

FCC Test Report

Report No.: FCC_RF_SL21042901-ROK-001_5G Rev_2.0

FCC ID: TC2-R1041

Test Model (host): RC-FA1

Series Model: RC-FA5

Received Date: 05/03/2021

Test Date: 05/06/2021-07/31/2021

Issued Date: 07/31/2021

Applicant: Roku, Inc.

Address: 1155 Coleman Ave., San Jose, CA 95110 USA

Manufacturer: Roku, Inc.

Address: 1155 Coleman Ave., San Jose, CA 95110 USA

Issued By: Bureau Veritas Consumer Products Services, Inc.

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FCC Test Site Reg No.: 540430



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Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty.....	6
2.2 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Operation Modes	8
3.2.1 Test Mode Applicability and Tested Channel Detail	9
3.3 Description of Support Units	10
3.3.1 Duty Cycle of Test Signal	11
3.4 General Description of Applied Standard	12
4 Test Types and Results	13
4.1 Antenna Requirement.....	13
4.2 Radiated Emission and Bandedge Measurement	14
4.2.1 Limits of Radiated Emission Measurement	14
4.2.2 Test Instruments	15
4.2.3 Test Procedure.....	15
4.2.4 Deviation from Test Standard.....	16
4.2.5 Test Setup.....	17
4.2.6 EUT Operating Condition	18
4.2.7 Test Results	19
4.3 Conducted Emission Measurement	53
4.3.1 Limits of Conducted Emission Measurement	53
4.3.2 Test Instruments	53
4.3.3 Test Procedure.....	54
4.3.4 Deviation from Test Standard.....	54
4.3.5 Test Setup.....	54
4.3.6 EUT Operating Condition	54
4.3.7 Test Results	55
4.4 Transmit Power Measurement.....	56
4.4.1 Limits of Transmit Power Measurement	56
4.4.2 Test Setup.....	57
4.4.3 Test Instruments	57
4.4.4 Test Procedure.....	57
4.4.5 Deviation from Test Standard.....	58
4.4.6 EUT Operating Condition	58
4.4.7 Test Results	59
4.5 26dB Bandwidth & 6dB Bandwidth Measurement.....	60
4.5.1 Limits of 6 dB Bandwidth Measurement.....	60
4.5.2 Test Setup.....	60
4.5.3 Test Instruments	60
4.5.4 Test Procedure.....	60
4.5.5 Test Results	61
4.6 Peak Power Spectral Density Measurement.....	68
4.6.1 Limits of Peak Power Spectral Density Measurement.....	68
4.6.2 Test Setup.....	68
4.6.3 Test Instruments	68
4.6.4 Test Procedure.....	68
4.6.5 Deviation from Test Standard.....	68
4.6.6 EUT Operating Condition	68
4.6.7 Test Results	69
4.7 Frequency Stability Measurement	76

4.7.1 Limits of Frequency Stability Measurement	76
4.7.2 Test Setup.....	76
4.7.3 Test Instruments	76
4.7.4 Test Procedure.....	76
4.7.5 Deviation from Test Standard.....	76
4.7.6 EUT Operating Condition	76
4.7.7 Test Results	77
5 Pictures of Test Arrangements.....	78
Appendix – Information on the Testing Laboratories	79

Release Control Record

Issue No.	Description	Date Issued
FCC_RF_SL21042901-ROK-001_5G	Original release	06/09/2021
FCC_RF_SL21042901-ROK-001_5G Rev_1.0	Minor update per client review	06/18/2021
FCC_RF_SL21042901-ROK-001_5G Rev_2.0	Update Radiated Test	07/31/2021

1 Certificate of Conformity

Product: WiFi Remote Control

Brand: Roku, Inc.

Test Model (host): RC-FA1

Series Model: RC-FA5

Sample Status: Engineering Sample

Applicant: Roku, Inc.

Test Date: 05/06/2021-07/31/2021

Standard: 47 CFR FCC Part 15, Subpart E (Section 15.407)
789033 D02 General UNII Test Procedures New Rules v02r01
ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc. Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Deon Dai, **Date:** 07/31/2021
Deon Dai / Test Engineer

Approved by : Gary Chou, **Date:** 07/31/2021
Gary Chou / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart E (Section 15.407)			
Standard Section	Test Item	Result	Remarks
15.203	Antenna Requirement	Pass	The EUT uses a PCB trace antenna to permanently attach to the device.
15.407 (b)(6)	AC Power Conducted Emissions	N/A	Work with Battery
15.407 (b)(1/2/3/4(i/ii)/6)	Radiated Emissions & Band Edge Measurement*	Pass	Meet the requirement of limit.
15.407 (a)(1/2/3)	Max Average Transmit Power	Pass	Meet the requirement of limit.
-	Occupied Bandwidth	Pass	Meet the requirement of limit.
15.407 (e)	6 dB Emission Bandwidth	Pass	Meet the requirement of limit. (U-NII-3 only)
15.407 (a)(1/2/3)	Peak Power Spectral Density	Pass	Meet the requirement of limit.
15.407(g)	Frequency Stability	Pass	Meet the requirement of limit.

Note: N/A: EUT worked with battery.

2.1 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:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	WiFi Remote Control
Brand	Roku, Inc.
Test Model (host)	RC-FA1
Identification No. of EUT	N/A
Series Model	RC-FA5
Status of EUT	Engineering Sample
Power Supply Rating	3Vdc powered by batteries
Modulation Type	64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11a: up to 6 Mbps 802.11n: up to 6.5 Mbps
Operating Frequency	5150 ~ 5250MHz, 5745~5825MHz
Number of Channel	5150~5250MHz: 802.11a, 802.11n (HT20): 4 5745~5825MHz: 802.11a, 802.11n (HT20): 5
Antenna Type	PCB Trace Antenna
Antenna Gain (dBi)	5
Antenna Connector	N/A

Note:

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.
2. Model RC-FA5 is electrically identical to tested model RC-FA1. The only difference between the models are minor external cosmetic appearances which does not affect any Electromagnetic Compatibility or RF characteristics of the device.

3.2 Description of Operation Modes

FOR 5180 ~ 5240MHz

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

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

FOR 5745 ~ 5825MHz:

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

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

Power setting is as below:

802.11a		802.11n	
Channel	Power Setting	Channel	Power Setting
36	65	36	65
40	65	40	65
48	65	48	65
149	65	149	65
157	65	157	65
165	65	165	65

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.

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE $\geq$ 1G	RE<1G	PLC	APCM	
A	√	√	√	√	Powered by battery
B	-	-	-	-	Powered by adapter

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz

RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

NOTE:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.
2. "-" means no effect.

Radiated Emission Test (Above 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	FREQ. Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11a	5180-5240	36 to 48	36, 40, 48	OFDM	BPSK	6
-	802.11n (HT20)		36 to 48	36, 40, 48	OFDM	BPSK	6.5
-	802.11a	5745-5825	149 to 165	149, 157, 165	OFDM	BPSK	6
-	802.11n (HT20)		149 to 165	149, 157, 165	OFDM	BPSK	6.5

Radiated Emission Test (Below 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	FREQ. Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11a	5180-5320	36 to 64	62	OFDM	BPSK	6
-	802.11a	5745-5825	149 to 165	149	OFDM	BPSK	6

Power Line Conducted Emission Test:

- ☐ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☐ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	FREQ. Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11a	5180-5320	36 to 64	62	OFDM	BPSK	6
-	802.11a	5745-5825	149 to 165	149	OFDM	BPSK	6

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	FREQ. Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11a	5180-5240	36 to 48	36, 40, 48	OFDM	BPSK	6
-	802.11n (HT20)		36 to 48	36, 40, 48	OFDM	BPSK	6.5
-	802.11a	5745-5825	149 to 165	149, 157, 165	OFDM	BPSK	6
-	802.11n (HT20)		149 to 165	149, 157, 165	OFDM	BPSK	6.5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested By
RE≥1G	25deg. C, 65%RH	3Vdc	Deon Dai
RE<1G	25deg. C, 65%RH	3Vdc	Deon Dai
PLC	25deg. C, 68%RH	3Vdc	Deon Dai
APCM	21deg. C, 60%RH	3Vdc	Deon Dai

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude 3550	N/A	N/A	N/A
B.						
C.						
D.						
E.						
F.						
G.						

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB	1	0.8m	No	0	Connect from EUT to Laptop
2.						
3.						

3.3.1 Duty Cycle of Test Signal

MODULATION TYPE: BPSK

Duty cycle of test signal is $\geq 98\%$, duty factor is not required.

If Duty cycle of test signal is $< 98\%$, duty factor is required.

802.11a: Duty cycle = 100%

802.11n (HT20): Duty cycle = 100%



3.4 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)

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.

4 Test Types and Results

4.1 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 PCT trace antenna to permanently attach to the device.	
Result	☒ PASS ☐ FAIL	

4.2 Radiated Emission and Bandedge Measurement

4.2.1 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:

- The lower limit shall apply at the transition frequencies.
- 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 New Rules v02r01		Field Strength at 3m	
		PK:74 (dBuV/m)	AV:54 (dBuV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
5150~5250 MHz	15.407(b)(1)	PK:-27 (dBm/MHz)	PK:68.2(dBuV/m)
5250~5350 MHz	15.407(b)(2)		
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(dBuV/m) ^{*1} PK:105.2 (dBuV/m) ^{*2} PK: 110.8(dBuV/m) ^{*3} PK:122.2 (dBuV/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.		^{*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.	

Note:

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

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

4.2.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Receiver (Rohde and Schwarz)	ESW44	1328.4100K-1016 62-MH	10/23/2020	10/23/2021
Biconilog Antenna (Sunol)	JB6	A111717	9/4/2020	9/4/2021
Horn Antenn (ETS-Lindgren)	3117	218554	07/24/2020	7/24/2021
Pre-Amplifier (RF-Lambda)	RAMP00M50GA	18040300055	10/1/2020	10/1/2021
Hon Antenna DRG	SAS-574	579	08/05/2020	08/05//2022
PXA Signal Analyzer (Keysight)	N9030B	MY57140100	07/22/2020	07/22/2022
SMA Fixed Attenuator (50ohms, 2w, 30dB, DC-6GHz)	VAT-03W2+	n/a	07/21/2020	07/21/2022
FSB Antenna Cable, 0.5m (Microwave Town)	FSB360PK-KMKM-00.50M	201906110002	10/1/2020	10/1/2021
FSB Antenna Cable, 4m (Microwave Town)	FSB360PK-KMKM-400M	21030447-002	10/1/2020	10/1/2021
10m Semi-Anechoic Chambe (ETS-Lindgren)	S2010BL8X8	1462	07/21/2020	07/21/2022
Notch Filters MICRO-TRONICS	BRM50705	041	07/21/2020	07/21/2022
Loop Antenna	N/A	00049120	11/25/2020	11/25/2021

4.2.3 Test Procedure

For Radiated emission below 30MHz

- 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.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- 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.
- 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:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. 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.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) 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

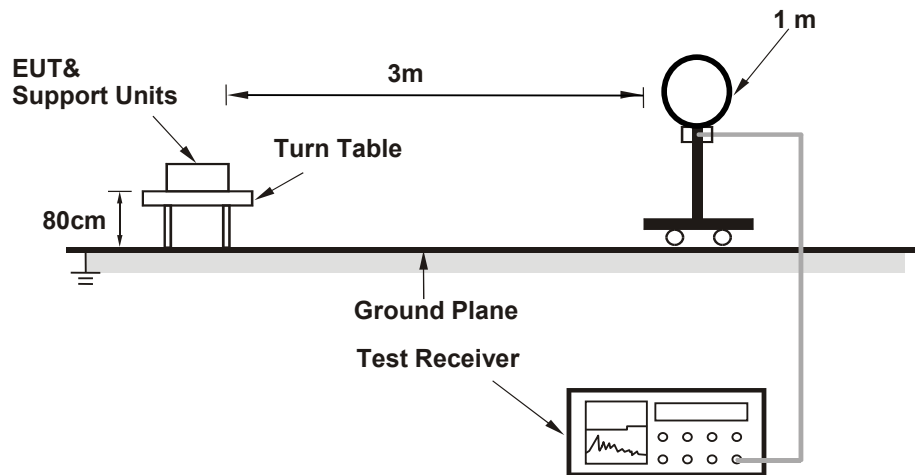
1. For average emissions measurements, follow the procedures described in section II.G.6., "Procedures for Average Unwanted Emissions Measurements above 1000 MHz", except for the following changes:
2. Set RBW=100 kHz
3. Set VBW=300 kHz
4. Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

4.2.4 Deviation from Test Standard

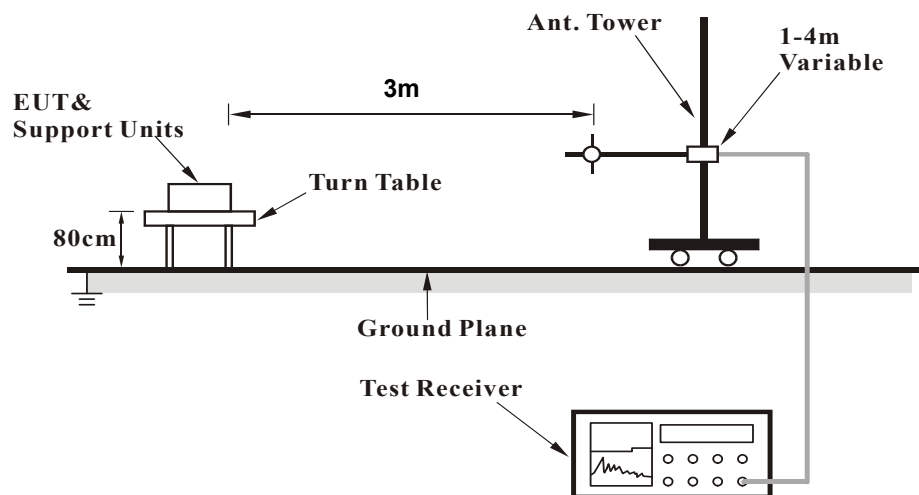
No deviation.

4.2.5 Test Setup

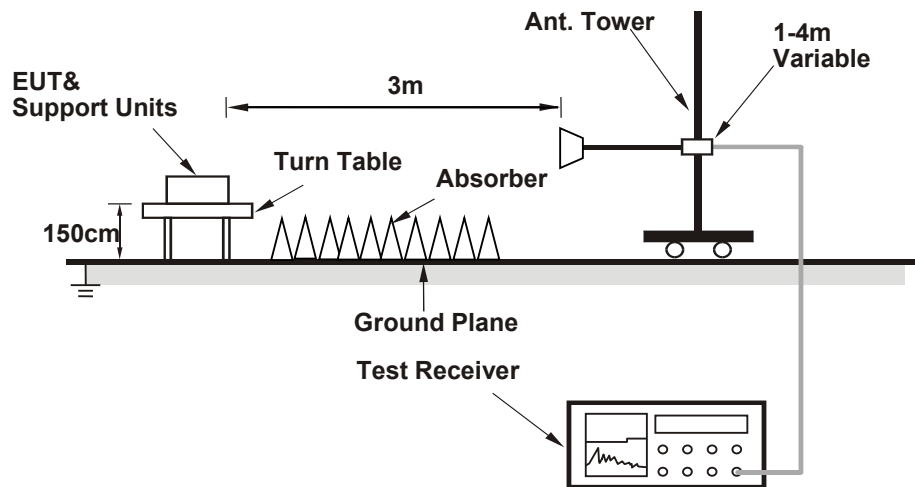
For Radiated emission below 30MHz



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).

4.2.6 EUT Operating Condition

- Placed the EUT on the testing table.
- Prepared notebooks to act as communication partner and placed it outside of testing area.
- 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.
- The necessary accessories enable the system in full functions.

4.2.7 Test Results

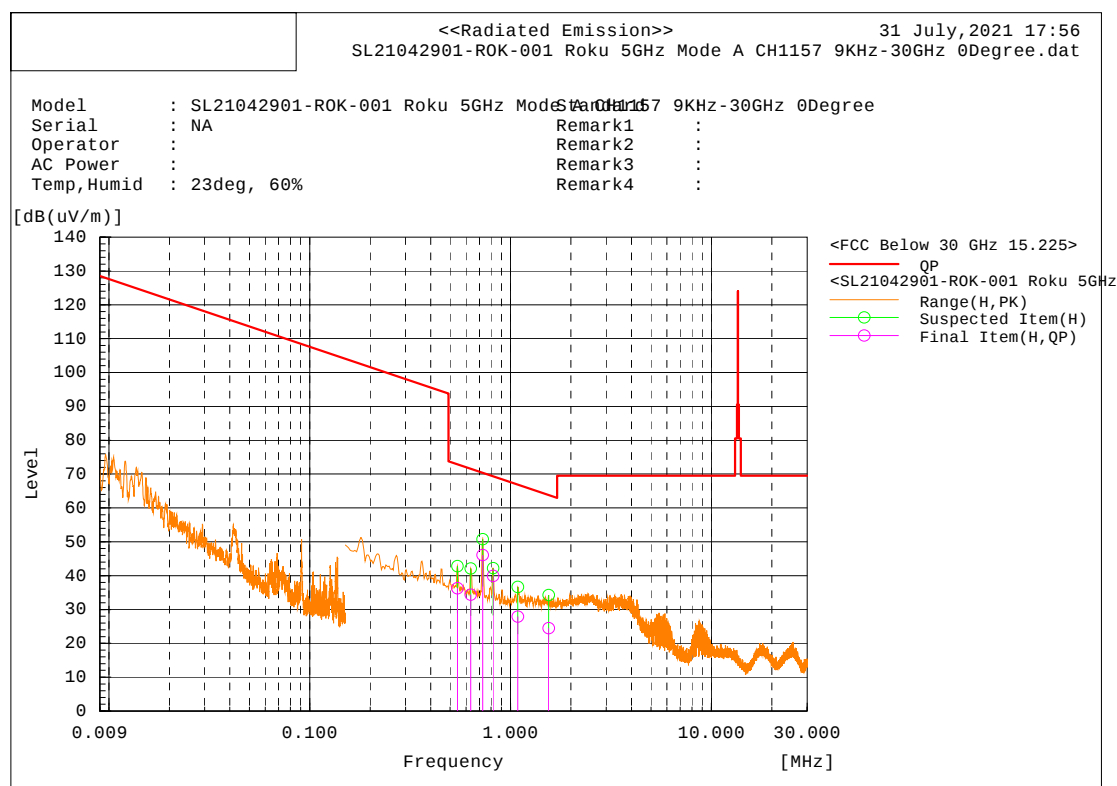
Below 30MHz Worst-Case Data:

CHANNEL	802.11a Channel 48	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	9KHz-30MHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m- 0 Degree										
No.	Frequency (MHz)	Degree (0/90)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	LimitQP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	0.544	0	18.6	17.7	36.3	72.9	-36.6	100	6.2	Pass
2	0.634	0	17.9	16.5	34.4	71.6	-37.2	100	173.2	Pass
3	0.726	0	30.6	15.5	46.1	70.4	-24.3	100	134.6	Pass
4	0.819	0	25.4	14.5	39.9	69.3	-29.4	100	223.9	Pass
5	1.087	0	15.6	12.3	27.9	66.9	-39	100	123.1	Pass
6	1.547	0	14.8	9.7	24.5	63.8	-39.3	100	357.9	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. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

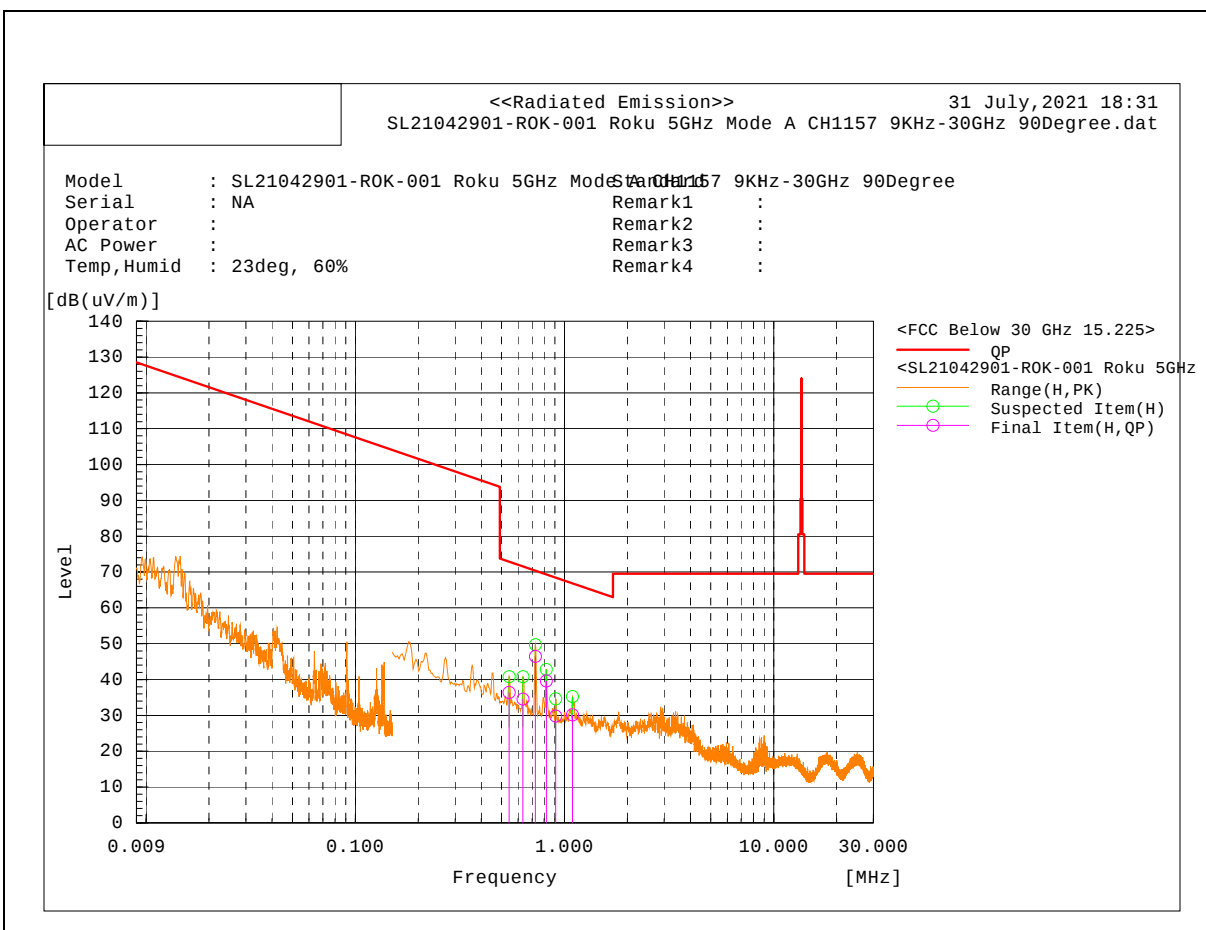


CHANNEL	802.11a Channel 48	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	9KHz-30MHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m- 0 Degree										
No.	Frequency (MHz)	Degree (0/90)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	0.544	90	18.7	17.7	36.4	72.9	-36.5	100	286.3	Pass
2	0.634	90	18.1	16.5	34.6	71.6	-37	100	358.6	Pass
3	0.726	90	31	15.5	46.5	70.4	-23.9	100	175.9	Pass
4	0.819	90	25.1	14.5	39.6	69.3	-29.7	100	0	Pass
5	0.908	90	16.2	13.6	29.8	68.4	-38.6	100	53	Pass
6	1.09	90	17.8	12.3	30.1	66.9	-36.8	100	162.8	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. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



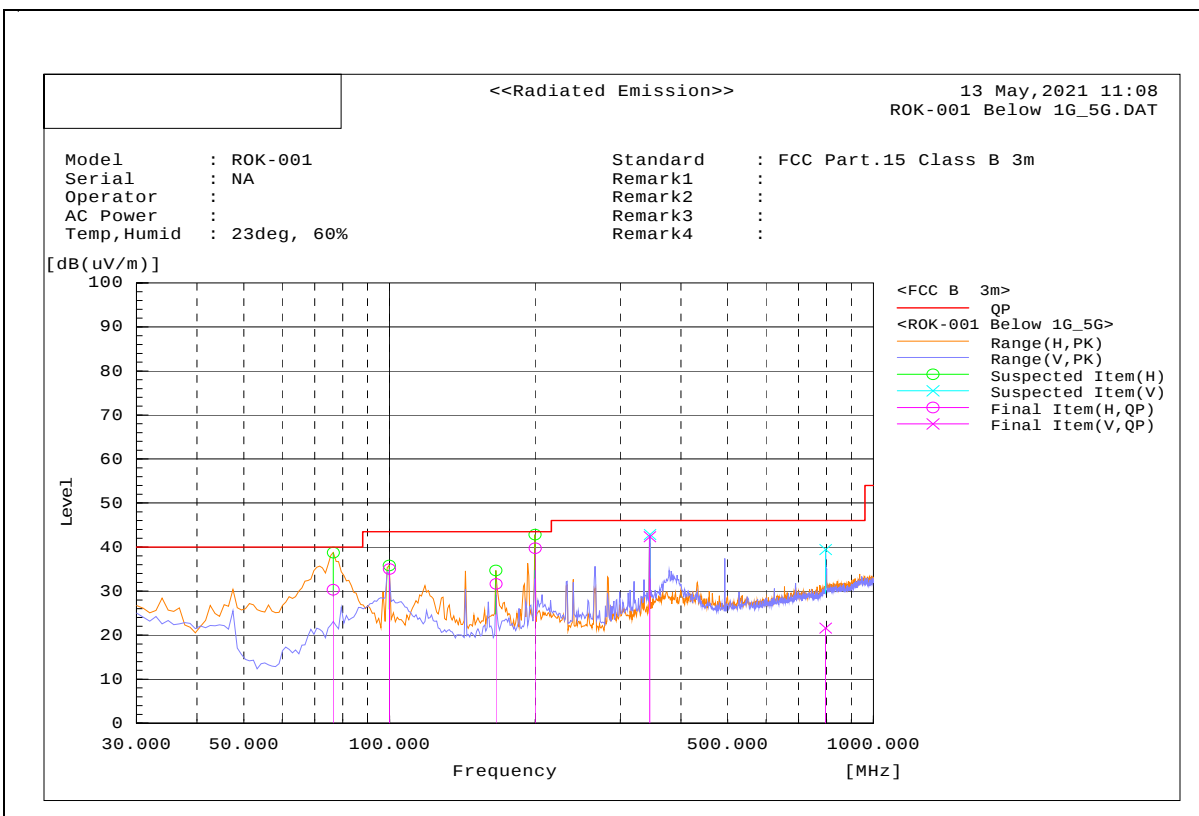
Below 1GHz Worst-Case Data:

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

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	76.47	H	17	13.3	30.3	40	-9.7	116	165	Pass
2	99.922	H	19	16	35	43.5	-8.5	120	232	Pass
3	165.924	H	13	18.6	31.6	43.5	-11.9	101	295	Pass
4	199.999	H	20.6	19.2	39.8	43.5	-3.7	114	0	Pass
5	344.975	V	21.1	21.3	42.4	46	-3.6	100	27.3	Pass
6	796.146	V	-7.7	29.3	21.6	46	-24.4	123	250	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. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



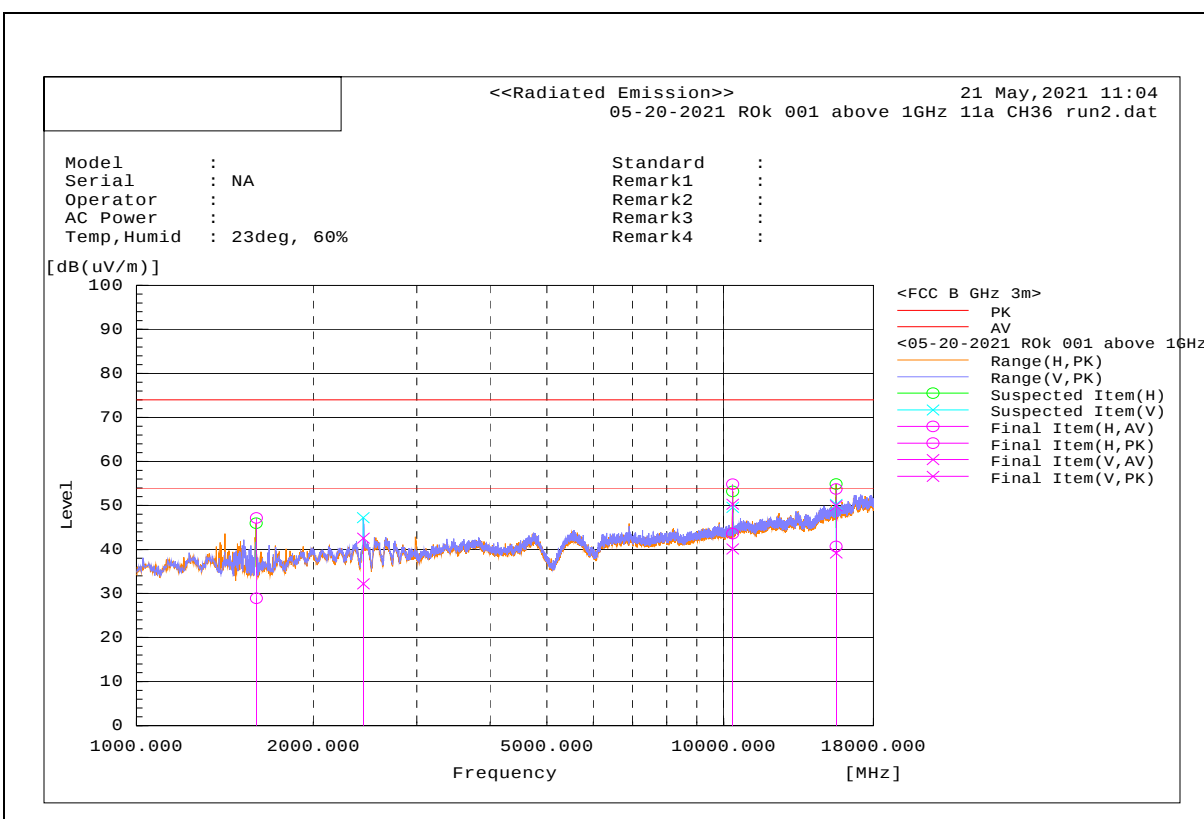
Above 1GHz Test Data:

Above 1GHz – 802.11a – 5180MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No.	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1599.793	H	45.4	63.7	-16.5	28.9	47.2	54	74	-25.1	-26.8	100.6	103.3	Pass
2	2434.058	V	43.6	54	-11.4	32.2	42.6	54	74	-21.8	-31.4	336.9	116.9	Pass
3	10360.33	H	38.5	49.7	5.1	43.6	54.8	54	74	-10.4	-19.2	121.9	305.7	Pass
4	10360.14	V	35.1	45.2	5.1	40.2	50.3	54	74	-13.8	-23.7	173.3	340.9	Pass
5	15540.49	H	29	42.1	11.7	40.7	53.8	54	74	-13.3	-20.2	227.9	327.8	Pass
6	15540.09	V	27.5	38.3	11.7	39.2	50	54	74	-14.8	-24	128.4	110.8	Pass
7	24466.842	V	21.1	32.3	17.4	38.5	49.7	54	74	15.5	-24.3	100	283.6	Pass
8	24465.082	H	20.7	32.3	17.4	38.1	49.7	54	74	15.9	-24.3	201	226.4	Pass

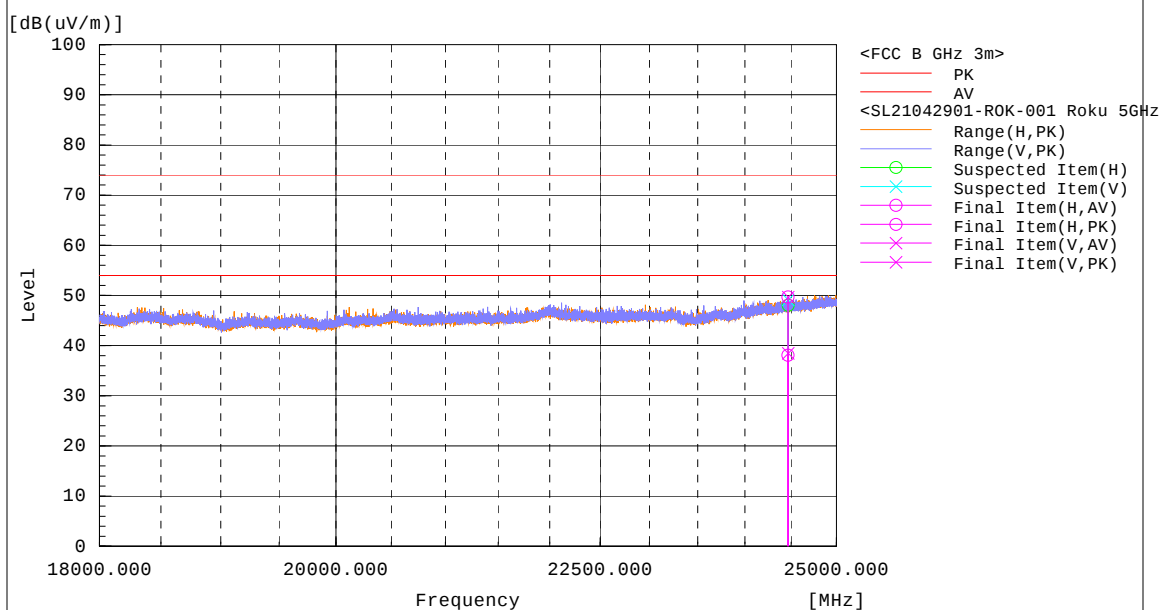
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.



<<Radiated Emission>> 23 July, 2021 15:23
SL21042901-ROK-001 Roku 5GHz Mode A CH36 18GHz-25GHz.dat

Model : SL21042901-ROK-001 Roku 5GHz Mode A CH36 18GHz-25GHz
Serial :
Operator :
AC Power :
Temp, Humid :
Remark1 :
Remark2 :
Remark3 :
Remark4 :

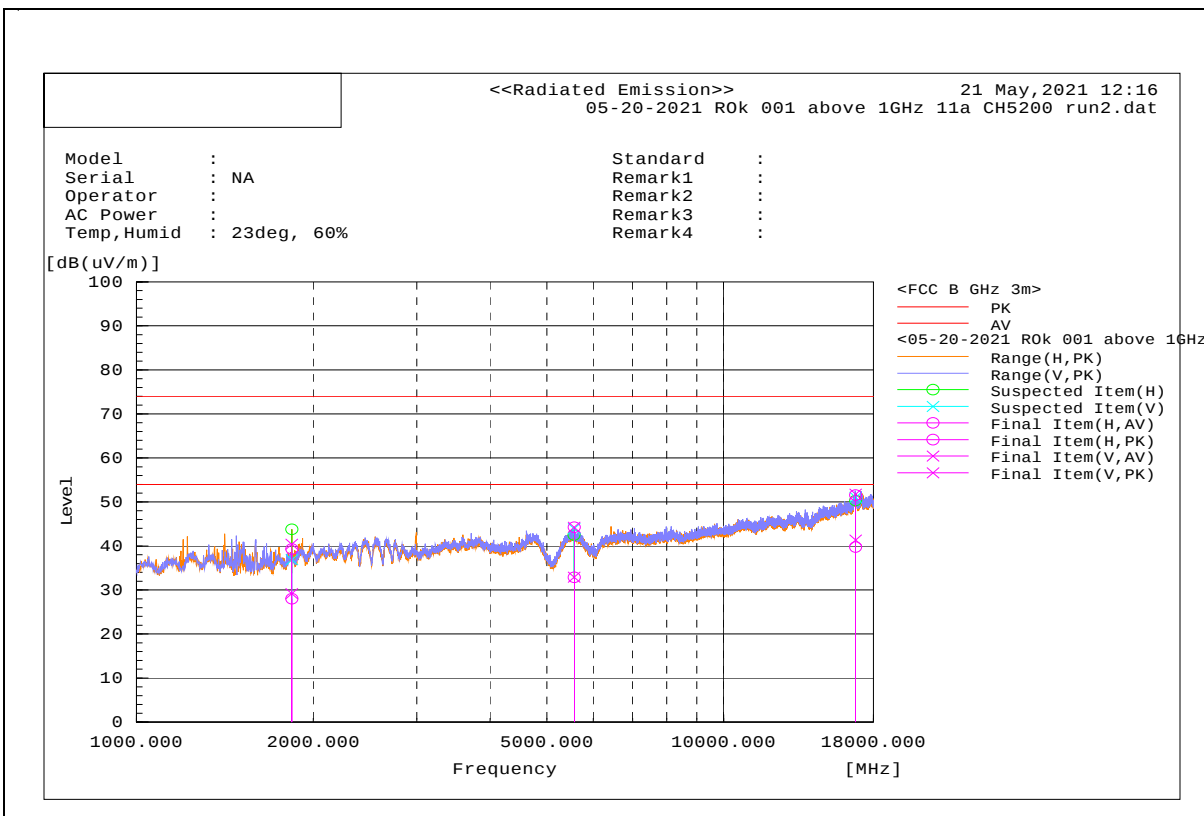


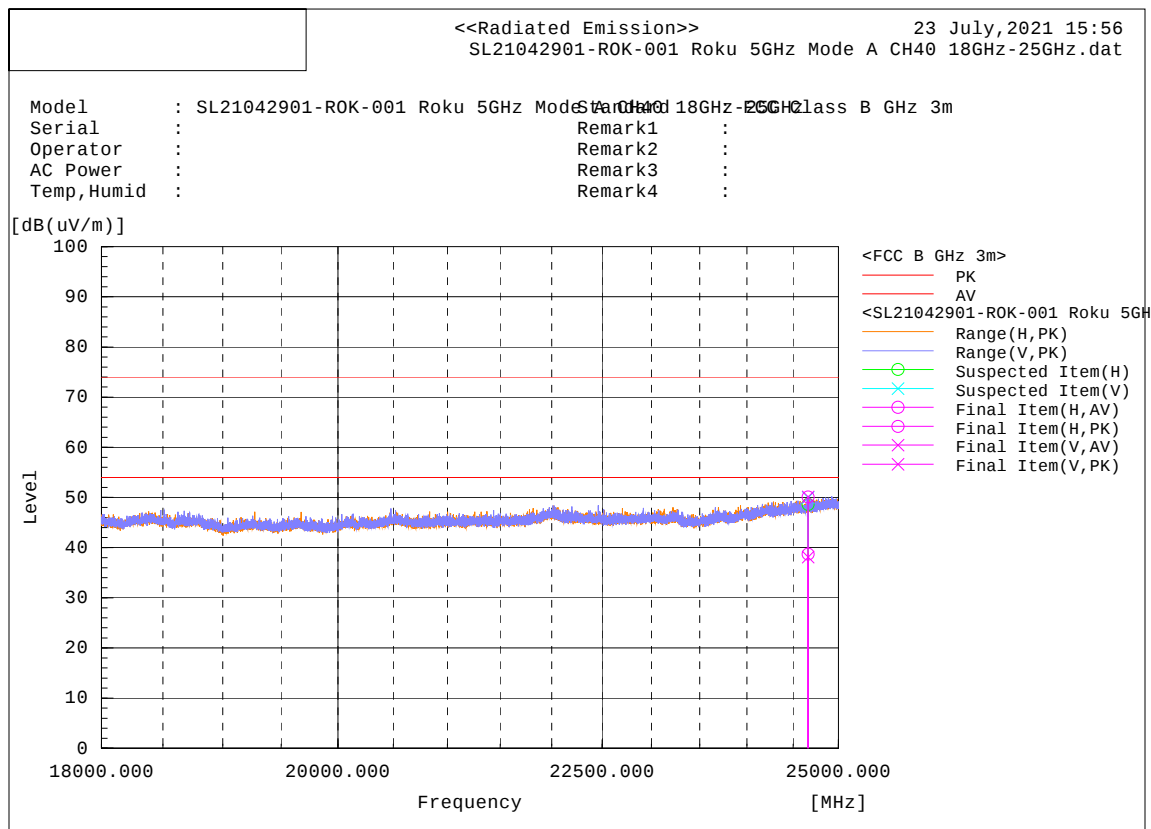
Above 1GHz – 802.11a – 5200MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1838.577	H	41.6	52.9	-13.6	28	39.3	54	74	-26	-34.7	400	0	Pass
2	1837.527	V	42.8	54	-13.6	29.2	40.4	54	74	-24.8	-33.6	371.5	99.4	Pass
3	5562.25	V	37.7	49.1	-4.8	32.9	44.3	54	74	-21.1	-29.7	314.5	0	Pass
4	5562.917	H	37.7	49.1	-4.8	32.9	44.3	54	74	-21.1	-29.7	400	229.1	Pass
5	16776.39	H	24.3	36.2	15.4	39.7	51.6	54	74	-14.3	-22.4	400	247.9	Pass
6	16777.46	V	25.9	36.3	15.4	41.3	51.8	54	74	-12.7	-22.2	346.9	122.9	Pass
7	24664.28	V	20.5	32.5	17.6	38.1	50.1	54	74	15.9	-23.9	382	64.5	Pass
8	24664.122	H	21.1	32.5	17.6	38.7	50.1	54	74	15.3	-23.9	352	330.8	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Pre-amplifier Gain (dB).
3. Margin value = Emission level – Limit value.



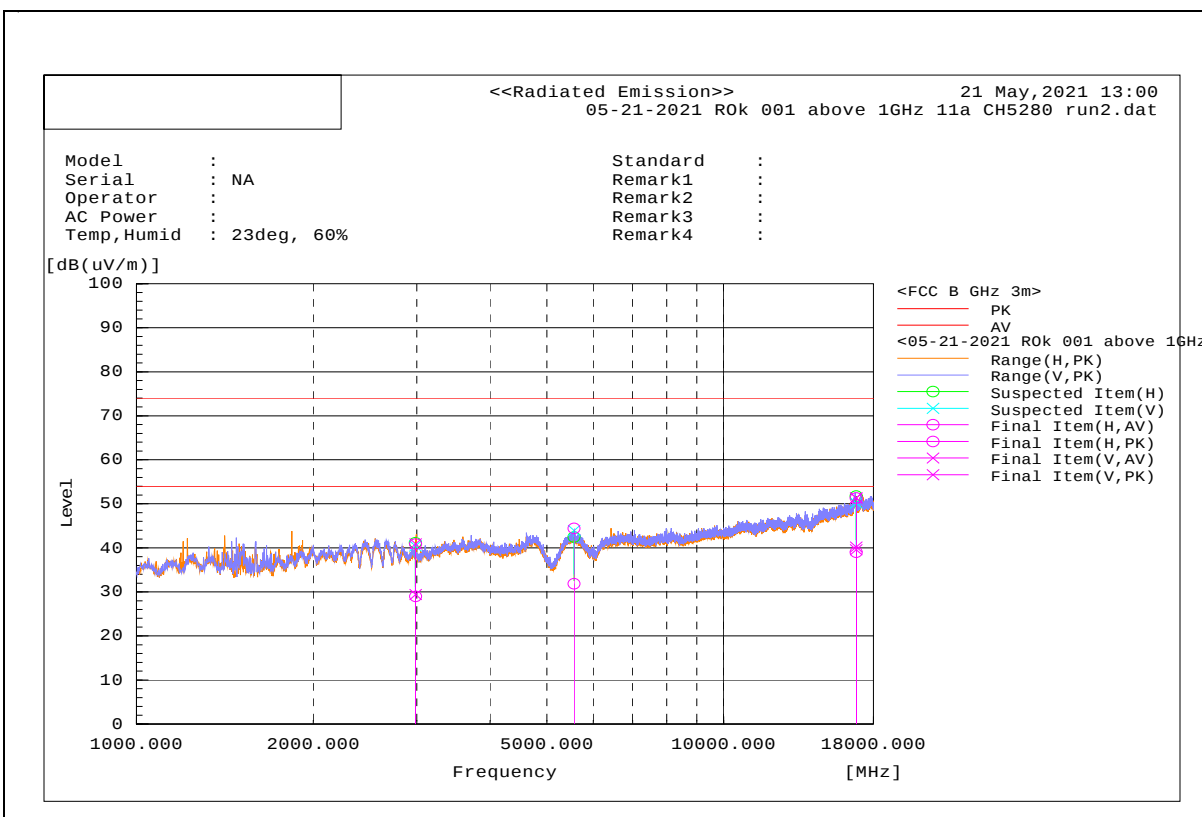


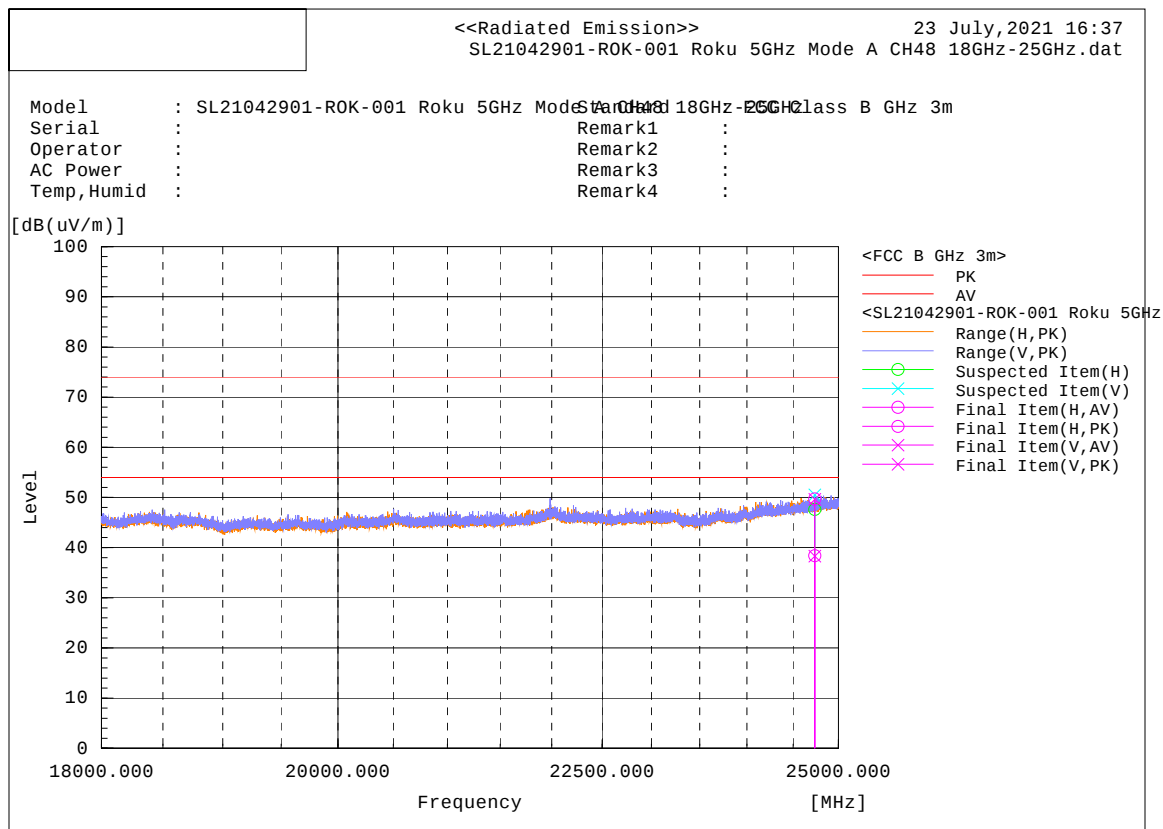
Above 1GHz – 802.11a – 5240MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2986.767	H	39.3	51.2	-10.3	29	40.9	54	74	-25	-33.1	100.6	241.9	Pass
2	2986.434	V	39.7	51.2	-10.3	29.4	40.9	54	74	-24.6	-33.1	144.1	112.4	Pass
3	5561.613	H	36.7	49.2	-4.8	31.9	44.4	54	74	-22.1	-29.6	399.9	172.2	Pass
4	16817.47	H	23.5	35.8	15.5	39	51.3	54	74	-15	-22.7	128.2	354.3	Pass
5	16818.73	V	24.1	35.8	15.5	39.6	51.3	54	74	-14.4	-22.7	326.7	25.2	Pass
6	16818.65	V	24.7	35.9	15.5	40.2	51.4	54	74	-13.8	-22.6	101.8	331.3	Pass
7	24735.952	V	20.7	32	17.6	38.3	49.6	54	74	15.7	-24.4	328	322.6	Pass
8	24737.08	H	20.8	32.1	17.6	38.4	49.7	54	74	15.6	-24.3	307	1.6	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Pre-amplifier Gain (dB).
3. Margin value = Emission level – Limit value.



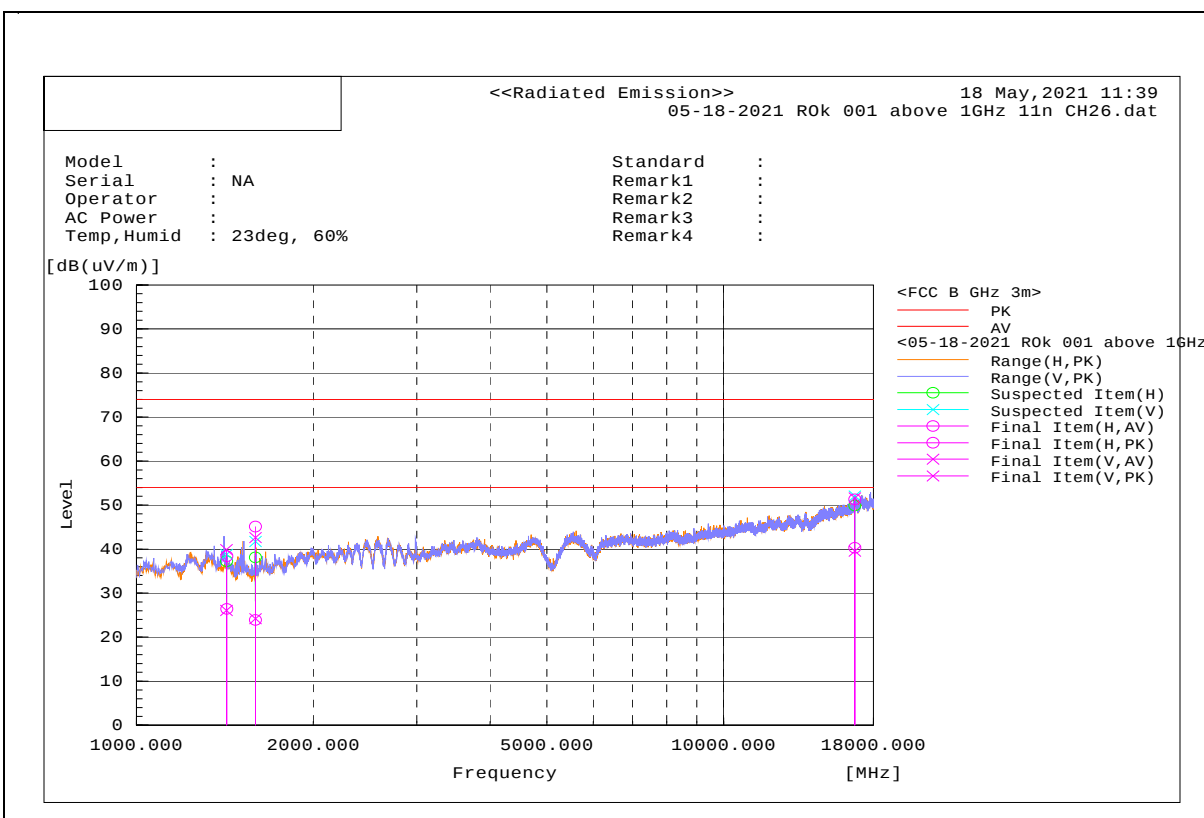


Above 1GHz – 802.11n – 5180MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1424.43	H	43.3	55.3	-16.9	26.4	38.4	54	74	-27.6	-35.6	305.4	322.1	Pass
2	1422.65	V	42.9	56.7	-16.8	26.1	39.9	54	74	-27.9	-34.1	102	294.2	Pass
3	1593.696	V	40.8	59.2	-16.6	24.2	42.6	54	74	-29.8	-31.4	142.8	255.6	Pass
4	1593.807	H	40.5	61.7	-16.6	23.9	45.1	54	74	-30.1	-28.9	228.8	205.9	Pass
5	16730.09	V	24.3	36.4	15.3	39.6	51.7	54	74	-14.4	-22.3	102	110.8	Pass
6	16729.97	H	25	36	15.3	40.3	51.3	54	74	-13.7	-22.7	116.3	355.8	Pass
7	24838.296	H	22	33.1	17.7	39.7	50.8	54	74	14.3	-23.2	261	56.5	Pass
8	24838.846	V	21.8	33	17.7	39.5	50.7	54	74	14.5	-23.3	177	17.3	Pass

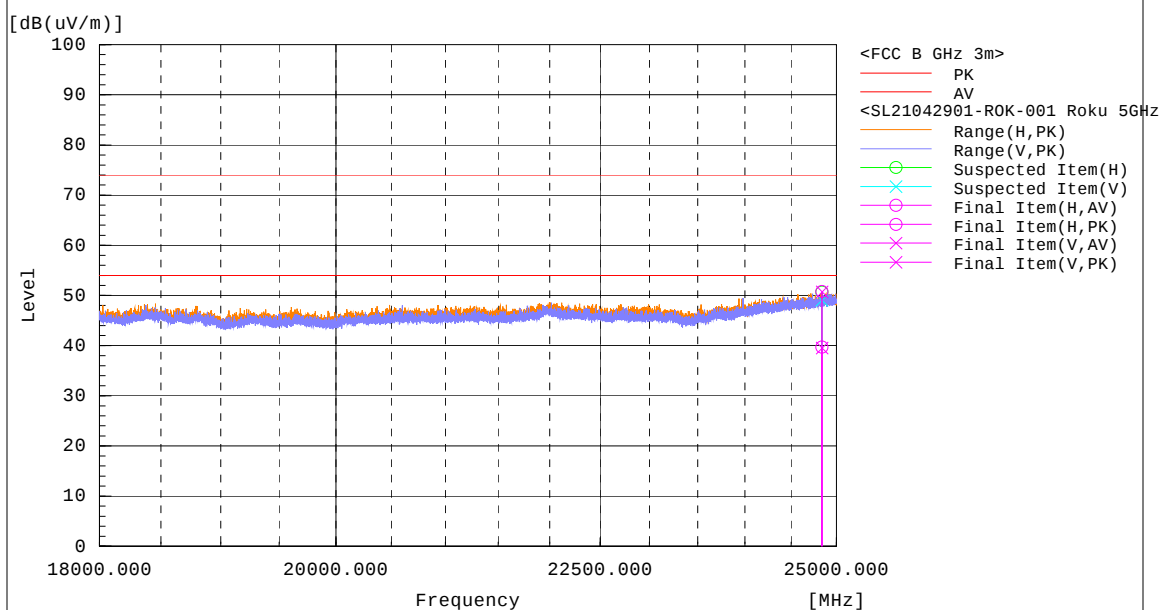
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Pre-amplifier Gain (dB).
3. Margin value = Emission level – Limit value.



<<Radiated Emission>> 26 July,2021 15:38
SL21042901-ROK-001 Roku 5GHz Mode N CH36 18GHz-25GHz.dat

Model : SL21042901-ROK-001 Roku 5GHz Mode N CH36 18GHz-25GHz Class B GHz 3m
Serial :
Operator :
AC Power :
Temp, Humid : 23deg, 60%
Remark1 :
Remark2 :
Remark3 :
Remark4 :

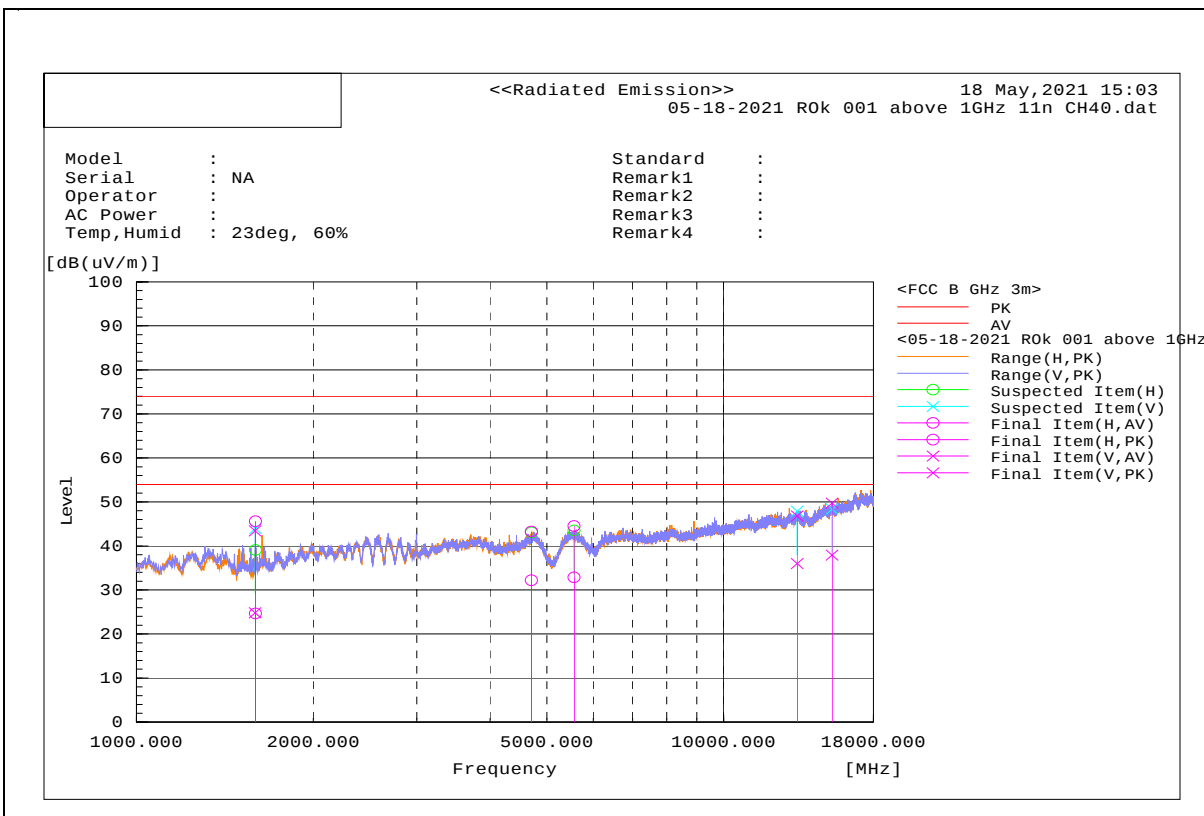


Above 1GHz – 802.11n – 5200MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	5562.151	H	37.7	49.3	-4.8	32.9	44.5	54	74	-21.1	-29.5	395.2	1.7	Pass
2	13341.06	V	29.2	40	6.8	36	46.8	54	74	-18	-27.2	249.2	94.4	Pass
3	1594.103	H	41.3	62.2	-16.6	24.7	45.6	54	74	-29.3	-28.4	184.9	165.5	Pass
4	4705.326	H	38.5	49.6	-6.3	32.2	43.3	54	74	-21.8	-30.7	399.4	272.4	Pass
5	1591.898	V	41.4	60	-16.6	24.8	43.4	54	74	-29.2	-30.6	136	300	Pass
6	15290.83	V	26.4	38.3	11.5	37.9	49.8	54	74	-16.1	-24.2	238.7	54.5	Pass
7	24838.19	H	22	33.4	17.7	39.7	51.1	54	74	14.3	-22.9	117	215.9	Pass
8	24839.606	V	22.4	33.3	17.7	40.1	51	54	74	13.9	-23	132	99.6	Pass

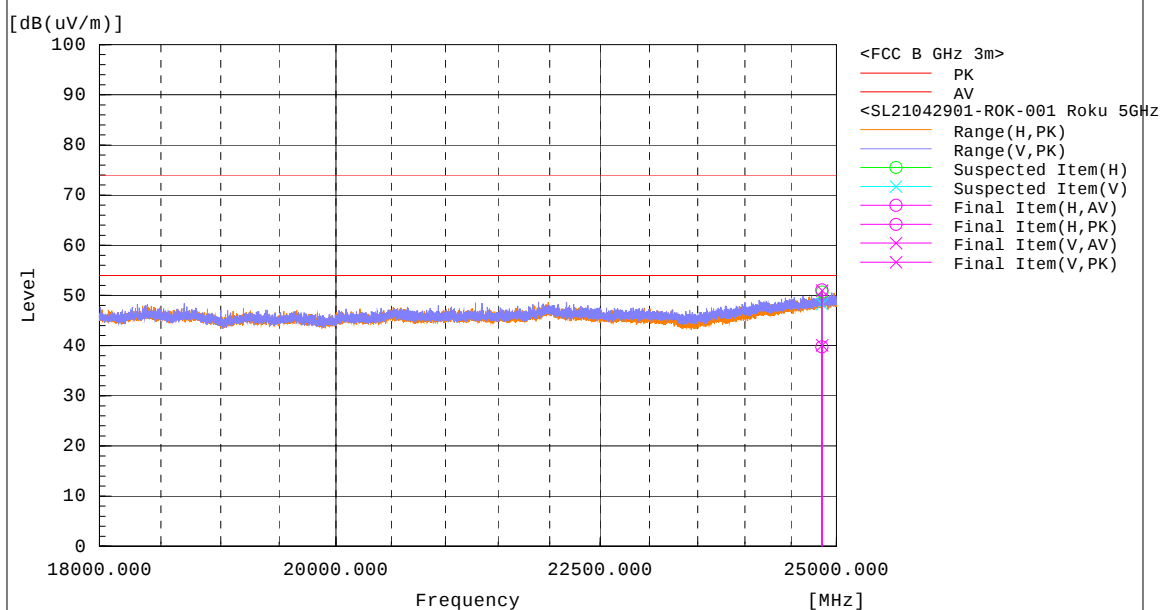
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Pre-amplifier Gain (dB).
3. Margin value = Emission level – Limit value.



<<Radiated Emission>> 26 July,2021 16:16
SL21042901-ROK-001 Roku 5GHz Mode N CH40 18GHz-25GHz.dat

Model : SL21042901-ROK-001 Roku 5GHz Mode N CH40 18GHz-25GHz Class B GHz 3m
Serial :
Operator :
AC Power :
Temp, Humid : 23deg, 60%
Remark1 :
Remark2 :
Remark3 :
Remark4 :

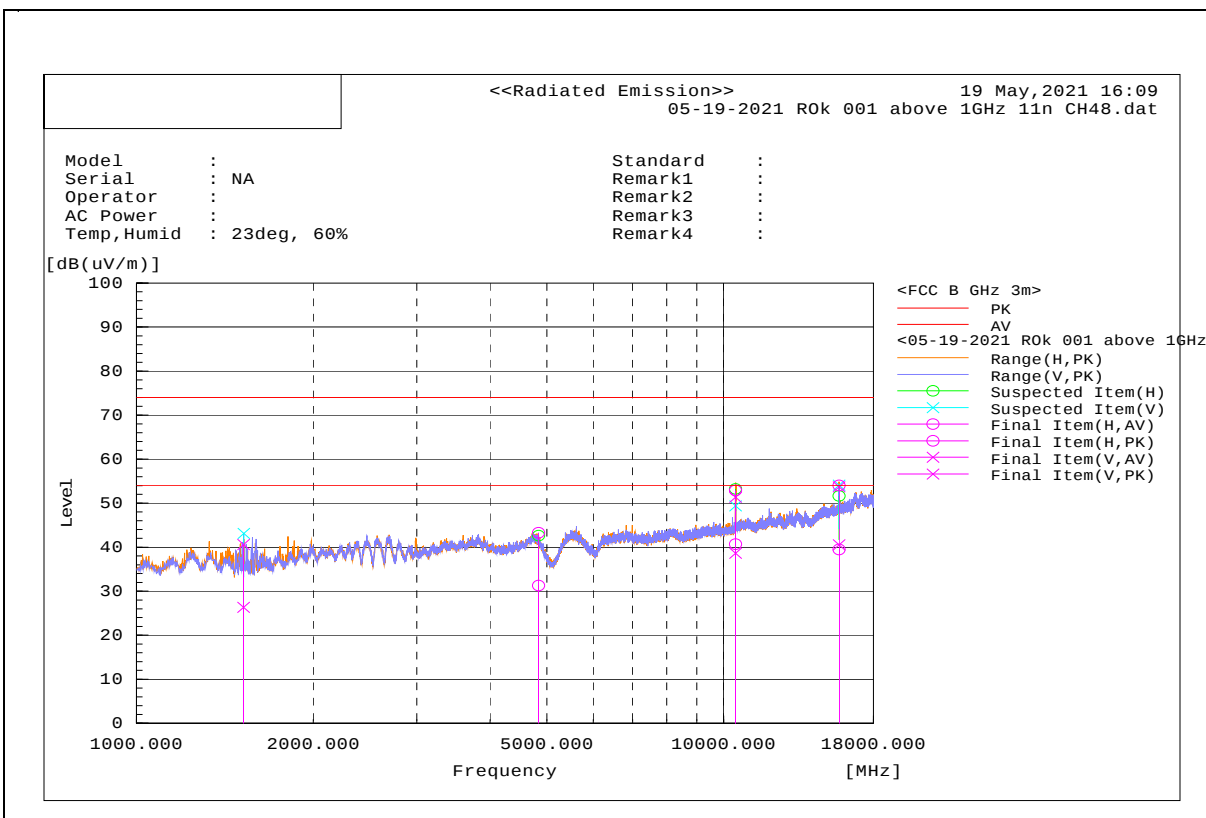


Above 1GHz – 802.11n – 5240MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1521.743	V	43.6	57.8	-17.2	26.4	40.6	54	74	-27.6	-33.4	325.9	323.4	Pass
2	4837.188	H	37.3	49.3	-6	31.3	43.3	54	74	-22.7	-30.7	388.1	61.7	Pass
3	10480.13	H	35.4	47.6	5.3	40.7	52.9	54	74	-13.3	-21.1	261	225.6	Pass
4	10478.75	V	33.3	46.1	5.3	38.6	51.4	54	74	-15.4	-22.6	239.1	261.5	Pass
5	15721.38	V	28.3	41.5	12.2	40.5	53.7	54	74	-13.5	-20.3	173.3	157.6	Pass
6	15720.35	H	27.3	41.8	12.2	39.5	54	54	74	-14.5	-20	101.9	157.6	Pass
7	24872.364	H	20.4	32.7	17.7	38.1	50.4	54	74	15.9	-23.6	359	19.5	Pass
8	24873.012	V	21.5	33.8	17.7	39.2	51.5	54	74	14.8	-22.5	100	337.4	Pass

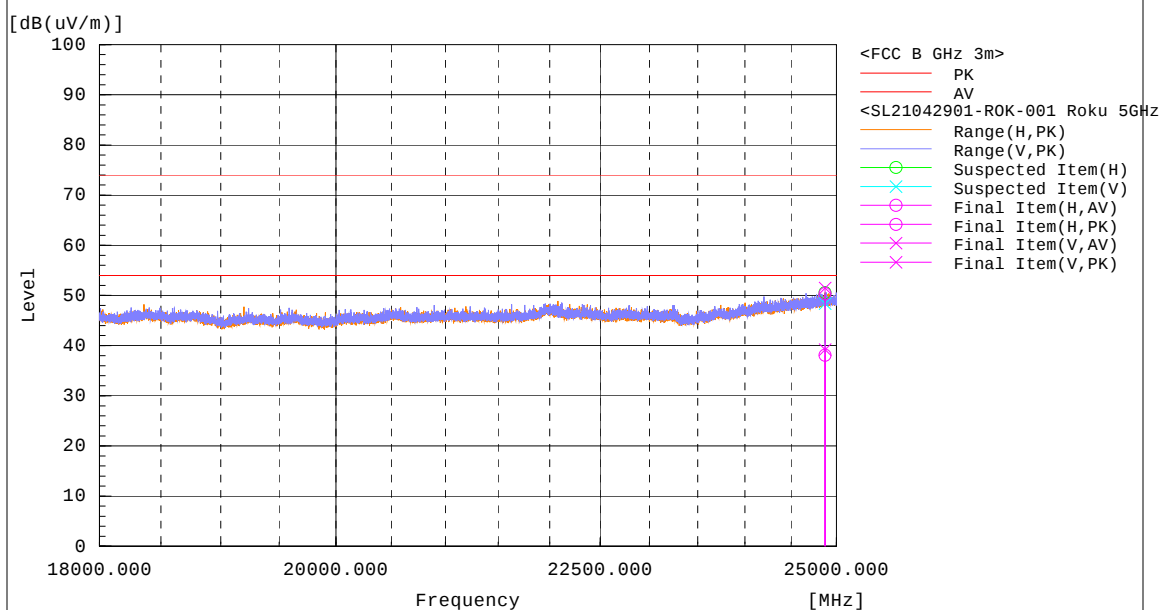
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



<<Radiated Emission>> 26 July,2021 16:51
SL21042901-ROK-001 Roku 5GHz Mode N CH48 18GHz-25GHz.dat

Model : SL21042901-ROK-001 Roku 5GHz Mode N CH48 18GHz-25GHz Class B GHz 3m
Serial :
Operator :
AC Power :
Temp, Humid : 23deg, 60%
Remark1 :
Remark2 :
Remark3 :
Remark4 :

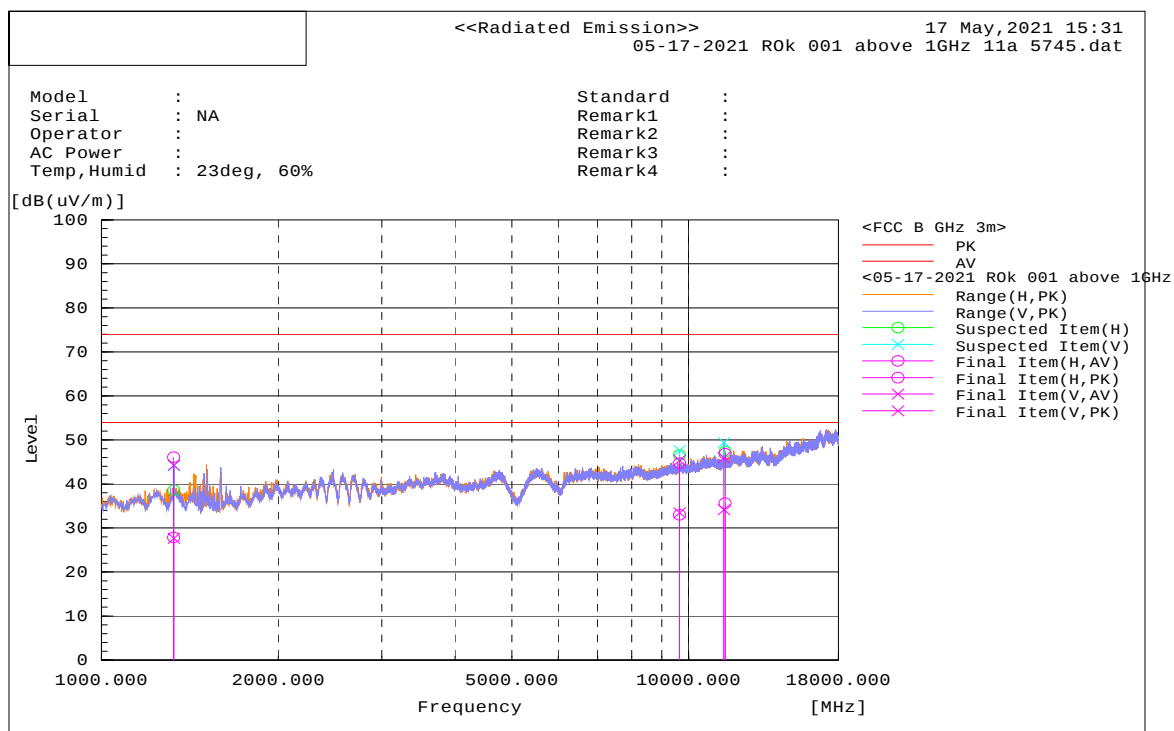


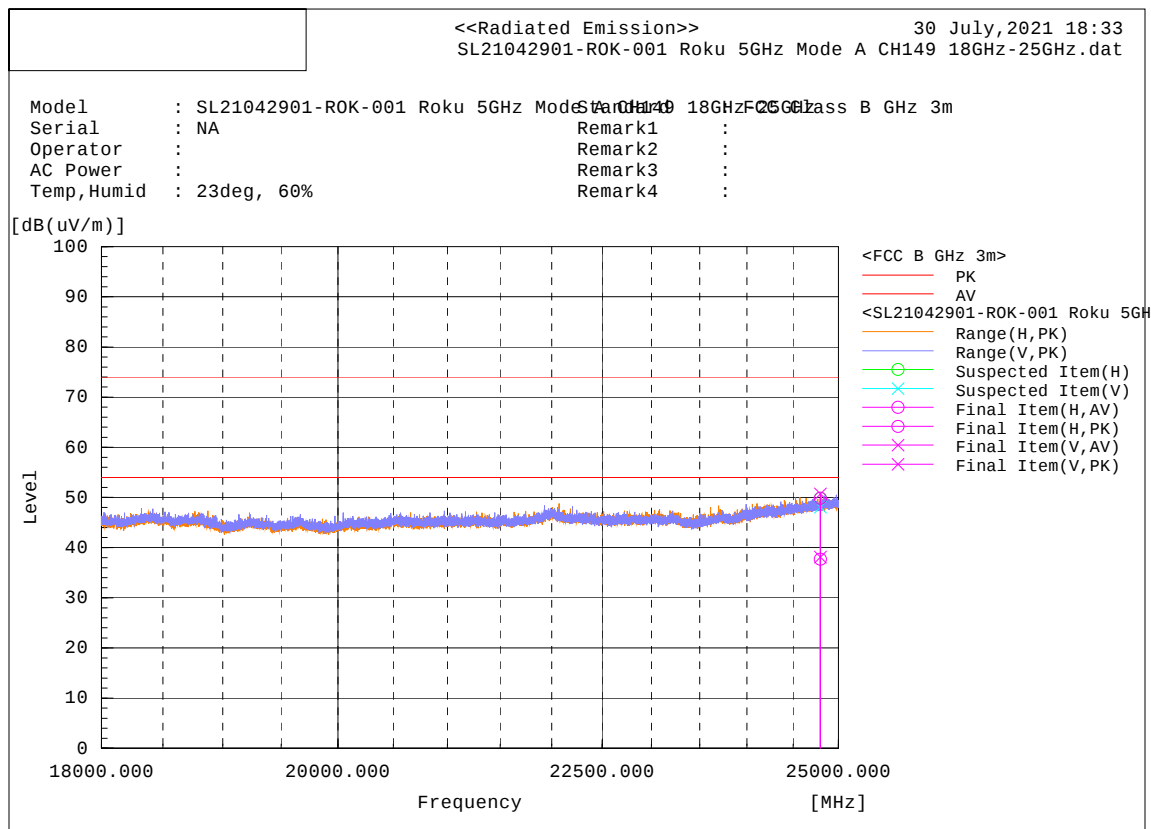
Above 1GHz – 802.11a – 5745 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1327.652	V	44	60.6	-16.3	27.7	44.3	54	74	-26.3	-29.7	92	3	Pass
2	1327.214	H	44.2	62.4	-16.3	27.9	46.1	54	74	-26.1	-27.9	364.4	60.6	Pass
3	9648.155	V	29.3	41.2	4.2	33.5	45.4	54	74	-20.5	-28.6	104.5	216.6	Pass
4	9647.913	H	28.8	40.5	4.2	33	44.7	54	74	-21	-29.3	392.4	173.7	Pass
5	11488.083	V	28.1	39.9	6.1	34.2	46	54	74	-19.8	-28	107.4	300.5	Pass
6	11538.553	H	29.4	40.7	6.2	35.6	46.9	54	74	-18.4	-27.1	105	358.6	Pass
7	24798.866	V	20.4	33	17.7	38.1	50.7	54	74	15.9	-23.3	389	305.7	Pass
8	24798.392	H	20	32.1	17.7	37.7	49.8	54	74	16.3	-24.2	344	52.7	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



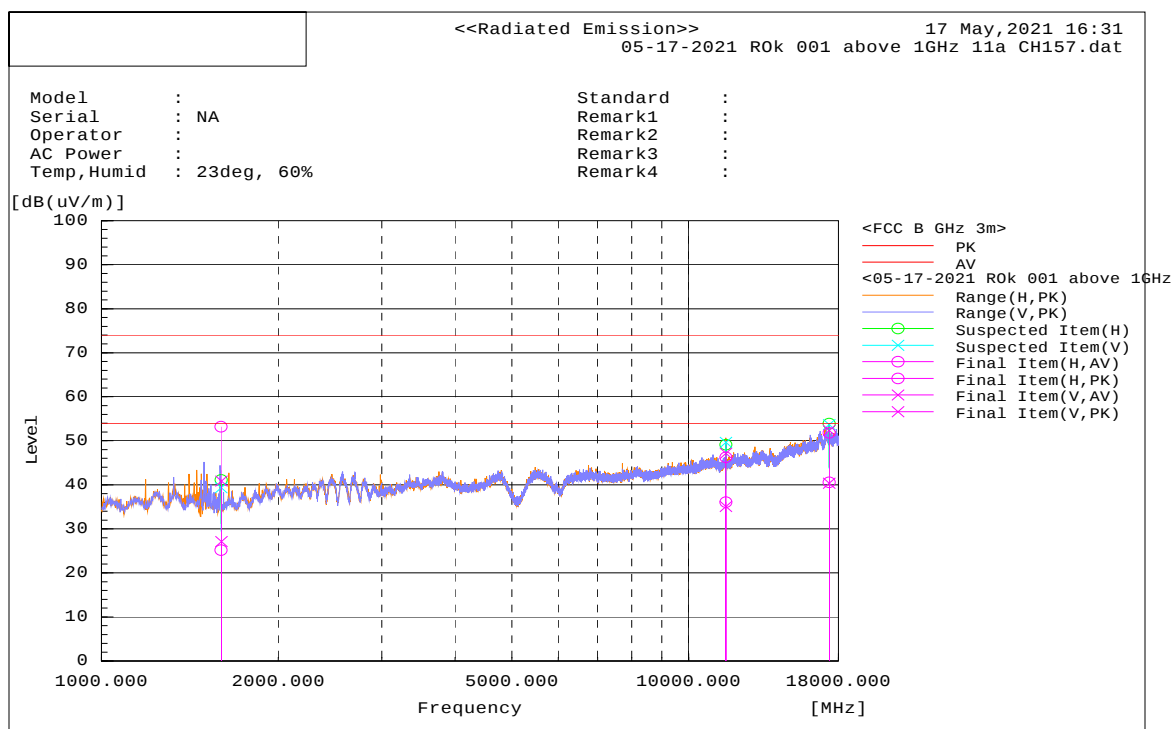


Above 1GHz – 802.11a – 5785 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1597.648	H	41.7	69.7	-16.5	25.2	53.2	54	74	-28.8	-20.8	102.1	221.8	Pass
2	1599.708	V	43.6	57.4	-16.5	27.1	40.9	54	74	-26.9	-33.1	128	14.4	Pass
3	11572.85	V	28.9	41	6.2	35.1	47.2	54	74	-18.9	-26.8	397.8	0	Pass
4	11572.509	H	29.8	40.1	6.2	36	46.3	54	74	-18	-27.7	338.3	170.4	Pass
5	17355.71	H	25.1	36.3	15.5	40.6	51.8	54	74	-13.4	-22.2	377	319.1	Pass
6	17357.03	V	24.9	36.9	15.5	40.4	52.4	54	74	-13.6	-21.6	293.7	291.2	Pass
7	24443.792	V	22	33	17.4	39.4	50.4	54	74	14.6	-23.6	100	80.7	Pass
8	24445.092	H	20.6	32.5	17.4	38	49.9	54	74	16	-24.1	110	96.8	Pass

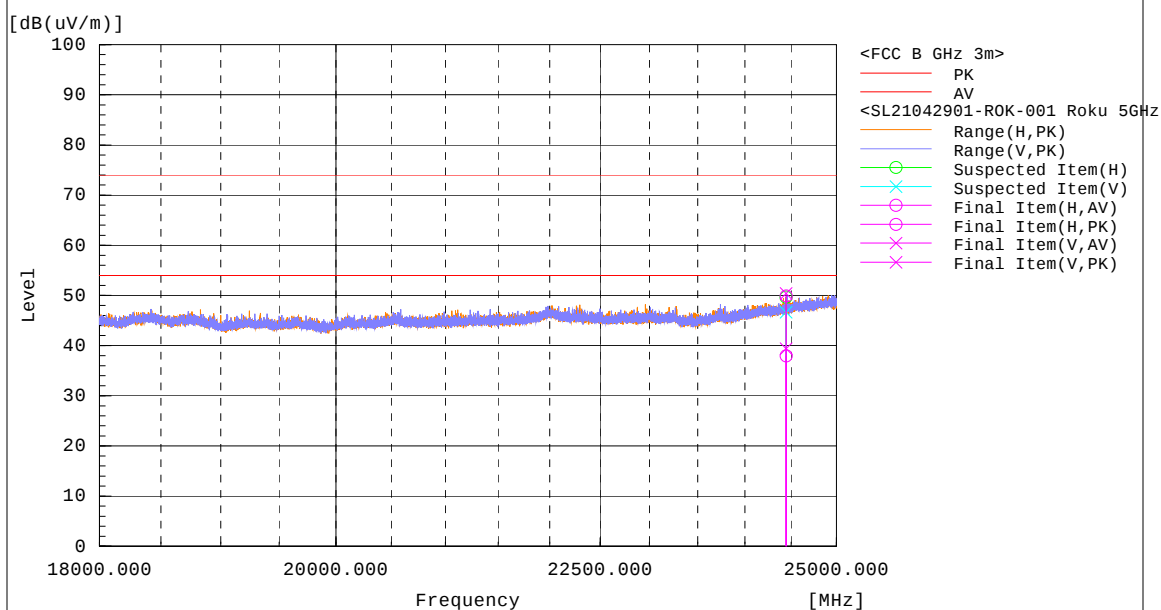
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



<<Radiated Emission>> 30 July,2021 19:44
SL21042901-ROK-001 Roku 5GHz Mode A CH157 18GHz-25GHz.dat

Model : SL21042901-ROK-001 Roku 5GHz Mode A CH157 18GHz-25GHz
Serial : NA Remark1 :
Operator : Remark2 :
AC Power : Remark3 :
Temp, Humid : 23deg, 60% Remark4 :

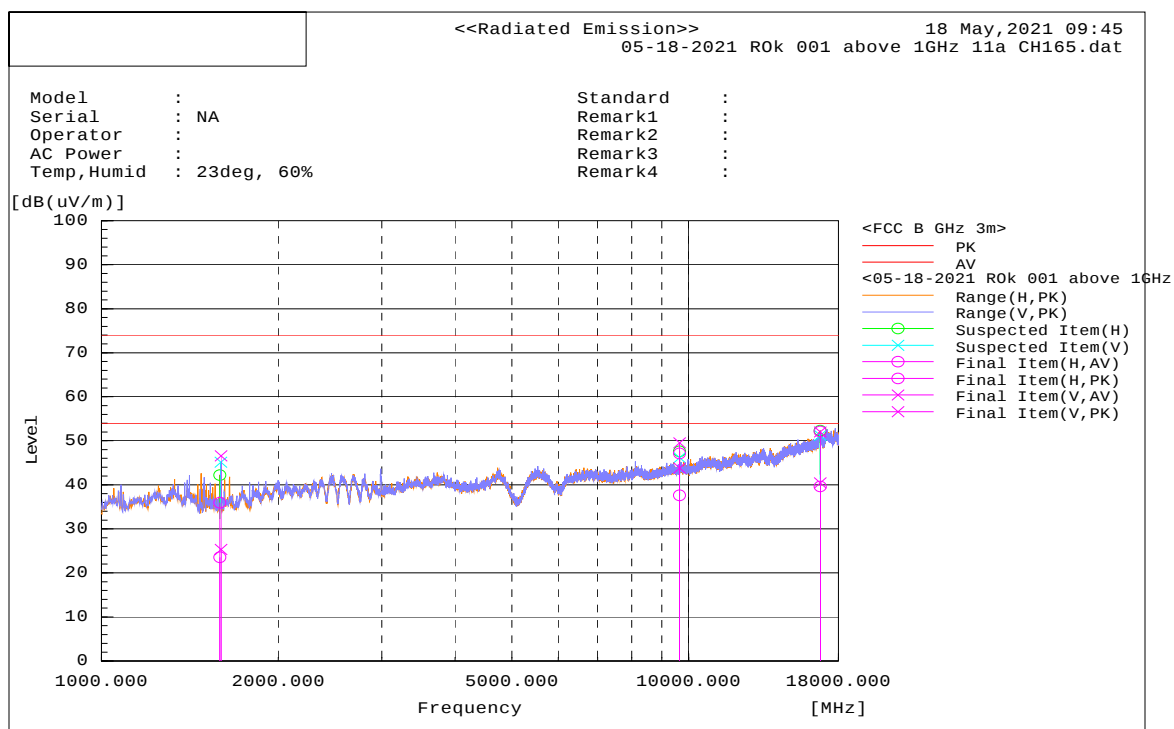


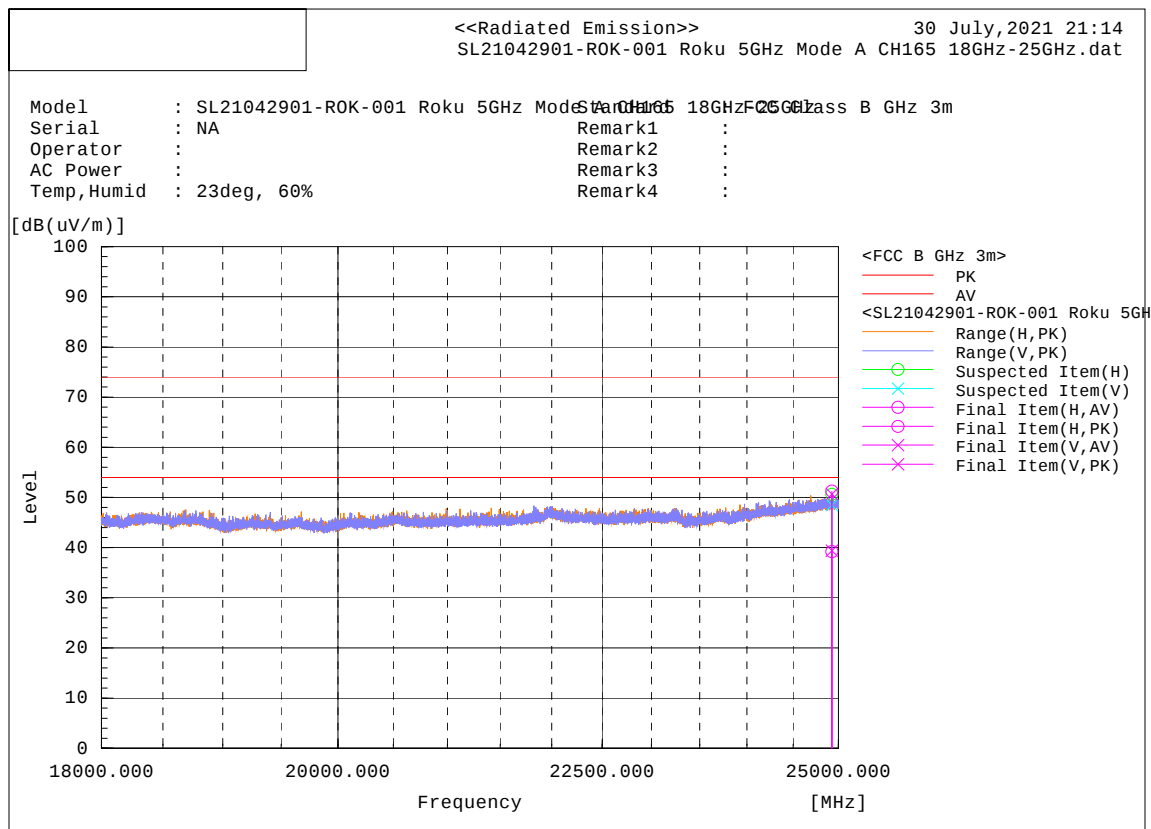
Above 1GHz – 802.11a – 5825 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1590.306	H	40.1	52.6	-16.6	23.5	36	54	74	-30.5	-38	100	288.5	Pass
2	1597.245	V	41.9	63.1	-16.5	25.4	46.6	54	74	-28.6	-27.4	100.6	72.9	Pass
3	9647.954	V	39.6	45.3	4.2	43.8	49.5	54	74	-10.2	-24.5	206.8	153.2	Pass
4	9648.104	H	33.4	42.9	4.2	37.6	47.1	54	74	-16.4	-26.9	0	0	Pass
5	16757.16	H	24.3	36.7	15.4	39.7	52.1	54	74	-14.3	-21.9	171	167.1	Pass
6	16756.66	V	25.1	36.7	15.4	40.5	52.1	54	74	-13.5	-21.9	377.1	358.2	Pass
7	24926.734	V	21.6	32.9	17.8	39.4	50.7	54	74	14.6	-23.3	103	60.1	Pass
8	24926.774	H	21.4	33.4	17.8	39.2	51.2	54	74	14.8	-22.8	291	71.5	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



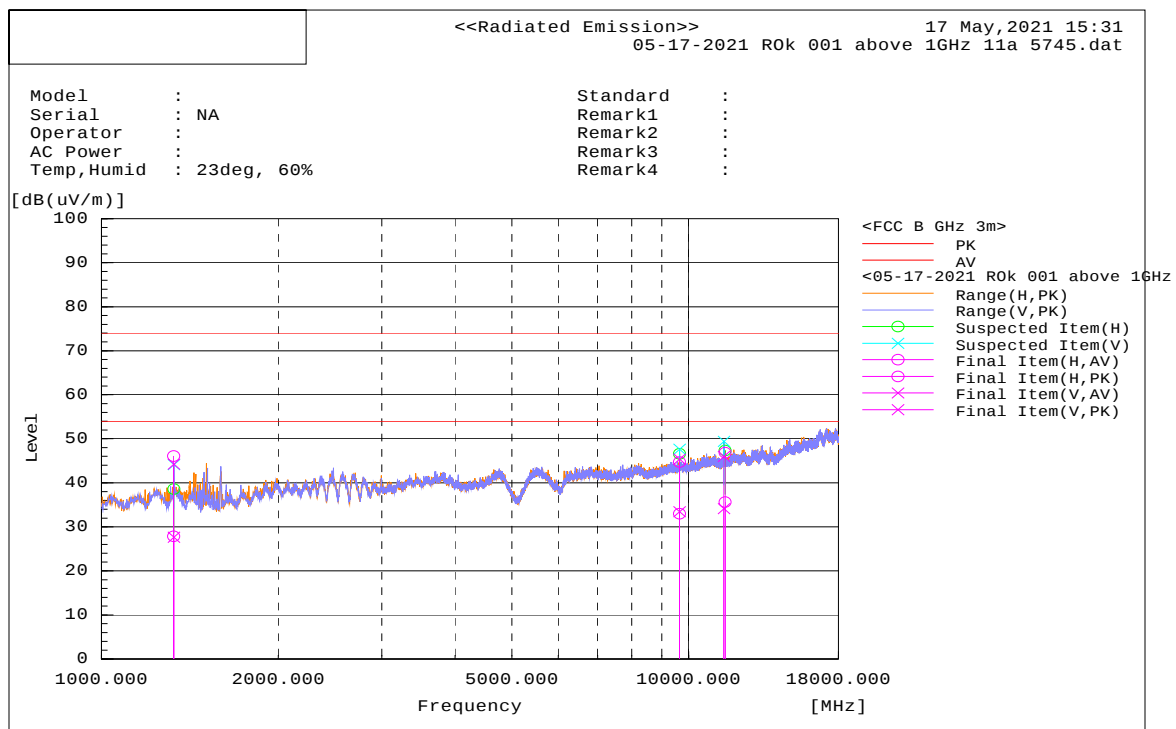


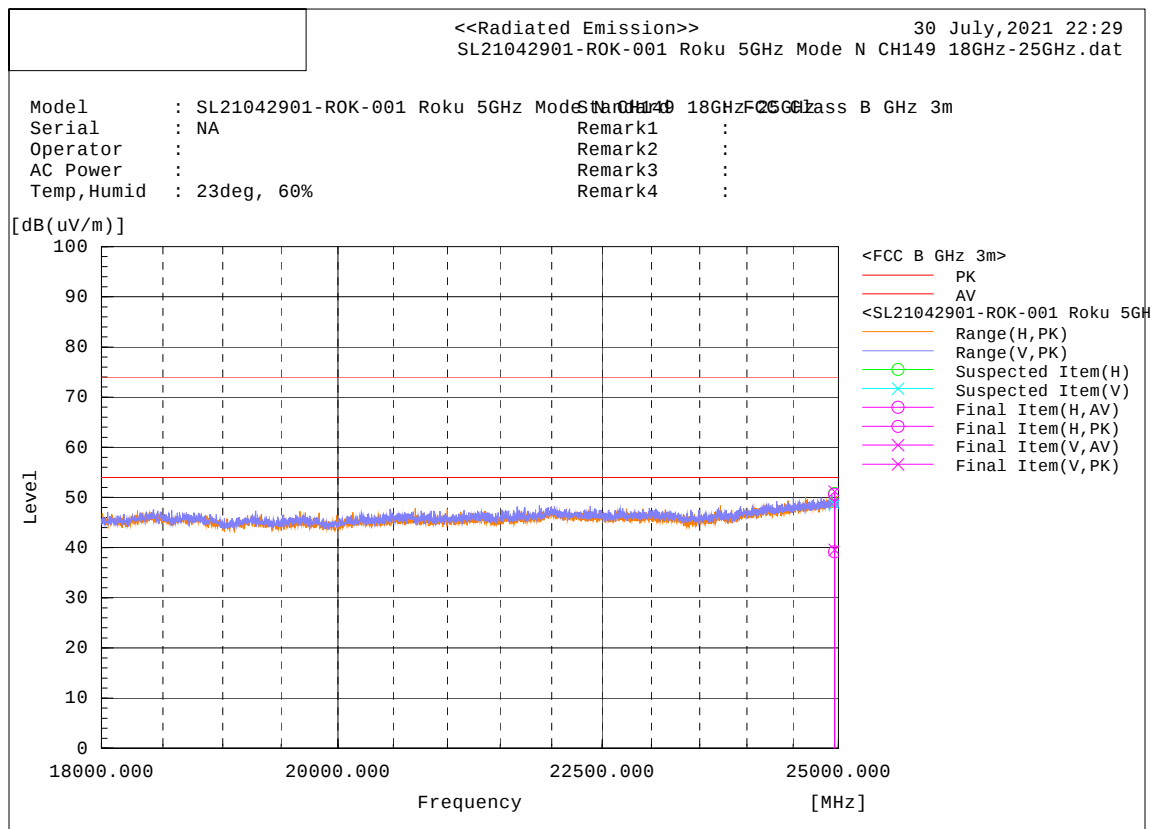
Above 1GHz – 802.11n – 5745 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2457.281	H	42.2	54.2	-11.3	30.9	42.9	54	74	-23.1	-31.1	128.6	178.7	Pass
2	4758.869	H	38.5	49.6	-6.1	32.4	43.5	54	74	-21.6	-30.5	194	236.2	Pass
3	4759.042	V	38.3	49.9	-6.1	32.2	43.8	54	74	-21.8	-30.2	395.5	338.7	Pass
4	16757.66	V	23.7	36	15.4	39.1	51.4	54	74	-14.9	-22.6	378	46.5	Pass
5	16756.44	H	25	36.8	15.4	40.4	52.2	54	74	-13.6	-21.8	325.7	16	Pass
6	17141.99	H	24.7	36	16	40.7	52	54	74	-13.3	-22	346.6	116	Pass
7	24955.79	V	21.8	33.4	17.8	39.6	51.2	54	74	14.4	-22.8	100	202.7	Pass
8	24957.288	H	21.4	32.8	17.8	39.2	50.6	54	74	14.8	-23.4	155	150.5	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



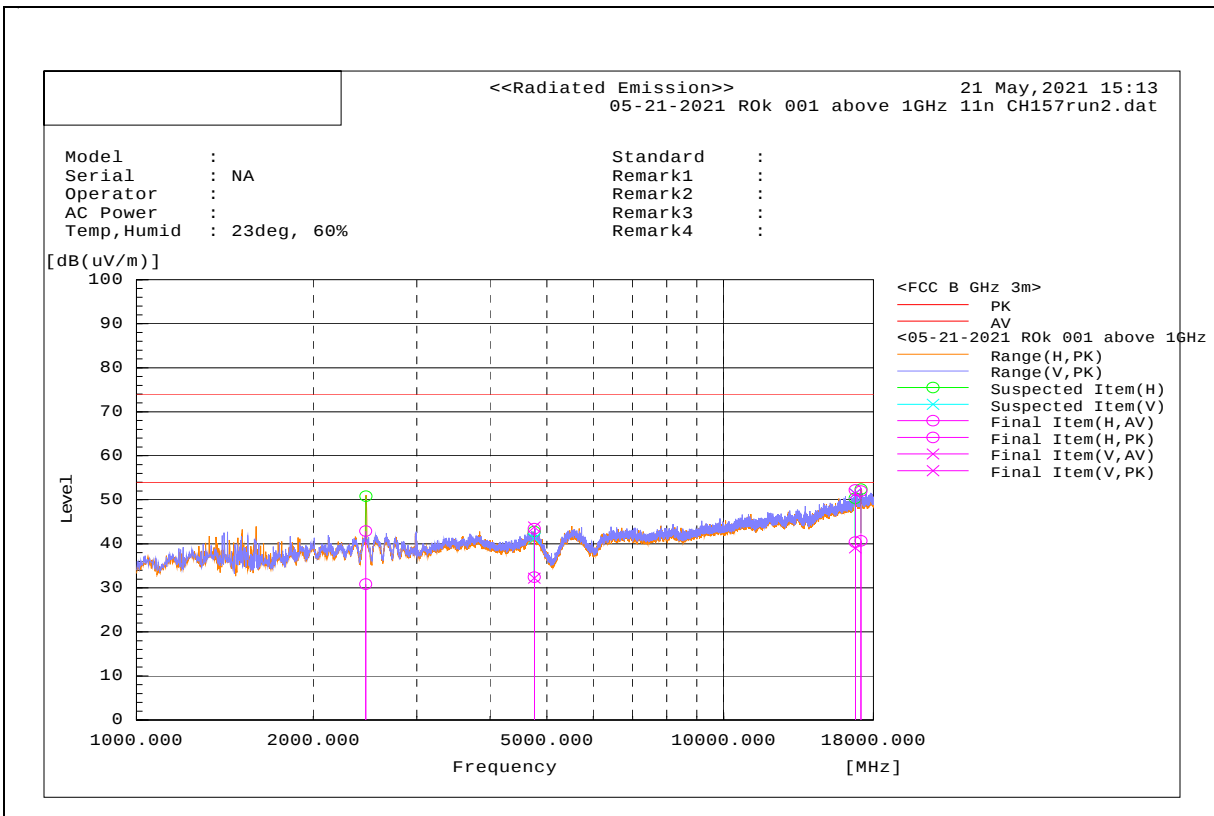


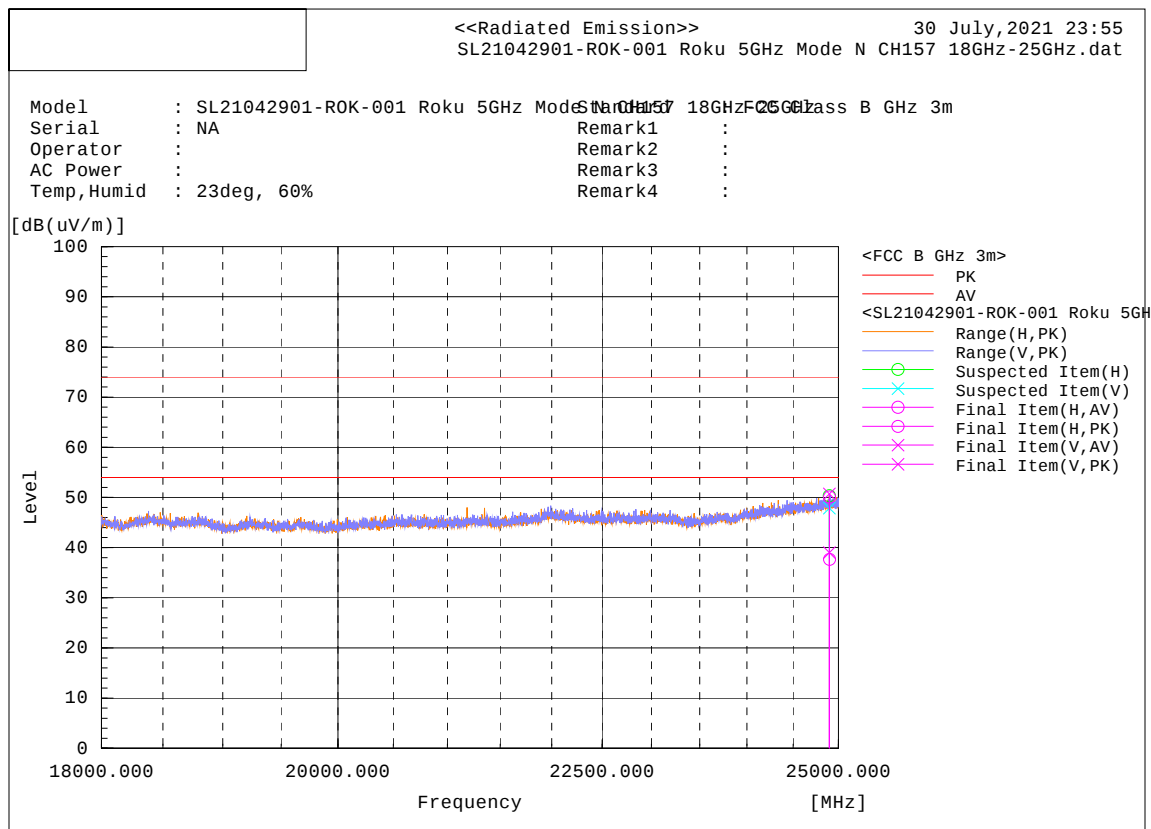
Above 1GHz – 802.11n – 5785 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2457.281	H	42.2	54.2	-11.3	30.9	42.9	54	74	-23.1	-31.1	128.6	178.7	Pass
2	4758.869	H	38.5	49.6	-6.1	32.4	43.5	54	74	-21.6	-30.5	194	236.2	Pass
3	4759.042	V	38.3	49.9	-6.1	32.2	43.8	54	74	-21.8	-30.2	395.5	338.7	Pass
4	16757.66	V	23.7	36	15.4	39.1	51.4	54	74	-14.9	-22.6	378	46.5	Pass
5	16756.44	H	25	36.8	15.4	40.4	52.2	54	74	-13.6	-21.8	325.7	16	Pass
6	17141.99	H	24.7	36	16	40.7	52	54	74	-13.3	-22	346.6	116	Pass
7	24898.814	V	21.3	33	17.7	39	50.7	54	74	15	-23.3	337	1.4	Pass
8	24899.306	H	19.9	32.4	17.7	37.6	50.1	54	74	16.4	-23.9	268	210.3	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.



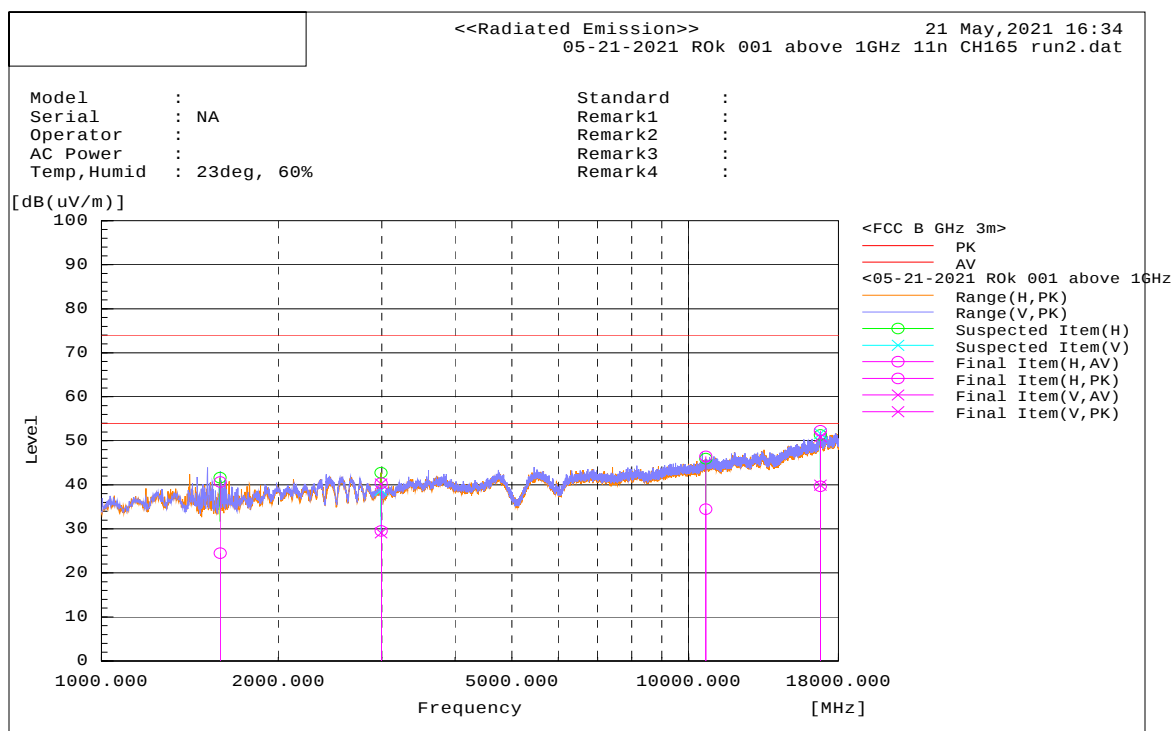


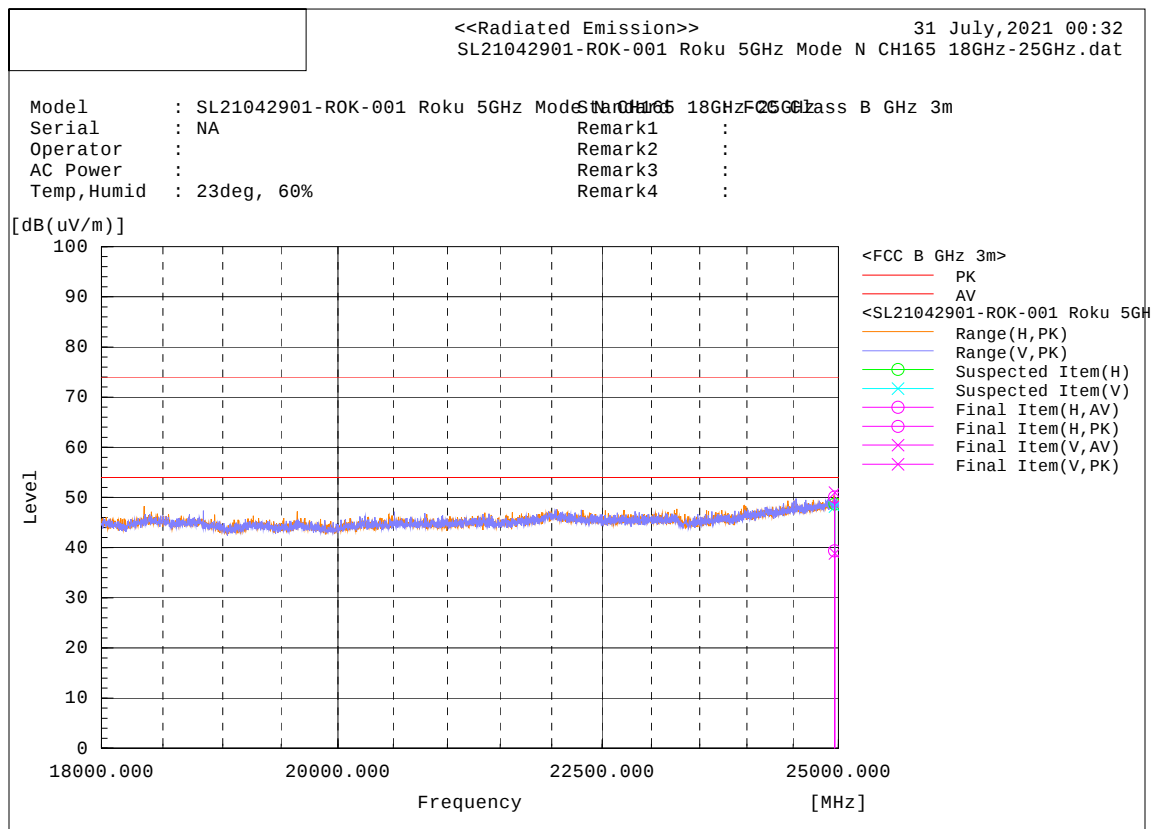
Above 1GHz – 802.11n – 5825 MHz

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No .	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK dB(uV/m)	Limit AV dB(uV/m)	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	1592.227	H	41.1	57.3	-16.6	24.5	40.7	54	74	-29.5	-33.3	388.1	17.2	Pass
2	2994.287	H	39.9	50.7	-10.3	29.6	40.4	54	74	-24.4	-33.6	88.7	298	Pass
3	2991.89	V	39.4	50.5	-10.3	29.1	40.2	54	74	-24.9	-33.8	283.1	124.1	Pass
4	10694.18	H	29	41	5.5	34.5	46.5	54	74	-19.5	-27.5	388.1	280.3	Pass
5	16761.114	V	24.6	35.5	15.4	40	50.9	54	74	-14	-23.1	85.2	226.3	Pass
6	16760.43	H	24.3	36.9	15.4	39.7	52.3	54	74	-14.3	-21.7	371.9	61.3	Pass
7	24958.806	V	21.1	33.2	17.8	38.9	51	54	74	15.1	-23	162	18	Pass
8	24957.102	H	21.6	32.3	17.8	39.4	50.1	54	74	14.6	-23.9	329	57.3	Pass

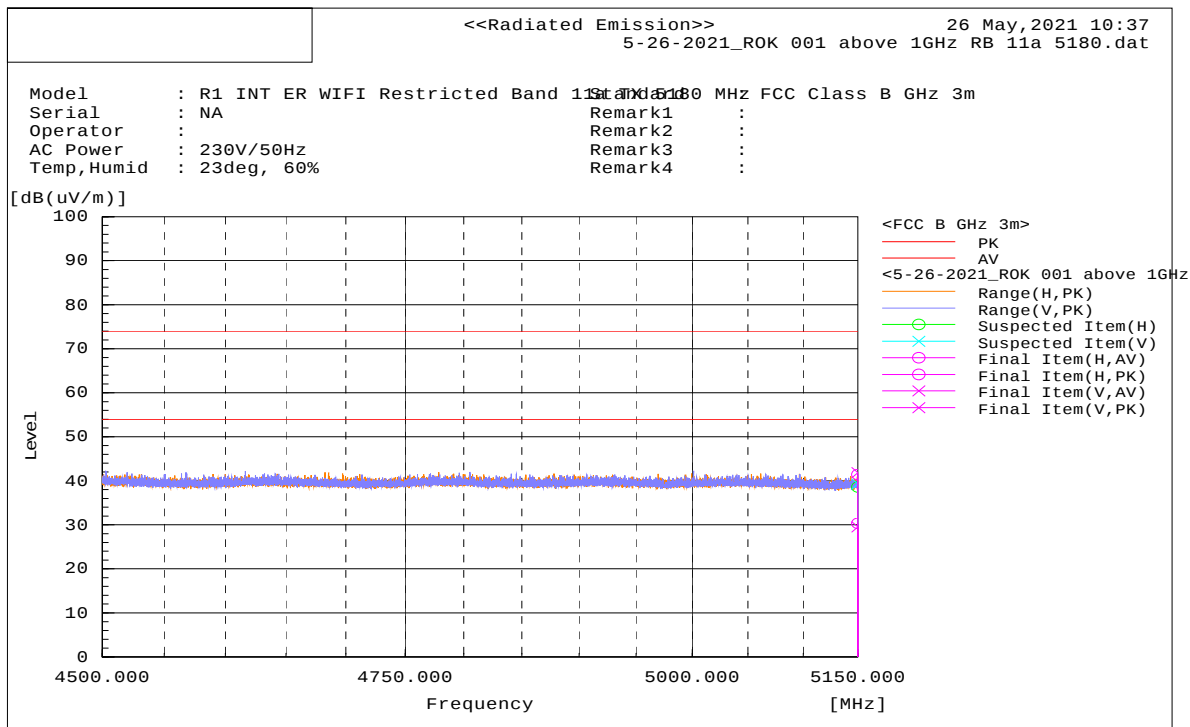
REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. Margin value = Emission level – Limit value.
4. The emission levels of above 18G were less than 20dB margin against the limit not record.





RESTRICTED BAND Test Plots 802.11a – 5180MHz

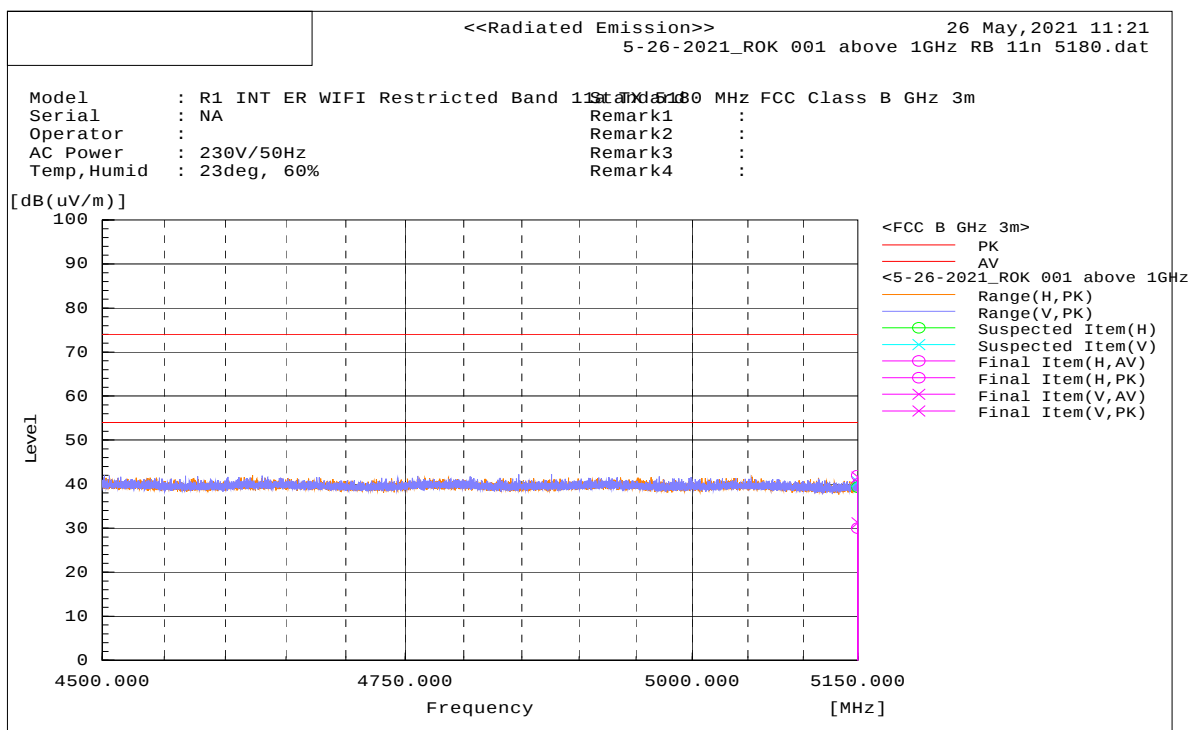


Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	5150.075	V	35.3	47.6	-5.7	29.6	41.9	54	74	-24.4	-32.1	261.7	95.3	Pass
2	5149.94	H	36.1	47.1	-5.7	30.4	41.4	54	74	-23.6	-32.6	144	0	Pass

RESTRICTED BAND

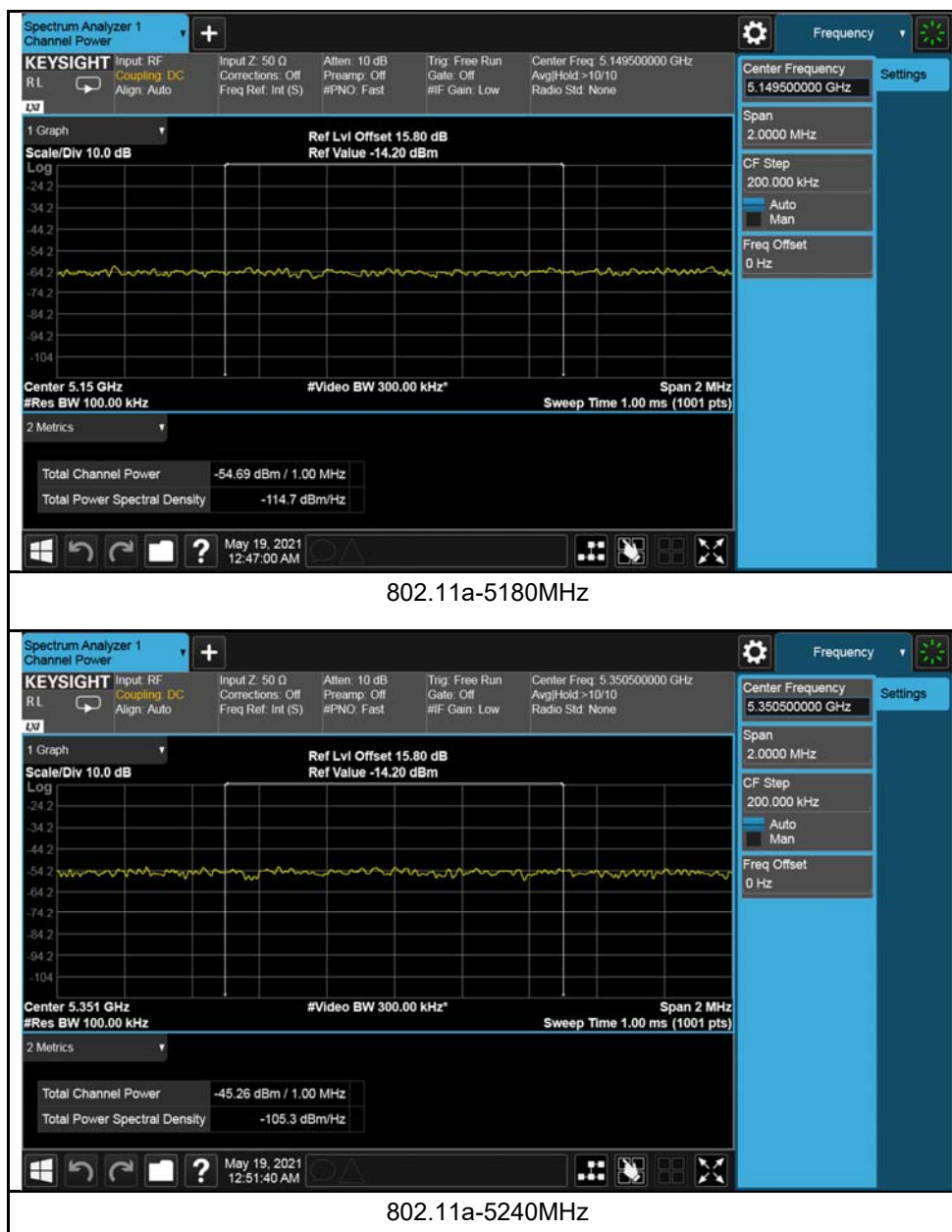
802.11n – 5180MHz



Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

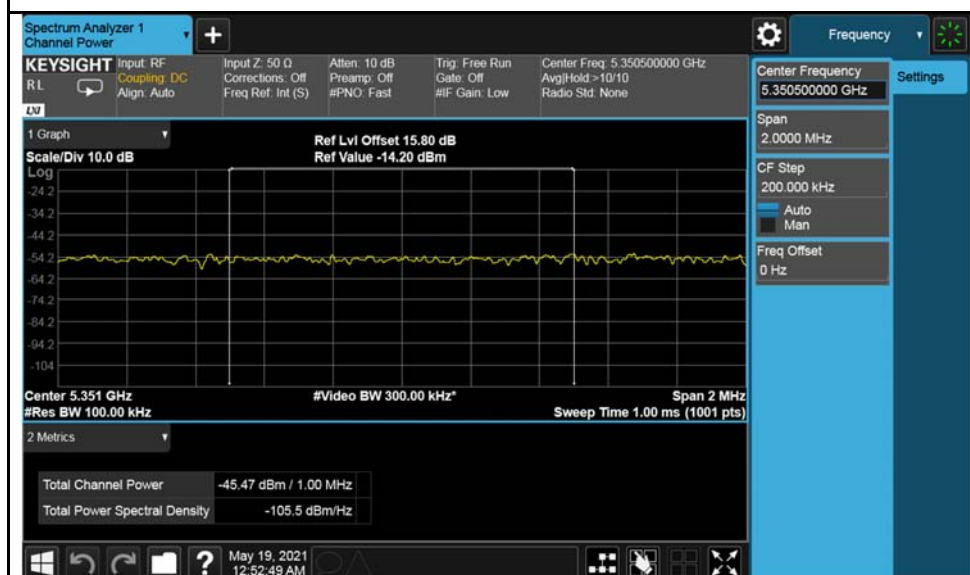
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	5149.762	H	35.7	47.7	-5.7	30	42	54	74	-24	-32	356.3	78.2	Pass
2	5149.934	V	36.9	47.3	-5.7	31.2	41.6	54	74	-22.8	-32.4	217.1	157.7	Pass

Band Edge Test Plots for U-NII-1 Band:





802.11n-5180MHz

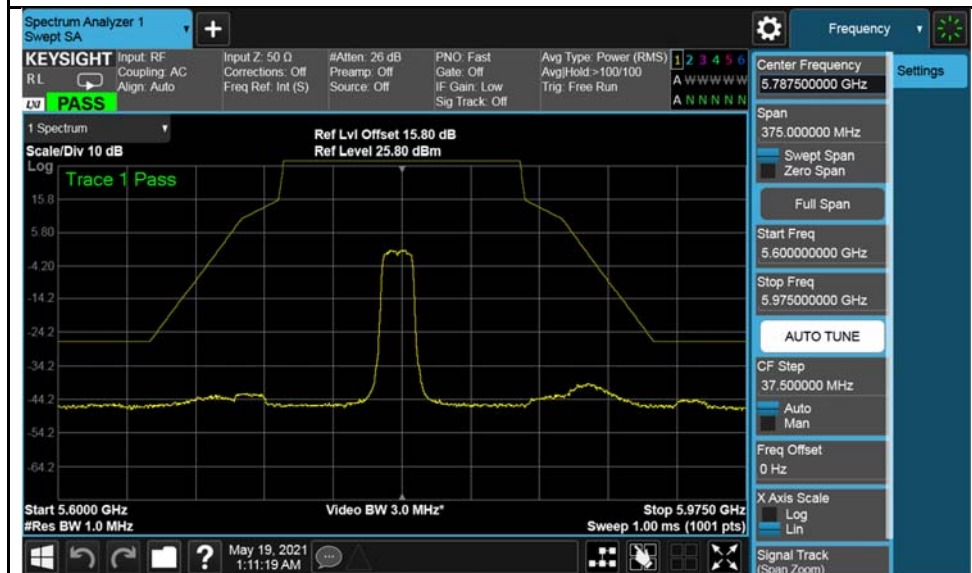


802.11n-5240MHz

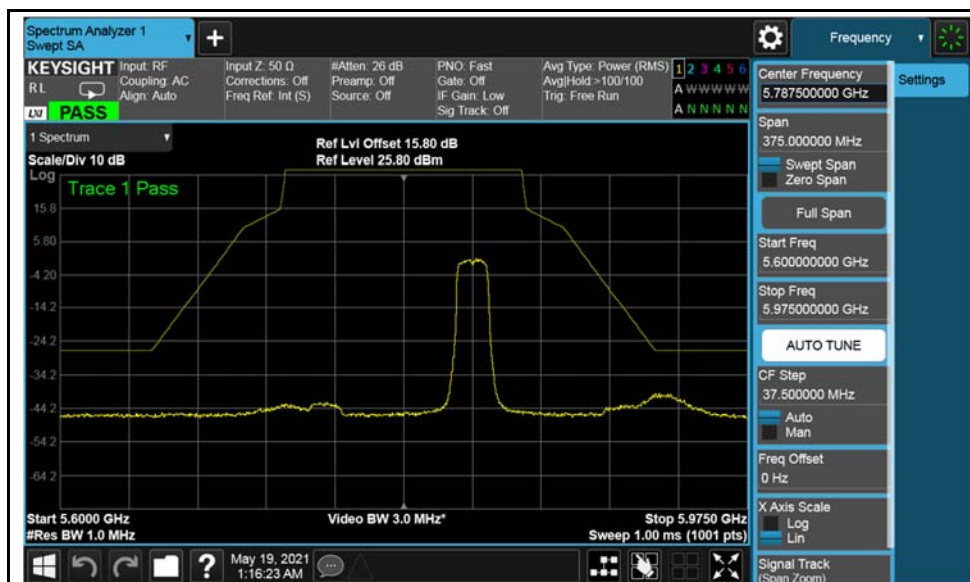
Test Plots for U-NII-3 Band:



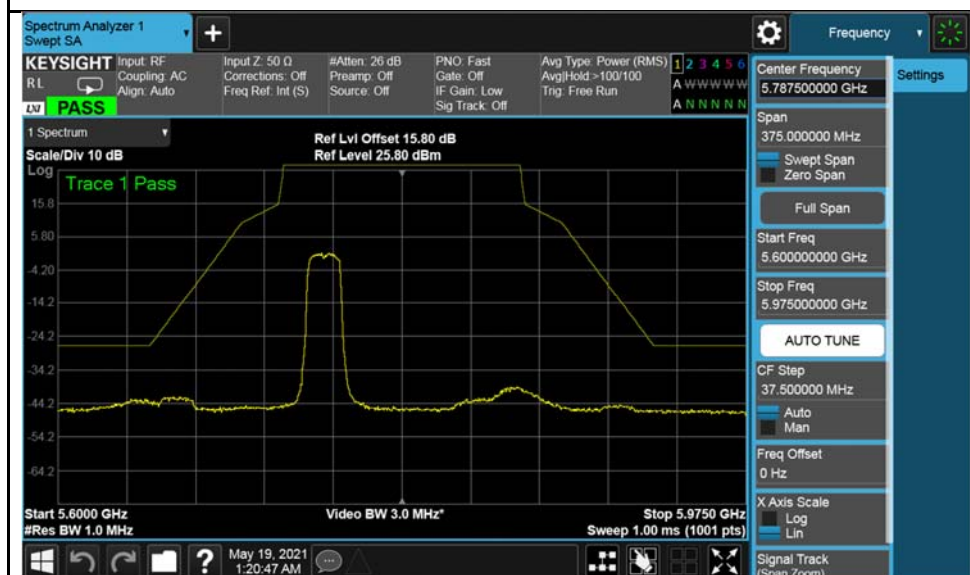
802.11a-5745MHz



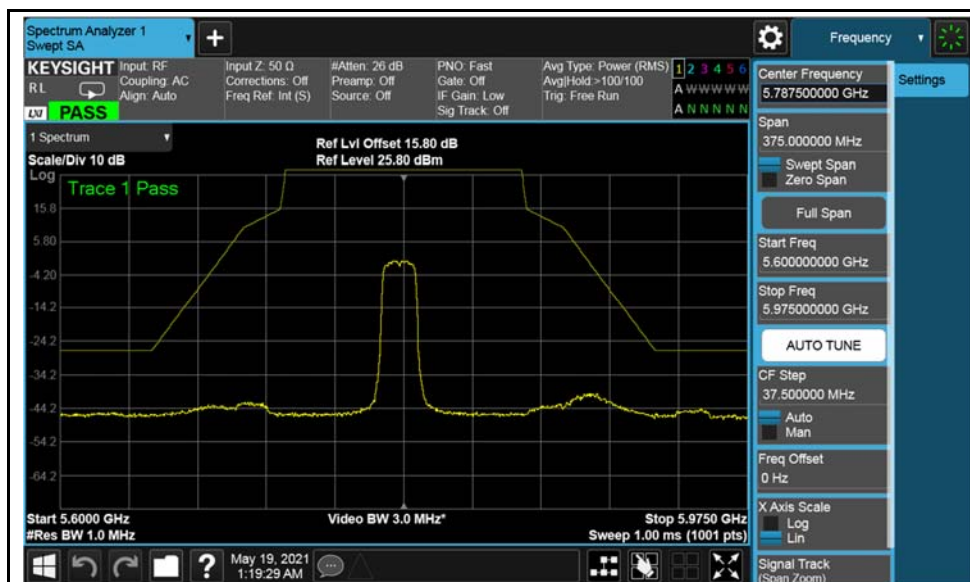
802.11a-5785MHz



802.11a-5825MHz



802.11n-5745MHz



802.11n-5785MHz



802.11n-5825MHz

4.3 Conducted Emission Measurement

4.3.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.3.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
EMI Test Receiver ROHDE & SCHWARZ	ESIB 40	100179	08/28/2020	08/28/2021
Transient Limiter ELECTRO-METRICS	EM-7600-5	106	12/31/2020	12/31/2021
LISN EMCO	3816/2NM	214372	03/10/2020	03/10/2021

4.3.3 Test Procedure

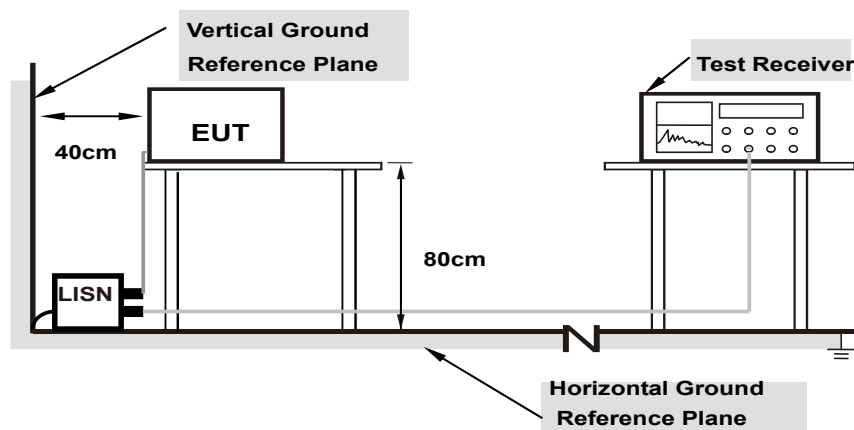
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

4.3.4 Deviation from Test Standard

No deviation.

4.3.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.3.6 EUT Operating Condition

Same as 4.1.6.

4.3.7 Test Results

N/A

4.4 Transmit Power Measurement

4.4.1 Limits of Transmit Power Measurement

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	1 Watt (30 dBm) (Max. e.i.r.p $\leq$ 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
		Fixed point-to-point Access Point	1 Watt (30 dBm)
		Indoor Access Point	1 Watt (30 dBm)
	√	Client device	250mW (24 dBm)
U-NII-2A	---		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-2C	---		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-3	---		1 Watt (30 dBm)

*B is the 26 dB emission bandwidth in megahertz

Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

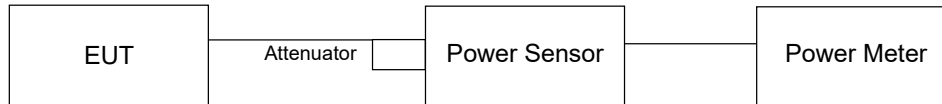
Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

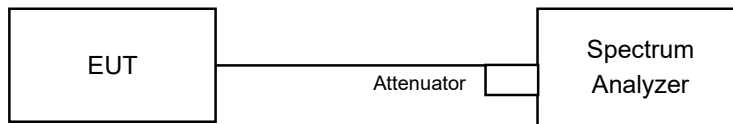
4.4.2 Test Setup

FOR POWER OUTPUT MEASUREMENT

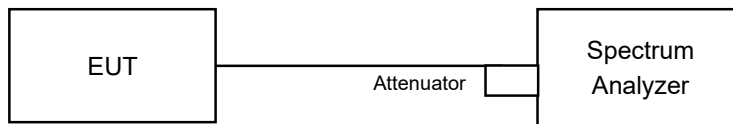
◆ Power Meter Measurement



◆ Spectrum Measurement



FOR 26dB OCCUPIED BANDWIDTH



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedure

For Average Power Measurement

For 802.11a, 802.11n (HT20), 802.11n (HT40)

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst and set the detector to AVERAGE. Duty factor is not added to measured value.

For 802.11ac (VHT80)

- 1) Set span to encompass the entire 26 dB EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- 2) Set sweep trigger to "free run".
- 3) Set RBW = 1 MHz.
- 4) Set VBW ≥ 3 MHz
- 5) Number of points in sweep ≥ 2 Span / RBW.
- 6) Sweep time ≤ (number of points in sweep) * T
- 7) Using emission bandwidth to determine the frequency span for integration the channel bandwidth.
- 8) Detector = RMS.
- 9) Trace mode = max hold.
- 10) Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.

◆ Power Meter Measurement

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

◆ Spectrum Measurement

Follow FCC KDB 789033 UNII test procedure:

Method SA-1

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Number of points in sweep $\geq 2 \text{ Span} / \text{RBW}$.
5. Sweep time = auto.
6. Set trigger to free run (duty cycle ≥ 98 percent)
7. Detector = RMS.
8. Trace average at least 100 traces in power averaging mode
9. Compute power by integrating the spectrum across the 26 dB EBW of the signal.

Follow FCC KDB 789033 UNII test procedure:

Method SA-2

1. Set span to encompass the emission bandwidth (EBW) of the signal.
2. Set RBW = 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Number of points in sweep $\geq 2 \text{ Span} / \text{RBW}$.
5. Sweep time = auto.
6. Detector = RMS.
7. Trace average at least 100 traces in power averaging mode
8. Compute power by integrating the spectrum across the 26 dB EBW of the signal.
9. Duty factor need added to measured value (duty cycle < 98 percent).

FOR 26dB OCCUPIED BANDWIDTH

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW $> \text{RBW}$.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.7 Test Results

Output Power measurement result for UNII-1 Band

Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output Power	802.11a	5180	Low	6.74	24	Pass
		5200	Mid	7.12	24	Pass
		5240	High	7.03	24	Pass
	802.11n-HT20	5180	Low	6.74	24	Pass
		5200	Mid	7.13	24	Pass
		5240	High	6.93	24	Pass

Output Power measurement result for UNII-3 Band

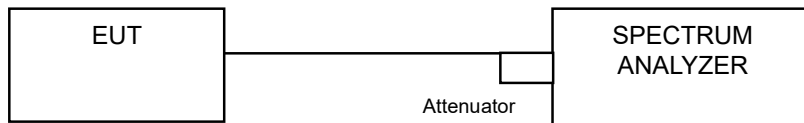
Type	Test mode	Freq (MHz)	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output Power	802.11a	5745	Low	7.03	30	Pass
		5785	Mid	6.50	30	Pass
		5825	High	6.29	30	Pass
	802.11n-HT20	5745	Low	6.89	30	Pass
		5785	Mid	6.15	30	Pass
		5825	High	6.22	30	Pass

4.5 26dB Bandwidth & 6dB Bandwidth Measurement

4.5.1 Limits of 6 dB Bandwidth Measurement

The minimum of 6 dB Bandwidth Measurement is 0.5 MHz.

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

26dB Emission bandwidth measurement procedure (Other than 5.725-5.85 GHz)

- Allow the trace to stabilize.
- Use the spectrum analyzer built-in measurement function to determine the 26dB BW.
Set RBW = around 1% of emission bandwidth
Set VBW > RBW
Detector = Peak
Trace mode = max hold
- Capture the plot.
- Repeat above steps for different test channel and other modulation type.

6 dB Minimum emission bandwidth measurement procedure

- Allow the trace to stabilize.
- Use the spectrum analyzer built-in measurement function to determine the 6dB BW.
Set RBW = 100 KHz
Set VBW $\geq 3 \times$ RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
- Capture the plot.
- Repeat above steps for different test channel and other modulation type.

4.5.5 Test Results

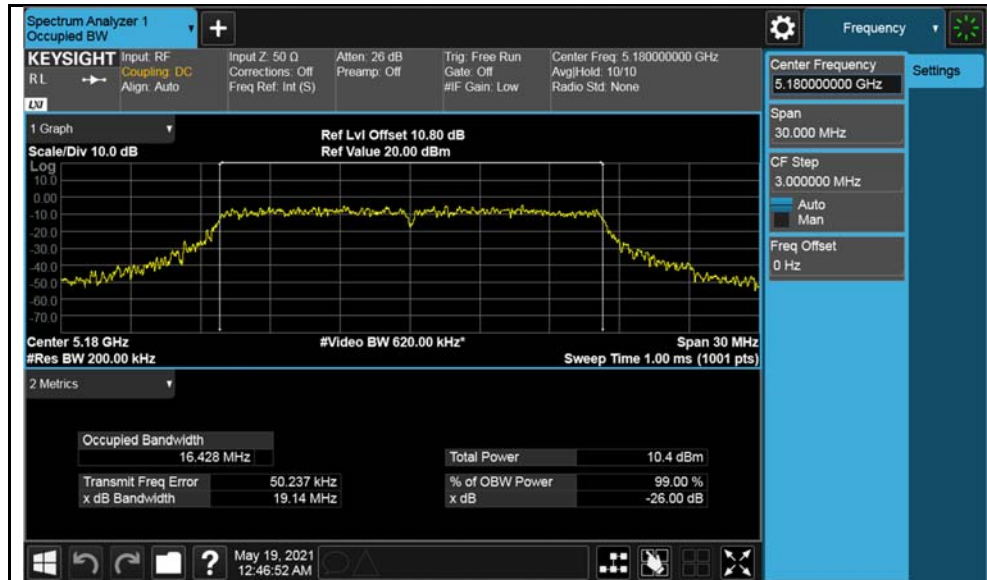
26dB Bandwidth measurement result for UNII-1 Band

Type	Test mode	Freq (MHz)	CH	Result (MHz)
26dB BW	802.11a	5180	Low	19.14
		5200	Mid	19.07
		5240	High	19.23
	802.11n-HT20	5180	Low	20.62
		5200	Mid	20.58
		5240	High	20.91

6dB Bandwidth measurement result for UNII-3 Band

Type	Test mode	Freq (MHz)	CH	Result (MHz)	Limit (MHz)	Result
6dB BW	802.11a	5745	Low	16.39	0.5	Pass
		5785	Mid	16.38	0.5	Pass
		5825	High	16.38	0.5	Pass
	802.11n-HT20	5745	Low	17.59	0.5	Pass
		5785	Mid	17.60	0.5	Pass
		5825	High	17.67	0.5	Pass

Occupied Bandwidth Test Plots UNII-1 Band



802.11a-5180MHz



802.11a-5200MHz



802.11a-5240MHz



802.11n-HT20-5180MHz



802.11n-HT20-5200MHz



802.11n-HT20-5240MHz

6dB Bandwidth Test Plots

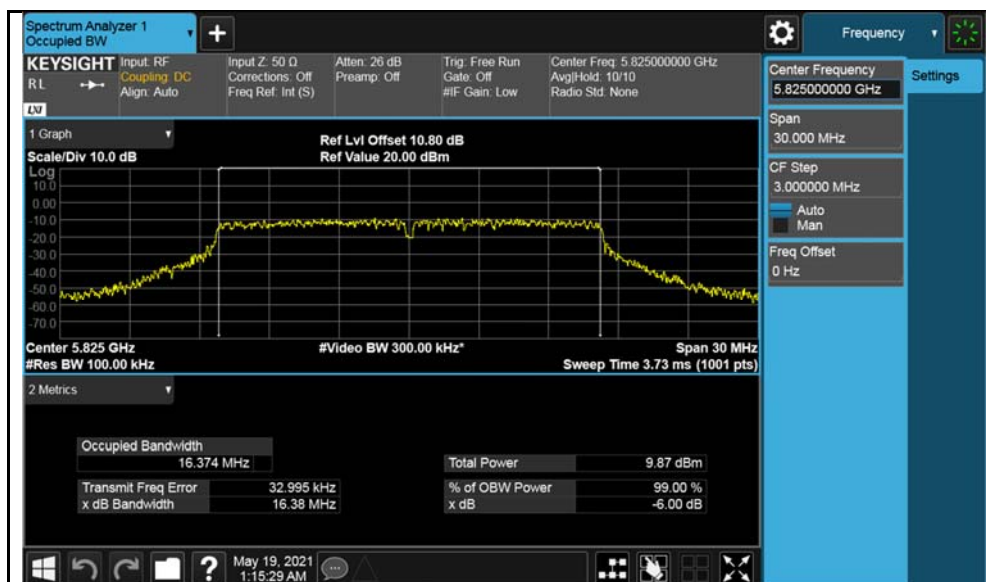
U-NII-3 Band:



802.11a-5745MHz



802.11a-5785MHz



802.11a-5825MHz



802.11n-HT20-5745MHz



802.11n-HT20-5785MHz



802.11n-HT20-5825MHz

4.6 Peak Power Spectral Density Measurement

4.6.1 Limits of Peak Power Spectral Density Measurement

Operation Band	EUT Category		Limit
U-NII-1		Outdoor Access Point	17dBm/ MHz
		Fixed point-to-point Access Point	
		Indoor Access Point	
	√	Client device	11dBm/ MHz
U-NII-2A	---		11dBm/ MHz
U-NII-2C	---		11dBm/ MHz
U-NII-3	---		30dBm/ 500kHz

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-1

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 1 MHz, Set VBW $\geq$ 3 MHz, Detector = RMS
3. Sweep time = auto, trigger set to "free run".
4. Trace average at least 100 traces in power averaging mode.
5. Record the max value

For U-NII-3:

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 300 kHz, Set VBW $\geq$ 1 MHz, Detector = RMS
3. Use the peak marker function to determine the maximum power level in any 300 kHz band segment within the fundamental EBW.
4. Scale the observed power level to an equivalent value in 500 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where $BWCF = 10\log(500 \text{ kHz}/300\text{kHz})$
5. Sweep time = auto, trigger set to "free run".
6. Trace average at least 100 traces in power averaging mode.
7. Record the max value

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

Same as Item 4.3.6.

4.6.7 Test Results

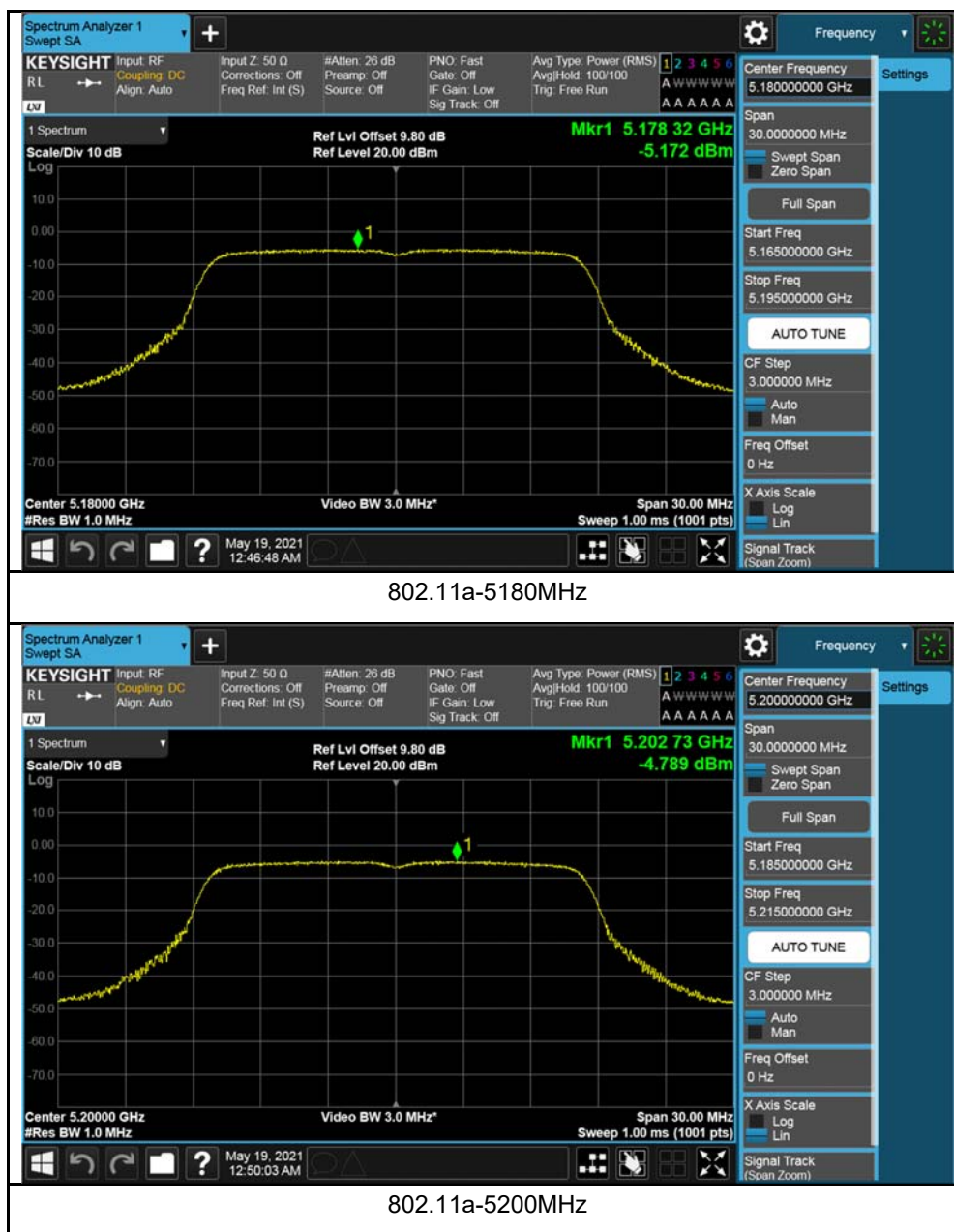
PSD measurement result for UNII-1 Band

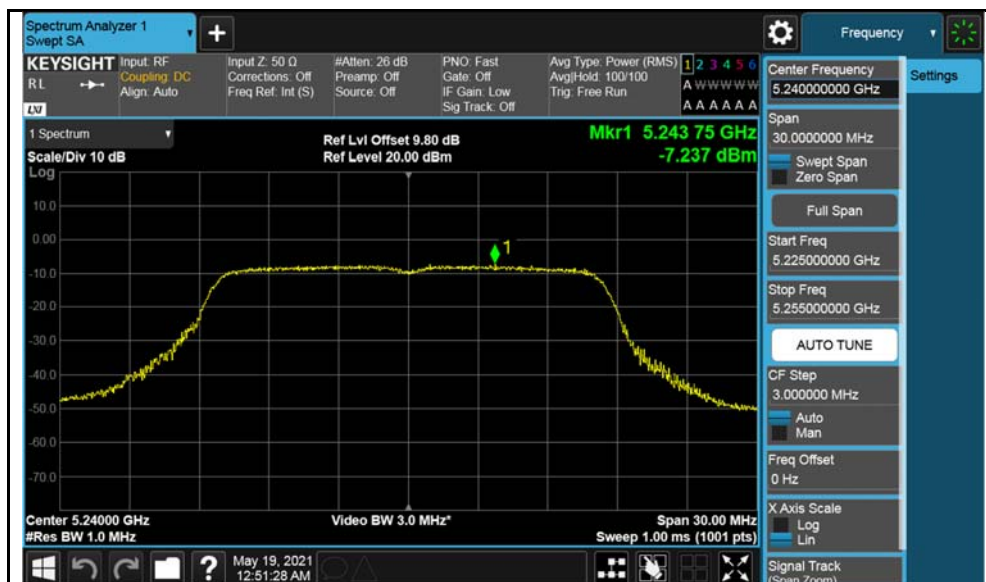
Type	Test mode	Freq (MHz)	CH	Conducted PSD (dBm/MHz)	Limit (dBm/MHz)	Result
Output Power	802.11a	5180	Low	-5.17	11	Pass
		5200	Mid	-4.79	11	Pass
		5240	High	-7.24	11	Pass
	802.11n-HT20	5180	Low	-5.30	11	Pass
		5200	Mid	-4.53	11	Pass
		5240	High	-5.12	11	Pass

PSD measurement result for UNII-3 Band

Type	Test mode	Freq (MHz)	CH	Conducted PSD (dBm/MHz)	Correction factor (dB)	Correction PSD (dBm/MHz)	Limit (dBm/MHz)	Result
Output Power	802.11a	5180	Low	-13.10	6.99	-6.11	30	Pass
		5200	Mid	-13.65	6.99	-6.66	30	Pass
		5240	High	-13.48	6.99	-6.49	30	Pass
	802.11n-HT20	5180	Low	-13.33	6.99	-6.34	30	Pass
		5200	Mid	-13.68	6.99	-6.69	30	Pass
		5240	High	-13.68	6.99	-6.69	30	Pass
Note	BW correction factor = $10\log(500\text{kHz}/\text{RBW})$, RBW was set to 100kHz during test.							

Test Plot for UNII-1 Band:

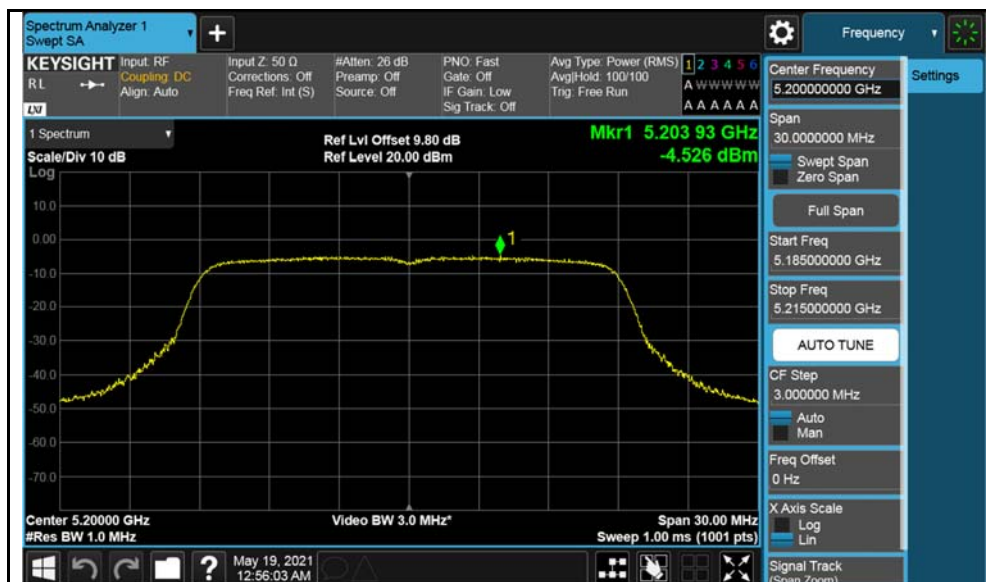




802.11a-5240MHz



802.11n-HT20-5180MHz

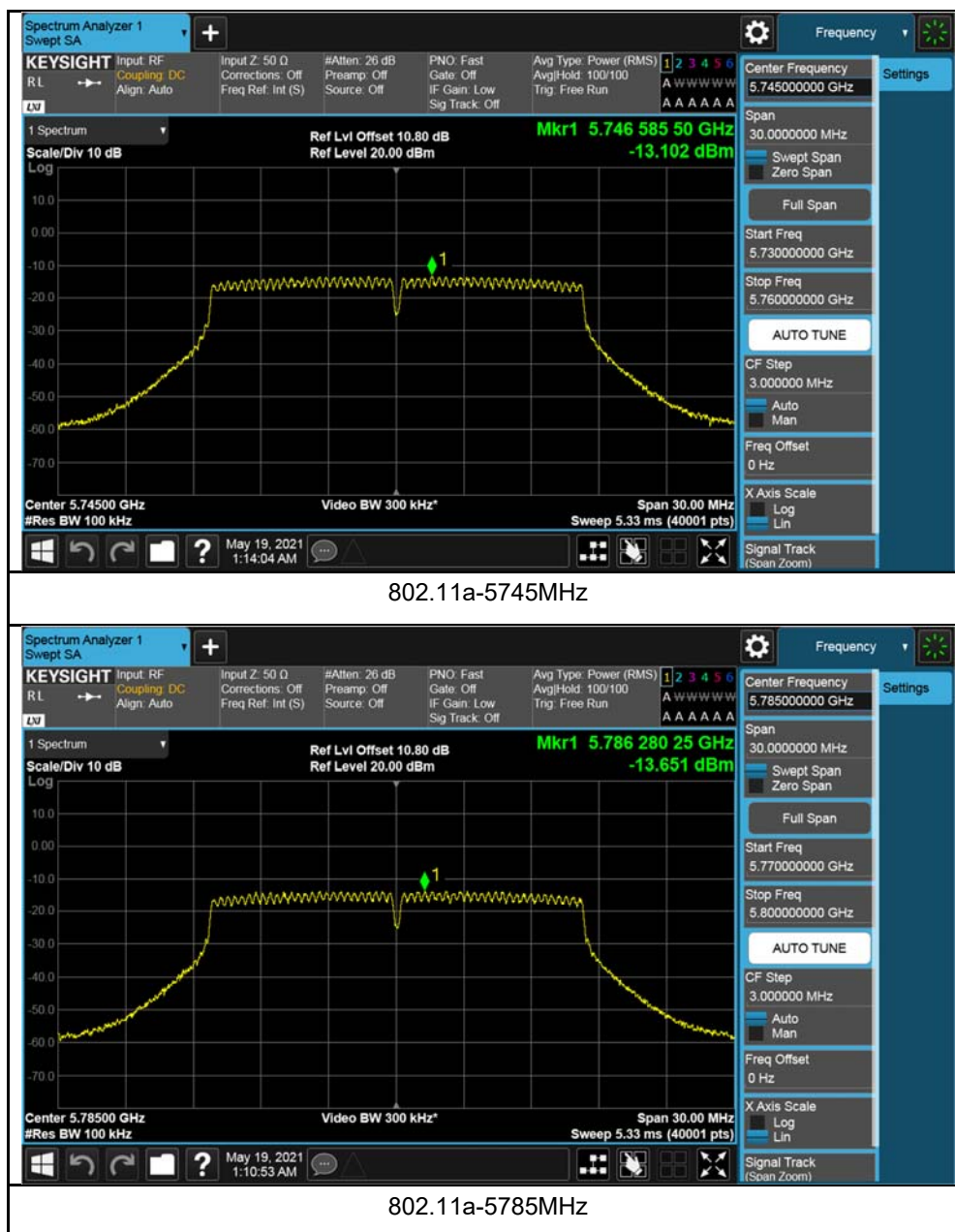


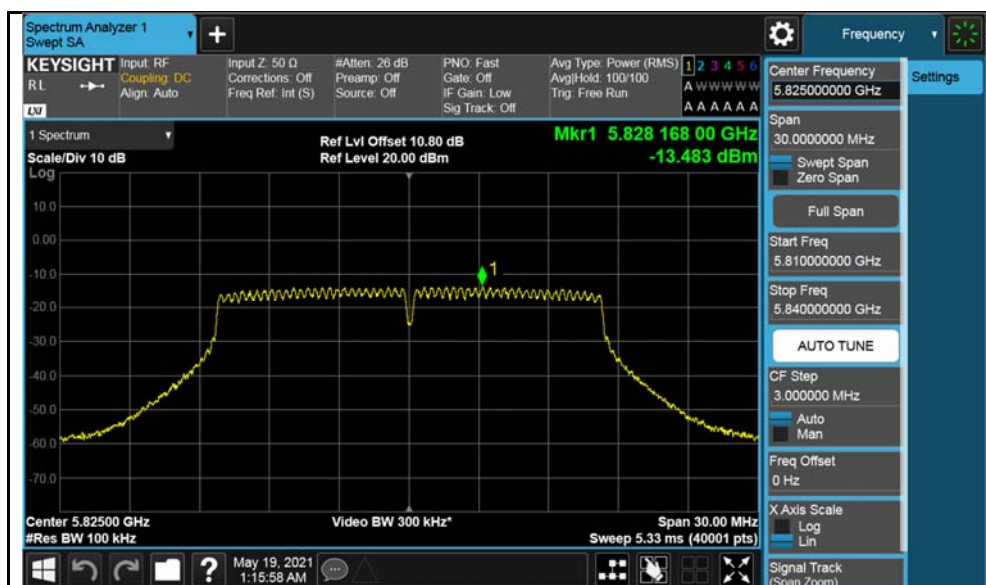
802.11n-HT20-5200MHz



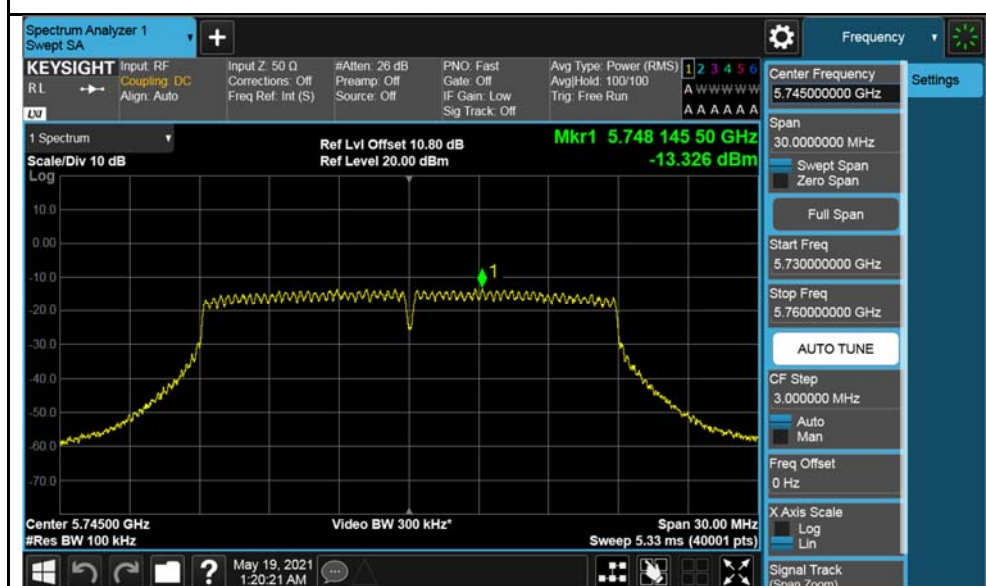
802.11n-HT20-5240MHz

Test Plot for UNII-3 Band:

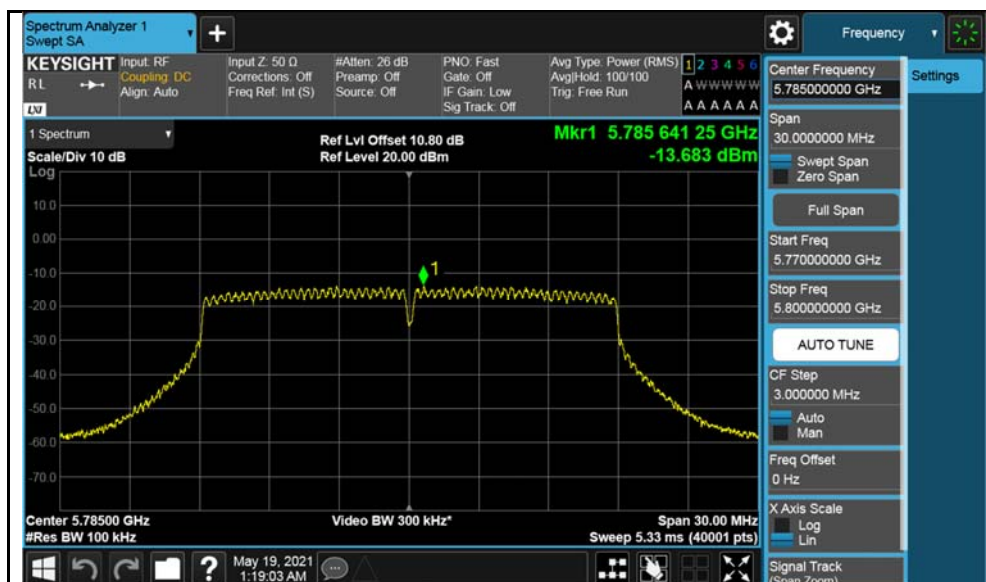




802.11a-5825MHz



802.11n-HT20-5745MHz



802.11n-HT20-5785MHz



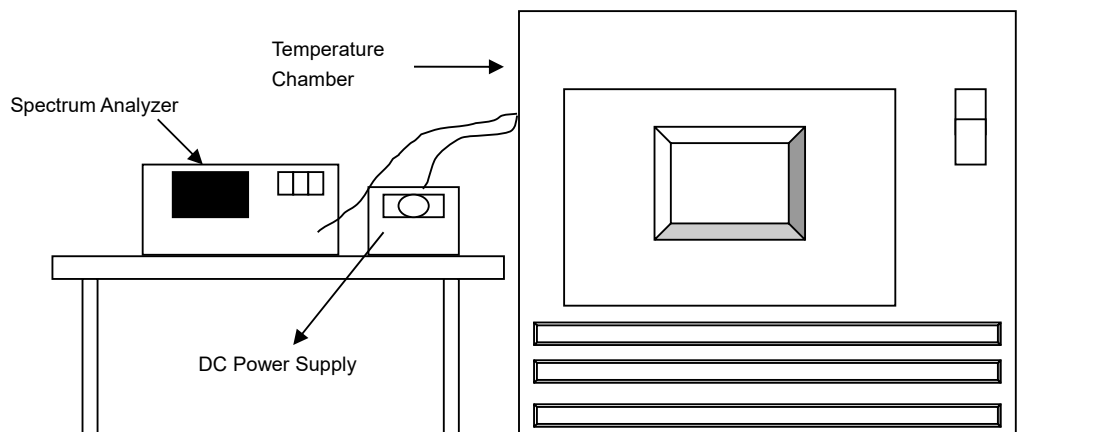
802.11n-HT20-5825MHz

4.7 Frequency Stability Measurement

4.7.1 Limits of Frequency Stability Measurement

The frequency of the carrier signal shall be maintained within band of operation.

4.7.2 Test Setup



4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.4 Test Procedure

- The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
- Turn the EUT on and couple its output to a spectrum analyzer.
- Turn the EUT off and set the chamber to the highest temperature specified.
- Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 Minutes.
- Repeat step (d) with the temperature chamber set to the next desired temperature until measurements down to the lowest specified temperature have been completed..
- The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 Minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

4.7.5 Deviation from Test Standard

No deviation.

4.7.6 EUT Operating Condition

Set the EUT transmit at un-modulation mode to test frequency stability.

4.7.7 Test Results

Frequency Stability Versus Temp.									
Operating Frequency: 5180 MHz									
TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)
50	3.0	5179.997	-0.000058	5180.002	0.000039	5179.995	-0.000097	5180.002	0.000039
40	3.0	5179.997	-0.000058	5179.997	-0.000058	5179.997	-0.000058	5180.002	0.000039
30	3.0	5179.998	-0.000039	5179.995	-0.000097	5179.997	-0.000058	5179.998	-0.000039
20	3.0	5179.996	-0.000077	5179.995	-0.000097	5179.996	-0.000077	5179.997	-0.000058
10	3.0	5179.988	-0.000232	5179.995	-0.000097	5179.995	-0.000097	5179.997	-0.000058
0	3.0	5179.998	-0.000039	5179.997	-0.000058	5179.998	-0.000039	5179.995	-0.000097
-10	3.0	5179.995	-0.000097	5179.995	-0.000097	5179.996	-0.000077	5179.995	-0.000097
-20	3.0	5179.997	-0.000058	5179.997	-0.000058	5180.005	0.000097	5179.995	-0.000097
-30	3.0	5179.994	-0.000116	5179.997	-0.000058	5180.003	0.000058	5179.996	-0.000077

Frequency Stability Versus Voltage									
Operating Frequency: 5180 MHz									
TEMP. (°C)	Power Supply (Vdc)	0 Minute		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)
20	3.45	5179.995	-0.000097	5179.997	-0.000058	5180.003	0.000058	5179.997	-0.000058
	3.0	5179.995	-0.000097	5179.996	-0.000077	5180.003	0.000058	5179.997	-0.000058
	2.55	5179.998	-0.000039	5180.002	0.000039	5179.995	-0.000097	5180.002	0.000039

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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