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-3)

REPORT #: EMC_ A2ZDE-048-18001_15.407_UNII-3-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 and the relevant ISED Canada standard RSS-247.

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 13:26:30 -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: / 5GHz Radio Information	Nominal band: 5725 MHz – 5850 MHz Center to center: 5745 MHz (ch 149) – 5825 MHz (ch 165), 5 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 18.56 dBm
Power Supply/ Rated Operating Voltage Range:	AC/DC Adapter: Vlow:10.3 V/ Vnom: 12.0 VDC / Vmax: 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

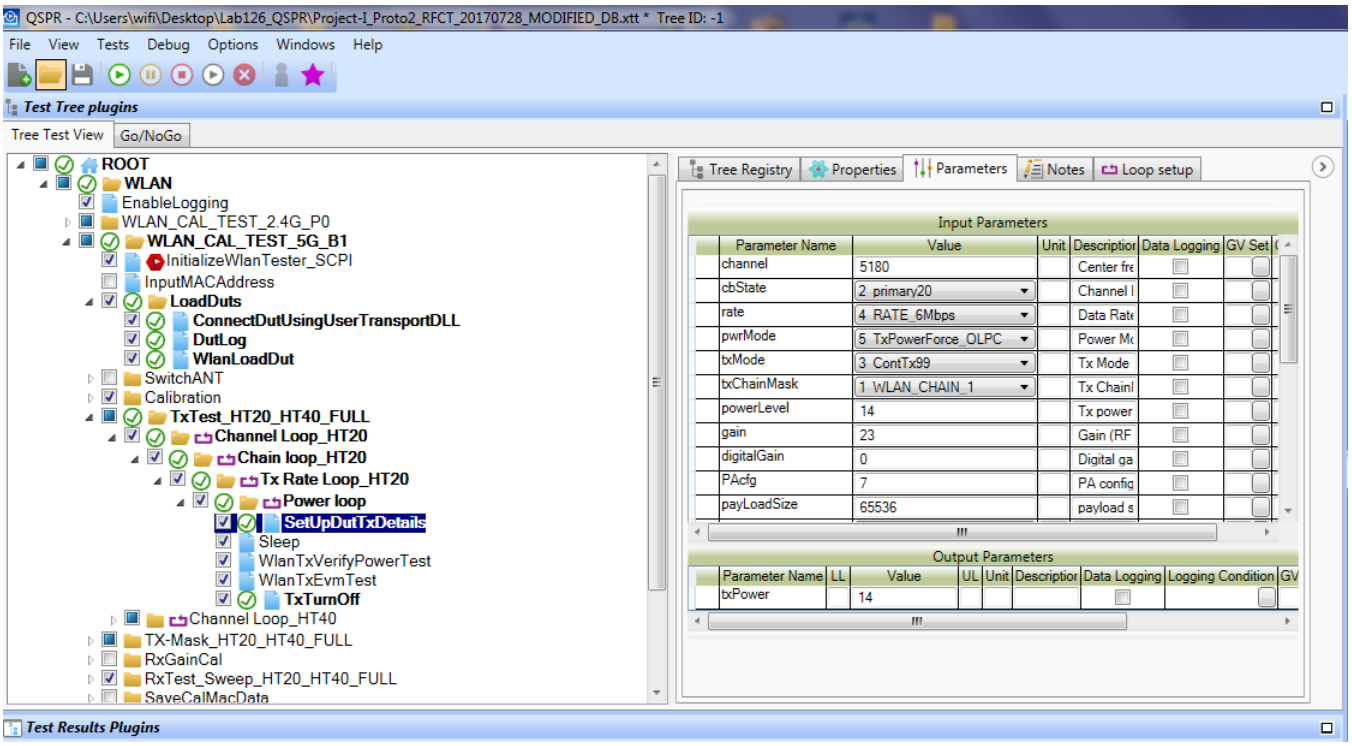
EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#2 + AE#1 + AE#2	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software “QSPR” provided by client that is not available to the end user. The measurement equipment was connected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



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 the 5.0 GHz radios currently supported by this device 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 3					
802.11 / channel	149	153	157	161	165
a	16	16	16	16	16
n20	16	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

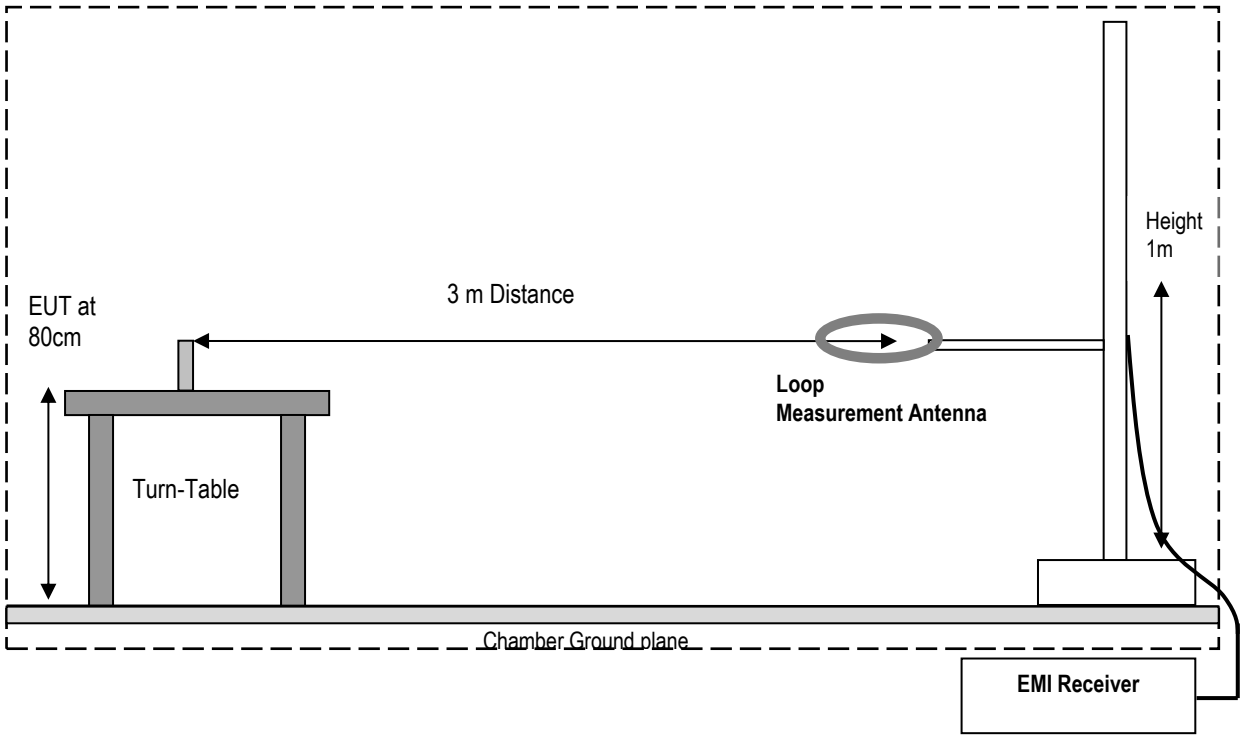
7 Measurement Procedures

7.1 Radiated Measurement

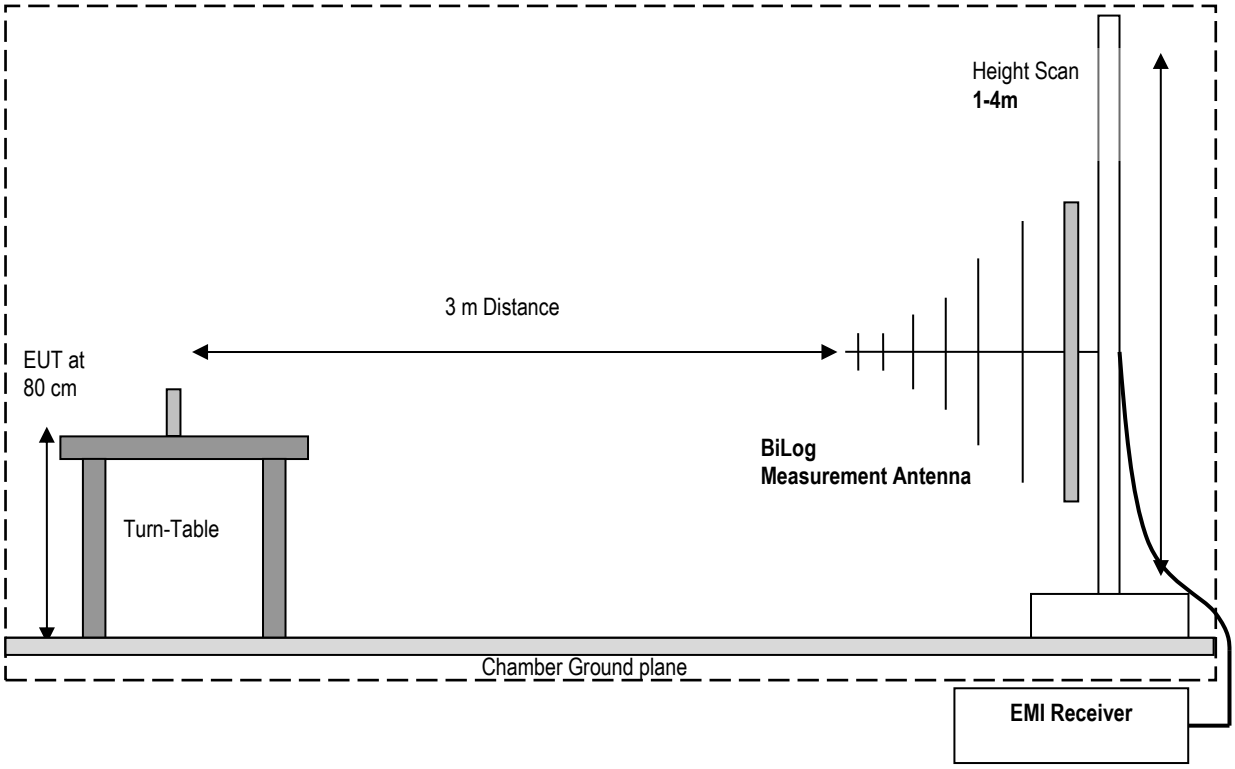
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

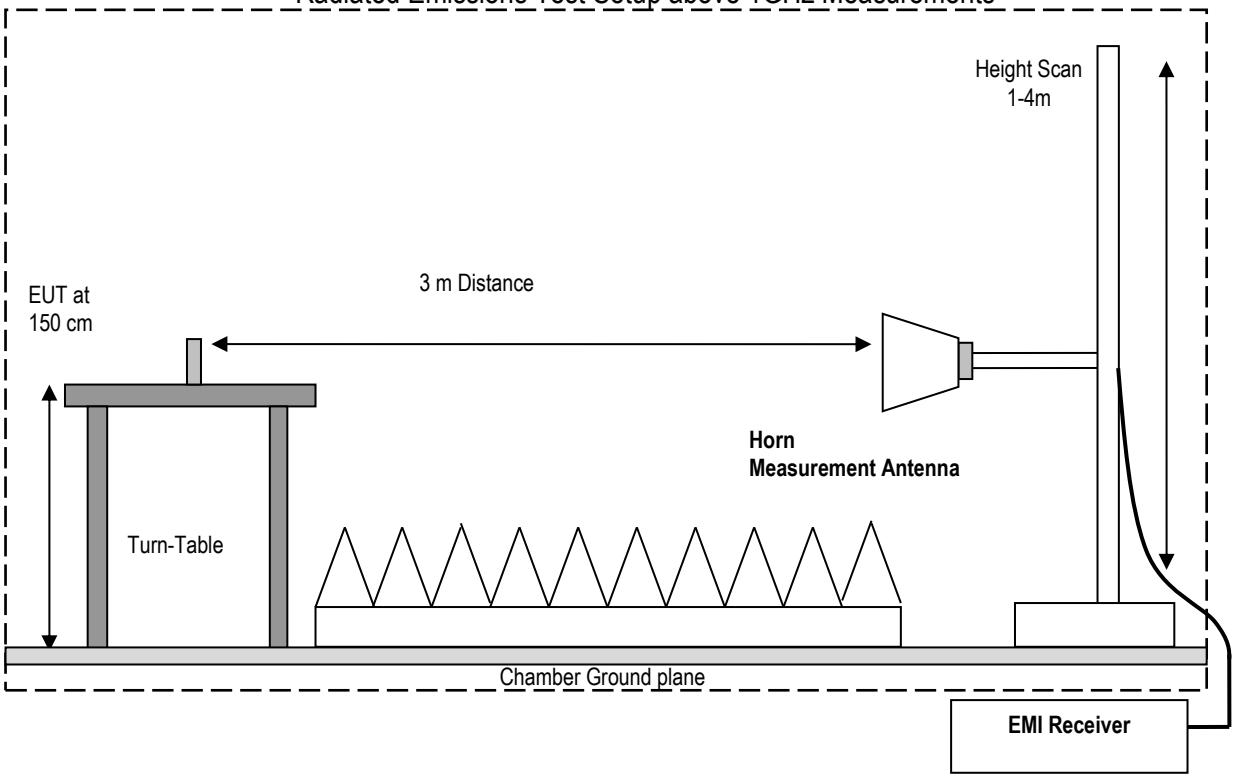
Radiated Emissions Test Setup below 30MHz Measurements



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:

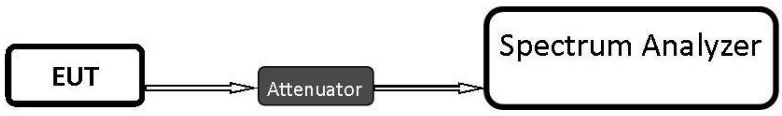
FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

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:

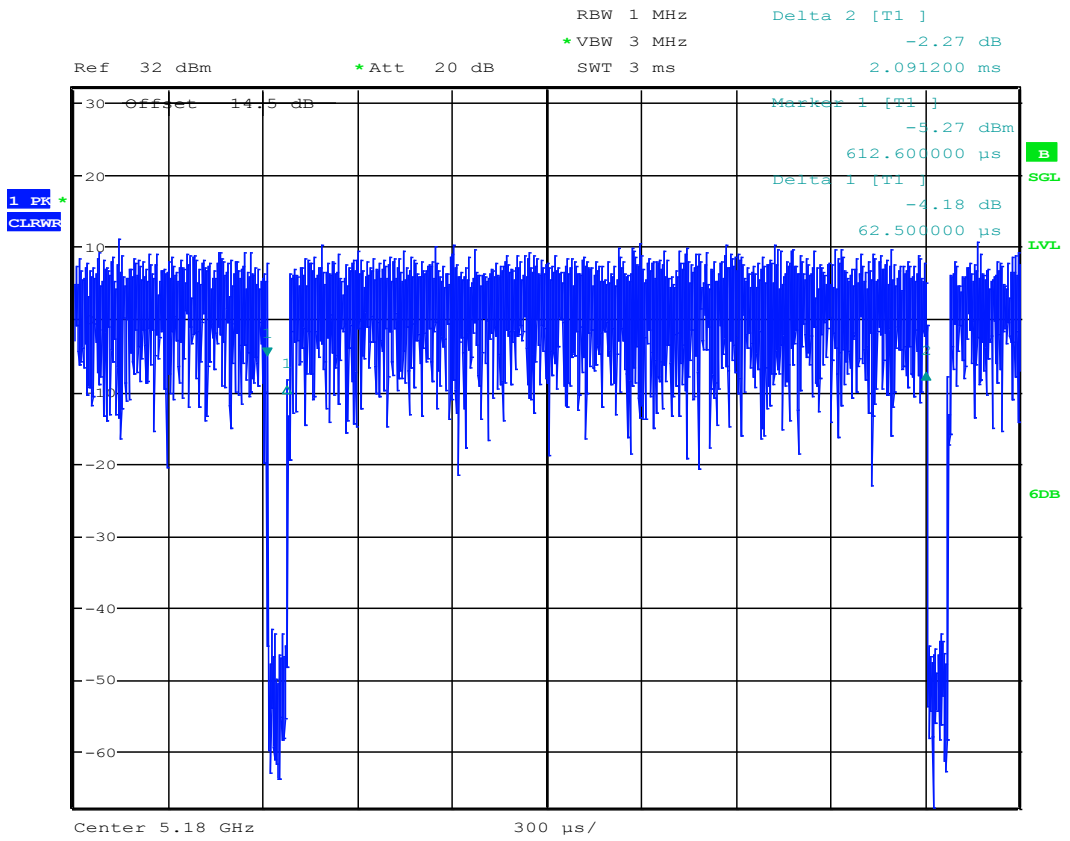
- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW >=EBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

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

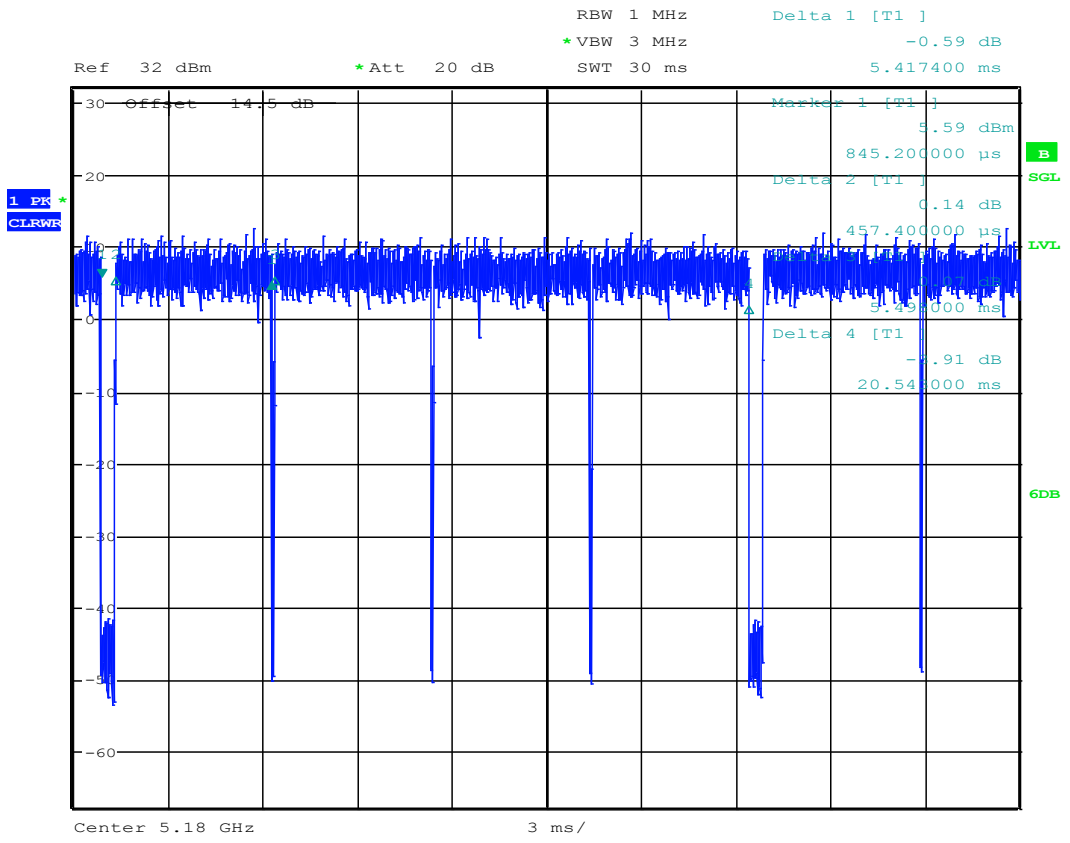
Mid channel / 5785 MHz	Modulation/Packet Type: 802.11a 6Mbps



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

Plot #2

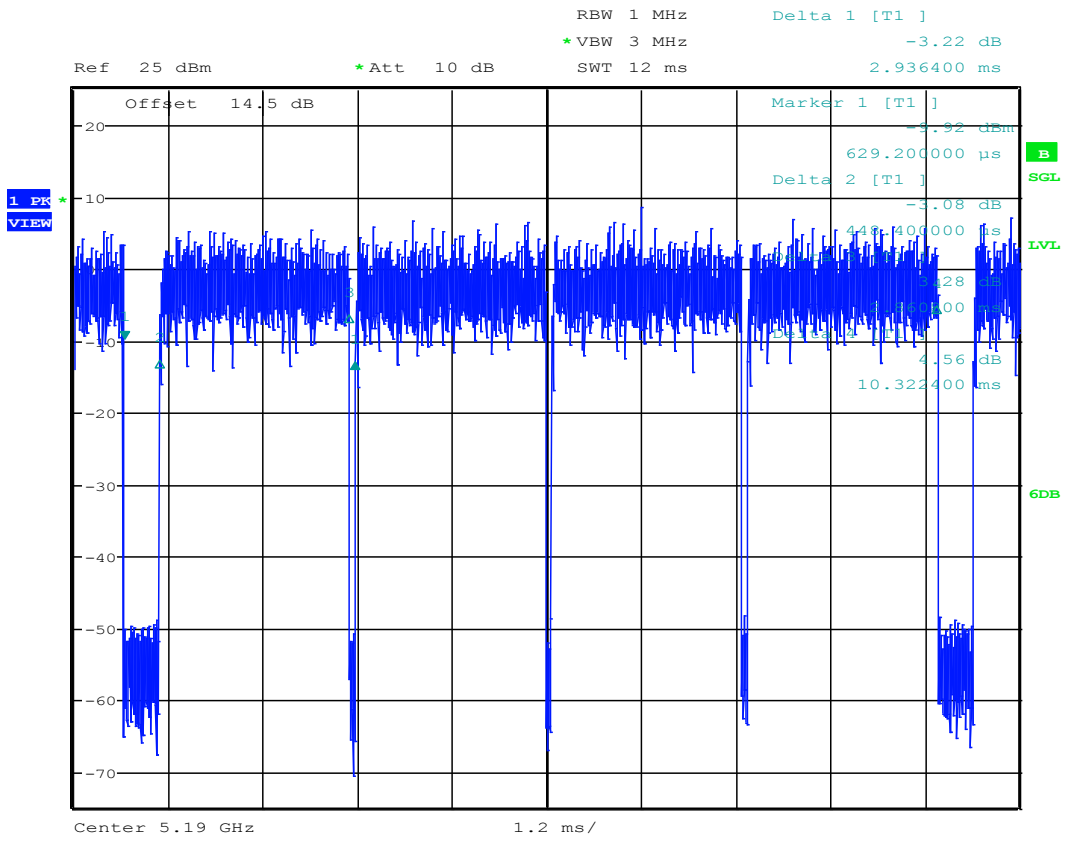
Mid channel / 5785 MHz	Modulation/Packet Type: 802.11n_20 MCS0



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

Plot #3

Mid channel / 5785 MHz	Modulation/Packet Type: 802.11n_HT40 MCS0



Date: 18.JAN.2019 16:45:03

8.2 Maximum Conducted Output Power

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

Spectrum Analyzer settings:

- Measure the duty cycle, x, of the transmitter output signal.
- Set span to at encompass the EBW.
- Set RBW = 1 MHz
- Set VBW ≥ 3 □ RBW.
- Number of points in sweep ≥ 2 □ span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- Allow the sweep to "free run".
- Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
- Compute power by integrating the spectrum across the EBW of the signal using the instrument's band power measurement function with band limits set equal to the EBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1MHz intervals extending across the EBW of the signal.
- Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on- and off-times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is 25 %.

8.2.2 Limits:

Maximum Conducted Output Power:

- FCC §15.407: 1 W
- IC RSS-247: 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
22° C	1	802.11 a/n	AC/DC ADAPTER	11dBi

8.2.4 Measurement result:

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

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	149	18.04	18.17	29.17	25 / 36 (EIRP)	Pass
			157	18.36	18.49	29.49	25 / 36 (EIRP)	Pass
			165	18.27	18.40	29.40	25 / 36 (EIRP)	Pass
	1	6Mbps	149	17.96	18.09	29.09	25 / 36 (EIRP)	Pass
			157	18.39	18.52	29.52	25 / 36 (EIRP)	Pass
			165	18.43	18.56	29.56	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	149	17.71	17.92	20.93	31.93	25 / 36 (EIRP)	Pass
			157	18.07	18.28	21.35	32.35	25 / 36 (EIRP)	Pass
			165	17.97	18.18	21.26	32.26	25 / 36 (EIRP)	Pass
	1	MCS0	149	17.7	17.91	-	-	25 / 36 (EIRP)	-
			157	18.17	18.38	-	-	25 / 36 (EIRP)	-
			165	18.1	18.31	-	-	25 / 36 (EIRP)	-
802.11n_40 MIMO	0	MCS0	151	17.3	17.59	20.72	31.72	25 / 36 (EIRP)	Pass
			159	18.04	18.33	21.31	32.31	25 / 36 (EIRP)	Pass
	1	MCS0	151	17.53	17.82	-	-	25 / 36 (EIRP)	-
			159	17.98	18.27	-	-	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 chose 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
157 / 1	16.69	16.82	48.10	-	16.82	27.82	25 / 36	11a SiSO
157 / 1	16.55	16.76	47.47	104.95	20.21	31.21	25 / 36	11n 20 MIMO
159 / 1	16.68	16.97	49.82	108.35	20.35	31.35	25 / 36	11n 40 MIMO
157 / 2	17.69	17.82	60.56	-	17.82	28.82	25 / 36	11a SISO
157 / 2	17.38	17.59	57.47	-	-	-	-	-
159 / 2	17.38	17.67	58.53	-	-	-	-	-

B3 Radio Power Summary								
Channel / Chain	PWR	DCFF	Pwr mW	Sum MiMo mW	Pwr dBm	EIRP	Conducted / EIRP Limit (dBm)	Mode
157 / 1	17.6	17.73	59.32	-	17.73	28.73	25 / 36	11a SiSO
157 / 1	17.35	17.56	57.08	115.75	20.64	31.64	25 / 36	11n 20 MIMO
159 / 1	17.24	17.53	56.67	115.20	20.61	31.61	25 / 36	11n 40 MIMO
157 / 2	17.68	17.81	60.42	-	17.81	28.81	25 / 36	11a SISO
157 / 2	17.47	17.68	58.68	-	-	-	-	-
159 / 2	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
157 / 1	17.03	17.16	52.02	-	17.16	28.16	25 / 36	11a SiSO
157 / 1	16.77	16.98	49.94	100.46	20.02	31.02	25 / 36	11n 20 MIMO
159 / 1	16.75	17.04	50.63	105.25	20.22	31.22	25 / 36	11n 40 MIMO
157 / 2	17.15	17.28	53.48	-	17.28	28.28	25 / 36	11a SISO
157 / 2	16.82	17.03	50.52	-	-	-	-	-
159 / 2	17.08	17.37	54.62	-	-	-	-	-

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 this device at Cetecom.

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.

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 = 500 kHz
- 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) & RSS-247 6

- The maximum power spectral density shall not exceed 30 dBm in any 500 kHz 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	11dBi

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 / 500kHz)	PSD corrected by DCCF	Limit (dBm / 500 kHz)	Result
1	802.11a	6Mpbs	0	149	4.13	4.25	25	Pass
2				157	4.47	4.59	25	Pass
3				165	3.99	4.11	25	Pass
4	802.11n_20	MCS0	0	149	3.61	3.7	25	Pass
5				157	3.89	3.98	25	Pass
6				165	4.49	4.58	25	Pass
7	802.11n_20	MCS0	0	151	0.46	0.67	25	Pass
8				159	1.31	1.52	25	Pass
9	802.11a	6Mpbs	1	149	4.39	4.51	25	Pass
10				157	5.11	5.23	25	Pass
11				165	3.93	4.05	25	Pass
12	802.11n_20	MCS0	1	149	3.99	4.08	25	Pass
13				157	4.36	4.45	25	Pass
14				165	3.88	3.97	25	Pass
15	802.11n_40	MCS0	1	151	0.94	1.15	25	Pass
16				159	1.56	1.77	25	Pass

- Limit is for the DCFF Conducted measurement
- Conducted Limit of SISO = 30dBm – (11-6 dBi) = 25 dBm:

Power Spectral Density Table for MIMO mode.

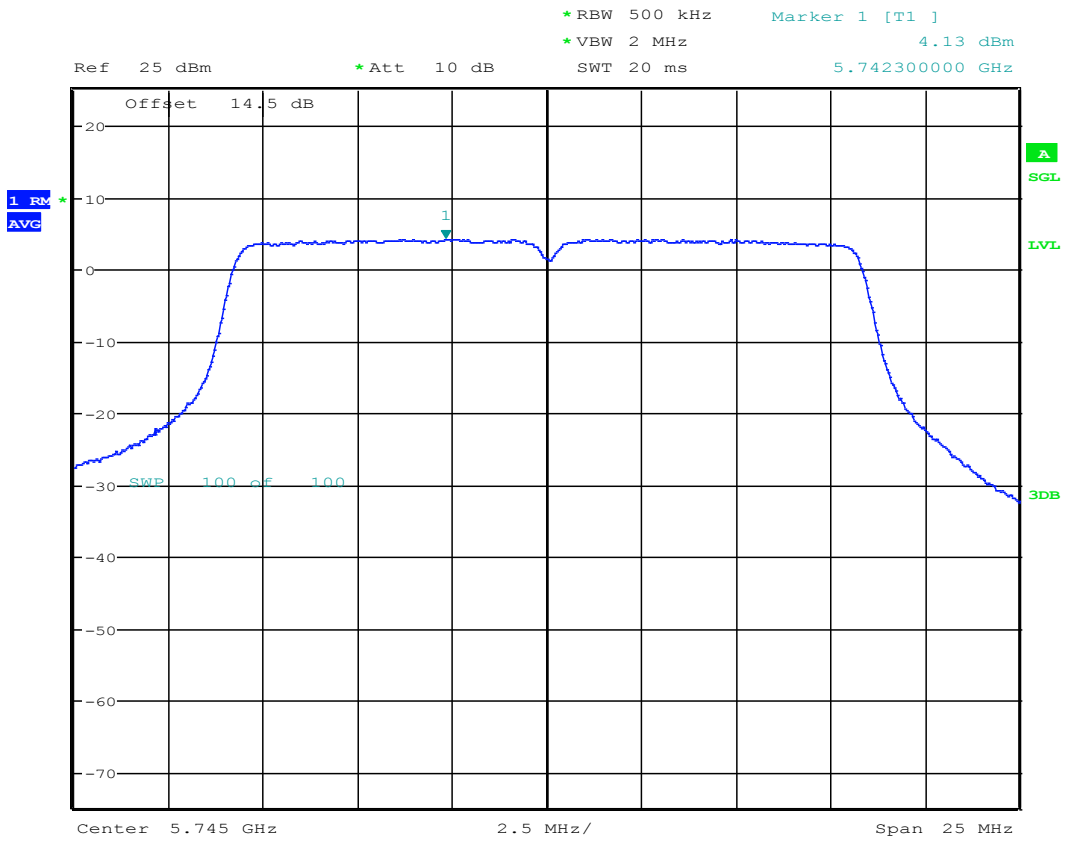
Mode 802.11	Channel	DCC PSD in dBm chain 0	DCC PSD in dBm chain 1	DCC PSD in mW chain 0	DCC PSD in mW chain 1	Sum DCC PSD in mW	Summed PSD in dBm	LIMIT (dBm / 500 KHz)
n 20 MIMO	149	3.7	4.08	2.34	2.56	4.90	6.90	25 dBm
	157	3.98	4.45	2.50	2.79	5.29	7.23	25 dBm
	165	4.58	3.97	2.87	2.49	5.37	7.30	25 dBm
n_40 MIMO	151	0.67	1.15	1.17	1.30	2.47	3.93	25 dBm
	159	1.52	1.77	1.42	1.50	2.92	4.66	25 dBm

- Conducted PSD Limit of MIMO = 30 dBm – ((Directional Gain = GANT) - 6 dBi)
  = 30dBm – (11-6 dBi) = 25 dBm. No correlation between Spatial Streams for MIMO.

8.3.5 Measurement Plots:

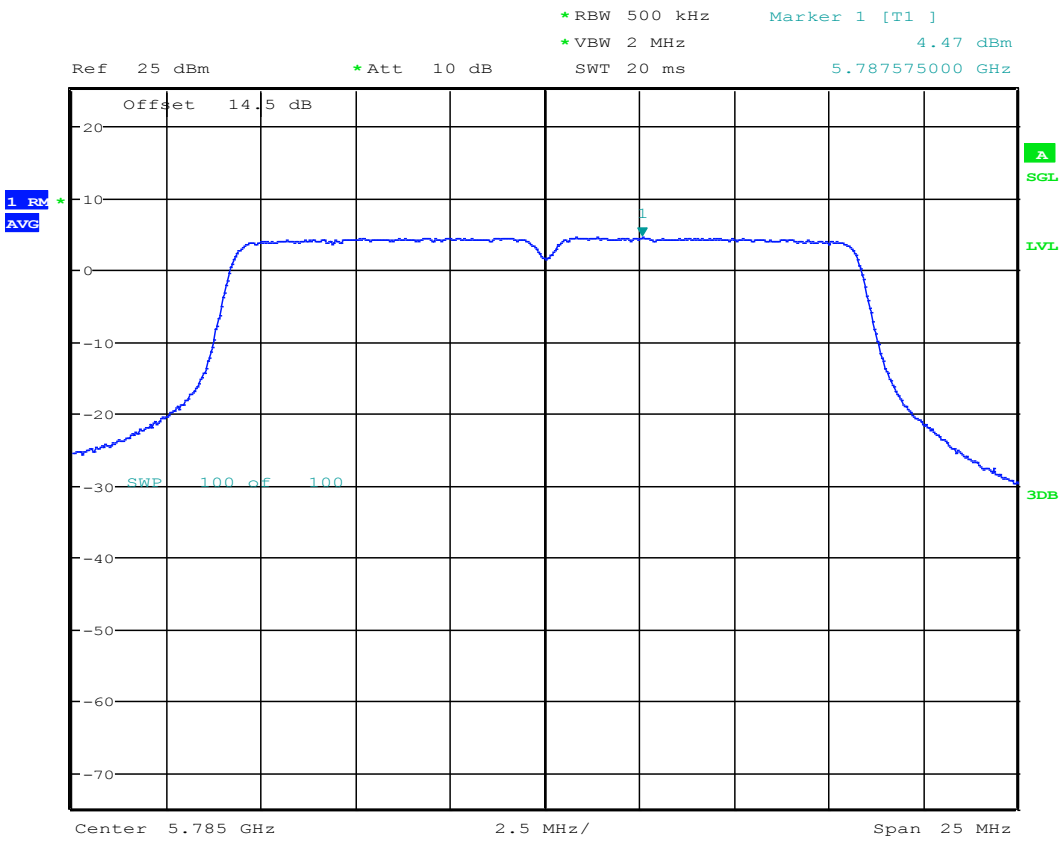
Plot #1

Low channel	Modulation/Packet Type: 802.11a 6Mbps



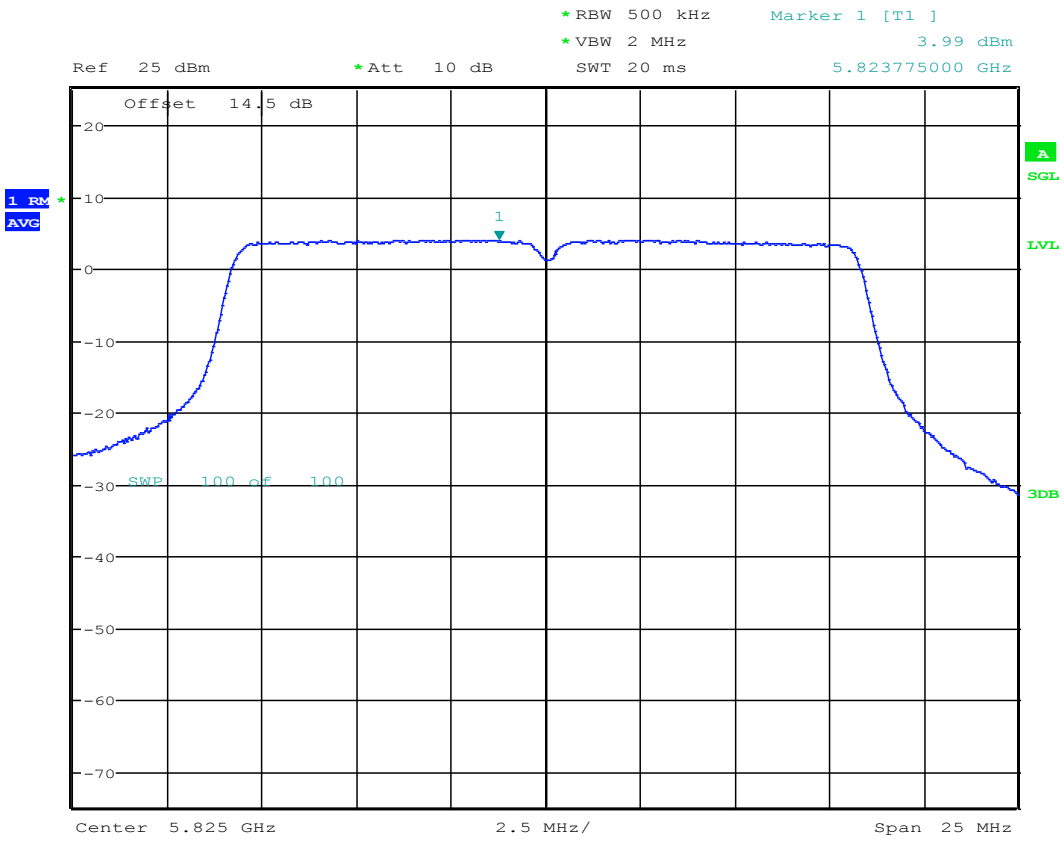
Plot #2

Mid channel	Modulation/Packet Type: 802.11a 6Mbps



Plot #3

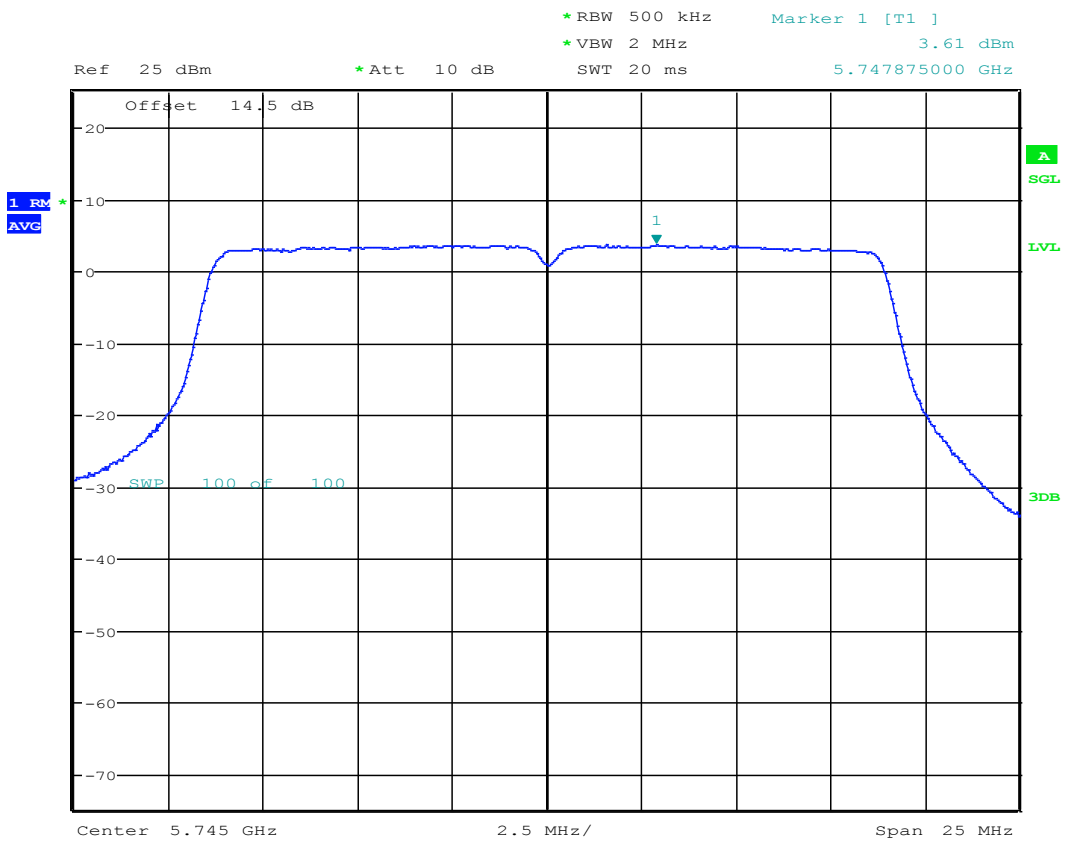
High channel	Modulation/Packet Type: 802.11a 6Mbps



Date: 14.JAN.2019 13:39:30

Plot #4

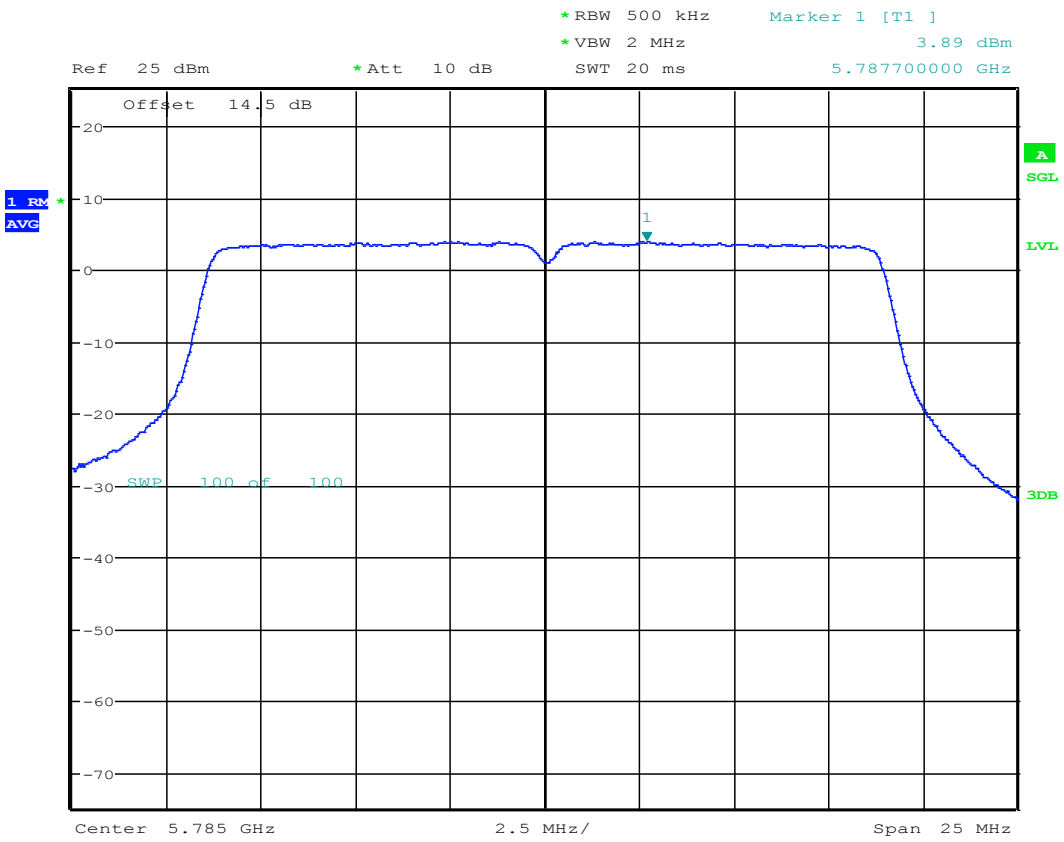
Low channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 13:43:25

Plot #5

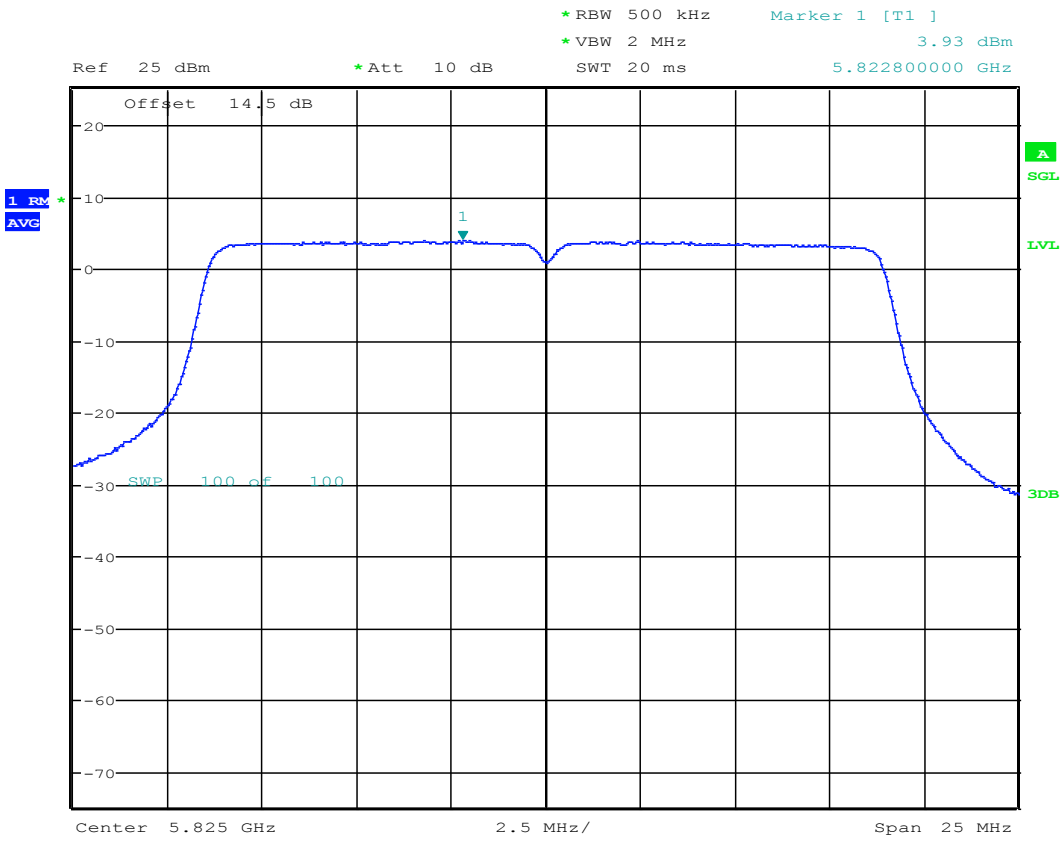
Mid channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 13:42:01

Plot #6

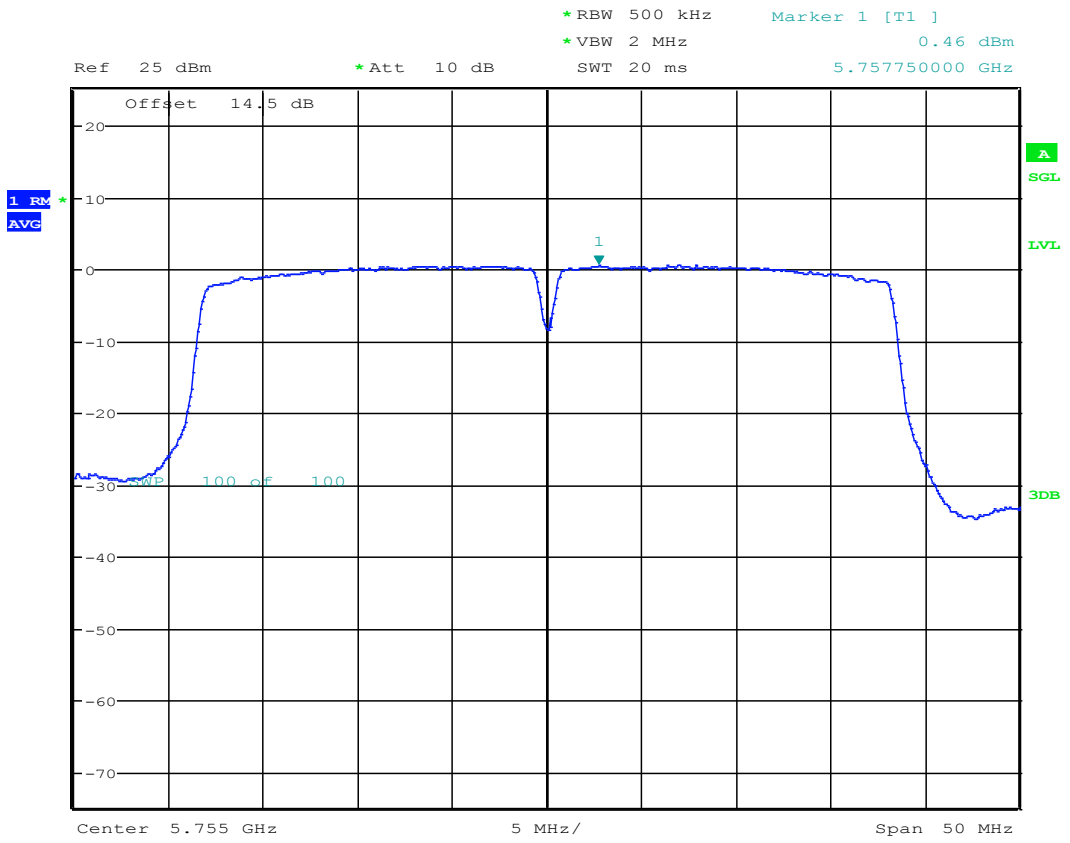
High channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 13:38:26

Plot #7

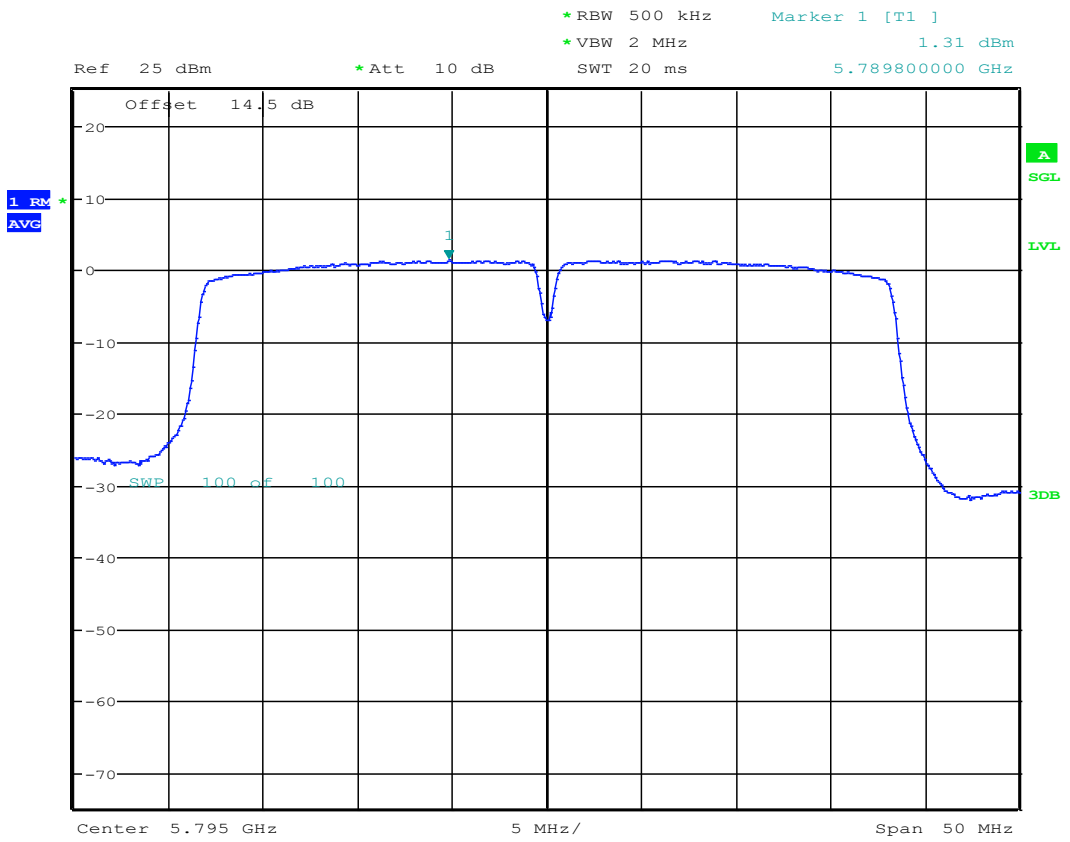
Low channel	Modulation/Packet Type: 802.11n_40 MCS0



Date: 14.JAN.2019 13:30:32

Plot #8

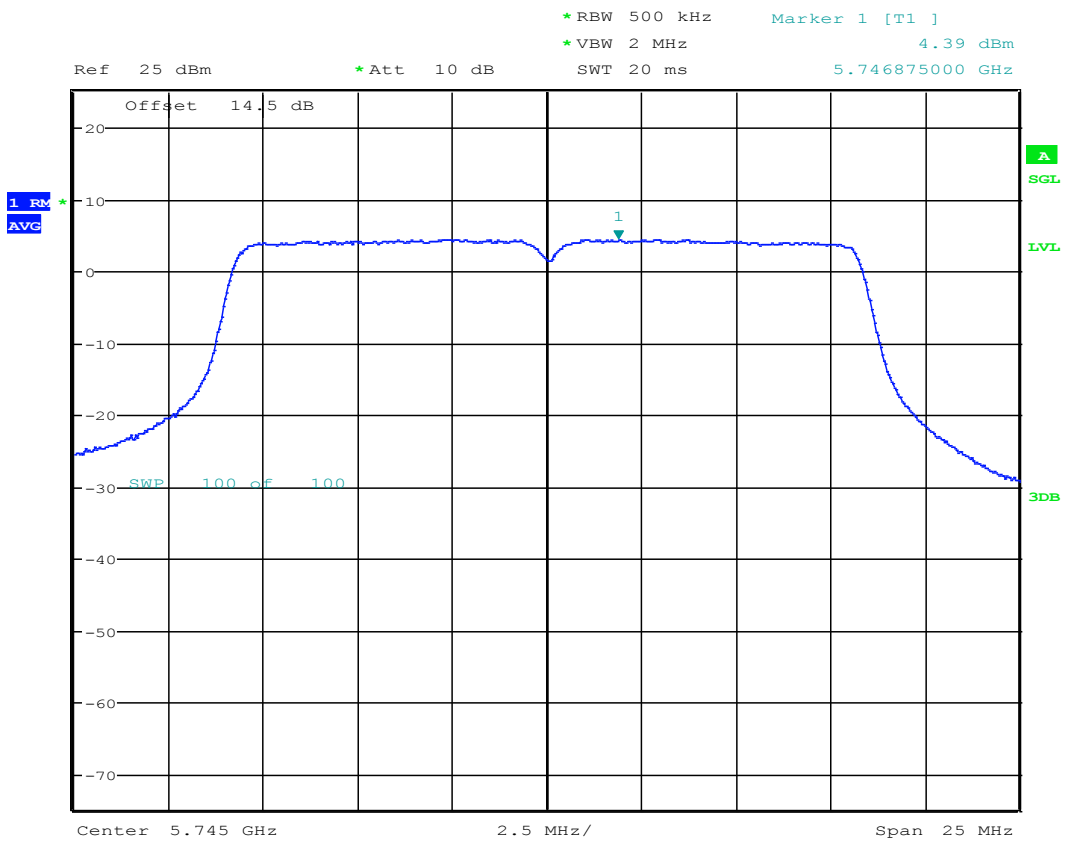
Mid channel	Modulation/Packet Type: 802.11n_40 MCS0



Date: 14.JAN.2019 13:29:25

Plot #9 Chain 1

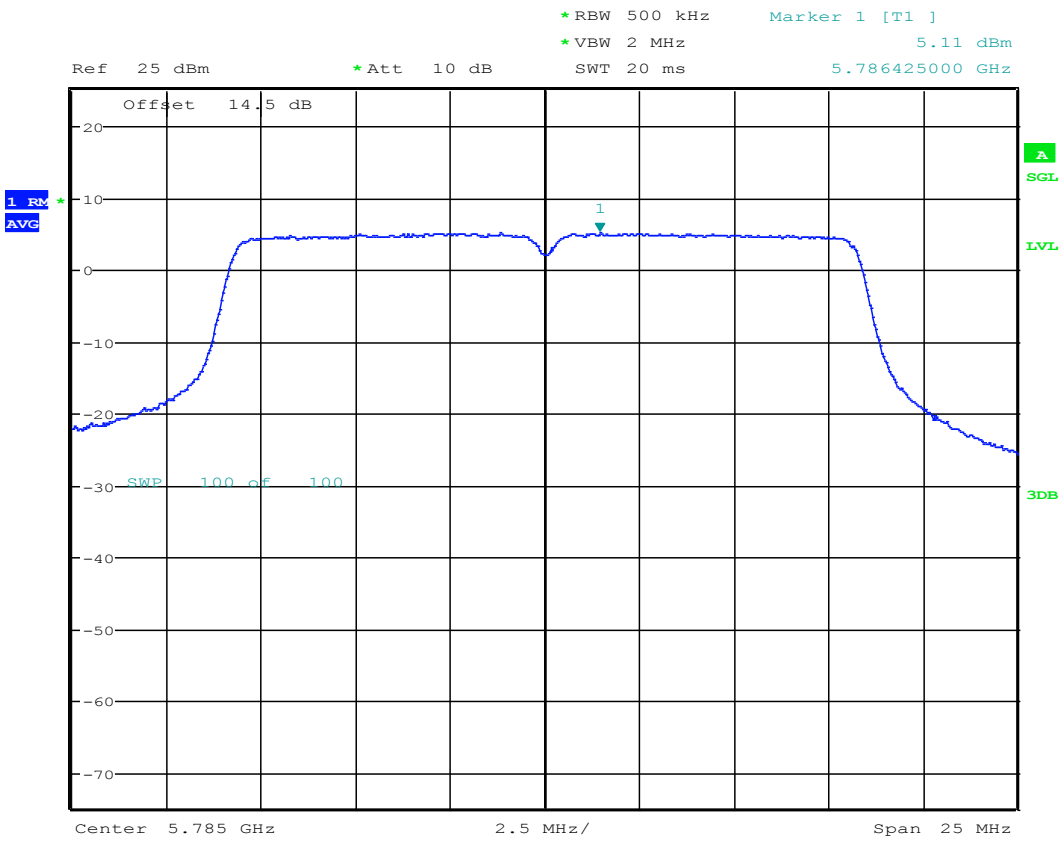
Low channel	Modulation/Packet Type: 802.11a 6Mbps



Date: 14.JAN.2019 13:11:55

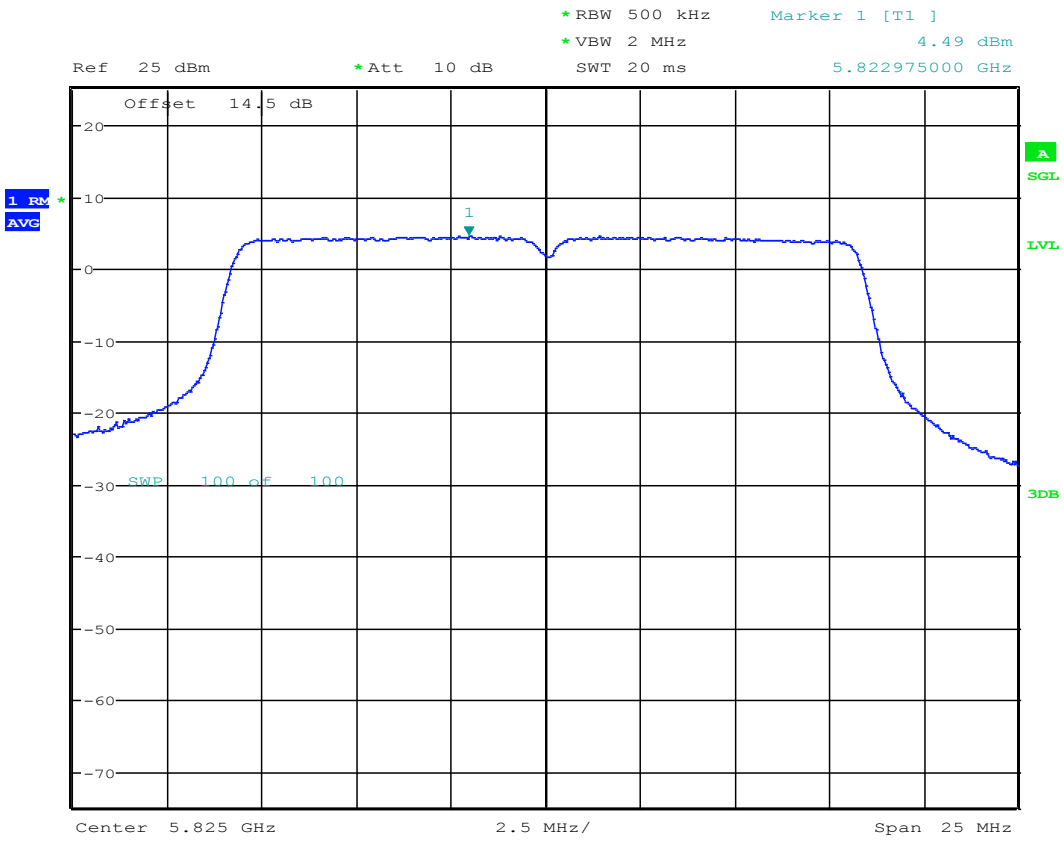
Plot #10

Mid channel	Modulation/Packet Type: 802.11a 6Mbps



Plot #11

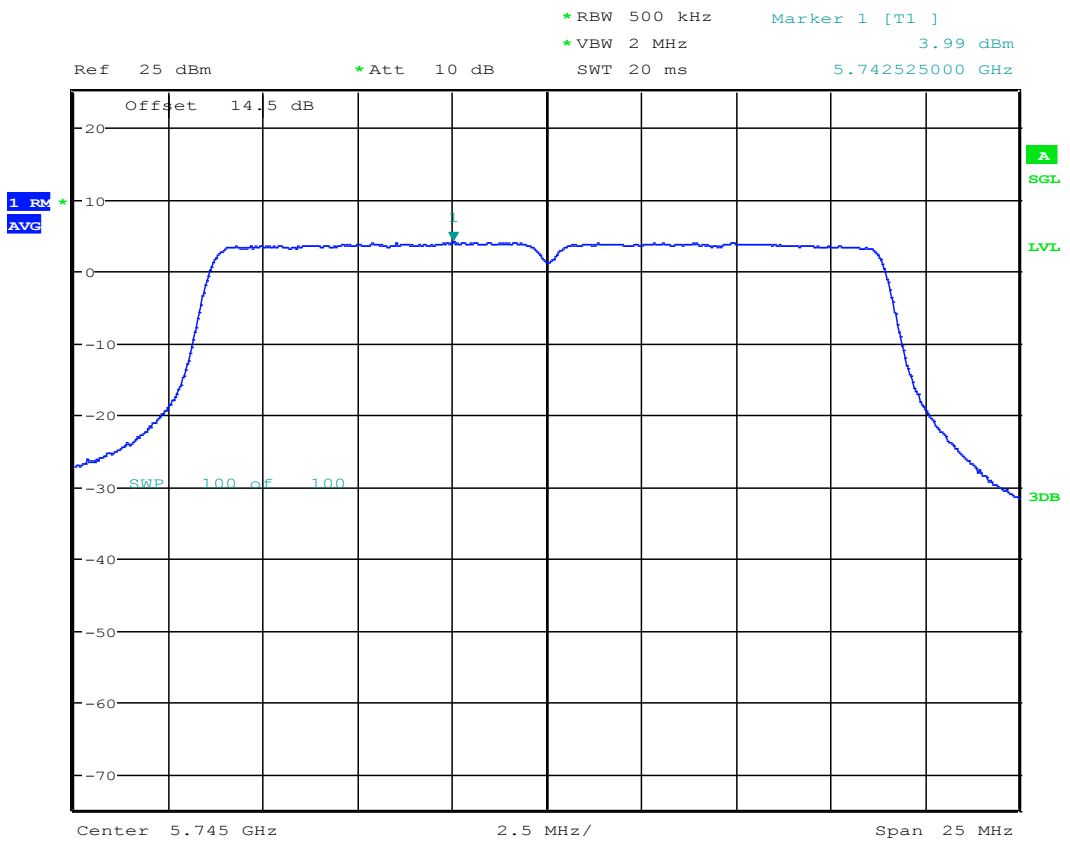
High channel	Modulation/Packet Type: 802.11a 6Mbps



Date: 14.JAN.2019 13:18:21

Plot #12

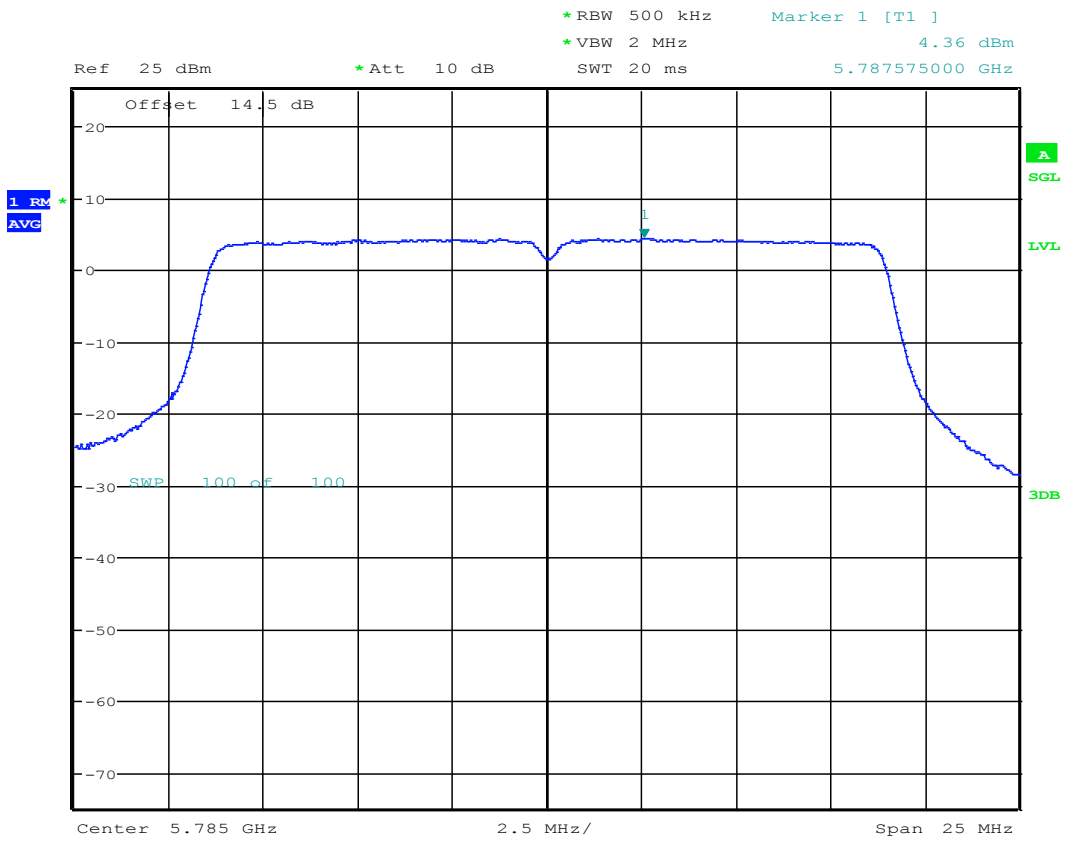
Low channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 13:10:38

Plot #13

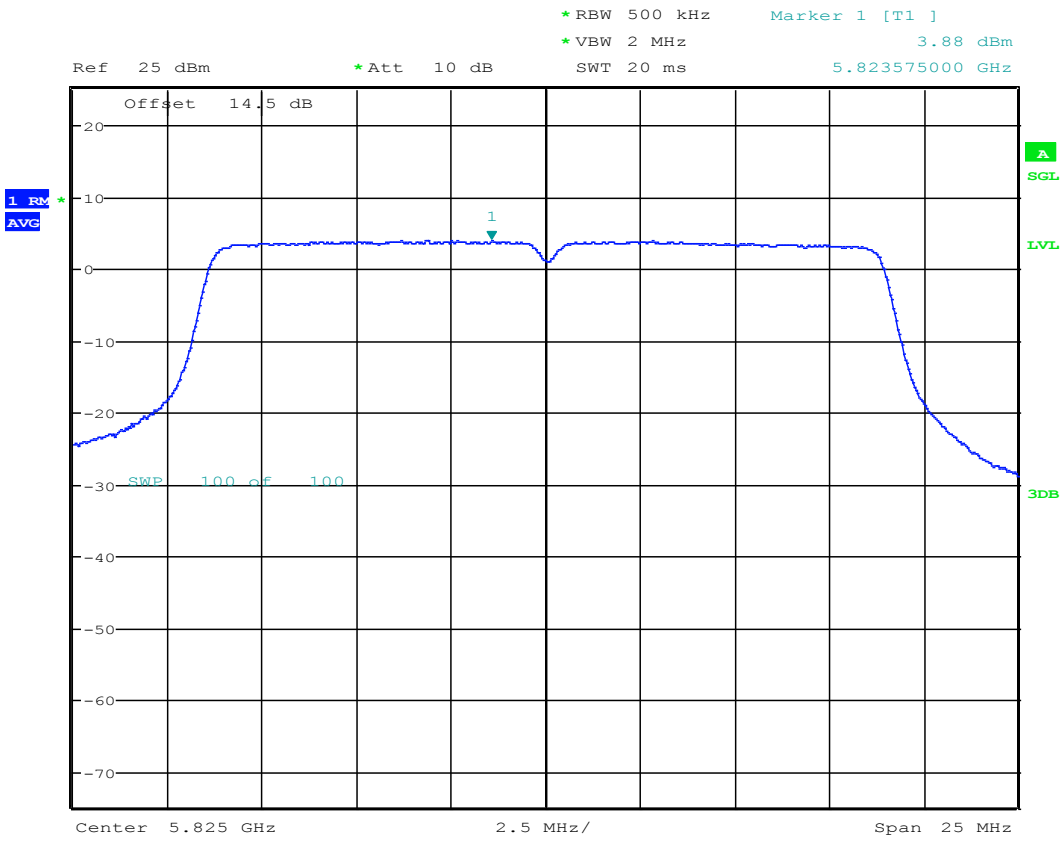
Mid channel	Modulation/Packet Type: 802.11n_20 MCS0



Date: 14.JAN.2019 13:15:48

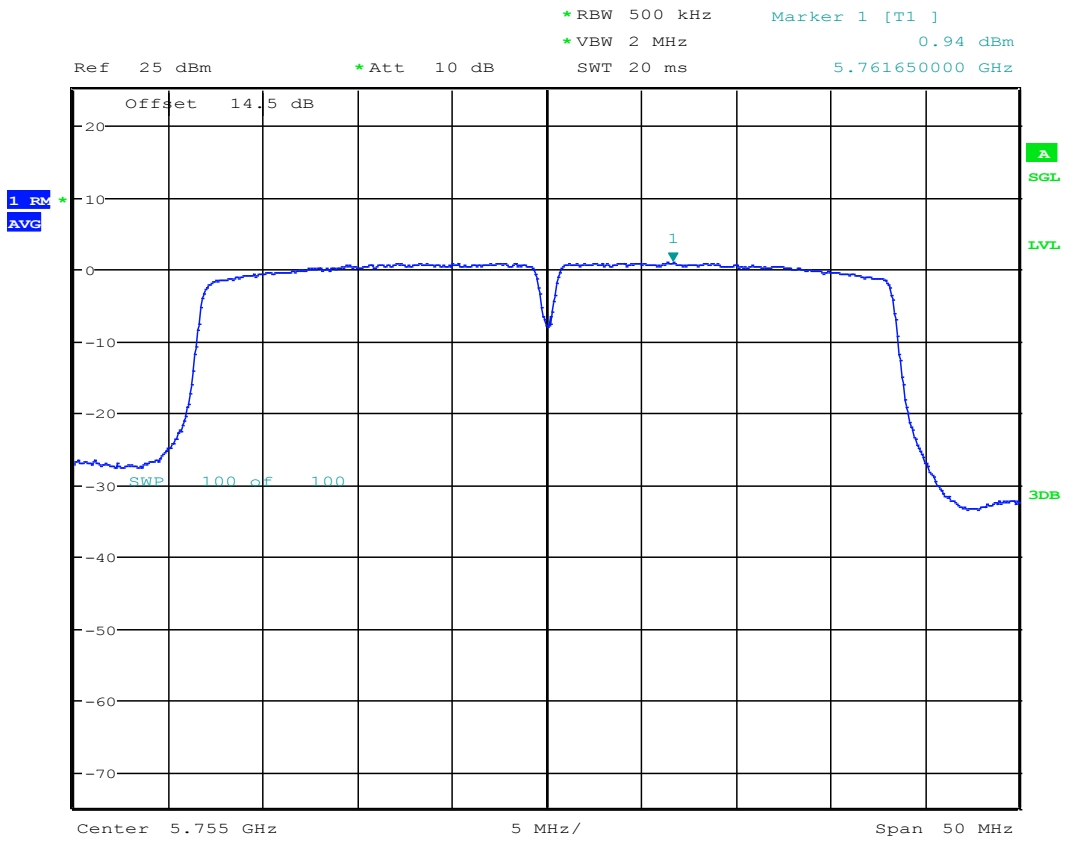
Plot #14

High channel	Modulation/Packet Type: 802.11n_20 MCS0



Plot #15

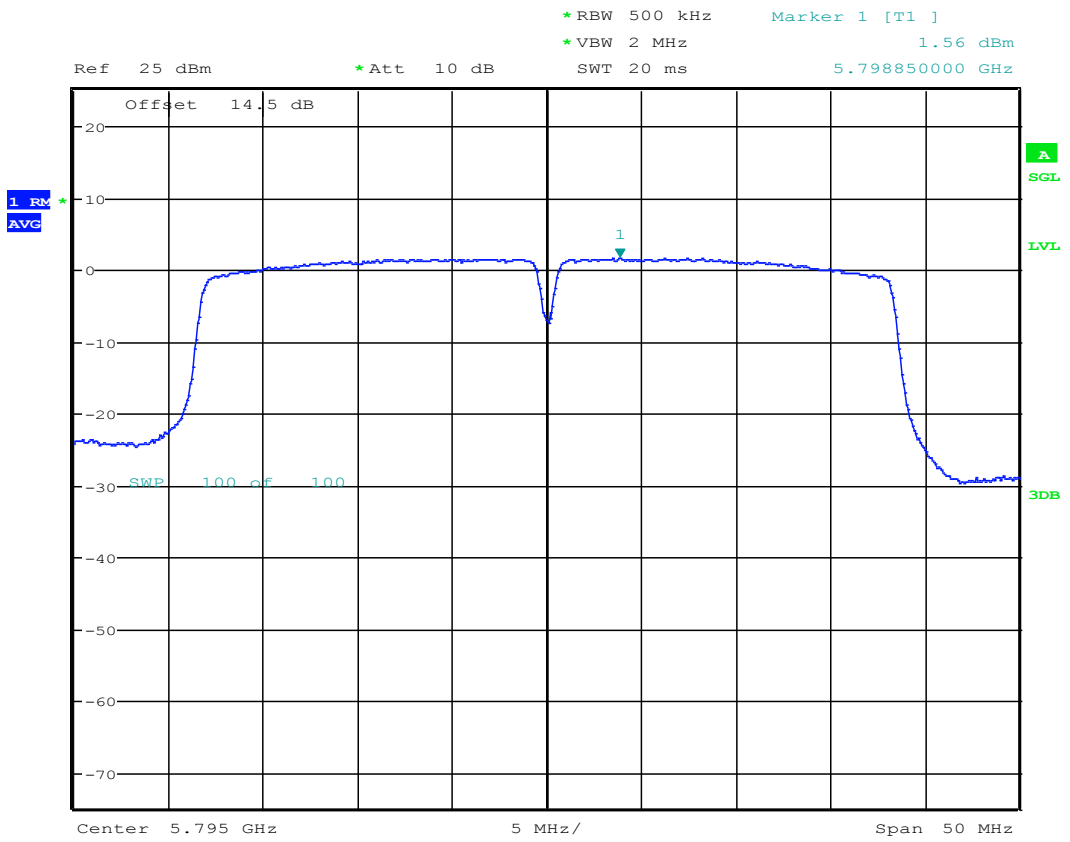
Low channel	Modulation/Packet Type: 802.11n_40 MCS0



Date: 14.JAN.2019 13:24:06

Plot #16

Mid channel	Modulation/Packet Type: 802.11n_40 MCS0



Date: 14.JAN.2019 13:25:50

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), RSS-247 6

- For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

8.4.3 Limits restricted band §15.407/15.209/15.205 and RSS-Gen 8.9/8.10

- *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 & RSS-Gen 8.10
- 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
22.4° C	1	802.11a/n	AC/DC Converter	11 dBi

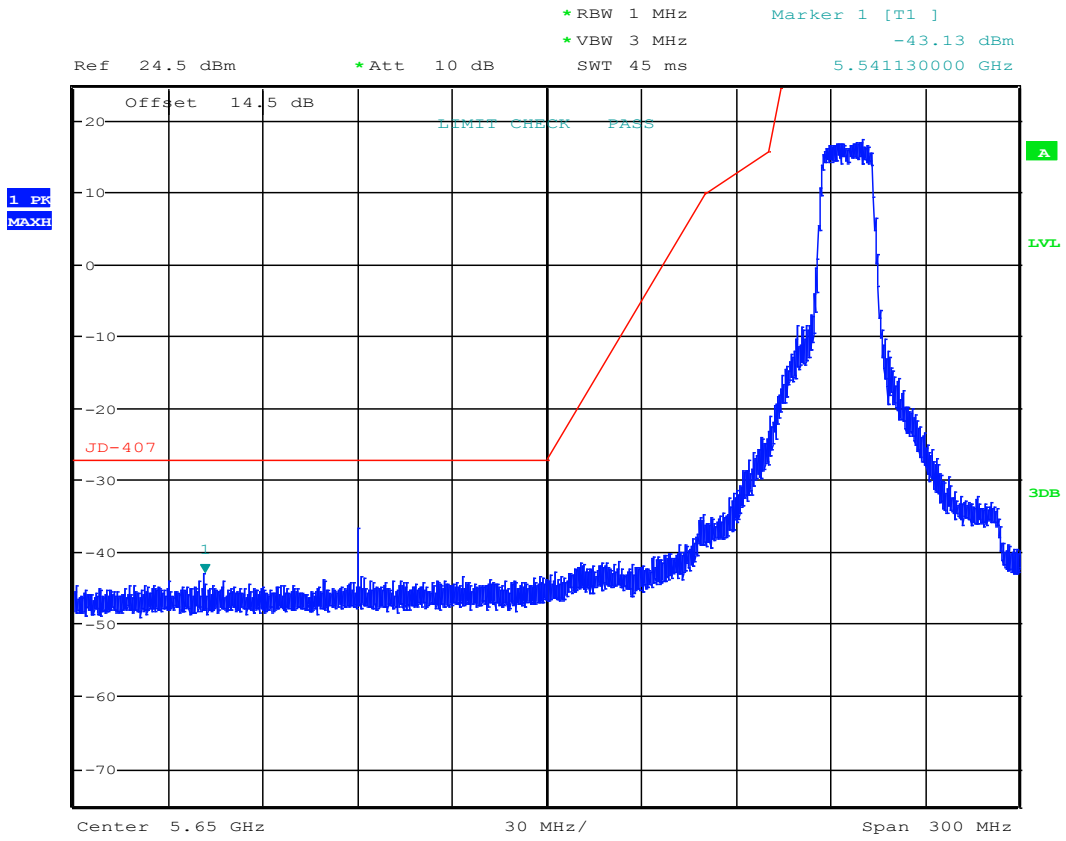
8.4.5 Measurement result:

- The value of below table shows worst case of each mode.

Plot #	EUT operating mode	Tx Chain	Band Edge	Frequency (MHz)	Measured Emission Level(dBm)	Corrected by duty cycle (dBm)	Corrected by Antenna Gain (dBm)	Limit (dBm)	Result
1	802.11a	0	Lower, Non-restricted	5541.13	-43.13	-43.00	-32.00	-27	Pass
2	802.11a	0	Upper, Non-restricted	5931.9	-41.44	-41.31	-30.31	-27	Pass
3	802.11n_20	0	Lower, Non-restricted	5647.96	-43.49	-43.28	-29.27	-27	Pass
4	802.11n_20	0	Upper, Non-restricted	5936.85	-41.7	-41.49	-27.48	-27	Pass
5	802.11n_40	0	Lower, Non-restricted	5648.8	-43.89	-43.60	-29.59	-27	Pass
6	802.11n_40	0	Upper, Non-restricted	5926.68	-42.72	-42.43	-28.42	-27	Pass
7	802.11a	1	Lower, Non-restricted	5647.15	-47.26	-47.13	-36.13	-27	Pass
8	802.11a	1	Upper, Non-restricted	6945.28	-46.06	-45.93	-34.93	-27	Pass
9	802.11n_20	1	Lower, Non-restricted	5626.42	-47.24	-47.03	-33.02	-27	Pass
10	802.11n_20	1	Upper, Non-restricted	5982.15	-47.21	-47.00	-32.99	-27	Pass
11	802.11n_40	1	Lower, Non-restricted	5649.52	-41	-40.71	-26.70	-27	Pass
12	802.11n_40	1	Upper, Non-restricted	5929.47	-45.2	-44.91	-30.90	-27	Pass

8.4.6 Measurement Plots:

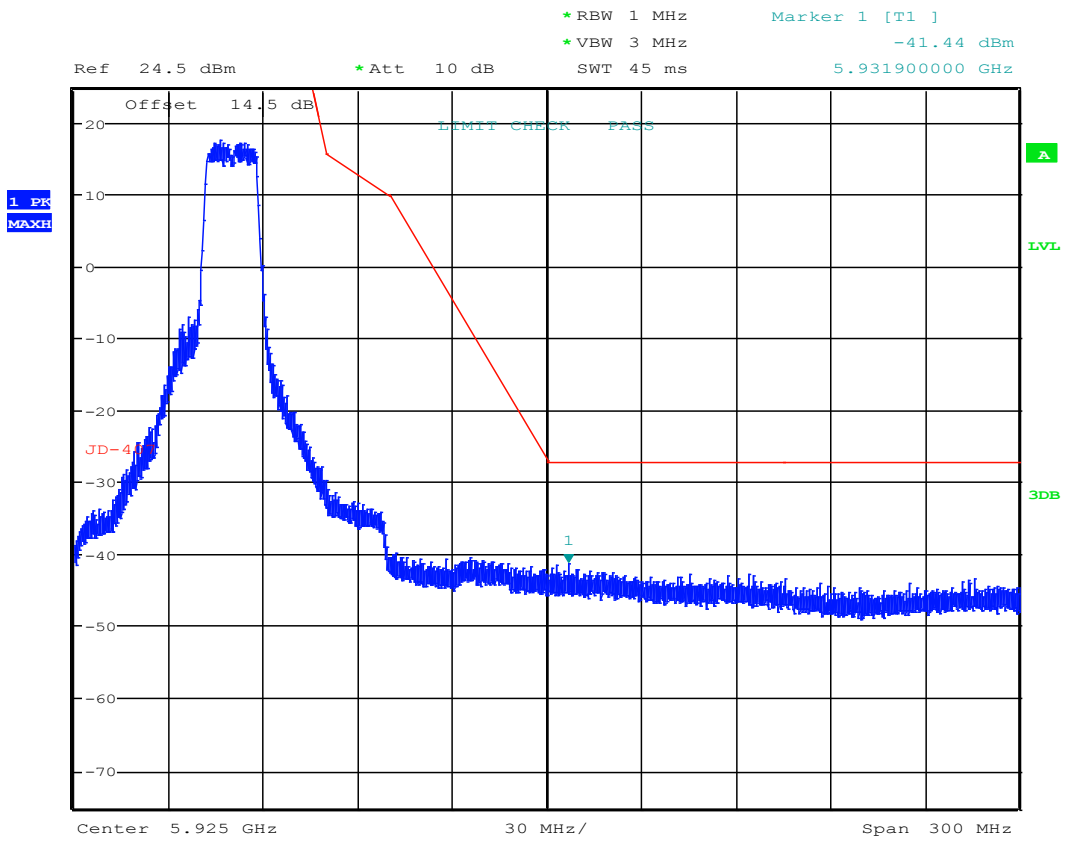
Plot #1	
Low channel / 5745 MHz	Modulation/Packet Type: 802.11a 6Mbps



Date: 15.JAN.2019 16:26:10

Plot #2

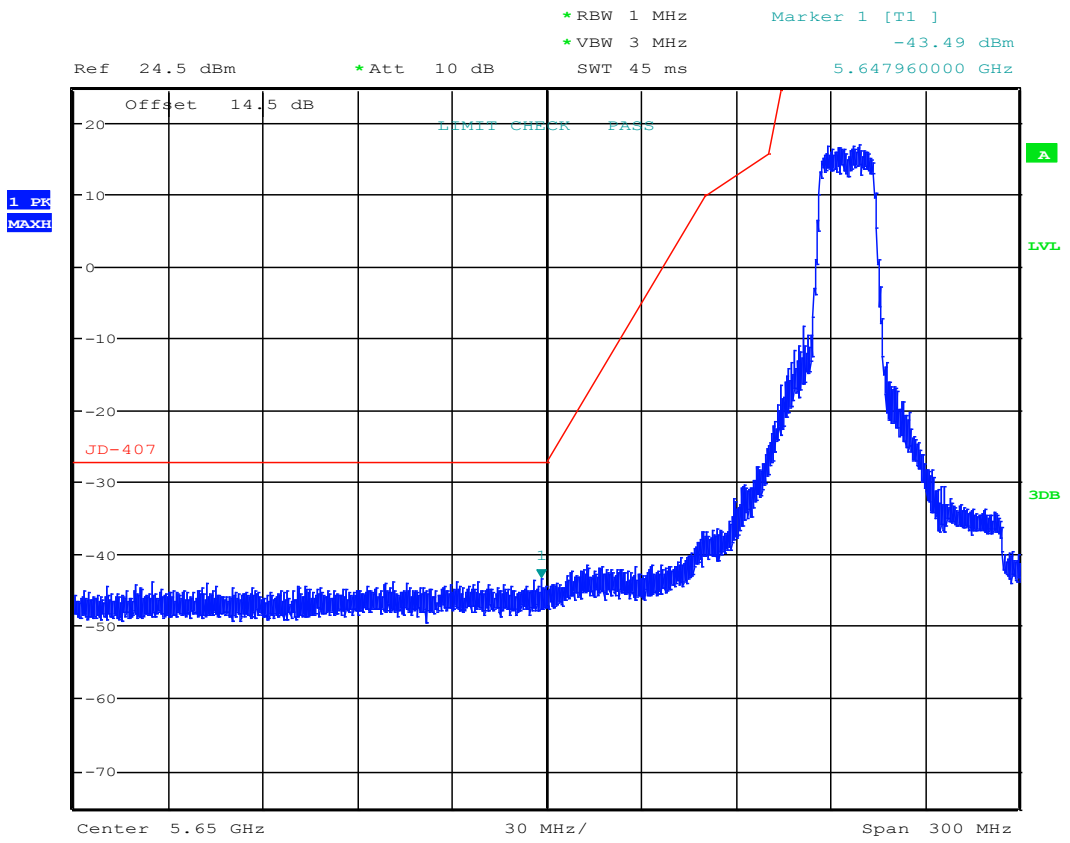
High channel / 5825 MHz	Modulation/Packet Type: 802.11a 6Mbps



Date: 15.JAN.2019 16:49:38

Plot #3

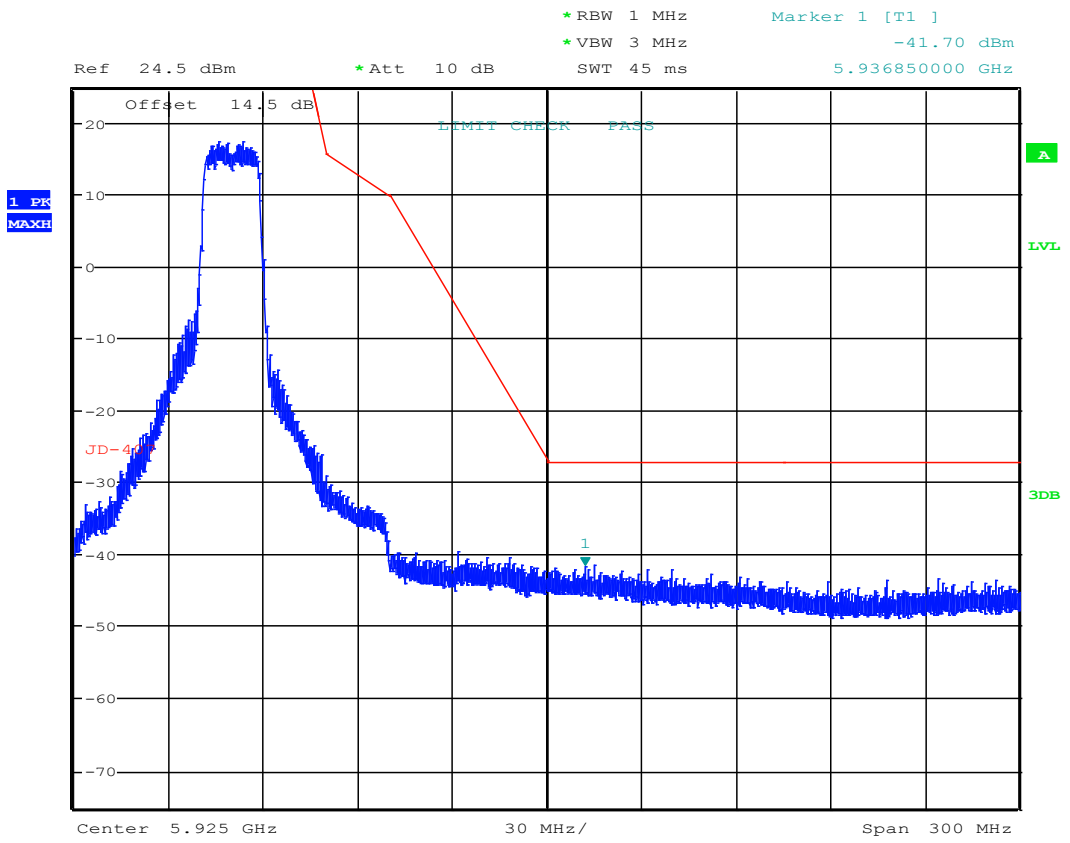
Low channel / 5745 MHz	Modulation/Packet Type: 802.11n_20 MCS0



Date: 15.JAN.2019 16:23:10

Plot #4

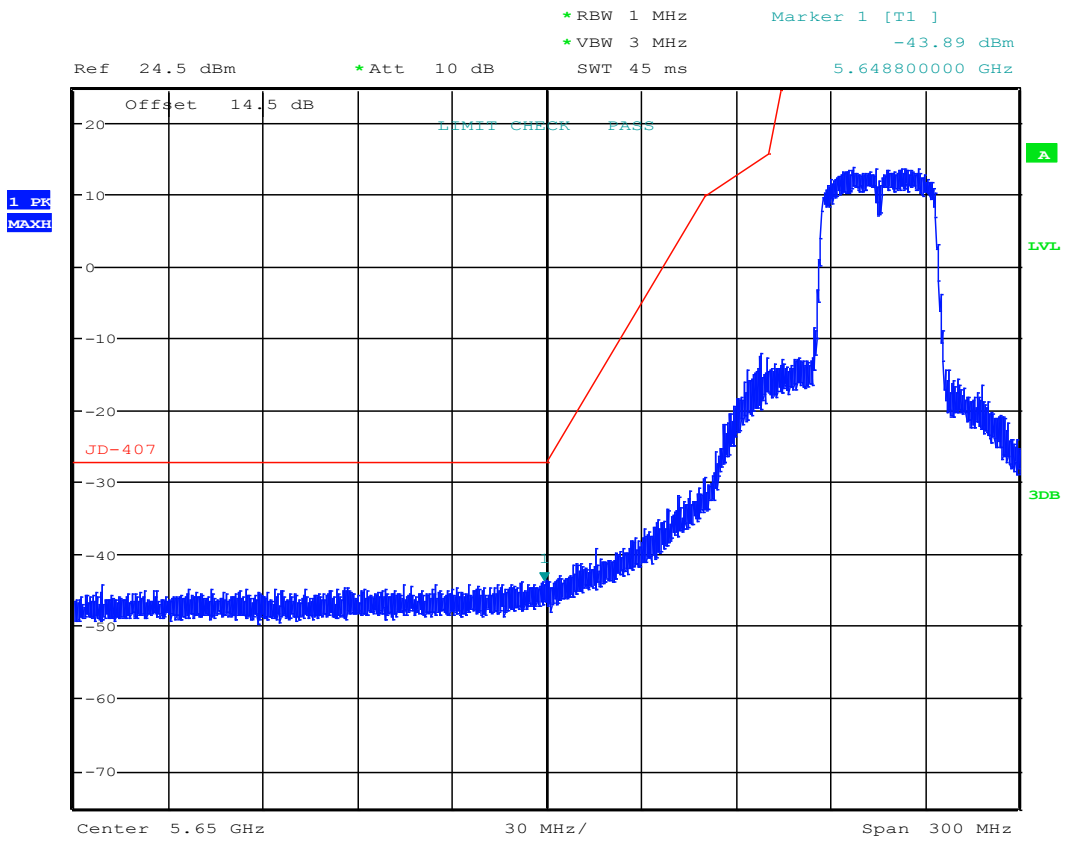
High channel / 5825 MHz	Modulation/Packet Type: 802.11n_20 MCS0



Date: 15.JAN.2019 16:46:06

Plot #5

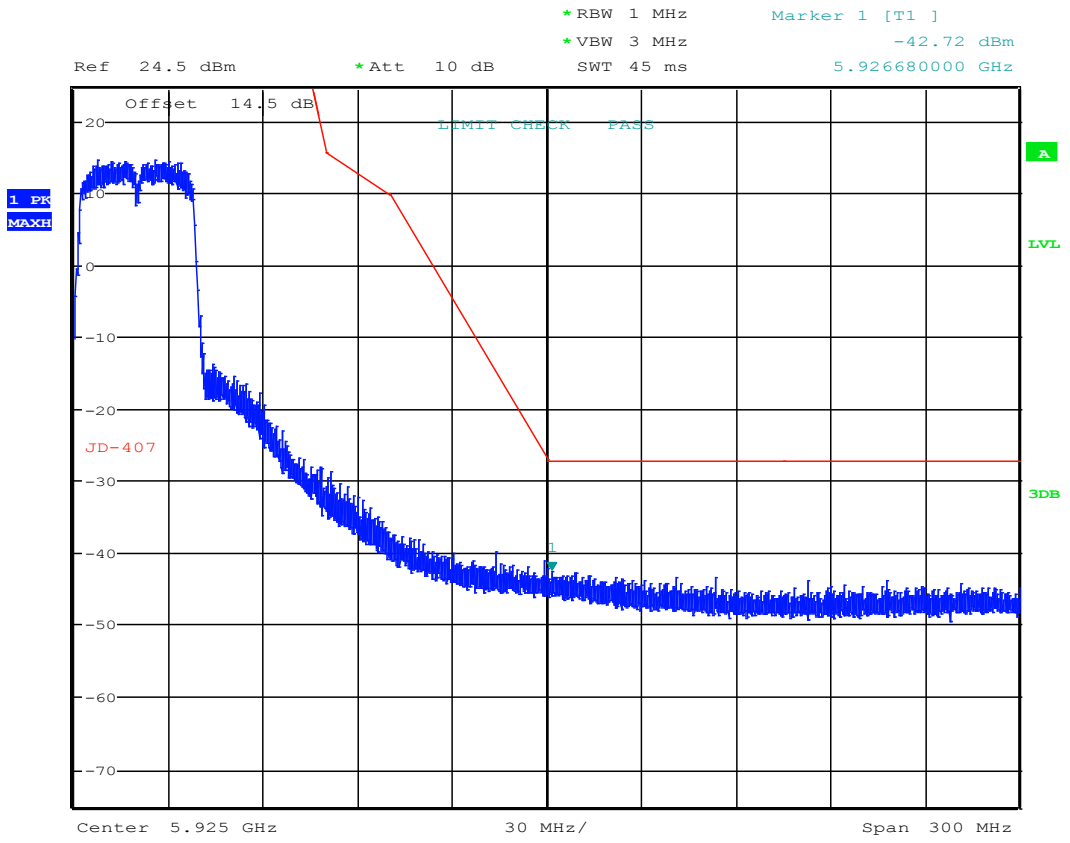
Low channel / 5755 MHz	Modulation/Packet Type: 802.11n_40 MCS0



Date: 15.JAN.2019 16:28:52

Plot #6

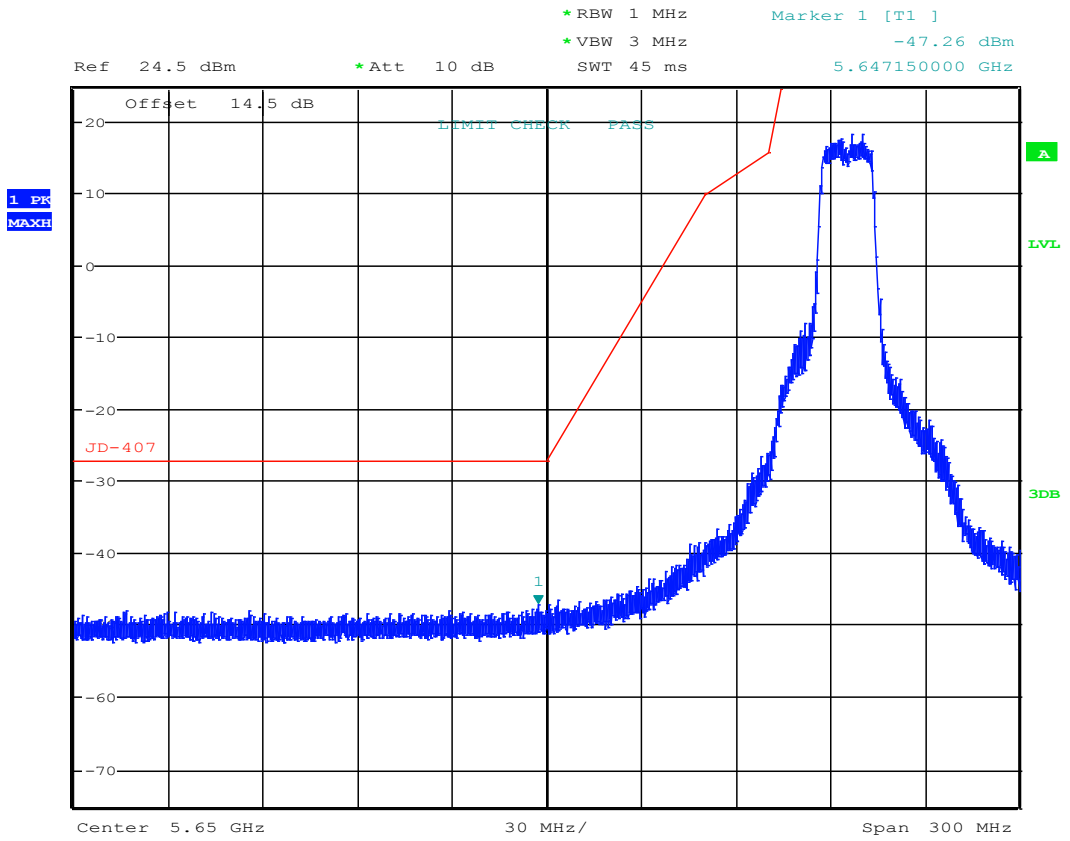
High channel / 5795 MHz	Modulation/Packet Type: 802.11n_40 MCS0



Date: 15.JAN.2019 16:31:47

Plot #7

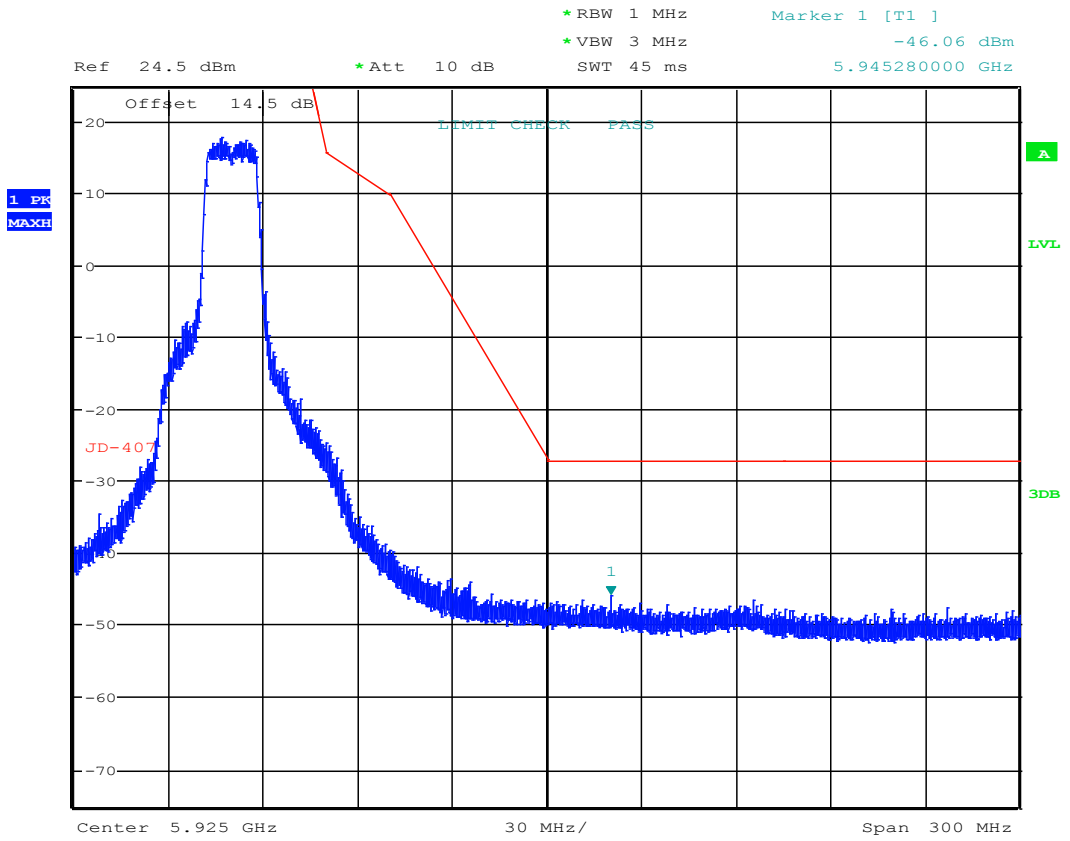
Low channel / 5745 MHz	Modulation/Packet Type: 802.11a 6Mbps Peak



Date: 15.JAN.2019 17:06:00

Plot #8

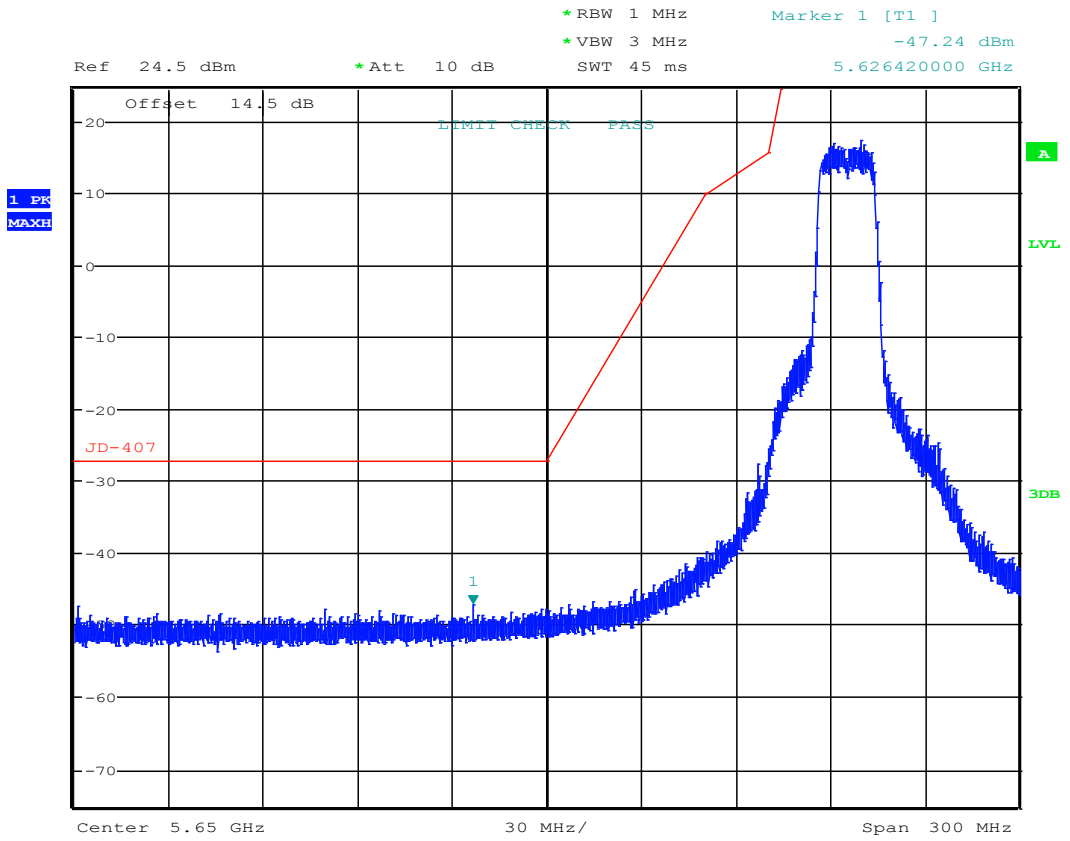
Low channel / 5745 MHz	Modulation/Packet Type: 802.11a 6Mbps Avg



Date: 15.JAN.2019 16:53:26

Plot #9

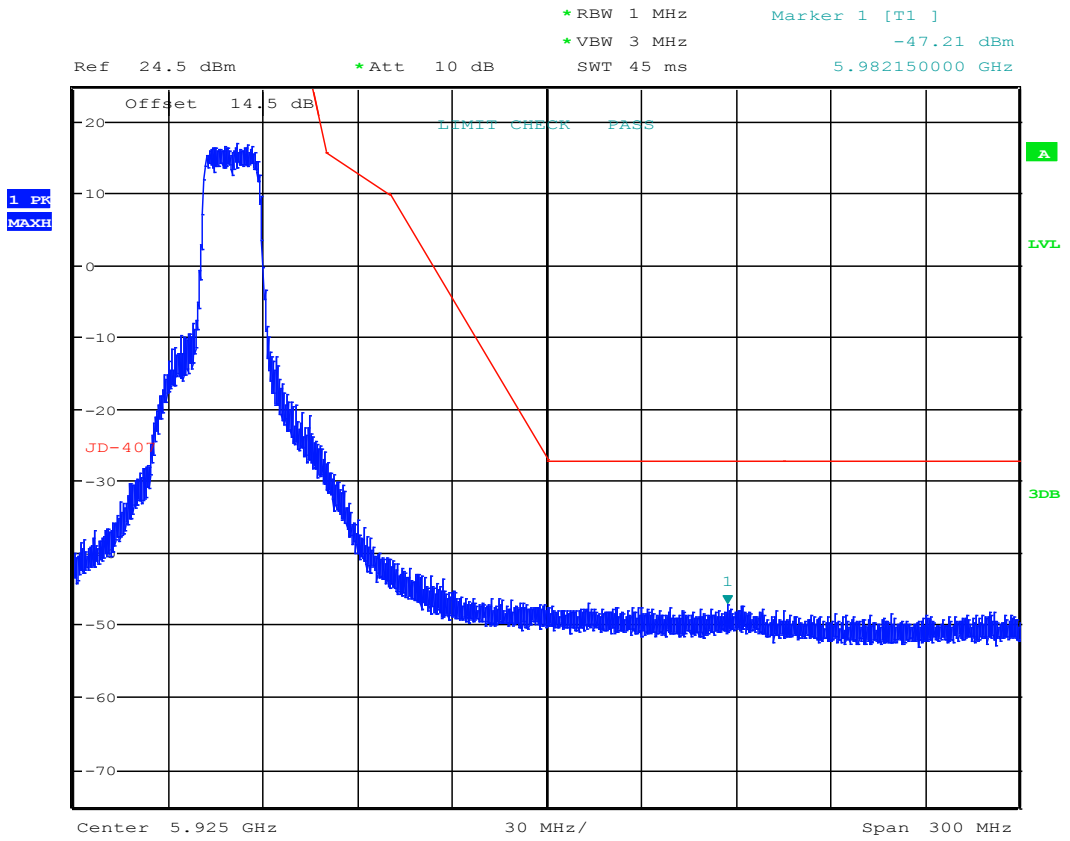
Low channel / 5745 MHz	Modulation/Packet Type: 802.11n_20 MCS0 Peak



Date: 15.JAN.2019 17:03:03

Plot #10

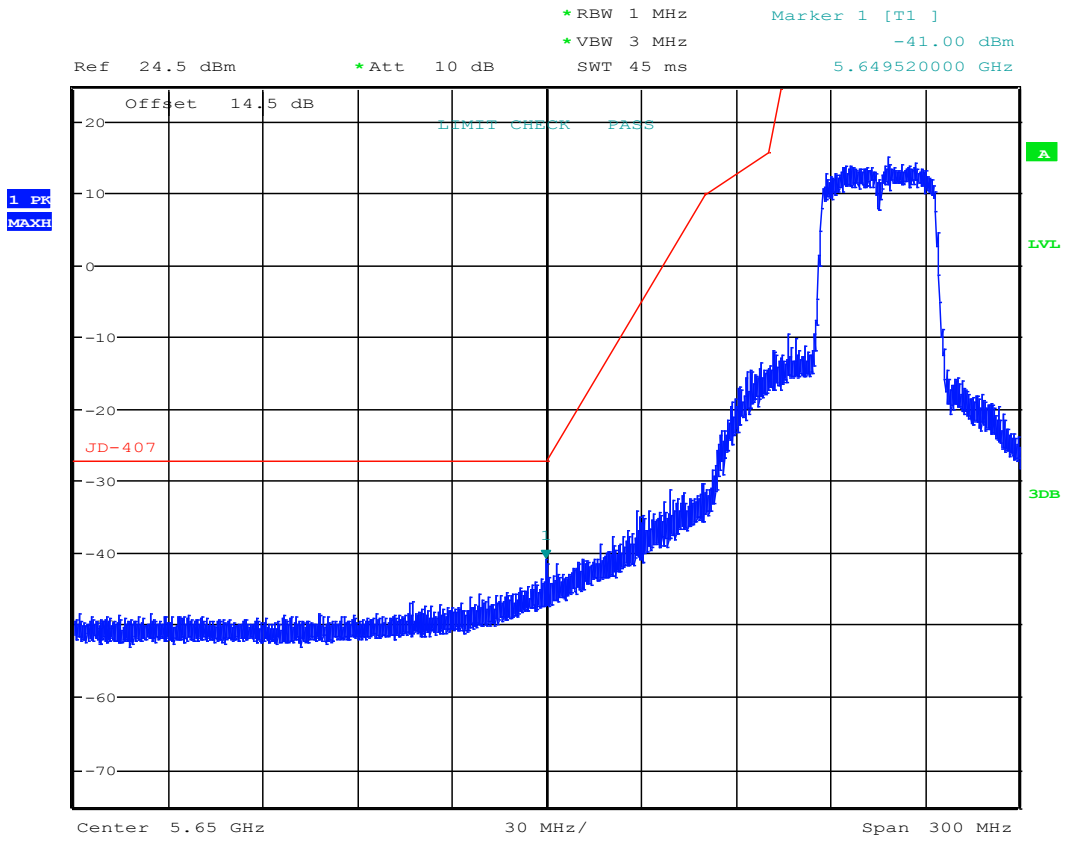
Low channel / 5745 MHz	Modulation/Packet Type: 802.11n_20 MCS0 Avg



Date: 15.JAN.2019 16:55:33

Plot #11

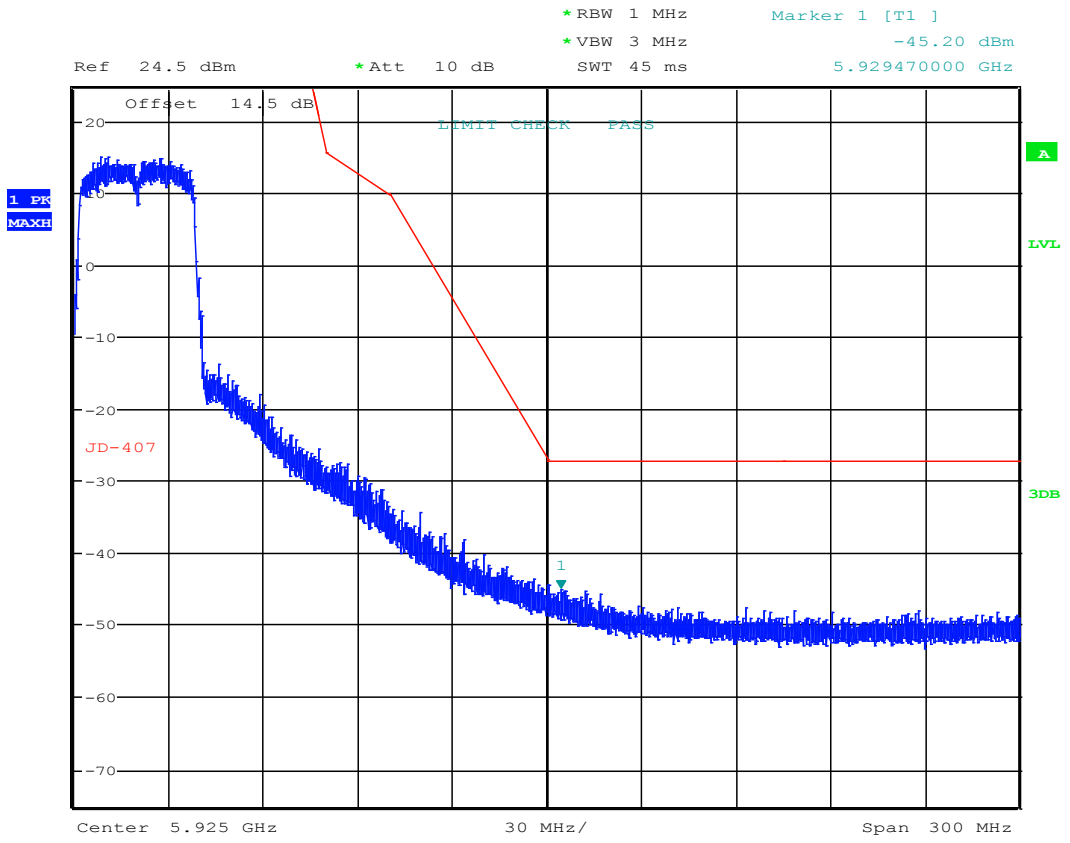
Low channel / 5755 MHz	Modulation/Packet Type: 802.11n_40 MCS0 Peak



Date: 15.JAN.2019 17:07:35

Plot #12

Low channel / 5755 MHz	Modulation/Packet Type: 802.11n_40 MCS0 Avg



Date: 15.JAN.2019 17:12:58

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 6 dB EBW:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) ≥ 3 x RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

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)

- Within the 5.725-5.85 GHz band, the minimum 6 dB 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
22.5° C	1	802.11 a /n	AC/DC Adapter

8.5.4 Measurement result:

Plot #	Mode	Channel	6 dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
1	802.11a	149	16.42	> 0.5	Pass
2	802.11a	157	16.42	> 0.5	Pass
3	802.11a	165	16.43	> 0.5	Pass
4	802.11n_20	149	17.62	> 0.5	Pass
5	802.11n_20	157	17.62	> 0.5	Pass
6	802.11n_20	165	16.64	> 0.5	Pass
7	802.11n_40	151	36.26	> 0.5	Pass
8	802.11n_40	159	35.12	> 0.5	Pass

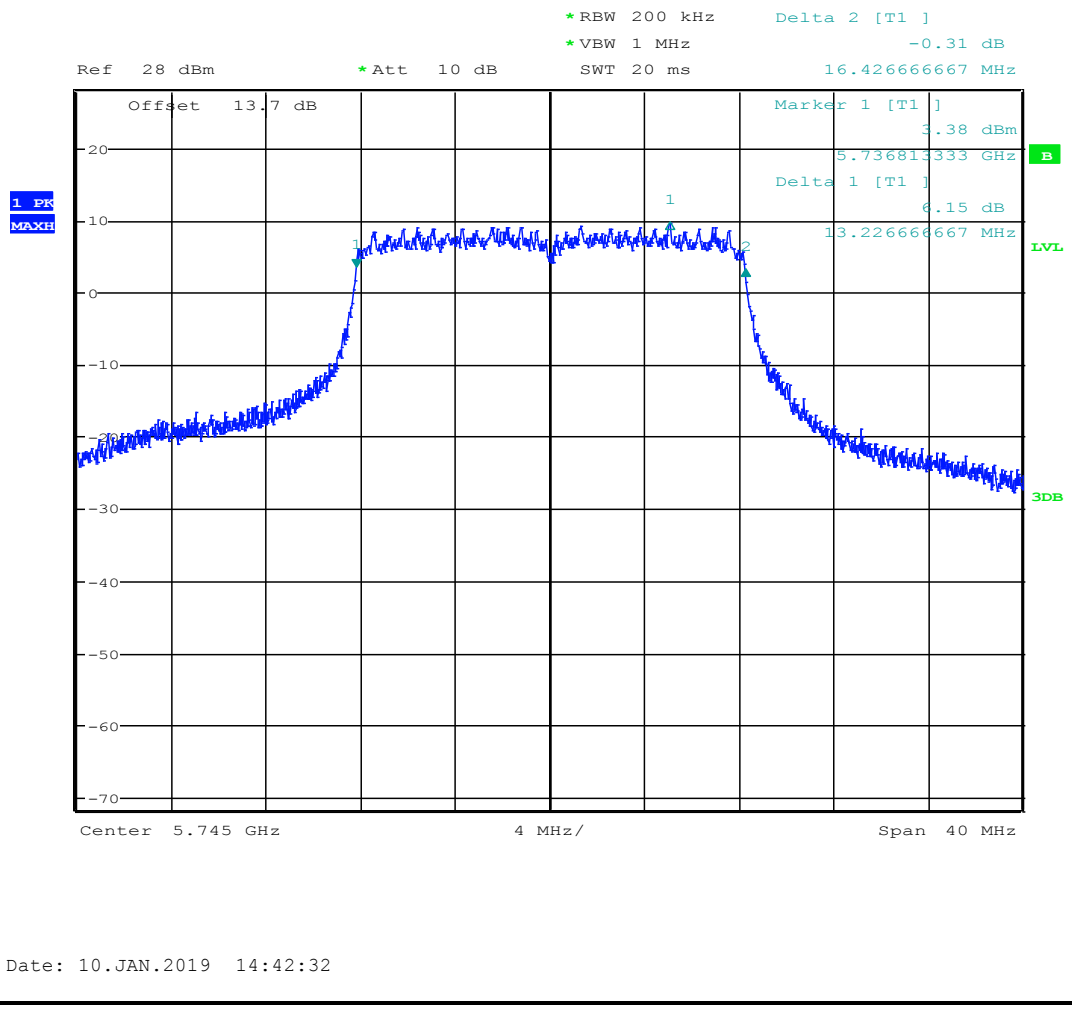
Plot #	Mode	Channel	26 dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
9	802.11a	149	24.57	> 0.5	Pass
10	802.11a	157	28.21	> 0.5	Pass
11	802.11a	165	28.09	> 0.5	Pass
12	802.11n_20	149	21.38	> 0.5	Pass
13	802.11n_20	157	22.48	> 0.5	Pass
14	802.11n_20	165	21.4	> 0.5	Pass
15	802.11n_40	151	41.31	> 0.5	Pass
16	802.11n_40	159	49.88	> 0.5	Pass

Plot #	Mode	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
17	802.11a	149	16.54	> 0.5	Pass
18	802.11a	157	16.61	> 0.5	Pass
19	802.11a	165	16.58	> 0.5	Pass
20	802.11n_20	149	17.63	> 0.5	Pass
21	802.11n_20	157	17.65	> 0.5	Pass
22	802.11n_20	165	17.65	> 0.5	Pass
23	802.11n_40	151	36.08	> 0.5	Pass
24	802.11n_40	159	36.1	> 0.5	Pass

8.5.5 Measurement Plots:

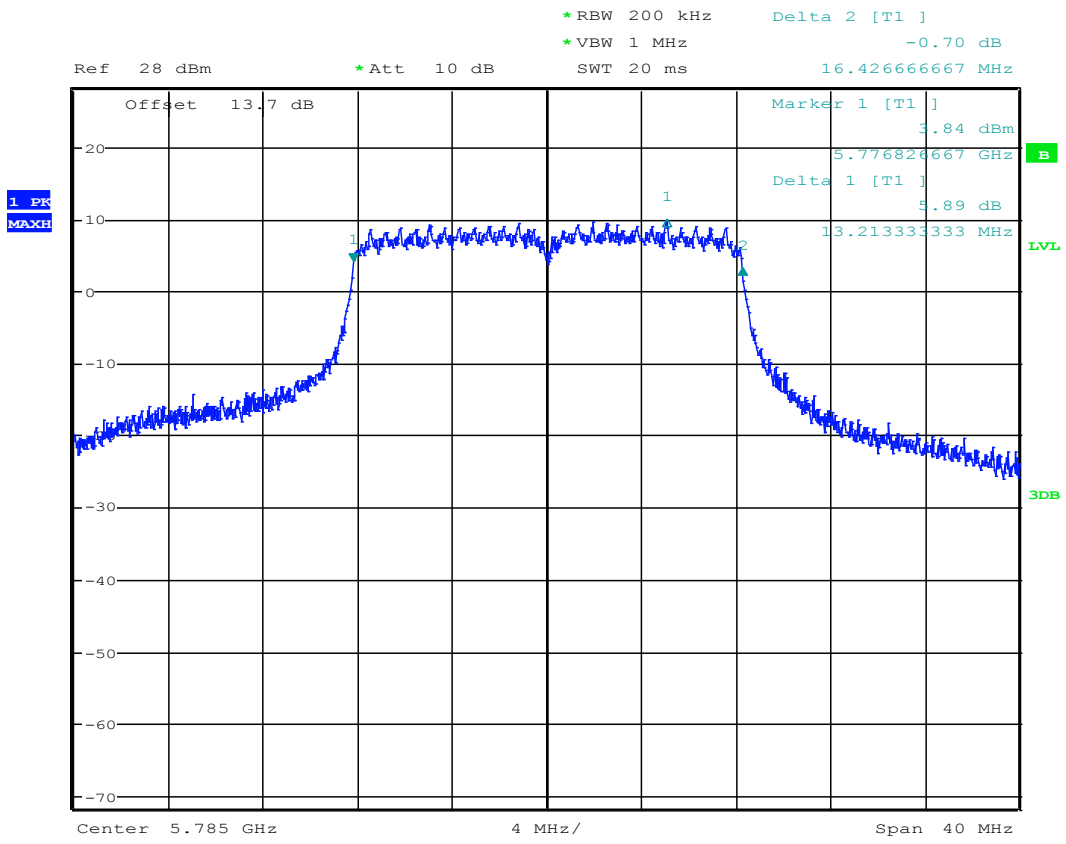
Plot #1

Low channel	Mode: 802.11a 6Mbps



Plot #2

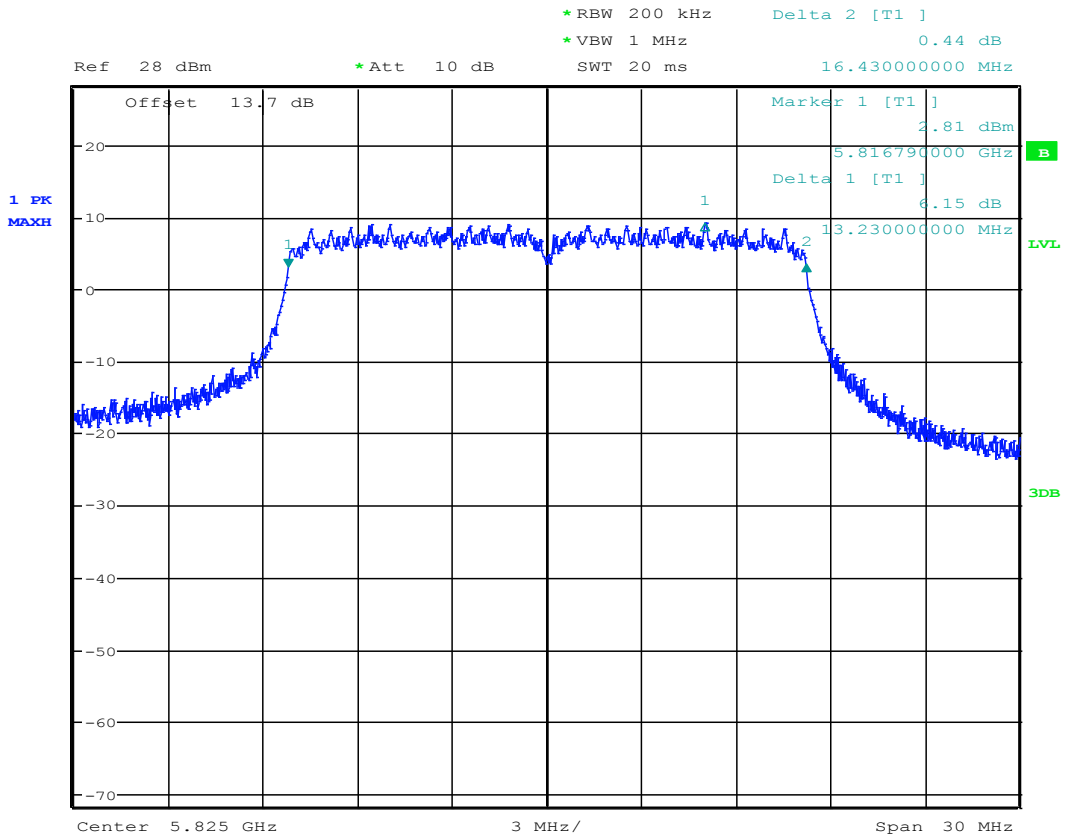
Mid channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 14:00:27

Plot #3

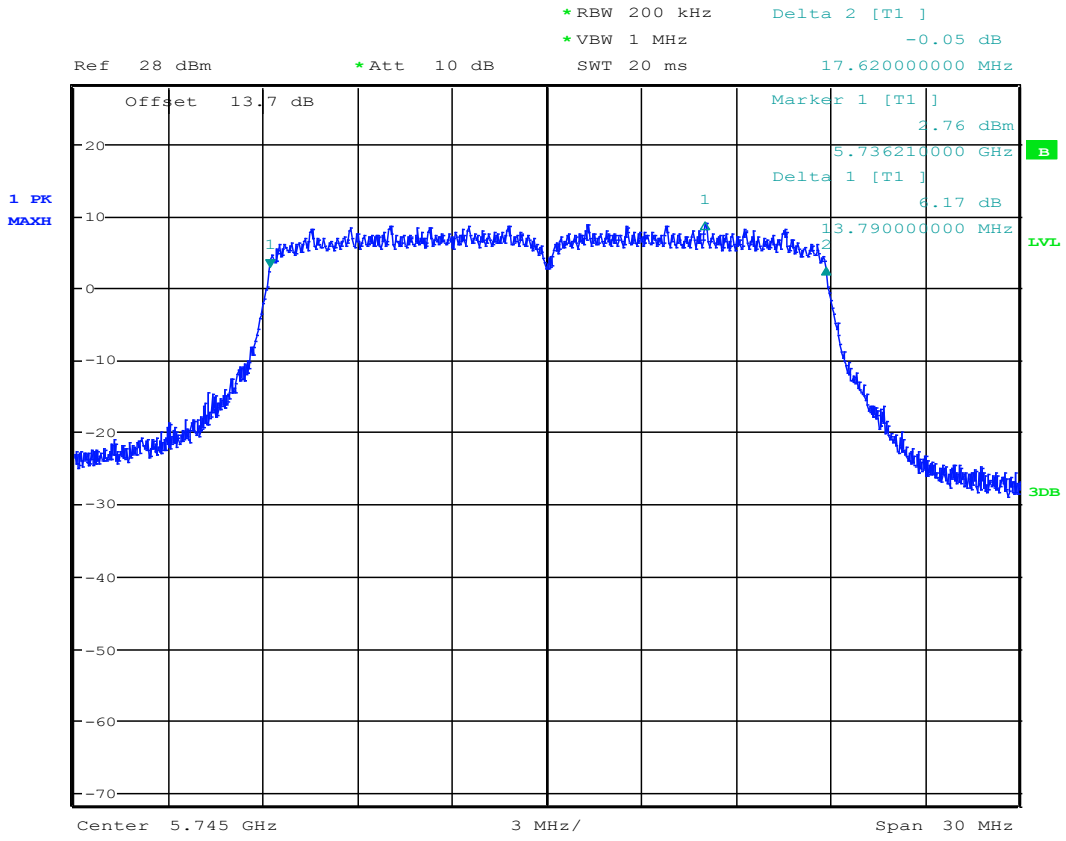
High channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 13:09:07

Plot #4

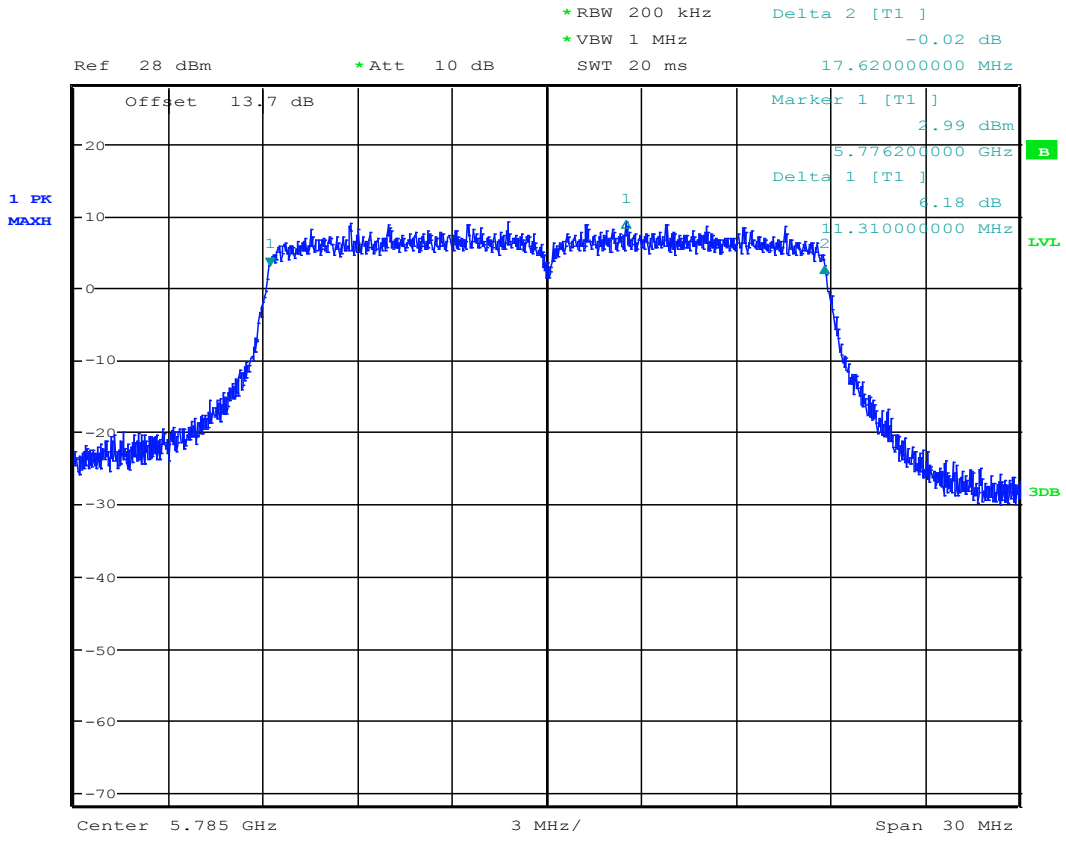
Low channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 10:53:18

Plot #5

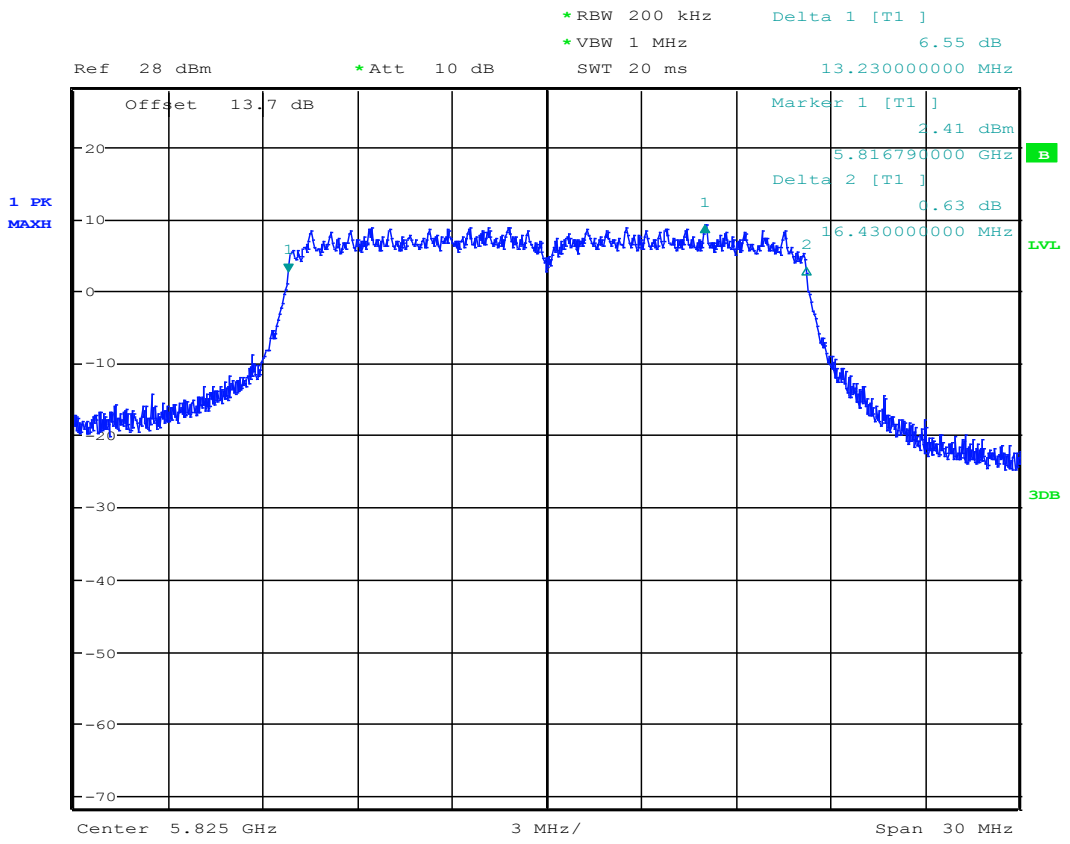
Mid channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 11:04:07

Plot #6

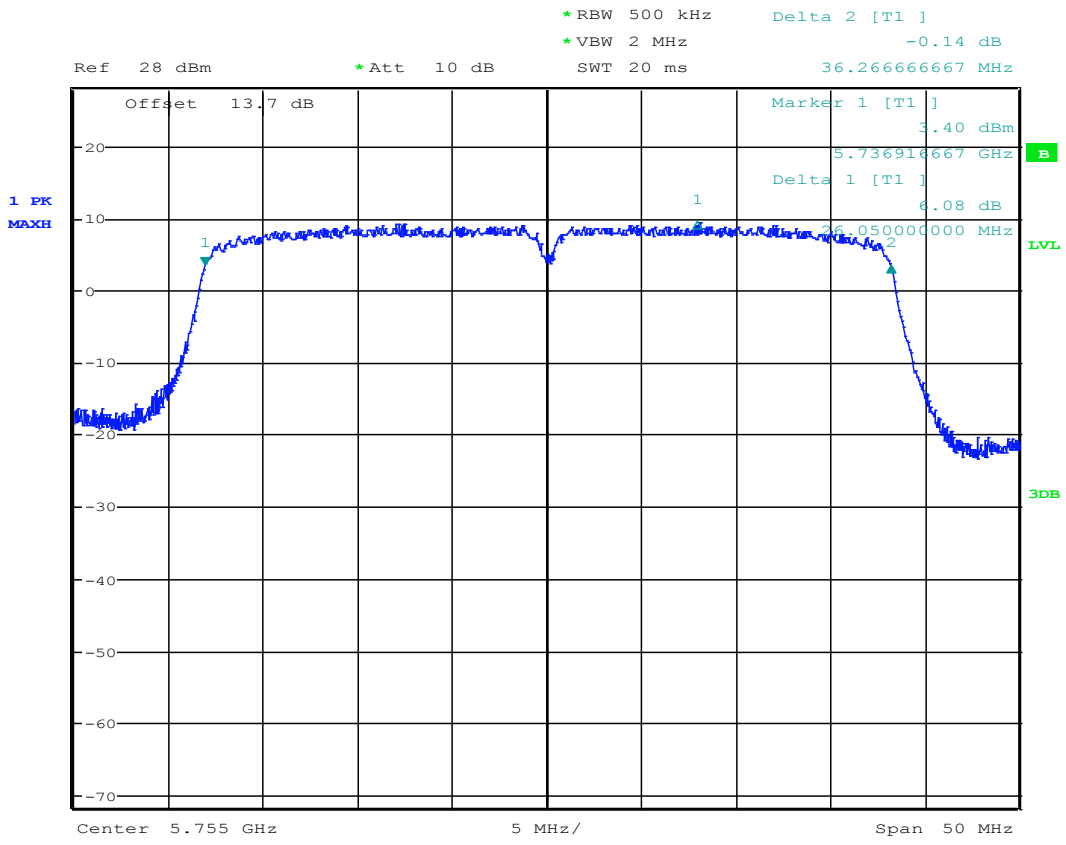
High channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 13:08:32

Plot #7

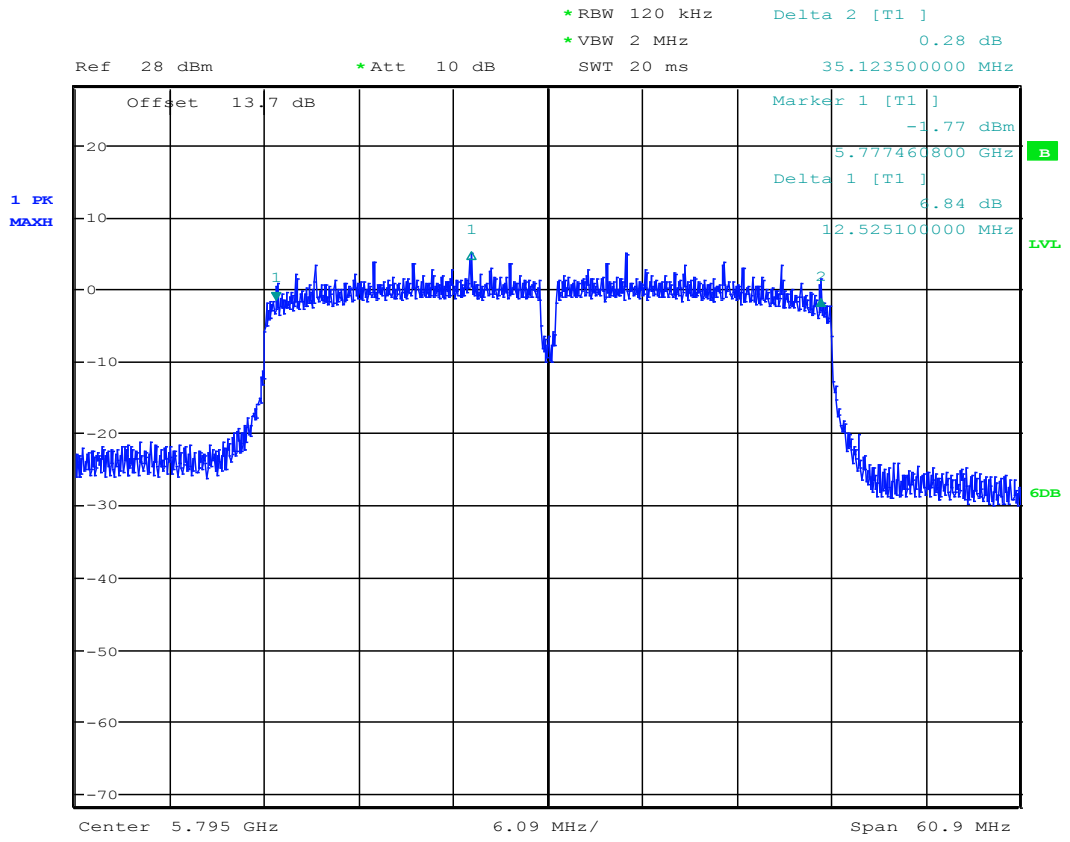
Low channel	Mode: 802.11n_40 MCS0



Date: 9.JAN.2019 21:00:01

Plot #8

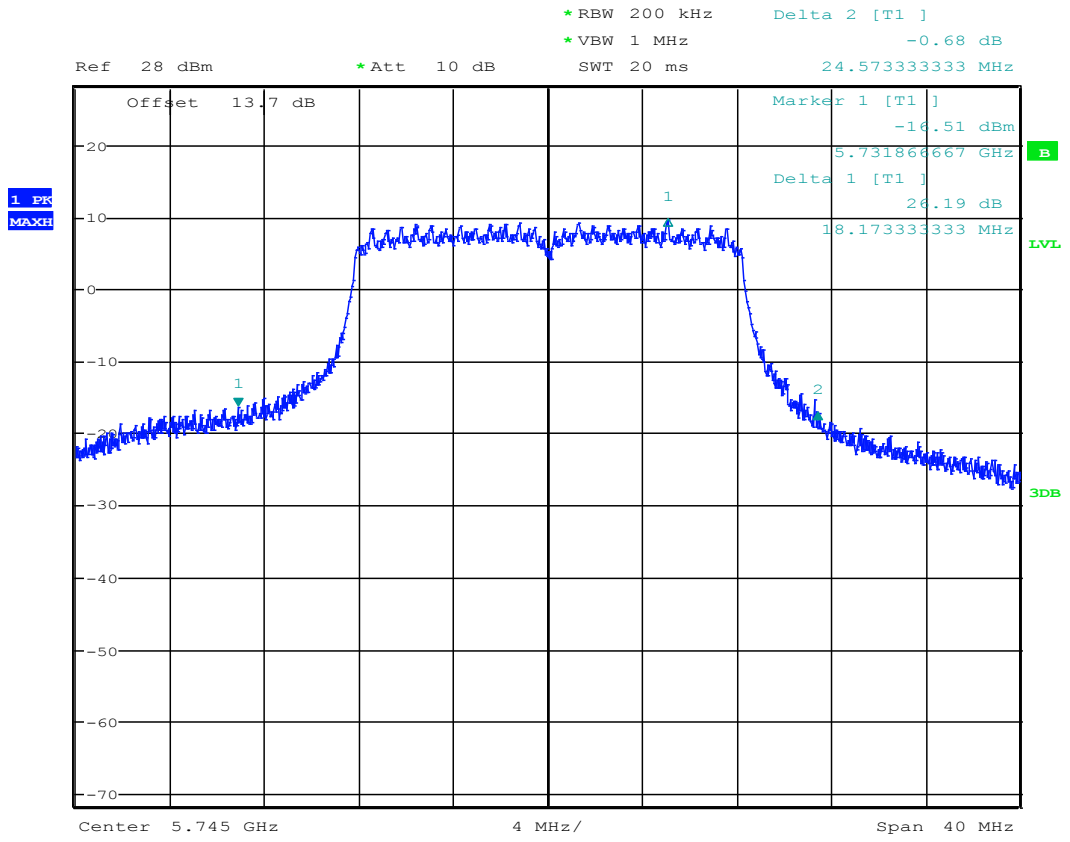
High channel	Mode: 802.11n_40 MCS0



Date: 10.JAN.2019 09:54:46

Plot #9

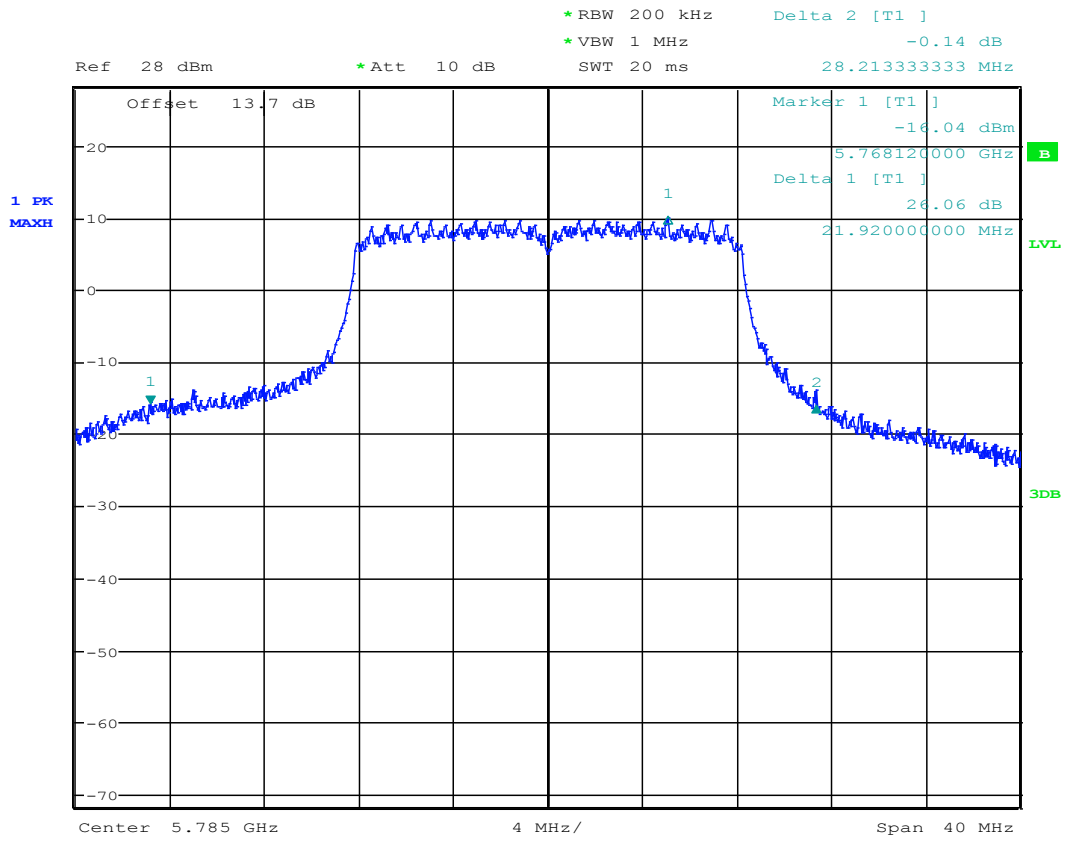
Low channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 14:39:05

Plot #10

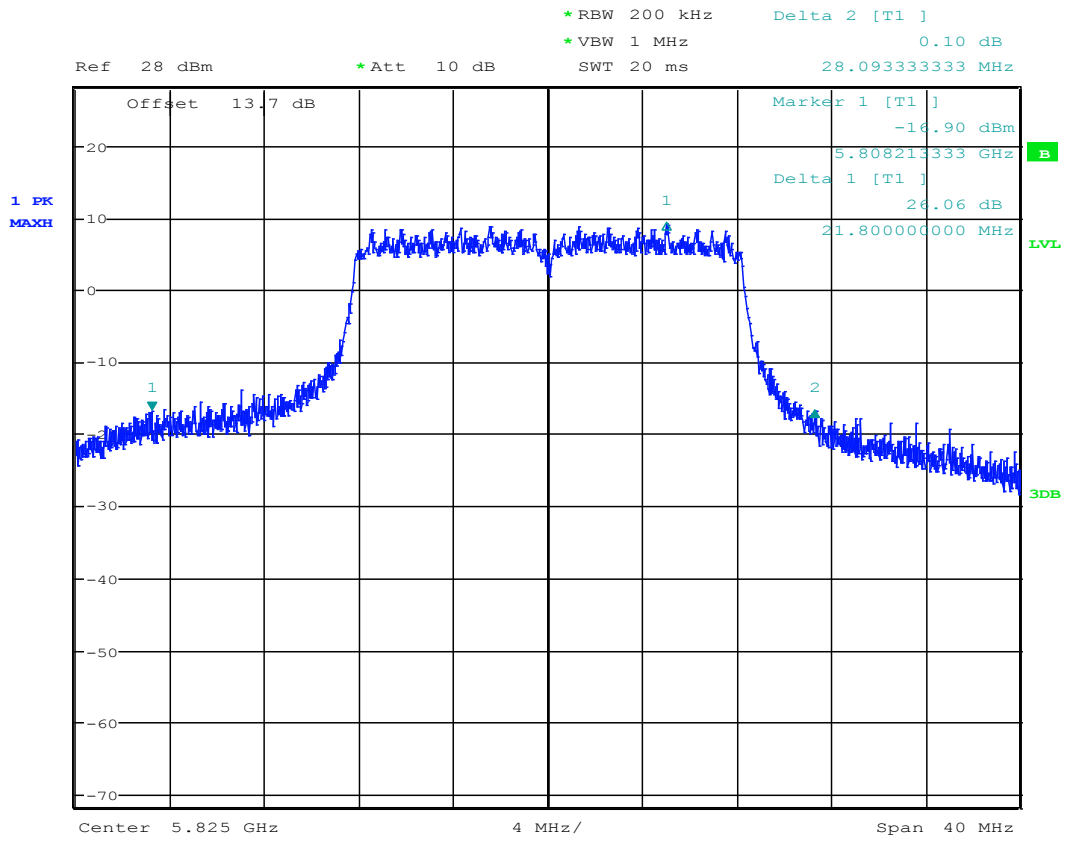
Mid channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 13:52:02

Plot #11

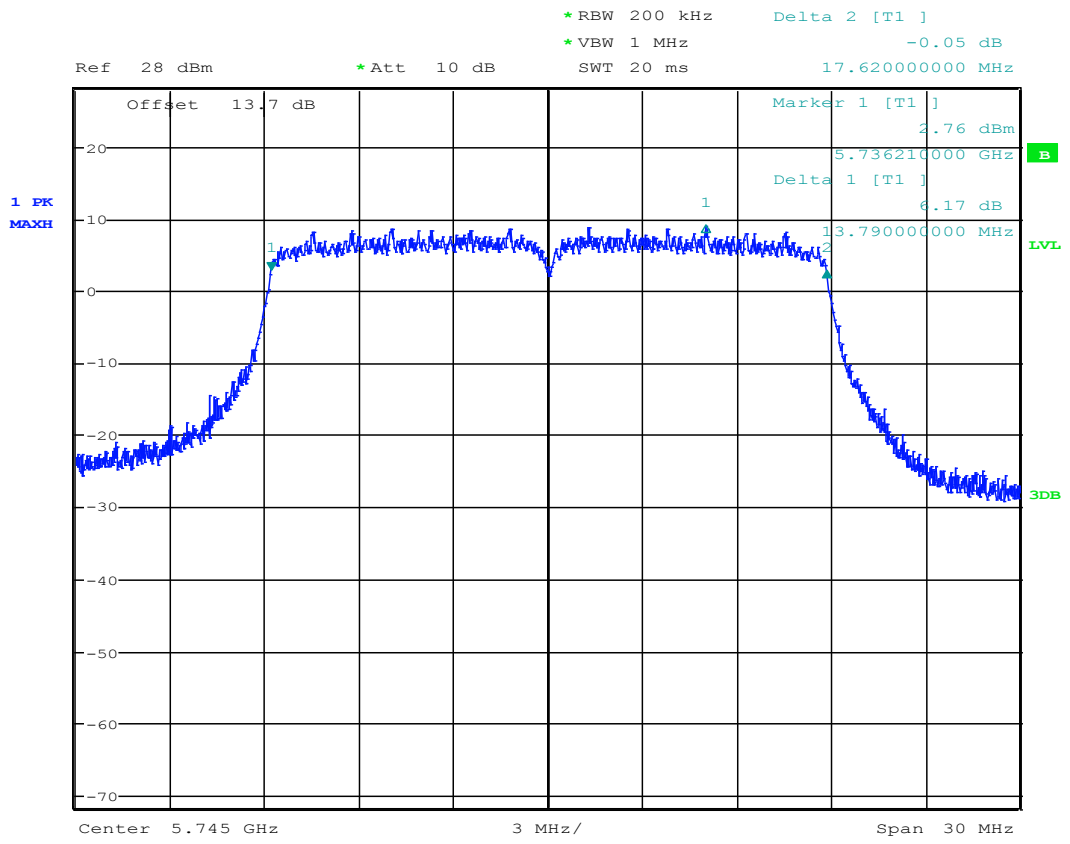
High channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 13:36:23

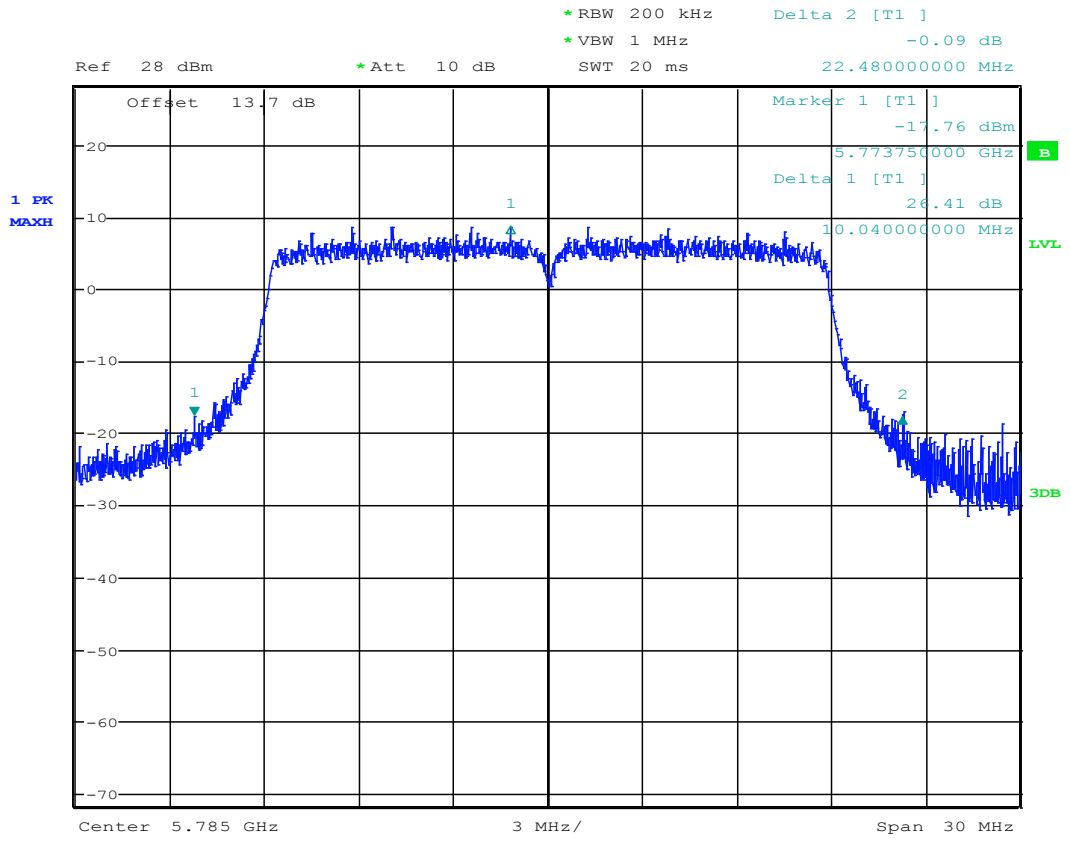
Plot #12

Low channel	Mode: 802.11n_20 MCS0



Plot #13

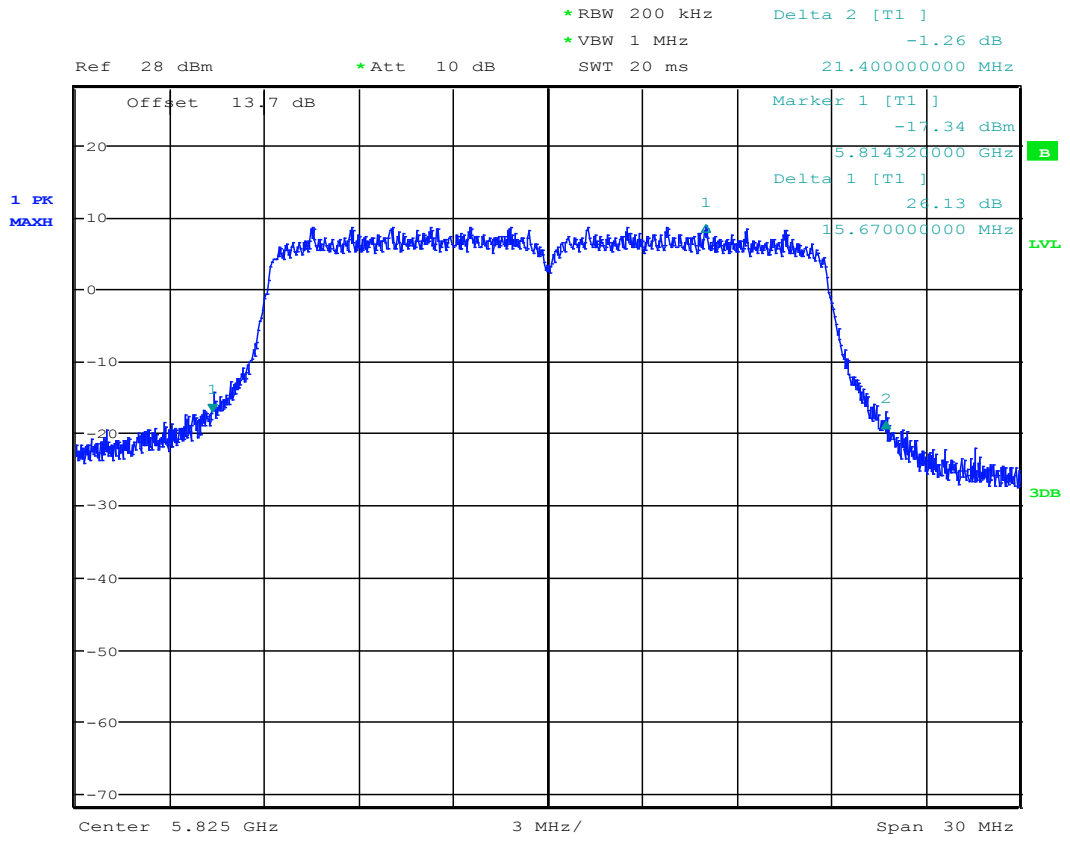
Mid channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 11:01:39

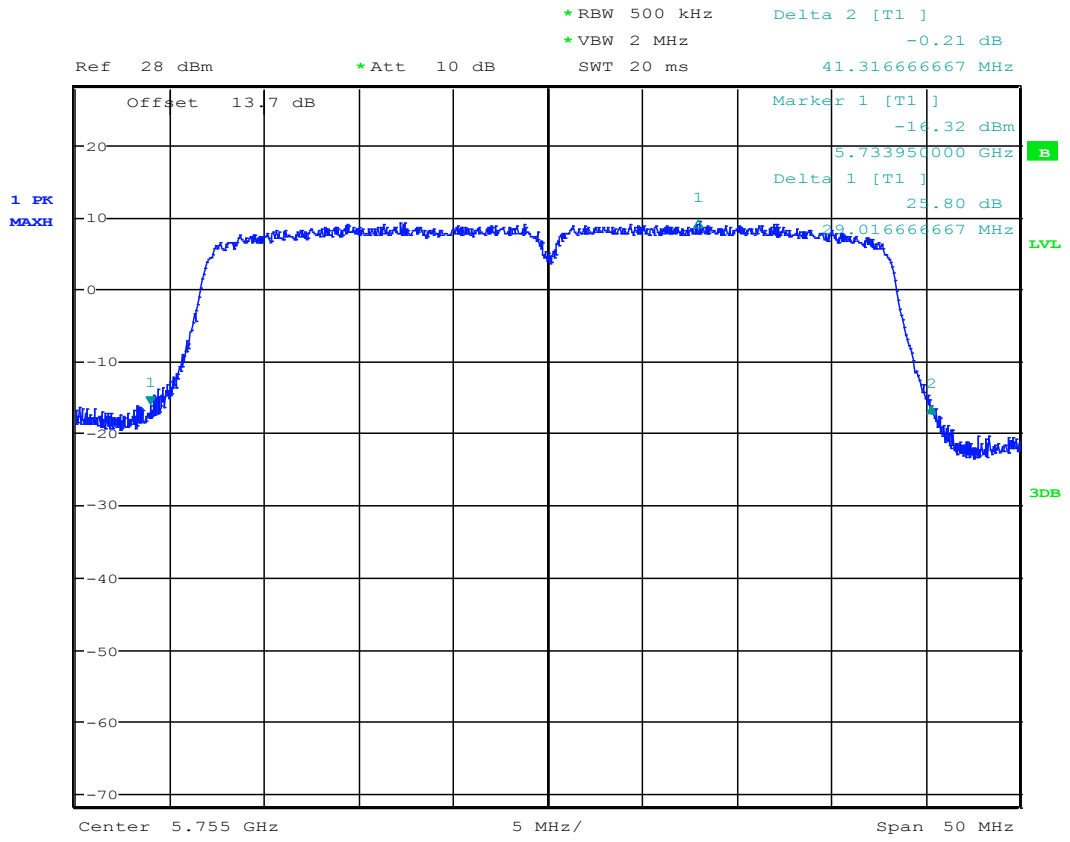
Plot #14

High channel	Mode: 802.11n_20 MCS0



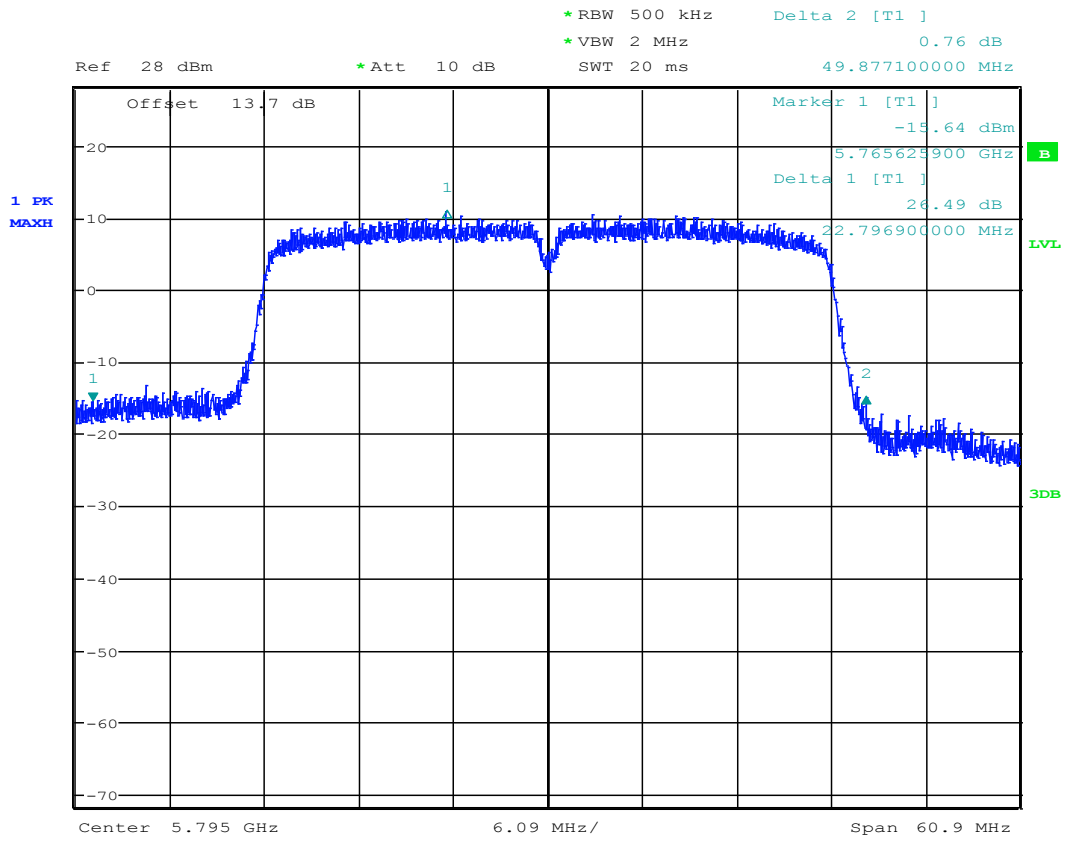
Plot #15

Low channel	Mode: 802.11n_40 MCS0



Plot #16

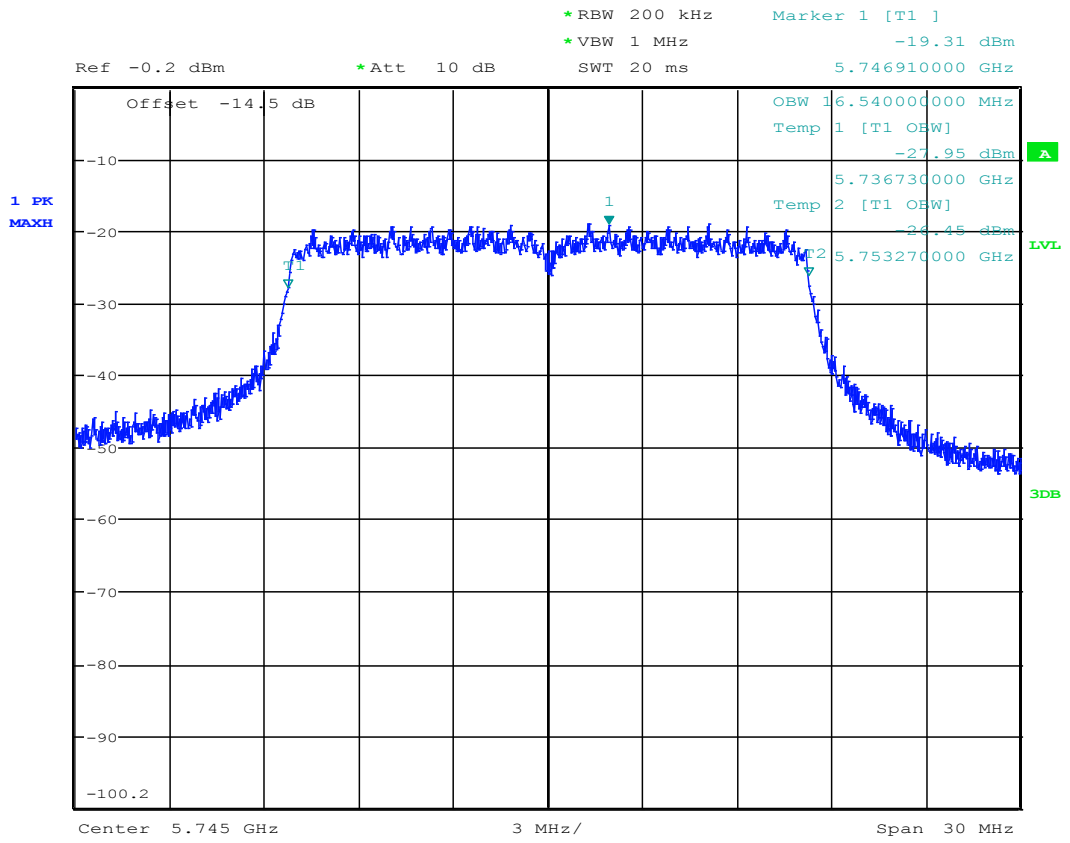
High channel	Mode: 802.11n_40 MCS0



Date: 10.JAN.2019 10:13:29

Plot #17

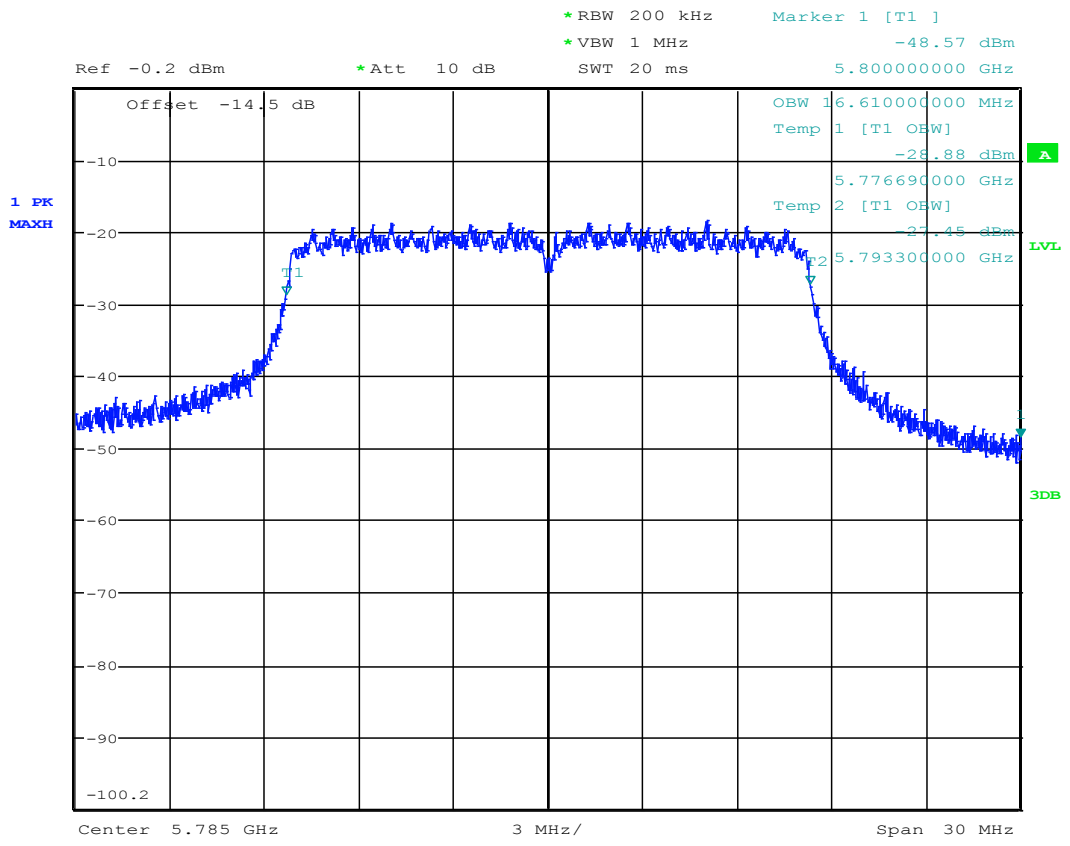
Low channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 14:36:12

Plot #18

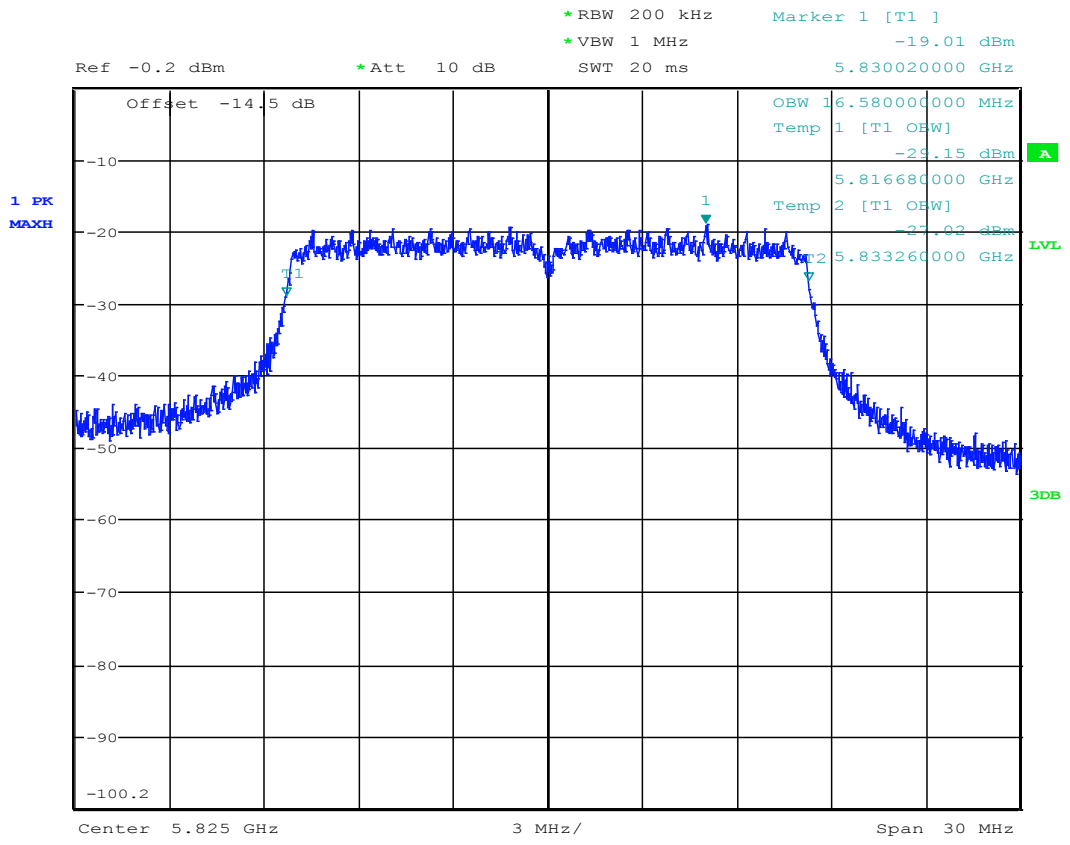
Mid channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 14:33:36

Plot #19

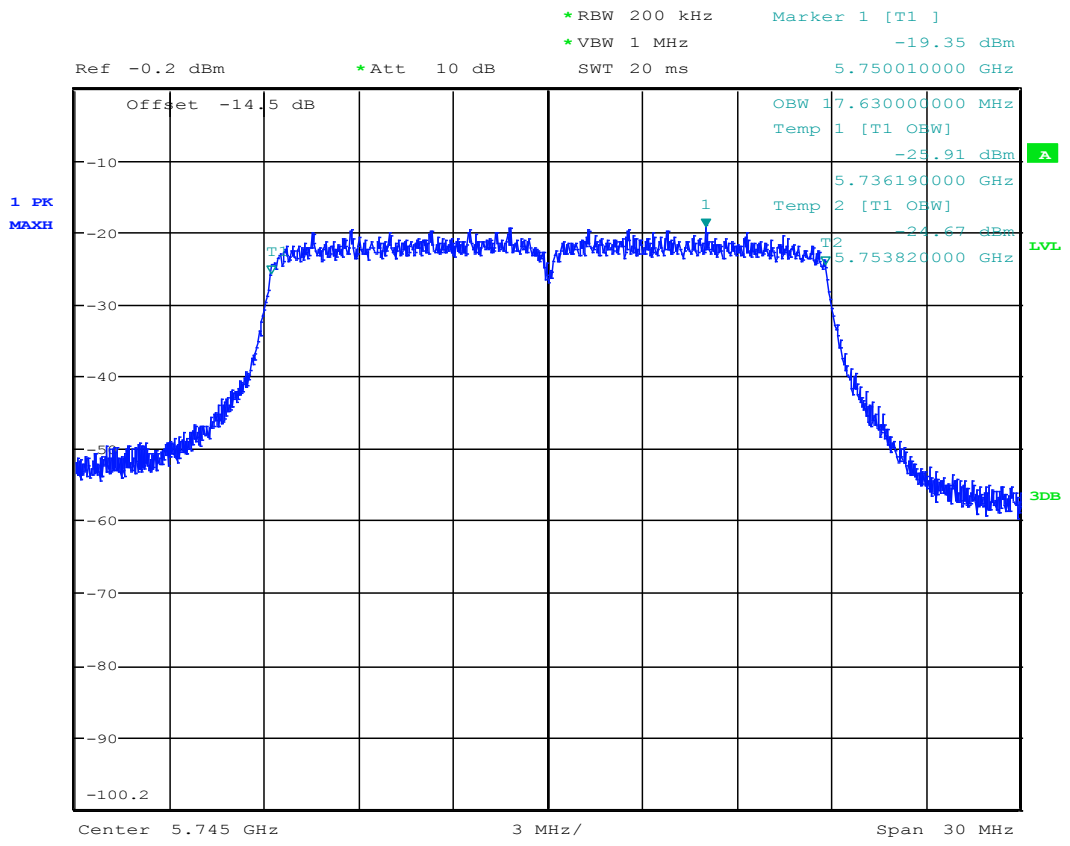
High channel	Mode: 802.11a 6Mbps



Date: 10.JAN.2019 13:11:07

Plot #20

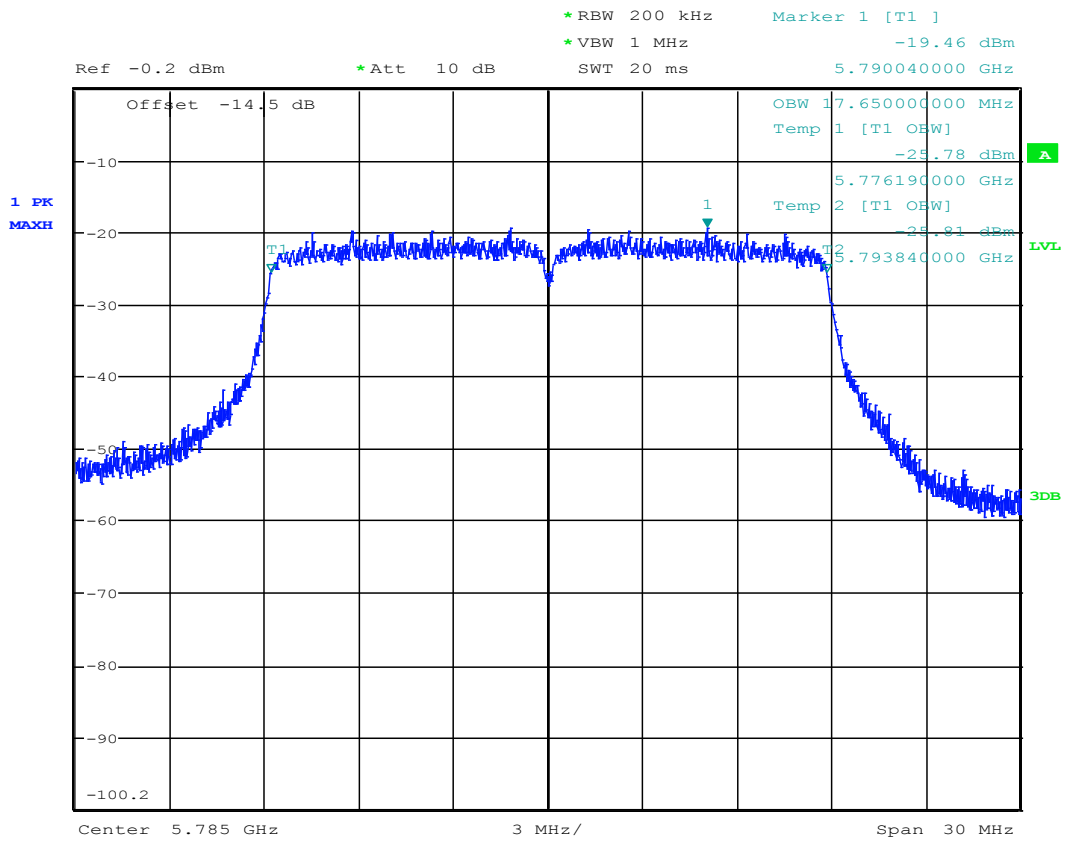
Low channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 10:46:06

Plot #21

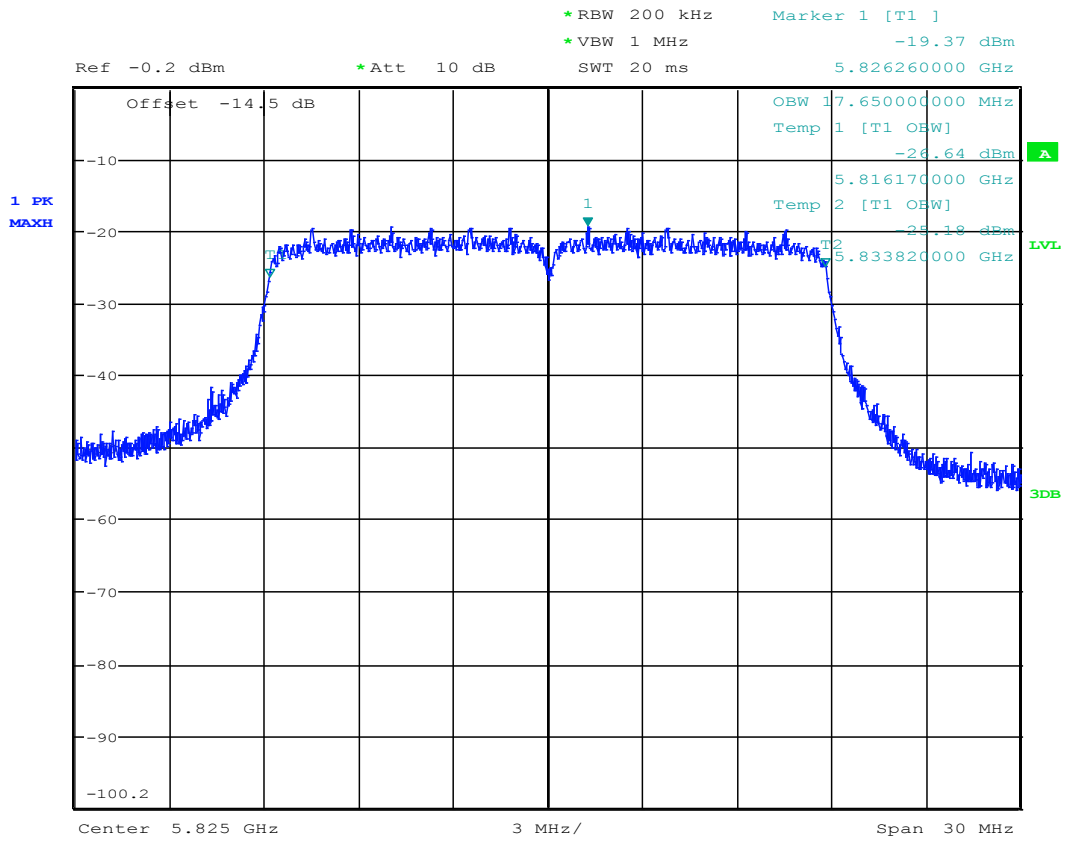
Mid channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 10:55:46

Plot #22

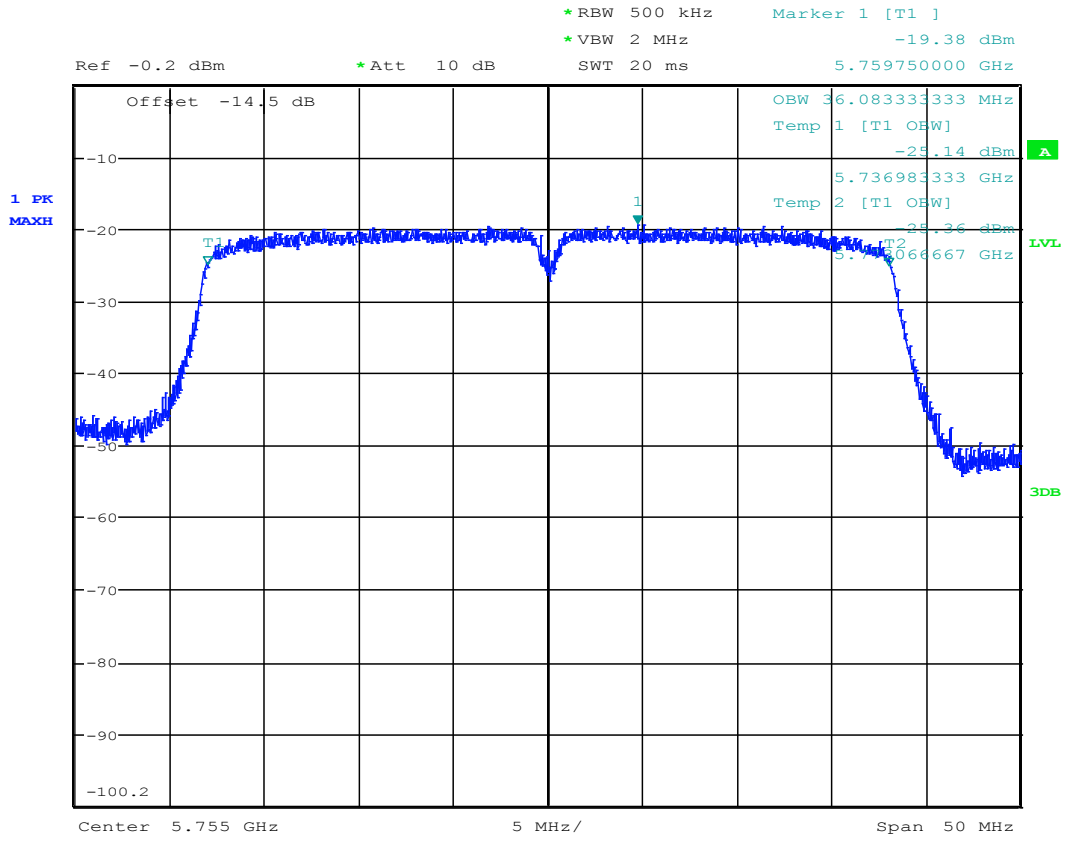
High channel	Mode: 802.11n_20 MCS0



Date: 10.JAN.2019 12:13:14

Plot #23

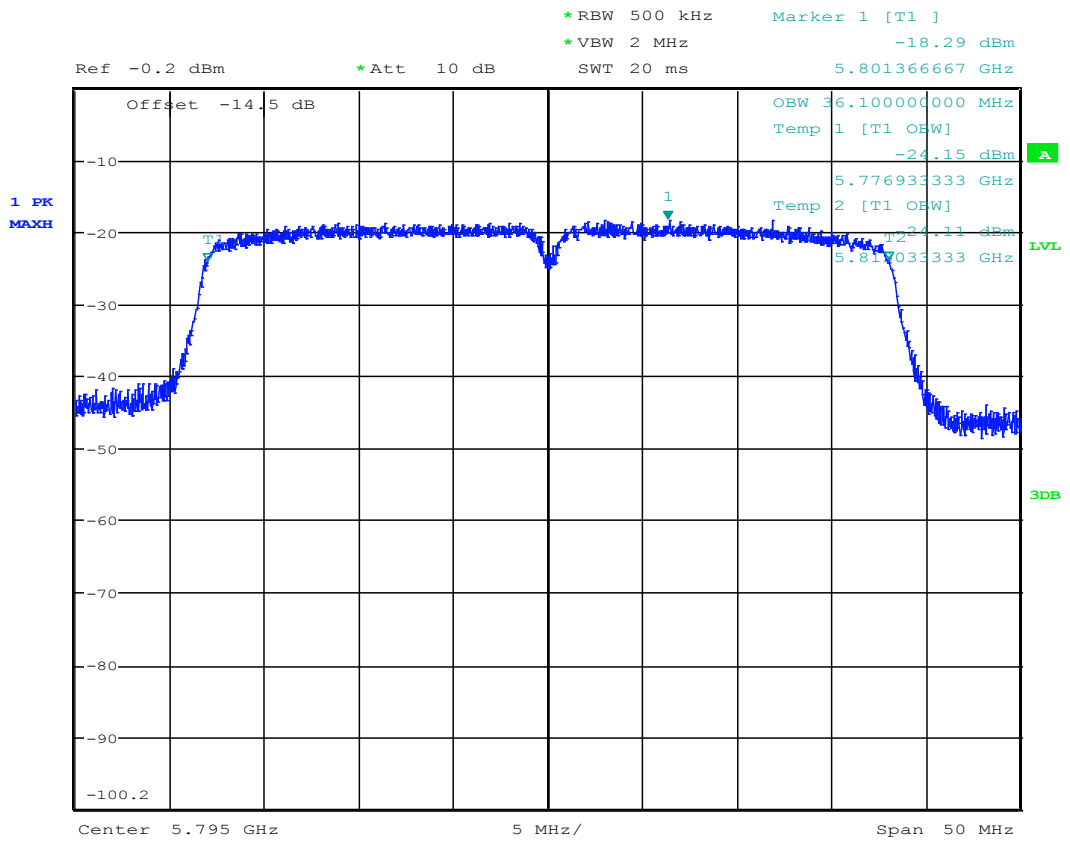
Low channel	Mode: 802.11n_40 MCS0



Date: 9.JAN.2019 21:00:58

Plot #24

High channel	Mode: 802.11n_40 MCS0



Date: 10.JAN.2019 10:01:50

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	157	5785.041	5785	7.00
25	a	157	5785.003	5785	0.52
40	a	157	5785.001	5785	0.22
0	n-20	157	5785.039	5785	6.74
25	n-20	157	5784.99	5785	1.82
40	n-20	157	5785.008	5785	1.30
0	n-40	159	5795.035	5795	6.04
25	n-40	159	5794.998	5795	0.27
40	n-40	159	5795.005	5795	0.86

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

- 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 & RSS-Gen 8.9

- 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 & RSS-Gen 8.10

- 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 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	High n40 MIMO	30 MHz – 18 GHz	See section 8.6.2	Pass

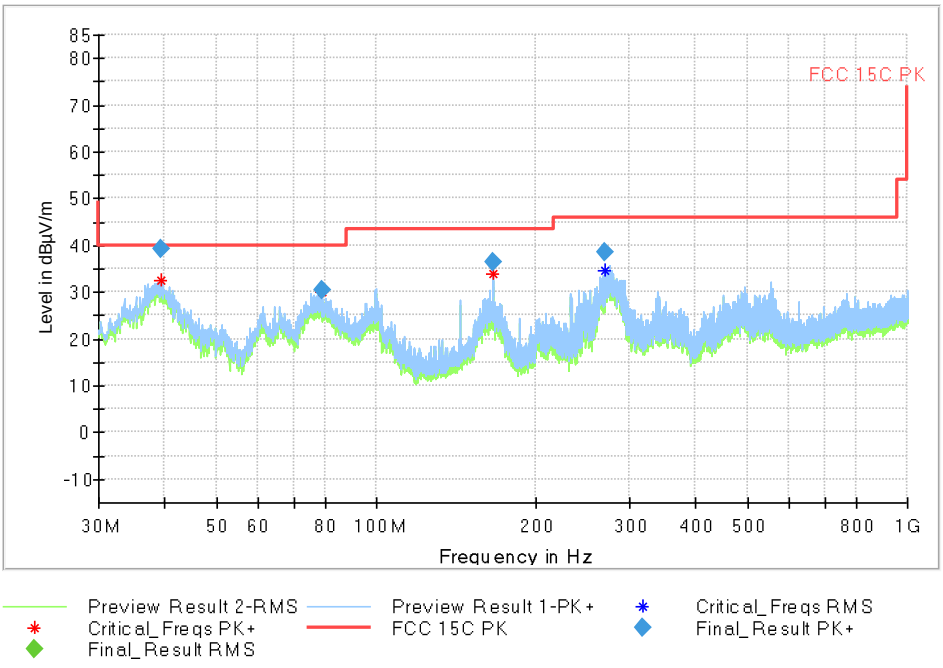
8.7.5 Measurement Plots:

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

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.421	39.15	40.00	0.85	100.0	100.0	108.0	V
78.866	30.52	40.00	9.48	100.0	100.0	151.0	V
165.990	36.53	43.50	6.97	100.0	100.0	100.0	V
268.993	38.40	46.00	7.60	100.0	100.0	173.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.421	287.0	-14	5:34:12 PM - 1/8/2019
78.866	70.0	-24	5:26:14 PM - 1/8/2019
165.990	205.0	-20	5:31:35 PM - 1/8/2019
268.993	199.0	-18	5:28:57 PM - 1/8/2019

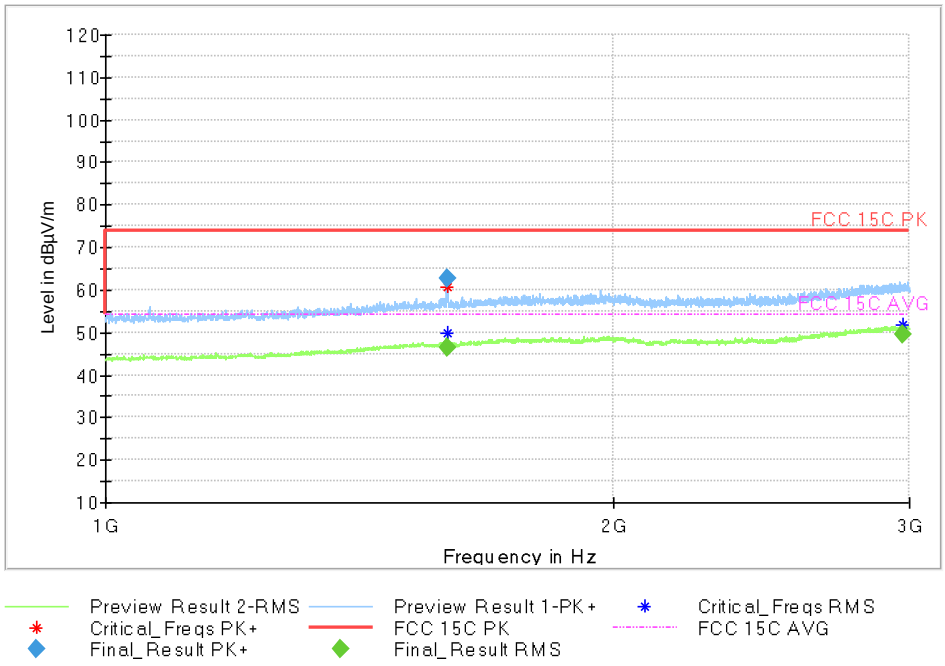


Plot #2 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Low**	**95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Heig (cm
1595.210	---	46.40	53.98	7.58	300.0	1000.0	31
1595.895	62.54	---	74.00	11.46	300.0	1000.0	28
2973.145	---	49.60	53.98	4.38	300.0	1000.0	26

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)	Comr
1595.210	271.0	20	-10	0	30	27	3:00:21 PM -
1595.895	227.0	20	-10	0	30	43	2:54:23 PM -
2973.145	-78.0	23	-9	0	32	26	2:57:26 PM -

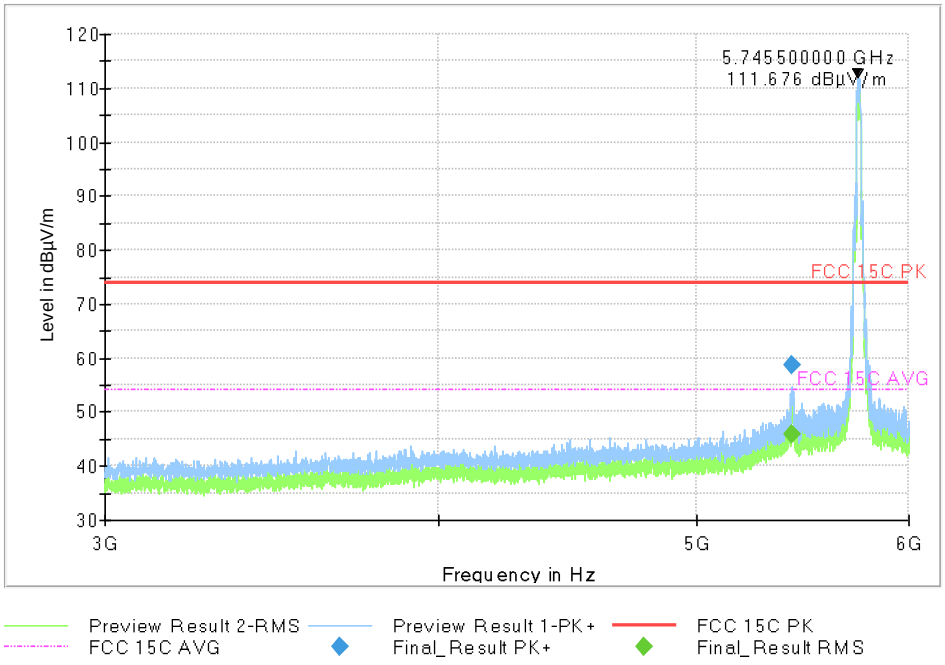


Plot #3 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Low**	**95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5423.233	---	45.97	53.98	8.01	100.0	1000.0	187.0	V
5424.823	58.61	---	73.99	15.38	100.0	1000.0	184.0	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
5423.233	176.0	2	14	0	-12	44	5:30:02 PM - 12/26/2018
5424.823	178.0	2	14	0	-12	57	5:27:21 PM - 12/26/2018

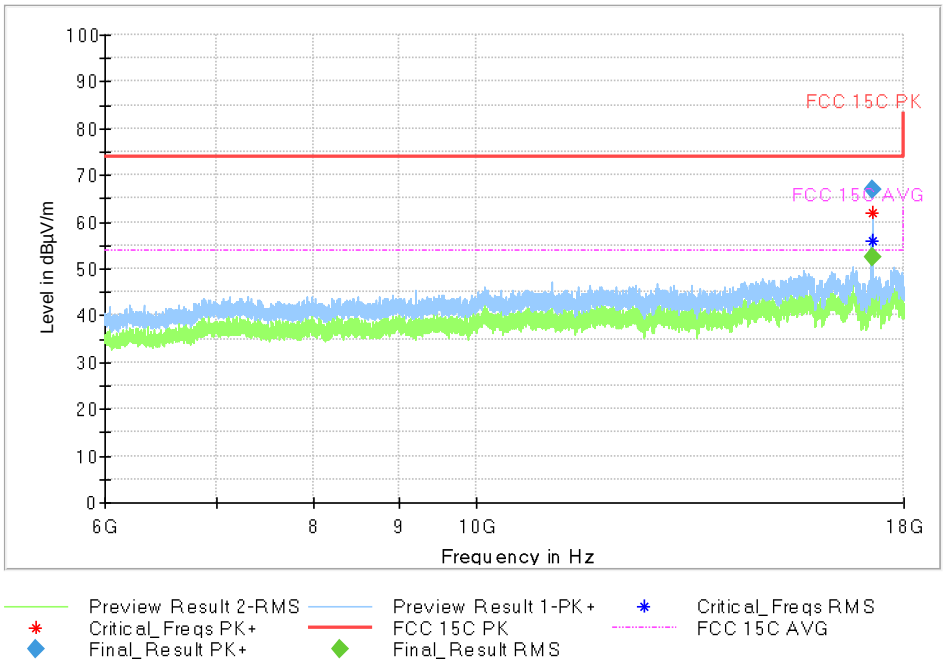


Plot #4 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Low**	**95.18% Duty Cycle**

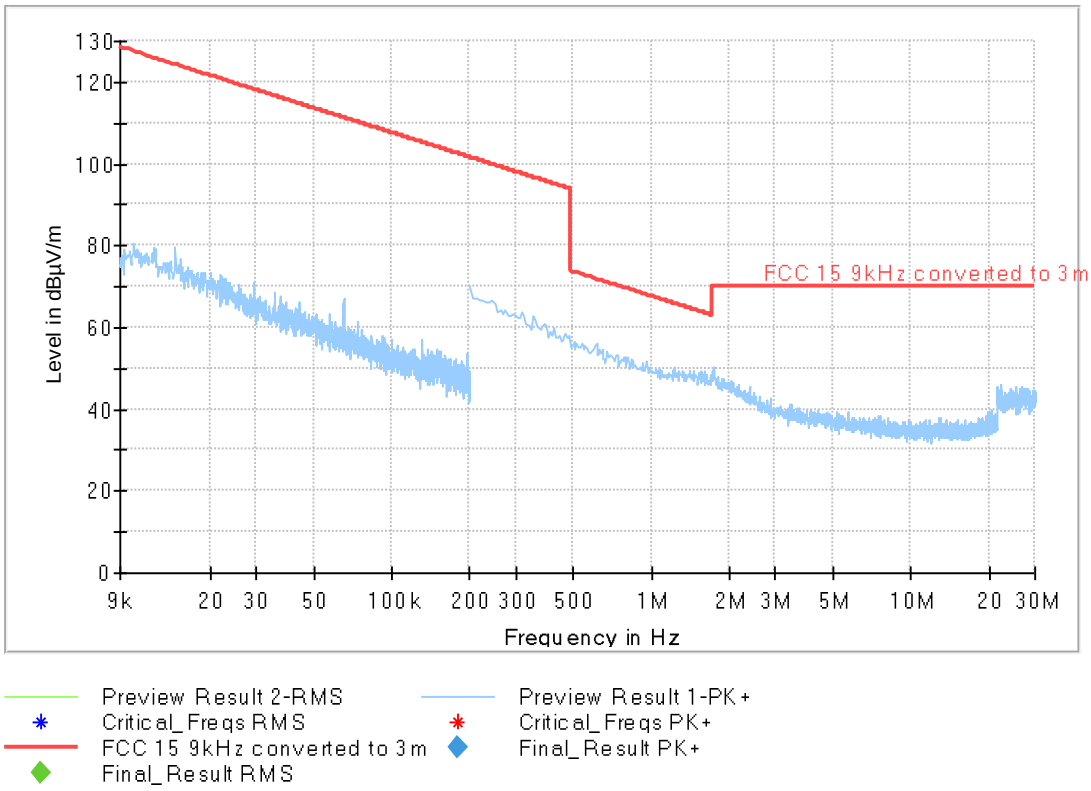
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
17238.128	---	52.34	53.98	1.64	100.0	1000.0	167.0	V
17240.085	67.05	---	73.98	6.93	100.0	1000.0	210.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
17238.128	301.0	-9	1:36:20 PM - 12/21/2018
17240.085	301.0	-9	1:33:09 PM - 12/21/2018



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

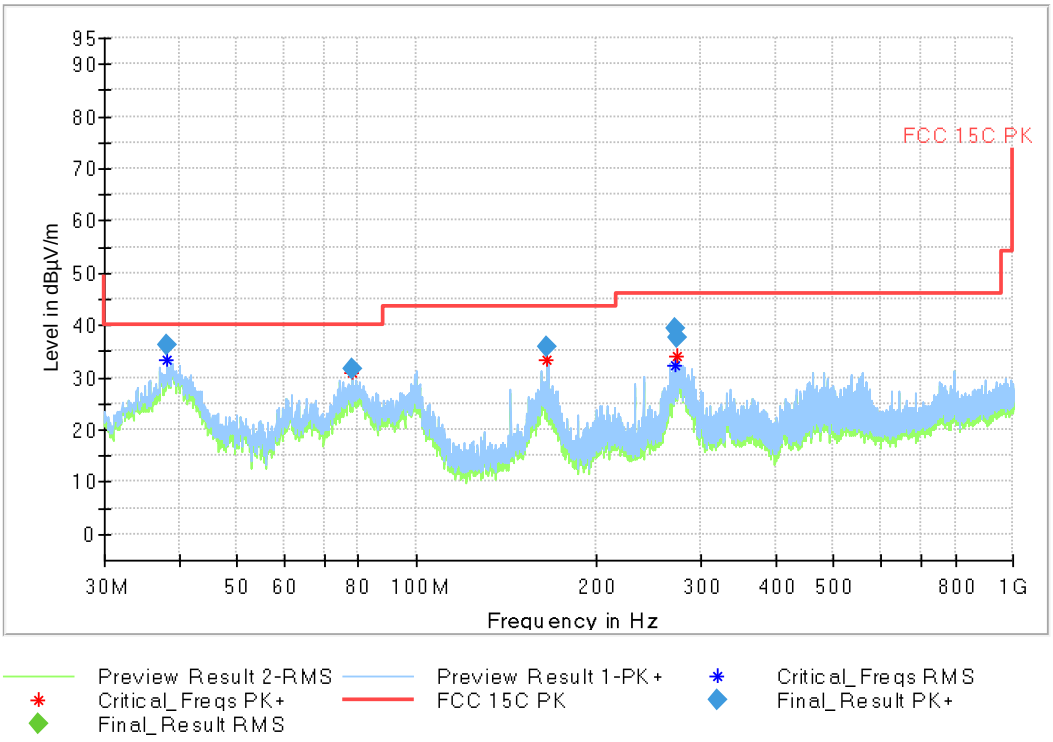


Plot #6 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11n_20 MIMO	Channel: Mid	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
38.271	36.10	40.00	3.90	100.0	100.0	117.0	V
77.922	31.54	40.00	8.46	100.0	100.0	130.0	V
165.988	35.93	43.50	7.57	100.0	100.0	138.0	V
271.200	39.28	46.00	6.72	100.0	100.0	123.0	V
273.718	37.52	46.00	8.48	100.0	100.0	117.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
38.271	47.0	-14	5:45:41 PM - 1/8/2019
77.922	227.0	-25	5:56:22 PM - 1/8/2019
165.988	196.0	-20	5:51:01 PM - 1/8/2019
271.200	186.0	-18	5:53:39 PM - 1/8/2019
273.718	34.0	-18	5:48:15 PM - 1/8/2019

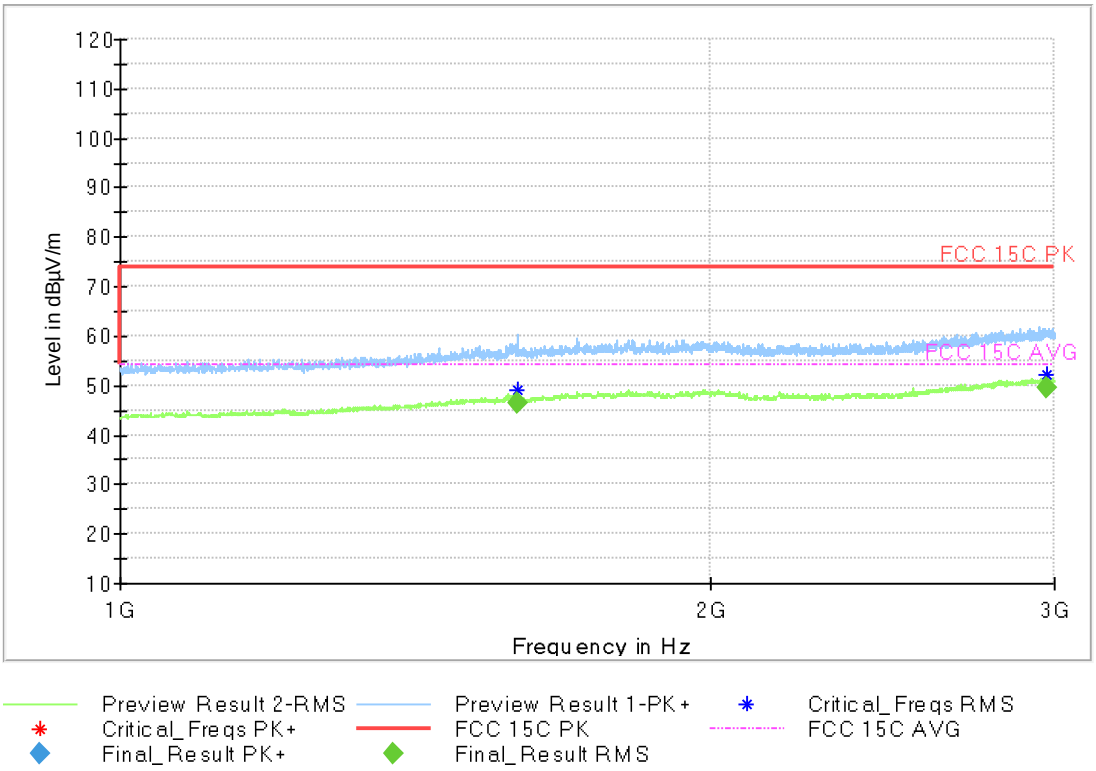


Plot #7 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Heig (cm)	Pol
1596.380	46.26	53.98	7.72	300.0	1000.0	164.0	V
2973.135	49.57	53.98	4.41	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
1596.380	218.0	20	-10	0	30	26	3:18:42 PM - 1/7/2019
2973.135	90.0	23	-9	0	32	26	3:16:07 PM - 1/7/2019

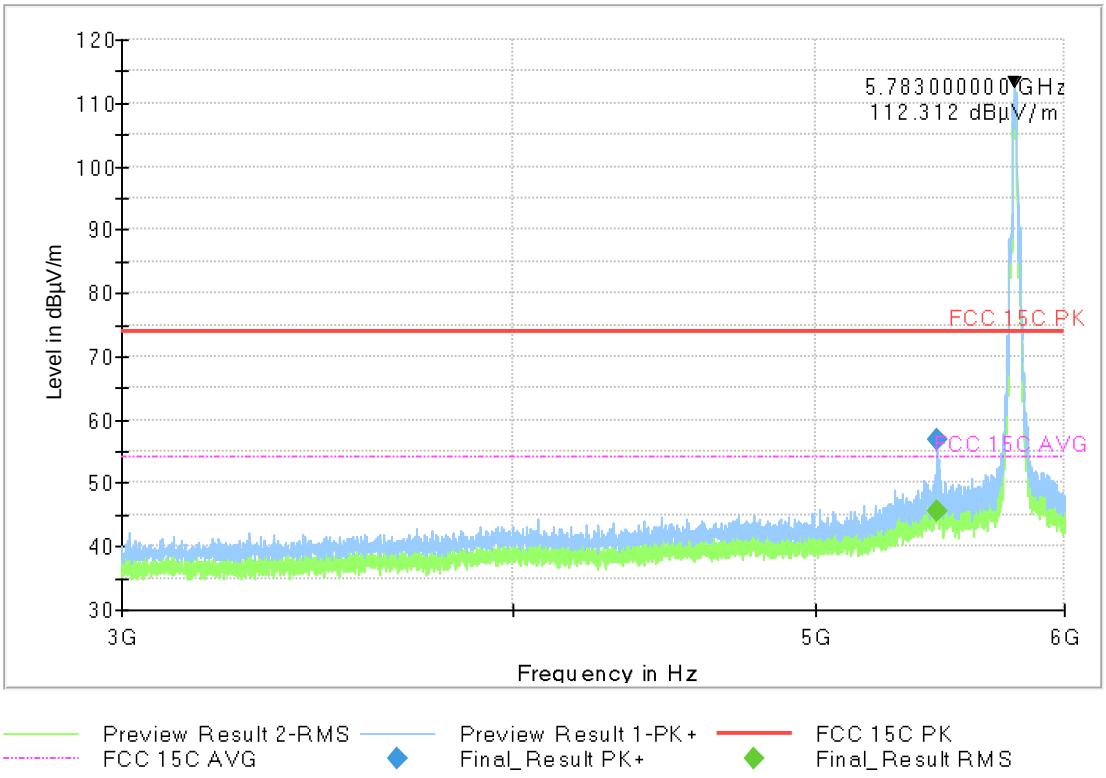


Plot #8 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: Mid**	**95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5463.727	---	45.43	53.98	8.55	100.0	1000.0	159.0	V
5466.397	56.75	---	73.99	17.24	100.0	1000.0	159.0	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
5463.727	172.0	2	14	0	-12	44	5:44:57 PM - 12/26/2018
5466.397	173.0	2	14	0	-12	55	5:42:20 PM - 12/26/2018

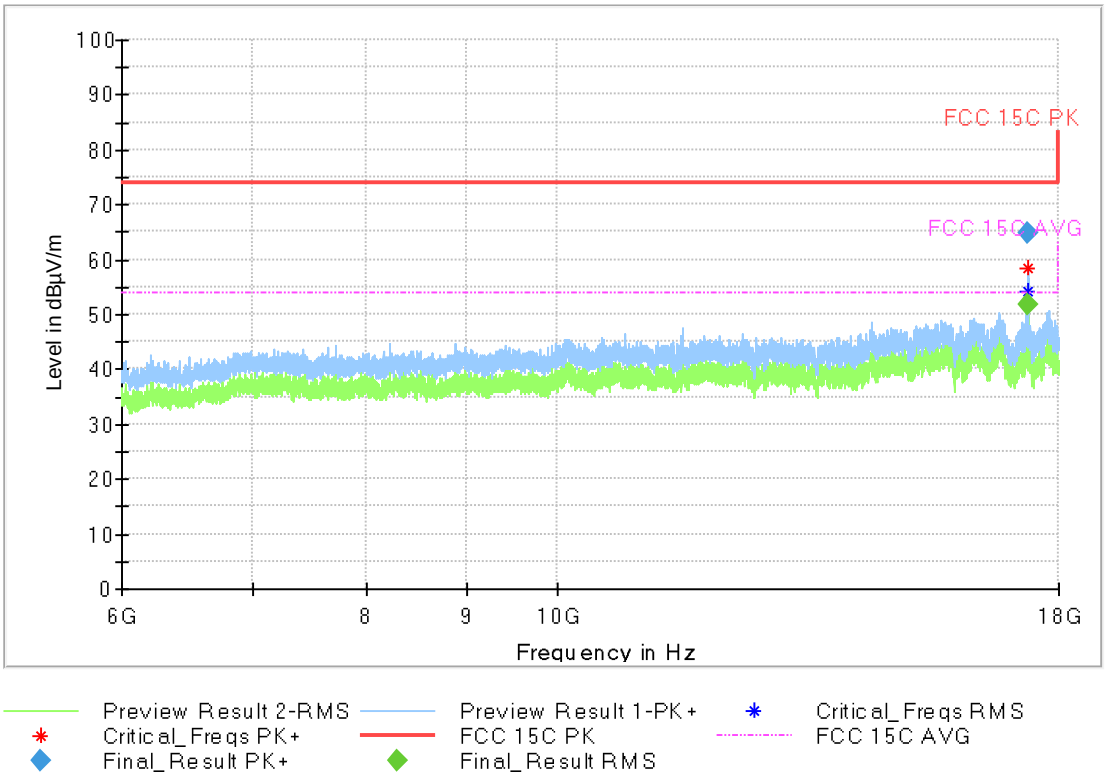


Plot #9 Radiated Emissions: 6-18 GHz		
Modulation: 802.11n_20 Tx Chain0	**Channel: Mid**	**95.18% Duty Cycle**

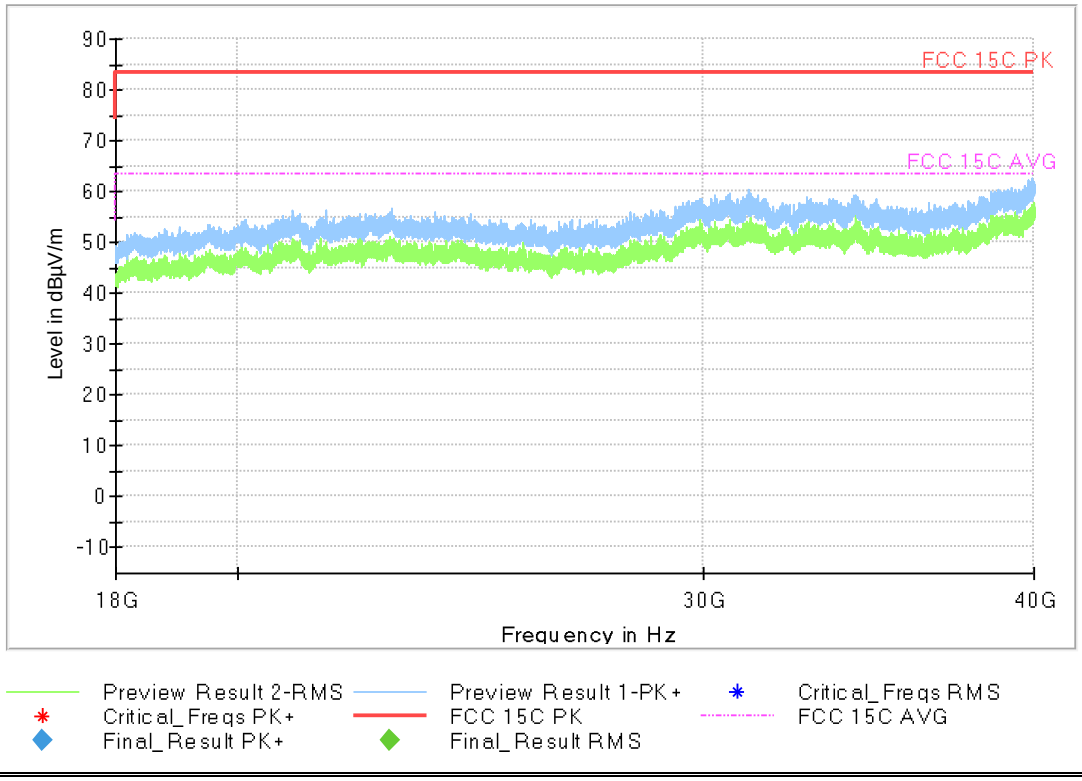
Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
17350.259	64.95	---	73.98	9.03	100.0	1000.0	124.0	V
17355.170	---	51.69	53.98	2.29	100.0	1000.0	124.0	V

(continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
17350.259	301.0	-15	6:58:30 PM - 1/2/2019
17355.170	302.0	-15	7:47:47 PM - 1/2/2019



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

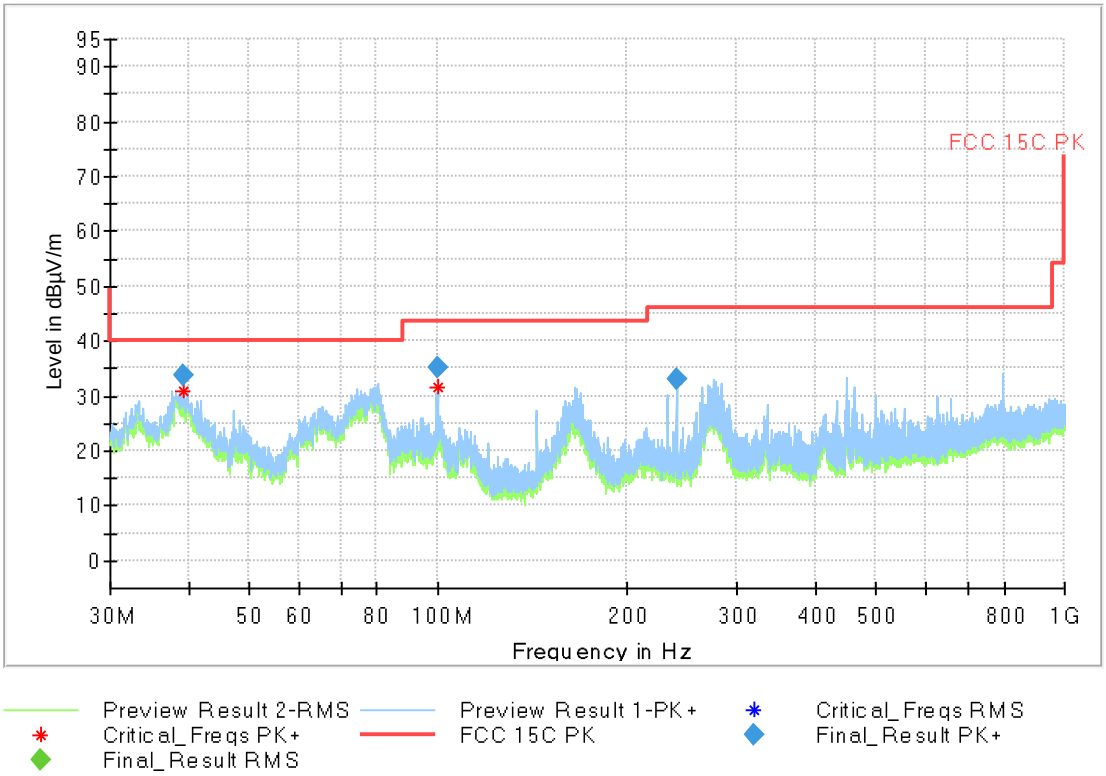


Plot #11 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11n_20 MIMO	**Channel: High**	**95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
39.359	33.67	---	40.00	6.33	100.0	100.0	202.0	V
99.750	35.18	---	43.50	8.32	100.0	100.0	123.0	V
240.003	33.02	---	46.00	12.98	100.0	100.0	237.0	H

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
39.359	29.0	-14	6:15:57 PM - 1/8/2019
99.750	178.0	-22	6:18:50 PM - 1/8/2019
240.003	295.0	-19	6:21:29 PM - 1/8/2019

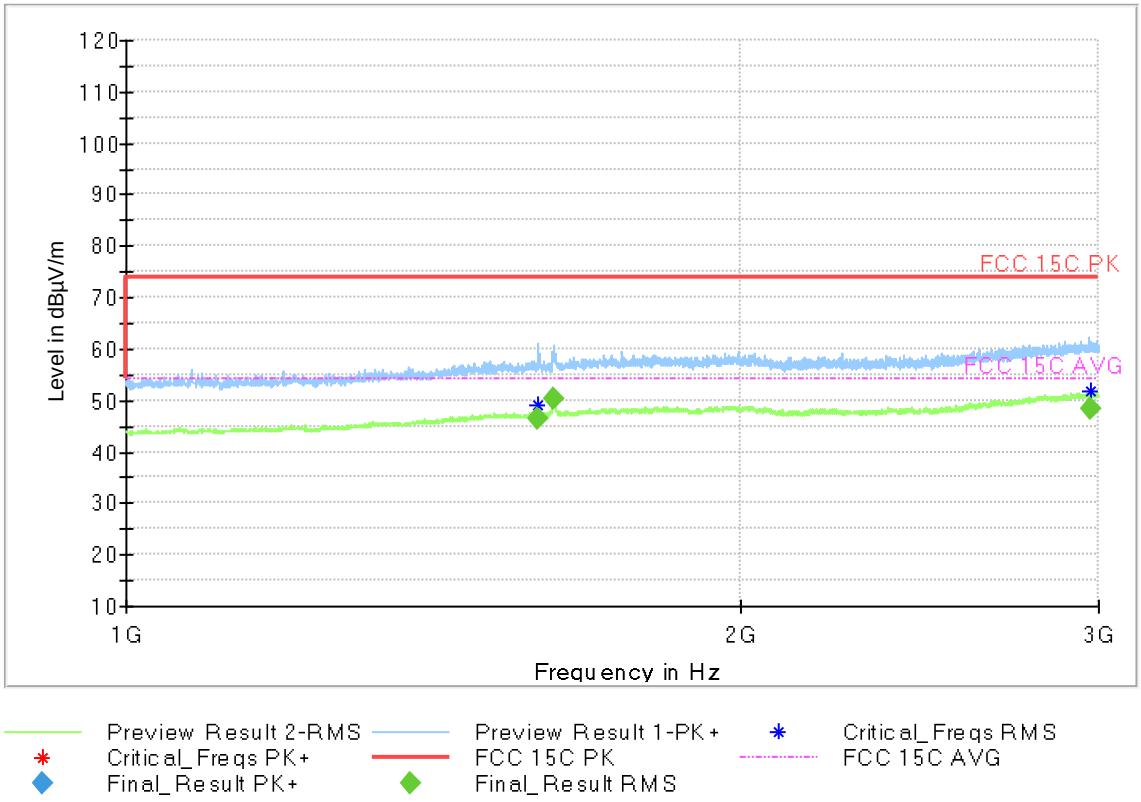


Plot #12 Radiated Emissions: 1-3 GHz		
Modulation: 802.11n_20 MIMO	Channel: High	95.18% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1593.765	---	46.53	53.98	7.45	300.0	1000.0	163.0	V
1621.700	---	50.27	53.98	3.70	300.0	1000.0	155.0	H
2975.695	---	48.38	53.98	5.60	300.0	1000.0	325.0	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
1593.765	79.0	20	-10	0	30	27	3:35:17 PM - 1/7/2019
1621.700	344.0	20	-10	0	30	30	3:40:55 PM - 1/7/2019
2975.695	279.0	23	-9	0	32	25	3:38:09 PM - 1/7/2019

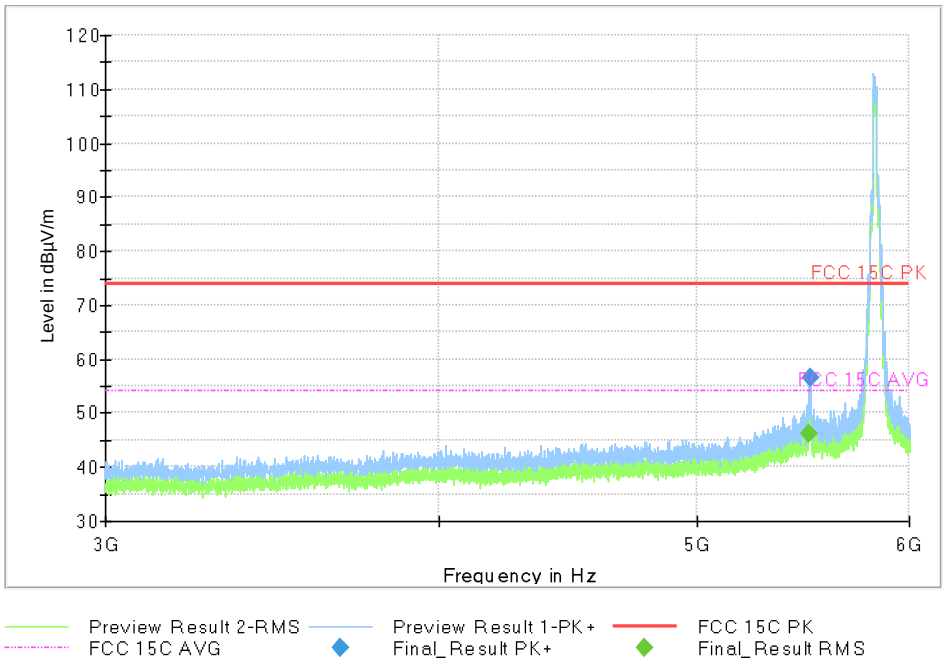


Plot #13 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_20 MIMO	**Channel: High**	**95.18% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5506.510	---	46.11	53.98	7.87	100.0	1000.0	173.0	V
5508.513	56.42	---	73.99	17.56	100.0	1000.0	172.0	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
5506.510	162.0	2	14	0	-12	45	5:59:02 PM - 12/26/2018
5508.513	171.0	2	14	0	-12	55	5:56:23 PM - 12/26/2018



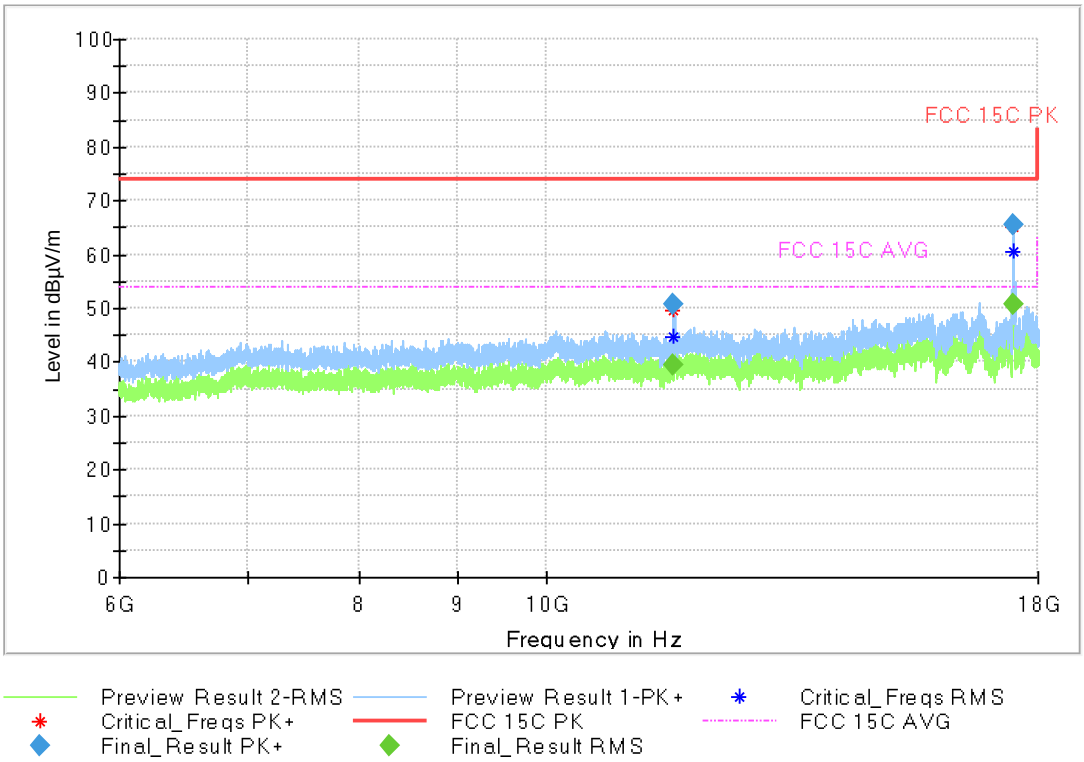
Plot #14 Radiated Emissions: 6-18 GHz

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
11648.235	---	39.29	53.98	14.69	100.0	1000.0	130.0	H
11648.928	50.54	---	73.98	23.44	100.0	1000.0	145.0	H
17479.406	---	50.63	53.98	3.35	100.0	1000.0	152.0	V
17482.243	65.63	---	73.98	8.35	100.0	1000.0	159.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
11648.235	211.0	-23	6:43:31 PM - 1/2/2019
11648.928	210.0	-23	6:36:02 PM - 1/2/2019
17479.406	95.0	-16	6:46:38 PM - 1/2/2019
17482.243	98.0	-16	6:40:21 PM - 1/2/2019

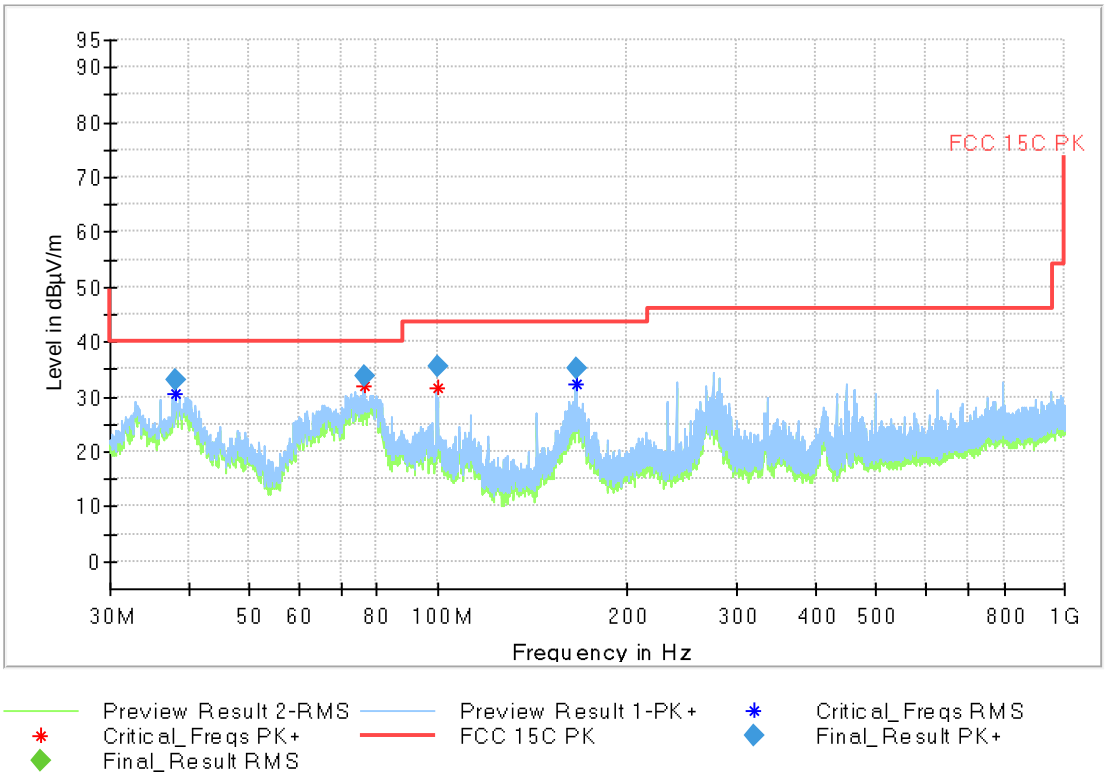


Plot #15 Radiated Emissions: 30 MHz – 1GHz		
Modulation: 802.11n_40 MIMO	**Channel: High**	**93.46% Duty Cycle**

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
38.194	32.94	---	40.00	7.06	100.0	100.0	195.0	V
76.619	33.81	---	40.00	6.19	100.0	100.0	108.0	V
99.752	35.63	---	43.50	7.87	100.0	100.0	201.0	V
166.266	35.19	---	43.50	8.31	100.0	100.0	116.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
38.194	90.0	-14	6:39:08 PM - 1/8/2019
76.619	180.0	-25	6:44:45 PM - 1/8/2019
99.752	178.0	-22	6:41:54 PM - 1/8/2019
166.266	224.0	-20	6:47:29 PM - 1/8/2019



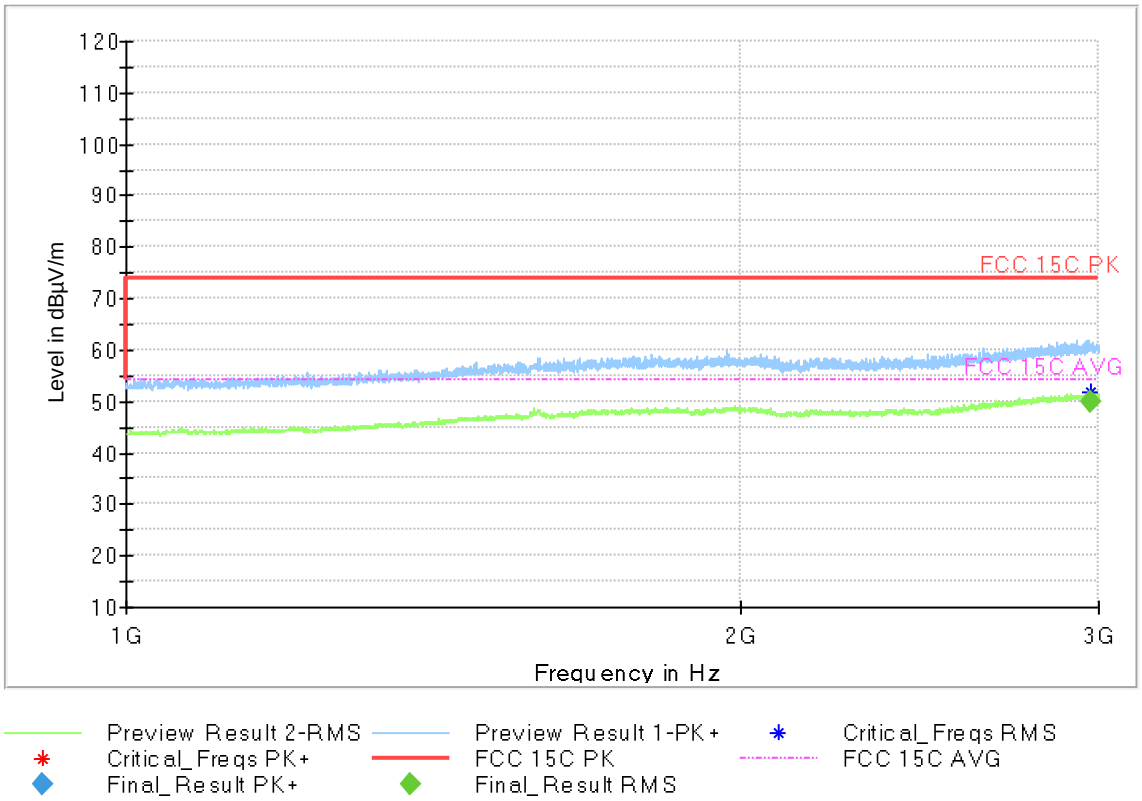
Plot #12 Radiated Emissions: 1-3 GHz

Modulation: 802.11n_40 MIMO	Channel: High	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
2973.740	---	50.07	53.98	3.91	300.0	1000.0	292.0	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
2973.740	336.0	23	-9	0	32	27	3:51:36 PM - 1/7/2019

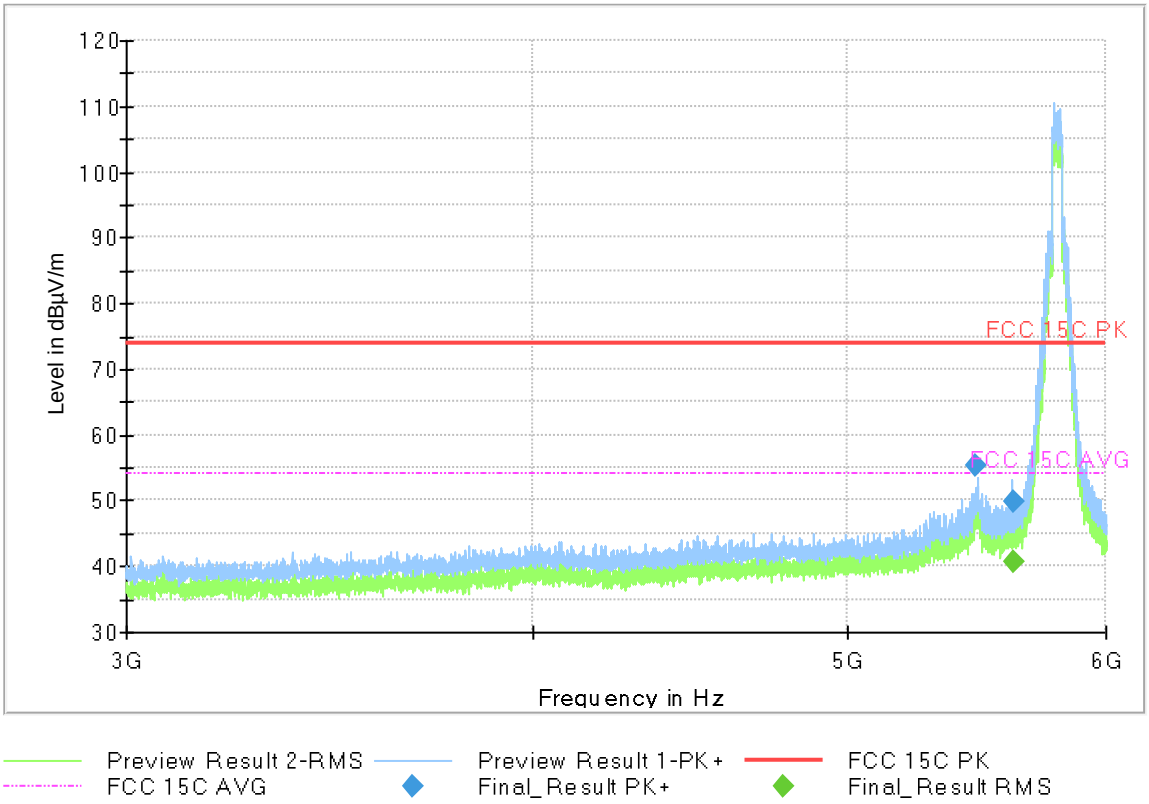


Plot #13 Radiated Emissions: 3-6 GHz		
Modulation: 802.11n_40 MIMO	Channel: High	93.46% Duty Cycle

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
5475.457	55.22	---	73.99	18.77	100.0	1000.0	152.0	V
5620.590	49.83	---	73.99	24.15	100.0	1000.0	166.0	V
5623.053	---	40.70	53.98	13.28	100.0	1000.0	174.0	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
5475.457	170.0	2	14	0	-12	54	5:08:23 PM - 12/26/2018
5620.590	155.0	2	14	0	-12	48	5:11:40 PM - 12/26/2018
5623.053	164.0	1	14	0	-12	39	5:14:23 PM - 12/26/2018



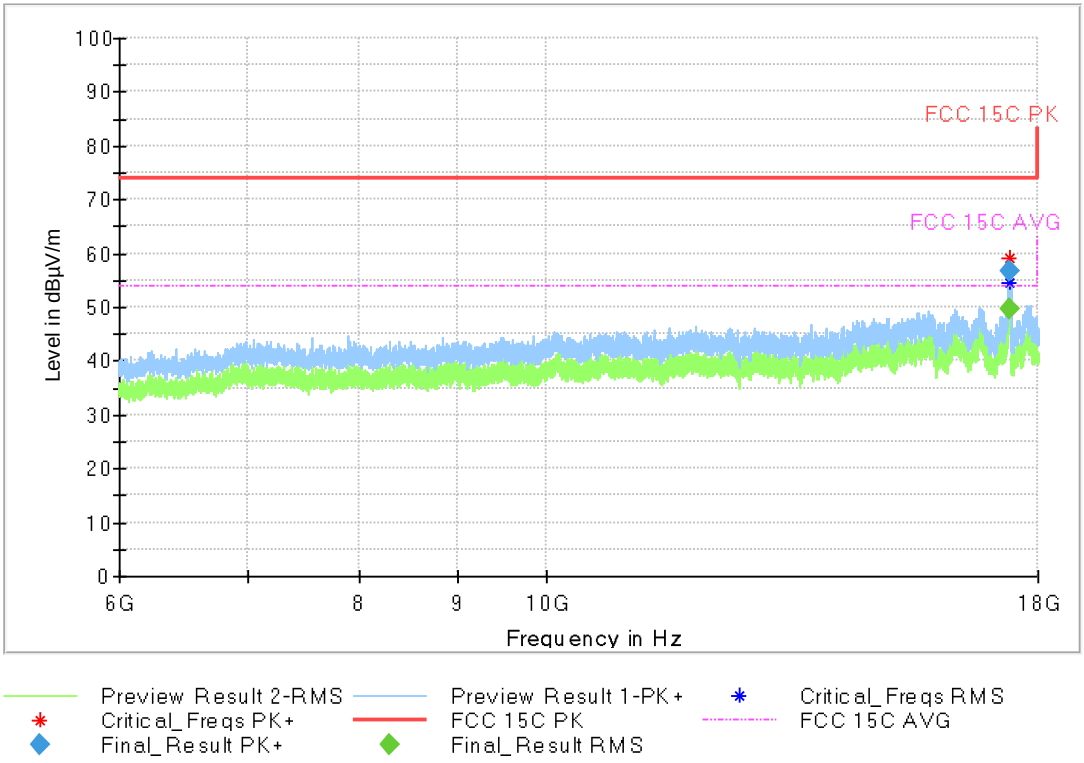
Plot #14 Radiated Emissions: 6-18 GHz

Modulation: 802.11n_40 MIMO	Channel: High	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
17399.760	---	49.54	53.98	4.44	100.0	1000.0	172.0	V
17403.428	56.82	---	73.98	17.16	100.0	1000.0	266.0	V

continuation of the Result table

Frequency (MHz)	Azimuth (deg)	Corr. (dB/m)	Comment
17399.760	86.0	-15	6:11:11 PM - 1/2/2019
17403.428	88.0	-15	6:08:23 PM - 1/2/2019



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 & RSS-Gen 8.8

FCC §15.207(a) & RSS-Gen 8.8

- 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:

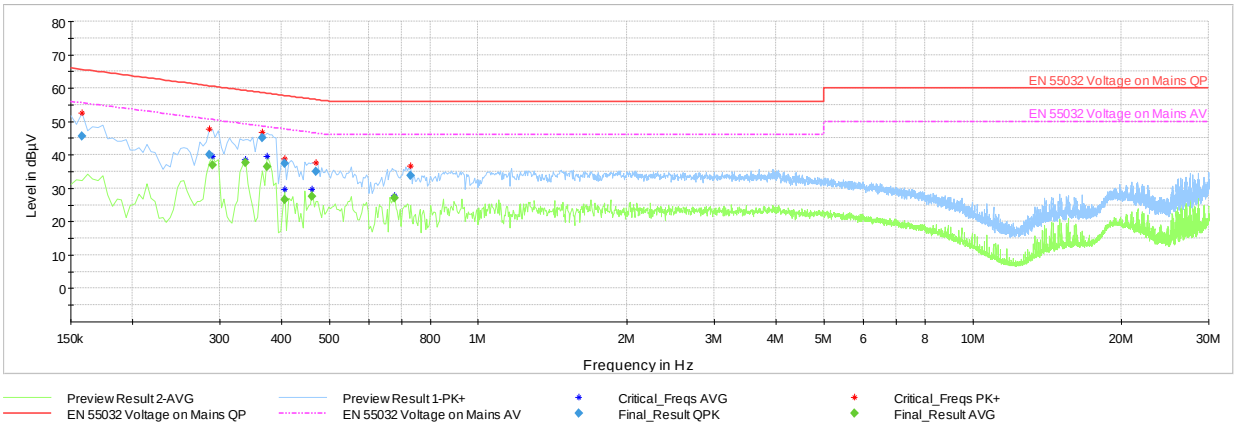
Ambient Temperature ©	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22° C	2	UNII-1 n20 Dual Chain	Line & Neutral	110V / 60Hz

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 Test Plots:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)	Frequency
0.158000	45.64	---	65.57	19.93	500.0	9.000	L1	GND	10.7	0.158
0.286000	40.10	---	60.64	20.54	500.0	9.000	L1	GND	10.4	0.286
0.290000	---	36.89	50.52	13.64	500.0	9.000	L1	GND	10.4	0.290
0.338000	---	37.66	49.25	11.59	500.0	9.000	N	GND	10.3	0.338
0.366000	45.03	---	58.59	13.56	500.0	9.000	L1	GND	10.3	0.366
0.374000	---	36.54	48.41	11.87	500.0	9.000	N	GND	10.3	0.374
0.406000	---	26.62	47.73	21.11	500.0	9.000	L1	GND	10.4	0.406
0.406000	37.51	---	57.73	20.22	500.0	9.000	L1	GND	10.4	0.406
0.462000	---	27.64	46.66	19.01	500.0	9.000	L1	GND	10.2	0.462
0.470000	35.11	---	56.51	21.40	500.0	9.000	N	GND	10.2	0.470
0.678000	---	26.99	46.00	19.01	500.0	9.000	L1	GND	10.2	0.678
0.730000	33.86	---	56.00	22.14	500.0	9.000	L1	GND	10.3	0.730



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-3	Initial Version	James Donnellan
2019/03/08	EMC_A2ZDE-048-18001_15.407_UNII-3-Rev1	Updated Mfg. Address.	James Donnellan
2019/05/23	EMC_A2ZDE-048-18001_15.407_UNII-3-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