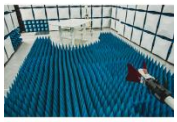
Element Materials Technology
(formerly PCTEST)
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 408.538.5600
http://www.element.com



MEASUREMENT REPORT
FCC PART 15.407 / ISED RSS-248 UNII 802.11a/ax OFDM WIFI 6E

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

Date of Testing:
10/25/2024 - 1/13/2025
Test Report Issue Date:
2/12/2025
Test Site/Location:
Element Materials Technology, Morgan Hill, CA, USA
Test Report Serial No.:
1C2410210072-14-R2.BCG

FCC ID:	**BCGA3266**
IC:	**579C-A3266**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A3266
EUT Type:	Tablet Device
Frequency Range:	6115 – 6415MHz & 6535 – 6855MHz
Modulation Type:	OFDM
FCC Classification:	15E 6 GHZ Very Low Power Device (6VL)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-248 Issue 3
Test Procedure(s):	ANSI C63.10-2020, KDB 789033 D02 v02r01 KDB 662911 D01 v02r01, KDB 987594 D02 v03 KDB 987594 D03 v03, KDB 987594 D04 v03

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 C63.10-2020 and KDB 789033 D02 v02r01. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1C2410210072-14-R2.BCG) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose accordingly

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.02

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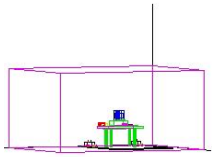
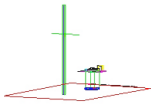


MEASUREMENT REPORT



UNII Band	Channel Bandwidth (MHz)	Mode	Tx Frequency (MHz)	SISO				SDM	
				Antenna WF8		Antenna WF7a		Summed	
				Max. Power (mW)	Max e.i.r.p. (dBm)	Max. Power (mW)	Max e.i.r.p. (dBm)	Max. Power (mW)	Max e.i.r.p. (dBm)
5	20	802.11a/ax	6115 - 6415	3.524	5.47	3.069	4.87	3.793	5.79
7		802.11a/ax	6535 - 6855	2.270	3.56	2.931	4.67	3.020	4.80
5	40	802.11ax	6125 - 6405	7.396	8.69	6.039	7.81	7.295	8.63
7		802.11ax	6565 - 6845	4.477	6.51	5.902	7.71	5.984	7.77
5	80	802.11ax	6145 - 6385	12.531	10.98	10.520	10.22	13.397	11.27
7		802.11ax	6625 - 6785	8.091	9.08	10.495	10.21	10.839	10.35
5	160	802.11ax	6185 - 6345	22.909	13.60	19.907	12.99	23.823	13.77
7		802.11ax	6665	13.836	11.41	18.239	12.61	19.320	12.86

EUT Overview Very Low Power

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1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Materials Technology 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 located in Morgan Hill, CA 95037, U.S.A.

- 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 designated by NIST under the U.S. and Canada Mutual Agreements (MRAs)

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA3266** and **IC: 579C-A3266**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter while operating in the 6GHz band.

Test Device Serial No.: GK905D9C95, WR52XQW2NN, Q402QNQ6HR, C3RR4NXP6J, VQDMXWXDC4, D6X2747Q24, DLX9Z0000D0000RMA

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, 802.15.4, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), NB UNII (1x, HDR4, HDR8), WPT

This device supports BT Beamforming.

Very Low Power (VLP) mode is supported for U-NII Bands 5 and 7. VLP channels below 6105 MHz in the UNII-5 band are disabled in the US and its territories.

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Band 5		Band 7	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
33	6115	117	6535
:	:	:	:
61	6255	149	6695
:	:	:	:
93	6415	181	6855

Table 2-1. 802.11a / 802.11ax (20MHz) Frequency / Channel Operations

Band 5		Band 7	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
35	6125	123	6565
:	:	:	:
59	6245	155	6725
:	:	:	:
91	6405	179	6845

Table 2-2. 802.11ax (40MHz BW) Frequency / Channel Operations

Band 5		Band 7	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
39	6145	119	6545
:	:	:	:
55	6225	151	6705
:	:	:	:
87	6385	183	6865

Table 2-3. 802.11ax (80MHz BW) Frequency / Channel Operations

Band 5		Band 7	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
47	6185	143	6665
:	:		
79	6345		

Table 2-4. 802.11ax (160MHz BW) Frequency / Channel Operations

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Notes:

1. 6GHz NII operation is possible in 20MHz, 40MHz, 80MHz, and 160MHz channel bandwidths. 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) KDB 789033 D02 v02r01 and ANSI C63.10-2020. 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								
802.11 Mode / Band		Antenna WF8		Antenna WF7a		SDM		
		Duty Cycle [%]	Radiated DCCF [dB]	Duty Cycle [%]	Radiated DCCF [dB]	Duty Cycle [%]	Radiated DCCF [dB]	
6GHz	11a (20MHz) (Low Rate)	97.86	0.09	97.88	0.09	N/A	N/A	
	11a (20MHz) (Mid Rate)	96.09	0.17	96.14	0.17	N/A	N/A	
	11a (20MHz) (High Rate)	93.86	0.28	93.82	0.28	N/A	N/A	
	11ax(SU) (20MHz) (Low Rate)	96.12	0.17	96.09	0.17	95.96	0.18	
	11ax(SU) (20MHz) (Mid Rate)	93.18	0.31	93.15	0.31	93.41	0.30	
	11ax(SU) (20MHz) (High Rate)	93.61	0.29	93.65	0.29	92.13	0.36	
	11ax(SU) (40MHz) (Low Rate)	96.23	0.17	96.18	0.17	95.70	0.19	
	11ax(SU) (40MHz) (Mid Rate)	92.94	0.32	92.92	0.32	93.24	0.30	
	11ax(SU) (40MHz) (High Rate)	93.82	0.28	93.84	0.28	92.62	0.33	
	11ax(SU) (80MHz) (Low Rate)	96.07	0.17	96.14	0.17	95.76	0.19	
	11ax(SU) (80MHz) (Mid Rate)	92.62	0.33	92.64	0.33	92.41	0.34	
	11ax(SU) (80MHz) (High Rate)	92.53	0.34	92.49	0.34	90.95	0.41	
	11ax(SU) (160MHz) (Low Rate)	94.21	0.26	94.25	0.26	94.10	0.26	
	11ax(SU) (160MHz) (Mid Rate)	90.68	0.43	90.64	0.43	90.43	0.44	
	11ax(SU) (160MHz) (High Rate)	90.30	0.44	90.28	0.44	87.56	0.58	

Table 2-5. Measured Duty Cycles

The device employs MIMO technology. Below are the possible configurations.

WiFi Configurations		SISO		CDD		SDM		STBC	
		Antenna WF8	Antenna WF7a	Antenna WF8	Antenna WF7a	Antenna WF8	Antenna WF7a	Antenna WF8	Antenna WF7a
6GHz	11a (20MHz)	✓	✓	×	×	×	×	×	×
	11ax(SU) (20MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (40MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (80MHz)	✓	✓	✓	✓	✓	✓	✓	✓
	11ax(SU) (160MHz)	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-6. WIFI Configurations

✓= Support ; × = NOT Support
SISO = Single Input Single Output
SDM = Spatial Diversity Multiplexing – MIMO function
CDD = Cyclic Delay Diversity - 2Tx Function
STBC = Space-Time Block Coding – 2Tx Function

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2. The device supports the following data rates (shown in Mbps):

802.11a	MCS Index	Spatial Stream	OFDM (802.11ax)												
20MHz	HE		20MHz			40MHz			80MHz			160MHz			
			0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	
6	0	1	8.6	8.1	7.3	17.2	16.3	14.6	36	34	30.6	72.1	68.1	61.3	
9	1	1	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5	Low rate
12	2	1	25.8	24.4	21.9	51.6	48.8	43.9	108.1	102.1	91.9	216.2	204.2	183.8	
18	3	1	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245	Mid rate
24	4	1	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5	
36	5	1	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490	
48	6	1	77.4	73.1	65.8	154.9	146.3	131.6	324.3	306.3	275.6	648.5	612.5	551.3	
54	7	1	86	81.3	73.1	172.1	162.5	146.3	360.3	340.3	306.3	720.6	680.6	612.5	
-	8	1	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735	High Rate
-	9	1	114.7	108.3	97.5	229.4	216.7	195	480.4	453.7	408.3	960.8	907.4	816.7	
-	10	1	129	121.9	109.7	258.1	243.8	219.4	540.4	510.4	459.4	1080.9	1020.8	918.8	
-	11	1	143.4	135.4	121.9	286.8	270.8	243.8	600.5	567.1	510.4	1201	1134.3	1020.8	
6	0	2	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5	
9	1	2	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245	Low rate
12	2	2	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5	
18	3	2	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490	Mid rate
24	4	2	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735	
36	5	2	137.6	130	117	275.3	260	234	576.5	544.4	490	1152.9	1088.9	980	
48	6	2	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225	1102.5	
54	7	2	172.1	162.5	146.3	344.1	325	292.5	720.6	680.6	612.5	1441.2	1361.1	1225	
-	8	2	206.5	195	175.5	412.9	390	351	864.7	816.7	735	1729.4	1633.3	1470	High Rate
-	9	2	229.4	216.7	195	458.8	433.3	390	960.8	907.4	816.7	1921.6	1814.8	1633.3	
-	10	2	258.1	243.8	219.4	516.2	487.5	438.8	1080.9	1020.8	918.8	2161.8	2041.7	1837.5	
-	11	2	286.8	270.8	243.8	573.5	541.7	487.5	1201	1134.3	1020.8	2402	2268.5	2041.7	

Table 2-7. Data Rate Supported

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

Antenna	Simultaneous Tx Config	Bluetooth 2.4GHz	Thread	WLAN	NB UNII	WIFI 5GHz	WIFI 6GHz
		BDR, EDR, HDR4/8, LE1/2M	802.15.4	802.11 b/g/n/ax	BDR, HDR4/8	802.11 a/n/ac/ax	802.11 a/ax
Ant WF8	Config 1	✓	×	×	×	✓	×
Ant WF8	Config 2	✓	×	×	×	×	✓
Ant WF8	Config 3	×	✓	×	×	✓	×
Ant WF8	Config 4	×	✓	×	×	×	✓
Ant WF8	Config 5	×	×	✓	✓	×	×

Table 2-8. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All the above simultaneous transmission configurations have been tested and the worst-case configuration was found to be Config 1 and reported in RF Bluetooth and RF UNII OFDM 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 (2.4 GHz), in both connected and disconnected modes, and Wi-Fi (2.4 GHz) – Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power. Bluetooth can simultaneously transmit with IEEE 802.11a/n/ac/ax 5/6 GHz on separate antenna.

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2.3 Antenna Description

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

UNII Band	Tx Frequency (MHz)	Highest Antenna Gain (dBi)		Lowest Antenna Gain (dBi)	
		Antenna WF8	Antenna WF7a	Antenna WF8	Antenna WF7a
5	6115-6415	4.30	3.50	2.10	2.70
7	6535-6855	2.10	3.30	0.20	1.10

Table 2-9. Antenna Gains

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
6	Tablet Device	Model:	A3269	S/N:	VQDMXWXDC4

Table 2-10. Test Support Equipment List

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2020, KDB 789033 D02 v02r01 and KDB 987594 D02 v03. ANSI C63.10-2020 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.3 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, and 7.5 for antenna port conducted emissions test setups.

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 the worst cases were reported.

- 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

802.11ax HE20/40/80/160 2TX SDM mode test data provided in this report covers 802.11ax HE20/40/80/160 2TX STBC mode.

For 802.11ax-RU test results, see separate UNII 6E OFDMA report, 1C2410210072-15-R1.BCG.

The data rates have been categorized into three groups: low, middle, and high data rates (see Table 2-7). All three groups have been investigated, and only the worst-case data rate has been reported.

2.6 Software and Firmware

The test was conducted with firmware version 22D20 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 C63.10-2020) 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 7.10. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

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3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

Per KDB 414788, 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).

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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 (±dB)
Conducted Bench Top Measurements	2.07
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)	5.22

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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 with the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Anritsu	ML2495A	Power Meter	7/8/2024	Annual	7/8/2025	1039008
Anritsu	MA2411B	Pulse Power Sensor	7/1/2024	Annual	7/1/2025	1911105
Anritsu	MA2411B	Pulse Power Sensor	10/21/2024	Annual	10/21/2025	1027293
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	3/14/2024	Annual	3/14/2025	T058701-01
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/9/2024	Annual	4/9/2025	00218555
Fairview Microwave	FMCA1975-36	30MHz-40GHz Conducted Cable *	6/10/2024	Annual	6/10/2025	-
Fairview Microwave	FM2CP1122-10	Directional Coupler *	6/10/2024	Annual	6/10/2025	1946
Fairview Microwave/MCL	FMCA1975-36/BW-K10-2W44+	30MHz-40GHz RF Cable/Attenuator *	6/10/2024	Annual	6/10/2025	-
Keysight Technology	N9040B	UXA Signal Analyzer	5/28/2024	Annual	5/28/2025	MY57212015
Keysight Technology	N9030A	PXA Signal Analyzer	7/11/2024	Annual	7/11/2025	MY49430244
Mini-Circuits	ZN2PD-9G	Power Splitter*	8/16/2024	Annual	8/16/2025	SF456200530
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/14/2024	Annual	8/14/2025	101648
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/29/2024	Annual	5/29/2025	101619
Rohde & Schwarz	ESW44	EMI Test Receiver	5/1/2024	Annual	5/1/2025	101867
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	7/3/2024	Annual	7/3/2025	102356
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/21/2024	Annual	10/21/2025	187423
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/10/2024	Annual	6/10/2025	100057
Rohde & Schwarz	HFH2-Z2	Loop Antenna	6/21/2024	Annual	6/21/2025	100519
Rohde & Schwarz	ENV216	Two-Line V-Network	4/24/2024	Annual	4/24/2025	101364
Rohde & Schwarz	SMW200A	Vector Signal Generator	4/4/2024	Annual	4/4/2025	109456
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	4/29/2024	Annual	4/29/2025	00304

Table 6-1. Test Equipment List

Note:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.
2. * denotes passive equipment that have been internally verified/calibrated.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.
FCC ID: BCGA3266
IC: 579C-A3266
FCC Classification: 15E 6 GHZ Very Low Power Device (6VL)

FCC Part Section(s) / KDB Reference	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049, 15.407(a)(11)	RSS-Gen [6.7], RSS-248 [4.4]	Occupied Bandwidth/ 26dB Bandwidth	99% of the occupied bandwidth of any channel must be contained within each of its respective U-NII sub bands < 320MHz (5.925 - 7.125GHz)	CONDUCTED	PASS	Section 7.2
15.407(a)(9)	RSS-248 [4.5.6]	Maximum Power Spectral Density	< -5dBm/MHz e.i.r.p for Very Low Power		PASS	Section 7.4
15.407(a)(9)	RSS-248 [4.5.6]	Maximum EIRP	< 14dBm over the frequency band of operation for Very Low Power		PASS	Section 7.3
15.407(b)(7)	RSS-248 [4.6.2]	In-Band Emissions	EUT must meet the limits detailed in 15.407(b)(7) and RSS-248 [4.6.2] b)		PASS	Section 7.5
15.407(d)(6)	RSS-248 [4.7]	Contention Based Protocol	EUT must detect AWGN signal with 90% (or better) certainty		PASS	Section 7.6
15.407(d.10)	RSS-248[4.6]	Transmit Power Control	EUT must employ a TPC mechanism to operate 6dB below the maximum EIRP PSD value of −5 dBm/MHz		PASS	Section 7.7
15.407(b)(6)	RSS-248 [4.7.2]	Undesirable Emissions	< -27dBm/MHz e.i.r.p. outside of the 5.925 – 7.125GHz band	RADIATED	PASS	Section 7.8
15.205, 15.209	RSS-248 [4.6.2] 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 7.8, 7.8.1
15.407(b)(9)	RSS-Gen [8.8]	AC Conducted Emissions (150kHz – 30MHz)	< FCC 15.207 (RSS-Gen [8.8]) limits	LINE CONDUCTED	PASS	Section 7.10

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among the 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 "Conducted Automation Software," Version 1.1.1.
5) For radiated testing, 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 3.1.0.
6) All radiated measurements were tested at the highest supported power setting per band.

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7.2 26dB & 99% Bandwidth Measurement

§2.1049, §15.407; RSS-Gen [6.7], RSS-248 [4.4]

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 C63.10-2020 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

Test Procedure Used

ANSI C63.10-2020 – Section 12.5
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 = in the range of 1% to 5% 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.

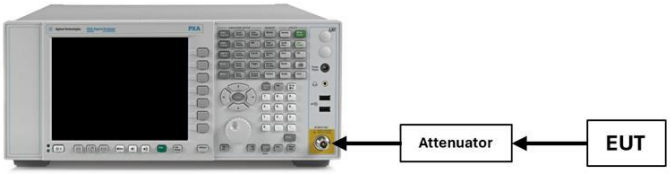

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. All antenna configurations were investigated and only the worst case are reported.
2. All data rates have been investigated, and tabular data has been reported. Only the worst-case plot per bandwidth was reported.

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7.2.1 Antenna WF8 26dB & 99% Bandwidth Measurements – VLP

	Frequency [MHz]	Channel	802.11 MODE	Data Rate [Mbps]	Measured 99% Occupied Bandwidth	Measured 26dB Bandwidth	Maximum Bandwidth Limit [MHz]	Pass / Fail
Band 5	6115	33	a	12.00	16.78	21.11	320	Pass
	6255	61	a	12.00	16.76	21.07	320	Pass
	6415	93	a	12.00	16.76	21.15	320	Pass
	6115	33	ax (20MHz)	49/51.6 (MCS4)	19.04	21.23	320	Pass
	6255	61	ax (20MHz)	24/25.8 (MCS2)	19.04	21.40	320	Pass
	6415	93	ax (20MHz)	135/143.4 (MCS11)	19.04	21.40	320	Pass
	6125	35	ax (40MHz)	98/103.2 (MCS4)	37.94	41.49	320	Pass
	6245	59	ax (40MHz)	49/51.6 (MCS2)	37.99	41.56	320	Pass
	6405	91	ax (40MHz)	49/51.6 (MCS2)	38.00	41.77	320	Pass
	6145	39	ax (80MHz)	567/600.5 (MCS11)	77.23	82.28	320	Pass
	6225	55	ax (80MHz)	204/216.2 (MCS4)	77.27	81.96	320	Pass
	6385	87	ax (80MHz)	204/216.2 (MCS4)	77.21	82.19	320	Pass
	6185	47	ax (160MHz)	1020.8/1201 (MCS11)	156.26	165.85	320	Pass
	6345	79	ax (160MHz)	1020.8/1201 (MCS11)	155.98	166.33	320	Pass
Band 7	6535	117	a	12.00	16.73	21.05	320	Pass
	6695	149	a	12.00	16.77	21.02	320	Pass
	6855	181	a	12.00	16.77	21.04	320	Pass
	6535	117	ax (20MHz)	49/51.6 (MCS4)	19.02	21.32	320	Pass
	6695	149	ax (20MHz)	24/25.8 (MCS2)	19.03	21.48	320	Pass
	6855	181	ax (20MHz)	24/25.8 (MCS2)	19.05	21.30	320	Pass
	6565	123	ax (40MHz)	49/51.6 (MCS2)	37.93	41.68	320	Pass
	6725	155	ax (40MHz)	49/51.6 (MCS2)	38.07	41.68	320	Pass
	6845	179	ax (40MHz)	98/103.2 (MCS4)	37.93	41.64	320	Pass
	6625	135	ax (80MHz)	204/216.2 (MCS4)	77.38	82.36	320	Pass
	6705	151	ax (80MHz)	204/216.2 (MCS4)	77.27	82.30	320	Pass
	6785	167	ax (80MHz)	204/216.2 (MCS4)	77.29	82.18	320	Pass
	6665	143	ax (160MHz)	367.5/432.4 (MCS4)	156.17	166.41	320	Pass

Table 7-2. Conducted Bandwidth Measurements Antenna WF8

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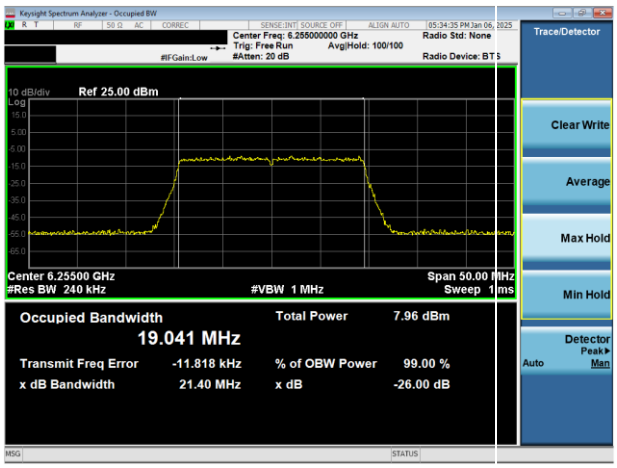
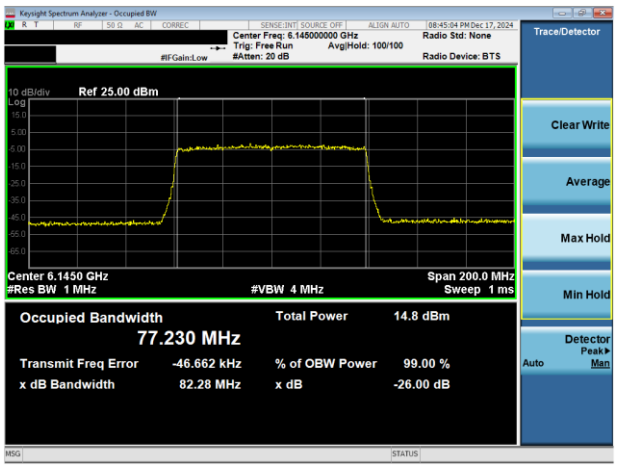
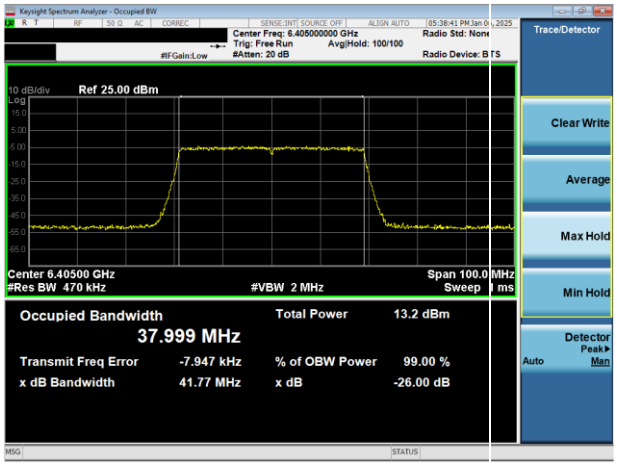


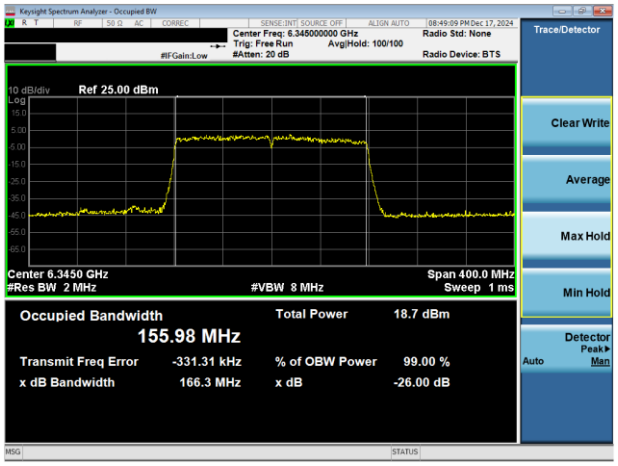
Plot 7-1. 26dB & 99% Bandwidth Plot Antenna WF8 (20MHz 802.11ax (UNII Band 5) – Ch. 61)



Plot 7-3. 26dB & 99% Bandwidth Plot Antenna WF8 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



Plot 7-2. 26dB & 99% Bandwidth Plot Antenna WF8 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



Plot 7-4. 26dB & 99% Bandwidth Plot Antenna WF8 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

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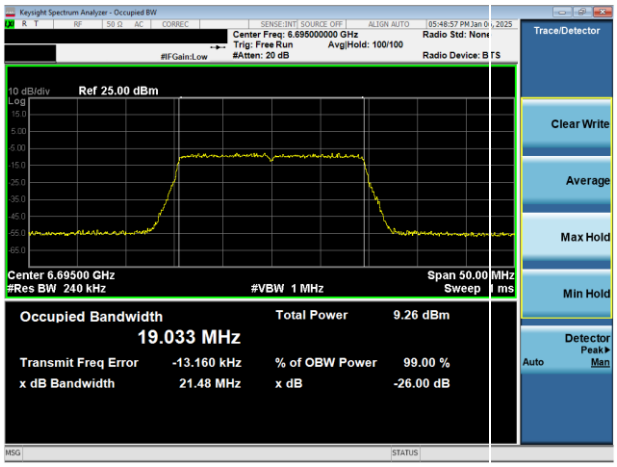
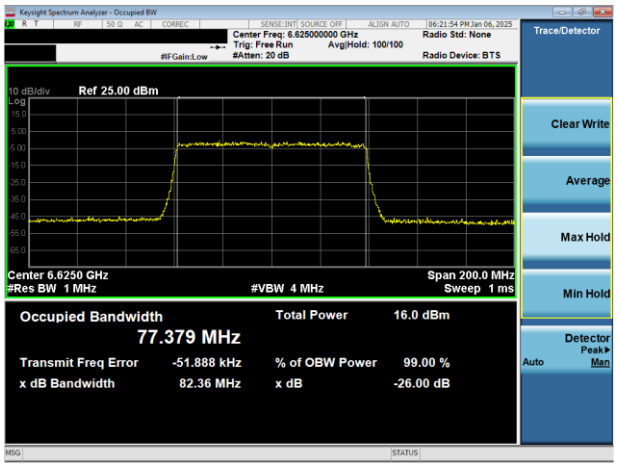
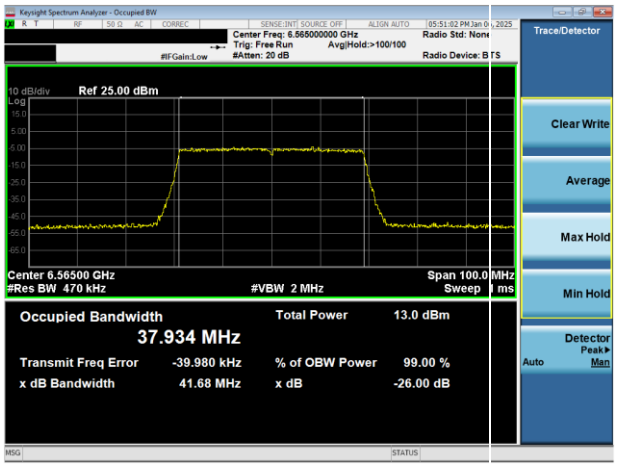


Plot 7-5. 26dB & 99% Bandwidth Plot Antenna WF8 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



Plot 7-7. 26dB & 99% Bandwidth Plot Antenna WF8 (80MHz 802.11ax (UNII Band 7) – Ch. 135)



Plot 7-6. 26dB & 99% Bandwidth Plot Antenna WF8 (40MHz 802.11ax (UNII Band 7) – Ch. 123)

Plot 7-8. 26dB & 99% Bandwidth Plot Antenna WF8 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.2.2 Antenna WF7a 26dB & 99% Bandwidth Measurements – VLP

	Frequency [MHz]	Channel	802.11 MODE	Data Rate [MHz]	Measured 99% Occupied Bandwidth	Measured 26dB Bandwidth	Maximum Bandwidth Limit [MHz]	Pass / Fail
Band 5	6115	33	a	12.00	16.78	21.05	320	Pass
	6255	61	a	12.00	16.76	21.11	320	Pass
	6415	93	a	12.00	16.73	21.07	320	Pass
	6115	33	ax (20MHz)	135/143.4 (MCS11)	19.04	21.41	320	Pass
	6255	61	ax (20MHz)	24/25.8 (MCS2)	19.08	21.38	320	Pass
	6415	93	ax (20MHz)	24/25.8 (MCS2)	19.08	21.37	320	Pass
	6125	35	ax (40MHz)	49/51.6 (MCS2)	37.92	41.48	320	Pass
	6245	59	ax (40MHz)	49/51.6 (MCS2)	37.99	41.56	320	Pass
	6405	91	ax (40MHz)	98/103.2 (MCS4)	37.97	41.55	320	Pass
	6145	39	ax (80MHz)	102/108.1 (MCS2)	77.13	82.31	320	Pass
	6225	55	ax (80MHz)	102/108.1 (MCS2)	77.18	82.34	320	Pass
	6385	87	ax (80MHz)	102/108.1 (MCS2)	77.35	82.18	320	Pass
	6185	47	ax (160MHz)	1020.8/1201 (MCS11)	156.12	165.70	320	Pass
	6345	79	ax (160MHz)	1020.8/1201 (MCS11)	156.33	165.74	320	Pass
Band 7	6535	117	a	12.00	16.76	21.04	320	Pass
	6695	149	a	12.00	16.74	21.02	320	Pass
	6855	181	a	12.00	16.75	21.05	320	Pass
	6535	117	ax (20MHz)	49/51.6 (MCS4)	19.03	21.41	320	Pass
	6695	149	ax (20MHz)	135/143.4 (MCS11)	19.09	21.33	320	Pass
	6855	181	ax (20MHz)	49/51.6 (MCS4)	19.04	21.30	320	Pass
	6565	123	ax (40MHz)	98/103.2 (MCS4)	37.92	41.50	320	Pass
	6725	155	ax (40MHz)	49/51.6 (MCS2)	37.98	41.82	320	Pass
	6845	179	ax (40MHz)	49/51.6 (MCS2)	37.97	41.84	320	Pass
	6625	135	ax (80MHz)	102/108.1 (MCS2)	77.31	82.24	320	Pass
	6705	151	ax (80MHz)	204/216.2 (MCS4)	77.16	82.57	320	Pass
	6785	167	ax (80MHz)	102/108.1 (MCS2)	77.23	82.24	320	Pass
	6665	143	ax (160MHz)	1020.8/1201 (MCS11)	156.12	165.71	320	Pass

Table 7-3. Conducted Bandwidth Measurements Antenna WF7a

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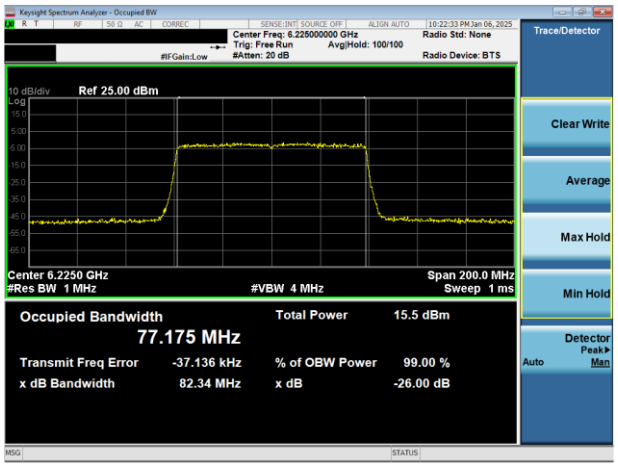
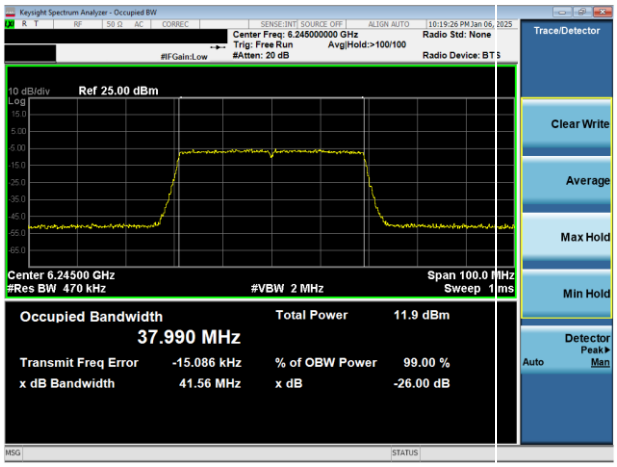
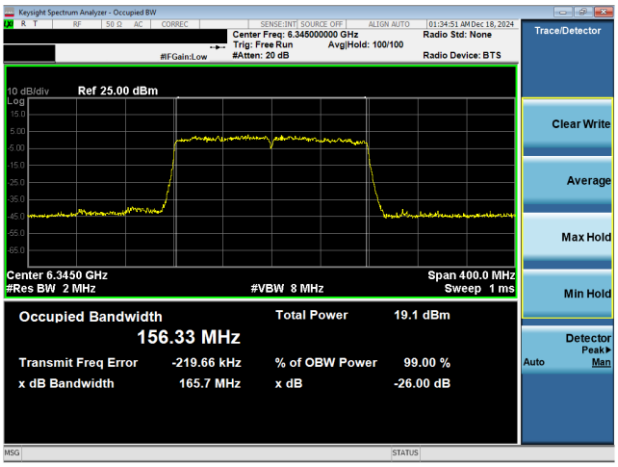
Plot 7-9. 26dB & 99% Bandwidth Plot Antenna WF7a (20MHz 802.11ax (UNII Band 5) – Ch. 33)



Plot 7-11. 26dB & 99% Bandwidth Plot Antenna WF7a (80MHz 802.11ax (UNII Band 5) – Ch. 55)



Plot 7-10. 26dB & 99% Bandwidth Plot Antenna WF7a (40MHz 802.11ax (UNII Band 5) – Ch. 59)



Plot 7-12. 26dB & 99% Bandwidth Plot Antenna WF7a (160MHz 802.11ax (UNII Band 5) – Ch. 79)

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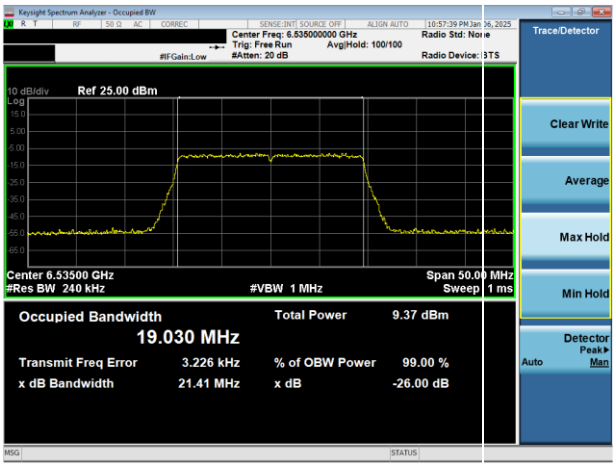
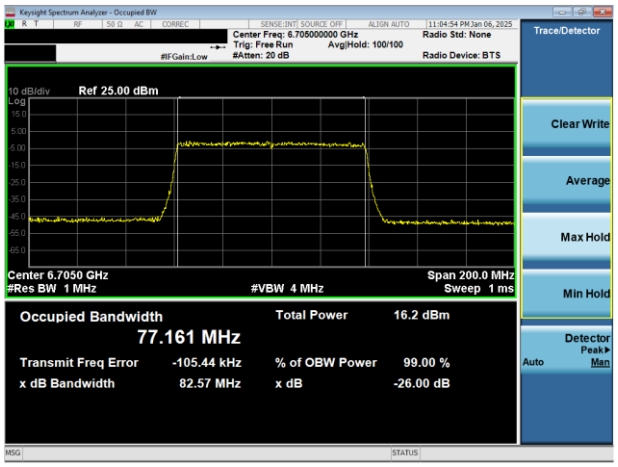
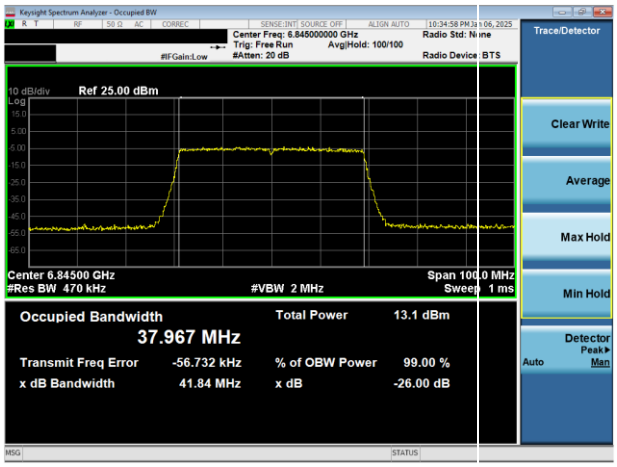


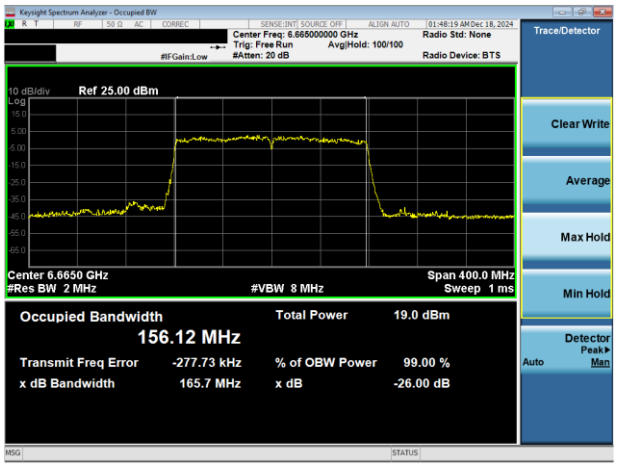
Plot 7-13. 26dB & 99% Bandwidth Plot Antenna WF7a (20MHz 802.11ax (UNII Band 7) – Ch. 117)



Plot 7-15. 26dB & 99% Bandwidth Plot Antenna WF7a (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-14. 26dB & 99% Bandwidth Plot Antenna WF7a (40MHz 802.11ax (UNII Band 7) – Ch. 179)



Plot 7-16. 26dB & 99% Bandwidth Plot Antenna WF7a (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.3 Conducted Output Power and Max EIRP Measurement

§15.407(a)(9), RSS-248[4.5.6]

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 C63.10-2020 and KDB 789033 D02 v02r01, and at the appropriate frequencies.

In the 5.925 – 7.125GHz band, the maximum e.i.r.p. over the frequency band of operation must not exceed 14dBm for Very Low Power (VLP) devices.

Test Procedure Used

ANSI C63.10-2020 – Section 12.4.3.2 Method PM-G
KDB 789033 D02 v02r01 – Section E)3)b) Method PM-G
ANSI C63.10-2020 – Section 14.4 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 7-2. Test Instrument & Measurement Setup

Test Notes

None.

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7.3.1 Antenna WF8 Conducted Output Power Measurements – VLP

6GHz (20MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]		Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
				802.11a	802.11ax				
	6115	33	AVG	-0.43	0.27	4.30	4.57	14.00	-9.43
	6255	61	AVG	-0.16	0.17	4.30	4.47	14.00	-9.53
	6415	93	AVG	0.78	1.17	4.30	5.47	14.00	-8.53
	6535	117	AVG	0.58	1.46	2.10	3.56	14.00	-10.44
	6695	149	AVG	0.72	1.14	2.10	3.24	14.00	-10.76
	6855	181	AVG	0.94	1.28	2.10	3.38	14.00	-10.62

Table 7-4. Antenna WF8 20MHz BW 802.11a/ax(SU) (UNII) Maximum Conducted Output Power

6GHz (40MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6125	35	AVG	3.24	4.30	7.54	14.00	-6.46
	6245	59	AVG	3.36	4.30	7.66	14.00	-6.34
	6405	91	AVG	4.39	4.30	8.69	14.00	-5.31
	6565	123	AVG	4.20	2.10	6.30	14.00	-7.70
	6725	155	AVG	4.41	2.10	6.51	14.00	-7.49
	6845	179	AVG	4.17	2.10	6.27	14.00	-7.73

Table 7-5. Antenna WF8 40MHz 802.11ax(SU) BW (UNII) Maximum Conducted Output Power

6GHz (80MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6145	39	AVG	5.74	4.30	10.04	14.00	-3.96
	6225	55	AVG	5.69	4.30	9.99	14.00	-4.01
	6385	87	AVG	6.68	4.30	10.98	14.00	-3.02
	6625	135	AVG	6.84	2.10	8.94	14.00	-5.06
	6705	151	AVG	6.93	2.10	9.03	14.00	-4.97
	6785	167	AVG	6.98	2.10	9.08	14.00	-4.92

Table 7-6. Antenna WF8 80MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

6GHz (160MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6185	47	AVG	8.23	4.30	12.53	14.00	-1.47
	6345	79	AVG	9.30	4.30	13.60	14.00	-0.40
	6665	143	AVG	9.31	2.10	11.41	14.00	-2.59

Table 7-7. Antenna WF8 160MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

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7.3.2 Antenna WF7a Conducted Output Power Measurements – VLP

6GHz (20MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]		Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
				802.11a	802.11ax				
	6115	33	AVG	-0.15	0.21	3.50	3.71	14.00	-10.29
	6255	61	AVG	-0.26	0.02	3.50	3.52	14.00	-10.49
	6415	93	AVG	0.96	1.37	3.50	4.87	14.00	-9.13
	6535	117	AVG	0.85	1.37	3.30	4.67	14.00	-9.33
	6695	149	AVG	0.95	1.31	3.30	4.61	14.00	-9.39
	6855	181	AVG	0.85	1.12	3.30	4.42	14.00	-9.59

Table 7-8. Antenna WF7a 20MHz BW 802.11a/ax(SU) (UNII) Maximum Conducted Output Power

6GHz (40MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6125	35	AVG	3.19	3.50	6.69	14.00	-7.31
	6245	59	AVG	3.40	3.50	6.90	14.00	-7.10
	6405	91	AVG	4.31	3.50	7.81	14.00	-6.19
	6565	123	AVG	4.40	3.30	7.70	14.00	-6.30
	6725	155	AVG	4.41	3.30	7.71	14.00	-6.29
	6845	179	AVG	4.40	3.30	7.70	14.00	-6.30

Table 7-9. Antenna WF7a 40MHz 802.11ax(SU) BW (UNII) Maximum Conducted Output Power

6GHz (80MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6145	39	AVG	5.83	3.50	9.33	14.00	-4.67
	6225	55	AVG	5.95	3.50	9.45	14.00	-4.56
	6385	87	AVG	6.72	3.50	10.22	14.00	-3.79
	6625	135	AVG	6.87	3.30	10.17	14.00	-3.83
	6705	151	AVG	6.83	3.30	10.13	14.00	-3.87
	6785	167	AVG	6.91	3.30	10.21	14.00	-3.79

Table 7-10. Antenna WF7a 80MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

6GHz (160MHz Bandwidth)	Frequency [MHz]	Channel	Detector	Conducted Power [dBm]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6185	47	AVG	8.35	3.50	11.85	14.00	-2.15
	6345	79	AVG	9.49	3.50	12.99	14.00	-1.01
	6665	143	AVG	9.31	3.30	12.61	14.00	-1.39

Table 7-11. Antenna WF7a 160MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

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7.3.3 SDM Conducted Output Power Measurements – VLP

6GHz (20MHz Bandwidth)	Frequency [MHz]	Channel	Mode	Detector	Conducted Power [dBm]			Directional 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				
	6115	33	SDM	AVG	-2.23	-2.12	0.84	3.92	4.76	14.00	-9.24
	6255	61	SDM	AVG	-2.00	-2.01	1.01	3.92	4.93	14.00	-9.07
	6415	93	SDM	AVG	-1.26	-1.02	1.87	3.92	5.79	14.00	-8.21
	6535	117	SDM	AVG	-0.92	-1.10	2.00	2.74	4.74	14.00	-9.26
	6695	149	SDM	AVG	-0.99	-0.93	2.05	2.74	4.79	14.00	-9.21
	6855	181	SDM	AVG	-0.85	-1.05	2.06	2.74	4.80	14.00	-9.20

Table 7-12. SDM 20MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

6GHz (40MHz Bandwidth)	Frequency [MHz]	Channel	Mode	Detector	Conducted Power [dBm]			Directional 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				
	6125	35	SDM	AVG	0.94	1.13	4.04	3.92	7.96	14.00	-6.04
	6245	59	SDM	AVG	1.06	1.08	4.08	3.92	8.00	14.00	-6.00
	6405	91	SDM	AVG	1.61	1.78	4.71	3.92	8.63	14.00	-5.37
	6565	123	SDM	AVG	2.08	1.92	5.01	2.74	7.75	14.00	-6.25
	6725	155	SDM	AVG	2.17	1.86	5.03	2.74	7.77	14.00	-6.23
	6845	179	SDM	AVG	2.15	1.85	5.01	2.74	7.75	14.00	-6.25

Table 7-13. SDM 40MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

6GHz (80MHz Bandwidth)	Frequency [MHz]	Channel	Mode	Detector	Conducted Power [dBm]			Directional 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				
	6145	39	SDM	AVG	3.54	3.56	6.56	3.92	10.48	14.00	-3.52
	6225	55	SDM	AVG	3.69	3.47	6.59	3.92	10.51	14.00	-3.49
	6385	87	SDM	AVG	4.33	4.35	7.35	3.92	11.27	14.00	-2.73
	6625	135	SDM	AVG	4.74	4.46	7.61	2.74	10.35	14.00	-3.65
	6705	151	SDM	AVG	4.60	4.46	7.54	2.74	10.28	14.00	-3.72
	6785	167	SDM	AVG	4.44	4.67	7.57	2.74	10.31	14.00	-3.69

Table 7-14. SDM 80MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

6GHz (160MHz Bandwidth)	Frequency [MHz]	Channel	Mode	Detector	Conducted Power [dBm]			Directional 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				
	6185	47	SDM	AVG	5.89	6.20	9.06	3.92	12.98	14.00	-1.02
	6345	79	SDM	AVG	6.75	6.93	9.85	3.92	13.77	14.00	-0.23
	6665	143	SDM	AVG	7.25	6.96	10.12	2.74	12.86	14.00	-1.14

Table 7-15. SDM 160MHz BW 802.11ax(SU) (UNII) Maximum Conducted Output Power

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Note:

Per ANSI C63.10-2020 and KDB 662911 v02r01 Section E)1), the conducted powers at Antenna WF8 and Antenna WF7a were first measured separately during SDM transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.10-2020 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.

$$\text{Directional gain} = G_{Ant} + \text{Array Gain dBi}$$

Per ANSI C63.10-2020 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.

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

Sample SDM Calculation:

At 6115MHz in 802.11ax (20MHz BW) mode, the average conducted output power was measured to be -1.91 dBm for Antenna WF8 and -2.12 dBm for Antenna WF7a.

Antenna WF8 + Antenna WF7a = SDM

(-2.23 dBm + -2.12 dBm) = (0.598 mW + 0.614 mW) = 1.212 mW = 0.84 dBm

Sample e.i.r.p. Calculation:

At 6115MHz in 802.11ax (20MHz BW) mode, the average MIMO conducted power was calculated to be 1 dBm with directional gain of 3.92 dBi.

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

0.84 dBm + 3.92 dBi = 4.76 dBm

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7.4 Maximum Power Spectral Density

§15.407(a)(9), RSS-248 [4.5.6]

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 C63.10-2020 and KDB 789033 D02 v02r01, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2020 and KDB 789033 D02 v02r01, was used to measure the power spectral density.

In the 5.925 – 6.425GHz & 6.525 – 6875GHz bands, the maximum permissible power spectral density must not exceed -5dBm e.i.r.p. in any 1-megahertz band for Very Low Power operating modes.

Test Procedure Used

ANSI C63.10-2020 – Section 12.4.2.2
KDB 789033 D02 v02r01 – Section F
ANSI C63.10-2020 – Section 14.5.2.2 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. Set span to encompass the entire 99% OBW of the signal
3. RBW = 1MHz
4. VBW = 3MHz
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.

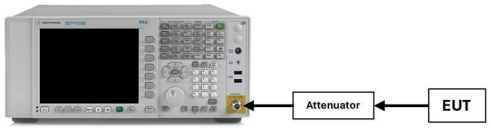

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

1. "All data rates have been investigated, and tabular data has been reported. Only the worst-case plot per bandwidth was reported.

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7.4.1 Antenna WF8 Power Spectral Density Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p Density [dBm/MHz]	Max EIRP Density [dBm/MHz]	Margin [dB]
Band 5	6115	33	a	12	-10.22	4.30	-5.92	-5	-0.92
	6255	61	a	12	-11.21	4.30	-6.91	-5	-1.91
	6415	93	a	12	-10.13	4.30	-5.83	-5	-0.83
	6115	33	ax (20MHz)	24/25.8 (MCS2)	-10.76	4.30	-6.46	-5	-1.46
	6255	61	ax (20MHz)	24/25.8 (MCS2)	-10.82	4.30	-6.52	-5	-1.52
	6415	93	ax (20MHz)	24/25.8 (MCS2)	-10.10	4.30	-5.80	-5	-0.80
	6125	35	ax (40MHz)	49/51.6 (MCS2)	-11.19	4.30	-6.89	-5	-1.89
	6245	59	ax (40MHz)	49/51.6 (MCS2)	-11.01	4.30	-6.71	-5	-1.71
	6405	91	ax (40MHz)	98/103.2 (MCS4)	-9.90	4.30	-5.60	-5	-0.60
	6145	39	ax (80MHz)	102/108.1 (MCS2)	-11.45	4.30	-7.15	-5	-2.15
	6225	55	ax (80MHz)	204/216.2 (MCS4)	-11.22	4.30	-6.92	-5	-1.92
	6385	87	ax (80MHz)	102/108.1 (MCS2)	-10.21	4.30	-5.91	-5	-0.91
	6185	47	ax (160MHz)	367.5/432.4 (MCS4)	-11.40	4.30	-7.10	-5	-2.10
	6345	79	ax (160MHz)	367.5/432.4 (MCS4)	-10.57	4.30	-6.27	-5	-1.27
Band 7	6535	117	a	24	-9.99	2.10	-7.89	-5	-2.89
	6695	149	a	24	-9.81	2.10	-7.71	-5	-2.71
	6855	181	a	24	-9.93	2.10	-7.83	-5	-2.83
	6535	117	ax (20MHz)	24/25.8 (MCS2)	-9.77	2.10	-7.67	-5	-2.67
	6695	149	ax (20MHz)	49/51.6 (MCS4)	-9.58	2.10	-7.48	-5	-2.48
	6855	181	ax (20MHz)	49/51.6 (MCS2)	-9.94	2.10	-7.84	-5	-2.84
	6565	123	ax (40MHz)	98/103.2 (MCS4)	-10.03	2.10	-7.93	-5	-2.93
	6725	155	ax (40MHz)	98/103.2 (MCS4)	-9.87	2.10	-7.77	-5	-2.77
	6845	179	ax (40MHz)	98/103.2 (MCS4)	-9.80	2.10	-7.70	-5	-2.70
	6625	135	ax (80MHz)	102/108.1 (MCS2)	-10.87	2.10	-8.77	-5	-3.77
	6705	151	ax (80MHz)	102/108.1 (MCS2)	-10.17	2.10	-8.07	-5	-3.07
	6785	167	ax (80MHz)	204/216.2 (MCS4)	-10.25	2.10	-8.15	-5	-3.15
	6665	143	ax (160MHz)	367.5/432.4 (MCS4)	-10.63	2.10	-8.53	-5	-3.53

Table 7-16. Power Spectral Density Measurements Antenna WF8

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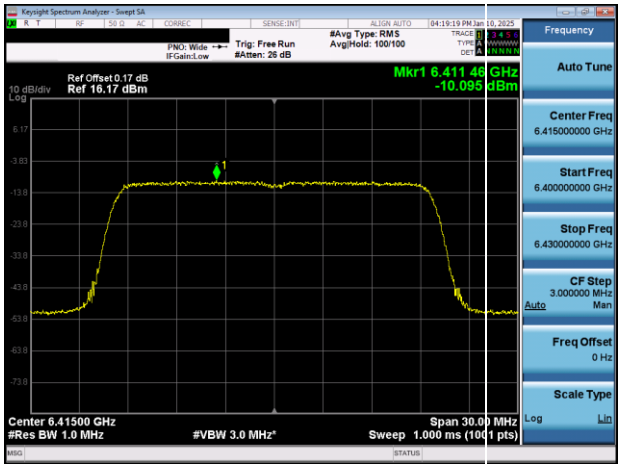
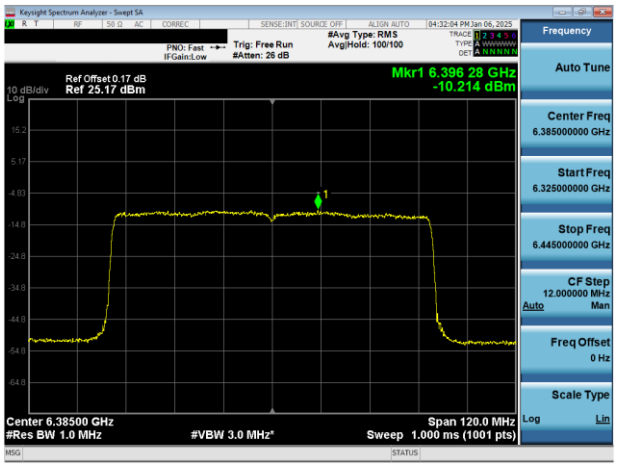
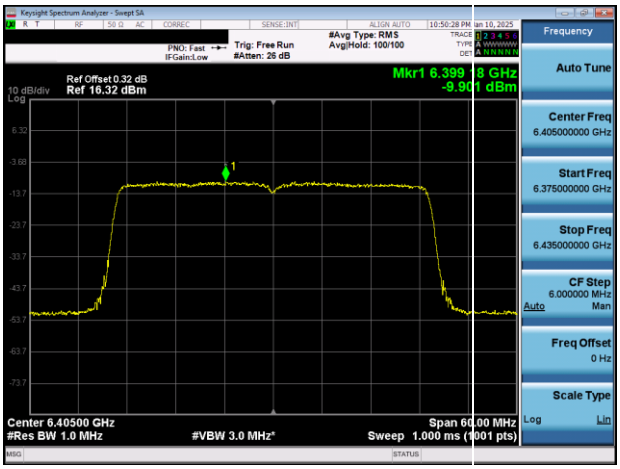


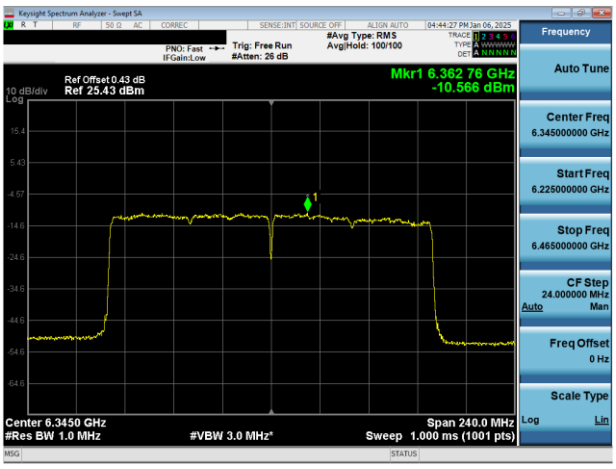
Plot 7-17. PSD Plot Antenna WF8 (20MHz 802.11ax (UNII Band 5) – Ch. 93)



Plot 7-19. PSD Plot Antenna WF8 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-18. PSD Plot Antenna WF8 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



Plot 7-20. PSD Plot Antenna WF8 (160MHz 802.11ax (UNII Band 5 – Ch. 79)

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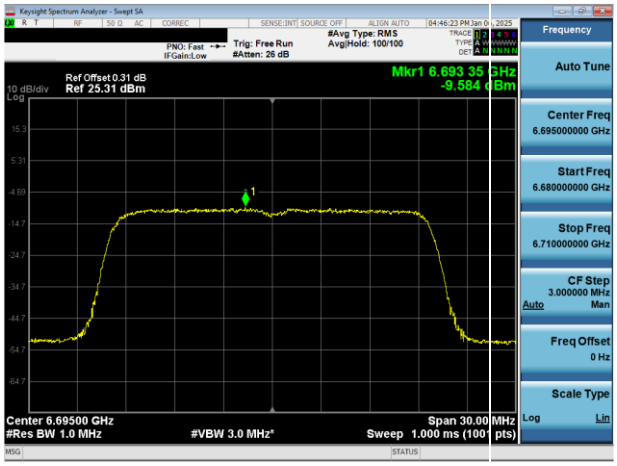
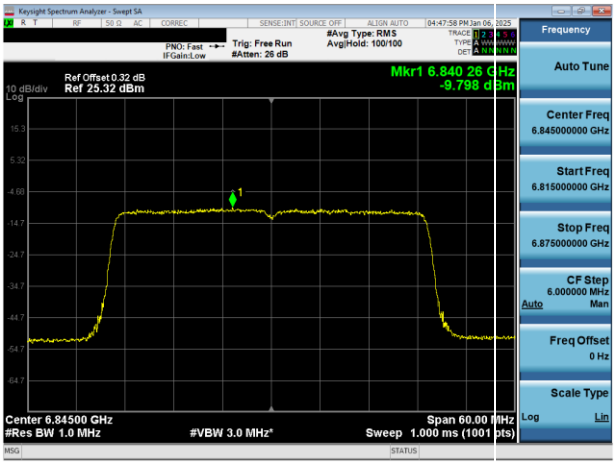
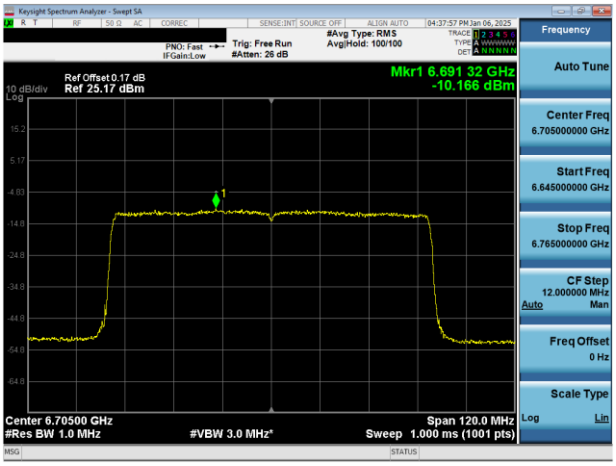


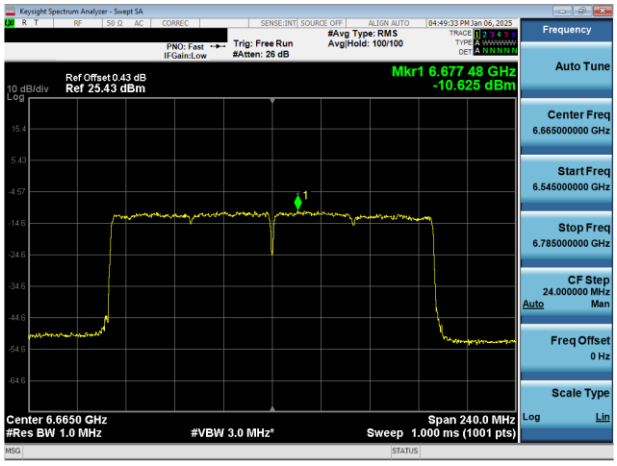
Plot 7-21. PSD Plot Antenna WF8 (20MHz 802.11a (UNII Band 7) – Ch. 149)



Plot 7-22. PSD Plot Antenna WF8 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



Plot 7-23. PSD Plot Antenna WF8 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-24. PSD Plot Antenna WF8 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.4.2 Antenna WF7a Power Spectral Density Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [MHz]	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p Density [dBm/MHz]	Max EIRP Density [dBm/MHz]	Margin [dB]
Band 5	6115	33	a	12	-11.08	3.50	-7.58	-5	-2.58
	6255	61	a	24	-10.78	3.50	-7.28	-5	-2.28
	6415	93	a	12	-10.23	3.50	-6.73	-5	-1.73
	6115	33	ax (20MHz)	49/51.6 (MCS4)	-11.24	3.50	-7.74	-5	-2.74
	6255	61	ax (20MHz)	24/25.8 (MCS2)	-11.00	3.50	-7.50	-5	-2.50
	6415	93	ax (20MHz)	49/51.6 (MCS4)	-10.33	3.50	-6.83	-5	-1.83
	6125	35	ax (40MHz)	49/51.6 (MCS2)	-11.18	3.50	-7.68	-5	-2.68
	6245	59	ax (40MHz)	98/103.2 (MCS4)	-10.92	3.50	-7.42	-5	-2.42
	6405	91	ax (40MHz)	49/51.6 (MCS2)	-9.93	3.50	-6.43	-5	-1.43
	6145	39	ax (80MHz)	204/216.2 (MCS4)	-11.26	3.50	-7.76	-5	-2.76
	6225	55	ax (80MHz)	204/216.2 (MCS4)	-11.32	3.50	-7.82	-5	-2.82
	6385	87	ax (80MHz)	204/216.2 (MCS4)	-9.89	3.50	-6.39	-5	-1.39
	6185	47	ax (160MHz)	1020.8/1201 (MCS11)	-11.51	3.50	-8.01	-5	-3.01
	6345	79	ax (160MHz)	1020.8/1201 (MCS11)	-10.57	3.50	-7.07	-5	-2.07
Band 7	6535	117	a	12	-10.14	3.30	-6.84	-5	-1.84
	6695	149	a	54	-9.34	3.30	-6.04	-5	-1.04
	6855	181	a	24	-10.11	3.30	-6.81	-5	-1.81
	6535	117	ax (20MHz)	49/51.6 (MCS4)	-9.94	3.30	-6.64	-5	-1.64
	6695	149	ax (20MHz)	135/143.4 (MCS11)	-9.11	3.30	-5.81	-5	-0.81
	6855	181	ax (20MHz)	24/25.8 (MCS2)	-10.15	3.30	-6.85	-5	-1.85
	6565	123	ax (40MHz)	49/51.6 (MCS2)	-9.59	3.30	-6.29	-5	-1.29
	6725	155	ax (40MHz)	98/103.2 (MCS4)	-9.79	3.30	-6.49	-5	-1.49
	6845	179	ax (40MHz)	98/103.2 (MCS4)	-9.48	3.30	-6.18	-5	-1.18
	6625	135	ax (80MHz)	204/216.2 (MCS4)	-10.69	3.30	-7.39	-5	-2.39
	6705	151	ax (80MHz)	102/108.1 (MCS2)	-10.37	3.30	-7.07	-5	-2.07
	6785	167	ax (80MHz)	102/108.1 (MCS2)	-10.23	3.30	-6.93	-5	-1.93
	6665	143	ax (160MHz)	367.5/432.4 (MCS4)	-10.87	3.30	-7.57	-5	-2.57

Table 7-17. Power Spectral Density Measurements Antenna WF7a

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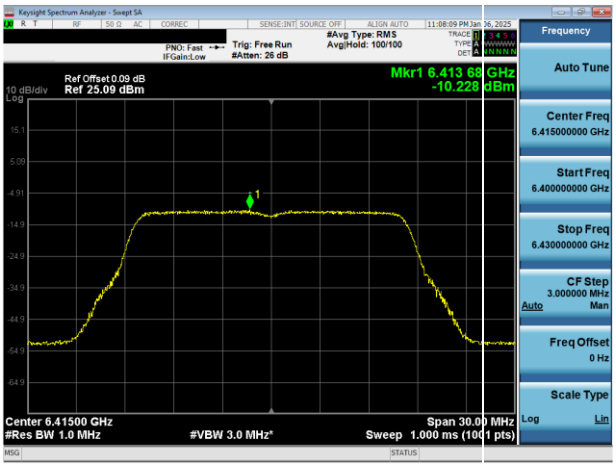
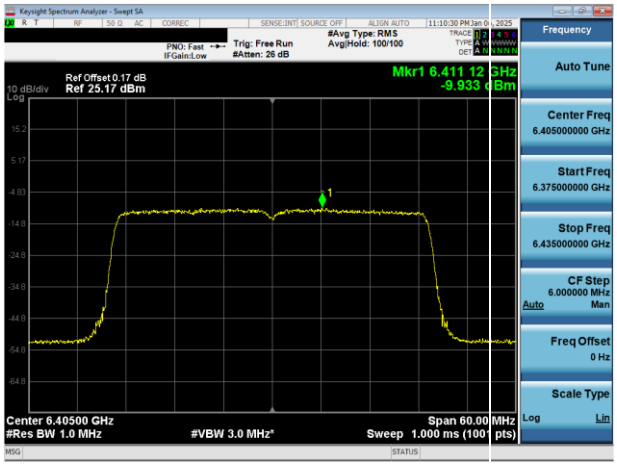
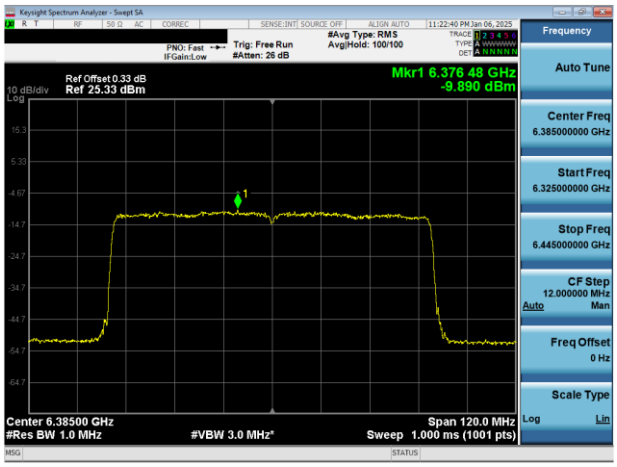


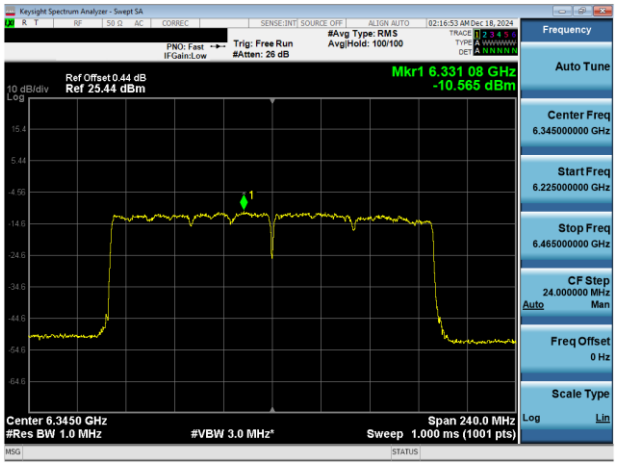
Plot 7-25. PSD Plot Antenna WF7a (20MHz 802.11a (UNII Band 5) – Ch. 93)



Plot 7-26. PSD Plot Antenna WF7a (40MHz 802.11ax (UNII Band 5) – Ch. 91)



Plot 7-27. PSD Plot Antenna WF7a (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-28. PSD Plot Antenna WF7a (160MHz 802.11ax (UNII Band 5) – Ch. 79)

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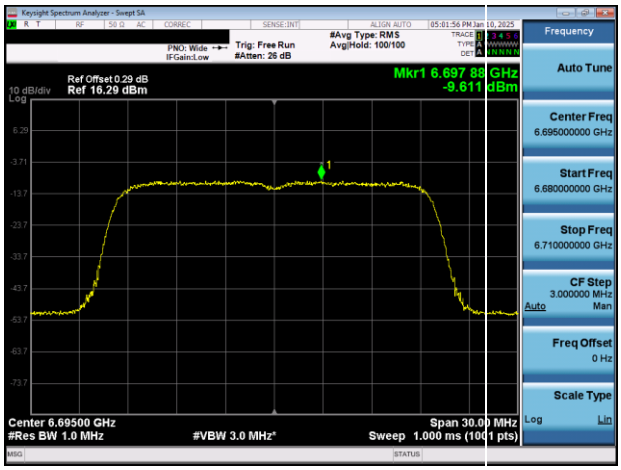
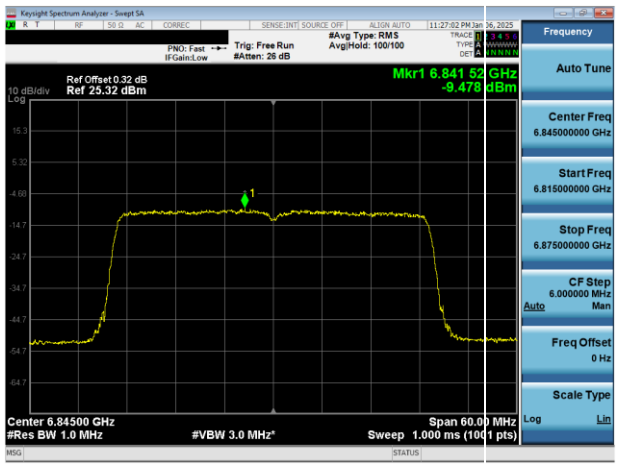
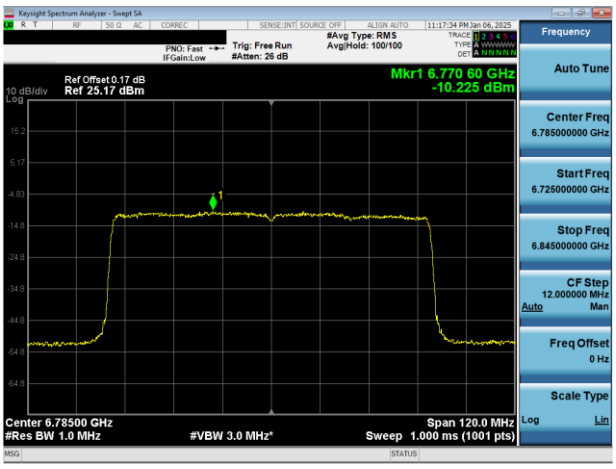


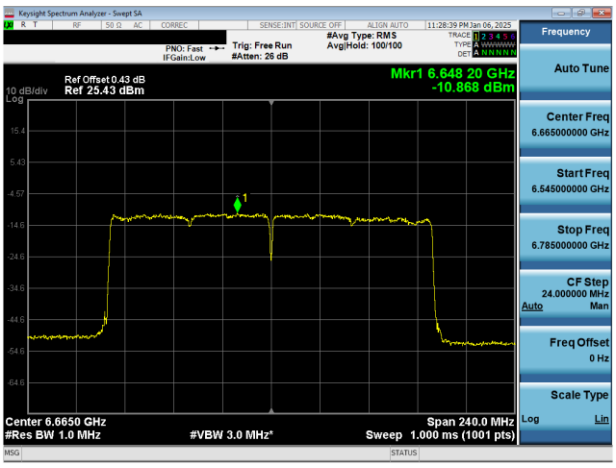
Plot 7-29. PSD Plot Antenna WF7a (20MHz 802.11ax (UNII Band 7) – Ch. 149)



Plot 7-30. PSD Plot Antenna WF7a (40MHz 802.11ax (UNII Band 7) – Ch. 179)



Plot 7-31. PSD Plot Antenna WF7a (80MHz 802.11ax (UNII Band 7) – Ch. 167)



Plot 7-32. PSD Plot Antenna WF7a (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.4.3 SDM Power Spectral Density Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [MHz]	Mode	Antenna WF8 Measured Power Density [dBm/MHz]	Antenna WF7a Measured Power Density [dBm/MHz]	Summed MIMO Power Density [dBm/MHz]	Directional Gain [dBi]	e.i.r.p Density [dBm/MHz]	Max EIRP Density [dBm/MHz]	Margin [dB]
Band 5	6115	33	ax (20MHz)	98/103.2 (MCS4)	SDM	-13.39	-13.48	-10.42	3.92	-6.50	-5	-1.50
	6255	61	ax (20MHz)	98/103.2 (MCS4)	SDM	-13.19	-12.56	-9.85	3.92	-5.93	-5	-0.93
	6415	93	ax (20MHz)	98/103.2 (MCS4)	SDM	-12.87	-12.80	-9.82	3.92	-5.91	-5	-0.91
	6125	35	ax (40MHz)	196/206.5 (MCS4)	SDM	-13.58	-13.19	-10.37	3.92	-6.45	-5	-1.45
	6245	59	ax (40MHz)	196/206.5 (MCS4)	SDM	-12.29	-12.95	-9.60	3.92	-5.68	-5	-0.68
	6405	91	ax (40MHz)	196/206.5 (MCS4)	SDM	-12.23	-13.06	-9.61	3.92	-5.69	-5	-0.69
	6145	39	ax (80MHz)	408/432.4 (MCS4)	SDM	-13.66	-13.50	-10.57	3.92	-6.65	-5	-1.65
	6225	55	ax (80MHz)	408/432.4 (MCS4)	SDM	-13.67	-13.33	-10.49	3.92	-6.57	-5	-1.57
	6385	87	ax (80MHz)	408/432.4 (MCS4)	SDM	-12.70	-12.90	-9.79	3.92	-5.87	-5	-0.87
	6185	47	ax (160MHz)	735/864.7 (MCS4)	SDM	-13.94	-13.99	-10.95	3.92	-7.04	-5	-2.04
	6345	79	ax (160MHz)	735/864.7 (MCS4)	SDM	-13.36	-13.27	-10.30	3.92	-6.39	-5	-1.39
Band 7	6535	117	ax (20MHz)	48/51.6 (MCS2)	SDM	-12.03	-11.91	-8.96	2.74	-6.22	-5	-1.22
	6695	149	ax (20MHz)	48/51.6 (MCS2)	SDM	-12.50	-10.98	-8.66	2.74	-5.92	-5	-0.92
	6855	181	ax (20MHz)	98/103.2 (MCS4)	SDM	-11.93	-11.82	-8.86	2.74	-6.12	-5	-1.12
	6565	123	ax (40MHz)	196/206.5 (MCS4)	SDM	-11.79	-11.90	-8.83	2.74	-6.09	-5	-1.09
	6725	155	ax (40MHz)	196/206.5 (MCS4)	SDM	-11.88	-11.46	-8.65	2.74	-5.91	-5	-0.91
	6845	179	ax (40MHz)	196/206.5 (MCS4)	SDM	-11.74	-11.83	-8.77	2.74	-6.03	-5	-1.03
	6625	135	ax (80MHz)	408/432.4 (MCS4)	SDM	-13.01	-13.27	-10.13	2.74	-7.39	-5	-2.39
	6705	151	ax (80MHz)	408/432.4 (MCS4)	SDM	-12.47	-12.19	-9.32	2.74	-6.58	-5	-1.58
	6785	167	ax (80MHz)	408/432.4 (MCS4)	SDM	-12.42	-11.95	-9.17	2.74	-6.43	-5	-1.43
	6665	143	ax (160MHz)	735/864.7 (MCS4)	SDM	-13.07	-13.05	-10.05	2.74	-7.31	-5	-2.31

Table 7-18. Power Spectral Density Measurements SDM

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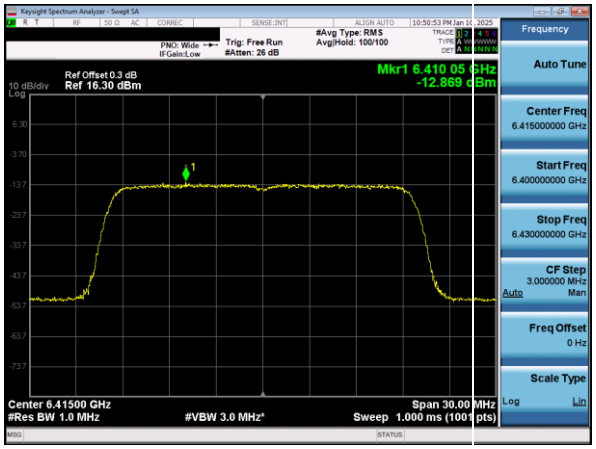
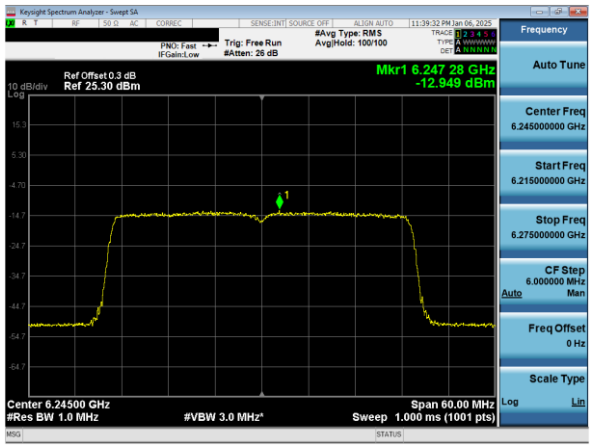
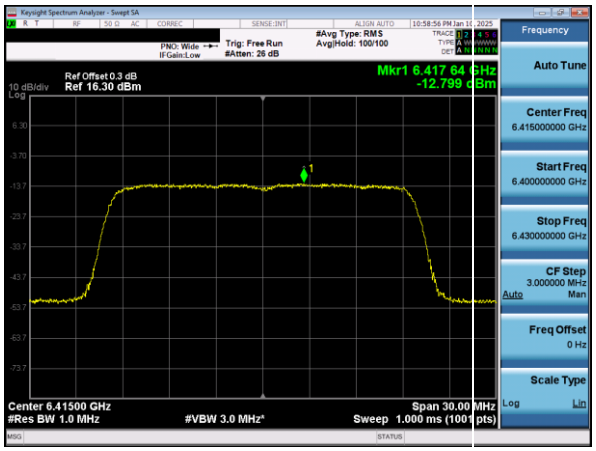


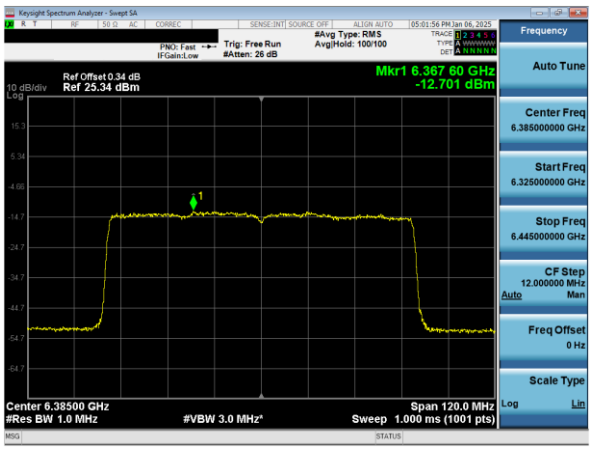
Plot 7-33. Power Spectral Density Plot SDM Antenna WF8 (20MHz 802.11ax (UNII Band 5) – Ch.93)



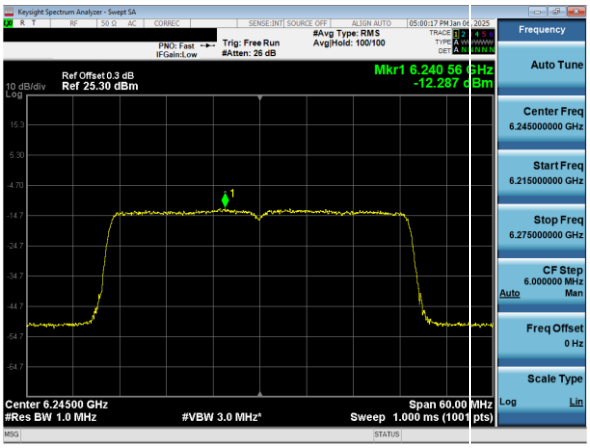
Plot 7-36. Power Spectral Density Plot SDM Antenna WF7a (40MHz 802.11ax (UNII Band 5) – Ch. 59)



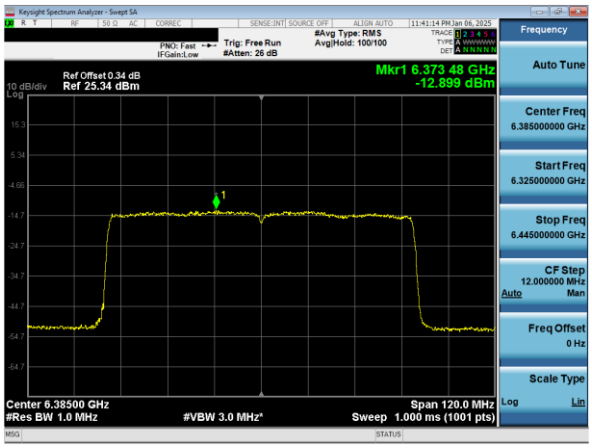
Plot 7-34. Power Spectral Density Plot SDM Antenna WF7a (20MHz 802.11ax (UNII Band 5) – Ch.93)



Plot 7-37. Power Spectral Density Plot SDM Antenna WF8 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-35. Power Spectral Density Plot SDM Antenna WF8 (40MHz 802.11ax (UNII Band 5) – Ch. 59)



Plot 7-38. Power Spectral Density Plot SDM Antenna WF7a (80MHz 802.11ax (UNII Band 5) – Ch. 87

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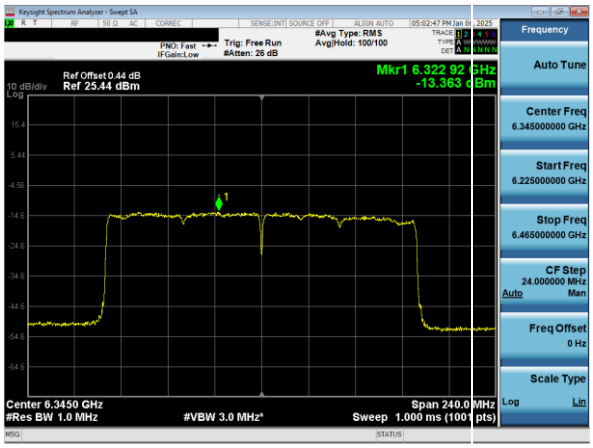
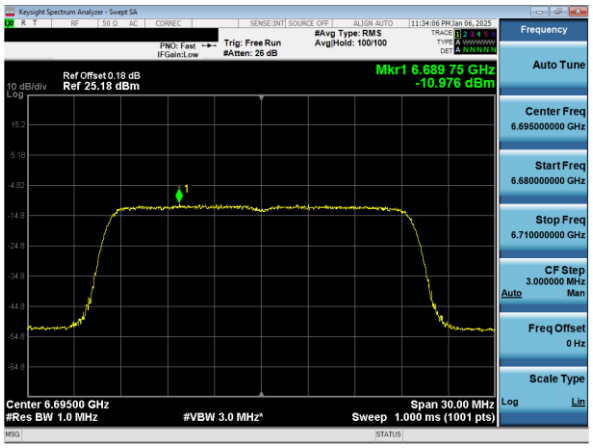
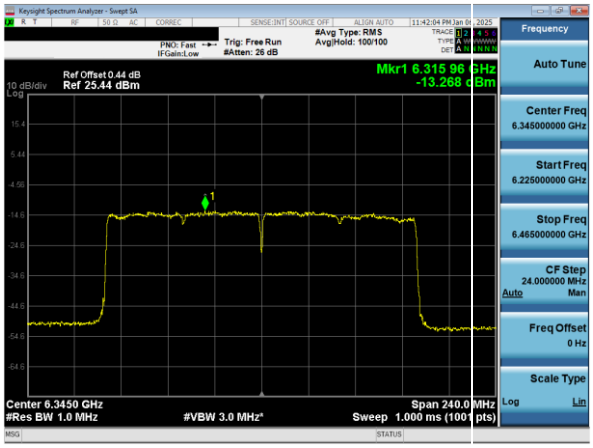


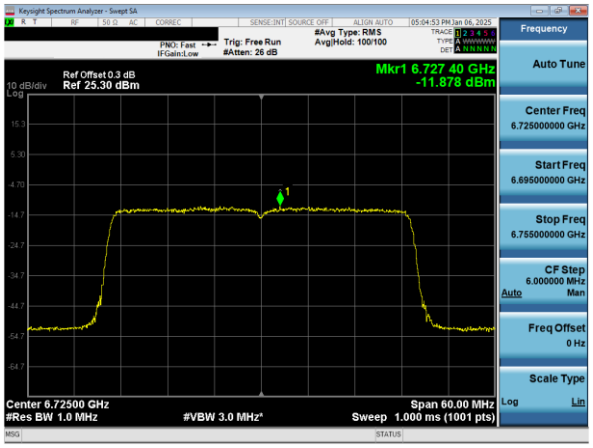
Plot 7-39. Power Spectral Density Plot SDM Antenna WF8 (160MHz 802.11ax (UNII Band 5) – Ch. 79)



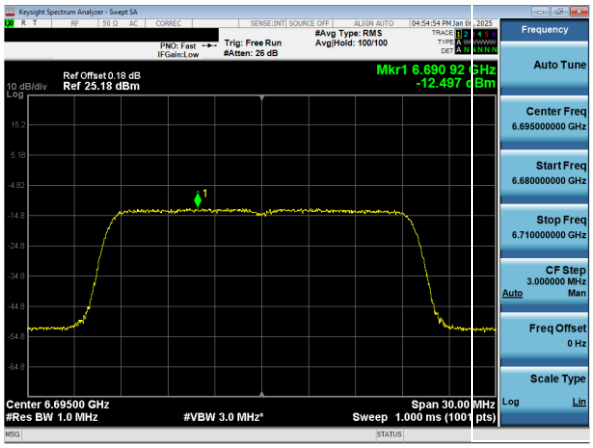
Plot 7-42. Power Spectral Density Plot SDM Antenna WF7a (20MHz 802.11ax (UNII Band 7) – Ch. 149)



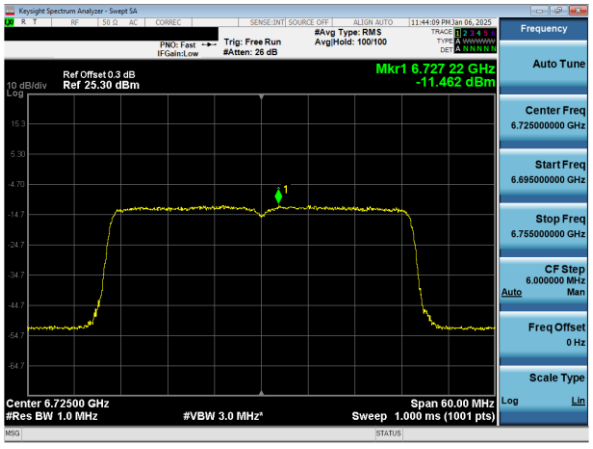
Plot 7-40. Power Spectral Density Plot SDM Antenna WF7a (160MHz 802.11ax (UNII Band 5) – Ch. 79)



Plot 7-43. Power Spectral Density Plot SDM Antenna WF8 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



Plot 7-41. Power Spectral Density Plot SDM Antenna WF8 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



Plot 7-44. Power Spectral Density Plot SDM Antenna WF7a (40MHz 802.11ax (UNII Band 7) – Ch. 155)

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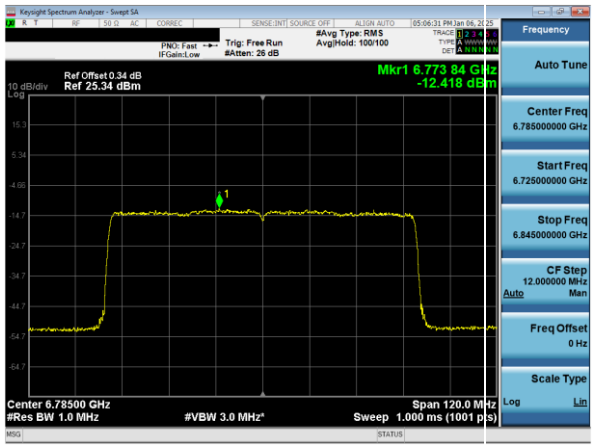
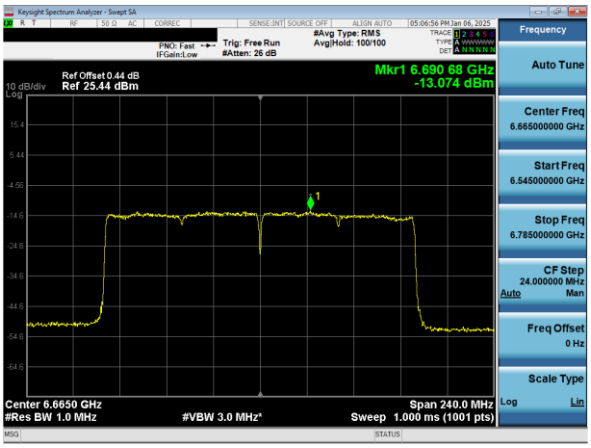
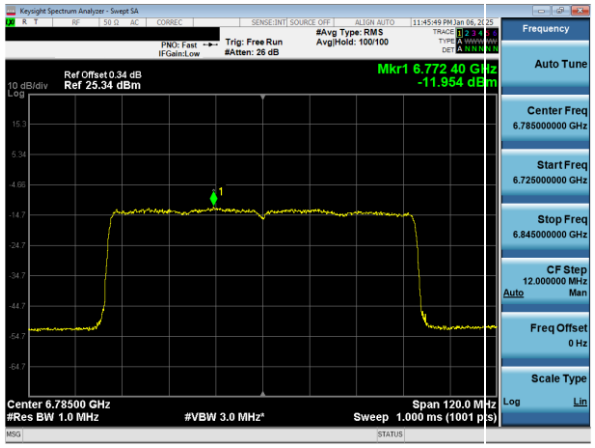


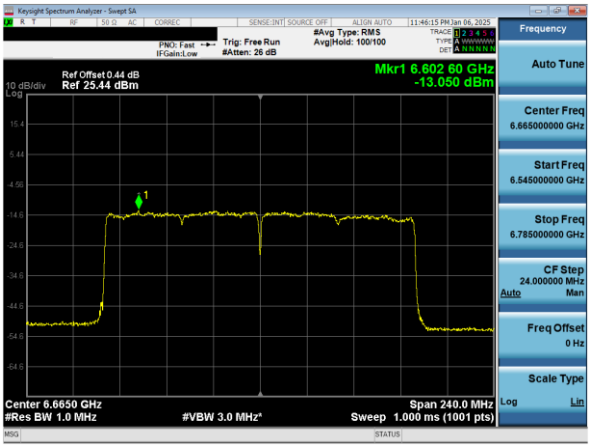
Plot 7-45. Power Spectral Density Plot SDM Antenna WF8 (80MHz 802.11ax (UNII Band 7) – Ch. 167)



Plot 7-47. Power Spectral Density Plot SDM Antenna WF8 (160MHz 802.11ax (UNII Band 7) – Ch. 143)



Plot 7-46. Power Spectral Density Plot SDM Antenna WF7a (80MHz 802.11ax (UNII Band 7) – Ch. 167)



Plot 7-48. Power Spectral Density Plot SDM Antenna WF7a (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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Note:

Per ANSI C63.10-2020 Section 14.5.2.2 and KDB 662911 v02r01 Section E)2), the power spectral density at Antenna WF8 and Antenna WF7a were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample Directional Gain Calculation:

For correlated signals, assuming the antenna gain is 4.30 dBi for Antenna WF8 and 3.50 dBi for Antenna WF7a.

$$\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \ldots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$
$$= 10 \log[(10^{1.80/20} + 10^{-0.20/20})^2 / 2] \text{ dBi}$$
$$= 6.92 \text{ dBi}$$

For uncorrelated signals, assuming the antenna gain is 4.30 dBi for Antenna WF8 and 3.50 dBi for Antenna WF7a.

$$\text{Directional gain} = 10 \log[(10^{G_1/10} + 10^{G_2/10} + \ldots + 10^{G_N/10}) / N_{ANT}] \text{ dBi}$$
$$= 10 \log[(10^{1.80/10} + 10^{-0.20/10} / 2] \text{ dBi}$$
$$= 3.92 \text{ dBi}$$

Sample SDM Primary Calculation:

At 6115MHz in 802.11ax (20MHz BW) mode, the average conducted power spectral density was measured to be -13.39 dBm for Antenna WF8 and -10.42 dBm for Antenna WF7a.

Antenna WF8 + Antenna WF7a = SDM Primary

(-13.39 dBm + -13.48 dBm) = (0.046 mW + 0.045 mW) = 0.091 mW = -10.42 dBm

Sample e.i.r.p Power Spectral Density Calculation:

At 6115MHz in 802.11ax (20MHz BW) mode, the average SDM Primary power density was calculated to be -10.42 dBm with directional gain of 3.92 dBi.

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

-10.42 dBm + 3.92 dBi = -6.50 dBm

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7.5 In-Band Emissions

§15.407(b)(7); RSS-248[4.6.2]

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 C63.10-2020 and KDB 789033 D02 v02r01, and at the appropriate frequencies.

For transmitters operating within the 5.925-7.125 GHz bands: Power spectral density must be suppressed by 20 dB at 1 MHz outside of channel edge, by 28 dB at one channel bandwidth from the channel center, and by 40 dB at one- and one-half times the channel bandwidth away from channel center. At frequencies between one megahertz outside an unlicensed device's channel edge and one channel bandwidth from the center of the channel, the limits must be linearly interpolated between 20 dB and 28 dB suppression, and at frequencies between one and one- and one-half times an unlicensed device's channel bandwidth, the limits must be linearly interpolated between 28 dB and 40 dB suppression. Emissions removed from the channel center by more than one- and one-half times the channel bandwidth must be suppressed by at least 40 dB.

Test Procedure Used

ANSI C63.10-2020 – Section 12.4.2.2
KDB 987594 D02 v03 – Section J

Test Settings

1. Connect output of the antenna port to a spectrum analyzer or EMI receiver, with appropriate attenuation, as to not damage the instrumentation.
2. Set the reference level of the measuring equipment in accordance with procedure 4.1.6.2 of ANSI C63.10-2020.
3. Measure the 26 dB EBW using the test procedure 12.4.1 of ANSI C63.10-2020. (This will be used to determine the channel edge.)
4. Measure the power spectral density (which will be used for emissions mask reference) using the following procedure:
    a) Set the span to encompass the entire 26 dB EBW of the signal.
    b) Set RBW = same RBW used for 26 dB EBW measurement.
    c) Set VBW ≥ 3 X RBW
    d) Number of points in sweep ≥ [2 X span / RBW].
    e) Sweep time = auto.
    f) Detector = RMS (i.e., power averaging)
    g) Trace average at least 100 traces in power averaging (rms) mode.
    h) Use the peak search function on the instrument to find the peak of the spectrum.
5. For the purposes of developing the emission mask, the channel bandwidth is defined as the 26 dB EBW.
6. Using the measuring equipment limit line function, develop the emissions mask based on the following requirements. The emissions power spectral density must be reduced below the peak power spectral density (in dB) as follows:
    i) Suppressed by 20 dB at 1 MHz outside of the channel edge. (The channel edge is defined as the 26-dB point on either side of the carrier center frequency.)
    j) Suppressed by 28 dB at one channel bandwidth from the channel center.
    k) Suppressed by 40 dB at one- and one-half times the channel bandwidth from the channel center.
7. Adjust the span to encompass the entire mask as necessary.
8. Clear trace.
9. Trace average at least 100 traces in power averaging (rms) mode.
10. Adjust the reference level as necessary so that the crest of the channel touches the top of the emission mask.

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Test Setup

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

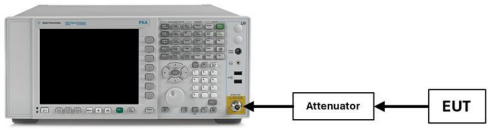

Figure 7-4. Test Instrument & Measurement Setup

Test Notes

1. Low, mid, and high channels were tested and only worst case channel plots have been reported.

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7.5.1 Antenna WF8 In-Band Emission Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna WF8 In-Band Emission
Band 5	6115	33	a	12	Pass
	6255	61	a	12	Pass
	6415	93	a	12	Pass
	6115	33	ax (20MHz)	24/25.8 (MCS2)	Pass
	6255	61	ax (20MHz)	24/25.8 (MCS2)	Pass
	6415	93	ax (20MHz)	24/25.8 (MCS2)	Pass
	6125	35	ax (40MHz)	49/51.6 (MCS2)	Pass
	6245	59	ax (40MHz)	49/51.6 (MCS2)	Pass
	6405	91	ax (40MHz)	98/103.2 (MCS4)	Pass
	6145	39	ax (80MHz)	102/108.1 (MCS2)	Pass
	6225	55	ax (80MHz)	204/216.2 (MCS4)	Pass
	6385	87	ax (80MHz)	102/108.1 (MCS2)	Pass
	6185	47	ax (160MHz)	367.5/432.4 (MCS4)	Pass
	6345	79	ax (160MHz)	367.5/432.4 (MCS4)	Pass
Band 7	6535	117	a	24	Pass
	6695	149	a	24	Pass
	6855	181	a	24	Pass
	6535	117	ax (20MHz)	24/25.8 (MCS2)	Pass
	6695	149	ax (20MHz)	49/51.6 (MCS4)	Pass
	6855	181	ax (20MHz)	49/51.6 (MCS2)	Pass
	6565	123	ax (40MHz)	98/103.2 (MCS4)	Pass
	6725	155	ax (40MHz)	98/103.2 (MCS4)	Pass
	6845	179	ax (40MHz)	98/103.2 (MCS4)	Pass
	6625	135	ax (80MHz)	102/108.1 (MCS2)	Pass
	6705	151	ax (80MHz)	102/108.1 (MCS2)	Pass
	6785	167	ax (80MHz)	204/216.2 (MCS4)	Pass
	6665	143	ax (160MHz)	367.5/432.4 (MCS4)	Pass

Table 7-19. In-Band Emission Measurements Antenna WF8

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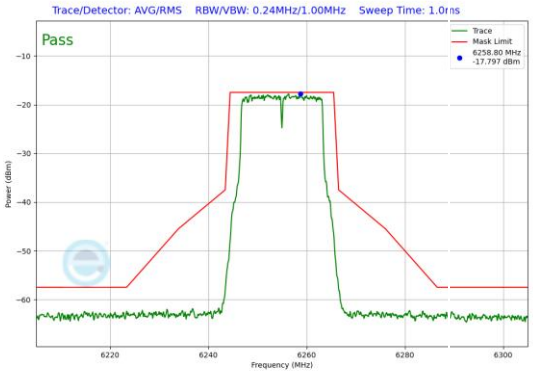
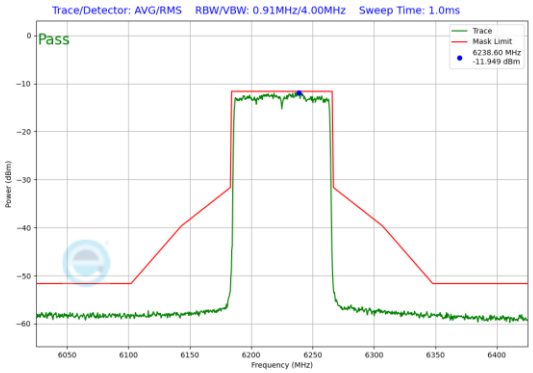
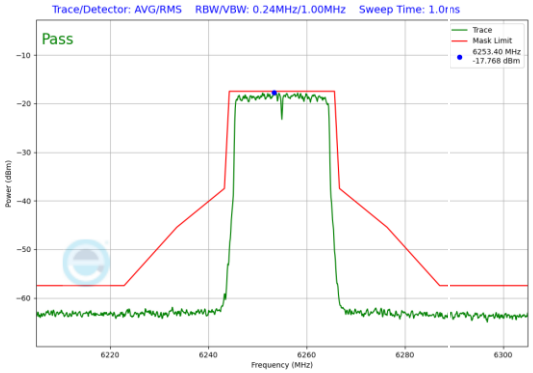


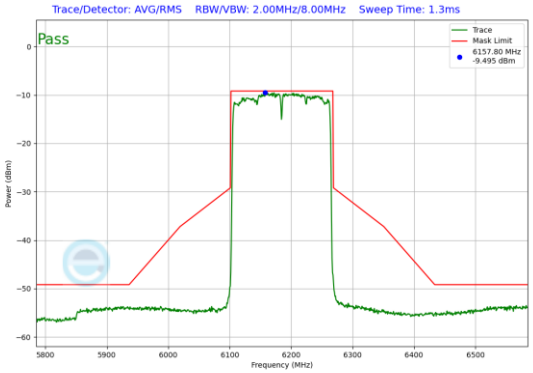
Plot 7-49. In-Band Emission Plot Antenna WF8 (20MHz 802.11a (UNII Band 5) – Ch. 61)



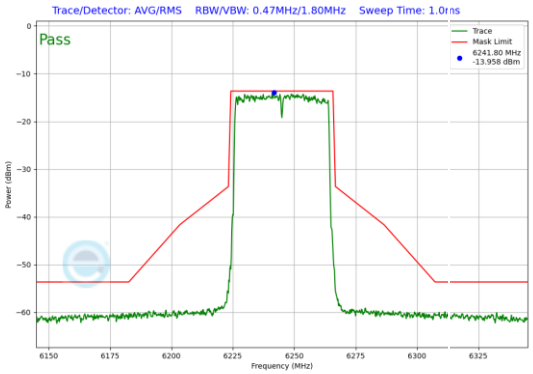
Plot 7-52. In-Band Emission Plot Antenna WF8 (80MHz 802.11ax (UNII Band 5) – Ch. 55)



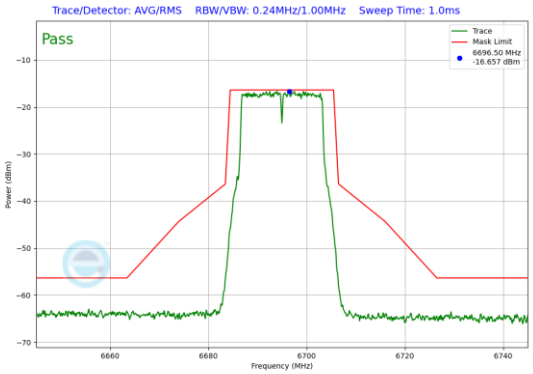
Plot 7-50. In-Band Emission Plot Antenna WF8 (20MHz 802.11ax (UNII Band 5) – Ch. 61)



Plot 7-53. In-Band Emission Plot Antenna WF8 (160MHz 802.11ax (UNII Band 5) – Ch. 47)



Plot 7-51. In-Band Emission Plot Antenna WF8 (40MHz 802.11ax (UNII Band 5) – Ch. 59)



Plot 7-54. In-Band Emission Plot Antenna WF8 (20MHz 802.11a (UNII Band 7) – Ch. 149)

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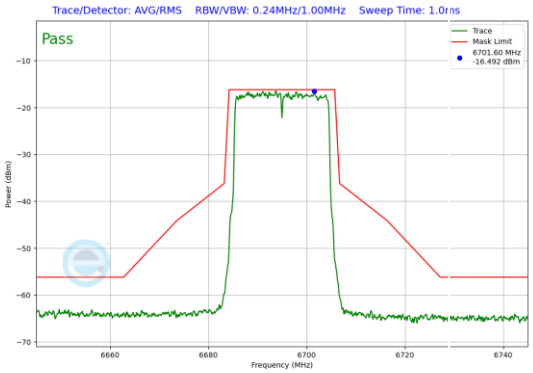
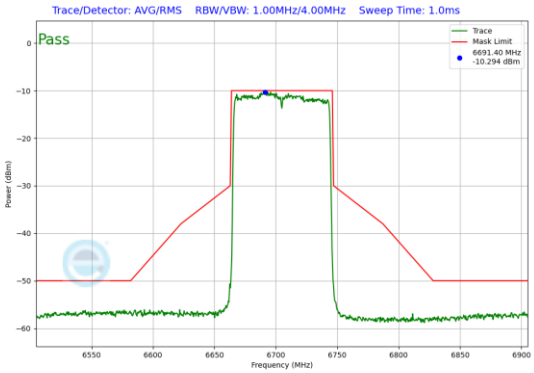
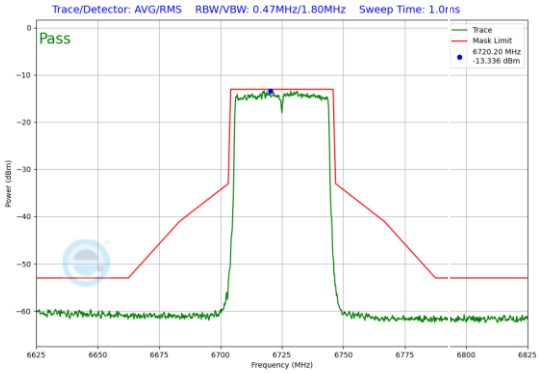


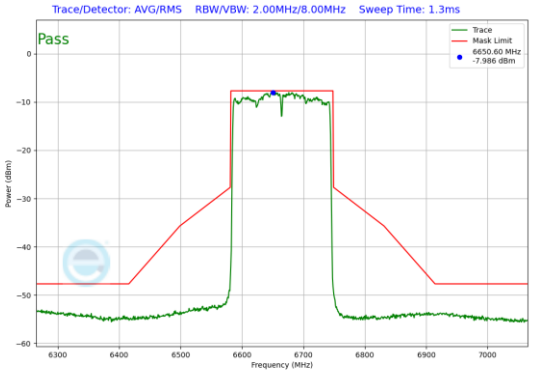
Plot 7-55. In-Band Emission Plot Antenna WF8 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



Plot 7-57. In-Band Emission Plot Antenna WF8 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-56. In-Band Emission Plot Antenna WF8 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



Plot 7-58. In-Band Emission Plot Antenna WF8 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.5.2 Antenna WF7a In-Band Emission Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [MHz]	Antenna WF7a In-Band Emission
Band 5	6115	33	a	12	Pass
	6255	61	a	24	Pass
	6415	93	a	12	Pass
	6115	33	ax (20MHz)	49/51.6 (MCS4)	Pass
	6255	61	ax (20MHz)	24/25.8 (MCS2)	Pass
	6415	93	ax (20MHz)	49/51.6 (MCS4)	Pass
	6125	35	ax (40MHz)	49/51.6 (MCS2)	Pass
	6245	59	ax (40MHz)	98/103.2 (MCS4)	Pass
	6405	91	ax (40MHz)	49/51.6 (MCS2)	Pass
	6145	39	ax (80MHz)	204/216.2 (MCS4)	Pass
	6225	55	ax (80MHz)	204/216.2 (MCS4)	Pass
	6385	87	ax (80MHz)	204/216.2 (MCS4)	Pass
	6185	47	ax (160MHz)	1020.8/1201 (MCS11)	Pass
	6345	79	ax (160MHz)	1020.8/1201 (MCS11)	Pass
Band 7	6535	117	a	54	Pass
	6695	149	a	54	Pass
	6855	181	a	54	Pass
	6535	117	ax (20MHz)	135/143.4 (MCS11)	Pass
	6695	149	ax (20MHz)	135/143.4 (MCS11)	Pass
	6855	181	ax (20MHz)	24/25.8 (MCS2)	Pass
	6565	123	ax (40MHz)	49/51.6 (MCS2)	Pass
	6725	155	ax (40MHz)	98/103.2 (MCS4)	Pass
	6845	179	ax (40MHz)	98/103.2 (MCS4)	Pass
	6625	135	ax (80MHz)	204/216.2 (MCS4)	Pass
	6705	151	ax (80MHz)	102/108.1 (MCS2)	Pass
	6785	167	ax (80MHz)	102/108.1 (MCS2)	Pass
	6665	143	ax (160MHz)	367.5/432.4 (MCS4)	Pass

Table 7-20. In-Band Emission Measurements Antenna WF7a

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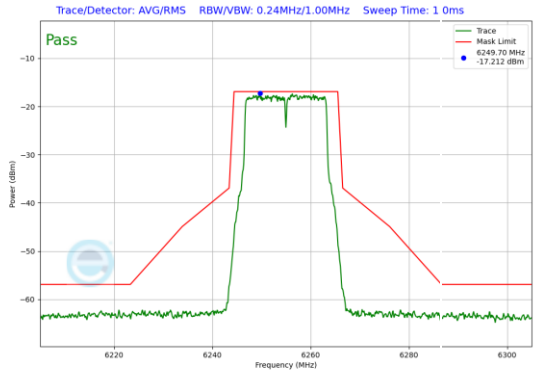
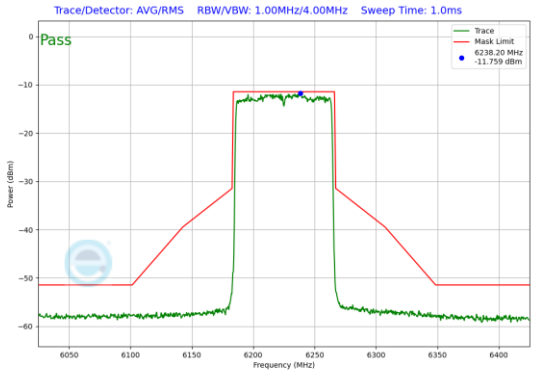
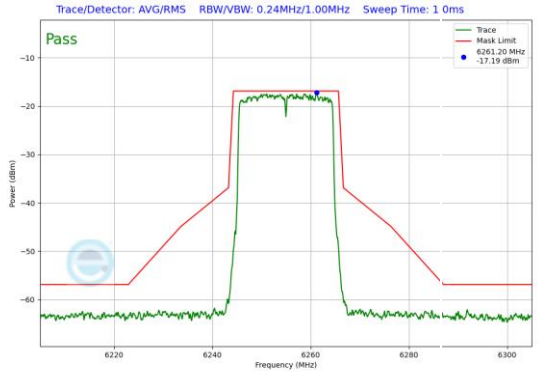


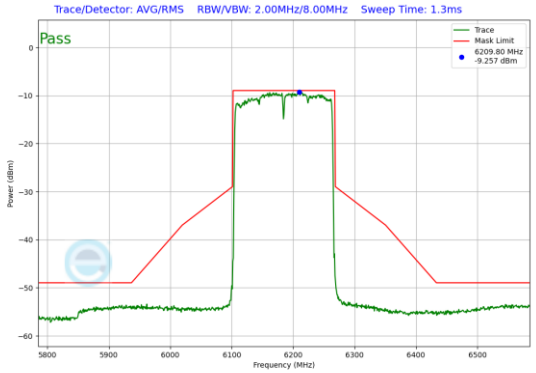
Plot 7-59. In-Band Emission Plot Antenna WF7a (20MHz 802.11a (UNII Band 5) – Ch. 61)



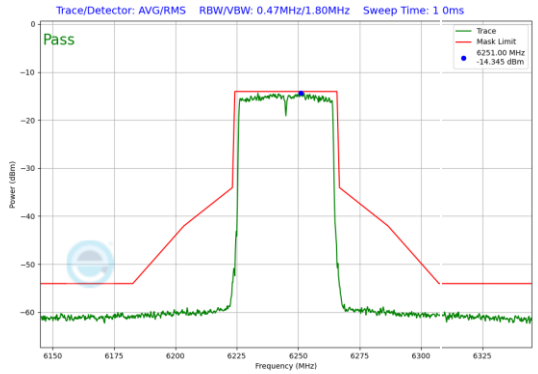
Plot 7-62. In-Band Emission Plot Antenna WF7a (80MHz 802.11ax (UNII Band 5) – Ch. 55)



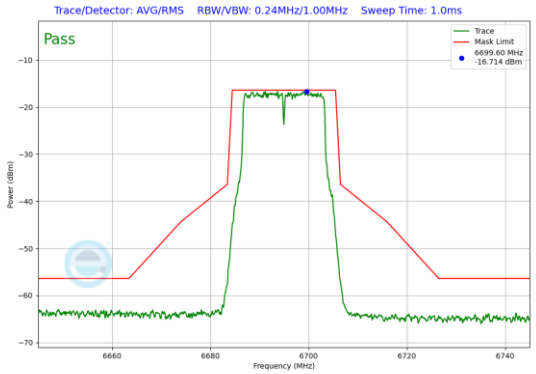
Plot 7-60. In-Band Emission Plot Antenna WF7a (20MHz 802.11ax (UNII Band 5) – Ch. 61)



Plot 7-63. In-Band Emission Plot Antenna WF7a (160MHz 802.11ax (UNII Band 5) – Ch. 47)



Plot 7-61. In-Band Emission Plot Antenna WF7a (40MHz 802.11ax (UNII Band 5) – Ch. 59)



Plot 7-64. In-Band Emission Plot Antenna WF7a (20MHz 802.11a (UNII Band 7) – Ch. 149)

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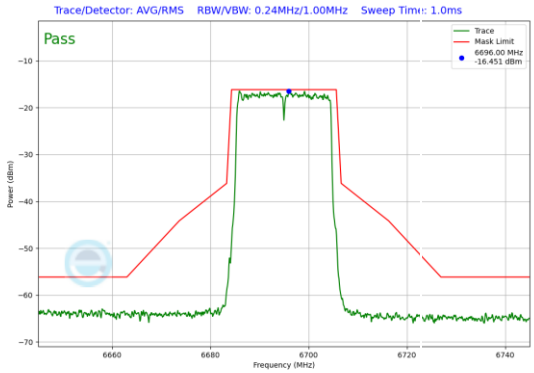
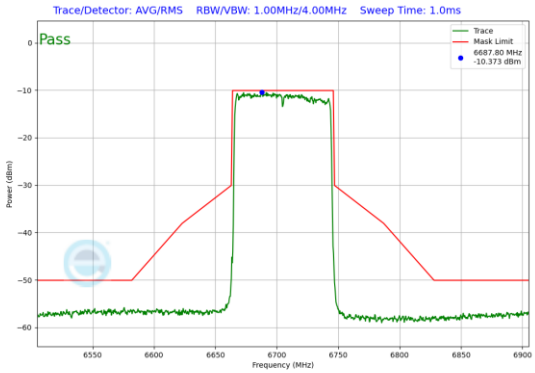
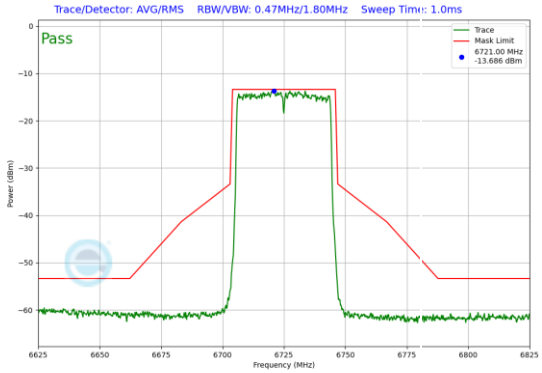


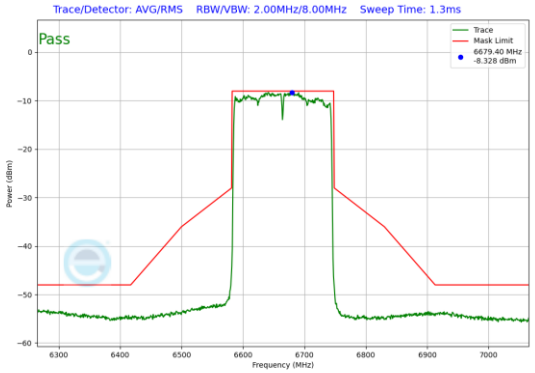
Plot 7-65. In-Band Emission Plot Antenna WF7a (20MHz 802.11ax (UNII Band 7) – Ch. 149)



Plot 7-67. In-Band Emission Plot Antenna WF7a (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-66. In-Band Emission Plot Antenna WF7a (40MHz 802.11ax (UNII Band 7) – Ch. 155)



Plot 7-68. In-Band Emission Plot Antenna WF7a (160MHz 802.11ax (UNII Band 7) – Ch. 143)

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7.5.3 SDM In-Band Emission Measurements – VLP

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [MHz]	Antenna WF8 In-Band Emission	Antenna WF7a In-Band Emission
Band 5	6115	33	ax (20MHz)	98/103.2 (MCS4)	Pass	Pass
	6255	61	ax (20MHz)	98/103.2 (MCS4)	Pass	Pass
	6415	93	ax (20MHz)	98/103.2 (MCS4)	Pass	Pass
	6125	35	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6245	59	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6405	91	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6145	39	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6225	55	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6385	87	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6185	47	ax (160MHz)	735/864.7 (MCS4)	Pass	Pass
	6345	79	ax (160MHz)	735/864.7 (MCS4)	Pass	Pass
Band 7	6535	117	ax (20MHz)	48/51.6 (MCS2)	Pass	Pass
	6695	149	ax (20MHz)	48/51.6 (MCS2)	Pass	Pass
	6855	181	ax (20MHz)	98/103.2 (MCS4)	Pass	Pass
	6565	123	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6725	155	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6845	179	ax (40MHz)	196/206.5 (MCS4)	Pass	Pass
	6625	135	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6705	151	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6785	167	ax (80MHz)	408/432.4 (MCS4)	Pass	Pass
	6665	143	ax (160MHz)	735/864.7 (MCS4)	Pass	Pass

Table 7-21. In-Band Emission Measurements SDM

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