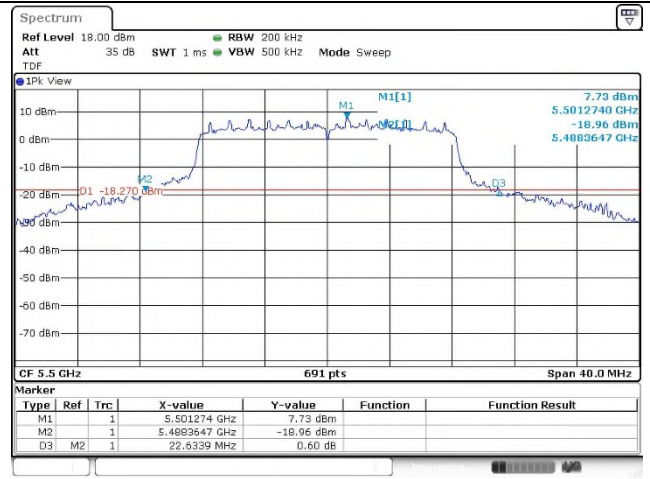
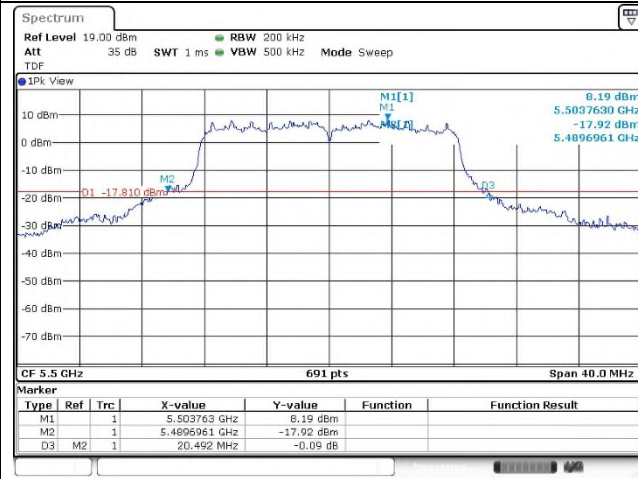


**OFDM: 802.11a (Band 2C)**

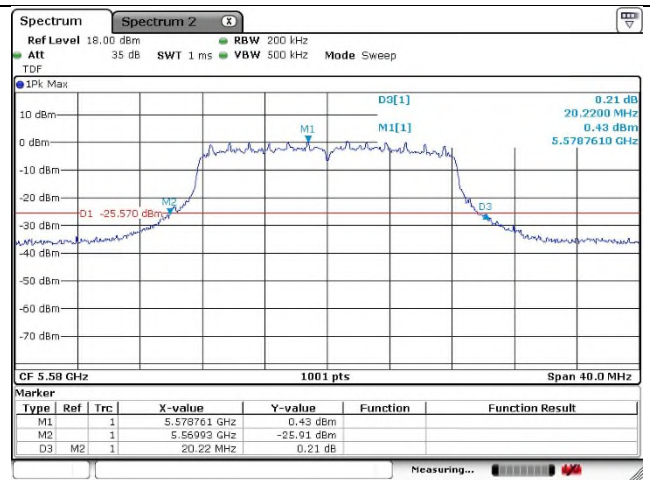
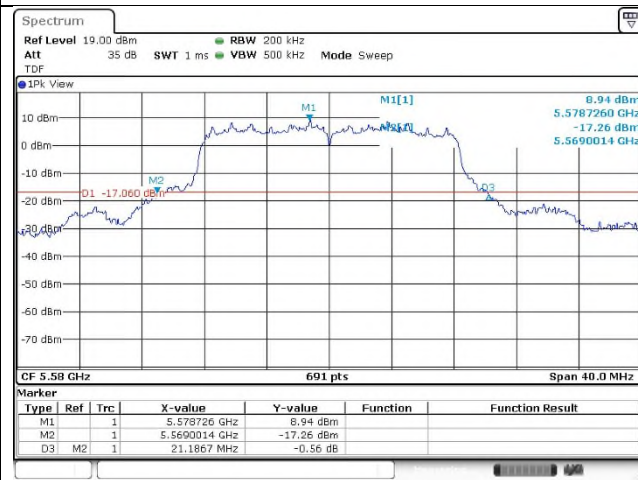
**Ant.1**

**Ant.2**

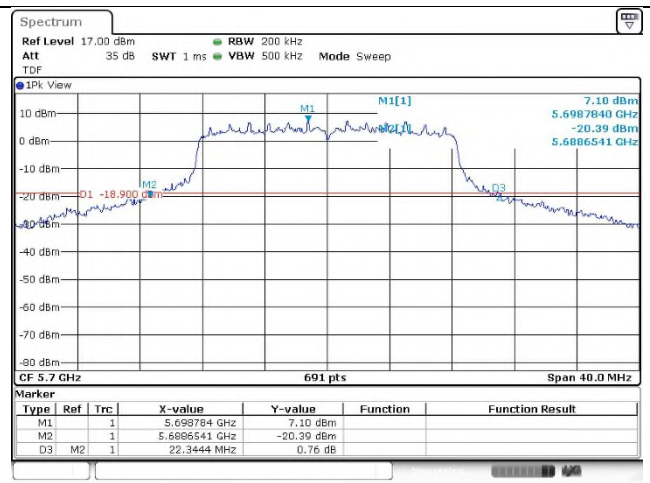
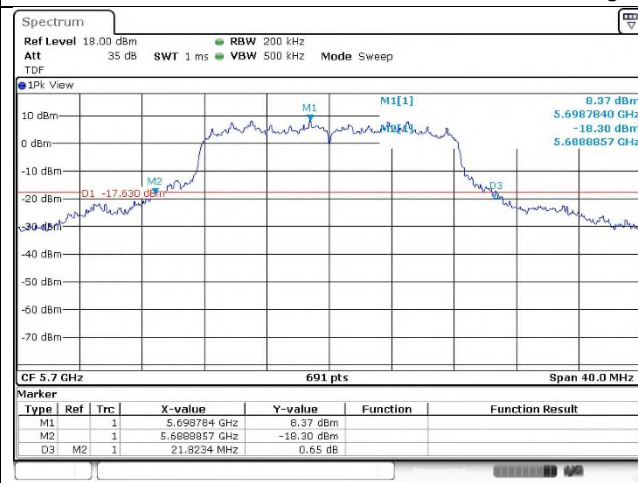
**Low channel**



**Middle channel**



**High channel**

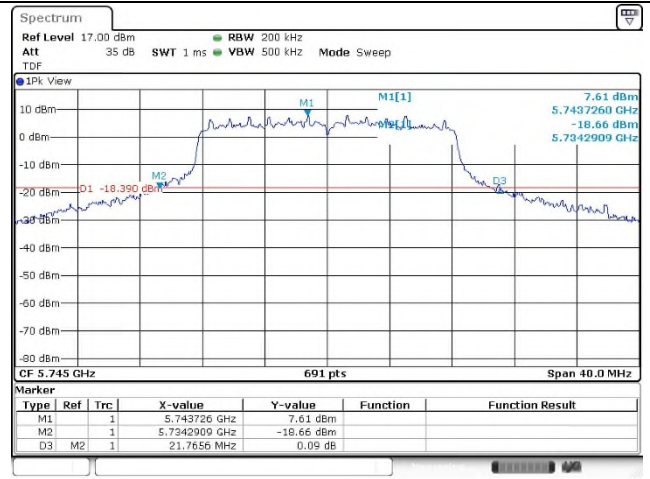
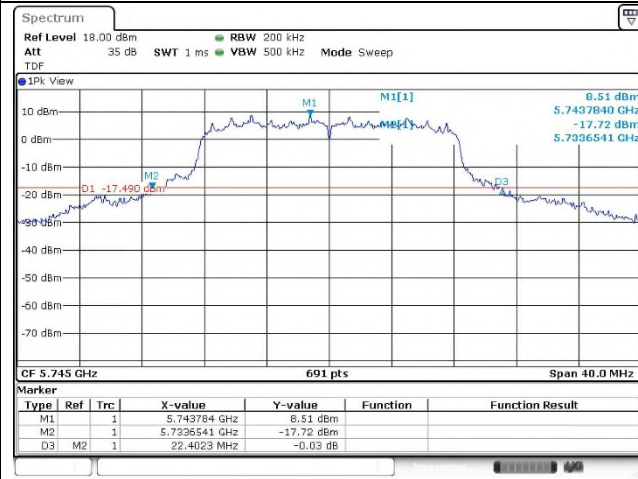


**OFDM: 802.11a (Band 3)**

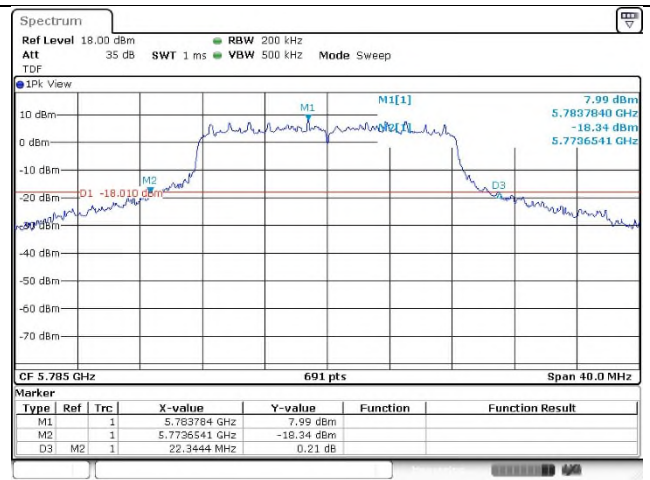
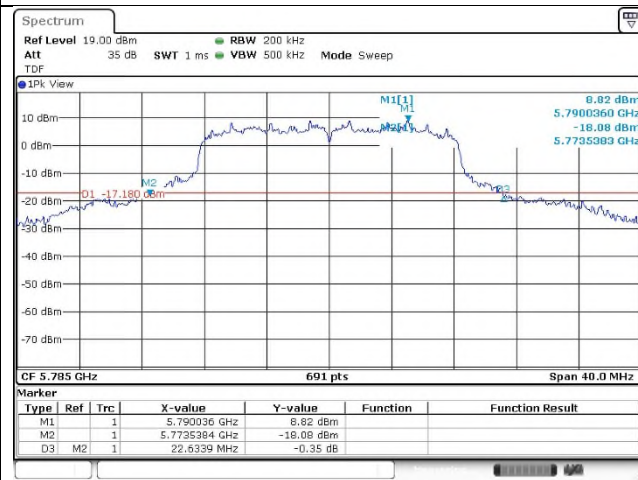
**Ant.1**

**Ant.2**

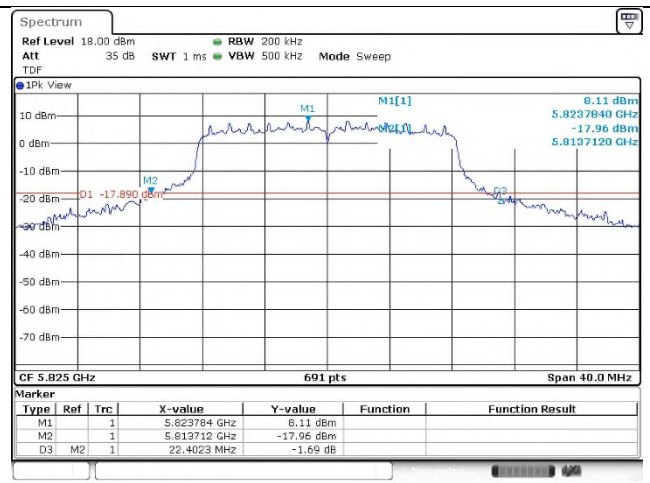
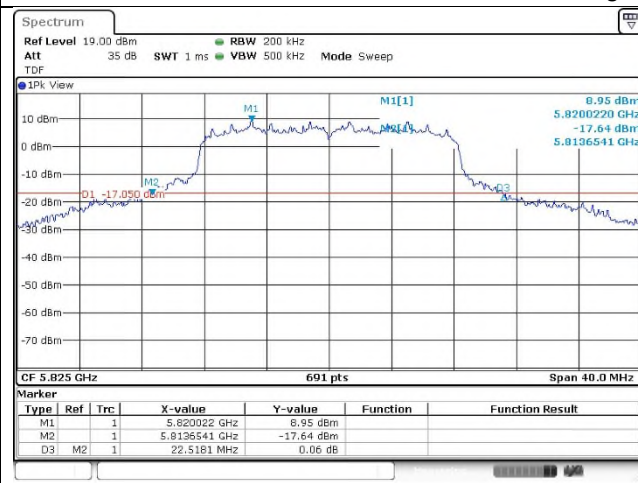
**Low channel**



**Middle channel**



**High channel**

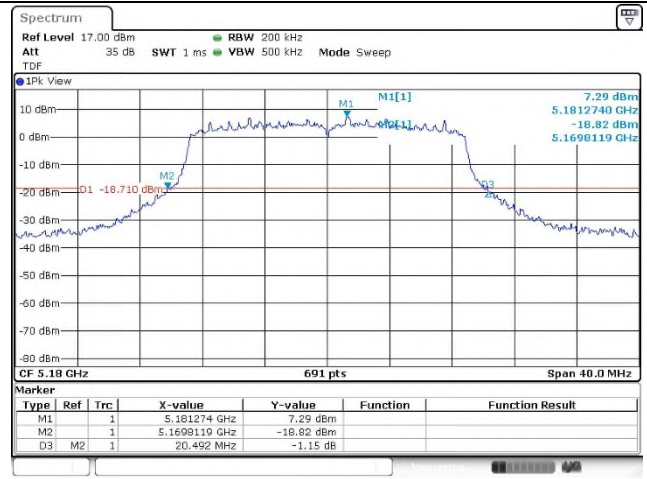
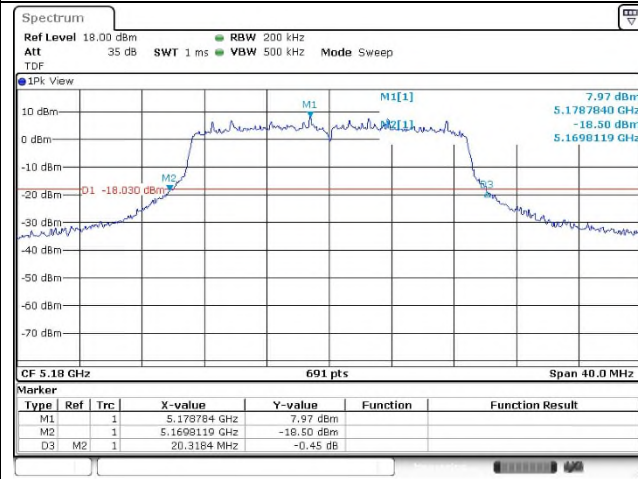


**OFDM: 802.11ac\_VHT20 (Band 1)**

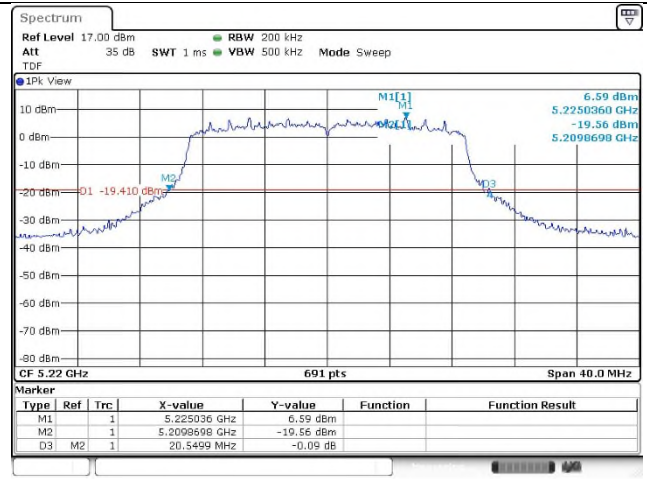
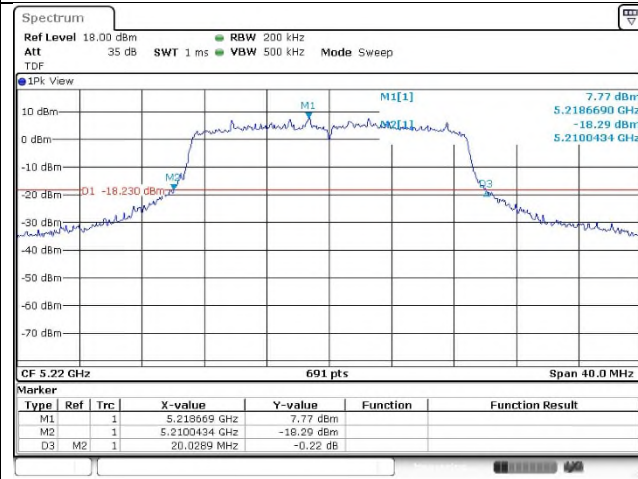
**Ant.1**

**Ant.2**

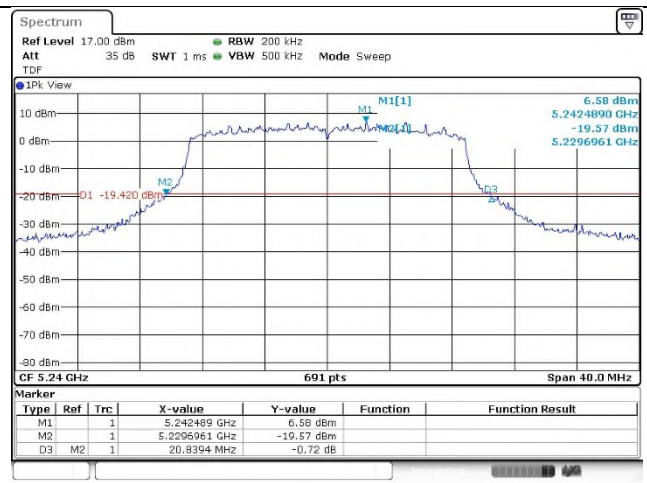
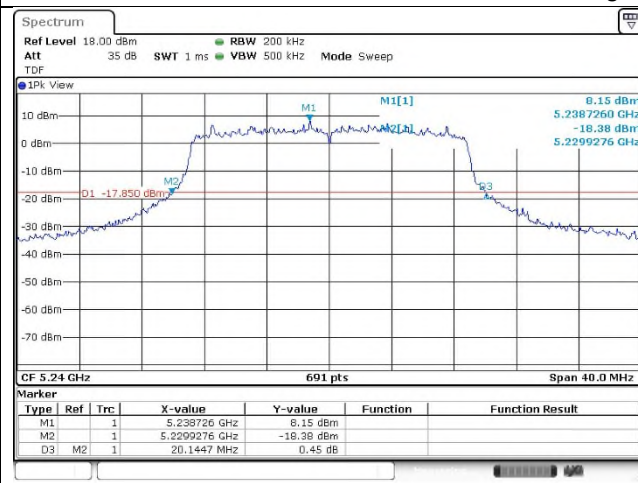
**Low channel**



**Middle channel**



**High channel**

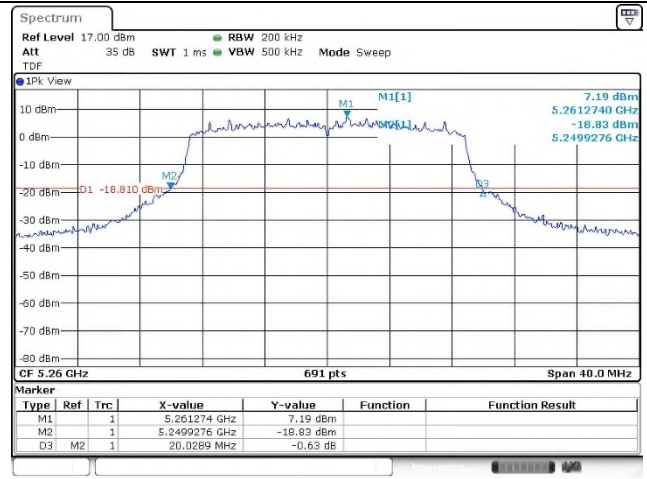
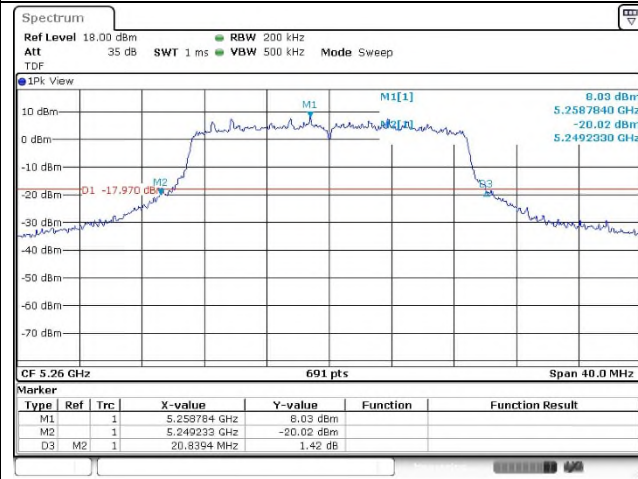


**OFDM: 802.11ac\_VHT20 (Band 2A)**

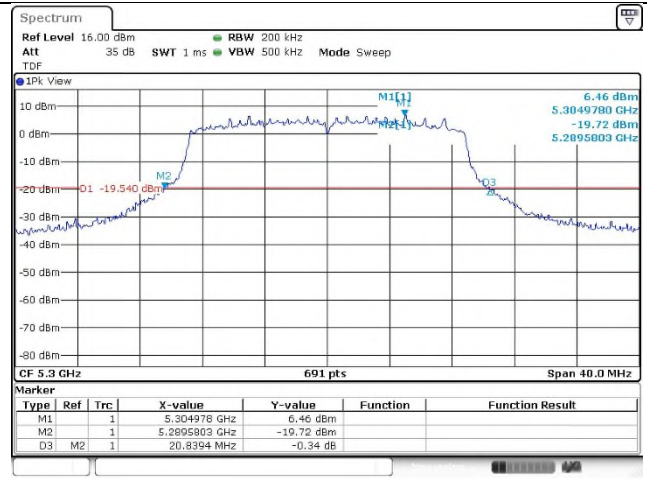
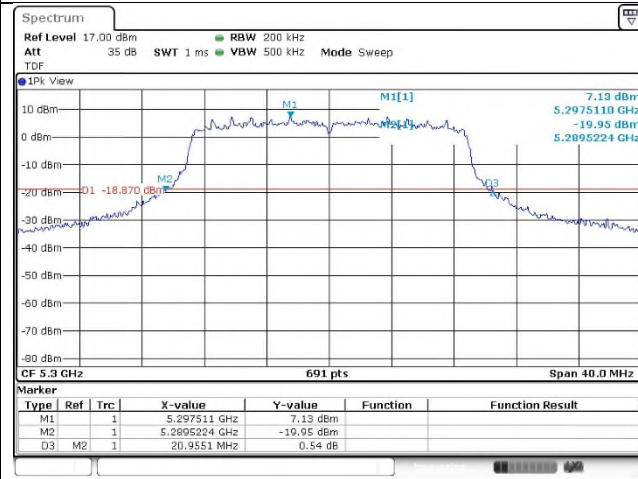
**Ant.1**

**Ant.2**

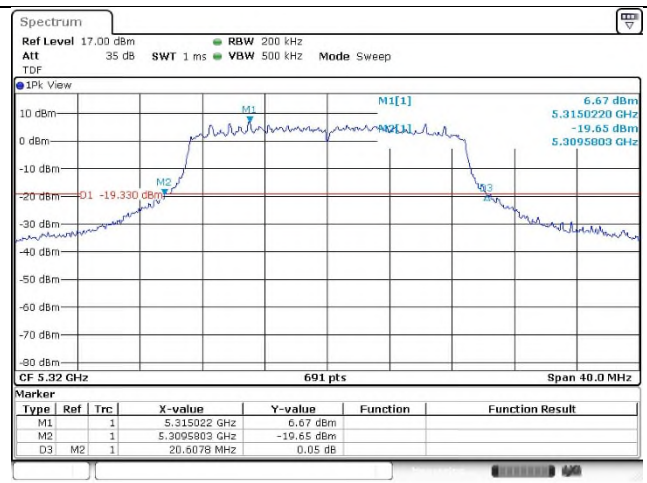
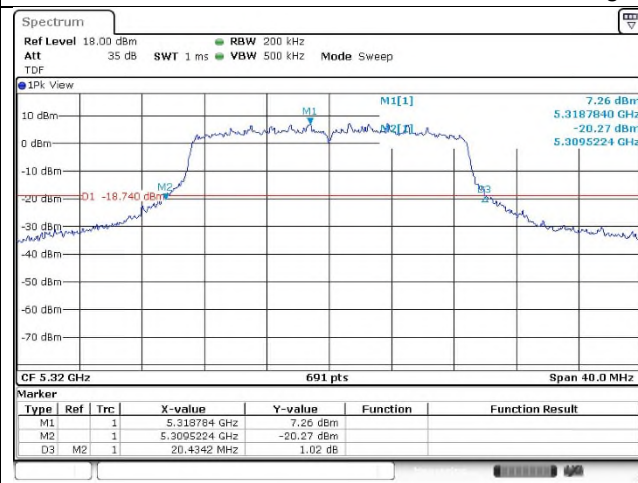
**Low channel**



**Middle channel**



**High channel**

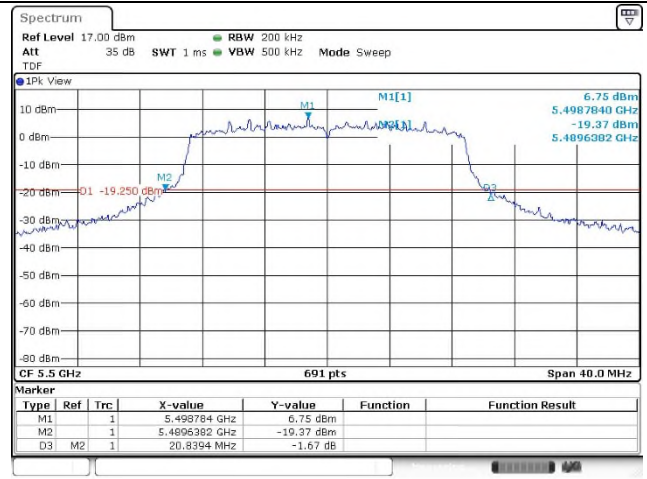
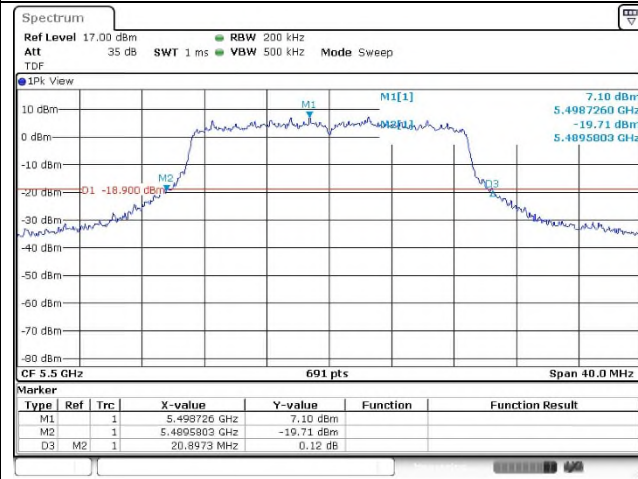


**OFDM: 802.11ac\_VHT20 (Band 2C)**

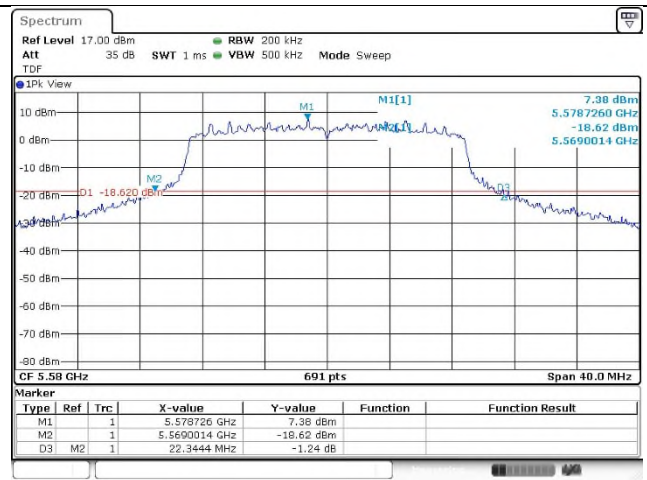
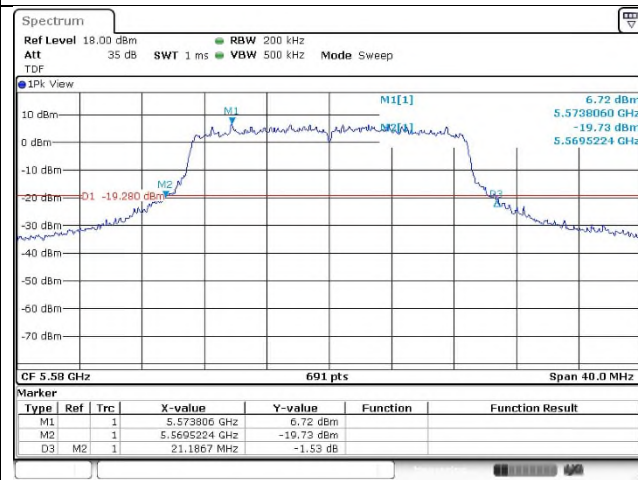
**Ant.1**

**Ant.2**

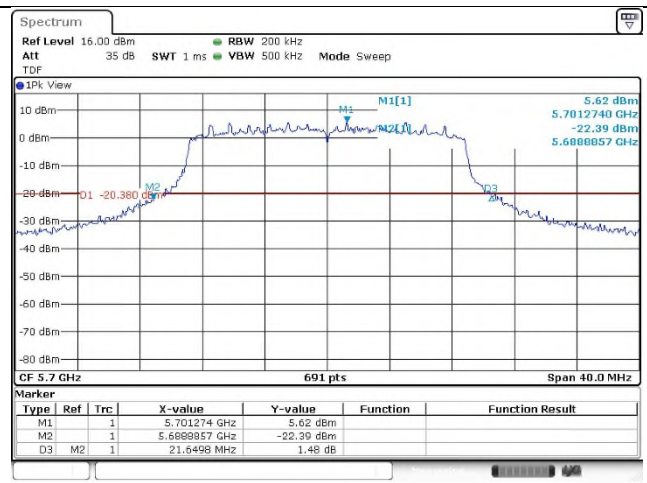
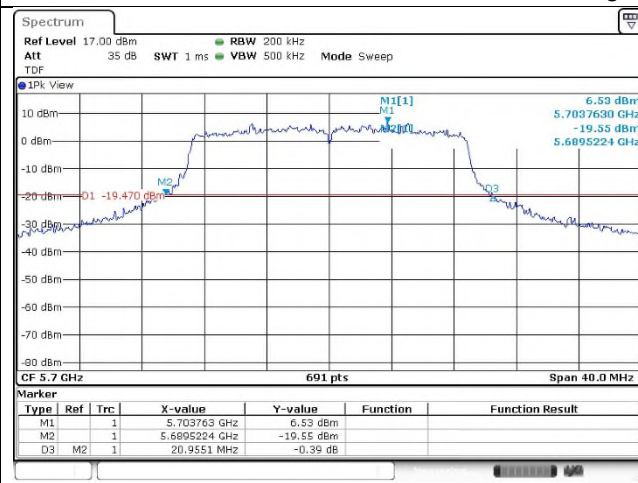
**Low channel**



**Middle channel**



**High channel**

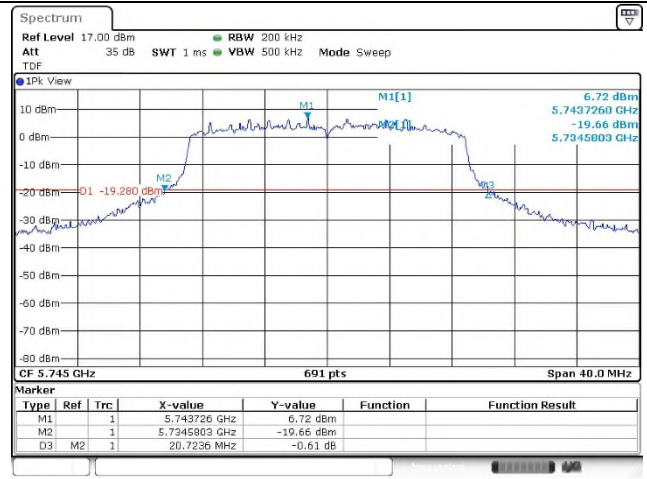
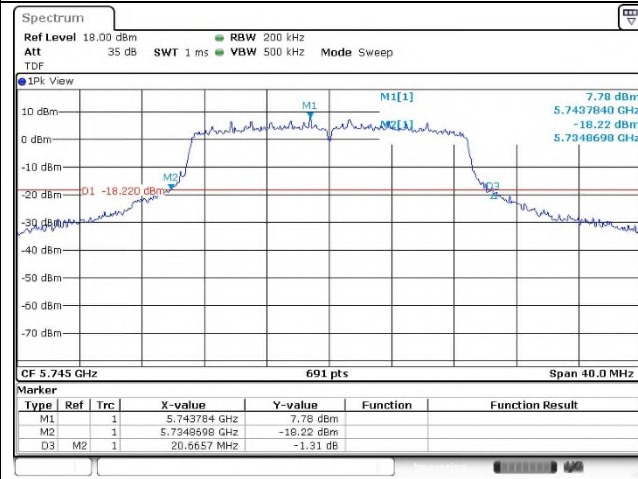


**OFDM: 802.11ac\_VHT20 (Band 3)**

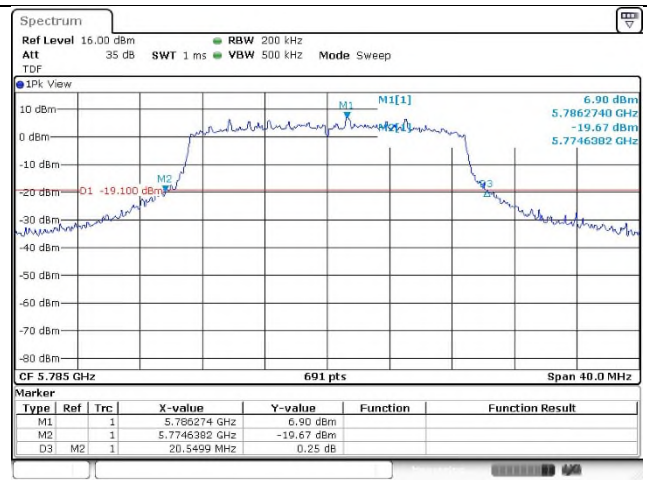
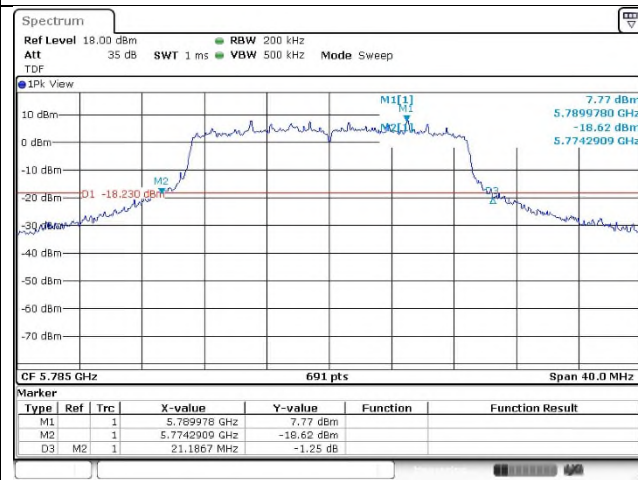
**Ant.1**

**Ant.2**

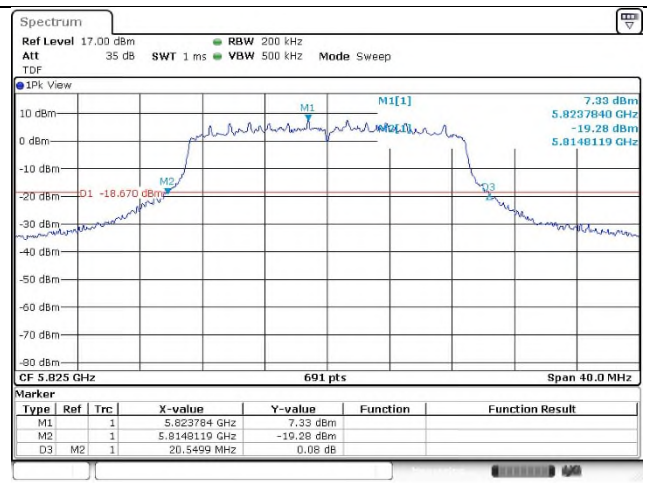
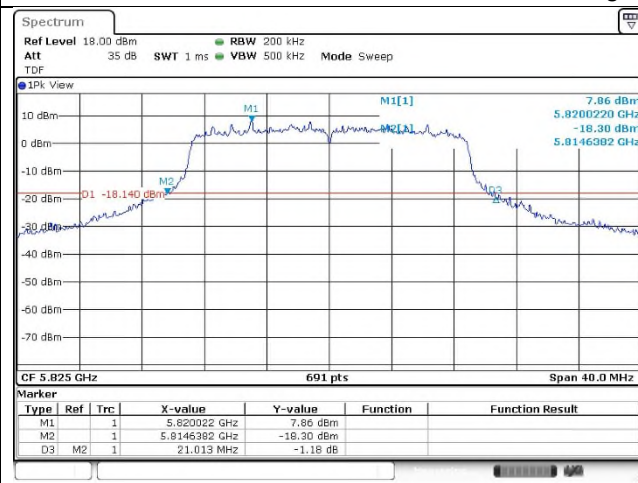
**Low channel**



**Middle channel**



**High channel**

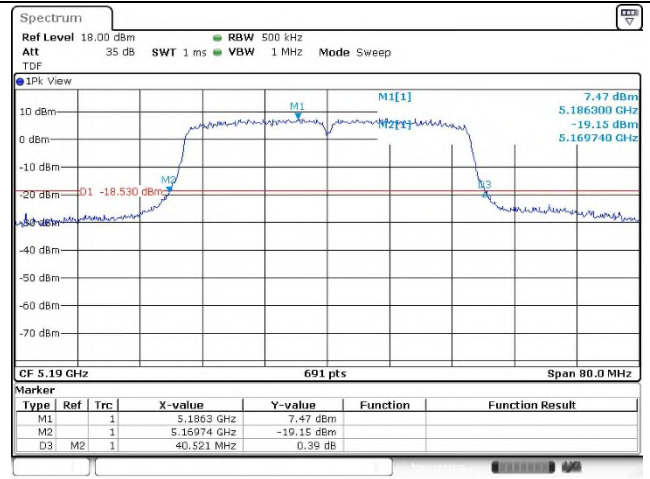
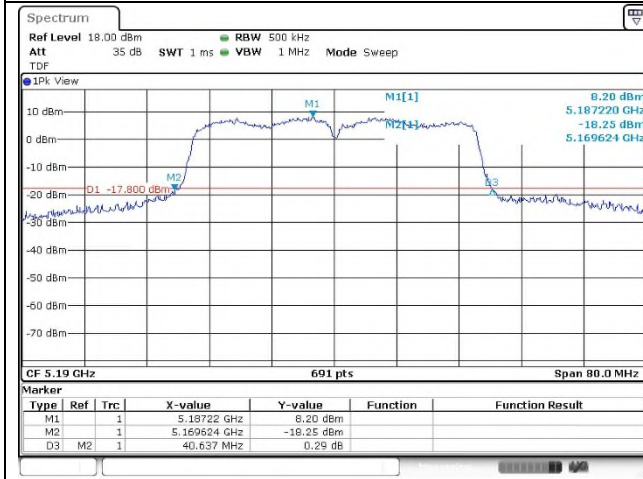


**OFDM: 802.11n\_HT40 (Band 1)**

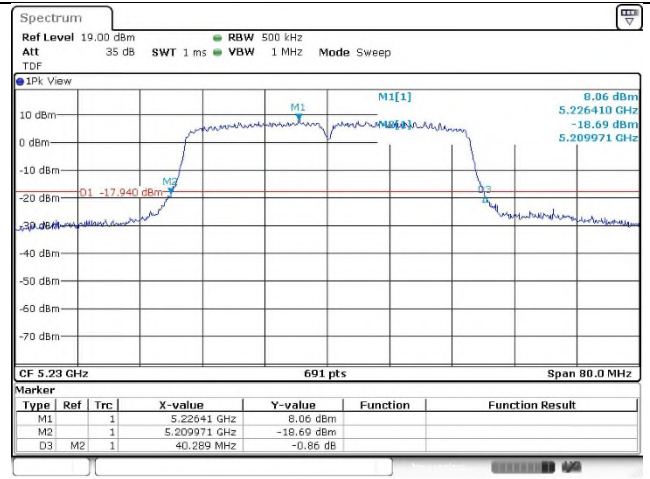
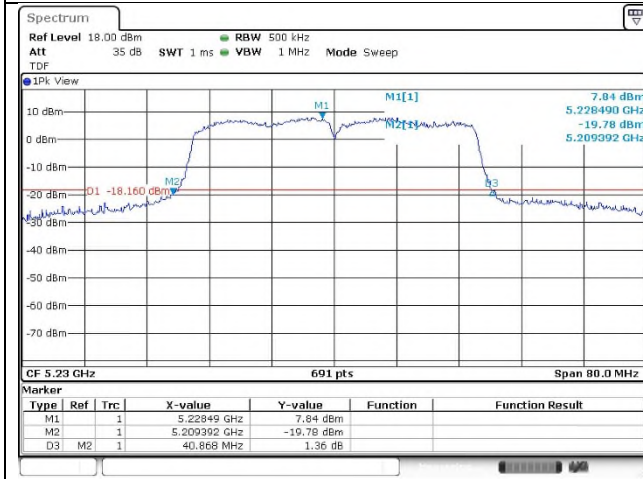
**Ant.1**

**Ant.2**

**Low channel**



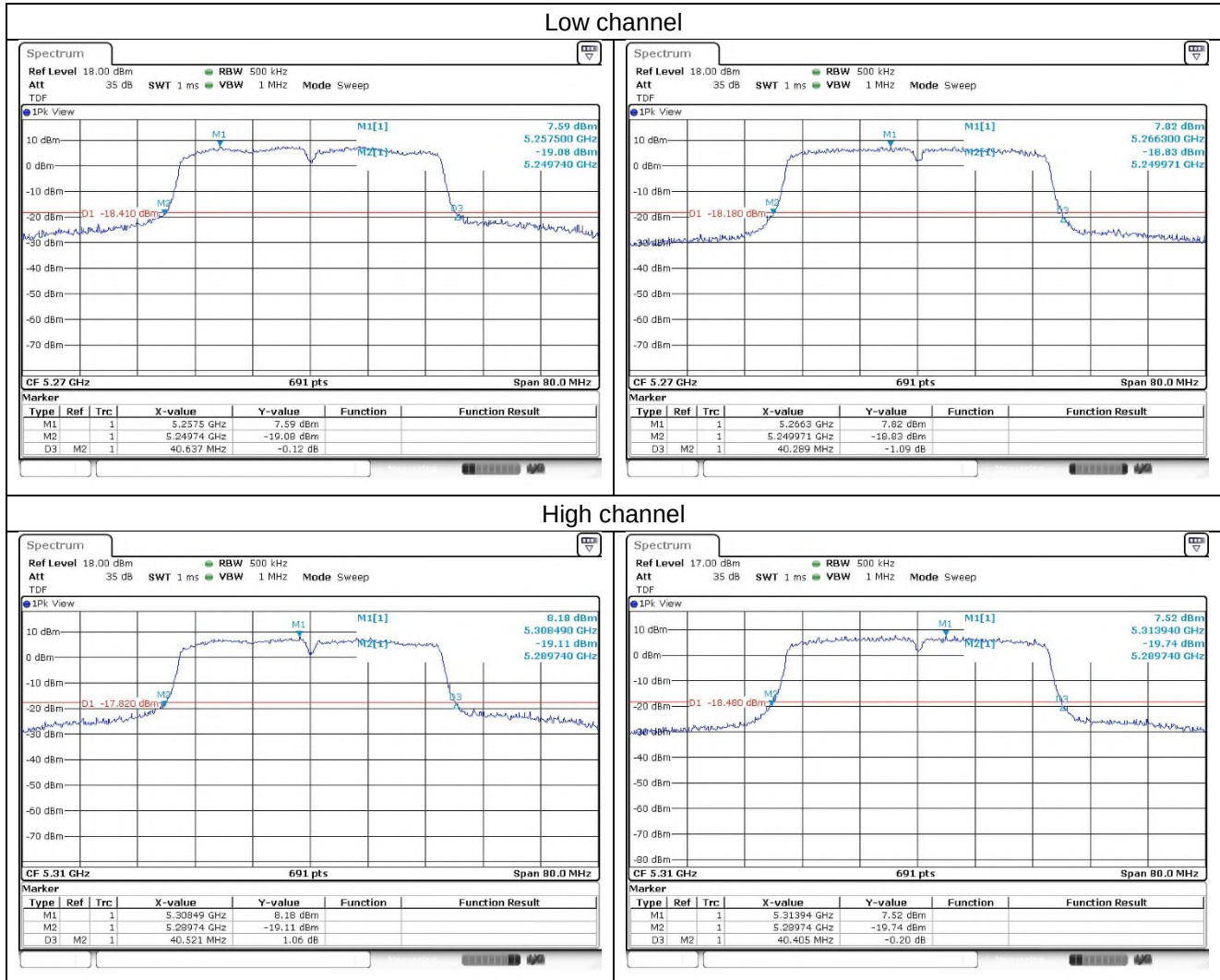
**High channel**



**OFDM: 802.11n\_HT40 (Band 2A)**

**Ant.1**

**Ant.2**

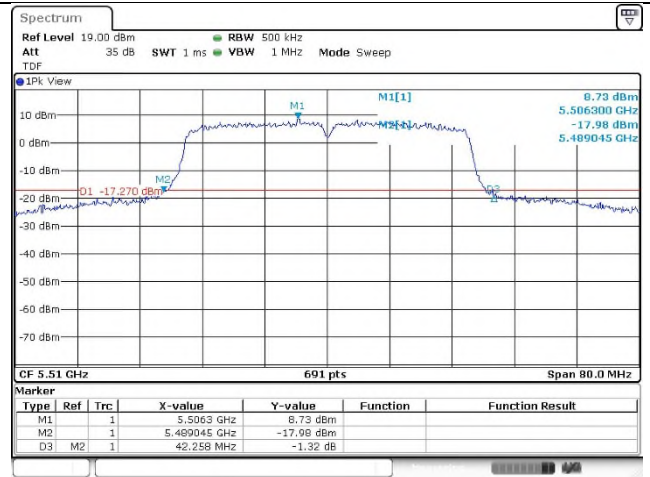
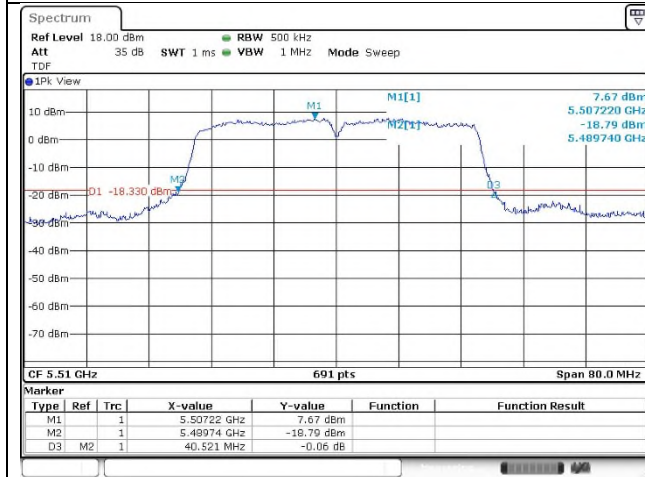


**OFDM: 802.11n\_HT40 (Band 2C)**

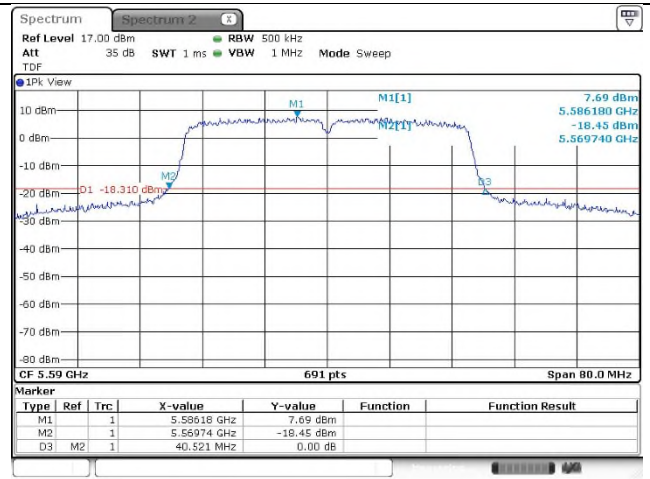
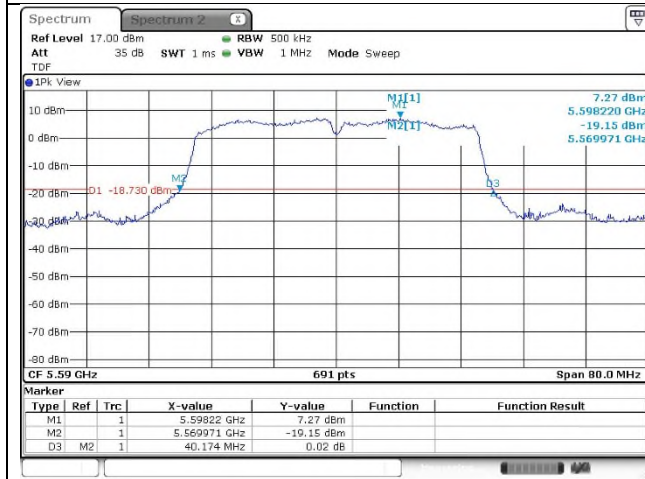
**Ant.1**

**Ant.2**

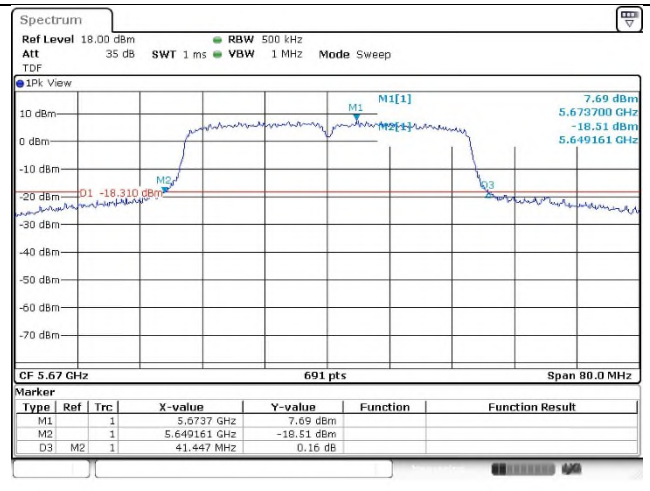
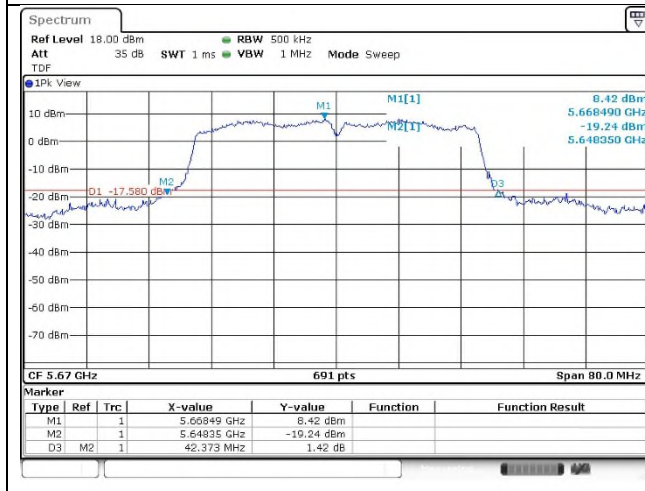
**Low channel**



**Middle channel**



**High channel**

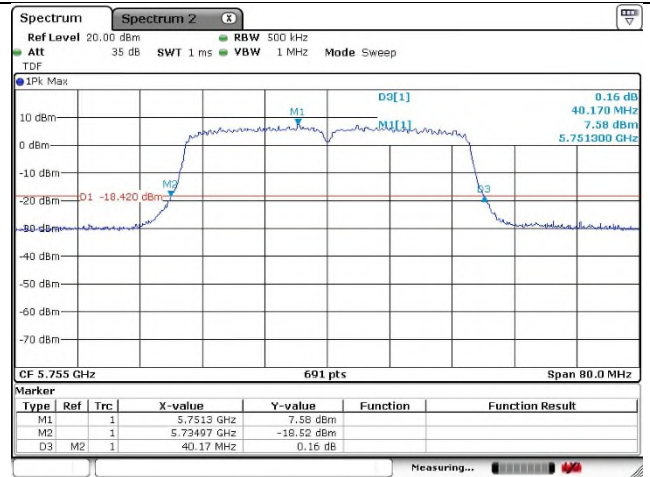
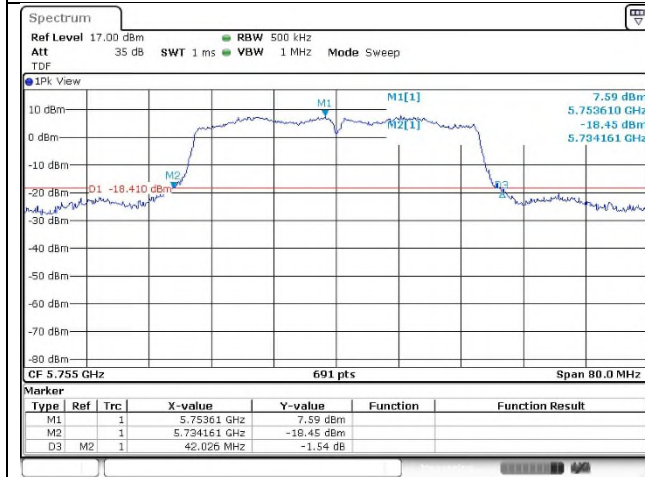


### OFDM: 802.11n\_HT40 (Band 3)

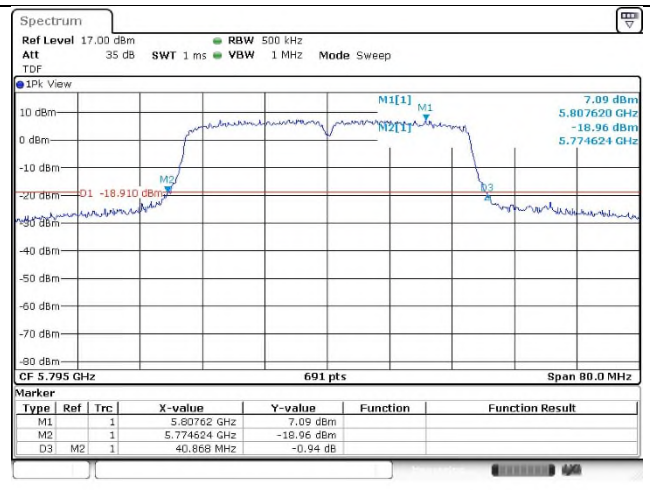
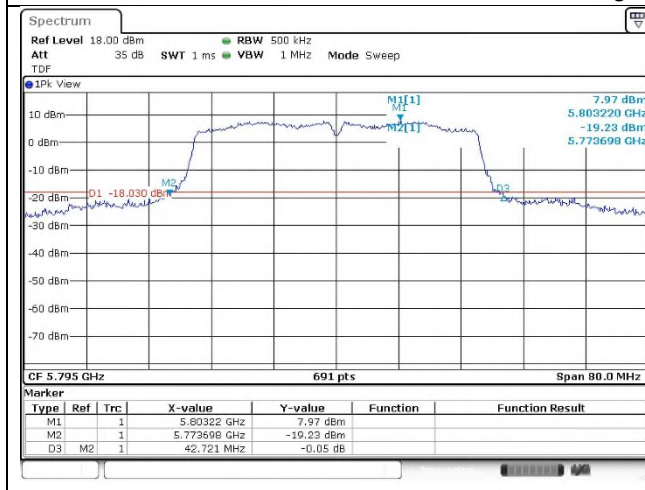
Ant.1

Ant.2

#### Low channel



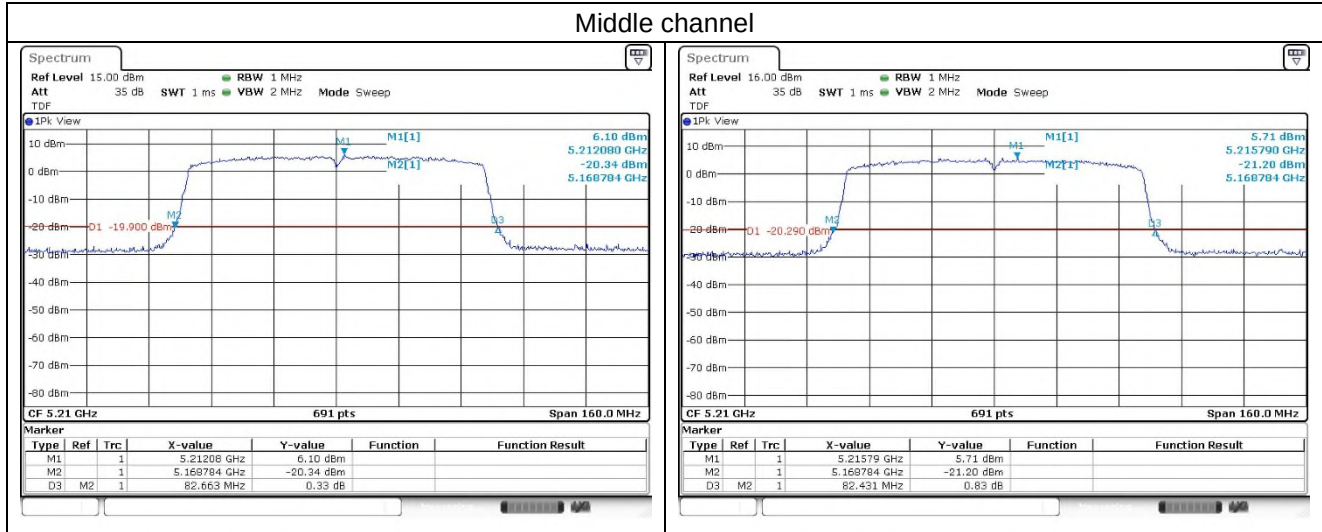
#### High channel



## OFDM: 802.11ac\_VHT80 (Band 1)

Ant.1

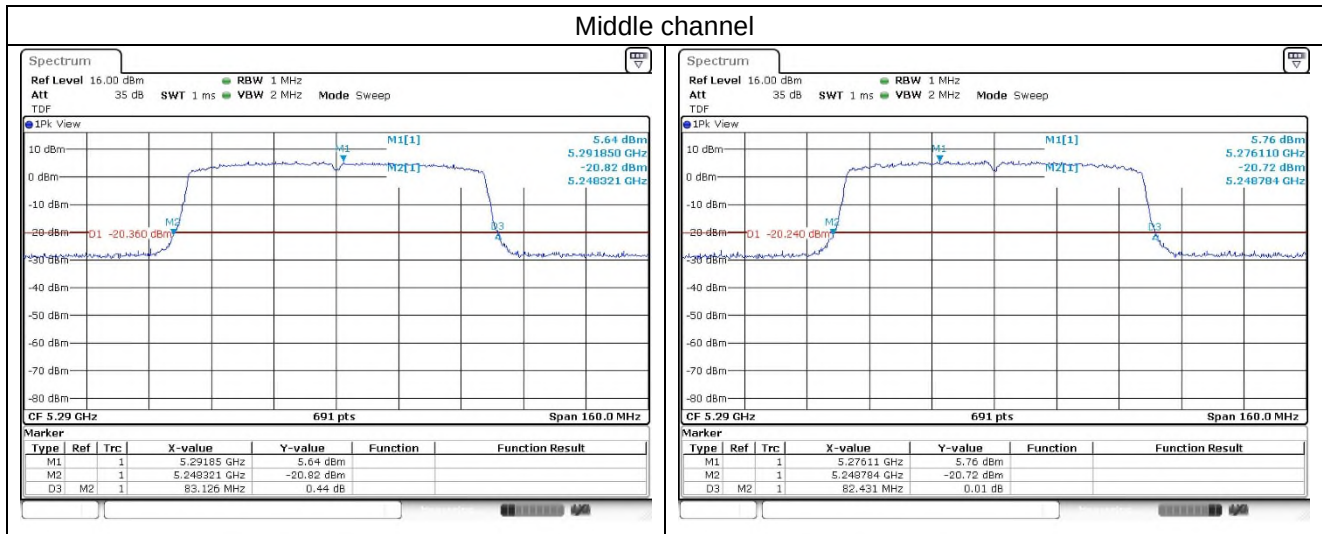
Ant.2



## OFDM: 802.11ac\_VHT80 (Band 2A)

Ant.1

Ant.2

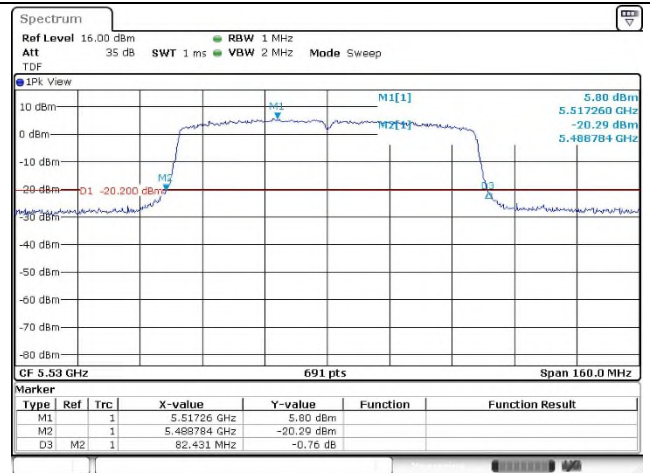
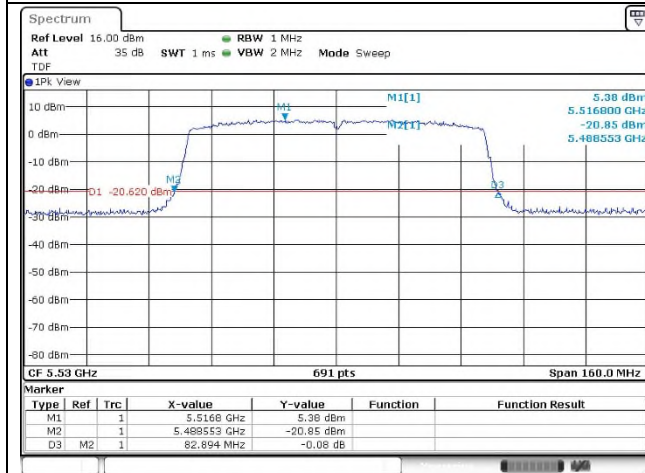


## OFDM: 802.11ac\_VHT80 (Band 2C)

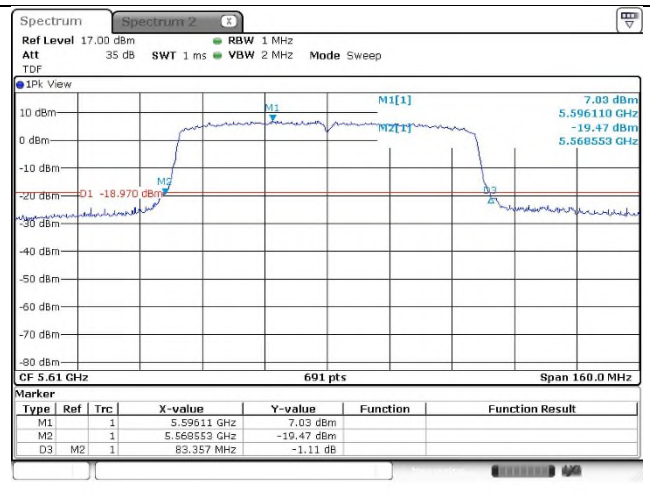
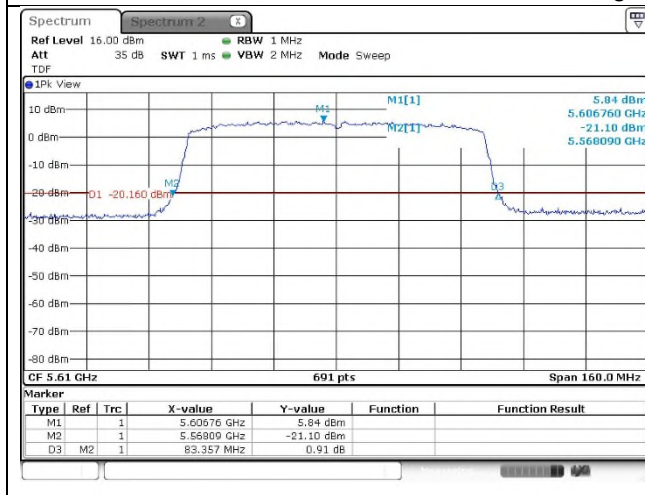
Ant.1

Ant.2

### Low channel



### High channel

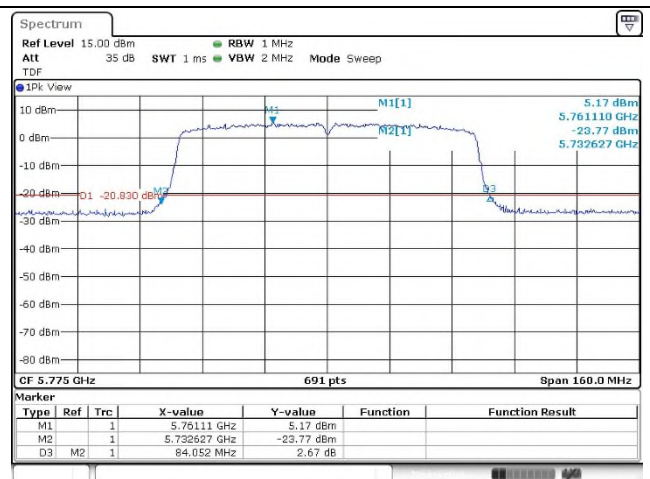
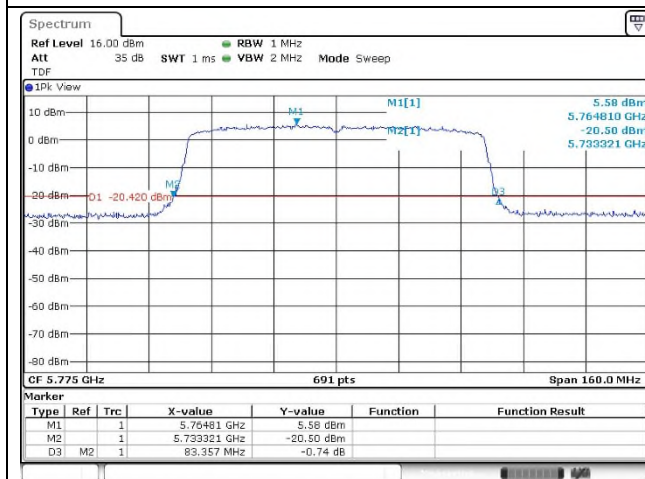


## OFDM: 802.11ac\_VHT80 (Band 3)

Ant.1

Ant.2

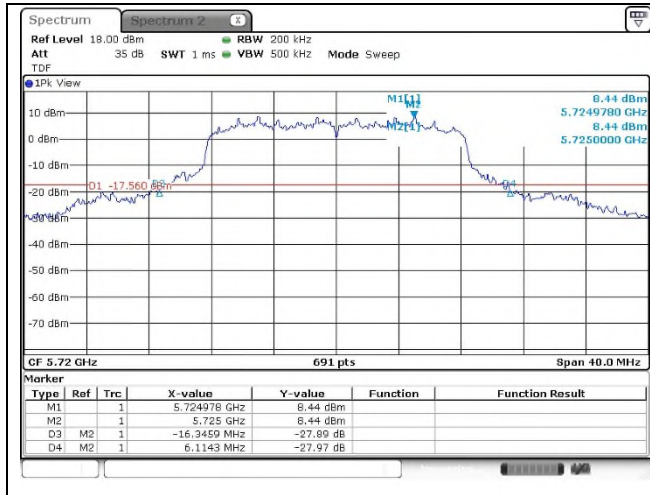
### Middle channel



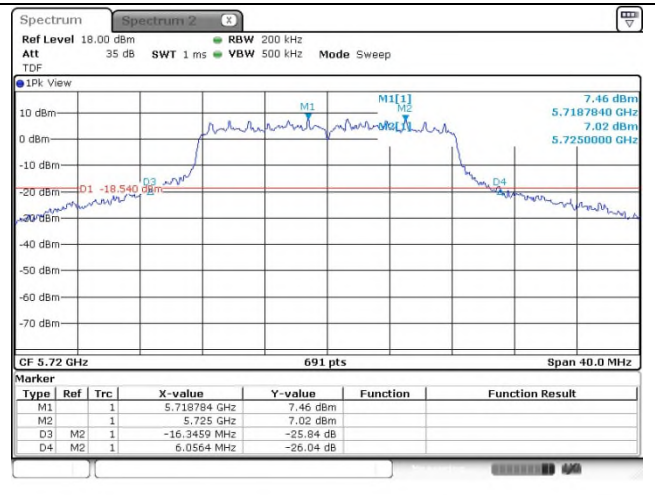
## Straddle channels

### OFDM: 802.11a

Ant.1

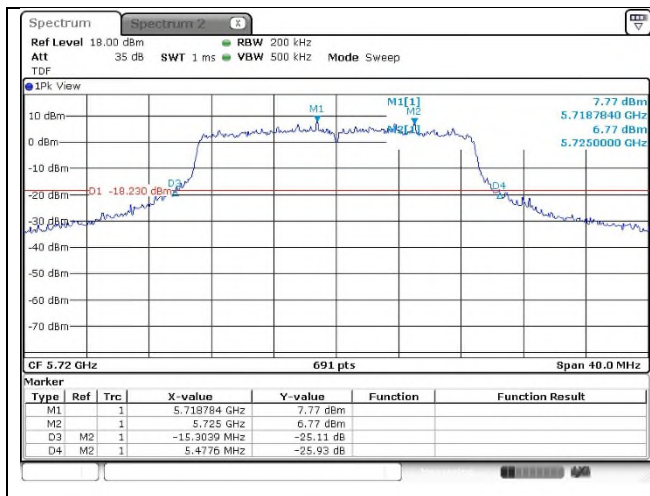


Ant.2

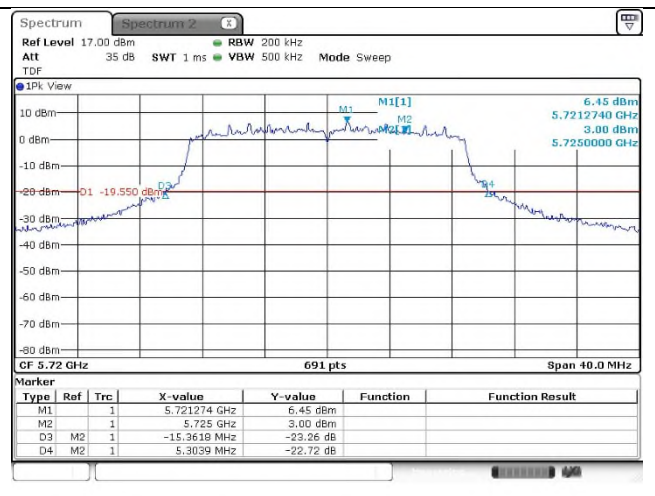


### OFDM: 802.11ac\_VHT20

Ant.1

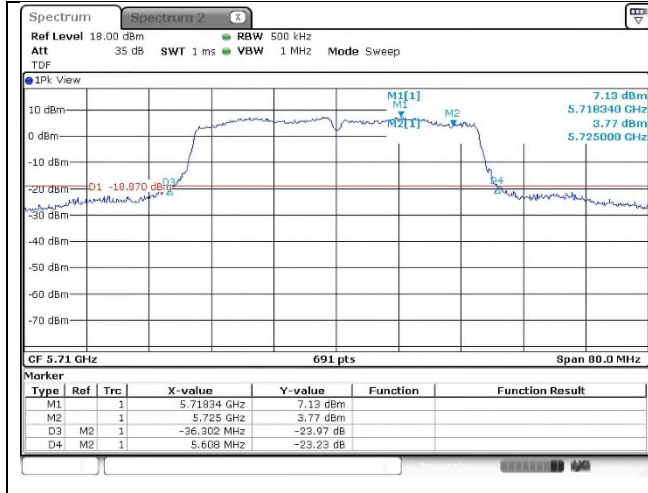


Ant.2

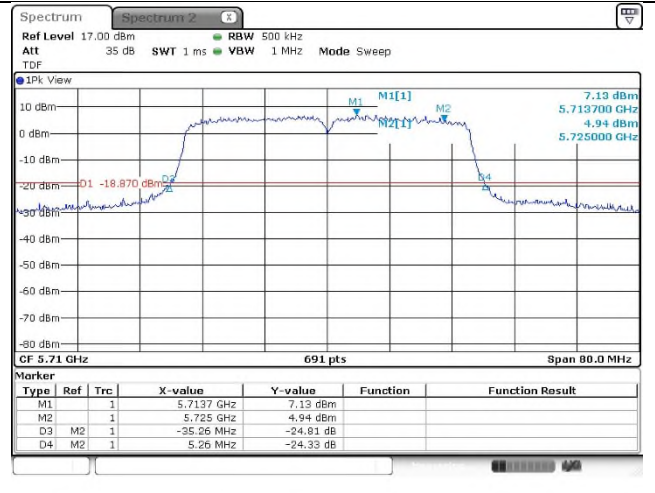


## OFDM: 802.11n\_HT40

Ant.1

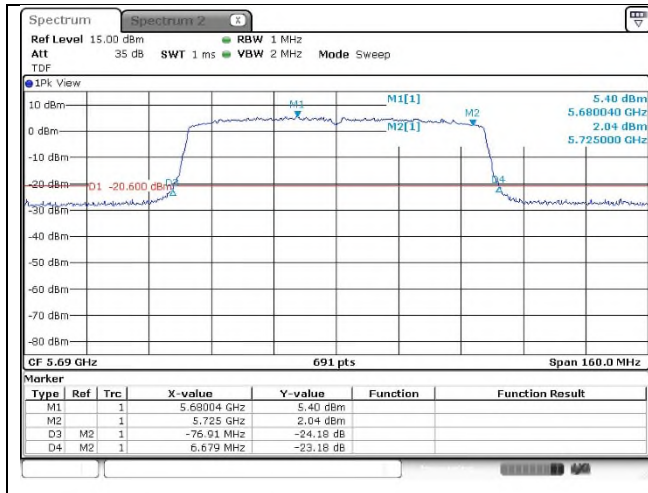


Ant.2

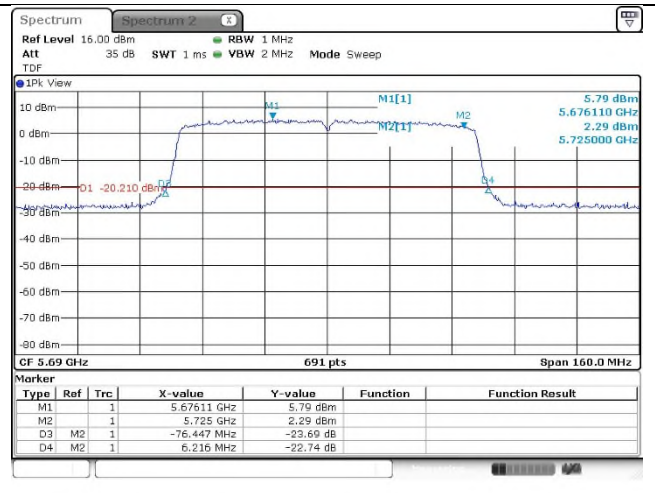


## OFDM: 802.11ac\_VHT80

Ant.1



Ant.2



## 4. 6 dB Bandwidth

### 4.1. Test Setup



### 4.2. Limit

According to §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.

### 4.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section II.C.2 of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Set RBW = 100 kHz.
3. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. 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.

#### Remark;

In case of band crossing channels 138, 142 and 144, the measurement is complied with section III.A of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

#### 4.4. Test Result

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

| Mode       | Band    | Data Rate (Mbps) | Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) |        | Minimum Bandwidth (kHz) |
|------------|---------|------------------|---------|-----------------|----------------------|--------|-------------------------|
|            |         |                  |         |                 | Ant.1                | Ant.2  |                         |
| 11a        | U-NII 3 | 6                | Low     | 5 745           | 15.100               | 15.500 | 500                     |
|            |         |                  | Middle  | 5 785           | 13.950               | 15.780 |                         |
|            |         |                  | High    | 5 825           | 15.120               | 16.040 |                         |
| 11ac_VHT20 |         | MCS0             | Low     | 5 745           | 16.270               | 16.840 |                         |
|            |         |                  | Middle  | 5 785           | 15.740               | 16.880 |                         |
|            |         |                  | High    | 5 825           | 14.670               | 15.760 |                         |
| 11n_HT40   |         | MCS0             | Low     | 5 755           | 35.090               | 35.450 |                         |
|            |         |                  | High    | 5 795           | 35.340               | 35.400 |                         |
| 11ac_VHT80 |         | MCS0             | Middle  | 5 775           | 71.550               | 75.120 |                         |

#### - Straddle channels

| Mode       | Band    | Data Rate (Mbps) | Channel  | Frequency (MHz) | 6 dB Bandwidth (MHz) |       | Minimum Bandwidth (kHz) |
|------------|---------|------------------|----------|-----------------|----------------------|-------|-------------------------|
|            |         |                  |          |                 | Ant.1                | Ant.2 |                         |
| 11a        | U-NII 3 | 6                | Straddle | 5 720           | 2.641                | 3.162 | 500                     |
| 11ac_VHT20 |         | MCS0             |          | 5 720           | 2.641                | 3.220 |                         |
| 11n_HT40   |         | MCS0             |          | 5 710           | 2.713                | 2.713 |                         |
| 11ac_VHT80 |         | MCS0             |          | 5 690           | 2.742                | 2.742 |                         |

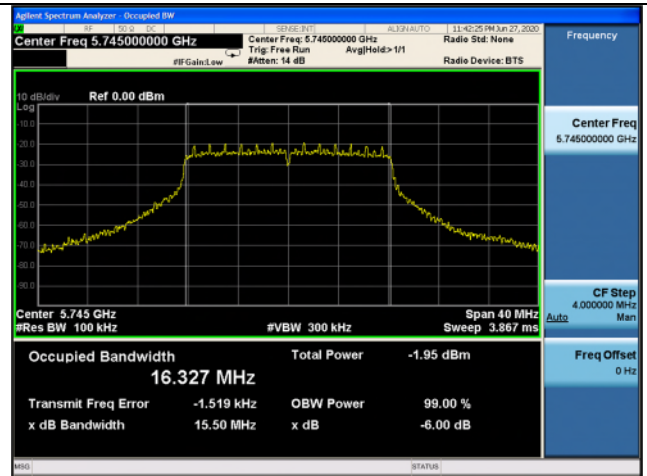
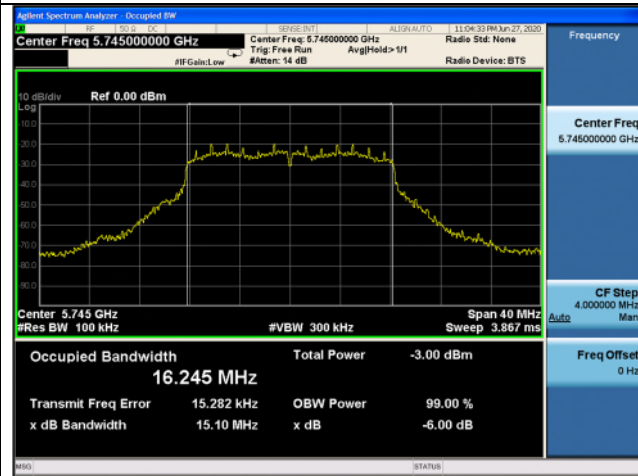
- Test plots

OFDM: 802.11a (Band 3)

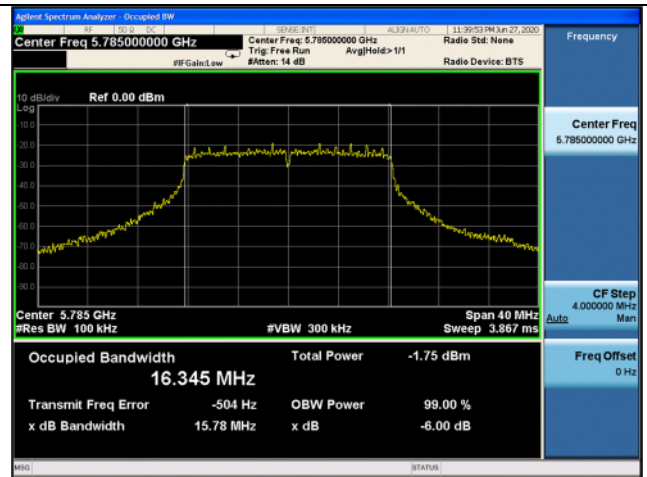
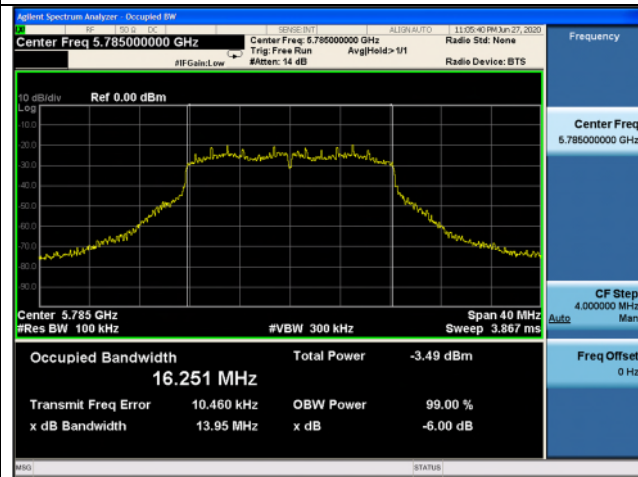
Ant.1

Ant.2

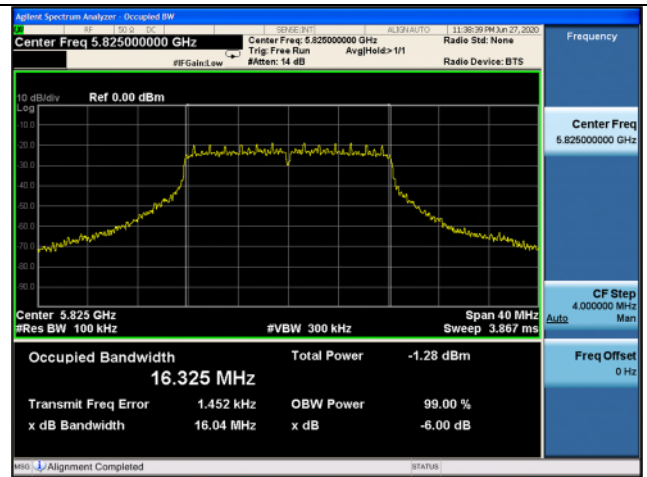
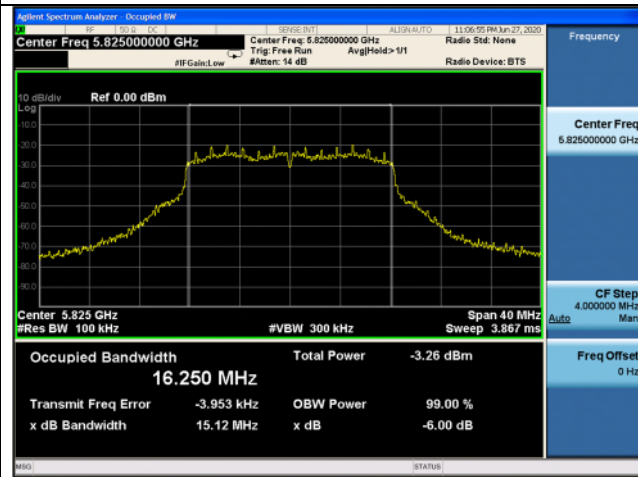
Low channel



Middle channel



High channel

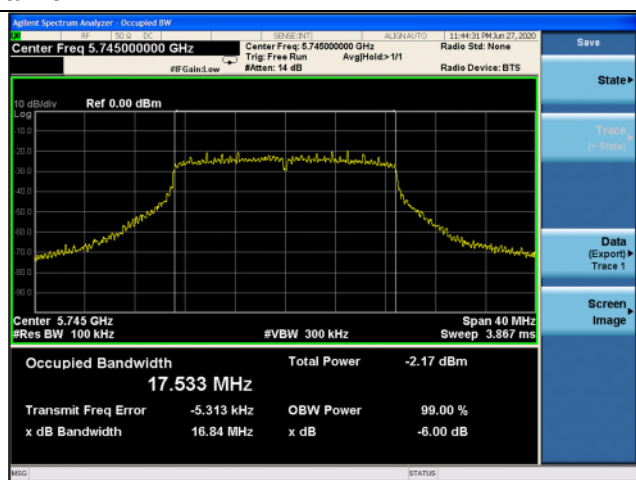
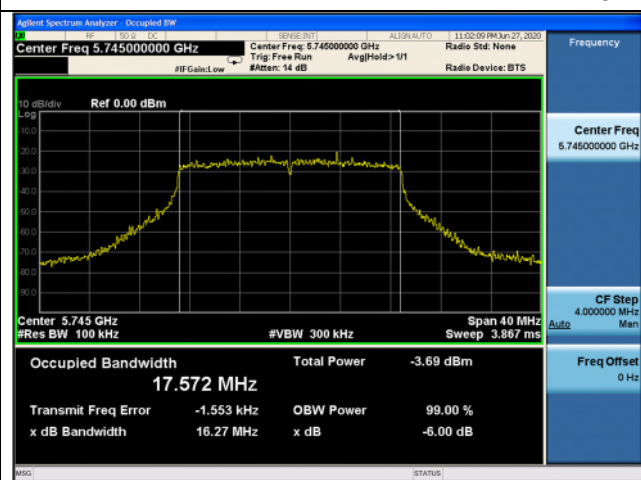


OFDM: 802.11ac\_VHT20 (Band 3)

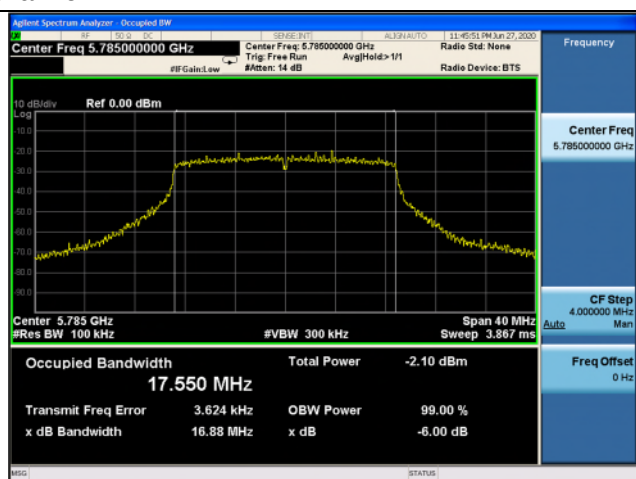
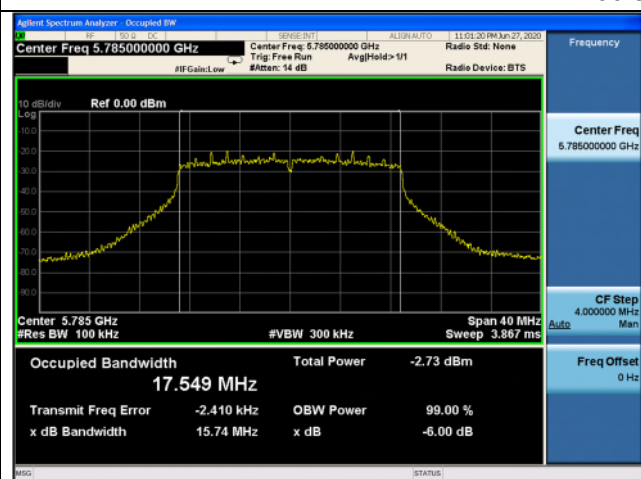
Ant.1

Ant.2

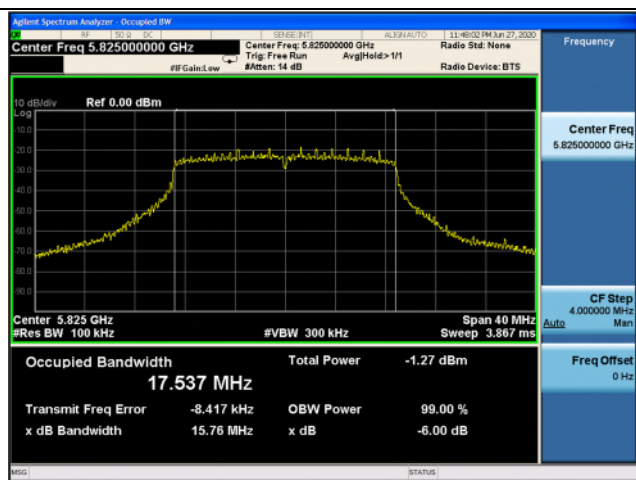
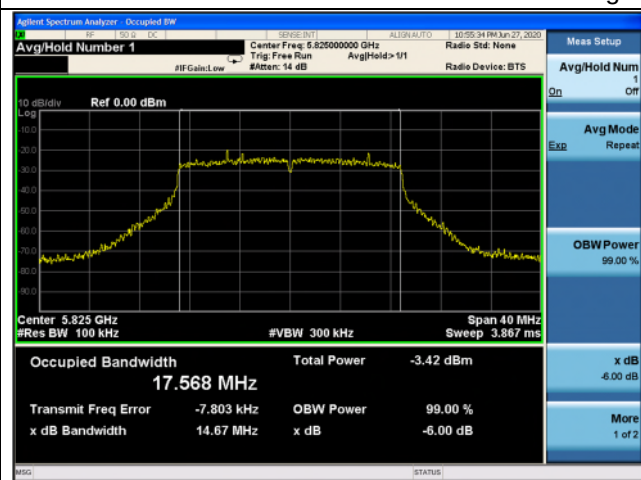
Low channel



Middle channel



High channel

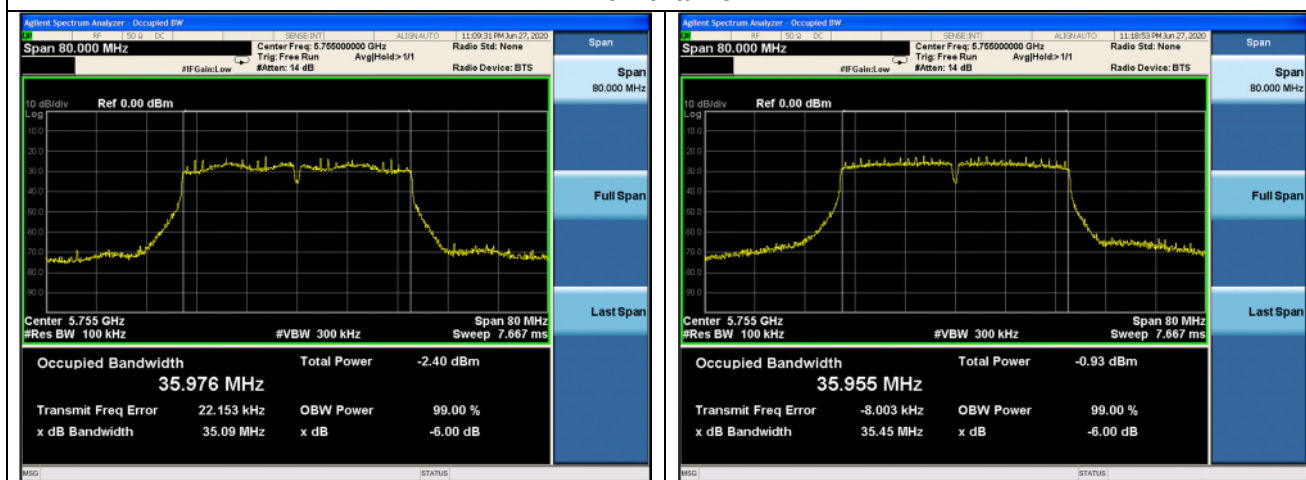


**OFDM: 802.11n\_HT40 (Band 3)**

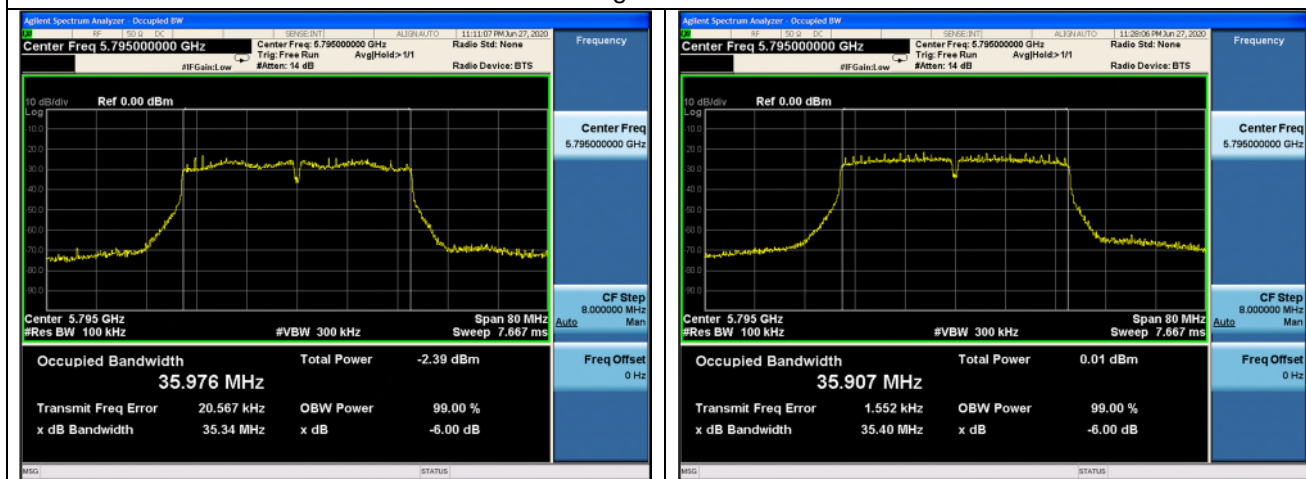
**Ant.1**

**Ant.2**

**Low channel**



**High channel**

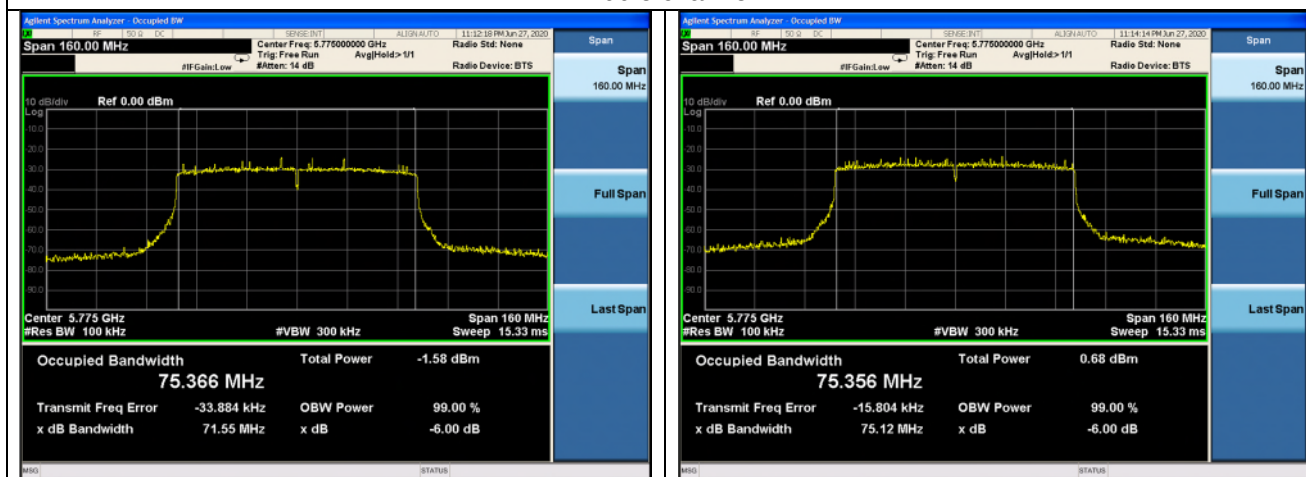


**802.11ac\_VHT80 (Band 3)**

**Ant.1**

**Ant.2**

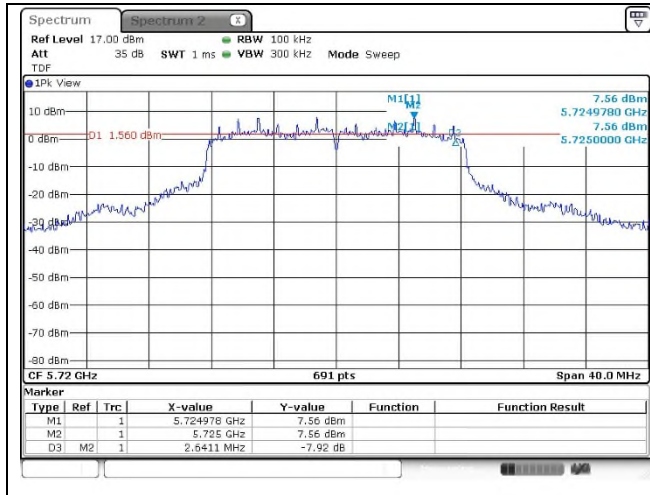
**Middle channel**



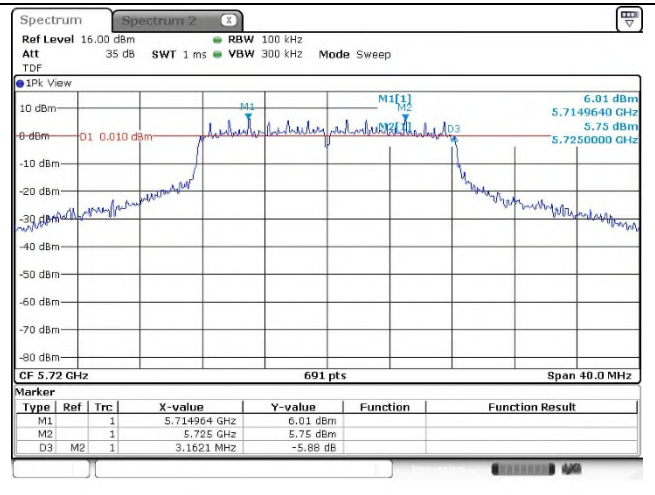
## Straddle channels

### OFDM: 802.11a

Ant.1

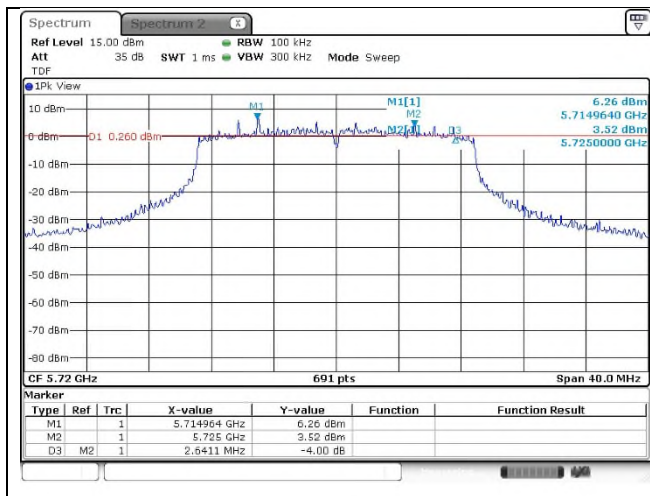


Ant.2

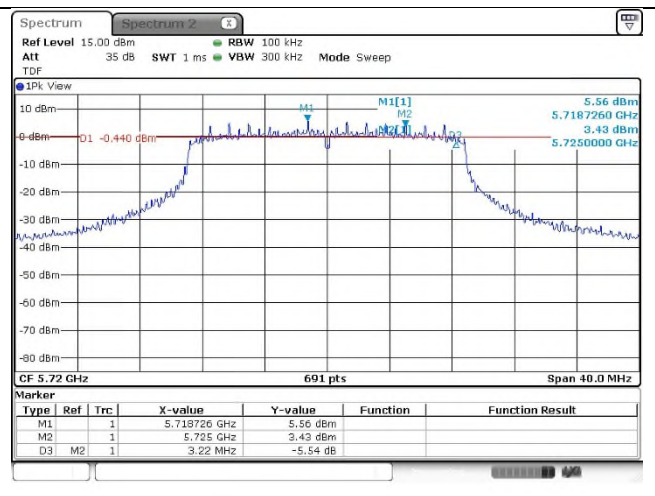


### OFDM: 802.11ac\_VHT20

Ant.1

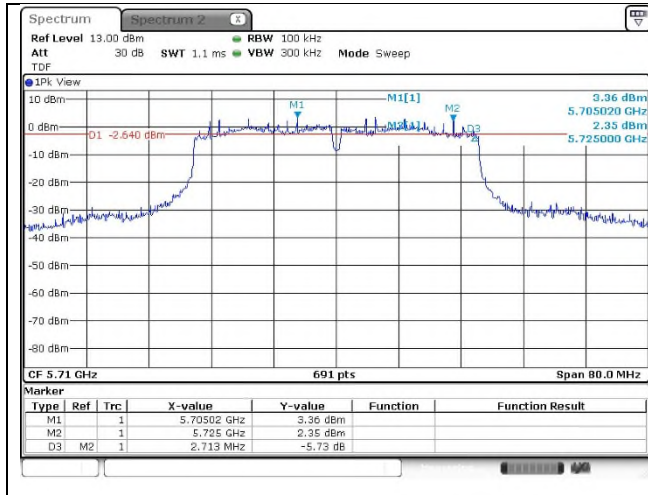


Ant.2

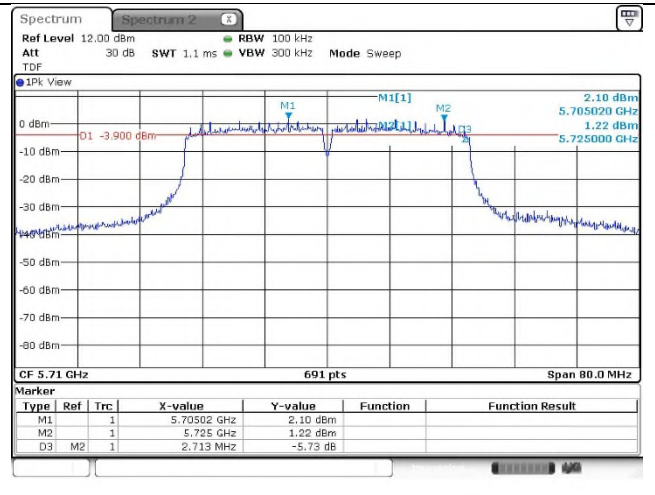


## OFDM: 802.11n\_HT40

Ant.1

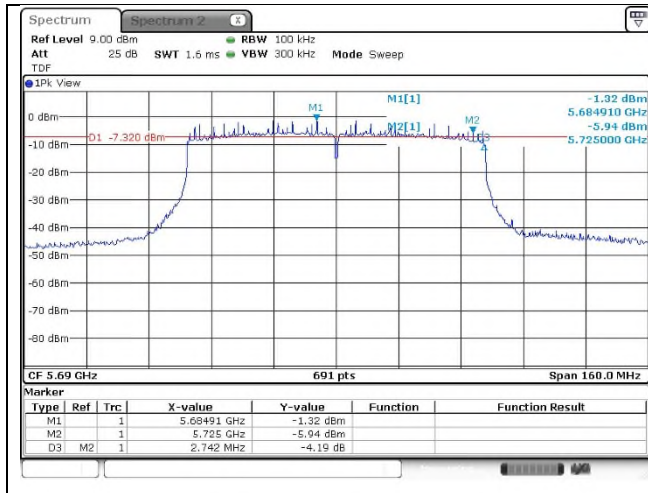


Ant.2

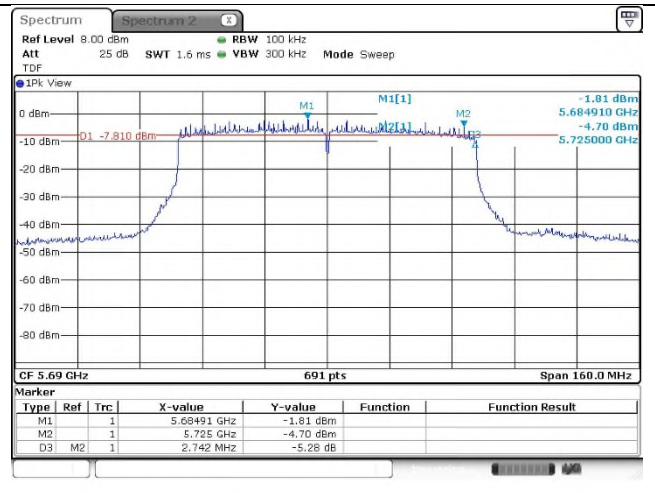


## OFDM: 802.11ac\_VHT80

Ant.1

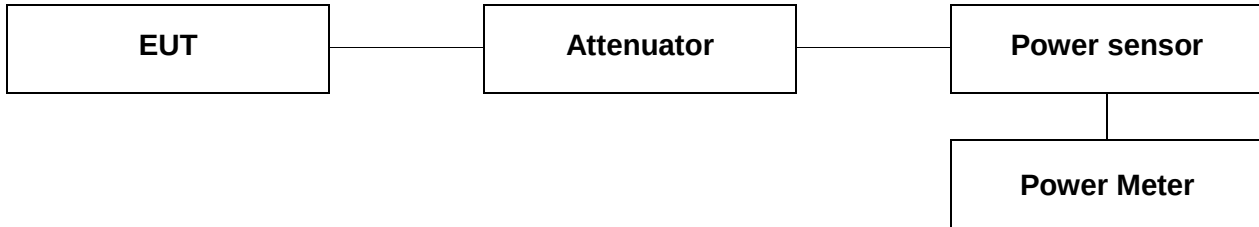


Ant.2



## 5. Maximum Peak Conducted Output Power

### 5.1. Test Setup



### 5.2. Limit

According to 15.407(a)(1)(iv)

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.407(a)(2)

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.407(a)(3)

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

### 5.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section II.E.3.a of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
  - The EUT is configured to transmit continuously or to transmit with a consistent duty cycle.
  - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
  - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
3. If the transmitter does not transmit continuously, measure the duty cycle,  $x$ , of the transmitter output signal as described in section II.B.
4. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
5. Adjust the measurement in dBm by adding  $10 \log (1/x)$  where  $x$  is the duty cycle (e.g.,  $10 \log (1/0.25)$  if the duty cycle is 25 %).
6. In case of band crossing channels 138, 142 and 144, the measurement is complied with section III.A of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

## 5.4. Test Result

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

| Mode | Band     | Data Rate<br>(Mbps) | Channel | Frequency<br>(MHz) | Average Power<br>(dB m) |       |               |
|------|----------|---------------------|---------|--------------------|-------------------------|-------|---------------|
|      |          |                     |         |                    | Ant.1                   | Ant.2 | Ant.1 + Ant.2 |
| 11a  | U-NII 1  | 6                   | Low     | 5 180              | 17.03                   | 17.45 | 20.26         |
|      |          |                     | Middle  | 5 220              | 17.21                   | 17.37 | 20.30         |
|      |          |                     | High    | 5 240              | 17.19                   | 17.55 | 20.38         |
|      | U-NII 2A |                     | Low     | 5 260              | 17.18                   | 17.44 | 20.32         |
|      |          |                     | Middle  | 5 300              | 17.35                   | 17.46 | 20.42         |
|      |          |                     | High    | 5 320              | 17.00                   | 17.57 | 20.30         |
|      | U-NII 2C |                     | Low     | 5 500              | 17.25                   | 17.48 | 20.38         |
|      |          |                     | Middle  | 5 580              | 17.14                   | 18.05 | 20.63         |
|      |          |                     | High    | 5 700              | 16.72                   | 17.23 | 19.99         |
|      | U-NII 3  |                     | Low     | 5 745              | 17.07                   | 17.70 | 20.41         |
|      |          |                     | Middle  | 5 785              | 17.44                   | 17.86 | 20.67         |
|      |          |                     | High    | 5 825              | 17.41                   | 17.78 | 20.61         |

| Band     | FCC Limit          |                       |                   |                     |                        |                 |
|----------|--------------------|-----------------------|-------------------|---------------------|------------------------|-----------------|
|          | Frequency<br>(MHz) | Fixed Limit<br>(dB m) | 26 dB BW<br>(MHz) | 11+10LogB<br>(dB m) | Antenna Gain<br>(dB i) | Limit<br>(dB m) |
| U-NII 1  | 5 180              | 23.98                 |                   |                     | -3.68                  | 23.98           |
|          | 5 220              |                       |                   |                     |                        |                 |
|          | 5 240              |                       |                   |                     |                        |                 |
| U-NII 2A | 5 260              |                       | 20.608            | 24.14               | -3.01                  |                 |
|          | 5 300              |                       | 20.550            | 24.13               |                        |                 |
|          | 5 320              |                       | 20.550            | 24.13               |                        |                 |
| U-NII 2C | 5 500              |                       | 20.492            | 24.12               | -2.44                  |                 |
|          | 5 580              |                       | 20.220            | 24.06               |                        |                 |
|          | 5 700              |                       | 21.823            | 24.39               |                        |                 |
| U-NII 3  | 5 745              | 30                    |                   |                     | -2.93                  | 30              |
|          | 5 785              |                       |                   |                     |                        |                 |
|          | 5 825              |                       |                   |                     |                        |                 |

**Remark;**

1. According to KDB 662911, Average power of each port and antenna gain was combined by using below calculation.

- Average power:  $10 \log \{10^{(\text{Ant.1 power} / 10)} + 10^{(\text{Ant.2 power} / 10)}\}$

- Unequal antenna gains, with equal transmit powers. For antenna gains given by  $G_1, G_2, \dots, G_N$  dB i

(i) If transmit signals are correlated, then

Directional gain =  $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$  dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

| Mode       | Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | Average Power (dB m) |       |               |
|------------|----------|------------------|---------|-----------------|----------------------|-------|---------------|
|            |          |                  |         |                 | Ant.1                | Ant.2 | Ant.1 + Ant.2 |
| 11ac_VHT20 | U-NII 1  | MCS0             | Low     | 5 180           | 15.80                | 16.58 | 19.22         |
|            |          |                  | Middle  | 5 220           | 15.82                | 16.54 | 19.21         |
|            |          |                  | High    | 5 240           | 15.86                | 16.68 | 19.30         |
|            | U-NII 2A |                  | Low     | 5 260           | 15.90                | 16.60 | 19.27         |
|            |          |                  | Middle  | 5 300           | 16.00                | 16.72 | 19.39         |
|            |          |                  | High    | 5 320           | 15.75                | 16.63 | 19.22         |
|            | U-NII 2C |                  | Low     | 5 500           | 15.90                | 16.26 | 19.09         |
|            |          |                  | Middle  | 5 580           | 15.78                | 16.90 | 19.39         |
|            |          |                  | High    | 5 700           | 15.58                | 16.13 | 18.87         |
|            | U-NII 3  |                  | Low     | 5 745           | 16.03                | 16.56 | 19.31         |
|            |          |                  | Middle  | 5 785           | 16.39                | 16.58 | 19.50         |
|            |          |                  | High    | 5 825           | 16.33                | 16.63 | 19.49         |

| Band     | FCC Limit          |                       |                   |                     |                        |                 |
|----------|--------------------|-----------------------|-------------------|---------------------|------------------------|-----------------|
|          | Frequency<br>(MHz) | Fixed Limit<br>(dB m) | 26 dB BW<br>(MHz) | 11+10LogB<br>(dB m) | Antenna Gain<br>(dB i) | Limit<br>(dB m) |
| U-NII 1  | 5 180              | 23.98                 |                   |                     | -3.68                  | 23.98           |
|          | 5 220              |                       |                   |                     |                        |                 |
|          | 5 240              |                       |                   |                     |                        |                 |
| U-NII 2A | 5 260              |                       | 20.029            | 24.02               | -3.01                  |                 |
|          | 5 300              |                       | 20.839            | 24.19               |                        |                 |
|          | 5 320              |                       | 20.434            | 24.10               |                        |                 |
| U-NII 2C | 5 500              |                       | 20.839            | 24.19               | -2.44                  |                 |
|          | 5 580              |                       | 21.187            | 24.26               |                        |                 |
|          | 5 700              |                       | 20.955            | 24.21               |                        |                 |
| U-NII 3  | 5 745              | 30                    |                   |                     | -2.93                  | 30              |
|          | 5 785              |                       |                   |                     |                        |                 |
|          | 5 825              |                       |                   |                     |                        |                 |

**Remark;**

1. According to KDB 662911, Average power of each port and antenna gain was combined by using below calculation.

- Average power:  $10 \log \{10^{(\text{Ant.1 power} / 10)} + 10^{(\text{Ant.2 power} / 10)}\}$

- Unequal antenna gains, with equal transmit powers. For antenna gains given by  $G_1, G_2, \dots, G_N$  dB i

(i) If transmit signals are correlated, then

Directional gain =  $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$  dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

| Mode     | Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | Average Power (dB m) |       |               |
|----------|----------|------------------|---------|-----------------|----------------------|-------|---------------|
|          |          |                  |         |                 | Ant.1                | Ant.2 | Ant.1 + Ant.2 |
| 11n_HT40 | U-NII 1  | MCS0             | Low     | 5 190           | 12.20                | 13.03 | 15.65         |
|          |          |                  | High    | 5 230           | 16.27                | 16.71 | 19.51         |
|          | U-NII 2A |                  | Low     | 5 270           | 16.27                | 16.71 | 19.51         |
|          |          |                  | High    | 5 310           | 12.29                | 12.51 | 15.41         |
|          | U-NII 2C |                  | Low     | 5 510           | 16.18                | 17.01 | 19.63         |
|          |          |                  | Middle  | 5 590           | 16.23                | 16.89 | 19.58         |
|          |          |                  | High    | 5 670           | 16.40                | 16.80 | 19.61         |
|          | U-NII 3  |                  | Low     | 5 755           | 15.85                | 17.55 | 19.79         |
|          |          |                  | High    | 5 795           | 16.36                | 16.64 | 19.51         |

| Band     | FCC Limit          |                       |                   |                     |                        |                 |
|----------|--------------------|-----------------------|-------------------|---------------------|------------------------|-----------------|
|          | Frequency<br>(MHz) | Fixed Limit<br>(dB m) | 26 dB BW<br>(MHz) | 11+10LogB<br>(dB m) | Antenna Gain<br>(dB i) | Limit<br>(dB m) |
| U-NII 1  | 5 190              | 23.98                 |                   |                     | -3.68                  | 23.98           |
|          | 5 230              |                       |                   |                     |                        |                 |
| U-NII 2A | 5 270              |                       | 40.289            | 27.05               | -3.01                  |                 |
|          | 5 310              |                       | 40.405            | 27.06               |                        |                 |
| U-NII 2C | 5 510              |                       | 40.521            | 27.08               | -2.44                  |                 |
|          | 5 590              |                       | 40.174            | 27.04               |                        |                 |
|          | 5 670              |                       | 41.447            | 27.17               |                        |                 |
| U-NII 3  | 5 755              | 30                    |                   |                     | -2.93                  | 30              |
|          | 5 795              |                       |                   |                     |                        |                 |

**Remark;**

1. According to KDB 662911, Average power of each port and antenna gain was combined by using below calculation.

- Average power:  $10 \log \{10^{(\text{Ant.1 power} / 10)} + 10^{(\text{Ant.2 power} / 10)}\}$

- Unequal antenna gains, with equal transmit powers. For antenna gains given by  $G_1, G_2, \dots, G_N$  dB i

(i) If transmit signals are correlated, then

Directional gain =  $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$  dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

| Mode       | Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | Average Power (dB m) |       |               |
|------------|----------|------------------|---------|-----------------|----------------------|-------|---------------|
|            |          |                  |         |                 | Ant.1                | Ant.2 | Ant.1 + Ant.2 |
| 11ac_VHT80 | U-NII 1  | MCS0             | Middle  | 5 210           | 12.24                | 12.72 | 15.50         |
|            | U-NII 2A |                  | Middle  | 5 290           | 11.85                | 12.42 | 15.15         |
|            | U-NII 2C |                  | Low     | 5 530           | 13.08                | 13.93 | 16.54         |
|            |          |                  | High    | 5 610           | 12.83                | 13.85 | 16.38         |
|            | U-NII 3  |                  | Middle  | 5 775           | 13.24                | 13.79 | 16.53         |

| Band     | FCC Limit          |                       |                   |       |                     |                        |                 |
|----------|--------------------|-----------------------|-------------------|-------|---------------------|------------------------|-----------------|
|          | Frequency<br>(MHz) | Fixed Limit<br>(dB m) | 26 dB BW<br>(MHz) |       | 11+10LogB<br>(dB m) | Antenna Gain<br>(dB i) | Limit<br>(dB m) |
| U-NII 1  | 5 210              | 23.98                 |                   |       |                     | -3.68                  | 23.98           |
| U-NII 2A | 5 290              |                       | 82.431            | 30.16 |                     | -3.01                  |                 |
| U-NII 2C | 5 530              |                       | 82.431            | 30.16 |                     | -2.44                  |                 |
|          | 5 610              |                       | 83.357            | 30.21 |                     |                        |                 |
| U-NII 3  | 5 775              | 30                    |                   |       |                     | -2.93                  | 30              |

**Remark;**

1. According to KDB 662911, Average power of each port and antenna gain was combined by using below calculation.

- Average power:  $10 \log \{10^{(\text{Ant.1 power} / 10)} + 10^{(\text{Ant.2 power} / 10)}\}$

- Unequal antenna gains, with equal transmit powers. For antenna gains given by  $G_1, G_2, \dots, G_N$  dB i

(i) If transmit signals are correlated, then

Directional gain =  $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}]$  dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

**- Straddle channels**

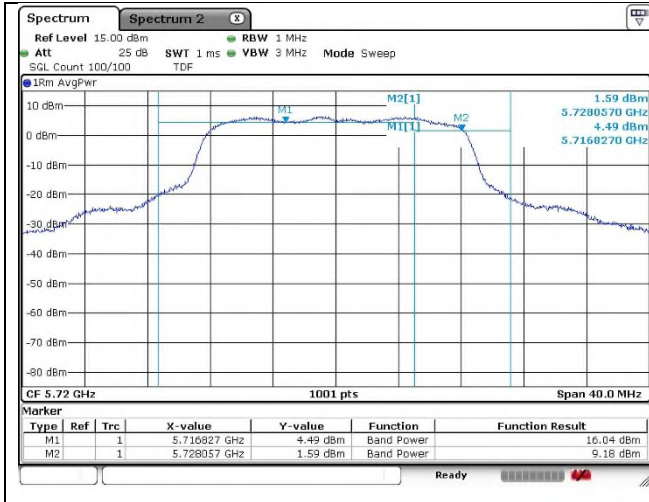
| Mode       | Band     | Frequency (MHz) | Data Rate (Mbps) | Average Power (dB m) |       |               |
|------------|----------|-----------------|------------------|----------------------|-------|---------------|
|            |          |                 |                  | Ant.1                | Ant.2 | Ant.1 + Ant.2 |
| 11a        | U-NII 2C | 5 720           | 6                | 16.04                | 15.48 | 18.78         |
|            | U-NII 3  |                 |                  | 9.18                 | 8.83  | 12.02         |
| 11ac_VHT20 | U-NII 2C | 5 720           | MCS0             | 14.84                | 14.34 | 17.61         |
|            | U-NII 3  |                 |                  | 8.59                 | 8.18  | 11.40         |
| 11n_HT40   | U-NII 2C | 5 710           | MCS0             | 15.54                | 14.70 | 18.15         |
|            | U-NII 3  |                 |                  | 4.46                 | 3.60  | 7.06          |
| 11ac_VHT80 | U-NII 2C | 5 690           | MCS0             | 13.26                | 13.22 | 16.25         |
|            | U-NII 3  |                 |                  | -1.97                | -1.89 | 1.08          |

| Mode       | Band     | Limit           |                    |                |                  |                     |              |
|------------|----------|-----------------|--------------------|----------------|------------------|---------------------|--------------|
|            |          | Frequency (MHz) | Fixed Limit (dB m) | 26 dB BW (MHz) | 11+10LogB (dB m) | Antenna Gain (dB i) | Limit (dB m) |
| 11a        | U-NII 2C | 5 720           | 23.98              | 16.346         | 23.13            | -2.44               | 23.13        |
|            | U-NII 3  |                 | 30                 |                |                  | -2.93               | 30           |
| 11ac_VHT20 | U-NII 2C | 5 720           | 23.98              | 15.304         | 22.85            | -2.44               | 22.85        |
|            | U-NII 3  |                 | 30                 |                |                  | -2.93               | 30           |
| 11n_HT40   | U-NII 2C | 5 710           | 23.98              | 35.260         | 26.47            | -2.44               | 23.98        |
|            | U-NII 3  |                 | 30                 |                |                  | -2.93               | 30           |
| 11ac_VHT80 | U-NII 2C | 5 690           | 23.98              | 76.447         | 29.83            | -2.44               | 23.98        |
|            | U-NII 3  |                 | 30                 |                |                  | -2.93               | 30           |

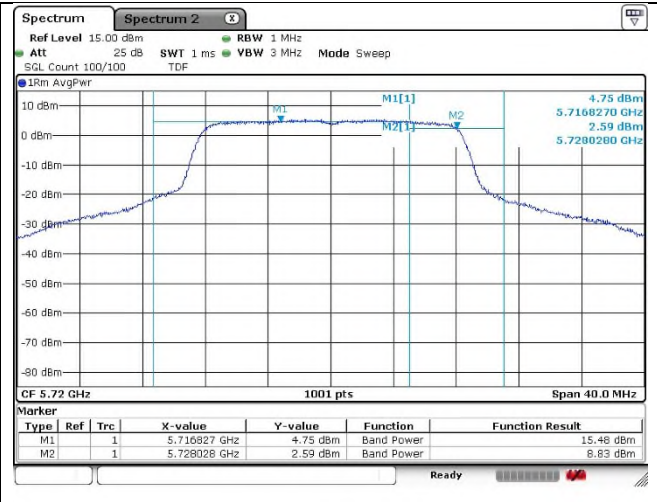
- Test plots (Straddle channels)

OFDM: 802.11a

Ant.1

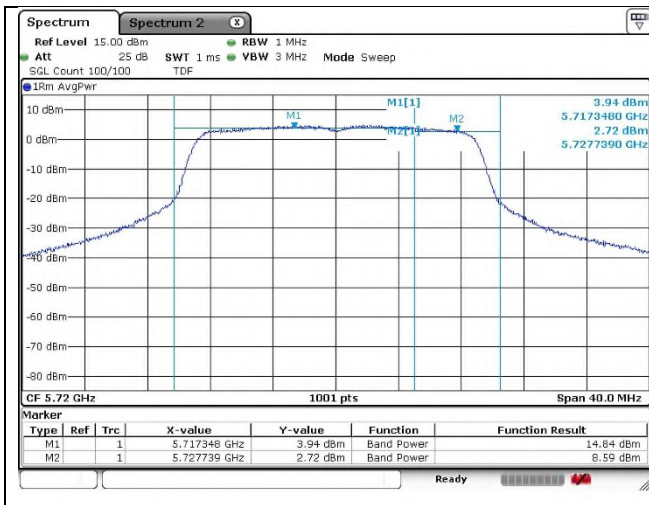


Ant.2

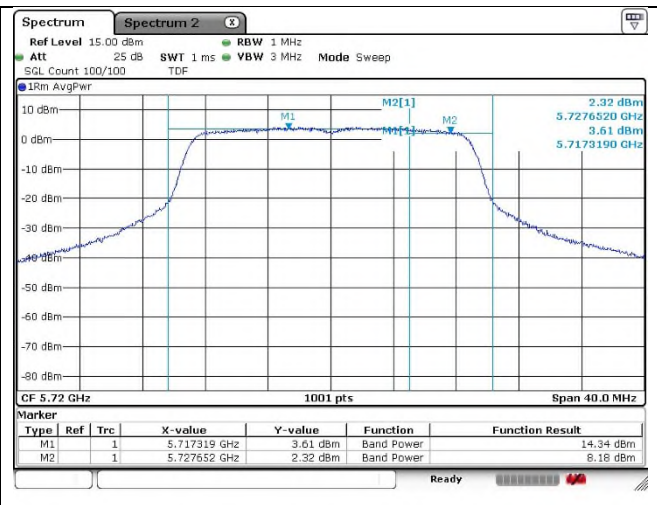


OFDM: 802.11ac\_VHT20

Ant.1

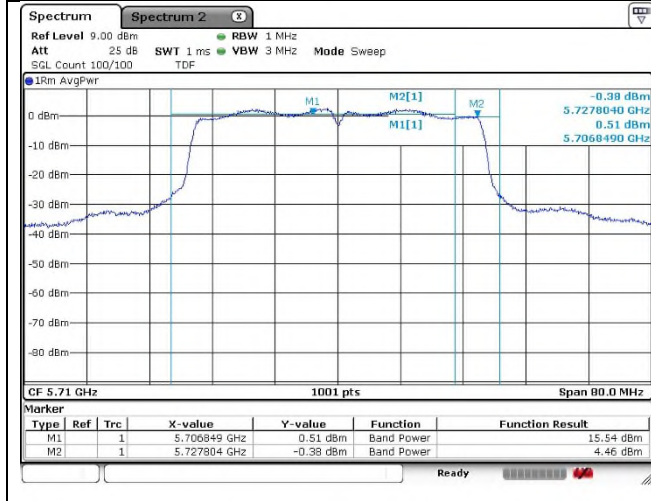


Ant.2

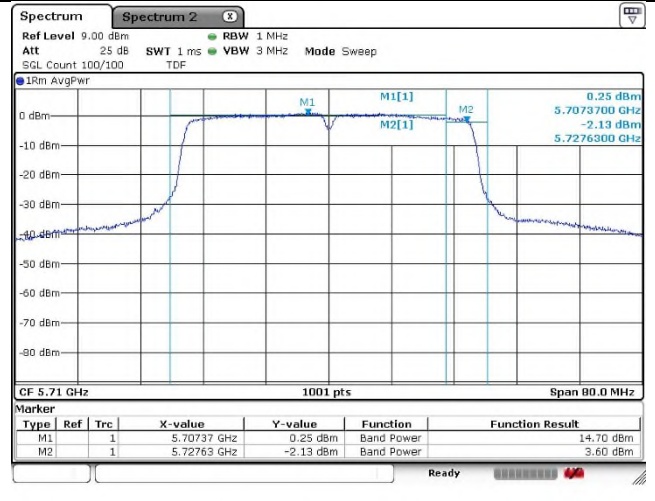


### OFDM: 802.11n\_HT40

Ant.1

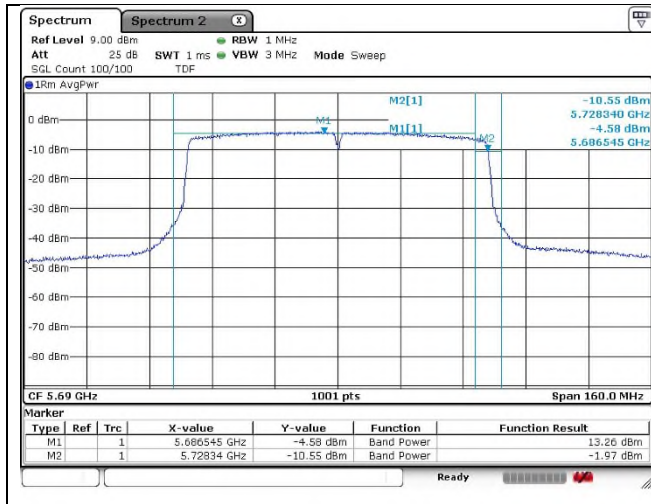


Ant.2

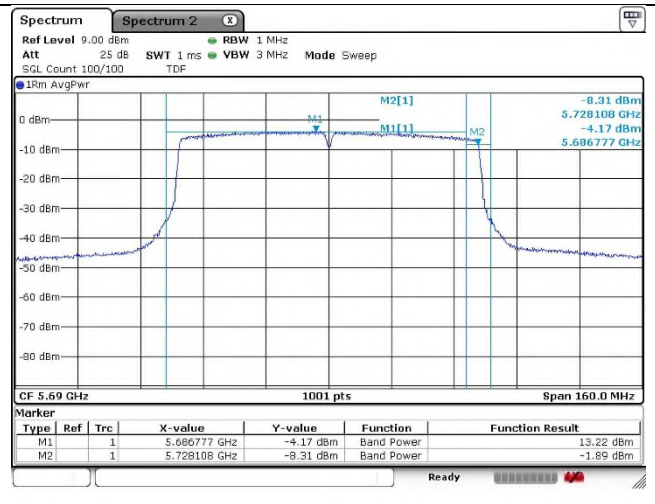


### OFDM: 802.11ac\_VHT80

Ant.1



Ant.2



## 6. Power Spectral Density

### 6.1. Test Setup



### 6.2. Limit

According to 15.407(a)(1)(iv)

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.407(a)(2)

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to 15.407(a)(3)

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

### 6.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section II.F of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power...". (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
3. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
4. Make the following adjustments to the peak value of the spectrum, if applicable:
  - a) **If Method SA-2 or SA-2 Alternative was used, add  $10 \log(1/x)$ , where  $x$  is the duty cycle, to the peak of the spectrum.**
  - b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
5. The result is the Maximum PSD over 1 MHz reference bandwidth.
6. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (*i.e.*, 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth ( $< 1$  MHz, or  $< 500$  kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:
  - a) Set  $RBW \geq 1/T$ , where  $T$  is defined in section II.B.1.a).
  - b) Set  $VBW \geq 3$  RBW.
  - c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add  $10 \log(500 \text{ kHz}/RBW)$  to the measured result, whereas  $RBW (< 500 \text{ kHz})$  is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
  - d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add  $10 \log(1 \text{ MHz}/RBW)$  to the measured result, whereas  $RBW (< 1 \text{ MHz})$  is the reduced resolution bandwidth of spectrum analyzer set during measurement.
  - e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.
7. In case of band crossing channels 138, 142 and 144, the measurement is complied with section III.A of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

## 6.4. Test Result

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

### 11a

| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/1 MHz)   |
|----------|------------------|---------|-----------------|------------|-------|---------------|----------------------|
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 1  | 6                | Low     | 5 180           | 6.67       | 6.12  | 9.41          | 11                   |
|          |                  | Middle  | 5 220           | 6.83       | 6.05  | 9.47          |                      |
|          |                  | High    | 5 240           | 6.60       | 6.23  | 9.43          |                      |
| U-NII 2A |                  | Low     | 5 260           | 6.75       | 6.16  | 9.48          |                      |
|          |                  | Middle  | 5 300           | 6.59       | 6.12  | 9.37          |                      |
|          |                  | High    | 5 320           | 6.68       | 6.14  | 9.43          |                      |
| U-NII 2C |                  | Low     | 5 500           | 6.87       | 5.63  | 9.30          |                      |
|          |                  | Middle  | 5 580           | 6.82       | 6.18  | 9.52          |                      |
|          |                  | High    | 5 700           | 6.31       | 5.18  | 8.79          |                      |
| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/500 kHz) |
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 3  | 6                | Low     | 5 745           | 4.03       | 2.91  | 6.52          | 30                   |
|          |                  | Middle  | 5 785           | 4.21       | 3.29  | 6.78          |                      |
|          |                  | High    | 5 825           | 4.36       | 3.05  | 6.76          |                      |

### Remark;

- According to KDB 662911, PSD of each port was combined by using below calculation.

$$\text{PSD: } 10 \log \{10^{(\text{Ant.1 PSD} / 10)} + 10^{(\text{Ant.2 PSD} / 10)}\}$$

**11ac\_VHT20**

| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/1 MHz)   |
|----------|------------------|---------|-----------------|------------|-------|---------------|----------------------|
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 1  | MCS0             | Low     | 5 180           | 4.84       | 4.92  | 7.89          | 11                   |
|          |                  | Middle  | 5 220           | 5.13       | 4.50  | 7.84          |                      |
|          |                  | High    | 5 240           | 5.08       | 5.04  | 8.07          |                      |
| U-NII 2A |                  | Low     | 5 260           | 5.06       | 4.82  | 7.95          |                      |
|          |                  | Middle  | 5 300           | 5.20       | 4.77  | 8.00          |                      |
|          |                  | High    | 5 320           | 4.77       | 4.81  | 7.80          |                      |
| U-NII 2C |                  | Low     | 5 500           | 5.04       | 4.13  | 7.62          |                      |
|          |                  | Middle  | 5 580           | 4.94       | 4.70  | 7.83          |                      |
|          |                  | High    | 5 700           | 4.62       | 3.83  | 7.25          |                      |
| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/500 kHz) |
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 3  | MCS0             | Low     | 5 745           | 2.34       | 1.66  | 5.02          | 30                   |
|          |                  | Middle  | 5 785           | 2.46       | 1.74  | 5.13          |                      |
|          |                  | High    | 5 825           | 2.43       | 1.70  | 5.09          |                      |

**Remark;**

1. According to KDB 662911, PSD of each port was combined by using below calculation.

- PSD:  $10 \log \{10^{(\text{Ant.1 PSD} / 10)} + 10^{(\text{Ant.2 PSD} / 10)}\}$

**11n\_HT40**

| Band     | Data Rate<br>(Mbps) | Channel | Frequency<br>(MHz) | PSD<br>(dB m) |       |               | Limit<br>(dB m/1 MHz)   |
|----------|---------------------|---------|--------------------|---------------|-------|---------------|-------------------------|
|          |                     |         |                    | Ant.1         | Ant.2 | Ant.1 + Ant.2 |                         |
| U-NII 1  | MCS0                | Low     | 5 190              | -1.35         | -1.33 | 1.67          | 11                      |
|          |                     | High    | 5 230              | 3.09          | 1.96  | 5.57          |                         |
| U-NII 2A |                     | Low     | 5 270              | 2.90          | 1.83  | 5.41          |                         |
|          |                     | High    | 5 310              | -1.82         | -2.10 | 1.05          |                         |
| U-NII 2C |                     | Low     | 5 510              | 2.76          | 2.07  | 5.44          |                         |
|          |                     | Middle  | 5 590              | 2.13          | 1.79  | 4.97          |                         |
|          |                     | High    | 5 670              | 2.92          | 1.49  | 5.27          |                         |
| Band     | Data Rate<br>(Mbps) | Channel | Frequency<br>(MHz) | PSD<br>(dB m) |       |               | Limit<br>(dB m/500 kHz) |
|          |                     |         |                    | Ant.1         | Ant.2 | Ant.1 + Ant.2 |                         |
| U-NII 3  | MCS0                | Low     | 5 755              | -0.33         | -0.34 | 2.68          | 30                      |
|          |                     | High    | 5 795              | -0.22         | -1.31 | 2.28          |                         |

**Remark;**

- According to KDB 662911, PSD of each port was combined by using below calculation.

- PSD:  $10 \log \{10^{(\text{Ant.1 PSD} / 10)} + 10^{(\text{Ant.2 PSD} / 10)}\}$

**11ac\_VHT80**

| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/1 MHz)   |
|----------|------------------|---------|-----------------|------------|-------|---------------|----------------------|
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 1  | MCS0             | Middle  | 5 210           | -3.80      | -3.26 | -0.51         | 11                   |
| U-NII 2A |                  | Middle  | 5 290           | -3.81      | -3.10 | -0.43         |                      |
| U-NII 2C |                  | Low     | 5 530           | -4.77      | -4.43 | -1.59         |                      |
|          |                  | High    | 5 610           | -3.75      | -2.53 | -0.09         |                      |
| Band     | Data Rate (Mbps) | Channel | Frequency (MHz) | PSD (dB m) |       |               | Limit (dB m/500 kHz) |
|          |                  |         |                 | Ant.1      | Ant.2 | Ant.1 + Ant.2 |                      |
| U-NII 3  | MCS0             | Middle  | 5 775           | -6.55      | -7.31 | -3.90         | 30                   |

**Remark;**

- According to KDB 662911, PSD of each port was combined by using below calculation.

- PSD:  $10 \log \{10^{(\text{Ant.1 PSD} / 10)} + 10^{(\text{Ant.2 PSD} / 10)}\}$

**- Straddle channels**

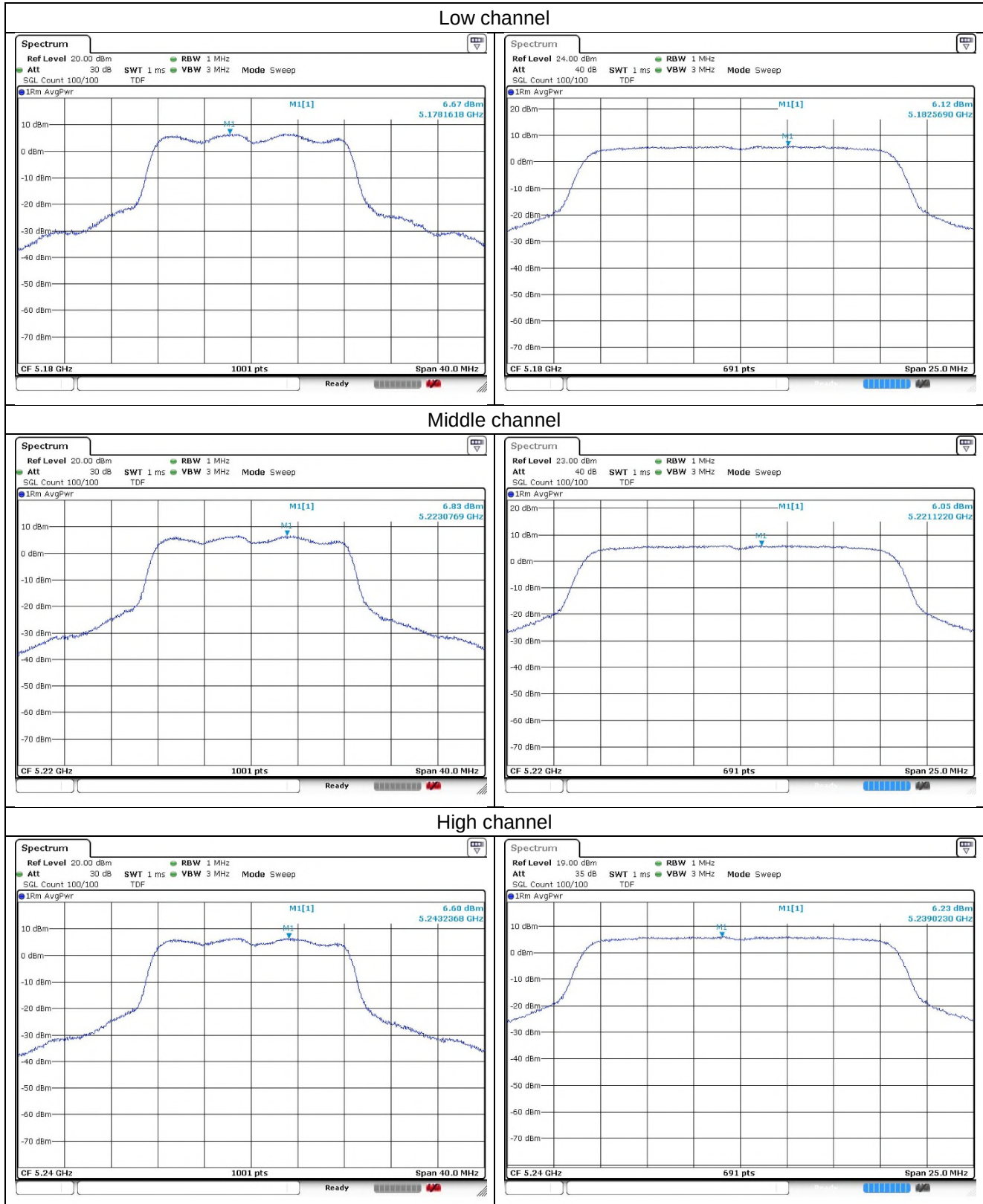
| Mode       | Band     | Frequency<br>(MHz) | Data Rate<br>(Mbps) | PSD<br>(dB m) |       |               | Limit<br>(dB m/1 MHz or<br>dB m/500 kHz) |
|------------|----------|--------------------|---------------------|---------------|-------|---------------|------------------------------------------|
|            |          |                    |                     | Ant.1         | Ant.2 | Ant.1 + Ant.2 |                                          |
| 11a        | U-NII 2C | 5 720              | 6                   | 7.01          | 5.50  | 9.33          | 11                                       |
|            | U-NII 3  |                    |                     | 3.86          | 2.11  | 6.08          | 30                                       |
| 11ac_VHT20 | U-NII 2C | 5 720              | MCS0                | 5.17          | 4.66  | 7.93          | 11                                       |
|            | U-NII 3  |                    |                     | 1.30          | 0.56  | 3.96          | 30                                       |
| 11n_HT40   | U-NII 2C | 5 710              | MCS0                | 2.73          | 1.07  | 4.99          | 11                                       |
|            | U-NII 3  |                    |                     | -2.82         | -3.33 | -0.06         | 30                                       |
| 11ac_VHT80 | U-NII 2C | 5 690              | MCS0                | -3.68         | -4.00 | -0.83         | 11                                       |
|            | U-NII 3  |                    |                     | -8.72         | -9.19 | -5.94         | 30                                       |

- Test plots

OFDM: 802.11a (Band 1)

Ant.1

Ant.2

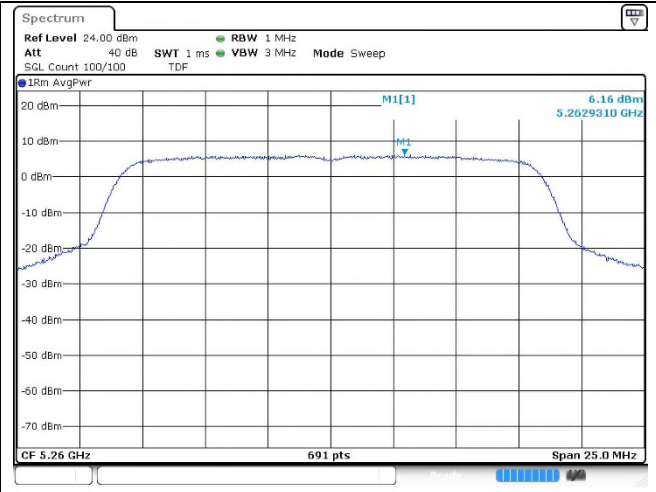
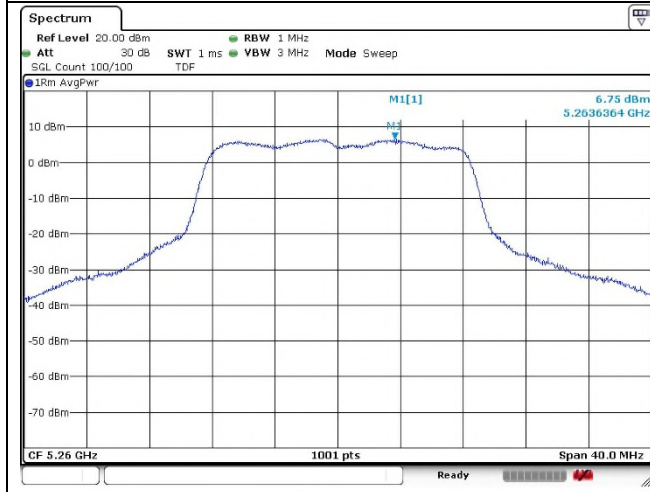


## OFDM: 802.11a (Band 2A)

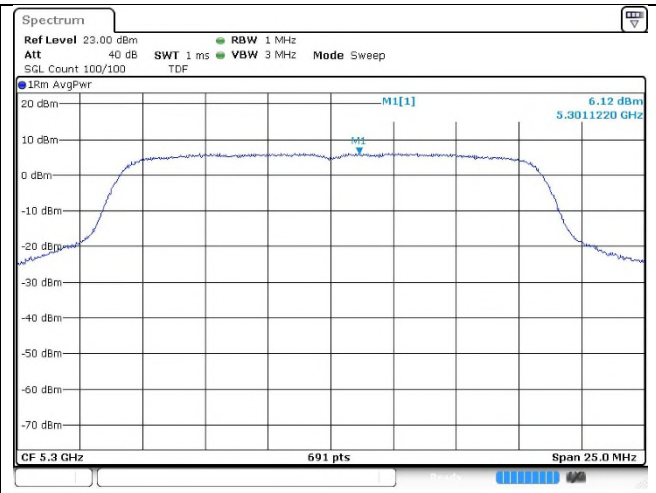
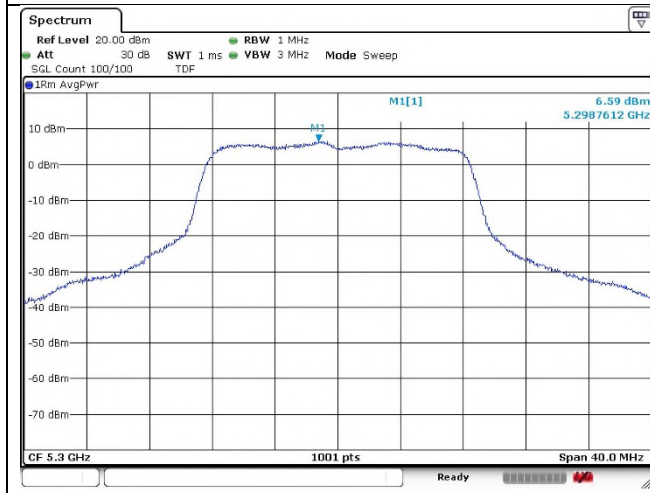
Ant.1

Ant.2

### Low channel



### Middle channel



### High channel

