# Test Report
# Model: C9120AXI-T
# Cisco Catalyst 9120AX Series

FCC ID: LDKVCVER1937

## 5470-5725 MHz

**Against the following Specifications:**

**CFR47 Part 15.407**

**LP0002 (2018-01-10)**

ACCREDITED

**Cisco Systems**
170 West Tasman Drive
San Jose, CA 95134

| | |
|---|---|
| | |
| **Author:** Johanna Knudsen<br>**Tested By:** Johanna Knudsen | **Approved By:** Gerard Thorpe<br>**Title:** Manager<br>**Revision:** Controlled by Doc Central |

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## Section 1: Overview

**The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:**

| **Specifications:** |
| --- |
| CFR47 Part 15.407<br>LP0002 (2018-01-10) |



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## Section2: Assessment Information

### 2.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

| | |
|---|---|
| Temperature | 15°C to 35°C (54°F to 95°F) |
| Atmospheric Pressure | 860mbar to 1060mbar (25.4" to 31.3") |
| Humidity | 10% to 75*% |

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)

### Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m



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Measurement Uncertainty Values

| | |
|---|---|
| voltage and power measurements | ± 2 dB |
| conducted EIRP measurements | ± 1.4 dB |
| radiated measurements | ± 3.2 dB |
| frequency measurements | ± 2.4 10-7 |
| temperature measurements | ± 0.54º |
| humidity measurements | ± 2.3% |
| DC and low frequency measurements | ± 2.5% |

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Radiated emissions (expanded uncertainty, confidence interval 95%)

| | |
|---|---|
| 30 MHz - 300 MHz | +/- 3.8 dB |
| 300 MHz - 1000 MHz | +/- 4.3 dB |
| 1 GHz - 10 GHz | +/- 4.0 dB |
| 10 GHz - 18GHz | +/- 8.2 dB |
| 18GHz - 26.5GHz | +/- 4.1 dB |
| 26.5GHz - 40GHz | +/- 3.9 dB |

Conducted emissions (expanded uncertainty, confidence interval 95%)

| | |
|---|---|
| 30 MHz – 40GHz | +/- 0.38 dB |

A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

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**2.2 Date of testing**

03-May-19 - 10-May-19

**2.3 Report Issue Date**

23-May-19

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**2.4 Testing facilities**

This assessment was performed by:

**Testing Laboratory**

Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134 USA
NCC (National Communications Commission) APEC Tel MRA -Phase I

**Headquarters**

Cisco Systems, Inc.,
170 West Tasman Drive
San Jose, CA 95134,
USA

**Registration Numbers for Industry Canada**

| Cisco System Site | Address | Site Identifier |
|---|---|---|
| Building P, 10m Chamber | 125 West Tasman Dr<br>San Jose, CA 95134 | Company #: 2461N-2 |
| Building P, 5m Chamber | 125 West Tasman Dr<br>San Jose, CA 95134 | Company #: 2461N-1 |
| Building I, 5m Chamber | 285 W. Tasman Drive<br>San Jose, California 95134 | Company #: 2461M-1 |
| Building 7, 5m Chamber | 425 E. Tasman Drive<br>San Jose, California 95134 | Company #: 2461N-3 |

**Test Engineers**

Johanna Knudsen

**2.5 Equipment Assessed (EUT)**

C9120AXI-T



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**2.6 EUT Description**

The radio supports the following modes of operation. The modes are further defined in the radio Theory of Operation. The modes included in this report represent the worst case data for all modes.

802.11a - Non HT20, One Antenna, 6 to 54 Mbps, 1ss

The following antennas are supported by this product series.
The data included in this report represent the worst case data for all antennas.

| Frequency | Part Number | Antenna Type | Antenna Gain (dBi) |
|---|---|---|---|
| **5GHz** | - | Internal, Dual-band Omni-directional | 6 |



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## Section 3: Result Summary

### 3.1 Results Summary Table

**Conducted emissions**

Worst-case results from the tables are in **bold,** and are represented in plots that follow the tables.

| Basic Standard | Technical Requirements / Details | Result |
|---|---|---|
| FCC 15.407<br><br>LP0002<br>(2018-01-10)<br>(4.7.2.3) | **99% & 26 dB Bandwidth:**<br>The 99% 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. There is no limit for 99% OBW.<br><br>The 26 dB emission is the 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 26 dB relative to the maximum level measured in the fundamental emission. | Pass |
| FCC 15.407<br><br>LP0002<br>(2018-01-10)<br>(4.7.3.2) (1) | **Output Power:**<br>**15.407** (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. | Pass |
| FCC 15.407<br><br>LP0002<br>(2018-01-10)<br>(4.7.3.2) (2) | **Power Spectral Density:**<br>**15.407** (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. 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. | Pass |
| FCC 15.407<br><br>LP0002<br>(2018-01-10)<br>(4.7.4.1) | **Conducted Spurious Emissions / Band-Edge:**<br>**15.407** (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz. | Pass |
| FCC 15.407<br>FCC 15.209<br>FCC 15.205<br><br>LP0002<br>(2018-01-10)<br>(4.8.1.4) | **Restricted band:**<br>Unwanted emissions falling within the restricted bands, as defined in FCC 15.205 (a) must also comply with the radiated emission limits specified in FCC 15.209 (a). | Pass |

**Radiated Emissions (General requirements)**

| Basic Standard | Technical Requirements / Details | Result |
|---|---|---|
| FCC 15.209<br>FCC 15.205<br><br>LP0002<br>(2018-01-10)<br>(2.8) | **TX Spurious Emissions:**<br>Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the filed strength limits table in this section. | Not covered by this test report |



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| | | |
|---|---|---|
| FCC 15.207<br><br>LP0002<br>(2018-01-10)<br>(2.3) | **AC conducted Emissions:**<br>Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table in these sections. The more stringent limit applies at the frequency range boundaries. | Not covered by this test report |



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## Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing.

### 4.1 Sample Details

| Sample No. | Equipment Details | Manufacturer | Hardware Rev. | Firmware Rev. | Software Rev. | Serial Number |
|---|---|---|---|---|---|---|
| S01 | C9120AXI-T | Cisco | P3C | NA | NA | FOC23070L39 |

### 4.2 System Details

| System # | Description | Samples |
|---|---|---|
| 1 | EUT for RF conducted measurements | S01 |

### 4.3 Mode of Operation Details

| Mode# | Description | Comments |
|---|---|---|
| 1 | Continuous Transmitting, RF conducted measurements | Continuously transmitting, constant high duty cycle. |



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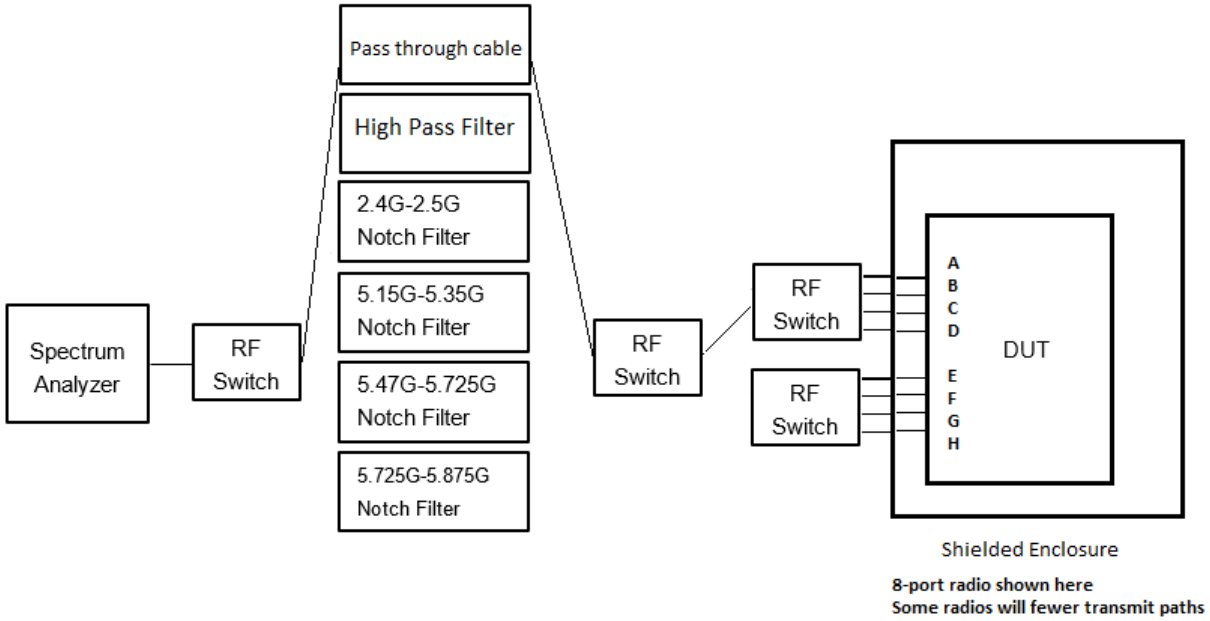
**Appendix A: Emission Test Results**

## Conducted Test Setup Diagram




## Target Maximum Channel Power

The following table details the maximum supported Total Channel Power for all operating modes.

| | Maximum Channel Power (dBm) | | |
|---|---|---|---|
| | Frequency (MHz) | | |
| **Operating Mode** | **5500** | **5560** | **5720** |
| **Non HT20, 6 to 54 Mbps** | **16** | **20** | **20** |



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# A.1 Duty Cycle

## Duty Cycle Test Requirement

**From KDB 789033 D02 General UNII Test Procedures New Rules v02r01**

**B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level**

1. All measurements are to be performed with the EUT transmitting at 100 percent duty cycle at its maximum power control level; however, if 100 percent duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, *T*, are required for each tested mode of operation.

## Duty Cycle Test Method

**From KDB 789033 D02 General UNII Test Procedures New Rules v02r01:**

**B. Duty Cycle (x), Transmission Duration (T), and Maximum Power Control Level**

The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T, where T is defined in section II.B.1.a), and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

## Duty Cycle Test Information

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |

| Tested By : | Date of testing: |
|---|---|
| Johanna Knudsen | 03-May-19 to 10-May-19 |
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment

## Duty Cycle Data Table

Duty Cycle table and screen captures are shown below for power/psd modes.

| Mode | Data Rate | On-time (ms) | Total Time (ms) | Duty Cycle (%) | Correction Factor (dB) |
|---|---|---|---|---|---|
| NonHT20 | 6Mbps | 22 | 22 | 100% | 0 |



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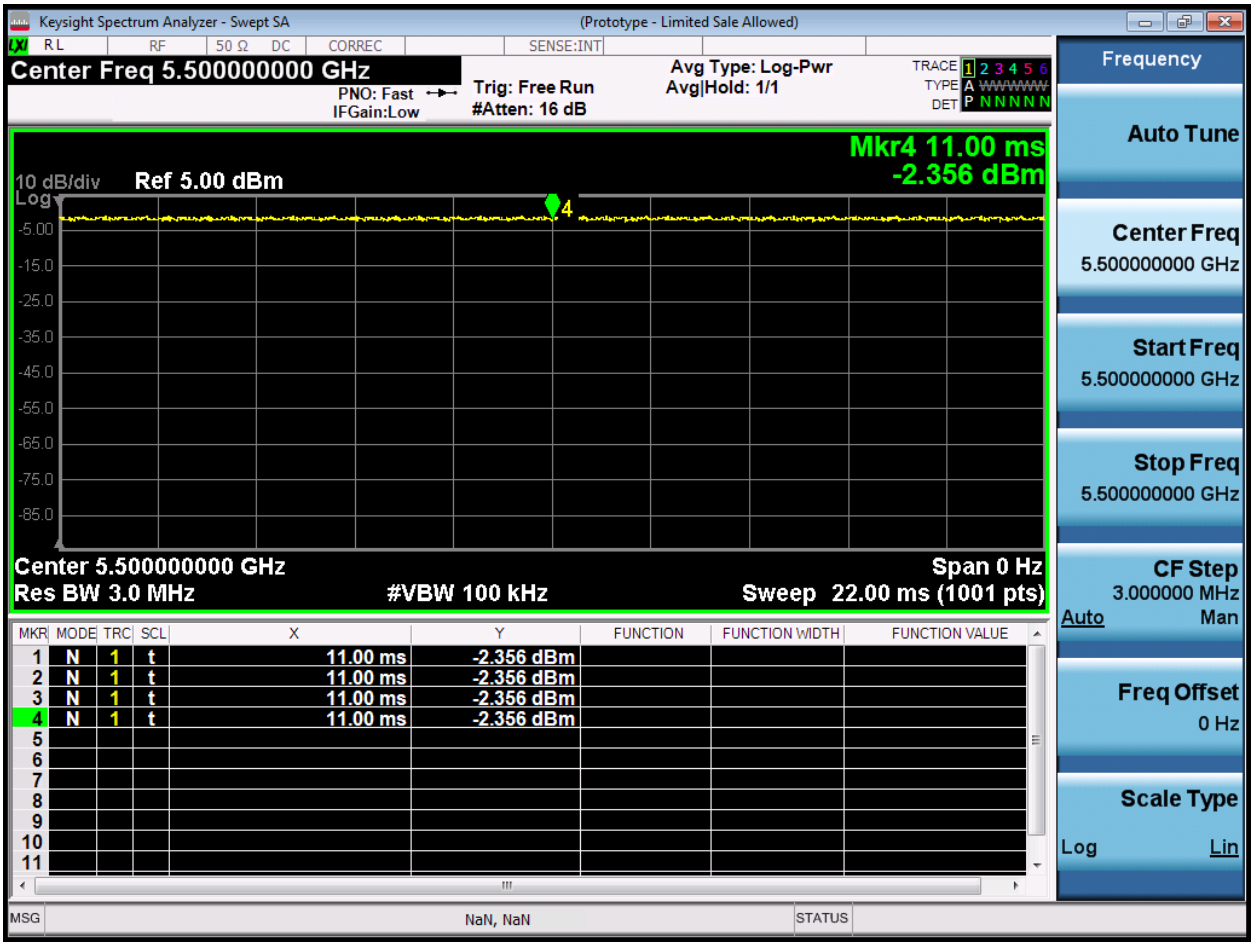
## Duty Cycle Data Screenshots



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# A.2 99% and 26dB Bandwidth

## 99% and 26dB Bandwidth Test Requirement

There is no requirement for the value of bandwidth. However, the 26dB BW (EBW) is used to calculate the power limits in 15.407 (a) (2). Power measurements are made using the 99% Bandwidth as the integration bandwidth.

**Band-crossing emissions:** For an emission that crosses the boundary between two adjacent U-NII bands, the boundary frequency between the bands serves as one edge for defining the portion of the EBW that falls within a particular U-NII band. However, the -26 dB points are measured relative to the highest point on the contiguous segment—regardless of which band contains that highest point (Figure4).

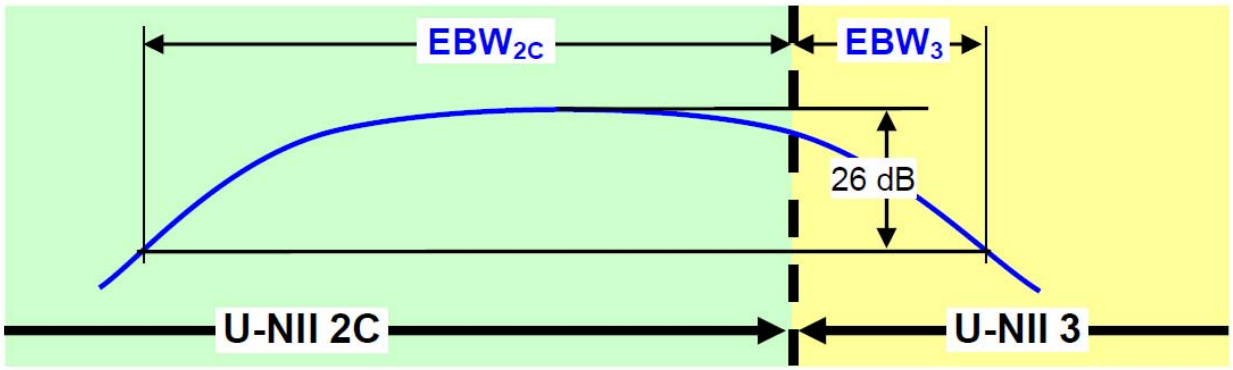


**Figure 3. Emission Bandwidth (EBW) within a Band for Band-Crossing Signals**

## 99% and 26dB Bandwidth Test Procedure

**Ref. KDB 789033 Section D. 99 Percent Occupied Bandwidth**
**ANSI C63.10: 2013 Section 6.9.3**
**KDB 662911**

| **99% BW**<br>Test Parameters |
|---|
| 1. Set center frequency to the nominal EUT channel center frequency.<br>2. Set span = 1.5 times to 5.0 times the OBW.<br>3. Set RBW = 1 % to 5 % of the OBW<br>4. Set VBW ≥ 3 · RBW<br>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.<br>6. Use the 99 % power bandwidth function of the instrument (if available). |

**Ref KDB 789033 in Section C. Measurement Bandwidth, Section 1**

| **26 BW**<br>Test parameters |
|---|
| X dB BW = -26dB (using the OBW function of the spectrum analyzer)<br><br>Emission Bandwidth (EBW)<br>a) Set RBW = approximately 1% of the emission bandwidth.<br>b) Set the VBW > RBW.<br>c) Detector = Peak.<br>d) Trace mode = max hold.<br>e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. |



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| |
|---|
| Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%. |

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |

| | |
|---|---|
| **Tested By :**<br>Johanna Knudsen | **Date of testing:**<br>03-May-19 to 10-May-19 |
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment



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| Frequency (MHz) | Mode | Data Rate (Mbps) | 26dB BW (MHz) | 99% BW (MHz) |
|---|---|---|---|---|
| 5500 | Non HT20, 6 to 54 Mbps | 6 | 21.3 | 16.581 |
| | | | | |
| 5560 | Non HT20, 6 to 54 Mbps | 6 | 35.8 | 18.675 |
| | | | | |
| **5720** | **Non HT20, 6 to 54 Mbps** | **6** | **19.9** | **13.885** |



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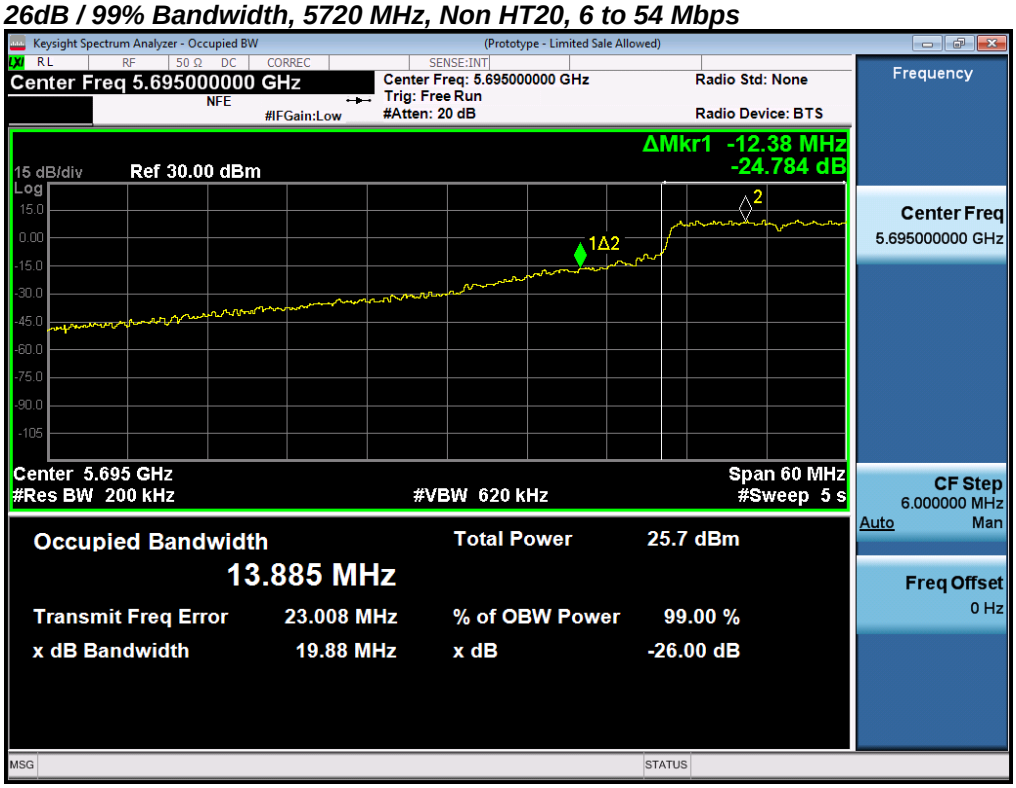
***26dB / 99% Bandwidth, 5720 MHz, Non HT20, 6 to 54 Mbps***



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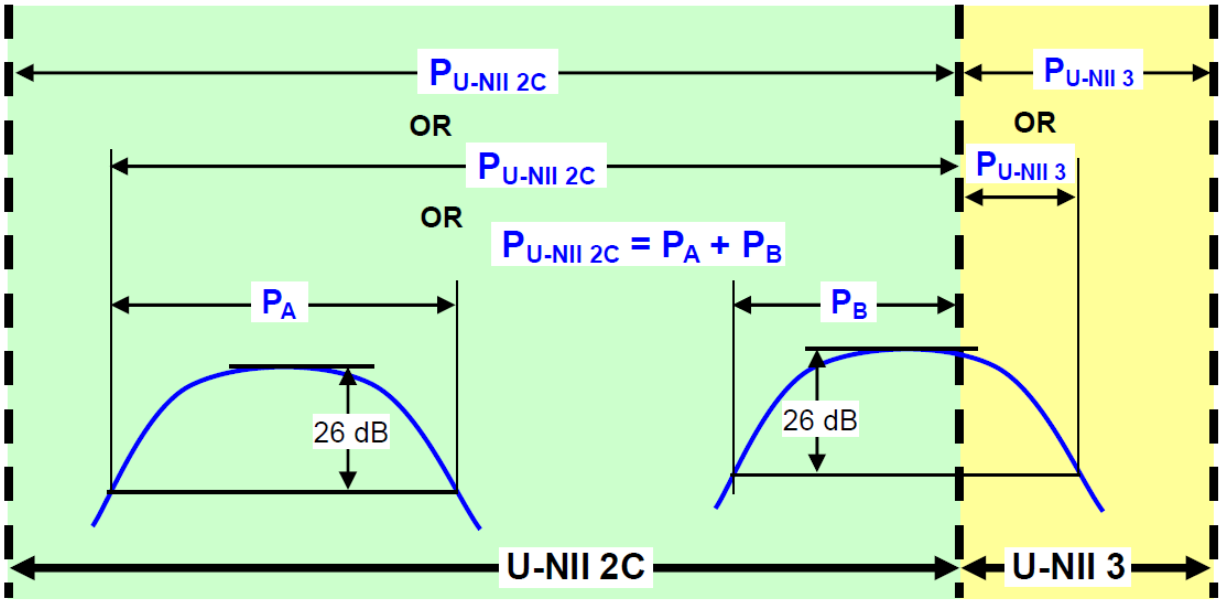
# A.3 Maximum Conducted Output Power

## Maximum Conducted Output Power Test Requirement

**15.407 (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. … 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.

**Band-Crossing Signals** When measuring the portion of the maximum conducted output power within a single U-NII band, the power shall be integrated across only the portion of the EBW that falls within that band. That is, if an EBW extends across the boundary between two adjacent bands, the boundary frequency between the bands serves as one edge of the frequency range to be integrated. Integration across an entire U-NII band without regard to 26 dB points is also acceptable for determining conducted output power within that band.




**Conducted output power within a U-NII band**: Integrate over the band or integrate over a span including the 26 dB EBWs of transmission segments within the band or integrate over 26 dB EBW of each transmission segment in the band and sum.

**Figure 4. Conducted Output Power Measurement Examples**

## Maximum Conducted Output Power Test Procedure

**Ref. KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**ANSI C63.10: 2013**

| **Maximum Conducted Output Power**<br>Test Procedure |
|---|
| 1. Set the radio in the continuous transmitting mode at full power<br>2. Compute power by integrating the spectrum across the EBW (or alternatively entire 99% OBW) of the signal using the instrument's band power measurement function. The integration shall be performed using the spectrum analyzer band-power measurement function with band limits set equal to the EBW or the OBW band edges. |



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| |
|---|
| 3. Capture graphs and record pertinent measurement data. |

**Ref. KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**2. Measurement using a Spectrum Analyzer or EMI Receiver (SA), (d) Method SA-2**

| **Maximum Conducted Output Power**<br>Test parameters |
|---|
| Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).<br>(i) Measure the duty cycle, x, of the transmitter output signal as described in section II.B.<br>(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.<br>(iii) Set RBW = 1 MHz.<br>(iv) Set VBW ≥ 3 MHz.<br>(v) 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>(vi) Sweep time = auto.<br>(vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.<br>(viii) Do not use sweep triggering. Allow the sweep to "free run".<br>(ix) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.<br>(x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) |

The "measure-and-sum technique" is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. ANSI C63.10 section 14.3.2.2

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |

| **Tested By :**<br>Johanna Knudsen | **Date of testing:**<br>03-May-19 to 10-May-19 |
|---|---|
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment



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**Maximum Output Power**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Max Power (dBm) | Total Tx Channel Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5500 | Non HT20, 6 to 54 Mbps | 1 | 5 | 15.6 | 15.6 | 24.0 | 8.4 |
| | | | | | | | |
| **5560** | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **20.6** | **20.6** | **24.0** | **3.4** |
| | | | | | | | |
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 5 | 19.8 | 19.8 | 23.0 | 3.2 |



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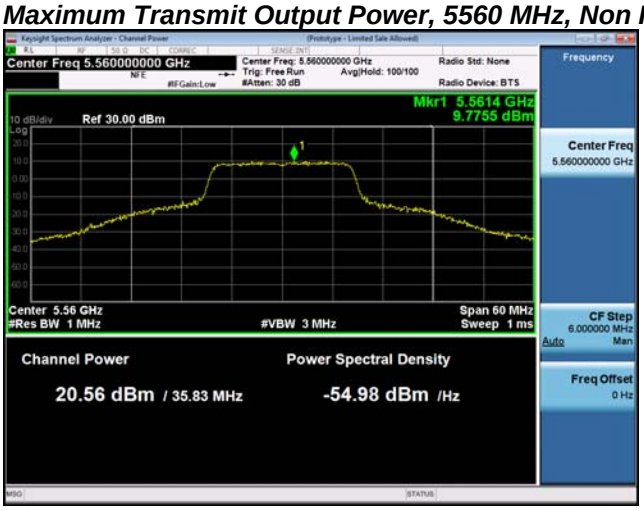
***Maximum Transmit Output Power, 5560 MHz, Non HT20, 6 to 54 Mbps***




***Antenna A***



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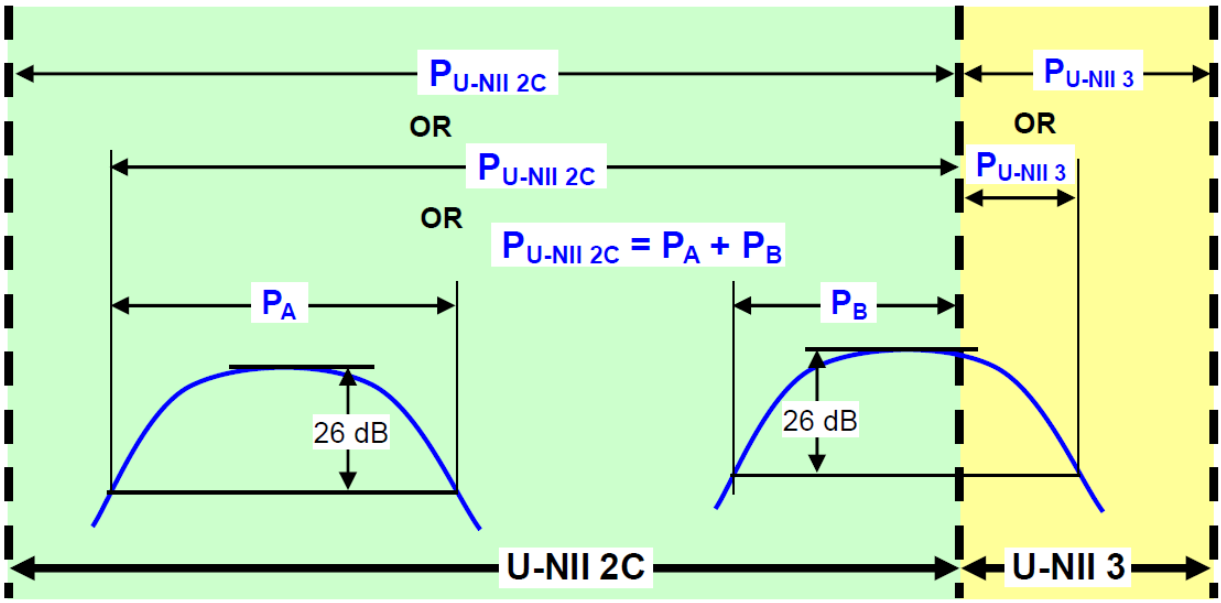
# A.4 Power Spectral Density

## Power Spectral Density Test Requirement

**15.407** (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.

**Band-Crossing Signals**
When measuring the portion of the maximum conducted output power within a single U-NII band, the power shall be integrated across only the portion of the EBW that falls within that band. That is, if an EBW extends across the boundary between two adjacent bands, the boundary frequency between the bands serves as one edge of the frequency range to be integrated. Integration across an entire U-NII band without regard to 26 dB points is also acceptable for determining conducted output power within that band.




**Conducted output power within a U-NII band**: Integrate over the band or integrate over a span including the 26 dB EBWs of transmission segments within the band or integrate over 26 dB EBW of each transmission segment in the band and sum.

**Figure 4. Conducted Output Power Measurement Examples**

## Power Spectral Density Test Procedure

**Ref. KDB 789033 D02 General UNII Test Procedures New Rules v02r01, F. Maximum Power Spectral Density**
**ANSI C63.10: 2013 Peak Power Spectral Density 12.5, 12.3.2.4 Method SA-2**

| **Power Spectral Density**<br>Test Procedure |
|---|
| The rules requires "maximum power spectral density" measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission.<br>1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the |



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| |
|---|
| appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power…". (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)<br>2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.<br>3. Make the following adjustments to the peak value of the spectrum, if applicable: a) If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.<br>b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.<br><br>4. The result is the Maximum PSD over 1 MHz reference bandwidth. |

**Ref. KDB 789033 D02 General UNII Test Procedures New Rules v02r01, F. Maximum Power Spectral Density**

**ANSI C63.10: 2013 Peak Power Spectral Density 12.5, 12.3.2.4 Method SA-2**

| **Power Spectral Density**<br>Test parameters |
|---|
| Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).<br>(i) Measure the duty cycle, x, of the transmitter output signal as described in section II.B.<br>(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.<br>(iii) Set RBW = 1 MHz.<br>(iv) Set VBW ≥ 3 MHz.<br>(v) 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>(vi) Sweep time = auto.<br>(vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.<br>(viii) Do not use sweep triggering. Allow the sweep to "free run".<br>(ix) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.<br>(x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth)<br>**F. Maximum Power Spectral Density (PSD)**<br>2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.<br>3. Make the following adjustments to the peak value of the spectrum, if applicable: a) If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum. |

The "measure-and-sum technique" is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. ANSI C63.10 section 14.3.2.2

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |



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| **Tested By :**<br>Johanna Knudsen | **Date of testing:**<br>03-May-19 to 10-May-19 |
|---|---|
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment



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**Power Spectral Density**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 PSD (dBm/MHz) | Total PSD (dBm/MHz) | Limit (dBm/MHz) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5500 | Non HT20, 6 to 54 Mbps | 1 | 5 | 4.7 | 4.7 | 11.0 | 6.3 |
| | | | | | | | |
| 5560 | Non HT20, 6 to 54 Mbps | 1 | 5 | 9.8 | 9.8 | 11.0 | 1.2 |
| | | | | | | | |
| **5720** | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **10.2** | **10.2** | **11.0** | **0.8** |



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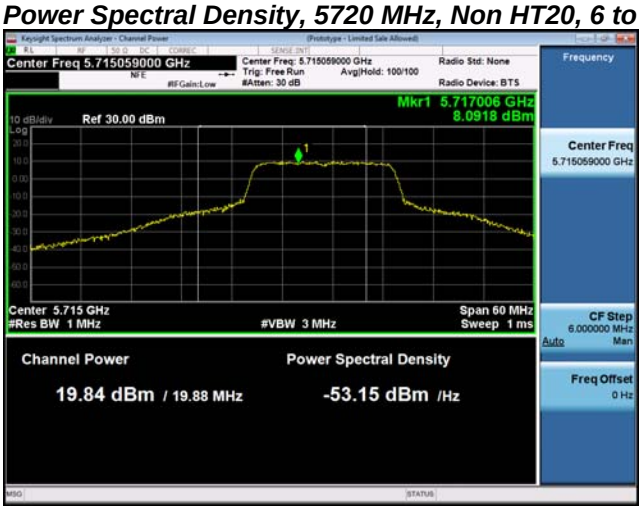
***Power Spectral Density, 5720 MHz, Non HT20, 6 to 54 Mbps***

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# A.5 Conducted Spurious Emissions

## Conducted Spurious Emissions Test Requirement

**15.407(b**) *Undesirable emission limits.* Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

**(3)** For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz..
**(6)** Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.
(**7)** The provisions of §15.205 apply to intentional radiators operating under this section.
**(8)** When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits

**15.205 / 15.209** - Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Use formula below to substitute conducted measurements in place of radiated measurements

E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3 meter

1) Average Plot, Limit= -41.25 dBm eirp
2) Peak plot, Limit = -21.25 dBm eirp

**KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**2. Unwanted Emissions that fall Outside of the Restricted Bands**
a) For all measurements, follow the requirements in II.G.3. *"General Requirements for Unwanted Emissions Measurements."*
b) At frequencies below 1000 MHz, use the procedure described in II.G.4. *"Procedure for Unwanted Emissions Measurements Below 1000 MHz."*
c) At frequencies above 1000 MHz, use the procedure for maximum emissions described in II.G.5., *"Procedure for Unwanted Emissions Measurements Above 1000 MHz."*
(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.[3]

## Conducted Spurious Emissions Test Procedure

**KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**Ref.** ANSI C63.10: 2013

| **Conducted Spurious Emissions**<br>Test Procedure |
|---|
| 1. Connect the antenna port(s) to the spectrum analyzer input.<br>2. Place the radio in continuous transmit mode<br>3. Configure Spectrum analyzer as per test parameters below (be sure to enter all losses between the transmitter output and the spectrum analyzer).<br>4. Use the peak marker function to determine the maximum spurs amplitude level.<br>5. The "measure-and-sum technique" is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. The worst case output is recorded. (see ANSI C63.10:2013 section 14.3.2.2) |



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| |
|---|
| 6. Capture graphs and record pertinent measurement data. |

**Ref. ANSI C63.10: 2013 section 12.7.6 (Peak) and 12.7.7.2 (Average)**
**KDB 789033 D02 General UNII Test Procedures New Rules v02r01, Sec. 5 (Peak), Sec. 6 (Average Method AD)**

| **Conducted Spurious Emissions**<br>Test parameters | |
|---|---|
| **Peak**<br>RBW = 1 MHz<br>VBW ≥ 3 MHz<br>Sweep = Auto<br>Detector = Peak<br>Trace = Max Hold. | **Average**<br>RBW = 1 MHz<br>VBW ≥ 3 MHz<br>Sweep = Auto<br>Detector = RMS<br>Power Averaging |

Add the max antenna gain + ground reflection factor (4.7 dB for frequencies between 30 MHz and 1000 MHz, and 0 dB for frequencies > 1000 MHz).

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |

| **Tested By :**<br>Johanna Knudsen | **Date of testing:**<br>03-May-19 to 10-May-19 |
|---|---|
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment



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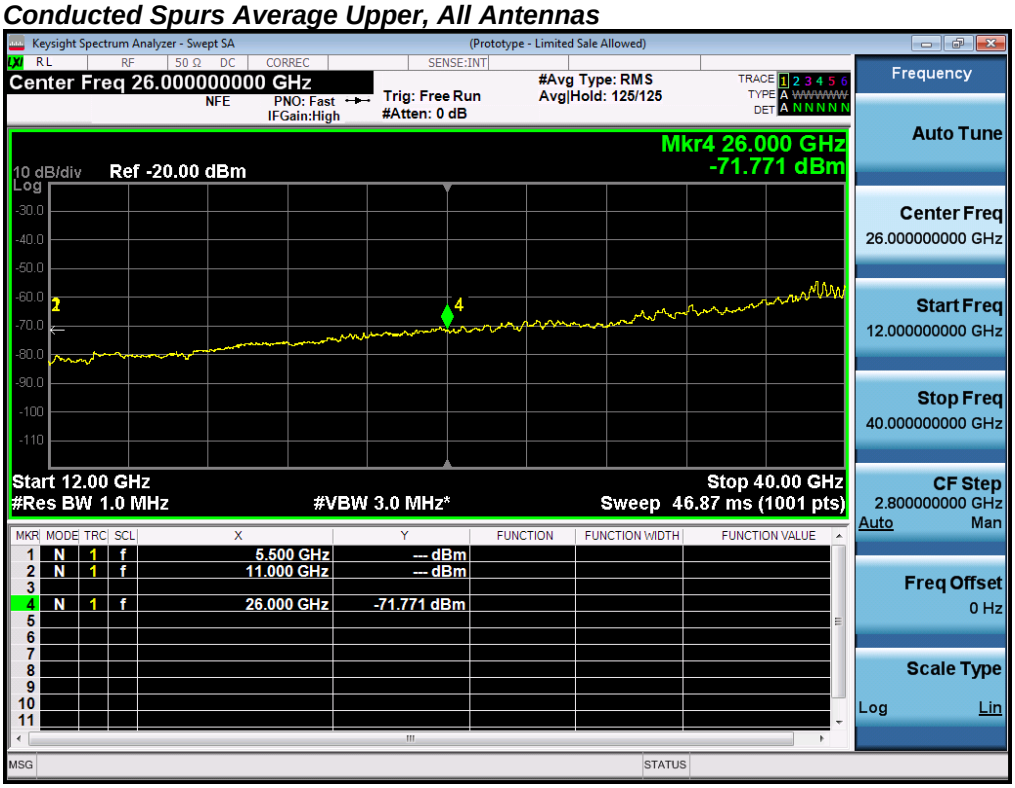
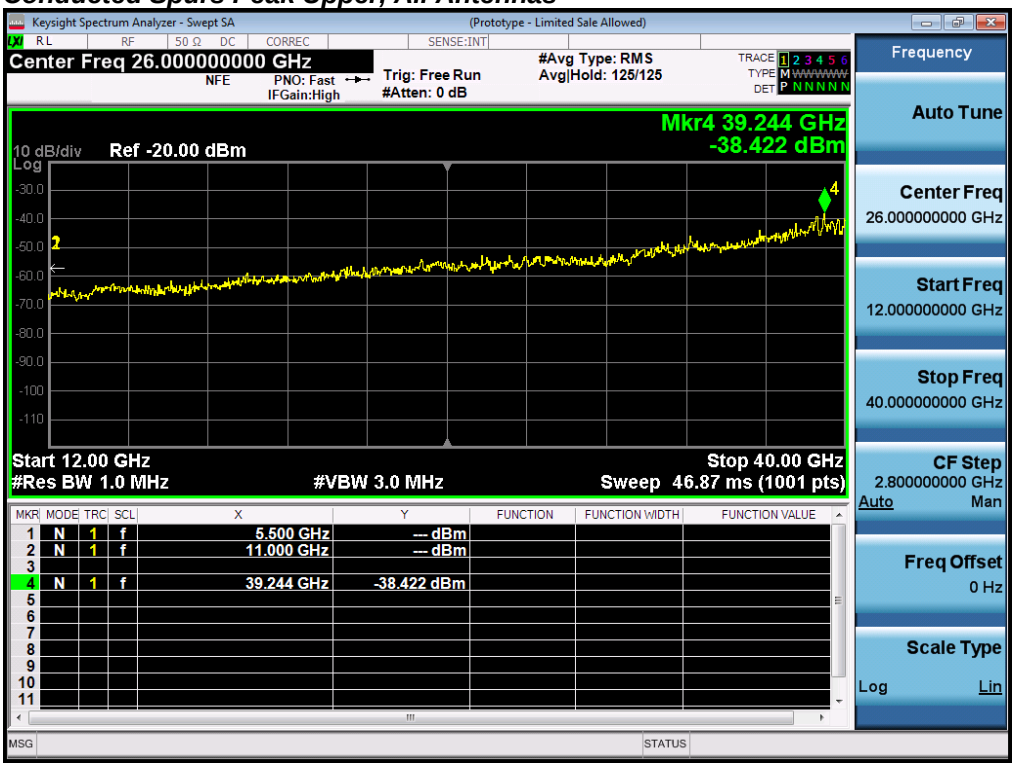
### *Conducted Spurs Average Upper, All Antennas*




### *Conducted Spurs Peak Upper, All Antennas*



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| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5500 | Non HT20, 6 to 54 Mbps | 1 | 5 | -63.2 | -58.2 | -41.25 | 17.0 |
| | | | | | | | |
| 5560 | Non HT20, 6 to 54 Mbps | 1 | 5 | -58.2 | -53.2 | -41.25 | 12.0 |
| | | | | | | | |
| **5720** | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **-53.0** | **-48.0** | **-41.25** | **6.8** |



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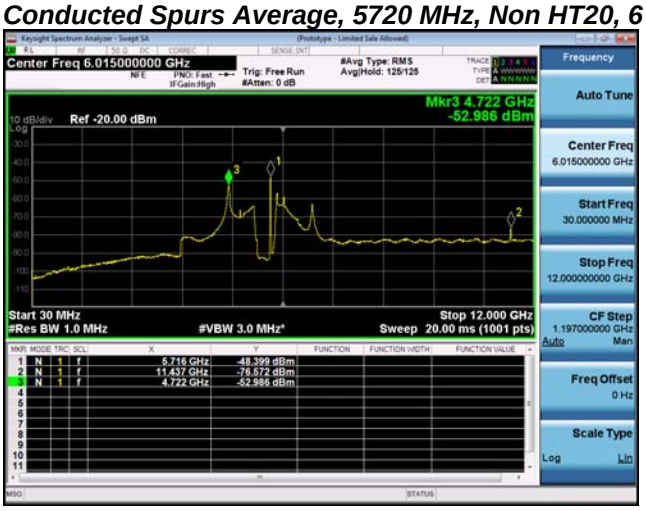
***Conducted Spurs Average, 5720 MHz, Non HT20, 6 to 54 Mbps***

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| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5500 | Non HT20, 6 to 54 Mbps | 1 | 5 | -51.8 | -46.8 | -21.25 | 25.6 |
| | | | | | | | |
| 5560 | Non HT20, 6 to 54 Mbps | 1 | 5 | -51.6 | -46.6 | -21.25 | 25.4 |
| | | | | | | | |
| **5720** | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **-39.4** | **-34.4** | **-21.25** | **13.2** |



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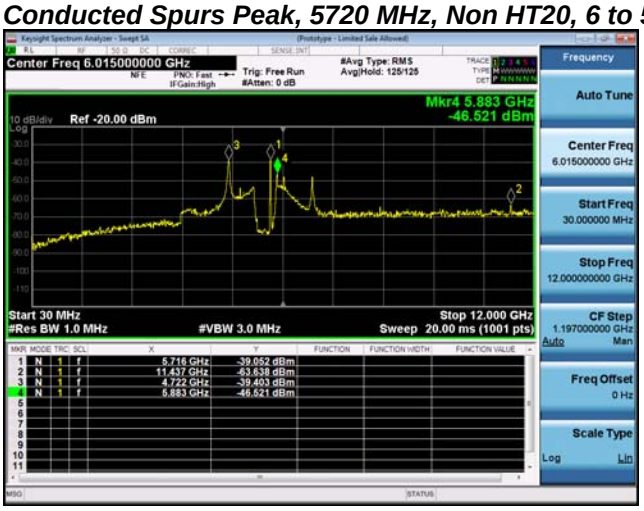
***Conducted Spurs Peak, 5720 MHz, Non HT20, 6 to 54 Mbps***

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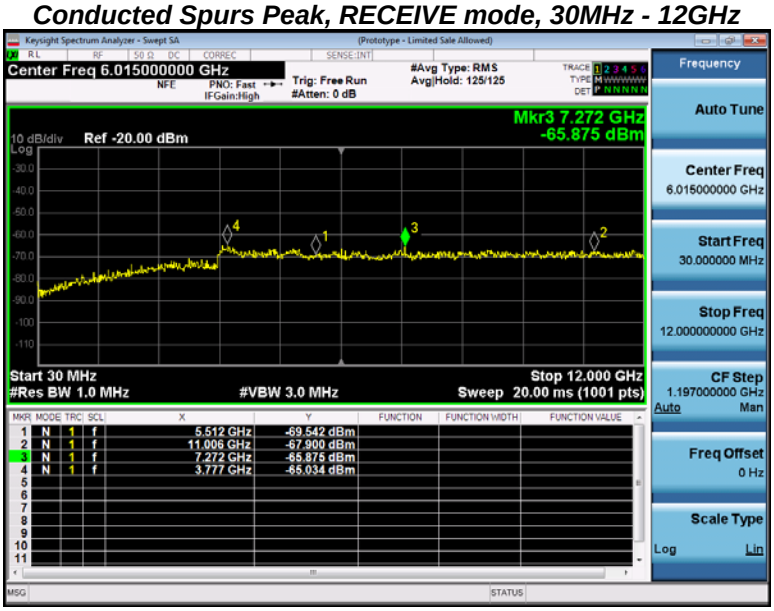
***Conducted Spurs Peak, RECEIVE mode, 30MHz - 12GHz***




***Conducted Spurs Peak, RECEIVE mode, 12-40GHz***

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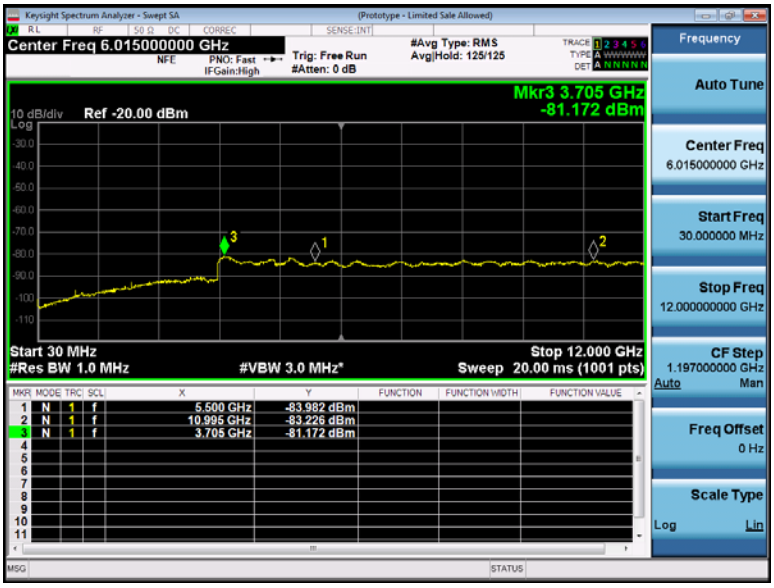
***Conducted Spurs Average, RECEIVE mode, 30MHz - 12GHz***




***Conducted Spurs Average, RECEIVE mode, 12-40GHz***

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# A.6 Conducted Bandedge

**15.407(b**) *Undesirable emission limits.* Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

**(3)** For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz..
**(6)** Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.
(**7)** The provisions of §15.205 apply to intentional radiators operating under this section.
**(8)** When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits

**15.205 / 15.209** - Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Use formula below to substitute conducted measurements in place of radiated measurements

E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3 meter

1) Average Plot, Limit= -41.25 dBm eirp
2) Peak plot, Limit = -21.25 dBm eirp

**KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**2. Unwanted Emissions that fall Outside of the Restricted Bands**
a) For all measurements, follow the requirements in II.G.3. *"General Requirements for Unwanted Emissions Measurements."*
b) At frequencies below 1000 MHz, use the procedure described in II.G.4. *"Procedure for Unwanted Emissions Measurements Below 1000 MHz."*
c) At frequencies above 1000 MHz, use the procedure for maximum emissions described in II.G.5., *"Procedure for Unwanted Emissions Measurements Above 1000 MHz."*
(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.[3]

## Conducted Band Edge Test Procedure

**KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**Ref.** ANSI C63.10: 2013

| **Conducted Spurious Emissions**<br>Test Procedure |
|---|
| 1. Connect the antenna port(s) to the spectrum analyzer input.<br>2. Place the radio in continuous transmit mode<br>3. Configure Spectrum analyzer as per test parameters below (be sure to enter all losses between the transmitter output and the spectrum analyzer).<br>4. Use the peak marker function to determine the maximum spurs amplitude level.<br>5. The "measure-and-sum technique" is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. The worst case output is recorded. (see ANSI C63.10:2013 section 14.3.2.2) |



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| |
|---|
| 6. Capture graphs and record pertinent measurement data. |

**Ref. ANSI C63.10: 2013 section 12.7.6 (Peak) and 12.7.7.2 (Average)**
**KDB 789033 D02 General UNII Test Procedures New Rules v02r01, Sec. 5 (Peak), Sec. 6 (Average Method AD)**

| **Conducted Spurious Emissions**<br>Test parameters | |
|---|---|
| **Peak**<br>RBW = 1 MHz<br>VBW ≥ 3 MHz<br>Sweep = Auto<br>Detector = Peak<br>Trace = Max Hold. | **Average**<br>RBW = 1 MHz<br>VBW ≥ 3 MHz<br>Sweep = Auto<br>Detector = RMS<br>Power Averaging |

**Samples, Systems, and Modes**

| System Number | Description | Samples | System under test | Support equipment |
|---|---|---|---|---|
| 1 | EUT | S01 | ☑ | ☐ |
| | Support | NA | ☐ | ☑ |

| **Tested By :**<br>Johanna Knudsen | **Date of testing:**<br>03-May-19 to 10-May-19 |
|---|---|
| **Test Result : PASS** | |

**Test Equipment**

See Appendix C for list of test equipment



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| Frequency (MHz) 5500 | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **-55.3** | **-50.3** | **-41.25** | **9.1** |



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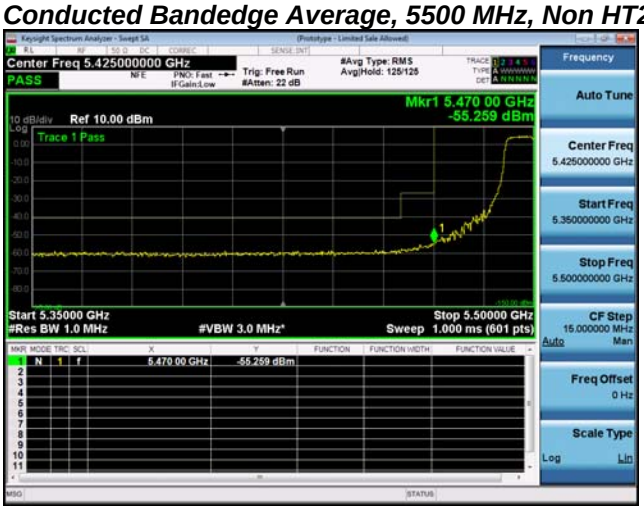
***Conducted Bandedge Average, 5500 MHz, Non HT20, 6 to 54 Mbps***

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**Non-Restricted Band (Peak)**

| Frequency (MHz) 5500 | | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | **Non HT20, 6 to 54 Mbps (marker at 5.46275GHz)** | **1** | **5** | **-37.3** | **-32.3** | **-27.00** | **5.3** |



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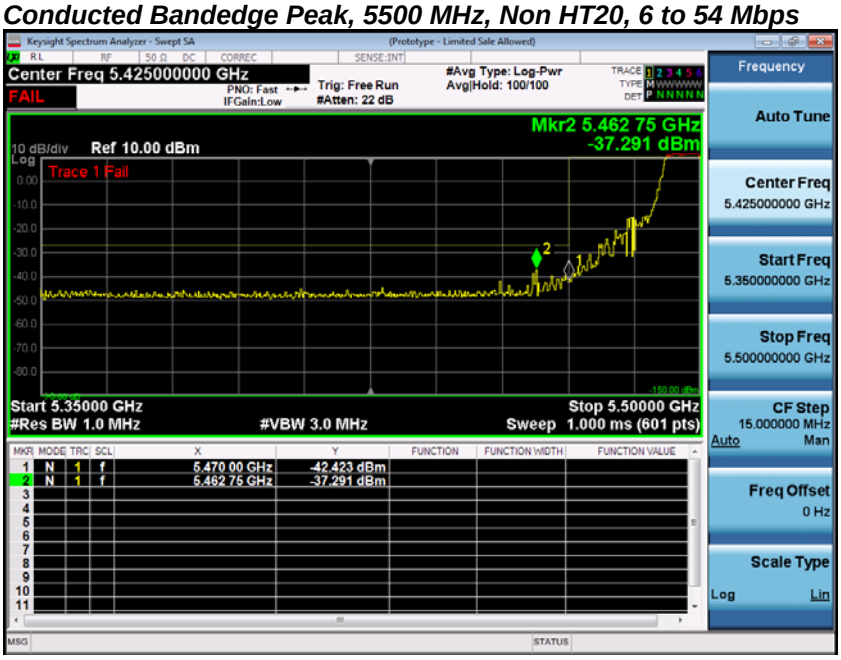
***Conducted Bandedge Peak, 5500 MHz, Non HT20, 6 to 54 Mbps***

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**Non-Restricted Band (Peak)**

| Frequency (MHz) 5700 | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| | Non HT20, 6 to 54 Mbps | 1 | 5 | -33.555 | -28.555 | -27 | 1.555 |



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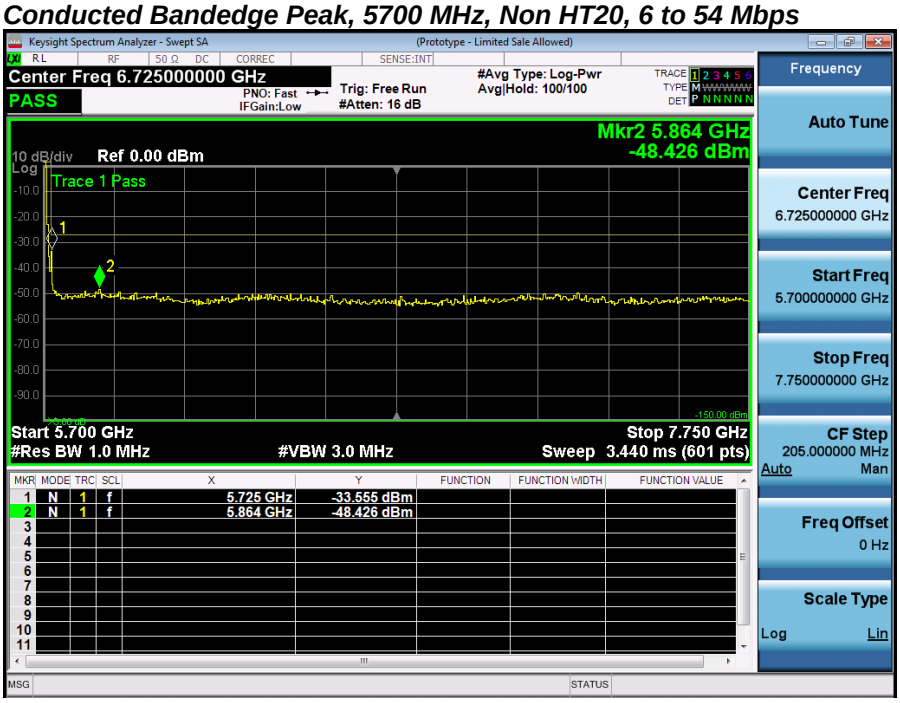
***Conducted Bandedge Peak, 5700 MHz, Non HT20, 6 to 54 Mbps***

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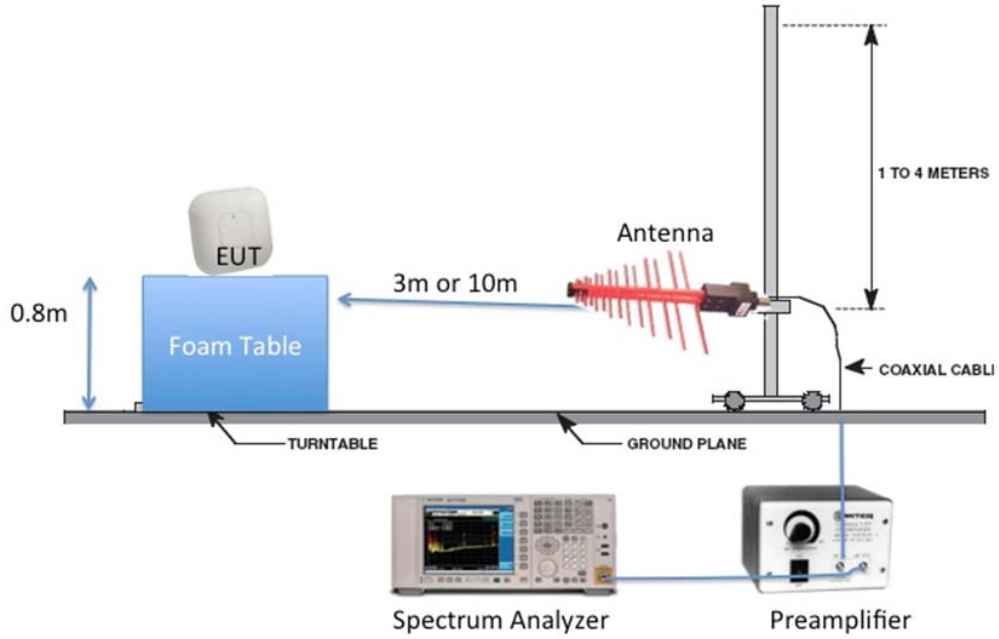
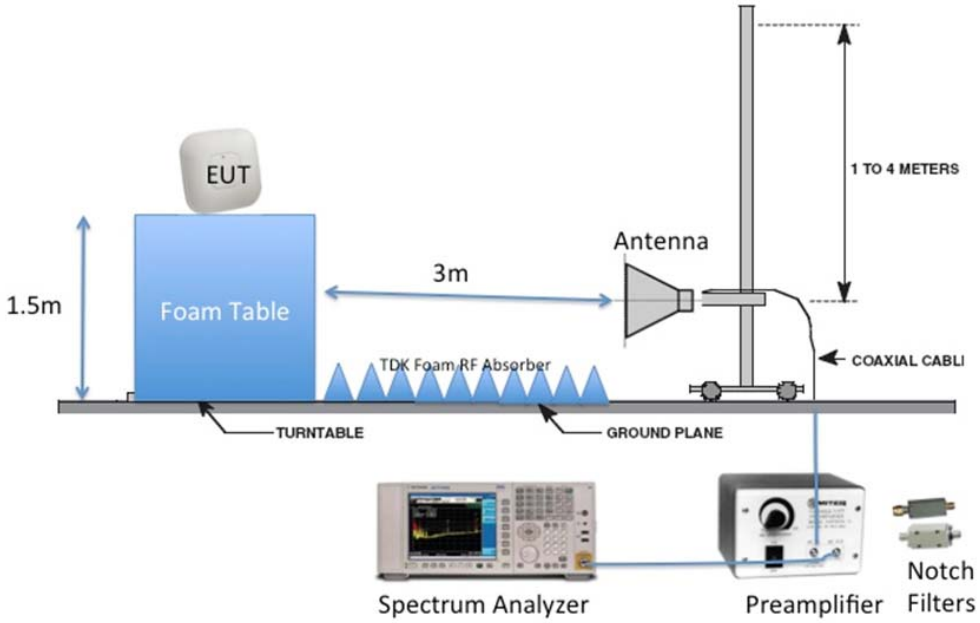
**Appendix B: Emission Test Results**

**Testing Laboratory:** Cisco Systems, Inc., 125 West Tasman Drive, San Jose, CA 95134, USA

## Radiated Emission Setup Diagram-Below 1G




## Radiated Emission Setup Diagram-Above 1G



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## B.1 Radiated Spurious Emissions

This section not covered by this test report.



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## B.2 Radiated Emissions 30MHz to 1GHz

This section not covered by this test report.



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## B.3 AC Conducted Emissions

This section not covered by this test report.



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## Appendix C: List of Test Equipment Used to perform the test

| Equip# | Manufacturer/ Model | Description | Last Cal | Next Cal | Test Item |
|---|---|---|---|---|---|
| CIS057478 | Cisco ATIL | Automation Test Insertion Loss | Cal Not Required | | A1 thru A8 |
| CIS055096 | PXI-1042 National Instruments | Chassis | Cal Not Required | | A1 thru A8 |
| CIS057239 | National Instruments PXI-8115 | Embedded Controller | Cal Not Required | | A1 thru A8 |
| *CIS057225* | *National Instruments PXI-5422* | *200 MS/s, 16-bit Arbitrary Waveform Generator* | *28-Sep-18* | *28-Sep-19* | *A1 thru A8* |
| *CIS057226* | *National Instruments PXI-5422* | *200 MS/s, 16-bit Arbitrary Waveform Generator* | *28-Sep-18* | *28-Sep-19* | *A1 thru A8* |
| CIS057250 | National Instruments PXI-2796 | 40 GHz Dual 6x1 Multiplexer (SP6T) | Cal Not Required | | A1 thru A8 |
| CIS056093 | National Instruments PXI-2796 | 40 GHz Dual 6x1 Multiplexer (SP6T) | Cal Not Required | | A1 thru A8 |
| CIS057251 | National Instruments PXI-2799 | Switch 1x1 | Cal Not Required | | A1 thru A8 |
| CIS055109 | Agilent N9030A-550 | PXA Signal Analyzer, 3Hz to 50GHz | 29-Oct-18 | 29-Oct-19 | A1 thru A8 |
| CIS054413 | N5182B Keysight | MXG X-Series RF Vector Signal Generator | 24 Apr 2019 | 24 Apr 2020 | A1 thru A8 |
| CIS054303 | Keysight N5182B | MXG X-Series RF Vector Signal Generator | 9-Oct-18 | 9-Oct-19 | A1 thru A8 |
| CIS006322 | Lufft 5063-33W | Dial hygrometer | 27-Dec-18 | 27-Dec-19 | A1 thru A8 |
| CIS056327 | Pasternack PE5019-1 | Torque wrench | 20-Mar-19 | 20-Mar-20 | A1 thru A8 |



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## Appendix D: Abbreviation Key and Definitions

**The following table defines abbreviations used within this test report.**

| Abbreviation | Description | Abbreviation | Description |
|---|---|---|---|
| EMC | Electro Magnetic Compatibility | °F | Degrees Fahrenheit |
| EMI | Electro Magnetic Interference | °C | Degrees Celsius |
| EUT | Equipment Under Test | Temp | Temperature |
| ITE | Information Technology Equipment | S/N | Serial Number |
| TAP | Test Assessment Schedule | Qty | Quantity |
| ESD | Electro Static Discharge | emf | Electromotive force |
| EFT | Electric Fast Transient | RMS | Root mean square |
| EDCS | Engineering Document Control System | Qp | Quasi Peak |
| Config | Configuration | Av | Average |
| CIS# | Cisco Number (unique identification number for Cisco test equipment) | Pk | Peak |
| Cal | Calibration | kHz | Kilohertz ($1x10^3$) |
| EN | European Norm | MHz | MegaHertz ($1x10^6$) |
| IEC | International Electro technical Commission | GHz | Gigahertz ($1x10^9$) |
| CISPR | International Special Committee on Radio Interference | H | Horizontal |
| CDN | Coupling/Decoupling Network | V | Vertical |
| LISN | Line Impedance Stabilization Network | dB | decibel |
| PE | Protective Earth | V | Volt |
| GND | Ground | kV | Kilovolt ($1x10^3$) |
| L1 | Line 1 | µV | Microvolt ($1x10^{-6}$) |
| L2 | Line2 | A | Amp |
| L3 | Line 3 | µA | Micro Amp ($1x10^{-6}$) |
| DC | Direct Current | mS | Milli Second ($1x10^{-3}$) |
| RAW | Uncorrected measurement value, as indicated by the measuring device | µS | Micro Second ($1x10^{-6}$) |
| RF | Radio Frequency | µS | Micro Second ($1x10^{-6}$) |
| SLCE | Signal Line Conducted Emissions | m | Meter |
| Meas dist | Measurement distance | Spec dist | Specification distance |
| N/A or NA | Not Applicable | SL | Signal Line (or Telecom Line) |
| P | Power Line | L | Live Line |
| N | Neutral Line | R | Return |
| S | Supply | AC | Alternating Current |



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## Appendix E: Photographs of Test Setups

EUT Photos have been omitted from this test report. Photos can be found in EDCS# 17749029



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## Appendix F: Software Used to Perform Testing

Cisco Internal LabView Radio Test Automation Software – RF Automation Main rev50
Cisco Internal LabView Radio Test Automation Software – Report Generation Main rev21



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## Appendix G: Test Procedures

Measurements were made in accordance with

- KDB 789033 - D02 General UNII Test Procedures New Rules v02r01
- KDB 662911 - MIMO
- ANSI C63.4 2014 Unintentional Radiators
- ANSI C63.10 2013 Intentional Radiators

Test procedures are summarized below:

| | |
|---|---|
| FCC 5GHz Test Procedures | EDCS # 1445048 |
| FCC 5GHz RSE Test Procedures | EDCS # 1511600 |



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## Appendix H: Scope of Accreditation (A2LA certificate number 1178-01)

The scope of accreditation of Cisco Systems, Inc. can be found on the A2LA web page at:

http://www.a2la.org/scopepdf/1178-01.pdf



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## Appendix I: Test Assessment Plan

Compliance Test Plan (Excel) EDCS# 16415414
Radio Test Plan: EDCS# 16915207

## Appendix J: Worst Case Justification

N/A

## Appendix K: UUT Software Info from CLI

Cisco AP Software, (ap1g7), [cheetah-build6:/san2/BUILD/workspace/Nightly-Cheetah-axel-bcm-mfg-c8_9_throttle]
Technical Support: http://www.cisco.com/techsupport
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Compiled Mon Apr 29 03:12:01 PDT 2019

ROM: Bootstrap program is U-Boot boot loader
BOOTLDR: U-Boot boot loader Version

# End



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