FCC Test Report

FOR

Amazon

Model Name:
D5N83A

Product Description:
Networking Device

FCC ID: UUU-5411

Applied Rules and Standards:
47 CFR Part 15.205, 209, 207(a)

REPORT #: EMC_ A2ZDE-048-18001_CO-TX-Rev3

DATE: 2019-06-11

A2LA Accredited

IC recognized #
3462B-2

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.407 of Title 47 of the Code of Federal Regulations.

No deviations were ascertained on tests performed.

Company	Description	Model #
Amazon	Networking Device	D5N83A

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2019-06-11	Compliance	Cindy Li (EMC Lab Manager)	Cindy Li Digitally signed by Cindy Li DN: cn=Cindy Li, o=Cetecom Inc., ou=EMC, email=cindy.li@cetecom.com, c=US Date: 2019.06.11 12:34:22 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2019-06-11	Compliance	James Donnellan (Compliance)	James Donnellan

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Rami Saman

2.2 Identification of the Client

Applicant's Name:	Amazon
Street Address:	410 Terry Ave,
City/Zip Code:	Seattle, WA 98109
Country:	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Foxconn Cloud Network Technology Singapore Pte.
Manufacturers Address:	No.2, 2nd Donghuan Road,10th Yousong Industrial District, Longhua, Baoan,
City/Zip Code	Shenzhen City, Guangdong Province
Country	China

3 Equipment under Test (EUT)

3.1 EUT Specifications

Model No:	D5N83A
HW Version :	DVT
SW Version :	emmc-denali_dvt-ipq806x-1.0.0.217_1205
FCC-ID:	UUU-5411
HVIN:	N/A
PMN:	N/A
Product Description:	Networking Device
Frequency Range / Number of channels: / Radios	Nominal Band UNII 1: 5150 MHz- 5250 MHz Nominal band UNII 3: 5725 MHz – 5850 MHz Nominal band WiFi 2.4 GHz: 2400 MHz – 2483.5 MHz Center to center: 5180 MHz (ch 36) – 5240 MHz (ch 48), 4 channels Center to center: 5745 MHz (ch 149) – 5825 MHz (ch 165), 5 channels Center to center 2412 MHz (ch 1): 2462 MHz (ch 11), 11 channels 4X Qualcomm QCA9886, 5 GHz WiFi 1X Qualcomm QCA9882. 2.4 GHz WIFI 802.11b/g/n
Type(s) of Modulation:	BPSK, QPSK, 16-QAM, 64QAM, 256 QAM
Modes of Operation:	802.11a/n/ac, 20MHz and 40MHz 802,11 b,g,n
Antenna Information as declared:	11 dBi for 5 GHz Radios 3 dBi for 2.4 GHz Radio
Max. Conducted Output Power:	See related reports UNII 1, 3 and WLAN reports
Power Supply/ Rated Operating Voltage Range:	AC/DC Adapter: Vlow:10.3 V/ V nom: 12.0 VDC / V max: 15.0 VDC
Operating Temperature Range:	0 ºC to 40 ºC
Other Radios included in the device:	N/A
Sample Revision:	☐Prototype Unit; ☐ Production Unit; ■Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	G070R2027494003B	DVT	emmc-denali_dvt-ipq806x-1.0.0.217_1205	Radiated Unit

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	AC/DC Adapter	ADH006	Ac Bel	AH06F83V003P2
2	Laptop	Dell	Latitude E6430s	00186-210-105-587

3.4 Test Sample Configuration

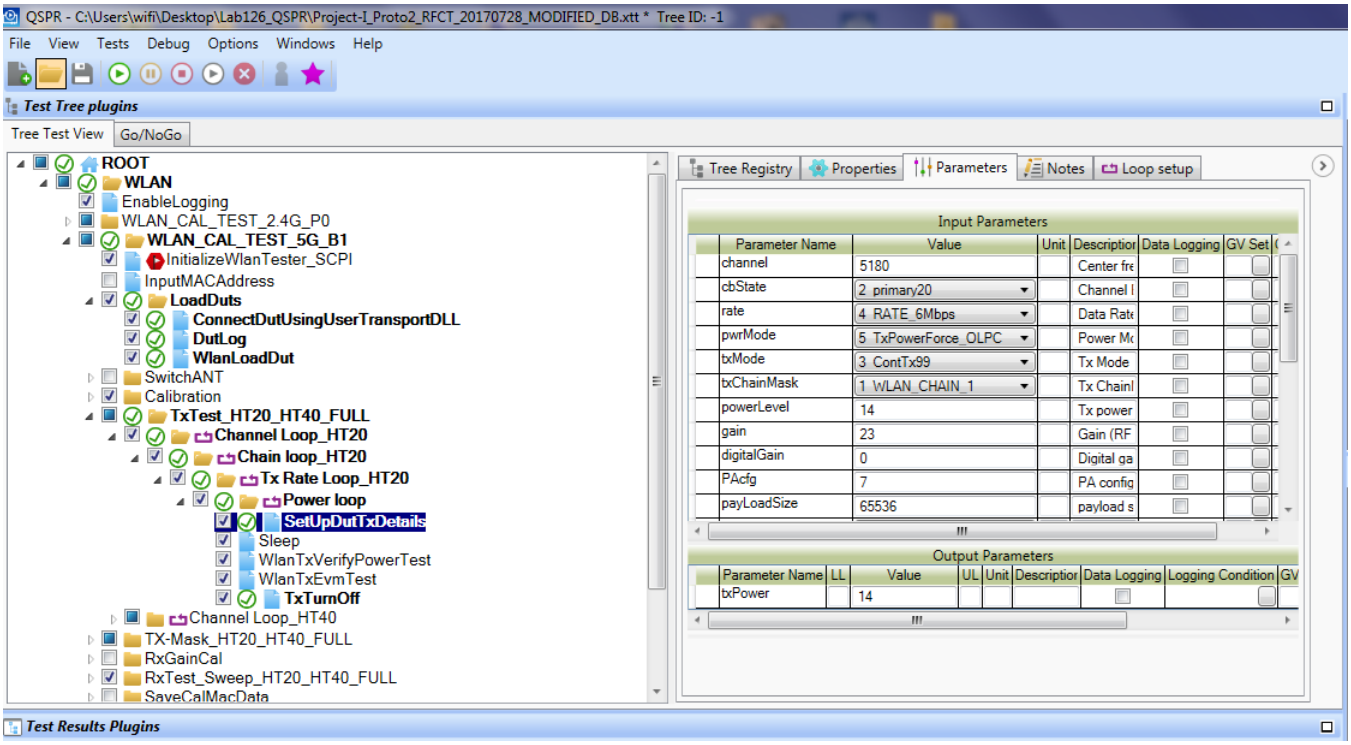
EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1 + AE#2	The radio of the EUT was configured to a specified channel with highest possible duty cycle using software “QSPR” provided by client that is not available to the end user. Unless otherwise stated the radio under test was tested with both chains active.

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels with the highest possible duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT based on the specific antenna location for the radio under test.

The EUT,s were configured by “QSPR” provided by client (not available to the end user).

QSPR Tool:



Additional Testing Notes:

This Radiated testing was executed with both chains of the 5.0 GHz and 2.4 GHz radios transmitting.
The USB port on the device is considered as a maintenance port and was used during product setup and Channel configuration. One of two Ethernet ports was connected to a laptop during radiated testing and was active via the QSPR application and a ping from the Laptop to the DUT.
Ex. “ping -6 fe80::5153:d896::3955:1eB2 –s 6500 –t”.
For this Co transmission testing 80211.n20 MCS0 and 2.4GHz WiFi 80211.b were used.
The 5GHz radios with their directional antenna configurations are identical and it’s appropriate to test each individually with the 2.4 GHz radio and its antenna pair as outlined in Section 8.1.4 for co transmission testing.

The target power settings in below table were set in QSPR as provided by client For UNII-1.

UNII-1 Power Settings				
802.11 / channel	36	40	44	48
a	16	16	16	16
n20	16	16	16	16
n40	16		16	

The target power settings in below table were set in QSPR as provided by client for UNII-3.

UNII 3					
802.11 / channel	149	153	157	161	165
a	16	16	16	16	16
n20	16	16	16	16	16
n40	16		16		

The target power settings in below table were set in QSPR as provided by client for WiFi 2.4GHz.

WiFI 2.4 GHz											
802.11 / channel	1	2	3	4	5	6	7	8	9	10	11
b	23	23	23	26	26	26	26	26	23	23	23
g	20	20	20	26	26	26	26	26	20	20	20
n 20	19	19	19	26	26	26	26	26	18	18	18
n 40	16					1 6	16				

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.407 of Title 47 of the Code of Federal Regulations.

Testing procedures are based on radiated and AC conducted emissions testing per 789033 D02 DTS UN-II Test Procedures New Rules v02r01 – "GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES (PART 15, SUBPART E)" – Nov 29, 2018, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.407(e)	Emission Bandwidth	Nominal	802.11 a/n	☐	■	☐	Complies
§15.407(a)	Power Spectral Density	Nominal	802.11 a/n	☐	■	☐	Complies
§15.407(a)	Maximum Conducted Output Power and EIRP	Nominal	802.11 a/n	☐	■	☐	Complies
§15.407(b)	Band edge compliance Unrestricted Band Edges	Nominal	802.11 a/n	☐	■	☐	Complies
§15.407(b); 15.209; 15.205	Band edge compliance Restricted Band Edges	Nominal	802.11 a/n	☐	■	☐	Complies
§15.407(b); §15.209; 15.205	TX Spurious emissions-Radiated	Nominal	802.11n_20 MIMO	■	☐	☐	Complies
§15.407(g)	Frequency stability	Extreme temperature -0°C-40°C	802.11n_20 & 802.11b	☐	■	☐	Complies
§15.207(a)	AC Conducted Emissions	Nominal	802.11n_20 & 802.11b	■	☐	☐	Complies

Note1: NA= Not Applicable; NP= Not Performed.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30 MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)
RF conducted measurement	±0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: http://physics.nist.gov/cuu/Uncertainty/typeb.html. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions during Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

12/19/2018 - 1/21/2019

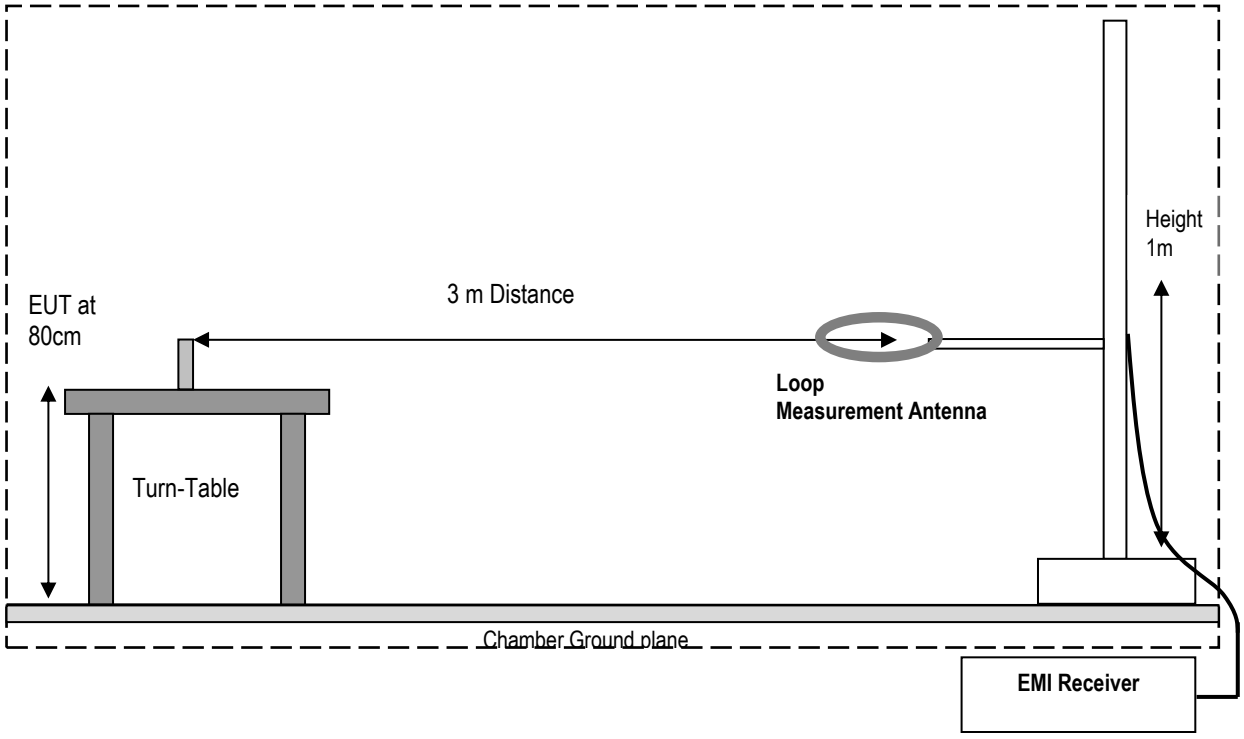
7 Measurement Procedures

7.1 Radiated Measurement

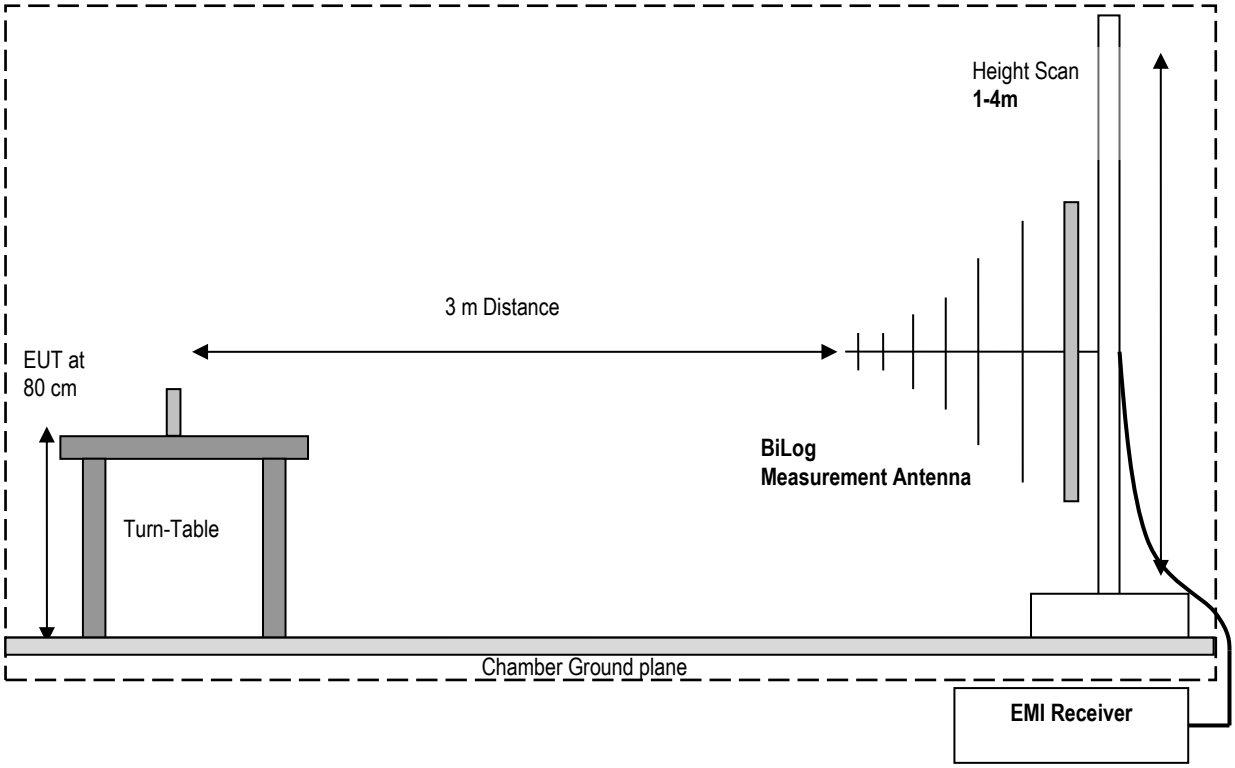
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

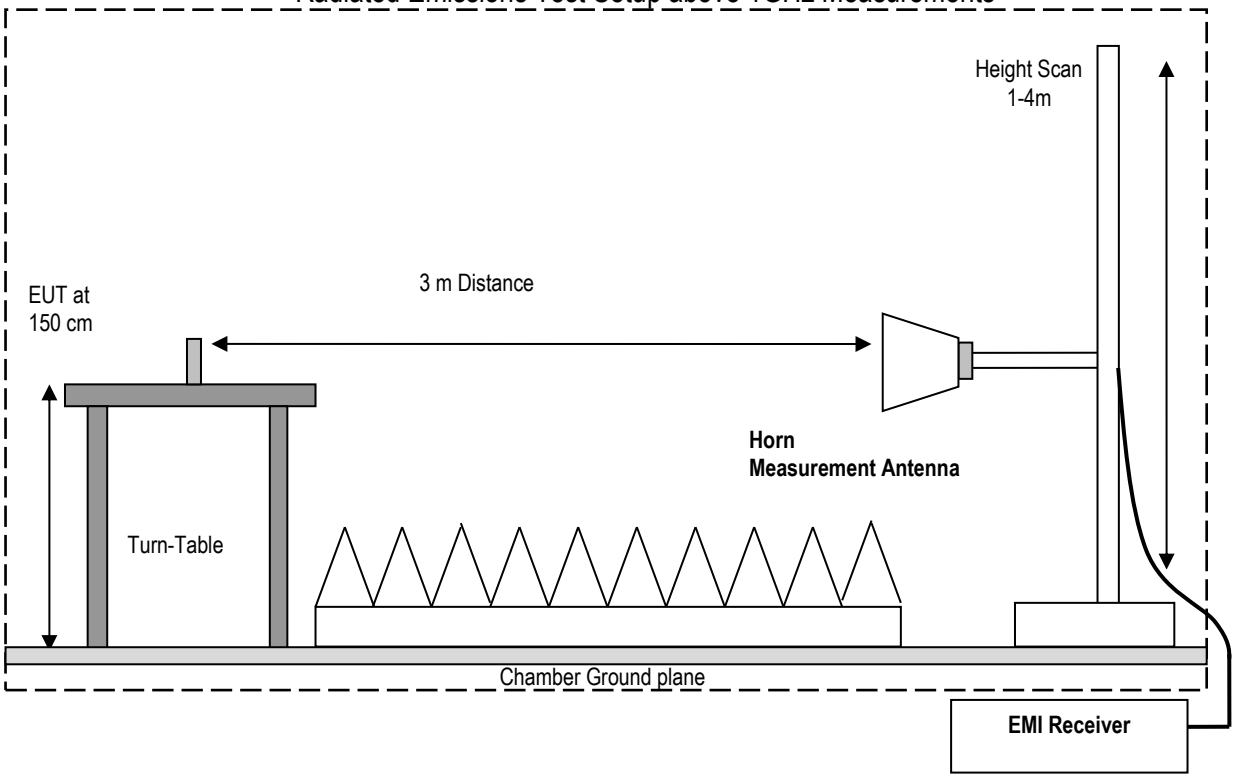
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.2 RF Conducted Measurement Procedure

Testing procedures are based on 789033 D02 General UNII Test Procedures New Rules v02r01 – "GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES (PART 15, SUBPART E)" - May 2, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.
- Calculate the conducted power by taking into account attenuation of the cable and the attenuator

8 Test Result Data

8.1 Radiated Transmitter Spurious Emissions and Restricted Bands

8.1.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.1.2 Limits:

FCC §15.247

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC §15.209

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
  *PEAK LIMIT= 74 dBµV/m
  *AVG. LIMIT= 54 dBµV/m

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23.5° C	1	802.11n_20 MIMO for 5GHz & 802.11b for 2.4GHz	AC/DC Supply

8.1.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-4	2.4GHz & B1 UNII-1	30 MHz – 18 GHz	See section 8.6.2	Pass
5-8	2.4GHz & B1 UNII-3	30 MHz – 18 GHz	See section 8.6.2	Pass
9-12	2.4GHz & B2 UNII-1	30 MHz – 18 GHz	See section 8.6.2	Pass
13-16	2.4GHz & B2 UNII-3	30 MHz – 18 GHz	See section 8.6.2	Pass
17-20	2.4GHz & B3 UNII-1	30 MHz – 18 GHz	See section 8.6.2	Pass
21-24	2.4GHz & B3 UNII-3	30 MHz – 18 GHz	See section 8.6.2	Pass
25--28	2.4GHz & B4 UNII-1	30 MHz – 18 GHz	See section 8.6.2	Pass
29-32	2.4GHz & B4 UNII-3	30 MHz – 18 GHz	See section 8.6.2	Pass

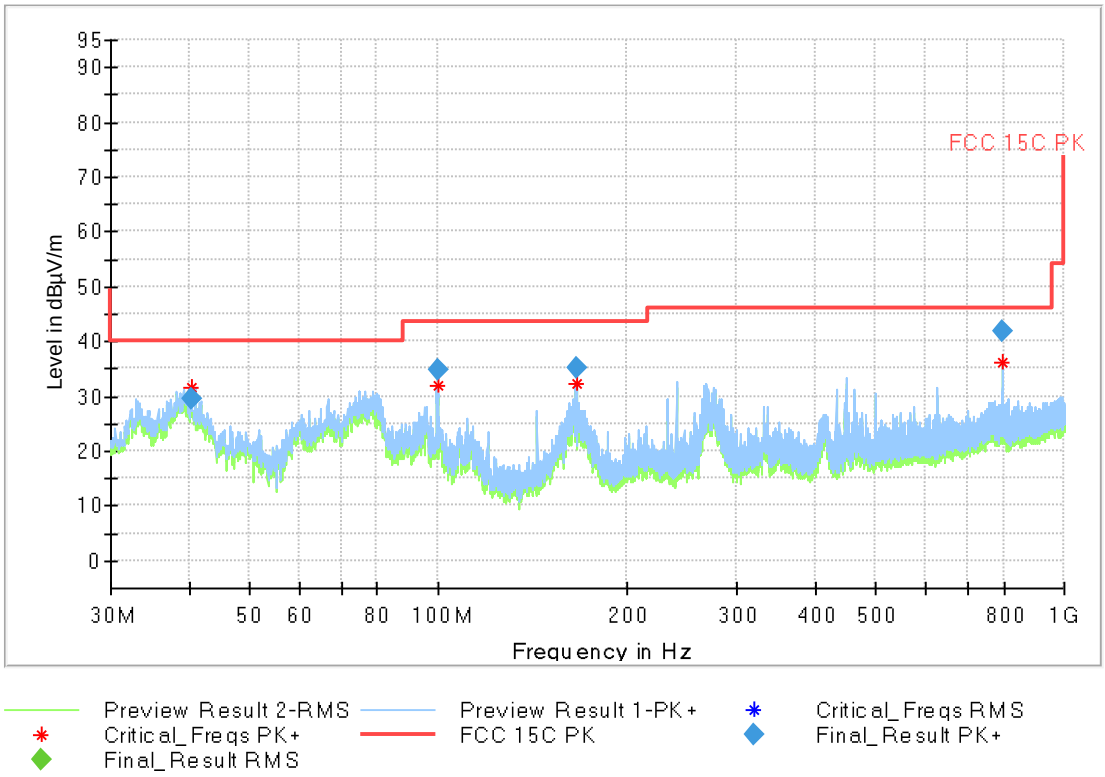
8.1.5 Measurement Plots:

Plot #1 (30MHz – 1GHz) of 1-4 B1 UNII-1-5GHz+2.4G-MidCh-Ch6 Co-transmission

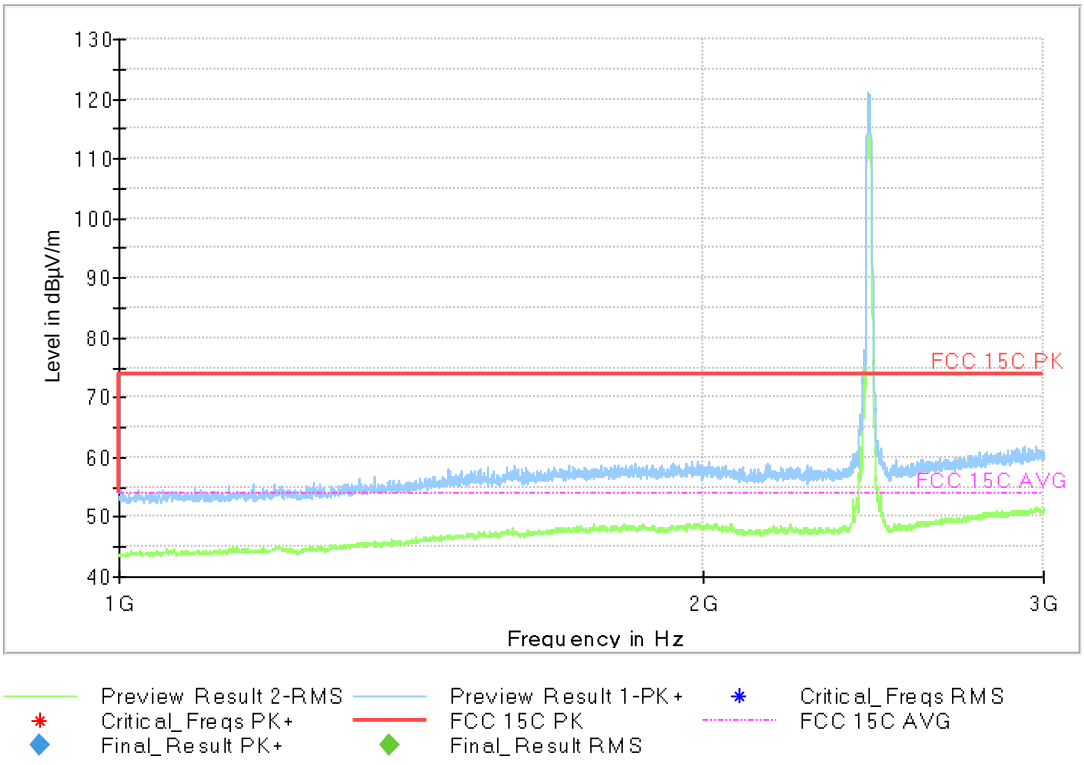
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
40.531	29.63	---	40.00	10.37	100.0	100.0	124.0	V
99.743	34.93	---	43.50	8.57	100.0	100.0	124.0	V
166.275	35.10	---	43.50	8.40	100.0	100.0	117.0	V
798.224	41.77	---	46.00	4.23	100.0	100.0	108.0	H

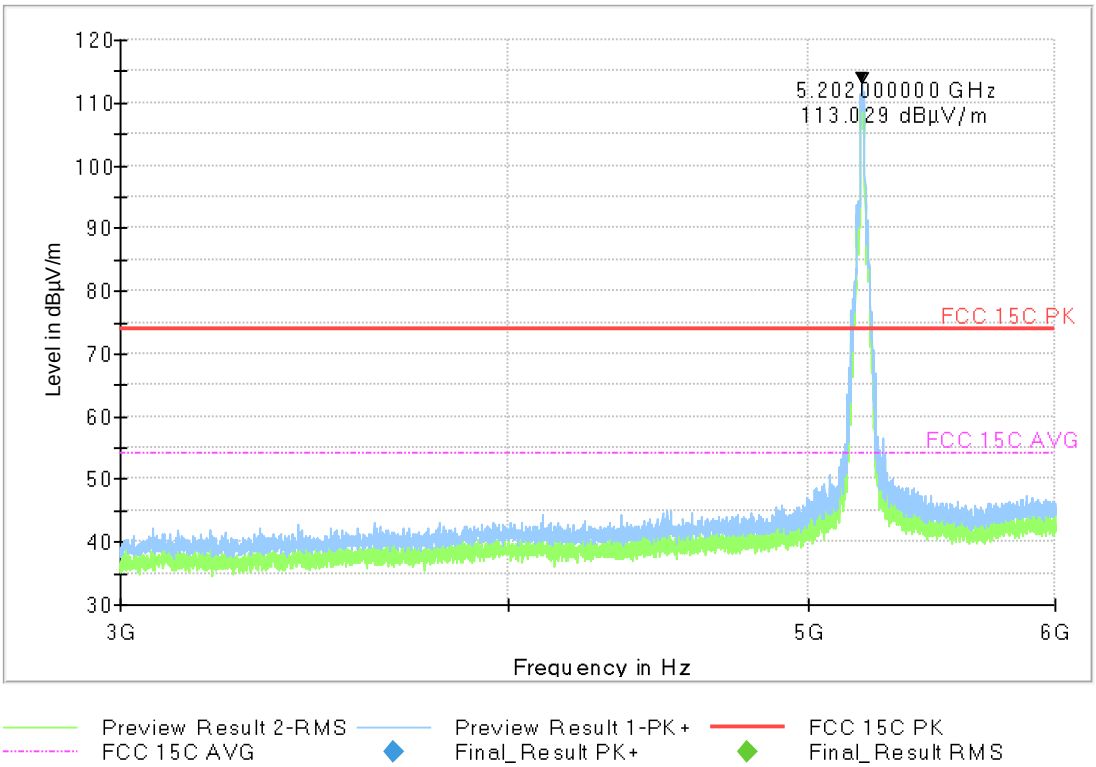
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
40.531	53.0	-15	6:58:51 PM - 1/8/2019
99.743	185.0	-22	7:01:40 PM - 1/8/2019
166.275	223.0	-20	7:04:22 PM - 1/8/2019
798.224	93.0	-7	7:07:14 PM - 1/8/2019



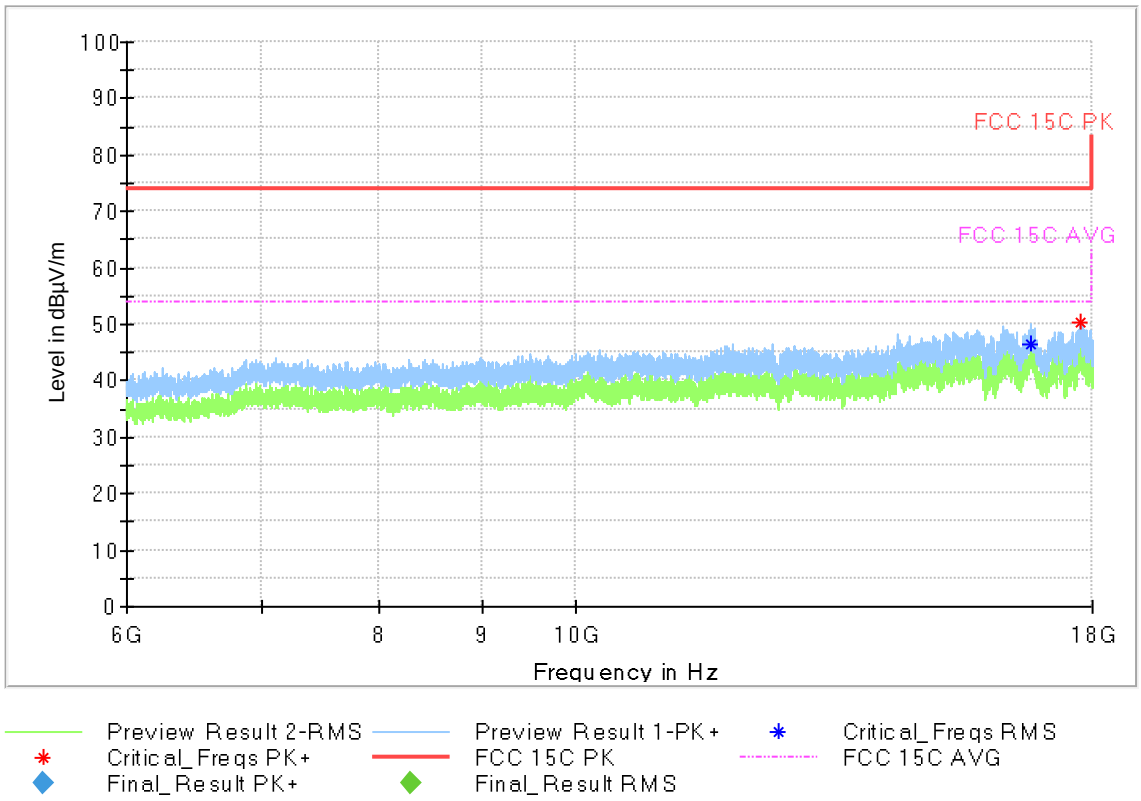
Plot #2 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



Plot #3 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



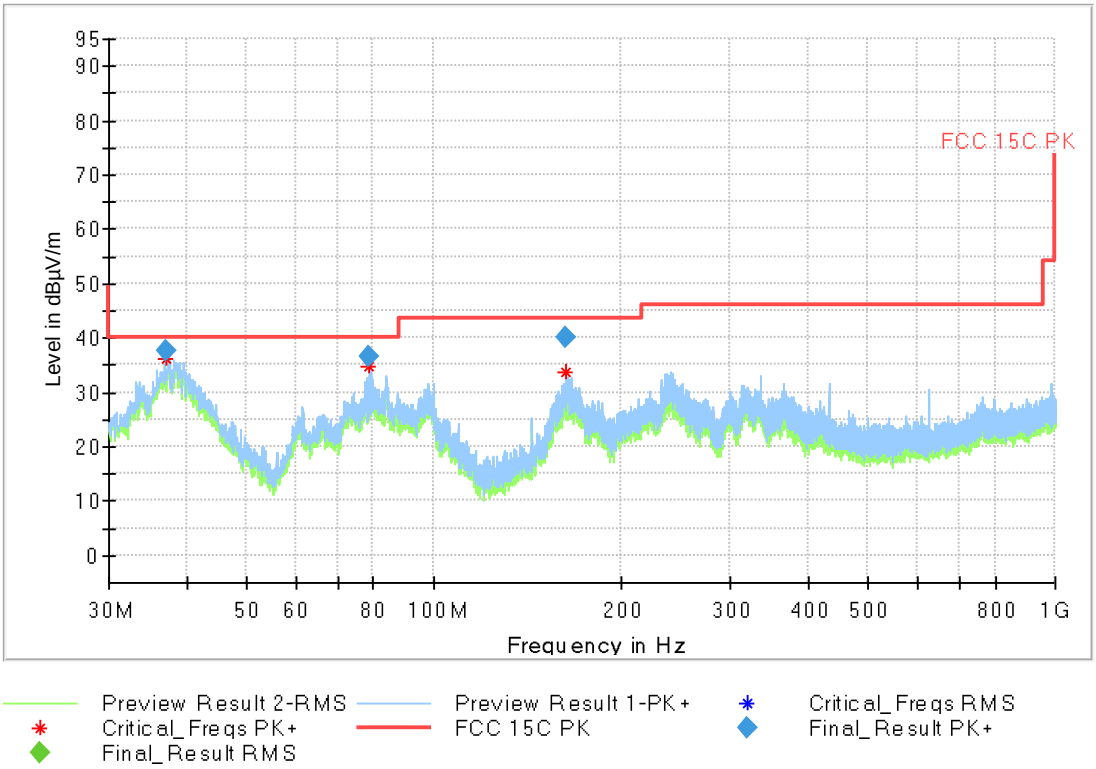
Plot #4 Radiated Emissions: 6 - 18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



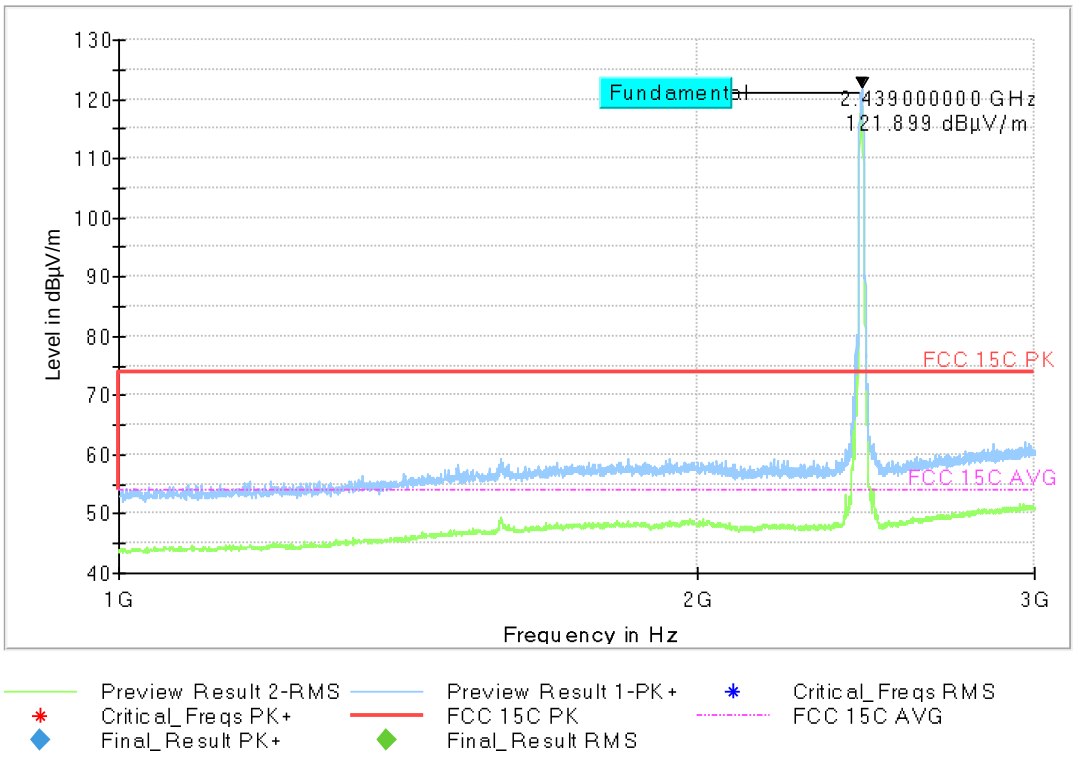
Plot #5 (30MHz – 1GHz) of 5-8 B1 UNII-3-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
37.000	37.63	---	40.00	2.37	100.0	100.0	108.0	V
78.561	36.56	---	40.00	3.44	100.0	100.0	108.0	V
163.017	40.04	---	43.50	3.46	100.0	100.0	281.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
37.000	31.0	-13	10:37:25 AM - 1/9/2019
78.561	81.0	-25	10:34:46 AM - 1/9/2019
163.017	136.0	-20	10:32:28 AM - 1/9/2019



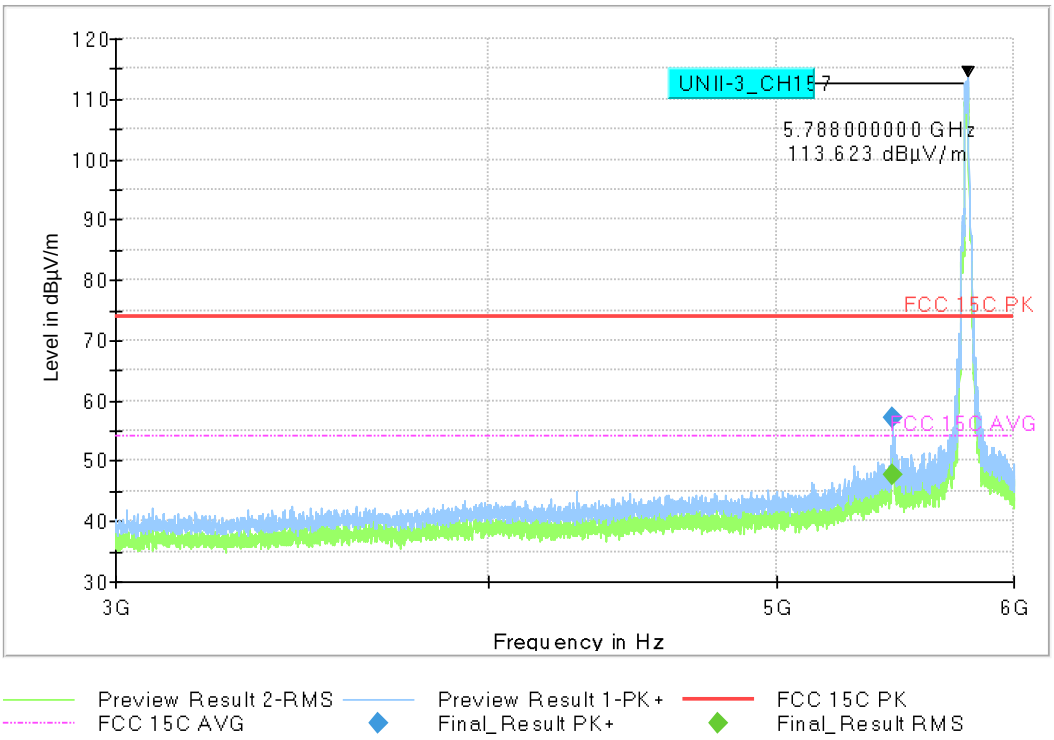
Plot #6 Radiated Emissions: 1 GHz – 3GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



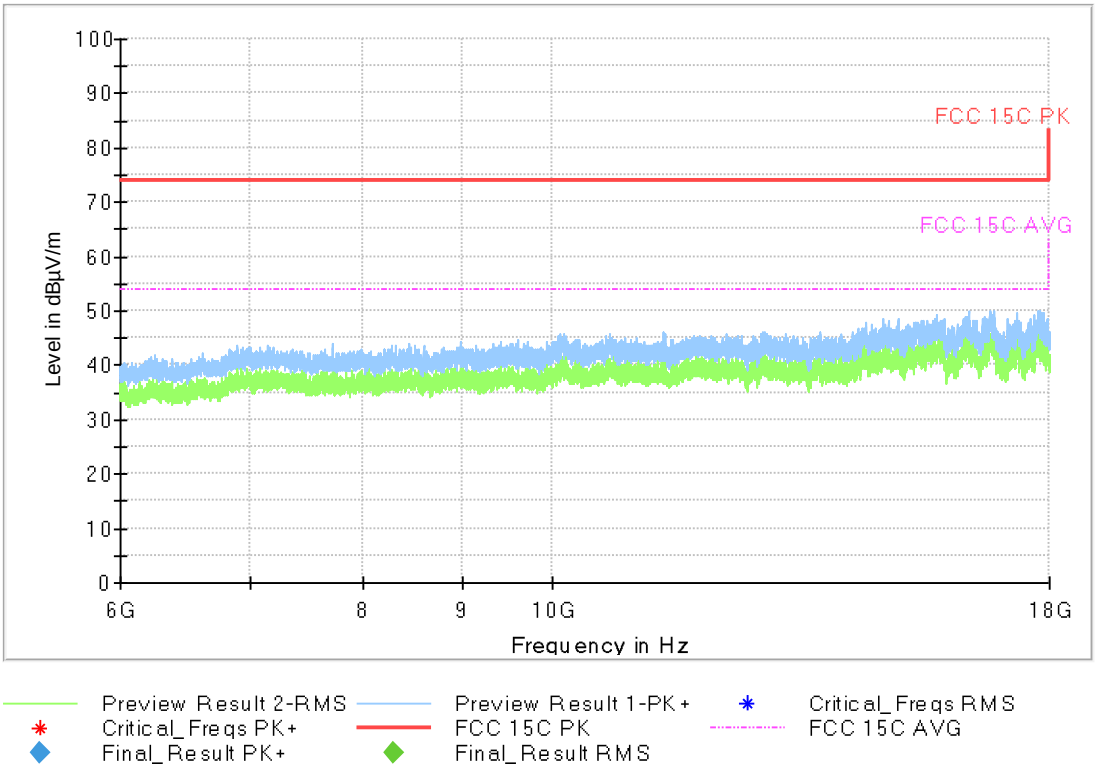
Plot #7 Radiated Emissions: 3 GHz – 6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5465.047	---	47.61	53.98	6.37	100.0	1000.0	180.0	V
5465.533	57.11	---	73.99	16.87	100.0	1000.0	162.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5465.047	167.0	2	14	0	-12	46	10:36:24 AM - 12/27/201
5465.533	168.0	2	14	0	-12	55	10:30:31 AM - 12/27/201



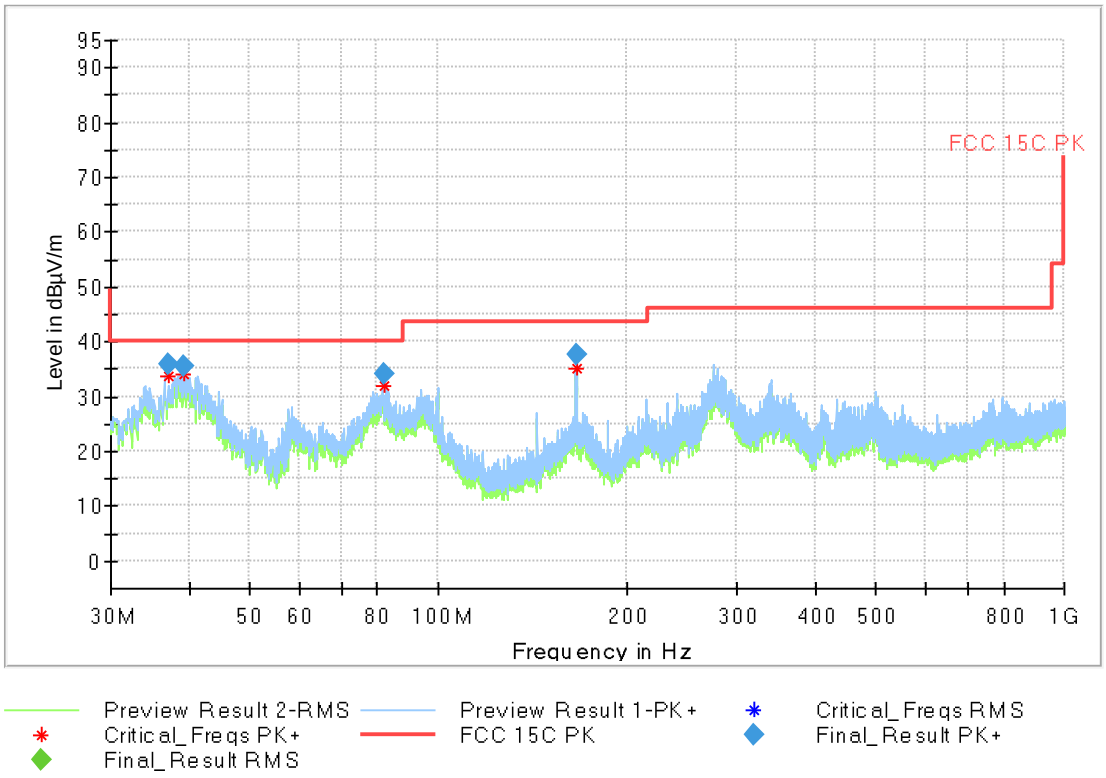
Plot #8 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



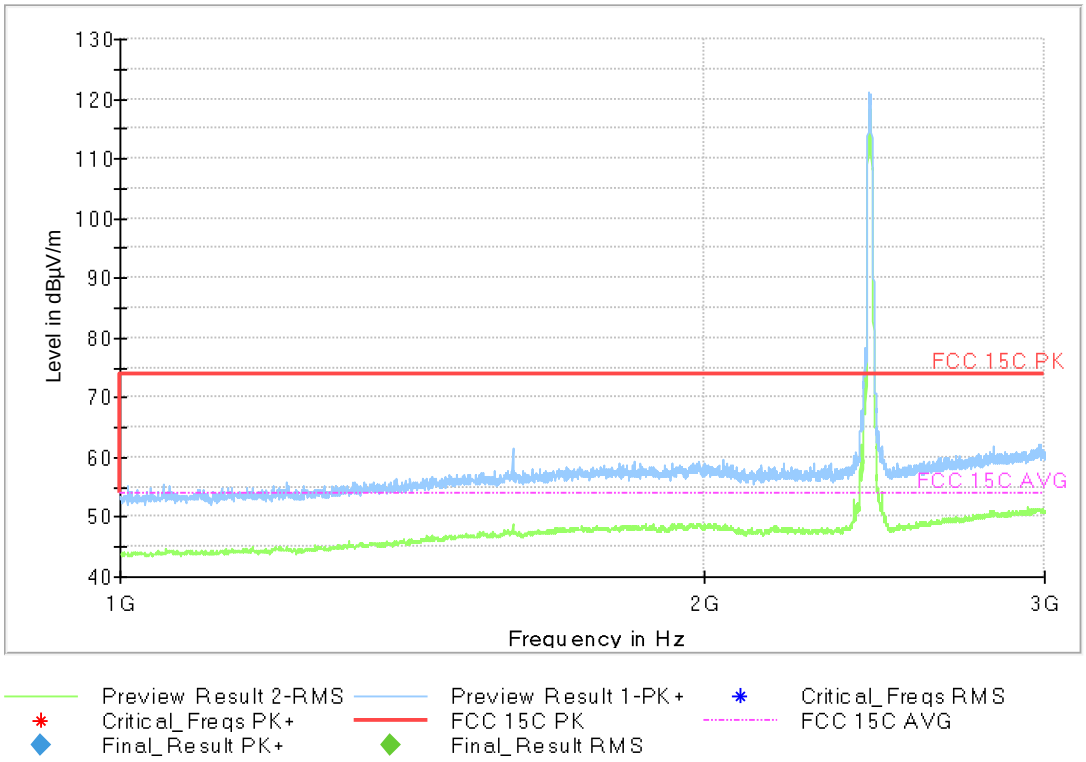
Plot #9 (30MHz – 1GHz) 1 of 4 B2 UNII-1-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO;	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
37.040	35.86	---	40.00	4.14	100.0	100.0	116.0	V
39.135	35.35	---	40.00	4.65	100.0	100.0	108.0	V
82.208	34.02	---	40.00	5.98	100.0	100.0	181.0	V
166.274	37.44	---	43.50	6.06	100.0	100.0	108.0	V

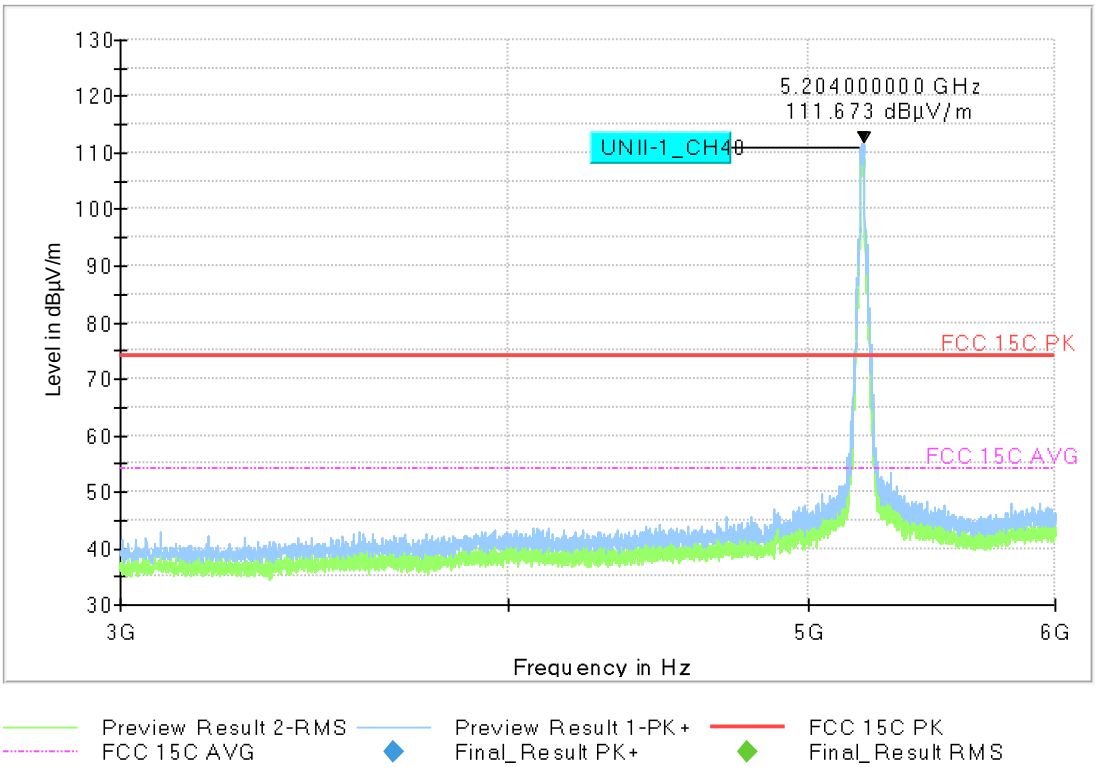
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
37.040	66.0	-13	2:38:35 PM - 1/9/2019
39.135	151.0	-14	2:43:27 PM - 1/9/2019
82.208	142.0	-23	2:40:52 PM - 1/9/2019
166.274	214.0	-20	2:46:12 PM - 1/9/2019



Plot #10 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



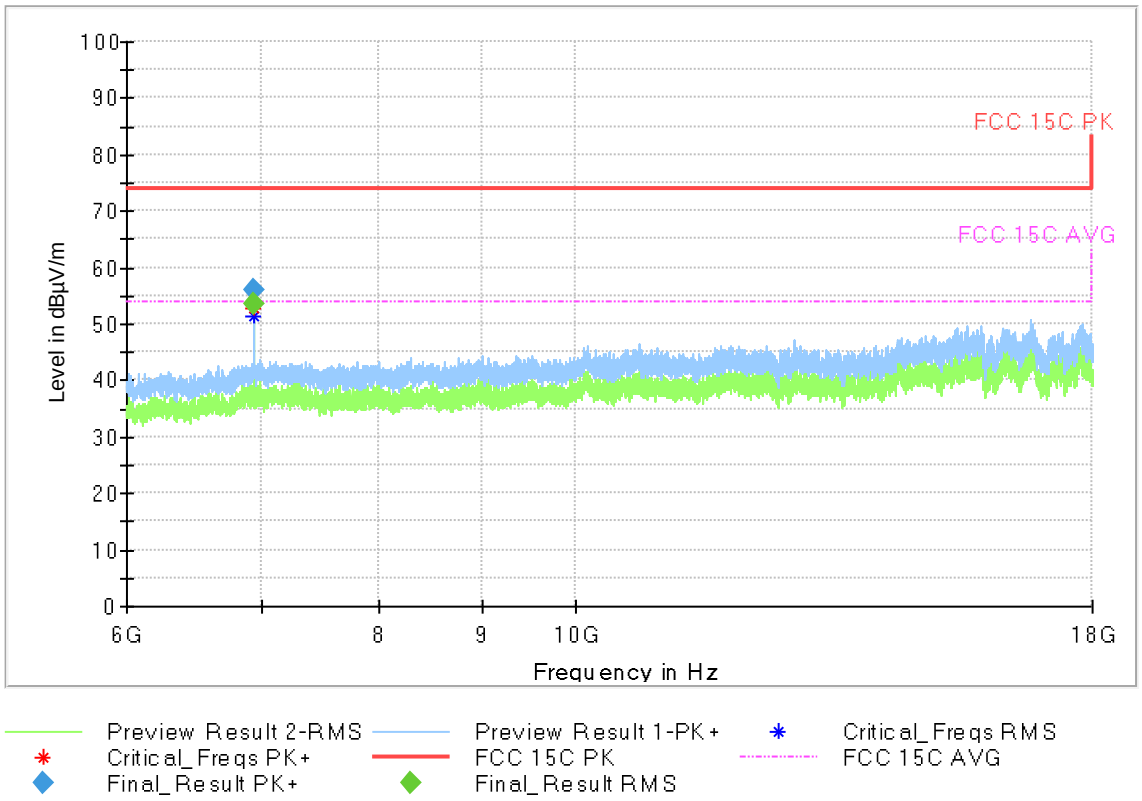
Plot #11 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



Plot #12 Radiated Emissions: 6 - 18 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
6933.195	---	53.45	53.98	0.53	100.0	1000.0	188.0	H
6933.228	55.88	---	73.99	18.11	100.0	1000.0	188.0	H

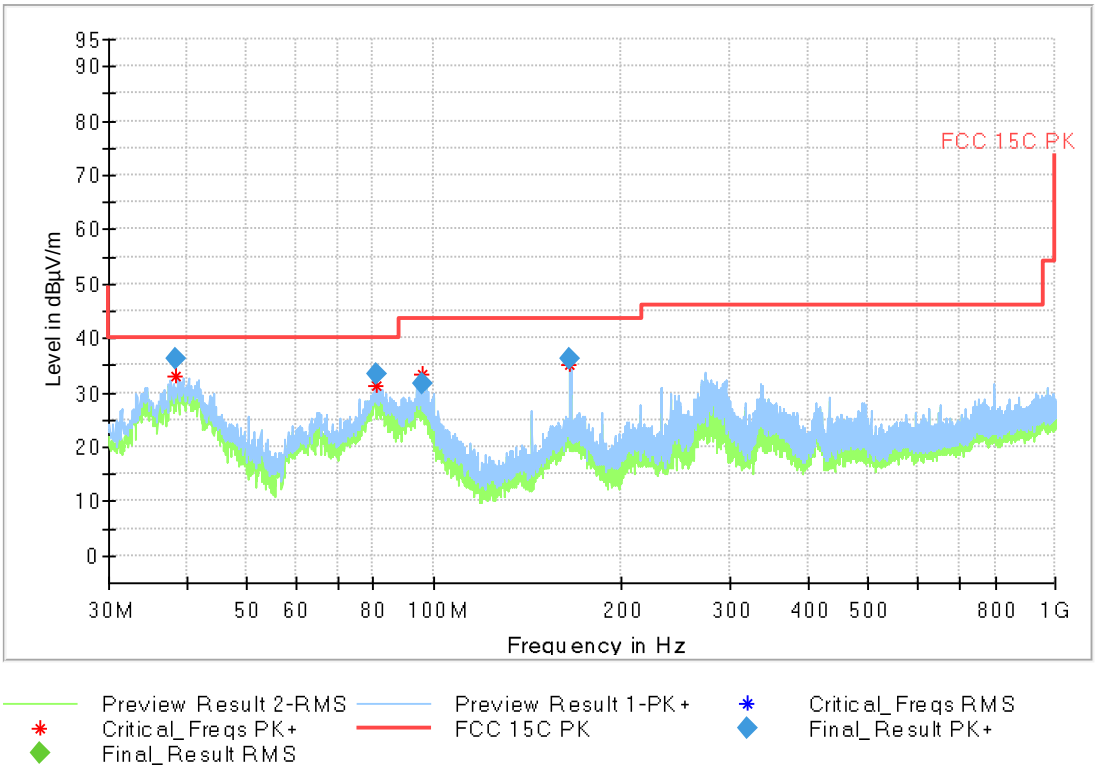
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
6933.195	352.0	-30	5:11:57 PM - 1/2/2019
6933.228	354.0	-30	5:09:20 PM - 1/2/2019



Plot #13 (30MHz – 1GHz) 1 of 4 for B2 UNII-3-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
38.367	36.33	---	40.00	3.67	100.0	100.0	116.0	V
80.609	33.48	---	40.00	6.52	100.0	100.0	116.0	V
95.720	31.79	---	43.50	11.71	100.0	100.0	116.0	V
165.997	36.21	---	43.50	7.29	100.0	100.0	117.0	V

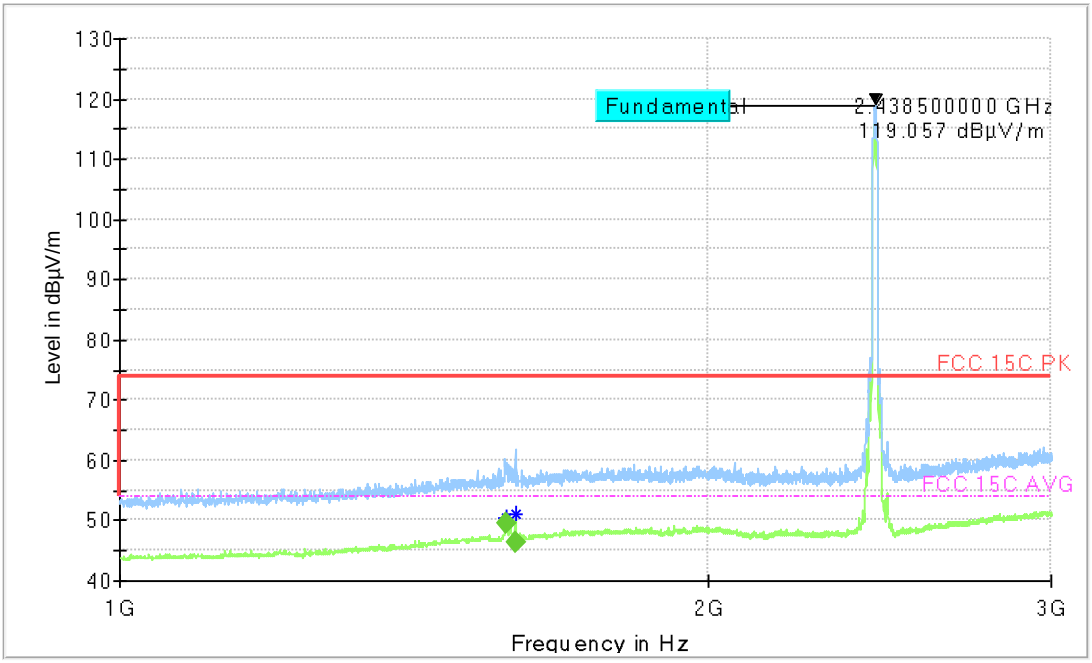
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
38.367	123.0	-14	2:58:58 PM - 1/9/2019
80.609	10.0	-24	3:02:02 PM - 1/9/2019
95.720	-42.0	-22	3:04:39 PM - 1/9/2019
165.997	218.0	-20	3:07:32 PM - 1/9/2019



Plot # 14 Radiated Emissions: 1 GHz – 3GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1576.845	---	49.54	53.98	4.44	300.0	1000.0	151.0	V
1596.485	---	46.31	53.98	7.67	300.0	1000.0	325.0	V

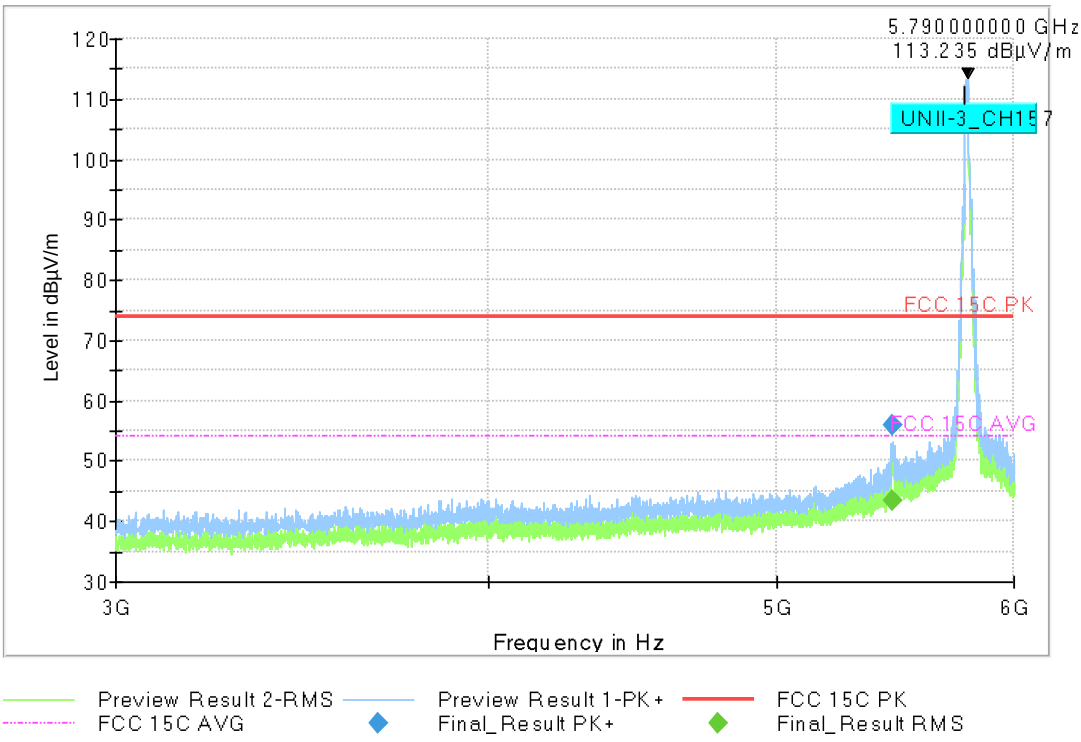
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1576.845	359.0	20	-10	0	30	30	7:08:09 PM - 1/7/2019
1596.485	53.0	20	-10	0	30	26	7:05:08 PM - 1/7/2019



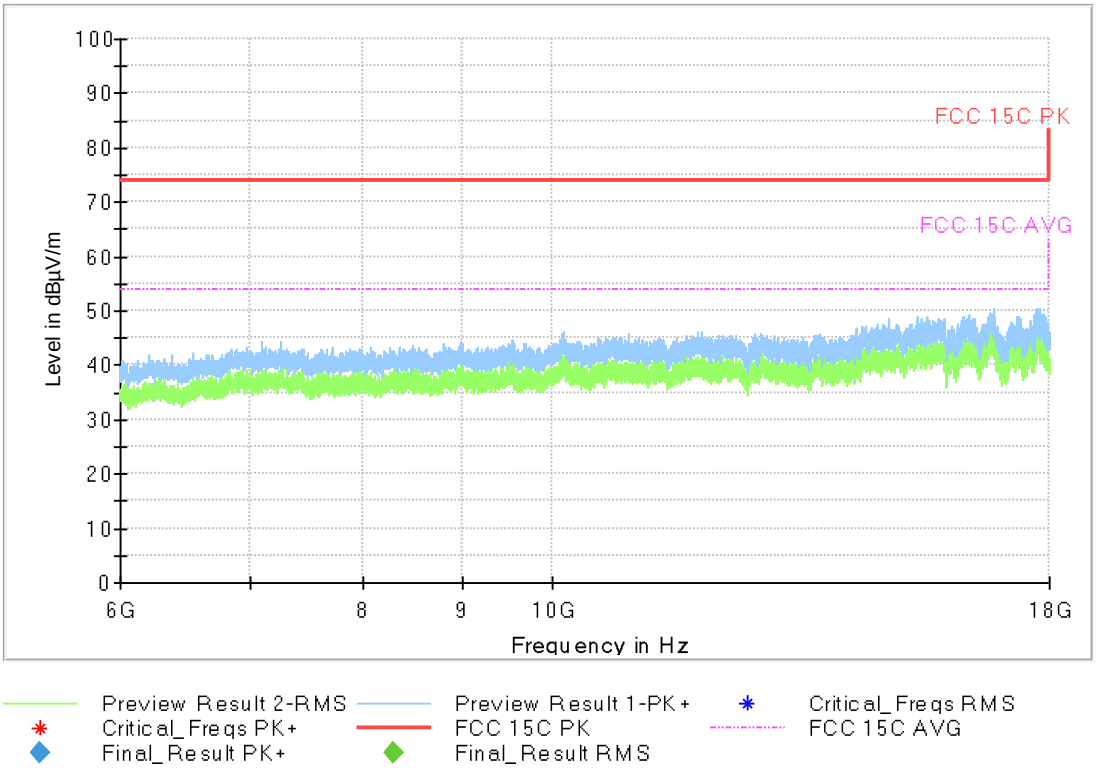
Plot #15 Radiated Emissions: 3 GHz – 6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5461.537	55.83	---	73.99	18.15	100.0	1000.0	159.0	V
5462.770	---	43.53	53.98	10.45	100.0	1000.0	159.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5461.537	333.0	2	14	0	-12	54	11:58:22 AM - 12/27/2018
5462.770	345.0	2	14	0	-12	42	12:00:53 PM - 12/27/2018



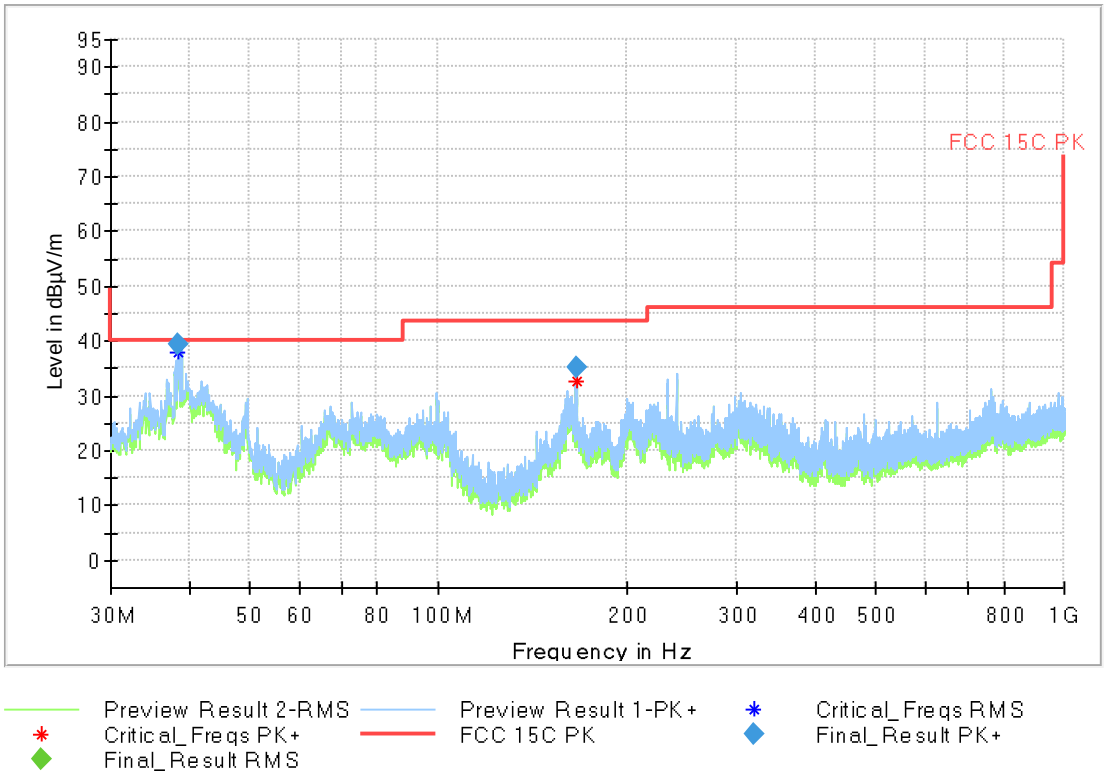
Plot # 16 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



Plot # 17 (30MHz – 1GHz) 1 of 4 B3 UNII-1-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
38.465	39.25	---	40.00	0.75	100.0	100.0	117.0	V
166.003	35.18	---	43.50	8.32	100.0	100.0	100.0	V

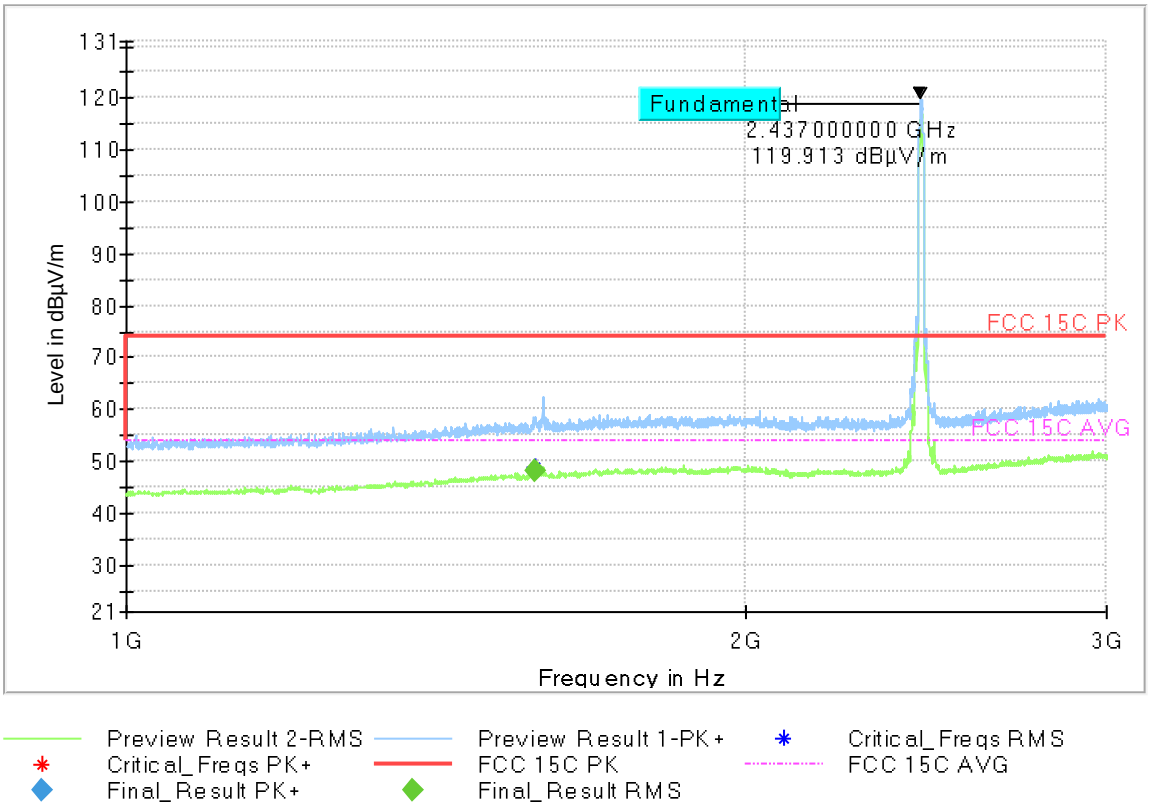
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
38.465	201.0	-14	11:47:16 AM - 1/9/2019
166.003	228.0	-20	11:49:52 AM - 1/9/2019



Plot #18 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1579.790	---	48.03	53.98	5.95	300.0	1000.0	146.0	V

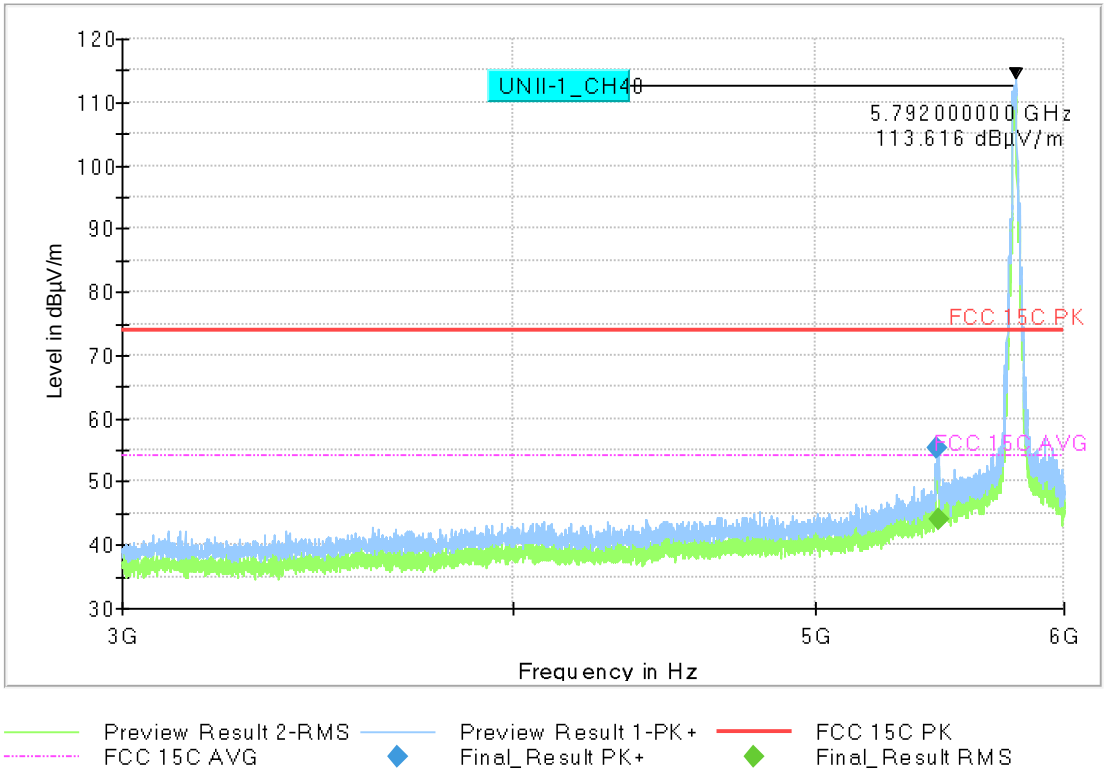
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1579.790	-5.0	20	-10	0	30	28	5:14:12 PM - 1/7/2019



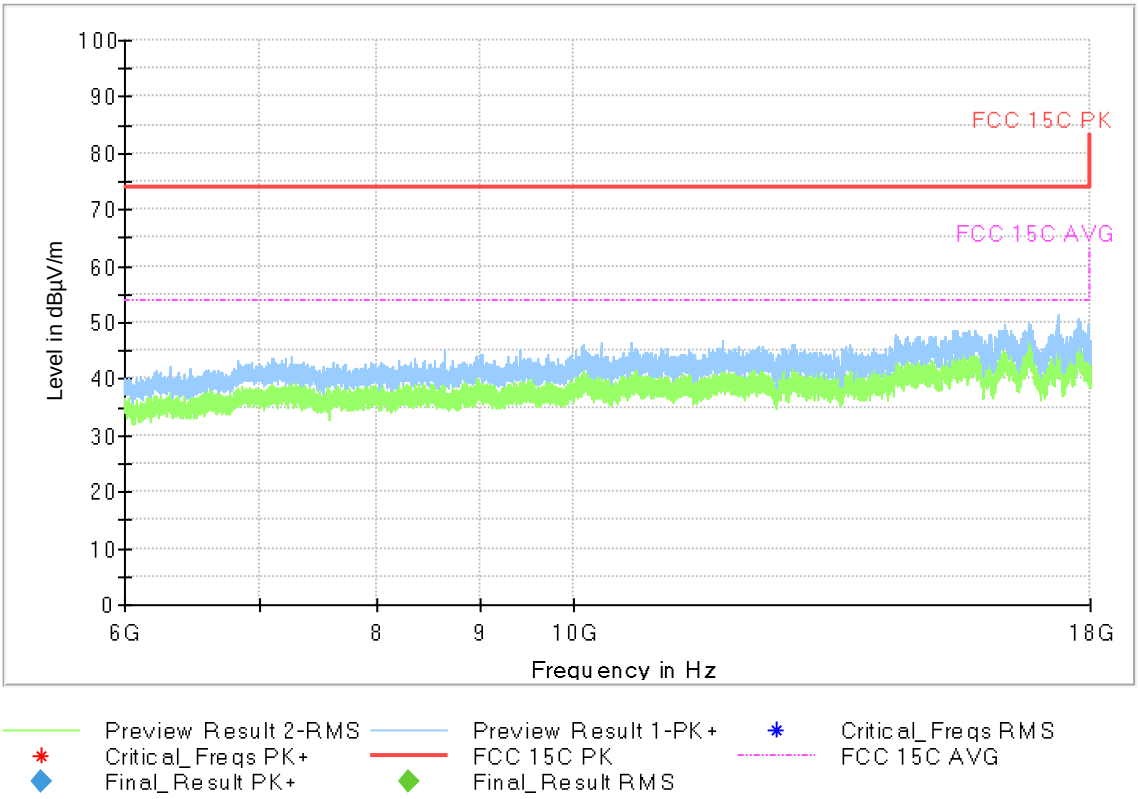
Plot #19 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5467.560	55.41	---	73.99	18.58	100.0	1000.0	166.0	H
5469.913	---	44.18	53.98	9.80	100.0	1000.0	171.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5467.560	317.0	2	14	0	-12	54	12:21:26 PM - 12/27/2018
5469.913	314.0	2	14	0	-12	43	12:24:01 PM - 12/27/2018



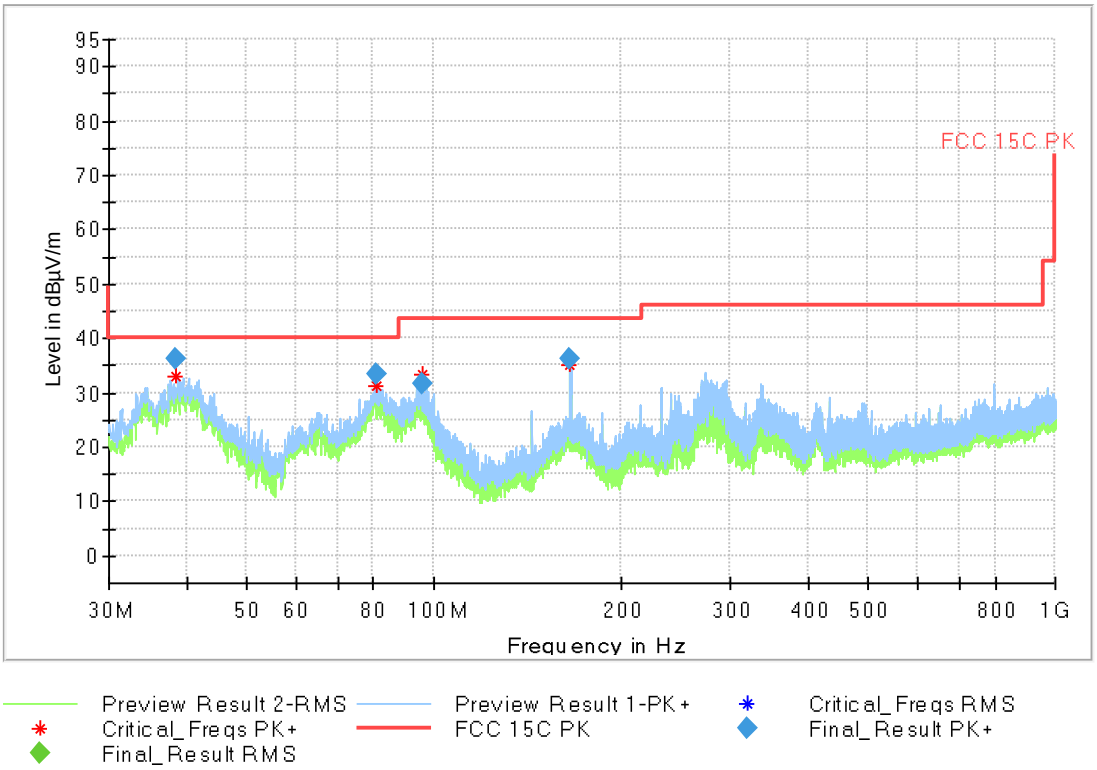
Plot #20 Radiated Emissions: 6 - 18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



Plot #21 (30MHz – 1GHz) 1 of 4 for B3 UNII-3-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
38.367	36.33	---	40.00	3.67	100.0	100.0	116.0	V
80.609	33.48	---	40.00	6.52	100.0	100.0	116.0	V
95.720	31.79	---	43.50	11.71	100.0	100.0	116.0	V
165.997	36.21	---	43.50	7.29	100.0	100.0	117.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
38.367	123.0	-14	2:58:58 PM - 1/9/2019
80.609	10.0	-24	3:02:02 PM - 1/9/2019
95.720	-42.0	-22	3:04:39 PM - 1/9/2019
165.997	218.0	-20	3:07:32 PM - 1/9/2019

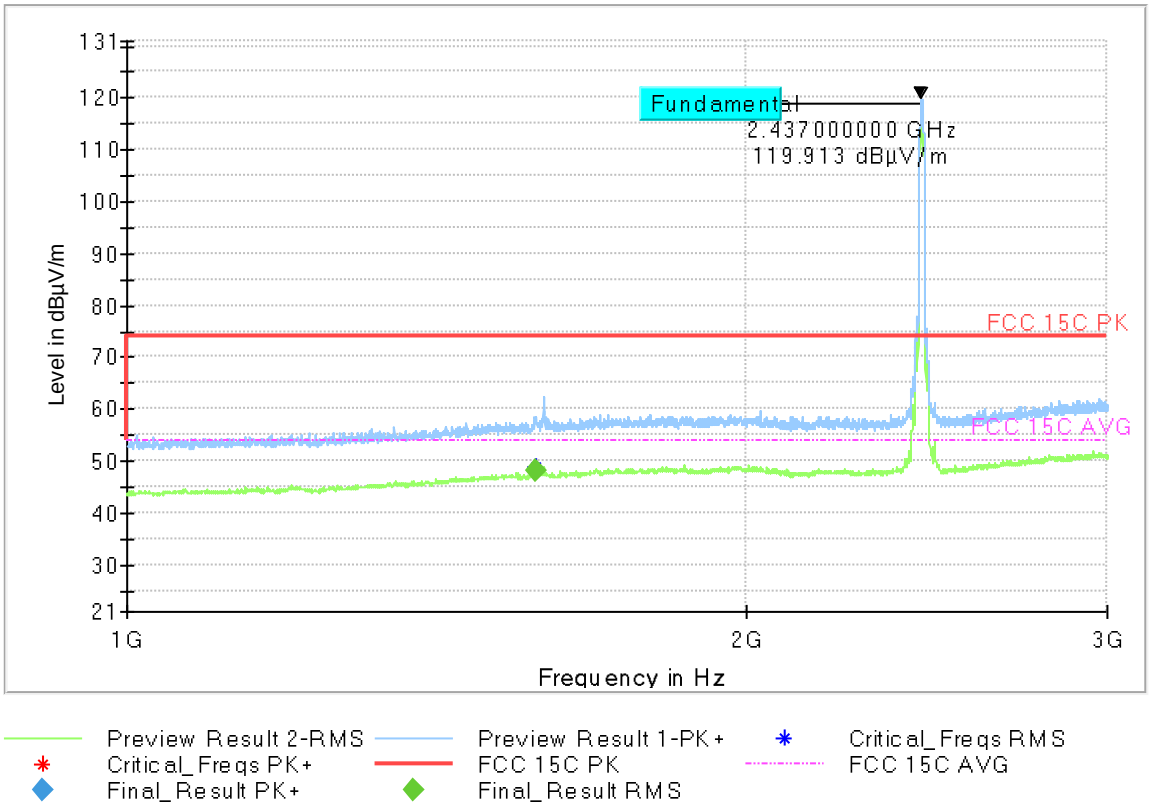


Plot # 22 Radiated Emissions: 1 GHz – 3GHz

Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1579.790	---	48.03	53.98	5.95	300.0	1000.0	146.0	V

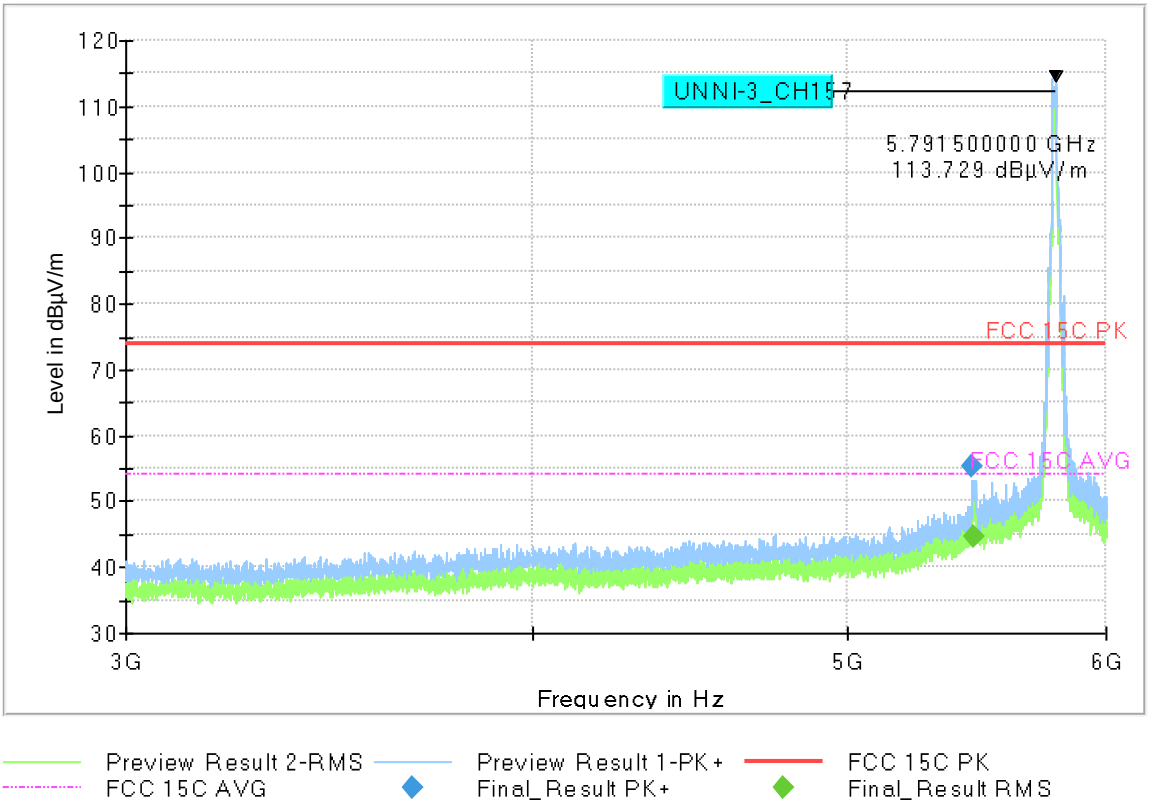
Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1579.790	-5.0	20	-10	0	30	28	5:14:12 PM - 1/7/2019



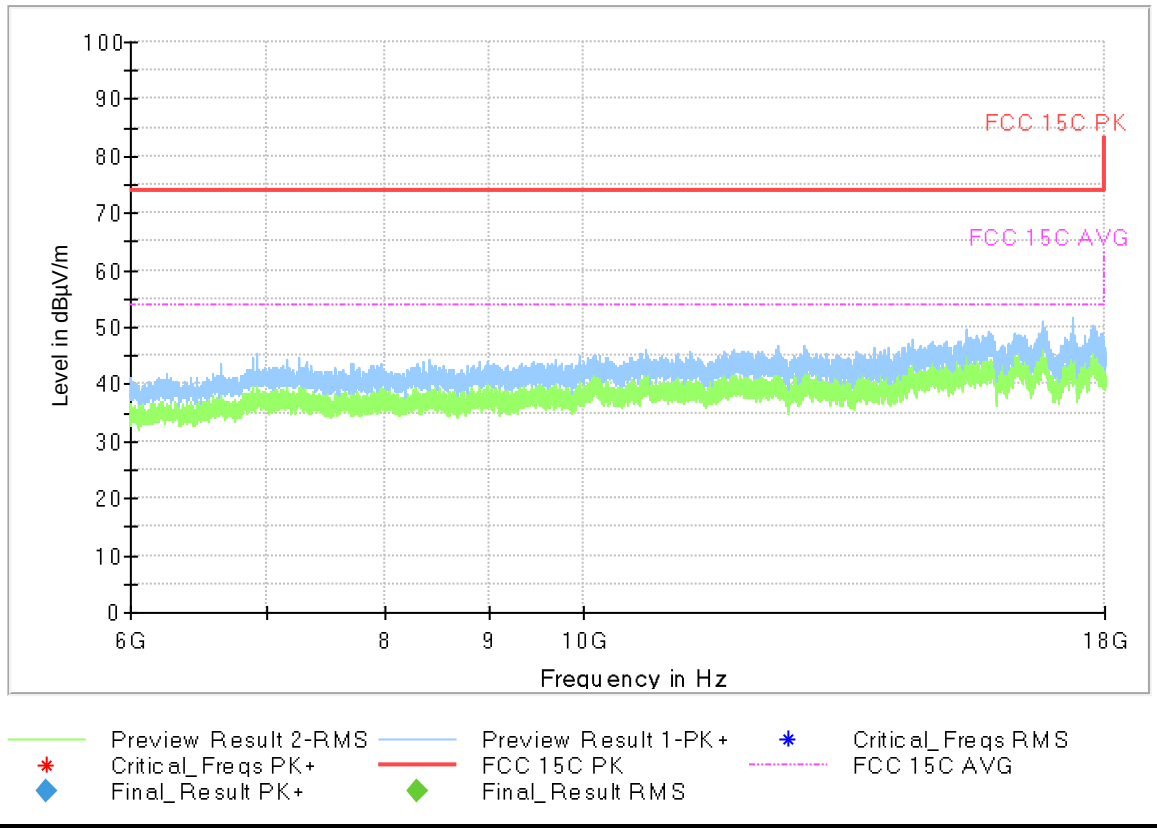
Plot #23 Radiated Emissions: 3 GHz – 6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5460.223	55.37	---	73.99	18.62	100.0	1000.0	170.0	V
5465.283	---	44.53	53.98	9.45	100.0	1000.0	172.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5460.223	321.0	2	14	0	-12	54	12:35:05 PM - 12/27/2018
5465.283	317.0	2	14	0	-12	43	12:39:14 PM - 12/27/2018



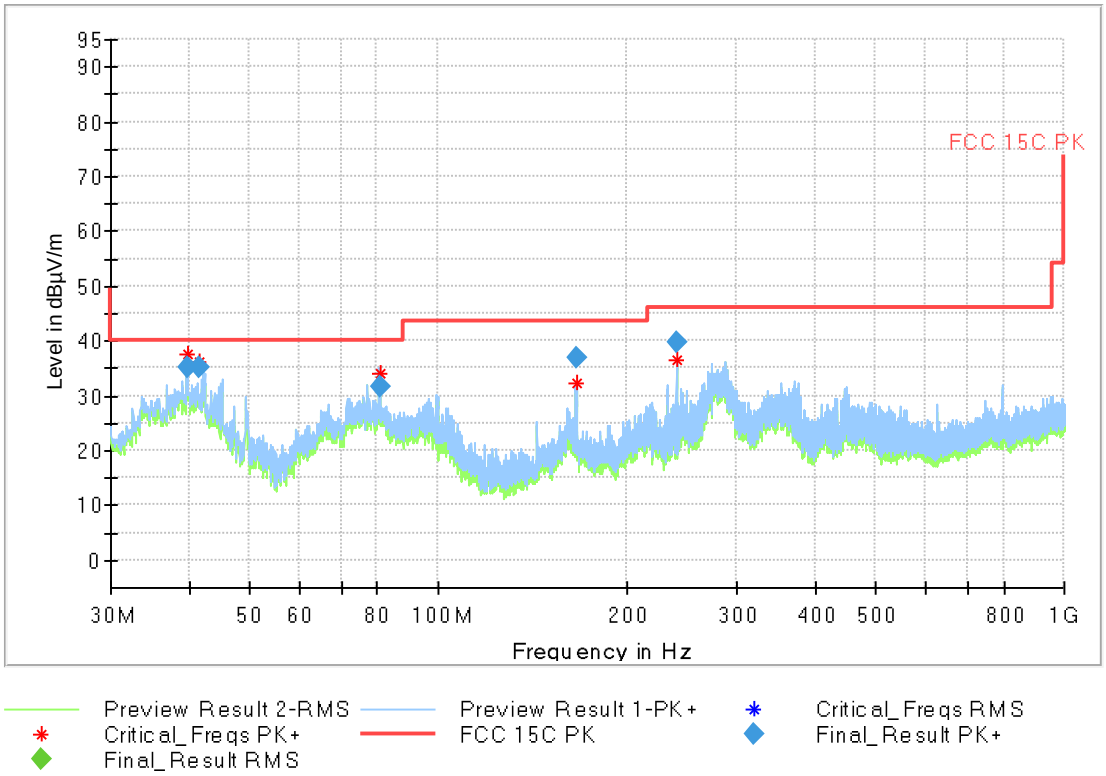
Plot # 24 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



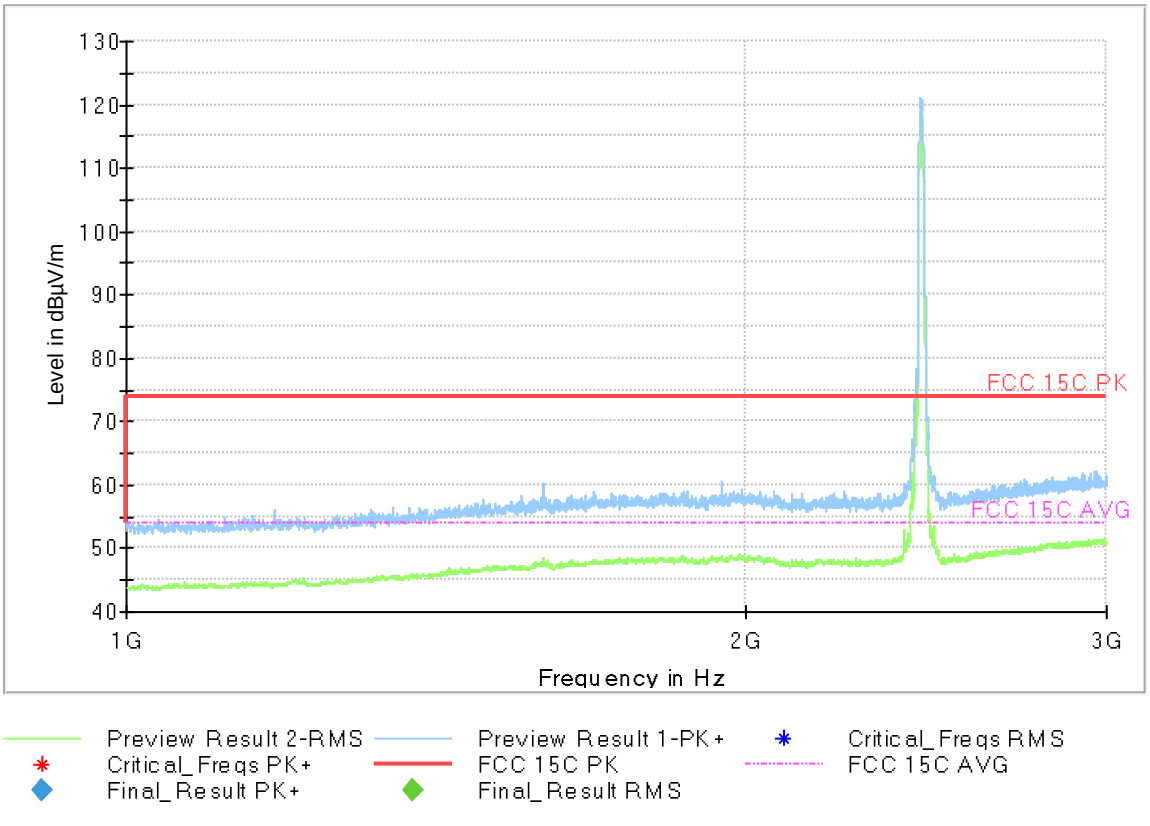
Plot # 25 (30MHz – 1GHz) 1 of 4 B4 UNII-1 + 2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.858	35.11	---	40.00	4.89	100.0	100.0	165.0	V
41.674	35.29	---	40.00	4.71	100.0	100.0	108.0	V
80.869	31.65	---	40.00	8.35	100.0	100.0	116.0	V
166.259	36.90	---	43.50	6.60	100.0	100.0	100.0	V
239.993	39.82	---	46.00	6.18	100.0	100.0	138.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.858	24.0	-14	2:16:09 PM - 1/9/2019
41.674	302.0	-15	2:04:52 PM - 1/9/2019
80.869	17.0	-24	2:07:41 PM - 1/9/2019
166.259	242.0	-20	1:59:59 PM - 1/9/2019
239.993	45.0	-19	1:57:03 PM - 1/9/2019



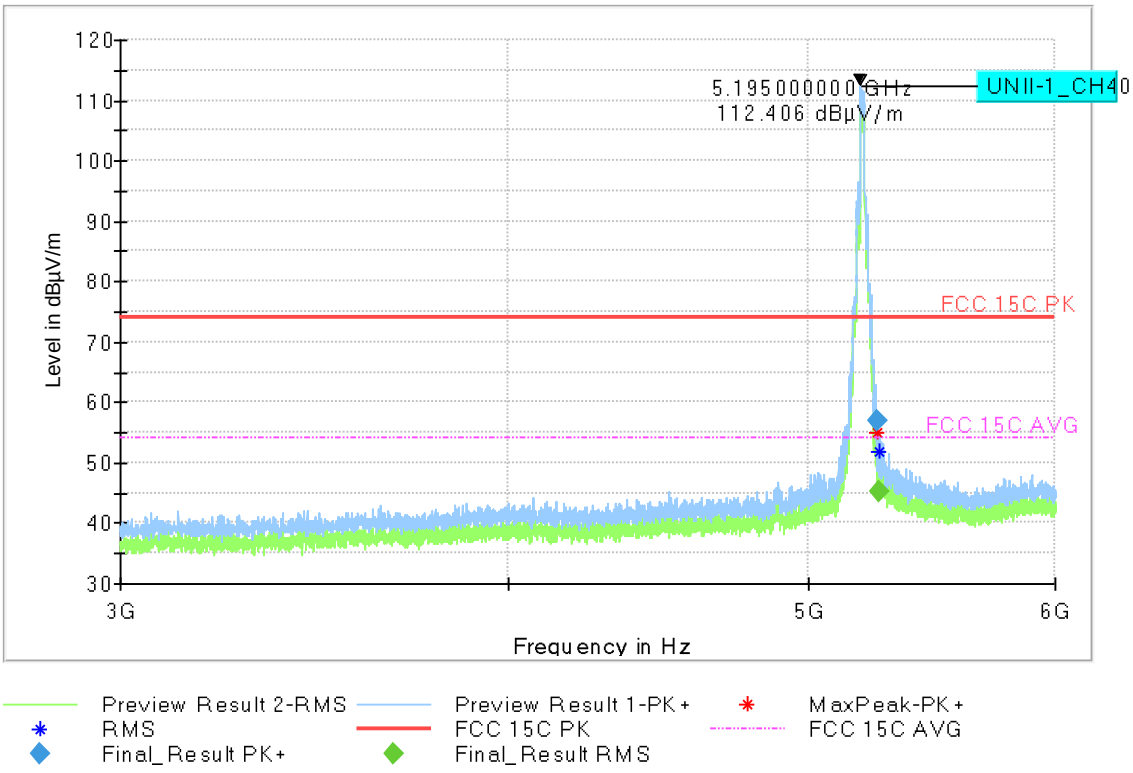
Plot # 26 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



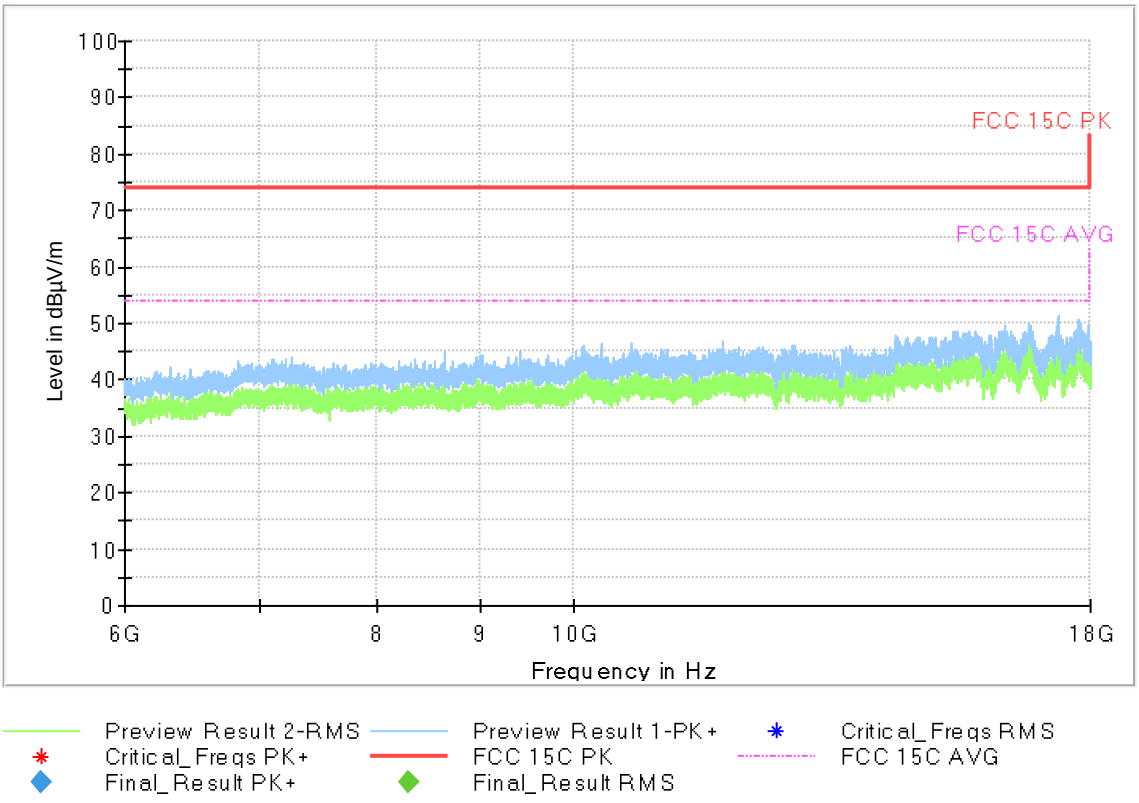
Plot # 27 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5259.440	56.80	---	73.99	17.19	100.0	1000.0	159.0	V
5263.310	---	45.23	53.98	8.75	100.0	1000.0	166.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5259.440	326.0	1	14	0	-13	56	2:53:04 PM - 12/27/2018
5263.310	338.0	1	14	0	-13	45	3:05:34 PM - 12/27/2018



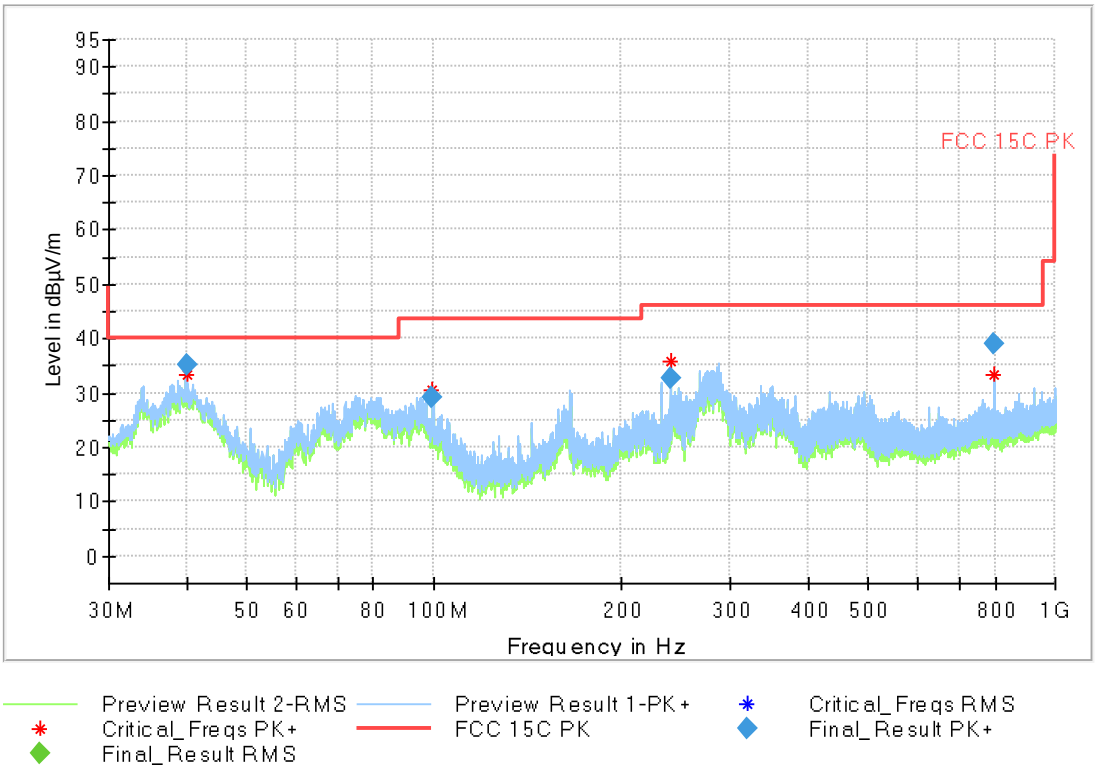
Plot # 28 Radiated Emissions: 6 - 18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



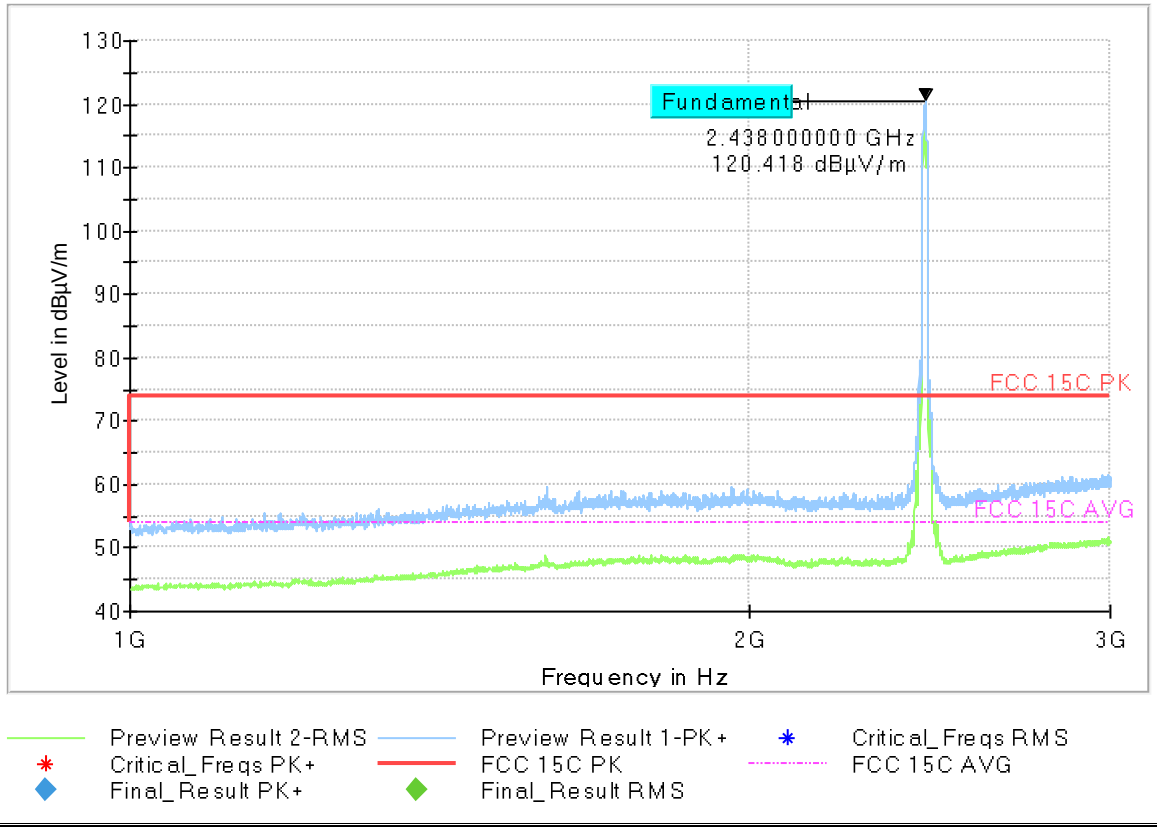
Plot #29 (30MHz – 1GHz) 1 of 4 for B4 UNII-3-5GHz+2.4G-MidCh-Ch6 Co-transmission		
Modulation: 802.11n_20 MIMO	Channel: Mid	UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
40.171	35.06	---	40.00	4.94	100.0	100.0	128.0	V
99.591	29.30	---	43.50	14.20	100.0	100.0	117.0	V
239.991	32.84	---	46.00	13.16	100.0	100.0	122.0	H
796.607	39.03	---	46.00	6.97	100.0	100.0	117.0	H

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
40.171	208.0	-15	1:34:59 PM - 1/9/2019
99.591	161.0	-22	1:44:13 PM - 1/9/2019
239.991	-33.0	-19	1:38:36 PM - 1/9/2019
796.607	94.0	-7	1:41:18 PM - 1/9/2019



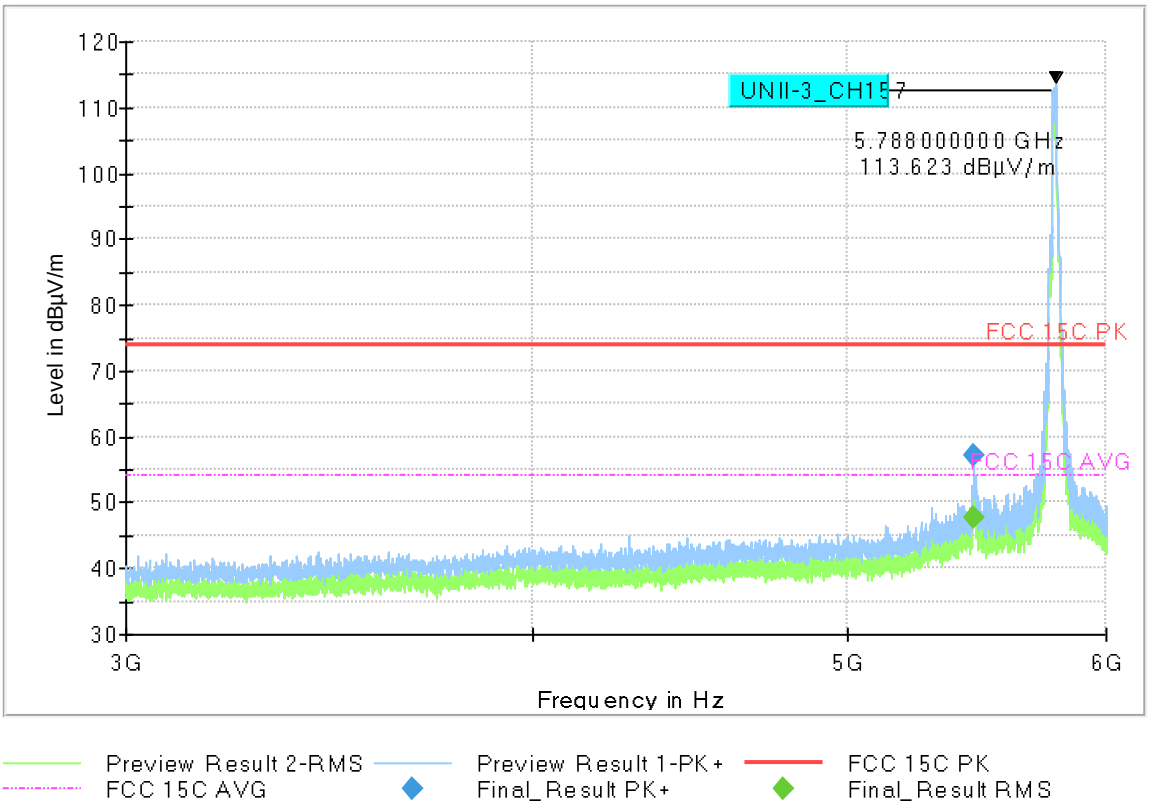
Plot # 30 Radiated Emissions: 1 GHz – 3GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



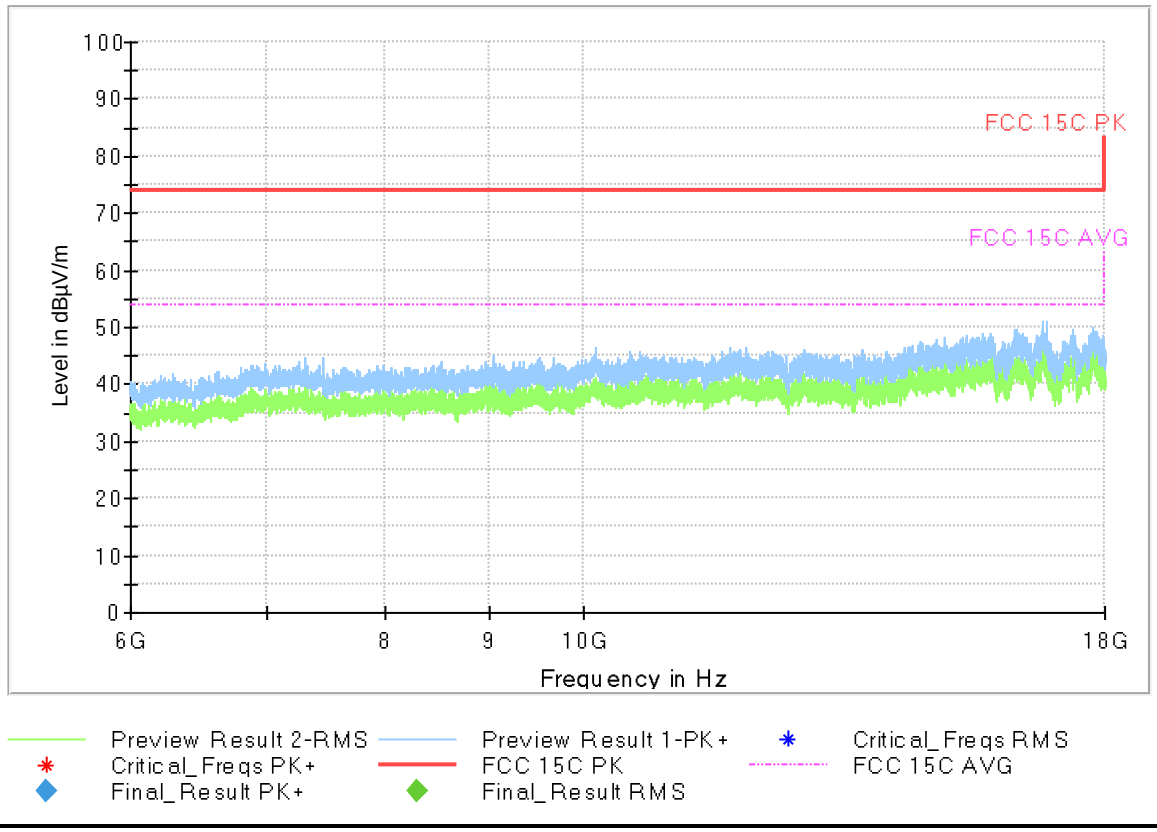
Plot #31 Radiated Emissions: 3 GHz – 6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5465.047	---	47.61	53.98	6.37	100.0	1000.0	180.0	V
5465.533	57.11	---	73.99	16.87	100.0	1000.0	162.0	V

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
5465.047	167.0	2	14	0	-12	46	10:36:24 AM - 12/27/2018
5465.533	168.0	2	14	0	-12	55	10:30:31 AM - 12/27/2018



Plot # 32 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**UNII 95.86% Duty Cycle, WiFi 2.4 11b 99% DC**



8.2 AC Power Line Conducted Emissions

8.2.1 Measurement according to ANSI C63.4

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Detector: Peak / Average for Pre-scan
- Quasi-Peak/Average for Final Measurements

8.2.2 Limits: §15.207

FCC §15.207(a)

- Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

8.2.3 Test conditions and setup:

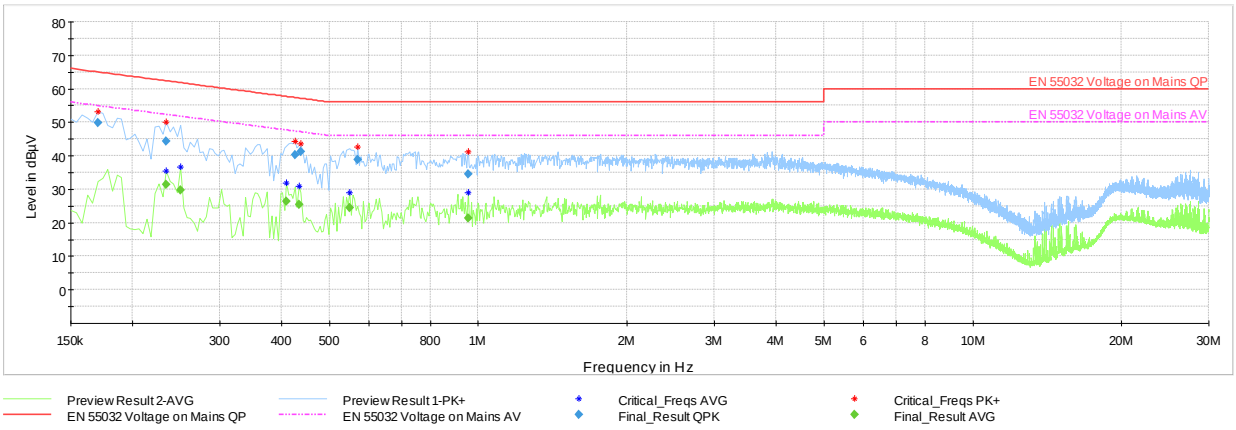
Ambient Temperature ©	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22° C	2	All Radios Active	Line & Neutral	110V / 60Hz

8.2.4 Measurement Result:

Plot #	Port	EUT Set-Up #:	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	2	All Radios Active Mid Channel	150 kHz – 30 MHz	See section 8.3.2	Pass

8.2.5 Test Plots:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Frequency (MHz)
0.170000	49.75	---	64.96	15.21	500.0	9.000	L1	GND	10.9	0.170000
0.234000	---	31.43	52.31	20.87	500.0	9.000	N	GND	10.6	0.234000
0.234000	44.33	---	62.31	17.98	500.0	9.000	L1	GND	10.6	0.234000
0.250000	---	29.74	51.76	22.02	500.0	9.000	N	GND	10.6	0.250000
0.410000	---	26.44	47.65	21.21	500.0	9.000	N	GND	10.4	0.410000
0.426000	40.17	---	57.33	17.16	500.0	9.000	N	GND	10.3	0.426000
0.434000	---	25.33	47.18	21.84	500.0	9.000	L1	GND	10.2	0.434000
0.438000	41.18	---	57.10	15.92	500.0	9.000	L1	GND	10.3	0.438000
0.550000	---	24.48	46.00	21.52	500.0	9.000	L1	GND	10.2	0.550000
0.570000	38.76	---	56.00	17.24	500.0	9.000	L1	GND	10.2	0.570000
0.954000	---	21.41	46.00	24.59	500.0	9.000	N	GND	10.3	0.954000
0.954000	34.47	---	56.00	21.53	500.0	9.000	N	GND	10.3	0.954000



9 Test setup photos

Setup photos are included in supporting file name: "EMC_A2ZDE-048-18001_15.247_Setup_Photos.pdf"

10 Test Equipment and Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Biconlog Antenna	EMCO	3142E	166067	3 years	6/28/2017
Loop Antenna	ETS Lindgren	6507	161344	3 years	10/26/2017
Horn Antenna	EMCO	3115	35114	3 years	7/31/2017
Horn Antenna	ETS Lindgren	3117 PA	169547	3 years	8/8/2017
Compact Digital Barometer	Control Company	35519-055	91119547	2 Years	6/20/2017
Spectrum Analyzer	R&S	FSV40	101022	3 years	7/5/2017
LISN	FCC	FCC-LISN-50-25-2-08	8014	3 Years	11/10/2016
EMI Receiver	R&S	ESU40	100251	3 years	7/10/2017
NSA Chamber	Cetecom	NSA 3m Chamber	EMC-2	3 Years	7/21/2016

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 Revision History

Date	Report Name	Changes to report	Prepared by
2019/02/28	EMC_A2ZDE-048-18001_CO-TX	Initial version	James Donnellan
2019/03/08	EMC_A2ZDE-048-18001_CO-TX-Rev1	Updated Mfg. Address.	James Donnellan
2019/06/10	EMC_A2ZDE-048-18001_CO-TX-Rev2	Added comment to Section 3.5 and updated table in Section 8.1.4, Updated Section 10.	James Donnellan
2019/06/11	EMC_A2ZDE-048-18001_CO-TX-Rev3	Fixed Typo S 8.1.5 on p.33	James Donnellan