



**FCC 47 CFR PART 15 SUBPART E**

**UNII**

**CERTIFICATION TEST REPORT**

**FOR**

**GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC**

**MODEL NUMBER : SM-A710F/DS, SM-A710F**

**FCC ID: A3LSMA710F**

**REPORT NUMBER: 15K22125-E6**

**ISSUE DATE: NOV 26, 2015**

*Prepared for*  
**SAMSUNG ELECTRONICS CO., LTD.**  
**129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,**  
**GYEONGGI-DO, 16677, KOREA**

*Prepared by*  
**UL Korea, Ltd. Suwon Laboratory**  
**218 Maeyeong-ro, Yeongtong-gu,**  
**Suwon-si, Gyeonggi-do, 16675, Korea**  
**TEL: (031) 337-9902**  
**FAX: (031) 213-5433**



Revision History

| Rev. | Issue Date | Revisions     | Revised By  |
|------|------------|---------------|-------------|
| --   | 11/26/15   | Initial issue | Junwhan Lee |

## TABLE OF CONTENTS

|                                                             |           |
|-------------------------------------------------------------|-----------|
| <b>1. ATTESTATION OF TEST RESULTS .....</b>                 | <b>6</b>  |
| <b>2. TEST METHODOLOGY .....</b>                            | <b>7</b>  |
| <b>3. FACILITIES AND ACCREDITATION .....</b>                | <b>7</b>  |
| <b>4. CALIBRATION AND UNCERTAINTY .....</b>                 | <b>7</b>  |
| 4.1. MEASURING INSTRUMENT CALIBRATION .....                 | 7         |
| 4.2. SAMPLE CALCULATION .....                               | 7         |
| 4.3. MEASUREMENT UNCERTAINTY .....                          | 8         |
| <b>5. EQUIPMENT UNDER TEST .....</b>                        | <b>9</b>  |
| 5.1. DESCRIPTION OF EUT .....                               | 9         |
| 5.2. MAXIMUM OUTPUT POWER .....                             | 9         |
| 5.3. DESCRIPTION OF AVAILABLE ANTENNAS .....                | 10        |
| 5.4. WORST-CASE CONFIGURATION AND MODE .....                | 10        |
| 5.5. DESCRIPTION OF TEST SETUP .....                        | 11        |
| <b>6. TEST AND MEASUREMENT EQUIPMENT .....</b>              | <b>13</b> |
| <b>7. SUMMARY TABLE .....</b>                               | <b>14</b> |
| <b>8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS .....</b> | <b>15</b> |
| 8.1. ON TIME AND DUTY CYCLE RESULTS .....                   | 15        |
| 8.2. DUTY CYCLE PLOTS .....                                 | 15        |
| <b>9. MEASUREMENT METHOD .....</b>                          | <b>17</b> |
| <b>10. ANTENNA PORT TEST RESULTS .....</b>                  | <b>18</b> |
| 10.1. 6 dB BANDWIDTH .....                                  | 18        |
| 10.1.1. 802.11a MODE IN THE 5.8 GHz BAND .....              | 19        |
| 10.1.2. 802.11n HT20 MODE IN THE 5.8 GHz BAND .....         | 19        |
| 10.1.3. 802.11n HT40 MODE IN THE 5.8 GHz BAND .....         | 19        |
| 10.1.4. 6 dB BANDWIDTH PLOTS .....                          | 20        |
| 10.2. 26 dB BANDWIDTH .....                                 | 23        |
| 10.2.1. 802.11a MODE IN THE 5.2 GHz BAND .....              | 24        |
| 10.2.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND .....         | 24        |
| 10.2.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND .....         | 24        |
| 10.2.4. 802.11a MODE IN THE 5.3 GHz BAND .....              | 25        |
| 10.2.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND .....         | 25        |
| 10.2.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND .....         | 25        |
| 10.2.7. 802.11a MODE IN THE 5.5 GHz BAND .....              | 26        |
| 10.2.8. 802.11n HT20 MODE IN THE 5.5 GHz BAND .....         | 26        |

|          |                                                           |     |
|----------|-----------------------------------------------------------|-----|
| 10.2.9.  | 802.11n HT40 MODE IN THE 5.5 GHz BAND.....                | 26  |
| 10.2.10. | 802.11a MODE IN THE 5.8 GHz BAND.....                     | 27  |
| 10.2.11. | 802.11n HT20 MODE IN THE 5.8 GHz BAND.....                | 27  |
| 10.2.12. | 802.11n HT40 MODE IN THE 5.8 GHz BAND.....                | 27  |
| 10.2.13. | 26 dB BANDWIDTH PLOTS.....                                | 28  |
| 10.3.    | 99% BANDWIDTH.....                                        | 40  |
| 10.3.1.  | 802.11a MODE IN THE 5.2 GHz BAND.....                     | 41  |
| 10.3.2.  | 802.11n HT20 MODE IN THE 5.2 GHz BAND.....                | 41  |
| 10.3.3.  | 802.11n HT40 MODE IN THE 5.2 GHz BAND.....                | 41  |
| 10.3.4.  | 802.11a MODE IN THE 5.3 GHz BAND.....                     | 42  |
| 10.3.5.  | 802.11n HT20 MODE IN THE 5.3 GHz BAND.....                | 42  |
| 10.3.6.  | 802.11n HT40 MODE IN THE 5.3 GHz BAND.....                | 42  |
| 10.3.7.  | 802.11a MODE IN THE 5.5 GHz BAND.....                     | 42  |
| 10.3.8.  | 802.11n HT20 MODE IN THE 5.5 GHz BAND.....                | 43  |
| 10.3.9.  | 802.11n HT40 MODE IN THE 5.5 GHz BAND.....                | 43  |
| 10.3.10. | 802.11a MODE IN THE 5.8 GHz BAND.....                     | 43  |
| 10.3.11. | 802.11n HT20 MODE IN THE 5.8 GHz BAND.....                | 44  |
| 10.3.12. | 802.11n HT40 MODE IN THE 5.8 GHz BAND.....                | 44  |
| 10.3.13. | 99% BANDWIDTH PLOTS.....                                  | 45  |
| 10.4.    | OUTPUT POWER AND PPSD.....                                | 57  |
| 10.4.1.  | 802.11a MODE IN THE 5.2 GHz BAND.....                     | 58  |
| 10.4.2.  | 802.11n HT20 MODE IN THE 5.2 GHz BAND.....                | 59  |
| 10.4.3.  | 802.11n HT40 MODE IN THE 5.2 GHz BAND.....                | 60  |
| 10.4.4.  | 802.11a MODE IN THE 5.3 GHz BAND.....                     | 61  |
| 10.4.5.  | 802.11n HT20 MODE IN THE 5.3 GHz BAND.....                | 62  |
| 10.4.6.  | 802.11n HT40 MODE IN THE 5.3 GHz BAND.....                | 63  |
| 10.4.7.  | 802.11a MODE IN THE 5.5 GHz BAND.....                     | 64  |
| 10.4.8.  | 802.11n HT20 MODE IN THE 5.5 GHz BAND.....                | 65  |
| 10.4.9.  | 802.11n HT40 MODE IN THE 5.5 GHz BAND.....                | 66  |
| 10.4.10. | 802.11a MODE IN THE 5.8 GHz BAND.....                     | 67  |
| 10.4.11. | 802.11n HT20 MODE IN THE 5.8 GHz BAND.....                | 68  |
| 10.4.12. | 802.11n HT40 MODE IN THE 5.8 GHz BAND.....                | 69  |
| 10.4.13. | 802.11a MODE AT STRADDLE CHANNEL.....                     | 70  |
| 10.4.14. | 802.11n HT20 MODE AT STRADDLE CHANNEL.....                | 71  |
| 10.4.15. | 802.11n HT40 MODE AT STRADDLE CHANNEL.....                | 72  |
| 10.4.16. | OUTPUT POWER AND PPSD PLOTS.....                          | 73  |
| 11.      | TRANSMITTER ABOVE 1 GHz.....                              | 85  |
| 11.1.    | 5.2 GHz.....                                              | 86  |
| 11.1.1.  | TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND.....      | 86  |
| 11.1.2.  | TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND..... | 94  |
| 11.1.3.  | TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND..... | 102 |
| 11.2.    | 5.3 GHz.....                                              | 108 |
| 11.2.1.  | TX ABOVE 1 GHz 802.11a MODE IN THE 5.3 GHz BAND.....      | 108 |
| 11.2.2.  | TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND..... | 116 |
| 11.2.3.  | TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND..... | 124 |
| 11.3.    | 5.5-5.6 GHz.....                                          | 130 |
| 11.3.1.  | TX ABOVE 1 GHz 802.11a MODE IN THE 5.5 GHz BAND.....      | 130 |

|         |                                                           |     |
|---------|-----------------------------------------------------------|-----|
| 11.3.2. | TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.5 GHz BAND..... | 140 |
| 11.3.3. | TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.5 GHz BAND..... | 150 |
| 11.4.   | 5.8 GHz.....                                              | 160 |
| 11.4.1. | TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND.....      | 160 |
| 11.4.2. | TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.8 GHz BAND..... | 172 |
| 11.4.3. | TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.8 GHz BAND..... | 184 |
| 12.     | WORST-CASE BELOW 1 GHz (in the 5.3 GHz Band) .....        | 194 |
| 13.     | AC POWER LINE CONDUCTED EMISSIONS.....                    | 196 |
| 14.     | DYNAMIC FREQUENCY SELECTION.....                          | 201 |
| 14.1.   | OVERVIEW .....                                            | 201 |
| 14.1.1. | LIMITS.....                                               | 201 |
| 14.1.1. | TEST AND MEASUREMENT SYSTEM.....                          | 205 |
| 14.1.2. | SETUP OF EUT .....                                        | 208 |
| 14.1.3. | DESCRIPTION OF EUT .....                                  | 209 |
| 14.2.   | RESULTS FOR 20 MHz BANDWIDTH.....                         | 210 |
| 14.2.1. | TEST CHANNEL.....                                         | 210 |
| 14.2.2. | RADAR WAVEFORM AND TRAFFIC.....                           | 210 |
| 14.2.3. | OVERLAPPING CHANNEL TESTS.....                            | 212 |
| 14.2.4. | MOVE AND CLOSING TIME.....                                | 212 |
| 14.3.   | RESULTS FOR 40 MHz BANDWIDTH.....                         | 215 |
| 14.3.1. | TEST CHANNEL.....                                         | 215 |
| 14.3.2. | RADAR WAVEFORM AND TRAFFIC.....                           | 215 |
| 14.3.3. | OVERLAPPING CHANNEL TESTS.....                            | 217 |
| 14.3.4. | MOVE AND CLOSING TIME.....                                | 217 |
| 15.     | SETUP PHOTOS .....                                        | 220 |

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SAMSUNG ELECTRONICS CO., LTD.  
**EUT DESCRIPTION:** GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC  
**MODEL NUMBER:** SM-A710F/DS, SM-A710F  
**SERIAL NUMBER:** R38GA0JTKBJ (RADIATED); R38GA0JQBRZ (CONDUCTED)  
**DATE TESTED:** OCT 29, 2015 - NOV 26, 2015

| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart E | Pass         |

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For  
UL Korea, Ltd. By:



CY Choi  
Suwon Lab Engineer  
UL Korea, Ltd.

Tested By:



Junwhan Lee  
Suwon Lab Engineer  
UL Korea, Ltd.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033 D02 v01, ANSI C63.10-2009.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 218 Maeyeong-ro                               |
|-----------------------------------------------|
| <input checked="" type="checkbox"/> Chamber 1 |
| <input checked="" type="checkbox"/> Chamber 2 |

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 2.32 dB     |
| Radiated Disturbance, Below 1GHz      | 4.14 dB     |
| Radiated Disturbance, Above 1 GHz     | 5.97 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC.  
This test report addresses the NII (UNII) operational mode.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

| Frequency Range [MHz] | Mode         | Output Power |       |
|-----------------------|--------------|--------------|-------|
|                       |              | [dBm]        | [mW]  |
| 5180 - 5240           | 802.11a      | 12.47        | 17.65 |
|                       | 802.11n HT20 | 12.52        | 17.85 |
| 5190 - 5230           | 802.11n HT40 | 11.52        | 14.18 |
| 5260 - 5320           | 802.11a      | 12.64        | 18.38 |
|                       | 802.11n HT20 | 12.46        | 17.62 |
| 5270 - 5310           | 802.11n HT40 | 11.87        | 15.37 |
| 5500 - 5720           | 802.11a      | 12.56        | 18.02 |
|                       | 802.11n HT20 | 12.40        | 17.38 |
| 5510 - 5710           | 802.11n HT40 | 11.89        | 15.45 |
| 5745 - 5825           | 802.11a      | 12.88        | 19.39 |
|                       | 802.11n HT20 | 12.79        | 19.02 |
| 5755 - 5795           | 802.11n HT40 | 11.51        | 14.15 |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of:

| Frequency Range<br>[MHz] |      | Antenna Gain<br>[dBi] |
|--------------------------|------|-----------------------|
| UNII 1<br>5150 – 5250    | 5150 | -0.99                 |
|                          | 5200 | -0.78                 |
| UNII 2A<br>5250 – 5350   | 5300 | -1.02                 |
| UNII 2C<br>5470 – 5725   | 5500 | -1.56                 |
|                          | 5600 | -1.32                 |
|                          | 5700 | -1.34                 |
| UNII 3<br>5725 – 5825    | 5800 | -0.87                 |

### 5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that the X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in the Z orientation.

Based on the baseline scan, the worst-case data rates were:

802.11a mode: 6 Mbps  
802.11n HT20mode: MCS0  
802.11n HT40mode: MCS0  
802.11ac VHT80mode: MCS0

## 5.5. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |            |                |        |
|------------------------|--------------|------------|----------------|--------|
| Description            | Manufacturer | Model      | Serial Number  | FCC ID |
| Charger                | SAMSUNG      | EP-TA20EWE | R37G8H02Q92SE3 | N/A    |
| Data Cable             | SAMSUNG      | ECB-DU4AWE | N/A            | N/A    |
| Earphone               | SAMSUNG      | EHS64AVFWE | N/A            | N/A    |

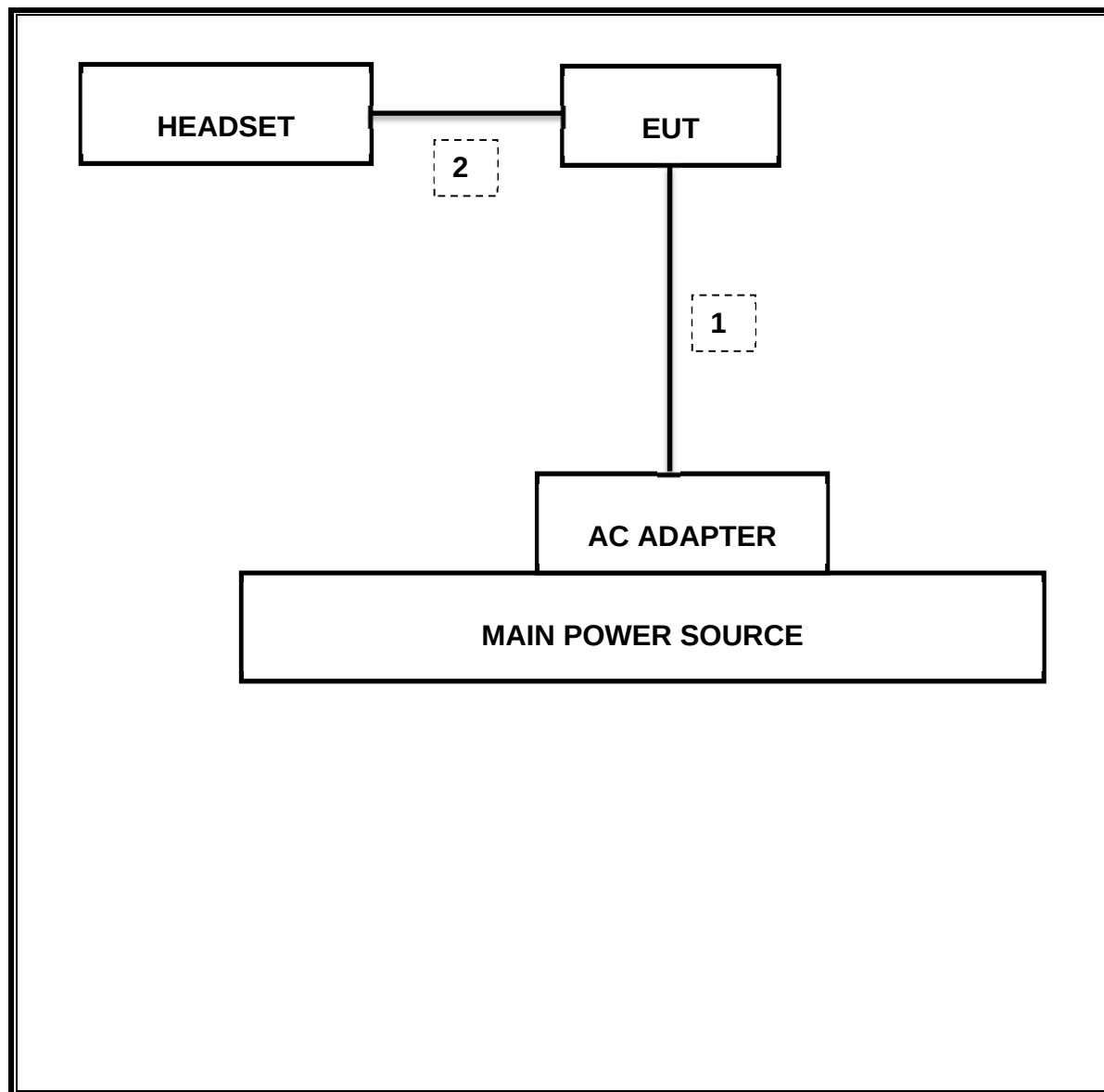
### I/O CABLES

| I/O Cable List |          |                      |                |            |                  |         |
|----------------|----------|----------------------|----------------|------------|------------------|---------|
| Cable No       | Port     | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1              | DC Power | 1                    | Mini-USB       | Shielded   | 0.8m             | N/A     |
| 2              | Audio    | 1                    | Mini-Jack      | Unshielded | 1.0m             | N/A     |

### TEST SETUP

The EUT is a stand-alone unit during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Test Equipment List        |               |                        |             |          |
|----------------------------|---------------|------------------------|-------------|----------|
| Description                | Manufacturer  | Model                  | S/N         | Cal Due  |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK   | VULB9163               | 749         | 04-25-16 |
| Antenna, Horn, 18 GHz      | ETS           | 3115                   | 00161451    | 05-17-16 |
| Antenna, Horn, 18 GHz      | ETS           | 3117                   | 00168724    | 06-17-16 |
| Antenna, Horn, 18 GHz      | ETS           | 3117                   | 00168717    | 06-17-16 |
| Antenna, Horn, 40 GHz      | ETS           | 3116C                  | 00166255    | 09-23-16 |
| Antenna, Horn, 40 GHz      | ETS           | 3116C-PA               | 00168841    | 09-29-16 |
| Preamplifier, 1000 MHz     | Sonoma        | 310N                   | 341282      | 08-18-16 |
| Preamplifier, 1000 MHz     | Sonoma        | 310N                   | 351741      | 08-18-16 |
| Preamplifier, 18 GHz       | Miteq         | AFS42-00101800-25-S-42 | 1876511     | 08-18-16 |
| Preamplifier, 18 GHz       | Miteq         | AFS42-00101800-25-S-42 | 1896138     | 08-18-16 |
| Spectrum Analyzer, 44 GHz  | Agilent / HP  | N9030A                 | MY54170614  | 08-19-16 |
| Spectrum Analyzer, 44 GHz  | Agilent / HP  | N9030A                 | MY54490312  | 08-19-16 |
| Bluetooth Tester           | TESCOM        | TC-3000C               | 3000C000546 | 08-18-16 |
| Average Power Sensor       | R&S           | NRZ-Z91                | 102681      | 08-18-16 |
| Average Power Sensor       | Agilent / HP  | U2000                  | MY54270007  | 08-18-16 |
| EMI Test Receive, 40 GHz   | R&S           | ESU40                  | 100439      | 08-19-16 |
| EMI Test Receive, 40 GHz   | R&S           | ESU40                  | 100457      | 08-19-16 |
| EMI Test Receive, 3 GHz    | R&S           | ESR3                   | 101832      | 08-19-16 |
| Attenuator / Switch driver | HP            | 11713A                 | 3748A04272  | N/A      |
| Low Pass Filter 3GHz       | Micro-Tronics | LPS17541               | 009         | 08-18-16 |
| Low Pass Filter 3GHz       | Micro-Tronics | LPS17541               | 015         | 08-18-16 |
| High Pass Filter 5GHz      | Micro-Tronics | HPS17542               | 009         | 08-18-16 |
| High Pass Filter 6GHz      | Micro-Tronics | HPM17543               | 010         | 08-18-16 |
| High Pass Filter 5GHz      | Micro-Tronics | HPS17542               | 016         | 08-18-16 |
| High Pass Filter 6GHz      | Micro-Tronics | HPM17543               | 015         | 08-18-16 |
| LISN                       | R&S           | ENV-216                | 101836      | 08-19-16 |
| LISN                       | R&S           | ENV-216                | 101837      | 08-19-16 |

## 7. SUMMARY TABLE

| FCC Part Section    | Test Description                                 | Test Limit               | Test Condition       | Test Result | Worst Case               |
|---------------------|--------------------------------------------------|--------------------------|----------------------|-------------|--------------------------|
| 15.407 (a)          | Occupied Band width (26dB)                       | N/A                      | Conducted            | Pass        | 39.79 MHz                |
| 15.407              | 6dB Band width (5.8Ghz)                          | 500KHz                   |                      | Pass        | 2.749 MHz (Straddle Ch.) |
| 15.407 (a)(2)       | TX Cond. Power 5.15-2.25, 5.25-5.35 & 5.47-5.725 | <24dBm or 11+10Log(OBW)  |                      | Pass        | 12.644 dBm (AV)          |
| 15.407 (a)(3)       | TX Cond. Power 5.725-5.825                       | < 30dBm or 17+10Log(OBW) |                      | Pass        | 12.849 dBm (AV)          |
| 15.407 (a)(5)       | PSD (5.2,5.3,5.5GHz)                             | <11dBm                   |                      | Pass        | 3.26 dBm (AV)            |
| 15.407 (a)(5)       | PSD (5.8GHz)                                     | 30dBm per 500kHz         |                      | Pass        | 0.52 dBm (AV)            |
| 15.207 (a)          | AC Power Line conducted emissions                | Section 10               | Radiated             | Pass        | 44.21 dBuV (QP)          |
| 15.407 (b) & 15.209 | Radiated Spurious Emission                       | < 68.2dBuV/m             |                      | Pass        | 64.59 dBuV/m (QP)        |
| 15.407 (h)(2)       | Dynamic Frequency Selection                      | N/A                      | Radiated / Conducted | Pass        | N/A                      |

## 8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

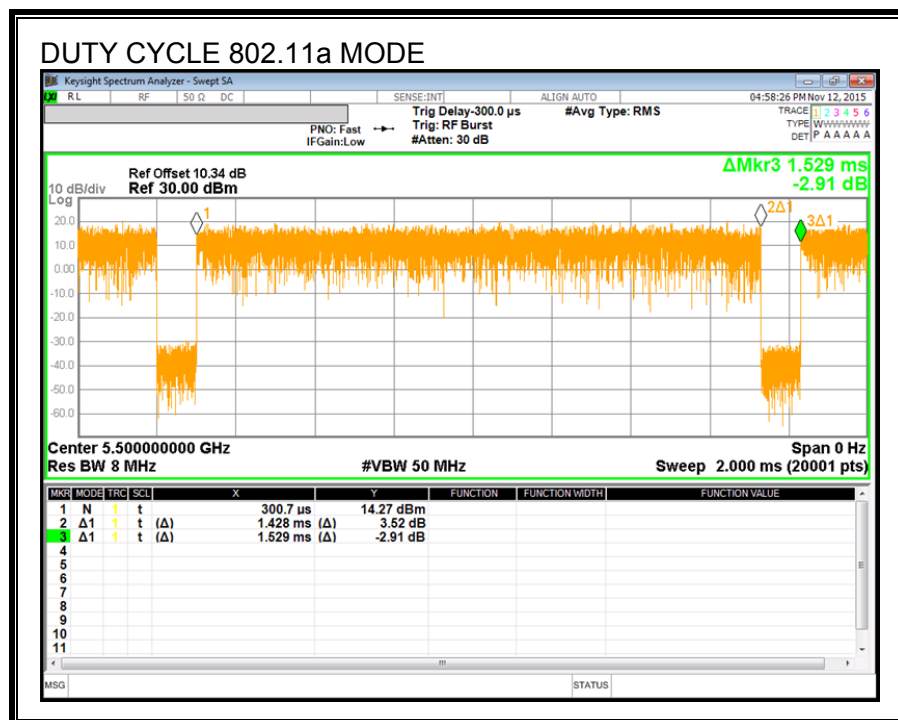
### LIMITS

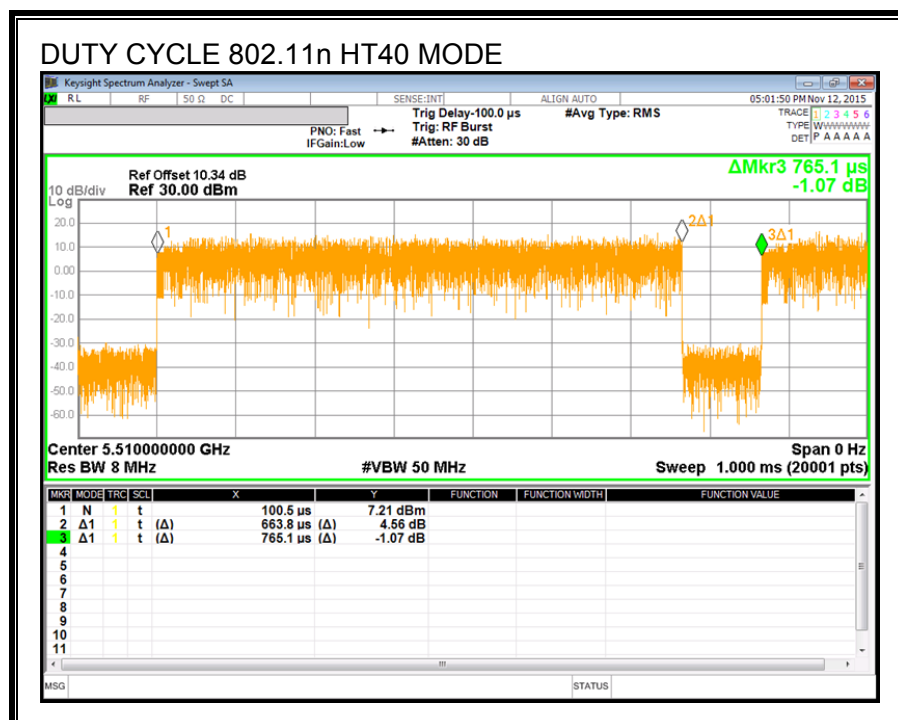
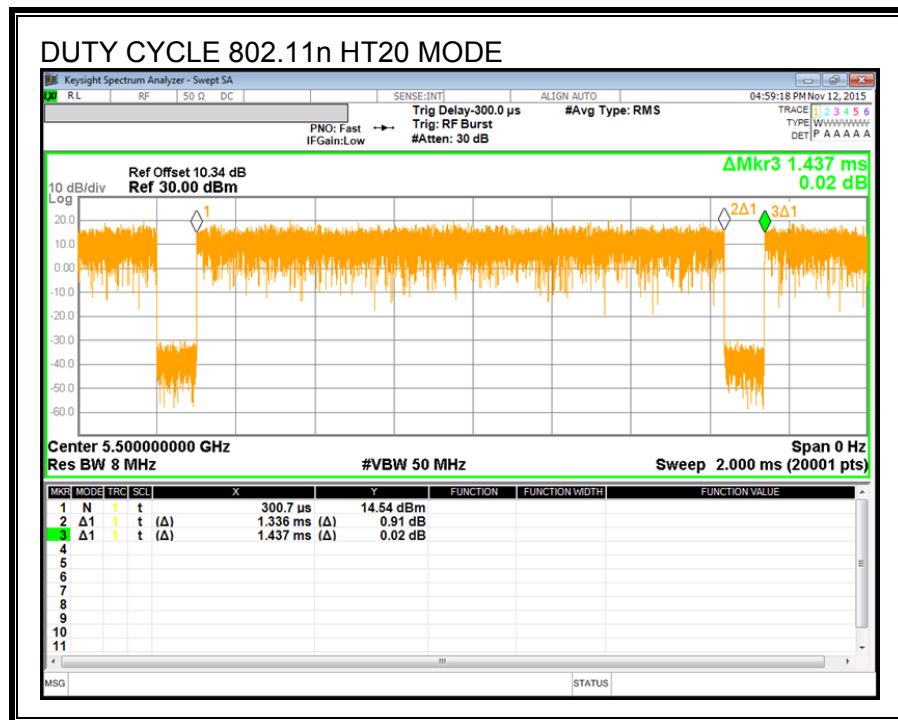
None; for reporting purposes only.

### 8.1. ON TIME AND DUTY CYCLE RESULTS

| Mode         | ON Time<br>B<br>[msec] | Period<br>[msec] | Duty Cycle<br>x<br>[linear] | Duty<br>Cycle<br>[%] | Duty Cycle<br>Correction Factor<br>[dB] | 1/T<br>Minimum VBW<br>[kHz] |
|--------------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| 802.11a      | 1.428                  | 1.529            | 0.934                       | 93.4%                | 0.30                                    | 0.700                       |
| 802.11n HT20 | 1.336                  | 1.437            | 0.930                       | 93.0%                | 0.32                                    | 0.749                       |
| 802.11n HT40 | 0.664                  | 0.765            | 0.868                       | 86.8%                | 0.62                                    | 1.506                       |

### 8.2. DUTY CYCLE PLOTS





## 9. MEASUREMENT METHOD

KDB 789033 D02 General UNII Test Procedures New Rules v01  
KDB 905462 D03 Clients Without Radar Detection New Rules v01r01

The Duty Cycle is less than 98% and consistent therefore KDB 789033 Method SA-2 is used for power and PPSD

The Duty Cycle is less than 98% and consistent, KDB 789033 Method AD with Power RMS Averaging and duty cycle correction is used.

Straddle Channels: KDB 644545 D03 v01

## 10. ANTENNA PORT TEST RESULTS

### 10.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.407

The minimum 6 dB bandwidth shall be at least 500 kHz.

#### TEST PROCEDURE

Reference to 789033 D02 General UNII Test Procedures New Rules v01: The transmitter output is connected to a spectrum analyzer with the RBW set to 100KHz, the VBW  $\geq 3 \times$  RBW, peak detector and max hold.

#### RESULTS

- Calculation for 6dB Bandwidth of UNII-3 Straddle Channel

ex) 802.11a mode

- o Fundamental frequency : 5720MHz
- o 6dB BW : 16.313MHz
- o Starting Frequency of UNII-3 band : 5725MHz
- o 6dB Bandwidth of UNII-3 band Portion  
 $= (5720 + (16.313 / 2) - 5725) = 3.156 \text{ MHz}$

**10.1.1. 802.11a MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 6 dB Bandwidth [MHz] | Minimum Limit [MHz] |
|----------|-----------------|----------------------|---------------------|
| Straddle | 5720            | 3.159                | 0.5                 |
| Low      | 5745            | 16.330               | 0.5                 |
| Mid      | 5785            | 16.306               | 0.5                 |
| High     | 5825            | 16.294               | 0.5                 |
| Worst    |                 | 3.159                |                     |

**10.1.2. 802.11n HT20 MODE IN THE 5.8 GHz BAND**

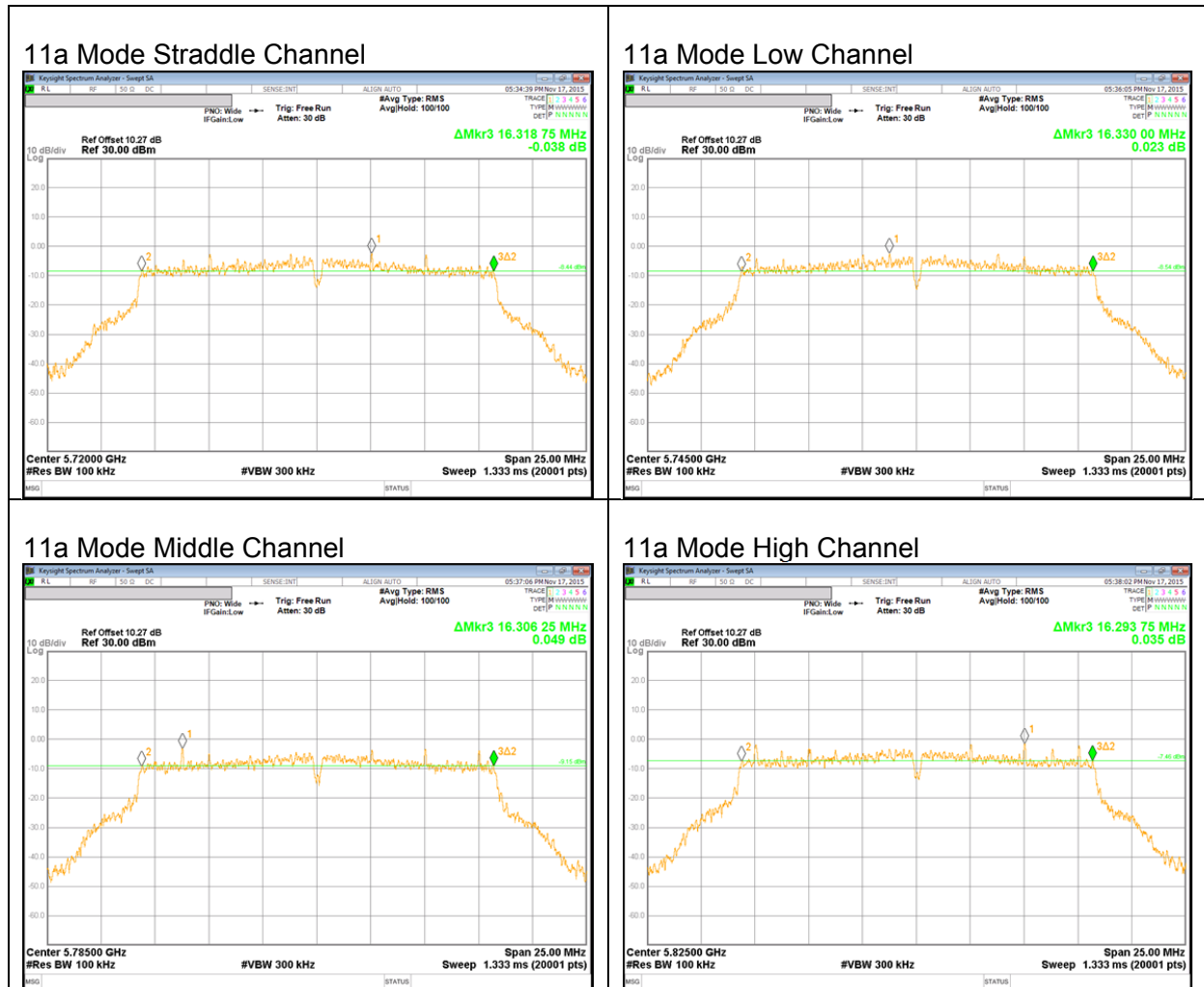
| Channel  | Frequency [MHz] | 6 dB Bandwidth [MHz] | Minimum Limit [MHz] |
|----------|-----------------|----------------------|---------------------|
| Straddle | 5720            | 3.506                | 0.5                 |
| Low      | 5745            | 17.524               | 0.5                 |
| Mid      | 5785            | 16.884               | 0.5                 |
| High     | 5825            | 17.518               | 0.5                 |
| Worst    |                 | 3.506                |                     |

**10.1.3. 802.11n HT40 MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 6 dB Bandwidth [MHz] | Minimum Limit [MHz] |
|----------|-----------------|----------------------|---------------------|
| Straddle | 5710            | 2.749                | 0.5                 |
| Low      | 5765            | 35.663               | 0.5                 |
| High     | 5795            | 36.025               | 0.5                 |
| Worst    |                 | 2.749                |                     |

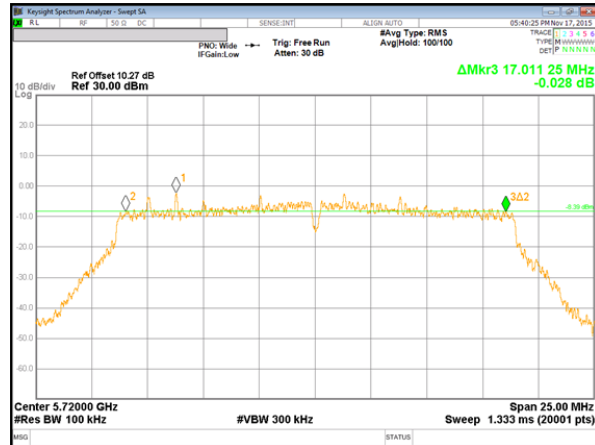
## 10.1.4. 6 dB BANDWIDTH PLOTS

### IEEE 802.11a mode

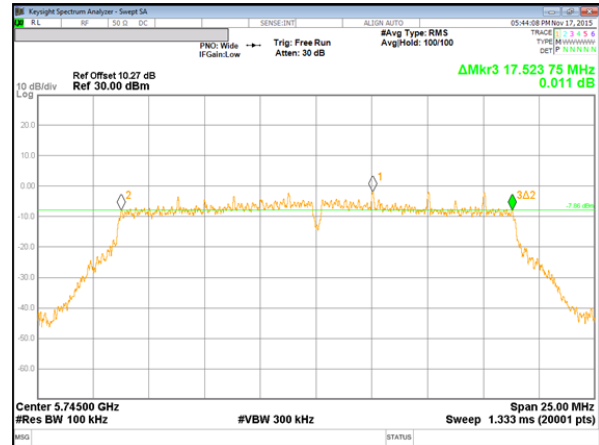


**IEEE 802.11n HT20 mode**

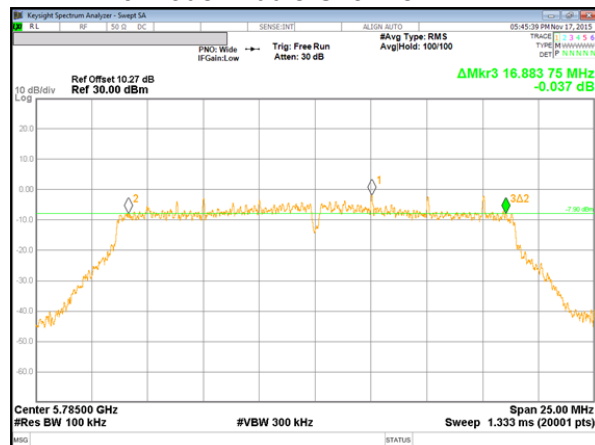
11n HT20 Mode Straddle Channel



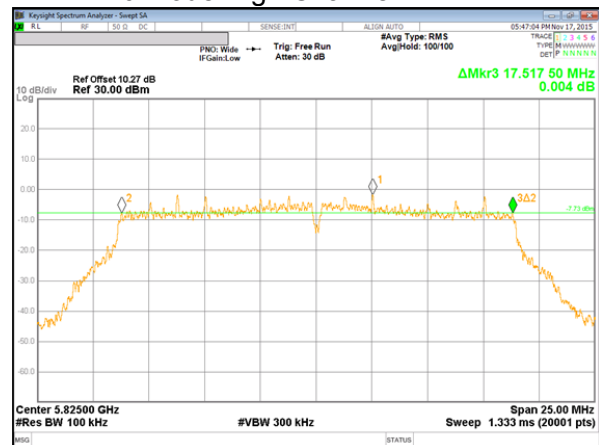
11n HT20 Mode Low Channel



11n HT20 Mode Middle Channel

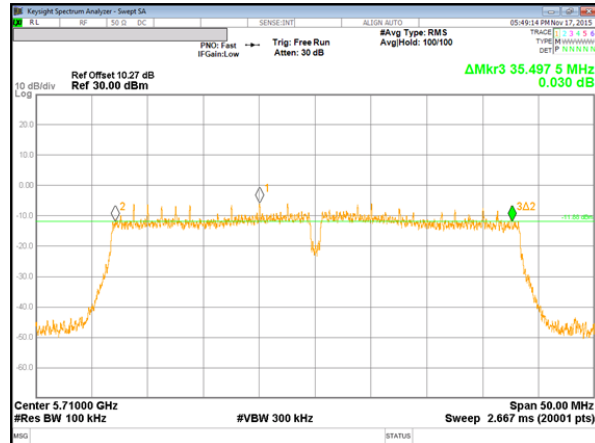


11n HT20 Mode High Channel

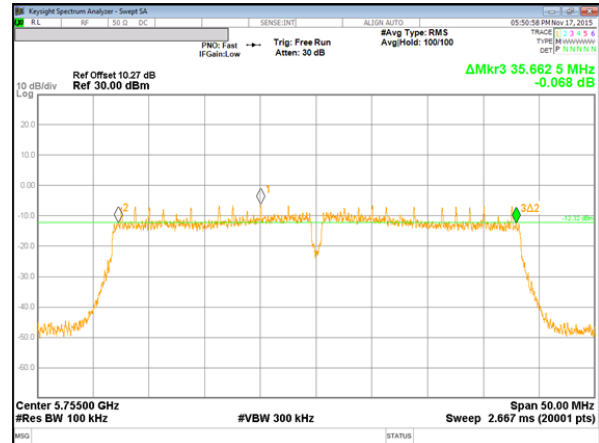


**IEEE 802.11n HT40 mode**

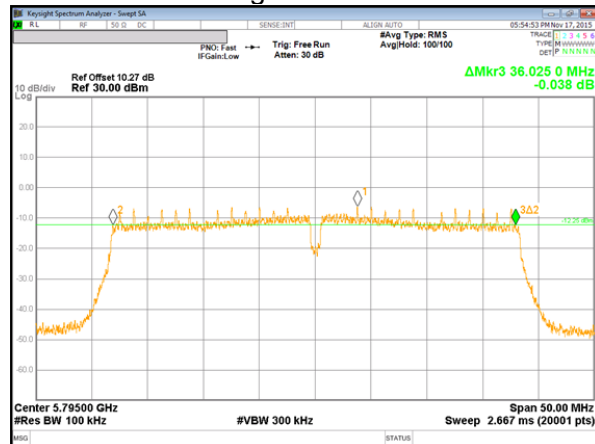
11n HT40 Mode Straddle Channel



11n HT40 Mode Low Channel



11n HT40 Mode High Channel



## 10.2. 26 dB BANDWIDTH

### LIMITS

None; for reporting purposes only.

### RESULTS

- Calculation for 26dB Bandwidth of UNII-2C and UNII-3 Straddle Channel

ex) 802.11a mode

- o Fundamental frequency : 5720MHz
- o 26dB BW : 21.10MHz
- o Turning Frequency : 5725MHz
- o 26dB Bandwidth of UNII-2C band Portion  
 $= (5725 - (5720 - (21.10 / 2))) = 15.55 \text{ MHz}$
- o 26dB Bandwidth of UNII-3 band Portion  
 $= (5720 + (21.10 / 2) - 5725) = 5.55 \text{ MHz}$

### 10.2.1. 802.11a MODE IN THE 5.2 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5180            | 21.08                 |
| Mid     | 5200            | 21.04                 |
| High    | 5240            | 20.99                 |
| Worst   |                 | 21.08                 |

### 10.2.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5180            | 21.53                 |
| Mid     | 5200            | 21.30                 |
| High    | 5240            | 21.41                 |
| Worst   |                 | 21.53                 |

### 10.2.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5190            | 39.59                 |
| High    | 5230            | 39.67                 |
| Worst   |                 | 39.67                 |

#### 10.2.4. 802.11a MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5260            | 20.98                 |
| Mid     | 5300            | 21.09                 |
| High    | 5320            | 20.88                 |
| Worst   |                 | 21.09                 |

#### 10.2.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5260            | 21.39                 |
| Mid     | 5300            | 21.45                 |
| High    | 5320            | 21.39                 |
| Worst   |                 | 21.45                 |

#### 10.2.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|---------|-----------------|-----------------------|
| Low     | 5270            | 39.44                 |
| High    | 5310            | 39.59                 |
| Worst   |                 | 39.59                 |

### 10.2.7. 802.11a MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Low      | 5500            | 20.97                 |
| Mid      | 5580            | 21.09                 |
| High     | 5700            | 21.10                 |
| Straddle | 5720            | 15.50                 |
| Worst    |                 | 21.10                 |

### 10.2.8. 802.11n HT20 MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Low      | 5500            | 21.58                 |
| Mid      | 5580            | 21.36                 |
| High     | 5700            | 21.39                 |
| Straddle | 5720            | 15.62                 |
| Worst    |                 | 21.58                 |

### 10.2.9. 802.11n HT40 MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Low      | 5510            | 39.75                 |
| Mid      | 5550            | 39.65                 |
| High     | 5670            | 39.76                 |
| Straddle | 5710            | 34.78                 |
| Worst    |                 | 39.76                 |

**10.2.10. 802.11a MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Straddle | 5720            | 5.50                  |
| Low      | 5745            | 21.15                 |
| Mid      | 5785            | 21.00                 |
| High     | 5825            | 20.98                 |
| Worst    |                 | 21.15                 |

**10.2.11. 802.11n HT20 MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Straddle | 5720            | 5.62                  |
| Low      | 5745            | 21.23                 |
| Mid      | 5785            | 21.31                 |
| High     | 5825            | 21.49                 |
| Worst    |                 | 21.49                 |

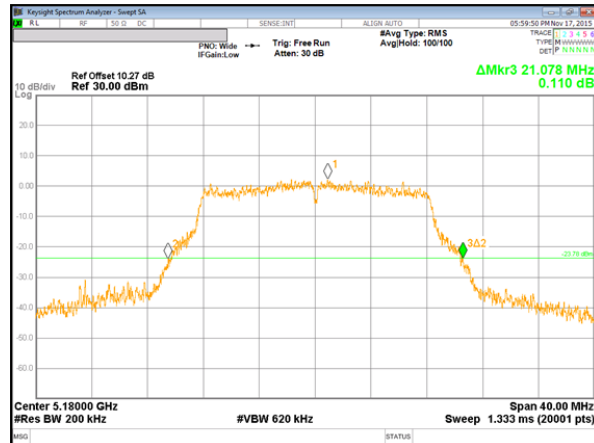
**10.2.12. 802.11n HT40 MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 26 dB Bandwidth [MHz] |
|----------|-----------------|-----------------------|
| Straddle | 5710            | 4.78                  |
| Low      | 5755            | 39.79                 |
| High     | 5795            | 39.43                 |
| Worst    |                 | 39.79                 |

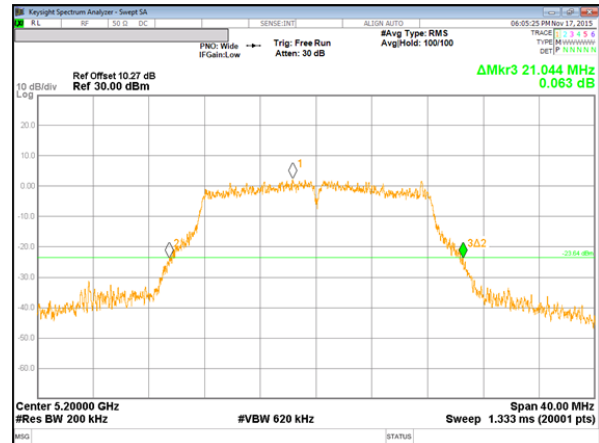
## 10.2.13. 26 dB BANDWIDTH PLOTS

### UNII 5.2 GHz IEEE 802.11a mode

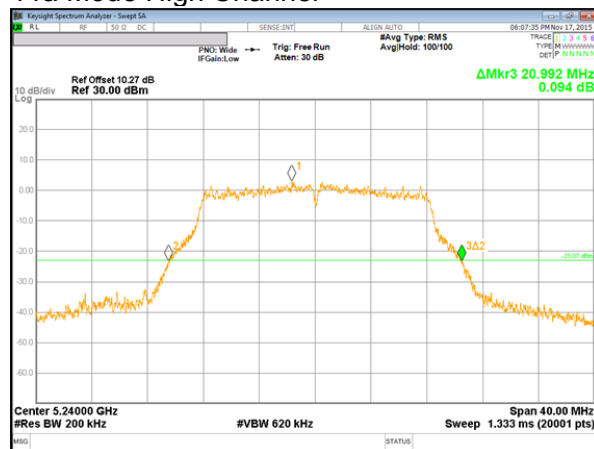
11a Mode Low Channel



11a Mode Middle Channel

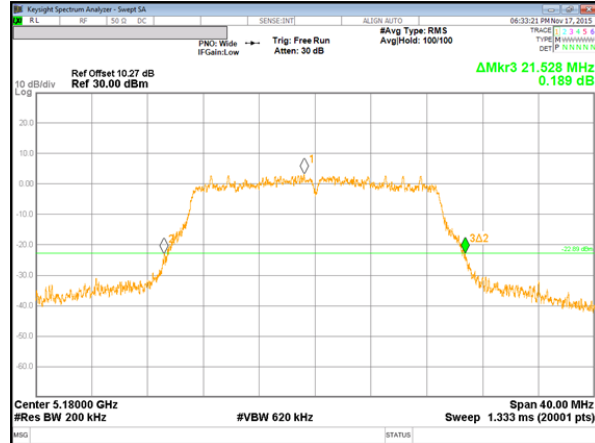


11a Mode High Channel

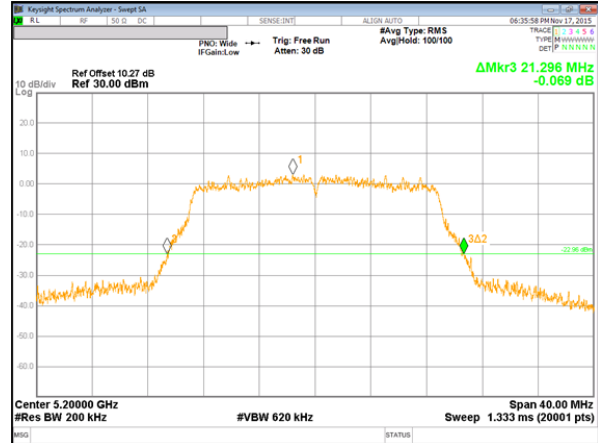


## UNII 5.2 GHz IEEE 802.11n HT20 mode

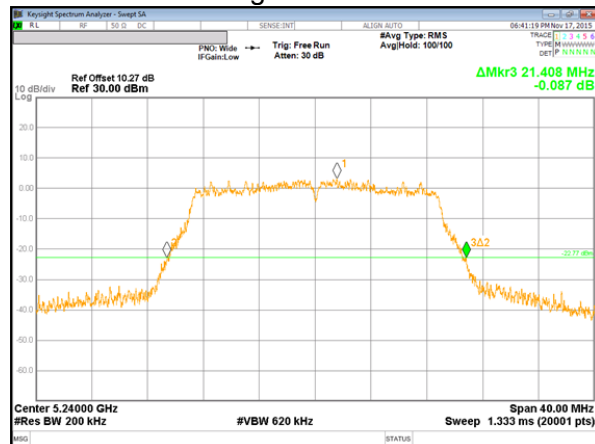
11n HT20 Mode Low Channel



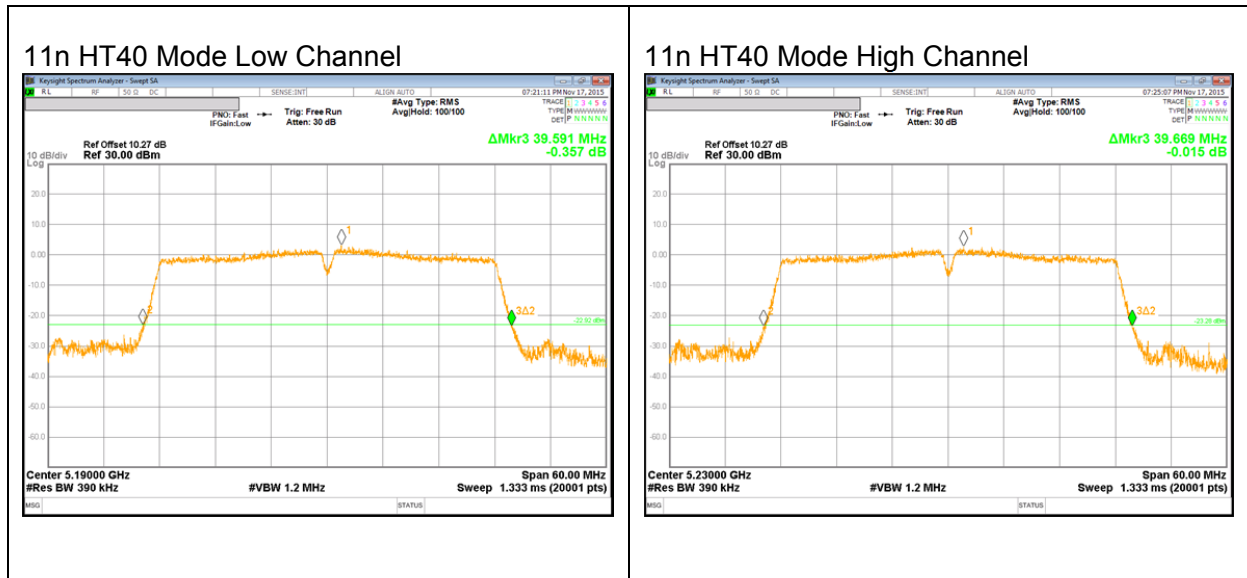
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel

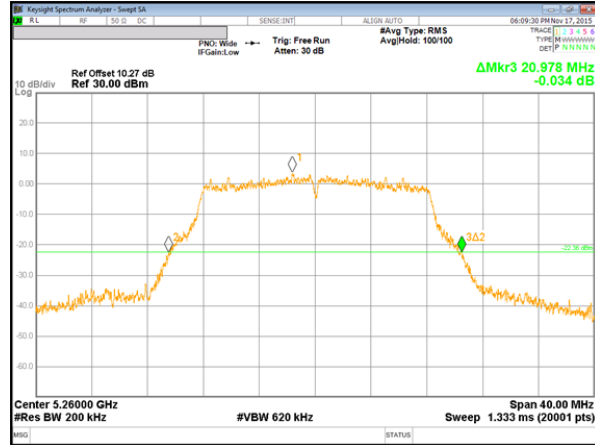


## UNII 5.2 GHz IEEE 802.11n HT40 mode

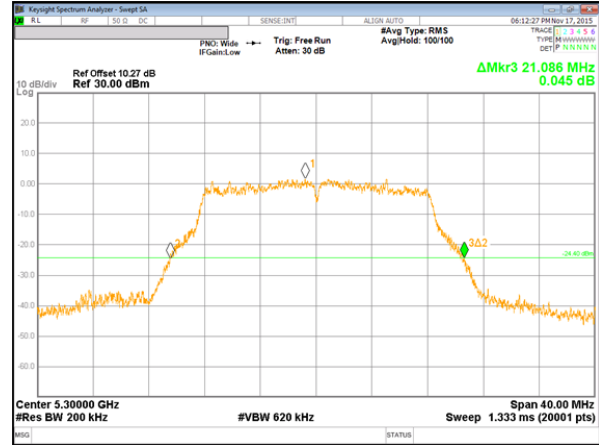


## UNII 5.3 GHz IEEE 802.11a mode

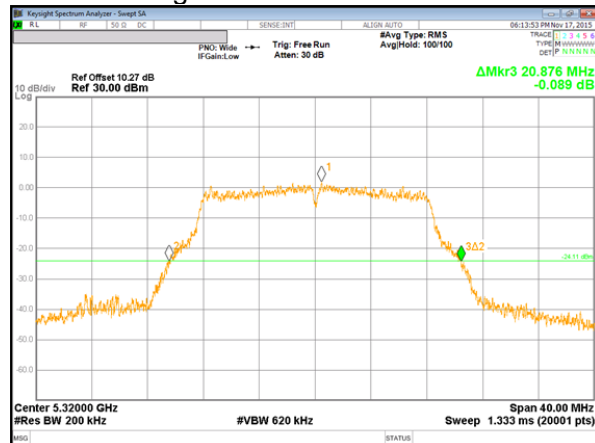
11a Mode Low Channel



11a Mode Middle Channel



11a Mode High Channel

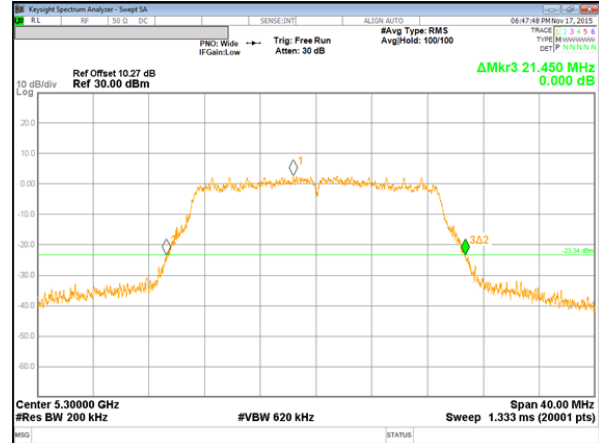


## UNII 5.3 GHz IEEE 802.11n HT20 mode

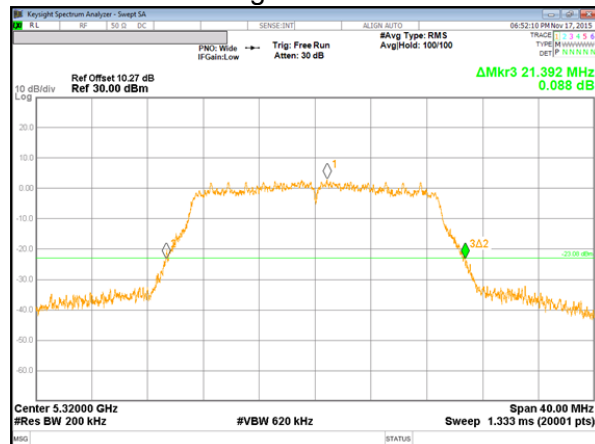
11n HT20 Mode Low Channel



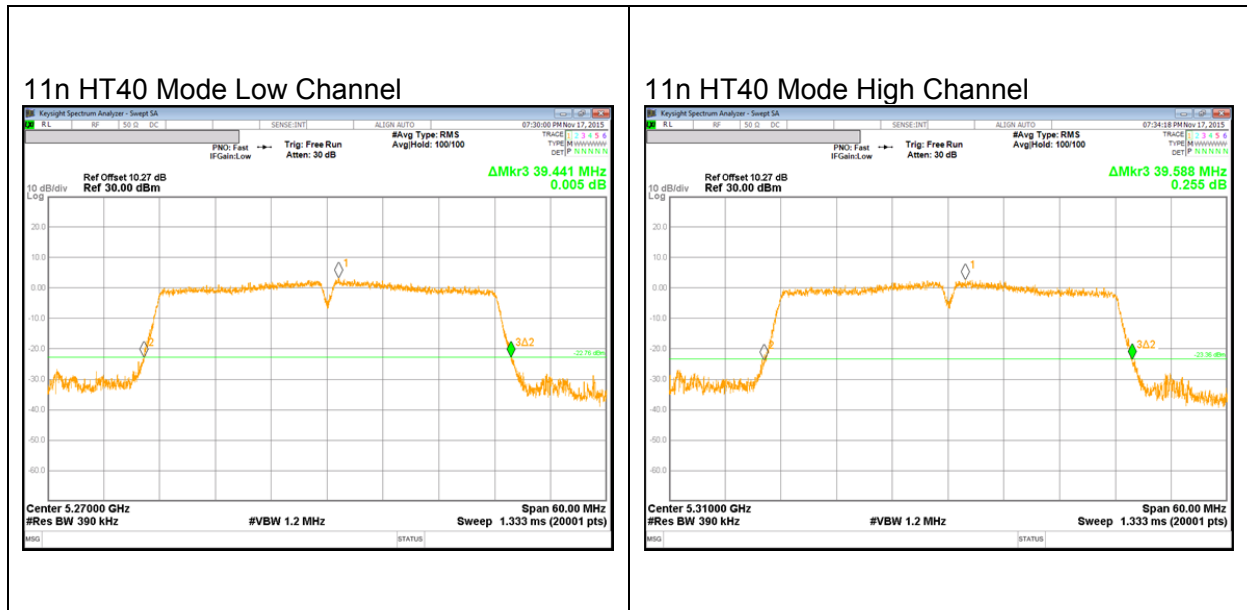
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel



**UNII 5.3 GHz IEEE 802.11n HT40 mode**

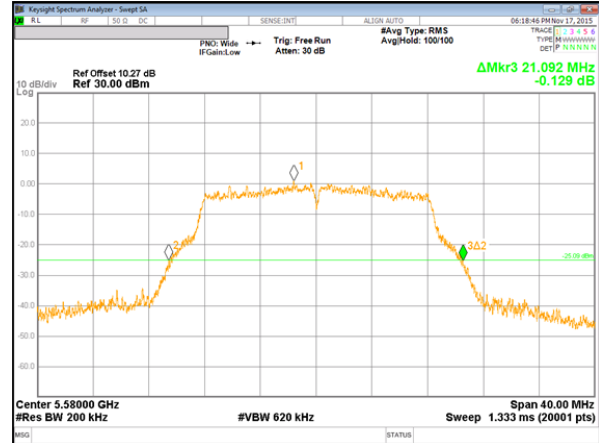


## UNII 5.5 GHz IEEE 802.11a mode

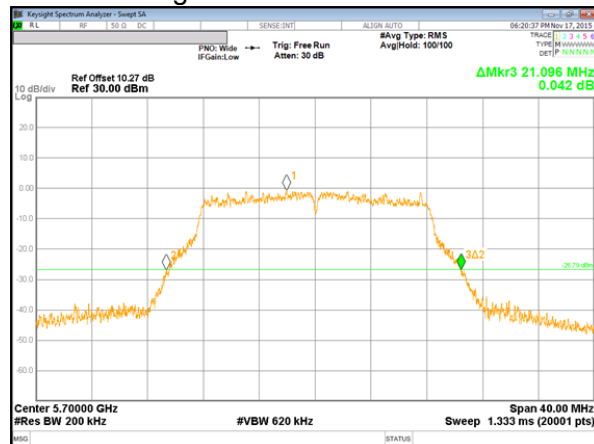
11a Mode Low Channel



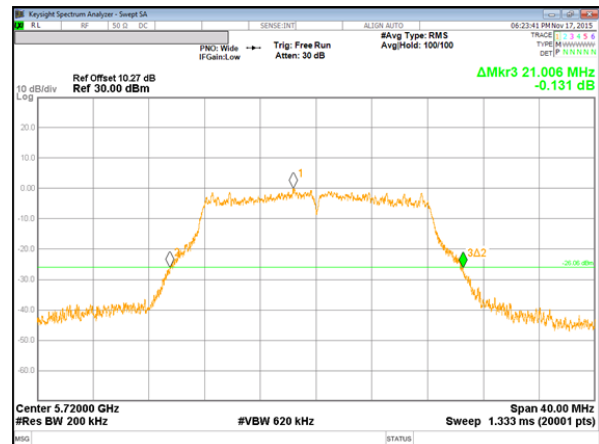
11a Mode Middle Channel



11a Mode High Channel

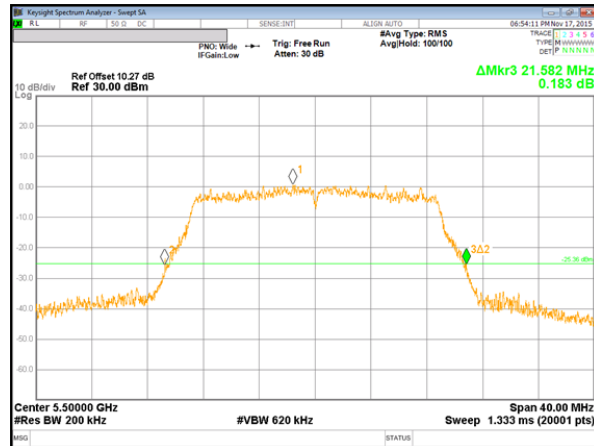


11a Mode Straddle Channel



## UNII 5.5 GHz IEEE 802.11n HT20 mode

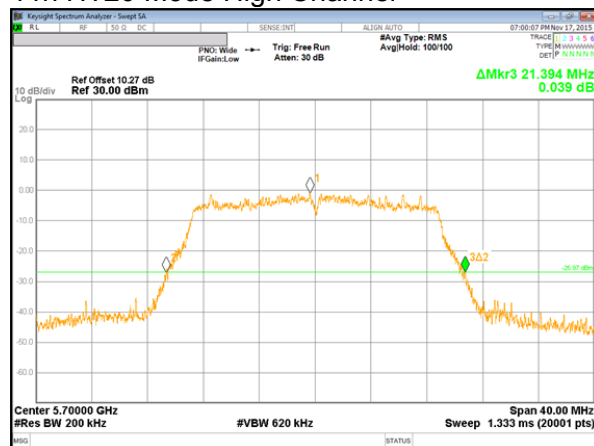
11n HT20 Mode Low Channel



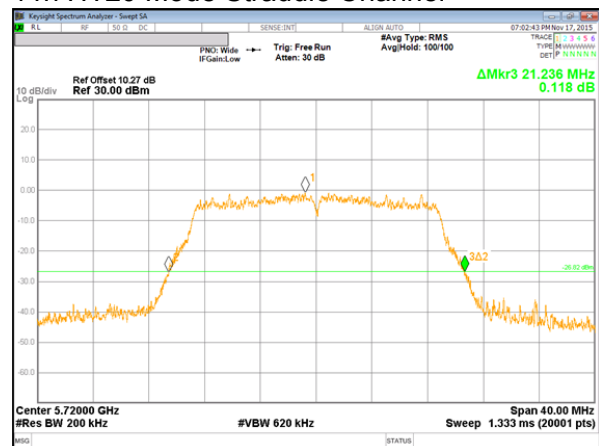
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel

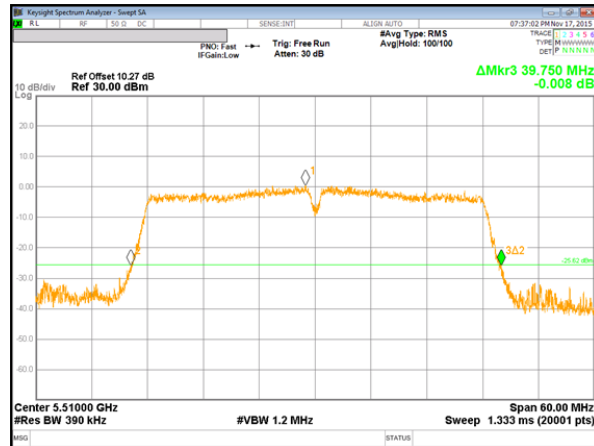


11n HT20 Mode Straddle Channel

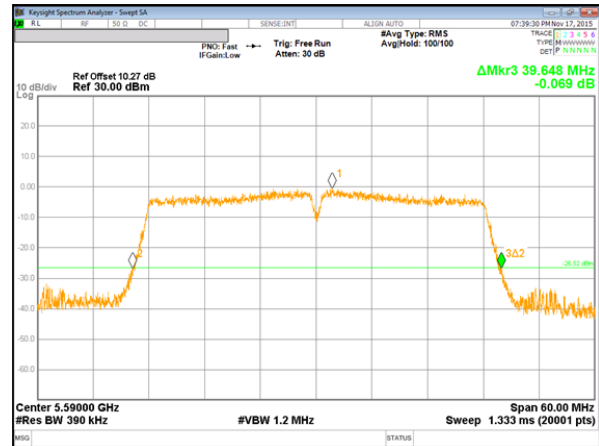


## UNII 5.5 GHz IEEE 802.11n HT40 mode

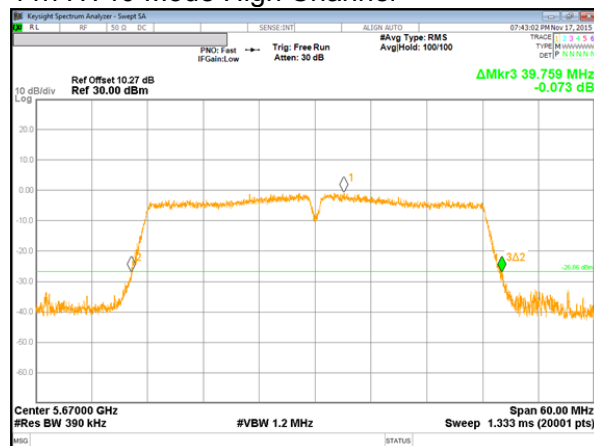
11n HT40 Mode Low Channel



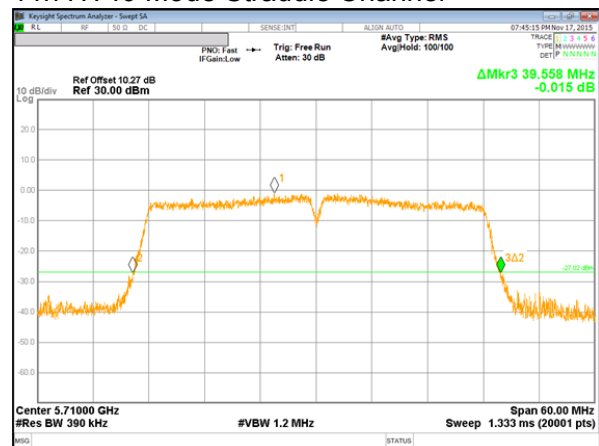
11n HT40 Mode Middle Channel



11n HT40 Mode High Channel

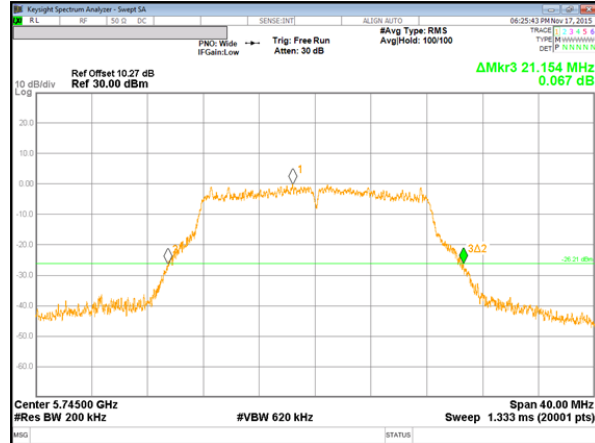


11n HT40 Mode Straddle Channel

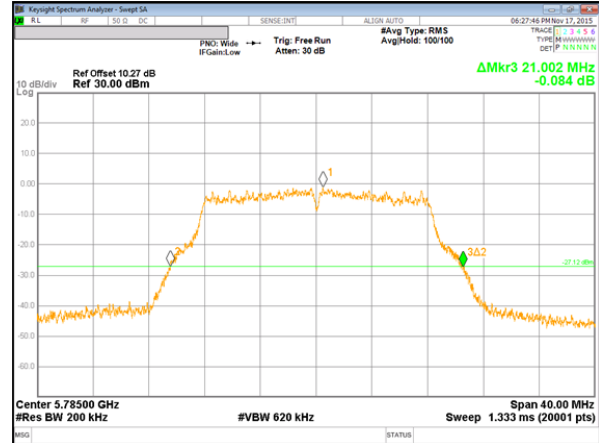


## UNII 5.8 GHz IEEE 802.11a mode

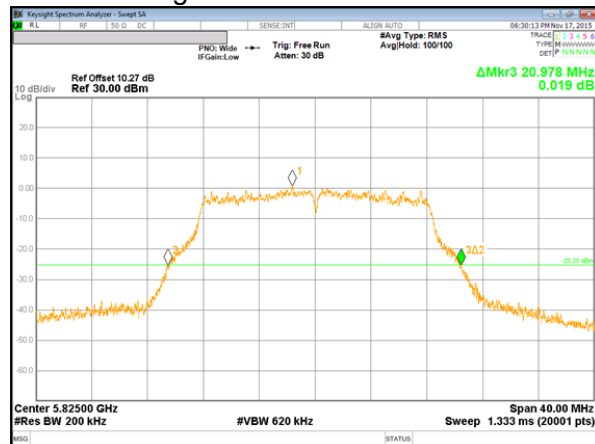
11a Mode Low Channel



11a Mode Middle Channel



11a Mode High Channel

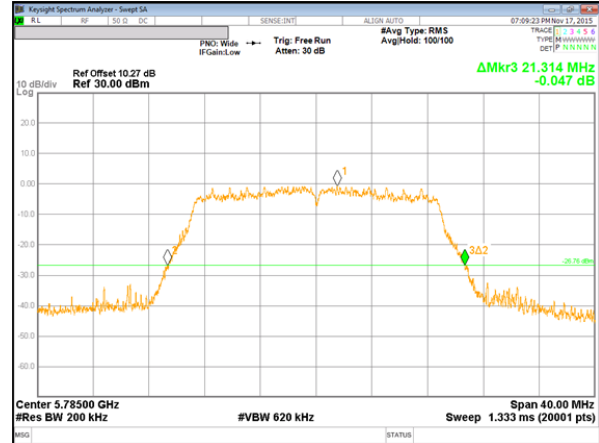


## UNII 5.8 GHz IEEE 802.11n HT20 mode

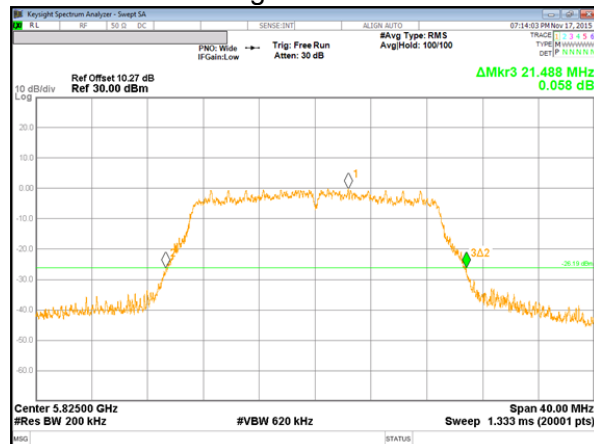
11n HT20 Mode Low Channel



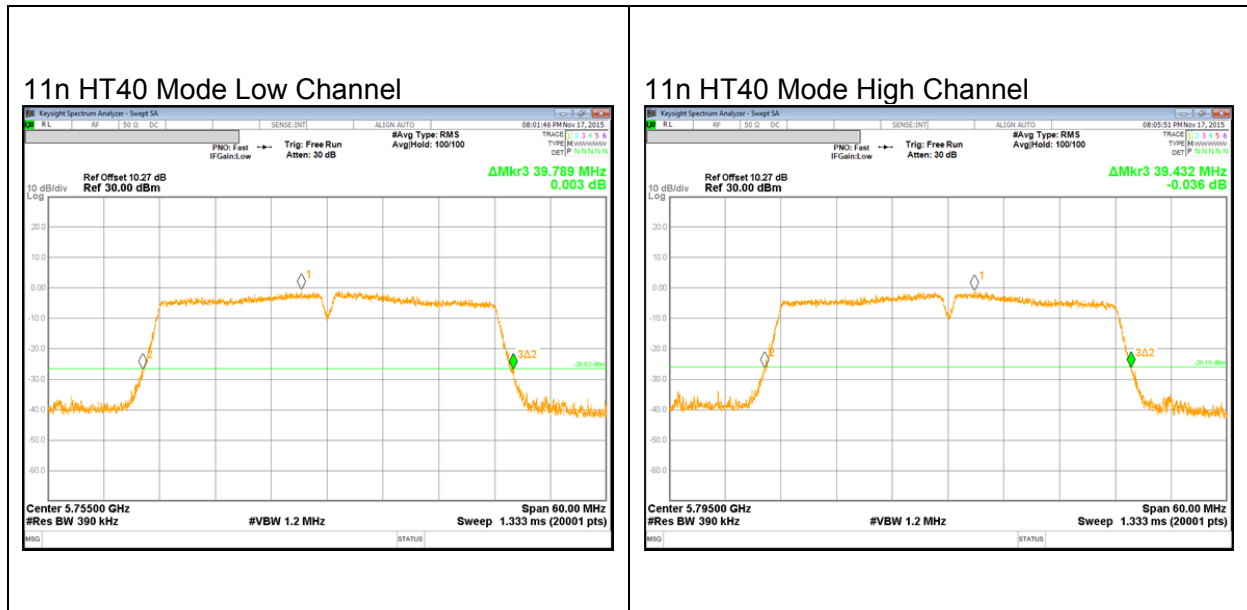
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel



**UNII 5.8 GHz IEEE 802.11n HT40 mode**



### 10.3. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### RESULTS

- Calculation for 99% Bandwidth of UNII-2C and UNII-3 Straddle Channel

ex) 802.11a mode

- o Fundamental frequency : 5720MHz
- o 99% BW : 16.484MHz
- o Turning Frequency : 5725MHz
- o 99% Bandwidth of UNII-2C band Portion  
 $= (5725 - (5720 - (16.484 / 2))) = 13.242 \text{ MHz}$
- o 99% Bandwidth of UNII-3 band Portion  
 $= (5720 + (16.484 / 2) - 5725) = 3.242 \text{ MHz}$

**10.3.1. 802.11a MODE IN THE 5.2 GHz BAND**

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5180            | 16.483              |
| Mid     | 5200            | 16.507              |
| High    | 5240            | 16.487              |
| Worst   |                 | 16.507              |

**10.3.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND**

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5180            | 17.693              |
| Mid     | 5200            | 17.671              |
| High    | 5240            | 17.696              |
| Worst   |                 | 17.696              |

**10.3.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND**

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5190            | 36.111              |
| High    | 5230            | 36.174              |
| Worst   |                 | 36.174              |

#### 10.3.4. 802.11a MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5260            | 16.485              |
| Mid     | 5300            | 16.477              |
| High    | 5320            | 16.502              |
| Worst   |                 | 16.502              |

#### 10.3.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5260            | 17.697              |
| Mid     | 5300            | 17.677              |
| High    | 5320            | 17.692              |
| Worst   |                 | 17.697              |

#### 10.3.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low     | 5270            | 36.176              |
| High    | 5310            | 36.164              |
| Worst   |                 | 36.176              |

#### 10.3.7. 802.11a MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Low      | 5500            | 16.489              |
| Mid      | 5580            | 16.475              |
| High     | 5700            | 16.496              |
| Straddle | 5720            | 13.250              |
| Worst    |                 | 16.496              |

### 10.3.8. 802.11n HT20 MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Low      | 5500            | 17.678              |
| Mid      | 5580            | 17.681              |
| High     | 5700            | 17.681              |
| Straddle | 5720            | 13.850              |
| Worst    |                 | 17.681              |

### 10.3.9. 802.11n HT40 MODE IN THE 5.5 GHz BAND

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Low      | 5510            | 36.106              |
| Mid      | 5550            | 36.092              |
| High     | 5670            | 36.199              |
| Straddle | 5710            | 33.100              |
| Worst    |                 | 36.199              |

### 10.3.10. 802.11a MODE IN THE 5.8 GHz BAND

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Straddle | 5720            | 3.250               |
| Low      | 5745            | 16.532              |
| Mid      | 5785            | 16.488              |
| High     | 5825            | 16.509              |
| Worst    |                 | 16.532              |

**10.3.11. 802.11n HT20 MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Straddle | 5720            | 3.850               |
| Low      | 5745            | 17.686              |
| Mid      | 5785            | 17.696              |
| High     | 5825            | 17.696              |
| Worst    |                 | 17.696              |

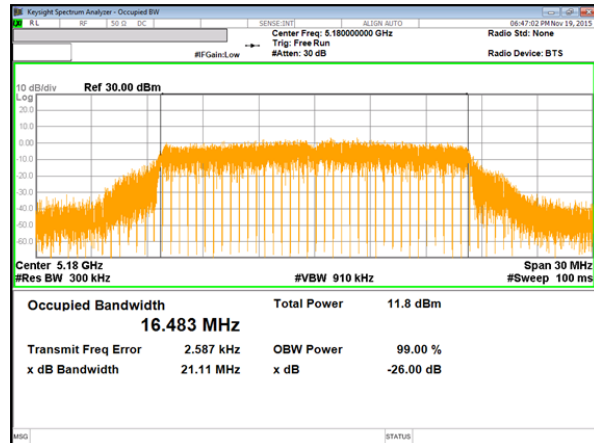
**10.3.12. 802.11n HT40 MODE IN THE 5.8 GHz BAND**

| Channel  | Frequency [MHz] | 99% Bandwidth [MHz] |
|----------|-----------------|---------------------|
| Straddle | 5710            | 3.100               |
| Low      | 5755            | 36.209              |
| High     | 5795            | 36.181              |
| Worst    |                 | 36.209              |

### 10.3.13. 99% BANDWIDTH PLOTS

#### UNII 5.2 GHz IEEE 802.11a mode

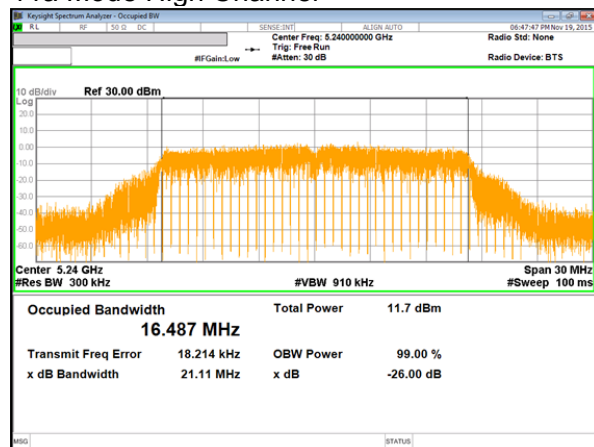
11a Mode Low Channel



11a Mode Middle Channel

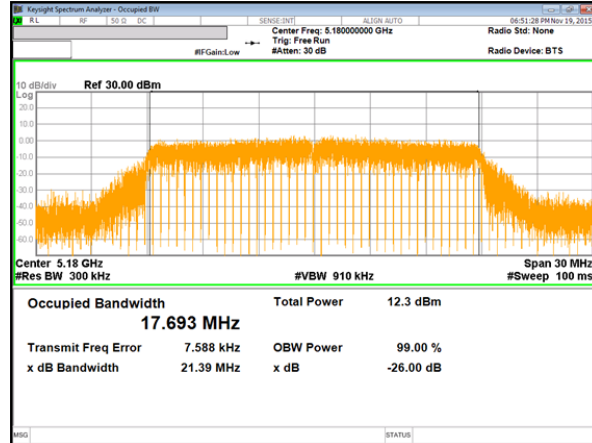


11a Mode High Channel

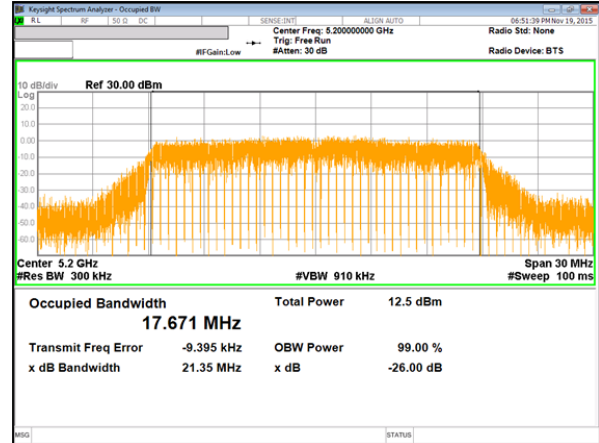


## UNII 5.2 GHz IEEE 802.11n HT20 mode

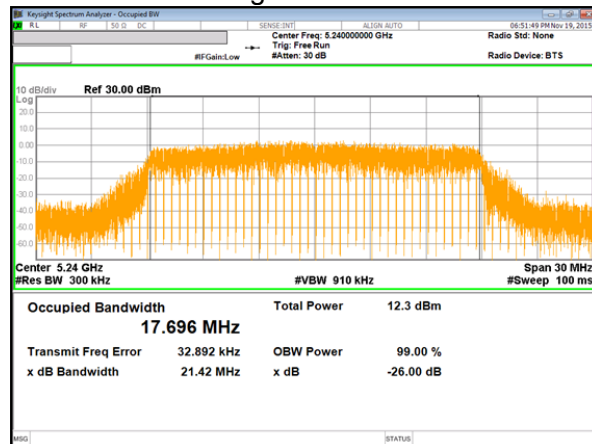
11n HT20 Mode Low Channel



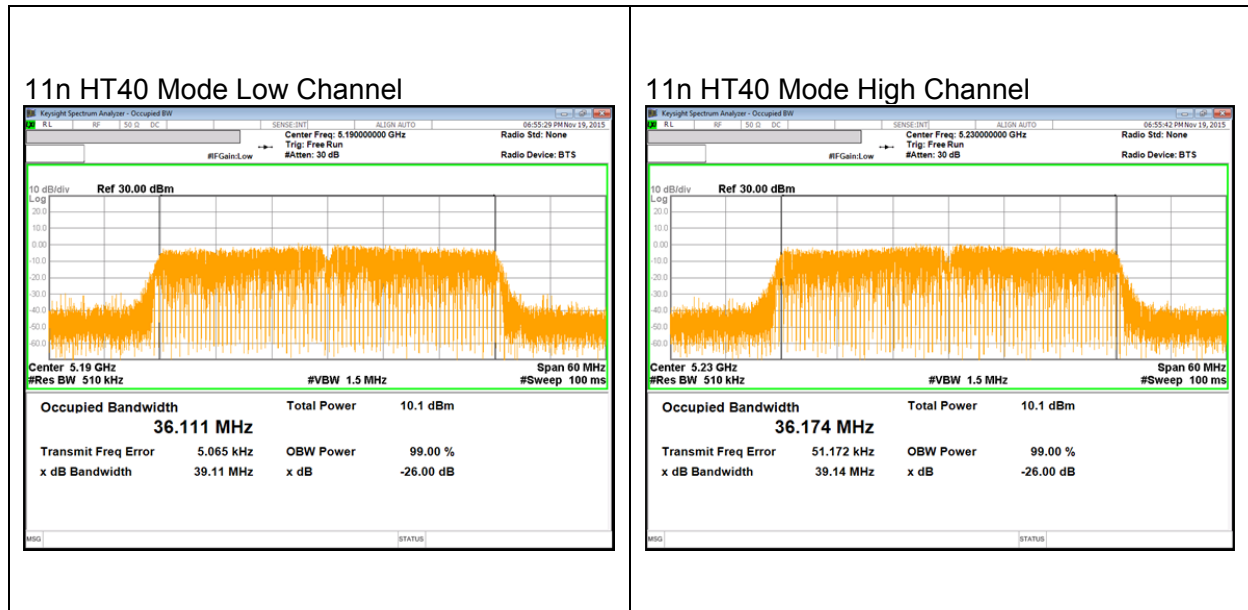
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel

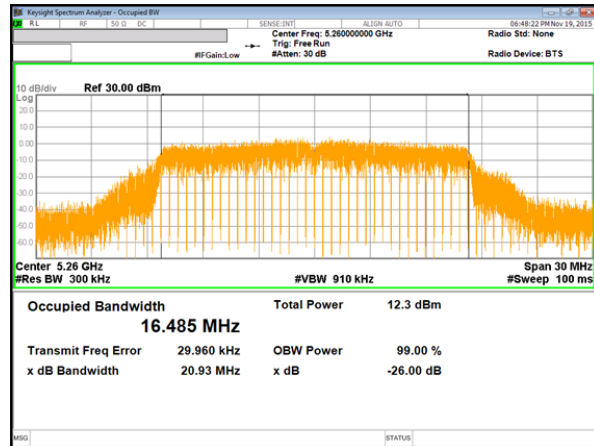


**UNII 5.2 GHz IEEE 802.11n HT40 mode**

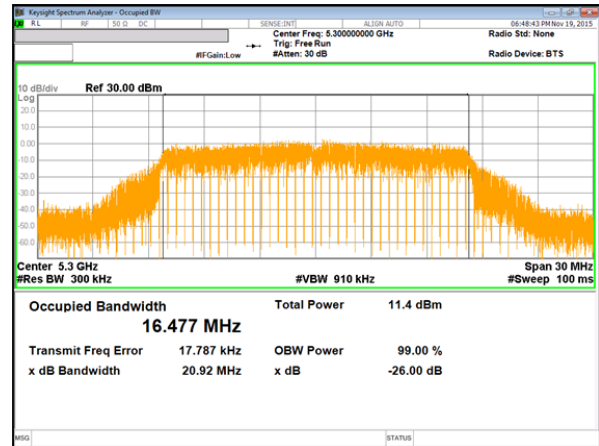


## UNII 5.3 GHz IEEE 802.11a mode

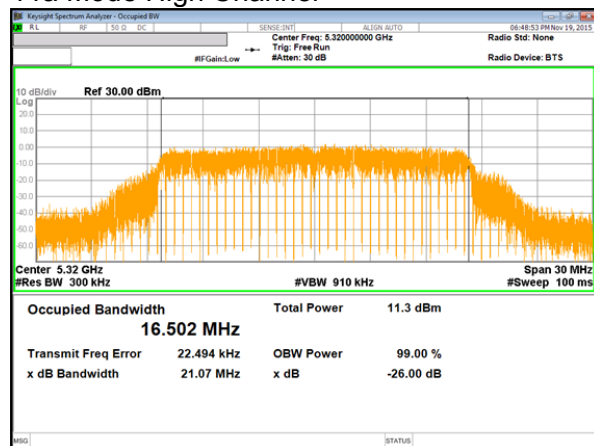
### 11a Mode Low Channel



### 11a Mode Middle Channel

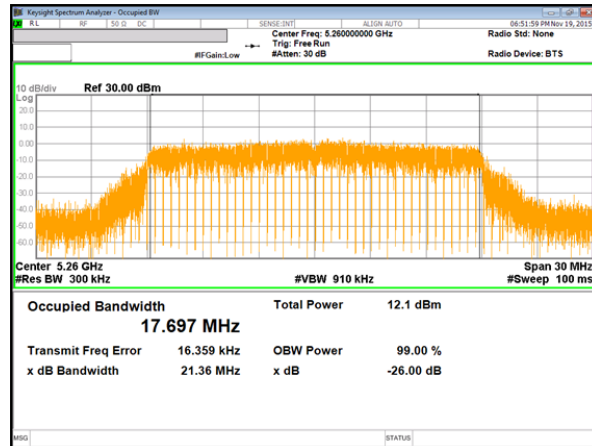


### 11a Mode High Channel

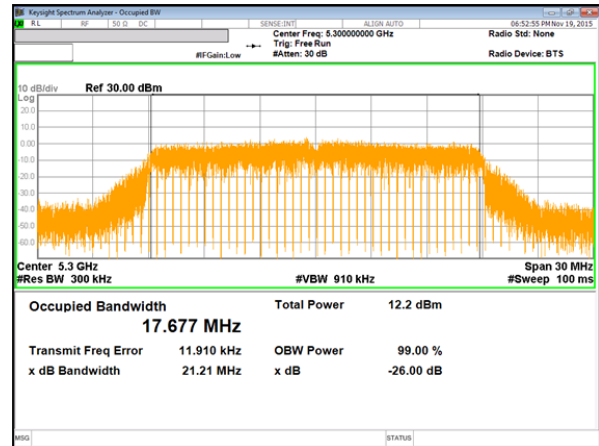


## UNII 5.3 GHz IEEE 802.11n HT20 mode

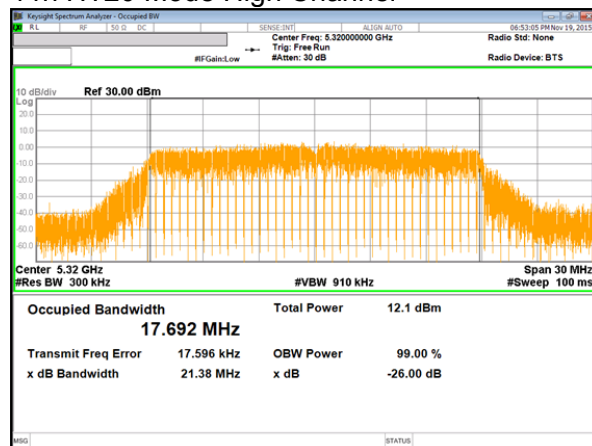
11n HT20 Mode Low Channel



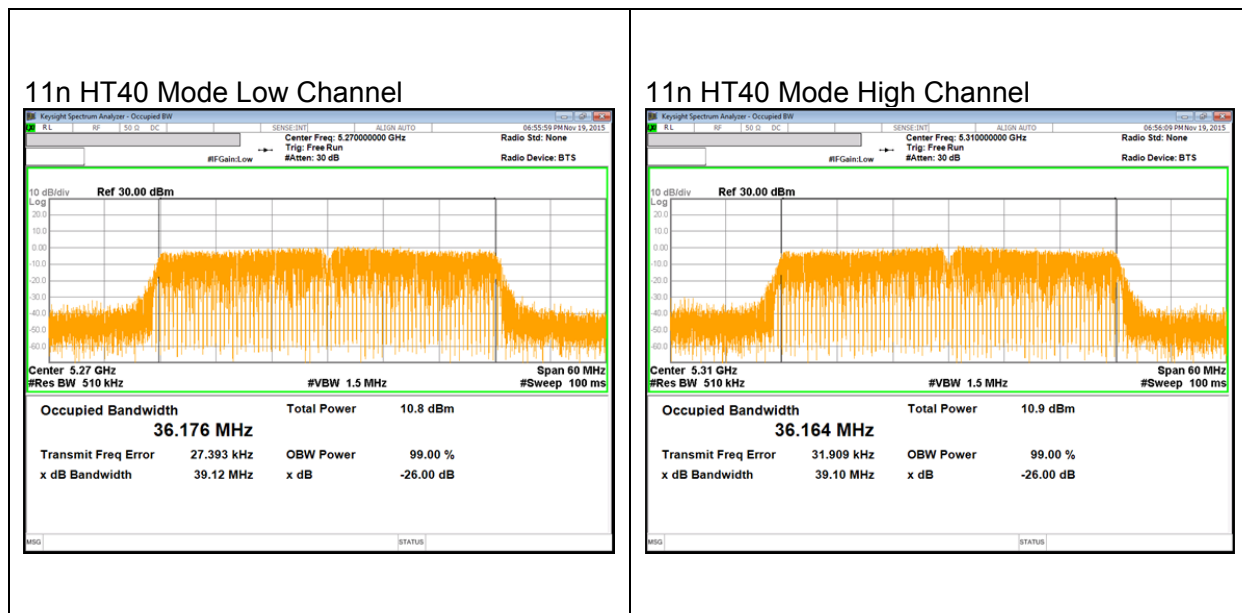
11n HT20 Mode Middle Channel



11n HT20 Mode High Channel

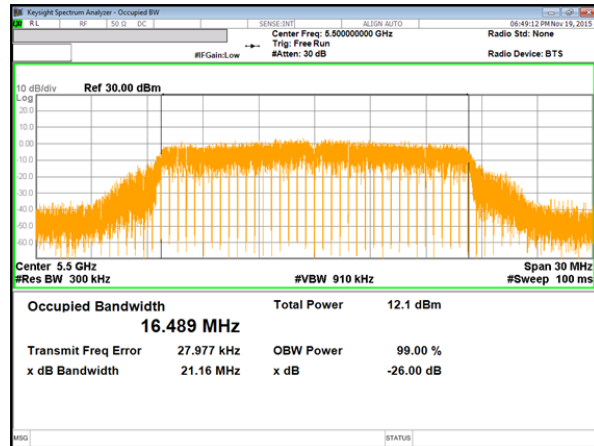


**UNII 5.3 GHz IEEE 802.11n HT40 mode**

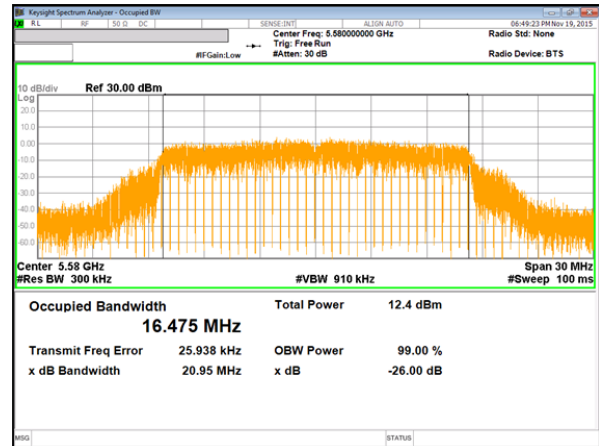


## UNII 5.5 GHz IEEE 802.11a mode

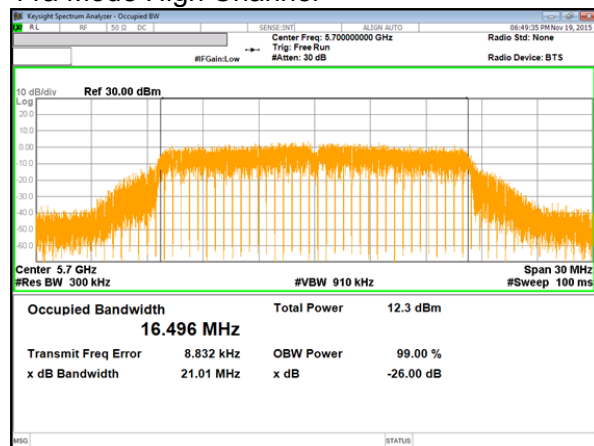
### 11a Mode Low Channel



### 11a Mode Middle Channel



### 11a Mode High Channel



### 11a Mode Straddle Channel

