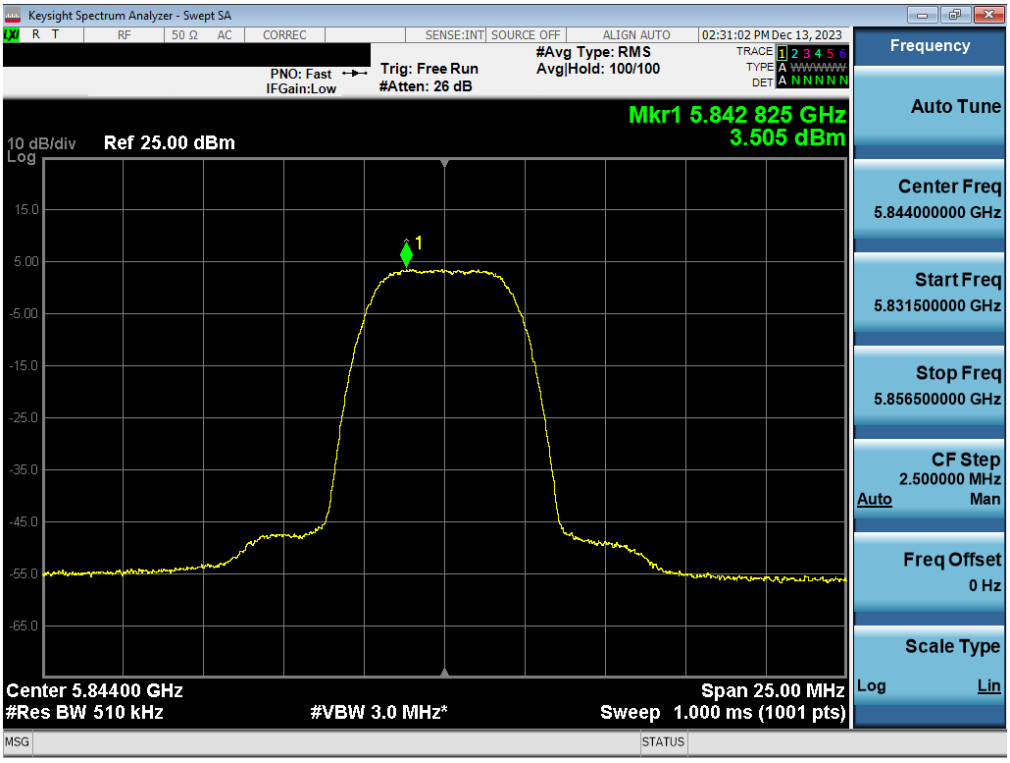
Plot 7-45. PSD Antenna WF8 (HDR4, iPA 5844MHz)



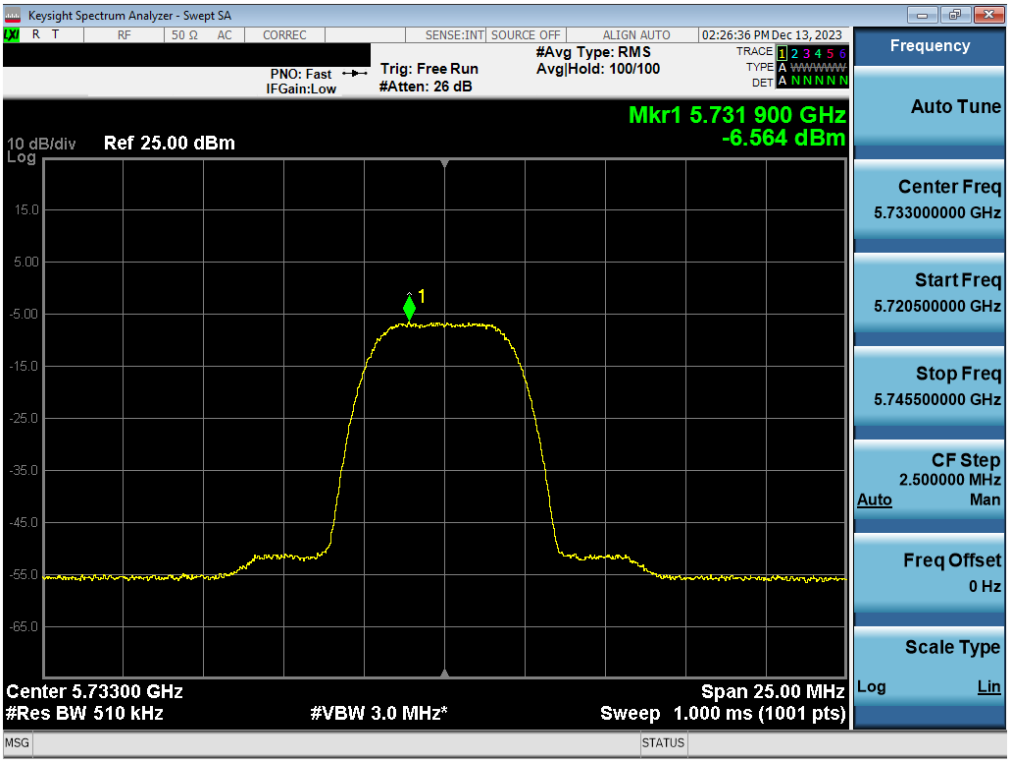
Plot 7-46. PSD Antenna WF8 (HDR8, ePA 5733MHz)



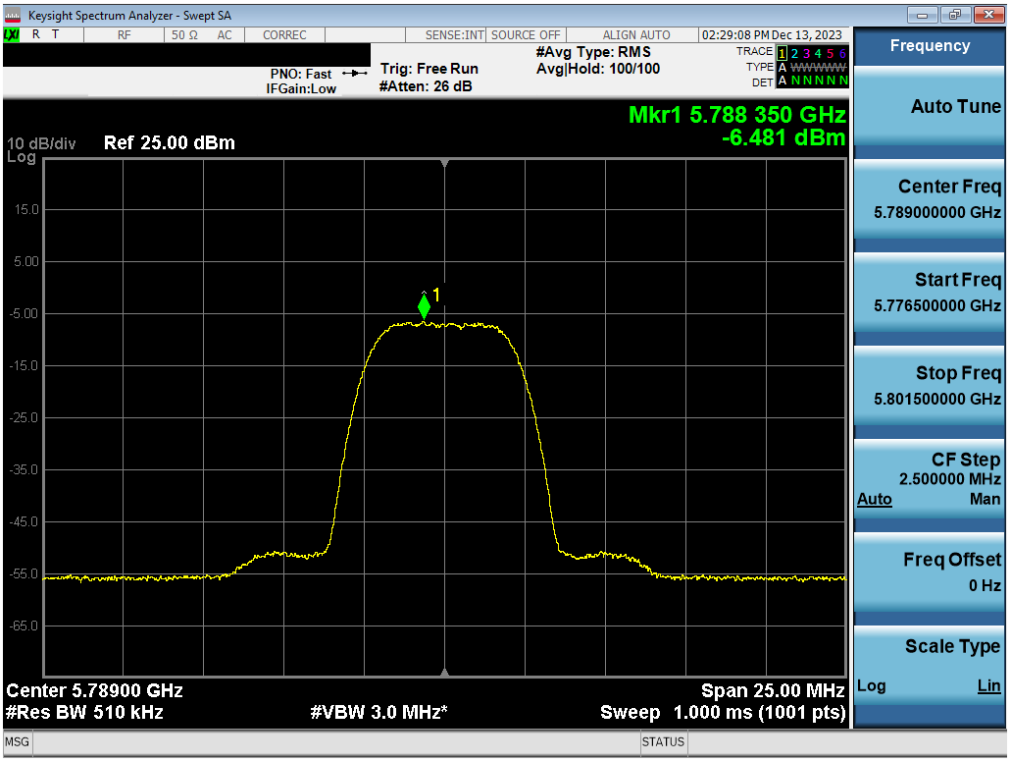
Plot 7-47. PSD Antenna WF8 (HDR8, ePA 5789MHz)



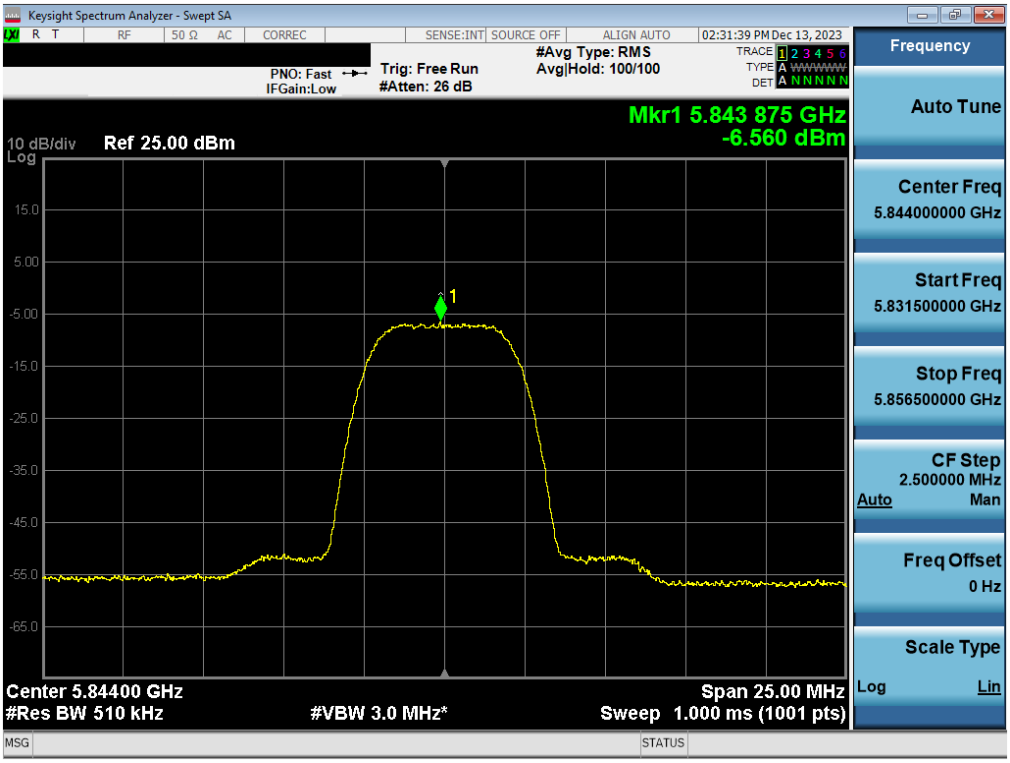
Plot 7-48. PSD Antenna WF8 (HDR8, ePA 5844MHz)



Plot 7-49. PSD Antenna WF8 (HDR8, iPA 5733MHz)



Plot 7-50. PSD Antenna WF8 (HDR8, iPA 5789MHz)



Plot 7-51. PSD Antenna WF8 (HDR8, iPA 5844MHz)

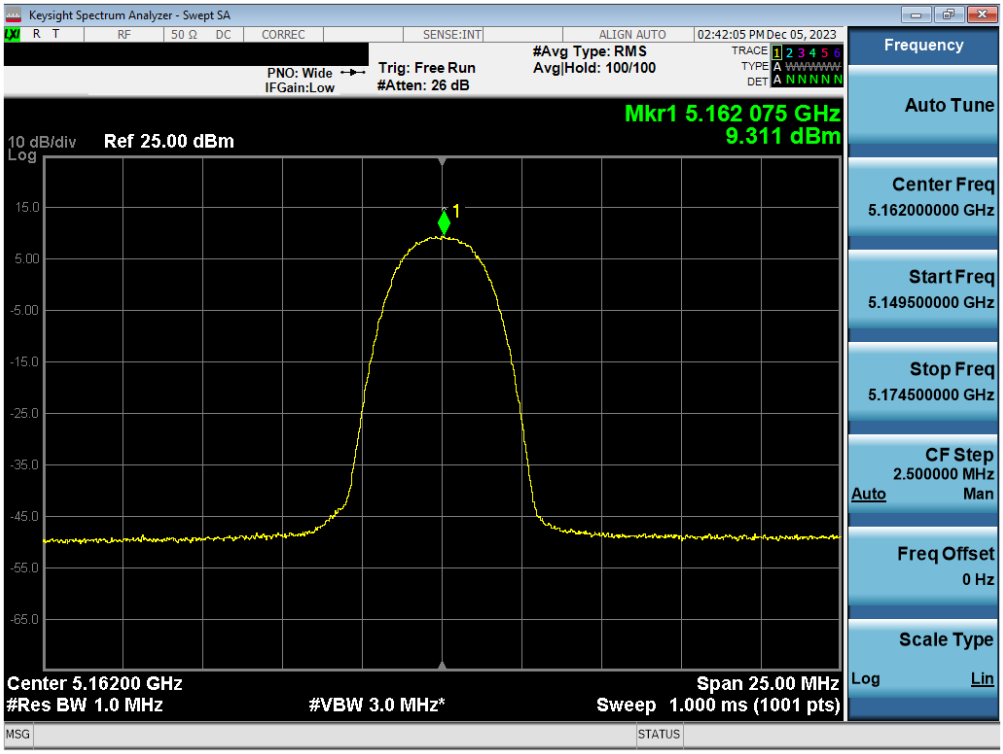
7.5.2 Antenna WF7a Power Spectral Density Measurements

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	4.0	HDR4	ePA	9.31	11.00	-1.69
	5204	4.0	HDR4	ePA	9.77	11.00	-1.23
	5245	4.0	HDR4	ePA	9.31	11.00	-1.70
	5162	4.0	HDR4	iPA	-1.38	11.00	-12.38
	5204	4.0	HDR4	iPA	-0.88	11.00	-11.88
	5245	4.0	HDR4	iPA	-1.02	11.00	-12.02
	5162	8.0	HDR8	ePA	6.64	11.00	-4.36
	5204	8.0	HDR8	ePA	6.41	11.00	-4.59
	5245	8.0	HDR8	ePA	6.50	11.00	-4.50
	5162	8.0	HDR8	iPA	-4.08	11.00	-15.08
	5204	8.0	HDR8	iPA	-3.08	11.00	-14.08
	5245	8.0	HDR8	iPA	-3.54	11.00	-14.54

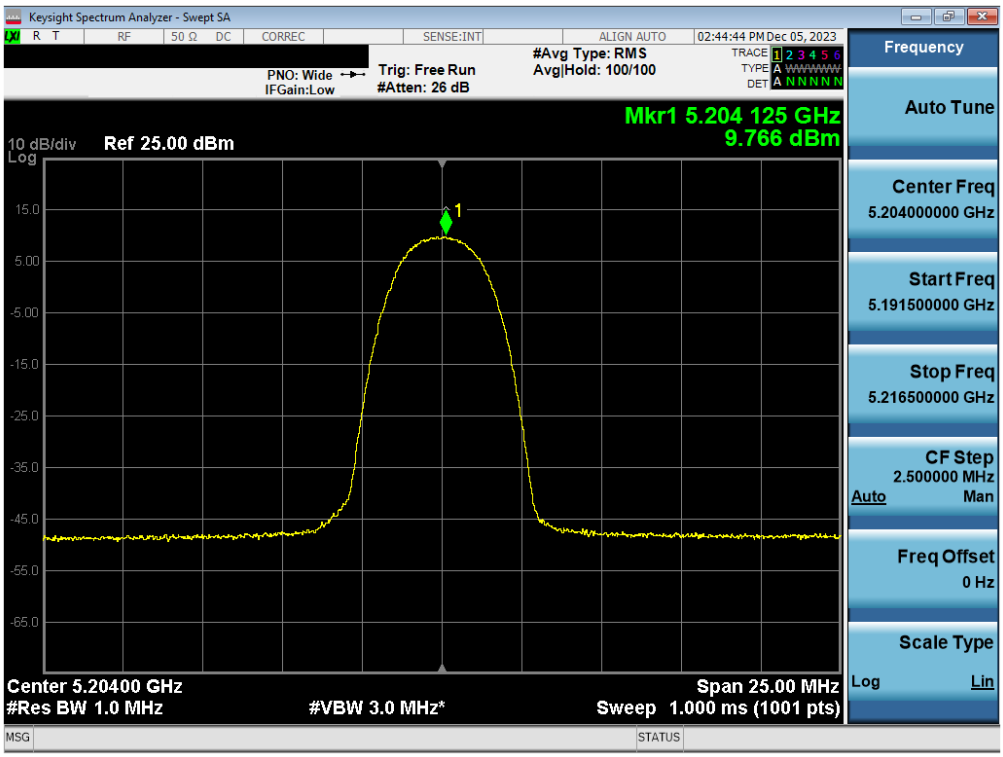
Table 7-15. FCC Power Spectral Density Measurements Antenna WF7a

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p. Power Density [dBm/MHz]	ISED Max e.i.r.p. Power Density [dBm/MHz]	Margin [dB]
Band 1	5162	4.0	HDR4	ePA	4.94	2.90	7.84	10.00	-2.16
	5204	4.0	HDR4	ePA	5.28	2.90	8.18	10.00	-1.83
	5245	4.0	HDR4	ePA	5.68	2.90	8.58	10.00	-1.43
	5162	4.0	HDR4	iPA	-1.38	2.90	1.52	10.00	-8.48
	5204	4.0	HDR4	iPA	-0.88	2.90	2.02	10.00	-7.98
	5245	4.0	HDR4	iPA	-1.02	2.90	1.88	10.00	-8.12
	5162	8.0	HDR8	ePA	5.33	2.90	8.23	10.00	-1.77
	5204	8.0	HDR8	ePA	5.29	2.90	8.19	10.00	-1.81
	5245	8.0	HDR8	ePA	5.79	2.90	8.69	10.00	-1.31
	5162	8.0	HDR8	iPA	-4.08	2.90	-1.18	10.00	-11.18
	5204	8.0	HDR8	iPA	-3.08	2.90	-0.18	10.00	-10.18
	5245	8.0	HDR8	iPA	-3.54	2.90	-0.64	10.00	-10.64

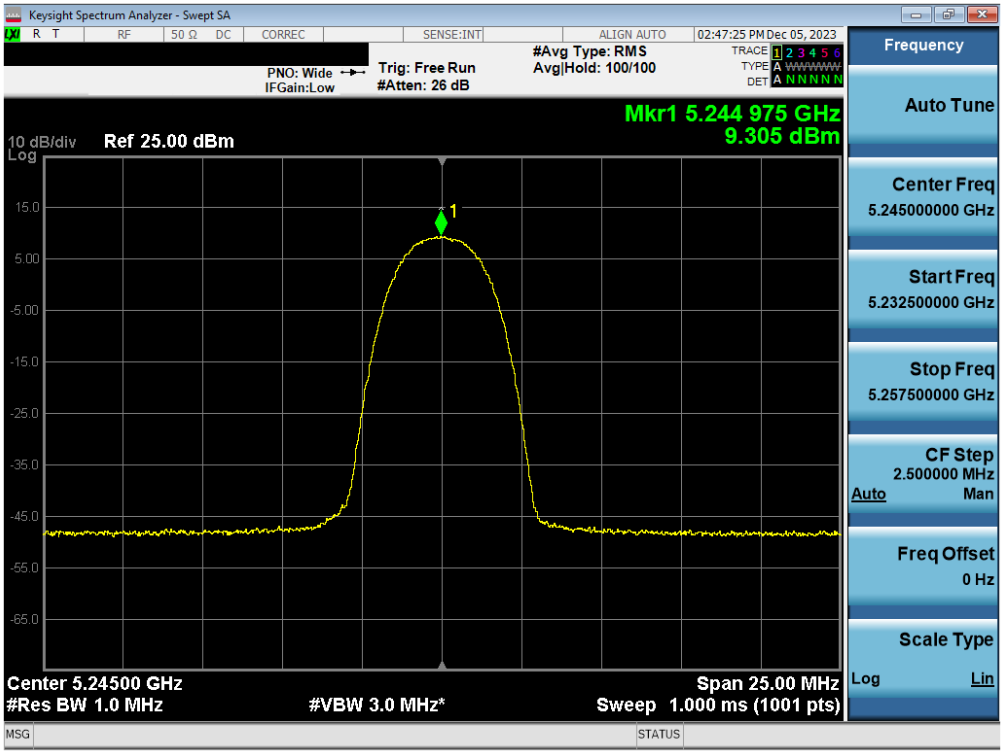
Table 7-16. ISED Power Spectral Density Measurements Antenna WF7a



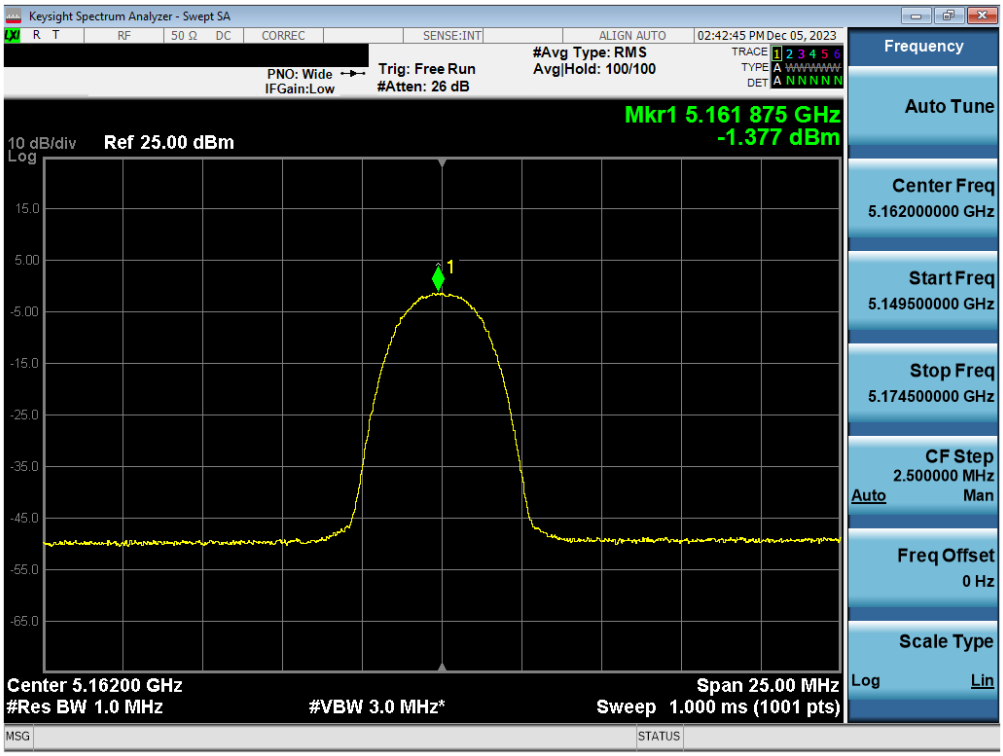
Plot 7-52. FCC PSD Antenna WF7a (HDR4, ePA – 5162MHz)



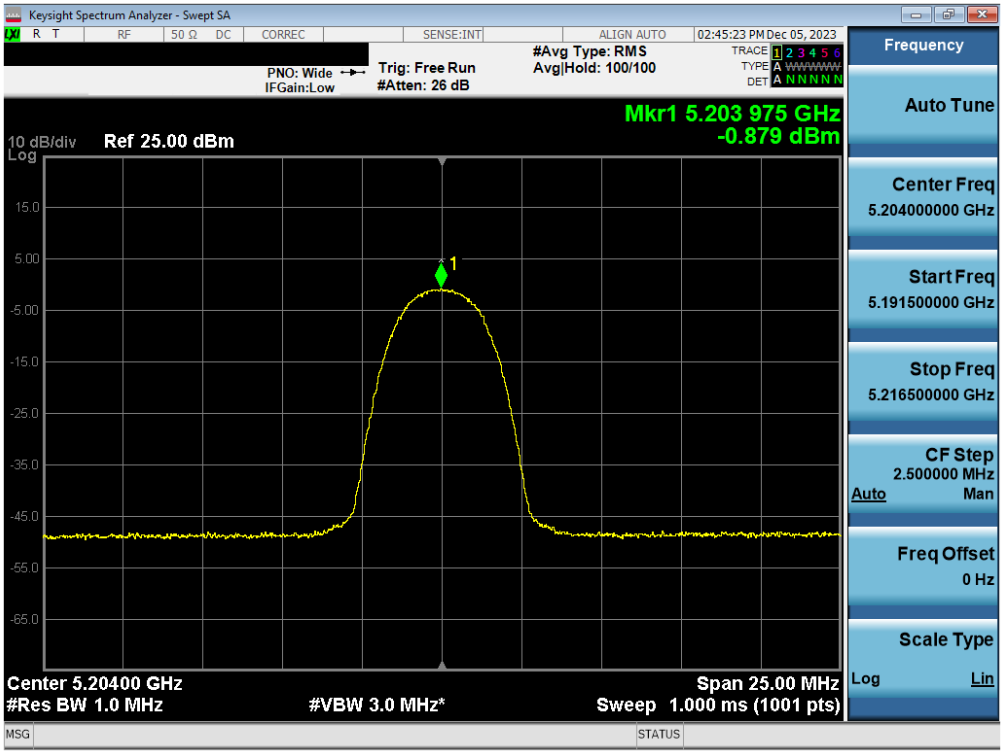
Plot 7-53. FCC PSD Antenna WF7a (HDR4, ePA – 5204MHz)



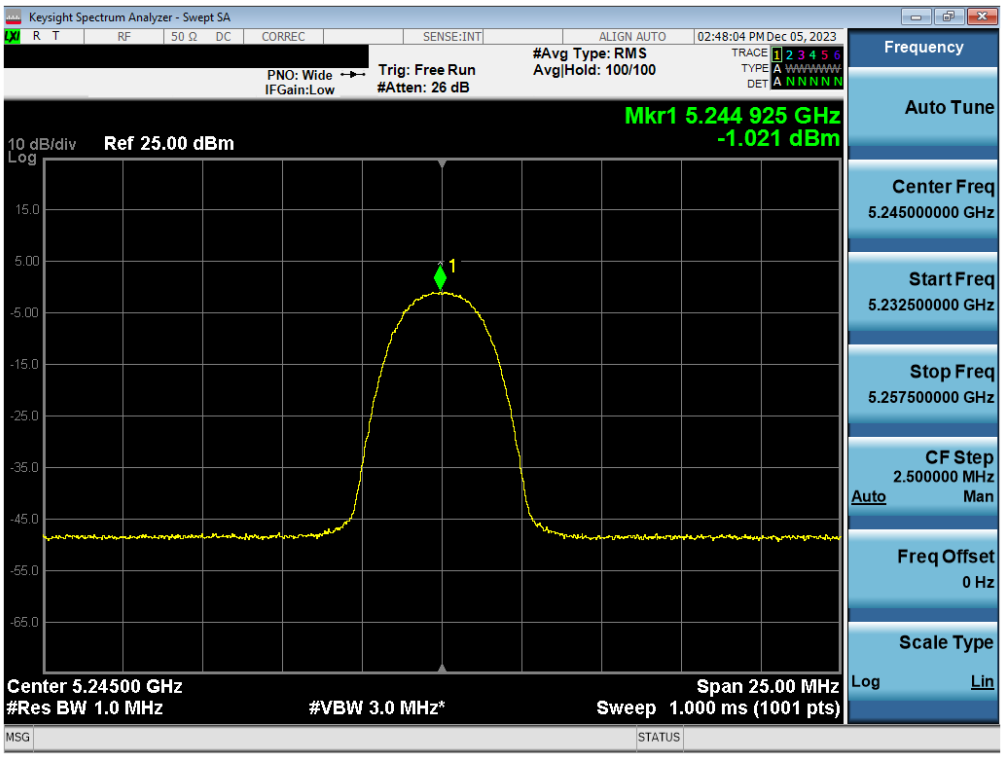
Plot 7-54. FCC PSD Antenna WF7a (HDR4, ePA– 5245MHz)



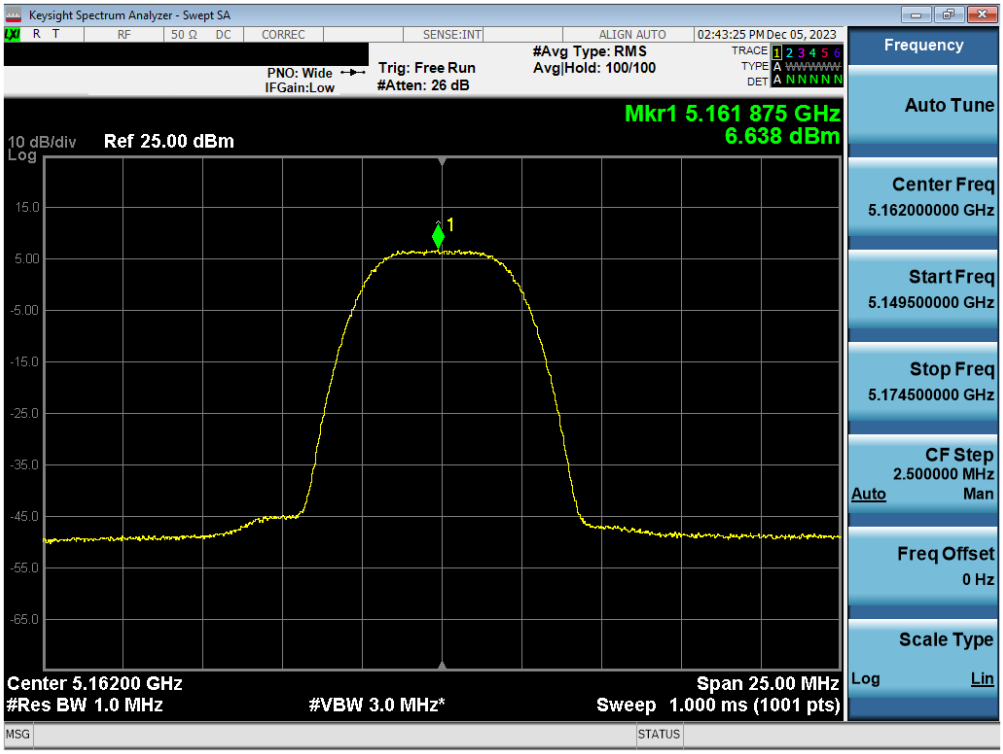
Plot 7-55. FCC/ISED PSD Antenna WF7a (HDR4, iPA – 5162MHz)



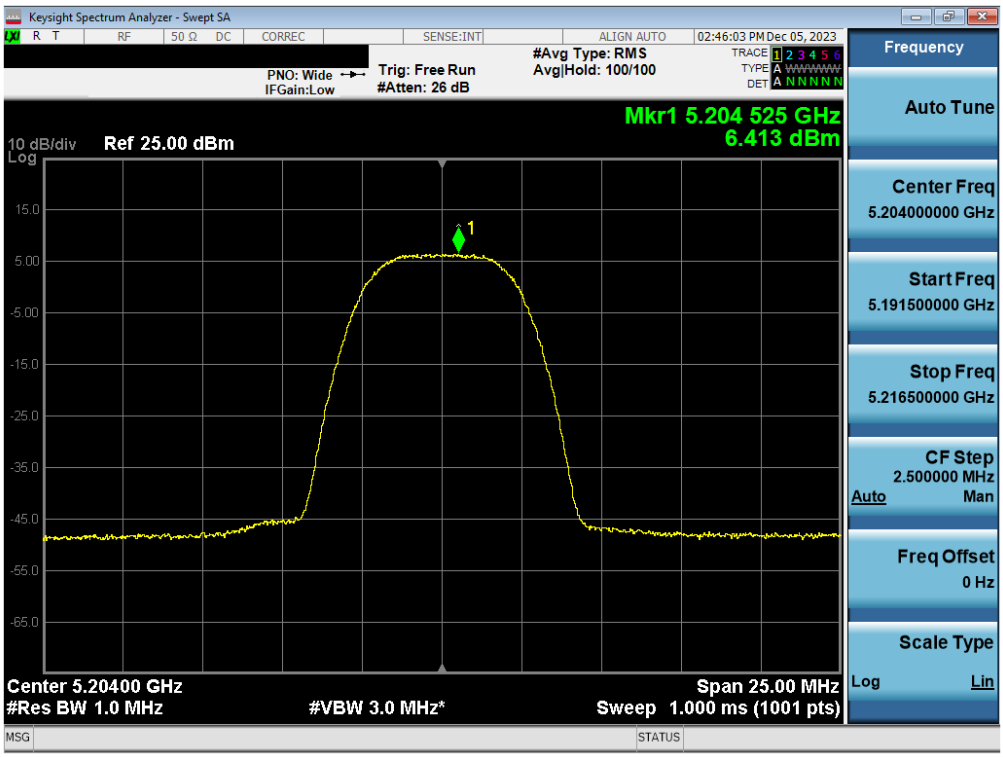
Plot 7-56. FCC/ISED PSD Antenna WF7a (HDR4, iPA – 5204MHz)



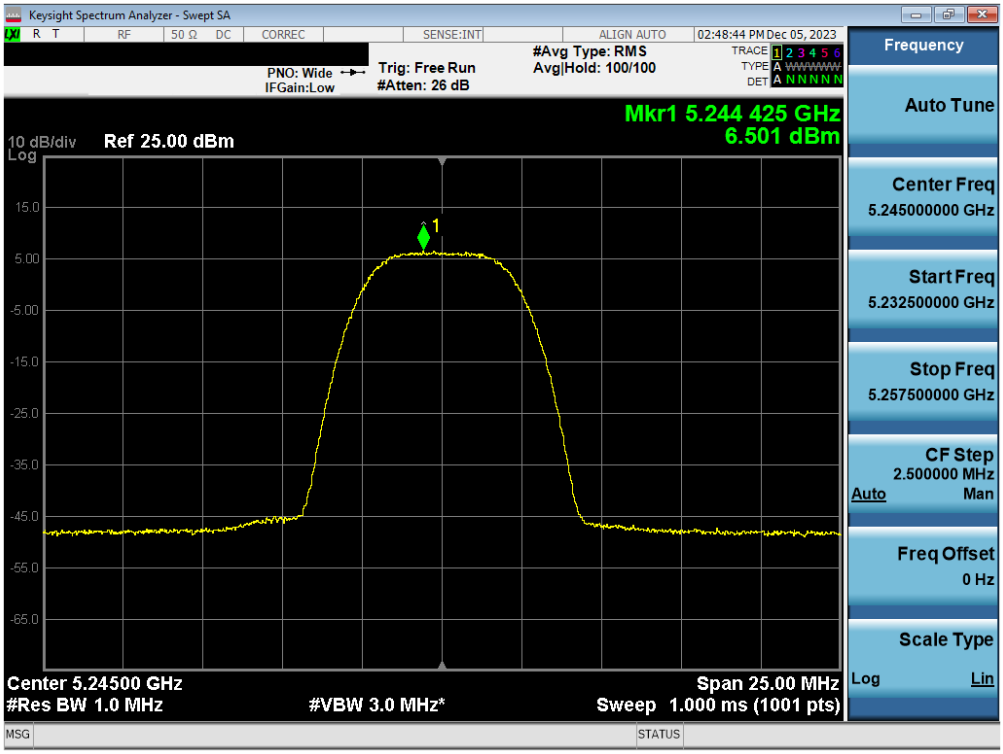
Plot 7-57. FCC/ISED PSD Antenna WF7a (HDR4, iPA– 5245MHz)



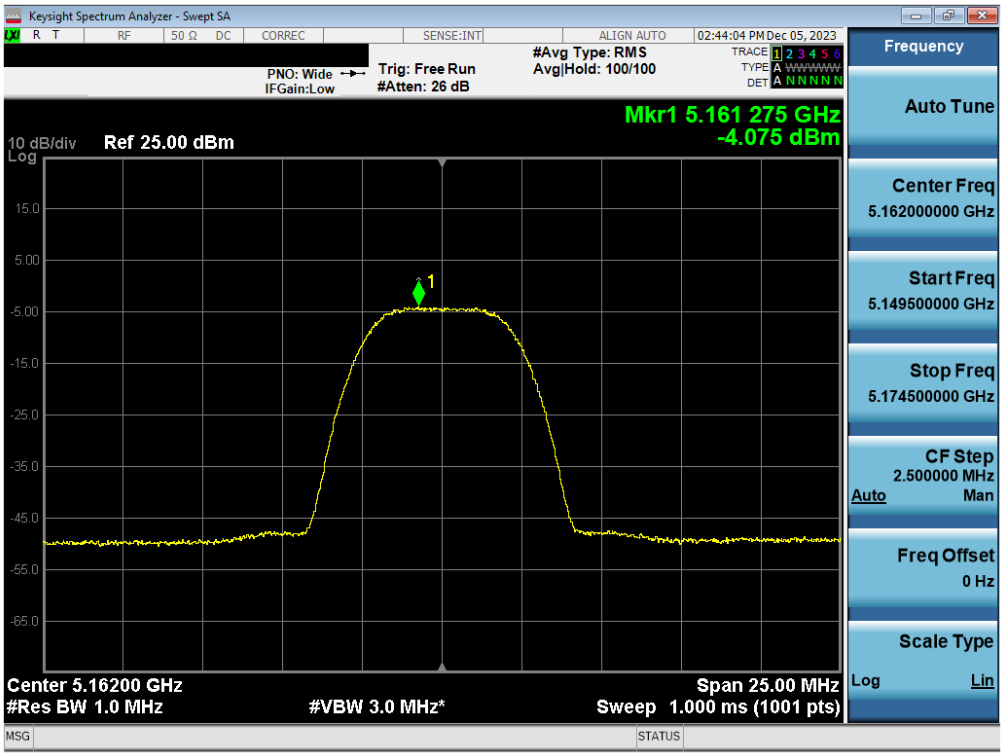
Plot 7-58. FCC PSD Antenna WF7a (HDR8, ePA – 5162MHz)



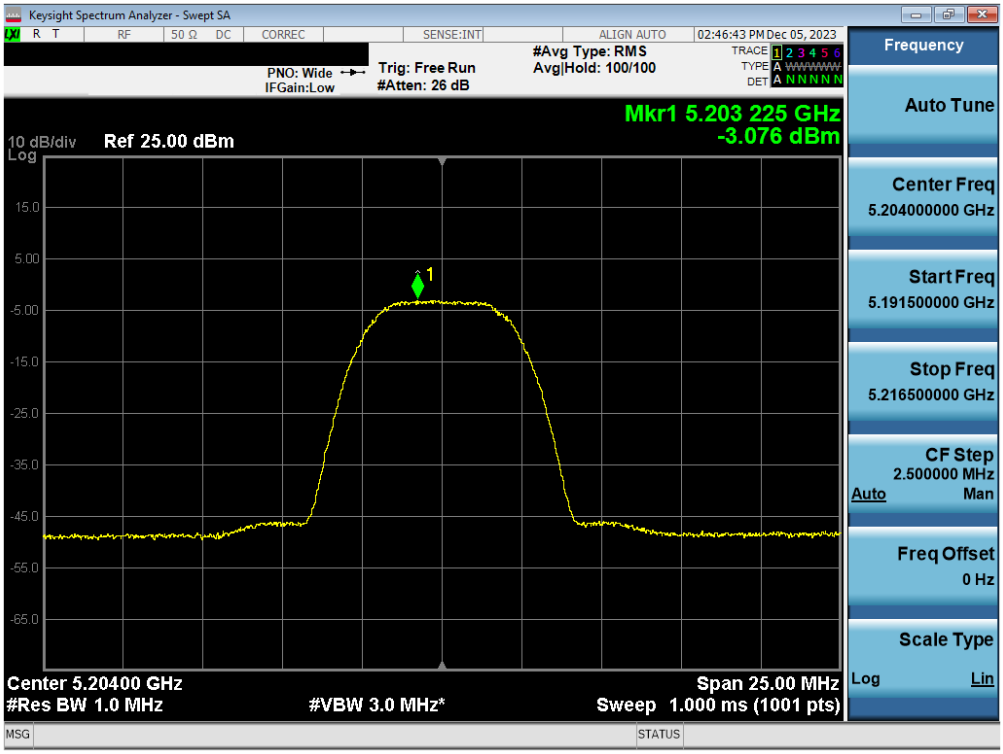
Plot 7-59. FCC PSD Antenna WF7a (HDR8, ePA – 5204MHz)



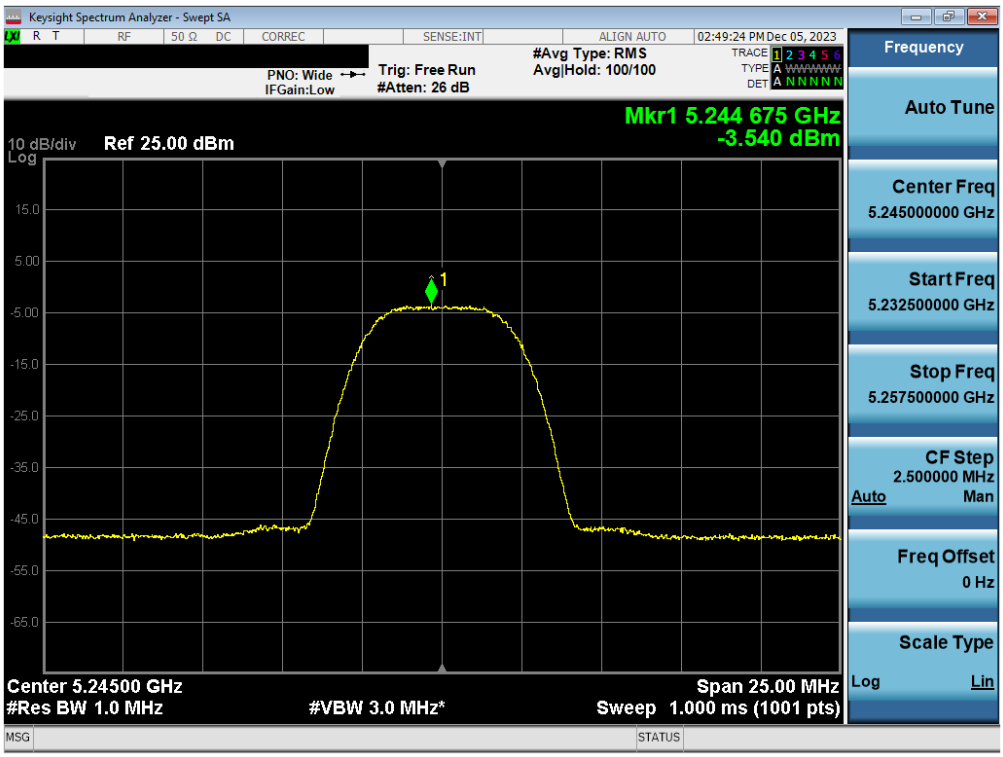
Plot 7-60. FCC PSD Antenna WF7a (HDR8, ePA– 5245MHz)



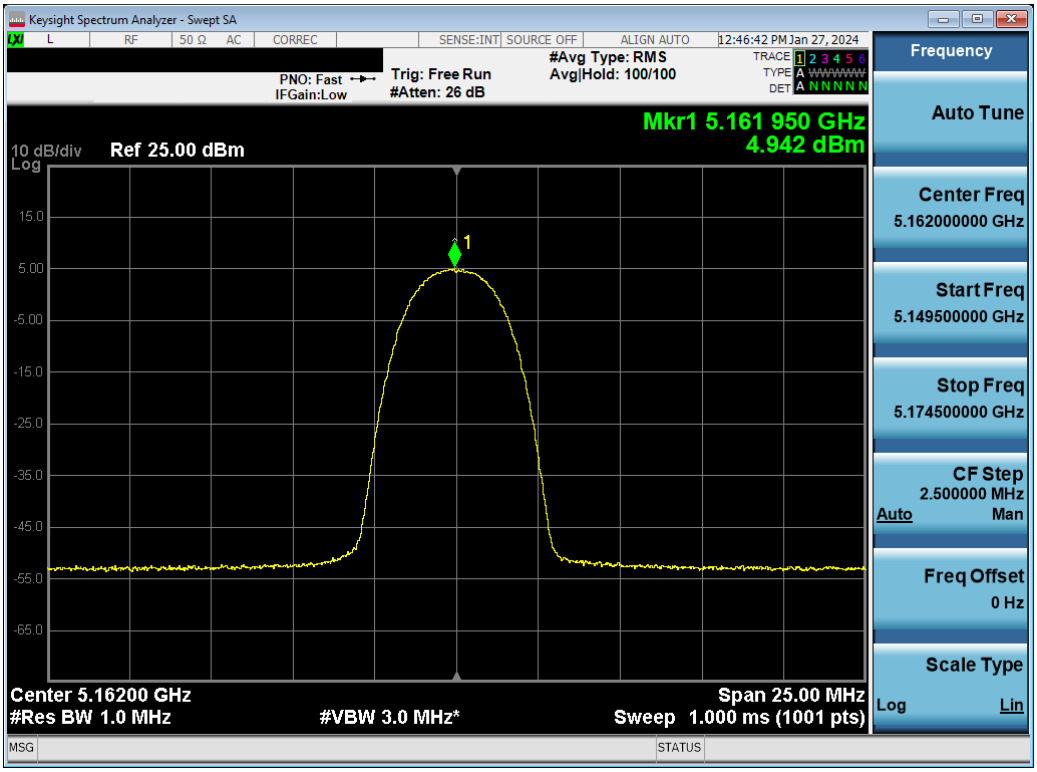
Plot 7-61. FCC/ISED PSD Antenna WF7a (HDR8, iPA – 5162MHz)



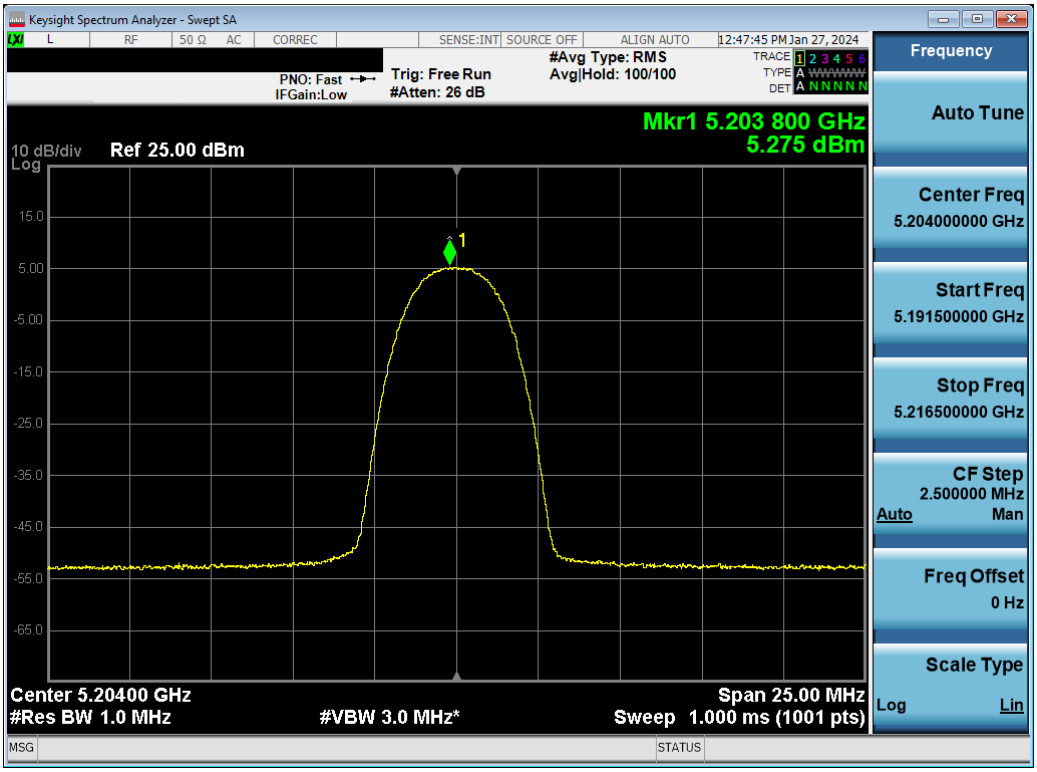
Plot 7-62. FCC/ISED PSD Antenna WF7a (HDR8, iPA – 5204MHz)



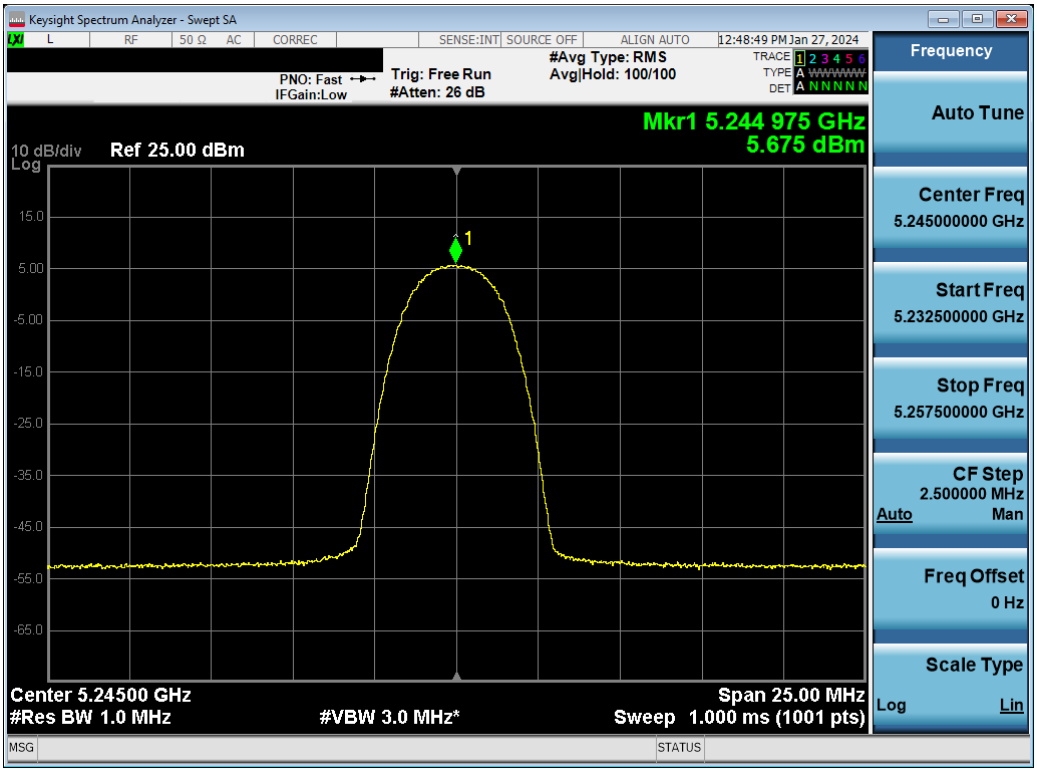
Plot 7-63. FCC/ISED PSD Antenna WF7a (HDR8, iPA– 5245MHz)



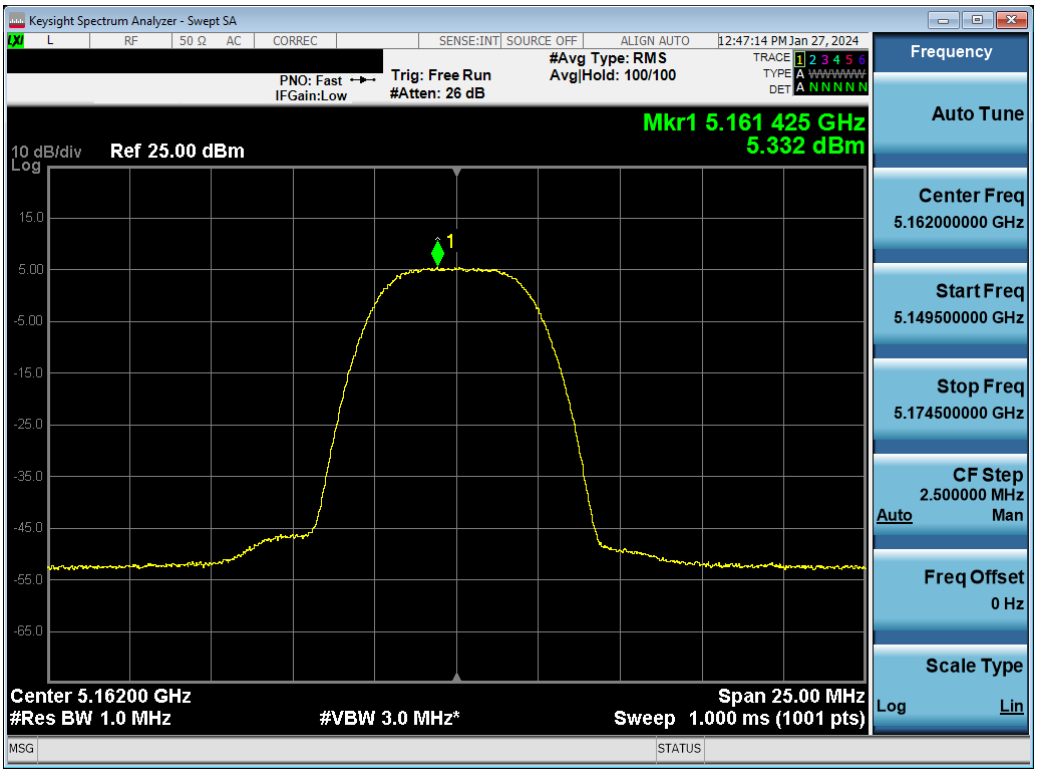
Plot 7-64. ISED PSD Antenna WF7a (HDR4, ePA – 5162MHz)



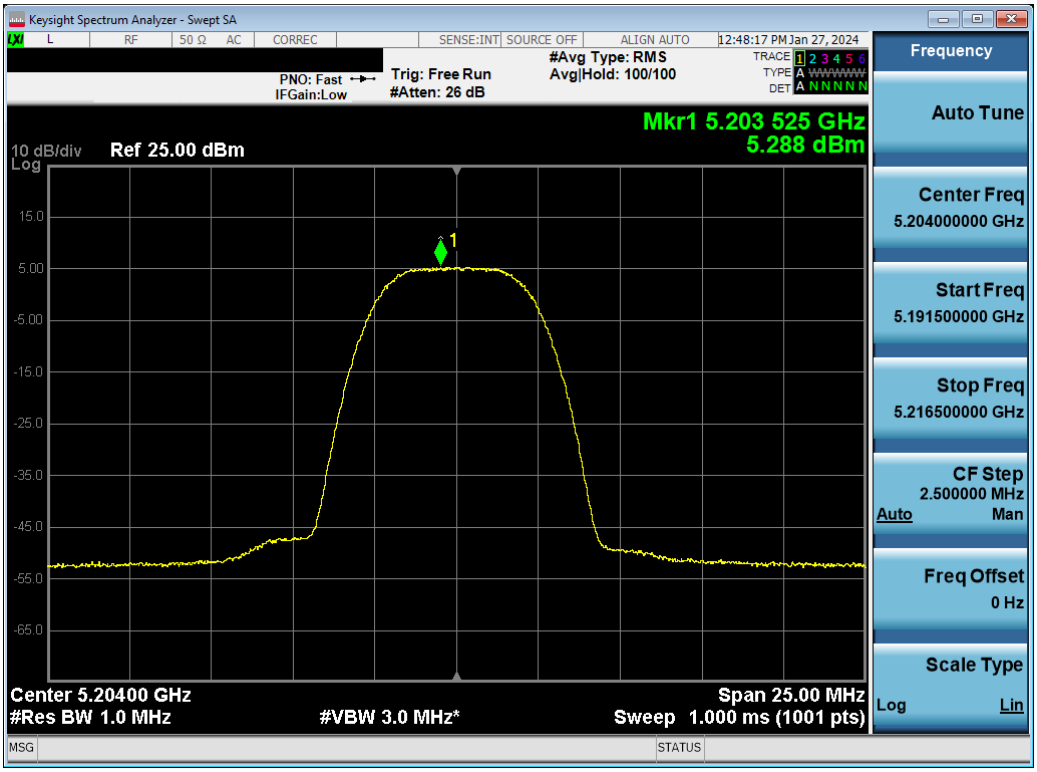
Plot 7-65. ISED PSD Antenna WF7a (HDR4, ePA – 5204MHz)



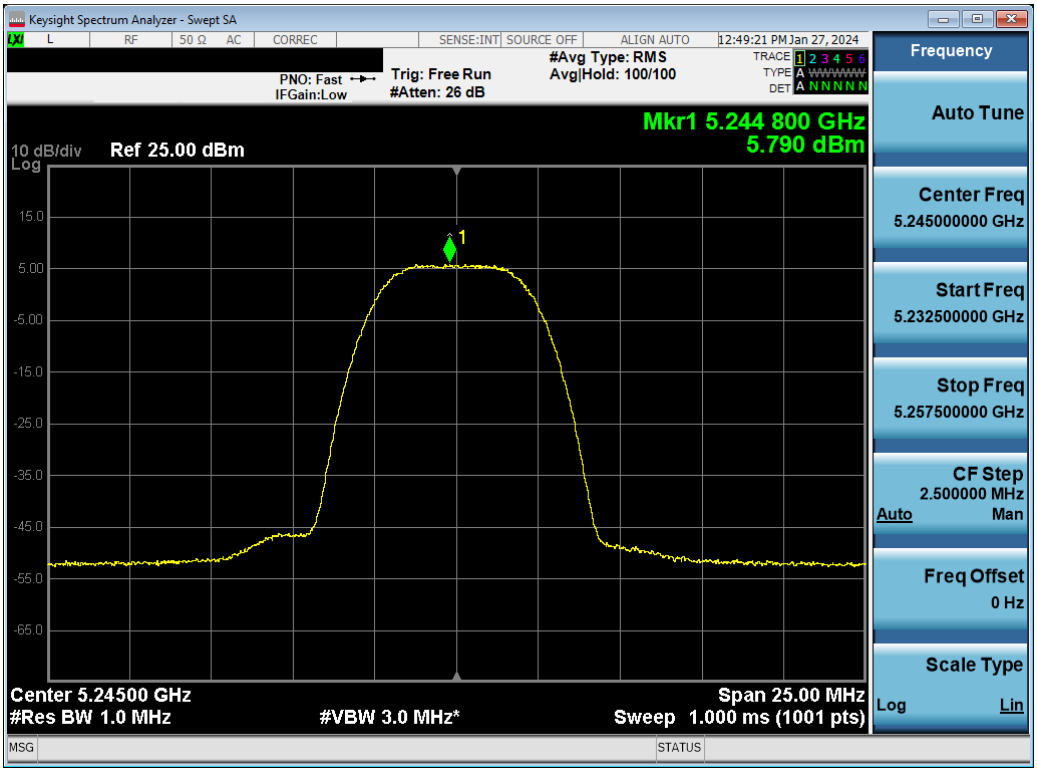
Plot 7-66. ISED PSD Antenna WF7a (HDR4, ePA– 5245MHz)



Plot 7-67. ISED PSD Antenna WF7a (HDR8, ePA – 5162MHz)



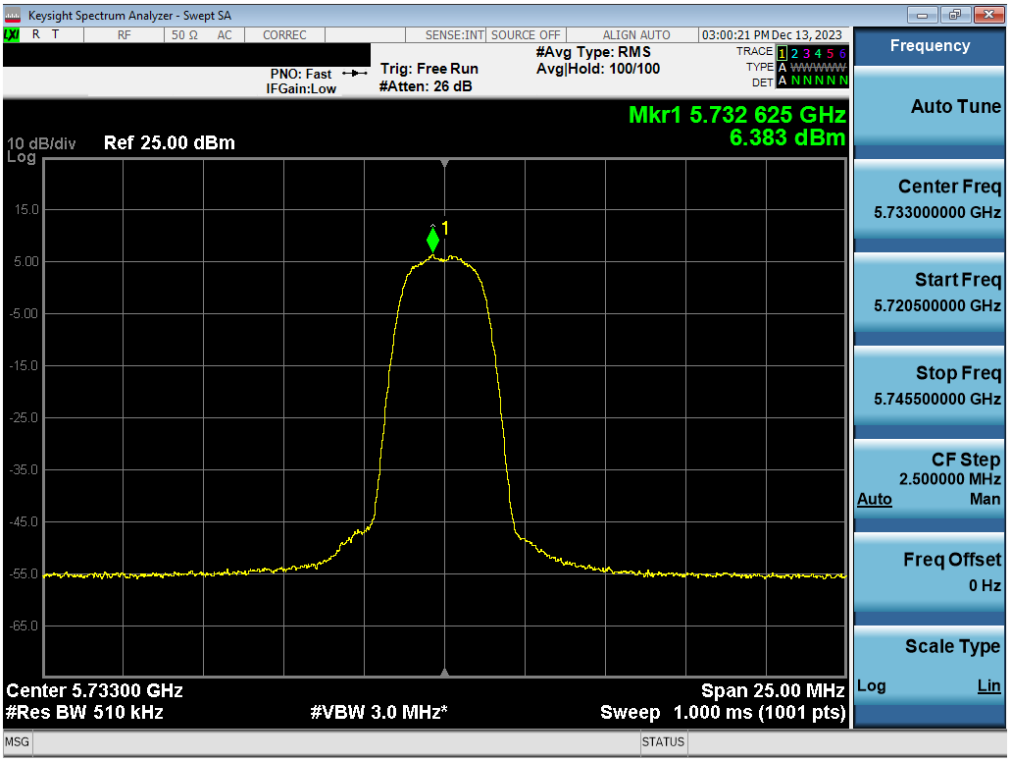
Plot 7-68. ISED PSD Antenna WF7a (HDR8, ePA – 5204MHz)



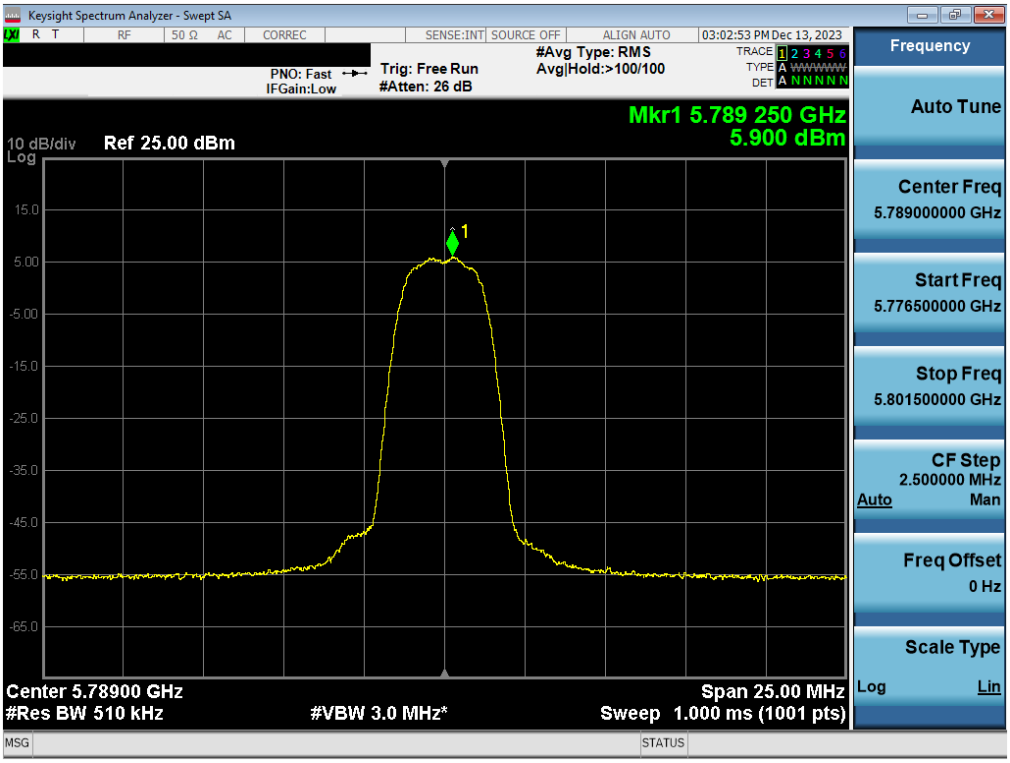
Plot 7-69. ISED PSD Antenna WF7a (HDR8, ePA– 5245MHz)

	Frequency [MHz]	Data Rate [Mbps]	Mode	Power Scheme	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5733	4.0	HDR4	ePA	6.38	30.00	-23.62
	5789	4.0	HDR4	ePA	5.90	30.00	-24.10
	5844	4.0	HDR4	ePA	6.38	30.00	-23.62
	5733	4.0	HDR4	iPA	-4.58	30.00	-34.58
	5789	4.0	HDR4	iPA	-4.07	30.00	-34.07
	5844	4.0	HDR4	iPA	-3.46	30.00	-33.46
	5733	8.0	HDR8	ePA	2.77	30.00	-27.23
	5789	8.0	HDR8	ePA	2.89	30.00	-27.11
	5844	8.0	HDR8	ePA	2.82	30.00	-27.18
	5733	8.0	HDR8	iPA	-7.38	30.00	-37.38
	5789	8.0	HDR8	iPA	-6.93	30.00	-36.93
	5844	8.0	HDR8	iPA	-6.46	30.00	-36.46

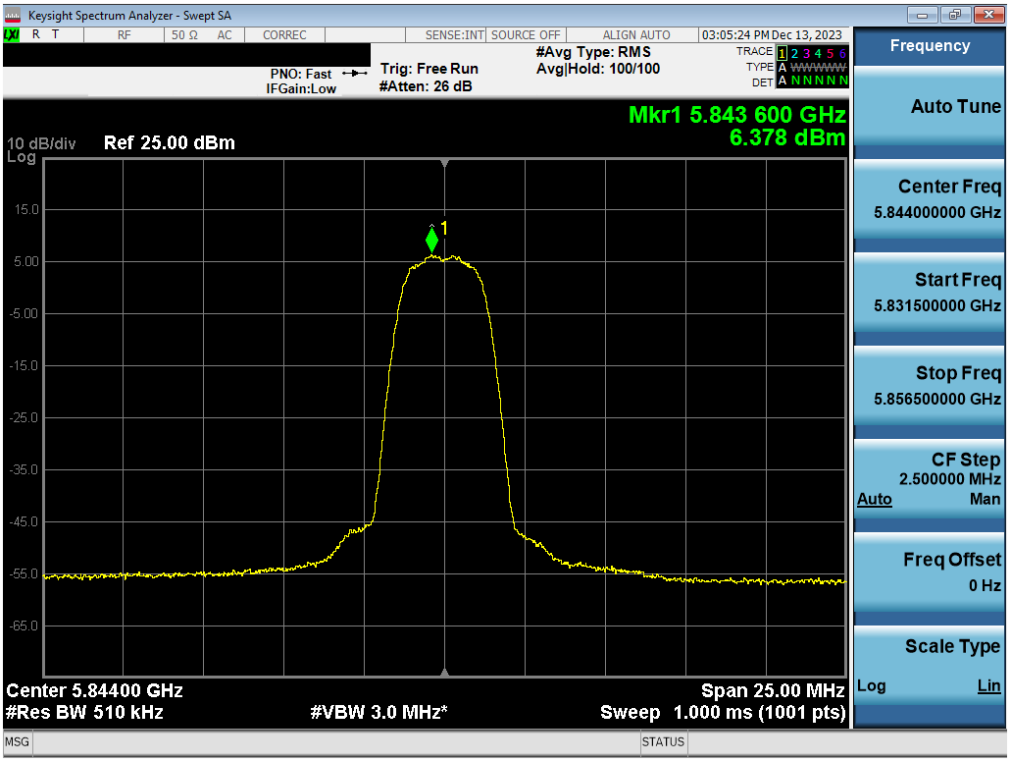
Table 7-17. Power Spectral Density Measurements Antenna WF7a



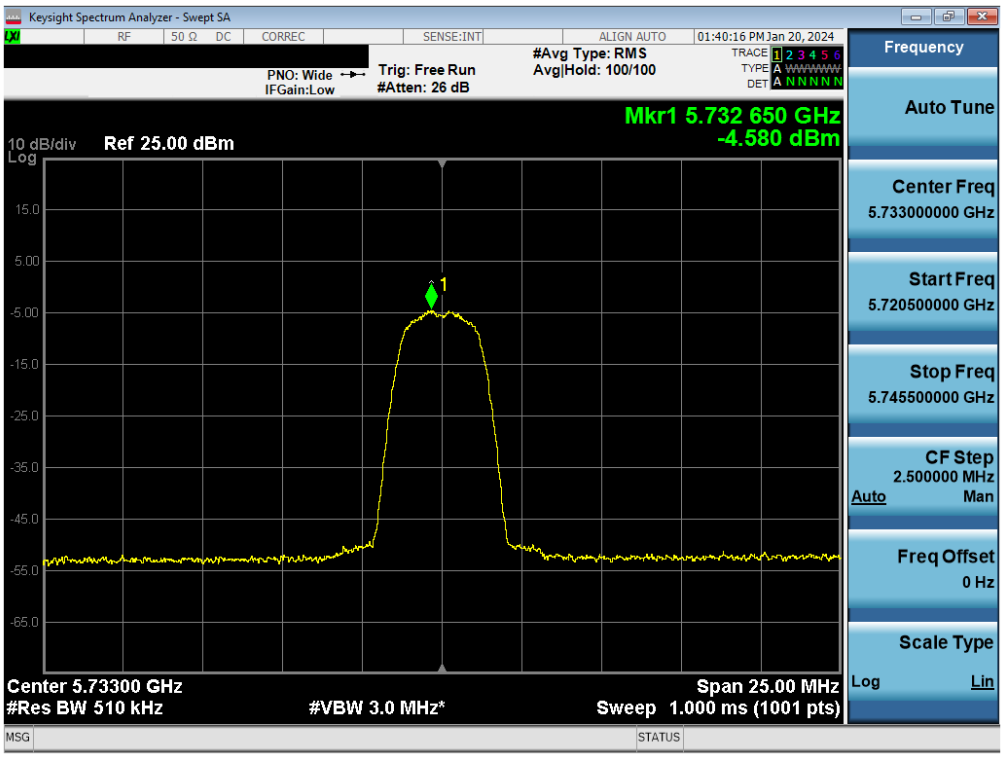
Plot 7-70. PSD Antenna WF7a (HDR4, ePA 5733MHz)



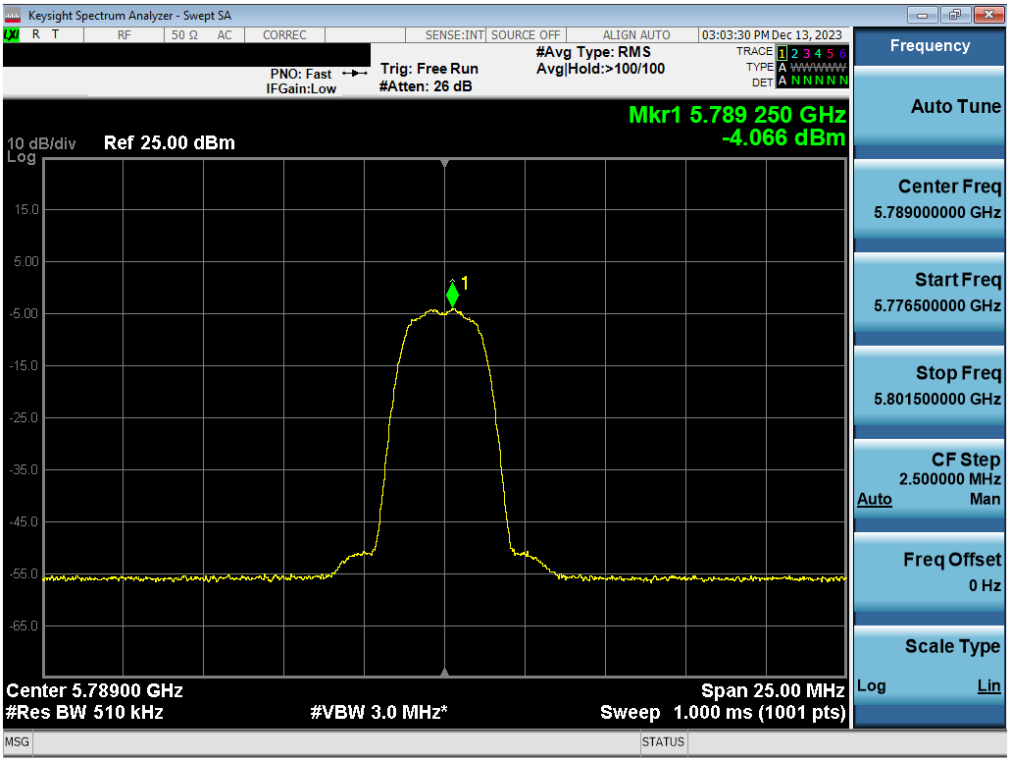
Plot 7-71. PSD Antenna WF7a (HDR4, ePA 5789MHz)



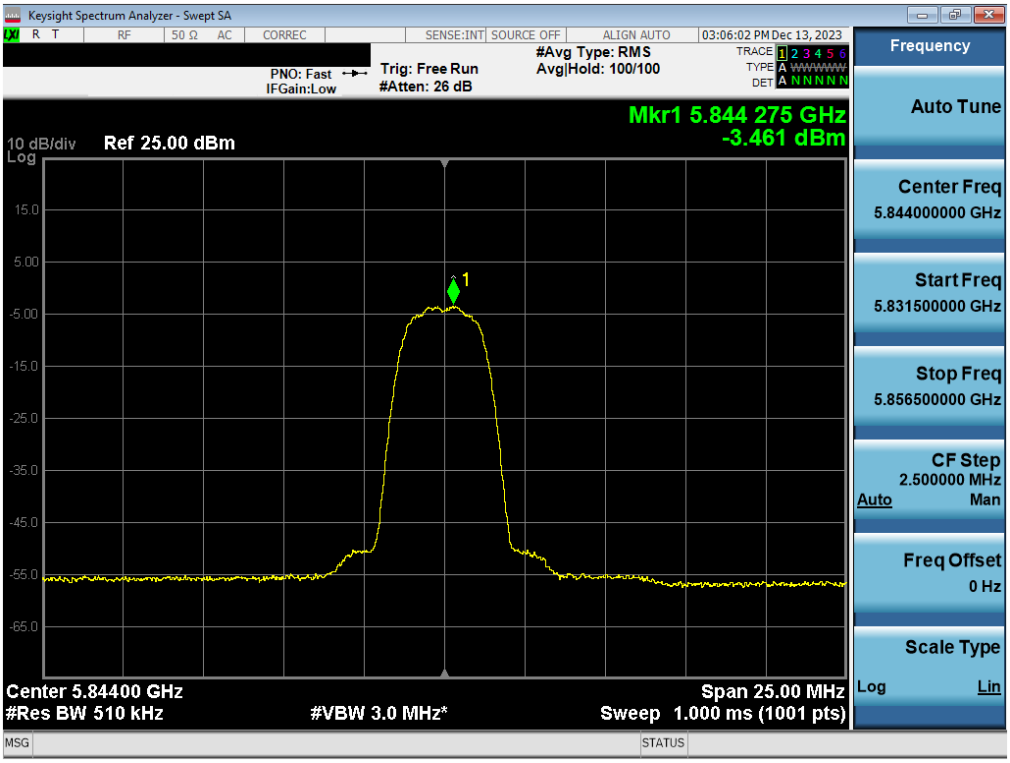
Plot 7-72. PSD Antenna WF7a (HDR4, ePA 5844MHz)



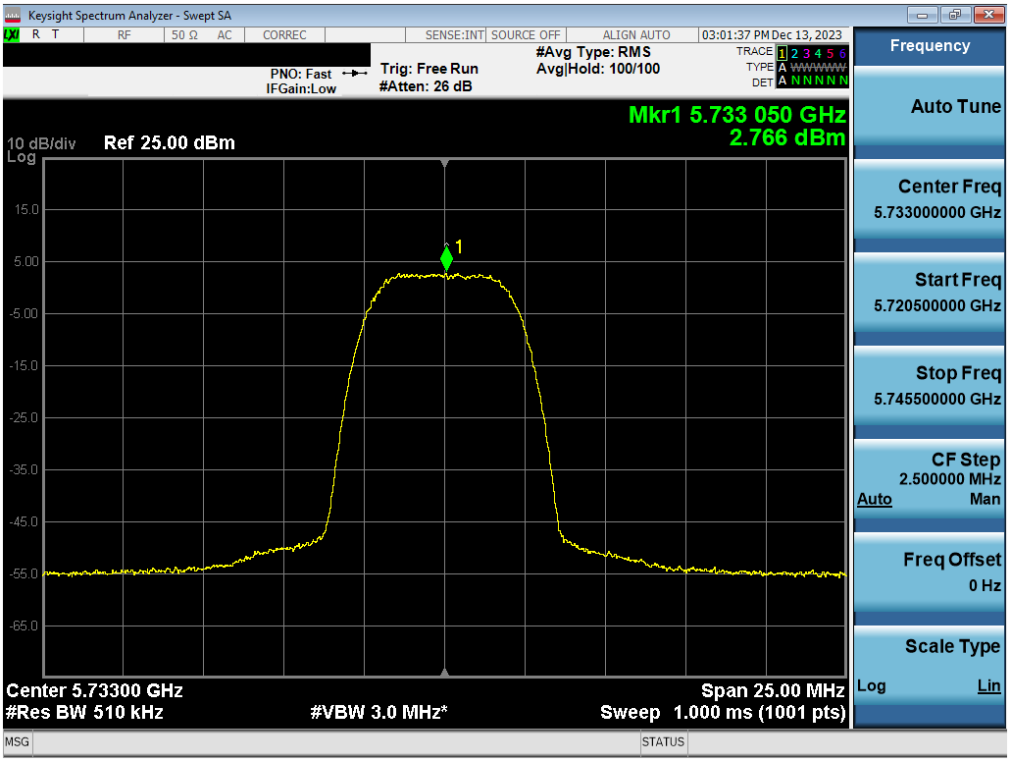
Plot 7-73. PSD Antenna WF7a (HDR4, iPA 5733MHz)



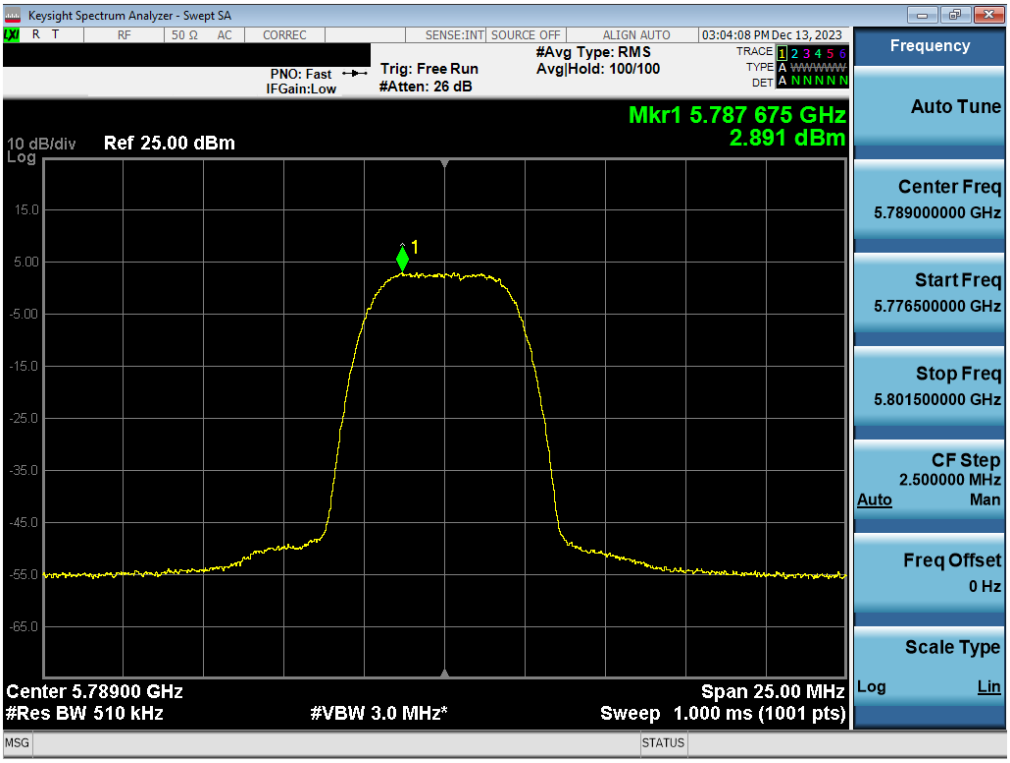
Plot 7-74. PSD Antenna WF7a (HDR4, iPA 5789MHz)



Plot 7-75. PSD Antenna WF7a (HDR4, iPA 5844MHz)



Plot 7-76. PSD Antenna WF7a (HDR8, ePA 5733MHz)



Plot 7-77. PSD Antenna WF7a (HDR8, ePA 5789MHz)