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TESTING
NVLAP LAB CODE: 100275-0

RF Transmitter Certification C2PC Test Report
(FCC ID: 2AD8UAZRBRH1)

Regulation

FCC CFR 47 Part 15 Subpart E, Section 15.407

Client

Nokia Solutions and Networks Oy

Product Evaluated

AZRB AirScale Micro RRH Band 46 LAA UNII 1&3 with New Omni-Directional Antenna GO4806-06664

GPCL Report Number
TR2018-0099 FCC

GPCL Project Number
2018-0099

Date Issued
June 11, 2018

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Revisions

Date	Revision	Section	Change

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The test results documented in this report refer exclusively to the test model/sample specified, under the conditions and modes of operation as described herein.

Prepared By:

Signed: _____ 6/11/2018
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NVLAP Approved Signatory

1. ATTESTATION OF TEST RESULTS

Company Name (Manufacturer)	Nokia Solutions and Networks Oy 2000 W. Lucent Lane Naperville, IL 60563
FCC ID	2AD8UAZRBRH1
Product Name	AZRB AirScale Micro RRH Band 46 LAA
Model Name	AZRB
Serial Number(s)	1M180528260 (AZRB) W47000317000010 (GO4806-06664-612 Antenna) 1M180528260 (474510A.X22 PSU, above 1GHz) U7173700002 (474130A.102 PSU, below 1GHz)
Test Requirement(s)	47 CFR FCC Part 15 Subpart E, Section 15.407
Test Procedures/Methods	• ANSI C63.10-2013 • FCC KDB 789033 D02, v02r01, December 2017 • FCC KDB 662911 D01, v02r01, October 2013 • FCC KDB 353028 D01, v01, April 2017
Frequency Band	5170-5250 MHz (UNII-1); 5735-5835 MHz (UNII-3) E-UTRAN Band 46
Operation Mode	Master Device
FCC Part 15 Subpart B Section 15.109 Class B	Passed
Date Tested	June 5 – 11, 2018
Type of Equipment	Transceiver
Submission Type	C2PC Radio Equipment Certification
Test Laboratory	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue Murray Hill, New Jersey 07974-0636 USA FCC Registration No/Designation No: 896745/US5302
Test Engineers	M. Soli

The above product has been evaluated and found to be in compliance with the Commission's Rules and Regulations set forth in the above standards.

This test report is a supplemental one to the TR2018-0033 FCC test report submitted in the original filing which remains valid.

FCC Section 2.911(e) Certification of Technical Test Data

The technical test data presented in this report are accurate.

2. SUMMARY OF THE TEST RESULTS

Applied Standards: 47 CFR FCC Part Subpart E Section 15.407 UNII-1 & UNII-3				
Section	**FCC Rules**	**Description of Tests**	**Test Condition**	**Results In Compliance**
4.4	15.407 (a)(1)	Maximum Outdoor EIRP	Calculated	Yes
4.5	15.407 (b)(1)(4-5)(8)	Unwanted Radiated Out-of-Band Emissions	Radiated	Yes
4.6	15.407 (b)(1)(4-8)	Unwanted Radiated Spurious Emissions		Yes

2.1. Measurement Uncertainties for EMC Radiated Emissions

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Table below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. EMC Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 32, *etc.*, using ESHS 30, EMC-60, LISNs/AMNs and antennas)	Radiated Emissions (AR-4 - AR-9 Semi-Anechoic Chambers)	30 – 200 200 – 1000	±5.1 ~ ±5.4 dB ±4.3 ~ ±4.7 dB
	Radiated Emissions (OATS)	1000 – 18,000	±3.3 dB

2.2. Measurement Uncertainties for Antenna Port Conducted Testing

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Expanded Uncertainty (k=2)
RF Power	± 1.4 dB
Occupied Bandwidth	± 2.2 dB
Conducted Spurious Emissions	± 2.8 dB

3. GENERAL INFORMATION

3.1. Product Descriptions

Table 3.1.1 Product Specifications

Specification Items	Description	
Product Type	LAA LTE RRH	
Radio Type	Intentional Transceiver	
Power Type	DC: -38V to -57V AC: 80V to 276V (via external AC/DC Converter)	
FCC Rules	15.407	
Operation Mode	Master Device, Point to Multipoint	
Modulation	OFDM (QPSK, 16QAM, 64QAM, 256QAM)	
Technology	LAA LTE-TDD	
Frequency Range	5170-5250 MHz (UNII-1); 5735-5835 MHz (UNII-3) E-UTRAN Band 46	
Bandwidth(s)	20/40/60MHz	
Max Rated Conducted RF Power	5170-5250 MHz (UNII-1)	Antennas with Max Gain ≤ 6 dBi: 26dBm per chain and 29dBm total Antennas with Max Gain = 9.5 dBi: 22.5 dBm per chain and 25.5dBm total
	5735-5835 MHz (UNII-3)	Antennas with Max Gain ≤ 6 dBi: 27dBm per chain and 30dBm total Antennas with Max Gain = 9.5 dBi: 23.5 dBm per chain and 26.5dBm total
Max Rated EIRP Power	5170-5250 MHz (UNII-1	32dBm per port and 35dBm total
	5735-5835 MHz (UNII-3)	33dBm per port and 36dBm total
Max OD EIRP at any Elevation Angle above 30° from Horizon	5170-5250 MHz (UNII-1)	≤ 125mW (21 dBm) Outdoor
Software Version (Master)	FL18_ENB	
Hardware Version (Master)	474510A.X22	
Antennas	Refer to Section 3.5. No beamforming	

3.2. Accessories

A Nokia BBU, ASMi, was used for all testing. ASMi consists of an ASIA system module circuit pack and an ABIA baseband sub-module circuit pack. The ASMi was connected to the AZRB through fiber connection. The above accessory device is unmodified and is commercially available per FCC requirement given in 2.1033(b)(8).

3.3.Description of Antenna(s)

Currently, there are six antennas available of two types to be equipped for this low power Band 46 LAA RRH AZRB, see the table below. Five of them (#1-#5) have been qualified in the original FCC certification for meeting FCC Section 15.203 and KDB 353028 D01 requirements on antennas. The #6 is the new antenna to be qualified.

The demonstration of meeting the FCC Section 15.203 and KDB 353028 D01 requirements on antennas presented in the Exhibit 5 of the original filing under FCC ID: 2AD8UAZRBRH1 is still valid for the new antenna #6, where it stated that unique (non-standard) antenna connectors were designed with the product and professional installation was used. There are provisions for special connectors to be used for any external antennas.

Table 3.3.1 UNII-1/3 Antenna Data from Manufacturers

Antenna No	Model Name	Antenna Type/ Size (mm)	Frequency (MHz)	Tx/Rx Port	Max Gain (dBi)	
					Port 1	Port 2
1	AARC	Directional 295(L) × 270(W) × 30(D)	5150 ~ 5850	Tx/Rx 1/2	4.91	4.91
2	FA2RC	Directional 160(L) × 110(W) × 44(D)	5150 ~ 5850	Tx/Rx 1/2	6.0	6.0
3	VVSSP-360S-F	Omni-Directional 600(L) × 100(R)	5150 ~ 5925	Tx/Rx 1/2	5.1	5.1
4	GQ2410-06645	Omni-Directional 634(L) × 127.5(R)	5150 ~ 5925	Tx/Rx 1/2	5.9	5.9
5	2205	Directional 198(W) × 24.5(D) × 198(H)	5150 ~ 5925	Tx/Rx 1/2	9.5	9.5
6	GO4806-06664	Omni-Directional 1219(L) × 52(D)	5150 ~ 5925	Tx/Rx 1/2	6.0	6.0

The antenna patterns in the UNII-1 band (5.17GHz-5.25GHz) were also provided by their manufacturers for each port in the elevation angle above 30° from the horizontal plane and presented below.

Table 3.3.2 Antenna Gains in UNII-1 Band in Elevation Angles 30° above the Horizontal Plane for Outdoor EUT

Antenna No	Model	Antenna Type	Max Gain in Elevation Angle 30° above Horizont (dBi)
1	AARC	Directional	-9.1
2	FA2RC	Directional	-7.0
3	VVSSP-360S-F	Omni-Directional	-9.5
4	GQ2410-06645	Omni-Directional	-11.0
5	2205	Directional	-7.0
6	GO4806-06664	Omni-Directional	-9.0

Table 3.3.3 UNII-1/3 Antennas Tested In the Original Filing (with the Highest Gain of Each Type)

Antenna No	Model Name	Antenna Type	Frequency (MHz)	Max Gain (dBi)	
				Port 1	Port 2
4	GQ2410-06645	Omni-Directional	5150 ~ 5925	5.9	5.9
5	2205	Directional	5150 ~ 5925	9.5	9.5

The compliance of the EUT with the maximum setting and the new omni-directional antenna #6 GO4806-06664 was evaluated.

4. REQUIRED MEASUREMENTS AND RESULTS

4.1. Regulatory Requirements

Per 2.1043(b)(2), when a Class II permissive change is made by the grantee, the grantee shall provide complete information and the results of tests of the characteristics affected by such change. Since the only change is adding a new omni-directional antenna #6 GO4806-06664 and its maximum antenna gain is higher (only 0.1dB) than the omni-directional antenna #4 GQ2410-06645 tested and qualified previously, the new omni-directional antenna #6 GO4806-06664 needs to be evaluated. The tests in this report were performed for Unlicensed-National Information Infrastructure Devices Operating in the 5170-5250 MHz and 5735-5835 MHz Bands in accordance with the requirements of FCC CFR 47 Part 15 Subpart E. Only the radiated unwanted emissions and the maximum outdoor EIRP were evaluated. The requirements are provided in the following:

(1) Antennas to Be Tested (15.203, 15.204, KDB 353028 D01)

Section 15.204(c) requires that compliance testing use the *actual* antennas to be certified with the part 15 intentional radiator. All devices (*e.g.*, radio card, module) must be tested with the antennas connected to the device. Compliance testing shall be performed using the highest gain antenna for each type of antenna to be certified with the intentional radiator. During this testing, the intentional radiator shall be operated at its maximum available output power level. The antenna type refers to antennas that have similar in-band and out-of-band radiation patterns. Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator. No retesting of this system configuration is required.

Section 15.204(b) states that an approved "transmission system" must always be marketed as a complete system, *i.e.,* including the antenna.

KDB 353028 D01 Section III.A stated that when submitting test data for part 15 transmitters to be used with multiple antennas, the testing for the highest gain of each type of antenna was required. For systems that can operate at different power levels, test data with the highest output power must be submitted. If the antenna list exhibit includes antennas of the same type but with different manufacturers/vendors, test data for only one manufacturer version needs to be submitted.

(2) Maximum Outdoor EIRP Limit (FCC 15.407 (a)(1))

For an *outdoor* unit, the maximum EIRP at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(3) Unwanted Emission Limits (FCC 15.407 (b)(1)(4-8)), 15.209 (a) and 15.205 (a, b, c).

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

i. For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

ii. For transmitters operating in the 5.725-5.85 GHz band: 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.

iii. The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

iv. Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.

v. The provisions of Section 15.205 apply to UNII intentional radiators, where the field strength of emissions appearing *within Section 15.205 restricted frequency bands* shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1GHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1GHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the *average* value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

vi. When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Therefore,

1) the emissions from the UNII transmitter in the frequency spectrum up to the 10th harmonics are subject to the following requirements:

   a. For emissions outside the restricted bands, per 15.407(b)(6-7), KDB789033 D02 II.G.2.a-c,
      (i) f < 1GHz, the limits specified in 15.209 need to be met by QPK or PK;
      (ii) f > 1GHz, the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK;

   b. For emissions in the restricted bands, per 15.407(b)(6-7), 15.205 (b), KDB 789033 D02 II.G.1.a-c,
      (i) f < 1GHz, the limits specified in 15.209 need to be met by QPK or PK;

(ii) f > 1GHz, the limits specified in 15.209 need to be met by AVE and the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK

2) the emissions from the digital circuits of the EUT in the frequency spectrum up to the 5th harmonics are subject to the 15.109 limit.

Either radiated measurement with antenna in place or Antenna-port conducted measurement plus cabinet emissions test with antenna terminated can be used.

Table 4.1.1 FCC Part 15.205 (a) Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
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			

4.2. UNII-1/3 Band Carrier Frequencies

Table 4.2.1 (a) 5.1GHz UNII-1 (5170-5250MHz) Frequency Channel Plan

Channel No.	Freq (MHz)	Bandwidth
36	5180	20MHz
40	5200	
44	5220	
48	5240	
36, 40	5180, 5200	40MHz
44, 48	5220, 5240	
36, 40, 44	5180, 5200, 5220	60MHz
40, 44, 48	5200, 5220, 5240	

Table 4.2.1 (b) 5.8GHz UNII-3 (5735 -5835MHz) Frequency Channel Plan

Channel No.	Freq (MHz)	Bandwidth
149	5745	20MHz
153	5765	
157	5785	
161	5805	
165	5825	
149, 153	5745, 5765	40MHz
157, 161	5785, 5805	
161, 165	5805, 5825	
149, 153, 157	5745, 5765, 5785	60MHz
157, 161, 165	5785, 5805, 5825	

Table 4.2.2(a) 5.1GHz UNII-1 (5170 -5250MHz) Frequency Channels Used for Testing

Channel No.	Freq (MHz)	Bandwidth
36	5180	20MHz
44	5220	
48	5240	
36, 40	5180, 5200	40MHz
44, 48	5220, 5240	
36, 40, 44	5180, 5200, 5220	60MHz
40, 44, 48	5200, 5220, 5240	

Table 4.2.2(b) 5.8GHz UNII-3 (5735 -5835MHz) Channels Used for Testing

Channel No.	Freq (MHz)	Bandwidth
149	5745	20MHz
157	5785	
165	5825	
149, 153	5745, 5765	40MHz
157, 161	5785, 5805	
161, 165	5805, 5825	
149, 153, 157	5745, 5765, 5785	60MHz
157, 161, 165	5785, 5805, 5825	

4.3. Test Configurations and Setup

The maximum gain of the #6 antenna is 6dBi. Therefore, it should have the same power setting as #1-#4 antennas evaluated in the original filing. All measurements were performed with the EUT transmitting at 100% duty cycle (at least 98% if required by the EUT for amplitude control purposes) at the following power control level.

Table 4.3.1 Power Levels Tested

Band	Total Per Port Power Setting for Antennas #1-#4 & #6 ($G^{max} \leq 6$ dBi)	Total Per Port Power Setting for Antenna #5 ($G^{max} = 9.5$ dBi)
UNII-1	26 dBm	22.5 dBm
UNII-3	27 dBm	23.5 dBm

The worst or near worst cases of the unwanted radiated emissions identifidied from the original evaluation for the omni-directional antenna #4 among various modulation types (Q/16QAM, 64QAM and 256QAM) and bandwidth modes (20MHz, 40MHz and 60MHz) were evaluated for the new antenna.

The test setup diagrams are given below.

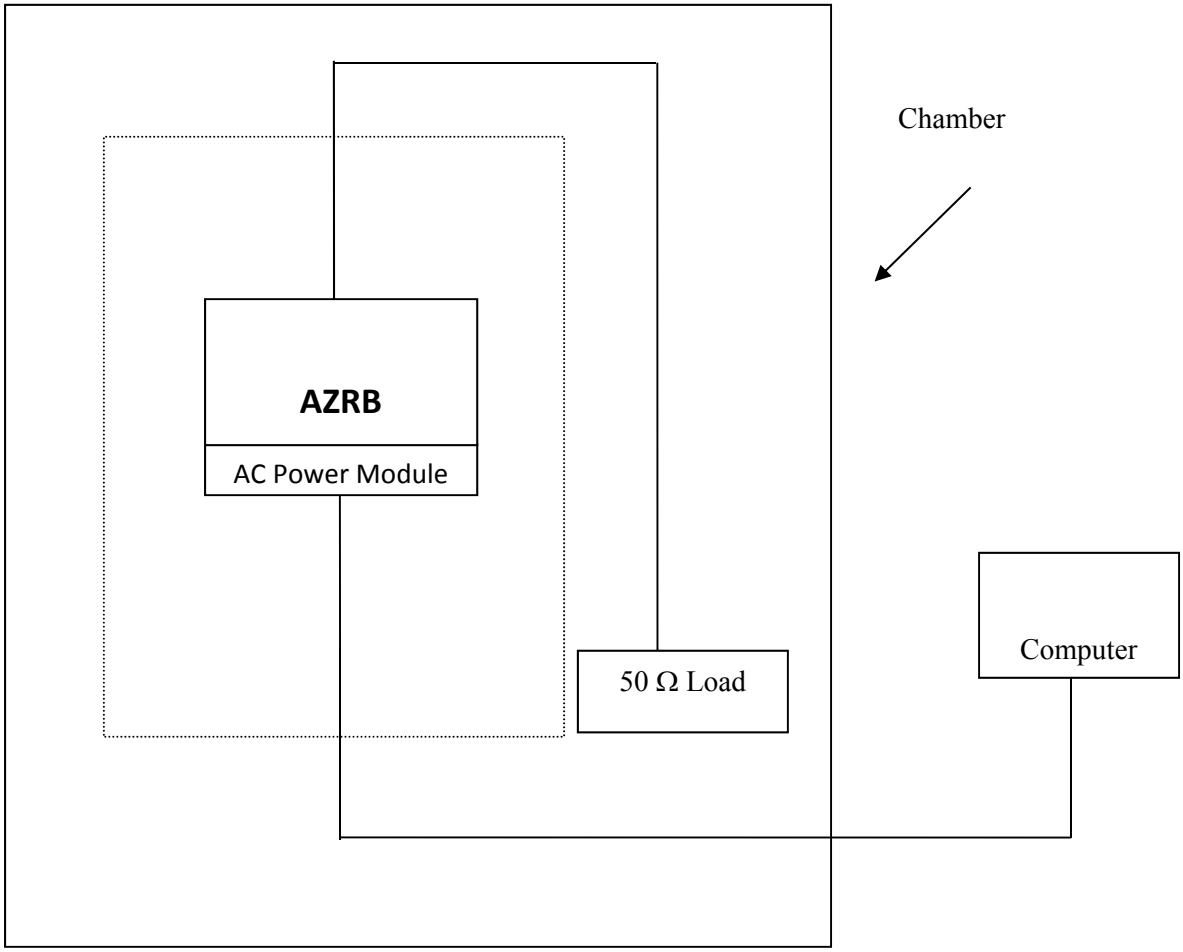


Figure 4.3.1 Setup Diagram of Radiated Test

4.4. MEASUREMENT REQUIRED: MAXIMUM OUTDOOR EIRP – FCC SECTION 15.407 (a)(1)

For UNII-1 band, the power setting for antennas with the maximum gain ≤ 6dBi is 26dBm per port per Table 4.3.1. The test report TR2018-0033 FCC, Section 4.6 Table 4.6.5, or Exhibit 12 in the original filing under FCC ID 2AD8UAZRBRH1, showed that the maximum output power per port measured among all operation modes supported for 26dBm power setting is slightly less than 26dBm per port.

The maximum antenna gains at any elevation angle above 30 degrees as measured from the horizon were provided in Table 3.3.2. Per KDB 789033 D02 Section II.H.1, for a fixed infrastructure without electrically or mechanically steerable beam antennas, the elevation plane radiation pattern can be used to calculate the maximum EIRP. For MIMO devices, take the maximum gain of each antenna and apply the guidance in KDB 662911 for calculating the overall gain including directional gain for maximum EIRP calculation. Since the EUT does *not* have beamforming function and two signals are *uncorrelated*, the directional antenna gain is the gain of an individual antenna per KDB 662911.

The maximum EIRP (dBm) of the EUT equipped with the antenna #6 given in Section 3.3 in the elevation angle above 30 Degrees in UNII-1 Band (5.15-5.25 GHz) is given in the table below.

Table 4.4.1 Maximum EIRP (dBm) in the Elevation Angle above 30 Degrees in UNII-1 Band (5.15-5.25 GHz)

Antenna No	Max Power Per Port (dBm)	Antenna Max Directional Gain above 30° (dBi)	Max EIRP above 30° (dBm)	Limit (dBm)	Results
6	26.0	-9.0	17.0	21	pass

The maximum EIRP of the EUT equipped with the antennas #6 at the elevation angles above 30 degrees is less than 21 dBm (125mW), the limit for an outdoor access point in UNII-1 band, and is in full compliance with the Rules of the Commission.

4.5. MEASUREMENT REQUIRED: UNWANTED RADITED OUT-OF-BAND EMISSIONS – FCC SECTION 15.407 (b)(1)(4-5)(8)

The requirements of the out-of-band emissions are provided in Section 4.1. Per KDB 789033 D02 guidance II.G.3.b, "The unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance."

The out-of-band emissions were evaluated by radiated measurement per KDB 789033 D02 measurement guidance for the EUT equipped with the omni-directional antenna #6 which has the highest antenna gain among all omni-directional antennas.

Per KDB 789033 D02, for the radiated measurement, the field strength limit is obtained from the EIRP limit by

$$EIRP = \frac{\sqrt{\mathrm{E\ x\ d}}}{30},$$

where

- E is the field strength in V/m;
- d is the measurement distance in m;
- EIRP is the equivalent isotropically radiated power in W.

Therefore, with E in,

$$E\ (\mathrm{dB\mu V/m}) = EIRP(dBm) - 20 * \log(d) + 104.77.$$

At 3m with EIRP = - 27dBm, E = 68.2 dBμV/m.

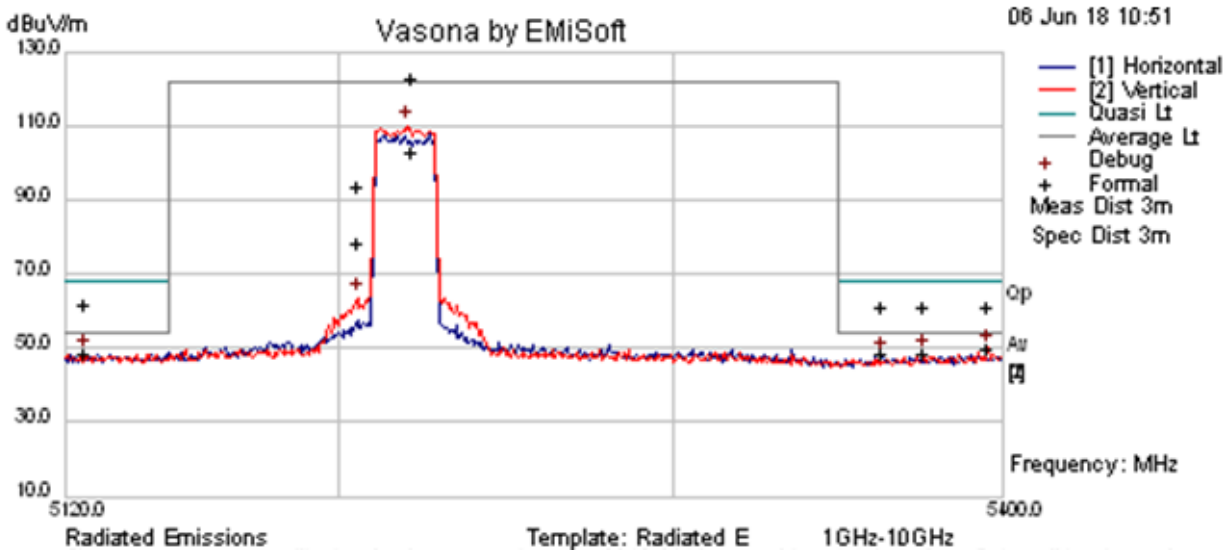
Table 4.5.1 FCC 15.407 UNII-1/3 Out-of-Band limits

Band (GHz)	Frequency Investigated (GHz)	E^{lim} (dBuV/m) at 3m	Detector	RBW (MHz)
5.15–5.25	f < 4.5 & 5.46 < f	54/68.2 for restric band, 68.2 for non-restric band	AV/PK, PK	1
	4.5 < f < 5.15 & 5.35 < f < 5.46	54/68.2	AV/PK	
5.725–5.85	f < 5.650 & 5.925 < f	54/68.2 for restric band, 68.2 for non-restric band	AV/PK, PK	
	5.650 < f < 5.700 & 5.875 < f < 5.925	68.2 to 105.2	PK	
	5.700 < f < 5.720 & 5.855 < f < 5.875	105.2 to 110.8	PK	
	5.720 < f < 5.725 and 5.850 < f < 5.855	110.8 to 122.2	PK	

The out-of-band emissions provided in this section are the unwanted emissions outside and near the band edges. The unwanted emissions at the frequencies away from the band edges were provided in the next section. The recommendations of ANSI C63.10 were followed for the EUT testing setup and cabling. The test setup diagram was given in Section 4.3. The emissions were maximized by rotating the turntable 360° and moving the receiving antenna height to scan and capture the emissions from the EUT.

As stated in Section 4.3, the configurations which give the out-of-band emissions with the minimum emission margins for one-20MHz carrier, two-20MHz carriers and three-20MHz carriers were evaluated for the EUT equipped with antenna #6. The results were shown below in Figures 4.5.1 and 4.5.2.

The unwanted radiated out-of-band emissions measured with the EUT equipped with the antenna #6 transmitting in the UNII-1 and UNII-3 bands are all below the FCC required limits in both the restricted and non-restricted bands (see Table 4.5.1 where the restricted bands are provided in Table 4.1.1) and are in full compliance with the Rules of the Commission.

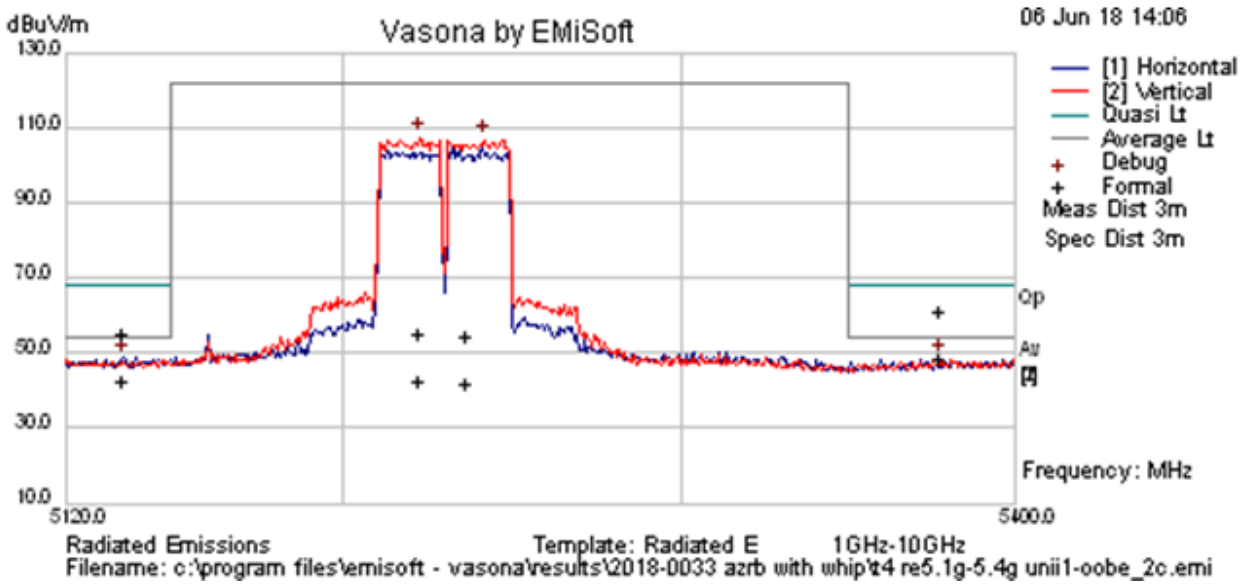


FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5222.61	100.54	22.21	-3.7	119.06	Peak	V	176	360	122.2	-3.14	Pass	Tx
5395.55	27.23	22.27	-3.56	45.94	Average	V	165	233	54	-8.06	Pass	
5363.5	25.57	22.26	-3.59	44.25	Average	H	103	357	54	-9.75	Pass	
5126.2	25.8	22.18	-3.78	44.2	Average	V	213	243	54	-9.8	Pass	
5376.44	25.5	22.27	-3.58	44.19	Average	V	159	251	54	-9.81	Pass	
5126.2	39.19	22.18	-3.78	57.6	Peak	V	213	243	68.2	-10.6	Pass	
5376.44	38.65	22.27	-3.58	57.34	Peak	V	159	251	68.2	-10.86	Pass	
5395.55	38.52	22.27	-3.56	57.23	Peak	V	165	233	68.2	-10.97	Pass	
5363.5	38.13	22.26	-3.59	56.8	Peak	H	103	357	68.2	-11.4	Pass	

PREVIEW DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5395.55	31.14	22.27	-3.56	49.85	Debug	V	99	315	54	-4.15	Pass	
5376.44	29.75	22.27	-3.58	48.44	Debug	V	99	315	54	-5.56	Pass	
5126.2	29.82	22.18	-3.78	48.22	Debug	V	99	315	54	-5.78	Pass	
5363.5	29.34	22.26	-3.59	48.02	Debug	H	99	315	54	-5.98	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.1(a) The Radiated Out-of-Band Emissions Evaluated for One 20MHz Carrier at UNII-1 Channel 44 (5220MHz), 26dBm, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, File No T3a).



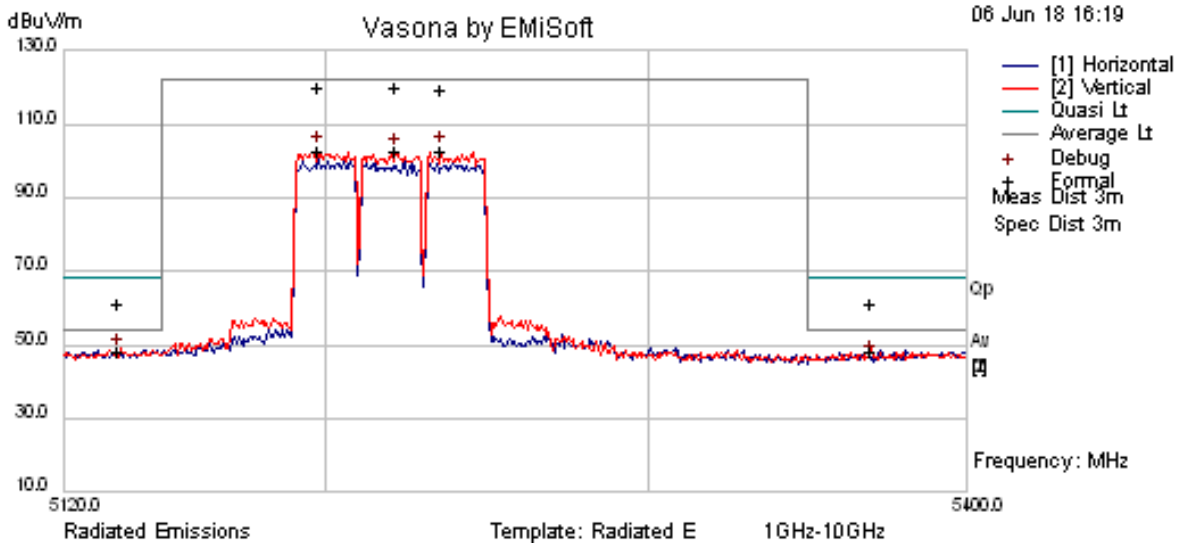
FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5378.12	25.57	22.27	-3.58	44.27	Average	H	251	172	54	-9.73	Pass	
5378.12	38.52	22.27	-3.58	57.21	Peak	H	251	172	68.2	-10.99	Pass	
5136.91	19.85	22.18	-3.77	38.27	Average	H	223	87	54	-15.73	Pass	
5136.91	33.02	22.18	-3.77	51.43	Peak	H	223	87	68.2	-16.77	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5136.91	30.19	22.18	-3.77	48.6	Debug	H	99	315	54	-5.4	Pass	
5378.12	29.83	22.27	-3.58	48.52	Debug	H	99	315	54	-5.48	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.1(b) The Radiated Out-of-Band Emissions for Two 20MHz Carriers at UNII-1 Channels 44 (5220MHz) and 48 (5240), 26dBm Total, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, T4).



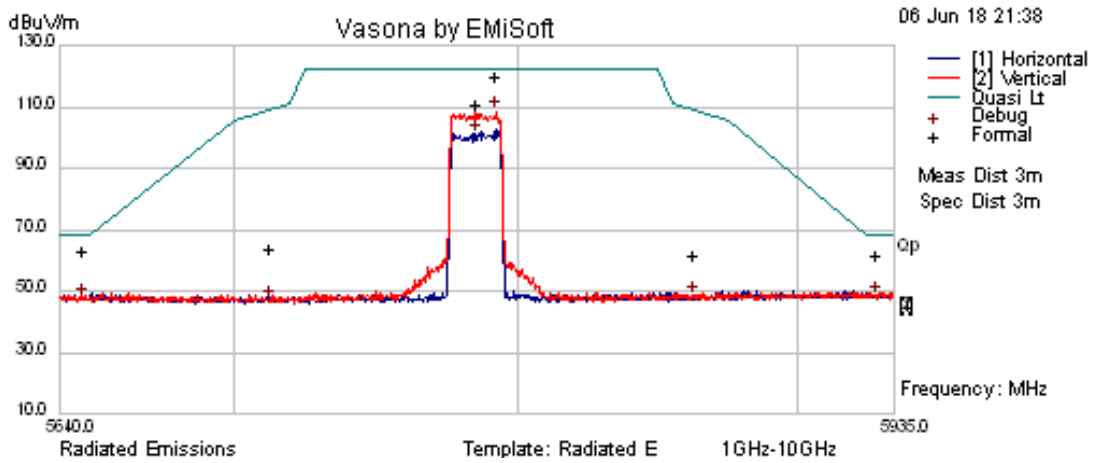
FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5198	97.44	22.2	-3.72	115.92	Peak	V	267	59	122.2	-6.28	Pass	Tx
5221.56	96.98	22.21	-3.7	115.49	Peak	V	242	68	122.2	-6.71	Pass	Tx
5235.59	96.76	22.22	-3.69	115.29	Peak	V	237	231	122.2	-6.91	Pass	Tx
5370.04	25.42	22.27	-3.58	44.1	Average	H	128	341	54	-9.9	Pass	
5136.66	25.65	22.18	-3.77	44.06	Average	H	264	270	54	-9.94	Pass	
5136.66	38.65	22.18	-3.77	57.07	Peak	H	264	270	68.2	-11.13	Pass	
5370.04	38.13	22.27	-3.58	56.81	Peak	H	128	341	68.2	-11.39	Pass	
5221.56	80.04	22.21	-3.7	98.56	Average	V	242	68	122	-23.44	Pass	Tx
5198	80.04	22.2	-3.72	98.53	Average	V	267	59	122	-23.47	Pass	Tx
5235.59	80	22.22	-3.69	98.53	Average	V	237	231	122	-23.47	Pass	Tx

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5198	84.03	22.2	-3.72	102.51	Preview	V	200	45	122	-19.49	Pass	Tx
5235.59	83.92	22.22	-3.69	102.45	Preview	V	200	45	122	-19.55	Pass	Tx
5221.56	83.55	22.21	-3.7	102.07	Preview	V	200	45	122	-19.93	Pass	Tx
5370.04	27.27	22.27	-3.58	45.95	Debug	H	99	315	54	-8.05	Pass	
5136.66	28.85	22.18	-3.77	47.26	Debug	H	99	315	54	-6.74	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.1(c) The Radiated Out-of-Band Emissions with the Minimum Margin for Three 20MHz Carriers at UNII-1 Channel 40 (5200MHz), 44 (5220 MHz) and 48 (5240 MHz), 26dBm Total, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, T5).



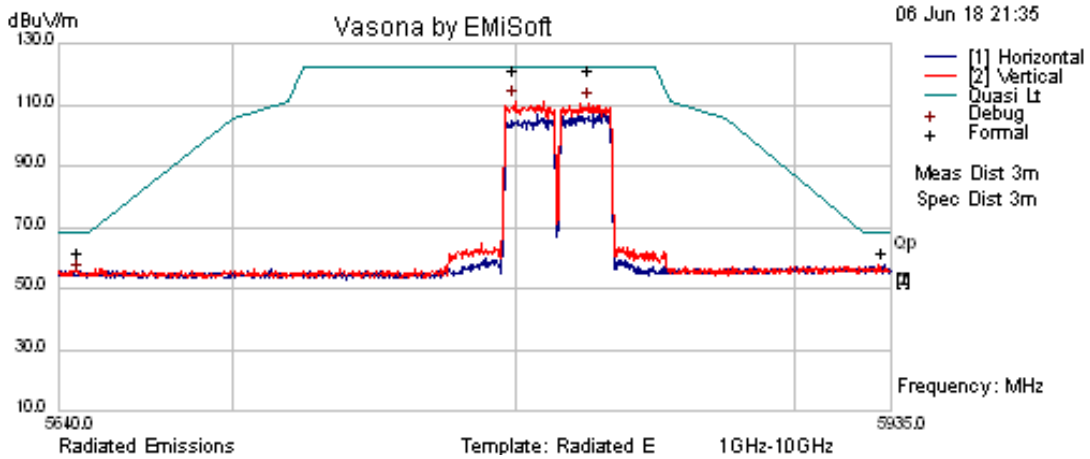
FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5792.4	97.07	22.41	-3.25	116.22	Peak	V	254	267	122.2	-5.98	Pass	Tx
5648.06	40.31	22.36	-3.37	59.3	Peak	H	235	93	68.2	-8.9	Pass	
5929.1	38.78	22.45	-3.15	58.09	Peak	H	187	219	68.2	-10.11	Pass	
5785.47	87.66	22.41	-3.26	106.8	Peak	H	267	345	122.2	-15.4	Pass	Tx
5713.07	41.11	22.38	-3.32	60.18	Peak	H	234	36	108.86	-48.68	Pass	
5863.27	38.52	22.43	-3.2	57.75	Peak	H	157	155	108.48	-50.73	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5792.4	89.23	22.41	-3.25	108.39	Preview	V	200	45	122.2	-13.81	Pass	Tx
5929.1	28.97	22.45	-3.15	48.27	Debug	H	99	315	68.2	-19.93	Pass	
5648.06	28.31	22.36	-3.37	47.31	Debug	H	99	315	68.2	-20.89	Pass	
5785.47	81.7	22.41	-3.26	100.85	Debug	H	99	315	122.2	-21.35	Pass	Tx
5863.27	29.14	22.43	-3.2	48.37	Debug	H	99	315	108.48	-60.11	Pass	
5713.07	27.82	22.38	-3.32	46.89	Debug	H	99	315	108.86	-61.97	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.2(a) The Radiated Out-of-Band Emissions for One 20MHz Carrier at UNII-3 Channel 157 (5785MHz), 27dBm, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, File No T6a).



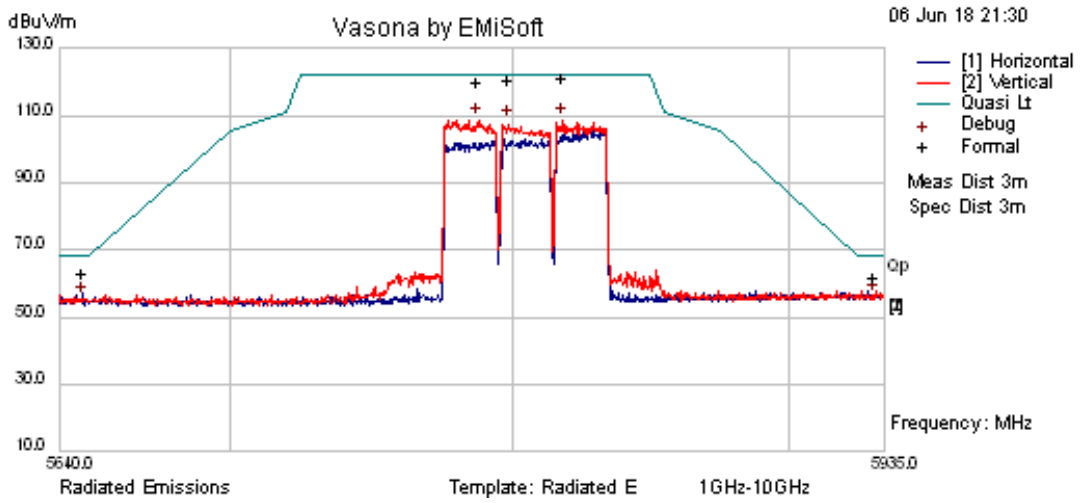
FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5826.06	98.5	22.42	-3.23	117.69	Peak	V	228	133	122.2	-4.51	Pass	Tx
5799.68	98.39	22.41	-3.25	117.55	Peak	V	227	257	122.2	-4.65	Pass	Tx
5932.31	38.26	22.45	-3.15	57.56	Peak	H	127	228	68.2	-10.64	Pass	
5646.62	38.52	22.36	-3.37	57.51	Peak	H	383	280	68.2	-10.69	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5799.68	92.24	22.41	-3.25	111.4	Preview	V	300	225	122.2	-10.8	Pass	Tx
5826.06	91.54	22.42	-3.23	110.73	Preview	V	200	45	122.2	-11.47	Pass	Tx
5932.31	38.65	22.45	-3.15	57.95	Preview	H	380	0	68.2	-10.25	Pass	
5646.62	35.2	22.36	-3.37	54.19	Debug	H	99	315	68.2	-14.01	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.2(b) The Radiated Out-of-Band Emissions for Two 20MHz Carriers at UNII-3 Channel 161 (5805MHz) and 165 (5825MHz), 27dBm Total, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, File No T7a).



FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5818.23	97.79	22.42	-3.24	116.97	Peak	V	276	48	122.2	-5.23	Pass	Tx
5798.99	96.98	22.41	-3.25	116.14	Peak	V	209	57	122.2	-6.06	Pass	Tx
5788.25	96.64	22.41	-3.26	115.79	Peak	V	223	53	122.2	-6.41	Pass	Tx
5648.06	39.62	22.36	-3.37	58.62	Peak	H	257	99	68.2	-9.58	Pass	
5931.37	38.39	22.45	-3.15	57.69	Peak	H	286	311	68.2	-10.51	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5788.25	89.33	22.41	-3.26	108.48	Preview	V	200	45	122.2	-13.72	Pass	Tx
5818.23	89.16	22.42	-3.24	108.34	Preview	V	200	45	122.2	-13.86	Pass	Tx
5798.99	88.29	22.41	-3.25	107.45	Preview	V	200	45	122.2	-14.75	Pass	Tx
5648.06	36	22.36	-3.37	55	Debug	H	99	315	68.2	-13.2	Pass	
5931.37	36.51	22.45	-3.15	55.81	Debug	H	99	315	68.2	-12.39	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.5.2(c) The Radiated Out-of-Band Emissions Evaluated for Three 20MHz Carriers at UNII-3 Channel 157 (5785MHz), 161 (5805MHz) and 165 (5825MHz), 27dBm Total, Q/16QAM, Omni-Directional Antenna #6 (Preview RBW: 30k and Formal RBW: 1MHz, File No T8).

4.6. MEASUREMENT REQUIRED: UNWANTED RADIATED SPURIOUS EMISSIONS – FCC SECTION 15.407 (b)(1)(4-8)

The requirements of the unwanted emissions are provided in Section 4.1. Per KDB 789033 D02 guidance II.G.3.b, "The unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance."

The Limits of FCC 15.109 Class B, 15.209 and 15.407 were given in Tables 4.6.1 and 4.6.2, where the conversion between the EIRP and electrical field strength was given in the above section. The restricted bands of operation specified in FCC 15.205(a) were provided in Section 4.1. The FCC 15.109 Class B limits are identical to the 15.209 limits between 30MHz and 30GHz for the EUT operating in UNII bands.

Table 4.6.1. FCC 15.109 Class B and 15.209 Radiated Emissions Limits

Frequency (MHz)	Field Stength at 3m (dB uV/m)		RBW (kHz)	Detector
	FCC 15.109 Class B	FCC 15.209		
10 - 30		49.5	9	QP
30 - 88	40	40	120	QP
88 - 216	43.5	43.5		
216 - 230	46	46		
230 - 960	46	46		
960 - 1000	54	54		
1000 - 3000	54	54	1000	Ave.
	74	74		Peak
> 3000 - 5 f_c	54	54	1000	Ave.
	74	74		Peak
5 f_c - 10 f_c / 40GHz		54	1000	Ave.
		74		Peak

Table 4.6.2. Combined Worst Radiated Emission Limits per 15.407 UNII-1/3, 15.209 and 15.109 at 3m

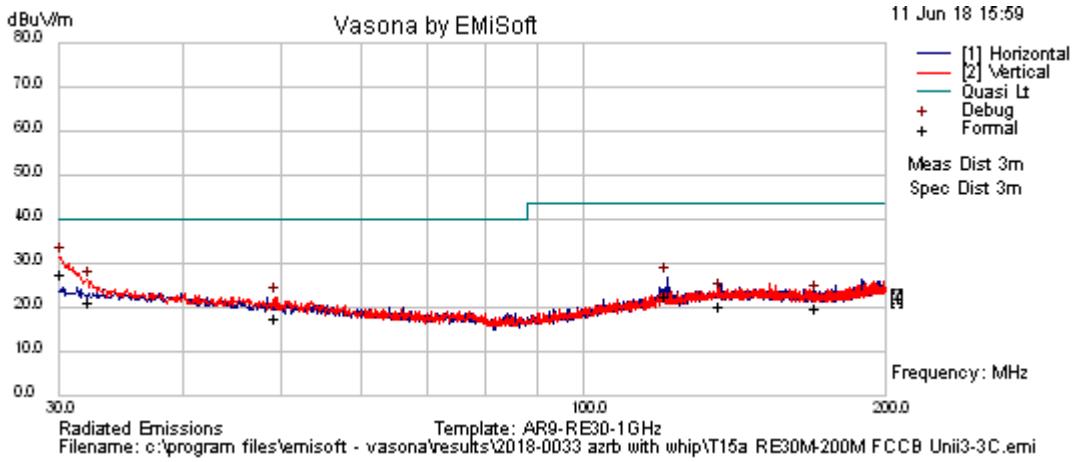
Frequency (MHz)	E (dBuV/m)	RBW (kHz)	Detector
10 - 30	47.7	9kHz	Peak
30 - 88	40/59	120kHz	QP/Peak
88 - 216	43.5/59		
216 - 960	46/59		
960 - 1000	54/59		
1G - 40G in Restricted Bands	54/68.2	1000	Ave/Peak
1G - 40G in Non-Restricted Bands	68.2	1000	Peak
Band Edges	See Section 4.8	1000	Peak

The unwanted emissions were evaluated by radiated measurement from 30MHz to 40GHz. The emissions near the band edges were provided in the above section. The EUT with the omni-directional antenna #4

which had the highest gain among all omni-directional antennas were evaluated in the original filing for one-20MHz carrier, two-20MHz carriers and three-20MHz carriers with various carrier modulations (Q/16QAM, 64QAM and 256QAM). The configurations which give the spurious emissions with the minimum emission margin for the antenna #4 were evaluated for the EUT equipped with the antenna #6 for one-20MHz carrier, two-20MHz carriers and three-20MHz carriers. The AC power Supply P/N 474510A.X22 (S/N-1M180528260) was used in the original filing and this testing above 1 GHz. The new AC power supply P/N 474130A.102 (S/N U7173700002) was used in this testing below 1GHz.

The recommendations of ANSI C63.10 were followed for EUT testing setup and cabling. The measurement guidance given in KDB 789033 D02 was followed. The test setup diagram was given in Section 4.3. The emissions were maximized by rotating the turntable 360° and moving the receiving antenna height to scan and capture the emissions from the EUT.

The unwanted radiated spurious emissions measured in the frequency range of 30MHz-40GHz for the EUT, which operated in UNII-1/3 bands and was equipped with the new omni-directional antenna #6, met the FCC 15.407 and 15.209 requirements in both the restricted and non-restricted bands (see Table 4.6.2 where the restricted bands are provided in Table 4.1.1) for intentional radiators and the FCC 15.109 Class B requirements for unintentional radiators and are in full compliance with the Rules of the Commission.

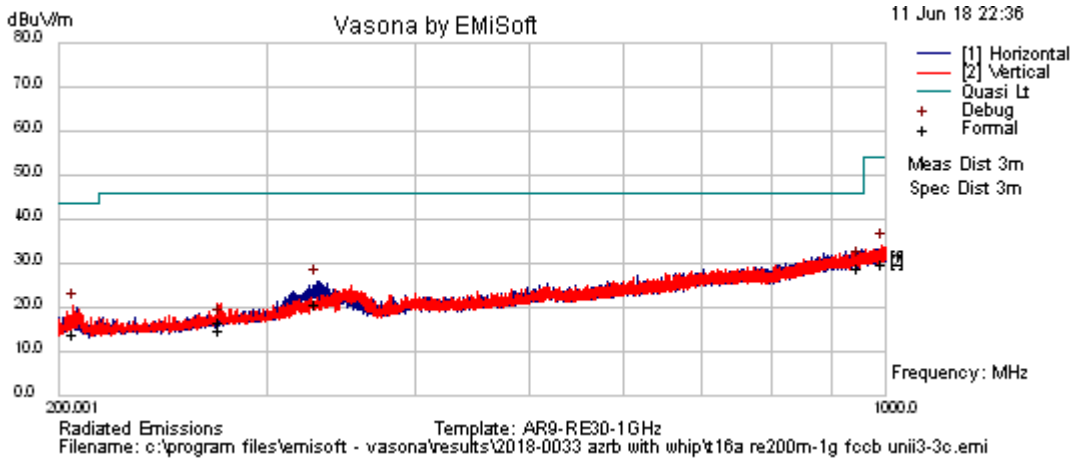


FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
30.1924	30.75	12.24	-18.3	24.68	Quasi Max	V	101	8	40	-15.32	Pass	
32.3086	24.86	12.26	-18.7	18.45	Quasi Max	V	157	35	40	-21.55	Pass	
121.19	27.66	12.62	-20.4	19.88	Quasi Max	H	126	329	43.5	-23.62	Pass	
49.3347	23.99	12.36	-21.4	14.91	Quasi Max	V	196	335	40	-25.09	Pass	
137.241	24.52	12.66	-19.6	17.58	Quasi Max	H	295	358	43.5	-25.92	Pass	
170.538	24.43	12.74	-20	17.22	Quasi Max	H	156	52	43.5	-26.28	Pass	

PREVIEW DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
30.1924	37.36	12.24	-18.3	31.28	Preview	V	100	270	40	-8.72	Pass	
32.3086	32.16	12.26	-18.7	25.75	Preview	V	100	180	40	-14.25	Pass	
121.19	34.59	12.62	-20.4	26.81	Preview	H	285	315	43.5	-16.69	Pass	
49.3347	31.33	12.36	-21.4	22.25	Preview	V	100	270	40	-17.75	Pass	
137.241	29.96	12.66	-19.6	23.02	Debug	H	99	315	43.5	-20.48	Pass	
170.538	29.79	12.74	-20	22.57	Debug	H	99	315	43.5	-20.93	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.6.1(a) The Radiated Unwanted Emissions in 30MHz-200MHz for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 157 (5785MHz) Q/16QAM, 161 (5805MHz) 64QAM and 165 (5825MHz) 256QAM, 27dBm Total, New AC power Supply PN-474130A.102, against FCC Part 15.209 and 15.109 Class B Limits at 3m (T15a).



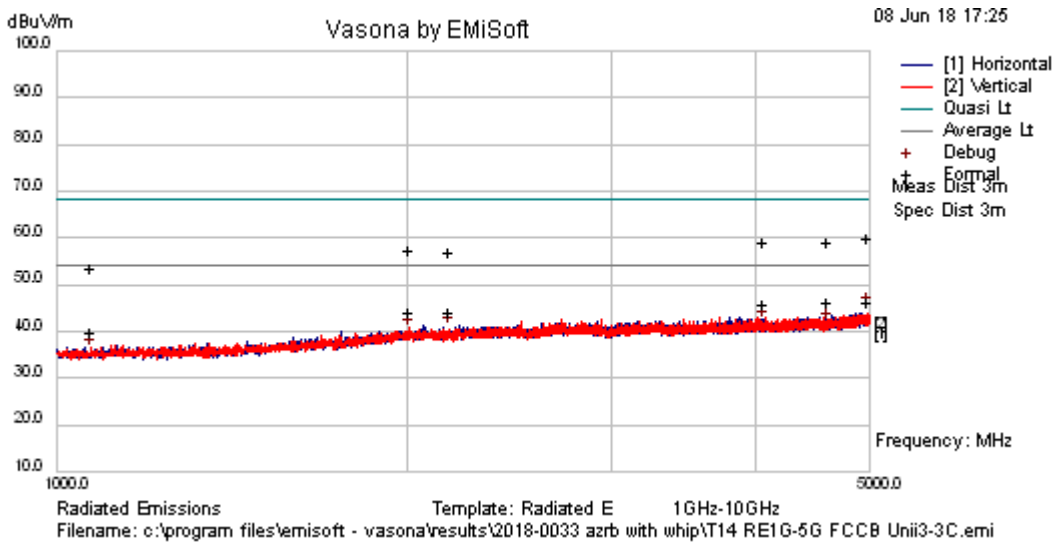
FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
951.332	24.69	8.54	-7.23	26	Quasi Max	H	249	302	46	-20	Pass	
994.649	24.86	8.75	-6.65	26.96	Quasi Max	V	238	318	54	-27.04	Pass	
330.794	28.3	6.95	-17	18.21	Quasi Max	H	147	11	46	-27.79	Pass	
205.732	24.52	6.73	-19.8	11.48	Quasi Max	V	308	49	43.5	-32.02	Pass	
274.397	25.34	6.85	-18.2	13.95	Quasi Max	V	128	227	46	-32.05	Pass	
274.397	23.42	6.85	-18.2	12.03	Quasi Max	H	201	224	46	-33.97	Pass	

PREVIEW DATA

Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
994.649	32.08	8.75	-6.65	34.19	Preview	V	200	0	54	-19.81	Pass	
330.794	36.23	6.95	-17	26.14	Preview	H	100	0	46	-19.86	Pass	
205.732	33.7	6.73	-19.8	20.66	Preview	V	300	45	43.5	-22.84	Pass	
274.397	28.64	6.85	-18.2	17.25	Debug	H	99	315	46	-28.75	Pass	
951.332	29.05	8.54	-7.23	30.36	Debug	H	99	315	46	-15.64	Pass	
274.397	28.64	6.85	-18.2	17.25	Debug	V	99	315	46	-28.75	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

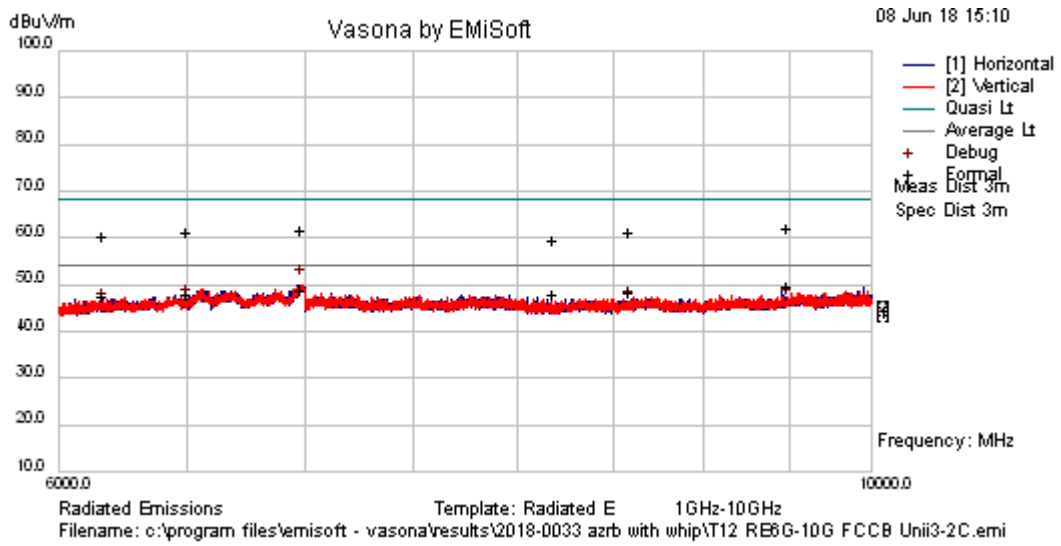
Figure 4.6.1(b) The Radiated Unwanted Emissions in 200MHz-1GHz for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 157 (5785MHz) Q/16QAM, 161 (5805MHz) 64QAM and 165 (5825MHz) 256QAM, 27dBm Total, New AC power Supply PN-474130A.102, against FCC Part 15.209 and 15.109 Class B Limits at 3m Distance (T16a).



FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
4989.05	30.63	16.14	-3.89	42.88	Average	V	178	304	54	-11.12	Pass	
4605.99	31.12	15.88	-4.18	42.82	Average	V	110	339	54	-11.18	Pass	
4056.06	31.29	15.46	-4.55	42.19	Average	H	211	343	54	-11.81	Pass	
4989.05	44.1	16.14	-3.89	56.35	Peak	V	178	304	68.2	-11.85	Pass	
4056.06	44.64	15.46	-4.55	55.54	Peak	H	211	343	68.2	-12.66	Pass	
4605.99	43.82	15.88	-4.18	55.52	Peak	V	110	339	68.2	-12.68	Pass	
2182.73	33.07	14.45	-7.07	40.45	Average	V	324	359	54	-13.55	Pass	NA
2009.11	33.63	14.37	-7.6	40.4	Average	H	387	331	54	-13.6	Pass	NA
2009.11	47.2	14.37	-7.6	53.97	Peak	H	387	331	68.2	-14.23	Pass	
2182.73	46.06	14.45	-7.07	53.44	Peak	V	324	359	68.2	-14.76	Pass	
1068.21	35.22	13.61	-12.4	36.47	Average	H	228	201	54	-17.53	Pass	
1068.21	48.75	13.61	-12.4	50	Peak	H	228	201	68.2	-18.2	Pass	

PREVIEW DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
4989.05	31.73	16.14	-3.89	43.98	Preview	V	200	270	54	-10.02	Pass	
4056.06	30.22	15.46	-4.55	41.13	Debug	H	100	315	54	-12.87	Pass	
4605.99	29.06	15.88	-4.18	40.75	Debug	V	100	315	54	-13.25	Pass	
2182.73	32.53	14.45	-7.07	39.91	Debug	V	100	315	54	-14.09	Pass	
2009.11	32.47	14.37	-7.6	39.24	Debug	H	100	315	54	-14.76	Pass	
1068.21	33.57	13.61	-12.4	34.83	Debug	H	100	315	54	-19.17	Pass	

Figure 4.6.1(c) The Radiated Unwanted Emissions in 1GHz-5GHz Evaluated for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 149 (5745MHz), 153 (5765MHz) and 157 (5785MHz), Q/16QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 3m (Preview 30k RBW Peak, Formal 1MHz RBW Peak & Average, T14).



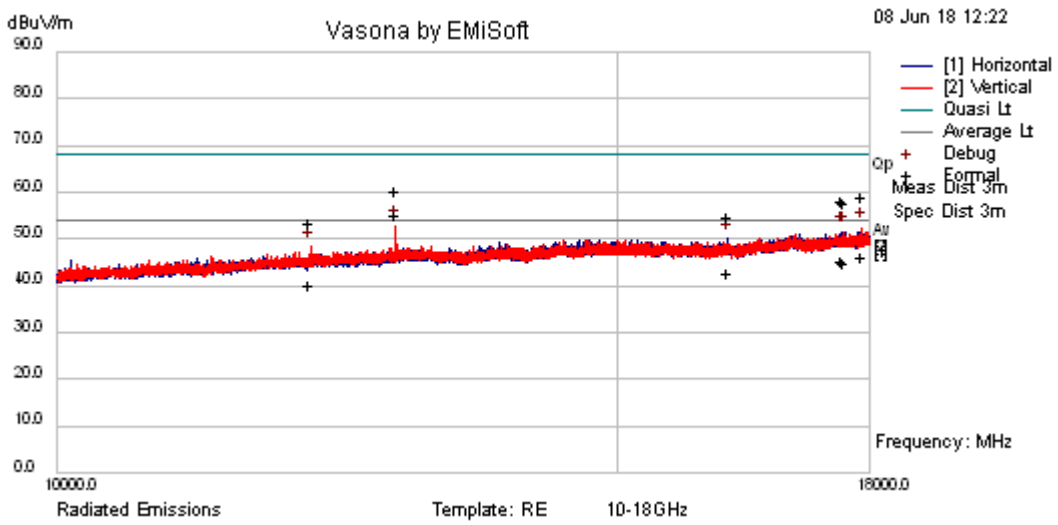
FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
9499.58	30.8	17.74	-2.38	46.16	Average	H	205	203	54	-7.84	Pass	
6991.94	31.28	16.6	-2.61	45.27	Average	V	110	339	54	-8.73	Pass	NA
8598.92	30.37	17.35	-2.74	44.98	Average	V	220	306	54	-9.02	Pass	NA
8187.4	30.01	17.17	-2.76	44.42	Average	H	297	305	54	-9.58	Pass	
6501.02	30.63	16.43	-2.68	44.37	Average	V	293	304	54	-9.63	Pass	NA
9499.58	43.13	17.74	-2.38	58.5	Peak	H	205	203	68.2	-9.7	Pass	
6991.94	44.36	16.6	-2.61	58.35	Peak	V	110	339	68.2	-9.85	Pass	
6166.24	30.47	16.31	-2.96	43.82	Average	H	112	29	54	-10.18	Pass	NA
8598.92	43.27	17.35	-2.74	57.88	Peak	V	220	306	68.2	-10.32	Pass	
6501.02	43.82	16.43	-2.68	57.57	Peak	V	293	304	68.2	-10.63	Pass	
6166.24	43.56	16.31	-2.96	56.91	Peak	H	112	29	68.2	-11.29	Pass	
8187.4	41.77	17.17	-2.76	56.18	Peak	H	297	305	68.2	-12.02	Pass	

PREVIEW DATA

Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
6991.94	36.08	16.6	-2.61	50.06	Preview	V	100	45	54	-3.94	Pass	
9499.58	30.47	17.74	-2.38	45.84	Debug	H	99	315	54	-8.16	Pass	
6166.24	31.74	16.31	-2.96	45.09	Debug	H	99	315	54	-8.91	Pass	
8187.4	30.05	17.17	-2.76	44.46	Debug	H	99	315	54	-9.54	Pass	
8598.92	30.87	17.35	-2.74	45.48	Debug	V	101	315	54	-8.52	Pass	
6501.02	31.92	16.43	-2.68	45.67	Debug	V	101	315	54	-8.33	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.6.1(d) The Radiated Unwanted Emissions in 6GHz-10GHz Evaluated for the EUT with Antenna #6 in UNII-3, Two 20MHz Carriers at Channel 149 (5745MHz) and 153 (5765MHz), Q/16QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 3m (Preview 30k RBW Peak, Formal 1MHz RBW Peak & Average, T12).



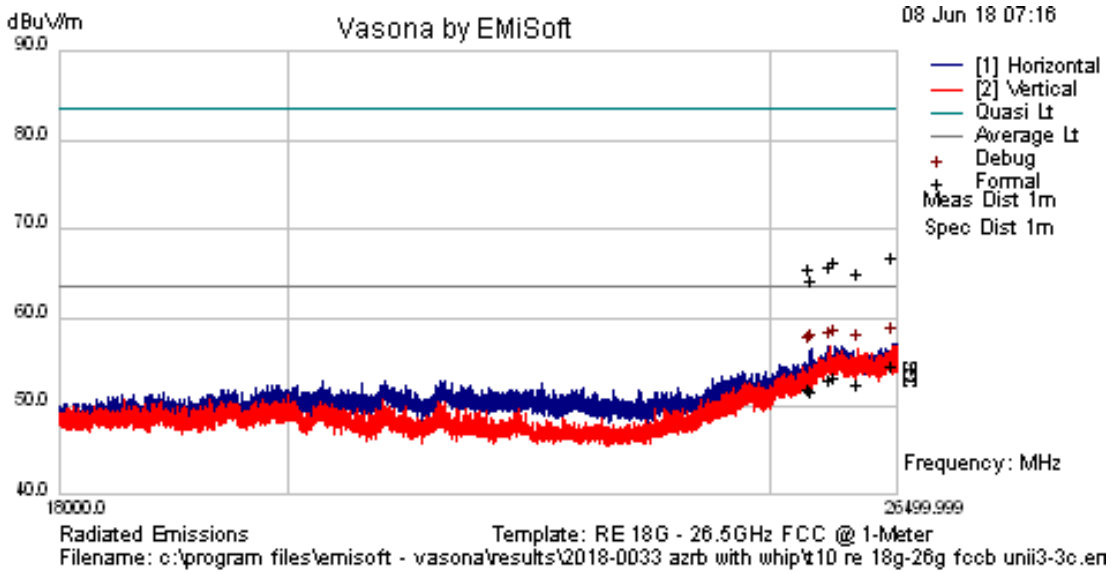
FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
12779.5	41.36	8.39	1.7	51.46	Average	V	113	259	54	-2.54	Pass	NA
17915.4	26.91	11.05	4.62	42.59	Average	V	268	44	54	-11.41	Pass	
12779.5	46.69	8.39	1.7	56.78	Peak	V	113	259	68.2	-11.42	Pass	
17648.9	26.23	10.78	4.51	41.53	Average	H	128	213	54	-12.47	Pass	
17677.7	26.09	10.81	4.53	41.43	Average	V	221	196	54	-12.57	Pass	
17915.4	39.62	11.05	4.62	55.29	Peak	V	268	44	68.2	-12.91	Pass	
17648.9	39.48	10.78	4.51	54.77	Peak	H	128	213	68.2	-13.43	Pass	
17677.7	38.78	10.81	4.53	54.12	Peak	V	221	196	68.2	-14.08	Pass	
16249.5	25.98	10.03	3.2	39.21	Average	H	324	159	54	-14.79	Pass	NA
16249.5	38.03	10.03	3.2	51.26	Peak	H	324	159	68.2	-16.94	Pass	
12009.7	28.41	8.06	0.09	36.56	AvgMax	V	293	319	54	-17.44	Pass	
12009.7	41.91	8.06	0.09	50.05	Peak	V	293	319	68.2	-18.15	Pass	

PREVIEW DATA

Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
12779.7	42.86	8.39	1.7	52.95	Preview	V	100	315	54	-1.05	Pass	
17915.2	36.6	11.05	4.62	52.27	Preview	V	285	180	54	-1.73	Pass	
12009.7	40.12	8.06	0.09	48.27	Debug	V	99	315	54	-5.73	Pass	
17677.7	36.29	10.81	4.53	51.63	Debug	V	99	315	54	-2.37	Pass	
17648.9	36.2	10.78	4.51	51.5	Debug	H	99	315	54	-2.5	Pass	
16249.5	36.64	10.03	3.2	49.87	Debug	H	99	315	54	-4.13	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.6.1(e) The Radiated Unwanted Emissions in 10GHz-18GHz Evaluated for the EUT with Antenna #6 in UNII-3, Two 20MHz Carriers at Channel 149 (5745MHz) and 153 (5765MHz), Q/16QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 3m (Preview 100k RBW Peak, Formal 1MHz RBW Peak & Average, T11).



(Note: Green limit line should be at 78dBµV/m.)

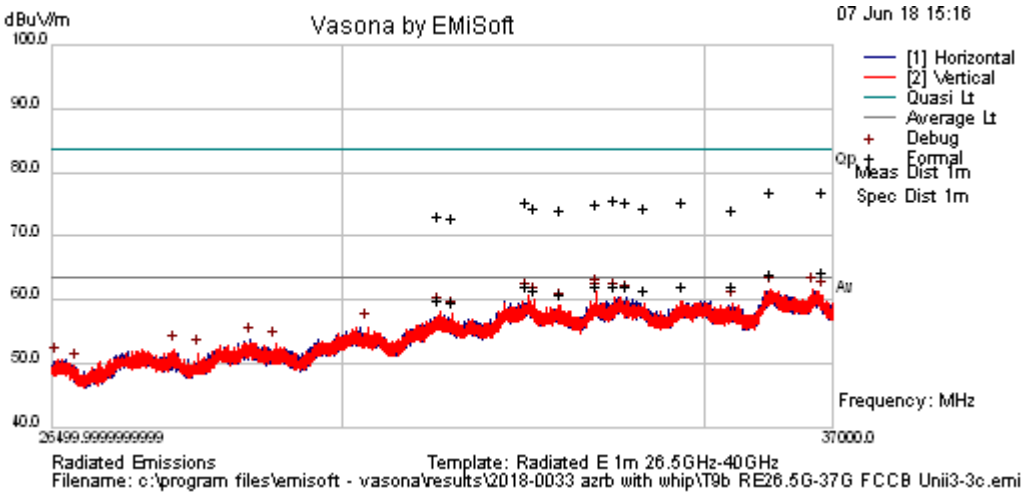
FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
26430.2	29.2	11.35	12.16	52.7	Average	H	129	28	63.5	-10.8	Pass	NA
25757.8	29.64	11.11	10.74	51.49	Average	H	127	137	63.5	-12.01	Pass	NA
25699.9	29.44	11.09	10.69	51.22	Average	V	106	142	63.5	-12.28	Pass	NA
26021.4	28.35	11.2	11.02	50.58	Average	V	158	341	63.5	-12.92	Pass	NA
25444.4	28.78	11	10.45	50.23	Average	H	223	253	63.5	-13.27	Pass	NA
25479.7	28.46	11.01	10.48	49.96	Average	H	125	146	63.5	-13.54	Pass	NA
26430.2	41.51	11.35	12.16	65.01	Peak	H	129	28	78.2	-13.19	Pass	
25757.8	42.72	11.11	10.74	64.57	Peak	H	127	137	78.2	-13.63	Pass	
25699.9	42.18	11.09	10.69	63.95	Peak	V	106	142	78.2	-14.25	Pass	
25444.4	42.18	11	10.45	63.62	Peak	H	223	253	78.2	-14.58	Pass	
26021.4	40.98	11.2	11.02	63.2	Peak	V	158	341	78.2	-15.0	Pass	
25479.7	40.84	11.01	10.48	62.34	Peak	H	125	146	78.2	-15.86	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
26434.1	33.55	11.35	12.17	57.07	Preview	H	150	264	63.5	-6.43	Pass	
25699.9	34.75	11.09	10.69	56.53	Debug	V	99	352	63.5	-6.97	Pass	
26021.4	34.04	11.2	11.02	56.26	Debug	V	99	352	63.5	-7.24	Pass	
25444.4	34.58	11	10.45	56.03	Debug	H	99	352	63.5	-7.47	Pass	
25479.7	34.85	11.01	10.48	56.35	Debug	H	99	352	63.5	-7.15	Pass	
25757.8	34.99	11.11	10.74	56.84	Debug	H	99	352	63.5	-6.66	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.6.1(f) The Radiated Unwanted Emissions in 18GHz-26.5GHz Evaluated for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 157 (5785MHz) Q/16QAM, 161 (5805MHz) 64QAM and 165 (5825MHz) 256QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 1m (Preview 100k RBW Peak, Formal 1MHz RBW Peak & Average, T10).



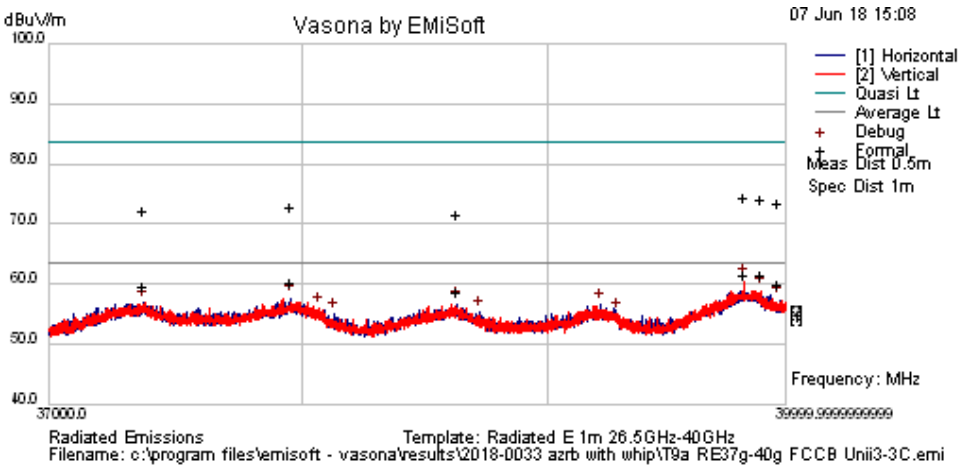
(Note: Green limit line should be at 78dBµV/m.)

FORMAL DATA												
Freq. (MHz)	**Raw (dBuV)**	**Cable (dB)**	**Factor (dB)**	**Level (dBuV/m)**	**Emission Type**	**Pol (H/V)**	**Ht (cm)**	**Az (deg)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass /Fail**	**Comments**
36826.2	33.53	0	28.54	62.07	Average	V	173	0	63.5	-1.43	Pass	NA
36022.5	34.29	0	27.39	61.68	Average	H	226	0	63.5	-1.82	Pass	NA
33700.1	35.7	0	24.29	60	Average	V	157	0	63.5	-3.5	Pass	NA
33437.8	35.85	0	24.15	60	Average	H	127	0	63.5	-3.5	Pass	NA
35436.2	33.98	0	26.01	59.99	Average	V	176	0	63.5	-3.51	Pass	NA
33431.8	35.82	0	24.15	59.97	Average	V	143	0	63.5	-3.53	Pass	NA
34686.1	34.99	0	24.94	59.93	Average	V	225	0	63.5	-3.57	Pass	NA
33872.8	35.49	0	24.42	59.91	Average	H	135	0	63.5	-3.59	Pass	NA
32462.6	35.82	0	24	59.83	Average	V	241	0	63.5	-3.67	Pass	NA
32567.3	35.34	0	24.03	59.37	Average	V	238	0	63.5	-4.13	Pass	NA
34139.4	34.7	0	24.57	59.27	Average	V	212	0	63.5	-4.23	Pass	NA
32934.9	34.43	0	24.14	58.57	Average	V	111	0	63.5	-4.93	Pass	NA
31268.4	34.48	0	23.09	57.58	Average	V	147	0	63.5	-5.92	Pass	
31442.2	34.29	0	23.2	57.49	Average	V	195	0	63.5	-6.01	Pass	
36022.5	47.45	0	27.39	74.84	Peak	H	226	0	83.5	-8.66	Pass	
36826.2	46.05	0	28.54	74.6	Peak	V	173	0	83.5	-8.9	Pass	
33700.1	49.26	0	24.29	73.56	Peak	V	157	0	83.5	-9.94	Pass	
33872.8	48.88	0	24.42	73.3	Peak	H	135	0	83.5	-10.2	Pass	
32462.6	49.26	0	24	73.27	Peak	V	241	0	83.5	-10.23	Pass	
34686.1	48.1	0	24.94	73.04	Peak	V	225	0	83.5	-10.46	Pass	
33431.8	48.75	0	24.15	72.9	Peak	V	143	0	83.5	-10.6	Pass	
33437.8	48.62	0	24.15	72.77	Peak	H	127	0	83.5	-10.73	Pass	
34139.4	47.58	0	24.57	72.15	Peak	V	212	0	83.5	-11.35	Pass	
32567.3	48.1	0	24.03	72.13	Peak	V	238	0	83.5	-11.37	Pass	
32934.9	47.84	0	24.14	71.98	Peak	V	111	0	83.5	-11.52	Pass	
35436.2	45.92	0	26.01	71.93	Peak	V	176	0	83.5	-11.57	Pass	
31268.4	47.84	0	23.09	70.93	Peak	V	147	0	83.5	-12.57	Pass	
31442.2	47.33	0	23.2	70.53	Peak	V	195	0	83.5	-12.97	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
36680.2	33.19	0	28.39	61.57	Preview	V	125	0	63.5	-1.93	Pass	
36021.9	34.16	0	27.39	61.54	Preview	H	200	220	63.5	-1.96	Pass	
33432.3	37.02	0	24.15	61.18	Preview	V	250	66	63.5	-2.32	Pass	
36822.5	32.22	0	28.54	60.76	Preview	V	225	110	63.5	-2.74	Pass	
33446.7	36.57	0	24.15	60.72	Preview	H	250	22	63.5	-2.78	Pass	
32463.7	36.53	0	24	60.53	Preview	V	150	132	63.5	-2.97	Pass	
33700.7	36.2	0	24.3	60.5	Preview	V	150	66	63.5	-3	Pass	
33878.3	35.88	0	24.42	60.3	Preview	H	225	308	63.5	-3.2	Pass	
32569.8	35.9	0	24.03	59.93	Preview	V	125	22	63.5	-3.57	Pass	
34690.1	34.91	0	24.95	59.85	Preview	V	150	176	63.5	-3.65	Pass	
34140.4	34.84	0	24.57	59.41	Preview	V	250	220	63.5	-4.09	Pass	
35437.6	33.31	0	26.01	59.32	Preview	V	150	132	63.5	-4.18	Pass	
32935.5	34.95	0	24.14	59.09	Preview	V	100	110	63.5	-4.41	Pass	
31267	35.16	0	23.09	58.25	Preview	V	125	44	63.5	-5.25	Pass	
31438.2	34.51	0	23.2	57.71	Preview	V	100	242	63.5	-5.79	Pass	
30318.5	32.89	0	22.88	55.77	Preview	V	100	220	63.5	-7.73	Pass	
28844.5	32.34	0	21.41	53.75	Preview	H	200	242	63.5	-9.75	Pass	
29150.7	31.4	0	21.74	53.14	Preview	V	250	22	63.5	-10.36	Pass	
27908.9	31.95	0	20.3	52.25	Preview	V	125	198	63.5	-11.25	Pass	
28208.7	30.97	0	20.63	51.61	Preview	V	150	154	63.5	-11.89	Pass	
26555.7	31.57	0	19.08	50.65	Preview	V	175	286	63.5	-12.85	Pass	
26773.7	30.11	0	19.33	49.44	Preview	H	200	0	63.5	-14.06	Pass	

Figure 4.6.1(g) The Radiated Unwanted Emissions in 26.5GHz-37GHz Evaluated for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 157 (5785MHz) Q/16QAM, 161 (5805MHz) 64QAM and 165 (5825MHz) 256QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 1m (Preview 30k RBW Peak, Formal 1MHz RBW Peak & Average, T9b).



(Note: Green limit line should be at 78dBµV/m.)

FORMAL DATA												
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
39823.7	37.26	0	22.03	59.29	Average	V	192	-3	63.5	-4.21	Pass	
39893.6	36.96	0	22.19	59.15	Average	V	200	0	63.5	-4.35	Pass	
37955.7	36.03	0	22.1	58.13	Average	H	189	0	63.5	-5.37	Pass	
39968.7	35.39	0	22.37	57.76	Average	H	169	0	63.5	-5.74	Pass	
37371.4	35.09	0	22.44	57.53	Average	H	151	0	63.5	-5.97	Pass	NA
38632.5	34.86	0	21.47	56.32	Average	H	252	0	63.5	-7.18	Pass	
39823.7	50.16	0	22.03	72.19	Peak	V	192	-3	78	-5.81	Pass	
39893.6	49.65	0	22.19	71.84	Peak	V	200	0	78	-6.16	Pass	
39968.7	48.75	0	22.37	71.11	Peak	H	169	0	78	-6.89	Pass	
37955.7	48.49	0	22.1	70.59	Peak	H	189	0	78	-7.41	Pass	
37371.4	47.71	0	22.44	70.15	Peak	H	151	0	78	-7.85	Pass	
38632.5	47.84	0	21.47	69.31	Peak	H	252	0	78	-8.69	Pass	

PREVIEW DATA

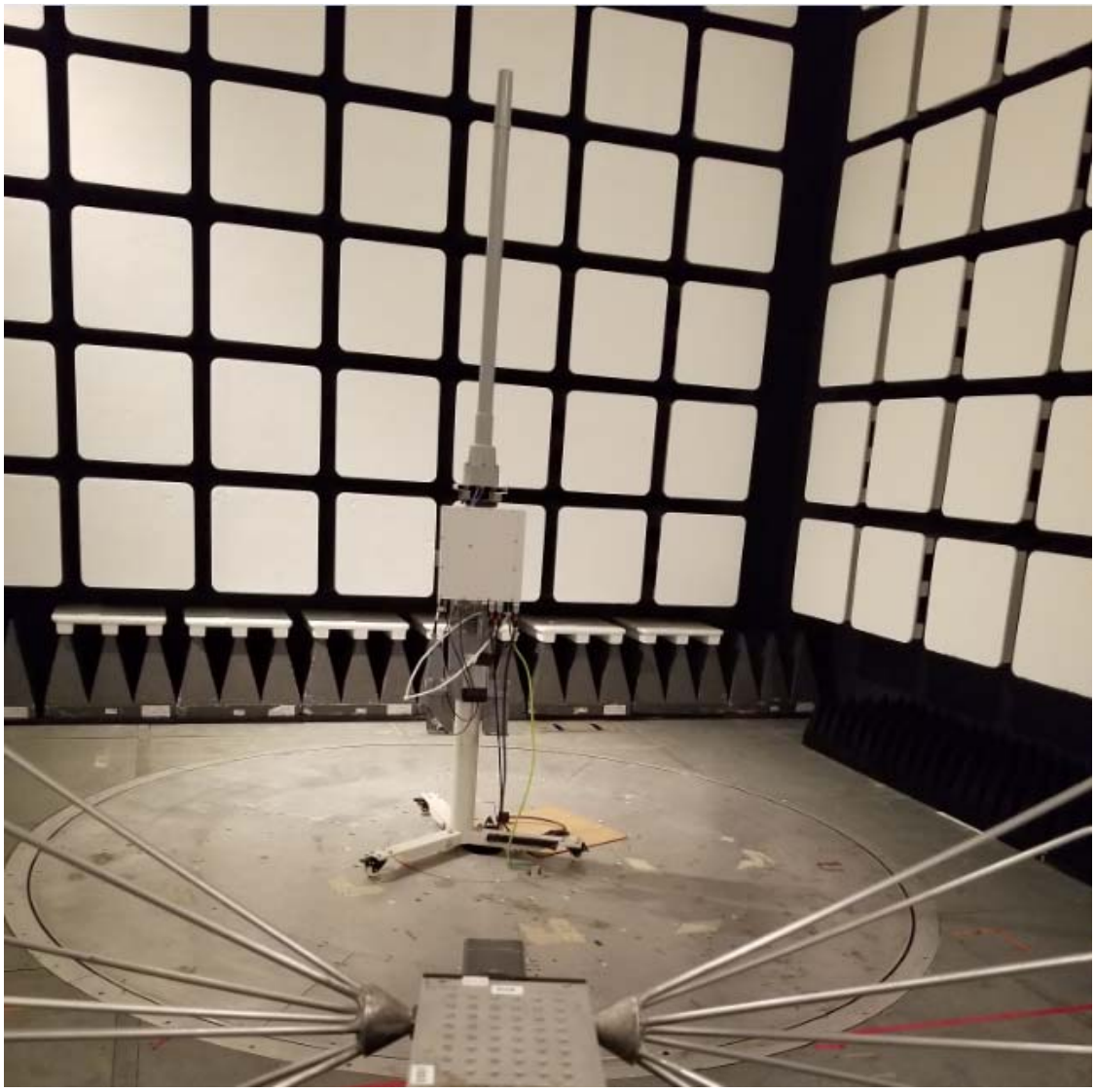
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
39823.7	38.43	0	22.03	60.46	Preview	V	250	352	63.5	-3.04	Pass	
39893.6	36.68	0	22.19	58.87	Preview	V	100	352	63.5	-4.63	Pass	
37955.7	35.48	0	22.1	57.59	Preview	H	250	0	63.5	-5.91	Pass	
39968.7	34.94	0	22.37	57.3	Preview	H	125	264	63.5	-6.2	Pass	
37371.4	34.5	0	22.44	56.94	Preview	H	225	286	63.5	-6.56	Pass	
38632.5	35.21	0	21.47	56.68	Preview	H	125	44	63.5	-6.82	Pass	
39224.1	35.39	0	21.21	56.6	Preview	H	150	330	63.5	-6.9	Pass	
38072.3	33.97	0	22.01	55.98	Preview	V	100	308	63.5	-7.52	Pass	
38720.9	33.97	0	21.39	55.37	Preview	H	200	110	63.5	-8.13	Pass	
39294.8	33.7	0	21.22	54.93	Preview	V	150	308	63.5	-8.57	Pass	
38131	32.96	0	21.95	54.91	Preview	H	125	242	63.5	-8.59	Pass	

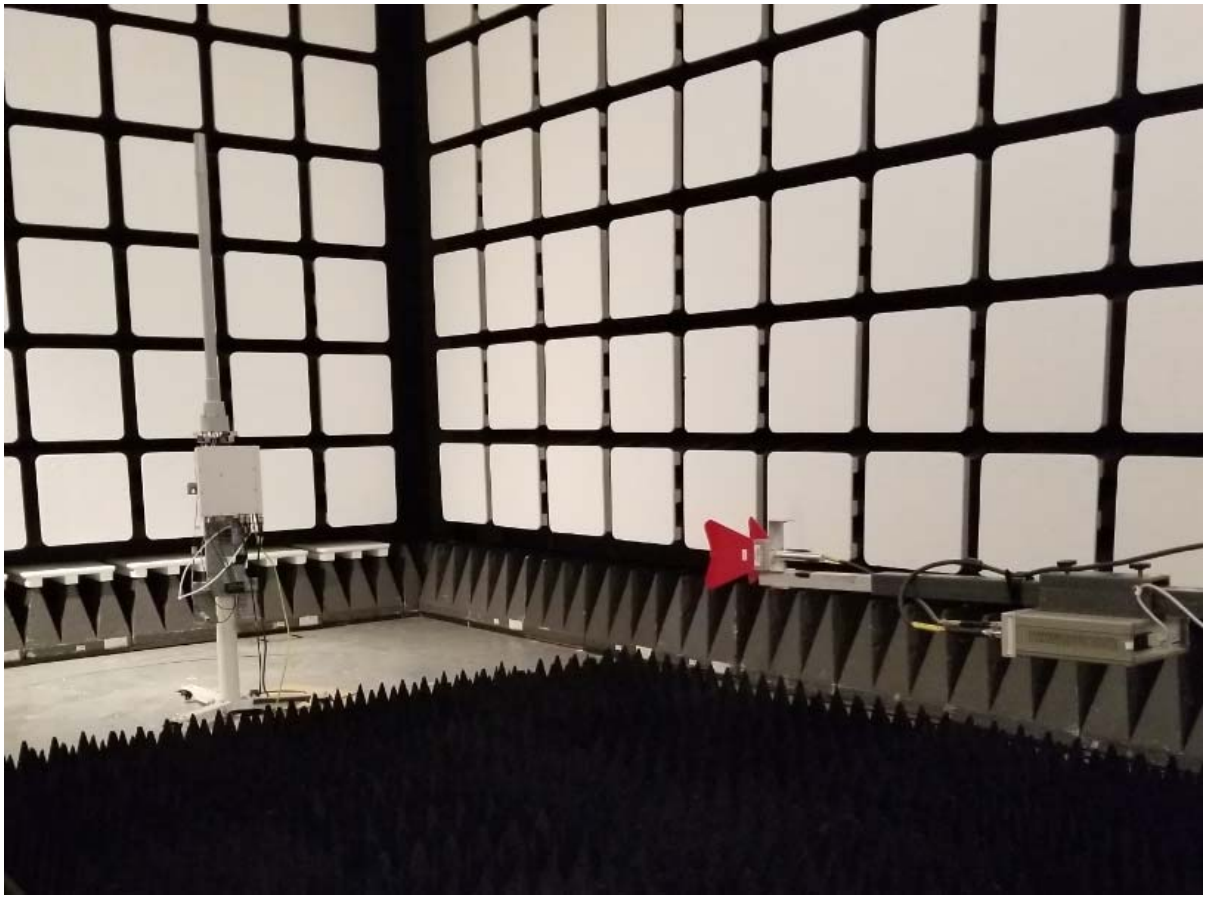
Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Figure 4.6.1(h) The Radiated Unwanted Emissions in 37GHz-40GHz Evaluated for the EUT with Antenna #6 in UNII-3, Three 20MHz Carriers at Channel 157 (5785MHz) Q/16QAM, 161 (5805MHz) 64QAM and 165 (5825MHz) 256QAM, 27dBm Total, against FCC Part 15.407 and 15.209 Limits at 1m (Preview 30k RBW Peak, Formal 1MHz RBW Peak & Average, T9a).

5. PHOTOGRAPHS OF EUT SETUP

The setup photos of the radiated emissions tests were provided below.





6. LIST OF TEST EQUIPMENT

Table 6.1 List of Test Equipment Used

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due
Ridged Horn Ant 26.5 GHz - 40 GHz	A.H. Systems	SAS-200/573	137	2017-10-04	2019-10-04
Double Ridged Horn Antenna 18-40 GHz	EMC Test Systems	3116	2539	2017-06-16	2019-06-16
Multi-Device Controller	EMC Test Systems	2090	0004-1507	NA	NA
Biconical Antenna	EMCO	3109	2187	2016-12-01	2018-12-01
Log Periodic Ant	EMCO	3146	2082	2017-05-24	2019-05-24
Double-Ridged Waveguide Horn 1-18 GHz	ETS Lindgren	3117	00135198	2017-06-09	2019-06-09
Pre-Amplifier 1-26.5 GHz	Hewlett Packard	8449B	3008A01270	2018-01-17	2019-01-17
Test Receiver EMI 20Hz to 40 GHz	Rohde & Schwarz	ESIB40	100119	2017-11-06	2019-11-06
Amplifier 9kHz-1GHz	Sonoma Instrument	310N	185785	2018-01-09	2020-01-09
Attenuator 6dB	Weinschel	2/6	CD2545	2017-03-03	2019-03-03

7. TEST FACILITIES

All measurement facilities used to collect the measurement data under normal condition are located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA. The field strength measurements of radiated spurious emissions are made in a FCC and IC registered semi-anechoic chamber AR9 (FCC Site Registration Number: 896745, IC Filing Number: 6933F-9). The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 32.

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

United States Department of Commerce
National Institute of Standards and Technology

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Murray Hill, NJ

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This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2017-08-17 through 2018-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

8. REFERENCES

[1]. Title 47 Code of Federal Regulations (CFR) Parts 2 and 15.

[2]. ANSI C63.10, American Nation Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, 2013.

[3]. FCC KDB 789033 D02, Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E), December 2017, v02r01.

[4]. FCC KDB 662911D01, Emissions Testing of Transmitters with Multiple Outputs in the Same Band, October 2013, v02r01.

[5]. FCC KDB 353028 D01, Basic Equipment Authorization Guidance for Antennas Used with Part 15 Intentional Radiators, April 2017, v01.