

# RF TEST REPORT



Supersede Report No.: FCC-IC\_RF\_SL14091601-FOR-017\_UNII

Applicant	:	Fortinet, Inc.
Product Name	:	802.11 ac Module
Model No.	:	PCE4502AN
Test Standard	:	47 CFR 15.407 RSS-210 Issue 8: 2010
Test Method	:	RSS-Gen Issue 4: 2014 ANSI C63.10: 2009 789033 D01 General UNII Test Procedures Old Rules v01r04
FCC ID	:	TVE-120502
IC Certification Number	:	7280B-120502
Dates of test	:	10/06/2014 – 10/16/2014
Issue Date	:	12/15/2014
Test Result	:	<u>Pass</u> Fail
Equipment complied with the specification [X]		
Equipment did not comply with the specification [ ]		

This Test Report is Issued Under the Authority of:

Angel Escamilla	Nima Molaei
Test Engineer	Engineer Reviewer
This test report may be reproduced in full only Test result presented in this test report is applicable to the tested sample only	

Issued By:  
SIEMIC Laboratories  
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## Laboratory Introduction

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In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

### Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRR, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

### Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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## 1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC-IC_RF_SL14091601-FOR-017_UNII_Rev1.0	1.0	- RSS-Gen Issue 4:2014 test method was updated - Radiated spurious emissions limits were updated	12/15/2014
FCC-IC_RF_SL14091601-FOR-017_UNII	None	Original	11/18/2014

## 2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Fortinet, Inc.  
Product: 802.11 ac Module  
Model: PCE4502AN

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1<sup>st</sup> page.

## 3 Customer information

Applicant Name	:	Fortinet, Inc.
Applicant Address	:	899 Kifer Road, Sunnyvale, California, United States, 94086
Manufacturer Name	:	Fortinet, Inc.
Manufacturer Address	:	899 Kifer Road, Sunnyvale, California, United States, 94086

## 4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

## 5 Modification

Index	Item	Description	Note
-	-	-	-

## 6 EUT Information

### 6.1 EUT Description

Product Name	:	802.11 ac Module
Model No.	:	PCE4502AN
Trade Name	:	Fortinet
Serial No.	:	142220073561
Input Power	:	100-240VAC (Laptop power adapter)
Power Adapter Manu/Model	:	Lenovo/42T4438
Power Adapter SN	:	N/A
Hardware version	:	N/A
Software version	:	N/A
Date of EUT received	:	10/06/2014
Equipment Class/ Category	:	UNII
Clock Frequencies	:	N/A
Port/Connectors	:	N/A

### 6.2 Radio Description

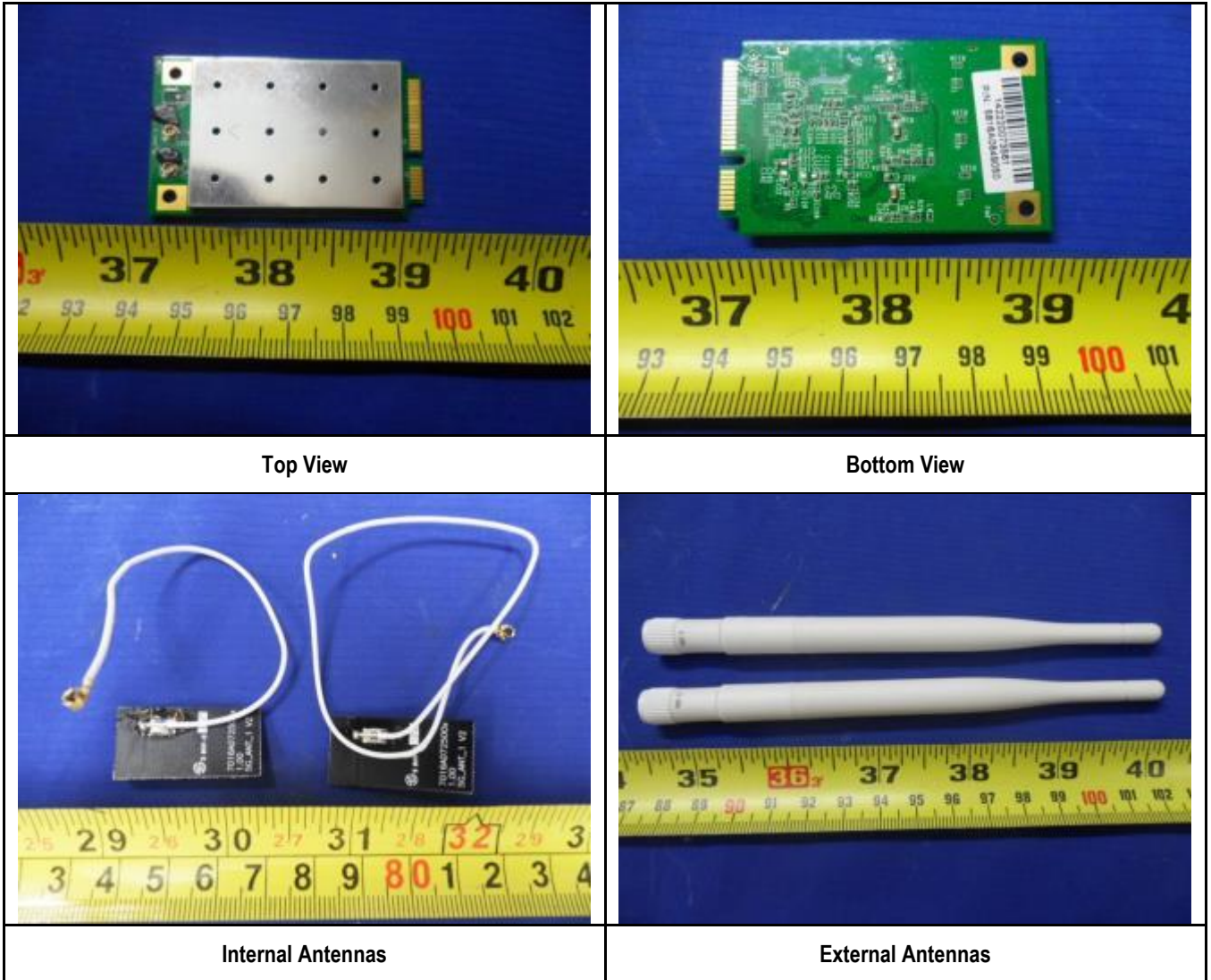
#### Spec for Radio -

Radio Type	802.11a	802.11n-20M	802.11n-40M	802.11ac-80M
Operating Frequency	5180-5320MHz 5500-5700MHz 5745-5825MHz	5180-5320MHz 5500-5700MHz 5745-5825MHz	5190-5310MHz 5510-5670MHz 5755-5795MHz	5210MHz, 5290MHz 5530MHz, 5775MHz
Modulation	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Spacing	20MHz	20MHz (5GHz)	40MHz	80MHz
Number of Channels	19	19 (5GHz)	9(5GHz)	4
Antenna Type	Internal Patch Antennas Dipole Antennas			
Antenna Gain (Peak)	Internal Patch Antennas: 5.5dBi (Ant1)& 6dBi (Ant2) Dipole Antennas: 4 dBi  Directional antenna gain formula Directional Antenna Gain = $10 * \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}]$ Therefore: Directional Antenna Gain = $10 * \log[(10^{5.5/20} + 10^{6/20})^2 / 2] = 8.76\text{dBi}$			
Antenna Connector Type	UFL (Patch antenna), SMA (Dipole antenna)			

## EUT Power level setting

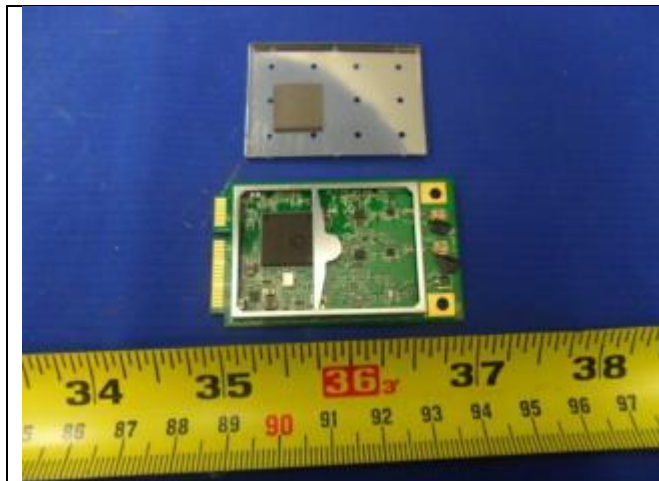
Mode	Frequency (MHz)	ART Power setting
802.11-a	5260	17
802.11-a	5280	17
802.11-a	5320	17
802.11-n-20	5260	17
802.11-n-20	5280	17
802.11-n-20	5320	17
802.11-n-40	5270	17
802.11-n-40	5320	14
802.11-ac-80	5290	14
802.11-a	5500	21
802.11-a	5580	21
802.11-a	5700	18
802.11-n-20	5500	18
802.11-n-20	5580	18
802.11-n-20	5700	17
802.11-n-40	5510	16
802.11-n-40	5550	19
802.11-n-40	5670	19
802.11-ac-80	5530	15

### 6.3 EUT Photos - External

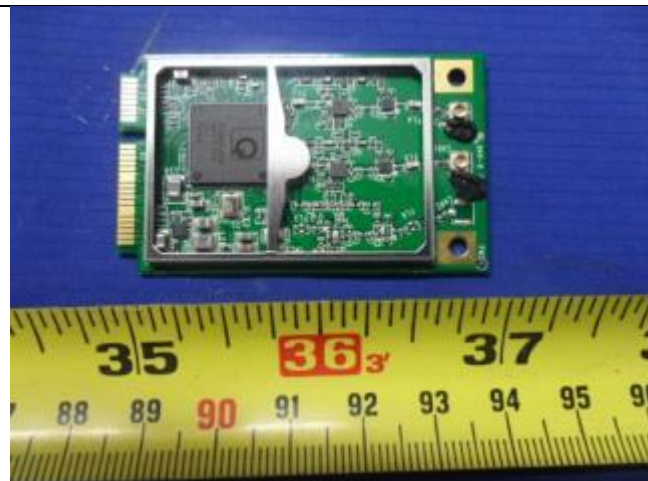




#### 6.4 EUT Photos - Internal



EUT Without Shielding View 1



EUT Without Shielding View 2

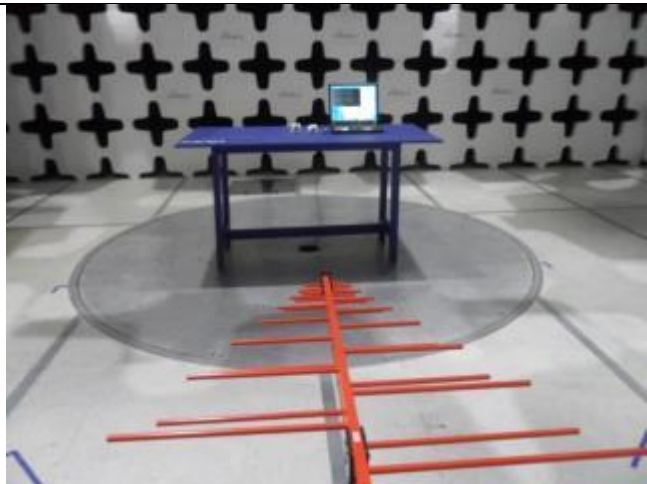
## 6.5 EUT Test Setup Photos



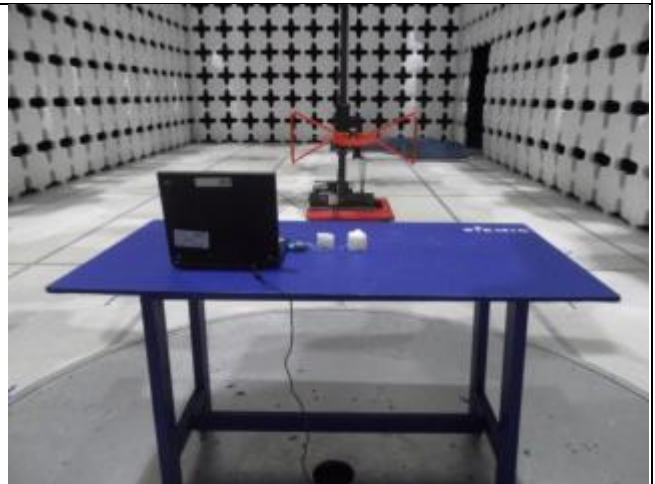
AC Line Conducted Emissions – Front View



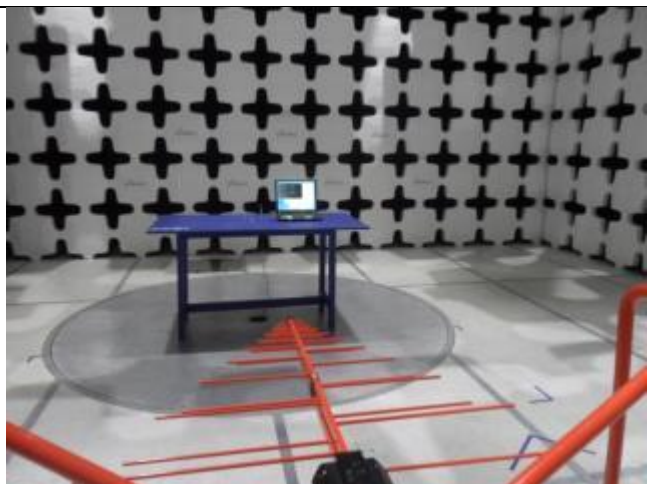
AC Line Conducted Emissions – Rear View



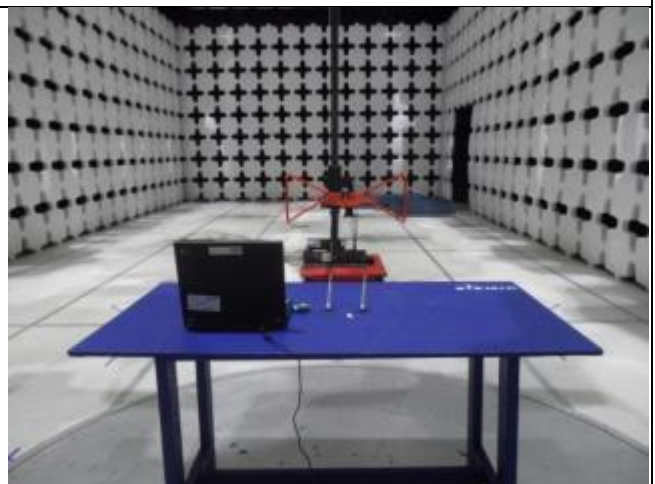
Radiated Emissions (<1GHz) – Front View (Int. Antennas)



Radiated Emissions (<1GHz) – Rear View (Int. Antennas)



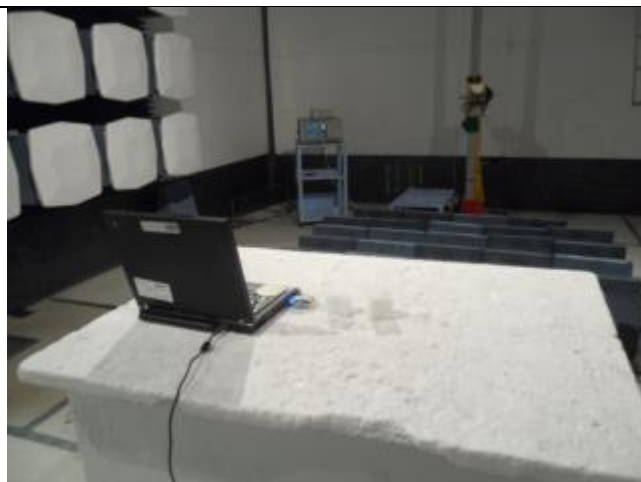
Radiated Emissions (<1GHz) – Front View (Ext. Antennas)



Radiated Emissions (<1GHz) – Rear View (Ext. Antennas)



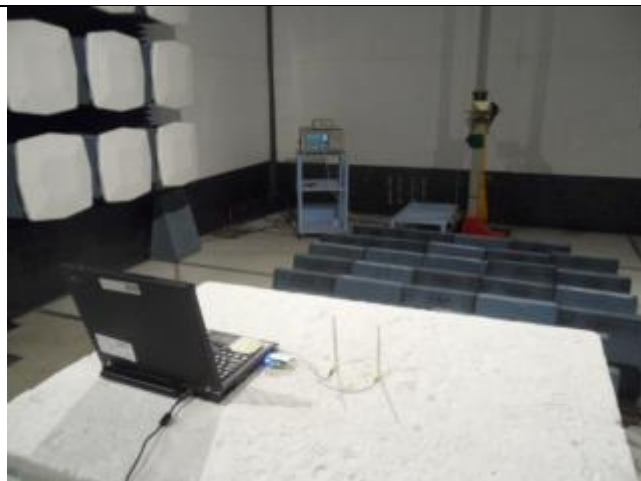
**Radiated Emissions (>1GHz) – Front View (Int. Antennas)**



**Radiated Emissions (>1GHz) – Rear View (Int. Antennas)**



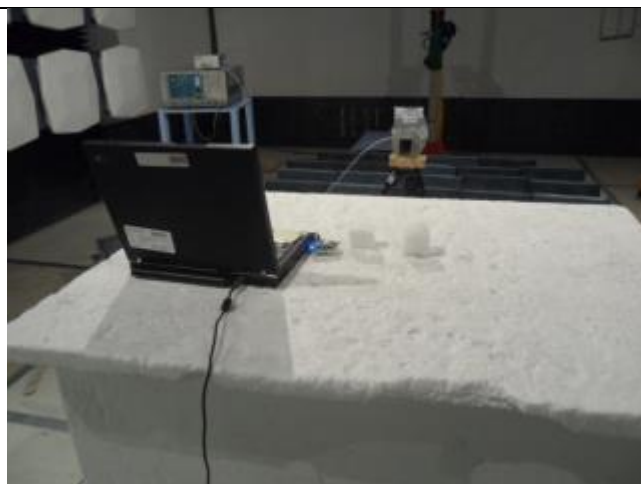
**Radiated Emissions (>1GHz) – Front View (Ext. Antennas)**



**Radiated Emissions (>1GHz) – Rear View (Ext. Antennas)**



**Radiated Emissions (>18GHz) – Front View (Int. Antennas)**

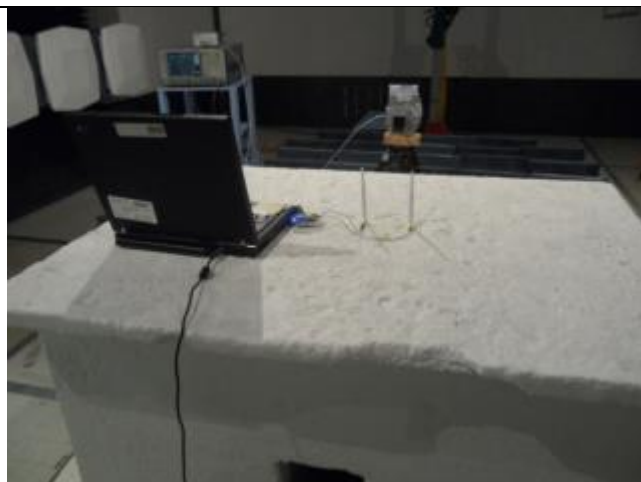


**Radiated Emissions (>18GHz) – Rear View (Int. Antennas)**





**Radiated Emissions (>18GHz) – Front View (Ext. Antennas)**



**Radiated Emissions (>18GHz) – Rear View (Ext. Antennas)**

## 7 Supporting Equipment/Software and cabling Description

### 7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	R60	LV-BB670	Lenovo	-
2	AC/DC Power Supply	PA1024-2HUB	-	Powertron Electronics Corp.	-

### 7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
-	-	-	-	-	-	-	-

### 7.3 Test Software Description

Test Item	Software	Description
RF Testing	cmd.exe	Set the EUT to transmit continuously in diferent test mode

## 8 Test Summary

Test Item	Test standard		Test Method/Procedure	Pass / Fail
Restricted Band of Operation	FCC IC	15.205 RSS 210 (2.2)	ANSI C63.10 – 2009 789033 D01 General UNII Test Procedures v01r03	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
AC Conducted Emissions Voltage	FCC IC	15.207(a) RSS Gen (8.8)	ANSI C63.10 – 2009 RSS Gen (8.8)	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A

Test Item	Test standard		Test Method/Procedure	Pass / Fail
26 dB Emission Bandwidth	FCC IC	15.407 (a) (2) RSS 210 (A9.2) (2)	789033 D01 General UNII Test Procedures Old Rules v01r04	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
99% Bandwidth	IC	RSS 210 (6.6)	RSS Gen (6.6)	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
Maximum Conducted Output Power	FCC IC	15.407 (a) (2) RSS 210 (A9.2) (1)	789033 D01 General UNII Test Procedures Old Rules v01r04	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
Power reduction (Antenna Gain > 6 dBi)	FCC IC	15.407 (a) (2)	-	<input type="checkbox"/> Pass <input checked="" type="checkbox"/> N/A
Band Edge and Radiated Spurious Emissions	FCC IC	15.407(b)(2), RSS210(A9.3)(1)	ANSI C63.10 – 2009 789033 D01 General UNII Test Procedures Old Rules v01r04	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
Power Spectral Density	FCC IC	15.407 (a) (2) RSS 210 (A9.2) (1)	789033 D01 General UNII Test Procedures Old Rules v01r04	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
Peak Excursion Ratio	FCC IC	15.407(a)(6) RSS 210 (A9.2)	789033 D01 General UNII Test Procedures Old Rules v01r04	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A
Frequency Stability	FCC IC	15.407 (g) RSS 210 (A9.5) (e)	-	<input type="checkbox"/> Pass <input checked="" type="checkbox"/> N/A
Transmit Power Control (TPC)	FCC IC	15.407 (h)(1) RSS 210 (A9.2) (3)	-	<input type="checkbox"/> Pass <input checked="" type="checkbox"/> N/A
User Manual	FCC IC	-	-	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> N/A

Remark

1. All measurement uncertainties are not taken into consideration for all presented test result.
2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual.

## 9 Measurement Uncertainty

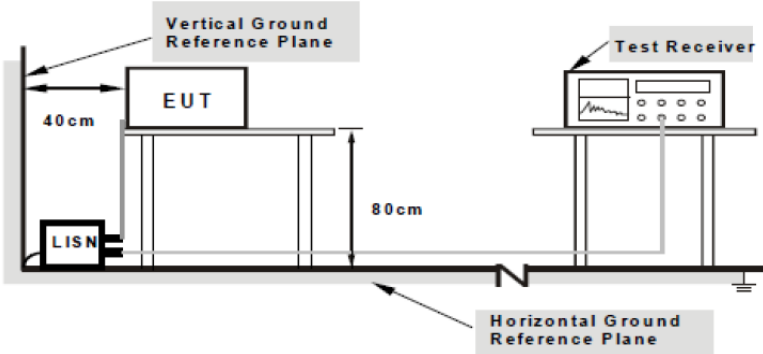
Emissions			
Test Item	Frequency Range	Description	Uncertainty
Band Edge and Radiated Spurious Emissions	30MHz – 1GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
Band Edge and Radiated Spurious Emissions	1GHz – 40GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+4.3dB/-4.1dB

## 10 Measurements, Examination and Derived Results

### 10.1 Conducted Emissions

#### Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
47CFR§15.207 RSS210(A8.1)	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	<input checked="" type="checkbox"/>
Test Setup	 <p>Note: 1. Support units were connected to second LISN. 2. Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.</p>		
Procedure	<ul style="list-style-type: none"> <li>- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B.</li> <li>- The power supply for the EUT was fed through a 50<math>\Omega</math>/50<math>\mu</math>H EUT LISN, connected to filtered mains.</li> <li>- The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.</li> <li>- All other supporting equipment was powered separately from another main supply.</li> </ul>		
Remark	EUT was tested connected directly to a laptop.		
Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail		

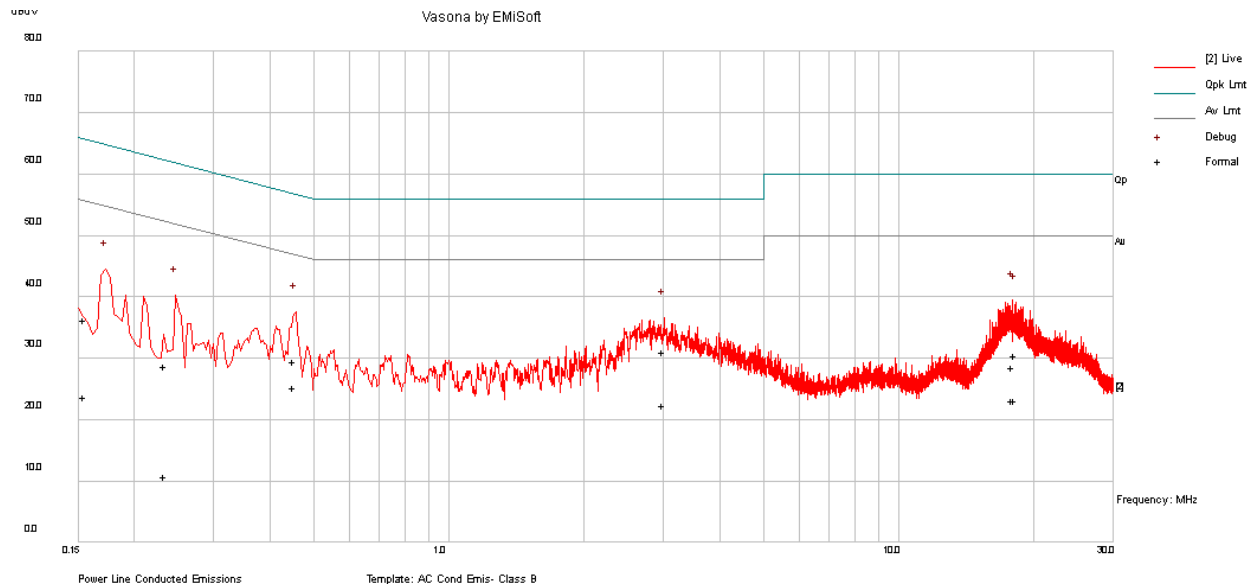
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A



## Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	<input checked="" type="checkbox"/> Pass  <input type="checkbox"/> Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Angel Escamilla			
Test Date:	10/20/2014			
Remarks	Line			

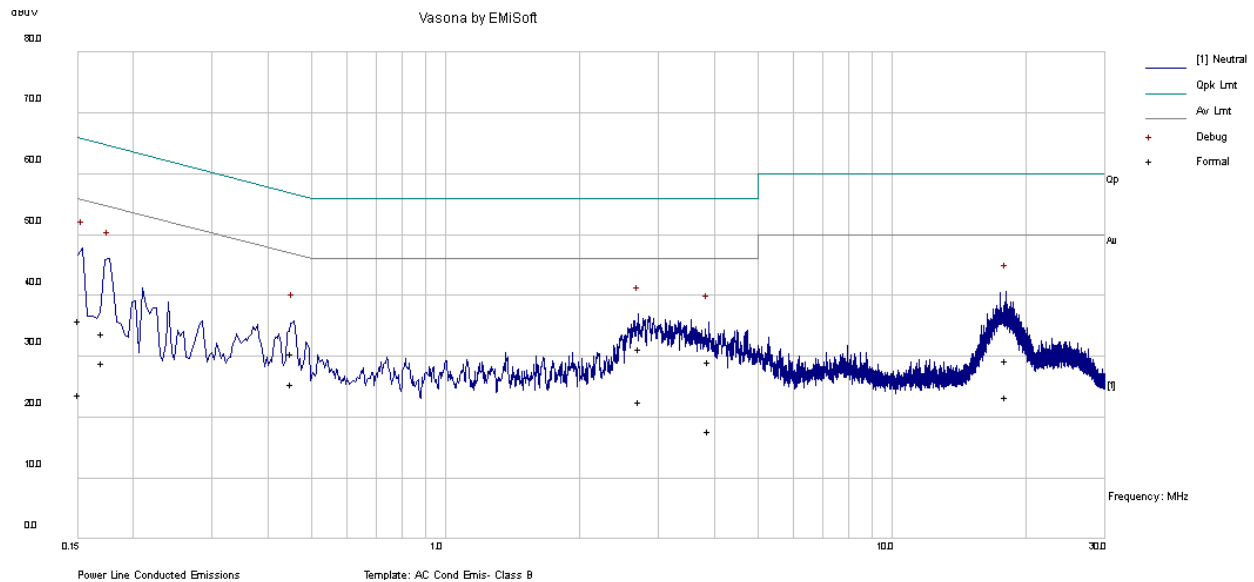


Live Line Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.15	25.59	10.00	0.76	36.35	Quasi Peak	Line	65.75	-29.40	Pass
0.23	17.96	10.00	0.73	28.70	Quasi Peak	Line	62.31	-33.61	Pass
0.45	18.86	10.01	0.73	29.60	Quasi Peak	Line	56.83	-27.23	Pass
3.00	20.13	10.03	0.98	31.14	Quasi Peak	Line	56.00	-24.86	Pass
17.89	16.36	10.07	2.09	28.52	Quasi Peak	Line	60.00	-31.48	Pass
18.14	18.30	10.07	2.11	30.48	Quasi Peak	Line	60.00	-29.52	Pass

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.15	12.99	10.00	0.76	23.75	Average	Line	55.75	-32.00	Pass
0.23	-0.02	10.00	0.73	10.71	Average	Line	52.31	-41.59	Pass
0.45	14.59	10.01	0.73	25.33	Average	Line	46.83	-21.50	Pass
3.00	11.33	10.03	0.98	22.34	Average	Line	46.00	-23.66	Pass
17.89	10.98	10.07	2.09	23.14	Average	Line	50.00	-26.86	Pass
18.14	10.98	10.07	2.11	23.16	Average	Line	50.00	-26.84	Pass

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	<input checked="" type="checkbox"/> Pass  <input type="checkbox"/> Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Angel Escamilla			
Test Date:	10/20/2014			
Remarks	Neutral			




### Neutral Line@ 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.15	25.08	10.00	0.76	35.83	Quasi Peak	Neutral	65.95	-30.12	Pass
0.17	23.09	10.00	0.75	33.84	Quasi Peak	Neutral	64.91	-31.08	Pass
0.45	19.79	10.01	0.73	30.52	Quasi Peak	Neutral	56.84	-26.32	Pass
2.72	20.20	10.03	0.97	31.19	Quasi Peak	Neutral	56.00	-24.81	Pass
3.88	17.99	10.03	1.07	29.09	Quasi Peak	Neutral	56.00	-26.91	Pass
18.03	17.07	10.07	2.10	29.24	Quasi Peak	Neutral	60.00	-30.76	Pass

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
18.03	11.18	10.07	2.10	23.35	Average	Neutral	50.00	-26.65	Pass
3.88	6.64	10.03	1.07	17.74	Average	Neutral	46.00	-28.26	Pass
0.45	14.65	10.01	0.73	25.39	Average	Neutral	46.84	-21.45	Pass
0.15	12.99	10.00	0.76	23.75	Average	Neutral	55.95	-32.21	Pass
0.17	18.26	10.00	0.75	29.01	Average	Neutral	54.91	-25.90	Pass
2.72	11.56	10.03	0.97	22.56	Average	Neutral	46.00	-23.44	Pass

## 10.2 26 dB & 99% Bandwidth

### Requirement(s):

Spec	Item	Requirement	Applicable
15.407 (a) (2) RSS 210 (A9.2) (2)	a) (2)	26 dB Emission BW: Report only for power limit calculation.	<input checked="" type="checkbox"/>
	(4.6.1)	99% BW: For FCC reference only; required by IC.	<input checked="" type="checkbox"/>
	e)	Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.	<input type="checkbox"/>
Test Setup			
Test Procedure	<p><u>26dB Emission bandwidth measurement procedure</u></p> <ul style="list-style-type: none"> <li>- Allow the trace to stabilize.</li> <li>- Use the spectrum analyzer built-in measurement function to determine the 26dB BW. <ul style="list-style-type: none"> <li>o Set RBW = around 1% of emission bandwidth</li> <li>o Set VBW &gt; RBW</li> <li>o Detector = Peak</li> <li>o Trace mode = max hold</li> </ul> </li> <li>- Capture the plot.</li> <li>- Repeat above steps for different test channel and other modulation type.</li> </ul> <p><u>99% Occupied bandwidth measurement procedure</u></p> <ul style="list-style-type: none"> <li>- Allow the trace to stabilize.</li> <li>- Use the spectrum analyzer built-in measurement function to determine the 99% OBW. <ul style="list-style-type: none"> <li>o Set RBW = close to 1% of the selected span as is</li> <li>o Set VBW = 3 x RBW</li> <li>o Detector = Peak</li> <li>o Trace mode = max hold</li> <li>o Sweep = auto couple</li> </ul> </li> <li>- Capture the plot.</li> <li>- Repeat above steps for different test channel and other modulation type.</li> </ul>		
Test Date	10/06/2014	Environmental condition	Temperature 23°C Relative Humidity 44% Atmospheric Pressure 1021mbar
Remark	N/A		
Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail		

### Equipment Setting

Test	RBW	VBW	Span	Detector	Sweep	Trace	Notes
26 dB Emission Bandwidth	1% of 26 dB EBW	>RBW	>EBW	PK	Auto	Maxhold	-
99% OBW	1% of selected span	3 x RBW	>EBW	PK	Auto	Max hold	-

Test Data    ☒ Yes      ☐ N/A

Test Plot    ☒ Yes      ☐ N/A

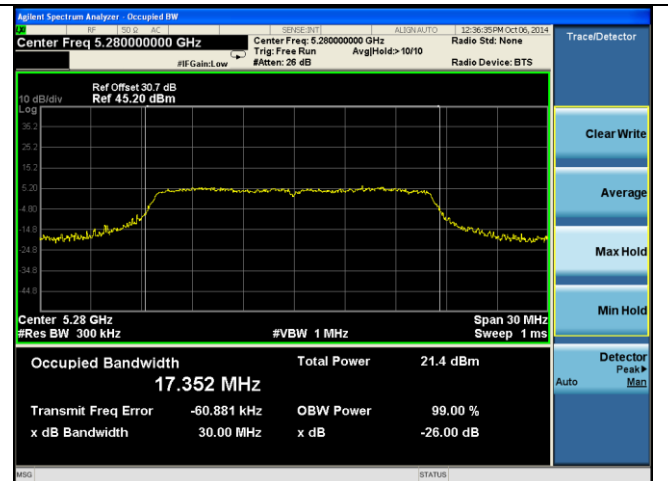
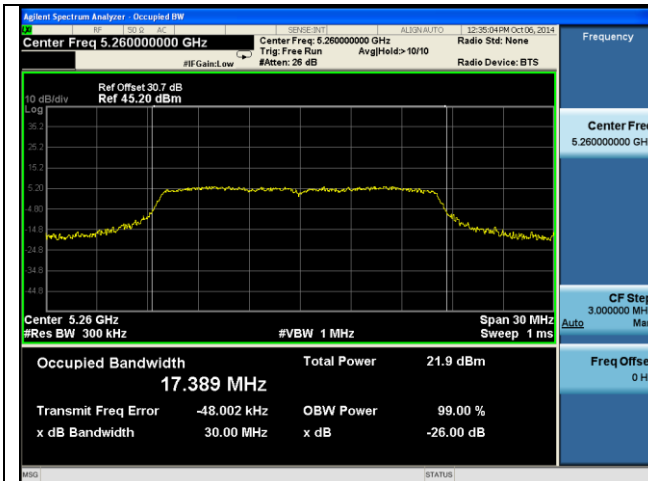
#### 26dB Bandwidth measurement results

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
26dB BW	802.11-a	5260	Low	30.00	-	-
26dB BW	802.11-a	5280	Mid	30.00	-	-
26dB BW	802.11-a	5320	High	29.73	-	-
26dB BW	802.11-n-20	5260	Low	30.00	-	-
26dB BW	802.11-n-20	5280	Mid	29.93	-	-
26dB BW	802.11-n-20	5320	High	29.61	-	-
26dB BW	802.11-n-40	5270	Low	50.00	-	-
26dB BW	802.11-n-40	5310	High	49.86	-	-
26dB BW	802.11-ac-80	5290	Mid	100.00	-	-
26dB BW	802.11-a	5500	Low	30.00	-	-
26dB BW	802.11-a	5580	Mid	29.98	-	-
26dB BW	802.11-a	5700	High	29.97	-	-
26dB BW	802.11-n-20	5500	Low	30.00	-	-
26dB BW	802.11-n-20	5580	Mid	30.00	-	-
26dB BW	802.11-n-20	5700	High	30.00	-	-
26dB BW	802.11-n-40	5510	Low	49.97	-	-
26dB BW	802.11-n-40	5550	Mid	50.00	-	-
26dB BW	802.11-n-40	5670	High	50.00	-	-
26dB BW	802.11-ac-80	5530	Mid	99.94	-	-

#### 99% Bandwidth measurement results

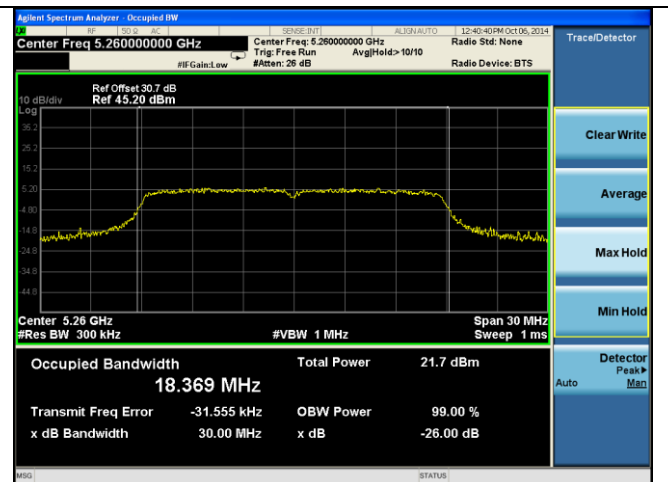
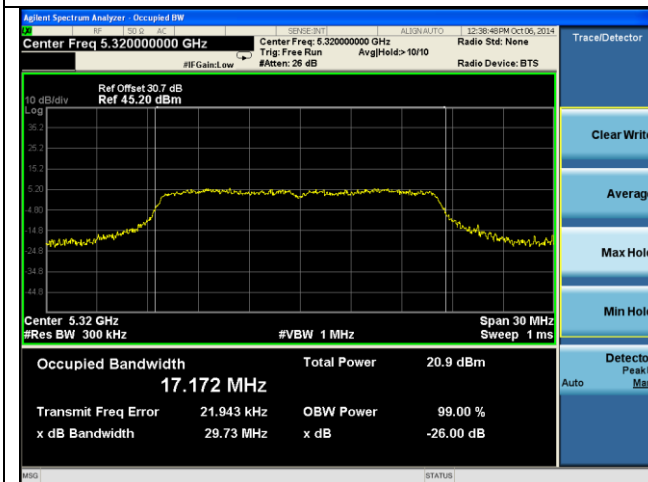
Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
99% BW	802.11-a	5260	Low	17.389	-	-
99% BW	802.11-a	5280	Mid	17.352	-	-
99% BW	802.11-a	5320	High	17.172	-	-
99% BW	802.11-n-20	5260	Low	18.369	-	-
99% BW	802.11-n-20	5280	Mid	18.247	-	-
99% BW	802.11-n-20	5320	High	18.172	-	-
99% BW	802.11-n-40	5270	Low	36.663	-	-
99% BW	802.11-n-40	5310	High	36.417	-	-
99% BW	802.11-ac-80	5290	Mid	76.004	-	-
99% BW	802.11-a	5500	Low	17.498	-	-
99% BW	802.11-a	5580	Mid	17.521	-	-
99% BW	802.11-a	5700	High	17.405	-	-
99% BW	802.11-n-20	5500	Low	18.571	-	-
99% BW	802.11-n-20	5580	Mid	18.888	-	-
99% BW	802.11-n-20	5700	High	18.642	-	-
99% BW	802.11-n-40	5510	Low	36.780	-	-
99% BW	802.11-n-40	5550	Mid	36.836	-	-
99% BW	802.11-n-40	5670	High	36.839	-	-
99% BW	802.11-ac-80	5530	Mid	76.007	-	-

## 26dB and 99% Bandwidth Test Plots



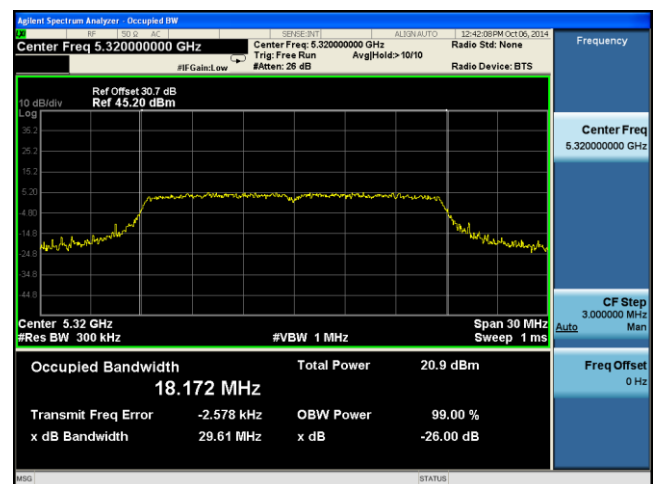
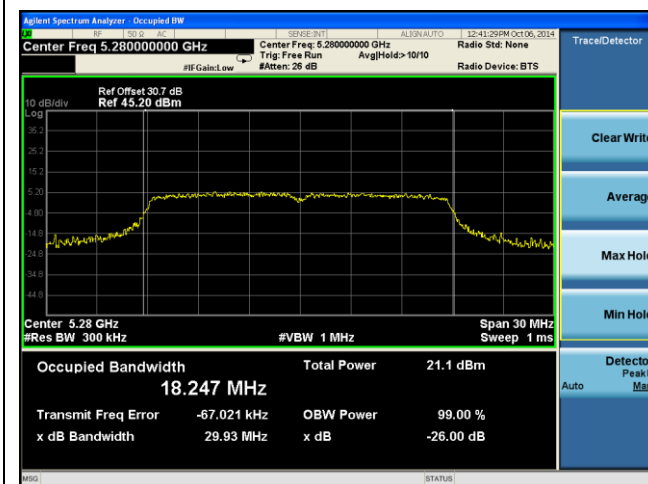
26dB & 99% BW - 802.11a 5260MHz

26dB & 99% BW - 802.11a 5280MHz



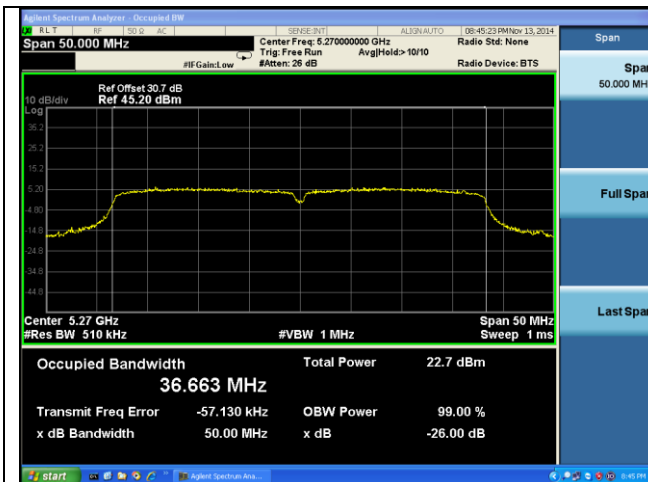
26dB & 99% BW - 802.11a 5320MHz

26dB & 99% BW - 802.11n-20M 5260MHz

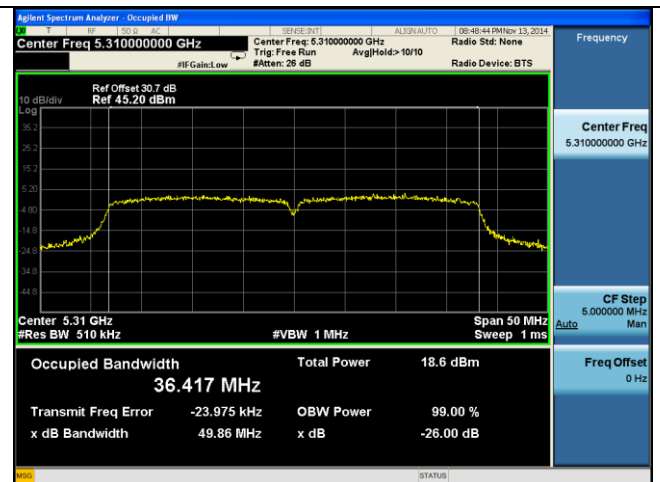


26dB & 99% BW - 802.11n-20M 5280MHz

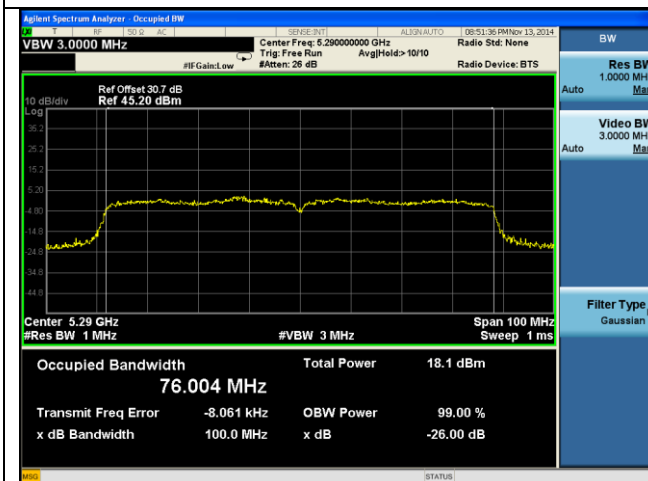
26dB & 99% BW - 802.11n-20M 5320MHz



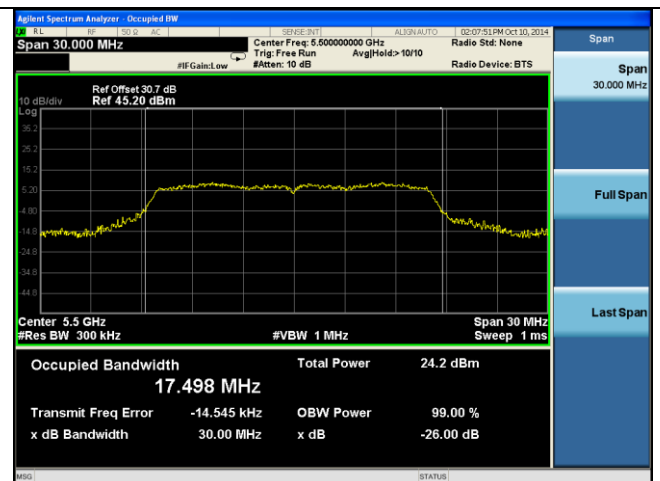
26dB & 99% BW - 802.11n-40M 5270MHz



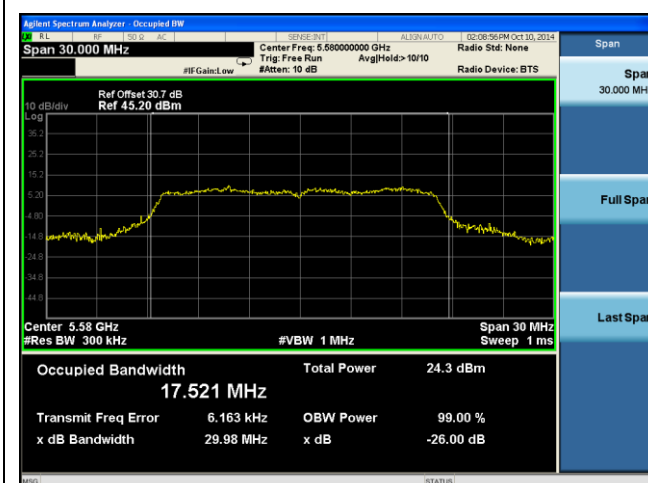
26dB & 99% BW - 802.11n-40M 5310MHz



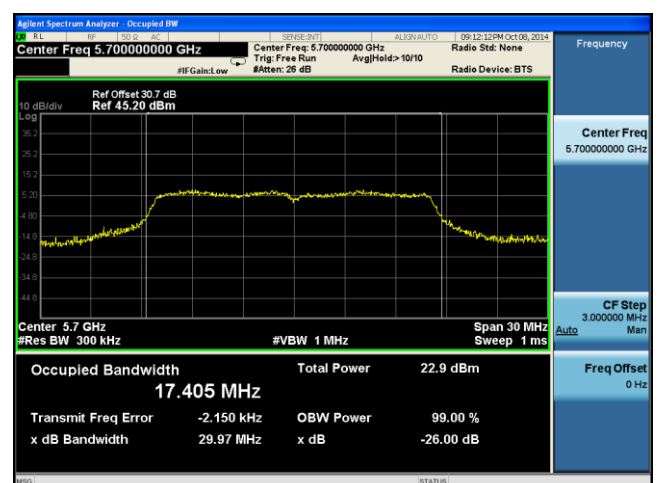
26dB & 99% BW - 802.11ac-80M 5290MHz



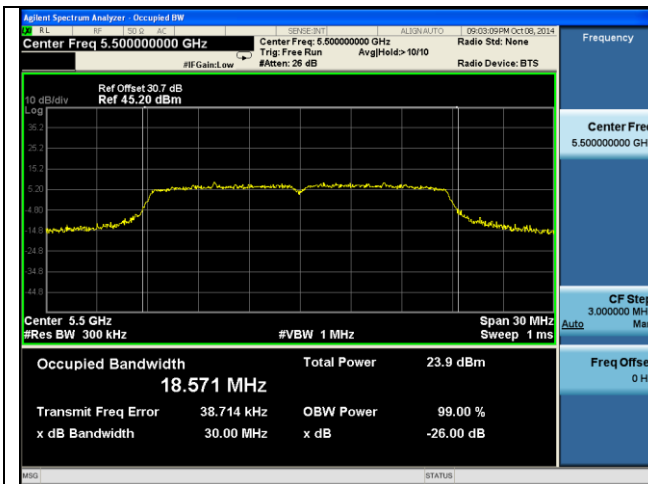
26dB & 99% BW - 802.11a 5500MHz



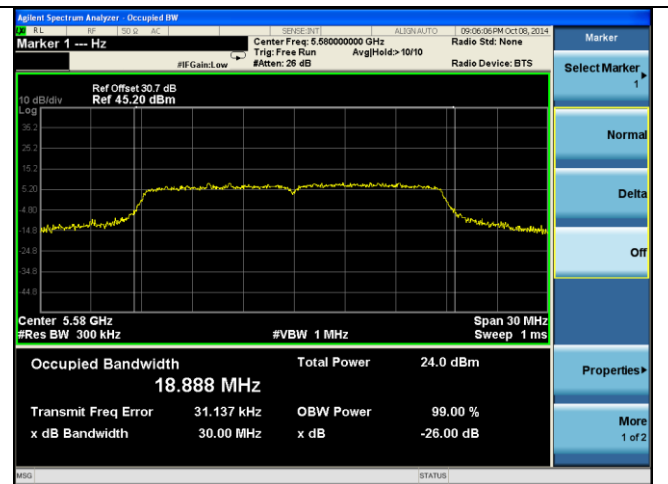
26dB & 99% BW - 802.11a 5580MHz



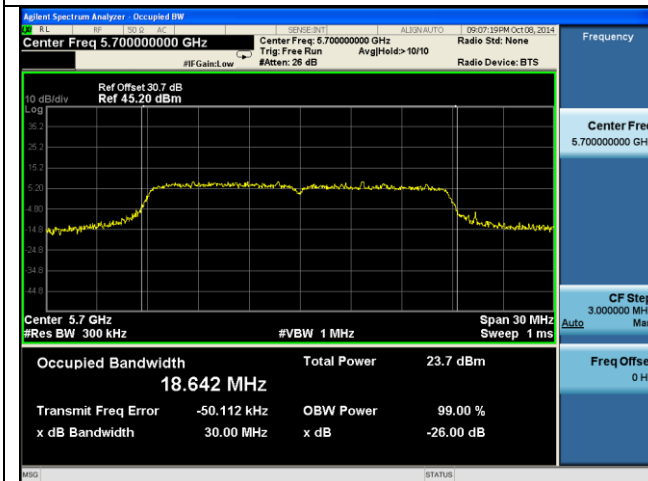
26dB & 99% BW - 802.11a 5700MHz



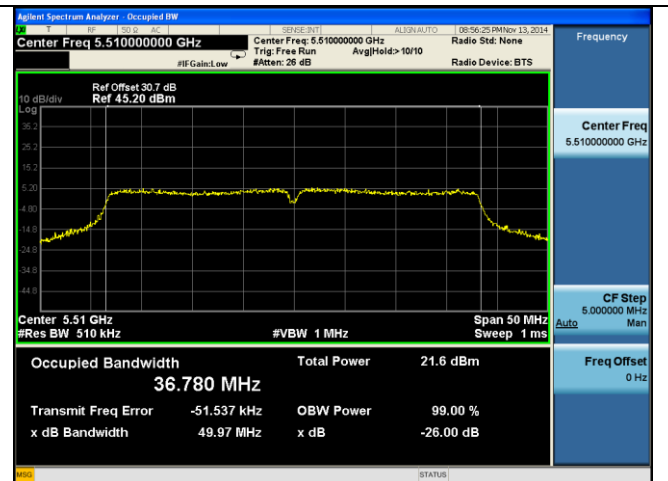
26dB & 99% BW - 802.11n-20M 5500MHz



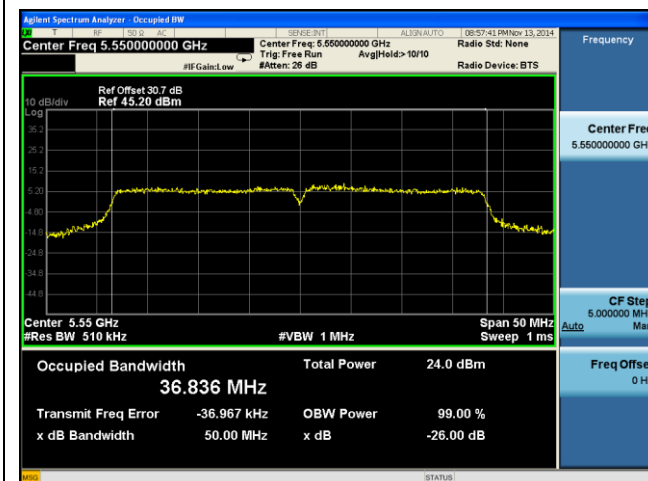
26dB & 99% BW - 802.11n-20M 5580MHz



26dB & 99% BW - 802.11n-20M 5700MHz



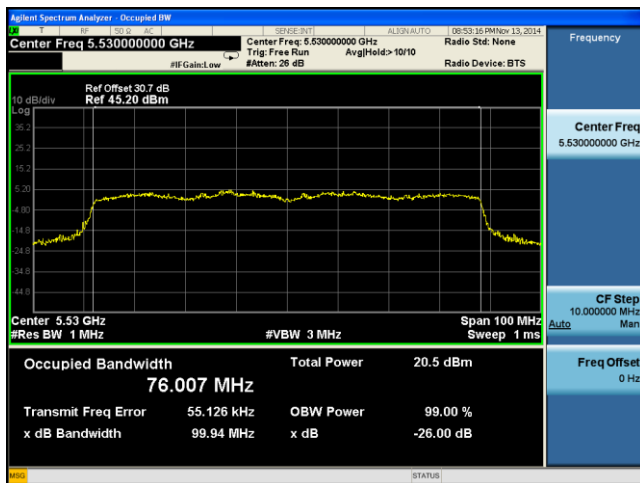
26dB & 99% BW - 802.11n-40M 5510MHz



26dB & 99% BW - 802.11n-40M 5550MHz



26dB & 99% BW - 802.11n-40M 5670MHz




**26dB & 99% BW - 802.11ac-80M 5530MHz**



### 10.3 Peak Output Power

#### Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.407	a)(2)	For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm +10 log B, where B is the 26 dB emission bandwidth in megahertz.	<input checked="" type="checkbox"/>
RSS 210	(A9.2) (2)	Band 5250-5350 MHz : The maximum conducted output power shall not exceed 250 mW or 11 + 10 log B, dBm, whichever power is less. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.	<input checked="" type="checkbox"/>
Test Setup			
Test Procedure	<p>789033 D01 General UNII Test Procedures Old Rules v01r04</p> <p><u>Measurement using a Power Meter (PM)</u></p> <p>Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.</p> <ul style="list-style-type: none"> <li>- Connect EUT's RF output power to power meter</li> <li>- Set EUT to be continuous transmission mode</li> <li>- Measurement the average output power using power meter and record the result</li> <li>- Repeat above steps for different test channel and other modulation type.</li> </ul>		
Test Date	10/13/2014	Environmental condition	Temperature 22°C Relative Humidity 44% Atmospheric Pressure 1021mbar
Remark	<p>The directional gain exceeds 6dBi; therefore, the maximum conducted output power limit was calculated as follow:</p> <p>For FCC: (250 mW or 11 dBm +10 log B) - The amount in dB that the directional gain of the antenna exceeds 6 dBi Where B is the 26 dB emission bandwidth in MHz</p> <p>For IC: (250 mW or 11 dBm +10 log B) - The amount in dB that the directional gain of the antenna exceeds 6 dBi Where B is the 99% emission bandwidth in MHz</p> <p>The E.I.R.P. limit for IC was calculated as follow: 1.0 W or 17 + 10 log B, Where B is the 99% emission bandwidth in MHz</p>		
Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail		

Test Data    ☒ Yes                      ☐ N/A

Test Plot    ☐ Yes (See below)            ☒ N/A

### FCC Output Power Measurement results

Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)			Limit (dBm)	Result
				Chain1	Chain2	Combined Power or Highest Power		
Output Power	802.11-a	5260	Low	17.20	16.00	17.20	≤21.236	Pass
Output Power	802.11-a	5280	Mid	17.00	16.10	17.00	≤21.236	Pass
Output Power	802.11-a	5320	High	16.80	16.30	16.80	≤21.236	Pass
Output Power	802.11-n-20	5260	Low	17.10	16.10	19.64	≤21.236	Pass
Output Power	802.11-n-20	5280	Mid	16.90	16.10	19.53	≤21.236	Pass
Output Power	802.11-n-20	5320	High	16.90	16.30	19.51	≤21.236	Pass
Output Power	802.11-n-40	5270	Low	16.50	15.70	19.13	≤21.236	Pass
Output Power	802.11-n-40	5310	High	12.70	12.90	15.81	≤21.236	Pass
Output Power	802.11-ac-80	5290	Mid	12.50	12.30	15.41	≤21.236	Pass
Output Power	802.11-a	5500	Low	20.50	20.00	20.50	≤21.236	Pass
Output Power	802.11-a	5580	Mid	20.20	20.20	20.20	≤21.236	Pass
Output Power	802.11-a	5700	High	17.00	17.60	17.60	≤21.236	Pass
Output Power	802.11-n-20	5500	Low	17.70	17.30	20.51	≤21.236	Pass
Output Power	802.11-n-20	5580	Mid	17.30	17.80	20.57	≤21.236	Pass
Output Power	802.11-n-20	5700	High	16.00	16.80	19.43	≤21.236	Pass
Output Power	802.11-n-40	5510	Low	15.90	15.70	18.81	≤21.236	Pass
Output Power	802.11-n-40	5550	Mid	17.90	17.70	20.81	≤21.236	Pass
Output Power	802.11-n-40	5670	High	17.80	18.20	21.01	≤21.236	Pass
Output Power	802.11-ac-80	5530	Mid	14.80	14.70	17.76	≤21.236	Pass

### IC E.I.R.P. calculation limit

Type	Test mode	Freq (MHz)	CH	99% BW Result (MHz)	Conducted Power Limit (dBm)	EIRP Power Limit (dBm)
99% BW	802.11-a	5260	Low	17.389	23.40	29.40
99% BW	802.11-a	5280	Mid	17.352	23.39	29.39
99% BW	802.11-a	5320	High	17.172	23.35	29.35
99% BW	802.11-n-20	5260	Low	18.369	23.64	29.64
99% BW	802.11-n-20	5280	Mid	18.247	23.61	29.61
99% BW	802.11-n-20	5320	High	18.172	23.59	29.59
99% BW	802.11-n-40	5270	Low	36.378	24.00	30.00
99% BW	802.11-n-40	5310	High	36.358	24.00	30.00
99% BW	802.11-ac-	5290	Mid	75.962	24.00	30.00
99% BW	802.11-a	5500	Low	17.498	23.43	29.43
99% BW	802.11-a	5580	Mid	17.521	23.44	29.44
99% BW	802.11-a	5700	High	17.405	23.41	29.41
99% BW	802.11-n-20	5500	Low	18.571	23.69	29.69
99% BW	802.11-n-20	5580	Mid	18.888	23.76	29.76
99% BW	802.11-n-20	5700	High	18.642	23.71	29.71
99% BW	802.11-n-40	5510	Low	36.615	24.00	30.00
99% BW	802.11-n-40	5550	Mid	36.891	24.00	30.00
99% BW	802.11-n-40	5670	High	36.770	24.00	30.00
99% BW	802.11-ac-	5530	Mid	75.654	24.00	30.00

Note: B is 99%dB bandwidth for IC limit.

### Test Result for IC E.I.R.P

Type	CH	Test mode	Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Conducted Power Limit (dBm)	E.I.R.P (dBm)	E.I.R.P. Limit (dB)	Result
E.I.R.P	Low	802.11-a	5260	8.764	17.20	23.40	25.964	29.40	Pass
E.I.R.P	Mid	802.11-a	5280	8.764	17.00	23.39	25.764	29.39	Pass
E.I.R.P	High	802.11-a	5320	8.764	16.80	23.35	25.564	29.35	Pass
E.I.R.P	Low	802.11-n-20	5260	8.764	19.64	23.64	28.404	29.64	Pass
E.I.R.P	Mid	802.11-n-20	5280	8.764	19.53	23.61	28.294	29.61	Pass
E.I.R.P	High	802.11-n-20	5320	8.764	19.51	23.59	28.274	29.59	Pass
E.I.R.P	Low	802.11-n-40	5270	8.764	19.13	24.00	27.894	30.00	Pass
E.I.R.P	High	802.11-n-40	5310	8.764	15.81	24.00	24.574	30.00	Pass
E.I.R.P	Mid	802.11-ac-80	5290	8.764	15.41	24.00	24.174	30.00	Pass
E.I.R.P	Low	802.11-a	5500	8.764	20.50	23.43	29.264	29.43	Pass
E.I.R.P	Mid	802.11-a	5580	8.764	20.20	23.44	28.964	29.44	Pass
E.I.R.P	High	802.11-a	5700	8.764	17.60	23.41	26.364	29.41	Pass
E.I.R.P	Low	802.11-n-20	5500	8.764	20.51	23.69	29.274	29.69	Pass
E.I.R.P	Mid	802.11-n-20	5580	8.764	20.57	23.76	29.334	29.76	Pass
E.I.R.P	High	802.11-n-20	5700	8.764	19.43	23.71	28.194	29.71	Pass
E.I.R.P	Low	802.11-n-40	5510	8.764	18.81	24.00	27.574	30.00	Pass
E.I.R.P	Mid	802.11-n-40	5550	8.764	20.81	24.00	29.574	30.00	Pass
E.I.R.P	High	802.11-n-40	5670	8.764	21.01	24.00	29.774	30.00	Pass
E.I.R.P	Mid	802.11-ac-80	5530	8.764	17.76	24.00	26.524	30.00	Pass

## 10.4 Peak Excursion Ratio

### Requirement(s):

Spec	Item	Requirement	Applicable
15.407	(a)(6)	≤ 13 dB /MHz bandwidth or the emission bandwidth whichever is less.	☒
RSS 210	A9.2		
Test Setup	<div><div>Spectrum Analyzer</div><div>EUT</div></div>		
Test Procedure	789033 D01 General UNII Test Procedures Old Rules v01r04, procedure G		
Test Date	10/06/2014	Environmental condition	Temperature 21°C Relative Humidity 46% Atmospheric Pressure 1022mbar
Remark	None		
Result	☒ Pass      ☐ Fail		

### Equipment Setting

Test	RBW	VBW	Span	Detector	Sweep	Trace	Notes
PK Excursion Ratio	1MHz	≥3MHz	≥EBW or 99% OBW	PK	Auto	Maxhold	-

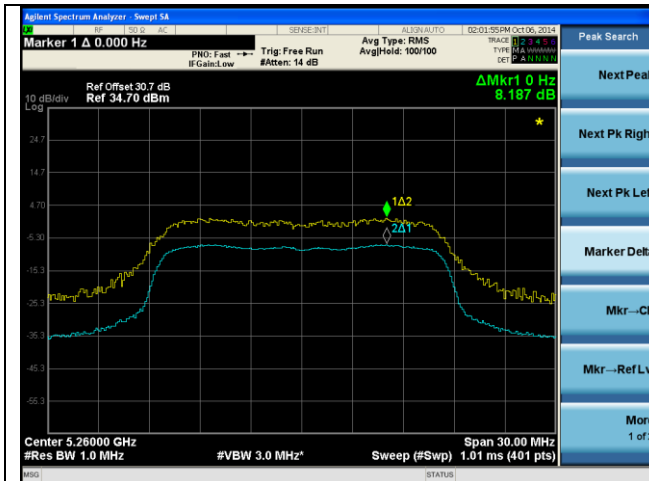
**Test Data**    ☒ Yes                      ☐ N/A

**Test Plot**    ☒ Yes (See below)                      ☐ N/A

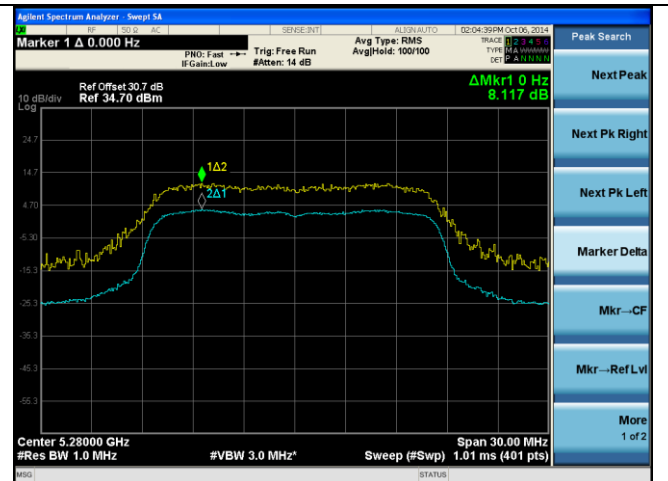
Peak Excursion Ratio measurement result

Type	Freq (MHz)	Test mode	CH	Measured Peak Excursion ratio (dB)	Limit (dB)	Result
PK Excursion Ratio	5260	802.11-a	Low	8.187	13	Pass
PK Excursion Ratio	5280	802.11-a	Mid	8.117	13	Pass
PK Excursion Ratio	5320	802.11-a	High	8.235	13	Pass
PK Excursion Ratio	5260	802.11-n-20	Low	8.280	13	Pass
PK Excursion Ratio	5280	802.11-n-20	Mid	8.167	13	Pass
PK Excursion Ratio	5320	802.11-n-20	High	8.324	13	Pass
PK Excursion Ratio	5270	802.11-n-40	Low	8.322	13	Pass
PK Excursion Ratio	5310	802.11-n-40	High	8.242	13	Pass
PK Excursion Ratio	5290	802.11-ac-80	Mid	8.929	13	Pass
PK Excursion Ratio	5500	802.11-a	Low	8.291	13	Pass
PK Excursion Ratio	5580	802.11-a	Mid	8.175	13	Pass
PK Excursion Ratio	5700	802.11-a	High	8.193	13	Pass
PK Excursion Ratio	5500	802.11-n-20	Low	8.430	13	Pass
PK Excursion Ratio	5580	802.11-n-20	Mid	8.406	13	Pass
PK Excursion Ratio	5700	802.11-n-20	High	8.273	13	Pass
PK Excursion Ratio	5510	802.11-n-40	Low	8.934	13	Pass
PK Excursion Ratio	5550	802.11-n-40	Mid	8.550	13	Pass
PK Excursion Ratio	5670	802.11-n-40	High	9.031	13	Pass
PK Excursion Ratio	5530	802.11-ac-80	Mid	8.415	13	Pass

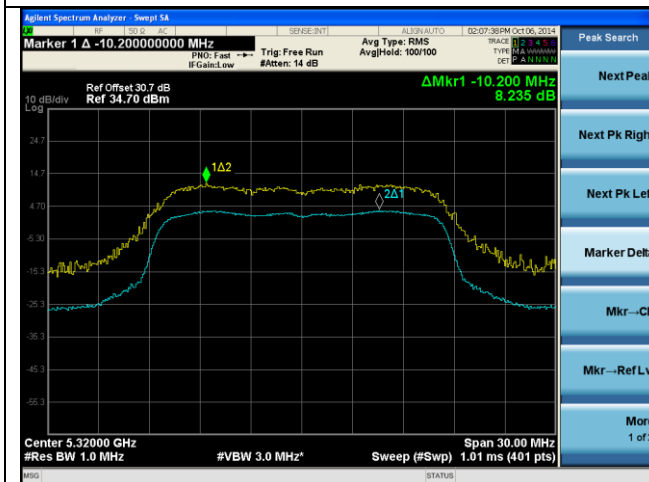
## Peak Excursion Ratio Test Plots



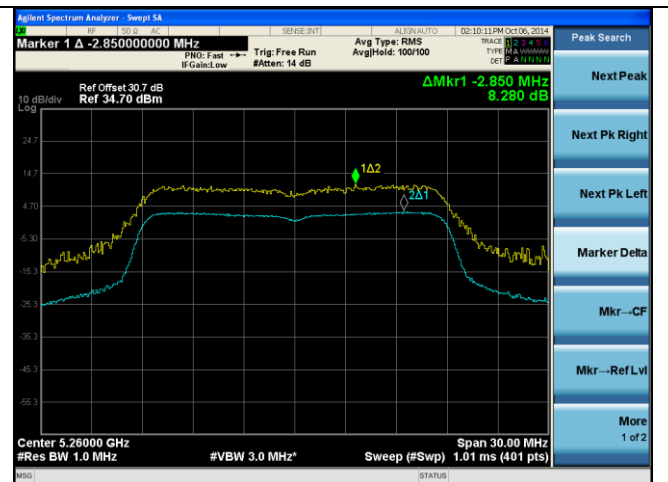
Peak Excursion Ratio - 802.11a 5260MHz



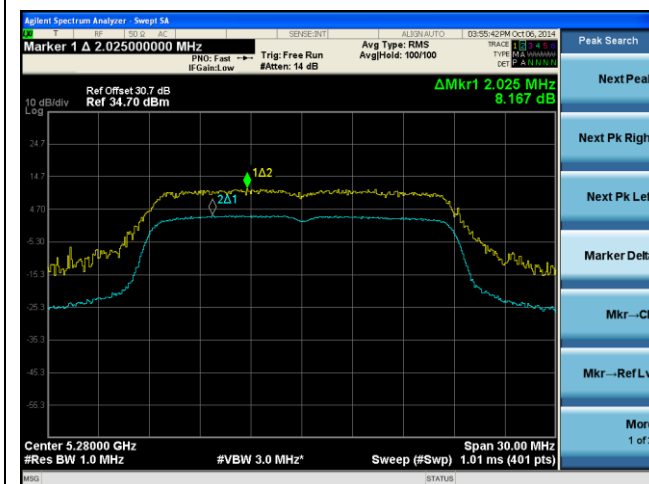
Peak Excursion Ratio - 802.11a 5280MHz



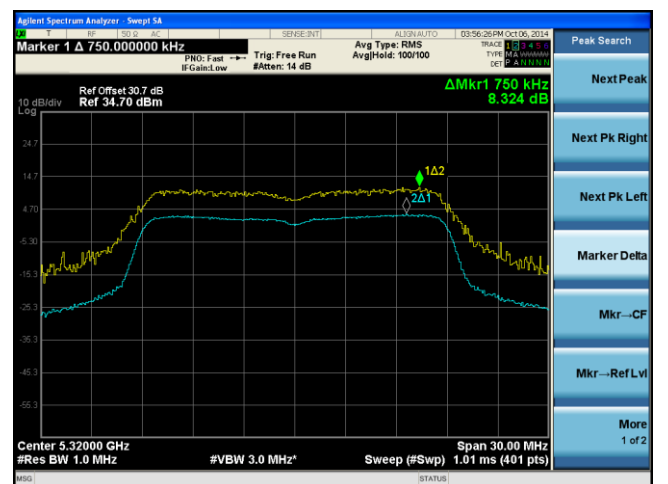
Peak Excursion Ratio - 802.11a 5320MHz



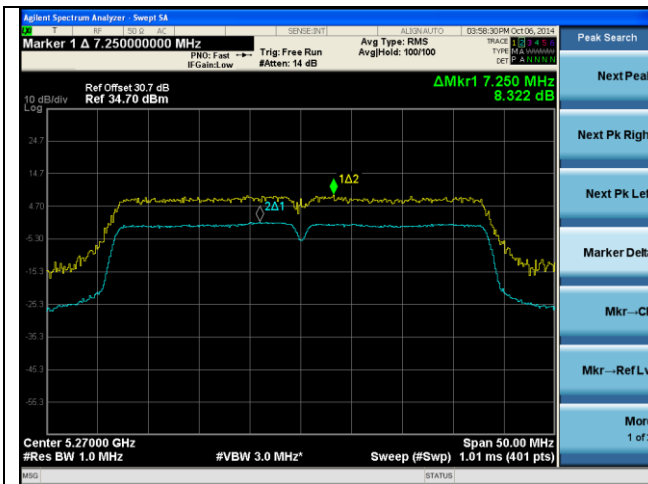
Peak Excursion Ratio - 802.11n-20M 5260MHz



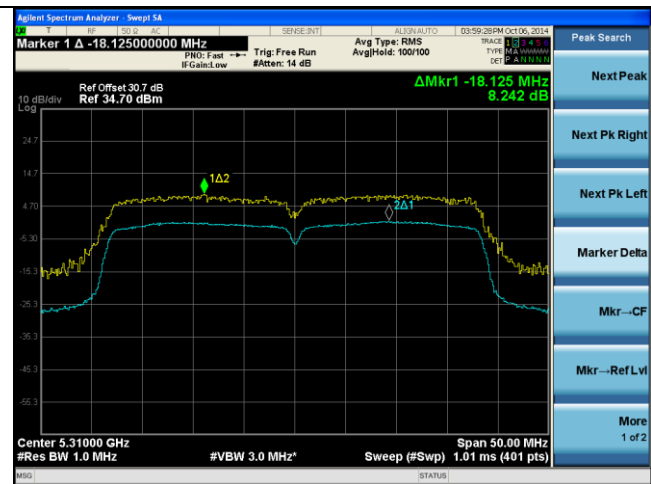
Peak Excursion Ratio - 802.11n-20M 5280MHz



Peak Excursion Ratio - 802.11n-20M 5320MHz



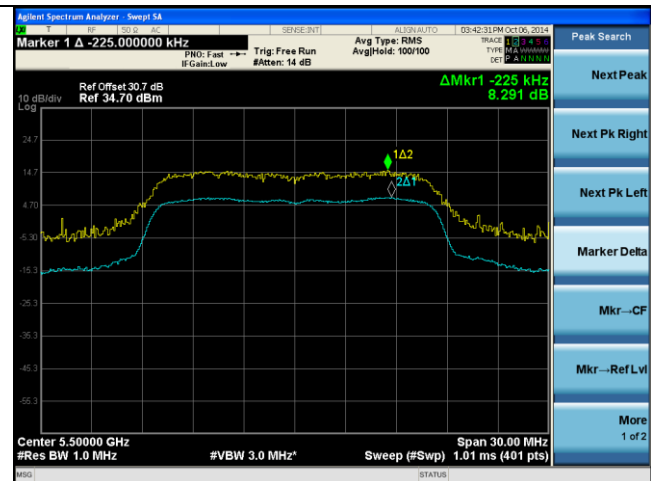
Peak Excursion Ratio - 802.11n-40M 5270MHz



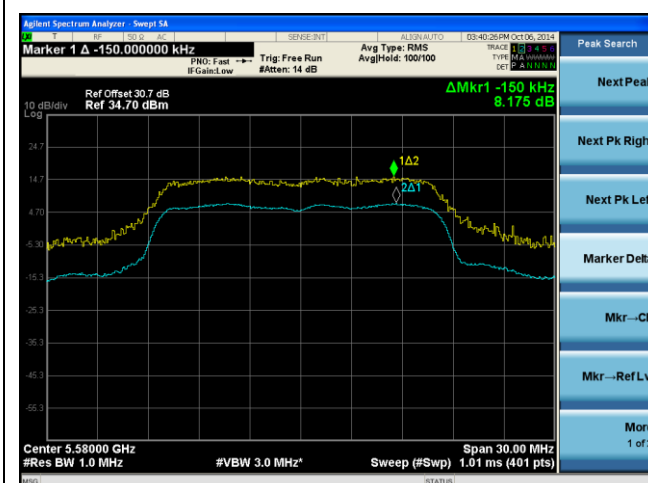
Peak Excursion Ratio - 802.11n-40M 5310MHz



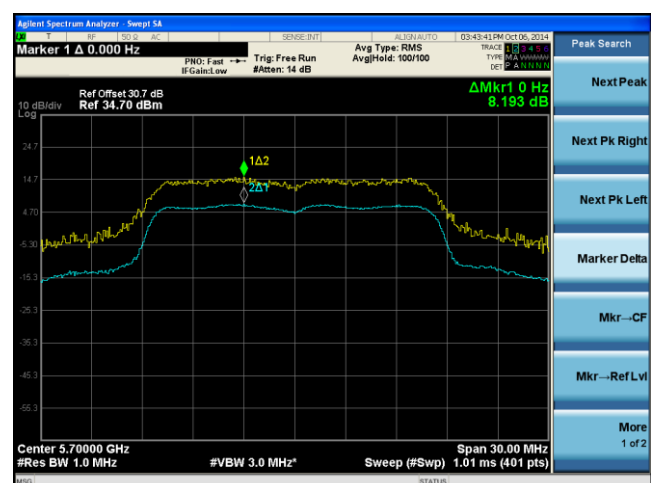
Peak Excursion Ratio - 802.11ac-80M 5290MHz



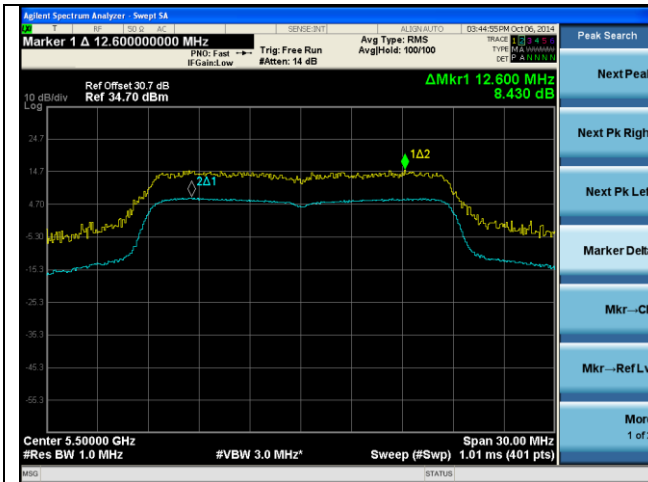
Peak Excursion Ratio - 802.11a 5500MHz



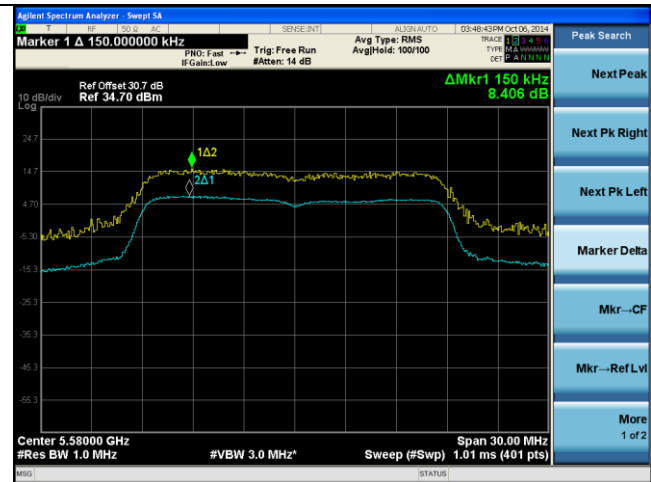
Peak Excursion Ratio - 802.11a 5580MHz



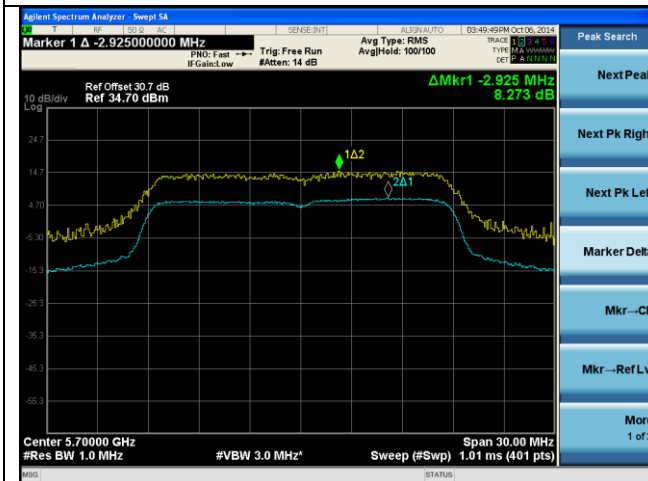
Peak Excursion Ratio - 802.11a 5700MHz



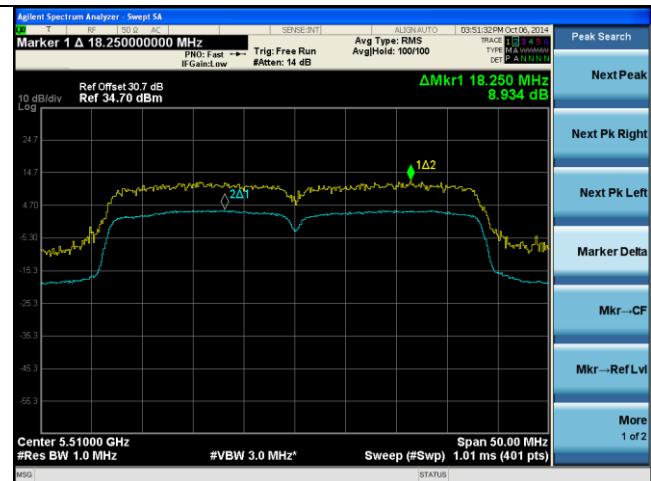
Peak Excursion Ratio - 802.11n-20M 5500MHz



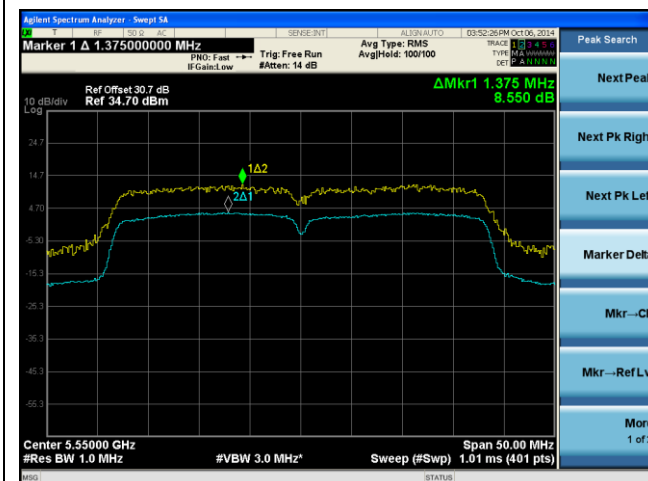
Peak Excursion Ratio - 802.11n-20M 5580MHz



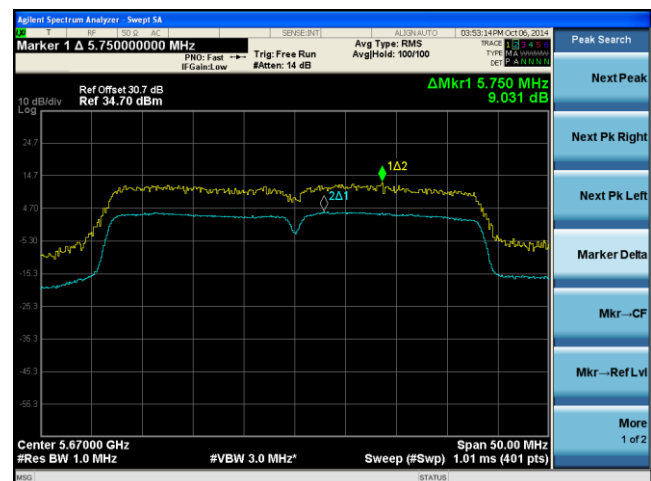
Peak Excursion Ratio - 802.11n-20M 5700MHz



Peak Excursion Ratio - 802.11n-40M 5510MHz



Peak Excursion Ratio - 802.11n-40M 5550MHz



Peak Excursion Ratio - 802.11n-40M 5670MHz





Peak Excursion Ratio - 802.11ac-80M 5530MHz

## 10.5 Band Edge

### Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.407	b)(1)	For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.	<input type="checkbox"/>
RSS210	(A9.2) (1)		
§ 15.407	b)(2)	For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.	<input checked="" type="checkbox"/>
RSS210	(A9.2) (2)		
§ 15.407	b)(3)	For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.	<input checked="" type="checkbox"/>
RSS210	(A9.2) (3)		
§ 15.407	b)(4)	For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.	<input type="checkbox"/>
RSS210	(A9.2) (4)		
Test Setup	<div><div>Spectrum Analyzer</div><div>EUT</div></div>		
Test Procedure	<p>789033 D01 General UNII Test Procedures Old Rules v01r04</p> <p><u>Band Edge measurement procedure (Integration Method)</u></p> <ul style="list-style-type: none"><li>- Set analyzer center frequency to the frequency of the emission to be measured.</li><li>- Set the span to 2 MHz.</li><li>- Set RBW = 100 kHz</li><li>- Set VBW ≥ 3 · RBW</li><li>- Detector = RMS</li><li>- Averaging type = power</li><li>- Sweep time = auto</li><li>- Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 percent duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100 percent duty cycle—rather than turning on and off with the transmit cycle, at least 100 traces shall be averaged.)</li></ul>		
Test Date	11/18/2014	Environmental condition	Temperature 22°C Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	-		
Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail		

### Equipment Setting

TEST	RBW	VBW	SPAN	Detector	SWEEP	Trace	NOTES
Band Edge	100KHz	$\geq 3 \cdot$ RBW	2MHz	RMS	Auto	Average	-

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

### Band Edge Measurement Results

Type	Freq (MHz)	CH	Conducted Band Edge (dBm/MHz)			Antenna Gain (dBi)	EIRP (dBm)	Limit (dB)	Result
			Chain1	Chain2	Combined Power or Highest Power				
802.11a Band Edge	5150	Low	-47.15	-46.90	-46.90	8.764	-38.14	≤-27	Pass
802.11a Band Edge	5350	High	-46.85	-46.82	-46.82	8.764	-38.06	≤-27	Pass
802.11n-20M Band Edge	5150	Low	-47.13	-47.16	-44.13	8.764	-35.37	≤-27	Pass
802.11n-20M Band Edge	5350	High	-46.78	-46.90	-43.83	8.764	-35.07	≤-27	Pass
802.11n-40M Band Edge	5150	Low	-47.24	-47.25	-44.23	8.764	-35.47	≤-27	Pass
802.11n-40M Band Edge	5350	High	-40.92	-42.93	-38.80	8.764	-30.04	≤-27	Pass
802.11ac-80M Band Edge	5350	High	-39.89	-39.23	-36.54	8.764	-28.01	≤-27	Pass
802.11a Band Edge	5470	Low	-39.20	-39.95	-39.20	8.764	-30.68	≤-27	Pass
802.11a Band Edge	5725	High	-41.77	-40.31	-40.31	8.764	-31.79	≤-27	Pass
802.11n-20M Band Edge	5470	Low	-40.32	-42.71	-38.34	8.764	-30.82	≤-27	Pass
802.11n-20M Band Edge	5725	High	-42.59	-41.83	-39.18	8.764	-30.66	≤-27	Pass
802.11n-40M Band Edge	5470	Low	-41.68	-40.65	-38.12	8.764	-29.60	≤-27	Pass
802.11n-40M Band Edge	5725	High	-41.25	-41.45	-38.34	8.764	-29.81	≤-27	Pass
802.11ac-80M Band Edge	5470	Low	-39.45	-38.13	-35.73	8.764	-27.20	≤-27	Pass