Project #: 22765-15

Company: American Innovations

EUT: RM5 I/O4

Wireless Test Report

FCC and IC

Prepared for:

American Innovations
12211 Technology Blvd.
Austin, TX 78727

By

Nemko PTI, Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

March 14, 2022

Written by

Shakil Murad
Wireless Engineer

Revision History

Revision Number	Description	Date
Draft01	Initial release for review	3/14/2022
Draft02	Updated EUT name	3/14/2022
Draft03	Included Receiver Spurious Emissions data	7/29/2022
Final	Final Report	7/29/2022

Table of Contents

Compliance Certificate

FCC MRA Designation Number: US5270 NVLAP Accreditation Number: 200062-0

Applicant	Device & Test Identification
American Innovations 12211 Technology Blvd. Austin, TX 78727	Model: RM5 I/O4 FCC ID: DJU-6267210001 IC ID: 2466B-6267210001

The device named above was tested utilizing the following standards and found to be in compliance with the required criteria:

Requirement	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 5 Amd 1	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document.
**Corresponding RSS references are listed in the body of the report.

I, Shakil Murad, for Nemko PTI, Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

NVLAP TESTING
NVLAP LAB CODE 200062-0

Shakil Murad
Wireless Engineer

This report has been reviewed and accepted by the Applicant**.** The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

Representative of Applicant

Test Result Summary

Test	FCC Part 15 Rule Paragraphs	IC RSS References	Test Results
Antenna Requirement	15.203	RSS-Gen 8.3	Pass
Fundamental Power	15.247 (a)(3)	RSS-247 5.4 (d)	Pass
Power Spectral Density	15.247 (e)	RSS-247 5.2 (b)	Pass
Occupied Bandwidth	15.247 (a)(2), 2.1049	RSS-247 5.2 (a)	Pass
Band Edge	15.247 (d);15.205 (a)	RSS-247 5.5; RSS-Gen 4.9	Pass
Conducted Spurious Emissions	15.247 (d); 15.209 (a)	RSS-247 5.5	Pass
Transmitter Radiated Spurious Emissions	15.247 (d), 15.209 (a)	RSS-247 5.5; RSS-Gen 6.13 & 8.10	Pass
Receiver Radiated Spurious Emissions	15.109	RSS-Gen 7.3	Pass

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Nemko PTI, Inc., follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

Equipment Under Test		
EUT Name:	**MokingBird**	
Model:	**RM5 I/O4**	
Serial Number:	**None**	
Model Variance:	**None**	
Description:	**Operating Frequency**	2402 – 2480 MHz
	Modulation Type	FSK2
	Chip Rate	250 kbps
Input Power:	12 Volts DC.	

Note: EUT is powered by DC source only.

1.3 EUT Test Configuration

The EUT was exercised in a manner consistent with normal operations. The EUT is powered by +12 VDC via an external DC power supply.

1.4 Modifications to Equipment

The PCB mounted chip antenna was removed, and a small coaxial cable was soldered in its place to facilitate conducted RF measurements.

1.5 Test Site

Measurements were made at the Nemko PTI semi-anechoic facility designated Site 45 (FCC 776781, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665. CAB Identifier: US 0123.

1.6 Measurement Corrections

Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as 1/d above 30 MHz) are applied and documented where used.

1.7 Applicable Documents

Table 1.7.1: Applicable Documents

Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10 2015	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.0 Fundamental Power

2.1 Test Procedure

The radio was connected directly to the spectrum analyzer for measurement. Low, mid, and high channel output power was measured. Testing was performed on 12/9/2021.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Conducted Power Limit
15.247(a)(3) // RSS-247 5.2	1 W peak (+30dBm) Limit Restated as Field: 125.23 dBµV/m @ 3 m

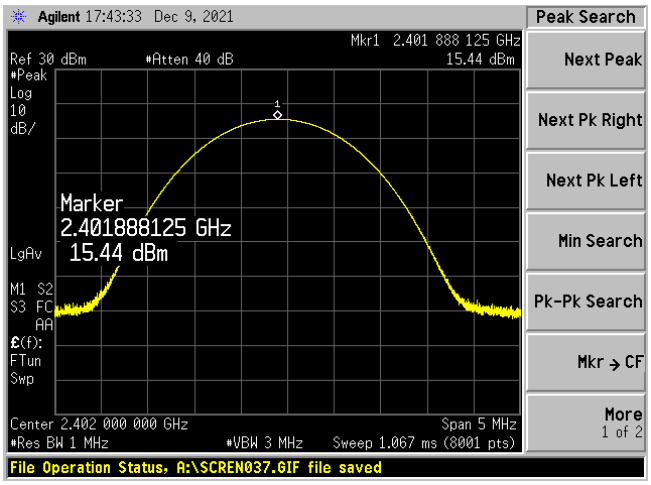
2.3 Test Results, Peak Power

Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
EUT (6 dB) Bandwidth:	0.92	MHz							
Measurement Parameters:	RBW	1	MHz	VBW	3	MHz	Span	5	MHz

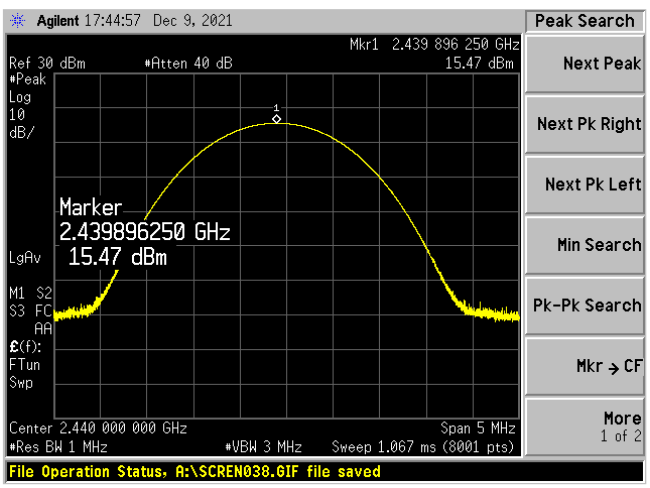
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)	Corrected Power (dBm)	Limit (dBm)	Test Result
2	2402	15.44	0	15.44	30	Pass
40	2440	15.47	0	15.47	30	Pass
80	2480	15.38	0	15.38	30	Pass

The requirements were satisfied.

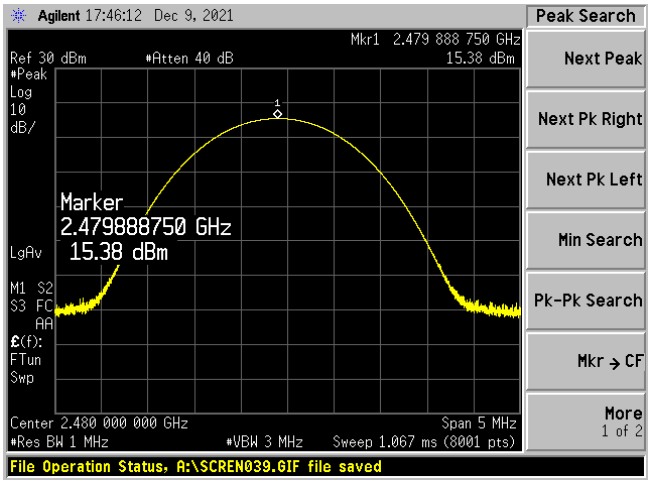
Peak output power test plots:



Low Channel



Mid Channel



High Channel

3.0 Occupied Bandwidth

3.1 Test Procedure

Bandwidth is measured and recorded. The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application. Testing was performed on 12/9/2021.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Bandwidth
15.247(a)(2), 2.1049 // RSS-247, RSS-Gen 4.6	6 dB 500 kHz minimum 99% (all methods)

In cases where the software function fails to find/mark the correct edge of the modulated envelope, a manual measurement (marker-delta over display line) is taken with the same spectrum analyzer settings.

3.3 Test Results, Occupied Bandwidth

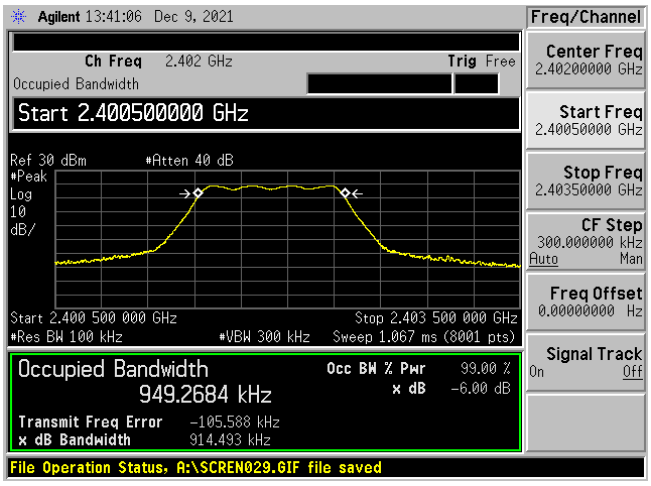
Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
Measurement Parameters:	RBW	100	kHz	VBW	300	kHz	Span	3	MHz	Detector	Peak
Measurement Bandwidth:		- 6	dB								

Channel	Frequency (MHz)	Measured Bandwidth (kHz)	Reported Maximum Bandwidth (kHz)
2	2402	914.493	918.503
40	2440	918.503	
80	2480	913.72	

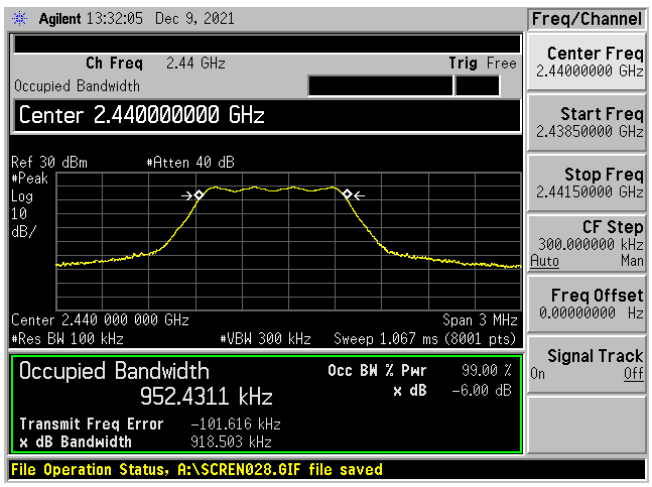
Recorded 99% maximum Bandwidth is 952.4311 kHz

The EUT met the requirements. Test plots are presented on the following page.

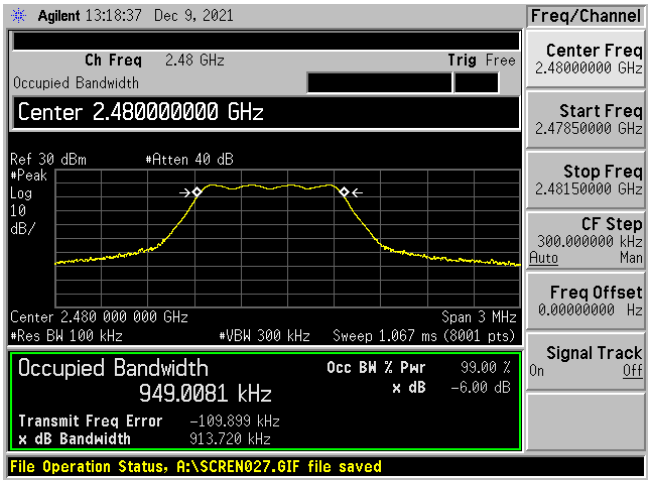
Occupied Bandwidth data plots, Recorded: 6 dB, 99% BW



Low Channel



Mid Channel



High Channel

4.0 Power Spectral Density

4.1 Test Procedure

The radio was connected directly to the spectrum analyzer for measurement. Low, mid, and high channel was measured. Testing was performed on 12/9/2021.

4.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Power Spectral Density, Conducted Limit
15.247(e) // RSS-247, 5.2	8 dBm / 3 kHz Restated as field strength: 103.23 dBµV/m at 3 m

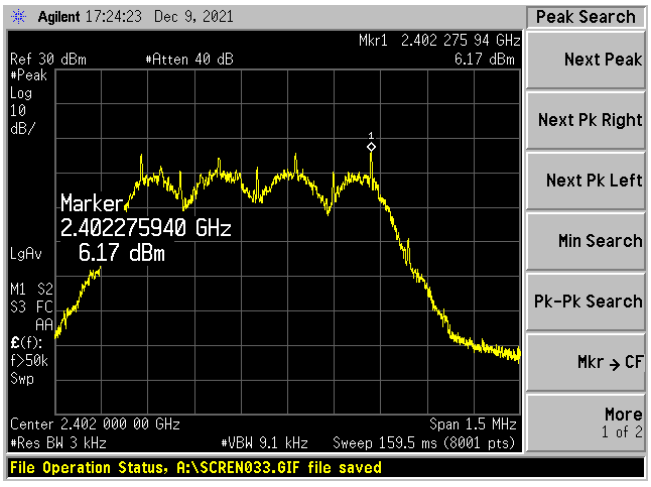
4.3 Test Results, Power Spectral Density

Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
EUT Channel Bandwidth:	0.92	MHz							
Measurement Parameters:	RBW	3	kHz	VBW	9	kHz	Span	1.5	MHz	Detector	Peak

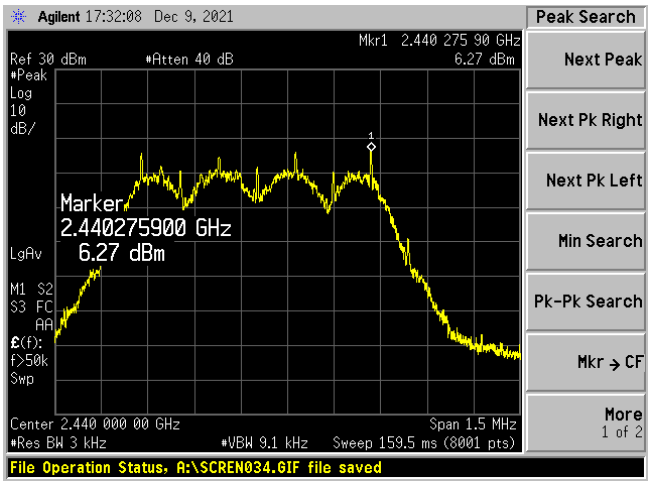
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)	Corrected Power (dBm)	Limit (dBm)	Test Result
2	2402	6.17	0	6.17	8	Pass
40		6.27	0	6.27	8	Pass
80	2440	6.22	0	6.22	8	Pass

The requirements were satisfied. Test plots are presented on the following page.

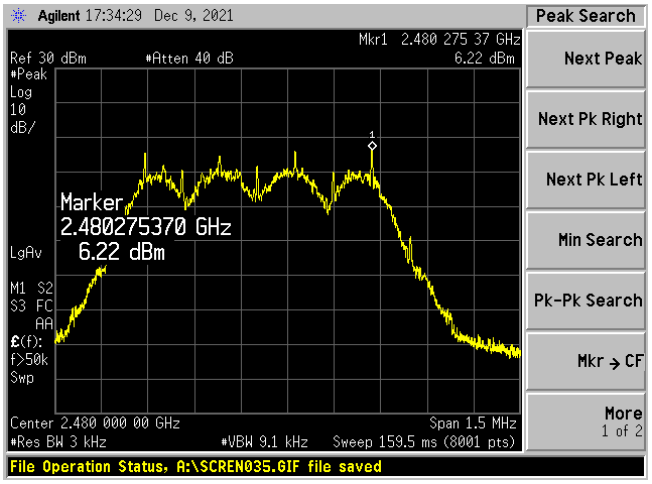
Power Spectral Density test plots:



Low Channel



Mid Channel



High Channel

5.0 Band Edge

5.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is approximately centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method is utilized. The radio was connected directly to the spectrum analyzer for measurement. Testing was performed on 12/20/2021.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Unwanted Emissions
15.247, 15.205 // RSS-247 5.5; RSS-Gen 4.9	Emissions Adjacent to Authorized Band

5.3 Test Results

Measurements included fundamental and more than 2 standard bandwidths (standard bandwidth 1 MHz) beyond the band edges to provide a clear view of the fundamental and the declining emission levels. Beyond this point, the general emission limits are applied in the radiated emission tests reported elsewhere in the report.

This is a conducted measurement with limits derived from the general emission field strength limits. The far field path loss equation is utilized to convert the field strength limits to EIRP limits in dBm as follows:

Given EIRP = $E_{dB\mu V/m} + 20Log_{10}(d) - 104.8$

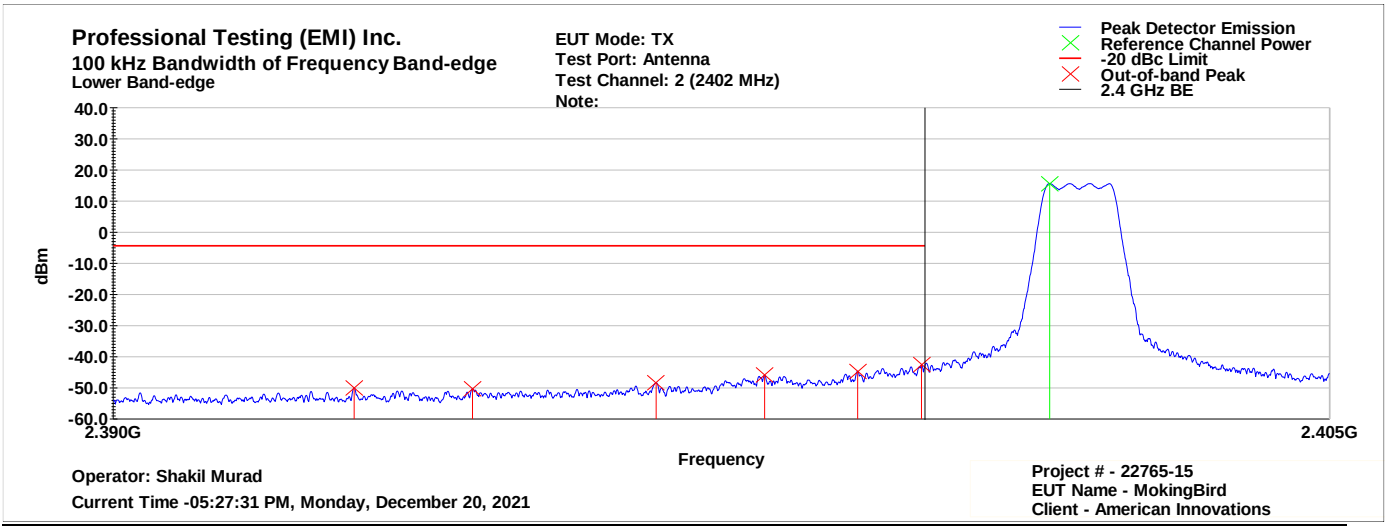
EIRP = 54 dBµV/m + $20Log_{10}$(3 m) – 104.8 dB = -41.25 dBm (commonly -41 dBm is applied)

Emissions below band were measured with peak detection in 100 kHz RBW.

Emissions above band measured with peak detection and 1 Hz video average in 1 MHz RBW if the peak emission exceeds the average limit.

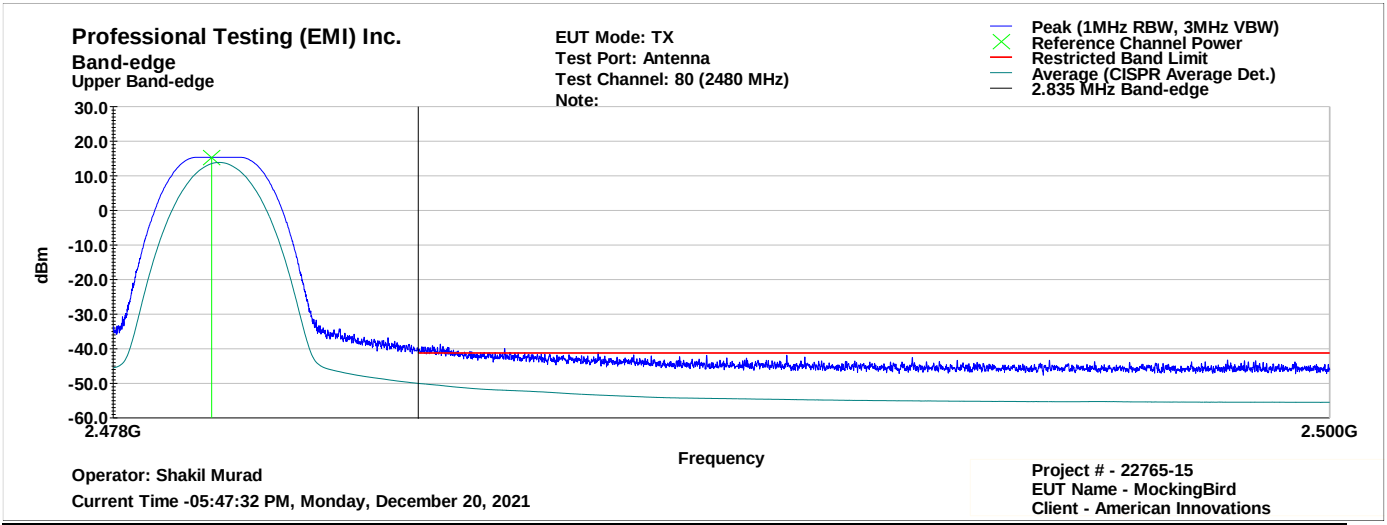
The requirement was satisfied. Test plots and tabular data are presented on the following page.

Lower Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2392.964	-50.022	-4.363	-45.659	PASS
2394.421	-50.255	-4.363	-45.892	PASS
2396.684	-48.351	-4.363	-43.988	PASS
2398.021	-45.952	-4.363	-41.589	PASS
2399.169	-44.676	-4.363	-40.313	PASS
2399.956	-42.625	-4.363	-38.262	PASS

Upper Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2483.500	-50.035	-41.250	-8.785	PASS

6.0 Conducted Antenna Port Spurious Emissions, Transmit Mode

6.1 Test Procedure

Conducted antenna port emissions are measured with the EUT transmitting on the required frequencies. Testing was performed on 12/21/2021.

Table 6.1.1: Test Parameters

30 MHz to 1 GHz	1 GHz to 18 GHz	18 GHz to 25 GHz
120kHz RBW / 300kHz VBW	1MHz RBW / 3MHz VBW	1MHz RBW / 3MHz VBW
Quasi-peak	Peak & Average	Peak & Average

6.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Unwanted Emissions
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Antenna Port Conducted Spurious/Harmonic Emissions Transmit Mode

6.3 Test Results

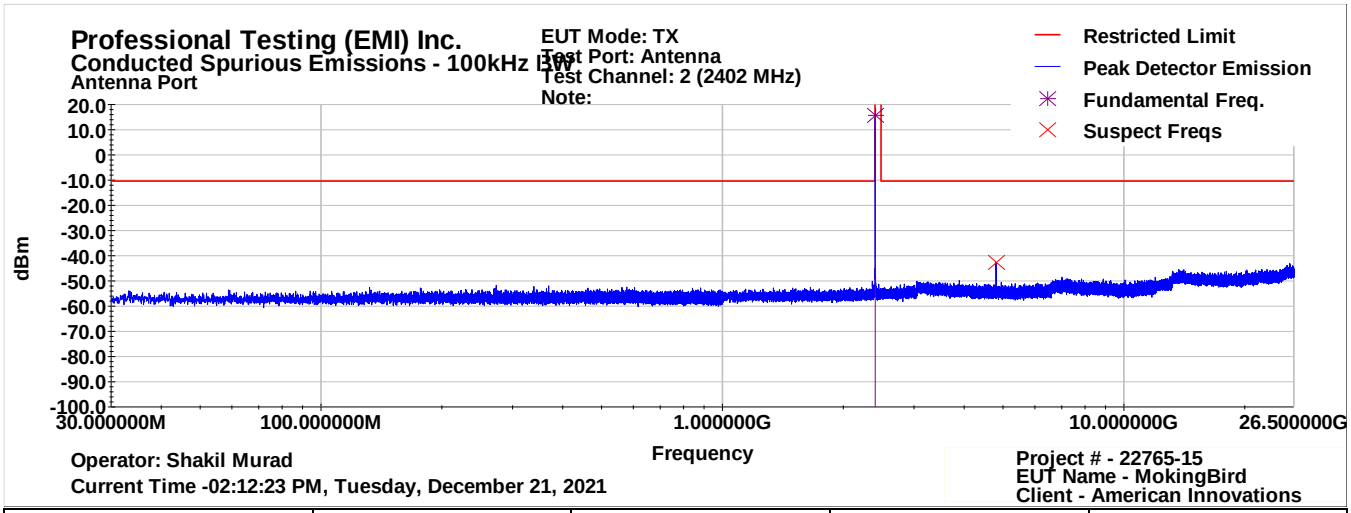
Three channels were tested. EUT was transmitting continuously and unmodulated.

The top, middle and bottom channels were tested. 15.209 limits were applied to entire band for worst-case limits.

The EUT satisfied the requirements. Test plots and tabular data are presented on the following page.

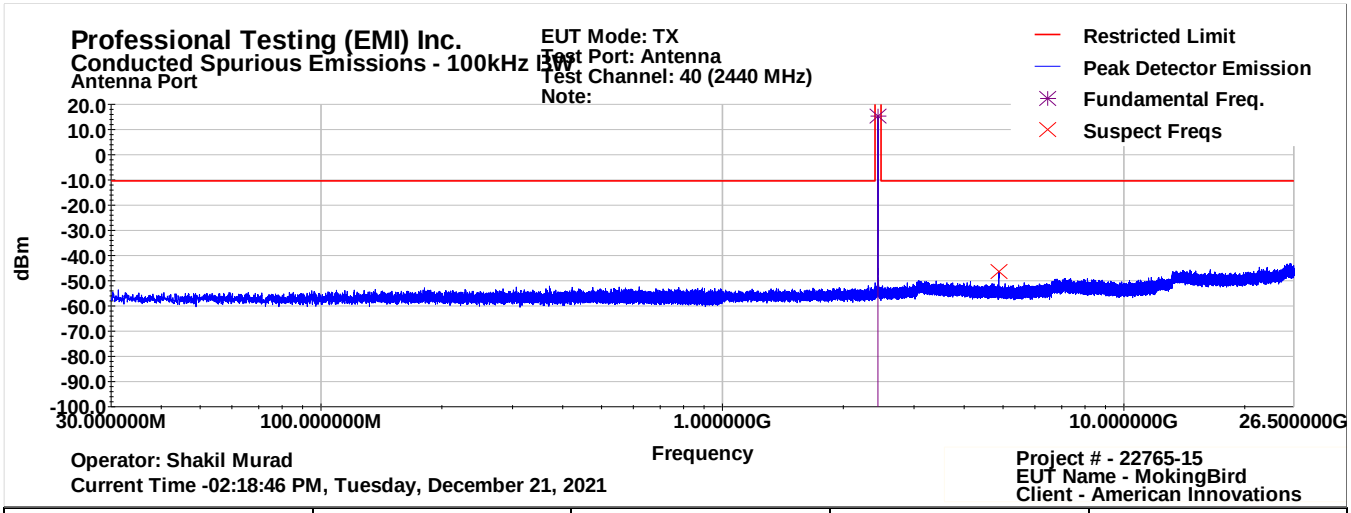
6.3.1 100 kHz Bandwidth Test data

Bottom Channel: 100 kHz Bandwidth



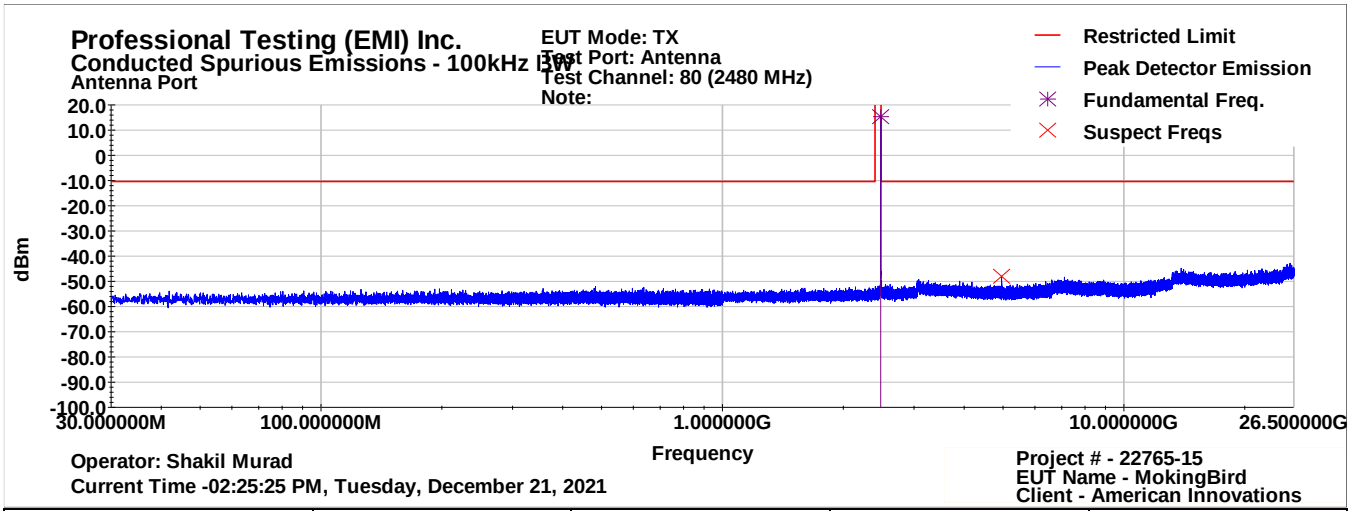
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4804.625	-42.675	-10.390	32.285	PASS

Middle Channel: 100 kHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4879.700	-46.410	-10.390	36.020	PASS

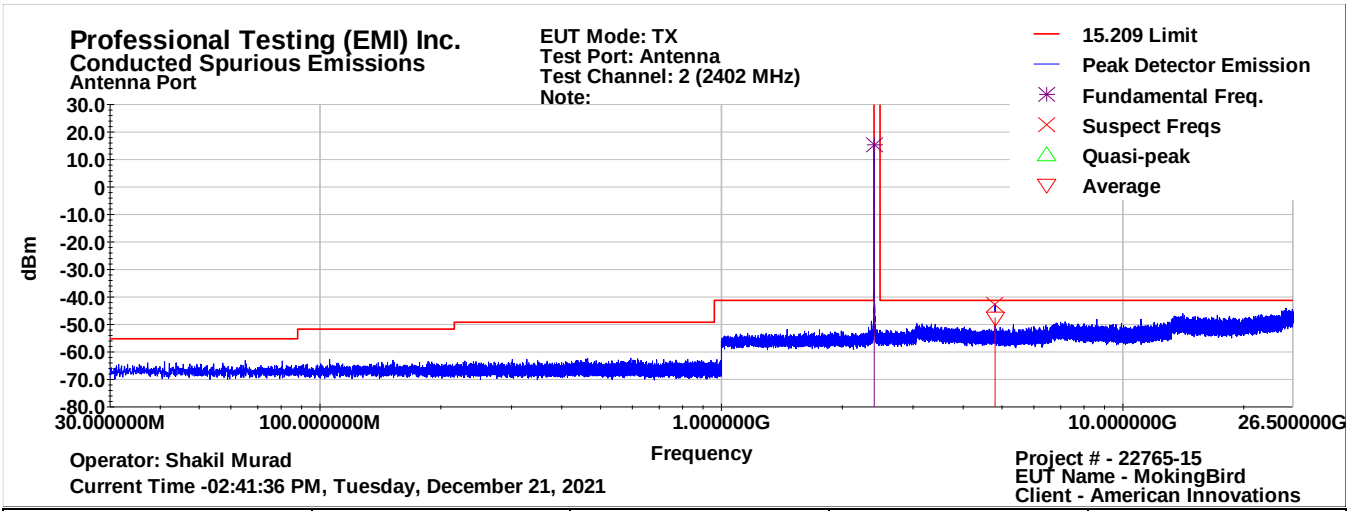
Top Channel: 100 kHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4959.175	-48.078	-10.390	37.688	PASS

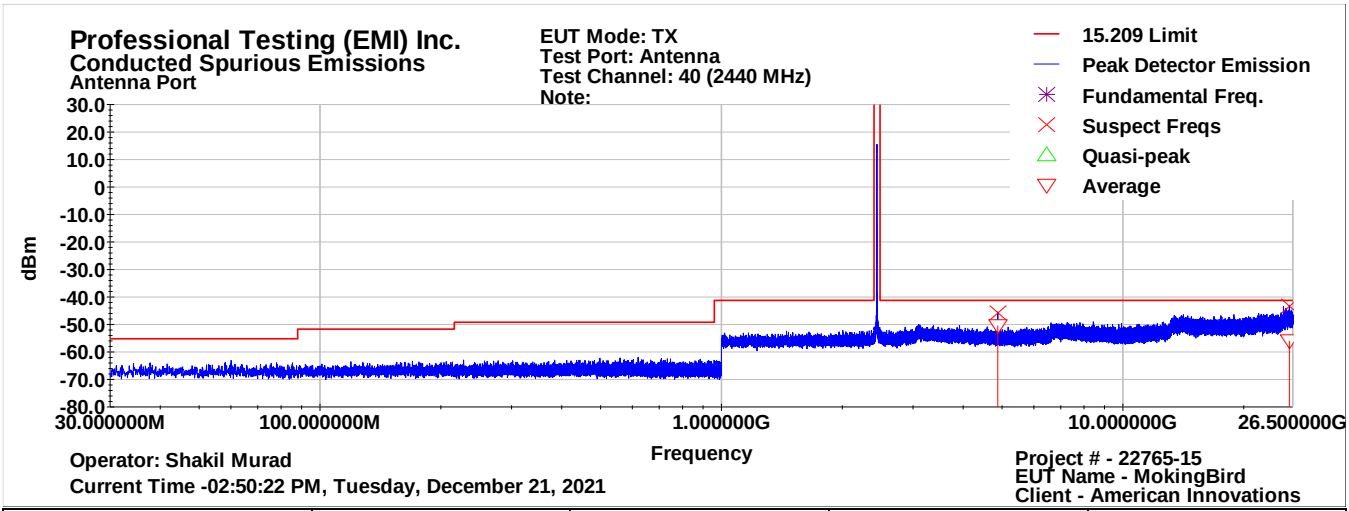
6.3.1 1 MHz Bandwidth Test data

Bottom Channel: 1 MHz Bandwidth



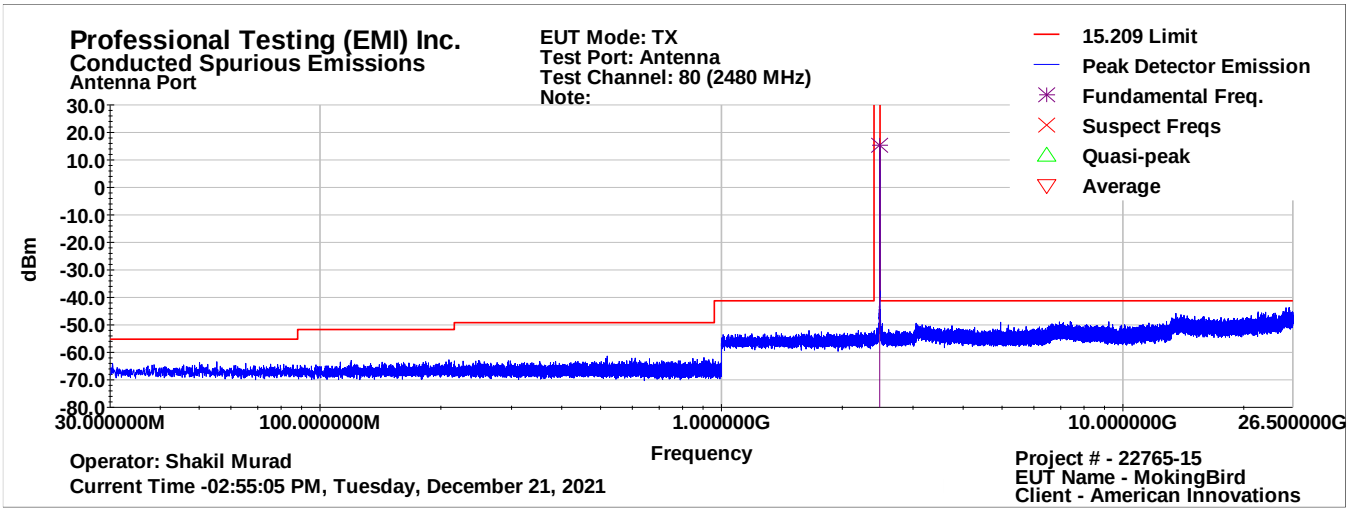
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4804.277	-47.517	-41.250	6.267	PASS

Middle Channel: 1 MHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4879.374	-50.425	-41.250	9.175	PASS
25974.709	-55.951	-41.250	14.701	PASS

Top Channel: 1 MHz Bandwidth



7.0 Transmitter Radiated Spurious Emissions

7.1 Test Procedure

Radiated emissions are measured with the EUT transmitting on the required frequencies.

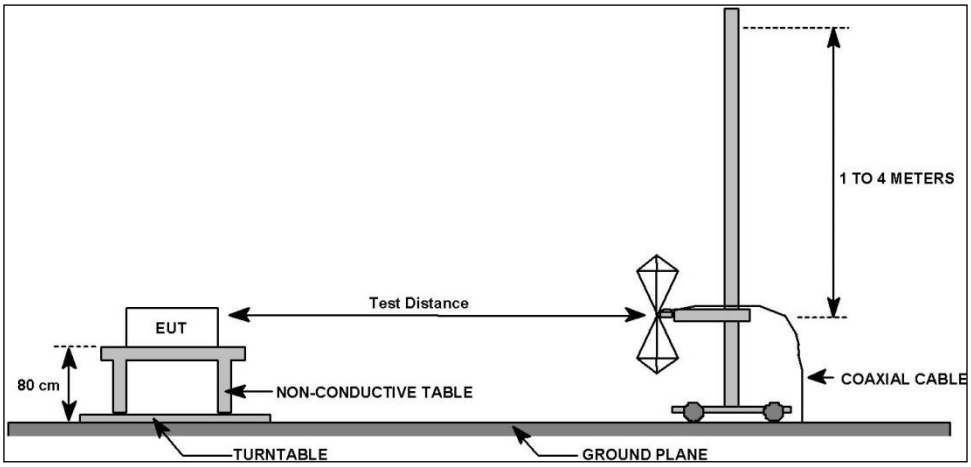


Table 7.1.1: Test Distance, Table Height, and Detection Method

30 MHz to 1 GHz	1 GHz to 18 GHz	18 GHz to 26.5 GHz
10 m, 80 cm	3 m, 1.5 m	1 m, 1.5 m
Quasi-peak	Peak & Average	Peak & Average

7.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Parameter
15.247(d), 15.205 // RSS-247 5.5, RSS-Gen 6.13 & 8.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode

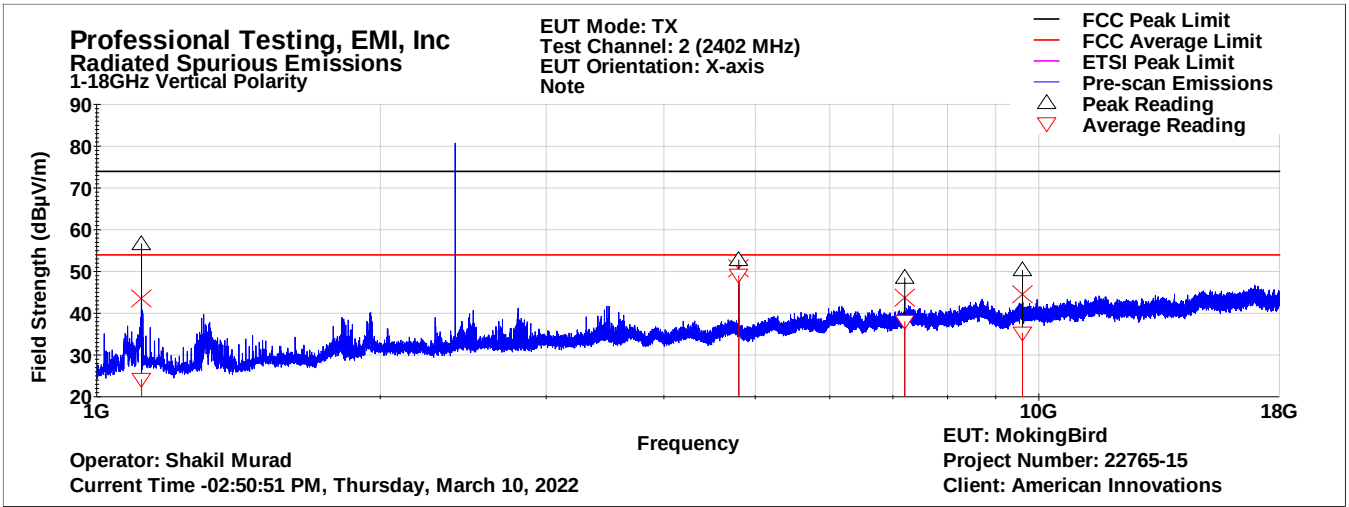
7.3 Test Results

Three channels were tested. EUT was transmitting continuously unmodulated. Device tested in normal operational orientation. Filters used to remove fundamental during testing.

The EUT satisfied the requirement. Test plots and tabular data are presented on the following page.

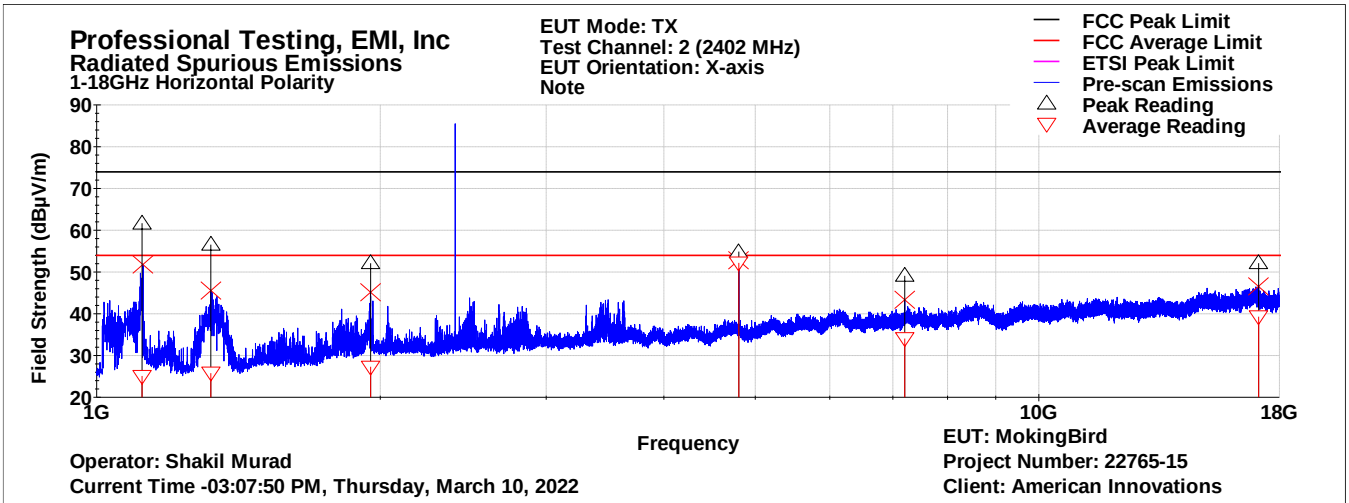
7.3.1 Bottom Channel, 1 GHz to 26.5 GHz

1GHz - 18GHz Vertical Polarity Emissions Data



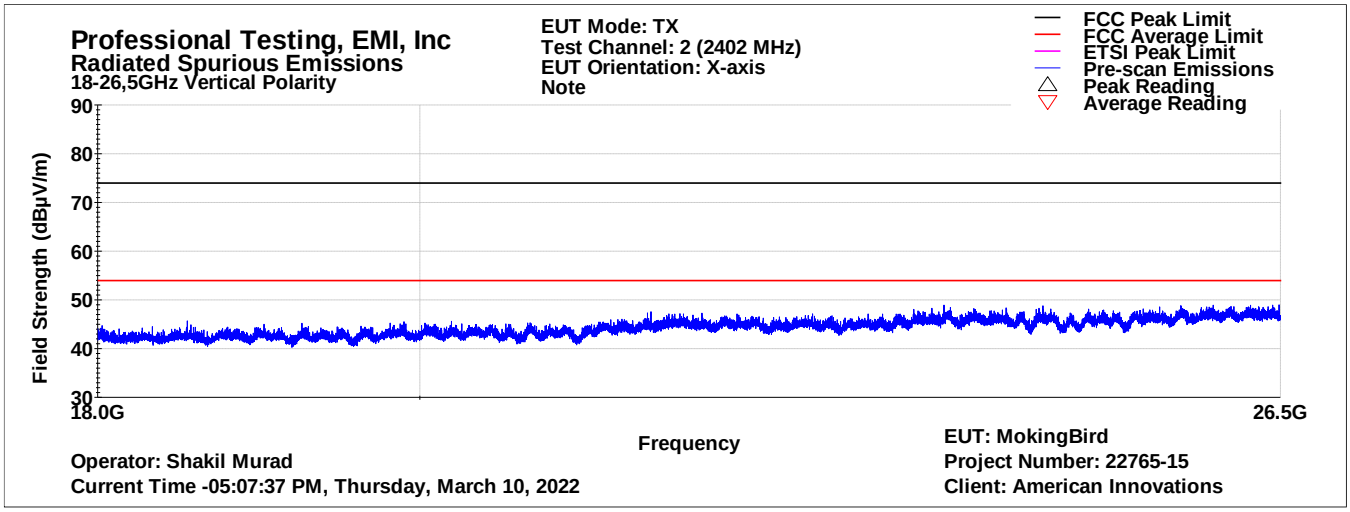
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1116.15	52	292	56.661	73.958	-17.297	PASS	24.190	53.958	-29.768	PASS
4803.87	283	126	52.841	73.958	-21.117	PASS	49.075	53.958	-4.883	PASS
7205.87	341	192	48.531	73.958	-25.427	PASS	38.051	53.958	-15.907	PASS
9607.77	343	207	50.302	73.958	-23.656	PASS	35.331	53.958	-18.627	PASS

1GHz - 18GHz Horizontal Polarity Emissions Data



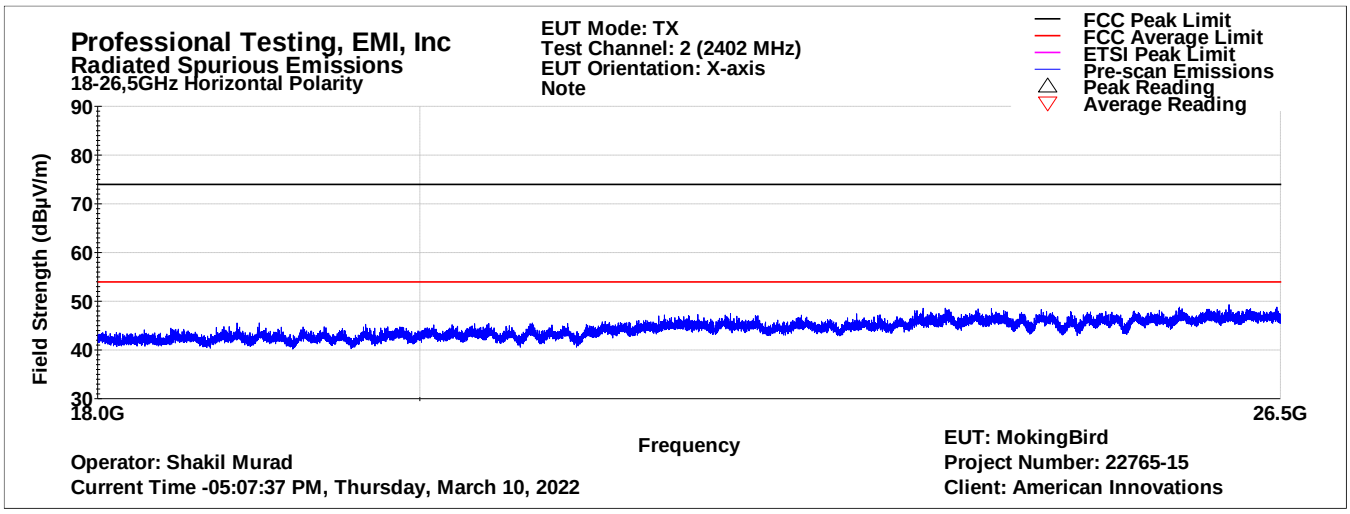
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1117.37	78	102	61.662	73.958	-12.296	PASS	25.092	53.958	-28.866	PASS
1322.00	-3	157	56.539	73.958	-17.419	PASS	25.760	53.958	-28.198	PASS
1953.60	303	377	52.089	73.958	-21.869	PASS	27.313	53.958	-26.645	PASS
4803.76	169	332	54.881	73.958	-19.077	PASS	52.170	53.958	-1.788	PASS
7205.74	313	210	49.070	73.958	-24.888	PASS	34.048	53.958	-19.910	PASS
17109.01	302	157	52.104	73.958	-21.854	PASS	39.293	53.958	-14.665	PASS

18GHz - 26.5GHz Vertical Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

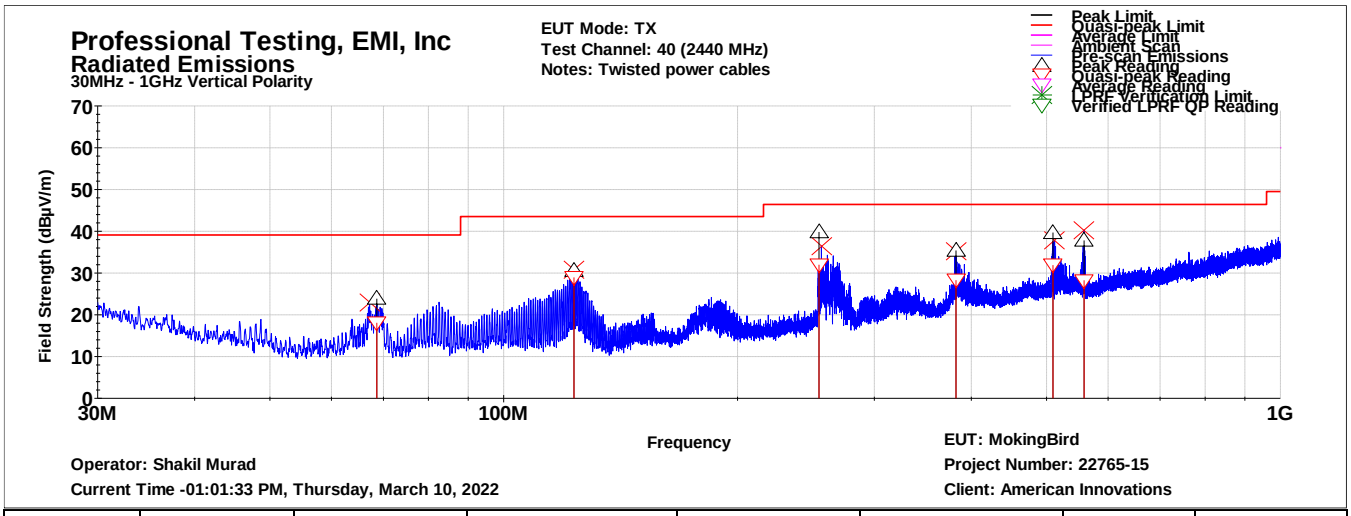
18GHz - 26.5GHz Horizontal Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

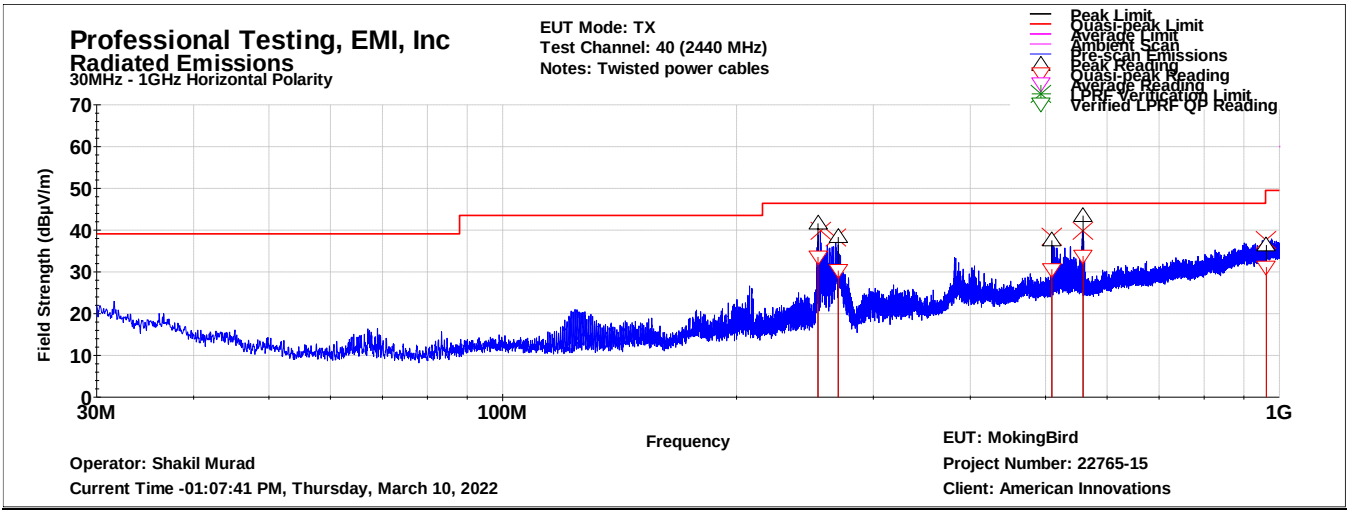
7.3.2 Middle Channel, 30 MHz to 26.5 GHz

30MHz - 1GHz Vertical Polarity Emissions Data



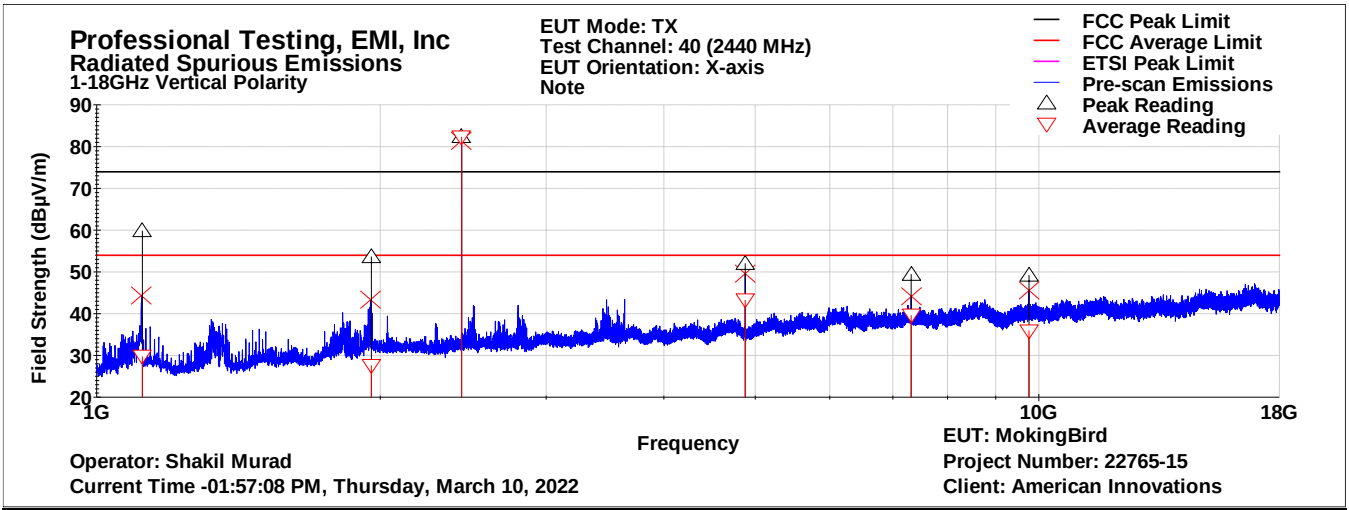
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
68.649	27.000	117.000	18.077	39.100	-21.023	PASS	23.831
123.171	1.000	311.000	28.933	43.500	-14.567	PASS	30.468
254.686	300.000	178.000	31.966	46.400	-14.434	PASS	39.818
382.186	358.000	129.000	28.280	46.400	-18.120	PASS	35.389
509.614	105.000	412.000	31.891	46.400	-14.509	PASS	39.676
558.776	71.000	398.000	28.239	46.400	-18.161	PASS	37.801

30MHz - 1GHz Horizontal Polarity Emissions Data



Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
254.640	255.000	348.000	33.578	46.400	-12.822	PASS	41.601
270.411	243.000	335.000	30.280	46.400	-16.120	PASS	38.330
509.434	243.000	142.000	30.637	46.400	-15.763	PASS	37.534
558.769	297.000	142.000	33.818	46.400	-12.582	PASS	43.456
962.171	131.000	103.000	31.144	49.500	-18.356	PASS	36.437

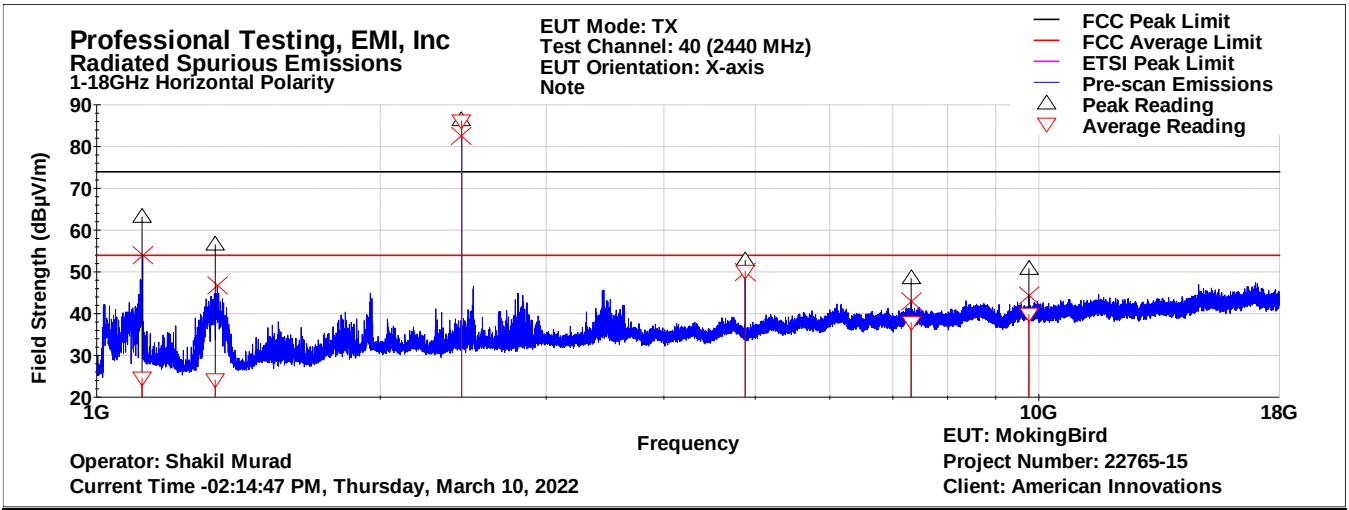
1GHz - 18GHz Vertical Polarity Emissions Data



Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1118.21	100	218	59.840	73.958	-14.118	PASS	29.762	53.958	-24.196	PASS
1956.86	-2	302	53.629	73.958	-20.329	PASS	27.614	53.958	-26.344	PASS
2439.88	323	102	82.370	73.958	8.412	FAIL	82.330	53.958	28.372	Note *
4879.87	276	154	52.044	73.958	-21.914	PASS	43.263	53.958	-10.695	PASS
7319.90	357	150	49.469	73.958	-24.489	PASS	39.617	53.958	-14.341	PASS
9763.16	16	323	49.203	73.958	-24.755	PASS	35.956	53.958	-18.002	PASS

Note *: This is the fundamental frequency.

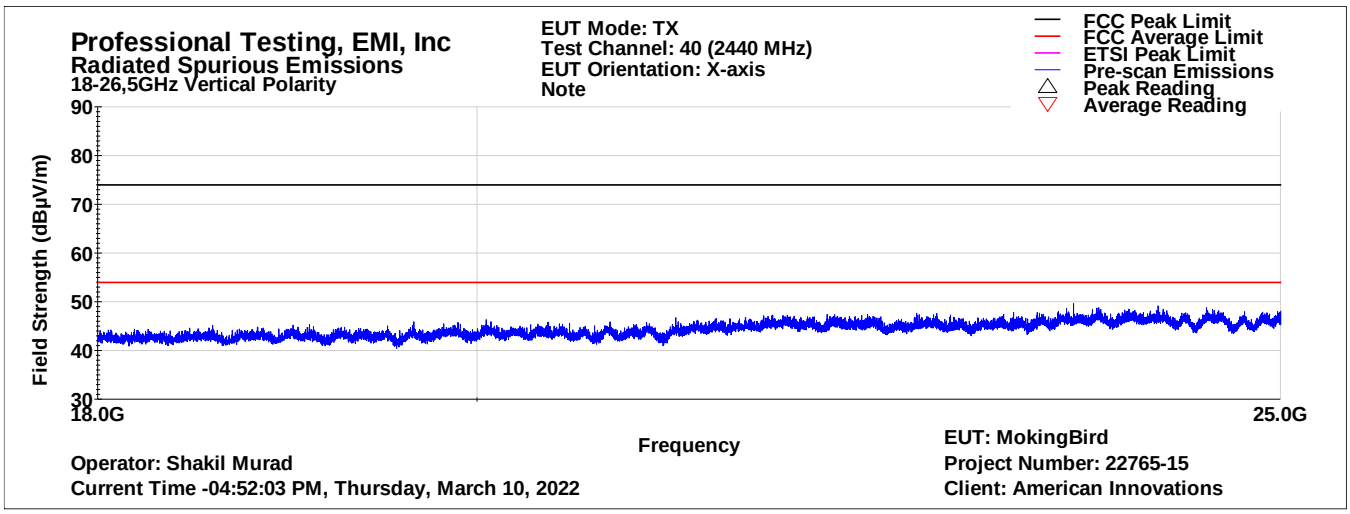
1GHz - 18GHz Horizontal Polarity Emissions Data



Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1117.47	58	140	63.190	73.958	-10.768	PASS	24.616	53.958	-29.342	PASS
1336.47	67	184	56.558	73.958	-17.400	PASS	24.211	53.958	-29.747	PASS
2439.88	190	377	86.279	73.958	12.321	FAIL	86.242	53.958	32.284	Note*
4879.91	88	377	52.793	73.958	-21.165	PASS	50.242	53.958	-3.716	PASS
7319.88	307	271	48.486	73.958	-25.472	PASS	37.923	53.958	-16.035	PASS
9759.58	154	149	50.824	73.958	-23.134	PASS	39.931	53.958	-14.027	PASS

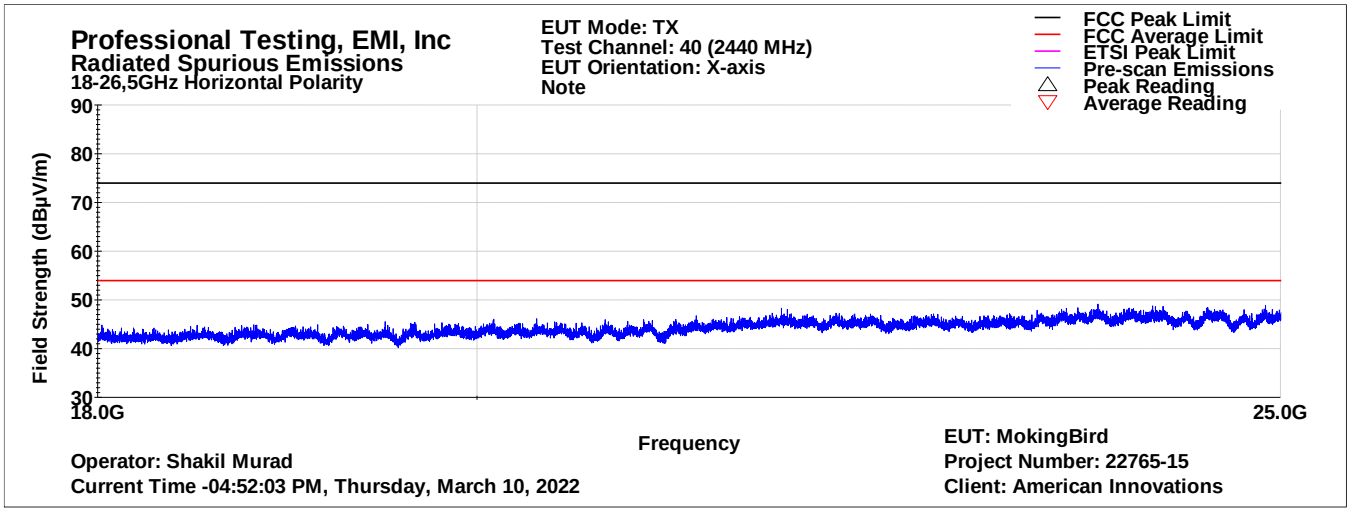
Note *: This is the fundamental frequency.

18GHz - 26.5GHz Vertical Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

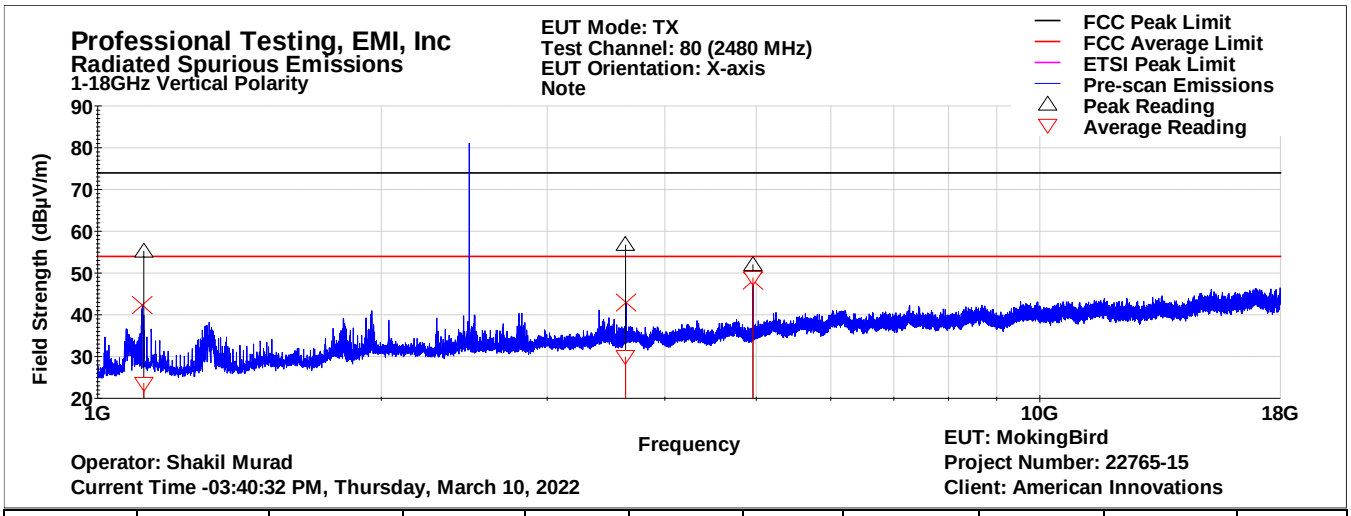
18GHz - 26.5GHz Horizontal Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

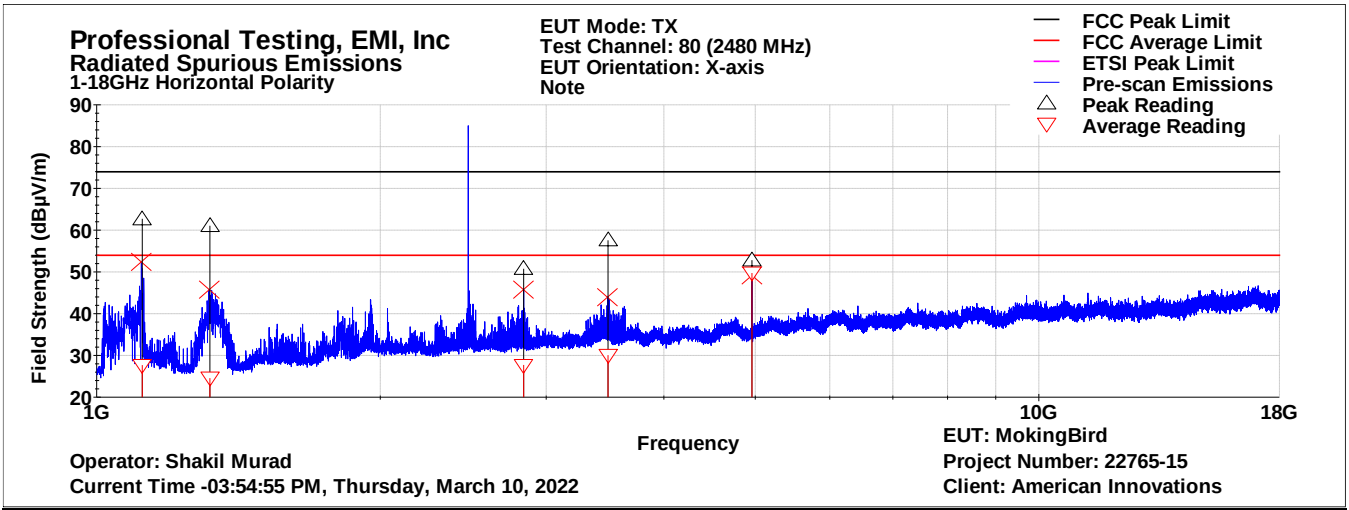
7.3.3 Top Channel, 1GHz to 26.5 GHz

1GHz - 18GHz Vertical Polarity Emissions Data



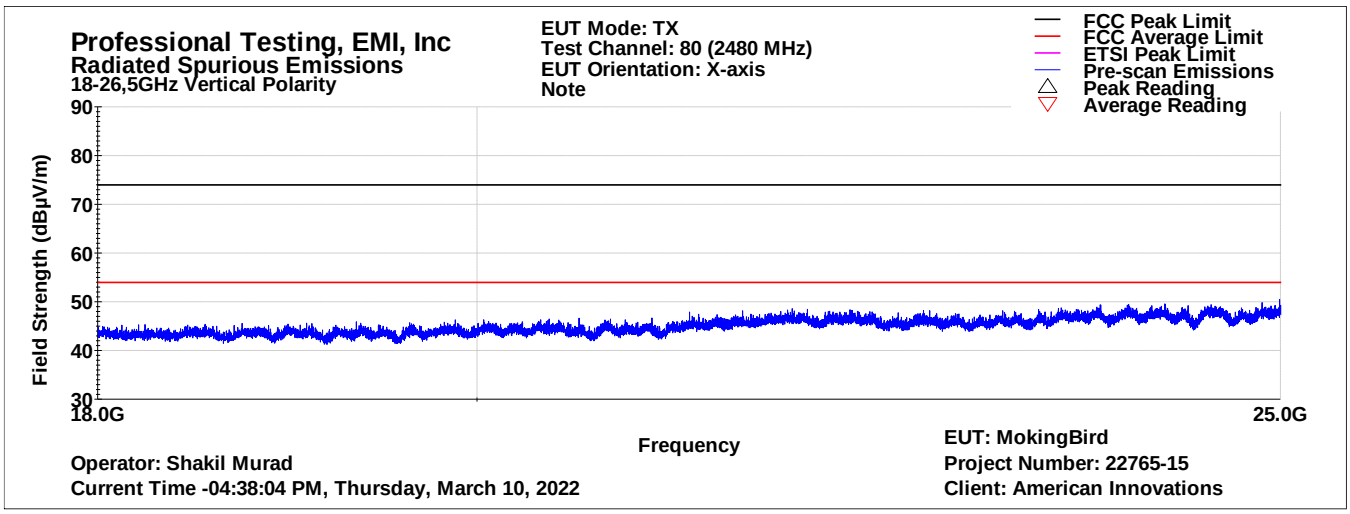
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1119.39	345	101	55.279	73.958	-18.679	PASS	23.697	53.958	-30.261	PASS
3633.52	92	284	56.785	73.958	-17.173	PASS	29.969	53.958	-23.989	PASS
4959.87	271	135	52.055	73.958	-21.903	PASS	48.930	53.958	-5.028	PASS

1GHz - 18GHz Horizontal Polarity Emissions Data



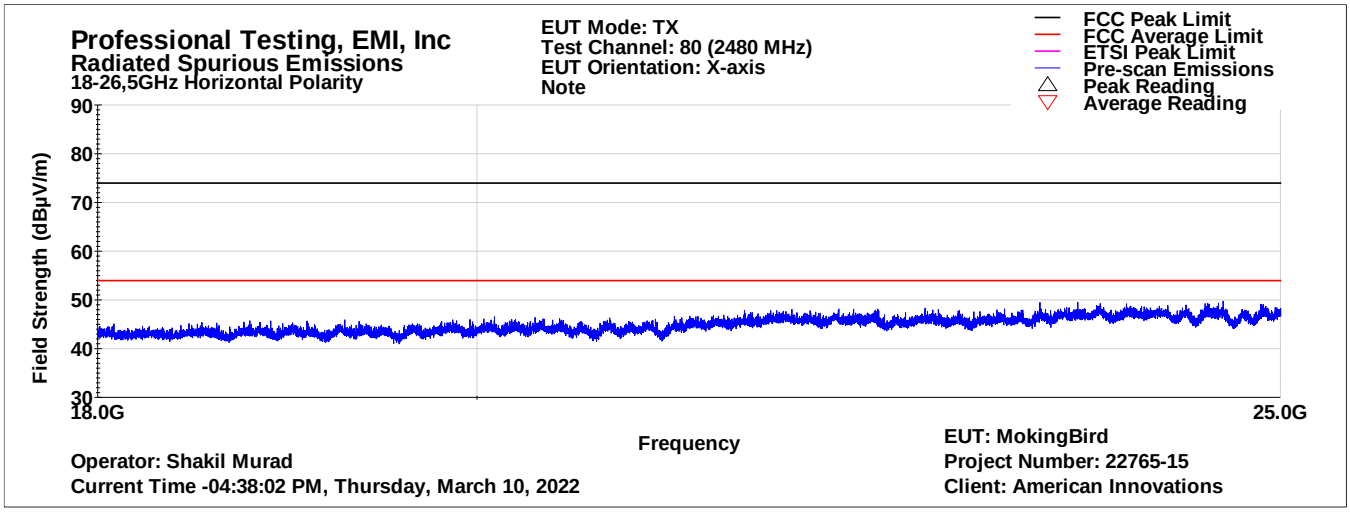
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1118.03	46	102	62.693	73.958	-11.265	PASS	27.664	53.958	-26.294	PASS
1318.91	63	154	61.038	73.958	-12.920	PASS	24.565	53.958	-29.393	PASS
2839.35	1	102	50.748	73.958	-23.210	PASS	27.716	53.958	-26.242	PASS
3489.82	65	102	57.559	73.958	-16.399	PASS	30.077	53.958	-23.881	PASS
4959.75	180	210	52.802	73.958	-21.156	PASS	49.714	53.958	-4.244	PASS

18GHz - 26.5GHz Vertical Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

18GHz - 26.5GHz Horizontal Polarity Emissions Data



Note: no emissions were observed, emissions were at or below the noise levels.

8.0 Radiated Spurious Emissions, Receive Mode

8.1 Test Procedure

Receive mode radiated emissions were measured with the EUT in normal operation transmitting/receiving on the middle channel.

Table 8.1.1: Test Distance, Table Height, and Detection Method

30 MHz to 1 GHz	1 GHz to 18 GHz	18 GHz to 25 GHz
10 m, 80 cm	3 m, 80 cm	1 m, 80 cm
Quasi-peak	Peak & Average	Peak & Average

8.2 Test Criteria

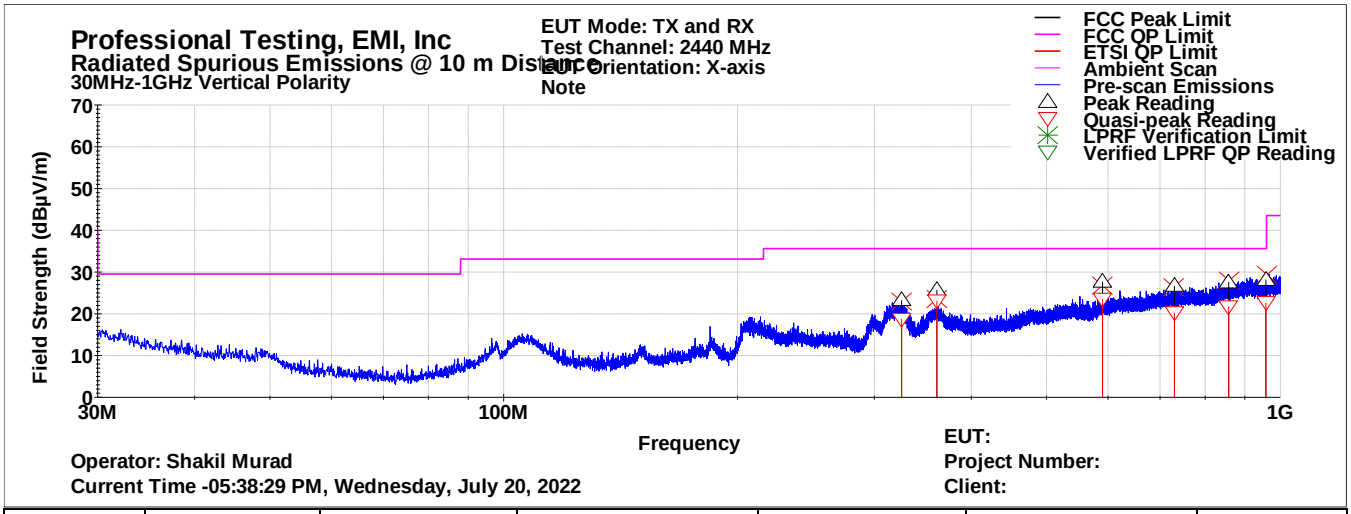
47 CFR (USA) // IC (Canada)	
Section Reference	Parameter
15.109 // RSS-Gen 7.3	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode

8.3 Test Results

The requirement was satisfied. Test plots and tabular data are presented on the following page.

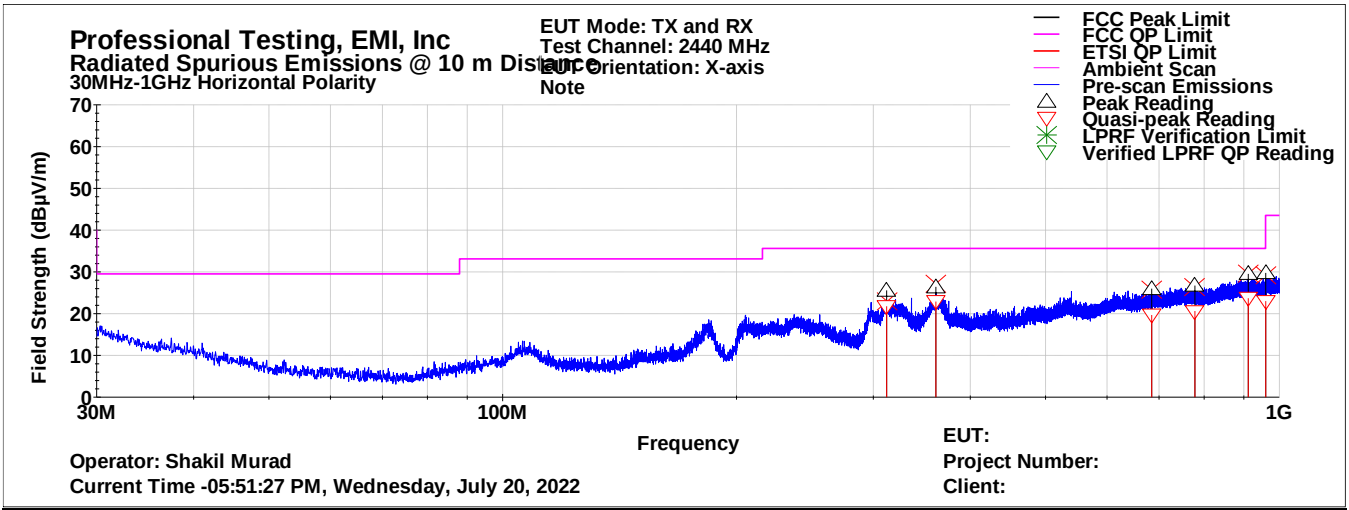
8.3.1 Test Data, 30 MHz to 14 GHz

30MHz - 1GHz Vertical Polarity Emissions Data



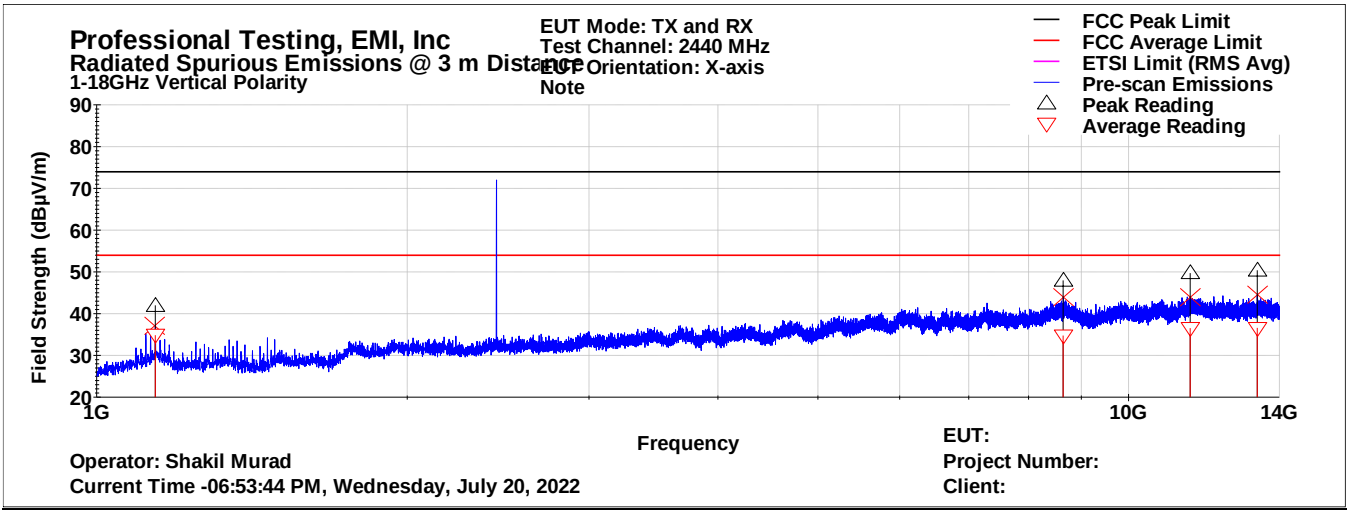
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results
325.360	256.000	136.000	18.750	35.600	-16.850	PASS
361.183	148.000	314.000	23.077	35.600	-12.523	PASS
590.329	94.000	387.000	23.566	35.600	-12.034	PASS
730.561	249.000	103.000	20.270	35.600	-15.330	PASS
858.080	300.000	145.000	21.724	35.600	-13.876	PASS
958.157	201.000	156.000	22.640	35.600	-12.960	PASS

30MHz - 1GHz Horizontal Polarity Emissions Data



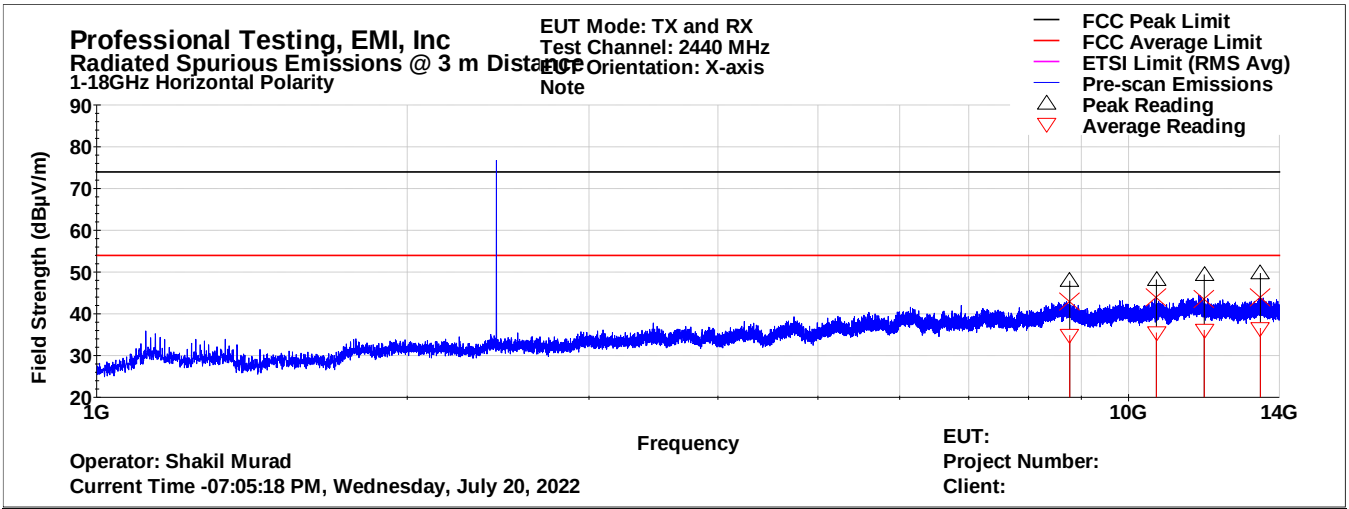
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results
312.119	261.000	287.000	21.751	35.600	-13.849	PASS
361.207	61.000	345.000	22.873	35.600	-12.727	PASS
684.976	63.000	300.000	19.662	35.600	-15.938	PASS
778.642	336.000	245.000	20.608	35.600	-14.992	PASS
912.000	106.000	130.000	23.681	35.600	-11.919	PASS
960.462	88.000	105.000	22.981	43.500	-20.519	PASS

1GHz - 14GHz Vertical Polarity Emissions Data



Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1139.74	292	204	41.964	73.958	-31.994	PASS	34.841	53.958	-19.117	PASS
8640.93	219	132	47.937	73.958	-26.021	PASS	34.747	53.958	-19.211	PASS
11475.29	355	264	49.708	73.958	-24.250	PASS	36.529	53.958	-17.429	PASS
13328.54	57	215	50.362	73.958	-23.596	PASS	36.578	53.958	-17.380	PASS

1GHz - 14GHz Horizontal Polarity Emissions Data



Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
8769.82	252	325	47.908	73.958	-26.050	PASS	34.871	53.958	-19.087	PASS
10640.80	351	217	48.211	73.958	-25.747	PASS	35.503	53.958	-18.455	PASS
11839.51	89	108	49.386	73.958	-24.572	PASS	36.135	53.958	-17.823	PASS
13419.89	340	127	49.740	73.958	-24.218	PASS	36.596	53.958	-17.362	PASS

9.0 Antenna Construction

9.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

9.2 Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Antenna Construction
15.203, 15.247 // RSS-Gen 8.3	Type of Antenna(s) Type of Connector Gain

9.3 Results

Table 8.3.1 Antenna Construction Details
Chip Antenna
Manufacturer: Ethertronics an AVX Group Company Model/PN: M310220 Antenna peak gain: 1.7 dBi. No connector. Chip is soldered to circuit board.

User cannot substitute antenna.

Gain is under maximum limit of 6 dBi.

The requirement was satisfied.

10.0 Equipment

10.1 Fundamental Power, Bandwidth, PSD, Band Edge, Conducted Spurious Emissions

Asset#	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
2262	Keysight	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY42510155	11/8/2023

10.2 Radiated Emissions

Radiated Emissions Test Equipment List					
Tile! Software Version:			**Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM**		
Test Profile:			**2020_RE_Unintentional_TILE7_v4**		
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	4/9/2023
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1326	EMCO	1051-12	Controller, Antenna Mast	9101-1564	N/A
1244	EMCO	1050C	Controller, Antenna Mast	1100	N/A
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/14/2022
C233	Sucoflex	None	Cable, SMA-SMA, 7.62m, 9kHz - 1.5 GHz, Purple	None	10/22/2023
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	4/20/2022
1425	Electro-Metrics	BPA-1000	Preamp, Broadband 10k-1GHz	123	3/13/2022
C289	Pasternack	PE354-24	Cable, N-SMA, 0.610m Blue	1310	9/9/2022
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/15/2022
C038	none	LMR-400	Cable Coax, N-N, 0.15m	None	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	4/16/2023
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, 100MHz-18GHz	None	1/14/2024
745	0	ZKL1500-1	Amplifier, 40dB, 0.1-1500MHz	618-00180	N/A
1326	EMCO	1051-12	Controller, Antenna Mast	9101-1564	N/A
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	N/A

1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/10/2022
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/12/2022

11.0 Measurement Bandwidths

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per Range**
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps

*Notes:
1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since Nemko PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at Nemko PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of Nemko PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report