# Test Report
# Model: C9120AXE-(x)
# Cisco Catalyst C9120AX Series
# (x= B)

FCC ID: LDKEDAC92157

## 5725-5850 MHz

**Against the following Specifications:**

**CFR47 Part 15.407**



**Cisco Systems**

170 West Tasman Drive

San Jose, CA  95134

| | |
|---|---|
|  |  |
| **Author:** Abhishek Upadhyay | **Approved By:** Gerard Thorpe |
| **Tested By:** Abhishek Upadhyay | **Title:** Manager |
| | **Revision:** Controlled by Doc Central |

This report replaces any previously entered test report under EDCS – **18357910**.This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

**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 |

## Section 2: 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

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 | ± 0.54° |
| 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**

16-Sep-19 - 24-Sep-19

**2.3 Report Issue Date**

10/22/2019

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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

**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 San Jose, CA 95134 | Company #: 2461N-2 |
| Building P, 5m Chamber | 125 West Tasman Dr San Jose, CA 95134 | Company #: 2461N-1 |
| Building I, 5m Chamber | 285 W. Tasman Drive San Jose, California 95134 | Company #: 2461M-1 |

**Test Engineers**

Abhishek Upadhyay

**2.5 Equipment Assessed (EUT)**

C9120AXE-B

**2.6 EUT Description**

The Cisco Aironet 802.11ac 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) |
|---|---|---|---|
| **-E SKU** | | | |
| 2.4GHz&5GHz | AIR-ANT2524DB-R/= | 2.4 GHz 2 dBi/5 GHz 4 dBi Dipole Ant., Black, connectors RP-TNC | 2dBi@2.4GHz 4dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2524DG-R/= | 2.4 GHz 2 dBi/5 GHz 4 dBi Dipole Ant., Gray, connectors RP-TNC | 2dBi@2.4GHz 4dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2524DW-R/= | 2.4 GHz 2 dBi/5 GHz 4 dBi Dipole Ant., White, connectors RP-TNC | 2dBi@2.4GHz 4dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2535SDW-R | 2.4 GHz 3dBi/5 GHz 5 dBi Low Profile Antenna, White, connectors RP-TNC | 3dBi@2.4GHz 5dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2566P4W-R= | 2.4 GHz 6 dBi/5 GHz 6 dBi Directionnel Ant., 4-port, connectors RP-TNC | 6dBi@2.4GHz 6dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2524V4C-R= | 2.4GHz 2 dBi/5GHz 4 dBi Ceiling Mount Omni Ant., 4-port, connectors RP-TNC | 2dBi@2.4GHz 4dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2544V4M-R= | 2.4GHz 4 dBi/5GHz 4 dBi Wall Mount Omni Ant., 4-port, connectors RP-TNC | 4dBi@2.4GHz 4dBi@5GHz |
| 2.4GHz&5GHz | AIR-ANT2566D4M-R= | 2.4 GHz 6 dBi/5 GHz 6 dBi 60 Deg. Patch Ant., 4-port, RP-TNC | 6dBi@2.4GHz 6dBi@5GHz |
| **-P SKU** | | | |
| 2.4GHz&5GHz | AIR-ANT2513P4M-N= | 2.4 GHz 13 dBi/5 GHz 13 dBi Patch Ant., 4-port, N Type | 13dBi@2.4GHz 13dBi@5GHz |

## Section 3: Result Summary

### 3.1 Results Summary Table

**Conducted emissions**

| Basic Standard | Technical Requirements / Details | Result |
|---|---|---|
| FCC 15.407 | **6dB Bandwidth:**<br>Systems using digital modulation techniques may operate in the 2400-2483.5MHz band. The minimum 6dB bandwidth shall be at least 500 kHz. | Pass |
| FCC 15.407 | **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 | **Output Power:**<br>For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. | Pass |
| FCC 15.407 | **Power Spectral Density:**<br>**15.407** The maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. | Pass |
| FCC 15.407 | **Conducted Spurious Emissions / Band-Edge:**<br>For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz. | Pass |
| FCC 15.209<br>FCC 152.05 | **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 | **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 in this report |
| FCC 15.207 | **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 in this report |

**\*** MPE calculation is recorded in a separate report

## 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 | C9120AXE-B | Cisco Systems | P2-2 | 1268.14948 .r14702 14702 | cheetah-build6:/s an2/BUILD/work space/Nightly-Ch eetah-axel-bcm- mfg-c8_10_thrott le Rev Compiled Fri Sep 6 08:06:05 PDT 2019 | FOC23302F0Q |

**4.2 System Details**

| System # | Description | Samples |
|---|---|---|
| 1 | C9120AXE-B | S01 |

**4.3 Mode of Operation Details**

| Mode# | Description | Comments |
|---|---|---|
| 1 | Continuous Transmitting, RF conducted measurements | Continuously Transmitting, 97.02% duty cycle<br><br>Cisco AP Software, (ap1g7), [cheetah-build6:/san2/BUILD/workspace/Nightly-Cheetah-axel-bcm-mfg-c8 _10_throttle]<br><br>Compiled Fri Sep 6 08:06:05 PDT 2019 |

**Appendix A: Emission Test Results**
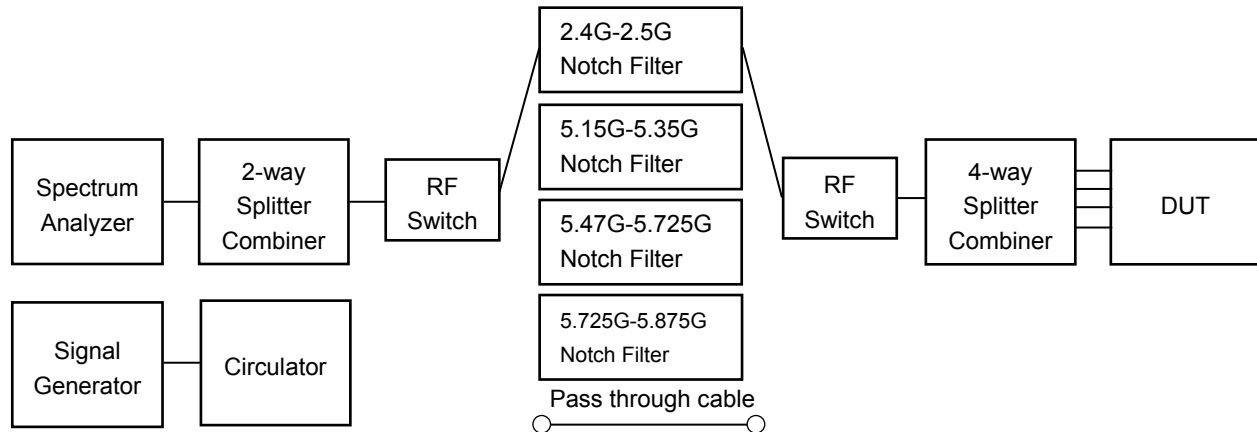
## Conducted Test Setup Diagram

```
                                    ┌──────────────┐
                                    │ 2.4G-2.5G    │
                                    │ Notch Filter │
                                    └──────────────┘
┌──────────┐   ┌──────────┐   ┌────────┐ ┌──────────────┐ ┌────────┐   ┌──────────┐   ┌──────┐
│ Spectrum │   │ 2-way    │   │ RF     │ │ 5.15G-5.35G  │ │ RF     │   │ 4-way    │   │      │
│ Analyzer │───│ Splitter │───│ Switch │ │ Notch Filter │ │ Switch │───│ Splitter │───│ DUT  │
│          │   │ Combiner │   │        │ └──────────────┘ │        │   │ Combiner │   │      │
└──────────┘   └──────────┘   └────────┘ ┌──────────────┐ └────────┘   └──────────┘   └──────┘
                                         │ 5.47G-5.725G │
                                         │ Notch Filter │
┌──────────┐   ┌──────────┐              └──────────────┘
│ Signal   │   │          │             ┌───────────────┐
│ Generator│───│Circulator│             │ 5.725G-5.875G │
│          │   │          │             │ Notch Filter  │
└──────────┘   └──────────┘             └───────────────┘
                                          Pass through cable
                                          o───────────o
```

## Target Maximum Channel Power

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

**Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi**

| | Maximum Channel Power (dBm) | | | |
|---|---|---|---|---|
| | Frequency (MHz) | | | |
| **Operating Mode** | **5720** | **5745** | **5785** | **5825** |
| **Non HT20, 6 to 54 Mbps** | 6 | 13 | 14 | 14 |

## 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: |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 to 24-Sep-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.

**Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi**

| Mode | Data Rate | On-time (ms) | Total Time (ms) | Duty Cycle (%) | Correction Factor (dB) |
|---|---|---|---|---|---|
| NonHT20 | 6Mbps | 0.293 | 0.303 | 97.02 | 0.13 |

**Duty Cycle Data Screenshots (Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)**
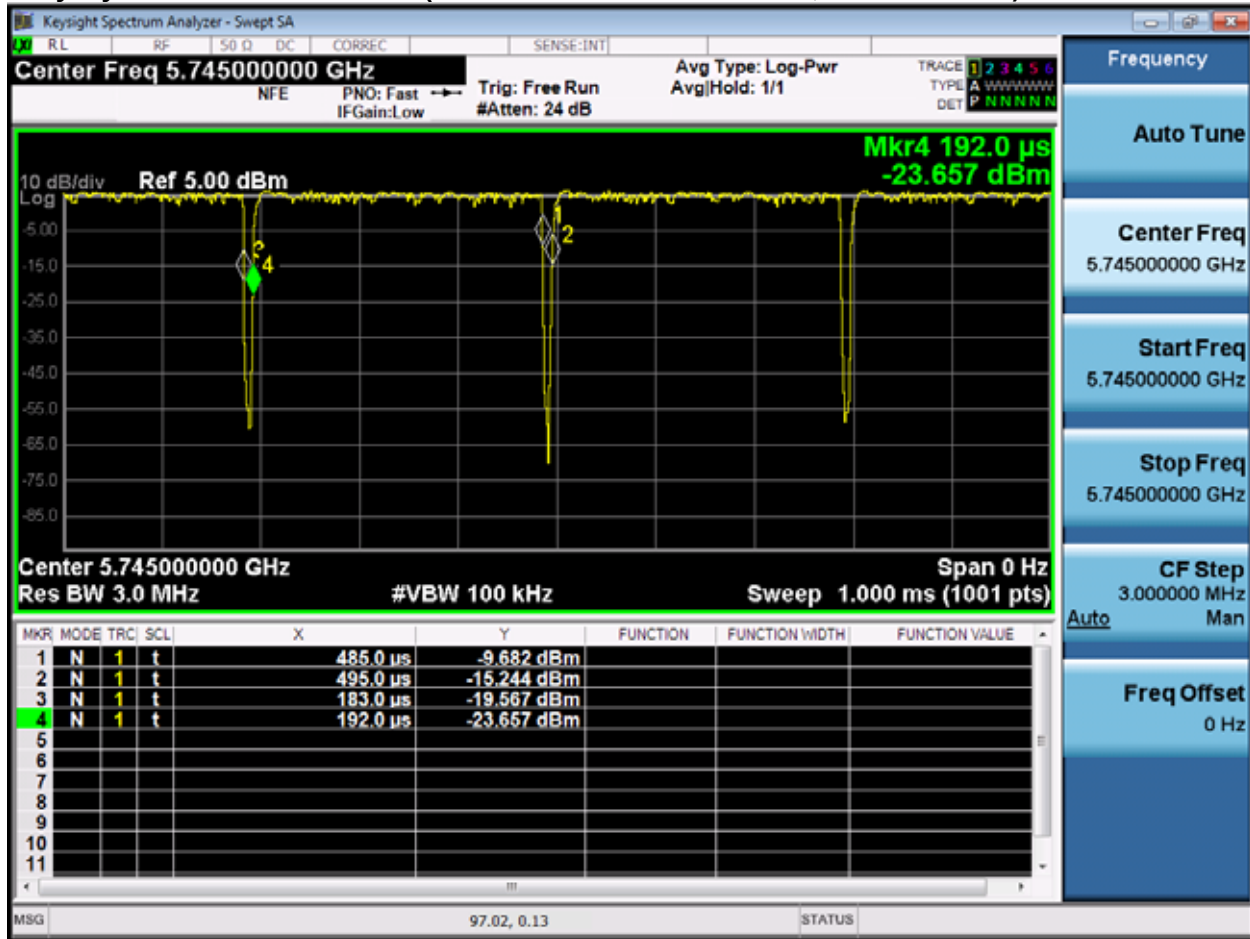
# A.2 6dB Bandwidth

## 6dB Bandwidth Test Requirement

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

### Emission bandwidth (EBW) in U-NII bands
**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 (Figure3).
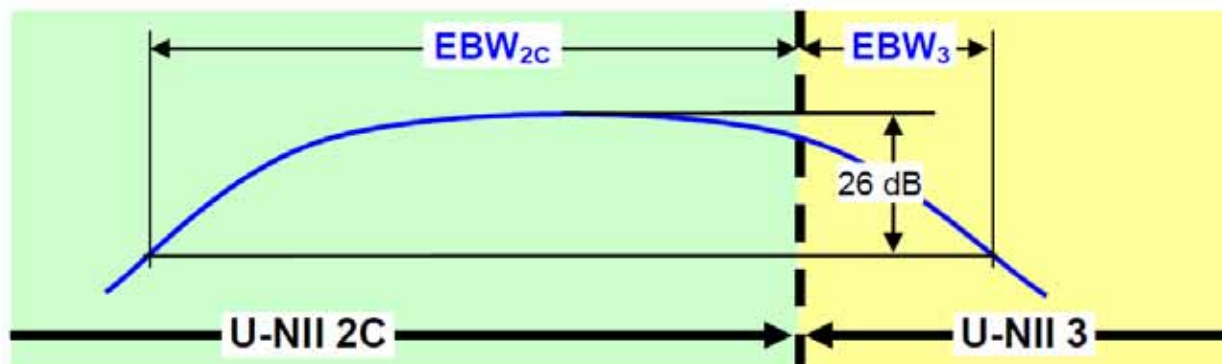


Figure 3.  Emission Bandwidth (EBW) within a Band for Band-Crossing Signals

## 6dB Bandwidth Test Procedure

**From KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**Section C. Bandwidth Measurement**

| 6 BW |
|---|
| Test Procedure |
| 1. Set the radio in the continuous transmitting mode.<br>2. Allow the trace to stabilize.<br>3. Setting the x-dB bandwidth mode to -6dB within the measurement set up function.<br>4. Select the automatic OBW measurement function of an instrument to perform bandwidth measurement.<br>5. Capture graphs and record pertinent measurement data. |

**From KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**Section C. Bandwidth Measurement**

| 6 BW |
|---|
| Test parameters |
| 2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz<br><br>a) Set RBW = 100 kHz.<br>b) Set the video bandwidth (VBW) ≥ 3 × RBW.<br>c) Detector = Peak.<br>d) Trace mode = max hold.<br>e) Sweep = auto couple.<br>f) Allow the trace to stabilize.<br>g) Measure the maximum width of the emission that is constrained by the frequencies associated with the |

two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

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

| Tested By : | Date of testing: |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

**Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi**

| Frequency (MHz) | Mode | Data Rate (Mbps) | 6dB BW (MHz) | Limit (kHz) | Margin (MHz) |
|---|---|---|---|---|---|
| **5720** | **Non HT20, 6 to 54 Mbps** | **6** | **3.2** | **>500** | **2.7** |
| | | | | | |
| 5745 | Non HT20, 6 to 54 Mbps | 6 | 16.4 | >500 | 15.9 |
| | | | | | |
| 5785 | Non HT20, 6 to 54 Mbps | 6 | 16.4 | >500 | 15.9 |
| | | | | | |
| **5825** | **Non HT20, 6 to 54 Mbps** | **6** | **16.4** | **>500** | **15.9** |

*6dB Bandwidth, 5720 MHz, Non HT20, 6 to 54 Mbps (*Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)



*6dB Bandwidth, 5825 MHz, Non HT20, 6 to 54 Mbps (*Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)

# A.3 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).
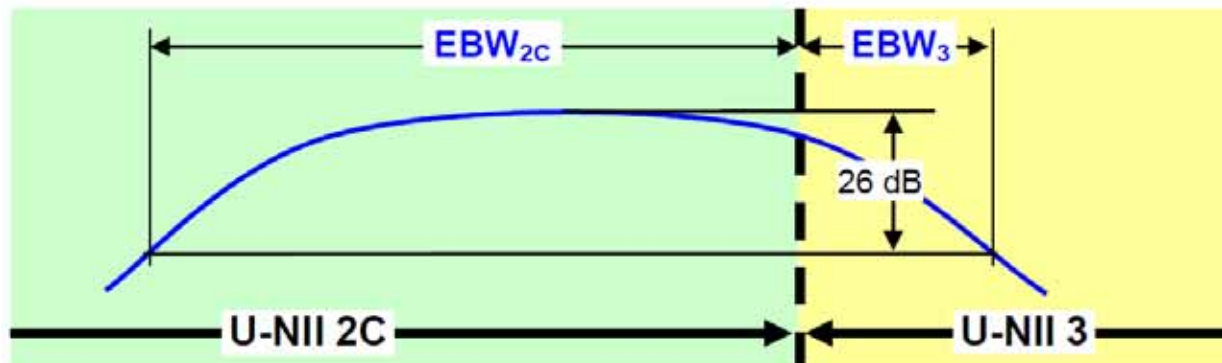


Figure 3.  Emission Bandwidth (EBW) within a Band for Band-Crossing Signals

## 99% and 26dB Bandwidth Test Procedure

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

**From KDB 789033 D02 General UNII Test Procedures New Rules v02r01**
**Section D. 99 Percent Occupied Bandwidth**

| 99% BW |
| --- |
| Test Parameters |
| 1. Set center frequency to the nominal EUT channel center frequency. |
| 2. Set span = 1.5 times to 5.0 times the OBW. |
| 3. Set RBW = 1 % to 5 % of the OBW |
| 4. Set VBW ≥ 3 · RBW |
| 5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. |
| 6. Use the 99 % power bandwidth function of the instrument (if available). |

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

**Section C. Measurement Bandwidth, Section 1**

| **26 BW** |
|---|
| 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. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%. |

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

| **Tested By :** | **Date of testing:** |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

*(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*

| Frequency (MHz) | Mode | Data Rate (Mbps) | 26dB BW (MHz) | 99% BW (MHz) |
|---|---|---|---|---|
| **5720** | **Non HT20, 6 to 54 Mbps** | **6** | **8.2** | **7.847** |
| | | | | |
| 5745 | Non HT20, 6 to 54 Mbps | 6 | 25.5 | 16.659 |
| | | | | |
| 5785 | Non HT20, 6 to 54 Mbps | 6 | 31.0 | 16.759 |
| | | | | |
| **5825** | **Non HT20, 6 to 54 Mbps** | **6** | **32.8** | **16.842** |

*26dB / 99% Bandwidth, 5720 MHz, Non HT20, 6 to 54 Mbps(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*



*26dB / 99% Bandwidth, 5825 MHz, Non HT20, 6 to 54 Mbps(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*
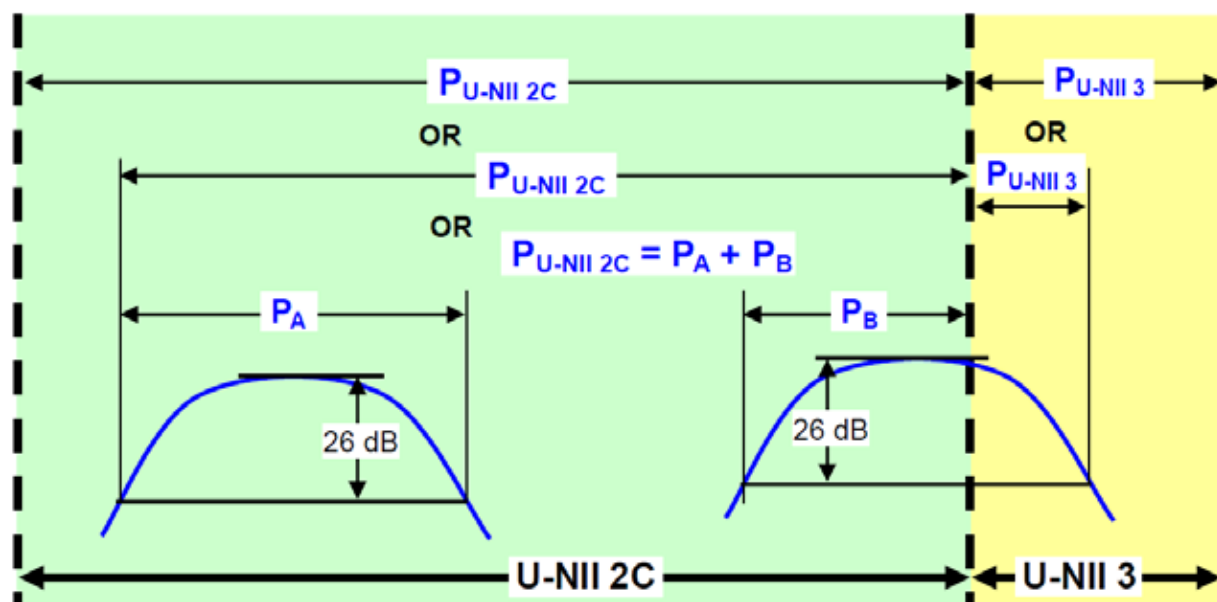
# A.4 Maximum Conducted Output Power

## Maximum Conducted Output Power Test Requirement

**15.407 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

**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** |
|---|
| Test Procedure |

1. Set the radio in the continuous transmitting mode at full power
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.
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**

Test parameters

Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).
(i) Measure the duty cycle, x, of the transmitter output signal as described in section II.B.
(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(iii) Set RBW = 1 MHz.
(iv) Set VBW $\geq$ 3 MHz.
(v) Number of points in sweep $\geq$ 2 Span / RBW. (This ensures that bin-to-bin spacing is $\leq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
(vi) Sweep time = auto.
(vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
(viii) Do not use sweep triggering. Allow the sweep to "free run".
(ix) Trace average at least 100 traces in power averaging (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.
(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

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

| Tested By : | Date of testing: |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

**(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Max Power (dBm) | Duty Cycle correction (dBm) | Total Tx Channel Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | 5.6 | 0.1 | 5.7 | 30.0 | 24.3 |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | 13.1 | 0.1 | 13.2 | 30.0 | 16.8 |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | 13.6 | 0.1 | 13.7 | 30.0 | 16.3 |
| 5825 | **Non HT20, 6 to 54 Mbps** | **1** | **4,5,6** | **13.8** | **0.1** | **13.9** | **30.0** | **16.1** |

*Maximum Transmit Output Power, 5825 MHz, Non HT20, 6 to 54 Mbps*(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)



*Antenna A*

# A.5 Power Spectral Density
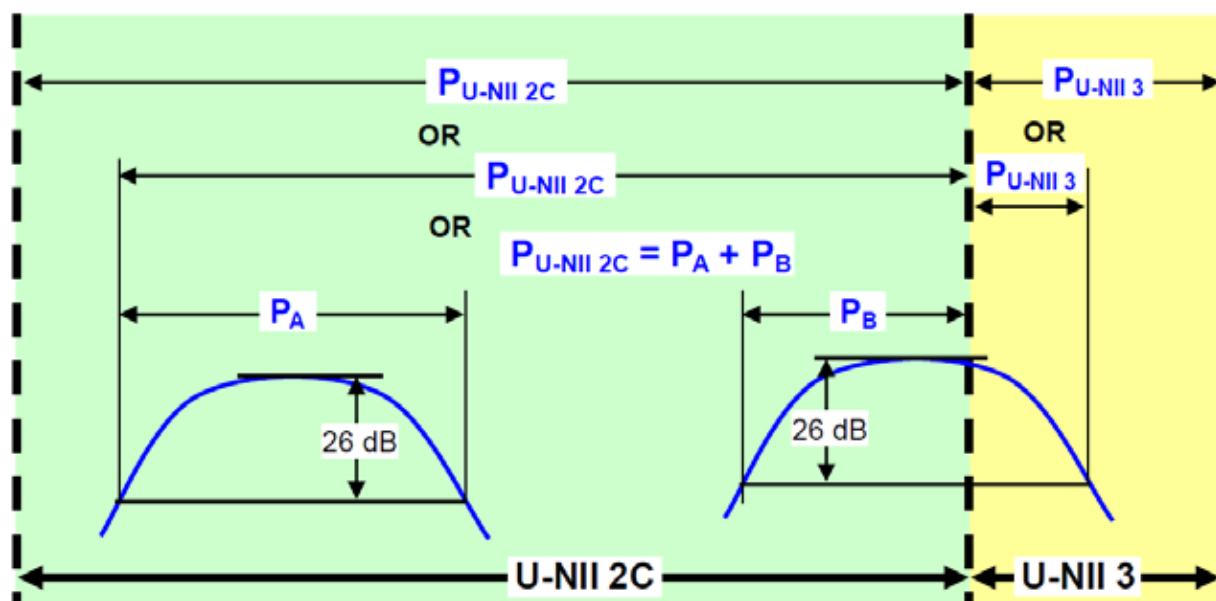
## Power Spectral Density Test Requirement

**15.407**
(3) For the band 5.725-5.85 GHz…the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(5) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

**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 (PSD)**

| |
|---|
| **Power Spectral Density** |
| 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 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.) |
| 2. Use the peak search function on the instrument to find the peak of the spectrum and record its value. |
| 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. |
| 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> 4. The result is the Maximum PSD over 1 MHz reference bandwidth. <br> 5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). **For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz.** |

**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**

| |
|---|
| **Power Spectral Density** |
| Test parameters |

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

(i) Measure the duty cycle, x, of the transmitter output signal as described in section II.B.

(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(iii) Set RBW = 1 MHz. (this should be 500kHz per KDB789033, Section F, (5))

(iv) Set VBW ≥ 3 MHz.

(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.)

(vi) Sweep time = auto.

(vii) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.

(viii) Do not use sweep triggering. Allow the sweep to "free run".

(ix) Trace average at least 100 traces in power averaging (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.

(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)

**F. Maximum Power Spectral Density (PSD)**

2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.

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.

5. … **For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz.**

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

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

| Tested By : | Date of testing: |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

**(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 PSD (dBm/MHz) | Duty cycle correction (dBm/MHz) | Total PSD (dBm/500MHz) | Limit (dBm/500MHz) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | -1.9 | 0.1 | -1.8 | 30.0 | 31.8 |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | -1.0 | 0.1 | -0.9 | 30.0 | 30.9 |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 4,5,6 | -0.6 | 0.1 | -0.5 | 30.0 | 30.5 |
| 5825 | **Non HT20, 6 to 54 Mbps** | 1 | 4,5,6 | -0.4 | 0.1 | -0.3 | 30.0 | 30.3 |

*Power Spectral Density, 5825 MHz, Non HT20, 6 to 54 Mbps(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*
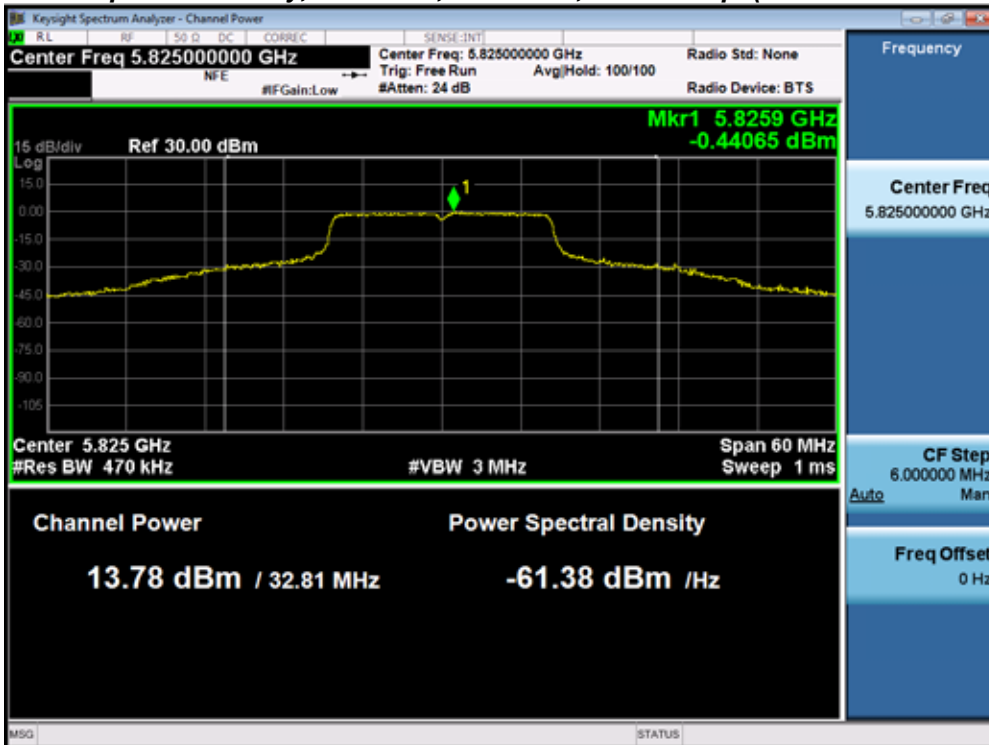


*Antenna A*

# A.6 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:

    (**4**) For transmitters operating in the 5.725-5.85 GHz band:
    (i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

    (**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.

**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

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

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

## Conducted Spurious Emissions Test Procedure

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

| Conducted Spurious Emissions |
|---|
| Test Procedure |
| 1. Connect the antenna port(s) to the spectrum analyzer input.<br>2. Place the radio in continuous transmit mode. Use the procedures in KDB 789033 D02 General UNII Test Procedures New Rules v01r03 to substitute conducted measurements in place of radiated measurements.<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. Record the marker waveform peak to spur difference. Also measure any emissions in the restricted bands.<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.<br>6. Capture graphs and record pertinent measurement data. |

**Ref.** KDB 789033 D02 General UNII Test Procedures New Rules v01r03
        ANSI C63.10: 2013 section 12.7.7.3 (average) & 12.7.6 (peak)

| Conducted Spurious Emissions |
|---|
| Test parameters |
| Span = 30MHz to 18GHz / 18GHz to 40GHz<br>RBW = 1 MHz<br>VBW ≥ 3 x RBW for Peak, 1kHz for Average<br>Sweep = Auto couple<br>Detector = Peak<br>Trace = Max Hold. |

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).

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

| Tested By : | Date of testing: |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

*Conducted Spurs Average Upper, 5745 MHz, Non HT20, 6 to 54 Mbps(*Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)
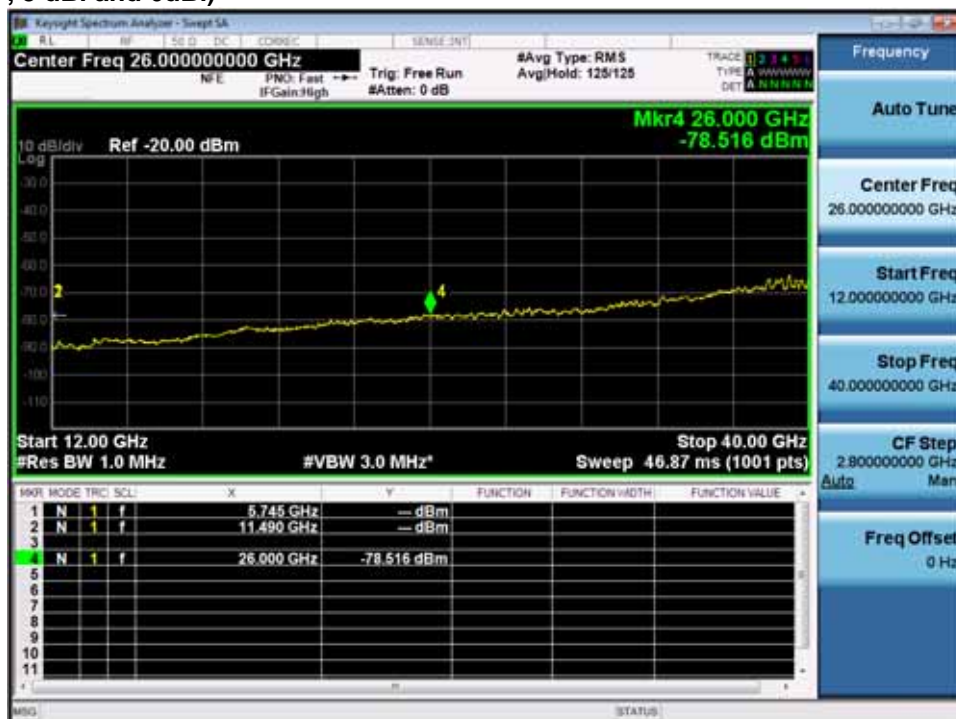


*Conducted Spurs Peak Upper, 5745 MHz, Non HT20, 6 to 54 Mbps(*Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)

**Conducted Spurious Emissions- Upper (Peak and Average)** *(Antenna Internal Gain = 6dBi)*

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 6 | -44.7 | -38.6 | -21.25 | 17.35 |
| | | | | | | | |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 6 | -78.5 | -72.4 | -41.25 | 31.15 |

**Conducted Spurious Emissions- Upper (Peak and Average)** *(Antenna Internal Gain = 5dBi)*

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 5 | -44.7 | -39.6 | -21.25 | 18.35 |
| | | | | | | | |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 5 | -78.5 | -73.4 | -41.25 | 32.15 |

**Conducted Spurious Emissions- Upper (Peak and Average)** *(Antenna Internal Gain = 4dBi)*

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 4 | -44.7 | -40.6 | -21.25 | 19.35 |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 4 | -78.5 | -74.4 | -41.25 | 33.15 |

**Conducted Spurs Average (Antenna internal gain =6dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Duty cycle correction (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | **Non HT20, 6 to 54 Mbps** | 1 | 6 | -60.2 | 0.1 | -54.1 | -41.25 | 12.9 |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 6 | -60.9 | 0.1 | -54.8 | -41.25 | 13.6 |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 6 | -62.7 | 0.1 | -56.6 | -41.25 | 15.4 |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 6 | -62.9 | 0.1 | -56.8 | -41.25 | 15.6 |

**Conducted Spurs Average (Antenna internal gain =5dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Duty cycle correction (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | **Non HT20, 6 to 54 Mbps** | 1 | 5 | -60.2 | 0.1 | -55.1 | -41.25 | 13.8 |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 5 | -60.9 | 0.1 | -55.8 | -41.25 | 14.5 |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 5 | -62.7 | 0.1 | -57.6 | -41.25 | 16.3 |

| Frequency (MHz) | Mode | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 5 | -62.9 | 0.1 | -57.8 | -41.25 | 16.5 |

**Conducted Spurs Average (Antenna internal gain =5dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Duty cycle correction (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | **Non HT20, 6 to 54 Mbps** | **1** | **4** | **-60.2** | **0.1** | **-56.1** | **-41.25** | **14.8** |
| 5745 | Non HT20, 6 to 54 Mbps | 1 | 4 | -60.9 | 0.1 | -56.8 | -41.25 | 15.5 |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 4 | -62.7 | 0.1 | -58.6 | -41.25 | 17.3 |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 4 | -62.9 | 0.1 | -58.8 | -41.25 | 17.5 |

*Conducted Spurs Average, 5720 MHz, Non HT20, 6 to 54 Mbps* (Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)



*Antenna A*

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**Conducted Spurs Peak (Antenna internal gain =6dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Duty cycle correction (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 6 | -51.2 | 0.1 | -45.1 | -21.25 | 23.9 |
| **5745** | **Non HT20, 6 to 54 Mbps** | **1** | **6** | **-50.4** | **0.1** | **-44.3** | **-21.25** | **23.1** |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 6 | -50.5 | 0.1 | -44.4 | -21.25 | 23.2 |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 6 | -50.6 | 0.1 | -44.5 | -21.25 | 23.3 |

**Conducted Spurs Peak (Antenna internal gain =5dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Duty cycle correction (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 5 | -51.2 | 0.1 | -46.1 | -21.25 | 24.8 |
| **5745** | **Non HT20, 6 to 54 Mbps** | **1** | **5** | **-50.4** | **0.1** | **-45.3** | **-21.25** | **24.0** |

| Frequency (MHz) | Mode | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5785 | | 1 | 5 | -50.5 | 0.1 | -45.4 | -21.25 | 24.1 |
| | Non HT20, 6 to 54 Mbps | | | | | | | |
| 5825 | | 1 | 5 | -50.6 | 0.1 | -45.5 | -21.25 | 24.2 |
| | Non HT20, 6 to 54 Mbps | | | | | | | |

**Conducted Spurs Peak (Antenna internal gain =4dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Spur Power (dBm) | Tx 2 Spur Power (dBm) | Total Conducted Spur (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 5720 | Non HT20, 6 to 54 Mbps | 1 | 4 | -51.2 | 0.2 | -47.1 | -21.25 | 25.8 |
| **5745** | **Non HT20, 6 to 54 Mbps** | **1** | **4** | **-50.4** | **0.2** | **-46.3** | **-21.25** | **25.0** |
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 4 | -50.5 | 0.2 | -46.4 | -21.25 | 25.1 |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 4 | -50.6 | 0.2 | -46.5 | -21.25 | 25.2 |

*Conducted Spurs Peak, 5745 MHz, Non HT20, 6 to 54 Mbps (Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*
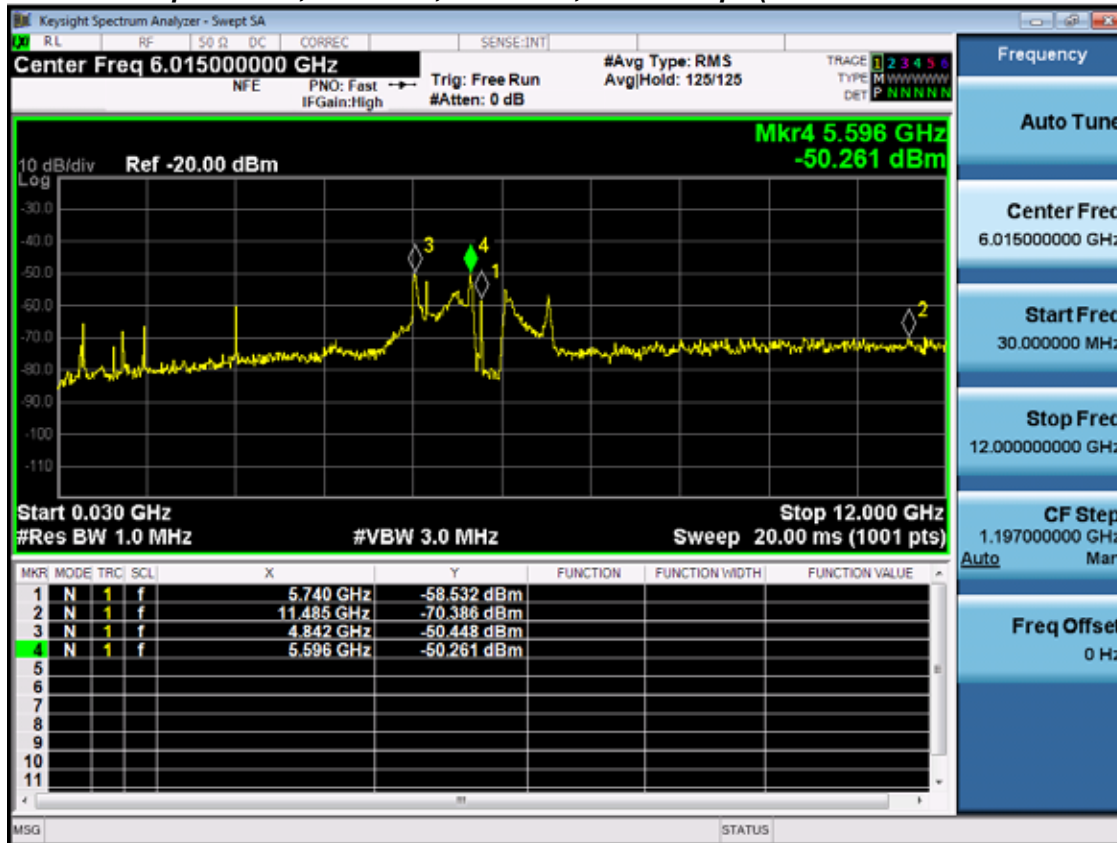


*Antenna A*

# A.7 Conducted Bandedge

## Conducted Band Edge 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:

    (**4**) For transmitters operating in the 5.725-5.85 GHz band:
    (i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

    (**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

**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]
(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

## Conducted Band Edge Test Procedure

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

| **Conducted Band edge** |
| --- |
| Test Procedure |
| 1. Connect the antenna port(s) to the spectrum analyzer input.<br>2. Place the radio in continuous transmit mode. Use the procedures in KDB 558074 D01 DTS Meas Guidance v03r05 to substitute conducted measurements in place of radiated measurements.<br>3. Configure Spectrum analyzer as per test parameters below below (be sure to enter all losses between the transmitter output and the spectrum analyzer).<br>4. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands..<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.<br>6. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands<br>7. Capture graphs and record pertinent measurement data. |

**Ref.** 789033 D02 General UNII Test Procedures New Rules v02r01

ANSI C63.10: 2013 Section 12.7.6 (Peak), Section 12.7.7.2 (Method AD)

| **Conducted Spurious Emissions** | |
|---|---|
| Test parameters | |
| **Peak** | **Average** |
| Span = 30MHz to 26.5GHz / 26.5GHz to 40GHz | Span = 30MHz to 26.5GHz / 26.5GHz to 40GHz |
| RBW = 1 MHz | RBW = 1 MHz |
| VBW ≥ 3 MHz | VBW ≥ 3 MHz |
| Sweep = Auto couple | Sweep = Auto couple |
| Detector = Peak | Detector = RMS |
| Trace = Max Hold. | Power Averaging |

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

| **Tested By :** | **Date of testing:** |
|---|---|
| Abhishek Upadhyay | 16-Sep-19 - 24-Sep-19 |
| **Test Result : PASS** | |

**Test Equipment**
See Appendix C for list of test equipment

**Conducted Bandedge Peak Left (Antenna internal gain =6dBi)**

| Frequency (MHz) 5745 | 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 | 6 | -57.0 | -50.9 | -27.00 | 23.9 |

**Conducted Bandedge Peak Left (Antenna internal gain =5dBi)**

**Conducted Bandedge Peak Left (Antenna internal gain =4dBi)**

| Frequency (MHz) 5745 | 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 | -57.0 | -51.9 | -27.00 | 24.9 |

| Frequency (MHz) 5745 | 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 | 4 | -57.0 | -52.9 | -27.00 | 25.9 |

*Conducted Bandedge Peak 15407L, 5745 MHz, Non HT20, 6 to 54 Mbps(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*



*Antenna A*

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**Conducted Bandedge Peak Right (Antenna internal gain =6dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 6 | -54.7 | -48.6 | -27.00 | 21.6 |
| | | | | | | | |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 6 | -55.0 | -48.9 | -27.00 | 21.9 |

**Conducted Bandedge Peak Right (Antenna internal gain =5dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 5785 | Non HT20, 6 to 54 Mbps | 1 | 5 | -54.7 | -49.6 | -27.00 | 22.6 |
| | | | | | | | |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 5 | -55.0 | -49.9 | -27.00 | 22.9 |

**Conducted Bandedge Peak Right (Antenna internal gain =4dBi)**

| Frequency (MHz) | Mode | Tx Paths | Correlated Antenna Gain (dBi) | Tx 1 Bandedge Level (dBm) | Total Tx Bandedge Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| **5785** | **Non HT20, 6 to 54 Mbps** | **1** | **4** | **-54.7** | **-50.6** | **-27.00** | **23.6** |
| | | | | | | | |
| 5825 | Non HT20, 6 to 54 Mbps | 1 | 4 | -55.0 | -50.9 | -27.00 | 23.9 |

*Conducted Bandedge Peak 15407R, 5785 MHz, Non HT20, 6 to 54 Mbps(Antenna Internal Gain = 4 dBi , 5 dBi and 6dBi)*
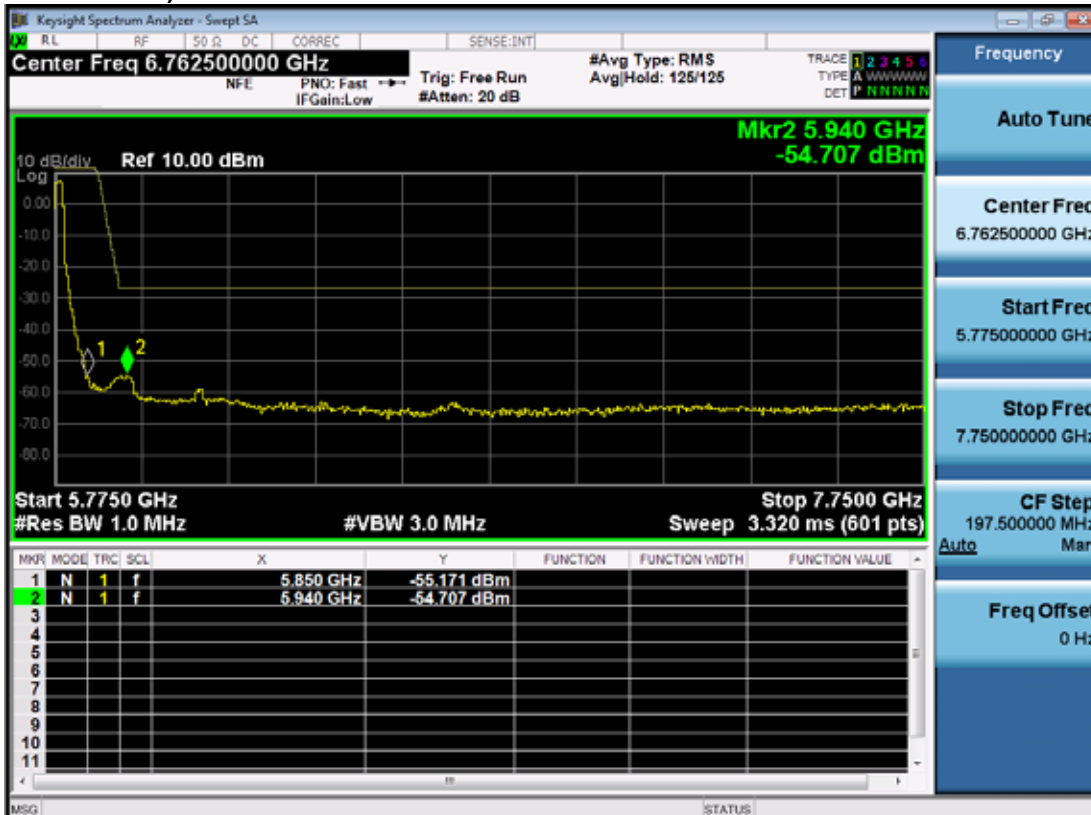


*Antenna A*

**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
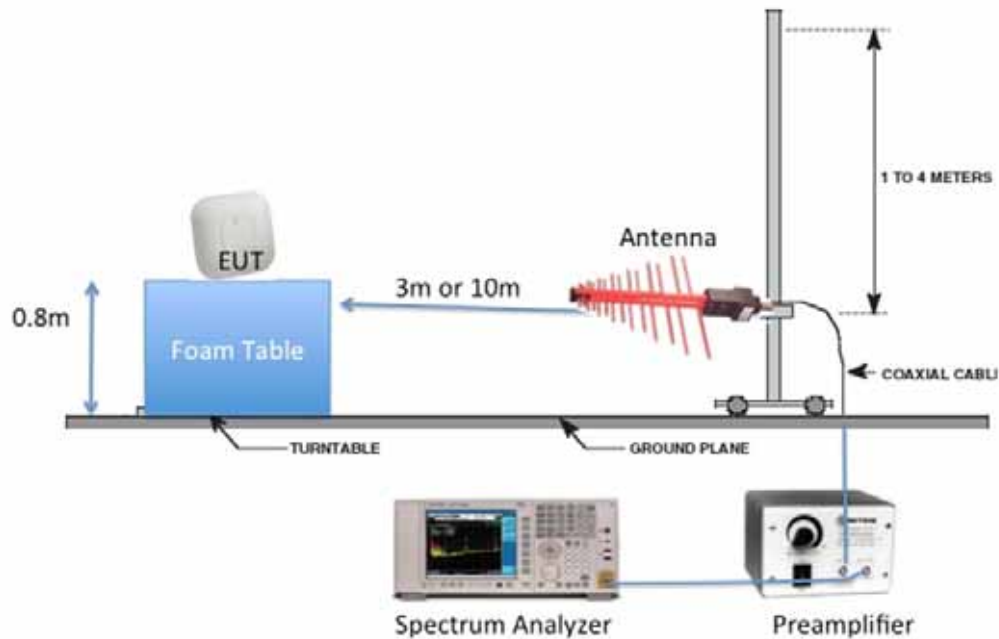


# Radiated Emission Setup Diagram-Above 1G
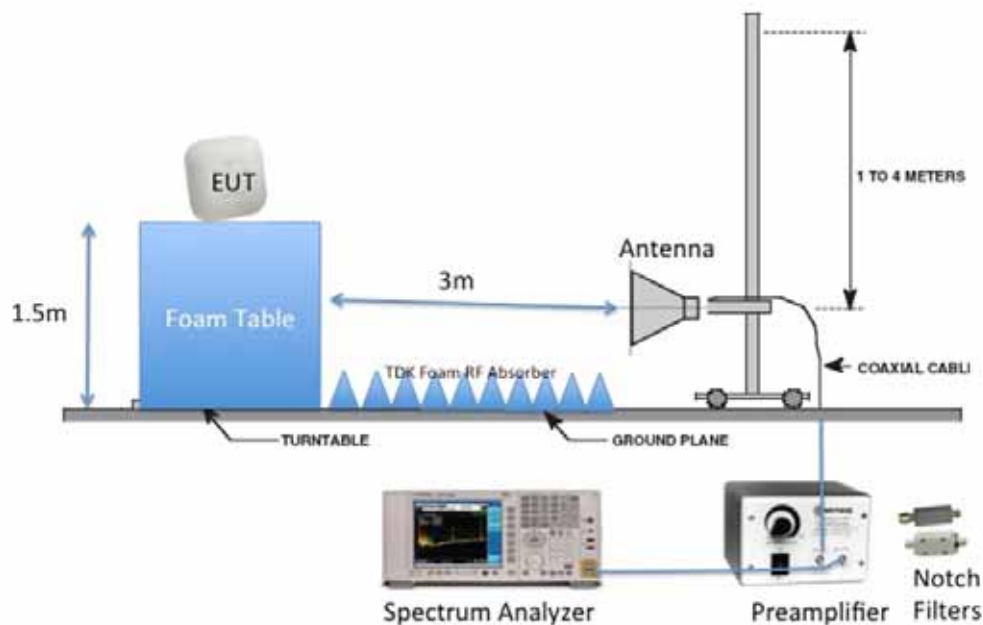
## B.1 Radiated Spurious Emissions

Not covered by the scope of this test report.

## B.2 Receiver Spurious Emissions

Not covered by the scope of this test report.

## B.3 Radiated Emissions 30MHz to 1GHz

Not covered by the scope of this test report.

## B.4 AC Conducted Emissions

Not covered by the scope of this test report.

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

| Equip# | Manufacturer/ Model | Description | Last Cal | Next Due | Test Item |
|---|---|---|---|---|---|
| 57478 | Cisco | Automation Test Insertion Loss | Cal not required | | A1-A8 |
| 53615 | Keysight N9030A-550 | PXA Signal Analyzer, 3Hz to 50GHz | 16 Jul 2019 | 16 Jul 2020 | A1-A8 |
| 55096 | NI PXI-1042 | CHASSIS, PXI | Cal not required | | A1-A8 |
| 57239 | NI PXI-8115 | Embedded Controller | Cal not required | | A1-A8 |
| 57250 | NI PXI-2796 | 40 GHz Dual 6x1 Multiplexer (SP6T) | Cal not required | | A1-A8 |
| 57251 | NI PXI-2799 | Switch 1x1 | Cal not required | | A1-A8 |
| 56093 | NI PXI-2796 | 40 GHz Dual 6x1 Multiplexer (SP6T) | Cal not required | | A1-A8 |
| 7329 | Omega CT485B | Chart recorder | 18 Feb 2019 | 18 Feb 2020 | A1-A8 |
| 56328 | Pasternack PE5019-1 | Torque wrench | 14 Feb 2019 | 14 Feb 2020 | A1-A8 |
| 56329 | Pasternack PE5019-1 | Torque wrench | 28 Feb 2019 | 28 Feb 2020 | A1-A8 |
| 56330 | Pasternack PE5019-1 | Torque wrench | 28 Feb 2019 | 28 Feb 2020 | A1-A8 |
| 54303 | Keysight N5182B | MXG X-Series RF Vector Signal Generator | 8 Oct 2018 | 27 Dec 2019 | A1-A8 |
| 49389 | ROHDE & SCHWARZ NRP2 | Power Meter | 21 Nov 2018 | 21 Nov 2019 | A1-A8 |
| 49390 | ROHDE & SCHWARZ NRP-Z21 | Power Sensor | 21 Nov 2018 | 21 Nov 2019 | A1-A8 |

## 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 $(1 \times 10^3)$ |
| EN | European Norm | MHz | MegaHertz $(1 \times 10^6)$ |
| IEC | International Electro technical Commission | GHz | Gigahertz $(1 \times 10^9)$ |
| 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 $(1 \times 10^3)$ |
| L1 | Line 1 | μV | Microvolt $(1 \times 10^{-6})$ |
| L2 | Line2 | A | Amp |
| L3 | Line 3 | μA | Micro Amp $(1 \times 10^{-6})$ |
| DC | Direct Current | mS | Milli Second $(1 \times 10^{-3})$ |
| RAW | Uncorrected measurement value, as indicated by the measuring device | μS | Micro Second $(1 \times 10^{-6})$ |
| RF | Radio Frequency | μS | Micro Second $(1 \times 10^{-6})$ |
| 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 |

## Appendix E: Photographs of Test Setups

Please refer to the attachment

## Appendix F: Software Used to Perform Testing

Cisco Internal LabView Radio Test Automation Software – RF Automation Main rev 57 patch 91
Cisco Internal LabView Radio Test Automation Software – Report Generation Main rev 44

## 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 |

## 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

## Appendix I: Test Assessment Plan

Radio Reg Plan: EDCS# 16415403

## Appendix J: UUT Software Info

```
APA453.0E7B.CCD0#
APA453.0E7B.CCD0#Show ver
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          San Jose, California 95134-1706

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Cisco AP Software, (ap1g7),
[cheetah-build6:/san2/BUILD/workspace/Nightly-Cheetah-axel-bcm-mfg-c8_10_throttle]
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2019 by Cisco Systems, Inc.
Compiled Fri Sep  6 08:06:05 PDT 2019

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

APA453.0E7B.CCD0 uptime is 0 days, 5 hours, 53 minutes
Last reload time  : Fri Sep 6 16:50:44 UTC 2019
Last reload reason : kernel panic

cisco C9120AXE-B  with 1809824/1061760K bytes of memory.
Processor board ID 0
AP Running Image     : 8.8.1.10
Primary Boot Image   : 8.8.1.10
Backup Boot Image    : 0.0.0.0
Primary Boot Image Hash:
Backup  Boot Image Hash:
1 Gigabit Ethernet interfaces
2 802.11 Radios
Radio Driver version : 17.10 RC77.13
Radio FW version : 1268.14948.r14702 14702
NSS FW version : NA
Base ethernet MAC Address        : A4:53:0E:7B:CC:D0
Part Number                      : 0-000000-00
PCA Assembly Number              : 800-105708-01
PCA Revision Number              : 09

```
PCB Serial Number                   : FOC23302F0Q
Top Assembly Part Number            : 800-105708-01
Top Assembly Serial Number          : 0
Top Revision Number                 : 09
Product/Model Number                : C9120AXE-B


APA453.0E7B.CCD0#Test watchdog monitoring off
APA453.0E7B.CCD0#
APA453.0E7B.CCD0#devshell
EXITING CISCO SHELL. PLEASE EXECUTE EXIT IN DEVSHELL TO GET BACK TO CISCO SHELL.


BusyBox v1.29.3 () built-in shell (ash)

Welcome to Cisco.

Usage of this device is governed by Cisco's End User License Agreement,
available at:
http://www.cisco.com/c/en/us/td/docs/general/warranty/English/EU1KEN_.html.
mA4530E7BCCD0:/# cat MERAKI_BUILD.extra
Fri Sep  6 08:06:05 PDT 2019
cheetah-build6
/san2/BUILD/workspace/Nightly-Cheetah-axel-bcm-mfg-c8_10_throttle


* (HEAD detached at fb31ca5b6a)

svn base: fb31ca5b6ab1468794221acdd081bea192921139
commit: fb31ca5b6ab1468794221acdd081bea192921139
tree 9933345a372cf5493649162765b52efdf4ff9219
mA4530E7BCCD0:/#
mA4530E7BCCD0:/# show_cookie
Part Number                         : 0-000000-00
Board Revision                      : 00
PCB Serial Number                   : FOC23302F0Q
PCB Fab Part Number                 : 0-000000-00
Deviation Number                    : 0
MAC Address                         : A4:53:0E:7B:CC:D0
MAC Address Block Size              : 4
Radio 0 MAC Address                 : D4:AD:BD:A2:16:80
Radio 0 MAC Address Block Size      : 16
Radio 1 MAC Address                 : D4:AD:BD:A2:16:90
Radio 1 MAC Address Block Size      : 16
PCA Assembly Number                 : 800-105708-01
PCA Revision Number                 : 09
Product/Model Number                : C9120AXE-B
Top Assembly Part Number            : 800-105708-01
Top Revision Number                 : 09
Top Assembly Serial Number          : 0
RMA Test History                    : 00
RMA History                         : 00
RMA Number                          : 00-00-00-00
Device Type                         : 4C
Max Association Allowed             : 2
Radio(2.4G) Carrier Set             : 0000
Radio(2.4G) Max Transmit Power Level : 100
Radio(2.4G) Antenna Diversity Support: 01
Radio(2.4G) Encryption Ability      : 0002
Radio(5G) Carrier Set               : 0029
Radio(5G) Max Transmit Power Level  : 100
Radio(5G) Antenna Diversity Support : 01
Radio(5G) Encryption Ability        : 0002
Radio(802.11g) Radio Mode           : 255
```

```
PEP Product Identifier (PID)        : C9120AXE-B
PEP Version Identifier (VID)        : V01
System Flags                        : 00
Controller Type                     : 0000
Host Controller Type                : 0000
Mfr Service Date                    : 2019.08.03-47:59:59
Radio(49) Carrier Set               : 0000
Radio(49) Max Transmit Power Level  : 0
Radio(49) Antenna Diversity Support : 00
Radio(49) Encryption Ability        : 0000
Radio(58) Carrier Set               : 0029
Radio(58) Max Transmit Power Level  : 100
Radio(58) Antenna Diversity Support : 01
Radio(58) Encryption Ability        : 0002
ACT2 ID                             : C9120
Static AP Mode                      : 0
mA4530E7BCCD0:/# cat /storage/rxtx_mode
tx
mA4530E7BCCD0:/# echo tx > /storage/rxtx_mode
mA4530E7BCCD0:/# cd /usr/bin/bcm/mfg
mA4530E7BCCD0:/usr/bin/bcm/mfg# ./init_config.sh
show_carrier_cookies | grep -o '..$'
41
wl -i apr1v0 country US
wl -i apr0v0 country US
Chanspec set to 0x1001
[*09/06/2019 22:46:29.0500] wlc_ucode_download: wl1: Loading 129 MU ucode
Chanspec set to 0xd024
[*09/06/2019 22:46:29.1280] wlc_ucode_download: wl0: Loading 129 MU ucode
mA4530E7BCCD0:/usr/bin/bcm/mfg# rhl_gpio 4 1
mA4530E7BCCD0:/usr/bin/bcm/mfg# ./dfstool.lua

Vanc dfstool
BOARD: Axel BCM !!!!!!

Display config:
wl -i apr0v0 status | head -3
"Not associated. Last associated with SSID: """

Display config:
wl -i apr1v0 status | head -3
"Not associated. Last associated with SSID: """

show_carrier_cookies | grep -o '..$'
rc:result="41"

wl -i apr1v0 country US
wl -i apr0v0 country US
>
```

## -------------- *End* --------------