# RF TEST REPORT

Report No.: FCC_SL17072501-RUC-022_W53W56
Supersede Report No.:

| | | |
|---|---|---|
| Applicant | : | Ruckus Wireless, Inc. |
| Product Name | : | E510 Access Point |
| Model No. | : | E510 |
| Test Standard | : | 47 CFR 15.407 |
| Test Method | : | ANSI C63.4: 2014<br>789033 D02 General UNII Test Procedures New Rules v01 |
| FCC ID | : | S9GE510 |
| IC ID | : | 5912A-E510 |
| Dates of test | : | 10/24/2017-10/31/2017 |
| Issue Date | : | 11/07/2017 |
| Test Result | : | ☒ Pass ☐ Fail |
| Equipment complied with the specification [X]<br>Equipment did not comply with the specification [ ] | | |

| This Test Report is Issued Under the Authority of: | |
|---|---|
| Gary Chou | |
| Gary Chou | Chen Ge |
| Test Engineer | Engineer Reviewer |
| This test report may be reproduced in full only<br>Test result presented in this test report is applicable to the tested sample only | |

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA

# Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.


In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

## Accreditations for Conformity Assessment

| Country/Region | Accreditation Body | Scope |
| --- | --- | --- |
| USA | FCC, A2LA | EMC, RF/Wireless, Telecom |
| Canada | IC, A2LA, NIST | EMC, RF/Wireless, Telecom |
| Taiwan | BSMI, NCC, NIST | EMC, RF, Telecom, Safety |
| Hong Kong | OFTA, NIST | RF/Wireless, Telecom |
| Australia | NATA, NIST | EMC, RF, Telecom, Safety |
| Korea | KCC/RRA, NIST | EMI, EMS, RF, Telecom, Safety |
| Japan | VCCI, JATE, TELEC, RFT | EMI, RF/Wireless, Telecom |
| Mexico | NOM, COFETEL, Caniety | Safety, EMC, RF/Wireless, Telecom |
| Europe | A2LA, NIST | EMC, RF, Telecom, Safety |
| Israel | MOC, NIST | EMC, RF, Telecom, Safety |

## Accreditations for Product Certifications

| Country | Accreditation Body | Scope |
| --- | --- | --- |
| USA | FCC TCB, NIST | EMC, RF, Telecom |
| Canada | IC FCB, NIST | EMC, RF, Telecom |
| Singapore | iDA, NIST | EMC, RF, Telecom |
| EU | NB | EMC & R&TTE Directive |
| Japan | MIC (RCB 208) | RF, Telecom |
| Hong Kong | OFTA (US002) | RF, Telecom |

## CONTENTS

# 1 Report Revision History

| Report No. | Report Version | Description | Issue Date |
| --- | --- | --- | --- |
| FCC_SL17072501-RUC-022_W53W56 | None | Original | 11/07/2017 |
| | | | |
| | | | |
| | | | |
| | | | |

## 2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Ruckus Wireless, Inc.
Product: E510 Access Point
Model: E510

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

## 3 Customer information

| | | |
| --- | --- | --- |
| Applicant Name | : | Ruckus Wireless, Inc. |
| Applicant Address | : | 350 West Java Drive, Sunnyvale, California 94089 U.S.A |
| Manufacturer Name | : | Ruckus Wireless, Inc. |
| Manufacturer Address | : | 350 West Java Drive, Sunnyvale, California 94089 U.S.A |

## 4 Test site information

| | |
| --- | --- |
| Lab performing tests | SIEMIC Laboratories |
| Lab Address | 775 Montague Expressway, Milpitas, CA 95035 |
| FCC Test Site No. | 881796 |
| IC Test Site No. | 4842D-2 |
| VCCI Test Site No. | A0133 |

## 5 Modification

| Index | Item | Description | Note |
| --- | --- | --- | --- |
| - | - | - | - |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# 6 EUT Information

## 6.1 EUT Description

| | |
| --- | --- |
| Product Name | E510 Access Point |
| Model No. | E510 |
| Trade Name | Ruckus |
| Serial No. | 361706000066 |
| Host Model No. | N/A |
| Input Power | 48VDC (PoE) |
| Power Adapter Manu/Model | N/A |
| Power Adapter SN | N/A |
| Date of EUT received | 10/20/2017 |
| Equipment Class/ Category | DTS, UNII |
| Port/Connectors | PoE, Ethernet |

## 6.2 Radio Description

| Radio Type | 802.11a | 802.11n-20M | 802.11n-40M | 802.11ac-80M |
| --- | --- | --- | --- | --- |
| Operating Frequency | 5260-5320MHz<br>5500-5720MHz | 5260-5320MHz<br>5500-5720MHz | 5270-5310MHz<br>5510-5710MHz | 5290MHz, 5530MHz<br>5610MHz, 5690MHz |
| Modulation | OFDM (BPSK, QPSK, 16QAM, 64QAM) | OFDM (BPSK, QPSK, 16QAM, 64QAM) | OFDM (BPSK, QPSK, 16QAM, 64QAM) | OFDM (BPSK, QPSK, 16QAM, 64QAM) |
| Channel Spacing | 20MHz | 20MHz | 40MHz | 80MHz |
| Number of Channels | 16 | 16 | 6 | 4 |
| Antenna Type | External PCB Antenna | | | |
| Antenna Gain (Peak) | 5GHz: 3.5 dBi | | | |
| Antenna Connector Type | U.FL | | | |
| Note | 2.4GHz and 5GHz Radio transmit simultaneously | | | |

EUT Power level setting

| Mode | Frequency | Power Setting |
| --- | --- | --- |
| 802.11-a | 5260 | 42 |
| 802.11-a | 5280 | 42 |
| 802.11-a | 5320 | 42 |
| 802.11-n-20 | 5260 | 42 |
| 802.11-n-20 | 5280 | 42 |
| 802.11-n-20 | 5320 | 42 |
| 802.11-n-40 | 5270 | 43 |
| 802.11-n-40 | 5310 | 40 |
| 802.11-ac-80 | 5290 | 40 |
| | | |
| 802.11-a | 5500 | 40 |
| 802.11-a | 5580 | 40 |
| 802.11-a | 5700 | 40 |
| 802.11-n-20 | 5500 | 40 |
| 802.11-n-20 | 5580 | 40 |
| 802.11-n-20 | 5700 | 40 |
| 802.11-n-40 | 5510 | 42 |
| 802.11-n-40 | 5590 | 42 |
| 802.11-n-40 | 5670 | 40 |
| 802.11-ac-80 | 5530 | 40 |
| 802.11-ac-80 | 5610 | 40 |

CROSS Band channels power setting

| Mode | Frequency | Power Setting |
| --- | --- | --- |
| 802.11-a | 5720 | 40 |
| 802.11-n-20 | 5720 | 40 |
| 802.11-n-40 | 5710 | 40 |
| 802.11-ac-80 | 5690 | 40 |

Note: All data rate has been verified and worst case was used for all test items.

# 7 Supporting Equipment/Software and cabling Description

## 7.1 Supporting Equipment

| Item | Supporting Equipment Description | Model | Serial Number | Manufacturer | Note |
|---|---|---|---|---|---|
| 1 | Laptop | VOSTRO 1520 | 26543939185 | Dell | - |
| | | | | | |
| | | | | | |

## 7.2 Cabling Description

| Item | Connection Start | | Connection Stop | | Length / shielding Info | | Note |
|---|---|---|---|---|---|---|---|
| | From | I/O Port | To | I/O Port | Length (m) | Shielding | |
| 1 | EUT | RJ45 | Power Over Ethernet Injector | RJ45 | >3m | N/A | - |
| 2 | Laptop | RJ45 | Power Over Ethernet Injector | RJ45 | >3m | N/A | |

## 7.3 Test Software Description

| Test Item | Software | Description |
|---|---|---|
| RF Testing | Command prompt | Set the EUT to transmit continuously in diferent test mode |
| | | |
| | | |

# 8 Test Summary

| Test Item | Test standard | | Test Method/Procedure | Pass / Fail |
|---|---|---|---|---|
| Restricted Band of Operation | FCC | 15.205 | ANSI C63.4 – 2014<br>789033 D02 General UNII Test Procedures New Rules v01 | ☒ Pass<br>☐ N/A |
| AC Conducted Emissions Voltage | FCC | 15.207(a) | ANSI C63.4 – 2014 | ☒ Pass<br>☐ N/A |

| Test Item | Test standard | | Test Method/Procedure | Pass / Fail |
|---|---|---|---|---|
| 26 & 6 dB Emission Bandwidth | FCC | 15.407 (a) (2) | 789033 D02 General UNII Test Procedures New Rules v01 | ☒ Pass<br>☐ N/A |
| Maximum conducted Output Power | FCC | 15.407 (a) (2) | 789033 D02 General UNII Test Procedures New Rules v01 | ☒ Pass<br>☐ N/A |
| Power reduction (Antenna Gain > 6 dBi) | FCC | 15.407 (a) (2) | - | ☐ Pass<br>☒ N/A |
| Band Edge and Radiated Spurious Emissions | FCC | 15.407(b)(2),<br>15.407(b)(6) | ANSI C63.4 – 2014<br>789033 D02 General UNII Test Procedures New Rules v01 | ☒ Pass<br>☐ N/A |
| Power Spectral Density | FCC | 15.407 (a) (2) | 789033 D02 General UNII Test Procedures New Rules v01 | ☒ Pass<br>☐ N/A |
| Frequency Stability | FCC | 15.407 (g) | - | ☐ Pass<br>☒ N/A |
| Transmit Power Control (TPC) | FCC | 15.407 (h)(1) | - | ☐ Pass<br>☒ N/A |
| User Manual | FCC | - | - | ☒ Pass<br>☐ N/A |
| Remark | 1. All measurement uncertainties are not taken into consideration for all presented test result.<br>2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual. | | | |

# 9 Measurement Uncertainty

## 9.1 Conducted Emissions

The test is to measure the conducted emissions to the mains port of the EUT.
Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the LISN
- Uncertainty of cables
- Uncertainty due to the mismatches
- Etc, see the below table for details

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|---|---|---|---|---|---|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.125 |
| LISN Insertion Loss | 0.40 | Normal | 2 | 1 | 0.20 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| Mismatch LISN - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| LISN Impedance | 2.5 | Triangular | 2.449 | 1 | 1.0208248 |
| Combined Standard Uncertainty | | | | | 1.928133 |
| Expanded Uncertainty (K=2) | | | | | 3.856266 |

The total derived measurement uncertainty is +/- 3.86 dB.

## 9.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.
Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|---|---|---|---|---|---|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.125 |
| Antenna Factor | 0.65 | Normal | 2 | 1 | 0.325 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| Mismatch Filter - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| NSA Calibration | 4.0 | U-Shape | 1.414 | 1 | 2.8288543 |
| Combined Standard Uncertainty | | | | | 3.0059131 |
| Expanded Uncertainty (K=2) | | | | | 6.0118262 |

The total derived measurement uncertainty is +/- 6.00 dB.

## 9.3 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|---|---|---|---|---|---|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.0692840 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.1050000 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.1250000 |
| Antenna Factor | 0.65 | Normal | 2 | 1 | 0.3250000 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.8660508 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.8660508 |
| Mismatch Filter - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| VSWR Calibration | 2.0 | U-Shape | 1.414 | 1 | 1.4144272 |
| Combined Standard Uncertainty | | | | | 4.2363 |
| Expanded Uncertainty (K=2) | | | | | 8.4726 |

The total derived measurement uncertainty is +/- 8.47 dB.

## 9.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|---|---|---|---|---|---|
| Reference Level | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Attenuator | 0.25 | Normal | 2 | 1 | 0.125 |
| Mismatch | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| Combined Standard Uncertainty | | | | | 0.476087 |
| Expanded Uncertainty (K=2) | | | | | 0.952174 |

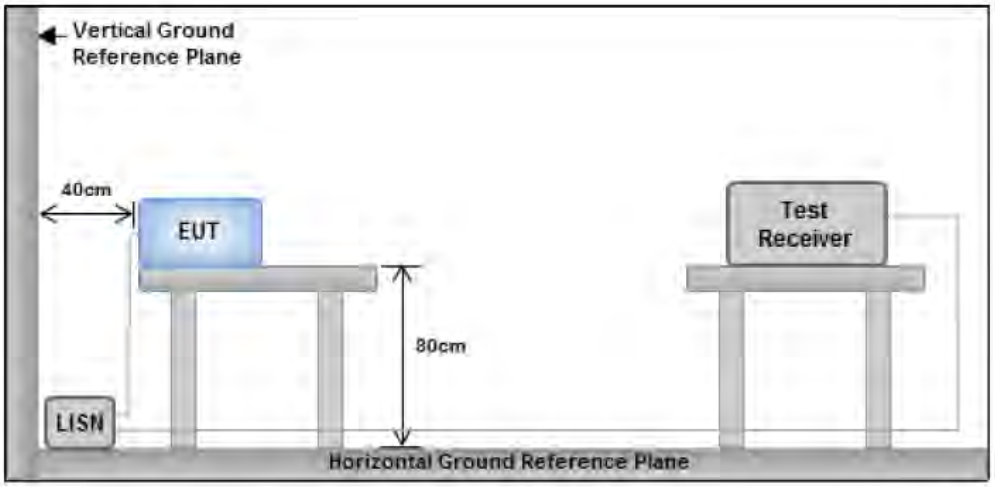
The total derived measurement uncertainty is +/- 0.95 dB.

# 10 Measurements, Examination and Derived Results

## 10.1 Conducted Emissions

Conducted Emission Limit

| Frequency ranges (MHz) | Limit (dBuV) | |
|---|---|---|
| | QP | Average |
| 0.15 ~ 0.5 | 66 – 56 | 56 – 46 |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

| Spec | Item | Requirement | Applicable |
|---|---|---|---|
| 15.207(a) | a) | For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges. | ☒ |
| Test Setup |  Note: 1. Support units were connected to second LISN.<br>2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes | | |
| Procedure | - The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B.<br>- The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.<br>- The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.<br>- All other supporting equipment was powered separately from another main supply. | | |
| Remark | EUT was tested in two modes of operations: (1) P.O.E Mode; (2) Power Supply Mode | | |
| Result | ☒ Pass ☐ Fail | | |

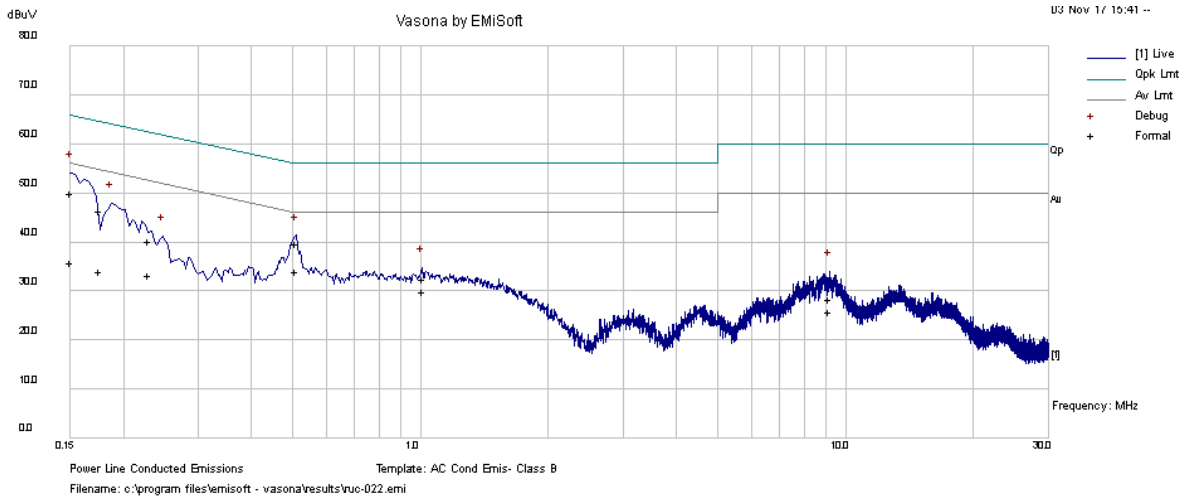
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Gary Chou at Conducted Emission test site.

## Conducted Emission Test Results

| Test specification: | Conducted Emissions | | | |
|---|---|---|---|---|
| Environmental Conditions: | Temp(° C): | 21 | Result: | ☒ Pass ☐ Fail |
| | Humidity (%): | 42 | | |
| | Atmospheric(mbar): | 1021 | | |
| Mains Power: | 120Vac, 60Hz | | | |
| Tested by: | Gary Chou | | | |
| Test Date: | 11/03/2017 | | | |
| Remarks | Power Supply, Live | | | |

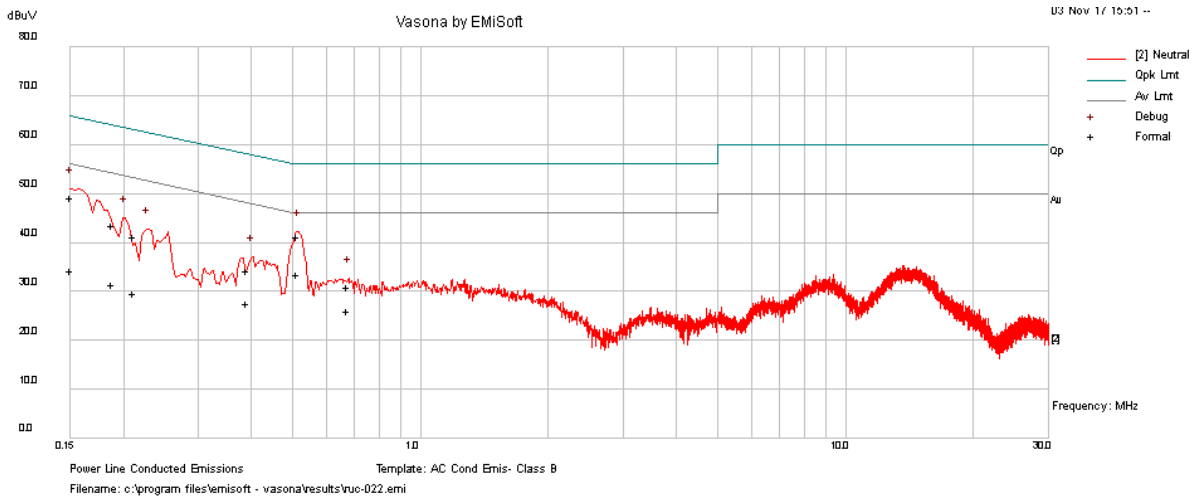



Line Plot at 120Vac, 60Hz

| Frequency (MHz) | Raw (dBuV) | Cable Loss (dB) | Factors (dB) | Level (dBuV) | Measurement Type | Line / Neutral | Limit (dBuV) | Margin (dB) | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|
| 0.15 | 38.84 | 9.33 | 1.74 | 49.91 | Quasi Peak | Live | 66 | -16.09 | Pass |
| 0.51 | 29.73 | 9.33 | 0.63 | 39.68 | Quasi Peak | Live | 56 | -16.32 | Pass |
| 0.18 | 35.59 | 9.33 | 1.44 | 46.36 | Quasi Peak | Live | 64.65 | -18.29 | Pass |
| 0.23 | 29.86 | 9.32 | 1.1 | 40.28 | Quasi Peak | Live | 62.47 | -22.19 | Pass |
| 1.02 | 22.64 | 9.33 | 0.53 | 32.5 | Quasi Peak | Live | 56 | -23.50 | Pass |
| 9.19 | 18.05 | 9.86 | 0.51 | 28.42 | Quasi Peak | Live | 60 | -31.58 | Pass |
| 0.15 | 24.84 | 9.33 | 1.74 | 35.9 | Average | Live | 56 | -20.10 | Pass |
| 0.51 | 23.93 | 9.33 | 0.63 | 33.88 | Average | Live | 46 | -12.12 | Pass |
| 0.18 | 23.17 | 9.33 | 1.44 | 33.94 | Average | Live | 54.65 | -20.71 | Pass |
| 0.23 | 22.76 | 9.32 | 1.1 | 33.18 | Average | Live | 52.47 | -19.29 | Pass |
| 1.02 | 19.96 | 9.33 | 0.53 | 29.82 | Average | Live | 46 | -16.18 | Pass |
| 9.19 | 15.38 | 9.86 | 0.51 | 25.74 | Average | Live | 50 | -24.26 | Pass |

## Conducted Emission Test Results

| Test specification: | Conducted Emissions | | | |
|---|---|---|---|---|
| Environmental Conditions: | Temp(° C): | 21 | Result: | ☒ Pass ☐ Fail |
| | Humidity (%): | 42 | | |
| | Atmospheric(mbar): | 1021 | | |
| Mains Power: | 120Vac, 60Hz | | | |
| Tested by: | Gary Chou | | | |
| Test Date: | 11/03/2017 | | | |
| Remarks | Power Supply, Neutral | | | |



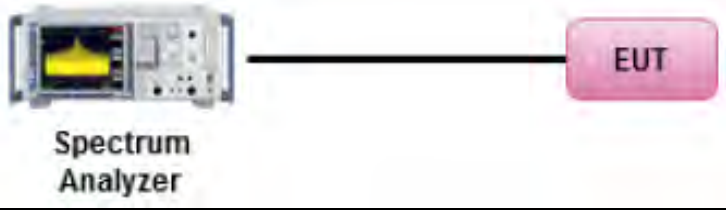

Neutral Plot at 120Vac, 60Hz

| Frequency (MHz) | Raw (dBuV) | Cable Loss (dB) | Factors (dB) | Level (dBuV) | Measurement Type | Line / Neutral | Limit (dBuV) | Margin (dB) | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|
| 0.51 | 31.29 | 9.33 | 0.62 | 41.24 | Quasi Peak | Neutral | 56 | -14.76 | Pass |
| 0.15 | 38.11 | 9.33 | 1.74 | 49.18 | Quasi Peak | Neutral | 66 | -16.82 | Pass |
| 0.19 | 32.95 | 9.32 | 1.34 | 43.62 | Quasi Peak | Neutral | 64.12 | -20.51 | Pass |
| 0.21 | 30.64 | 9.32 | 1.18 | 41.15 | Quasi Peak | Neutral | 63.12 | -21.97 | Pass |
| 0.39 | 24.27 | 9.33 | 0.71 | 34.31 | Quasi Peak | Neutral | 58.04 | -23.74 | Pass |
| 0.67 | 20.97 | 9.33 | 0.57 | 30.86 | Quasi Peak | Neutral | 56 | -25.14 | Pass |
| 0.51 | 23.6 | 9.33 | 0.62 | 33.55 | Average | Neutral | 46 | -12.45 | Pass |
| 0.15 | 23.19 | 9.33 | 1.74 | 34.26 | Average | Neutral | 56 | -21.74 | Pass |
| 0.19 | 20.85 | 9.32 | 1.34 | 31.51 | Average | Neutral | 54.12 | -22.61 | Pass |
| 0.21 | 19.01 | 9.32 | 1.18 | 29.52 | Average | Neutral | 53.12 | -23.61 | Pass |
| 0.39 | 17.64 | 9.33 | 0.71 | 27.68 | Average | Neutral | 48.04 | -20.37 | Pass |
| 0.67 | 16.02 | 9.33 | 0.57 | 25.92 | Average | Neutral | 46 | -20.08 | Pass |

## 10.2 6dB & 26 dB Bandwidth

Requirement(s):

| Spec | Item | Requirement | Applicable |
|---|---|---|---|
| § 15.407 | - | 26 dB Emission BW: Report only for reference. | ☒ |
| | | 6 dB Emission BW: Report only for reference(Cross Band) | ☒ |
| | a) (2) | 26 dB Emission BW: Report only for power limit calculation. | ☐ |

| | | | | |
|---|---|---|---|---|
| Test Setup |  | | | |
| Test Procedure | 789033 D02 General UNII Test Procedures New Rules v01<br><br>26dB Emission bandwidth measurement procedure (Other than 5.725-5.85 GHz)<br>- Use the spectrum analyzer built-in measurement function to determine the 26dB BW.<br>o Set RBW = around 1% of emission bandwidth<br>o Set VBW > RBW<br>o Detector = Peak<br>o Trace mode = max hold<br>- Allow the trace to stabilize.<br>- Capture the plot.<br>- Repeat above steps for different test channel and other modulation type.<br>-<br>6dB Emission bandwidth measurement procedure<br>- Use the spectrum analyzer built-in measurement function to determine the 26dB BW.<br>o Set RBW = 100kHz<br>o Set VBW > 3RBW<br>o Detector = Peak<br>o Trace mode = max hold<br>- Allow the trace to stabilize.<br>- Capture the plot.<br>- Repeat above steps for different test channel and other modulation type. | | | |
| Test Date | 10/24/2017 | Environmental condition | Temperature<br>Relative Humidity<br>Atmospheric Pressure | 23°C<br>42%<br>1021mbar |
| Remark | N/A | | | |
| Result | ☒ Pass ☐ Fail | | | |

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes ☐ N/A

Test was done by Chen Ge at RF test site.

26dB Bandwidth measurement result for 5.3GHz

| Type | Test mode | Freq (MHz) | CH | Result (MHz) |
| --- | --- | --- | --- | --- |
| 26dB BW | 802.11a | 5260 | Low | 16.405 |
| | 802.11a | 5280 | Mid | 16.410 |
| | 802.11a | 5320 | High | 16.429 |
| | 802.11n-20 | 5260 | Low | 17.619 |
| | 802.11n-20 | 5280 | Mid | 17.598 |
| | 802.11n-20 | 5320 | High | 17.637 |
| | 802.11n-40 | 5270 | Low | 35.997 |
| | 802.11n-40 | 5310 | High | 36.030 |
| | 802.11ac-80 | 5290 | Mid | 75.737 |

26dB Bandwidth measurement result for 5.5GHz

| Type | Test mode | Freq (MHz) | CH | Result (MHz) |
| --- | --- | --- | --- | --- |
| 26dB BW | 802.11a | 5500 | Low | 16.422 |
| | 802.11a | 5580 | Mid | 16.448 |
| | 802.11a | 5700 | High | 16.464 |
| | 802.11n-20 | 5500 | Low | 17.614 |
| | 802.11n-20 | 5580 | Mid | 17.646 |
| | 802.11n-20 | 5700 | High | 17.650 |
| | 802.11n-40 | 5510 | Low | 36.049 |
| | 802.11n-40 | 5590 | Mid | 36.036 |
| | 802.11n-40 | 5670 | High | 35.965 |
| | 802.11ac-80 | 5530 | Low | 75.650 |
| | 802.11ac-80 | 5610 | High | 75.704 |

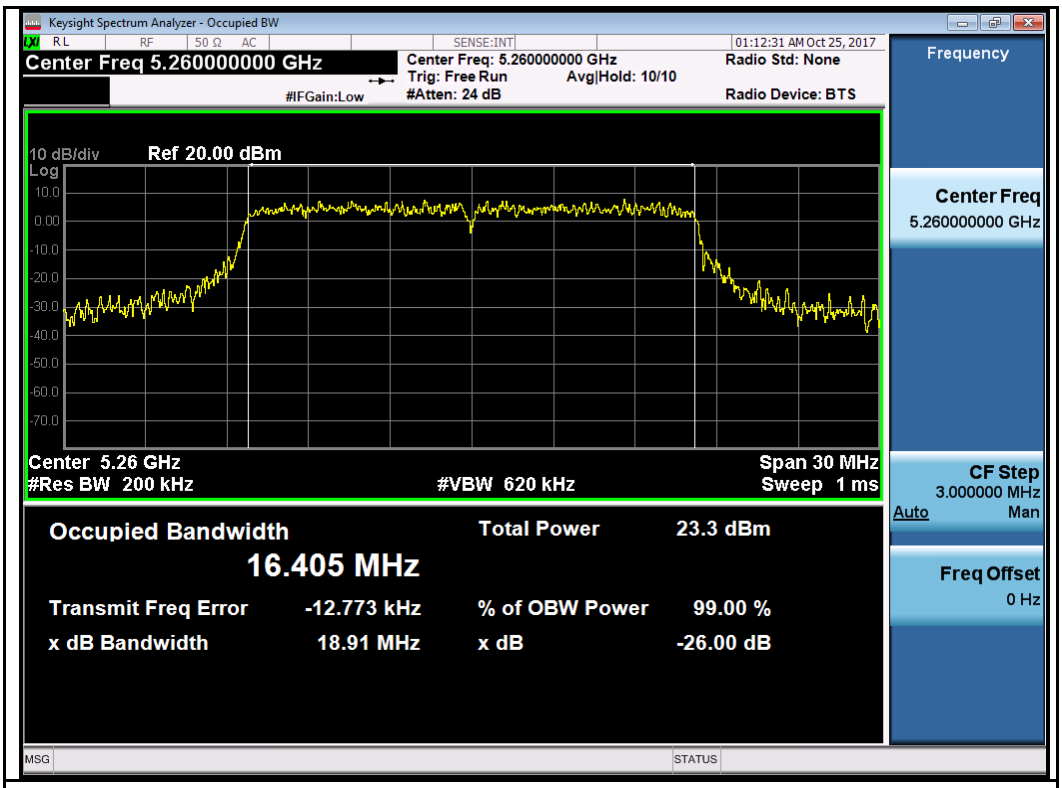
26dB Bandwidth measurement result for cross channels

| Type | Test mode | Freq (MHz) | CH | Result (MHz) |
| --- | --- | --- | --- | --- |
| 26dB BW | 802.11a | 5720 | CROSS | 19.66 |
| | 802.11n-20 | 5720 | CROSS | 20.25 |
| | 802.11n-40 | 5710 | CROSS | 38.70 |
| | 802.11ac-80 | 5690 | CROSS | 81.27 |

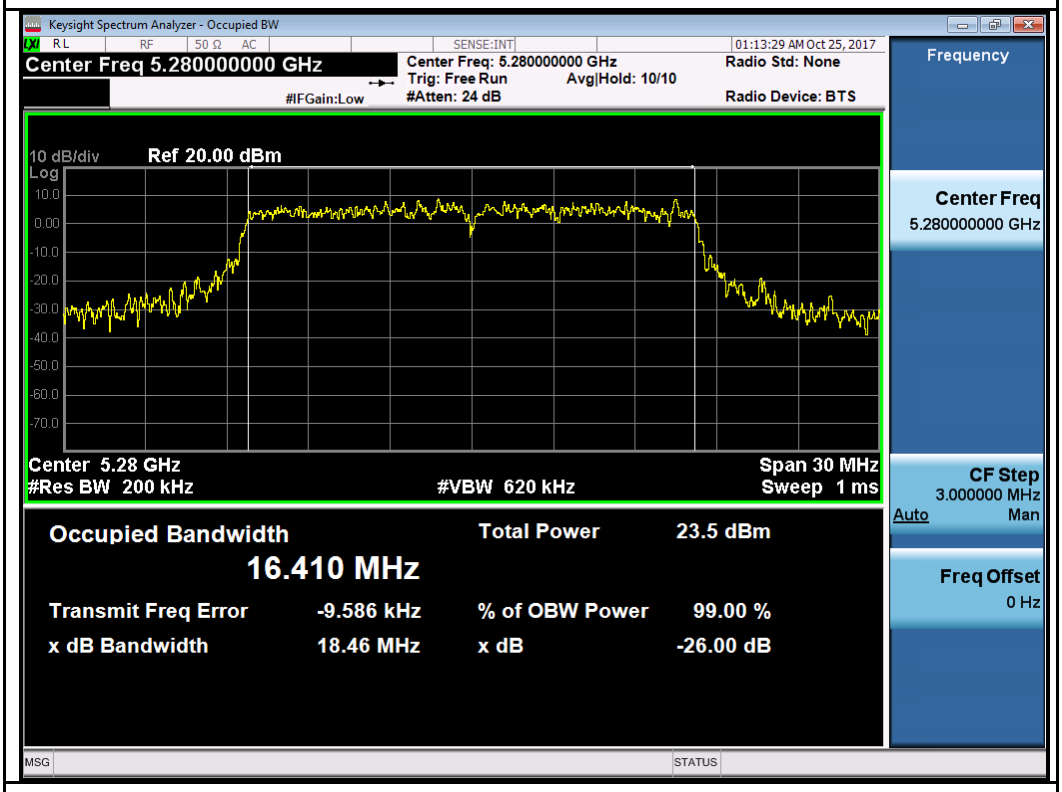
6 Bandwidth measurement result for cross channels

| Type | Test mode | Freq (MHz) | CH | Result (MHz) |
| --- | --- | --- | --- | --- |
| 26dB BW | 802.11a | 5720 | CROSS | 16.34 |
| | 802.11n-20 | 5720 | CROSS | 17.66 |
| | 802.11n-40 | 5710 | CROSS | 35.96 |
| | 802.11ac-80 | 5690 | CROSS | 76.04 |

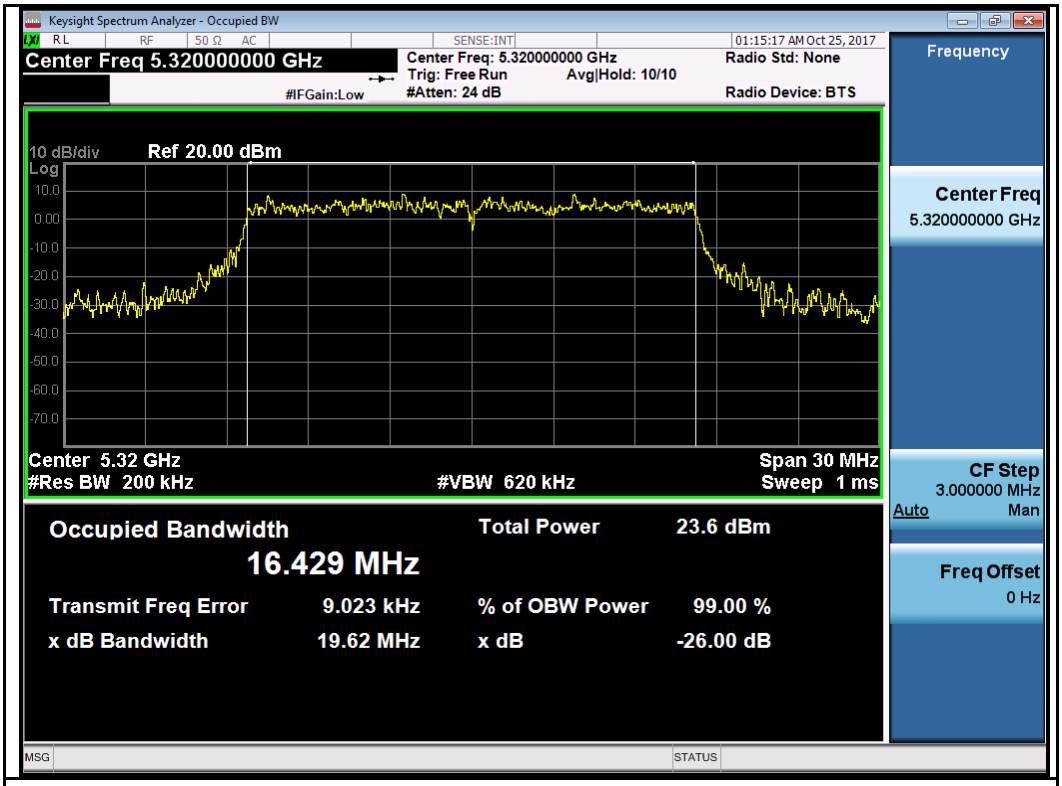
26dB Bandwidth Test Plots
W53:



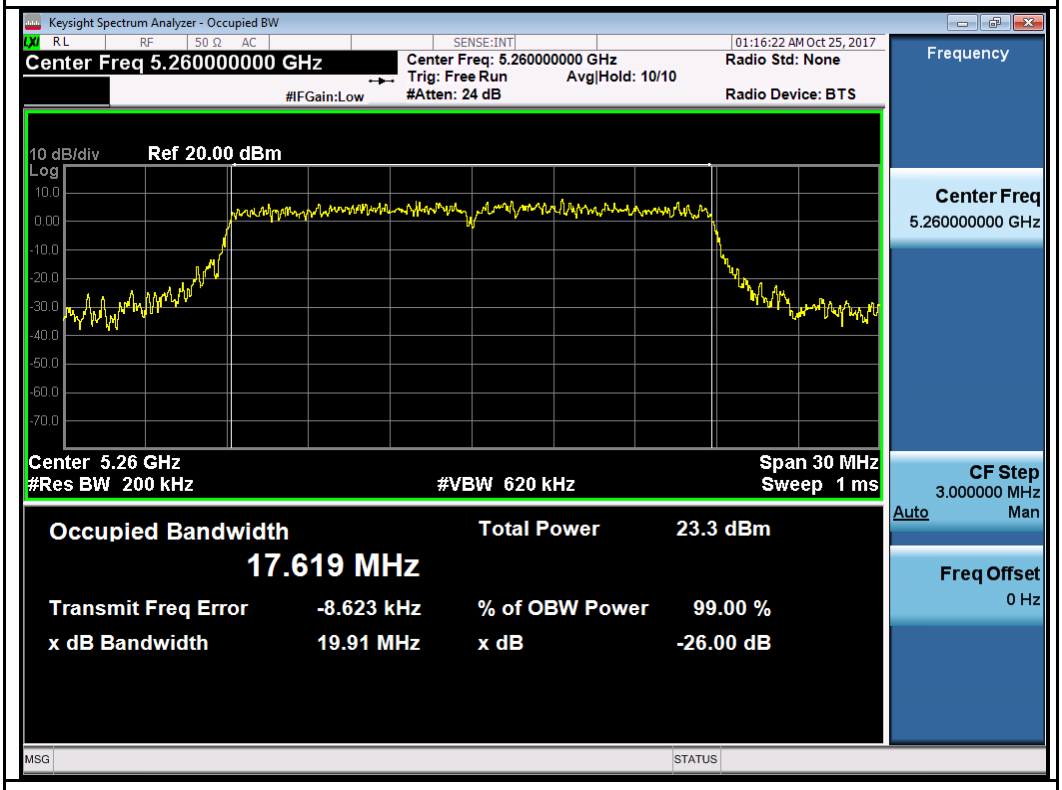

802.11a-5260MHz



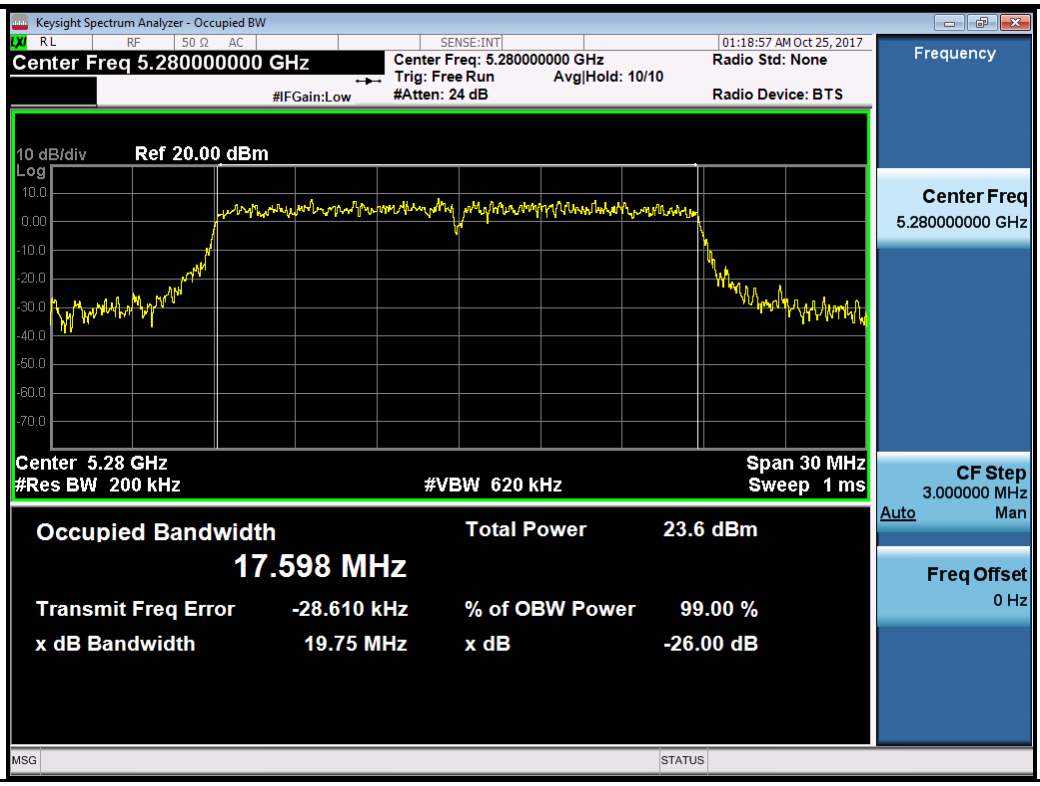

802.11a-5280MHz



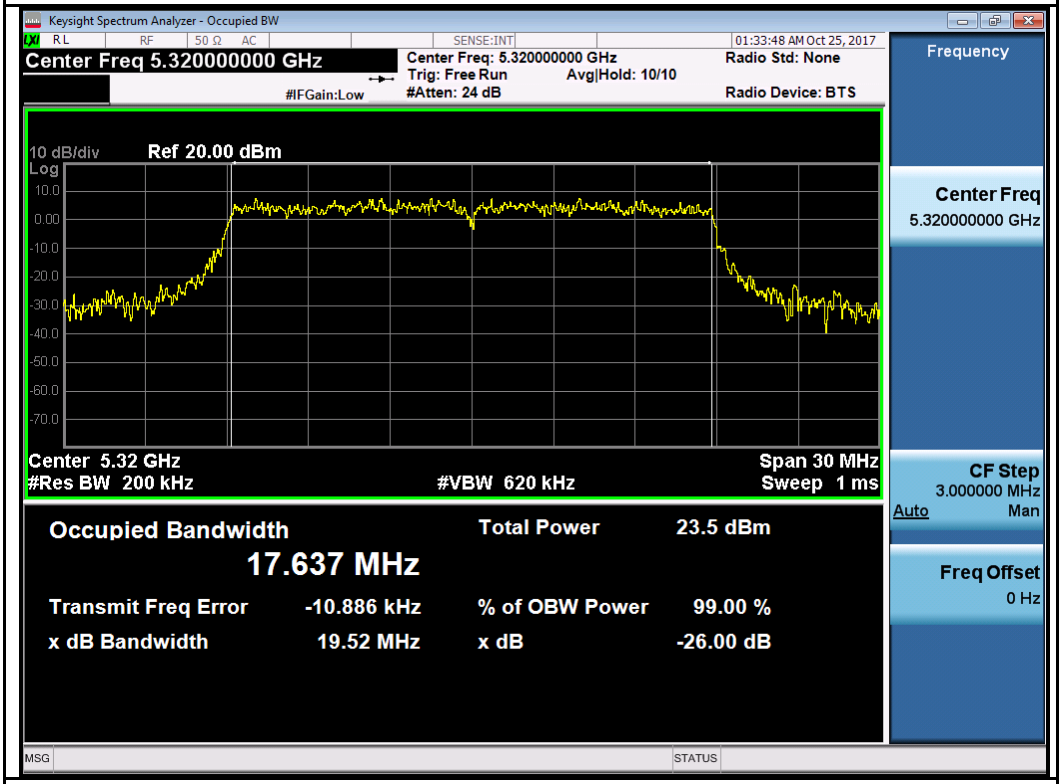

802.11a-5320MHz



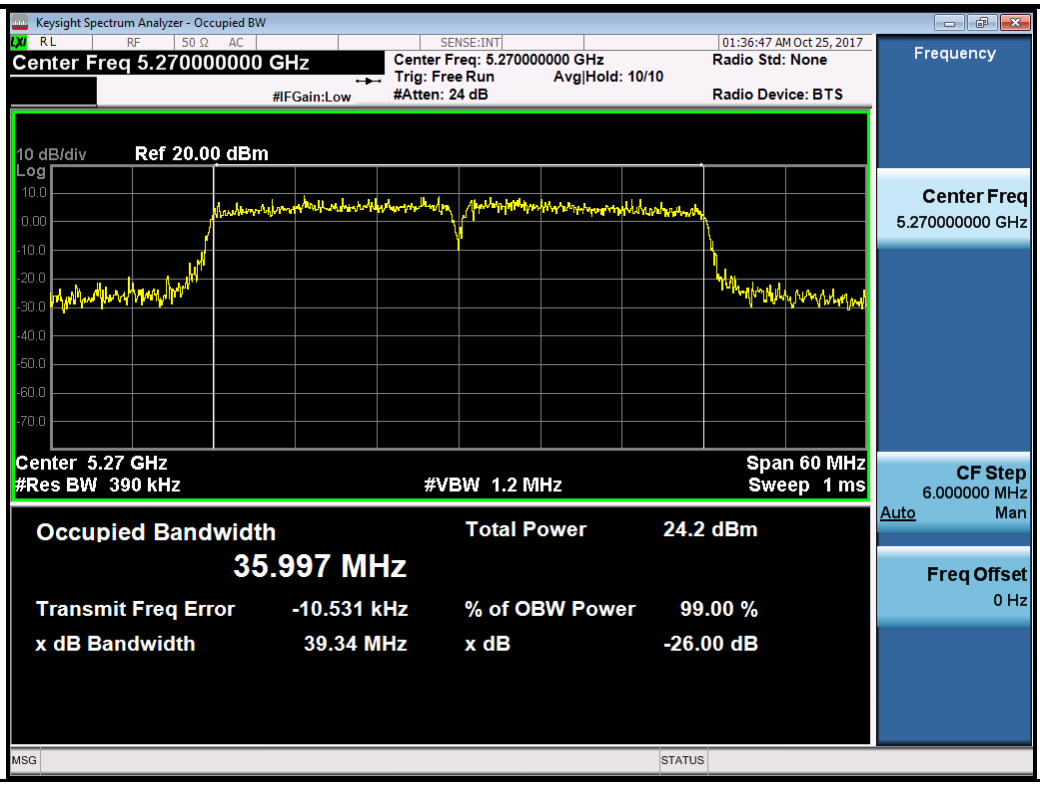

802.11n-HT20-5260MHz



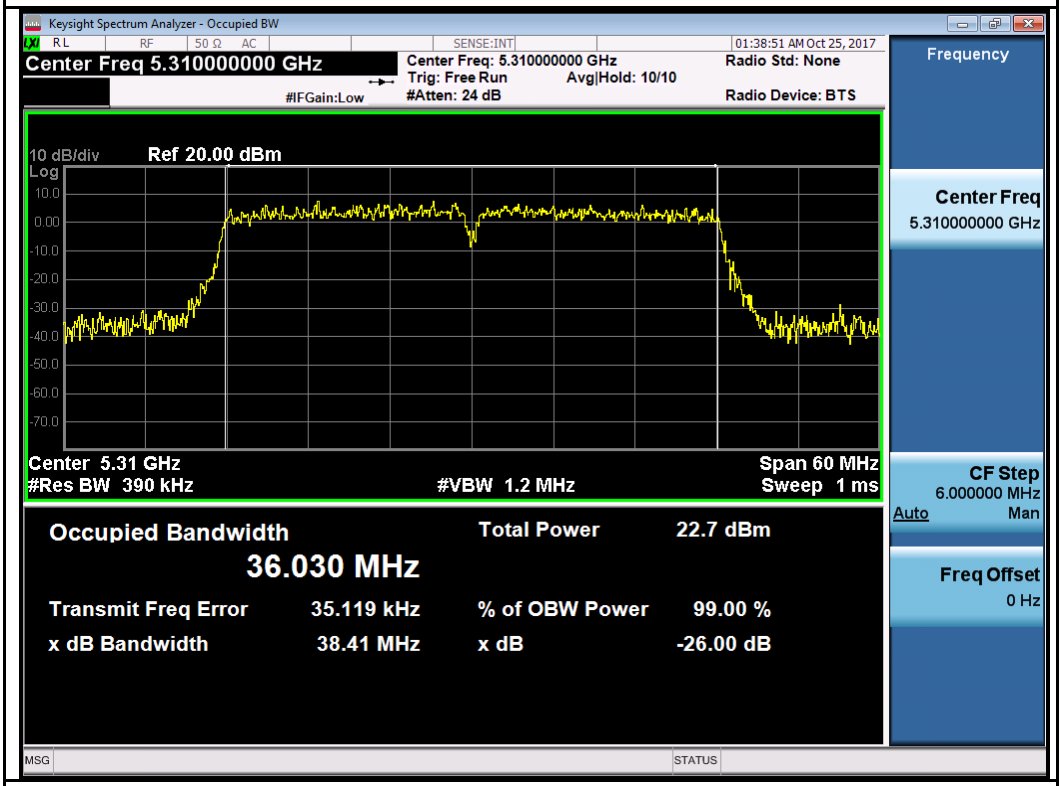

802.11n-HT20-5280MHz



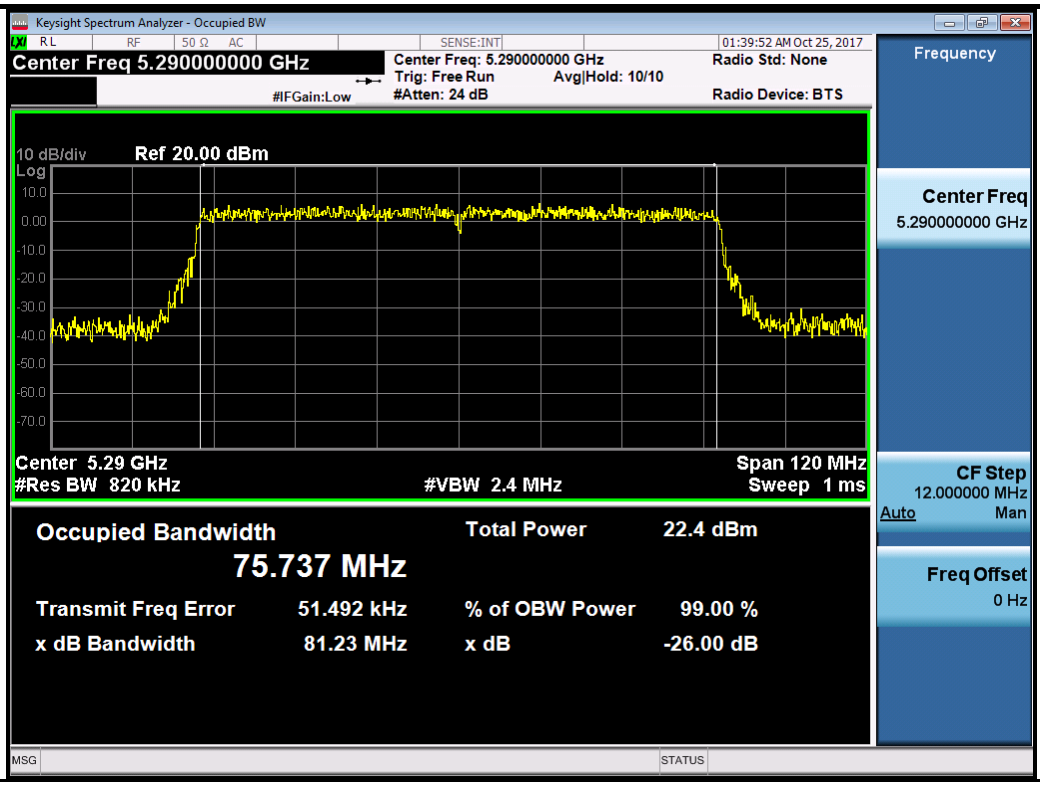

802.11n-HT20-5320MHz




802.11n-HT40-5270MHz

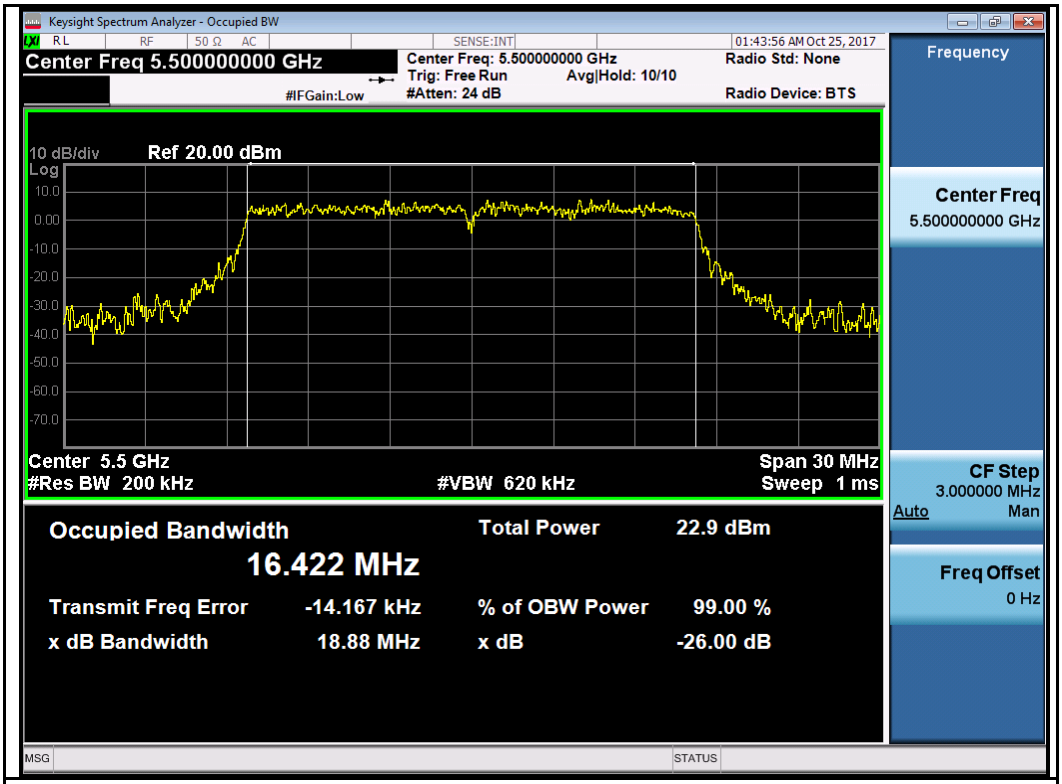



802.11n-HT40-5310MHz

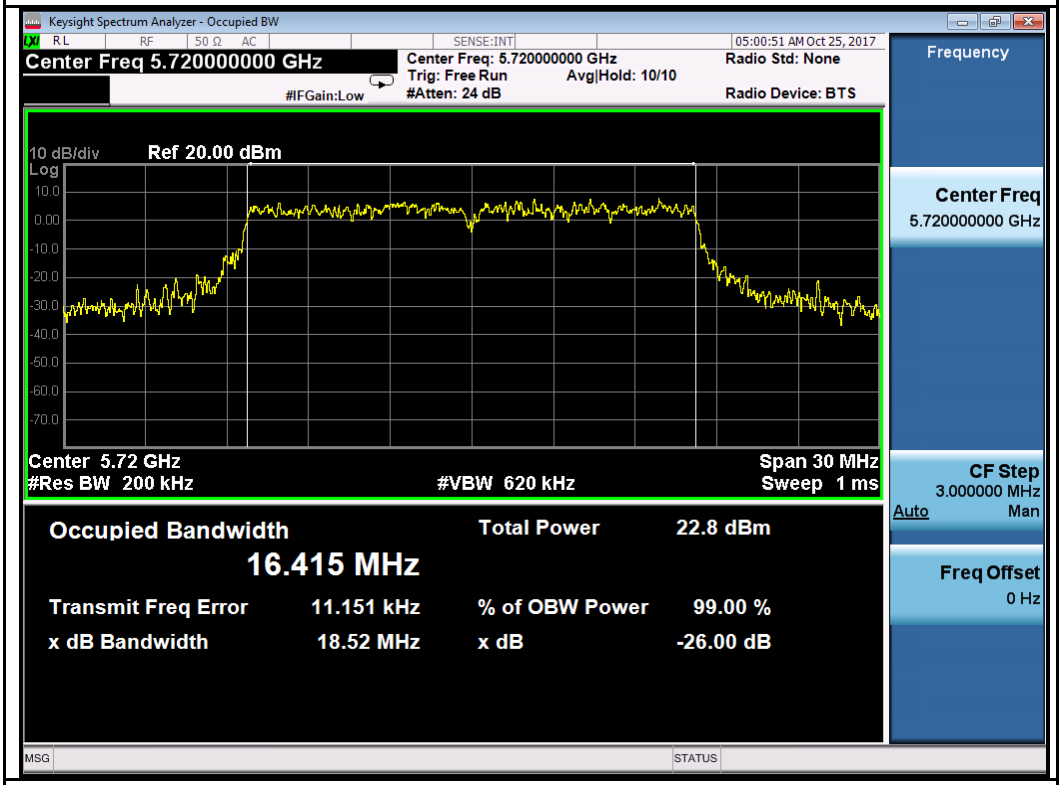



802.11ac-VHT80-5290MHz

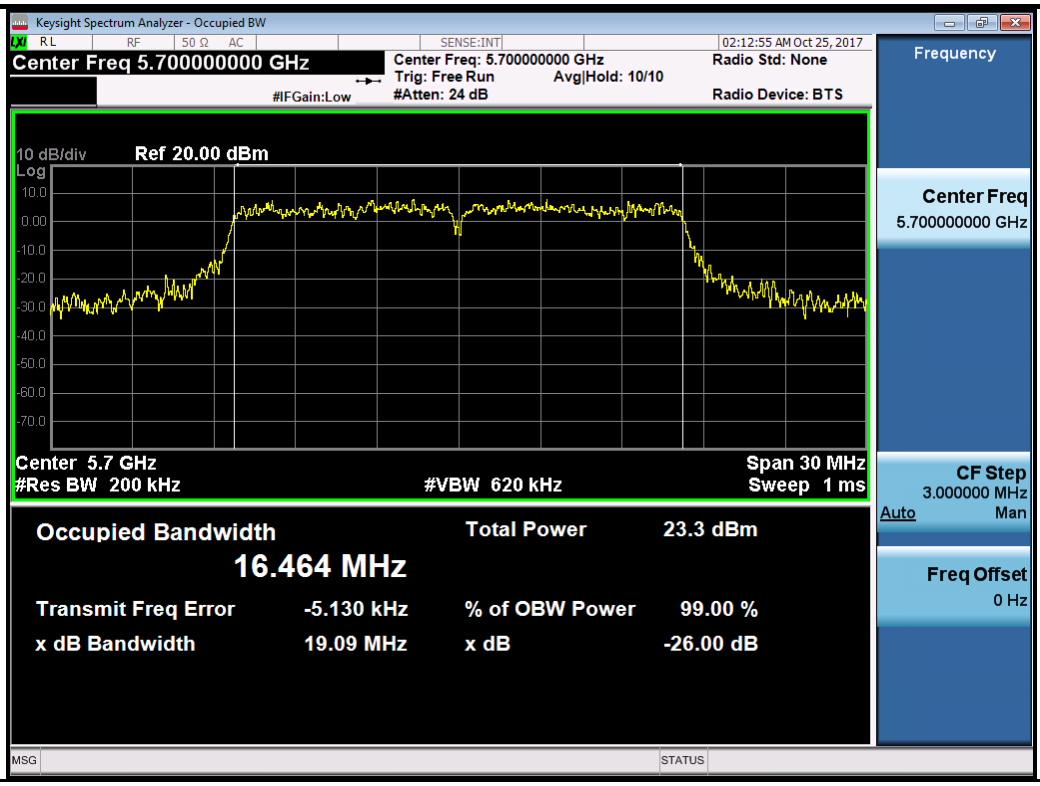
W56:



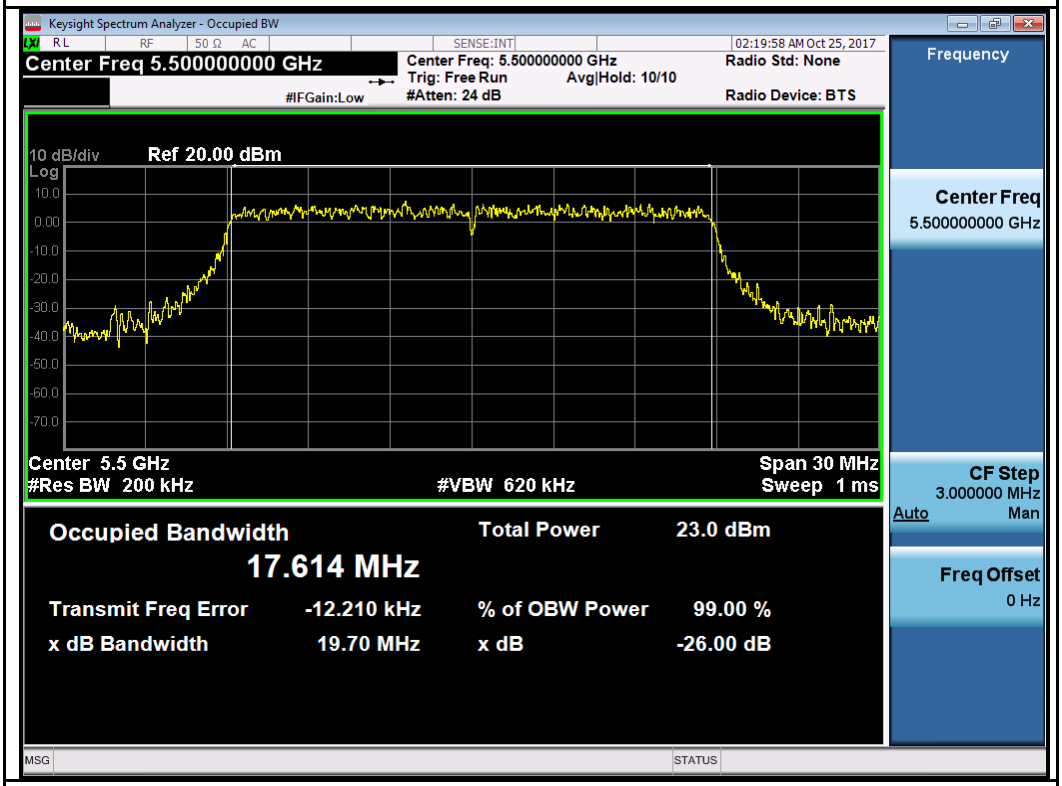

802.11a-5500MHz



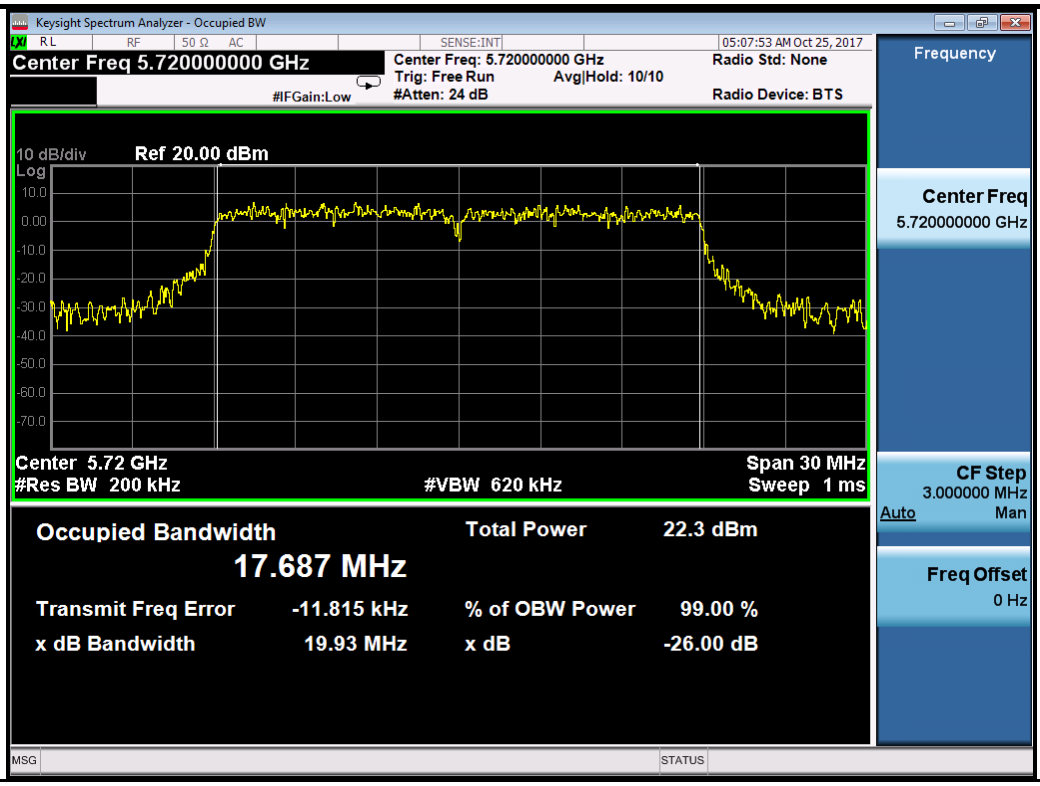

802.11a-5580MHz



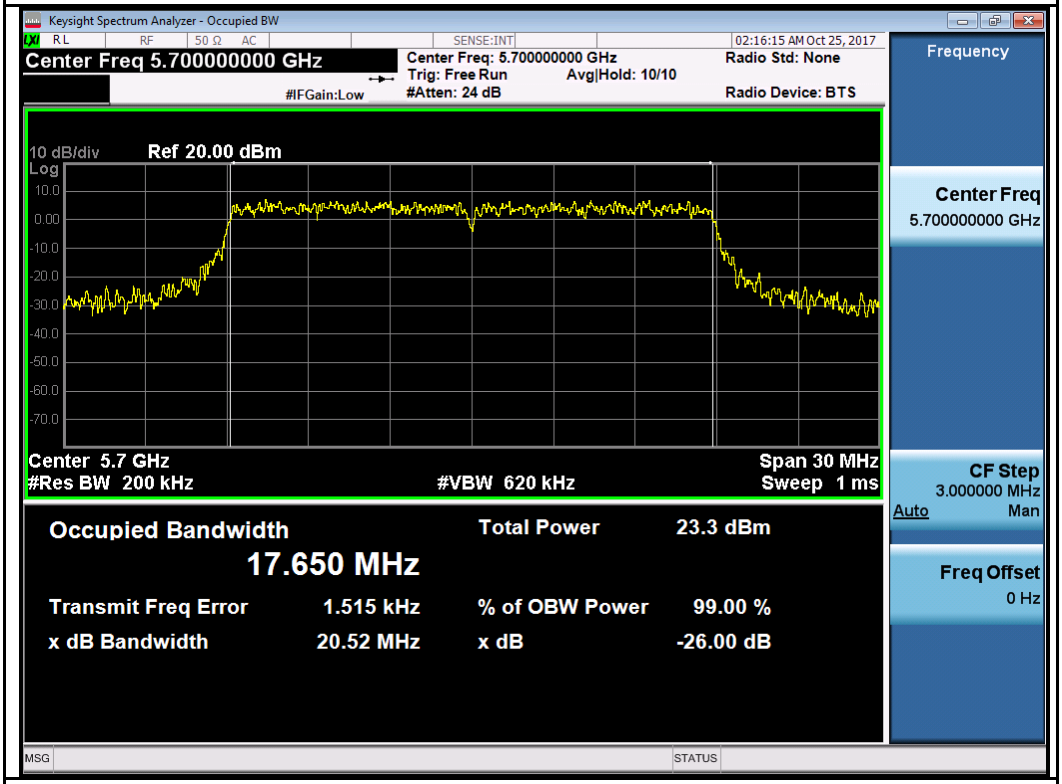

802.11a-5700MHz



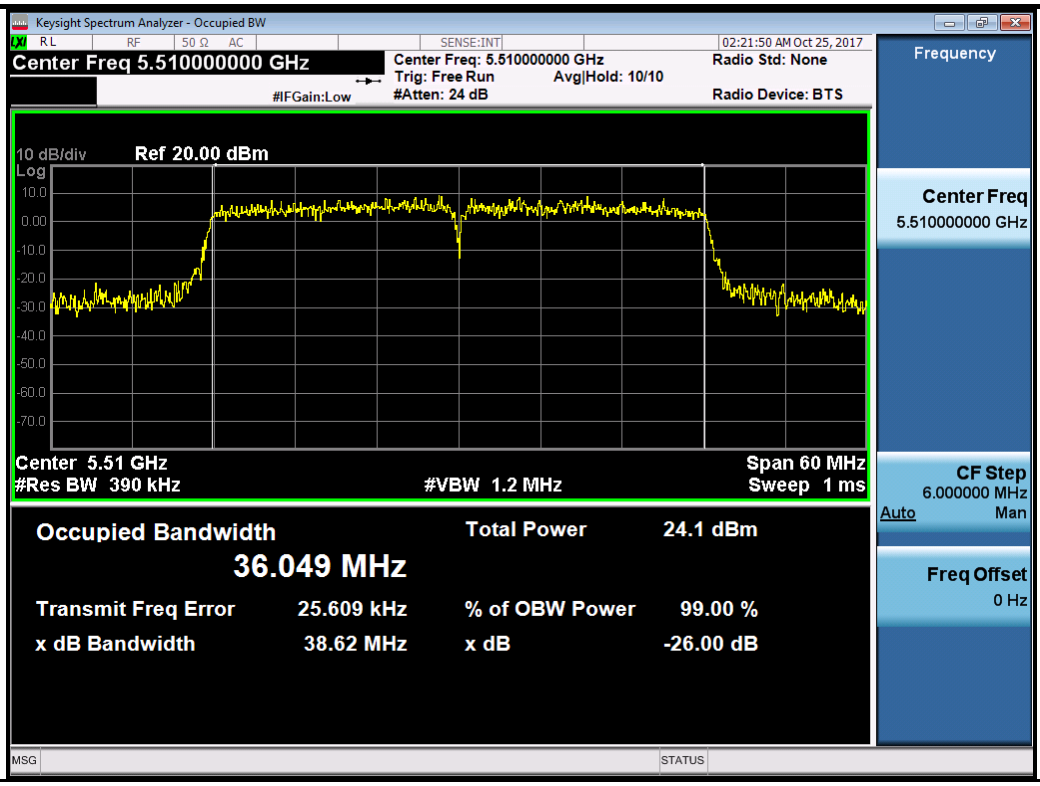

802.11n-HT20-5500MHz



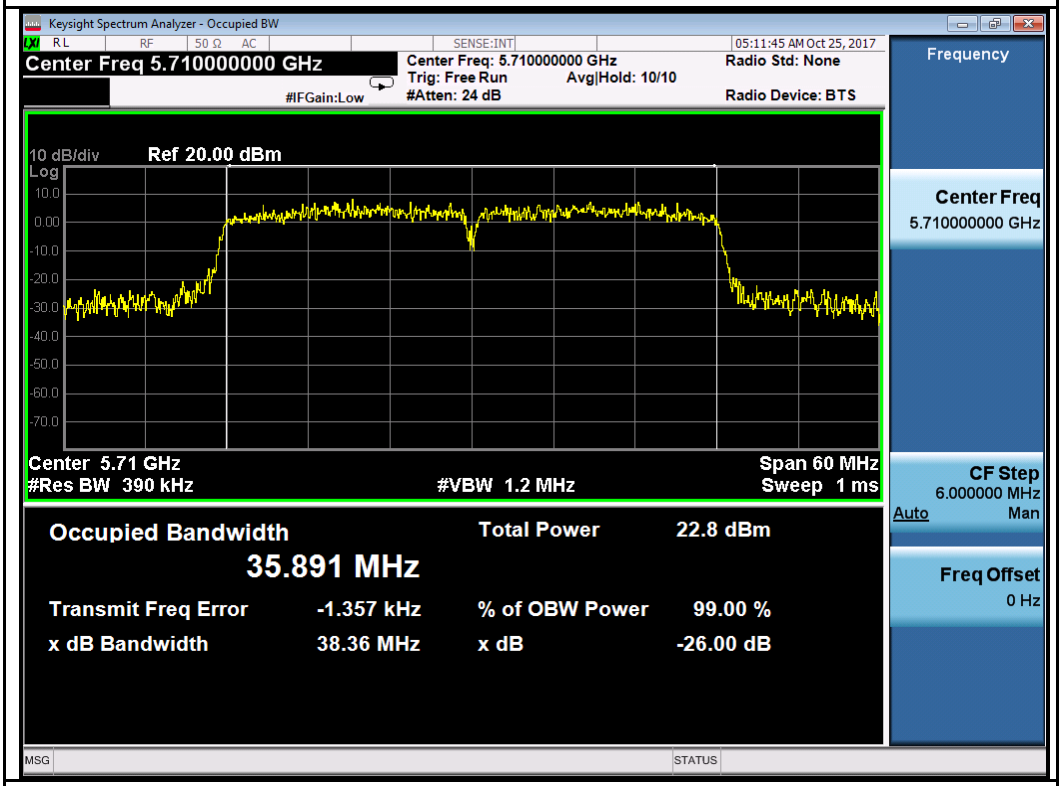

802.11n-HT20-5580MHz



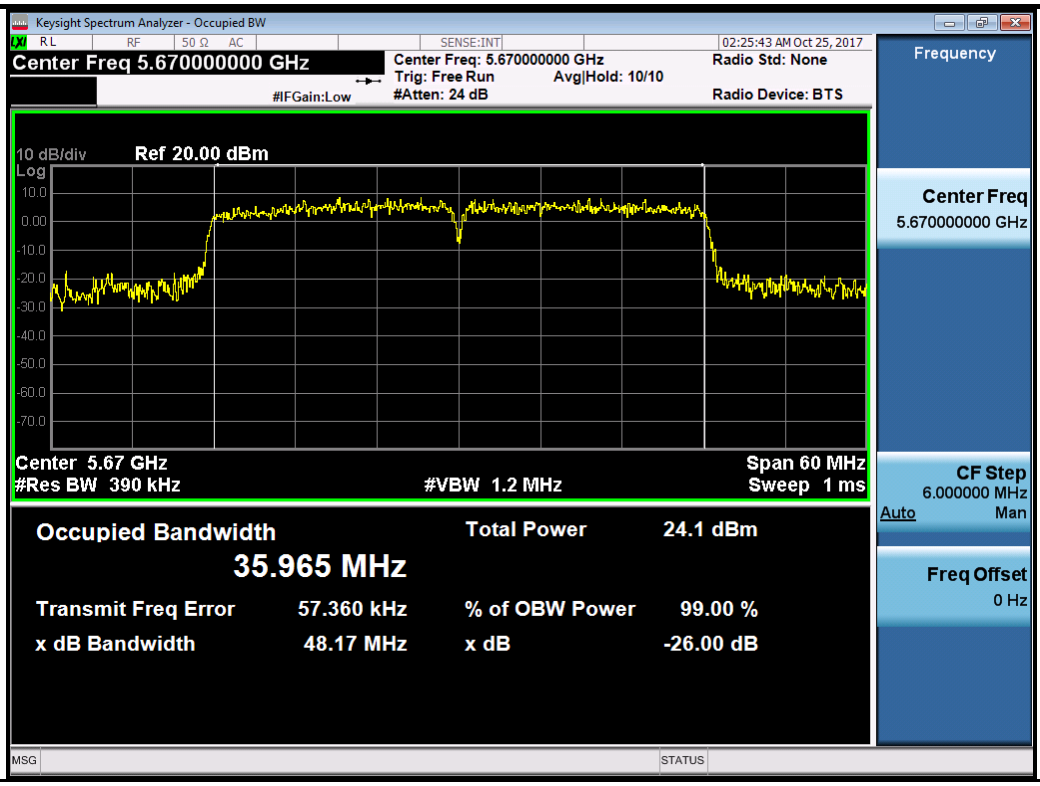

802.11n-HT20-5700MHz



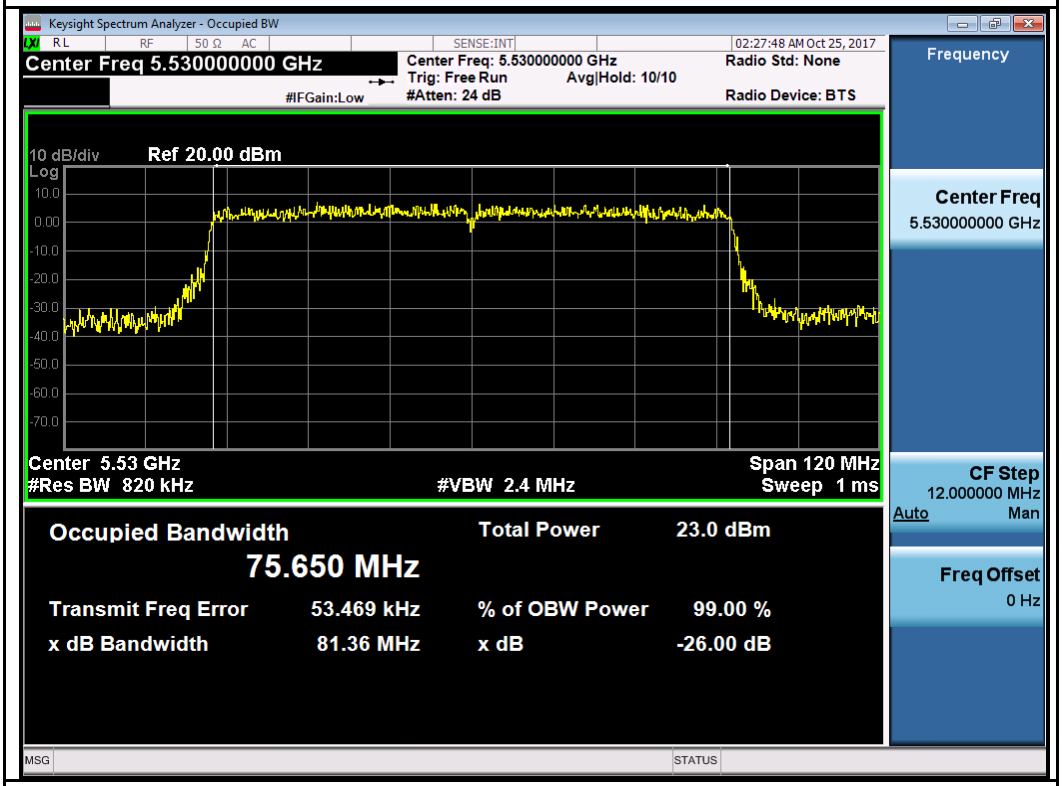

802.11n-HT40-5510MHz



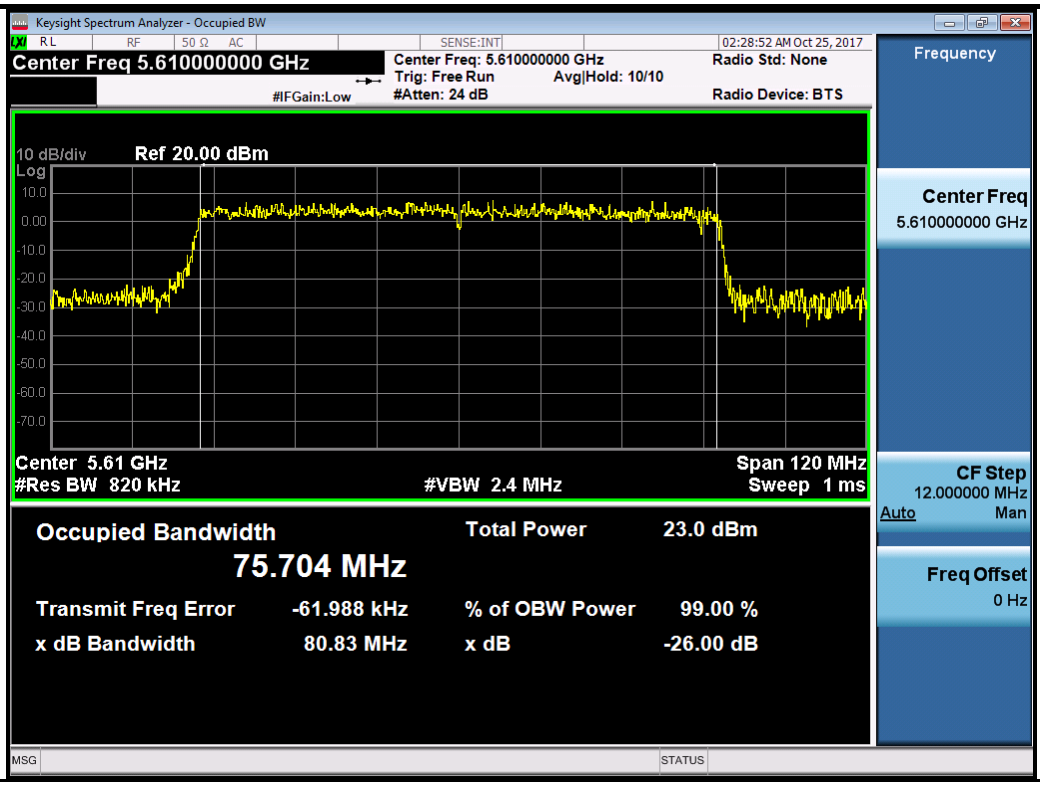

802.11n-HT40-5550MHz




802.11n-HT40-5670MHz

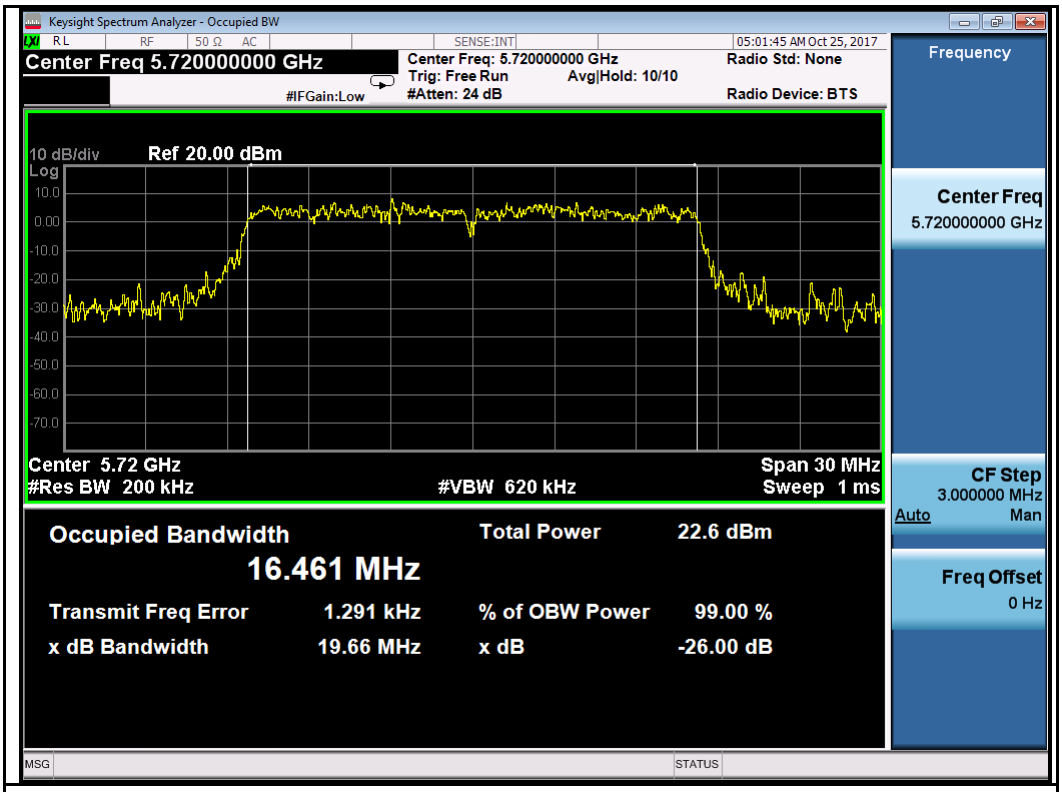



802.11ac-VHT80-5530MHz

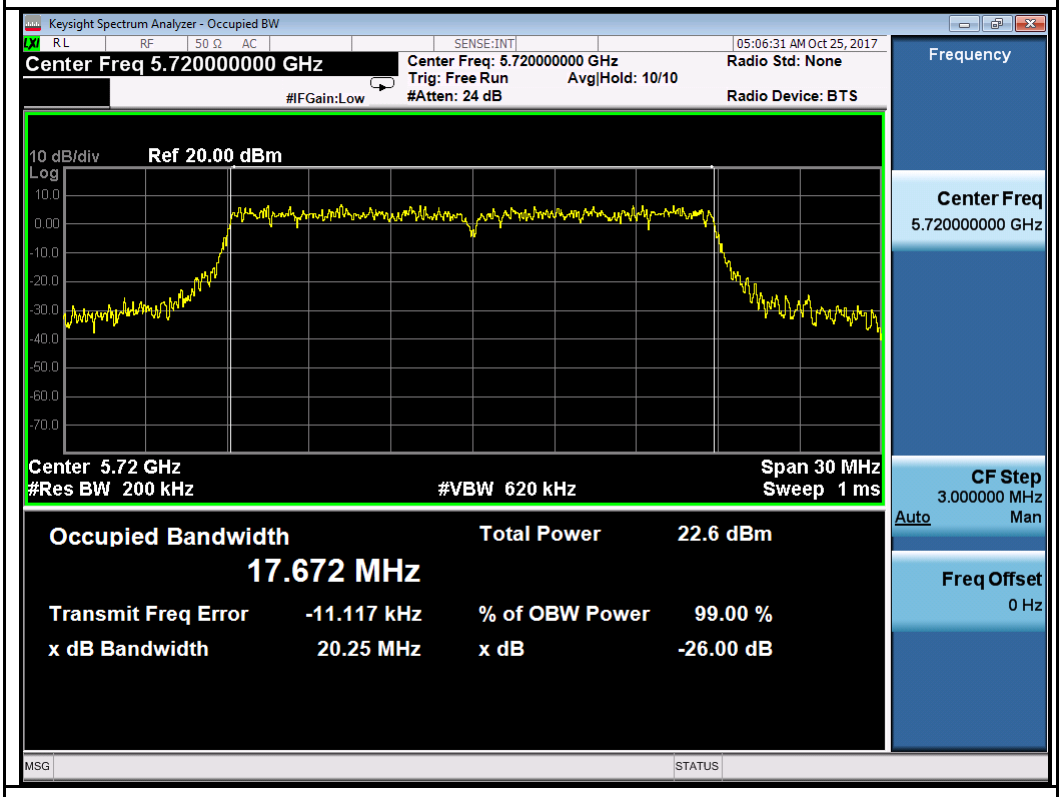



802.11ac-VHT80-5610MHz

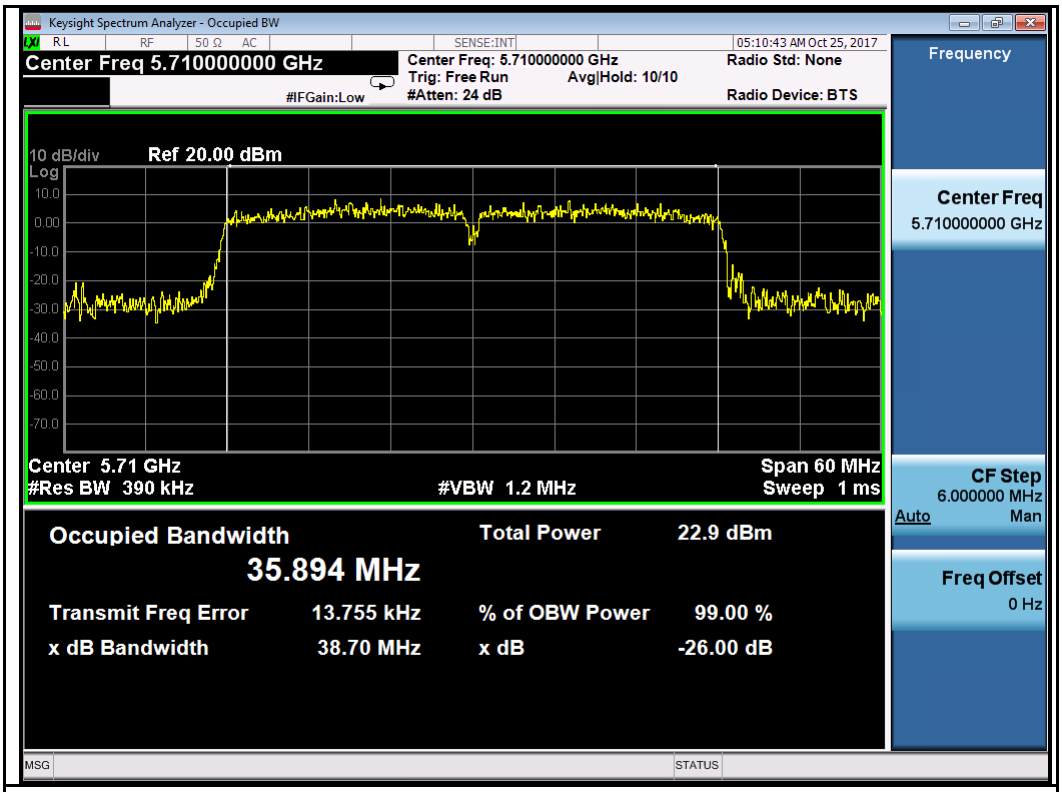
26dB BW Cross Band:



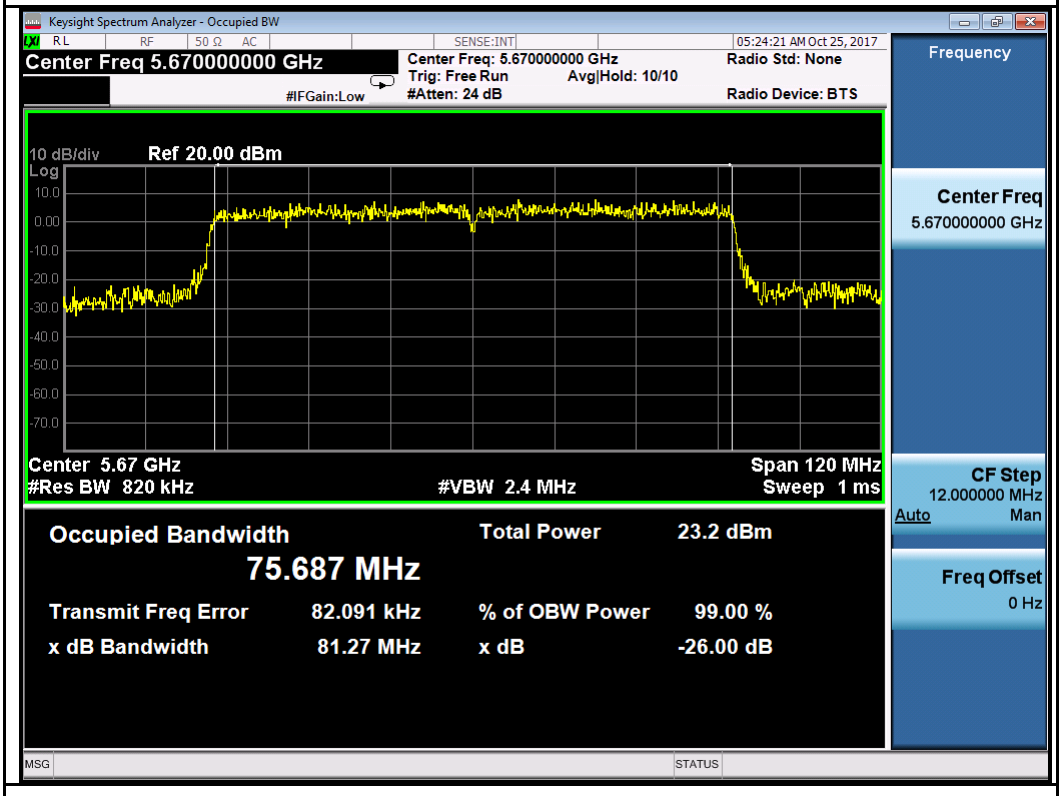

802.11a-5720MHz




802.11n-HT20 5720MHz

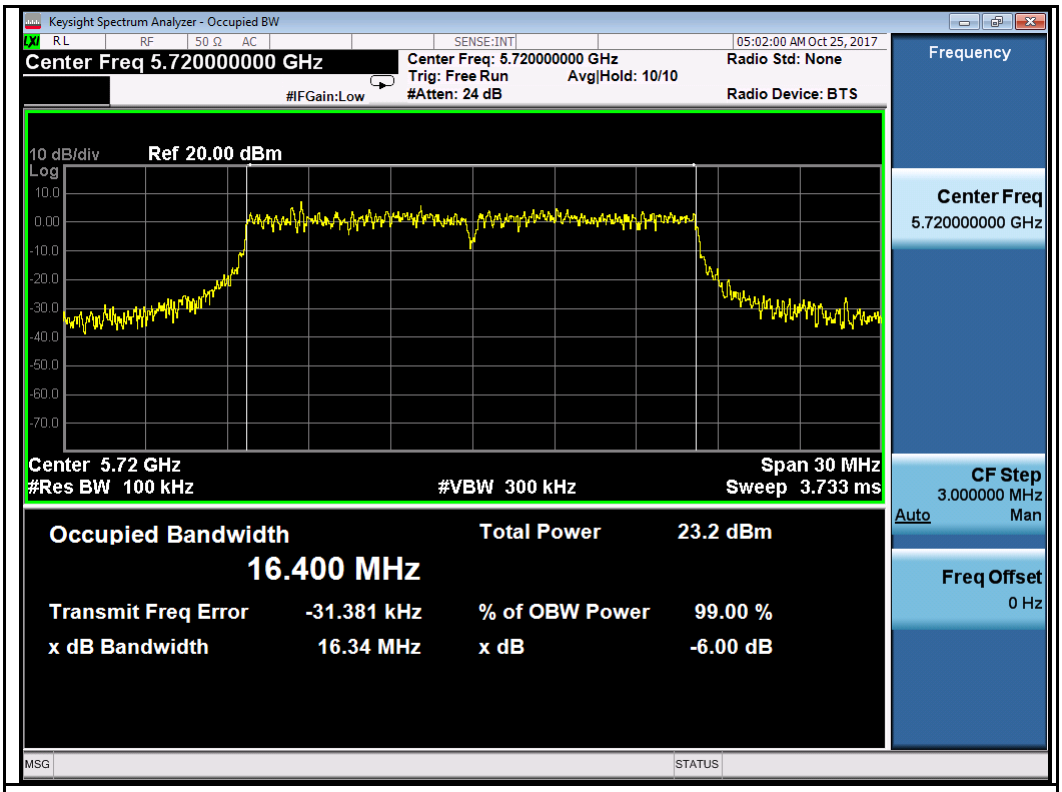



802.11n-HT40 5710MHz

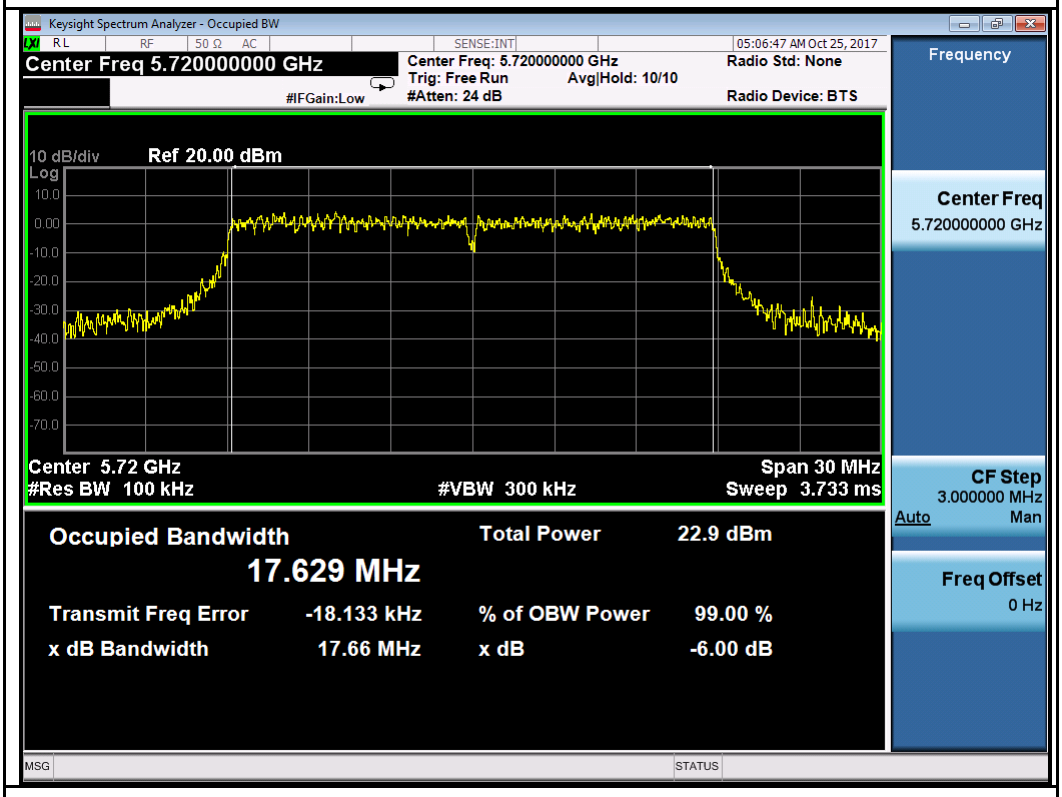



802.11ac-VHT80-5690MHz

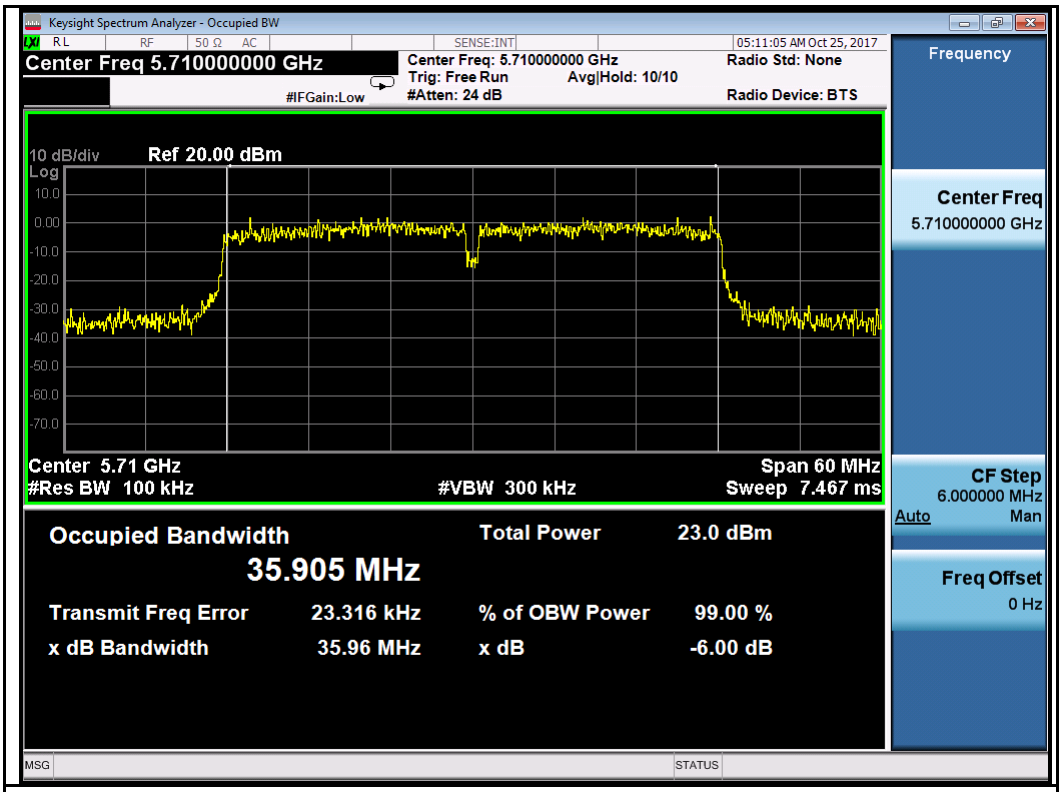
6dB BW Cross Band:



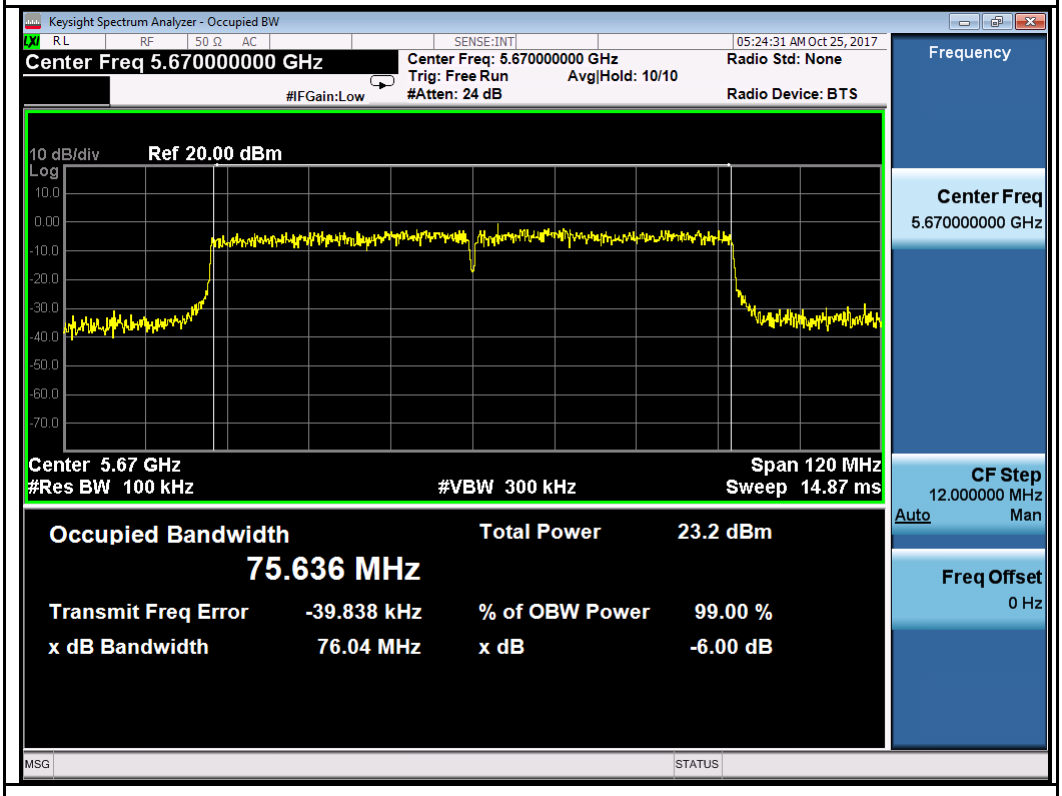

802.11a-5720MHz




802.11n-HT20 5720MHz




802.11n-HT40 5710MHz

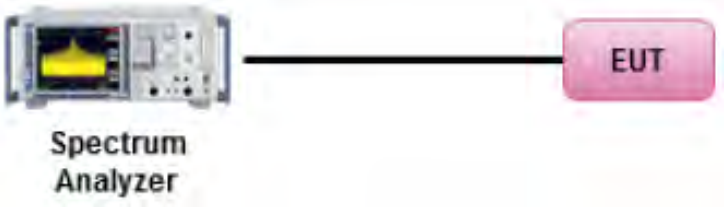



802.11ac-VHT80-5690MHz

## 10.3 Output Power

Requirement(s):

| Spec | Item | Requirement | Applicable |
|---|---|---|---|
| § 15.407 | a)(2) | For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm 10 log B, where B is the 26 dB emission bandwidth in megahertz. | ☒ |
| | a)(3) | For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. | ☒ |

| | | | | |
|---|---|---|---|---|
| Test Setup |  | | | |
| Test Procedure | 789033 D02 General UNII Test Procedures New Rules v01r02<br><br>Measurement using a Spectrum Analyzer or EMI Receiver (SA)<br>Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep):<br><br>- Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.<br>- Set RBW = 1 MHz<br>- Set VBW = 3 MHz<br>- Number of points in sweep ≥ 2 × span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)<br>- Sweep time = auto.<br>- Detector = power averaging (rms), if available. Otherwise, use sample detector mode.<br>- If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."<br>- Trace average at least 100 traces in power averaging (rms) mode.<br>- 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 spectrum. | | | |
| Test Date | 10/24/2017 | Environmental condition | Temperature<br>Relative Humidity<br>Atmospheric Pressure | 23°C<br>44%<br>1021mbar |
| Remark | N/A | | | |
| Result | ☒ Pass ☐ Fail | | | |

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at RF test site.

Output Power measurement result for 5.3GHz

| Type | Test mode | Freq (MHz) | CH | Conducted Power (dBm) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| Output Power | 802.11a | 5260 | Low | 20.008 | 19.612 | 22.825 | 24 | Pass |
| | 802.11a | 5280 | Mid | 19.719 | 19.647 | 22.694 | 24 | Pass |
| | 802.11a | 5320 | High | 20.253 | 19.872 | 23.077 | 24 | Pass |
| | 802.11n-20M | 5260 | Low | 20.155 | 20.078 | 23.127 | 24 | Pass |
| | 802.11n-20M | 5280 | Mid | 20.083 | 19.572 | 22.845 | 24 | Pass |
| | 802.11n-20M | 5320 | High | 19.995 | 19.900 | 22.958 | 24 | Pass |
| | 802.11n-40M | 5270 | Low | 20.535 | 20.867 | 23.714 | 24 | Pass |
| | 802.11n-40M | 5310 | Mid | 18.808 | 18.620 | 21.725 | 24 | Pass |
| | 802.11ac-80M | 5290 | High | 19.241 | 18.852 | 22.061 | 24 | Pass |

Output Power measurement result for 5.5GHz

| Type | Test mode | Freq (MHz) | CH | Conducted Power (dBm) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| Output Power | 802.11a | 5500 | Low | 19.357 | 19.194 | 22.286 | 24 | Pass |
| | 802.11a | 5580 | Mid | 20.043 | 19.711 | 22.890 | 24 | Pass |
| | 802.11a | 5700 | High | 19.368 | 19.713 | 22.554 | 24 | Pass |
| | 802.11n-20M | 5500 | Low | 19.198 | 19.538 | 22.382 | 24 | Pass |
| | 802.11n-20M | 5580 | Mid | 20.108 | 19.708 | 22.923 | 24 | Pass |
| | 802.11n-20M | 5700 | High | 19.752 | 19.831 | 22.802 | 24 | Pass |
| | 802.11n-40M | 5510 | Low | 20.603 | 20.233 | 23.432 | 24 | Pass |
| | 802.11n-40M | 5550 | Mid | 20.594 | 21.278 | 23.960 | 24 | Pass |
| | 802.11n-40M | 5670 | High | 20.345 | 20.077 | 23.223 | 24 | Pass |
| | 802.11ac-80M | 5530 | Low | 19.893 | 19.871 | 22.892 | 24 | Pass |
| | 802.11ac-80M | 5610 | High | 19.318 | 20.271 | 22.831 | 24 | Pass |

Note: Two chains are cross-polarized, additional gain is 10 log10(NANT)=0dB, max directional gain of the EUT is 3.5dBi. No limit adjustment is needed. All the mode transmission is MIMO.

Output Power measurement result for CROSS channels (in band 5470-5725MHz)

| Type | Test mode | Freq (MHz) | CH | Conducted Power (dBm) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| | 802.11a | 5720 | CROSS | 19.58 | 19.47 | 22.54 | 24 | Pass |
| | 802.11n-20M | 5720 | CROSS | 19.34 | 19.29 | 22.33 | 24 | Pass |
| | 802.11n-40M | 5710 | CROSS | 19.74 | 19.76 | 22.76 | 24 | Pass |
| | 802.11ac-80M | 5690 | CROSS | 20.14 | 20.42 | 23.29 | 24 | Pass |

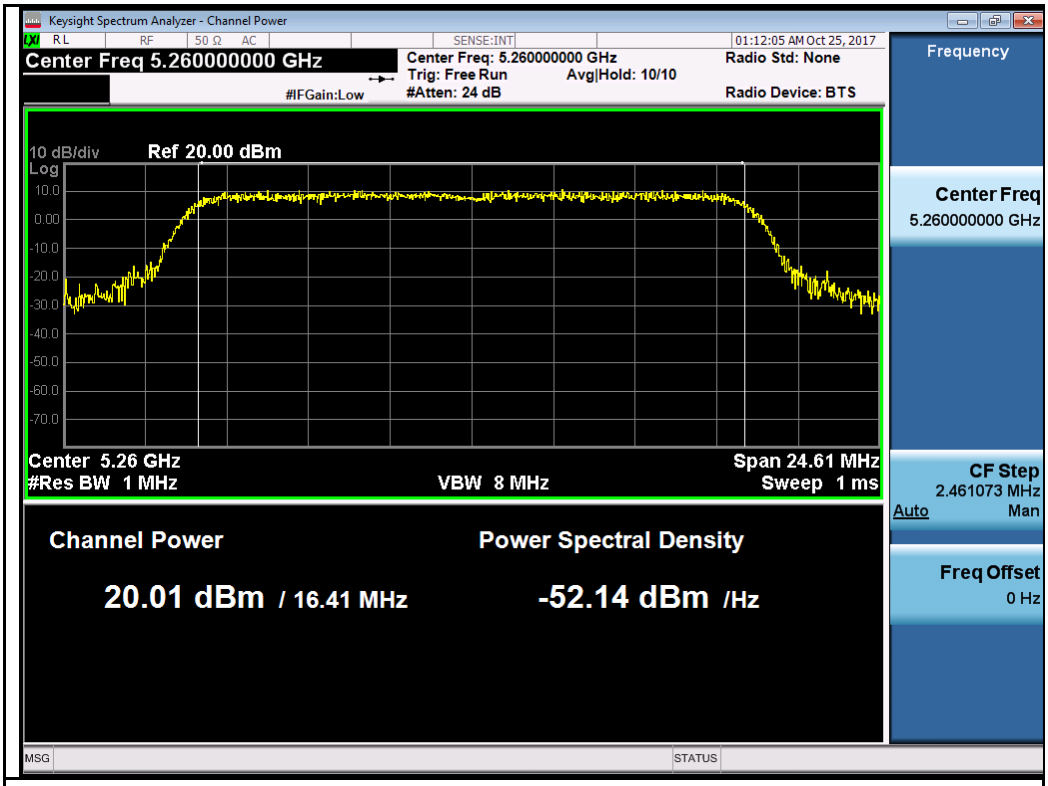
Output Power measurement result for CROSS channels (in band 5725-5850MHz)

| Type | Test mode | Freq (MHz) | CH | Conducted Power (dBm) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| Output Power | 802.11a | 5720 | CROSS | 19.58 | 19.47 | 22.54 | 30 | Pass |
| | 802.11n-20M | 5720 | CROSS | 19.34 | 19.29 | 22.33 | 30 | Pass |
| | 802.11n-40M | 5710 | CROSS | 19.74 | 19.76 | 22.76 | 30 | Pass |
| | 802.11ac-80M | 5690 | CROSS | 20.14 | 20.42 | 23.29 | 30 | Pass |

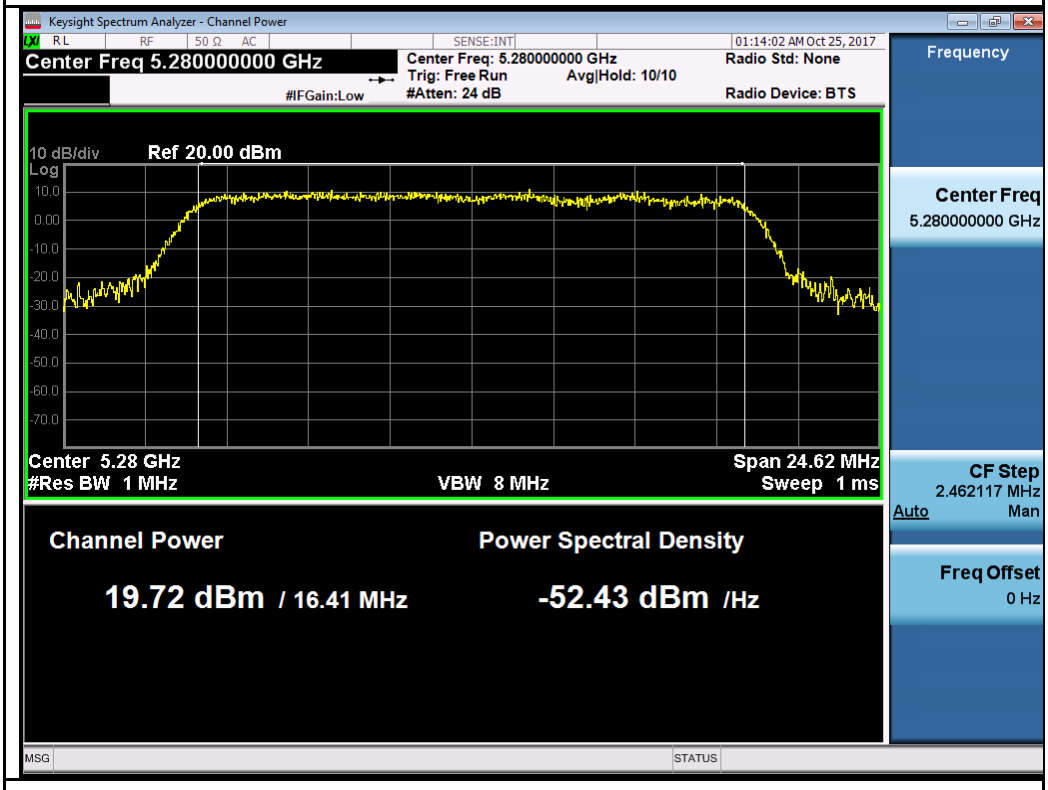
Note: Two chains are cross-polarized, additional gain is 10 log10(NANT)=0dB, max directional gain of the EUT is 3.5dBi. No limit adjustment is needed. All the mode transmission is MIMO

Test Plot for W53:

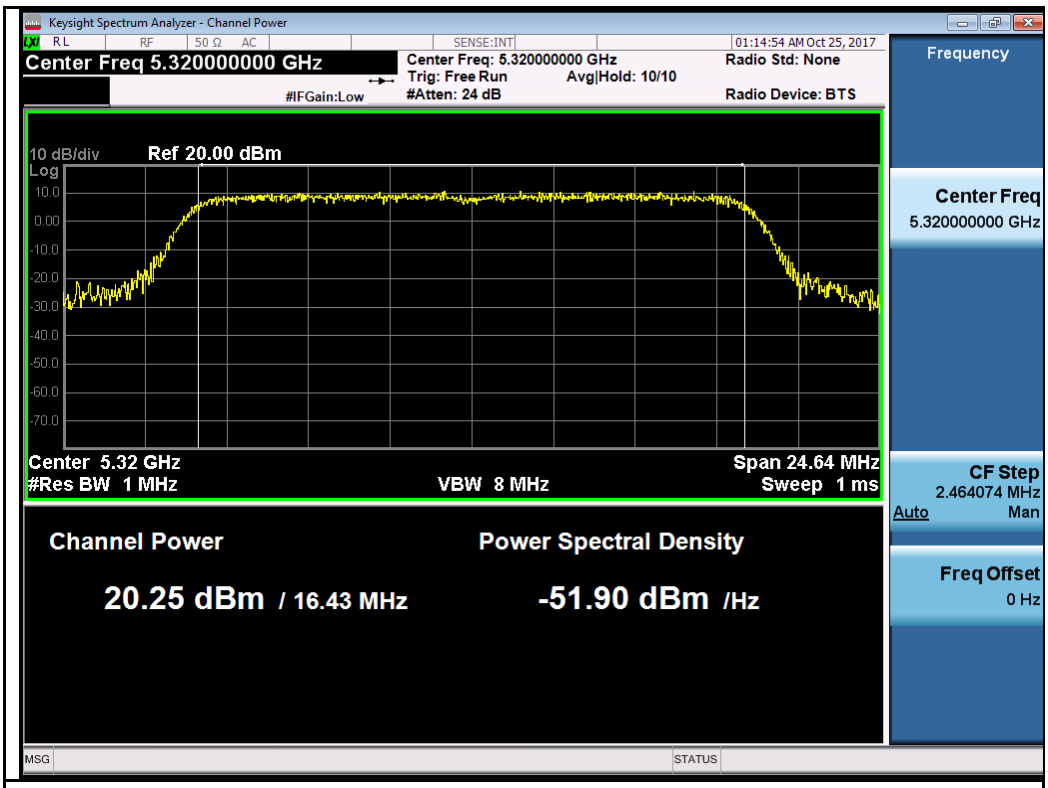
Chain 0:



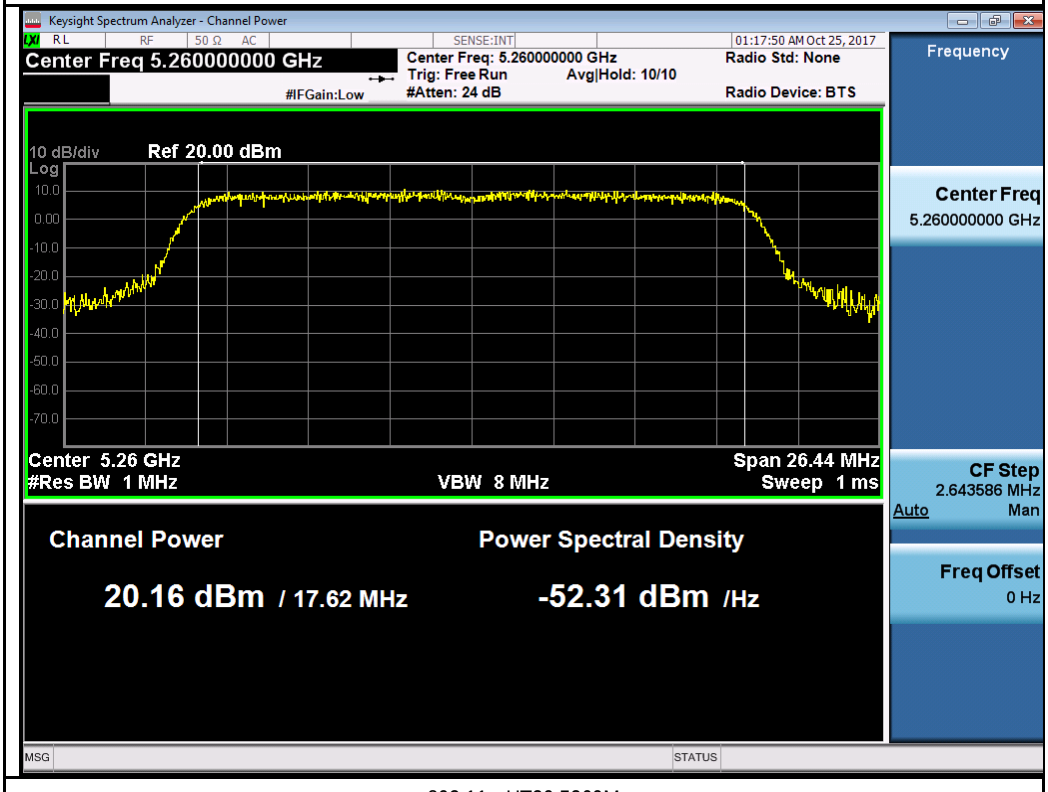

802.11a-5260M



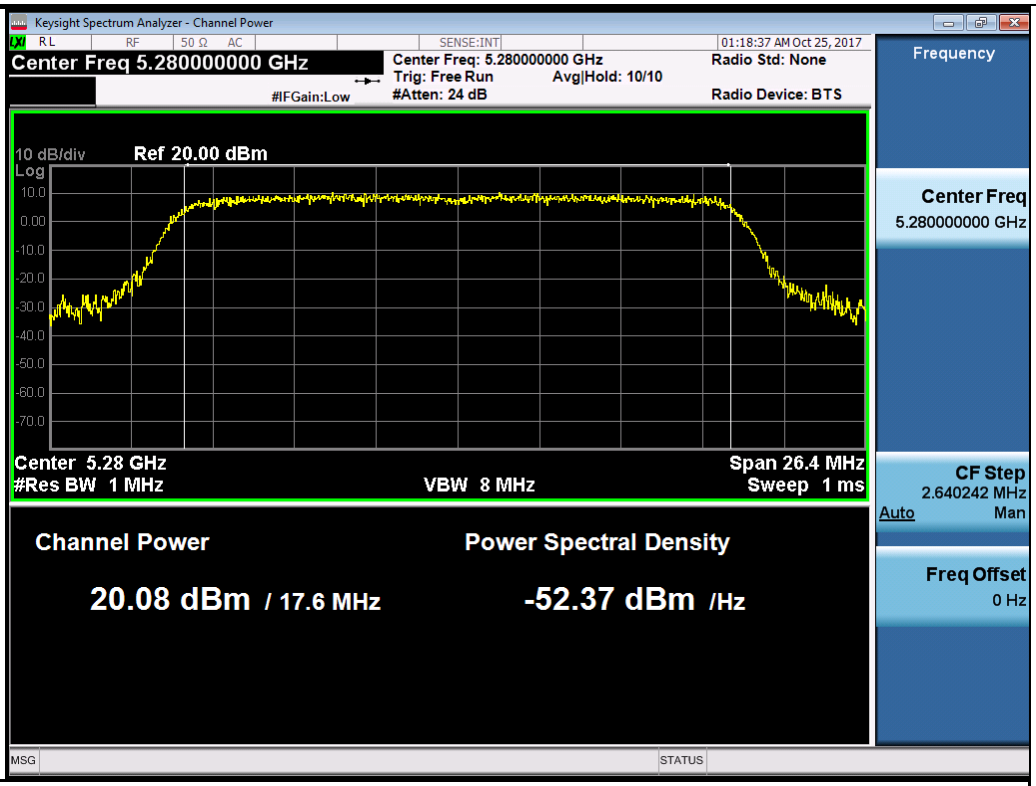

802.11a-5280M



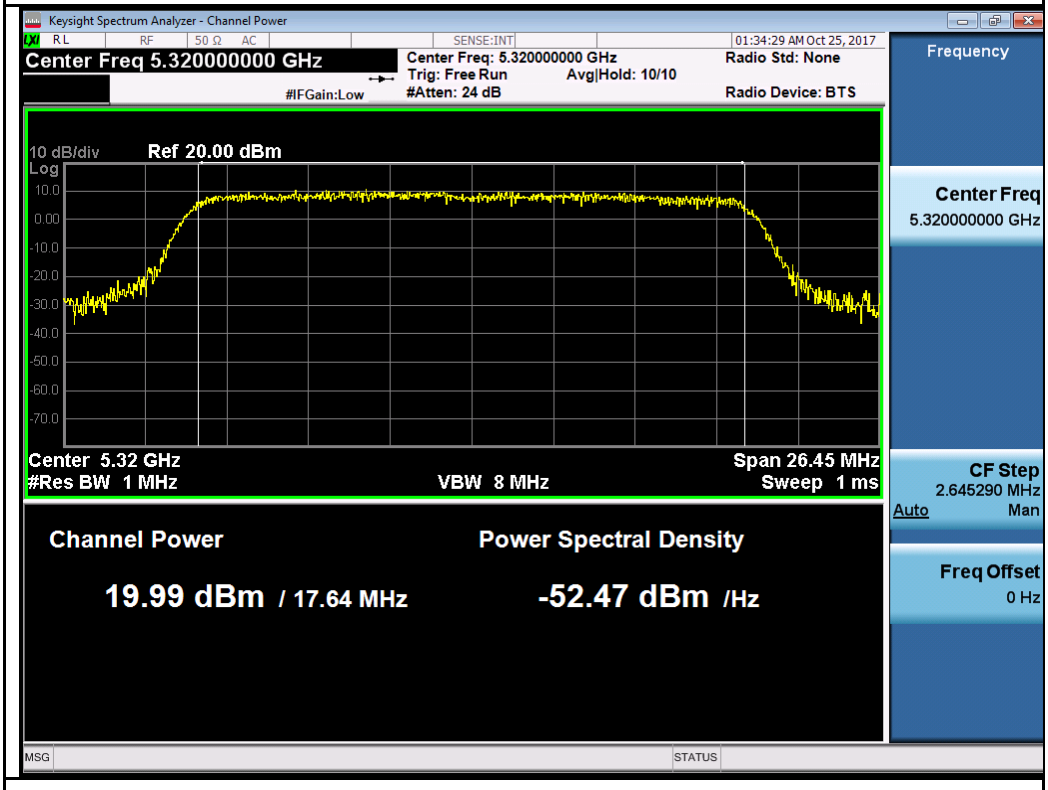

802.11a-5320M



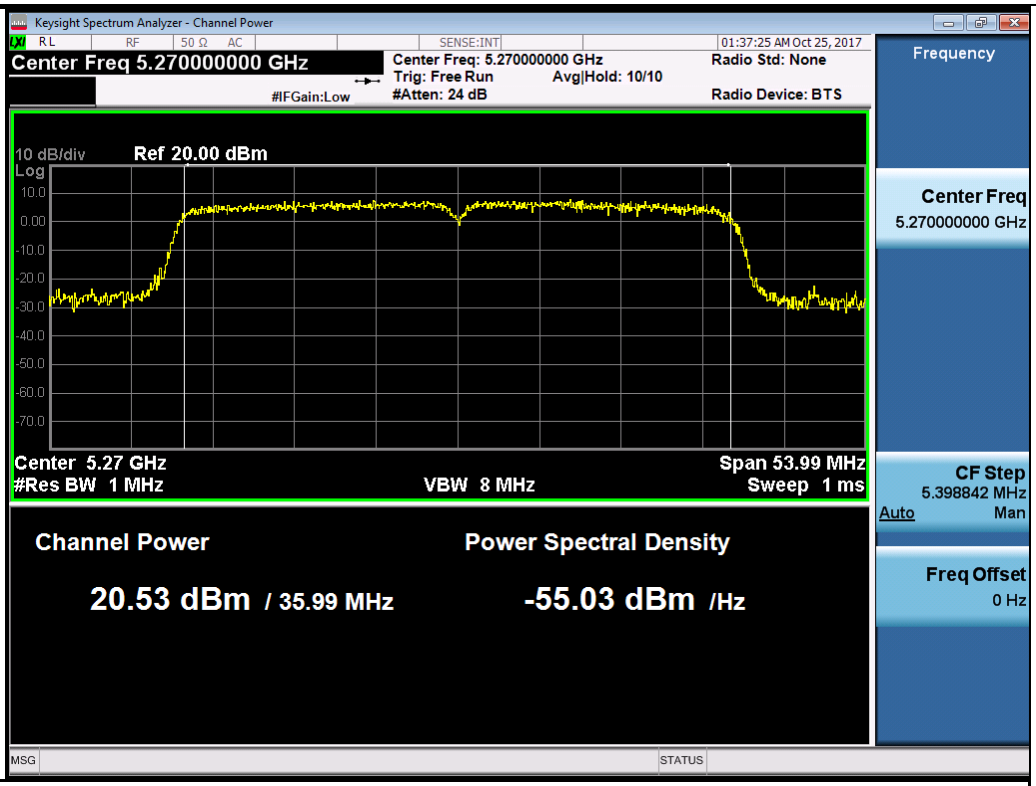

802.11n-HT20 5260M



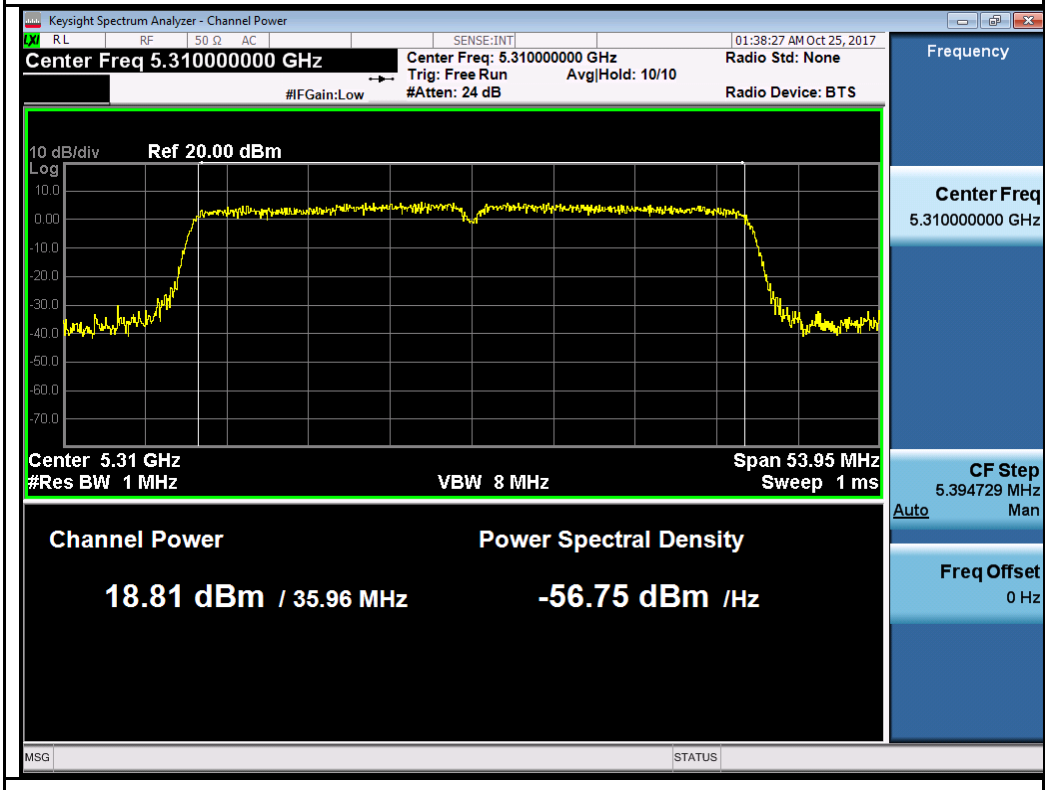

802.11n-HT20 5280M



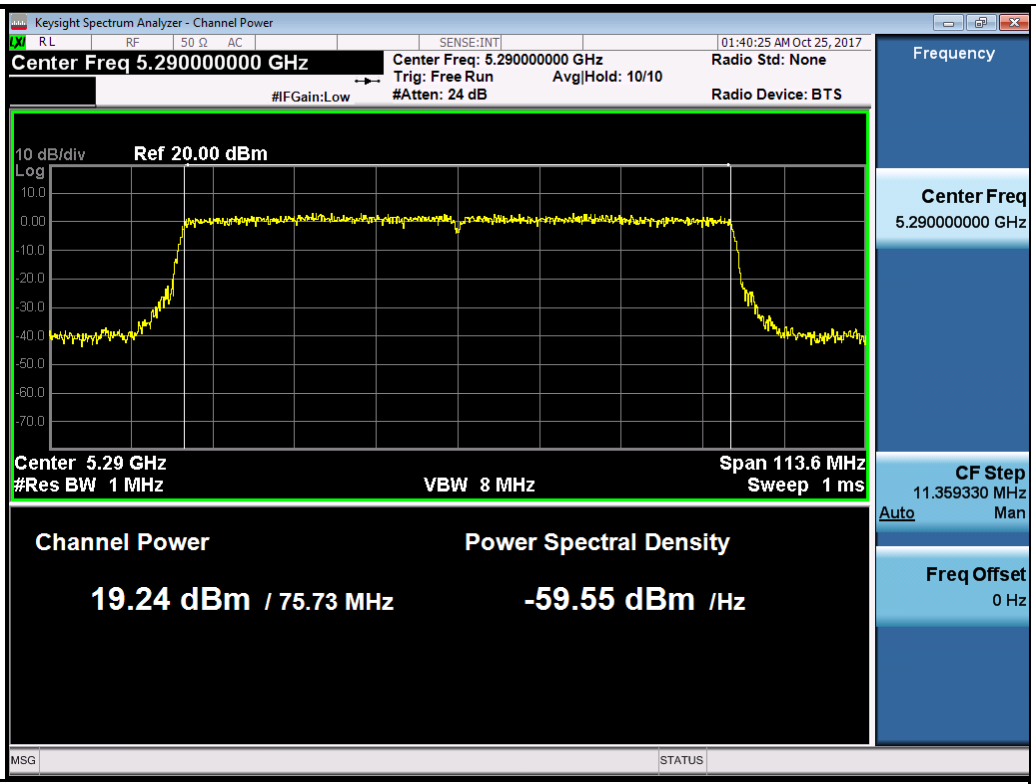

802.11n-HT20 5320M




802.11n-HT40 5270M

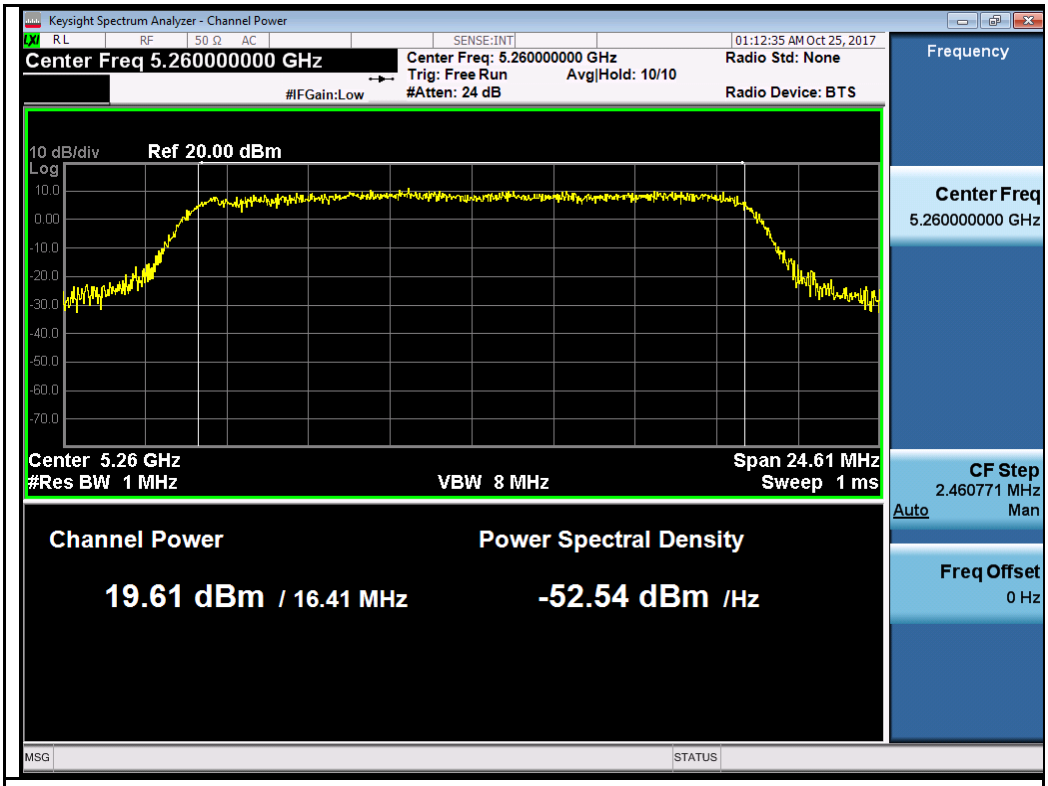



802.11n-HT40 5310M

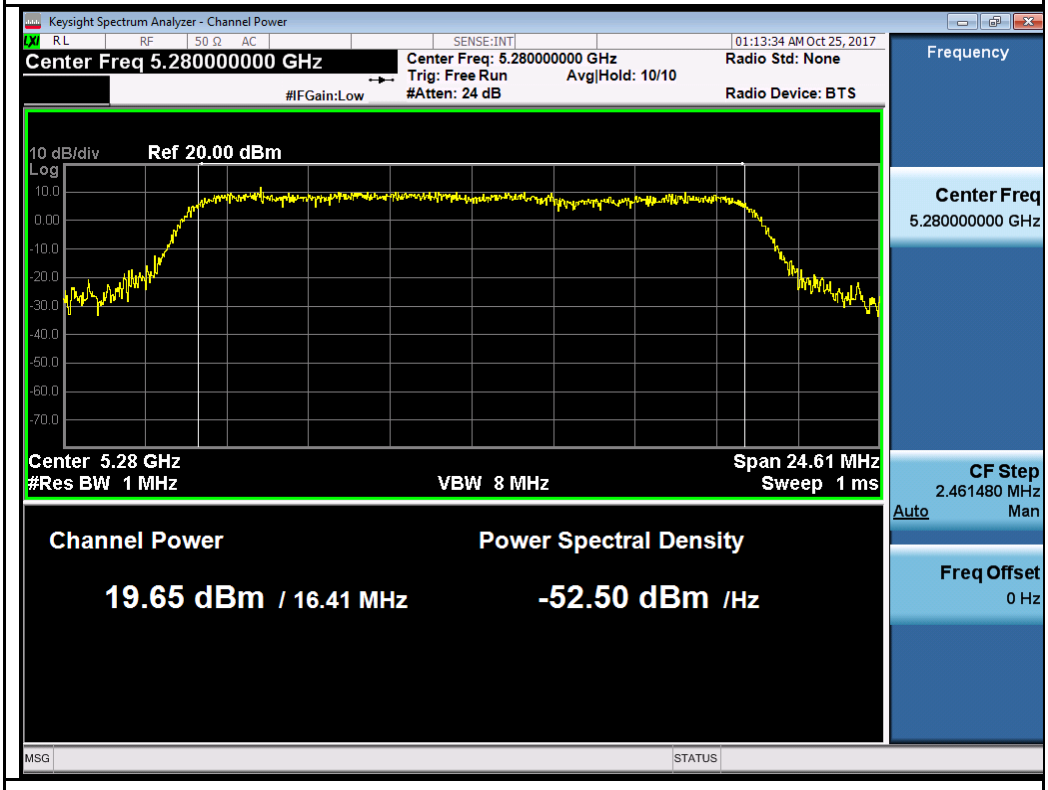



802.11ac-VHT80 5290M

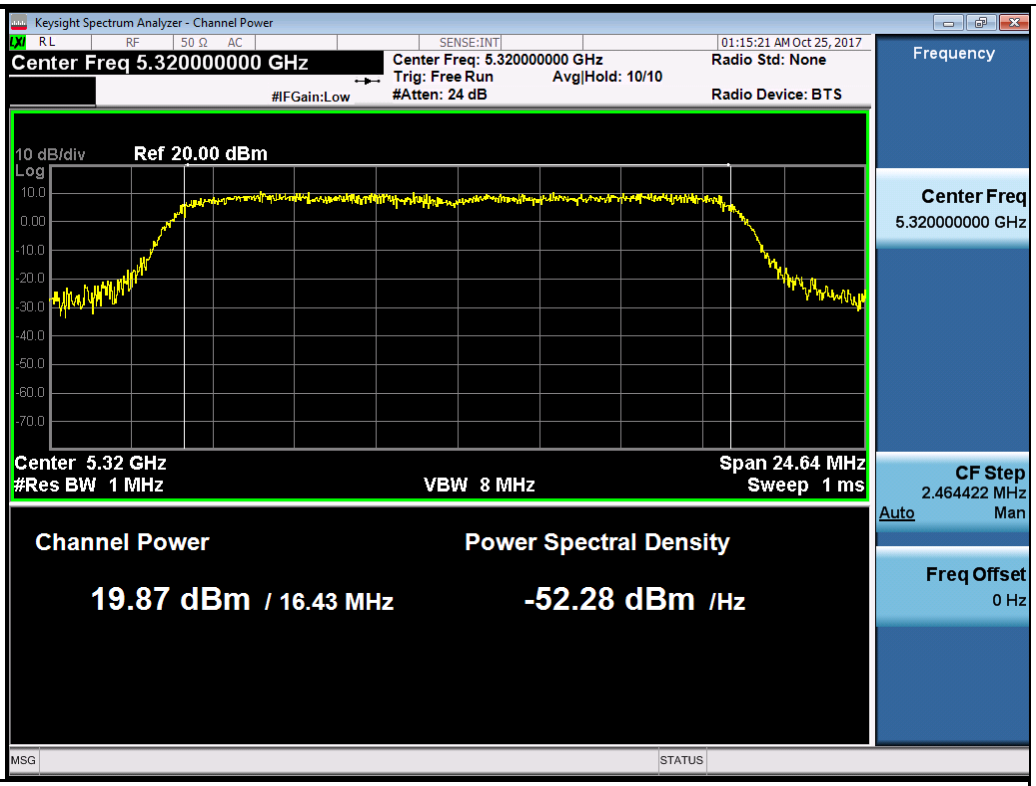
Chain 1:



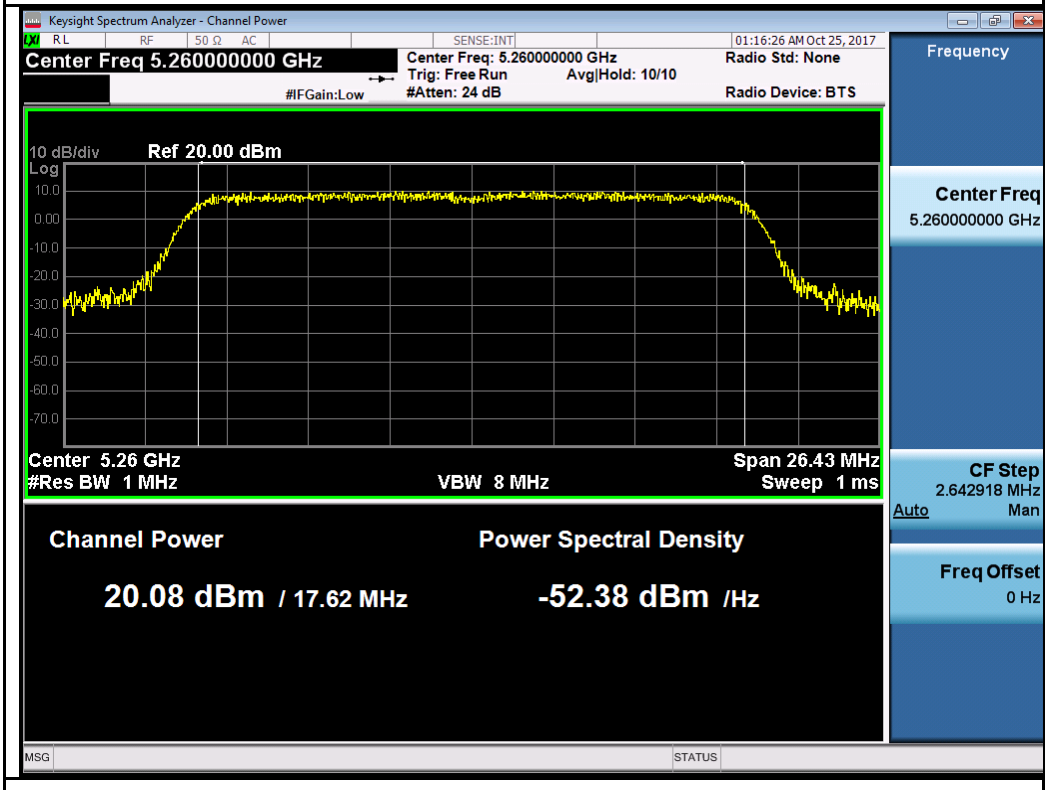

802.11a-5260M



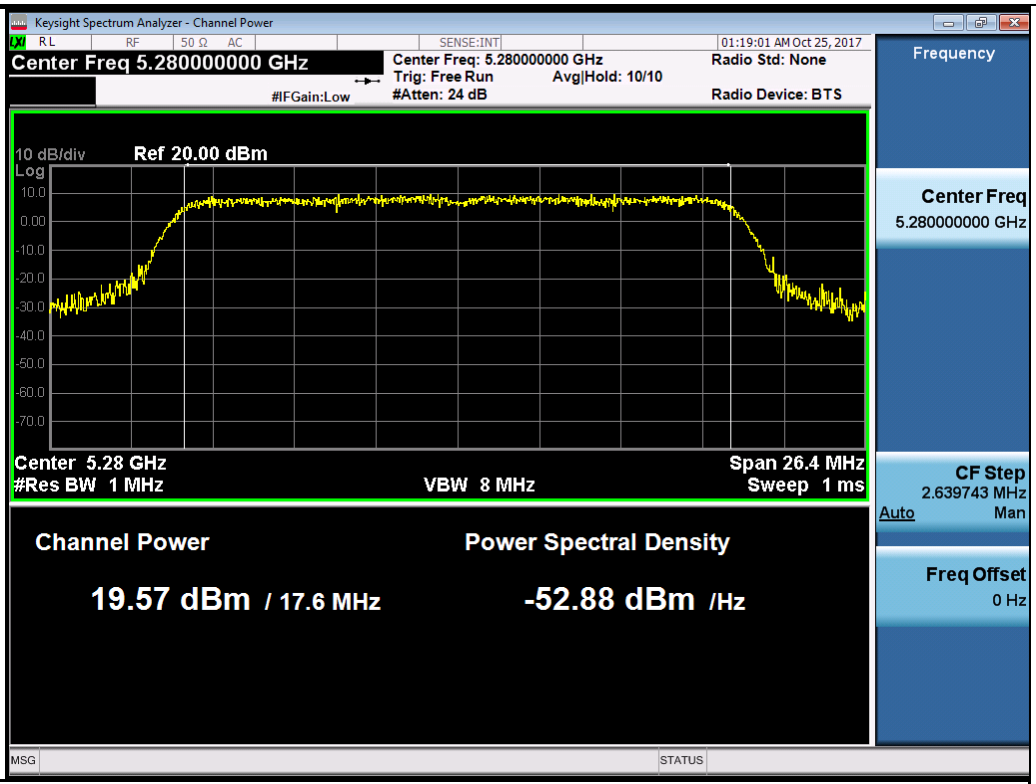

802.11a-5280M



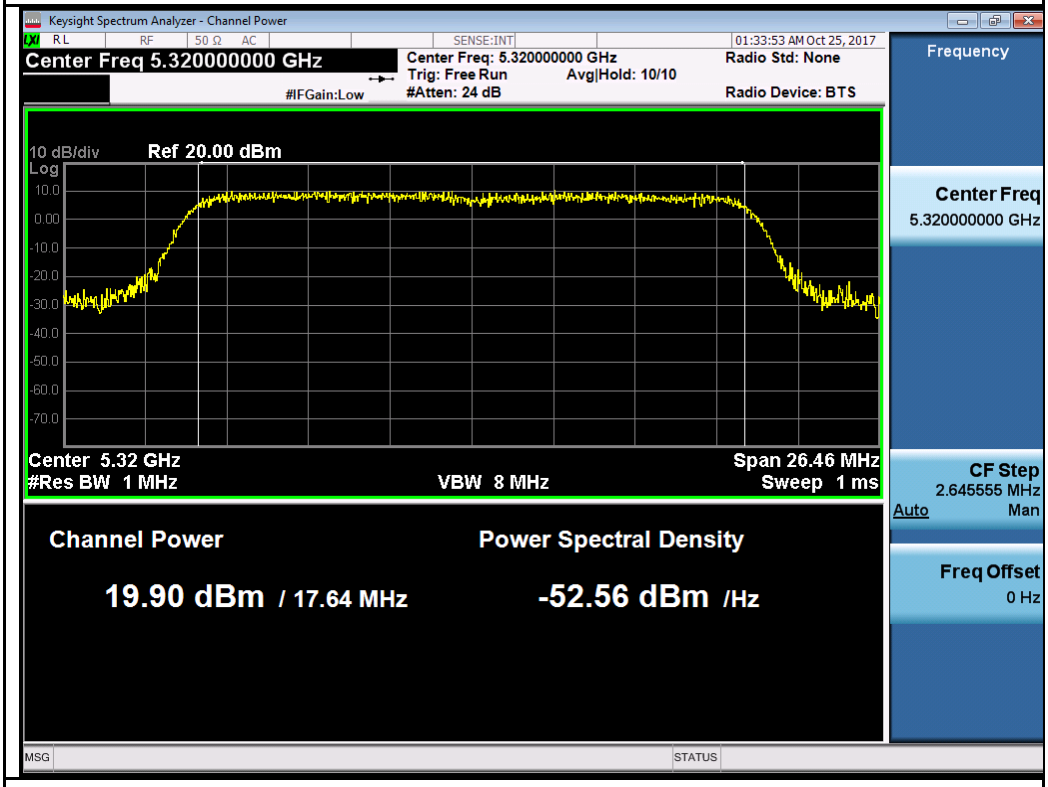

802.11a-5320M



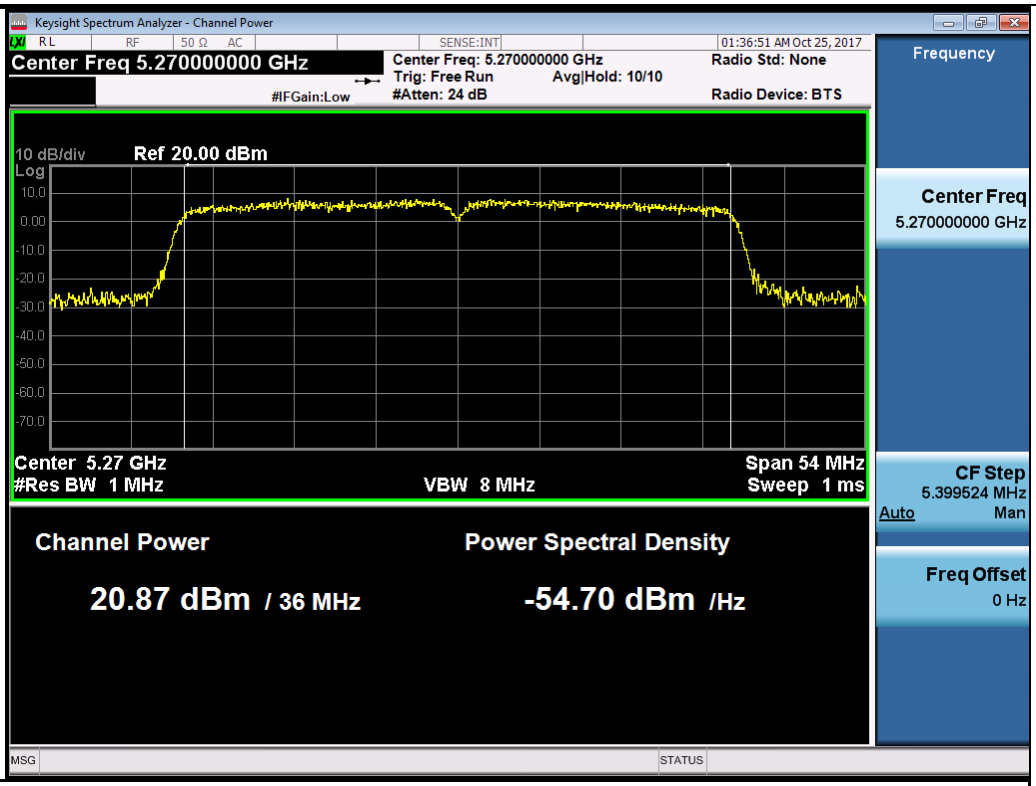

802.11n-HT20 5260M



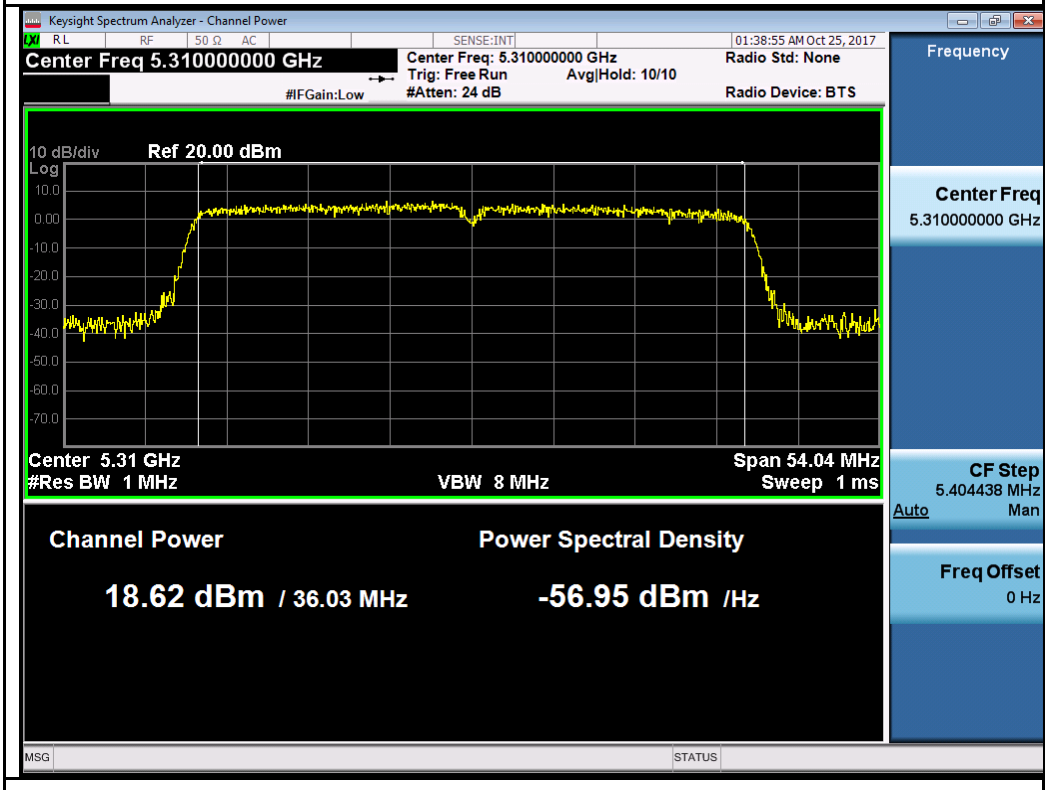

802.11n-HT20 5280M



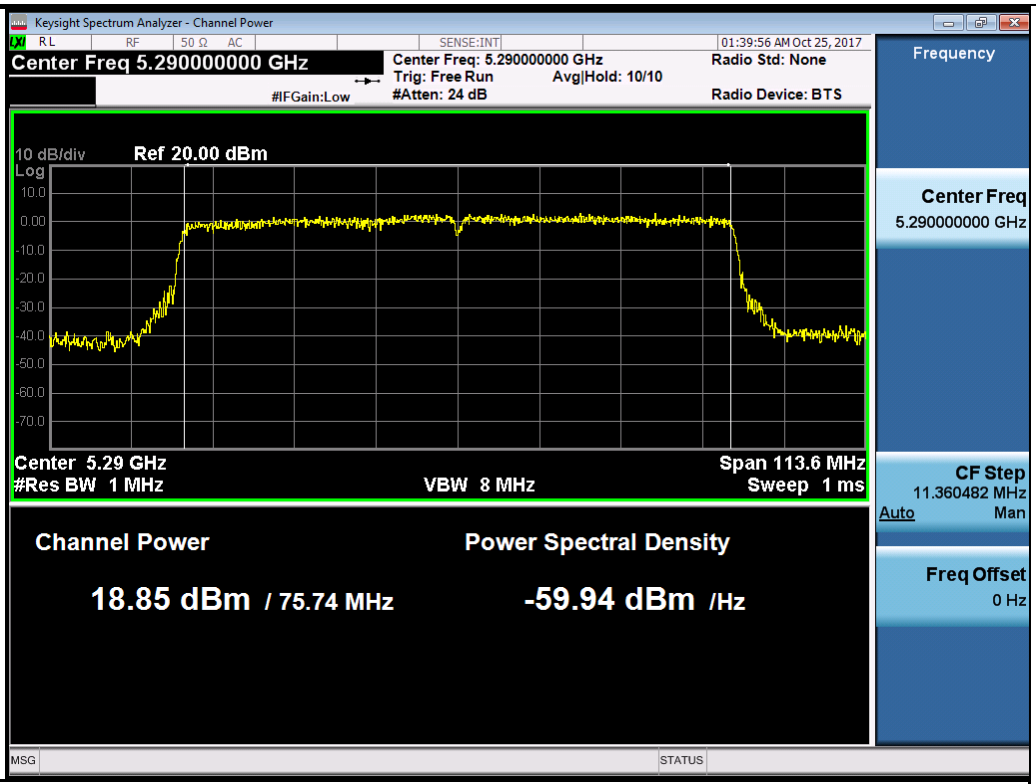

802.11n-HT20 5320M




802.11n-HT40 5270M



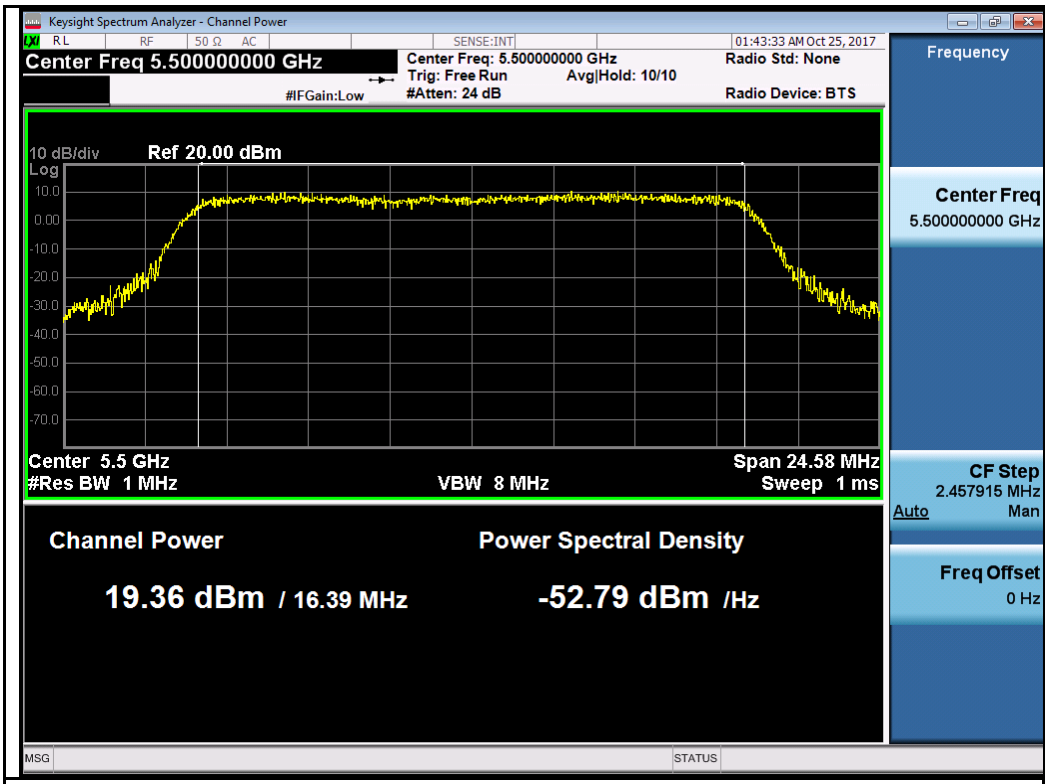

802.11n-HT40 5310M



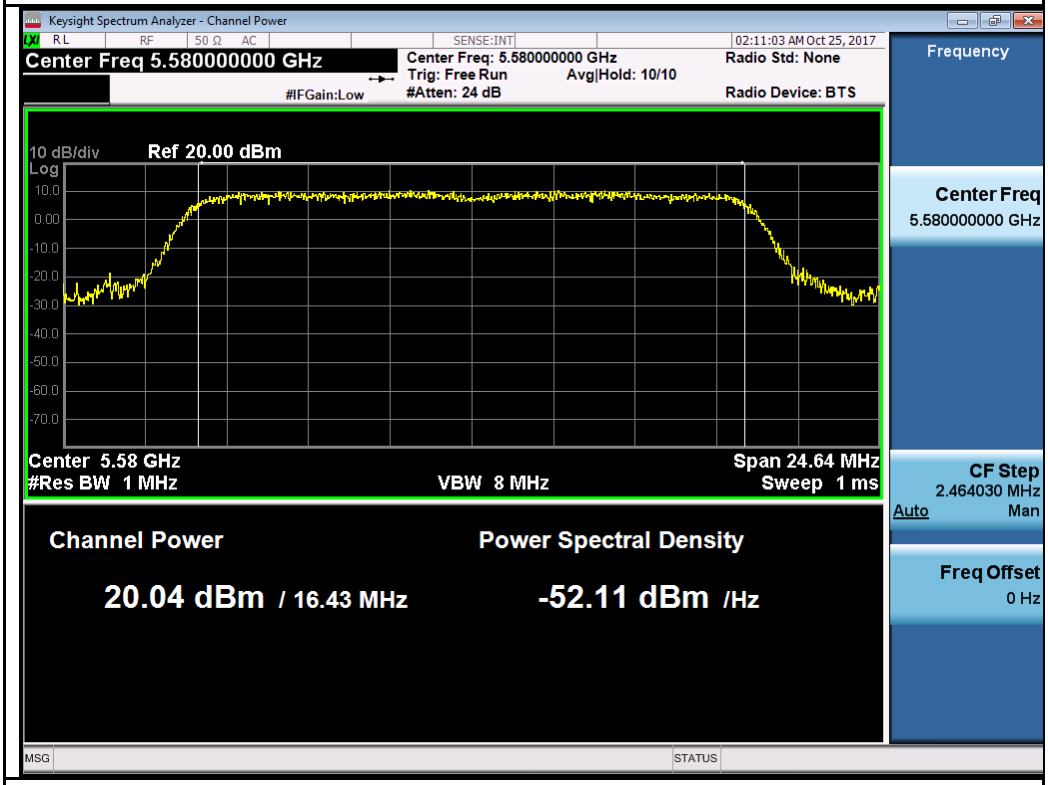

802.11ac-VHT80 5290M

Test Plot for W56:

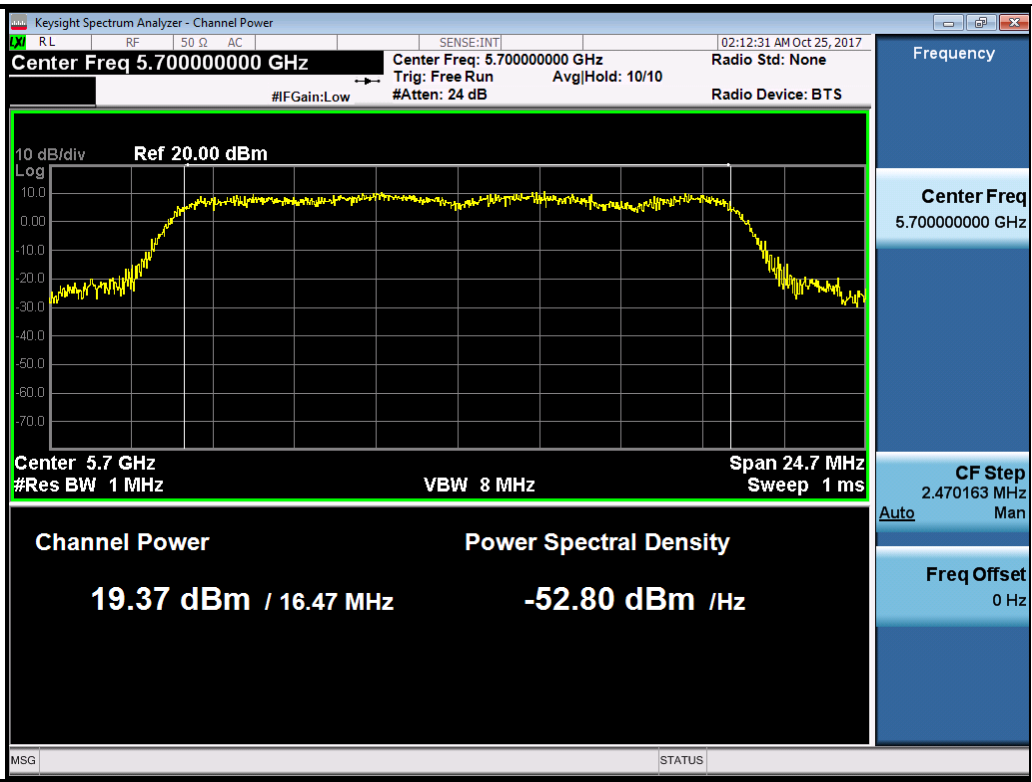
Chain 0:



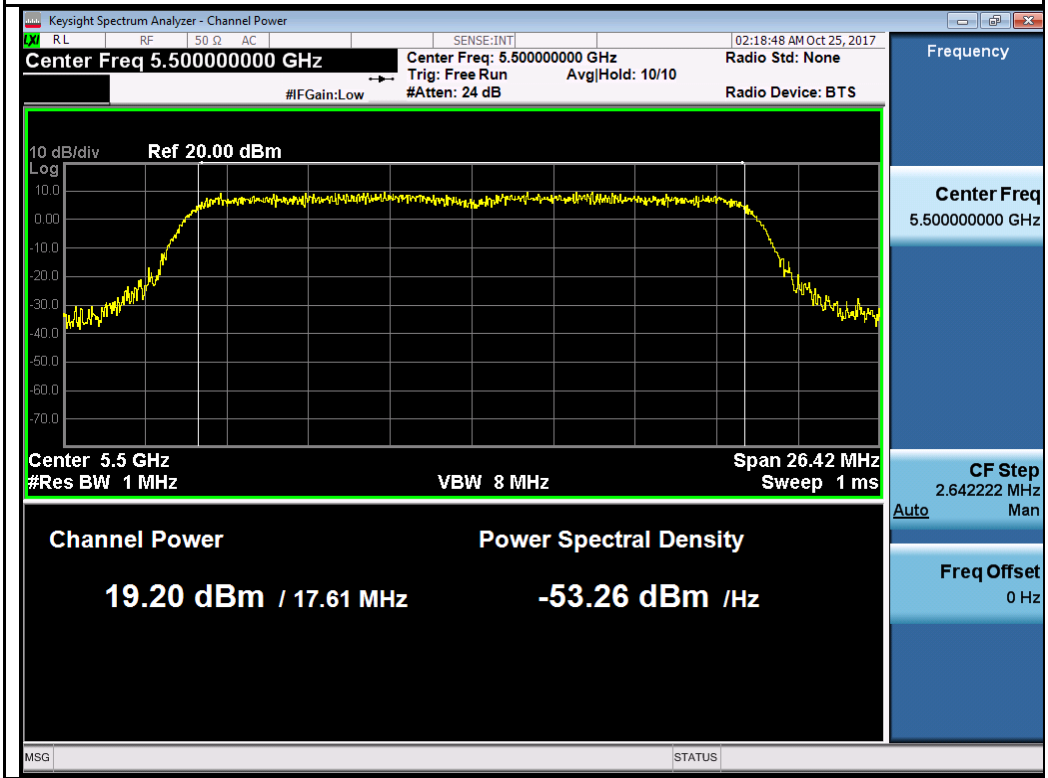

802.11a-5500M



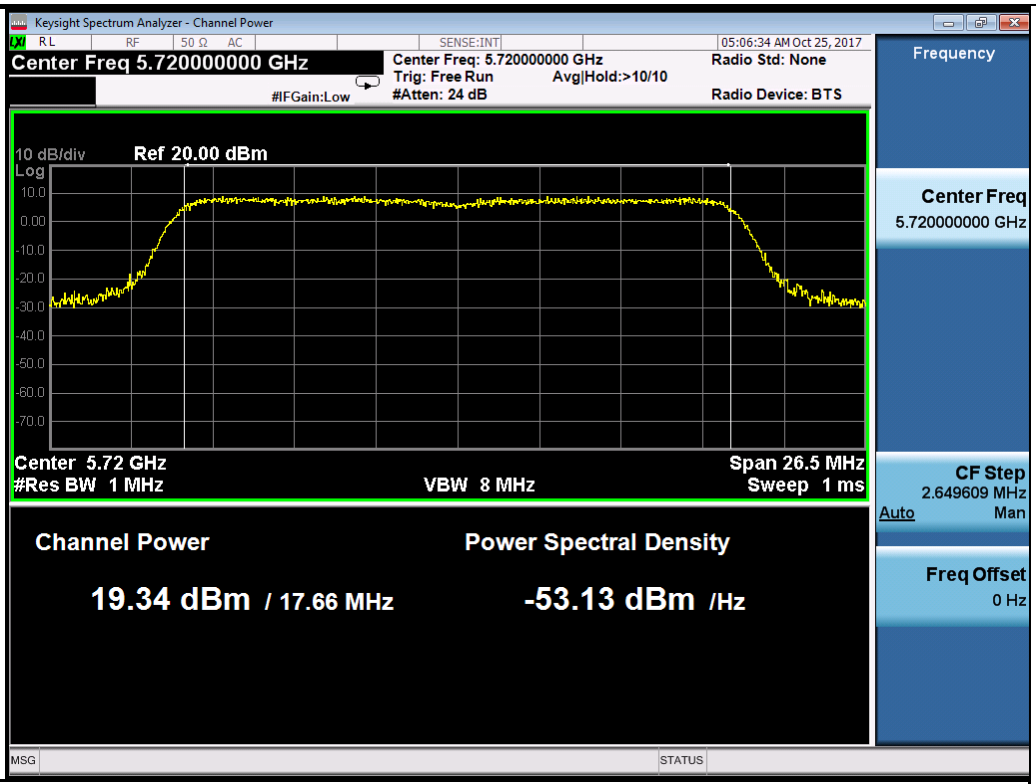

802.11a-5580M



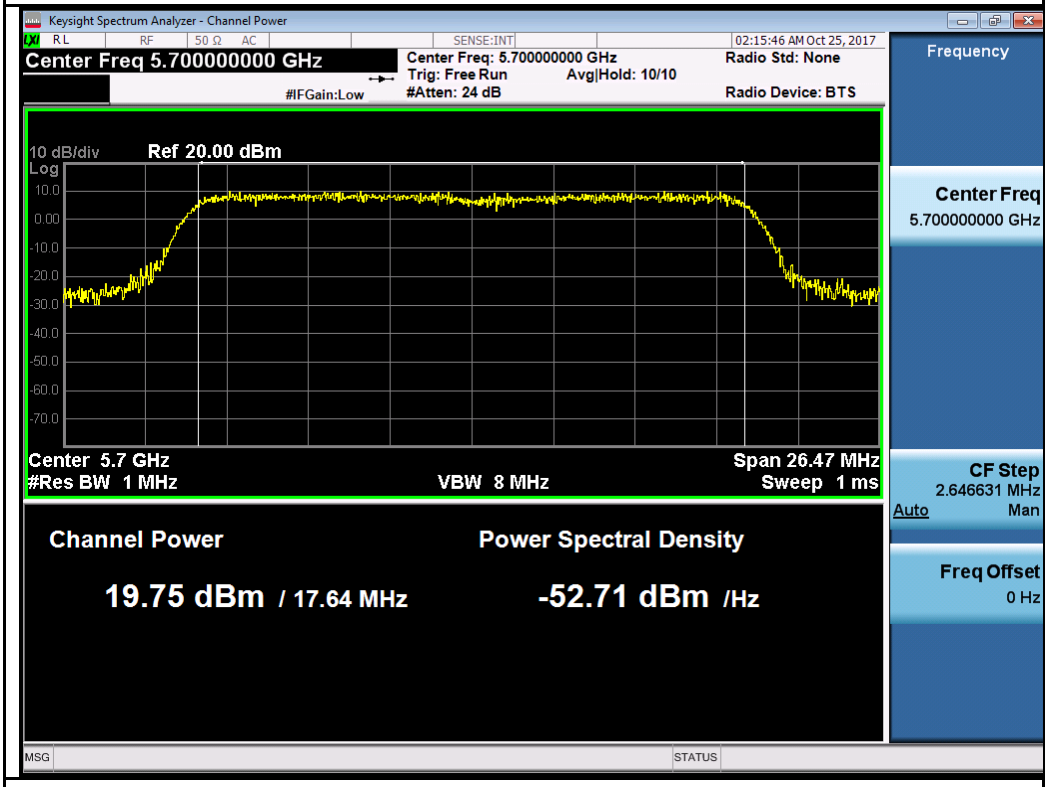

802.11a-5700M



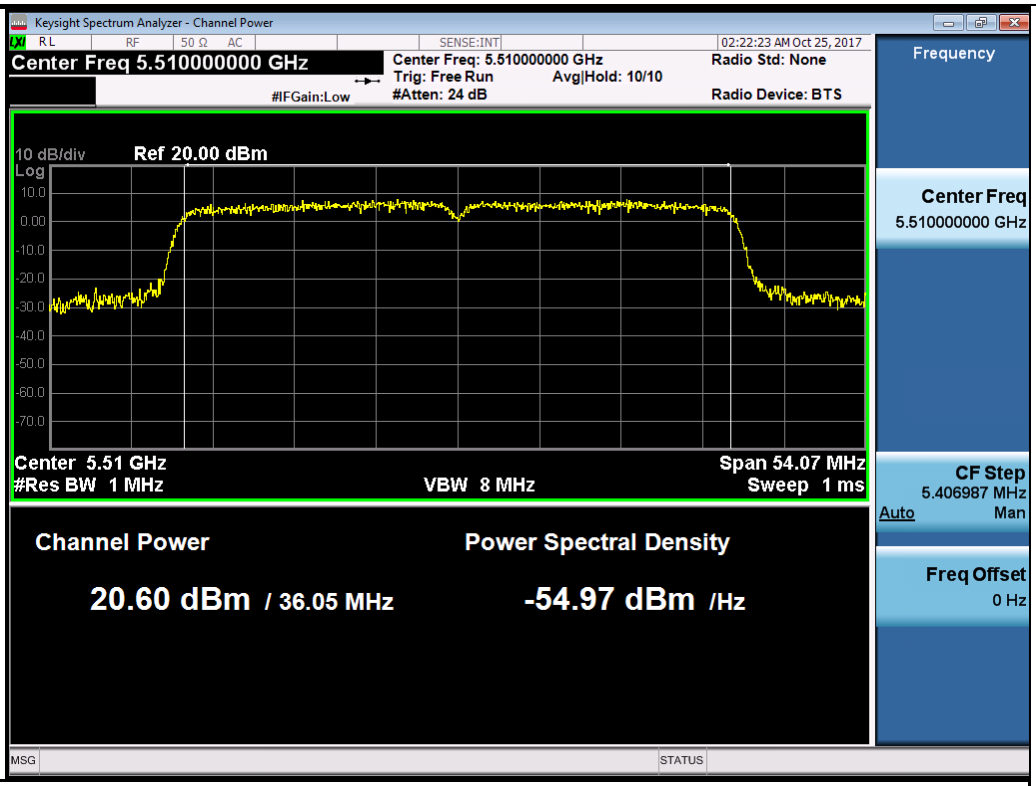

802.11n-HT20 5500M



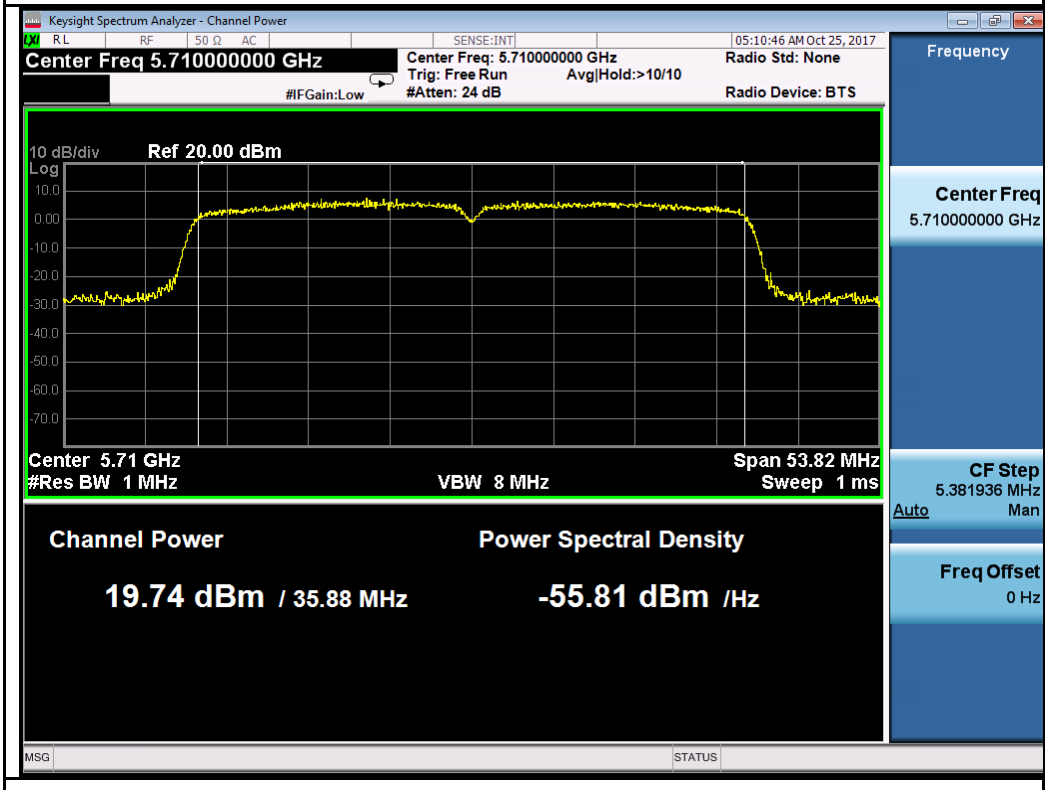

802.11n-HT20 5580M



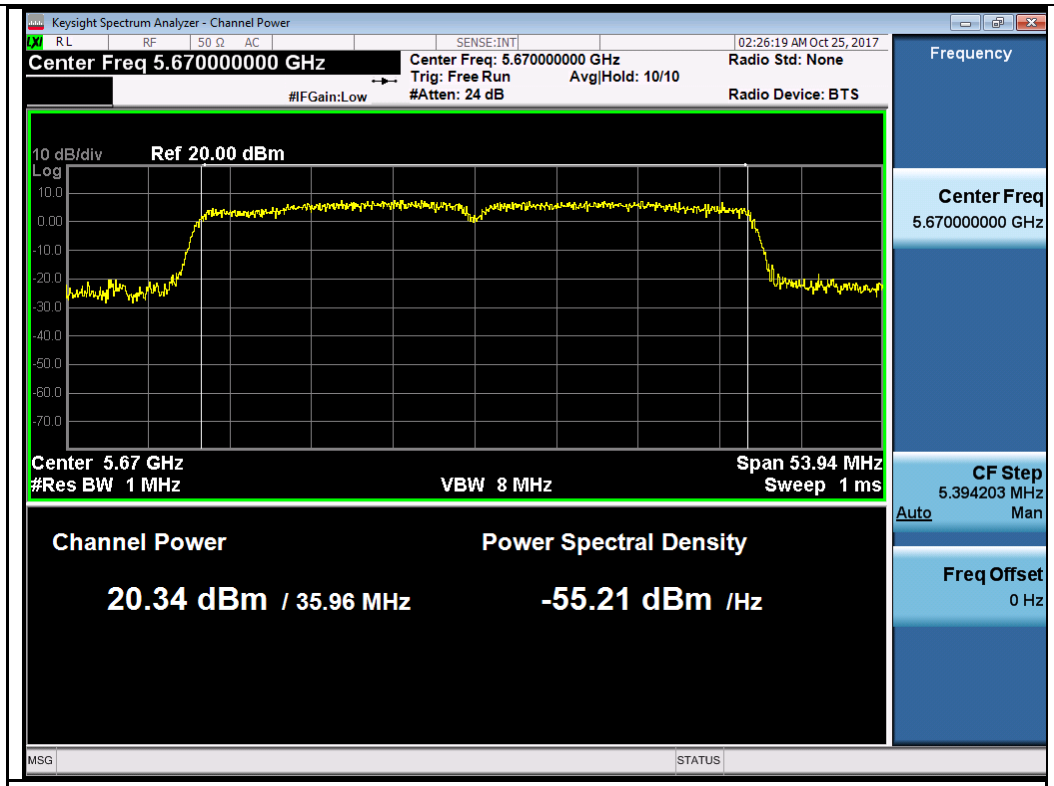

802.11n-HT20 5700M



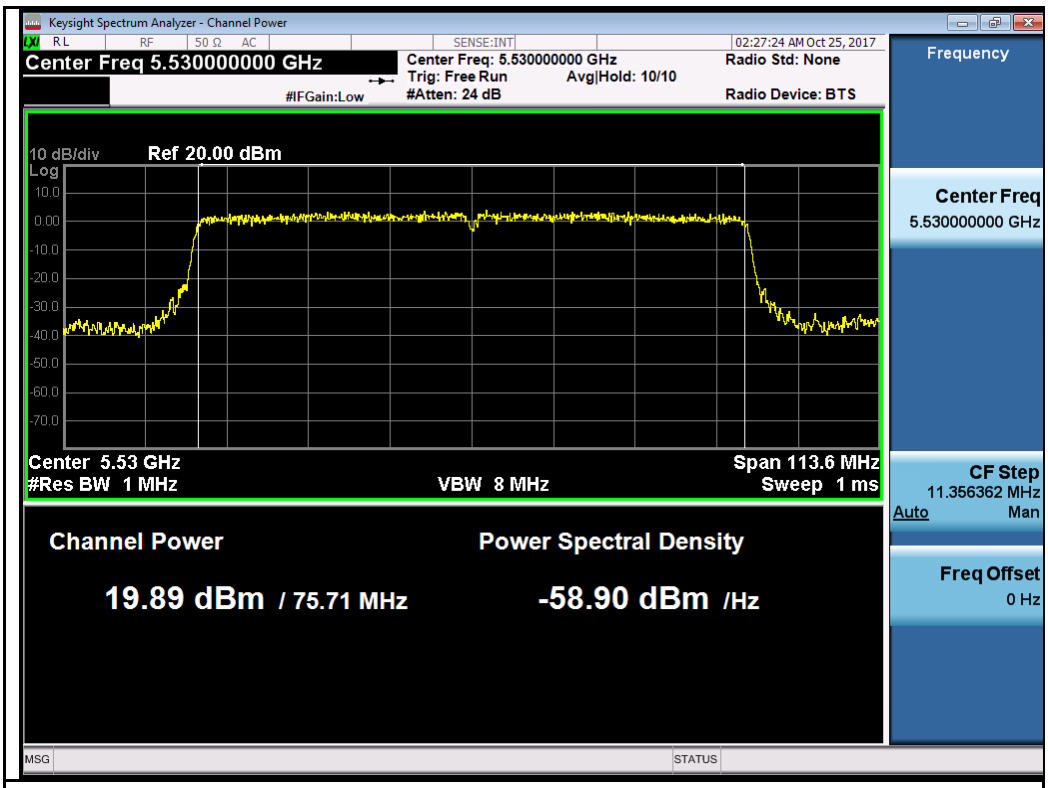

802.11n-HT40 5510M



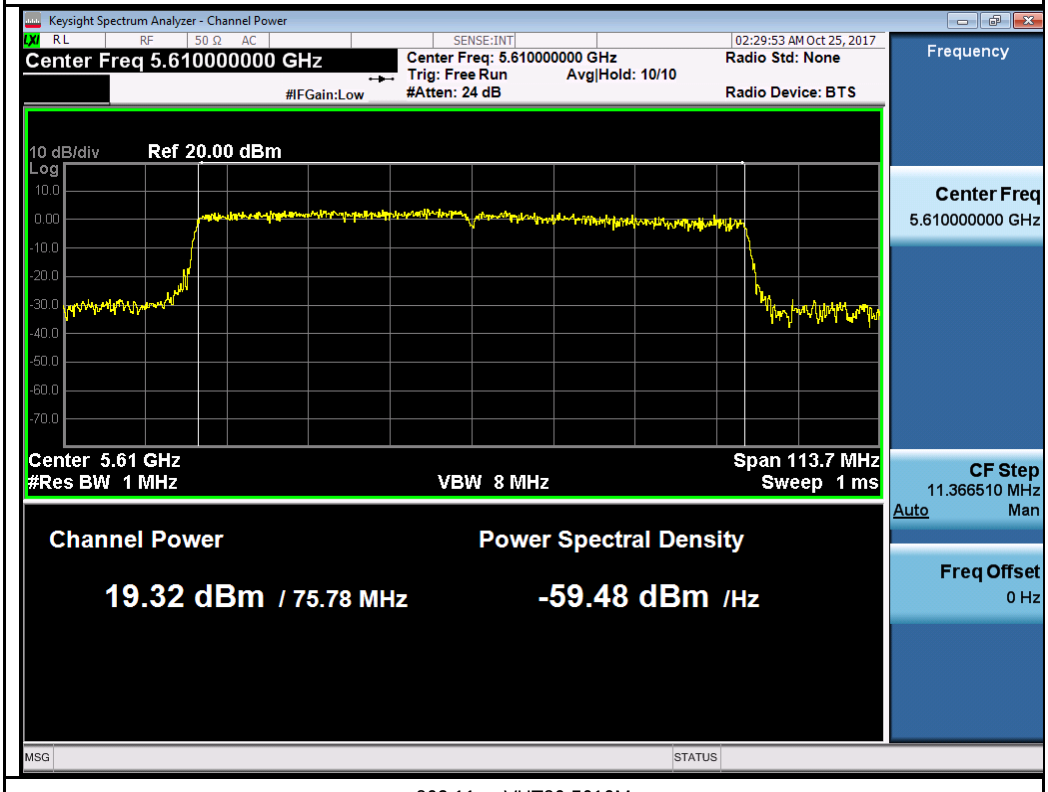

802.11n-HT40 5550M




802.11n-HT40 5670M

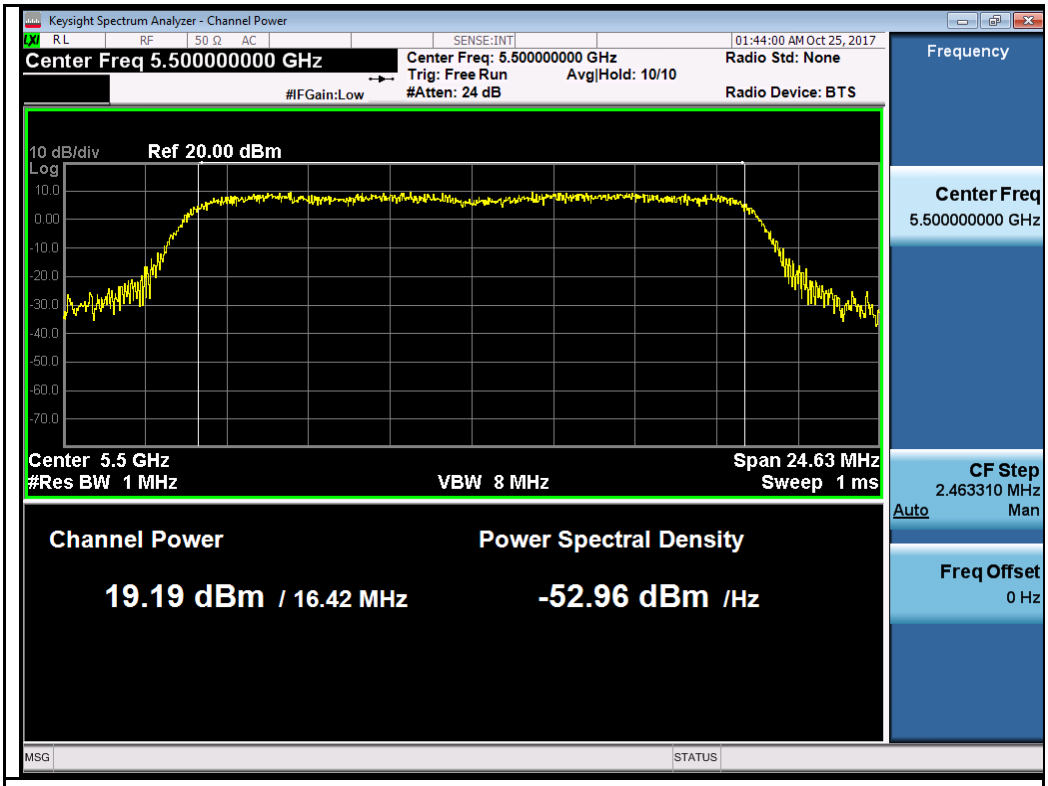



802.11ac-VHT80 5530M

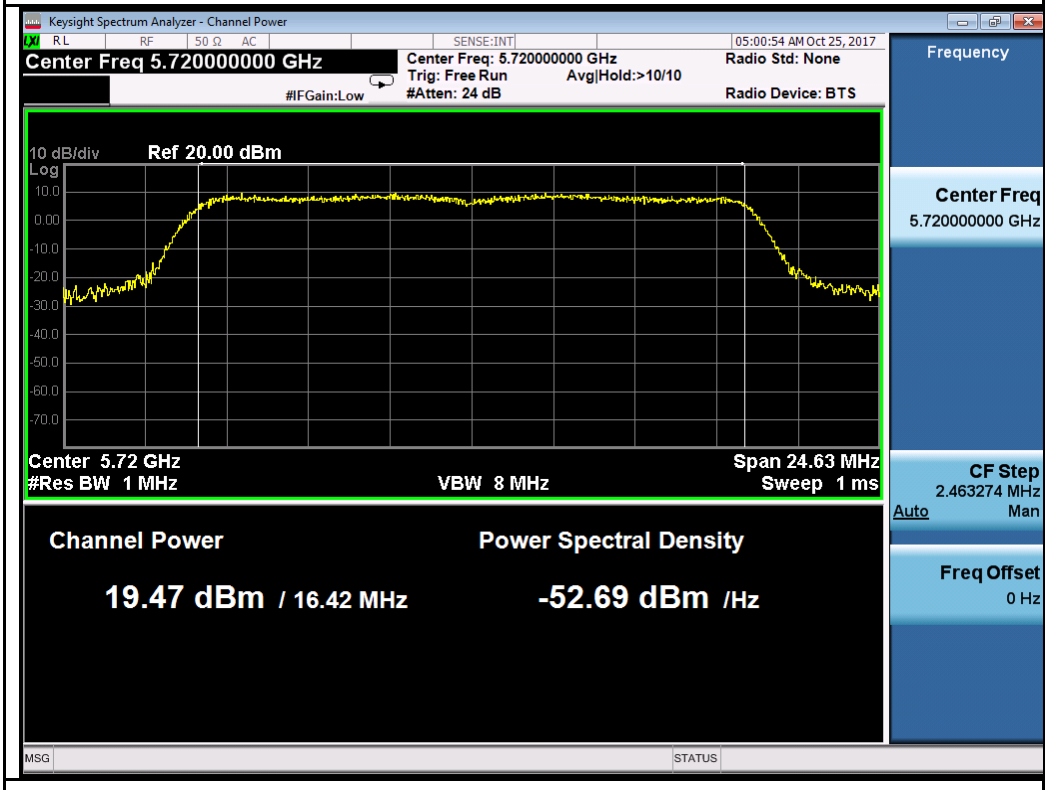



802.11ac-VHT80 5610M

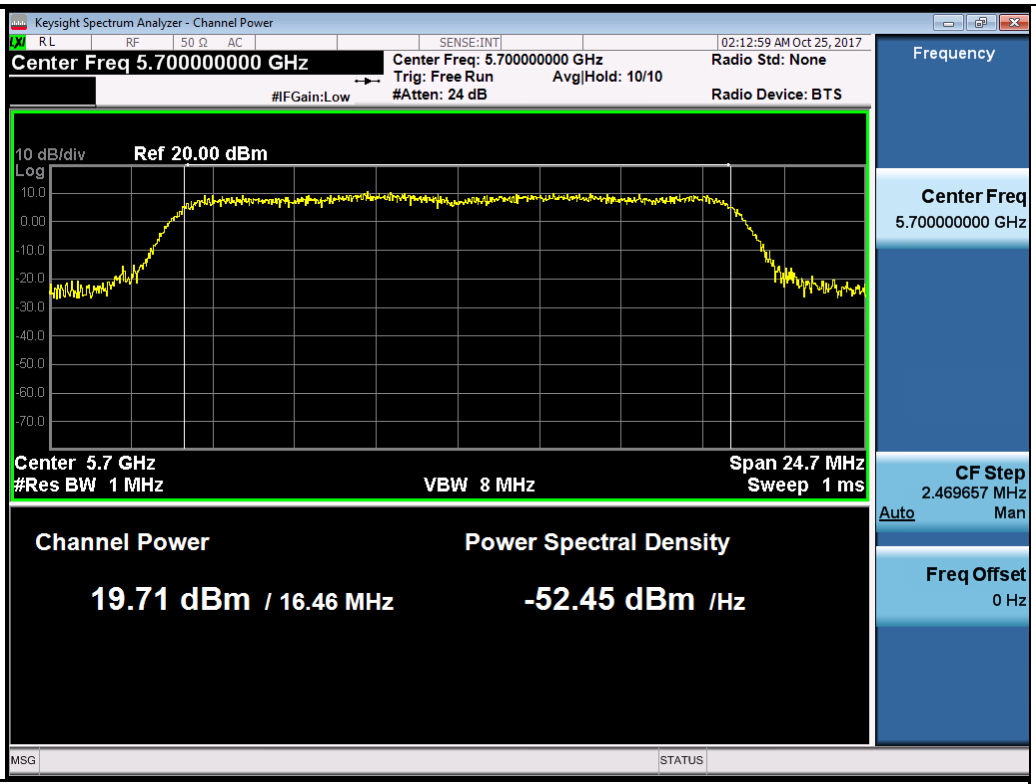
Chain 1:



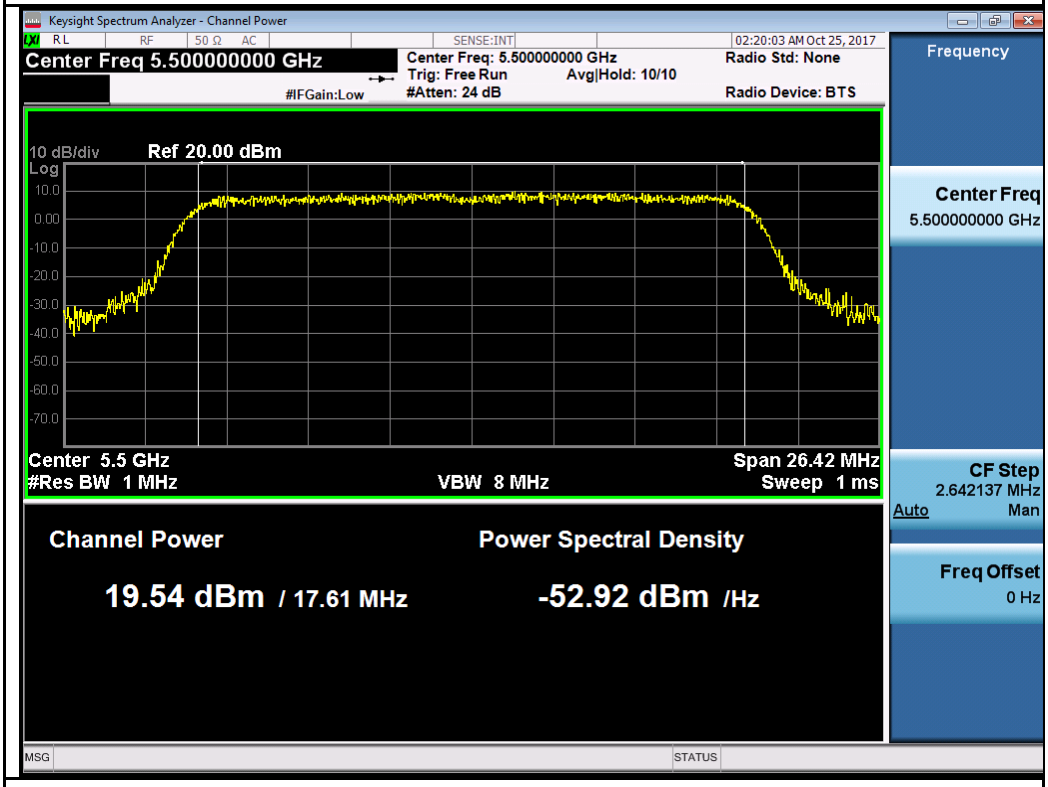

802.11a-5500M



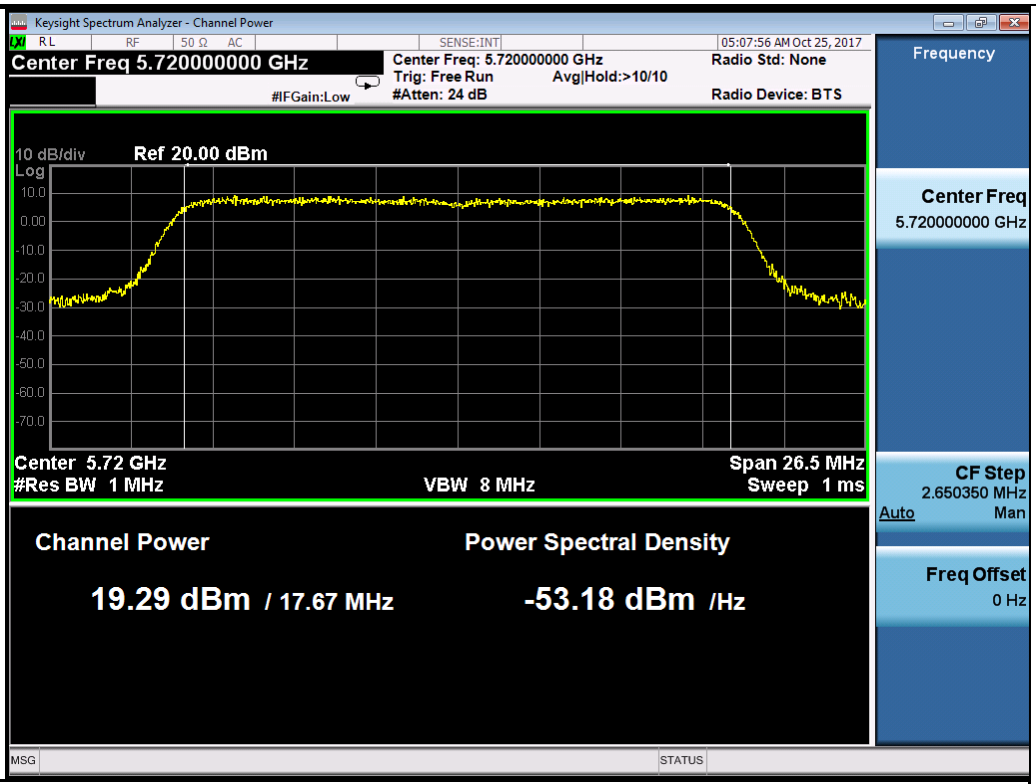

802.11a-5580M



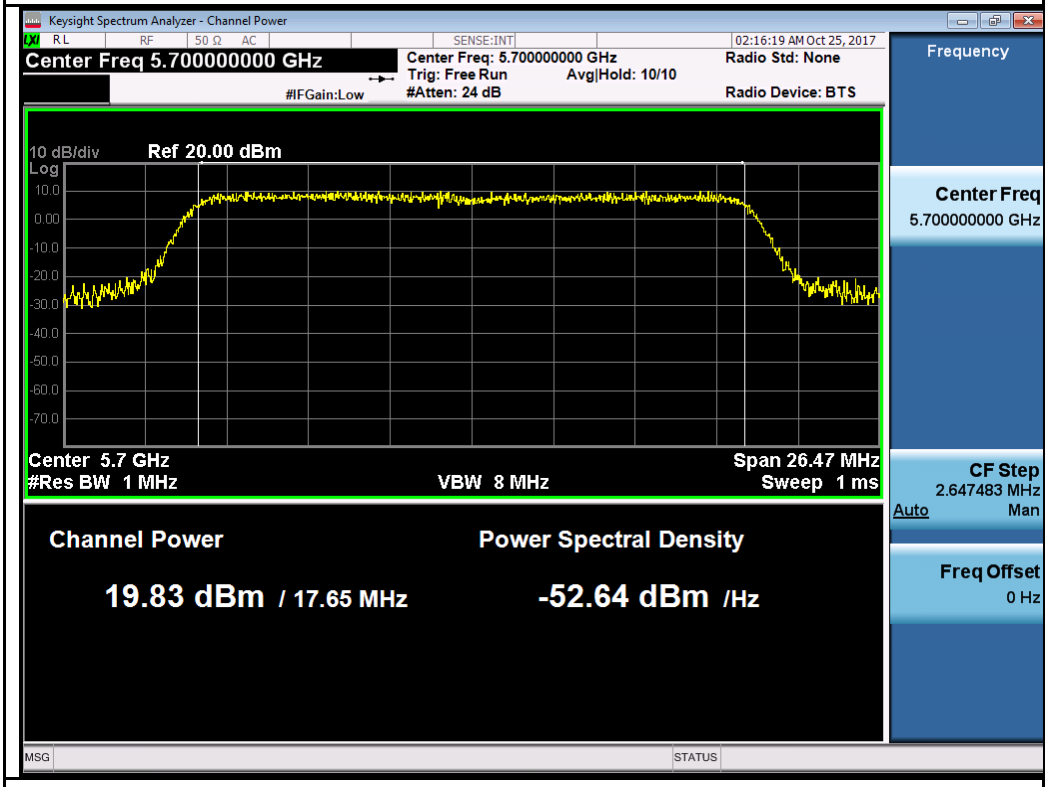

802.11a-5700M



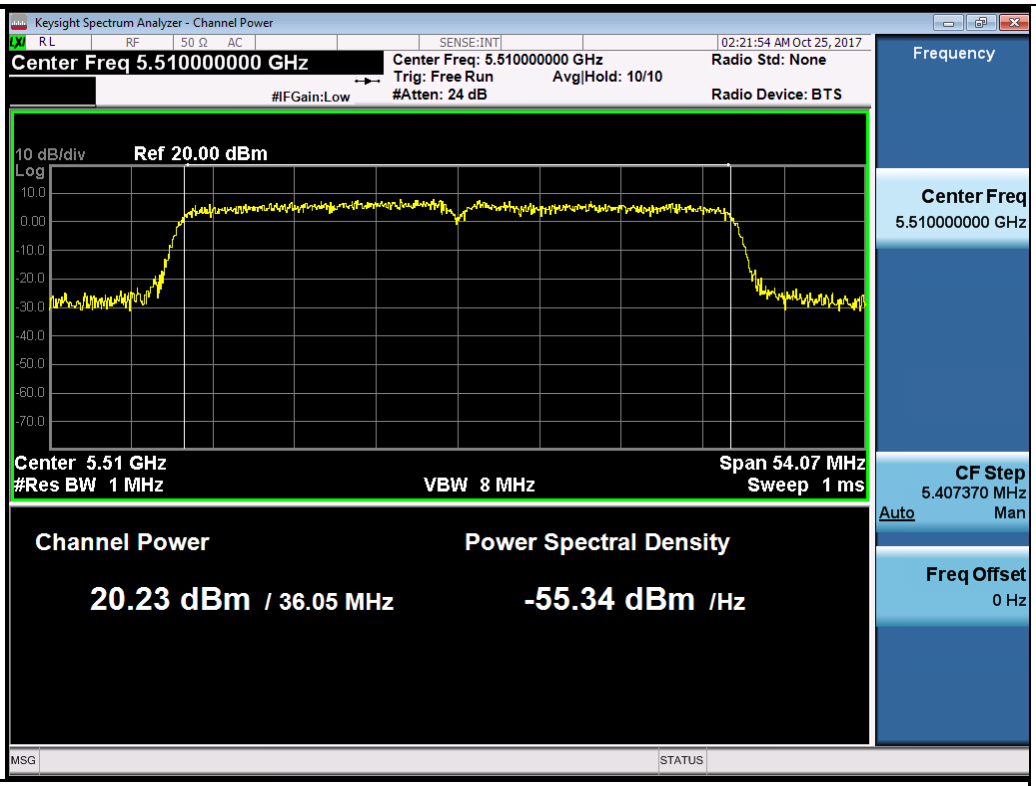

802.11n-HT20 5500M



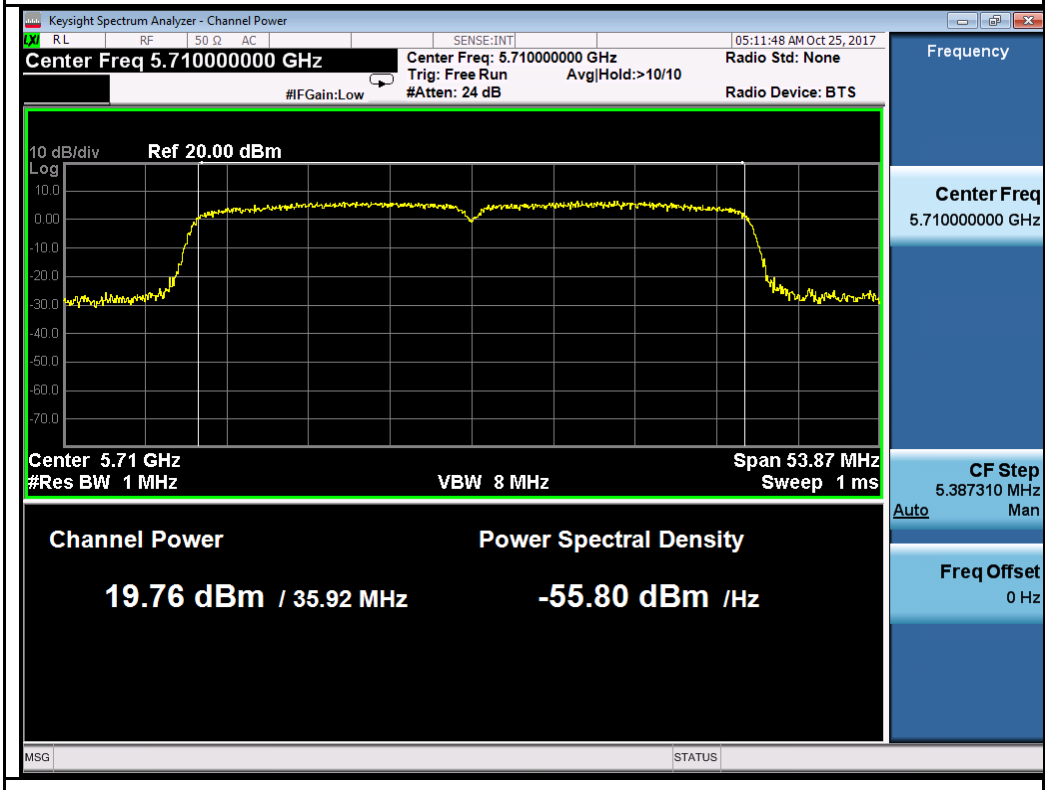

802.11n-HT20 5580M



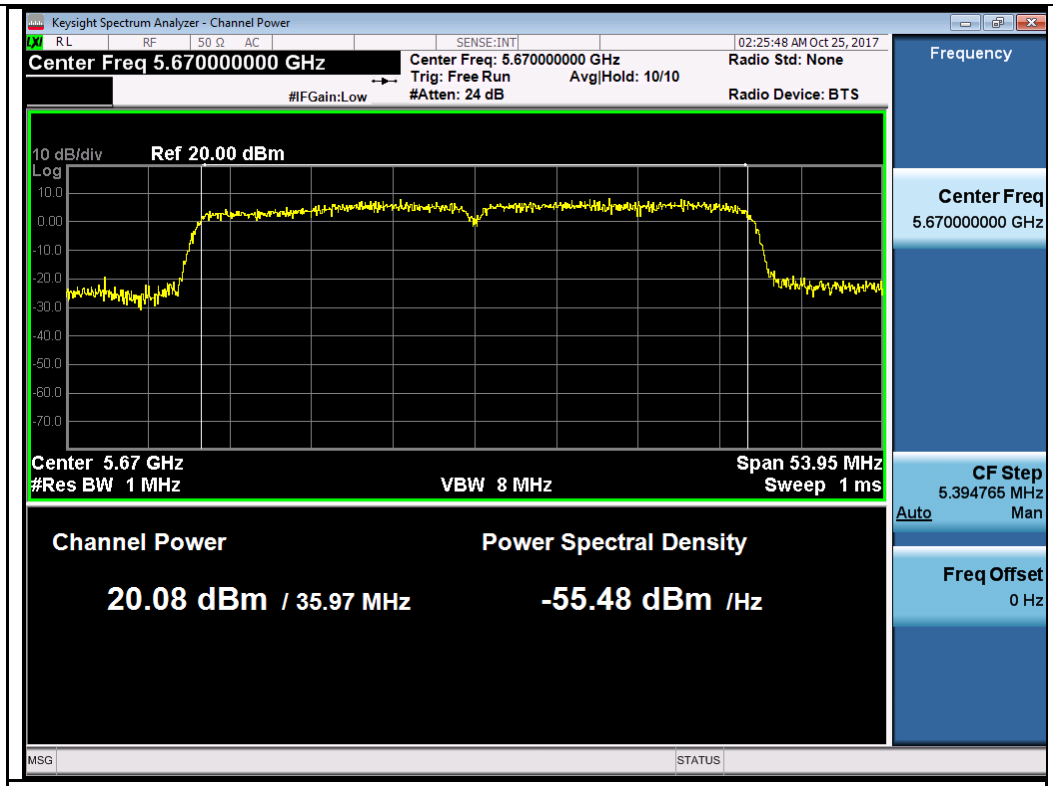

802.11n-HT20 5700M



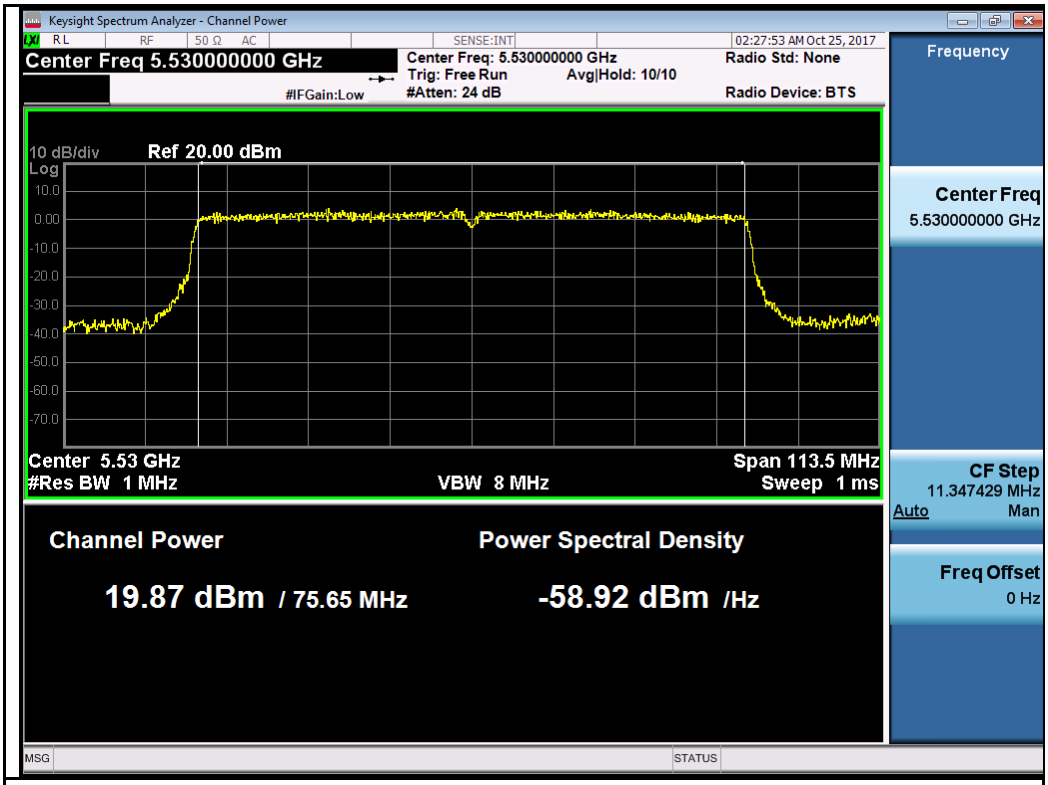

802.11n-HT40 5510M



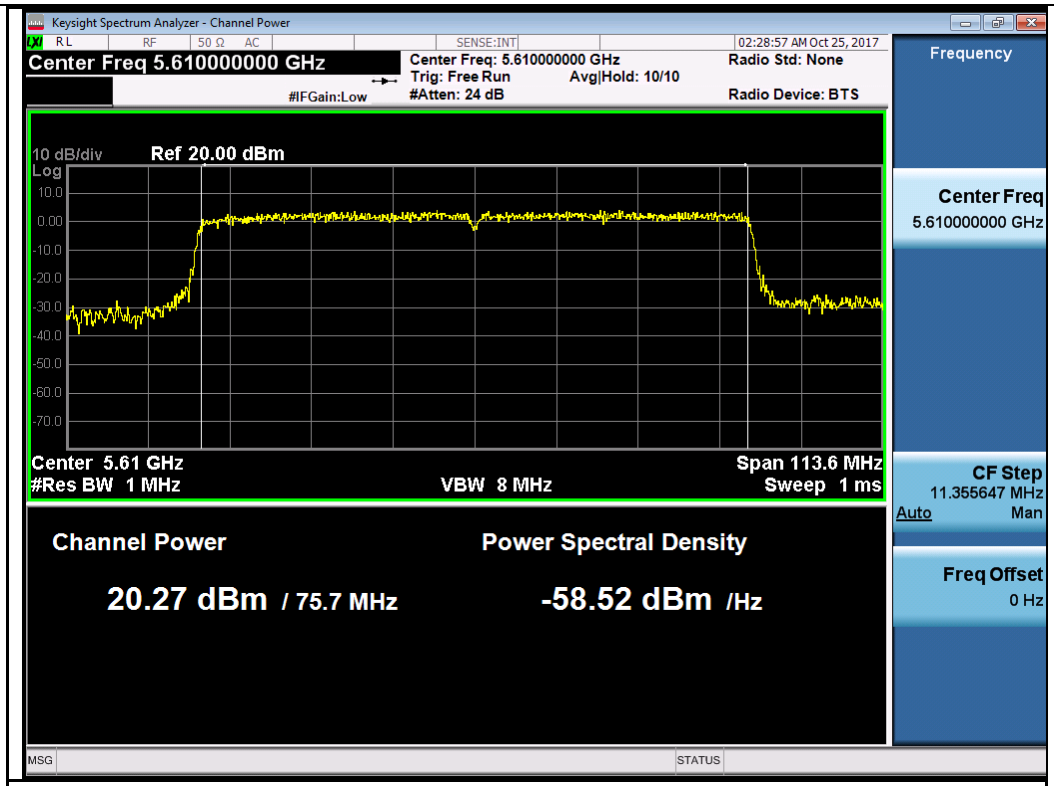

802.11n-HT40 5550M




802.11n-HT40 5670M



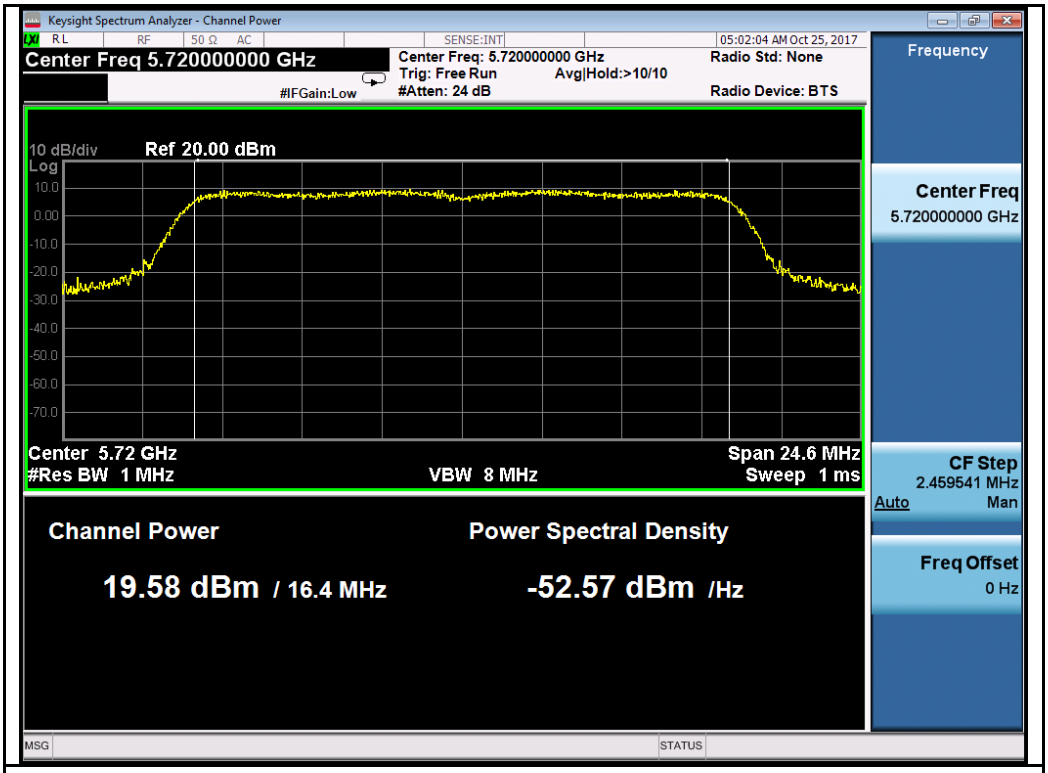

802.11ac-VHT80 5530M



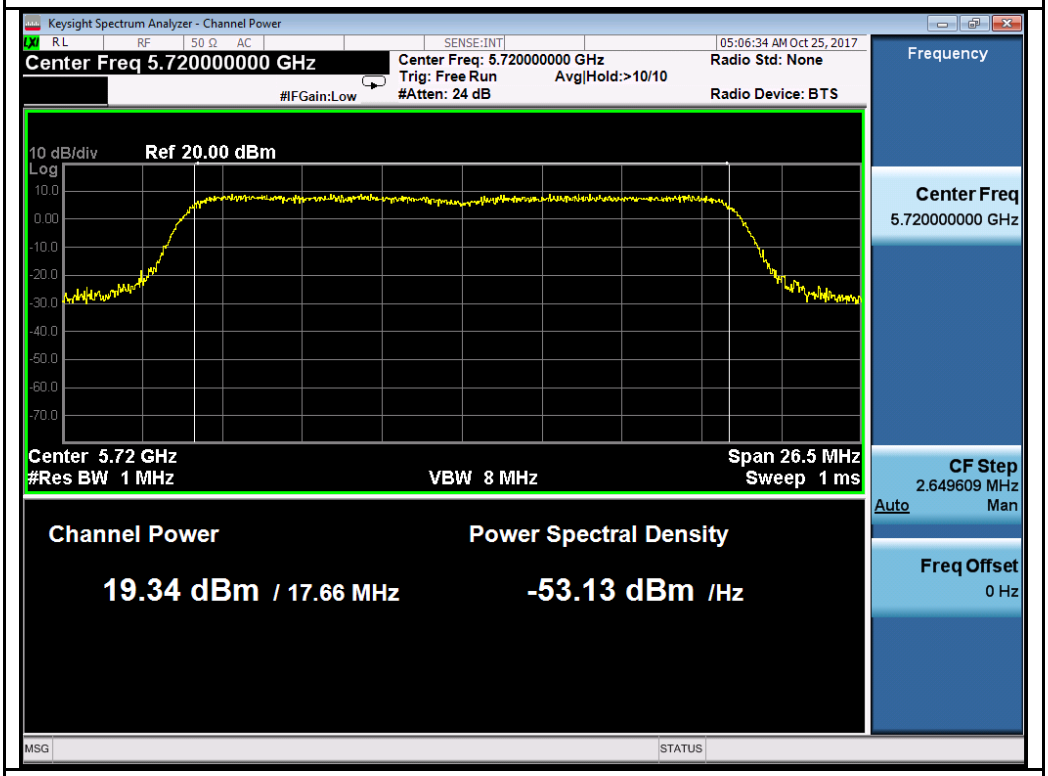

802.11ac-VHT80 5610M

Test Plot for Crossband:

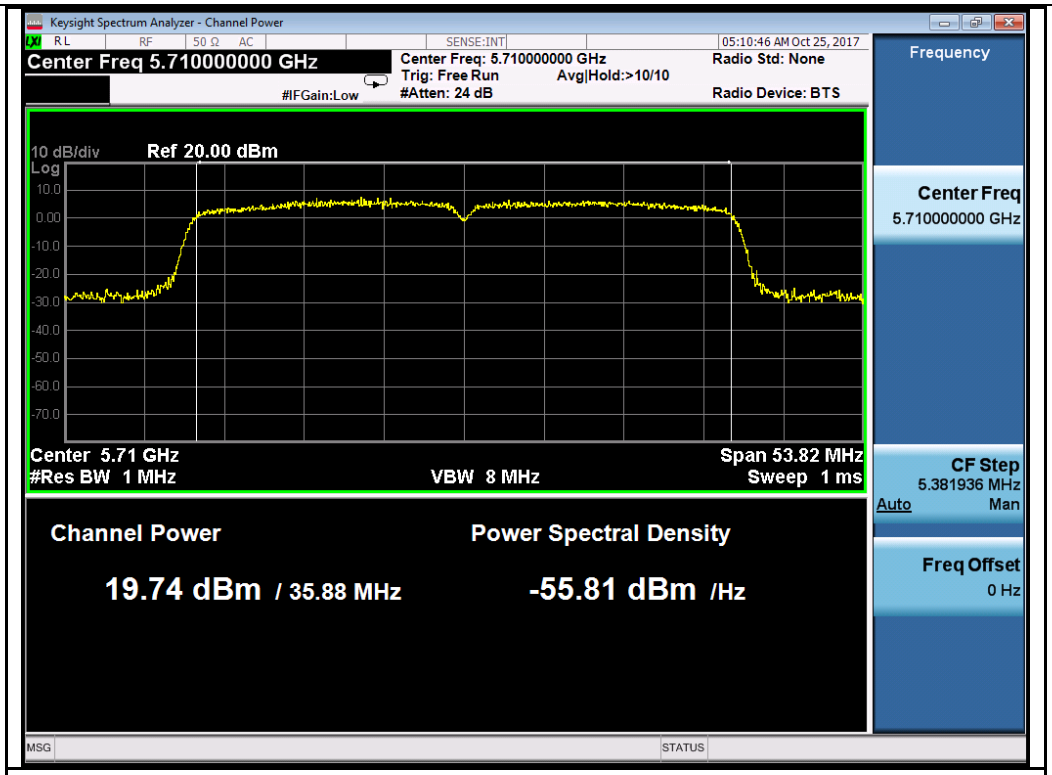
Chain 0:



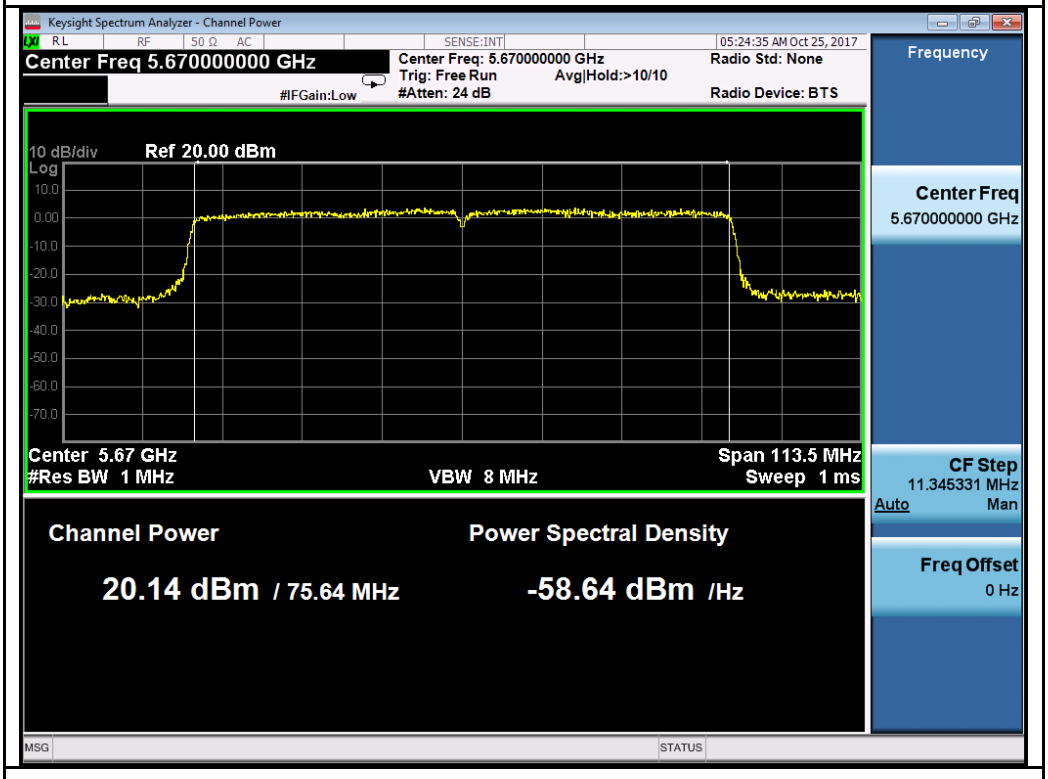

802.11a-5720M




802.11n-HT20 5720M

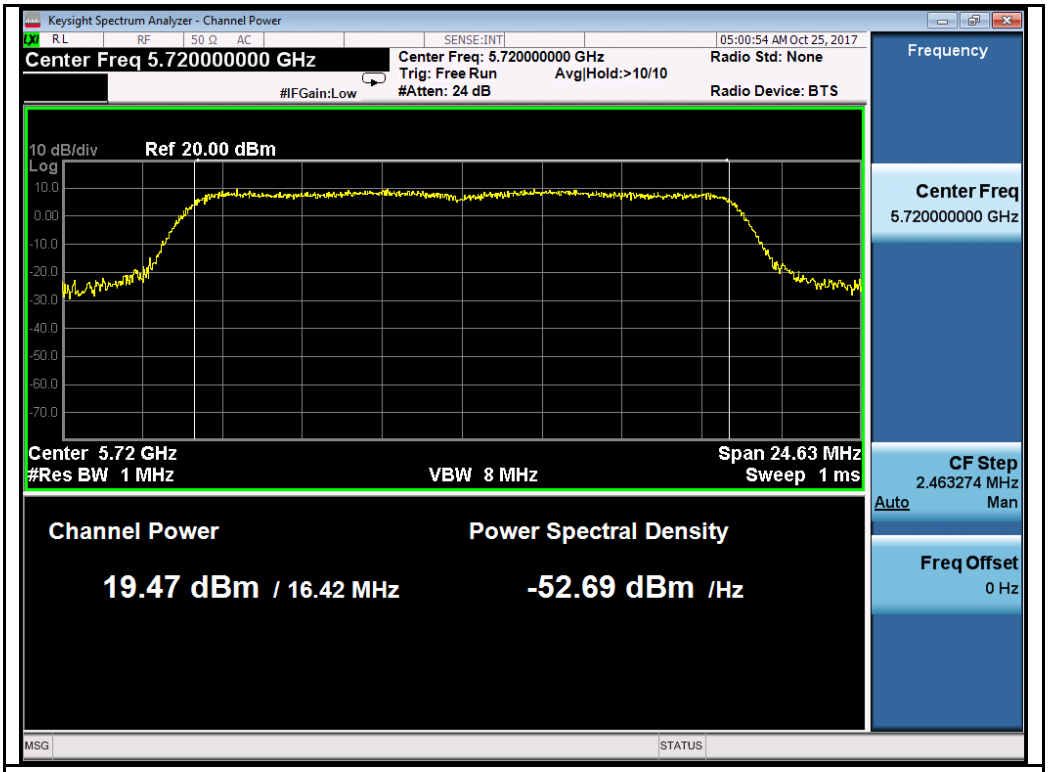



802.11n-HT40 5710M

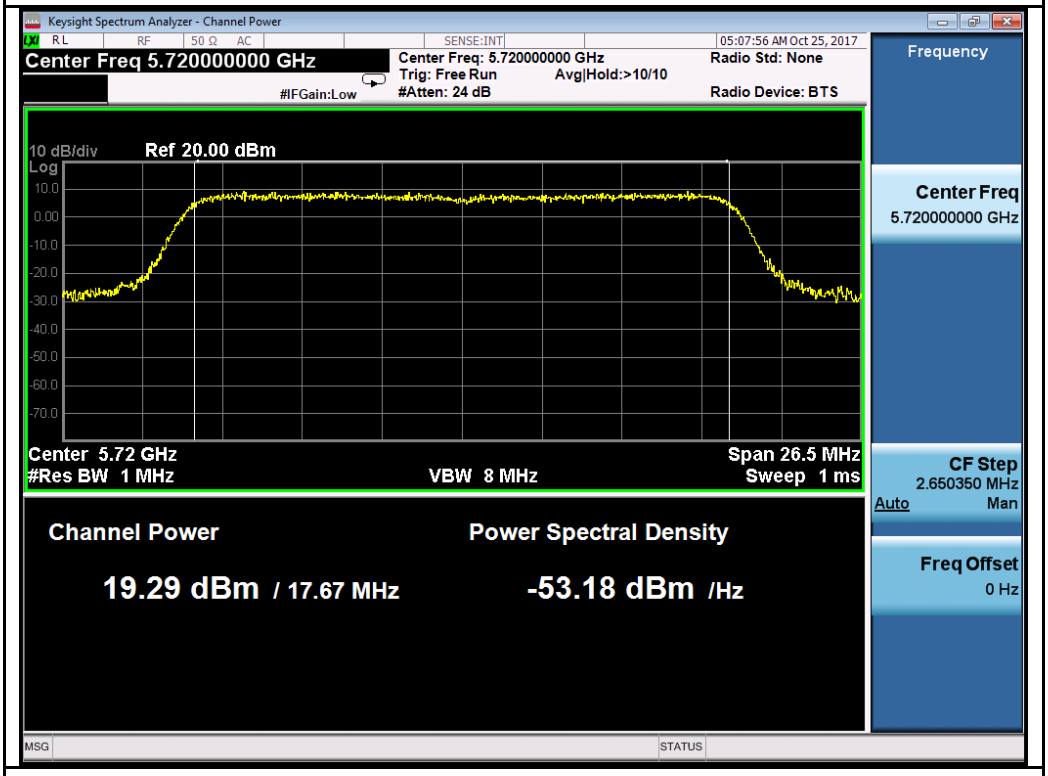



802.11ac-VHT80 5690M

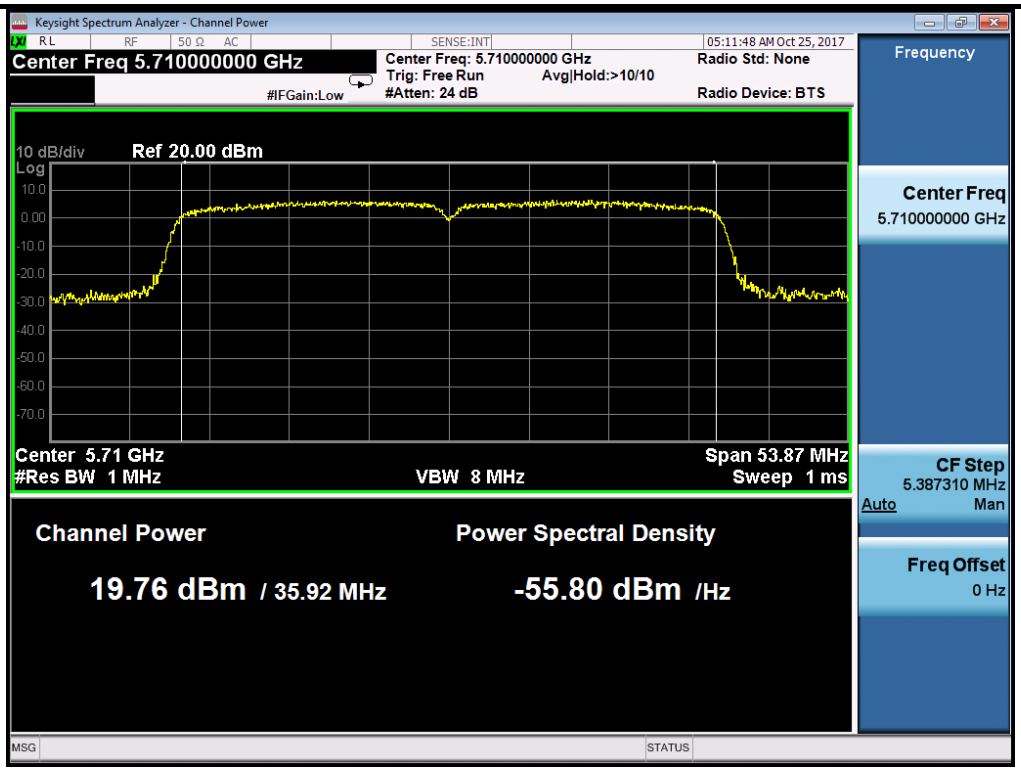
Chain 1:



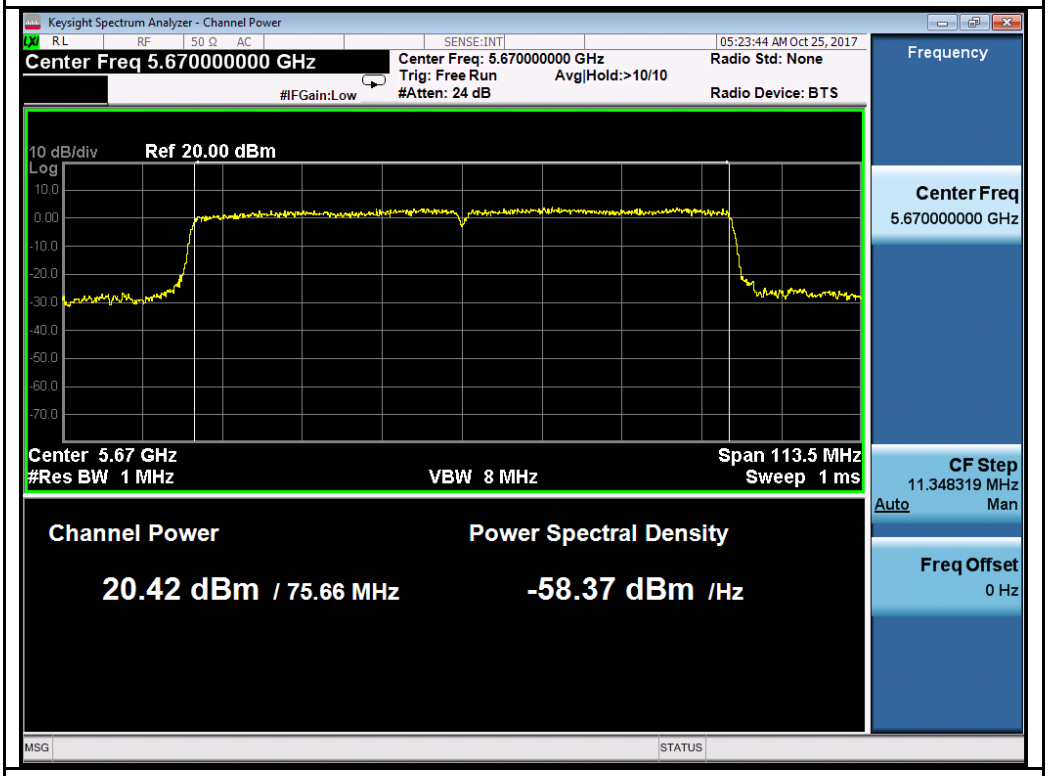

802.11a-5720M




802.11n-HT20 5720M




802.11n-HT40 5710M

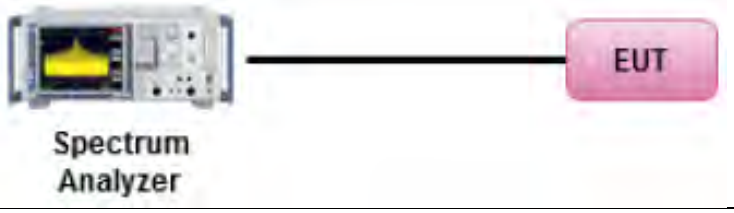



802.11ac-VHT80 5690M

## 10.4 Peak Power Spectral Density

Requirement(s):

| Spec | Item | Requirement | Applicable |
|---|---|---|---|
| § 15.407 | a)(1)(i) | For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. | ☐ |
| | a)(1)(ii) | For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. | ☐ |
| | a)(2) | For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. | ☒ |
| | a)(3) | For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. | ☒ |

| | | | |
|---|---|---|---|
| Test Setup |  | | |
| Test Procedure | 789033 D02 General UNII Test Procedures New Rules v01, II.F. Method SA-1<br><br>Maximum spectral density measurement procedure<br>- Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.<br>- Set RBW = 1 MHz<br>- Set VBW ⩾ 3 MHz<br>- Detector = RMS.<br>- Sweep time = auto couple.<br>- Trace mode = max hold.<br>- Trace average at least 100 traces in power averaging<br>- Use the peak marker function to determine the maximum amplitude level within the RBW. Apply correction to the result if different RBW is used. | | |
| Test Date | 10/24/2017 | Environmental condition | Temperature 22°C<br>Relative Humidity 46%<br>Atmospheric Pressure 1020mbar |
| Remark | N/A | | |
| Result | ☒ Pass ☐ Fail | | |

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at RF test site.

PSD measurement result for 5.3GHz

| Type | Test mode | Freq (MHz) | CH | Conducted PSD (dBm/MHz) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| PSD | 802.11a | 5260 | Low | 7.613 | 7.541 | 10.587 | 11 | Pass |
| | 802.11a | 5280 | Mid | 7.960 | 7.850 | 10.916 | 11 | Pass |
| | 802.11a | 5320 | High | 7.892 | 7.906 | 10.909 | 11 | Pass |
| | 802.11n-20M | 5260 | Low | 7.668 | 7.678 | 10.683 | 11 | Pass |
| | 802.11n-20M | 5280 | Mid | 7.596 | 7.675 | 10.646 | 11 | Pass |
| | 802.11n-20M | 5320 | High | 7.892 | 7.808 | 10.861 | 11 | Pass |
| | 802.11n-40M | 5270 | Low | 5.408 | 5.384 | 8.406 | 11 | Pass |
| | 802.11n-40M | 5310 | Mid | 3.843 | 3.809 | 6.836 | 11 | Pass |
| | 802.11ac-80M | 5290 | High | -0.087 | -0.081 | 2.926 | 11 | Pass |

PSD measurement result for 5.5GHz

| Type | Test mode | Freq (MHz) | CH | Conducted PSD (dBm/MHz) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| PSD | 802.11a | 5500 | Low | 7.340 | 7.307 | 10.334 | 11 | Pass |
| | 802.11a | 5580 | Mid | 7.784 | 7.837 | 10.821 | 11 | Pass |
| | 802.11a | 5700 | High | 7.944 | 7.914 | 10.939 | 11 | Pass |
| | 802.11n-20M | 5500 | Low | 7.236 | 7.229 | 10.243 | 11 | Pass |
| | 802.11n-20M | 5580 | Mid | 7.598 | 7.648 | 10.633 | 11 | Pass |
| | 802.11n-20M | 5700 | High | 7.313 | 7.423 | 10.379 | 11 | Pass |
| | 802.11n-40M | 5510 | Low | 5.433 | 5.676 | 8.566 | 11 | Pass |
| | 802.11n-40M | 5550 | Mid | 5.856 | 5.665 | 8.772 | 11 | Pass |
| | 802.11n-40M | 5670 | High | 5.565 | 5.189 | 8.391 | 11 | Pass |
| | 802.11ac-80M | 5530 | Low | 0.385 | 0.684 | 3.547 | 11 | Pass |
| | 802.11ac-80M | 5610 | High | 0.855 | 1.123 | 4.001 | 11 | Pass |

Note: Two chains are cross-polarized, additional gain is 10 log10(NANT)=0dB, max directional gain of the EUT is 3.5dBi. No limit adjustment is needed. All the mode transmission is MIMO.

PSD measurement result for cross channels (in band 5470-5725MHz)

| Type | Test mode | Freq (MHz) | CH | Conducted PSD (dBm/MHz) | | | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | Chain0 | Chain1 | Combined Power | | |
| PSD | 802.11a | 5720 | CROSS | 7.76 | 7.47 | 10.63 | 11 | Pass |
| | 802.11n-20M | 5720 | CROSS | 6.59 | 6.62 | 9.62 | 11 | Pass |
| | 802.11n-40M | 5710 | CROSS | 4.80 | 4.64 | 7.73 | 11 | Pass |
| | 802.11ac-80M | 5690 | CROSS | 1.64 | 1.65 | 4.66 | 11 | Pass |

PSD measurement result for cross channels (in band 5725-5850MHz)

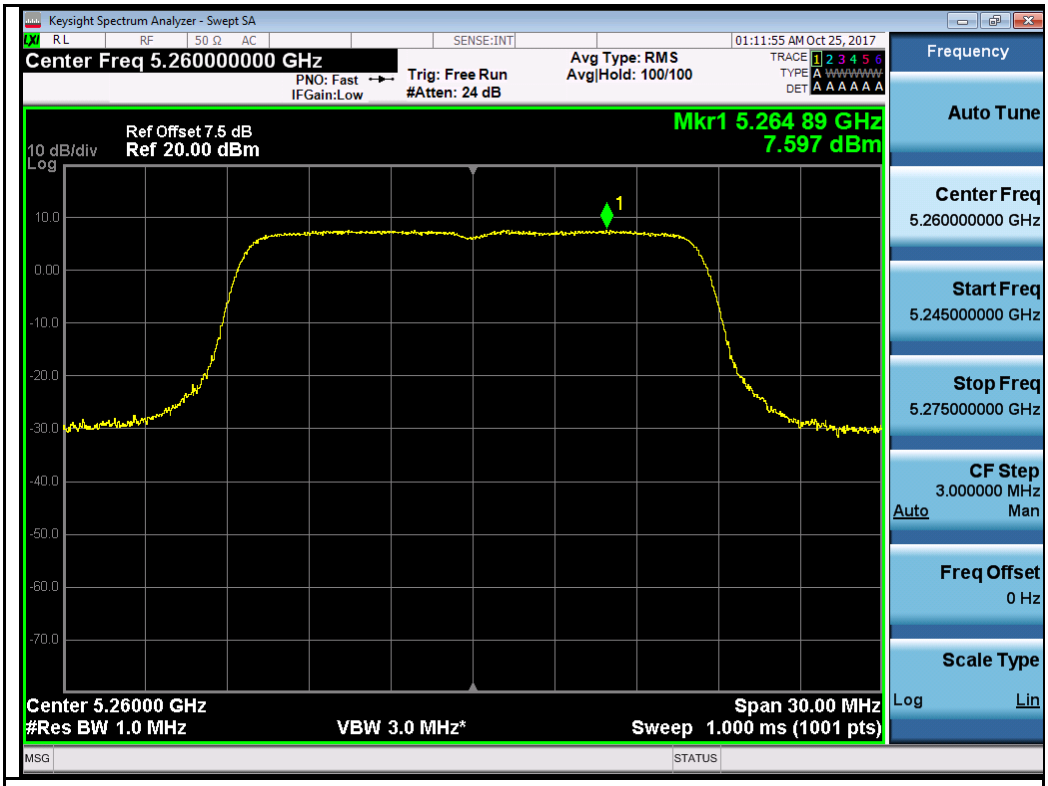
| Test mode | Freq (MHz) | CH | Conducted PSD (dBm/MHz) | | | Corrected Level (dBm/500kHz) | Limit (dBm/500kkHz) | Result |
|---|---|---|---|---|---|---|---|---|
| | | | Chain0 | Chain1 | Combined PSD | | | |
| 802.11a | 5720 | CROSS | -0.36 | -0.67 | 2.50 | 9.49 | 30 | Pass |
| 802.11n-20M | 5720 | CROSS | -0.41 | -0.80 | 2.41 | 9.40 | 30 | Pass |
| 802.11n-40M | 5710 | CROSS | -3.25 | -3.47 | -0.35 | 6.64 | 30 | Pass |
| 802.11ac-80M | 5690 | CROSS | -6.49 | -6.52 | -3.49 | 3.50 | 30 | Pass |

Correction factor=10*log(500/100)=6.99

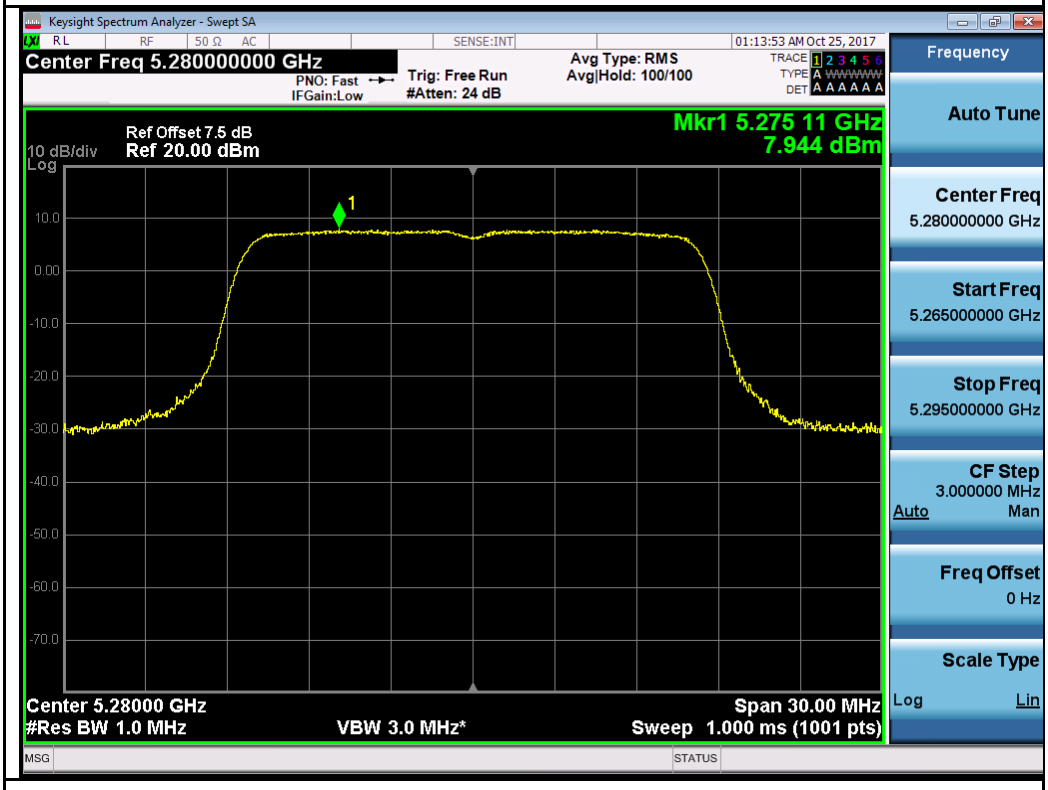
Note: Two chains are cross-polarized, additional gain is 10 log10(NANT)=0dB, max directional gain of the EUT is 3.5dBi. No limit adjustment is needed. All the mode transmission is MIMO.

Test Plot for W53:

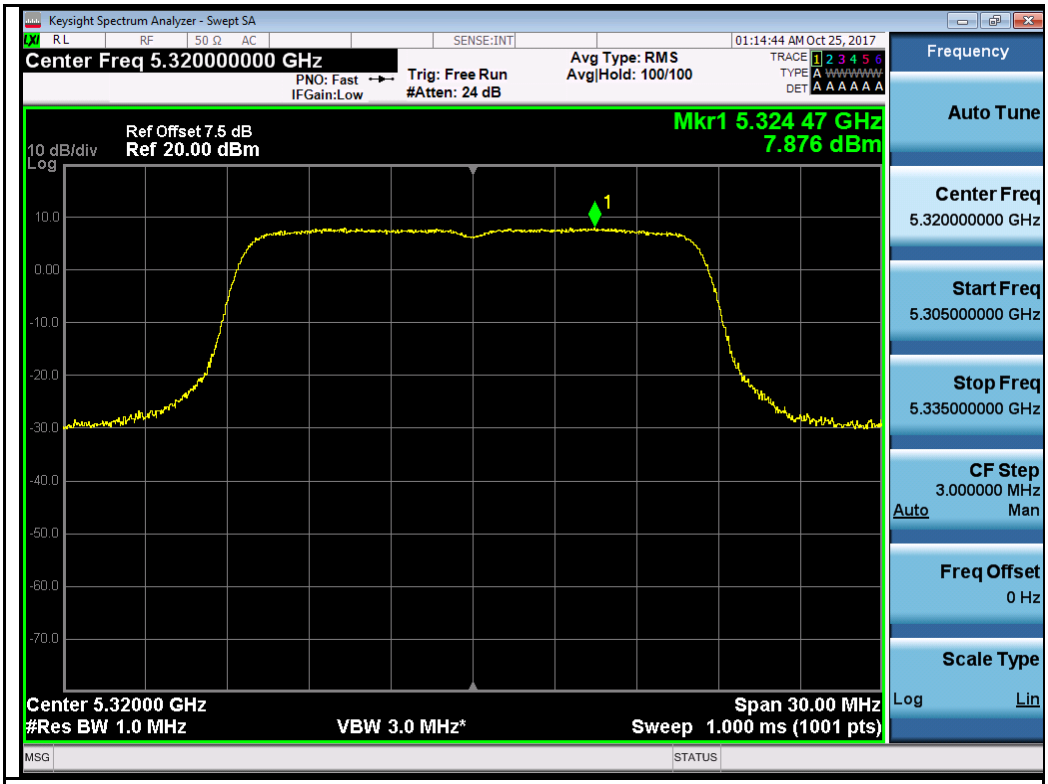
Chain 0:



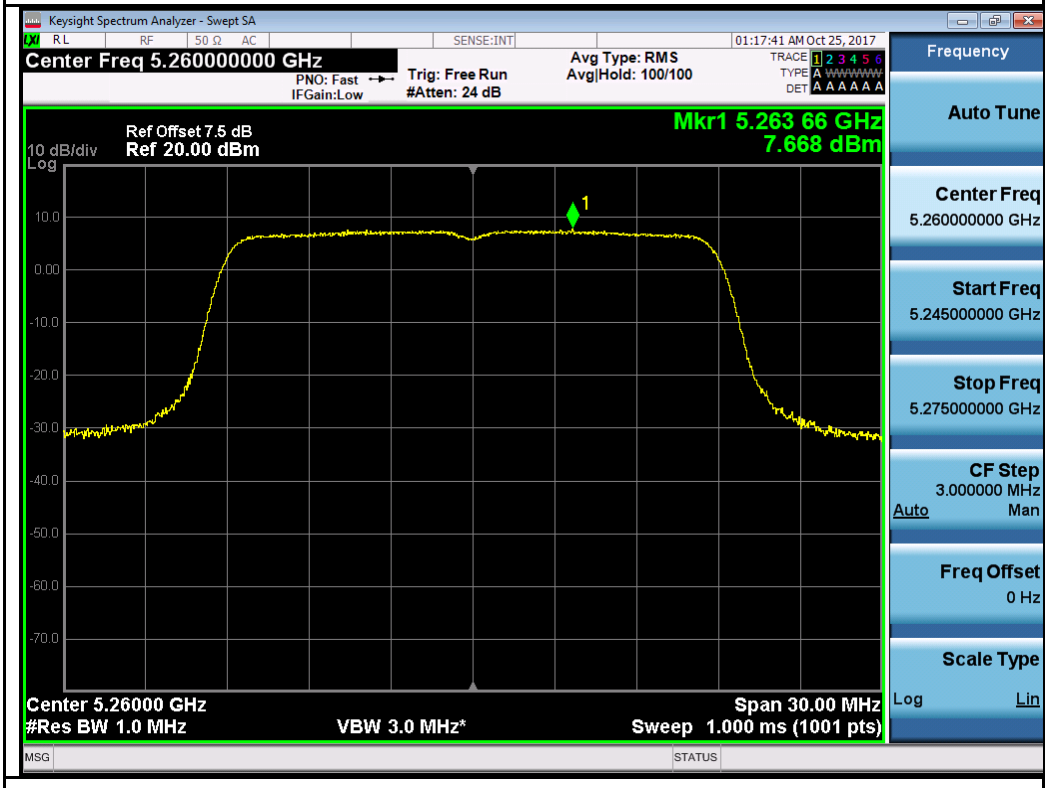

802.11a-5260M




802.11a-5280M

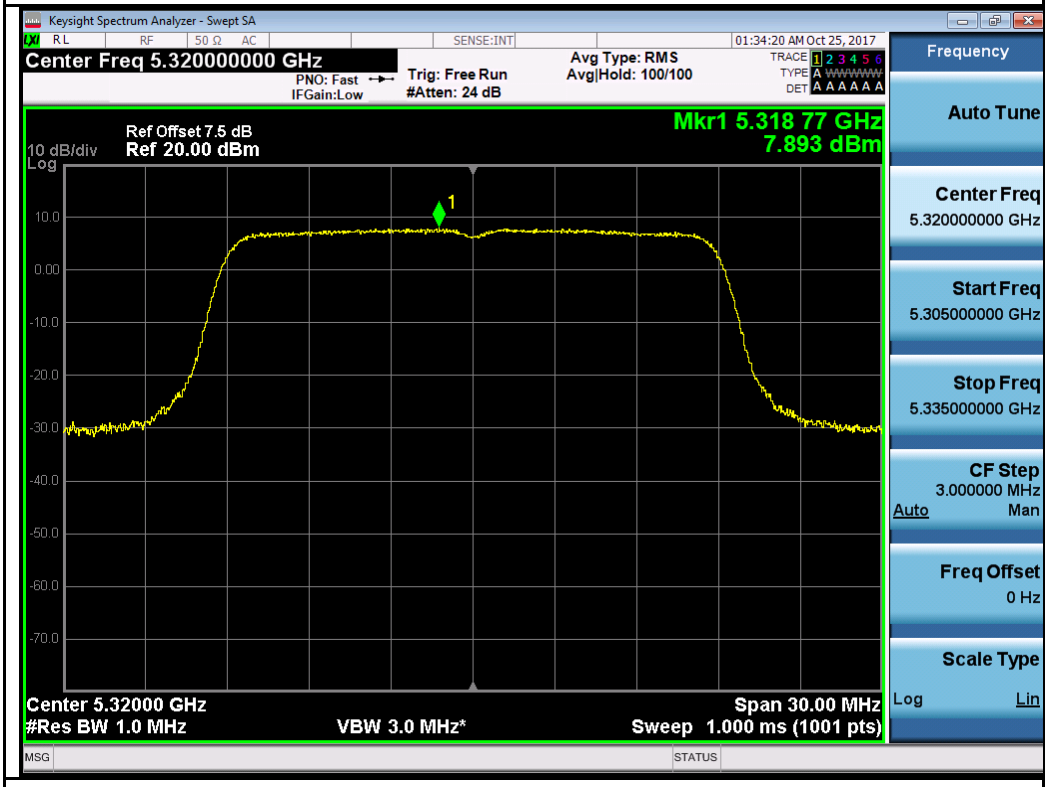



802.11a-5320M




802.11n-HT20 5260M


802.11n-HT20 5280M



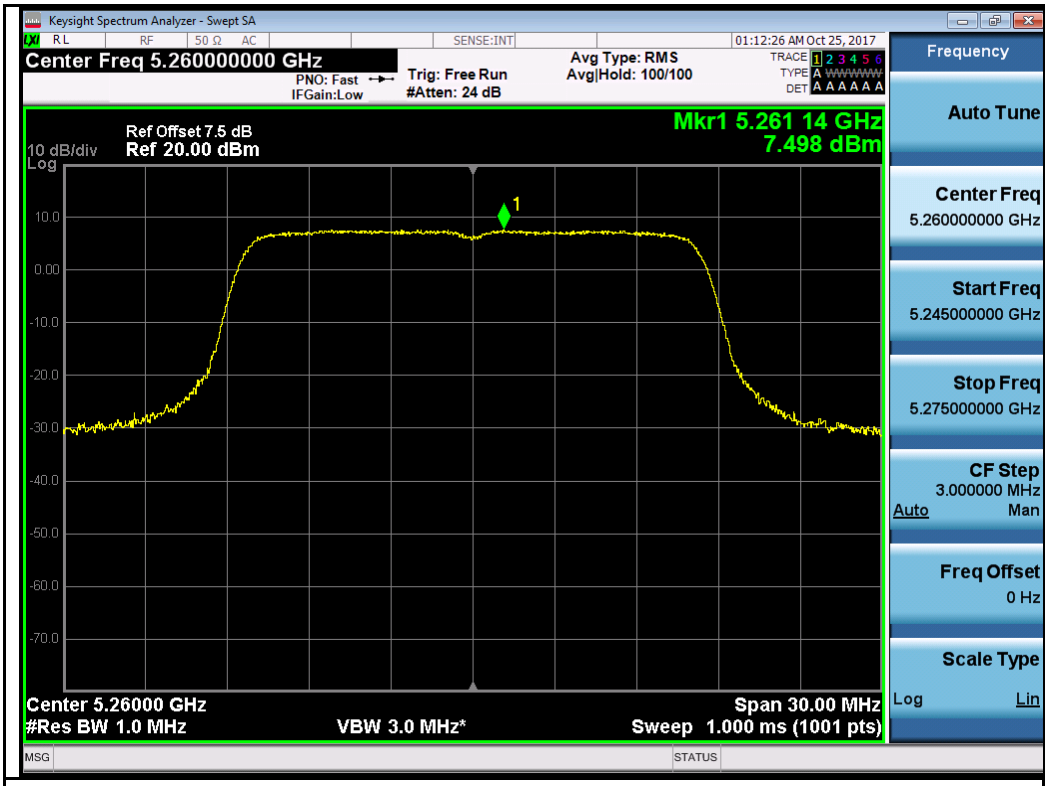

802.11n-HT20 5320M


802.11n-HT40 5270M

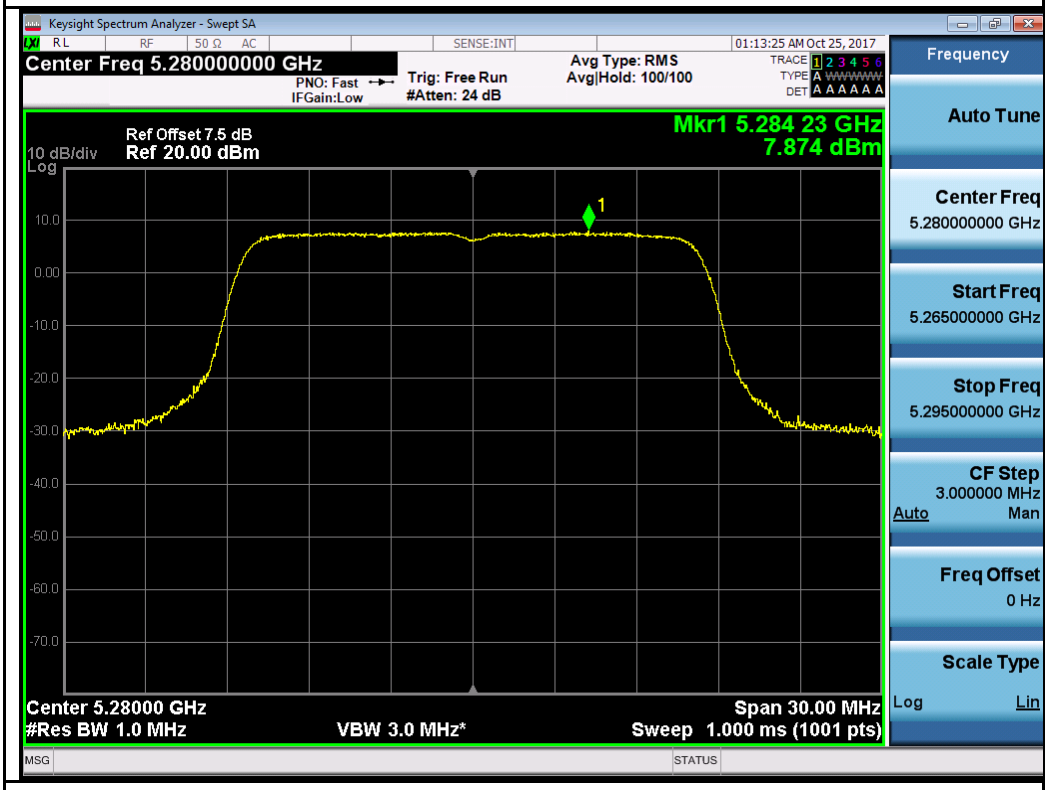

802.11n-HT40 5310M


802.11ac-VHT80 5290M

Chain 1:

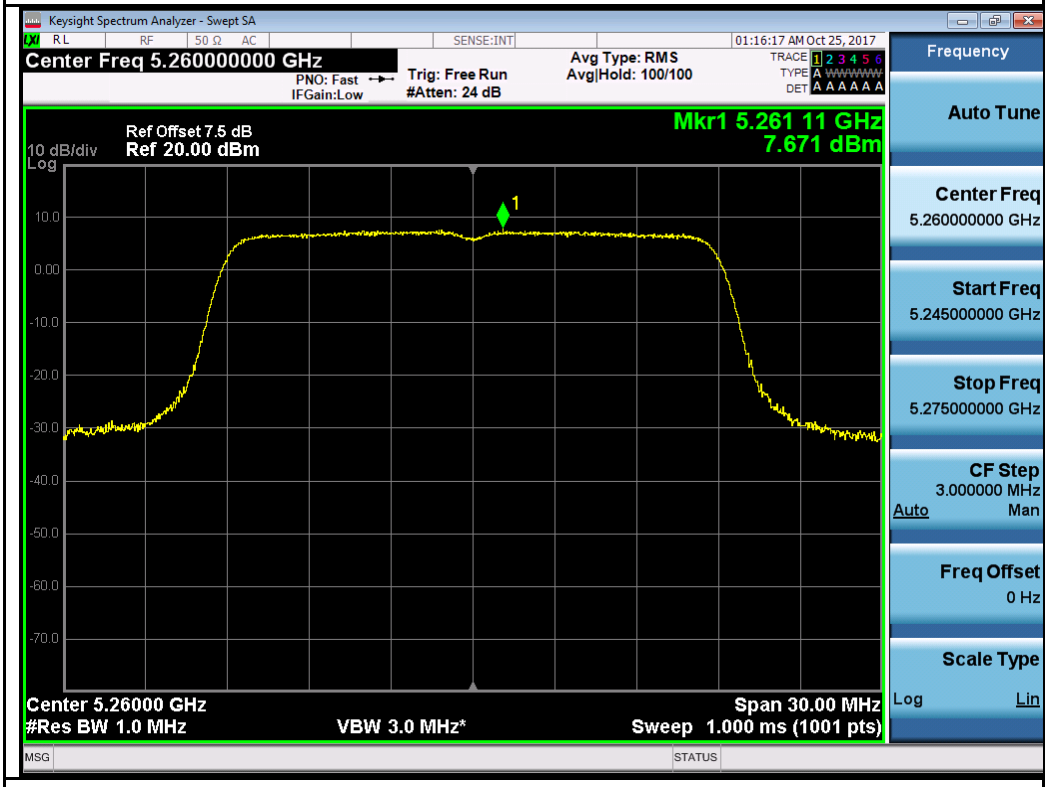



802.11a-5260M



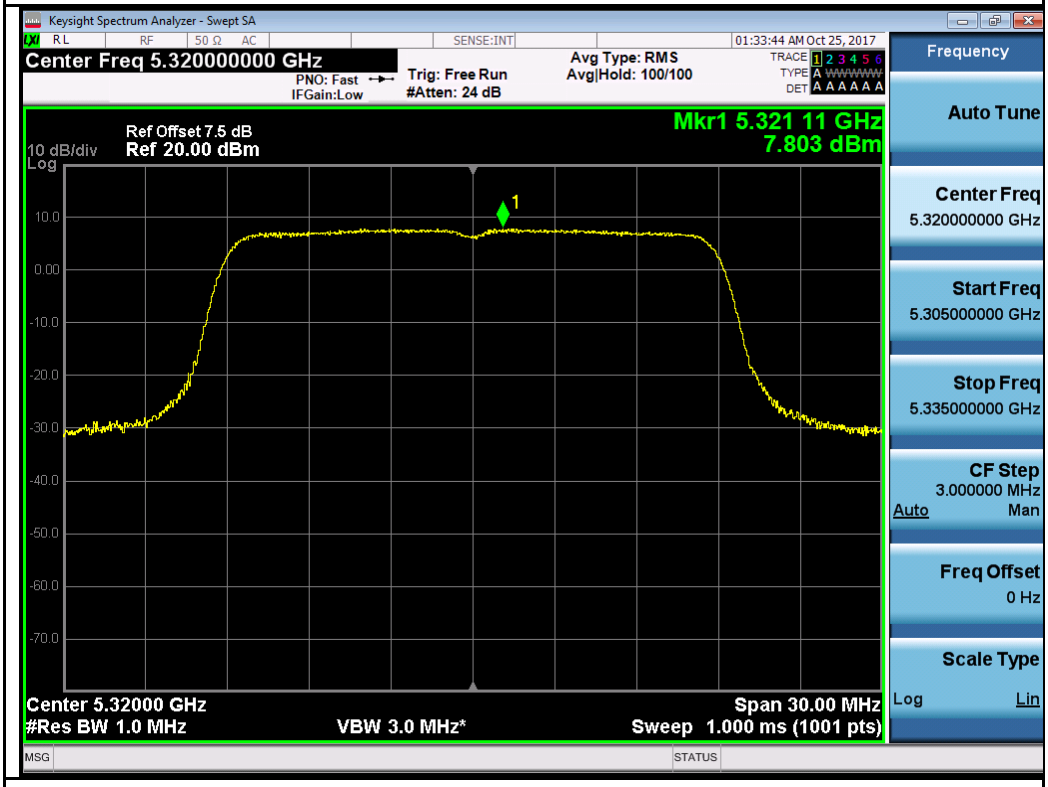

802.11a-5280M


802.11a-5320M




802.11n-HT20 5260M


802.11n-HT20 5280M




802.11n-HT20 5320M

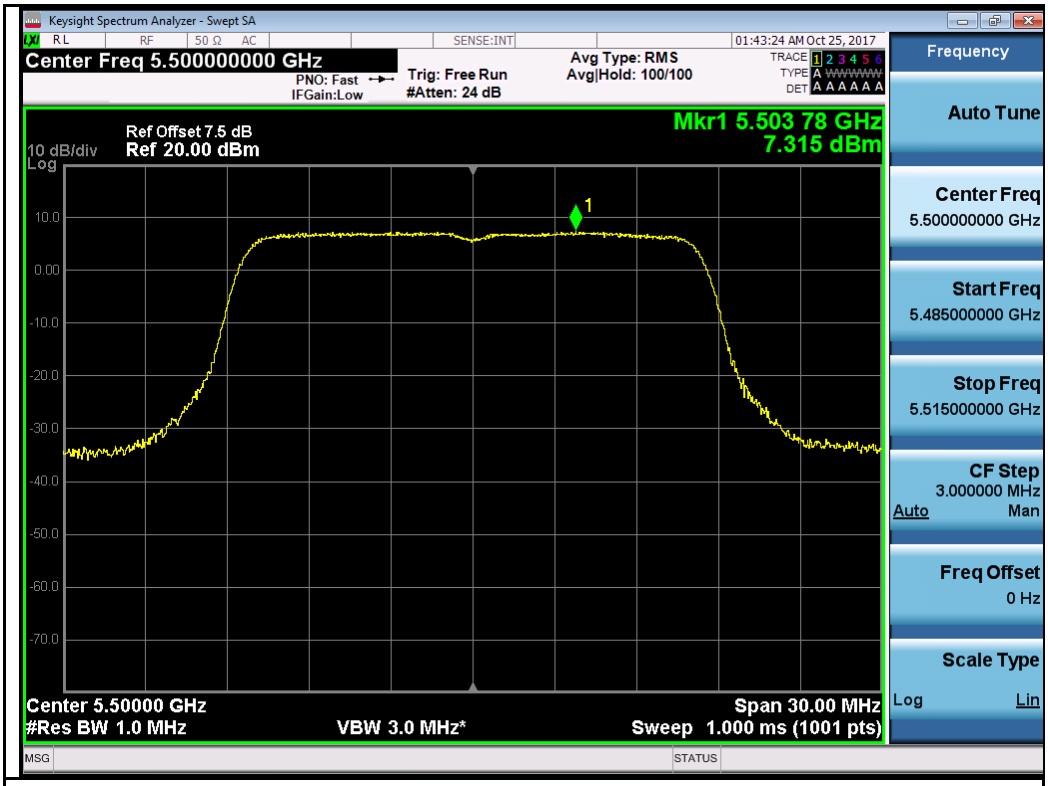

802.11n-HT40 5270M


802.11n-HT40 5310M

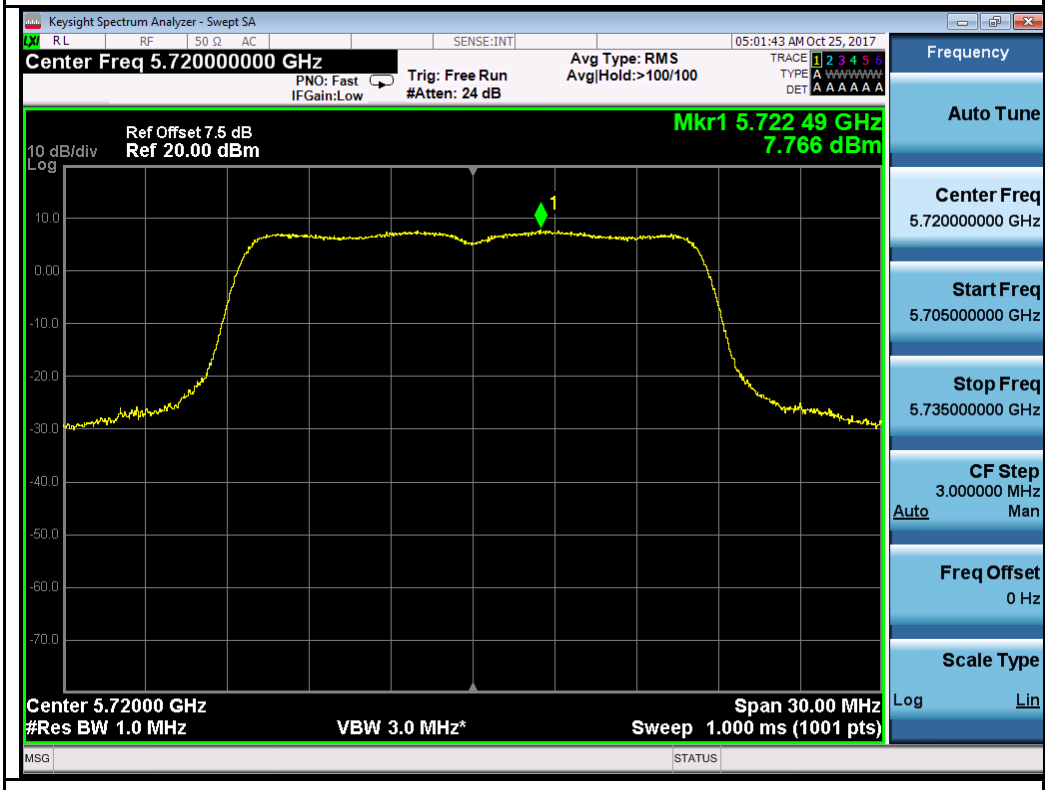

802.11ac-VHT80 5290M

Test Plot for W56:

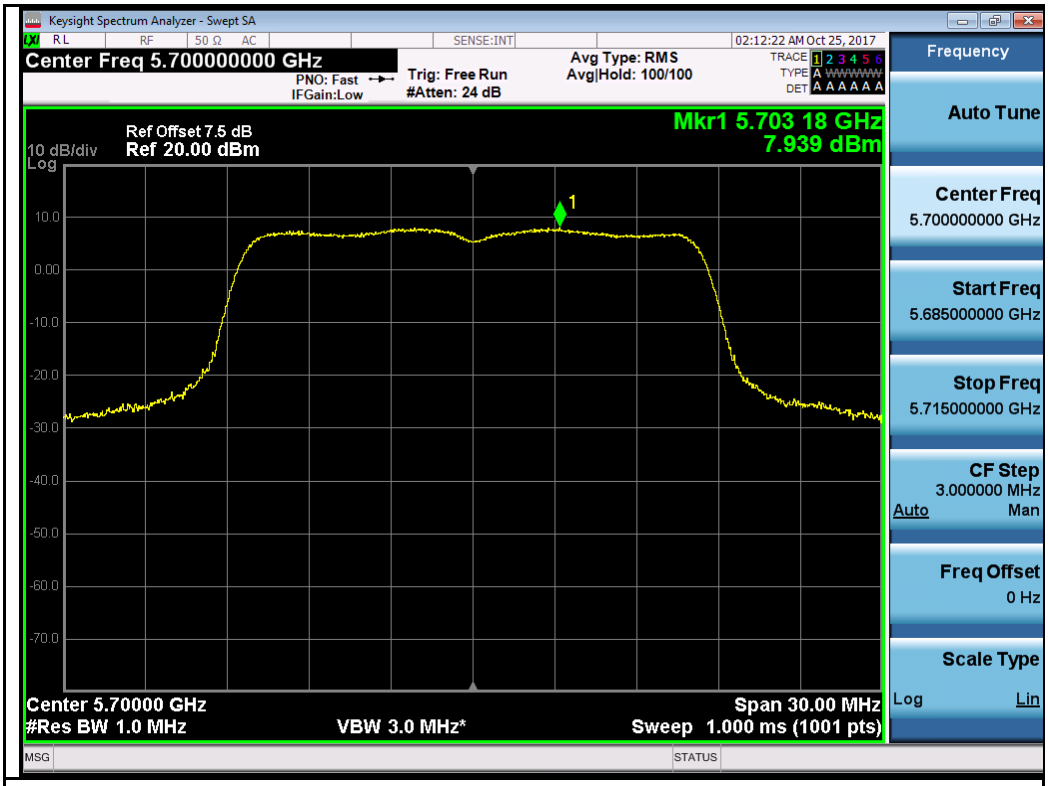
Chain 0:



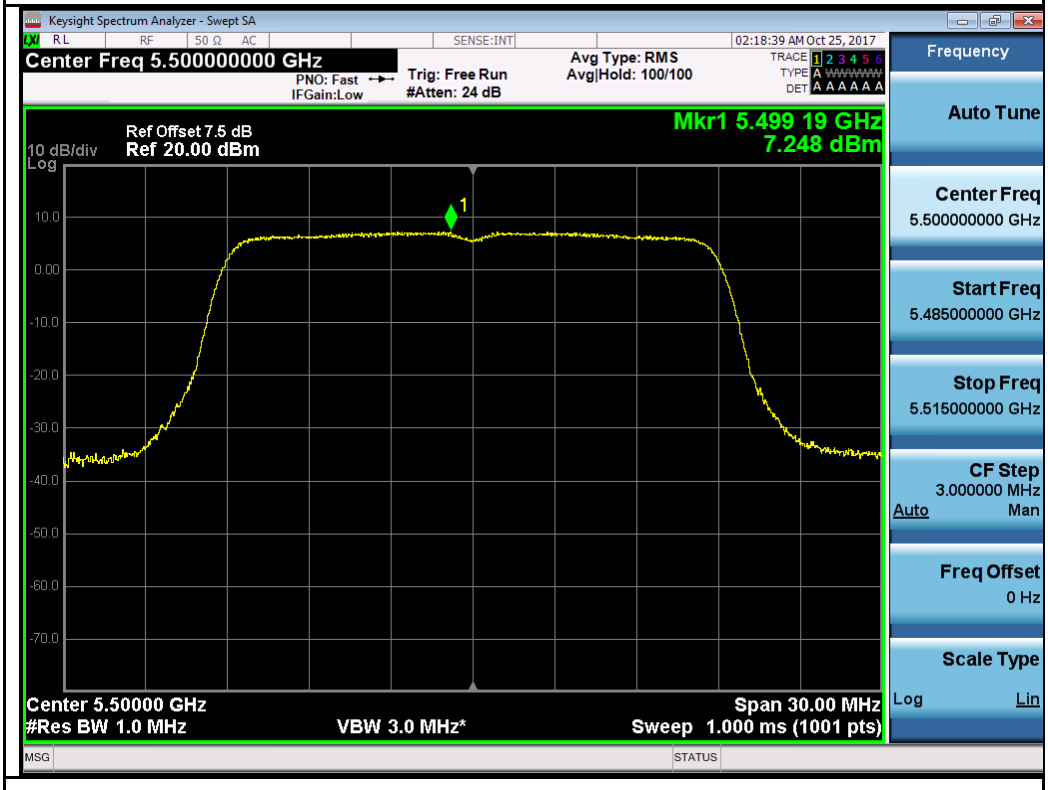

802.11a-5500M




802.11a-5580M




802.11a-5700M




802.11n-HT20 5500M