TEST REPORT

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.: CTK-2023-01831

1. Applicant

◦ Name : SD Biosensor, Inc.

◦ Address : C-4th&5th, 16, Deogyeong-daero, 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do,16690, REPUBLIC OF KOREA

◦ Date of Receipt : 2023-02-27

2. Manufacturer

◦ Name : AMPAK Technology Inc.

◦ Address : 8F, No.15-1 Zhonghua Road,Hsinchu Industrial Park, Hukou, Hsinchu,Taiwan, 30352

3. Use of Report : For FCC Conformance

4. Test Sample / Model: AP6256 / AP6256

5. Date of Test : 2023-05-11 to 2023-06-07

6. Test Standard(method) used : FCC 47 CFR part 15 subpart E 15.407

7. Testing Environment: refer to 9 page

8. Test Results : Compliance

9. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
(Address : (Unhak-Dong) 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea)

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This report cannot be reproduced or copied without the written consent of CTK.

Approval	Tested by Su-jun Hwang: (Signature)	Technical Manager Young-taek Lee: (Signature)

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2023-08-22

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REPORT REVISION HISTORY

Date	Revision	Page No
2023-08-22	Issued (CTK-2023-01831)	all

CONTENTS

1. General Product Description

1.1 Applicant Information

Company	SD Biosensor, Inc.
Contact Point	C-4th&5th, 16, Deogyeong-daero, 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do,16690, REPUBLIC OF KOREA
Contact Person	Name : Hyun-Soo Woo E-mail : hswoo@sdbiosensor.com Tel : +82-31-8065-0262 Fax : +82-31-300-0488

1.2 Product Information

FCC ID	RPJAP6256	
Product Description	AP6256	
Model name	AP6256	
Variant Model name	-	
Operating Frequency	UNII 1	20 MHz_BW : 5 180 MHz – 5 240 MHz 40 MHz_BW : 5 190 MHz – 5 230 MHz 80 MHz_BW : 5 210 MHz
	UNII 2A	20 MHz_BW : 5 260 MHz – 5 320 MHz 40 MHz_BW : 5 270 MHz – 5 310 MHz 80 MHz_BW : 5 290 MHz
	UNII 2C	20 MHz_BW : 5 500 MHz – 5 720 MHz 40 MHz_BW : 5 510 MHz – 5 710 MHz 80 MHz_BW : 5 530 MHz – 5 690 MHz
	UNII 3	20 MHz_BW : 5 745 MHz – 5 825 MHz 40 MHz_BW : 5 755 MHz – 5 795 MHz 80 MHz_BW : 5 775 MHz
RF Output Power	802.11a : -3.71 dBm (0.426 mW) 802.11n_HT20 : -3.72 dBm (0.425 mW) 802.11n_HT40 : -3.22 dBm (0.476 mW) 802.11ac_VHT20 : -3.71 dBm (0.426 mW) 802.11ac_VHT40 : -3.26 dBm (0.472 mW) 802.11ac_VHT80 : -2.98 dBm (0.504 mW)	
Antenna Specification	Antenna type : Chip Antenna Peak Gain : 5.1d dBi	
Type of Modulation	802.11a/n/ac : OFDM	
Data Rate	802.11a : 54 / 48 / 36 / 24 / 18 / 12 / 9 / 6 Mbps 802.11n : MCS(0 – 7) 802.11ac : MNSS(0 – 8)	
Power Source	DC 3.3 V	
Test Software(Version)	RFTestTool	
RF Power setting in Test SW	"Default	
Dynamic Frequency Selection	Slave without radar detection	

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND772353R5S
AC/DC Adapter	HP	HSTNN-LA40	7628050001

2. Accreditations

2.1 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A
KOREA	NRRA	KR0025

2.2 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Limit	Status (Note 1)	Test Condition
15.407 (e)	6 dB Bandwidth	> 500 kHz (5 725 – 5 850 MHz)	C	Conducted
15.407 (a)	26 dB Bandwidth and 99% Bandwidth	NA	C	
15.407 (a)(1),(2),(3)	Conducted Output Power	< 250 mW (5 150 – 5 250 MHz) < 250 mW (5 250 – 5 350 MHz, 5 470 – 5 725 MHz) < 1 W (5 725 – 5 850 MHz)	C	
15.407 (a)(1),(2),(3)	Power Spectral Density	< 11 dBm/MHz (5 150 – 5 250 MHz) < 11 dBm/MHz (5 250 – 5 350 MHz, 5 470 – 5 725 MHz) < 30 dBm/500 KHz (5 725 – 5 850 MHz)	C	
15.407 (g)	Frequency Stability	NA	C	
15.407 (b)	Undesirable emission	< -27 dBm/MHz EIRP (5 150 – 5 250 MHz, 5 250 – 5 350 MHz, 5 470 – 5 725 MHz) < -27 dBm/MHz EIRP < 10 dBm/MHz EIRP < 15.6 dBm/MHz EIRP < 27 dBm/MHz EIRP (5 725 – 5 850 MHz)	C	Radiated
15.205, 15.407 (b)(9),(10)	Radiated Spurious Emission	15.209(a)	C	
15.407 (b)(9)	AC Conducted Emissions	15.207(a)	C	Line Conducted
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
Note 2: The data in this test report are traceable to the national or international standards.				
Note 3: The sample was tested according to the following specification: FCC Part 15.407, ANSI C63.10-2013				
Note 4: The tests were performed according to the method of measurements prescribed in KDB No.789033.				

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission.
For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit.
All modulation modes were tests. The results are only attached worst cases.

Test Frequency & Bandwidth

- 802.11a, 802.11n_HT20, 802.11ac_VHT20

	Lowest channel	Middle channel	Highest channel
UNII 1	5 180 MHz	5 200 MHz	5 240 MHz
UNII 2A	5 260 MHz	5 300 MHz	5 320 MHz
UNII 2C	5 500 MHz	5 600 MHz	5 700 MHz, 5 720 MHz
UNII 3	5 745 MHz	5 785 MHz	5 825 MHz

- 802.11n_HT40, 802.11ac_VHT40

	Lowest channel	Middle channel	Highest channel
UNII 1	5 190 MHz	-	5 230 MHz
UNII 2A	5 270 MHz	-	5 310 MHz
UNII 2C	5 510 MHz	5 590 MHz	5 670 MHz, 5 710 MHz
UNII 3	5 755 MHz	-	5 795 MHz

- 802.11ac_VHT80

	Lowest channel	Middle channel	Highest channel
UNII 1	5 210 MHz	-	-
UNII 2A	5 290 MHz	-	-
UNII 2C	5 530 MHz	5 610 MHz	5 690 MHz
UNII 3	5 775 MHz	-	-

Test mode & Worst case & Duty

Test mode	Modulation	Data rate	Duty Cycle	Duty Cycle Factor
802.11a	OFDM	6 Mbps	94.14 %	0.26 dB
802.11n_HT20	OFDM	MCS 0	93.16 %	0.31 dB
802.11n_HT40	OFDM	MCS 0	86.96 %	0.61 dB
802.11ac_VHT20	OFDM	MNSS 0	92.88 %	0.32 dB
802.11ac_VHT40	OFDM	MNSS 0	87.22 %	0.59 dB
802.11ac_VHT80	OFDM	MNSS 0	76.71 %	1.15 dB

3.3 Testing Environment

Test Item	Test Date	Temperature (℃)	Relative Humidity (%)
6 dB Bandwidth	2023-05-11 ~ 2023-05-15	22 ~ 23	28 ~ 36
26 dB Bandwidth and 99% Bandwidth	2023-05-11 ~ 2023-05-15	22 ~ 23	28 ~ 36
Conducted Output Power	2023-05-11 ~ 2023-05-15	22 ~ 23	28 ~ 36
Power Spectral Density	2023-05-11 ~ 2023-05-15	22 ~ 23	28 ~ 36
Frequency Stability	2023-05-16 ~ 2023-05-17	22 ~ 23	28 ~ 36
Radiated Emissions (1GHz Adobe)	2023-05-11 ~ 2023-06-07	22 ~ 24	34 ~ 48
Radiated Emissions (1GHz Below)	2023-05-24 ~ 2023-05-25	21 ~ 22	38 ~ 41
AC Conducted Emissions	2023-05-30	23	42

3.4 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor k = 2, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	1.5 dB (C.L.: Approx. 95 %, k = 2)
Power Spectral Density	1.5 dB (C.L.: Approx. 95 %, k = 2)
Occupied Bandwidth	0.1 MHz (C.L.: Approx. 95 %, k = 2)
Unwanted Emission(conducted)	3.0 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f ≤ 1 GHz)	3.88 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f > 1 GHz)	4.50 dB (C.L.: Approx. 95 %, k = 2)
Line Conducted Emission	1.94 dB (C.L.: Approx. 95 %, k = 2)

3.5 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	EP5RE Ver. 6.0.10, ES10 Ver. 2022.04.000
Line Conducted Test	EMC32 Ver. 10.50.00

4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

KDB 789033 – Section C.2
ANSI C63.10-2013 - Section 6.9.2

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Settings :
Center frequency = the highest, middle and the lowest channels
a) RBW = 100 kHz
b) VBW ≥ 3 x RBW
c) Detector = peak
d) Trace mode = Max hold
e) Sweep = auto couple
f) Allow trace to fully stabilize
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Minimum Standard:

6 dB Bandwidth > 500 kHz

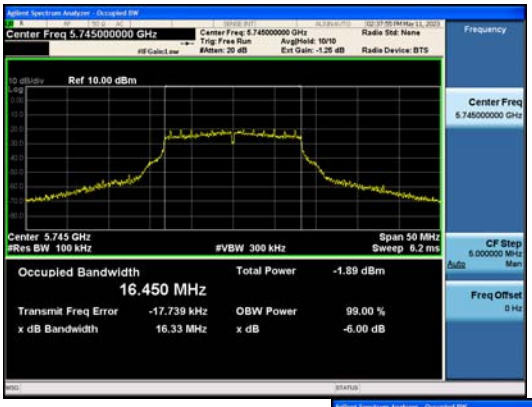
Test Data:

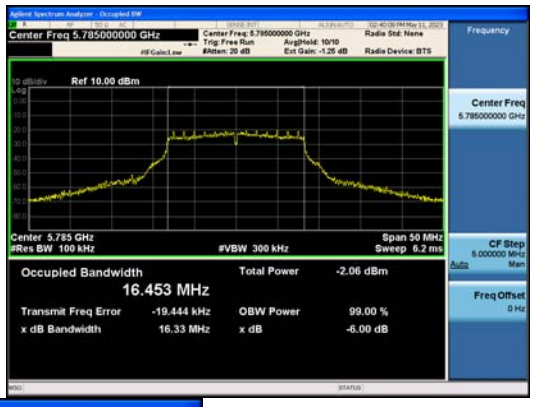
	6 dB Bandwidth (MHz)		
Mode / Frequency	802.11a	802.11n_HT20	802.11ac_VHT20
5 745 MHz	16.33	17.56	17.53
5 785 MHz	16.33	17.54	17.36
5 825 MHz	16.36	17.57	17.56
Measurement uncertainty	± 0.1 MHz		

	6 dB Bandwidth (MHz)	
Mode / Frequency	802.11n_HT40	802.11ac_VHT40
5 755 MHz	36.33	36.34
5 795 MHz	36.34	36.32
Measurement uncertainty	± 0.1 MHz	

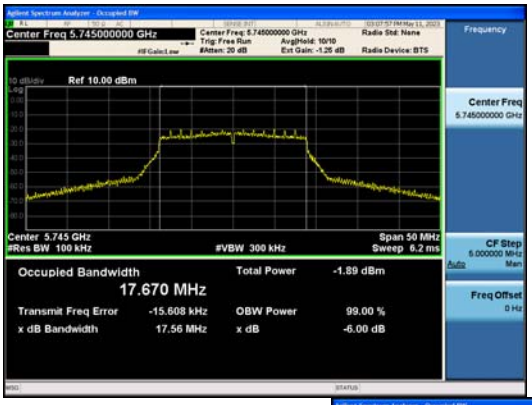
	6 dB Bandwidth (MHz)
Mode / Frequency	802.11ac_VHT80
5 775 MHz	76.04
Measurement uncertainty	± 0.1 MHz

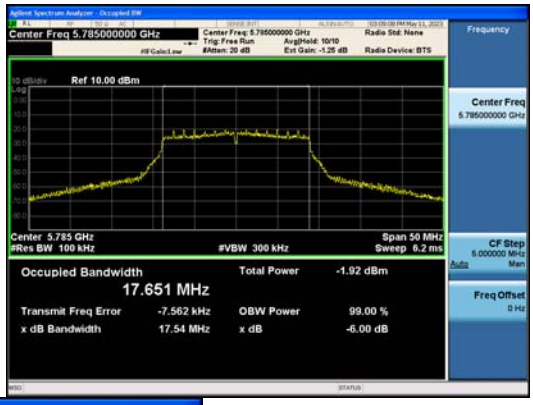
See next pages for actual measured spectrum plots.





802.11a_UNII 3





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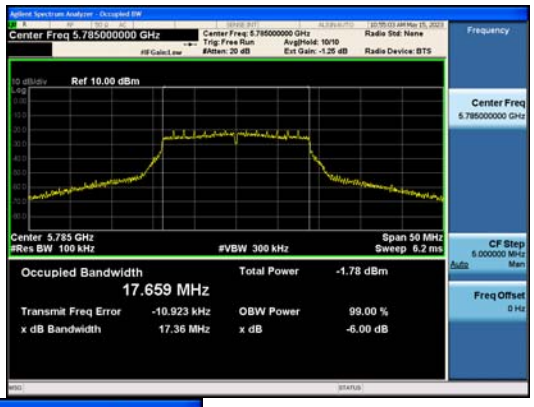

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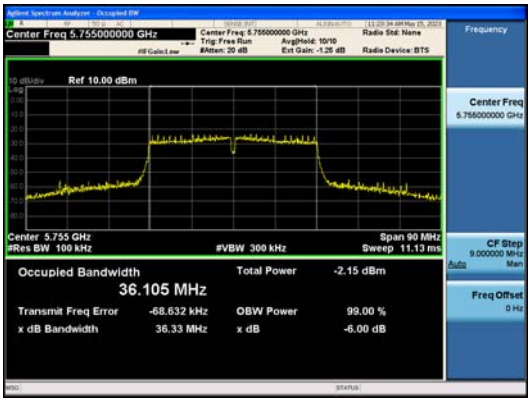
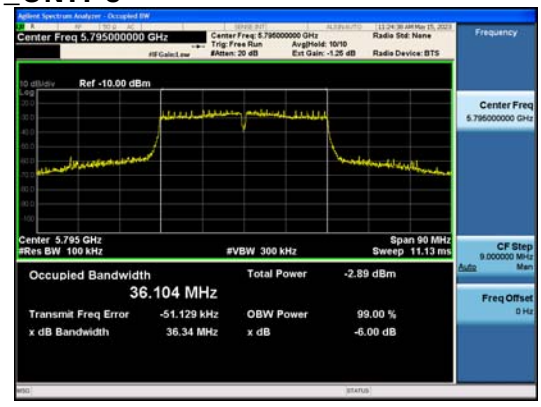
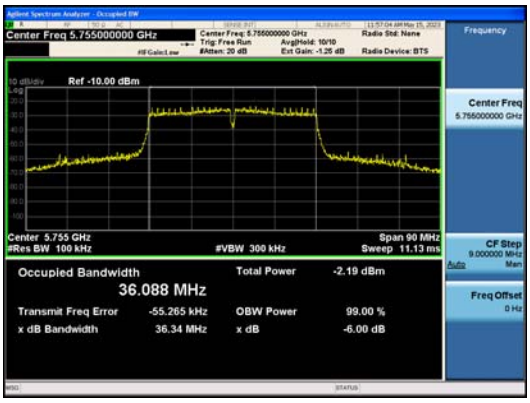
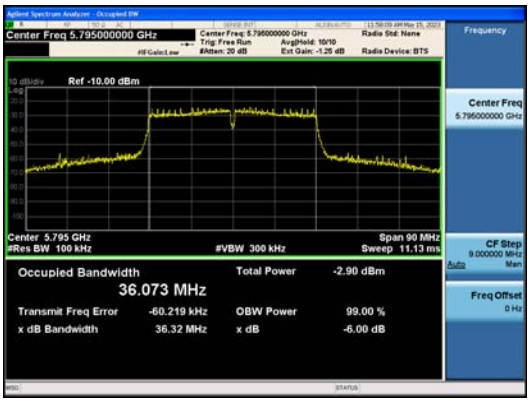


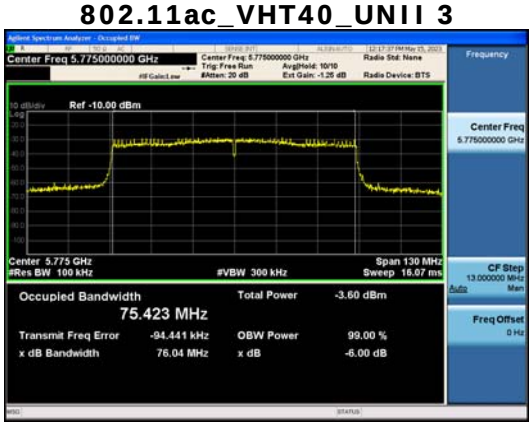


802.11n_HT40_UNII 3





802.11ac_VHT40_UNII 3



802.11ac_VHT80_UNII 3

4.2 26 dB Bandwidth and 99% Bandwidth

Test Procedures

KDB 789033 – Section C.1
ANSI C63.10-2013 - Section 6.9.2

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

KDB 789033 – Section C.1
ANSI C63.10-2013 - Section 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.
Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :
Center frequency = the highest, middle and the lowest channels
a) RBW = approximately 1 % of the emission bandwidth
b) VBW ≥ RBW
c) Detector = peak
d) Trace mode = Max hold
e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Minimum Standard:

NA

Test Data:

	26 dB Bandwidth and 99% Bandwidth (MHz)					
Mode	802.11a		802.11n_HT20		802.11ac_VHT20	
Frequency	26 dB	99%	26 dB	99%	26 dB	99%
5 180 MHz	29.59	17.26	30.84	18.18	31.24	18.37
5 200 MHz	28.76	17.09	29.37	18.06	27.49	18.11
5 240 MHz	28.77	17.12	27.98	18.13	27.57	18.14
5 260 MHz	28.97	17.06	30.54	18.05	28.21	18.12
5 300 MHz	28.42	17.03	28.51	18.07	27.79	18.02
5 320 MHz	24.43	16.78	24.63	17.89	23.79	17.90
5 500 MHz	21.62	16.66	21.76	17.8	21.61	17.83
5 600 MHz	21.15	16.59	21.64	17.76	21.48	17.79
5 700 MHz	21.11	16.63	21.32	17.76	21.60	17.77
5 720 MHz	20.95	16.61	21.44	17.76	21.49	17.76
5 745 MHz	21.61	17.30	21.93	18.43	22.28	18.39
5 785 MHz	21.67	17.36	22.05	18.40	22.28	18.43
5 825 MHz	21.76	17.45	21.88	18.34	22.10	18.42
Measurement uncertainty	± 0.1 MHz					

	26 dB Bandwidth and 99% Bandwidth (MHz)			
Mode	802.11n_HT40		802.11ac_VHT40	
Frequency	26 dB	99 %	26 dB	99 %
5 190 MHz	55.34	36.61	57.84	36.62
5 230 MHz	56.96	36.61	62.24	36.58
5 270 MHz	50.91	36.54	57.34	36.52
5 310 MHz	53.06	36.53	57.06	36.50
5 510 MHz	40.70	36.26	39.68	36.25
5 590 MHz	39.64	36.21	40.11	36.23
5 670 MHz	39.60	36.21	39.81	36.23
5 710 MHz	39.80	36.19	39.72	36.25
5 755 MHz	39.85	36.27	40.26	36.30
5 795 MHz	40.01	36.26	40.23	36.27
Measurement uncertainty	± 0.1 MHz			

	26 dB Bandwidth and 99% Bandwidth (MHz)	
Mode	802.11ac_VHT80	
Frequency	26 dB	99 %
5 210 MHz	107.04	75.95
5 290 MHz	113.21	76.01
5 530 MHz	80.68	75.70
5 610 MHz	81.43	75.60
5 690 MHz	81.61	75.70
5 775 MHz	80.72	75.45
Measurement uncertainty	± 0.1 MHz	

ee next pages for actual measured spectrum plots.

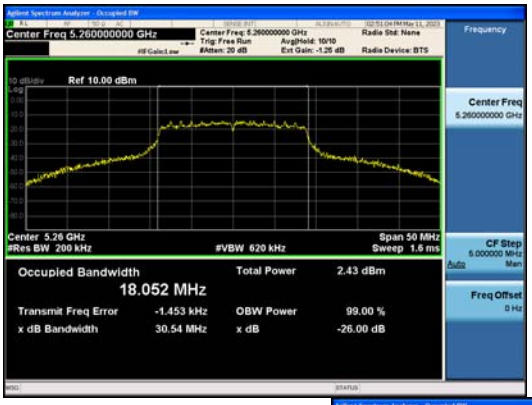
802.11a_UNII 1

802.11a_UNII 2A

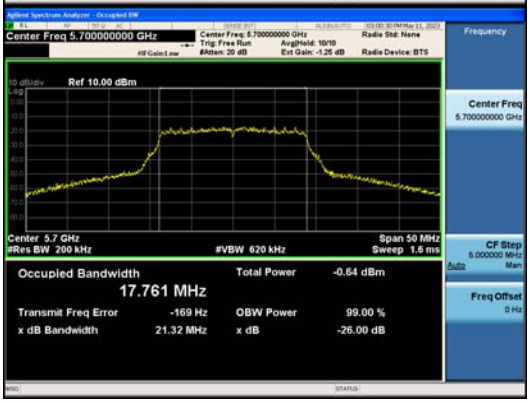
802.11a_UNII 2C

802.11a_UNII 3

802.11n_HT20_UNII 1



A802.11n_HT20_UNII 2A



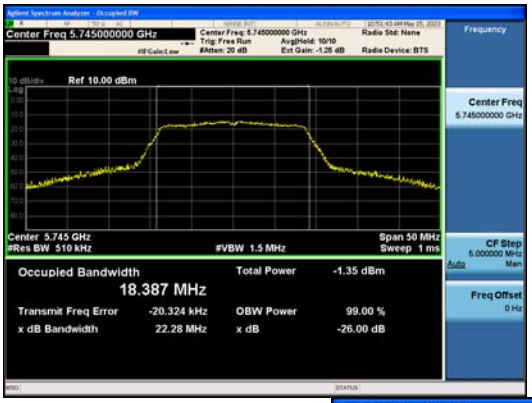
802.11n_HT20_UNII 2C

802.11n_HT20_UNII 3

802.11ac_VHT20_UNII 1

802.11ac_VHT20_UNII 2A

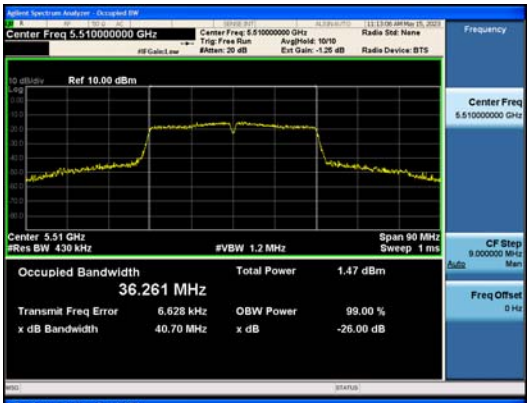
802.11ac_VHT20_UNII 2C



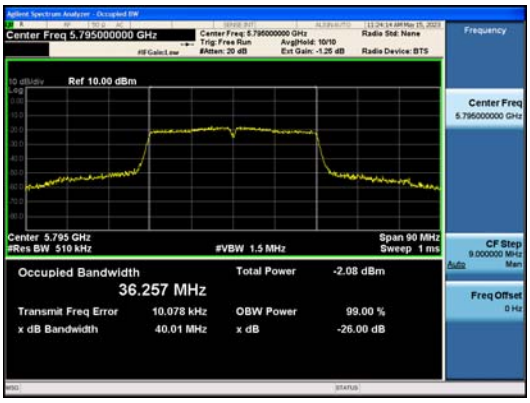
802.11ac_VHT20_UNII 3

802.11n_HT40_UNII 1

802.11n_HT40_UNII 2A



802.11n_HT40_UNII 2C

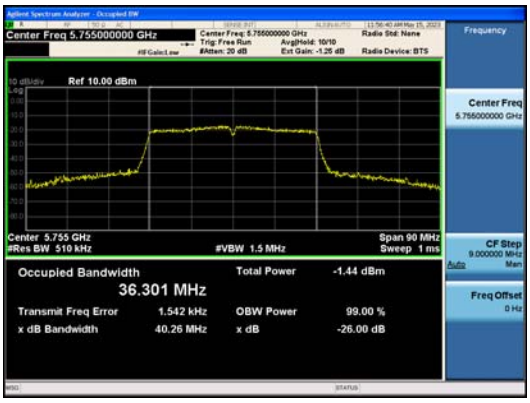


802.11n_HT40_UNII 3

802.11ac_VHT40_UNII 1

802.11ac_VHT40_UNII 2A

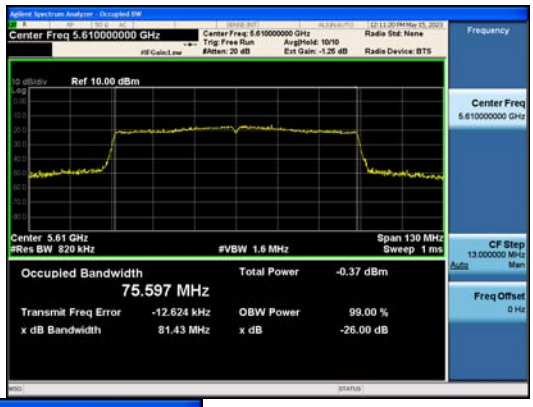
802.11ac_VHT40_UNII 2C



802.11ac_VHT40_UNII 3

802.11ac_VHT80_UNII 1

802.11ac_VHT80_UNII 2A



802.11ac_VHT80_UNII 2C

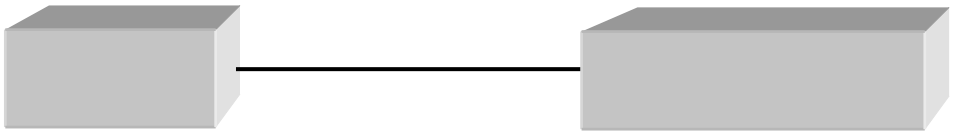
802.11ac_VHT80_UNII 3

4.3 OUTPUT POWER

Test Procedures

KDB 789033 – Section E.2.d (Method SA-2, Maximum Conducted Output Power)
ANSI C63.10-2013 – Section 12.3.2.4

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings :
Center frequency = the highest, middle and the lowest channels
a) RBW = 1 MHz
b) VBW ≥ 3 x RBW
c) Sweep time = auto
d) Detector = power averaging (rms)
e) Trace mode = Average at least 100
f) Duty cycle factor = 10log(1/x)

Test mode	Duty Cycle Factor (dB)
802.11a	0.26 dB
802.11n_HT20	0.31 dB
802.11n_HT40	0.61 dB
802.11ac_VHT20	0.32 dB
802.11ac_VHT40	0.59 dB
802.11ac_VHT80	1.15 dB

Limit

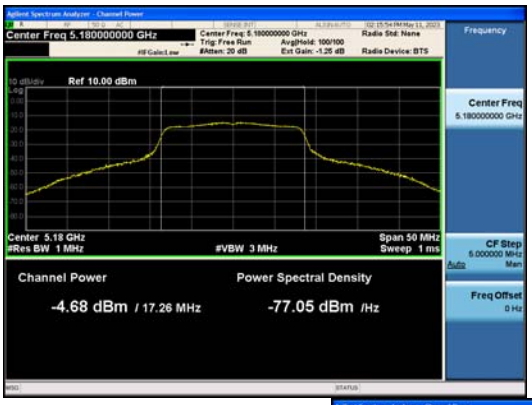
Mode	ANT Gain (dBi)	Band	Limit (dBm)
802.11a/n/ac	5.1	UNII 1	24.00
		UNII 2A	24.00
		UNII 2C	24.00
		UNII 3	30.00

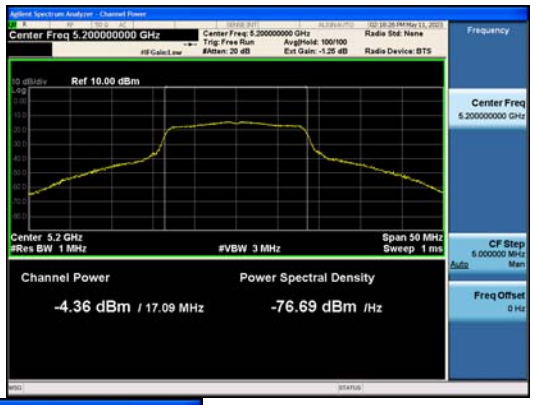
Test Data

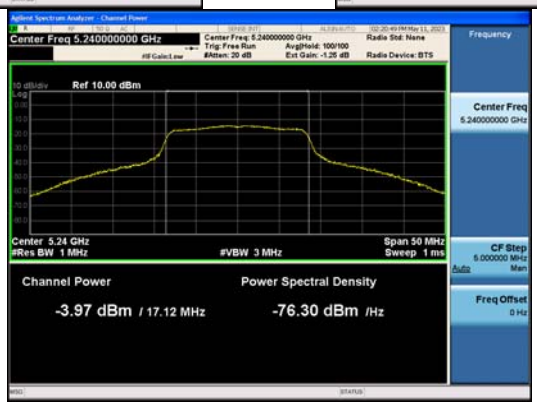
Test Mode	Frequency (MHz)	Measured Output Power (dBm)	Duty cycle Factor (dB)	Result Output Power (dBm)	Limit (dBm)	Note
802.11a	5 180	-4.68	0.26	-4.42	24.00	
	5 200	-4.36		-4.10	24.00	
	5 240	-3.97		-3.71	24.00	
	5 260	-3.99		-3.73	24.00	
	5 300	-4.18		-3.92	24.00	
	5 320	-4.34		-4.08	24.00	
	5 500	-4.99		-4.73	24.00	
	5 600	-5.78		-5.52	24.00	
	5 700	-7.12		-6.86	24.00	
	5 720	-7.11		-6.85	24.00	
	5 745	-7.64		-7.38	30.00	
	5 785	-7.68		-7.42	30.00	
	5 825	-8.93		-8.67	30.00	
802.11n _HT20	5 180	-4.79	0.31	-4.48	24.00	
	5 200	-4.22		-3.91	24.00	
	5 240	-4.03		-3.72	24.00	
	5 260	-3.97		-3.66	24.00	
	5 300	-4.04		-3.73	24.00	
	5 320	-4.33		-4.02	24.00	
	5 500	-5.11		-4.80	24.00	
	5 600	-5.79		-5.48	24.00	
	5 700	-7.11		-6.80	24.00	
	5 720	-7.01		-6.70	24.00	
	5 745	-7.68		-7.37	30.00	
	5 785	-7.75		-7.44	30.00	
	5 825	-8.57		-8.26	30.00	
802.11ac _VHT20	5 180	-4.78	0.32	-4.47	24.00	
	5 200	-4.37		-3.90	24.00	
	5 240	-4.04		-3.71	24.00	
	5 260	-4.05		-3.65	24.00	
	5 300	-3.82		-3.72	24.00	
	5 320	-4.02		-4.01	24.00	
	5 500	-4.79		-4.79	24.00	
	5 600	-5.66		-5.47	24.00	
	5 700	-6.90		-6.79	24.00	

	5 720	-6.75		-6.69	24.00	
	5 745	-7.43		-7.36	30.00	
	5 785	-7.64		-7.43	30.00	
	5 825	-8.55		-8.25	30.00	
802.11n _HT40	5 190	-5.01	0.61	-4.40	24.00	
	5 230	-4.82		-4.21	24.00	
	5 270	-4.35		-3.74	24.00	
	5 310	-3.83		-3.22	24.00	
	5 510	-5.11		-4.50	24.00	
	5 590	-5.96		-5.35	24.00	
	5 670	-6.49		-5.88	24.00	
	5 710	-7.25		-6.64	24.00	
	5 755	-7.80		-7.19	30.00	
	5 795	-8.51		-7.90	30.00	
802.11ac _VHT40	5 190	-5.08	0.59	-4.49	24.00	
	5 230	-4.83		-4.24	24.00	
	5 270	-4.43		-3.84	24.00	
	5 310	-3.85		-3.26	24.00	
	5 510	-5.12		-4.53	24.00	
	5 590	-5.74		-5.15	24.00	
	5 670	-6.40		-5.81	24.00	
	5 710	-7.25		-6.66	24.00	
	5 755	-7.92		-7.33	30.00	
	5 795	-8.53		-7.94	30.00	
802.11ac _VHT80	5 210	-5.31	1.15	-4.16	24.00	
	5 290	-4.13		-2.98	24.00	
	5 530	-6.13		-4.98	24.00	
	5 610	-6.84		-5.69	24.00	
	5 690	-7.52		-6.37	24.00	
	5 775	-9.01		-7.86	30.00	
Measurement uncertainty	± 1.5 dB					

See next pages for actual measured spectrum plots.







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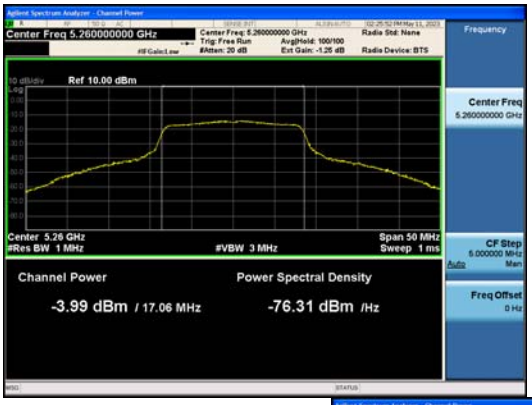
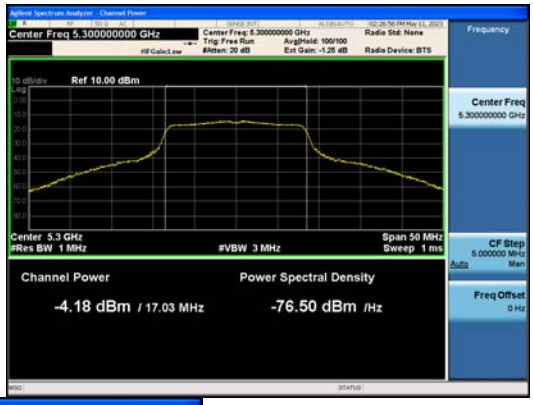
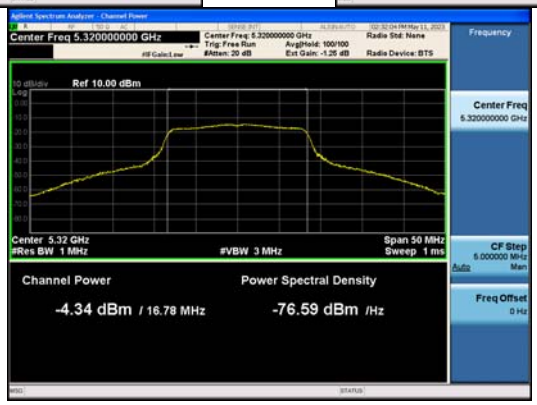
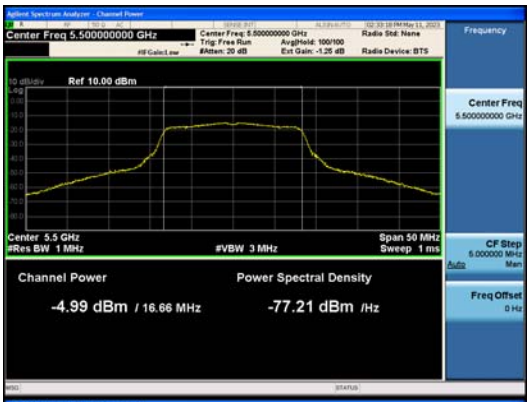
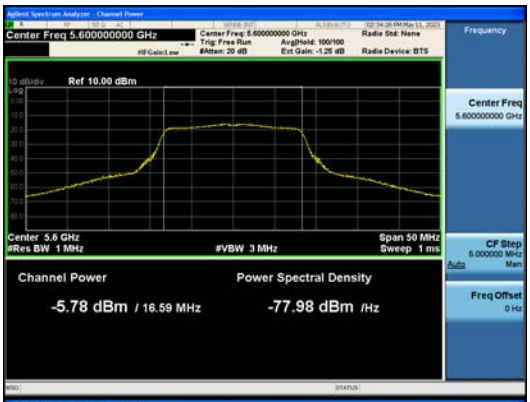


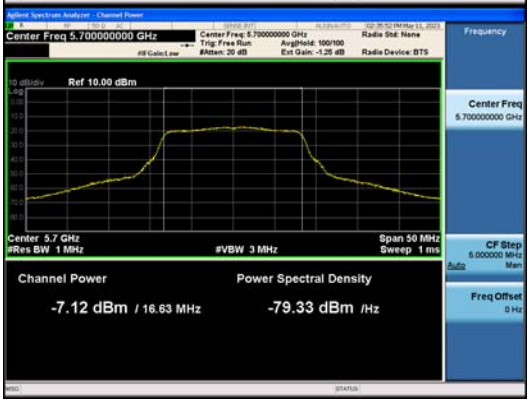


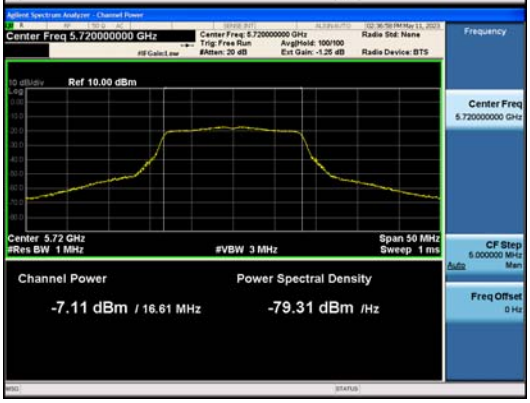


802.11a_UNII 2A

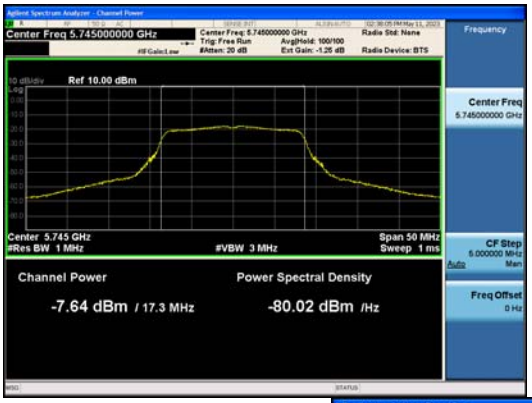


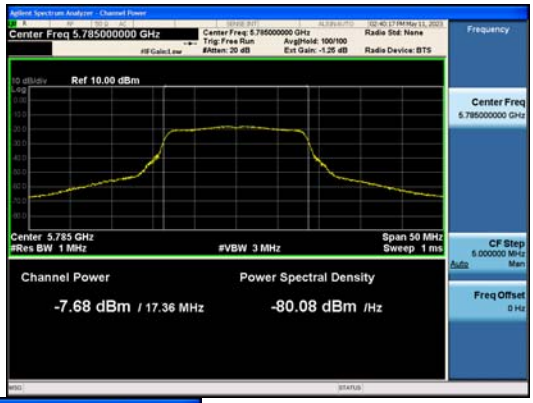


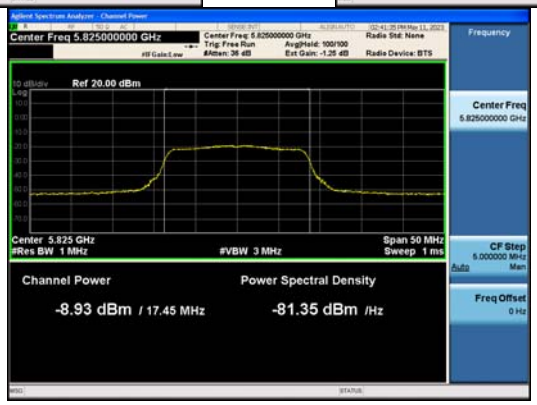




802.11a_UNII 2C







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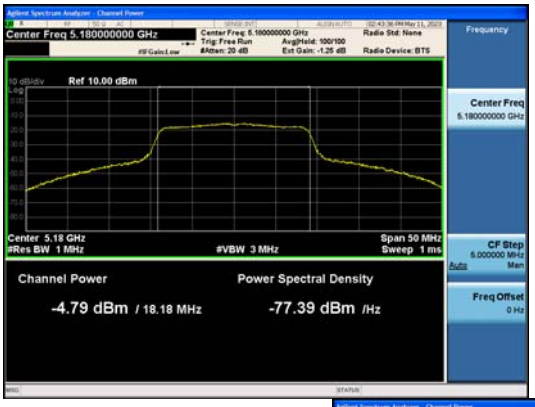

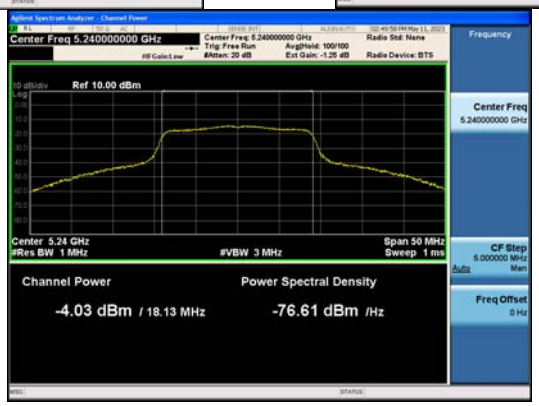

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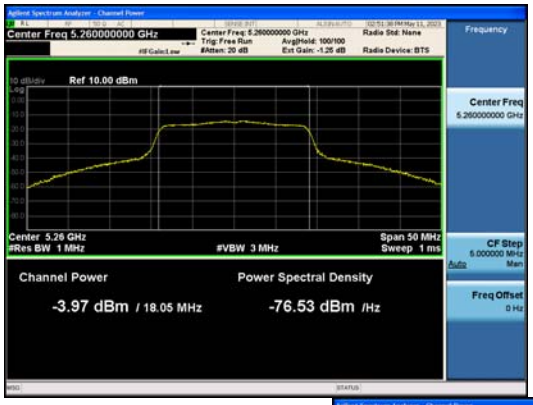
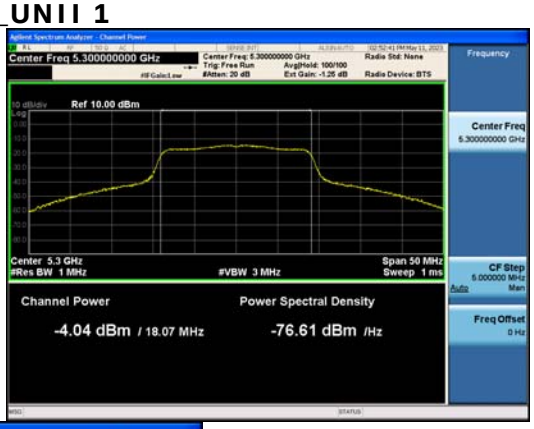
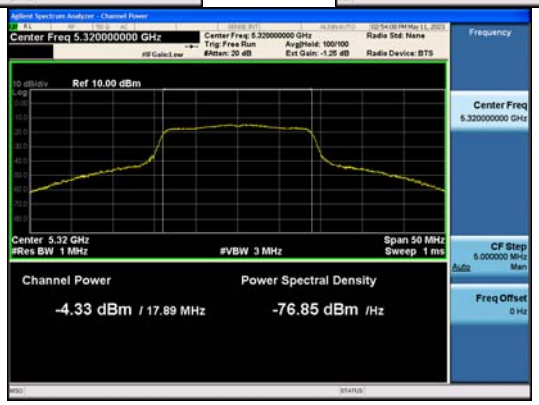
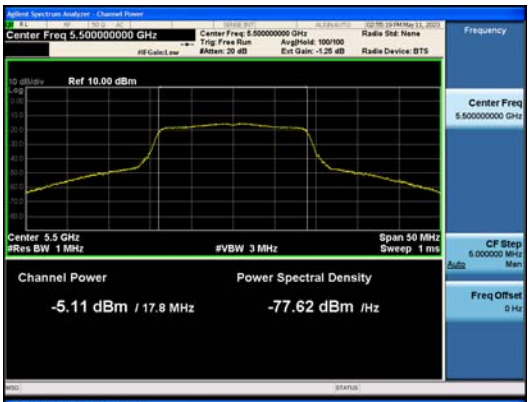
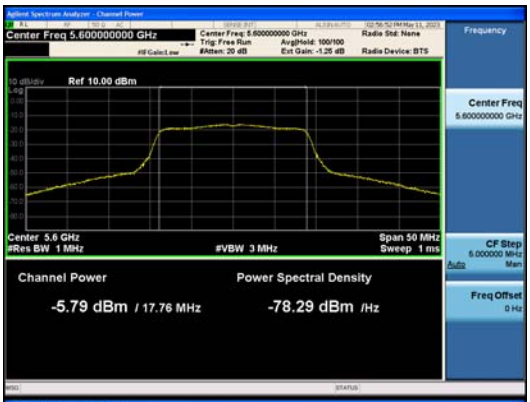


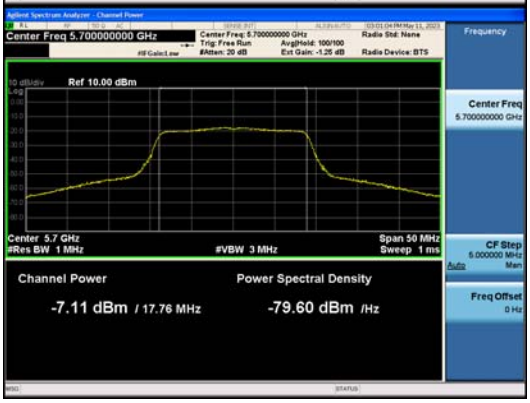


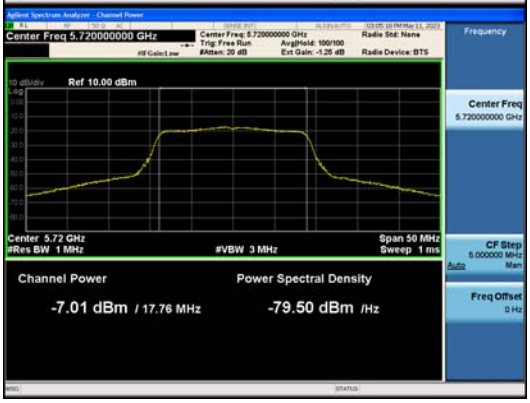


802.11n_HT20_UNII 2A









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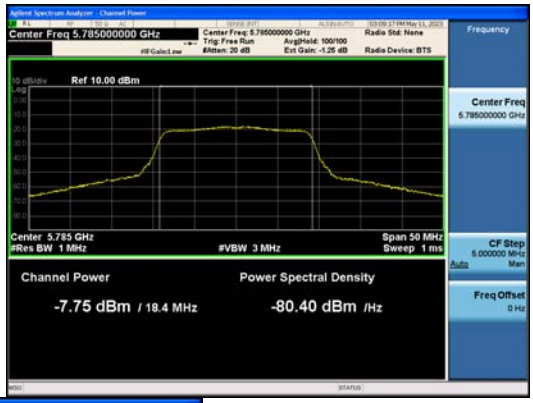

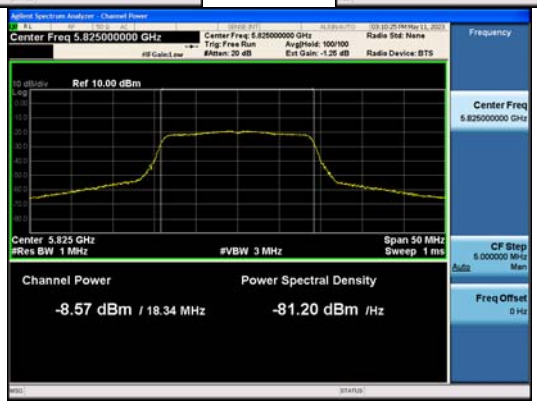

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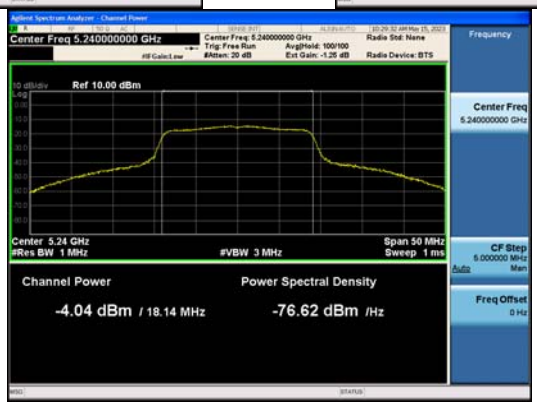
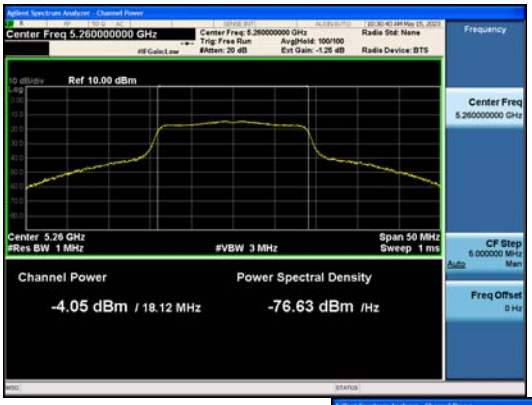
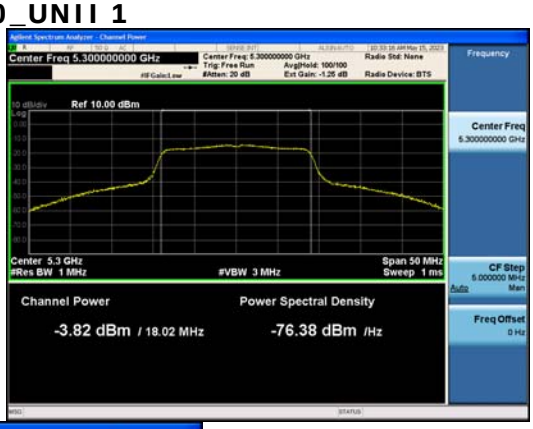
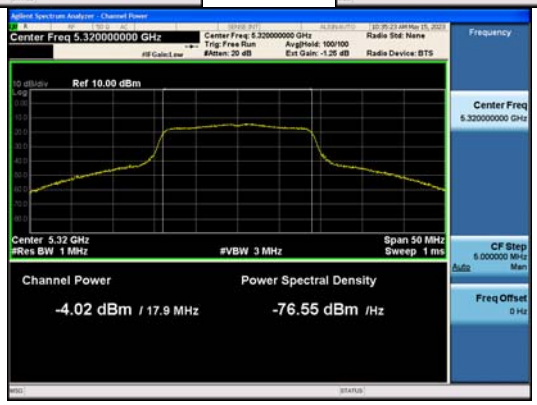


802.11ac_VHT20_UNII 1







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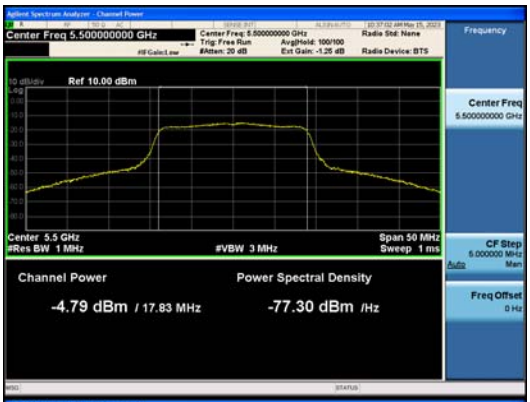

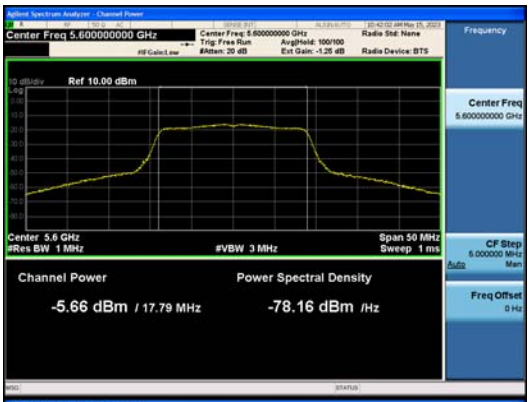

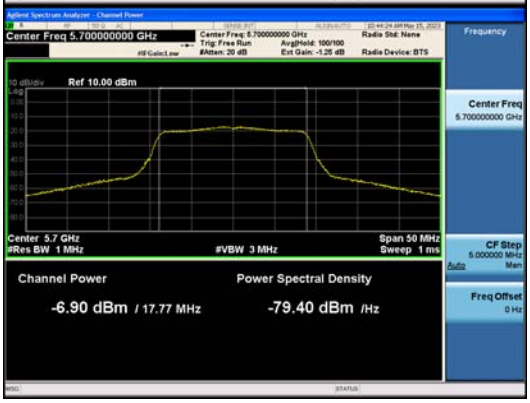

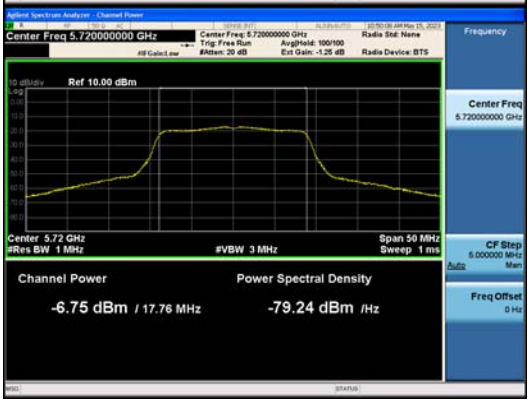

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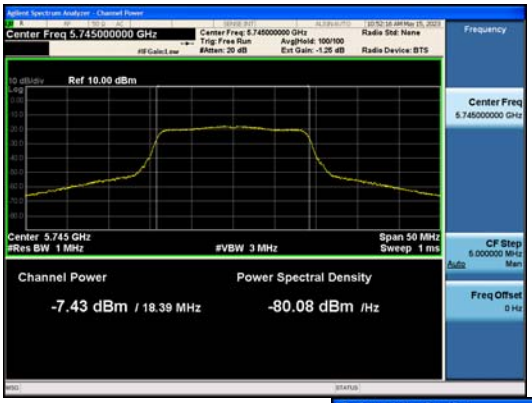

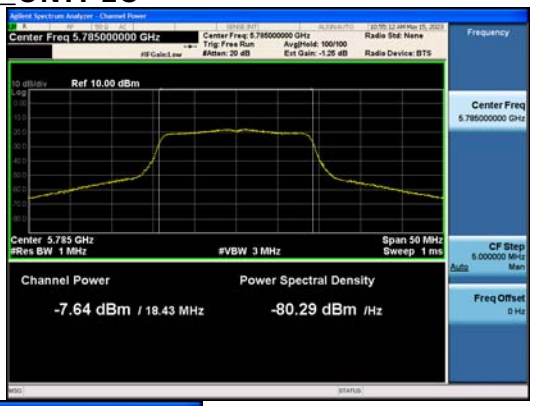

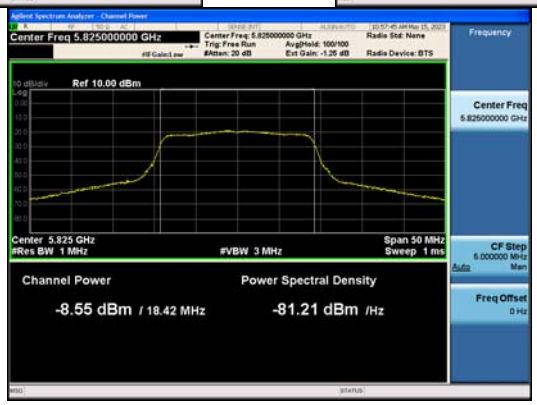

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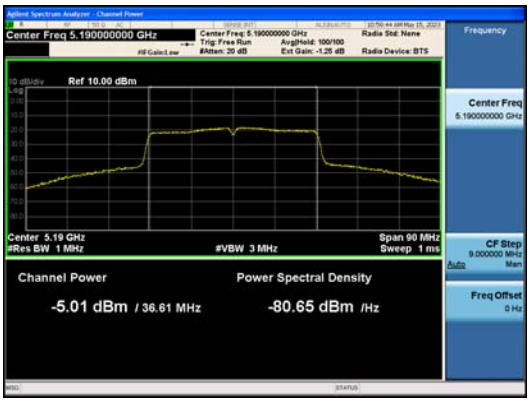

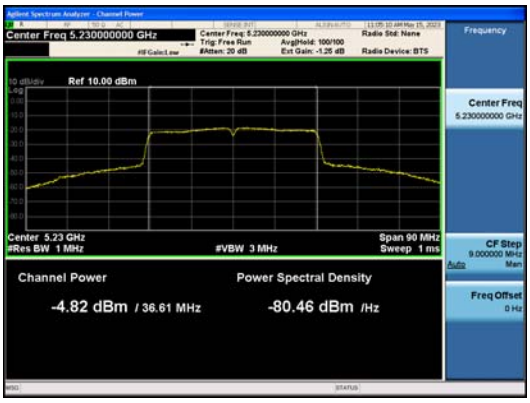

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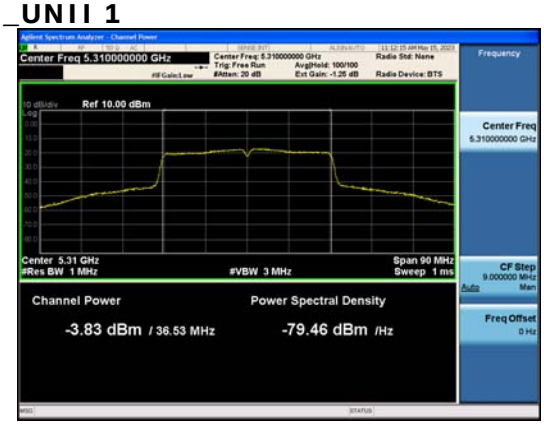

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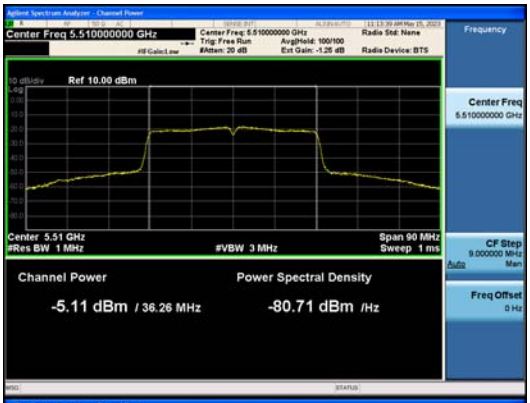

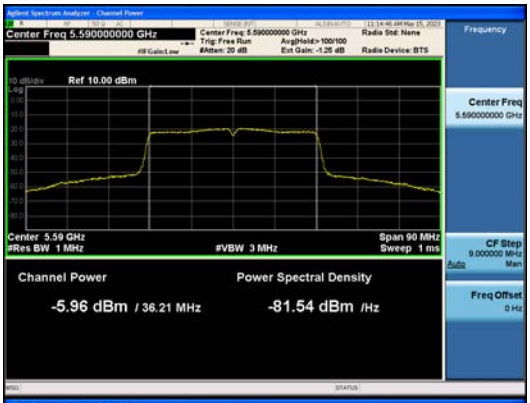

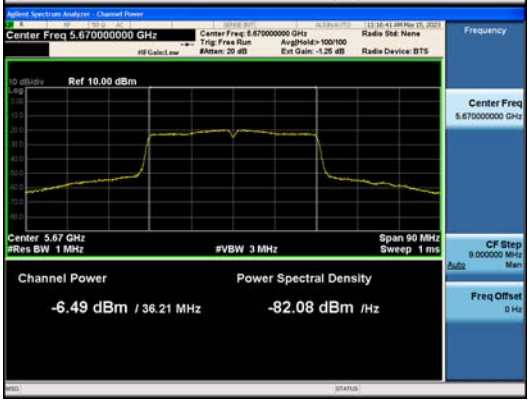

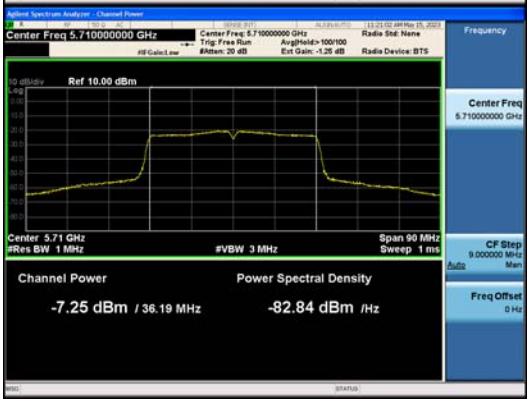

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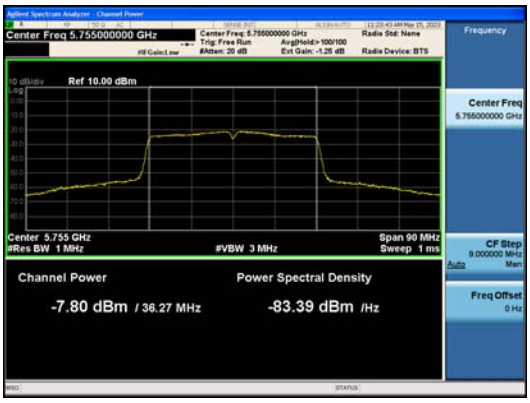

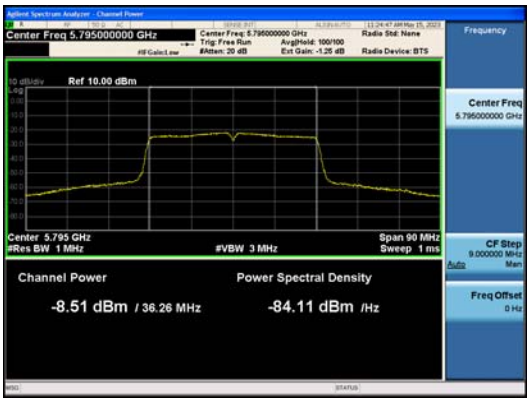

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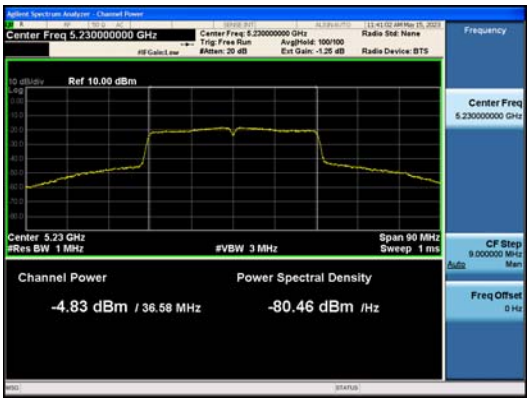
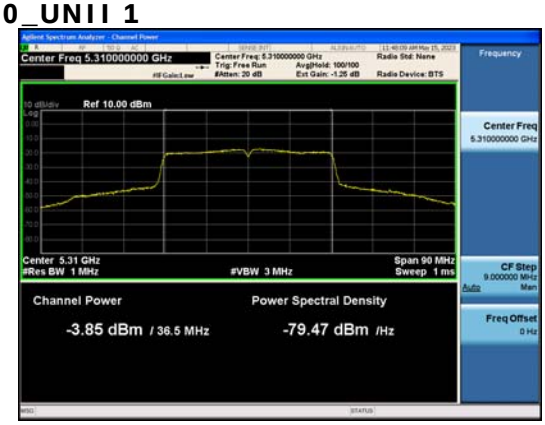


802.11ac_VHT40_UNII 1



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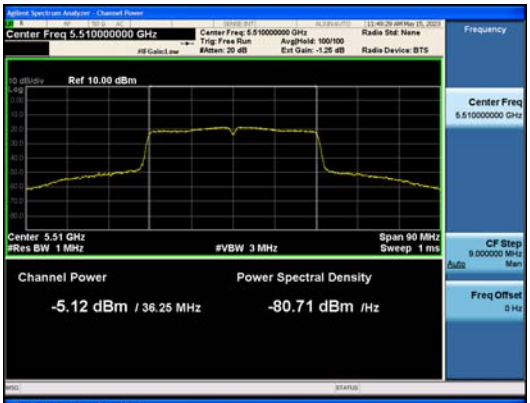
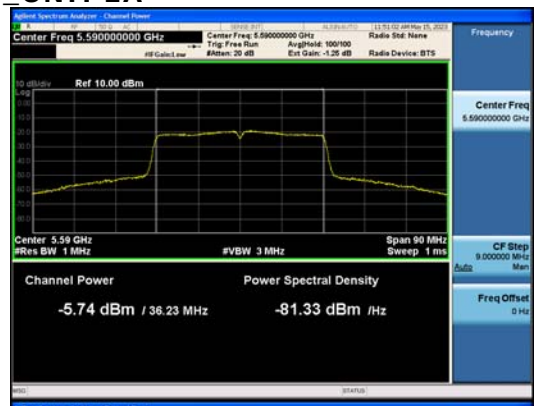
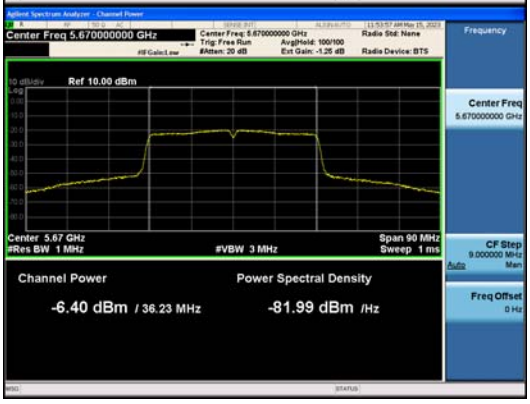
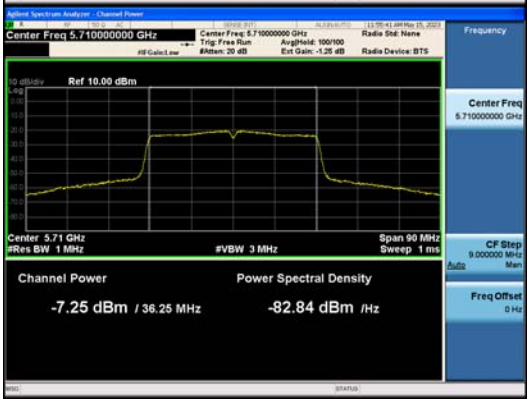
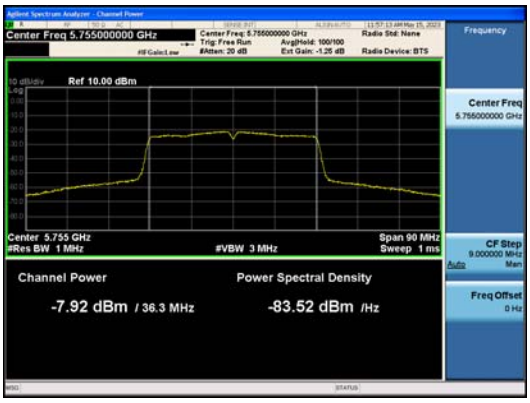


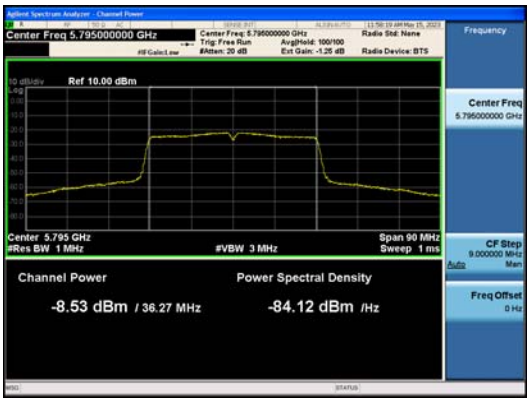




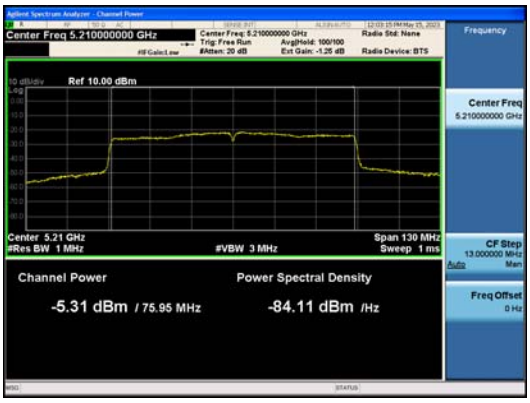


802.11ac_VHT40_UNII 2C

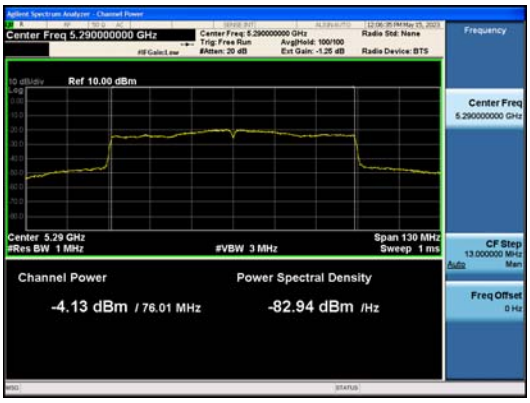




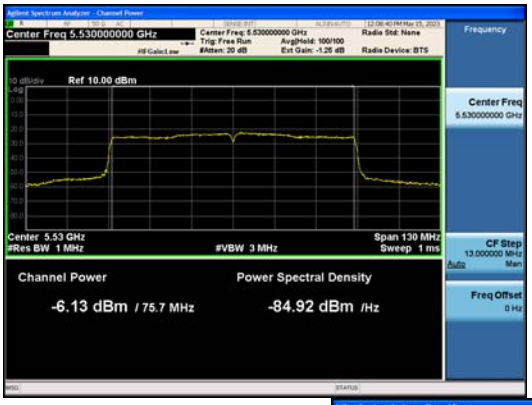
802.11ac_VHT40_UNII 3

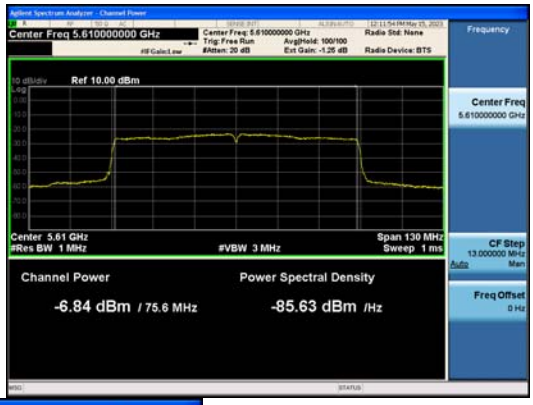


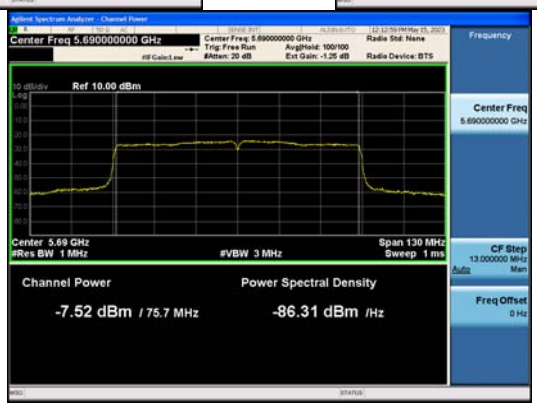
802.11ac_VHT80_UNII 1



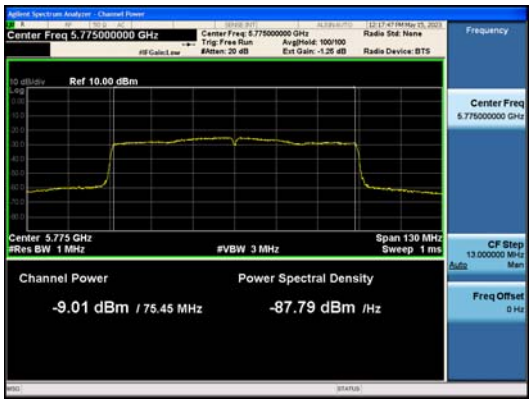
802.11ac_VHT80_UNII 2A







802.11ac_VHT80_UNII 2C



802.11ac_VHT80_UNII 3

4.4 Power Spectral Density

Test Procedures

KDB 789033 – Section F (Method SA-2, Maximum Power Spectral Density)
ANSI C63.10-2013 – Section 12.5

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Test Settings :
Center frequency = the highest, middle and the lowest channels
a) RBW = 1 MHz, 500 KHz (UNII 3)
b) VBW = 3 MHz, 1.5 MHz (UNII 3)
c) Sweep time = auto
d) Detector = power averaging (rms)
e) Trace mode = Average at least 100
f) Duty cycle factor = 10log(1/x)

Test mode	Duty Cycle Factor (dB)
802.11a	0.26 dB
802.11n_HT20	0.31 dB
802.11n_HT40	0.61 dB
802.11ac_VHT20	0.32 dB
802.11ac_VHT40	0.59 dB
802.11ac_VHT80	1.15 dB

Limit

Mode	ANT Gain (dBi)	Band	Limit (dBm)
802.11a/n/ac	5.1	UNII 1	11.00
		UNII 2A	11.00
		UNII 2C	11.00
		UNII 3	30.00

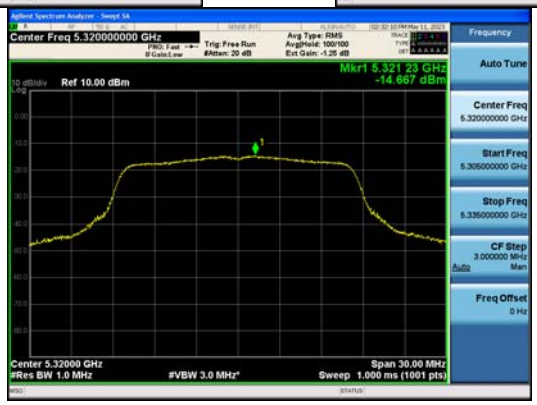
Test Data

Test Mode	Frequency (MHz)	Measured Power Density (dBm)	Duty cycle Factor (dB)	Result Power Density (dBm)	Limit (dBm)	Note
802.11a	5 180	-14.75	0.26	-14.49	11.00	
	5 200	-14.52		-14.26	11.00	
	5 240	-13.83		-13.57	11.00	
	5 260	-14.19		-13.93	11.00	
	5 300	-14.34		-14.08	11.00	
	5 320	-14.67		-14.41	11.00	
	5 500	-15.05		-14.79	11.00	
	5 600	-16.08		-15.82	11.00	
	5 700	-17.34		-17.08	11.00	
	5 720	-17.14		-16.88	11.00	
	5 745	-20.46		-20.20	30.00	
	5 785	-20.68		-20.42	30.00	
	5 825	-21.69		-21.43	30.00	
802.11n _HT20	5 180	-15.22	0.31	-14.91	11.00	
	5 200	-14.68		-14.37	11.00	
	5 240	-14.25		-13.94	11.00	
	5 260	-14.16		-13.85	11.00	
	5 300	-14.19		-13.88	11.00	
	5 320	-14.70		-14.39	11.00	
	5 500	-15.44		-15.13	11.00	
	5 600	-16.03		-15.72	11.00	
	5 700	-17.37		-17.06	11.00	
	5 720	-17.34		-17.03	11.00	
	5 745	-20.79		-20.48	30.00	
	5 785	-20.82		-20.51	30.00	
	5 825	-21.64		-21.33	30.00	
802.11ac _VHT20	5 180	-15.31	0.32	-14.99	11.00	
	5 200	-14.65		-14.33	11.00	
	5 240	-14.59		-14.27	11.00	
	5 260	-14.22		-13.90	11.00	
	5 300	-14.22		-13.90	11.00	
	5 320	-14.30		-13.98	11.00	
	5 500	-15.19		-14.87	11.00	
	5 600	-16.08		-15.76	11.00	

	5 700	-17.46		-17.14	11.00	
	5 720	-17.18		-16.86	11.00	
	5 745	-20.46		-20.14	30.00	
	5 785	-20.70		-20.38	30.00	
	5 825	-21.87		-21.55	30.00	
802.11n _HT40	5 190	-18.44	0.61	-17.83	11.00	
	5 230	-18.20		-17.59	11.00	
	5 270	-17.70		-17.09	11.00	
	5 310	-17.37		-16.76	11.00	
	5 510	-18.50		-17.89	11.00	
	5 590	-19.11		-18.50	11.00	
	5 670	-19.64		-19.03	11.00	
	5 710	-20.50		-19.89	11.00	
	5 755	-23.96		-23.35	30.00	
	5 795	-24.09		-23.48	30.00	
802.11ac _VHT40	5 190	-18.48	0.59	-17.89	11.00	
	5 230	-18.22		-17.63	11.00	
	5 270	-17.98		-17.39	11.00	
	5 310	-17.28		-16.69	11.00	
	5 510	-18.49		-17.90	11.00	
	5 590	-19.14		-18.55	11.00	
	5 670	-19.69		-19.10	11.00	
	5 710	-20.86		-20.27	11.00	
	5 755	-23.99		-23.40	30.00	
	5 795	-24.42		-23.83	30.00	
802.11ac _VHT80	5 210	-21.39	1.15	-20.24	11.00	
	5 290	-20.59		-19.44	11.00	
	5 530	-22.50		-21.35	11.00	
	5 610	-22.90		-21.75	11.00	
	5 690	-23.64		-22.49	11.00	
	5 775	-28.35		-27.20	30.00	
Measurement uncertainty		± 1.5 dB				

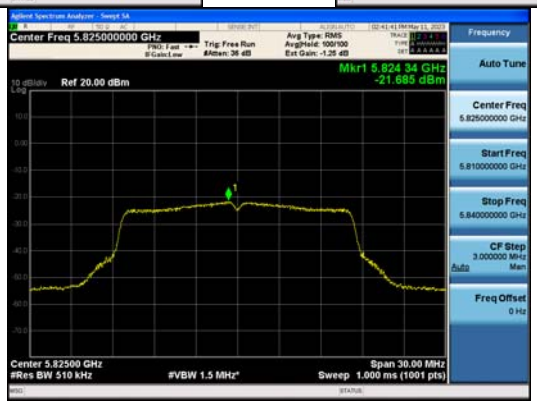
See next pages for actual measured spectrum plots.

802.11a_UNII 1

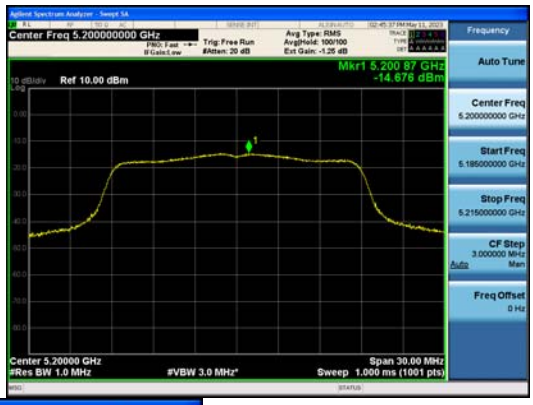


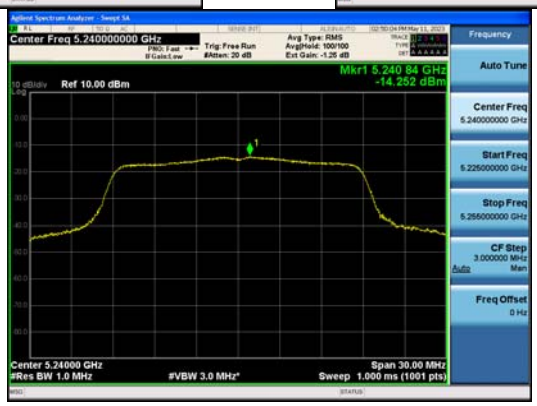
802.11a_UNII 2A

802.11a_UNII 2C

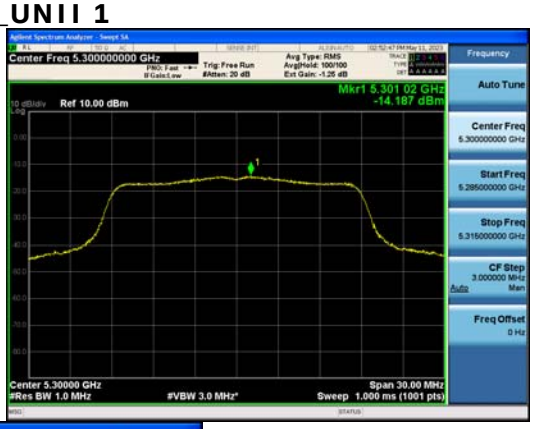


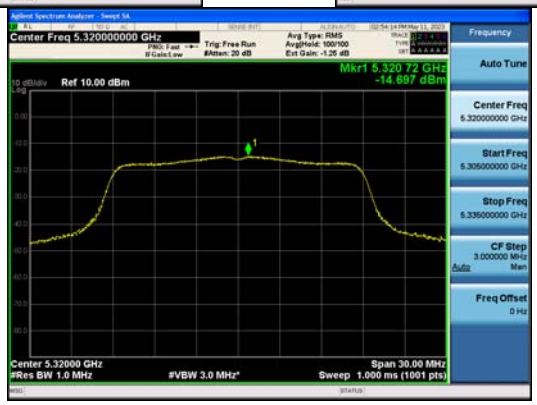
802.11a_UNII 3





802.11n_HT20_UNII 1

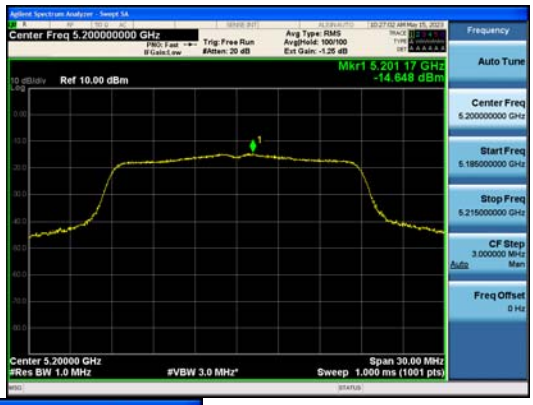




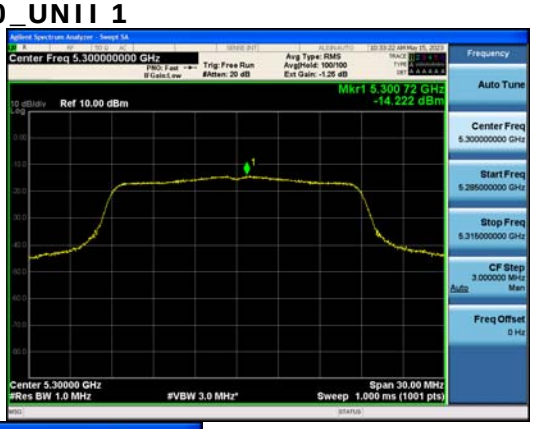
802.11n_HT20_UNII 2A

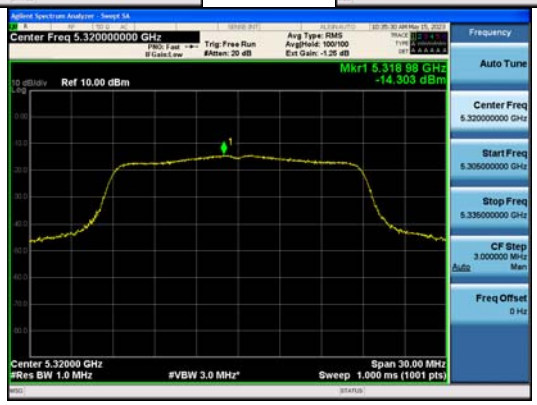
802.11n_HT20_UNII 2C

802.11n_HT20_UNII 3



802.11ac_VHT20_UNII 1





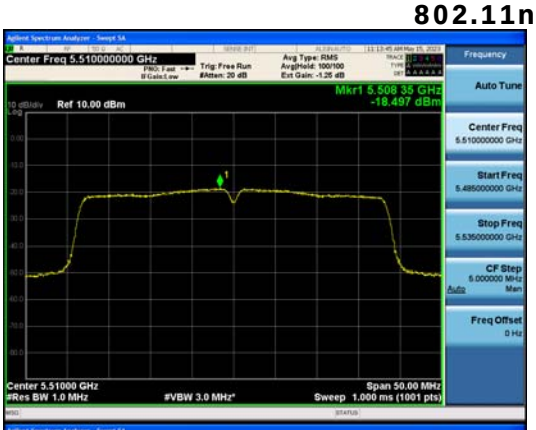
802.11ac_VHT20_UNII 2A

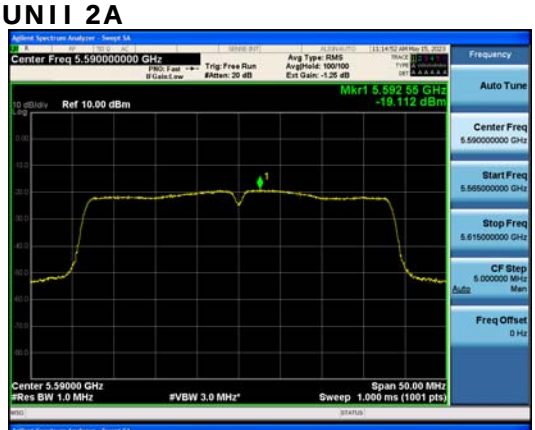
802.11ac_VHT20_UNII 2C

802.11ac_VHT20_UNII 3

802.11n_HT40_UNII 1

802.11n_HT40_UNII 2A

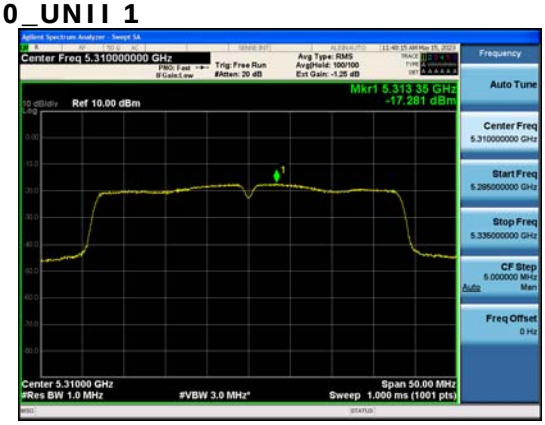




802.11n_HT40_UNII 2C

802.11n_HT40_UNII 3

802.11ac_VHT40_UNII 1



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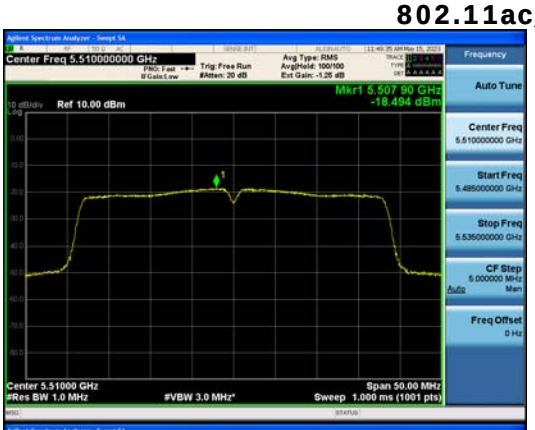
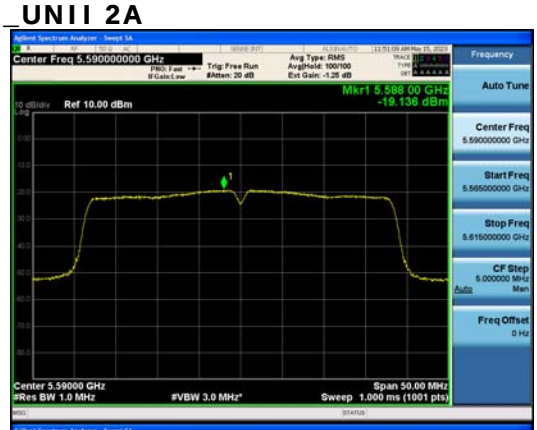




802.11ac_VHT40_UNII 2C

802.11ac_VHT40_UNII 3

802.11ac_VHT80_UNII 1

802.11ac_VHT80_UNII 2A

802.11ac_VHT80_UNII 2C

802.11ac_VHT80_UNII 3

4.5 Frequency Stability

Test Procedures
KDB 789033 – Section A.3

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -20 ℃ and +50 ℃(Declaration by the Manufacturer). The temperature was incremented by 10 ℃ intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.
Data for the worst case channel is shown below.

Measured Frequency Error (Hz)							
Voltage (VDC)	Temperature (℃) / Operating time(Minute)	Test Frequency (MHz)					
		5 180	5 200	5 240	5 260	5 300	5 320
3.30	-20 / 2	-6 388	-5 765	-5 487	-5 793	-5 573	-5 739
3.30	-20 / 5	-5 386	-5 302	-5 504	-5 706	-5 810	-5 851
3.30	-20 / 10	-5 487	-5 628	-5 476	-5 527	-5 527	-5 679
3.30	-10 / 2	7 293	7 747	7 901	7 852	7 968	7 903
3.30	-10 / 5	7 726	7 511	7 789	7 713	7 855	7 867
3.30	-10 / 10	7 737	7 824	7 990	7 965	7 879	7 797
3.30	0 / 2	8 548	8 488	8 546	8 458	8 571	8 586
3.30	0 / 5	8 388	8 399	8 461	8 374	8 468	8 515
3.30	0 / 10	8 339	8 367	8 456	8 380	8 478	8 514
3.30	0 / 2	8 548	8 488	8 546	8 458	8 571	8 586
3.30	0 / 5	8 388	8 399	8 461	8 374	8 468	8 515
3.30	0 / 10	8 339	8 367	8 456	8 380	8 478	8 514
3.30	10 / 2	3 161	2 777	2 583	2 406	2 389	2 437
3.30	10 / 5	2 330	2 327	2 374	2 253	2 302	2 359
3.30	10 / 10	2 887	2 373	2 300	2 193	2 258	2 281
3.30	20(Ref) / 2	-6 417	-7 157	-7 318	-7 610	-7 681	-7 560
3.30	20(Ref) / 5	-7 454	-7 493	-7 523	-7 650	-7 680	-7 687
3.30	20(Ref) / 10	-7 319	-7 367	-7 436	-7 614	-7 587	-7 556
3.30	30 / 2	-17 709	-17 839	-17 984	-18 153	-18 207	-18 264
3.30	30 / 5	-17 553	-17 670	-17 753	-17 860	-17 985	-18 088
3.30	30 / 10	-17 668	-17 776	-17 877	-18 066	-18 147	-18 154

3.30	40 / 2	-23 530	-23 907	-24 225	-24 518	-24 648	-24 783
3.30	40 / 5	-24 176	-24 329	-24 440	-24 663	-24 821	-24 874
3.30	40 / 10	-24 450	-24 552	-24 728	-24 868	-25 057	-25 145
3.30	50 / 2	-22 345	-22 108	-22 158	-22 478	-22 578	-22 550
3.30	50 / 5	-21 807	-21 793	-21 844	-22 021	-22 236	-22 342
3.30	50 / 10	-22 228	-22 203	-22 297	-22 670	-22 760	-22 900
2.805	20(Ref)	-7 307	-7 369	-7 370	-7 480	-7 500	-7 523
3.795	20(Ref)	-7 350	-7 402	-7 423	-7 596	-7 625	-7 597

Measured Frequency Error (kHz)							
Voltage (VDC)	Temperature (℃) / Operating time(Minute)	Test Frequency (MHz)					
		5 500	5 600	5 720	5 745	5 785	5 825
3.30	-20 / 2	-6 088	-6 061	-6 184	-6 207	-6 143	-6 113
3.30	-20 / 5	-6 194	-6 291	-6 724	-6 632	-6 426	-6 578
3.30	-20 / 10	-5 822	-6 136	-6 135	-6 345	-6 319	-6 296
3.30	-10 / 2	8 184	8 501	8 614	8 531	8 644	8 756
3.30	-10 / 5	8 093	8 254	8 307	8 531	8 585	8 674
3.30	-10 / 10	8 124	8 273	8 395	8 454	8 570	8 543
3.30	0 / 2	8 952	9 127	9 181	9 207	9 358	9 446
3.30	0 / 5	8 845	9 053	9 179	9 210	9 272	9 355
3.30	0 / 10	8 831	9 090	9 155	9 262	9 328	9 411
3.30	0 / 2	8 952	9 127	9 260	9 207	9 358	9 446
3.30	0 / 5	8 845	9 053	9 179	9 210	9 272	9 355
3.30	0 / 10	8 831	9 090	9 155	9 262	9 328	9 411
3.30	10 / 2	2 583	2 681	2 786	2 773	2 762	2842
3.30	10 / 5	2 513	2 580	2 496	2 561	2 593	2 603
3.30	10 / 10	2 434	2 515	2 486	2 521	2 567	2 588
3.30	20(Ref) / 2	-7 830	-7 660	-8 171	-8 110	-8 152	-8 184
3.30	20(Ref) / 5	-7 852	-7 950	-8 174	-8 226	-8 253	-8 282
3.30	20(Ref) / 10	-7 740	-7 838	-8 153	-8 213	-8 268	-8 281
3.30	30 / 2	-18 802	-18 971	-19 414	-19 511	-19 635	-19 714
3.30	30 / 5	-18 553	-18 863	-19 315	-19 451	-19 581	-19 705
3.30	30 / 10	-18 674	-18 950	-19 487	-19 524	-19 606	-19 828
3.30	40 / 2	-25 513	-25 980	-26 592	-26 666	-26 826	-27 028
3.30	40 / 5	-25 655	-26 099	-26 635	-26 803	-26 929	-27 098
3.30	40 / 10	-25 889	-26 346	-26 935	-27 034	-27 216	-27 363

3.30	50 / 2	-23 483	-24 010	-24 187	-24 357	-24 392	-24 487
3.30	50 / 5	-22 985	-24 058	-24 084	-23 944	-24 079	-24 082
3.30	50 / 10	-23 714	-24 122	-24 476	-24 568	-24 674	-24 792
2.805	20(Ref)	-7 743	-7 813	-8 086	-8 139	-8 212	-8 411
3.795	20(Ref)	-7 760	-7 825	-8 057	-8 074	-8 134	-8 216

Note :

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature range as tested.

4.6 Unwanted Emissions

Test Location

☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

KDB 789033 - Section G
ANSI C63.10-2013 – Section 12.7

1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings :

Frequency Range = 9 kHz ~ 40 GHz (5 GHz 10th harmonic)

a) RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz,

200 Hz for f < 150 kHz

b) VBW ≥ RBW

c) Sweep time = auto couple

Limit

1. UNII 1, 2A : All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

2. UNII 2C : All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

3. UNII 3 : All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

* E.I.R.P -27 dBm/MHz
E[dBuV/m] = EIRP[dBm] + 95.2, for d = 3m

4. Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.

- 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

5. FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
[1]0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	[2]Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

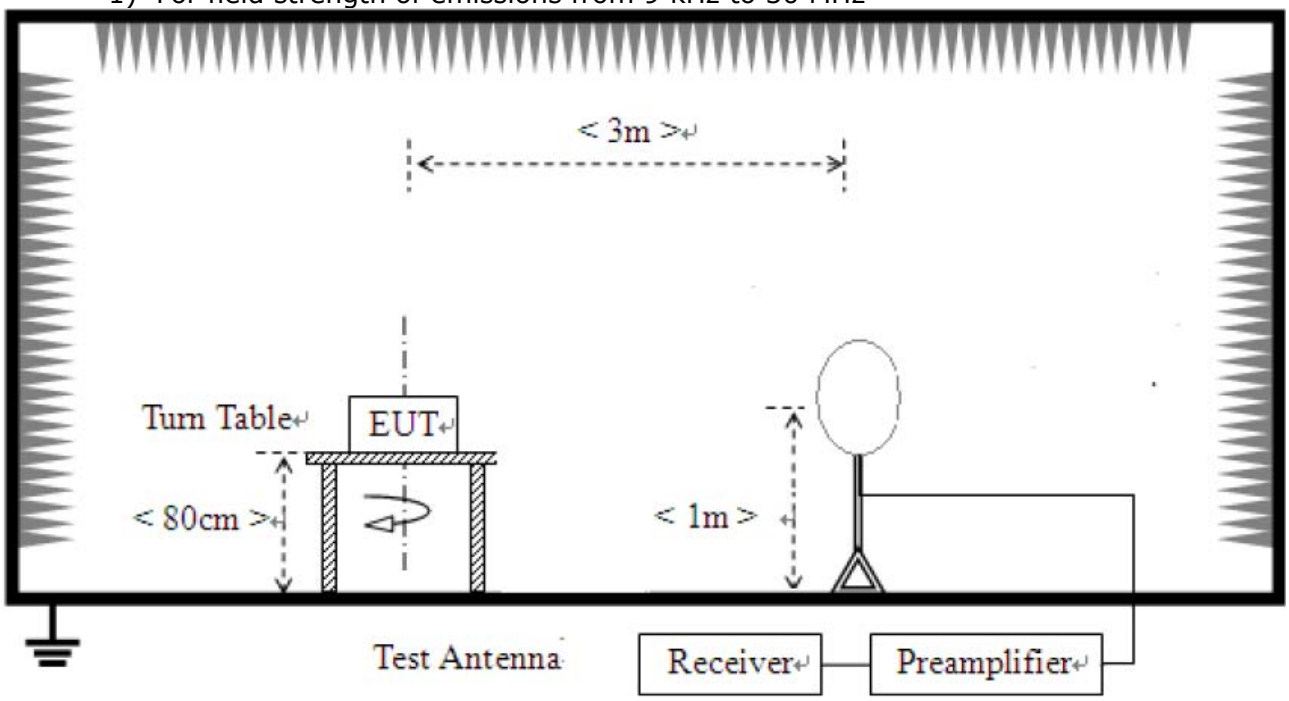
§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Note :

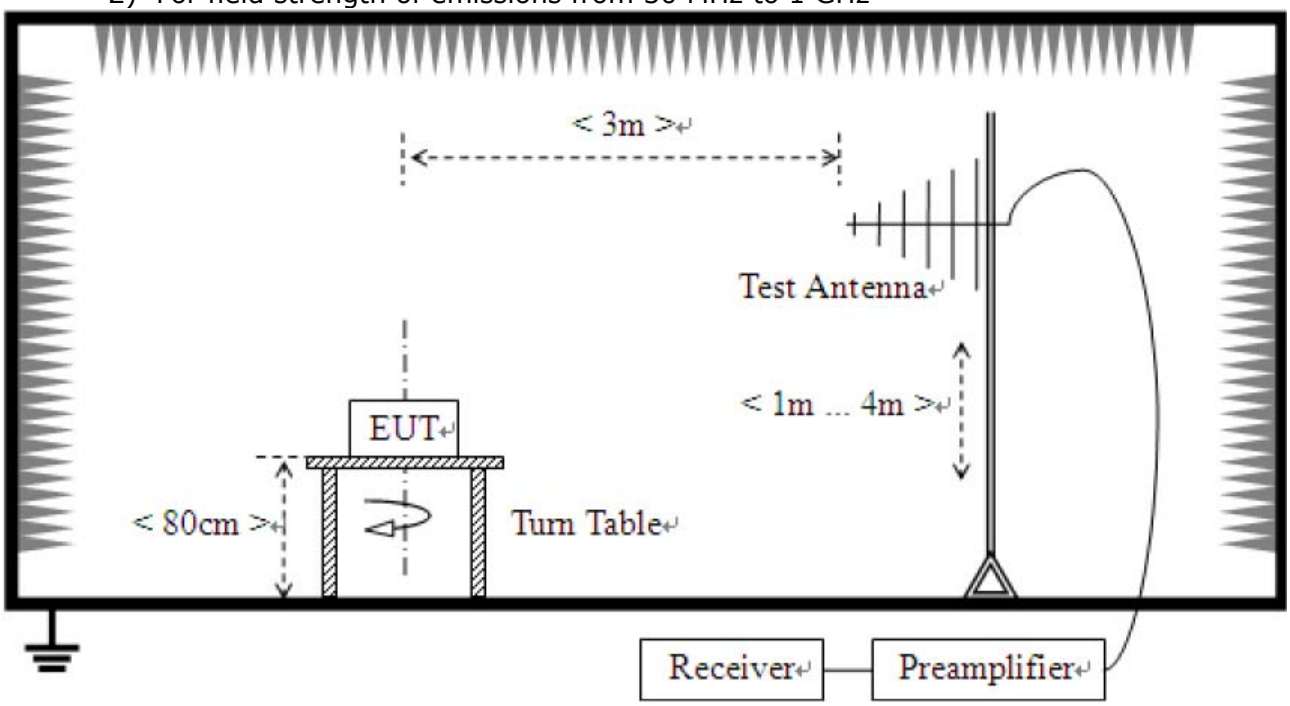
1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

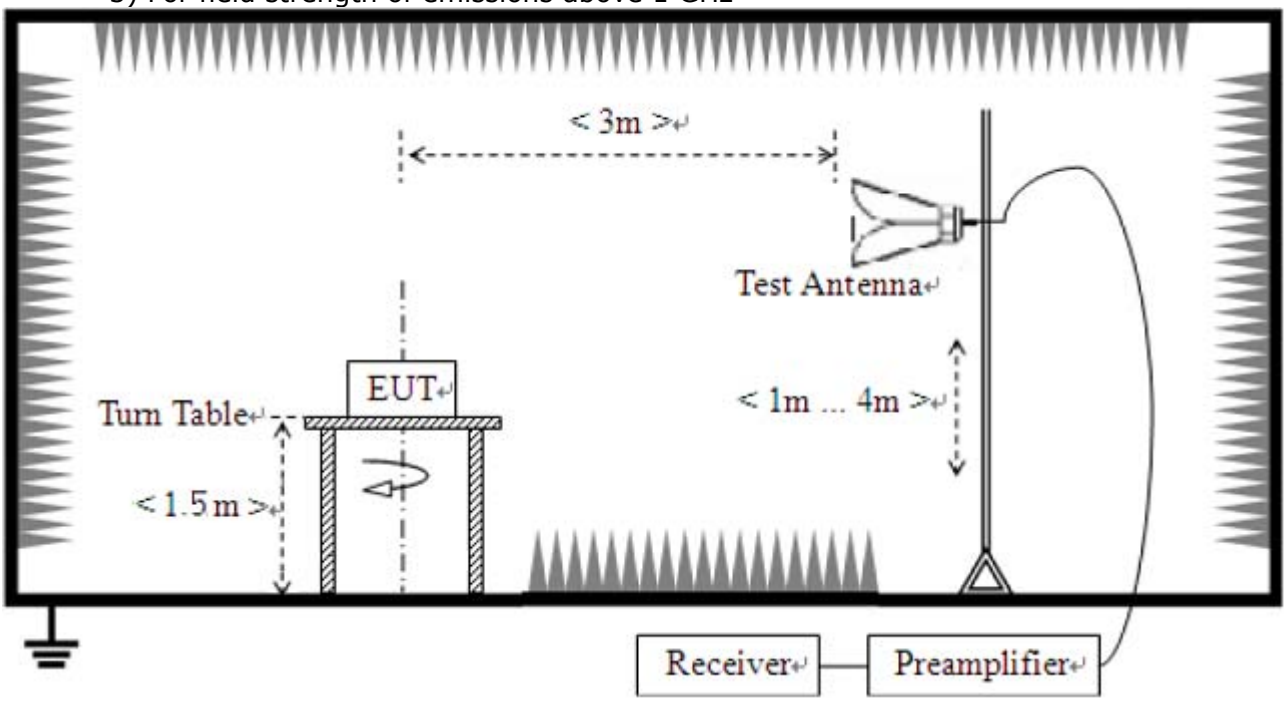
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



Test Mode

We have done all test mode.
So the results are only attached worst cases.

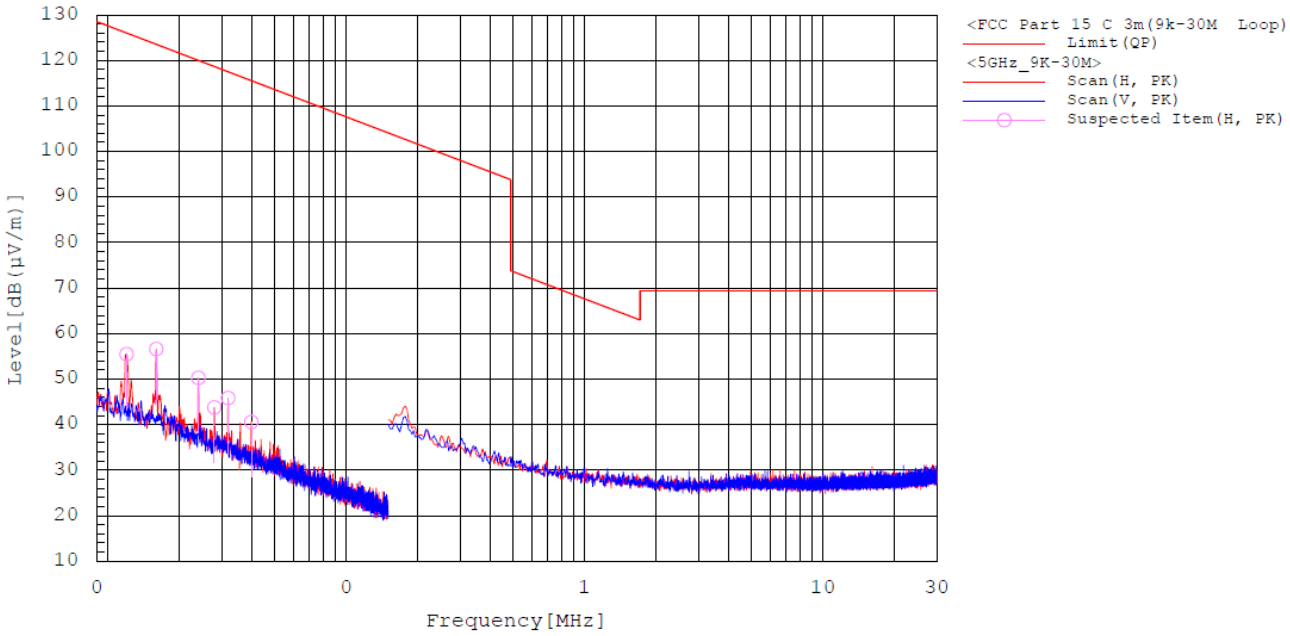
Test Results

1) 9 kHz to 30 MHz

Test mode : Transmitter (Worst Case)

The requirements are:
☒ Complies

Test Data



Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
The emissions 9 kHz to 30 MHz were 20 dB lower than the limit.						

Remark :
1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down positon(X,Y axis). The worst emission was found in lie-down positon(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.