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

5725-5850 MHz

Against the following Specifications:

47 CFR 15.205

47 CFR 15.209

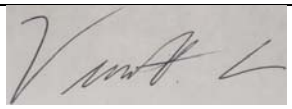
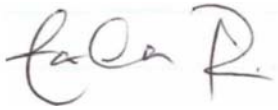
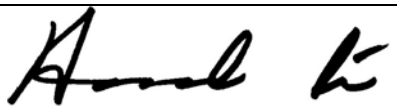
47 CFR 15.407

RSS-247 issue 2

RSS-Gen issue 5

ACCREDITED

Cisco Systems
170 West Tasman Drive
San Jose, CA 95134

Author:	
Tested By: **Title**: Test Engineers	 Vincent Chiu, Farida Rahmanzai, Danh Le  Farida Rahmanzai  Danh Le
Approved By: **Title**: Compliance Manager	 Howard Ji
Version:	1.0

This report replaces any previously entered test report under EDCS – 21673980. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 1526152.
This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

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 15.205 47 CFR 15.209 47 CFR 15.407 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*%

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

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

Radiated emissions (expanded uncertainty, confidence interval 95%)

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

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40GHz	+/- 0.38 dB

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

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

31-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 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 7, 5m Chamber	425 E. Tasman Drive San Jose, California 95134	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 Slot1.6 EUT Description
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	IR1831-K9	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)
2.4/5 GHz	W-ANTM2050D-RPSMA=	Omnidirectional swivel stick dipole	**2 / 4**	**0**
	W-ANTM2-O-2-RPSMA	Omnidirectional	**4 / 4**	**0**
	ANT-7-5G4WL2G1-O=	7-in-1 vehicle mount omnidirectional	**8 / 8**	**3**
	5G-ANTM-O-4-B=	9-in-1 vehicle mount omnidirectional	**8 / 8**	**3**

Section 3: Result Summary

3.1 Results Summary Table

Radiated Emissions (General requirements)

Basic Standard	Technical Requirements / Details	Result
FCC 15.205 FCC 15.209 FCC 15.407 (b) (6)	**TX Spurious Emissions:** Unwanted emissions 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.	Pass

Radiated Emissions (General requirements)

Basic Standard	Technical Requirements / Details	Result
RSS-Gen	**TX Spurious Emissions:** 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 RSS-Gen 8.10 must also comply with the radiated emission limits specified in RSS-Gen 8.9	Pass
RSS-Gen	**RX Spurious Emissions:** Spurious emissions from the receivers shall not exceed the radiated limits of receiver spurious emissions shown in RSS-Gen section 8.9 & 8.10	Pass
15.207 RSS-Gen	**AC conducted Emissions**: U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207 & RSS-Gen	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 Dual Band Radio in IR1835 Host system with 5GHz 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 5GHz Wi-Fi radio actives + ext. PS + ext. 8 dBi patch ant.	S01, S02

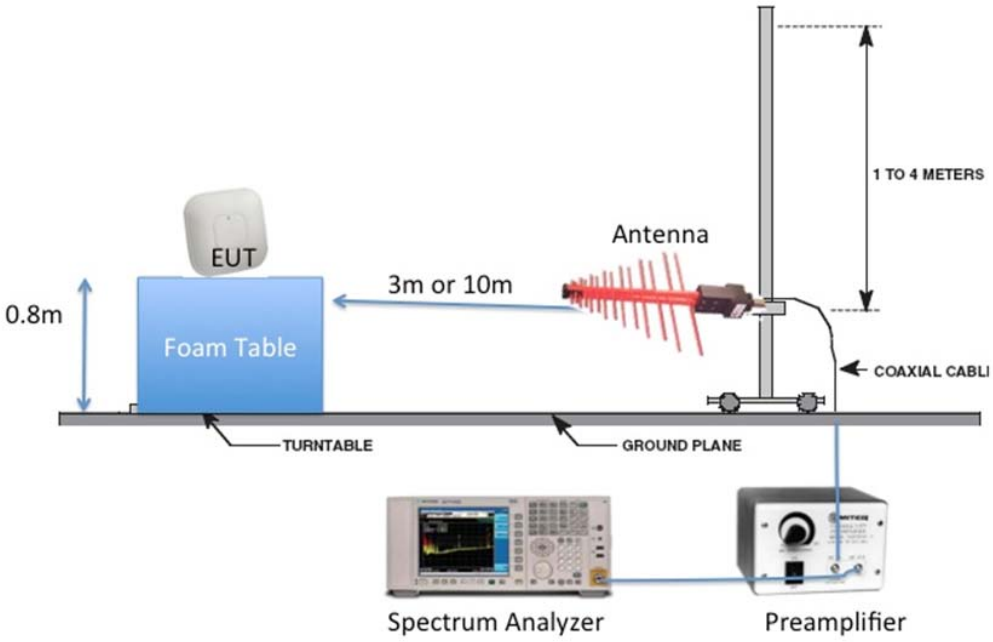
4.3 Mode of Operation / Modulation / Data Rate Details

Mode (Radio band support, # of active antenna)	Wi-Fi Mode	Modulation	Data Rate
Transmit (dual antenna)	802.11HE20(5GHz)	MIMO-OFDMA	M0h1
Receive (dual antenna)	802.11HE20(5GHz)	MIMO-OFDMA	M0h1
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			

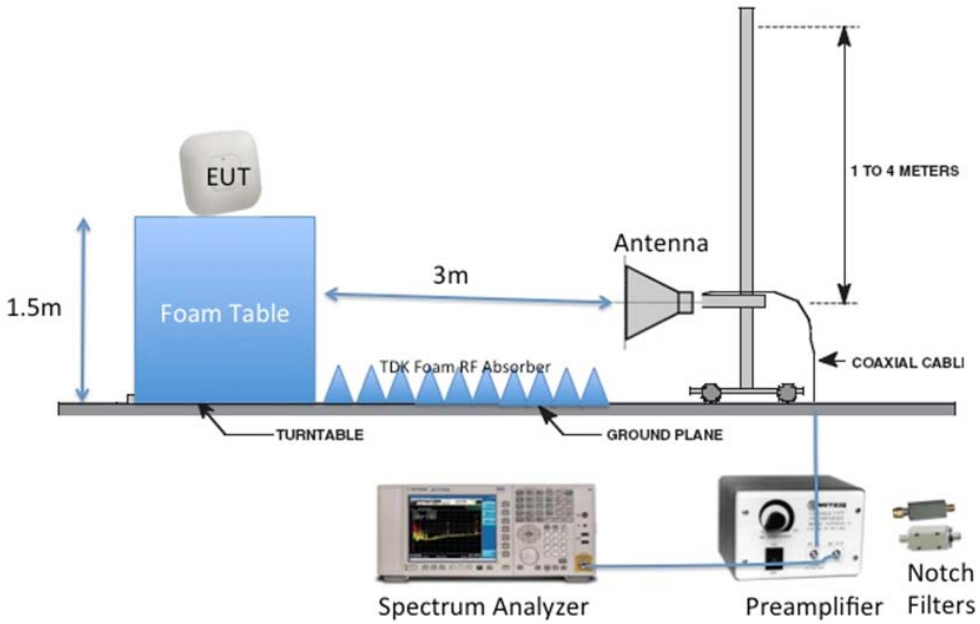
Appendix A: Radiated Spurious Emission

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

15.407 (b) (7) The provisions of 15.205 apply to intentional radiators operating under this section

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.

Restricted Bands for FCC			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	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

MHz	MHz	GHz
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	

Non-Restricted Bands Limits

Below 1 GHz

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).

FCC15.407

(b) (6) Unwanted emissions below 1GHz must comply with general field strength limits set forth in §15.209.

RSS-Gen 8.9: Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table below. Additionally, the level of any transmitter 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

Above 1 GHz

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 5.725-5.850 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.

RSS-247 6.2.4.2

Devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:

a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;

b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;

c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and

a) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

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:

$$\mathbf{V/m} = \frac{\sqrt{30 \times Pt \times gt}}{d}$$

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

dBm to Watts W = 10((dBm – 30)/10)

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

(2) Convert from Watt to field strength

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

$$\mathbf{V/m} = \frac{\sqrt{30 \times Pt \times gt}}{3}$$

$$= \frac{\sqrt{30 \times 0.000001995 \times 1}}{3}$$

= **0.00257**

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

dBµV/m = 20 log (V/m) + 120

= **68.2**

A.2.2: Test Procedure

Ref. ANSI C63.10-2013 section 6.5 & 6.6, Cispr16-1-1

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 ≥ 3 x 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

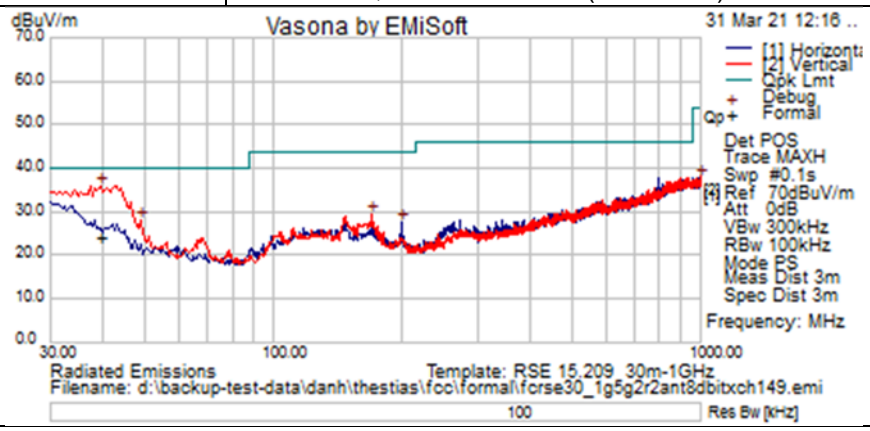
Above 18 GHz,
Save plots: Peak plot (Vertical and Horizontal) @1m

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

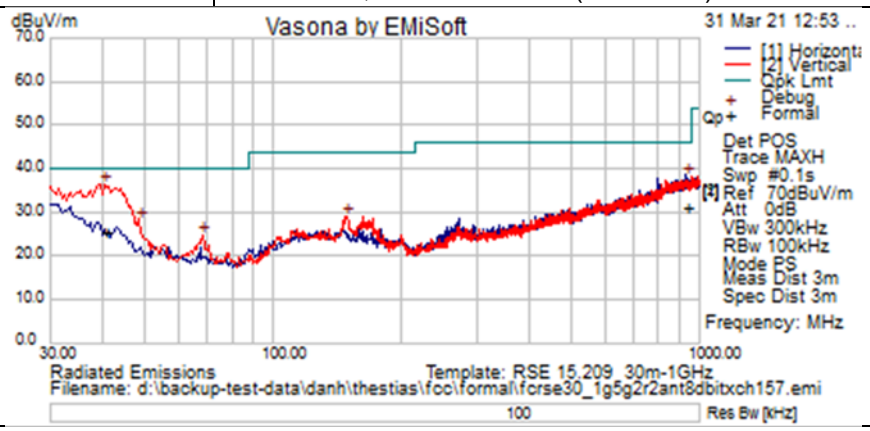
Subtest Date:	31-Mar-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 149 (5745 MHz)



TX Spurious Emissions from 30MHz-1GHz – Ch149 (5745 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
39.109	9.32	0.63	14.51	24.46	Quasi Max	V	205	61	40	-15.54	Pass	

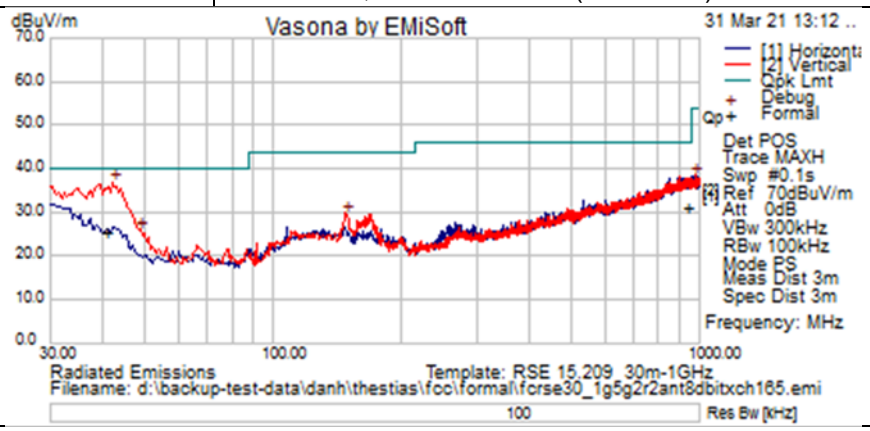
Subtest Date:	31-Mar-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 157 (5785 MHz)



TX Spurious Emissions from 30MHz-1GHz – Ch157 (5785 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
40.40975	11.3	0.64	13.55	25.49	Quasi Max	V	105	162	40	-14.51	Pass	
932.13625	5.46	3.08	22.8	31.33	Quasi Max	H	355	306	46	-14.67	Pass	

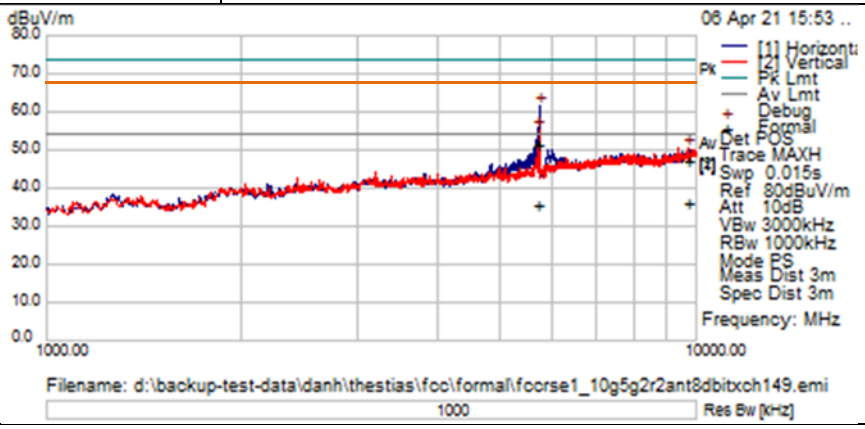
Subtest Date:	31-Mar-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 165 (5825 MHz)



TX Spurious Emissions from 30MHz-1GHz – Ch165 (5825 MHz)

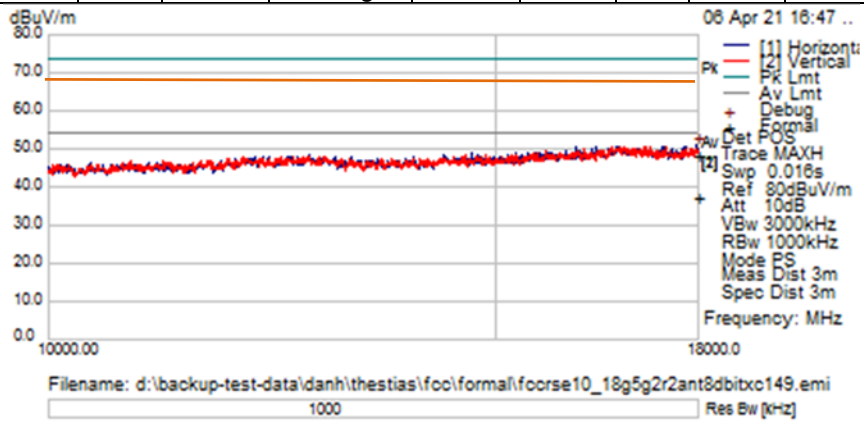
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
40.40975	11.3	0.64	13.55	25.49	Quasi Max	V	105	162	40	-14.51	Pass	
932.13625	5.46	3.08	22.8	31.33	Quasi Max	H	355	306	46	-14.67	Pass	

Subtest Date:	06-April-2021 to 08-April-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz - 40GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 149 (5745 MHz)

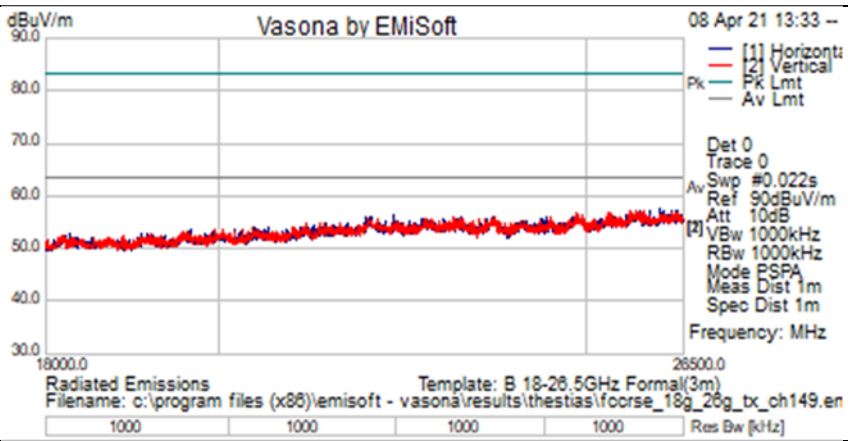


TX Spurious Emissions from 1GHz-10GHz – Ch149 (5745 MHz)

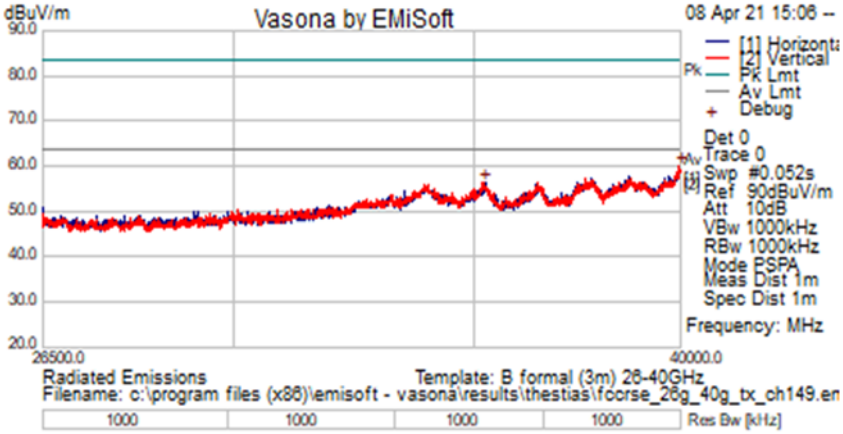
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5741.875	57.5	9.13	-5.1	61.54	Peak	H	250	290	-----	-----	Ignored	Fundamental
5705.906	47.24	9.12	-5.08	51.28	Peak Max	V	346	352	74	-22.72	Pass	
5705.906	31.72	9.12	-5.08	35.77	Average	H	254	365	54	-18.23	Pass	
9690.625	37.52	12.32	-2.67	47.17	Peak Max	V	230	163	74	-26.83	Pass	
9690.625	26.72	12.32	-2.67	36.37	Average	H	109	319	54	-17.63	Pass	



TX Spurious Emissions from 10GHz-18GHz – Ch149 (5745 MHz)



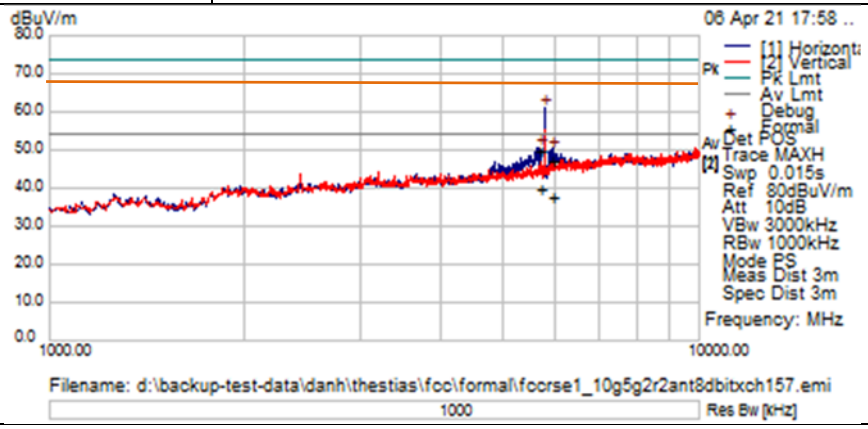
TX Spurious Emissions from 18GHz-26.5GHz – Ch149 (5745 MHz)



TX Spurious Emissions from 26.5GHz-40GHz – Ch149 (5745 MHz)

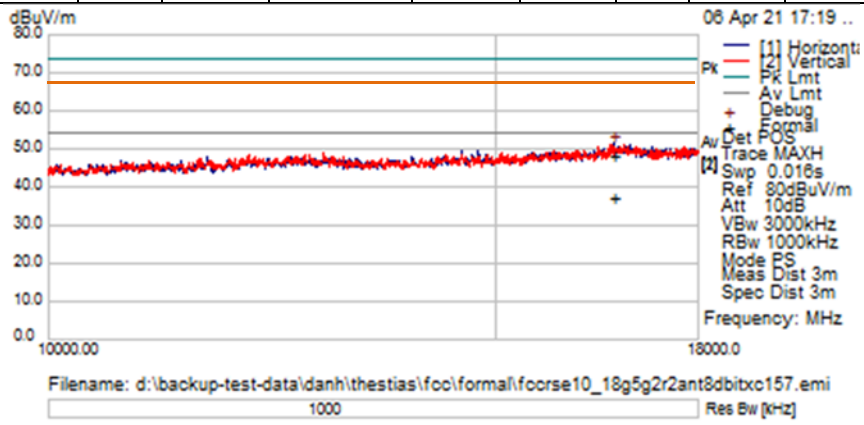
Note: No measurable emissions found from 10GHz - 40GHz

Subtest Date:	06-April-2021 to 08-April-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz - 40GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 157 (5785 MHz)

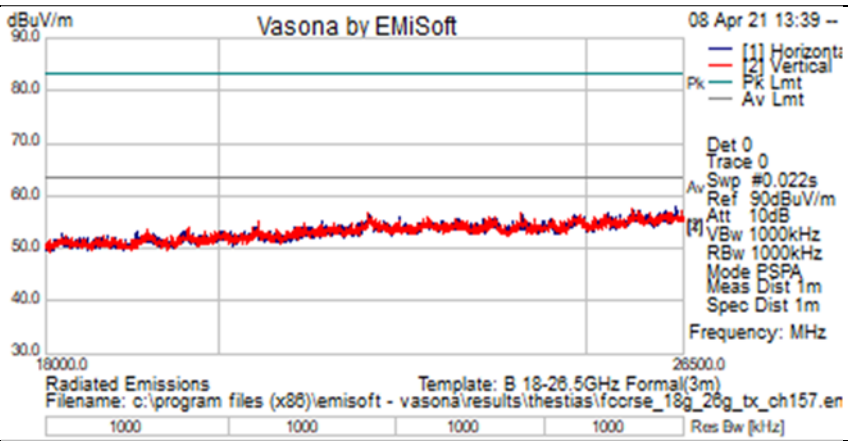


TX Spurious Emissions from 1GHz-10GHz – Ch157 (5785 MHz)

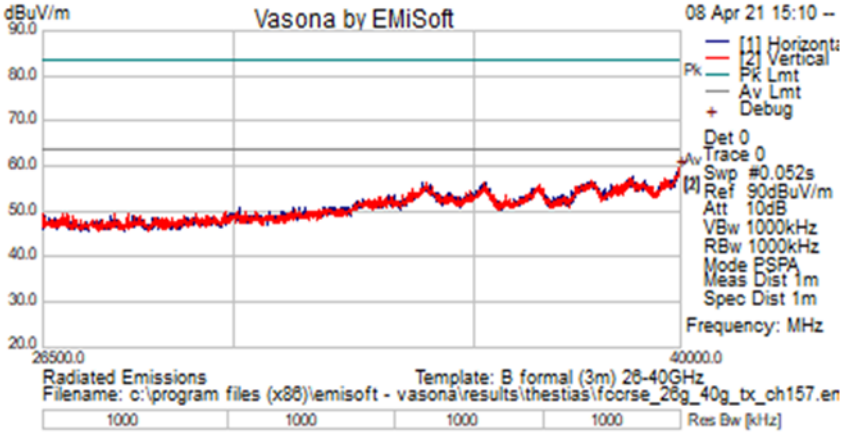
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5781.25	57.06	9.15	-5.03	61.18	Peak	H	250	52	-----	-----	Ignored	Fundamental
5685.625	35.91	9.06	-5.26	39.71	Average	H	207	306	54	-14.29	Pass	
5685.625	46.16	9.06	-5.26	49.96	Peak Max	H	207	306	74	-24.04	Pass	
5938.75	32.59	9.39	-4.32	37.65	Average	H	107	55	54	-16.35	Pass	
5938.75	42.44	9.39	-4.32	47.5	Peak Max	H	107	55	74	-26.5	Pass	



TX Spurious Emissions from 10GHz-18GHz – Ch157 (5785 MHz)



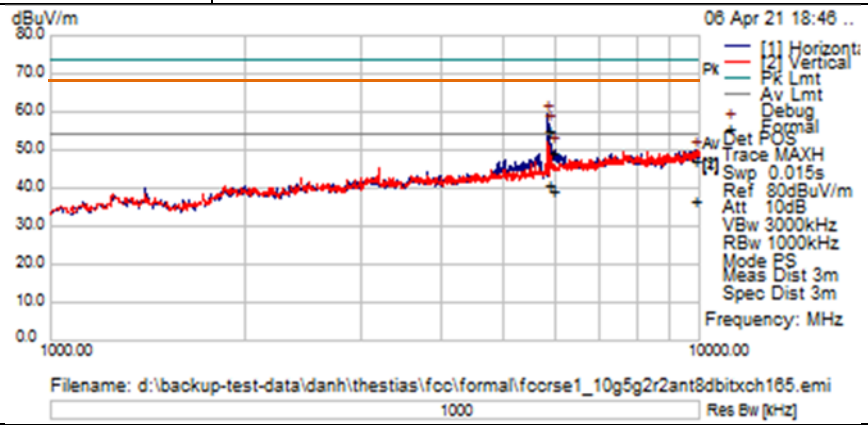
TX Spurious Emissions from 18GHz-26.5GHz – Ch157 (5785 MHz)



TX Spurious Emissions from 26.5GHz-40GHz – Ch157 (5785 MHz)

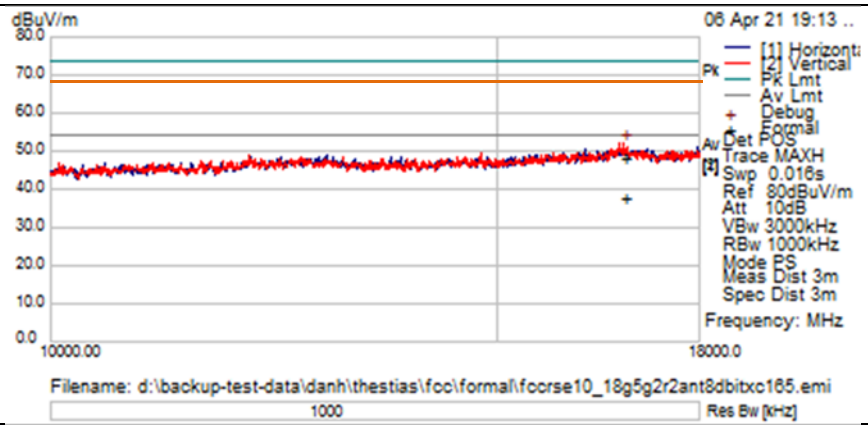
Note: No measurable emissions found from 10GHz - 40GHz

Subtest Date:	06-April-2021 to 08-April-2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1GHz - 40GHz
Comments on the above Test Results	**802.11HE20**, Tx Channel 165 (5825 MHz)

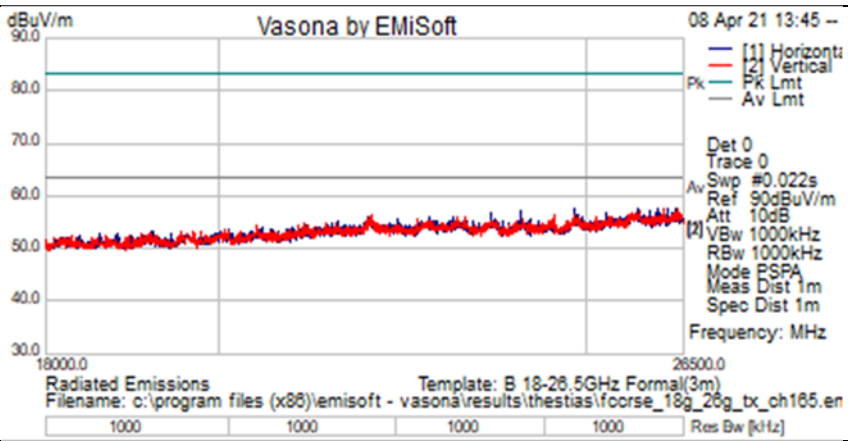


TX Spurious Emissions from 1GHz-10GHz – Ch165 (5825 MHz)

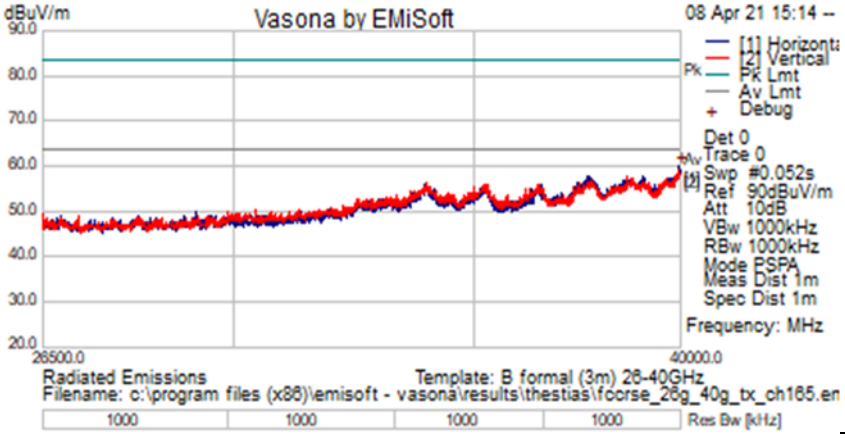
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
5820.625	55.47	9.26	-5.13	59.6	Peak	H	250	302	-----	-----	Ignored	Fundamental
5871.25	36.14	9.27	-4.71	40.7	Average	H	241	319	54	-13.3	Pass	
5871.25	50.79	9.27	-4.71	55.36	Peak Max	H	241	319	74	-18.64	Pass	
5921.875	34.39	9.35	-4.52	39.23	Average	H	101	0	54	-14.77	Pass	
5921.875	44.45	9.35	-4.52	49.28	Peak Max	H	101	0	74	-24.72	Pass	
9859.375001	26.68	12.43	-2.42	36.68	Average	V	195	172	54	-17.32	Pass	
9859.375001	37.33	12.43	-2.42	47.34	Peak Max	H	338	336	74	-26.66	Pass	



TX Spurious Emissions from 10GHz-18GHz – Ch165 (5825 MHz)



TX Spurious Emissions from 18GHz-26.5GHz – Ch165 (5825 MHz)



TX Spurious Emissions from 26.5GHz-40GHz – Ch165 (5825 MHz)

Note: No measurable emissions found from 10GHz - 40GHz

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	
Peak Span = 1-18GHz /18GHz-26.5GHz/26.5GHz-40GHz RBW = 1 MHz VBW ≥ 3 MHz Sweep = Auto couple Detector = Peak Trace = Max Hold.	**Average** Span = 1-18GHz /18GHz-26.5GHz/26.5GHz-40GHz RBW = 1 MHz VBW ≥ 3 MHz Sweep = Auto couple Detector = RMS Power Averaging

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

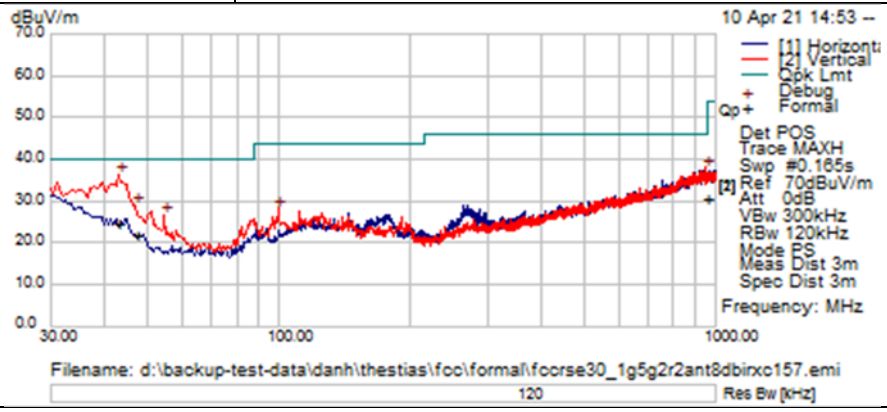
Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

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

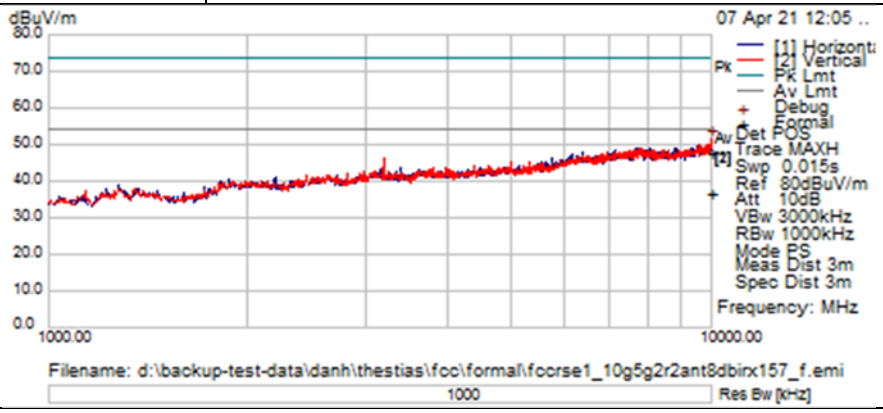
Subtest Date:	10th April 2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	30MHz - 1GHz
Comments on the above Test Results	Rx Channel 157 (5785 MHz)



Rx Spurious Emissions from 30MHz-1GHz – Ch157 (5785 MHz)

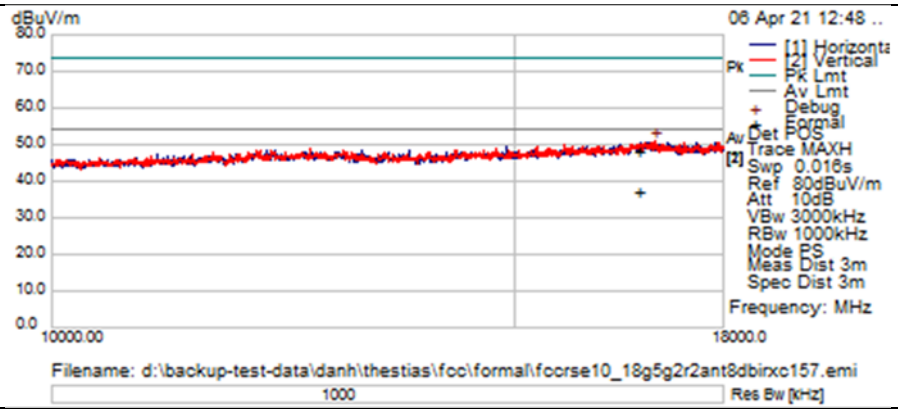
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
949.14375	4.92	3.12	22.8	30.84	Quasi Max	V	166	0	46	-15.16	Pass	
42.87225	12.35	0.66	11.7	24.71	Quasi Max	V	384	39	40	-15.29	Pass	
46.93125	12.01	0.69	9.23	21.92	Quasi Max	V	115	208	40	-18.08	Pass	

Subtest Date:	06-April-2021 – 08th April 2021
Engineer	Vincent Chiu Farida Rahmanzai Danh Le
Lab Information	Building 7, 5m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	1GHz - 40GHz
Comments on the above Test Results	Rx Channel 157 (5745MHz)

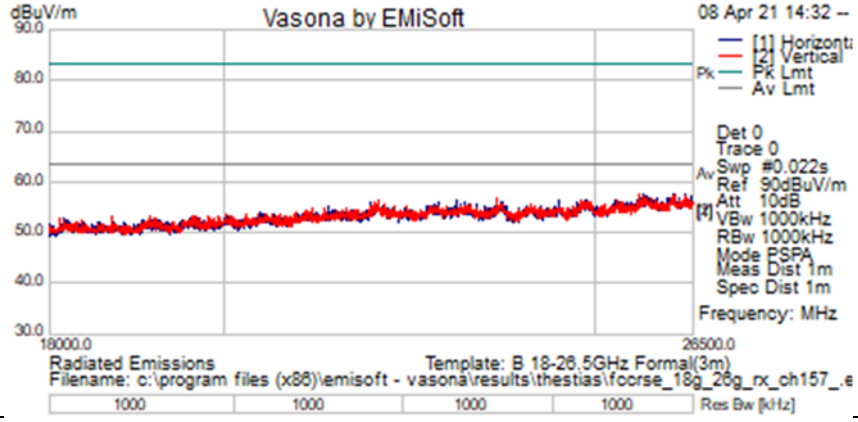


Rx Spurious Emissions from 1GHz-10GHz – Ch157 (5785 MHz)

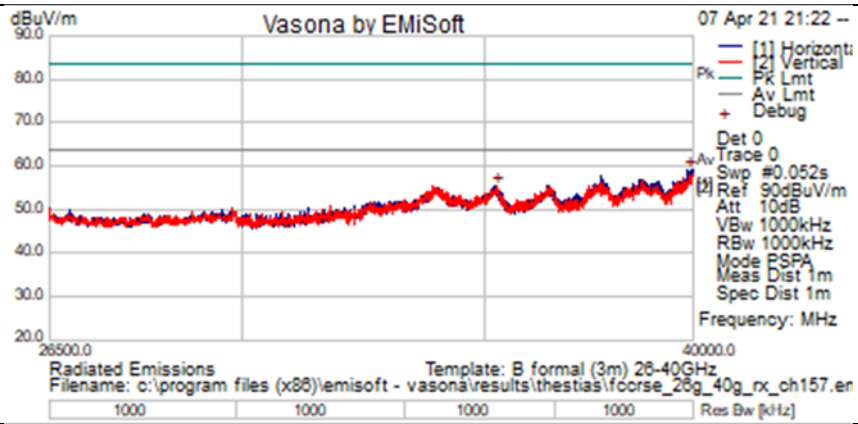
Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
9995.75	37.32	12.54	-2.14	47.72	Peak Max	V	236	325	74	-26.28	Pass	
9995.75	26.51	12.54	-2.14	36.9	Average Max	V	236	325	54	-17.1	Pass	



Rx Spurious Emissions from 10GHz-18GHz – Ch157 (5785 MHz)



Rx Spurious Emissions from 18GHz-26.5GHz – Ch157 (5785 MHz)



Rx Spurious Emissions from 26.5GHz-40GHz – Ch132 (5785 MHz)

Note: No measurable emissions found from 10GHz - 40GHz

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.

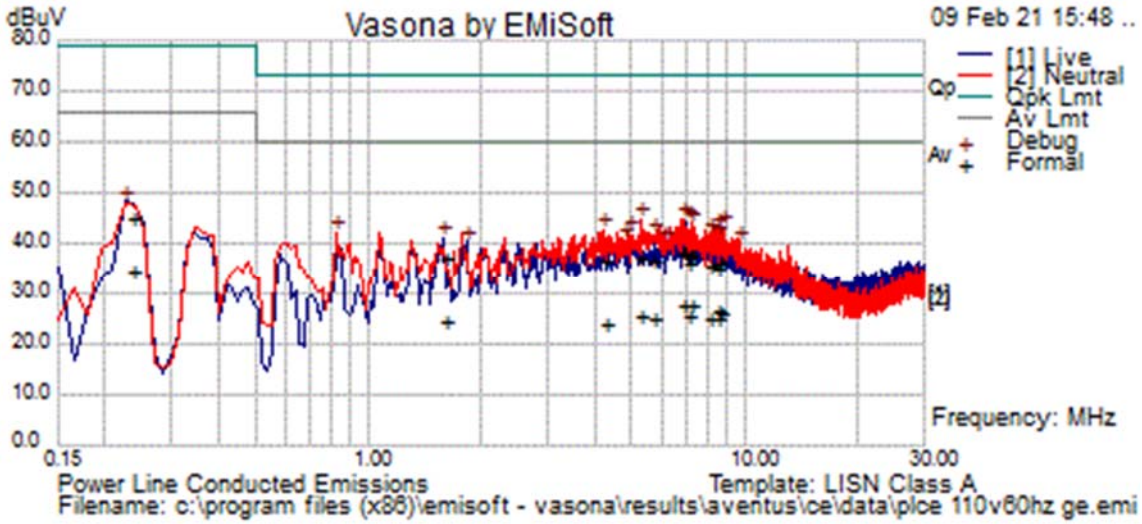
Measurement Procedure
Accordance with ANSI C63.10:2013 section 6.2

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

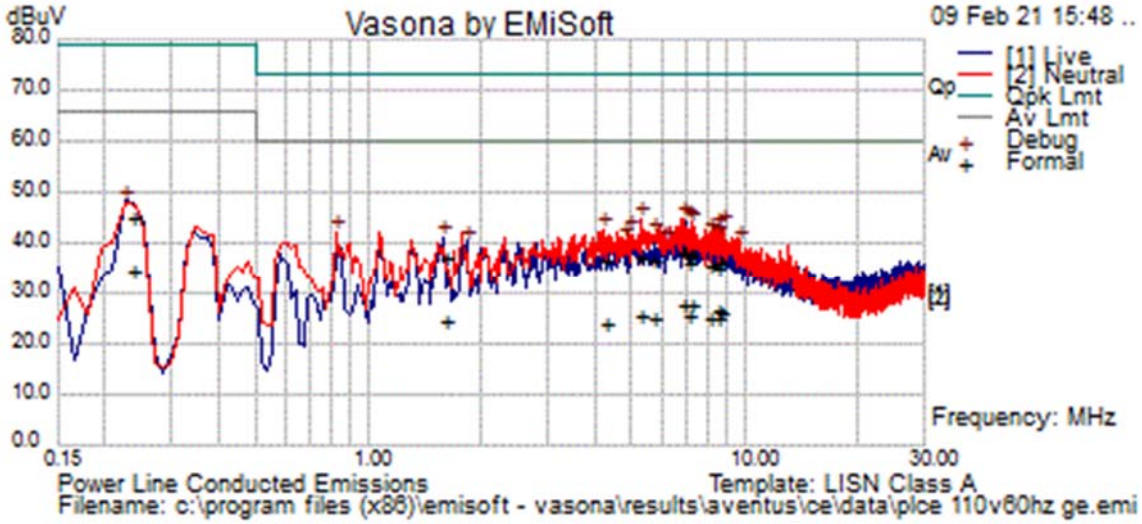
Subtest Date:	09 Feb 21
Engineer	Chakravarthy Sulva
Lab Information	Building P, formal immunity room
Subtest Title	Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	2.4GHz/5GHz



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

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
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
Test Equipment used for Radiated Emissions 30MHz to 1GHz					
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-0-2720-520520	Coaxial Cable, 272.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS25660	MICRO-COAX	UFB311A-1-0840-504504	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
Test Equipment used for Radiated Emissions 1GHz to 18GHz					
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-0-2720-520520	Coaxial Cable, 272.0 in. to 18GHz	30-Sep-2019	30-June-2021
CIS25660	MICRO-COAX	UFB311A-1-0840-504504	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 Cispr Site Verification	03-Oct-2020	03-Oct-2021
CIS56058	Wainwright Instruments	WRCJV12-5695-5 725-5850-5880-4+	SMA Band Reject Filter. 5.695GHz to 5.880GHz	30-Apr-2020	30-Apr-2021
Test Equipment used for Radiated Emissions 10GHz to 26GHz					
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
Test Equipment used for AC line conducted emissions 150kHz-30MHz					
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 ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	m	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

Appendix F: 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 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.