TEST REPORT

Report Number: 103930307MPK-002B
Project Number: G103930307
August 20, 2019

Testing performed on the
Connected AC Android Control Module
Model Number: AP6255

FCC ID: 2AHLA-SP01500243
IC: 4811A-SP01500243

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

For

Bosch Automotive Service Solutions, Inc.

Test Performed by:	Test Authorized by:
Intertek	Bosch Automotive Service Solutions, Inc.
1365 Adams Court	655 Eisenhower Dr
Menlo Park, CA 94025 USA	Owatonna, MN 55060 USA

Prepared by: _____ **Date:** August 20, 2019
Todd Moy

Reviewed by: _____ **Date:** August 20, 2019
Krishna K Vemuri

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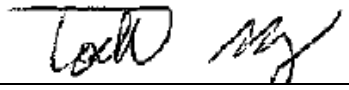
Report No. 103930307MPK-002B	
Equipment Under Test:	Connected AC Android Control Module
Trade Name:	Bosch Automotive Service Solutions, Inc.
Model Number:	AP6255
Part Number:	CBA-G19-UBS2
Applicant:	Bosch Automotive Service Solutions, Inc.
Contact:	Bill Brown
Address:	Bosch Automotive Service Solutions, Inc. 655 Eisenhower Dr San Jose, CA 95126
Country:	USA
Tel. Number:	(507) 455-8312
Email:	Bill.brown2@us.bosch.com
Applicable Regulation:	FCC Part 15, Subpart E (15.407) Industry Canada RSS-247, Issue 2
Date of Test:	June 24-July 25, 2019

We attest to the accuracy of this report:



Todd Moy
EMC Project Engineer

Krishna K Vemuri
Engineering Team Lead

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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
Frequency stability	15.407(g)	RSS-Gen	Complies*
Antenna Requirement	15.203	RSS-Gen	Complies. The EUT uses an antenna with a unique attachment.

*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: June 24, 2019

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: Jun 24, 2019

Test completion date: August 20, 2019

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

2.0 General Description

2.1 Product Description

Bosch Automotive Service Solutions, Inc. supplied the following description of the EUT:

The module is a single board computer with Rockchip ARM Cortex-A17 CPU, Quad core processor.

Features:

- On Board DDR3L 935MHz, 2GB
- Wi-Fi, IEEE 802.11a/b/g/n/ac dual-band radio with virtual-simultaneous dual-band operation
- Bluetooth, V4.2+EDR with integrated PA for Class 1.5 and Low Energy (BLE)
- On Board eMMC, 64GB
- 1 xmicro-SD
- 1 RS232
- 2 2W speaker outputs
- 2 USB 2.0 Host, 1 USB OTG 2.0
- 1 LVDS Output
- 1 Capacitive touchscreen input

Radio Information	
Applicant	Bosch Automotive Service Solutions, Inc.
Model Number	AP6255
FCC Identifier	2AHLA-SP01500243
IC Identifier	4811A-SP01500243
Modulation Technique	OFDM
Rated RF Output	9.19 dBm for 5745~5825 MHz
Frequency Range	U-NII 3: 5725 – 5850 MHz
Type of modulation	OFDM
Number of Channel(s)	5 for 802.11a/n 20 MHz 2 for 802.11n 40MHz 1 for 802.11ac 80MHz
Antenna(s) & Gain	Antenna with Unique Connection, Gain: +4.3 dBi
Applicant Name & Address	Bosch Automotive Service Solutions, Inc. 655 Eisenhower Dr San Jose, CA 95126 USA

The EUT supports the following configurations:

Channels in 5725 – 5850 MHz band							
Number	**Frequency, MHz**	**802.11a/n 20MHz Channels**		**802.11n 40MHz Channels**		**802.11ac 80MHz Channels**	
149	5745	√	X				
151	5755			√	X		
153	5765	√					
155	5775					√	X
157	5785	√	X				
159	5795			√	X		
161	5805	√					
165	5825	√	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

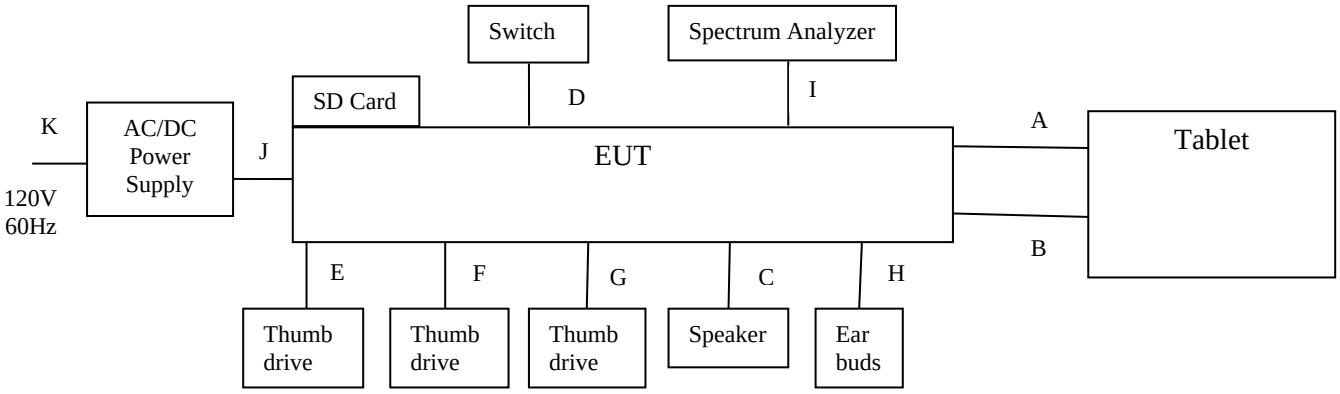
Support Equipment		
Description	**Manufacturer**	**Model Number**
Tablet	OSD DISPLAYS	OSD101T3990-81TS
Power Supply	XP POWER LLC	ECS130US12-XE1141
Thumb drive	Freescale	-
Thumb drive	HP	-
Thumb drive	Kingston	-
Speaker	Visaton	FR 58
Earbuds	-	-
Switch	-	-
SD Memory Card	-	-

Cables					
ID	**Description**	**Length (m)**	**Shielding**	**Ferrites**	**Termination**
A	Ribbon Cable	0.1	No	No	Tablet
B	Ribbon Cable	0.1	No	No	Tablet
C	Power Cable	0.6	No	No	Speaker
D	Power Cable	0.6	No	No	Switch
E	Micro-USB to USB	0.6	Yes	No	Thumb drive
F	USB Extender	0.6	Yes	No	Thumb drive
G	USB Extender	0.6	Yes	No	Thumb drive
H	Headphone Extender	0.4	No	No	Earbuds
I	SMA Cable	0.2	Yes	No	EUT
J	DC Power Cable	0.5	No	No	Power Supply
K	AC Power Cable	2.0	No	No	Power Supply

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	**Manufacturer**	**Part Number**	**Serial Number (LOT Number)**
Connected AC Android Control Module	Bosch Automotive Service Solutions, Inc	CBA-G19-UBS2	209498-1-010

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



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/ac 20MHz
OFDM, MCS0 – for 802.11n/ac 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.

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.

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
Todd Moy	June 26-August 20, 2019

4.1.3 Test Result

Refer to the following plots for the test result:

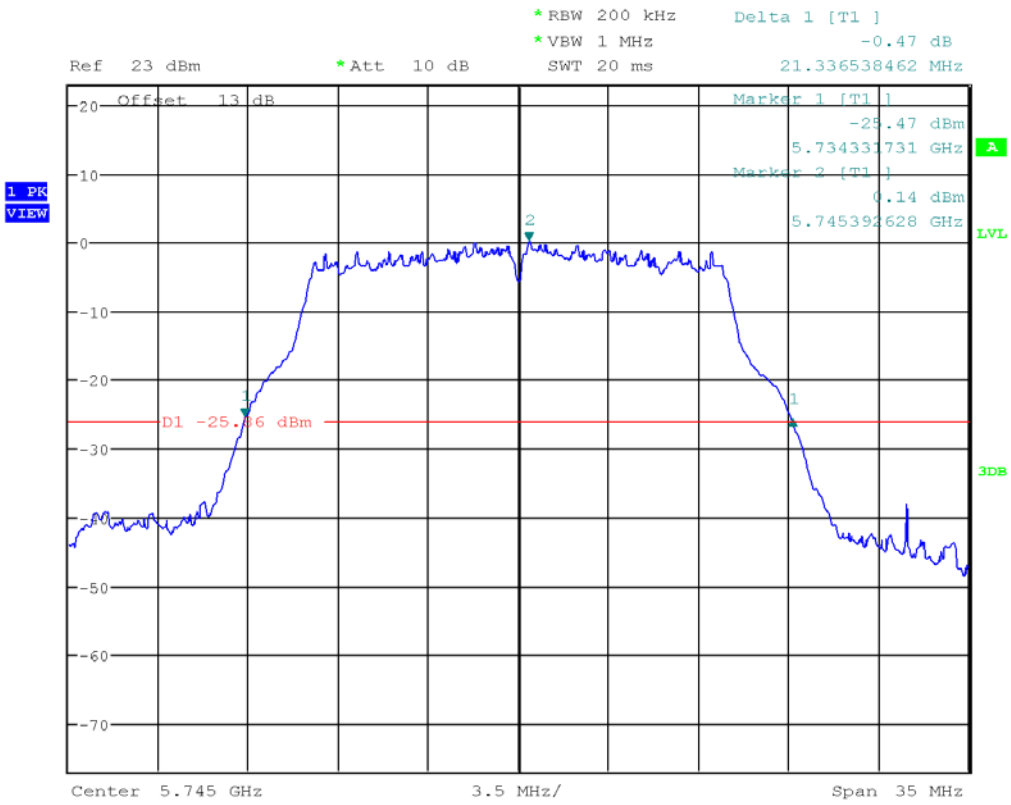
Mode	Channel	Frequency MHz	26-dB Bandwidth MHz	Plot #
802.11a	149	5745	21.337	1.1
	157	5785	21.449	1.2
	165	5825	21.325	1.3
802.11n 20MHz	149	5745	21.650	1.4
	157	5785	21.729	1.5
	165	5825	21.673	1.6
802.11n 40MHz	151	5755	40.497	1.7
	159	5795	40.321	1.8
802.11ac 80MHz	155	5775	82.429	1.9

Mode	Channel	Frequency MHz	Occupied Bandwidth MHz	Plot #
802.11a	149	5745	16.771	1.10
	157	5785	16.771	1.11
	165	5825	16.771	1.12
802.11n 20MHz	149	5745	17.893	1.13
	157	5785	17.893	1.14
	165	5825	18.005	1.15
802.11n 40MHz	151	5755	36.346	1.16
	159	5795	36.458	1.17
802.11ac 80MHz	155	5775	75.609	1.18

Mode	Channel	Frequency MHz	6 dB Bandwidth, MHz	Plot #
802.11a	149	5745	16.243	1.19
	157	5785	16.154	1.20
	165	5825	16.345	1.21
802.11n 20MHz	149	5745	17.466	1.22
	157	5785	17.388	1.23
	165	5825	17.354	1.24
802.11n 40MHz	151	5755	36.010	1.25
	159	5795	36.260	1.26
802.11ac 80MHz	155	5775	75.968	1.27

Plot 1.1

802.11a, 5745MHz



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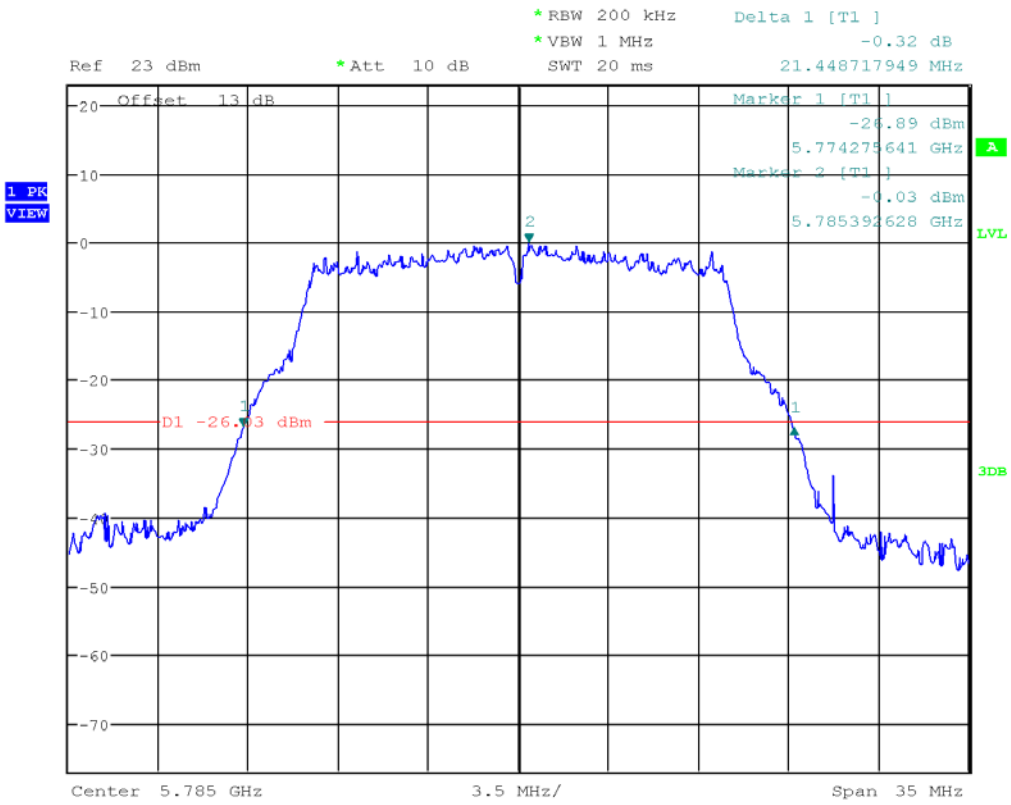
Plot 1.2

802.11a, 5785MHz



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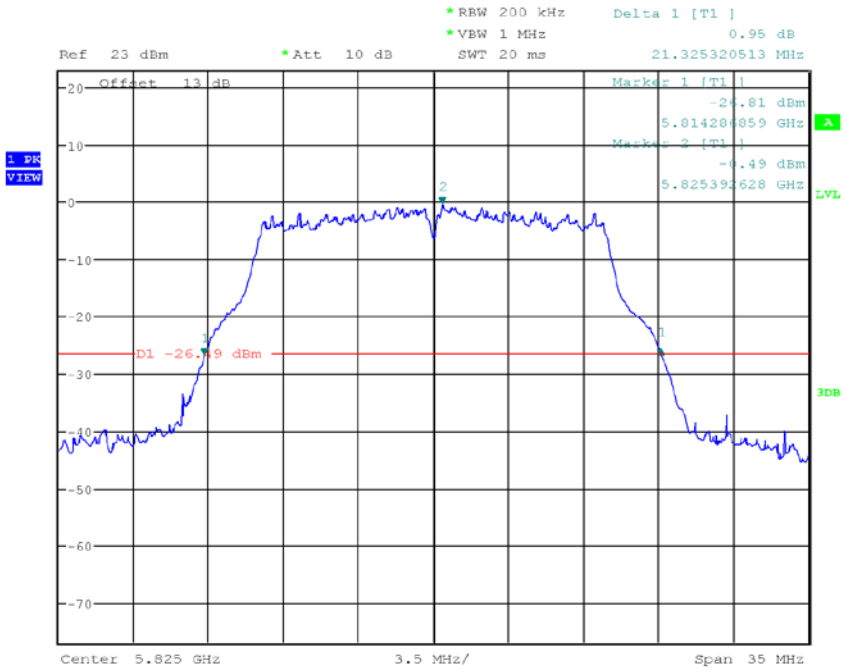
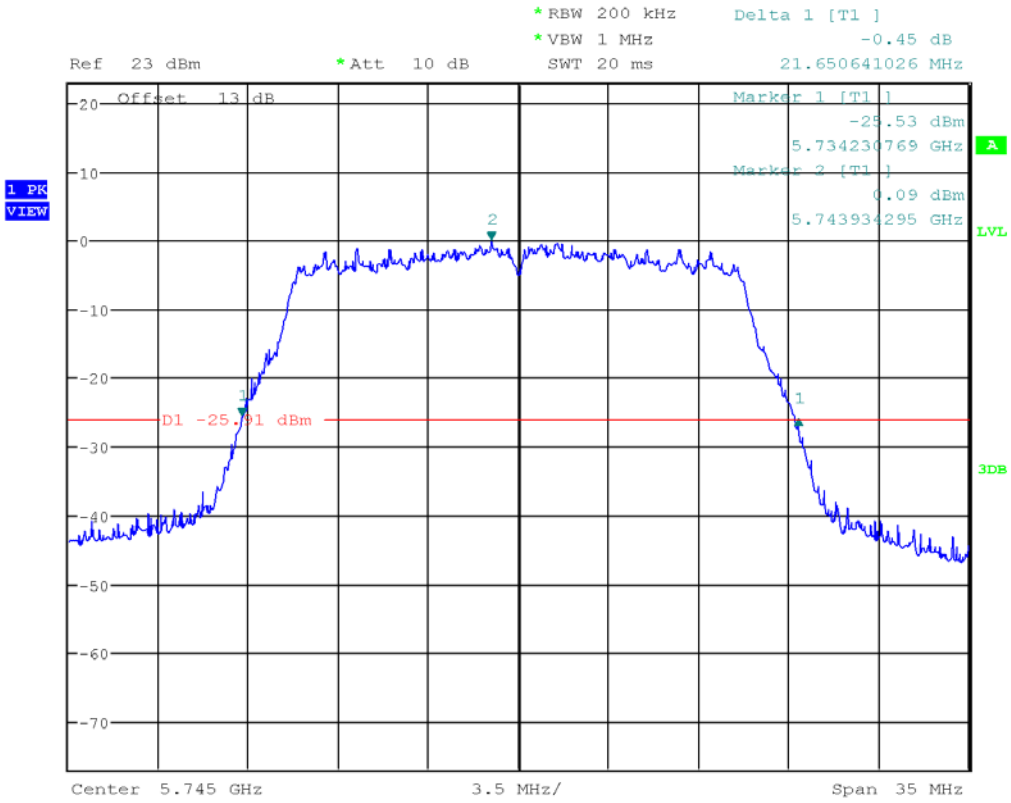
Plot 1.3

802.11a, 5825MHz



Plot 1.4

802.11n 20MHz, 5745MHz



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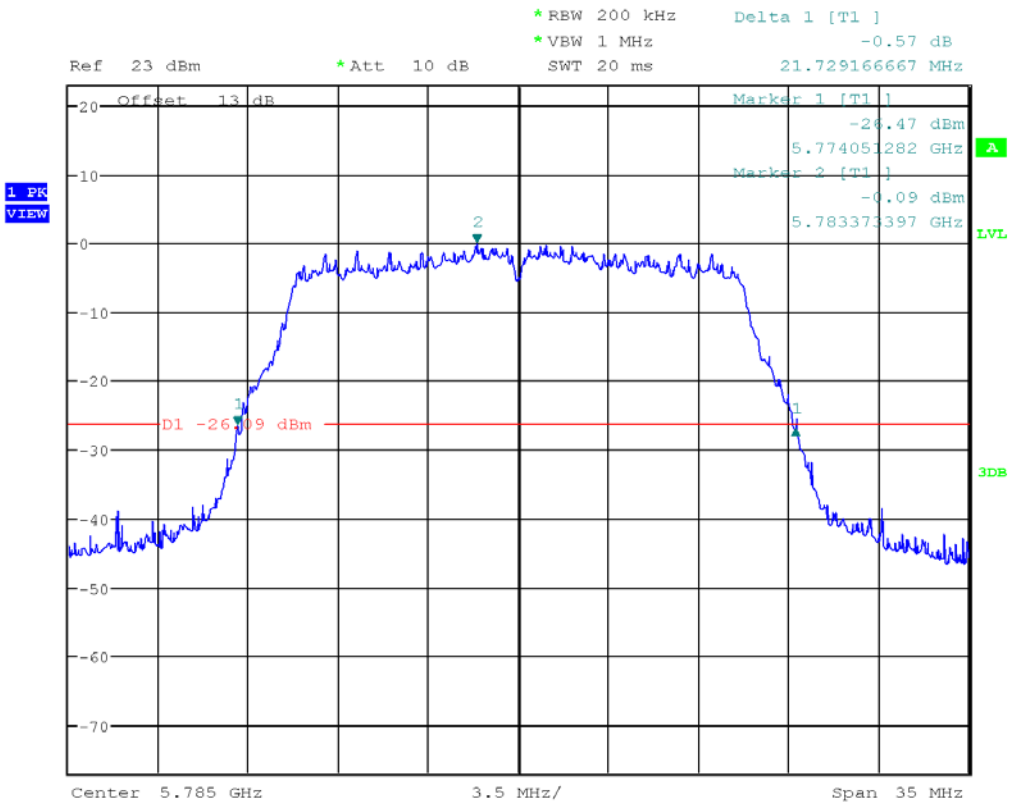
Plot 1.5

802.11n 20MHz, 5785MHz



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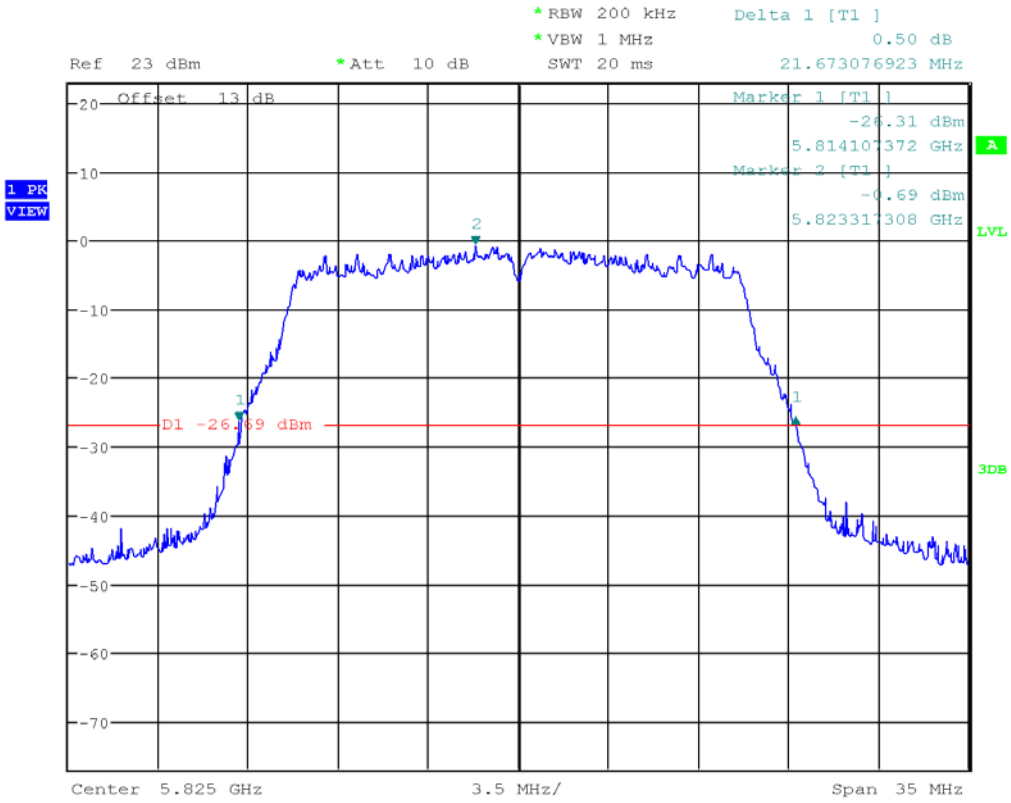
Plot 1.6

802.11n 20MHz, 5825MHz



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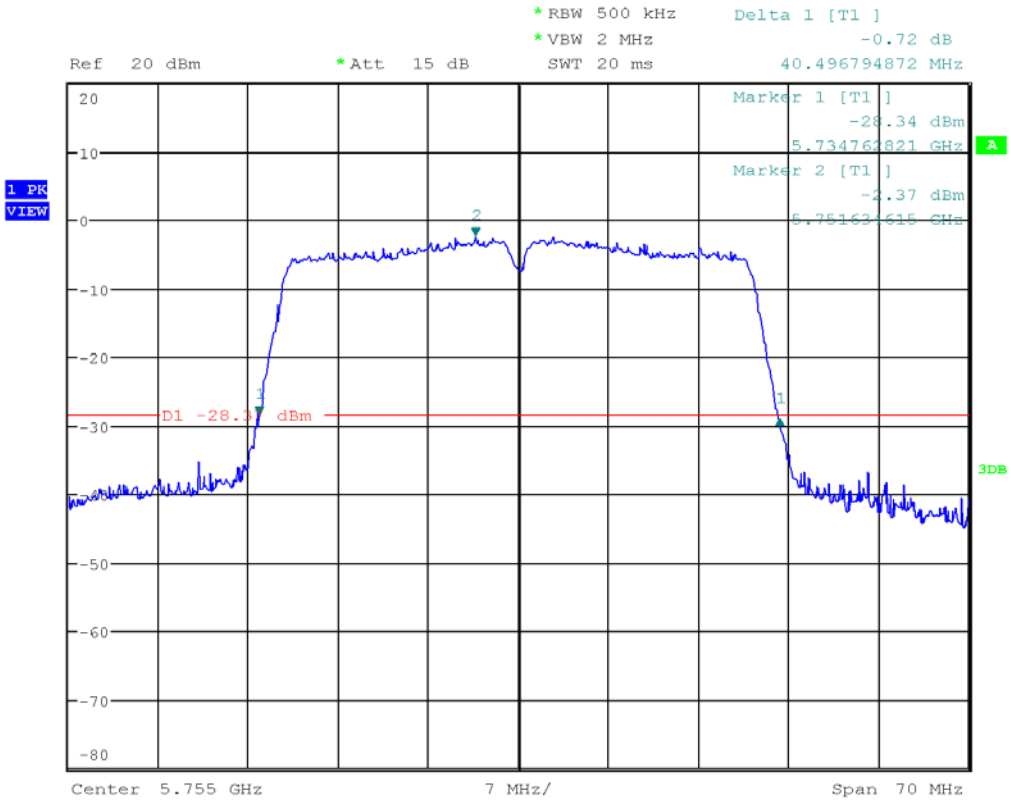
Plot 1.7

802.11n 40MHz, 5755MHz



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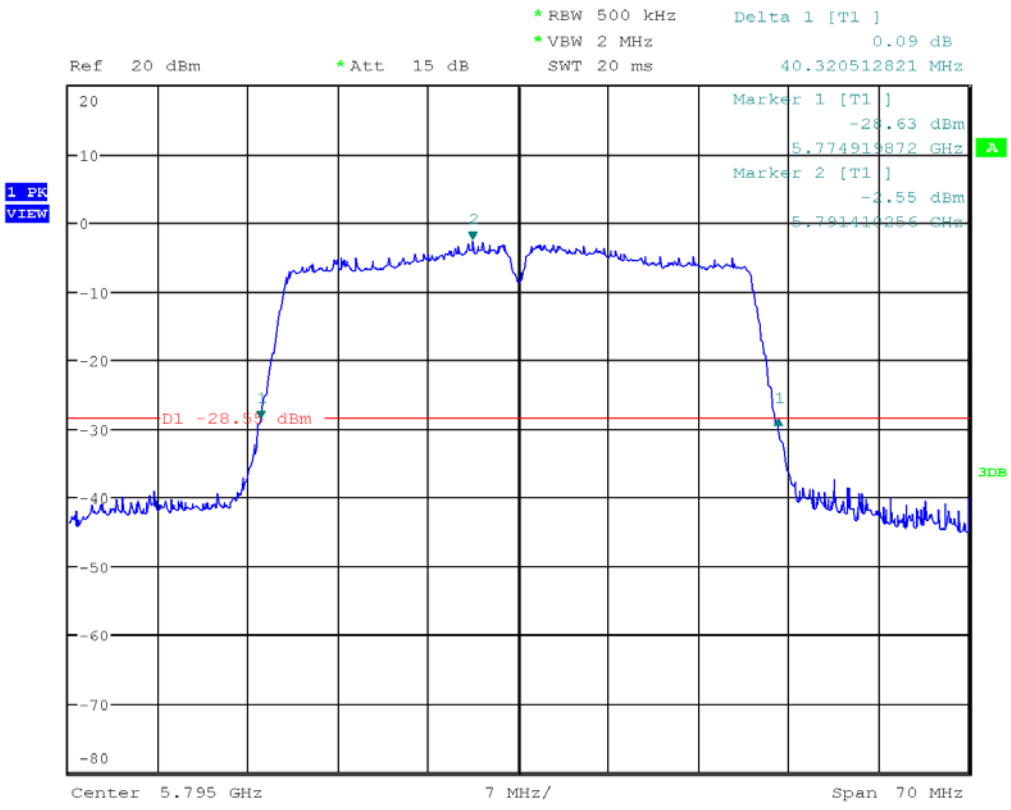
Plot 1.8

802.11n 40MHz, 5795MHz



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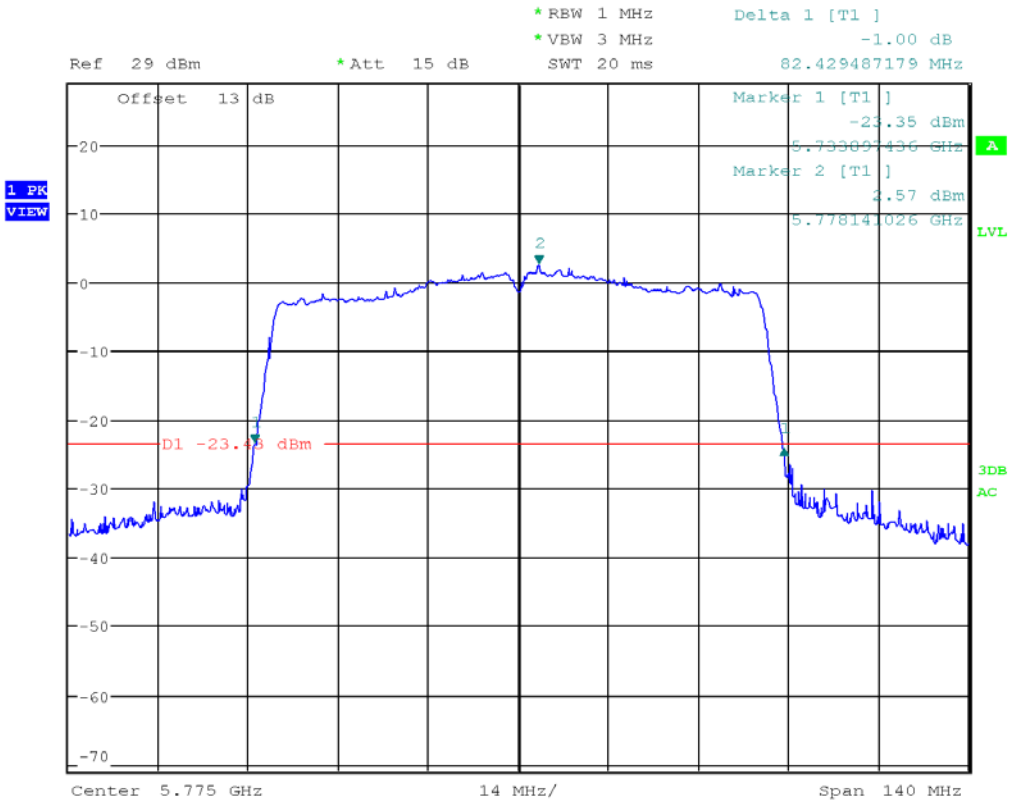
Plot 1.9

802.11ac, 80MHz 5775MHz



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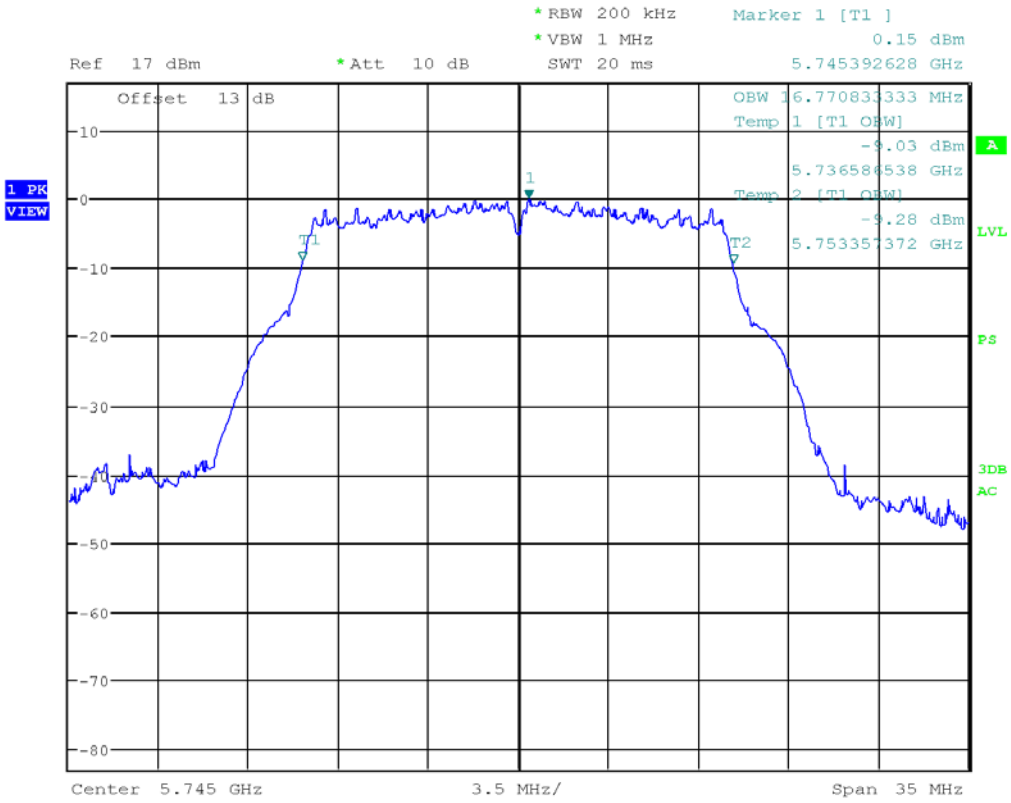
Plot 1.10

802.11a, 5745MHz



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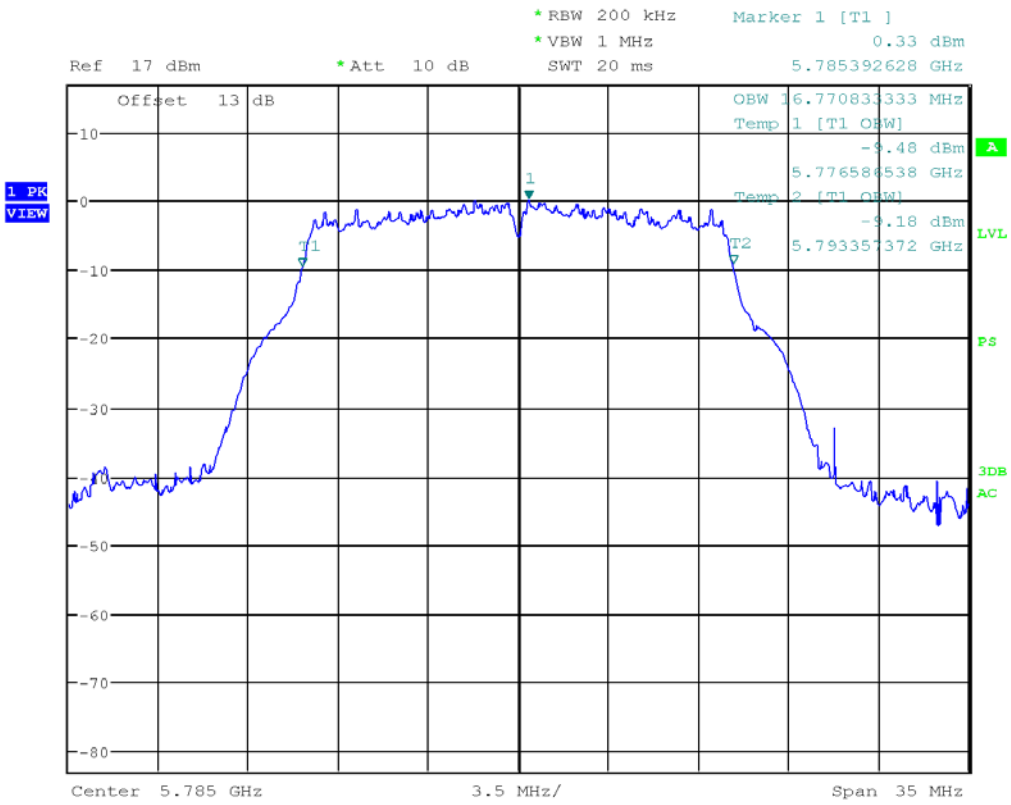
Plot 1.11

802.11a, 5785MHz



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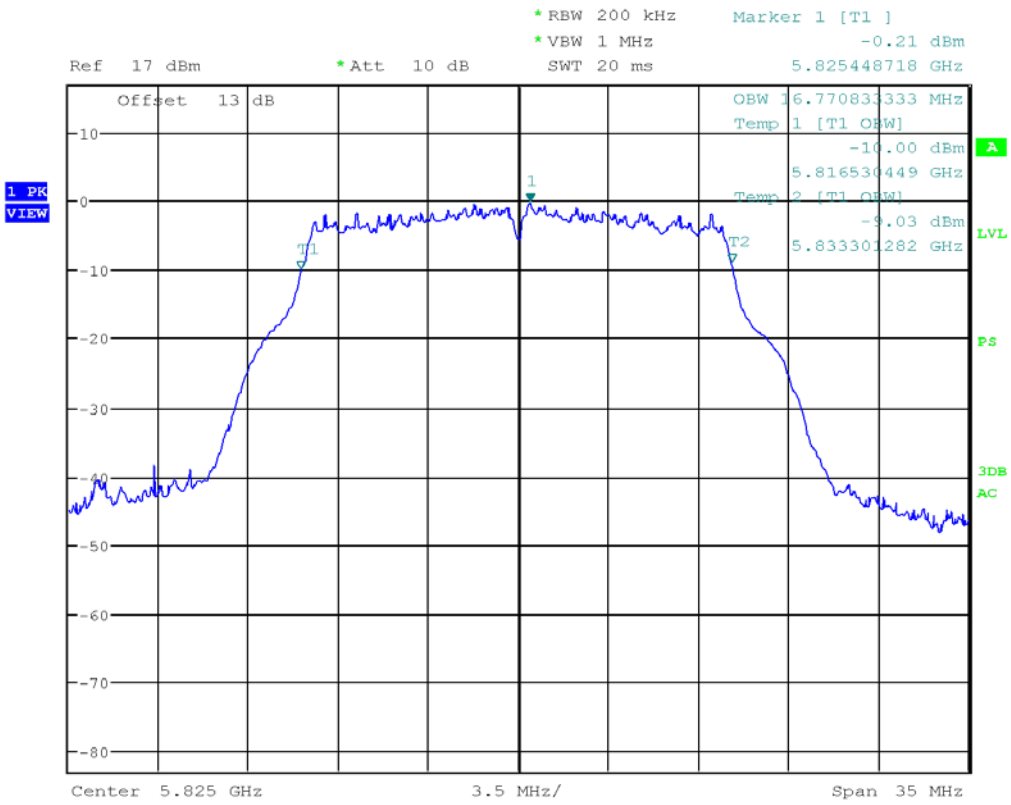
Plot 1.12

802.11a, 5825MHz



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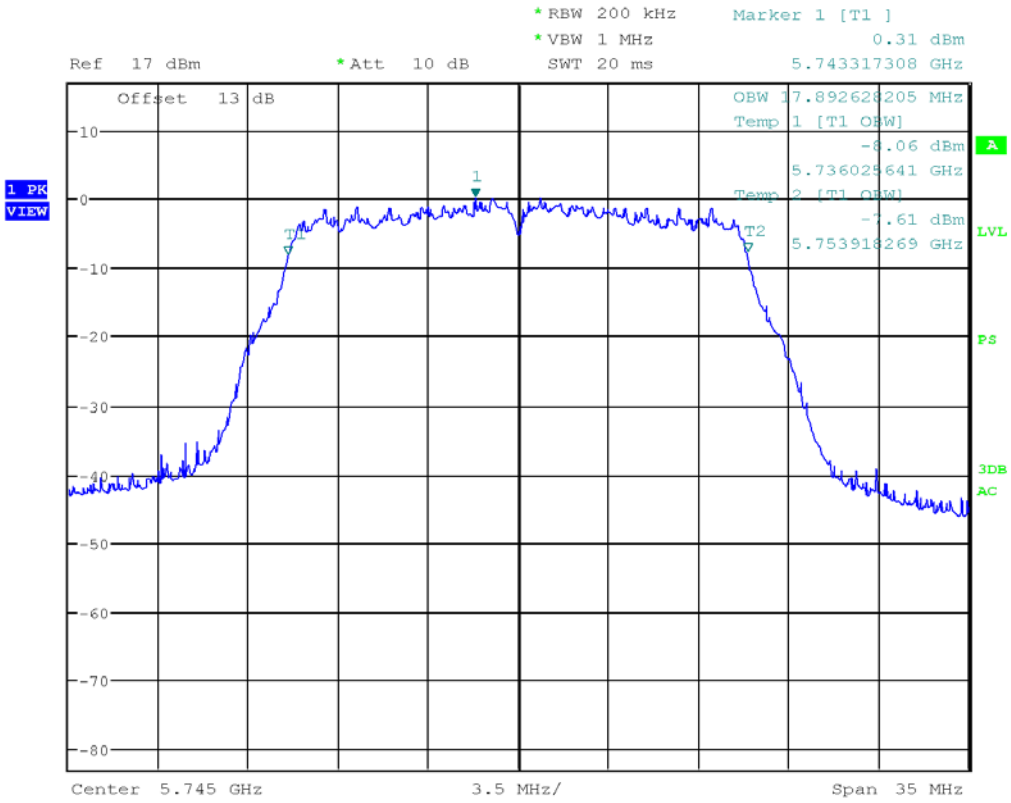
802.11n 20MHz, 5745MHz



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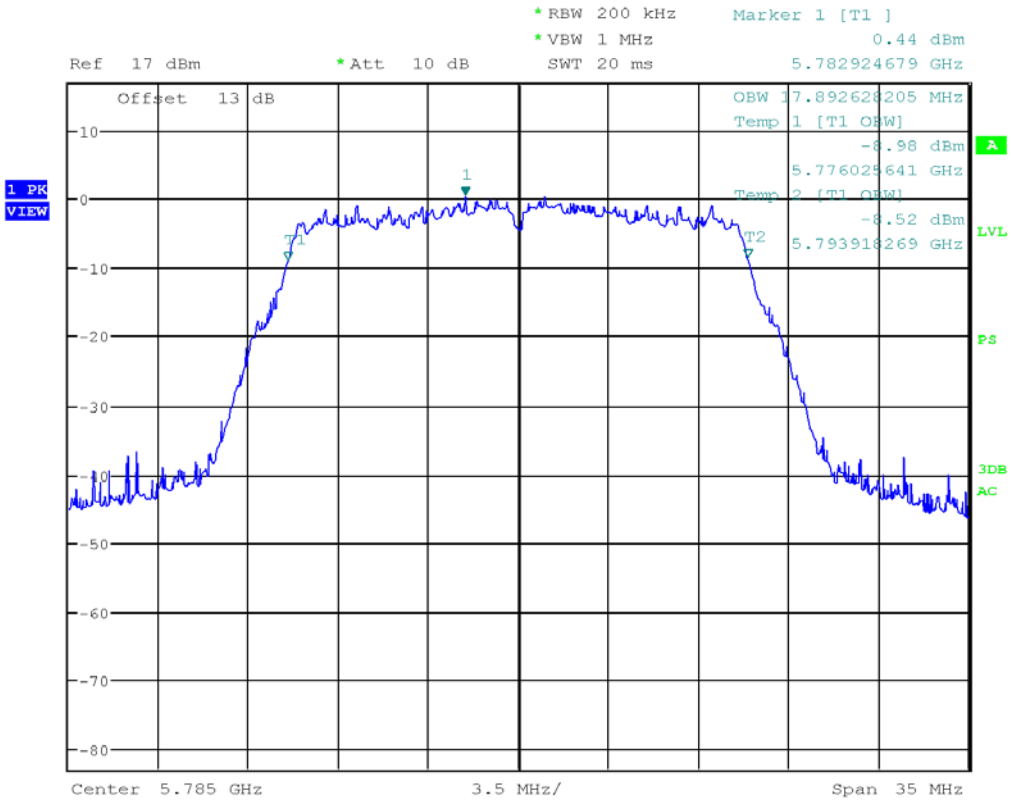
Plot 1.14

802.11n 20MHz, 5785MHz



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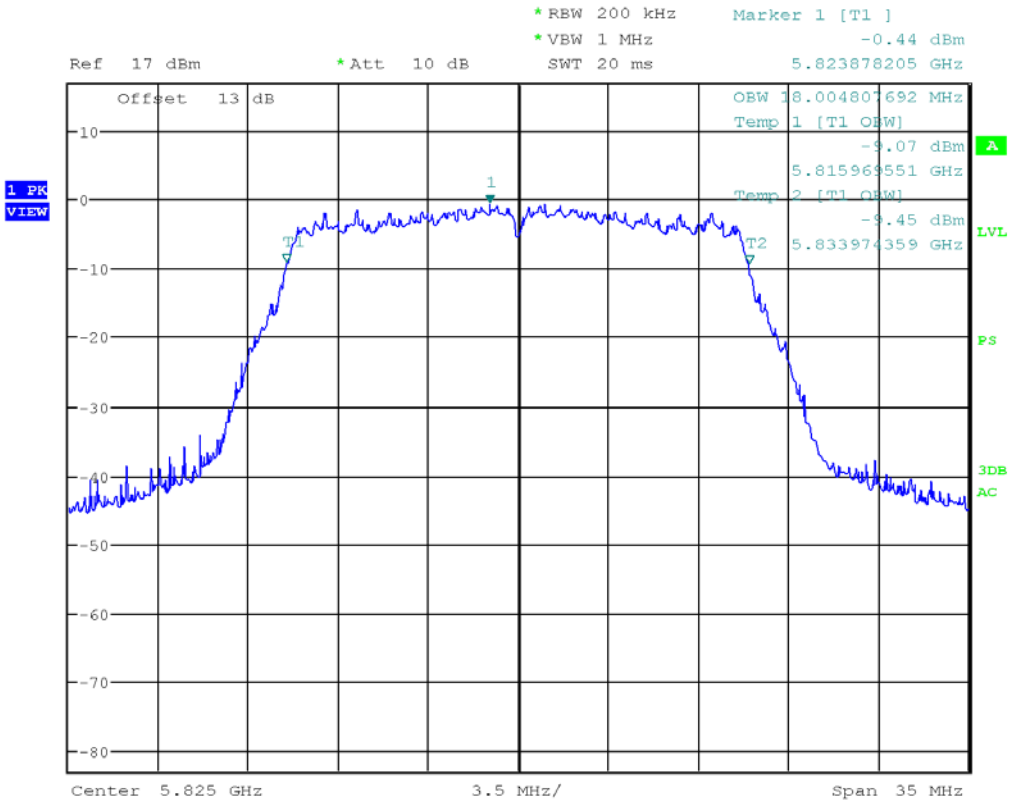
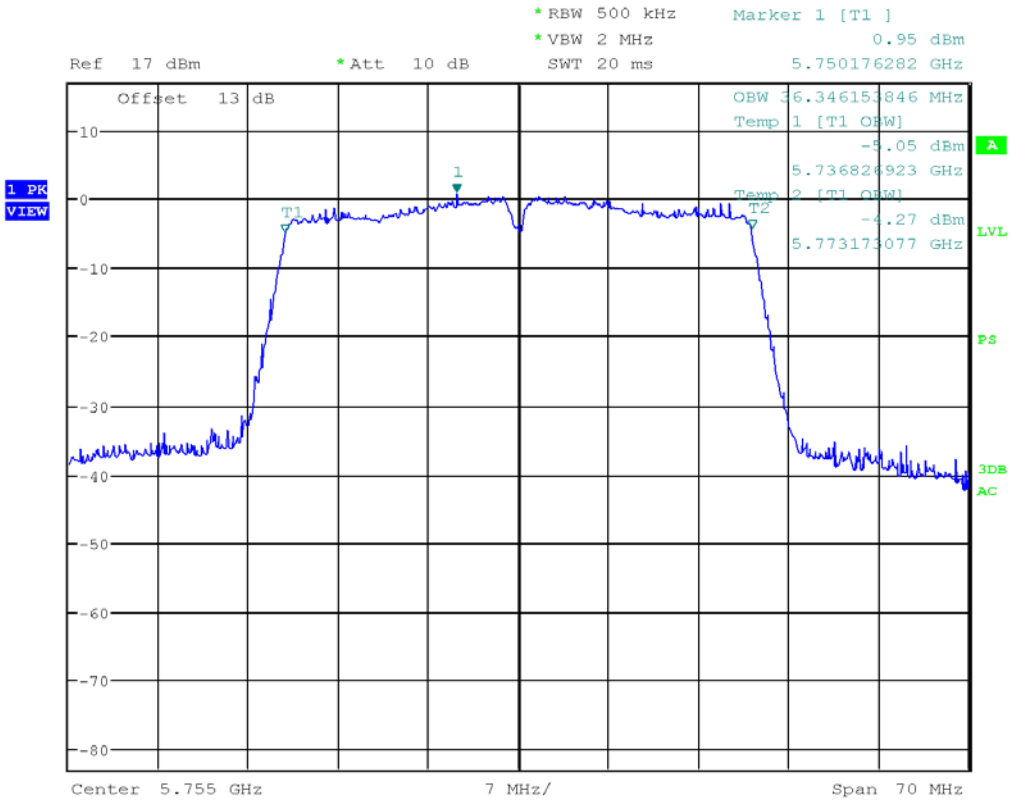
Plot 1.15

802.11n 20MHz, 5825MHz



Plot 1.16

802.11n 40MHz, 5755MHz



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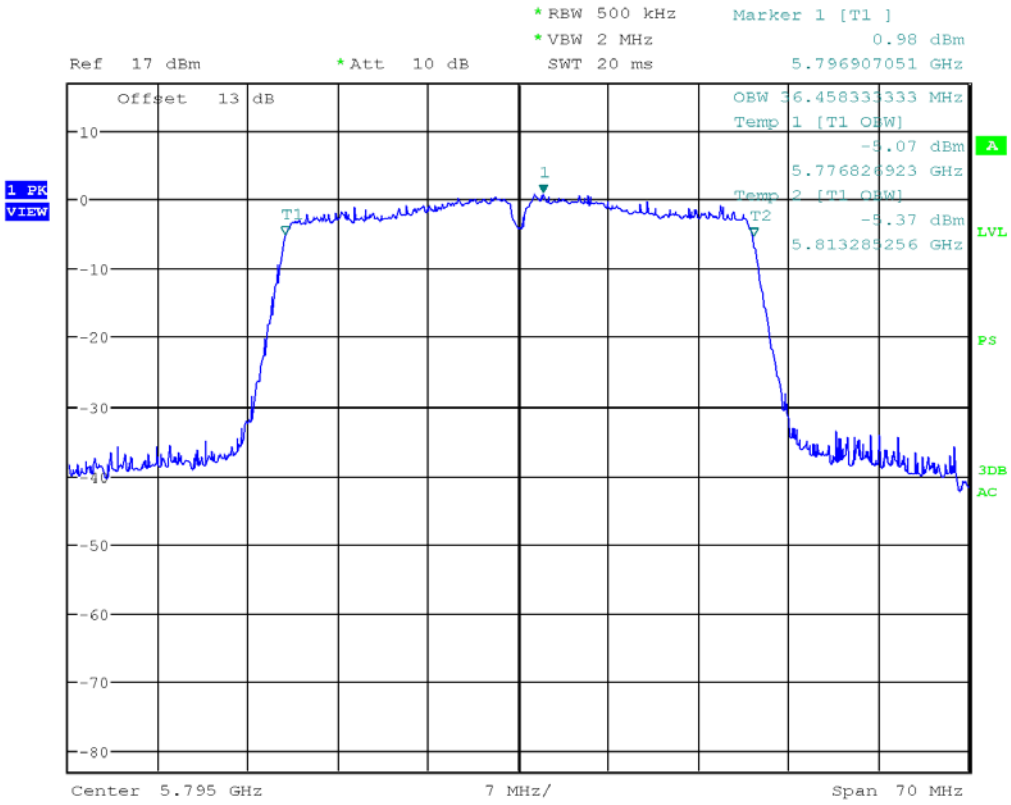
802.11n 40MHz, 5795MHz



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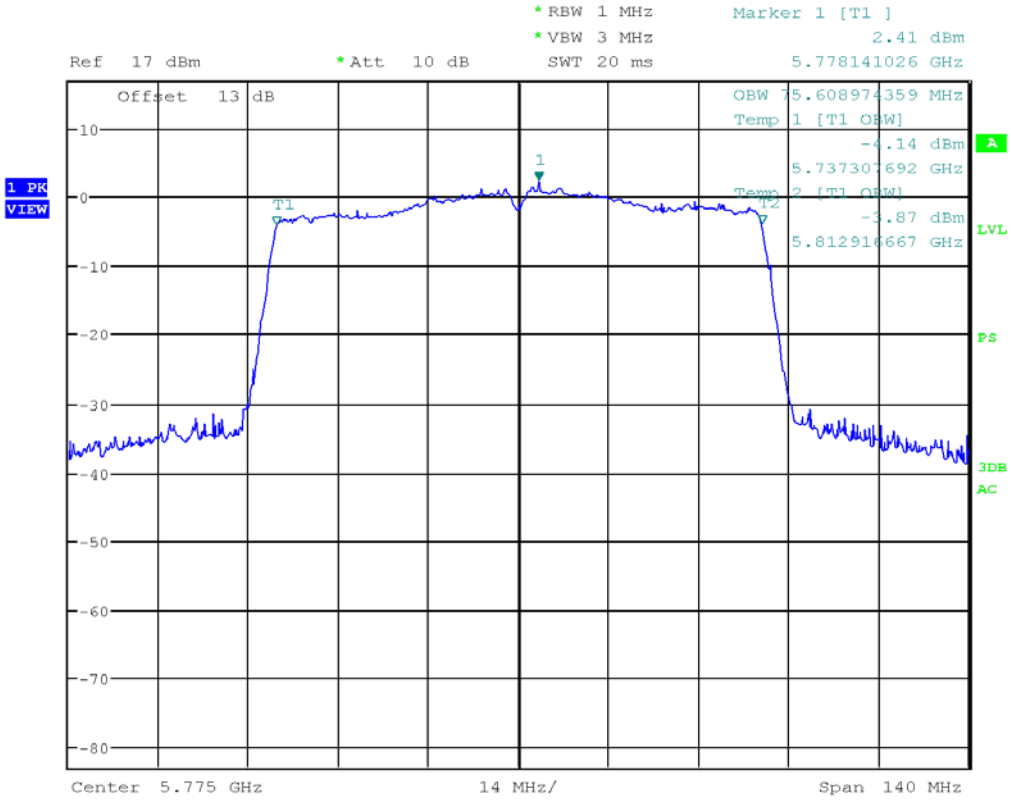
Plot 1.18

802.11ac, 80MHz 5775MHz



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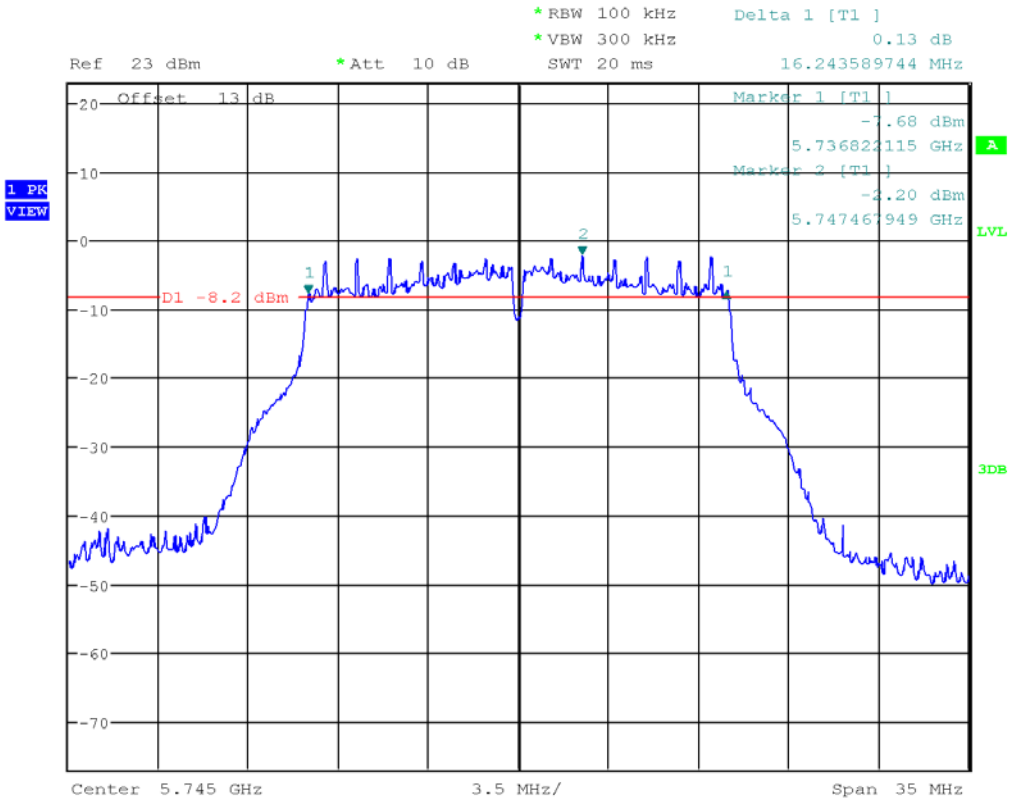
802.11a, 5745MHz



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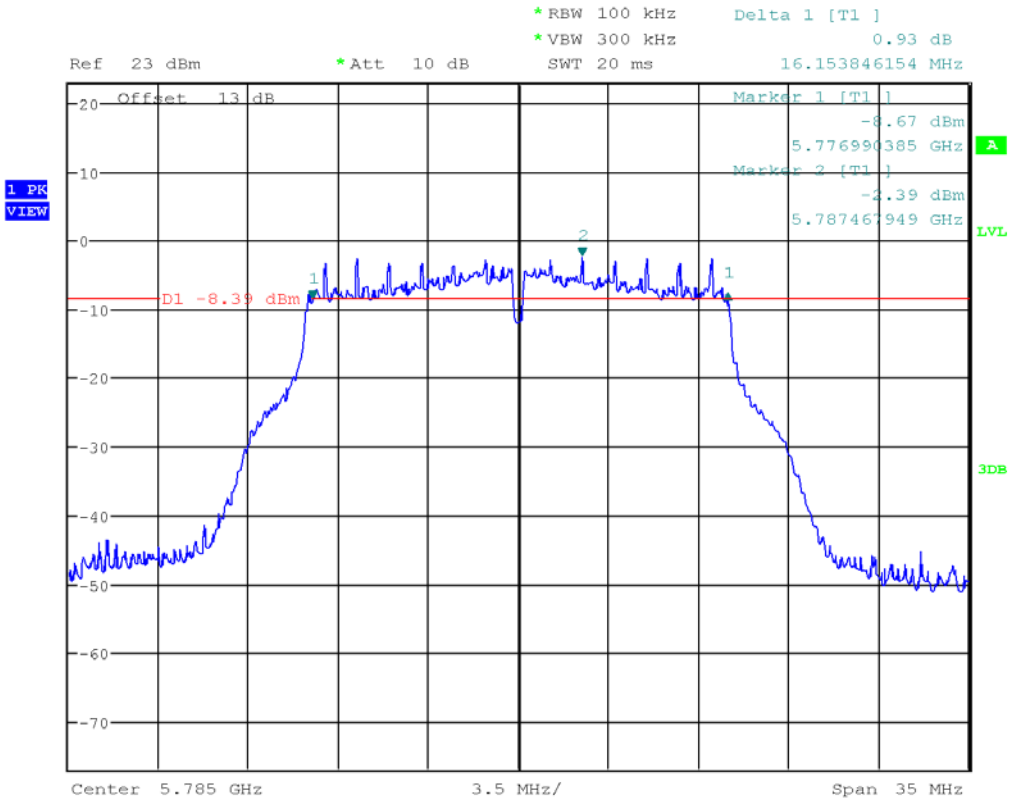
Plot 1.20

802.11a, 5785MHz



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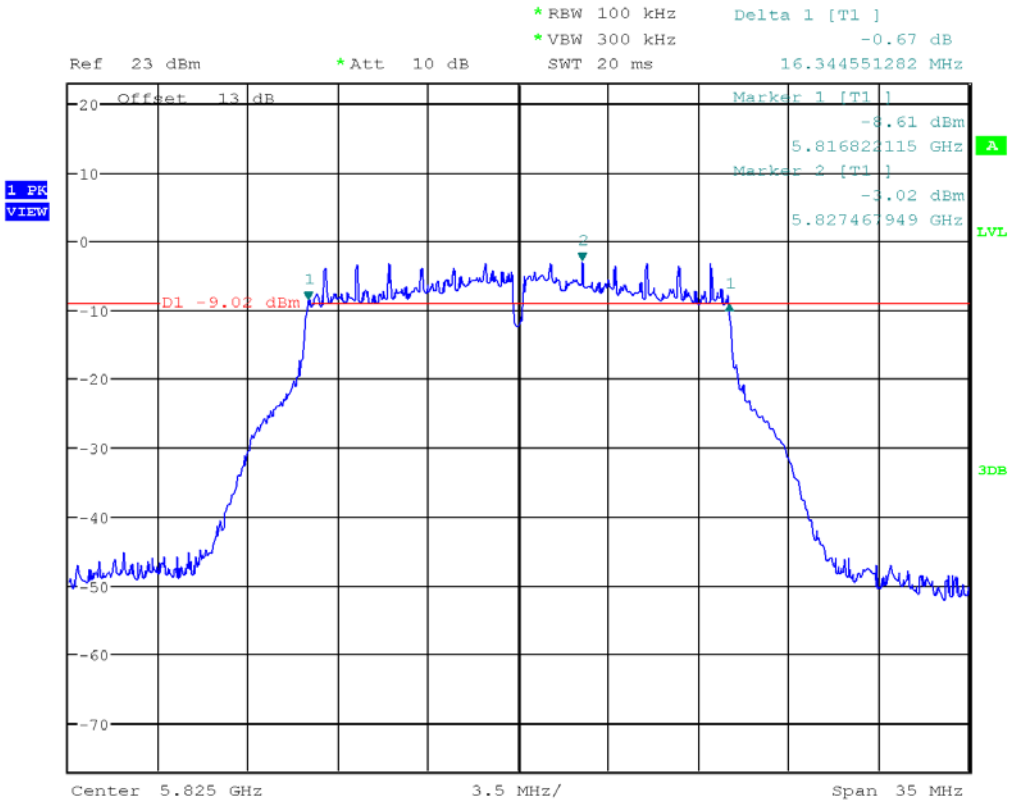
802.11a, 5825MHz



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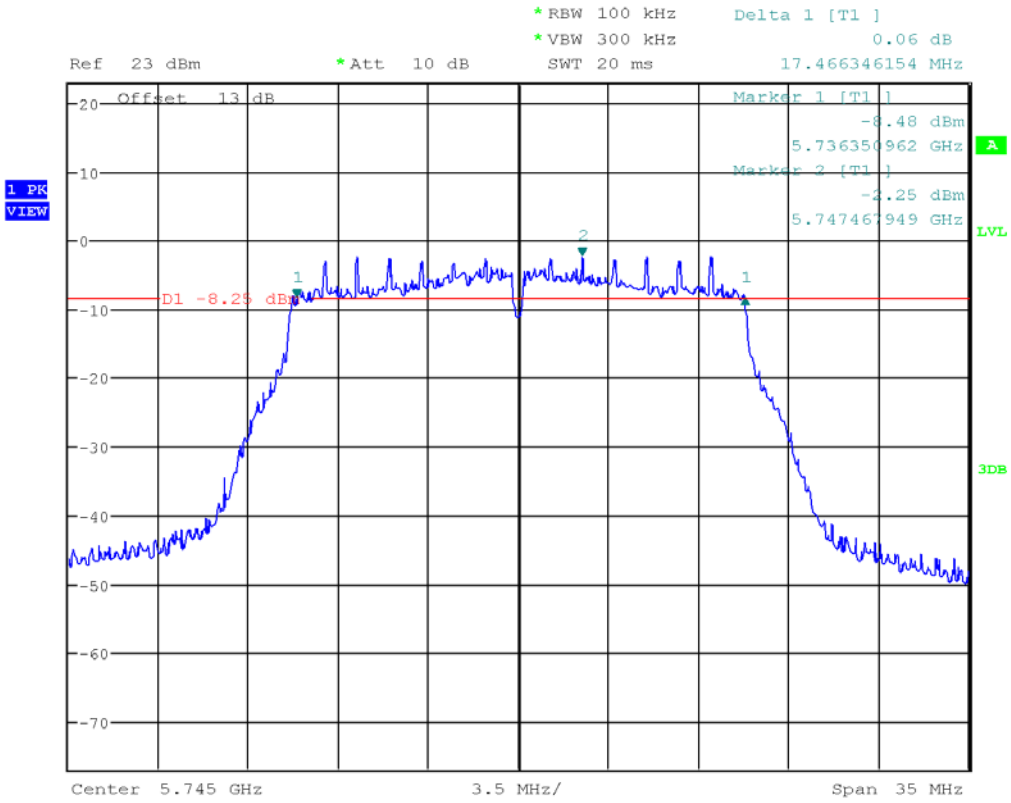
802.11n 20MHz, 5745MHz



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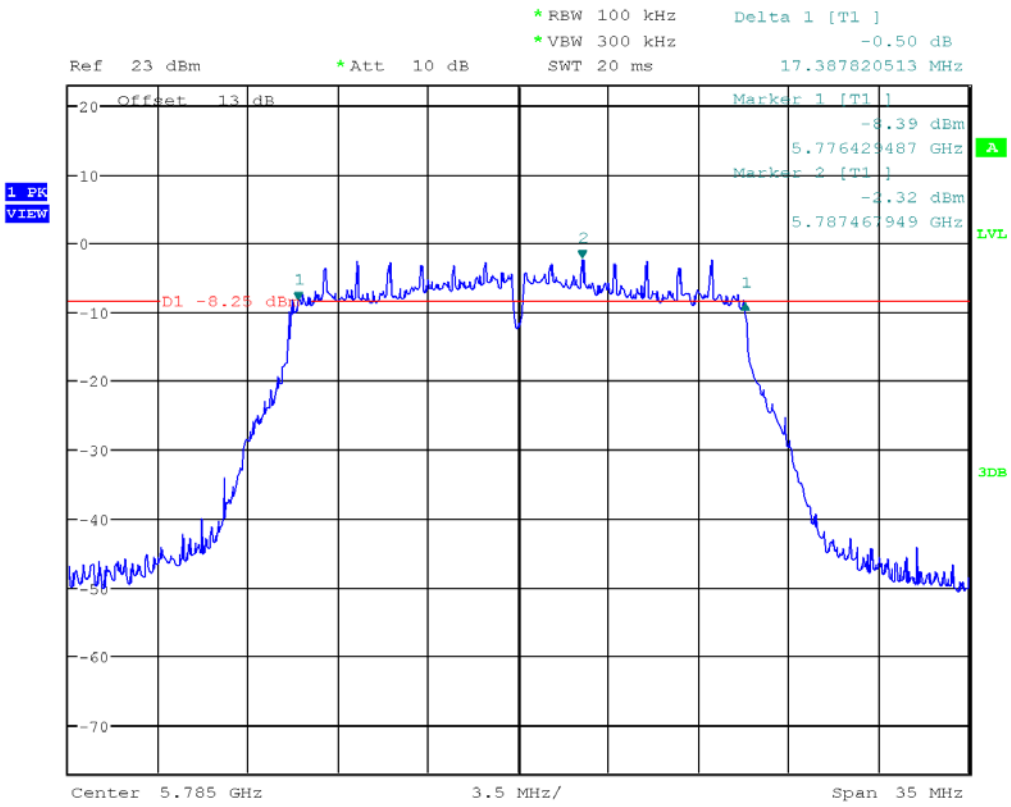
802.11n 20MHz, 5785MHz



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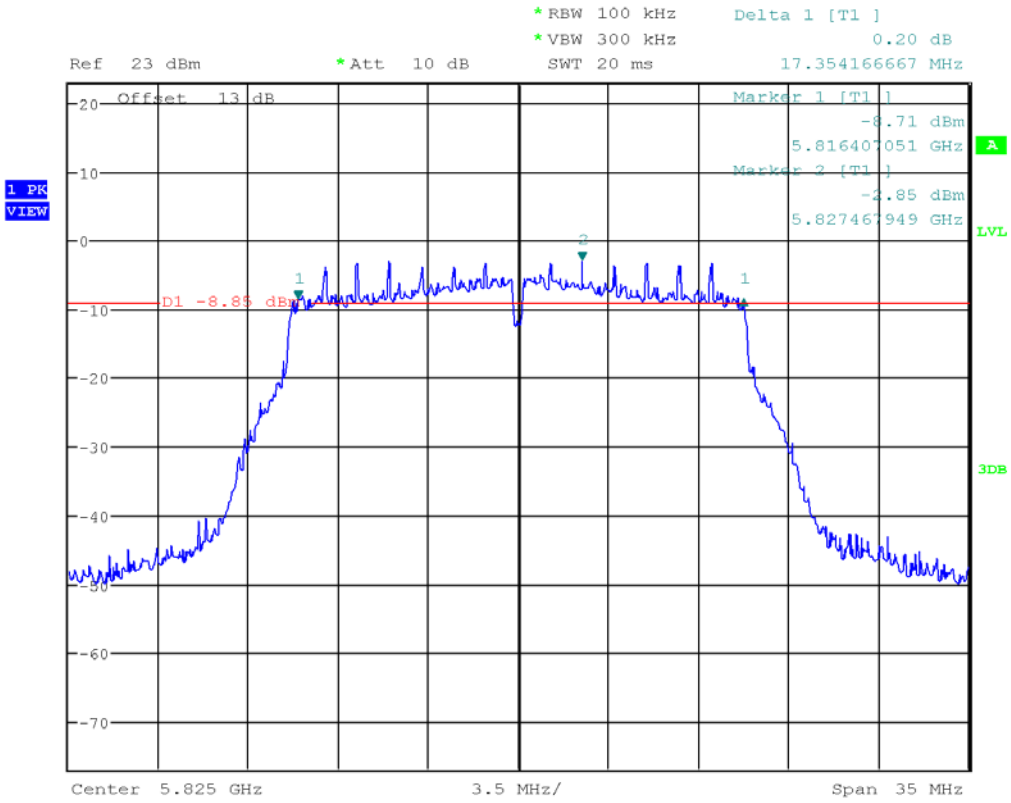
802.11n 20MHz, 5825MHz



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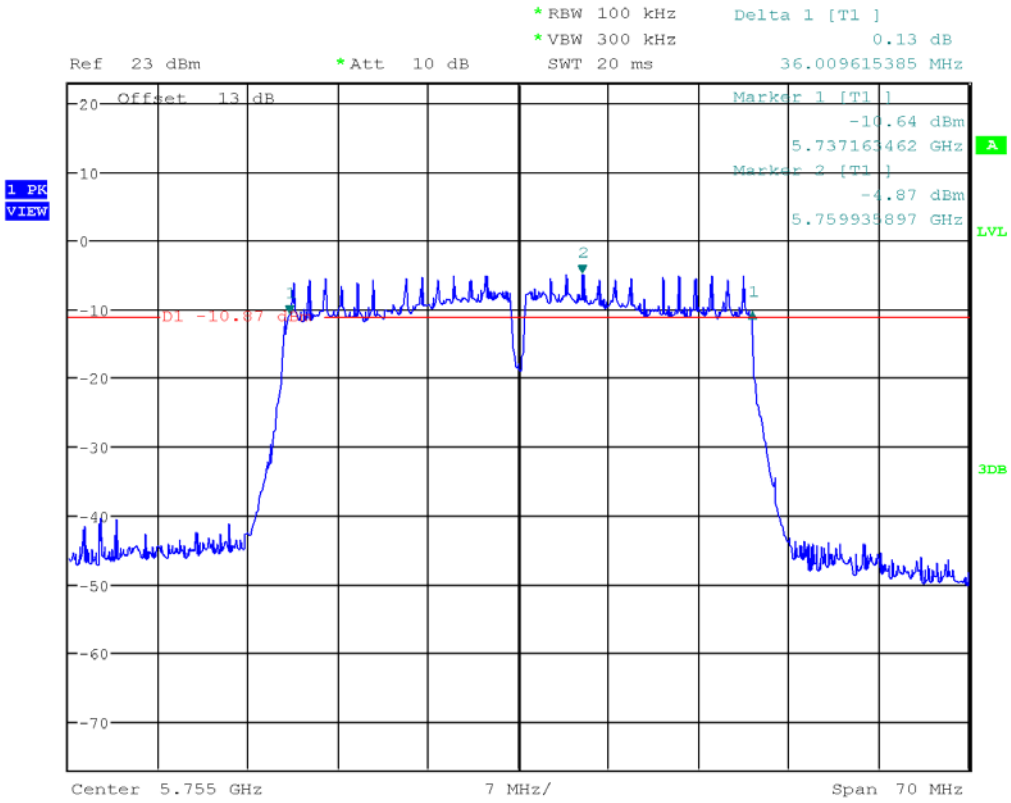
Plot 1.25

802.11n 40MHz, 5755MHz



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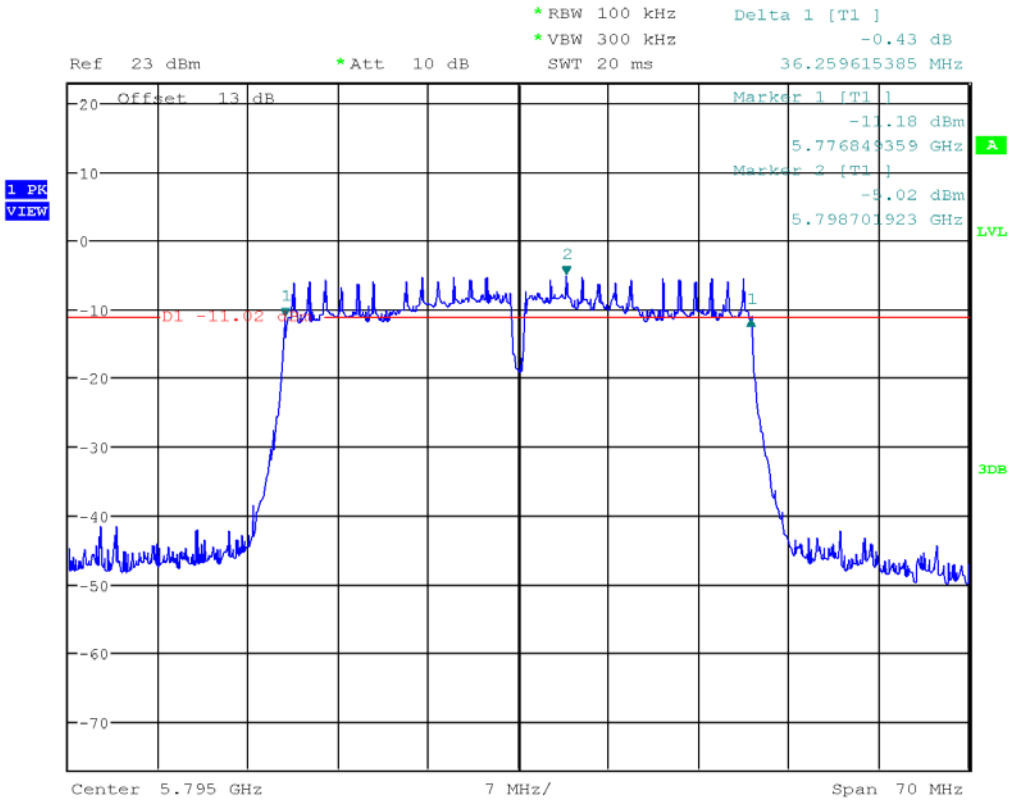
802.11n 40MHz, 5795MHz



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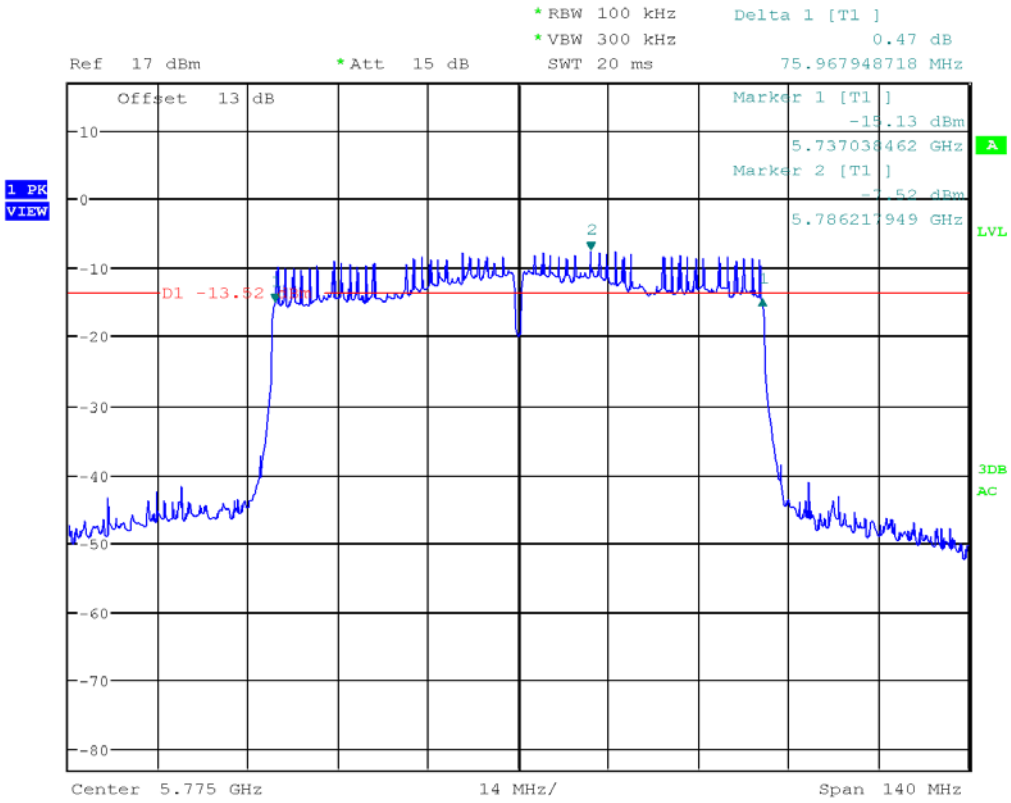
Plot 1.27

802.11ac, 80MHz 5775MHz



Date: 27.JUN.2019 08:40:31

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

4.2.1 Requirement

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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	Test Date
Todd Moy	June 26- 27, 2019

4.2.3 Test Results

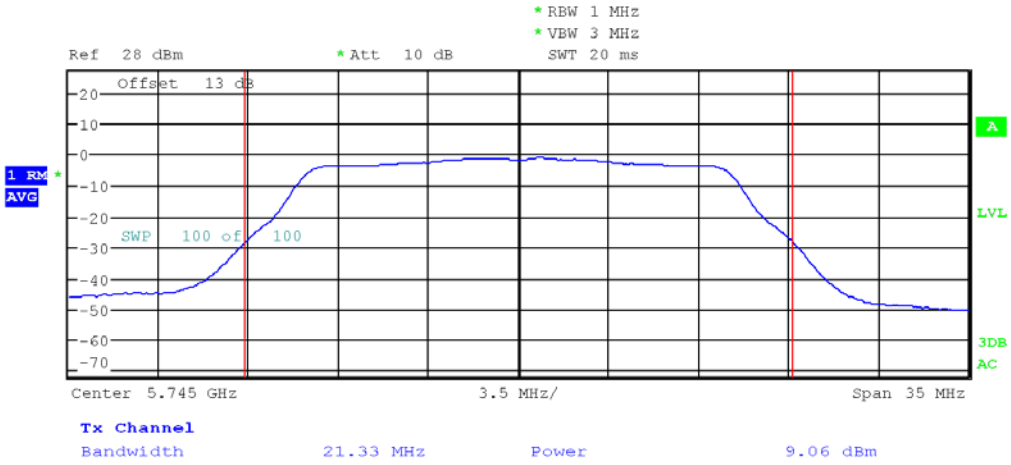
Refer to the following plots for the test result:

Mode	Channel	Frequency MHz	Conducted power (average) dBm	Conducted power Limit dBm	Plot #
802.11a	149	5745	9.06	30	2.1
	157	5785	9.06	30	2.2
	165	5825	8.63	30	2.3
802.11n 20MHz	149	5745	8.76	30	2.4
	157	5785	8.76	30	2.5
	165	5825	8.47	30	2.6
802.11n 40MHz	151	5755	9.19	30	2.7
	159	5795	9.20	30	2.8
802.11ac 80MHz	155	5775	8.88	30	2.9

Mode	Channel	Frequency MHz	PSD dBm	PPSD Limit dBm	Plot #
802.11a	149	5745	-4.210	30	2.10
	157	5785	-4.090	30	2.11
	165	5825	-4.430	30	2.12
802.11n 20MHz	149	5745	-4.770	30	2.13
	157	5785	-4.460	30	2.14
	165	5825	-4.930	30	2.15
802.11n 40MHz	151	5755	-7.180	30	2.16
	159	5795	-7.040	30	2.17
802.11ac 80MHz	155	5775	-13.240	30	2.18

Plot 2. 1

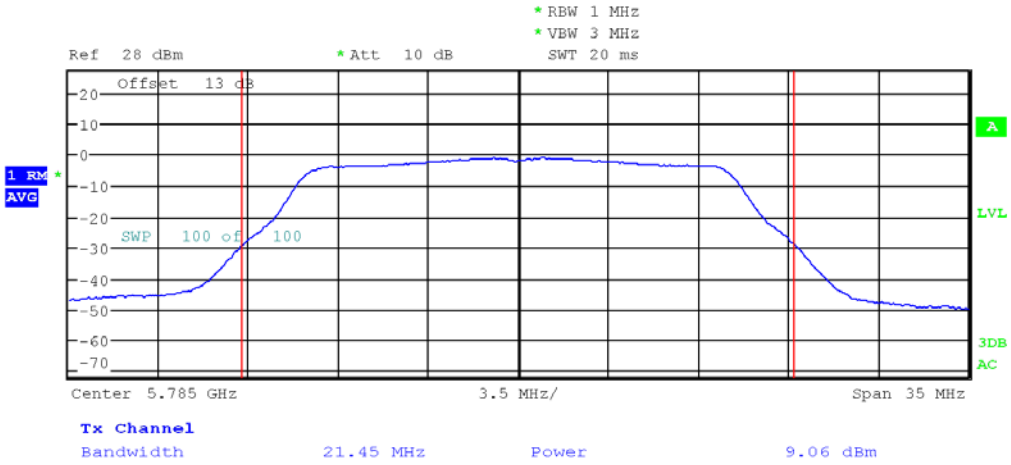
802.11a, 5745MHz



Date: 27.JUN.2019 10:51:43

Plot 2. 2

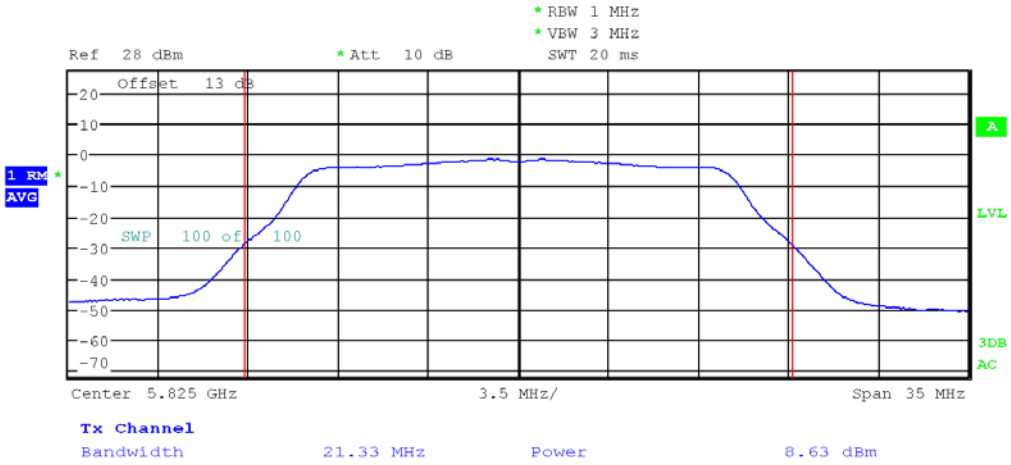
802.11a, 5785MHz



Date: 27.JUN.2019 10:52:45

Plot 2. 3

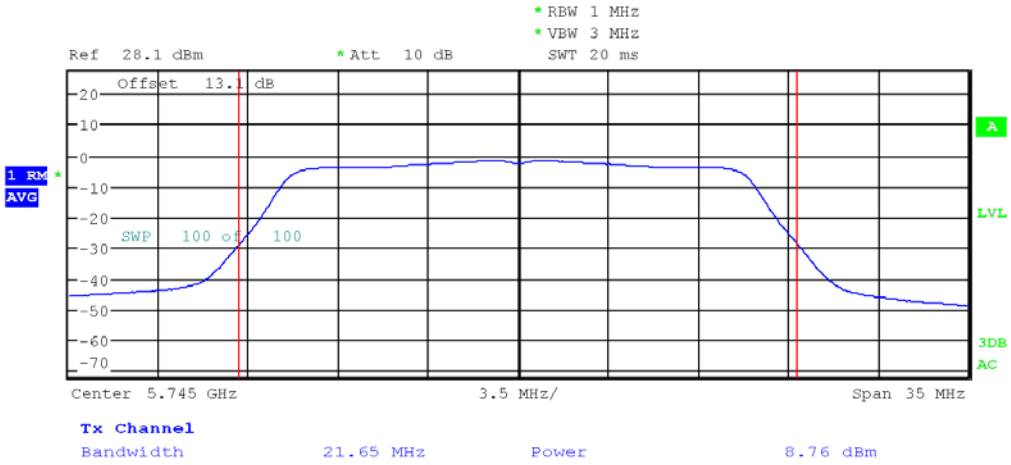
802.11a, 5825MHz



Date: 27.JUN.2019 10:54:25

Plot 2. 4

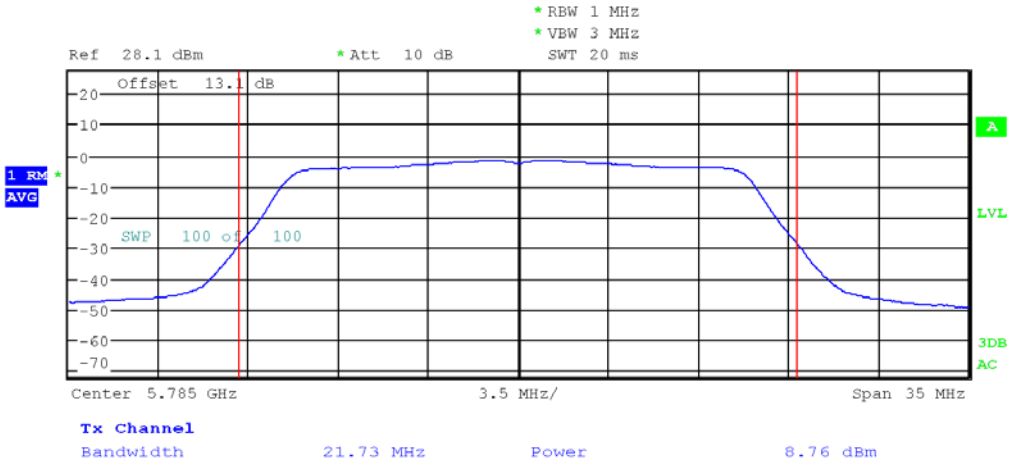
802.11n 20MHz, 5745MHz



Date: 27.JUN.2019 11:00:03

Plot 2. 5

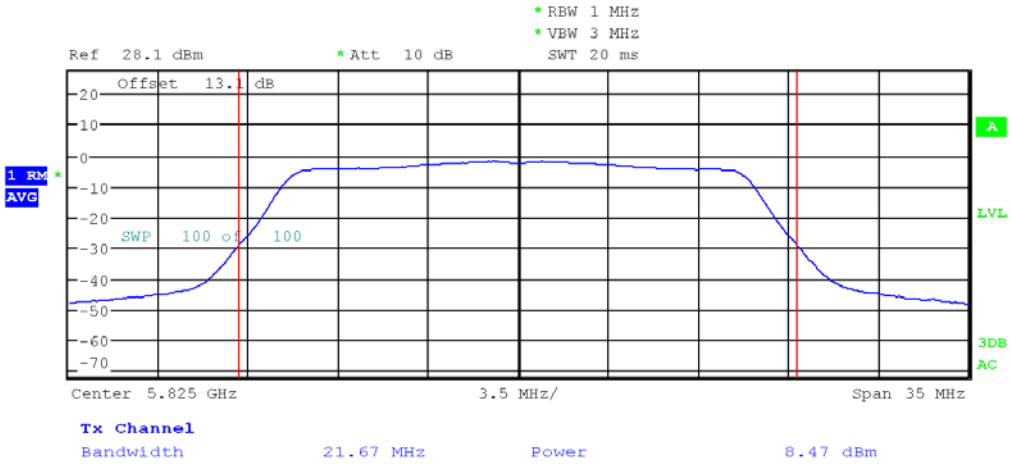
802.11n 20MHz, 5785MHz



Date: 27.JUN.2019 11:00:51

Plot 2. 6

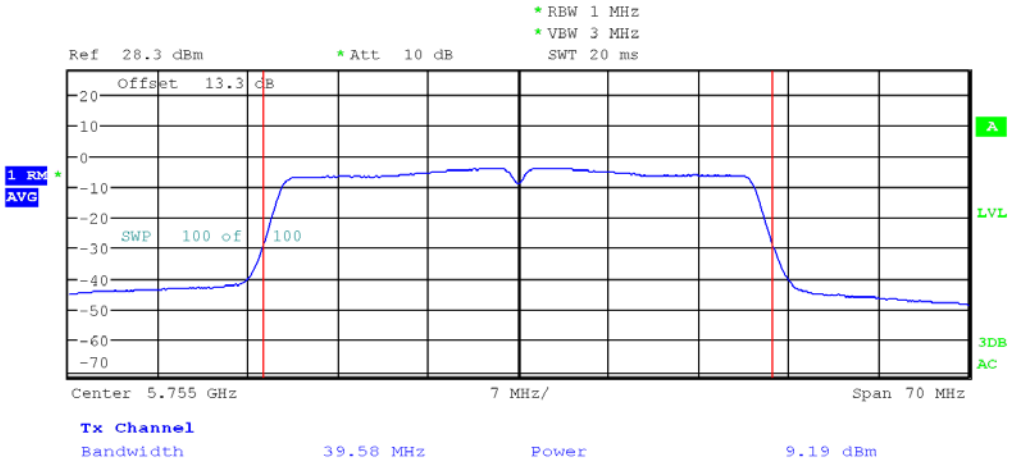
802.11n 20MHz, 5825MHz



Date: 27.JUN.2019 11:02:03

Plot 2. 7

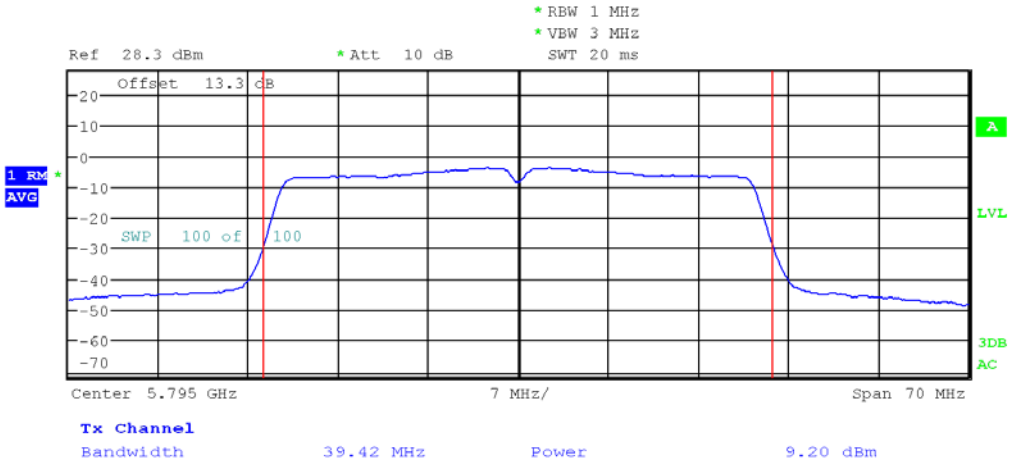
802.11n 40MHz, 5755MHz



Date: 27.JUN.2019 11:14:30

Plot 2. 8

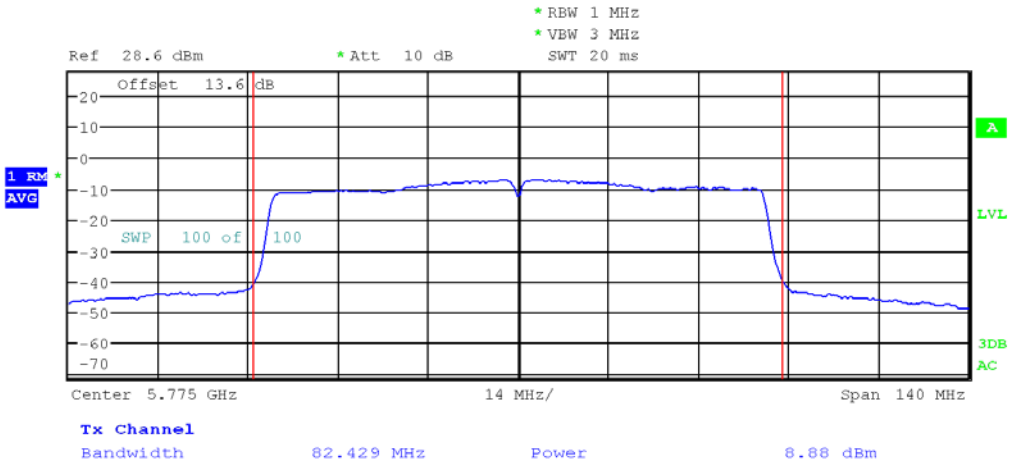
802.11n 40MHz, 5795MHz



Date: 27.JUN.2019 11:15:26

Plot 2. 9

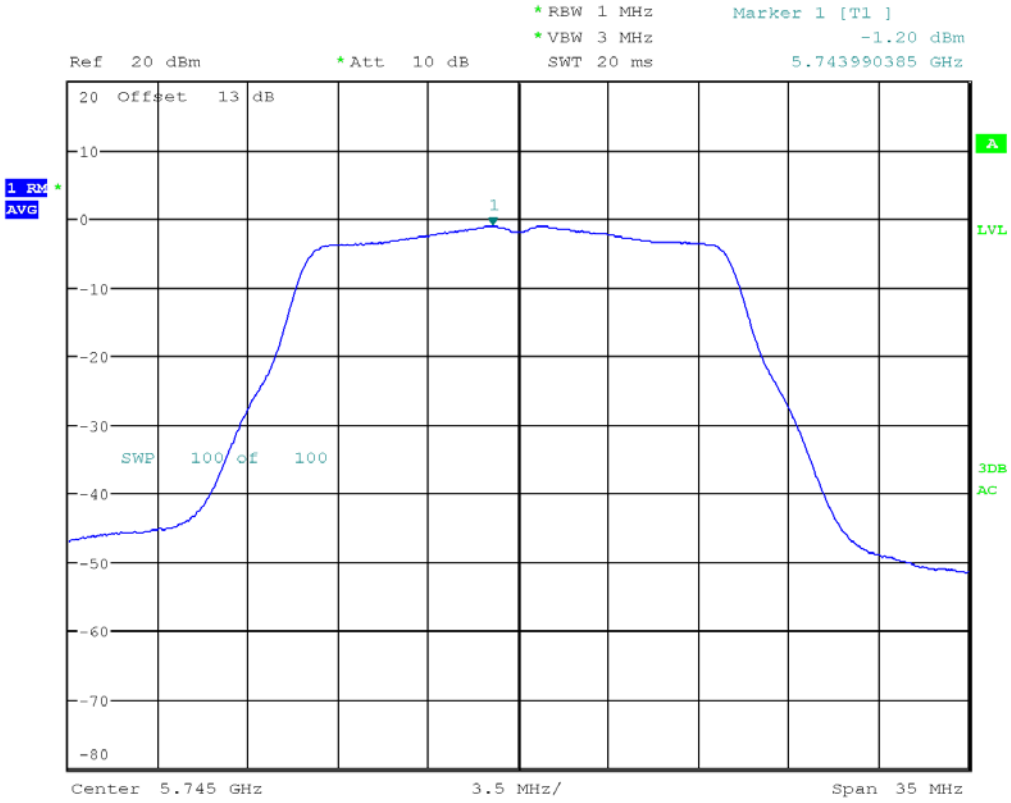
802.11ac 80MHz, 5775MHz



Date: 27.JUN.2019 11:28:03

Plot 2. 90

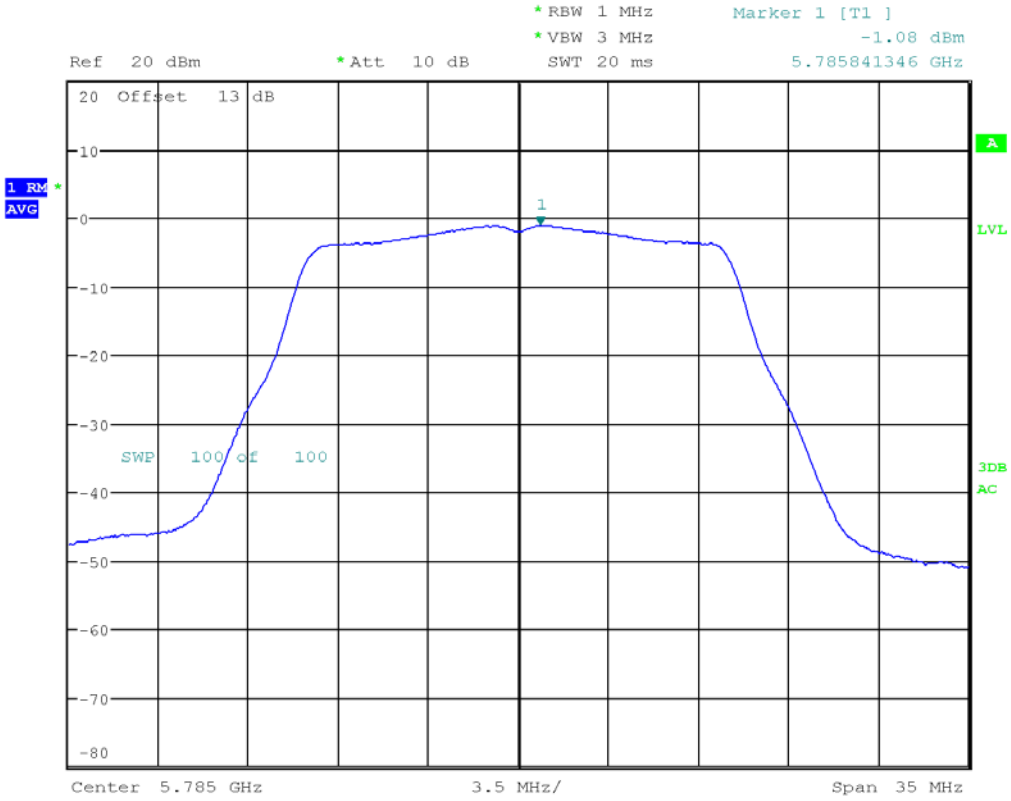
802.11a, 5745MHz



Date: 27.JUN.2019 13:28:14

Plot 2. 11

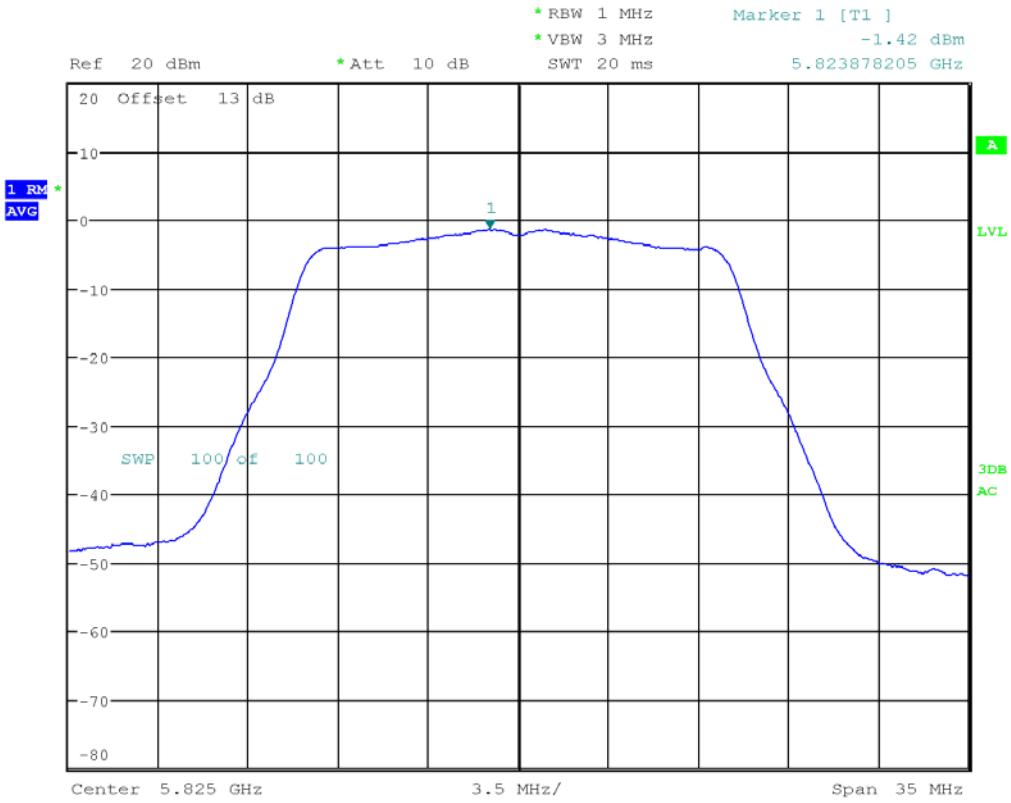
802.11a, 5785MHz



Date: 27.JUN.2019 13:29:04

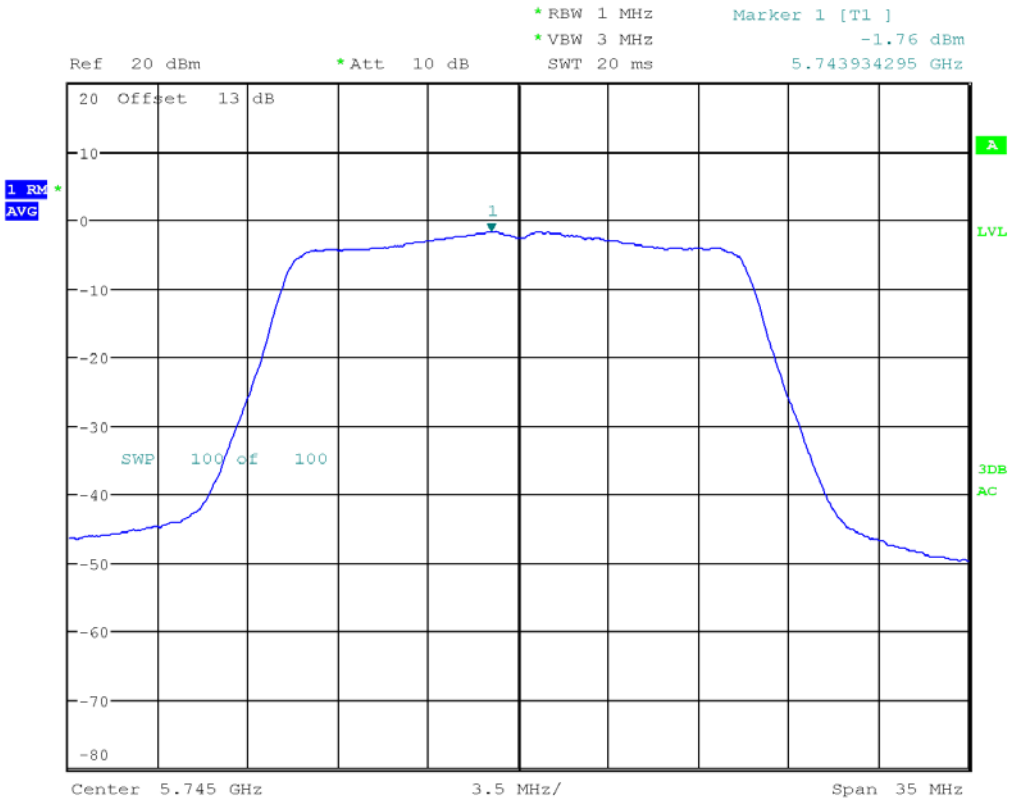
Plot 2. 12

802.11a, 5825MHz



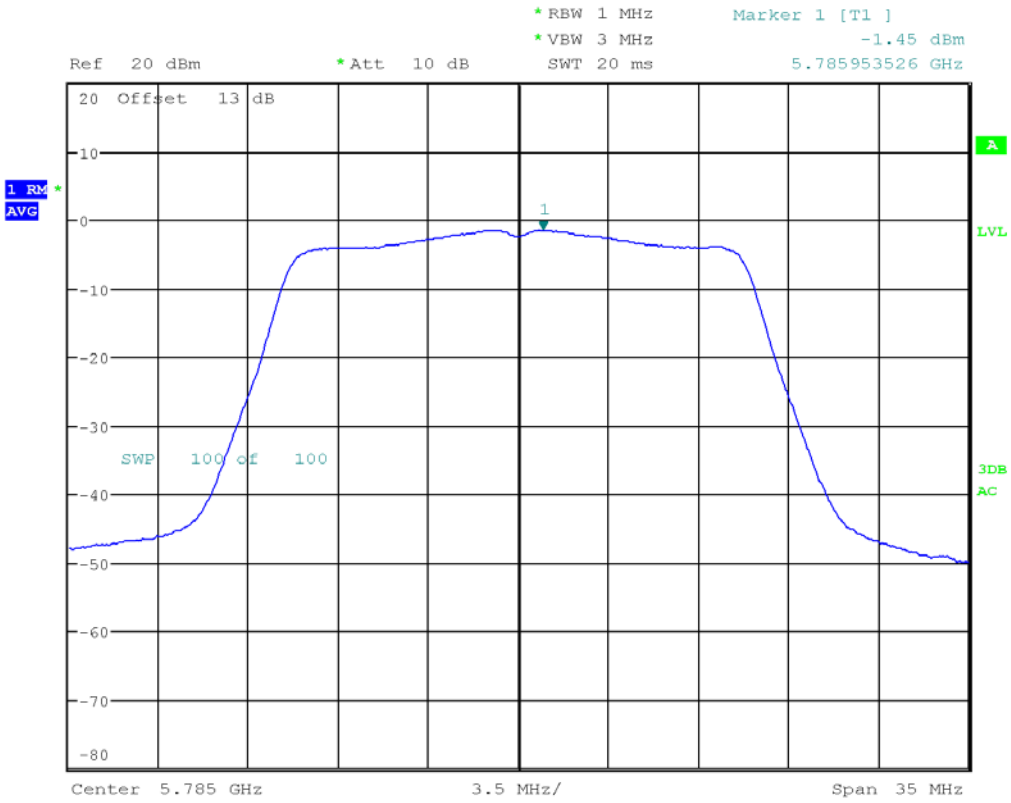
Plot 2. 13

802.11n 20MHz, 5745MHz



Plot 2. 14

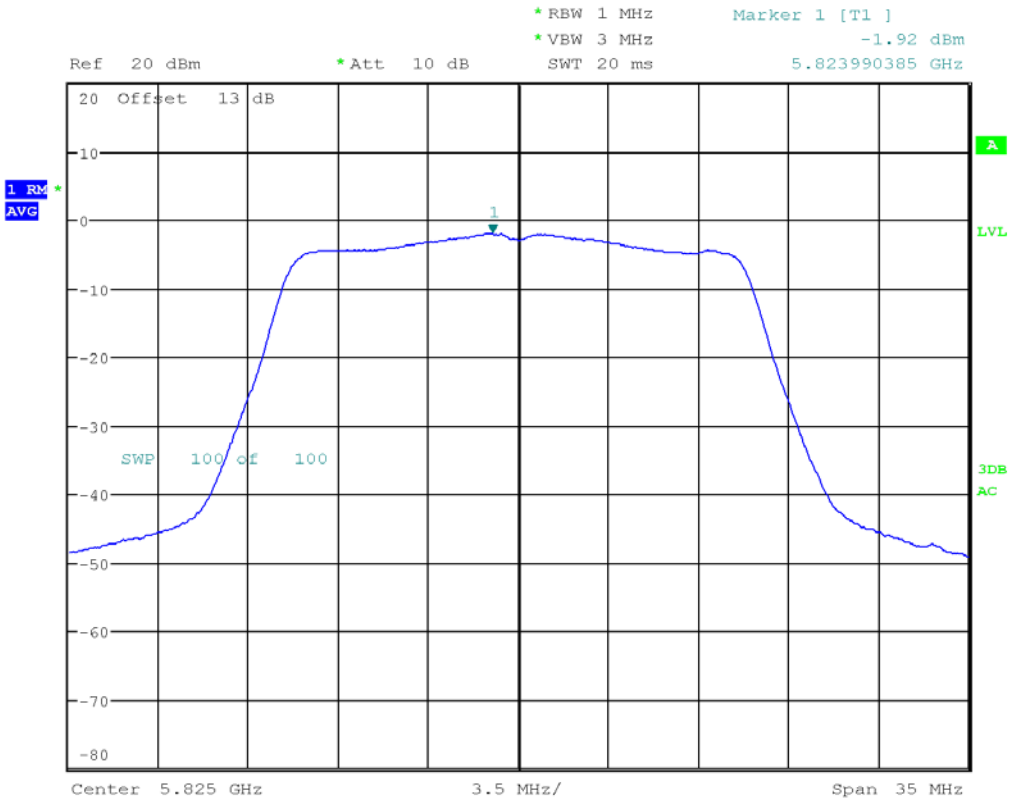
802.11n 20MHz, 5785MHz



Date: 27.JUN.2019 13:33:30

Plot 2. 15

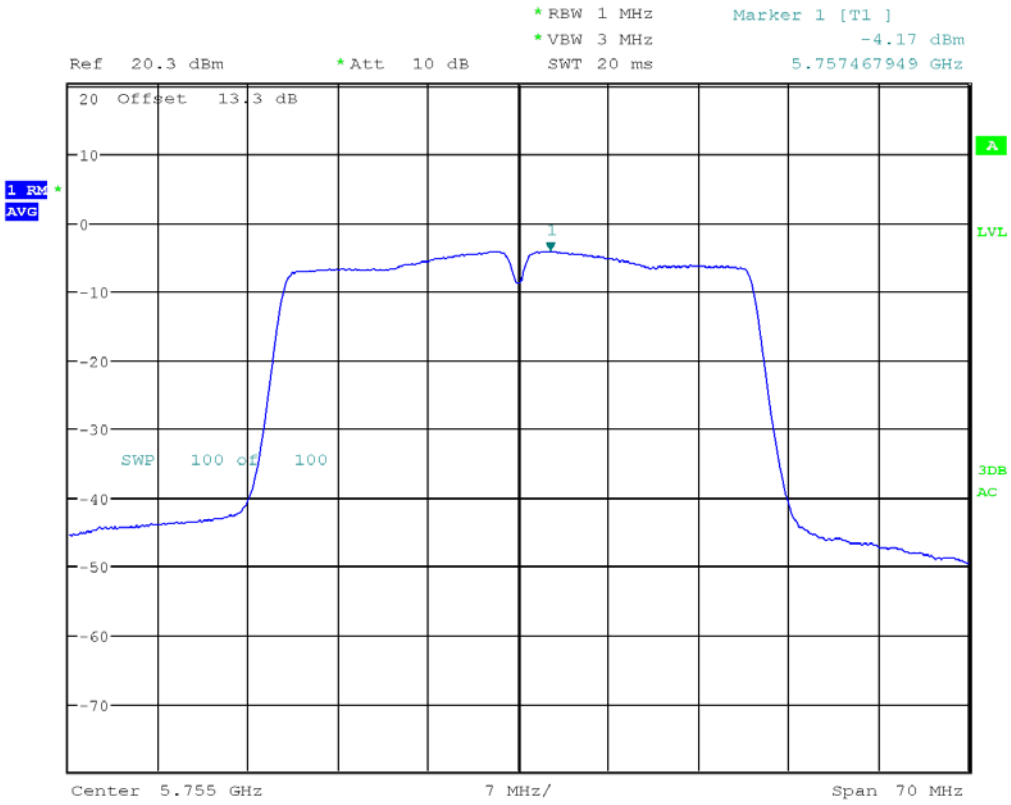
802.11n 20MHz, 5825MHz



Date: 27.JUN.2019 13:34:54

Plot 2. 16

802.11n 40MHz, 5755MHz



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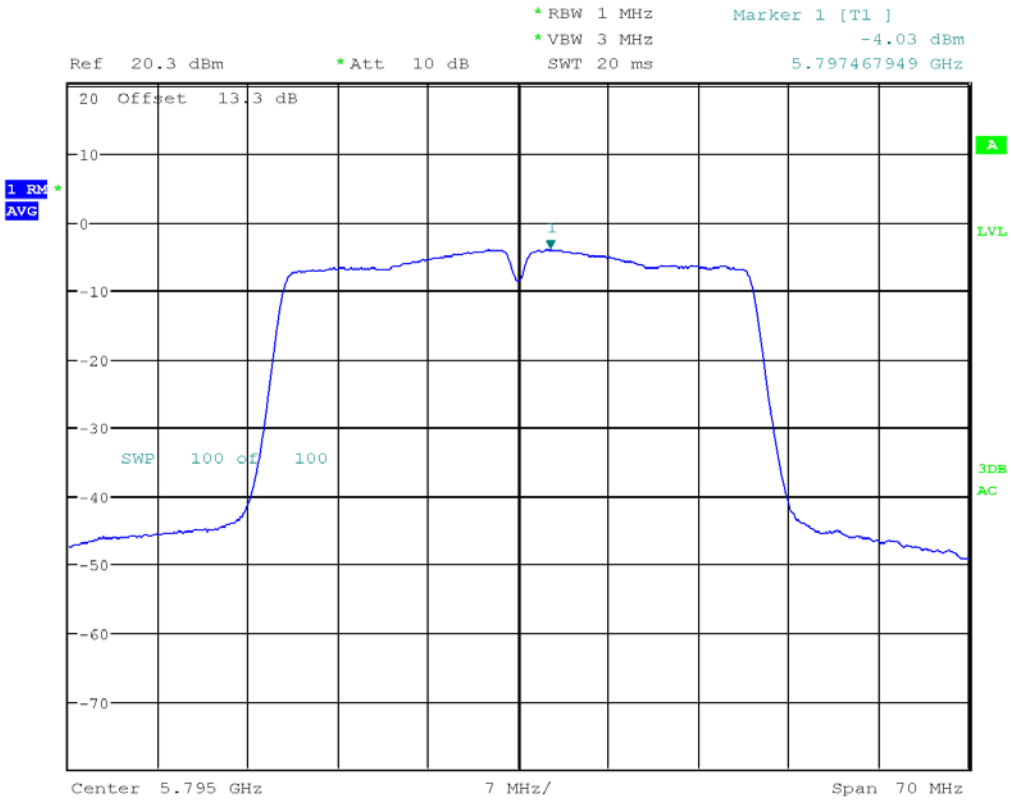
Plot 2. 17

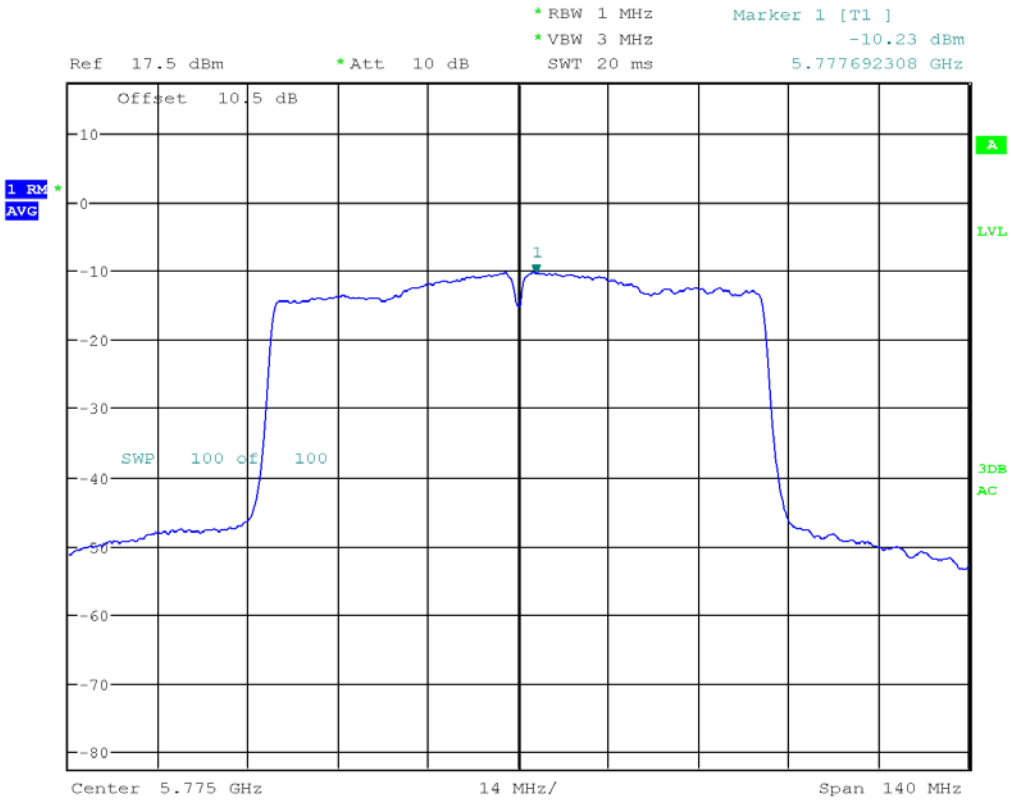
802.11n 40MHz, 5795MHz



Date: 27.JUN.2019 13:42:44

Plot 2. 18

802.11ac 80MHz, 5775MHz



Date: 27.JUN.2019 13:46:00

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.

Out-of-band radiated emission complied with both the average and peak limits of Section 15.209 and an EIRP of -27 dBm/MHz (or 68.23 dBuV at 3m)

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.

Radiated measurements were performed on the X, Y and Z orientation of the EUT. Data is presented with 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:
$E = EIRP - 20\log D + 104.8$
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.

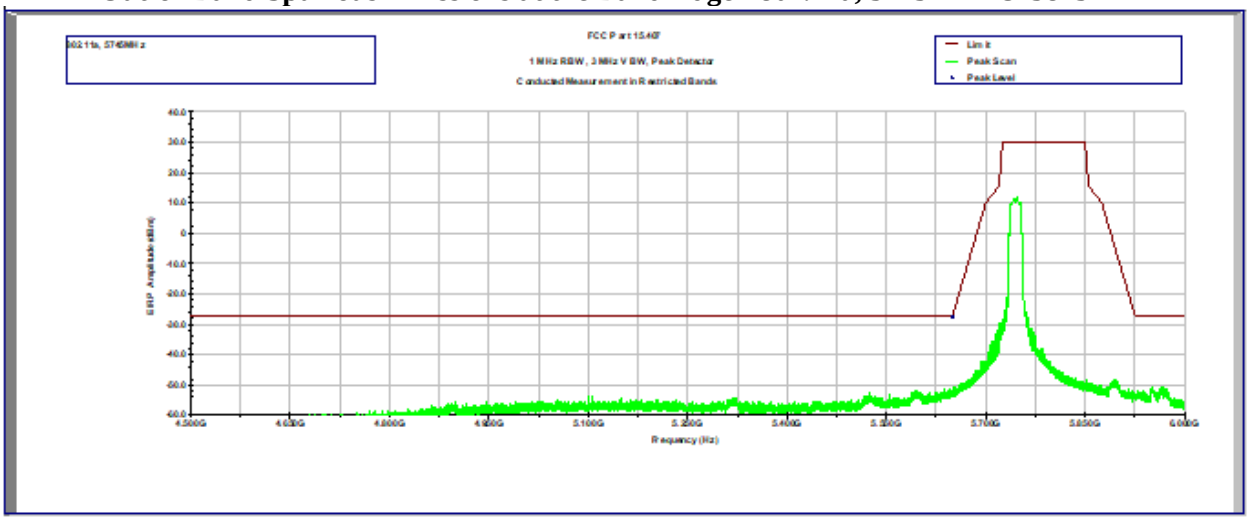
All conducted antenna port plots are corrected with the consideration of a 3.1 dBi Antenna Gain.

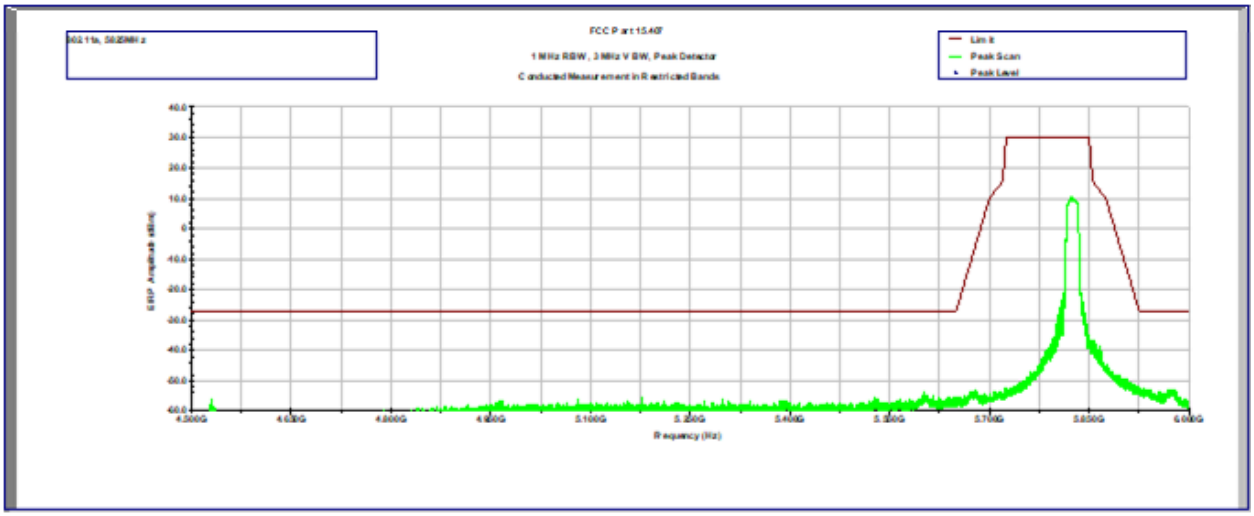
Radiated emission measurements were performed up to 40GHz. No Emissions were identified when scanned from 18-40 GHz.

Tested By	Test Date
Todd Moy	September 27 -October 11, 2018

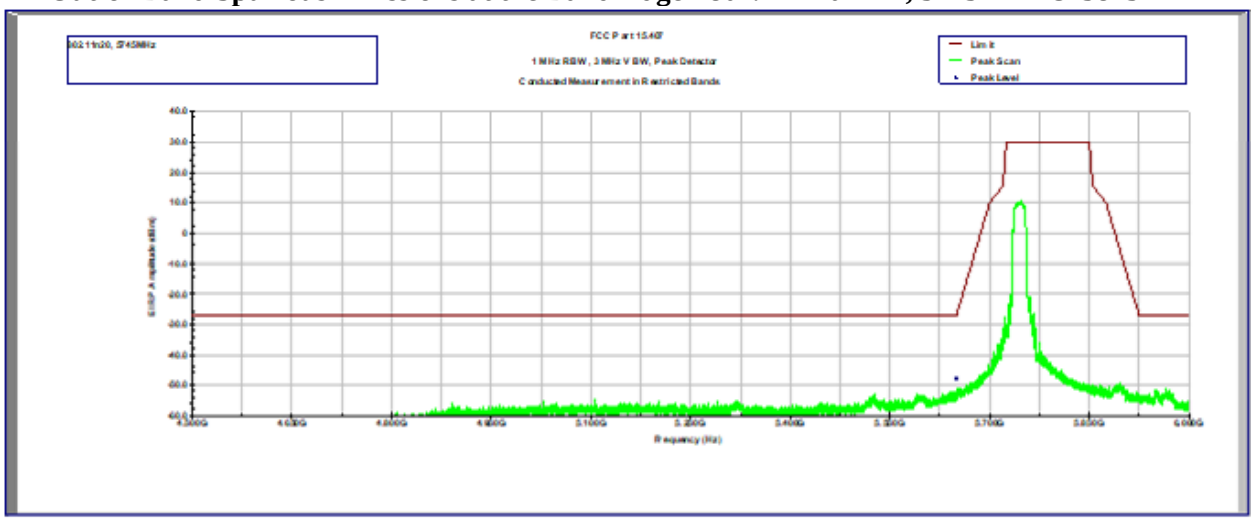
Test Results: 15.209/15.205 Restricted Band Emissions at Antenna Port

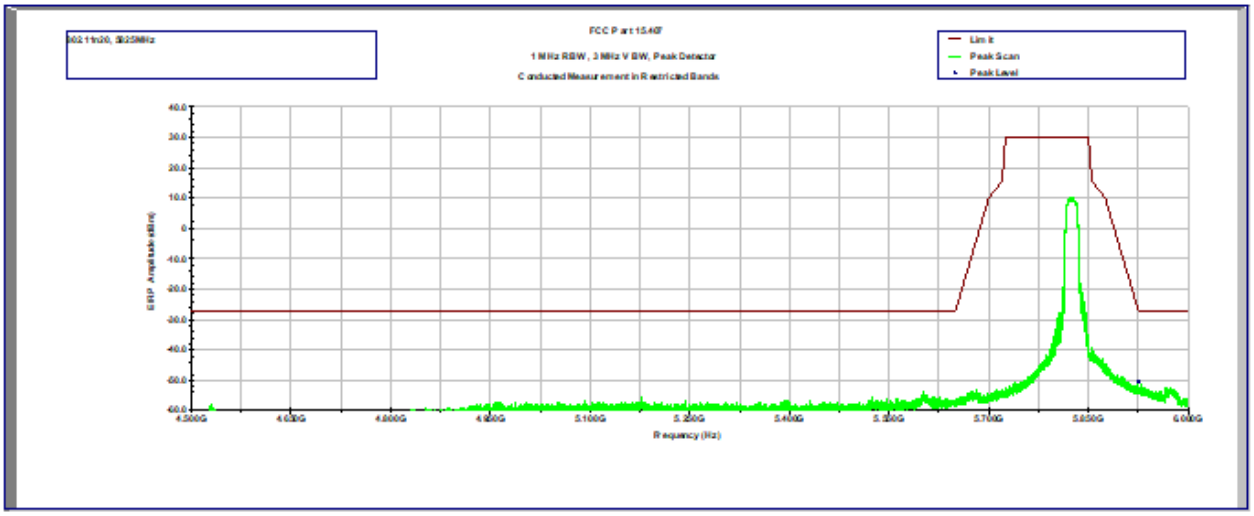
Out-of-Band Spurious Emissions at the Band Edge - 802.11a, 5745MHz & 5825MHz



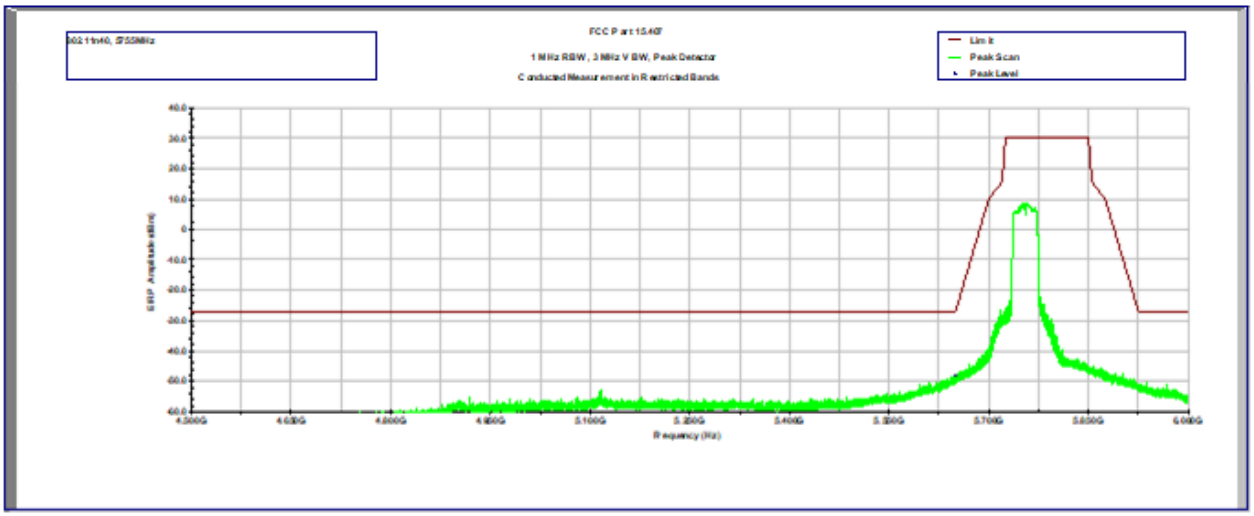


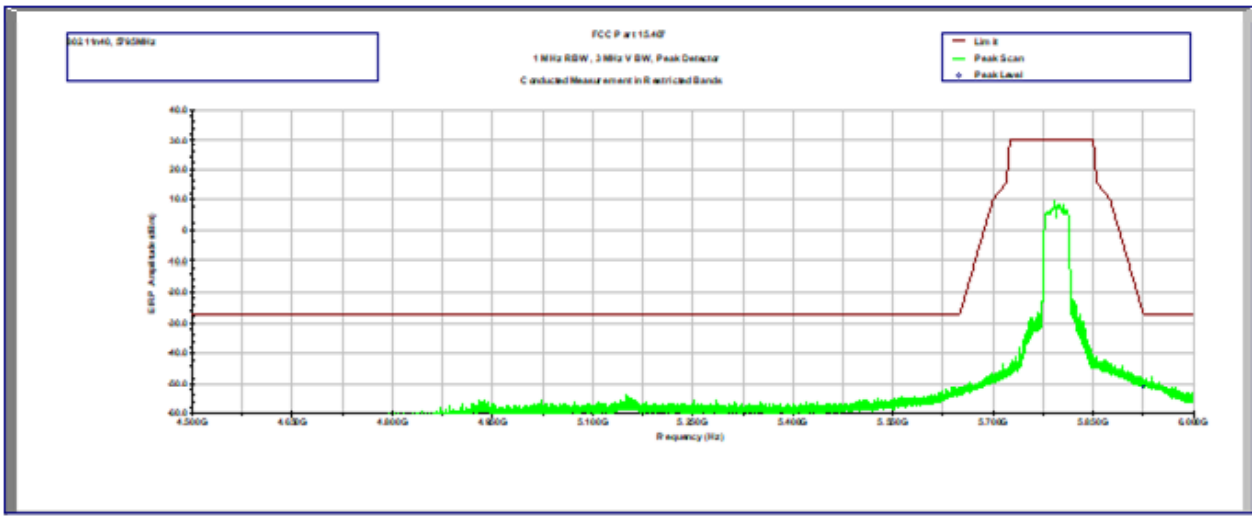
Out-of-Band Spurious Emissions at the Band Edge - 802.11n 20MHz, 5745MHz & 5825MHz



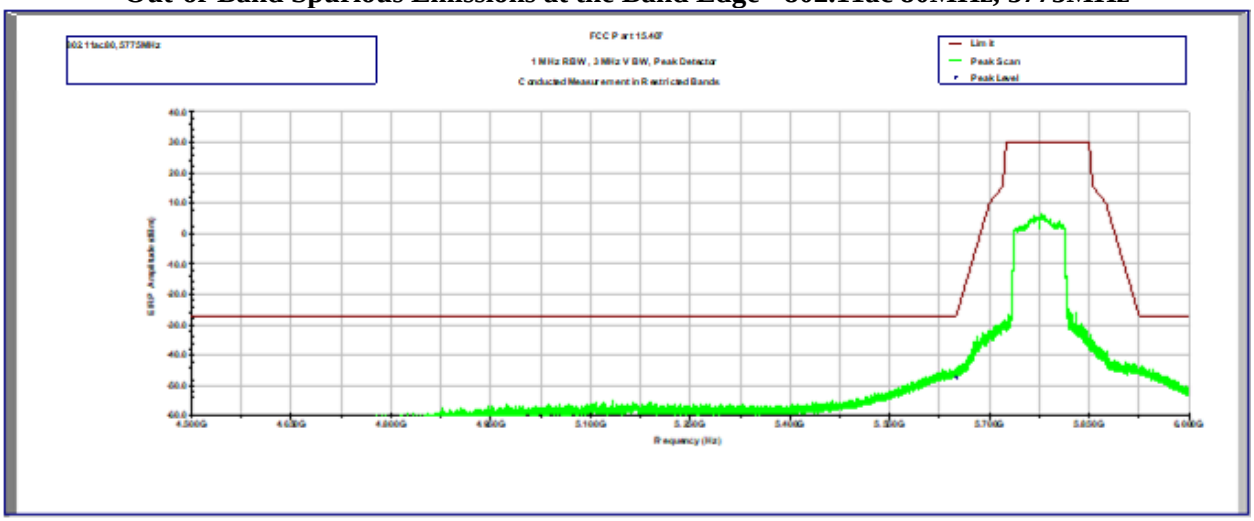


Out-of-Band Spurious Emissions at the Band Edge - 802.11n 40MHz, 5755MHz & 5795MHz





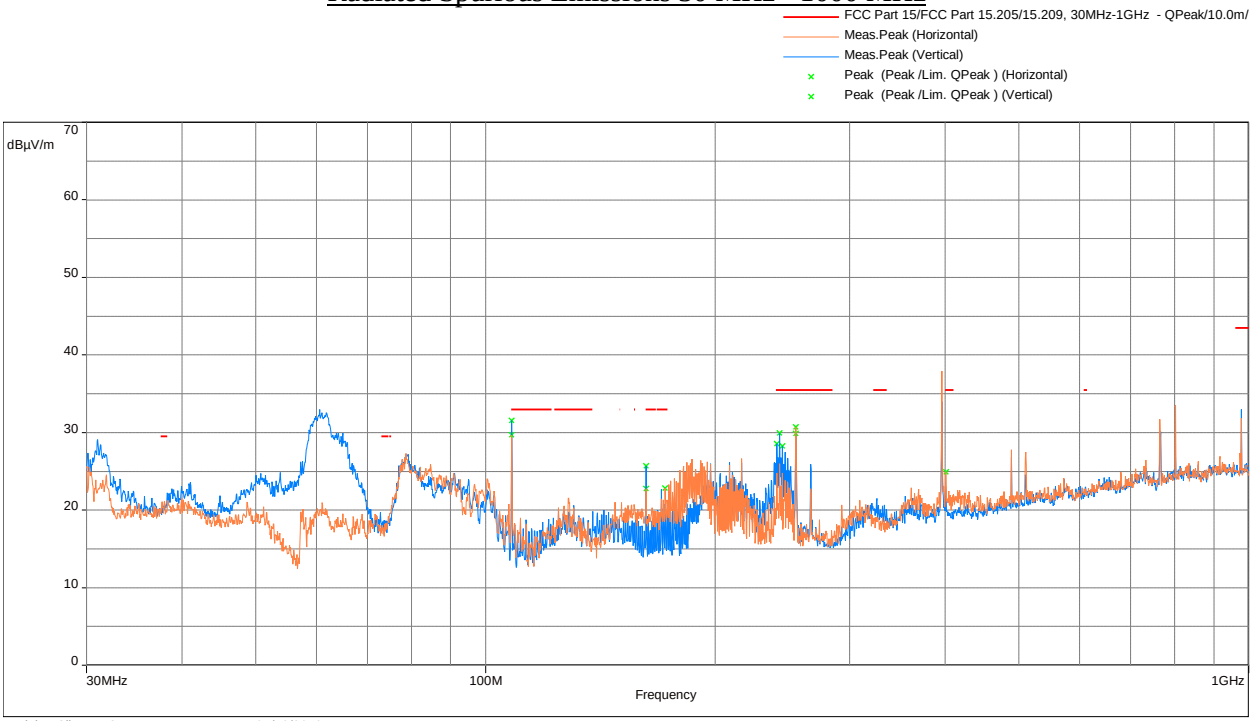
Out-of-Band Spurious Emissions at the Band Edge - 802.11ac 80MHz, 5775MHz



Out-of-Band Radiated Spurious Emissions

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5745MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



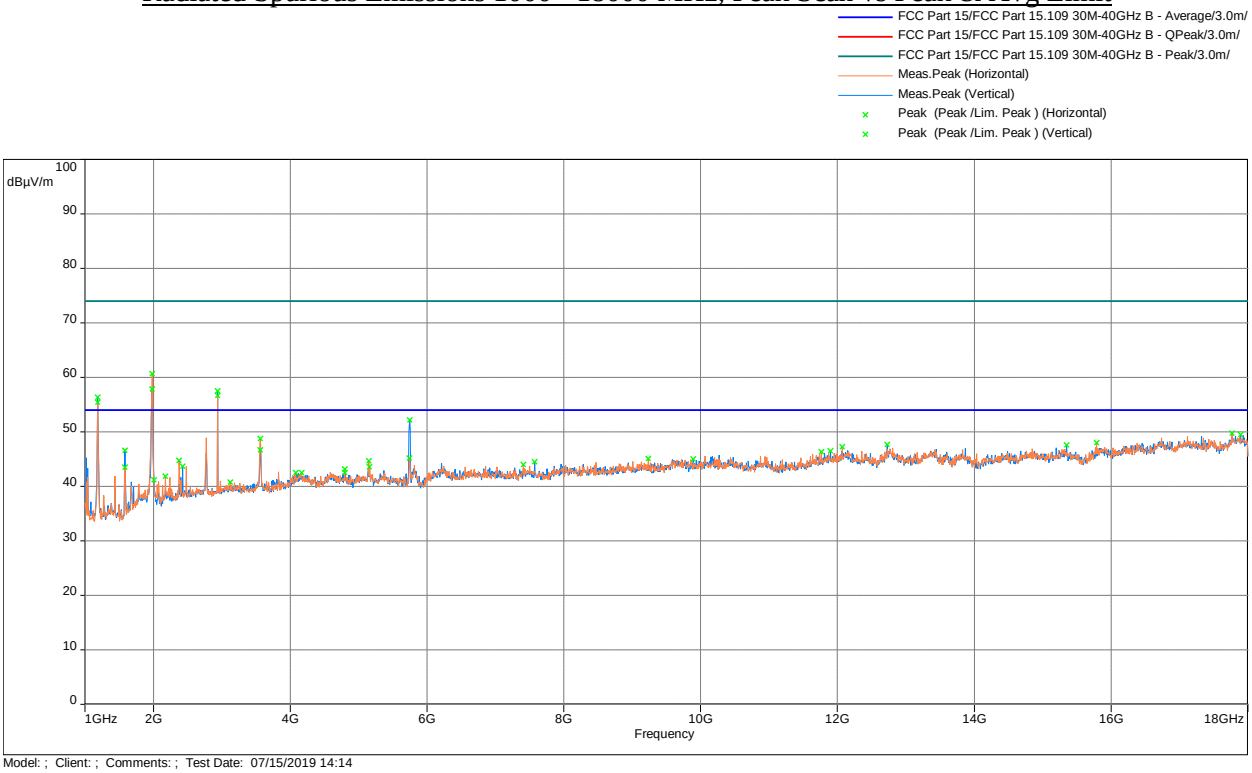
Model: ; Client: ; Comments: ; Test Date: 07/19/2019 14:41

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.143	28.0	33	-5.0	139	3.64	Horizontal	42.3	-14.3
108.217	28.9	33	-4.1	219.5	1.16	Vertical	43.2	-14.3
242.749	25.6	35.5	-9.9	221.5	1.12	Vertical	37.0	-11.4
255.035	24.4	35.5	-11.2	240.5	1	Vertical	35.9	-11.6
255.062	26.2	35.5	-9.3	188.75	3.74	Horizontal	37.8	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.620	33.0	57.8*	-24.8	278.25	3	Vertical	48.4	-15.4
396.110	37.9	57.8*	-19.9	160.5	2.98	Horizontal	45.5	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Model: ; Client: ; Comments: ; Test Date: 07/15/2019 14:14

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.352	35.3	54	-18.7	14.5	1.63	Vertical	-16.1
1188.350	32.9	54	-21.1	76.25	3.17	Horizontal	-16.1

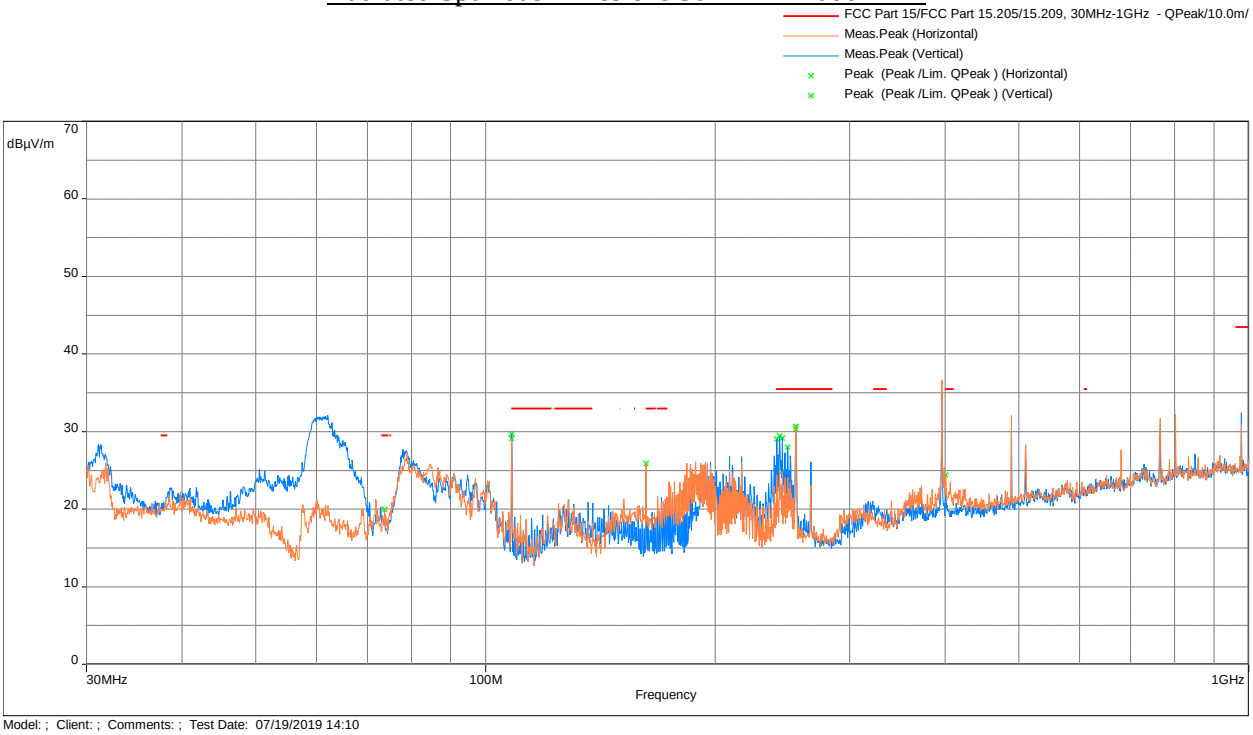
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	60.7	68.3*	-7.6	351.5	3.23	Horizontal	-13.5
1980.333	57.9	68.3*	-10.4	0.25	2.24	Vertical	-13.5
2939.700	57.6	68.3*	-10.8	231	2.24	Vertical	-12.4
2939.700	56.7	68.3*	-11.6	225.75	3.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5785MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



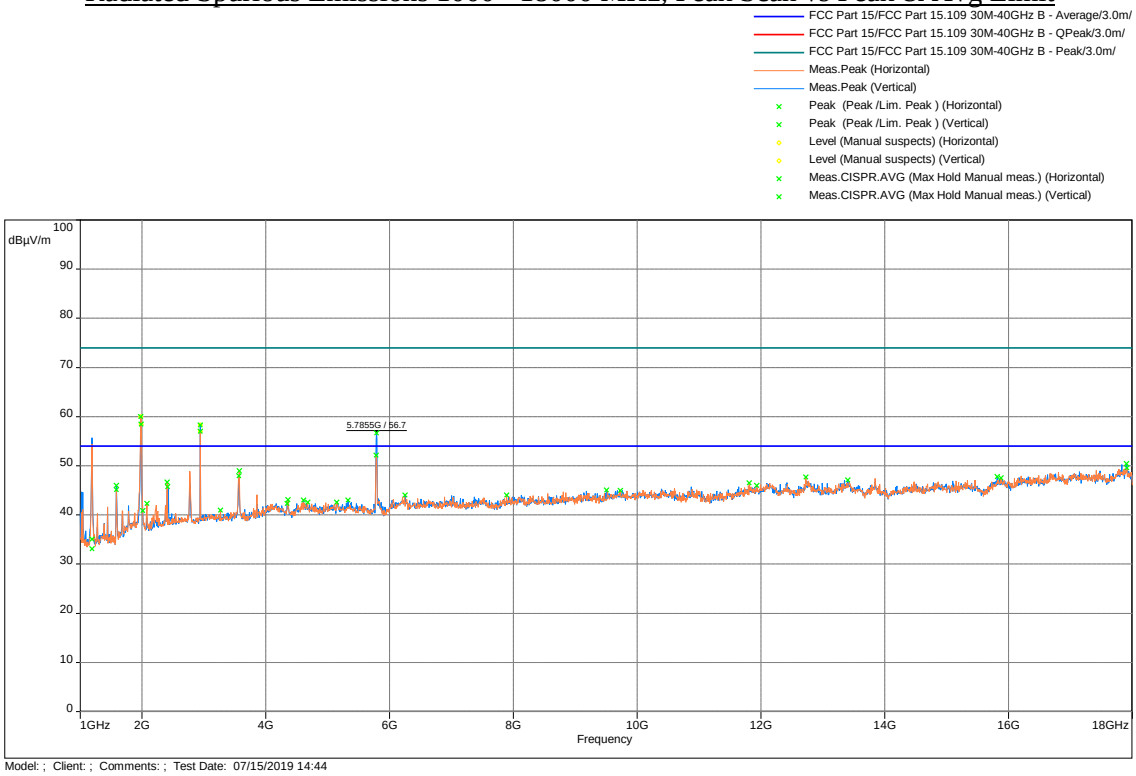
Model: ; Client: ; Comments: ; Test Date: 07/19/2019 14:10

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.213	27.7	33	-5.3	270	1.38	Vertical	42.0	-14.3
108.203	27.1	33	-5.9	325.5	4	Horizontal	41.5	-14.3
255.029	26.9	35.5	-8.6	137.25	1	Vertical	38.5	-11.6
255.056	26.1	35.5	-9.4	2	3.72	Horizontal	37.7	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	PK@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
62.107	32.1	57.8*	-25.7	291.75	2.99	Vertical	47.5	-15.4
396.078	35.9	57.8*	-21.9	289.5	2.02	Horizontal	43.5	-7.6
396.110	35.2	57.8*	-22.6	201.25	3.98	Vertical	42.8	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.358	35.0	54	-19.0	14.5	1.28	Vertical	-16.1
1188.294	33.1	54	-20.9	81.25	2.47	Horizontal	-16.1

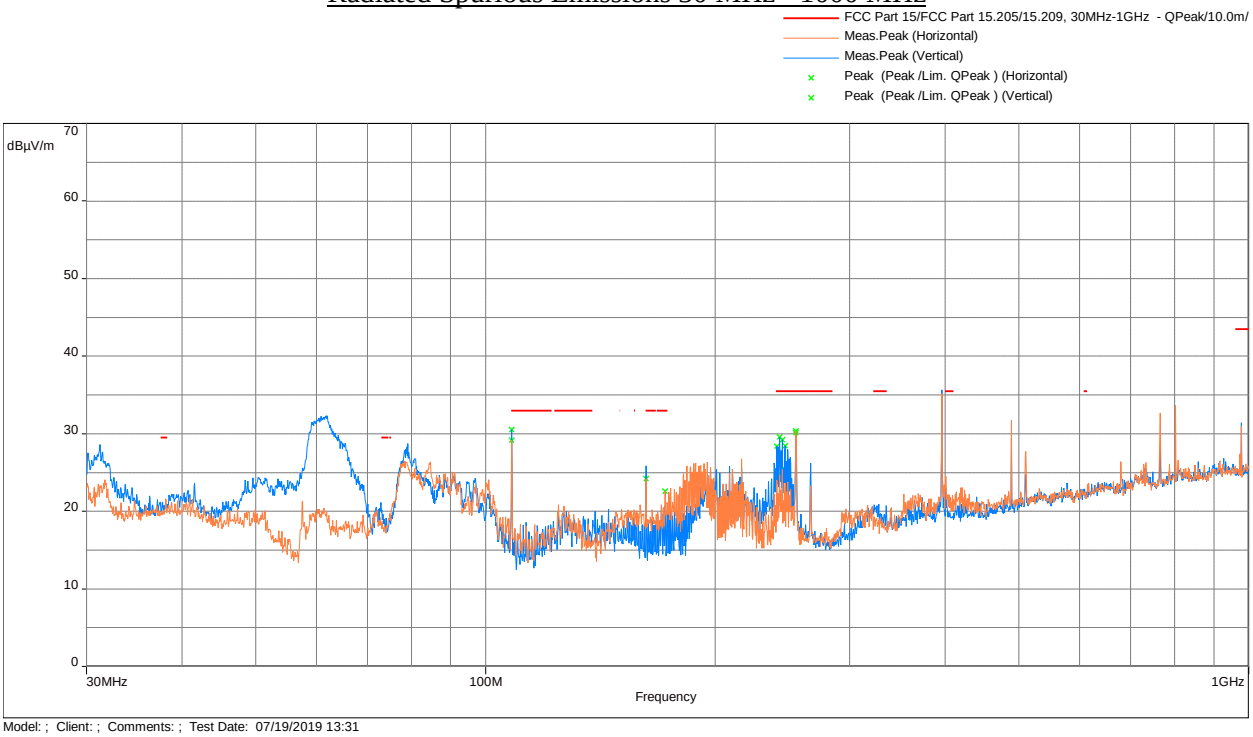
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	60.0	68.3*	-8.3	2	3.25	Horizontal	-13.5
1980.333	58.5	68.3*	-9.8	61.75	1.26	Vertical	-13.5
2939.133	57.0	68.3*	-11.3	225.25	3.25	Horizontal	-12.4
2939.700	58.3	68.3*	-10.0	222.75	2.26	Vertical	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11a 5825MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz

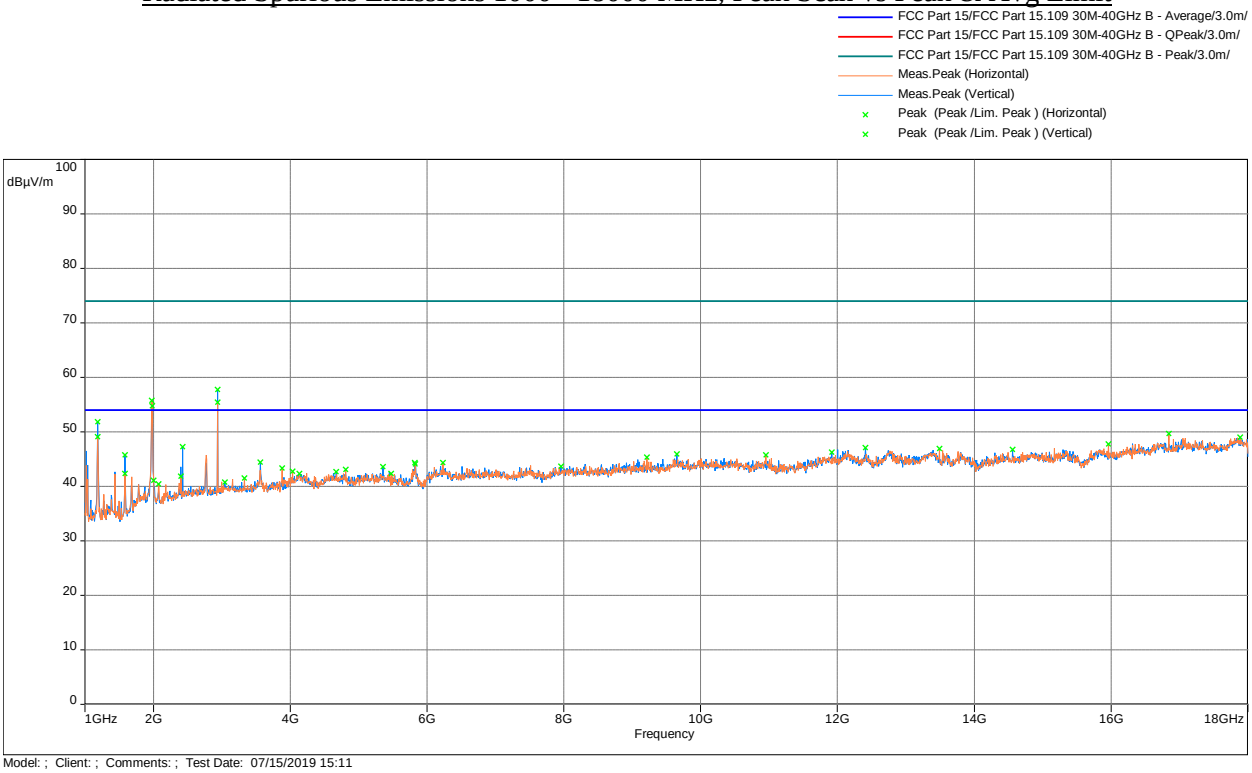


Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.146	27.5	33	-5.6	206.5	2.3	Vertical	41.8	-14.3
108.206	27.9	33	-5.1	143.5	3.96	Horizontal	42.3	-14.3

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
62.042	32.3	57.8*	-25.5	82.75	3	Vertical	47.7	-15.4
396.078	35.5	57.8*	-22.3	221.75	1	Vertical	43.1	-7.6
396.110	35.2	57.8*	-22.6	283	1.98	Horizontal	42.8	-7.6

Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Model: ; Client: ; Comments: ; Test Date: 07/15/2019 15:11

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1187.567	51.8	54	-2.2	253.25	1.26	Vertical	-16.1
1187.567	49.1	54	-4.9	0	2.27	Horizontal	-16.1

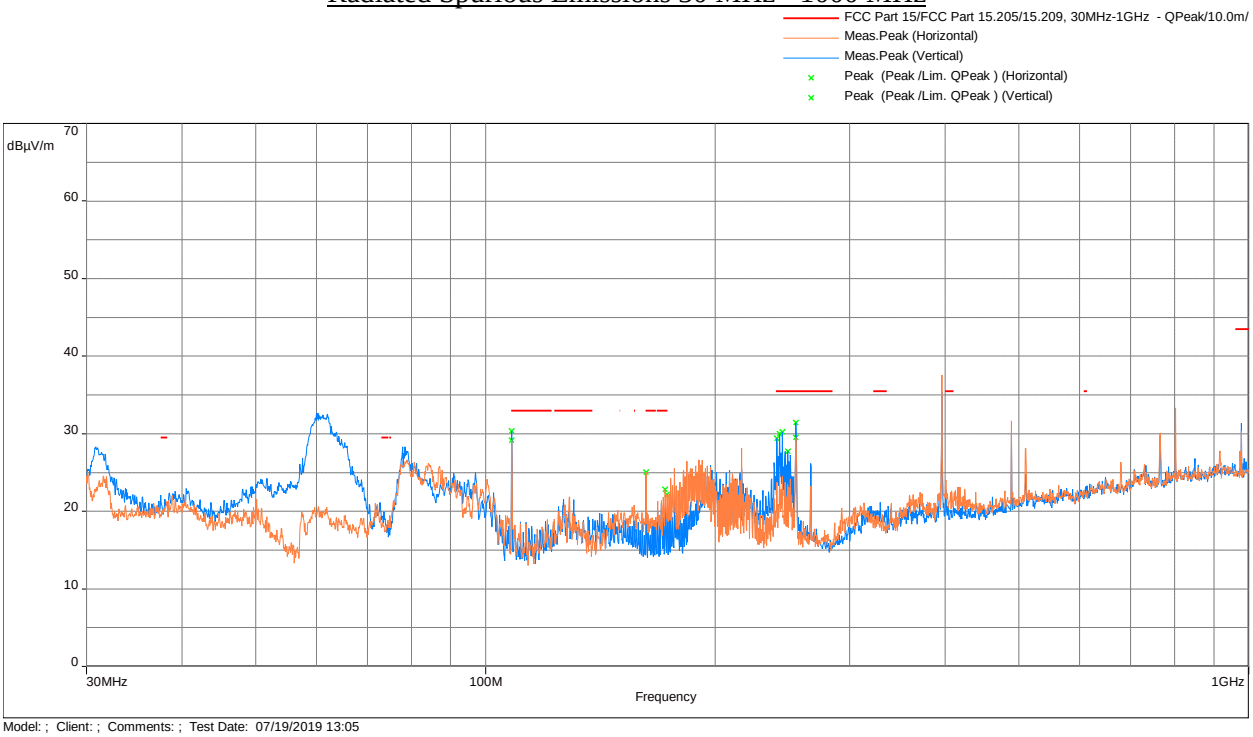
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1978.633	55.8	68.3*	-12.5	342	3.26	Horizontal	-13.5
1980.333	54.7	68.3*	-13.6	74.5	1.26	Vertical	-13.5
2938.567	57.8	68.3*	-10.6	137	1.26	Vertical	-12.4
2939.133	55.4	68.3*	-12.9	0.25	2.27	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5745MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz

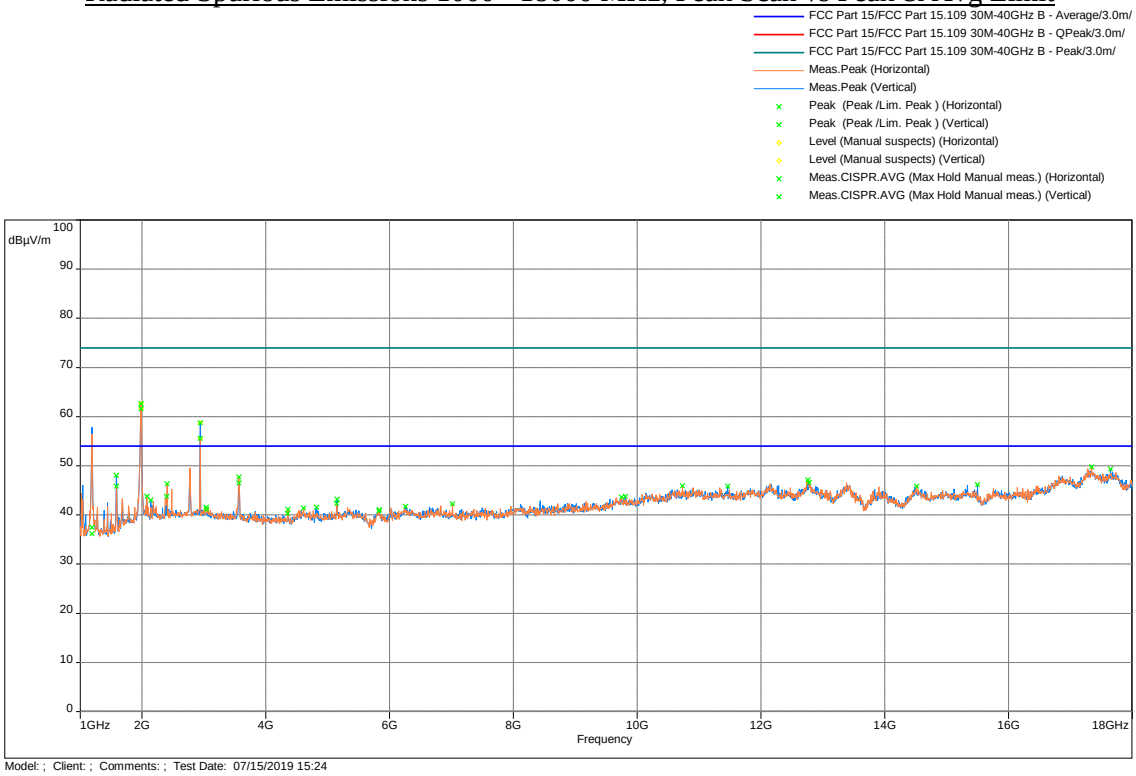


Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.225	27.8	33	-5.2	145	3.6	Horizontal	42.2	-14.3
244.804	25.5	35.5	-10.1	123.75	1	Vertical	37.0	-11.6
255.064	27.5	35.5	-8.1	137.5	1	Vertical	39.0	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.264	32.7	57.8*	-25.1	298	3	Vertical	48.1	-15.4
396.110	35.3	57.8*	-22.5	188	1	Vertical	42.9	-7.6
396.143	37.2	57.8*	-20.6	77.25	1.98	Horizontal	44.8	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.294	37.7	54	-16.3	17.75	1.26	Vertical	-16.1
1188.358	36.5	54	-17.5	84	1.26	Horizontal	-16.1

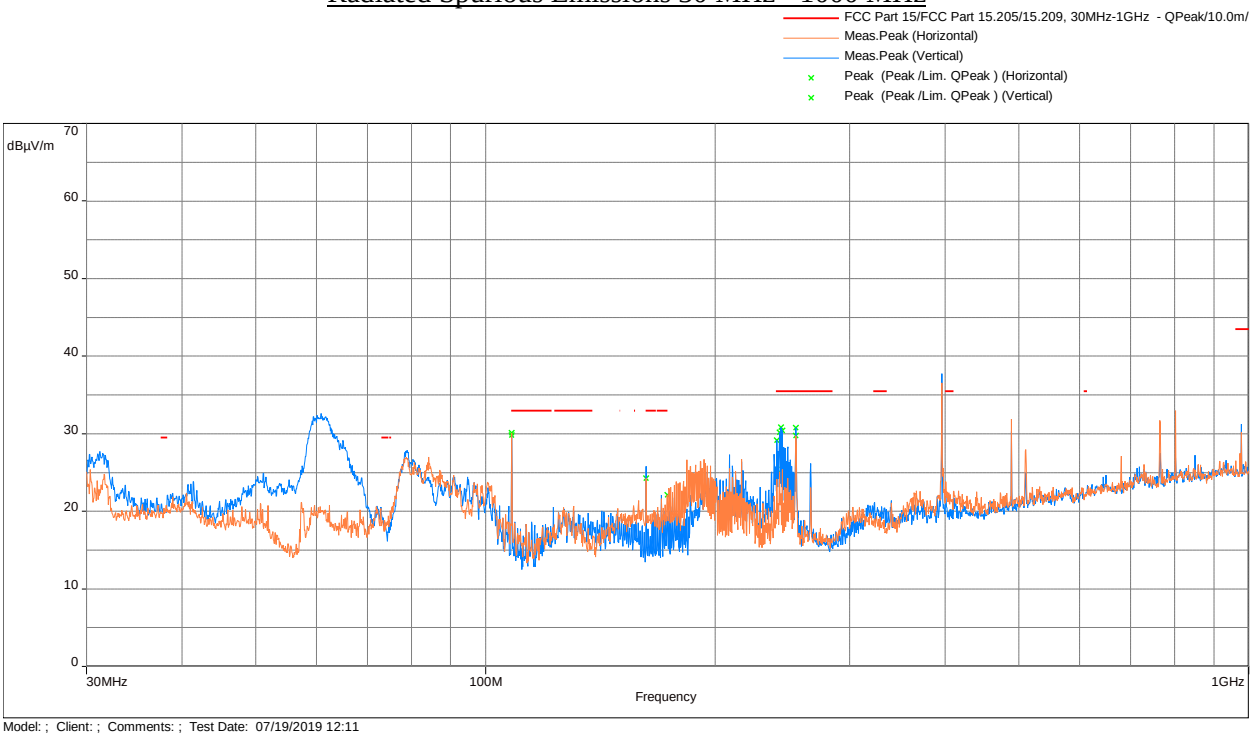
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	62.6	68.3*	-5.7	334.25	3.23	Horizontal	-13.5
1980.900	61.6	68.3*	-6.7	10.25	2.24	Vertical	-13.5
2938.000	58.7	68.3*	-9.6	61	1.26	Vertical	-12.4
2938.000	55.5	68.3	-12.8	0.5	2.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5785MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



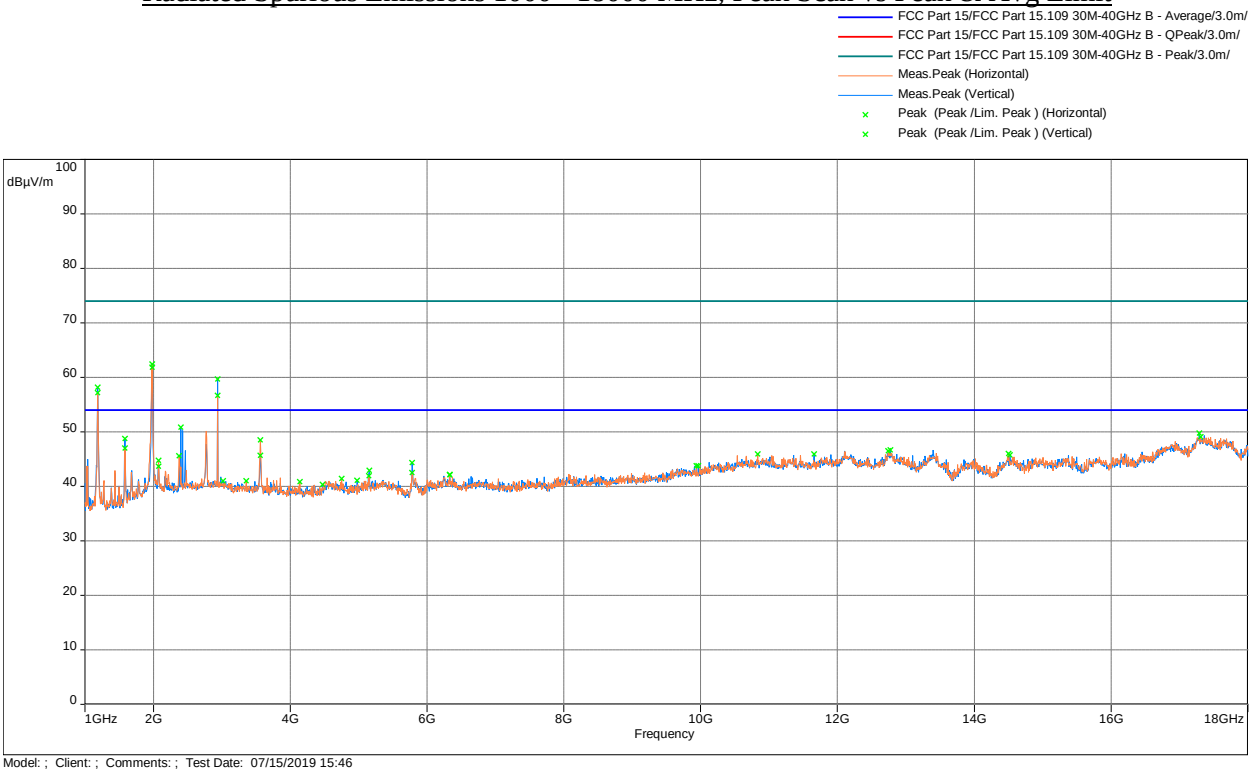
Model: ; Client: ; Comments: ; Test Date: 07/19/2019 12:11

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.216	28.1	33	-4.9	170.5	1.33	Vertical	42.5	-14.3
108.231	27.6	33	-5.4	147.5	3.64	Horizontal	41.9	-14.3
243.744	23.4	35.5	-12.1	137.25	1.06	Vertical	34.9	-11.5
255.085	25.6	35.5	-9.9	0	2.89	Horizontal	37.1	-11.6
255.091	27.4	35.5	-8.1	138.25	1.04	Vertical	39.0	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.846	32.6	57.8*	-25.2	263.75	2.99	Vertical	48.0	-15.4
396.078	37.0	57.8*	-20.8	86.75	1	Vertical	44.6	-7.6
396.110	36.6	57.8*	-21.2	160.75	2.02	Horizontal	44.2	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



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Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.294	39.6	54	-14.4	351.75	2.14	Vertical	-16.1
1188.165	36.5	54	-17.5	153	1.26	Horizontal	-16.1

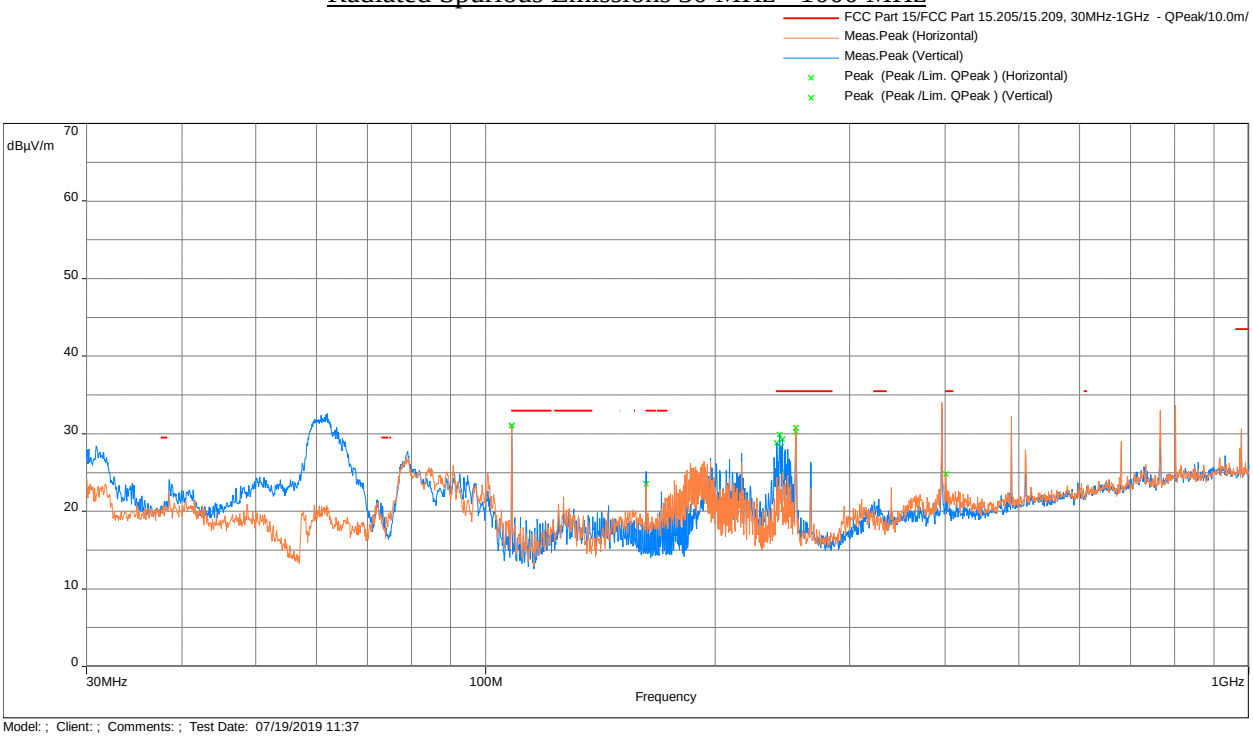
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	62.5	68.3*	-5.8	339.25	3.24	Horizontal	-13.5
1981.467	61.9	68.3*	-6.5	65.25	1.26	Vertical	-13.5
2938.000	59.6	68.3*	-8.7	56	1.26	Vertical	-12.4
2938.000	56.7	68.3	-11.7	229.5	3.24	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 20MHz 5825MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz

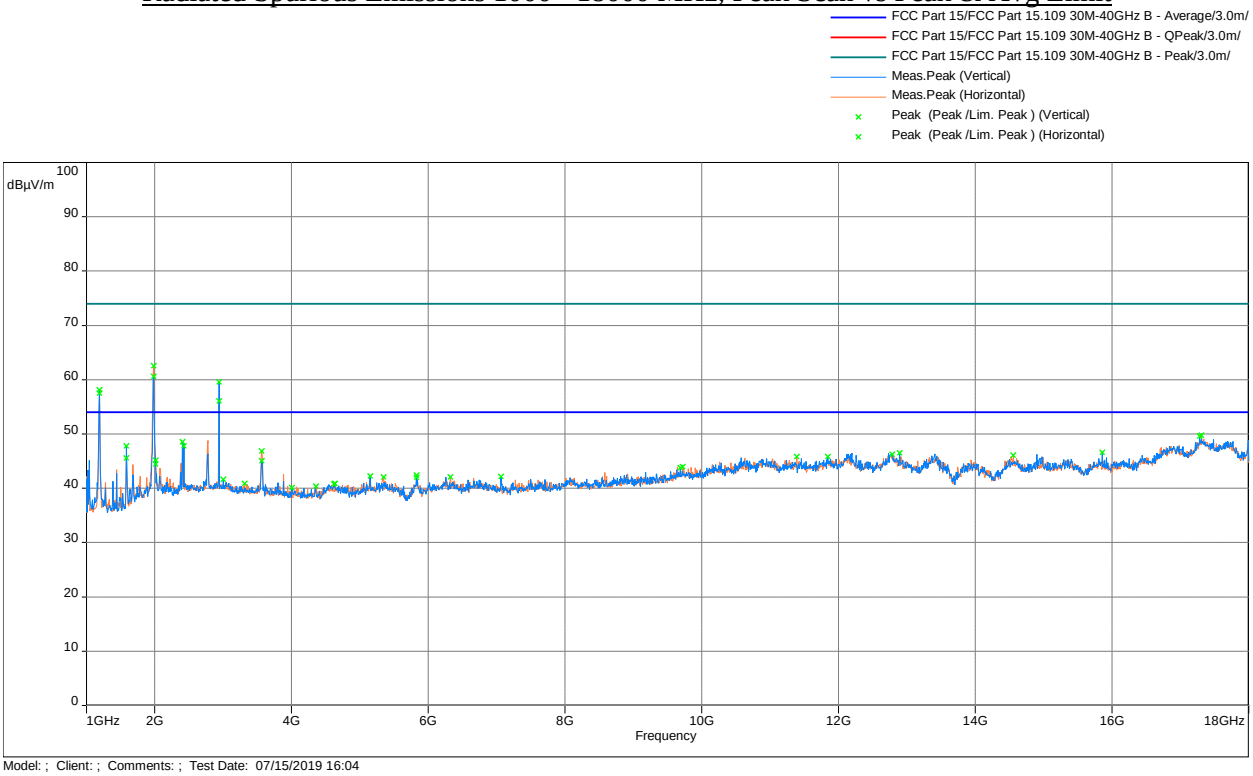


Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.225	28.2	33	-4.8	223	2.24	Vertical	42.5	-14.3
108.241	27.8	33	-5.3	144.25	4	Horizontal	42.1	-14.3
242.817	27.7	35.5	-7.8	135	1.04	Vertical	39.1	-11.4
255.037	25.6	35.5	-9.9	276	2.32	Vertical	37.1	-11.6
255.061	26.7	35.5	-8.8	179.75	3.78	Horizontal	38.3	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
61.978	32.6	57.8*	-25.2	79.75	3	Vertical	48.0	-15.4

Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Model: ; Client: ; Comments: ; Test Date: 07/15/2019 16:04

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.117	36.4	54	-17.6	157	1.25	Horizontal	-16.1
1188.294	38.9	54	-15.1	354.25	2.14	Vertical	-16.1

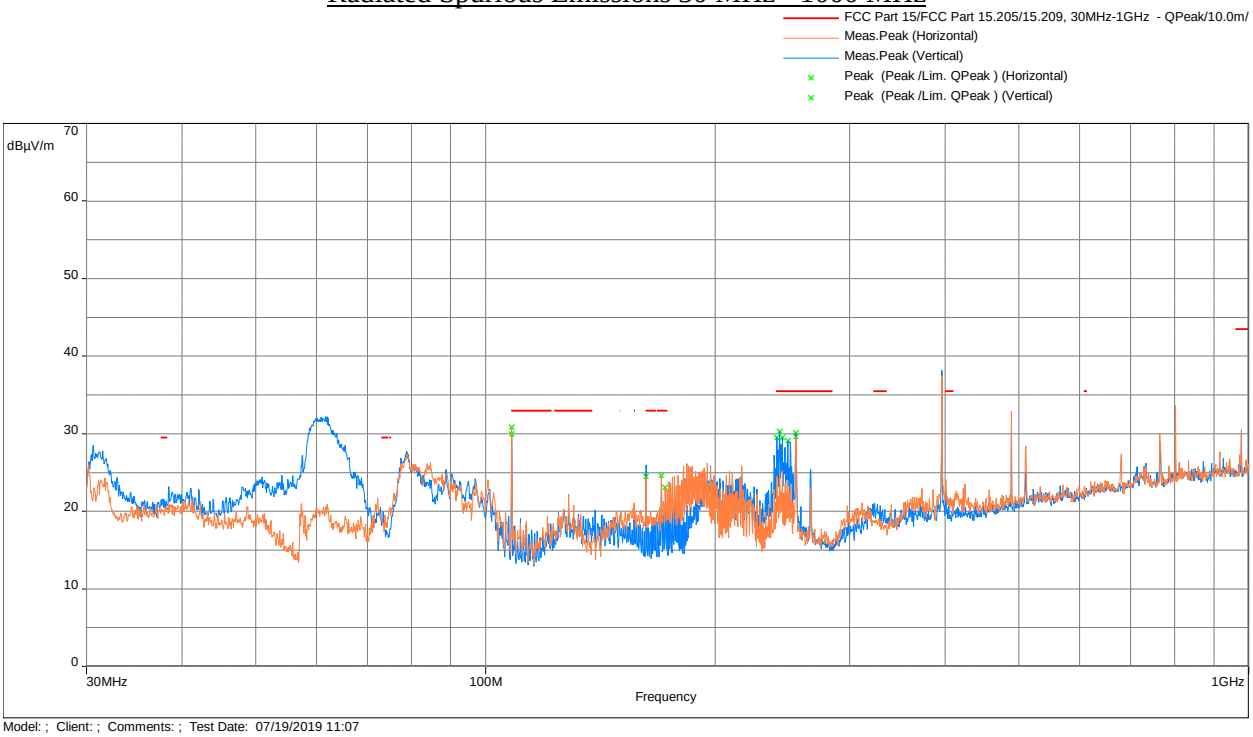
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	62.5	68.3*	-5.8	340	3.24	Horizontal	-13.5
1980.333	60.6	68.3*	-7.8	0	2.23	Vertical	-13.5
2938.000	56.0	68.3*	-12.3	221.5	3.24	Horizontal	-12.4
2938.000	59.6	68.3*	-8.7	55.75	1.26	Vertical	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5755MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz

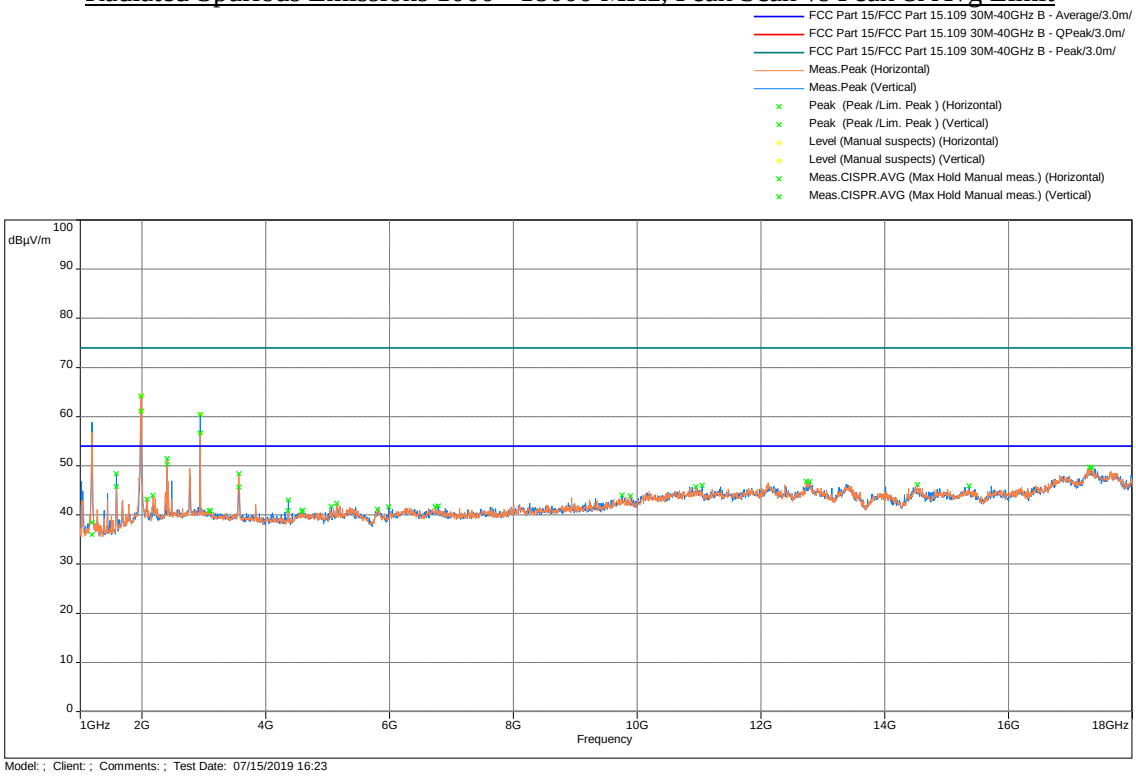


Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.208	27.4	33	-5.6	150.25	4	Horizontal	41.7	-14.3
108.300	28.8	33	-4.2	216.75	1.41	Vertical	43.1	-14.3
242.816	27.4	35.5	-8.1	119.25	1.3	Vertical	38.8	-11.4
255.043	26.0	35.5	-9.5	238.25	1	Vertical	37.6	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
61.751	32.2	57.8*	-25.6	94.75	3	Vertical	47.6	-15.4
396.078	37.4	57.8*	-20.4	175.5	1	Vertical	45.0	-7.6
396.110	37.5	57.8*	-20.3	329.5	1.98	Horizontal	45.1	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.173	39.1	54	-14.9	357.25	2.14	Vertical	-16.1
1188.229	36.6	54	-17.4	158.25	1.26	Horizontal	-16.1

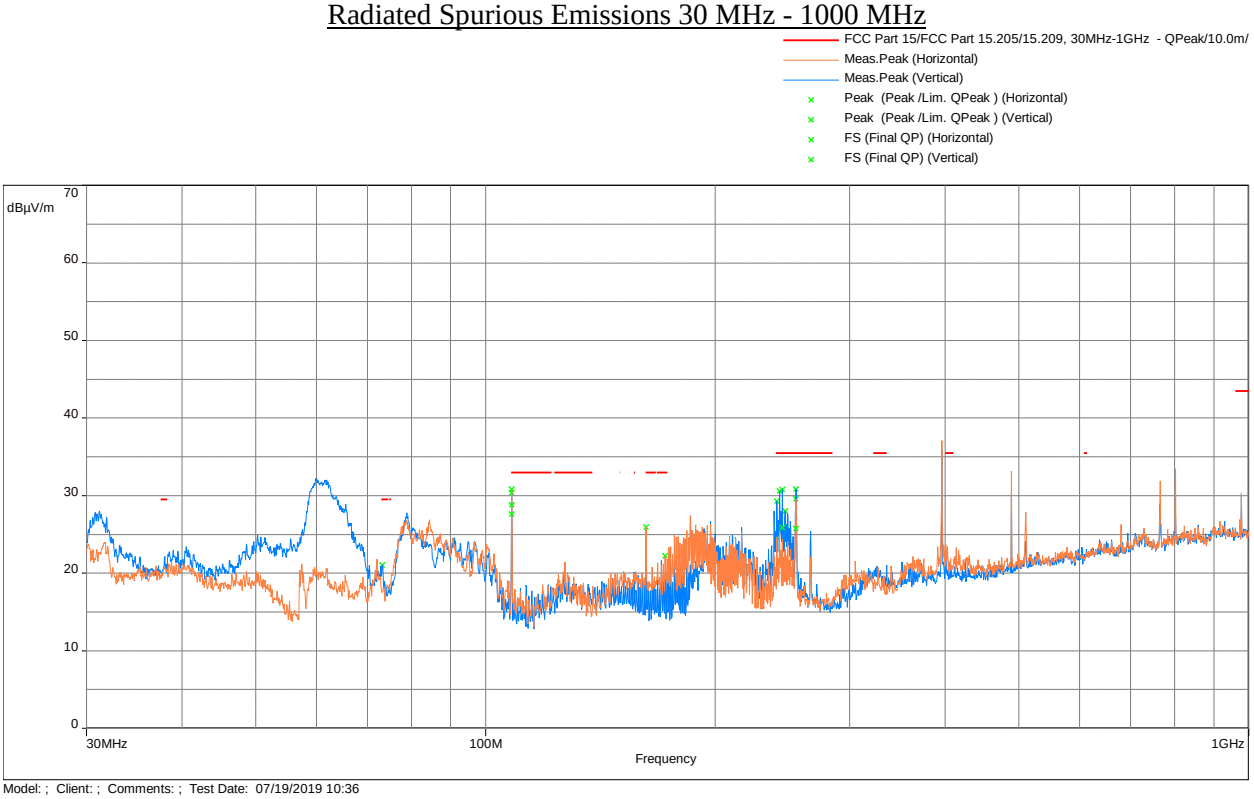
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	61.1	68.3*	-7.2	358.75	2.26	Vertical	-13.5
1980.333	64.2	68.3*	-4.1	357.75	3.24	Horizontal	-13.5
2937.433	60.4	68.3*	-7.9	55.75	1.26	Vertical	-12.4
2937.433	56.6	68.3*	-11.7	9.75	2.27	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n 40MHz 5795MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



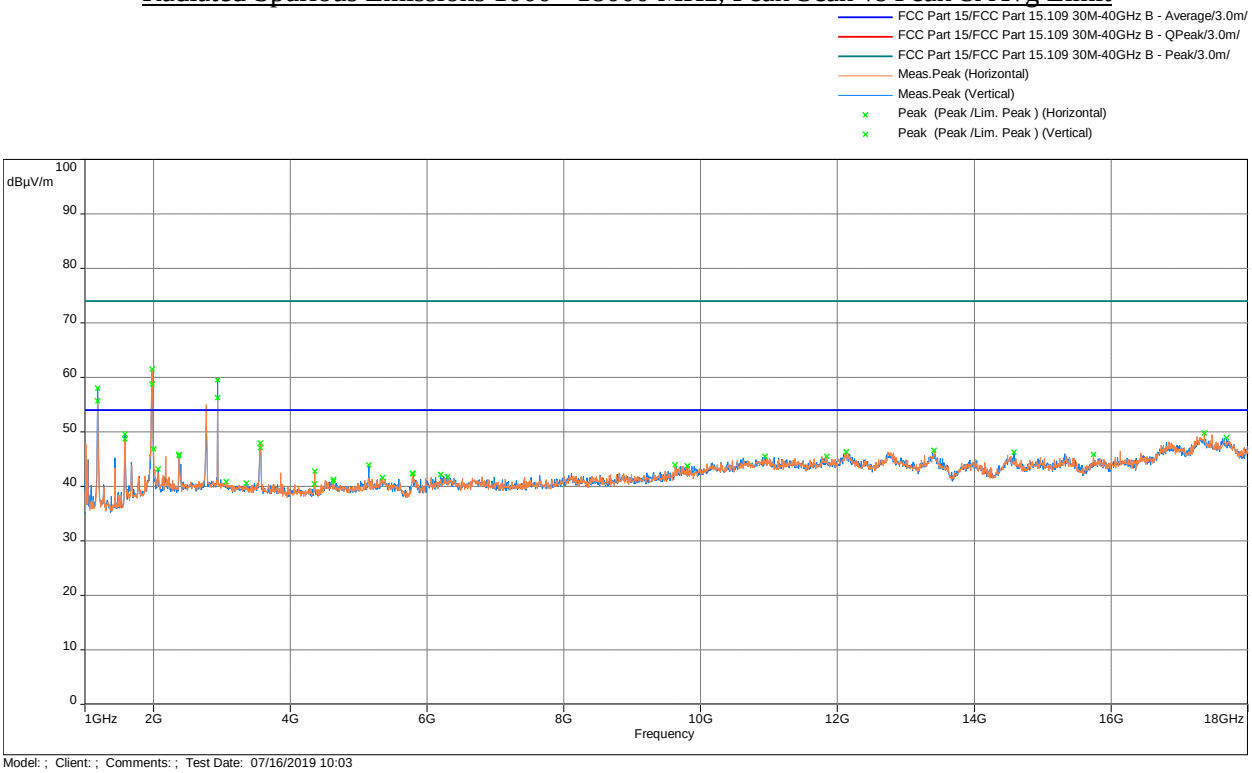
Model: ; Client: ; Comments: ; Test Date: 07/19/2019 10:36

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.216	28.8	33	-4.2	214.25	1.28	Vertical	43.1	-14.3
108.221	27.6	33	-5.4	135.5	3.64	Horizontal	41.9	-14.3
244.871	25.9	35.5	-9.6	117.25	1	Vertical	37.5	-11.6
255.159	25.8	35.5	-9.7	275.25	1	Vertical	37.3	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.070	32.2	57.8*	-25.6	291.75	3.99	Vertical	47.6	-15.4
396.110	35.9	57.8*	-21.9	163.25	1	Vertical	43.5	-7.6
396.110	37.1	57.8*	-20.7	83	1.98	Horizontal	44.7	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 10:03

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.165	39.0	54	-15.0	177.75	1.26	Vertical	-16.1
1188.294	37.7	54	-16.3	37.75	1.38	Horizontal	-16.1
2770.082	31.9	54	-22.1	191	2.06	Horizontal	-12.8

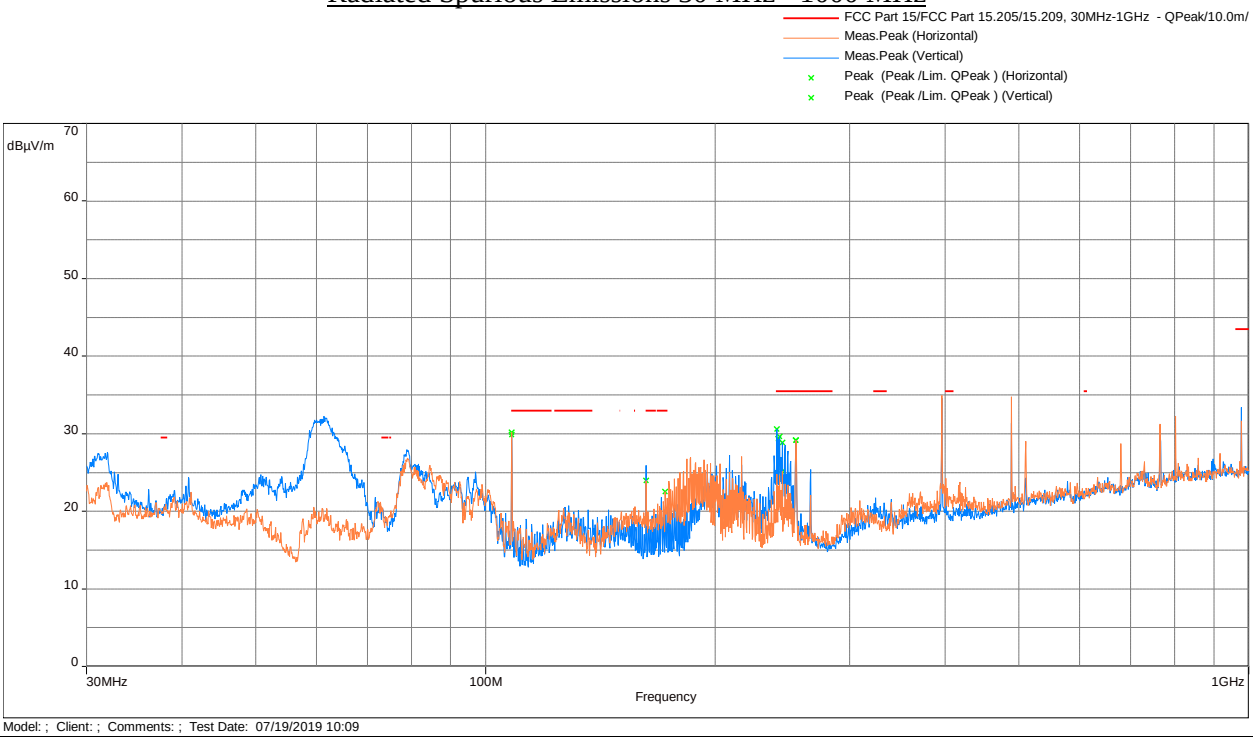
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	61.5	68.3*	-6.8	343.25	2.27	Horizontal	-13.5
1980.900	58.8	68.3*	-9.5	163.25	1.26	Vertical	-13.5
2939.133	59.5	68.3*	-8.8	316.25	2.26	Vertical	-12.4
2939.133	56.2	68.3*	-12.1	342	3.25	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11ac 80MHz 5775MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz

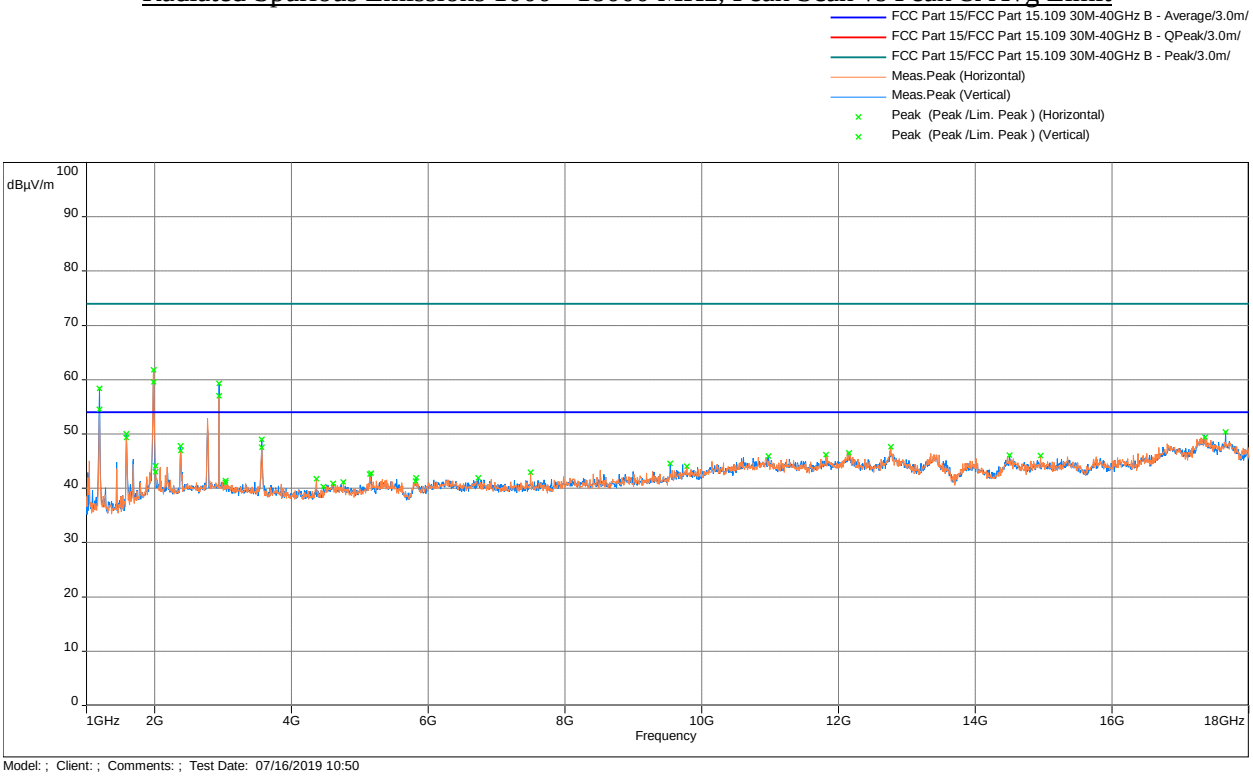


Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.235	27.9	33	-5.1	145	3.64	Horizontal	42.2	-14.3
108.292	25.8	33	-7.2	300.75	1.19	Vertical	40.1	-14.3
240.853	26.5	35.5	-9.0	139.5	1.04	Vertical	37.9	-11.4

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
61.396	32.3	57.8*	-25.5	95.25	2.99	Vertical	47.7	-15.4
396.110	34.6	57.8*	-23.2	320.75	1	Vertical	42.2	-7.6
396.143	34.8	57.8*	-23.0	319.5	3.02	Horizontal	42.4	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 10:50

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.294	38.1	54	-15.9	19.75	3.24	Vertical	-16.1
1188.294	37.7	54	-16.3	34.25	1.38	Horizontal	-16.1

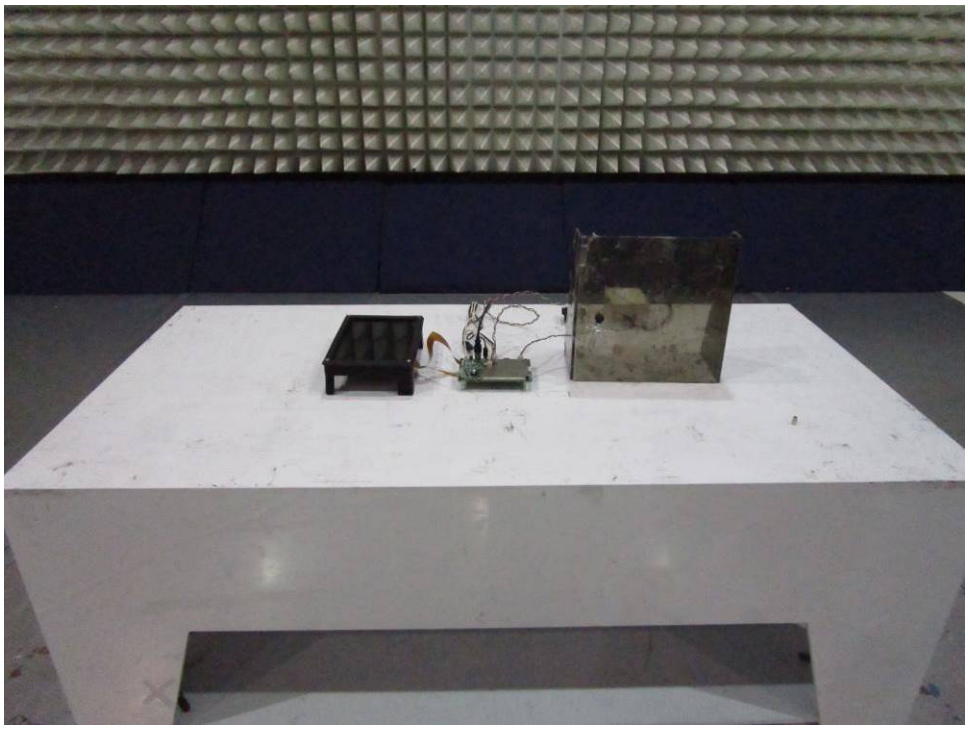
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	59.5	68.3*	-8.8	334	3.25	Vertical	-13.5
1980.333	61.8	68.3*	-6.5	359.5	2.27	Horizontal	-13.5
2939.133	59.3	68.3*	-9.0	178	2.26	Vertical	-12.4
2939.133	57.0	68.3*	-11.3	342.25	3.25	Horizontal	-12.4

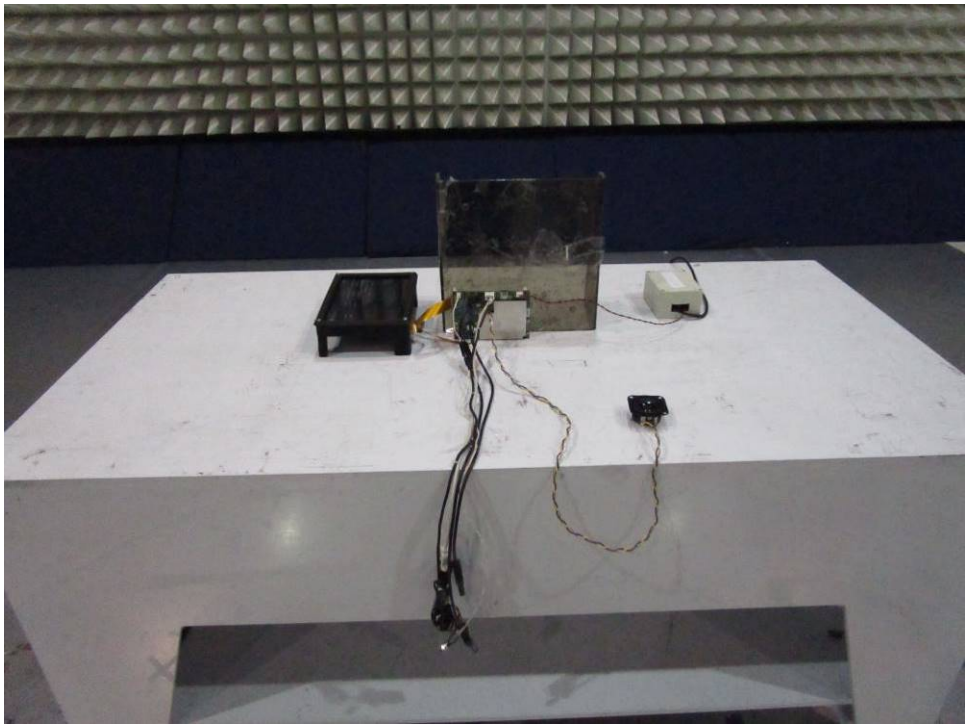
*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.407(b).

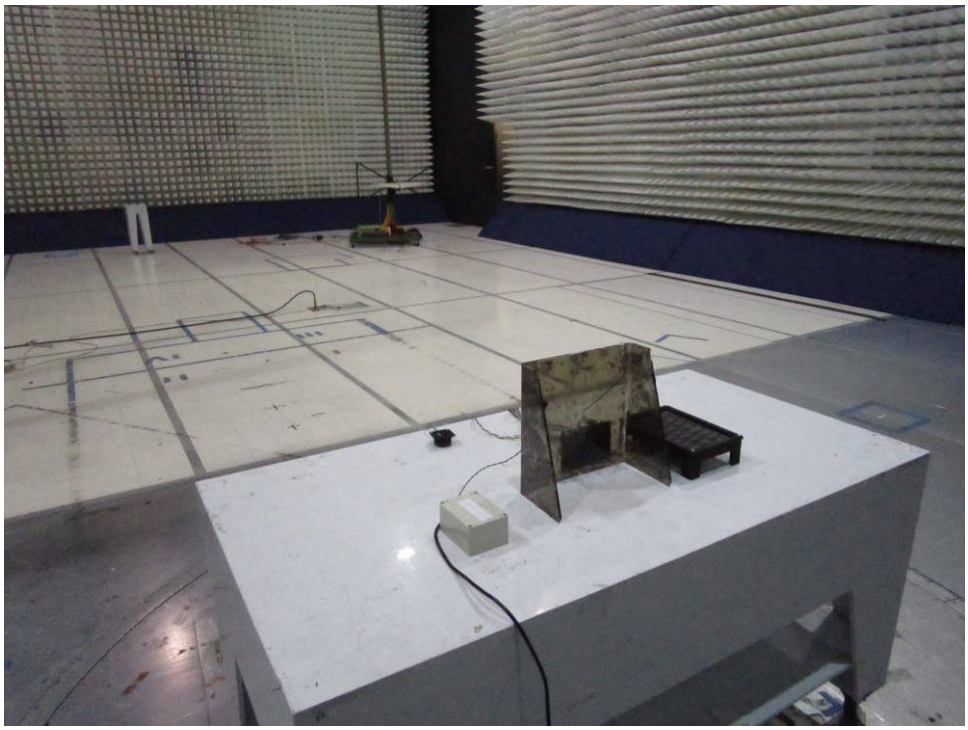
Note: Radiated emission measurements were performed up to 40GHz. No Emissions were identified when scanned from 18-40 GHz.

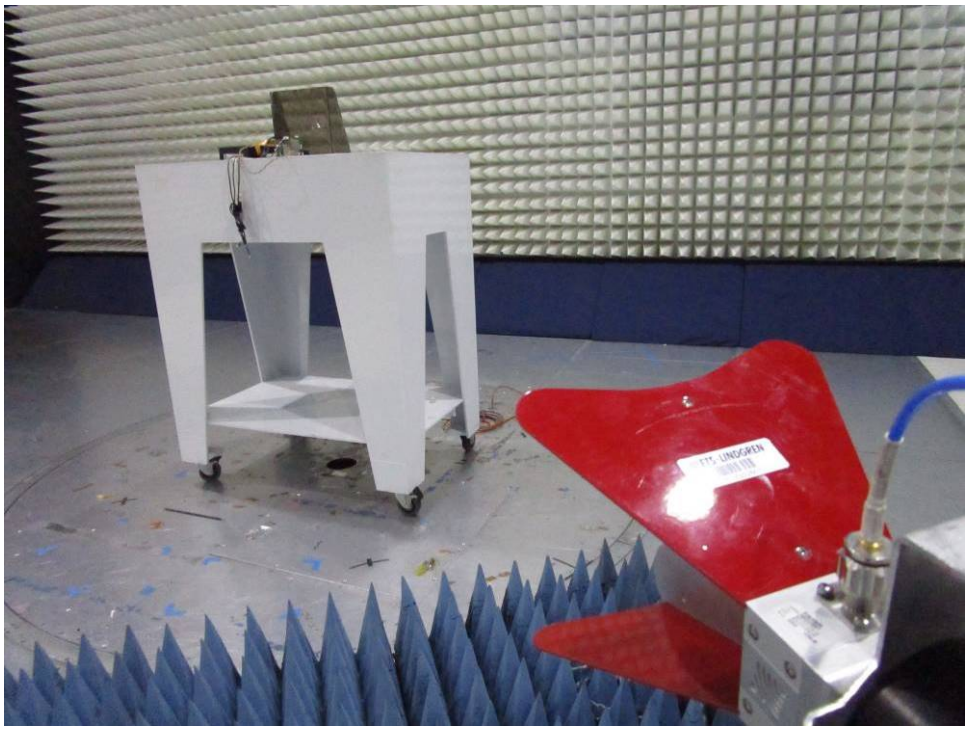
4.3.7 Test setup

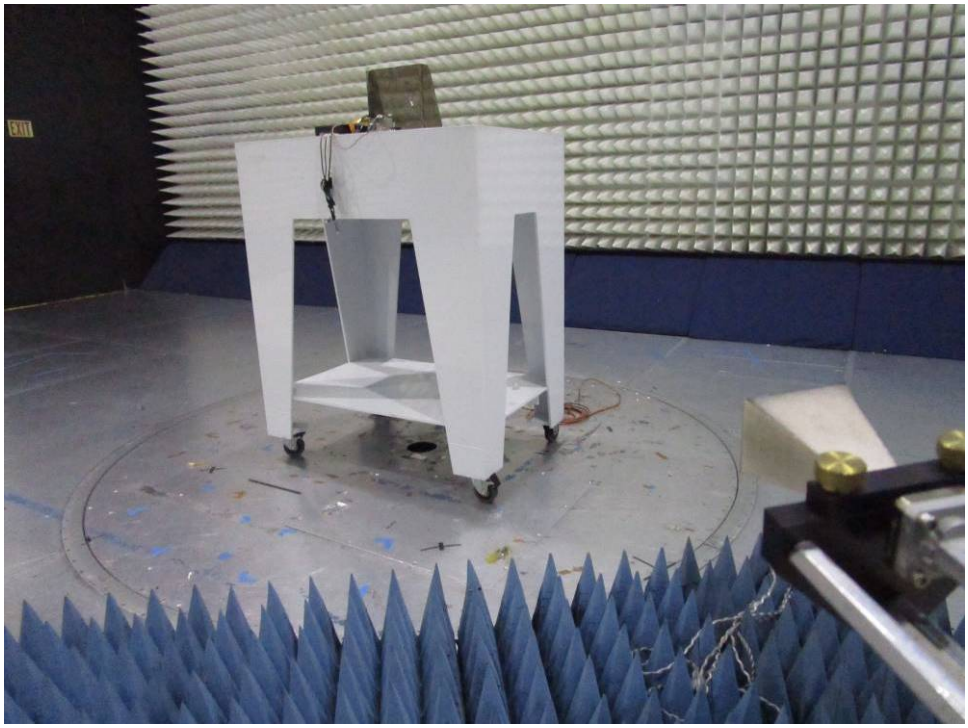
The following photographs show the testing configurations used.

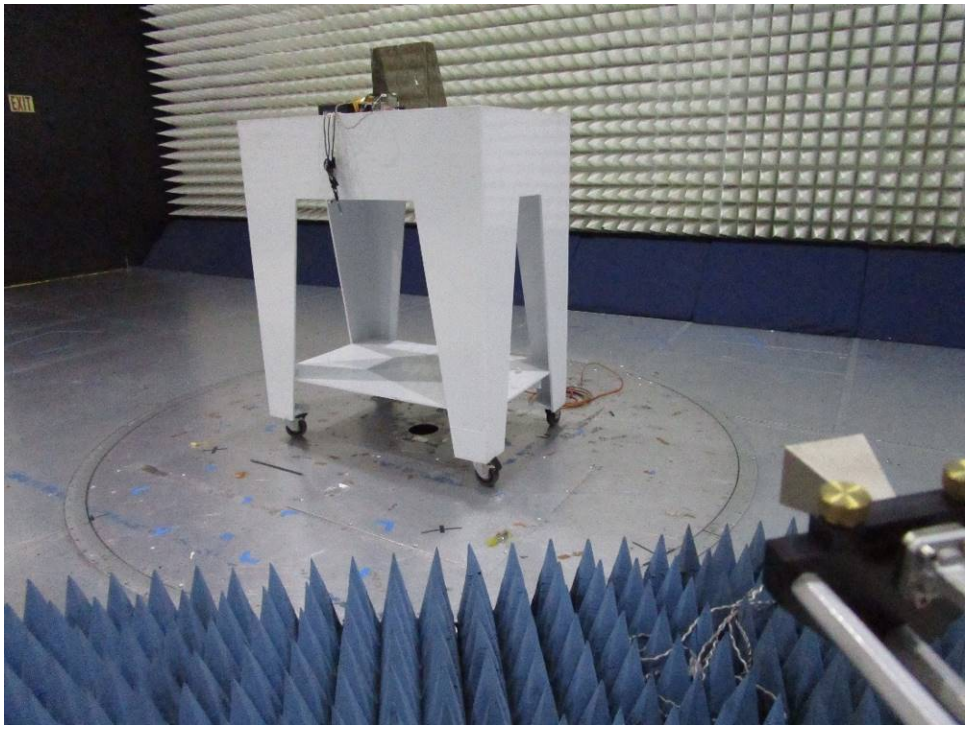







ETC LINDGREN





4.4 AC Line Conducted Emission
FCC: 15.207; RSS-GEN

4.4.1 Requirement

Frequency Band MHz	FCC Part 15.207 Limits	
	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *
0.50-5.00	56	46
5.00-30.00	60	50

*Note: *Decreases linearly with the logarithm of the frequency*
At the transition frequency the lower limit applies.

4.4.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4:2014.

Tested By	Test Date
Todd Moy	July 22, 2019

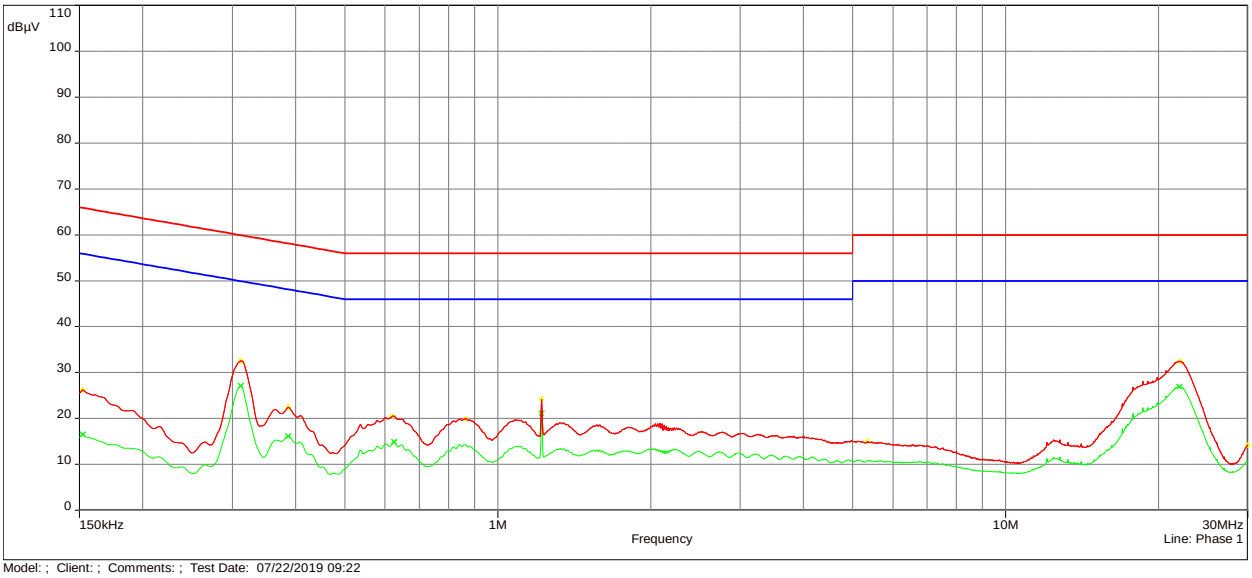
4.4.3 Test Results

15.207: Conducted Emissions 120VAC 60Hz

Phase 1

Sub-range 1
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 3, Preamp: Off, LN Preamp: Off, Preselector: On
Line:Phase 1

FCC Part 15/FCC Part 15.107 B - Average/
FCC Part 15/FCC Part 15.107 B - QPeak/
Meas.QPeak (Phase 1)
Mes. CISPR AVG (Phase 1)
QPeak (QPeak /Lim. QPeak) (Phase 1)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 1)

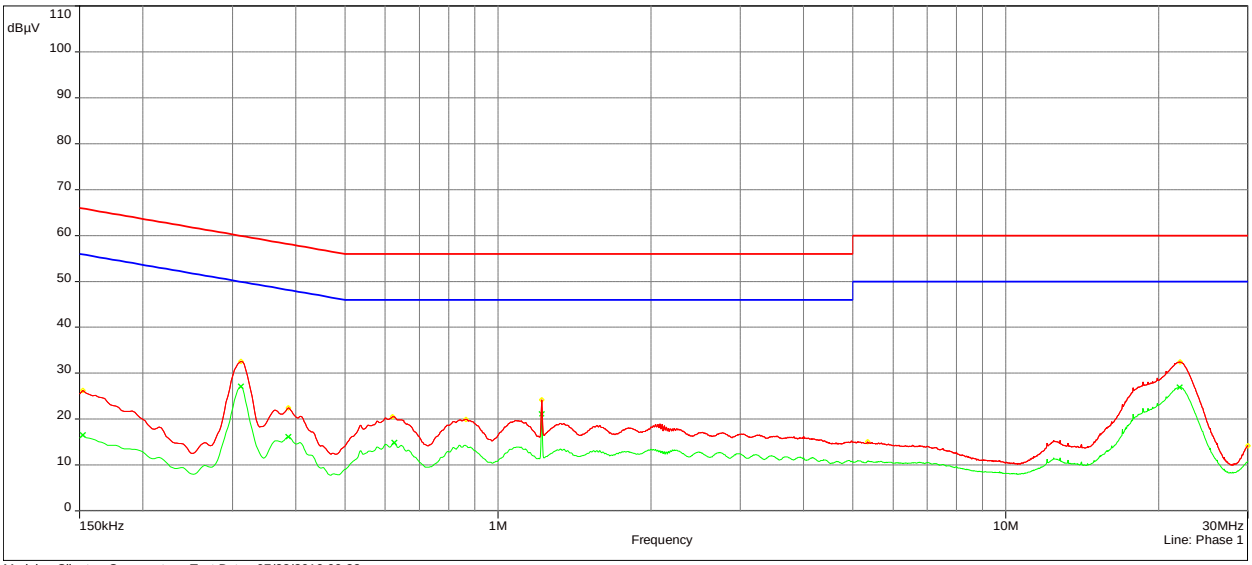


Model: ; Client: ; Comments: ; Test Date: 07/22/2019 09:22

Phase 2

Sub-range 1
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 3, Preamp: Off, LN Preamp: Off, Preselector: On
Line:Phase 1

FCC Part 15/FCC Part 15.107 B - Average/
FCC Part 15/FCC Part 15.107 B - QPeak/
Meas.QPeak (Phase 1)
Mes. CISPR AVG (Phase 1)
QPeak (QPeak /Lim. QPeak) (Phase 1)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 1)



Model: ; Client: ; Comments: ; Test Date: 07/22/2019 09:22

4.4.3 Test Results (Continued)

Quasi Peak Table					
Frequency (MHz)	QPeak (dBµV)	Lim. QPeak (dBµV)	QPeak-Lim (dB)	Phase	Correction (dB)
0.152	26.3	65.9	-39.6	Phase 1	11.3
0.152	26.5	65.9	-39.4	Phase 2	11.3
0.312	32.6	59.9	-27.3	Phase 1	11.0
0.312	32.9	59.9	-27.0	Phase 2	11.0
0.386	22.5	58.1	-35.7	Phase 1	10.9
0.386	22.4	58.1	-35.7	Phase 2	10.9
0.620	20.6	56	-35.4	Phase 1	10.9
0.620	20.4	56	-35.6	Phase 2	10.9
0.866	19.9	56	-36.1	Phase 1	10.9
0.868	19.9	56	-36.1	Phase 2	10.9
1.221	24.3	56	-31.8	Phase 1	10.9
1.221	24.1	56	-31.9	Phase 2	10.9
5.109	14.7	60	-45.3	Phase 2	11.1
5.348	15.1	60	-44.9	Phase 1	11.1
21.923	31.5	60	-28.6	Phase 2	11.3
22.040	32.4	60	-27.6	Phase 1	11.3
29.994	14.1	60	-45.9	Phase 2	11.2
29.999	14.2	60	-45.8	Phase 1	11.2

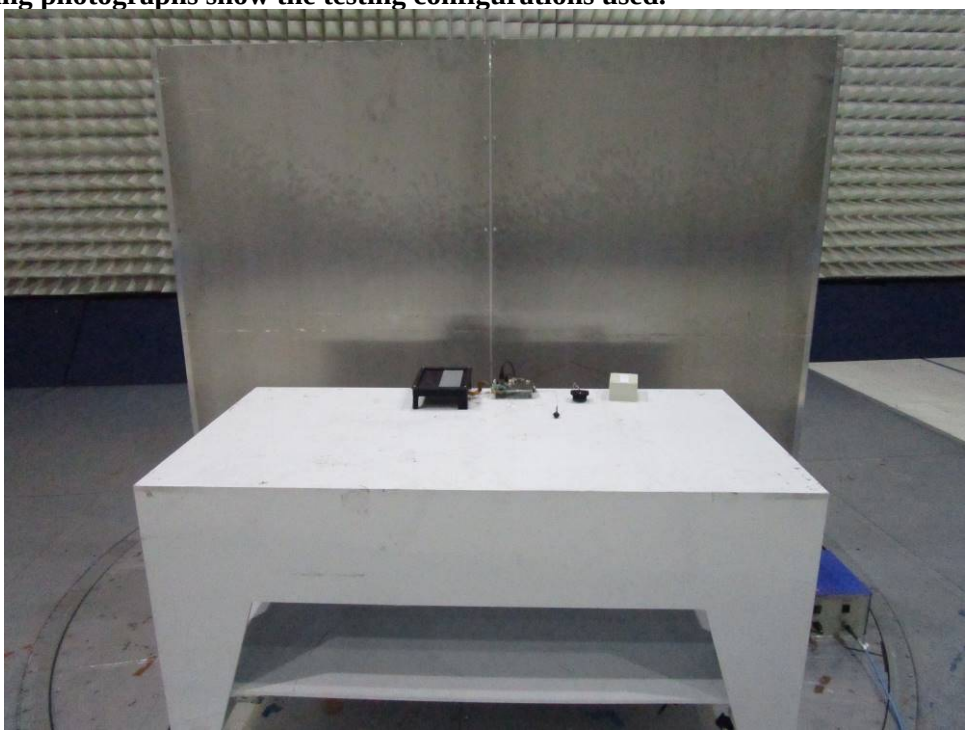
4.4.3 Test Results (Continued)

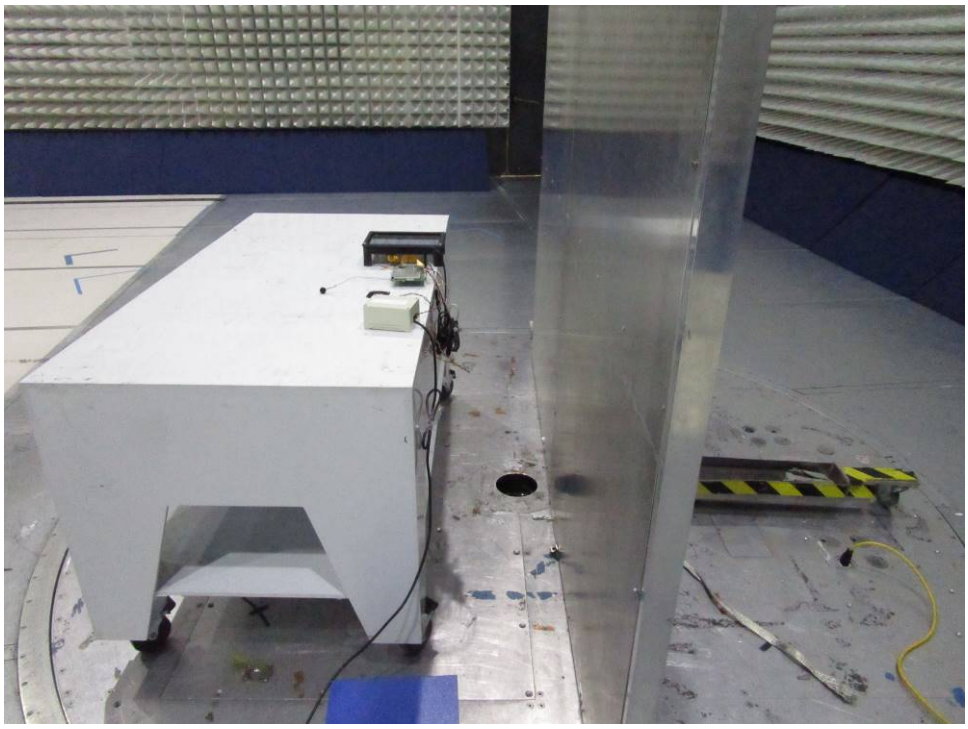
Average Table					
Frequency (MHz)	AVG (dBµV)	Lim. Average (dBµV)	AVG-Lim (dB)	Phase	Correction (dB)
0.152	16.5	55.9	-39.4	Phase 1	11.3
0.152	15.4	55.9	-40.5	Phase 2	11.3
0.312	27.1	49.9	-22.8	Phase 1	11.0
0.312	27.5	49.9	-22.4	Phase 2	11.0
0.386	16.1	48.1	-32.0	Phase 1	10.9
0.386	16.2	48.1	-32.0	Phase 2	10.9
0.625	14.7	46	-31.3	Phase 2	10.9
0.625	14.9	46	-31.1	Phase 1	10.9
0.863	14.2	46	-31.8	Phase 2	10.9
1.221	21.1	46	-25.0	Phase 1	10.9
1.221	21.0	46	-25.0	Phase 2	10.9
21.968	26.0	50	-24.0	Phase 2	11.3
22.027	26.9	50	-23.1	Phase 1	11.3

Results: **Complies** by 22.4 dB

4.4.4 Test setup

The following photographs show the testing configurations used.





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	03/26/20
Horn Antenna (10-40 GHz)	ETS-Lindgren	3116C	ITS 01376	12	04/15/20
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	02/08/20
Active Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/17/20
EMI Receiver	Rohde and Schwarz	ESR7	ITS 01607	12	10/23/19
Bi-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	04/24/20
Pre-Amplifier	Sonoma Instrument	310N	ITS 00415	12	04/17/20
Notch Filter	MICRO-TRONICS	BRM50703	ITS 01169	12	05/14/20
LISN	Com-Power	LIN-115A	ITS 01283	12	10/03/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01462	12	09/17/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	09/17/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	09/17/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01342	12	12/05/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01462	12	09/17/19
Attenuator	Fairview	SA 18H-30	ITS 01633	12	#

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 Spurious_30M-26GHz
BAT-EMC	Nexio	3.17.0.10	Bosch July 15, 2019
BAT-EMC	Nexio	3.17.0.10	Bosch July 17, 2019
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 / G103930307	TM	KV	August 20, 2019	Original document

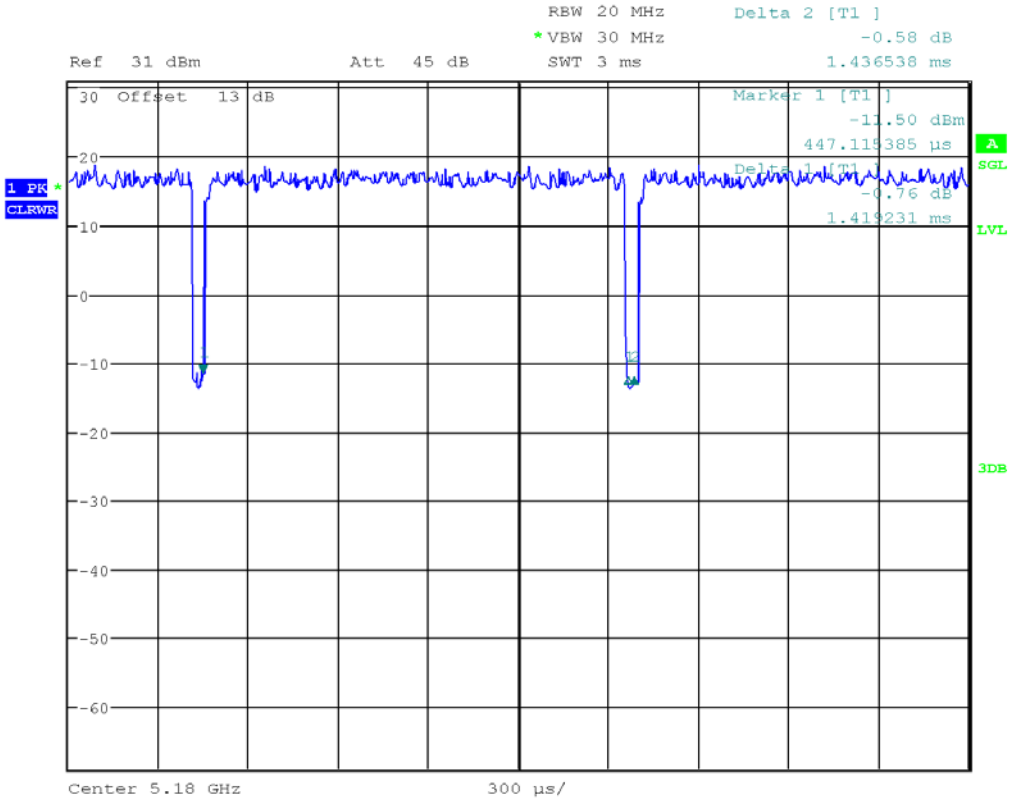
Annex A – Duty Cycle Measurement

Standard	Data Rate	On Time ms	Period ms	DCF Power Averaging	DCF Linear Voltage Averaging	Plot #
802.11a	6 Mbps	1.419	1.437	0.055	0.109	A.1
802.11n20	0 MCS	1.32	1.362	0.136	0.272	A.2
802.11n40	0 MCS	0.652	0.699	0.302	0.605	A.3
802.11ac80	0 MCS	0.322	0.367	0.568	1.136	A.4

Duty Cycle:
DC= On Time / Period

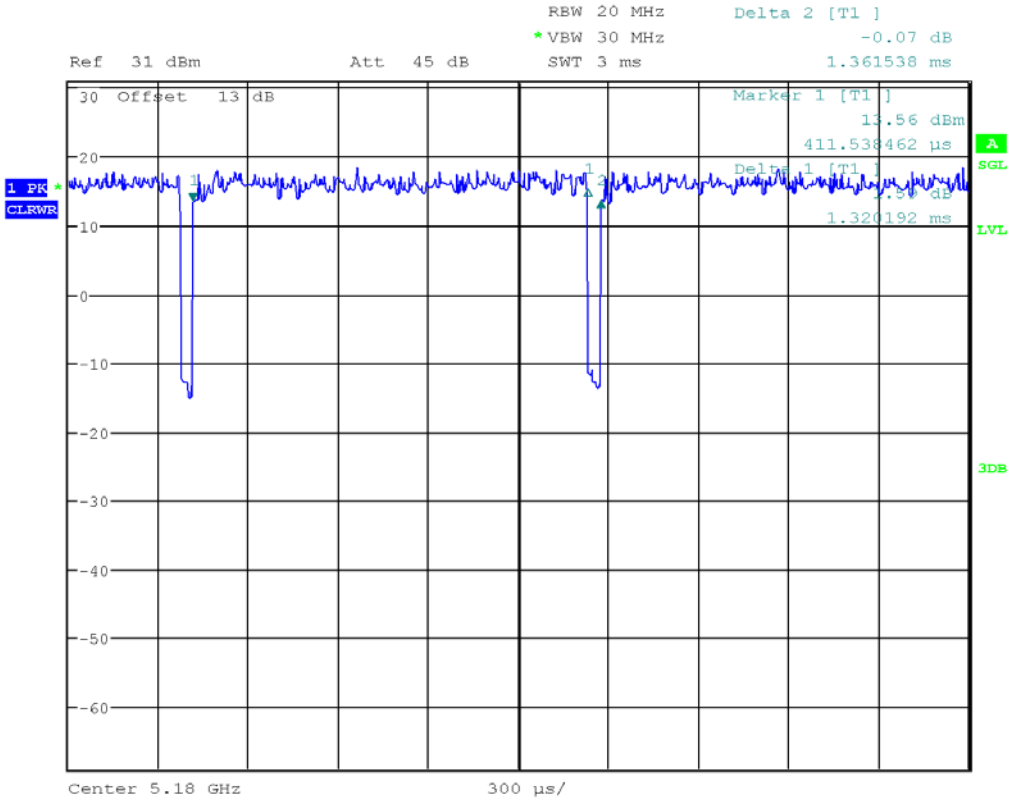
Duty Cycle Correction Factor (DCF) δ (dB):
DCF Power Averaging = 10 log (1/DC)
DCF Linear Voltage Averaging = 20 log (1/DC)

plot A.1 – 802.11a duty cycle



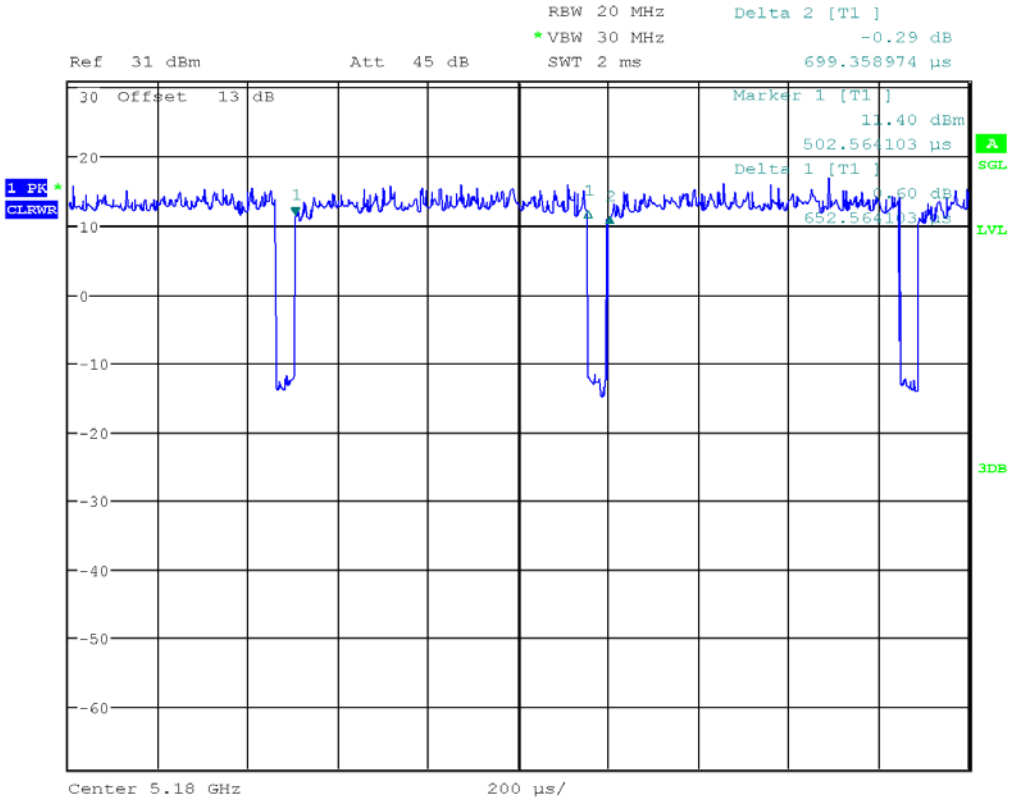
Date: 26.JUN.2019 11:20:23

plot A.2 – 802.11n20 duty cycle



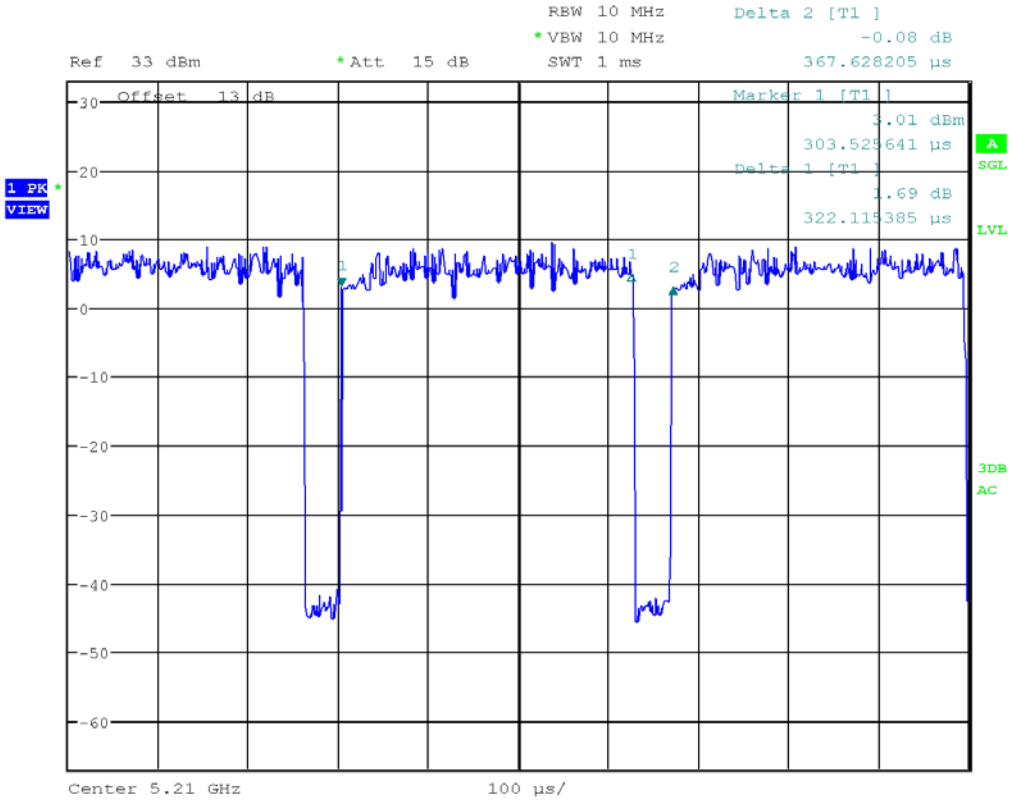
Date: 26.JUN.2019 11:23:12

plot A.3 – 802.11n40 duty cycle



Date: 26.JUN.2019 11:25:29

plot A.4 – 802.11ac80 duty cycle



Date: 27.JUN.2019 08:34:55