RADIO TEST REPORT

Product	:	Wi-Fi 6E BT M.2 Module
Model Name	:	WNFQ-268AXI(BT)
Series Model	:	WNFQ-268AX(BT)
FCC ID	:	RYK-WNFQ268AXBT
Test Regulation	:	FCC 47 CFR Part 15 Subpart E (Section 15.407)
Received Date	:	2021/9/3
Test Date	:	2021/9/6 ~ 2022/1/20
Issued Date	:	2022/1/28
Applicant	:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

REVISION HISTORY

Original Test Report No.: 4790042400-US-R1-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4790042400-US-R1-V0	2022/1/28	-	Initial issue

Table of Contents

1. Attestation of Test Results

APPLICANT:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
MANUFACTURER:	SparkLAN Communications, Inc. 8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493, Taiwan (R.O.C.)
EUT DESCRIPTION:	Wi-Fi 6E BT M.2 Module
BRAND:	SparkLAN
MODEL:	WNFQ-268AXI(BT)
SERIES MODEL:	WNFQ-268AX(BT)
SAMPLE STAGE:	Engineering Verification Test sample
DATE of TESTED:	2021/9/6 ~ 2022/1/20

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:

Sally Lu Date : 2022/1/28
Project Handler

Approved and Authorized By:

Waternil Guan Date : 2022/1/28
Engineer

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 Note1
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)/9)	Radiated Emissions and Band Edge Measurement	PASS
15.407(b)(9)	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS
15.407(h)	Dynamic Frequency Selection	See Note2

Note:
1. The Occupied Bandwidth was reference only.
2. The “Dynamic Frequency Selection measurement” was recorded in Report No.: 4790042400-US-R3-V0.

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.

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.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	±3.1 dB
RF Conducted	9 kHz - 40GHz	±1.9 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	±1.9 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	±5.4 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	±4.7 dB

6. Equipment under Test

6.1. Description of EUT

Product	Wi-Fi 6E BT M.2 Module	
Brand Name	SparkLAN	
Model Name	WNFQ-268AXI(BT)	
Series Model	WNFQ-268AX(BT)	
Operating Frequency	5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5720 MHz, 5745 ~ 5825 MHz	
Modulation	1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK	
Transfer Rate	802.11a: up to 54 Mbps 802.11n: up to MCS15 802.11ac: up to MCS9 802.11ax: up to MCS11	
Number of Channel	5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
	5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5500 ~ 5720 MHz	12 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		6 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		3 for 802.11ac (VHT80), 802.11ax (HE80),
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)

Maximum Output Power	**Non-Beamforming mode:** 5180 ~ 5240 MHz: 20.35 dBm 5260 ~ 5320 MHz: 19.98 dBm 5500 ~ 5720 MHz: 22.95 dBm 5745 ~ 5825 MHz: 22.90 dBm **Beamforming mode:** 5180 ~ 5240 MHz: 19.39 dBm 5260 ~ 5320 MHz: 19.36 dBm 5500 ~ 5720 MHz: 22.54 dBm 5745 ~ 5825 MHz: 22.09 dBm
Normal Voltage	3.3 Vdc
S/N	21765J2100036
Sample ID	4158081

Note:

1. The models difference table as below:

Model	Difference
WNFQ-268AXI(BT)	WNFQ-268AXI(BT) Operating Temp -40~+75; WNFQ-268AX(BT) Operating Temp -10~+65 In addition, the sample has A-E key and E key versions. Only the golden finger is different.
WNFQ-268AX(BT)	

*Except above change, there is no change to technical construction that is included circuit diagram, PCB Layout, components and component layout, all electrical construction, and mechanical construction.

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

Modulation Mode	Tx,Rx Function
802.11a	2TX,2RX
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
802.11ac (VHT160)	2TX,2RX
802.11ax (HE20)	2TX,2RX
802.11ax (HE40)	2TX,2RX
802.11ax (HE80)	2TX,2RX
802.11ax (HE160)	2TX,2RX

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40 / VHT80 / VHT160 and 802.11ax mode for HE20 / HE40 / HE80 / HE160, therefore investigated worst case to representative mode in test report.

3. The EUT contains following accessory devices.

Product	Brand	Model	Description
Antenna 1	SparkLAN	AD-500AX	-
Antenna 2	SparkLAN	AD-501AX	-
Antenna 3	SparkLAN	AD-502AX	-
Antenna 4	SparkLAN	AD-503AX	-
Antenna 5	JOHANSON	2450AD18A6050	-
Antenna 6	SparkLAN	AD-504AX	-
Antenna 7	SparkLAN	AD-505AX	-

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

6.2. Channel List

FOR 5180 ~ 5240MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

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), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
42	5210MHz

FOR 5260 ~ 5320MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

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), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
58	5290MHz

1 straddle channel is provided for 802.11ac (VHT160), 802.11ax (HE160):

Channel	Frequency
50	5250MHz

FOR 5500 ~ 5720MHz

12 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

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	144	5720 MHz

6 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
102	5510 MHz	126	5630 MHz
110	5550 MHz	134	5670 MHz
118	5590 MHz	142	5710 MHz

3 channels are provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency	Channel	Frequency
106	5530MHz	138	5690MHz
122	5610MHz	-	-

1 channel is provided for 802.11ac (VHT160), 802.11ax (HE160):

Channel	Frequency
114	5570MHz

FOR 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

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), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
155	5775MHz

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	23~26°C/ 60~65%RH	3.3Vdc	2021/09/06~ 2022/1/20	Mike Cai
Radiated Spurious Emission	966-2	23~26°C/ 60~65%RH	3.3Vdc	2021/09/06~ 2021/11/10	Mike Cai
AC power Line Conducted Emission	SR1	23~26°C/ 60~65%RH	3.3Vdc	2021/09/16~ 2021/11/10	Mike Cai

FCC Test Firm Registration Number: 498077

6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Frequency Band (MHz)	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	SparkLAN	AD-500AX	Dipole	2400~2483	2.65	RP-SMA
					5150~5250	4.35	
					5250~5350	4.35	
					5470~5725	4.35	
					5725~5850	4.81	
					5925~6425	4.98	
					6425~6525	4.85	
					6525~6875	4.79	
					6875~7125	4.82	
2	Chain (0)+(1)	SparkLAN	AD-501AX	Dipole	2400~2483	3.7	RP-SMA
					5150~5850	5	
					5925~7125	5	
3	Chain (0)+(1)	SparkLAN	AD-502AX	PIFA	2400~2483	3.5	IPEX
					5150~5850	5	
					5925~7125	3.9	
4	Chain (0)+(1)	SparkLAN	AD-503AX	Dipole	2400~2483	3.7	RP-SMA
					5150~5850	5	
					5925~7125	5	
5	Chain (0)+(1)	JOHANSON	2450AD18A6050	CHIP	2400~2483	2	NA
					5150~5850	1.5	
					5925~7125	2.7	
6	Chain (0)+(1)	SparkLAN	AD-504AX	Dipole	2400~2483	2.67	I-PEX
					5150~5250	4.35	
					5250~5350	3.83	
					5470~5725	4.7	
					5725~5850	4.87	
					5925~6425	4.91	
					6425~6525	4.85	
					6525~6875	4.94	
					6875~7125	4.94	
7	Chain (0)+(1)	SparkLAN	AD-505AX	Dipole	2400~2483	2.67	I-PEX
					5150~5250	4.35	
					5250~5350	3.83	
					5470~5725	4.7	
					5725~5850	4.87	
					5925~6425	4.91	
					6425~6525	4.85	
					6525~6875	4.94	
					6875~7125	4.94	

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.

6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the dipole antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case).
- The antennas AD-501AX, AD-503AX has the highest gain, the following conducted tests are all carried out using this antenna gain.
- For radiated tests, following Radiated versus Conducted Measurements Guidance, radiated emissions measurements test was done with 50ohm terminator on antenna port
- 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.
- 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 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.
- 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).

Non-Beamforming mode:

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	6Mbps
	802.11ax20		OFDMA	36 to 48	36, 44, 48	HE0
	802.11ax40			38 to 46	38, 46	HE0
	802.11ax80			42	42	HE0
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6Mbps
	802.11ax20		OFDMA	52 to 64	52, 60, 64	HE0
	802.11ax40			54 to 62	54, 62	HE0
	802.11ax80			58	58	HE0
	802.11ax160			50	50	HE0
	802.11a	5500-5720	OFDM	100 to 140	100,116,140	6Mbps
	802.11ax20		OFDMA	100 to 140	100,116,140	HE0
	802.11ax40			102 to 134	102, 110, 134	HE0
	802.11ax80			106, 122	106, 122	HE0
	802.11ax160			114	114	HE0
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6Mbps
	802.11ax20		OFDMA	149 to 165	149, 157, 165	HE0
	802.11ax40			151 to 159	151, 159	HE0
	802.11ax80			155	155	HE0
Radiated Emissions (Below 1GHz)	802.11a	5745-5825	OFDM	149 to 165	149	HE0
AC Power Line Conducted Emission	802.11a	5745-5825	OFDM	149 to 165	149	HE0
Antenna Port Conducted Measurement	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6Mbps
	802.11ax20		OFDMA	36 to 48	36, 44, 48	HE0
	802.11ax40			38 to 46	38, 46	HE0
	802.11ax80			42	42	HE0
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6Mbps
	802.11ax20		OFDMA	52 to 64	52, 60, 64	HE0
	802.11ax40			54 to 62	54, 62	HE0
	802.11ax80			58	58	HE0
	802.11ax160			50	50	HE0
	802.11a	5500-5720	OFDM	100 to 140	100,116,140	6Mbps
	802.11ax20		OFDMA	100 to 140	100,116,140	HE0
	802.11ax40			102 to 134	102, 110, 134	HE0
	802.11ax80			106, 122	106, 122	HE0
	802.11ax160			114	114	HE0
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6Mbps
	802.11ax20		OFDMA	149 to 165	149, 157, 165	HE0
	802.11ax40			151 to 159	151, 159	HE0
	802.11ax80			155	155	HE0

Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate
Conducted Emissions (Above 1GHz)	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6Mbps
	802.11ax20		OFDMA	36 to 48	36, 44, 48	HE0
	802.11ax40			38 to 46	38, 46	HE0
	802.11ax80			42	42	HE0
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6Mbps
	802.11ax20		OFDMA	52 to 64	52, 60, 64	HE0
	802.11ax40			54 to 62	54, 62	HE0
	802.11ax80			58	58	HE0
	802.11ax160			50	50	HE0
	802.11a	5500-5720	OFDM	100 to 140	100,116,140	6Mbps
	802.11ax20		OFDMA	100 to 140	100,116,140	HE0
	802.11ax40			102 to 134	102, 110, 134	HE0
	802.11ax80			106, 122	106, 122	HE0
	802.11ax160			114	114	HE0
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6Mbps
	802.11ax20		OFDMA	149 to 165	149, 157, 165	HE0
	802.11ax40			151 to 159	151, 159	HE0
	802.11ax80			155	155	HE0
Conducted Emissions (Below 1GHz)	802.11a	5745-5825	OFDM	149 to 165	149	HE0

Beamforming mode:

Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate
Antenna Port Conducted Measurement	802.11ax20	5180-5240	OFDMA	36 to 48	36, 44, 48	HE0
	802.11ax40			38 to 46	38, 46	HE0
	802.11ax80			42	42	HE0
	802.11ax20	5260-5320	OFDMA	52 to 64	52, 60, 64	HE0
	802.11ax40			54 to 62	54, 62	HE0
	802.11ax80			58	58	HE0
	802.11ax160			50	50	HE0
	802.11ax20	5500-5720	OFDMA	100 to 140	100,116,140	HE0
	802.11ax40			102 to 134	102, 110, 134	HE0
	802.11ax80			106, 122	106, 122	HE0
	802.11ax160			114	114	HE0
	802.11ax20	5745-5825	OFDMA	149 to 165	149, 157, 165	HE0
	802.11ax40			151 to 159	151, 159	HE0
	802.11ax80			155	155	HE0

Simultaneously transmission condition:

Condition	Technology	
1	WLAN (2.4GHz)	WLAN (5GHz)
2	BT-GFSK	WLAN (5GHz)

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

6.6. Duty cycle

802.11a: Duty cycle = 1.965/1.99 = 0.987%, duty cycle of test signal is ≥ 98 %, duty factor is not required.

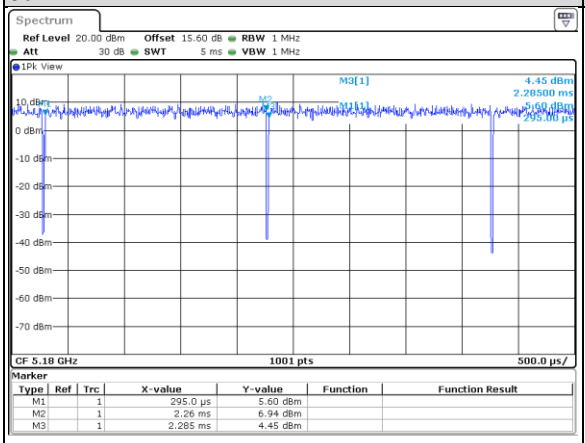
802.11ax(HE20): Duty cycle = 100%, duty cycle of test signal is ≥ 98 %, duty factor is not required.

802.11ax(HE40): Duty cycle = 100%, duty cycle of test signal is ≥ 98 %, duty factor is not required.

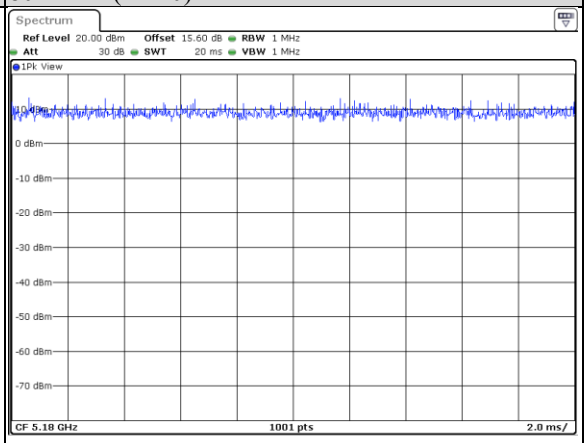
802.11ax(HE80): Duty cycle = 100%, duty cycle of test signal is ≥ 98 %, duty factor is not required.

802.11ax(HE160): Duty cycle = 100%, duty cycle of test signal is ≥ 98 %, duty factor is not required.

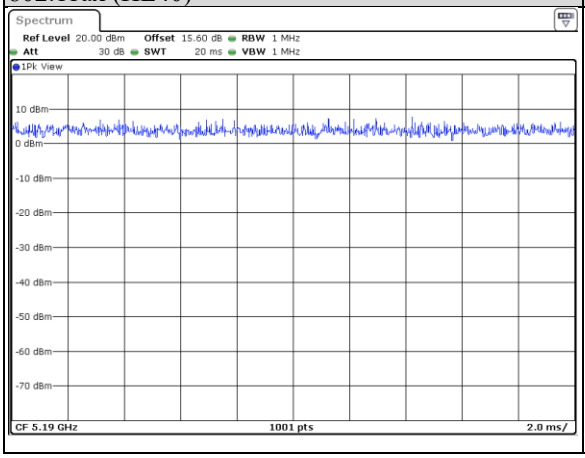
802.11a



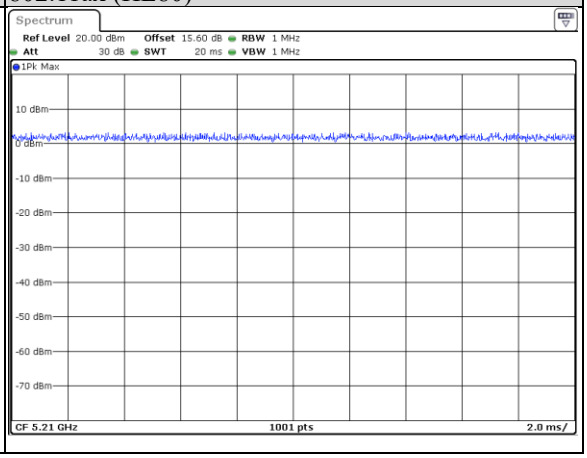
802.11ax (HE20)



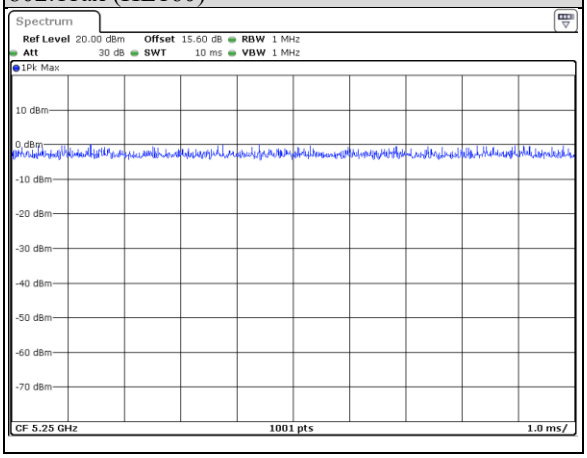
802.11ax (HE40)



802.11ax (HE80)



802.11ax (HE160)



7. Test Equipment

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2020/11/11	2021/11/10
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2020/12/11	2021/12/10
Loop Antenna	ETS lindgren	6502	00213440	2020/12/25	2021/12/24
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2021/1/13	2022/1/12
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2020/12/30	2021/12/29
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2020/12/30	2021/12/29
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2021/6/8	2022/6/7
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2021/2/3	2022/2/2
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2021/5/19	2022/5/18
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2021/1/22	2022/1/21
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2021/1/22	2022/1/21

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2020/11/6	2021/11/5
				2021/10/29	2022/10/28
Pulse Power Sensor	Anritsu	MA2411B	1531202	2020/12/21	2021/12/20
				2021/12/22	2022/12/21
Power Meter	Anritsu	ML2495A	1645002	2020/12/21	2021/12/20
				2021/12/22	2022/12/21
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2020/11/17	2021/11/16
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2021/8/30	2022/8/29
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2021/8/26	2022/8/25
Cables	TITAN	CFD200	T0732ACFD20020A300-1	2021/3/2	2022/3/1

UL Software		
Description	**Name**	**Version**
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF Conducted Test Tools	ver 2.4.0.620b
AC power Line Conducted Emission	EZ_EMC	UL-3A1.2

8. Description of Test Setup

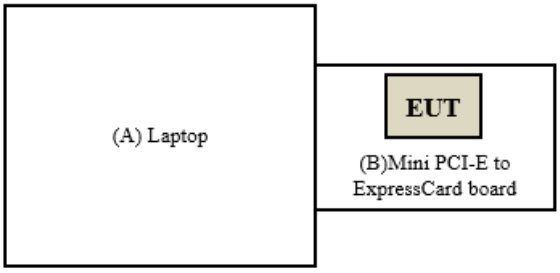
Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Laptop	Lenovo	E6430	2MMN3X1	Provide by lab
B	Mini PCI-E to ExpressCard board	SparkLAN	Card-01	001	N/A

Test Setup

Controlled using a bespoke application (QSPR_Version 5.0-00197) 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



Under Table

Remote Site

9. Test Results

9.1. 6dB Bandwidth

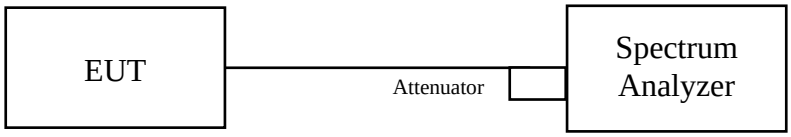
Requirements

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

Test procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. 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.

Test Data

802.11a

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
144 (U-NII-3 Band)	5720	2.47	2.47	0.5	PASS
149	5745	15.11	15.11	0.5	PASS
157	5785	15.07	15.11	0.5	PASS
165	5825	15.07	15.31	0.5	PASS

802.11ax (HE20)

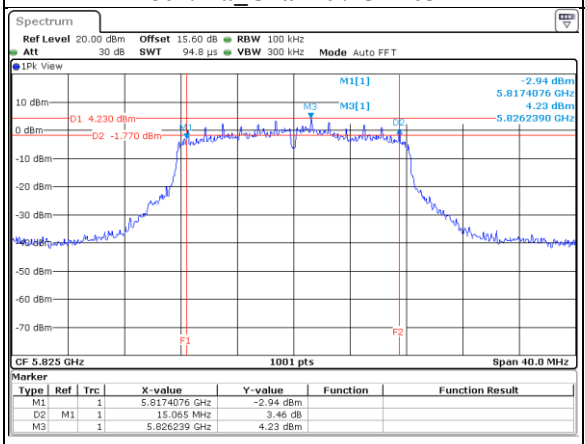
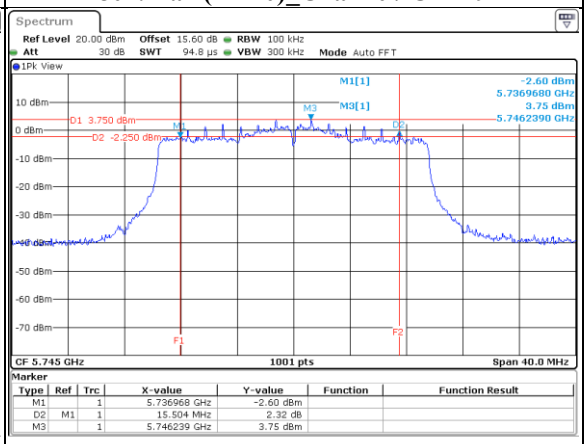
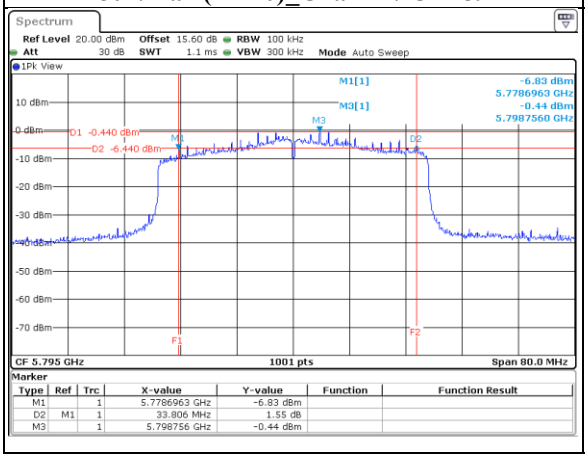
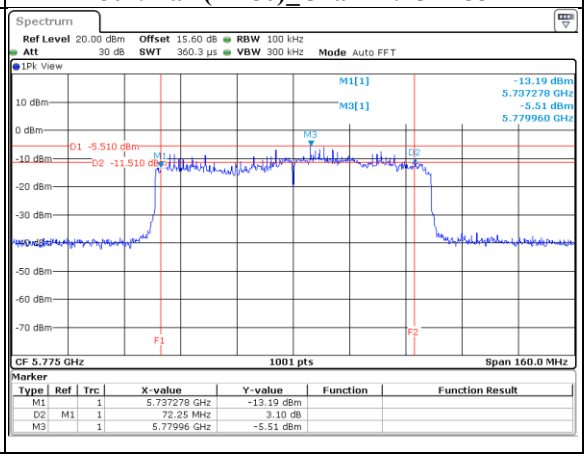
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
144 (U-NII-3 Band)	5720	2.47	2.55	0.5	PASS
149	5745	15.50	16.54	0.5	PASS
157	5785	16.22	16.82	0.5	PASS
165	5825	18.42	16.50	0.5	PASS

802.11ax (HE40)

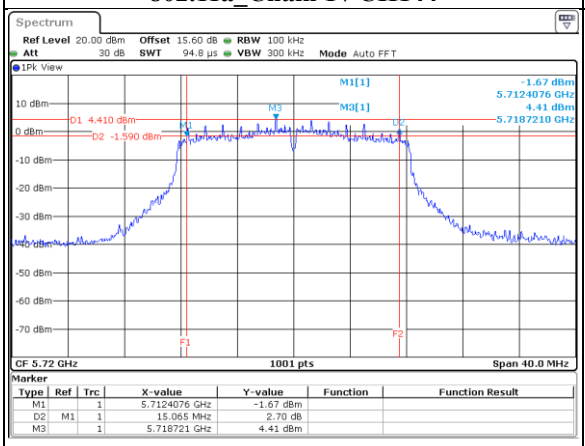
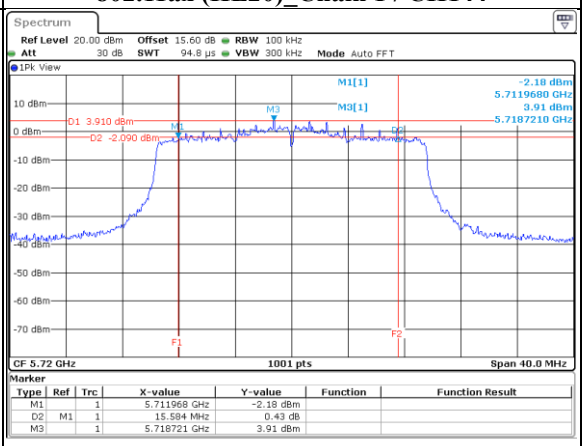
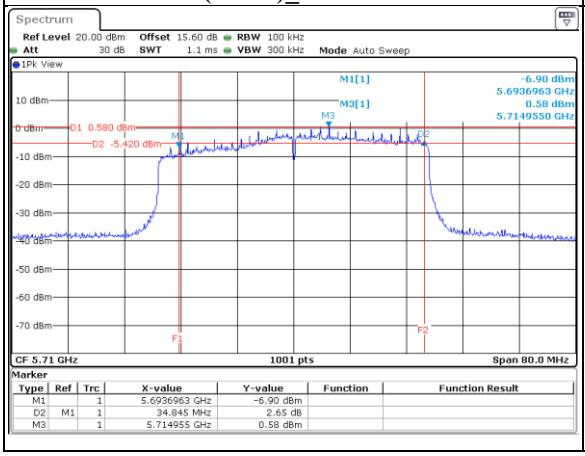
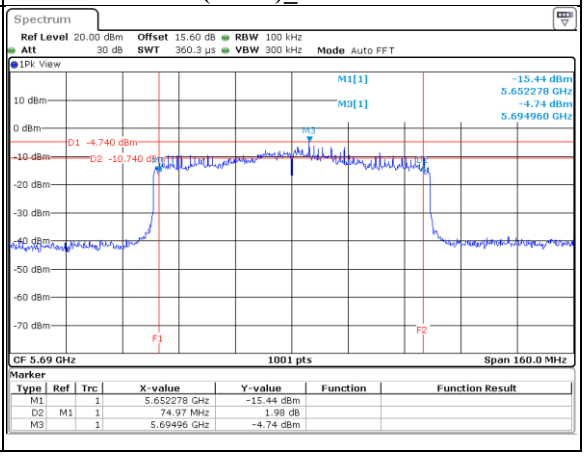
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
142 (U-NII-3 Band)	5710	2.50	3.54	0.5	PASS
151	5755	35.01	36.44	0.5	PASS
159	5795	35.09	33.81	0.5	PASS

802.11ax (HE80)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
138 (U-NII-3 Band)	5690	2.26	2.40	0.5	PASS
155	5775	72.57	72.25	0.5	PASS

Spectrum Plot of Worst Value	
802.11a_Chain 0 / CH165	**802.11ax (HE20)_Chain 0 / CH149**
	
802.11ax (HE40)_Chain 1 / CH159	**802.11ax (HE80)_Chain 1 / CH155**
	

Channel Straddling

Worst Spectrum Plot of Straddle Channel	
802.11a_Chain 1 / CH144	**802.11ax (HE20)_Chain 1 / CH144**
	
802.11ax (HE40)_Chain 1 / CH142	**802.11ax (HE80)_Chain 0 / CH138**
	

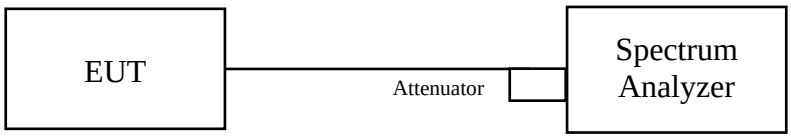
Note: The 6dB bandwidth above 5725MHz = Marker 1 + Delta 2 – 5725MHz

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.

Test Data

802.11a

Channel	Channel Frequency (MHz)	26 dB Bandwidth (MHz)	
		Chain 0	Chain 1
36	5180	19.10	19.42
44	5220	18.98	19.30
48	5240	20.02	19.30
52	5260	19.58	19.10
60	5300	19.02	19.62
64	5320	19.90	24.74
100	5500	19.74	20.54
116	5580	19.18	21.10
140	5700	19.50	19.54
144	5720	19.66	19.38
144 (U-NII-2c Band)	5720	15.35	14.75

802.11ax (HE20)

Channel	Channel Frequency (MHz)	26 dB Bandwidth (MHz)	
		Chain 0	Chain 1
36	5180	20.90	21.50
44	5220	20.86	20.98
48	5240	21.10	20.70
52	5260	20.90	20.74
60	5300	20.78	20.94
64	5320	20.82	27.37
100	5500	20.70	21.02
116	5580	21.02	21.82
140	5700	20.98	20.70
144	5720	20.82	21.02
144 (U-NII-2c Band)	5720	15.47	15.47

802.11ax (HE40)

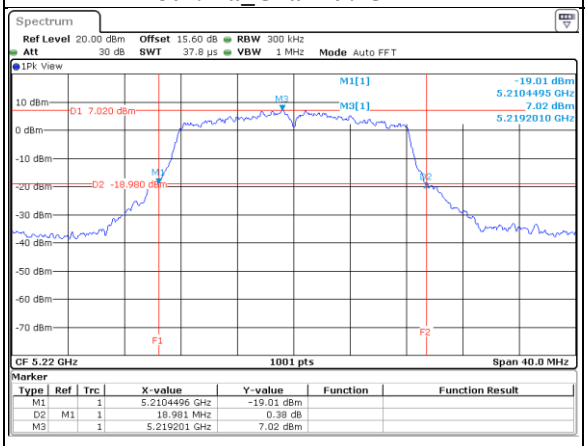
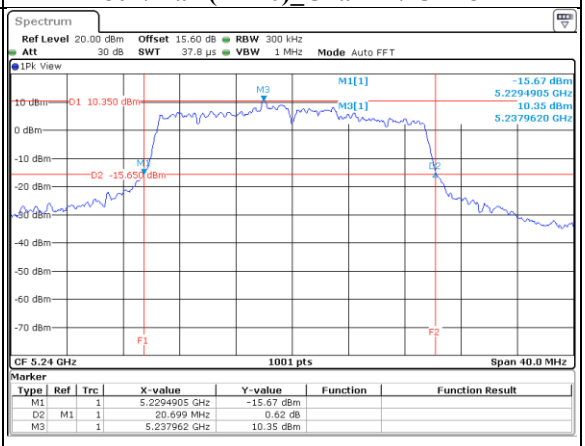
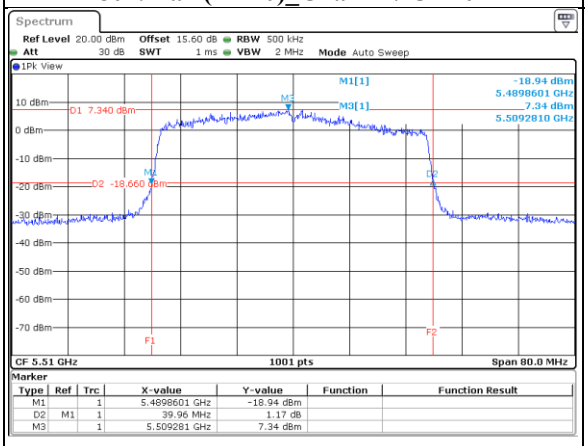
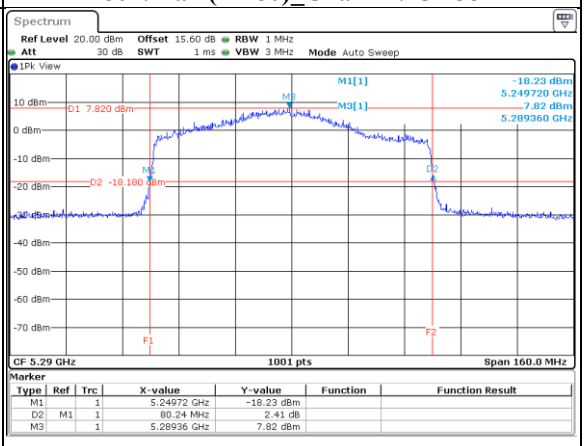
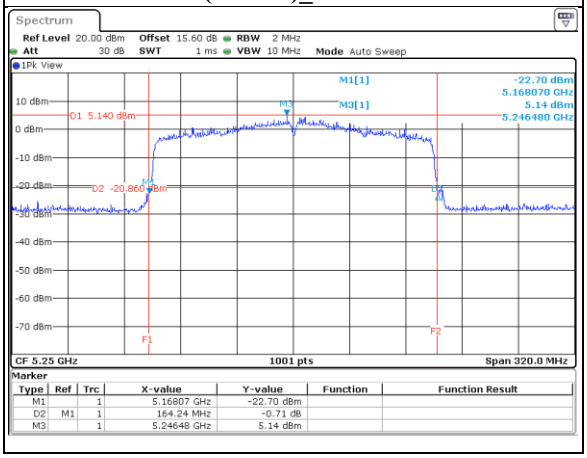
Channel	Channel Frequency (MHz)	26 dB Bandwidth (MHz)	
		Chain 0	Chain 1
38	5190	40.52	40.20
46	5230	40.28	40.60
54	5270	40.44	40.28
62	5310	40.60	40.60
102	5510	40.20	39.96
110	5550	40.52	41.00
134	5670	40.12	40.76
142	5710	40.36	40.60
142 (U-NII-2c Band)	5710	35.22	35.14

802.11ax (HE80)

Channel	Channel Frequency (MHz)	26 dB Bandwidth (MHz)	
		Chain 0	Chain 1
42	5210	81.84	80.40
58	5290	81.52	80.24
106	5530	81.20	82.32
122	5610	81.20	82.64
138	5690	82.64	83.60
138 (U-NII-2c Band)	5690	76.56	77.20

802.11ax (HE160)

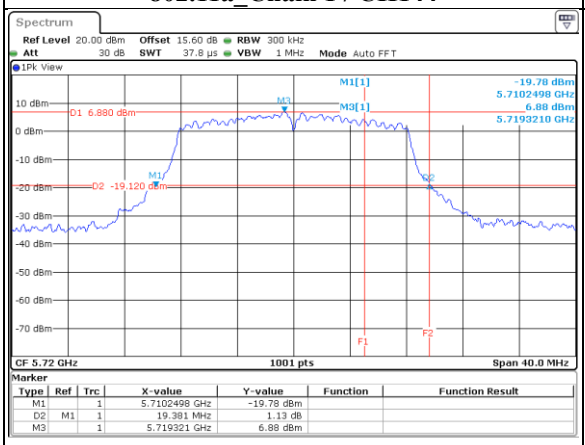
Channel	Channel Frequency (MHz)	26 dB Bandwidth (MHz)	
		Chain 0	Chain 1
50	5250	166.47	164.24
50 (U-NII-1 Band)	5250	82.57	81.93
50 (U-NII-2A Band)	5250	83.90	82.31
114	5570	165.59	164.96

Spectrum Plot of Worst Value	
802.11a_Chain 0 / CH44	**802.11ax (HE20)_Chain 1 / CH48**
	
802.11ax (HE40)_Chain 1 / CH102	**802.11ax (HE80)_Chain 1 / CH58**
	
802.11ax (HE160)_Chain 1 / CH50	
	

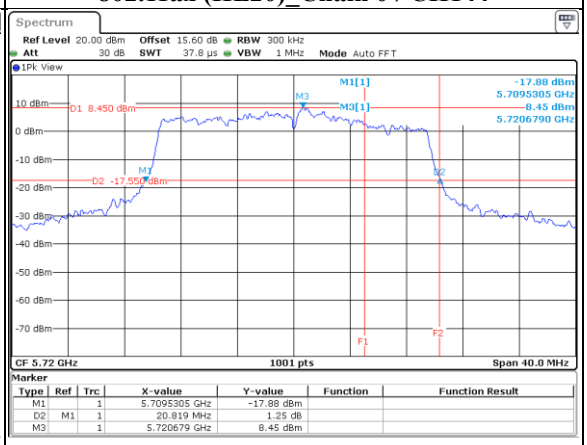
Channel Straddling

Worse Spectrum Plot of Straddle Channel

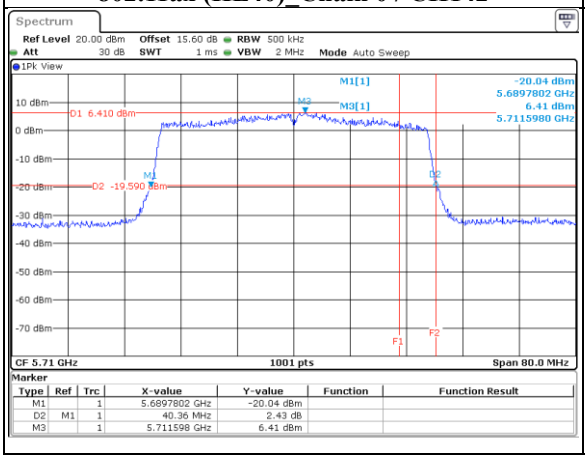
802.11a_Chain 1 / CH144



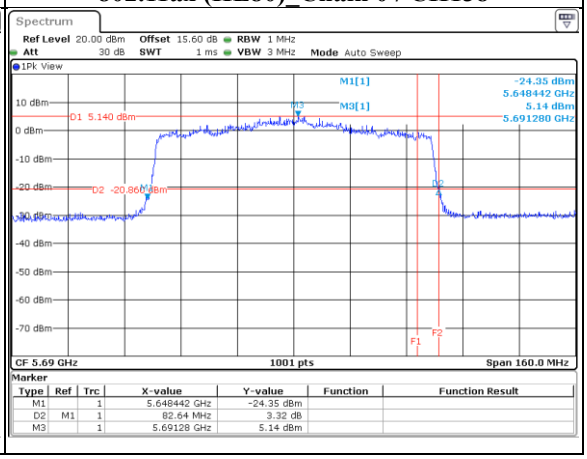
802.11ax (HE20)_Chain 0 / CH144



802.11ax (HE40)_Chain 0 / CH142



802.11ax (HE80)_Chain 0 / CH138



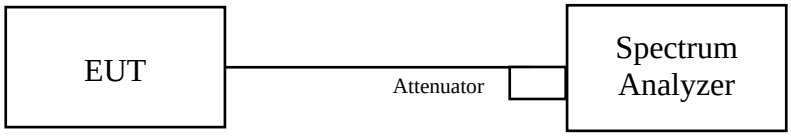
Note: The bandwidth below 5725MHz = Delta 2 – (Marker 1 + Delta 2 – 5725MHz)

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 ≥ 3 x 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)	
		Chain 0	Chain 1
36	5180	16.26	16.34
44	5220	16.34	16.34
48	5240	16.42	16.30
52	5260	16.34	16.38
60	5300	16.30	16.38
64	5320	16.30	16.66
100	5500	16.30	16.34
116	5580	16.30	16.42
140	5700	16.30	16.38
144	5720	16.34	16.38
149	5745	16.62	16.38
157	5785	16.30	16.42
165	5825	16.26	16.54

802.11ax (HE20)

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		Chain 0	Chain 1
36	5180	18.90	18.98
44	5220	18.94	18.86
48	5240	18.90	18.90
52	5260	18.98	18.86
60	5300	19.02	18.86
64	5320	18.98	19.06
100	5500	18.90	18.90
116	5580	18.90	18.94
140	5700	18.90	18.98
144	5720	18.90	18.86
149	5745	18.90	18.86
157	5785	18.90	18.98
165	5825	18.94	18.90

802.11ax (HE40)

Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		Chain 0	Chain 1
38	5190	37.64	37.48
46	5230	37.64	37.56
54	5270	37.56	37.24
62	5310	37.72	37.64
102	5510	37.64	37.32
110	5550	37.64	37.96
134	5670	37.64	37.56
142	5710	37.56	37.40
151	5755	37.64	37.80
159	5795	37.72	37.32

802.11ax (HE80)

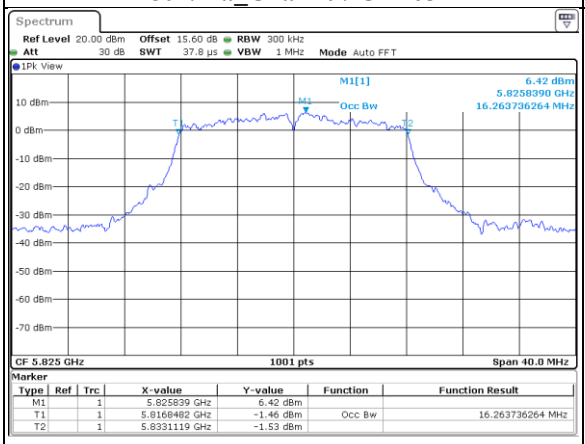
Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		Chain 0	Chain 1
42	5210	76.72	75.28
58	5290	76.72	74.81
106	5530	77.04	77.20
122	5610	76.88	77.68
138	5690	76.88	77.68
155	5775	77.04	77.52

802.11ax (HE160)

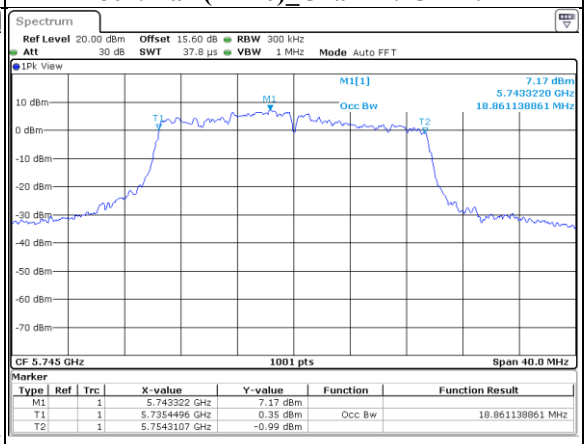
Channel	Channel Frequency (MHz)	Occupied Bandwidth (MHz)	
		Chain 0	Chain 1
50	5250	155.68	155.04
50 (U-NII-1 Band)	5250	77.68	77.36
50 (U-NII-2A Band)	5250	78.00	77.68
114	5570	155.68	155.36

Spectrum Plot of Worst Value

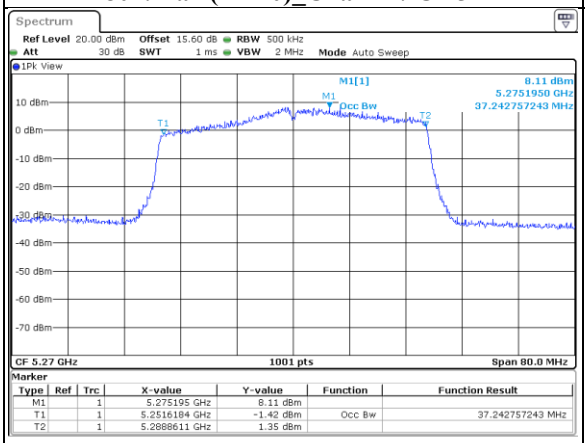
802.11a_Chain 0 / CH165



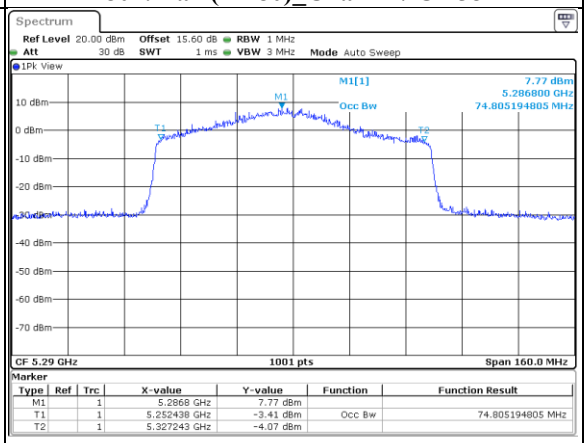
802.11ax (HE20)_Chain 1 / CH149



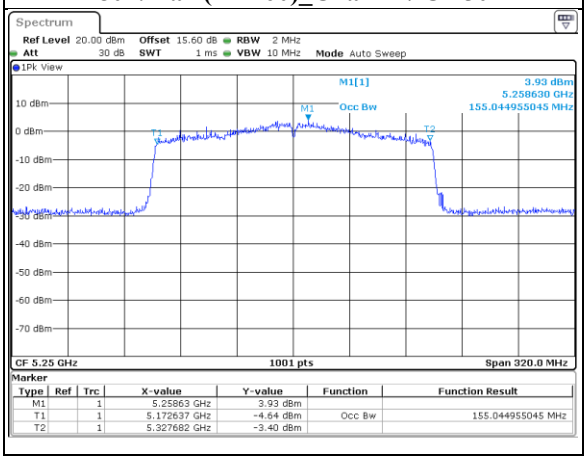
802.11ax (HE40)_Chain 1 / CH54



802.11ax (HE80)_Chain 1 / CH58



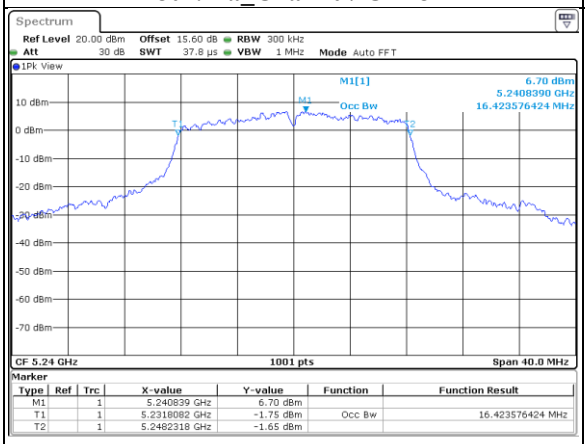
802.11ax (HE160)_Chain 1 / CH50



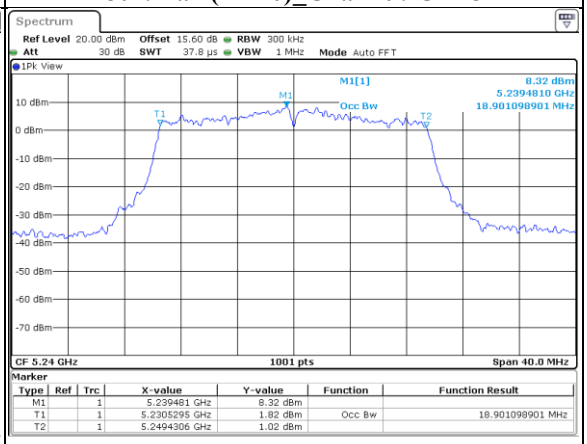
Note: 802.11ax (HE160) CH50 bandwidth below 5250MHz = 5250MHz – T1
802.11ax (HE160) CH50 bandwidth above 5250MHz = T2 – 5250MHz

Spectrum Plot for UNII-1 nearly DFS band Channels

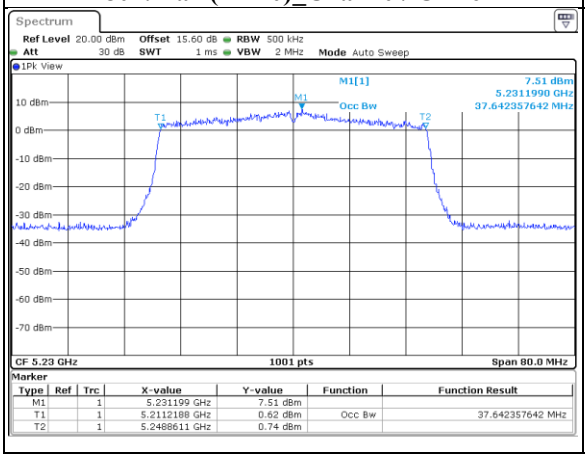
802.11a_Chain 0 / CH48



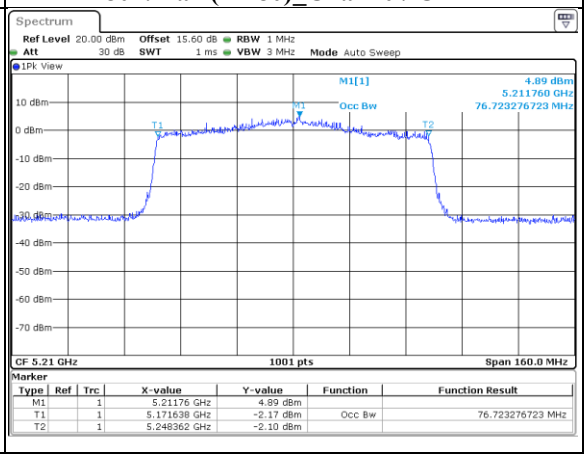
802.11ax (HE20)_Chain 0 / CH48



802.11ax (HE40)_Chain 0 / CH46



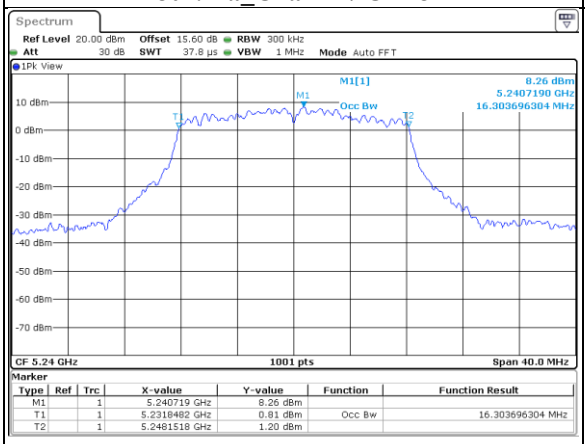
802.11ax (HE80)_Chain 0 / CH42



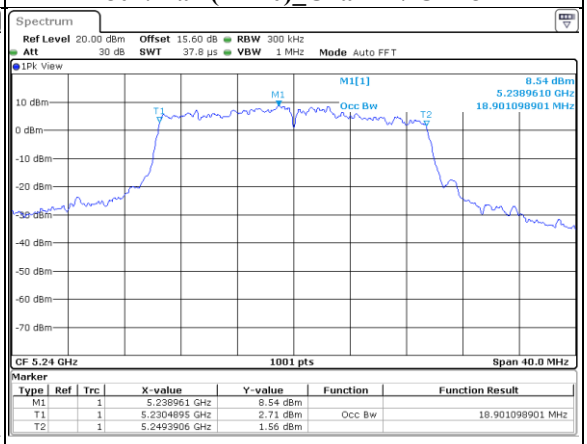
Note: The observed T2 is all <5250 MHz, so UNII-1 band channels which in nearly DFS band no need for DFS function.

Spectrum Plot for UNII-1 nearly DFS band Channels

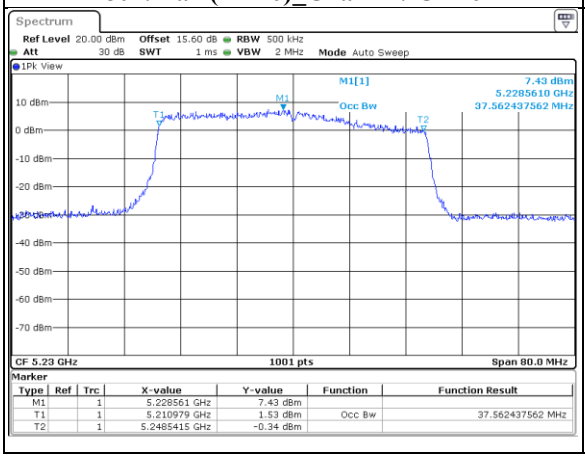
802.11a_Chain 1 / CH48



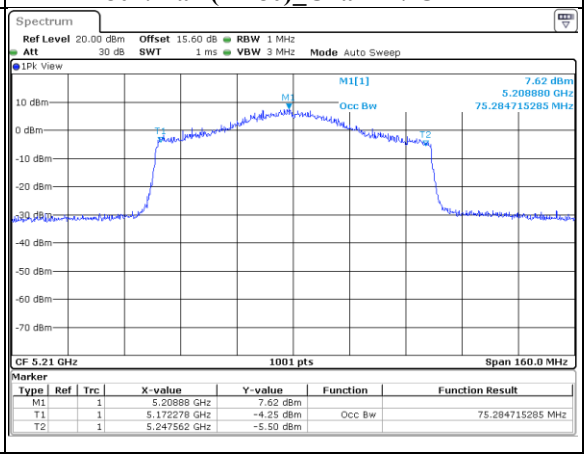
802.11ax (HE20)_Chain 1 / CH48



802.11ax (HE40)_Chain 1 / CH46



802.11ax (HE80)_Chain 1 / CH42



Note: The observed T2 is all <5250 MHz, so UNII-1 band channels which in nearly DFS band no need for DFS function.

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 ≦ 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)
	√	Client device	250mW (24 dBm) If G_{TX} > 6 dBi, then P_{Out} = 23.98 – (G_{TX} – 6)
U-NII-2A	√		250mW (24 dBm) or 11 dBm+10 log B* If G_{TX} > 6 dBi, then P_{Out} = 23.98 – (G_{TX} – 6)
U-NII-2C	√		250mW (24 dBm) or 11 dBm+10 log B* If G_{TX} > 6 dBi, then P_{Out} = 23.98 – (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:
1. P_{Out} = maximum conducted output power in dBm,
2. G_{TX} = the maximum transmitting antenna directional gain in dBi.
3. B is the 26 dB emission bandwidth in megahertz
4. Directional Gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{Gn/20})^2$ / Nant] dBi.

   Nant: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas

5. 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 $N_{ANT} \geq 5$.

Test Procedure

For Average Power Measurement

Test method PM-G

For 802.11a, 802.11ax (HE20), 802.11ax (HE40)

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

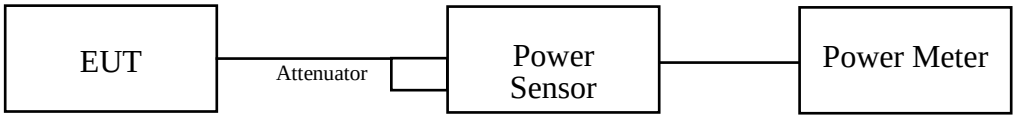
For 802.11ax (HE80), 802.11ax (HE160)

a. Set span to encompass the entire 26 dB EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
b. Set sweep trigger*.
c. Set RBW = 1 MHz.
d. Set VBW ≥ 3 MHz
e. Number of points in sweep ≥ 2 Span / RBW.
f. Sweep time ≤ (number of points in sweep) * T
g. Using emission bandwidth to determine the frequency span for integration the channel bandwidth.
h. Detector = RMS.
i. Trace mode = max hold.
j. Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.

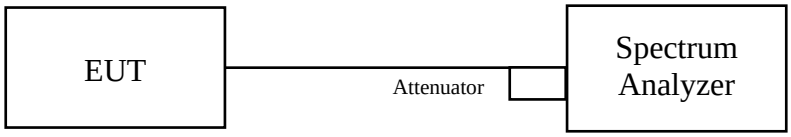
* If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 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.

Test Data

Non-Beamforming mode

802.11a

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
36	5180	12.89	14.86	50.119	17.00	23.98	PASS
44	5220	16.47	17.47	100.231	20.01	23.98	PASS
48	5240	17.10	17.56	108.393	20.35	23.98	PASS
52	5260	16.42	17.45	99.541	19.98	23.81	PASS
60	5300	16.23	17.56	99.083	19.96	23.79	PASS
64	5320	14.08	15.82	63.826	18.05	23.98	PASS
100	5500	13.56	15.77	60.395	17.81	23.95	PASS
116	5580	16.20	17.52	98.175	19.92	23.82	PASS
140	5700	14.40	15.32	61.518	17.89	23.9	PASS
144 (U-NII-2c Band)	5720	15.64	15.66	73.451	18.66	22.68	PASS
144 (U-NII-3 Band)	5720	10.12	10.63	21.827	13.39	30	PASS
149	5745	20.24	19.51	194.984	22.90	30	PASS
157	5785	18.98	18.32	146.893	21.67	30	PASS
165	5825	17.49	17.02	106.414	20.27	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
144	5720	16.71	16.85	95.28	19.79
Note: The total power was calculated through formula and record the value for reference only.					

802.11ax (HE20)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
36	5180	11.56	13.10	34.754	15.41	23.98	PASS
44	5220	16.78	16.62	93.541	19.71	23.98	PASS
48	5240	16.88	16.58	94.189	19.74	23.98	PASS
52	5260	16.02	17.47	95.94	19.82	23.98	PASS
60	5300	15.66	17.30	90.573	19.57	23.98	PASS
64	5320	13.14	15.08	52.845	17.23	23.98	PASS
100	5500	13.55	15.54	58.479	17.67	23.98	PASS
116	5580	15.99	17.33	93.756	19.72	23.98	PASS
140	5700	13.11	13.77	44.259	16.46	23.98	PASS
144 (U-NII-2c Band)	5720	15.37	15.44	69.343	18.41	22.89	PASS
144 (U-NII-3 Band)	5720	10.76	10.99	24.434	13.88	30	PASS
149	5745	19.45	19.52	177.828	22.50	30	PASS
157	5785	18.76	18.33	143.219	21.56	30	PASS
165	5825	19.47	17.89	149.968	21.76	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
144	5720	16.66	16.77	93.972	19.73
Note: The total power was calculated through formula and record the value for reference only.					

802.11ax (HE40)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
38	5190	10.34	11.56	25.119	14.00	23.98	PASS
46	5230	13.76	15.12	56.234	17.50	23.98	PASS
54	5270	14.11	15.03	57.544	17.60	23.98	PASS
62	5310	11.12	12.86	32.285	15.09	23.98	PASS
102	5510	12.01	13.89	40.365	16.06	23.98	PASS
110	5550	14.02	15.68	62.23	17.94	23.98	PASS
134	5670	15.59	14.50	64.417	18.09	23.98	PASS
142 (U-NII-2c Band)	5710	19.63	19.01	171.396	22.34	23.98	PASS
142 (U-NII-3 Band)	5710	11.27	10.93	25.763	14.11	30	PASS
151	5755	15.34	14.55	62.661	17.97	30	PASS
159	5795	16.65	15.23	79.616	19.01	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
142	5710	20.22	19.64	197.242	22.95
Note: The total power was calculated through formula and record the value for reference only.					

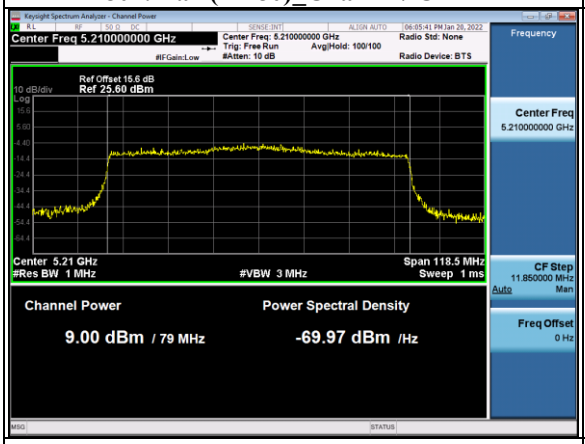
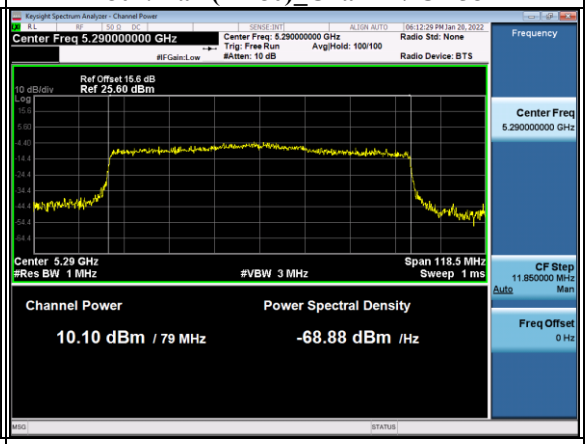
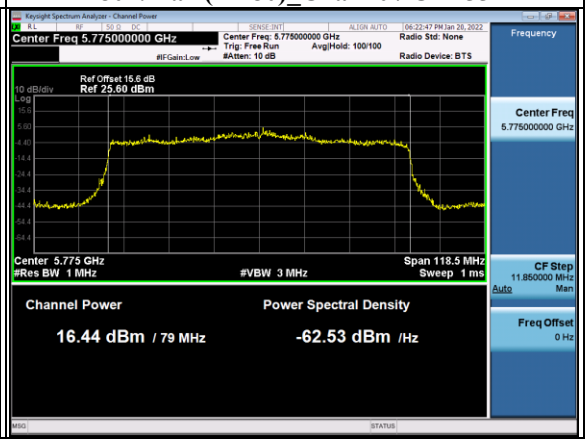
802.11ax (HE80)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
42	5210	7.31	9.00	13.335	11.25	23.98	PASS
58	5290	8.39	10.10	17.14	12.34	23.98	PASS
106	5530	9.03	10.49	19.187	12.83	23.98	PASS
122	5610	13.17	14.22	47.206	16.74	23.98	PASS
138 (U-NII-2c Band)	5690	18.99	18.36	147.911	21.70	23.98	PASS
138 (U-NII-3 Band)	5690	7.99	7.55	11.995	10.79	30	PASS
155	5775	16.44	15.76	81.658	19.12	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
138	5690	19.32	18.71	159.956	22.04
Note: The total power was calculated through formula and record the value for reference only.					

Spectrum Plot of Worst Value	
802.11ax (HE80)_Chain 1 / CH42	**802.11ax (HE80)_Chain 1 / CH58**
	
802.11ax (HE80)_Chain 0 / CH138	**802.11ax (HE80)_Chain 0 / CH155**
	

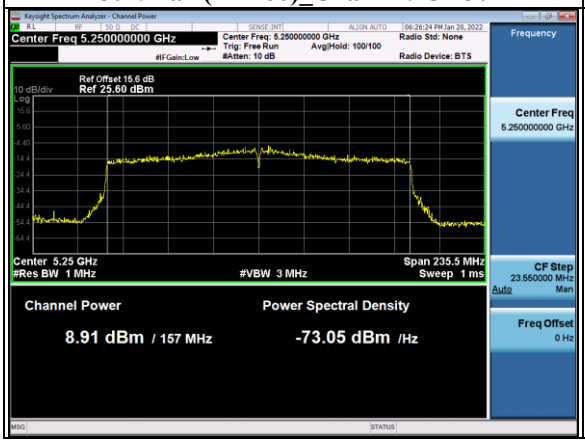
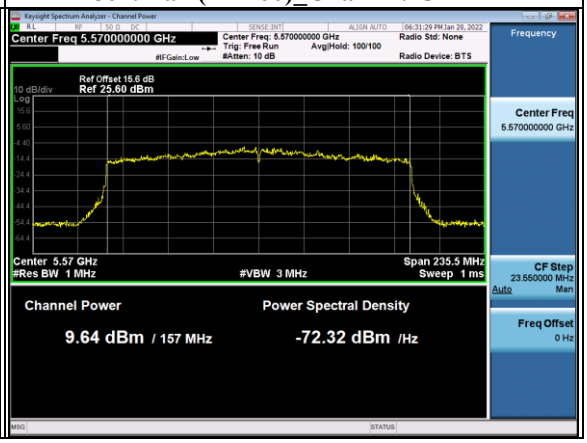
802.11ax (HE160)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
50 (U-NII-1 Band)	5250	4.99	5.89	7.047	8.48	23.98	PASS
50 (U-NII-2A Band)	5250	5.06	5.91	7.112	8.52	23.98	PASS
114	5570	7.75	9.64	15.171	11.81	23.98	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
50	5250	8.04	8.91	14.158	11.51
Note: The total power was calculated through formula and record the value for reference only.					

Spectrum Plot of Worst Value	
802.11ax (HE160)_Chain 1 / CH50	**802.11ax (HE160)_Chain 1 / CH114**
	

Beamforming mode

802.11ax (HE20)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
36	5180	11.26	12.81	32.434	15.11	23.98	PASS
44	5220	16.33	16.15	84.14	19.25	23.98	PASS
48	5240	16.50	16.26	86.896	19.39	23.98	PASS
52	5260	15.62	16.97	86.298	19.36	23.98	PASS
60	5300	15.23	16.94	82.794	19.18	23.98	PASS
64	5320	12.80	14.81	49.317	16.93	23.98	PASS
100	5500	13.20	15.13	53.456	17.28	23.98	PASS
116	5580	15.61	16.98	86.298	19.36	23.98	PASS
140	5700	12.68	13.51	41.02	16.13	23.98	PASS
144 (U-NII-2c Band)	5720	15.00	15.17	64.565	18.10	22.89	PASS
144 (U-NII-3 Band)	5720	10.39	10.72	22.751	13.57	30	PASS
149	5745	19.08	19.08	161.808	22.09	30	PASS
157	5785	18.37	18.07	132.739	21.23	30	PASS
165	5825	19.01	17.63	137.404	21.38	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
144	5720	16.29	16.50	87.297	19.41
Note: The total power was calculated through formula and record the value for reference only.					

802.11ax (HE40)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
38	5190	10.08	11.09	23.014	13.62	23.98	PASS
46	5230	13.39	14.69	51.286	17.10	23.98	PASS
54	5270	13.85	14.60	53.088	17.25	23.98	PASS
62	5310	10.79	12.40	29.376	14.68	23.98	PASS
102	5510	11.67	13.54	37.325	15.72	23.98	PASS
110	5550	13.52	15.26	56.105	17.49	23.98	PASS
134	5670	15.33	14.04	59.429	17.74	23.98	PASS
142 (U-NII-2c Band)	5710	19.20	18.63	156.315	21.94	23.98	PASS
142 (U-NII-3 Band)	5710	10.84	10.55	23.496	13.71	30	PASS
151	5755	14.92	14.21	57.412	17.59	30	PASS
159	5795	16.27	14.87	73.114	18.64	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
142	5710	19.79	19.26	179.473	22.54
Note: The total power was calculated through formula and record the value for reference only.					

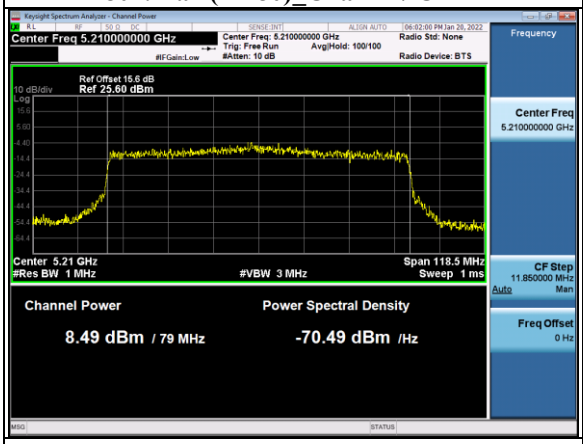
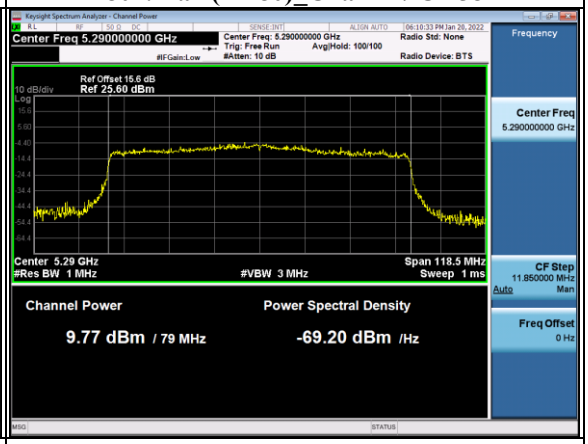
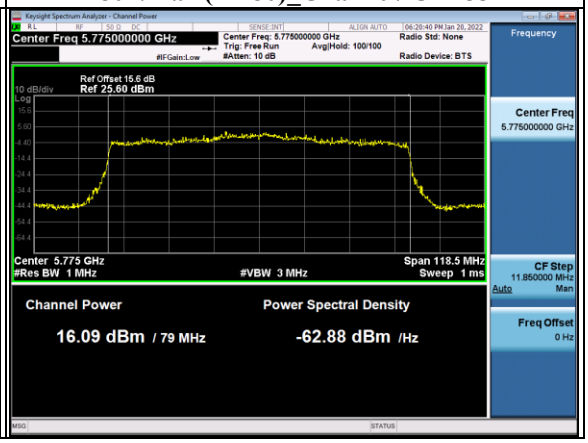
802.11ax (HE80)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
42	5210	6.95	8.60	12.19	10.86	23.98	PASS
58	5290	7.85	9.77	15.596	11.93	23.98	PASS
106	5530	8.76	10.24	18.072	12.57	23.98	PASS
122	5610	12.76	13.96	43.752	16.41	23.98	PASS
138 (U-NII-2c Band)	5690	18.56	18.00	134.896	21.30	23.98	PASS
138 (U-NII-3 Band)	5690	7.56	7.19	10.94	10.39	30	PASS
155	5775	16.09	15.29	74.473	18.72	30	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
138	5690	18.89	18.35	145.881	21.64
Note: The total power was calculated through formula and record the value for reference only.					

Spectrum Plot of Worst Value	
802.11ax (HE80)_Chain 1 / CH42	**802.11ax (HE80)_Chain 1 / CH58**
	
802.11ax (HE80)_Chain 0 / CH138	**802.11ax (HE80)_Chain 0 / CH155**
	

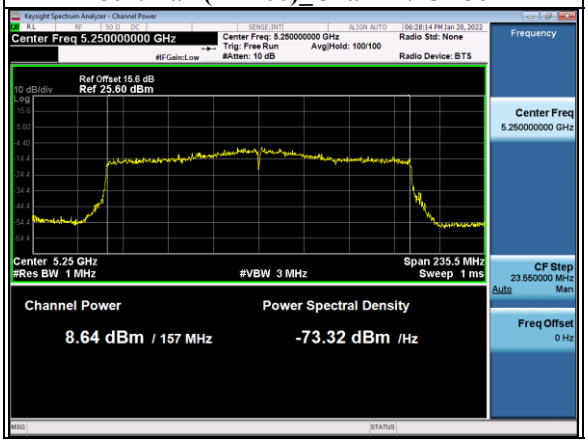
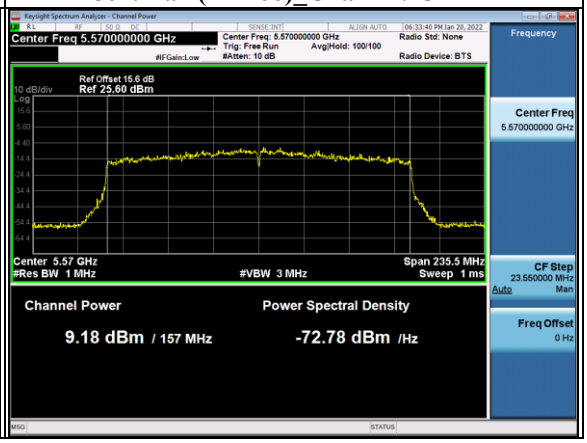
802.11ax (HE160)

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass/Fail
		Chain 0	Chain 1				
50 (U-NII-1 Band)	5250	4.68	5.62	6.592	8.19	23.98	PASS
50 (U-NII-2A Band)	5250	4.75	5.64	6.653	8.23	23.98	PASS
114	5570	7.51	9.18	13.932	11.44	23.98	PASS

Note: The directional gain = 5 dBi < 6 dBi, so the power limit shall not be reduced.

For Reference only – Straddle Channels Total Power

Channel	Channel Frequency (MHz)	Maximum Conducted Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
50	5250	7.73	8.64	13.243	11.22
Note: The total power was calculated through formula and record the value for reference only.					

Spectrum Plot of Worst Value	
802.11ax (HE160)_Chain 1 / CH50	**802.11ax (HE160)_Chain 1 / CH114**
	

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:
1. 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
2. G_{TX} = the maximum transmitting antenna directional gain in dBi.
3. Directional Gain = 10 log[($10^{G1/20}$ + $10^{G2/20}$ +...+$10^{Gn/20}$)^2 / Nant] dBi.

   Nant: Number of Transmit Antennas
   G1, G2,..., Gn: Gain of Individual Antennas

4. 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.

Test procedure

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

Using method as below:

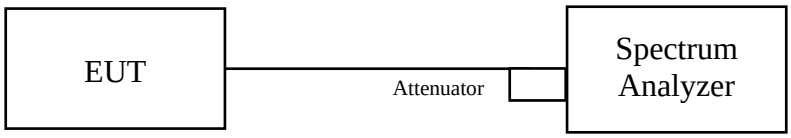
a. Set span to encompass the entire emission bandwidth (EBW) of the signal.
b. Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c. Sweep time = auto, trigger set to "free run".
d. Trace average at least 100 traces in power averaging mode.
e. Record the max value. (if Duty cycle <98 %, add 10 log (1/duty cycle))

For U-NII-3 band:

Using method as below:

a. Set span to encompass the entire emission bandwidth (EBW) of the signal.
b. Set RBW = 300 kHz, Set VBW ≥ 1 MHz, Detector = RMS
c. Use the peak marker function to determine the maximum power level in any 300 kHz band segment within the fundamental EBW.
d. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10 log (500 kHz/300kHz)
e. Sweep time = auto, trigger set to "free run".
f. Trace average at least 100 traces in power averaging mode.
g. Record the max value. (if Duty cycle <98 %, 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.

Test Data

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

802.11a

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/MHz)		Total PSD with duty factor (dBm/MHz)	PSD Maximum Limit (dBm/MHz)	Pass/Fail
		Chain 0	Chain 1			
36	5180	2.39	3.57	6.03	8.99	PASS
44	5220	5.58	6.23	8.93	8.99	PASS
48	5240	5.81	6.10	8.97	8.99	PASS
52	5260	5.52	6.35	8.97	8.99	PASS
60	5300	5.10	6.46	8.84	8.99	PASS
64	5320	2.92	4.73	6.93	8.99	PASS
100	5500	2.68	4.92	6.95	8.99	PASS
116	5580	5.00	6.46	8.8	8.99	PASS
140	5700	3.74	4.41	7.1	8.99	PASS
144 (U-NII-2c Band)	5720	5.49	5.80	8.66	8.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

802.11ax (HE20)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/MHz)		Total PSD with duty factor (dBm/MHz)	PSD Maximum Limit (dBm/MHz)	Pass/Fail
		Chain 0	Chain 1			
36	5180	0.70	1.79	4.29	8.99	PASS
44	5220	5.92	5.82	8.88	8.99	PASS
48	5240	5.80	5.76	8.79	8.99	PASS
52	5260	5.41	6.06	8.76	8.99	PASS
60	5300	4.42	5.72	8.13	8.99	PASS
64	5320	1.71	3.49	5.7	8.99	PASS
100	5500	2.24	4.64	6.61	8.99	PASS
116	5580	5.05	6.28	8.72	8.99	PASS
140	5700	1.92	2.09	5.02	8.99	PASS
144 (U-NII-2c Band)	5720	5.70	5.51	8.62	8.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

802.11ax (HE40)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/MHz)		Total PSD with duty factor (dBm/MHz)	PSD Maximum Limit (dBm/MHz)	Pass/Fail
		Chain 0	Chain 1			
38	5190	-3.29	-2.09	0.36	8.99	PASS
46	5230	-0.35	1.26	3.54	8.99	PASS
54	5270	1.00	1.61	4.33	8.99	PASS
62	5310	-3.23	-1.65	0.64	8.99	PASS
102	5510	-2.36	-0.21	1.86	8.99	PASS
110	5550	1.01	2.20	4.66	8.99	PASS
134	5670	1.87	0.40	4.21	8.99	PASS
142 (U-NII-2c Band)	5710	5.45	3.74	7.69	8.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

802.11ax (HE80)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/MHz)		Total PSD with duty factor (dBm/MHz)	PSD Maximum Limit (dBm/MHz)	Pass/Fail
		Chain 0	Chain 1			
42	5210	-8.92	-6.70	-4.66	8.99	PASS
58	5290	-8.22	-5.70	-3.77	8.99	PASS
106	5530	-7.99	-7.23	-4.58	8.99	PASS
122	5610	-3.24	-4.27	-0.71	8.99	PASS
138 (U-NII-2c Band)	5690	2.42	0.74	4.67	8.99	PASS

Note:

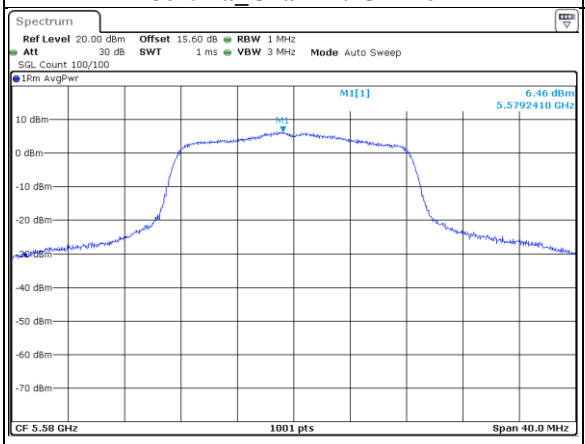
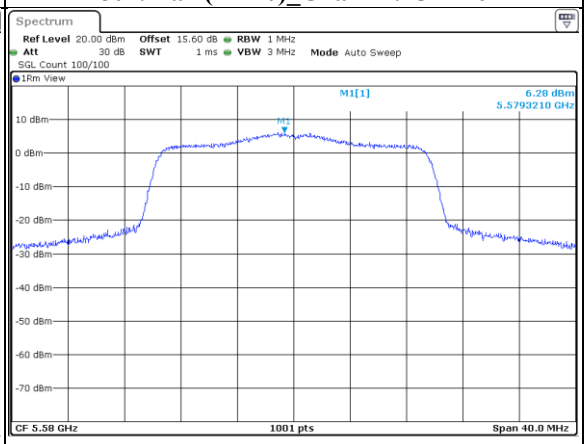
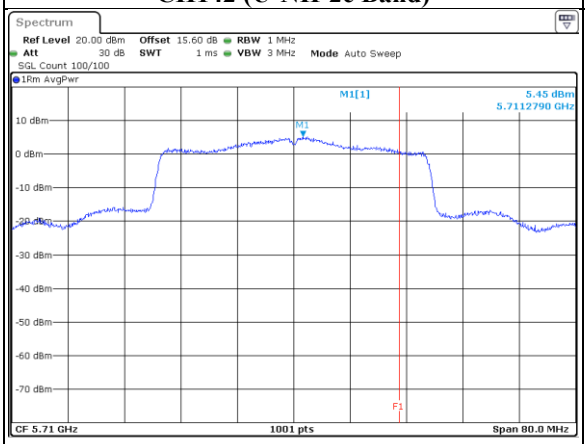
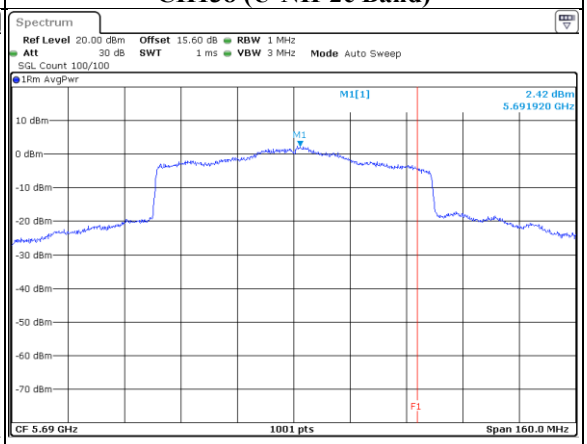
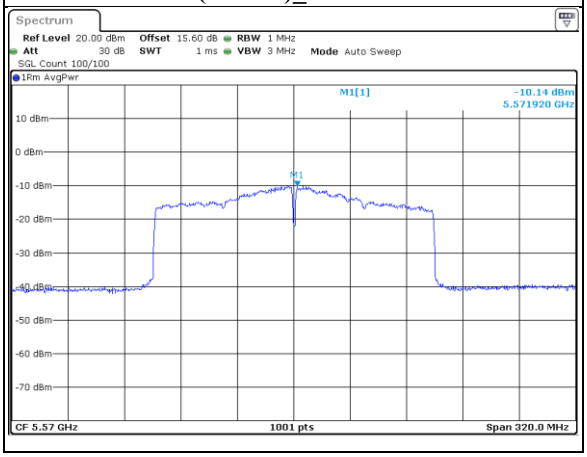
1. Directional gain = 8.01 dBi > 6 dBi, so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

802.11ax (HE160)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/MHz)		Total PSD with duty factor (dBm/MHz)	PSD Maximum Limit (dBm/MHz)	Pass/Fail
		Chain 0	Chain 1			
50 (U-NII-1 Band)	5250	-11.64	-11.18	-8.39	8.99	PASS
50 (U-NII-2A Band)	5250	-12.07	-11.36	-8.69	8.99	PASS
114	5570	-12.07	-10.14	-7.99	8.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi, so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.

Spectrum Plot of Worst Value	
802.11a_Chain 1 / CH116	**802.11ax (HE20)_Chain 1 / CH116**
	
802.11ax (HE40)_Chain 0 / CH142 (U-NII-2c Band)	**802.11ax (HE80)_Chain 0 / CH138 (U-NII-2c Band)**
	
802.11ax (HE160)_Chain 1 / CH114	
	

For U-NII-3 Band

802.11a

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)		Total PSD w/o BWCF (dBm/300 kHz)	Total PSD with BWCF (dBm/500 kHz)	Total PSD with duty factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
		Chain 0	Chain 1					
144 (U-NII-3 Band)	5720	-2.95	-2.30	0.4	2.62	2.62	27.99	PASS
149	5745	3.59	2.45	6.07	8.29	8.29	27.99	PASS
157	5785	2.34	1.88	5.13	7.35	7.35	27.99	PASS
165	5825	0.87	0.52	3.71	5.93	5.93	27.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.
3. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(500 kHz/300kHz).

802.11ax (HE20)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)		Total PSD w/o BWCF (dBm/300 kHz)	Total PSD with BWCF (dBm/500 kHz)	Total PSD with duty factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
		Chain 0	Chain 1					
144 (U-NII-3 Band)	5720	-3.37	-3.25	-0.3	1.92	1.92	27.99	PASS
149	5745	2.62	1.95	5.31	7.53	7.53	27.99	PASS
157	5785	1.84	1.51	4.69	6.91	6.91	27.99	PASS
165	5825	2.03	0.58	4.38	6.60	6.6	27.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.
3. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(500 kHz/300kHz).

802.11ax (HE40)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)		Total PSD w/o BWCF (dBm/300 kHz)	Total PSD with BWCF (dBm/500 kHz)	Total PSD with duty factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
		Chain 0	Chain 1					
142 (U-NII-3 Band)	5710	-4.27	-0.42	1.08	3.30	3.3	27.99	PASS
151	5755	-2.58	-5.22	-0.69	1.53	1.53	27.99	PASS
159	5795	0.92	-2.20	2.64	4.86	4.86	27.99	PASS

Note:

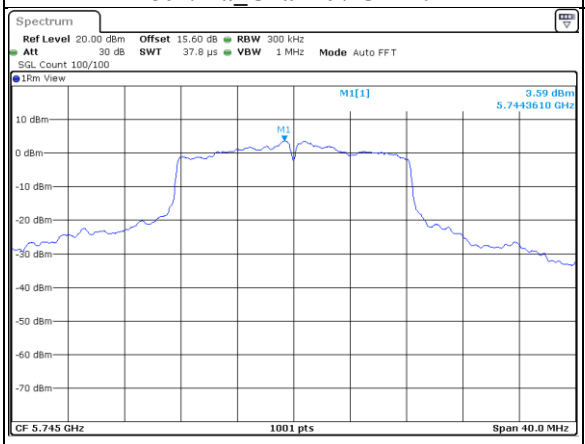
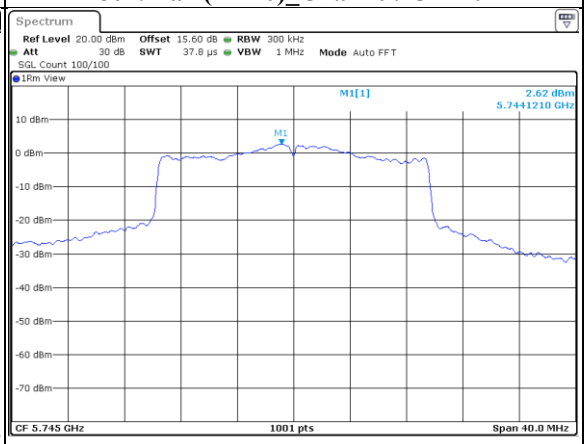
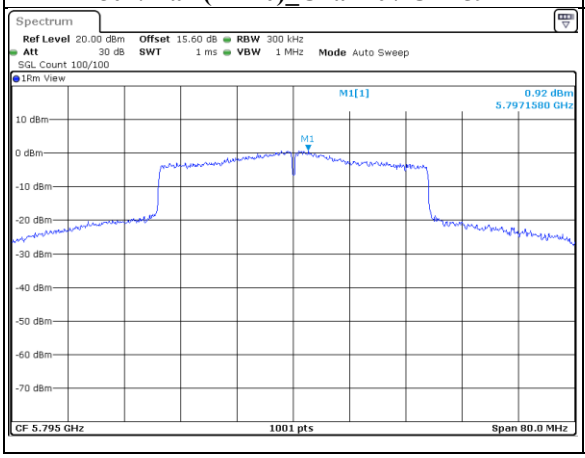
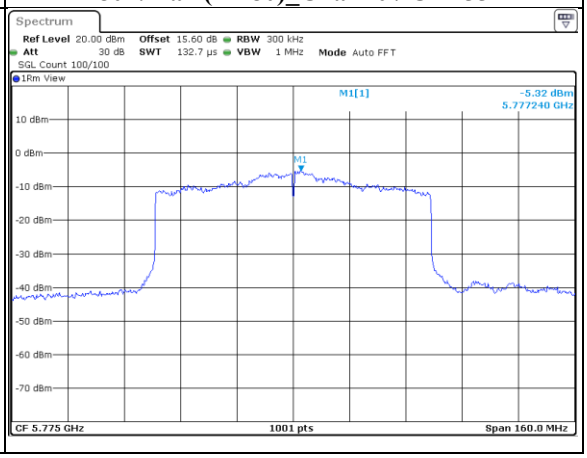
1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.
3. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(500 kHz/300kHz).

802.11ax (HE80)

Channel	Frequency (MHz)	PSD w/o duty factor (dBm/300 kHz)		Total PSD w/o BWCF (dBm/300 kHz)	Total PSD with BWCF (dBm/500 kHz)	Total PSD with duty factor (dBm/500 kHz)	Limit (dBm/500 kHz)	Pass / Fail
		Chain 0	Chain 1					
138 (U-NII-3 Band)	5690	-9.62	-7.30	-5.3	-3.08	-3.08	27.99	PASS
155	5775	-5.32	-5.93	-2.6	-0.38	-0.38	27.99	PASS

Note:

1. Directional gain = 8.01 dBi > 6 dBi , so the limit shall be reduced.
2. Refer to section 6.6 for duty cycle spectrum plot.
3. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log(500 kHz/300kHz).

Spectrum Plot of Worst Value	
802.11a_Chain 0 / CH149	**802.11ax (HE20)_Chain 0 / CH149**
	
802.11ax (HE40)_Chain 0 / CH159	**802.11ax (HE80)_Chain 0 / CH155**
	

9.6. Frequency Stability

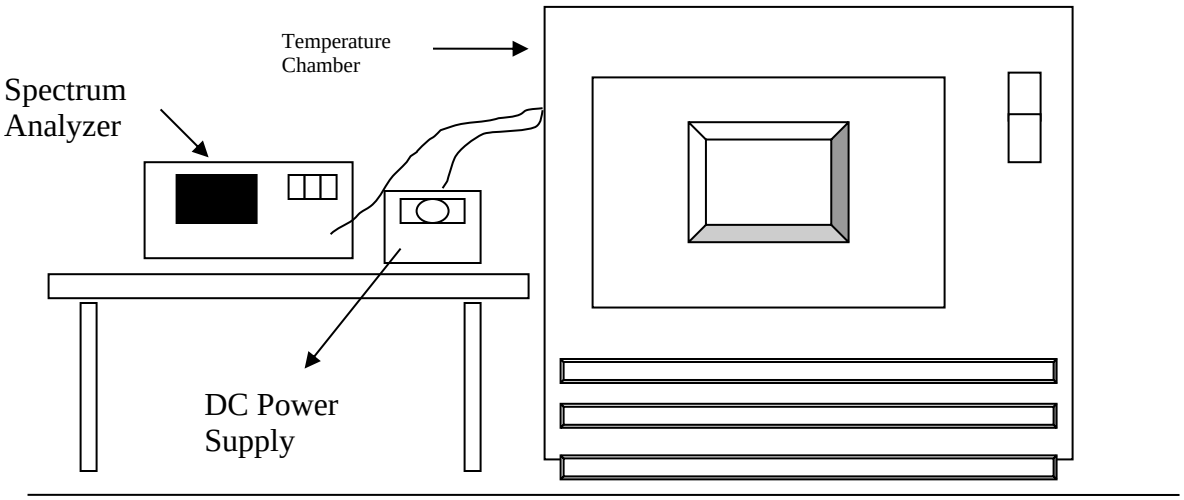
Requirements

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

Test procedure

a. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
b. Turn the EUT on and couple its output to a spectrum analyzer.
c. Turn the EUT off and set the chamber to the highest temperature specified.
d. 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.
e. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
f. 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 (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)
75	3.3	5180.022	4.25	5180.0227	4.38	5180.019	3.67	5180.0226	4.36
70	3.3	5179.974	-5.02	5179.9773	-4.38	5179.9732	-5.17	5179.9777	-4.31
60	3.3	5180.0237	4.58	5180.0263	5.08	5180.023	4.44	5180.0263	5.08
50	3.3	5179.9759	-4.65	5179.9752	-4.79	5179.9774	-4.36	5179.9779	-4.27
40	3.3	5180.0212	4.09	5180.02	3.86	5180.021	4.05	5180.0193	3.73
30	3.3	5180.0046	0.89	5180.0087	1.68	5180.0087	1.68	5180.0076	1.47
20	3.3	5179.9858	-2.74	5179.9861	-2.68	5179.9864	-2.63	5179.9834	-3.20
10	3.3	5180.0174	3.36	5180.0158	3.05	5180.017	3.28	5180.0164	3.17
0	3.3	5179.9845	-2.99	5179.983	-3.28	5179.9832	-3.24	5179.9833	-3.22
-10	3.3	5179.9767	-4.50	5179.9777	-4.31	5179.9779	-4.27	5179.978	-4.25
-20	3.3	5180.0011	0.21	5179.9994	-0.12	5179.9961	-0.75	5180.0008	0.15
-30	3.3	5180.0035	0.68	5180.0057	1.10	5180.0039	0.75	5180.0076	1.47
-40	3.3	5180.0011	0.21	5179.9978	-0.42	5180.0001	0.02	5179.9986	-0.27

TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)	Measured Frequency (MHz)	Freq. Drift (ppm)
20	3.795	5179.9867	-2.57	5179.986	-2.70	5179.9857	-2.76	5179.9841	-3.07
20	3.3	5179.9858	-2.74	5179.9861	-2.68	5179.9864	-2.63	5179.9834	-3.20
20	2.805	5179.9848	-2.93	5179.9866	-2.59	5179.986	-2.70	5179.9829	-3.30

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.

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 effective isotropic radiated power (eirp) to field strength:

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

Test Procedures

Following FCC KDB 789033 D02 General UNII Test Procedures Guidance:
Radiated versus Conducted Measurements.
The unwanted emission limits in both the restricted and non-restricted bands are based on antenna-port conducted measurements in conjunction with cabinet emissions tests are permitted to demonstrate compliance.
The following steps was performed:

a. Cabinet emissions measurements. Radiated measurement was performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna was replaced by a termination matching the nominal impedance of the antenna.
b. Conducted tests was performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT
c. EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater
d. EIRP adjustments for multiple outputs. (Follow the procedures specified in FCC KDB Publication 662911)

For Radiated Emission

[For 9 kHz ~ 30 MHz]

e. 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.
f. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
g. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
h. 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.
i. 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.

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 ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
802.11a	1MHz	10Hz
802.11ax (HE20)		10Hz
802.11ax (HE40)		10Hz
802.11ax (HE80)		10Hz
802.11ax (HE160)		10Hz

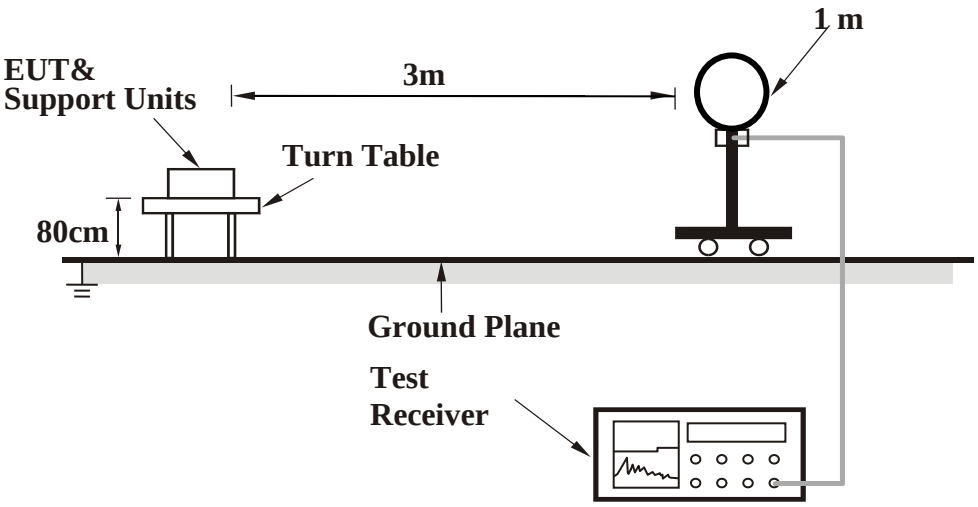
Note: Refer to section 6.6 for duty cycle.

d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
e. Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
f. Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
g. Test data of Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
h. Test data of Notation "@" = Fundamental Frequency
i. Test data of Notation " * " = Only required peak limit or the peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

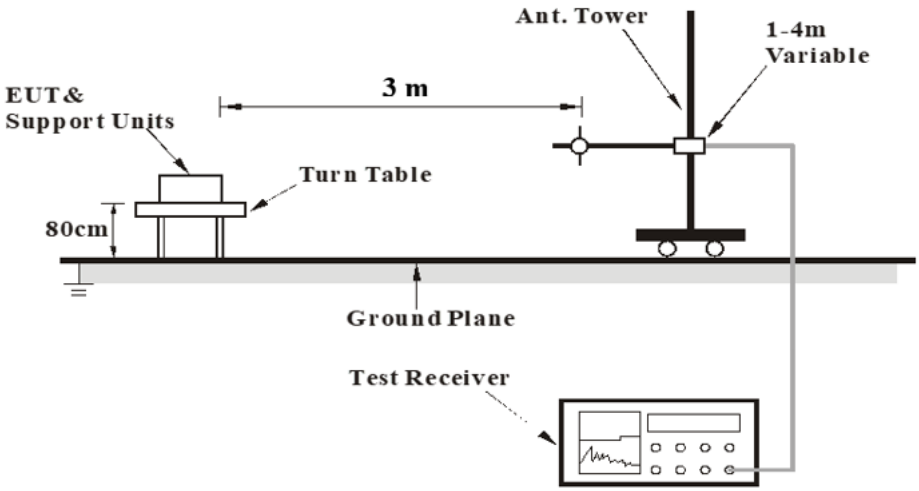
Test Setup

For Radiated Test Method:

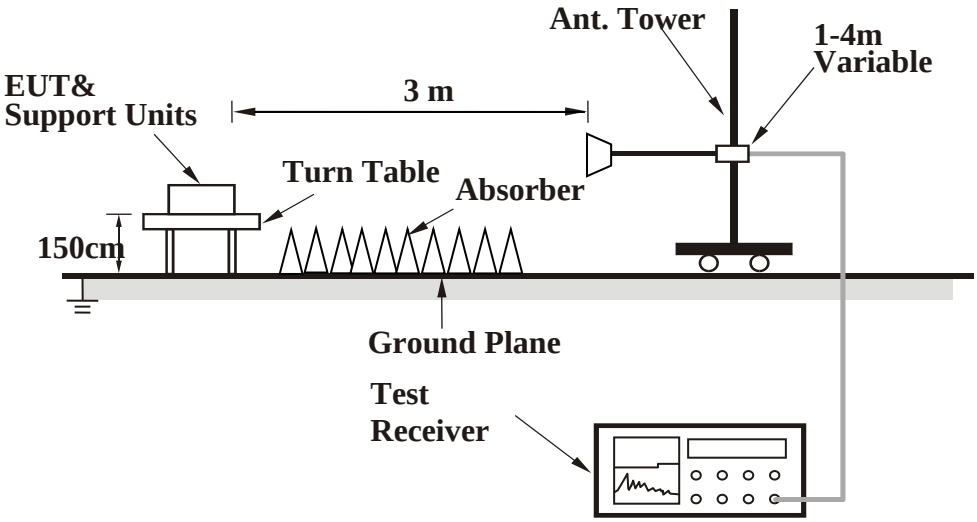
<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >

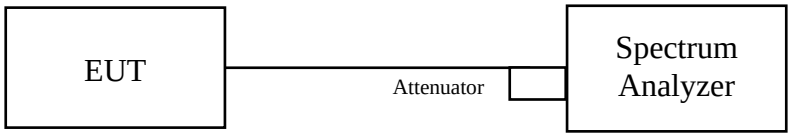


<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

For Conducted Test Method:



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

Test Data

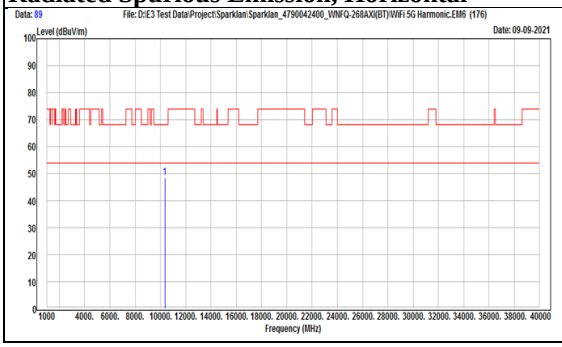
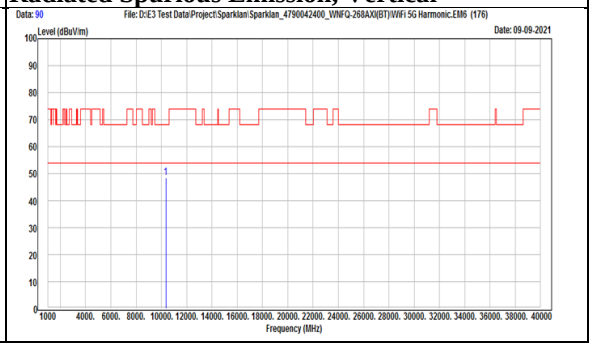
Radiated method

The level of unwanted emissions was measured when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation)

Above 1 GHz

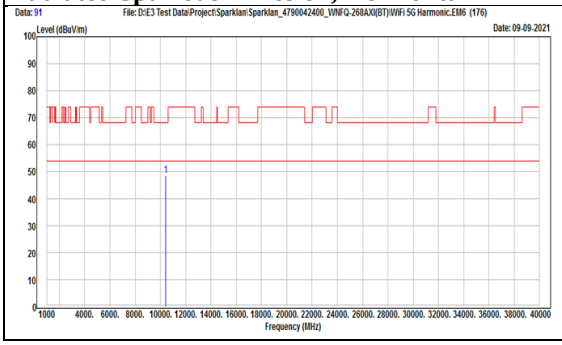
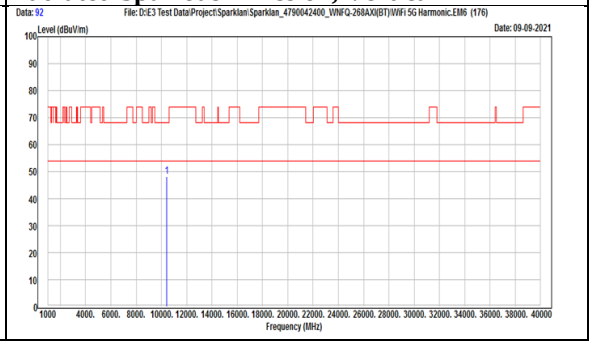
Mode	802.11a	Channel	36

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10360	31	17.39	48.39	68.2	-19.81	PK
Vertical	*	10360	31.1	17.39	48.49	68.2	-19.71	PK

TX, 802.11a (Ch 36) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 36) Radiated Spurious Emission, Vertical
	

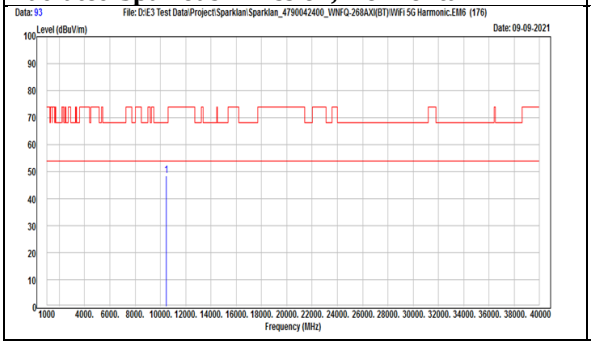
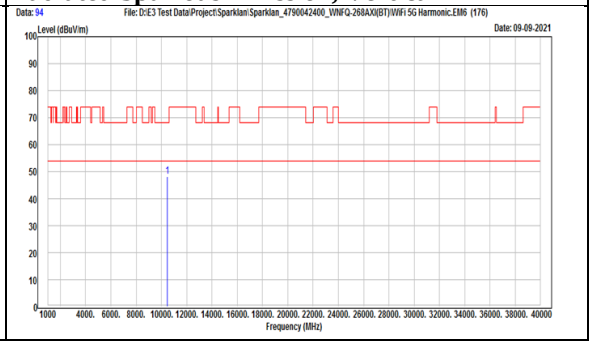
Mode	802.11a	Channel	44

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10440	30.87	17.63	48.5	68.2	-19.7	PK
Vertical	*	10440	30.57	17.63	48.2	68.2	-20	PK

TX, 802.11a (Ch 44) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 44) Radiated Spurious Emission, Vertical
	

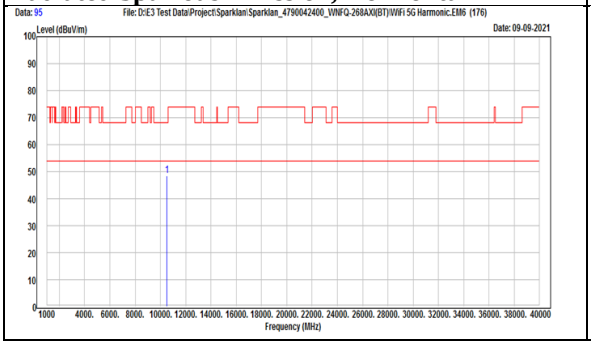
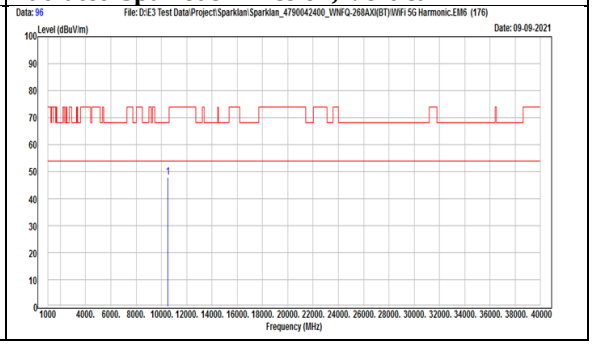
Mode	802.11a	Channel	48

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10480	30.66	17.69	48.35	68.2	-19.85	PK
Vertical	*	10480	30.54	17.69	48.23	68.2	-19.97	PK

TX, 802.11a (Ch 48) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 48) Radiated Spurious Emission, Vertical
	

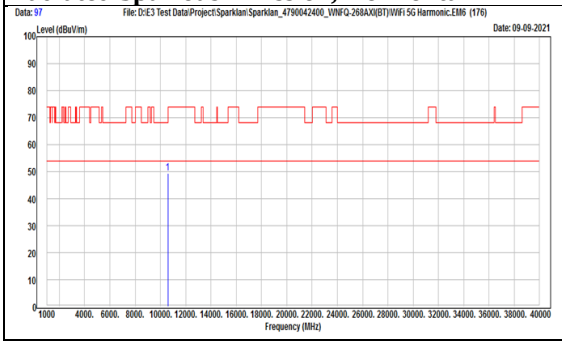
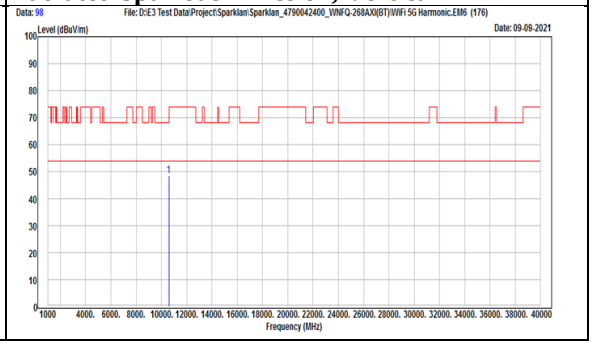
Mode	802.11a	Channel	52

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10520	30.9	17.73	48.63	68.2	-19.57	PK
Vertical	*	10520	30.22	17.73	47.95	68.2	-20.25	PK

TX, 802.11a (Ch 52) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 52) Radiated Spurious Emission, Vertical
	

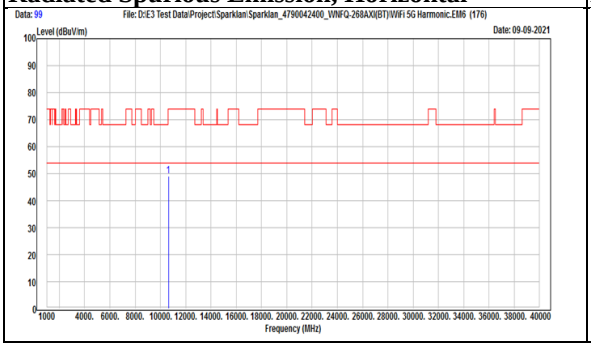
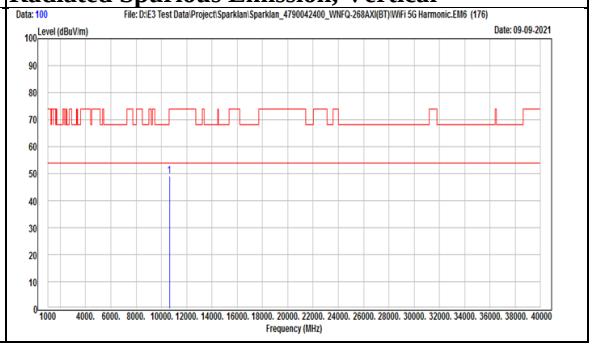
Mode	802.11a	Channel	60

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10600	31.76	17.73	49.49	68.2	-18.71	PK
Vertical	*	10600	30.65	17.73	48.38	68.2	-19.82	PK

TX, 802.11a (Ch 60) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 60) Radiated Spurious Emission, Vertical
	

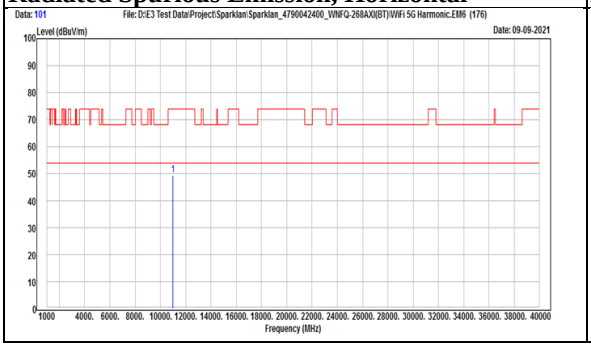
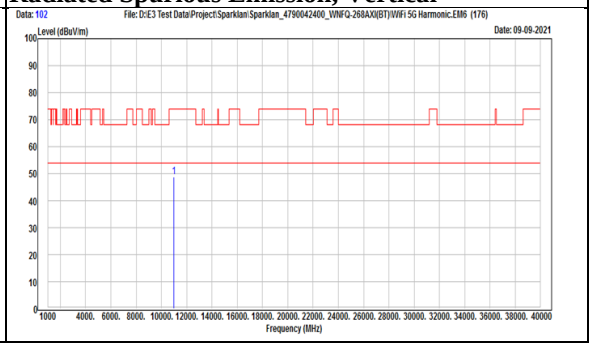
Mode	802.11a	Channel	64

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	10640	31.25	17.82	49.07	74	-24.93	PK
Vertical	*	10640	31.22	17.82	49.04	74	-24.96	PK

TX, 802.11a (Ch 64) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 64) Radiated Spurious Emission, Vertical
	

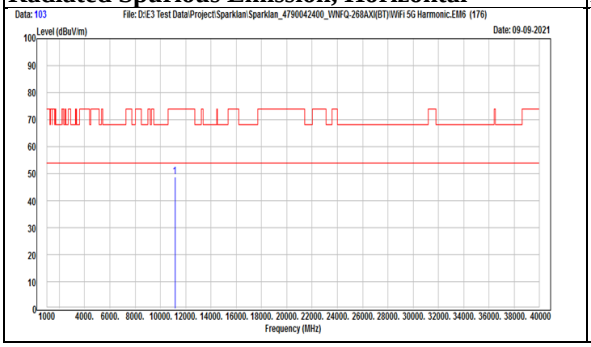
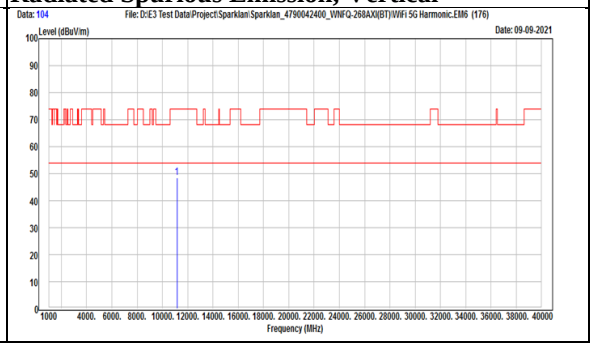
Mode	802.11a	Channel	100

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	11000	31.11	18.28	49.39	74	-24.61	PK
Vertical	*	11000	30.62	18.28	48.9	74	-25.1	PK

TX, 802.11a (Ch 100) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 100) Radiated Spurious Emission, Vertical
	

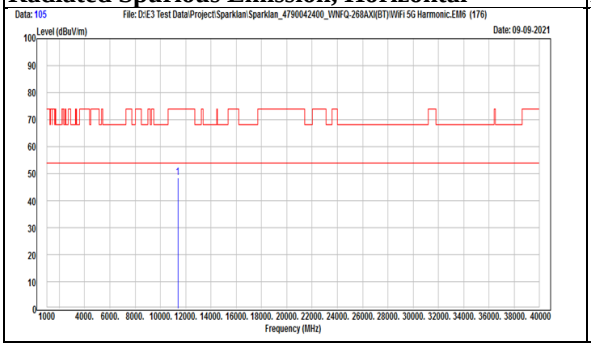
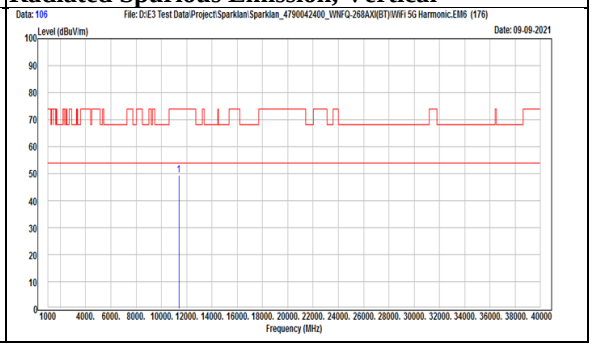
Mode	802.11a	Channel	116

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	11160	30.35	18.32	48.67	74	-25.33	PK
Vertical	*	11160	30.03	18.32	48.35	74	-25.65	PK

TX, 802.11a (Ch 116) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 116) Radiated Spurious Emission, Vertical
	

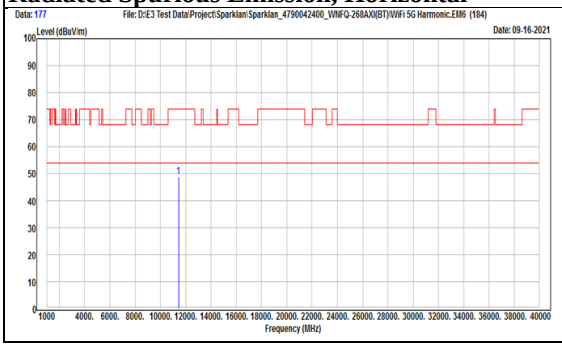
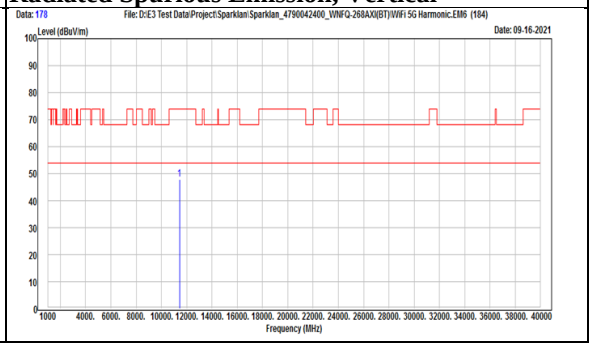
Mode	802.11a	Channel	140

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	11400	29.83	18.74	48.57	74	-25.43	PK
Vertical	*	11400	30.54	18.74	49.28	74	-24.72	PK

TX, 802.11a (Ch 140) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 140) Radiated Spurious Emission, Vertical
	

Mode	802.11a	Channel	144

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	11440	29.85	18.86	48.71	74	-25.29	PK
Vertical	*	11440	29.08	18.86	47.94	74	-26.06	PK

TX, 802.11a (Ch 144) Radiated Spurious Emission, Horizontal	TX, 802.11a (Ch 144) Radiated Spurious Emission, Vertical
	

Mode	802.11a	Channel	149

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	*	11490	30.45	19.02	49.47	74	-24.53	PK
Vertical	*	11490	30.58	19.02	49.6	74	-24.4	PK