FCC Test Report

FOR

Amazon

Model Name:
D5N83A

Product Description:
Networking Device

FCC ID: UUU-5411

Applied Rules and Standards:
47 CFR Part 15.407 (UNII-1)

REPORT #: EMC_ A2ZDE-048-18001_15.407_UNII-1-Rev2

DATE: 2019-05-23

A2LA Accredited

IC recognized #
3462B-2

***CETECOM* Inc.**
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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.

Company	Description	Model #
Amazon	Networking Device	D5N83A

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2019-05-23	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: 2019.05.23 13:25:55 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2019-05-23	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: / Radio	Nominal band: 5150 MHz – 5250 MHz Center to center: 5180 MHz (ch 36) – 5240 MHz (ch 48), 4 channels 4X Qualcomm QCA9886, 5 GHz WiFi.
Type(s) of Modulation:	BPSK, QPSK, 16-QAM, 64QAM, 256 QAM
Modes of Operation:	802.11a/n/ac, 20MHz and 40MHz
Antenna Information as declared:	11 dBi
Max. Conducted Output Power:	Conducted Power 18.27 dBm
Power Supply/ Rated Operating Voltage Range:	AC/DC Adapter: V low: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:	Qualcomm QCA9882. 2.4 GHz WIFI 802.11b/g/n
Sample Revision:	☐Prototype Unit; ☐ Production Unit; ■Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	PCB SN FQE01E0	DVT	emmc-denali_dvt-ipq806x-1.0.0.217_1205	Conducted Unit
2	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

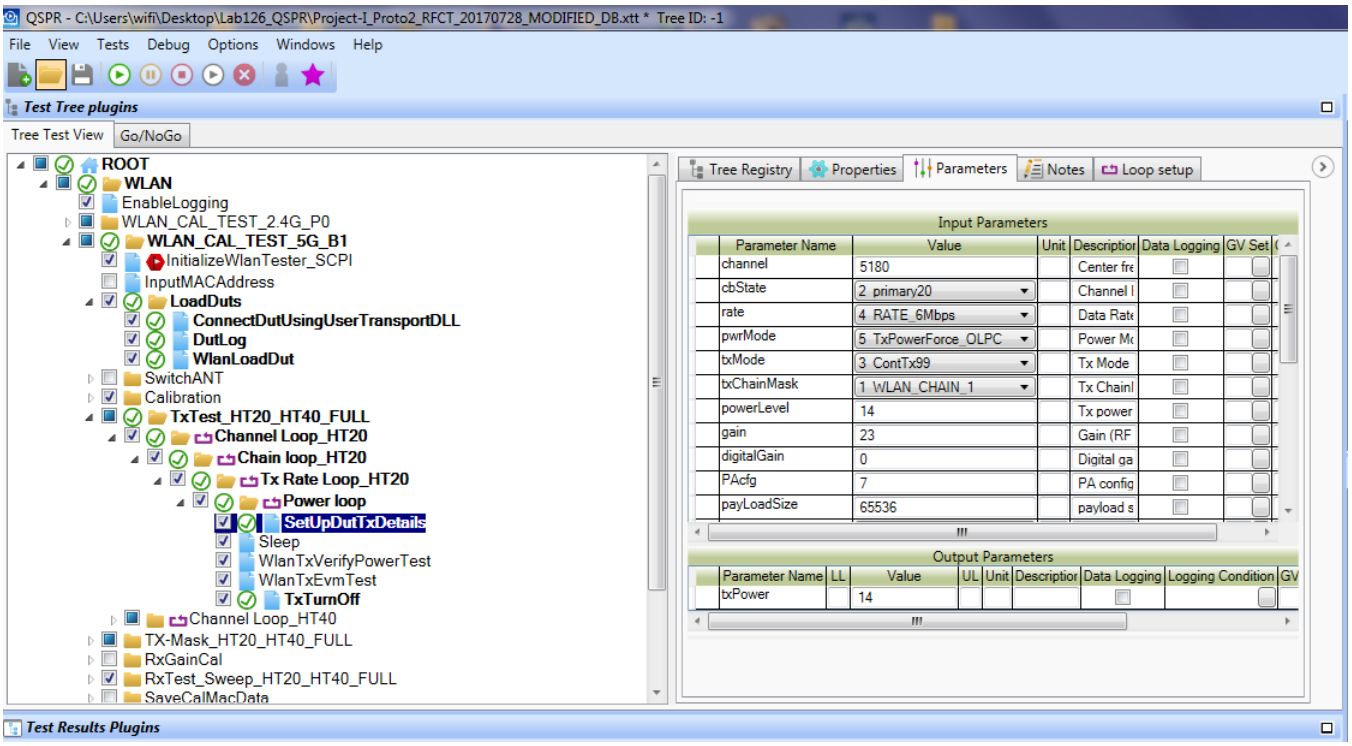
EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#2 + AE#1 + AE#2	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software “QSPR” provided by client that is not available to the end user. The measurement equipment was connected to the 50 ohm RF ports of the EUT.
2	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 Application Snapshot on Supporting Laptop:



Additional Testing Notes:

Radiated testing was executed with both 5.0 GHz antenna chains 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".
An additional report which outlines testing of co transmission between the 2.4 GHz and this and the 5.0 GHz radios currently supported by this devise is included in supporting file "EMC_A2ZDE-048-18001_CO-TX.pdf"

The target power settings in below table were set in QSPR as provided by client for all the various test.

UNII-1 Power Settings				
802.11 / channel	36	40	44	48
a	16	16	16	16
n20	16	16	16	16
n40	16		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 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	■	☐	☐	Complies
§15.207(a)	AC Conducted Emissions	Nominal	802.11n_20	■	☐	☐	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.

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

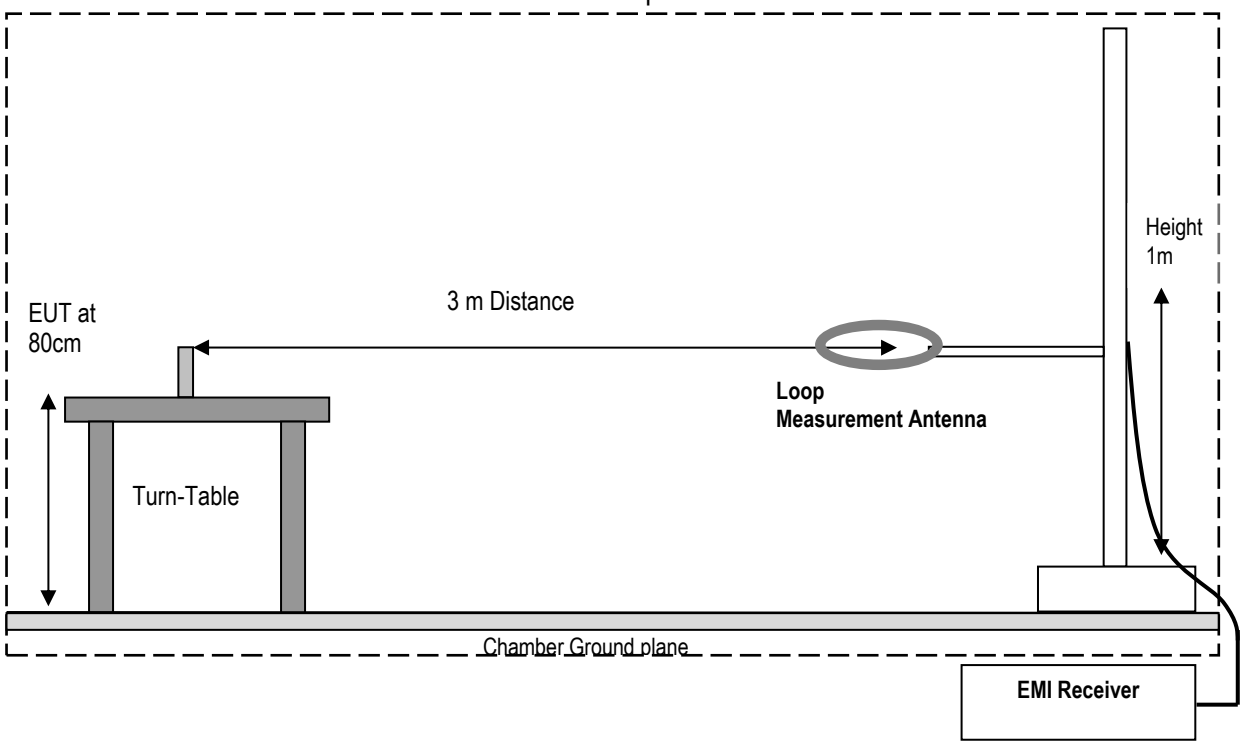
7 Measurement Procedures

7.1 Radiated Measurement

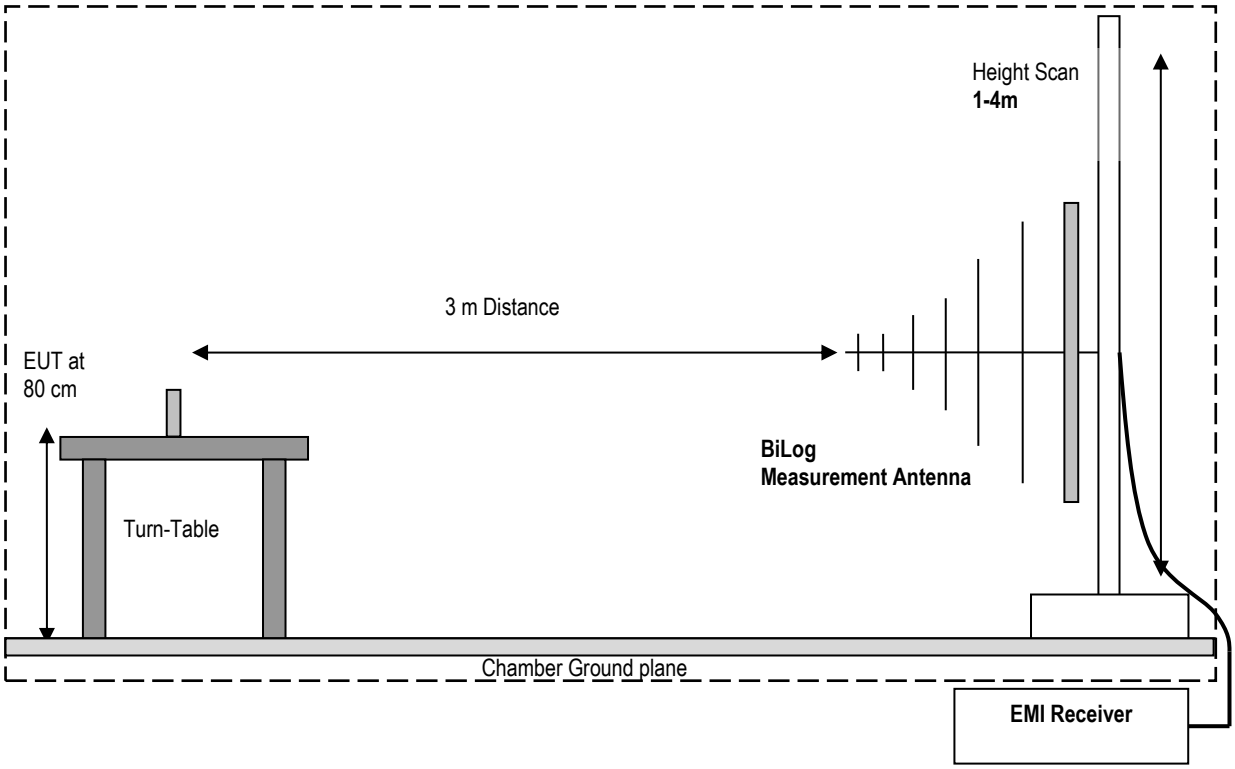
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

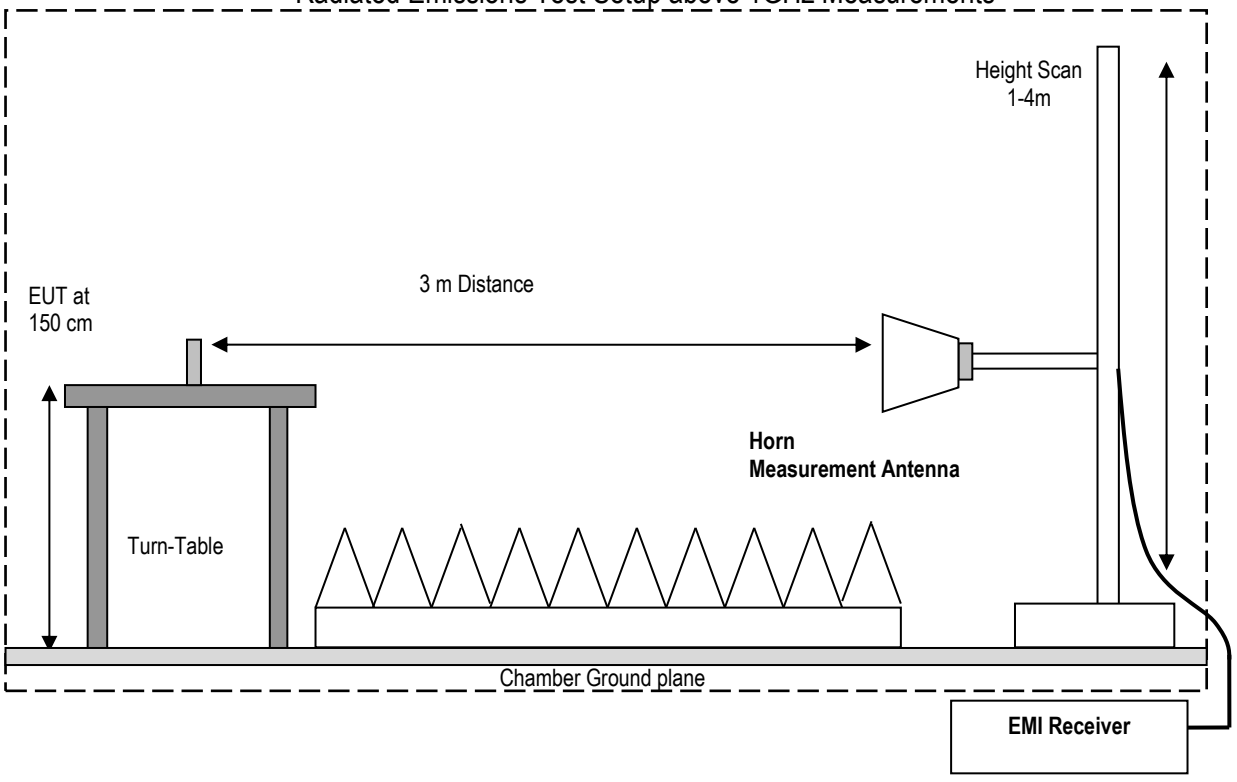
Radiated Emissions Test Setup below 30MHz Measurements



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:

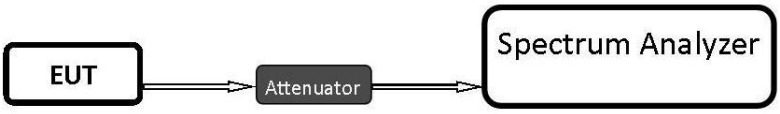
FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

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 Duty cycle

8.1.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer settings:

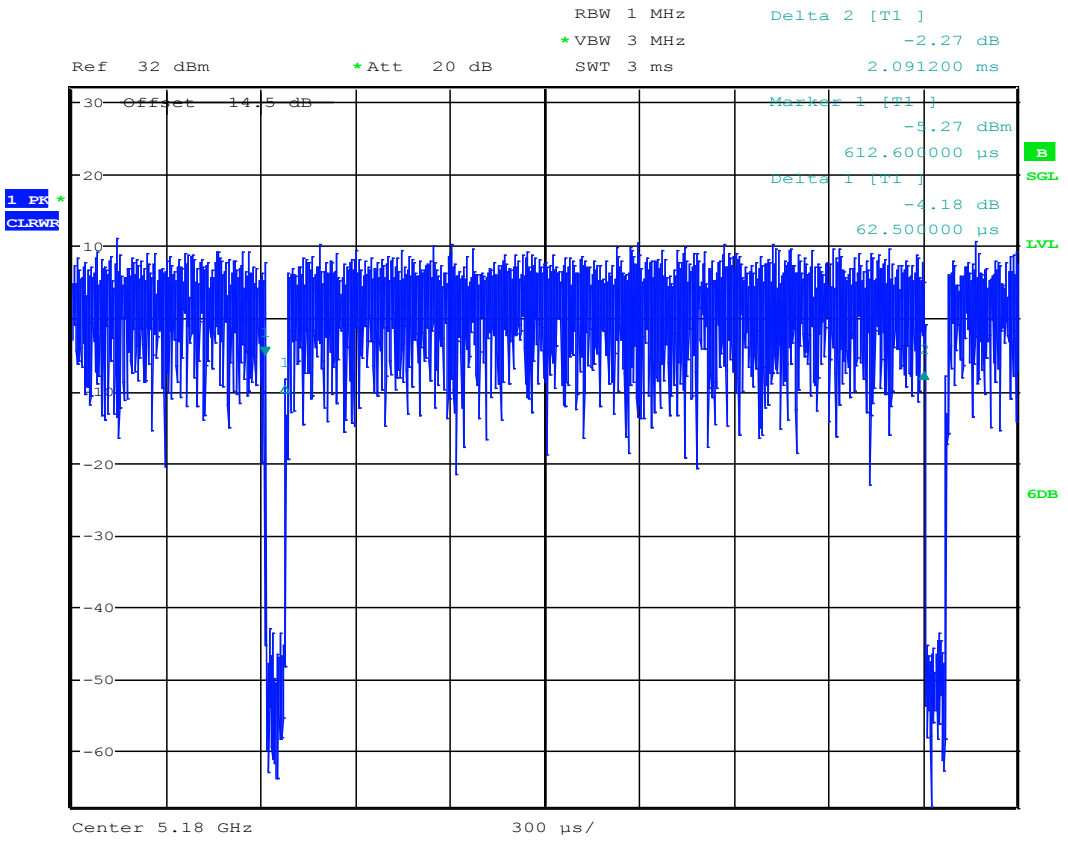
- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW >=EBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

8.1.2 Measurement result

Plot #	Mode	Data Rate	Duty Cycle	Transmission Duration T(ms)	Duty Cycle Correction Factor (dB)
1	802.11a	6Mpbs	97.01%	2.09	0.13
2	802.11n_20	MCS0	95.18%	22.54	0.21
3	802.11n_40	MCS0	93.46%	10.3224	0.29

Plot #1

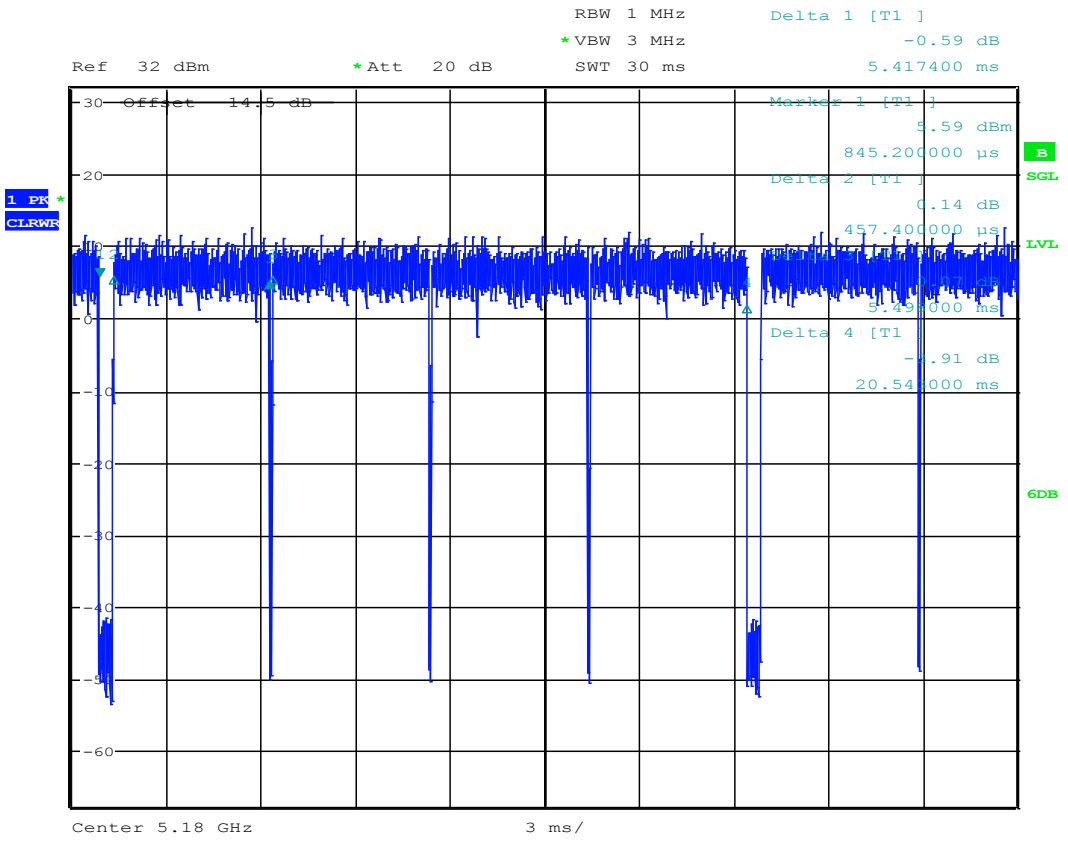
Low channel / 5180 MHz	Modulation/Packet Type: 802.11a 6Mbps



Date: 18.JAN.2019 17:14:32

Plot #3

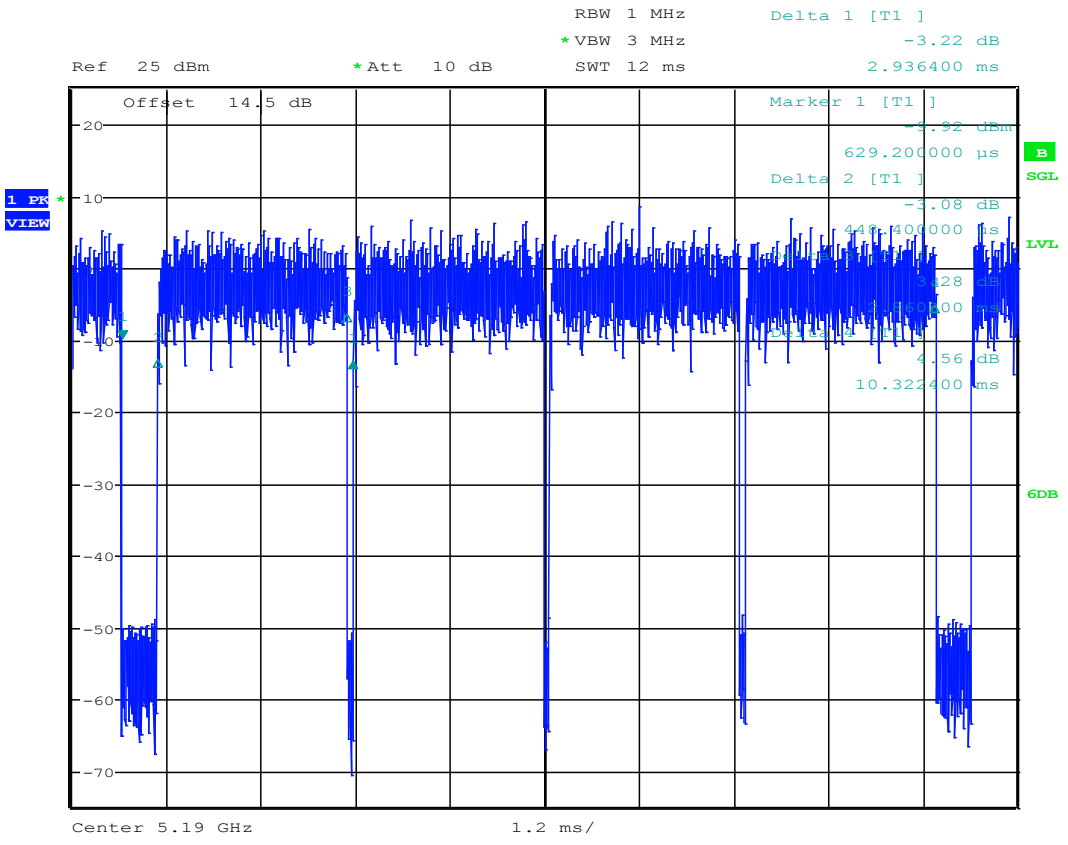
Low channel / 5180 MHz	Modulation/Packet Type: 802.11n_20 MCS0



Date: 18.JAN.2019 17:08:50

Plot #4

Mid channel / 5190 MHz	Modulation/Packet Type: 802.11n_40 MCS0



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8.2 Maximum Conducted Output Power

8.2.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

The KDB allows for methods outlined in ANSI C63.10 2013

- Per ANSI C63.10 2013 Section 11.9.2.3.1 Method AVGPM was used.
- Method AVGPM is a measurement using an RF average power meter,
- A FAST POWER Sensor and a laptop application to read the sensor was used instead of a power meter.
- The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- If the transmitter does not transmit continuously, measure the duty cycle, D.
- Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.
- Adjust the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle.

8.2.2 Limits:

Maximum Conducted Output Power:

- FCC §15.407: 1 W
- All limits are conducted. 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.

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Single Antenna Gain
23° C	1	802.11 a/n	AC/DC ADAPTER	11dBi

8.2.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 14.5 dB

Mode	Tx Chain	Date Rate	Channel	Measured conducted powered(dBm)	Corrected by DCCF(dBm)	EIRP (dBm)	Conducted / EIRP Limit (dBm)	Result
802.11a	0	6Mbps	36	17.34	17.47	28.47	25 / 36 (EIRP)	Pass
			44	17.43	17.56	28.56	25 / 36 (EIRP)	Pass
			48	17.3	17.43	28.43	25 / 36 (EIRP)	Pass
	1	6Mbps	36	18.14	18.27	29.27	25 / 36 (EIRP)	Pass
			44	17.71	17.84	28.84	25 / 36 (EIRP)	Pass
			48	17.46	17.59	28.59	25 / 36 (EIRP)	Pass

Mode	Tx Chain	Date Rate	Channel	Measured conducted powered (dBm)	Corrected by DCCF (dBm)	Summed power MIMO (dBm)	EIRP (dBm)	Conducted / EIRP Limit (dBm)	Result
802.11n_ 20 MIMO	0	MCS0	36	17.08	17.29	20.67	31.74	25 / 36 (EIRP)	Pass
			44	17.02	17.23	20.48	31.48	25 / 36 (EIRP)	Pass
			48	16.89	17.10	20.30	31.30	25 / 36 (EIRP)	Pass
	1	MCS0	36	17.78	17.99	-	-	25 / 36 (EIRP)	-
			44	17.48	17.69	-	-	25 / 36 (EIRP)	-
			48	17.25	17.46	-	-	25 / 36 (EIRP)	-
802.11n_ 40 MIMO	0	MCS0	38	16.98	17.27	20.70	31.70	25 / 36 (EIRP)	Pass
			46	17.16	17.45	20.50	31.50	25 / 36 (EIRP)	Pass
	1	MCS0	38	17.78	18.07	-	-	25 / 36 (EIRP)	-
			46	17.23	17.52	-	-	25 / 36 (EIRP)	-

- For 802.11a, 6Mbps was chosen as the worst case to test, since it has the highest power level based on pretesting of the device. For 802.11n 20&40 MIMO, MCS0 was chosen as the worst case to test, since it has the highest power level based on pretest
- EIRP= Conducted output power + Antenna gain
- Conducted Limit of SISO = 30dBm – (11-6 dBi) = 25 dBm
- Conducted Limit of MIMO = 30 dBm – ((Directional Gain = GANT) - 6 dBi)
  =30 dBm – (11-6 dBi) = 25 dBm. No correlation between Spatial Streams for MIMO.
- Note: For MIMO above the power of both chains was summed and the Antenna gain was added to this summed power to calculate the EIRP.

B2 Radio Power Summary								
Channel - Chain	PWR	DCFF	Pwr mW	Sum MiMo mW	Pwr dBm	EIRP	Conducted / EIRP Limit (dBm)	Mode
44 -0	17.31	17.44	55.49	-	17.44	28.44	25 / 36	11a SiSO
44 - 0	16.96	17.17	52.18	102.70	20.12	31.12	25 / 36	11n 20 MIMO
38 - 0	16.69	16.98	49.93	99.18	19.96	30.96	25 / 36	11n 40 MIMO
44 -1	17.12	17.25	53.11	-	17.25	28.25	25 / 36	11a SISO
44 - 1	16.82	17.03	50.52	-	-	-	-	-
38 - 1	16.63	16.92	49.25	-	-	-	-	-

B3 Radio Power Summary								
Channel - Chain	PWR	DCFF	Pwr mW	Sum MiMo mW	Pwr dBm	EIRP	Conducted / EIRP Limit (dBm)	Mode
44 -0	17.34	17.47	55.87	-	17.47	28.47	25 / 36	11a SiSO
44 - 0	17.14	17.35	54.38	108.27	20.34	31.34	25 / 36	11n 20 MIMO
38 - 0	17.66	17.95	62.43	120.96	20.83	31.83	25 / 36	11n 40 MIMO
44 -1	17.27	17.40	54.98	-	17.40	28.40	25 / 36	11a SISO
44 - 1	17.1	17.31	53.88	-	-	-	-	-
38 - 1	17.38	17.67	58.53	-	-	-	-	-

B4 Radio Power Summary								
Channel - Chain	PWR	DCFF	Pwr mW	Sum MiMo mW	Pwr dBm	EIRP	Conducted / EIRP Limit (dBm)	Mode
44 -0	17.09	17.22	52.74	-	17.22	28.22	25 / 36	11a SiSO
44 - 0	16.75	16.96	49.71	98.63	19.94	30.94	25 / 36	11n 20 MIMO
38 - 0	16.53	16.82	48.13	96.36	19.84	30.84	25 / 36	11n 40 MIMO
44 -1	16.97	17.10	51.31	-	17.10	28.10	25 / 36	11a SISO
44 - 1	16.68	16.89	48.92	-	-	-	-	-
38 - 1	16.54	16.83	48.24	-	-	-	-	-

Note: All power measurements were made using an ETS Lindgren Fast Power Sensor further described in Section 10 and the measurements are stored on a secure server project folder for the device at Cetecom.

Note: For MIMO above the power of both chains was summed and the Antenna gain was added to the summed power to calculate the EIRP.

8.3 Power Spectral Density

8.3.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer settings:

- Use the same setting in section 8.2.1 but not include the step labeled. “Compute power….”
- Set RBW = 1MHz
- Set the VBW ≥ 3 x RBW
- Use the peak search function on the instrument to find the peak of the spectrum and record its value
- Add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum

8.3.2 Limits:

FCC§15.407(a)

- The maximum power spectral density shall not exceed 17 dBm in any 1 MHz band
- All limits are conducted. 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.

8.3.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Single Antenna Gain
22.3° C	1	802.11a/n	AC/DC ADAPTER	11 dBi

8.3.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 14.5 dB
Power Spectral Density Table for SISO mode.

Plot #	Mode	Data Rate	Tx chain	channel	Maximum Power Spectral Density (dBm / MHz)	PSD corrected by DCCF	Limit (dBm / MHz)	Result
1	802.11a SISO	6Mpbs	0	36	6.77	6.89	12	Pass
2				44	6.99	7.11	12	Pass
3				48	6.52	6.64	12	Pass
4	802.11n_20 SISO	MCS0	0	36	5.92	6.01	12	Pass
5				44	6.62	6.71	12	Pass
6				48	5.69	5.78	12	Pass
7	802.11n_40 SISO	MCS0	0	38	4.02	4.23	12	Pass
8				46	3.79	4	12	Pass
1	802.11a SISO	6Mpbs	1	36	7.07	7.19	12	Pass
2				44	7.01	7.13	12	Pass
3				48	6.86	6.98	12	Pass
4	802.11n_20 SISO	MCS0	1	36	6.17	6.26	12	Pass
5				44	6.47	6.56	12	Pass
6				48	6.36	6.45	12	Pass
7	802.11n_40 SISO	MCS0	1	38	4.24	4.45	12	Pass
8				46	3.92	4.13	12	Pass

- Limit is for the DCCF Conducted measurement
- Conducted PSD Limit of SISO = 17dBm – (11-6 dBi) = 12 dBm:

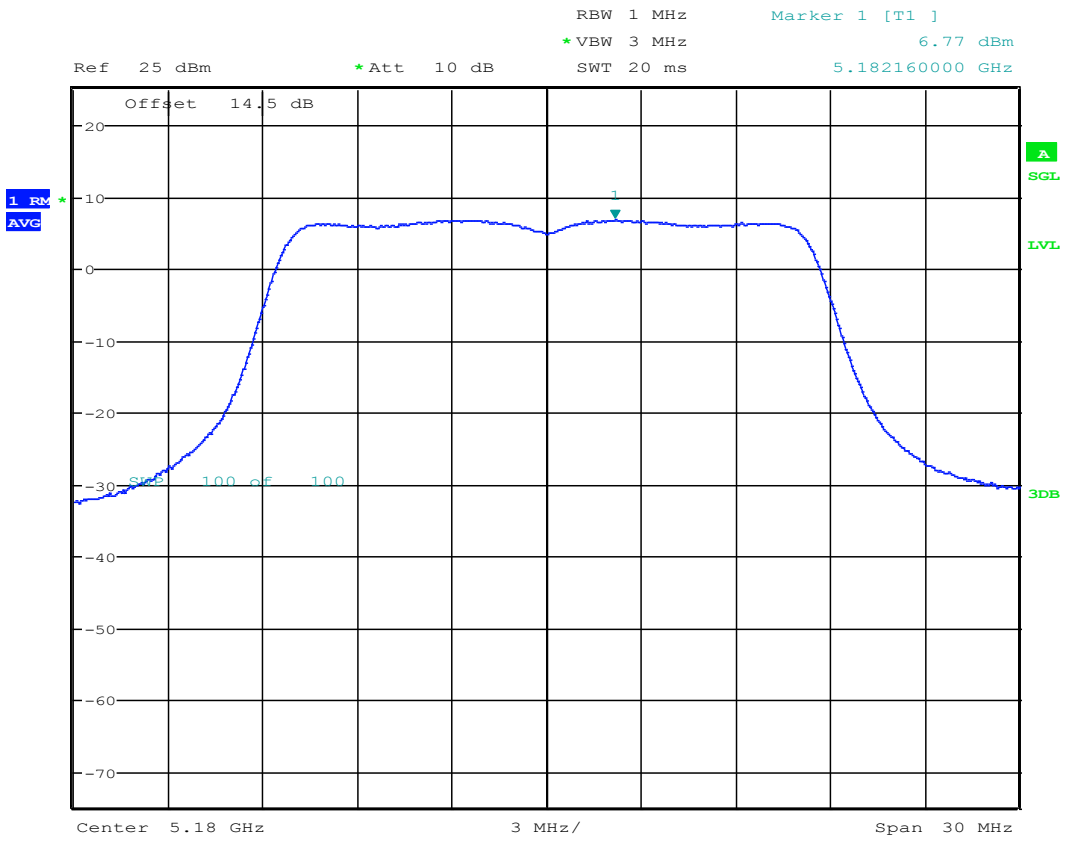
Power Spectral Density Table for MIMO mode.

Mode 802.11	Channel	DCC PSD in dBm chain 0	DCC PSD in dBm chain 1	DCC PSD in mW chain 0	DCC PSD in mW chain 1	Sum DCC PSD in mW	Summed PSD in dBm	LIMIT (dBm / MHz)
n 20 MIMO	36	6.01	6.26	3.99	4.23	8.22	9.15	12
	44	6.71	6.56	4.69	4.53	9.22	9.65	12
	48	5.78	6.45	3.78	4.42	8.20	9.14	12
n_40 MIMO	38	4.23	4.45	2.65	2.79	5.43	7.35	12
	46	4	4.13	2.51	2.59	5.10	7.08	12

- Conducted PSD Limit of MIMO = 17 dBm – ((Directional Gain = GANT) - 6 dBi)
  = 17dBm – (11-6 dBi) = 12 dBm. No correlation between Spatial Streams for MIMO.

8.3.5 Measurement Plots:

Plot #1	
Low channel	**Modulation/Packet Type: 802.11a 6Mbps**



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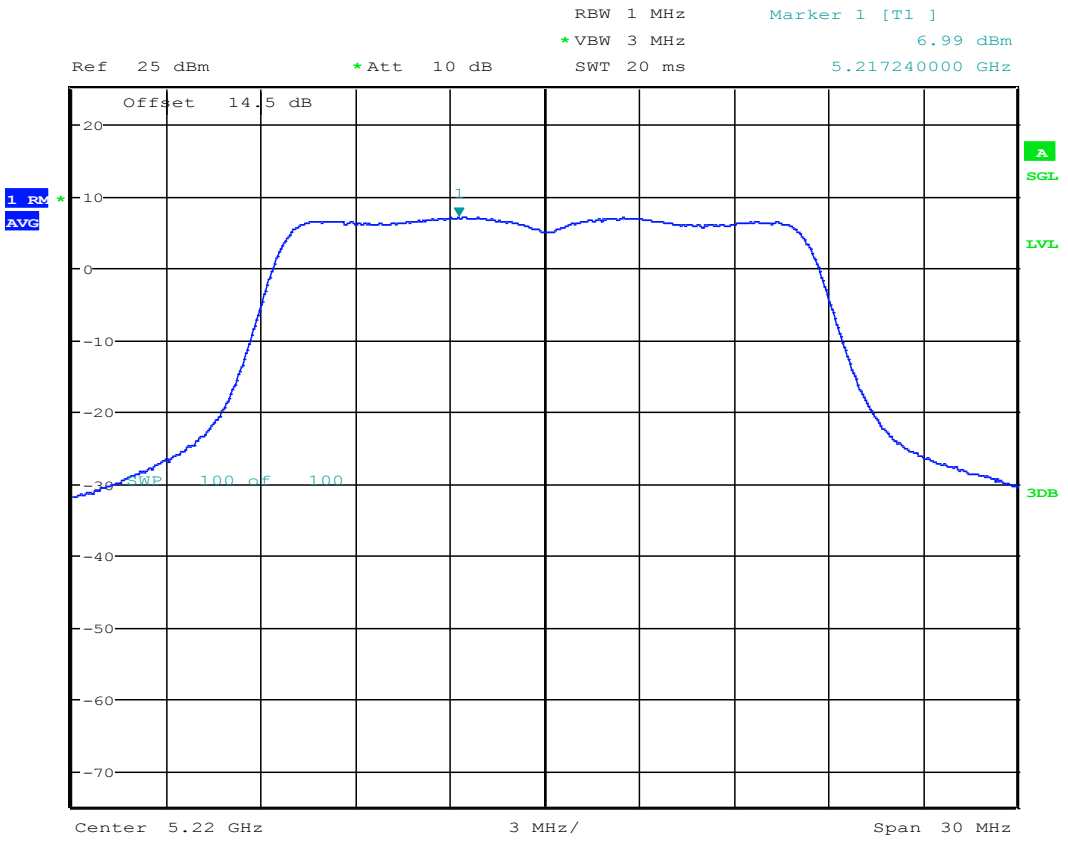
Plot #2

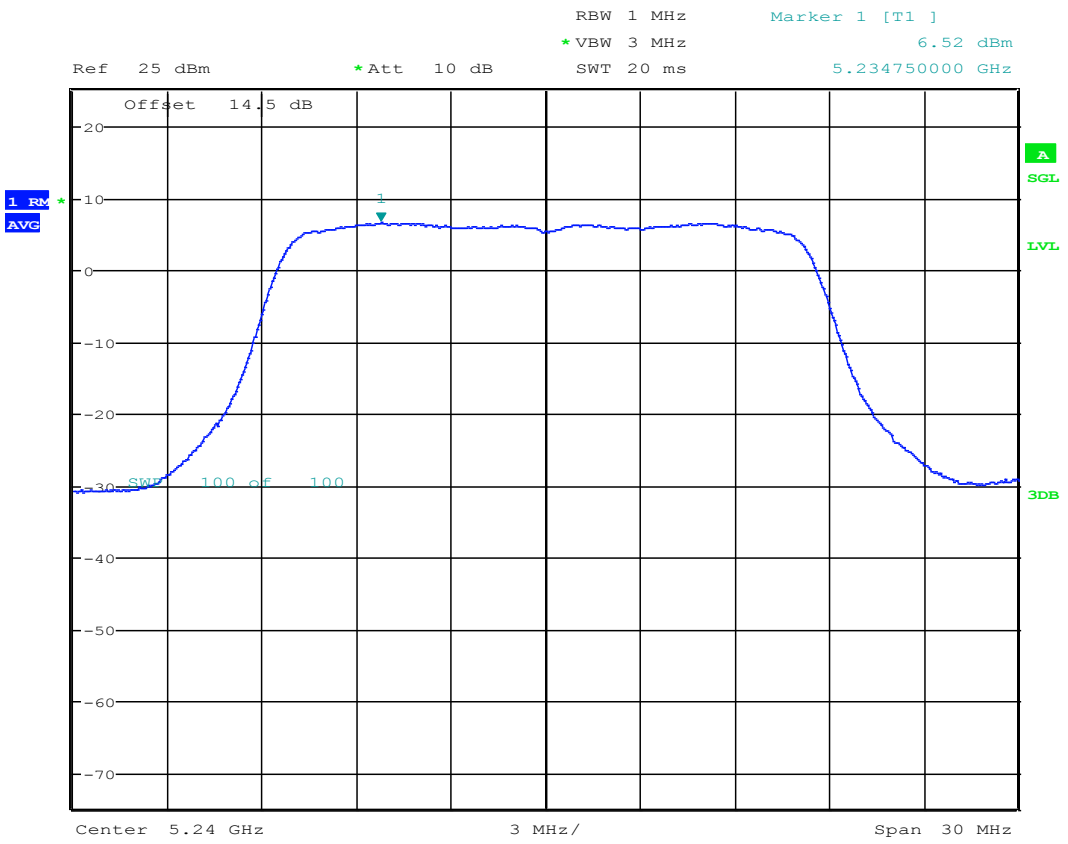
Mid channel	Modulation/Packet Type: 802.11a 6Mbps



Date: 10.JAN.2019 20:11:13

Plot #3

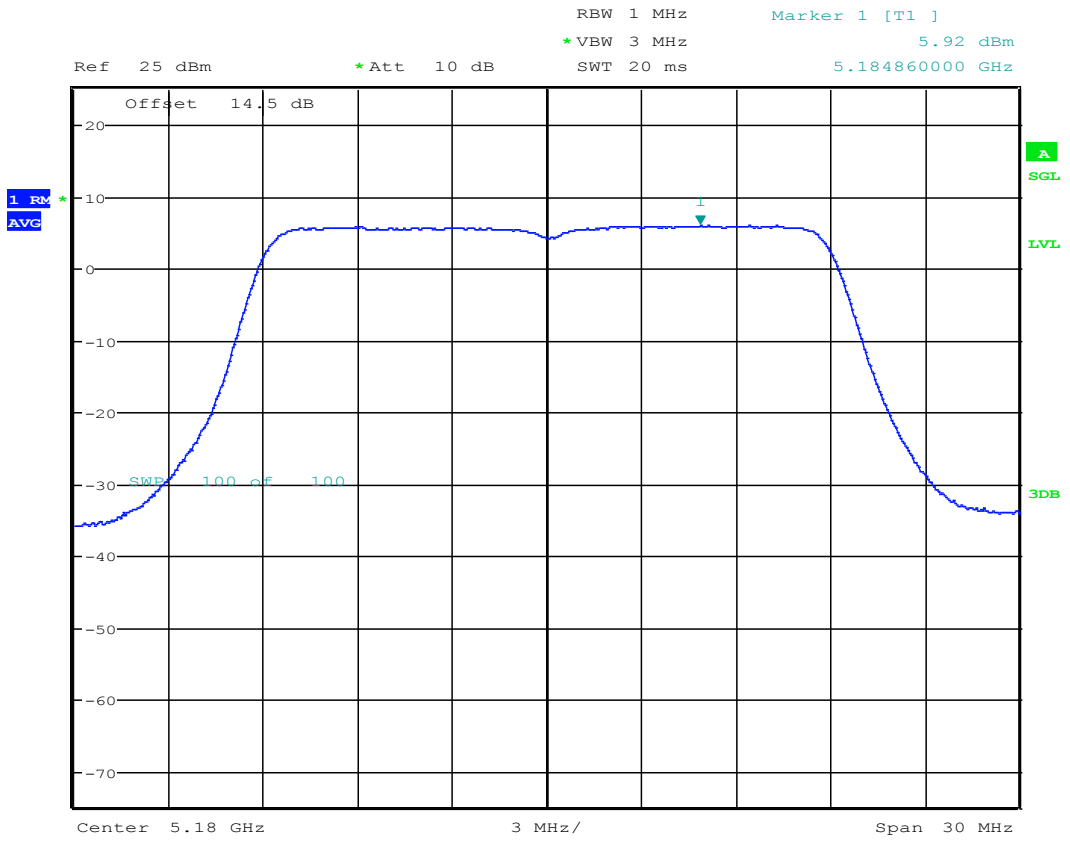
High channel	Modulation/Packet Type: 802.11a 6Mbps



Date: 10.JAN.2019 20:10:05

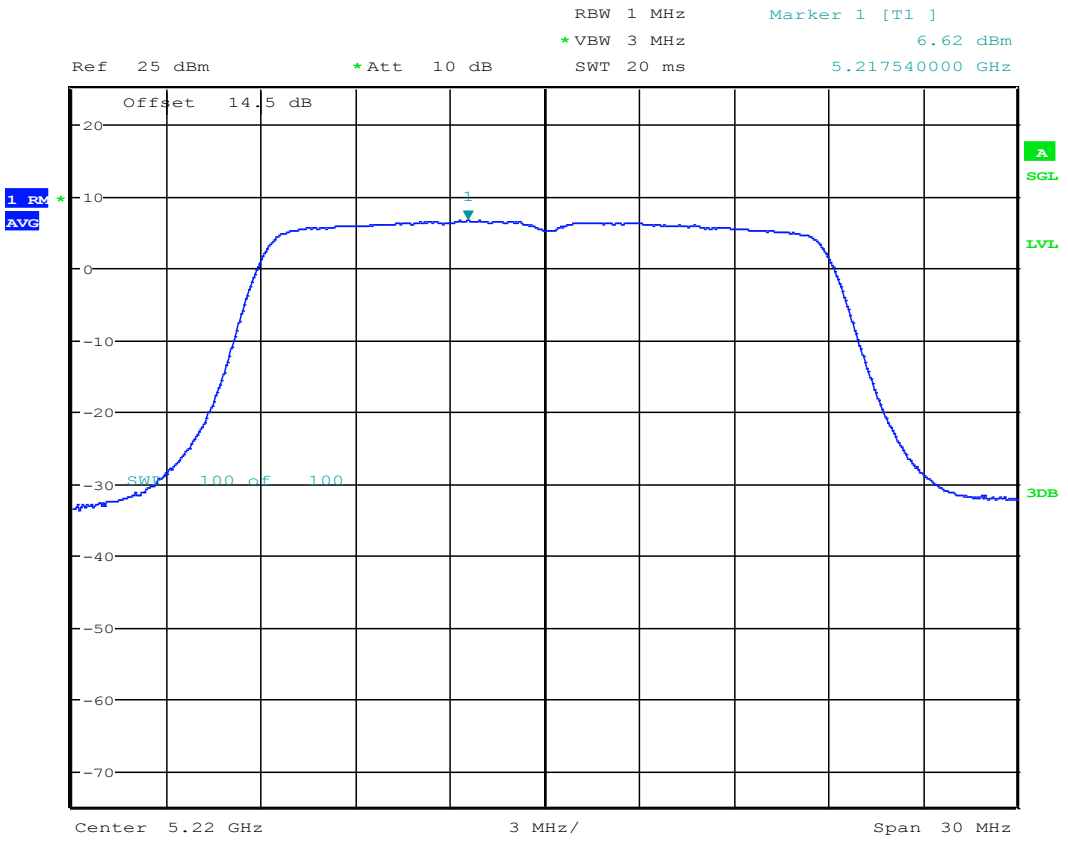
Plot #4

Low channel	Modulation/Packet Type: 802.11n_20 MCS0



Plot #5

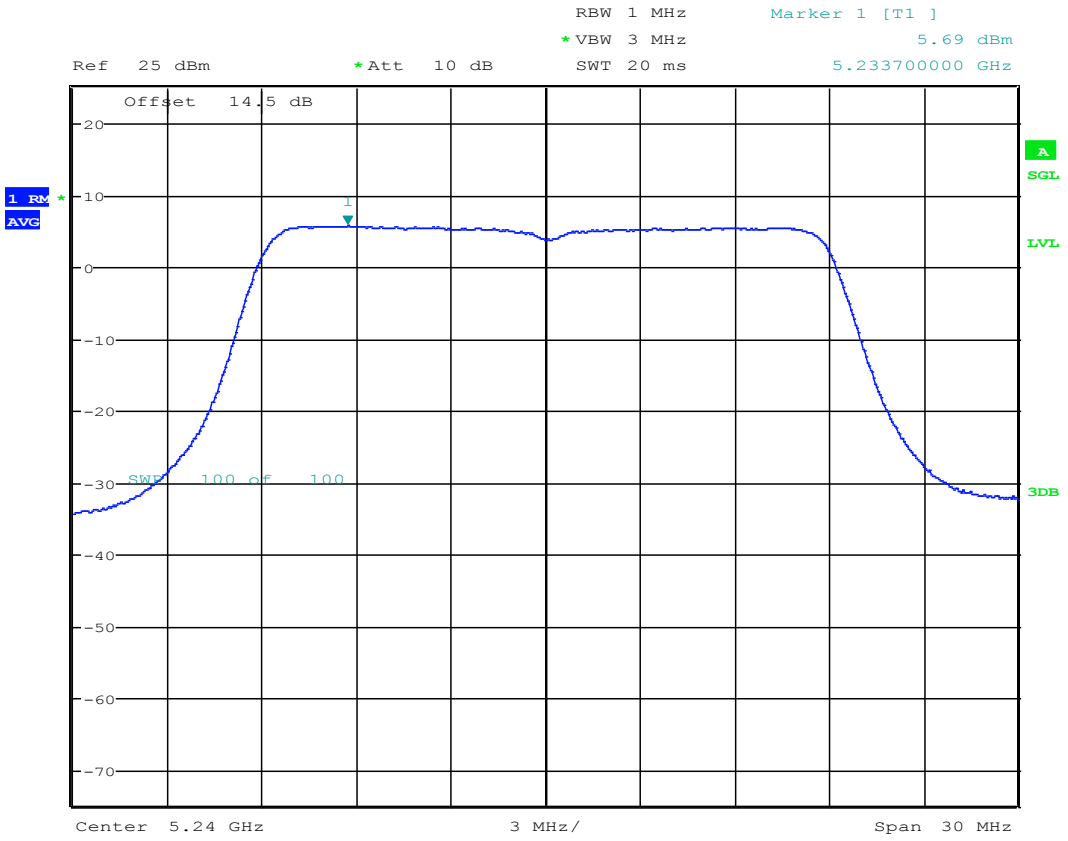
Mid channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 10.JAN.2019 20:12:27

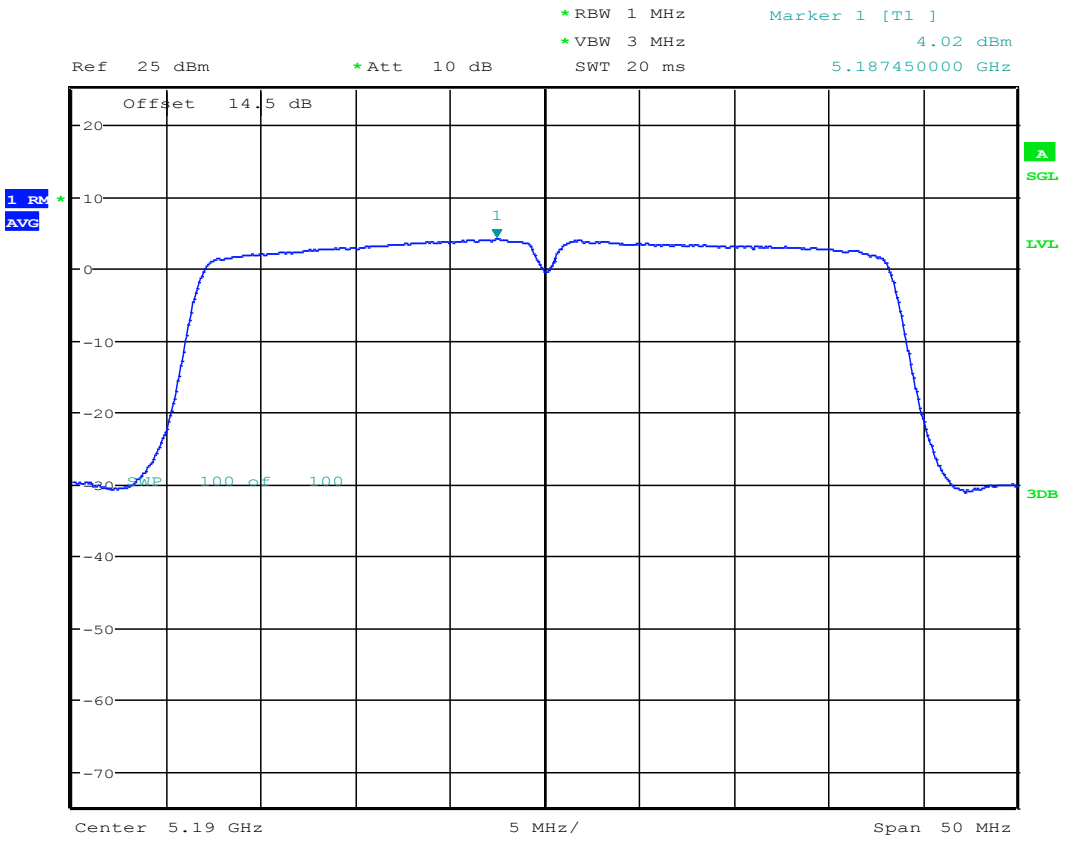
Plot #6

High channel	Modulation/Packet Type: 802.11n_20 MCS0



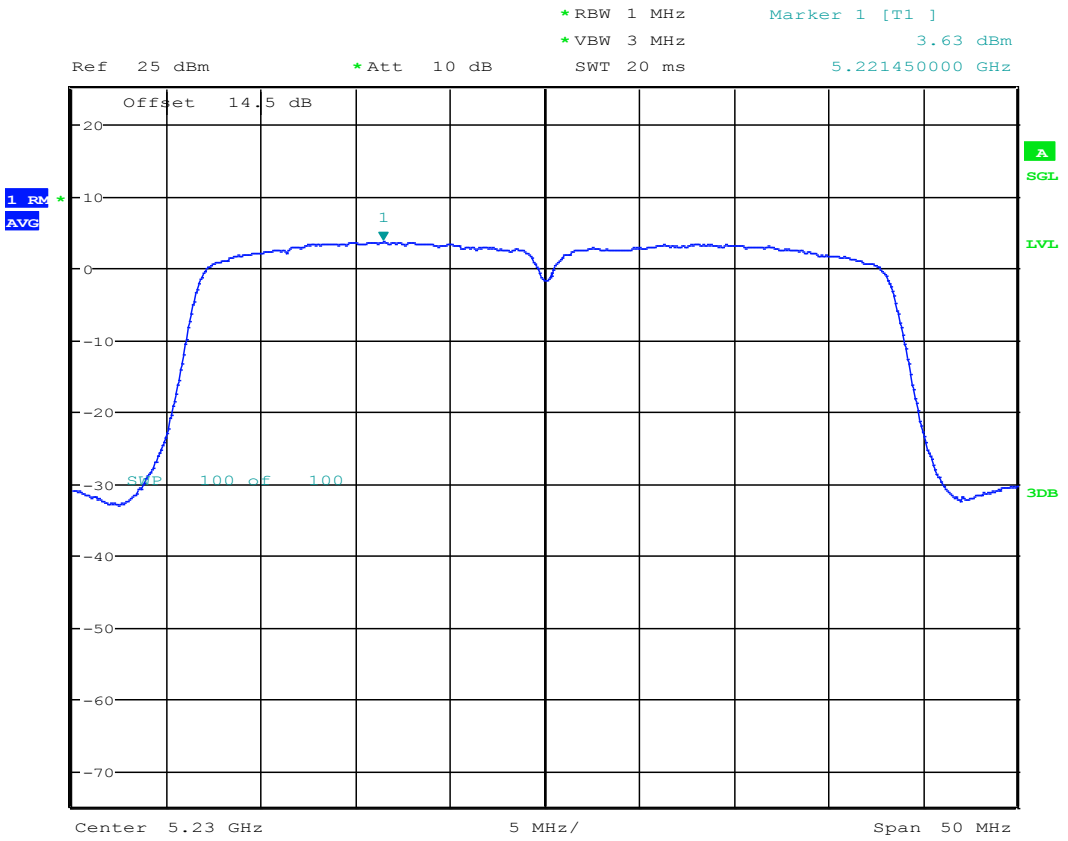
Plot #7

Low channel	Modulation/Packet Type: 802.11n_40 MCS0



Plot #8

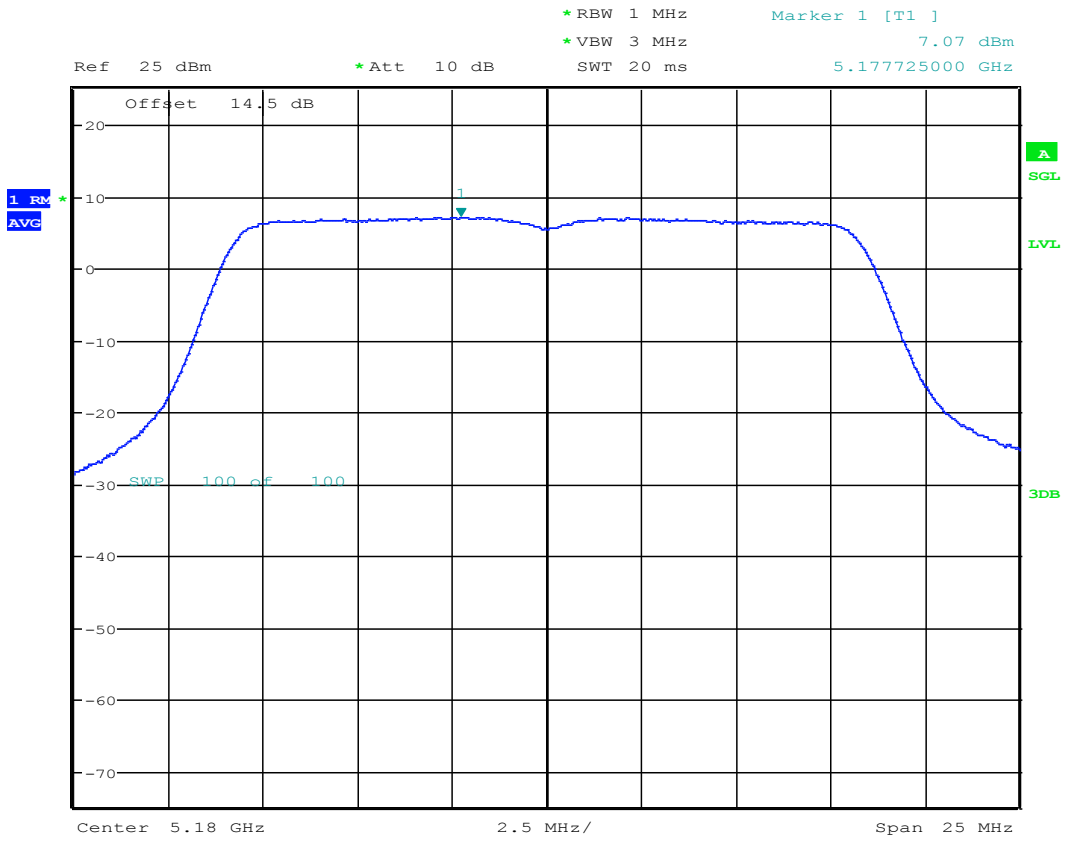
Mid channel	Modulation/Packet Type: 802.11n_40 MCS0



Date: 14.JAN.2019 11:22:16

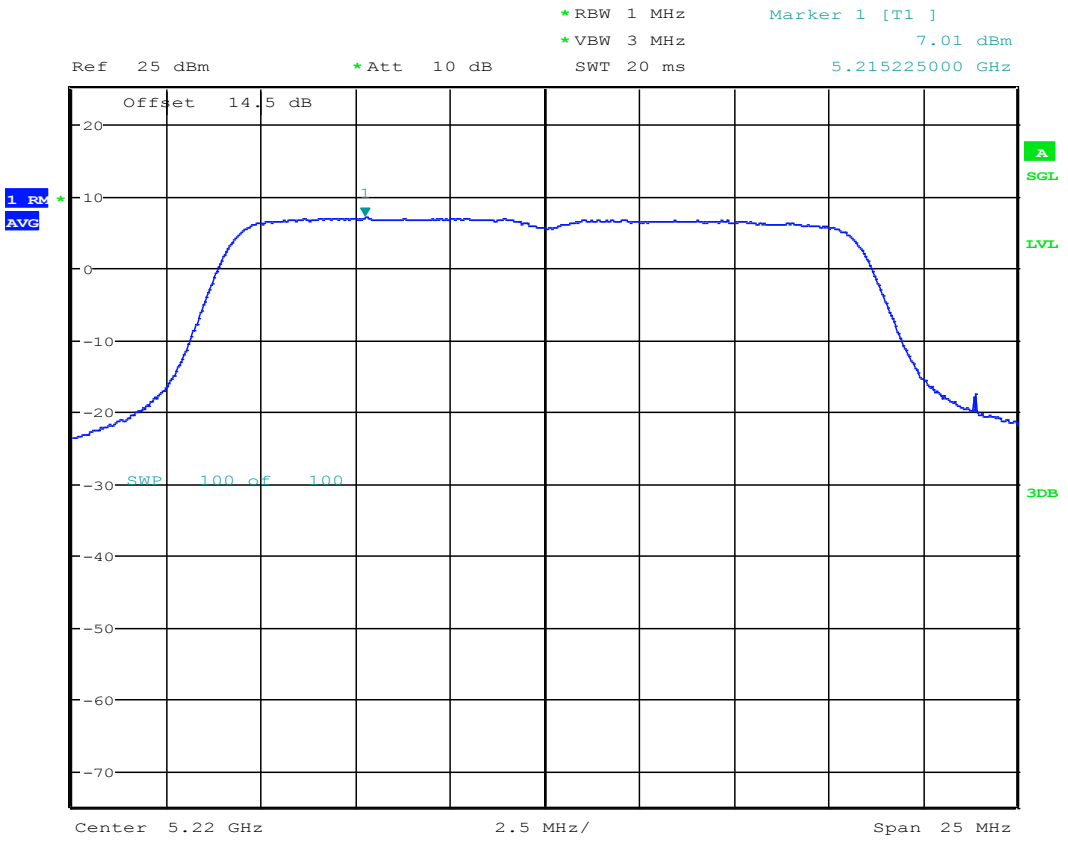
Plot #9 Chain 1

Low channel	Modulation/Packet Type: 802.11a 6Mbps



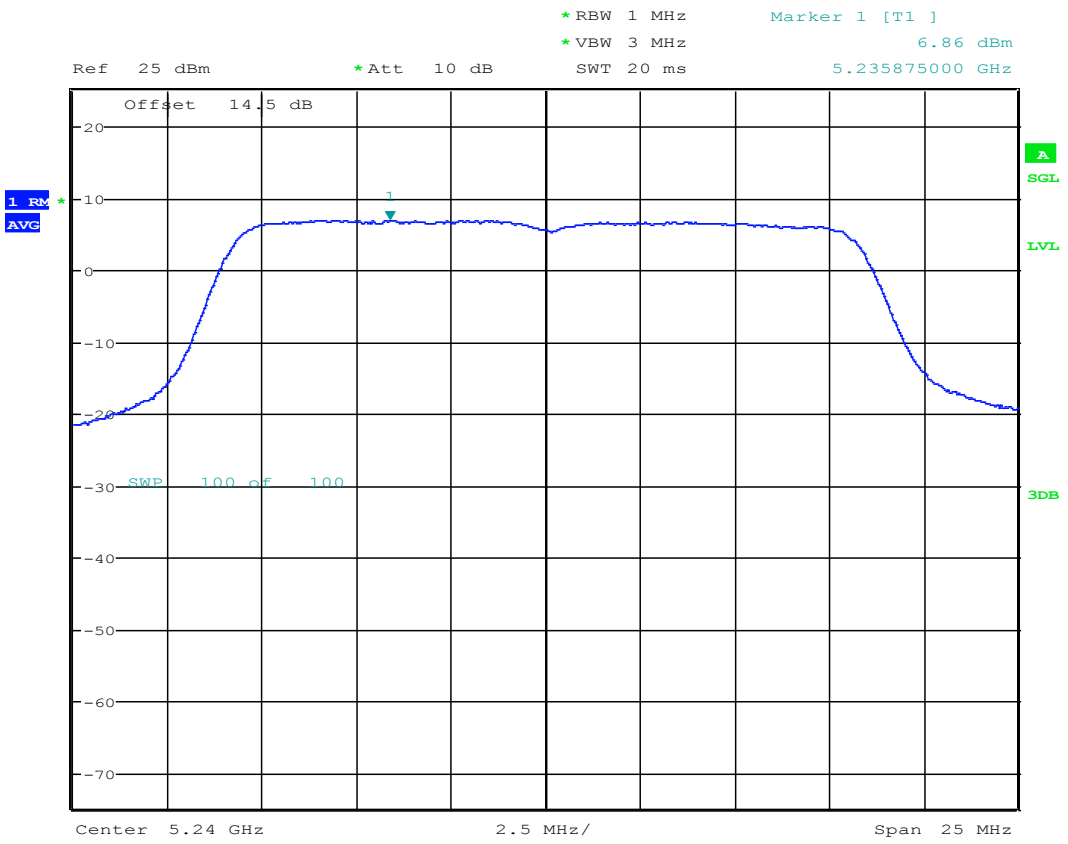
Plot #10

Mid channel	Modulation/Packet Type: 802.11a 6Mbps



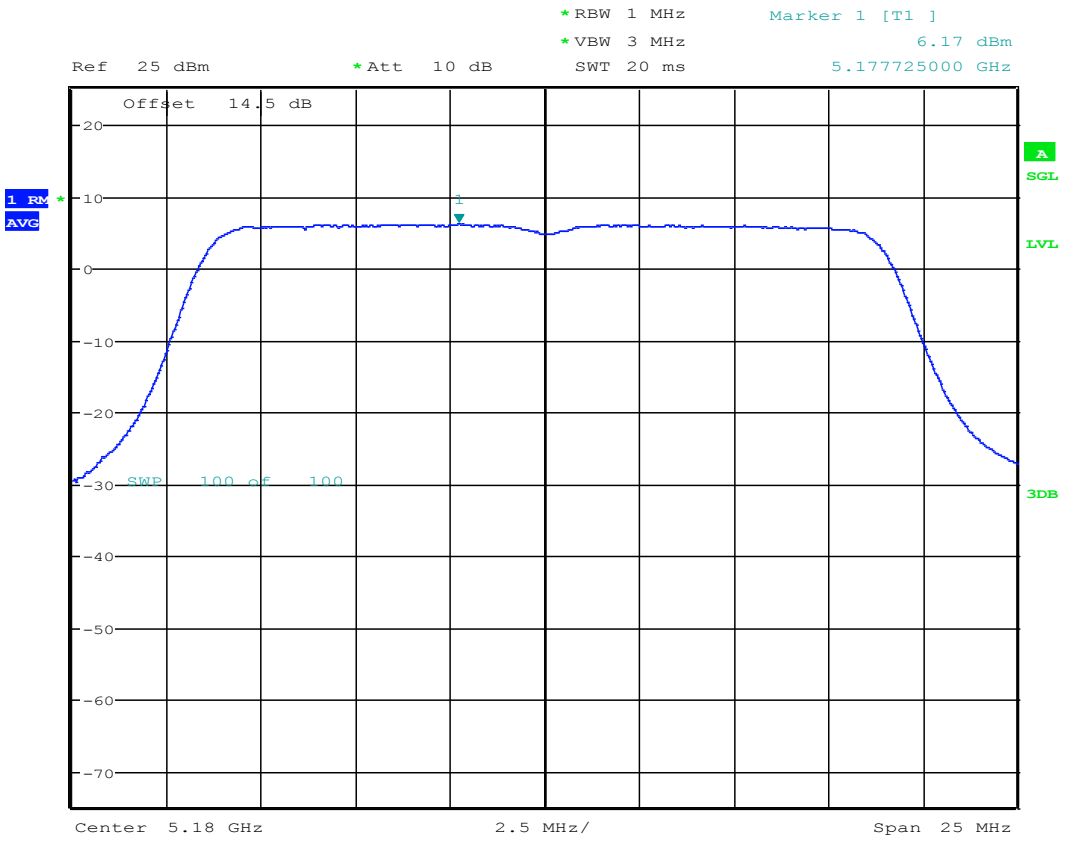
Plot #11

High channel	Modulation/Packet Type: 802.11a 6Mbps



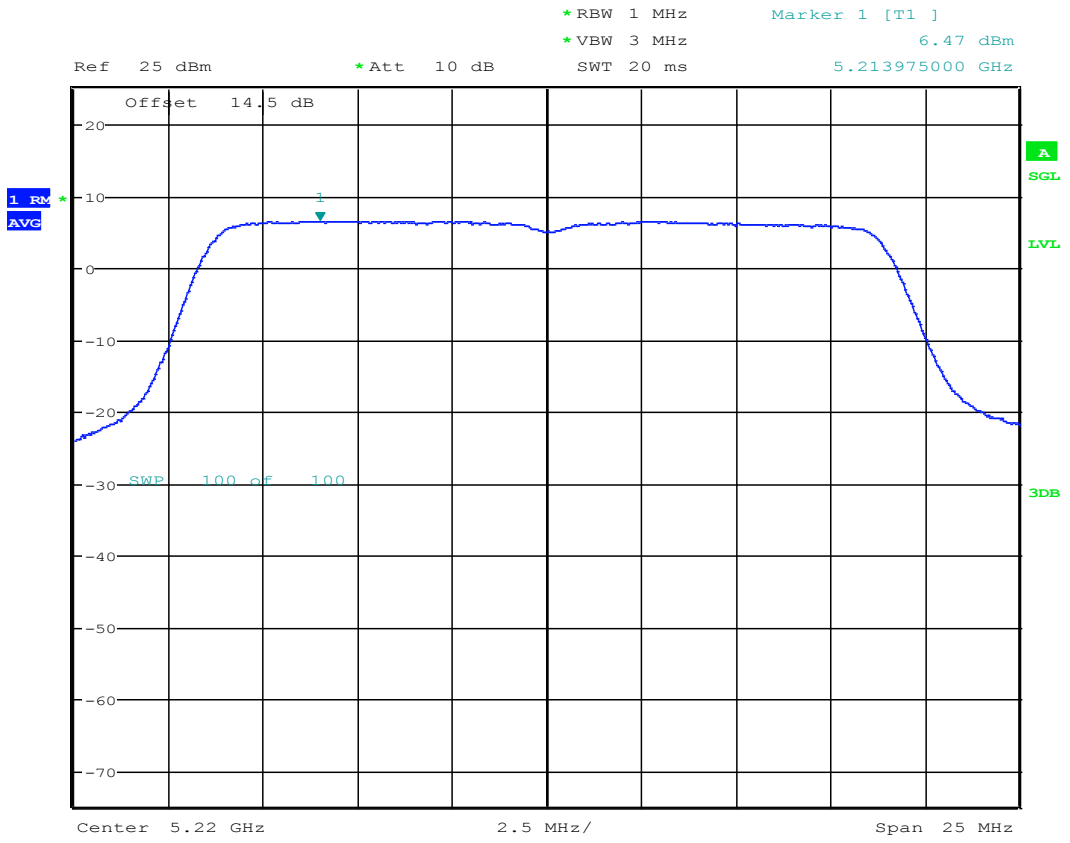
Plot #12

Low channel	Modulation/Packet Type: 802.11n_20 MCS0



Plot #13

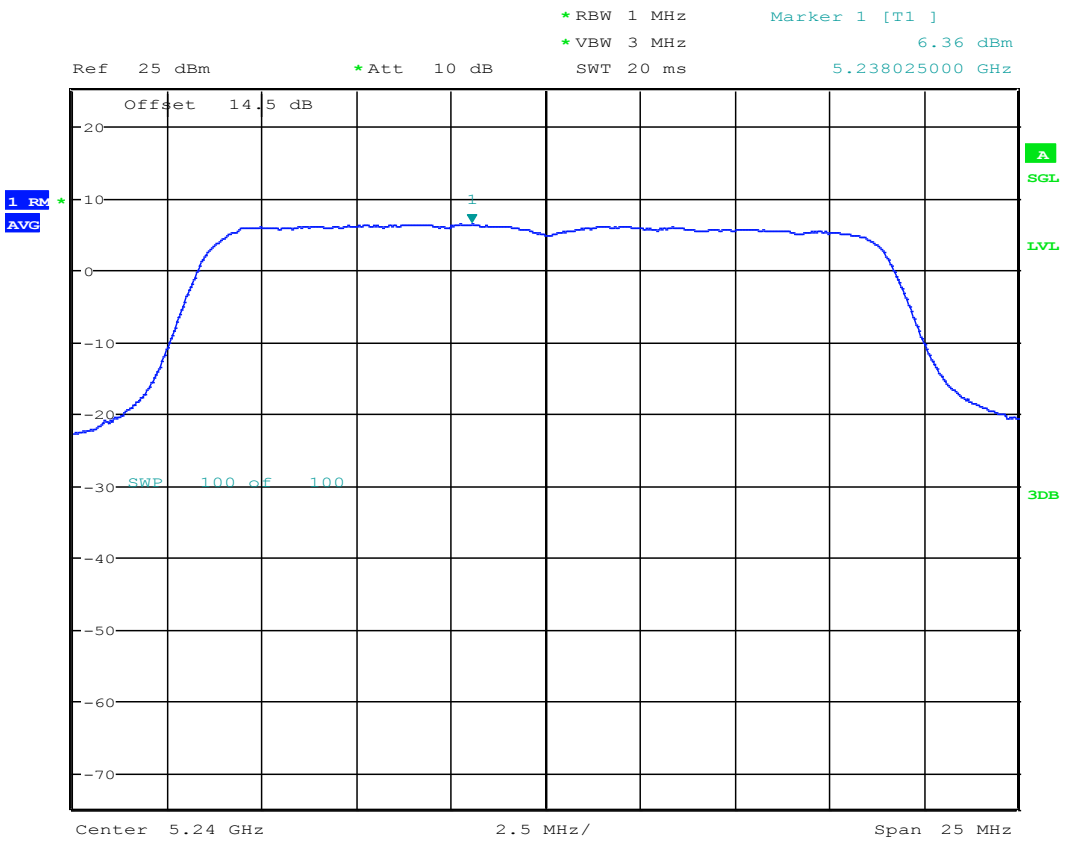
Mid channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 11:37:25

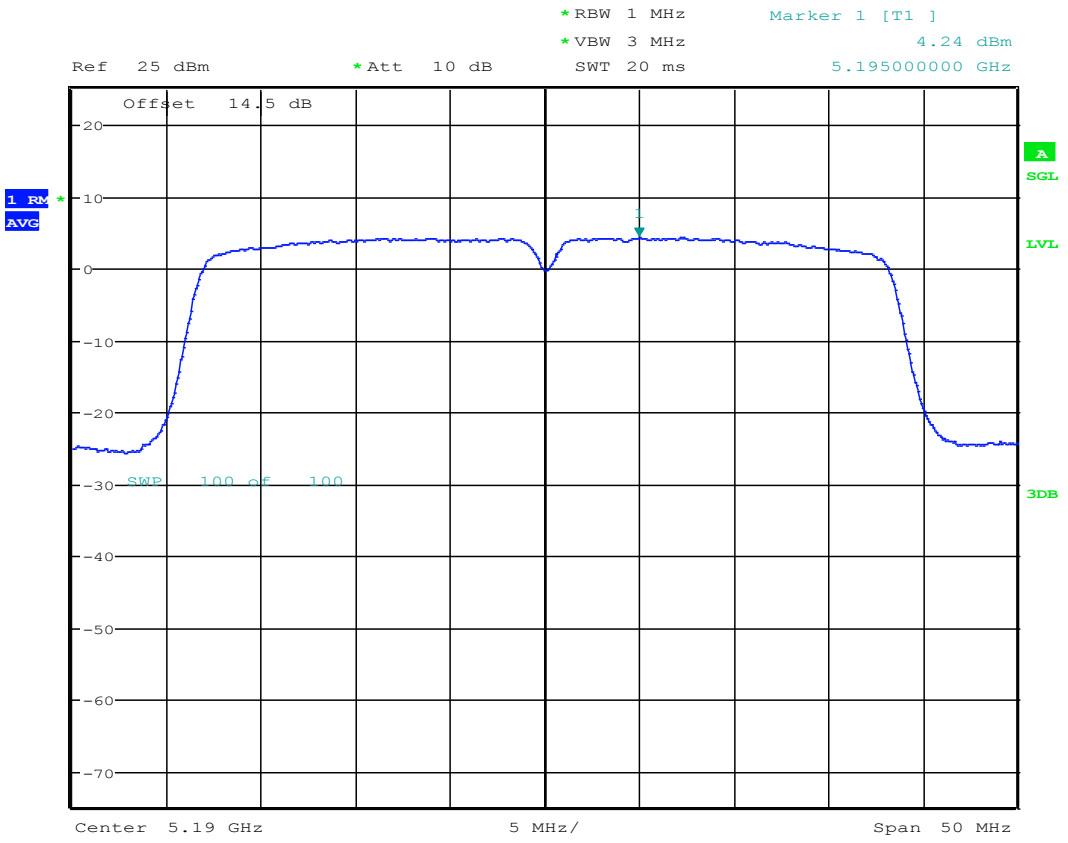
Plot #14

High channel	Modulation/Packet Type: 802.11n_20 MCS0



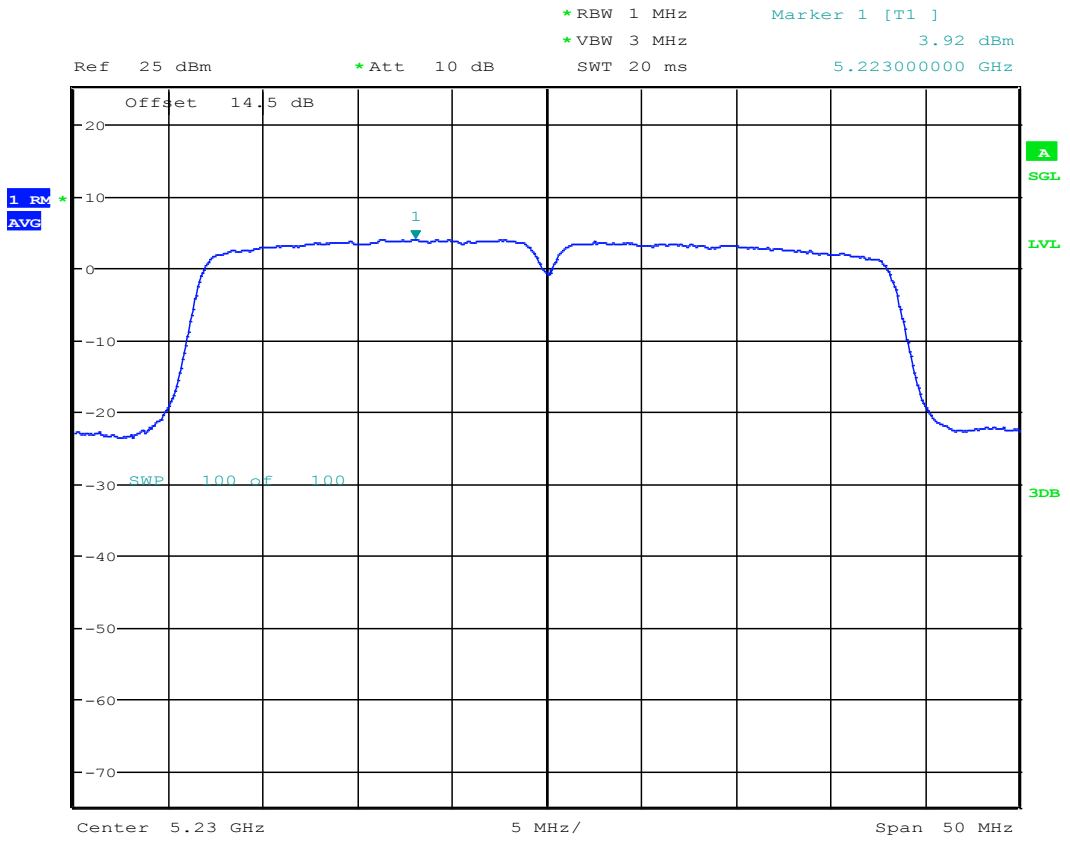
Plot #15

Low channel	Modulation/Packet Type: 802.11n_40 MCS0



Plot #16

Mid channel	Modulation/Packet Type: 802.11n_40 MCS0



8.4 Band Edge Compliance

8.4.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Non Restricted Band Edge and Restricted Band Edge Peak Measurement Spectrum Analyzer Settings:

- Follow the requirements in II.G.3, "General Requirements for Unwanted Emissions Measurements."
- Maximum emission levels are measured by setting the analyzer as follows:
- RBW = 1 MHz.
- VBW ≥ 3 MHz.
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.
- Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle. For example, at 50% duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission
- Upper control line is set to show the compliance of band emission mask according to 15.407(b)(4)(i)

Restricted Band Edge Average Measurement Spectrum Analyzer Settings:

- Follow the requirements in II.G.3. "General Requirements for Unwanted Emissions Measurements."
- RBW = 1 MHz.
- VBW ≥ 3 MHz.
- Detector = power averaging (rms), if span/(# of points in sweep) <= RBW/2. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, the detector mode shall be set to peak.
- Averaging type = power averaging (rms)
- Sweep time = auto.
- Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—rather than turning on and off with the transmit cycle, at least 100 traces shall be averaged.)
- If tests are performed with the EUT transmitting at a duty cycle less than 98%, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
- If power averaging (rms) mode was used in II.G.6.c)(iv), the correction factor is 10 log (1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB must be added to the measured emission levels.

8.4.2 Limits non restricted band:

FCC§15.407 (b),

- For transmitters operating in the 5.150-5.250 GHz band: All emissions outside the 5.150 GHz – 5.350 Ghz shall be limited to a level of −27 dBm/MHz EIRP

8.4.3 Limits restricted band §15.407/15.209/15.205.

- *PEAK LIMIT= 74 dBµV/m @3m =-21.23 dBm
- *AVG LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.
- 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			

8.4.4 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Single Antenna Gain
23.4° C	1	802.11a/n	AC/DC Converter	11 dBi

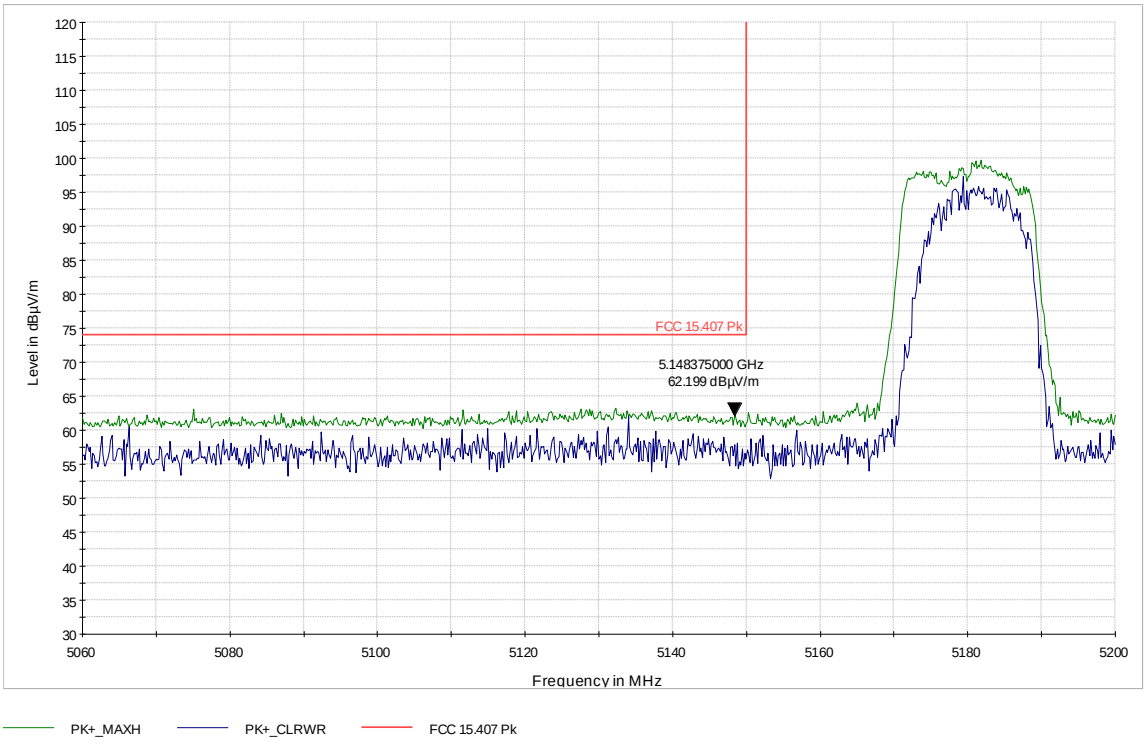
8.4.5 Measurement result:

- The value of below table shows worst case 80211.n 20/40 mode for each radio.

Plot #	EUT operating mode	Radio / Tx Chain	Band Edge	Frequency (MHz)	Measured Peak Value (dBuV/m)	Corrected by duty cycle (dBuV/m)	Limit (dBuV/m)	Result
1	802.11n 20	B1 MIMO	Lower Restricted peak	5148.3	62.20	N/A	74 Peak	Pass
2	802.11 n20	B1 MIMO	Lower Restricted Average	5147.15	45.31	45.52	54 AVG	Pass
3	802.11 n40	B1 MIMO	Lower Restricted peak	5149.6	63.22	N/A	74 Peak	Pass
4	802.11 n40	B1 MIMO	Lower Restricted Average	5149.25	51.13	51.42	54 AVG	Pass
5	802.11n 20	B2 MIMO	Lower Restricted peak	5135.6	63.87	N/A	74 Peak	Pass
6	802.11 n20	B2 MIMO	Lower Restricted Average	5133.85	44.81	45.02	54 AVG	Pass
7	802.11 n40	B2 MIMO	Lower Restricted peak	5149.97	64.49	N/A	74 Peak	Pass
8	802.11 n40	B2 MIMO	Lower Restricted Average	5147.85	53.27	53.56	54 AVG	Pass
9	802.11n 20	B3 MIMO	Lower Restricted peak	5141.72	63.50	N/A	74 Peak	Pass
10	802.11 n20	B3 MIMO	Lower Restricted Average	5132.8	44.70	44.91	54 AVG	Pass
11	802.11 n40	B3 MIMO	Lower Restricted peak	5147.33	63.16	N/A	74 Peak	Pass
12	802.11 n40	B3 MIMO	Lower Restricted Average	5147.15	45.30	45.59	54 AVG	Pass
13	802.11n 20	B4 MIMO	Lower Restricted peak	5138.92	63.07	N/A	74 Peak	Pass
14	802.11 n20	B4 MIMO	Lower Restricted Average	5138.57	44.36	44.57	54 AVG	Pass
15	802.11 n40	B4 MIMO	Lower Restricted peak	5147.50	63.22	N/A	74 Peak	Pass
16	802.11 n40	B4 MIMO	Lower Restricted Average	5145.75	49.37	49.66	54 AVG	Pass

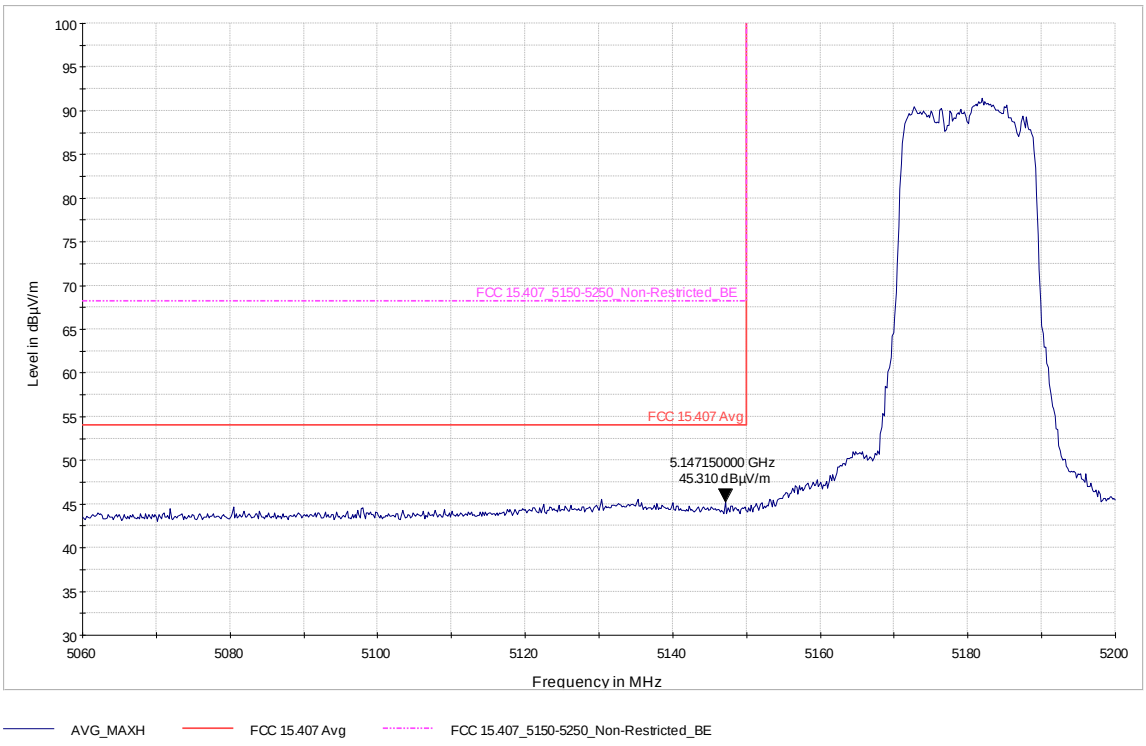
8.4.6 Measurement Plots:

Plot #1	
Low channel / 5180 MHz B1 36	**Modulation/Packet Type: 802.11a 6Mbps**



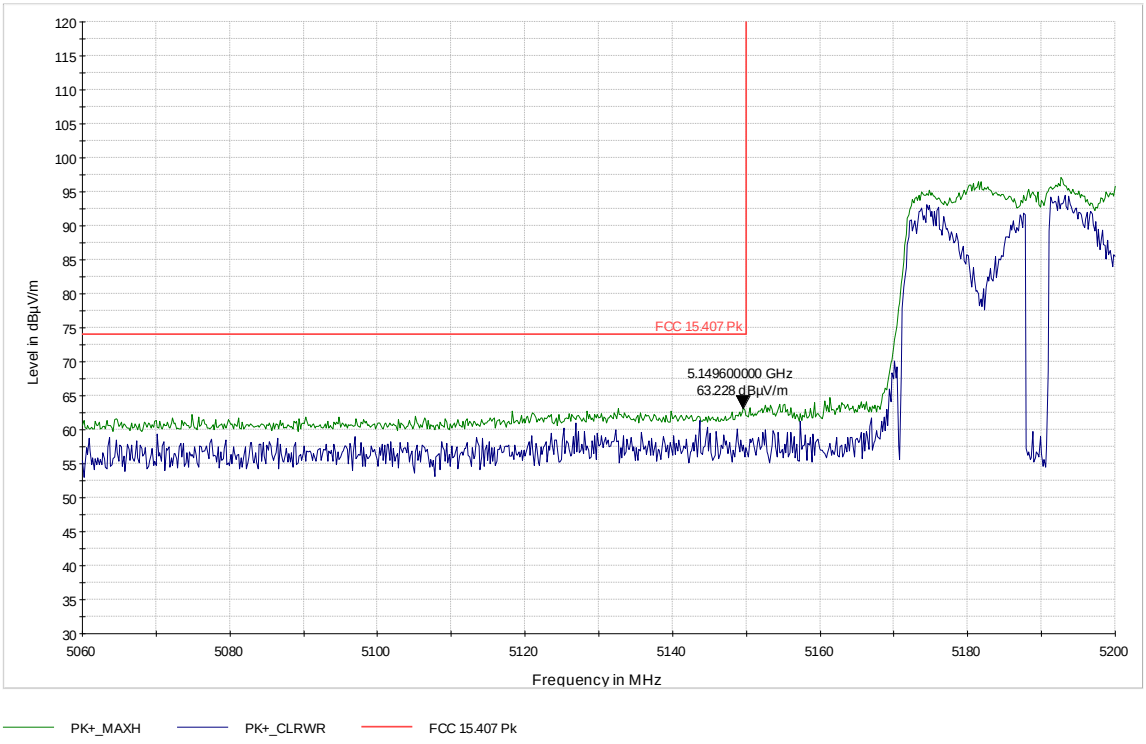
Plot #2

Low channel / 5180 MHz B1 36	Modulation/Packet Type: 802.11a 6Mbps

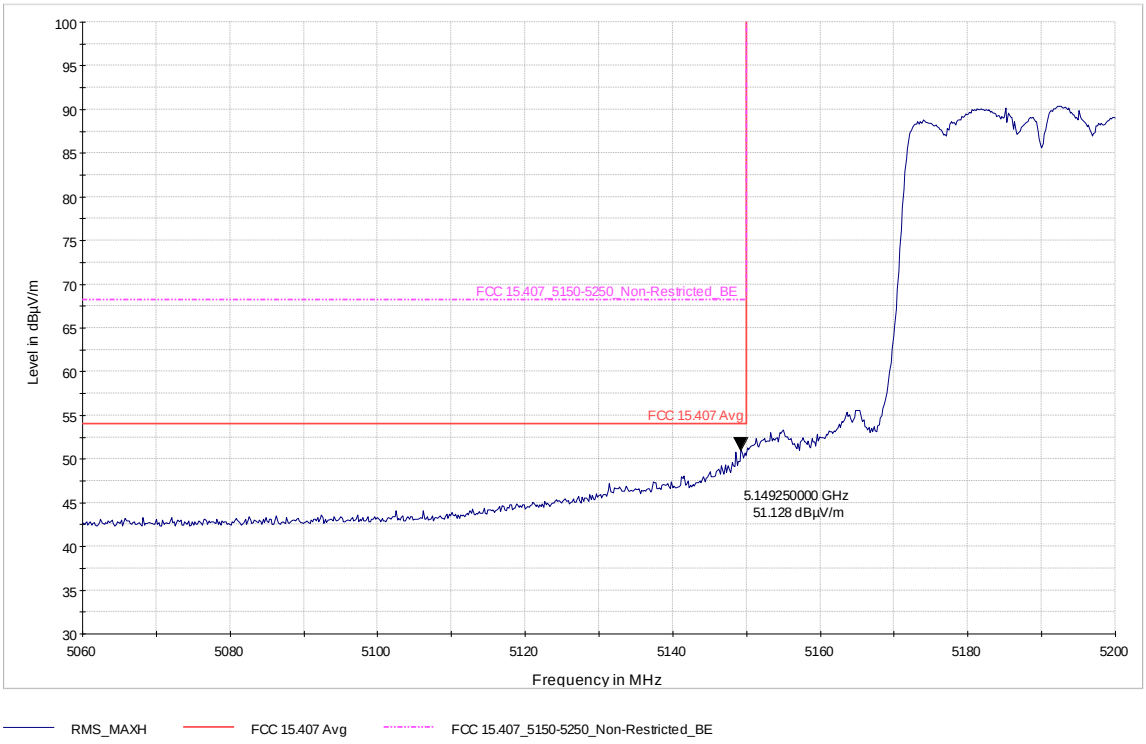


Plot #3

Low channel / 5190 MHz B1 38 pk	Modulation/Packet Type: 802.11n_40 MCS0

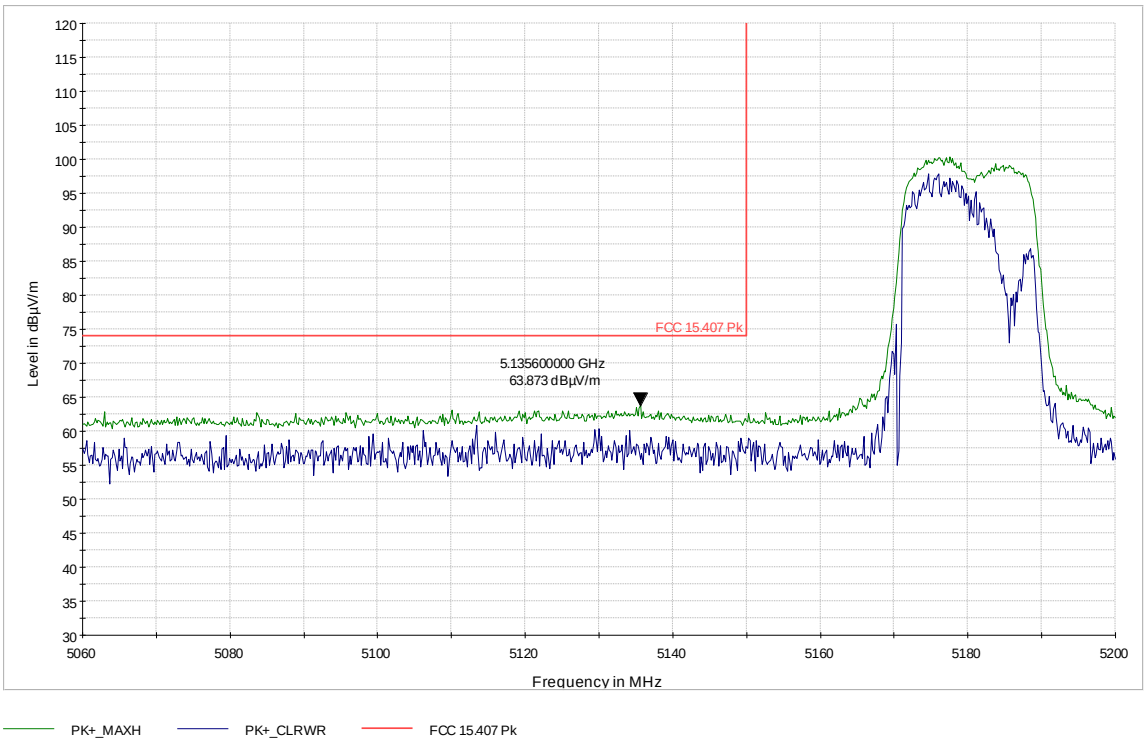


Plot #4	
Low channel 5190 / B1 38 avg	**Modulation/Packet Type: 802.11n_40 MCS0**

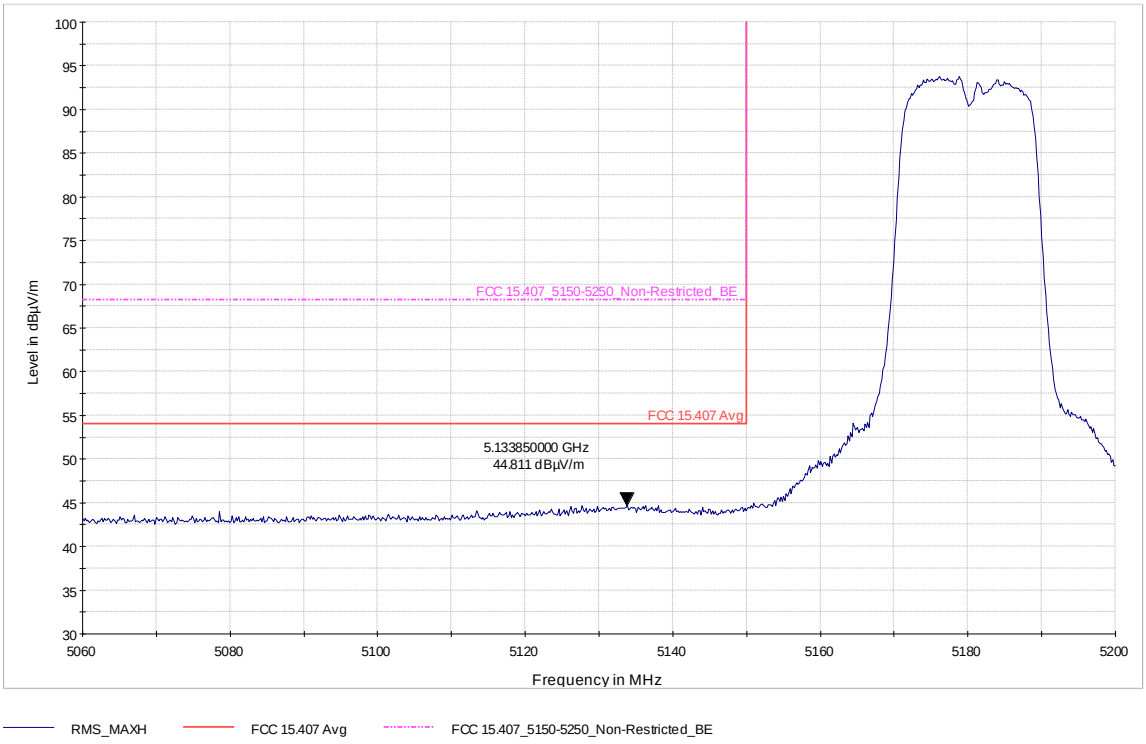


Plot #5

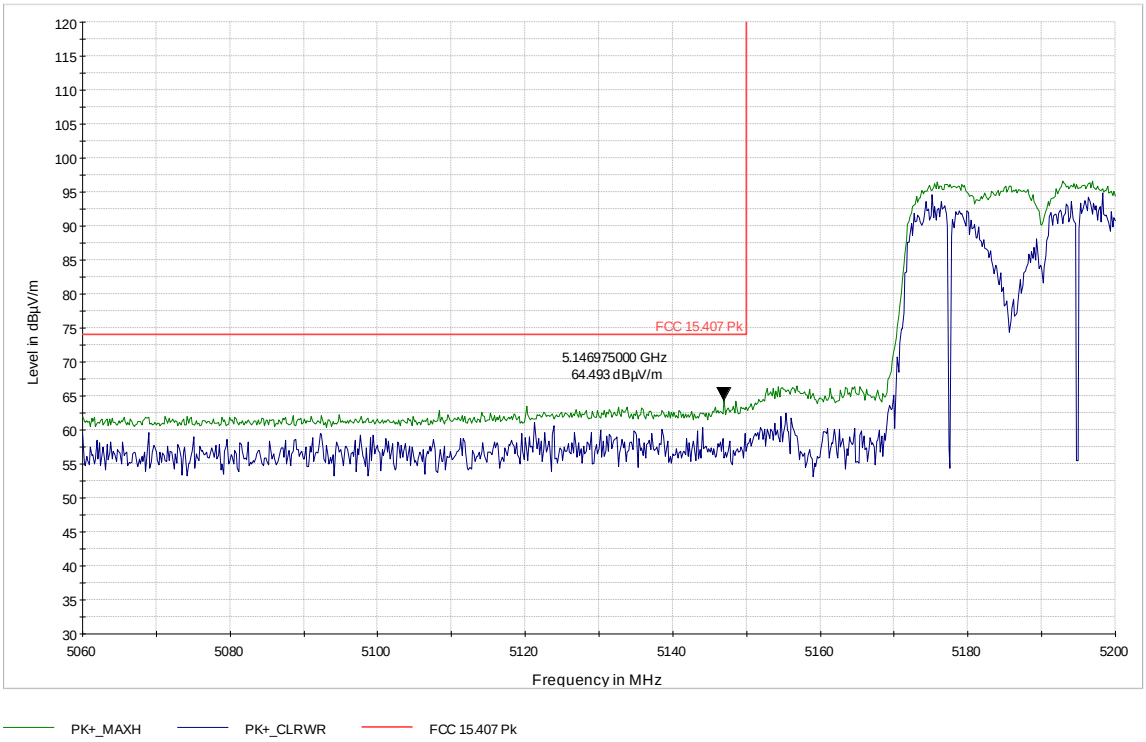
Low channel / 5180 MHz B2 36	Modulation/Packet Type: 802.11n_20 MCS0



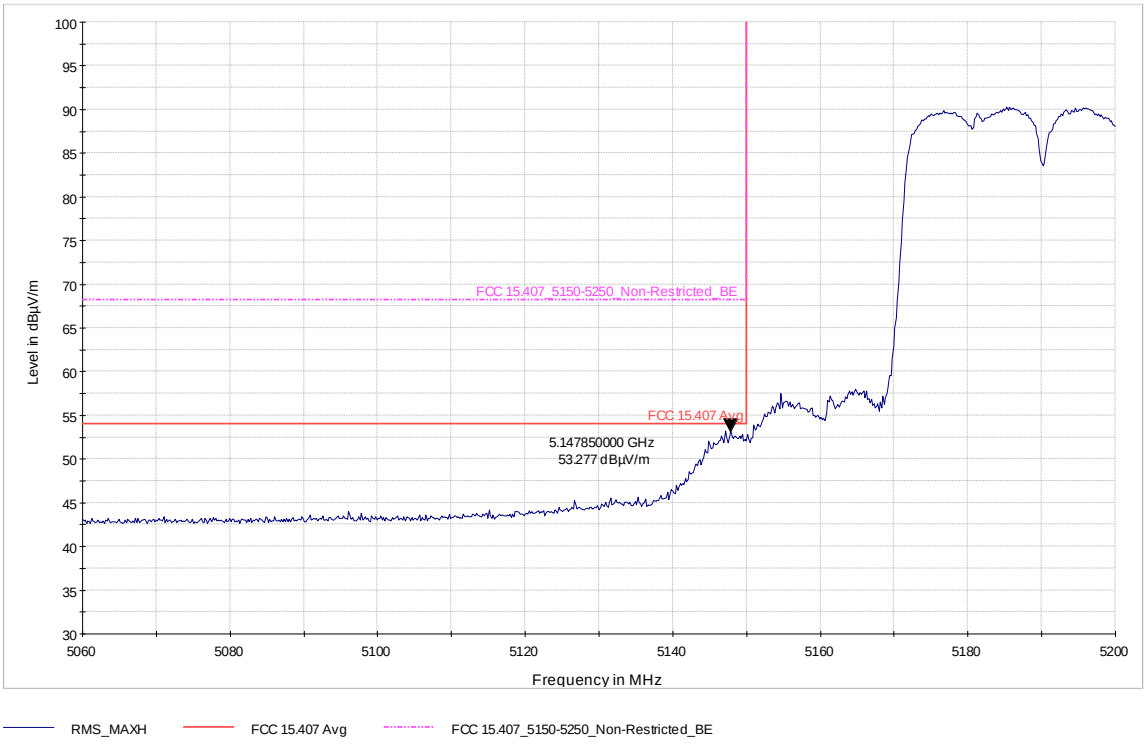
Plot #6	
High channel / 5180 MHz B2 36	**Modulation/Packet Type: 802.11n_20 MCS0**



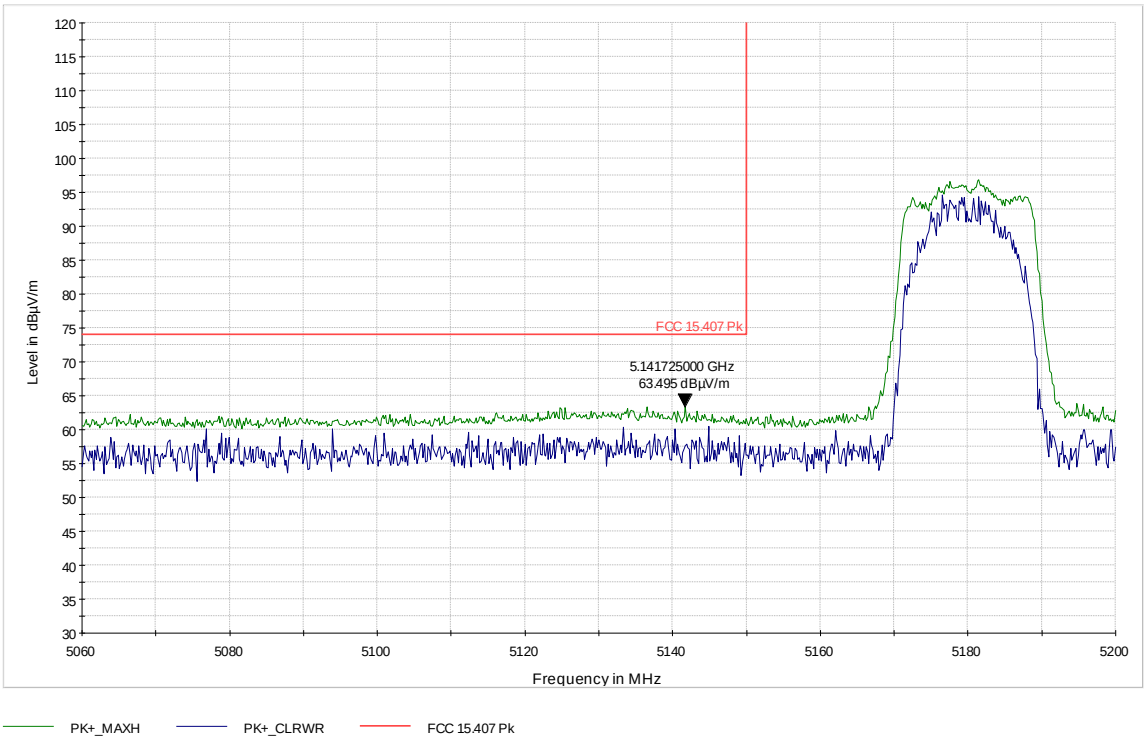
Plot #7	
Low channel / 5190 MHz B2 38 PK	**Modulation/Packet Type: 802.11a 6Mbps Peak**



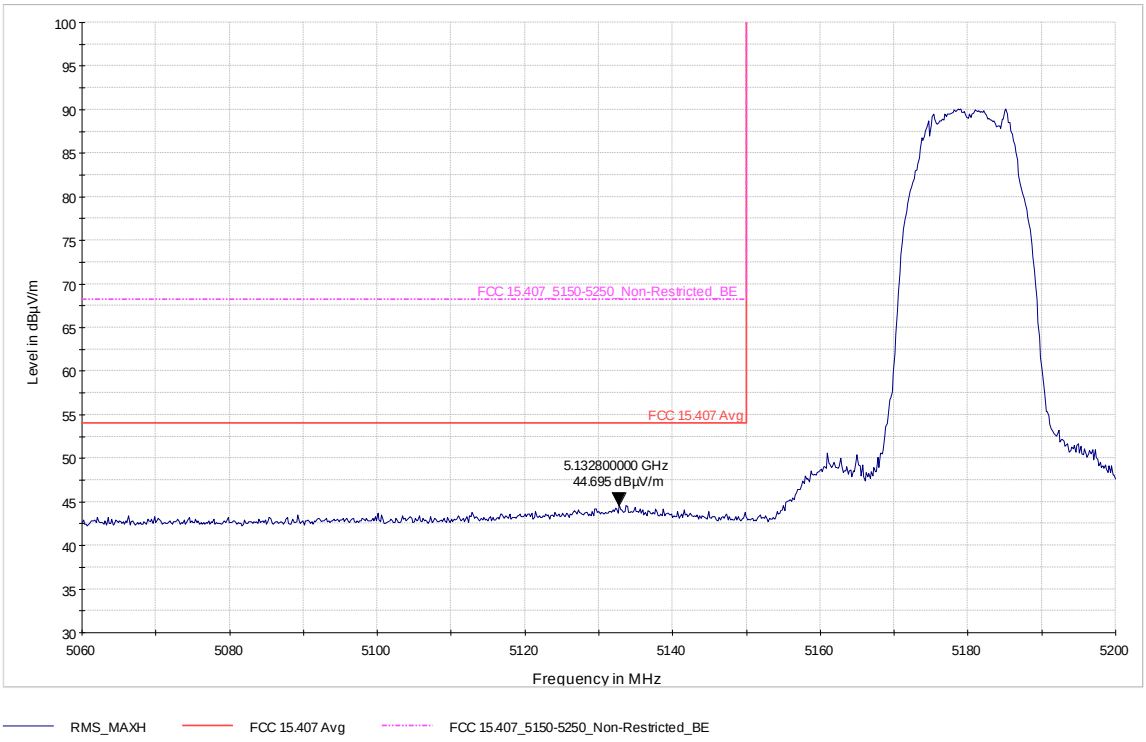
Plot #8	
Low channel / B2 38 AVG	**Modulation/Packet Type: 802.11a 6Mbps Avg**



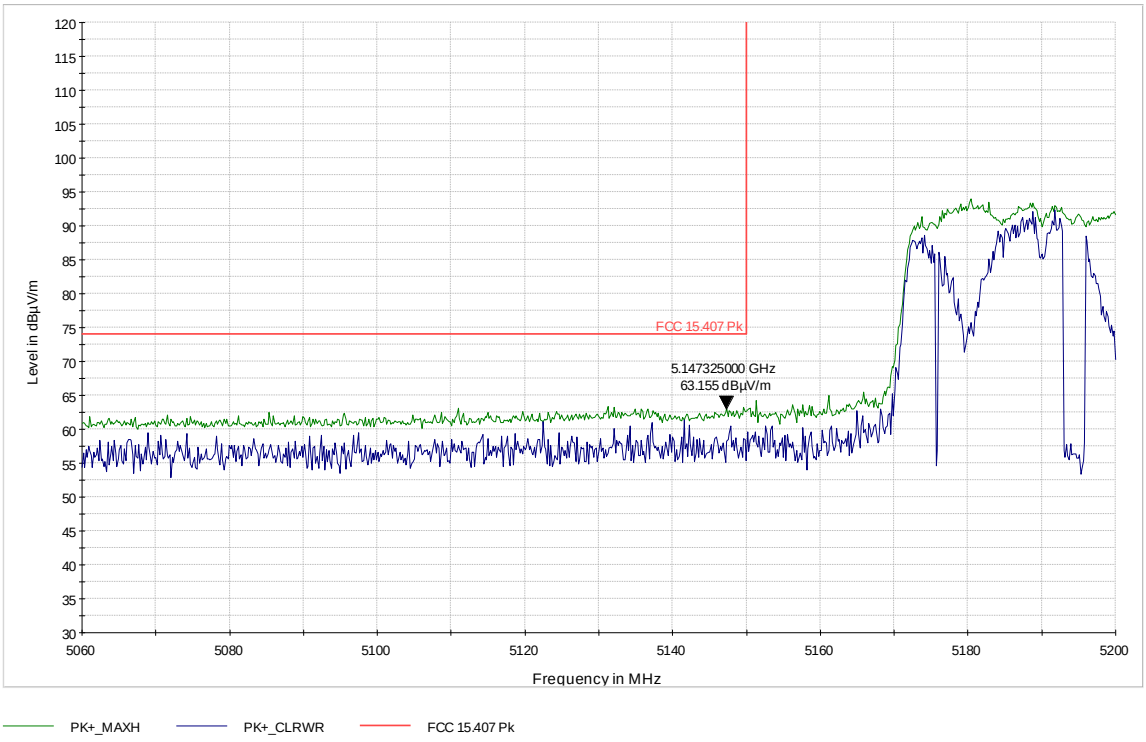
Plot #9	
Low channel / 5180 MHz B3 36 PK	**Modulation/Packet Type: 802.11n_20 MCS0 Peak**



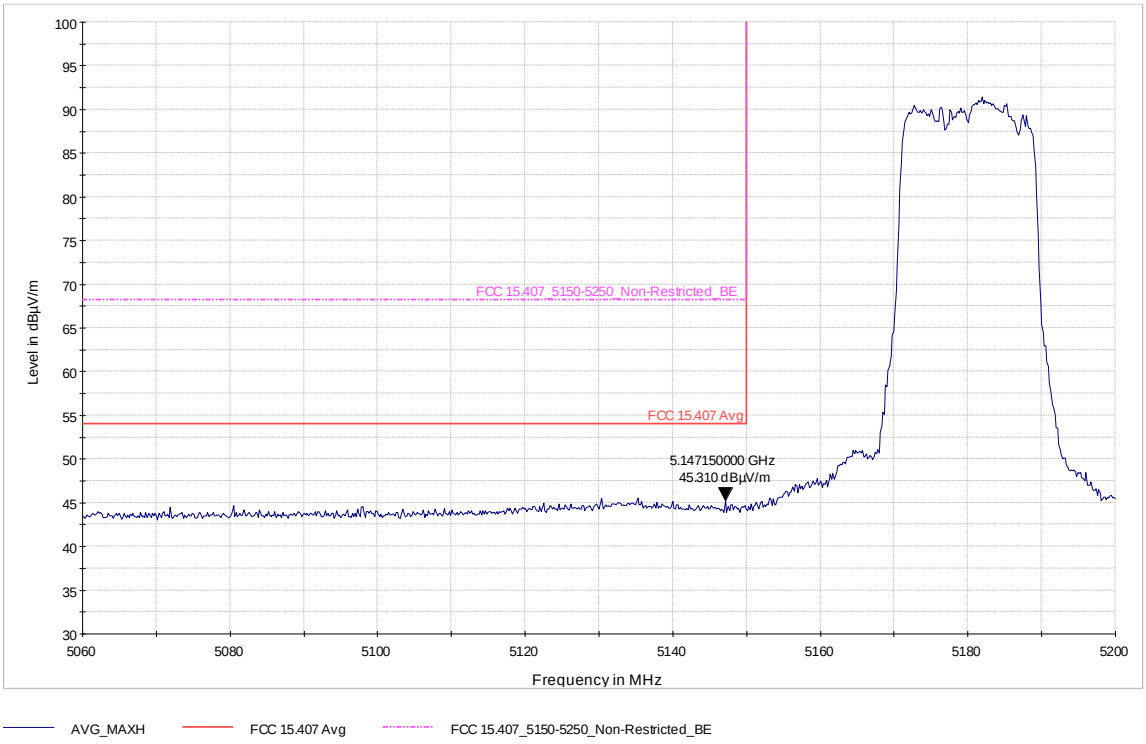
Plot #10	
Low channel / 5180 MHz B3 36 Avg	**Modulation/Packet Type: 802.11n_20 MCS0 Avg**



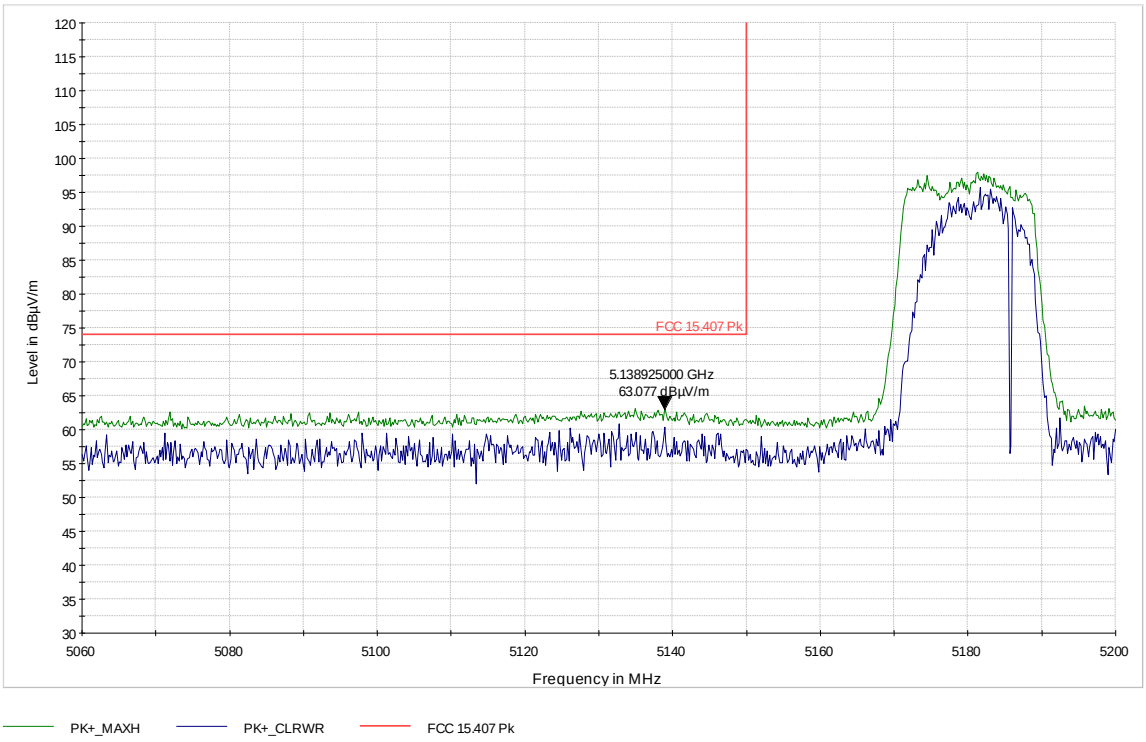
Plot #11	
Low channel / 5190 MHz B3 38 PK	**Modulation/Packet Type: 802.11n_40 MCS0 Peak**



Plot #12	
Low channel / 5180 MHz b4 36 AV	**Modulation/Packet Type: 802.11n_20 MCS0 Avg**

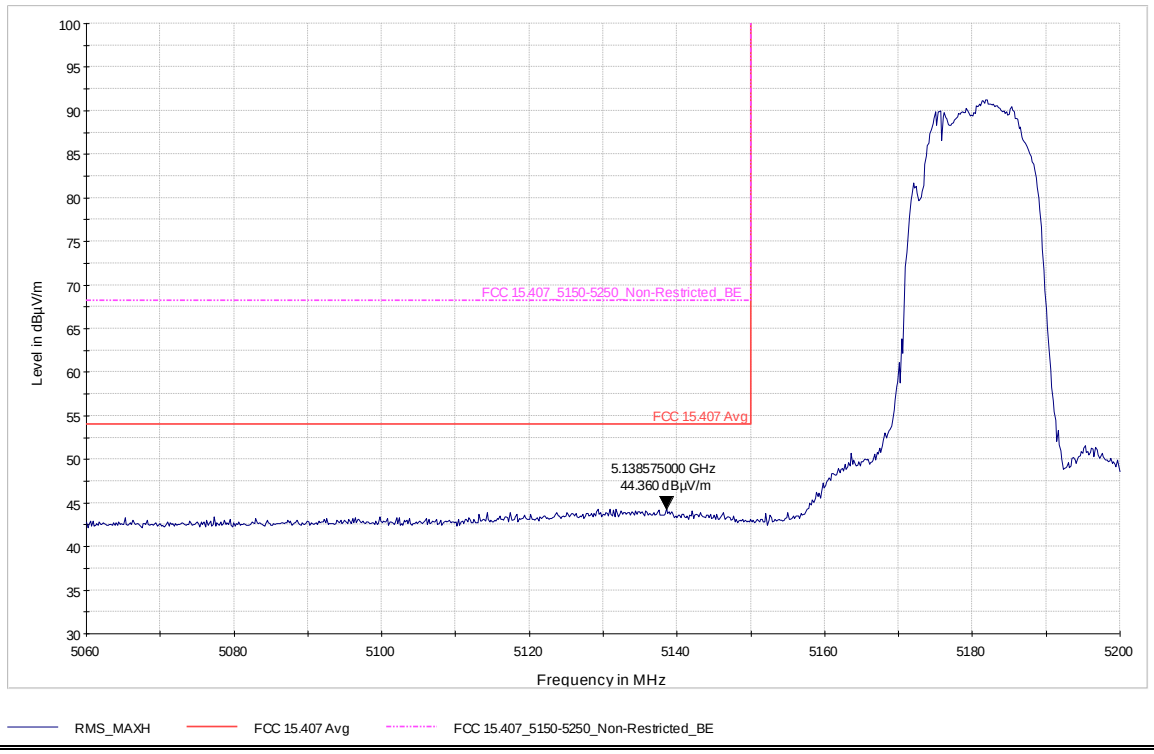


Plot #13	
Low channel / B4 36 pk	**Modulation/Packet Type: 802.11n_20 MCS0 Avg**

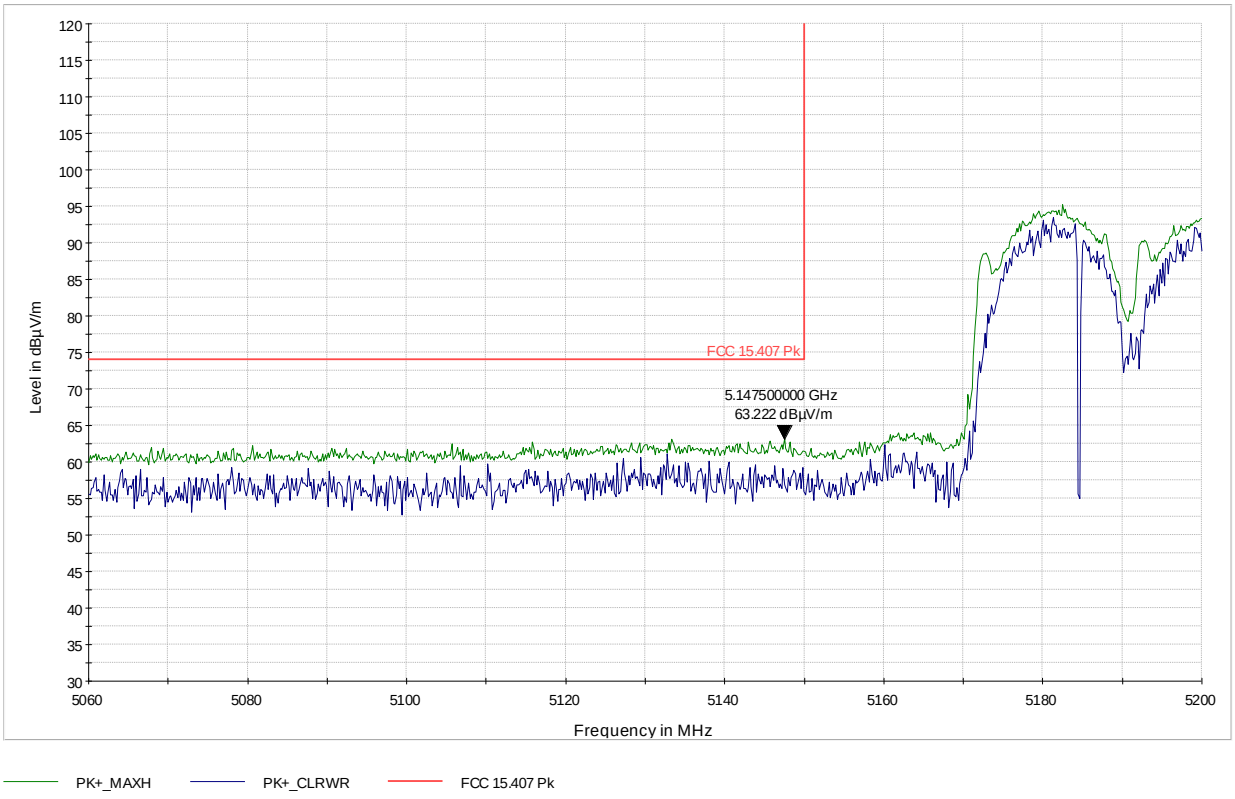


Plot #14

Low channel / 5180 MHz B4 36	Modulation/Packet Type: 802.11n_20 MCS0 Avg

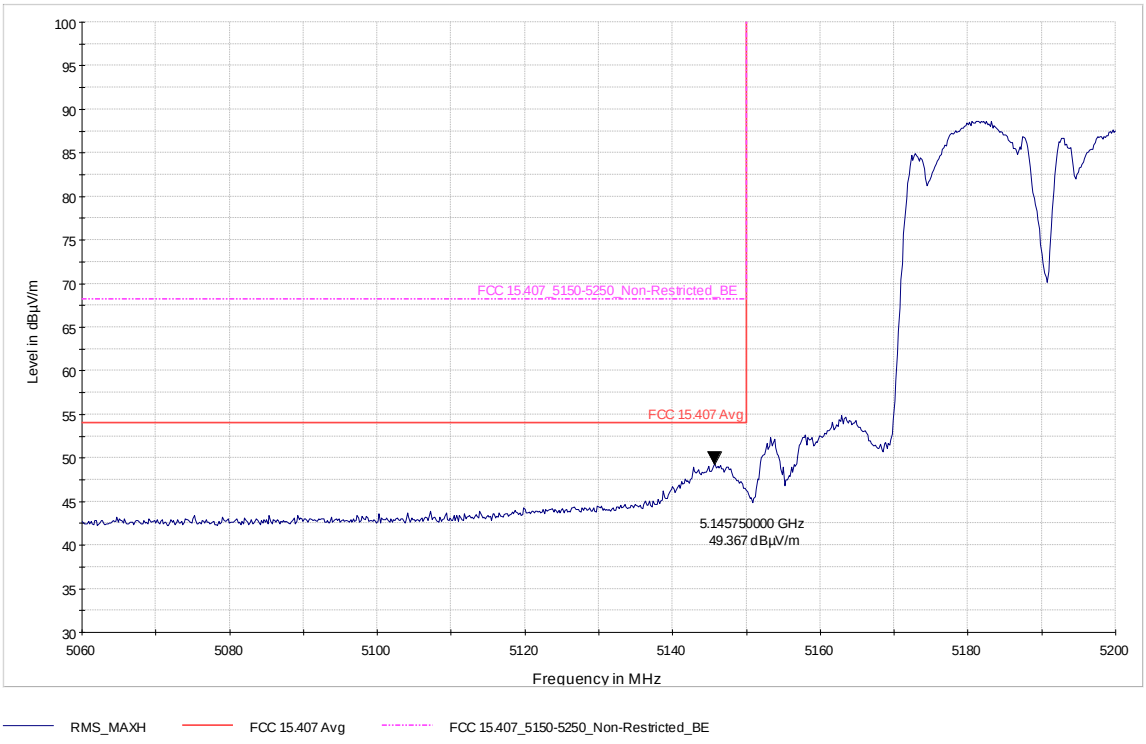


Plot #15	
Low channel / 5190 MHz	**Modulation/Packet Type: 802.11n_40 MCS0 PK**



Plot #16

Low channel / B4 38 5190 MHz	Modulation/Packet Type: 802.11n_40 MCS0 Avg



8.5 Emission Bandwidth 6 dB, 26dB and 99% Occupied Bandwidth

8.5.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer Settings for 26 dB EBW:

- Set RBW = approximately 1% of the emission bandwidth
- Set the VBW > RBW
- Detector = Peak
- Trace mode = Max Hold
- Sweep = Auto Couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%

Spectrum Analyzer Settings for 99% Occupied Bandwidth

- Set center frequency to the nominal EUT channel center frequency
- Set span = 1.5 times to 5.0 times the OBW
- Set RBW = 1% to 5% of the OBW
- Set VBW ≥ 3 x RBW
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used
- Use the 99% power bandwidth function of the instrument (if available)
- If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies

8.5.2 Limits:

FCC §15.407(e)

- Bandwidth of U-NII devices shall be at least 500 kHz.

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	802.11 b/g/n	USB 5VDC

8.5.4 Measurement result:

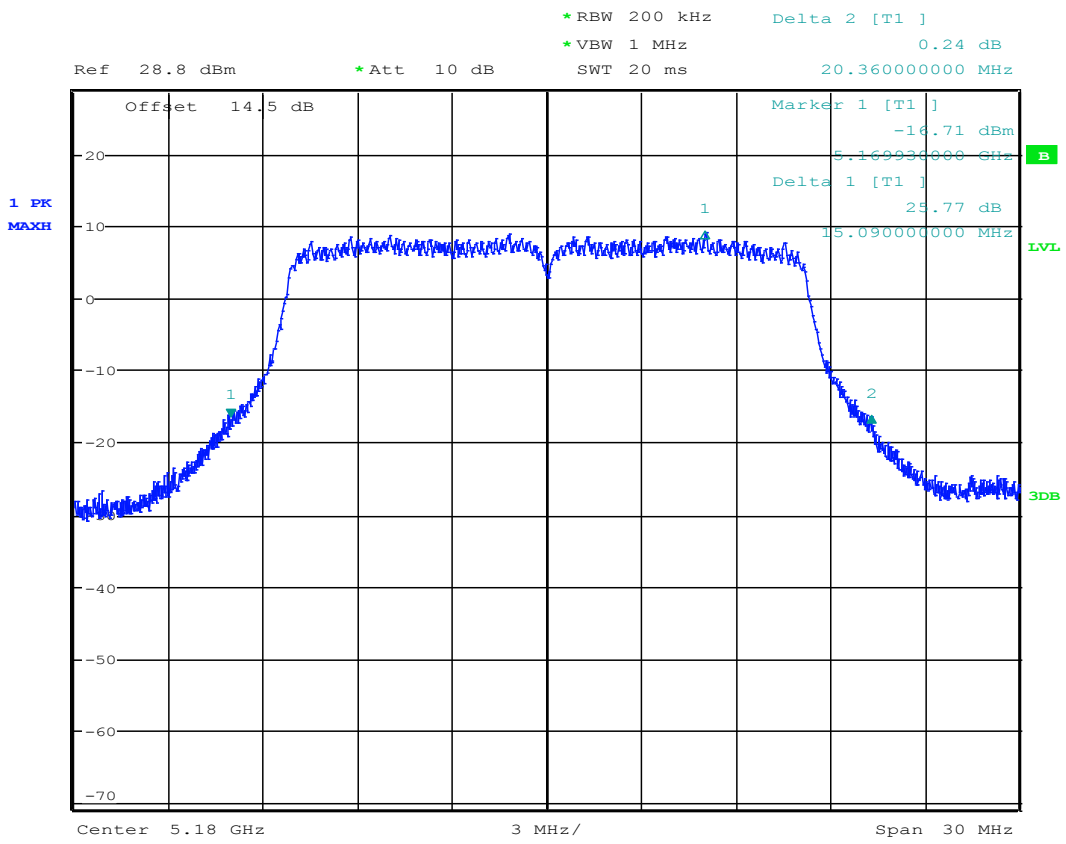
Plot #	Mode	Channel	26 dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
1	802.11a	36	20.36	> 0.5	Pass
2	802.11a	44	20.34	> 0.5	Pass
3	802.11a	48	20.48	> 0.5	Pass
4	802.11n_20	36	21.35	> 0.5	Pass
5	802.11n_20	44	21.33	> 0.5	Pass
6	802.11n_20	48	21.52	> 0.5	Pass
7	802.11n_40	38	40.62	> 0.5	Pass
8	802.11n_40	46	40.90	> 0.5	Pass

Plot #	Mode	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
9	802.11a	36	16.54	> 0.5	Pass
10	802.11a	44	16.48	> 0.5	Pass
11	802.11a	48	16.41	> 0.5	Pass
12	802.11n_20	36	17.64	> 0.5	Pass
13	802.11n_20	44	17.67	> 0.5	Pass
14	802.11n_20	48	17.58	> 0.5	Pass
15	802.11n_40	38	36.08	> 0.5	Pass
16	802.11n_40	46	36.11	> 0.5	Pass

Measurement Plots:

Plot #1

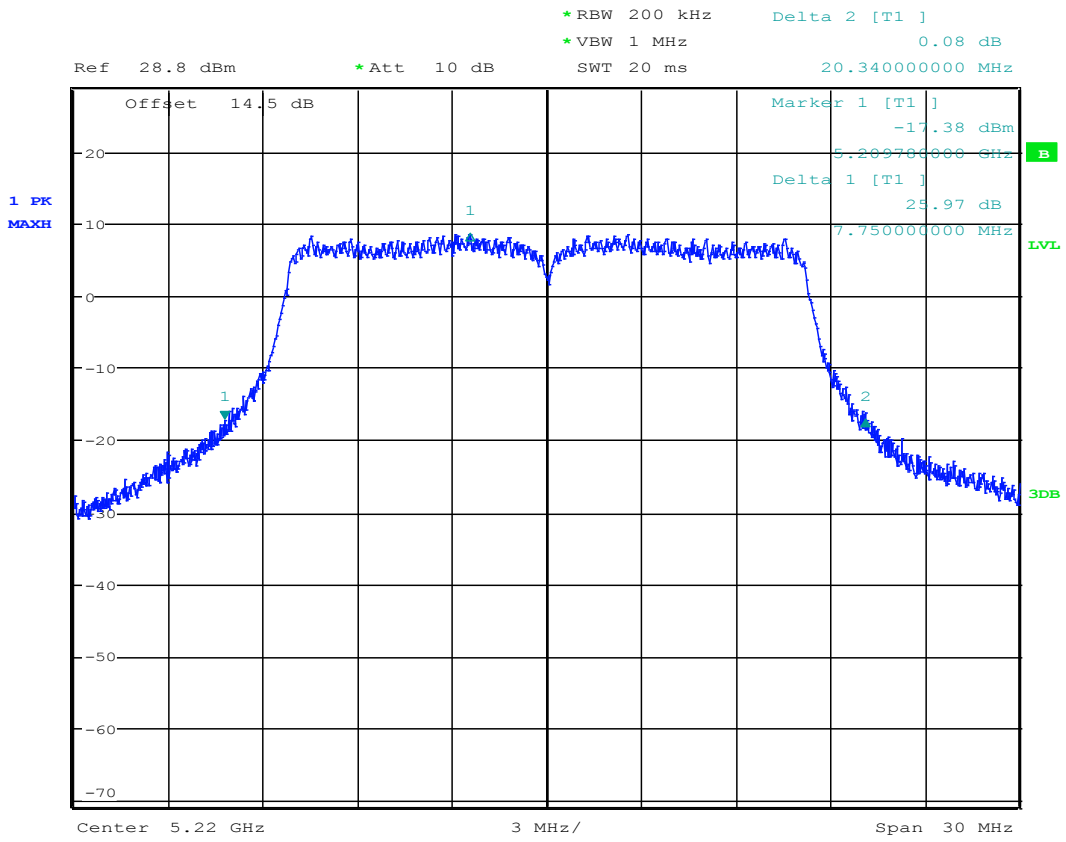
Low channel	Mode: 802.11a 6Mbps



Date: 14.JAN.2019 14:55:38

Plot #2

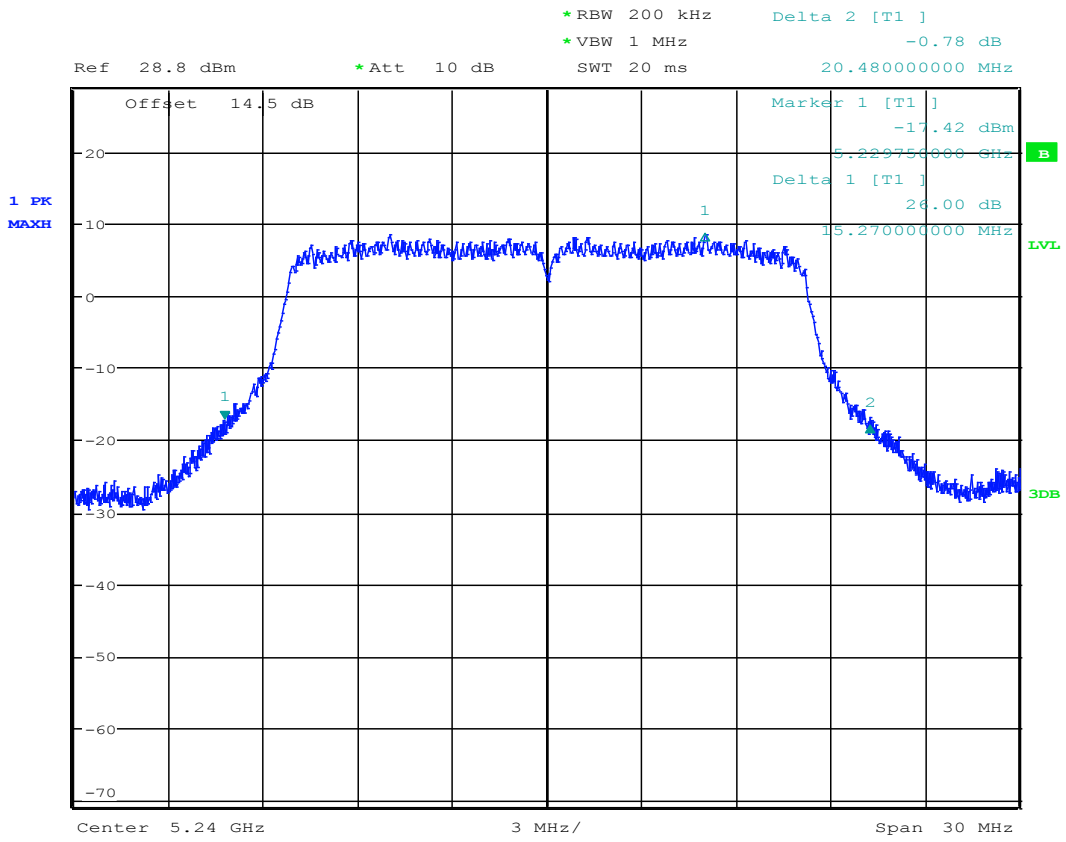
Mid channel	Mode: 802.11a 6Mbps



Date: 14.JAN.2019 15:09:23

Plot #3

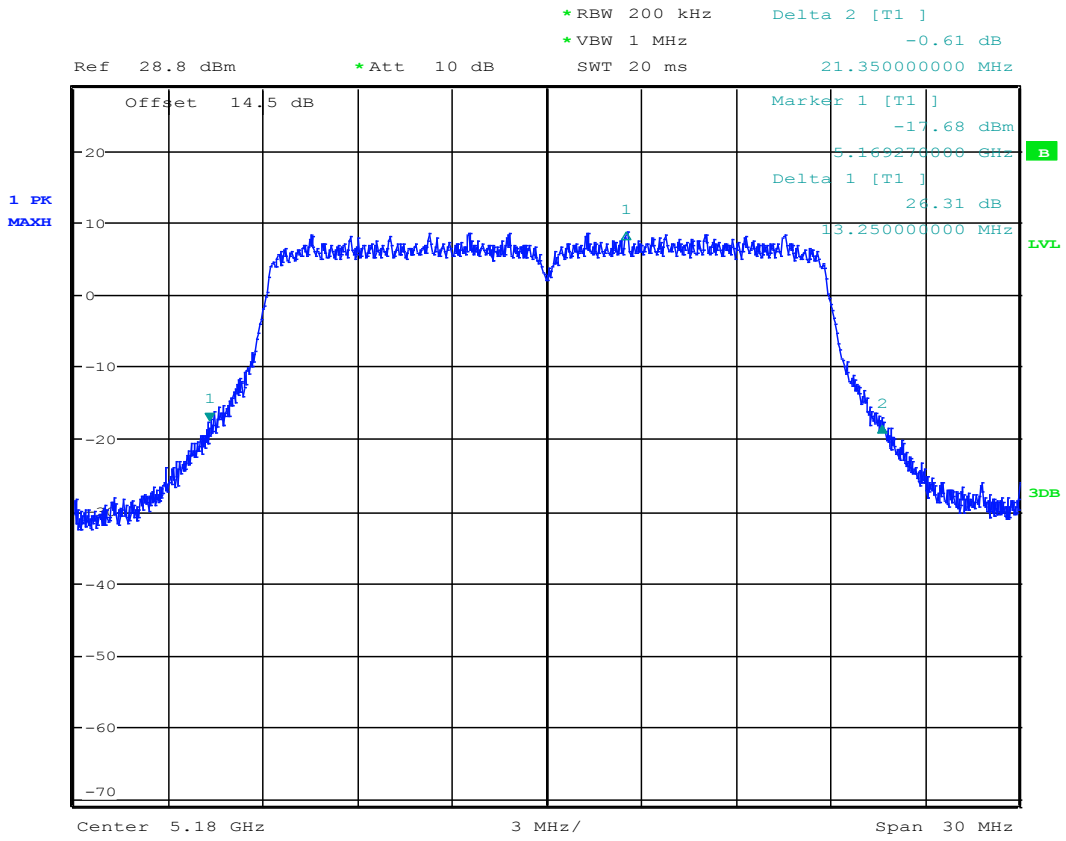
High channel	Mode: 802.11a 6Mbps



Date: 14.JAN.2019 15:20:31

Plot #4

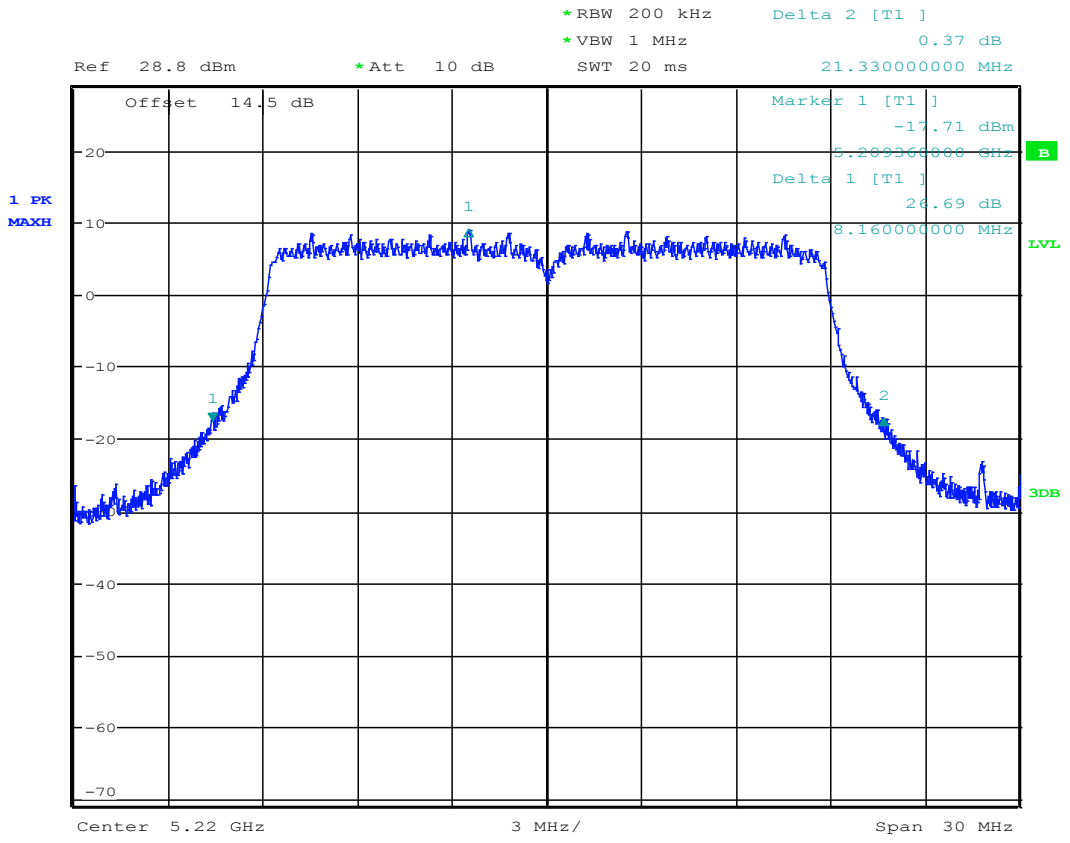
Low channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 14:59:34

Plot #5

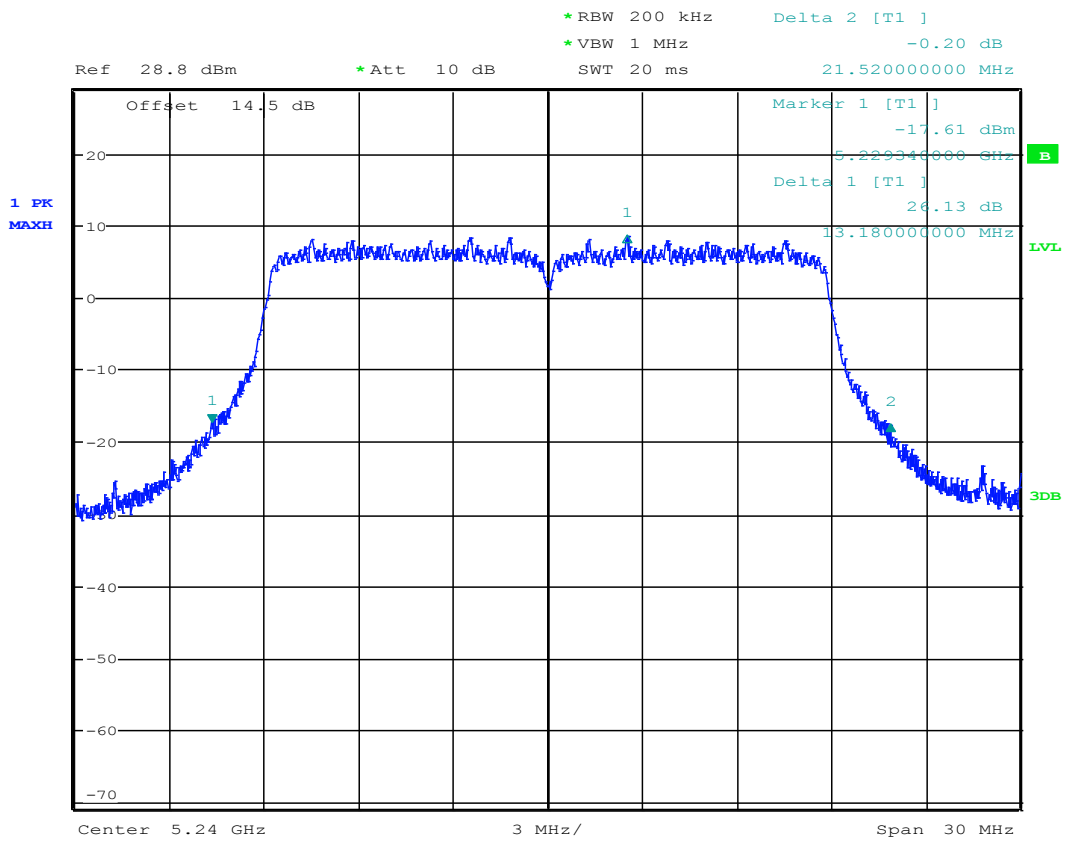
Mid channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 15:12:02

Plot #6

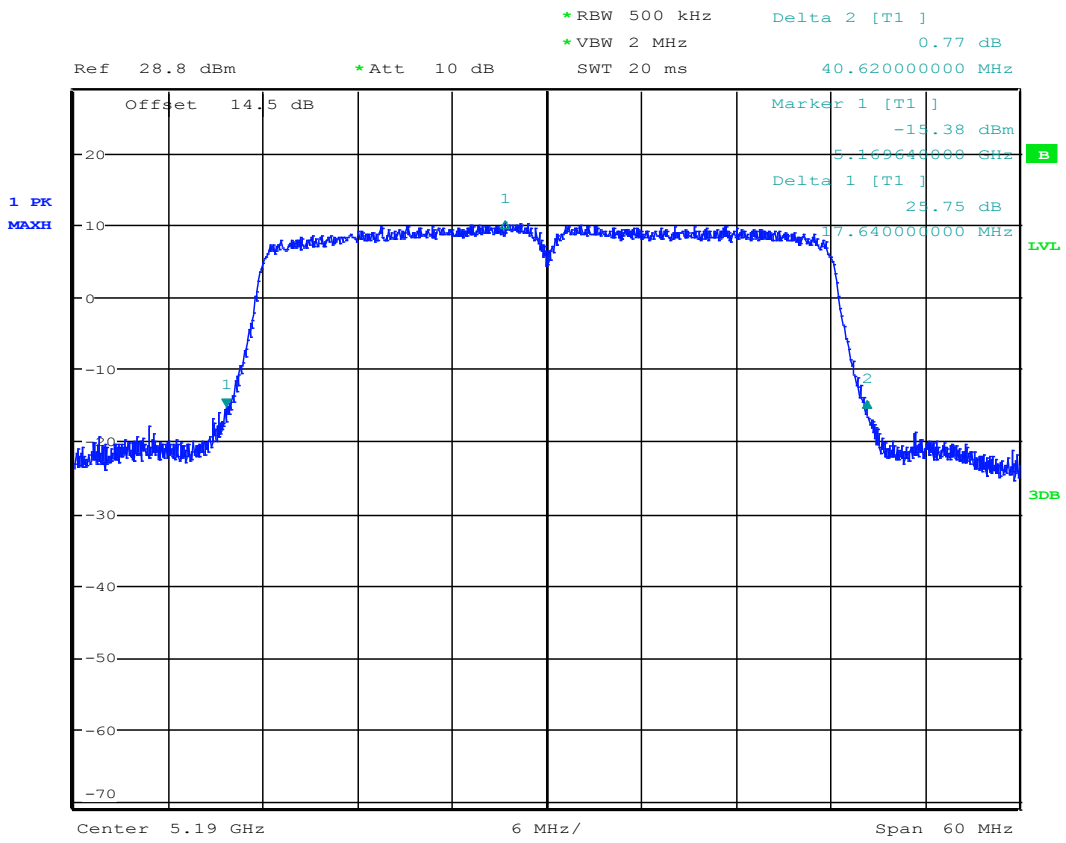
High channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 15:18:04

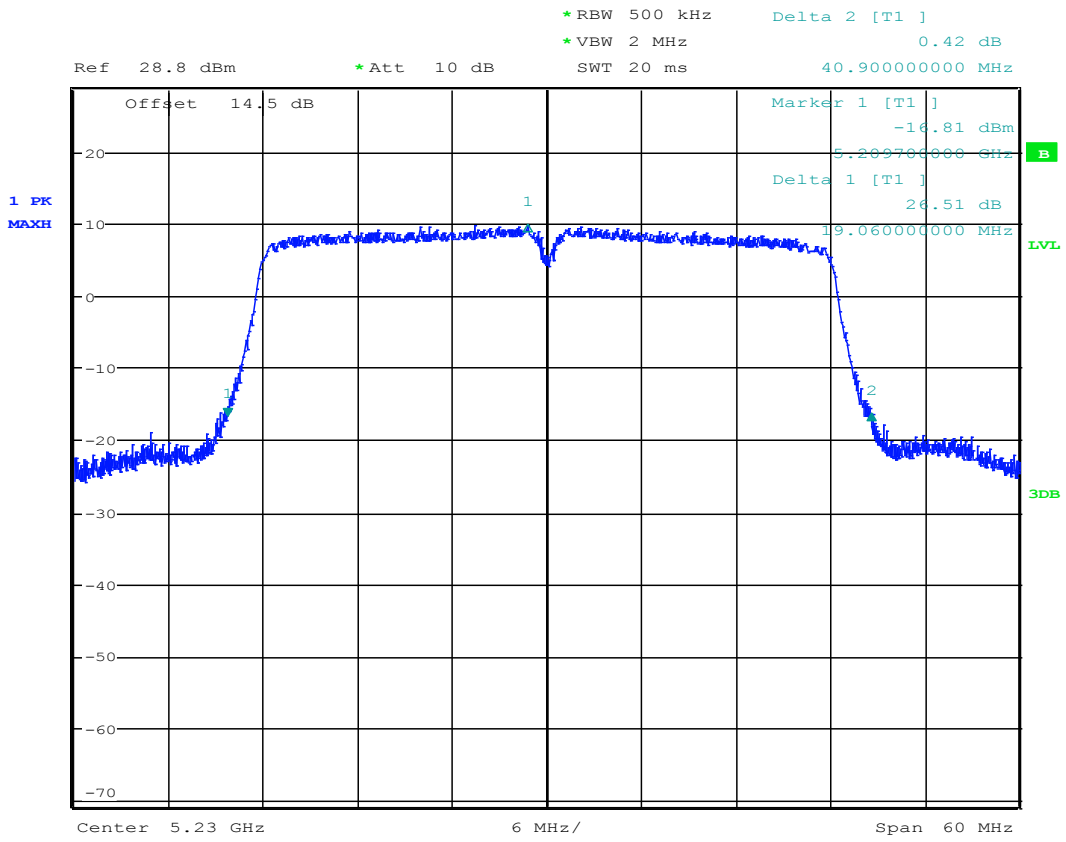
Plot #7

Low channel	Mode: 802.11n_40 MCS0



Plot #8

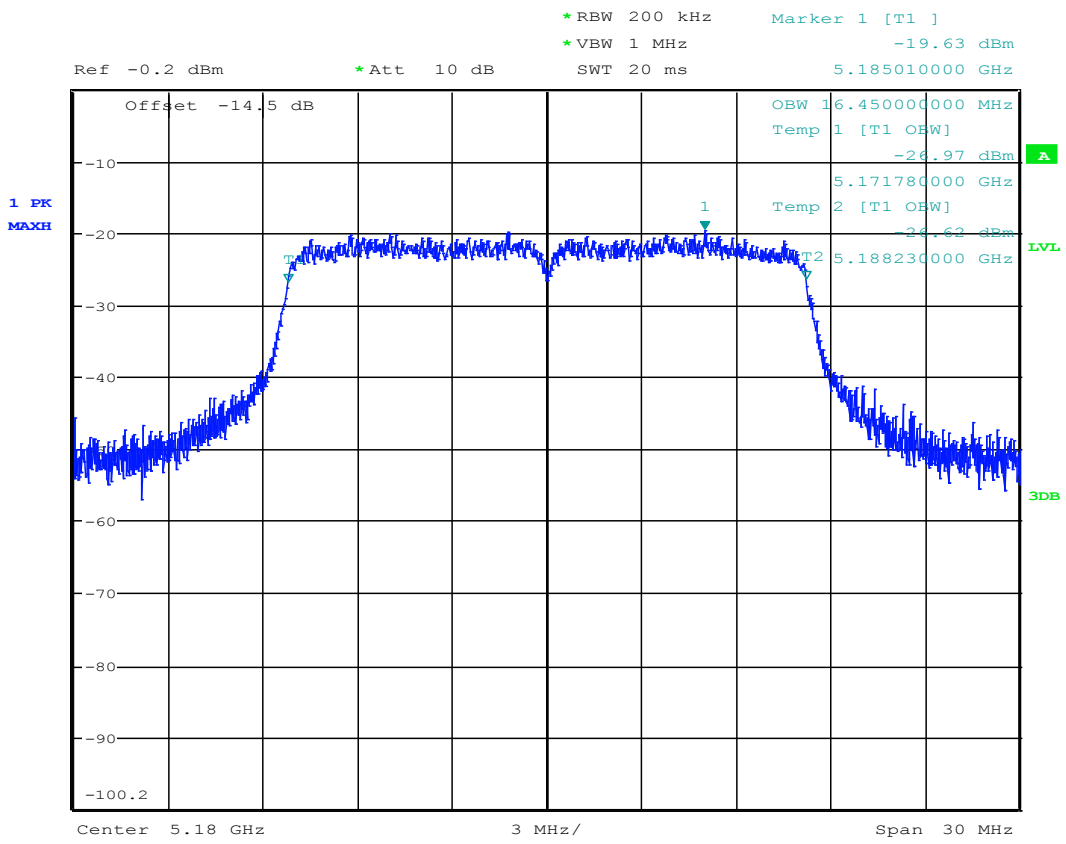
High channel	Mode: 802.11n_40 MCS0



Date: 14.JAN.2019 16:05:31

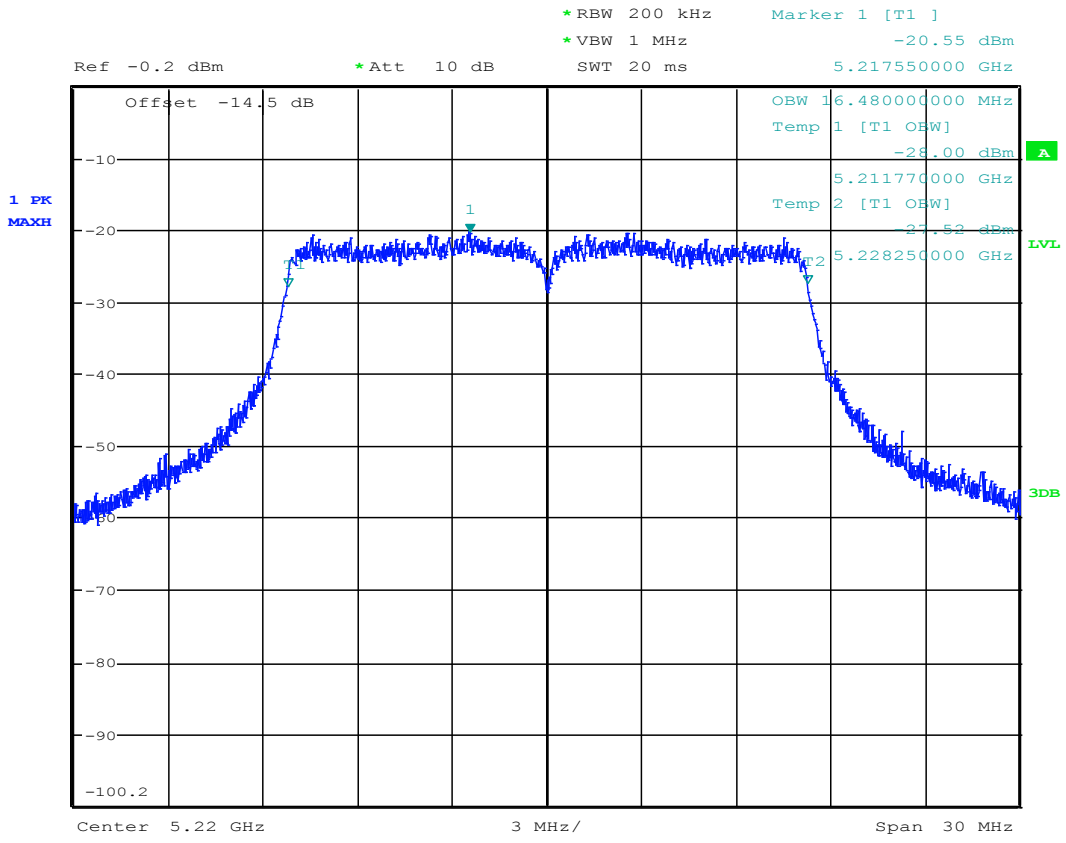
Plot #9

Low channel	Mode: 802.11a 6Mbps



Plot #10

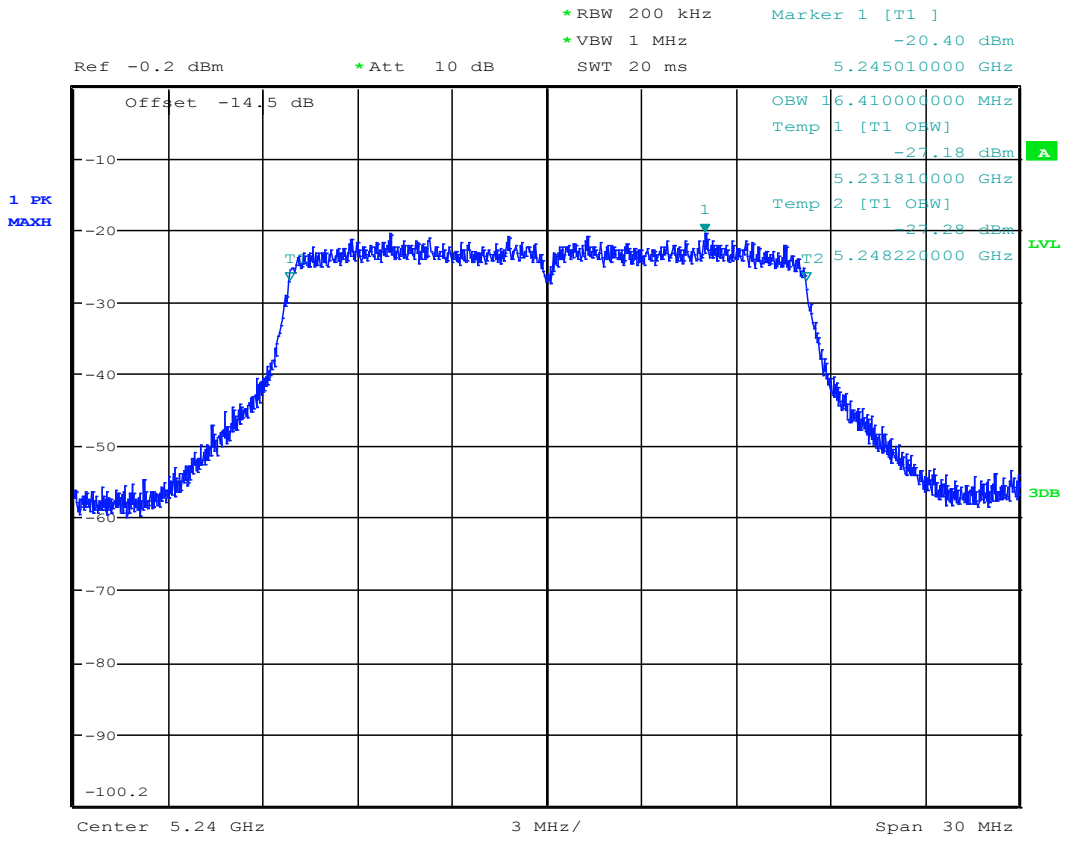
Mid channel	Mode: 802.11a 6Mbps



Date: 14.JAN.2019 15:50:25

Plot #11

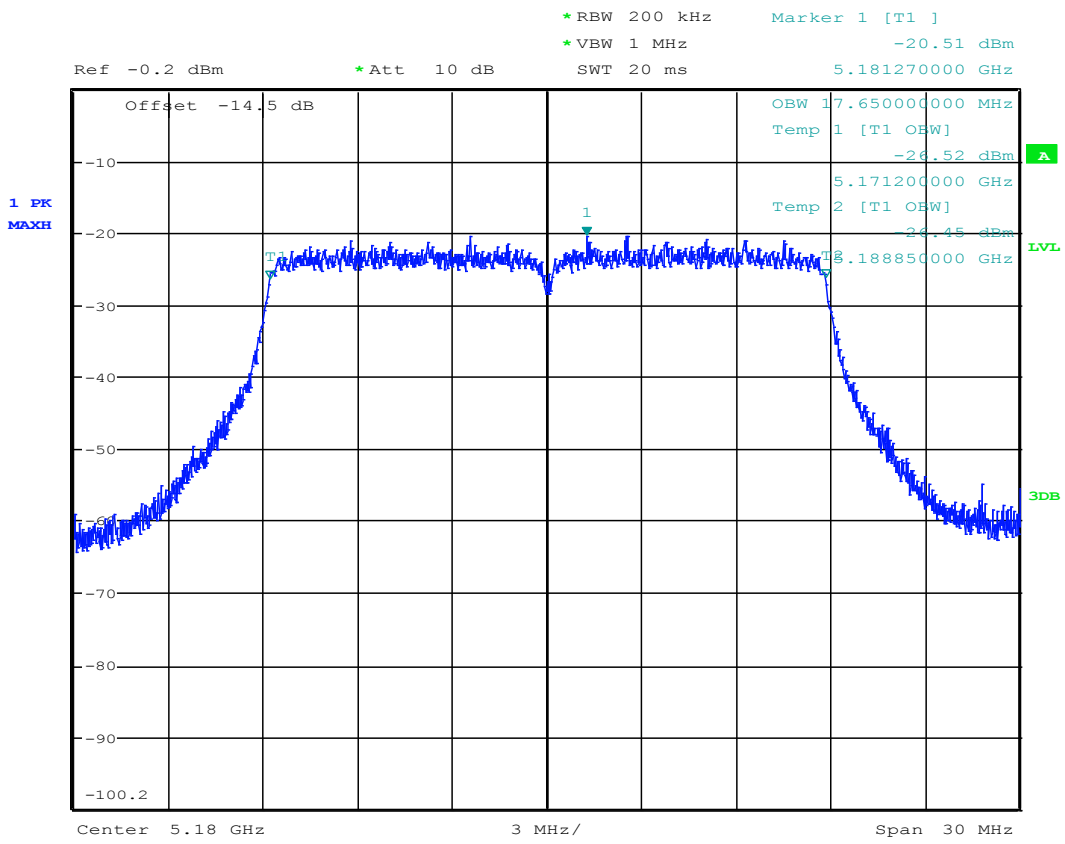
High channel	Mode: 802.11a 6Mbps



Date: 14.JAN.2019 15:51:32

Plot #12

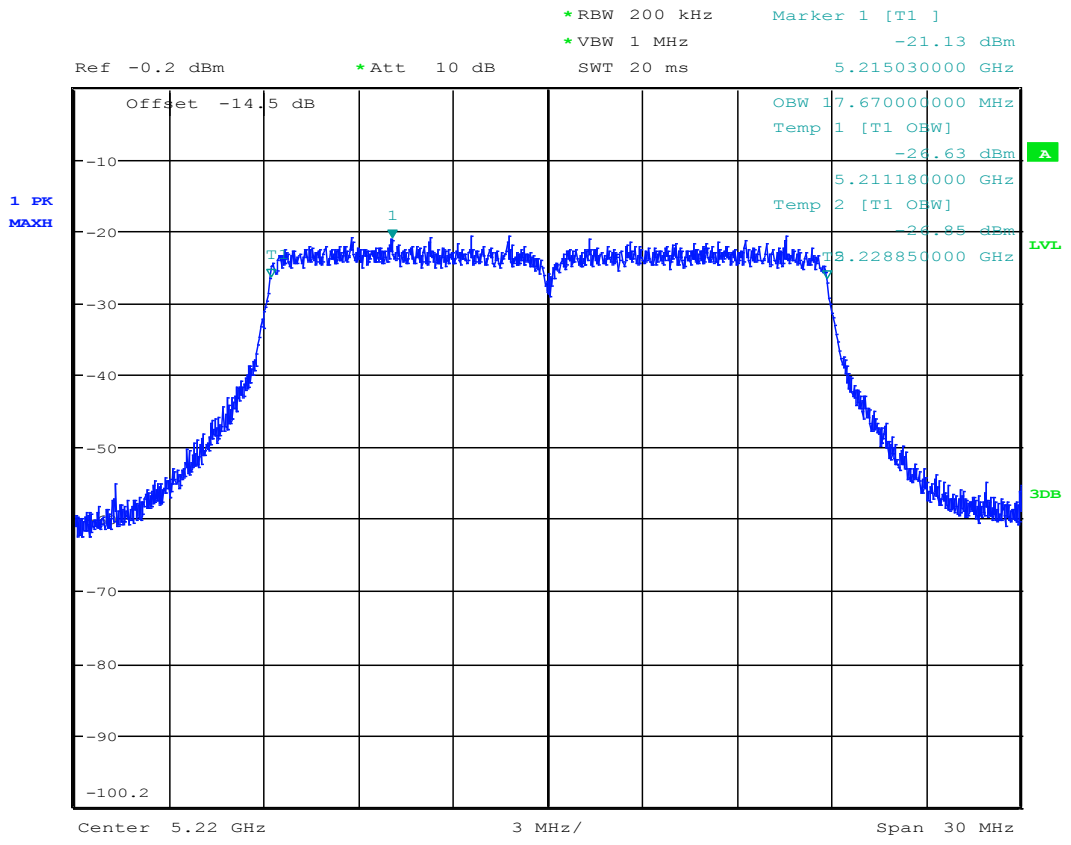
Low channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 15:47:37

Plot #13

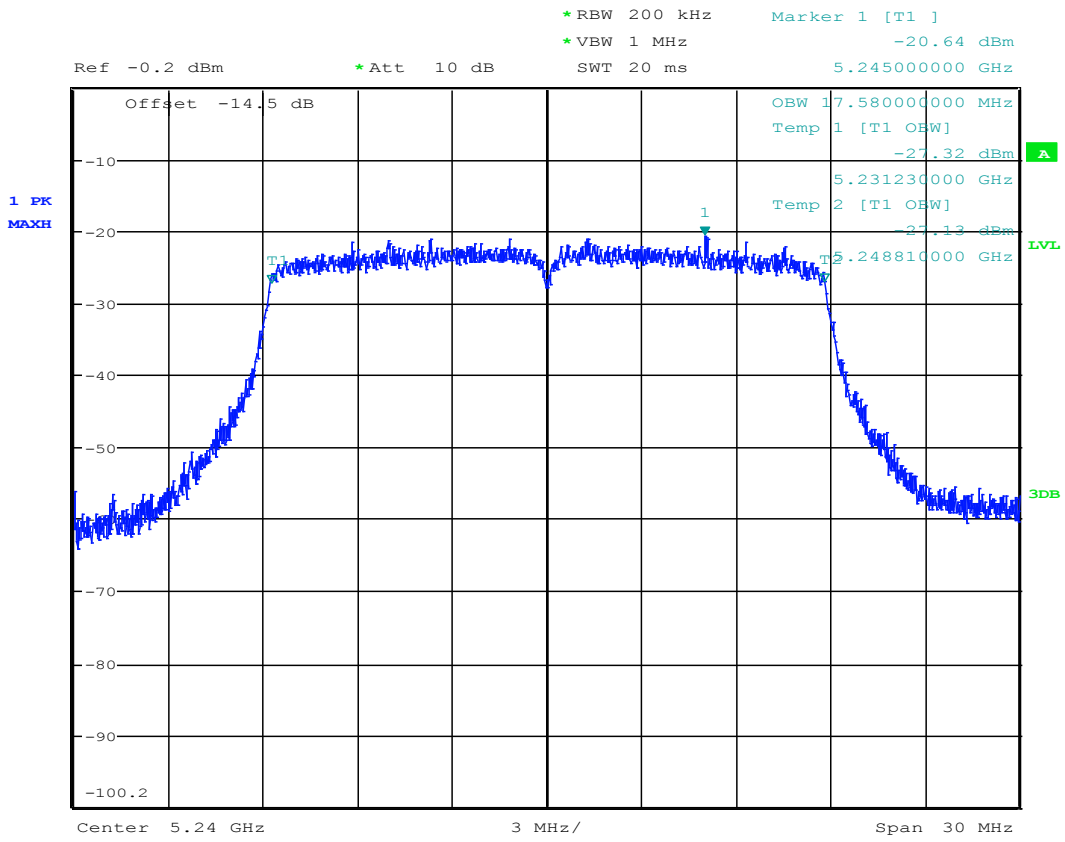
Mid channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 15:49:23

Plot #14

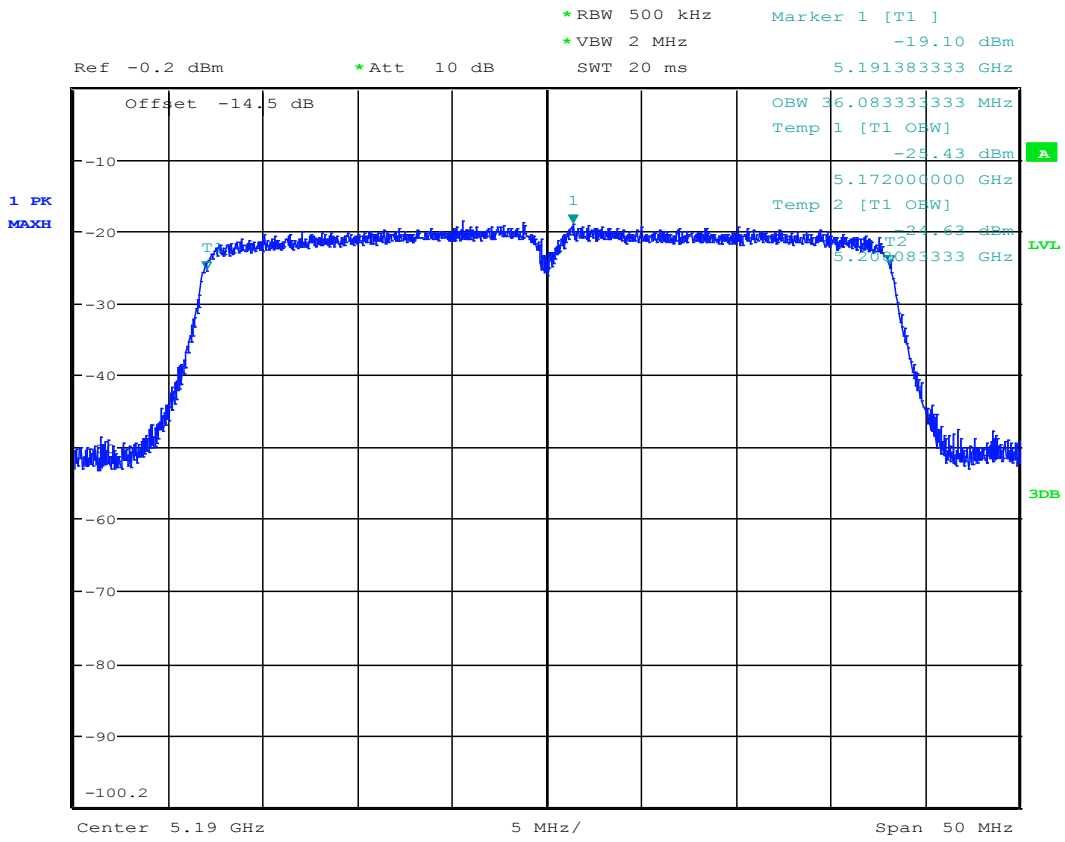
High channel	Mode: 802.11n_20 MCS0



Date: 14.JAN.2019 15:52:24

Plot #15

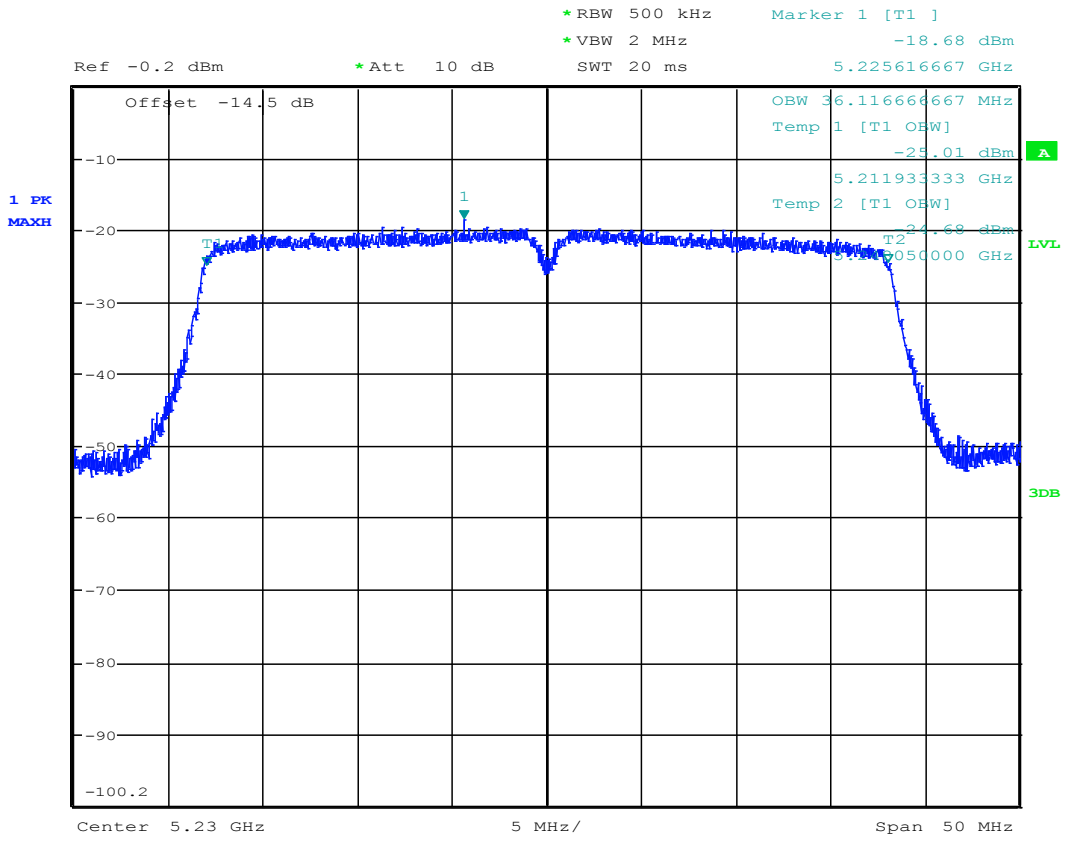
Low channel	Mode: 802.11n_40 MCS0



Date: 14.JAN.2019 16:01:16

Plot #16

High channel	Mode: 802.11n_40 MCS0



Date: 14.JAN.2019 16:02:33

8.6 Frequency stability

8.6.1 Measurement Procedure

- The EUT was placed inside temperature chamber
- Set the EUT to the operation mode needed
- Set the chamber to the highest temperature specified
- Allow sufficient time for the temperature of the chamber to stabilize, measure the operating frequency
- Repeat step with the temperature chamber set to lowest temperature

8.6.2 Limits:

FCC §15.407(g)

- 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 users manual

8.6.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
See section 8.6.4	2	802.11n_20 Tx Chain1	USB 5VDC

8.6.4 Measurement result:

Temp	802.11	Channel	Measured CF	ACF	Frequency Stability (ppm)
0	a	44	5220.0325	5220	6.23
25	a	44	5219.95	5220	-9.58
40	a	44	5219.9775	5220	-4.31
0	n 20	44	5220.016	5220	3.07
25	n 20	44	5219.995	5220	-0.96
40	n 20	44	5219.98375	5220	-3.11
0	n 40	46	5229.95	5230	-9.56
25	n 40	46	5229.99	5230	-1.91
40	n 40	46	5230.015	5230	2.87

8.7 Radiated Transmitter Spurious Emissions and Restricted Bands

8.7.1 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

8.7.2 Limits:

FCC §15.247 / 15.407

- 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

8.7.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23.5° C	2	802.11n_20/40 MIMO	AC/DC Supply

8.7.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-4	Low	30 MHz – 18 GHz	See section 8.6.2	Pass
5-10	Mid	9 kHz – 40 GHz	See section 8.6.2	Pass
11-14	High	30 MHz – 18 GHz	See section 8.6.2	Pass
15-18	Low n40 MIMO	30 MHz – 18 GHz	See section 8.6.2	Pass

8.7.5 Measurement Plots:

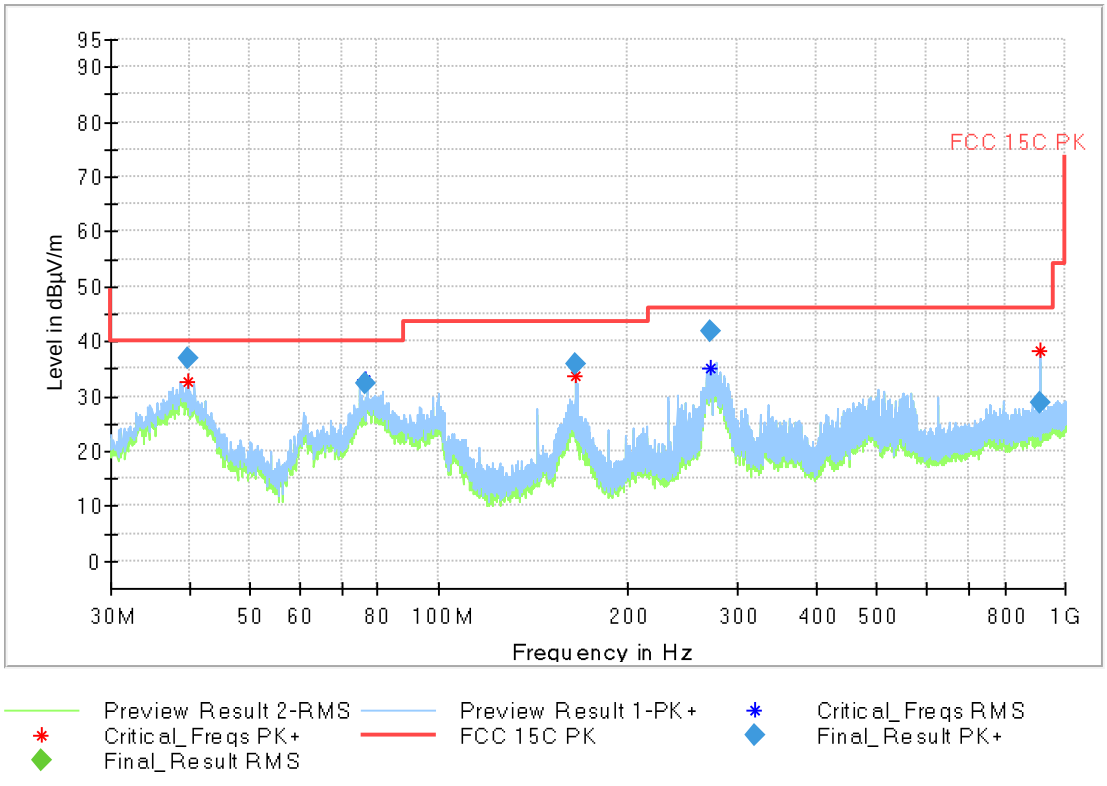
Plot #1 Radiated Emissions: 30 MHz – 1GHz

Modulation: 802.11n_20 MIMO | **Channel: Low** | **95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.911	37.00	---	40.00	3.00	100.0	100.0	117.0	V
76.587	32.40	---	40.00	7.60	100.0	100.0	123.0	V
165.984	35.81	---	43.50	7.69	100.0	100.0	100.0	V
272.379	41.86	---	46.00	4.14	100.0	100.0	128.0	V
913.952	28.93	---	46.00	17.07	100.0	100.0	193.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.911	122.0	-14	3:50:50 PM - 1/8/2019
76.587	115.0	-25	3:53:21 PM - 1/8/2019
165.984	198.0	-20	3:58:29 PM - 1/8/2019
272.379	184.0	-18	3:55:59 PM - 1/8/2019
913.952	61.0	-6	3:48:25 PM - 1/8/2019

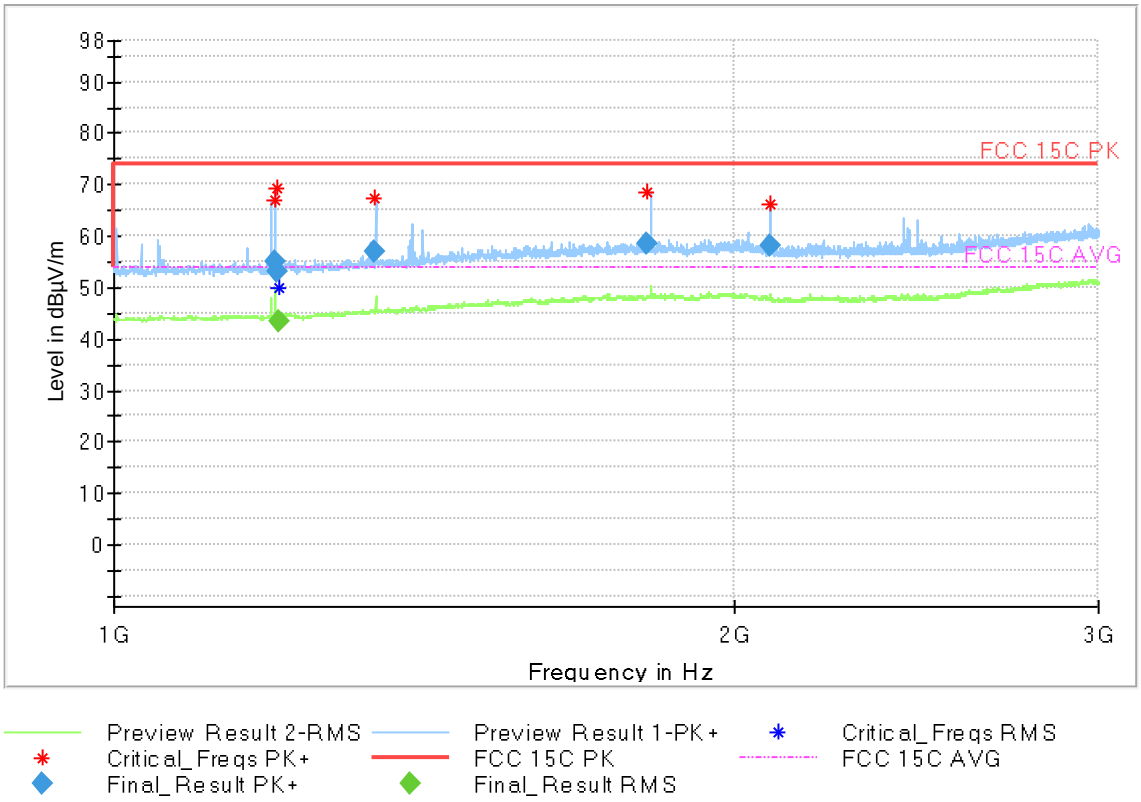


Plot #2 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	Channel: Low	95.18% Duty Cycle

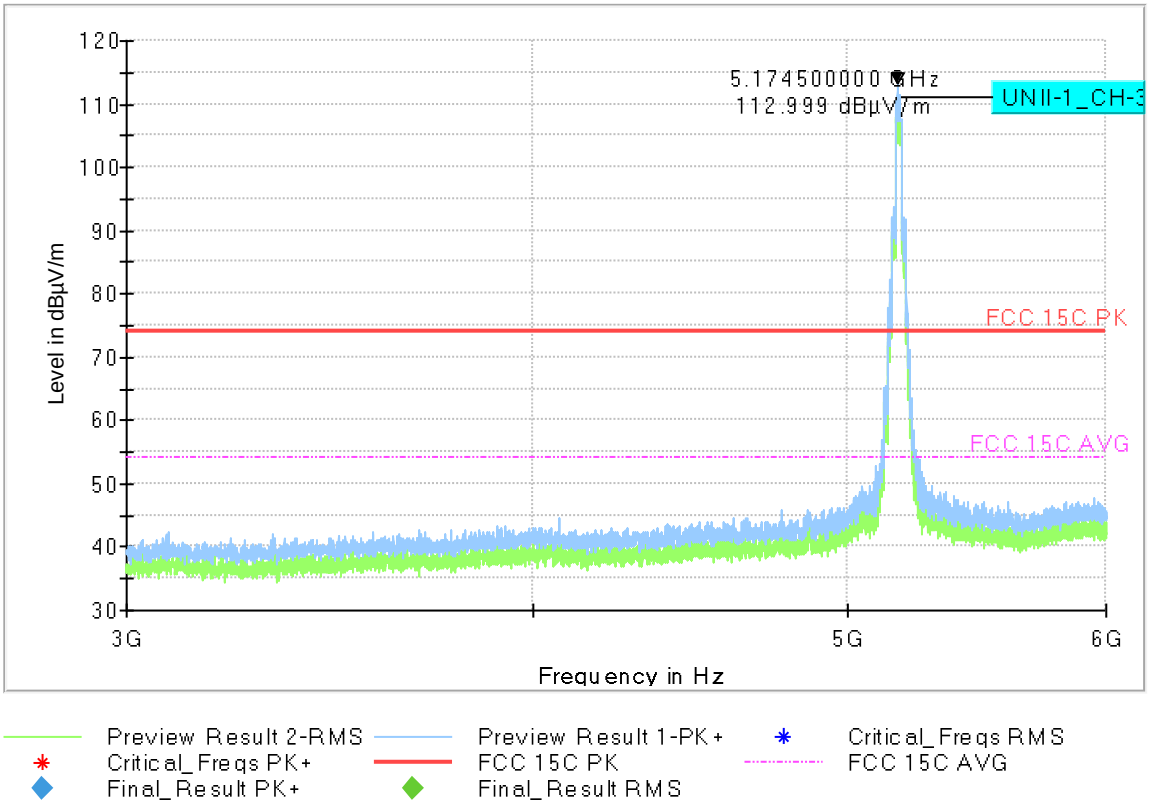
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1196.555	54.92	---	74.00	19.08	300.0	1000.0	108.0	V
1199.620	53.23	---	74.00	20.77	300.0	1000.0	191.0	H
1202.380	---	43.55	53.98	10.43	300.0	1000.0	229.0	H
1338.705	56.86	---	74.00	17.14	300.0	1000.0	100.0	V
1810.940	58.44	---	74.00	15.56	300.0	1000.0	128.0	V
2082.385	58.28	---	74.00	15.71	300.0	1000.0	325.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1196.555	58.0	17	-11	0	28	38	11:03:48 AM - 1/7/2019
1199.620	3.0	17	-11	0	28	36	11:15:07 AM - 1/7/2019
1202.380	40.0	17	-11	0	28	27	11:18:21 AM - 1/7/2019
1338.705	45.0	18	-11	0	28	39	11:06:31 AM - 1/7/2019
1810.940	55.0	20	-10	0	31	38	11:09:15 AM - 1/7/2019
2082.385	111.0	20	-10	0	30	38	11:11:40 AM - 1/7/2019



Plot #3 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Low**	**95.18% Duty Cycle**

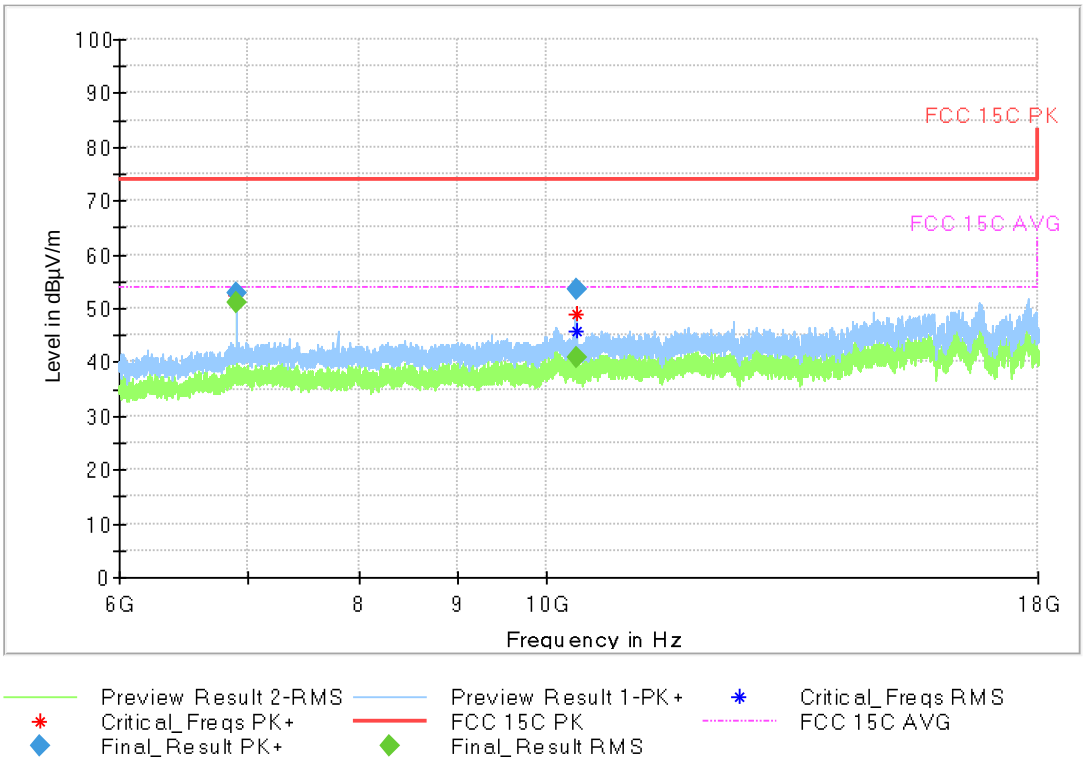


Plot #4 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Low**	**95.18% Duty Cycle**

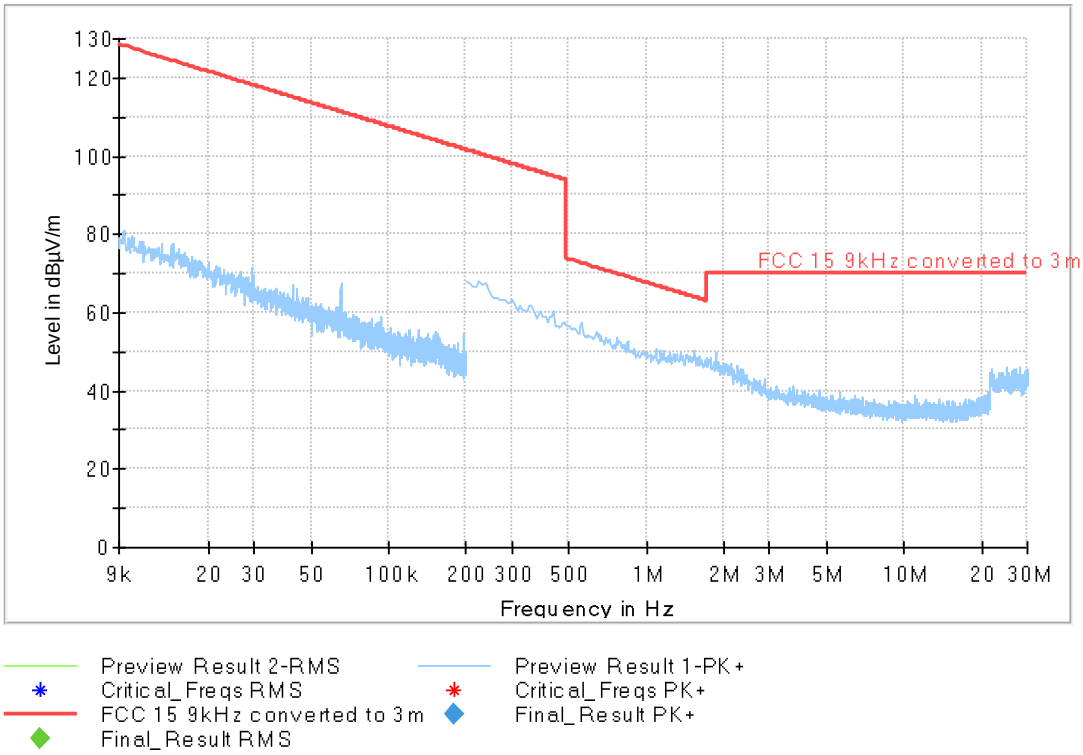
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
6906.606	---	51.08	53.98	2.90	100.0	1000.0	145.0	V
6906.624	52.81	---	73.99	21.17	100.0	1000.0	142.0	V
10362.158	---	40.70	53.98	13.28	100.0	1000.0	166.0	H
10363.629	53.46	---	73.98	20.52	100.0	1000.0	163.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
6906.606	186.0	-30	1:35:27 PM - 1/3/2019
6906.624	189.0	-30	1:28:50 PM - 1/3/2019
10362.158	147.0	-24	1:38:34 PM - 1/3/2019
10363.629	149.0	-24	1:31:58 PM - 1/3/2019



Plot #5 Radiated Emissions: 9 KHz – 30 MHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**

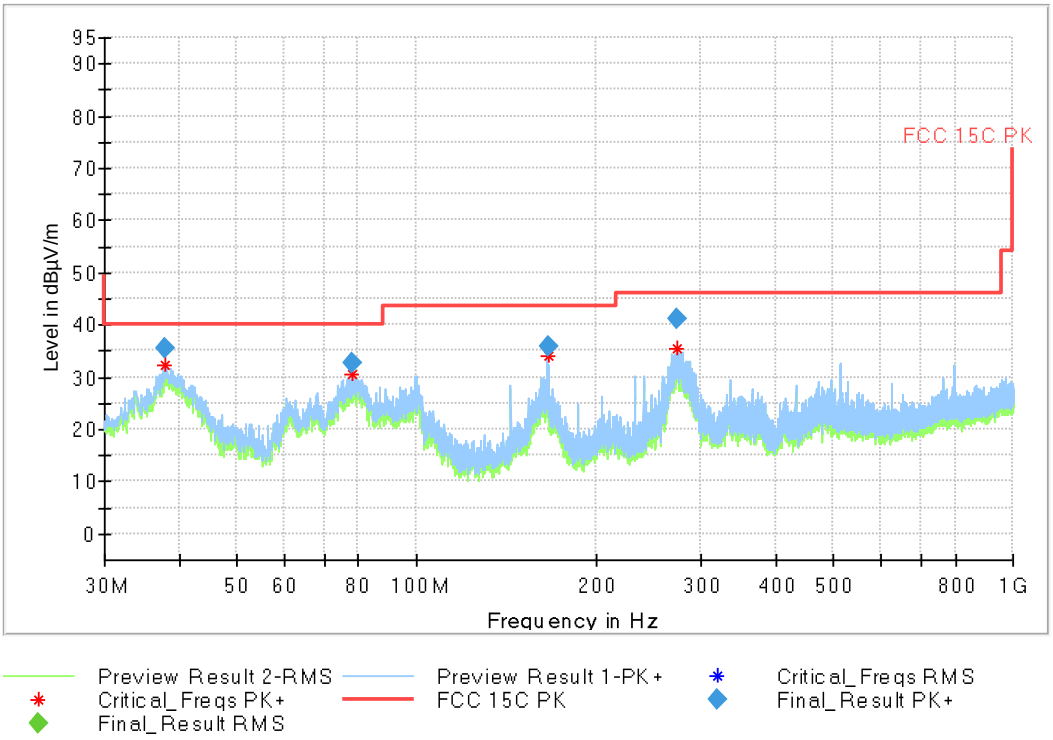


Plot #6 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
37.883	35.57	---	40.00	4.43	100.0	100.0	117.0	V
77.991	32.76	---	40.00	7.24	100.0	100.0	117.0	V
166.277	35.79	---	43.50	7.71	100.0	100.0	181.0	V
273.399	41.19	---	46.00	4.81	100.0	100.0	117.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
37.883	46.0	-14	4:08:54 PM - 1/8/2019
77.991	138.0	-25	4:16:48 PM - 1/8/2019
166.277	202.0	-20	4:11:34 PM - 1/8/2019
273.399	177.0	-18	4:14:12 PM - 1/8/2019

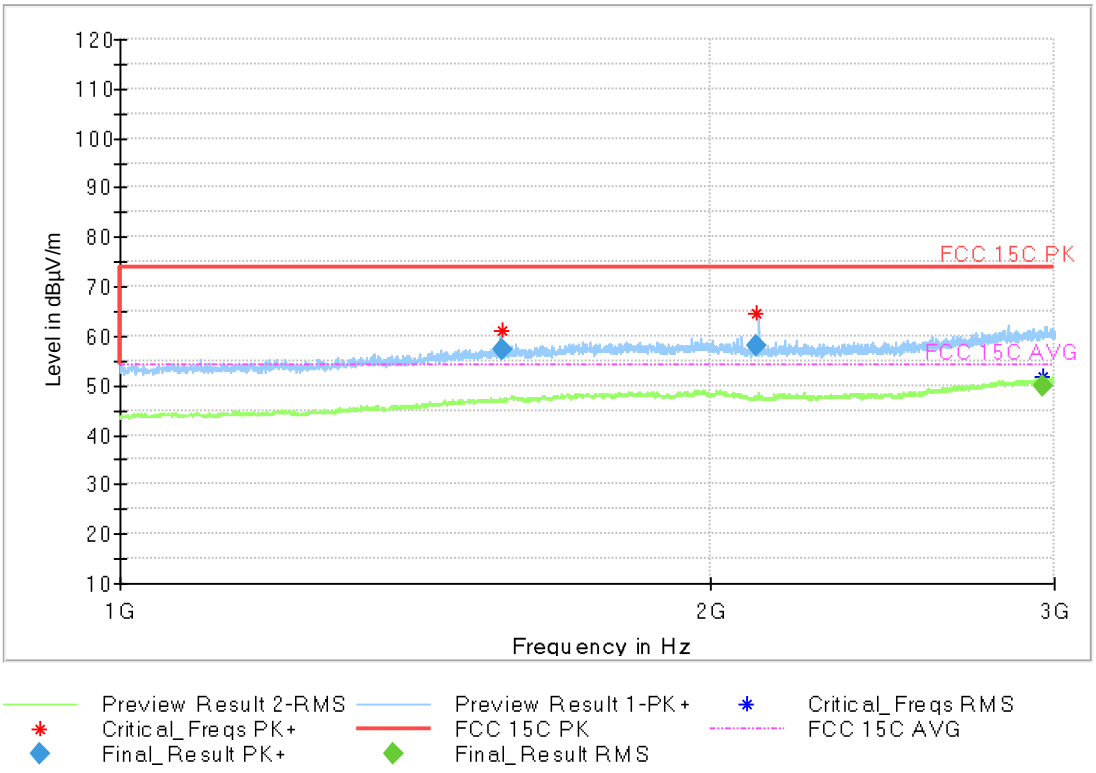


Plot #7 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**

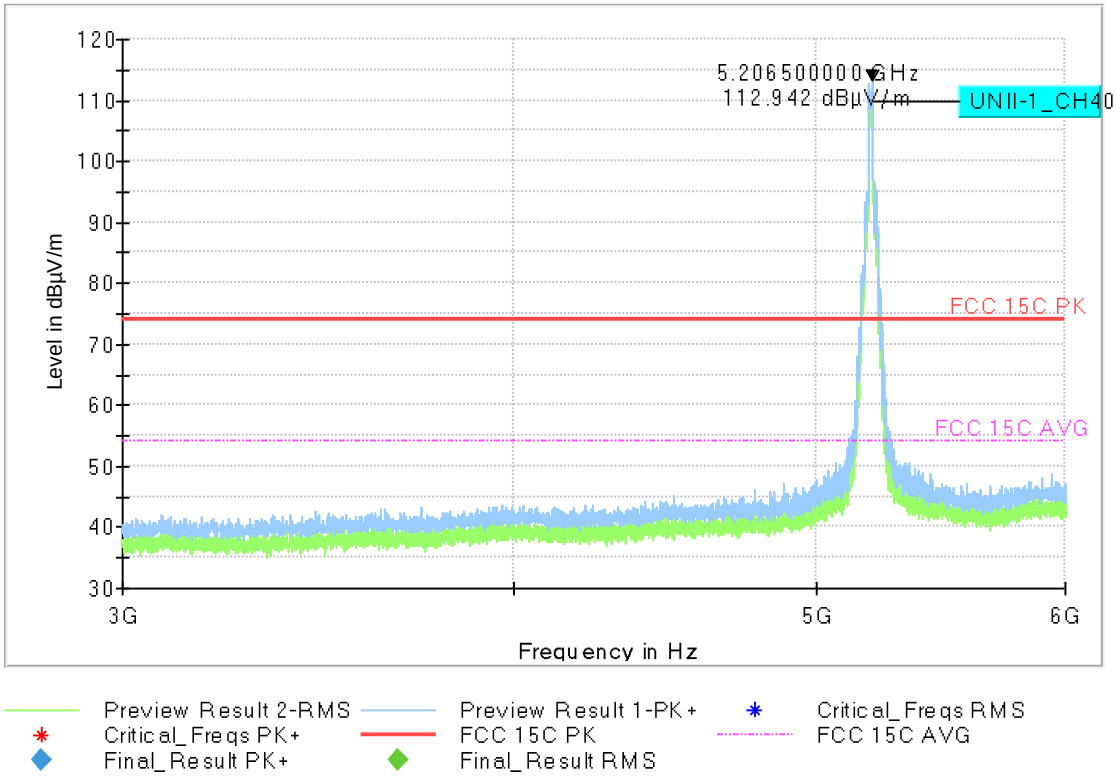
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1568.755	57.24	---	74.00	16.75	300.0	1000.0	100.0	V
2113.130	58.16	---	74.00	15.84	300.0	1000.0	164.0	V
2962.125	---	49.78	53.98	4.20	300.0	1000.0	100.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1568.755	-29.0	20	-10	0	30	38	11:38:49 AM - 1/7/2019
2113.130	258.0	20	-10	0	30	38	11:41:41 AM - 1/7/2019
2962.125	99.0	23	-9	0	32	27	11:44:42 AM - 1/7/2019



Plot #8 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**



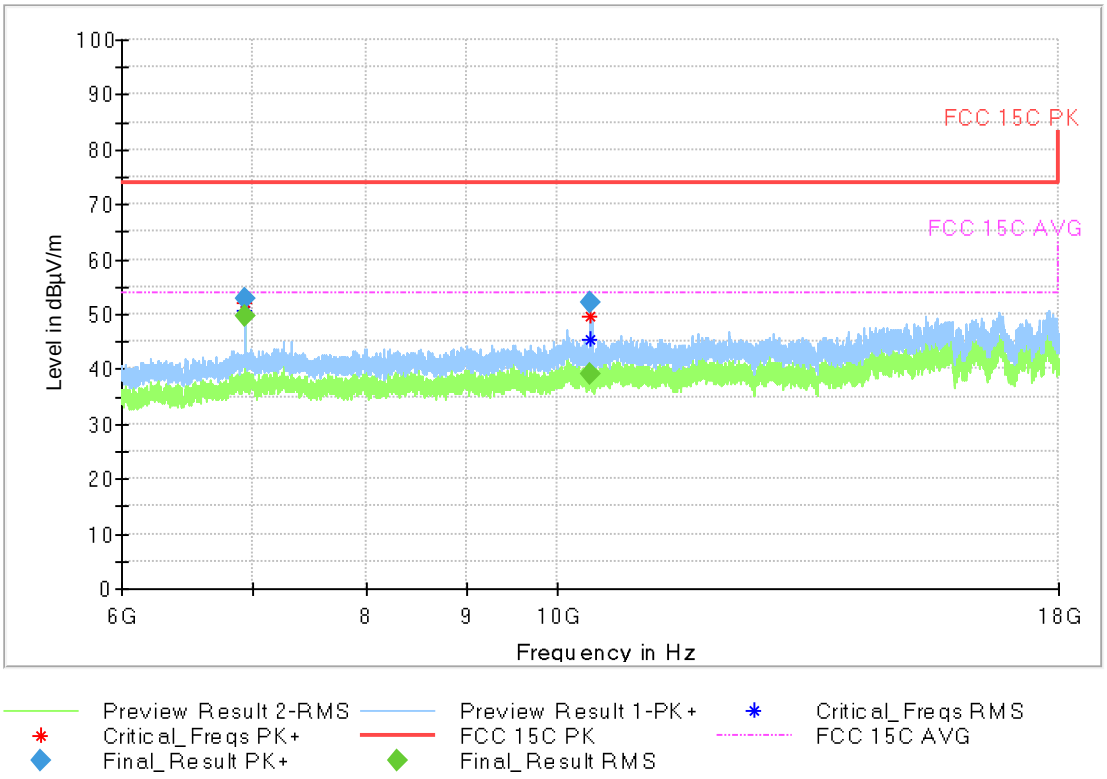
Plot #9 Radiated Emissions: 6-18 GHz

Modulation: 802.11n_20 Tx Chain0	Channel: Mid	95.18% Duty Cycle

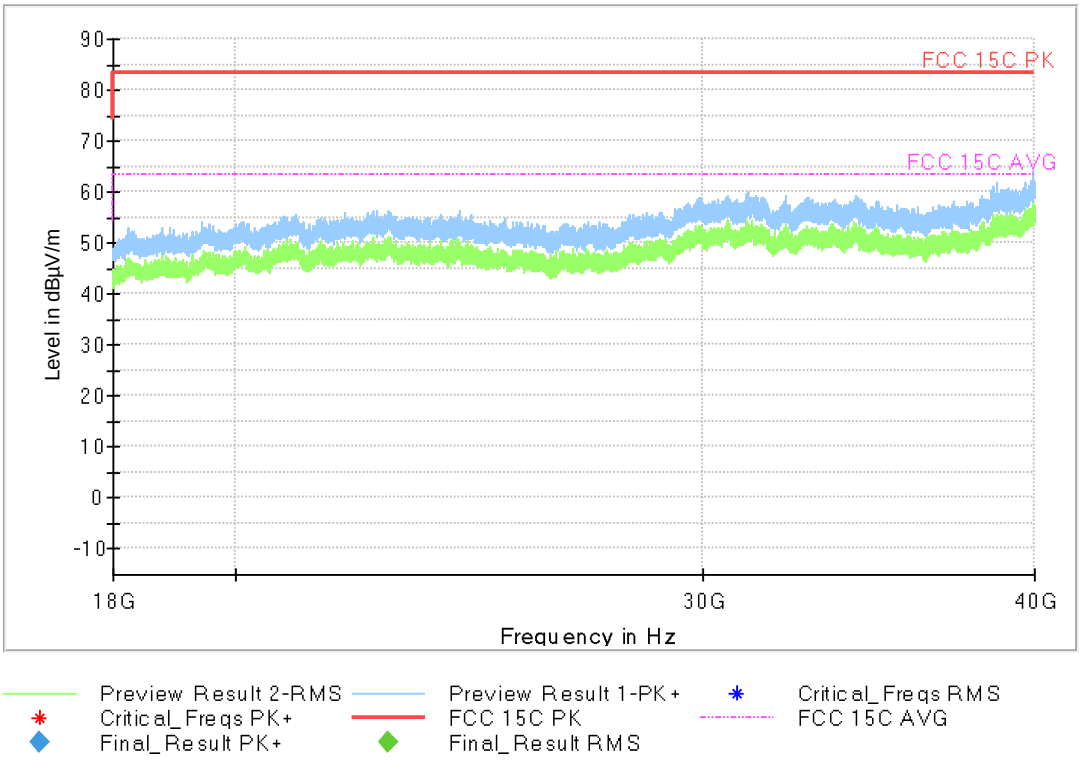
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
6933.231	---	49.71	53.98	4.27	100.0	1000.0	124.0	V
6933.246	52.96	---	73.99	21.02	100.0	1000.0	116.0	V
10395.354	---	38.93	53.98	15.05	100.0	1000.0	181.0	H
10400.307	51.96	---	73.98	22.03	100.0	1000.0	181.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
6933.231	190.0	-30	1:04:59 PM - 1/3/2019
6933.246	182.0	-30	12:59:00 PM - 1/3/2019
10395.354	151.0	-24	1:07:59 PM - 1/3/2019
10400.307	152.0	-24	1:02:00 PM - 1/3/2019



Plot #10 Radiated Emissions: 18-40 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**



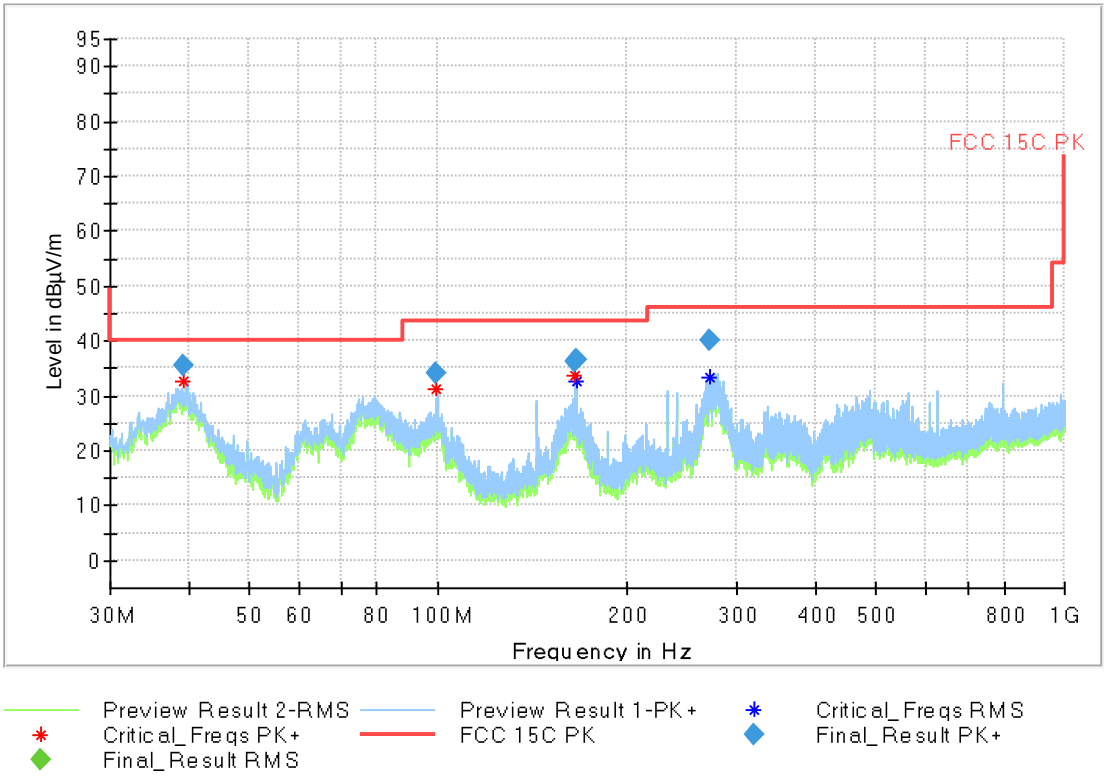
Plot #11 Radiated Emissions: 30 MHz – 1GHz

Modulation: 802.11n_20 MIMO	Channel: High	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.271	35.39	---	40.00	4.61	100.0	100.0	116.0	V
99.609	34.03	---	43.50	9.47	100.0	100.0	123.0	V
165.989	36.27	---	43.50	7.23	100.0	100.0	100.0	V
166.265	36.48	---	43.50	7.02	100.0	100.0	100.0	V
272.047	40.12	---	46.00	5.88	100.0	100.0	152.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.271	100.0	-14	4:27:03 PM - 1/8/2019
99.609	117.0	-22	4:29:44 PM - 1/8/2019
165.989	194.0	-20	4:37:23 PM - 1/8/2019
166.265	209.0	-20	4:32:22 PM - 1/8/2019
272.047	191.0	-18	4:34:47 PM - 1/8/2019

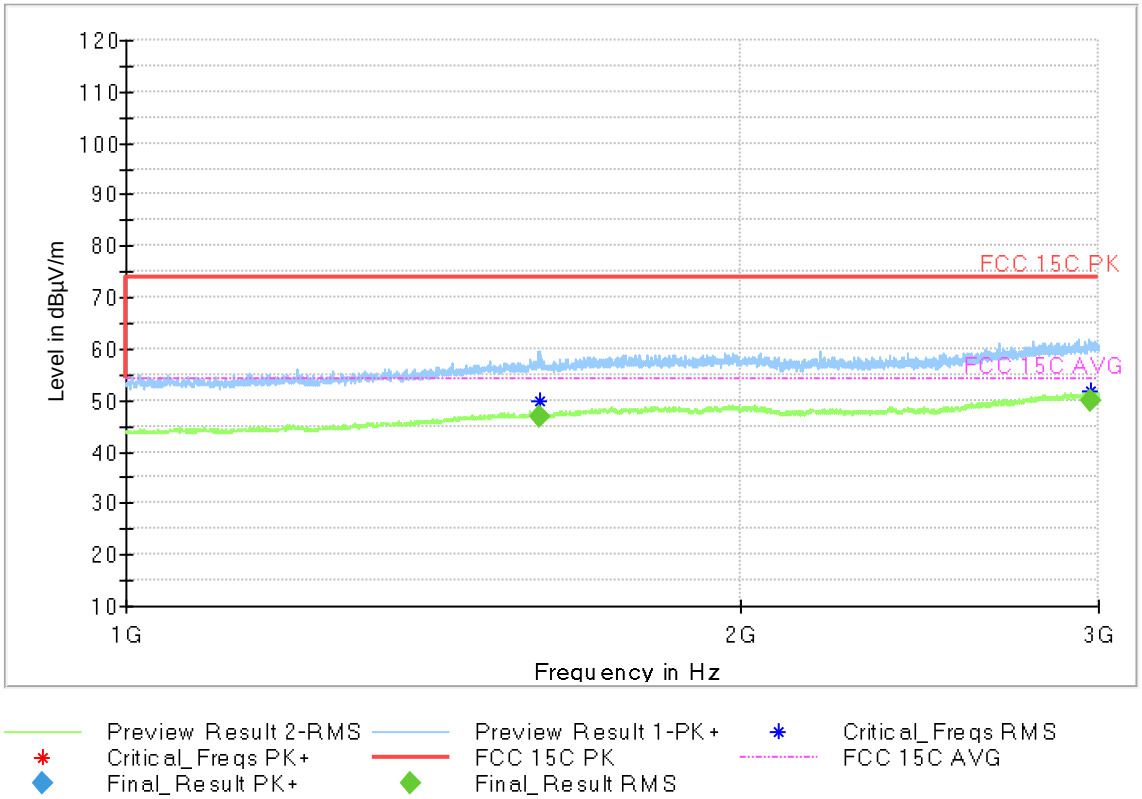


Plot #12 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	Channel: High	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1594.590	---	46.63	53.98	7.35	300.0	1000.0	186.0	V
2971.520	---	50.07	53.98	3.91	300.0	1000.0	309.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1594.590	75.0	20	-10	0	30	27	1:49:35 PM - 1/7/2019
2971.520	152.0	23	-9	0	32	27	1:52:23 PM - 1/7/2019

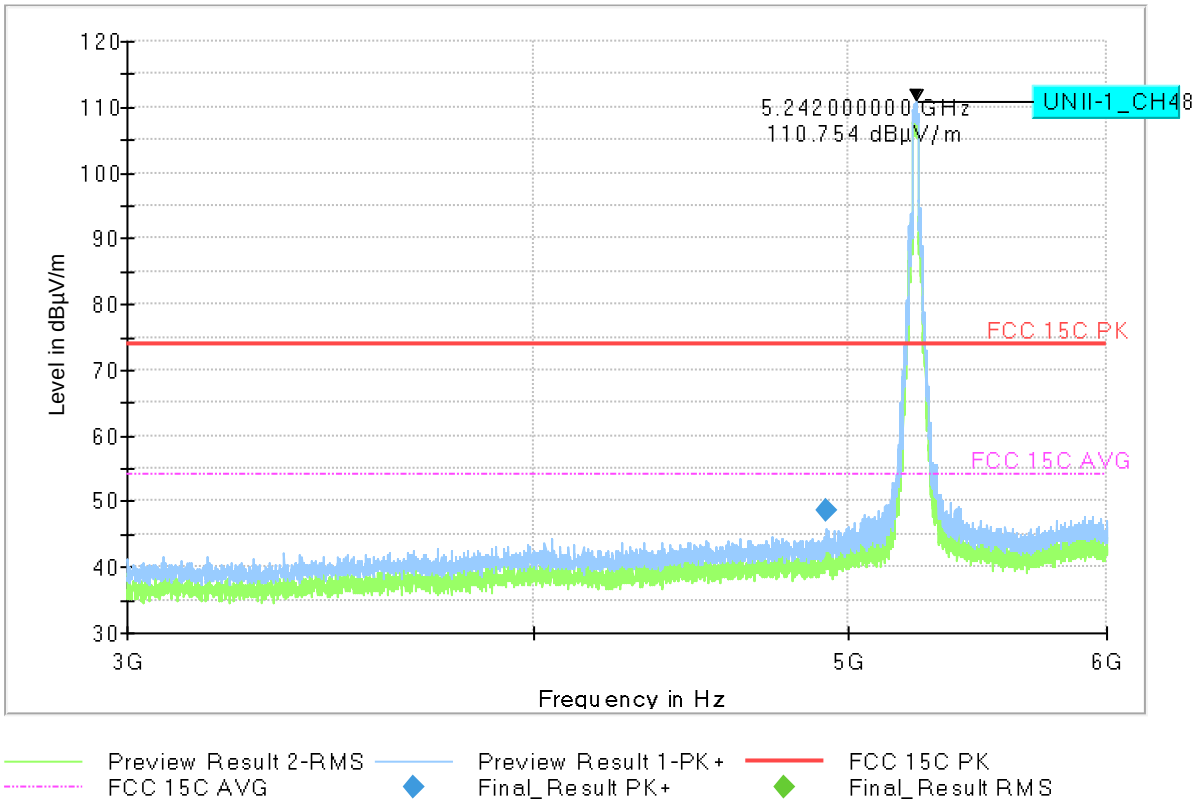


Plot #13 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	Channel: High	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4918.630	48.47	---	73.99	25.52	100.0	1000.0	130.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
4918.630	193.0	0	13	0	-14	49	4:39:01 PM - 12/26/2018



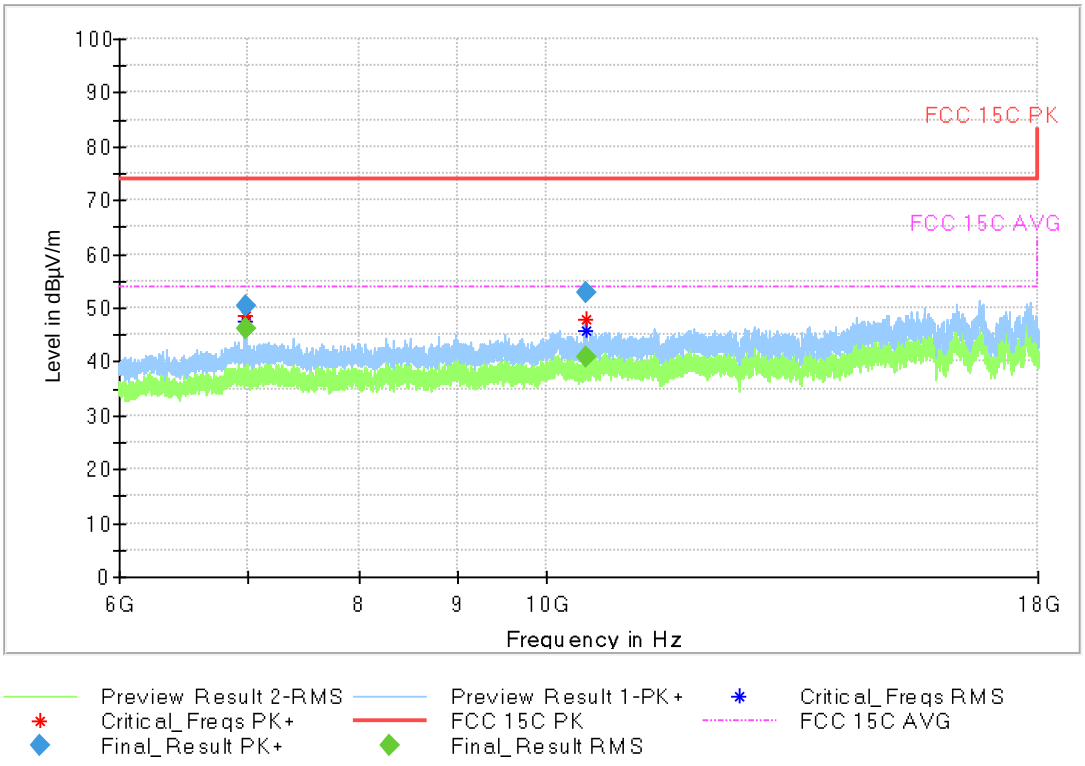
Plot #14 Radiated Emissions: 6-18 GHz

Modulation: 802.11n_20 MIMO	Channel: High	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
6986.463	50.23	---	73.99	23.76	100.0	1000.0	122.0	V
6986.831	---	46.08	53.98	7.90	100.0	1000.0	159.0	V
10480.858	---	40.74	53.98	13.24	100.0	1000.0	152.0	H
10482.870	52.86	---	73.98	21.13	100.0	1000.0	150.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
6986.463	184.0	-29	12:39:18 PM - 1/3/2019
6986.831	184.0	-29	12:45:15 PM - 1/3/2019
10480.858	149.0	-24	12:48:16 PM - 1/3/2019
10482.870	147.0	-24	12:42:19 PM - 1/3/2019



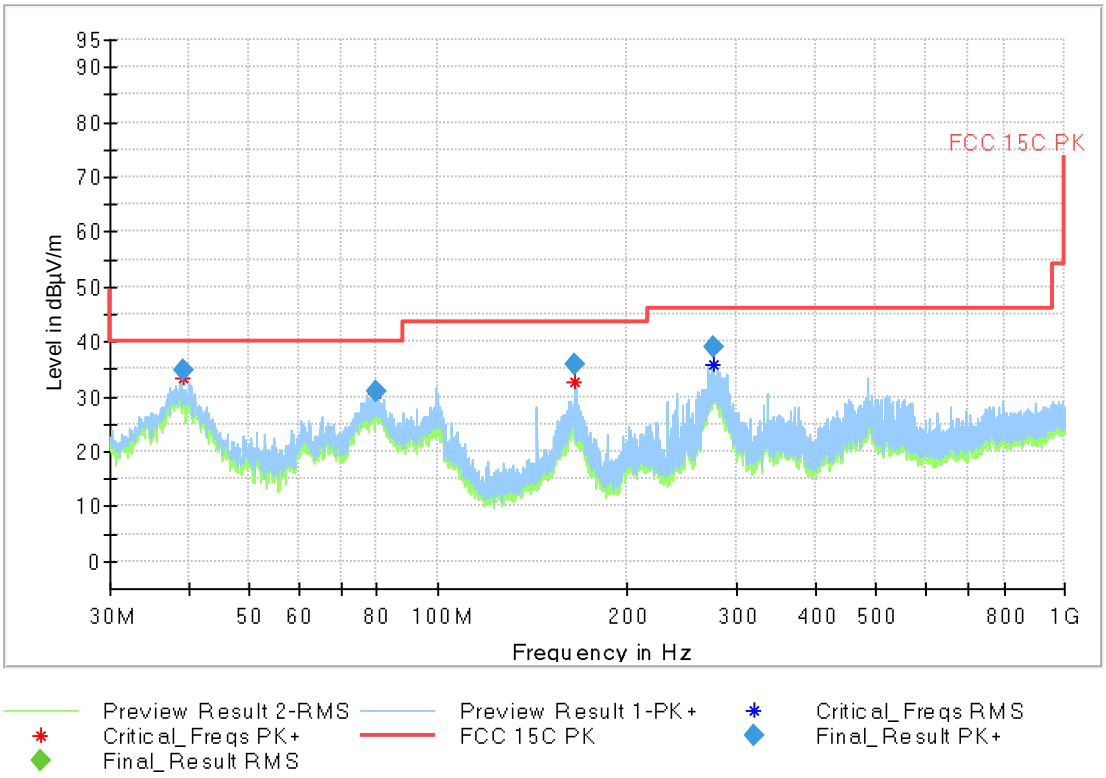
Plot #15 Radiated Emissions: 30 MHz – 1GHz

Modulation: 802.11n_40 MIMO	Channel: Low	93.46% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.139	34.66	---	40.00	5.34	100.0	100.0	100.0	V
79.648	31.00	---	40.00	9.00	100.0	100.0	221.0	V
165.982	35.68	---	43.50	7.82	100.0	100.0	117.0	V
274.771	38.99	---	46.00	7.01	100.0	100.0	131.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.139	-42.0	-14	5:08:46 PM - 1/8/2019
79.648	157.0	-24	5:15:53 PM - 1/8/2019
165.982	200.0	-20	5:10:41 PM - 1/8/2019
274.771	187.0	-18	5:13:14 PM - 1/8/2019



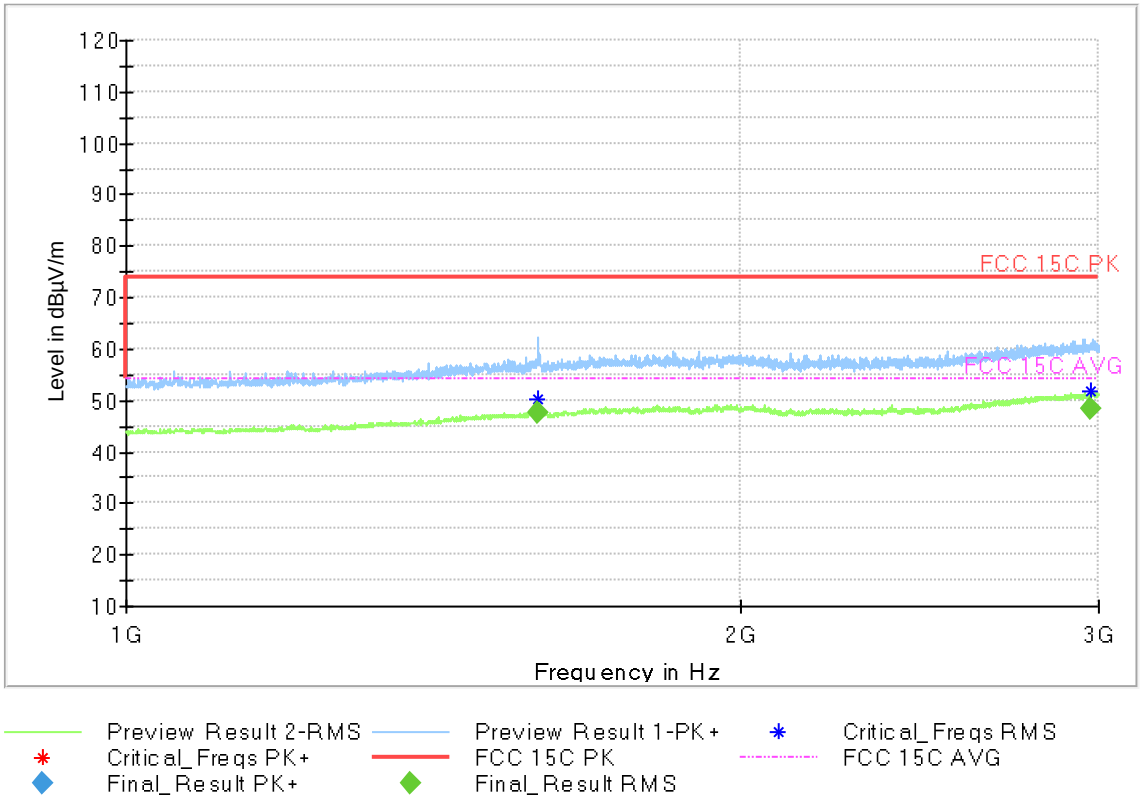
Plot #16 Radiated Emissions: 1-3 GHz

Modulation: 802.11n_40 MIMO	Channel: Low	93.46% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1593.395	---	47.62	53.98	6.36	300.0	1000.0	174.0	V
2976.050	---	48.35	53.98	5.63	300.0	1000.0	164.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
1593.395	76.0	20	-10	0	30	28	2:38:33 PM - 1/7/2019
2976.050	265.0	23	-9	0	32	25	2:41:23 PM - 1/7/2019

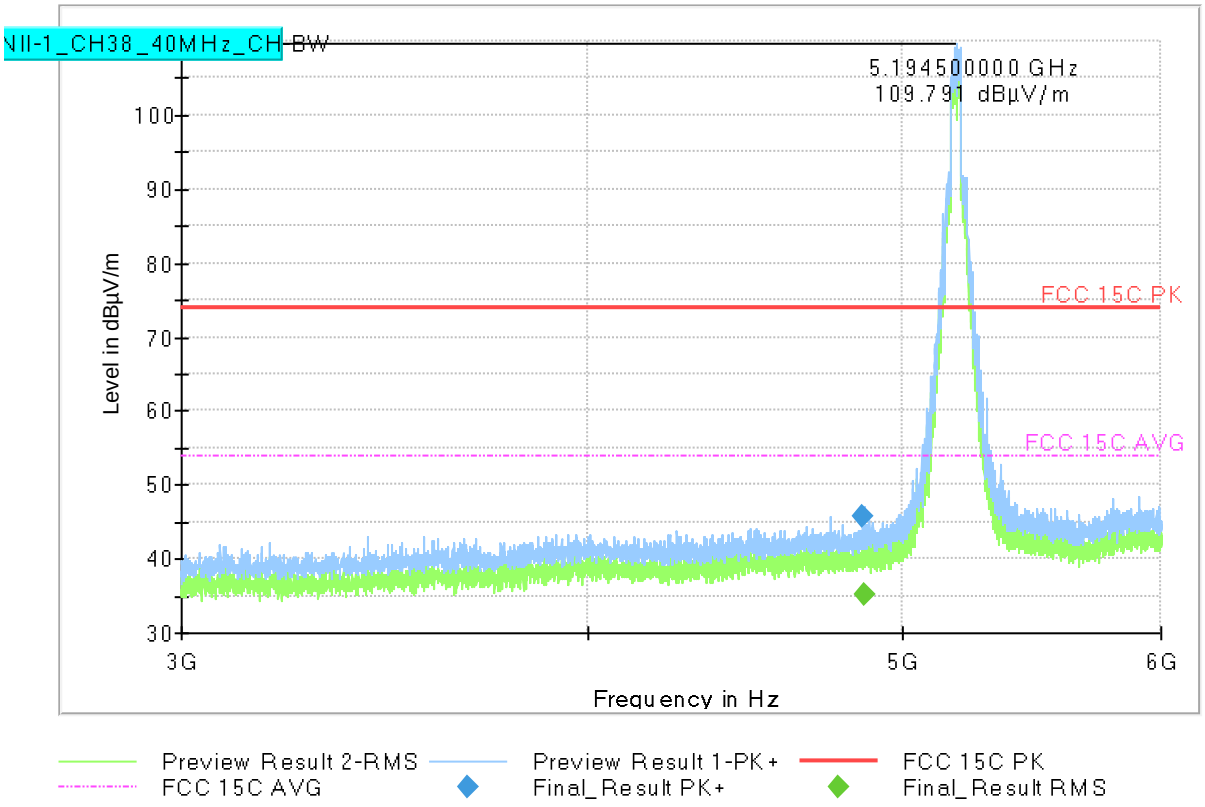


Plot #17 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	Channel: Low	94.36 % Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4859.427	45.76	---	73.99	28.23	100.0	1000.0	195.0	H
4862.763	---	35.05	53.98	18.93	100.0	1000.0	205.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comment
4859.427	182.0	-1	13	0	-14	46	4:53:42 PM - 12/26/2018
4862.763	193.0	-1	13	0	-14	36	4:56:34 PM - 12/26/2018



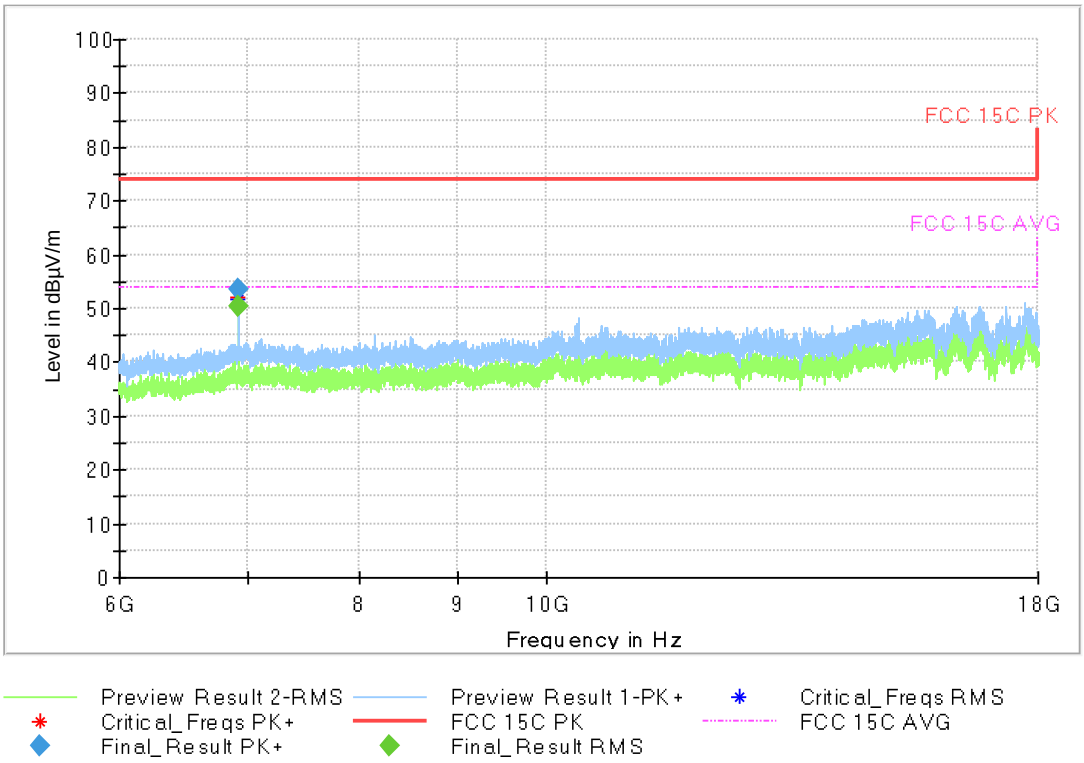
Plot #18 Radiated Emissions: 6-18 GHz

Modulation: 802.11n_40 MIMO	Channel: High	94.36 % Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
6919.850	---	50.40	53.98	3.58	100.0	1000.0	124.0	H
6920.003	53.66	---	73.99	20.32	100.0	1000.0	108.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
6919.850	183.0	-30	11:58:44 AM - 1/3/2019
6920.003	181.0	-30	11:53:29 AM - 1/3/2019



8.8 AC Power Line Conducted Emissions

8.8.1 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

8.8.2 Limits: §15.207 Per FCC 15.407 b(6)

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.

8.8.3 Test conditions and setup:

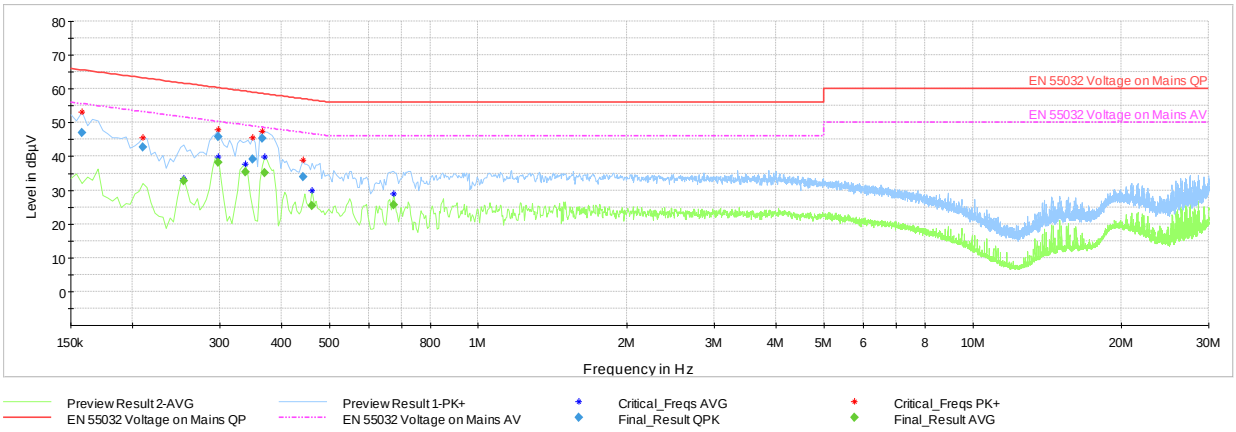
Ambient Temperature ©	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22.5° C	2	UNII-1 n20 Dual Chain	Line & Neutral	110V / 60Hz

8.8.4 Measurement Result:

Plot #	Port	EUT Set-Up #:	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	2	UNII-1 n20 Dual Chain Max Power	150 kHz – 30 MHz	See section 8.7.2	Pass

8.8.5 Measurement Plots:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Line	PE	Corr. (dB)	Frequency (MHz)
0.158000	46.98	---	65.57	18.59	500.0	9.000	L1	GND	10.7	0.158000
0.210000	42.63	---	63.21	20.57	500.0	9.000	N	GND	10.5	0.210000
0.254000	---	32.77	51.63	18.86	500.0	9.000	L1	GND	10.5	0.254000
0.298000	---	38.28	50.30	12.02	500.0	9.000	L1	GND	10.3	0.298000
0.298000	45.82	---	60.30	14.48	500.0	9.000	L1	GND	10.3	0.298000
0.338000	---	35.38	49.25	13.87	500.0	9.000	L1	GND	10.3	0.338000
0.350000	39.05	---	58.96	19.91	500.0	9.000	L1	GND	10.3	0.350000
0.366000	45.40	---	58.59	13.20	500.0	9.000	L1	GND	10.3	0.366000
0.370000	---	35.14	48.50	13.36	500.0	9.000	N	GND	10.3	0.370000
0.442000	33.98	---	57.02	23.04	500.0	9.000	N	GND	10.3	0.442000
0.462000	---	25.49	46.66	21.17	500.0	9.000	L1	GND	10.2	0.462000
0.674000	---	25.67	46.00	20.33	500.0	9.000	N	GND	10.2	0.674000



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	FSU26	200302	3 years	7/5/2017
Spectrum Analyzer	R&S	FSV40	101022	3 years	7/5/2017
RF Power Sensor	ETS Lindgren	7002-006	160436	3 Years	8/15/2016

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	Report prepared by
2019/02/28	EMC_A2ZDE-048-18001_15.407_UNII-1	Initial Version	James Donnellan
2019/03/08	EMC_A2ZDE-048-18001_15.407_UNII-1-Rev1	Updated Mfg. Address.	James Donnellan
2019/05/23	EMC_A2ZDE-048-18001_15.407_UNII-1-Rev2	Added comment to Section 8.2.4 and corrected / added limits on tables Section 8.3.4 Added table / comments and updated limits	James Donnellan