

**Radio Test Report**  
**(Radiated Spurious Emissions Only)**

**For**

**WiFi module: WP-WIFI6-A, WP-WIFI6-B**

**Supports**

**2.4 GHz / 5 GHz 802.11 a/ac/ax/b/g/n Wi-Fi radio**

**In**

**Host systems: IR1821-K9, IR1831-K9, IR1833-K9, IR1835-K9**

**FCC ID: LDKWPWIFI6**

**IC: 2461N-WPWIFI6**

**2400-2483.5 MHz**

Against the following Specifications:

47 CFR 15.247

47 CFR 15.205


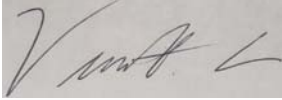
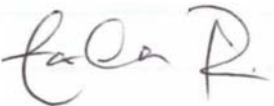


47 CFR 15.209

RSS-247 issue 2

RSS-Gen issue 5



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

<b>Author:</b>	
<b>Tested By:</b> <b>Title:</b> Test Engineers	 Vincent Chiu  Farida Rahmanzai  Danh Le
<b>Approved By:</b> <b>Title:</b> Compliance Manager	 Howard Ji
<b>Version:</b>	1.0

This report replaces any previously entered test report under EDCS –21673982. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 703456.

**SECTION 1: OVERVIEW .....4**

1.1 TEST SUMMARY .....	4
<b>SECTION 2: ASSESSMENT INFORMATION .....</b>	<b>5</b>
2.1 GENERAL .....	5
2.2 UNITS OF MEASUREMENT .....	5
2.3 DATE OF TESTING (INITIAL SAMPLE RECEIPT DATE TO LAST DATE OF TESTING) .....	7
2.4 REPORT ISSUE DATE .....	7
2.5 TESTING FACILITIES .....	7
2.6 EQUIPMENT ASSESSED (EUT) .....	8
2.7 EUT DESCRIPTION .....	8
<b>SECTION 3: RESULT SUMMARY .....</b>	<b>11</b>
3.1 RESULTS SUMMARY TABLE .....	11
<b>SECTION 4: SAMPLE DETAILS .....</b>	<b>12</b>
4.1 SAMPLE DETAILS .....	12
<b>APPENDIX A: RADIATED SPURIOUS EMISSION .....</b>	<b>13</b>
A.1: SETUP DIAGRAM .....	13
A.2: RADIATED SPURIOUS EMISSIONS TEST REQUIREMENTS & LIMITS .....	15
<i>A.2.1: Limit Conversion (power to field strength)</i> .....	19
<i>A.2.2: Test Procedure</i> .....	20
<i>A.2.3: TX Radiated Spurious Emissions Graphical Data Results</i> .....	21
A.3: RECEIVER SPURIOUS EMISSIONS .....	30
<i>A.3.1: Rx Radiated Spurious Emissions Graphical Data Results</i> .....	31
A.4 AC CONDUCTED EMISSIONS .....	34
<i>A.4.1: AC Line conducted emissions results</i> .....	35
<b>APPENDIX B: LIST OF TEST EQUIPMENT USED TO PERFORM THE TEST .....</b>	<b>37</b>
<b>APPENDIX C: PHOTOGRAPHS OF TEST SETUPS .....</b>	<b>39</b>
<b>APPENDIX D: ABBREVIATION KEY AND DEFINITIONS .....</b>	<b>40</b>
<b>APPENDIX E: SOFTWARE USED TO PERFORM TESTING .....</b>	<b>41</b>
<b>APPENDIX F: TEST PROCEDURES .....</b>	<b>42</b>
<b>APPENDIX G: SCOPE OF ACCREDITATION (A2LA CERTIFICATE NUMBER 1178-01) .....</b>	<b>43</b>
<b>APPENDIX H: TEST ASSESSMENT PLAN .....</b>	<b>44</b>
<b>APPENDIX I: WORST CASE JUSTIFICATION .....</b>	<b>44</b>

**Section 1: Overview****1.1 Test Summary**

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

Specifications
47 CFR 15.247 47 CFR 15.205 47 CFR 15.209  RSS-247 Issue 2 RSS-Gen Issue 5

## Section 2: Assessment Information

### 2.1 General

This report contains an assessment of an apparatus against Radio 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 (59°F to 95°F)  
Atmospheric Pressure    860mbar to 1060mbar (25.4" to 31.3")  
Humidity                    10% to 75\*%

1. All DC testing was performed at one or more of the following supply voltages:

12VDC (The supply voltage range supports 12V-36VDC)

### 2.2 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	$\pm 2$ dB
conducted EIRP measurements	$\pm 1.4$ dB
radiated measurements	$\pm 3.2$ dB
frequency measurements	$\pm 2.4$ 10 <sup>-7</sup>
temperature measurements	$\pm 0.54^\circ$ .
humidity measurements	$\pm 2.3\%$
DC and low frequency measurements	$\pm 2.5\%$ .

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.

**This report must not be reproduced except in full, without written approval of Cisco Systems.**

**2.3 Date of testing (initial sample receipt date to last date of testing)**

30-March-2021 to 09-April-2021

**2.4 Report Issue Date**

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

**2.5 Testing facilities**

This assessment was performed by:

**Testing Laboratory**

Cisco Systems, Inc.  
425 West Tasman Drive (Building 7)  
San Jose, CA 95134  
USA

**Headquarters**

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

**Registration Numbers for ISED (Innovation, Science and Economic Development Canada)**

Cisco System Site	Address	Site Identifier
Building P, 10m Chamber	125 West Tasman Dr San Jose, CA 95134 United States	Company #: 2461N-2
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134 United States	Company #: 2461N-1
Building 7, 5m Chamber	425 E. Tasman Drive San Jose, California 95134 United States	Company #: 2461N-3

**Test Engineers**

Farida Rahmanzai, Vincent Chiu, Danh Le

## **2.6 Equipment Assessed (EUT)**

**Radio Module:** WP-WIFI6-B

**Host System:** IR1835-K9

## **2.7 EUT Description**

WP-WIFI6 is Wifi 802.11ax Wi-Fi 6 access point module for industrial IoT routing and gateway platforms which is a field replaceable Wifi interface module designed for IR1800 series platform. It includes a 2x2 MIMO 802.11ax 2.4 GHz radio and a 2x2 MIMO 802.11ax 5 GHz radio

IR1835-K9 is the next generation of IR829, based on IOS XE, with advanced features such as modular WiFi, modular Cellular/WAN, CAN Bus, Dead Reckoning etc.

The product has the following interfaces:

4 GE LAN Ports

1 GE WAN / 1 Fiber Port (Alternate to GE Copper port)

1 RS-232 Serial

1 RS232/RS485

1 Type-A USB for Storage

1 GPS Slot

1 WIFI Slot

1 mSATA Slot

2 Cellular PIM Slots [Main Aux and GPS (Only on Sierra Wireless Modules)]

Alarm Port

Micro-USB

DC Power input (DC Min/Max 9-32)

## WiFi module Model/PID Differences

The WP-WIFI6 Access Point module is designed for use in many countries with varying regulatory requirements. The WP-WIFI6-A and WP-WIFI6-B, both have the same identical components, electronics circuitries, PCB layout and enclosure. The WP-WIFI6-A module is configured with the Canada country code and the WP-WIFI6-B module is configured with US country code. The US and Canada country codes are configured according to the test results demonstrated compliance in the RF conducted emissions FCC/RSS test reports. The difference between the 2 PIDs (WP-WIFI6-A and WP-WIFI6-B) is the UNII-1 (5150MHz – 5250MHz) band is not supported in the WP-WIFI6-A PID.

## Host system Model/PID differences

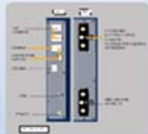
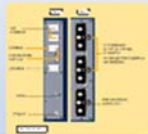
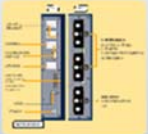
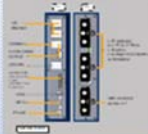
**IR1821-K9**

**IR1831-K9**

**IR1833-K9**

**IR1835-K9** ----- System Tested

The following host models are in the same IR18xx family. IR1835-K9 is the highly populated host model out of all 4 models and selected model for testing. The radio WP-WiFi6-E module in these host has the same identical components, electronics circuitries and PCB layout. Below table summarizes the differences between all four host models.

	IR1821-K9	No PoE IR1831-K9	With PoE IR1833-K9	IR1835-K9
				
Processor	600MHz	600MHz	600MHz	1200MHz
Memory	4GB	4GB	4GB	8GB
Single LTE Slots	✓	✗	✗	✗
Dual LTE Slot	✗	✓	✓	✓
WiFi (FRU)	✓	✓	✓	✓
PoE	✗	✗	✓	✓
mSATA (FRU)	✗	✗	✓	✓
Dedicated GPS (FRU)	✗	✗	✓	✓
GPIO	✗	✗	✗	✓
Serial Interface	RS232 (1)	RS232 (2)	RS232 (2)	RS232, RS232/485

## Antenna Specification

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	Peak Antenna Gain (dBi)	>30 degree 5 GHz Antenna Gain (dBi)
<b>2.4/5 GHz</b>	W-ANTM2050D-RPSMA=	Omnidirectional swivel stick dipole	<b>2 / 4</b>	<b>0</b>
	W-ANTM2-O-2-RPSMA	Omnidirectional	<b>4 / 4</b>	<b>0</b>
	ANT-7-5G4WL2G1-O=	7-in-1 vehicle mount omnidirectional	<b>8 / 8</b>	<b>3</b>
	5G-ANTM-O-4-B=	9-in-1 vehicle mount omnidirectional	<b>8 / 8</b>	<b>3</b>

## Section 3: Result Summary

### 3.1 Results Summary Table

#### Radiated Emissions (General requirements)

Basic Standard	Technical Requirements / Details	Result
FCC 15.209 FCC 15.205 FCC 15.247 (d) RSS-Gen	<b>TX Spurious Emissions:</b> 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. Unwanted emissions falling within the restricted bands, as defined in FCC 15.205 (a) and RSS-Gen 8.10 must also comply with the radiated emission limits specified in FCC 15.209 (a) and RSS-Gen 8.9	Pass

## 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. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

### 4.1 Sample Details

Sample Number	Equipment Details	Serial Number	CISCO Part Number
S01	WP-WiFi6-B Single Band Radio in IR1835 Host system with 2.4Ghz Wi-Fi radio actives	Module: FOC24490FG7 Host: FCW2443P0DH	Module: 68-103267-01 13
S02	External Patch antenna (8 dBi Gain)	-----	5G-ANTM-O-4-B=

Note: The host system is powered by 12VDC. The host supply voltage range supports 12V-36VDC.

### 4.2 System Details

System #	Description	Samples
1	WP-WiFi6-B Dual Band Radio in IR1835 Host system with 2.4GHz Wi-Fi radio actives + ext. PS + ext. 8 dBi patch ant.	S01, S02

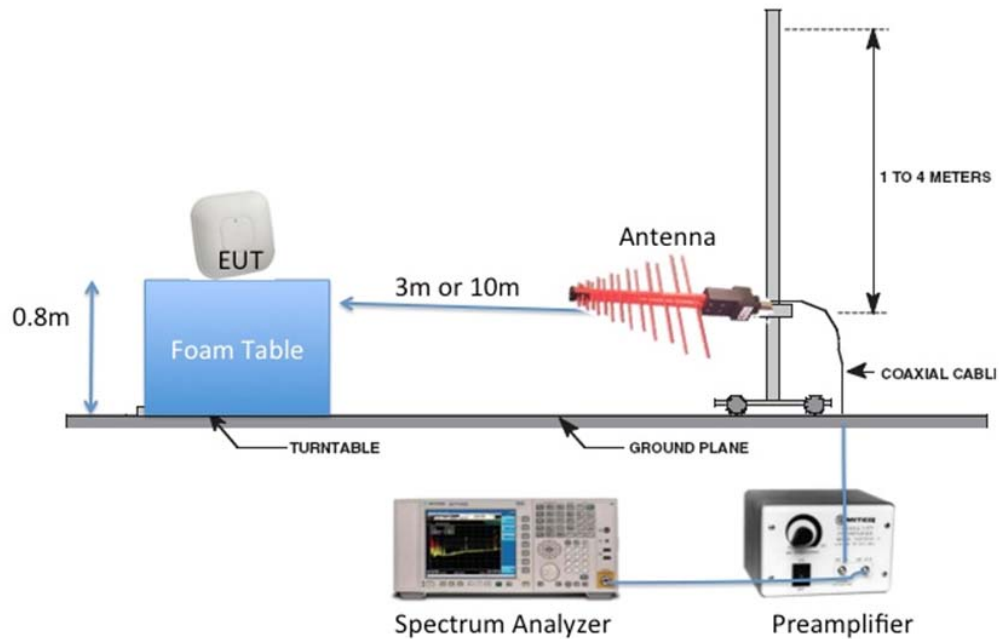
### 4.3 Mode of Operation Details

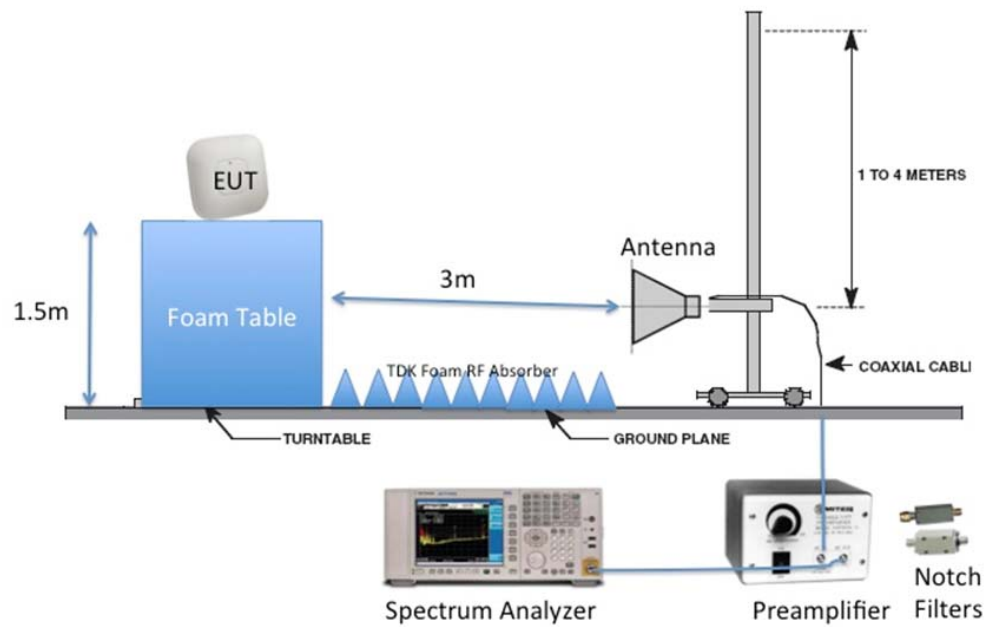
Mode (Radio band support, # of active antenna)	Wi-Fi Mode	Modulation	Data Rate
Transmit (dual antenna)	802.11HE20 (2.4GHz)	MIMO-OFDMA	M0h1
Receiver (dual antenna)	802.11HE20 (2.4GHz)	MIMO-OFDMA	M0h1
<b>Note: All testing was performed at 19dBm per antenna port which is maximum supported power level. The testing at maximum supported power will cover all other power levels and other supported modes</b>			

## Appendix A: Radiated Spurious Emission

### A.1: Setup Diagram

Radiated Emission Setup Diagram-Below 1G  
(Preamp used is optional)



**Radiated Emission Setup Diagram-Above 1G**

## **A.2: Radiated Spurious Emissions Test Requirements & Limits**

Emissions on frequency or frequencies which are outside the necessary bandwidth and level of which may be reduced without effecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

## Restricted bands Limits

**15.247 (d)** In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

**15.205 (b)** Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in [§ 15.209](#). At frequencies equal to or less than 1000 MHz, compliance with the limits in [§ 15.209](#) shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in [§ 15.209](#) shall be demonstrated based on the average value of the measured emissions. The provisions in [§ 15.35](#) apply to these measurements.

FCC Restricted Bands Table			
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

**RSS-Gen 8.10**

(b) Unwanted emissions that fall into restricted bands of Table 7 shall comply with the limits specified in table 5 (general field strength limits at frequencies above 30 MHz) and table 6 (general field strength limits at frequencies below 30 MHz).

(c) Unwanted emissions that do not fall within the restricted frequency bands of Table 7 comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

**Table 7 Restricted Bands**

<b>MHz</b>	<b>MHz</b>	<b>GHz</b>
0.090-0.110	74.8-75.2	9.0-9.2
2.1735-2.1905	108-138	9.3-9.5
3.020-3.026	156.52475-156.52525	10.6-12.7
4.125-4.128	156.7-156.9	13.25-13.4
4.17725-4.17775	240-285	14.47-14.5
4.20725-4.20775	322-335.4	15.35-16.2
5.677-5.683	399.9-410	17.7-21.4
6.215-6.218	608-614	22.01-23.12
6.26775-6.26825	960-1427	23.6-24.0
6.31175-6.31225	1435-1626.5	31.2-31.8
8.291-8.294	1645.5-1646.5	36.43-36.5
8.362-8.366	1660-1710	Above 38.6
8.37625-8.38675	1718.8-1722.2	*
8.41425-8.41475	2200-2300	
12.29-12.293	2310-2390	
12.51975-12.52025	2655-2900	
12.57675-12.57725	3260-3267	
13.36-13.41	3332-3339	
16.42-16.423	3345.8-3358	
16.69475-16.69525	3500-4400	
16.80425-16.80475	4500-5150	
25.5-25.67	5350-5460	
37.5-38.25	7250-7750	
73-74.6	8025-8500	

**FCC 15.209**

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a).

**RSS-Gen 8.9:**

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits Table			
Frequency (MHz)	Field strength (uV/meter)	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100**	40 Qp	3
88-216	150**	43.5 Qp	3
216-960	200**	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector

### A.2.1: Limit Conversion (power to field strength)

The field strength limit in dBμV can be converted from power (logarithmic) by using the field strength (linear) approach formula as follows:

$$V/m = \frac{\sqrt{30 \times P_t \times g_t}}{d}$$

where: **pt** = transmitter output power in watts,  
**gt** = numeric gain of the transmitting antenna (unit less),  
**E** = electric field strength in V/m,  
**d** = measurement distance in meters (m).

From the equation above, unit conversion from log => linear with a known power limit of -27 dBm.

#### (1) Conversion from dBm to Watt

$$\text{dBm to Watts } W = 10^{((\text{dBm} - 30)/10)}$$

$$\begin{aligned} P(W) &= 10^{(-27 - 120) / 20} \\ &= 10^{-5.7} \\ &= 1.995 \times 10^{-6} \end{aligned}$$

#### (2) Convert from Watt to field strength

a. Convert from Watt to V/m @ 3m distance

$$\begin{aligned} V/m &= \frac{\sqrt{30 \times P_t \times g_t}}{3} \\ &= \frac{\sqrt{30 \times 0.000001995 \times 1}}{3} \\ &= 0.00257 \end{aligned}$$

b. Convert field strength to power density (V/m to dBμV/m)

$$\begin{aligned} \text{dB}\mu\text{V/m} &= 20 \log (V/m) + 120 \\ &= 68.2 \end{aligned}$$

## A.2.2: Test Procedure

**Ref.** ANSI C63.10-2013 section 6.5 & 6.6, Cisp16-1-1

ANSI C63.10: 2013 section 4.1.4 / section 12.7.5 (Quasi-Peak), section 12.7.6 (peak), section 12.7.7.3 (average)

Test parameters
(i) Span = Entire frequency range or segment if necessary.
(ii) Reference Level = 80 dBuV
(iii) RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz)
(iv) VBW $\geq 3 \times$ RBW
(v) Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Change VBW to 10 Hz for average measurement
(vi) Sweep Time = Couple



Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

**30MHz – 18GHz,**

Save plots: Peak plot (Vertical and Horizontal) @3m

**Above 18 GHz,**

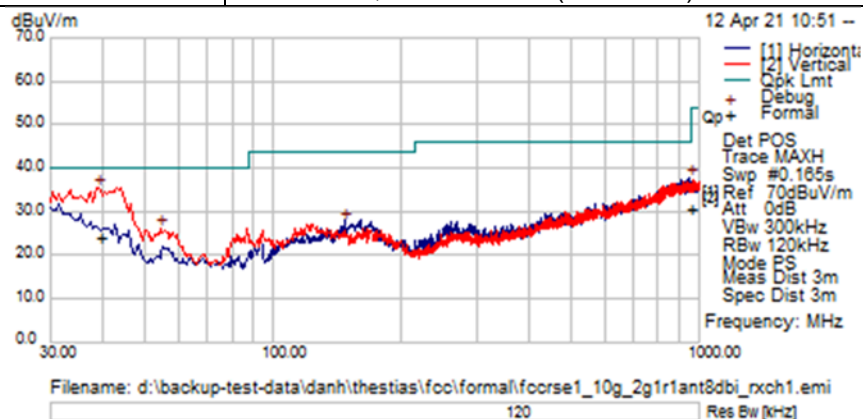
Save plots: Peak plot (Vertical and Horizontal) @1m

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.

**Note:** The data displayed on the plots detailed in the graphical test results section were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements.

### A.2.3: TX Radiated Spurious Emissions Graphical Data Results

<b>Subtest Date:</b>	12-April-2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Transmitter Spurious Emissions
<b>Frequency Range</b>	30MHz - 1GHz
<b>Comments on the above Test Results</b>	802.11HE20, Tx Channel 1 (2412 MHz)

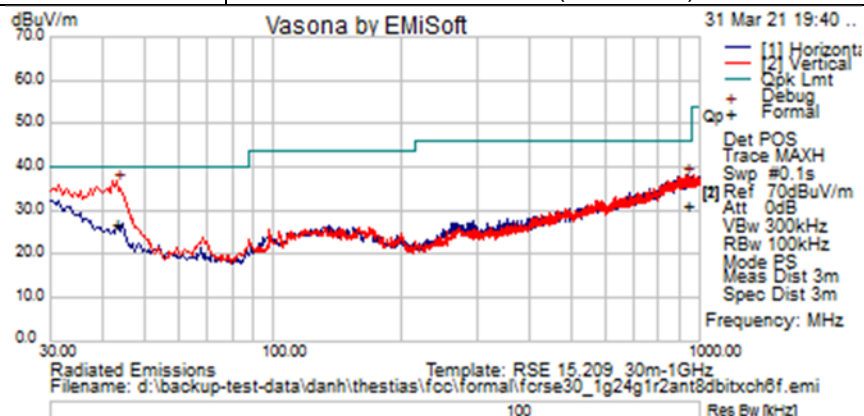


Title: TX Spurious Emissions from 30MHz-1GHz – Ch1 (2412 MHz)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
38.9985	8.9	0.63	14.6	24.13	Quasi-Pk	V	270	22	40	-15.87	Pass	
951.7645	4.95	3.12	22.88	30.94	Quasi-Pk	H	149	248	46	-15.06	Pass	

<b>Subtest Date:</b>	31-Mar-2021
----------------------	-------------

Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	802.11HE20, Tx Channel 6 (2437 MHz)

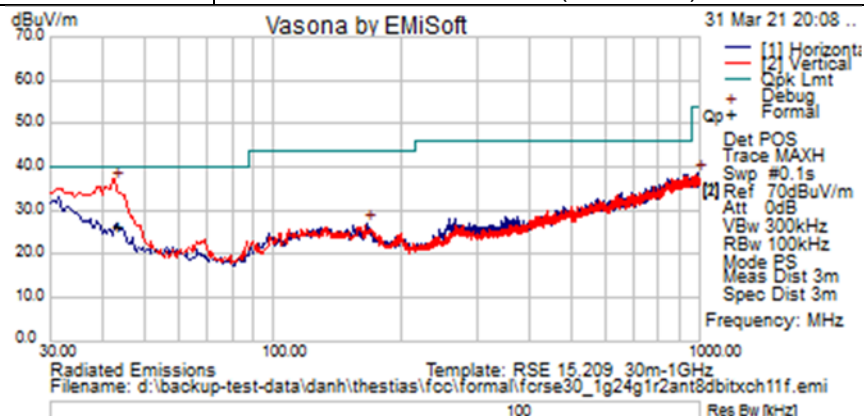


Title: TX Spurious Emissions from 30MHz-1GHz – Ch6 (2437 MHz)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
42.79	14.63	0.66	11.77	27.06	Quasi-Pk	V	100	322	40	-12.94	Pass	
934.22325	5.47	3.08	22.8	31.35	Quasi-Pk	H	191	365	46	-14.65	Pass	

Subtest Date:	31-Mar-2021
---------------	-------------

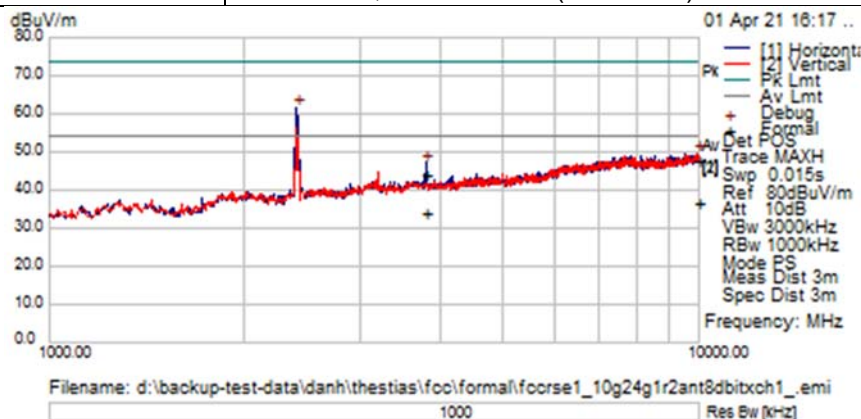
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	802.11HE20, Tx Channel 11 (2462 MHz)



Title: TX Spurious Emissions from 30MHz-1GHz – Ch11 (2462 MHz)

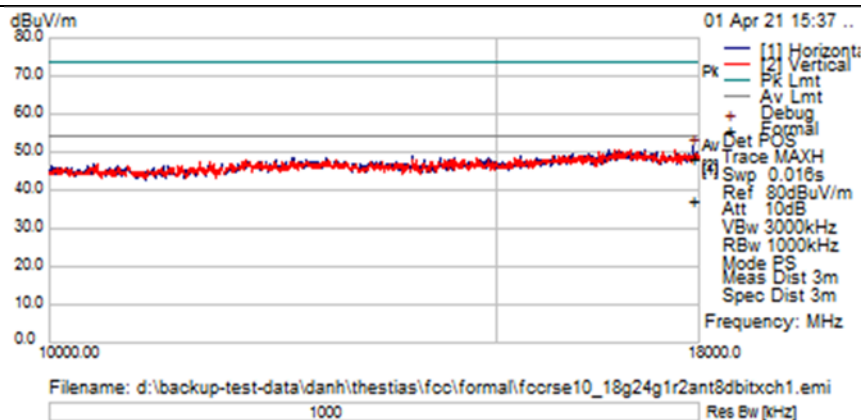
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
42.564	14.14	0.66	11.95	26.75	Quasi-Pk	V	106	325	40	-13.25	Pass	

<b>Subtest Date:</b>	01-April-2021 to 08-April-2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Transmitter Spurious Emissions
<b>Frequency Range</b>	1GHz – 26.5GHz
<b>Comments on the above Test Results</b>	802.11HE20, Tx Channel 1 (2412 MHz)

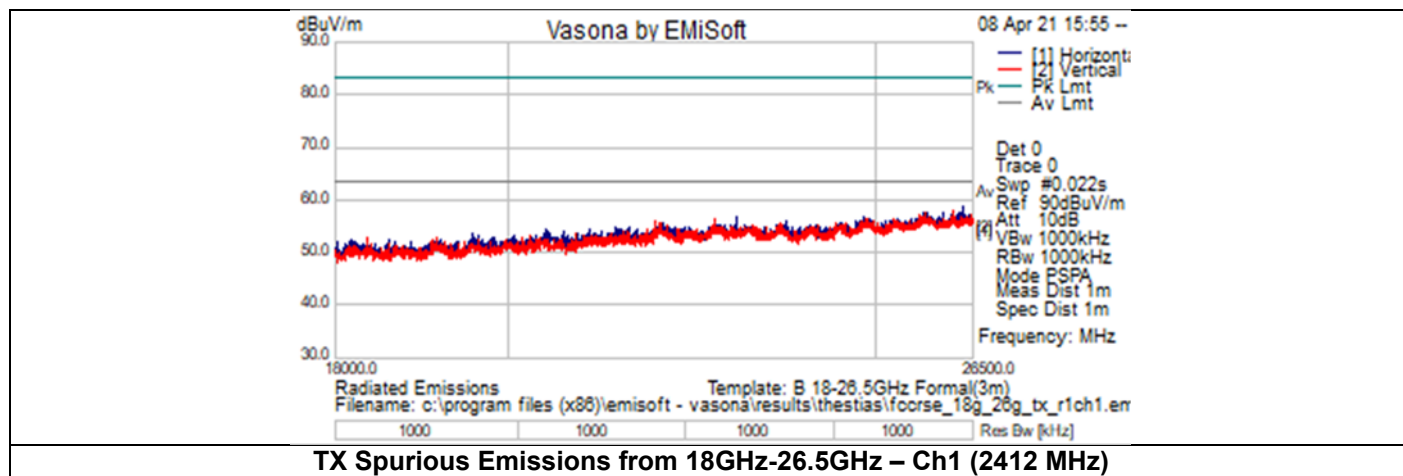


#### TX Spurious Emissions from 1GHz-10GHz – Ch1 (2412 MHz)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2400.625	63.71	5.56	-7.43	61.84	Peak	H	100	306	-----	-----	Ignored	Fundamental
3801.25	33.4	7.21	-6.38	34.23	Average	V	173	0	54	-19.77		
3801.25	43.27	7.21	-6.38	44.09	Peak	V	173	0	74	-29.91		
9955	26.37	12.48	-2.1	36.74	Average	V	267	43	54	-17.26		
9955	37.57	12.48	-2.1	47.95	Peak	V	267	43	74	-26.05		

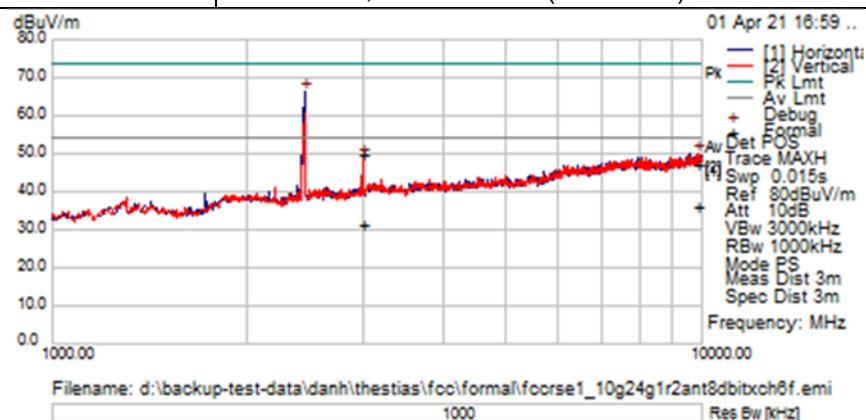


#### TX Spurious Emissions from 10GHz-18GHz – Ch1 (2412 MHz)



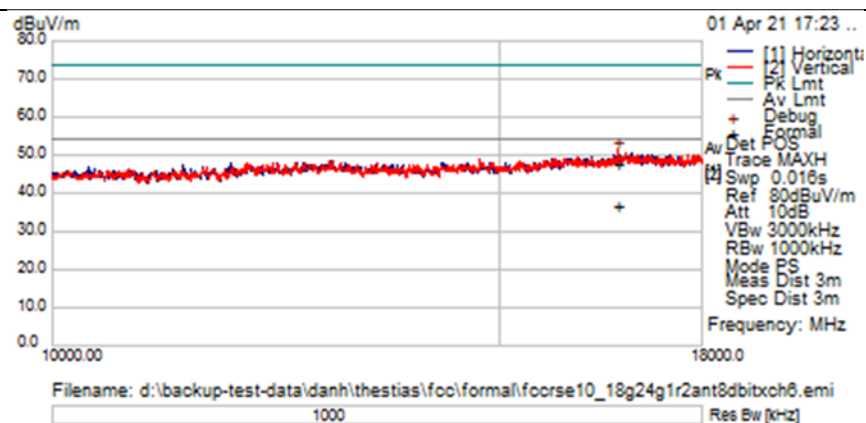
**Note:** No measurable emissions found from 10GHz – 26.5GHz.

<b>Subtest Date:</b>	01-April-2021 to 08-April-2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Transmitter Spurious Emissions
<b>Frequency Range</b>	1GHz – 26.5GHz
<b>Comments on the above Test Results</b>	802.11HE20, Tx Channel 6 (2437 MHz)

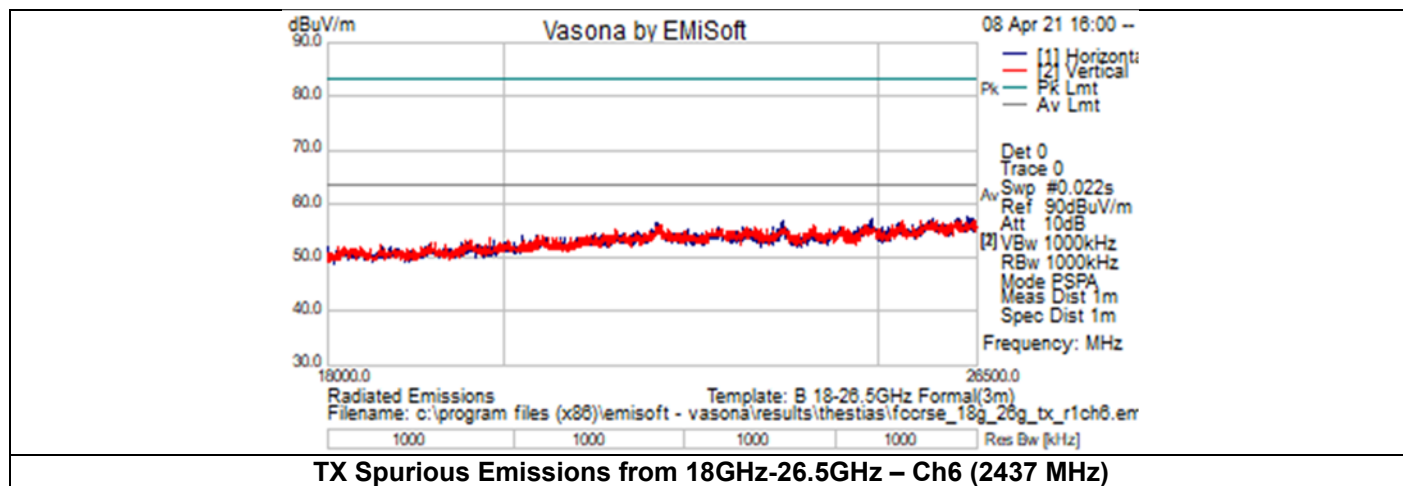


#### TX Spurious Emissions from 1GHz-10GHz – Ch6 (2437 MHz)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2445.6249	68.31	5.63	-7.4	66.54	Peak	H	150	259	-----	-----	Ignored	Fundamental
9859.375001	26.42	12.43	-2.42	36.43	Average	V	185	76	54	-17.57	Pass	
9859.375001	37.26	12.43	-2.42	47.27	Peak	V	185	76	74	-26.73	Pass	
2999.81	32.07	6.31	-7.17	31.21	Average	V	123	347	54	-22.79	Pass	
2999.81	50.95	6.31	-7.17	50.09	Peak	V	123	347	74	-23.91	Pass	

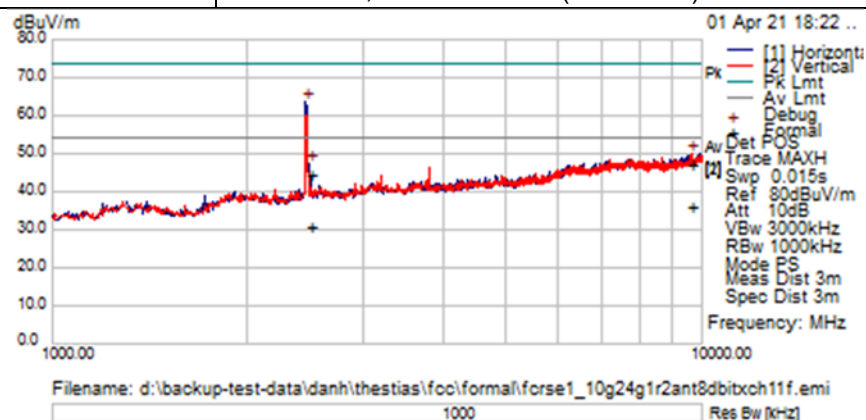


#### TX Spurious Emissions from 10GHz-18GHz – Ch6 (2437 MHz)



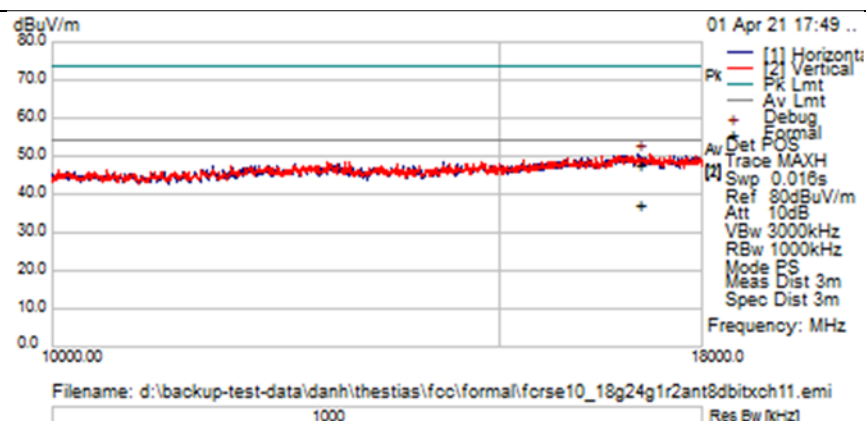
**Note:** No measurable emissions found from 10GHz – 26.5GHz.

<b>Subtest Date:</b>	01-April-2021 to 08-April-2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Transmitter Spurious Emissions
<b>Frequency Range</b>	1GHz – 26.5GHz
<b>Comments on the above Test Results</b>	802.11HE20, Tx Channel 11 (2462 MHz)

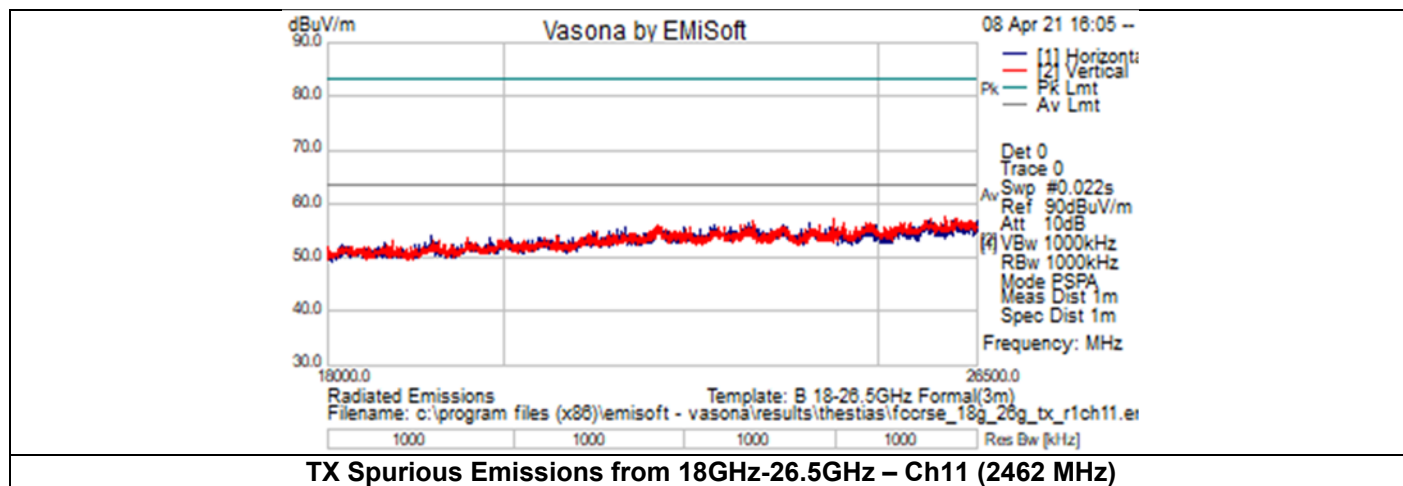


TX Spurious Emissions from 1GHz-10GHz – Ch11 (2462 MHz)

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2456.875	65.63	5.65	-7.32	63.96	Peak	H	200	54	-----	-----	Ignored	Fundamental
2490.625	32.46	5.7	-7.24	30.92	Average	H	357	236	54	-23.08	Pass	
2490.625	45.97	5.7	-7.24	44.43	Peak	H	357	236	74	-29.57	Pass	
9656.875	26.4	12.29	-2.71	35.99	Average	H	278	344	54	-18.01	Pass	
9656.875	37.49	12.29	-2.71	47.08	Peak	V	106	365	74	-26.92	Pass	



TX Spurious Emissions from 10GHz-18GHz – Ch11 (2462 MHz)



Note: No measurable emissions found from 10GHz – 26.5GHz.

### A.3: Receiver Spurious Emissions

#### RSS-Gen

Receivers are required to comply with the limits of spurious emissions as set out in this section. Receiver emission measurements are to be performed as per the normative test method referenced in Section 3.

For emissions at frequencies below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. At frequencies above 1 GHz, measurements shall be performed using a linear average detector with a minimum resolution bandwidth of 1 MHz

Ref. RSS-Gen sec 8.9 & 8.10

Ref. ANSI C63.10: 2013 Section 12.7.6 (Peak), Section 12.7.7.2 (Method AD), and Section 6.6

Radiated Spurious Emissions	
Test parameters	
<b>Peak</b> Span = 1-18GHz /18GHz-26.5GHz/26.5GHz-40GHz RBW = 1 MHz VBW $\geq$ 3 MHz Sweep = Auto couple Detector = Peak Trace = Max Hold.	<b>Average</b> Span = 1-18GHz /18GHz-26.5GHz/26.5GHz-40GHz RBW = 1 MHz VBW $\geq$ 3 MHz Sweep = Auto couple Detector = RMS Power Averaging

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

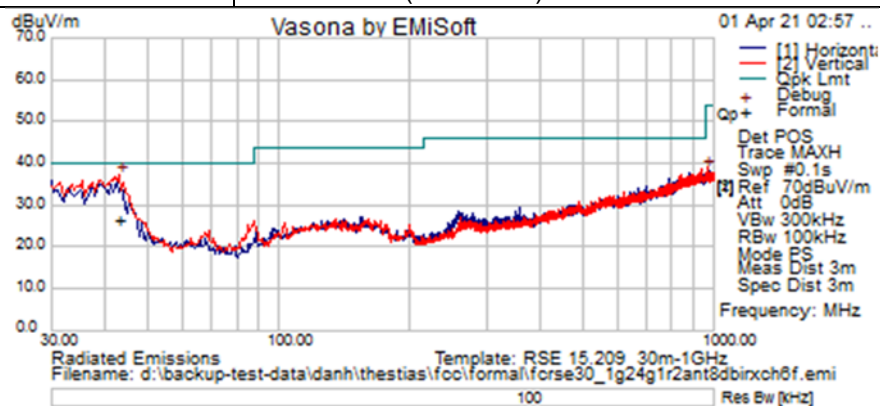
Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m  
 2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

Radiated emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals. Terminate the access Point RF ports with 50-ohm loads.

This report represents the worst-case data for all supported operating modes and antennas.

### A.3.1: Rx Radiated Spurious Emissions Graphical Data Results

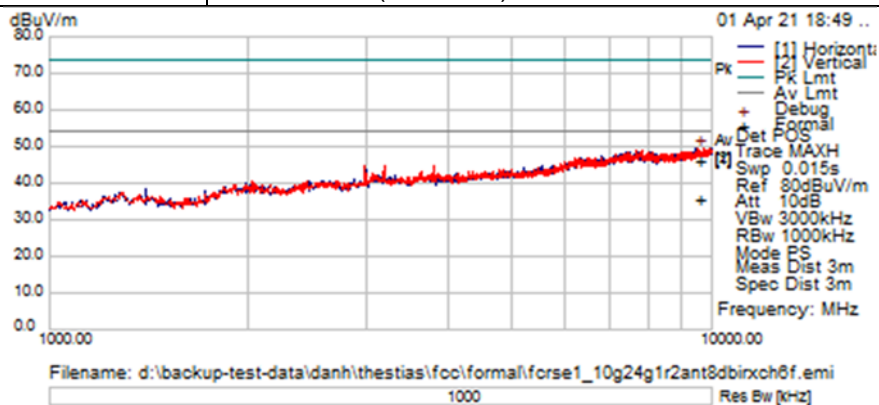
<b>Subtest Date:</b>	1 <sup>st</sup> April 2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Receiver Spurious Emissions
<b>Frequency Range</b>	30MHz - 1GHz
<b>Comments on the above Test Results</b>	Rx Channel 6 (2437 MHz)



**Rx Spurious Emissions from 30MHz-1GHz – Ch 7 (2437 MHz)**

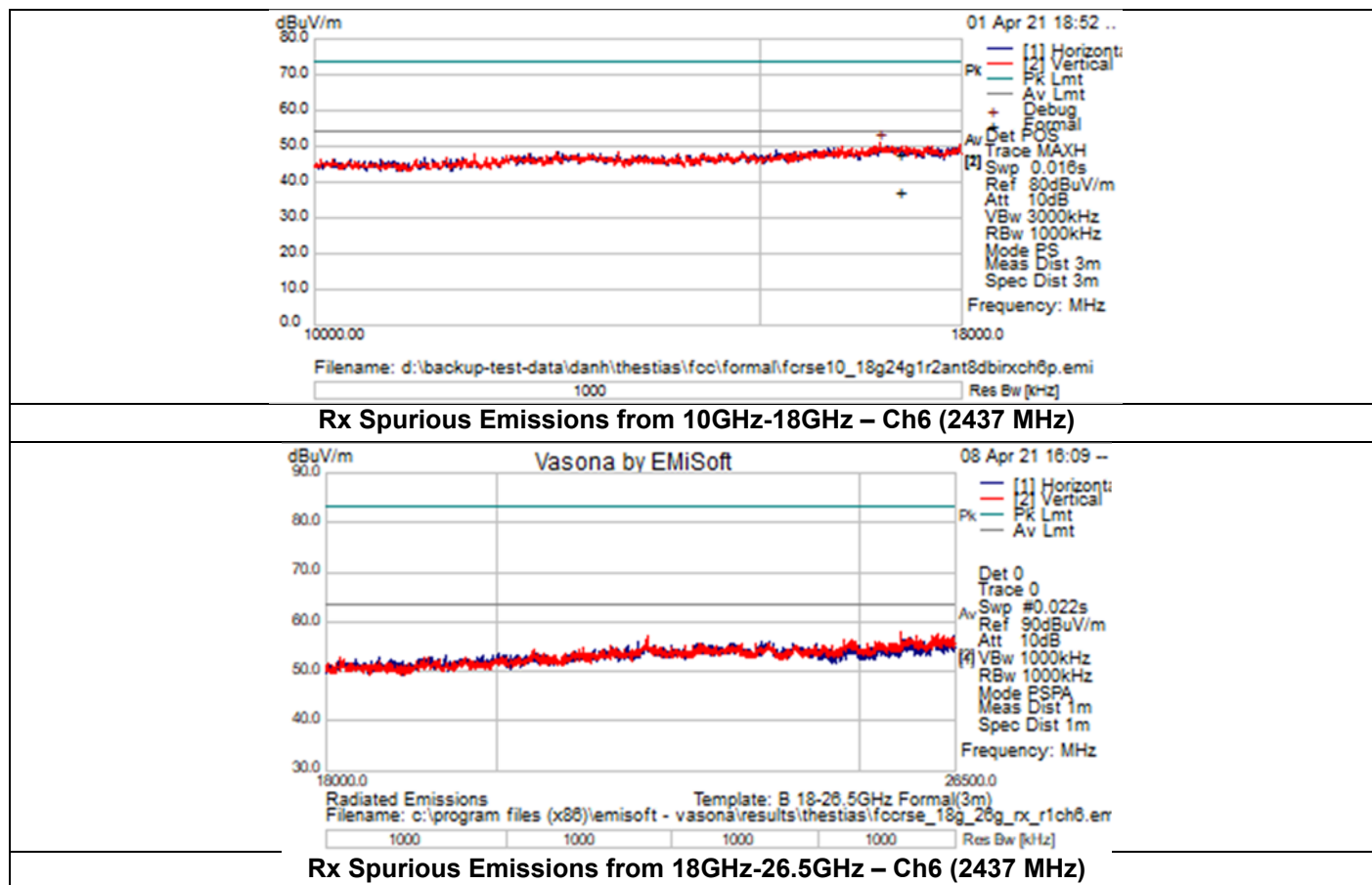
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
42.89475	14.44	0.66	11.68	26.78	Quasi Max	V	100	39	40	-13.22	Pass	

<b>Subtest Date:</b>	1 <sup>st</sup> April 2021 – 8 <sup>th</sup> April 2021
<b>Engineer</b>	Vincent Chiu Farida Rahmanzai Danh Le
<b>Lab Information</b>	Building 7, 5m Anechoic
<b>Subtest Title</b>	Receiver Spurious Emissions
<b>Frequency Range</b>	1GHz – 26.5GHz
<b>Comments on the above Test Results</b>	Rx Channel 6 (2437MHz)



**Rx Spurious Emissions from 1GHz-10GHz – Ch6 (2437 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
9544.37500	26.54	12.19	-2.82	35.91	Average Max	H	336	189	54	-18.09	Pass	
9544.37500	36.96	12.19	-2.82	46.33	Peak Max	V	215	252	74	-27.67	Pass	



Note: No measurable emissions found from 10GHz – 26.5GHz

## A.4 AC Conducted Emissions

**FCC 15.207 (a) & RSS-Gen 8.8** 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.

### Measurement Procedure

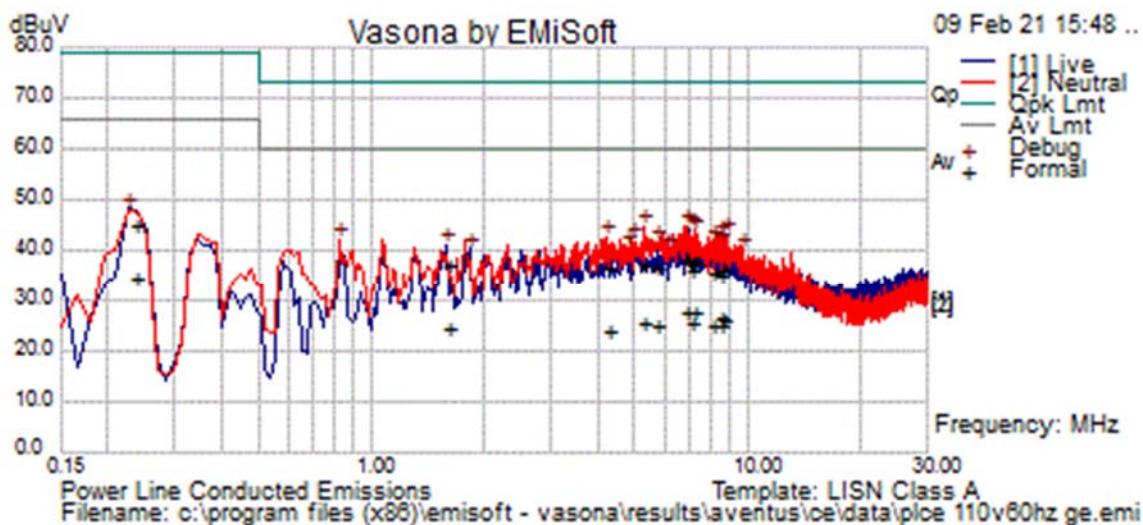
Accordance with ANSI C63.10:2013 section 6.2

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span: 150 KHz – 30 MHz  
Attenuation: 10 dB  
Sweep Time: Coupled  
Resolution Bandwidth: 9 KHz  
Video Bandwidth: 30 KHz  
Detector: Quasi-Peak / Average

### A.4.1: AC Line conducted emissions results

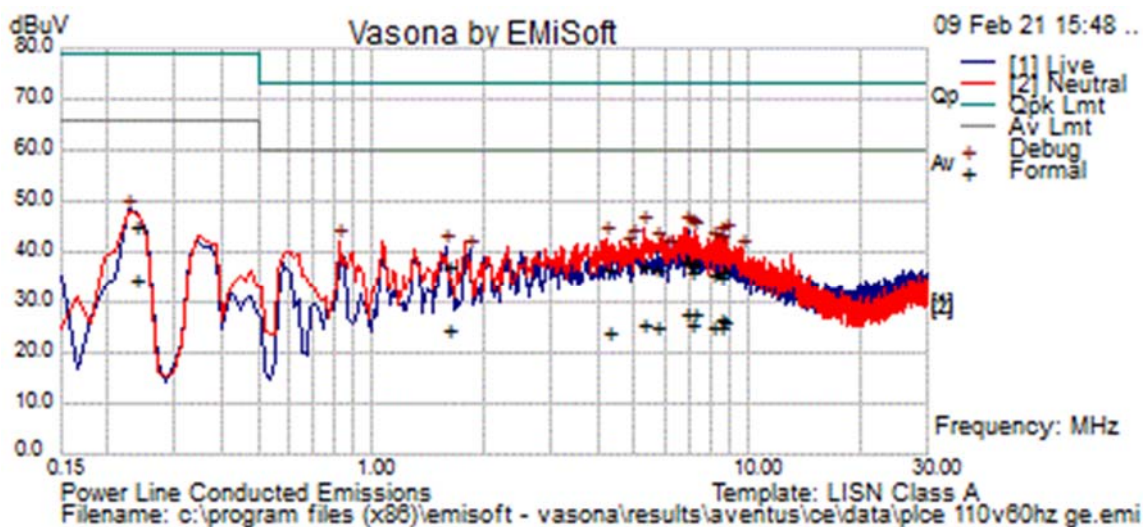
Subtest Date:	09 Feb 21
Engineer	Chakravarthy Sulva
Lab Information	Building P, formal immunity room
Subtest Title	Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	2.4GHz/5GHz



AC Conducted Emissions Test Result Tables for 2.4GHz/5GHz

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
0.236	14.1	20.6	0	34.7	Average	Live	52.35	-17.65	Pass	2.4GHz/5GHz
6.83	7.5	20.1	0	27.6	Average	Neutral	50	-22.4	Pass	2.4GHz/5GHz
7.236	7.4	20.1	0	27.5	Average	Neutral	50	-22.5	Pass	2.4GHz/5GHz
8.449	6.5	20.1	0.1	26.8	Average	Neutral	50	-23.2	Pass	2.4GHz/5GHz
8.676	6.1	20.2	0.1	26.4	Average	Neutral	50	-23.6	Pass	2.4GHz/5GHz
0.236	24.3	20.6	0	45	Quasi Peak	Live	62.35	-17.35	Pass	2.4GHz/5GHz
5.285	5.6	20.1	0.1	25.7	Average	Neutral	50	-24.3	Pass	2.4GHz/5GHz
6.83	18.4	20.1	0	38.6	Quasi Peak	Neutral	60	-21.4	Pass	2.4GHz/5GHz
7.04	5.3	20.1	0.1	25.5	Average	Live	50	-24.5	Pass	2.4GHz/5GHz
8.425	5	20.1	0.1	25.2	Average	Live	50	-24.8	Pass	2.4GHz/5GHz
5.755	4.9	20.1	0	25	Average	Live	50	-25	Pass	2.4GHz/5GHz
7.236	17.8	20.1	0	37.9	Quasi Peak	Neutral	60	-22.1	Pass	2.4GHz/5GHz
8.091	4.6	20.1	0.1	24.9	Average	Live	50	-25.1	Pass	2.4GHz/5GHz
1.586	4.3	20	0	24.3	Average	Live	46	-21.7	Pass	2.4GHz/5GHz
4.235	4.2	20	0	24.3	Average	Neutral	46	-21.7	Pass	2.4GHz/5GHz

<b>Subtest Date:</b>	09 Feb 21
<b>Engineer</b>	Chakravarthy Sulva
<b>Lab Information</b>	Building P, formal immunity room
<b>Subtest Title</b>	Conducted Emissions
<b>Frequency Range</b>	150 kHz - 30 MHz
<b>Comments on the above Test Results</b>	2.4GHz/5GHz



AC Conducted Emissions Test Result Tables for 2.4GHz/5GHz

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5.285	16.9	20.1	0.1	37	Quasi Peak	Neutral	60	-23	Pass	2.4GHz/5GHz
1.586	17	20	0	37	Quasi Peak	Live	56	-19	Pass	2.4GHz/5GHz
4.235	16.7	20	0	36.8	Quasi Peak	Neutral	56	-19.2	Pass	2.4GHz/5GHz
5.755	16.4	20.1	0	36.5	Quasi Peak	Live	60	-23.5	Pass	2.4GHz/5GHz
7.04	16.1	20.1	0.1	36.3	Quasi Peak	Live	60	-23.7	Pass	2.4GHz/5GHz
8.449	16.1	20.1	0.1	36.3	Quasi Peak	Neutral	60	-23.7	Pass	2.4GHz/5GHz
8.676	15.7	20.2	0.1	35.9	Quasi Peak	Neutral	60	-24.1	Pass	2.4GHz/5GHz
8.091	15.4	20.1	0.1	35.6	Quasi Peak	Live	60	-24.4	Pass	2.4GHz/5GHz
8.425	15	20.1	0.1	35.2	Quasi Peak	Live	60	-24.8	Pass	2.4GHz/5GHz

**Appendix B: List of Test Equipment Used to perform the test**

Equip#	Manufacturer	Model	Description	Last Cal	Next Due
<b>Test Equipment used for Radiated Emissions 30MHz to 1GHz</b>					
CIS44908	ROHDE & SCHWARZ	ESCI	EMI Test Receiver	12-Dec-2020	12-Dec-2021
CIS30654	SUNOL SCIENCES	JB1	Combination Antenna, 30MHz-2GHz	14-Jul-2020	14-Jul-2021
CIS47311	HUBER + SUHNER	Sucoflex 106PA	RF Type N Antenna Cable 18 GHz 8.5m	30-Sep-2019	30-June-2021
CIS25640	MICRO-COAX	UFB311A-0-2720-520	Coaxial Cable, 272.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS25660	MICRO-COAX	UFB311A-1-0840-504	Coaxial Cable, 84.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS08113	CISCO	NSA CAL	NSA Chamber	27-Mar-2021	27-Mar-2022
<b>Test Equipment used for Radiated Emissions 1GHz to 18GHz</b>					
CIS24905	Keysight (Agilent/HP)	E4440A	Spectrum Analyzer 3Hz-26.5GHz	21-Oct-2020	21-Oct-2021
CIS34741	ETS Lindgren	3117	Double Ridged Guide Horn Antenna	01-Oct-2020	01-Oct-2021
CIS39124	CISCO	TH0118	Mast Mount Preamplifier Array, 1-18GHz	21-Jan-2020	21-Jul-2021
CIS47311	HUBER + SUHNER	Sucoflex 106PA	RF Type N Antenna Cable 18 GHz 8.5m	30-Sep-2019	30-June-2021
CIS25640	MICRO-COAX	UFB311A-0-2720-520	Coaxial Cable, 272.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS25660	MICRO-COAX	UFB311A-1-0840-504	Coaxial Cable, 84.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS54402	HUBER + SUHNER	Sucoflex 102	K Type 40 GHz Cable	10-Feb-2021	10-Feb-2022
CIS8113	CISCO	NSA CAL	NSA Chamber	27-Mar-2021	27-Mar-2022
CIS43024	CISCO	Above 1GHz Site Ca	1GHz Cisp Site Verification	03-Oct-2020	03-Oct-2021
CIS56055	Wainwright Instruments	WRCGV8-2360-2400 -2483.5-40SS	SMA Band Reject Filter 2.36GHz to 2.5235 GHz	30-Apr-2020	30-Apr-2021
<b>Test Equipment used for Radiated Emissions 18GHz to 26GHz</b>					
CIS08113	CISCO	NSA CAL	NSA Chamber	27-Mar-2021	27-Mar-2022
CIS36710	Cisco	1840	18-40GHz EMI Test Head/Verification Fixture	17-Sep-2020	17-Sep-2021
CIS19630	Rohde & Schwarz	ESI 40(ESIB 40)	EMI RECEIVER TEST 20Hz-40GHz	28-Jan-2021	28-Jan-2022

Equip#	Manufacturer	Model	Description	Last Cal	Next Due
<b>Test Equipment used for AC line conducted emissions 150kHz-30MHz</b>					
008496	Fischer Custom Communications	FCC-450B-2.4-N	Instrumentation Limiter	12/15/2020	12/15/2021
007704	Fischer Custom Communications	FCC-LISN-50/250-50-2-01	LISN	12/7/2020	12/7/2021
018963	York	CNE V	Comparison Noise Emitter,30-1GHz	NA	NA
019207	TTE	H785-150K-50-21378	High Pass Filter 150kHz	1/25/2021	1/25/2022
020913	Fischer Custom Communications	FCC-LISN-PA-NEMA-5-15	AC Adapter	12/7/2020	12/7/2021
037229	Coleman	RG-223	25ft BNC cable	2/26/2020	2/26/2021
044021	Fischer Custom Communications	FCC-801-M2-32A	Power Line Coupling Decoupling Network	3/9/2020	3/9/2021
046718	Bird	5-T-MB	5W 50 Ohm BNC Termination 4GHz	3/15/2019	3/15/2021
049479	Coleman	RG223	BNC 2ft Cable	3/4/2020	3/4/2021
004729	Fluke	77 III	Digital Multimeter	5/19/2020	5/19/2021
058245	COMET	T7611-4	Humidity Temperature Probe	12/26/2020	12/26/2021
058276	ROHDE & SCHWARZ	ESR3	EMI Receiver	6/25/2020	6/25/2021

## **Appendix C: Photographs of Test Setups**

See FCC/RSS RSE Test Setup document – EDCS-21686217

## 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 <sup>3</sup> )
EN	European Norm	MHz	MegaHertz (1x10 <sup>6</sup> )
IEC	International Electro technical Commission	GHz	Gigahertz (1x10 <sup>9</sup> )
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 <sup>3</sup> )
L1	Line 1	μV	Microvolt (1x10 <sup>-6</sup> )
L2	Line2	A	Amp
L3	Line 3	μA	Micro Amp (1x10 <sup>-6</sup> )
DC	Direct Current	mS	Milli Second (1x10 <sup>-3</sup> )
RAW	Uncorrected measurement value, as indicated by the measuring device	μS	Micro Second (1x10 <sup>-6</sup> )
RF	Radio Frequency	μS	Micro Second (1x10 <sup>-6</sup> )
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: Software Used to Perform Testing**

EMIsoft Vasona, version 6.024

## Appendix F: Test Procedures

Measurements were made in accordance with

- KDB 558074 - D01 DTS Meas Guidance v05
- KDB 662911 - MIMO
- ANSI C63.4 2014 Unintentional Radiators
- ANSI C63.10 2013 Intentional Radiators

Test procedures are summarized below

FCC 2.4GHz Test Procedures	EDCS # 1445042
FCC 2.4GHz RSE Test Procedures	EDCS # 1480386

## **Appendix G: 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 H: Test Assessment Plan**

Compliance Test Plan (Excel) EDCS#21669684  
Target Power Tables EDCS#19467753

## **Appendix I: Worst Case Justification**

All 3 orientations (Z, Y, Z) of the EUT were assessed by performing pre-scan.  
The X orientation was determined to be the worst-case orientation.