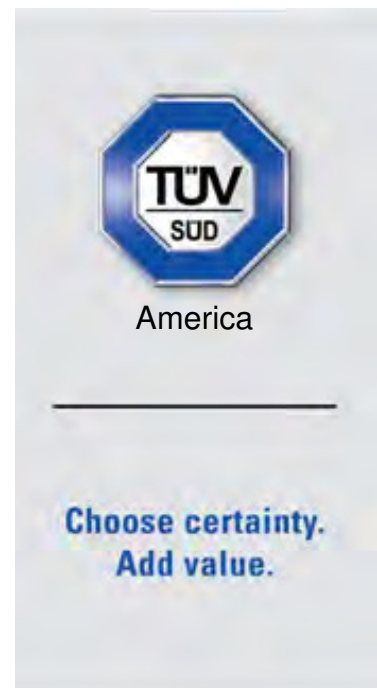




# Report On

Application for Grant of Equipment Authorization of the  
Novatel Wireless Inc.

MiFi 7000 Wireless Hotspot Modem

FCC Part 15 Subpart E §15.407  
RSS-247 Issue 2 February 2017

Report No. SD72118338-0716D Rev. 1 (Part 2 of 2)

August 2016

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## **2.7 UNWANTED EMISSIONS MEASUREMENT**

### **2.7.1 Specification Reference**

Part 15 Subpart E §15.407(b)(1),(4)(i) and (7) / 15.209 and RSS-247 6.2.1 (2) and 6.2.4 (2)

### **2.7.2 Standard Applicable**

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

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

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

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

6.2.4 (2) For the band 5725-5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p.

For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

### **2.7.3 Test Methodology**

Section II (G) Unwanted Emission Measurement of 789033 D02 General UNII Test Procedures v01r02

### **2.7.4 Equipment Under Test and Modification State**

Serial No: SZ170616900012 / Test Configuration B

### **2.7.5 Date of Test/Initial of test personnel who performed the test**

August 10, 12, 13, and 17, 2016/FSC and XYZ

### **2.7.6 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.7.7 Environmental Conditions**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 22-9 - 25.7 °C  
 Relative Humidity 43.9 – 56.0 %  
 ATM Pressure 98.7 - 98.9 kPa

## 2.7.8 Additional Observations

- This is an antenna-port conducted measurement test plus radiated cabinet spurious emissions measurements.
- Only the worst case data rate/modulation presented.
- Sweep time is set to auto.
- Transducer Factor (TDF) was added to compensate for the antenna gain, external attenuator and cable used.
- Additional 3dB offset was added for MIMO mode (verification performed on worst case antenna port).
- When measuring radiated cabinet spurious emissions, the field strength limit of 15.209 is first converted to dBm (EIRP) using the formula under Section G(2)(III) of 789033 D02 General UNII Test Procedures v01r02 for below 1GHz measurements, otherwise §15.407 limits applies. If Peak complies with the limit, no Average evaluation will be performed (above 1GHz measurements).
- Only worst case configuration (channel, data rate or MCS and BW) used for radiated cabinet spurious emissions test.
- Radiated measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.7.9 for sample computation.

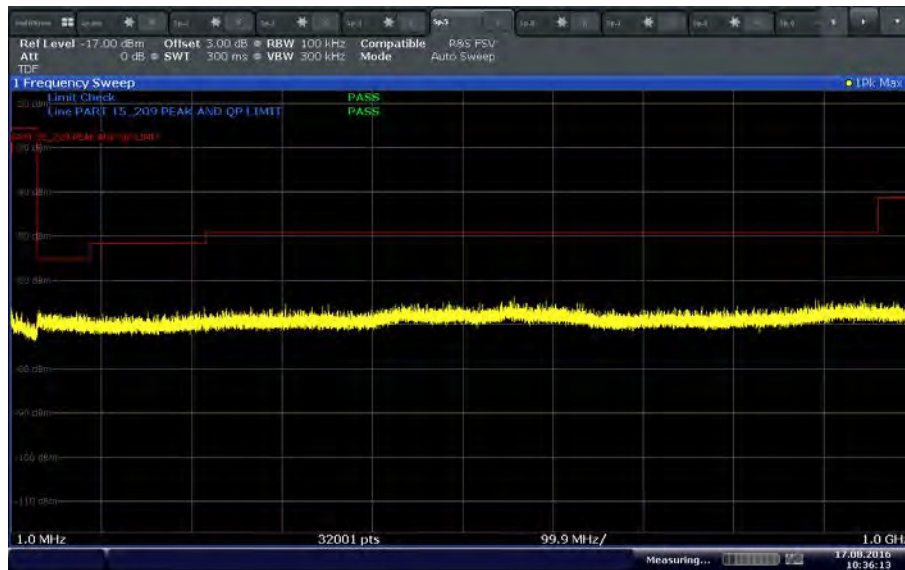
## 2.7.9 Sample Computation (Radiated Emission)

|                                                       |                            |       |       |
|-------------------------------------------------------|----------------------------|-------|-------|
| Measuring equipment raw measurement (dbμV) @ 30 MHz   |                            |       | 24.4  |
| Correction Factor (dB)                                | Asset# 1066 (cable)        | 0.3   | -12.6 |
|                                                       | Asset# 1172 (cable)        | 0.3   |       |
|                                                       | Asset# 1016 (preamplifier) | -30.7 |       |
|                                                       | Asset# 1175(cable)         | 0.3   |       |
|                                                       | Asset# 1002 (antenna)      | 17.2  |       |
| Reported QuasiPeak Final Measurement (dbμV/m) @ 30MHz |                            |       | 11.8  |

## 2.7.10 Test Results

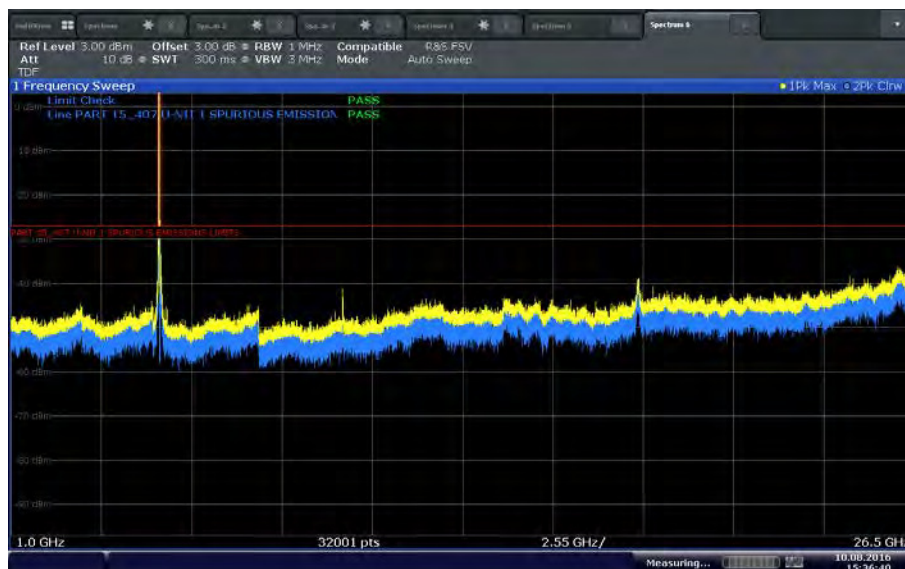
*See attached plots.*

## 2.7.11 Test Plots



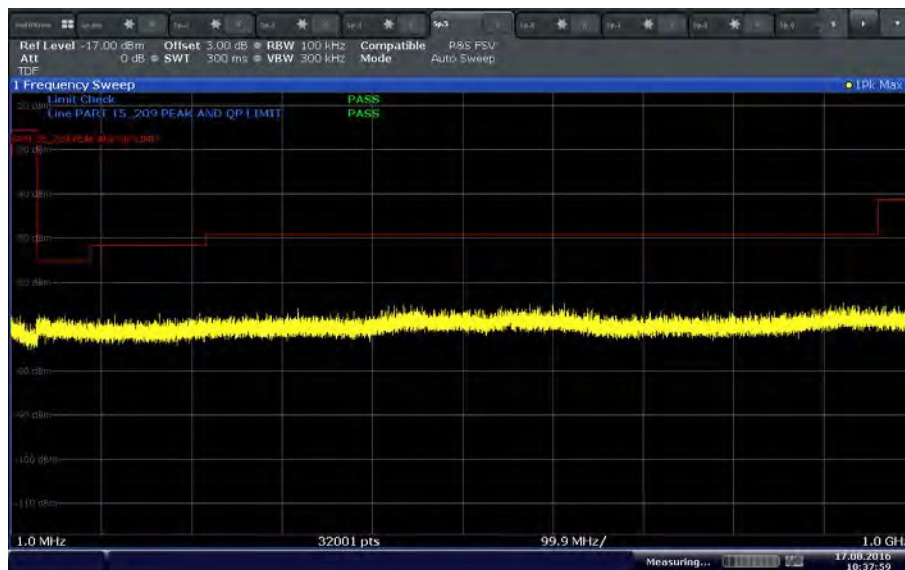
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802.11 a U-NII 1 Low Channel below 1GHz



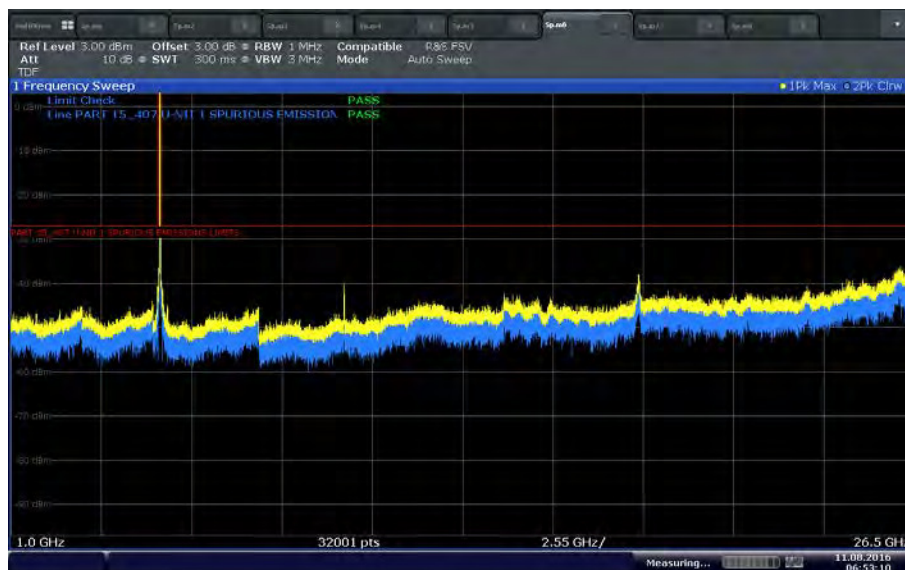
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802.11a U-NII 1 Low Channel above 1GHz



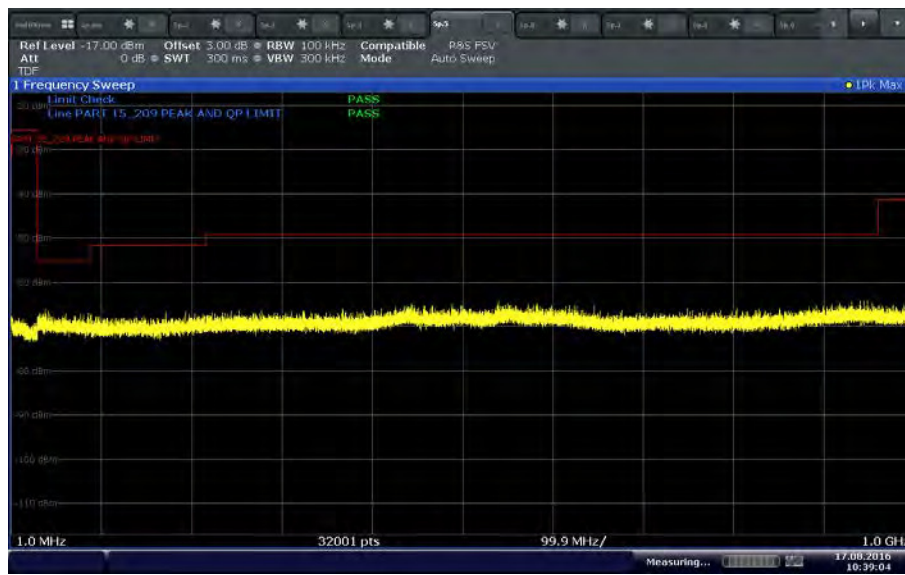
Date: 17 AUG 2016 10:37:59

### 802.11 a U-NII 1 Mid Channel below 1GHz



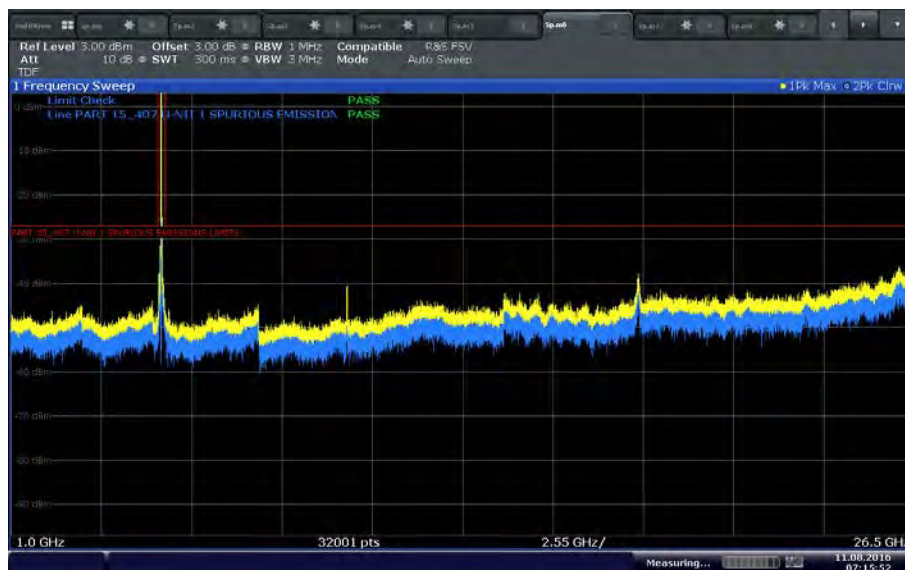
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### 802.11a U-NII 1 Mid Channel above 1GHz



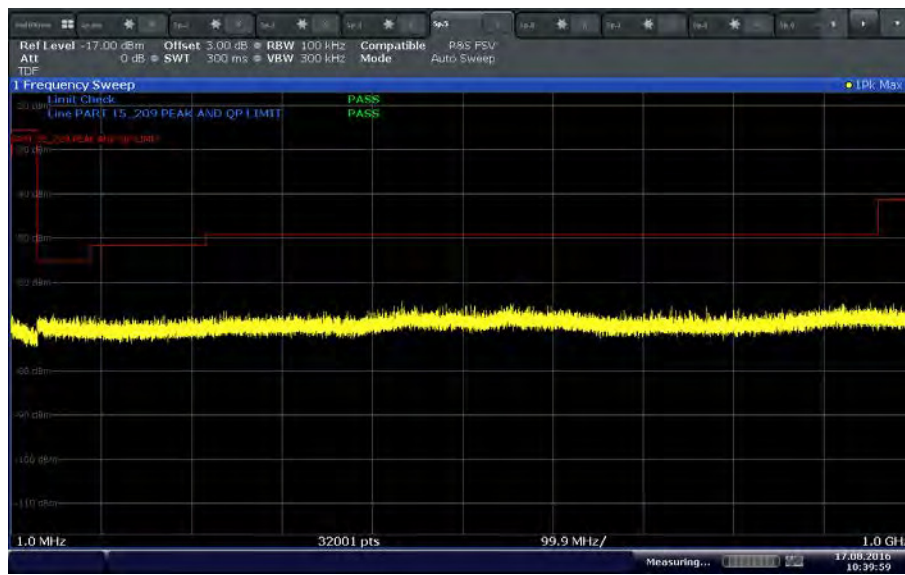
Date: 17 AUG 2016 10:39:04

### 802.11 a U-NII 1 High Channel below 1GHz



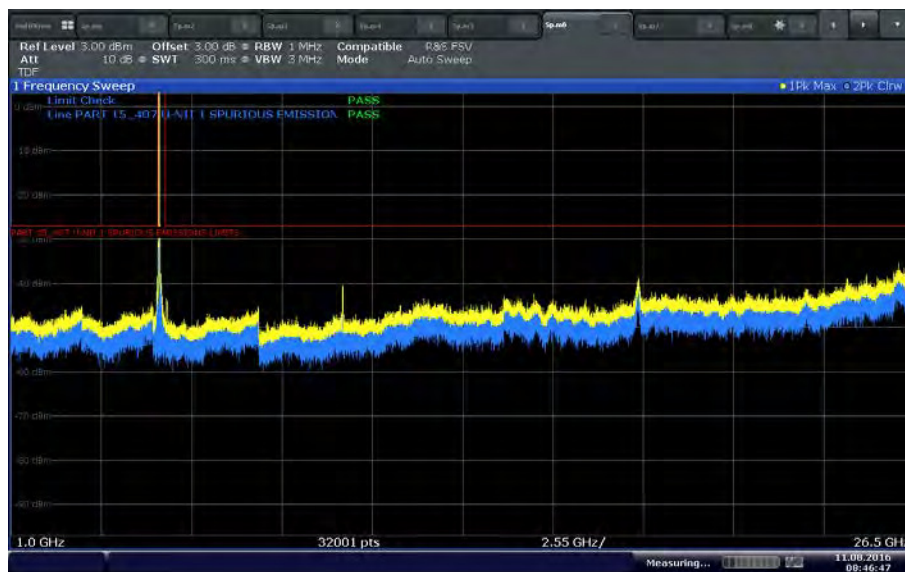
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### 802.11a U-NII 1 High Channel above 1GHz



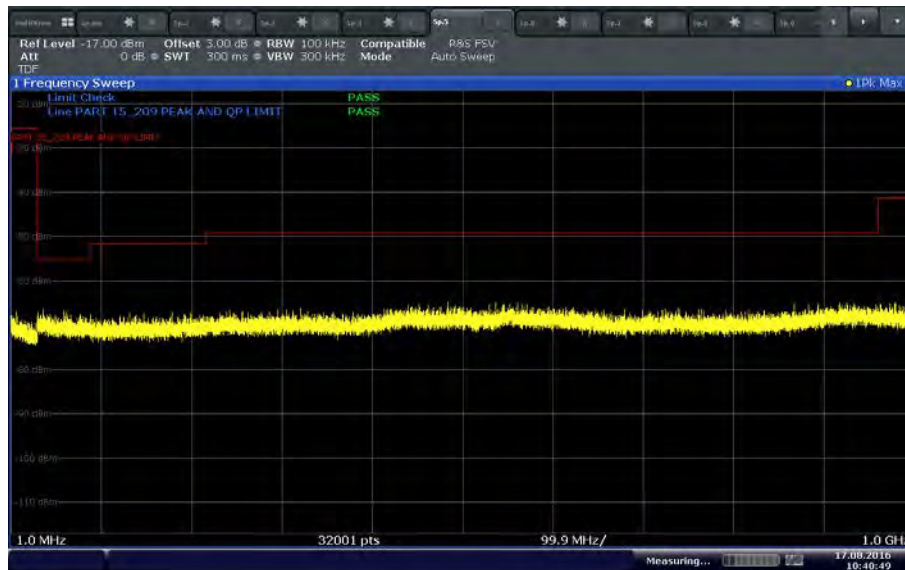
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#### 802.11 n (20 MHz) U-NII 1 Low Channel below 1GHz



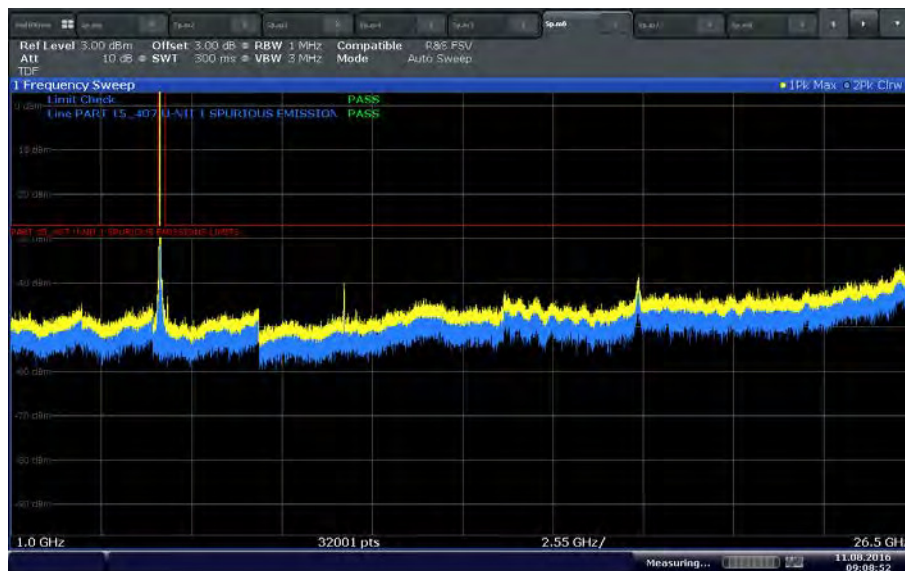
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#### 802.11 n (20 MHz) U-NII 1 Low Channel above 1GHz



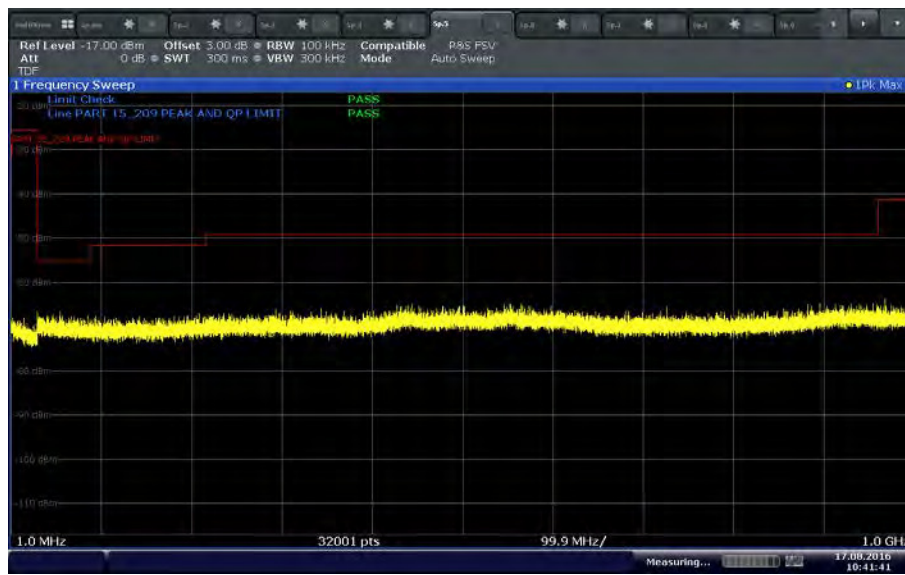
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802.11 n (20 MHz) U-NII 1 Mid Channel below 1GHz



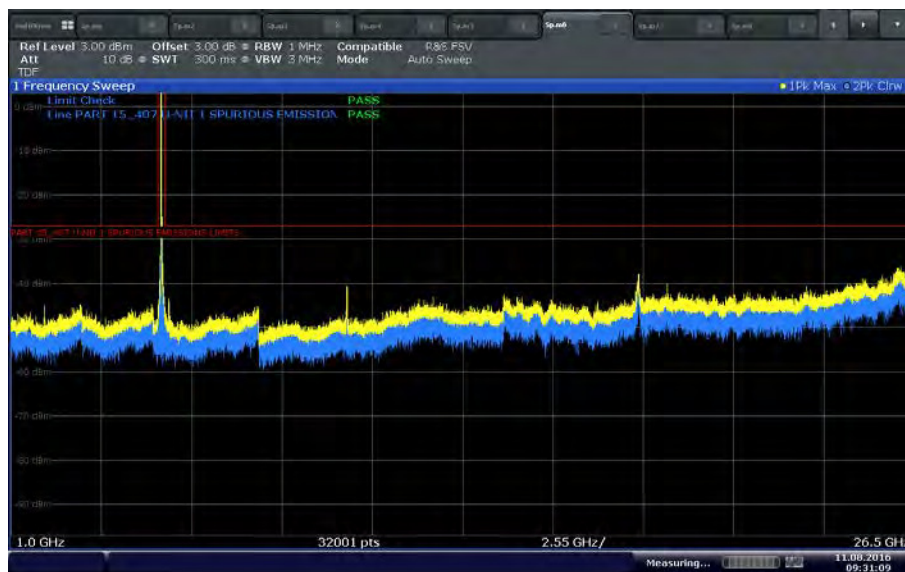
Date: 11 AUG 2016 09:08:52

802.11 n (20 MHz) U-NII 1 Mid Channel above 1GHz



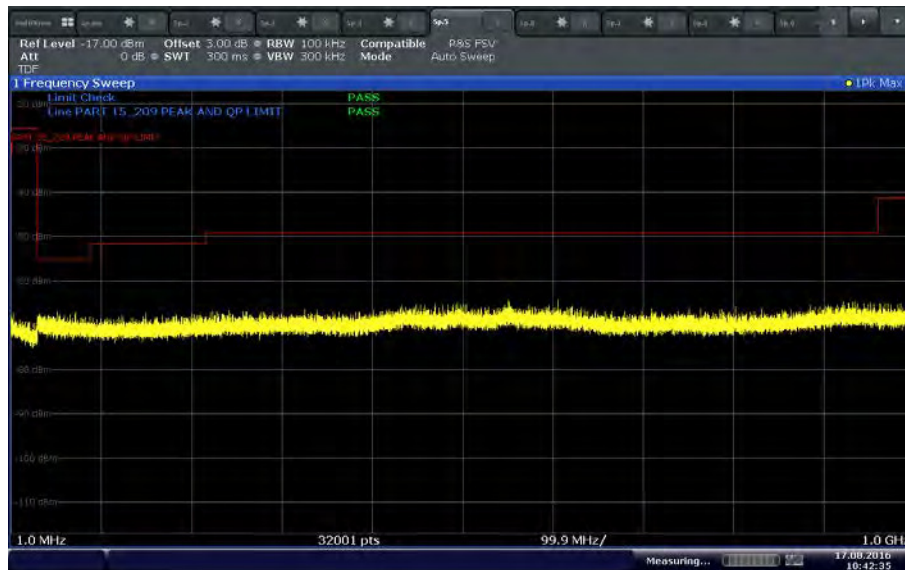
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### 802.11 n (20 MHz) U-NII 1 High Channel below 1GHz



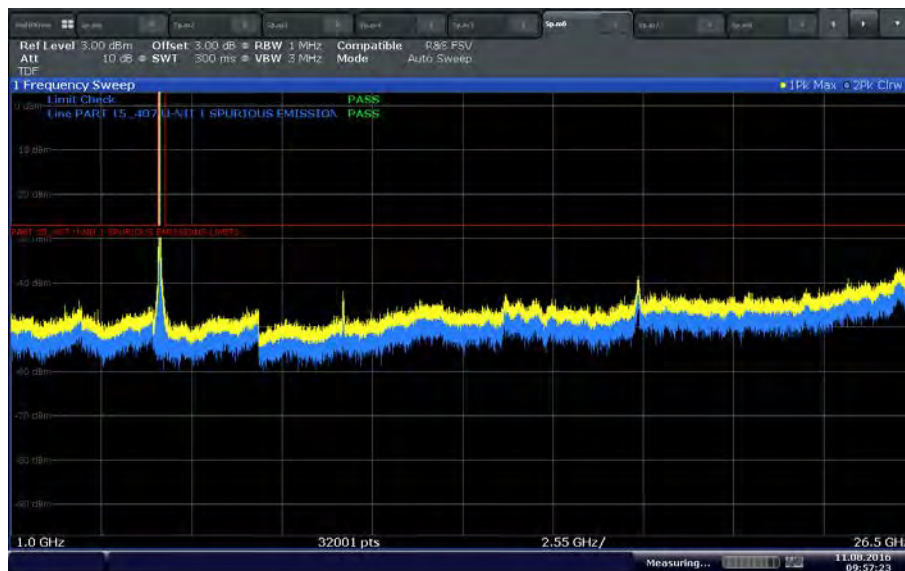
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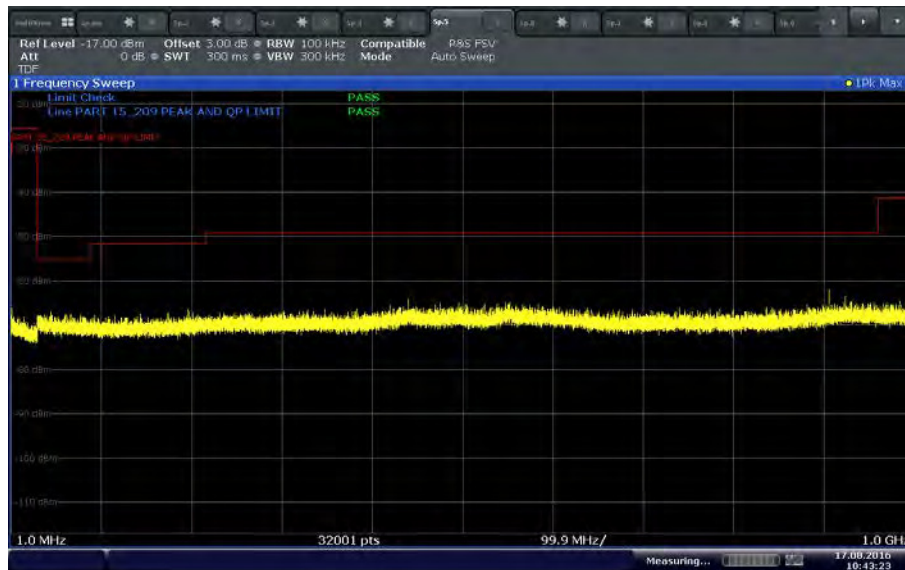
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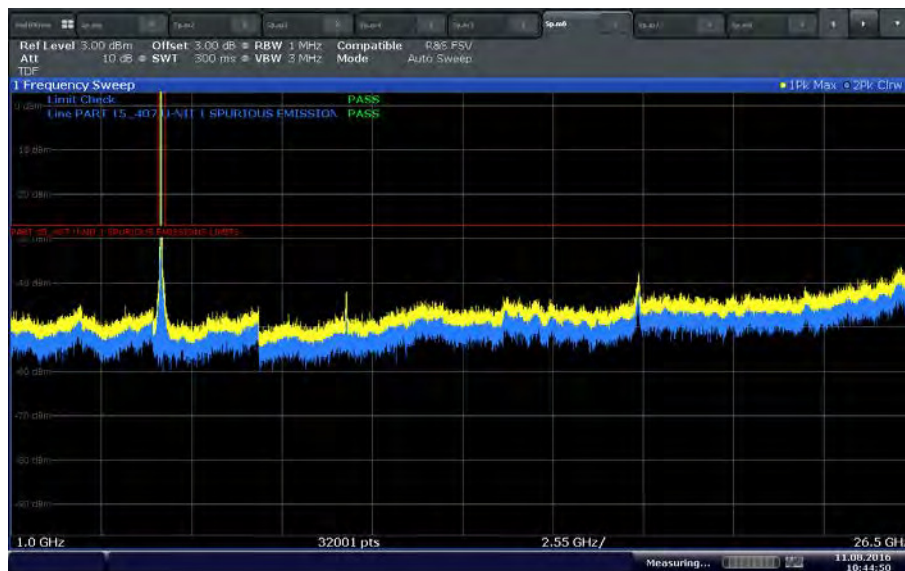
Date: 11 AUG 2016 09:57:23

#### 802.11 n (40 MHz) U-NII 1 Low Channel above 1GHz



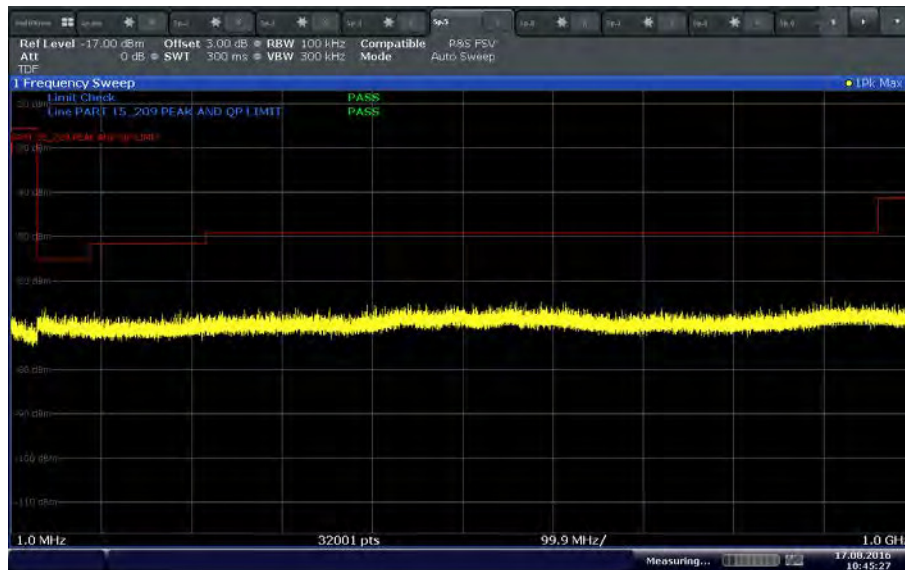
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### 802.11 n (40 MHz) U-NII 1 High Channel below 1GHz



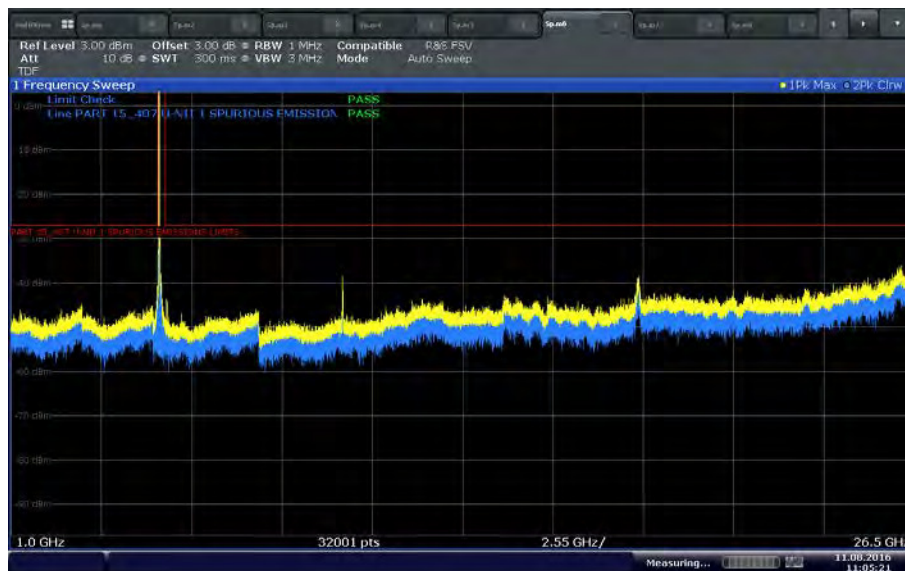
Date: 11 AUG 2016 10:44:50

### 802.11 n (40 MHz) U-NII 1 High Channel above 1GHz



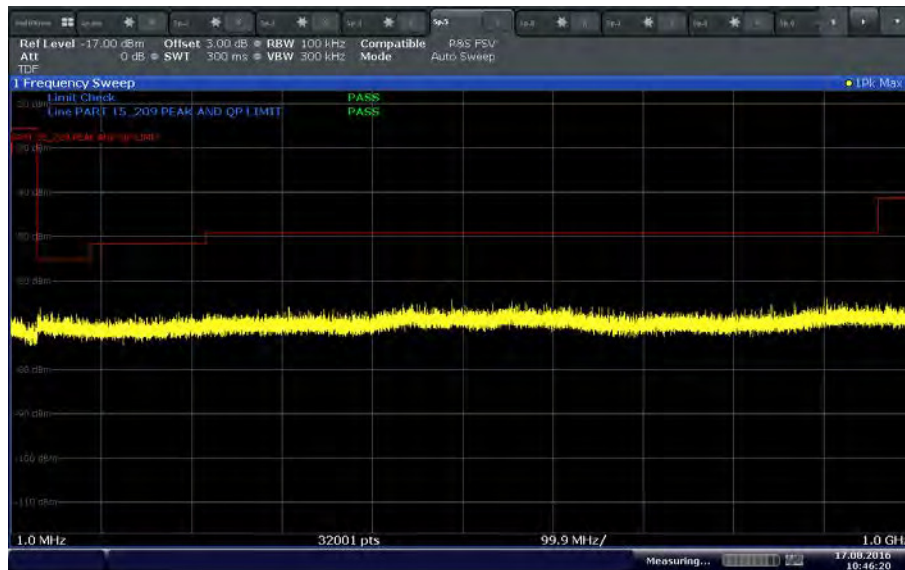
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#### 802.11 ac (20 MHz) U-NII 1 Low Channel below 1GHz



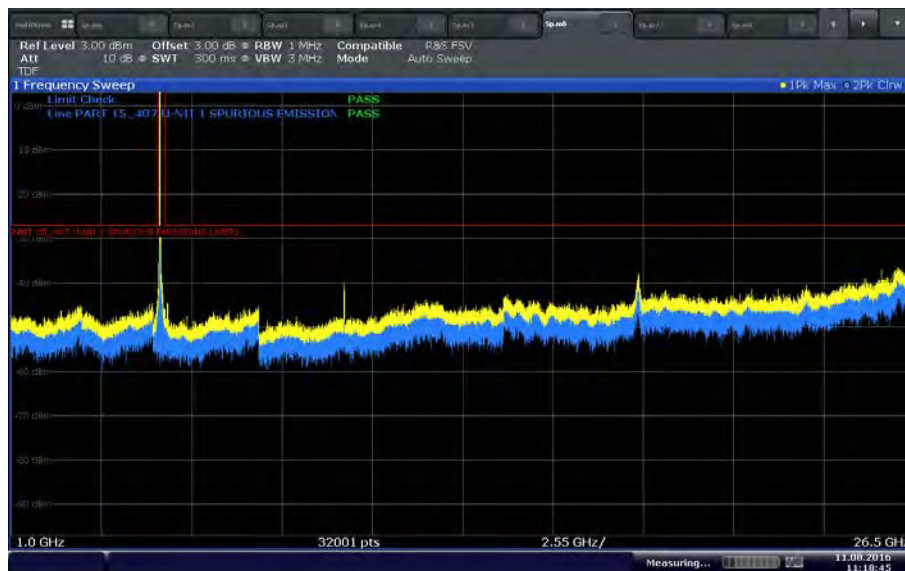
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#### 802.11 ac (20 MHz) U-NII 1 Low Channel above 1GHz



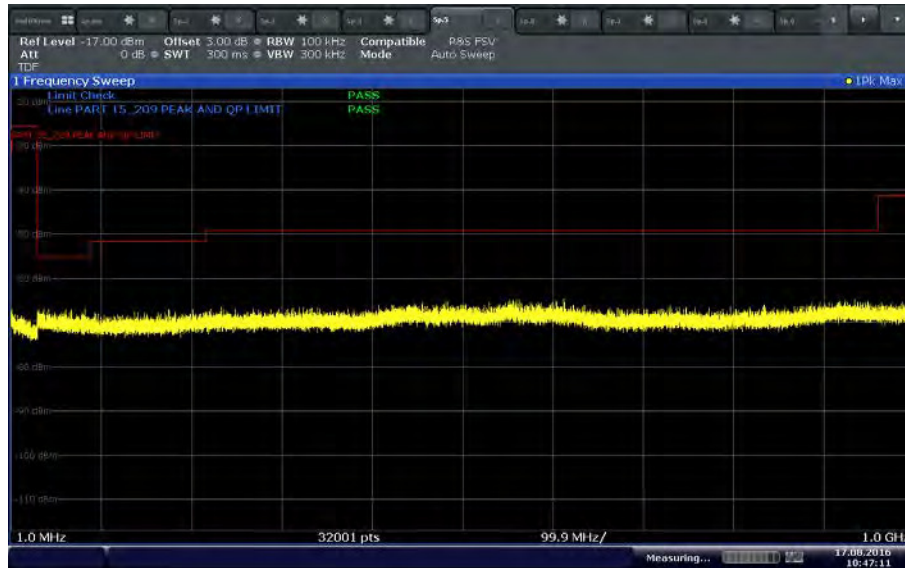
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802.11 ac (20 MHz) U-NII 1 Mid Channel below 1GHz



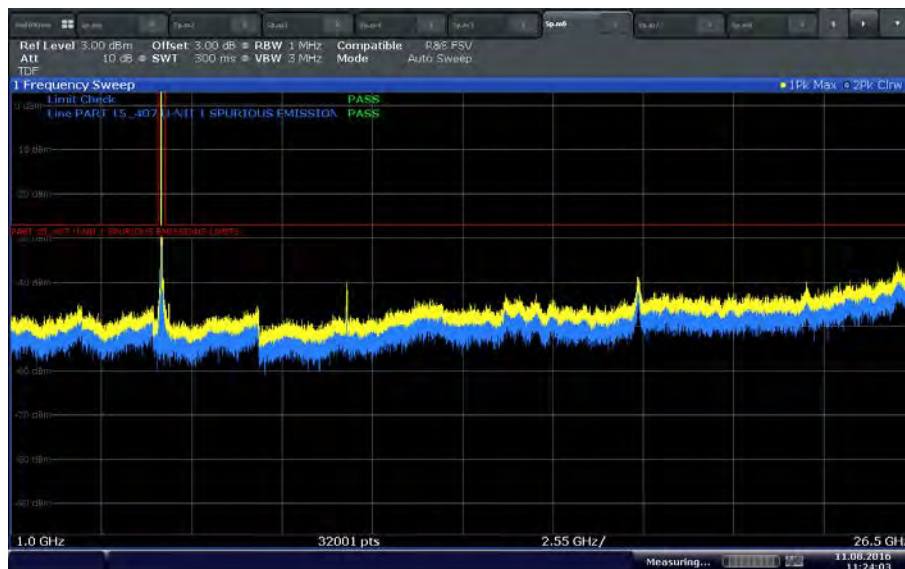
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802.11 ac (20 MHz) U-NII 1 Mid Channel above 1GHz



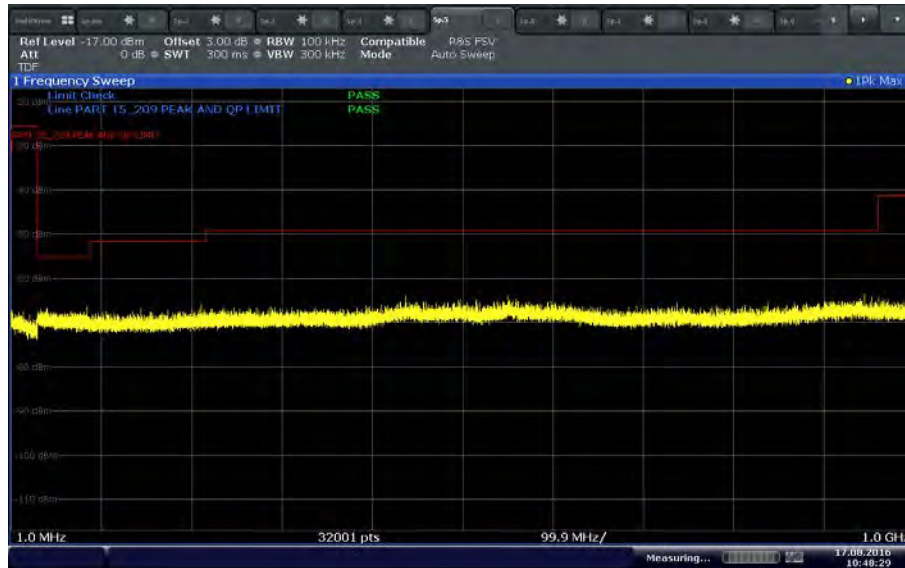
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802.11 ac (20 MHz) U-NII 1 High Channel below 1GHz



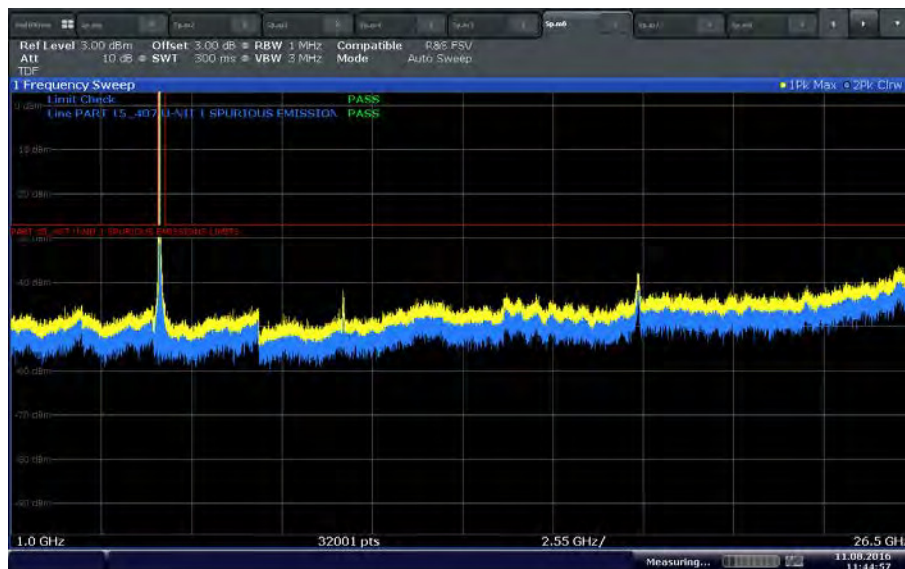
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802.11 ac (20 MHz) U-NII 1 High Channel above 1GHz



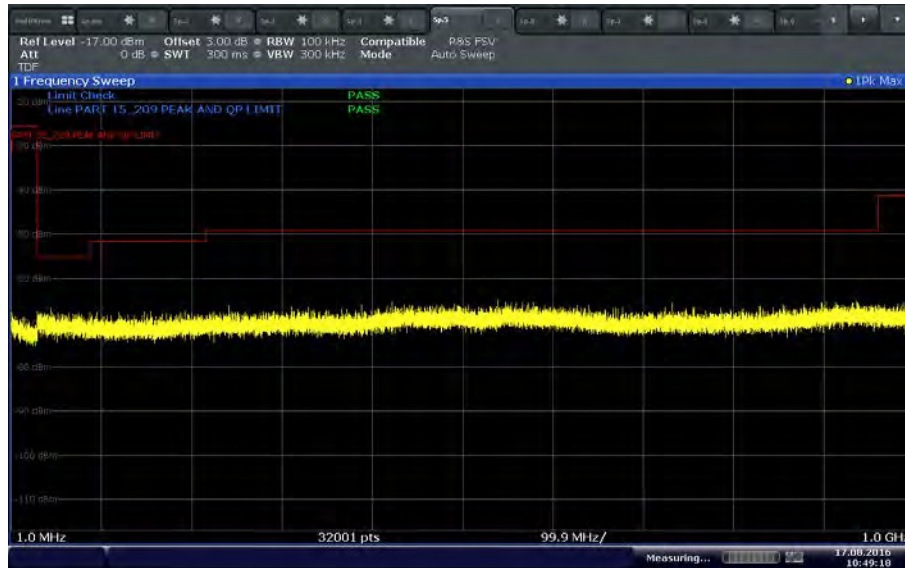
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802.11 ac (40 MHz) U-NII 1 Low Channel below 1GHz



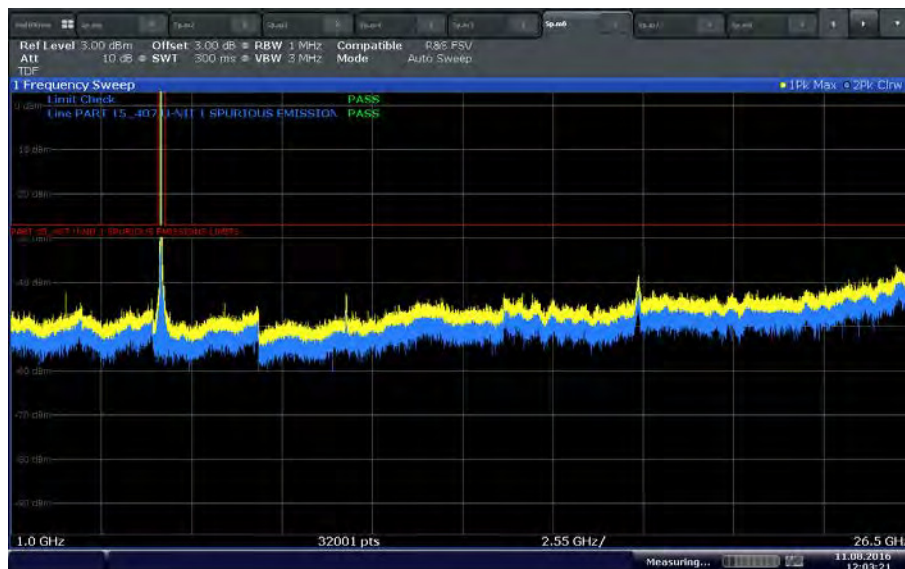
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802.11 ac (40 MHz) U-NII 1 Low Channel above 1GHz



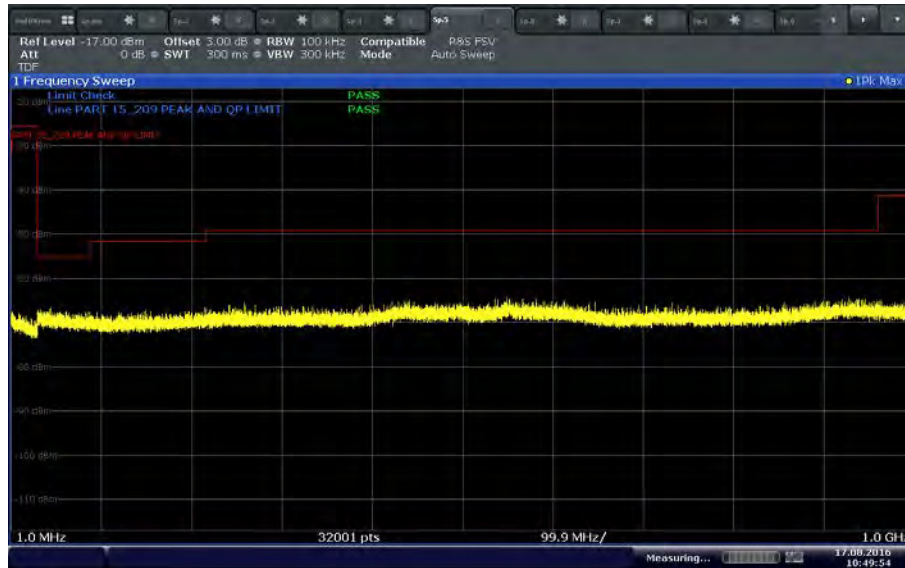
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802.11 ac (40 MHz) U-NII 1 High Channel below 1GHz



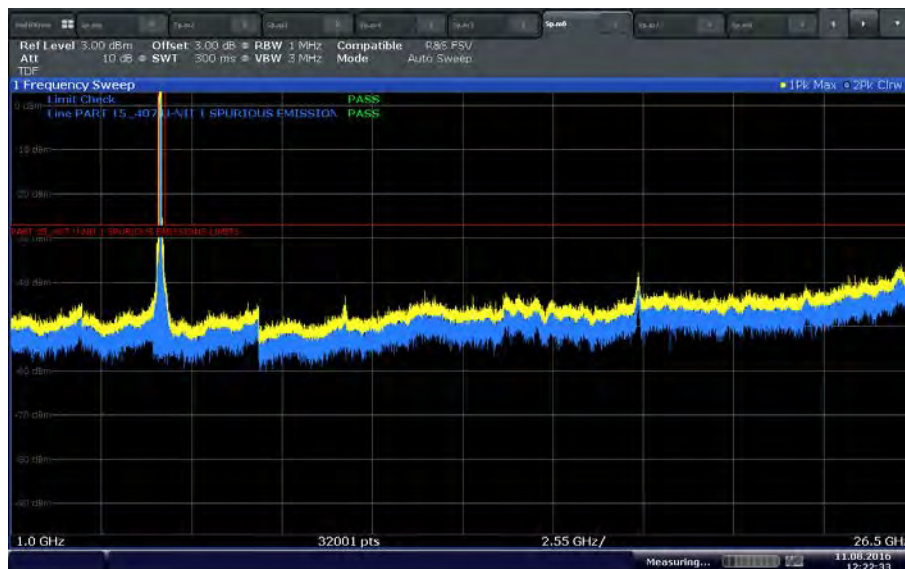
Date: 11 AUG 2016 12:03:21

802.11 ac (40 MHz) U-NII 1 High Channel above 1GHz



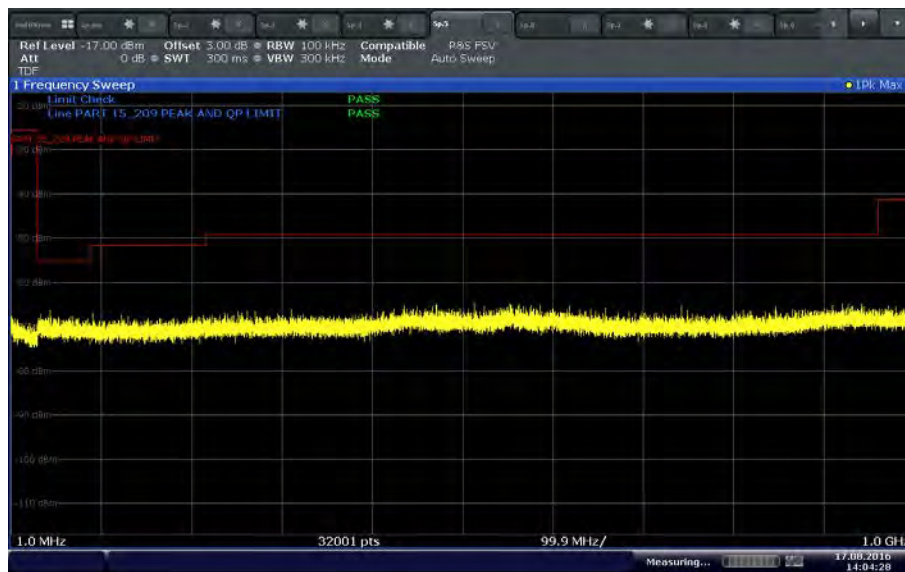
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802.11 ac (80 MHz) U-NII 1 Mid Channel below 1GHz



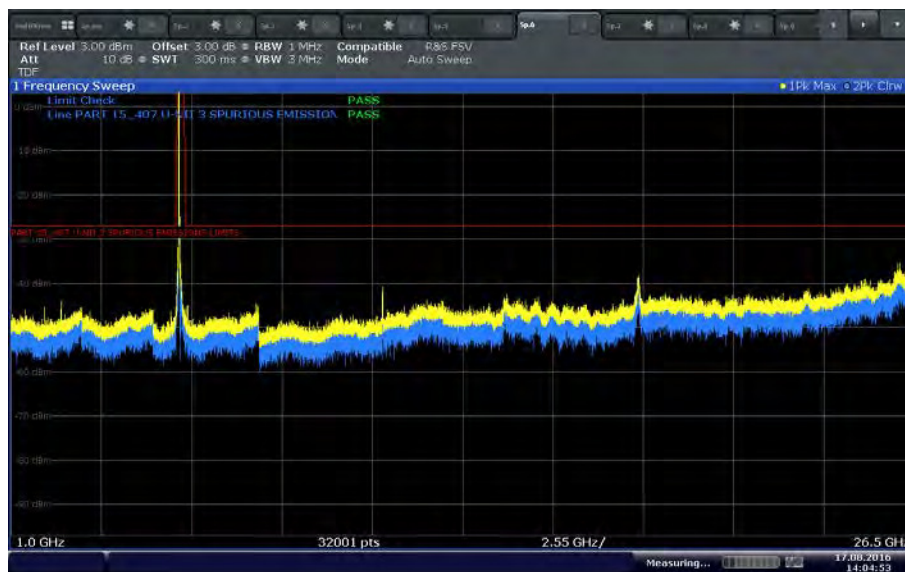
Date: 11 AUG 2016 12:22:33

802.11 ac (80 MHz) U-NII 1 Mid Channel above 1GHz



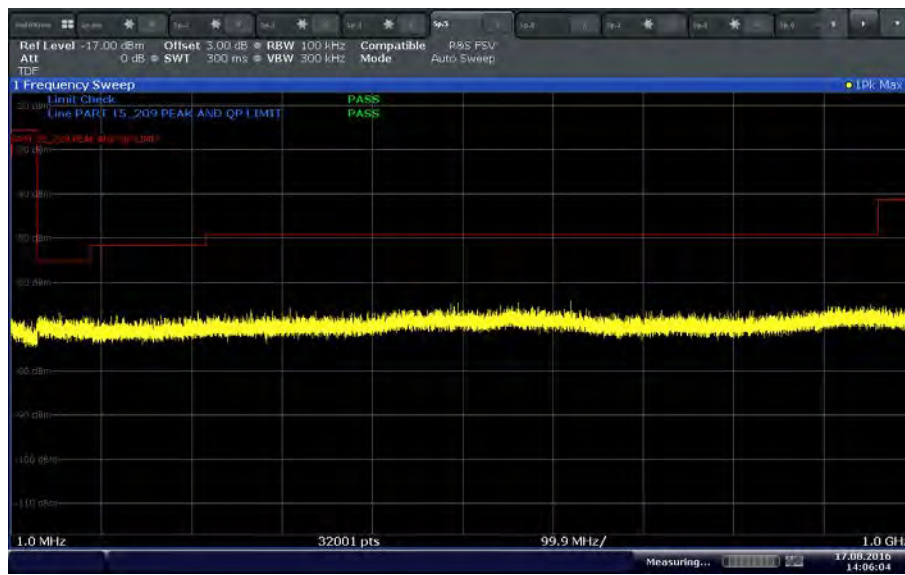
Date: 17 AUG 2016 14:04:28

### 802.11 a U-NII 3 Low Channel below 1GHz



Date: 17 AUG 2016 14:04:53

### 802.11a U-NII 3 Low Channel above 1GHz



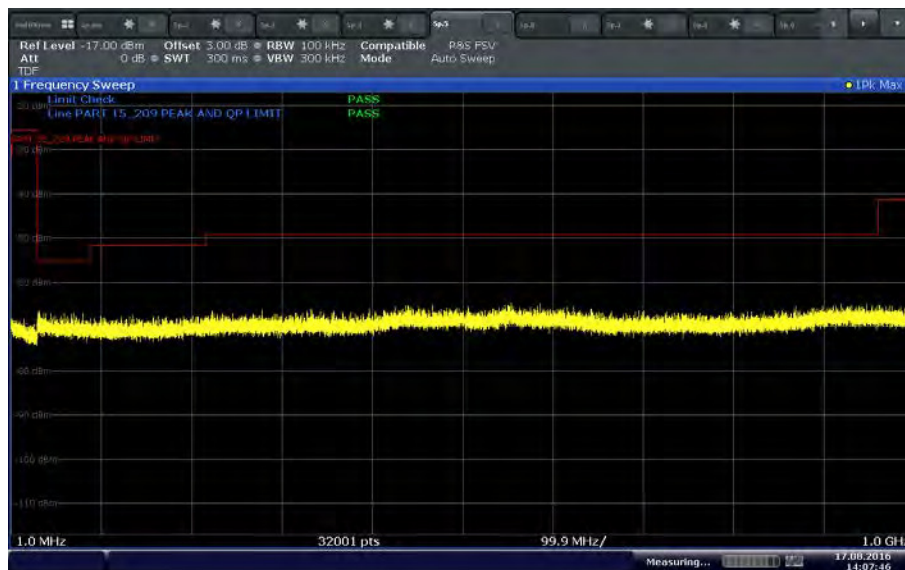
Date: 17.AUG.2016 14:06:04

### 802.11 a U-NII 3 Mid Channel below 1GHz



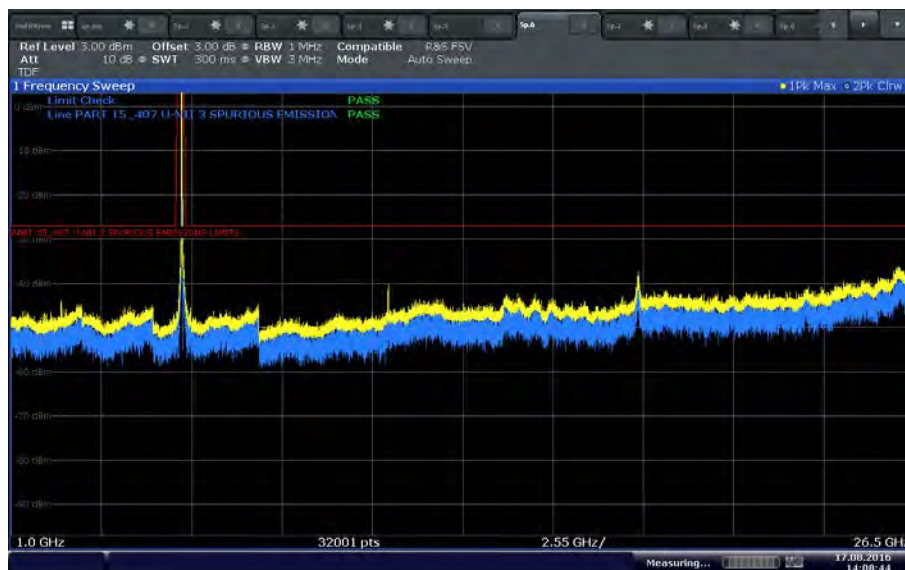
Date: 17.AUG.2016 14:06:42

### 802.11a U-NII 3 Mid Channel above 1GHz



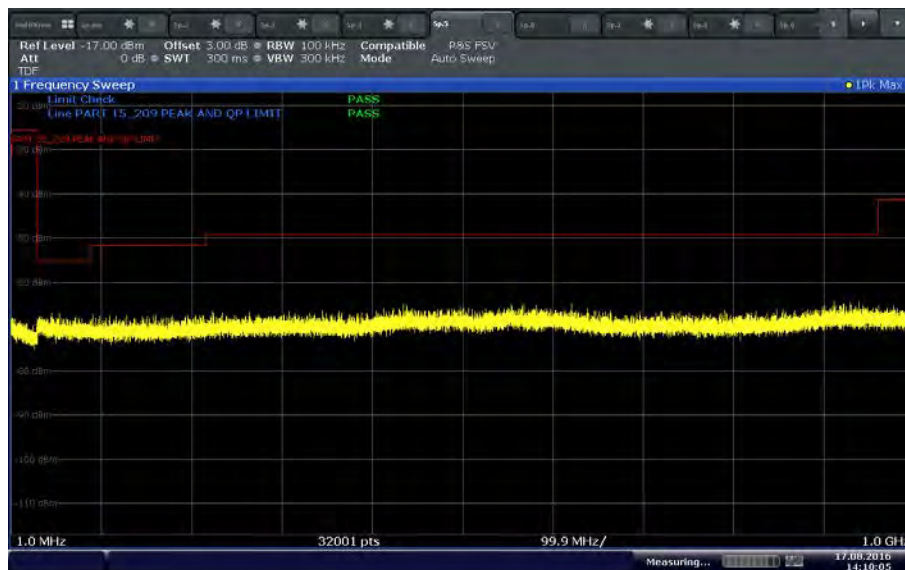
Date: 17.AUG.2016 14:07:47

### 802.11 a U-NII 3 High Channel below 1GHz



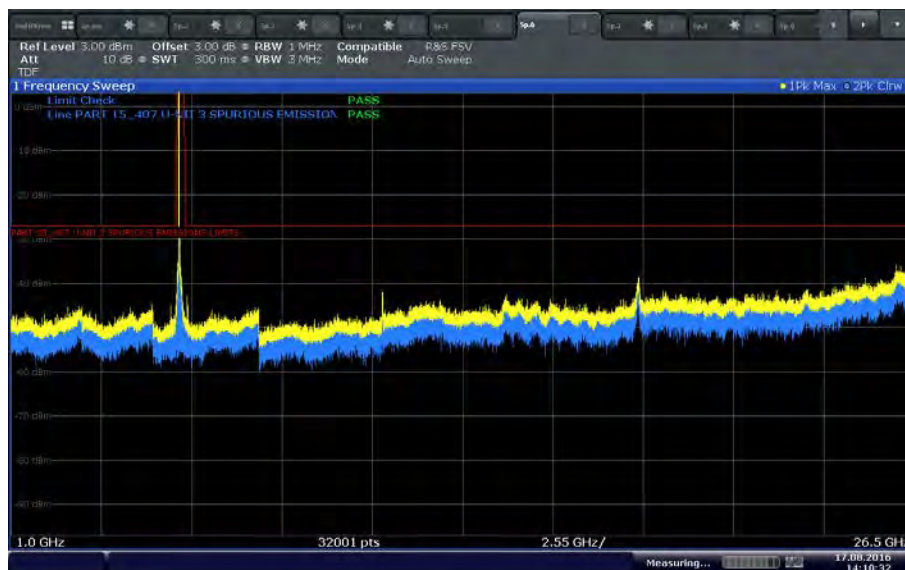
Date: 17.AUG.2016 14:08:44

### 802.11a U-NII 3 High Channel above 1GHz



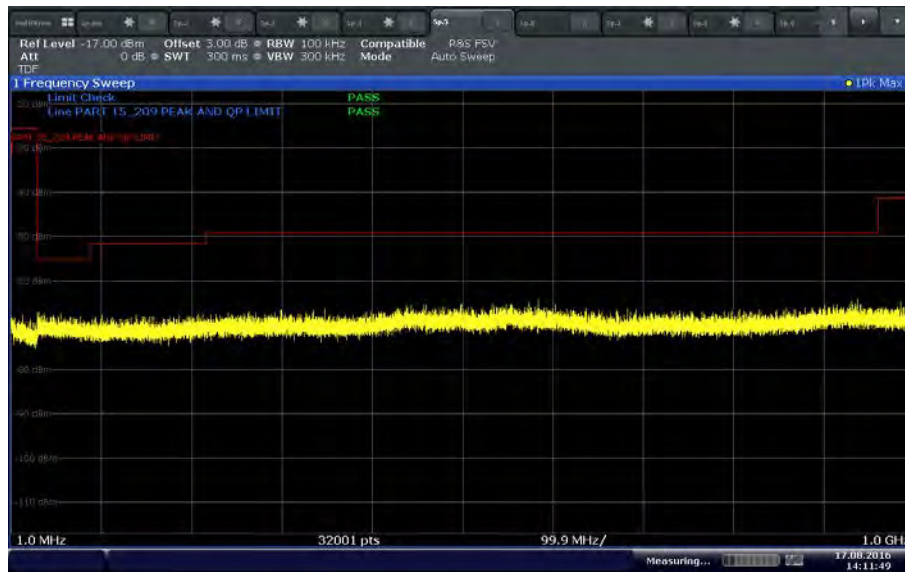
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### 802.11 n (20 MHz) U-NII 3 Low Channel below 1GHz



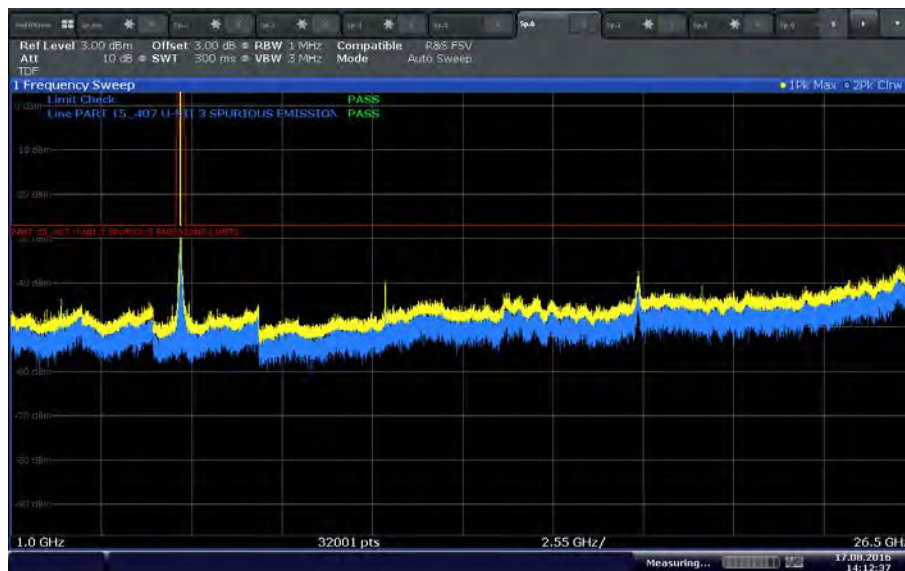
Date: 17.AUG.2016 14:10:32

### 802.11 n (20 MHz) U-NII 3 Low Channel above 1GHz



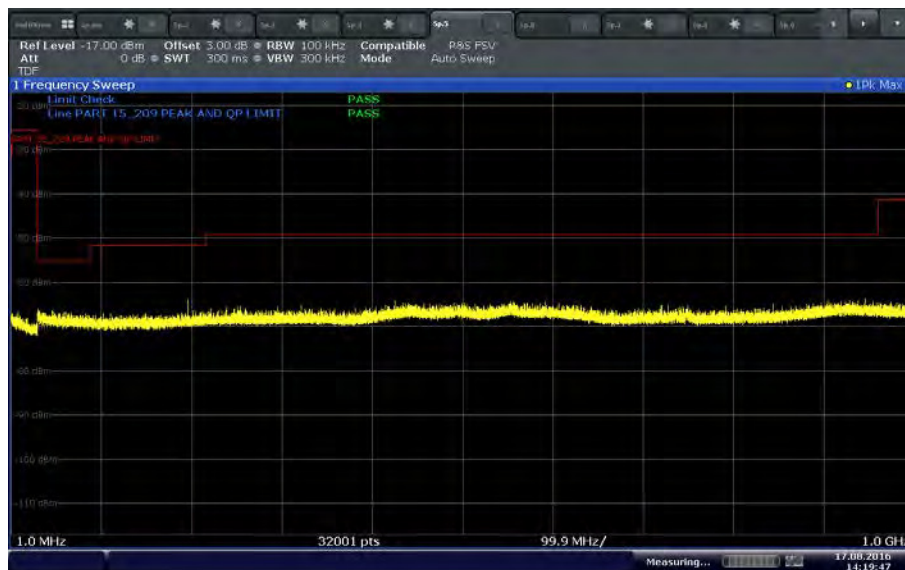
Date: 17 AUG 2016 14:11:50

#### 802.11 n (20 MHz) U-NII 3 Mid Channel below 1GHz



Date: 17 AUG 2016 14:12:38

#### 802.11 n (20 MHz) U-NII 3 Mid Channel above 1GHz



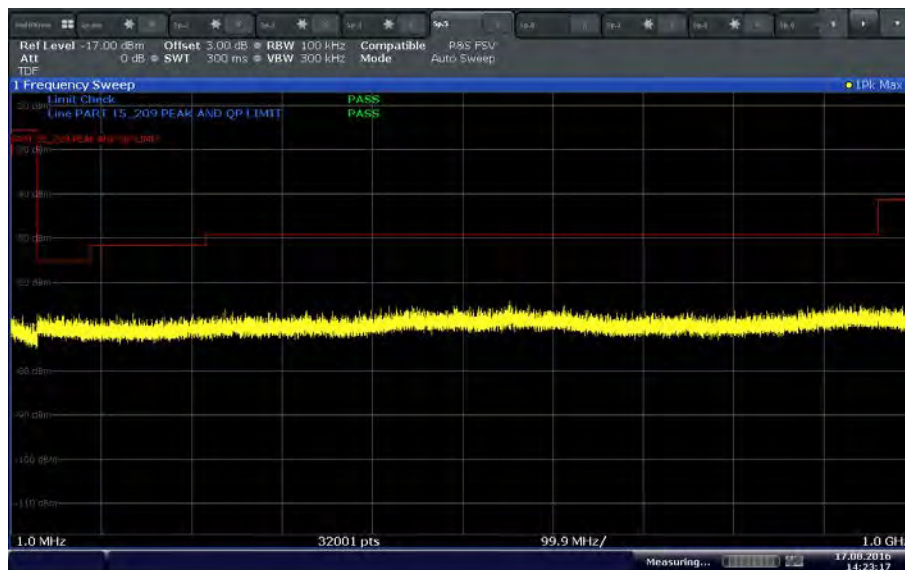
Date: 17 AUG 2016 14:19:47

### 802.11 n (20 MHz) U-NII 3 High Channel below 1GHz



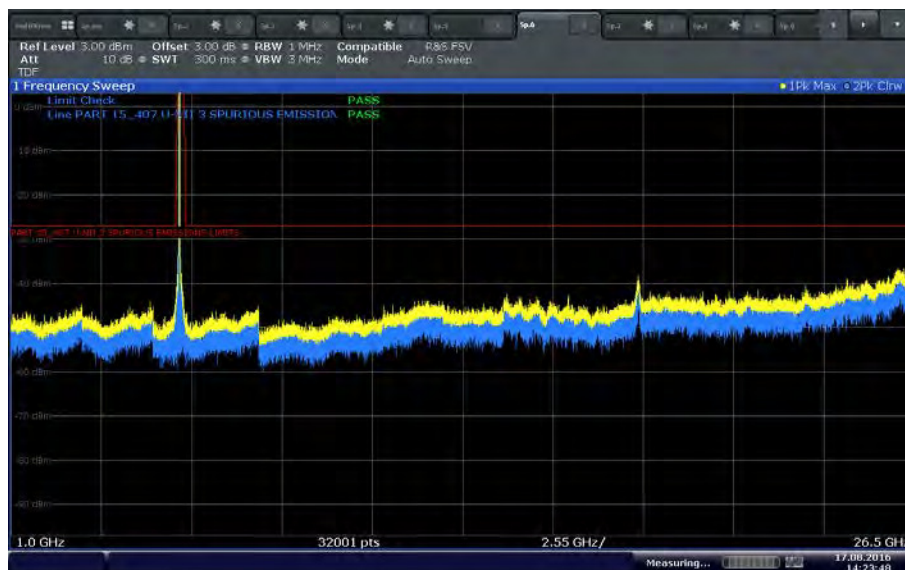
Date: 17 AUG 2016 14:21:40

### 802.11 n (20 MHz) U-NII 3 High Channel above 1GHz



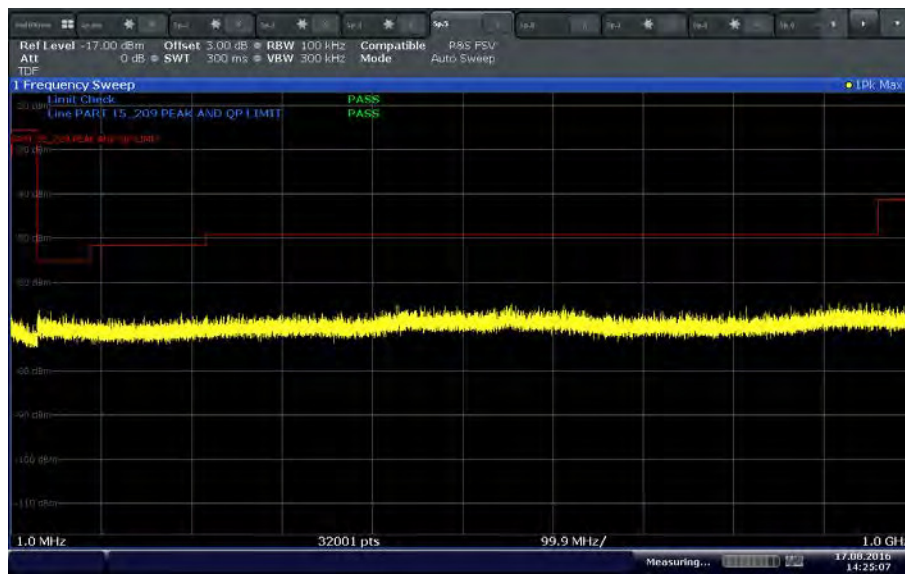
Date: 17 AUG 2016 14:23:17

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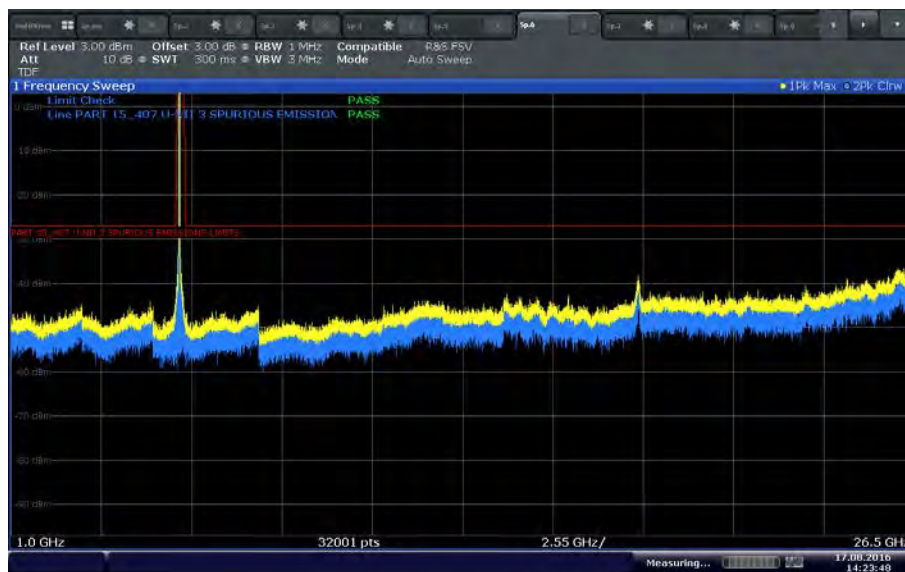
Date: 17 AUG 2016 14:23:40

#### 802.11 n (40 MHz) U-NII 3 Low Channel above 1GHz



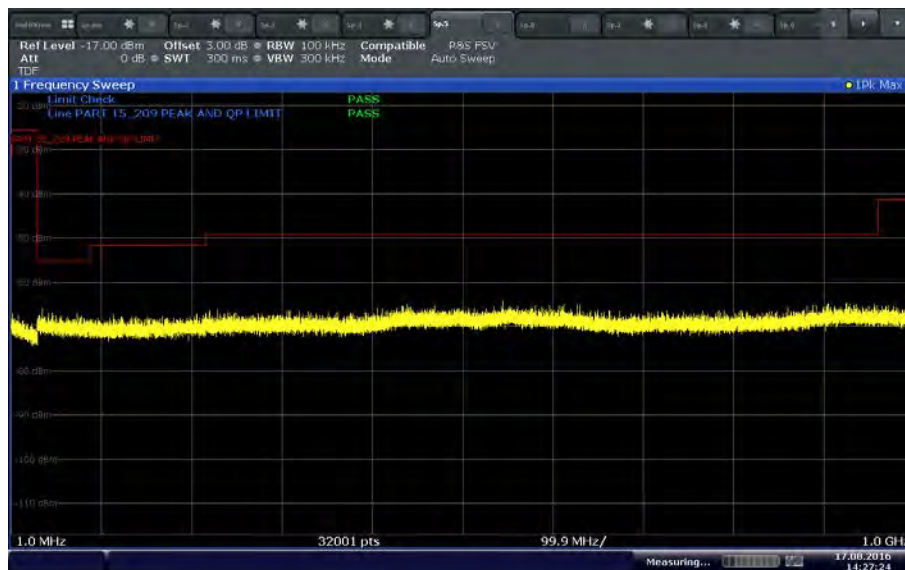
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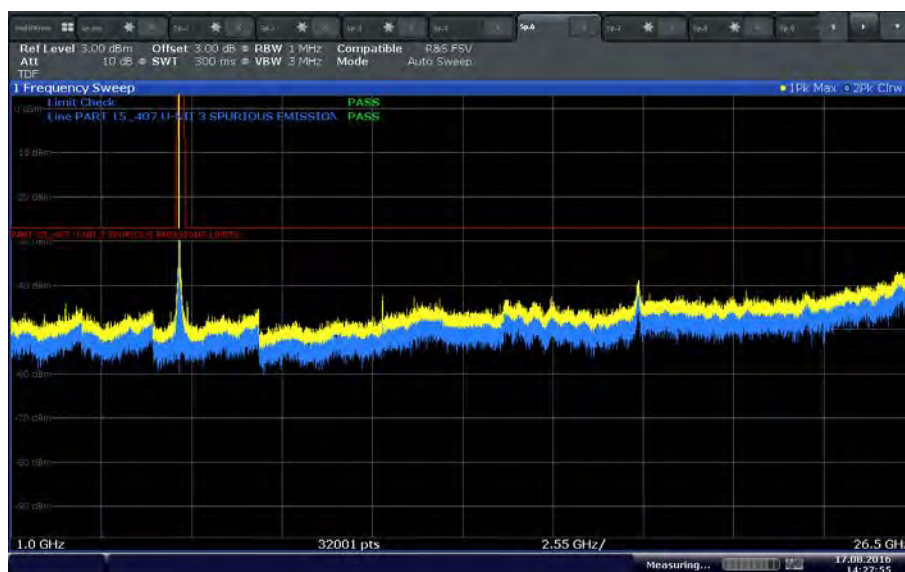
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### 802.11 n (40 MHz) U-NII 3 High Channel above 1GHz



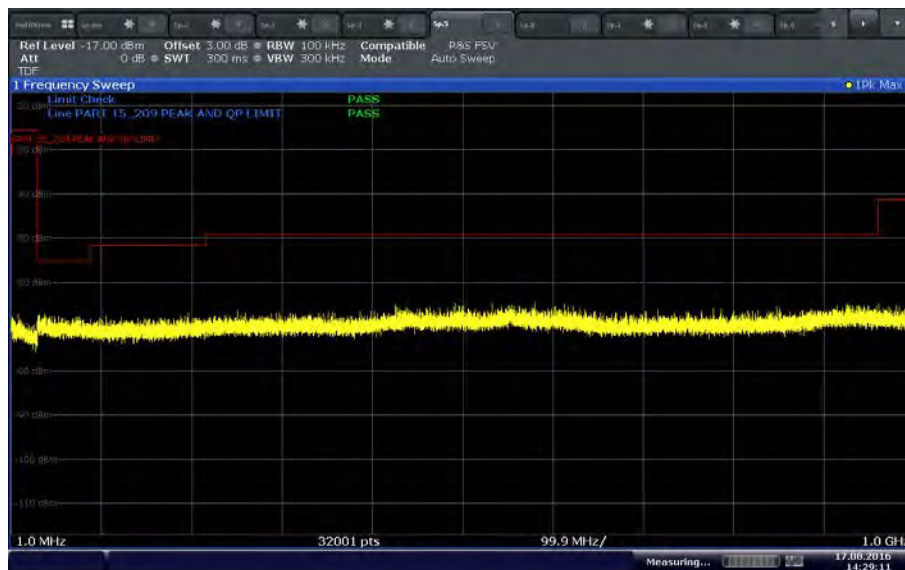
Date: 17 AUG 2016 14:27:23

802.11 ac (20 MHz) U-NII 3 Low Channel below 1GHz



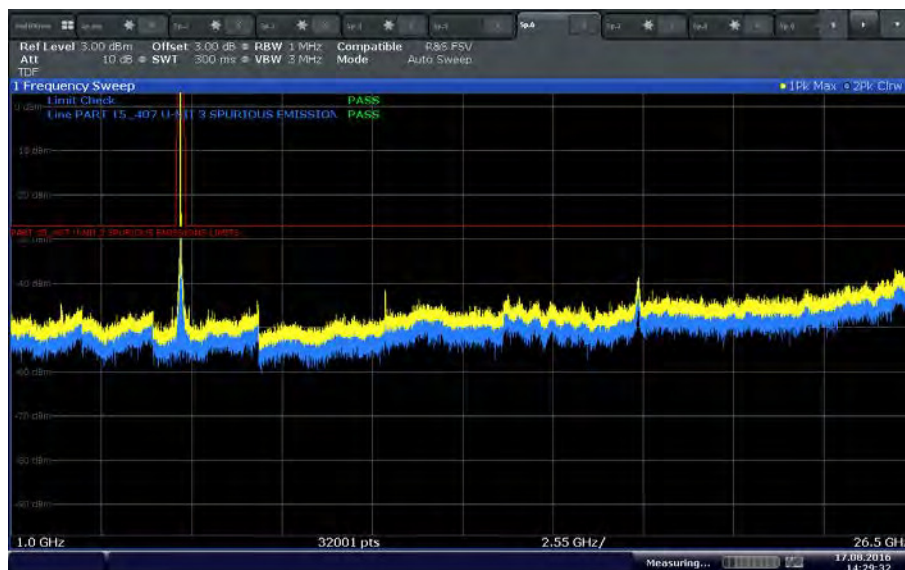
Date: 17 AUG 2016 14:27:55

802.11 ac (20 MHz) U-NII 3 Low Channel above 1GHz



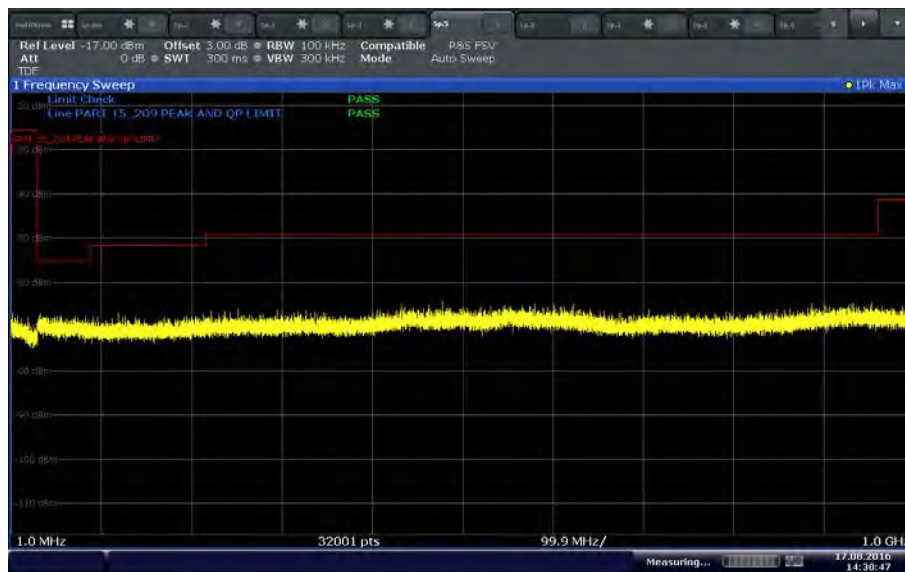
Date: 17 AUG 2016 14:29:11

802.11 ac (20 MHz) U-NII 3 Mid Channel below 1GHz



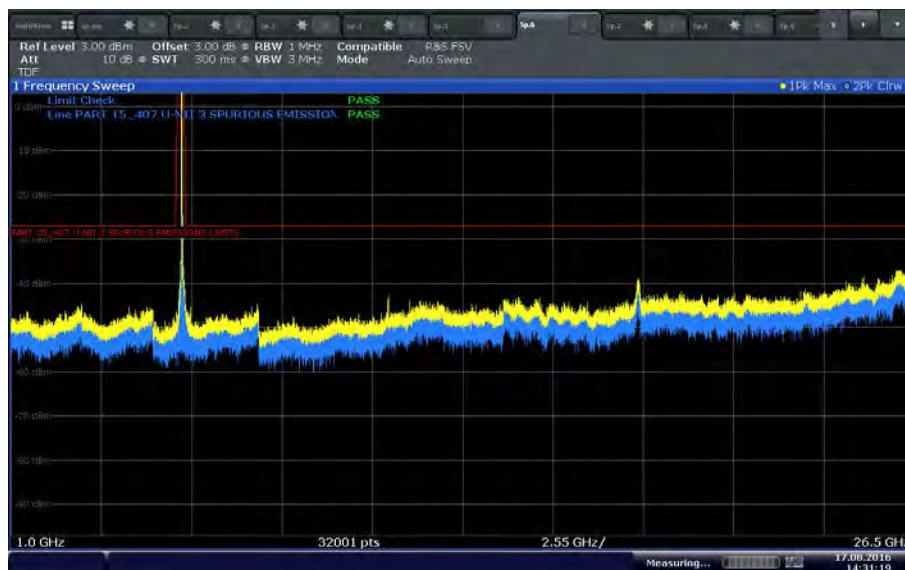
Date: 17 AUG 2016 14:29:32

802.11 ac (20 MHz) U-NII 3 Mid Channel above 1GHz



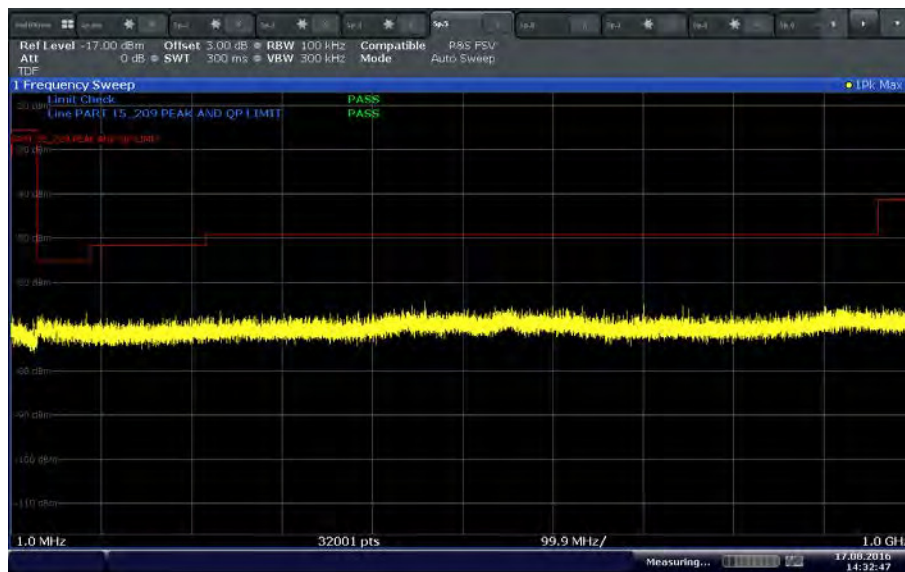
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802.11 ac (20 MHz) U-NII 3 High Channel below 1GHz



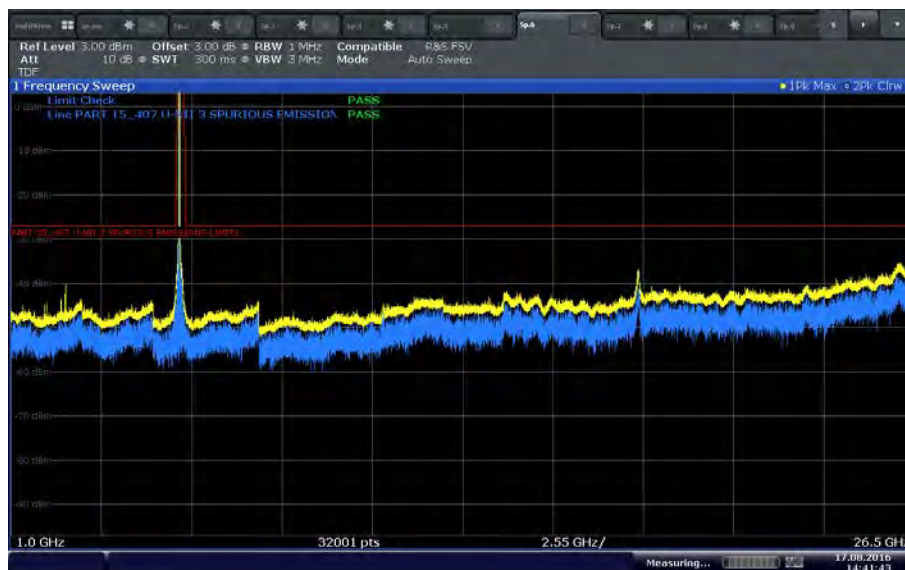
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802.11 ac (20 MHz) U-NII 3 High Channel above 1GHz



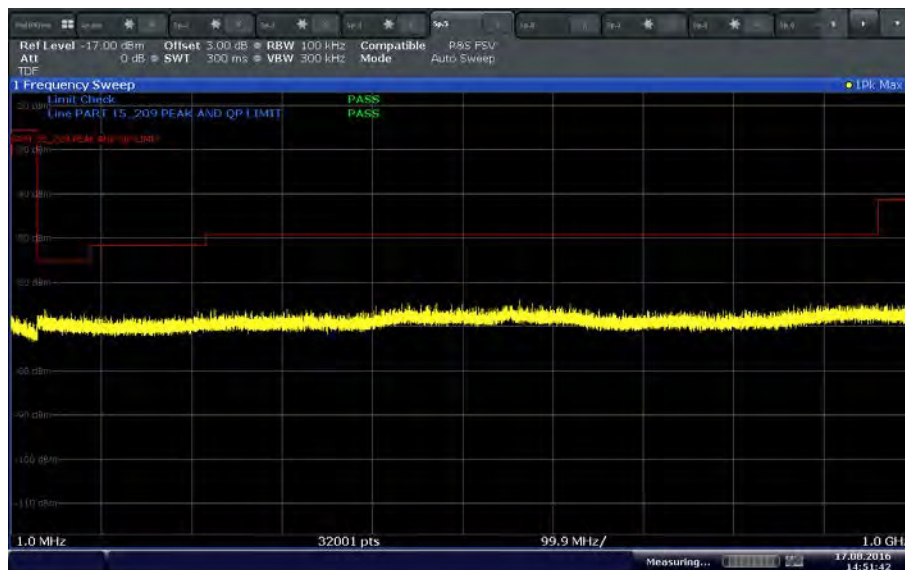
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### 802.11 ac (40 MHz) U-NII 3 Low Channel below 1GHz



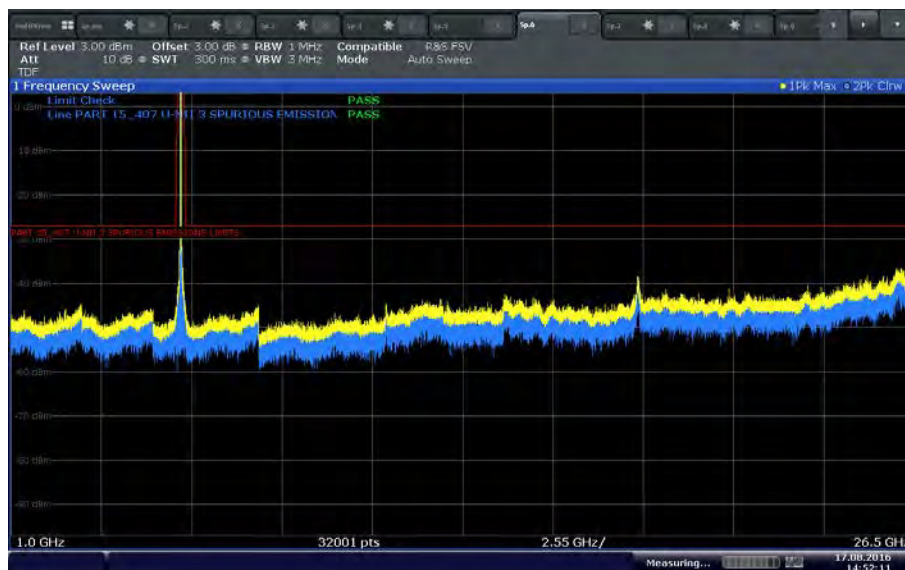
Date: 17 AUG 2016 14:41:43

### 802.11 ac (40 MHz) U-NII 3 Low Channel above 1GHz



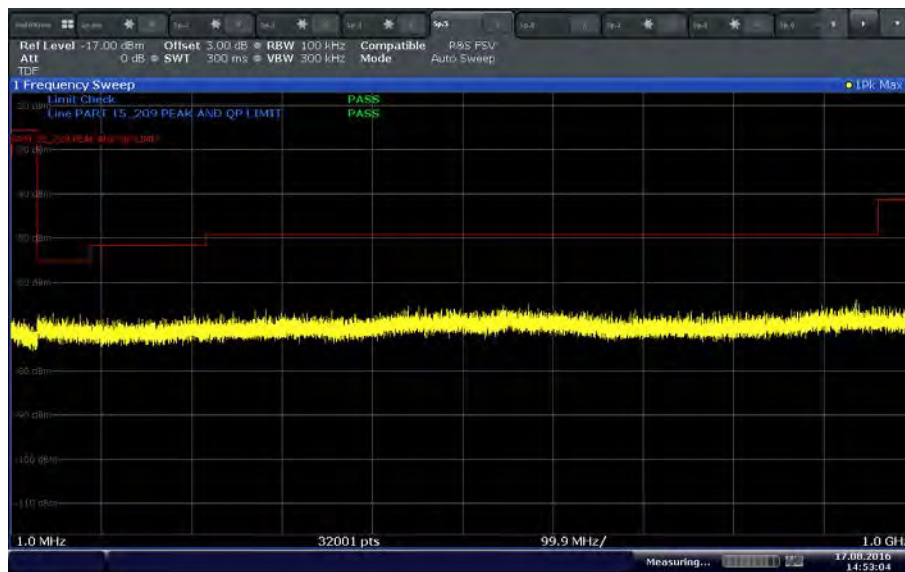
Date: 17 AUG 2016 14:51:42

802.11 ac (40 MHz) U-NII 3 High Channel below 1GHz



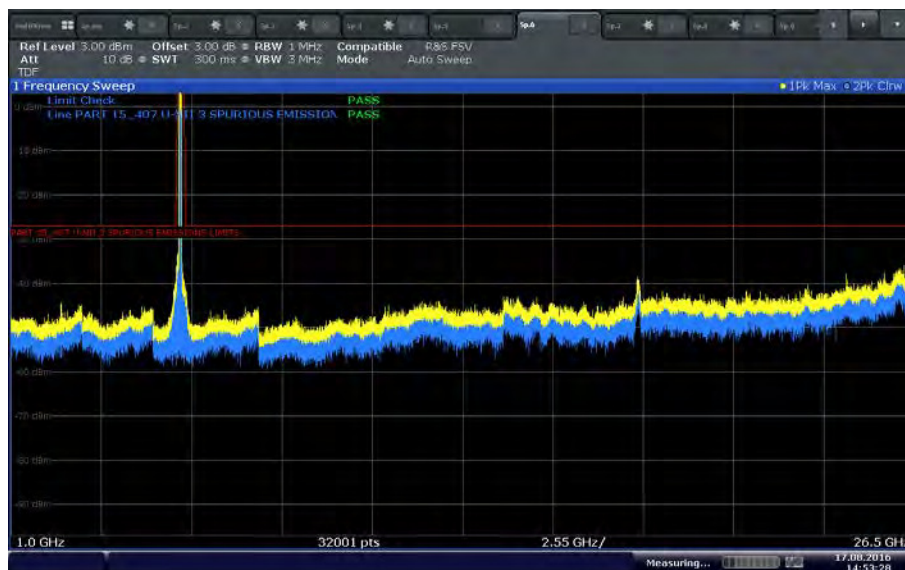
Date: 17 AUG 2016 14:52:11

802.11 ac (40 MHz) U-NII 3 High Channel above 1GHz



Date: 17.AUG 2016 14:53:04

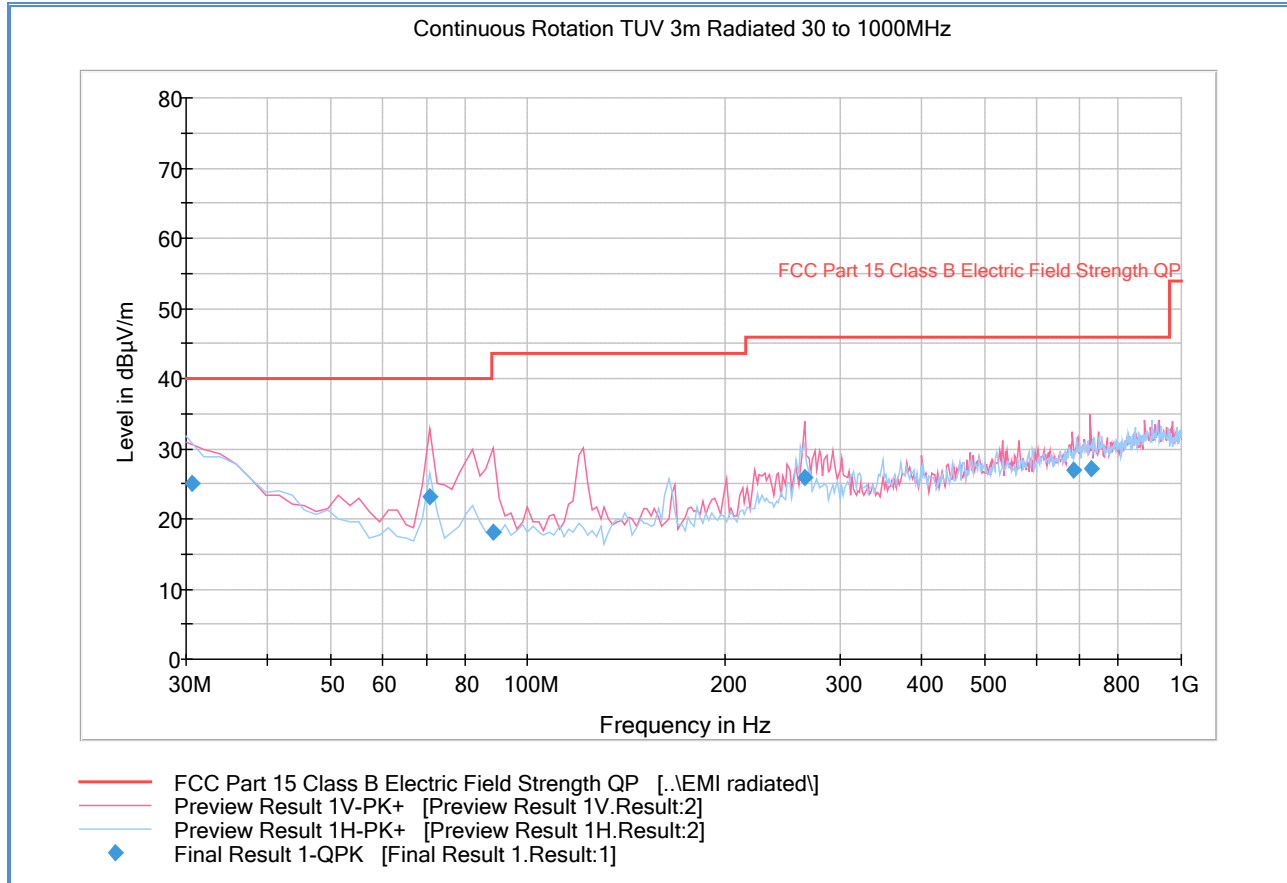
### 802.11 ac (80 MHz) U-NII 3 Mid Channel below 1GHz



Date: 17.AUG 2016 14:53:28

### 802.11 ac (80 MHz) U-NII 3 Mid Channel above 1GHz

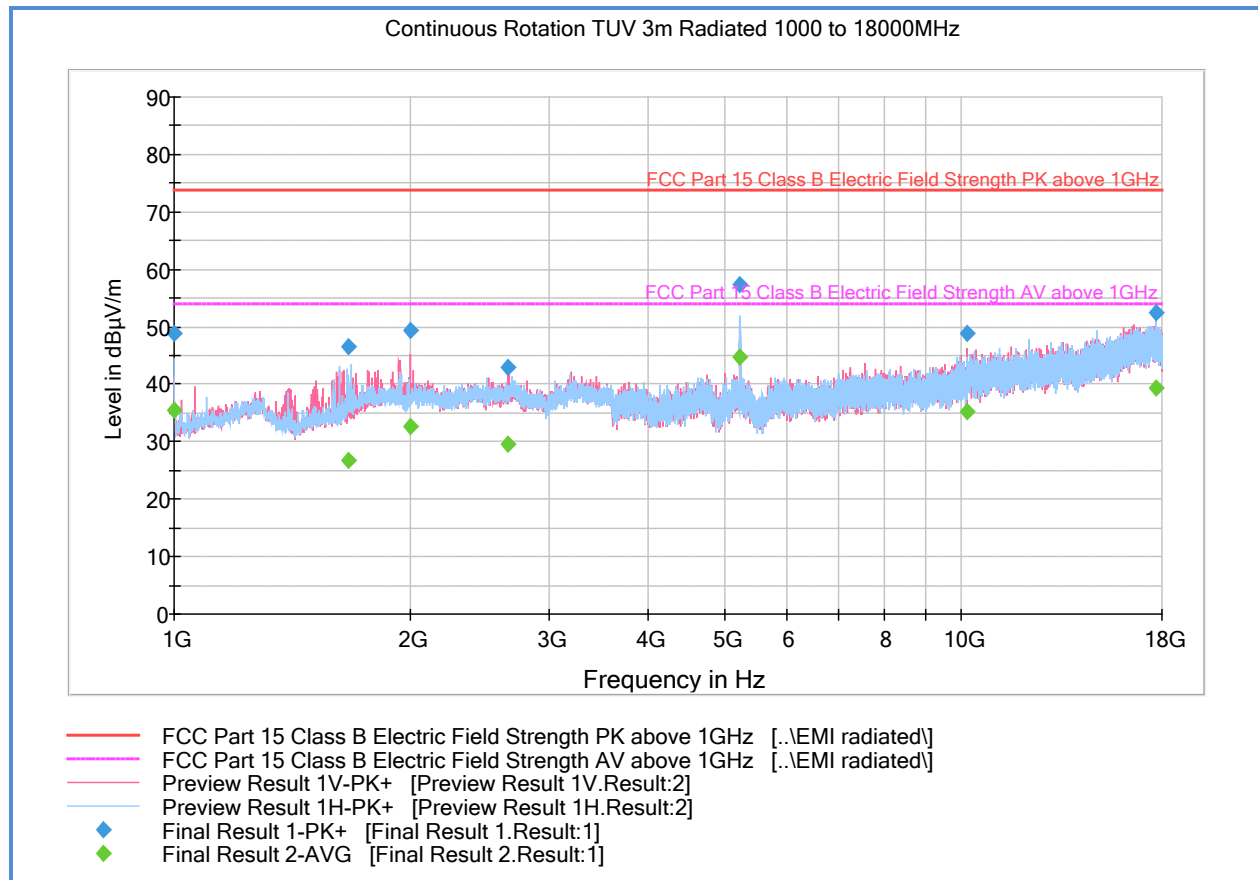
## 2.7.12 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11a U-NII 1)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.680000       | 25.1               | 1000.0          | 120.000         | 259.0       | H            | 15.0          | -6.2       | 14.9        | 40.0           |
| 70.661643       | 23.1               | 1000.0          | 120.000         | 100.0       | V            | 345.0         | -16.8      | 16.9        | 40.0           |
| 88.532745       | 18.0               | 1000.0          | 120.000         | 109.0       | V            | 352.0         | -15.6      | 25.5        | 43.5           |
| 266.010421      | 25.9               | 1000.0          | 120.000         | 208.0       | V            | 9.0           | -8.4       | 20.1        | 46.0           |
| 682.882405      | 27.0               | 1000.0          | 120.000         | 150.0       | V            | 15.0          | 2.3        | 19.0        | 46.0           |
| 727.511824      | 27.2               | 1000.0          | 120.000         | 100.0       | V            | 352.0         | 2.9        | 18.8        | 46.0           |

## 2.7.13 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11a U-NII 1)



### Peak Data

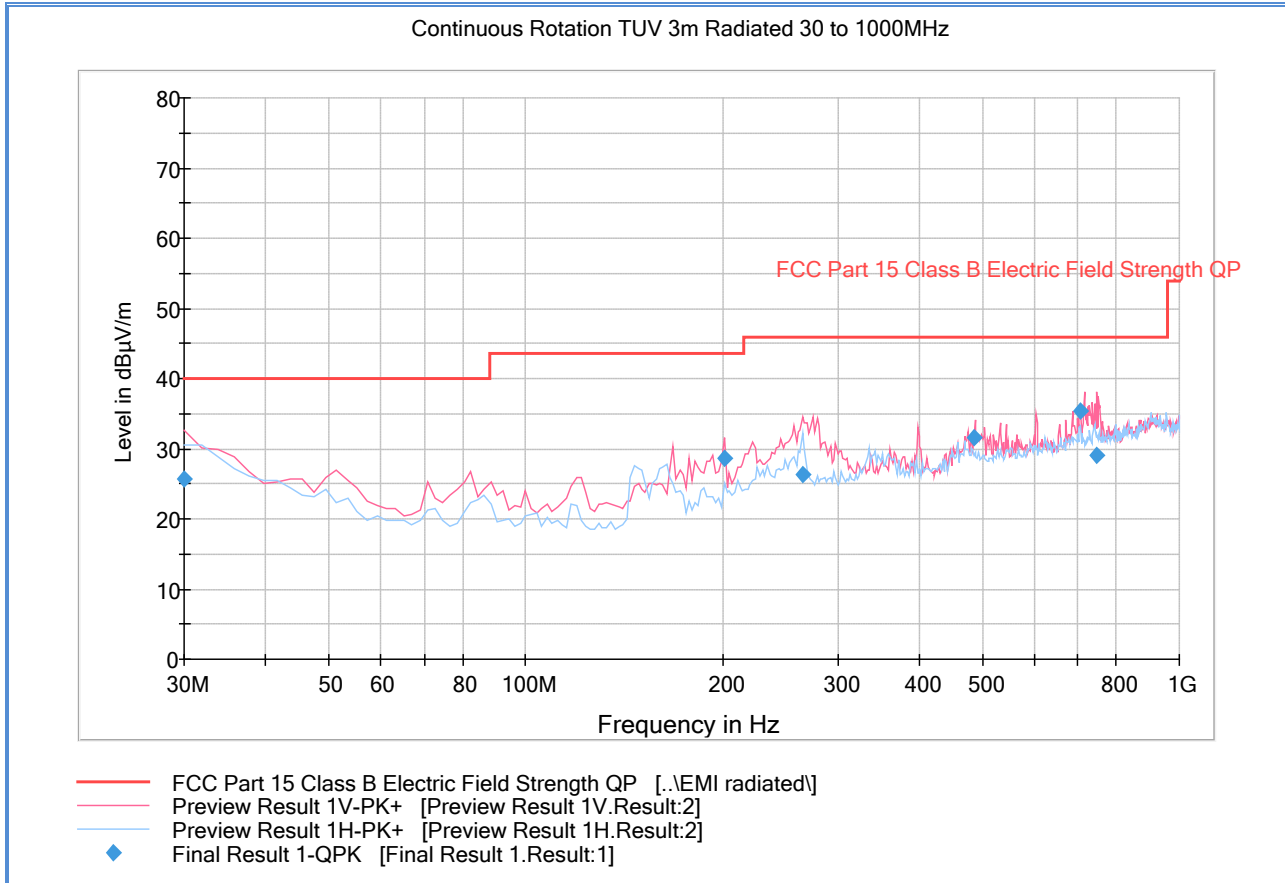
| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000     | 48.8             | 1000.0          | 1000.000        | 115.7       | H            | 353.0         | -7.7       | 25.1        | 73.9           |
| 1664.933333     | 46.5             | 1000.0          | 1000.000        | 204.5       | V            | 11.0          | -4.8       | 27.4        | 73.9           |
| 1993.366667     | 49.4             | 1000.0          | 1000.000        | 146.7       | V            | 341.0         | -0.2       | 24.5        | 73.9           |
| 2658.466667     | 42.9             | 1000.0          | 1000.000        | 195.5       | V            | 359.0         | -0.9       | 31.0        | 73.9           |
| 5242.633333     | 57.3             | 1000.0          | 1000.000        | 115.7       | H            | 11.0          | 3.9        | 16.6        | 73.9           |
| 10185.466666    | 48.8             | 1000.0          | 1000.000        | 130.7       | V            | 11.0          | 11.3       | 25.1        | 73.9           |
| 17710.800000    | 52.4             | 1000.0          | 1000.000        | 151.2       | H            | 341.0         | 20.2       | 21.5        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000     | 35.4             | 1000.0          | 1000.000        | 115.7       | H            | 353.0         | -7.7       | 18.5        | 53.9           |
| 1664.933333     | 26.8             | 1000.0          | 1000.000        | 204.5       | V            | 11.0          | -4.8       | 27.1        | 53.9           |
| 1993.366667     | 32.7             | 1000.0          | 1000.000        | 146.7       | V            | 341.0         | -0.2       | 21.2        | 53.9           |
| 2658.466667     | 29.7             | 1000.0          | 1000.000        | 195.5       | V            | 359.0         | -0.9       | 24.2        | 53.9           |
| 5242.633333     | 44.9             | 1000.0          | 1000.000        | 115.7       | H            | 11.0          | 3.9        | 9.0         | 53.9           |
| 10185.466666    | 35.1             | 1000.0          | 1000.000        | 130.7       | V            | 11.0          | 11.3       | 18.8        | 53.9           |
| 17710.800000    | 39.4             | 1000.0          | 1000.000        | 151.2       | H            | 341.0         | 20.2       | 14.5        | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not required since duty cycle is >98%.

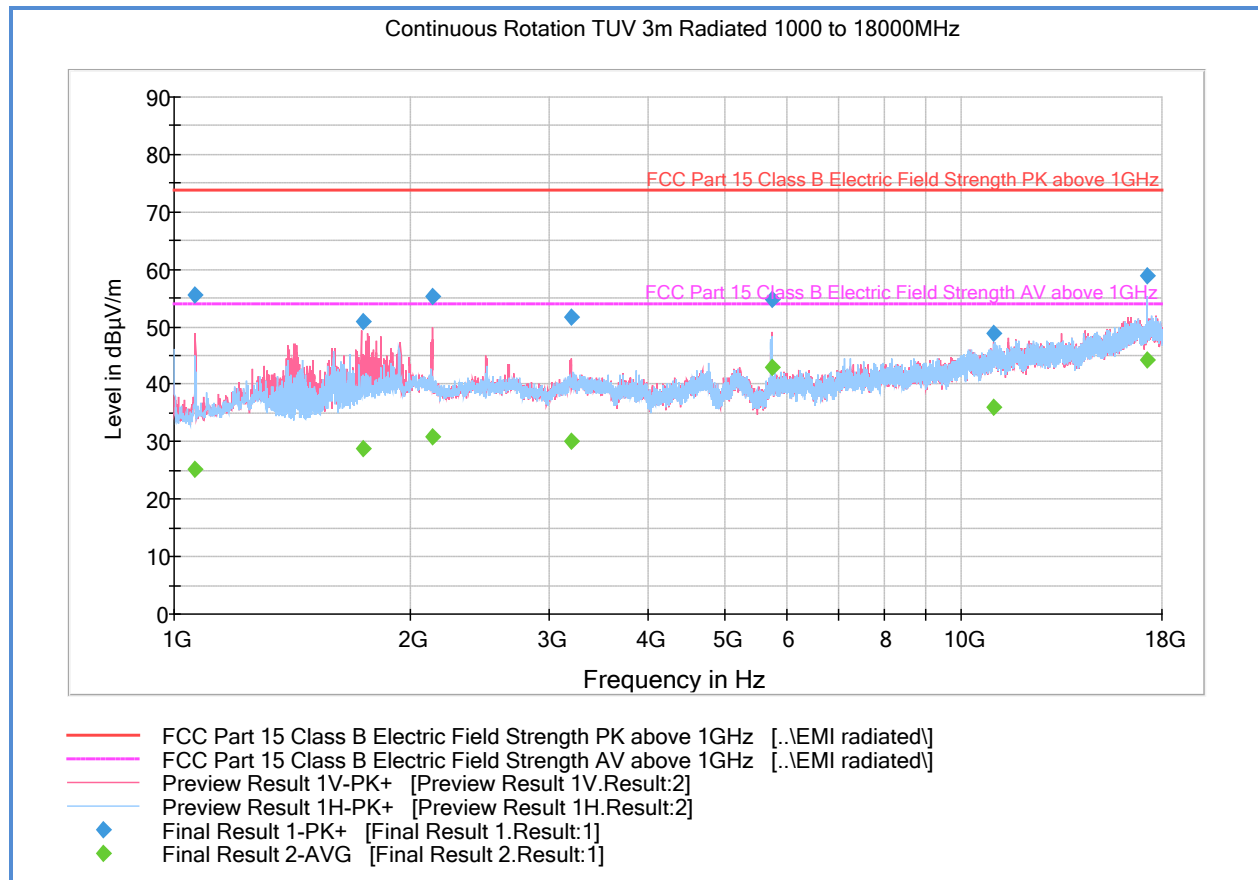
## 2.7.14 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11a U-NII 3)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.040000       | 25.7               | 1000.0          | 120.000         | 109.0       | V            | -3.0          | -5.8       | 14.3        | 40.0           |
| 201.342124      | 28.7               | 1000.0          | 120.000         | 100.0       | V            | 176.0         | -11.4      | 14.8        | 43.5           |
| 265.290421      | 26.3               | 1000.0          | 120.000         | 100.0       | V            | 335.0         | -8.4       | 19.7        | 46.0           |
| 485.573627      | 31.5               | 1000.0          | 120.000         | 115.0       | V            | 71.0          | -1.6       | 14.5        | 46.0           |
| 704.745170      | 35.3               | 1000.0          | 120.000         | 100.0       | V            | 58.0          | 3.0        | 10.7        | 46.0           |
| 747.974589      | 29.1               | 1000.0          | 120.000         | 100.0       | V            | 125.0         | 3.2        | 16.9        | 46.0           |

## 2.7.15 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11a U-NII 3)



### Peak Data

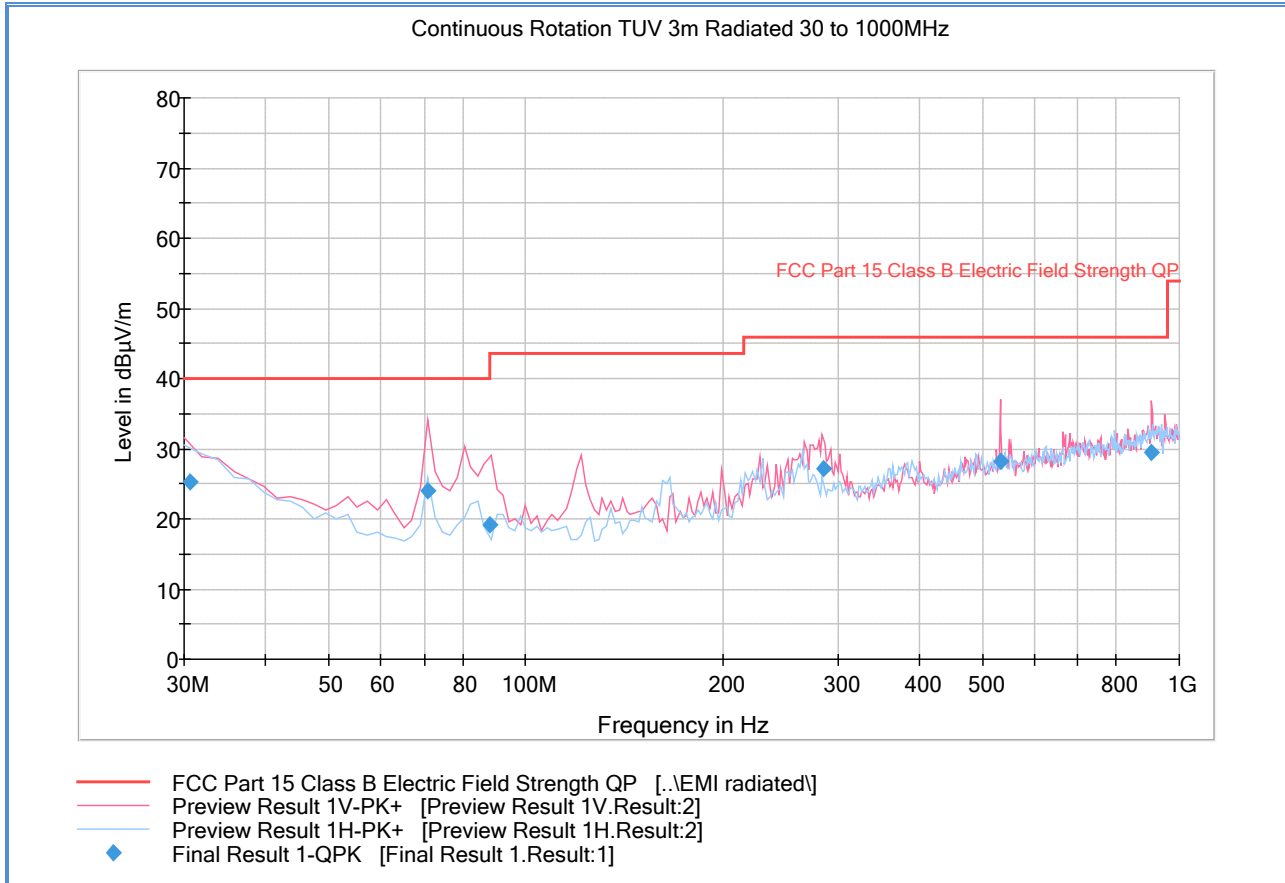
| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1064.600000     | 55.6             | 1000.0          | 1000.000        | 126.7       | V            | 279.0         | -7.5       | 18.3        | 73.9           |
| 1742.000000     | 51.0             | 1000.0          | 1000.000        | 103.7       | V            | 178.0         | -3.8       | 22.9        | 73.9           |
| 2131.833333     | 55.2             | 1000.0          | 1000.000        | 100.7       | V            | 235.0         | -1.3       | 18.7        | 73.9           |
| 3195.633333     | 51.7             | 1000.0          | 1000.000        | 99.7        | V            | 231.0         | 1.1        | 22.2        | 73.9           |
| 5747.966667     | 54.7             | 1000.0          | 1000.000        | 112.7       | V            | 158.0         | 4.7        | 19.2        | 73.9           |
| 10985.03333     | 48.9             | 1000.0          | 1000.000        | 239.4       | V            | 66.0          | 12.7       | 25.0        | 73.9           |
| 17237.23333     | 58.8             | 1000.0          | 1000.000        | 199.5       | H            | 23.0          | 19.7       | 15.1        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1064.600000     | 25.2             | 1000.0          | 1000.000        | 126.7       | V            | 279.0         | -7.5       | 28.7        | 53.9           |
| 1742.000000     | 28.7             | 1000.0          | 1000.000        | 103.7       | V            | 178.0         | -3.8       | 25.2        | 53.9           |
| 2131.833333     | 30.9             | 1000.0          | 1000.000        | 100.7       | V            | 235.0         | -1.3       | 23.0        | 53.9           |
| 3195.633333     | 30.0             | 1000.0          | 1000.000        | 99.7        | V            | 231.0         | 1.1        | 23.9        | 53.9           |
| 5747.966667     | 42.9             | 1000.0          | 1000.000        | 112.7       | V            | 158.0         | 4.7        | 11.0        | 53.9           |
| 10985.03333     | 36.0             | 1000.0          | 1000.000        | 239.4       | V            | 66.0          | 12.7       | 17.9        | 53.9           |
| 17237.23333     | 44.3             | 1000.0          | 1000.000        | 199.5       | H            | 23.0          | 19.7       | 9.6         | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not required since duty cycle is >98%.

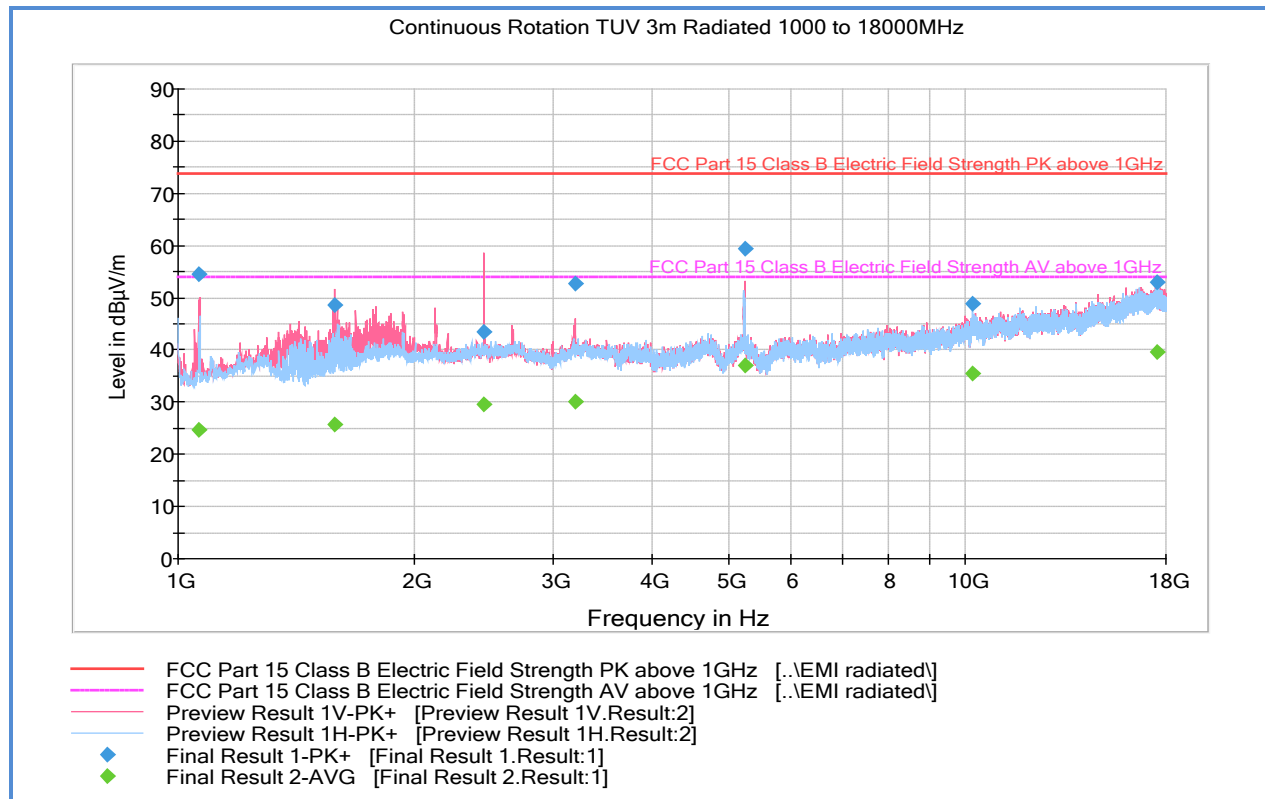
## 2.7.16 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11n U-NII 1)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.560000       | 25.3               | 1000.0          | 120.000         | 100.0       | V            | 15.0          | -6.1       | 14.7        | 40.0           |
| 70.861643       | 24.0               | 1000.0          | 120.000         | 109.0       | V            | 4.0           | -16.8      | 16.0        | 40.0           |
| 87.932745       | 19.2               | 1000.0          | 120.000         | 100.0       | V            | 15.0          | -15.7      | 20.8        | 40.0           |
| 285.529299      | 27.1               | 1000.0          | 120.000         | 100.0       | V            | 15.0          | -7.9       | 18.9        | 46.0           |
| 532.643046      | 28.1               | 1000.0          | 120.000         | 129.0       | V            | 347.0         | -0.9       | 17.9        | 46.0           |
| 903.653387      | 29.5               | 1000.0          | 120.000         | 100.0       | V            | 9.0           | 6.0        | 16.5        | 46.0           |

## 2.7.17 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11n U-NII 1)



### Peak Data

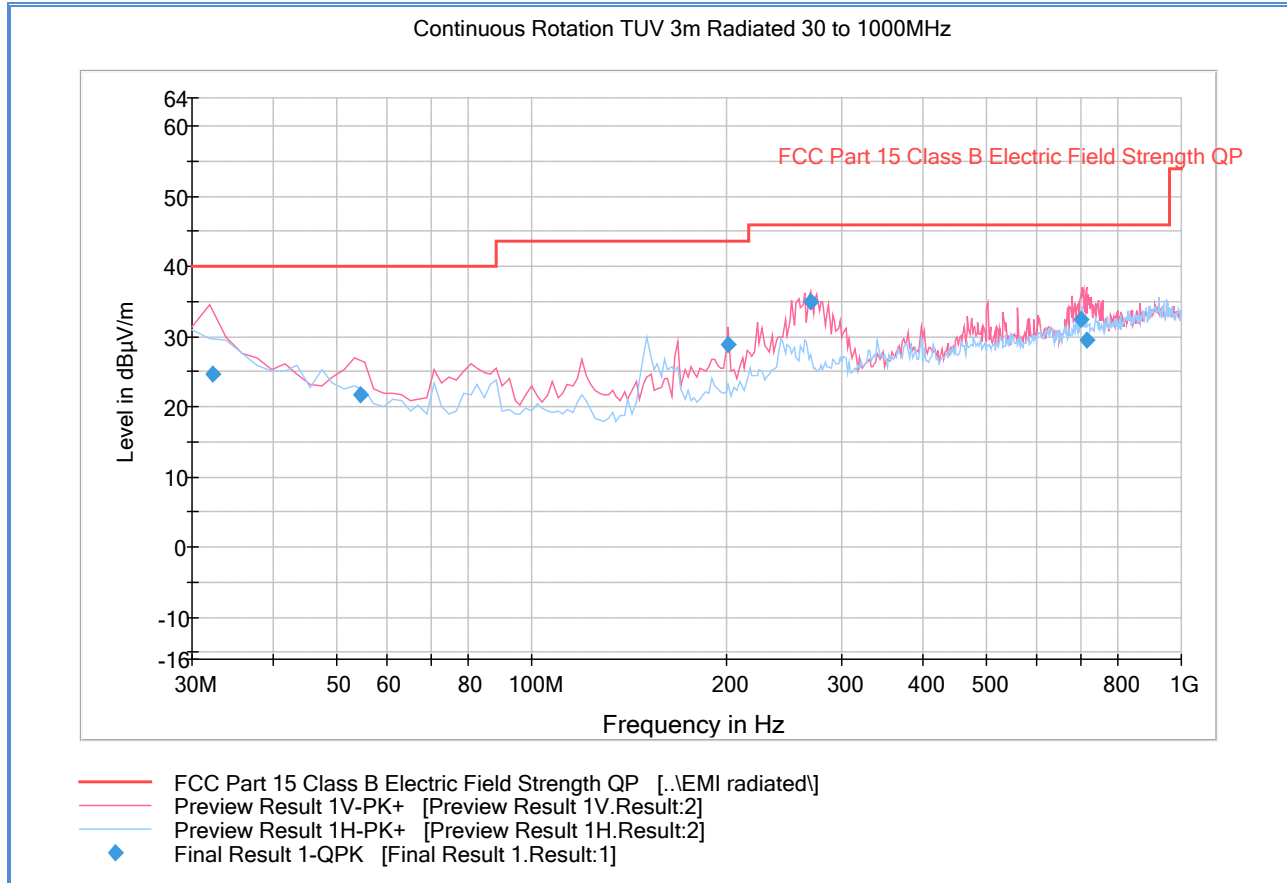
| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1061.066667     | 54.6             | 1000.0          | 1000.000        | 102.7       | V            | 142.0         | -7.6       | 19.3        | 73.9           |
| 1583.333333     | 48.6             | 1000.0          | 1000.000        | 177.6       | V            | 158.0         | -5.8       | 25.3        | 73.9           |
| 2443.833333     | 43.5             | 1000.0          | 1000.000        | 165.6       | V            | -17.0         | -1.0       | 30.4        | 73.9           |
| 3200.200000     | 52.8             | 1000.0          | 1000.000        | 102.7       | V            | 7.0           | 1.1        | 21.1        | 73.9           |
| 5246.733333     | 59.4             | 1000.0          | 1000.000        | 200.5       | V            | 298.0         | 3.9        | 14.5        | 73.9           |
| 10210.43333     | 48.8             | 1000.0          | 1000.000        | 222.4       | H            | 333.0         | 11.4       | 25.1        | 73.9           |
| 17517.76666     | 53.0             | 1000.0          | 1000.000        | 204.5       | H            | 311.0         | 20.1       | 20.9        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1061.066667     | 24.8             | 1000.0          | 1000.000        | 102.7       | V            | 142.0         | -7.6       | 29.1        | 53.9           |
| 1583.333333     | 25.7             | 1000.0          | 1000.000        | 177.6       | V            | 158.0         | -5.8       | 28.2        | 53.9           |
| 2443.833333     | 29.5             | 1000.0          | 1000.000        | 165.6       | V            | -17.0         | -1.0       | 24.4        | 53.9           |
| 3200.200000     | 30.2             | 1000.0          | 1000.000        | 102.7       | V            | 7.0           | 1.1        | 23.7        | 53.9           |
| 5246.733333     | 37.1             | 1000.0          | 1000.000        | 200.5       | V            | 298.0         | 3.9        | 16.8        | 53.9           |
| 10210.43333     | 35.5             | 1000.0          | 1000.000        | 222.4       | H            | 333.0         | 11.4       | 18.4        | 53.9           |
| 17517.76666     | 39.7             | 1000.0          | 1000.000        | 204.5       | H            | 311.0         | 20.1       | 14.2        | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not applied on Average data (2.17 dB) since there is no spurious emission within 6 dB of the limit (DCCF has no impact on the presented test results).

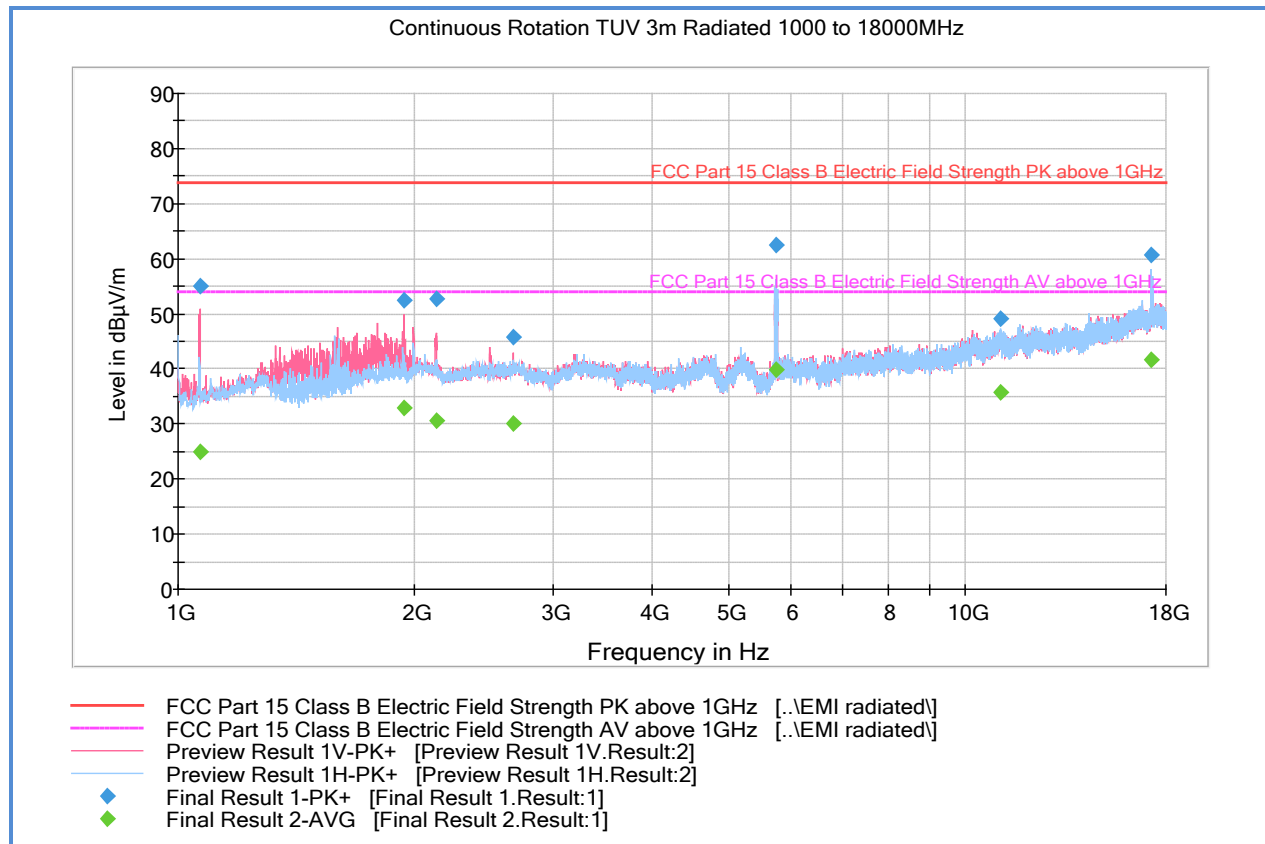
## 2.7.18 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11n U-NII 3)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 32.280000       | 24.6               | 1000.0          | 120.000         | 106.0       | V            | 338.0         | -7.1       | 15.4        | 40.0           |
| 54.446653       | 21.6               | 1000.0          | 120.000         | 100.0       | V            | 267.0         | -15.3      | 18.4        | 40.0           |
| 200.622124      | 28.9               | 1000.0          | 120.000         | 100.0       | V            | 173.0         | -11.5      | 14.6        | 43.5           |
| 269.018196      | 34.9               | 1000.0          | 120.000         | 100.0       | V            | 104.0         | -8.1       | 11.1        | 46.0           |
| 701.865170      | 32.5               | 1000.0          | 120.000         | 100.0       | V            | 146.0         | 2.9        | 13.5        | 46.0           |
| 715.168497      | 29.5               | 1000.0          | 120.000         | 100.0       | V            | 147.0         | 3.2        | 16.5        | 46.0           |

## 2.7.19 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11n U-NII 3)



### Peak Data

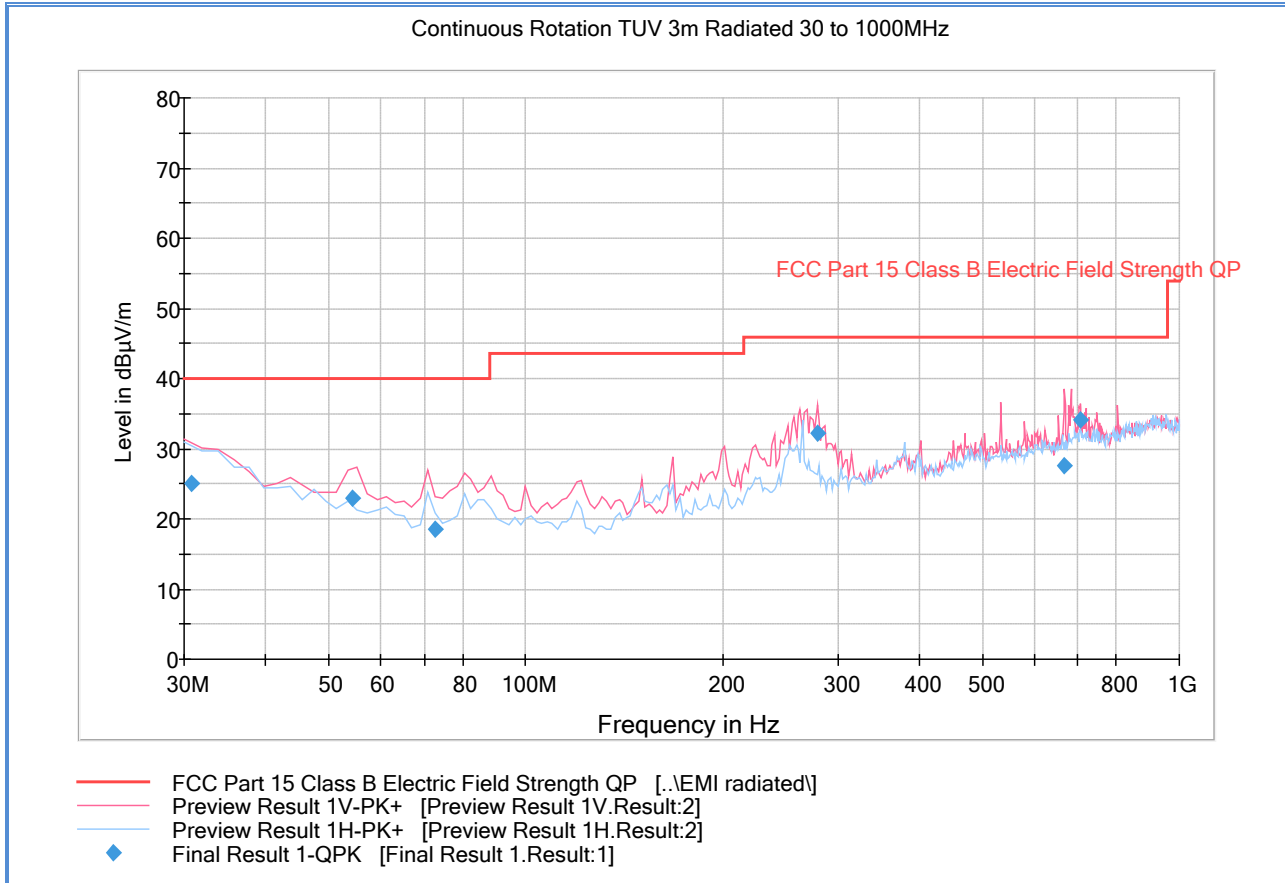
| Frequency (MHz) | MaxPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1066.500000     | 54.9             | 1000.0          | 1000.000        | 103.7       | V            | 134.0         | -7.5       | 19.0        | 73.9           |
| 1937.066667     | 52.5             | 1000.0          | 1000.000        | 241.3       | V            | 330.0         | -0.7       | 21.4        | 73.9           |
| 2128.033333     | 52.7             | 1000.0          | 1000.000        | 103.7       | V            | 71.0          | -1.2       | 21.2        | 73.9           |
| 2667.166667     | 45.8             | 1000.0          | 1000.000        | 131.7       | V            | 74.0          | -0.8       | 28.1        | 73.9           |
| 5764.166667     | 62.4             | 1000.0          | 1000.000        | 199.5       | H            | -2.0          | 4.7        | 11.5        | 73.9           |
| 11073.600000    | 49.2             | 1000.0          | 1000.000        | 232.4       | H            | 187.0         | 12.8       | 24.7        | 73.9           |
| 17253.733333    | 60.8             | 1000.0          | 1000.000        | 208.5       | H            | 33.0          | 19.7       | 13.1        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1066.500000     | 25.1             | 1000.0          | 1000.000        | 103.7       | V            | 134.0         | -7.5       | 28.8        | 53.9           |
| 1937.066667     | 32.8             | 1000.0          | 1000.000        | 241.3       | V            | 330.0         | -0.7       | 21.1        | 53.9           |
| 2128.033333     | 30.7             | 1000.0          | 1000.000        | 103.7       | V            | 71.0          | -1.2       | 23.2        | 53.9           |
| 2667.166667     | 30.1             | 1000.0          | 1000.000        | 131.7       | V            | 74.0          | -0.8       | 23.8        | 53.9           |
| 5764.166667     | 39.9             | 1000.0          | 1000.000        | 199.5       | H            | -2.0          | 4.7        | 14.0        | 53.9           |
| 11073.600000    | 35.6             | 1000.0          | 1000.000        | 232.4       | H            | 187.0         | 12.8       | 18.3        | 53.9           |
| 17253.733333    | 41.7             | 1000.0          | 1000.000        | 208.5       | H            | 33.0          | 19.7       | 12.2        | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not applied on Average data (2.17 dB) since there is no spurious emission within 6 dB of the limit (DCCF has no impact on the presented test results).

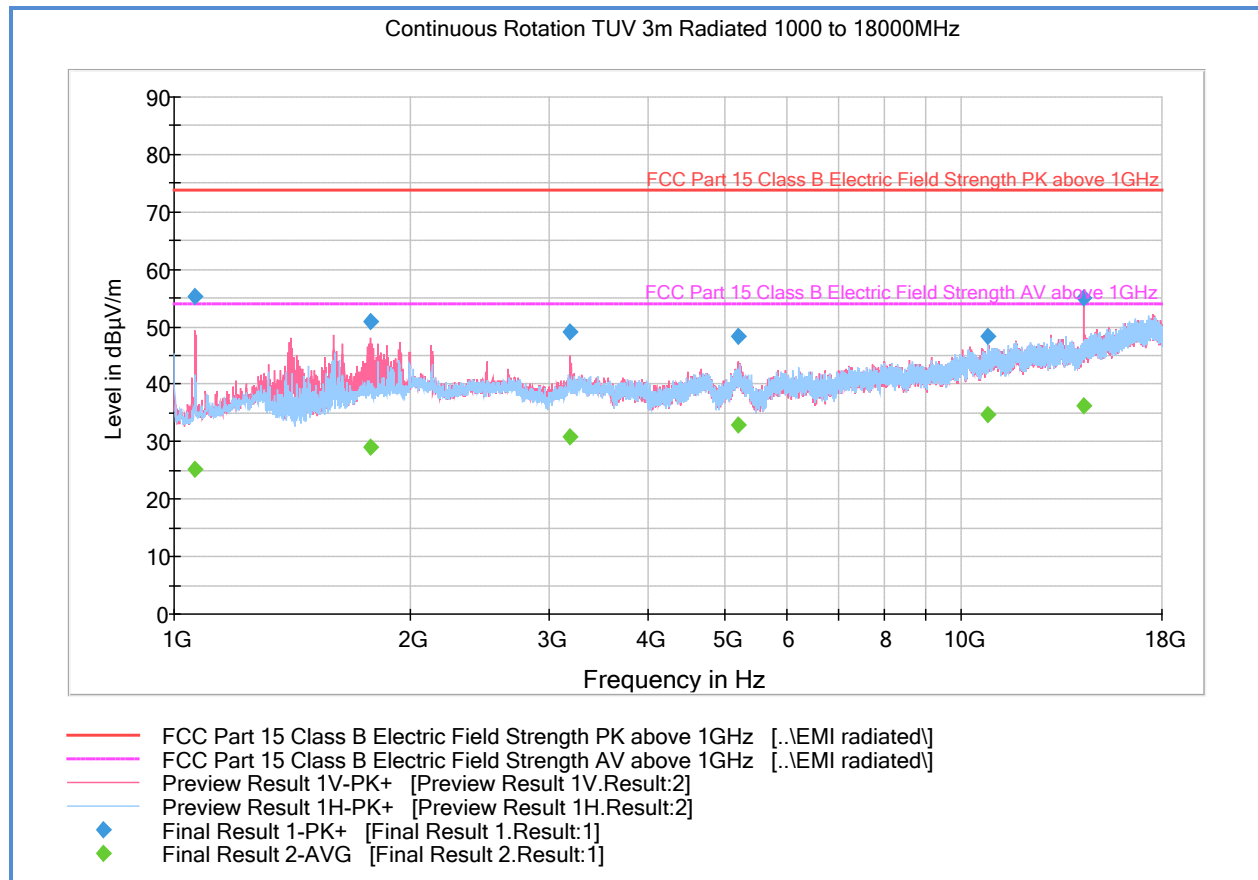
## 2.7.20 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11ac U-NII 1)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.800000       | 25.2               | 1000.0          | 120.000         | 150.0       | V            | 142.0         | -6.2       | 14.8        | 40.0           |
| 54.350541       | 22.9               | 1000.0          | 120.000         | 105.0       | V            | 117.0         | -15.3      | 17.1        | 40.0           |
| 72.821643       | 18.4               | 1000.0          | 120.000         | 109.0       | V            | -8.0          | -16.8      | 21.6        | 40.0           |
| 280.017635      | 32.2               | 1000.0          | 120.000         | 100.0       | V            | 159.0         | -7.8       | 13.8        | 46.0           |
| 665.915190      | 27.6               | 1000.0          | 120.000         | 100.0       | V            | 208.0         | 1.5        | 18.4        | 46.0           |
| 704.712946      | 34.2               | 1000.0          | 120.000         | 109.0       | V            | 197.0         | 3.0        | 11.8        | 46.0           |

## 2.7.21 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11ac U-NII 1)



### Peak Data

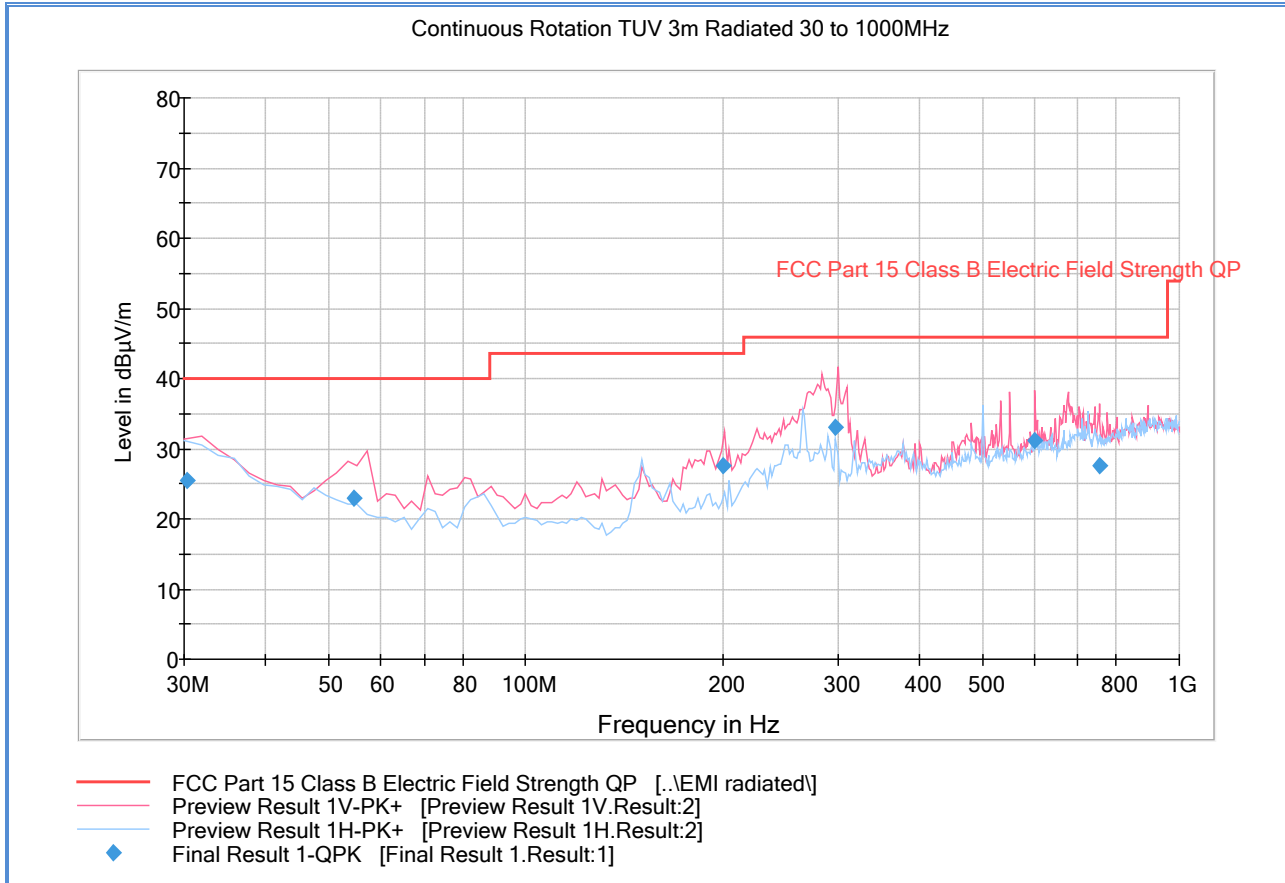
| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1061.566667     | 55.3             | 1000.0          | 1000.000        | 112.7       | V            | 116.0         | -7.6       | 18.6        | 73.9           |
| 1775.433333     | 51.0             | 1000.0          | 1000.000        | 103.7       | V            | 173.0         | -3.6       | 22.9        | 73.9           |
| 3185.866667     | 49.1             | 1000.0          | 1000.000        | 112.7       | V            | 67.0          | 1.1        | 24.8        | 73.9           |
| 5216.000000     | 48.4             | 1000.0          | 1000.000        | 200.5       | V            | 143.0         | 3.8        | 25.5        | 73.9           |
| 10819.56666     | 48.2             | 1000.0          | 1000.000        | 102.7       | H            | 200.0         | 12.7       | 25.7        | 73.9           |
| 14334.80000     | 55.1             | 1000.0          | 1000.000        | 199.5       | V            | 27.0          | 15.5       | 18.8        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1061.566667     | 25.2             | 1000.0          | 1000.000        | 112.7       | V            | 116.0         | -7.6       | 28.7        | 53.9           |
| 1775.433333     | 29.1             | 1000.0          | 1000.000        | 103.7       | V            | 173.0         | -3.6       | 24.8        | 53.9           |
| 3185.866667     | 30.9             | 1000.0          | 1000.000        | 112.7       | V            | 67.0          | 1.1        | 23.0        | 53.9           |
| 5216.000000     | 33.0             | 1000.0          | 1000.000        | 200.5       | V            | 143.0         | 3.8        | 20.9        | 53.9           |
| 10819.56666     | 34.8             | 1000.0          | 1000.000        | 102.7       | H            | 200.0         | 12.7       | 19.1        | 53.9           |
| 14334.80000     | 36.4             | 1000.0          | 1000.000        | 199.5       | V            | 27.0          | 15.5       | 17.5        | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not applied on Average data (2.27 dB) since there is no spurious emission within 6 dB of the limit (DCCF has no impact on the presented test results).

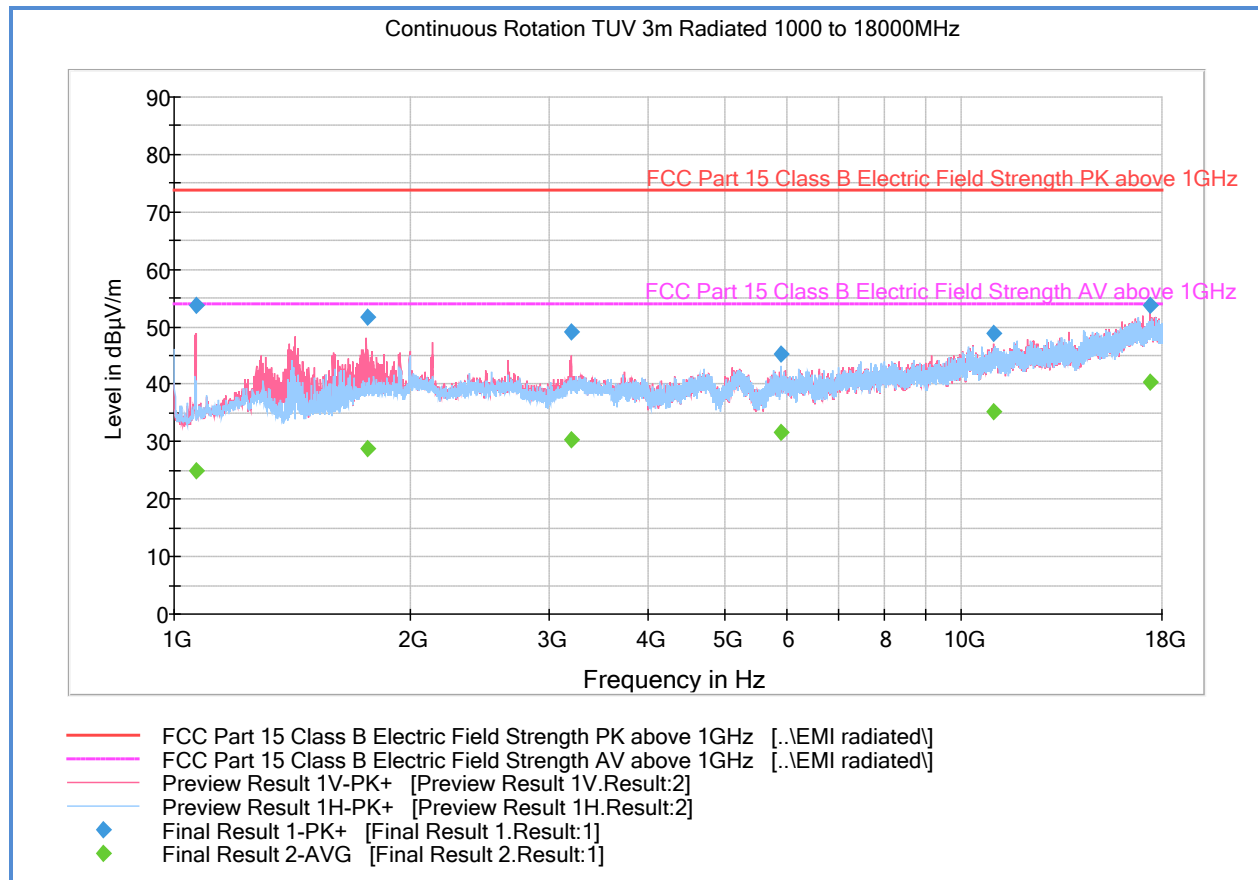
## 2.7.22 Test Results Below 1GHz (Cabinet Spurious Emissions 802.11ac U-NII 3)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.240000       | 25.5               | 1000.0          | 120.000         | 250.0       | V            | 219.0         | -5.9       | 14.5        | 40.0           |
| 54.454429       | 23.0               | 1000.0          | 120.000         | 100.0       | V            | 81.0          | -15.3      | 17.0        | 40.0           |
| 200.582124      | 27.6               | 1000.0          | 120.000         | 100.0       | V            | 127.0         | -11.5      | 15.9        | 43.5           |
| 296.800401      | 33.0               | 1000.0          | 120.000         | 106.0       | V            | 134.0         | -7.5       | 13.0        | 46.0           |
| 601.663006      | 31.1               | 1000.0          | 120.000         | 100.0       | V            | 120.0         | 0.7        | 14.9        | 46.0           |
| 756.910140      | 27.6               | 1000.0          | 120.000         | 100.0       | V            | 114.0         | 3.2        | 18.4        | 46.0           |

## 2.7.23 Test Results Above 1GHz (Cabinet Spurious Emissions 802.11ac U-NII 3)



### Peak Data

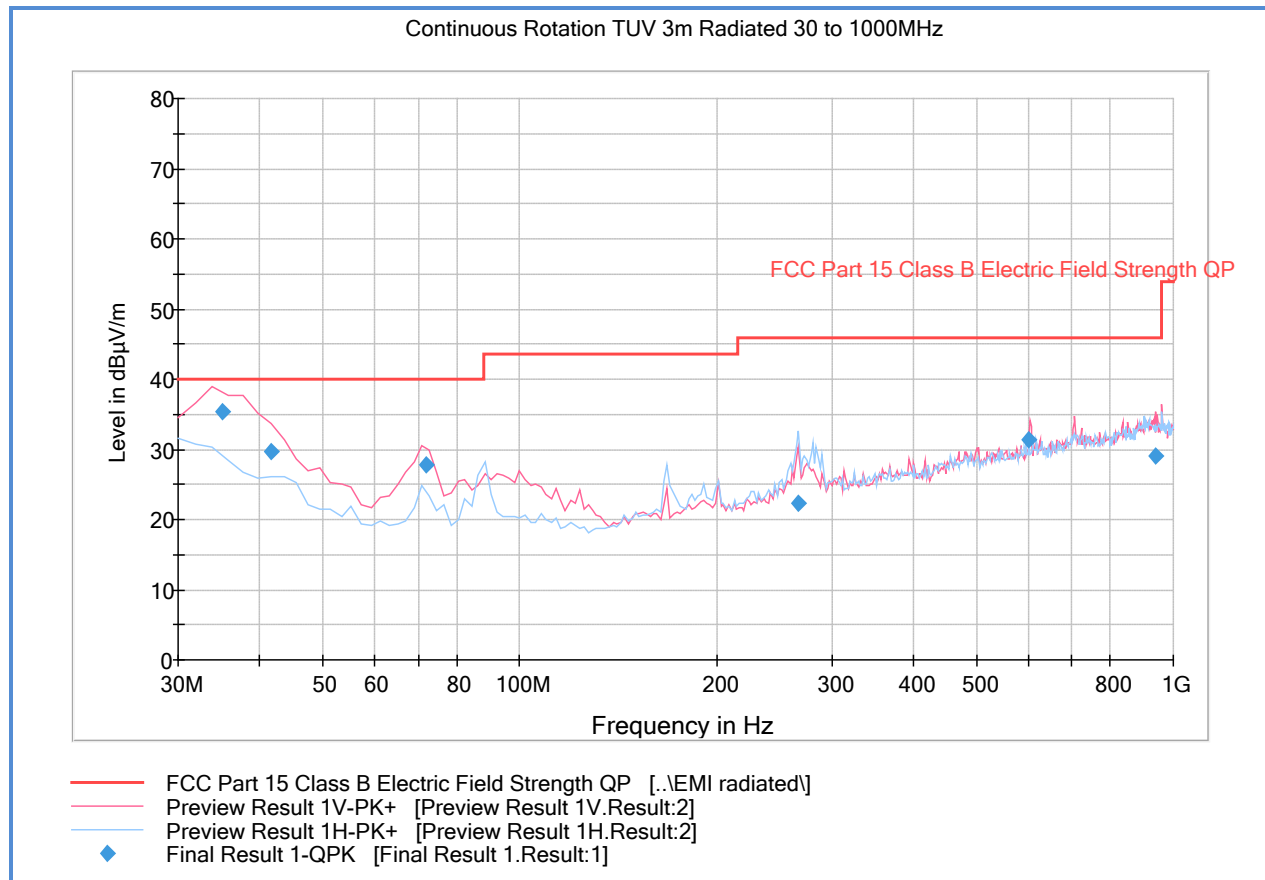
| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1066.866667     | 53.8             | 1000.0          | 1000.000        | 109.7       | V            | 282.0         | -7.4       | 20.1        | 73.9           |
| 1758.066667     | 51.6             | 1000.0          | 1000.000        | 116.7       | V            | 235.0         | -3.7       | 22.3        | 73.9           |
| 3198.066667     | 49.2             | 1000.0          | 1000.000        | 111.7       | V            | 58.0          | 1.1        | 24.7        | 73.9           |
| 5898.466667     | 45.3             | 1000.0          | 1000.000        | 124.7       | H            | 7.0           | 4.9        | 28.6        | 73.9           |
| 11007.86666     | 48.8             | 1000.0          | 1000.000        | 131.7       | V            | 182.0         | 12.7       | 25.1        | 73.9           |
| 17372.83333     | 53.8             | 1000.0          | 1000.000        | 222.4       | V            | 60.0          | 20.0       | 20.1        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1066.866667     | 24.8             | 1000.0          | 1000.000        | 109.7       | V            | 282.0         | -7.4       | 29.1        | 53.9           |
| 1758.066667     | 28.8             | 1000.0          | 1000.000        | 116.7       | V            | 235.0         | -3.7       | 25.1        | 53.9           |
| 3198.066667     | 30.3             | 1000.0          | 1000.000        | 111.7       | V            | 58.0          | 1.1        | 23.6        | 53.9           |
| 5898.466667     | 31.7             | 1000.0          | 1000.000        | 124.7       | H            | 7.0           | 4.9        | 22.2        | 53.9           |
| 11007.86666     | 35.3             | 1000.0          | 1000.000        | 131.7       | V            | 182.0         | 12.7       | 18.6        | 53.9           |
| 17372.83333     | 40.3             | 1000.0          | 1000.000        | 222.4       | V            | 60.0          | 20.0       | 13.6        | 53.9           |

**Test Notes:** Measurement was performed with a 5.0GHz notch filter. No significant emissions observed above 18GHz. Only the worst case configuration presented. Duty Cycle correction factor not applied on Average data (2.27 dB) since there is no spurious emission within 6 dB of the limit (DCCF has no impact on the presented test results).

## 2.7.24 Test Results Below 1GHz (Co-located TX, both WLAN and Cell radio are active)

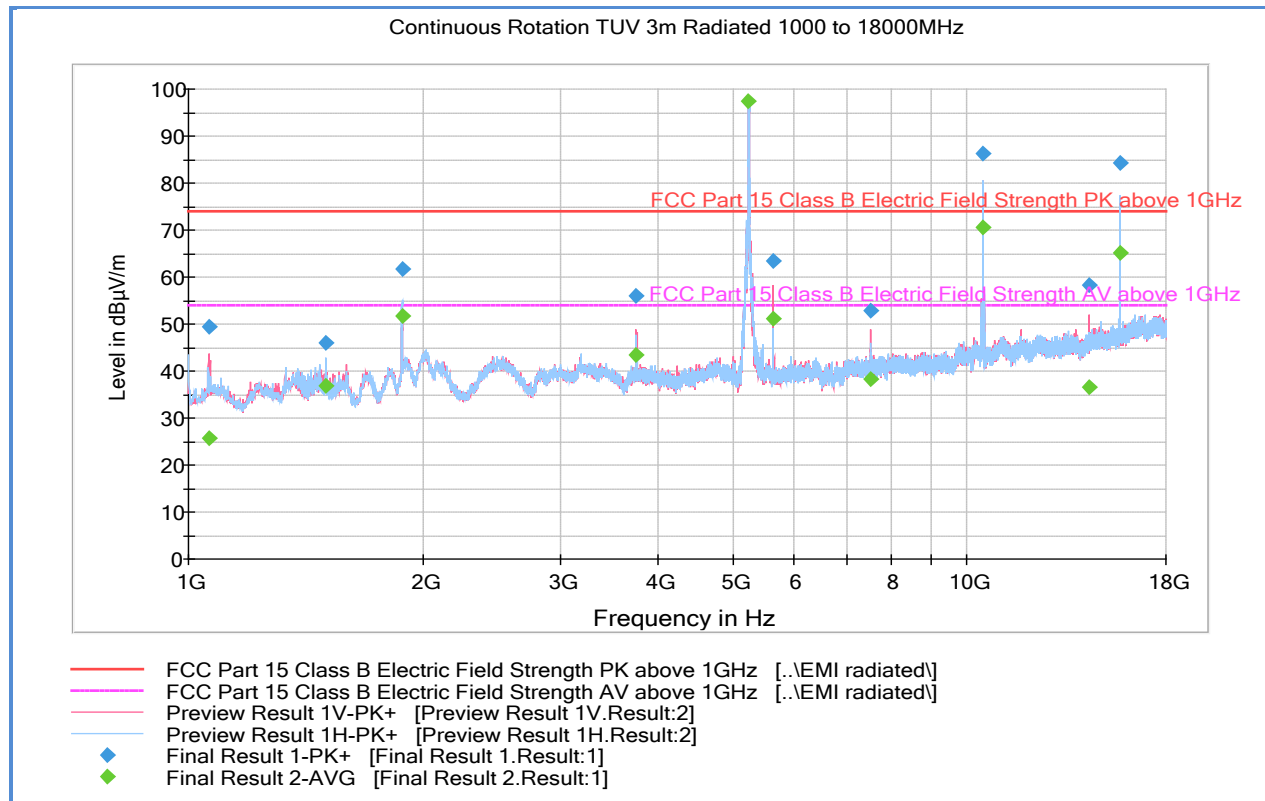


### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dB $\mu$ V/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dB $\mu$ V/m) |
|-----------------|--------------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------------|
| 35.047776       | 35.3                     | 1000.0          | 120.000         | 100.0       | V            | 277.0         | -8.5       | 4.7         | 40.0                 |
| 41.647214       | 29.7                     | 1000.0          | 120.000         | 100.0       | V            | 154.0         | -11.7      | 10.3        | 40.0                 |
| 71.861643       | 27.8                     | 1000.0          | 120.000         | 100.0       | V            | 67.0          | -16.8      | 12.2        | 40.0                 |
| 266.354309      | 22.4                     | 1000.0          | 120.000         | 100.0       | H            | 114.0         | -8.3       | 23.6        | 46.0                 |
| 601.686894      | 31.3                     | 1000.0          | 120.000         | 203.0       | V            | 155.0         | 0.7        | 14.7        | 46.0                 |
| 939.059479      | 29.0                     | 1000.0          | 120.000         | 231.0       | V            | 83.0          | 6.3        | 17.0        | 46.0                 |

**Test Notes:** Only worst case WLAN and licensed test configuration presented.

## 2.7.25 Test Results Above 1GHz (Co-located TX, both WLAN and Cell radio are active)



### Peak Data

| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB)       | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------------|----------------|
| 1062.866667     | 49.5             | 1000.0          | 1000.000        | 103.7       | V            | 270.0         | -7.5       | 24.4              | 73.9           |
| 1500.000000     | 46.1             | 1000.0          | 1000.000        | 102.7       | H            | 132.0         | -6.2       | 27.8              | 73.9           |
| 1881.133333     | 61.6             | 1000.0          | 1000.000        | 111.7       | H            | 73.0          | -1.8       | 12.3              | 73.9           |
| 3762.133333     | 56.0             | 1000.0          | 1000.000        | 194.5       | V            | 241.0         | 1.5        | 17.9              | 73.9           |
| 5237.933333     | 107.6            | 1000.0          | 1000.000        | 128.7       | H            | 215.0         | 3.9        | Downlink harmonic |                |
| 5640.000000     | 63.5             | 1000.0          | 1000.000        | 184.5       | V            | 216.0         | 4.4        | 10.4              | 73.9           |
| 7520.300000     | 53.0             | 1000.0          | 1000.000        | 103.7       | V            | 323.0         | 7.5        | 20.9              | 73.9           |
| 10478.666667    | 86.2             | 1000.0          | 1000.000        | 220.4       | V            | 287.0         | 12.0       | Downlink harmonic |                |
| 14327.433333    | 58.2             | 1000.0          | 1000.000        | 115.7       | V            | 74.0          | 15.5       | 15.7              | 73.9           |
| 15721.966667    | 84.3             | 1000.0          | 1000.000        | 127.7       | H            | 210.0         | 17.5       | Downlink harmonic |                |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB)       | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------------|----------------|
| 1062.866667     | 25.8             | 1000.0          | 1000.000        | 103.7       | V            | 270.0         | -7.5       | 28.1              | 53.9           |
| 1500.000000     | 36.9             | 1000.0          | 1000.000        | 102.7       | H            | 132.0         | -6.2       | 17.0              | 53.9           |
| 1881.133333     | 51.8             | 1000.0          | 1000.000        | 111.7       | H            | 73.0          | -1.8       | 2.1               | 53.9           |
| 3762.133333     | 43.3             | 1000.0          | 1000.000        | 194.5       | V            | 241.0         | 1.5        | 10.6              | 53.9           |
| 5237.933333     | 97.3             | 1000.0          | 1000.000        | 128.7       | H            | 215.0         | 3.9        | Downlink harmonic |                |
| 5640.000000     | 51.0             | 1000.0          | 1000.000        | 184.5       | V            | 216.0         | 4.4        | 2.9               | 53.9           |
| 7520.300000     | 38.4             | 1000.0          | 1000.000        | 103.7       | V            | 323.0         | 7.5        | 15.5              | 53.9           |
| 10478.666667    | 70.5             | 1000.0          | 1000.000        | 220.4       | V            | 287.0         | 12.0       | Downlink harmonic |                |
| 14327.433333    | 36.6             | 1000.0          | 1000.000        | 115.7       | V            | 74.0          | 15.5       | 17.3              | 53.9           |
| 15721.966667    | 65.3             | 1000.0          | 1000.000        | 127.7       | H            | 210.0         | 17.5       | Downlink harmonic |                |

**Test Notes:** Only worst case WLAN and licensed test configuration presented.



## **2.8 BAND-EDGE MEASUREMENTS**

### **2.8.1 Specification Reference**

Part 15 Subpart E §15.407(b)(1),(4)(i) and (7); §15.407(h)(2) / 15.209 and RSS-247 6.2.1 (2) and 6.2.4 (2)

### **2.8.2 Standard Applicable**

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

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

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

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

### **2.8.3 Test Methodology**

Section II (G) Unwanted Emission Measurement of 789033 D02 General UNII Test Procedures v01r02

### **2.8.4 Equipment Under Test and Modification State**

Serial No: SZ170616900012 / Test Configuration B

### **2.8.5 Date of Test/Initial of test personnel who performed the test**

August 10, 2016/FSC

### **2.8.6 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.8.7 Environmental Conditions**

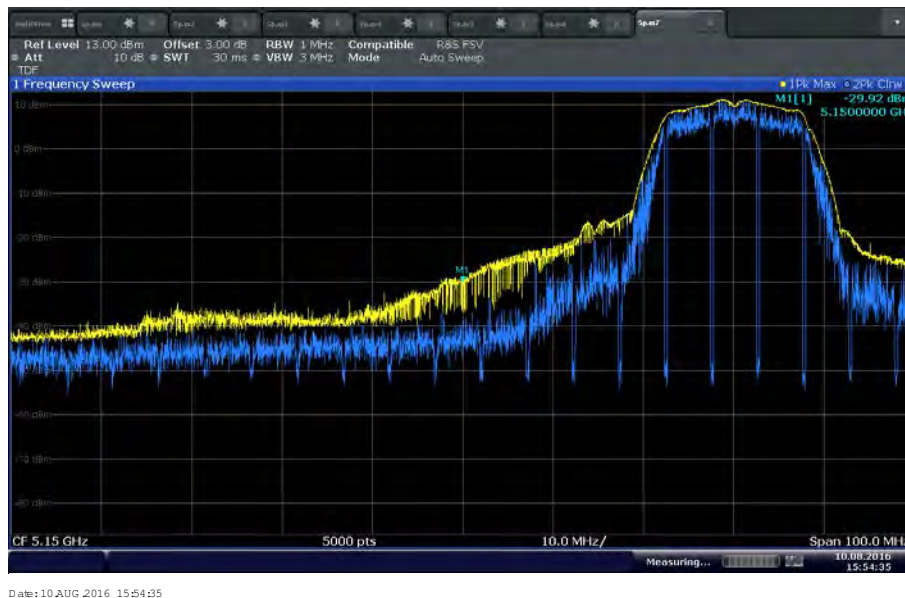
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.7 °C  
 Relative Humidity 43.9 %  
 ATM Pressure 98.9 kPa

## 2.8.8 Additional Observations

- This is a conducted test using Integration Method as per Section II (GUNwanted Emission Measurement of 789033 D02 General UNII Test Procedures v01r02.
- Only the worst case data rate/modulation presented.
- Transducer Factor (TDF) was added to compensate for the antenna gain, external attenuator and cable used.
- Additional 3dB offset was added for MIMO mode (verification performed on worst case antenna port).

## 2.8.9 Test Results



### 802.11a U-NII 1 Lower Band Edge (Peak Measurement)

#### Lower band edge peak calculation:

- 5150 MHz (in the restricted band)
- Use the following formula as per Section Section G(1) of 789033 D02 General UNII Test Procedures v01r02:

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-29.92 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 68.88 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



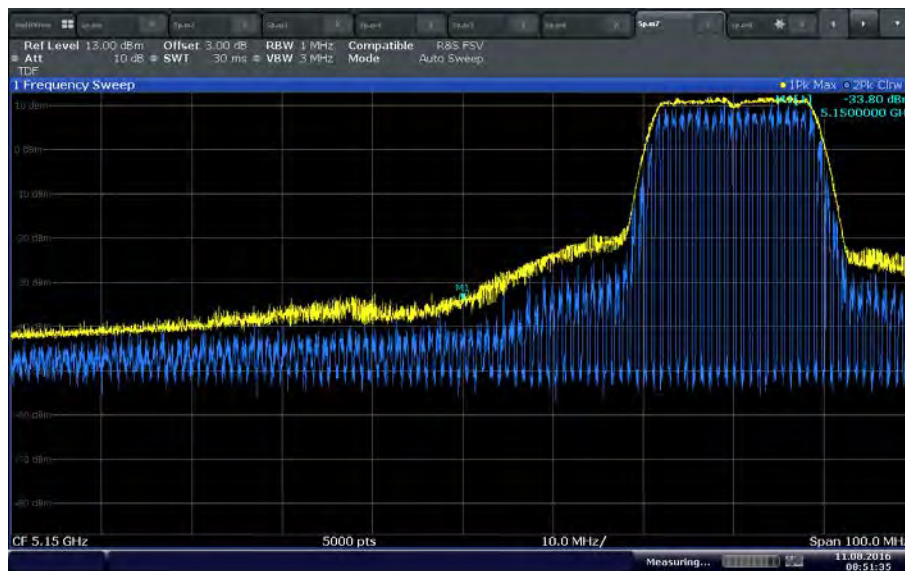
Date: 10 AUG 2016 16:05:46

#### 802.11a U-NII 1 Lower Band Edge (Average Measurement)

##### Lower band edge average calculation:

- 5150 MHz (in the restricted band)
- Use the following formula as per Section G(1) of 789033 D02 General UNII Test Procedures v01r02:

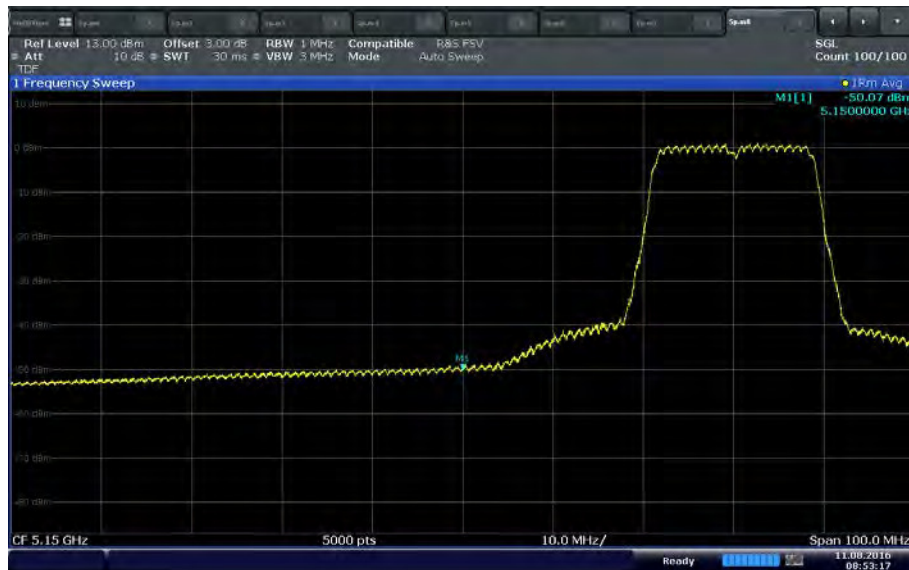
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-48.64 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 50.16 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 08:51:35

#### 802.11n (20MHz BW) U-NII 1 Lower Band Edge (Peak Measurement)

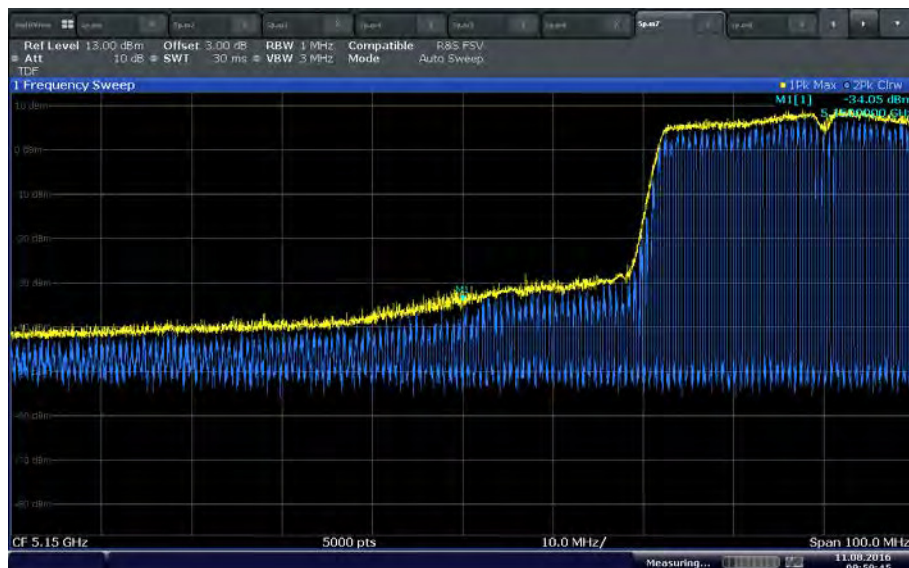
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-33.80 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 65 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 08:53:17

#### 802.11n U-NII 1 (20 MHz BW) Lower Band Edge (Average Measurement)

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 + \text{DCCF} \\
 &= (-50.07 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 + 2.17 \\
 &= 50.90 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 09:59:45

#### 802.11n (40MHz BW) U-NII 1 Lower Band Edge (Peak Measurement)

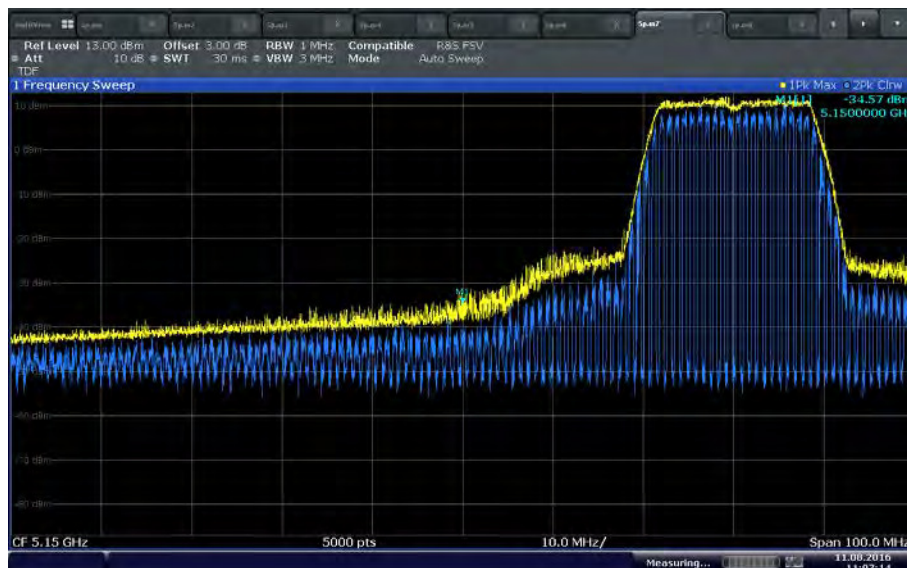
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-34.05 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 64.75 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 10:00:45

#### 802.11n U-NII 1 (40 MHz BW) Lower Band Edge (Average Measurement)

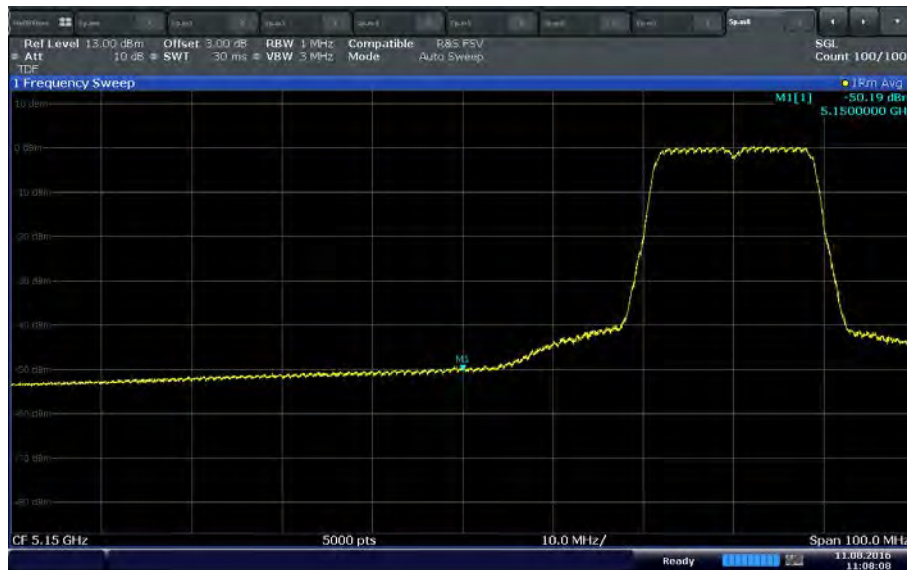
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 + \text{DCCF} \\
 &= (-47.77 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 + 2.17 \\
 &= 53.02 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 11:07:15

#### 802.11ac (20MHz BW) U-NII 1 Lower Band Edge (Peak Measurement)

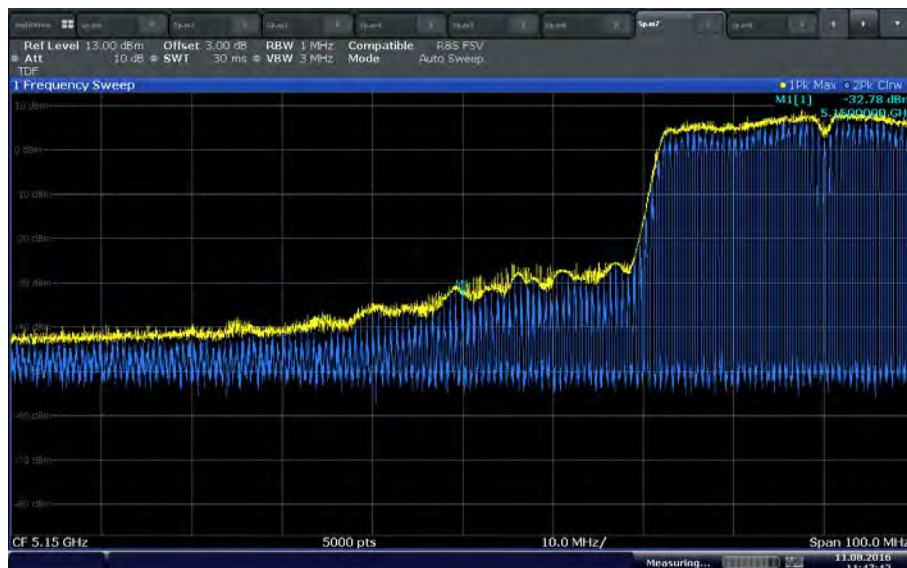
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-31.57 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 67.23 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 11:08:08

#### 802.11ac U-NII 1 (20 MHz BW) Lower Band Edge (Average Measurement)

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 + \text{DCCF} \\
 &= (-50.19 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 + 2.27 \\
 &= 50.88 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 11:47:42

#### 802.11 ac (40MHz BW) U-NII 1 Lower Band Edge (Peak Measurement)

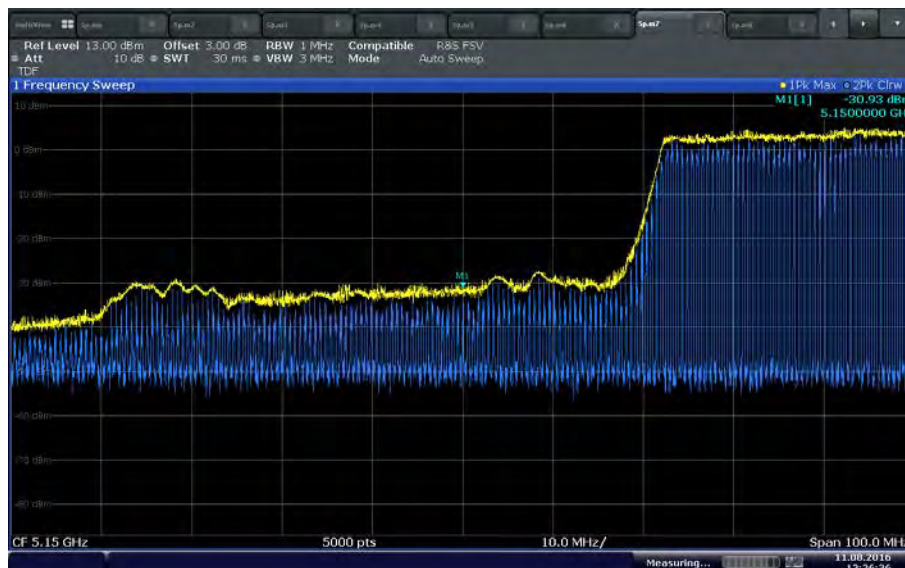
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-32.78 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 66.02 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 11:48:08

#### 802.11 ac U-NII 1 (40 MHz BW) Lower Band Edge (Average Measurement)

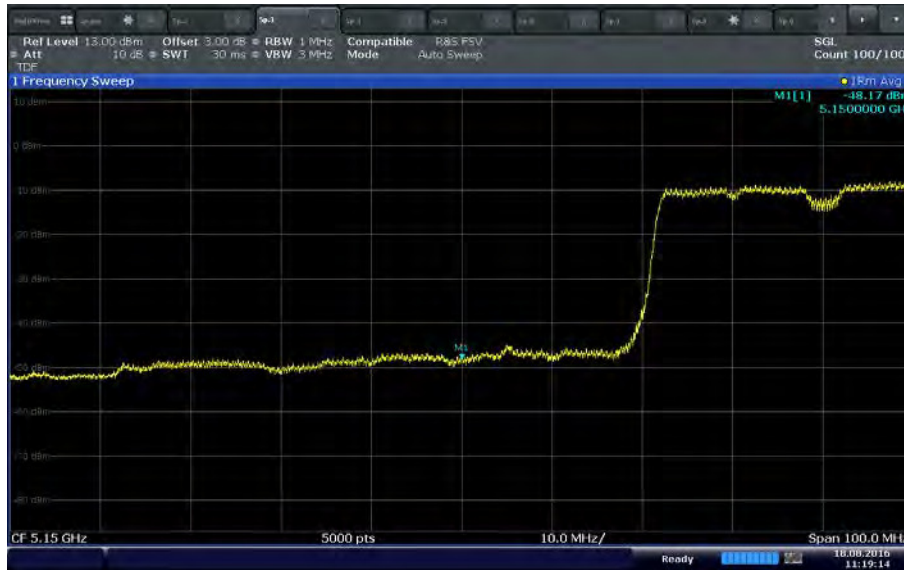
$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 + \text{DCCF} \\
 &= (-47.72 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 + 2.27 \\
 &= 53.35 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 12:26:36

#### 802.11ac (80MHz BW) U-NII 1 Lower Band Edge (Peak Measurement)

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 \\
 &= (-30.93 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 \\
 &= 67.87 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 18 AUG 2016 11:19:15

#### 802.11 ac U-NII 1 (80 MHz BW) Lower Band Edge (Average Measurement)

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.2 + \text{DCCF} \\
 &= (-48.17 \text{ dBm} + 3.6 \text{ dBi antenna gain}) + 95.2 + 2.27 \\
 &= 52.90 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters (Complies with 54 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Date: 11 AUG 2016 08:20:30

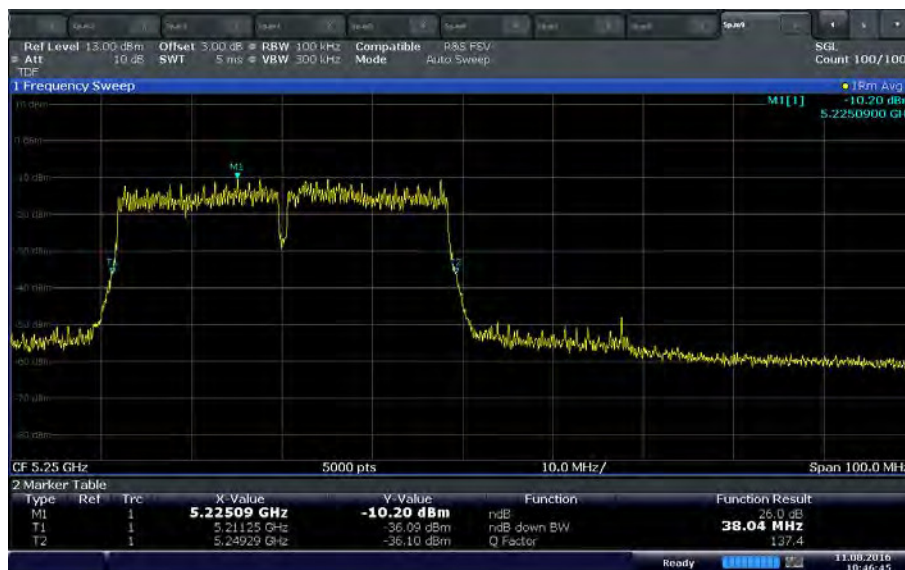
#### 802.11a U-NII 1 Upper Band Edge Verification

Band edge requirement for U-NII 1 is from 5150 MHz to 5350 MHz (upper edge of U-NII 2A). However there is a requirement under §15.407 (h)(2) that U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. The plot presented was a verification that the 26 dB BW of 802.11a U-NII 1 high channel stays within the U-NII 1 band (T2 should be ≤ 5250 MHz).



Date: 11 AUG 2016 09:40:08

#### 802.11n (20 MHz BW) U-NII 1 Upper Band Edge Verification



Date: 11 AUG 2016 10:46:46

#### 802.11n (40 MHz BW) U-NII 1 Upper Band Edge Verification



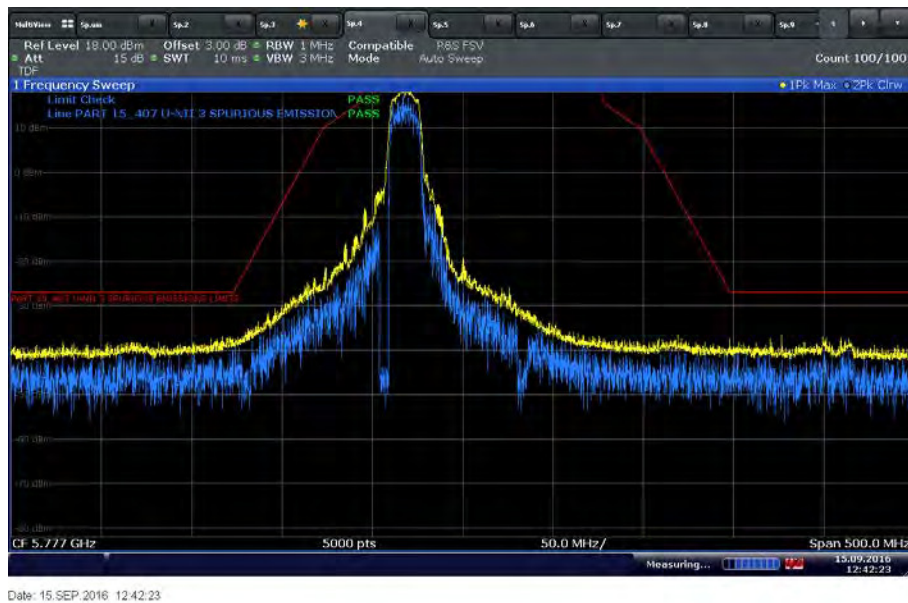
Date: 11 AUG 2016 11:34:30

#### 802.11ac (20 MHz BW) U-NII 1 Upper Band Edge Verification

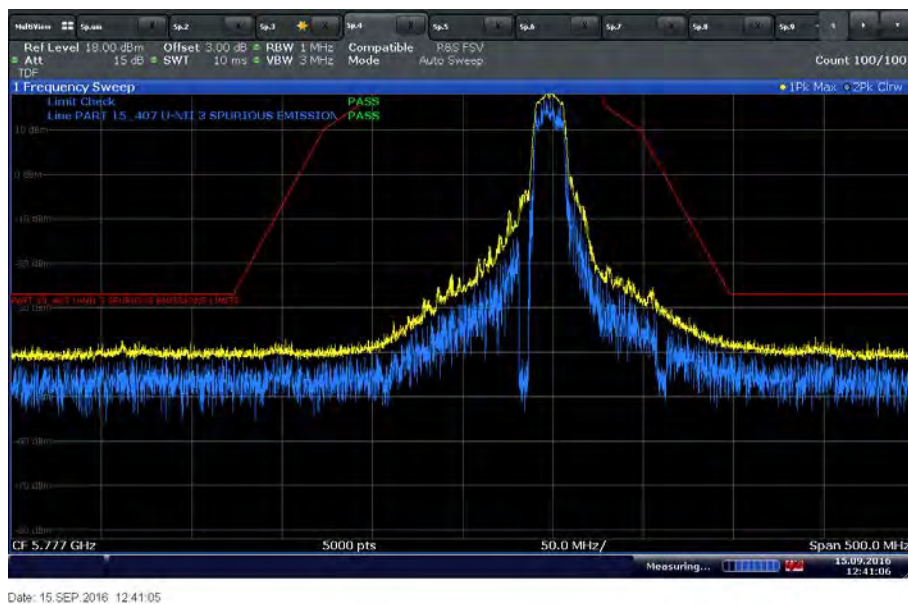


Date: 11 AUG 2016 12:04:46

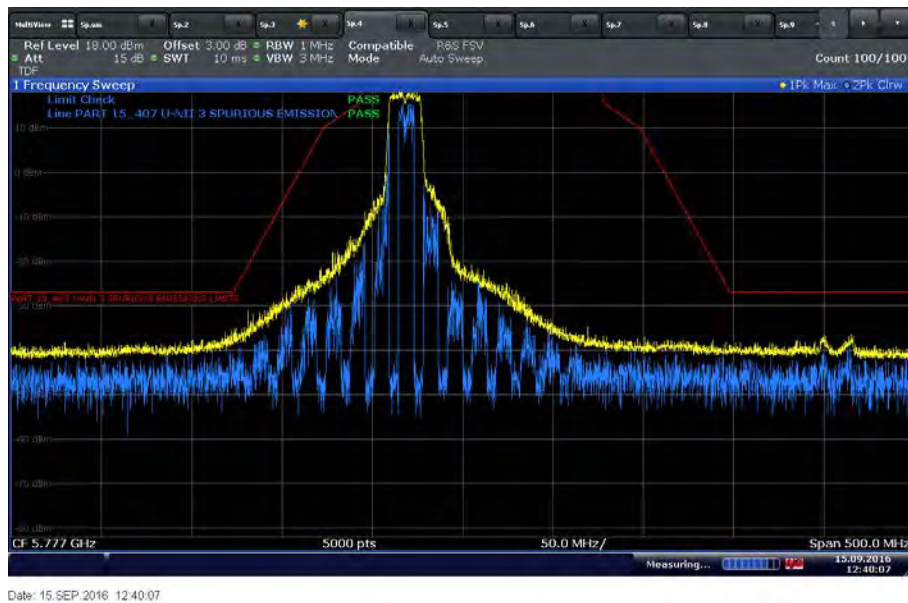
#### 802.11n (20 MHz BW) U-NII 1 Upper Band Edge Verification



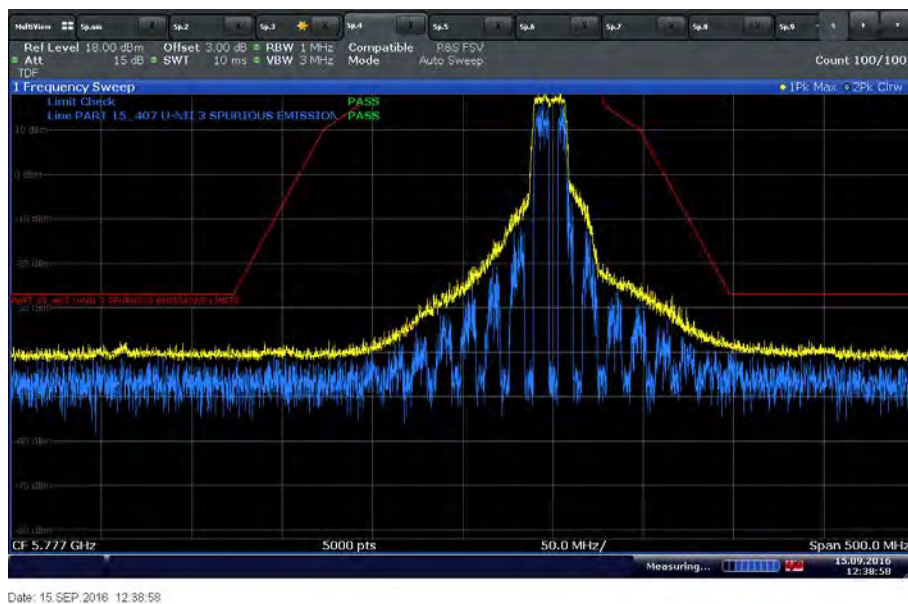
802.11a U-NII 3 Low Channel Emission Mask



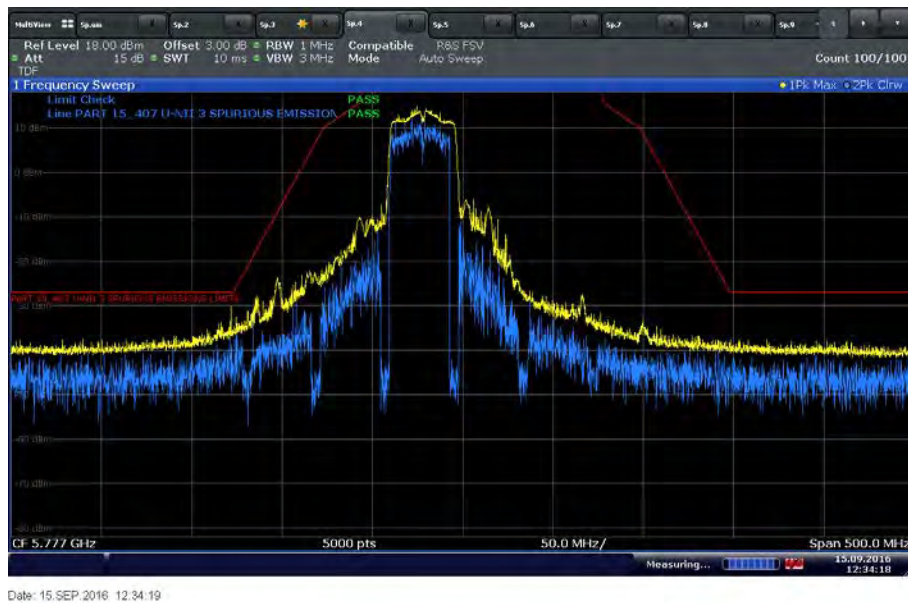
802.11a U-NII 3 High Channel Emission Mask



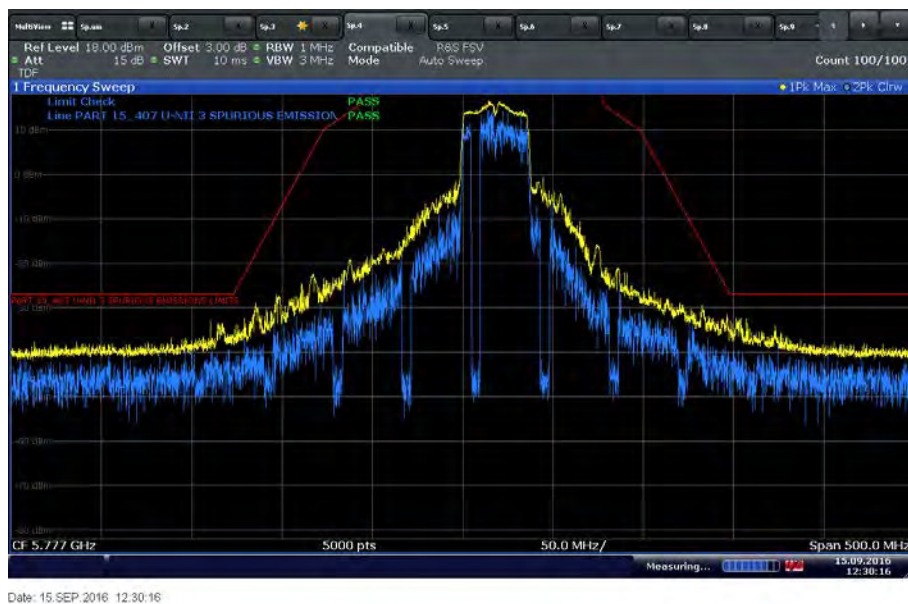
802.11n (20MHz BW) U-NII 3 Low Channel Emission Mask



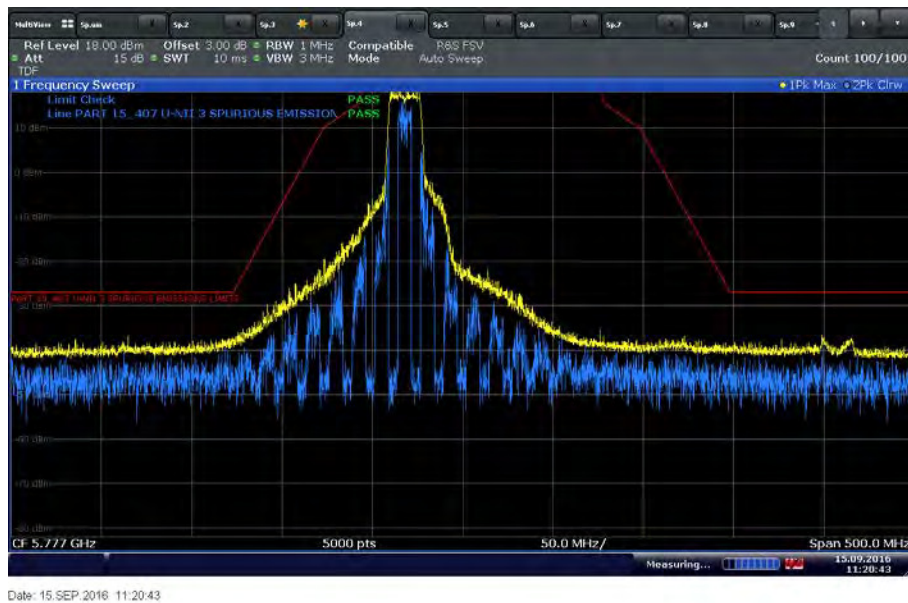
802.11n (20MHz BW) U-NII 3 High Channel Emission Mask



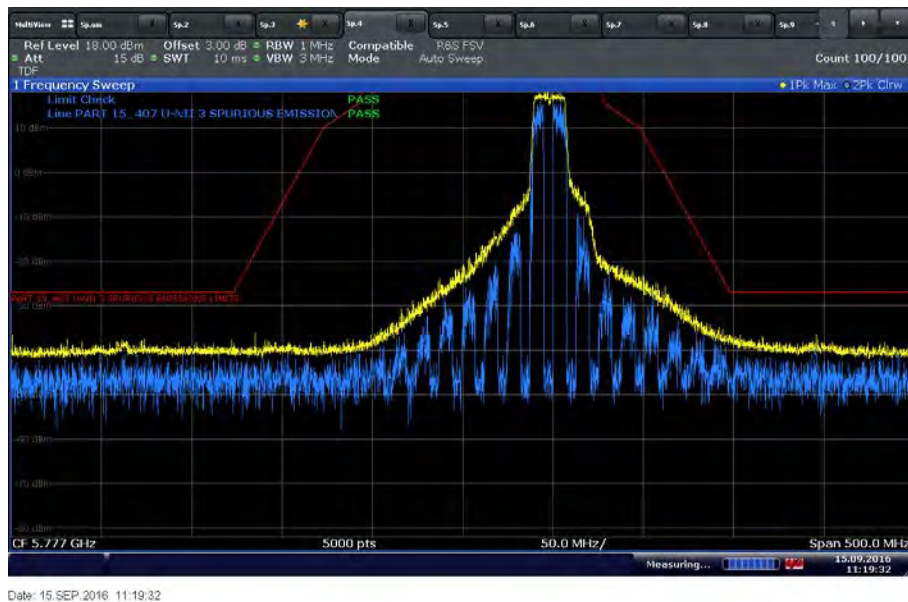
802.11n (40MHz BW) U-NII 3 Low Channel Emission Mask



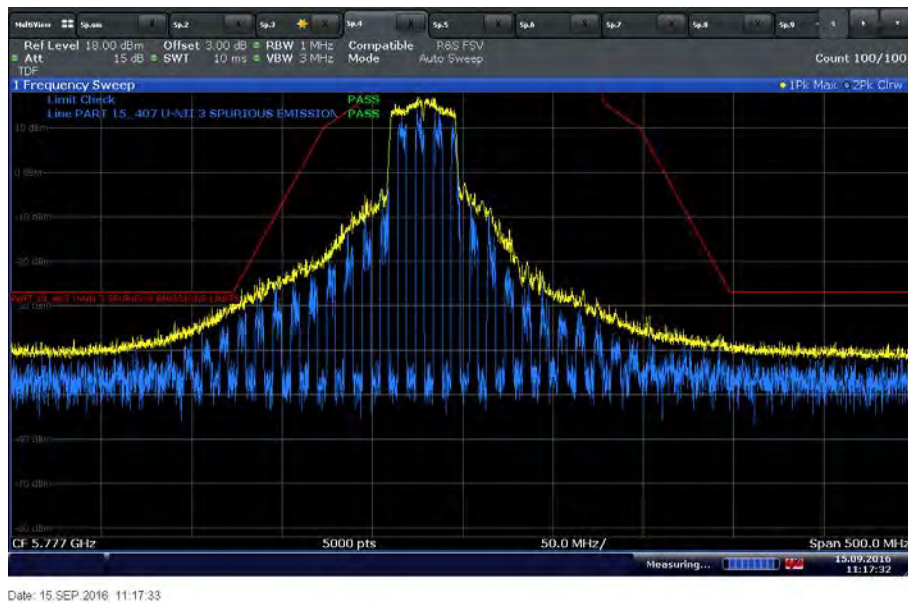
802.11n (40MHz BW) U-NII 3 High Channel Emission Mask



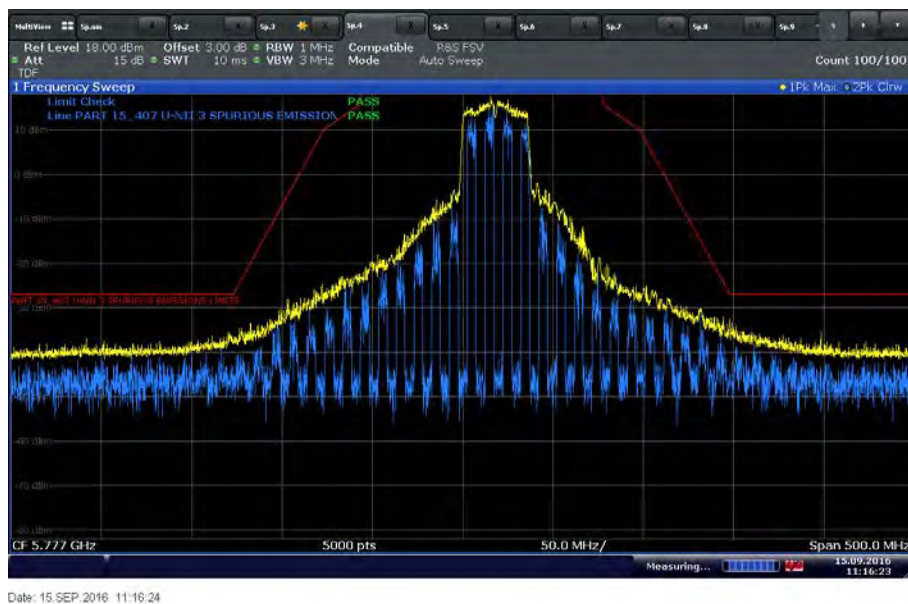
802.11ac (20MHz BW) U-NII 3 Low Channel Emission Mask



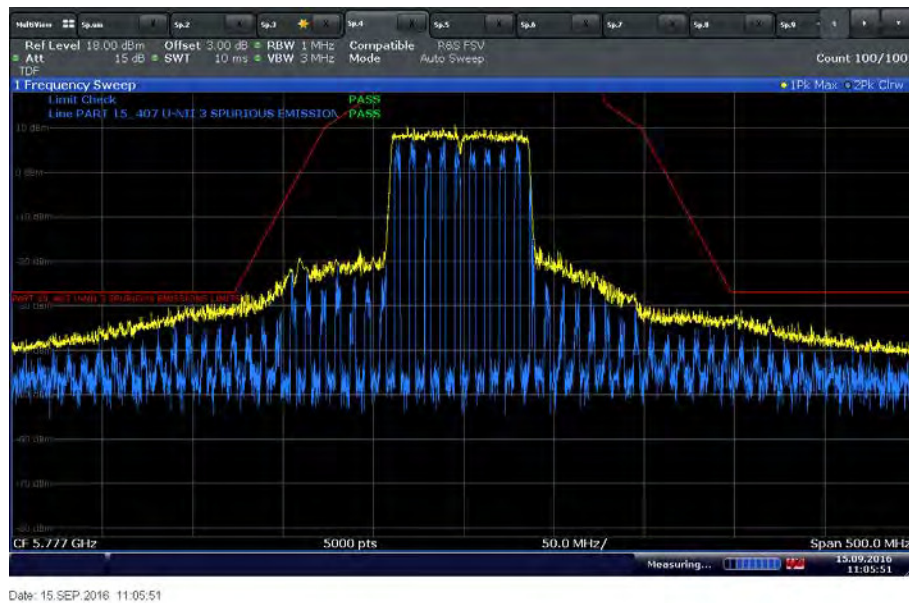
802.11ac (20MHz BW) U-NII 3 High Channel Emission Mask



802.11ac (40MHz BW) U-NII 3 Low Channel Emission Mask



802.11ac (40MHz BW) U-NII 3 High Channel Emission Mask



802.11ac (80MHz BW) U-NII 3 Mid Channel Emission Mask

## 2.9 FREQUENCY STABILITY

### 2.9.1 Specification Reference

§15.407 (g)

### 2.9.2 Standard Applicable

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

### 2.9.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

### 2.9.4 Date of Test/Initial of test personnel who performed the test

August 26, 2016/FSC

### 2.9.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.9.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8 °C  
Relative Humidity 51.8 %  
ATM Pressure 99.0 kPa

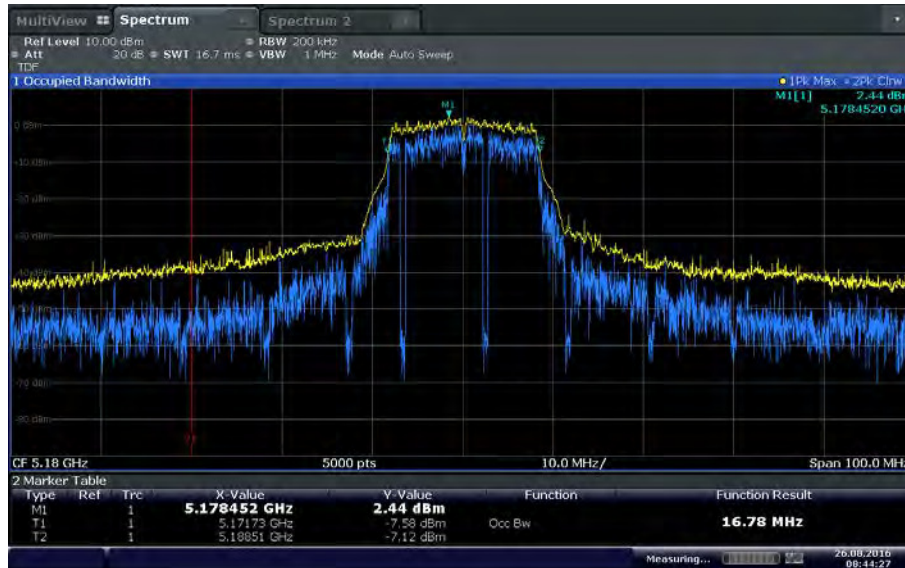
### 2.9.7 Additional Observations

- This is a verification tests of frequency stability that the EUT emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.
- Only the worst case channel, BW and data rate/modulation presented.
- Normal operation specification as provided by the manufacturer:

|             |                                   |
|-------------|-----------------------------------|
| Voltage     | 3.3VDC (Min with 3.2VDC shutdown) |
|             | 3.8VDC Nominal                    |
|             | 4.3 VDC Max                       |
| Temperature | -10°C (Min)                       |
|             | 45°C (Max)                        |

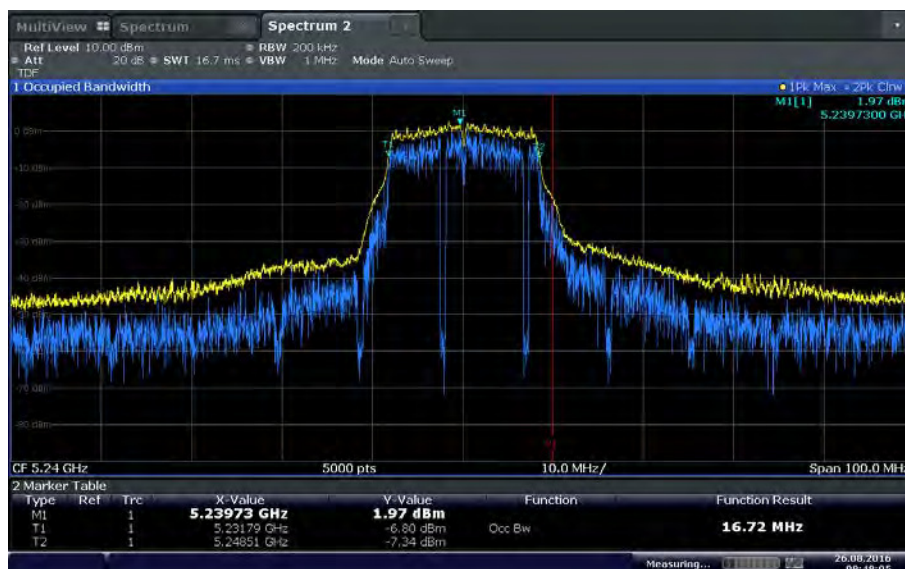
- Vertical line (V1) represents edge of band of operation (U-NII 1 or 3).
- EUT verified using 99% OBW test methodology.

## 2.9.8 Verification Plots



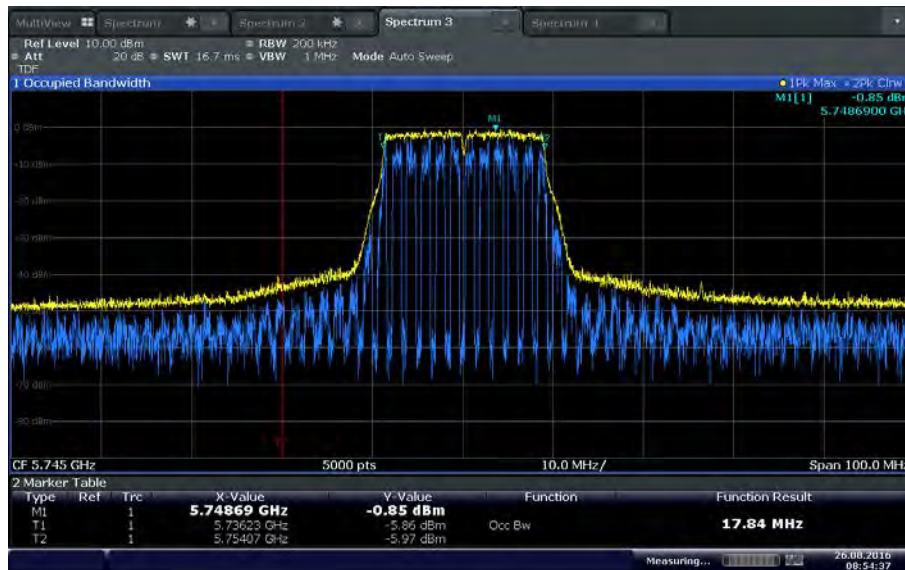
Date: 26 AUG 2016 08:44:27

802.11a Low Channel U-NII 1 @ -10°C



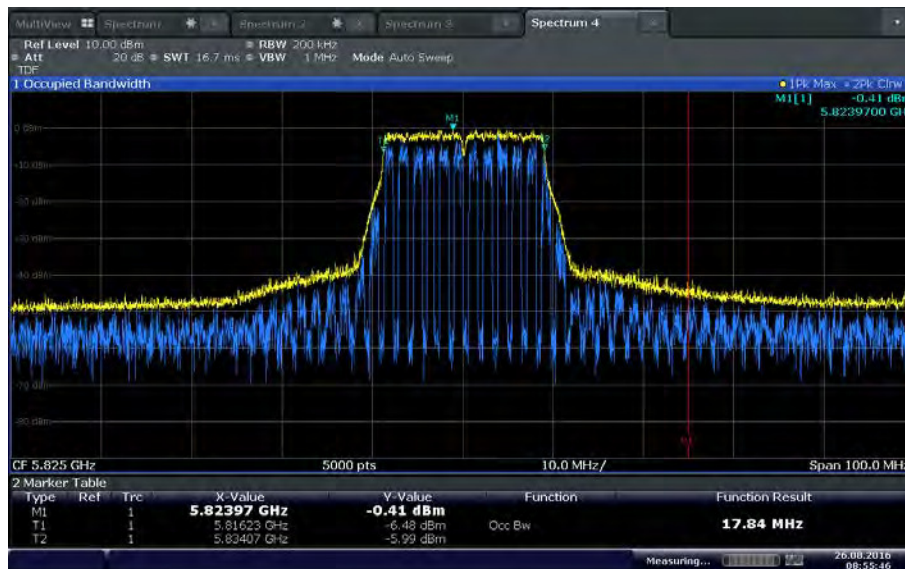
Date: 26 AUG 2016 08:48:05

802.11a High Channel U-NII 1 @ -10°C



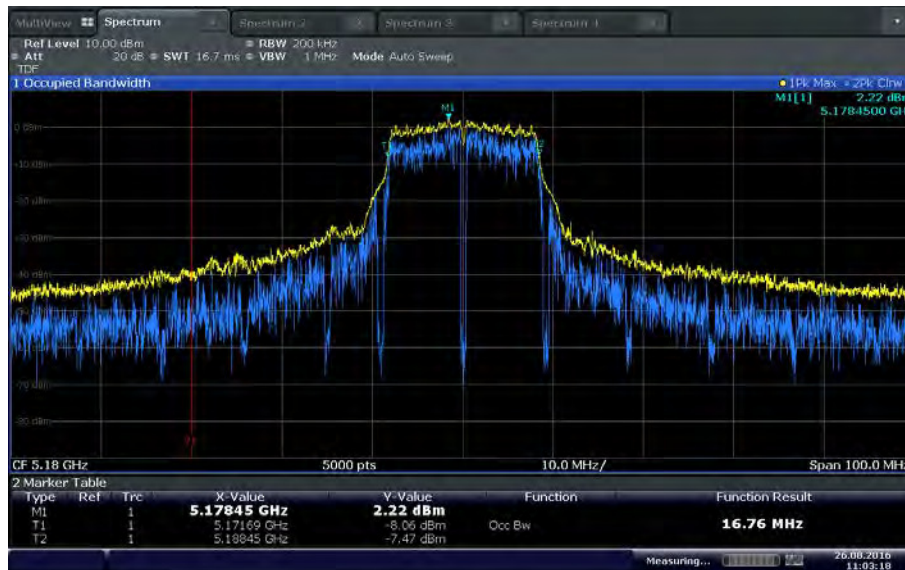
Date: 26 AUG. 2016 08:54:37

### 802.11n Low Channel U-NII 3 @ -10°C



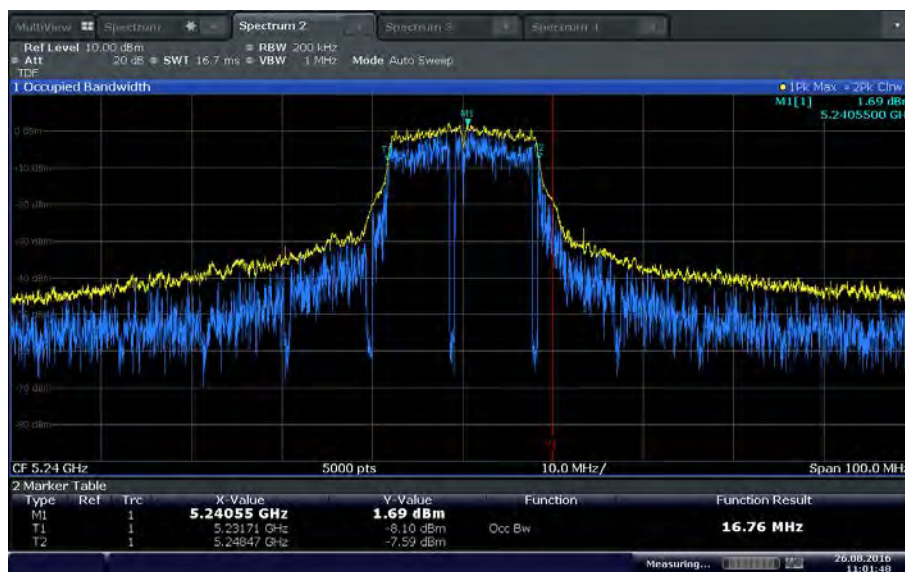
Date: 26 AUG. 2016 08:55:47

### 802.11n High Channel U-NII 3 @ -10°C



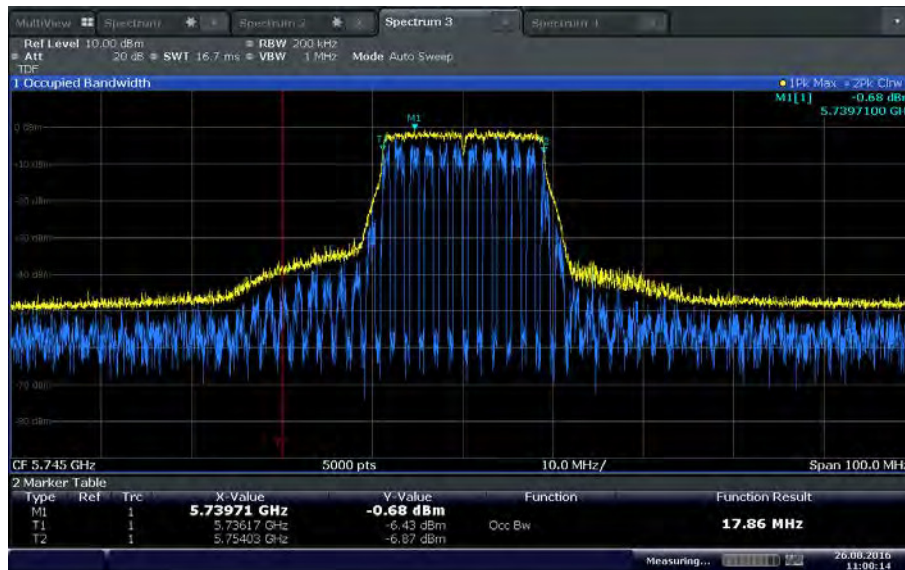
Date: 26 AUG 2016 11:03:18

### 802.11a Low Channel U-NII 1 @ 45°C



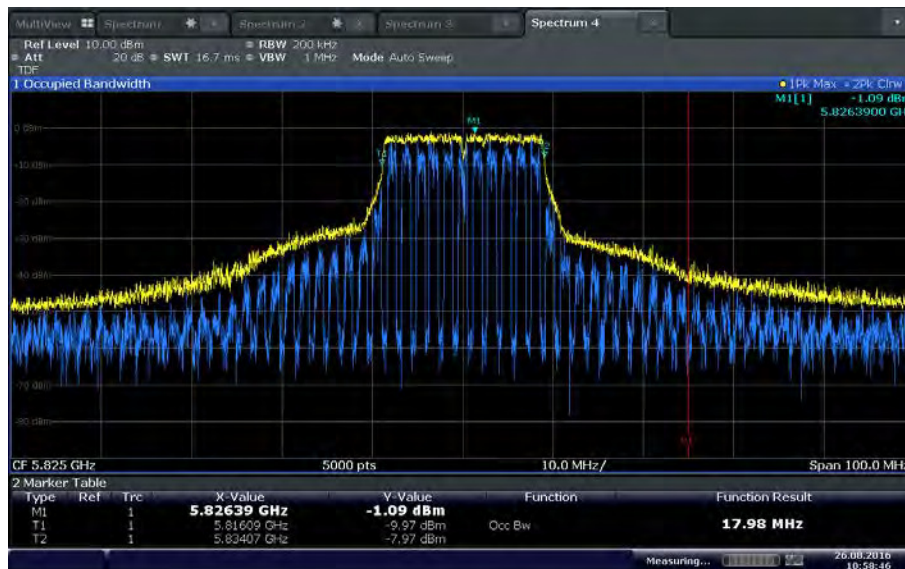
Date: 26 AUG 2016 11:01:48

### 802.11a High Channel U-NII 1 @ 45°C



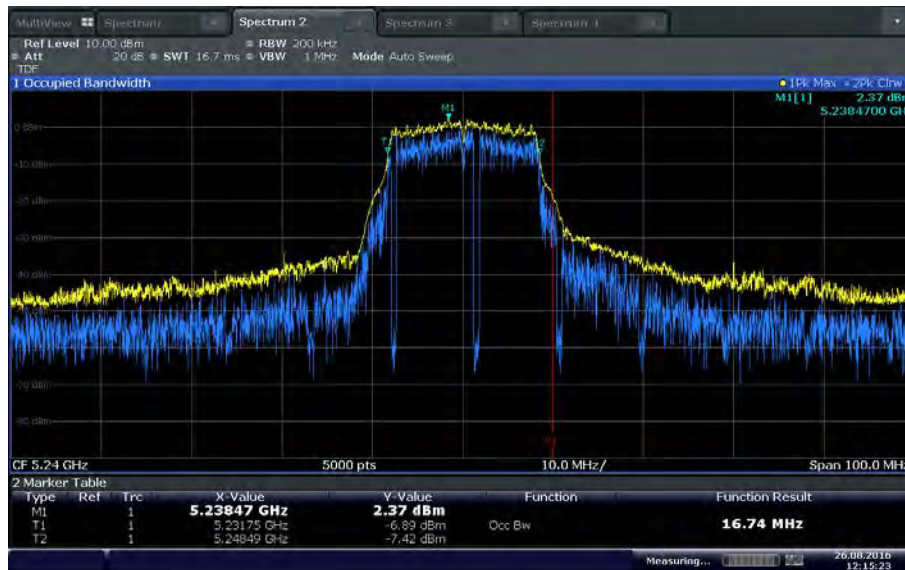
Date: 26 AUG 2016 11:00:15

### 802.11n Low Channel U-NII 3 @ 55°C



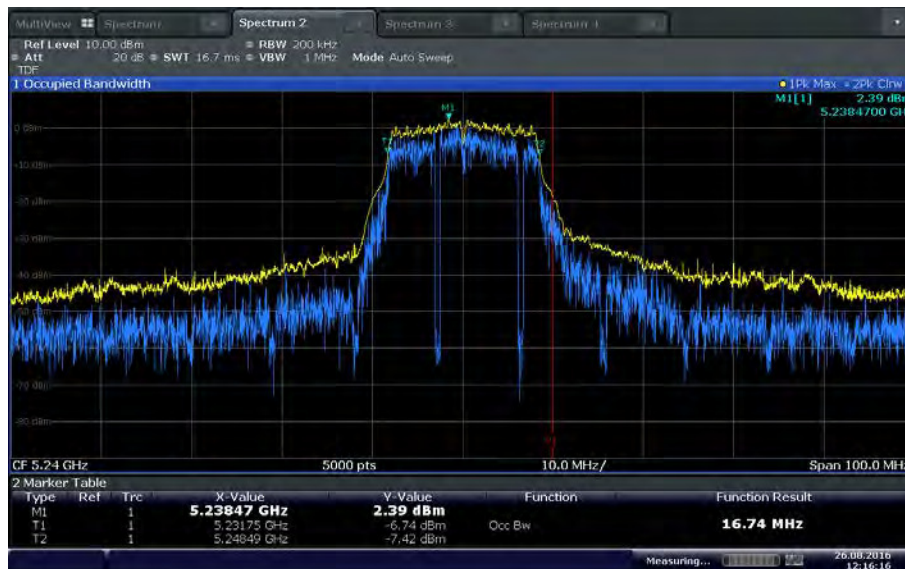
Date: 26 AUG 2016 10:58:47

### 802.11n High Channel U-NII 3 @ 45°C



Date: 26 AUG 2016 12:15:23

### 802.11a High Channel U-NII 1 @ 20°C/3.3VDC



Date: 26 AUG 2016 12:16:16

### 802.11a High Channel U-NII 1 @ 20°C/4.3VDC



## 2.10 INDOOR OPERATION ONLY

### 2.10.1 Specification Reference

RSS-247 6.2.1

### 2.10.2 Standard Applicable

LE-LAN devices are restricted to indoor operation only in the band 5150-5250 MHz.

### 2.10.3 Manufacturer Declaration

**NOVATEL WIRELESS**

Date: September 21, 2016

TUV SUD BABT FCB  
Octagon House,  
Segensworth Road,  
Fareham,  
Hampshire,  
PO15 5RL

#### U-NII Band 1 Declaration Letter

IC Certification No: 3229A-MIFI7000

To Whom It May Concern:

Pursuant to RSS-247 Paragraph 6.2.1, we, Novatel Wireless declare use in the U-NII (Unlicensed National Information Infrastructure) Band 1 (5150-5250 MHz) is restricted to Indoor Use Only to reduce potential for harmful interference to Co-Channel Mobile Satellite Systems.

In Addition, the fundamental emission is maintained within the band of operation within its "normal" operating condition on product Model MIFI7000.

Sincerely,

A handwritten signature in black ink, appearing to read "Roman Olmos", written over a horizontal line.

Roman Olmos  
Sr. Regulatory Engineer  
Novatel Wireless Inc.

**NOVATEL WIRELESS, INC.**  
9645 Scranton Road Suite 205, San Diego CA 92121  
Toll Free: 888.888.9231 • Main 858.812.3400 • Fax 858.812.3402  
[www.novatelwireless.com](http://www.novatelwireless.com) NASDAQ: MIFI



### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.7 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| ID Number (SDGE/SDRB)             | Test Equipment                             | Type                | Serial Number  | Manufacturer               | Cal Date                  | Cal Due Date |
|-----------------------------------|--------------------------------------------|---------------------|----------------|----------------------------|---------------------------|--------------|
| Radiated Test Setup               |                                            |                     |                |                            |                           |              |
| 1033                              | Bilog Antenna                              | 3142C               | 00044556       | EMCO                       | 09/25/14                  | 09/25/16     |
| 1040                              | EMI Test Receiver                          | ESIB40              | 100292         | Rhode & Schwarz            | 09/29/15                  | 09/29/16     |
| 1016                              | Pre-amplifier                              | PAM-0202            | 187            | PAM                        | 12/15/15                  | 12/15/16     |
| 7575                              | Double-ridged waveguide horn antenna       | 3117                | 00155511       | EMCO                       | 05/12/16                  | 05/12/17     |
| 1049                              | EMI Test Receiver                          | ESU                 | 100133         | Rhode & Schwarz            | 03/17/16                  | 03/17/17     |
| 8628                              | Pre-amplifier                              | QLJ 01182835-JO     | 8986002        | QuinStar Technologies Inc. | 01/11/16                  | 01/11/17     |
| 1054                              | Horn antenna (18-40 GHz)                   | 3116                | 9407-2233      | EMCO                       | 12/22/15                  | 12/22/17     |
| 8789                              | 20dB Attenuator                            | HAT-20              | YUU29001245    | Mini Circuits              | Verified by 1003 and 7611 |              |
| 8792                              | 20dB Attenuator                            | HAT-20              | YUU29001245    | Mini Circuits              | Verified by 1003 and 7611 |              |
|                                   | Pre-amplifier (18-40 GHz)                  | SLKka-30-6          | 15G27          | Spacek Labs                | Verified by 1003 and 7611 |              |
| 1003                              | Signal Generator                           | SMR-40              | 1104.0002.40   | Rhode & Schwarz            | 05/16/16                  | 05/16/17     |
| 7611                              | Signal/Spectrum Analyzer                   | FSW26               | 102017         | Rhode & Schwarz            | 02/01/16                  | 02/01/17     |
| 8818                              | 5.0GHz Band Notch Filter                   | BRM50716            | 015            | Micro-Tronics              | Verified by 1003 and 7611 |              |
| AC Conducted Emissions            |                                            |                     |                |                            |                           |              |
| 7620                              | EMI Test Receiver                          | ESU40               | 100399         | Rhode & Schwarz            | 09/03/15                  | 09/03/16     |
| 7568                              | LISN                                       | FCC-LISN-50-25-2-10 | 120305         | Fischer Custom Comm.       | 10/28/15                  | 10/28/16     |
| 8822                              | 20dB Attenuator                            | 34-20-34            | N/A            | MCE / Weinschel            | 02/29/16                  | 02/28/17     |
| 8824                              | 20dB Attenuator                            | 34-20-34            | N/A            | MCE / Weinschel            | 02/29/16                  | 02/28/17     |
| Antenna Conducted Port Test Setup |                                            |                     |                |                            |                           |              |
| 7611                              | Signal/Spectrum Analyzer                   | FSW26               | 102017         | Rhode & Schwarz            | 02/01/16                  | 02/01/17     |
| 8825                              | 20dB Attenuator                            | 46-20-34            | BK5773         | Weinschel Corp.            | Verified by 7611 and 7608 |              |
| 7606                              | USB RF Power Sensor                        | RadiPower RPR3006W  | 14I00048SNO048 | DARE!! Instruments         | 09/24/15                  | 09/24/16     |
| 7607                              | USB RF Power Sensor                        | RadiPower RPR3006W  | 14I00048SNO047 | DARE!! Instruments         | 11/18/15                  | 11/18/16     |
| 7579                              | Temperature Chamber                        | 115                 | 151617         | TestQuity                  | 08/25/15                  | 08/25/17     |
| Miscellaneous                     |                                            |                     |                |                            |                           |              |
| 1123                              | DC Power Supply                            | E3631A              | N/A            | Hewlett Packard            | Verified by 6452          |              |
| 6792                              | Multimeter                                 | 3478A               | 2911A70964     | Hewlett Packard            | 08/14/15                  | 08/14/16     |
| 7560                              | Barometer/Temperature/Humidity Transmitter | iBTHX-W             | 1240476        | Omega                      | 10/19/15                  | 10/19/16     |
|                                   | Test Software                              | EMC32               | V8.53          | Rhode & Schwarz            | N/A                       |              |

### 3.8 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

#### 3.8.1 Radiated Emission Measurements (Below 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.45                           | 0.26                          | 0.07         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.75                           | 0.43                          | 0.19         |
| 5                               | Site                       | Rectangular                   | 2.70                           | 1.56                          | 2.43         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.78         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 3.57         |

#### 3.8.2 Radiated Emission Measurements (Above 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.57                           | 0.33                          | 0.11         |
| 2                               | Cables                     | Rectangular                   | 0.70                           | 0.40                          | 0.16         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.37                           | 0.21                          | 0.05         |
| 5                               | Site                       | Rectangular                   | 2.70                           | 1.56                          | 2.43         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.78         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 3.56         |

#### 3.8.3 Conducted Antenna Port Measurement

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.34                           | 0.20                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| 3                               | EUT Setup                  | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.39         |
| Coverage Factor (k):            |                            |                               |                                |                               | 1.96         |
| Expanded Uncertainty:           |                            |                               |                                |                               | 0.76         |

### 3.8.4 AC Conducted Emissions

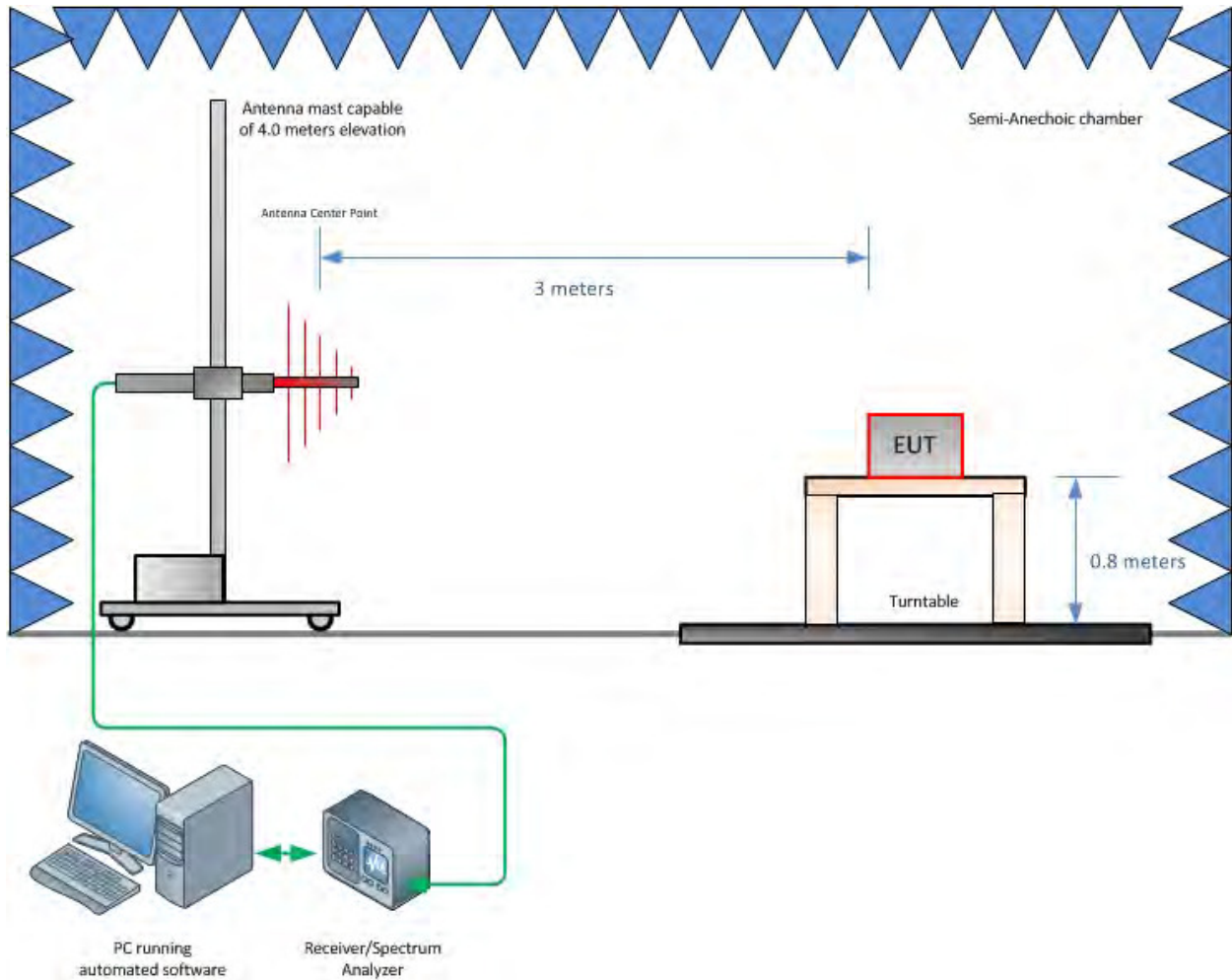
| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.36                           | 0.21                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | LISN                       | Rectangular                   | 0.66                           | 0.38                          | 0.15         |
| 4                               | Attenuator                 | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| 5                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.80         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 1.59         |



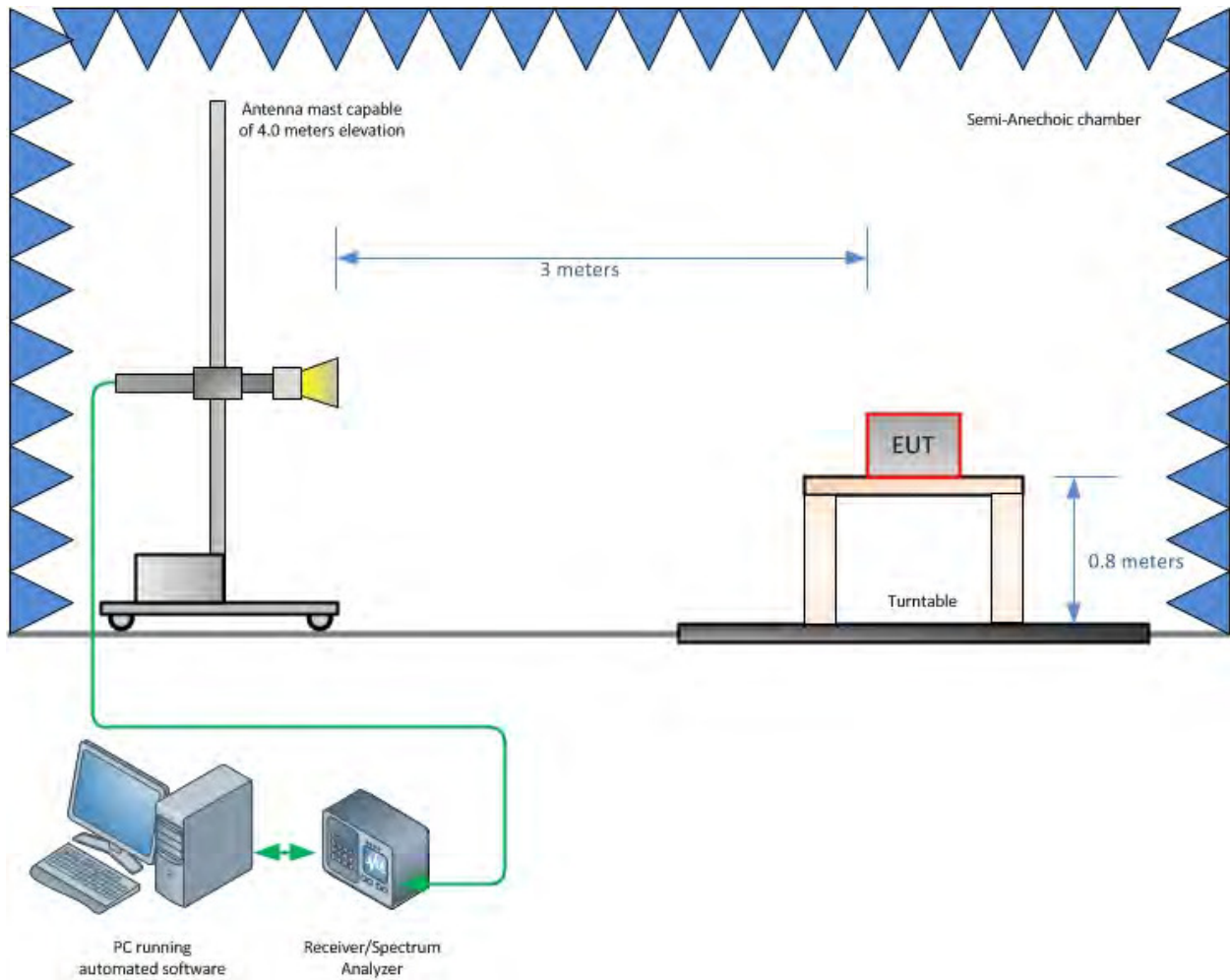
## **SECTION 4**

### **DIAGRAM OF TEST SETUP**

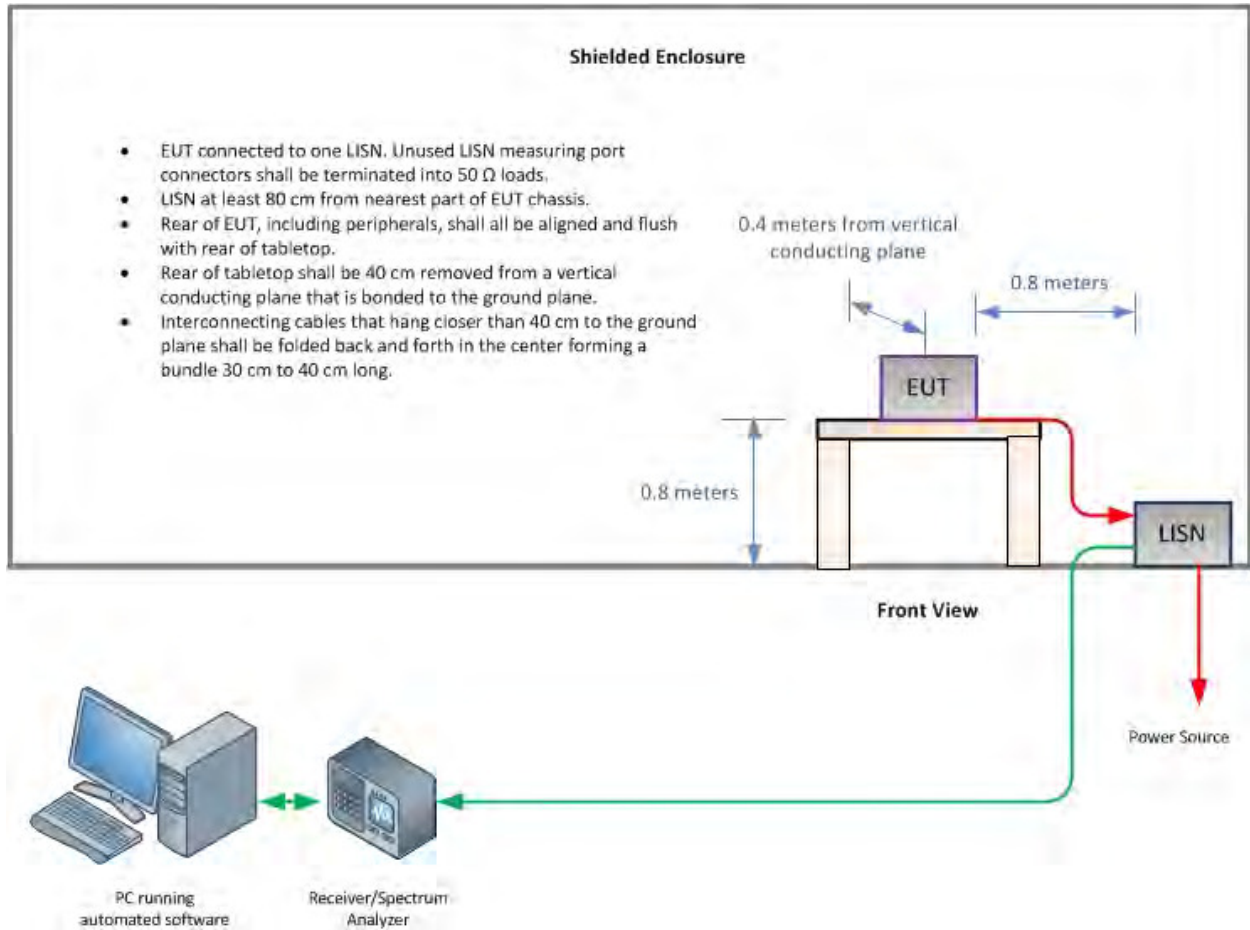
#### 4.7 TEST SETUP DIAGRAM



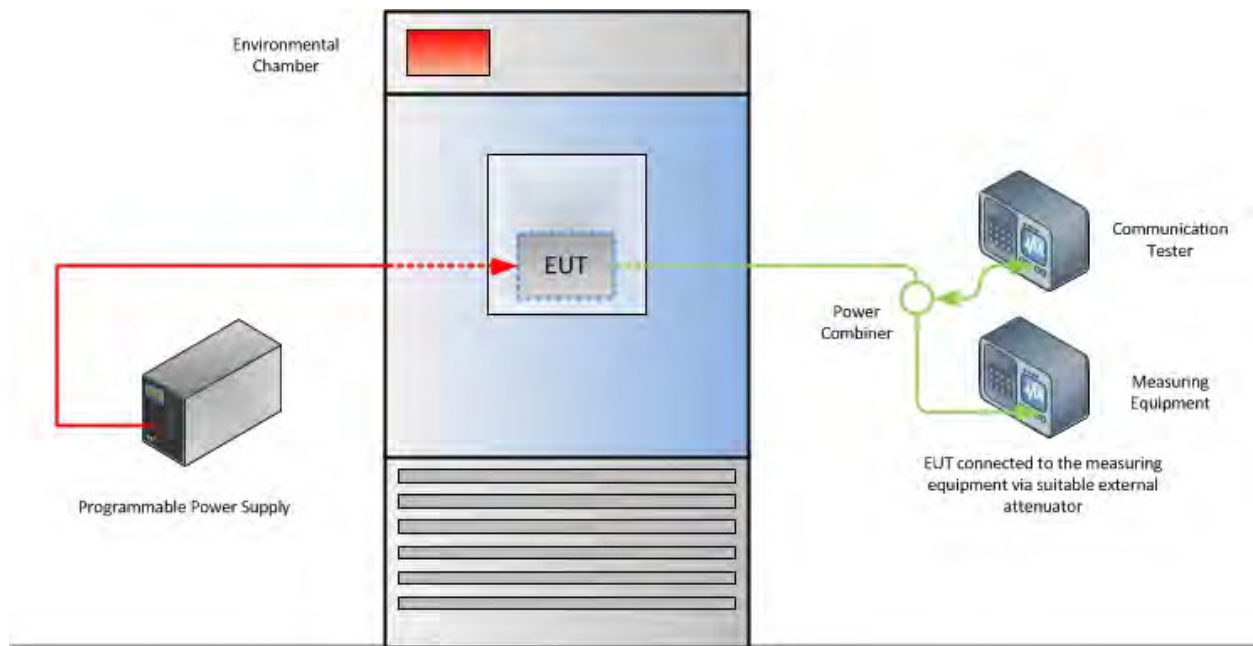
**Radiated Emission Test Setup (Below 1GHz)**



**Radiated Emission Test Setup (Above 1GHz)**



**Conducted Emission Test Setup**



#### Frequency Stability Test Configuration

*\* Diagram presented is for a typical licensed cellular test setup, the EUT on the other hand does not use a Communication tester instead it uses a direct connection to the support laptop (please see separate test setup photo for details).*



## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**

## 5.7 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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