TEST REPORT

Report Number: 103615308MPK-009C
Project Number: G103615308
November 12, 2018

Testing performed on the
Vocera V5000 Smartbadge
Model Number: V5000

FCC ID: QGZ V5000
IC: 4362A-V5000

to
FCC Part 15 Subpart E (15.407)
Industry Canada RSS-247, Issue 2

For

Vocera Communications

Test Performed by:	Test Authorized by:
Intertek	Vocera Communications
1365 Adams Court	525 Race St, Ste 150
Menlo Park, CA 94025 USA	San Jose, CA 95126 USA

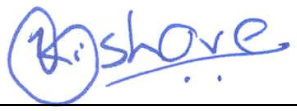
Prepared by: _____ **Date:** November 12, 2018
Anderson Soungpanya

Reviewed by: _____ **Date:** November 12, 2018
Krishna K Vemuri

Report No. 103615308MPK-009C	
Equipment Under Test:	Vocera V5000 Smartbadge
Trade Name:	Vocera Communications
Model Number:	V5000
Part Number:	220-02100
Applicant:	Vocera Communications
Contact:	Prakash Guda
Address:	Vocera Communications 525 Race St, Ste 150 San Jose, CA 95126
Country:	USA
Tel. Number:	(408) 882-5100
Email:	Pguda@vocera.com
Applicable Regulation:	FCC Part 15, Subpart E (15.407) Industry Canada RSS-247, Issue 2
Date of Test:	September 25 – November 09, 2018

We attest to the accuracy of this report:

Anderson Soungpanya
EMC Project Engineer



Krishna K Vemuri
Engineering Team Lead

TABLE OF CONTENTS

1.0 Introduction 4
1.1 Summary of Tests 4

2.0 General Description 5
2.1 Product Description 5
2.2 Related Submittal(s) Grants 7
2.3 Test Methodology 7
2.4 Test Facility 7
2.5 Measurement Uncertainty 7

3.0 System Test Configuration 8
3.1 Support Equipment 8
3.2 Block Diagram of Test Setup 8
3.3 Justification 10
3.4 Mode of Operation During Test 10
3.5 Modifications required for Compliance 11
3.6 Additions, deviations and exclusions from standards 11

4.0 Measurement Results 12
4.1 Emission Bandwidth and 99% Occupied Bandwidth 12
4.1.1 Requirement 12
4.1.2 Procedure 12
4.1.3 Test Result 13
4.2 Maximum Conducted Output Power & Power Spectral Density 29
4.2.1 Requirement 29
4.2.2 Procedure 29
4.2.3 Test Results 30
4.3 Transmitter Radiated Emissions 39
4.3.1 Requirement 39
4.3.2 Procedure 40
4.3.3 Field Strength Calculation 41
4.3.4 Antenna-port conducted measurements 42
4.3.5 General Procedure for conducted measurements in restricted bands 42
4.3.6 Test Results 42
4.3.7 Test setup 79
4.4 Dynamic Frequency Selection (DFS) 80
4.4.1 Requirement 80
4.4.2 Procedure 83
4.4.3 Test Results 87
4.4.4 Test setup 92

5.0 List of Test Equipment 93

6.0 Document History 94

1.0 Introduction

1.1 Summary of Tests

Test	Reference FCC	Reference RSS-247	Result
26 dB Emission Band width and 99% Occupied Bandwidth	15.407(a)(1)(2)(3)	RSS-247, 6.2.1	Complies
Conducted Output Power	15.407(a)(1)(2)(3)	RSS-247, 6.2.1	Complies
Peak Power Spectral Density	15.407(a)(1)(2)(3)	RSS-247, 6.2.1	Complies
Undesirable Emissions	15.407(b)(1-8)	RSS-247, 6.2.1	Complies
Transmitter Radiated Emissions	15.407(b)(1-8) 15.209, 15.205	RSS-247, 6.2.1	Complies
Dynamic Frequency Selection	15.407 (h)(2)	RSS-247, 6.3	Complies
Frequency stability	15.407(g)	RSS-Gen	Complies*
Antenna Requirement	15.203	RSS-Gen	Complies. The EUT uses internal antenna.

*Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

EUT receive date: September 17, 2018

EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

Test start date: September 25, 2018

Test completion date: November 09, 2018

The test results in this report pertain only to the item tested.

2.0 General Description

2.1 Product Description

Vocera Communications supplied the following description of the EUT:

The V5000 Smartbadge is a wearable communication device powered by a removable, rechargeable Lithium Ion battery. The badge contains a 2.4" color, capacitive touch screen, with an array of microphones, a hands free speaker and an audio receiver.

The information about the 5GHz radio, installed in the model V5000, is presented below.

Radio Information	
Applicant	Vocera Communications
Model Number	V5000
FCC Identifier	QGZ V5000
IC Identifier	4362A-V5000
Modulation Technique	OFDM
Rated RF Output	19.74 dBm for 5500~5720 MHz
Frequency Range	U-NII 2c: 5470 – 5725 MHz (5600-5650 is excluded for RSS-247)
Type of modulation	OFDM
Number of Channel(s)	12 for 802.11a/n 20 MHz 6 for 802.11n 40MHz 3 for 802.11ac 80MHz
Antenna(s) & Gain	Internal Antenna, Gain: +3.1 dBi
Applicant Name & Address	Vocera Communications 525 Race St, Ste 150 San Jose, CA 95126 USA

The EUT supports the following configurations:

FCC Channels in 5470 – 5725 MHz band							
Number	**Frequency, MHz**	**802.11a/n 20MHz Channels**		**802.11n 40MHz Channels**		**802.11ac 80MHz Channels**	
100	5500	√	X				
102	5510			√	X		
104	5520	√					
106	5530					√	X
108	5540	√					
110	5550			√	X		
112	5560	√					
116	5580	√	X				
118	5590			√			
120	5600	√					
122	5610					√	X
124	5620	√					
126	5630			√			
128	5640	√					
132	5660	√					
134	5670			√	X		
136	5680	√					
138	5690					√	X
140	5700	√	X				
142	5710			√	X		
144	5720	√	X				

RSS Channels in 5470 – 5725 MHz band							
Number	**Frequency, MHz**	**802.11a/n 20MHz Channels**		**802.11n 40MHz Channels**		**802.11ac 80MHz Channels**	
100	5500	√	X				
102	5510			√	X		
104	5520	√					
106	5530					√	X
108	5540	√					
110	5550			√	X		
112	5560	√					
116	5580	√	X				
118	5590			√			
132	5660	√					
134	5670			√	X		
136	5680	√					
138	5690					√	X
140	5700	√	X				
142	5710			√	X		
144	5720	√	X				

List of channels:
√ - available
X - tested

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E" (789033 D02 General U-NII Test Procedures New Rules v02r01).

Radiated emissions measurements were performed according to the procedures in ANSI C63.10: 2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 6 GHz	> 6 GHz
RF Power and Power Density – antenna conducted	1.1 dB	1.5 dB	–
Unwanted emissions - antenna conducted	1.2 dB	1.7 dB	2.0 dB
Bandwidth – antenna conducted	50 Hz	100 Hz	–
Radiated emissions	4.2 dB	5.4 dB	
AC mains conducted emissions	2.4 dB	-	-

3.0 System Test Configuration

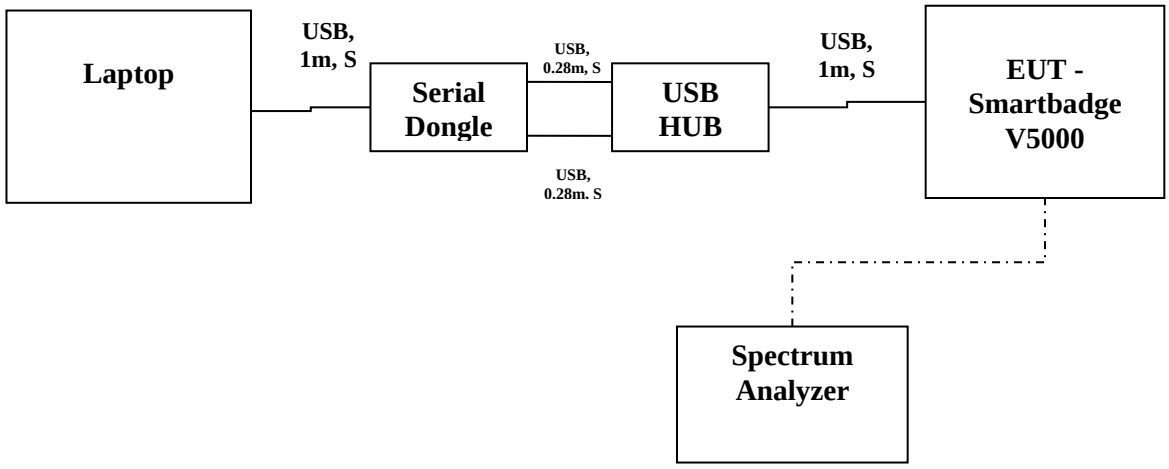
3.1 Support Equipment

Support Equipment		
Description	**Manufacturer**	**Model No./ Part No.**
Laptop	Lenovo	T440P
USB Hub	Tendak	CP-029-BK
Serial Dongle	Vocera	210-01516-B04

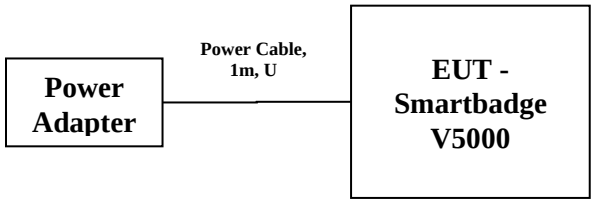
3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	**Manufacturer**	**Model Number**	**Serial Number**
Smartbadge – Conducted Unit	Vocera	V5000	SA3308HF5002D6
Smartbadge – Radiated Unit	Vocera	V5000	SA3308HR50031E
Power Adapter	Asian Power Devices Inc.	WB-10E05R	S8827999000015
Earphone	Kingstate Electronics Corp.	KJFGKS172JJB-01	Not listed

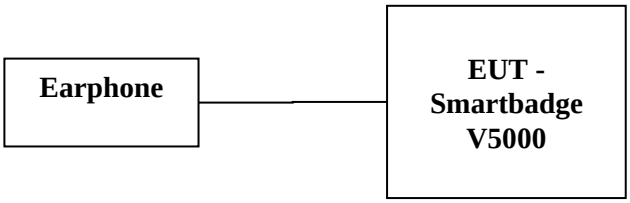
Antenna was removed and co-axial connector was installed for Conducted Measurements.



Radiated Measurements
Charging Mode



Radiated Measurements
Normal Mode



S = Shielded **U** = Unshielded	**F** = With Ferrite **M** = Meter

3.3 Justification

Preliminary testing was performed for all modulation/data rate modes. The worse-case data rate with highest power and widest spectrum were selected for final measurements:

OFDM, 6MB/s – for 802.11a
OFDM, MCS0 – for 802.11n 20MHz
OFDM, MCS0 – for 802.11n 40MHz
OFDM, MCS0 – for 802.11ac 80MHz

Different orientation of the EUT were tested and only the worse-case emissions were reported.

For radiated emission measurements the EUT is placed on a non-conductive table.

The EUT was tested in 2 configurations:
A/ Charging mode: tested with power adapter
B/ Normal mode: tested in battery mode and earphone.

Unless otherwise stated in this report, measurements made for, Radiated Spurious were made with the worst-case power setting (mid channel power).

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously using the maximum RF power setting provided by the manufacturers via test scripts. The corresponding output power in dBm can be found in section 4.2 of this report.

The table below reflects the RF power setting needed to be compliant with radiated restricted band edge requirements of 15.205 & 15.209.

Mode	Channel	Frequency MHz	RF Setting
802.11a	100	5500	15
	116	5580	16
	140	5700	16
	144	5720	19
802.11n 20MHz	100	5500	16
	116	5580	16
	140	5700	16
	144	5720	19
802.11n 40MHz	102	5510	14
	110	5550	16
	134	5670	16
	142	5710	19
802.11ac 80MHz	106	5530	10
	122	5610	16
	138	5690	19

3.5 Modifications required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Emission Bandwidth and 99% Occupied Bandwidth

15.407(a)(1)(2)(e)

4.1.1 Requirement

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500kHz.

4.1.2 Procedure

The Procedure, described in the FCC Publication 789033 D02 General U-NII Test Procedures New Rules v02r01, was used. Specifically, Section C.1 for Emission Bandwidth and Minimum Emission Bandwidth for measuring the Emission Bandwidth (EBW). Section C.2 was utilized for measuring the 6dB Bandwidth in the band 5.725-5.850 GHz. Section D was used for 99% Occupied Bandwidth.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier.

The Occupied bandwidth was measured using the build-in spectrum analyzer facility for 99% power bandwidth measurement.

Tested By	Test Date
Anderson Soungpanya	September 25 & 26, 2018

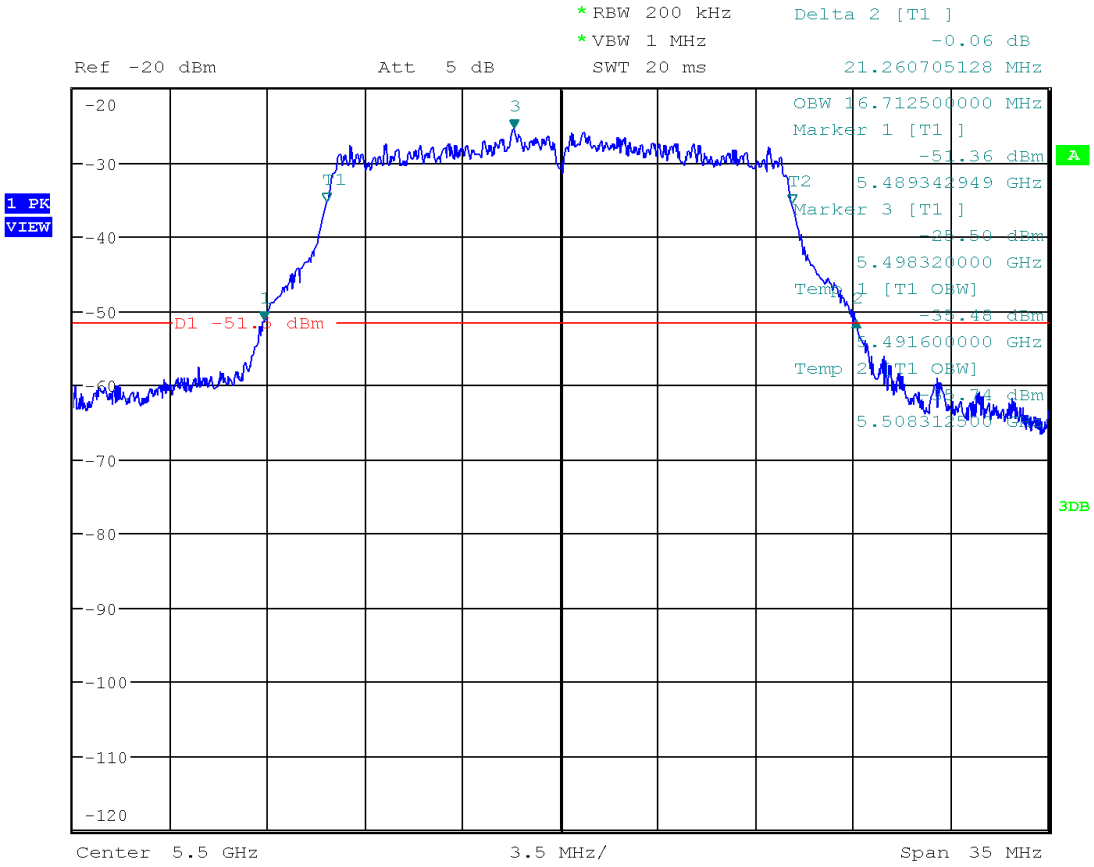
4.1.3 Test Result

Refer to the following plots for the test result:

Mode	Channel	Frequency MHz	26-dB Bandwidth, MHz	Occupied Bandwidth, MHz	Plot #
802.11a	100	5500	21.261	16.713	1.1
	116	5580	21.258	16.713	1.2
	140	5700	21.146	16.695	1.3
	144	5720	21.170	16.678	1.4
802.11n 20MHz	100	5500	21.485	17.868	1.5
	116	5580	21.595	17.850	1.6
	140	5700	21.482	17.903	1.7
	144	5720	21.450	17.850	1.8
802.11n 40MHz	102	5510	40.387	36.330	1.9
	110	5550	40.096	36.295	1.10
	134	5670	40.160	36.295	1.11
	142	5710	40.096	36.295	1.12
802.11ac 80MHz	106	5530	82.340	75.810	1.13
	122	5610	81.987	75.670	1.14
	138	5690	82.308	75.600	1.15

Plot 1.1

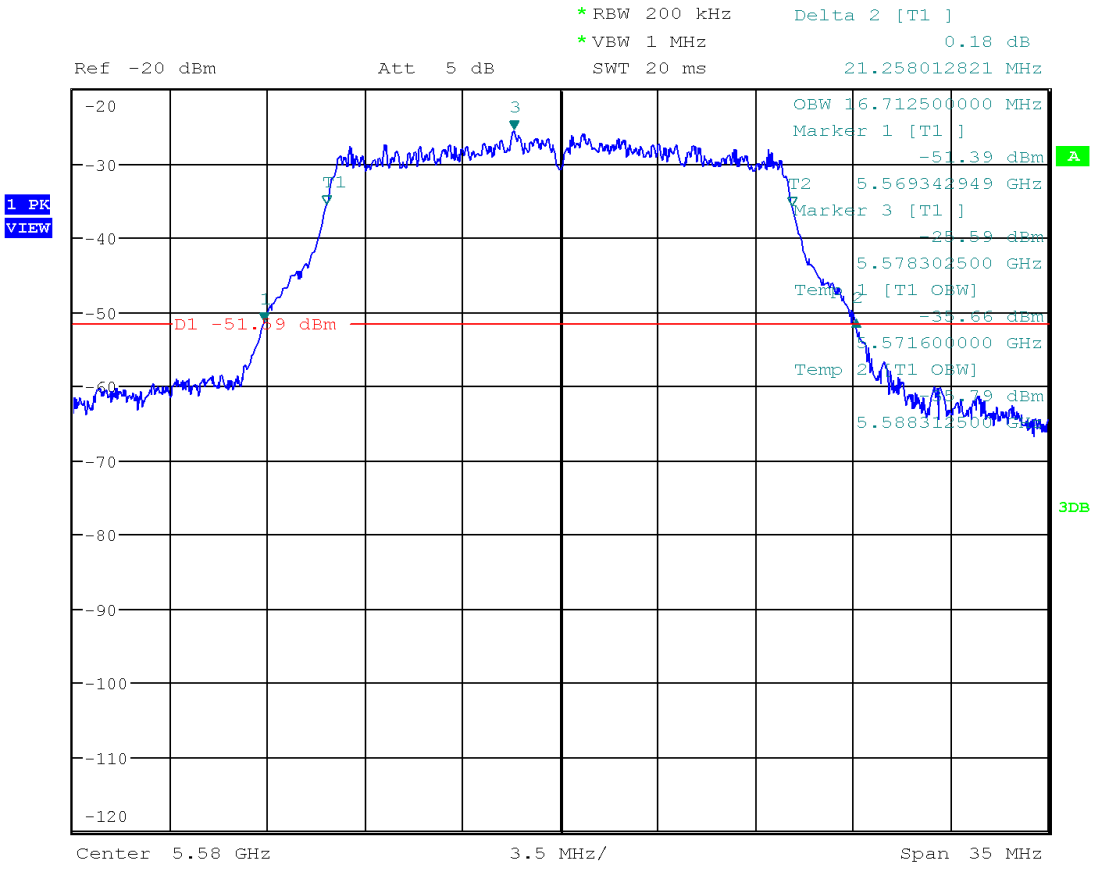
802.11a 5500MHz



Date: 25.SEP.2018 08:53:31

Plot 1.2

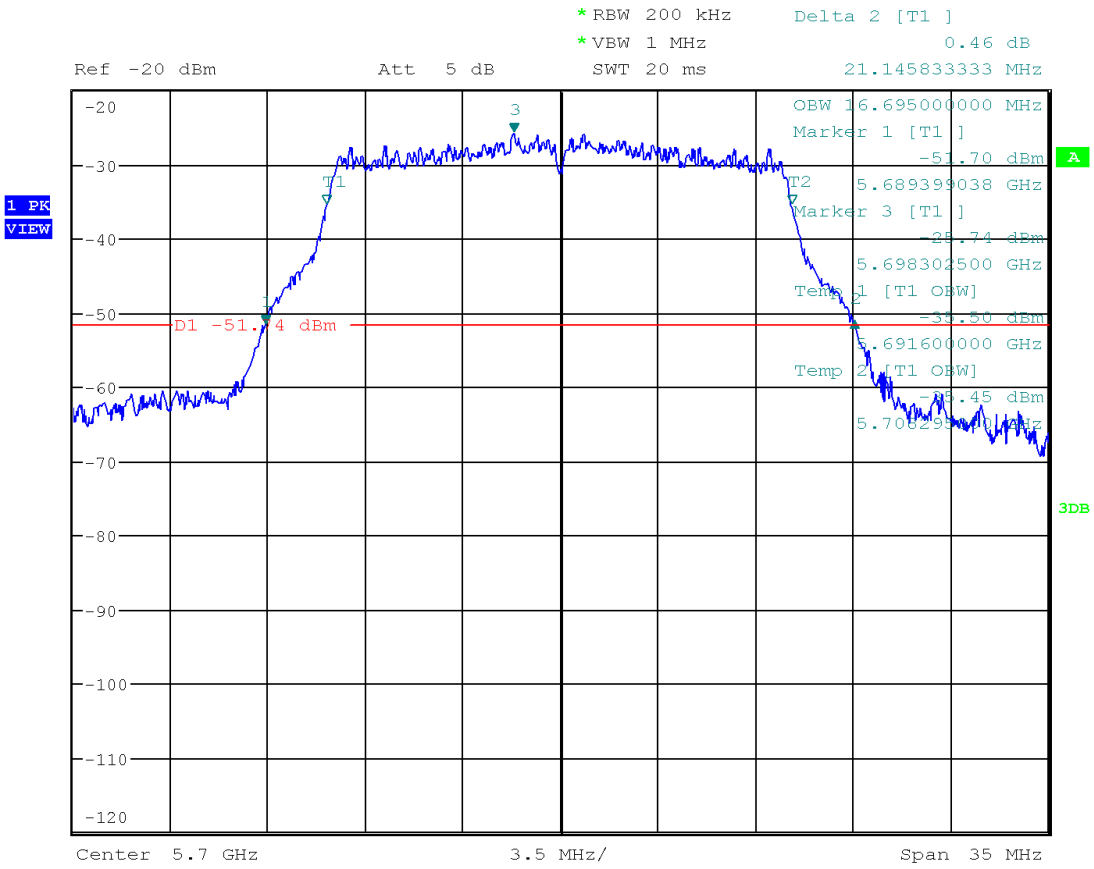
802.11a 5580MHz



Date: 25.SEP.2018 08:57:43

Plot 1.3

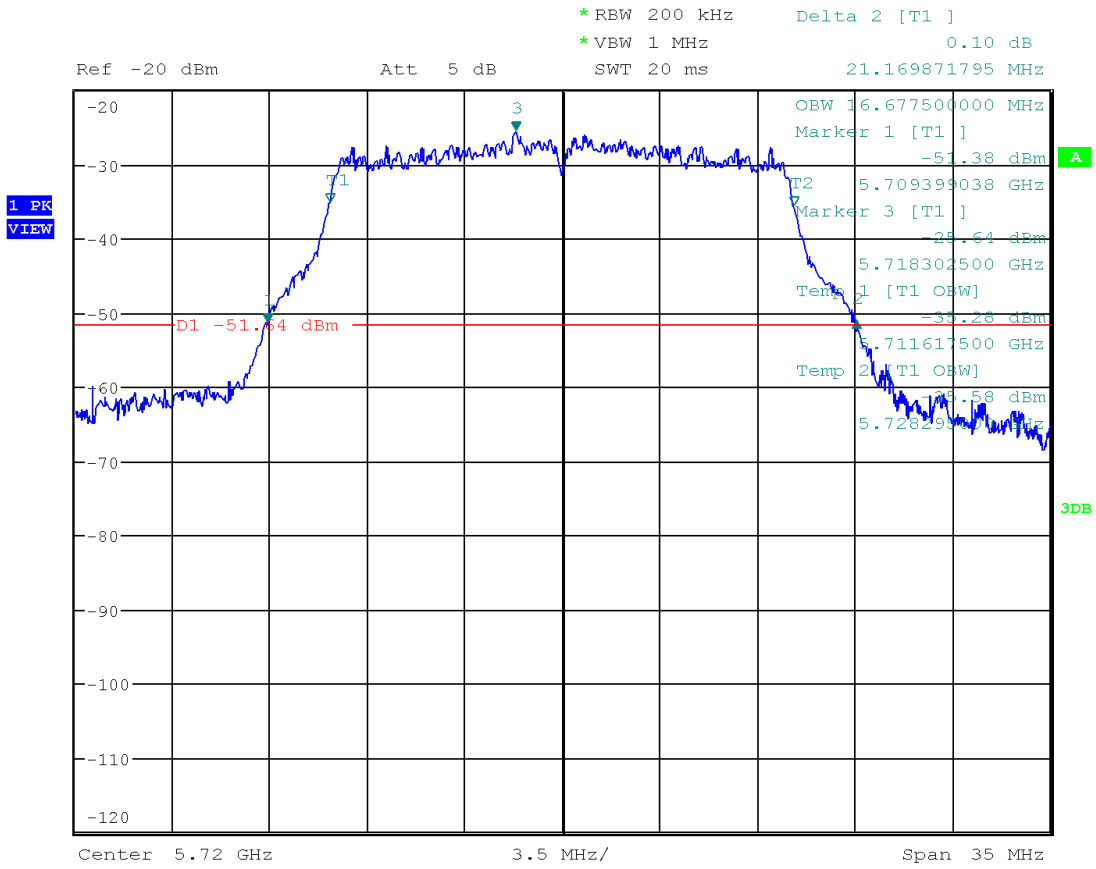
802.11a 5700MHz



Date: 25.SEP.2018 09:02:09

Plot 1.4

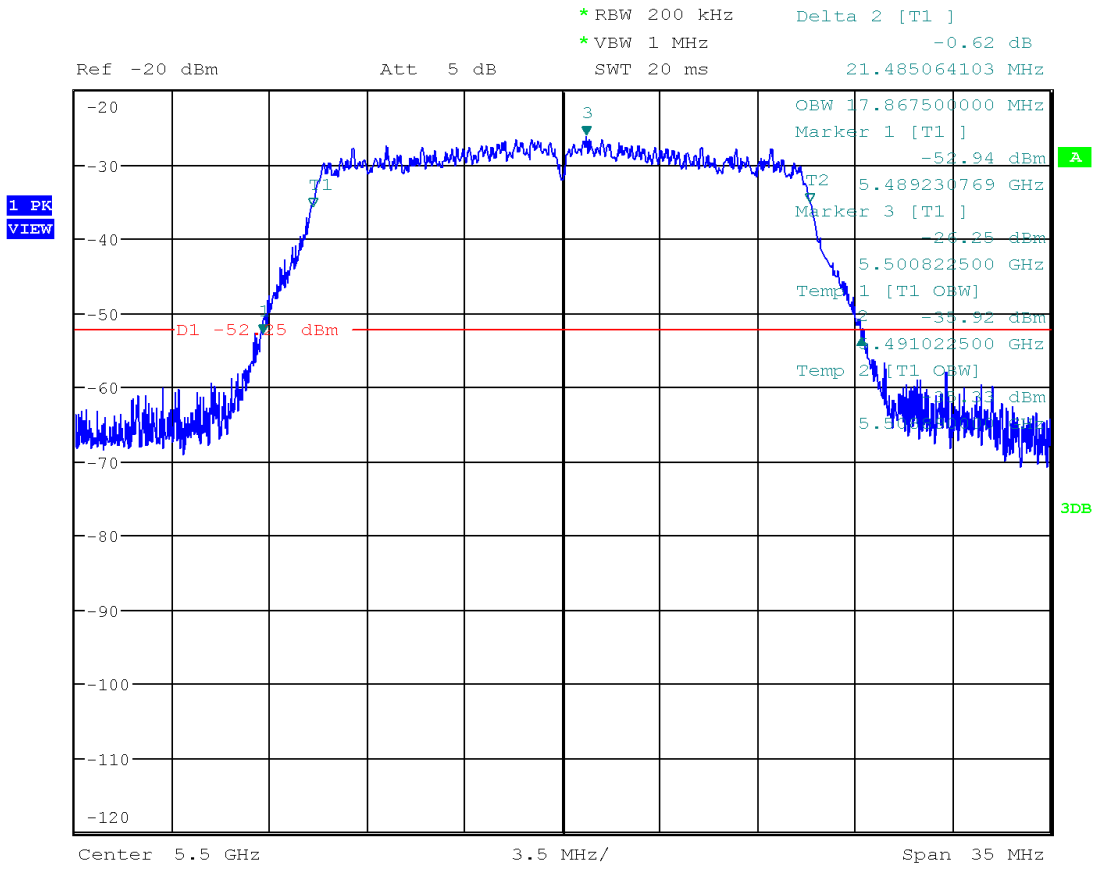
802.11a 5720MHz



Date: 25.SEP.2018 09:08:05

Plot 1.5

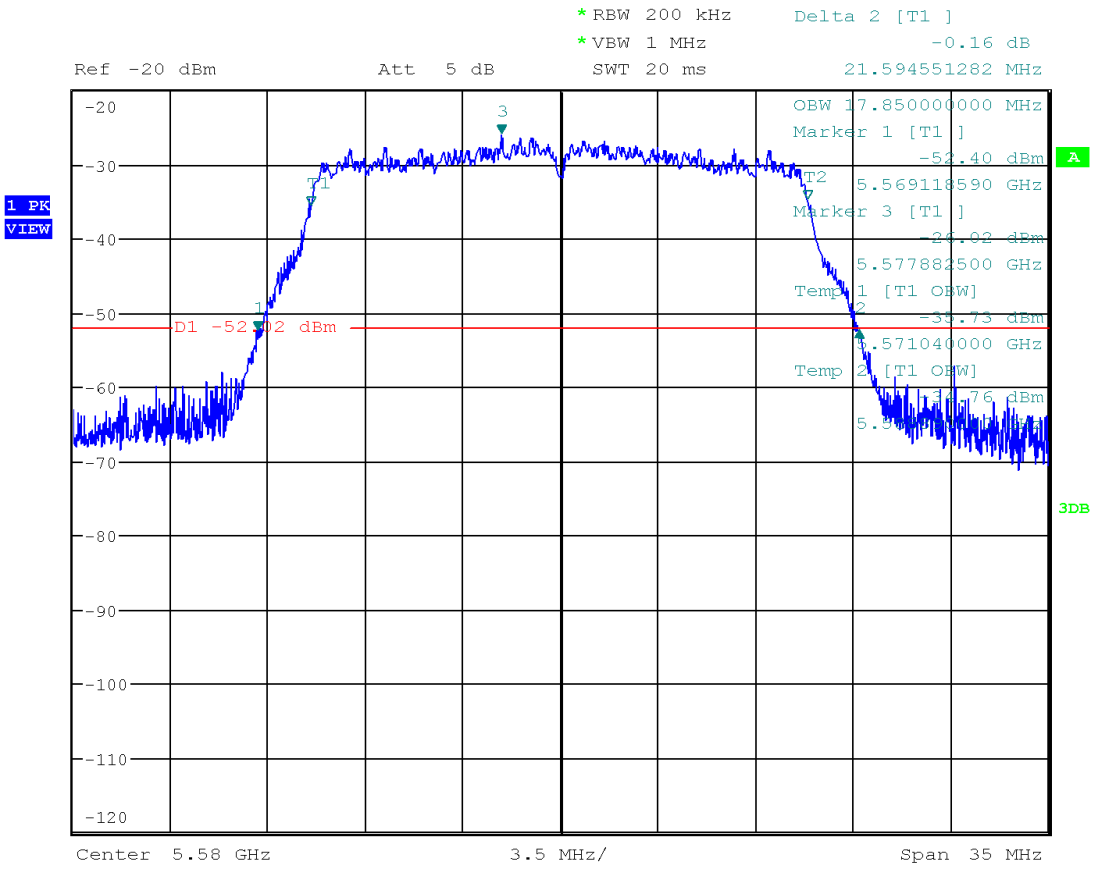
802.11n 20MHz, 5500MHz



Date: 25.SEP.2018 08:55:37

Plot 1.6

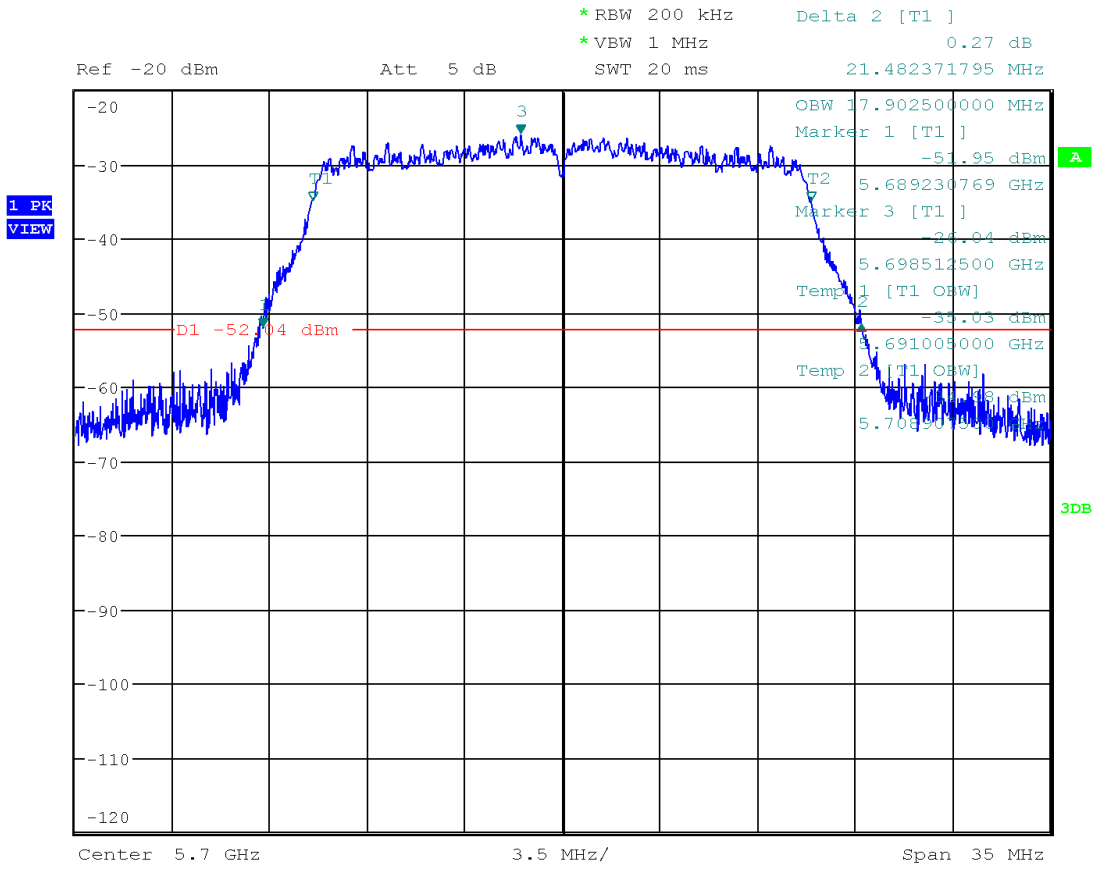
802.11n 20MHz, 5580MHz



Date: 25.SEP.2018 08:59:57

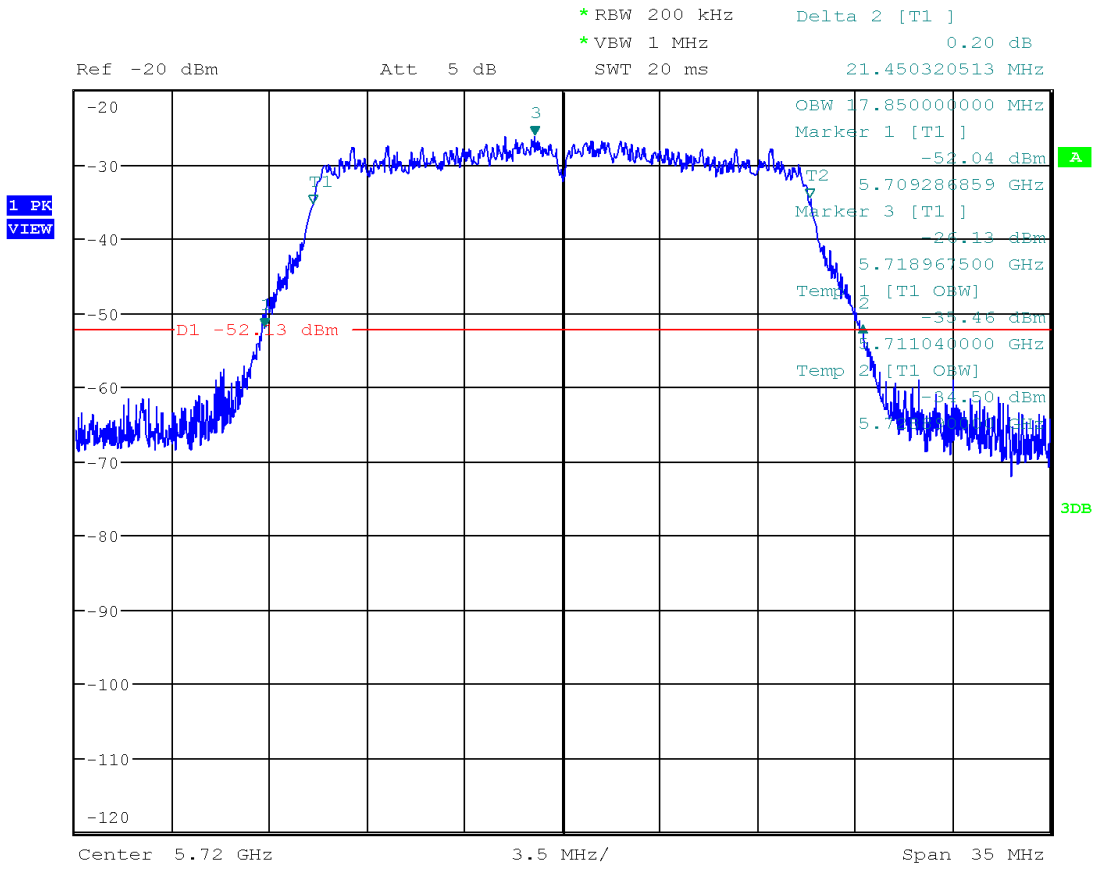
Plot 1.7

802.11n 20MHz, 5700MHz



Plot 1.8

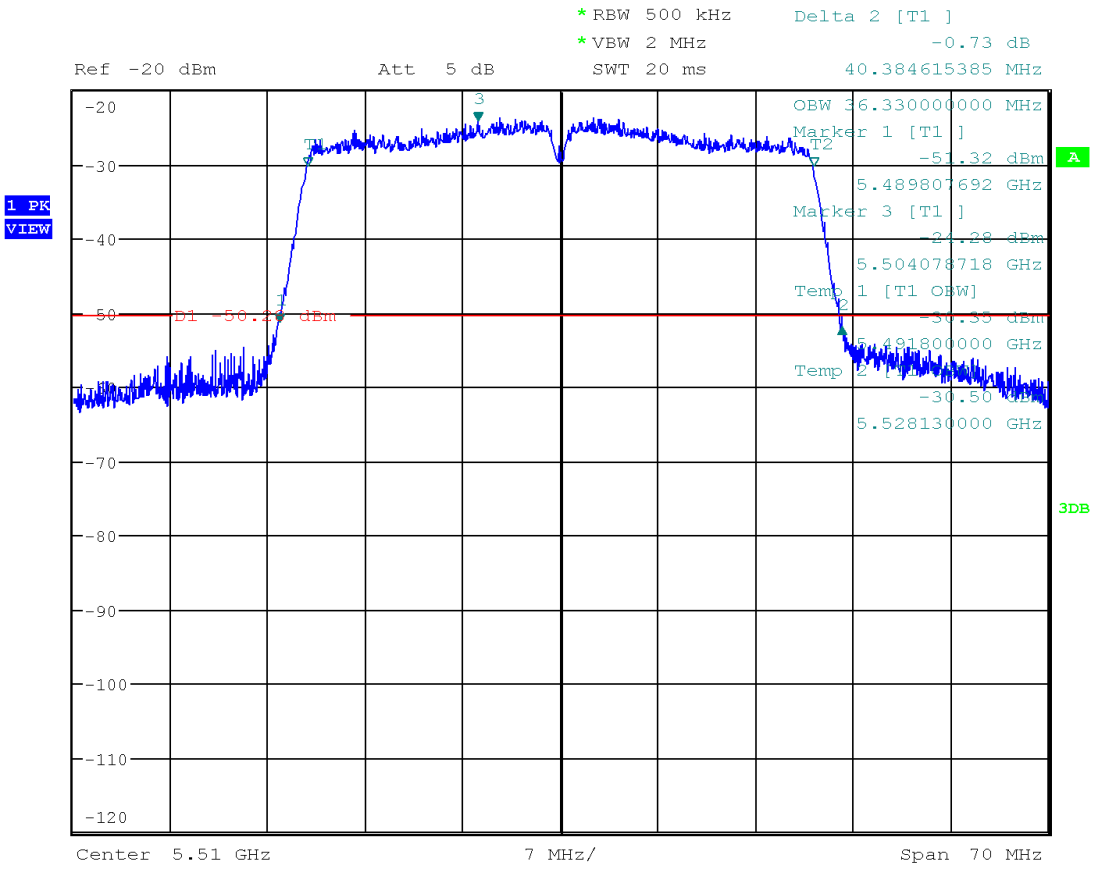
802.11n 20MHz, 5720MHz



Date: 25.SEP.2018 09:10:30

Plot 1.9

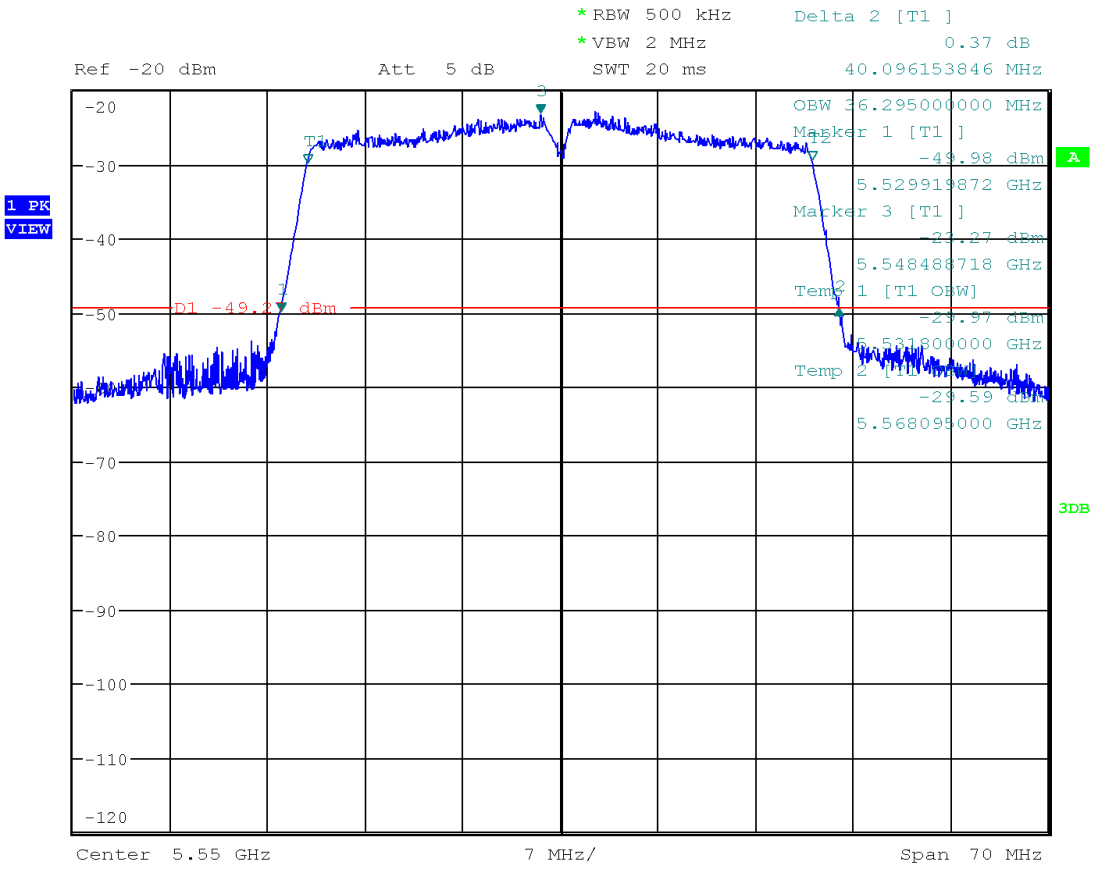
802.11n 40MHz, 5510MHz



Date: 26.SEP.2018 10:29:41

Plot 1.10

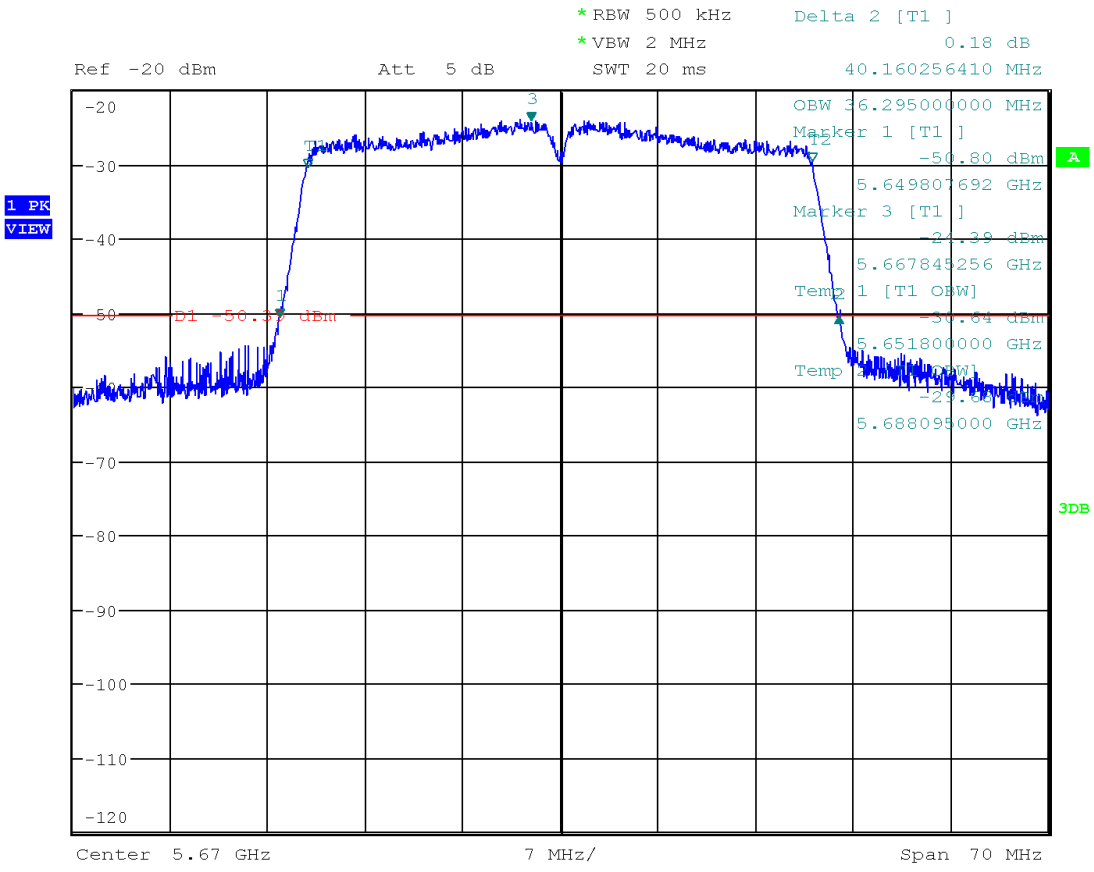
802.11n 40MHz, 5550MHz



Date: 26.SEP.2018 10:35:40

Plot 1.11

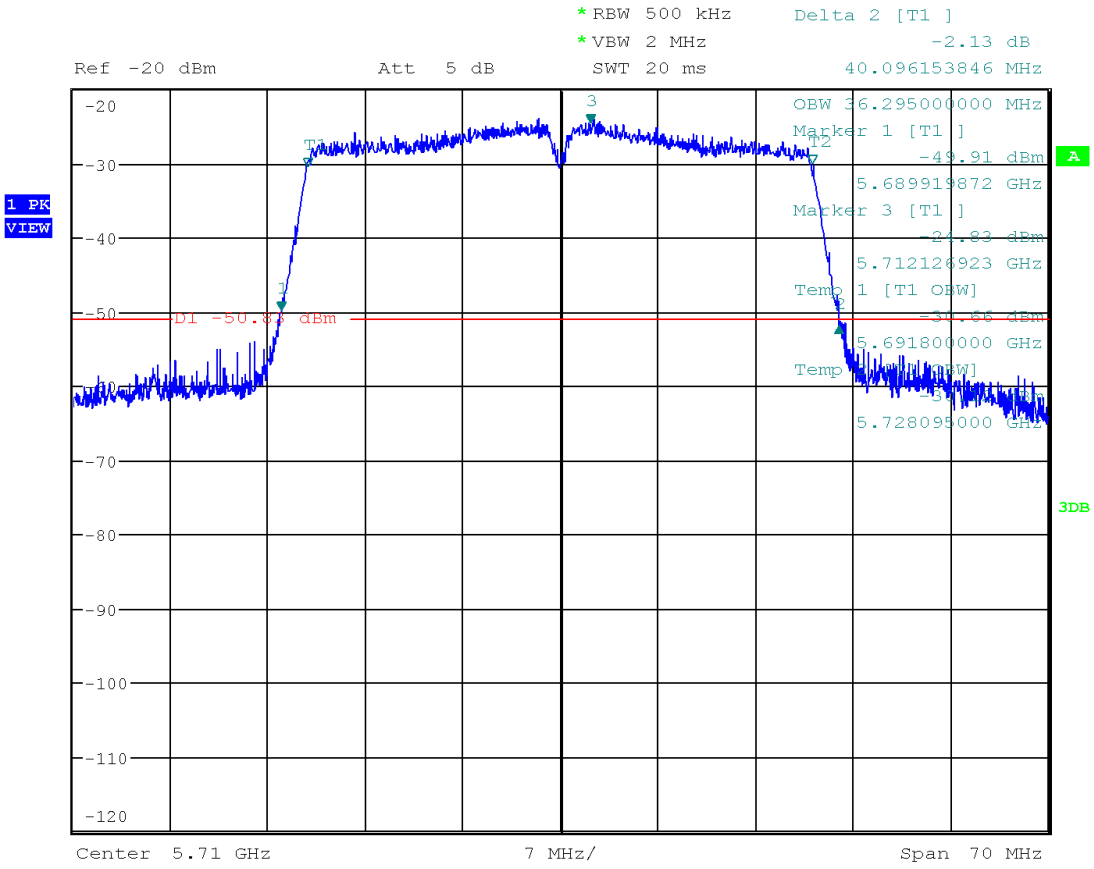
802.11n 40MHz, 5670MHz



Date: 26.SEP.2018 10:38:58

Plot 1.12

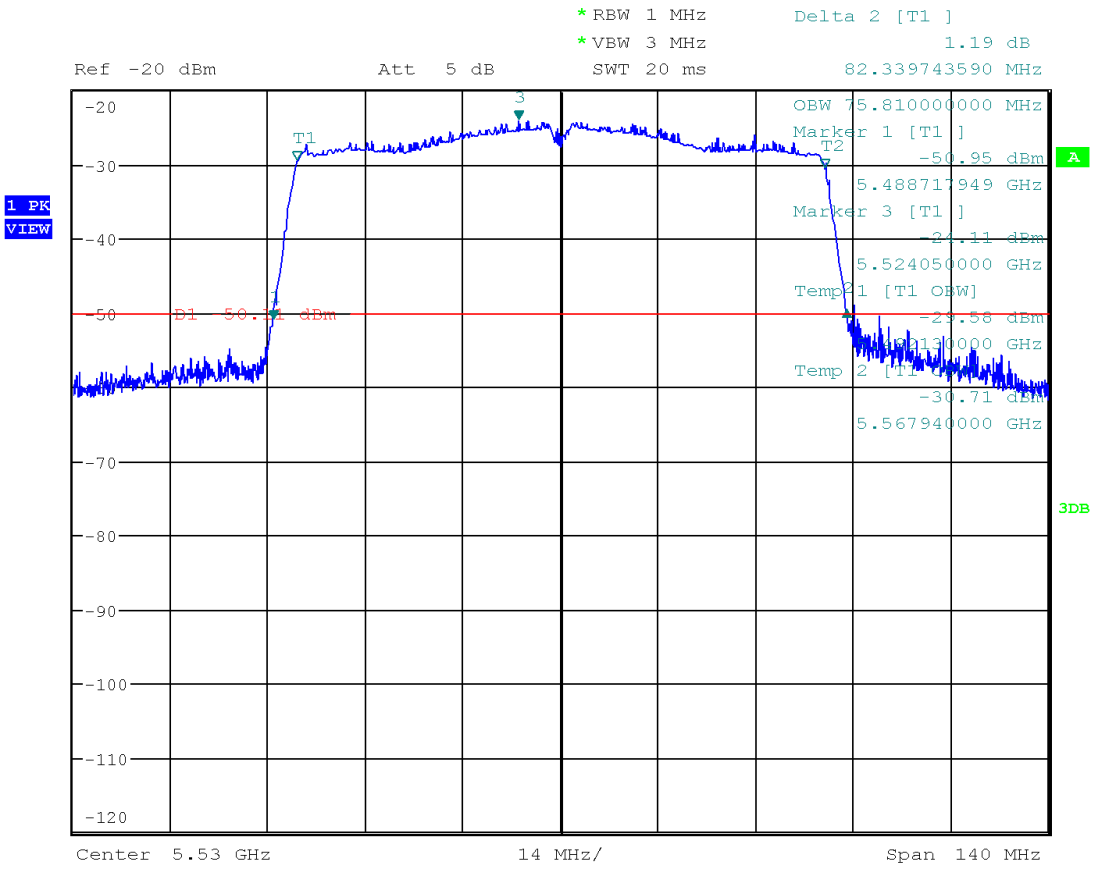
802.11n 40MHz, 5710MHz



Date: 26.SEP.2018 10:42:27

Plot 1.13

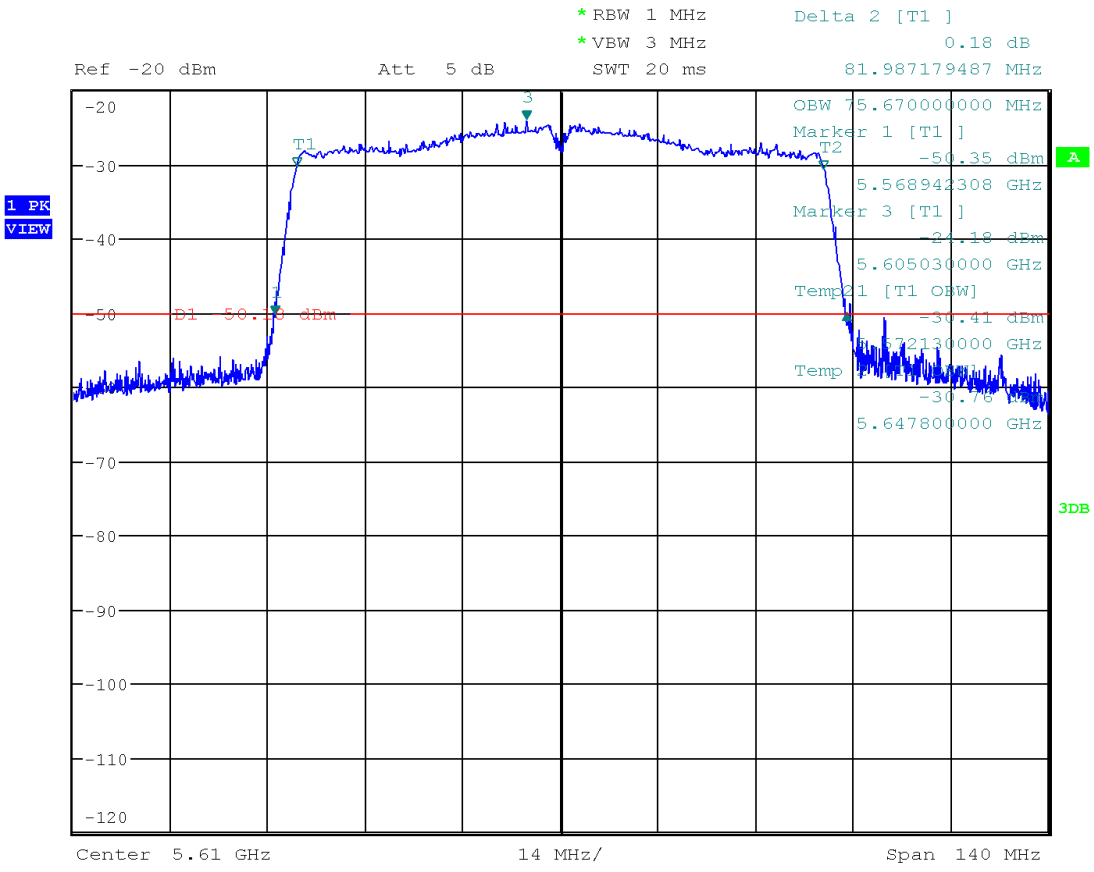
802.11ac 80MHz, 5530MHz



Date: 26.SEP.2018 11:04:24

Plot 1.14

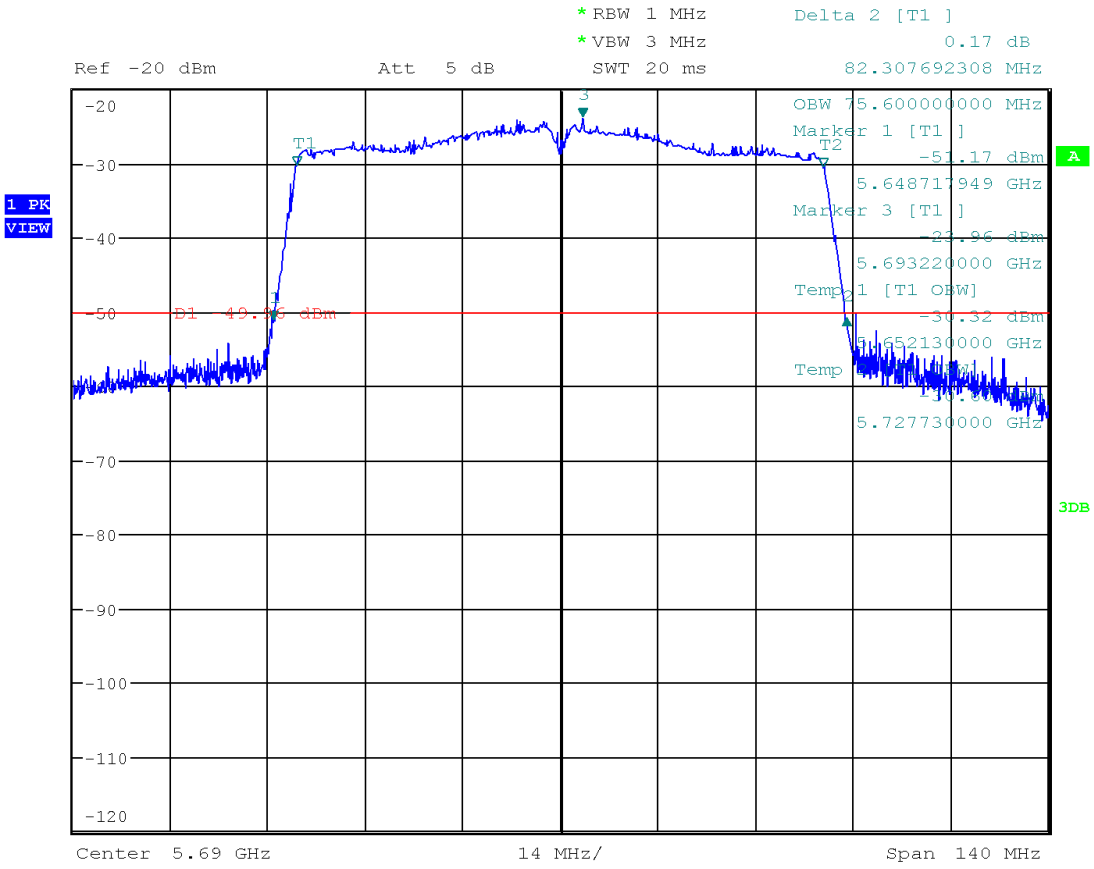
802.11ac 80MHz, 5610MHz



Date: 26.SEP.2018 11:06:22

Plot 1.15

802.11ac 80MHz, 5690MHz



Date: 26.SEP.2018 11:08:19

4.2 Maximum Conducted Output Power & Power Spectral Density
FCC Rule 15.407(a)(1)(iv)

4.2.1 Requirement

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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1-megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2.2 Procedure

The Procedure, described in the FCC Publication 789033 D02 General U-NII Test Procedures New Rules v02r01, was used. Specifically, Section E (2) (c) Method SA-1 for Maximum Conducted Output Power

The Procedure, described in the FCC Publication 789033 D02 General U-NII Test Procedures New Rules v02r01, was used. Specifically, procedure from Section F was utilized for Maximum Power Spectral Density (PSD).

Each antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Maximum Conducted Transmitter Output Power & Peak Power Spectral Density (PPSD).

Tested By:	Anderson Soungpanya
Test Date:	June 7-8, 2017

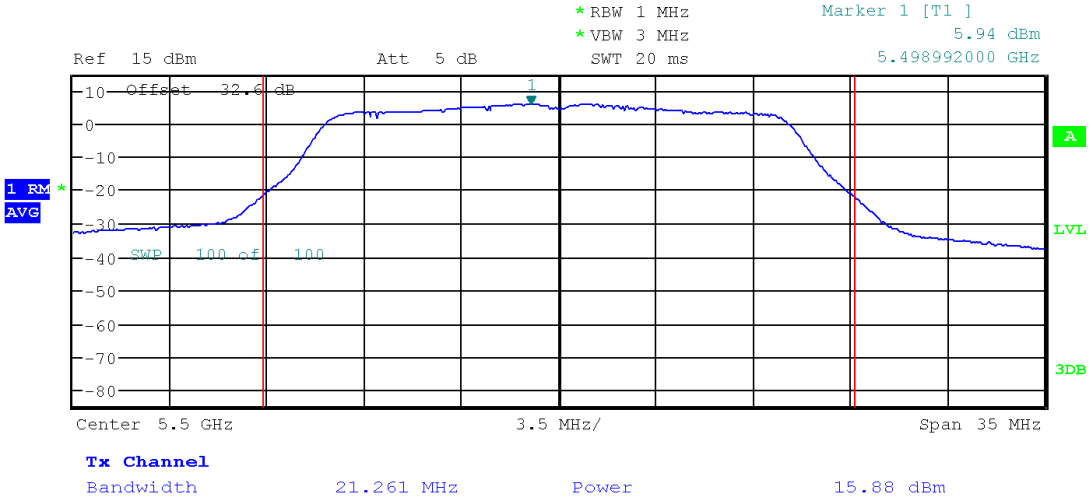
4.2.3 Test Results

Refer to the following plots for the test result:

Mode	Channel	Frequency MHz	Conducted power (Average) dBm	Conducted power Limit dBm	PSD (Peak) dBm	PSD Limit dBm	Plot #
802.11a	100	5500	15.88	24	5.94	11	2.1
	116	5580	16.76	24	6.82	11	2.2
	140	5700	16.70	24	6.75	11	2.3
	144	5720	19.74	24	9.69	11	2.4
802.11n 20MHz	100	5500	16.41	24	6.19	11	2.5
	116	5580	16.47	24	6.26	11	2.6
	140	5700	16.15	24	5.96	11	2.7
	144	5720	19.36	24	9.11	11	2.8
802.11n 40MHz	102	5510	14.88	24	1.72	11	2.9
	110	5550	16.77	24	3.68	11	2.10
	134	5670	16.63	24	3.60	11	2.11
	142	5710	19.73	24	6.71	11	2.12
802.11ac 80MHz	106	5530	10.67	24	-5.15	11	2.13
	122	5610	16.04	24	0.53	11	2.14
	138	5690	19.16	24	3.64	11	2.15

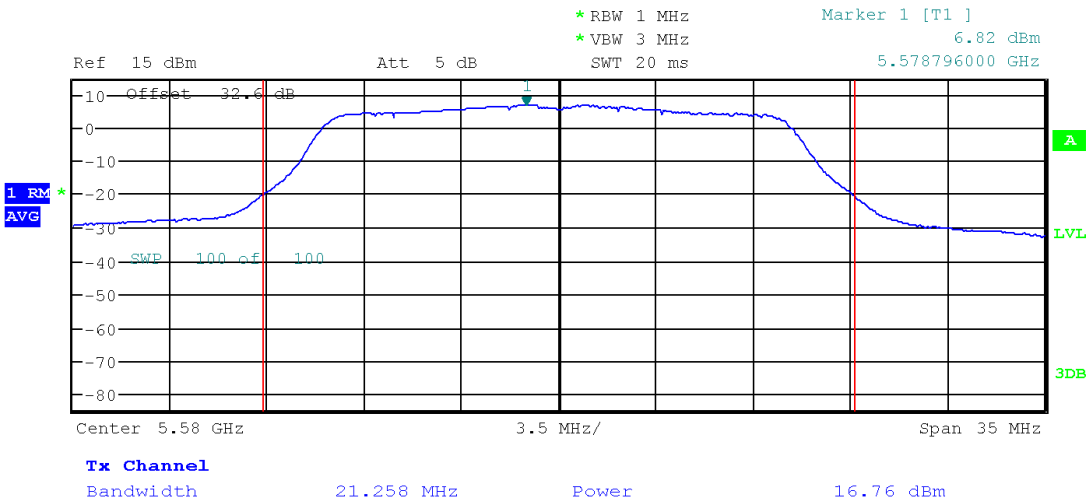
Plot 2. 1

802.11a, 5500MHz



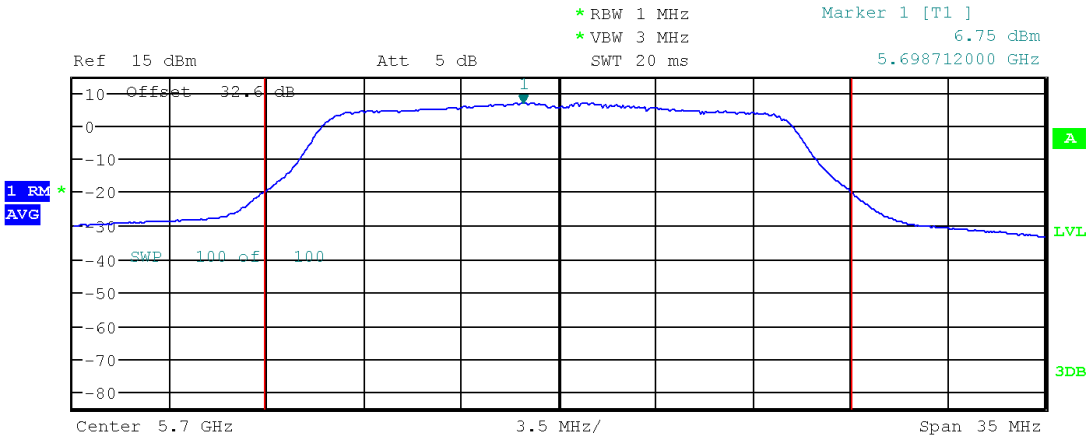
Plot 2. 2

802.11a, 5580MHz



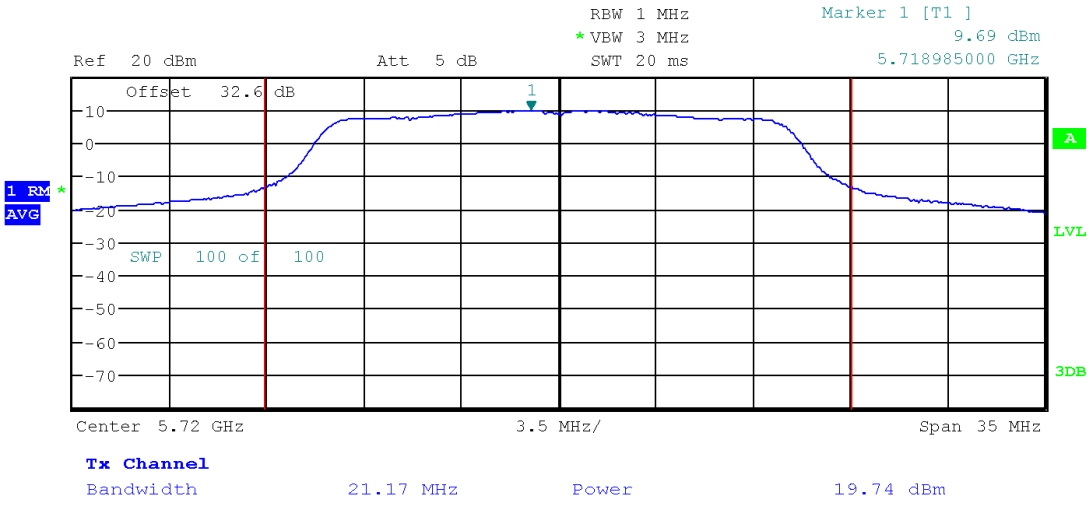
Plot 2. 3

802.11a, 5700MHz



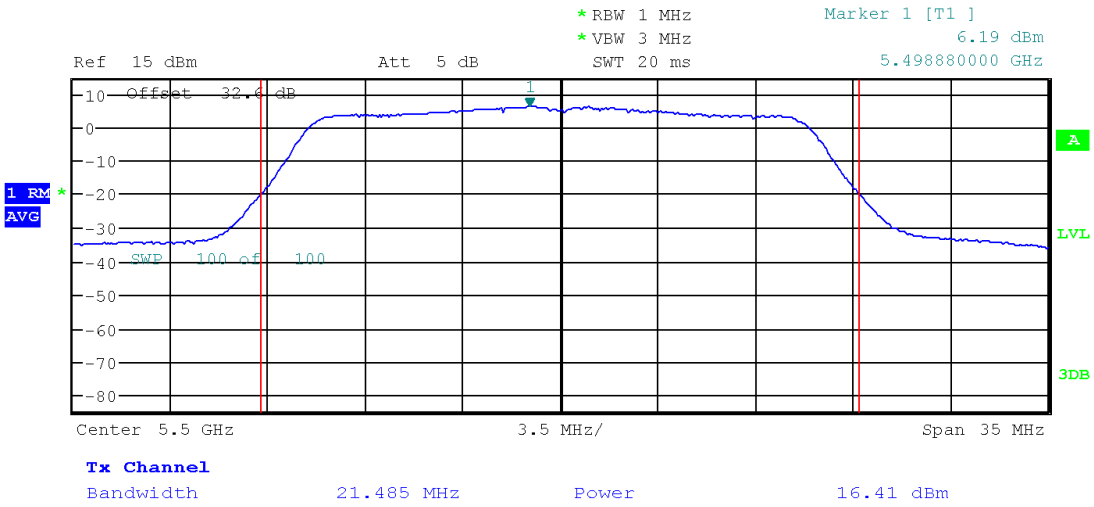
Plot 2. 4

802.11a, 5720MHz



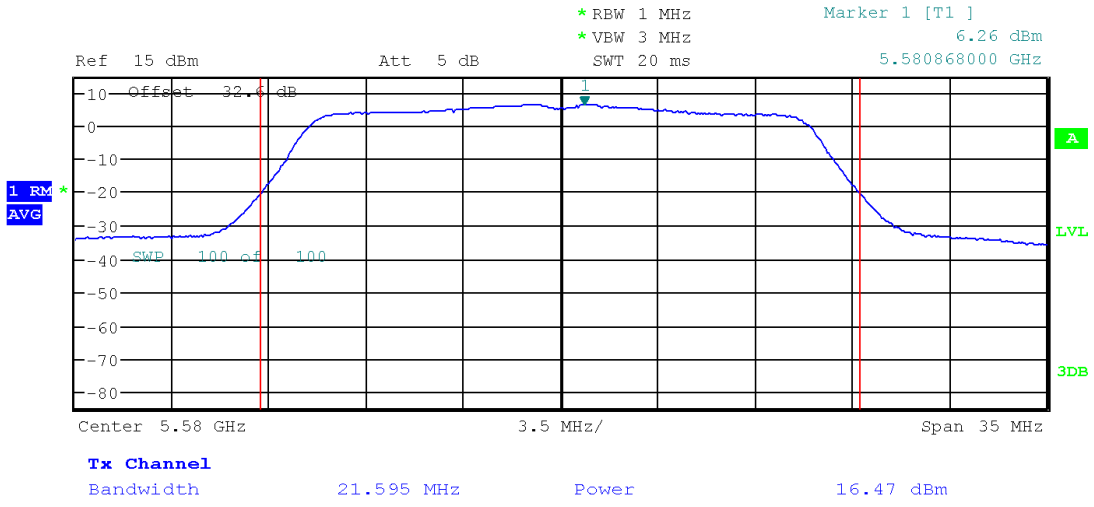
Plot 2.5

802.11n 20MHz, 5500MHz



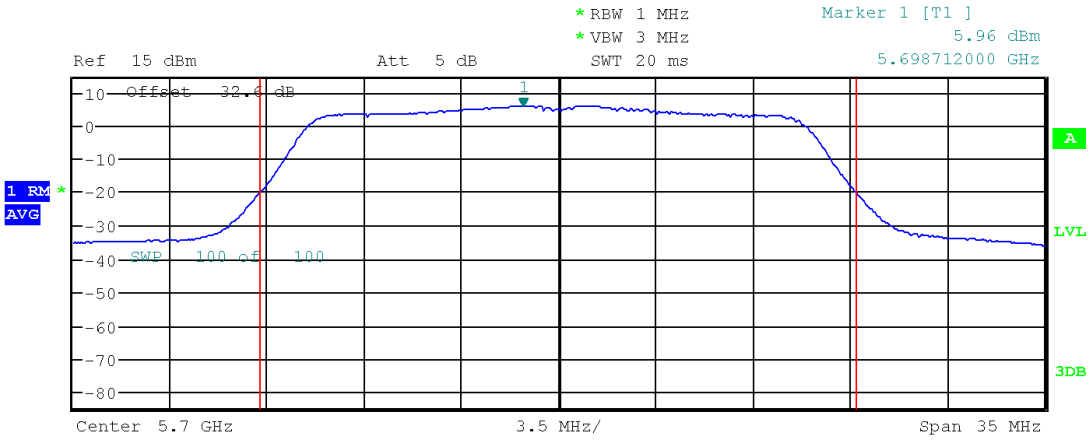
Plot 2.6

802.11n 20MHz, 5580MHz



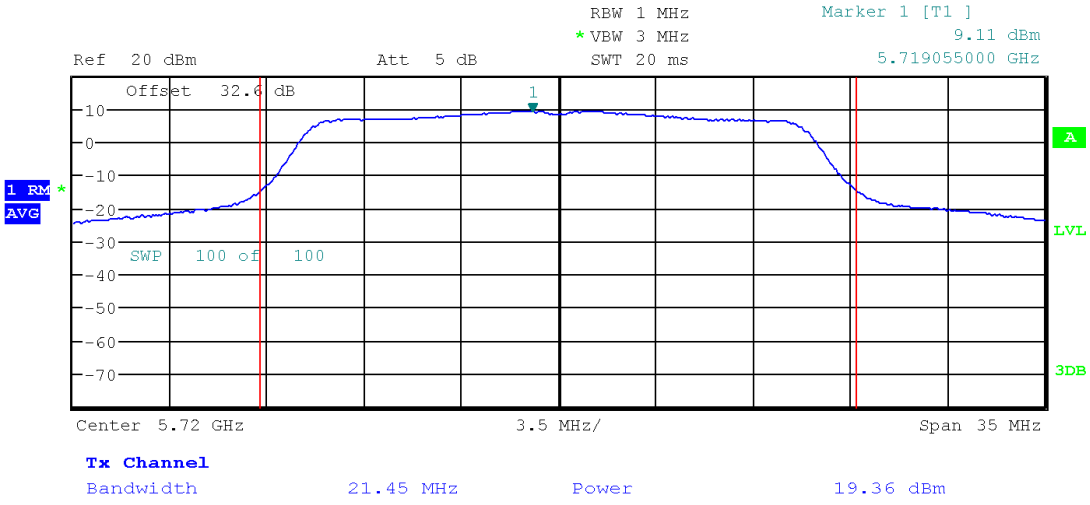
Plot 2.7

802.11n 20MHz, 5700MHz



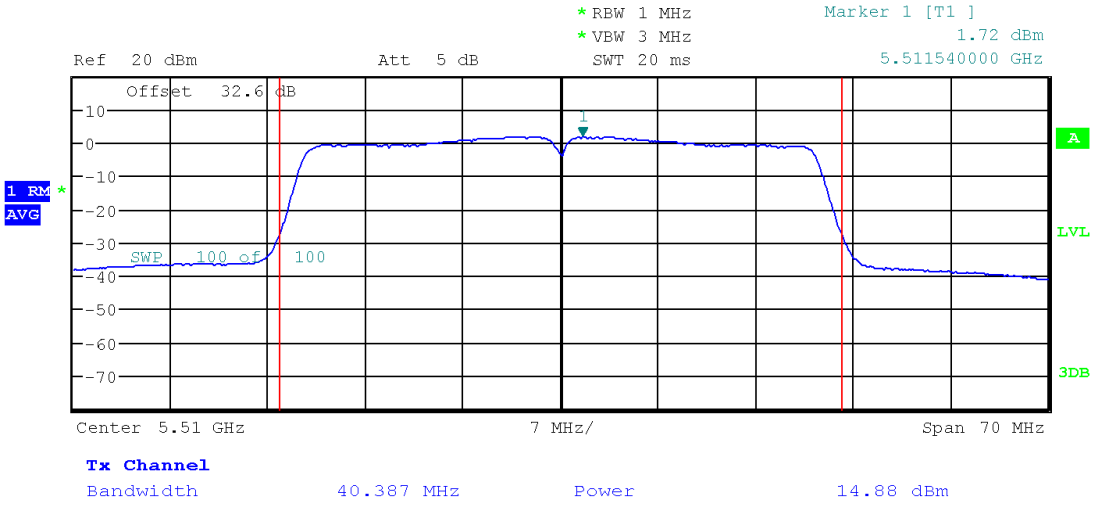
Plot 2.8

802.11n 20MHz, 5720MHz



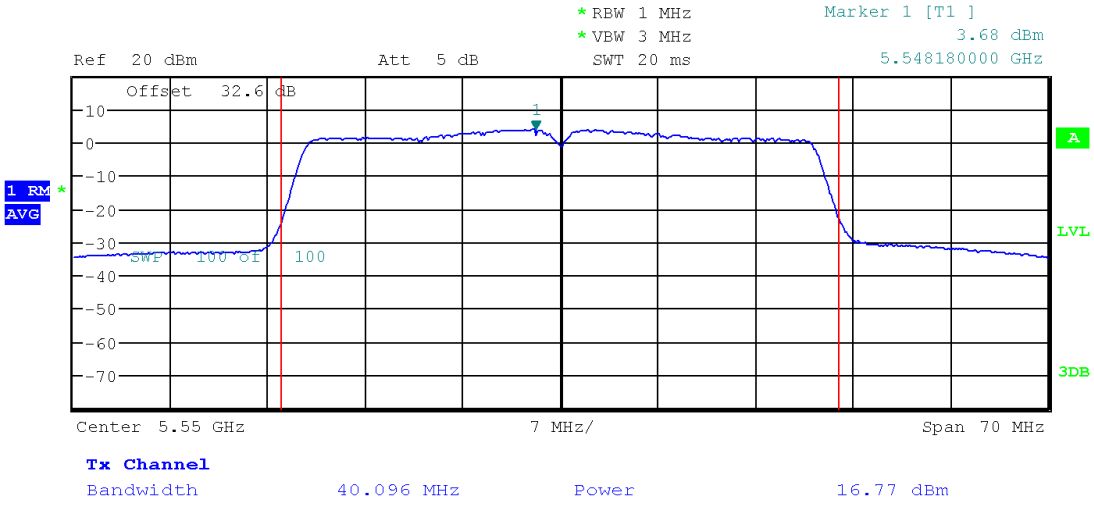
Plot 2.9

802.11n 240MHz, 5510MHz



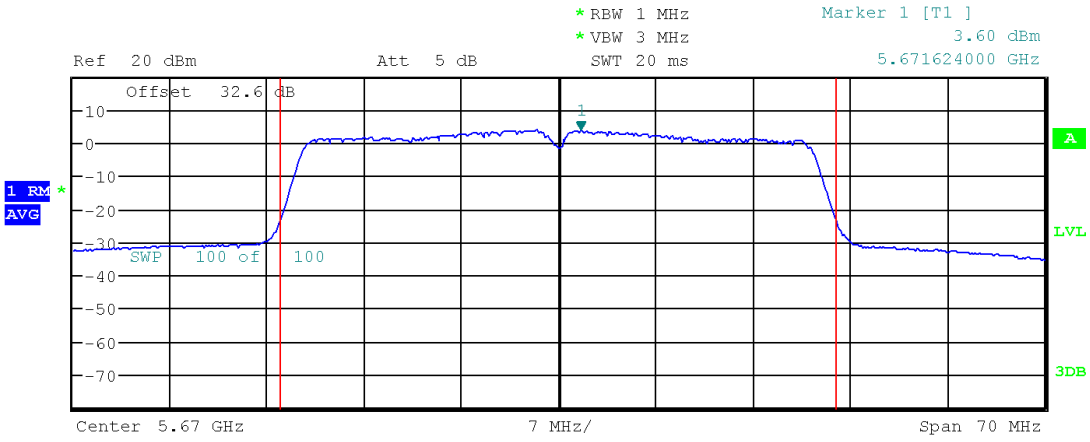
Plot 2.10

802.11n 40MHz, 5550MHz



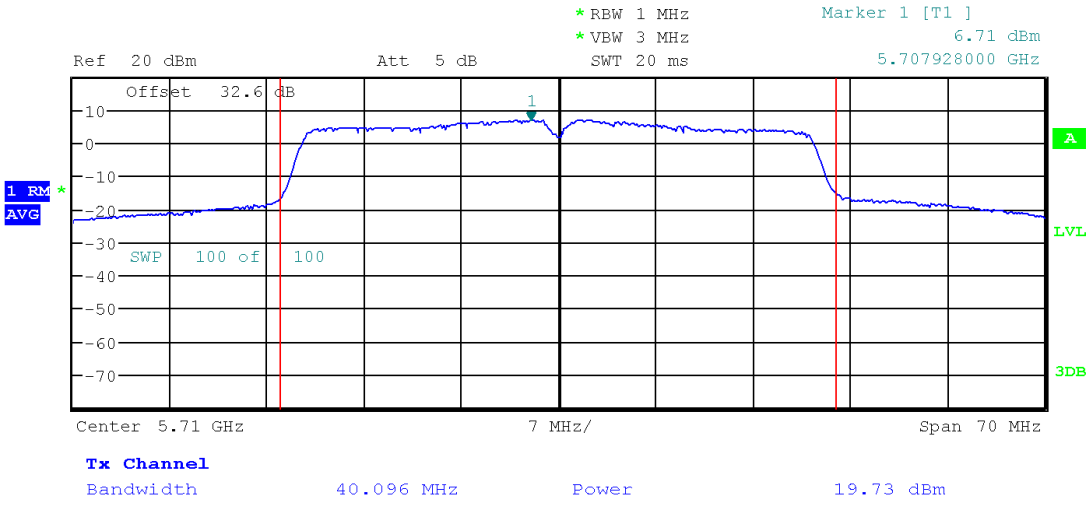
Plot 2.11

802.11n 40MHz, 5670MHz



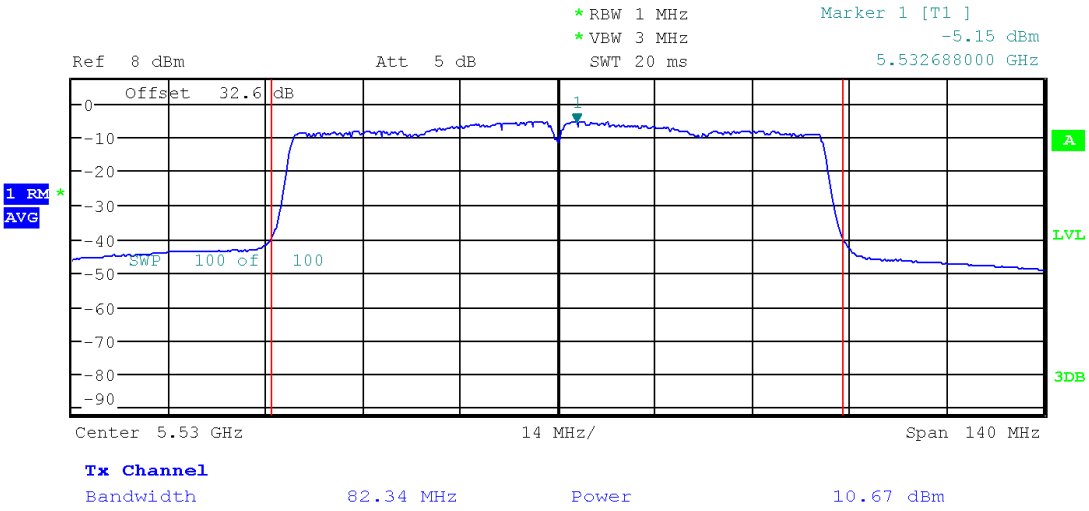
Plot 2.12

802.11n 40MHz, 5710MHz



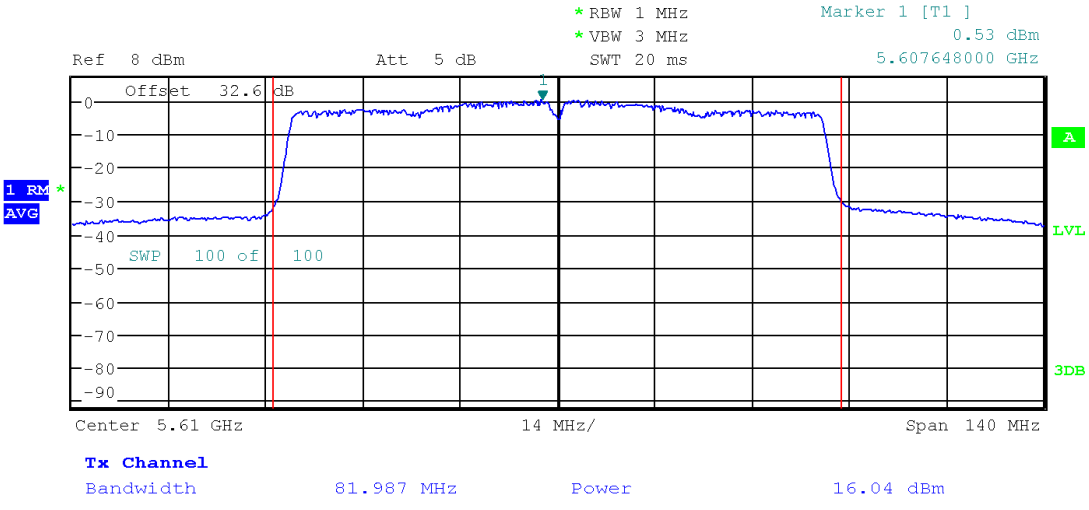
Plot 2.13

802.11ac 80MHz, 5530MHz



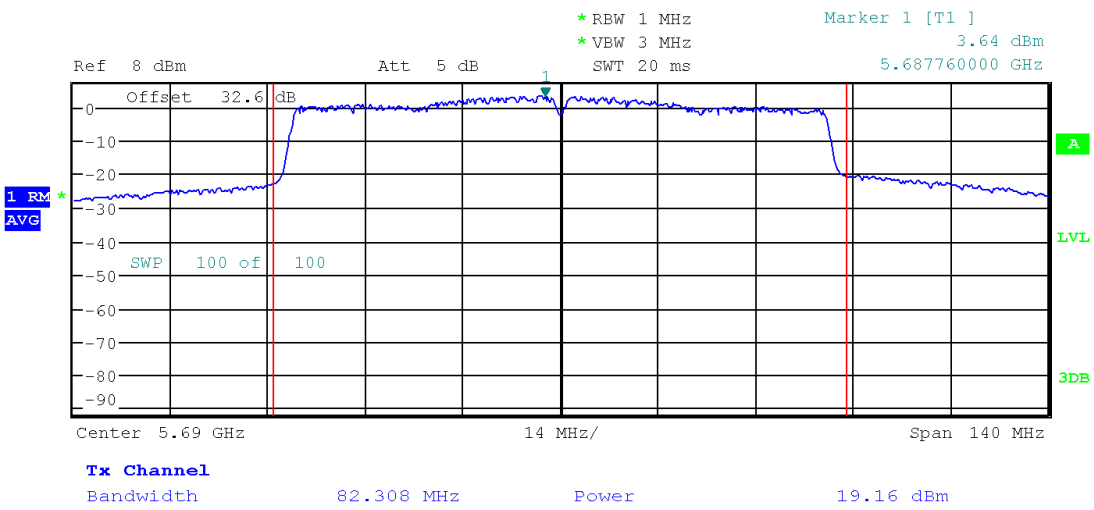
Plot 2.14

802.11ac 80MHz, 5610MHz



Plot 2.15

802.11ac 80MHz, 5690MHz



4.3 Transmitter Radiated Emissions
FCC Rule 15.407(b) (1-8) 15.209, 15.205

4.3.1 Requirement

(b) Undesirable emission limits. Except as shown in paragraph (b) (7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(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.

(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.

(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.

(4) For transmitters operating in the 5.725-5.85 GHz band:

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

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(7) The provisions of §15.205 apply to intentional radiators operating under this section.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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 EIRP of –27 dBm/MHz.

Note: An out-of-band emission that complies with both the average and peak limits of Section 15.209 is not required to satisfy the -27 dBm/MHz peak emission limit.

4.3.2 Procedure

Radiated emission measurements were performed from 30 MHz to 40 GHz according to the procedure described in ANSI C64.10. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic turntable that is 80 cm in height for below 1000MHz and 1.5m in height for above 1GHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Measurements made from 30 MHz to 40 GHz were measured with 50 ohm terminator on the output of the EUT RF port. A preamp was used from 30MHz to 40GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 40 GHz.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.3.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

4.3.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

4.3.5 General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified for determining quasi-peak, peak, and average conducted output power, respectively.

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
E = EIRP – 20log D + 104.8
where:
E = electric field strength in dBµV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.
f) Compare the resultant electric field strength level to the applicable limit.
g) Perform radiated spurious emission test

4.3.6 Test Results

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

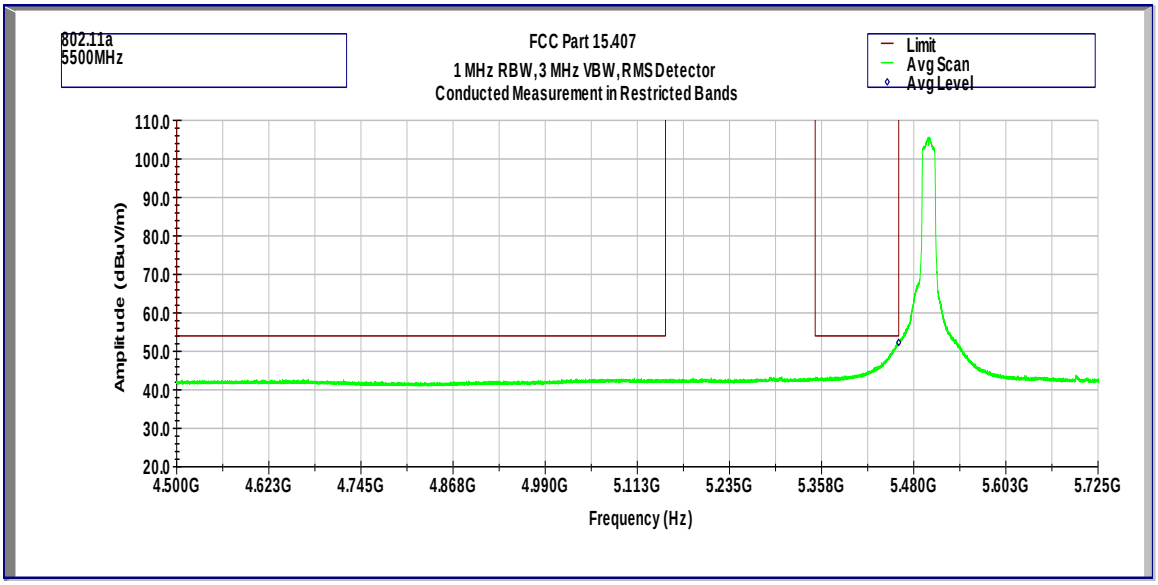
All conducted antenna port plots are corrected with the consideration of a 3.1 dBi Antenna Gain.

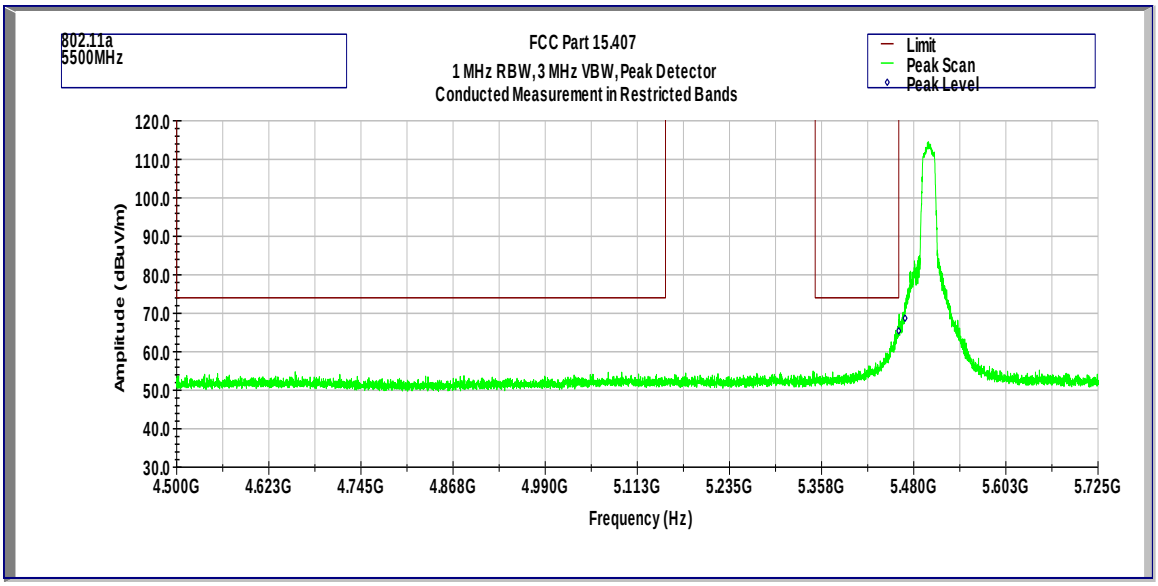
Radiated emission measurements were performed up to 40GHz. No Emissions were identified when scanned from 18-40 GHz.

Tested By	Test Date
Anderson Soungpanya	September 27 - October 11, 2018

Test Results: 15.209/15.205 Restricted Band Emissions at Antenna Port

Out-of-Band Spurious Emissions at the Band Edge - 802.11a, 5500 MHz

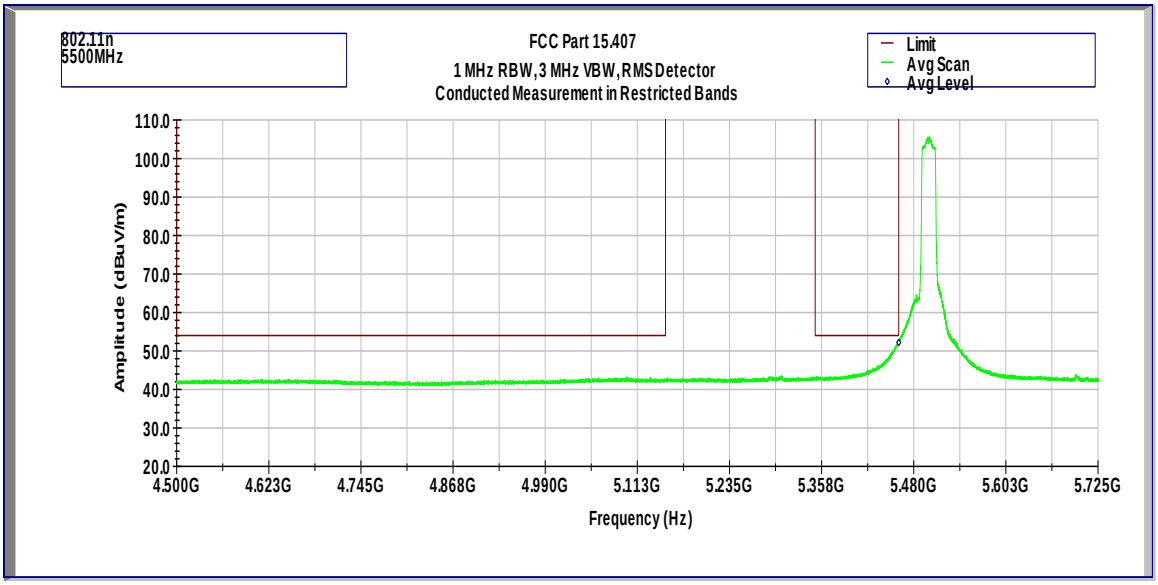


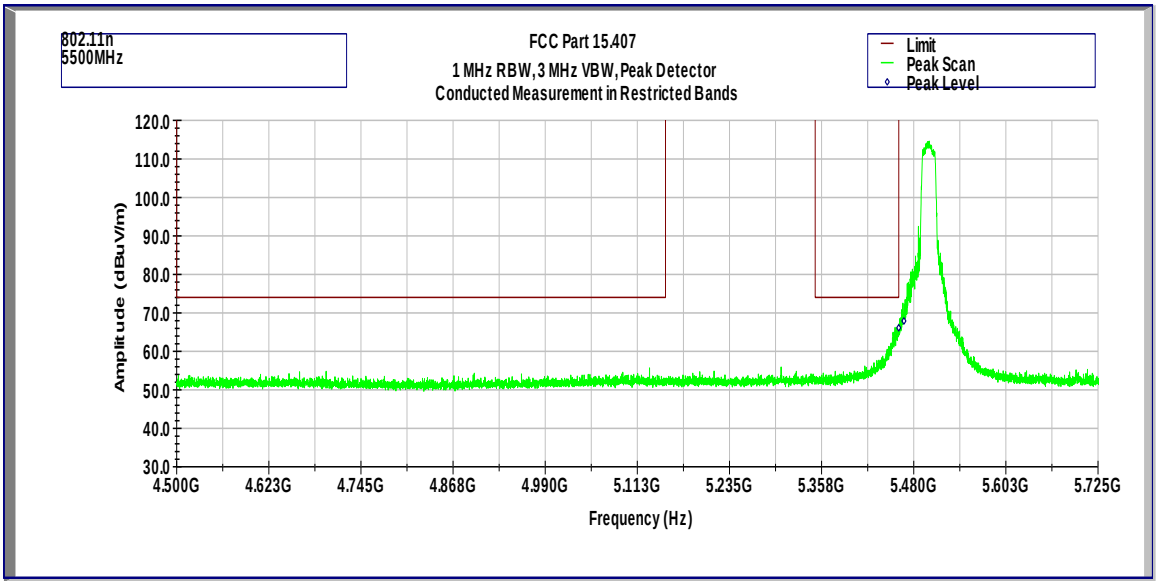


Frequency (MHz)	Detector	Amplitude (dBµV/m)	3m FS Limit (dBµV/m)	Margin (dB)	Pass / Fail?
5460	Average	52.30	54	-1.70	Pass
5460	Peak	65.70	74	-8.30	Pass
5470	Peak	68.10	68.23*	-0.13	Pass

*Limit at 5470MHz is -27 EIRP Peak. Converting the EIRP level to an equivalent electric field strength at 3m uses the following formula: FS = -27 – 20log (3m) + 104.8. FS = 68.23 dBuV/m

Out-of-Band Spurious Emissions at the Band Edge - 802.11n 20MHz, 5500 MHz

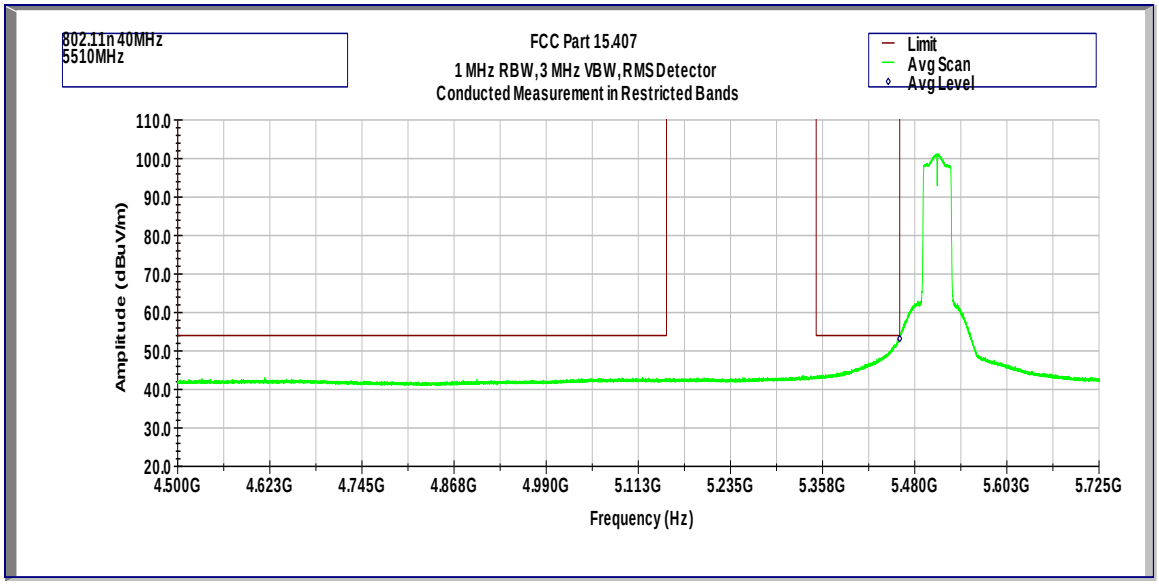


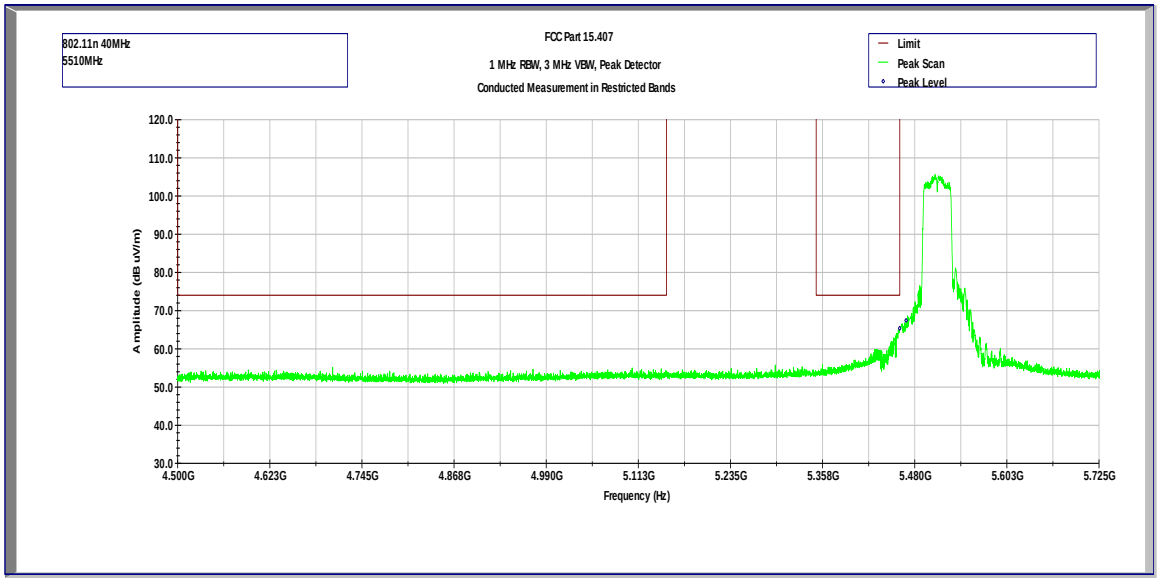


Frequency (MHz)	Detector	Amplitude (dBµV/m)	3m FS Limit (dBµV/m)	Margin (dB)	Pass / Fail?
5460	Average	52.20	54	-1.80	Pass
5460	Peak	66.10	74	-7.90	Pass
5470	Peak	67.90	68.23*	-0.33	Pass

*Limit at 5470MHz is -27 EIRP Peak. Converting the EIRP level to an equivalent electric field strength at 3m uses the following formula: FS = -27 – 20log (3m) + 104.8. FS = 68.23 dBuV/m

Out-of-Band Spurious Emissions at the Band Edge - 802.11n 40MHz, 5510 MHz

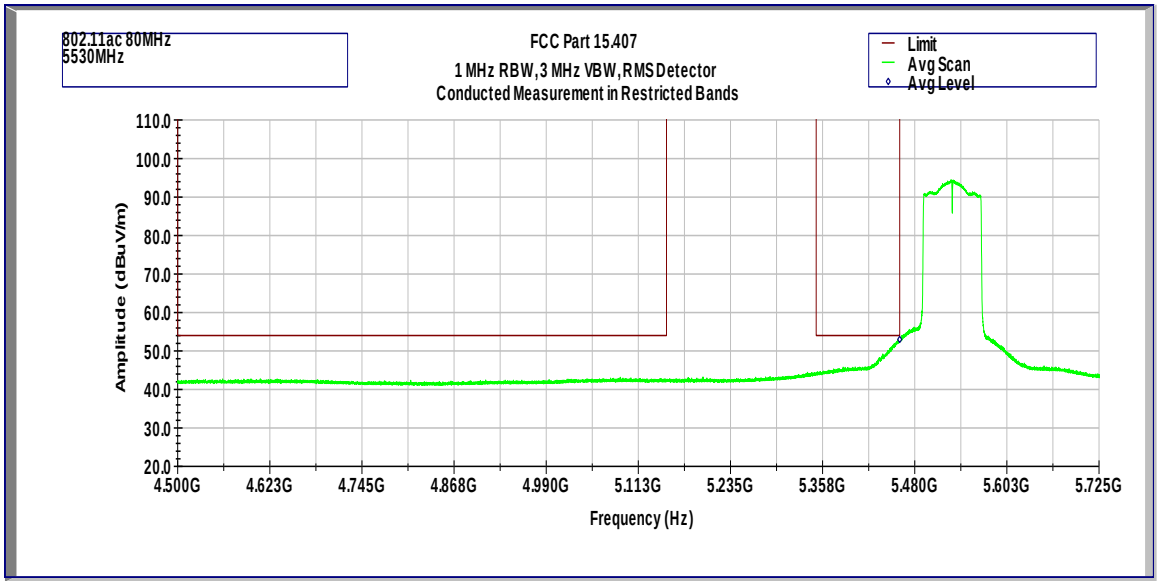


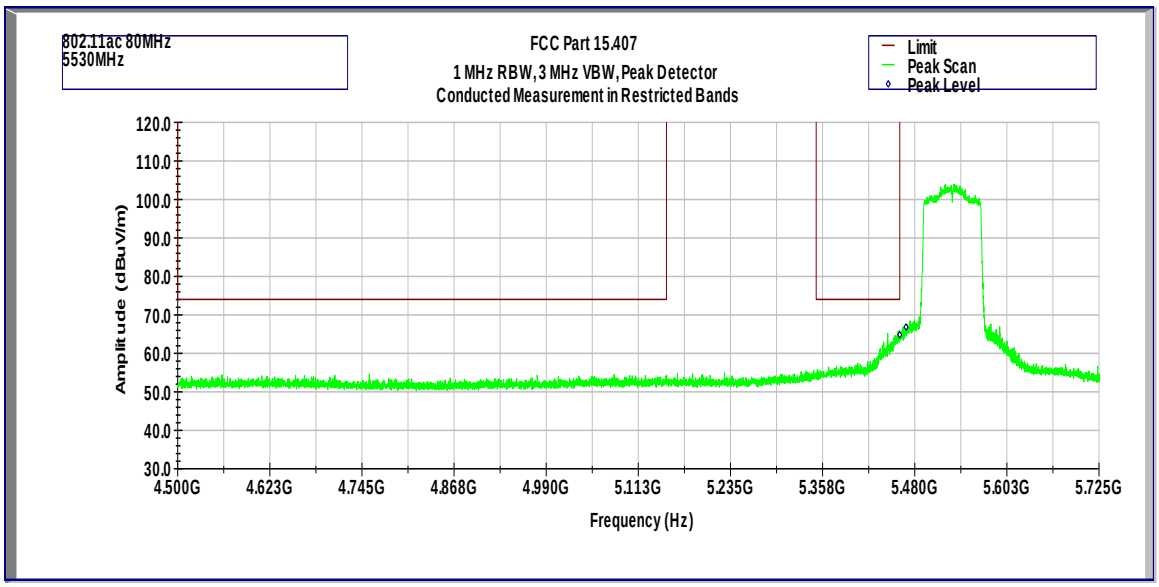


Frequency (MHz)	Detector	Amplitude (dBµV/m)	3m FS Limit (dBµV/m)	Margin (dB)	Pass / Fail?
5460	Average	53.20	54	-0.80	Pass
5460	Peak	65.30	74	-8.70	Pass
5470	Peak	67.40	68.23*	-0.83	Pass

*Limit at 5470MHz is -27 EIRP Peak. Converting the EIRP level to an equivalent electric field strength at 3m uses the following formula: FS = -27 – 20log (3m) + 104.8. FS = 68.23 dBuV/m

Out-of-Band Spurious Emissions at the Band Edge - 802.11ac 80MHz, 5530 MHz

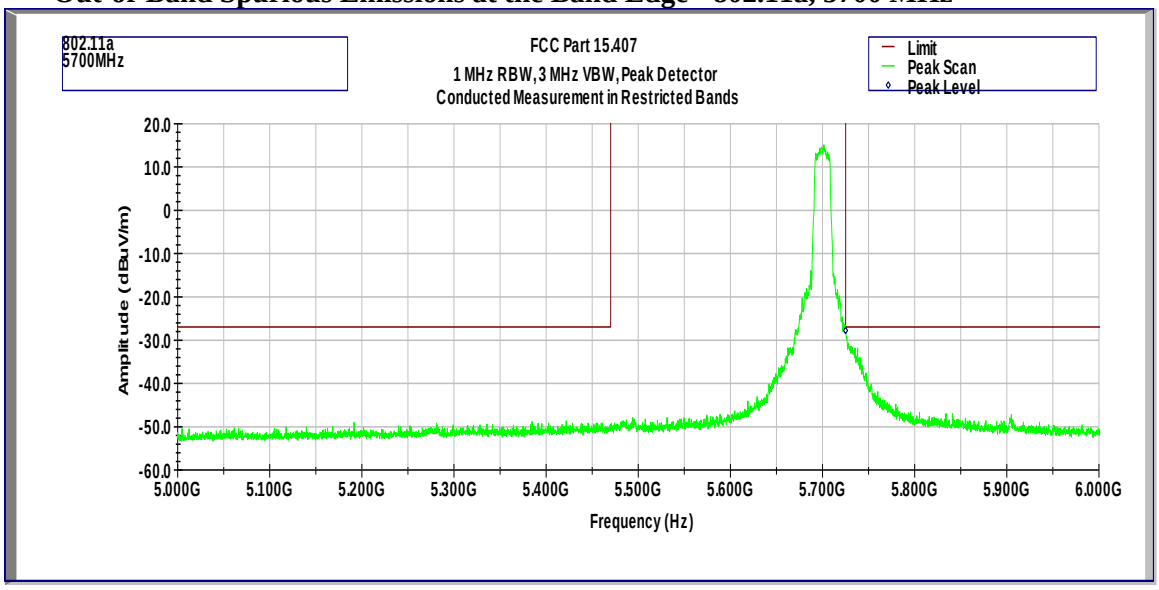




Frequency (MHz)	Detector	Amplitude (dBµV/m)	3m FS Limit (dBµV/m)	Margin (dB)	Pass / Fail?
5460	Average	53.00	54	-1.00	Pass
5460	Peak	64.80	74	-9.20	Pass
5470	Peak	66.80	68.23*	-1.43	Pass

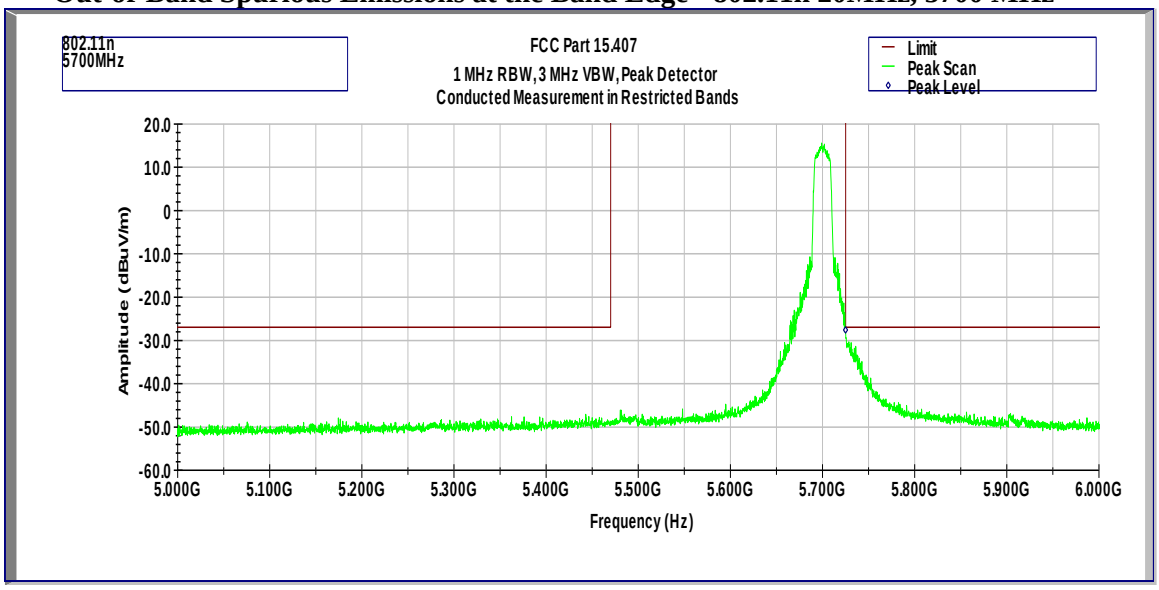
*Limit at 5470MHz is -27 EIRP Peak. Converting the EIRP level to an equivalent electric field strength at 3m uses the following formula: FS = -27 – 20log (3m) + 104.8. FS = 68.23 dBuV/m

Out-of-Band Spurious Emissions at the Band Edge - 802.11a, 5700 MHz



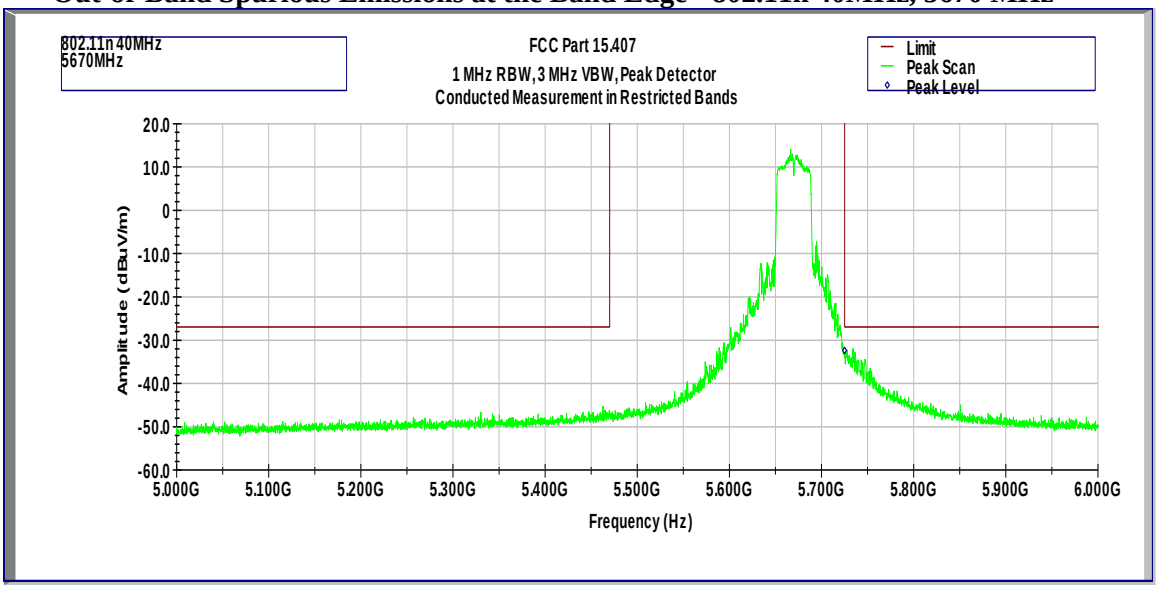
Frequency (MHz)	Detector	EIRP Amplitude (dBm)	Limit (dBm)	Margin (dB)	Pass / Fail?
5725	Peak	-27.25	-27	-0.25	Pass

Out-of-Band Spurious Emissions at the Band Edge - 802.11n 20MHz, 5700 MHz



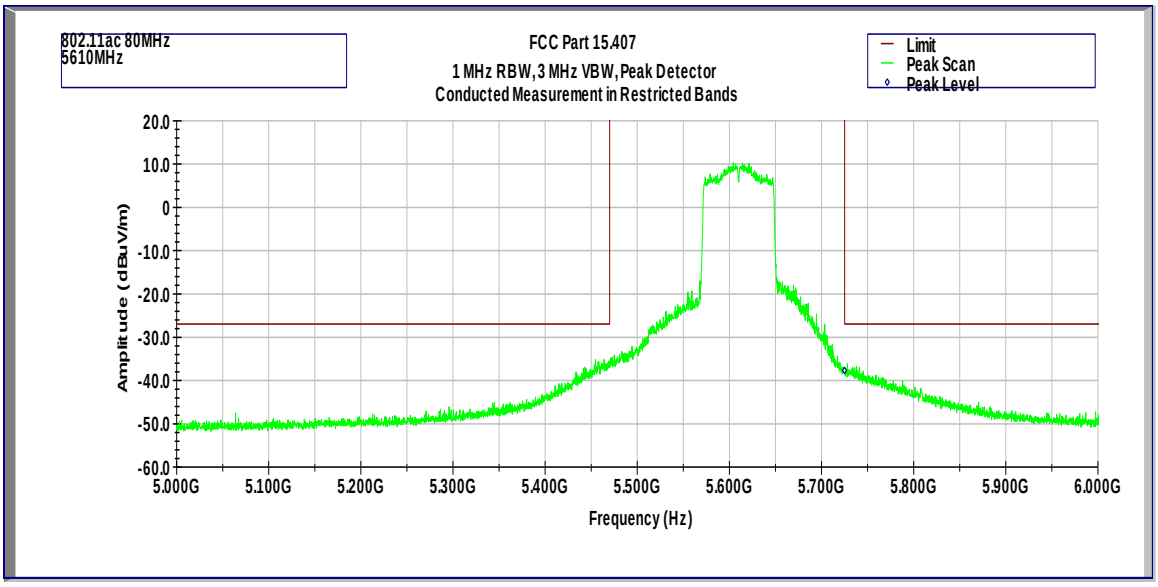
Frequency (MHz)	Detector	EIRP Amplitude (dBm)	Limit (dBm)	Margin (dB)	Pass / Fail?
5725	Peak	-27.60	-27	-0.60	Pass

Out-of-Band Spurious Emissions at the Band Edge - 802.11n 40MHz, 5670 MHz



Frequency (MHz)	Detector	EIRP Amplitude (dBm)	Limit (dBm)	Margin (dB)	Pass / Fail?
5725	Peak	-32.40	-27	-5.40	Pass

Out-of-Band Spurious Emissions at the Band Edge - 802.11ac 80MHz, 5610 MHz

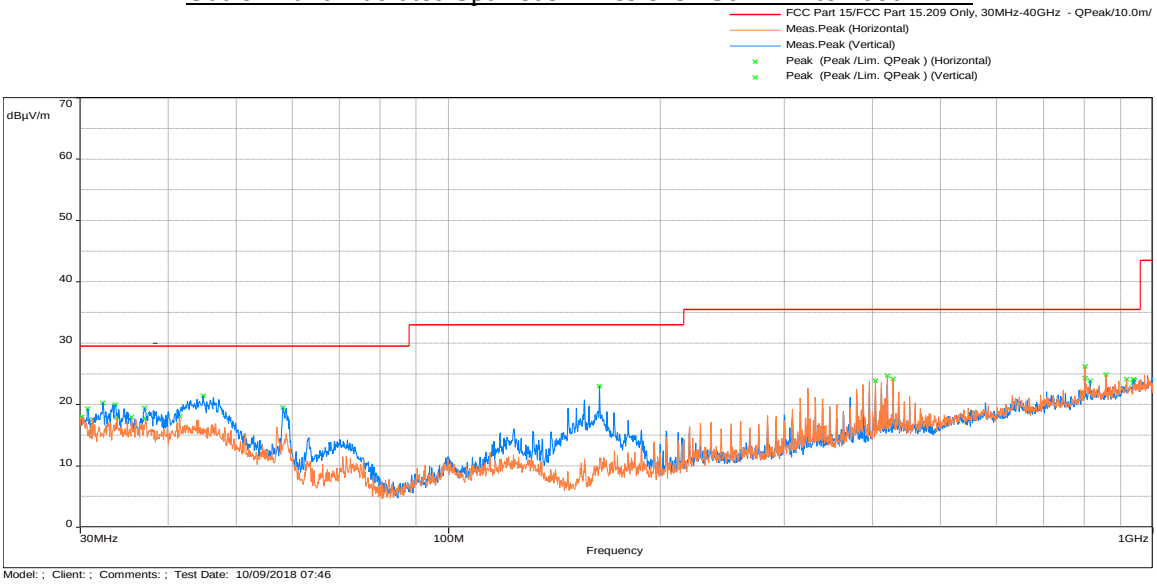


Frequency (MHz)	Detector	EIRP Amplitude (dBm)	Limit (dBm)	Margin (dB)	Pass / Fail?
5725	Peak	-37.70	-27	-10.70	Pass

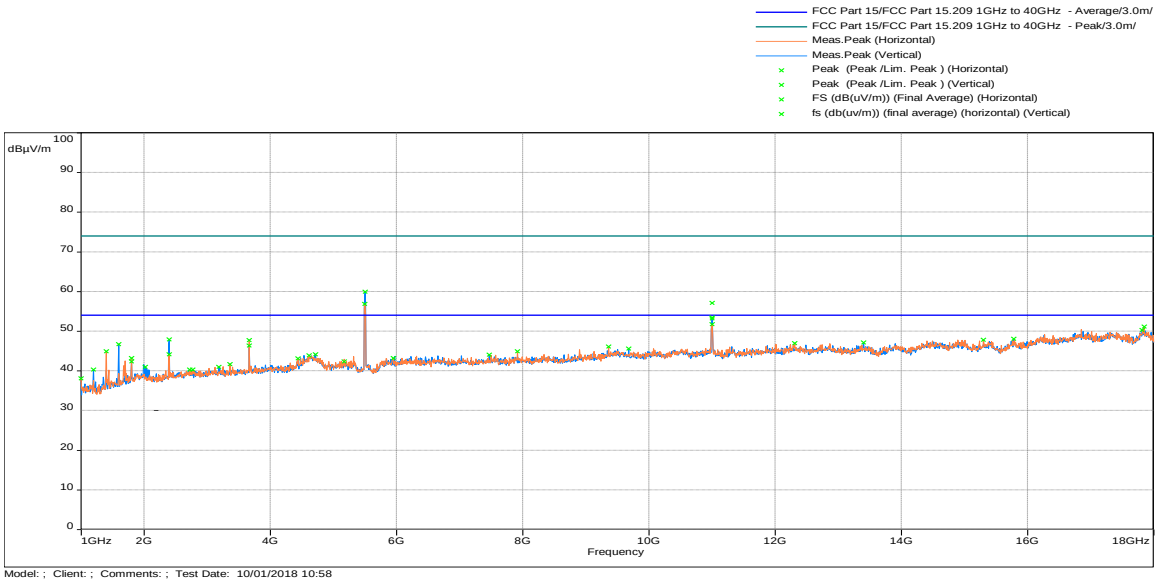
Out-of-Band Radiated Spurious Emissions (Charge Mode)

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5500MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



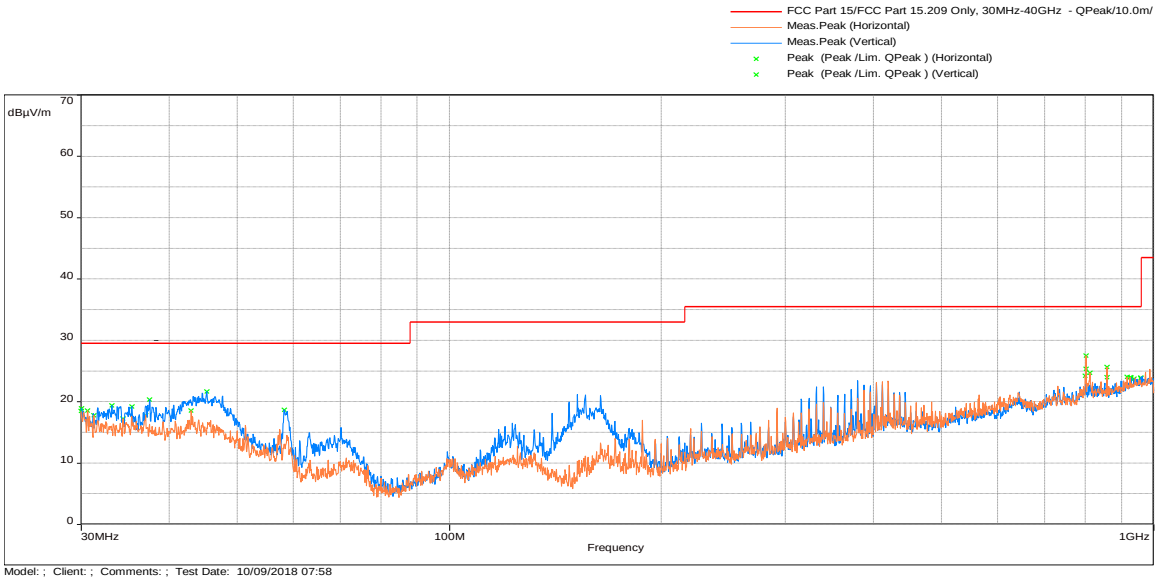
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



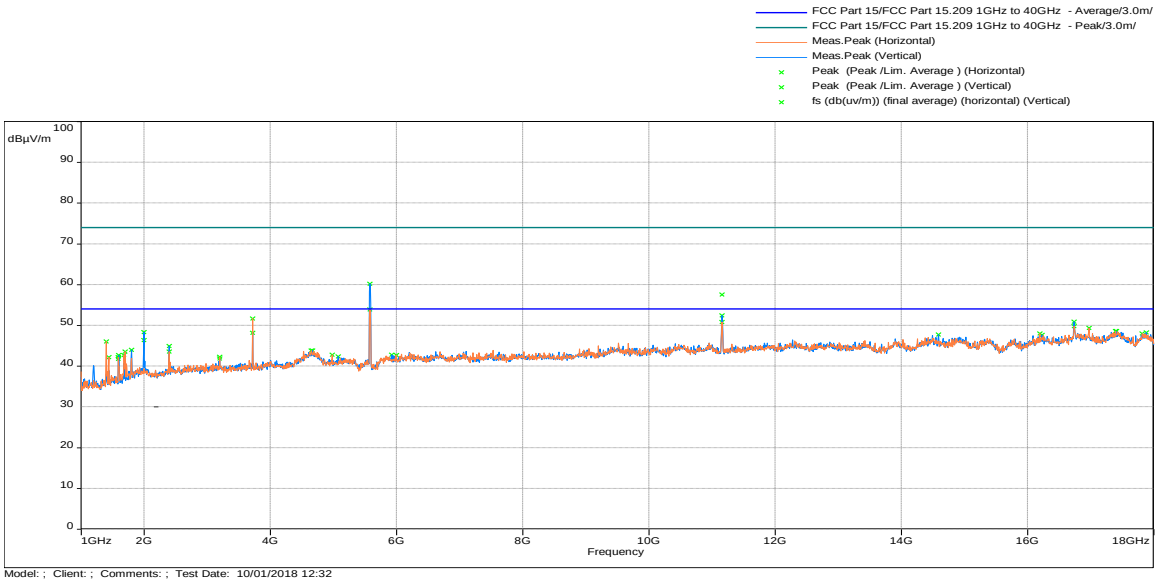
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
10998.83	Avg	43.49	54	-10.51	304	2.01	Vertical	-2.97
11002.80	Avg	50.18	54	-3.82	237	3.56	Horizontal	-2.98

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5580MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



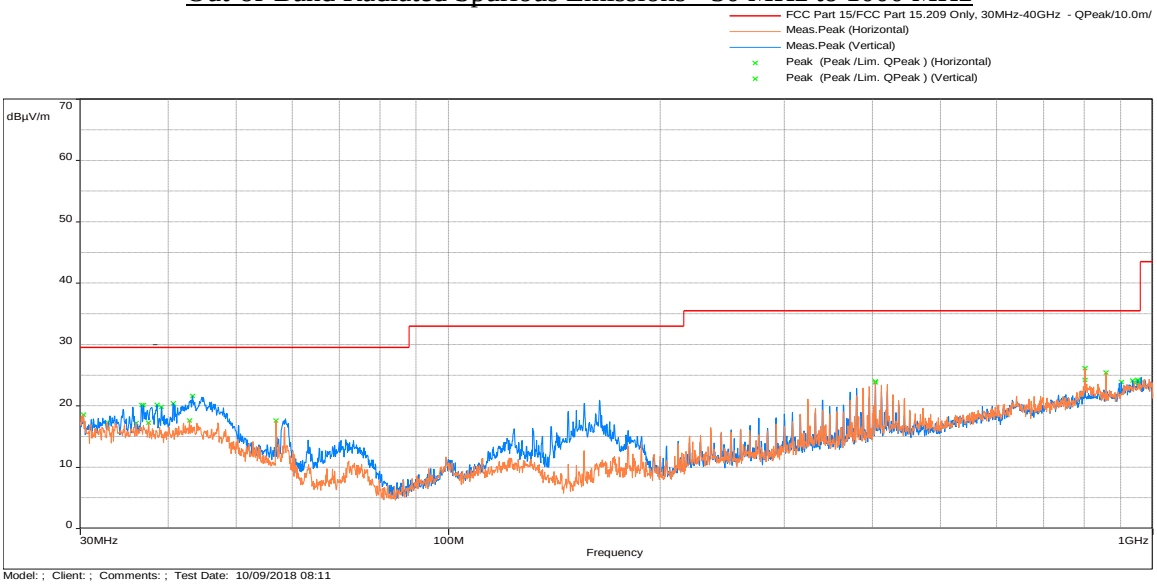
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



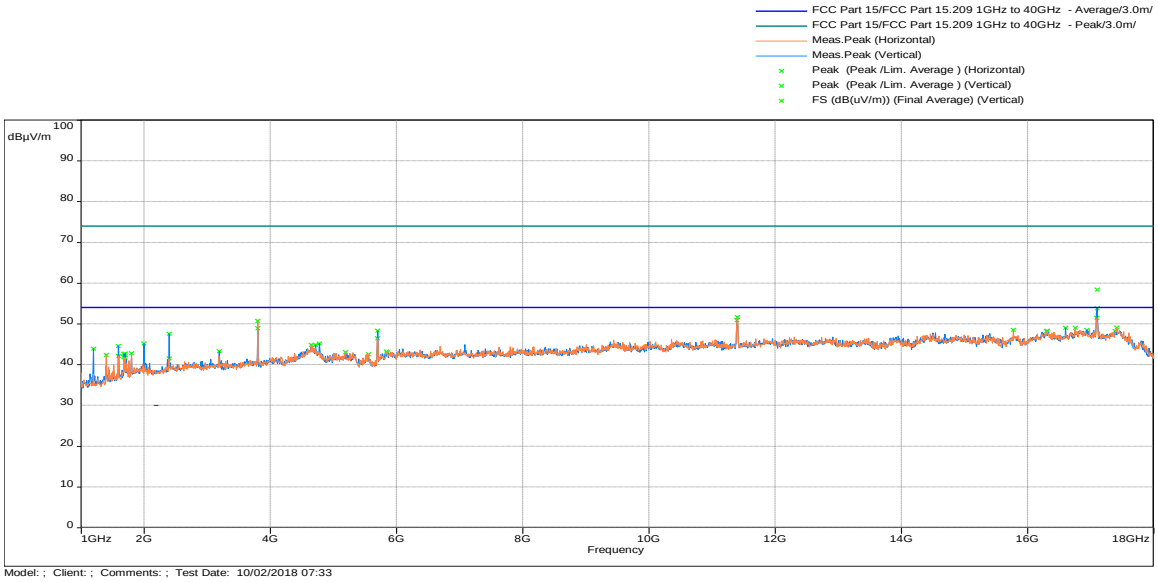
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
3720.00	Peak	51.64	54	-2.36	78	1.32	Horizontal	-10.94
11158.86	Avg	45.48	54	-8.52	306	2.21	Vertical	-3.32

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5700MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



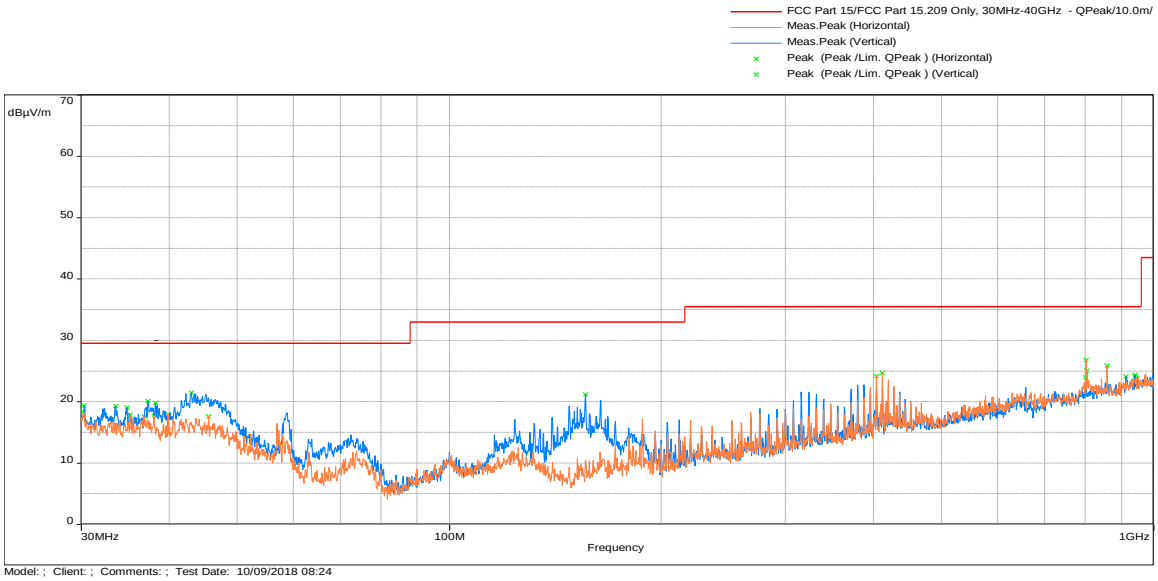
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



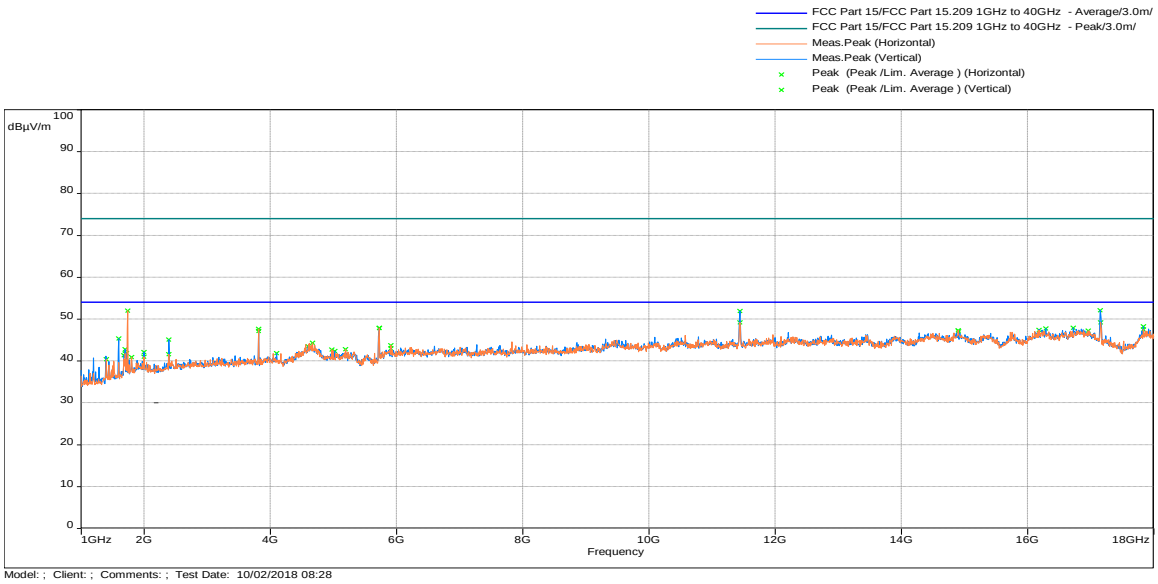
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
17102.88	Peak	58.38	74	15.62	308	1.32	Vertical	5.47
17102.88	Avg	42.69	54	-11.31	308	1.32	Vertical	5.47

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5720MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

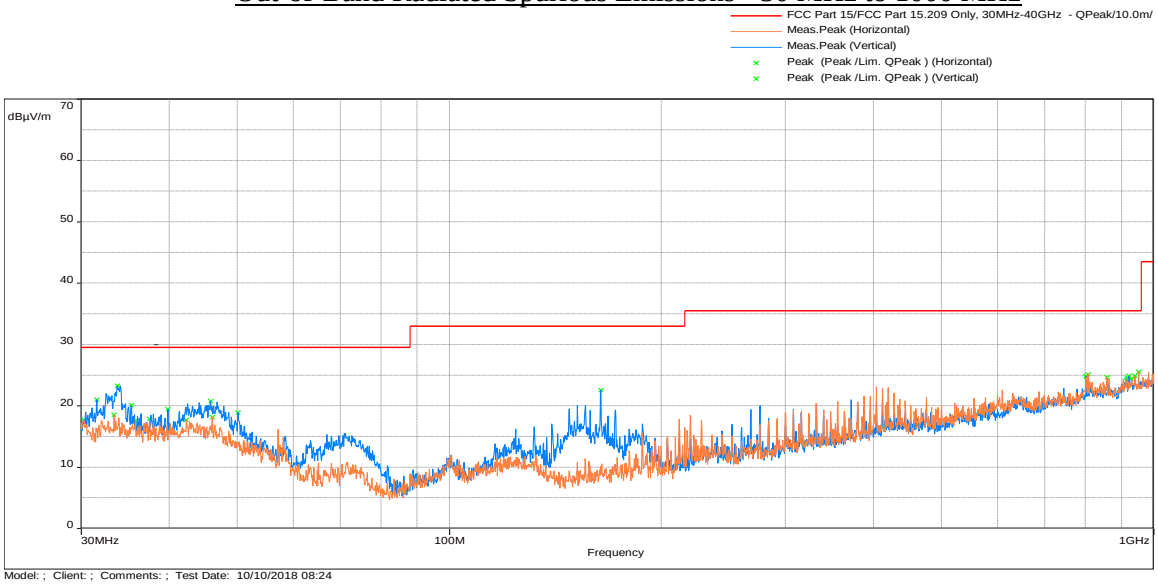


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

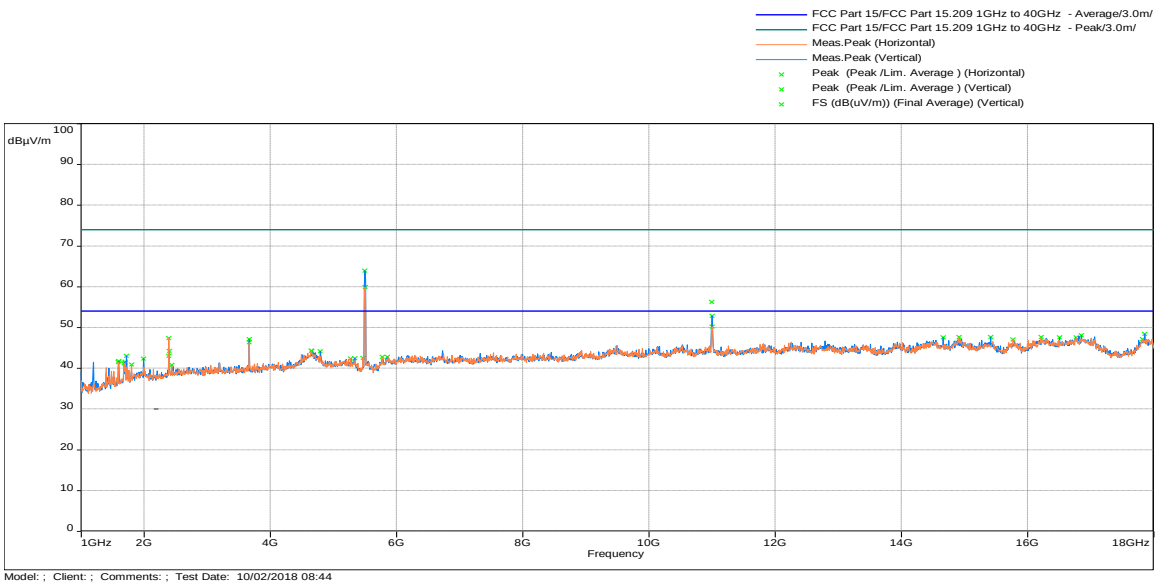


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5500MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



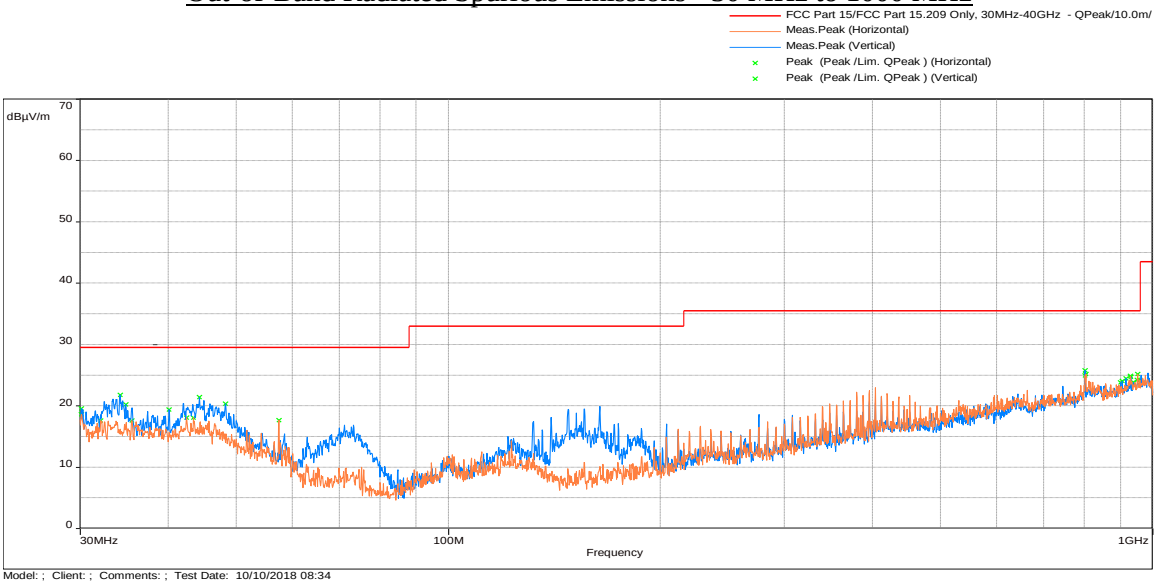
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



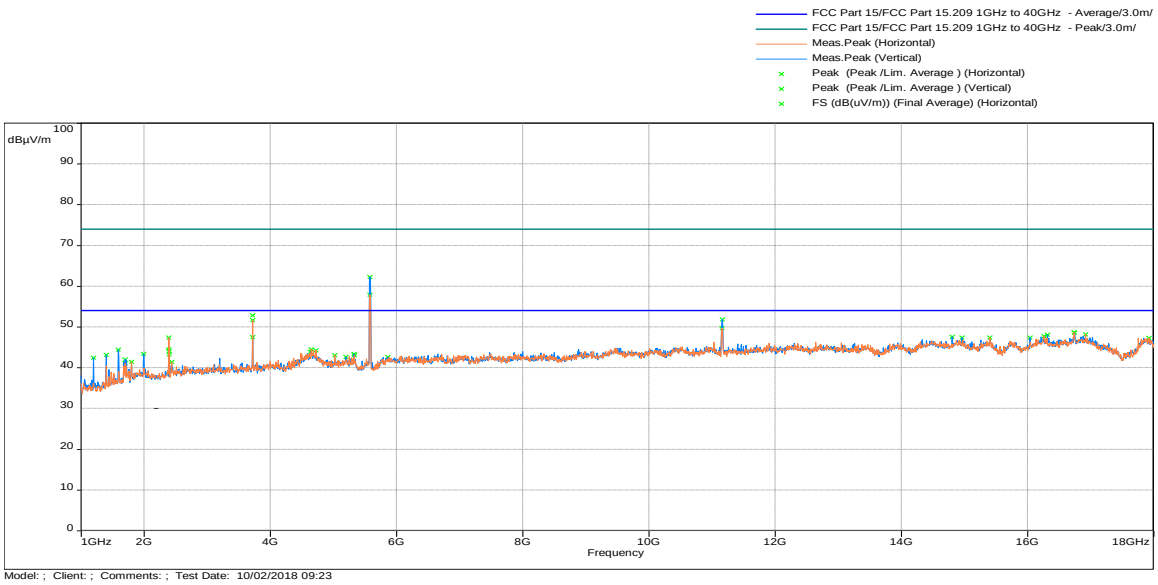
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
10998.43	Peak	56.26	74	-17.74	314	1.96	Vertical	-2.97
10998.43	Avg	44.23	54	-9.77	314	1.96	Vertical	-2.97

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5580MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



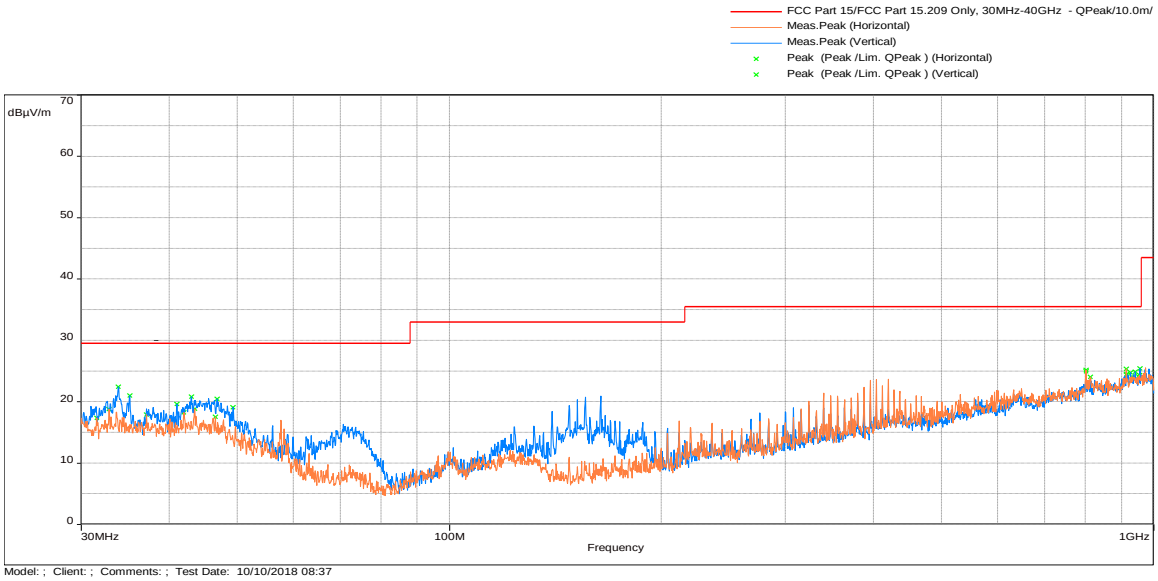
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



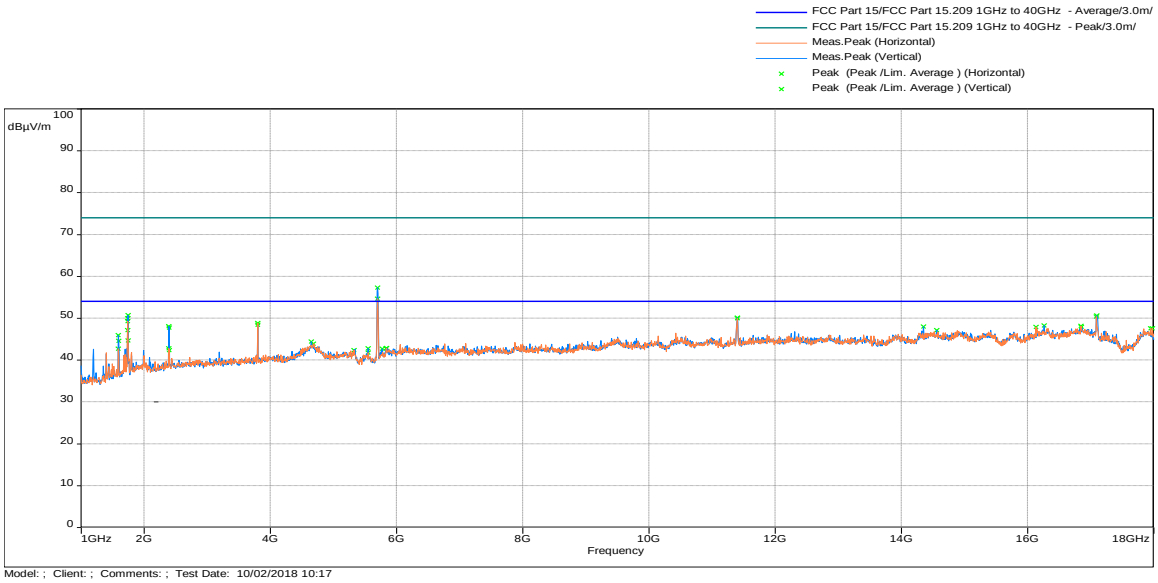
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
3720.02	Peak	52.79	54	-1.21	55	1.39	Horizontal	-10.95
11162.60	Peak	51.77	54	-2.23	314	1.75	Vertical	-3.33

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5700MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

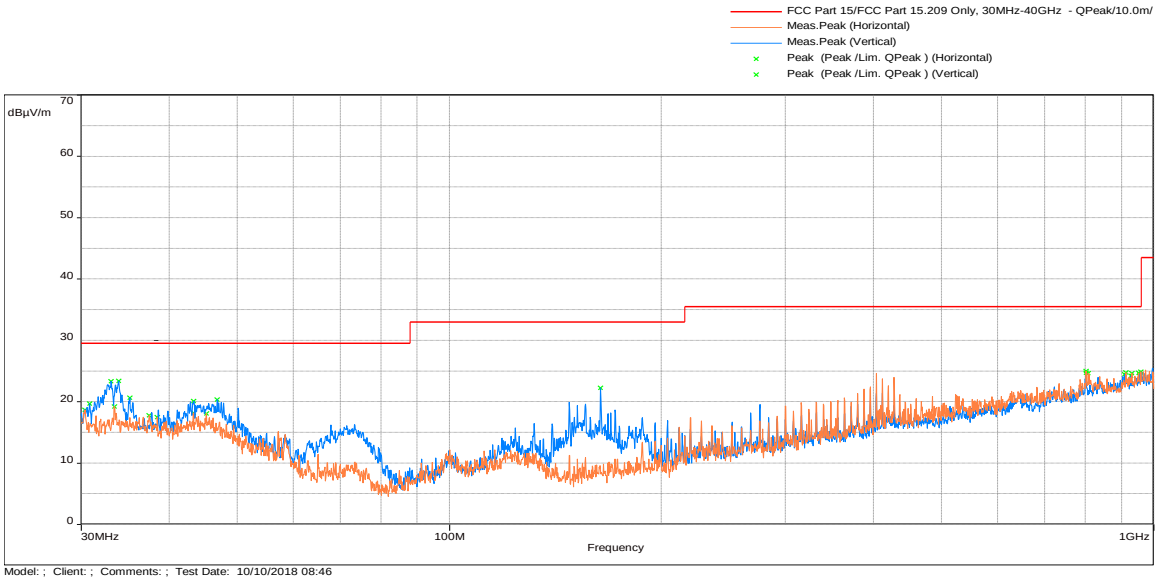


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

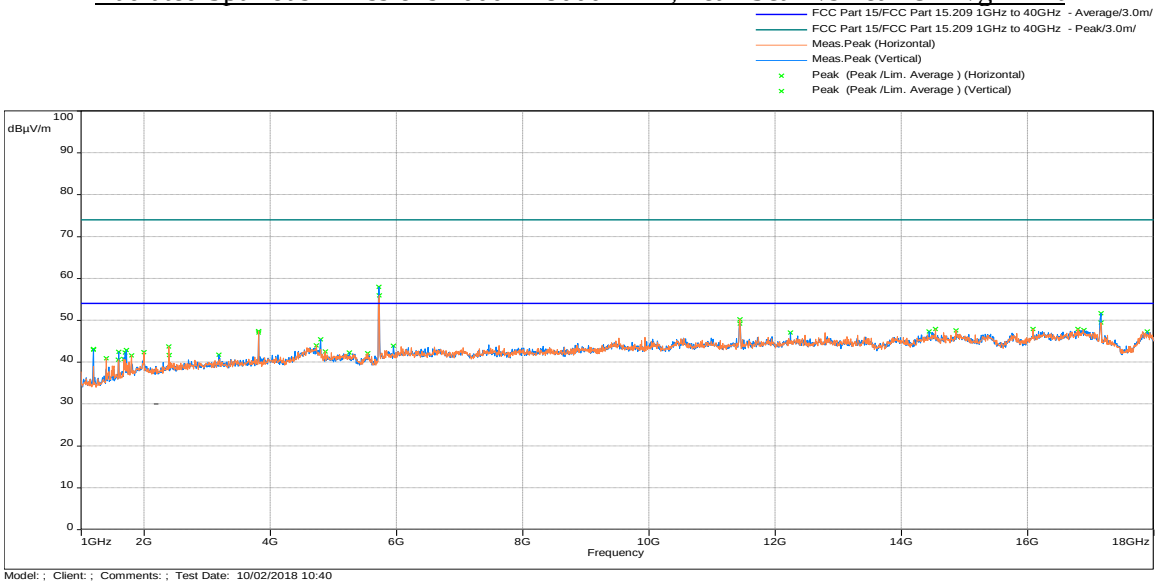


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5720MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

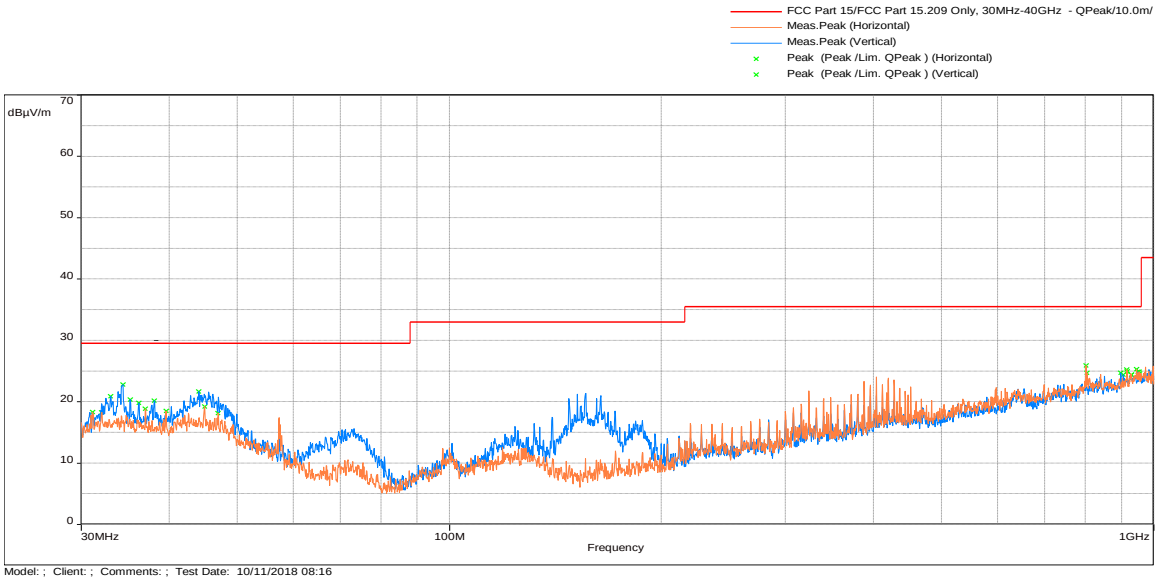


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

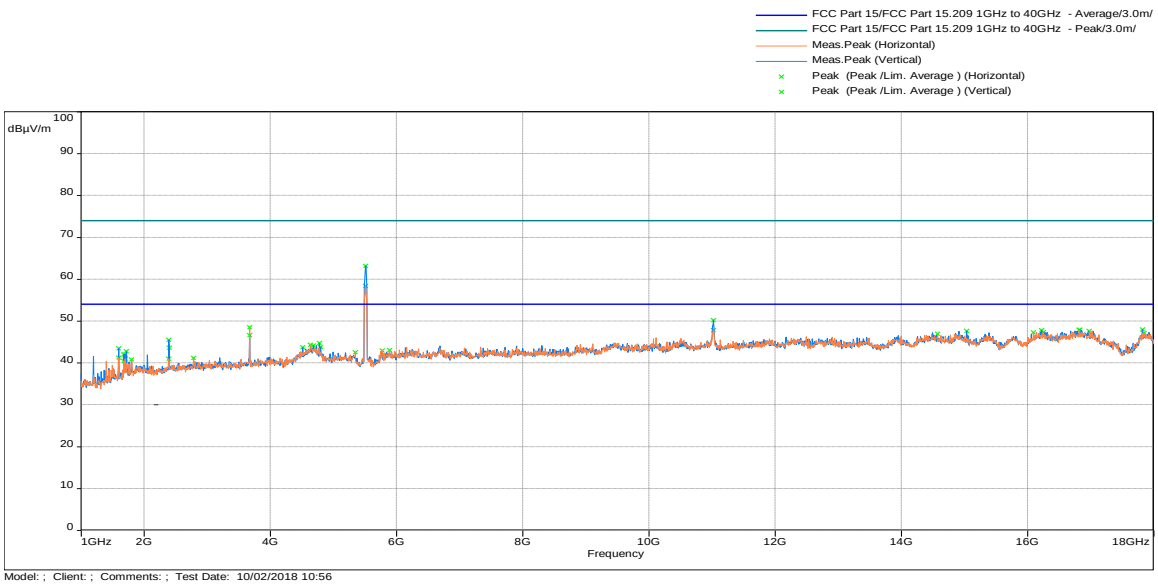


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5510MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

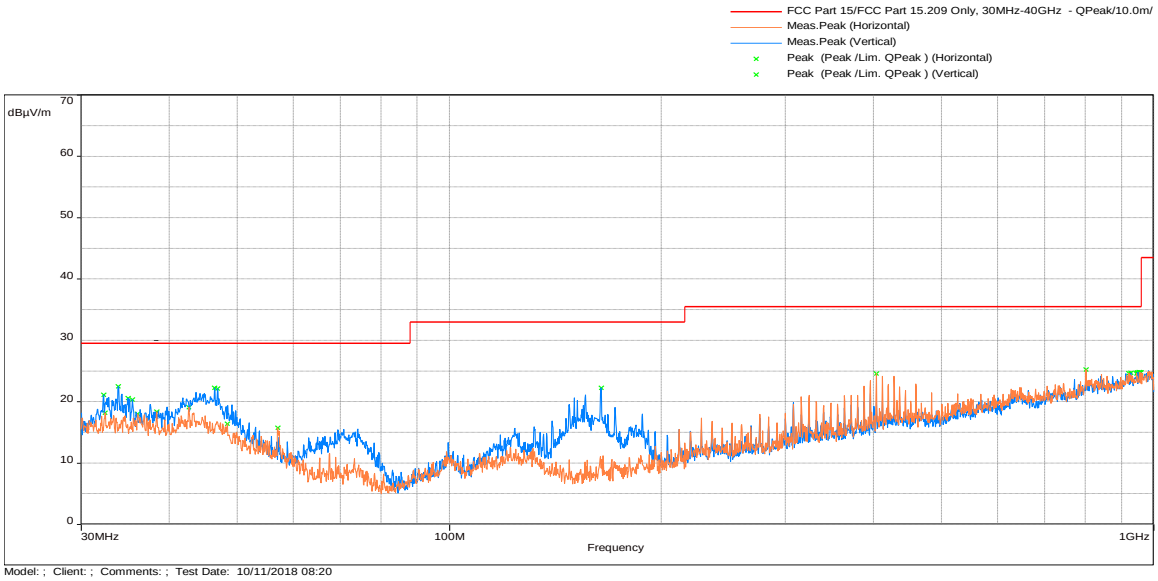


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

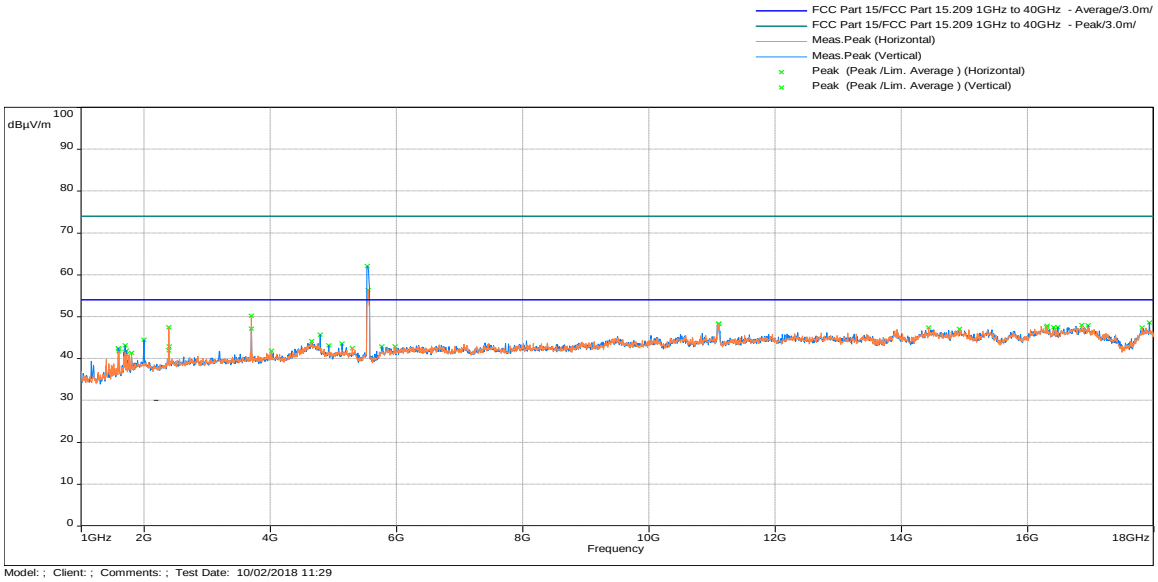


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5550MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

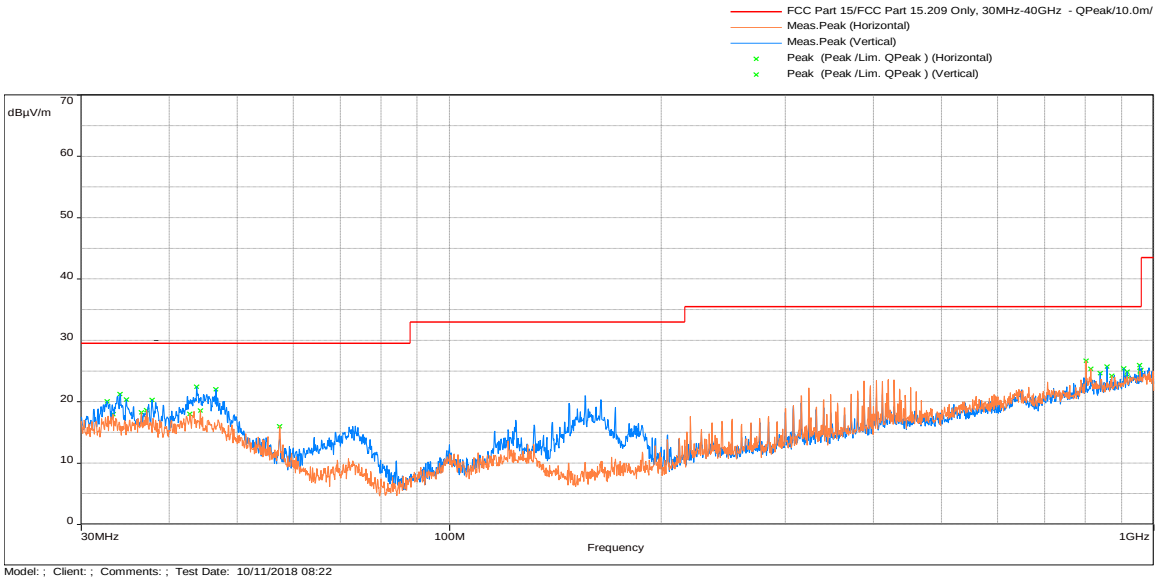


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

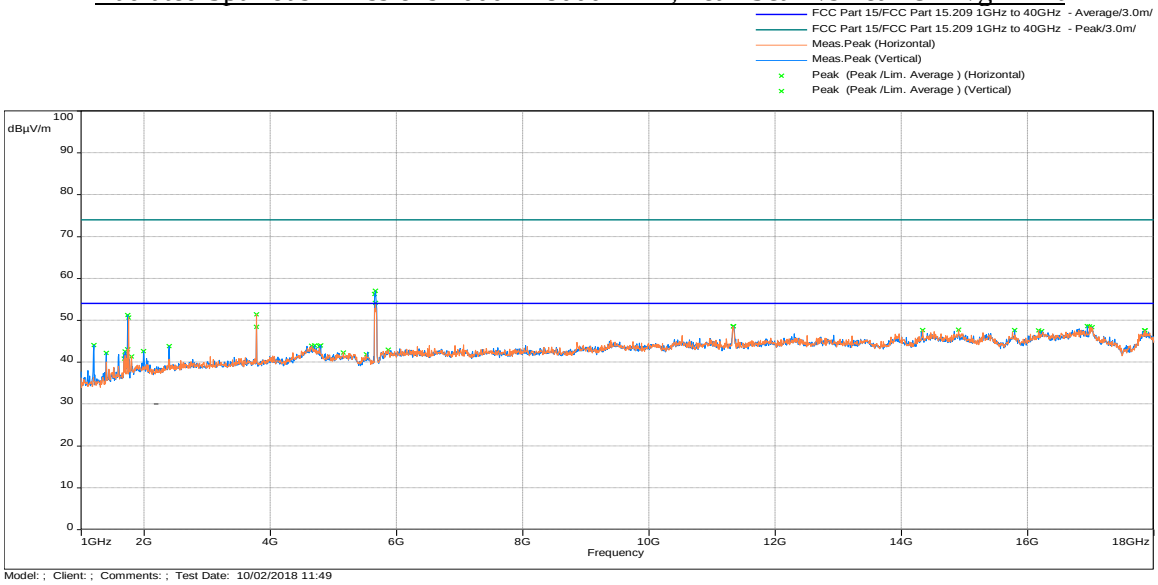


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5670MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

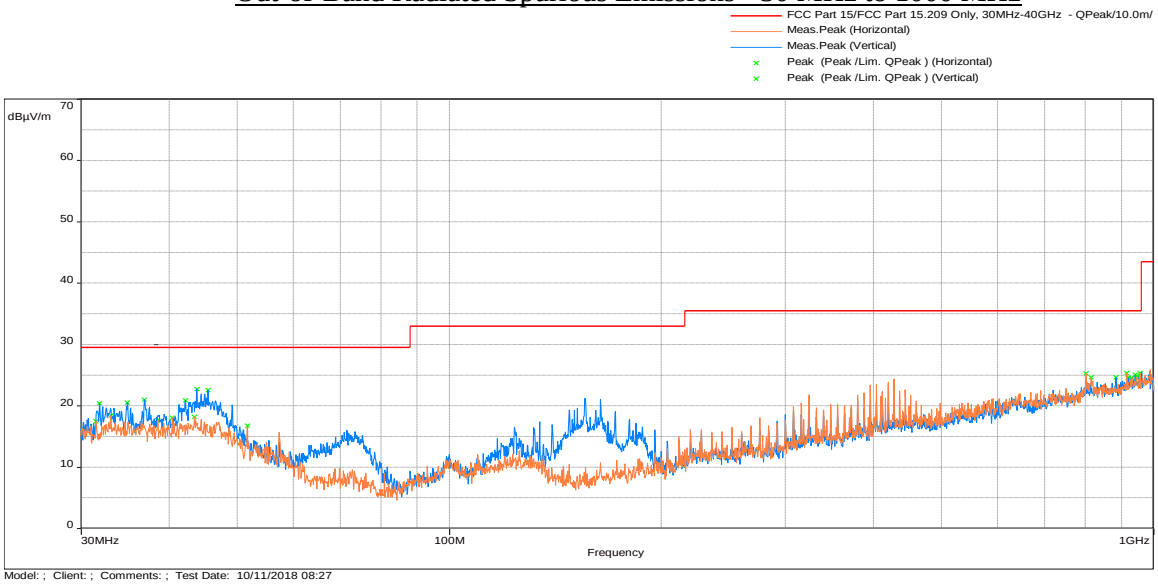


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



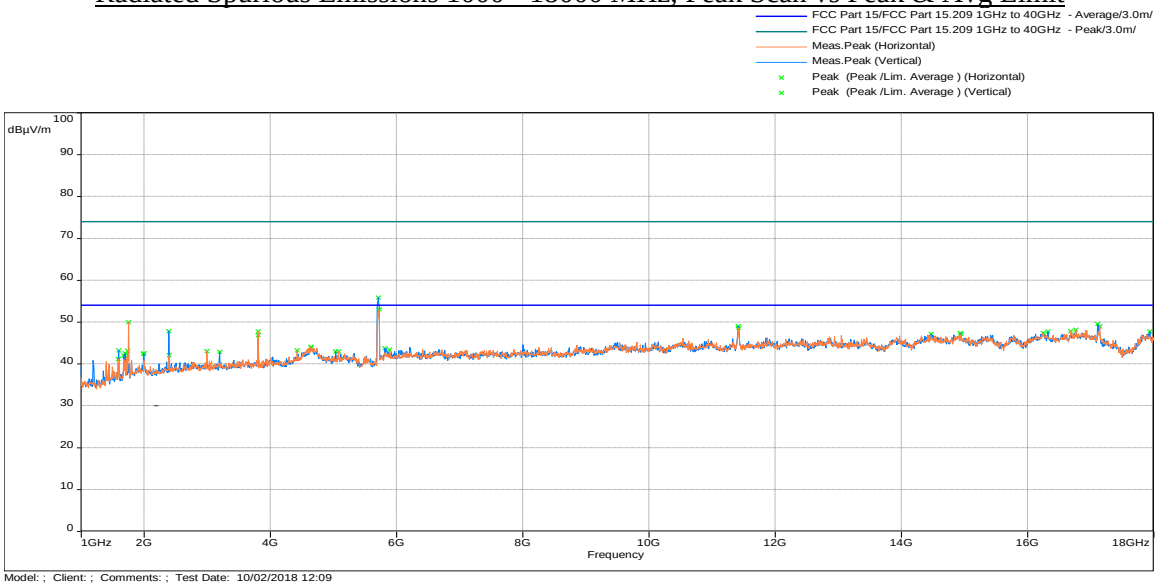
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5710MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



Model: ; Client: ; Comments: ; Test Date: 10/11/2018 08:27

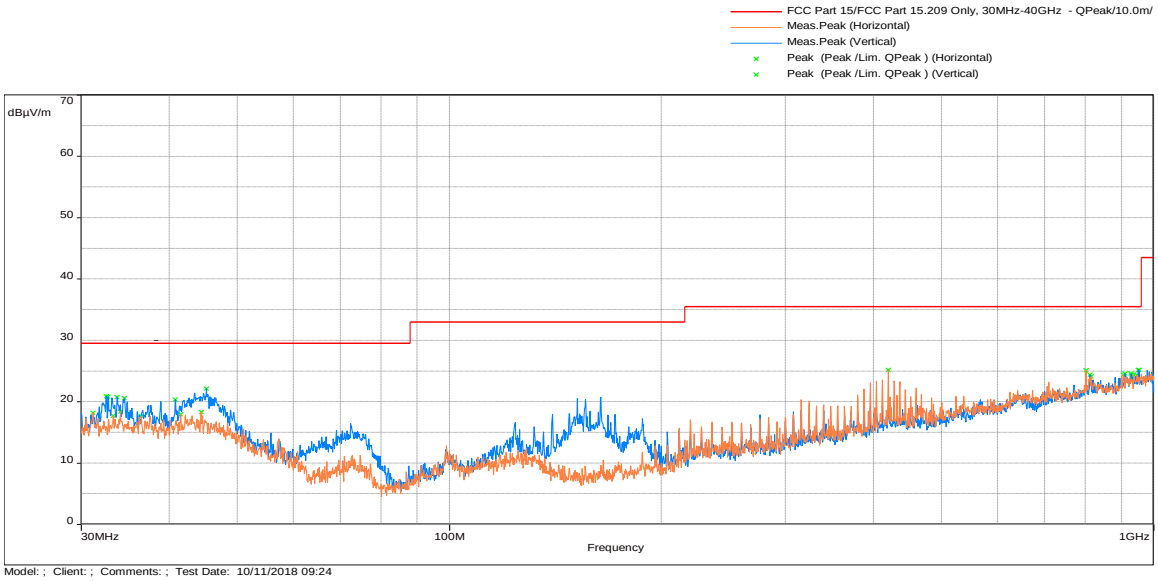
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



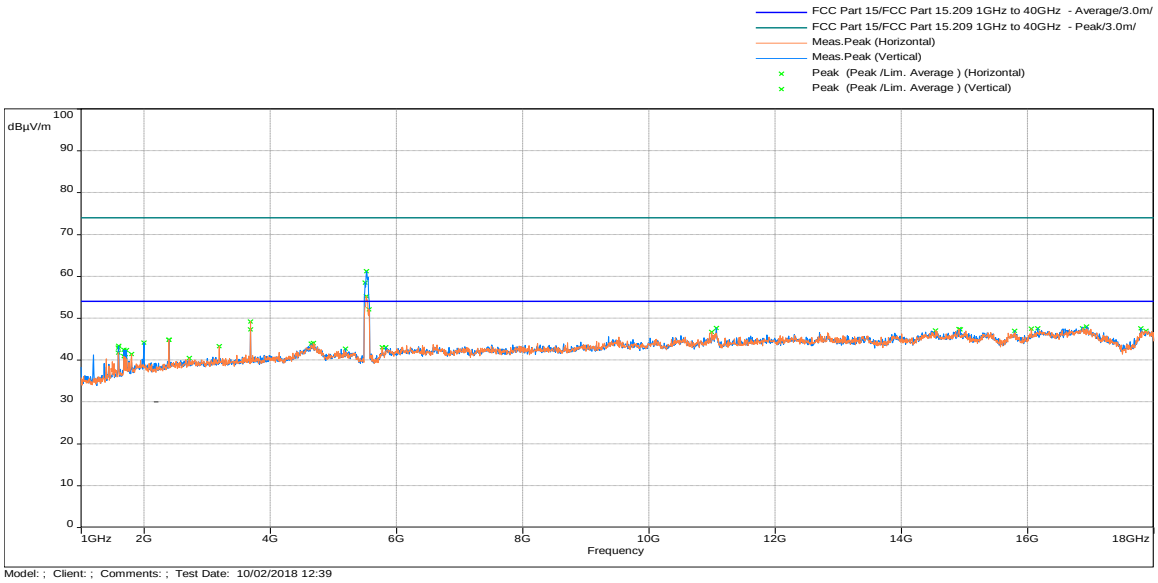
Model: ; Client: ; Comments: ; Test Date: 10/02/2018 12:09

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5530MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

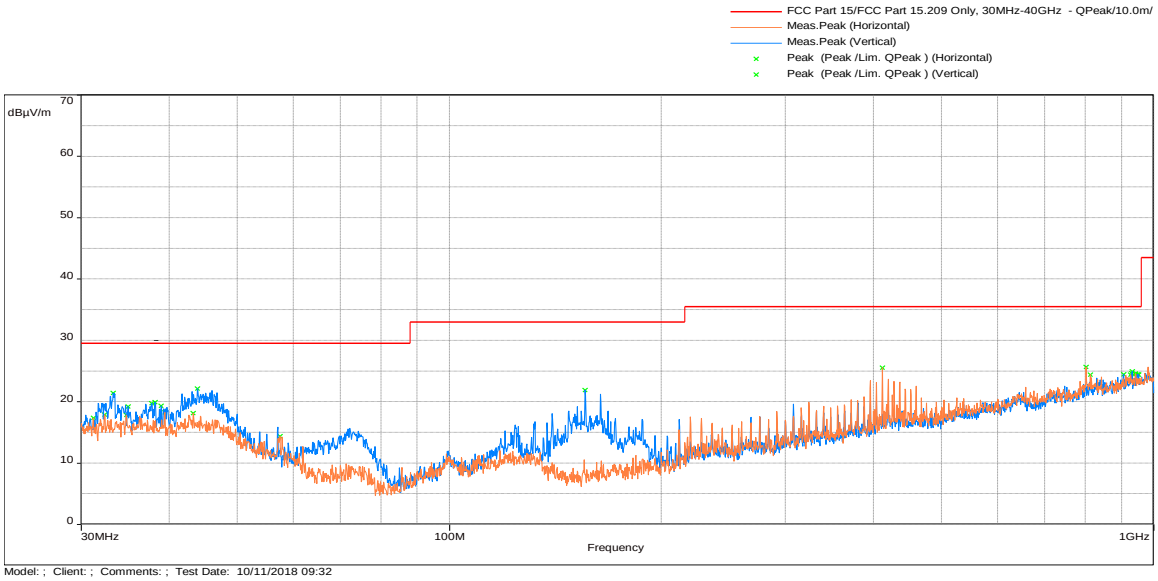


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

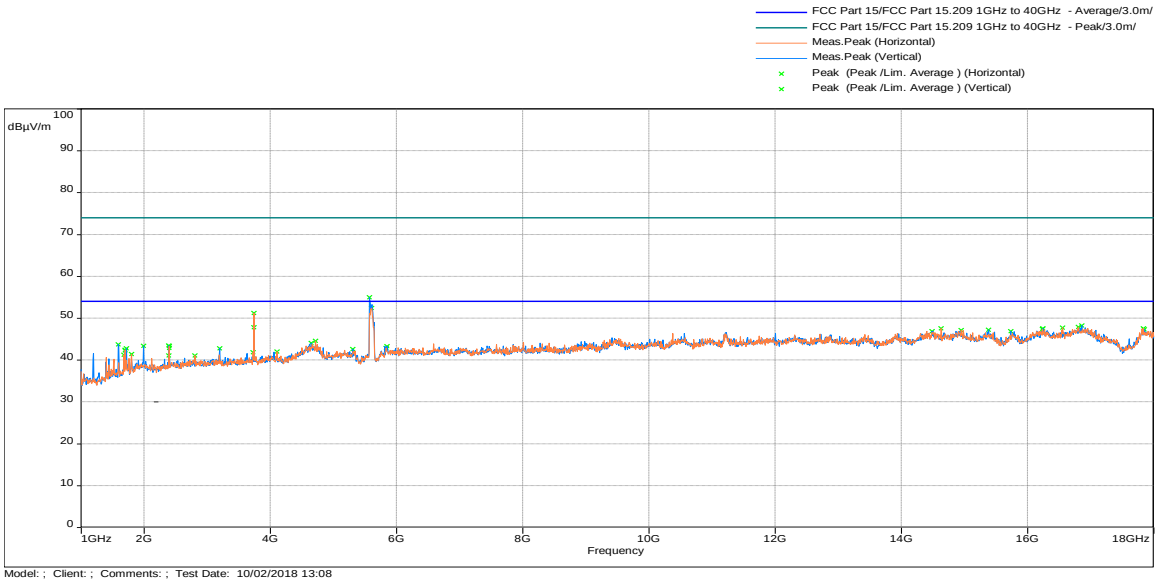


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5610MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

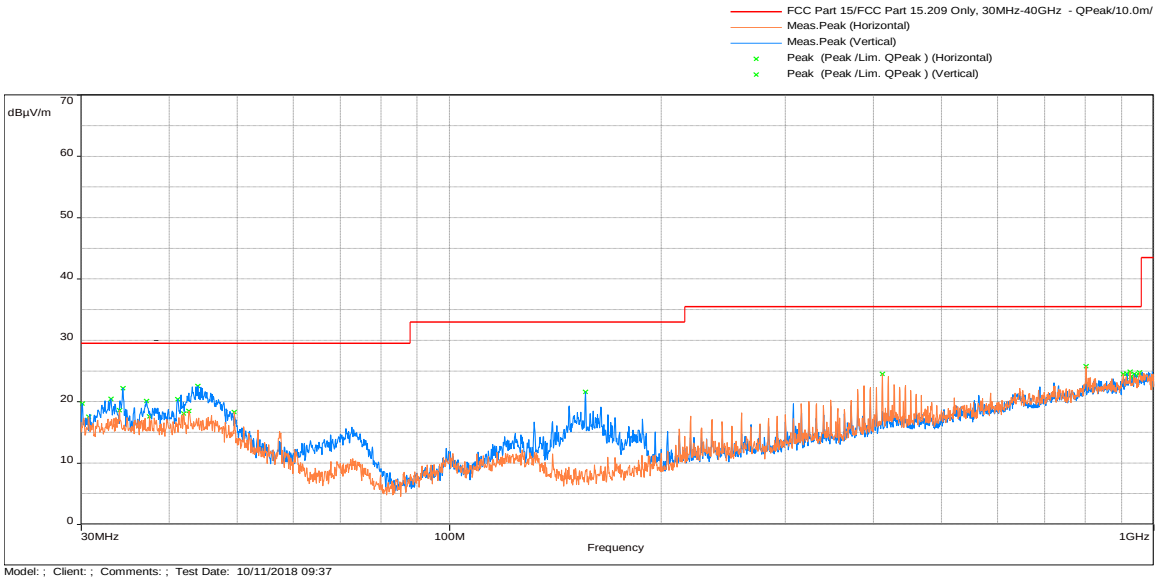


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

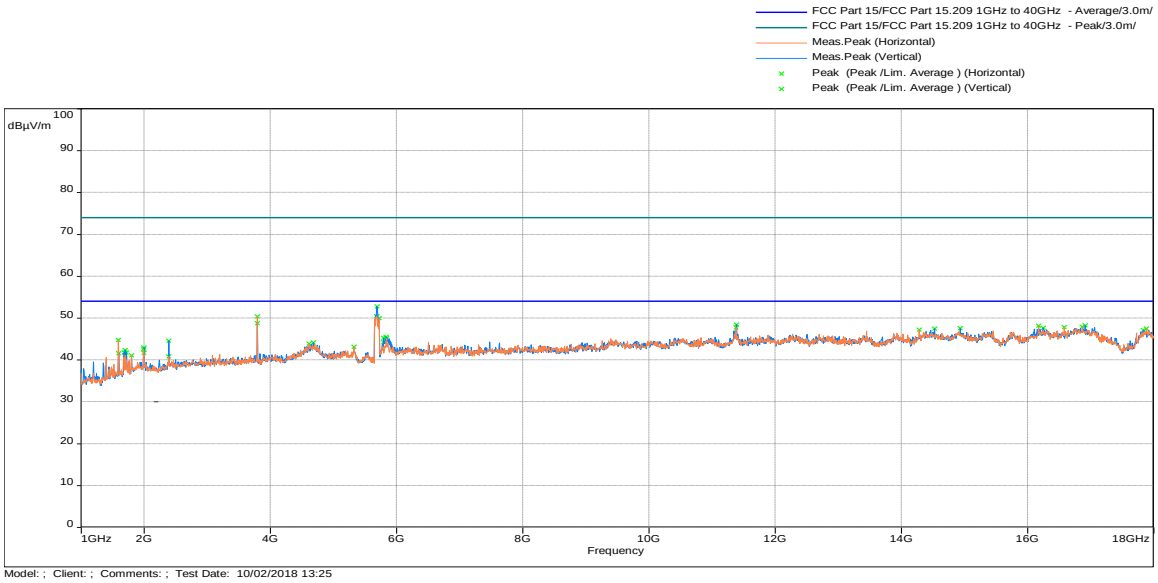


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5690MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

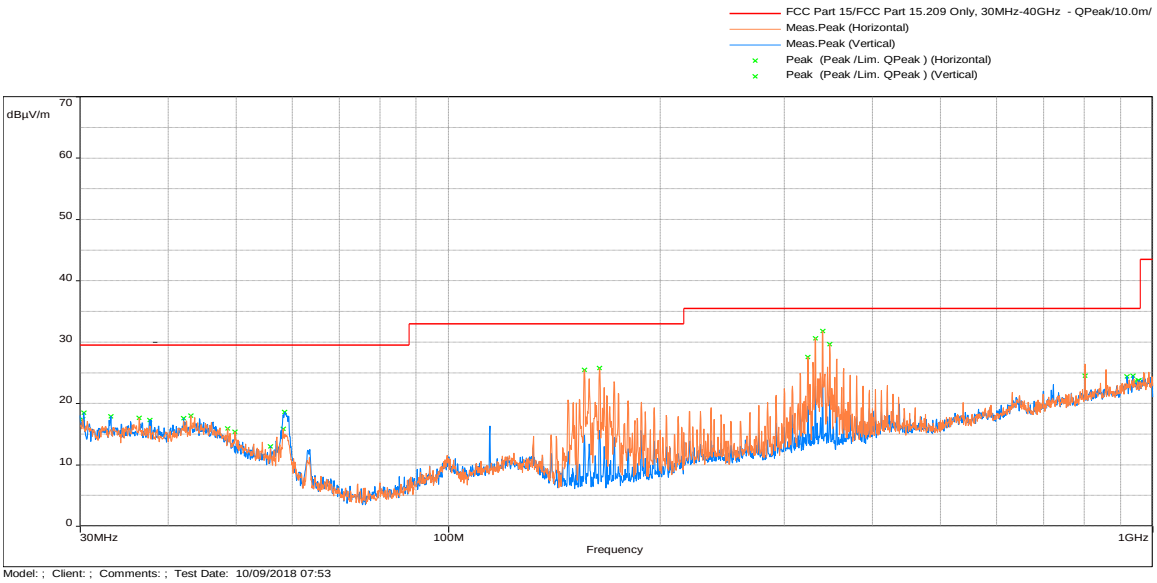


Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
3793.10	Peak	50.33	54	-3.67	70	1.39	Horizontal	-10.65
11390.40	Peak	48.41	54	-5.59	302	1.65	Vertical	-3.66

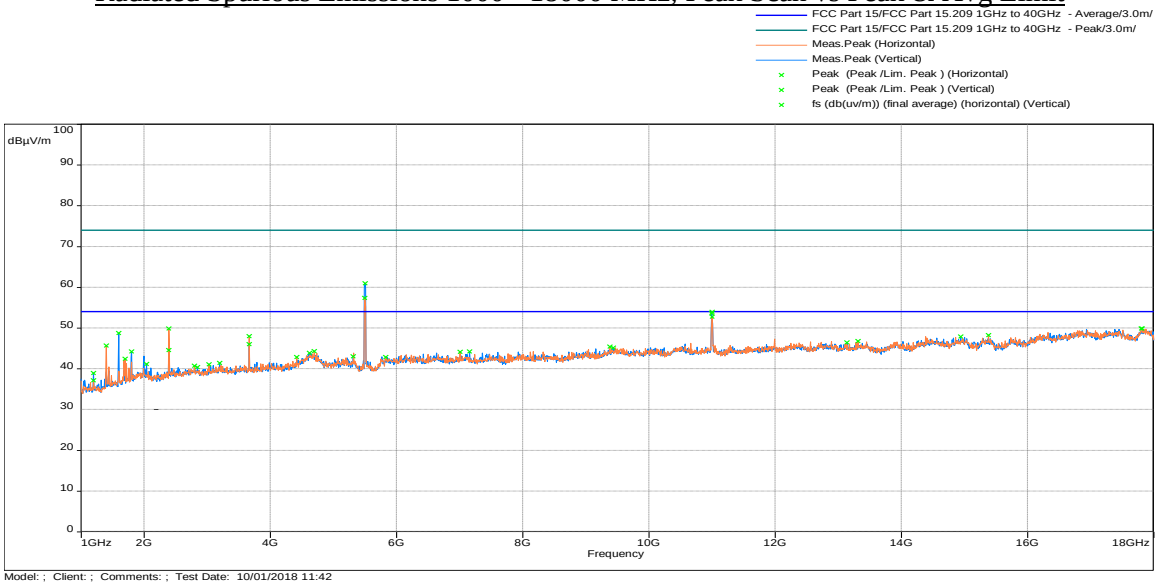
Out-of-Band Radiated Spurious Emissions (Normal Mode)

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5500MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



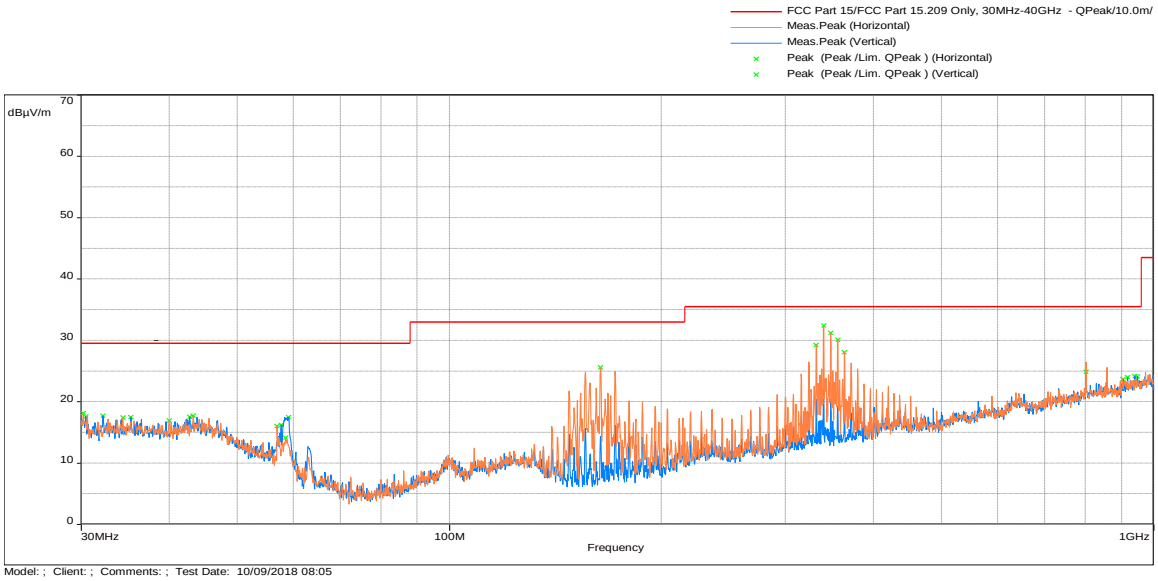
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



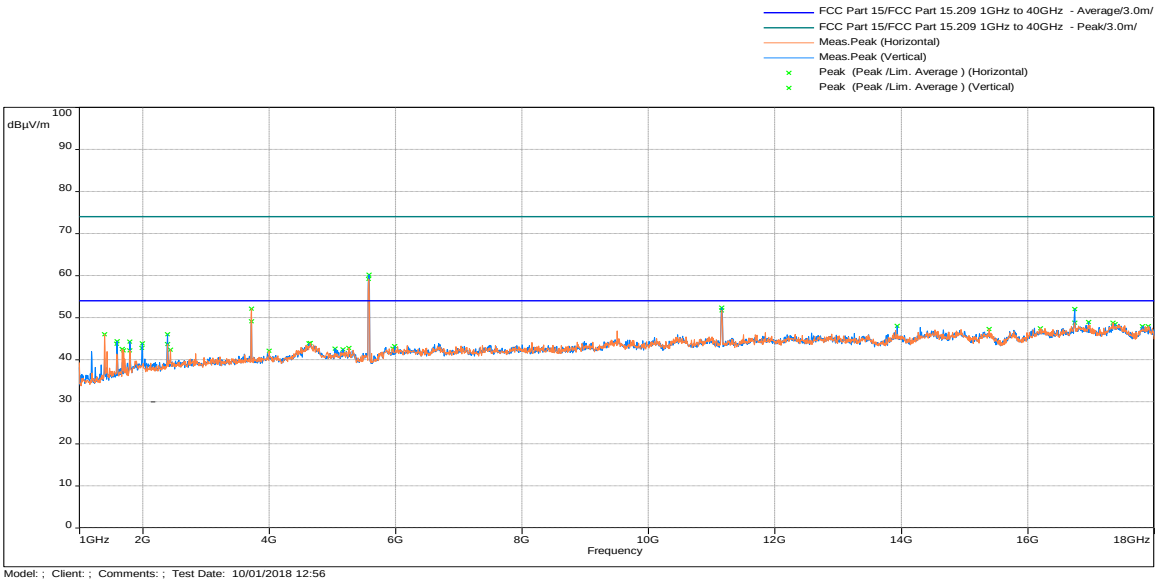
Frequency	Detector	FS@3m	Limit@3m	Margin	Azimuth	Height	Polarity	Correction
MHz		dBuV/m	dBuV/m	(dB)	(deg)	(m)		dB
10998.83	Avg	40.63	54	-13.37	269	2.88	Vertical	-2.97

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5580MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



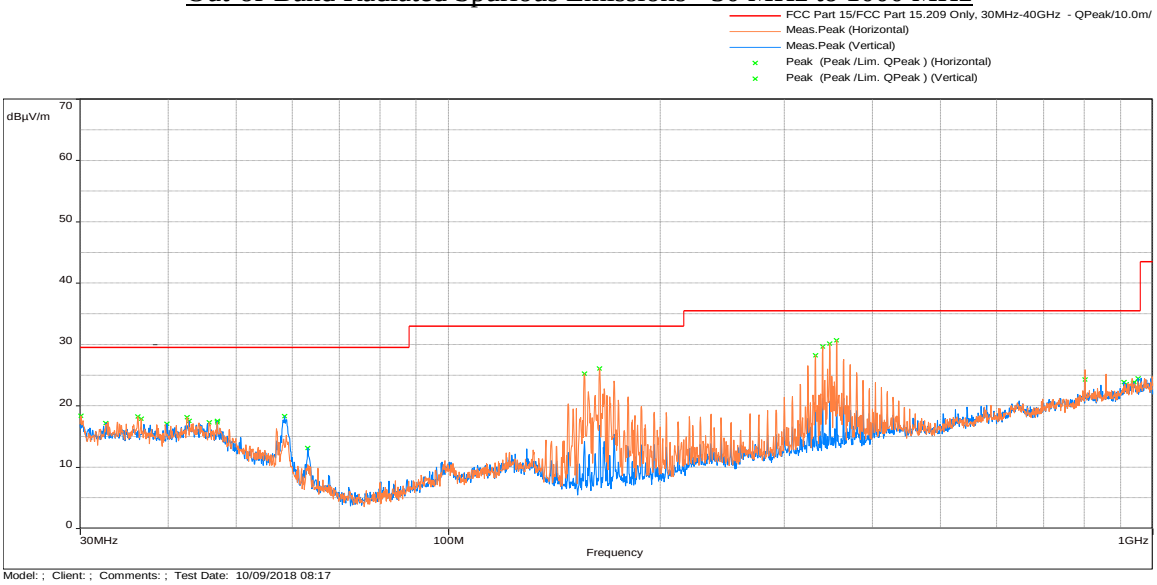
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



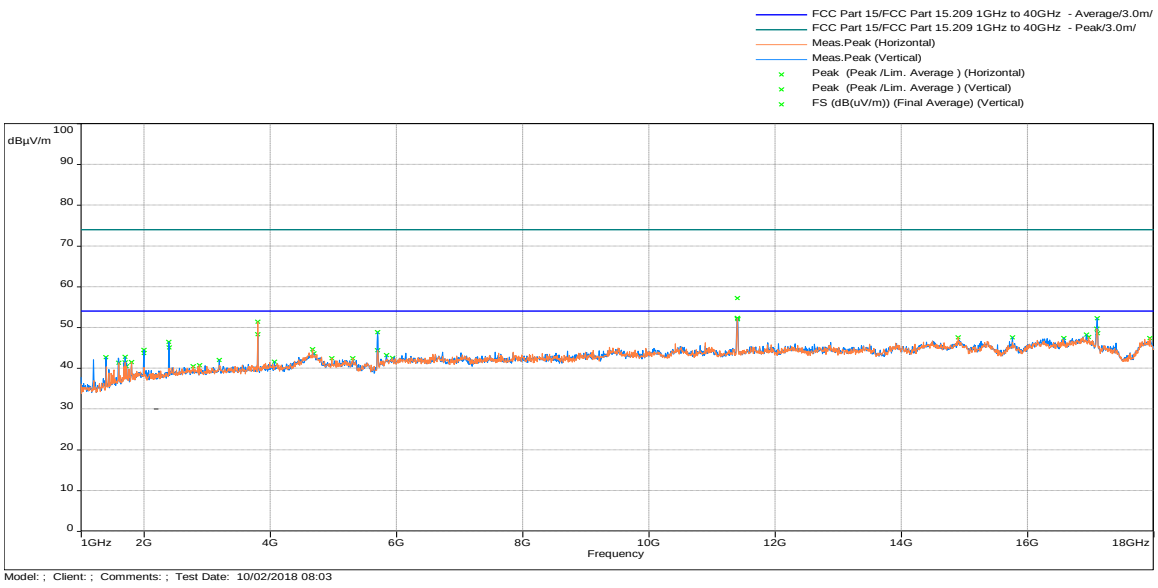
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
3720.00	Peak	52.12	54	-1.88	52	1.33	Vertical	-10.94
11160.90	Peak	52.33	54	-1.67	312	1.80	Vertical	-3.32
16742.00	Peak	52.03	54	-1.97	15	1.67	Vertical	5.38

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5700MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



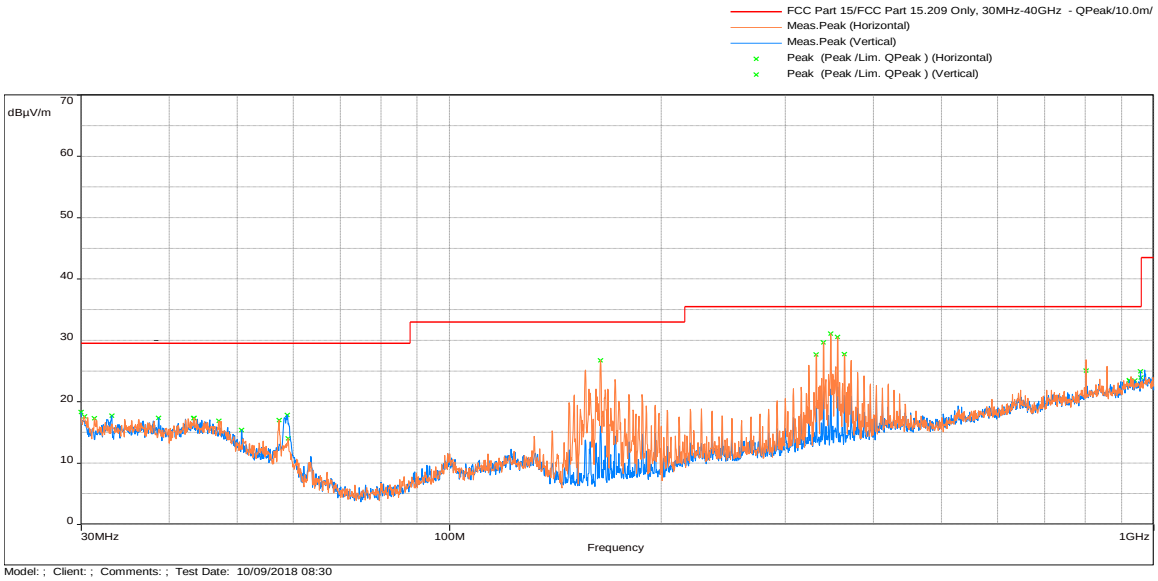
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



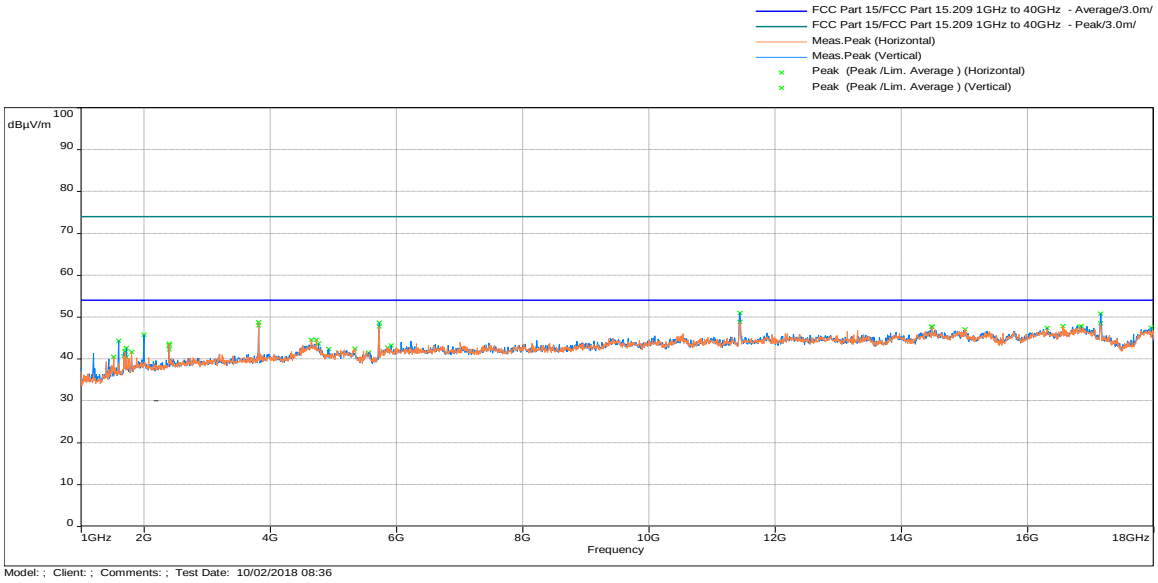
Frequency	Detector	FS@3m	Limit@3m	Margin	Azimuth	Height	Polarity	Correction
MHz		dBuV/m	dBuV/m	(dB)	(deg)	(m)		dB
11398.83	Peak	57.19	74	-16.81	321	2.33	Vertical	-3.65
11398.83	Avg	46.25	54	-7.75	321	2.33	Vertical	-3.65

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5720MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

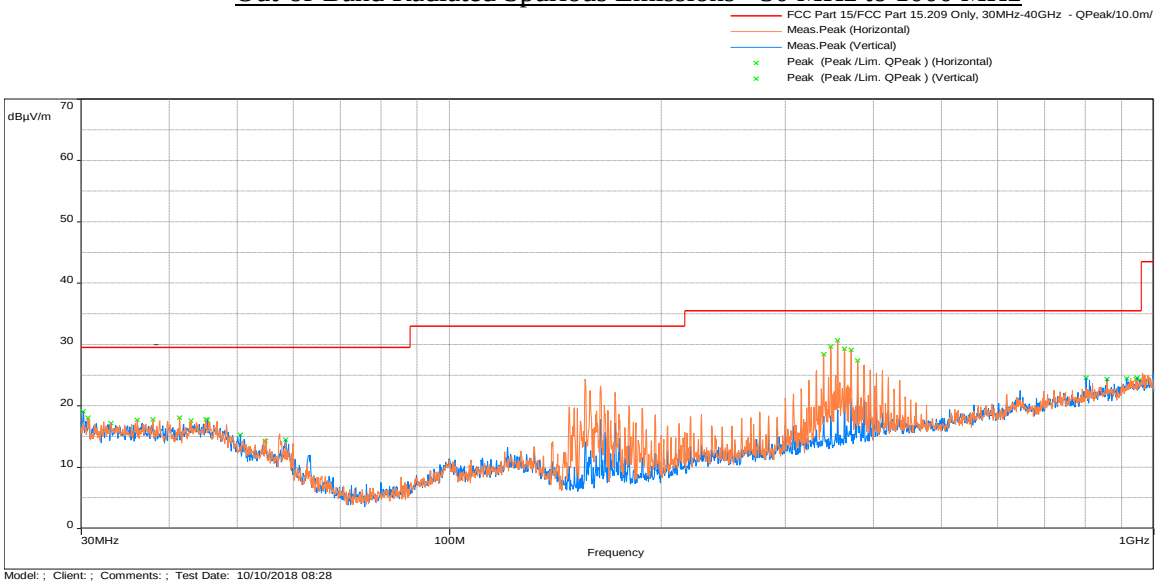


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

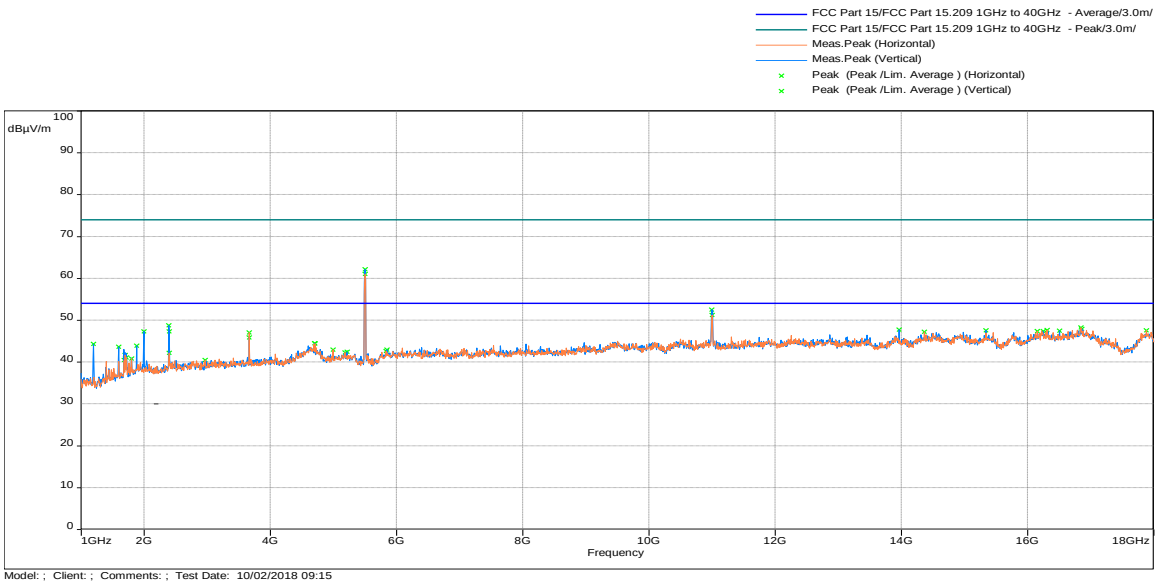


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5500MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

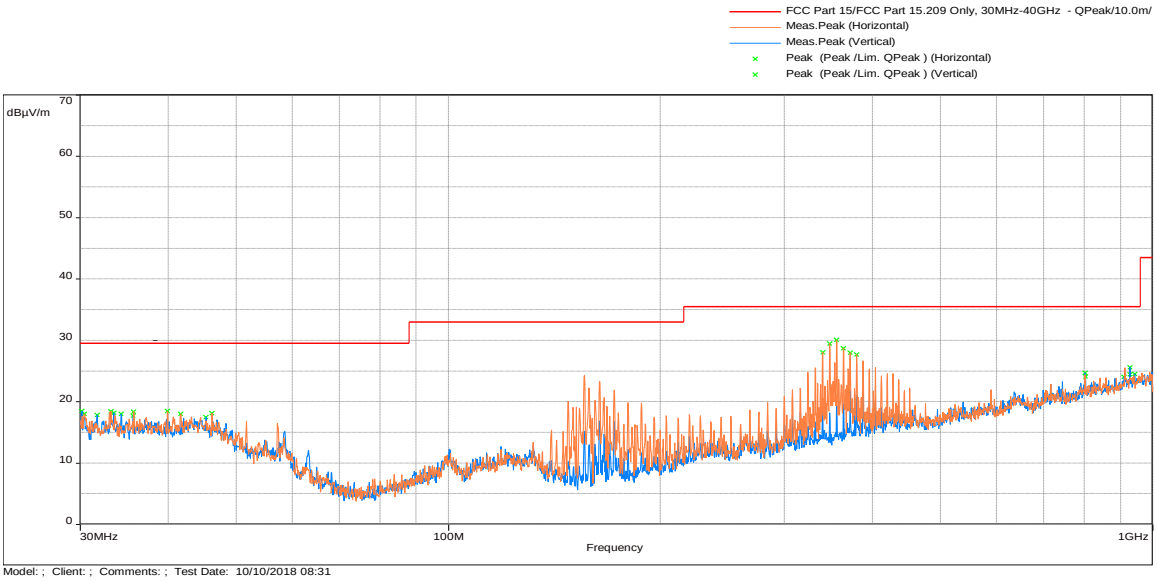


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

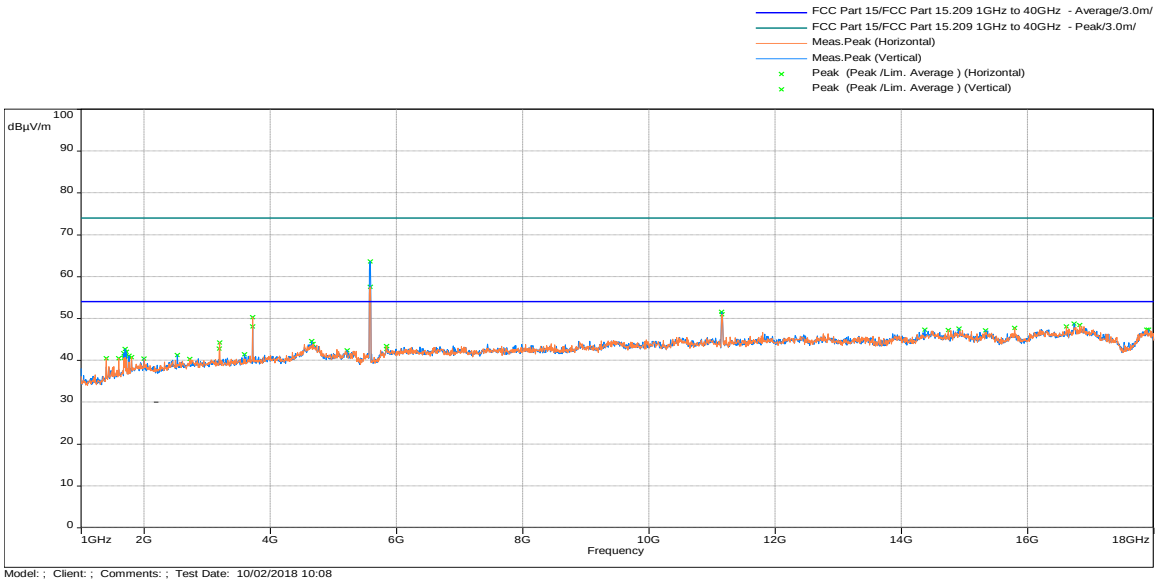


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5580MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

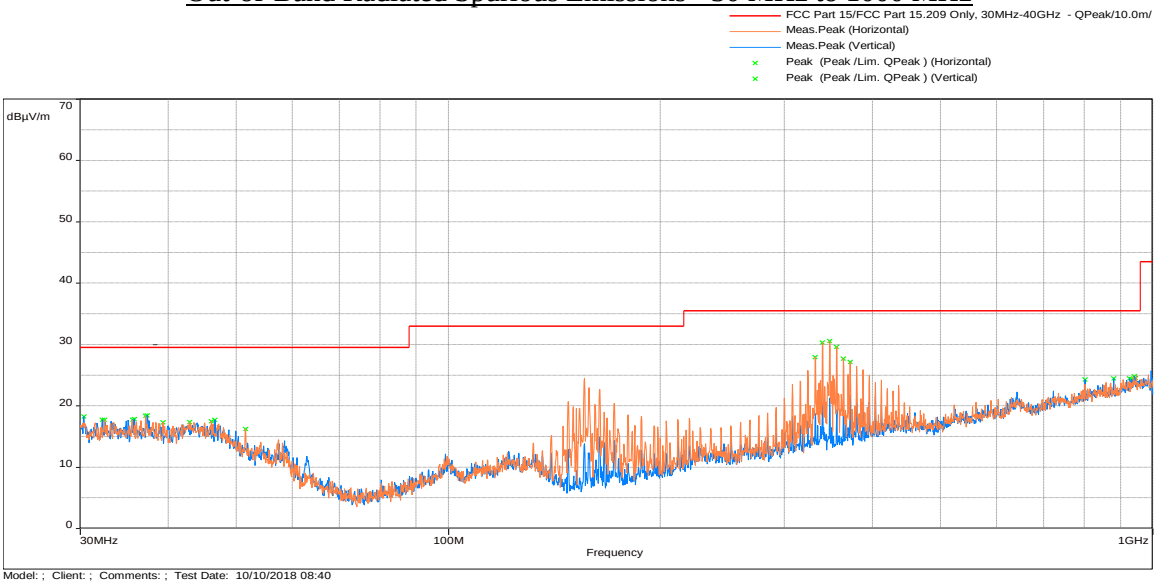


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

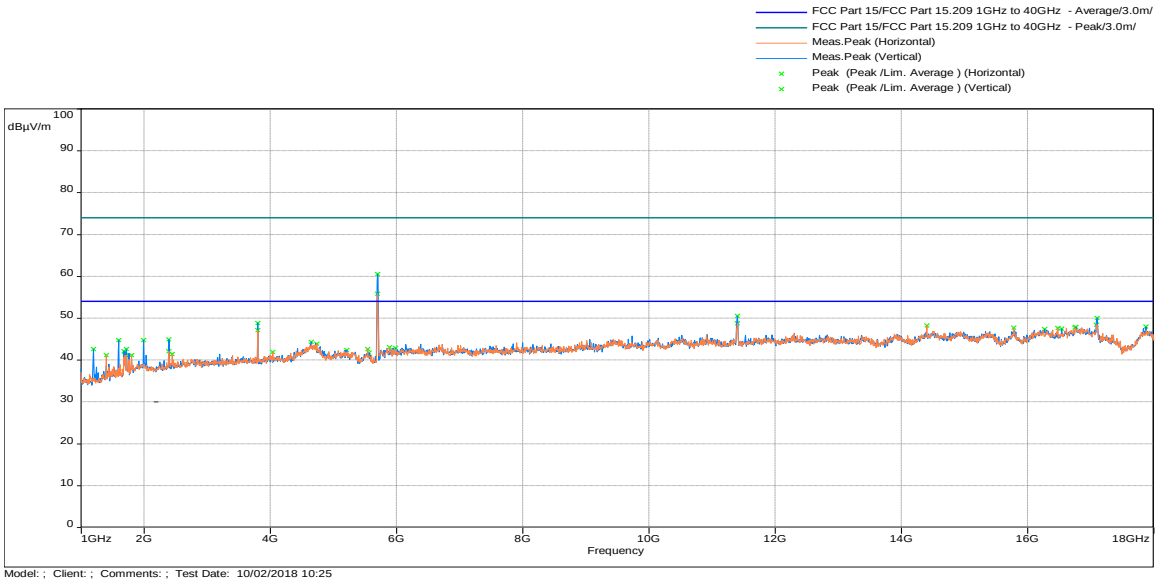


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5700MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

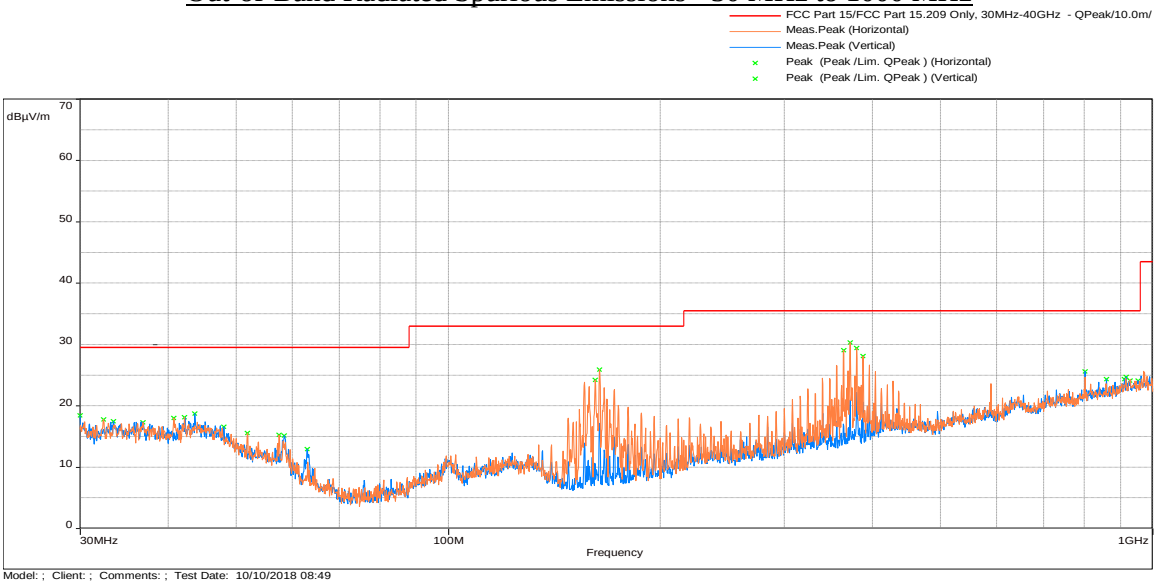


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

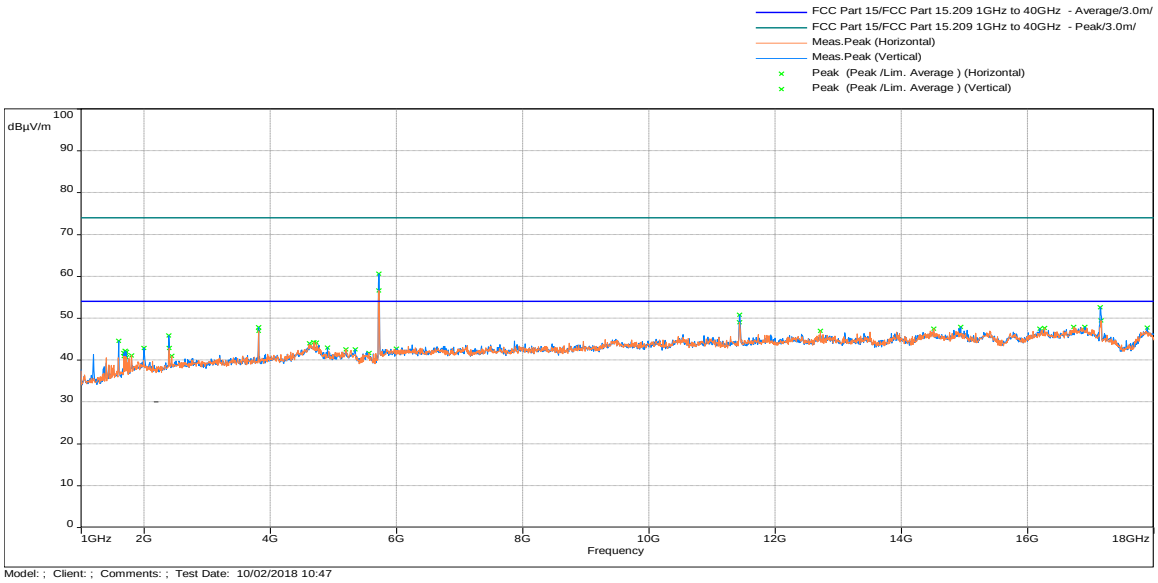


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5720MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

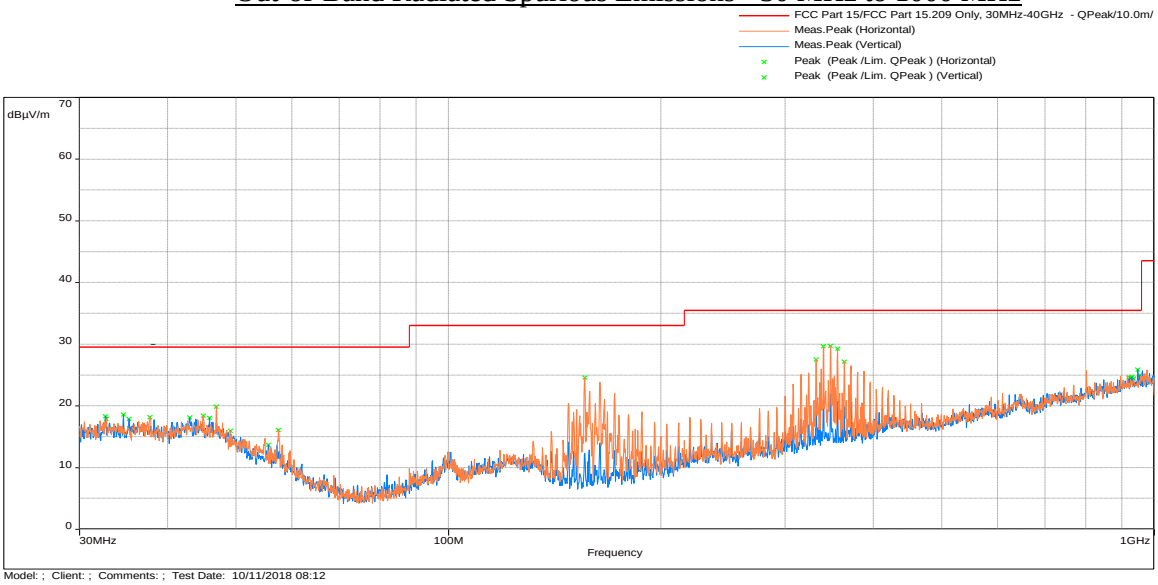


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

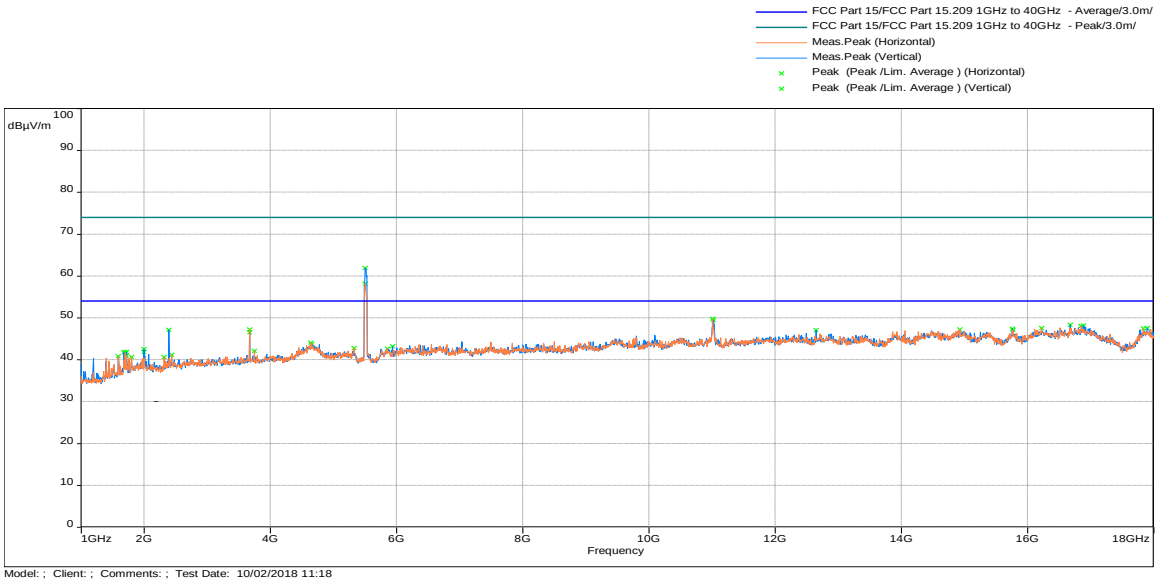


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5510MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

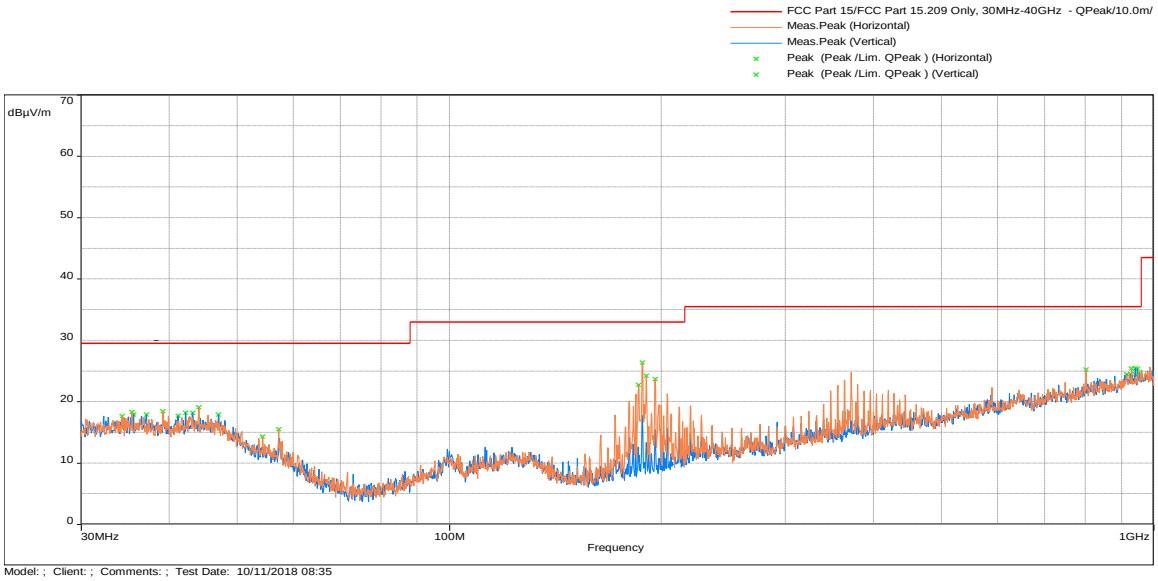


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

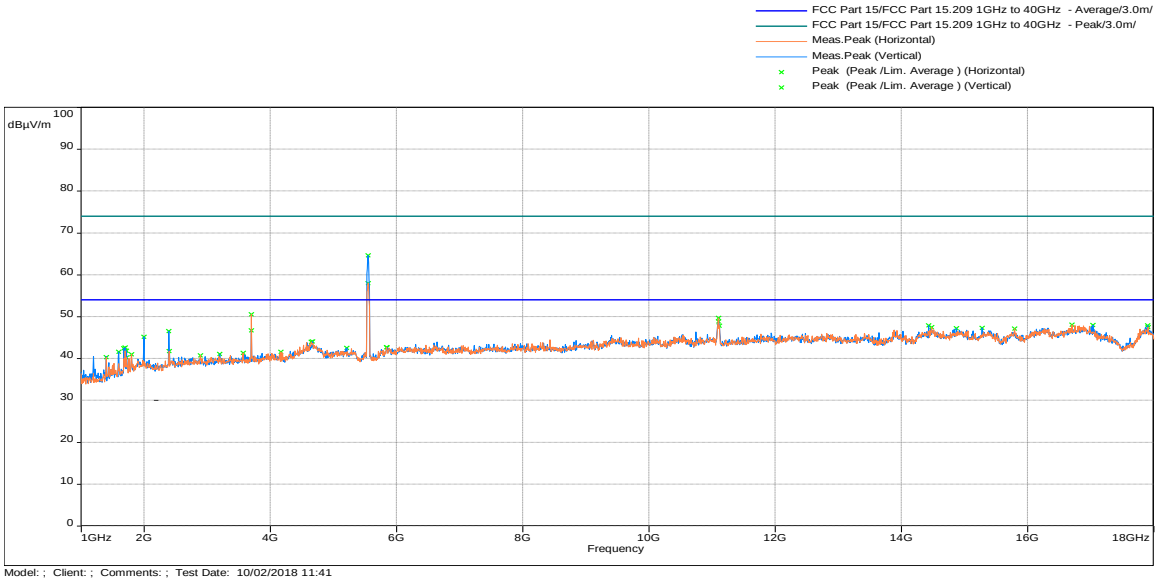


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5550MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

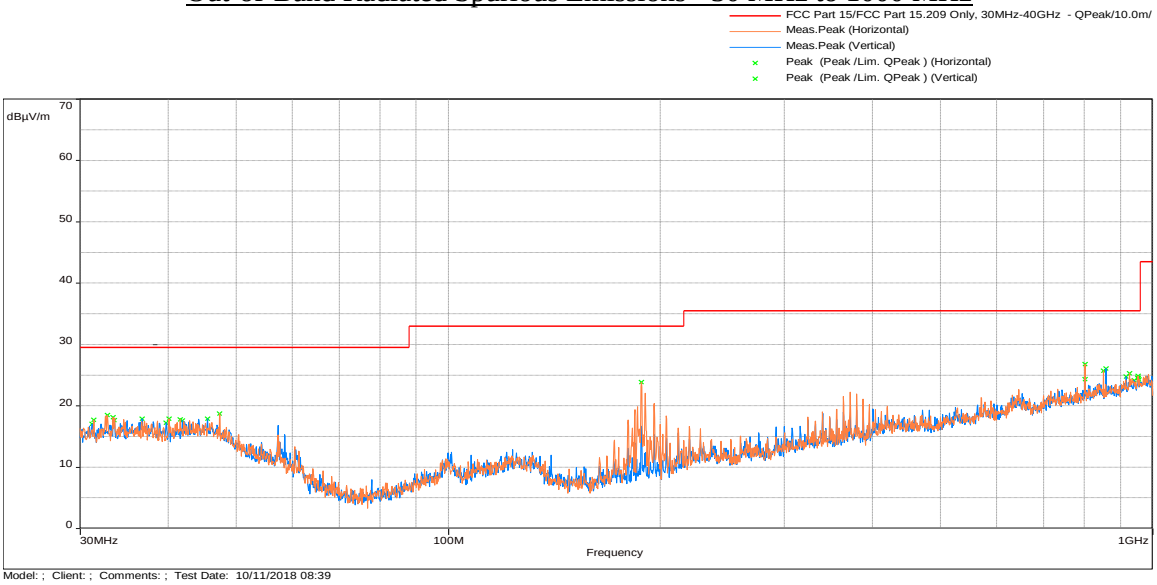


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

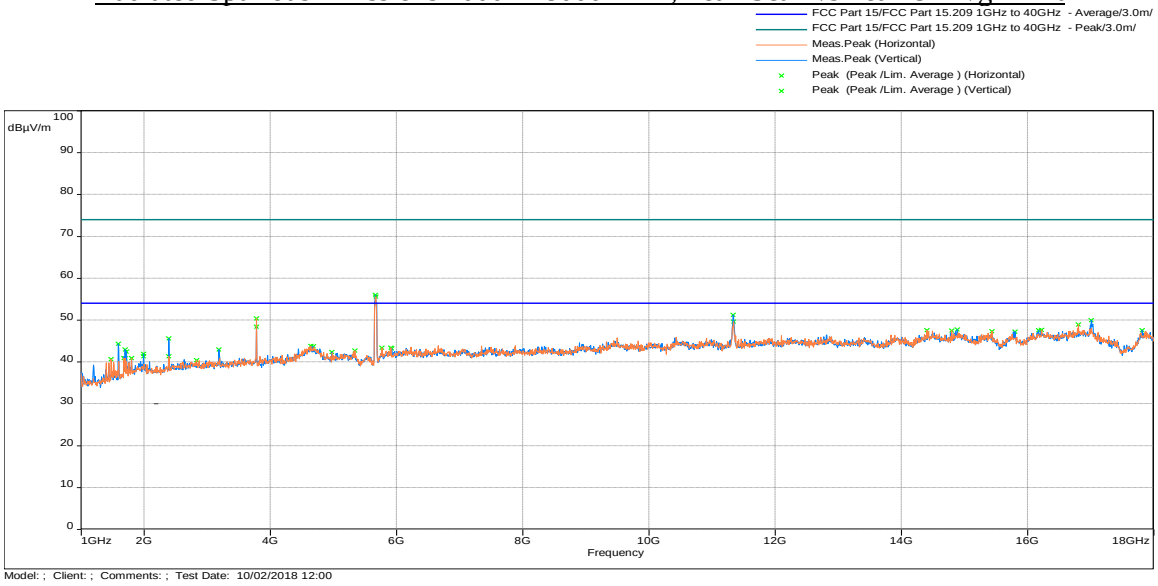


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5670MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



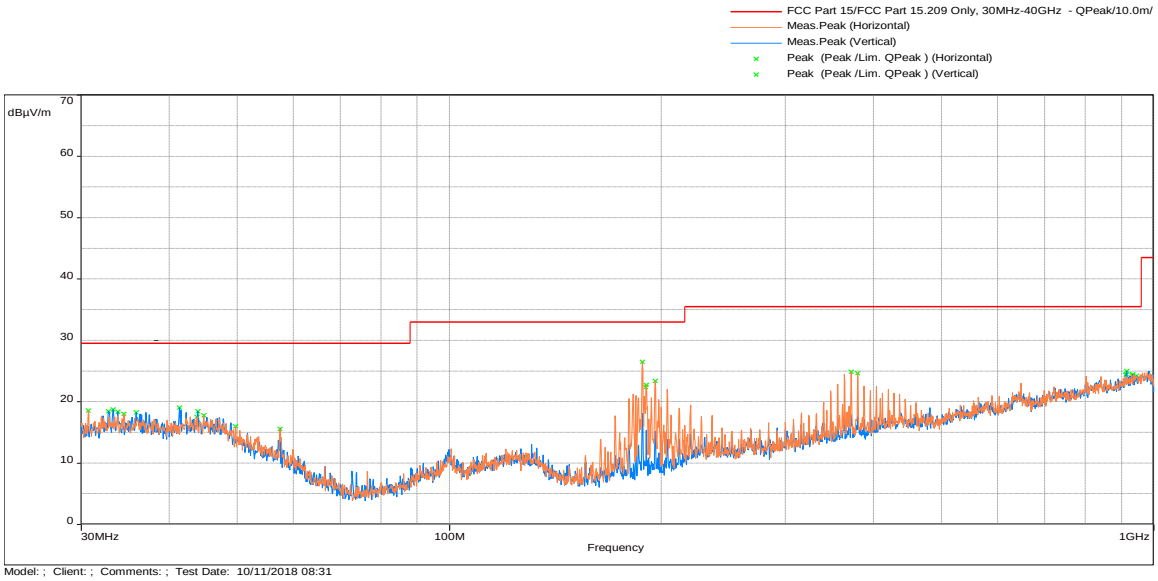
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



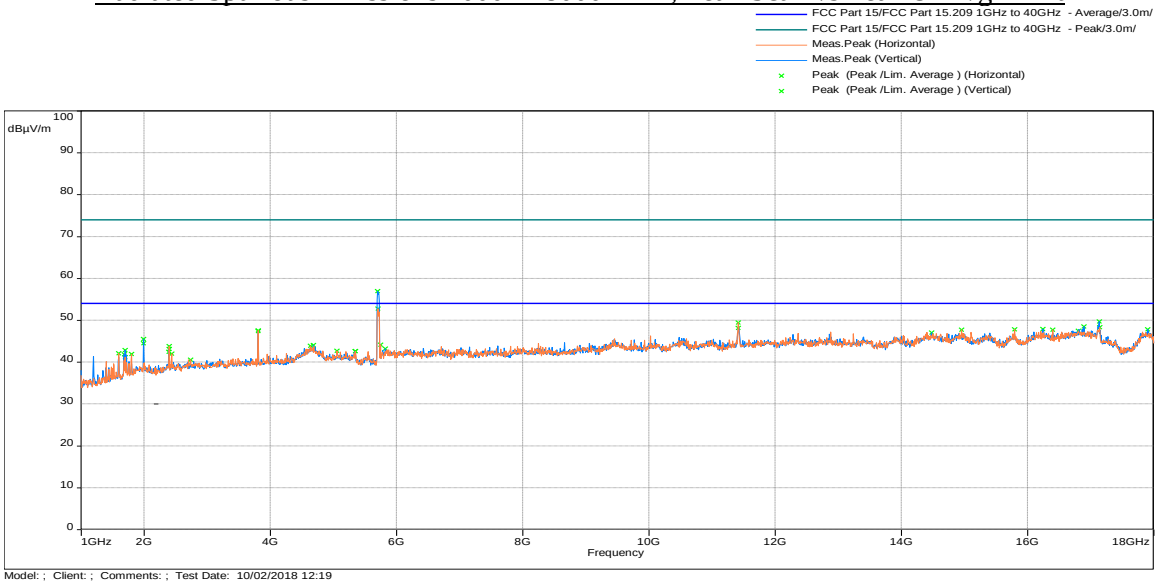
Frequency MHz	Detector	FS@3m dBuV/m	Limit@3m dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	Correction dB
3779.50	Peak	50.33	54	-3.67	57	1.35	Horizontal	-10.70
11336.00	Peak	51.17	54	-2.83	321	1.76	Vertical	-3.70
17010.60	Peak	49.90	54	-4.10	174	1.82	Vertical	5.01

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5710MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

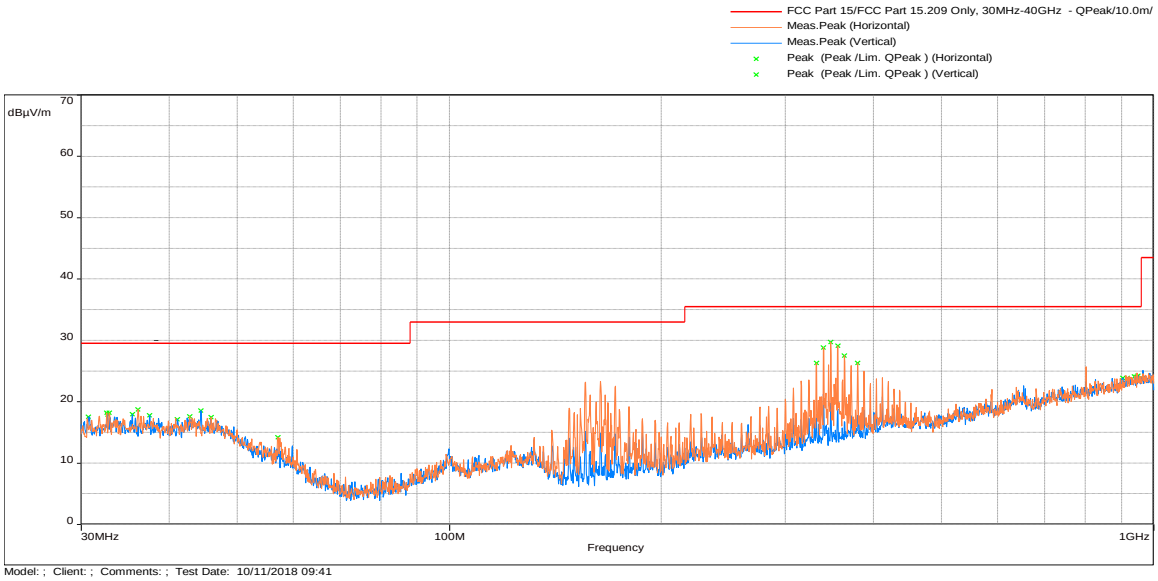


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

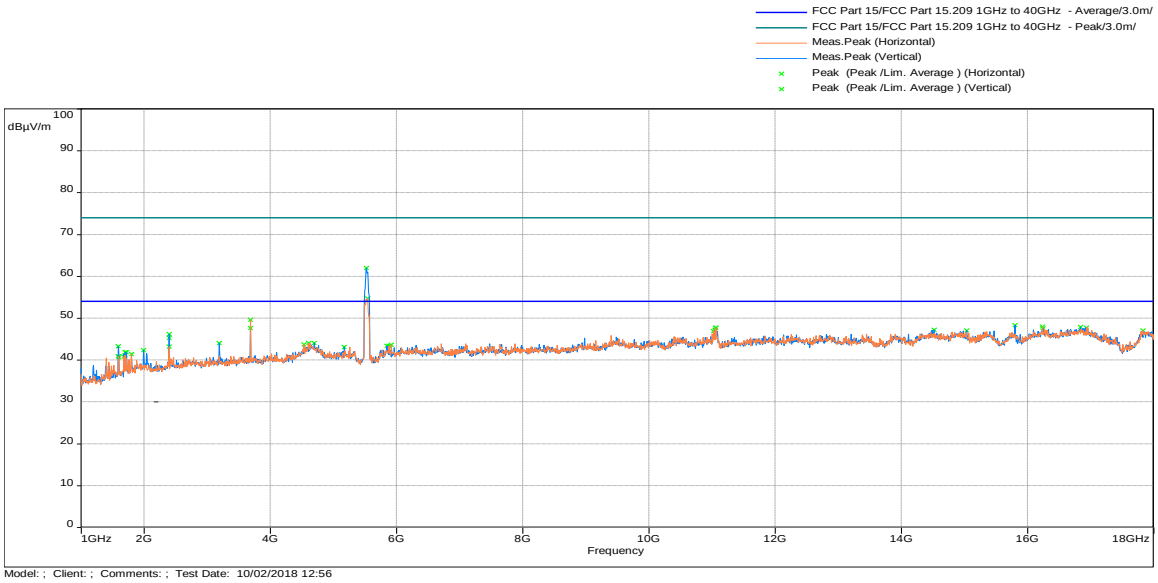


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5530MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

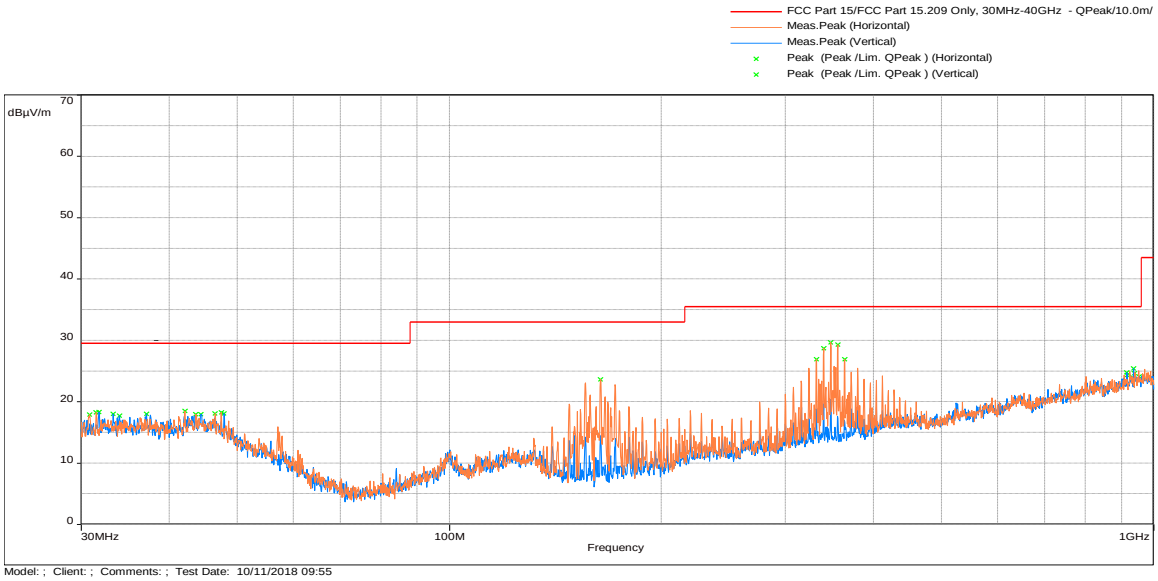


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

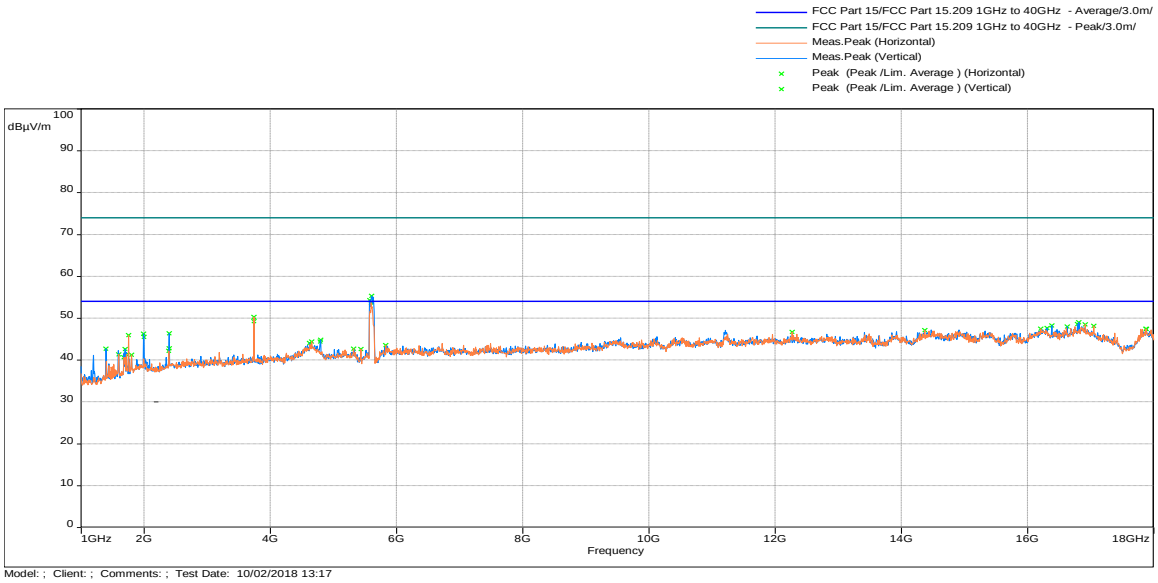


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5610MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

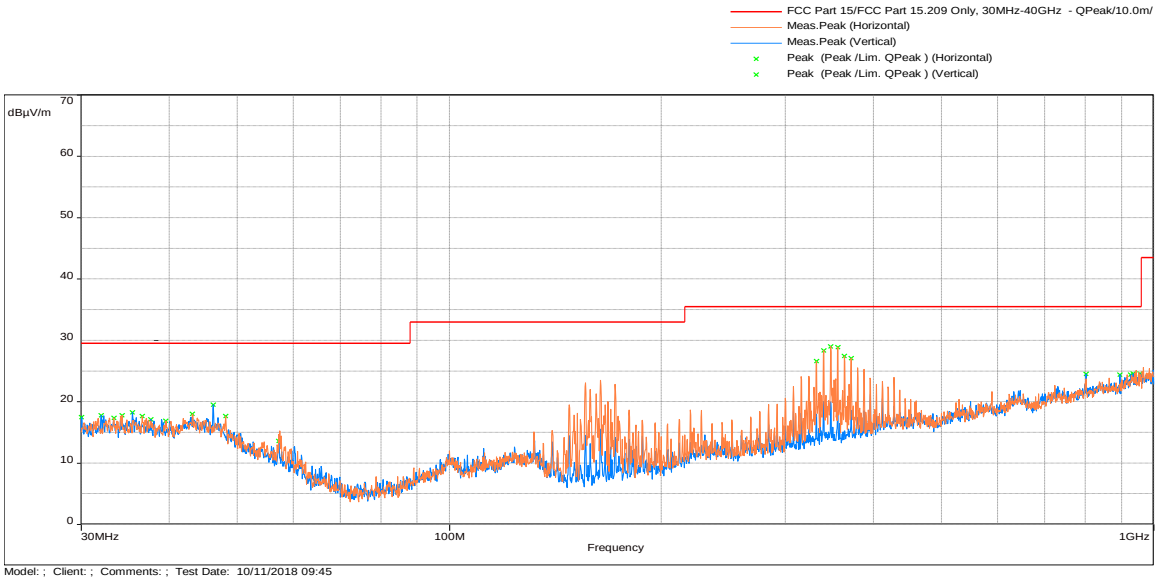


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit

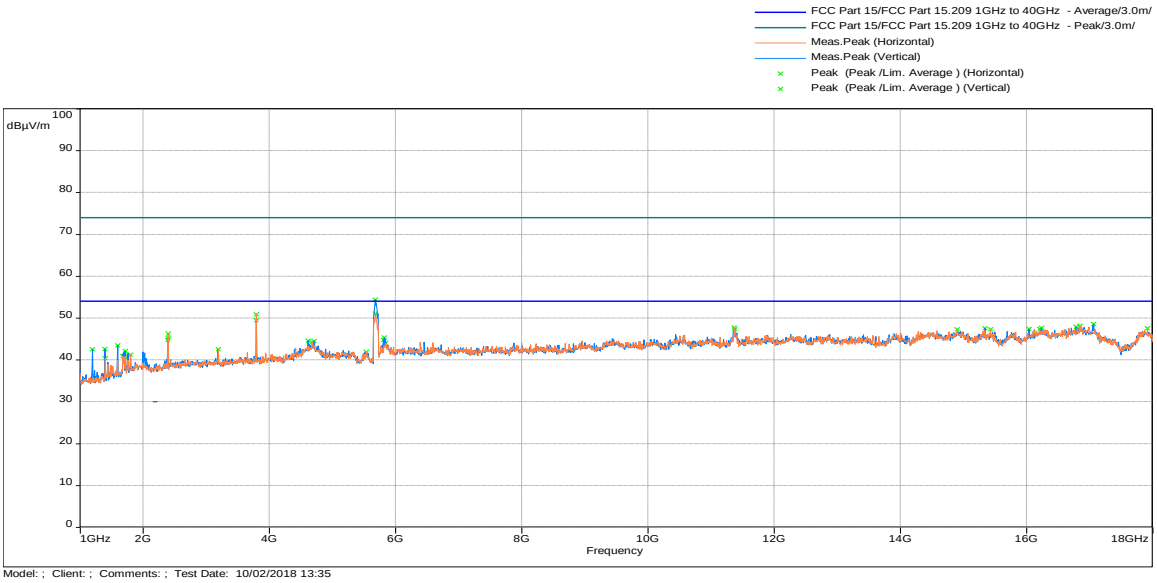


Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5690MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

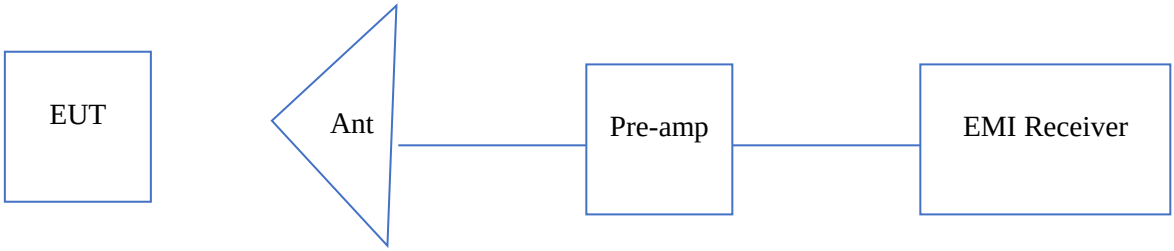


Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak & Avg Limit



4.3.7 Test setup

The following photographs show the testing configurations used.



4.4 Dynamic Frequency Selection (DFS)

4.4.1 Requirement

Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	**Client Without Radar Detection**	**Client With Radar Detection**
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	**Client With Radar Detection**
DFS Detection Threshold	Yes	Not Required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not Required

Additional requirements for devices with multiple bandwidth modes	**Master Device or Client with Radar Detection**	**Client Without Radar Detection**
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

4.4.1.1 DFS Detection Thresholds for Master or Client Devices with DFS Detection

Maximum Transmit Power	Values (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01	

Parameter	Value
Non-Occupancy Period	Minimum 30 minutes
Channel Availability Check Time	60 Seconds
Channel Move Time	10 seconds (see note 1)
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10 Second period. (see note 1 and 2)
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. (see note 3)
Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. **Note 2:** The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. **Note 3:** During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

4.4.1.2 Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	60.00%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Radar Type	Pulse Width (µsec)	Chrip Width (MHz)	PRI (µsec)	Number of Pulses per Burst	Number of Burst	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

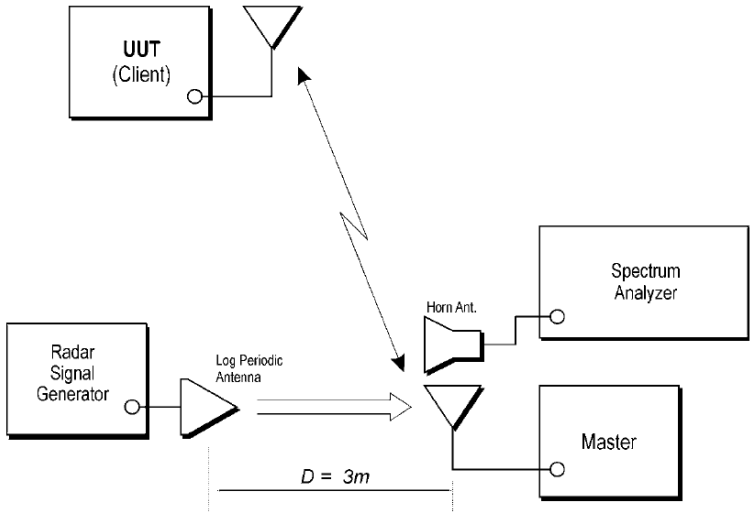
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

4.4.2 Procedure

DFS Waveform Calibration

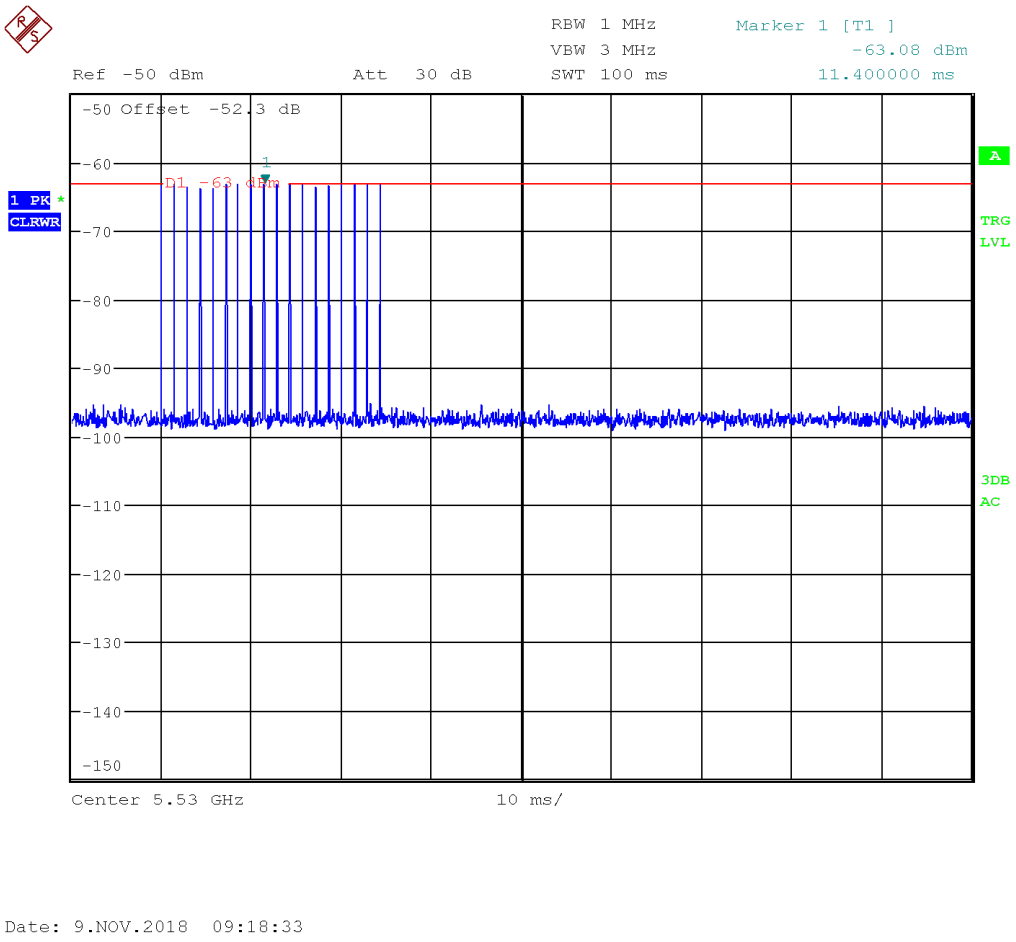
Calibration Procedure

For the DFS signal, horn antenna was attached to a signal generator (RS SMU700A). On the Receive side another horn antenna was attached to a spectrum analyzer with a preamp inline. The spectrum analyzer's resolution bandwidth was set to 3 MHz and the video bandwidth was set to 3 MHz with peak detection. The field was corrected to account for cable loss, antenna gain and preamp. The DFS signal was calibrated to a field strength of -63 dBm. Test wave form 0 was utilized. The calibration setup is diagrammed below along with a setup picture.



Tested By	Test Date
Anderson Soungpanya	November 09, 2018

Radar Type 0 Calibration 5530MHz



The Spectrum Analyzer Reference Level Offset is System Gain + Cable Loss

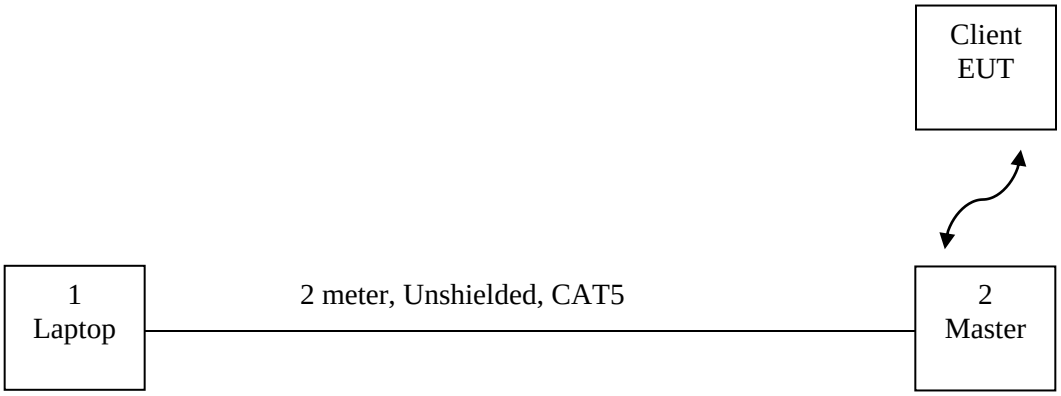
Frequency	Cable loss	System Gain (Preamp and Antenna Gain)	Reference Offset
MHz	dB	dBi	dB
5530	3.94	-56.2	-52.3

DFS Setup & Procedure

Test Procedure

A radiated test method was used and the test setup was made as depicted in the diagram below. DFS testing was setup as a client with injection into the master.

The diagram below depicts the setup of the EUT along with associated support equipment.



Item	Description	Model	Serial
1	HP Laptop	EliteBook 8460p	CNU14429SL
2	Ruckus Wireless, Inc.	R710 Access Point FCC ID: S9GR710	421503700725

Test Procedure Continued

The Master and Client (EUT) were placed in a semi-anechoic chamber. The simulated radar waveform was transmitted from a horn antenna towards the Master. The signal level of the simulated radar waveform was set 10 dB higher than calibrated level to -53 dBm and was applied to the Master. The horn antenna was connected to the spectrum analyzer and positioned towards the client with a level higher than emissions from the Master.

A Rhode & Schwarz Vector Signal Generator with Pulse Sequencer Software was used to generate the DFS radar signals. A Rhode & Schwarz Spectrum Analyzer was used to monitor the transmissions of the Client. The trigger of the spectrum analyzer was aligned with the end of the radar waveform burst from the signal generator.

Channel closing transmission time and channel move time were measured by applying a radar signal to the Master device. The EUT transmissions were observed while Type 0 Radar waveforms were applied. The time between the end of the applied radar waveform and the final transmission on the channel is the channel move time. The channel closing transmission time comprises only those fragments of the channel move time during which the EUT transmits.

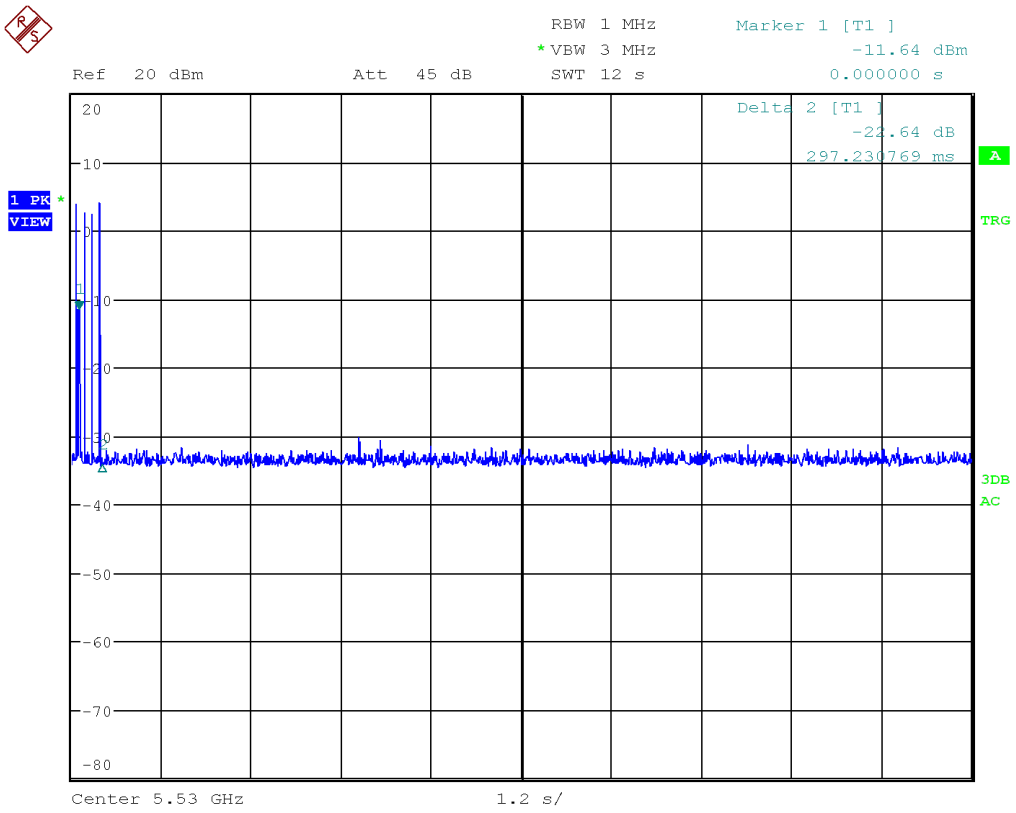
The EUT (client without DFS detection) was configured to communicate with a Master wirelessly. The test file/data was streamed from the Master to the Client. The channel load is recorded and presented in test results below.

4.4.3 Test Results

Channel Move Time Test Summary						
Description	**Plot #**	**Radar Type**	**Frequency MHz**	**Measured Value**	**Limit Requirements**	**Results**
Channel Move Time	1	0	5530	297.23ms	10s	Pass
Channel Closing Transmission Time Test Summary						
Description	**Plot #**	**Radar Type**	**Frequency MHz**	**Aggregate Measured Value**	**Limit Requirements**	**Results**
Closing Transmission Time	2	0	5530	< 207.5ms	260ms	Pass
Channel Unoccupancy Time Test Summary						
Description	**Plot #**	**Radar Type**	**Frequency MHz**	**Measured Value**	**Limit Requirements**	**Results**
Unoccupancy Time	3	0	5530	No Transmission Found	Minimum 30 minutes	Pass

Plot 1

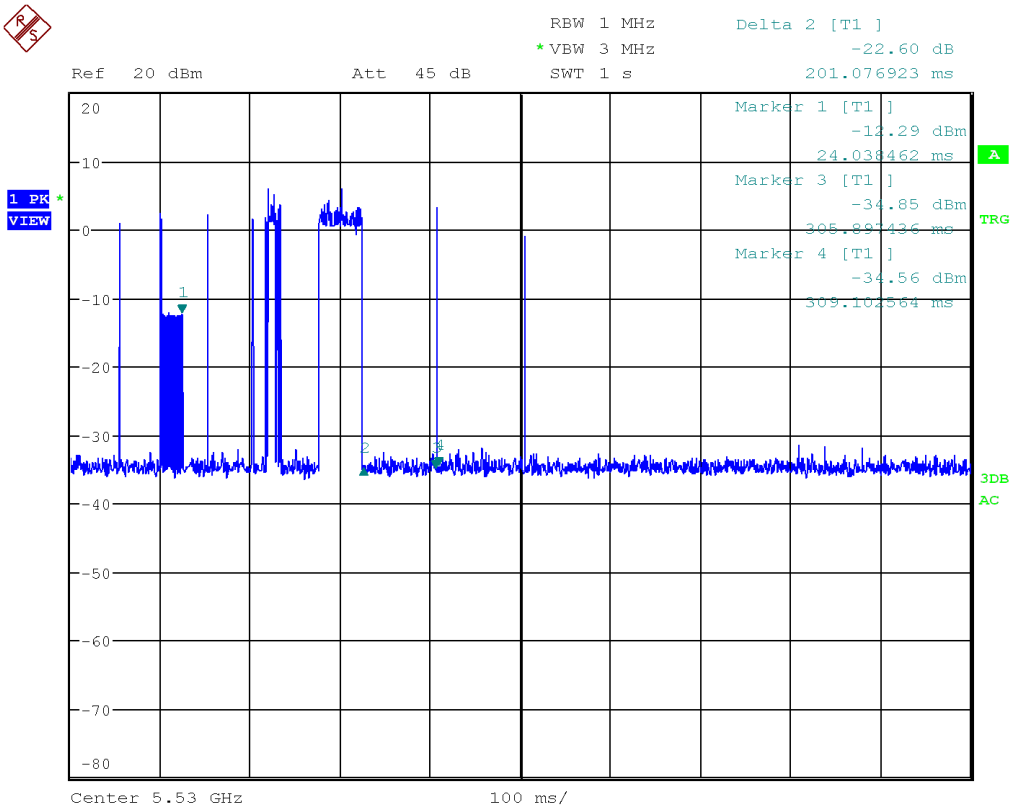
Channel Move Time (CMT), @ 5530 MHz, 802.11ac 80MHz



Date: 9.NOV.2018 15:43:18

Plot 2

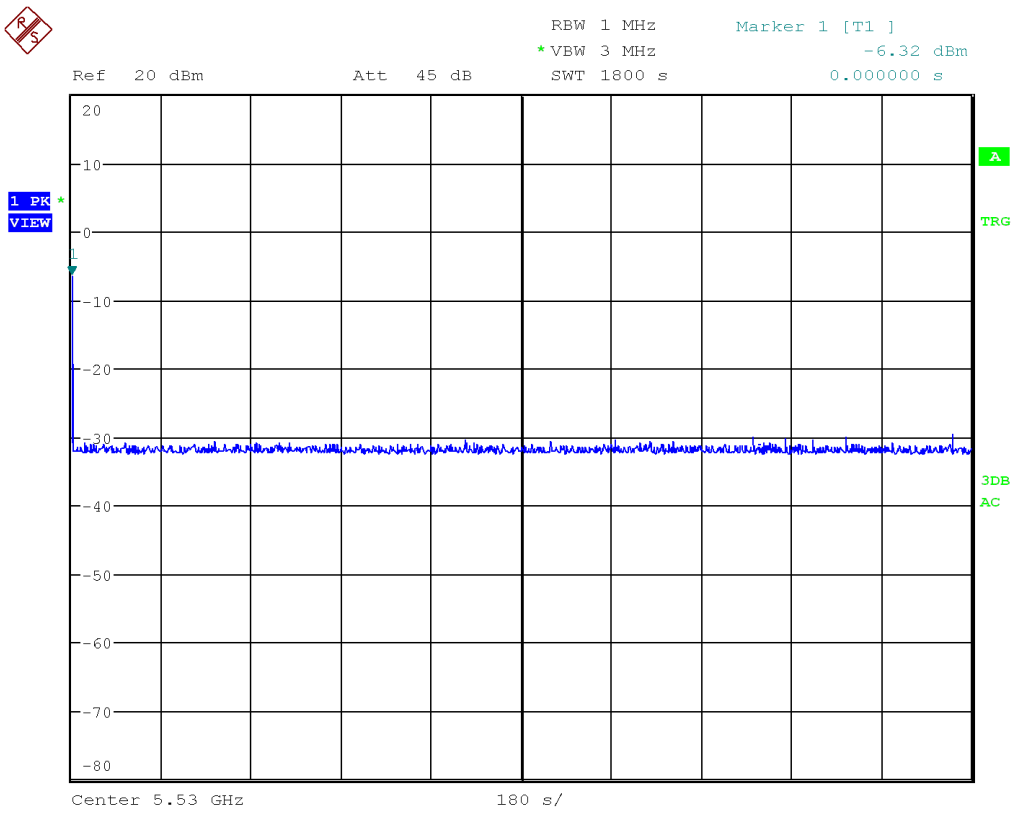
Channel Closing Transmission Time (CCTT), @ 5530 MHz, 802.11ac 80MHz



Date: 9.NOV.2018 15:53:33

Plot 3

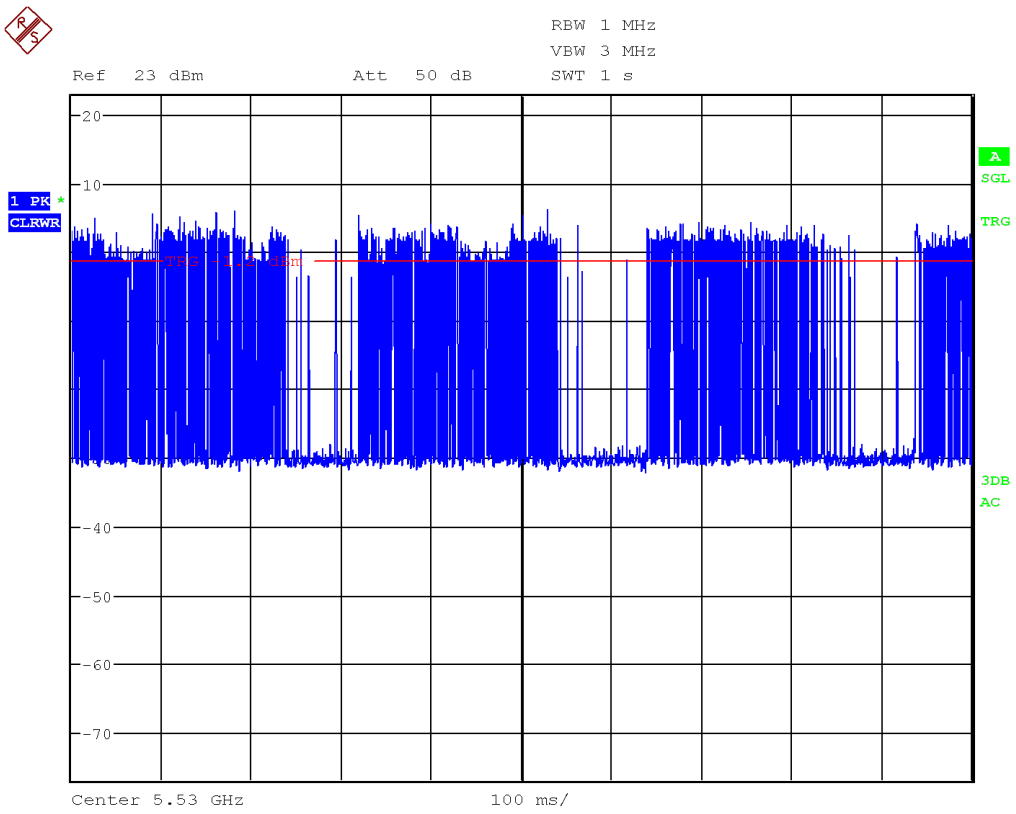
Channel Unoccupancy Time @ 5530 MHz, 802.11ac 80MHz



Date: 9.NOV.2018 19:08:16

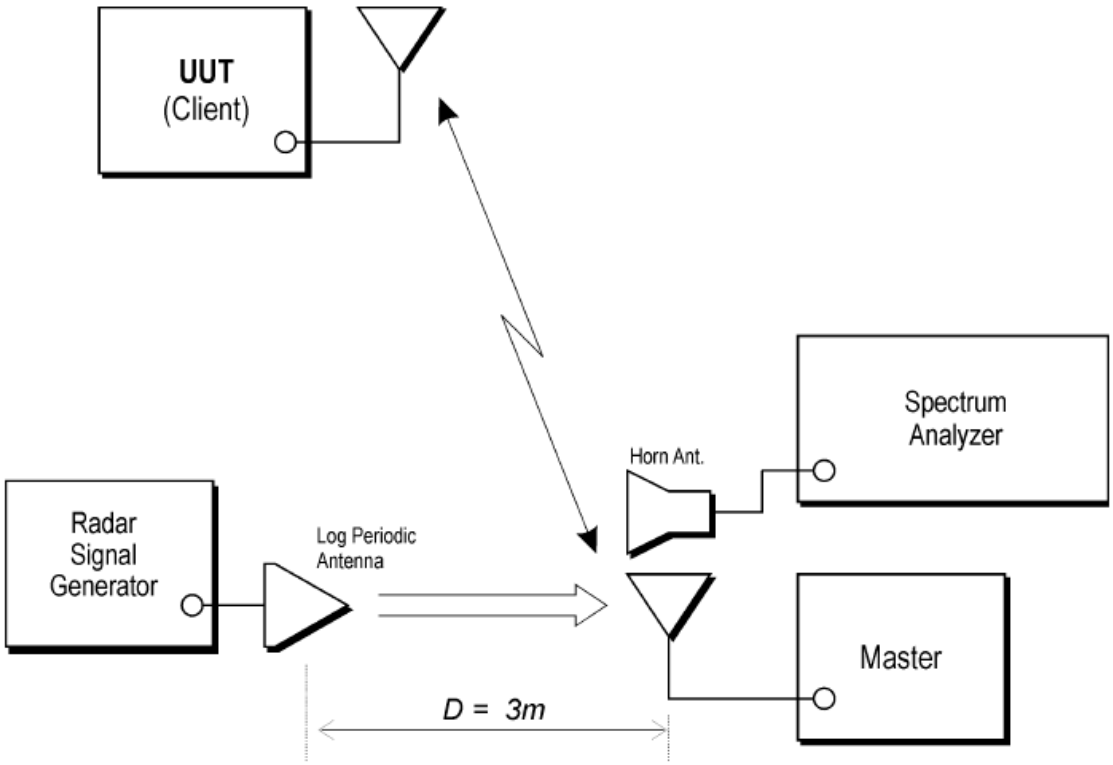
Plot 4

Channel Loading @ 5530MHz, 802.11ac 80MHz



Date: 9.NOV.2018 10:51:53

4.4.4 Test setup



5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS 00913	12	01/24/19
Horn Antenna (10-40 GHz)	ETS-Lindgren	3116C	ITS 01376	12	04/25/19
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	01/19/19
Active Horn Antenna (1-18GHz)	ETS-Lindgren	3117-PA	ITS 01325	12	01/25/19
EMI Receiver	Rohde and Schwarz	ESW44	ITS 01669	12	07/30/19
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	02/21/19
Pre-Amplifier	Sonoma Instrument	310N	ITS 01493	12	10/20/18
Notch Filter	MICRO-TRONICS	BRM50704	ITS 01168	12	03/14/19
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01538	12	06/25/19
RF Cable	Megaphase	TM40-K1K1-59	ITS 01657	12	06/26/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01330	12	11/29/18
RF Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/16/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/16/19
Attenuator	Fairview	SA 18H-30	ITS 01633	12	#
Vector Signal Generator	Rohde and Schwarz	SMU200A	ITS 00880	12	11/07/19
Spectrum Analyzer	Rohde and Schwarz	ESU40	ITS 00961	12	10/26/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01345	12	08/19/19
Horn Antenna (1-18GHz)	EMCO	3115	ITS 01595	12	03/07/19

Verify before use

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Restricted Band Edge_Avg Conducted Restricted Band Edge_Peak
BAT-EMC	Nexio	3.16.0.64	103615308_Vocera 5GWIFI.bpp
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewer Initials	Date	Change
1.0 / G103615308	AS	KV	November 12, 2018	Original document