# FCC Part 15E
# Measurement and Test Report

**For**

**Cyrus Technology GmbH**

**Hergelsbendenstrasse 49, D-52080 Aachen, Germany**

**FCC ID: 2AI3KCS22XA**

| | |
|---|---|
| **FCC Rule(s):** | FCC Part 15.407 |
| **Product Description:** | Rugged Phone |
| **Tested Model:** | CS22XA |
| **Report No.:** | WTX19X08058778W-3 |
| **Sample Receipt Date:** | 2019-08-23 |
| **Tested Date:** | 2019-08-23 to 2019-09-24 |
| **Issued Date:** | 2019-09-25 |
| **Tested By:** | Jason Su / Engineer |
| **Reviewed By:** | Silin Chen / EMC Manager |
| **Approved & Authorized By:** | Jandy So / PSQ Manager |

**Prepared By:**

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## Report version

| Version No. | Date of issue | Description |
|---|---|---|
| Rev.00 | 2019-09-25 | Original |
| / | / | / |

# 1. GENERAL INFORMATION

## 1.1 Product Description for Equipment Under Test (EUT)

**Client Information**

| | |
|---|---|
| Applicant: | Cyrus Technology GmbH |
| Address of applicant: | Hergelsbendenstrasse 49, D-52080 Aachen, Germany |
| Manufacturer: | Cyrus Technology GmbH |
| Address of manufacturer: | Hergelsbendenstrasse 49, D-52080 Aachen, Germany |

| **General Description of EUT** | |
|---|---|
| Product Name: | Rugged Phone |
| Brand Name: | CYRUS |
| Model No.: | CS22XA |
| Adding Model(s): | / |
| Rated Voltage: | DC3.85V |
| Battery Capacity: | 4400mAh |
| Power Adapter: | MKC-0502000SU<br>INPUT: AC100-240V, 50/60Hz, 0.4A;<br>Output: DC 5V, 2000mA |
| Software Version: | CS22XA_ROW_1.0.2 |
| Hardware Version: | L915-MB-V1.1 |
| | |
| *Note: The test data is gathered from a production sample, provided by the manufacturer.* | |

| **Technical Characteristics of EUT** | |
|---|---|
| Support Standards: | 802.11a, 802.11n(HT20) , 802.11n-HT40, 802.11ac-VH80 |
| Frequency Range: | 5150-5250MHz, 5250-5350MHz,<br>5470-5725MHz, 5725-5850MHz |
| RF Output Power: | 14.74dBm (Conducted) |
| Type of Modulation: | BPSK, QPSK,16QAM,64QAM, 256QAM |
| Data Rate: | 6-54Mbps, up to 200Mbps |
| Quantity of Channels: | 15 |
| Type of Antenna: | Integral Antenna |
| Antenna Gain: | 0.85dBi |

## 1.2 Test Standards

The tests were performed according to following standards:

**FCC Rules Part 15.407:** General technical requirements.
**ANSI C63.10-2013:** American National Standard for Testing Unlicensed Wireless Devices.
**KDB789033 D02 v02r01:** GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

**Maintenance of compliance** is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB789033 D02 v02r01
The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

## 1.4 Table for parameters of Test Software setting

Enter *#*#3646633#*#* into the calculator to enter the engineer mode, you can start to test. During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

| Mode | Test Frequency (MHz) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NCB: 20MHz | | | | | | | | | | | | |
| | 5180 | 5200 | 5240 | 5260 | 5300 | 5320 | 5500 | 5580 | 5700 | 5720 | 5745 | 5785 | 5825 |
| 802.11a 6Mbps | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| 802.11n-HT20 MCS0 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |

| Mode | NCB: 40MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5190 | 5230 | 5270 | 5310 | 5510 | 5550 | 5670 | 5710 | 5755 | 5795 |
| 802.11n-HT40 MCS0 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |

| Mode | NCB: 80MHz | | | | | |
|---|---|---|---|---|---|---|
| | 5210 | 5290 | 5530 | 5610 | 5690 | 5775 |
| 802.11ac-VH80 MCS0/Nss2 | 18 | 18 | 18 | 18 | 18 | 18 |

## 1.5 EUT Operating during test

EUT was programmed to be in continuously transmitting mode. During the test, EUT operation to normal function and programs under Android were executed.

## 1.6 Test Facility

**FCC – Registration No.: 125990**

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

**Industry Canada (IC) Registration No.: 11464A**

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

## 1.7 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

| **Test Mode List** | | |
|---|---|---|
| Test Mode | Description | Remark |
| TM1 | 802.11a | 5180MHz,5200MHz,5240MHz,5260MHz,5280MHz,5320MHz,5500MHz, 5600MHz,5700MHz,5745MHz, 5785MHz,5825MHz |
| TM2 | 802.11n-HT20 | 5180MHz,5200MHz,5240MHz,5260MHz,5280MHz,5320MHz,5500MHz, 5600MHz,5700MHz,5745MHz, 5785MHz,5825MHz |
| TM3 | 802.11n-HT40 | 5190MHz,5230MHz,5270MHz,5310MHz,5510MHz,5590MHz,5670MHz, 5755MHz,5795MHz |
| TM4 | 802.11ac-VH80 | 5210MHz,5290MHz,5530 MHz,5610 MHz,5775 MHz |

| **Test Conditions** | |
|---|---|
| Temperature: | 22~25 °C |
| Relative Humidity: | 50~55 %. |
| ATM Pressure: | 1019 mbar |

| **EUT Cable List and Details** | | | |
|---|---|---|---|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| USB-C Cable | 1.0 | Unshielded | Without Ferrite |
| Earphone Cable | 1.2 | Unshielded | Without Ferrite |

| **Special Cable List and Details** | | | |
|---|---|---|---|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| / | / | / | / |

| **Auxiliary Equipment List and Details** | | | |
|---|---|---|---|
| Description | Manufacturer | Model | Serial Number |
| / | / | / | / |

## 1.8 Measurement Uncertainty

| **Measurement uncertainty** | | |
|---|---|---|
| Parameter | Conditions | Uncertainty |
| RF Output Power | Conducted | ±0.42dB |
| Occupied Bandwidth | Conducted | ±1.5% |
| Power Spectral Density | Conducted | ±1.8dB |
| Conducted Spurious Emission | Conducted | ±2.17dB |
| Conducted Emissions | Conducted | 9-150kHz ±3.74dB |
| | | 0.15-30MHz ±3.34dB |
| Transmitter Spurious Emissions | Radiated | 30-200MHz ±4.52dB |
| | | 0.2-1GHz ±5.56dB |
| | | 1-6GHz ±3.84dB |
| | | 6-18GHz ±3.92dB |

## 1.9 Test Equipment List and Details

| No. | Description | Manufacturer | Model | Serial No. | Cal Date | Due Date |
|---|---|---|---|---|---|---|
| SEMT-1072 | Spectrum Analyzer | Agilent | E4407B | MY41440400 | 2019-04-30 | 2020-04-29 |
| SEMT-1031 | Spectrum Analyzer | Rohde & Schwarz | FSP30 | 836079/035 | 2019-04-30 | 2020-04-29 |
| SEMT-1007 | EMI Test Receiver | Rohde & Schwarz | ESVB | 825471/005 | 2019-04-30 | 2020-04-29 |
| SEMT-1008 | Amplifier | Agilent | 8447F | 3113A06717 | 2019-04-30 | 2020-04-29 |
| SEMT-1043 | Amplifier | C&D | PAP-1G18 | 2002 | 2019-04-30 | 2020-04-29 |
| SEMT-1011 | Broadband Antenna | Schwarz beck | VULB9163 | 9163-333 | 2019-05-05 | 2021-05-04 |
| SEMT-1042 | Horn Antenna | ETS | 3117 | 00086197 | 2019-05-05 | 2021-05-04 |
| SEMT-1121 | Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170582 | 2019-05-05 | 2021-05-04 |
| SEMT-1069 | Loop Antenna | Schwarz beck | FMZB 1516 | 9773 | 2019-05-05 | 2021-05-04 |
| SEMT-1001 | EMI Test Receiver | Rohde & Schwarz | ESPI | 101611 | 2019-04-30 | 2020-04-29 |
| SEMT-1003 | L.I.S.N | Schwarz beck | NSLK8126 | 8126-224 | 2019-04-30 | 2020-04-29 |
| SEMT-1002 | Pulse Limiter | Rohde & Schwarz | ESH3-Z2 | 100911 | 2019-04-30 | 2020-04-29 |
| SEMT-1168 | Pre-amplifier | Direction Systems Inc. | PAP-0126 | 14141-12838 | 2019-04-30 | 2020-04-29 |
| SEMT-1169 | Pre-amplifier | Direction Systems Inc. | PAP-2640 | 14145-14153 | 2019-04-30 | 2020-04-29 |
| SEMT-1163 | Spectrum Analyzer | Rohde & Schwarz | FSP40 | 100612 | 2019-04-30 | 2020-04-29 |
| SEMT-1170 | DRG Horn Antenna | A.H. SYSTEMS | SAS-574 | 571 | 2019-05-05 | 2021-05-04 |
| SEMT-1166 | Power Limiter | Agilent | N9356B | MY45450376 | 2019-04-30 | 2020-04-29 |
| SEMT-1048 | RF Limiter | ATTEN | AT-BSF-2400~2500 | / | 2019-04-30 | 2020-04-29 |
| SEMT-1076 | RF Switcher | Top Precision | RCS03-A2 | / | 2019-04-30 | 2020-04-29 |
| SEMT-C001 | Cable | Zheng DI | LL142-07-07-10M(A) | / | 2019-03-18 | 2020-03-17 |
| SEMT-C002 | Cable | Zheng DI | ZT40-2.92J-2.92J-6M | / | 2019-03-18 | 2020-03-17 |
| SEMT-C003 | Cable | Zheng DI | ZT40-2.92J-2.92J-2.5M | / | 2019-03-18 | 2020-03-17 |
| SEMT-C004 | Cable | Zheng DI | 2M0RFC | / | 2019-03-18 | 2020-03-17 |
| SEMT-C005 | Cable | Zheng DI | 1M0RFC | / | 2019-03-18 | 2020-03-17 |
| SEMT-C006 | Cable | Zheng DI | 1M0RFC | / | 2019-03-18 | 2020-03-17 |

| Software List | | | |
|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Version** |
| EMI Test Software (Radiated Emission)* | Farad | EZ-EMC | RA-03A1 |
| EMI Test Software (Conducted Emission)* | Farad | EZ-EMC | RA-03A1 |

*Remark: indicates software version used in the compliance certification testing

# 2. SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test Item | Result |
|---|---|---|
| §15.203; §15.405 | Antenna Requirement | Compliant |
| §15.207; §15.407(b)(6) | Conducted Emission | Compliant |
| §15.407(a)(1),(2) | Power Spectral Density | Compliant |
| §15.407(e) | Emission Bandwidth and Occupied Bandwidth | Compliant |
| §15.407(a)(1),(2) | Maximum Conducted Output Power | Compliant |
| §15.407(b)(1),(2),(3),(4) | Undesirable emission | Compliant |
| §15.205; §15.407(b)(1),(2),(3) | Radiated Emission | Compliant |
| §15.407(g) | Frequency Stability | Compliant |
| §15.407(h) | Dynamic Frequency Selection (DFS) | Compliant |

N/A: not applicable

# 3. RF Exposure

## 3.1 Standard Applicable

According to §1.1307 and §2.1093, the portable transmitter must comply the RF exposure requirements.

## 3.2 Test Result

This product complied with the requirement of the RF exposure, please see the SAR Report.

# 4. Antenna Requirement

## 4.1 Standard Applicable

According to FCC Part 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.

## 4.2 Evaluation Information

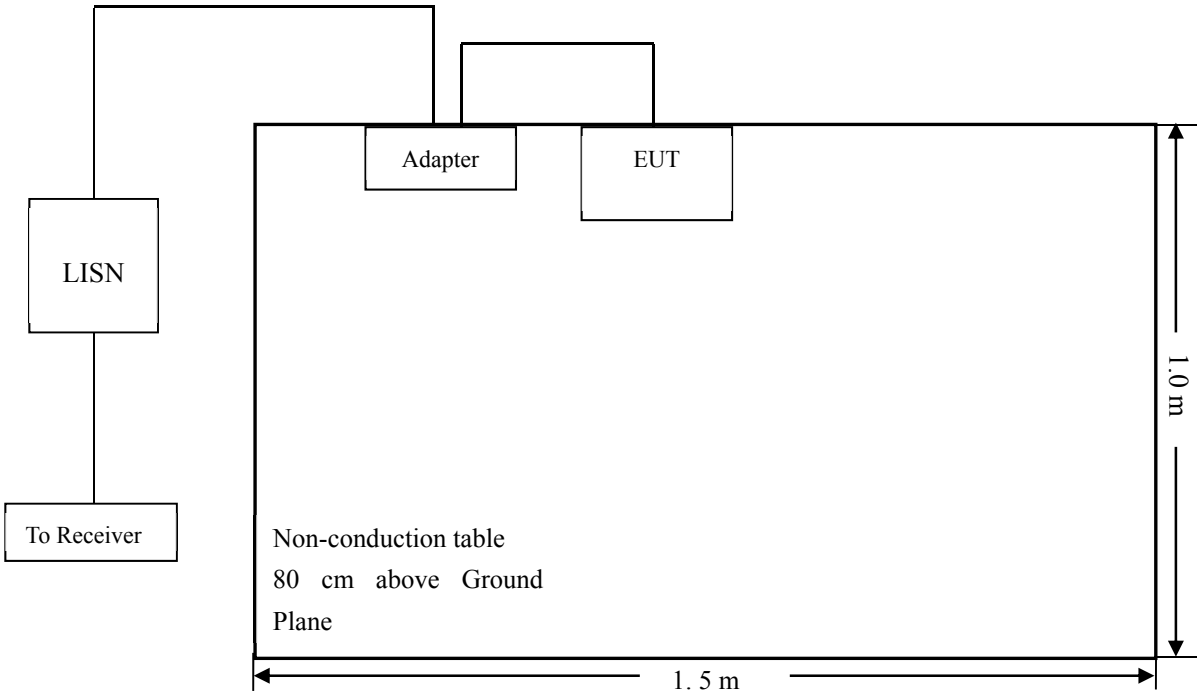
This product has an integral antenna, fulfill the requirement of this section.

# 5. Conducted Emissions

## 5.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

## 5.2 Basic Test Setup Block Diagram



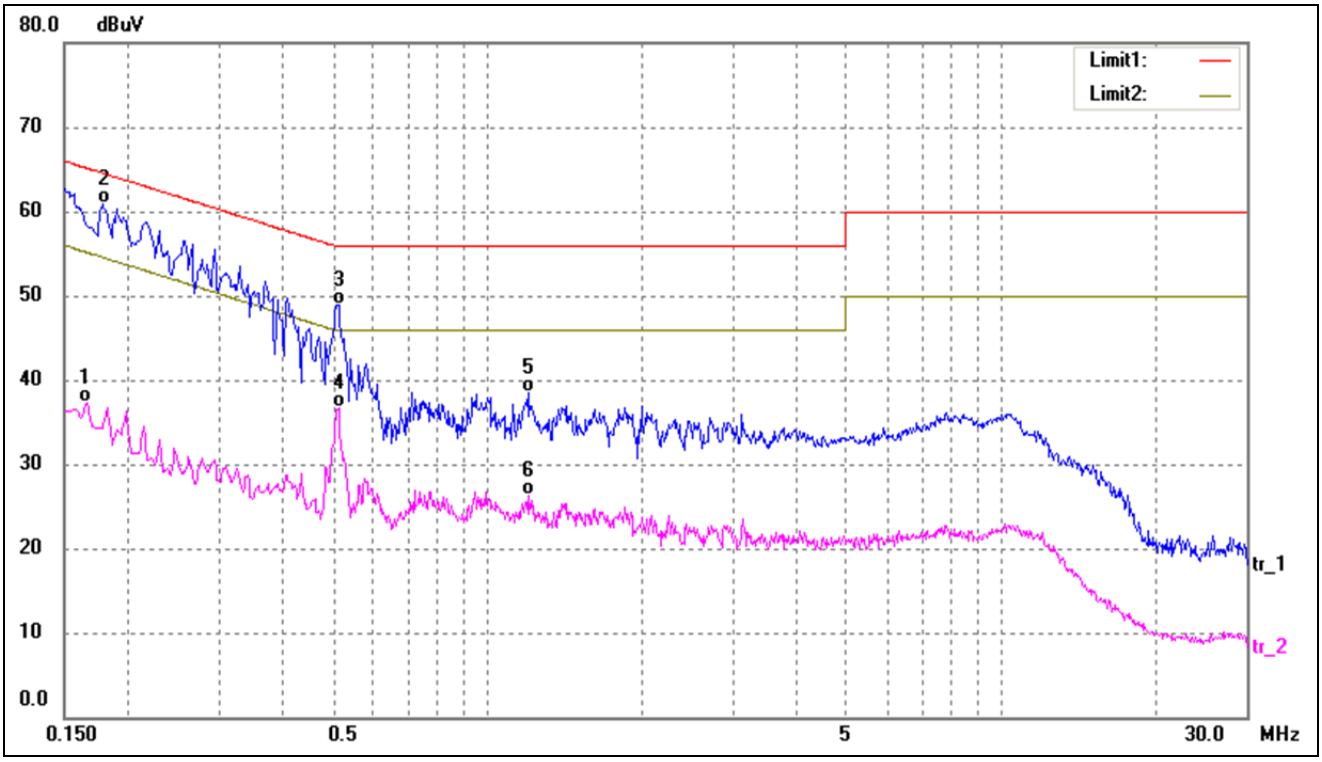

## 5.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency ..... 150 kHz
Stop Frequency ..... 30 MHz
Sweep Speed ..... Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth ..... 9 kHz
Quasi-Peak Adapter Mode ..... Normal

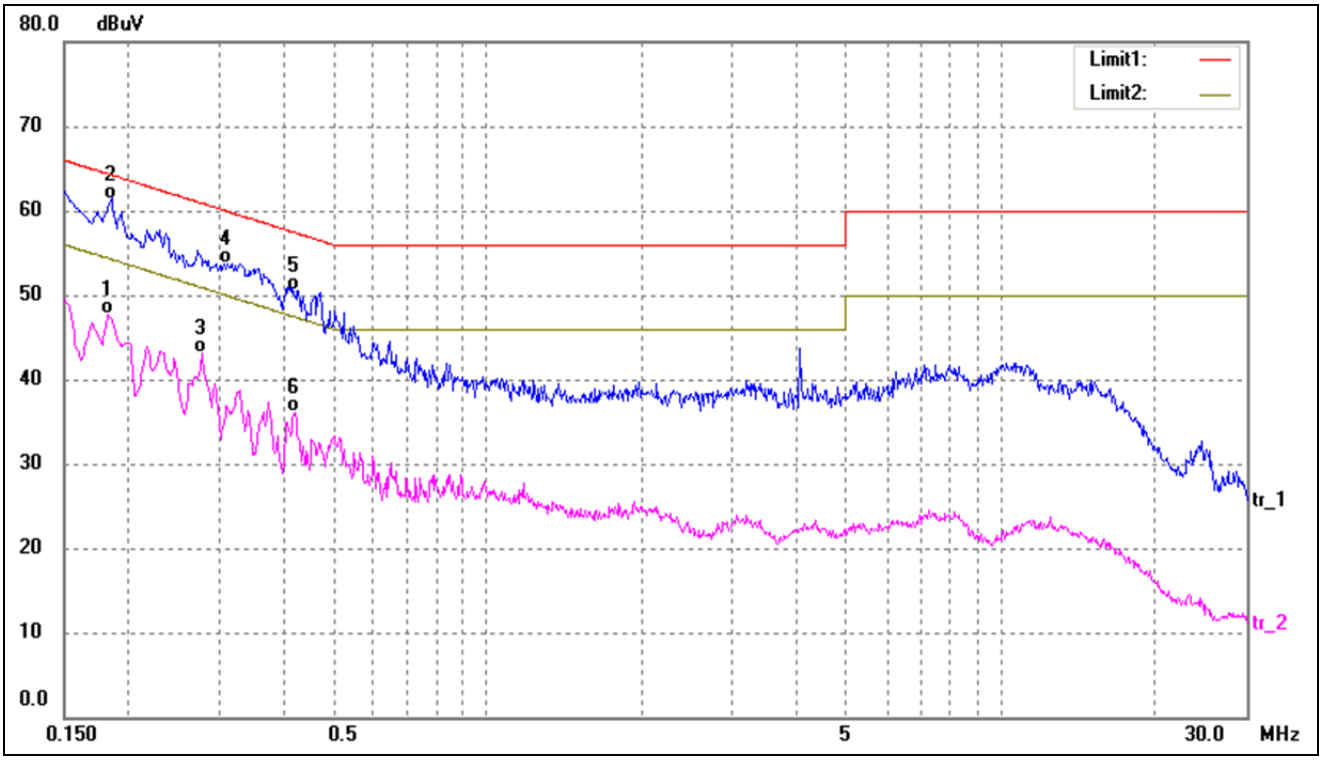
## 5.4 Summary of Test Results/Plots

| Test Mode | Communication | AC120V 60Hz | Polarity: | Neutral |
|---|---|---|---|---|




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Detector |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dB/m) | (dBuV) | (dBuV) | (dB) | |
| 1 | 0.1660 | 27.38 | 9.95 | 37.33 | 55.15 | -17.82 | AVG |
| 2* | 0.1780 | 50.97 | 9.96 | 60.93 | 64.57 | -3.64 | QP |
| 3 | 0.5140 | 38.94 | 10.02 | 48.96 | 56.00 | -7.04 | QP |
| 4 | 0.5140 | 26.68 | 10.02 | 36.70 | 46.00 | -9.30 | AVG |
| 5 | 1.2020 | 28.19 | 10.38 | 38.57 | 56.00 | -17.43 | QP |
| 6 | 1.2020 | 15.95 | 10.38 | 26.33 | 46.00 | -19.67 | AVG |

| Test Mode | Communication | AC120V 60Hz | Polarity: | Line |
|---|---|---|---|---|




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Detector |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dB/m) | (dBuV) | (dBuV) | (dB) | |
| 1 | 0.1819 | 37.66 | 9.96 | 47.62 | 54.39 | -6.77 | AVG |
| 2* | 0.1860 | 51.44 | 9.96 | 61.40 | 64.21 | -2.81 | QP |
| 3 | 0.2779 | 33.14 | 10.01 | 43.15 | 50.88 | -7.73 | AVG |
| 4 | 0.3116 | 43.71 | 10.01 | 53.72 | 59.93 | -6.21 | QP |
| 5 | 0.4193 | 40.53 | 10.01 | 50.54 | 57.46 | -6.92 | QP |
| 6 | 0.4220 | 26.14 | 10.01 | 36.15 | 47.41 | -11.26 | AVG |

# 6. Power Spectral Density

## 6.1 Standard Applicable

Section 15.407(a) Power limits:

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

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

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

## 6.2 Test Procedure

According to 789033 D02 v02r01 General UNII Test Procedures New Rules v02, the following is the measurement procedure.
For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500kHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in section II.B.l.a).
b) Set VBW ≥ 3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/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 10log(1MHz/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 sections 5.c) and 5.d) above, since RBW=100 kHZ is available on nearly all spectrum analyzers.

## 6.3 Summary of Test Results/Plots

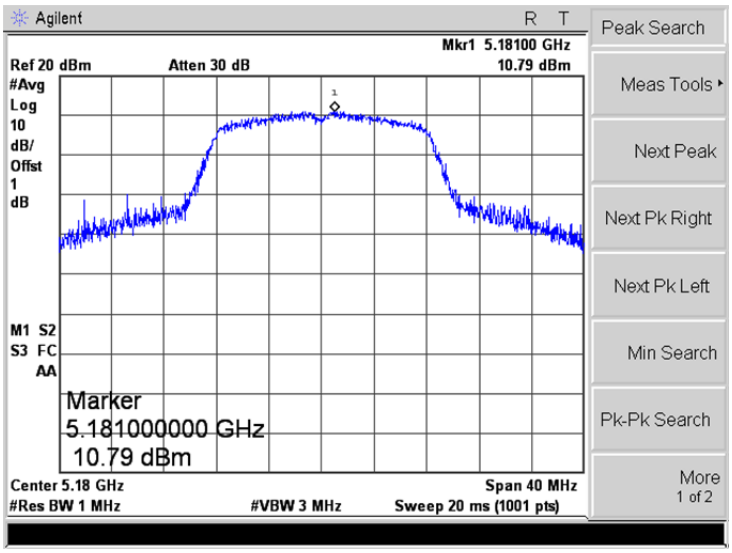
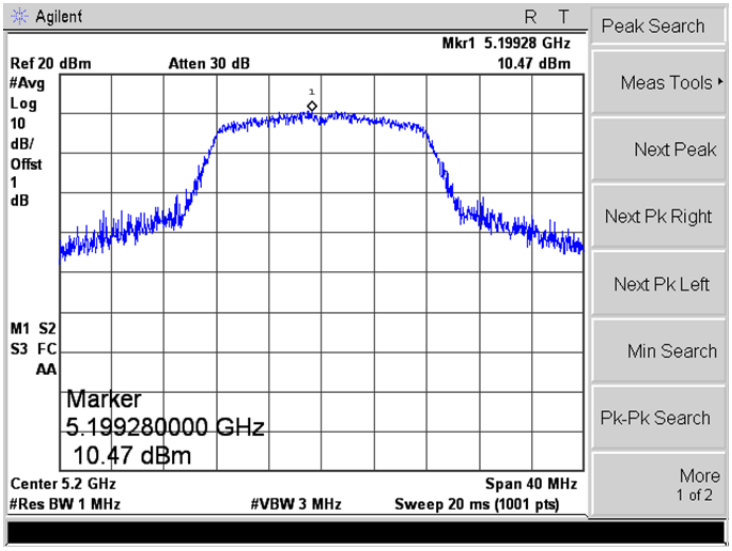
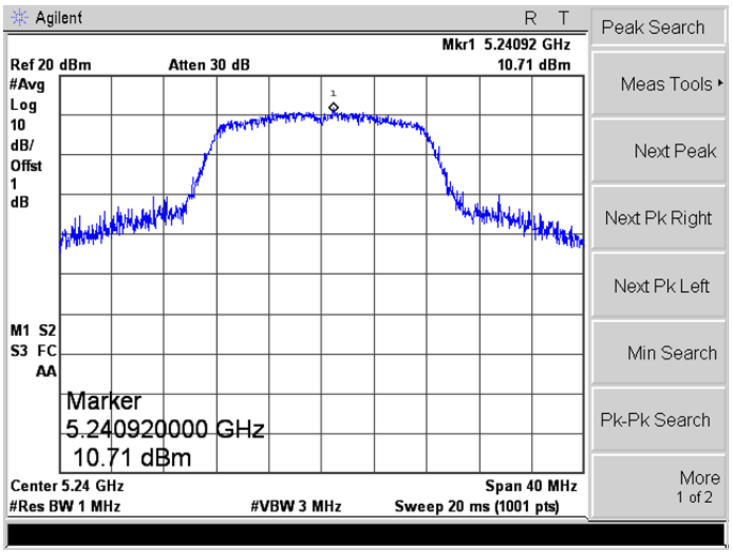
| **U-NII-1:5150-5250MHz** | | | |
|---|---|---|---|
| Operating mode | Test Channel | Power Spectral Density dBm/MHz | Limit (dBm/MHz) |
| 802.11a | 5180 | 10.79 | 11 |
| | 5200 | 10.47 | 11 |
| | 5240 | 10.71 | 11 |
| 802.11n-HT20 | 5180 | 7.687 | 11 |
| | 5200 | 8.796 | 11 |
| | 5240 | 8.844 | 11 |
| 802.11n-HT40 | 5190 | 5.380 | 11 |
| | 5230 | 5.751 | 11 |
| 802.11ac-HT80 | 5210 | 2.912 | 11 |

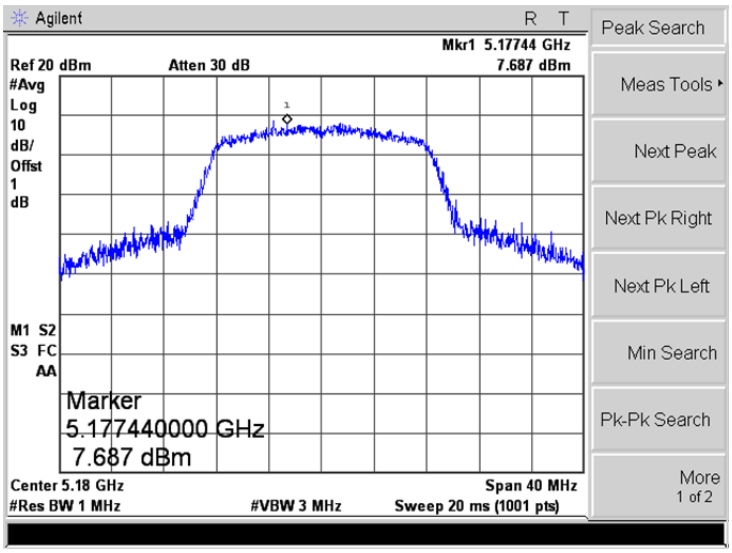
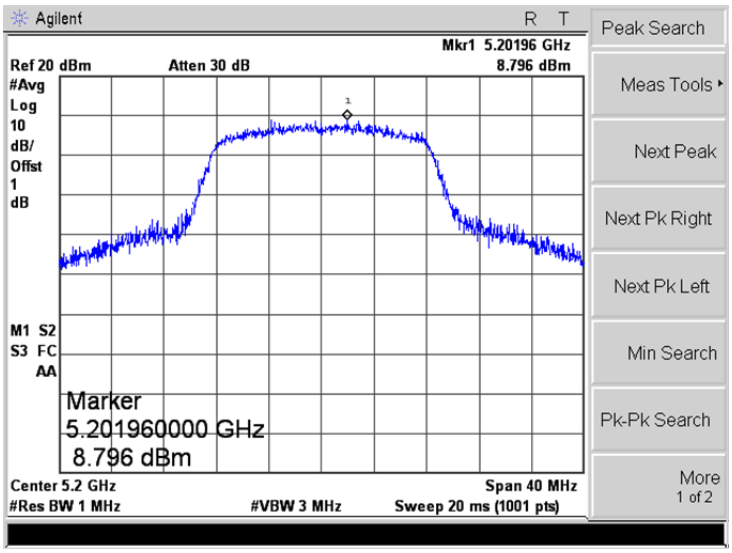
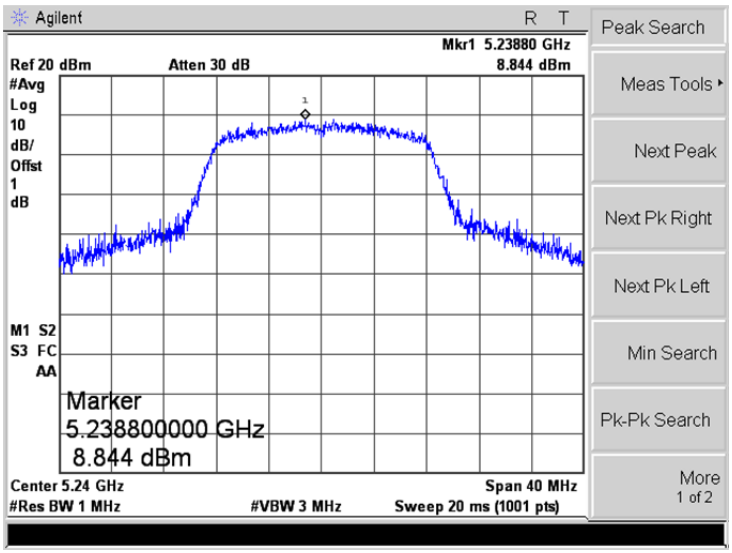
| **U-NII-2A: 5250-5350MHz** | | | |
|---|---|---|---|
| Operating mode | Test Channel | Power Spectral Density dBm/MHz | Limit (dBm/MHz) |
| 802.11a | 5260 | 7.874 | 11 |
| | 5280 | 7.324 | 11 |
| | 5320 | 7.297 | 11 |
| 802.11n-HT20 | 5260 | 7.427 | 11 |
| | 5280 | 7.095 | 11 |
| | 5320 | 7.478 | 11 |
| 802.11n-HT40 | 5270 | 3.916 | 11 |
| | 5310 | 4.213 | 11 |
| 802.11ac-HT80 | 5290 | 1.704 | 11 |

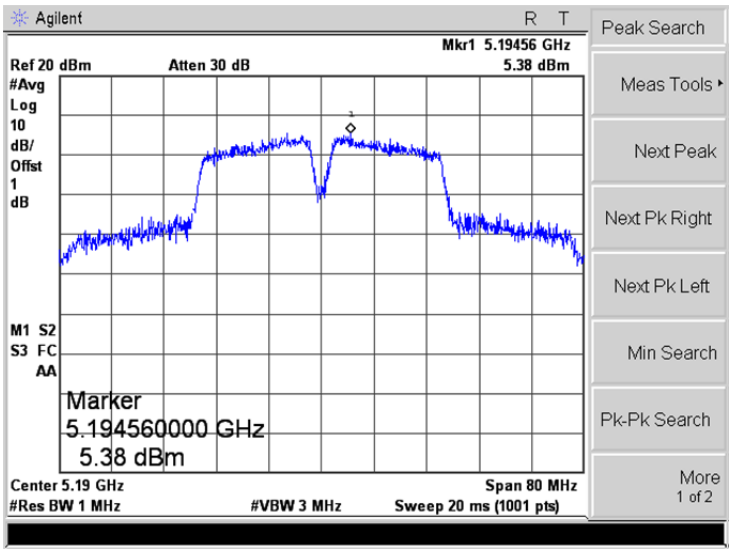
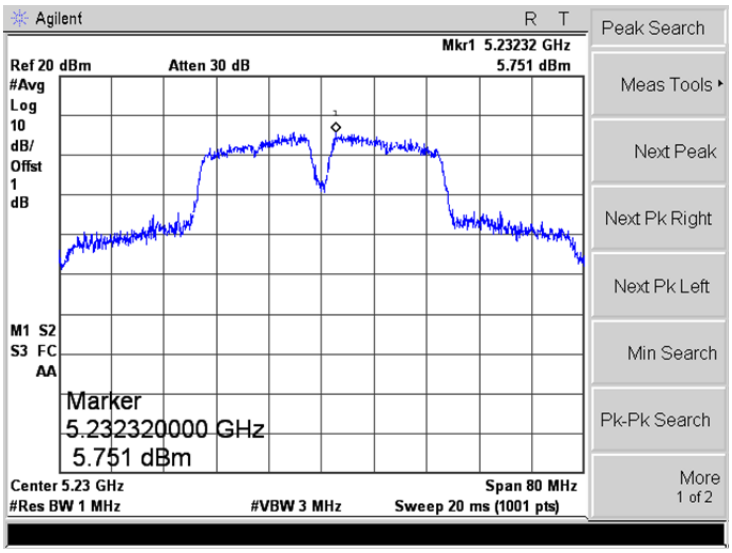
| U-NII-2C: 5470-5725MHz | | | |
|---|---|---|---|
| Operating mode | Test Channel | Power Spectral Density dBm/MHz | Limit (dBm/MHz) |
| 802.11a | 5500 | 8.625 | 11 |
| | 5600 | 7.986 | 11 |
| | 5700 | 6.613 | 11 |
| 802.11n-HT20 | 5500 | 7.657 | 11 |
| | 5600 | 6.571 | 11 |
| | 5700 | 6.409 | 11 |
| 802.11n-HT40 | 5510 | 4.354 | 11 |
| | 5590 | 4.280 | 11 |
| | 5670 | 3.799 | 11 |
| 802.11ac-HT80 | 5530 | 2.284 | 11 |
| | 5610 | 2.061 | 11 |

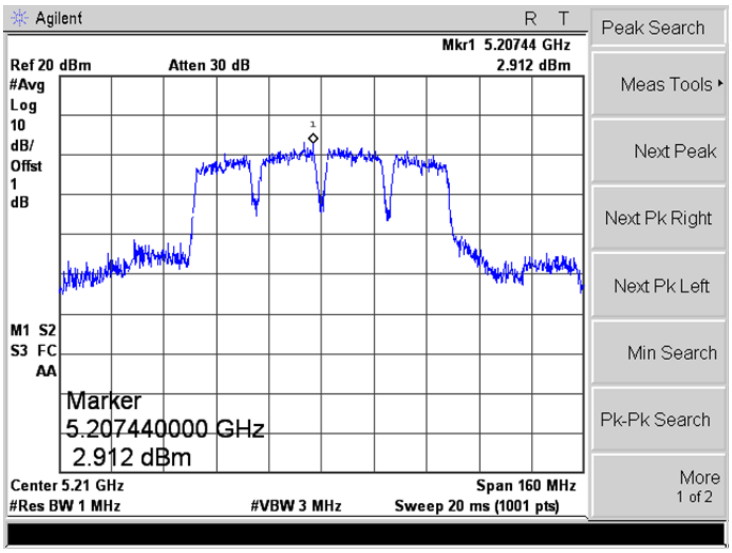
| U-NII-3: 5725-5850MHz | | | | | |
|---|---|---|---|---|---|
| Operating mode | Test Channel | Power Spectral Density dBm/300kHz | Factor | Power Spectral Density* dBm/500kHz | Limit dBm/500kHz |
| 802.11a | 5745 | 5.072 | 2.22 | 7.292 | 30 |
| | 5785 | 5.198 | 2.22 | 7.418 | 30 |
| | 5825 | 5.780 | 2.22 | 8.000 | 30 |
| 802.11n-HT20 | 5745 | 4.832 | 2.22 | 7.052 | 30 |
| | 5785 | 4.930 | 2.22 | 7.150 | 30 |
| | 5825 | 5.765 | 2.22 | 7.985 | 30 |
| 802.11n HT40 | 5755 | 3.508 | 2.22 | 5.728 | 30 |
| | 5795 | 3.098 | 2.22 | 5.318 | 30 |
| 802.11ac VH80 | 5775 | 0.089 | 2.22 | 2.309 | 30 |
| *Note: Maximum PSD=PSD(dBm/300kHz)+10log(500kHz/300kHz)=2.22 | | | | | |

➢ 5150-5250MHz

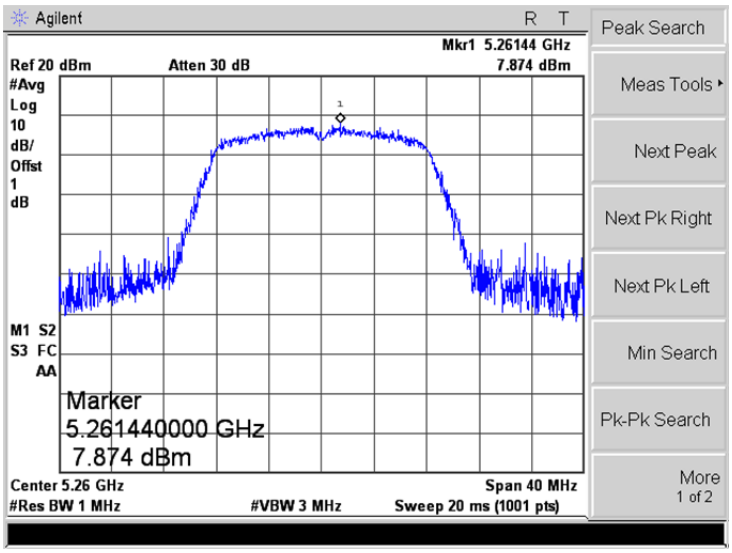
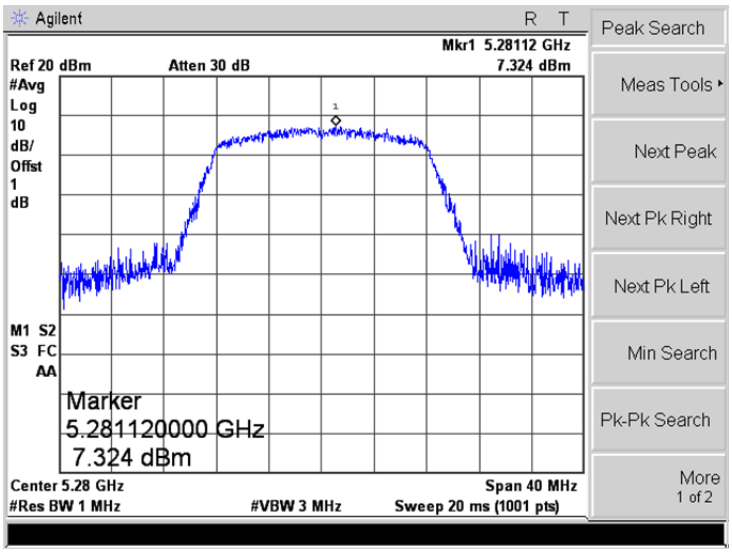
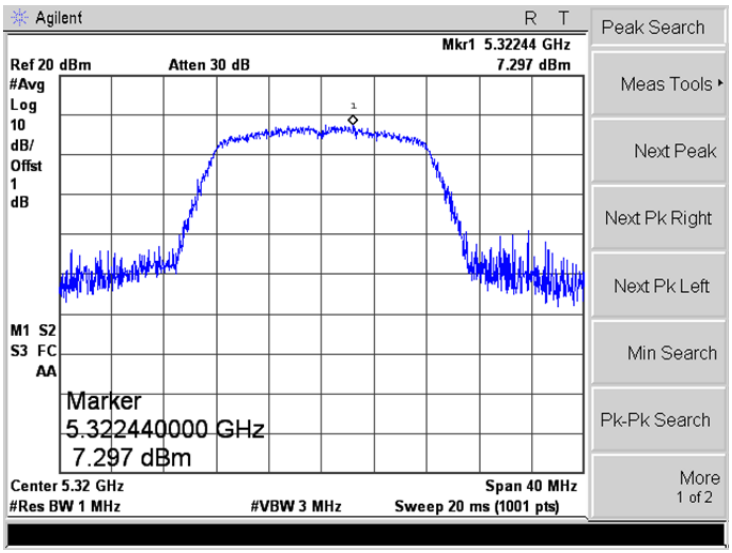
| **Mode:** | **802.11a** |
|---|---|
| 5180MHz |  |
| 5200MHz |  |
| 5240MHz |  |

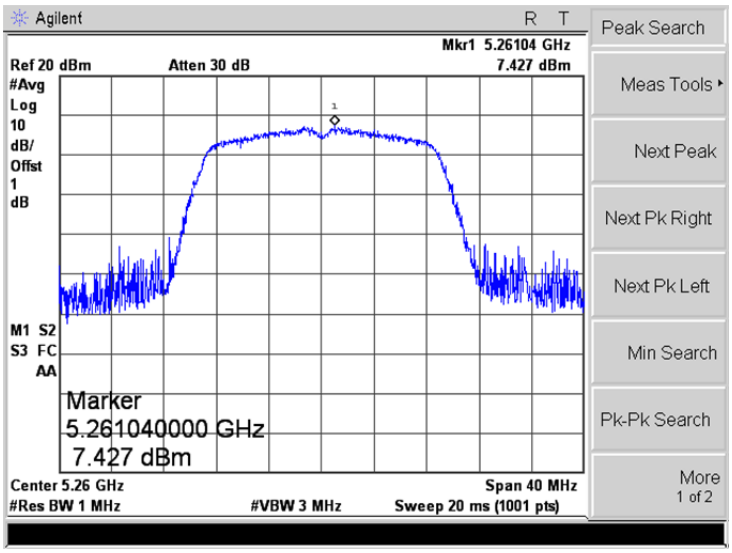
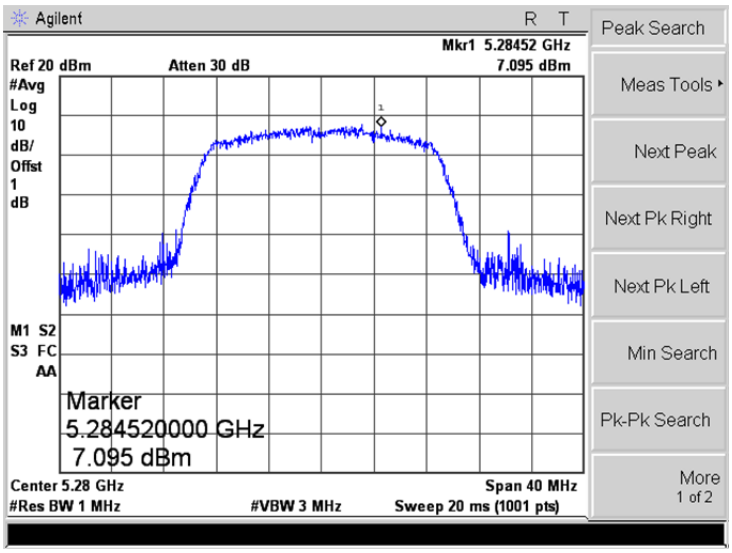
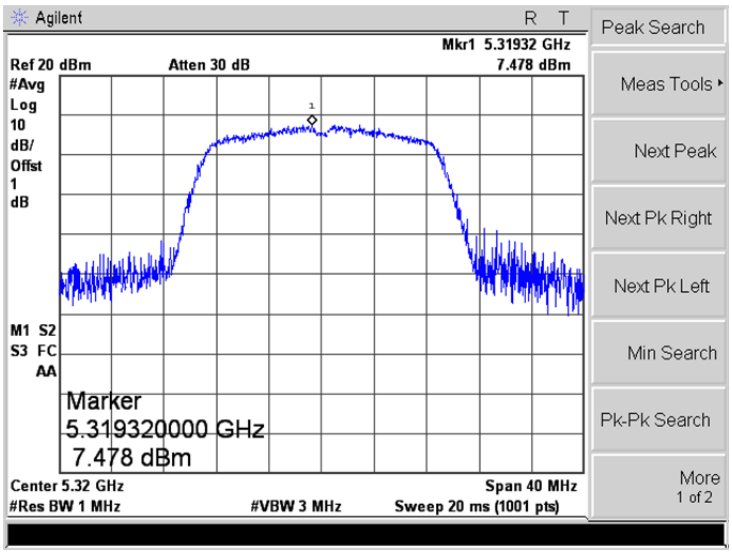
| Mode: | 802.11n-HT20 |
|---|---|
| 5180MHz |  |
| 5200MHz |  |
| 5240MHz |  |

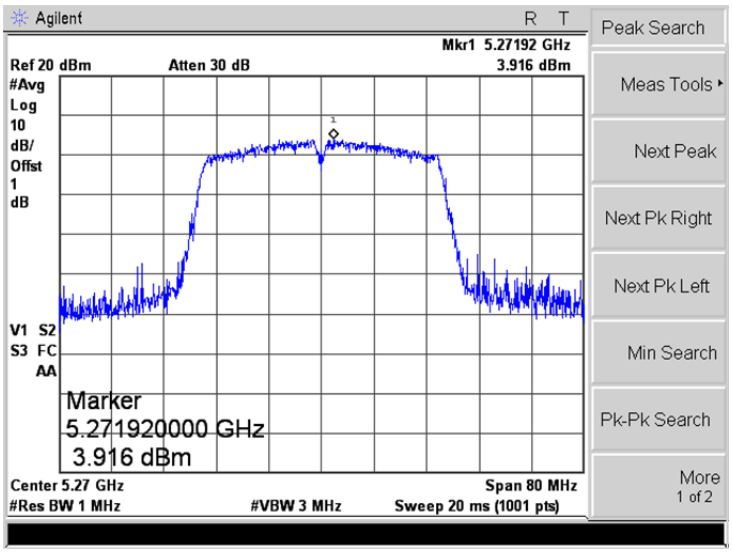
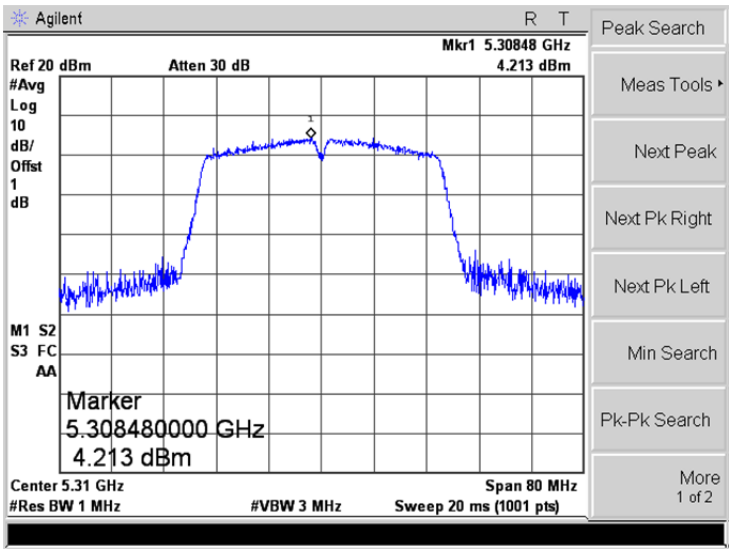
| Mode: | 802.11n-HT40 |
|---|---|
| 5190 MHz |  |
| 5230 MHz |  |

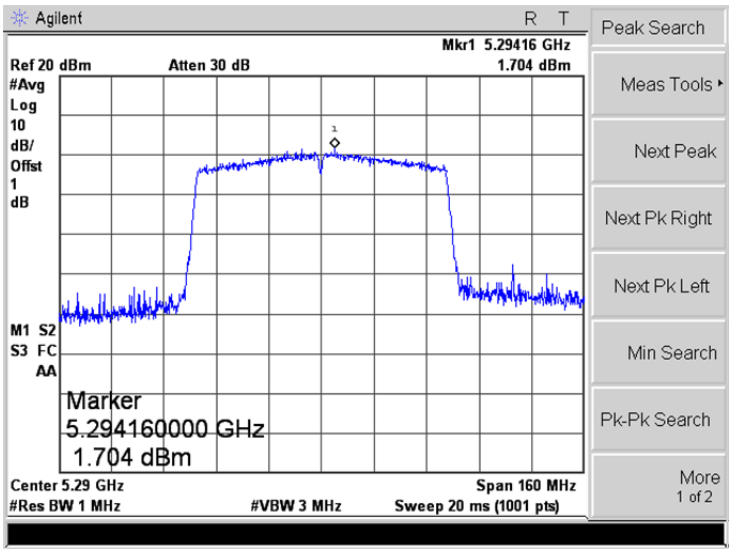
| Mode: | 802.11ac VH80 |
|---|---|
| 5210MHz |  |

➢ 5250-5350MHz

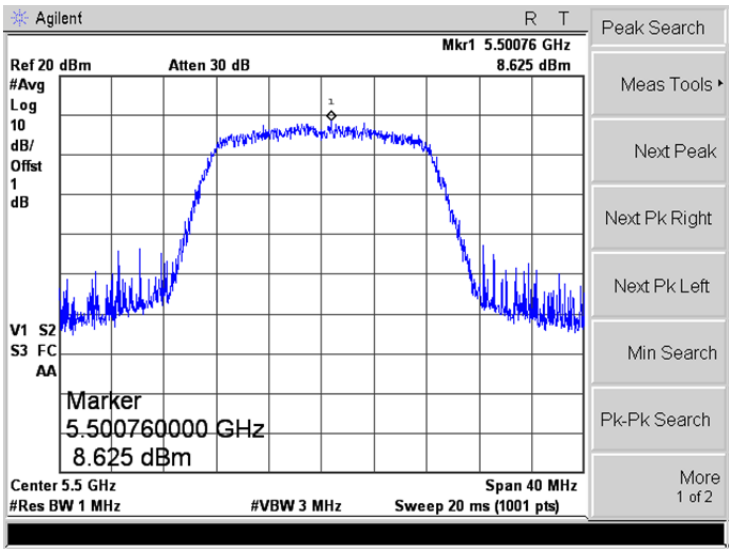
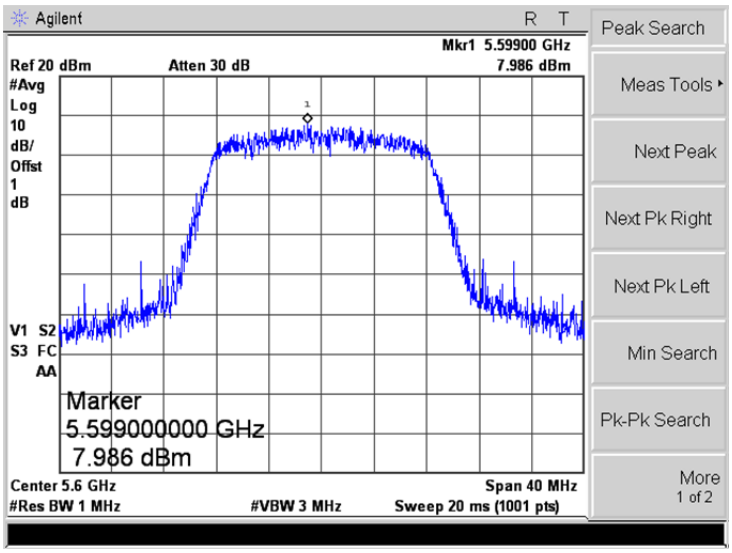
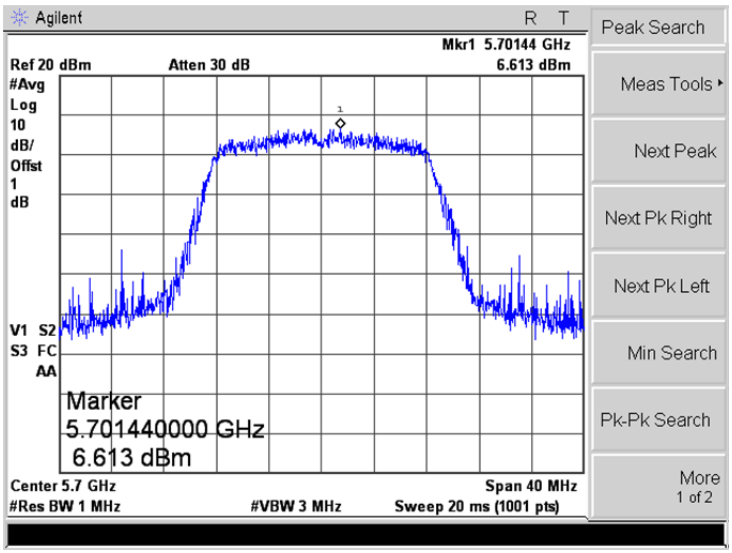
| **Mode:** | **802.11a** |
|---|---|
| 5260MHz |  |
| 5280MHz |  |
| 5320MHz |  |

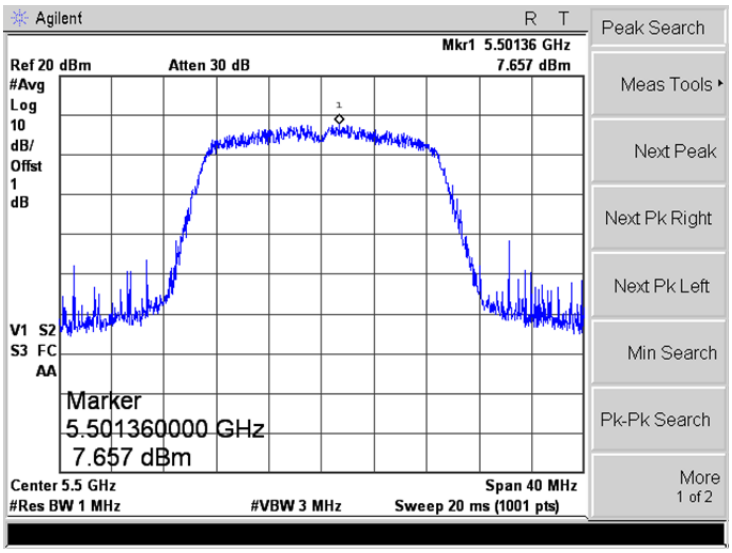
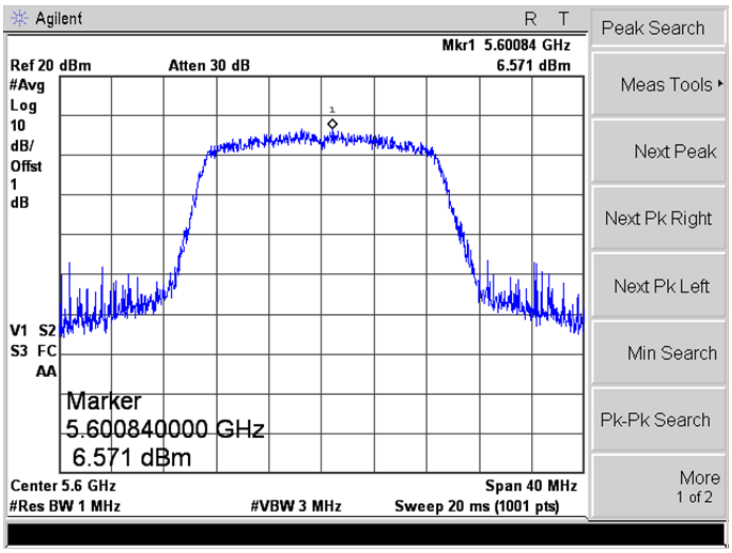
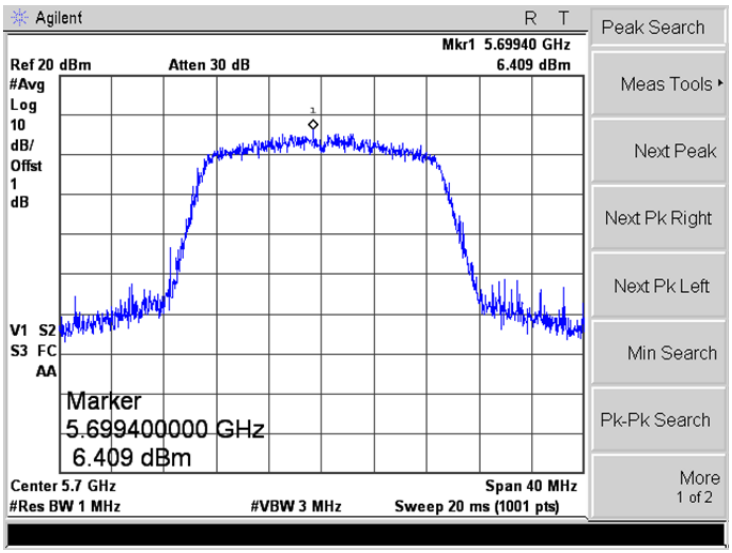
| Mode: | 802.11n-HT20 |
|---|---|
| 5260MHz |  |
| 5280MHz |  |
| 5320MHz |  |

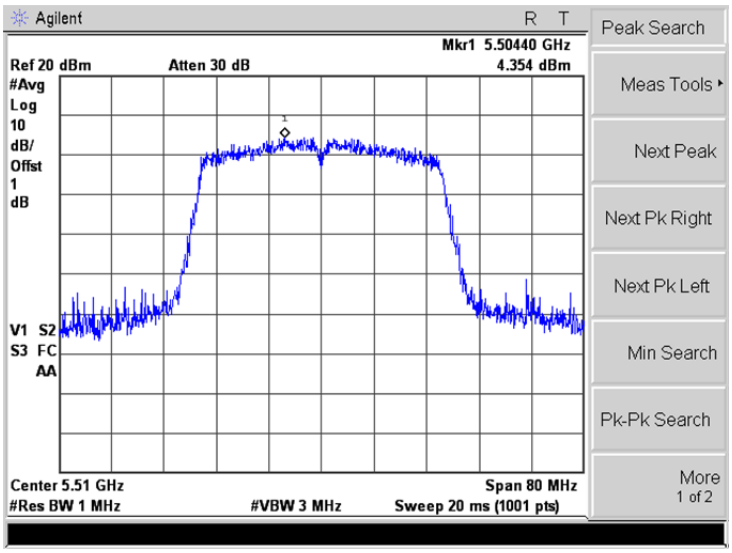
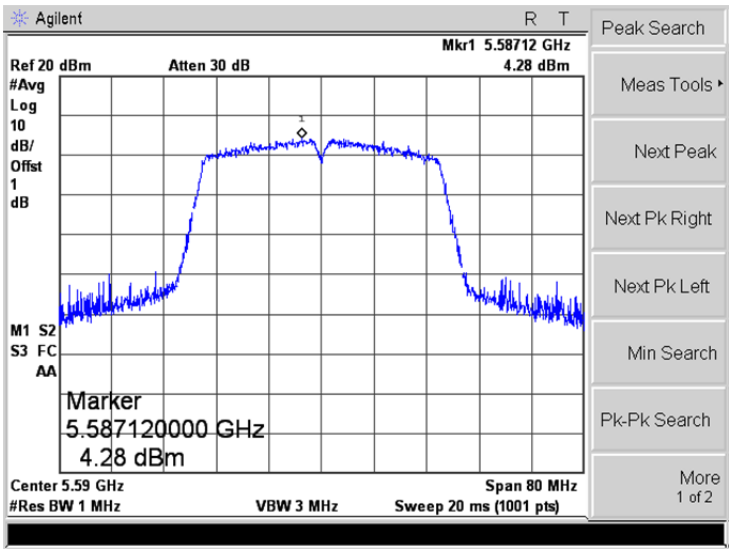
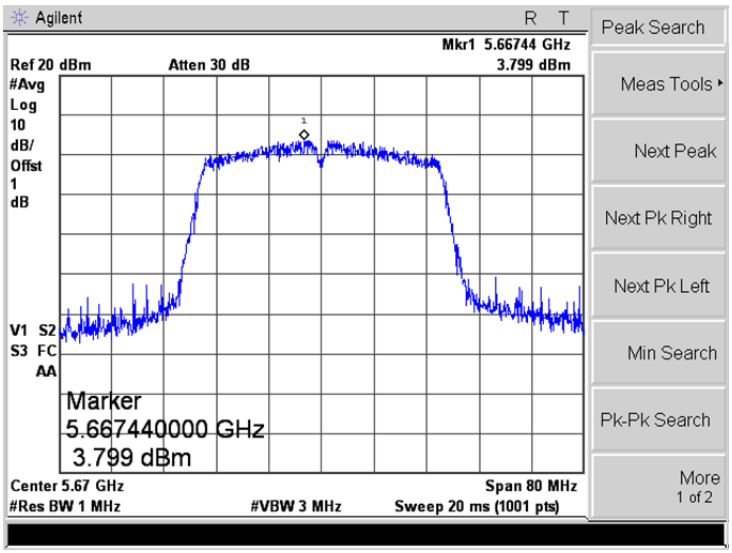
| Mode: | 802.11n-HT40 |
|---|---|
| 5270MHz |  |
| 5310MHz |  |

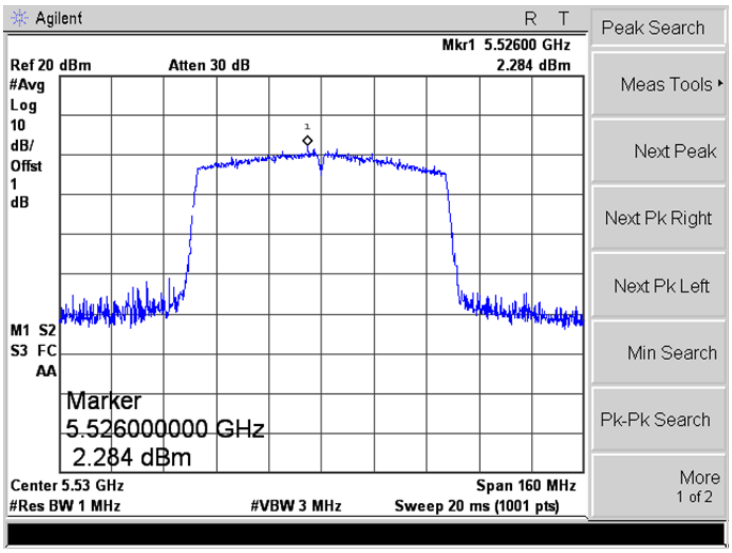
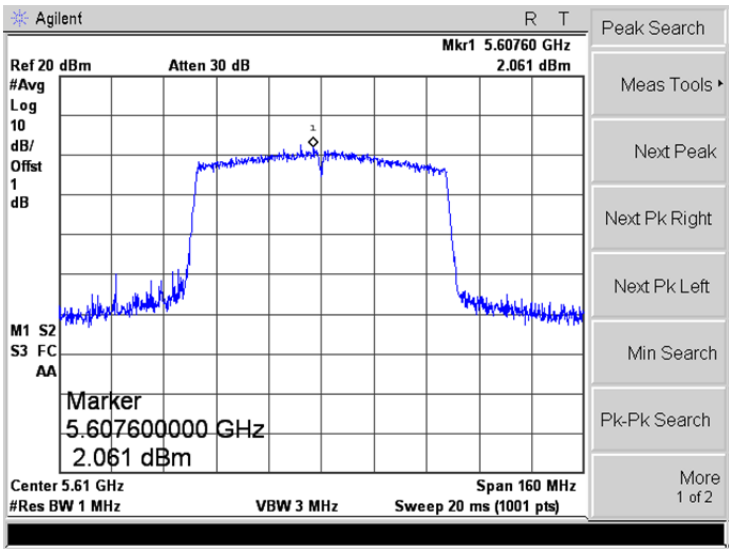
| Mode: | 802.11ac VH80 |
|---|---|
| 5290MHz |  |

➢ 5470-5725MHz

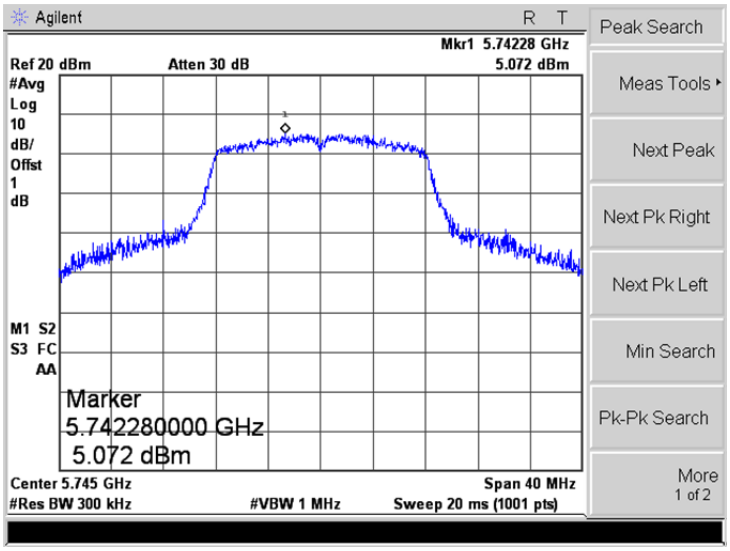
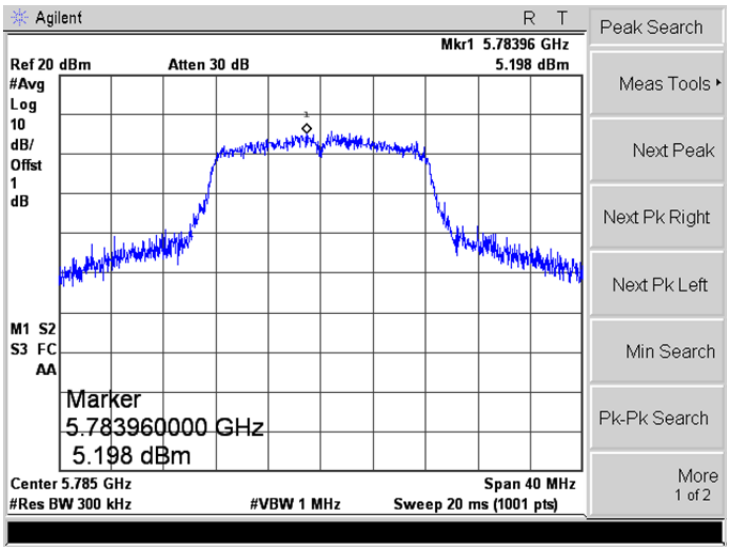
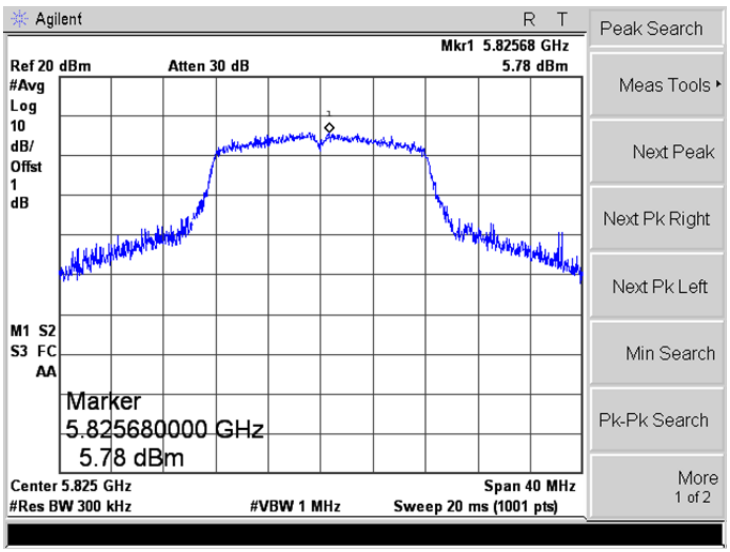
| **Mode:** | **802.11a** |
|---|---|
| 5500MHz |  |
| 5600MHz |  |
| 5700MHz |  |

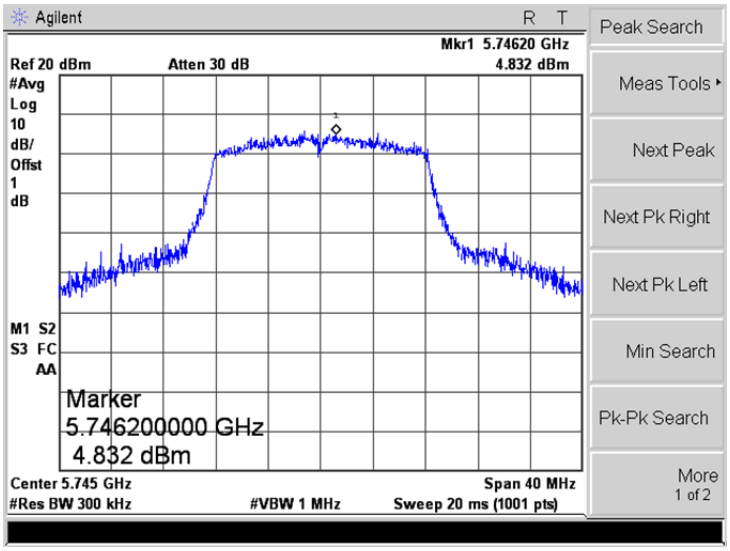
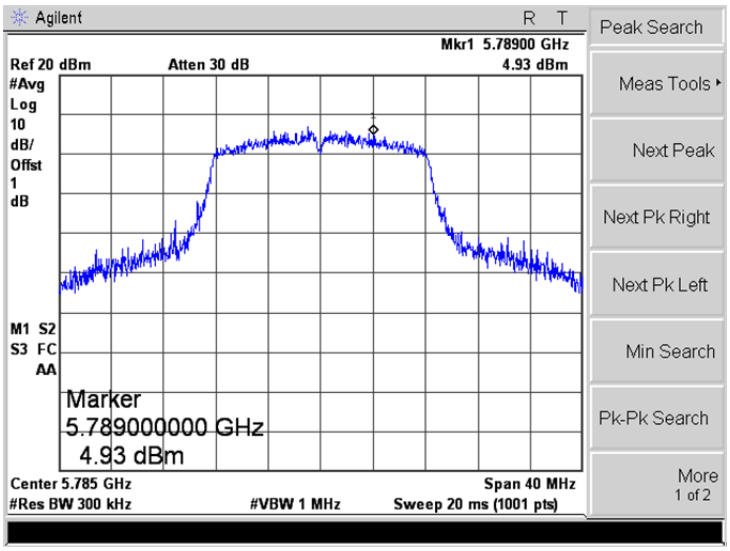
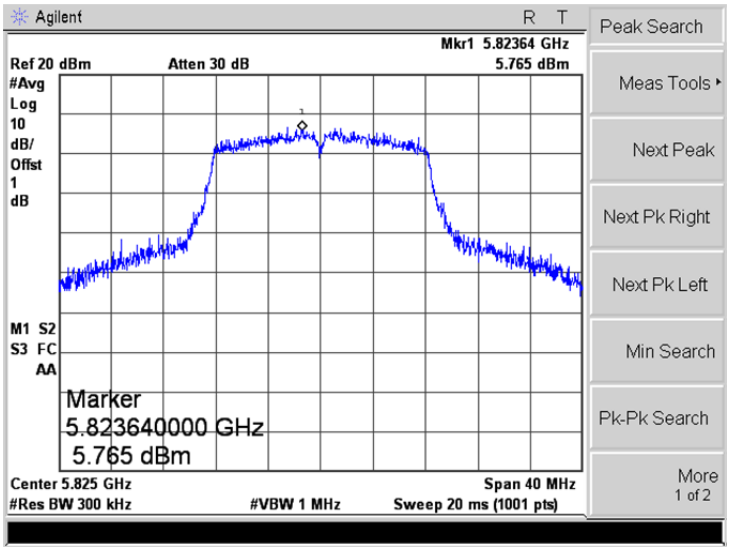
| Mode: | 802.11n-HT20 |
|---|---|
| 5500MHz |  |
| 5600MHz |  |
| 5700MHz |  |

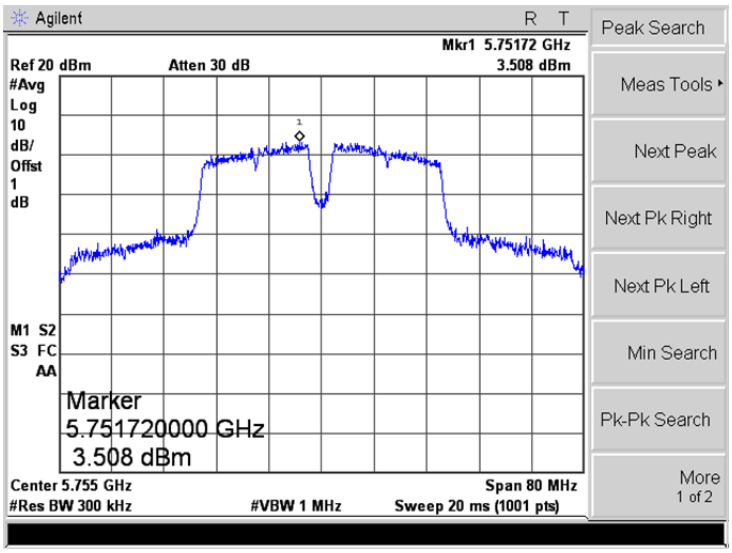
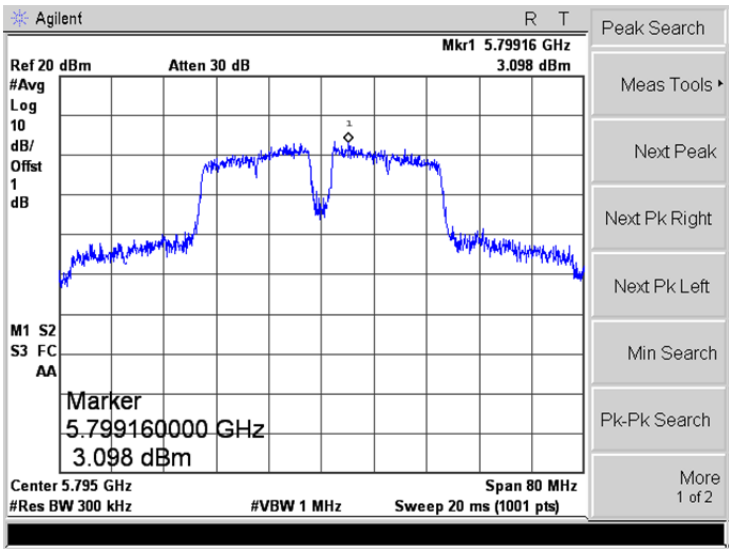
| Mode: | 802.11n-HT40 |
|---|---|
| 5510MHz |  |
| 5590MHz |  |
| 5670MHz |  |

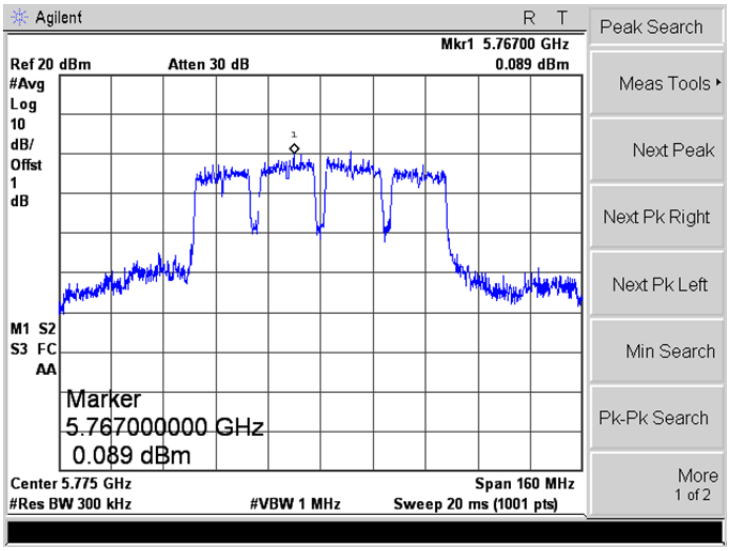
| Mode: | 802.11ac VH80 |
|---|---|
| 5530MHz |  |
| 5610MHz |  |

➢ 5725-5850MHz

| Mode: | 802.11a |
|---|---|
| 5745MHz |  |
| 5785MHz |  |
| 5825MHz |  |

| Mode: | 802.11n-HT20 |
|---|---|
| 5745MHz |  |
| 5785MHz |  |
| 5825MHz |  |

| Mode: | 802.11n-HT40 |
|---|---|
| 5755 MHz |  |
| 5795 MHz |  |

| Mode: | 802.11ac VH80 |
|---|---|
| 5775 MHz |  |

# 7. Emission Bandwidth and Occupied Bandwidth

## 7.1 Standard Applicable

According to 15.407(a) and (e):

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

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

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

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

## 7.2 Test Procedure

According to 789033 D02 v02r0r section C&D, the following is the measurement procedure.

1. Emission Bandwidth (EBW)
a) Set RBW = approximately 1% of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) 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. 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 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is 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.
Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

D. 99 Percent Occupied Bandwidth
The 99-percent occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission. Measurement of the 99-percent occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in section II.G.3.d). Measurements of 99-percent occupied bandwidth may also optionally be used in lieu of the EBW to 789033 D02 v02r01 General UNII Test Procedures New Rules v01 define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in section II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).

The following procedure shall be used for measuring (99 %) power bandwidth:
1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ≥ 3 * RBW
5. 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.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. 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.

## 7.3 Summary of Test Results/Plots

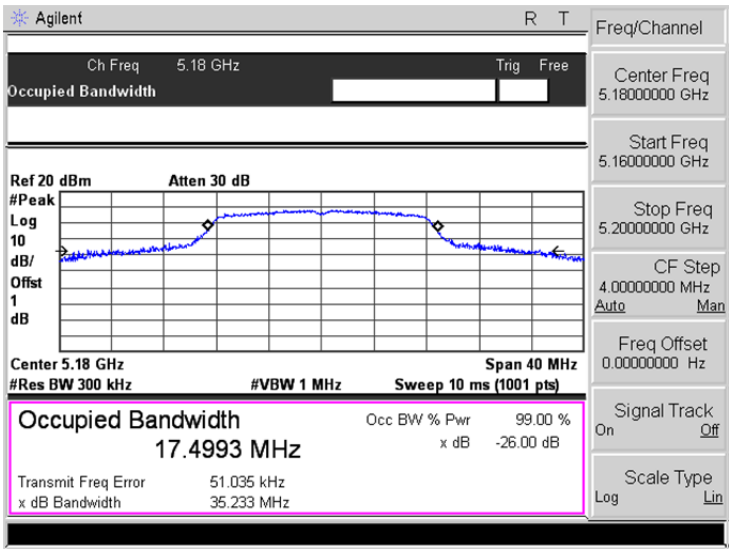
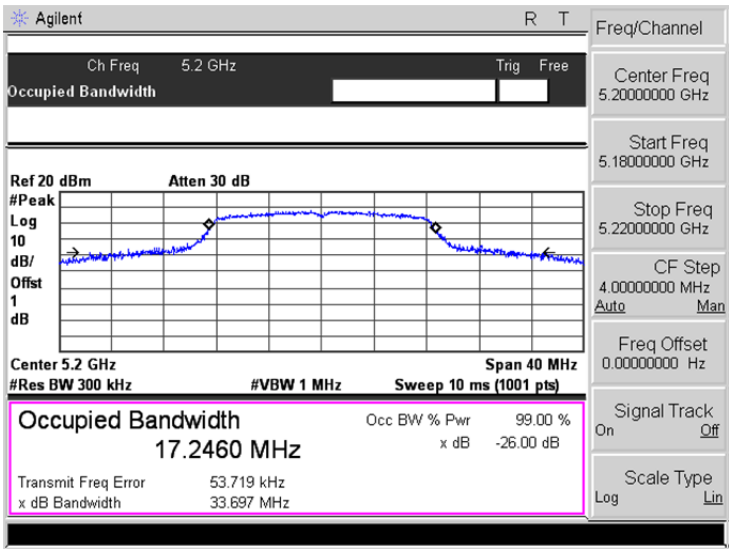
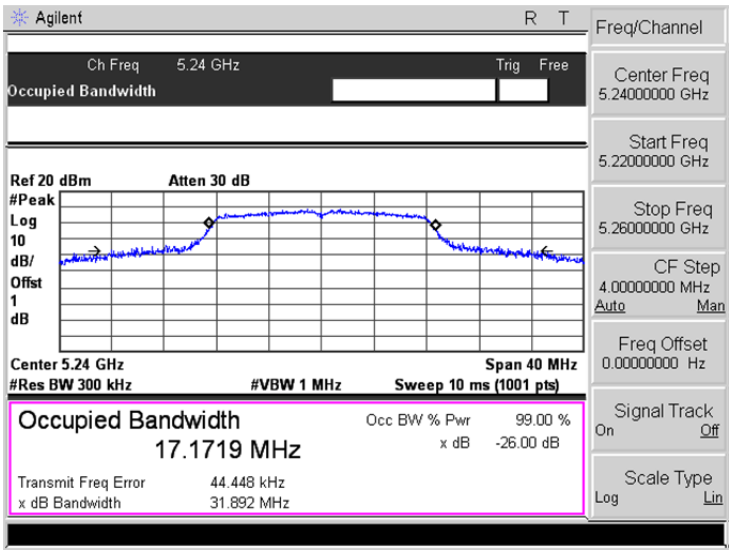
| U-NII-1:5150-5250MHz | | | | |
|---|---|---|---|---|
| **Test Mode** | **Test Channel MHz** | **26 dB Bandwidth MHz** | **99% Bandwidth MHz** | **Limit MHz** |
| 802.11a | 5180 | 35.233 | 17.4993 | Pass |
| | 5200 | 33.697 | 17.2460 | Pass |
| | 5240 | 31.892 | 17.1719 | Pass |
| 802.11n-HT20 | 5180 | 25.571 | 16.7918 | Pass |
| | 5200 | 25.157 | 16.7584 | Pass |
| | 5240 | 22.847 | 16.7755 | Pass |
| 802.11n-HT40 | 5190 | 75.858 | 44.9169 | Pass |
| | 5230 | 75.956 | 42.9833 | Pass |
| 802.11ac-HT80 | 5210 | 102.262 | 75.8978 | Pass |

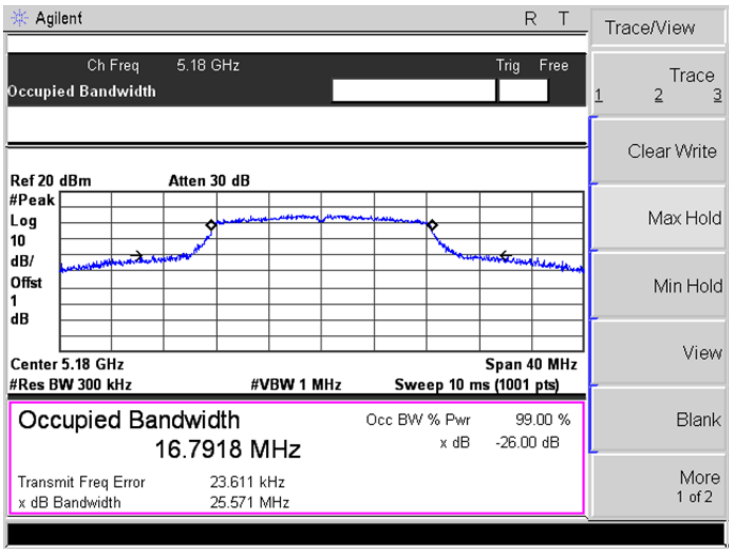
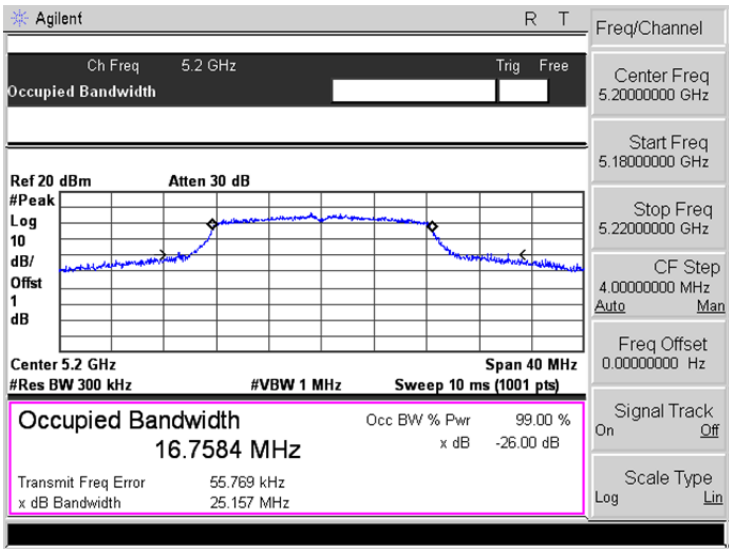
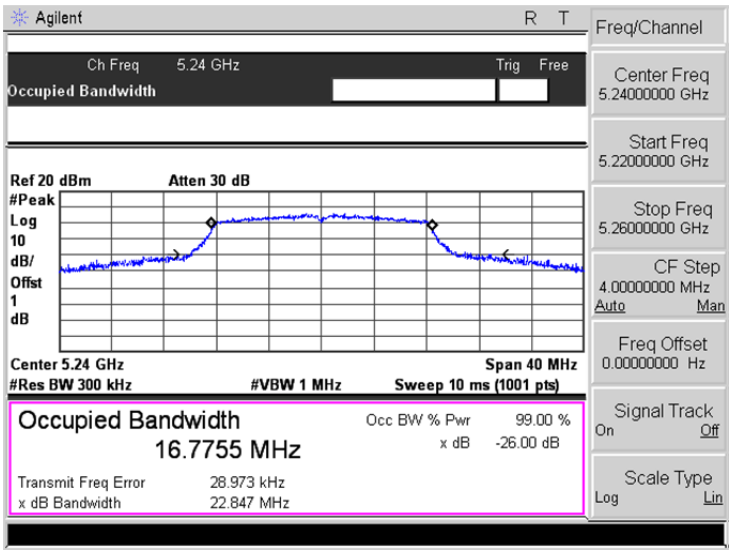
| U-NII-2A: 5250-5350MHz | | | | |
|---|---|---|---|---|
| **Test Mode** | **Test Channel MHz** | **26 dB Bandwidth MHz** | **99% Bandwidth MHz** | **Limit MHz** |
| 802.11a | 5260 | 30.724 | 17.0583 | Pass |
| | 5280 | 34.265 | 17.3090 | Pass |
| | 5320 | 31.045 | 17.1627 | Pass |
| 802.11n-HT20 | 5260 | 31.537 | 18.0513 | Pass |
| | 5280 | 34.272 | 18.0724 | Pass |
| | 5320 | 30.587 | 17.9486 | Pass |
| 802.11n-HT40 | 5270 | 65.601 | 36.7574 | Pass |
| | 5310 | 71.546 | 36.8436 | Pass |
| 802.11ac-HT80 | 5290 | 139.169 | 75.7828 | Pass |

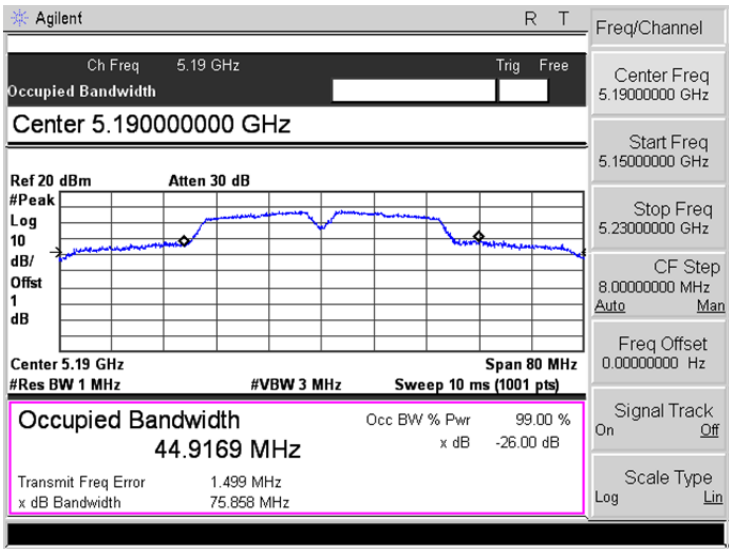
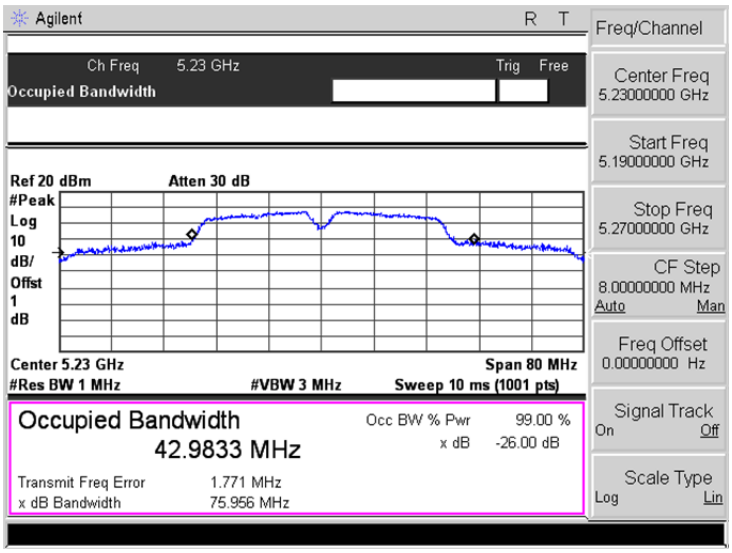
| U-NII-2C: 5470-5725MHz | | | | |
|---|---|---|---|---|
| **Test Mode** | **Test Channel MHz** | **26 dB Bandwidth MHz** | **99% Bandwidth MHz** | **Limit MHz** |
| 802.11a | 5500 | 20.070 | 16.6233 | Pass |
| | 5600 | 20.154 | 16.6027 | Pass |
| | 5700 | 20.222 | 16.7074 | Pass |
| 802.11n-HT20 | 5500 | 20.473 | 17.6979 | Pass |
| | 5600 | 20.457 | 17.6757 | Pass |
| | 5700 | 20.416 | 17.6884 | Pass |
| 802.11n-HT40 | 5510 | 41.452 | 36.2822 | Pass |
| | 5590 | 41.527 | 36.2946 | Pass |
| | 5670 | 41.746 | 36.4170 | Pass |
| 802.11ac-HT80 | 5530 | 79.390 | 75.1149 | Pass |
| | 5610 | 79.838 | 75.1603 | Pass |

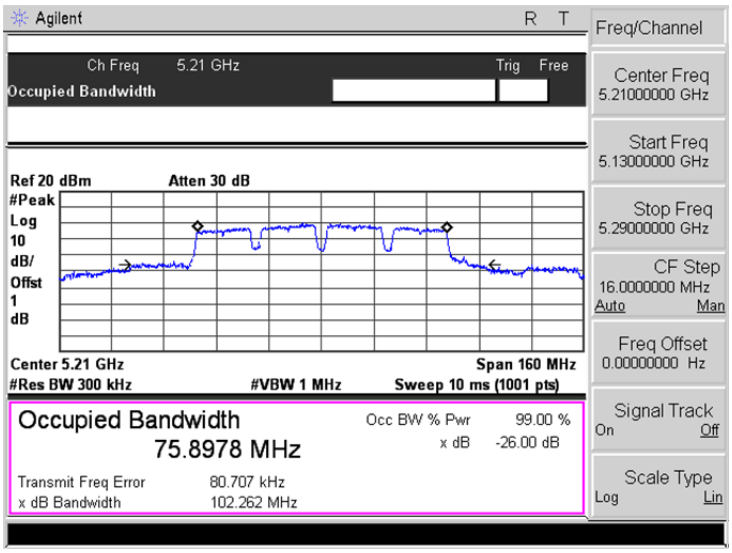
| U-NII-3: 5725-5850MHz | | | | |
|---|---|---|---|---|
| **Test Mode** | **Test Channel MHz** | **6 dB Bandwidth MHz** | **99% Bandwidth MHz** | **Limit MHz** |
| 802.11a | 5745 | 16.063 | 17.1438 | ≥500 |
| | 5785 | 16.175 | 16.9975 | ≥500 |
| | 5825 | 15.959 | 17.0675 | ≥500 |
| 802.11n-HT20 | 5745 | 16.061 | 16.6989 | ≥500 |
| | 5785 | 15.972 | 16.7356 | ≥500 |
| | 5825 | 16.075 | 16.7336 | ≥500 |
| 802.11n-HT40 | 5755 | 35.531 | 38.7807 | ≥500 |
| | 5795 | 35.600 | 41.1961 | ≥500 |
| 802.11ac VH80 | 5775 | 75.932 | 76.1005 | ≥500 |

➢ 5150-5250MHz

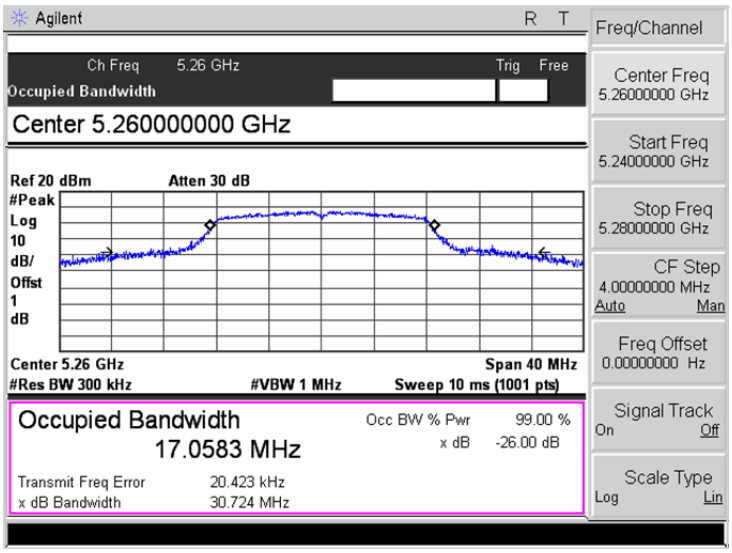
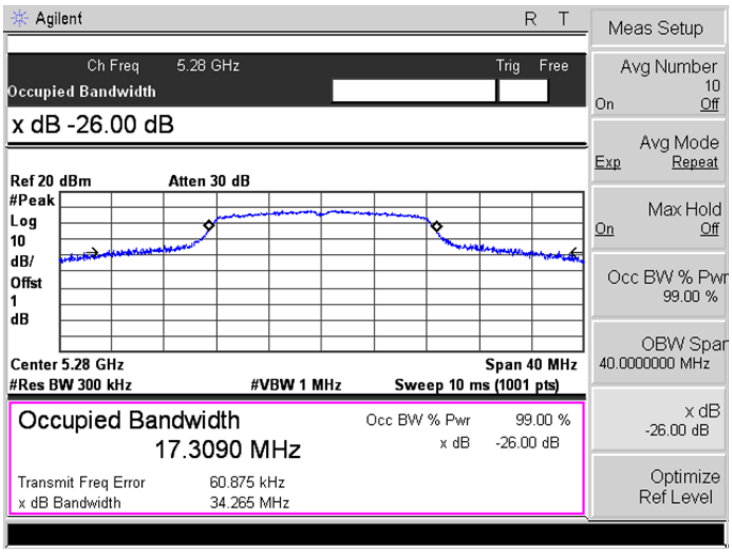
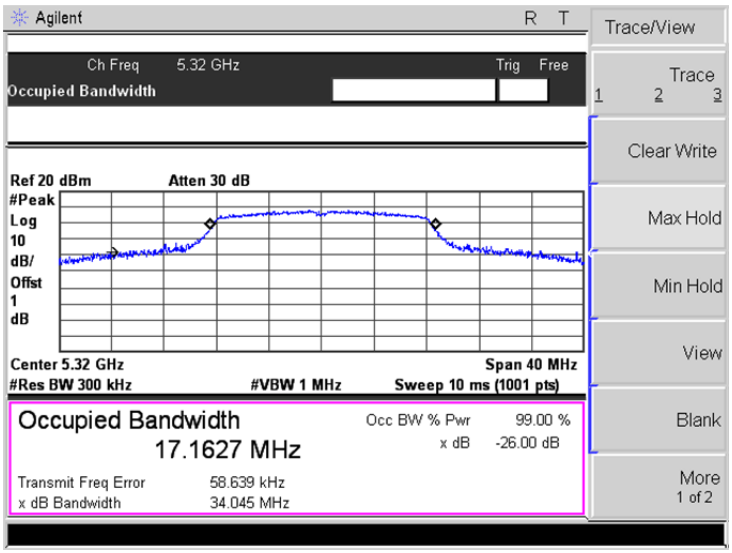
| **Mode:** | **802.11a** |
|---|---|
| 5180MHz |  |
| 5200MHz |  |
| 5240MHz |  |

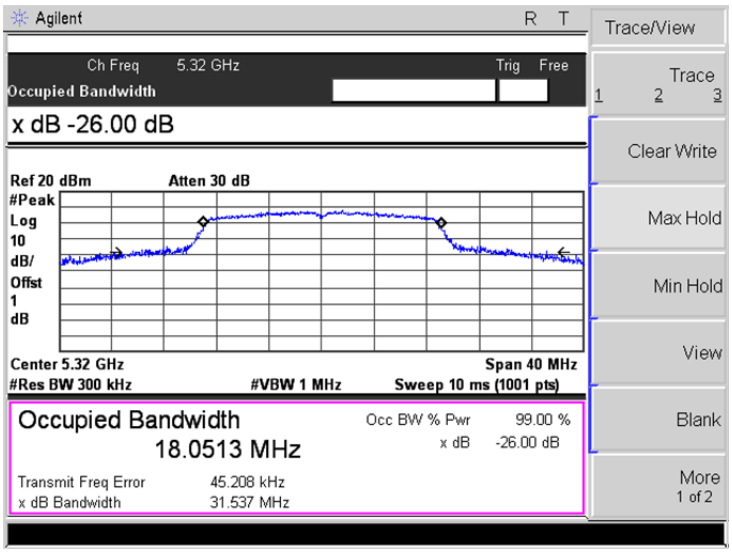
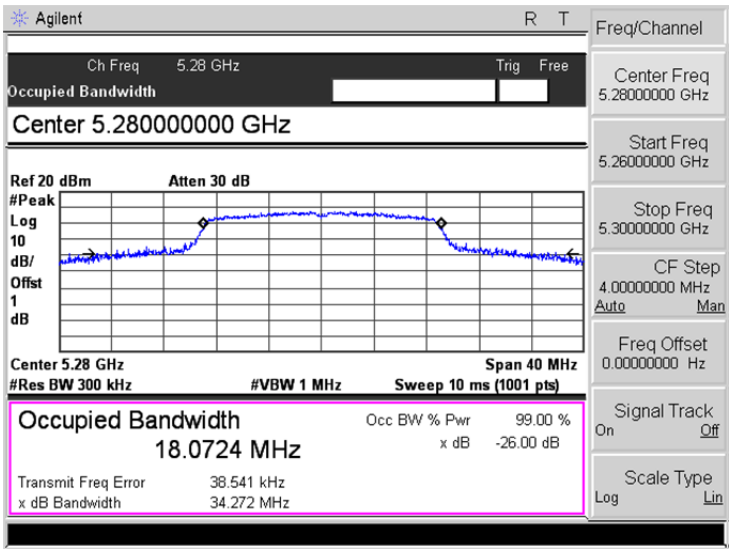
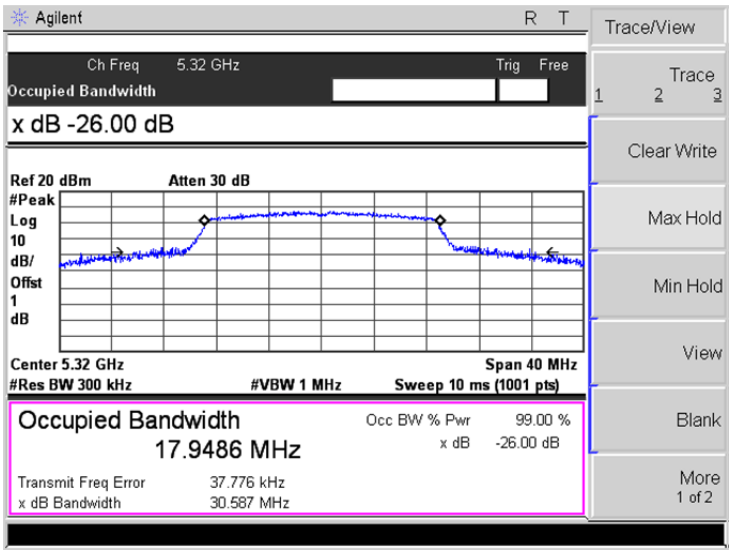
| Mode: | 802.11n-HT20 |
|---|---|
| 5180MHz |  |
| 5200MHz |  |
| 5240MHz |  |

| Mode: | 802.11n-HT40 |
|---|---|
| 5190 MHz |  |
| 5230 MHz |  |

| Mode: | 802.11ac VH80 |
|---|---|
| 5210MHz |  |

➢ 5250-5350MHz

| Mode: | 802.11a |
|---|---|
| 5260MHz |  |
| 5280MHz |  |
| 5320MHz |  |

| Mode: | 802.11n-HT20 |
|---|---|
| 5260MHz |  |
| 5280MHz |  |
| 5320MHz |  |