



# TEST REPORT



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[www.kctl.co.kr](http://www.kctl.co.kr)Report No.:  
KR24-SRF0004-B  
Page (1) of (137)**1. Client**

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2023-07-31

**2. Use of Report** : Certification**3. Name of Product / Model** : Wi-Fi/BLE combo module / CCAT710R**4. Manufacturer / Country of Origin** : Samsung Electronics Co., Ltd. / Korea**5. FCC ID** : A3LCCAT710R**6. IC Certificate No.** : 649E-CCAT710R**7. Date of Test** : 2023-10-23 to 2023-12-10**8. Location of Test** : ☒ Permanent Testing Lab ☐ On Site Testing  
(Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)**9. Test method used** : FCC Part 15 Subpart E, 15.407

RSS-247 Issue 3 August 2023

RSS-Gen Issue 5 February 2021

**10. Test Result** : Refer to the test result in the test report

This laboratory is not accredited for the test results marked. \*

|             |                                                                                                                       |                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Affirmation | Tested by                                                                                                             | Technical Manager                                                                                                     |
|             | Name : Euijung Kim <br>(Signature) | Name : Heesu Ahn <br>(Signature) |

The above testing certificate is the accredited test result by Korea Laboratory Accreditation Scheme, which signed the ILAC-MRA.

2024-02-05

Accredited by KOLAS, Republic of KOREA

**Eurofins KCTL Co.,Ltd.**

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by Eurofins KCTL Co.,Ltd.

|                                                                                                                                                                                                                                                                                                           |                                                           |                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>eurofins KCTL</b> Eurofins KCTL Co.,Ltd.<br>65, Sinwon-ro, Yeongtong-gu,<br>Suwon-si, Gyeonggi-do, 16677, Korea<br>TEL: 82-70-5008-1021<br>FAX: 82-505-299-8311<br><a href="http://www.kctl.co.kr">www.kctl.co.kr</a> | Report No.:<br><b>KR24-SRF0004-B</b><br>Page (2) of (137) |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## REPORT REVISION HISTORY

| Date       | Revision          | Page No         |
|------------|-------------------|-----------------|
| 2024-01-23 | Originally issued | -               |
| 2024-01-31 | Updated           | 4, 9, 10, 55~63 |
| 2024-02-05 | Updated           | 56~63           |
|            |                   |                 |
|            |                   |                 |

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Note. The report No. KR24-SRF0004-A is superseded by the report No. KR24-SRF0004-B.

## General remarks for test reports

### Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

### Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ Statement not required by the standard or client used for type testing

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## 1. General information

Client : Samsung Electronics Co., Ltd.  
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 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea  
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132  
 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056  
 CAB Identifier: KR0040  
 ISED Number: 8035A  
 KOLAS No.: KT231

## 2. Device information

Equipment under test : Wi-Fi/BLE combo module  
 Model : CCAT710R  
 Frequency range : Bluetooth(BDR/EDR, BLE): 2 402 MHz ~ 2 480 MHz  
 802.11 b/g/n/ax\_HT20/HE20: 2 412 MHz ~ 2 462 MHz  
 UNII-1 : 5 180 MHz ~ 5 240 MHz  
 UNII-2A : 5 260 MHz ~ 5 320 MHz  
 UNII-2C : 5 500 MHz ~ 5 720 MHz  
 UNII-3 : 5 745 MHz ~ 5 825 MHz  
 Modulation technique : Bluetooth(BDR/EDR)\_GFSK,  $\pi/4$ DQPSK, 8DPSK  
 Bluetooth(BLE)\_GFSK  
 WIFI(802.11a/b/g/n HT20/ac VHT20/ax HE20)\_DSSS, OFDM, OFDMA  
 Number of channels : Bluetooth(BDR/EDR)\_79ch  
 Bluetooth(BLE)\_40ch  
 2.4 GHz band : 11 ch (20 MHz)  
 UNII-1 : 4 ch (20 MHz)  
 UNII-2A : 4 ch (20 MHz)  
 UNII-2C : 12 ch (20 MHz)  
 UNII-3 : 5 ch (20 MHz)  
 Power source : DC 5.0 V, DC 12.0 V  
 Antenna type : Chip antenna  
 Antenna gain : Bluetooth(BDR/EDR/BLE) : -0.1 dBi  
 2.4 GHz band : -0.1 dBi  
 UNII-1 : 0.9 dBi  
 UNII-2A : 0.2 dBi  
 UNII-2C : -0.4 dBi  
 UNII-3 : -0.7 dBi  
 Software version : v1.0  
 Hardware version : v1.0  
 Operation temperature : -20 °C ~ 85 °C  
 Test device serial No. : Conducted : 700CXACR02000013R  
 Radiated : 700CXI9FR02000009R  
 Test Software / Version : UI\_mptool / 2.0.0.1

## 2.1. Frequency/channel operations

This device contains the following capabilities:

Bluetooth (BDR/EDR/BLE), WLAN 2.4 GHz\_802.11b/g/n(HT20)/ax(HE20),

WLAN 5 GHz\_802.11a/n(HT20)/ac(VHT20)/ax(HE20)

| UNII-1 |                 | UNII-2A |                 | UNII-2C |                 | UNII-3 |                 |
|--------|-----------------|---------|-----------------|---------|-----------------|--------|-----------------|
| Ch.    | Frequency (MHz) | Ch.     | Frequency (MHz) | Ch.     | Frequency (MHz) | Ch.    | Frequency (MHz) |
| 36     | 5 180           | 52      | 5 260           | 100     | 5 500           | 149    | 5 745           |
| 40     | 5 200           | 56      | 5 280           | 120     | 5 600           | 157    | 5 785           |
| 48     | 5 240           | 64      | 5 320           | 140     | 5 700           | 165    | 5 825           |
|        |                 |         |                 | 144     | 5 720           |        |                 |

Table 2.1.1. 802.11a/n(HT20)/ac(VHT20) mode

## 2.2. RF power setting in TEST SW

| Mode           | RU Type |               | Frequency     | RF Power setting value |
|----------------|---------|---------------|---------------|------------------------|
|                | RU Tone | RU offset     | [MHz]         |                        |
| 802.11a        | N/A     | N/A           | 5 180 ~ 5 220 | 13.75                  |
|                |         |               | 5 240         | 13.50                  |
|                |         |               | 5 260 ~ 5 720 | 13.75                  |
|                |         |               | 5 745 ~ 5 825 | 9.75                   |
| 802.11n HT20   | N/A     | N/A           | 5 180 ~ 5 720 | 13.00                  |
|                |         |               | 5 745 ~ 5 825 | 9.75                   |
| 802.11ac VHT20 | N/A     | N/A           | 5 180 ~ 5 720 | 13.00                  |
|                |         |               | 5 745 ~ 5 825 | 9.75                   |
| 802.11ax HE20  | 26      | 0             | 5 180 ~ 5 220 | 9.00                   |
|                |         | 4             |               |                        |
|                |         | 8             |               |                        |
|                |         | 0             | 5 240         | 4.50                   |
|                |         | 4             |               |                        |
|                |         | 8             |               |                        |
|                |         | 0             | 5 260 ~ 5 320 | 6.00                   |
|                |         | 4             |               |                        |
|                |         | 8             |               |                        |
|                |         | 0             | 5 500 ~ 5 720 | 11.00                  |
|                |         | 4             |               |                        |
|                |         | 8             |               |                        |
|                | 0       | 5 745 ~ 5 825 | 9.50          |                        |
|                | 4       |               |               |                        |
|                | 8       |               |               |                        |
|                | 52      | 37            | 5 180 ~ 5 220 | 12.50                  |
|                |         | 38            |               |                        |
|                |         | 40            |               |                        |
|                |         | 37            | 5 240         | 7.00                   |
|                |         | 38            |               |                        |
|                |         | 40            |               |                        |
|                |         | 37            | 5 260 ~ 5 320 | 8.50                   |
|                |         | 38            |               |                        |
|                |         | 40            |               |                        |
|                |         | 37            | 5 500 ~ 5 720 | 12.50                  |
|                |         | 38            |               |                        |
|                |         | 40            |               |                        |
|                | 37      | 5 745 ~ 5 825 | 9.50          |                        |
|                | 38      |               |               |                        |
|                | 40      |               |               |                        |
|                | 106     | 53            | 5 180 ~ 5 220 | 12.50                  |
|                |         | 54            |               |                        |
|                |         | 53            | 5 240         | 10.50                  |
|                |         | 54            |               |                        |
|                |         | 53            | 5 260 ~ 5 320 | 11.50                  |
|                |         | 54            |               |                        |
|                |         | 53            | 5 500 ~ 5 720 | 12.50                  |
|                |         | 54            |               |                        |
|                | 53      | 5 745 ~ 5 825 | 9.50          |                        |
|                | 54      |               |               |                        |
|                | 242     | 61            | 5 180 ~ 5 720 | 12.50                  |
|                |         |               | 5 745 ~ 5 825 | 9.50                   |
|                | SU      |               | 5 180 ~ 5 720 | 12.50                  |
|                |         |               | 5 745 ~ 5 825 | 9.50                   |

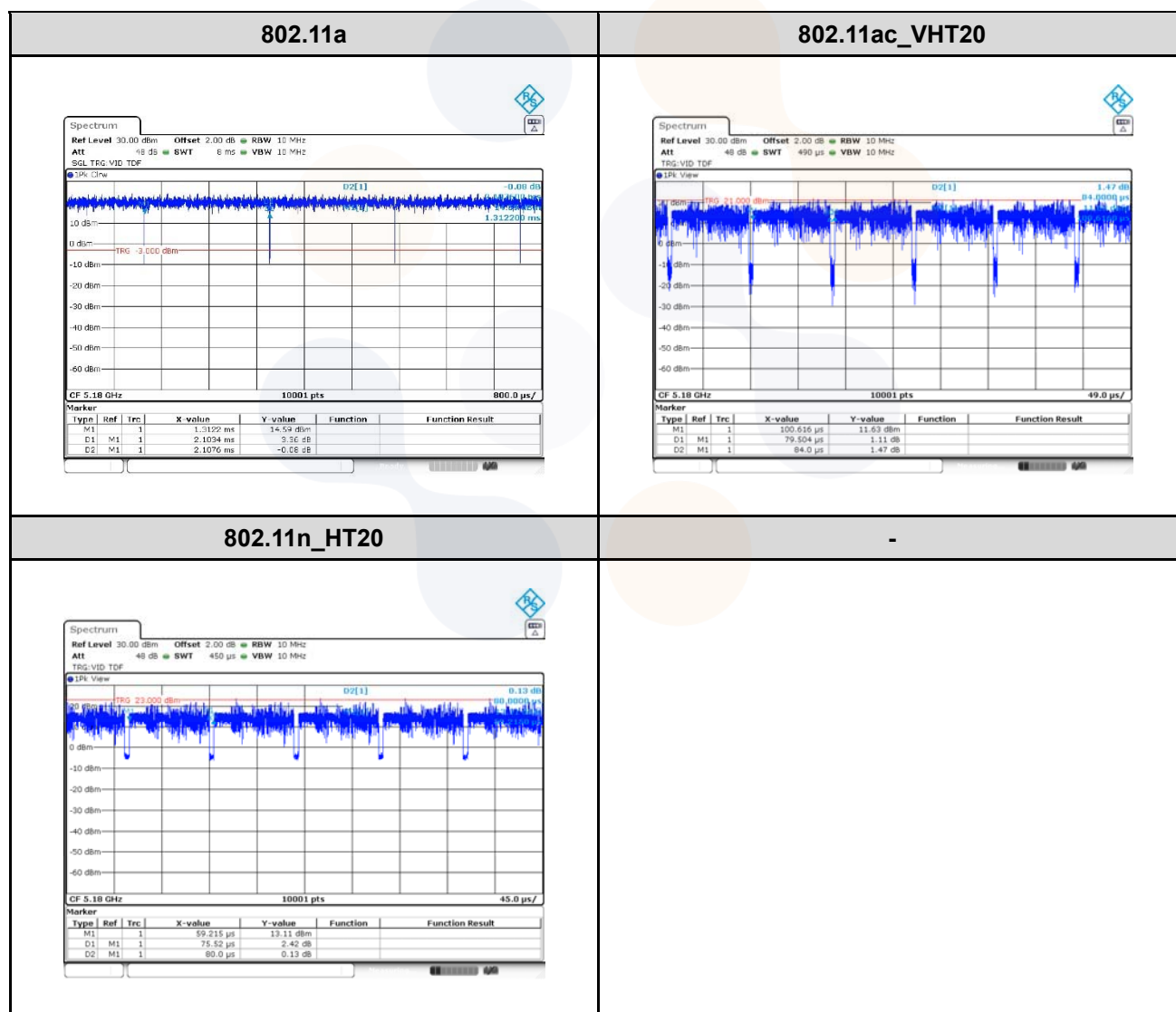


## 2.3. Duty Cycle Factor

| Test mode      | Period (ms) | T <sub>on</sub> time (ms) | Duty cycle |       | Duty cycle factor (dB) |
|----------------|-------------|---------------------------|------------|-------|------------------------|
|                |             |                           | (Linear)   | (%)   |                        |
| 802.11a        | 2.108       | 2.103                     | 0.998 0    | 99.80 | 0.01                   |
| 802.11n_HT20   | 0.080       | 0.076                     | 0.944 0    | 94.40 | 0.25                   |
| 802.11ac_VHT20 | 0.084       | 0.080                     | 0.946 5    | 94.65 | 0.24                   |

### Notes.

1. Duty cycle (Linear) = T<sub>on</sub> time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not compensated to average result if duty cycle is more than 98%



### 3. Antenna requirement

#### **Requirement of FCC part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

#### **Requirement of RSS-Gen Section 6.8:**

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

- The transmitter has permanently attached Chip antenna (Internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.407.



#### 4. Summary of tests

| FCC Part section(s)                   | IC Rule Reference                                   | Parameter                      | Test Condition | Test results |
|---------------------------------------|-----------------------------------------------------|--------------------------------|----------------|--------------|
| 15.407(a)                             | RSS-247 Issue 2, 6.2                                | Maximum conducted output power | Conducted      | Pass         |
| 15.407(a)                             | RSS-247 Issue 2, 6.2                                | Maximum power spectral density |                | Pass         |
| 15.407(a)                             | RSS-Gen Issue 5, 6.7                                | 26 dB Channel Bandwidth        |                | Pass         |
| 15.407(e)                             | RSS-247 Issue 2, 6.2.4                              | 6 dB Channel Bandwidth         |                | Pass         |
| 15.407(g)                             | RSS-Gen Issue 5, 6.11, 8.11                         | Frequency stability            |                | Pass         |
| -                                     | RSS-Gen Issue 5, 6.7                                | Occupied Bandwidth             |                | Pass         |
| 15.207(a)                             | RSS-Gen Issue 5, 8.8                                | AC Conducted Emissions         |                | Pass         |
| 15.407(b),<br>15.205(a),<br>15.209(a) | RSS-Gen Issue 5, 8.9, 8.10<br>RSS-247 Issue 2, 6.2, | Spurious emission              | Radiated       | Pass         |

#### Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. EUT was investigated in three orthogonal orientations X, Y and Z. it was determined that Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation.
4. The test procedure(s) in this report were performed in accordance as following.
  - ANSI C63.10-2013
  - KDB 789033 D02 v02r01
5. Based on the baseline scan, the worst-case data rates were:
  - 802.11a mode: 6Mbps
  - 802.11n HT20 mode: MCS0
  - 802.11ac VHT20 mode: MCS0

## 5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of  $k=2$  to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

| Parameter                    | Expanded uncertainty ( $\pm$ ) |        |
|------------------------------|--------------------------------|--------|
| Conducted RF power           | 0.9 dB                         |        |
| Conducted spurious emissions | 1.3 dB                         |        |
| Occupied Bandwidth           | 1.0 %                          |        |
| Power Spectral Density       | 1.0 dB                         |        |
| Radiated spurious emissions  | Below 30 MHz:                  | 2.3 dB |
|                              | 30 MHz ~ 1 000 MHz             | 2.5 dB |
|                              | 1 000 MHz ~ 18 000 MHz         | 4.7 dB |
|                              | Above 18 000 MHz               | 4.8 dB |
| Conducted emissions          | 9 kHz ~ 150 kHz                | 2.7 dB |
|                              | 150 kHz ~ 30 MHz               | 2.7 dB |

## 6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.

With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

| Frequency (MHz) | Factor(dB) | Frequency (MHz) | Factor(dB) |
|-----------------|------------|-----------------|------------|
| 30              | 10.12      | 9 000           | 12.03      |
| 50              | 10.27      | 10 000          | 12.12      |
| 100             | 10.33      | 11 000          | 12.13      |
| 200             | 10.42      | 12 000          | 12.36      |
| 300             | 10.51      | 13 000          | 12.45      |
| 400             | 10.56      | 14 000          | 12.60      |
| 500             | 10.61      | 15 000          | 13.01      |
| 600             | 10.66      | 16 000          | 12.92      |
| 700             | 10.70      | 17 000          | 13.28      |
| 800             | 10.73      | 18 000          | 13.16      |
| 900             | 10.75      | 19 000          | 13.48      |
| 1 000           | 10.76      | 20 000          | 13.39      |
| 2 000           | 10.93      | 21 000          | 13.64      |
| 3 000           | 11.12      | 22 000          | 13.75      |
| 4 000           | 11.24      | 23 000          | 13.87      |
| 5 000           | 11.36      | 24 000          | 13.90      |
| 6 000           | 11.56      | 25 000          | 14.06      |
| 7 000           | 11.59      | 26 000          | 14.25      |
| 8 000           | 11.71      | 26 500          | 14.07      |

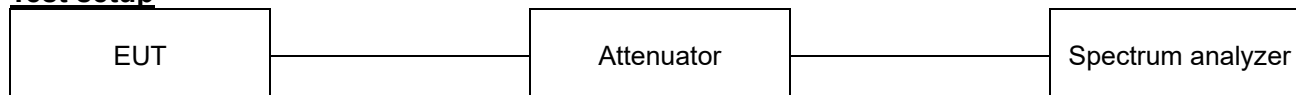
### Notes:

Offset(dB) = RF cable loss(dB) + Attenuator(dB)

## 7. Test results

### 7.1. Maximum conducted output power

#### Test setup



#### Limit

According to §15.407(a), RSS-247(6.2)

#### FCC

| Band    | EUT category                      | Conducted output power limit            |
|---------|-----------------------------------|-----------------------------------------|
| UNII-1  | Outdoor access point              | 1 W (30 dBm)                            |
|         | Indoor access point               |                                         |
|         | Fixed point-to-point access point |                                         |
|         | ✓ Client device                   | 250 mW (23.98 dBm)                      |
| UNII-2A | ✓                                 | 250 mW or 11 dBm + 10logB <sup>1)</sup> |
| UNII-2C | ✓                                 | 250 mW or 11 dBm + 10logB <sup>1)</sup> |
| UNII-3  | ✓                                 | 1 W (30 dBm)                            |

#### IC

| Band    | Maximum e.i.r.p. limit                                    |
|---------|-----------------------------------------------------------|
| UNII-1  | 200 mW or 10 + 10 log <sub>10</sub> B <sup>2)</sup> , dBm |
| UNII-2A | 1 W or 17 dBm + 10logB <sup>2)</sup>                      |
| UNII-2C | 1 W or 17 dBm + 10logB <sup>2)</sup>                      |
| UNII-3  | 1 W (30 dBm)                                              |

#### Note:

- 1) Conducted output power limit B is the 26 dB emission bandwidth.
- 2) Maximum e.i.r.p. limit B is the 99% emission bandwidth.

#### Test procedure

ANSI C63.10-2013-Section 12.3.2.4 or 12.3.3.1  
 KDB 789033 D02 v02r01 - Section E.2.d) or E.3.a)

### **Test settings**

**Used test method is Section E.2.d)**

#### **◆ KDB 789033 D02 v02r01**

### **Section E.2.d)**

**Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction):**

- (i) Measure the duty cycle,  $x$ , of the transmitter output signal as described in II.B.
- (ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (iii) Set RBW = 1 MHz
- (iv) Set RBW  $\geq$  3 MHz
- (v) Number of points in sweep  $\geq 2 \times \text{span/RBW}$ . (This ensures that bin-to-bin spacing is  $\leq \text{RBW}/2$ , so that narrowband signals are not lost between frequency bins.)
- (vi) Sweep time = auto.
- (vii) Detector = power averaging (rms), if available. Otherwise use sample detector mode.
- (viii) Do not use sweep triggering. Allow the sweep to “free run.”
- (ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
- (x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (xi) Add  $10 \log(1/x)$ , where  $x$  is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add  $10 \log(1/0.25) = 6 \text{ dB}$  if the duty cycle is 25%.

### **Section E.3.a)**

**Method PM (Measurement using an RF average power meter):**

- (i) 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 constant 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
- (ii) If the transmitter does not transmit continuously, measure the duty cycle,  $x$ , of the transmitter output signal as described in II
- (iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- (iv) 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%).

## Test results

[DC 5 V]

### Conducted output power

| Test mode      | Band    | Frequency (MHz) | Measured output power |          |              | FCC Limit (dBm) | IC Limit (dBm) |
|----------------|---------|-----------------|-----------------------|----------|--------------|-----------------|----------------|
|                |         |                 | Reading (dBm)         | DCF (dB) | Result (dBm) |                 |                |
| 802.11a        | UNII-1  | 5 180           | 15.55                 | -        | 15.55        | 23.98           | 22.16          |
|                |         | 5 200           | 15.57                 |          | 15.57        |                 |                |
|                |         | 5 240           | 15.66                 |          | 15.66        |                 |                |
|                | UNII-2A | 5 260           | 16.30                 |          | 16.30        | 23.74           | 23.17          |
|                |         | 5 280           | 16.41                 |          | 16.41        |                 |                |
|                |         | 5 320           | 16.50                 |          | 16.50        |                 |                |
|                | UNII-2C | 5 500           | 16.01                 |          | 16.01        | 23.74           | 23.16          |
|                |         | 5 600           | 16.58                 |          | 16.58        |                 |                |
|                |         | 5 700           | 16.66                 |          | 16.66        |                 |                |
|                | UNII-3  | 5 745           | 11.06                 |          | 11.06        | 30.00           | 30.00          |
|                |         | 5 785           | 10.87                 |          | 10.87        |                 |                |
|                |         | 5 825           | 10.45                 |          | 10.45        |                 |                |
| 802.11n HT20   | UNII-1  | 5 180           | 14.43                 | 0.25     | 14.68        | 22.47           | 22.47          |
|                |         | 5 200           | 14.54                 |          | 14.79        |                 |                |
|                |         | 5 240           | 14.75                 |          | 15.00        |                 |                |
|                | UNII-2A | 5 260           | 15.11                 |          | 15.36        | 23.47           | 23.47          |
|                |         | 5 280           | 15.21                 |          | 15.46        |                 |                |
|                |         | 5 320           | 15.33                 |          | 15.58        |                 |                |
|                | UNII-2C | 5 500           | 14.95                 |          | 15.20        | 23.47           | 23.47          |
|                |         | 5 600           | 15.37                 |          | 15.62        |                 |                |
|                |         | 5 700           | 15.49                 |          | 15.74        |                 |                |
|                | UNII-3  | 5 745           | 10.76                 |          | 11.01        | 30.00           | 30.00          |
|                |         | 5 785           | 10.56                 |          | 10.81        |                 |                |
|                |         | 5 825           | 10.23                 |          | 10.48        |                 |                |
| 802.11ac VHT20 | UNII-1  | 5 180           | 14.39                 | 0.24     | 14.63        | 22.46           | 22.46          |
|                |         | 5 200           | 14.45                 |          | 14.69        |                 |                |
|                |         | 5 240           | 14.82                 |          | 15.06        |                 |                |
|                | UNII-2A | 5 260           | 14.90                 |          | 15.14        | 23.46           | 23.46          |
|                |         | 5 280           | 15.16                 |          | 15.40        |                 |                |
|                |         | 5 320           | 15.31                 |          | 15.55        |                 |                |
|                | UNII-2C | 5 500           | 14.93                 |          | 15.17        | 23.46           | 23.46          |
|                |         | 5 600           | 15.48                 |          | 15.72        |                 |                |
|                |         | 5 700           | 15.51                 |          | 15.75        |                 |                |
|                | UNII-3  | 5 745           | 10.85                 |          | 11.09        | 30.00           | 30.00          |
|                |         | 5 785           | 10.73                 |          | 10.97        |                 |                |
|                |         | 5 825           | 10.34                 |          | 10.58        |                 |                |

### Notes:

1. Average result(dB m) = Average Reading (dB m) + DCF(dB)



**e.i.r.p**

| Test mode      | Band    | Frequency (MHz) | Measured output power        |                |                    | MAX. e.i.r.p Limit (dBm) |
|----------------|---------|-----------------|------------------------------|----------------|--------------------|--------------------------|
|                |         |                 | Conducted output power (dBm) | ANT gain (dBi) | MAX. e.i.r.p (dBm) |                          |
| 802.11a        | UNII-1  | 5 180           | 15.55                        | 0.90           | 16.45              | 22.16                    |
|                |         | 5 200           | 15.57                        |                | 16.47              |                          |
|                |         | 5 240           | 15.66                        |                | 16.56              |                          |
|                | UNII-2A | 5 260           | 16.30                        | 0.20           | 16.50              | 29.17                    |
|                |         | 5 280           | 16.41                        |                | 16.61              |                          |
|                |         | 5 320           | 16.50                        |                | 16.70              |                          |
|                | UNII-2C | 5 500           | 16.01                        | -0.40          | 15.61              | 29.16                    |
|                |         | 5 600           | 16.58                        |                | 16.18              |                          |
|                |         | 5 700           | 16.66                        |                | 16.26              |                          |
|                | UNII-3  | 5 745           | 11.06                        | -0.70          | 10.36              | 30.00                    |
|                |         | 5 785           | 10.87                        |                | 10.17              |                          |
|                |         | 5 825           | 10.45                        |                | 9.75               |                          |
| 802.11n HT20   | UNII-1  | 5 180           | 14.68                        | 0.90           | 15.58              | 22.47                    |
|                |         | 5 200           | 14.79                        |                | 15.69              |                          |
|                |         | 5 240           | 15.00                        |                | 15.90              |                          |
|                | UNII-2A | 5 260           | 15.36                        | 0.20           | 15.56              | 29.47                    |
|                |         | 5 280           | 15.46                        |                | 15.66              |                          |
|                |         | 5 320           | 15.58                        |                | 15.78              |                          |
|                | UNII-2C | 5 500           | 15.20                        | -0.40          | 14.80              | 29.47                    |
|                |         | 5 600           | 15.62                        |                | 15.22              |                          |
|                |         | 5 700           | 15.74                        |                | 15.34              |                          |
|                | UNII-3  | 5 745           | 11.01                        | -0.70          | 10.31              | 30.00                    |
|                |         | 5 785           | 10.81                        |                | 10.11              |                          |
|                |         | 5 825           | 10.48                        |                | 9.78               |                          |
| 802.11ac VHT20 | UNII-1  | 5 180           | 14.63                        | 0.90           | 15.53              | 22.46                    |
|                |         | 5 200           | 14.69                        |                | 15.59              |                          |
|                |         | 5 240           | 15.06                        |                | 15.96              |                          |
|                | UNII-2A | 5 260           | 15.14                        | 0.20           | 15.34              | 29.46                    |
|                |         | 5 280           | 15.40                        |                | 15.60              |                          |
|                |         | 5 320           | 15.55                        |                | 15.75              |                          |
|                | UNII-2C | 5 500           | 15.17                        | -0.40          | 14.77              | 29.46                    |
|                |         | 5 600           | 15.72                        |                | 15.32              |                          |
|                |         | 5 700           | 15.75                        |                | 15.35              |                          |
|                | UNII-3  | 5 745           | 11.09                        | -0.70          | 10.39              | 30.00                    |
|                |         | 5 785           | 10.97                        |                | 10.27              |                          |
|                |         | 5 825           | 10.58                        |                | 9.88               |                          |

**Notes:**

1. e.i.r.p. Calculation:

$$\text{e.i.r.p. (dB m)} = \text{Conducted output power (dB m)} + \text{Antenna gain (dB i)}$$

**[DC 12 V]**

**Conducted output power**

| Test mode      | Band    | Frequency (MHz) | Measured output power |          |              | FCC Limit (dBm) | IC Limit (dBm) |
|----------------|---------|-----------------|-----------------------|----------|--------------|-----------------|----------------|
|                |         |                 | Reading (dBm)         | DCF (dB) | Result (dBm) |                 |                |
| 802.11a        | UNII-1  | 5 180           | 15.54                 | -        | 15.54        | 23.98           | 22.16          |
|                |         | 5 200           | 15.64                 |          | 15.64        |                 |                |
|                |         | 5 240           | 15.68                 |          | 15.68        |                 |                |
|                | UNII-2A | 5 260           | 16.40                 |          | 16.40        | 23.74           | 23.16          |
|                |         | 5 280           | 16.31                 |          | 16.31        |                 |                |
|                |         | 5 320           | 16.58                 |          | 16.58        |                 |                |
|                | UNII-2C | 5 500           | 16.02                 |          | 16.02        | 23.74           | 23.16          |
|                |         | 5 600           | 16.61                 |          | 16.61        |                 |                |
|                |         | 5 700           | 16.71                 |          | 16.71        |                 |                |
|                | UNII-3  | 5 745           | 10.99                 |          | 10.99        | 30.00           | 30.00          |
|                |         | 5 785           | 11.00                 |          | 11.00        |                 |                |
|                |         | 5 825           | 10.54                 |          | 10.54        |                 |                |
| 802.11n HT20   | UNII-1  | 5 180           | 14.45                 | 0.25     | 14.70        | 22.47           | 22.47          |
|                |         | 5 200           | 14.44                 |          | 14.69        |                 |                |
|                |         | 5 240           | 14.72                 |          | 14.97        |                 |                |
|                | UNII-2A | 5 260           | 15.21                 |          | 15.46        | 23.47           | 23.47          |
|                |         | 5 280           | 15.19                 |          | 15.44        |                 |                |
|                |         | 5 320           | 15.32                 |          | 15.57        |                 |                |
|                | UNII-2C | 5 500           | 14.88                 |          | 15.13        | 23.47           | 23.47          |
|                |         | 5 600           | 15.37                 |          | 15.62        |                 |                |
|                |         | 5 700           | 15.42                 |          | 15.67        |                 |                |
|                | UNII-3  | 5 745           | 10.73                 |          | 10.98        | 30.00           | 30.00          |
|                |         | 5 785           | 10.65                 |          | 10.90        |                 |                |
|                |         | 5 825           | 10.26                 |          | 10.51        |                 |                |
| 802.11ac VHT20 | UNII-1  | 5 180           | 14.38                 | 0.24     | 14.62        | 22.46           | 22.46          |
|                |         | 5 200           | 14.44                 |          | 14.68        |                 |                |
|                |         | 5 240           | 14.80                 |          | 15.04        |                 |                |
|                | UNII-2A | 5 260           | 15.06                 |          | 15.30        | 23.46           | 23.46          |
|                |         | 5 280           | 15.10                 |          | 15.34        |                 |                |
|                |         | 5 320           | 15.25                 |          | 15.49        |                 |                |
|                | UNII-2C | 5 500           | 14.91                 |          | 15.15        | 23.46           | 23.46          |
|                |         | 5 600           | 15.50                 |          | 15.74        |                 |                |
|                |         | 5 700           | 15.52                 |          | 15.76        |                 |                |
|                | UNII-3  | 5 745           | 10.80                 |          | 11.04        | 30.00           | 30.00          |
|                |         | 5 785           | 10.80                 |          | 11.04        |                 |                |
|                |         | 5 825           | 10.32                 |          | 10.56        |                 |                |

**Notes:**

1. Average result(dB m) = Average Reading (dB m) + DCF(dB)

**e.i.r.p**

| Test mode    | Band    | Frequency (MHz) | Measured output power        |                |                    | MAX. e.i.r.p Limit (dBm) |
|--------------|---------|-----------------|------------------------------|----------------|--------------------|--------------------------|
|              |         |                 | Conducted output power (dBm) | ANT gain (dBi) | MAX. e.i.r.p (dBm) |                          |
| 802.11a      | UNII-1  | 5 180           | 15.54                        | 0.90           | 16.44              | 22.16                    |
|              |         | 5 200           | 15.64                        |                | 16.54              |                          |
|              |         | 5 240           | 15.68                        |                | 16.58              |                          |
|              | UNII-2A | 5 260           | 16.40                        | 0.20           | 16.60              | 29.16                    |
|              |         | 5 280           | 16.31                        |                | 16.51              |                          |
|              |         | 5 320           | 16.58                        |                | 16.78              |                          |
|              | UNII-2C | 5 500           | 16.02                        | -0.40          | 15.62              | 29.16                    |
|              |         | 5 600           | 16.61                        |                | 16.21              |                          |
|              |         | 5 700           | 16.71                        |                | 16.31              |                          |
|              | UNII-3  | 5 745           | 10.99                        | -0.70          | 10.29              | 30.00                    |
|              |         | 5 785           | 11.00                        |                | 10.30              |                          |
|              |         | 5 825           | 10.54                        |                | 9.84               |                          |
| 802.11n HT20 | UNII-1  | 5 180           | 14.70                        | 0.90           | 15.60              | 22.47                    |
|              |         | 5 200           | 14.69                        |                | 15.59              |                          |
|              |         | 5 240           | 14.97                        |                | 15.87              |                          |
|              | UNII-2A | 5 260           | 15.46                        | 0.20           | 15.66              | 29.47                    |
|              |         | 5 280           | 15.44                        |                | 15.64              |                          |
|              |         | 5 320           | 15.57                        |                | 15.77              |                          |
|              | UNII-2C | 5 500           | 15.13                        | -0.40          | 14.73              | 29.47                    |
|              |         | 5 600           | 15.62                        |                | 15.22              |                          |
|              |         | 5 700           | 15.67                        |                | 15.27              |                          |
|              | UNII-3  | 5 745           | 10.98                        | -0.70          | 10.28              | 30.00                    |
|              |         | 5 785           | 10.90                        |                | 10.20              |                          |
|              |         | 5 825           | 10.51                        |                | 9.81               |                          |
| 802.11n HT20 | UNII-1  | 5 180           | 14.62                        | 0.90           | 15.52              | 22.46                    |
|              |         | 5 200           | 14.68                        |                | 15.58              |                          |
|              |         | 5 240           | 15.04                        |                | 15.94              |                          |
|              | UNII-2A | 5 260           | 15.30                        | 0.20           | 15.50              | 29.46                    |
|              |         | 5 280           | 15.34                        |                | 15.54              |                          |
|              |         | 5 320           | 15.49                        |                | 15.69              |                          |
|              | UNII-2C | 5 500           | 15.15                        | -0.40          | 14.75              | 29.46                    |
|              |         | 5 600           | 15.74                        |                | 15.34              |                          |
|              |         | 5 700           | 15.76                        |                | 15.36              |                          |
|              | UNII-3  | 5 745           | 11.04                        | -0.70          | 10.34              | 30.00                    |
|              |         | 5 785           | 11.04                        |                | 10.34              |                          |
|              |         | 5 825           | 10.56                        |                | 9.86               |                          |

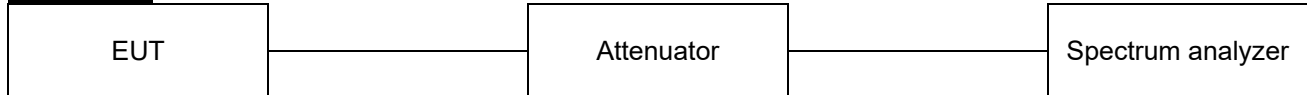
**Notes:**

1. e.i.r.p. Calculation:

$$\text{e.i.r.p. (dB m)} = \text{Conducted output power (dB m)} + \text{Antenna gain (dB i)}$$

## 7.2. Maximum Power Spectral Density

### Test setup



### Limit

According to §15.407(a), RSS-247(6.2)

| Band    | EUT category |                                   | Limit           |
|---------|--------------|-----------------------------------|-----------------|
| UNII-1  |              | Outdoor access point              | 17dBm/MHz       |
|         |              | Indoor access point               |                 |
|         |              | Fixed point-to-point access point |                 |
|         | √            | Client device                     | 11 dBm /MHz     |
| UNII-2A | √            |                                   | 11 dBm /MHz     |
| UNII-2C | √            |                                   | 11 dBm /MHz     |
| UNII-3  | √            |                                   | 30 dBm /500 kHz |

### Notes:

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power And the peak power spectral density shall be reduced by the amount in dB that the directional gain if the antenna exceed 6 dBi

### Test procedure

ANSI C63.10-2013 Section 12.3.2.2, 14.3.2.2  
 KDB 789033 D02 v02r01 - Section F

### Test settings

#### Section F

The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission. Refer to III.A for additional guidance for devices that use channel aggregation.

- Create an average power spectrum for the EUT operating mode being tested by following the instructions in 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.)
- Search function on the instrument to find the peak of the spectrum and record its value.
- Adjustments to the peak value of the spectrum, if applicable:
  - 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.
  - If Method SA-3 Alternative was used and the linear mode was used in II.E.2.g) (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- The result is the Maximum PSD over 1MHz reference bandwidth
- For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference

bandwidth specified in Section 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 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 II.B.I.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 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 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.

Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for the II.F.5.c) and II.F.5.d), since RBW=100 kHz is available on nearly all spectrum analyzers.

## Test results

[DC 5 V]

| Test mode      | Band    | Frequency (MHz) | Measured PSD (dBm/MHz) | DCF (dB) | Maximum PSD (dB m/MHz) | Limit (dBm/MHz) |
|----------------|---------|-----------------|------------------------|----------|------------------------|-----------------|
| 802.11a        | UNII 1  | 5 180           | 4.49                   | -        | 4.49                   | 11.00           |
|                |         | 5 200           | 4.22                   |          | 4.22                   |                 |
|                |         | 5 240           | 3.98                   |          | 3.98                   |                 |
|                | UNII 2A | 5 260           | 4.25                   |          | 4.25                   | 11.00           |
|                |         | 5 280           | 4.71                   |          | 4.71                   |                 |
|                |         | 5 320           | 4.42                   |          | 4.42                   |                 |
|                | UNII 2C | 5 500           | 4.46                   |          | 4.46                   | 11.00           |
|                |         | 5 600           | 4.92                   |          | 4.92                   |                 |
|                |         | 5 700           | 4.81                   |          | 4.81                   |                 |
| 802.11n HT20   | UNII 1  | 5 180           | 3.42                   | 0.25     | 3.67                   | 11.00           |
|                |         | 5 200           | 3.21                   |          | 3.46                   |                 |
|                |         | 5 240           | 3.35                   |          | 3.60                   |                 |
|                | UNII 2A | 5 260           | 3.27                   |          | 3.52                   | 11.00           |
|                |         | 5 280           | 3.52                   |          | 3.77                   |                 |
|                |         | 5 320           | 3.26                   |          | 3.51                   |                 |
|                | UNII 2C | 5 500           | 3.46                   |          | 3.71                   | 11.00           |
|                |         | 5 600           | 3.97                   |          | 4.22                   |                 |
|                |         | 5 700           | 4.03                   |          | 4.28                   |                 |
| 802.11ac VHT20 | UNII 1  | 5 180           | 3.17                   | 0.36     | 3.41                   | 11.00           |
|                |         | 5 200           | 3.24                   |          | 3.48                   |                 |
|                |         | 5 240           | 3.71                   |          | 3.95                   |                 |
|                | UNII 2A | 5 260           | 3.51                   |          | 3.75                   | 11.00           |
|                |         | 5 280           | 3.49                   |          | 3.73                   |                 |
|                |         | 5 320           | 3.27                   |          | 3.51                   |                 |
|                | UNII 2C | 5 500           | 3.73                   |          | 3.97                   | 11.00           |
|                |         | 5 600           | 3.94                   |          | 4.18                   |                 |
|                |         | 5 700           | 3.82                   |          | 4.06                   |                 |



| Test mode         | Band   | Frequency<br>(MHz) | Measured PSD<br>(dBm /500 kHz) | DCF<br>(dB) | Maximum PSD<br>(dBm /500 kHz) | Limit<br>(dBm /500 kHz) |
|-------------------|--------|--------------------|--------------------------------|-------------|-------------------------------|-------------------------|
| 802.11a           | UNII 3 | 5 745              | -2.57                          | -           | -2.57                         | 30.00                   |
|                   |        | 5 785              | -2.58                          |             | -2.58                         |                         |
|                   |        | 5 825              | -2.79                          |             | -2.79                         |                         |
| 802.11n<br>HT20   |        | 5 745              | -1.95                          | 0.25        | -1.70                         |                         |
|                   |        | 5 785              | -2.08                          |             | -1.83                         |                         |
|                   |        | 5 825              | -2.55                          |             | -2.30                         |                         |
| 802.11ac<br>VHT20 |        | 5 745              | -1.95                          | 0.36        | -1.71                         |                         |
|                   |        | 5 785              | -2.03                          |             | -1.79                         |                         |
|                   |        | 5 825              | -2.53                          |             | -2.29                         |                         |

**Notes:**

- Maximum PSD calculation
- Maximum PSD = Measured PSD + D.C.F

**[DC 12 V]**

| Test mode      | Band    | Frequency (MHz) | Measured PSD (dBm/MHz) | DCF (dB) | Maximum PSD (dB m/MHz) | Limit (dBm/MHz) |
|----------------|---------|-----------------|------------------------|----------|------------------------|-----------------|
| 802.11a        | UNII 1  | 5 180           | 4.38                   | -        | 4.38                   | 11.00           |
|                |         | 5 200           | 3.93                   |          | 3.93                   |                 |
|                |         | 5 240           | 4.14                   |          | 4.14                   |                 |
|                | UNII 2A | 5 260           | 4.27                   |          | 4.27                   | 11.00           |
|                |         | 5 280           | 4.78                   |          | 4.78                   |                 |
|                |         | 5 320           | 4.34                   |          | 4.34                   |                 |
|                | UNII 2C | 5 500           | 4.72                   |          | 4.72                   | 11.00           |
|                |         | 5 600           | 4.90                   |          | 4.90                   |                 |
|                |         | 5 700           | 4.79                   |          | 4.79                   |                 |
| 802.11n HT20   | UNII 1  | 5 180           | 3.37                   | 0.25     | 3.62                   | 11.00           |
|                |         | 5 200           | 3.29                   |          | 3.54                   |                 |
|                |         | 5 240           | 3.58                   |          | 3.83                   |                 |
|                | UNII 2A | 5 260           | 3.52                   |          | 3.77                   | 11.00           |
|                |         | 5 280           | 3.62                   |          | 3.87                   |                 |
|                |         | 5 320           | 3.38                   |          | 3.63                   |                 |
|                | UNII 2C | 5 500           | 3.56                   |          | 3.81                   | 11.00           |
|                |         | 5 600           | 3.83                   |          | 4.08                   |                 |
|                |         | 5 700           | 4.00                   |          | 4.25                   |                 |
| 802.11ac VHT20 | UNII 1  | 5 180           | 3.28                   | 0.24     | 3.52                   | 11.00           |
|                |         | 5 200           | 3.09                   |          | 3.33                   |                 |
|                |         | 5 240           | 3.13                   |          | 3.37                   |                 |
|                | UNII 2A | 5 260           | 3.39                   |          | 3.63                   | 11.00           |
|                |         | 5 280           | 3.55                   |          | 3.79                   |                 |
|                |         | 5 320           | 3.43                   |          | 3.67                   |                 |
|                | UNII 2C | 5 500           | 3.65                   |          | 3.89                   | 11.00           |
|                |         | 5 600           | 3.99                   |          | 4.23                   |                 |
|                |         | 5 700           | 3.90                   |          | 4.14                   |                 |

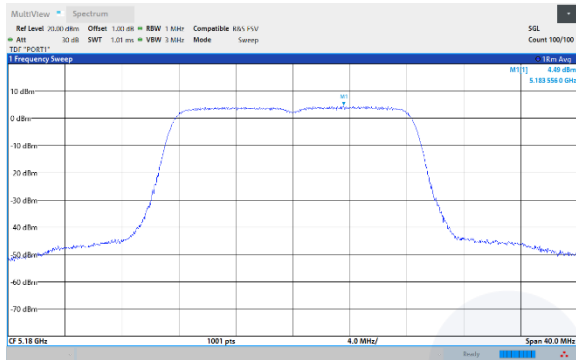
| Test mode         | Band   | Frequency<br>(MHz) | Measured PSD<br>(dBm /500 kHz) | DCF<br>(dB) | Maximum PSD<br>(dBm /500 kHz) | Limit<br>(dBm /500 kHz) |
|-------------------|--------|--------------------|--------------------------------|-------------|-------------------------------|-------------------------|
| 802.11a           | UNII 3 | 5 745              | -2.36                          | -           | -2.36                         | 30.00                   |
|                   |        | 5 785              | -2.45                          |             | -2.45                         |                         |
|                   |        | 5 825              | -2.86                          |             | -2.86                         |                         |
| 802.11n<br>HT20   |        | 5 745              | -2.15                          | 0.25        | -1.90                         |                         |
|                   |        | 5 785              | -2.21                          |             | -1.96                         |                         |
|                   |        | 5 825              | -2.59                          |             | -2.34                         |                         |
| 802.11ac<br>VHT20 |        | 5 745              | -2.29                          | 0.24        | -2.05                         |                         |
|                   |        | 5 785              | -2.33                          |             | -2.09                         |                         |
|                   |        | 5 825              | -2.44                          |             | -2.20                         |                         |

**Notes:**

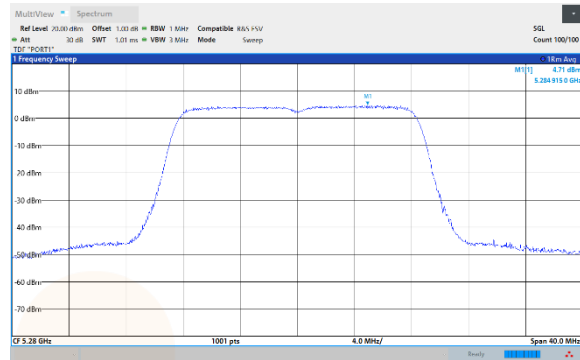
- Maximum PSD calculation
- Maximum PSD = Measured PSD + D.C.F

**In order to simplify the report, attached plots were only worst bandwidth [DC 5 V]**

**UNII-1 / 802.11a / Low ch.**



**UNII-2A / 802.11a / Mid ch.**



**UNII-2C / 802.11a / Mid ch.**

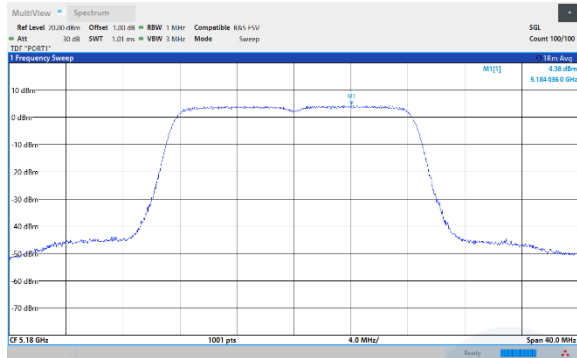


**UNII-3 / 802.11n HT20 / Low ch.**

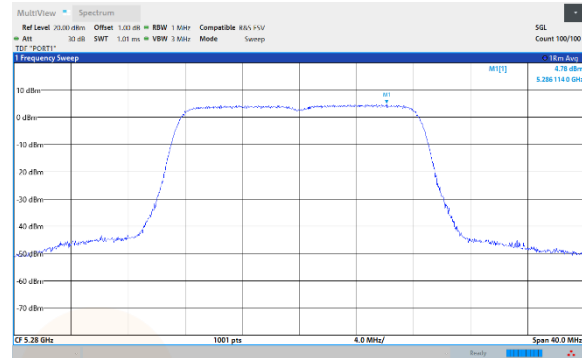


**[DC 12 V]**

**UNII-1 / 802.11a / Low ch.**



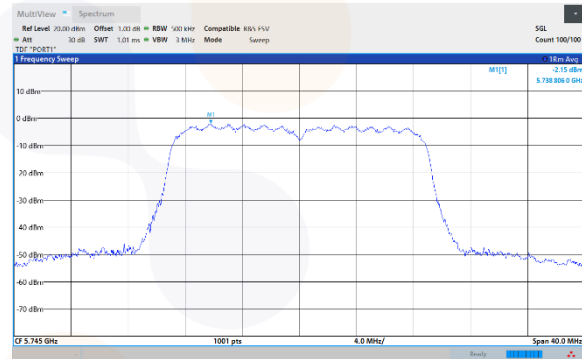
**UNII-2A / 802.11a / Mid ch.**



**UNII-2C / 802.11a / Mid ch.**

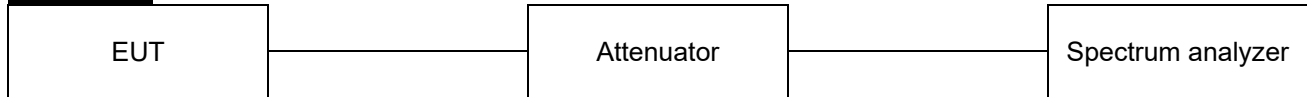


**UNII-3 / 802.11n HT20 / Low ch.**



### 7.3. 26 dB Bandwidth & 99% Bandwidth

#### Test setup



#### Limit

N/A

#### Test procedure

ANSI C63.10-2013 Section 12.4

KDB 789033 D02 v02r01 - Section C.1 (26dB bandwidth)

KDB 789033 D02 v02r01 - Section D (99% bandwidth)

#### Test settings

##### 1. 26 dB Bandwidth

- Set RBW = approximately 1% of the emission bandwidth.
- Set the VBW > RBW.
- Detector = Peak.
- Trace mode = max hold.
- 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%.

##### 2. 99% Occupied Bandwidth

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



## Test results

### [DC 5 V]

| Test mode         | Band    | Frequency(MHz) | 26 dB bandwidth (MHz) | 99% bandwidth (MHz) |
|-------------------|---------|----------------|-----------------------|---------------------|
| 802.11a           | UNII-1  | 5 180          | 18.88                 | 16.43               |
|                   |         | 5 200          | 18.88                 | 16.43               |
|                   |         | 5 240          | 18.83                 | 16.48               |
|                   | UNII-2A | 5 260          | 18.78                 | 16.48               |
|                   |         | 5 280          | 18.78                 | 16.48               |
|                   |         | 5 320          | 18.78                 | 16.48               |
|                   | UNII-2C | 5 500          | 18.78                 | 16.43               |
|                   |         | 5 600          | 18.83                 | 16.48               |
|                   |         | 5 700          | 18.88                 | 16.48               |
| 802.11n<br>HT20   | UNII-1  | 5 180          | 19.98                 | 17.68               |
|                   |         | 5 200          | 19.88                 | 17.68               |
|                   |         | 5 240          | 19.93                 | 17.68               |
|                   | UNII-2A | 5 260          | 19.93                 | 17.68               |
|                   |         | 5 280          | 19.93                 | 17.68               |
|                   |         | 5 320          | 19.93                 | 17.68               |
|                   | UNII-2C | 5 500          | 19.93                 | 17.68               |
|                   |         | 5 600          | 19.93                 | 17.68               |
|                   |         | 5 700          | 19.93                 | 17.68               |
| 802.11ac<br>VHT20 | UNII-1  | 5 180          | 19.78                 | 17.63               |
|                   |         | 5 200          | 19.73                 | 17.63               |
|                   |         | 5 240          | 19.73                 | 17.63               |
|                   | UNII-2A | 5 260          | 19.73                 | 17.63               |
|                   |         | 5 280          | 19.78                 | 17.63               |
|                   |         | 5 320          | 19.73                 | 17.63               |
|                   | UNII-2C | 5 500          | 19.73                 | 17.63               |
|                   |         | 5 600          | 19.83                 | 17.63               |
|                   |         | 5 700          | 19.83                 | 17.63               |

**[DC 12 V]**

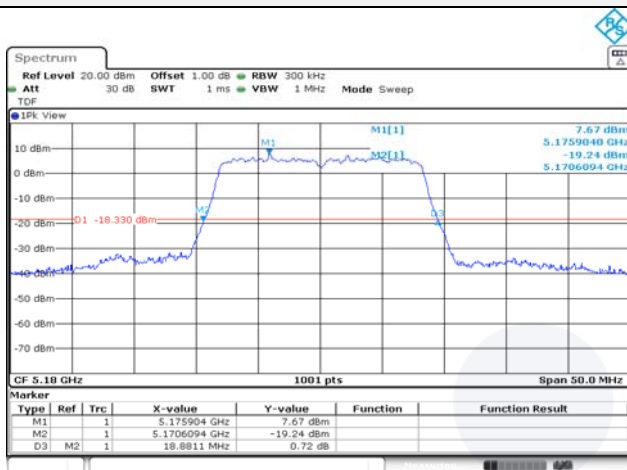
| Test mode         | Band    | Frequency(MHz) | 26 dB bandwidth (MHz) | 99% bandwidth (MHz) |
|-------------------|---------|----------------|-----------------------|---------------------|
| 802.11a           | UNII-1  | 5 180          | 18.88                 | 16.43               |
|                   |         | 5 200          | 18.88                 | 16.43               |
|                   |         | 5 240          | 18.83                 | 16.48               |
|                   | UNII-2A | 5 260          | 18.78                 | 16.98               |
|                   |         | 5 280          | 18.83                 | 16.43               |
|                   |         | 5 320          | 18.83                 | 16.48               |
|                   | UNII-2C | 5 500          | 18.78                 | 16.43               |
|                   |         | 5 600          | 18.88                 | 16.48               |
|                   |         | 5 700          | 18.83                 | 16.43               |
| 802.11n<br>HT20   | UNII-1  | 5 180          | 19.98                 | 17.68               |
|                   |         | 5 200          | 19.88                 | 17.68               |
|                   |         | 5 240          | 19.93                 | 17.68               |
|                   | UNII-2A | 5 260          | 19.88                 | 17.68               |
|                   |         | 5 280          | 19.93                 | 17.68               |
|                   |         | 5 320          | 19.93                 | 17.68               |
|                   | UNII-2C | 5 500          | 19.93                 | 17.68               |
|                   |         | 5 600          | 19.93                 | 17.68               |
|                   |         | 5 700          | 19.93                 | 17.68               |
| 802.11ac<br>VHT20 | UNII-1  | 5 180          | 19.78                 | 17.63               |
|                   |         | 5 200          | 19.73                 | 17.63               |
|                   |         | 5 240          | 19.73                 | 17.63               |
|                   | UNII-2A | 5 260          | 19.78                 | 17.63               |
|                   |         | 5 280          | 19.78                 | 17.63               |
|                   |         | 5 320          | 19.78                 | 17.63               |
|                   | UNII-2C | 5 500          | 19.78                 | 17.63               |
|                   |         | 5 600          | 19.78                 | 17.63               |
|                   |         | 5 700          | 19.73                 | 17.63               |

## 26 dB bandwidth

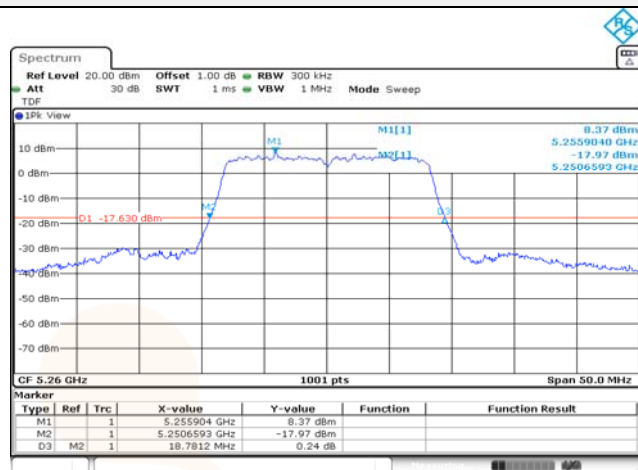
[DC 5 V]

In order to simplify the report, attached plots were only worst bandwidth

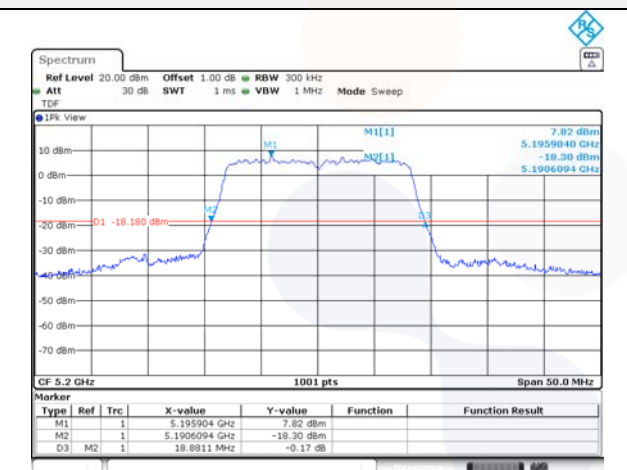
UNII-1 / 802.11a / Low ch.



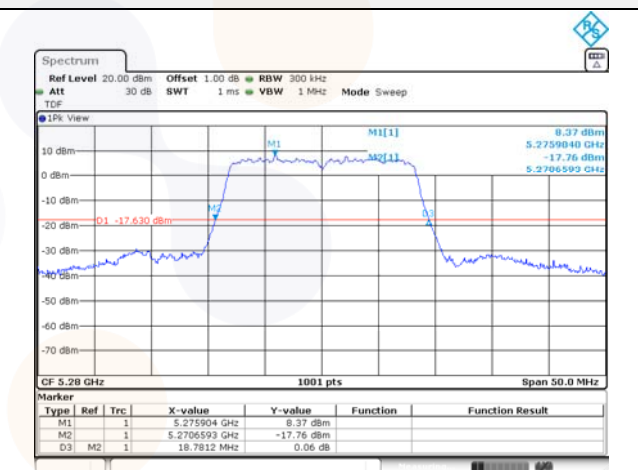
UNII-2A / 802.11a / Low ch.



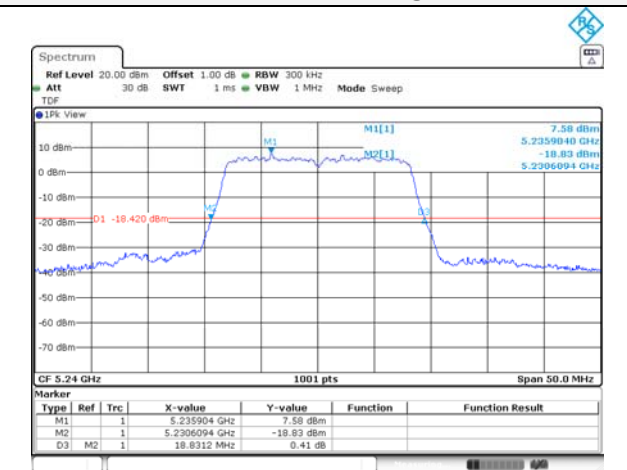
UNII-1 / 802.11a / Mid ch.



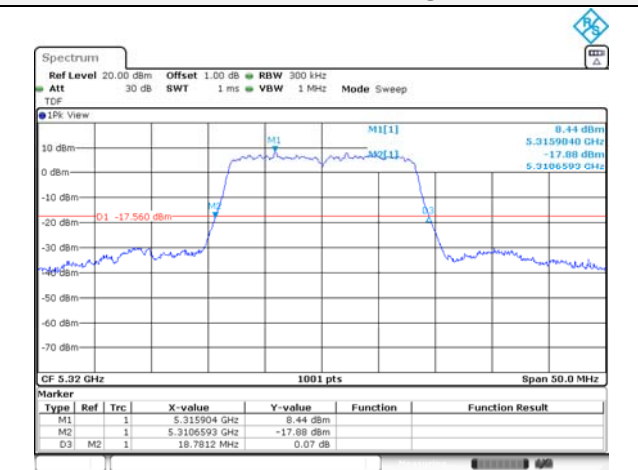
UNII-2A / 802.11a / Mid ch.



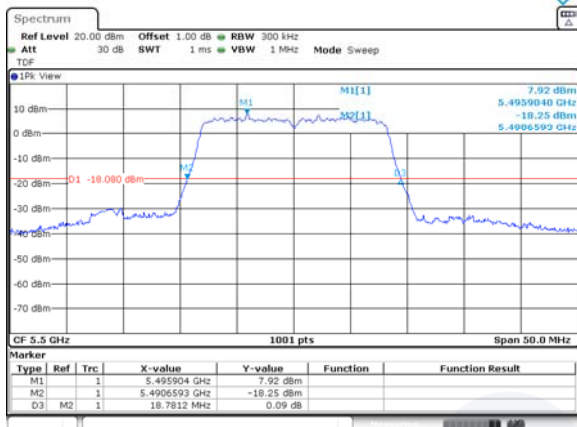
UNII-1 / 802.11a / High ch.



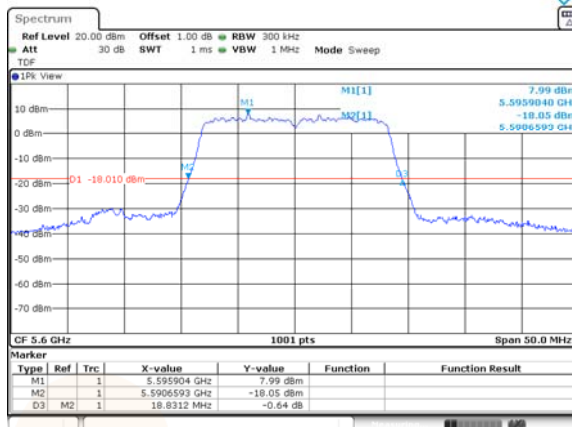
UNII-2A / 802.11a / High ch.



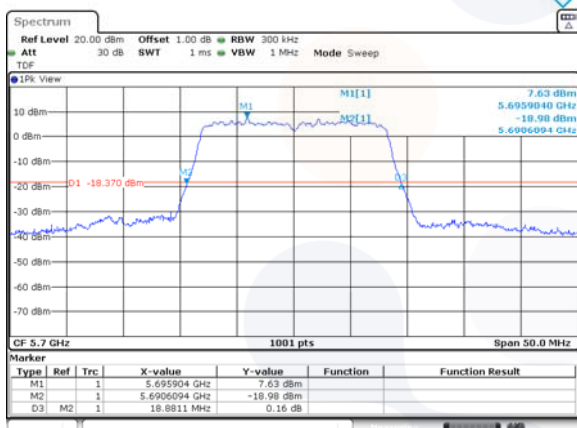
### UNII-2C / 802.11a / Low ch.



### UNII-2C / 802.11a / Mid ch.



### UNII-2C / 802.11a / High ch.

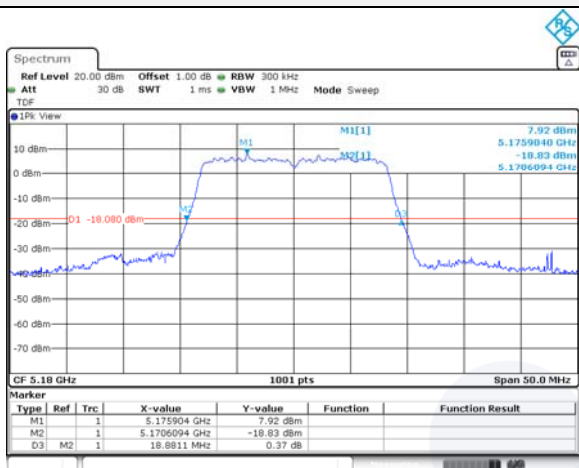


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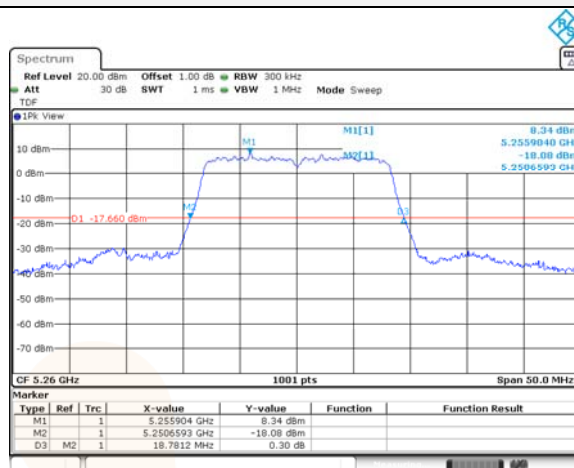
[DC 12 V]

In order to simplify the report, attached plots were only worst bandwidth

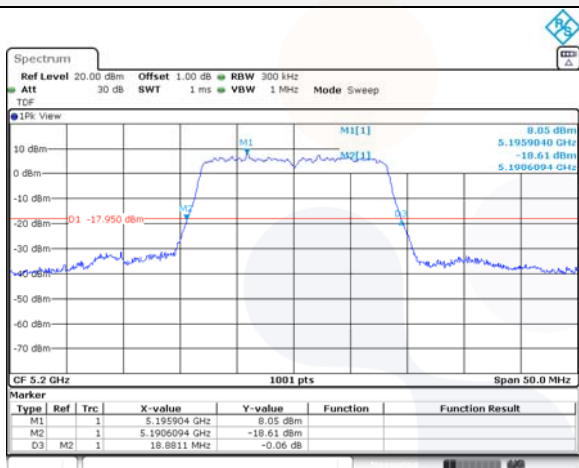
**UNII-1 / 802.11a / Low ch.**



**UNII-2A / 802.11a / Low ch.**



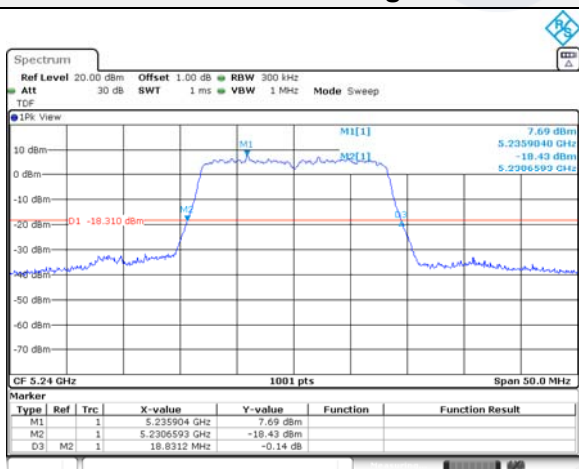
**UNII-1 / 802.11a / Mid ch.**



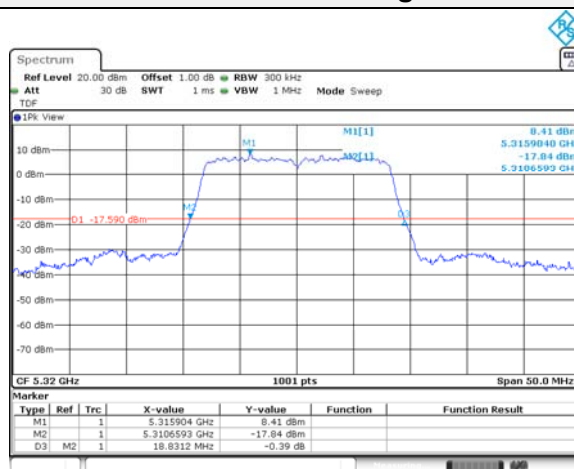
**UNII-2A / 802.11a / Mid ch.**



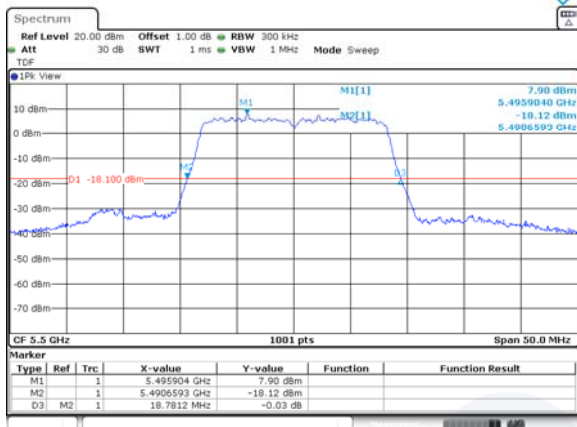
**UNII-1 / 802.11a / High ch.**



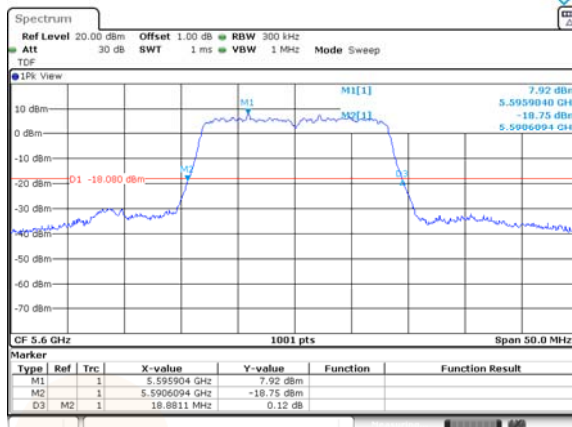
**UNII-2A / 802.11a / High ch.**



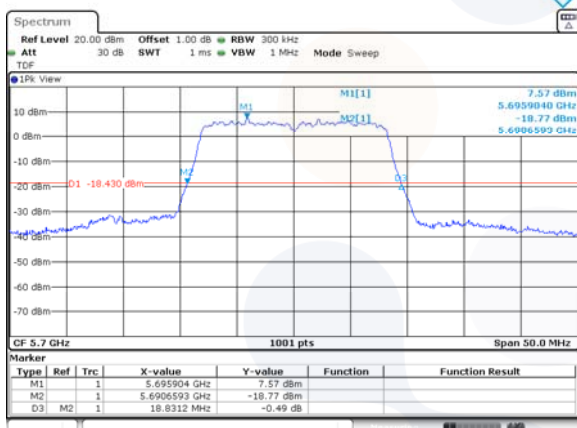
### UNII-2C / 802.11a / Low ch.



### UNII-2C / 802.11a / Mid ch.



### UNII-2C / 802.11a / High ch.



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## 99% Bandwidth

[DC 5 V]

In order to simplify the report, attached plots were only worst bandwidth

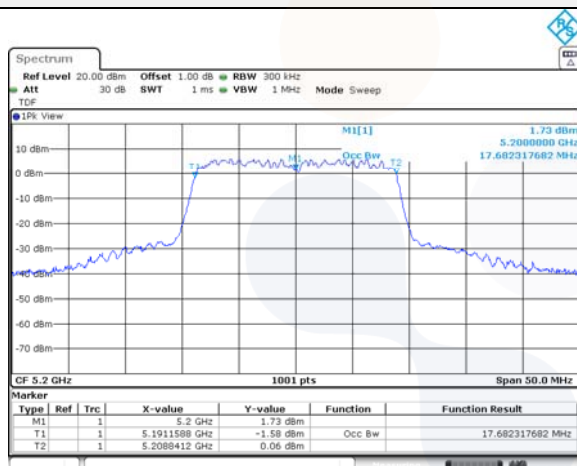
**UNII-1 / 802.11n HT20 / Low ch.**



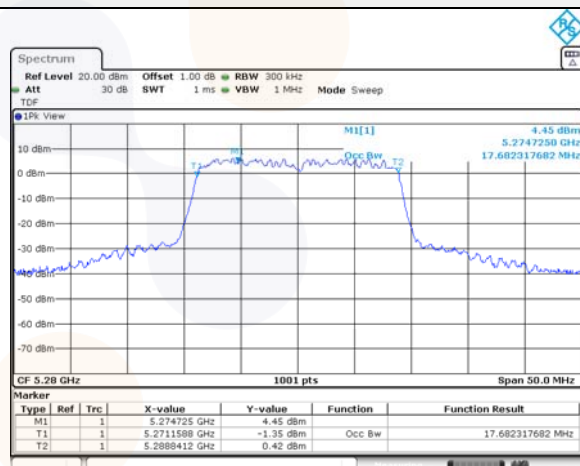
**UNII-2A / 802.11n HT20 / Low ch.**



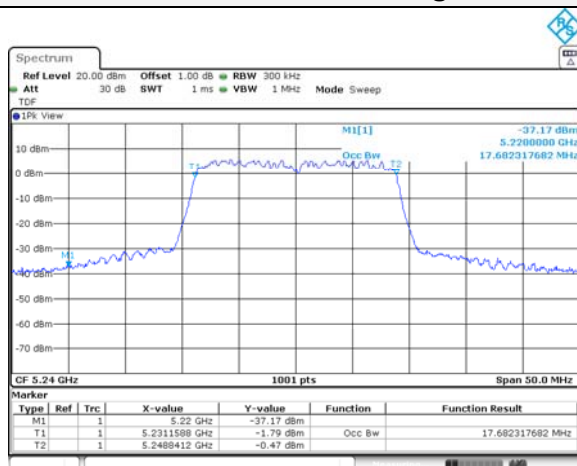
**UNII-1 / 802.11n HT20 / Mid ch.**



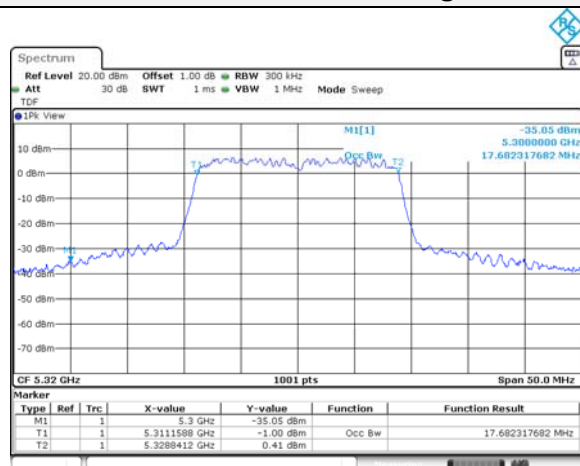
**UNII-2A / 802.11n HT20 / Mid ch.**



**UNII-1 / 802.11n HT20 / High ch.**

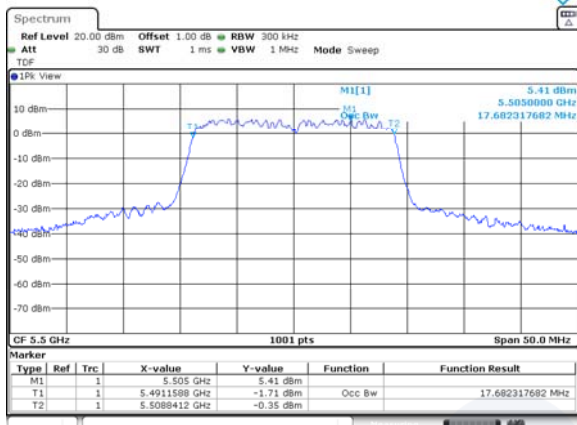


**UNII-2A / 802.11n HT20 / High ch.**

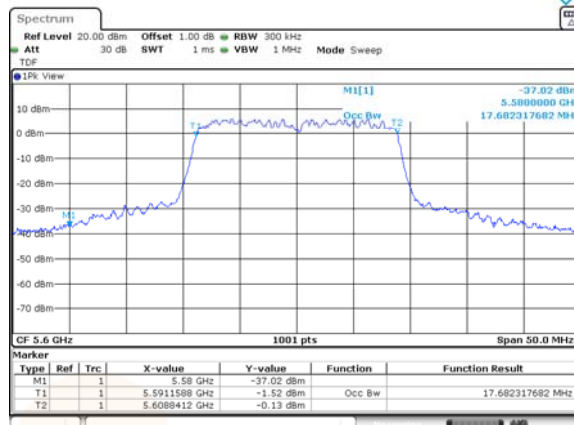




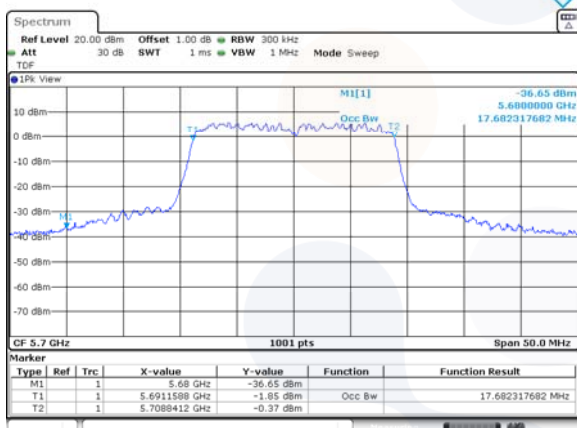
**UNII-2C / 802.11n HT20 / Low ch.**



**UNII-2C / 802.11n HT20 / Mid ch.**



**UNII-2C / 802.11n HT20 / High ch.**

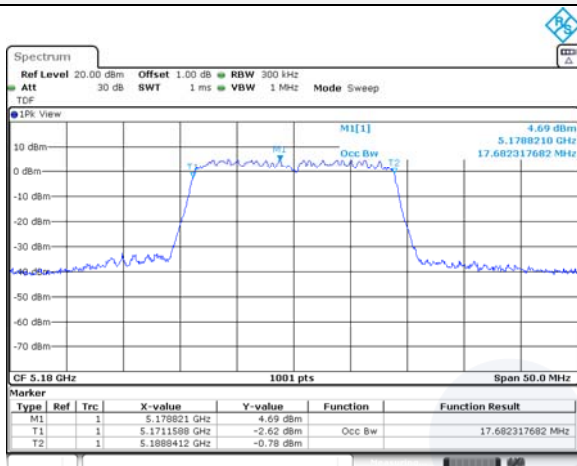


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[DC 12 V]

In order to simplify the report, attached plots were only worst bandwidth

**UNII-1 / 802.11n HT20 / Low ch.**



**UNII-2A / 802.11n HT20 / Low ch.**



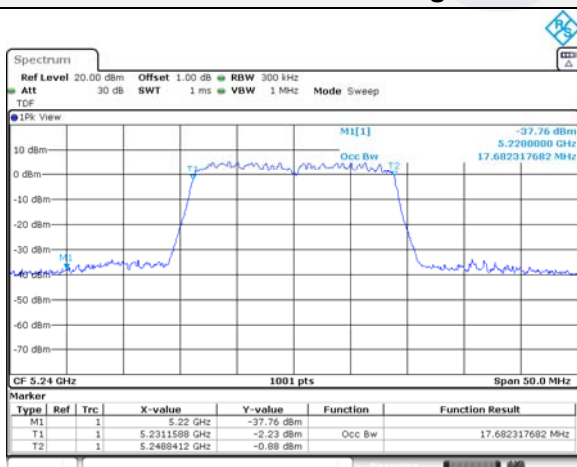
**UNII-1 / 802.11n HT20 / Mid ch.**



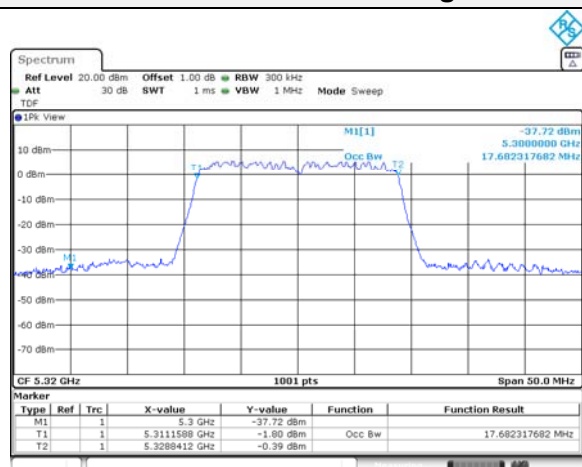
**UNII-2A / 802.11n HT20 / Mid ch.**



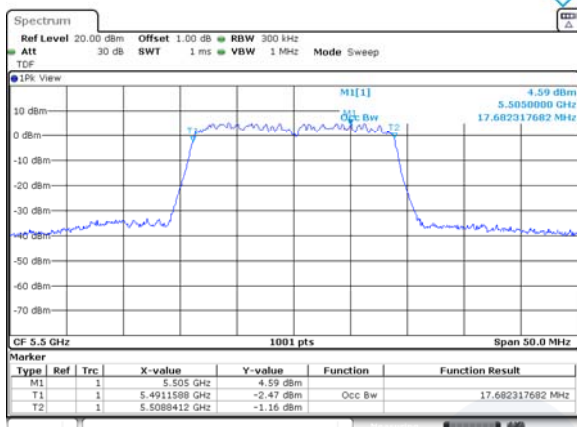
**UNII-1 / 802.11n HT20 / High ch.**



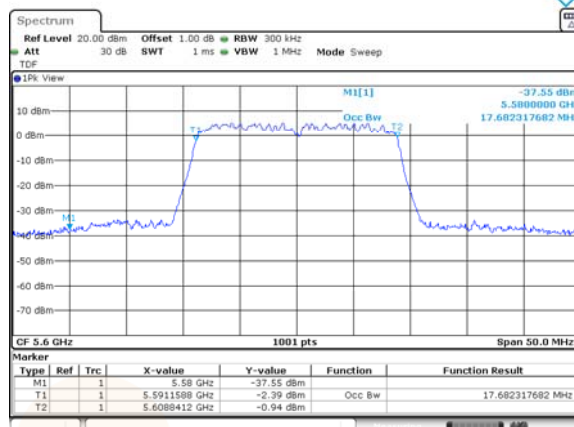
**UNII-2A / 802.11n HT20 / High ch.**



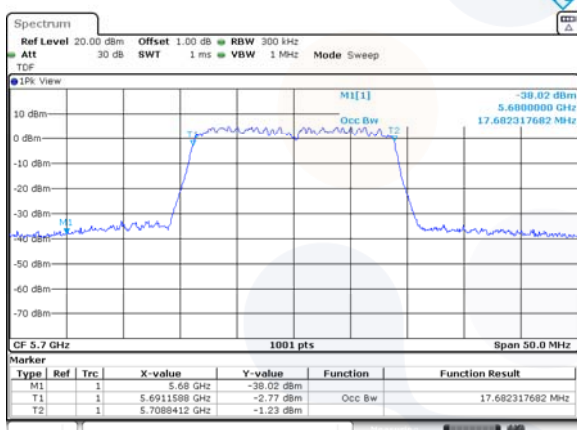
### UNII-2C / 802.11n HT20 / Low ch.



### UNII-2C / 802.11n HT20 / Mid ch.



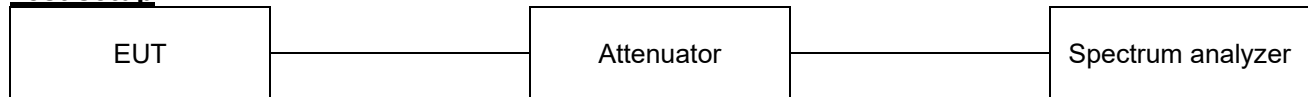
### UNII-2C / 802.11n HT20 / High ch.



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## 7.4. 6 dB Bandwidth

### Test setup



### Limit

According to §15.407(e), RSS-247(6.2.4), Within the 5.725-5.850 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500kHz.

### Test procedure

ANSI C63.10-2013 Section 6.9.2

KDB 789033 D02 v02r01 - Section C.2

### Test settings

Minimum Emission Bandwidth for the band 5.725–5.85 GHz

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725–5.85 GHz. The following procedure shall be used for measuring this Bandwidth:

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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.

## Test results

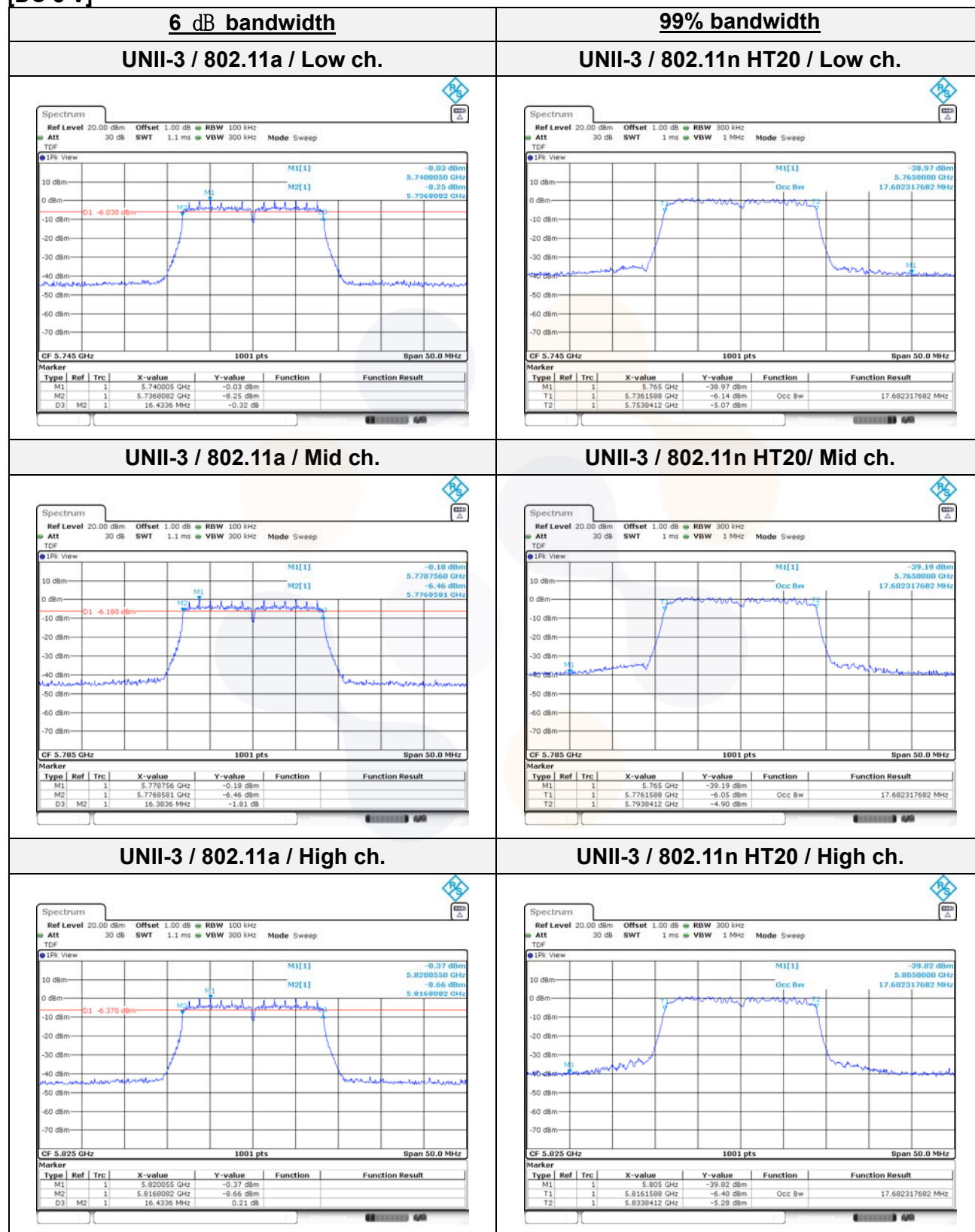
### [DC 5 V]

| Test mode      | Band   | Frequency (MHz) | 6dB bandwidth (MHz) | Limit (MHz) | 99% bandwidth (MHz) |
|----------------|--------|-----------------|---------------------|-------------|---------------------|
| 802.11a        | UNII-3 | 5 745           | 16.43               | 0.50        | 16.43               |
|                |        | 5 785           | 16.38               | 0.50        | 16.48               |
|                |        | 5 825           | 16.43               | 0.50        | 16.43               |
| 802.11n HT20   | UNII-3 | 5 745           | 17.08               | 0.50        | 17.68               |
|                |        | 5 785           | 17.03               | 0.50        | 17.68               |
|                |        | 5 825           | 17.03               | 0.50        | 17.68               |
| 802.11ac VHT20 | UNII-3 | 5 745           | 17.08               | 0.50        | 17.63               |
|                |        | 5 785           | 17.03               | 0.50        | 17.68               |
|                |        | 5 825           | 17.03               | 0.50        | 17.68               |

### [DC 12 V]

| Test mode      | Band   | Frequency (MHz) | 6dB bandwidth (MHz) | Limit (MHz) | 99% bandwidth (MHz) |
|----------------|--------|-----------------|---------------------|-------------|---------------------|
| 802.11a        | UNII-3 | 5 745           | 16.43               | 0.50        | 16.43               |
|                |        | 5 785           | 16.33               | 0.50        | 16.48               |
|                |        | 5 825           | 16.43               | 0.50        | 16.43               |
| 802.11n HT20   | UNII-3 | 5 745           | 17.08               | 0.50        | 17.68               |
|                |        | 5 785           | 17.03               | 0.50        | 17.68               |
|                |        | 5 825           | 17.08               | 0.50        | 17.68               |
| 802.11ac VHT20 | UNII-3 | 5 745           | 17.08               | 0.50        | 17.63               |
|                |        | 5 785           | 17.03               | 0.50        | 17.68               |
|                |        | 5 825           | 17.08               | 0.50        | 17.63               |

In order to simplify the report, attached plots were only worst bandwidth [DC 5 V]

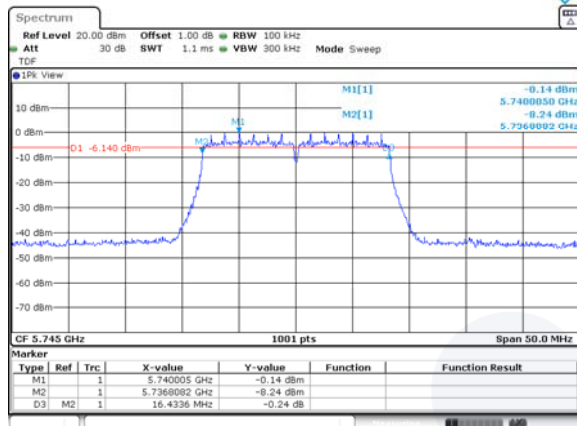




**[DC 12 V]**

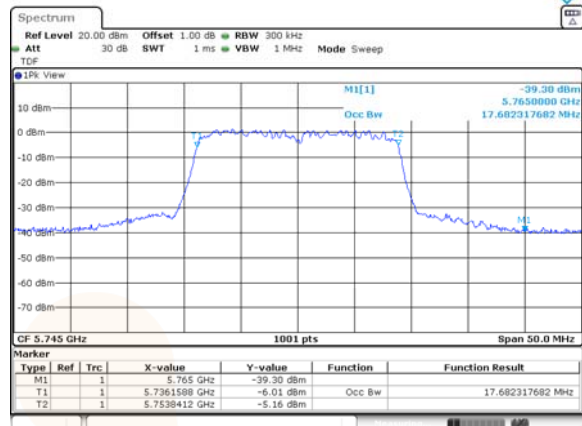
**6 dB bandwidth**

**UNII-3 / 802.11a / Low ch.**

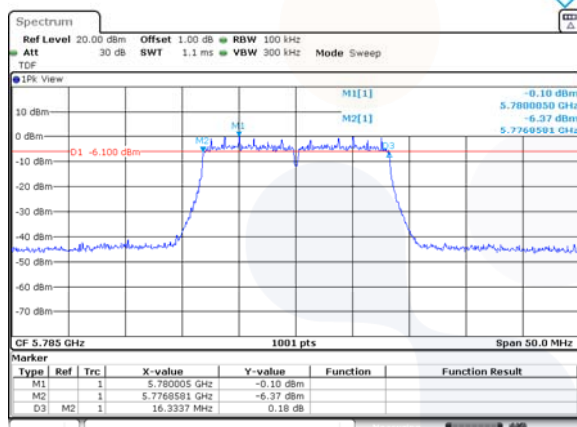


**99% bandwidth**

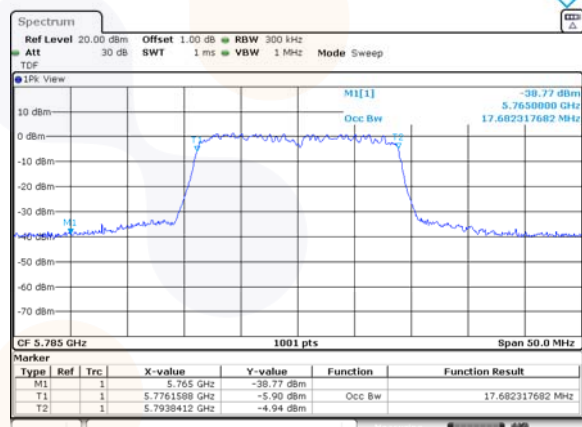
**UNII-3 / 802.11n HT20 / Low ch.**



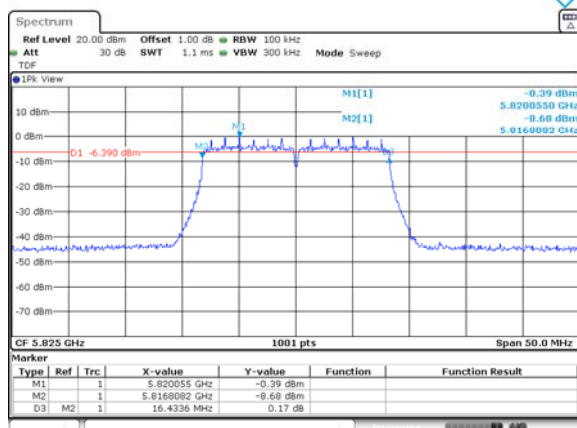
**UNII-3 / 802.11a / Mid ch.**



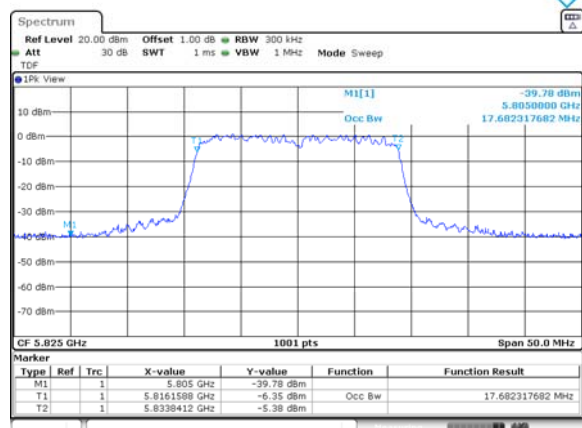
**UNII-3 / 802.11n HT20 / Mid ch.**



**UNII-3 / 802.11a / High ch.**



**UNII-3 / 802.11n HT20 / High ch.**





## 7.5. Straddle channel

### 26dB bandwidth & 99% Bandwidth

[DC 5 V]

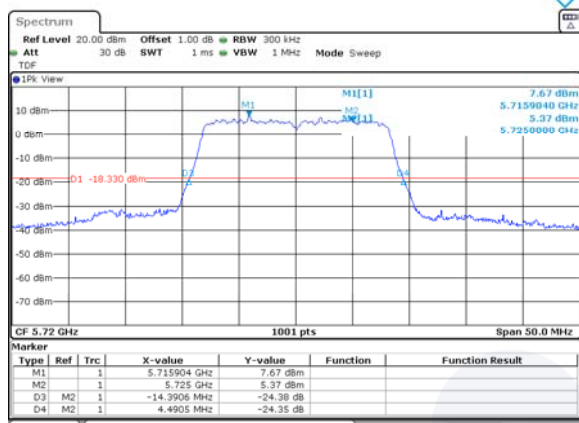
| Test mode      | Band    | Frequency (MHz) | 26dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|----------------|---------|-----------------|----------------------|---------------------|
| 802.11a        | UNII-2C | 5 720           | 14.39                | 16.43               |
| 802.11n HT20   |         |                 | 15.09                | 17.63               |
| 802.11ac VHT20 |         |                 | 14.89                | 17.63               |
| 802.11a        | UNII-3  | 5 720           | 4.49                 | -                   |
| 802.11n HT20   |         |                 | 4.89                 | -                   |
| 802.11ac VHT20 |         |                 | 4.84                 | -                   |

#### Notes:

- For 99% Bandwidth, measured 99% occupied bandwidth is separated as below
  - For UNII band 2C = 5725 MHz – T1(measured frequency on the marker table)
  - For UNII band 3 = T2(measured frequency on the marker table) – 5725 MHz

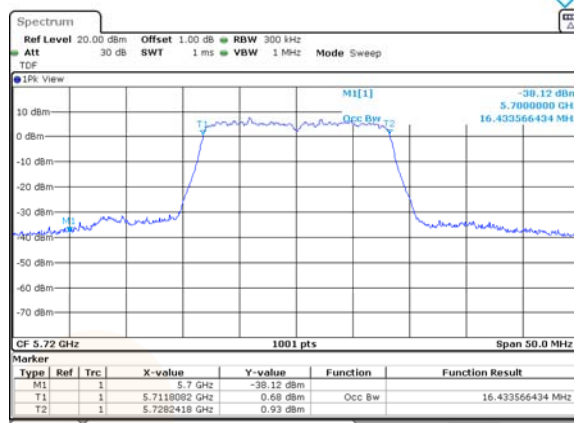
## 26 dB bandwidth

### 802.11a



## 99% bandwidth

### 802.11a



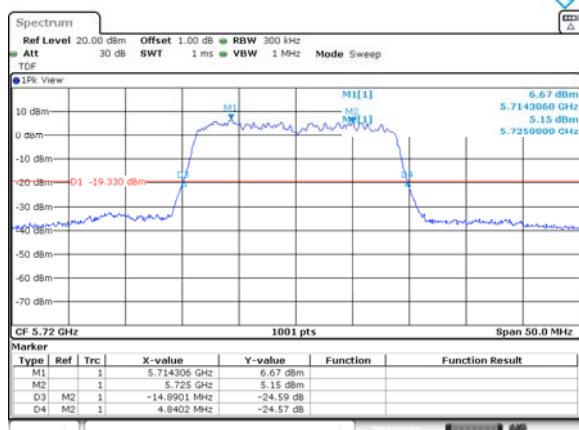
### 802.11n HT20



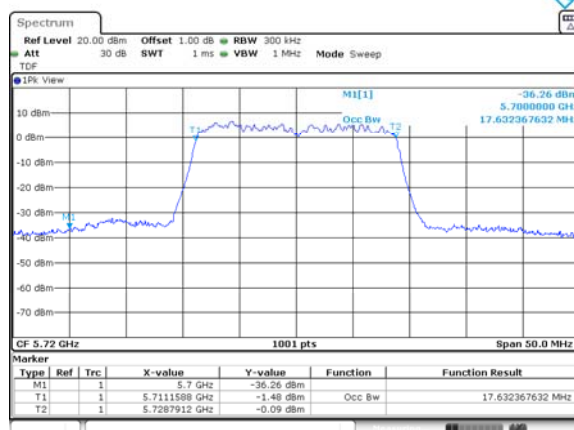
### 802.11n HT20



### 802.11ac VHT20



### 802.11ac VHT20



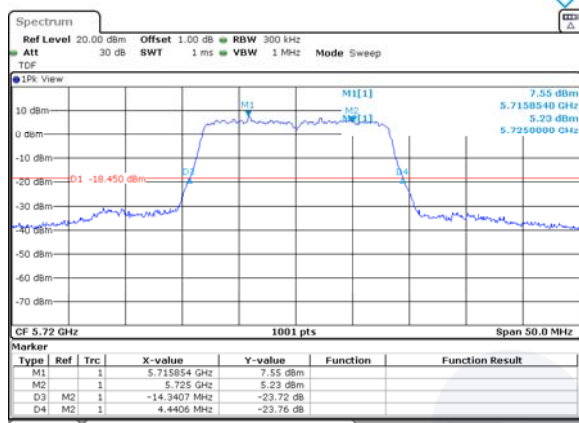
# **[DC 12 V]**

| Test mode      | Band    | Frequency (MHz) | 26dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|----------------|---------|-----------------|----------------------|---------------------|
| 802.11a        | UNII-2C | 5 720           | 14.34                | 16.43               |
| 802.11n HT20   |         |                 | 15.04                | 17.63               |
| 802.11ac VHT20 |         |                 | 14.94                | 17.63               |
| 802.11a        | UNII-3  | 5 720           | 4.44                 | -                   |
| 802.11n HT20   |         |                 | 4.89                 | -                   |
| 802.11ac VHT20 |         |                 | 4.84                 | -                   |

- For 99% Bandwidth, measured 99% occupied bandwidth is separated as below
  - For UNII band 2C = 5725 MHz – T1(measured frequency on the marker table)
  - For UNII band 3 = T2(measured frequency on the marker table) – 5725 MHz

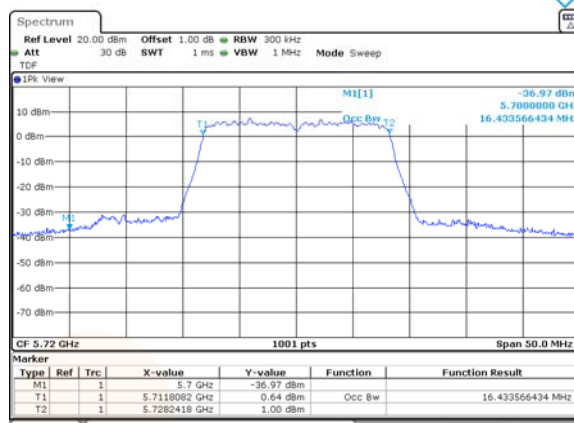
## 26 dB bandwidth

### 802.11a

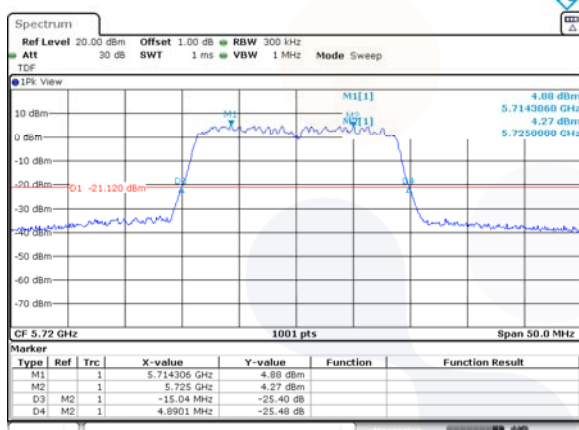


## 99% bandwidth

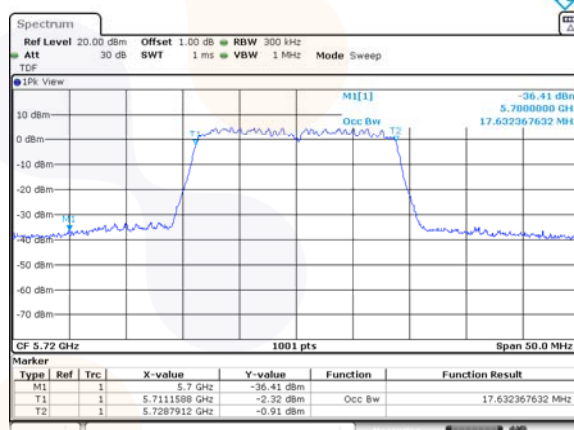
### 802.11a



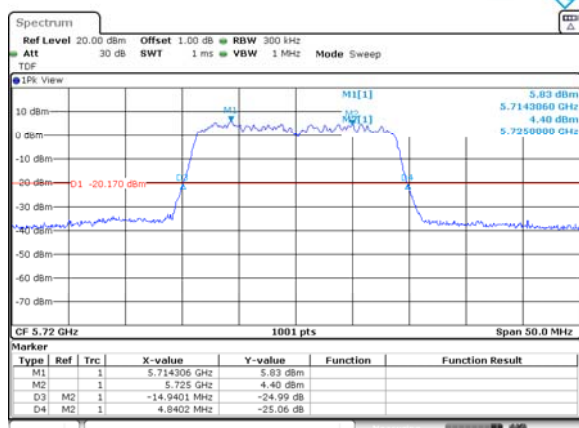
### 802.11n HT20



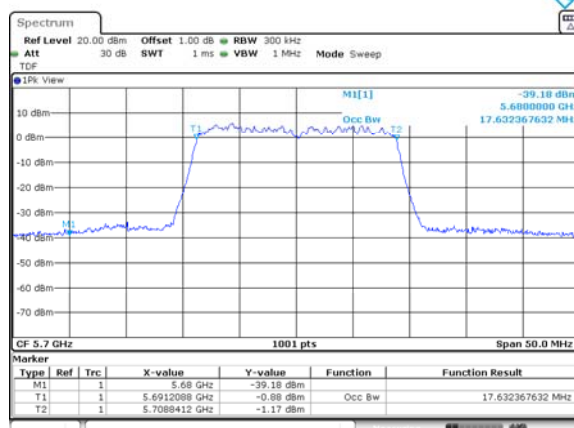
### 802.11n HT20



### 802.11ac VHT20



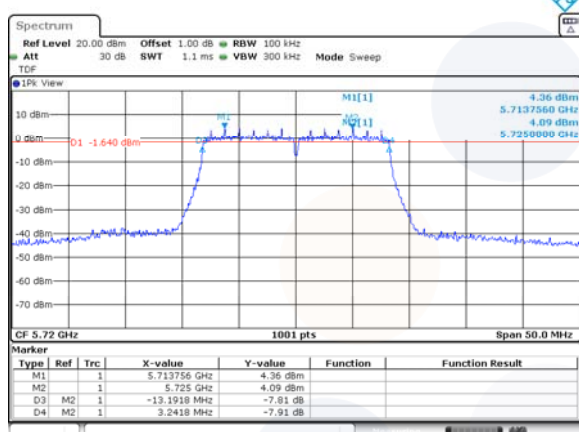
### 802.11ac VHT20



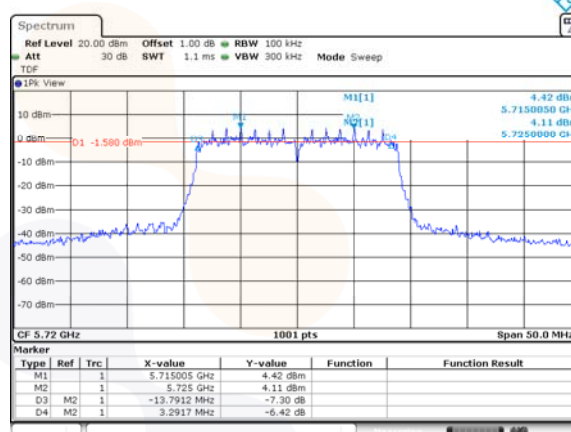
**6dB bandwidth**  
**[DC 5 V]**

| Test mode      | Band   | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) |
|----------------|--------|-----------------|---------------------|-------------|
| 802.11a        | UNII-3 | 5 720           | 3.24                | 0.50        |
| 802.11n HT20   |        |                 | 3.29                | 0.50        |
| 802.11ac VHT20 |        |                 | 3.29                | 0.50        |

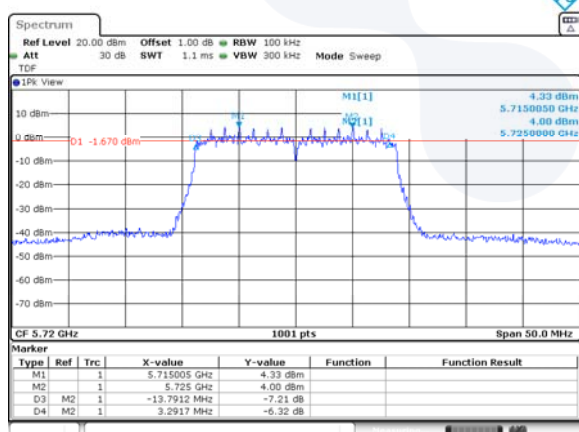
**802.11a**



**802.11n HT20**



**802.11ac VHT20**

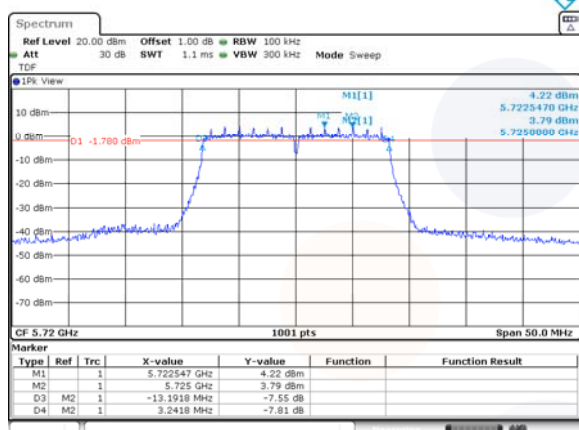


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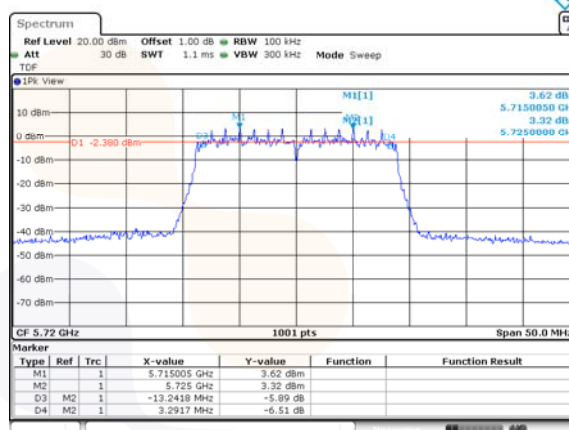
## [DC 12 V]

| Test mode      | Band   | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) |
|----------------|--------|-----------------|---------------------|-------------|
| 802.11a        | UNII-3 | 5 720           | 3.24                | 0.50        |
| 802.11n HT20   |        |                 | 3.29                | 0.50        |
| 802.11ac VHT20 |        |                 | 3.29                | 0.50        |

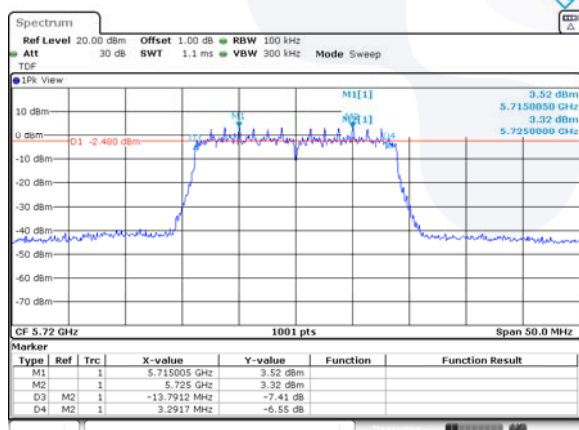
### 802.11a



### 802.11n HT20



### 802.11ac VHT20



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## [DC 5 V]

### Conducted Output Power

| Test mode      | Band    | Frequency (MHz) | Measured output power |          |              | Limit (dBm) |
|----------------|---------|-----------------|-----------------------|----------|--------------|-------------|
|                |         |                 | Reading (dBm)         | DCF (dB) | Result (dBm) |             |
| 802.11a        | UNII-2C | 5 720           | 14.91                 | -        | 14.91        | 23.39       |
|                | UNII-3  |                 | 8.66                  |          | 8.66         | 30.00       |
| 802.11n HT20   | UNII-2C | 5 720           | 14.57                 | 0.25     | 14.82        | 23.91       |
|                | UNII-3  |                 | 8.44                  |          | 8.69         | 30.00       |
| 802.11ac VHT20 | UNII-2C | 5 720           | 14.55                 | 0.24     | 14.79        | 23.98       |
|                | UNII-3  |                 | 8.52                  |          | 8.76         | 30.00       |

#### Notes:

1. Average result(dB m) = Average Reading (dB m) + DCF(dB)

### E.I.R.P

| Test mode      | Band    | Frequency (MHz) | Measured output power        |                |                    | MAX. e.i.r.p Limit (dBm) |
|----------------|---------|-----------------|------------------------------|----------------|--------------------|--------------------------|
|                |         |                 | Conducted output power (dBm) | ANT gain (dBi) | MAX. e.i.r.p (dBm) |                          |
| 802.11a        | UNII-2C | 5 720           | 14.91                        | -0.40          | 14.51              | 28.35                    |
|                | UNII-3  |                 | 8.66                         | -0.70          | 7.96               | 30.00                    |
| 802.11n HT20   | UNII-2C | 5 720           | 14.82                        | -0.40          | 14.42              | 28.60                    |
|                | UNII-3  |                 | 8.69                         | -0.70          | 7.99               | 30.00                    |
| 802.11ac VHT20 | UNII-2C | 5 720           | 14.79                        | -0.40          | 14.39              | 28.58                    |
|                | UNII-3  |                 | 8.76                         | -0.70          | 8.06               | 30.00                    |

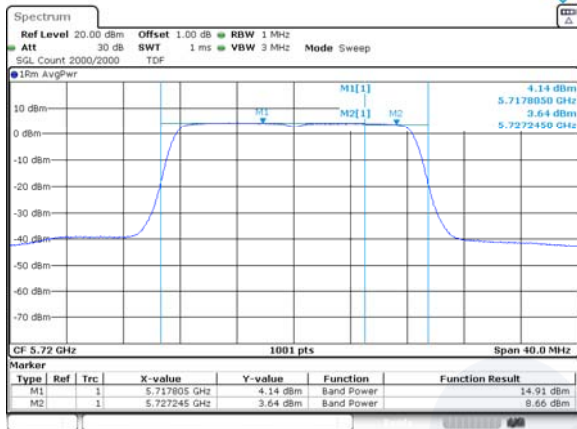
#### Notes:

1. e.i.r.p. Calculation:

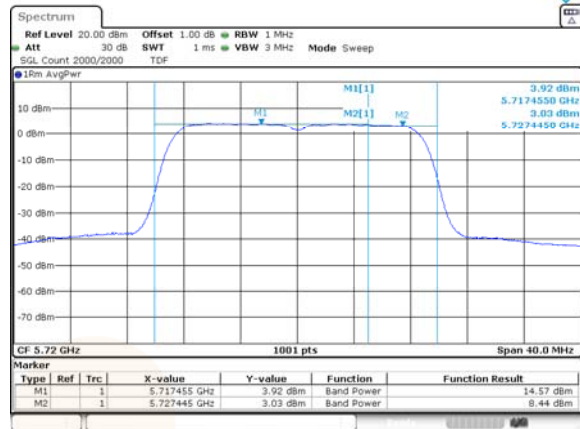
$$\text{e.i.r.p. (dB m)} = \text{Conducted output power (dB m)} + \text{Antenna gain (dB i)}$$



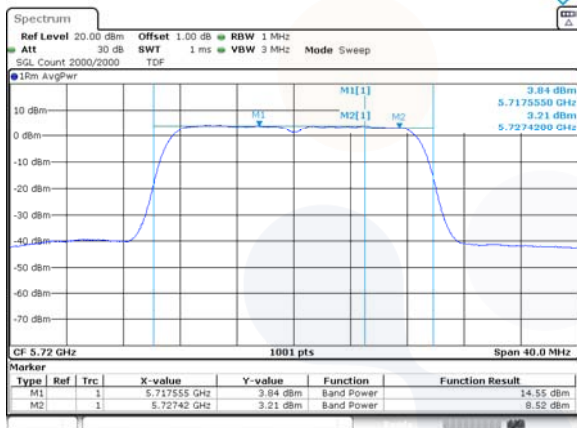
### 802.11a



### 802.11n HT20



### 802.11ac VHT20



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# [DC 12 V]

## Conducted Output Power

| Test mode      | Band    | Frequency (MHz) | Measured output power |          |              | Limit (dBm) |
|----------------|---------|-----------------|-----------------------|----------|--------------|-------------|
|                |         |                 | Reading (dBm)         | DCF (dB) | Result (dBm) |             |
| 802.11a        | UNII-2C | 5 720           | 14.83                 | -        | 14.83        | 23.39       |
|                | UNII-3  |                 | 8.58                  |          | 8.58         | 30.00       |
| 802.11n HT20   | UNII-2C | 5 720           | 13.70                 | 0.25     | 13.95        | 23.91       |
|                | UNII-3  |                 | 7.56                  |          | 7.81         | 30.00       |
| 802.11ac VHT20 | UNII-2C | 5 720           | 13.70                 | 0.24     | 13.94        | 23.98       |
|                | UNII-3  |                 | 7.67                  |          | 7.91         | 30.00       |

### Notes:

1. Average result(dB m) = Average Reading (dB m) + DCF(dB)

## E.I.R.P

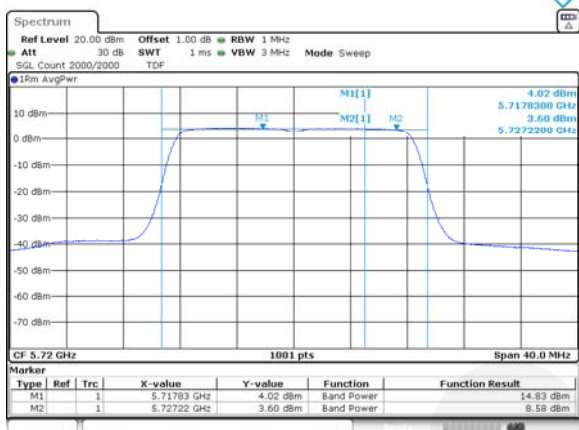
| Test mode      | Band    | Frequency (MHz) | Measured output power        |                |                    | MAX. e.i.r.p Limit (dBm) |
|----------------|---------|-----------------|------------------------------|----------------|--------------------|--------------------------|
|                |         |                 | Conducted output power (dBm) | ANT gain (dBi) | MAX. e.i.r.p (dBm) |                          |
| 802.11a        | UNII-2C | 5 720           | 14.83                        | -0.40          | 14.43              | 28.35                    |
|                | UNII-3  |                 | 8.58                         | -0.70          | 7.88               | 30.00                    |
| 802.11n HT20   | UNII-2C | 5 720           | 13.95                        | -0.40          | 13.55              | 28.60                    |
|                | UNII-3  |                 | 7.81                         | -0.70          | 7.11               | 30.00                    |
| 802.11ac VHT20 | UNII-2C | 5 720           | 13.94                        | -0.40          | 13.54              | 28.58                    |
|                | UNII-3  |                 | 7.91                         | -0.70          | 7.21               | 30.00                    |

### Notes:

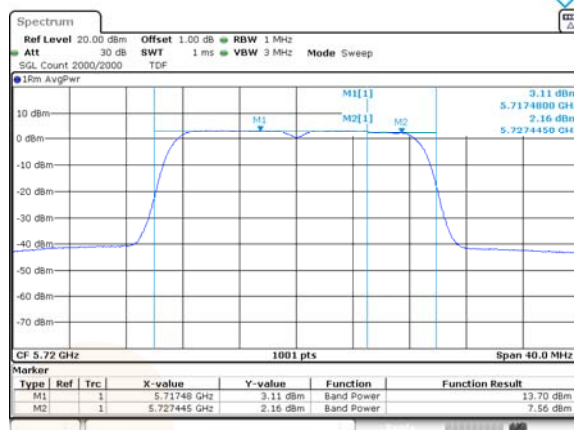
1. e.i.r.p. Calculation:

$$\text{e.i.r.p. (dB m)} = \text{Conducted output power (dB m)} + \text{Antenna gain (dB i)}$$

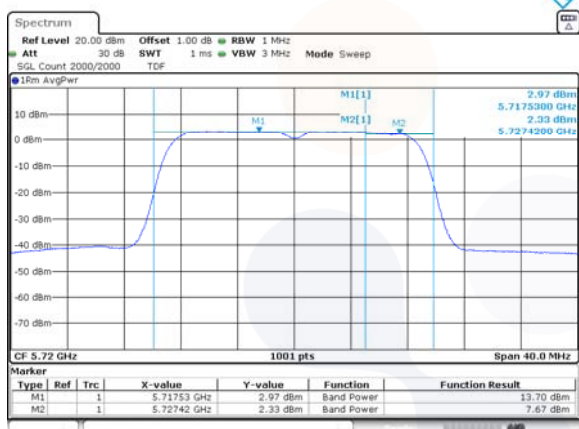
### 802.11a



### 802.11n HT20



### 802.11ac VHT20



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# [DC 5 V]

## Power Spectral Density

| Test mode      | Band    | Frequency (MHz) | Measured PSD (dBm/MHz) | DCF (dB) | Maximum PSD (dB m/MHz) | Limit (dBm/MHz) |
|----------------|---------|-----------------|------------------------|----------|------------------------|-----------------|
| 802.11a        | UNII-2C | 5 720           | 5.13                   | -        | 5.13                   | 11.00           |
| 802.11n HT20   |         |                 | 4.06                   | 0.25     | 4.31                   |                 |
| 802.11ac VHT20 |         |                 | 4.05                   | 0.24     | 4.29                   |                 |

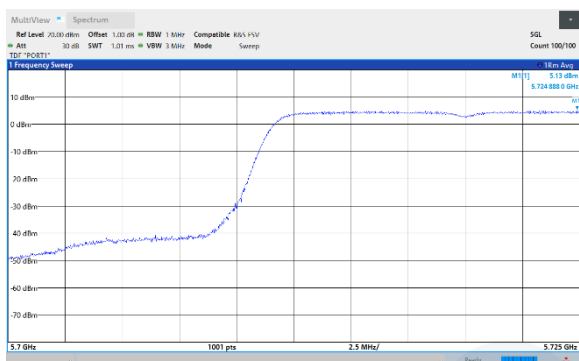
| Test mode      | Band   | Frequency (MHz) | Measured PSD (dBm/ 500 kHz) | DCF (dB) | Maximum PSD (dBm/ 500 kHz) | Limit (dBm /500 kHz) |
|----------------|--------|-----------------|-----------------------------|----------|----------------------------|----------------------|
| 802.11a        | UNII-3 | 5 720           | 2.44                        | -        | 2.44                       | 30.00                |
| 802.11n HT20   |        |                 | 1.37                        | 0.25     | 1.62                       |                      |
| 802.11ac VHT20 |        |                 | 1.53                        | 0.24     | 1.77                       |                      |

### Notes:

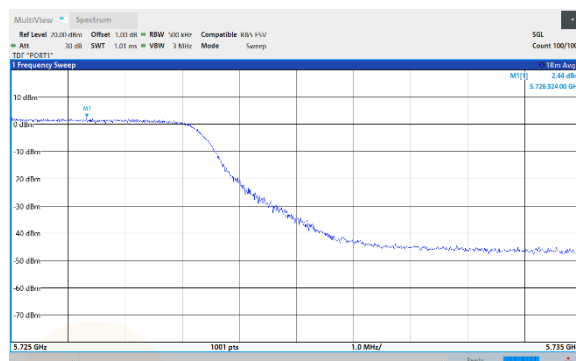
1. Maximum PSD calculation

- Maximum PSD = Measured PSD + D.C.F

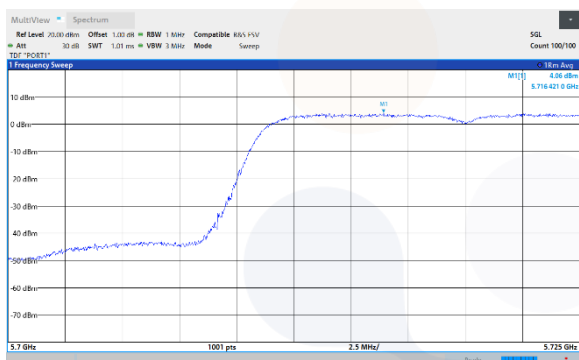
### UNII-2C / 802.11a



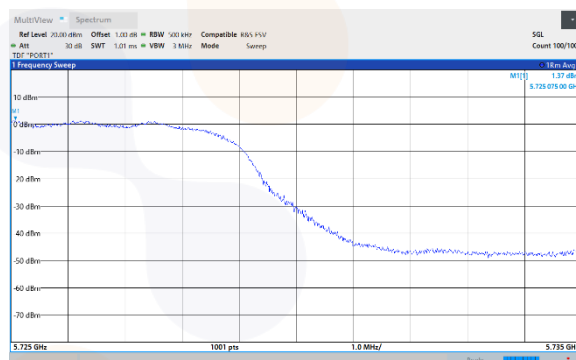
### UNII-3 / 802.11a



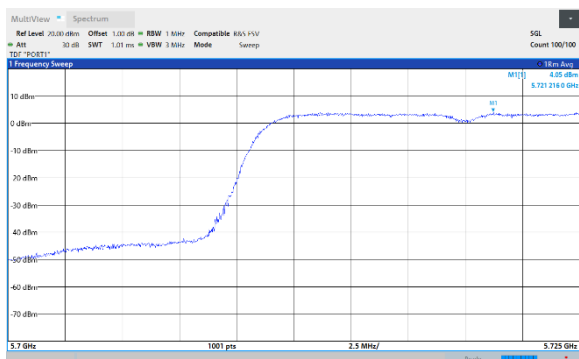
### UNII-2C / 802.11n HT20



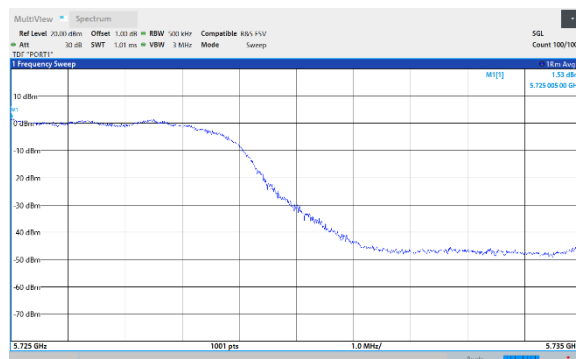
### UNII-3 / 802.11n HT20



### UNII-2C / 802.11ac VHT20



### UNII-3 / 802.11ac VHT20



# [DC 12 V]

## Power Spectral Density

| Test mode      | Band    | Frequency (MHz) | Measured PSD (dBm/MHz) | DCF (dB) | Maximum PSD (dB m/MHz) | Limit (dBm/MHz) |
|----------------|---------|-----------------|------------------------|----------|------------------------|-----------------|
| 802.11a        | UNII-2C | 5 720           | 5.02                   | -        | 5.02                   | 11.00           |
| 802.11n HT20   |         |                 | 4.11                   | 0.25     | 4.36                   |                 |
| 802.11ac VHT20 |         |                 | 3.80                   | 0.24     | 4.04                   |                 |

| Test mode      | Band   | Frequency (MHz) | Measured PSD (dBm/ 500 kHz) | DCF (dB) | Maximum PSD (dBm/ 500 kHz) | Limit (dBm /500 kHz) |
|----------------|--------|-----------------|-----------------------------|----------|----------------------------|----------------------|
| 802.11a        | UNII-3 | 5 720           | 2.21                        | -        | 2.21                       | 30.00                |
| 802.11n HT20   |        |                 | 1.50                        | 0.25     | 1.75                       |                      |
| 802.11ac VHT20 |        |                 | 1.44                        | 0.24     | 1.68                       |                      |

### Notes:

1. Maximum PSD calculation

- Maximum PSD = Measured PSD + D.C.F