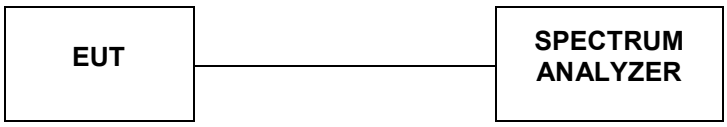
## 4.7. 26dBc Bandwidth

**TEST CONFIGURATION**




**TEST PROCEDURE**

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01 for one of the following procedures may be used for Emission Bandwidth (EBW) measurement:

a. Set RBW = 220 kHz/430 kHz /820 kHz (approximately 1% of the emission bandwidth).
b. Set the video bandwidth (VBW) = 3* RBW)
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize
g. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

**LIMIT**

No Limits for 26dBc Bandwith

**TEST RESULTS**

| Temperature | 23.6℃ | Humidity | 55.7% |
|---|---|---|---|
| Test Engineer | Moon Tan | Configurations | IEEE 802.11a/n/ac |

| Type | Channel | 99%Bandwidth (MHz) | 26dB Bandwidth (MHz) | Limit (KHz) | Result |
|---|---|---|---|---|---|
| 802.11a | 36 | 16.650 | 19.760 | - | Pass |
| | 40 | 16.601 | 19.760 | | |
| | 48 | 16.622 | 19.760 | | |
| 802.11nHT20 | 36 | 17.712 | 24.480 | - | Pass |
| | 40 | 17.730 | 21.320 | | |
| | 48 | 17.669 | 21.680 | | |
| 802.11n40 | 38 | 36.782 | 40.640 | - | Pass |
| | 46 | 36.667 | 40.160 | | |
| 802.11ac20 | 36 | 17.776 | 20.280 | - | Pass |
| | 40 | 17.780 | 20.320 | | |
| | 48 | 17.756 | 20.360 | | |
| 802.11ac40 | 38 | 36.532 | 40.400 | - | Pass |
| | 46 | 36.420 | 40.080 | | |
| 802.11ac80 | 42 | 76.015 | 80.480 | - | Pass |

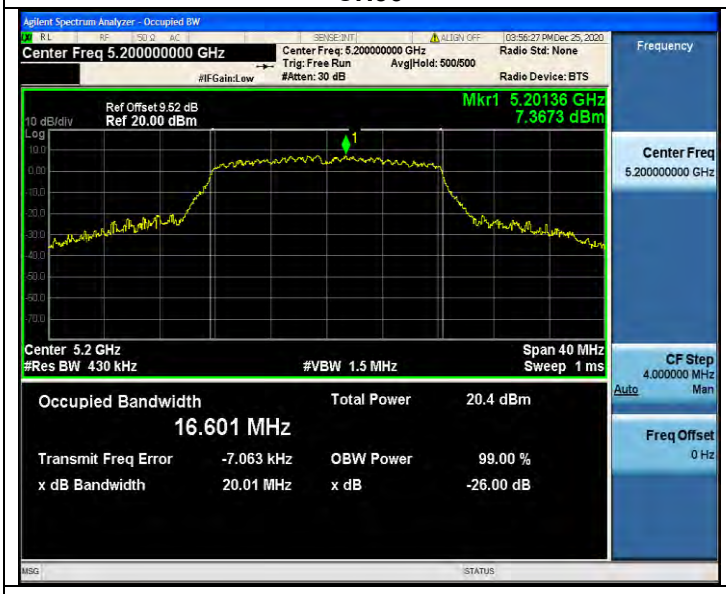
## 99%Bandwidth

### 802.11a

CH36

### 802.11n HT20

CH36




CH40

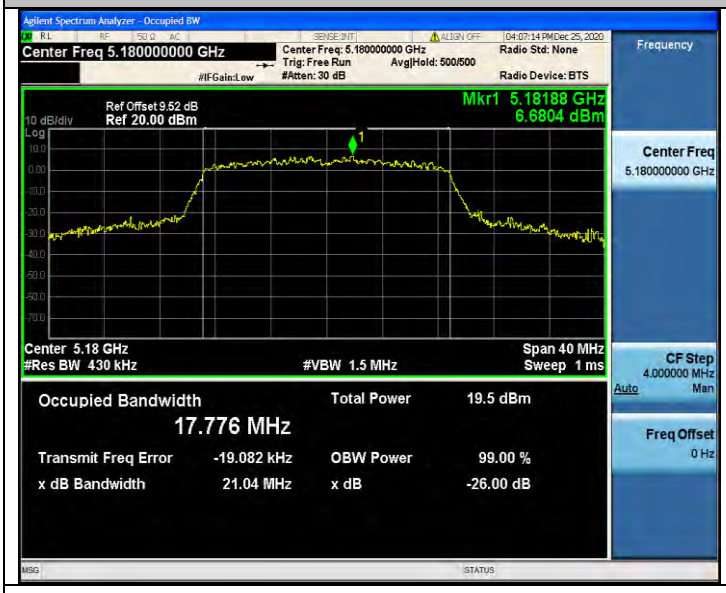
CH40

CH48

CH48

## 99%Bandwidth

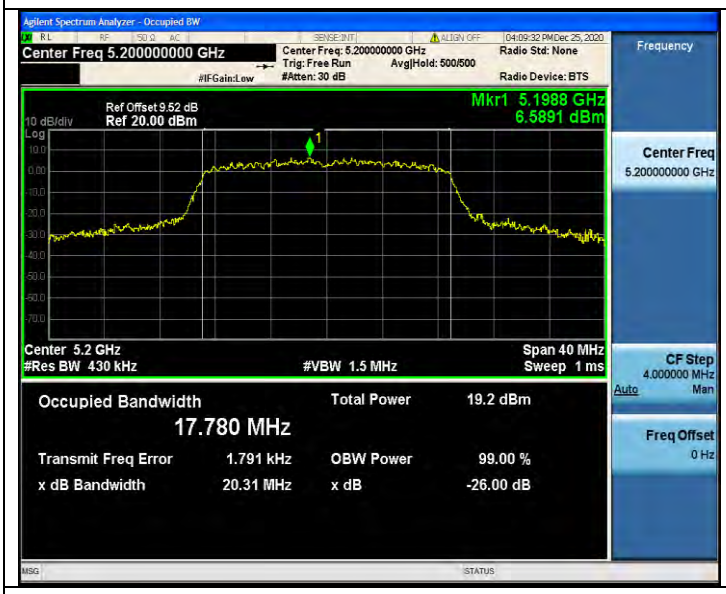
### 802.11ac20




### 802.11n HT40

### CH36

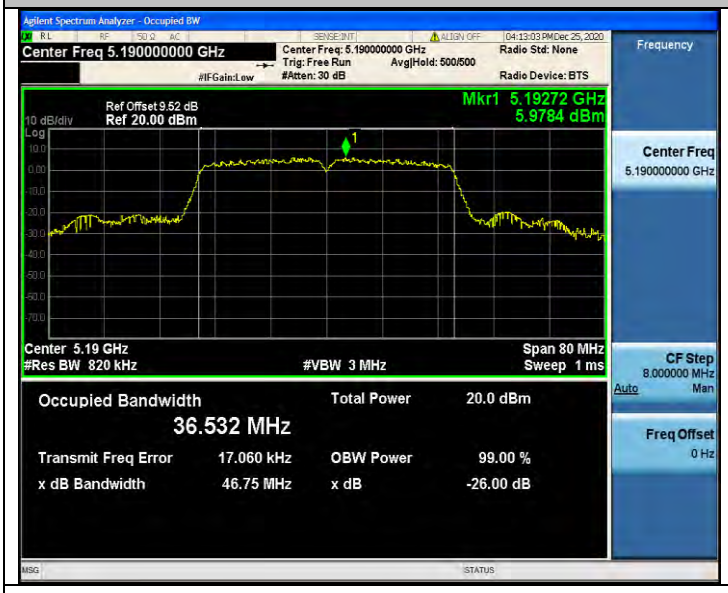
### CH38



### CH40

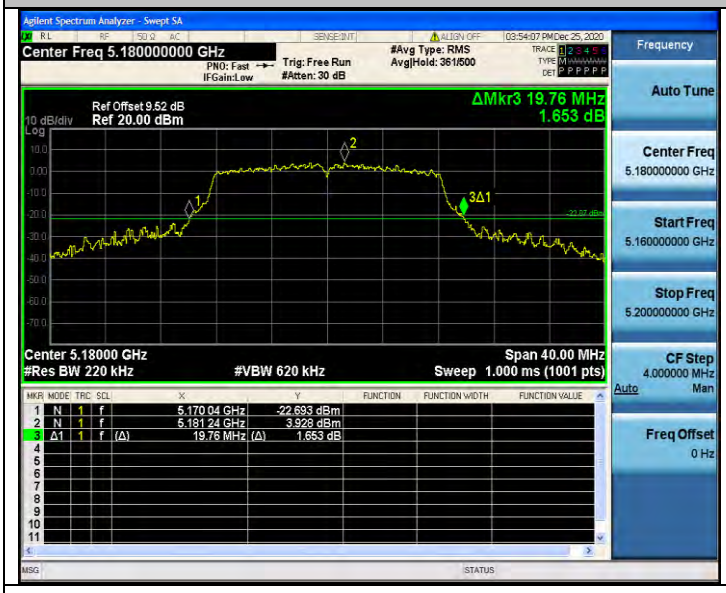
### CH46

### CH48

| 99%Bandwidth | |
|---|---|
| 802.11ac40 | 802.11ac80 |
|  | |
| CH38 | CH42 |
| | |
| CH46 | |

## 26dB Bandwidth

### 802.11a




CH36

### 802.11n HT20

CH36

CH40

CH40

CH48

CH48

## 26dB Bandwidth

### 802.11ac20

CH36

### 802.11n HT40

CH38

CH40

CH46

CH48

## 26dB Bandwidth

### 802.11ac40

### 802.11ac80

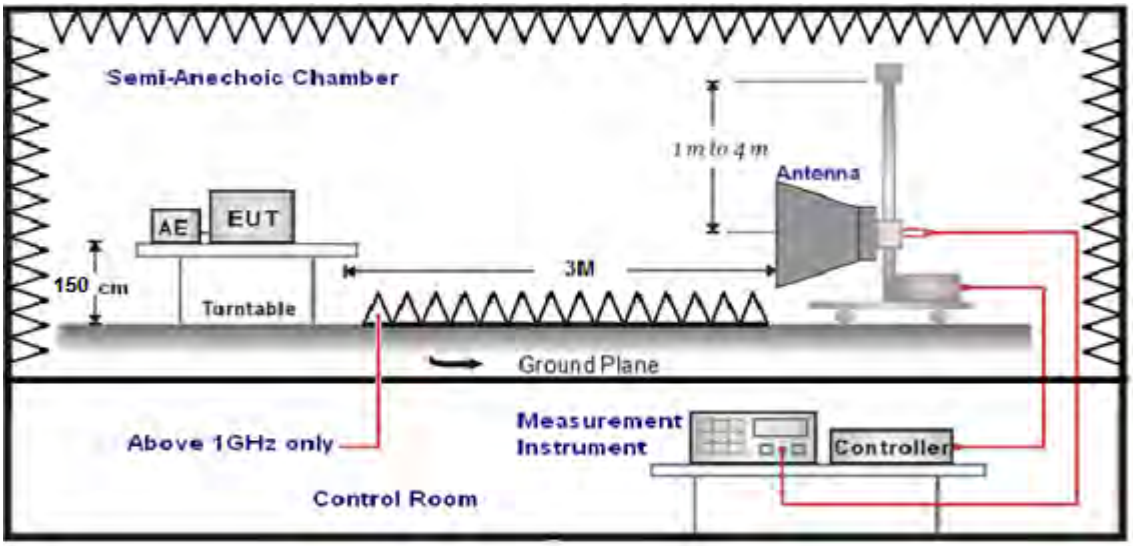
CH38

CH42

CH46

## 4.8. Band Edge Compliance

**TEST CONFIGURATION**




**LIMIT**

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

According to §15.407 (b): 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

| Frequency (MHz) | EIRP Limit (dBm) | Equivalent Field Strength at 3m (dBμV/m) |
|---|---|---|
| 5150-5250 | -27 | 68.2 |
| 5250-5350 | -27 | 68.2 |
| 5470-5725 | -27 | 68.2 |
| 5725-5850 | -27 (beyond 10MHz of the bandedge) | 68.2 |
| | -17 (within 10 MHz of band edge) | 78.2 |

**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 1.5m above 1GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type | Test Distance |
|---|---|---|
| 1GHz-18GHz | Double Ridged Horn Antenna | 3 |

6. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|---|---|---|
| 1GHz-18GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

**TEST RESULTS**

Remark:For radiated bandedge We measured at both mode, recorded worst case in antenna 0's 802.11 ac20 mode;

**For Radiated Bandedge Measurement**

| Temperature | 23.4℃ | Humidity | 54.5% |
|---|---|---|---|
| Test Engineer | Moon Tan | Configurations | IEEE 802.11a/n/ac |

| 802.11 ac20/ Channel 36 :5180 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor (dB) | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
| 4500.0 | 35.16 | 35.58 | 29.04 | 8.28 | 49.98 | 74.00 | -24.02 | Peak | Horizontal |
| 4500.0 | 30.08 | 35.58 | 29.04 | 8.28 | 44.90 | 54.00 | -9.10 | AV | Horizontal |
| 5150.0 | 39.05 | 35.58 | 29.04 | 8.28 | 53.87 | 74.00 | -20.13 | Peak | Horizontal |
| 5150.0 | 30.69 | 35.58 | 29.04 | 8.28 | 45.51 | 54.00 | -8.49 | AV | Horizontal |

| 802.11 ac20/ Channel 48 :5240 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor (dB) | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
| 5350.0 | 35.00 | 35.42 | 29.06 | 8.39 | 49.75 | 74.00 | -24.25 | Peak | Horizontal |
| 5350.0 | 30.17 | 35.42 | 29.06 | 8.39 | 44.92 | 54.00 | -9.08 | AV | Horizontal |
| 5460.0 | 39.14 | 35.42 | 29.06 | 8.39 | 53.89 | 74.00 | -20.11 | Peak | Horizontal |
| 5460.0 | 30.70 | 35.42 | 29.06 | 8.39 | 45.45 | 54.00 | -8.55 | AV | Horizontal |

| 802.11 ac20/ Channel 149 :5745 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor (dB) | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
| 5650.0 | 30.14 | 35.35 | 29.07 | 8.43 | 44.85 | 68.20 | -23.35 | Peak | Horizontal |
| 5700.0 | 30.38 | 35.35 | 29.07 | 8.43 | 45.09 | 68.20 | -23.11 | Peak | Horizontal |
| 5720.0 | 32.30 | 35.35 | 29.07 | 8.43 | 47.01 | 68.20 | -21.19 | Peak | Horizontal |
| 5725.0 | 30.51 | 35.35 | 29.07 | 8.43 | 45.22 | 68.20 | -22.98 | Peak | Horizontal |

| 802.11 ac20/ Channel 165 :5825 MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor (dB) | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
| 5850.0 | 30.01 | 35.3 | 29.11 | 8.51 | 44.71 | 68.20 | -23.49 | Peak | Horizontal |
| 5855.0 | 30.32 | 35.3 | 29.11 | 8.51 | 45.02 | 68.20 | -23.18 | Peak | Horizontal |
| 5875.0 | 32.05 | 35.3 | 29.11 | 8.51 | 46.75 | 68.20 | -21.45 | Peak | Horizontal |
| 5925.0 | 30.56 | 35.3 | 29.11 | 8.51 | 45.26 | 68.20 | -22.94 | Peak | Horizontal |

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. Margin value = Result Level-Limit value.
2. The other emission levels were very low against the limit.
3. The average measurement was not performed when the peak measured data under the limit of average detection.
4. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;

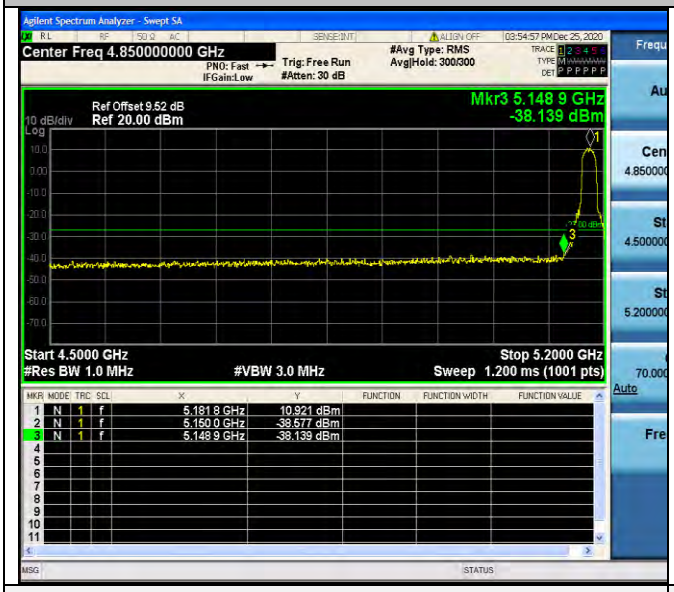
**For Conducted Band edge Measurement**

| Temperature | 23.6℃ | Humidity | 55.7% |
|---|---|---|---|
| Test Engineer | Moon Tan | Configurations | IEEE 802.11a/n/ac |

**The test results have included the antenna gain**

**5150-5250MHz:**

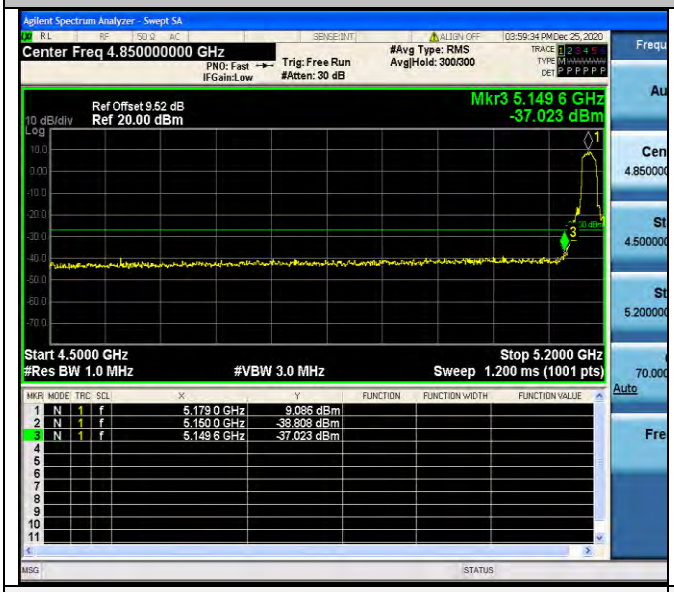
**802.11a**




5180 MHz

5240 MHz

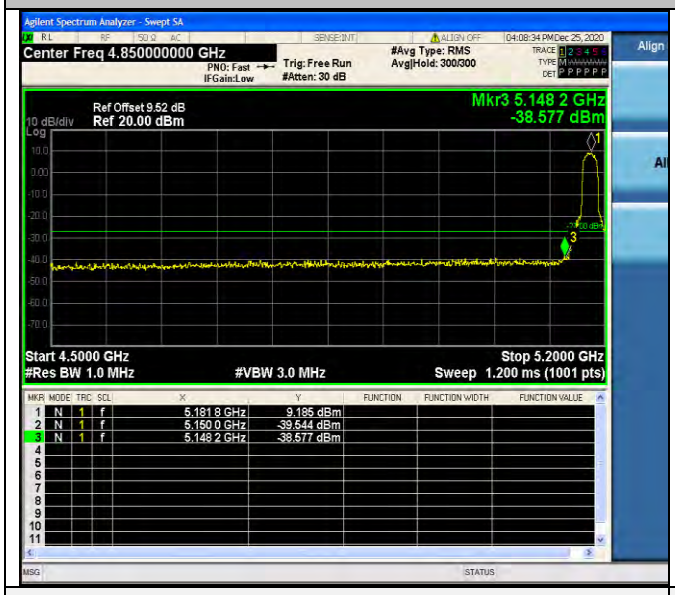
**802.11n HT20**



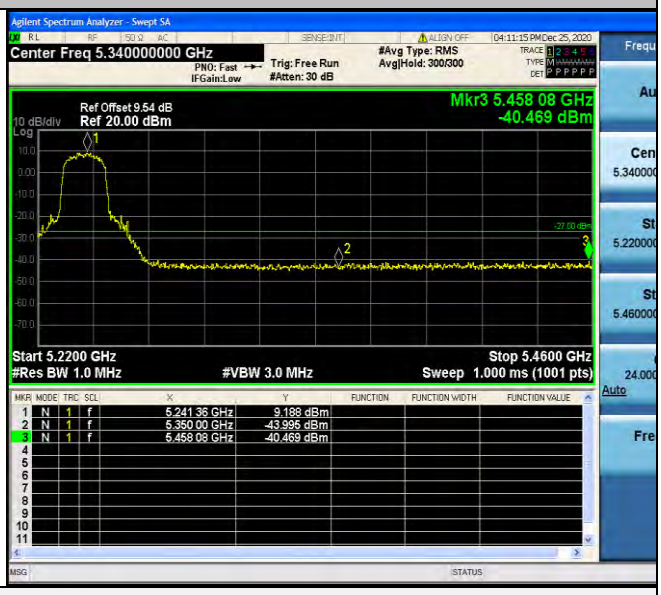

5180 MHz

5240 MHz

## 802.11ac20

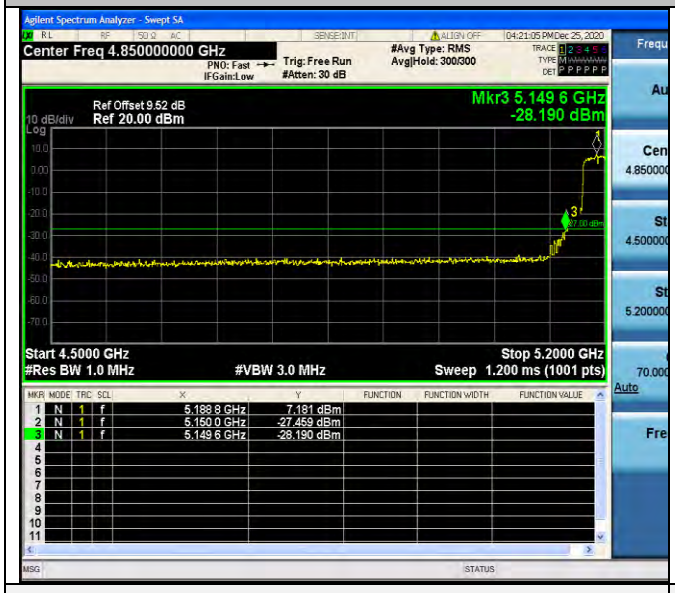



5180 MHz




5240 MHz

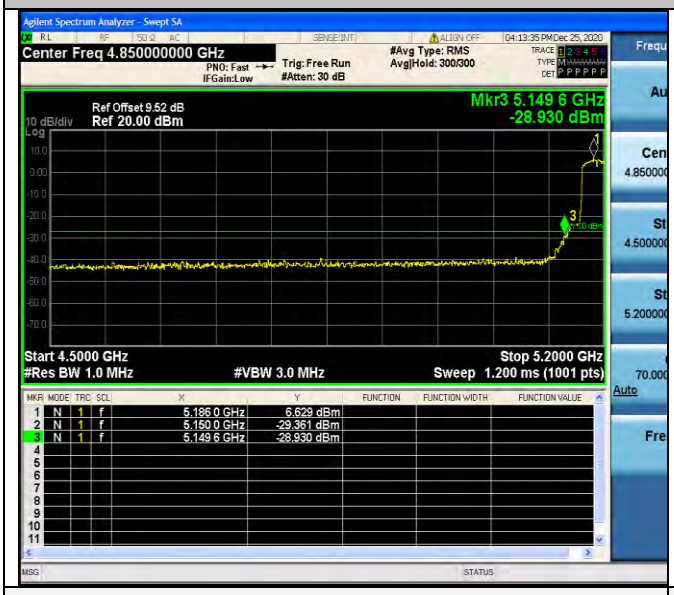
## 802.11n HT40




5190 MHz

5230 MHz

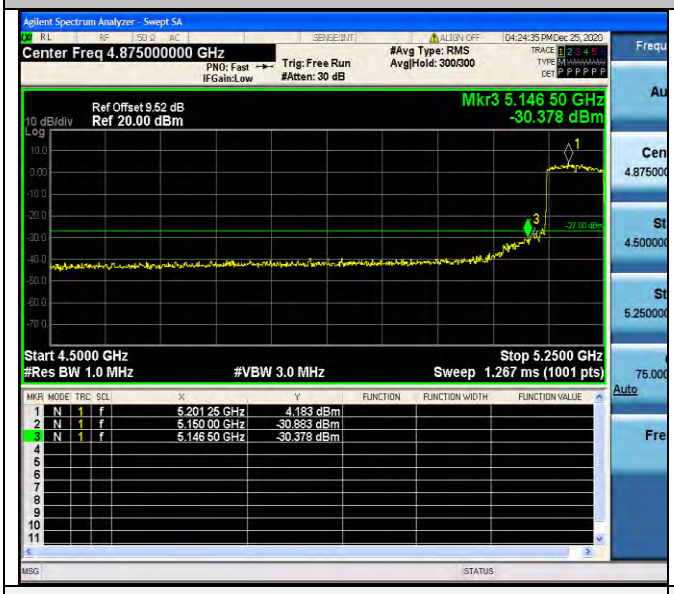
## 802.11ac40




5190 MHz

5230 MHz

## 802.11ac80




5210 MHz

**5725-5850MHz:**

| 802.11a | |
|---|---|
| | |
| 5745 MHz | 5825 MHz |

| 802.11n HT20 | |
|---|---|
| | |
| 5745 MHz | 5825 MHz |

## 802.11ac20

5745 MHz

5825 MHz

## 802.11n HT40

5755 MHz

5795 MHz

## 802.11ac40

5755 MHz

5795 MHz

## 802.11ac80

5775 MHz

## 4.9. Frequency Stability

**Standard Applicable**

According to FCC §15.407(g) “Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.”

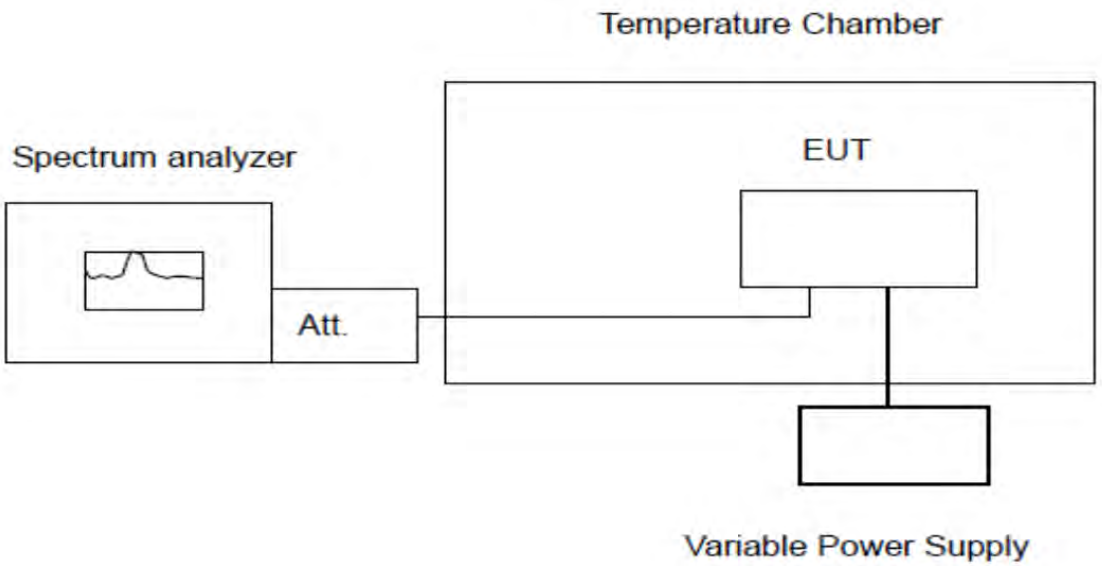
According to FCC §2.1055(a) “The frequency stability shall be measured with variation of ambient temperature as follows:”

(1) From -30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From -20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

### Test Configuration




### Test Procedure

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum anzlyer via feed through attenators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low engouh to obtain the desired frequency resoluation and measure EUT 20 degree operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30 degree. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure wuth 10 degree increased per stage until the highest temperature of +50 degree reached.

**Test Results**

PASS

Remark:

1. Measured all conditions and recorded worst case.

IEEE 802.11a Mode / 5180 – 5240 MHz / 5180 MHz

| Enviroment Temperature (Dregree) | Voltage (V) | Measured Frequency (MHz) | Limit Range (MHz) | Test Results |
|---|---|---|---|---|
| 20 | DC 24.2V | 5179.985995 | 5150 – 5250 | PASS |
| 20 | DC 19.8V | 5179.988967 | 5150 – 5250 | PASS |
| 50 | DC 22.0V | 5179.988648 | 5150 – 5250 | PASS |
| 40 | DC 22.0V | 5179.998677 | 5150 – 5250 | PASS |
| 30 | DC 22.0V | 5179.973345 | 5150 – 5250 | PASS |
| 20 | DC 22.0V | 5180.011088 | 5150 – 5250 | PASS |
| 10 | DC 22.0V | 5179.994746 | 5150 – 5250 | PASS |
| 0 | DC 22.0V | 5180.006375 | 5150 – 5250 | PASS |
| -10 | DC 22.0V | 5180.008071 | 5150 – 5250 | PASS |
| -20 | DC 22.0V | 5179.985583 | 5150 – 5250 | PASS |
| -30 | DC 22.0V | 5180.001517 | 5150 – 5250 | PASS |

IEEE 802.11a Mode / 5180 – 5240 MHz / 5240 MHz

| Enviroment Temperature (Dregree) | Voltage (V) | Measured Frequency (MHz) | Limit Range (MHz) | Test Results |
|---|---|---|---|---|
| 20 | DC 24.2V | 5239.958420 | 5150 – 5250 | PASS |
| 20 | DC 19.8V | 5239.999829 | 5150 – 5250 | PASS |
| 50 | DC 22.0V | 5239.980989 | 5150 – 5250 | PASS |
| 40 | DC 22.0V | 5240.018255 | 5150 – 5250 | PASS |
| 30 | DC 22.0V | 5239.968646 | 5150 – 5250 | PASS |
| 20 | DC 22.0V | 5239.991884 | 5150 – 5250 | PASS |
| 10 | DC 22.0V | 5239.999445 | 5150 – 5250 | PASS |
| 0 | DC 22.0V | 5239.986769 | 5150 – 5250 | PASS |
| -10 | DC 22.0V | 5240.011586 | 5150 – 5250 | PASS |
| -20 | DC 22.0V | 5240.039550 | 5150 – 5250 | PASS |
| -30 | DC 22.0V | 5239.998822 | 5150 – 5250 | PASS |

IEEE 802.11a Mode / 5745 – 5825 MHz / 5745 MHz

| Enviroment Temperature (Dregree) | Voltage (V) | Measured Frequency (MHz) | Limit Range (MHz) | Test Results |
|---|---|---|---|---|
| 20 | DC 24.2V | 5744.964798 | 5725 – 5850 | PASS |
| 20 | DC 19.8V | 5744.970505 | 5725 – 5850 | PASS |
| 50 | DC 22.0V | 5745.007216 | 5725 – 5850 | PASS |
| 40 | DC 22.0V | 5745.038440 | 5725 – 5850 | PASS |
| 30 | DC 22.0V | 5745.028261 | 5725 – 5850 | PASS |
| 20 | DC 22.0V | 5744.980241 | 5725 – 5850 | PASS |
| 10 | DC 22.0V | 5744.994261 | 5725 – 5850 | PASS |
| 0 | DC 22.0V | 5745.004118 | 5725 – 5850 | PASS |
| -10 | DC 22.0V | 5744.955061 | 5725 – 5850 | PASS |
| -20 | DC 22.0V | 5744.993495 | 5725 – 5850 | PASS |
| -30 | DC 22.0V | 5744.978317 | 5725 – 5850 | PASS |

IEEE 802.11a Mode / 5745 – 5825 MHz / 5825 MHz

| Enviroment Temperature (Dregree) | Voltage (V) | Measured Frequency (MHz) | Limit Range (MHz) | Test Results |
|---|---|---|---|---|
| 20 | DC 24.2V | 5825.018838 | 5725 – 5850 | PASS |
| 20 | DC 19.8V | 5824.988903 | 5725 – 5850 | PASS |
| 50 | DC 22.0V | 5824.972666 | 5725 – 5850 | PASS |
| 40 | DC 22.0V | 5824.994347 | 5725 – 5850 | PASS |
| 30 | DC 22.0V | 5825.019681 | 5725 – 5850 | PASS |
| 20 | DC 22.0V | 5824.991566 | 5725 – 5850 | PASS |
| 10 | DC 22.0V | 5825.005389 | 5725 – 5850 | PASS |
| 0 | DC 22.0V | 5825.023661 | 5725 – 5850 | PASS |
| -10 | DC 22.0V | 5825.037692 | 5725 – 5850 | PASS |
| -20 | DC 22.0V | 5824.985767 | 5725 – 5850 | PASS |
| -30 | DC 22.0V | 5824.959458 | 5725 – 5850 | PASS |

## 4.10. Antenna Requirement

**Standard Applicable**

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

**Antenna Information**

The antenna used for this product is Internal Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 4.61dBi.

Reference to the Test Report: **GTS20201209013-1-1.**

# 5. TEST SETUP PHOTOS OF THE EUT

Reference to the test report No. **GTS20201209013-1-1.**

# 6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

Reference to the test report No. **GTS20201209013-1-1.**

**.....End of Report.....**