
Project #: PRJ0040425

Company: American Innovations

Models (HVINs): RM520S, RM540S

**Wireless Certification Report
FCC 15.247 & RSS-247**

Prepared for:

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Austin, TX 78727

By

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October 25, 2023

Written by

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Wireless Engineer

Revision History

Revision Number	Description	Date
Draft01	Initial release	8/30/2023
Final01	Corrections from initial review	10/23/2023
Final02	Corrected FCC ID	10/24/2023
Final03	Corrected related equipment information	10/25/2023

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NOTICE:

- (1) This Report must not be used to claim product endorsement, by ANAB, ilac-MRA, NIST, the FCC or any other Agency. This report also does not warrant certification by ANAB or NIST.
- (2) This report shall not be reproduced except in full, without the written approval of Nemko USA, Inc.
- (3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Compliance Certificate

FCC MRA Designation Number: US3166
ANAB Accreditation Number: AT-3165.01

Applicant	Device & Test Identification
American Innovations 12211 Technology Blvd. Austin, TX 78727	Models: RM520S, RM540S FCC ID: DJU626734 IC: 2466B-626734 Laboratory Project ID: PRJ0040425 Certification Date: 10/25/2023

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	D01	DTS Measurement Guidance v05r02
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, Larry Finn, for Nemko USA, 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.



Larry Finn
Laboratory Manager

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

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 USA, 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:	Remote Monitor	
Model:	RM520S, RM540S	
Serial Number:	70000041	
Model Variance:	None	
Description:	Operating Frequency	2402 – 2480 MHz
	Modulation Type	FSK2
	Chip Rate	250 kbps
Input Power:	3.3 Volts DC (Supplied by 4 AA Batteries, internally regulated to 3.3VDC)	

Note: EUT is battery powered only.

This test report covers the BLE radio integrated into the device. An Iridium Satellite radio module is collocated with the BLE radio in the equipment. FCC and ISED identification are below:

Iridium Communications Inc. 9603N Satellite Modem
 FCC ID: Q639603N
 IC: 4629A-9603N

RF Exposure for the collocated radio condition is addressed in a separate report.

1.3 EUT Test Configuration

The EUT was exercised in a manner consistent with normal operations. The EUT is powered by +3.3VDC via internal batteries.

Channel Power Settings: Channels 2-79 = 160, Channel 80 = 20

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 USA, Inc. semi-anechoic facility designated Site 45 (FCC 905409, 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 (ANAB). 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

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

Table 1.7.1: Applicable Documents	
Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C - Intentional Radiators, Subpart B – Unintentional Radiators
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4:2014	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
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	General Requirements and Information for the Certification of Radio Apparatus

Table 1.7.2: Applicable Clauses		
Parameter	FCC Part 15 Rule Paragraphs	ISED RSS References
Transmitter Characteristics	15.247	RSS-247 5.2 (DTS) & 5.4, RSS-Gen
Bandwidth	15.247(a)(2), 2.1049, KDB 558074 D01	RSS-247 6.2.4.1, RSS-Gen 6.7
Spurious Emission	15.247(d), 15.209, 15.205	RSS-247 5.5, RSS-GEN 6.13 & 8.10
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 8.10
Antenna Requirement	15.247, 15.203	RSS-Gen 6.8

Nemko USA, Inc., follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing. A copy of Nemko USA's policy for EMC Measurement Uncertainty is provided in Appendix A.

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 8/24/2023.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Conducted Power Limit
15.247(b)(3) // RSS-247 5.4(d)	1 W peak (+30dBm) Limit Restated as Field: 125.23 dB μ V/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	22	MHz	Detector	Peak
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)		Corrected Power (dBm)		Limit (dBm)		Test Result			
2	2402	13.826	0		13.826		30		Pass			
40	2440	13.531	0		13.531		30		Pass			
80	2480	1.836	0		1.836		30		Pass			
79	2479	13.238	0		13.238		30		Pass			

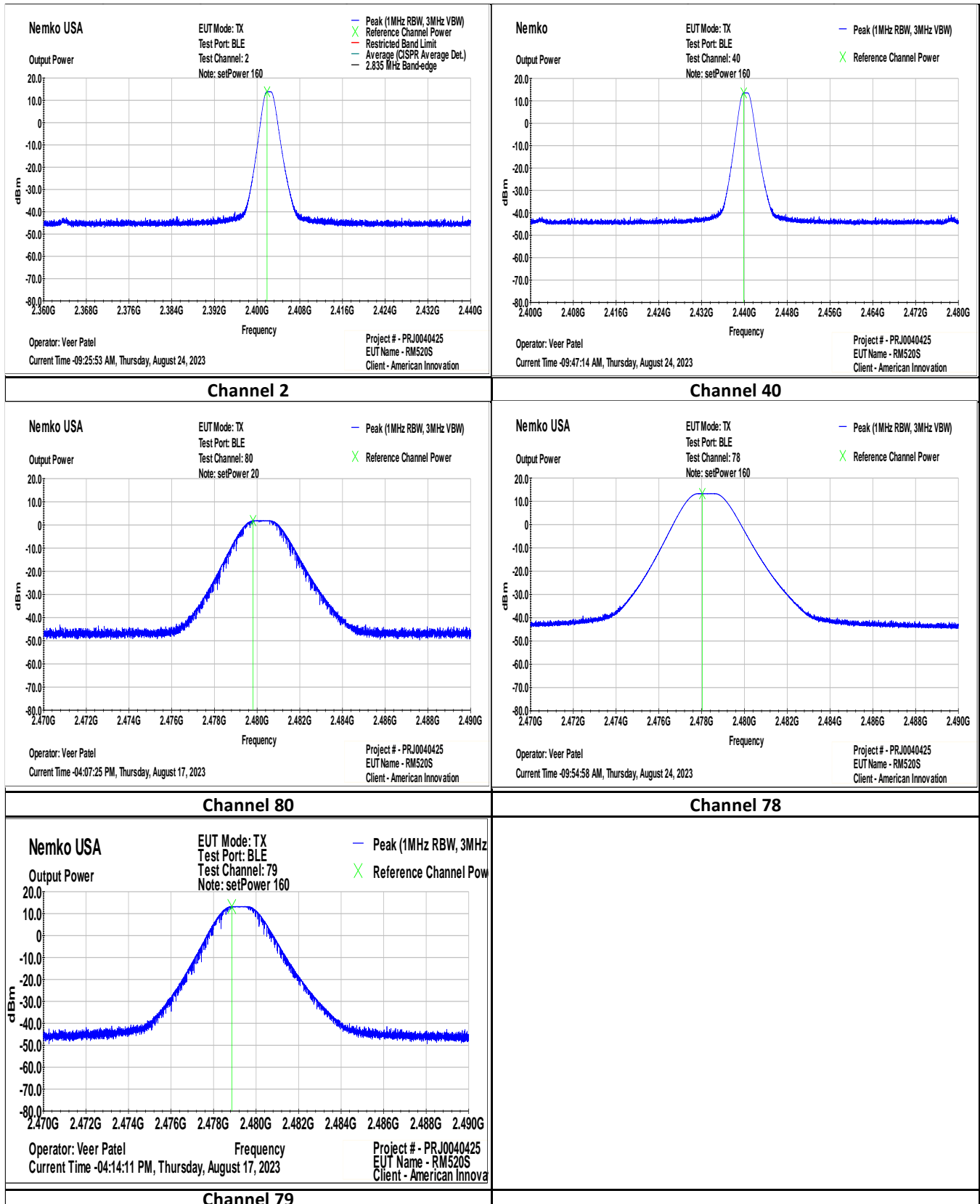
Power Level Settings:

Channels 2-79: 160

Channel 80: 20

The requirements were satisfied.

Peak output power test plots:



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 8/18/2023 and 10/6/2023.

3.2 Test Criteria

47 CFR (USA) // ISED (Canada)	
Section Reference	Bandwidth
15.247(a)(2), 2.1049, KDB 558074 D01 // RSS-Gen 6.6, RSS-247 5.2(a)	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.

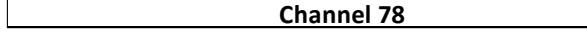
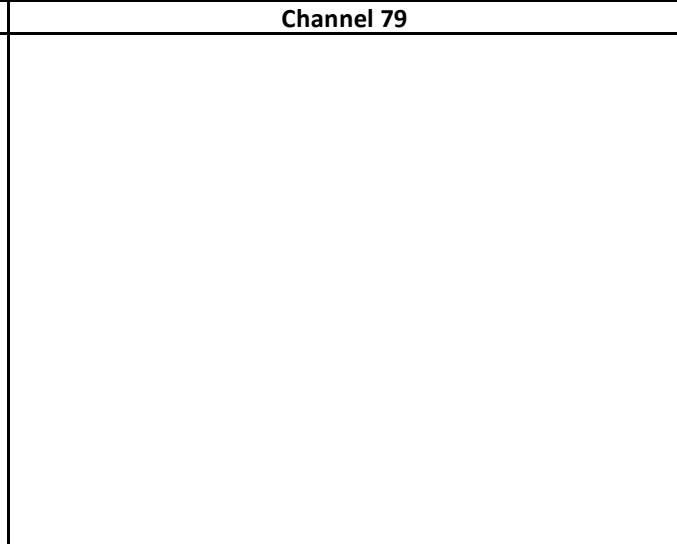
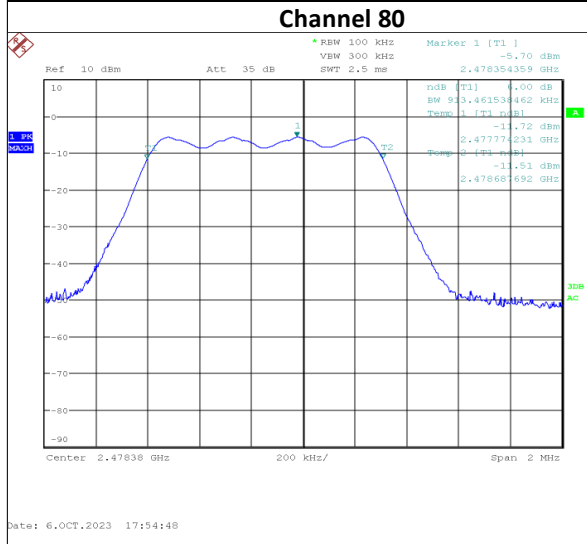
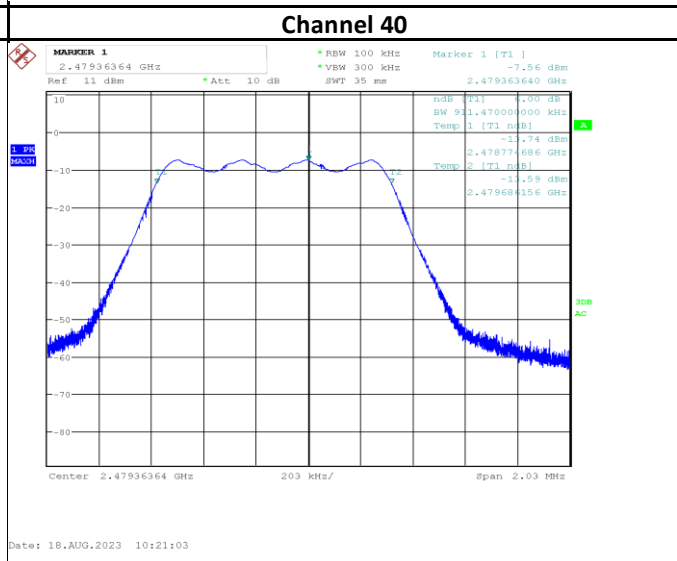
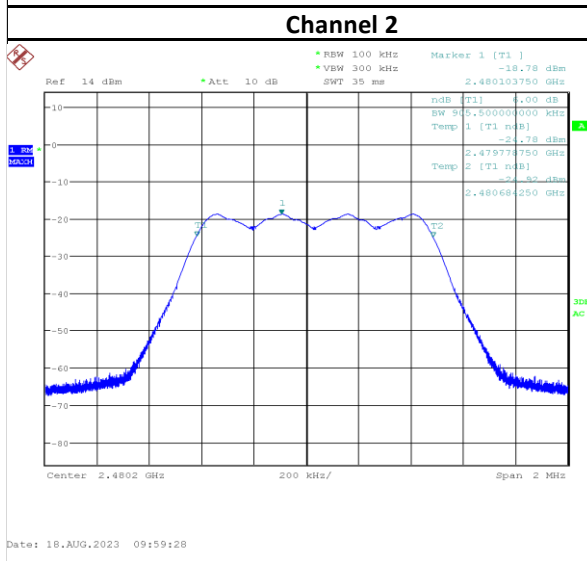
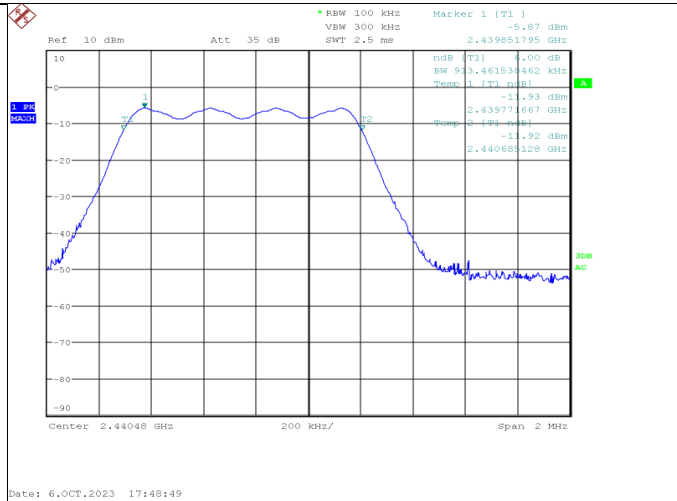
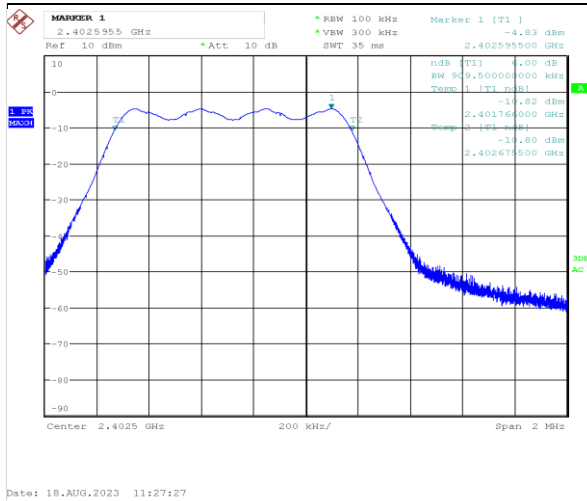
3.3 Test Results, Occupied Bandwidth

Occupied Bandwidth - Conducted Test Data													
Environmental Conditions:		Temperature		24.1	°C	Humidity		32	RH	Barometric Pressure		29.28	in Hg
Measurement Parameters:		RBW	100	kHz	VBW	300	kHz	Span	2	MHz	Detector	Peak	
Measurement Bandwidth:				- 6		dB							
	Frequency	Measured Bandwidth				Minimum 6dB Bandwidth							
Channel	(MHz)	(kHz)				(kHz)							
2	2402	909.5				905.5							
40	2440	933.5											
80	2480	905.5											
79	2479	911.5											
78	2478	933.5											

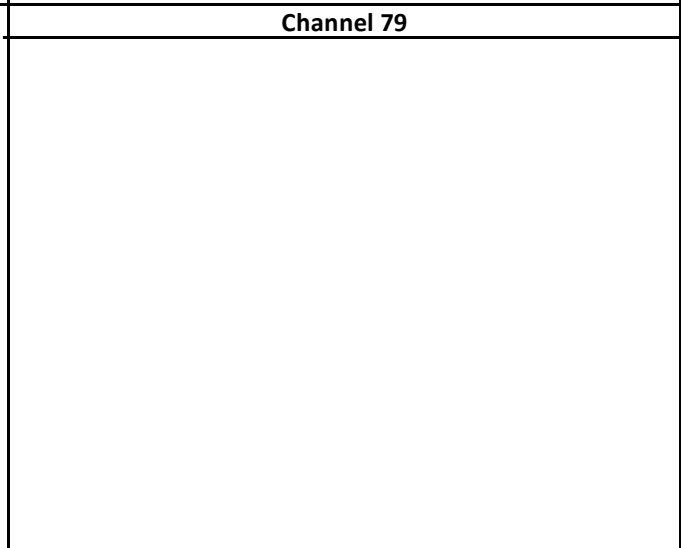
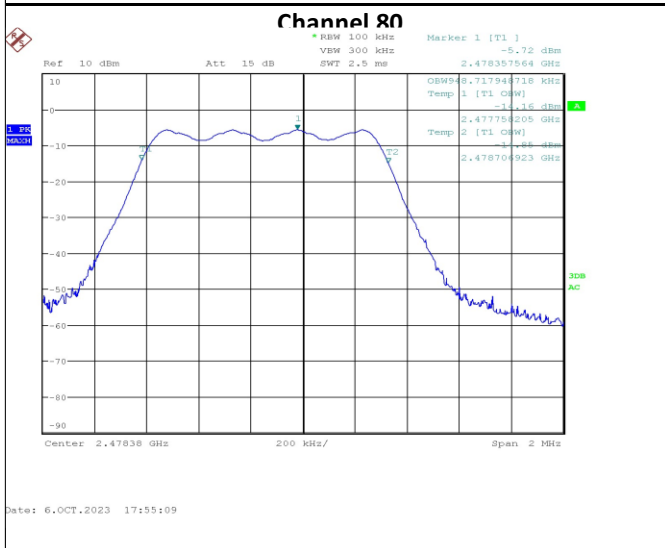
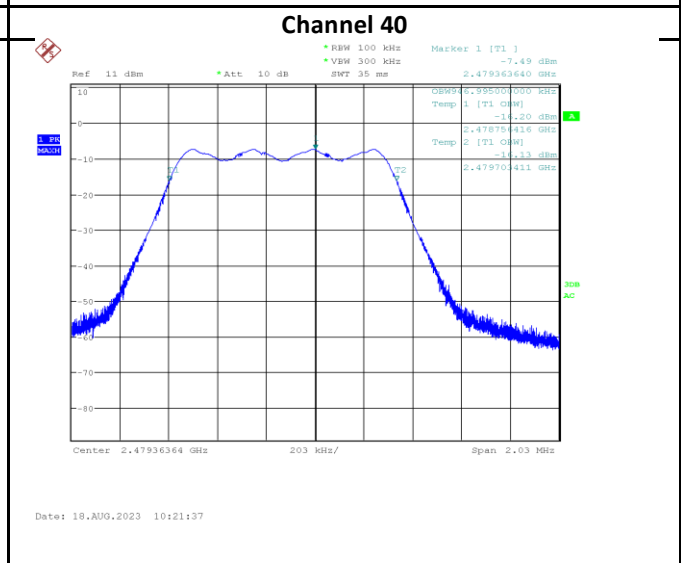
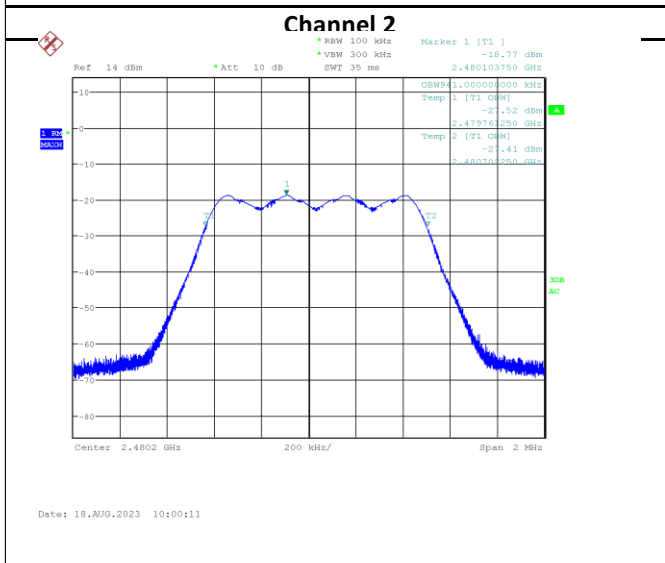
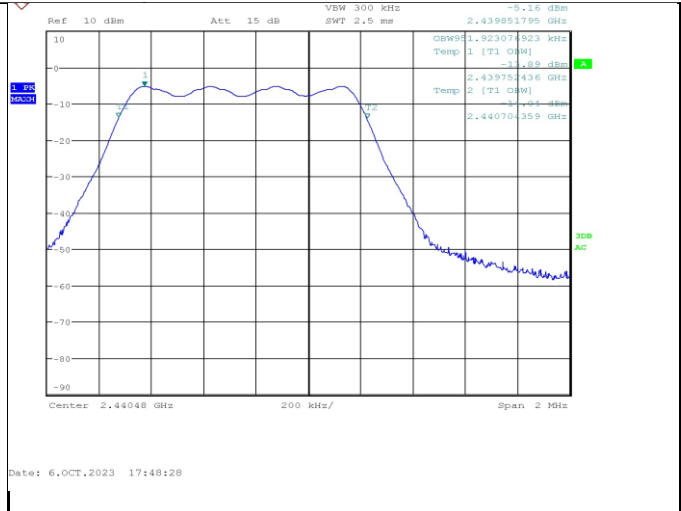
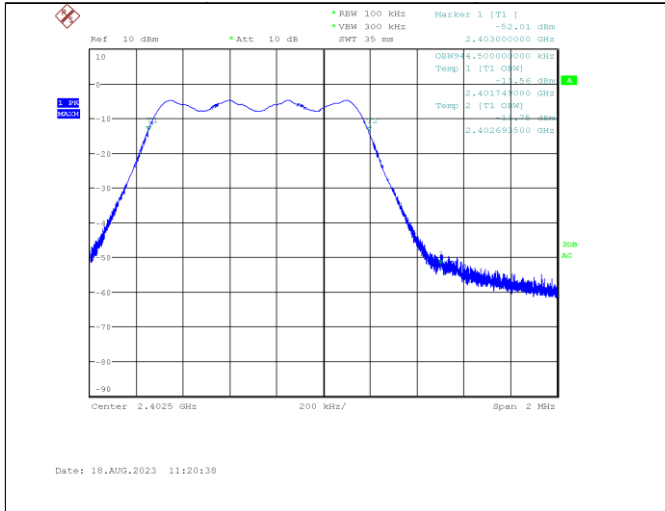
Recorded 99% maximum Bandwidth is 952.4 kHz

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

Occupied Bandwidth data plots, Recorded: 6 dB



Occupied Bandwidth data plots, Recorded: 99%



Channel 78

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 8/24/2023.

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 dB μ V/m at 3 m

4.3 Test Results, Power Spectral Density

Power Spectral Density - Conducted Test Data												
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	10	kHz	Span	2	MHz	Detector	Peak
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)		Corrected Power (dBm)		Limit (dBm)		Test Result			
2	2402	-16.1	20.487		4.387		8		Pass			
40	2440	-16.31	20.487		4.177		8		Pass			
80	2480	-28.17	20.487		-7.683		8		Pass			
79	2479	-16.6	20.487		3.887		8		Pass			
78	2478	-16.61	20.487		3.877		8		Pass			

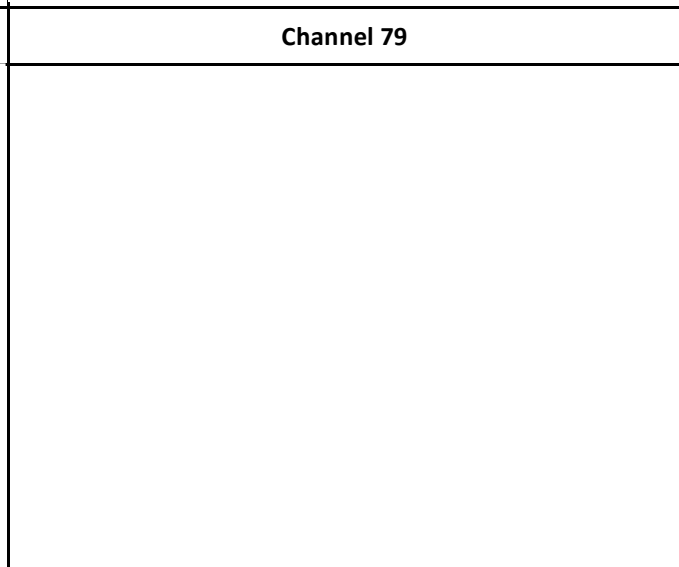
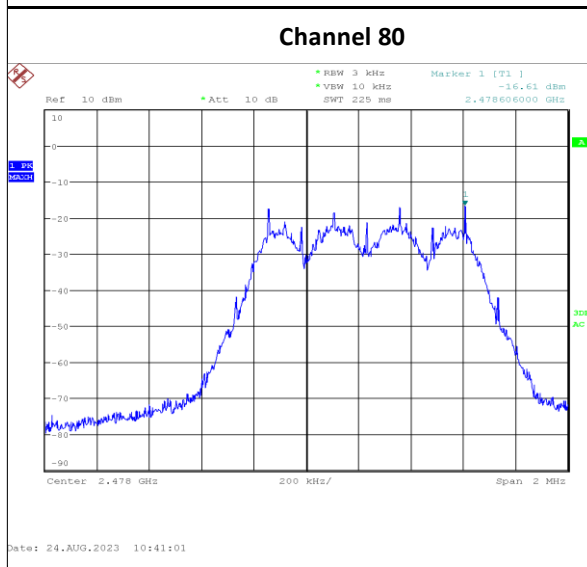
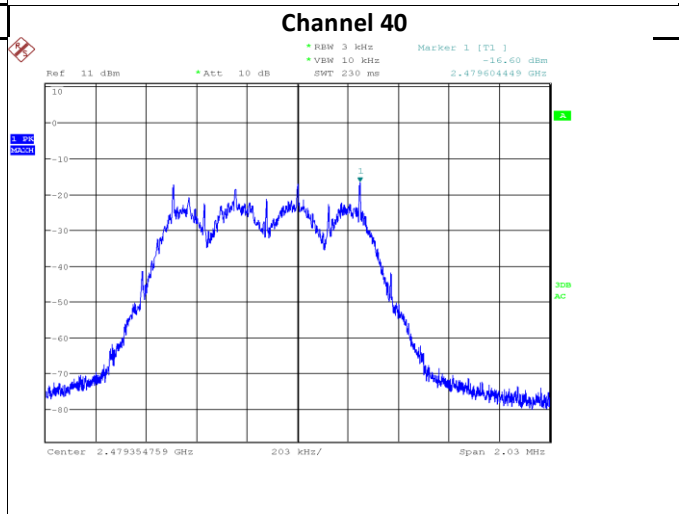
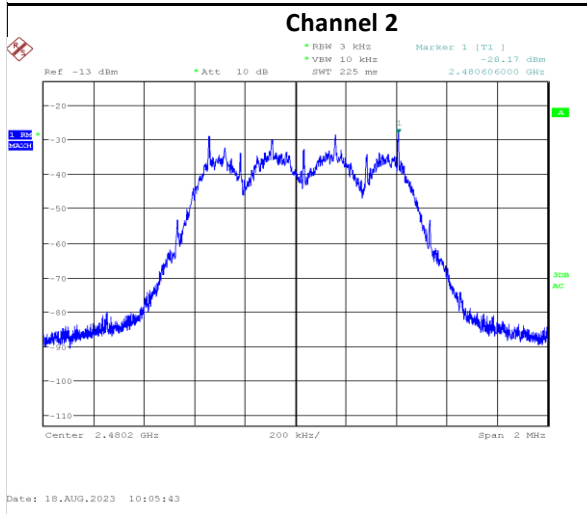
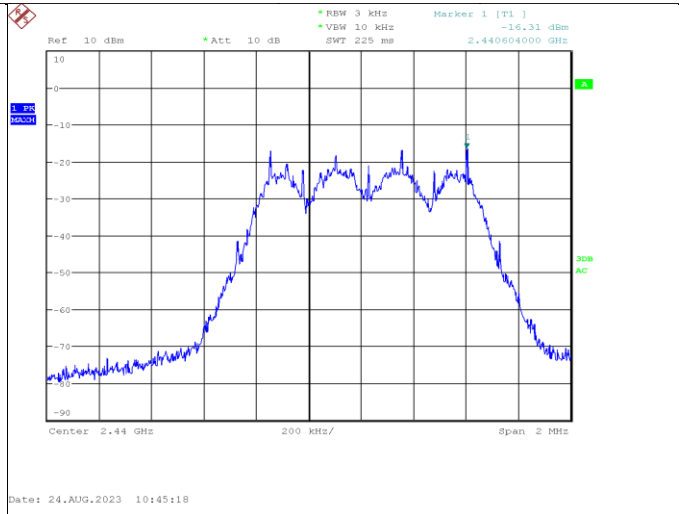
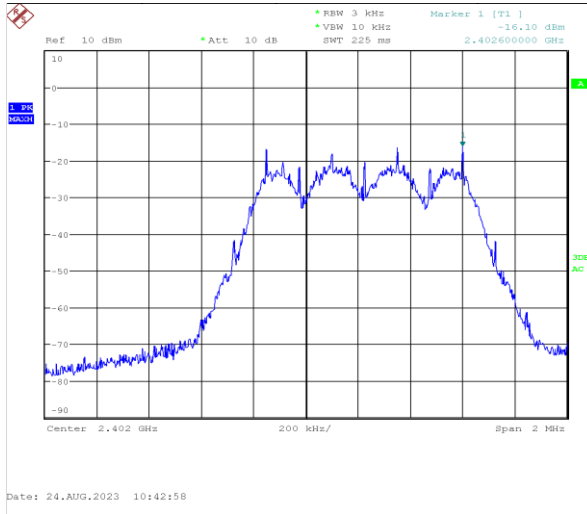
Power Level Settings:

Channels 2-79: 160

Channel 80: 20

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

Power Spectral Density test plots:



Channel 78

Channel 79

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 8/17/2023 and 8/24/2023.

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:

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

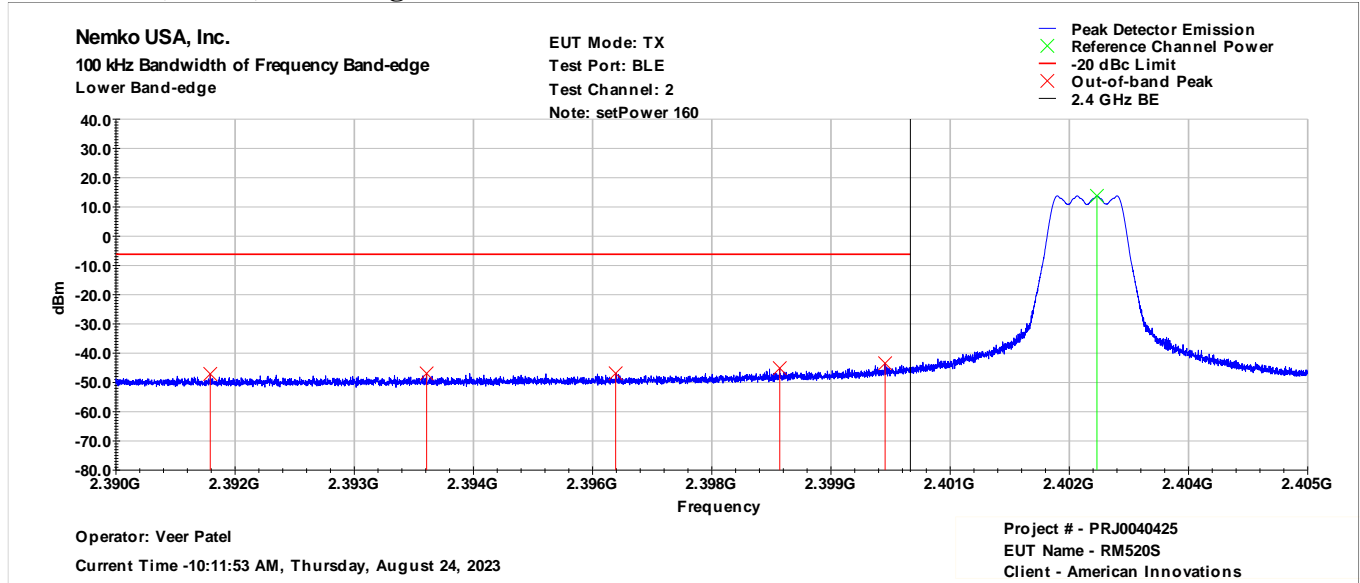
$$\text{EIRP} = 54 \text{ dB}\mu\text{V/m} + 20\text{Log}_{10}(3 \text{ m}) - 104.8 \text{ dB} = -41.25 \text{ dBm}$$

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.

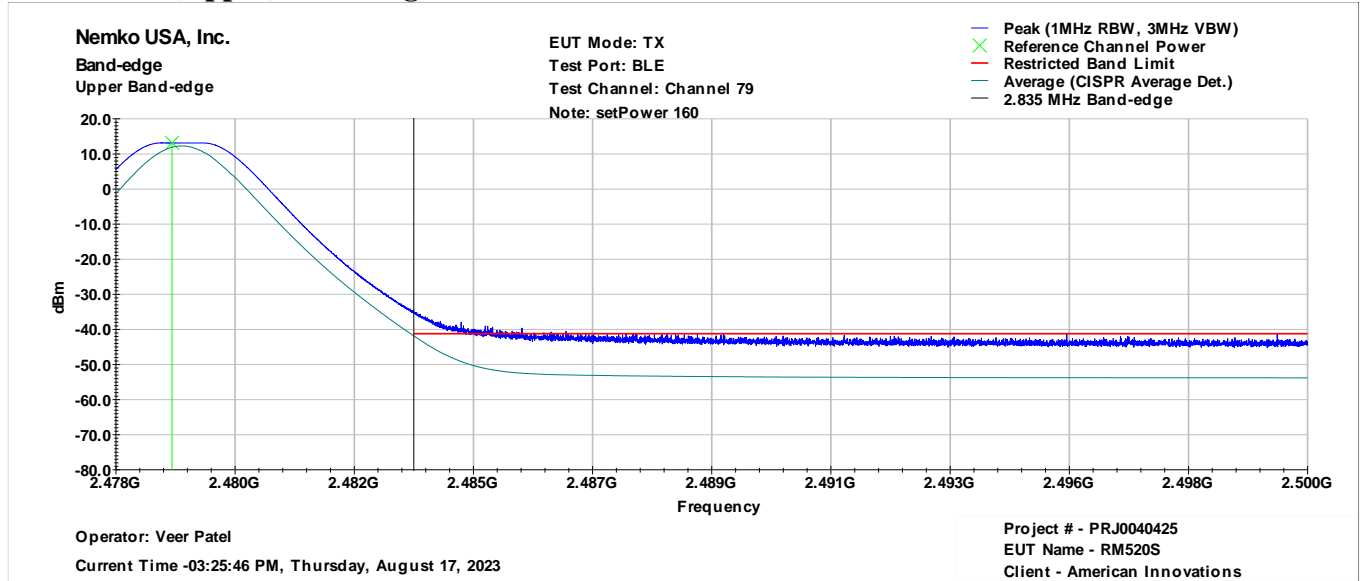
The requirement was satisfied. Test plots and tabular data are presented on the following page.

Channel 2 (Lower) Band-edge



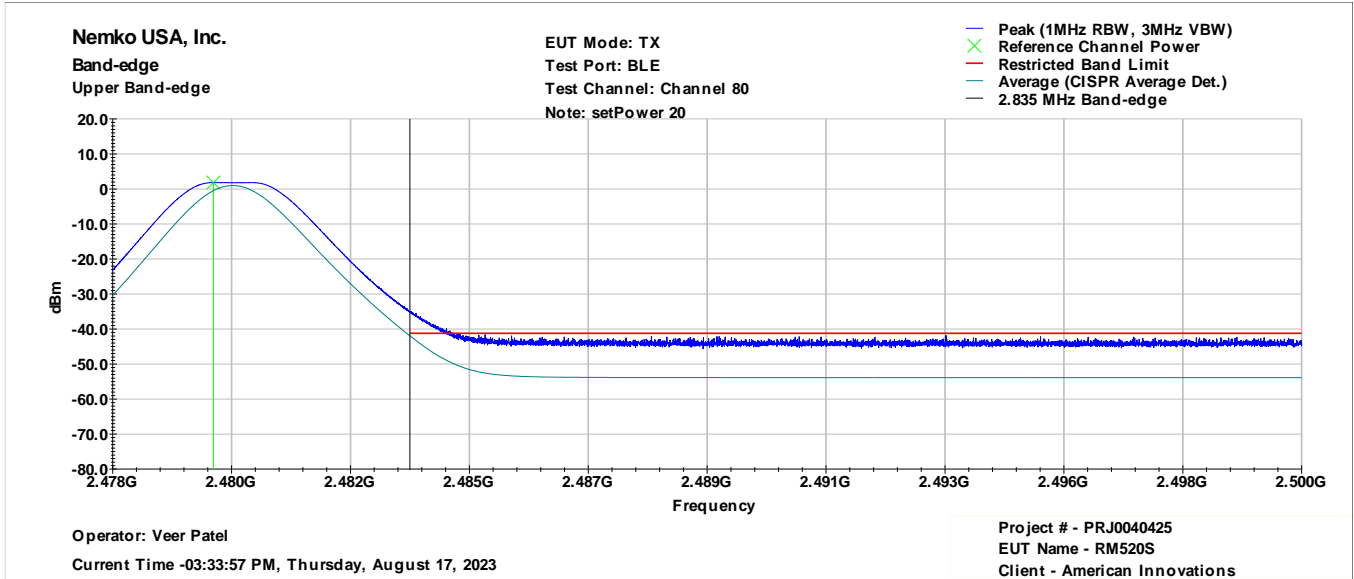
Frequency (MHz)	Corrected Reading (dBm)	Limit -20 dBc (dBm)	Margin (dB)	Results
2391.187	-47.135	-6.224	40.911	PASS
2393.911	-46.942	-6.224	40.718	PASS
2396.291	-46.902	-6.224	40.678	PASS
2398.355	-45.164	-6.224	38.940	PASS
2399.681	-43.483	-6.224	37.259	PASS

Channel 79 (Upper) Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2483.500	-41.865	-41.250	0.615	PASS
2487.556	-53.266	-41.250	12.016	PASS
2488.637	-53.417	-41.250	12.167	PASS
2489.715	-53.528	-41.250	12.278	PASS
2490.818	-53.621	-41.250	12.371	PASS
2491.830	-53.675	-41.250	12.425	PASS

Channel 80 (Upper) Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2483.500	-41.952	-41.250	0.702	PASS
2486.280	-53.778	-41.250	12.528	PASS
2487.336	-53.849	-41.250	12.599	PASS
2488.571	-53.871	-41.250	12.621	PASS
2489.957	-53.878	-41.250	12.628	PASS
2496.411	-53.883	-41.250	12.633	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 8/23-24/2023.

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

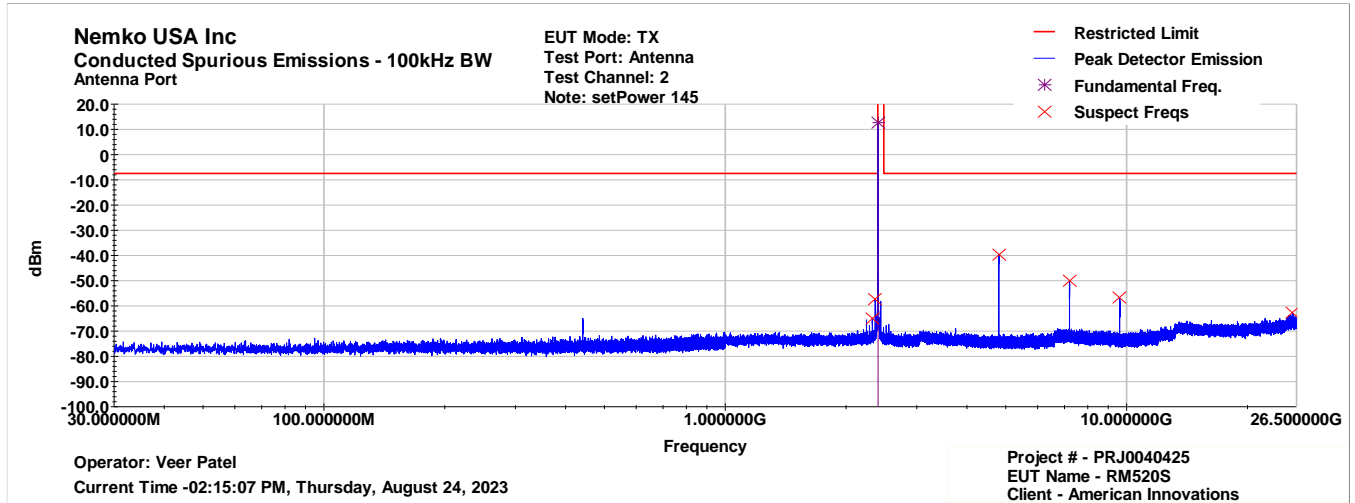
Three channels were tested. EUT was transmitting continuously and modulated.

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.

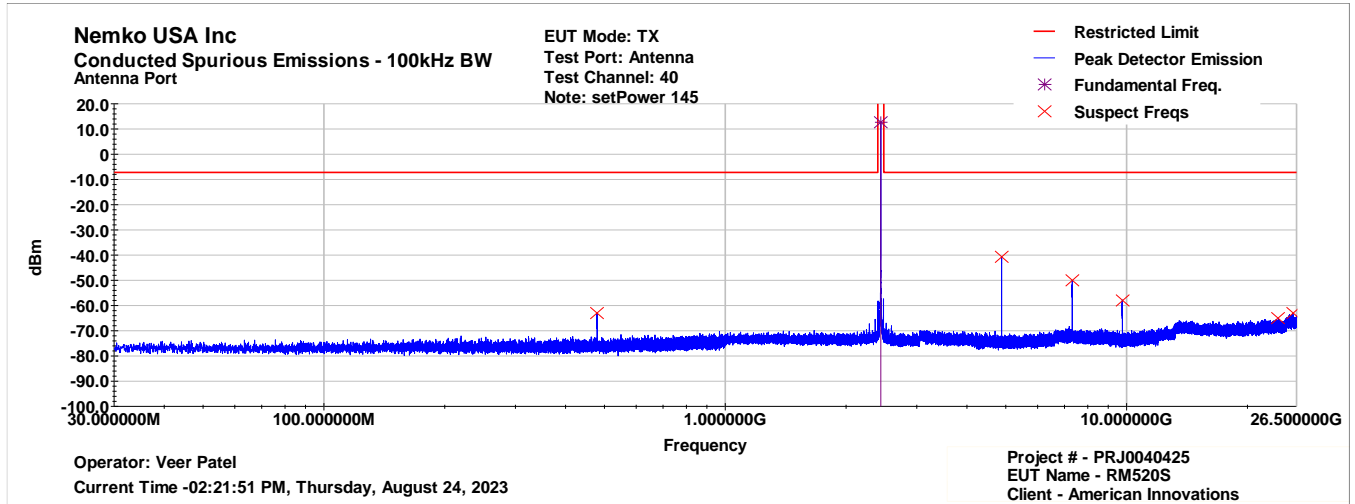
6.3.1 100 kHz Bandwidth Test data

Channel 2 Channel: 100 kHz Bandwidth



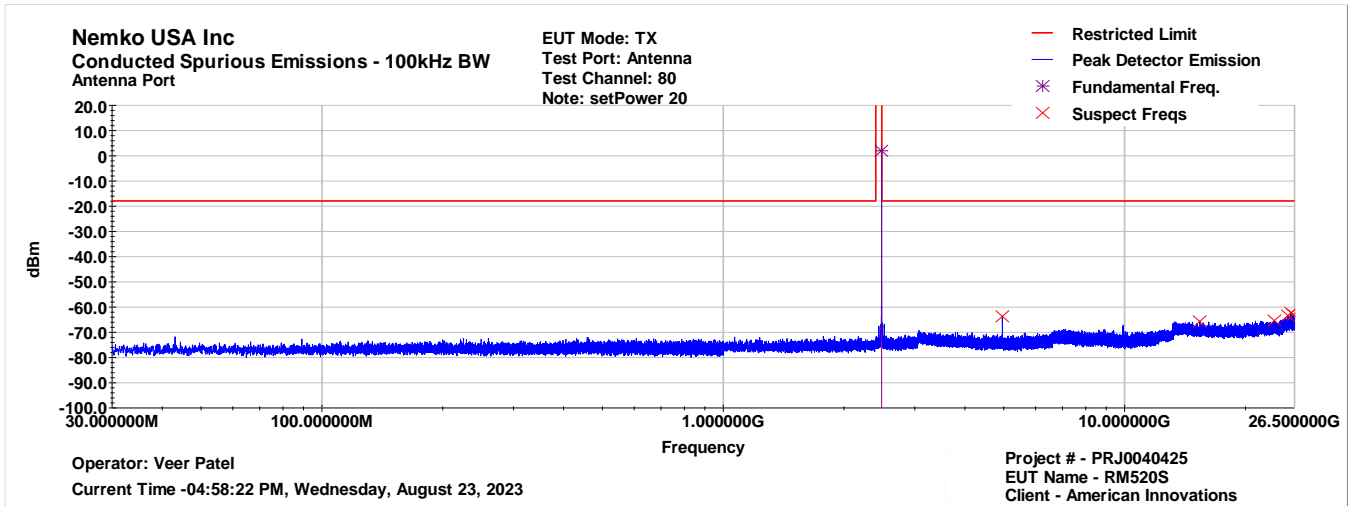
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2325.500	-64.871	-7.481	57.390	PASS
2363.450	-57.297	-7.481	49.816	PASS
4805.175	-39.582	-7.481	32.101	PASS
7206.200	-50.182	-7.481	42.701	PASS
9607.500	-56.747	-7.481	49.266	PASS
25875.292	-62.622	-7.481	55.141	PASS

Channel 40 Channel: 100 kHz Bandwidth



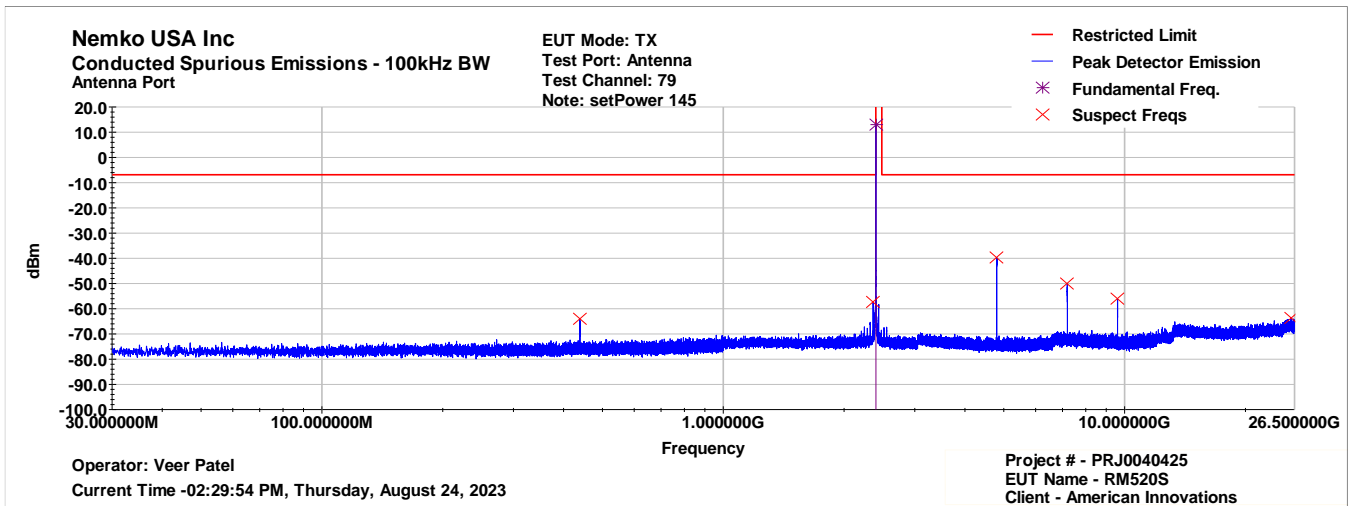
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
479.150	-63.067	-7.246	55.821	PASS
4880.800	-40.716	-7.246	33.470	PASS
7321.700	-50.085	-7.246	42.839	PASS
9761.500	-57.887	-7.246	50.641	PASS
23890.000	-65.129	-7.246	57.883	PASS
25960.479	-63.190	-7.246	55.944	PASS

Channel 80 Channel: 100 kHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4959.725	-63.582	-17.913	45.669	PASS
15386.958	-65.571	-17.913	47.658	PASS
23603.021	-65.354	-17.913	47.441	PASS
25495.875	-63.282	-17.913	45.369	PASS
25965.313	-62.349	-17.913	44.436	PASS
26345.938	-63.133	-17.913	45.220	PASS

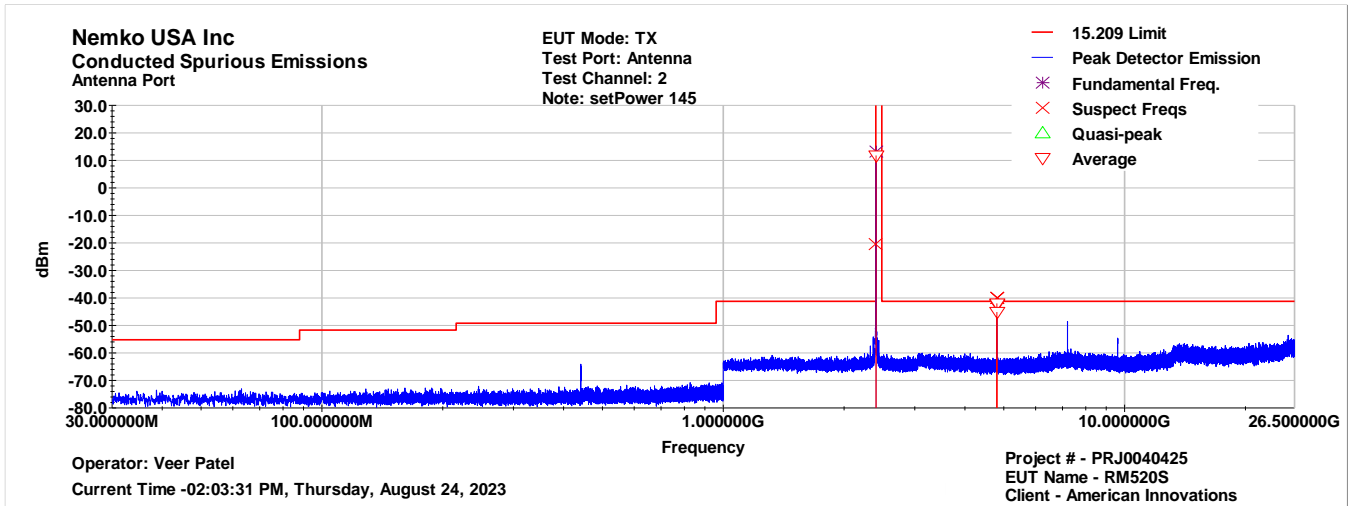
Channel 79 Channel: 100 kHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
439.138	-64.035	-6.879	57.156	PASS
2362.075	-57.523	-6.879	50.644	PASS
4800.775	-39.778	-6.879	32.899	PASS
7201.800	-50.146	-6.879	43.267	PASS
9602.275	-56.146	-6.879	49.267	PASS
25948.396	-63.536	-6.879	56.657	PASS

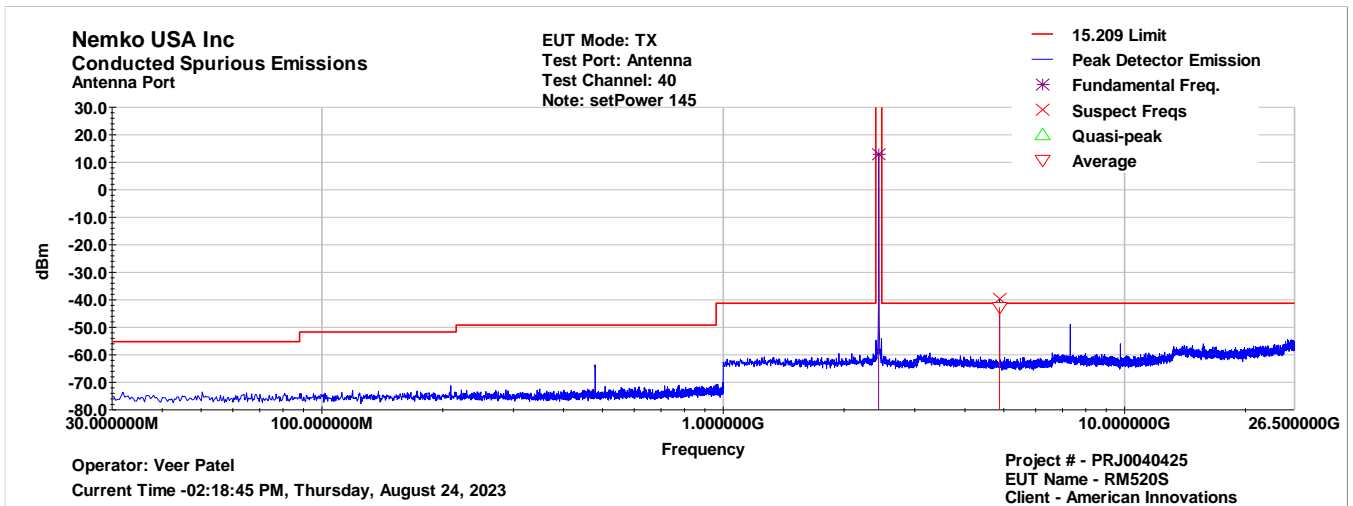
6.3.1 1 MHz Bandwidth Test data

Channel 2 Channel: 1 MHz Bandwidth



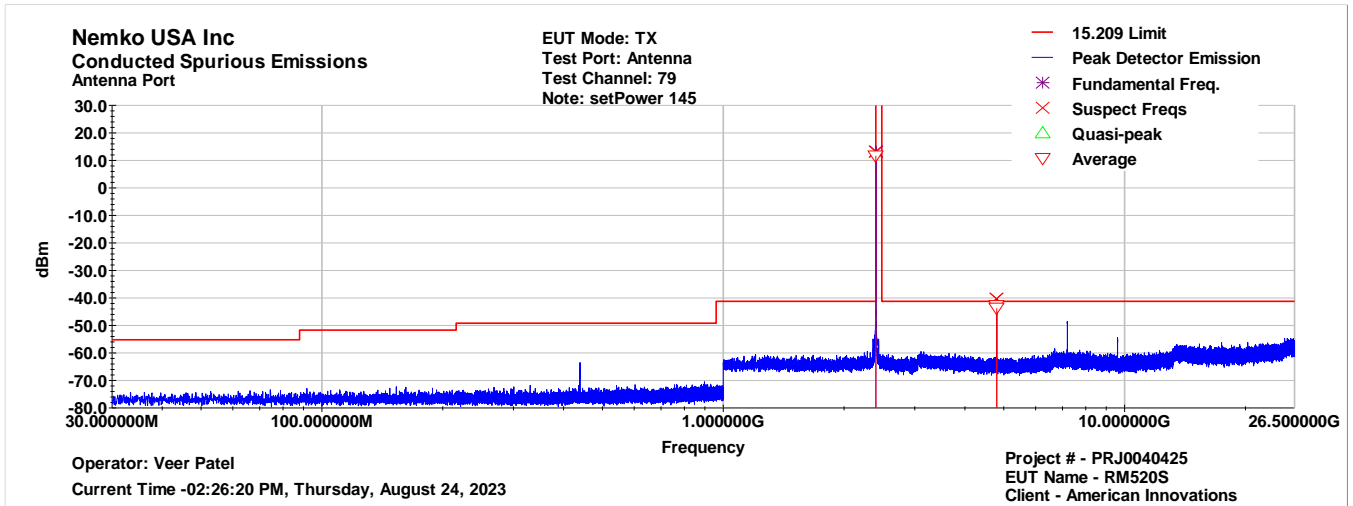
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4804.120	-41.998	-41.250	0.748	PASS

Channel 40 Channel: 1 MHz Bandwidth



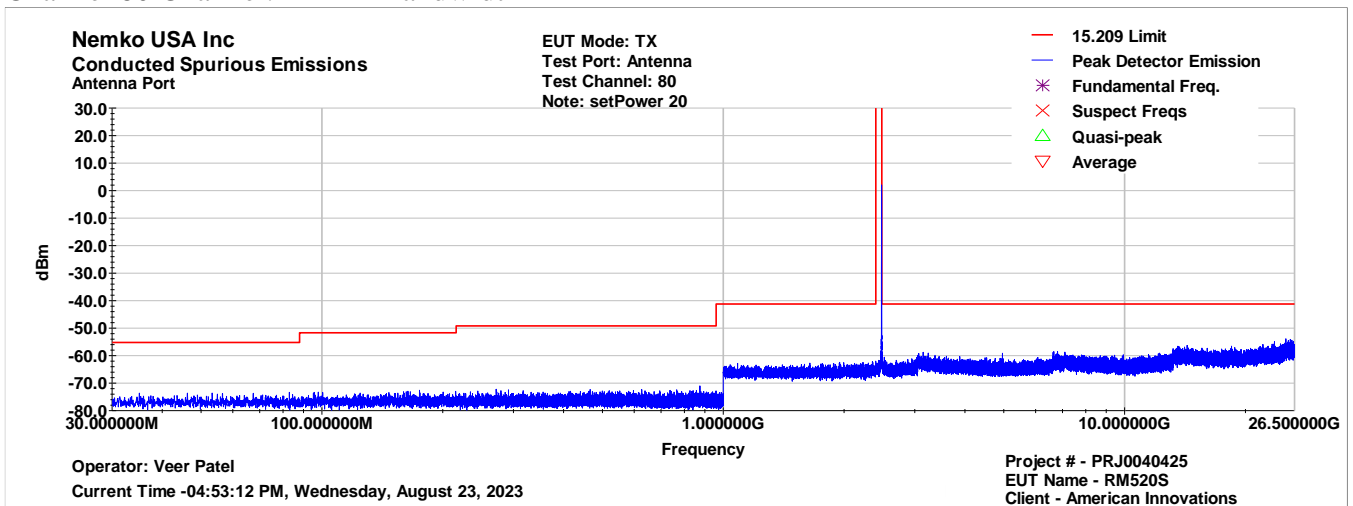
Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4880.230	-42.738	-41.250	1.488	PASS

Channel 79 Channel: 1 MHz Bandwidth



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
4800.799	-42.814	-41.250	1.564	PASS

Channel 80 Channel: 1 MHz Bandwidth



7.0 Radiated Spurious Emissions Test Results

7.1 Test Procedure

Conducted antenna port emissions are measured with the EUT in transmit mode for the bottom, middle, and top channels. Testing was performed on 10/5-6/2023.

Table 7.1.1: Test Parameters

30 MHz to 1 GHz	1 GHz to 18 GHz	18 GHz to 26 GHz
120kHz RBW / 300kHz VBW	1MHz RBW / 3MHz VBW	1MHz RBW / 3MHz VBW
Quasi-peak	Peak & Average	Peak & Average

7.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Unwanted Emissions
15.247(d), 15.209 (a) // RSS-247 5.5, RSS-Gen 6.13 & 8.10	Radiated Spurious Emissions; Transmit Mode

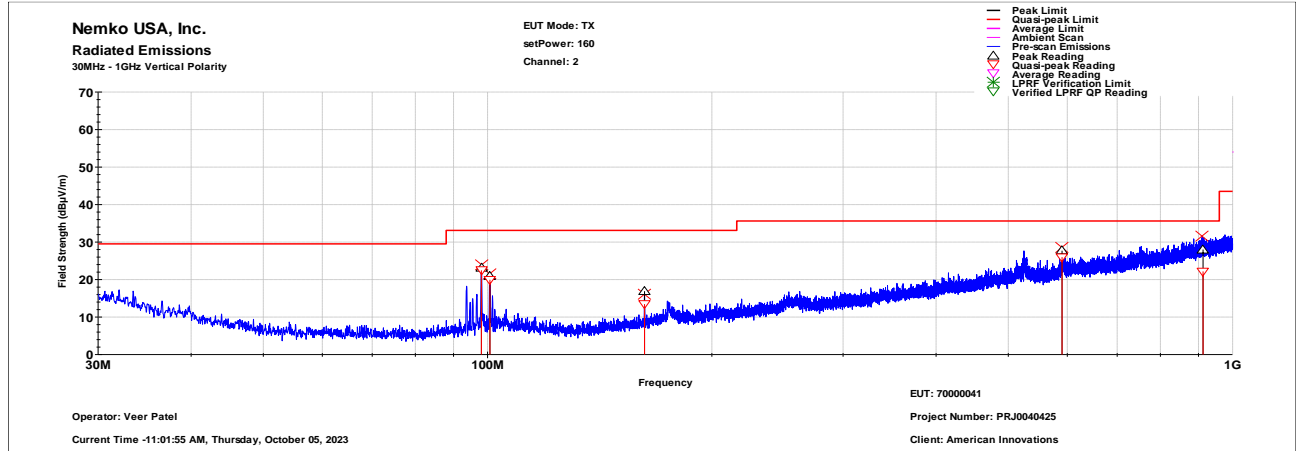
Table 7.2.1.1: Radiated Emissions Test Results Summary:

EUT Name	RM520S		Model or Serial #	70000041	
EUT Line Voltage	3.3	VDC	Frequency	N/A	Hz
Emissions Limit Level			EUT Test Mode or Configuration	Transmitting at maximum channel power	
Frequency Range	Test Distance (Meters)		Antenna Polarization	Test Results	
30MHz to 1GHz	10		Vertical	Pass	
			Horizontal	Pass	
1GHz to 18GHz	3		Vertical	Pass	
			Horizontal	Pass	
18GHz to 26.5GHz	3		Vertical	Pass	
			Horizontal	Pass	
Notes:					

7.2.2 Radiated Emissions Test Data

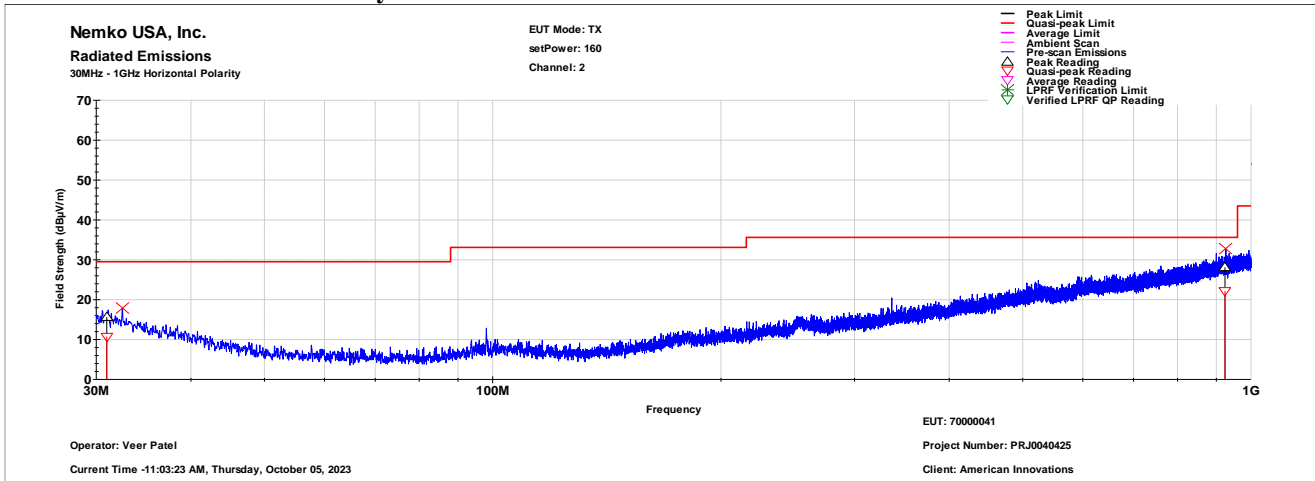
Channel 2

30MHz - 1GHz Vertical Polarity Measured Emissions Data



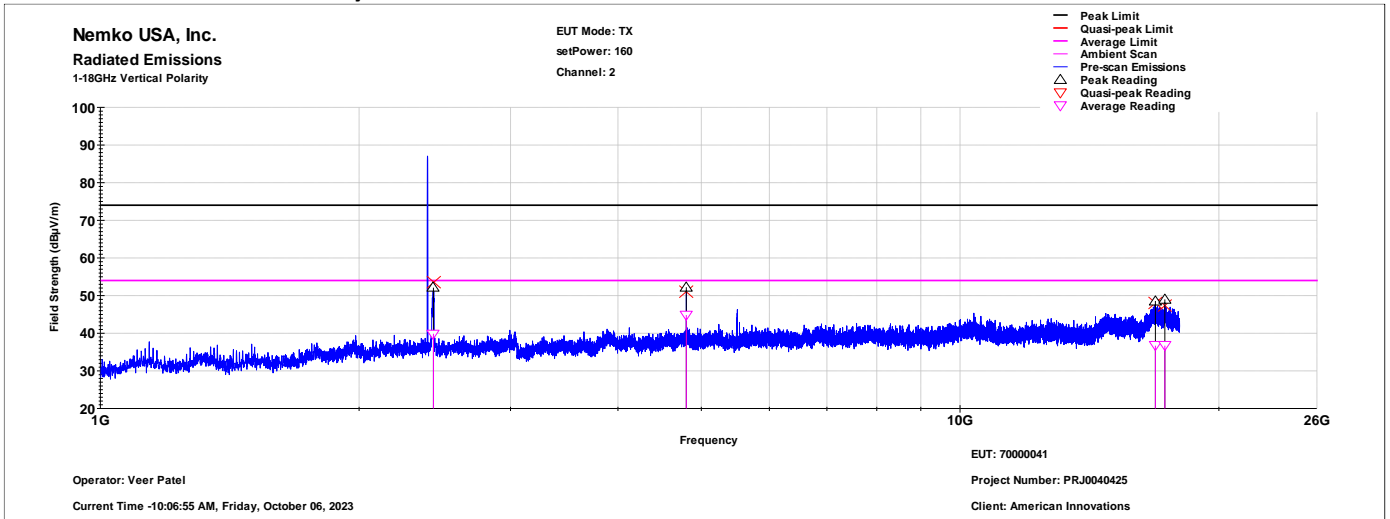
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
98.113	157.000	158.000	22.447	33.100	10.653	PASS	23.114
100.735	158.000	167.000	19.936	33.100	13.164	PASS	20.873
162.439	204.000	266.000	13.438	33.100	19.662	PASS	16.884
590.306	301.000	416.000	25.976	35.600	9.624	PASS	27.684
912.728	157.000	411.000	22.176	35.600	13.424	PASS	27.995

30MHz - 1GHz Horizontal Polarity Measured Emissions Data



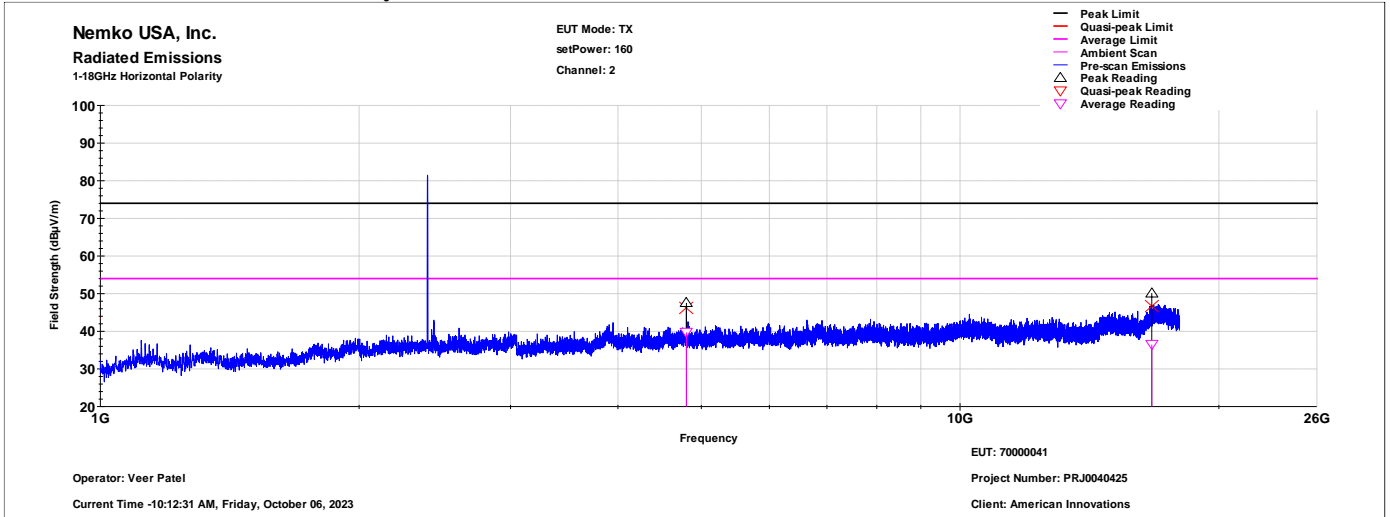
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
30.975	175.000	367.000	10.750	29.500	18.750	PASS	15.608
924.077	157.000	149.000	22.161	35.600	13.439	PASS	28.089

1GHz - 18GHz Vertical Polarity Measured Emissions Data:



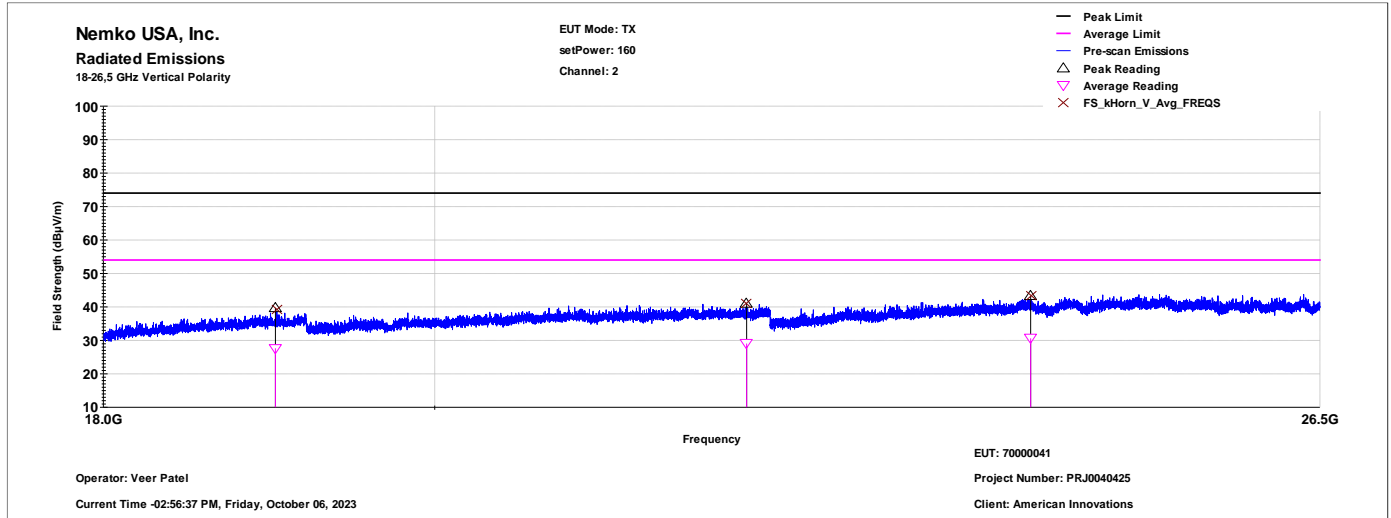
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
2440.46	104	172	NAN	NAN	NAN	NAN	52.089	74.000	21.911	PASS	39.835	54.000	14.165	PASS
4803.74	5	172	NAN	NAN	NAN	NAN	52.203	74.000	21.797	PASS	44.828	54.000	9.172	PASS
16871.39	71	170	NAN	NAN	NAN	NAN	48.544	74.000	25.456	PASS	36.681	54.000	17.319	PASS
17306.89	74	175	NAN	NAN	NAN	NAN	48.977	74.000	25.023	PASS	36.674	54.000	17.326	PASS

1GHz - 18GHz Horizontal Polarity Measured Emissions Data



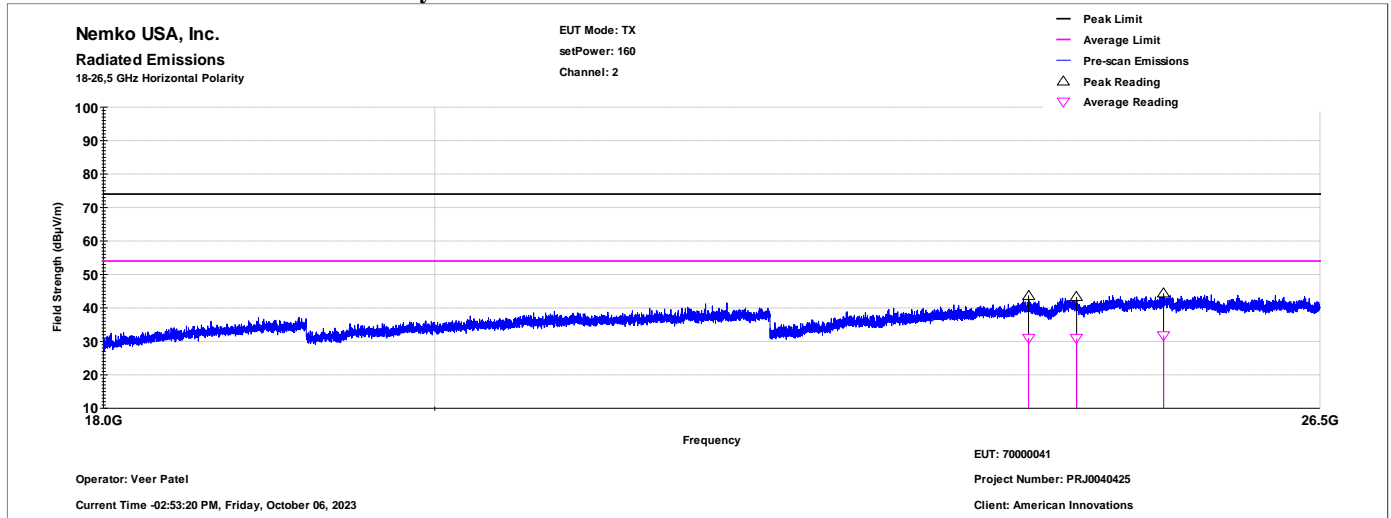
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
4804.42	67	200	NAN	NAN	NAN	NAN	47.528	74.000	26.472	PASS	39.731	54.000	14.269	PASS
16707.54	29	108	NAN	NAN	NAN	NAN	50.146	74.000	23.854	PASS	36.469	54.000	17.531	PASS

18GHz – 26.5GHz Vertical Polarity Measured 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
19012.34	152	100.000	39.700	74.000	34.300	PASS	27.617	54.000	26.383	PASS
22085.33	323	100.000	41.106	74.000	32.894	PASS	29.053	54.000	24.947	PASS
24172.26	29	100.000	43.307	74.000	30.693	PASS	30.601	54.000	23.399	PASS

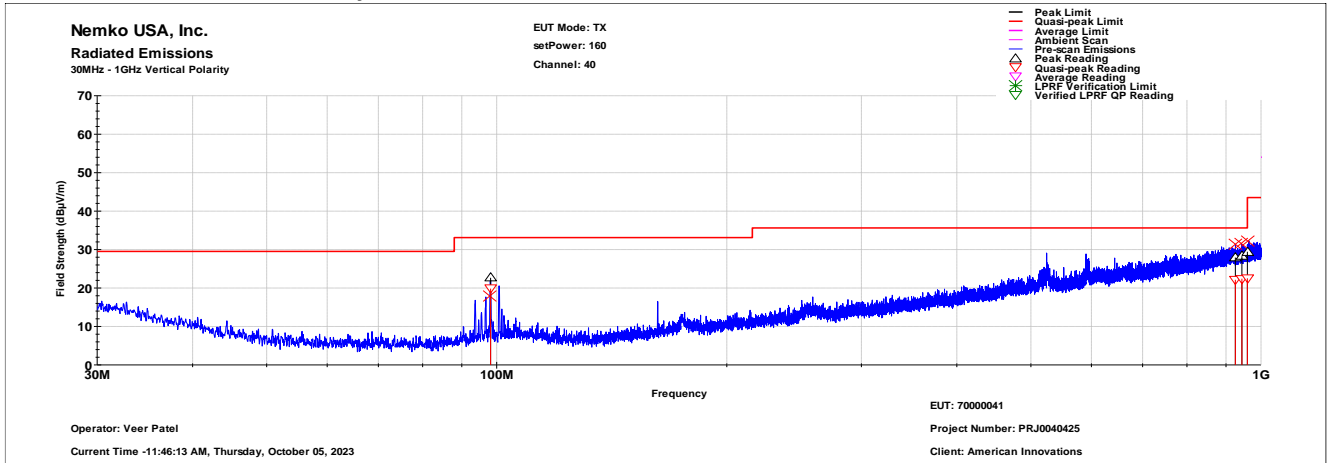
18GHz - 26.5GHz Horizontal Polarity Measured Emissions Data



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
24155.80	170	100.000	43.745	74.000	30.255	PASS	30.992	54.000	23.008	PASS
24527.79	30	100.000	43.251	74.000	30.749	PASS	30.862	54.000	23.138	PASS
25215.74	170	100.000	44.332	74.000	29.668	PASS	31.751	54.000	22.249	PASS

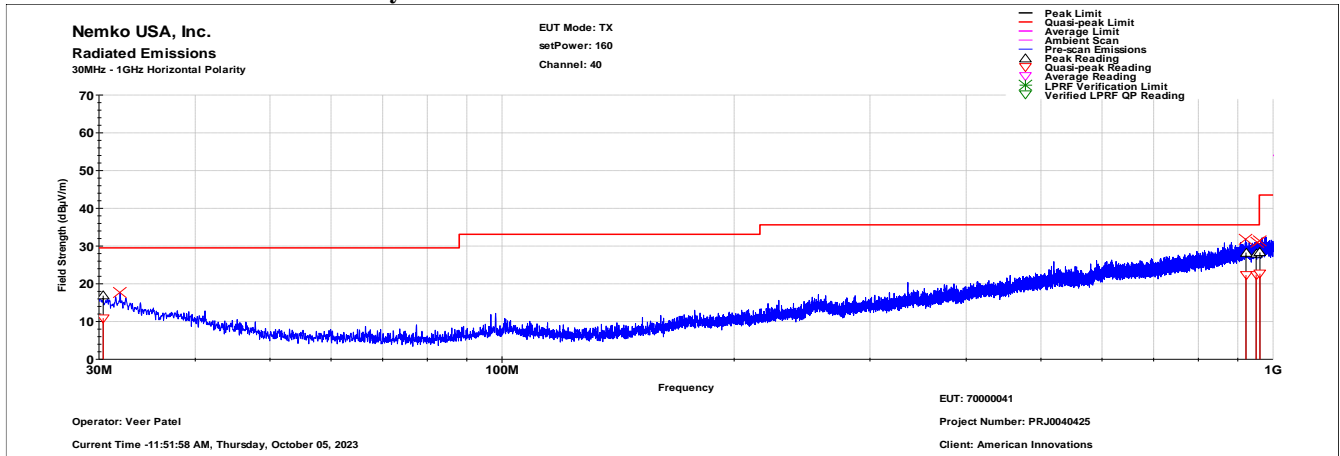
Channel 40

30MHz - 1GHz Vertical Polarity Measured Emissions Data



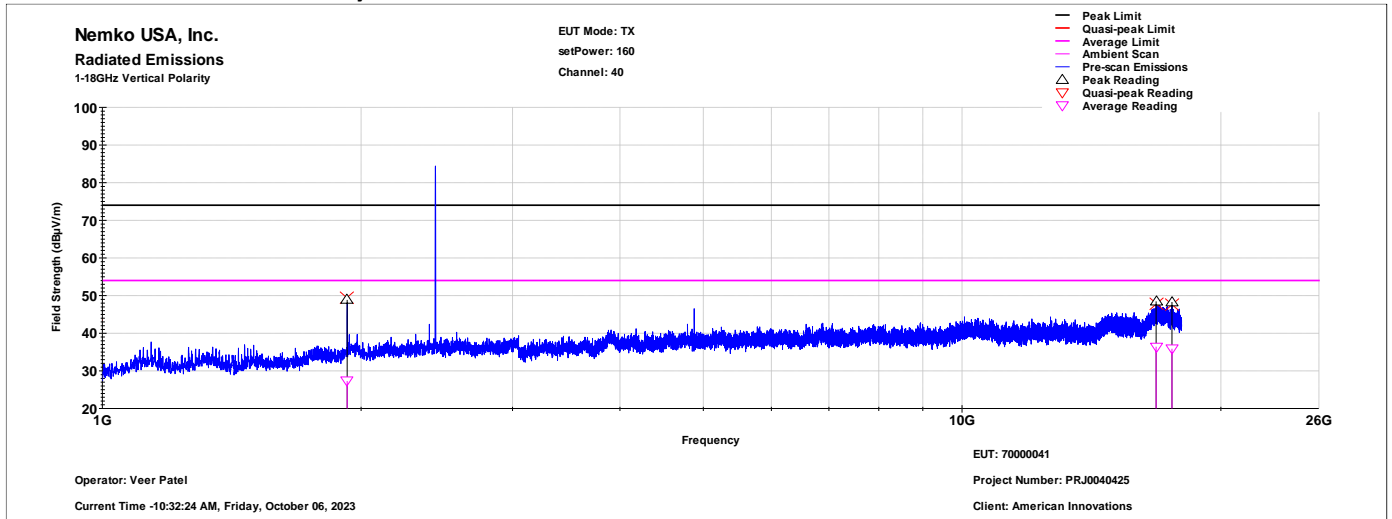
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
98.174	95.000	118.000	19.821	33.100	13.279	PASS	22.652
925.804	2.000	273.000	22.135	35.600	13.465	PASS	27.897
944.014	112.000	124.000	22.405	35.600	13.195	PASS	28.274
959.865	5.000	112.000	22.525	35.600	13.075	PASS	29.420

30MHz - 1GHz Horizontal Polarity Measured Emissions Data



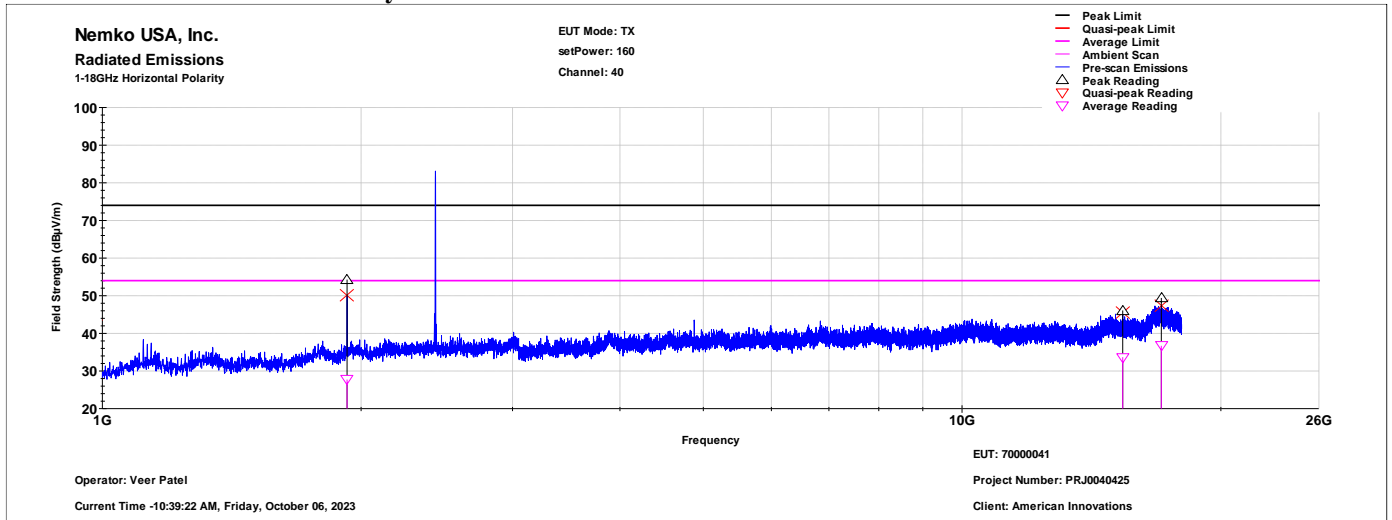
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
30.386	69.000	238.000	10.895	29.500	18.605	PASS	16.851
922.523	0.000	242.000	22.303	35.600	13.297	PASS	28.259
950.963	317.000	391.000	22.408	35.600	13.192	PASS	28.013
961.795	354.000	400.000	22.660	43.500	20.840	PASS	28.283

1GHz - 18GHz Vertical Polarity Measured Emissions Data:



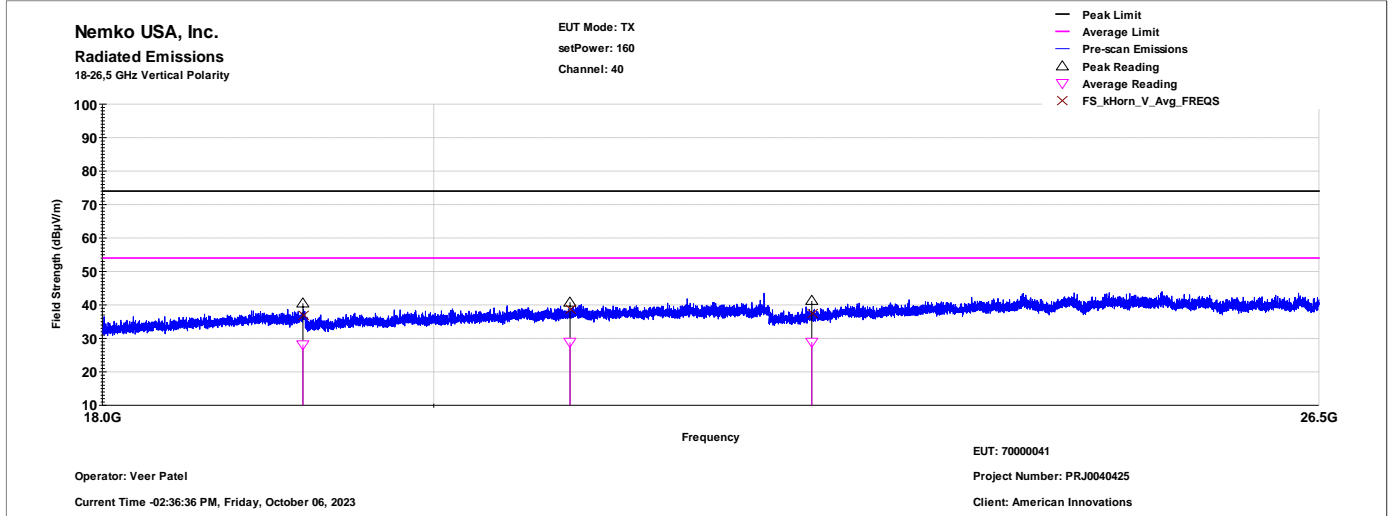
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1926.67	16	241	NAN	NAN	NAN	NAN	48.836	74.000	25.164	PASS	27.285	54.000	26.715	PASS
16813.20	161	119	NAN	NAN	NAN	NAN	48.462	74.000	25.538	PASS	36.410	54.000	17.590	PASS
17543.08	155	254	NAN	NAN	NAN	NAN	48.288	74.000	25.712	PASS	35.869	54.000	18.131	PASS

1GHz - 18GHz Horizontal Polarity Measured Emissions Data



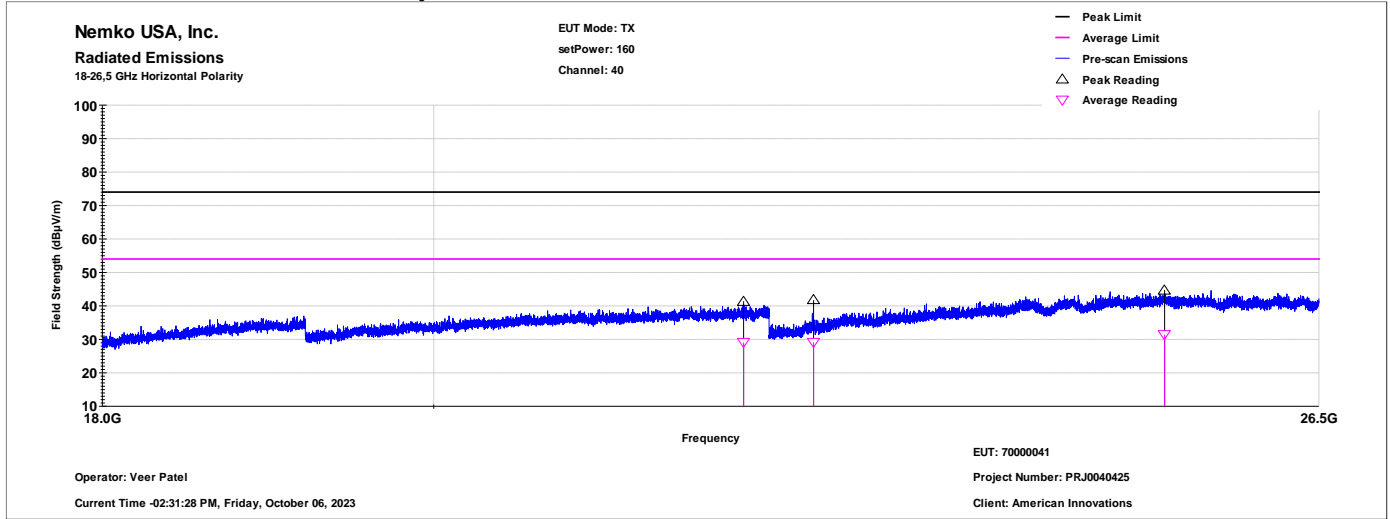
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1926.18	305	286	NAN	NAN	NAN	NAN	54.253	74.000	19.747	PASS	27.740	54.000	26.260	PASS
15375.86	40	120	NAN	NAN	NAN	NAN	46.082	74.000	27.918	PASS	33.664	54.000	20.336	PASS
17050.14	294	154	NAN	NAN	NAN	NAN	49.401	74.000	24.599	PASS	36.678	54.000	17.322	PASS

18GHz – 26.5GHz Vertical Polarity Measured 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
19185.17	324	100.000	40.459	74.000	33.541	PASS	28.134	54.000	25.866	PASS
20886.09	125	100.000	40.790	74.000	33.210	PASS	28.822	54.000	25.178	PASS
22554.48	166	100.000	41.173	74.000	32.827	PASS	28.894	54.000	25.106	PASS

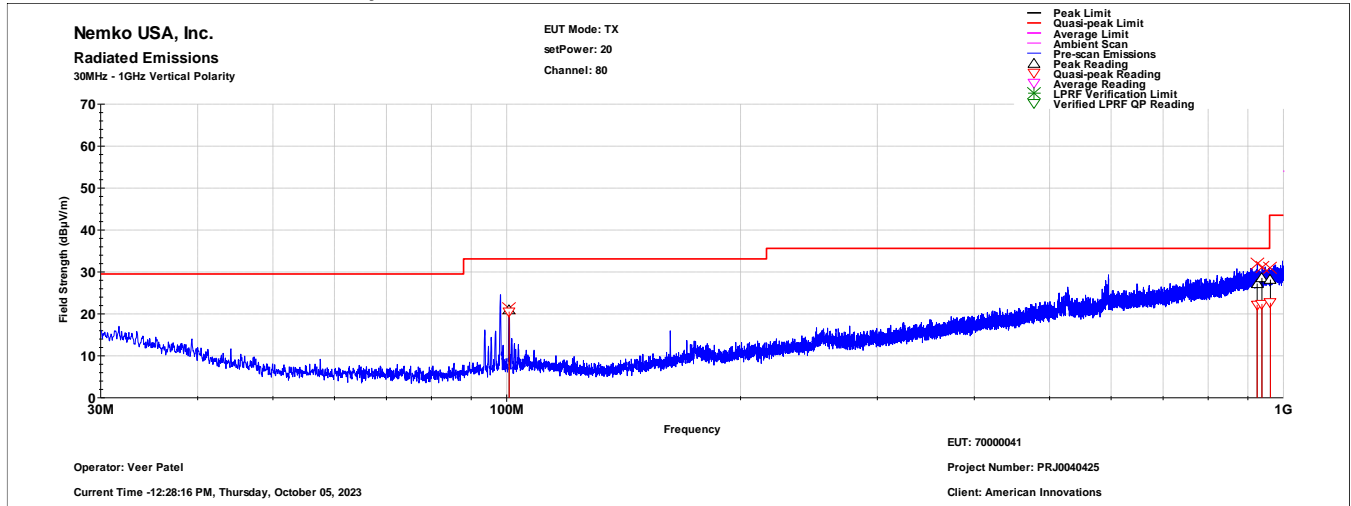
18GHz - 26.5GHz Horizontal Polarity Measured Emissions Data



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
22071.16	54	100.000	41.355	74.000	32.645	PASS	29.038	54.000	24.962	PASS
22567.54	122	100.000	41.690	74.000	32.310	PASS	29.082	54.000	24.918	PASS
25231.40	74	100.000	44.754	74.000	29.246	PASS	31.418	54.000	22.582	PASS

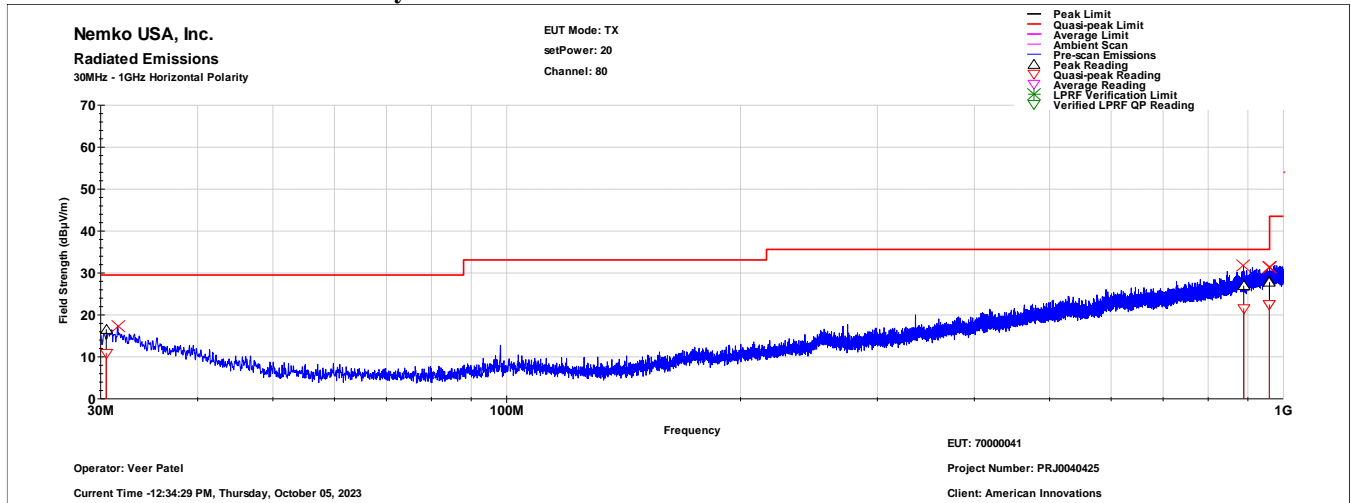
Channel 80

30MHz - 1GHz Vertical Polarity Measured Emissions Data



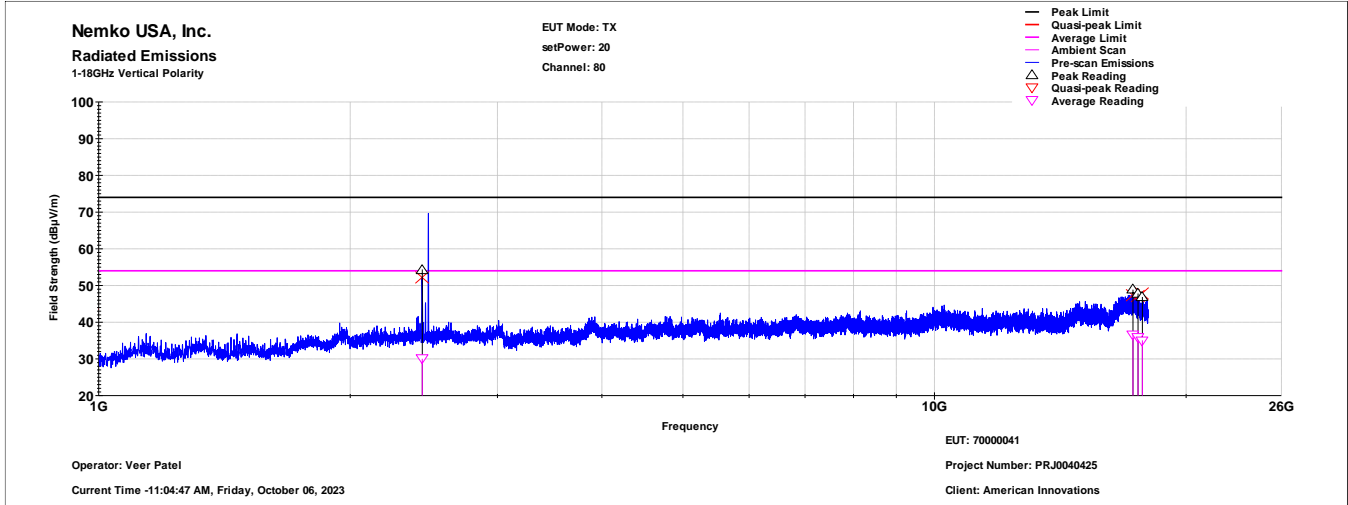
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
100.729	1.000	164.000	20.530	33.100	12.570	PASS	20.923
925.103	204.000	274.000	22.155	35.600	13.445	PASS	27.223
938.443	295.000	257.000	22.390	35.600	13.210	PASS	28.574
962.324	354.000	124.000	22.648	43.500	20.852	PASS	28.173

30MHz - 1GHz Horizontal Polarity Measured Emissions Data



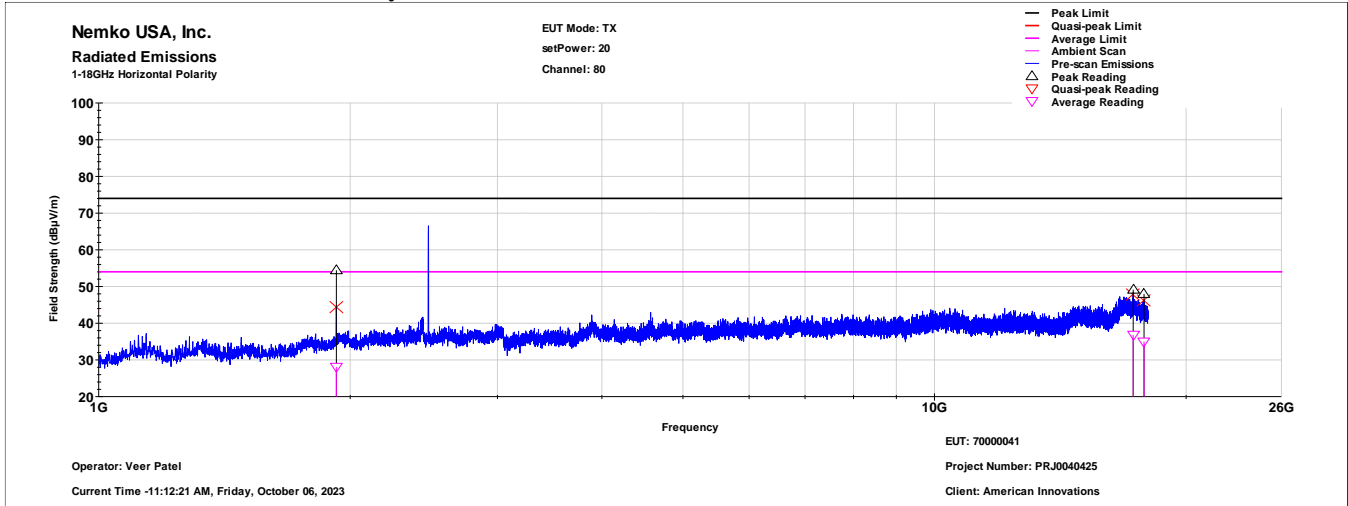
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
30.505	147.000	252.000	10.929	29.500	18.571	PASS	16.566
889.096	283.000	258.000	21.587	35.600	14.013	PASS	26.976
959.178	6.000	105.000	22.499	35.600	13.101	PASS	27.924
959.588	23.000	109.000	22.496	35.600	13.104	PASS	27.814

1GHz - 18GHz Vertical Polarity Measured Emissions Data:



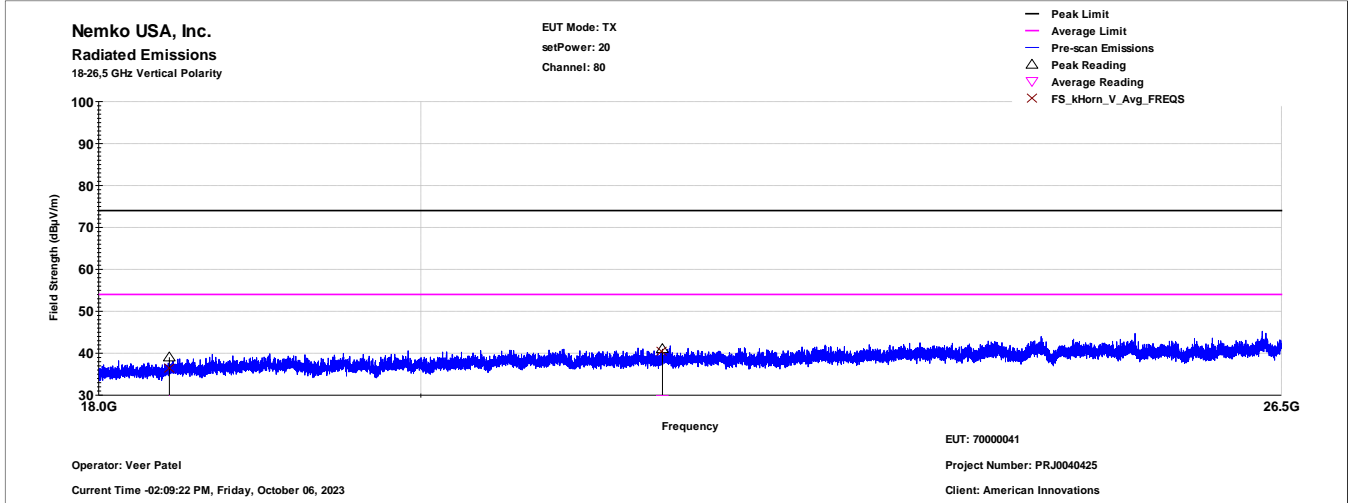
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
2438.67	97	327	NAN	NAN	NAN	NAN	54.354	74.000	19.646	PASS	30.030	54.000	23.970	PASS
17277.57	265	350	NAN	NAN	NAN	NAN	48.854	74.000	25.146	PASS	36.602	54.000	17.398	PASS
17516.76	353	181	NAN	NAN	NAN	NAN	47.817	74.000	26.183	PASS	35.867	54.000	18.133	PASS
17730.08	227	120	NAN	NAN	NAN	NAN	46.869	74.000	27.131	PASS	35.051	54.000	18.949	PASS

1GHz - 18GHz Horizontal Polarity Measured Emissions Data



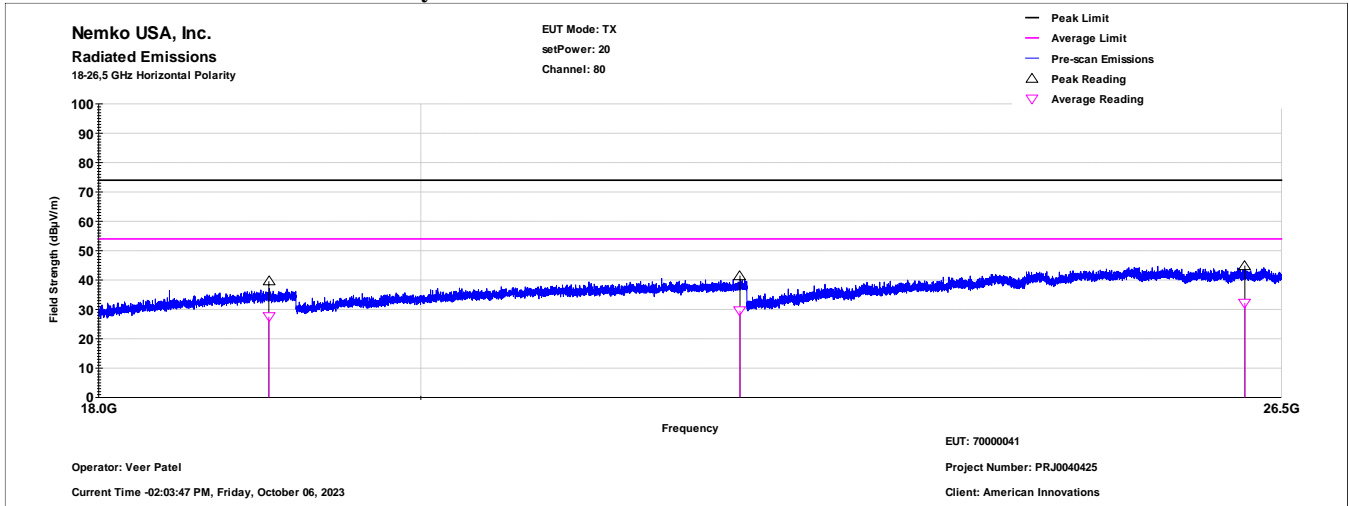
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1924.78	183	286	NAN	NAN	NAN	NAN	54.400	74.000	19.600	PASS	28.078	54.000	25.922	PASS
17284.27	11	169	NAN	NAN	NAN	NAN	49.130	74.000	24.870	PASS	36.790	54.000	17.210	PASS
17808.38	83	108	NAN	NAN	NAN	NAN	47.978	74.000	26.022	PASS	34.998	54.000	19.002	PASS

18GHz – 26.5GHz Vertical Polarity Measured 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
18421.47	191	100.000	39.030	74.000	34.970	PASS	27.039	54.000	26.961	PASS
21644.64	42	100.000	41.020	74.000	32.980	PASS	28.945	54.000	25.055	PASS

18GHz - 26.5GHz Horizontal Polarity Measured 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
19030.43	177	100.000	39.589	74.000	34.411	PASS	27.509	54.000	26.491	PASS
22199.99	93	100.000	41.511	74.000	32.489	PASS	29.551	54.000	24.449	PASS
26185.04	159	100.000	44.940	74.000	29.060	PASS	32.240	54.000	21.760	PASS

8.0 Spurious Emissions, Receive Mode

8.1 Test Procedure

Conducted antenna port emissions are measured with the EUT in receive mode. Testing was performed on 10/5-6/2023.

Table 8.1.1: Test Parameters

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

8.2 Test Criteria

47 CFR (USA) // IC (Canada)	
Section Reference	Unwanted Emissions
47 CFR 15.109(a) // RSS-Gen 7.3 & 8.10	Spurious Emissions; Receive Mode

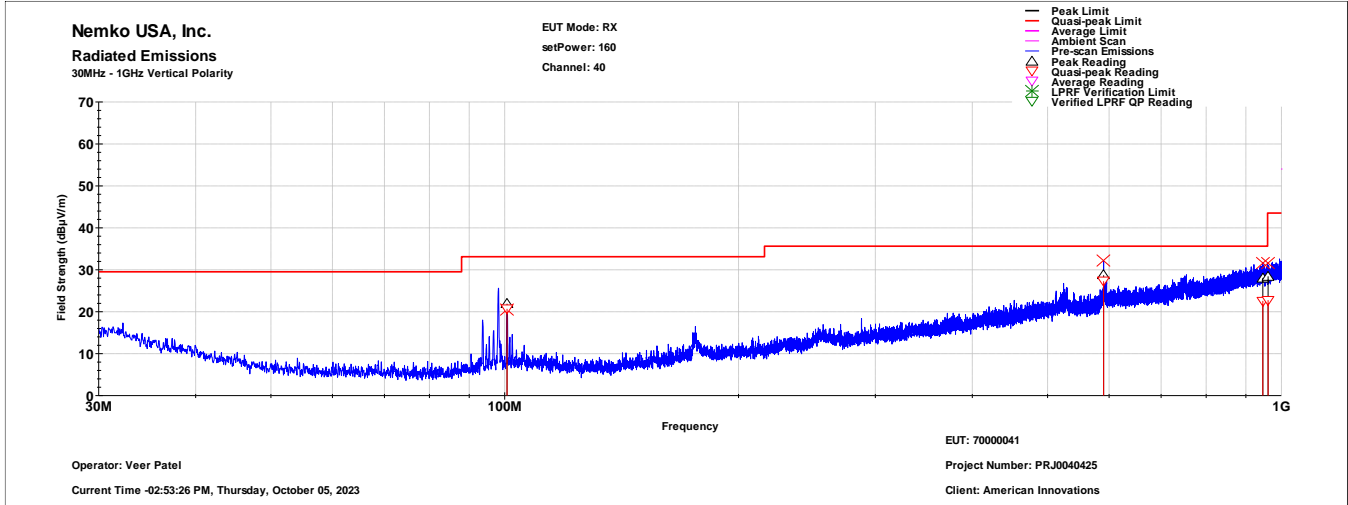
8.3 Test Results

EUT tested in receive mode (transmitter off).

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

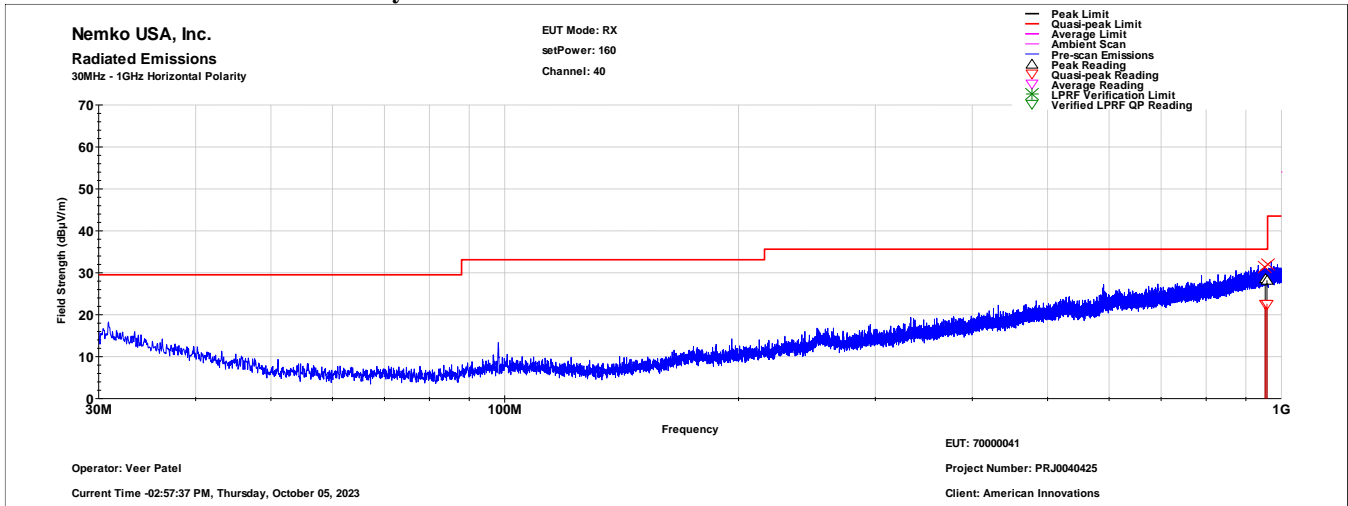
EUT Name	RM520S		Model or Serial #	70000041	
EUT Line Voltage	3.3	VDC	Frequency	N/A	Hz
Emissions Limit Level			EUT Test Mode or Configuration	Normal Mode	
Frequency Range	Test Distance (Meters)		Antenna Polarization	Test Results	
30MHz to 1GHz	10		Vertical	Pass	
			Horizontal	Pass	
1GHz to 18GHz	3		Vertical	Pass	
			Horizontal	Pass	
Notes:					

30MHz - 1GHz Vertical Polarity Measured Emissions Data



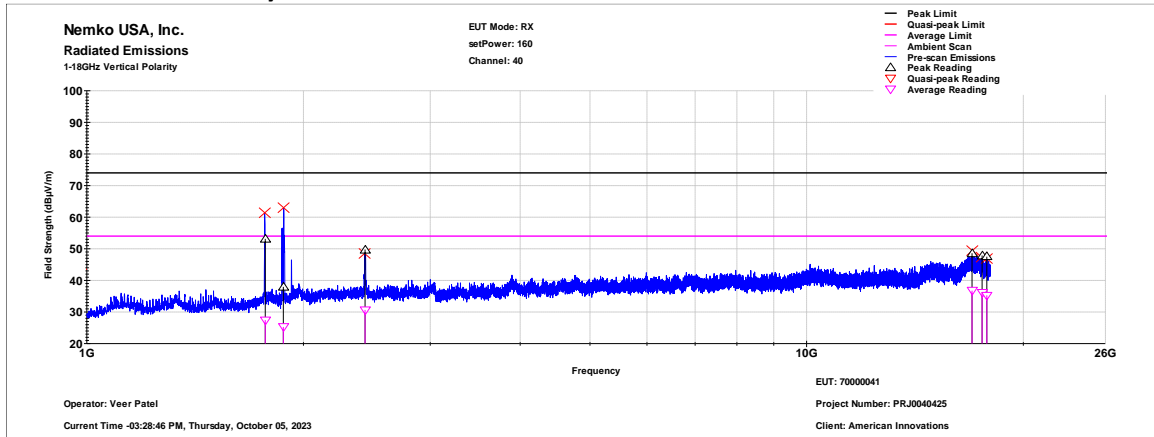
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
100.701	335.000	119.000	20.670	33.100	12.430	PASS	21.880
590.301	113.000	406.000	27.244	35.600	8.356	PASS	28.678
946.411	338.000	124.000	22.580	35.600	13.020	PASS	28.050
961.495	355.000	112.000	22.749	43.500	20.751	PASS	28.419

30MHz - 1GHz Horizontal Polarity Measured Emissions Data



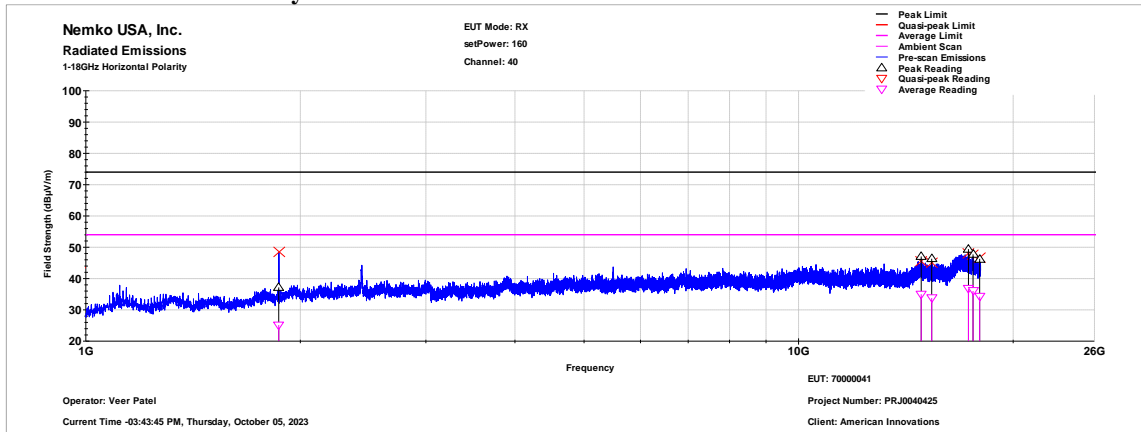
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
953.227	275.000	258.000	22.562	35.600	13.038	PASS	28.615
958.049	355.000	392.000	22.579	35.600	13.021	PASS	28.210

1GHz - 18GHz Vertical Polarity Measured 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)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1769.72	65	387	NAN	NAN	NAN	NAN	53.136	74.000	20.864	PASS	27.432	54.000	26.568	PASS
1874.92	77	170	NAN	NAN	NAN	NAN	37.951	74.000	36.049	PASS	25.246	54.000	28.754	PASS
2435.17	200	108	NAN	NAN	NAN	NAN	49.765	74.000	24.235	PASS	30.643	54.000	23.357	PASS
16973.56	291	114	NAN	NAN	NAN	NAN	48.570	74.000	25.430	PASS	36.724	54.000	17.276	PASS
17527.11	355	102	NAN	NAN	NAN	NAN	47.854	74.000	26.146	PASS	36.115	54.000	17.885	PASS
17792.19	334	119	NAN	NAN	NAN	NAN	47.491	74.000	26.509	PASS	35.263	54.000	18.737	PASS

1GHz - 18GHz Horizontal Polarity Measured 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)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1864.82	355	327	NAN	NAN	NAN	NAN	37.142	74.000	36.858	PASS	25.154	54.000	28.846	PASS
14857.47	57	258	NAN	NAN	NAN	NAN	47.043	74.000	26.957	PASS	34.997	54.000	19.003	PASS
15372.76	24	131	NAN	NAN	NAN	NAN	46.336	74.000	27.664	PASS	33.799	54.000	20.201	PASS
17307.48	135	222	NAN	NAN	NAN	NAN	49.397	74.000	24.603	PASS	36.691	54.000	17.309	PASS
17566.93	336	267	NAN	NAN	NAN	NAN	47.713	74.000	26.287	PASS	36.002	54.000	17.998	PASS
17949.24	313	139	NAN	NAN	NAN	NAN	46.288	74.000	27.712	PASS	34.181	54.000	19.819	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. *Provided by antenna manufacturer

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

Test Equipment List					
Asset#	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
2431	Rohde & Schwarz	132.6005K26	Test Receiver, ESU / EMI Test Receiver 20 Hz - 26.5 GHz	100027	6/5/2024
A135	MCE /Weinschel	34-20-34	Attenuator, 20 dB 25W, DC-4GHz	BP7923	4/11/2025
C205	Pasternack	none	Cable, SMA-SMA, 0.533m, brown	None	4/4/2024
2262	Keysight	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY42510155	7/6/2024

10.2 Radiated Emissions

Radiated Emissions Test Equipment List					
Tile! Software Version:		Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM)			
Test Profile:		2020_RE_Unintentional_TILE7_v6.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	4/9/2024
1457	HP	8447D	Preamp, .1-1300MHz	1937A02800	10/28/2024
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	3/22/2024
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	7/15/2024
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/16/2024
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1293	EMCO	6502	Antenna, Loop, Active, .01-30MHz	2040	11/17/2024
1509B	Braden	TDK 10M	TDK 10M Chamber, sVSWR > 1 GHz	DAC-012915-005	4/9/2024

2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, 100MHz-18GHz	None	1/20/2024
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/18/2024
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
2438	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	99232	10/12/2024
C137	Belden	M17/164	Cable, RF, N-N, 9.14m, Black, 9 kHz - 1 GHz	None	9/18/2024
C289	Pasternack	PE354-24	Cable, N-SMA, 0.610m Blue	1310	9/9/2024

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 ANAB policy. Since Nemko USA, Inc. operates in accordance with ANAB Document Number AR 2250: 2021/06/16, 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 ANAB Document Number AR 2250.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at Nemko USA 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 USA's 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	2.82
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	3.48
Radiated Emissions	30 to 1,000 MHz	10 m	3.88
	1 to 18 GHz	3 m	4.31

End of Report