

March 01, 2023

Roku, Inc. 1155 Coleman Ave San Jose CA 95110 USA

Dear Thien,

Enclosed is the EMC Wireless test report for compliance testing of the Roku, Inc., WiFi Remote Control as tested to the requirements of Title 47 of the CFR,Part 15 Subpart E/RSS-247 Issue 2 (2017-02) for Intentional Radiators.

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. If you have any questions regarding these results or if Eurofins Electrical and Electronic Testing NA, Inc. can be of further service to you, please feel free to contact me.

Gary Cheu

Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: WIR121850-ROKU_FCC_ISED-WLAN_5GHz



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FCC/ ISED Test Report

Applicant name: Roku, Inc.

Product: WiFi Remote Control

Report: WIR121850-ROKU_FCC_ISED-WLAN_5GHz

Applicant Address:

1155 Coleman Ave., San Jose, CA 95110 USA

Manufacturer Address:

1155 Coleman Ave., San Jose, CA 95110 USA

Prepared By: Eurofins Electrical and Electronic Testing NA, Inc. 3162 Belick St. Santa Clara CA, 95054

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FCC/ ISED Test Report

Applicant name: Roku, Inc.

Product: WiFi Remote Control

Standard
47 CFR FCC Part 15, Subpart E (Section 15.407)
RSS-247 Issue 2 (2017-02)
RSS-Gen Issue 5 (2019-03)
789033 D02 General UNII Test Procedures New Rules v02r01
ANSI C63.10:2013

Christopher Martin
Christopher Martin Test Engineer, Wireless Laboratory

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements FCC Rules under normal use and maintenance.

Gary Chou Gary Chou

Wireless Engineering Manager, Wireless Laboratory

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Maryland

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E&E

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Release Control Record

Issue No.	Description	Date Issued	
WIR121850-ROKU_FCC_ISED-WLAN_5GHz	Original release	03/ 01/2023	

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1 Summary of Test Results

		47 CFR FCC Part 15, Subpart E	Section 15.4	407)
Standard Section		+	D#	
FCC	ISED	Test Item	Result	Remarks
15.203	198	Antenna Requirement	Pass	Meet the requirement of limit.
15.407 (b)(6)	RSS-Gen 8.8	AC Power Conducted Emissions	Pass	Meet the requirement of limit.
15.407 (b)(1/2/3/4(i/ii)/6)	RSS-247	Radiated Emissions & Band Edge Measurement	Pass	Meet the requirement of limit.
15.407 (a)(1/2/3)	RSS-247	Max Average Transmit Power	Pass	Meet the requirement of limit.
-	RSS-Gen 6.6	Occupied Bandwidth	Pass	Meet the requirement of limit.
15.407 (e)	RSS-247	6 dB Emission Bandwidth	Pass	Meet the requirement of limit. (U-NII-3 only)
15.407 (a)(1/2/3)	RSS-247	Peak Power Spectral Density	Pass	Meet the requirement of limit.
15.407(g)	-	Frequency Stability	Pass	Meet the requirement of limit.

Note:

1.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Test Method	Typical Expanded Uncertainty	К	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

1.2 Modification Record

There were no modifications required for compliance.



2 General Information

2.1 General Description of EUT

Product:	WiFi Remote Control		
Brand:	Roku		
Model(s) Tested:	RC-EL2		
Series Model:	RC-EL3		
Sample Status:	Original		
	Primary Power:	3Vdc powered by battery	
	Voltage Frequency:	N/A	
	Technology / Type of Modulations:	256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM	
EUT Specifications:	Operating Frequency :	5180 MHz~5240MHz, 5260 MHz~5320 MHz 5500 MHz~5725 MHz 5745 MHz~5825MHz	
	FCC ID:	TC2-R1037	
	ISED ID:	TBD	
	Antenna Type: Chip Antenna	Antenna 1: 5000-6000 MHz: 4.5dBi Antenna 2: 5000-6000 MHz: 3.7dBi	
	Antenna connector:	N/A	
Analysis:	The results obtained relate only to the item(s) tested		
	Temperature: 20.3° C		
Environmental Test Conditions:	Relative Humidity: 47.5%		
	Barometric Pressure: 860-1060 mbar		
Evaluated by:	Christopher Martin		
Issue Date(s):	March 01, 2023		

NOTE: The following modules can be chosen to be configured in the EUT.

٠.	TOTEL THE	onoming intoduced build be t	modern to be coming an	ca iii die Eo ii
		Model No.	FCC ID	Note
	-	-	-	-
	-	-	-	-

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2.2 Description of Operation Modes

1TX 1RX

FOR 5180 ~ 5240MHz

4 channels are provided for 802.11a, 802.11n (20Mhz):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

FOR 5260 ~ 5320MHz

4 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency	Channel	Frequency
52	5260 MHz	60	5300 MHz
56	5280 MHz	64	5320 MHz

FOR 5500 ~ 5700MHz

3 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency	Channel	Frequency
100	5500 MHz	140	5700 MHz
116	5800 MHz		

FOR 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (20MHz):

Channel	Frequency	Channel	Frequency
149	5745MHz	161	5805MHz
153	5765MHz	165	5825MHz
157	5785MHz		



Power setting is as below:

80	2.11a	802.11n,	ac(20MHz)
Channel	Power Setting	Channel	Power Setting
36	Al an o Person	36	38 7 2
40	(A) 145 17 - 7	40	9923
48	144	48	\$E
52	86	52	86
56	86	56	87
64	86	64	88
100	82	100	82
116	84	116	84
140	89	140	90
149	-	149	-
157	-	157	-
165	-	165	-
802.11n,	ac(40MHz)	802.11ac(80MHz)	
Channel	Power Setting	Channel	Power Setting
38	-	38	-
46	-	155	-
151	-	48	-
159	-	-	-

1. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

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2.3 General Description of Applied Standard The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards: 47 CFR FCC Part 15, Subpart E (Section 15.407) Canada RSS-247 Issue 2 (2017-02) Canada RSS-Gen Issue 5 (2019-03) 789033 D02 General UNII Test Procedures New Rules v02r01 ANSI C63.10:2013 All test items have been performed and recorded as per the above standards.

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3 Test Types and Results

3.1 Antenna Requirement

Spec	Requirement	Applicable
15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) The antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. The installer shall be responsible for ensuring that the correct antenna is employed by the device.	×
Remark	The EUT uses a Chip Antenna antenna to permanently attach to the device.	
Result	☑ PASS ☐ FAIL	

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3.2 Radiated Emission and Bandedge Measurement

3.2.1 Limits of Radiated Emission Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000MHz, the field strength limits are based on average detector, however, the
 peak field strength of any emission shall not exceed the maximum permitted average limits, specified
 above by more than 20dB under any condition of modulation.

Limits of unwanted emission out of the restricted bands

Applicable To			Limit		
789033 D02 General UNII Test Procedure			Field Strength at 3m		
New Ru	les v0)2r01	PK:74 (dBμV/m)	AV:54 (dBμV/m)	
Frequency Band	Applicable To		EIRP Limit	Equivalent Field Strength at 3m	
5150~5250 MHz	15.407(b)(1)				
5250~5350 MHz	15.407(b)(2)		PK:-27 (dBm/MHz)	PK:68.2(dBµV/m)	
5470~5725 MHz		15.407(b)(3)			
5725~5850 MHz	×	15.407(b)(4)(i)	PK:-27 (dBm/MHz) *1 PK:10 (dBm/MHz) *2 PK:15.6 (dBm/MHz) *3 PK:27 (dBm/MHz) *4	PK: 68.2(dBμV/m)*1 PK:105.2 (dBμV/m)*2 PK: 110.8(dBμV/m)*3 PK:122.2 (dBμV/m)*4	
		15.407(b)(4)(ii)	Emission limits in section 15.247(d)		

^{*1} beyond 75 MHz or more above of the band edge.

Note

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3}$$
 µV/m, where P is the eirp (Watts).

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^{*2} below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above.

^{*3} below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above.

^{*4} from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.



3.2.2 Test Instruments

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2003	EMI Test Receiver	Keysight	N9030B	11/01/2022	11/01/2023
1S2399	Turntable Controller	SUNOL SCIENCE	SC99V	Not Required	Not Required
1S2486	5 Meter Chamber Control Room	Panashield	5 Meter Control Room	Not Required	Not Required
1S2435	Hom Antenna	ETS-LINDGREN	3117	03/03/2021	03/09/2023
1S4802	Preamplifier	EMC Instrument	EMC118A45SE	Note 1	Note 1
1S2668	Preamplifier	Sonoma Instrument	310N	Note 1	Note 1
1S2600	Antenna	TESEQ GmbH	D-12623	05/ 11/ 2021	05/ 11/ 2023
1S3983	Loop Antenna	ETS-LINDGREN	6512	10/ 14 /2021	10/ 14 /2023

Note 1: Verified by calibrated instrumentation at the time of testing

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3.2.3 Test Procedure

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

 The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T
 (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were investigated and the worst-case emissions are reported.

For Band edge Measurement

789033 D02 General U-NII Test Procedures New Rules v02r01, II.F. Method SA-1

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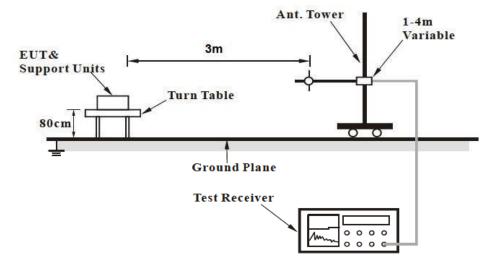
1.	For average emissions measurements, follow the procedures described in section II.G.6., "Procedures for Average Unwanted Emissions Measurements above 1000 MHz", except for the following changes:
2.	Set RBW=100 kHz
3.	Set VBW=300 kHz
4.	Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.
3.2.	4 Deviation from Test Standard
No	deviation.

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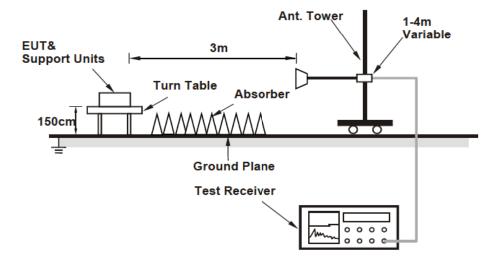


3.2.5 Test Setup

For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.2.6 EUT Operating Condition

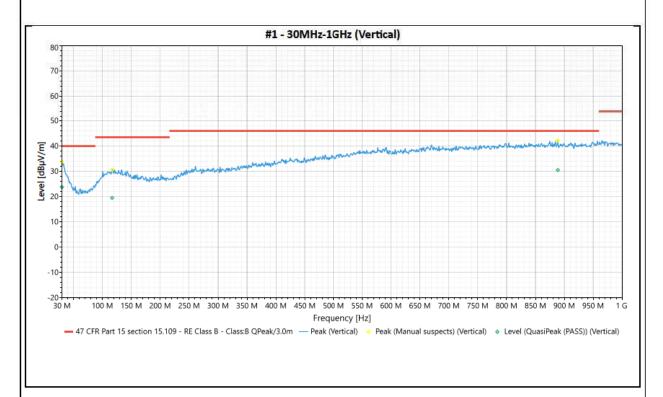
- a. Placed the EUT on the testing table.
- b. Prepared notebooks to act as communication partner and placed it outside of testing area.
- c. The communication partner connected with EUT via a USB cable and ran a test program (provided by manufacturer) to enable EUT under transmission condition continuously at specific channel frequency.
- d. The necessary accessories enable the system in full functions.



3.2.7 Test Results

Below 1GHz Worst-Case Data:

CHANNEL	802.11n Channel 52	DETECTOR	
FREQUENCY RANGE	30MHz – 1GHz	FUNCTION	Quasi Peak



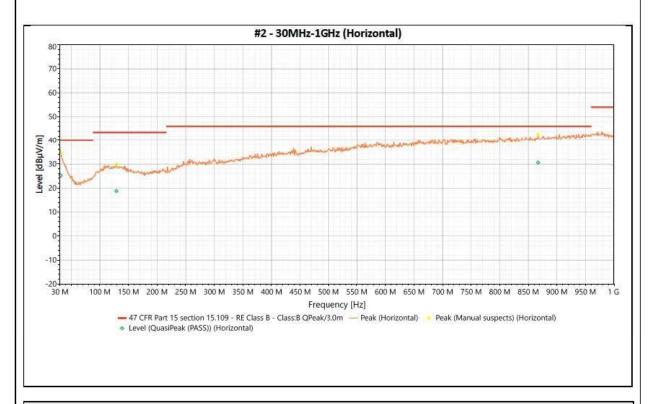
	Antenna Polarity & Test Distance: Vertical at 3m								
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Pass/ Fail
1	30.072	Vertical	23.772	40	-16.228	1.99	129	21.96	Pass
2	116.844	Vertical	19.521	43.5	-23.979	1	0	18.49	Pass
3	888.858	Vertical	30.489	46	-15.511	3.49	175	27	Pass

REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
- 2. AF (dB/m) = Antenna Factor (dB/m) Preamplifier Gain (dB).
- 3. Margin = Level (dBuV/m) Limit value(dBuV/m)

Below 1GHz Worst-Case Data:

CHANNEL	802.11n Channel 40	DETECTOR	
FREQUENCY RANGE	30MHz – 1GHz	FUNCTION	Quasi Peak



	Antenna Polarity & Test Distance: Vertical at 3m								
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Pass/ Fail
1	31.544	Horizontal	25.167	40	-14.833	1.99	286	23.28	Pass
2	128.772	Horizontal	18.786	43.5	-24.714	1.49	118	17.63	Pass
3	866.894	Horizontal	30.621	46	-15.379	1.49	354	27.64	Pass

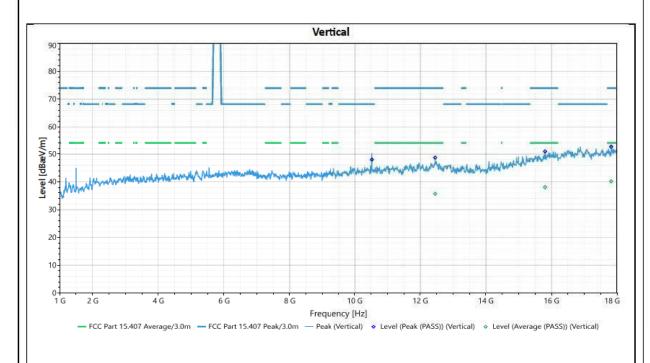
REMARKS:

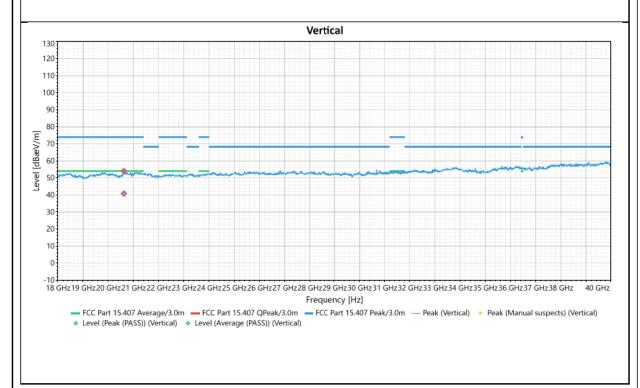
- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
- 2. AF (dB/m) = Antenna Factor (dB/m) Preamplifier Gain (dB).
- 3. Margin = Level (dBuV/m) Limit value(dBuV/m)



Above 1GHz Test Data:

CHANNEL	802.11a I 5260 MHz	DETECTOR	2004 3A17000	93
FREQUENCY RANGE	1GHz-40GHz	FUNCTION	Prak/Average	







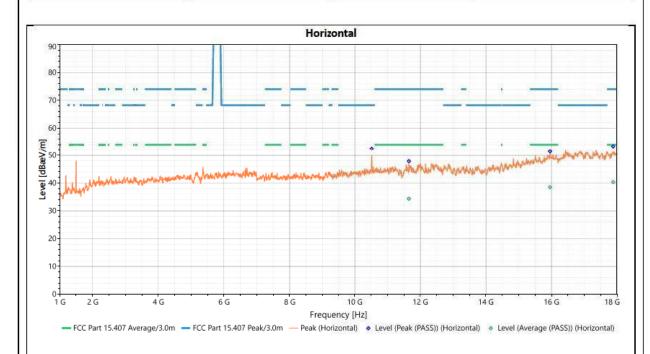
	Antenna Polarity & Test Distance: Vertical at 3m									
No.	Frequency (MHz)	Polarization	Level [dB(uV/m)]	Limit dB(uV/m)	Margin [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result	
1	12452.92	Vertical	48.713	74	-25.287	3.5	328	7.53	Peak (PASS)	
2	12452.92	Vertical	35.687	54	-18.313	3.5	328	7.53	Average (PASS)	
3	15805.35	Vertical	50.962	74	-23.038	3.5	137	8.85	Peak (PASS)	
4	15805.35	Vertical	38.057	54	-15.943	3.5	137	8.85	Average (PASS)	
5	17821.49	Vertical	52.66	74	-21.34	3.5	170	7.05	Peak (PASS)	
6	17821.49	Vertical	40.19	54	-13.81	3.5	170	7.05	Average (PASS)	
7	20618.05	Vertical	54.072	74	-19.928	1.14	160	8.4	Peak (PASS)	
8	20618.05	Vertical	40.807	54	-13.193	1.14	160	8.4	Average (PASS)	

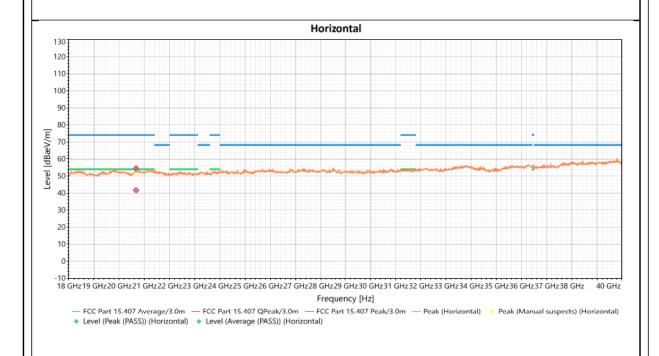
REMARKS:

- 1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- 2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) + Preamplifier
- 3. Margin value = Emission level Limit value.
- 4. The emission levels of other frequencies were less than 20dB margin agains



Frequency	802.11a I 5260 MHz	DETECTOR		ia:
FREQUENCY RANGE	1GHz-40GHz	FUNCTION	Prak/Average	







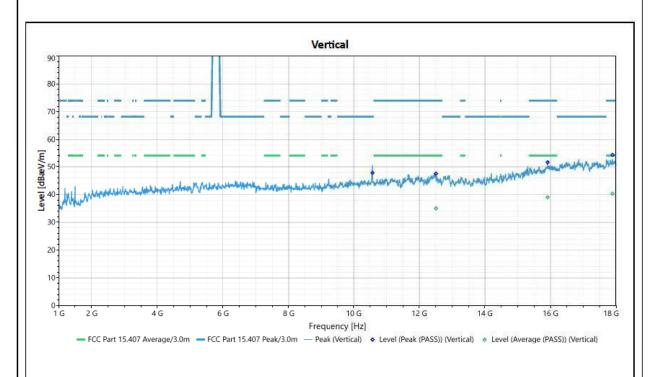
Antenna Polarity & Test Distance: Vertical at 3m									
No.	Frequency (MHz)	Polarization	Level [dB(uV/m)]	Limit dB(uV/m)	Margin [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	11652.16	Horizontal	47.854	74	-26.146	3	316	6.87	Peak (PASS)
2	11652.16	Horizontal	34.337	54	-19.663	3	316	6.87	Average (PASS)
3	15956.61	Horizontal	51.443	74	-22.557	2.49	34	8.77	Peak (PASS)
4	15956.61	Horizontal	38.483	54	-15.517	2.49	34	8.77	Average (PASS)
5	17882.71	Horizontal	53.367	74	-20.633	2	347	6.72	Peak (PASS)
6	17882.71	Horizontal	40.307	54	-13.693	2	347	6.72	Average (PASS)
7	20668.5	Horizontal	54.423	74	-19.577	1.89	50	8.33	Peak (PASS)
8	20668.5	Horizontal	41.655	54	-12.345	1.89	50	8.33	Average (PASS)

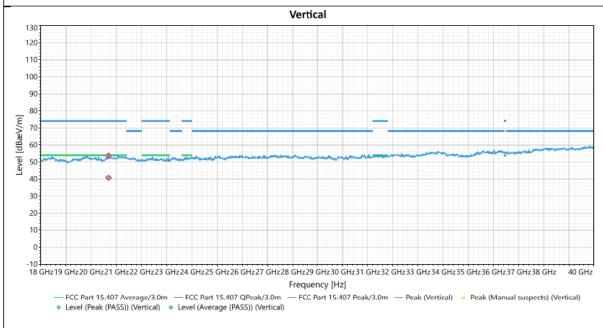
REMARKS:

- 1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- 2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
- 3. Margin value = Emission level Limit value.
- 4. The emission levels of other frequencies were less than 20dB margin agains



CHANNEL	802.11a 5280 MHz	DETECTOR			
FREQUENCY RANGE	1GHz-40GHz	FUNCTION	Prak/Average		







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Antenna Polarity & Test Distance: Vertical at 3m									
No.	Frequency (MHz)	Polarization	Level [dB(uV/m)]	Limit dB(uV/m)	Margin [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	12508.97	Vertical	47.499	74	-26.501	1	76	7.57	Peak (PASS)
2	12508.97	Vertical	34.964	54	-19.036	1	76	7.57	Average (PASS)
3	15915.79	Vertical	51.546	74	-22.454	3.49	265	8.92	Peak (PASS)
4	15915.79	Vertical	38.963	54	-15.037	3.49	265	8.92	Average (PASS)
5	17892.9	Vertical	54.24	74	-19.76	2.5	0	7.13	Peak (PASS)
6	17892.9	Vertical	40.293	54	-13.707	2.5	0	7.13	Average (PASS)
7	20686.24	Vertical	53.707	74	-20.293	1.49	314	8.45	Peak (PASS)
8	20686.24	Vertical	40.773	54	-13.227	1.49	314	8.45	Average (PASS)

REMARKS:

- 1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- 2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
- 3. Margin value = Emission level Limit value.
- 4. The emission levels of other frequencies were less than 20dB margin agains

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