



Test report No. : 4789623666-US-R1-V0
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Issued date : Jun. 2, 2021
FCC ID : 2ADEZWUBT236ACN

RADIO TEST REPORT

Product : 802.11ac/a/b/g/n USB Dongle
Model Name : 100097489
FCC ID : 2ADEZWUBT236ACN
Test Regulation : FCC 47 CFR Part 15 Subpart E (Section 15.407)
Received Date : Jul. 22, 2020
Test Date : Sep. 7, 2020 ~ Oct. 12, 2020
Issued Date : Jun. 2, 2021

Applicant : Life Technologies Holdings Pte Ltd
33, Marsiling Industrial Estate Road 3, #07-06, Singapore
739256

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



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Doc No: 17-EM-F0878 / 5.0



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1. Attestation of Test Results

APPLICANT: Life Technologies Holdings Pte Ltd
 33, Marsiling Industrial Estate Road 3, #07-06, Singapore 739256

MANUFACTURER SparkLAN Communications, Inc.
 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493,
 Taiwan

EUT DESCRIPTION: 802.11ac/a/b/g/n USB Dongle

MODEL: 100097489

SAMPLE STAGE: Production Unit

DATE of TESTED: Sep. 7, 2020 ~ Oct. 12, 2020

APPLICABLE STANDARDS	
STANDARD	Test Results
FCC 47 CFR PART 15 Subpart E (Section 15.407)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin

Cindy Hsin
 Project Handler

Date : Jun. 2, 2021

Approved and Authorized By:

Mike Cai

Mike Cai
 Engineer Project Associate

Date : Jun. 2, 2021

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2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.407(e)	6dB Bandwidth	PASS
15.403(i)	26dB Bandwidth	PASS
2.1049	Occupied Bandwidth	See Note2
15.407(a)(1/2/3)	Conducted Output Power	PASS
15.407(a)(1/2/3)	Power Spectral Density	PASS
15.407(g)	Frequency Stability	PASS
15.407(b) (1/2/3/4(i/ii)/6)	Radiated Emissions and Band Edge Measurement	PASS
15.407(b)(6)	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS
15.407(h)	Dynamic Frequency Selection	See Note3

Note:

1. For the Radiated Band Edge and OOB test plots were recorded in Appendix I, the Radiated Emissions test plots were recorded in Appendix II.
2. The Occupied Bandwidth was reference only.
3. The “Dynamic Frequency Selection measurement” was recorded in Report No.: 4789623666-US-R2-V0.

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3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB 789033 D02 General UNII Test Procedure New Rules v02r01, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

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5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	1.5
RF Conducted	9 kHz - 40GHz	2	1.0
Radiated disturbance below 30MHz	9 kHz - 30 MHz	2	1.9
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	2	5.4
Radiated disturbance above 1GHz	1GHz ~ 40GHz	2	4.7

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6. Equipment under Test

6.1. Description of EUT

Product	802.11ac/a/b/g/n USB Dongle	
Model Name	100097489	
Operating Frequency	5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5700 MHz, 5745 ~ 5825 MHz	
Modulation	256QAM, 64QAM, 16QAM, QPSK, BPSK	
Transfer Rate	802.11a: up to 54 Mbps 802.11n: up to MCS15 802.11ac: up to MCS9	
Number of Channel	5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
	5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
	5500 ~ 5700 MHz	11 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		5 for 802.11n (HT40), 802.11 ac (VHT40)
		2 for 802.11ac (VHT80)
	5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
Maximum Output Power	5180 ~ 5240 MHz: 14.92 dBm 5260 ~ 5320 MHz: 16.89 dBm 5500 ~ 5700 MHz: 16.85 dBm 5745 ~ 5825 MHz: 13.81 dBm	
Normal Voltage	5 Vdc	
S/N	20960Y1050004	
Software Version	N/A	

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Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11a	1TX,1RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX
802.11ac (VHT20)	2TX,2RX
802.11ac (VHT40)	2TX,2RX
802.11ac (VHT80)	2TX,2RX

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40, therefore investigated worst case to representative mode in test report.

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

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6.2. Channel List

FOR 5180 ~ 5240MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
42	5210MHz

FOR 5260 ~ 5320MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
52	5260 MHz	60	5300 MHz
56	5280 MHz	64	5320 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
58	5290MHz

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FOR 5500 ~ 5700MHz

11 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
100	5500 MHz	124	5620 MHz
104	5520 MHz	128	5640 MHz
108	5540 MHz	132	5660 MHz
112	5560 MHz	136	5680 MHz
116	5580 MHz	140	5700 MHz
120	5600 MHz	-	-

5 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
102	5510 MHz	126	5630 MHz
110	5550 MHz	134	5670 MHz
118	5590 MHz	-	-

2 channels are provided for 802.11ac (VHT80):

Channel	Frequency	Channel	Frequency
106	5530MHz	122	5610MHz

FOR 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
149	5745MHz	161	5805MHz
153	5765MHz	165	5825MHz
157	5785MHz	-	-

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
155	5775MHz

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6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	22~26°C / 63~68%RH	120Vac / 60 Hz	Sep. 7, 2020 ~ Oct. 12, 2020	Carlos Chen
Radiated Spurious Emission	966-2	23~25°C / 64~68%RH	120Vac / 60 Hz	Sep. 7, 2020 ~ Oct. 12, 2020	Carlos Chen
AC power Line Conducted Emission	SR1	22~26°C / 63~68%RH	120Vac / 60 Hz	Sep. 7, 2020 ~ Oct. 12, 2020	Carlos Chen

FCC Test Firm Registration Number: 498077

6.4. Description Of Available Antennas

Ant. No.	Brand Name	Model Name	Ant. Type	Frequency Band (MHz)	Ant. Gain (dBi)
0	N/A	N/A	PCB	5150	3.3
				5500	3.7
				5825	4.2
1	N/A	N/A	PCB	5150	3.1
				5500	3.5
				5825	4

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

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6.5. Test Mode Applicability and Tested Channel Detail

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- The fundamental of the EUT was investigated in three orthogonal axes X/Y/Z, it was determined that X axis was worst-case. Therefore, all final radiated testing was performed with the EUT in X axis.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case).

Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6.0
	802.11ac (VHT20)		OFDM	36 to 48	36, 44, 48	MCS0
	802.11ac (VHT40)		OFDM	38 to 46	38, 46	MCS0
	802.11ac (VHT80)		OFDM	42	42	MCS0
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6.0
	802.11ac (VHT20)		OFDM	52 to 64	52, 60, 64	MCS0
	802.11ac (VHT40)		OFDM	54 to 62	54, 62	MCS0
	802.11ac (VHT80)		OFDM	58	58	MCS0
	802.11a	5500-5700	OFDM	100 to 140	100, 116, 140	6.0
	802.11ac (VHT20)		OFDM	100 to 140	100, 116, 140	MCS0
	802.11ac (VHT40)		OFDM	102 to 134	102, 110, 134	MCS0
	802.11ac (VHT80)		OFDM	106, 122	106, 122	MCS0
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6.0
	802.11ac (VHT20)		OFDM	149 to 165	149, 157, 165	MCS0
	802.11ac (VHT40)		OFDM	151 to 159	151, 159	MCS0
	802.11ac (VHT80)		OFDM	155	155	MCS0
Radiated Emissions (Below 1GHz)	802.11ac (VHT40)	5500-5700	OFDM	102 to 134	102	MCS0
AC Power Line Conducted Emission	802.11ac (VHT40)	5500-5700	OFDM	102 to 134	102	MCS0

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Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate
Antenna Port Conducted Measurement	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6.0
	802.11ac (VHT20)		OFDM	36 to 48	36, 44, 48	MCS0
	802.11ac (VHT40)		OFDM	38 to 46	38, 46	MCS0
	802.11ac (VHT80)		OFDM	42	42	MCS0
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6.0
	802.11ac (VHT20)		OFDM	52 to 64	52, 60, 64	MCS0
	802.11ac (VHT40)		OFDM	54 to 62	54, 62	MCS0
	802.11ac (VHT80)		OFDM	58	58	MCS0
	802.11a	5500-5700	OFDM	100 to 140	100, 116, 140	6.0
	802.11ac (VHT20)		OFDM	100 to 140	100, 116, 140	MCS0
	802.11ac (VHT40)		OFDM	102 to 134	102, 110, 134	MCS0
	802.11ac (VHT80)		OFDM	106, 122	106, 122	MCS0
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6.0
	802.11ac (VHT20)		OFDM	149 to 165	149, 157, 165	MCS0
	802.11ac (VHT40)		OFDM	151 to 159	151, 159	MCS0
	802.11ac (VHT80)		OFDM	155	155	MCS0

Co-Location Mode

Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate
Radiated Emissions	802.11ac (VHT40)	5500-5700	OFDM	102 to 134	102	MCS0
	BT	2402-2480	GFSK	0 to 78	0	DH5
AC Power Line Conducted Emission	802.11ac (VHT40)	5500-5700	OFDM	102 to 134	102	MCS0
	BT	2402-2480	GFSK	0 to 78	0	DH5

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6.6. Duty cycle

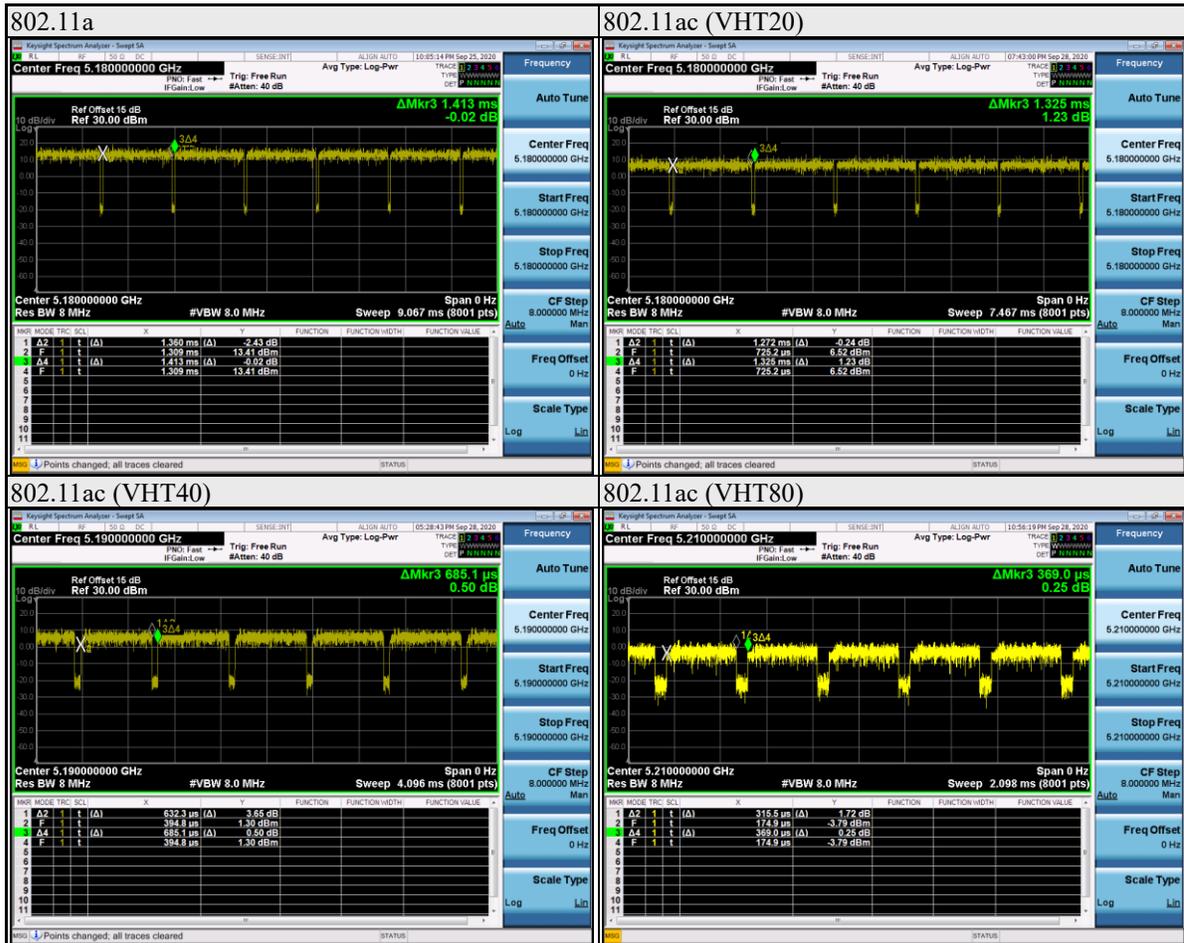
Duty cycle of test signal is < 98 %, duty factor is required.

802.11a: Duty cycle = 1.36/1.413 = 0.962, Duty factor = 10 * log(1/0.962) = 0.17

802.11ac (VHT20): Duty cycle = 1.272/1.325 = 0.96, Duty factor = 10 * log(1/0.96) = 0.18

802.11ac (VHT40): Duty cycle = 0.632/0.685 = 0.923, Duty factor = 10 * log(1/0.923) = 0.35

802.11ac (VHT80): Duty cycle = 0.315/0.369 = 0.854, Duty factor = 10 * log(1/0.854) = 0.69



Note: $T_{on} = \text{Mark2} - \text{Mark1}$, $T_{on} + T_{off} = \text{Mark3} - \text{Mark1}$.



7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 13, 2019	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Dec. 17, 2019	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 19, 2019	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 3, 2020	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 3, 2020	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	Dec. 27, 2019	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jun. 9, 2020	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Feb. 4, 2020	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	May 19, 2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	Jul. 2, 2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	Jan. 8, 2020	1 year

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 6, 2019	1 year
Pulse Power Sensor	Anritsu	MA2411B	1531202	Dec. 23, 2019	1 year
Power Meter	Anritsu	ML2495A	1645002	Dec. 23, 2019	1 year
Temperature & Humidity Test Chamber	GIANT FORCE	GTH-150-40-CP-AR	MAA1701-010	Mar. 23,2020	1 year
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	Nov. 19, 2019	1 year
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	Aug. 19, 2020	1 year
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	Aug. 12, 2020	1 year
Cables	HARBOUR INDUSTRIES	LL142	170205-5000-1	Feb. 5, 2020	1 year

UL Software		
Description	Name	Version
Radiated measurement	EZ_EMCC	1.1.4.2
Conducted measurement	Keysight.TestSystem	1.0.0.0
AC power Line Conducted Emission	EZ_EMCC	1.1.4.2

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8. Description of Test Setup

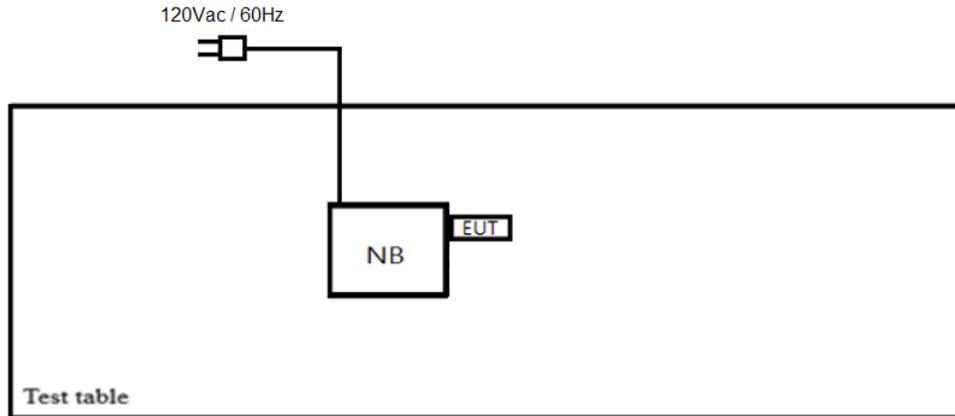
Support Equipment

Equipment	Brand Name	Model Name	S/N	Remark
Notebook	Lenovo	T430	PBE38AK	N/A

Test Setup

Controlled using a bespoke application (Realtek 11ac 8822B USB WLAN MP Version 0.0006.00.20180227) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test



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9. Test Results

9.1. 6dB Bandwidth

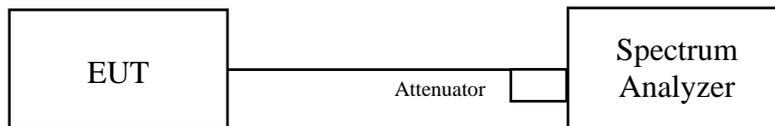
Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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Doc No: 17-EM-F0878 / 5.0



Test Data

802.11a

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
149	5745	16.308	0.5	Pass
157	5785	16.297	0.5	Pass
165	5825	16.308	0.5	Pass

802.11ac (VHT20)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
149	5745	17.126	17.006	0.5	Pass
157	5785	16.826	17.01	0.5	Pass
165	5825	16.927	17.04	0.5	Pass

802.11ac (VHT40)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
151	5755	35.842	35.632	0.5	Pass
159	5795	35.82	36.262	0.5	Pass

802.11ac (VHT80)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
155	5775	75.12	75.075	0.5	Pass

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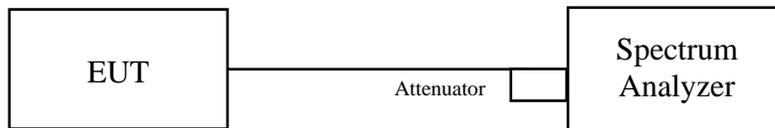


9.2. 26dB Bandwidth

Test procedure

- a. Set RBW = approximately 1% of the emission bandwidth.
- b. Set the 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 peak 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%.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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Test Data

802.11a

CHANNEL	CHANNEL FREQUENCY (MHz)	26 dB Bandwidth (MHz)	PASS / FAIL
36	5180	20.97	PASS
44	5220	21.05	PASS
48	5240	21.1	PASS
52	5260	21.35	PASS
60	5300	20.84	PASS
64	5320	20.73	PASS
100	5500	20.95	PASS
116	5580	20.94	PASS
140	5700	20.68	PASS

802.11ac (VHT20)

CHANNEL	CHANNEL FREQUENCY (MHz)	26 dB Bandwidth (MHz)		PASS / FAIL
		CHAIN 0	CHAIN 1	
36	5180	21.41	21.37	PASS
44	5220	21.32	21.45	PASS
48	5240	21.37	21.28	PASS
52	5260	20.97	21.28	PASS
60	5300	21.25	21.31	PASS
64	5320	21.2	21.29	PASS
100	5500	21.26	21.36	PASS
116	5580	21.18	21.4	PASS
140	5700	21.3	21.29	PASS

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802.11ac (VHT40)

CHANNEL	CHANNEL FREQUENCY (MHz)	26 dB Bandwidth (MHz)		PASS / FAIL
		CHAIN 0	CHAIN 1	
38	5190	44.16	44.51	PASS
46	5230	43.29	44.09	PASS
54	5270	43.51	43.71	PASS
62	5310	43.77	44.5	PASS
102	5510	44.6	43.79	PASS
110	5550	43.67	43.92	PASS
134	5670	44.05	43.55	PASS

802.11ac (VHT80)

CHANNEL	CHANNEL FREQUENCY (MHz)	26 dB Bandwidth (MHz)		PASS / FAIL
		CHAIN 0	CHAIN 1	
42	5210	82.71	82.28	PASS
58	5290	82.49	82.14	PASS
106	5530	82.79	82.24	PASS
122	5610	82.42	81.89	PASS

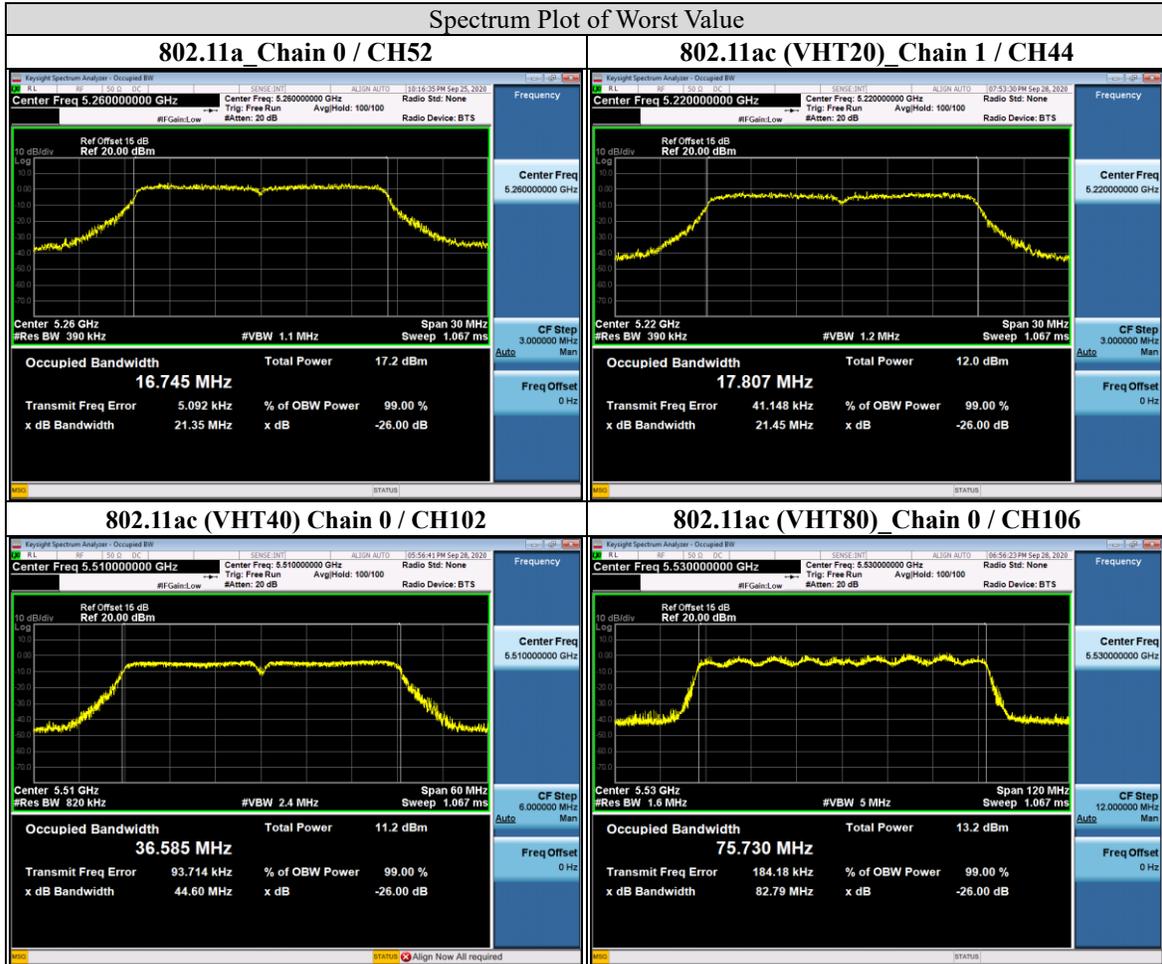
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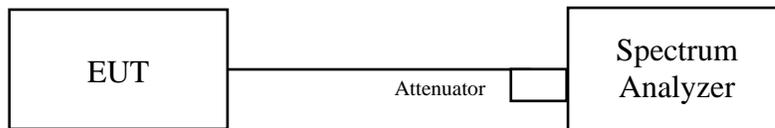


9.3. Occupied Bandwidth

Test procedure

- a. Set center frequency to the nominal EUT channel center frequency.
- b. Set span = 1.5 times to 5.0 times the OBW.
- c. Set RBW = 1% to 5% of the OBW
- d. Set VBW $\geq 3 \times$ RBW
- e. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f. Use the 99% power bandwidth function of the instrument (if available).
- g. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.



Test Data

802.11a

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)
36	5180	16.657
44	5220	16.694
48	5240	16.687
52	5260	16.653
60	5300	16.654
64	5320	16.652
100	5500	16.646
116	5580	16.677
140	5700	16.684
149	5745	16.653
157	5785	16.681
165	5825	16.652

802.11ac (VHT20)

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		CHAIN 0	CHAIN 1
36	5180	17.772	17.747
44	5220	17.687	17.763
48	5240	17.707	17.767
52	5260	17.711	17.769
60	5300	17.706	17.773
64	5320	17.726	17.754
100	5500	17.698	17.759
116	5580	17.723	17.747
140	5700	17.709	17.759
149	5745	17.693	17.752
157	5785	17.723	17.764
165	5825	17.705	17.791

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802.11ac (VHT40)

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		CHAIN 0	CHAIN 1
38	5190	36.526	36.537
46	5230	36.565	36.596
54	5270	36.577	36.589
62	5310	36.578	36.621
102	5510	36.491	36.65
110	5550	36.576	36.594
134	5670	36.584	36.588
151	5755	36.6	36.677
159	5795	36.509	36.585

802.11ac (VHT80)

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		CHAIN 0	CHAIN 1
42	5210	75.673	75.697
58	5290	75.697	75.724
106	5530	75.663	75.683
122	5610	75.641	75.665
155	5775	75.649	75.659

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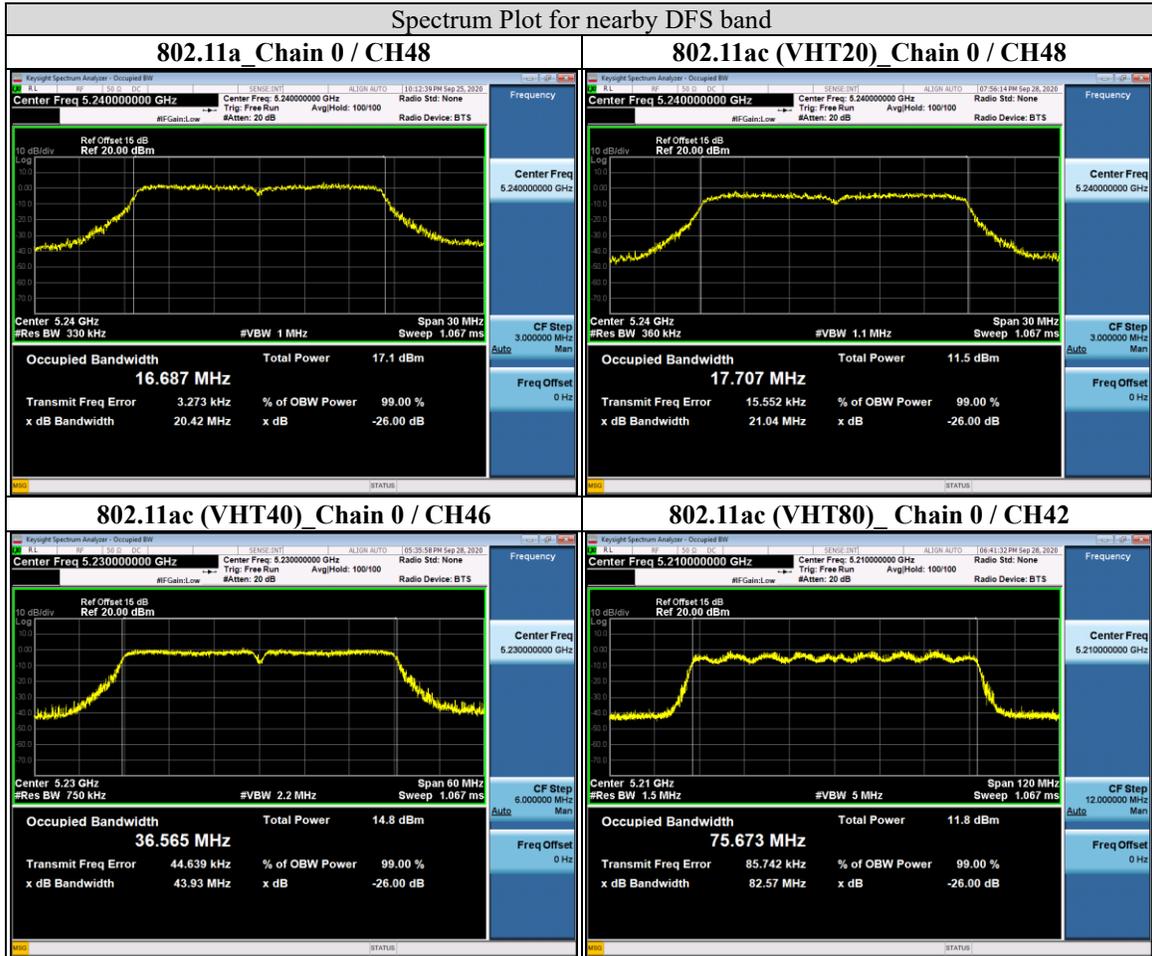


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Modulation	Channel	Channel Frequency (MHz)	Highest Occupied Channel Edge (MHz)
			CHAIN 0
802.11a	CH48	5240	5248.344
802.11ac (VHT20)	CH48	5240	5248.854
802.11ac (VHT40)	CH46	5230	5248.283
802.11ac (VHT80)	CH42	5210	5247.837

Note:

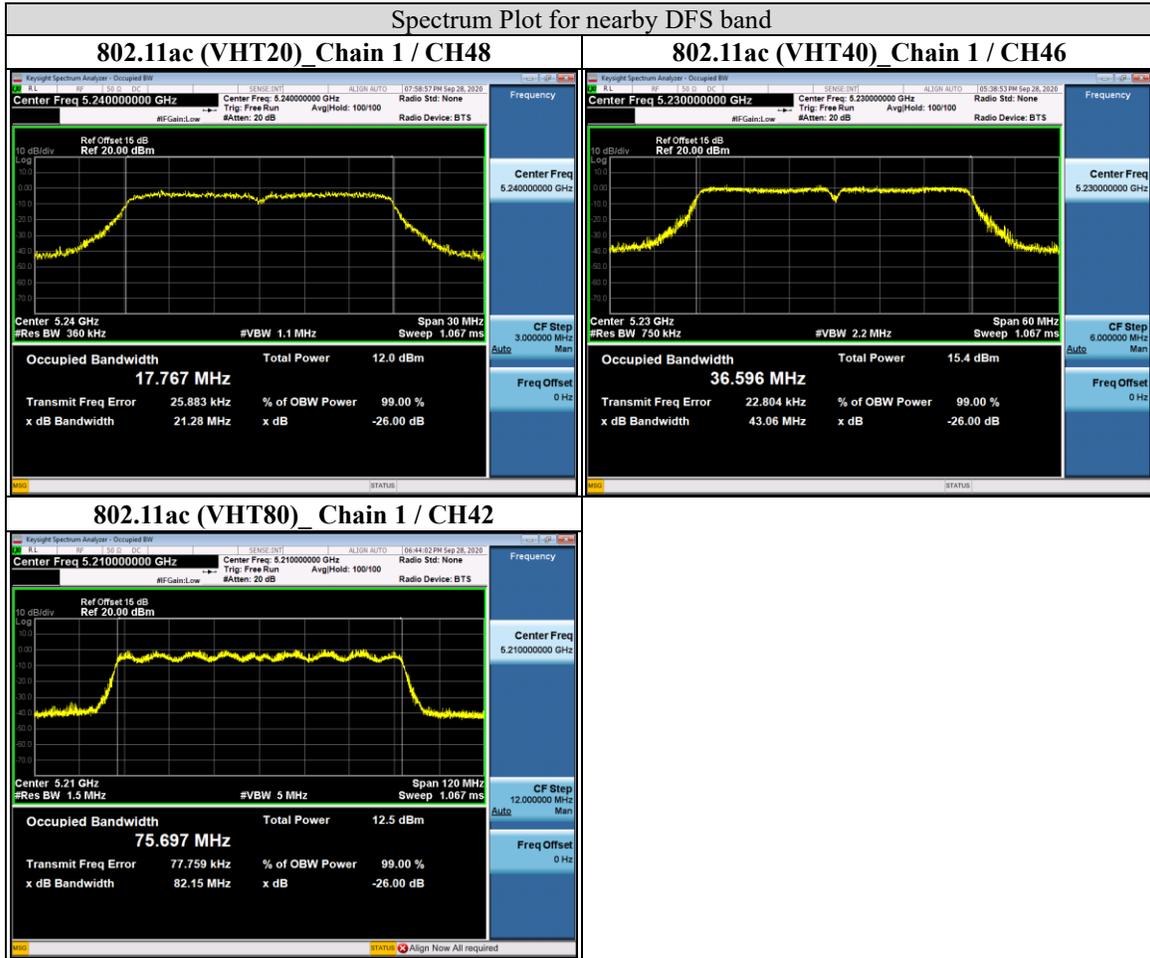
- The Highest Occupied Channel Edge is all <5250 MHz, so in nearby DFS band channels no need for DFS function
- Highest Occupied Channel Edge frequency calculation = Center Frequency + (1/2*Occupied Bandwidth)

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Modulation	Channel	Channel Frequency (MHz)	Highest Occupied Channel Edge (MHz)
			CHAIN 1
802.11ac (VHT20)	CH48	5240	5248.884
802.11ac (VHT40)	CH46	5230	5248.298
802.11ac (VHT80)	CH42	5210	5247.849

Note:

- The Highest Occupied Channel Edge is all <5250 MHz, so in nearby DFS band channels no need for DFS function
- Highest Occupied Channel Edge frequency calculation = Center Frequency + (1/2*Occupied Bandwidth)

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9.4. Conducted output power

Requirements

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	1 Watt (30 dBm) Max. e.i.r.p \leq 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon If $G_{TX} > 6$ dBi, then $P_{Out} = 30 - (G_{TX} - 6)$
		Fixed point-to-point Access Point	1 Watt (30 dBm) If $G_{TX} > 23$ dBi, then $P_{Out} = 30 - (G_{TX} - 23)$
		Indoor Access Point	1 Watt (30 dBm) If $G_{TX} > 6$ dBi, then $P_{Out} = 30 - (G_{TX} - 6)$
	V	Client device	250mW (24 dBm) If $G_{TX} > 6$ dBi, then $P_{Out} = 24 - (G_{TX} - 6)$
U-NII-2A	---		250mW (24 dBm) or 11 dBm+10 log B* If $G_{TX} > 6$ dBi, then $P_{Out} = 24 - (G_{TX} - 6)$
U-NII-2C	---		250mW (24 dBm) or 11 dBm+10 log B* If $G_{TX} > 6$ dBi, then $P_{Out} = 24 - (G_{TX} - 6)$
U-NII-3	---		For Point-to-multipoint systems (P2M): 1 Watt (30 dBm). If $G_{TX} > 6$ dBi, then $P_{Out} = 30 - (G_{TX} - 6)$ For Point-to-point systems (P2P): 1 Watt (30 dBm)

Note:

- P_{Out} = maximum conducted output power in dBm,
- G_{TX} = the maximum transmitting antenna directional gain in dBi.
- Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / N_{ant}]$ dBi.

N_{ant} : Number of Transmit Antennas

$G1, G2, \dots, Gn$: Gain of Individual Antennas

- B is the 26 dB emission bandwidth in megahertz

Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

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Test Procedure

For Average Power Measurement

Test method PM-G

For 802.11a, 802.11ac (VHT20), 802.11ac (VHT40)

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst and set the detector to AVERAGE. Duty factor is not added to measured value.

Test method SA-1

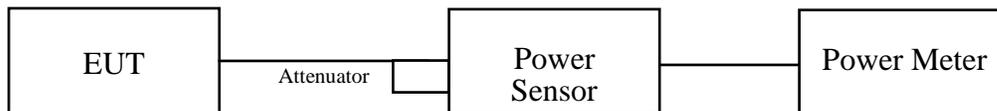
For 802.11ac (VHT80)

- Set span to encompass the entire EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- Set RBW = 1 MHz.
- Set VBW \geq 3 MHz
- Number of points in sweep \geq 2 Span / RBW.
- Sweep time = auto.
- Detector = RMS.
- Trace average at least 100 traces in power averaging mode.
- Compute power by integrating the spectrum across the EBW of the signal.

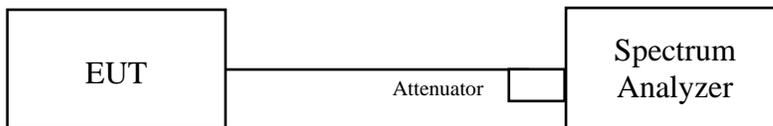
* If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle \geq 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run.”

Test Setup

For Average Power Measurement



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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Test Data

802.11a

CHAN.	FREQ. (MHz)	MAXIMUM CONDUCTED POWER (dBm)	TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
36	5180	14.87	30.69	14.87	24	PASS
44	5220	14.77	29.992	14.77	24	PASS
48	5240	14.91	30.974	14.91	24	PASS
52	5260	14.85	30.549	14.85	24	PASS
60	5300	14.87	30.69	14.87	24	PASS
64	5320	14.92	31.046	14.92	24	PASS
100	5500	14.68	29.376	14.68	24	PASS
116	5580	14.81	30.269	14.81	24	PASS
140	5700	14.66	29.242	14.66	24	PASS
149	5745	14.44	27.797	14.44	30	PASS
157	5785	14.36	27.29	14.36	30	PASS
165	5825	14.79	30.13	14.79	30	PASS

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802.11ac (VHT20)

CHAN.	FREQ. (MHz)	MAXIMUM CONDUCTED POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		chain 0	chain 1				
36	5180	11.34	10.56	24.99	13.98	24	PASS
44	5220	10.72	10.81	23.853	13.78	24	PASS
48	5240	11.12	10.73	24.772	13.94	24	PASS
52	5260	13.79	13.63	47	16.72	24	PASS
60	5300	13.88	13.76	48.202	16.83	24	PASS
64	5320	13.82	13.67	47.38	16.76	24	PASS
100	5500	13.87	13.88	48.812	16.89	24	PASS
116	5580	13.95	13.72	48.381	16.85	24	PASS
140	5700	13.46	13.79	46.115	16.64	24	PASS
149	5745	13.72	13.86	47.872	16.80	30	PASS
157	5785	13.82	13.88	48.533	16.86	30	PASS
165	5825	13.58	13.78	46.681	16.69	30	PASS

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802.11ac (VHT40)

CHAN.	FREQ. (MHz)	MAXIMUM CONDUCTED POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		chain 0	chain 1				
38	5190	11.95	11.44	29.6	14.71	24	PASS
46	5230	13.78	13.69	47.266	16.75	24	PASS
54	5270	13.81	13.76	47.812	16.80	24	PASS
62	5310	10.00	10.02	20.046	13.02	24	PASS
102	5510	10.75	10.99	24.445	13.88	24	PASS
110	5550	13.79	13.81	47.977	16.81	24	PASS
134	5670	13.74	13.94	48.433	16.85	24	PASS
151	5755	13.52	13.52	44.982	16.53	30	PASS
159	5795	13.55	13.67	45.927	16.62	30	PASS

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802.11ac (VHT80)

CHAN.	FREQ. (MHz)	MAXIMUM CONDUCTED POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		chain 0	chain 1				
42	5210	9.04	8.93	15.833	12.00	24	PASS
58	5290	7.13	7.05	10.234	10.10	24	PASS
106	5530	10.58	10.26	22.046	13.43	24	PASS
122	5610	10.47	10.56	22.519	13.53	24	PASS
155	5775	10.69	10.91	24.053	13.81	30	PASS

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9.5. Power Spectral Density

Requirements

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	17dBm/ MHz If $G_{TX} > 6$ dBi, then $PSD = 17 - (G_{TX} - 6)$
		Fixed point-to-point Access Point	17dBm/ MHz If $G_{TX} > 23$ dBi, then $PSD = 17 - (G_{TX} - 23)$
		Indoor Access Point	17dBm/ MHz If $G_{TX} > 6$ dBi, then $PSD = 17 - (G_{TX} - 6)$
	√	Client device	11dBm/ MHz If $G_{TX} > 6$ dBi, then $PSD = 11 - (G_{TX} - 6)$
U-NII-2A	---		11dBm/ MHz If $G_{TX} > 6$ dBi, then $PSD = 11 - (G_{TX} - 6)$
U-NII-2C	---		11dBm/ MHz If $G_{TX} > 6$ dBi, then $PSD = 11 - (G_{TX} - 6)$
U-NII-3	---		For Point-to-multipoint systems (P2M): 30dBm/ 500kHz. If $G_{TX} > 6$ dBi, then $PSD = 30 - (G_{TX} - 6)$ For Point-to-point systems (P2P): 30dBm/ 500kHz

Note:

- PSD = power spectral density that he same method as used to determine the conducted output power shall be used to determine the power spectral density. And power spectral density in dBm/MHz
- G_{TX} = the maximum transmitting antenna directional gain in dBi.
- Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / Nant]$ dBi.

Nant: Number of Transmit Antennas

G1, G2, ..., Gn: Gain of Individual Antennas

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Test procedure

For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-2_with Duty cycle <98 %

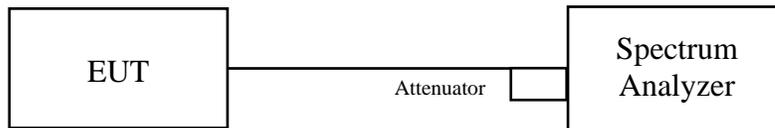
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz, Set VBW \geq 3 RBW, Detector = RMS
- Sweep time = auto, trigger set to “free run”.
- Trace average at least 100 traces in power averaging mode.
- Record the max value and add 10 log (1/duty cycle)

For U-NII-3 band:

with Duty cycle <98 %

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 500 kHz, Set VBW \geq 3 RBW, Detector = RMS
- Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
- Sweep time = auto, trigger set to “free run”.
- Trace average at least 100 traces in power averaging mode.
- Record the max value and add 10 log (1/duty cycle)

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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Test Data

For U-NII-1, U-NII-2A, U-NII-2C band

802.11a

CHAN.	FREQ. (MHz)	PSD (dBm)	TOTAL PSD with duty factor (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
36	5180	-1.86	-1.69	11	PASS
44	5220	-1.60	-1.43	11	PASS
48	5240	-1.73	-1.57	11	PASS
52	5260	-1.55	-1.38	11	PASS
60	5300	-2.01	-1.84	11	PASS
64	5320	-2.05	-1.88	11	PASS
100	5500	-1.98	-1.81	11	PASS
116	5580	-1.78	-1.61	11	PASS
140	5700	-2.09	-1.92	11	PASS

Note:

1. Refer to section 6.6 for duty cycle spectrum plot.

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802.11ac (VHT20)

CHAN.	FREQ. (MHz)	PSD (dBm)		TOTAL PSD with duty factor (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
36	5180	-8.23	-7.97	-4.91	9.89	PASS
44	5220	-7.70	-8.13	-4.72	9.89	PASS
48	5240	-7.76	-7.57	-4.48	9.89	PASS
52	5260	-5.60	-5.01	-2.10	9.89	PASS
60	5300	-5.30	-4.21	-1.53	9.89	PASS
64	5320	-4.51	-4.59	-1.36	9.89	PASS
100	5500	-4.92	-4.87	-1.70	9.89	PASS
116	5580	-4.79	-3.93	-1.15	9.89	PASS
140	5700	-4.57	-4.34	-1.27	9.89	PASS

Note:

1. Method a) of power density measurement of KDB 662911 is using for calculating total power density.
Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
3. Refer to section 6.6 for duty cycle spectrum plot.

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802.11ac (VHT40)

CHAN.	FREQ. (MHz)	PSD (dBm)		TOTAL PSD with duty factor (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
38	5190	-10.01	-10.21	-6.75	9.89	PASS
46	5230	-8.47	-8.42	-5.09	9.89	PASS
54	5270	-8.67	-8.61	-5.28	9.89	PASS
62	5310	-12.45	-12.32	-9.02	9.89	PASS
102	5510	-13.00	-12.70	-9.49	9.89	PASS
110	5550	-8.19	-8.01	-4.74	9.89	PASS
134	5670	-7.74	-7.61	-4.32	9.89	PASS

Note:

1. Method a) of power density measurement of KDB 662911 is using for calculating total power density.
Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
3. Refer to section 6.6 for duty cycle spectrum plot.

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802.11ac (VHT80)

CHAN.	FREQ. (MHz)	PSD (dBm)		TOTAL PSD with duty factor (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
42	5210	-16.43	-16.03	-12.52	9.89	PASS
58	5290	-18.71	-18.86	-15.09	9.89	PASS
106	5530	-14.52	-14.45	-10.78	9.89	PASS
122	5610	-14.12	-14.14	-10.43	9.89	PASS

Note:

1. Method a) of power density measurement of KDB 662911 is using for calculating total power density.
Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
3. Refer to section 6.6 for duty cycle spectrum plot.

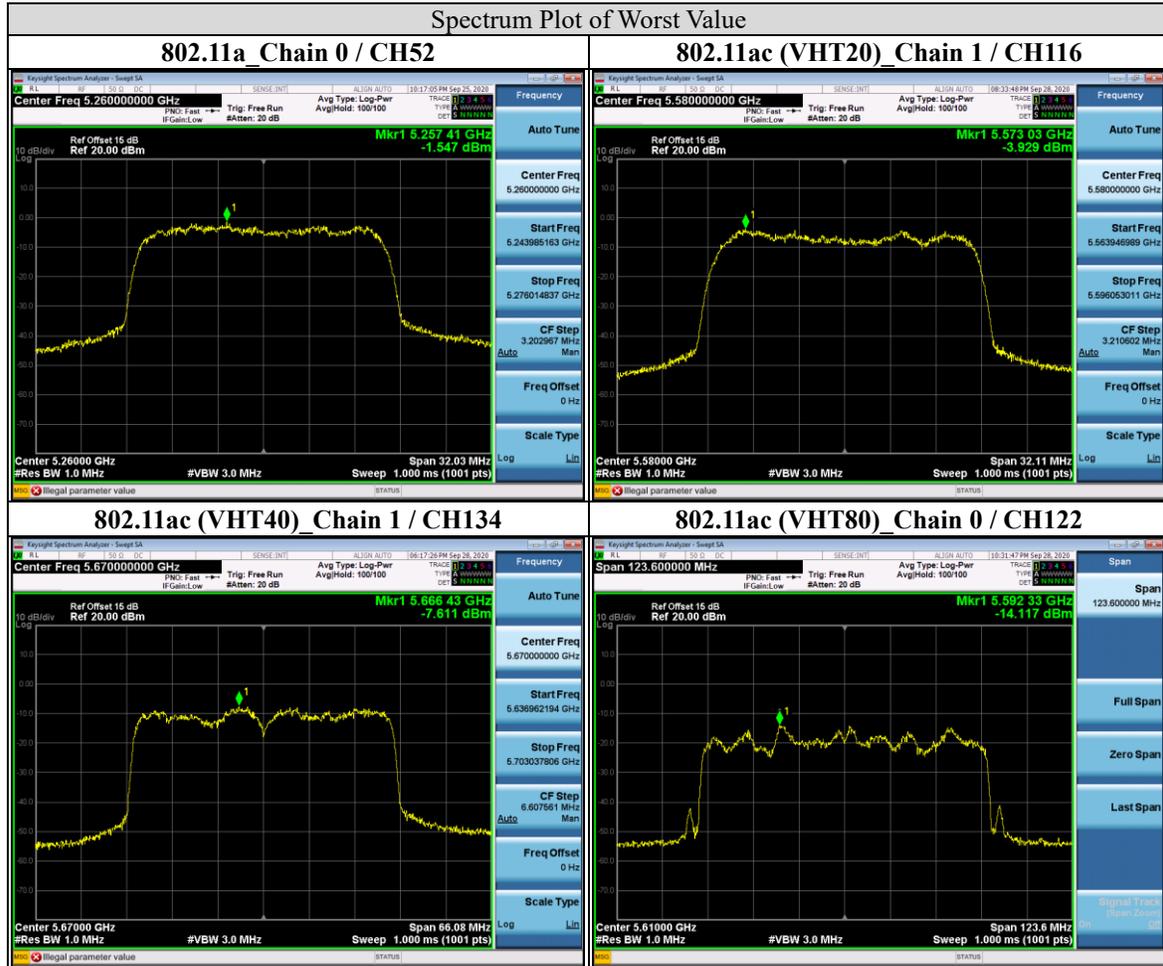
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For U-NII-3 band

802.11a

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)	PSD w/o duty factor (dBm/500 kHz)	Total PSD with Duty Factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
149	5745	-7.586	-5.37	-5.2	30	Pass
157	5785	-7.345	-5.13	-4.96	30	Pass
165	5825	-7.48	-5.26	-5.09	30	Pass

Note:

1. Refer to section 6.6 for duty cycle spectrum plot.

802.11ac (VHT20)

TX Chain	Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)	PSD w/o duty factor (dBm/500 kHz)	10 log (N=2) dB	Total PSD with Duty Factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
0	149	5745	-10.308	-8.09	3.01	-4.90	28.89	Pass
	157	5785	-9.616	-7.40	3.01	-4.21	28.89	Pass
	165	5825	-9.22	-7.00	3.01	-3.81	28.89	Pass
1	149	5745	-9.846	-7.63	3.01	-4.44	28.89	Pass
	157	5785	-9.513	-7.29	3.01	-4.1	28.89	Pass
	165	5825	-9.217	-7.00	3.01	-3.81	28.89	Pass

Note:

1. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

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802.11ac (VHT40)

TX Chain	Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)	PSD w/o duty factor (dBm/500 kHz)	10 log (N=2) dB	Total PSD with Duty Factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
0	151	5755	-14.714	-12.49	3.01	-9.13	28.89	Pass
	159	5795	-14.474	-12.25	3.01	-8.89	28.89	Pass
1	151	5755	-14.016	-11.80	3.01	-8.44	28.89	Pass
	159	5795	-14.271	-12.05	3.01	-8.69	28.89	Pass

Note:

1. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

802.11ac (VHT80)

TX Chain	Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)	PSD w/o duty factor (dBm/500 kHz)	10 log (N=2) dB	Total PSD with Duty Factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
0	155	5775	-20.77	-18.55	3.01	-14.85	28.89	Pass
1	155	5775	-21.291	-19.07	3.01	-15.37	28.89	Pass

Note:

1. Directional gain = 7.11 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

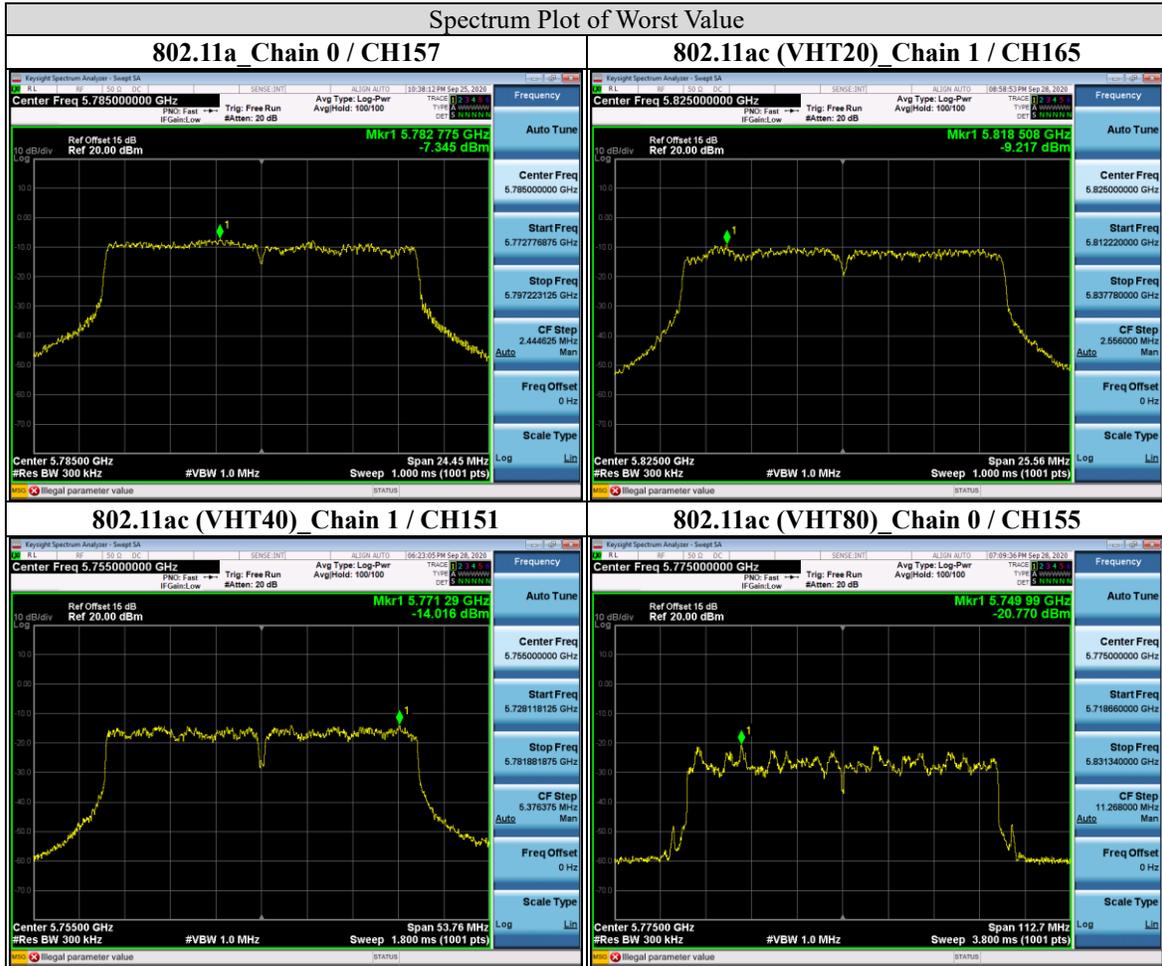
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9.6. Frequency Stability

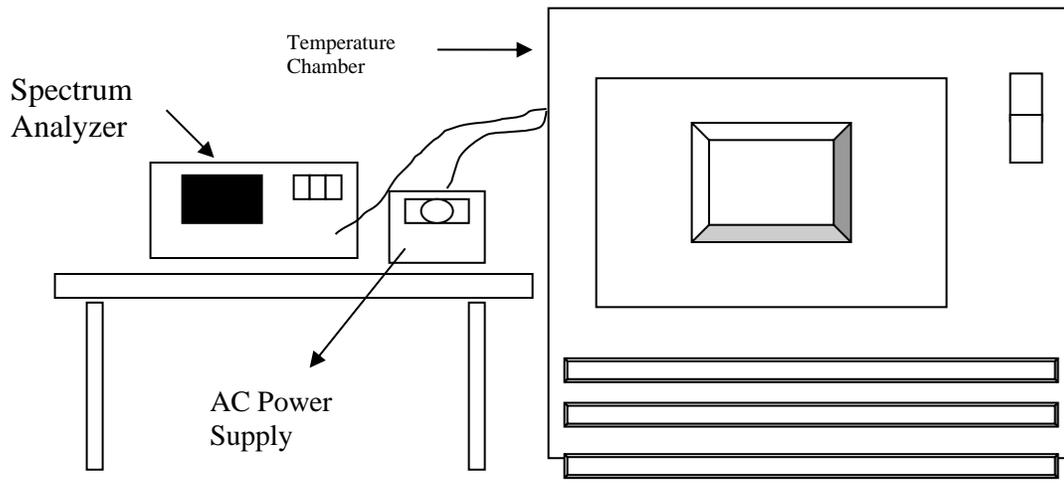
Requirements

The frequency of the carrier signal shall be maintained within band of operation.

Test procedure

- The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
- Turn the EUT on and couple its output to a spectrum analyzer.
- Turn the EUT off and set the chamber to the highest temperature specified.
- Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 Minutes.
- Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
- The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 Minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

Test Setup





Test Data

Frequency Stability Versus Temp.									
Operating Frequency: 5180 MHz									
TEMP. (°C)	Power Supply (Vac)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Freq. Drift (ppm)						
50	120	5179.98	-3.86	5179.992	-1.54	5179.989	-2.12	5179.99	-1.93
40	120	5179.987	-2.51	5179.987	-2.51	5180.017	3.28	5180.008	1.54
30	120	5180.014	2.70	5179.997	-0.58	5179.989	-2.12	5179.988	-2.32
20	120	5180.007	1.35	5179.983	-3.28	5179.997	-0.58	5180.021	4.05
10	120	5179.993	-1.35	5180.02	3.86	5179.978	-4.25	5179.986	-2.70
0	120	5180.013	2.51	5180.007	1.35	5180.023	4.44	5179.99	-1.93
-10	120	5180.02	3.86	5179.991	-1.74	5180.008	1.54	5179.994	-1.16
-20	120	5180.003	0.58	5180.023	4.44	5180	0.00	5180.023	4.44
-30	120	5180.011	2.12	5180.013	2.51	5179.996	-0.77	5180.011	2.12
TEMP. (°C)	Power Supply (Vac)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Freq. Drift (ppm)						
20	102	5179.998	-0.39	5180.019	3.67	5180.022	4.25	5179.996	-0.77
20	138	5179.99	-1.93	5179.976	-4.63	5180.024	4.63	5180.022	4.25

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9.7. Radiated Spurious Emission

Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

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Limits of unwanted emission out of the restricted bands

Applicable To		Limit	
789033 D02 General UNII Test Procedure New Rules v02r01		Field Strength at 3m	
		PK:74 (dBμV/m)	AV:54 (dBμV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
5150~5250 MHz	15.407(b)(1)	PK:-27 (dBm/MHz)	PK:68.2(dBμV/m)
5250~5350 MHz	15.407(b)(2)		
5470~5725 MHz	15.407(b)(3)		
5725~5850 MHz	15.407(b)(4)(i)	PK:-27 (dBm/MHz) *1 PK:10 (dBm/MHz) *2 PK:15.6 (dBm/MHz) *3 PK:27 (dBm/MHz) *4	PK: 68.2(dBμV/m) *1 PK:105.2 (dBμV/m) *2 PK: 110.8(dBμV/m) *3 PK:122.2 (dBμV/m) *4
*1 beyond 75 MHz or more above of the band edge. *2 below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above. *3 below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above. *4 from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.			

Note:

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V/m, where P is the eirp (Watts).$$

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Test Procedures

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

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Note:

- a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
802.11a	1MHz	1 kHz
802.11ac (VHT20)		1 kHz
802.11ac (VHT40)		2 kHz
802.11ac (VHT80)		4 kHz

Note: Refer to section 6.6 for duty cycle.

- d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported.

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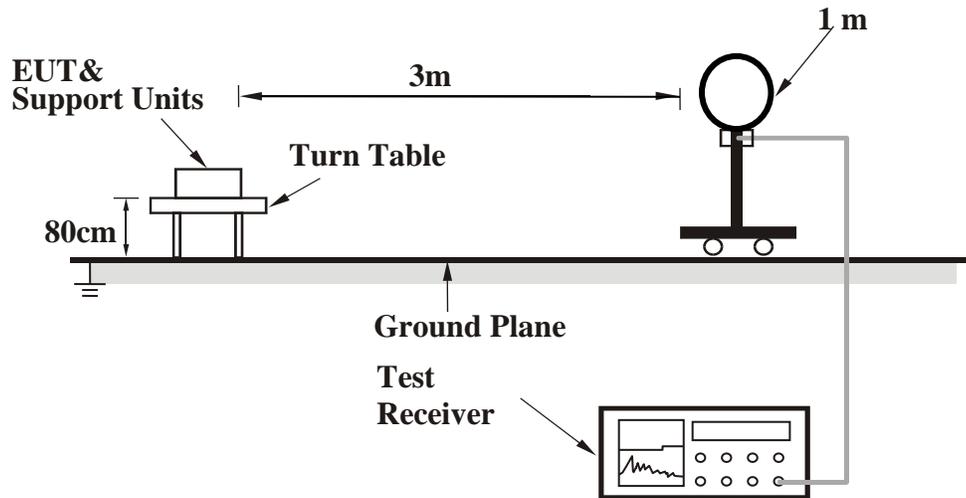
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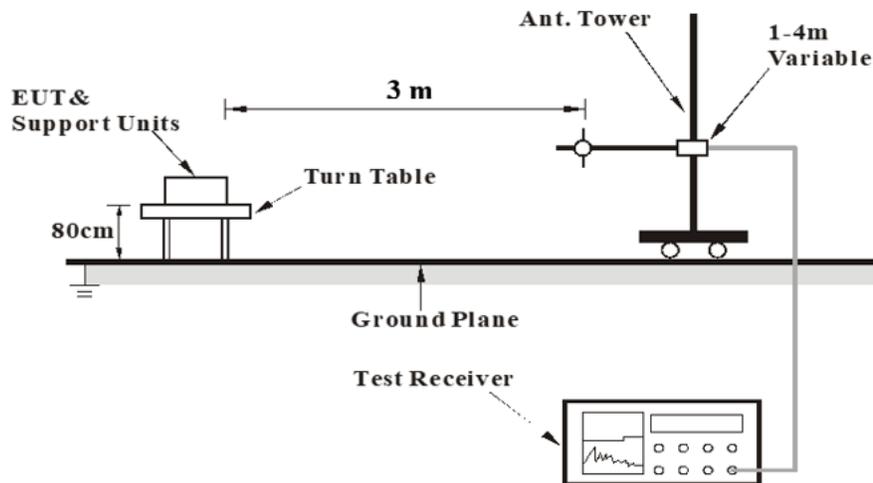


Test Setup

<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



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