Project 22457-15

Hubbell Control Solutions

NXRM2-H

Wireless Test Report

Prepared for:

Hubbell Control Solutions
710 Hesters Crossing Rd, Suite 100
Round Rock, TX 78681

By

Nemko PTI, Inc.
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January 28, 2022

Written by

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Wireless Engineer

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Compliance Certificate

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

Applicant	Device & Test Identification
Hubbell Control Solutions 710 Hesters Crossing Rd, Suite 100 Round Rock, TX 78681	FCC ID: YH9NXRM2 Industry Canada ID: 9044A-NXRM2 Model(s): NXRM2-H

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 Professional Testing (EMI), 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.

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
Duty Cycle	15.247 (a)(1)(3)	RSS-247 5.3 (a)	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	15.247 (d), 15.209 (a)	RSS-247 5.5, RSS-Gen 7.3 & 4.10	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.

Professional Testing (EMI), Inc., (PTI) 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

Manufacturer / Model	Serial #	Description
Hubbell Control Solutions Model: NXRM2-H	9300003D	2400-2483.5 MHz FHSS transceiver Bluetooth Low Energy radio protocols.

1.3 EUT Test Mode

EUT has the capability to operate in BLE and Wirepas modes. Wirepas has the similar characteristics and the power levels as the BLE as observed during evaluation. Therefore, test data for BLE mode is reported in this report.

1.4 EUT Test Mode

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1.5 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.

1.6 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.

1.7 Test Site

Measurements were made at the 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.

1.8 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.

1.9 Applicable Documents

Table 1.9.1: 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 2013	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. Measurements were performed on 1/14/2022.

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

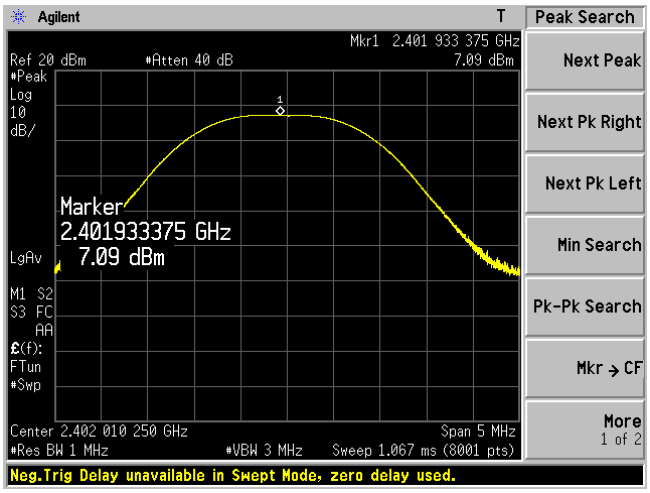
2.3 Test Results, Peak Power

Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
EUT (6 or 20 dB) Bandwidth:	0.70	MHz							
Measurement Parameters:	RBW	1	MHz	VBW	3	MHz	Span	5	MHz	Detector	Peak

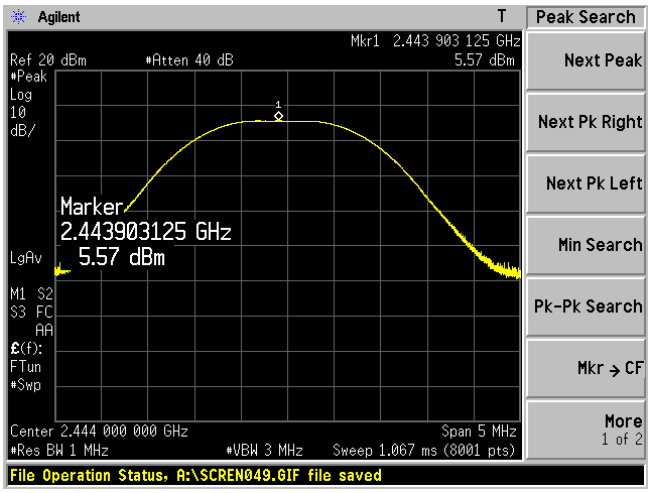
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)	Corrected Power (dBm)	Limit (dBm)	Test Result
Low	2402	7.09	0	7.09	30	Pass
Mid	2444	5.57	0	5.57	30	Pass
High	2480	4.16	0	4.16	30	Pass

The requirements were satisfied.

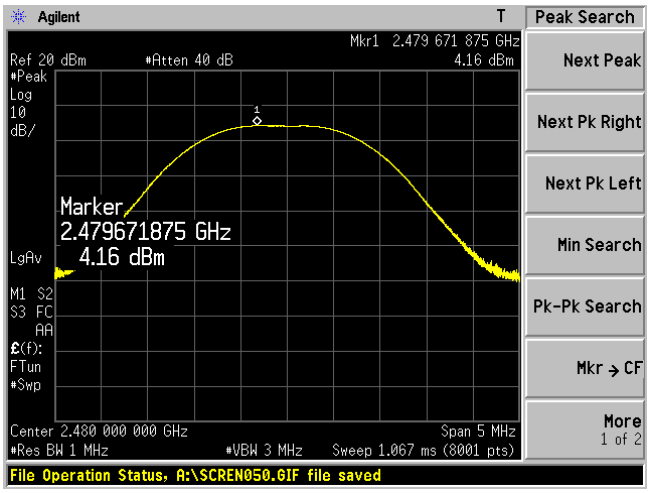
Peak output power test data:



Low Channel



Mid Channel



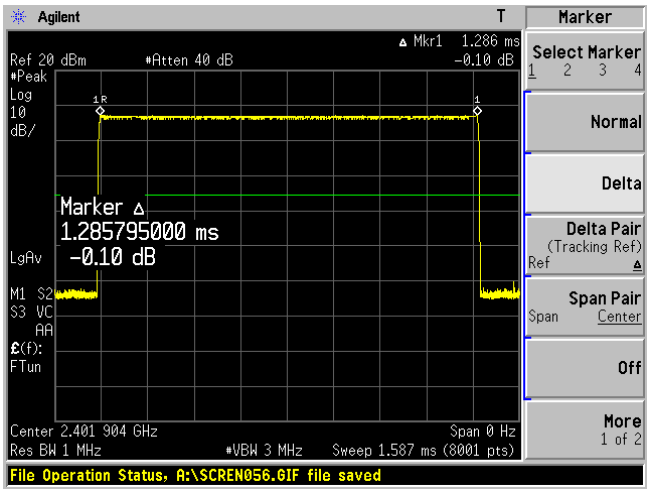
High Channel

2.4 Test Results, Duty Cycle

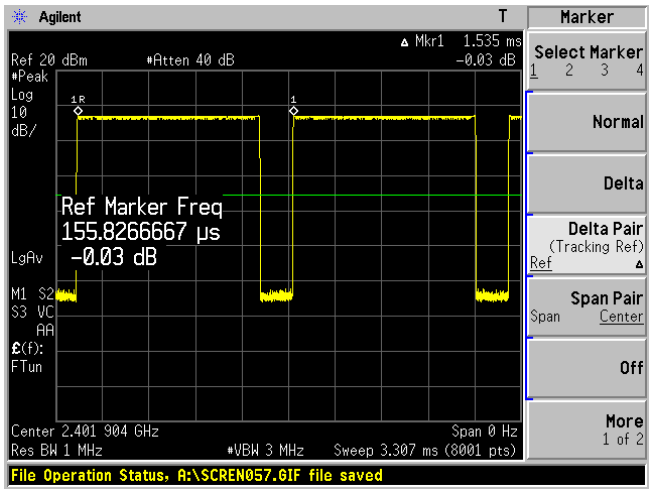
Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement. Measurements were performed on 1/14/2022.

Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
Measurement Parameters:	RBW	1	MHz	VBW	3	MHz	Span	0	MHz	Detector	Peak

Measured On Time (ms)	Max On Time Allowed (ms)	On Time Result	Measured Time Interval (ms)	Duty Cycle Factor (dB) (20 * Log(On time/Interval)	Duty Cycle Factor Allowed (dB)
1.286	400	Pass	1.535	-1.54	
RF Exposure Duty Cycle Reduction Factor (10 * Log(On Time/Period), (dB)					-0.8



Transmit Event Time



Time Interval (Return to channel time)

Duty Cycle Measurement

3.0 Power Spectral Density

3.1 Test Procedure

The radio was connected directly to the spectrum analyzer for measurement. Low, mid, and high channel was measured. Measurements were performed on 1/14/2022.

3.2 Test Criteria

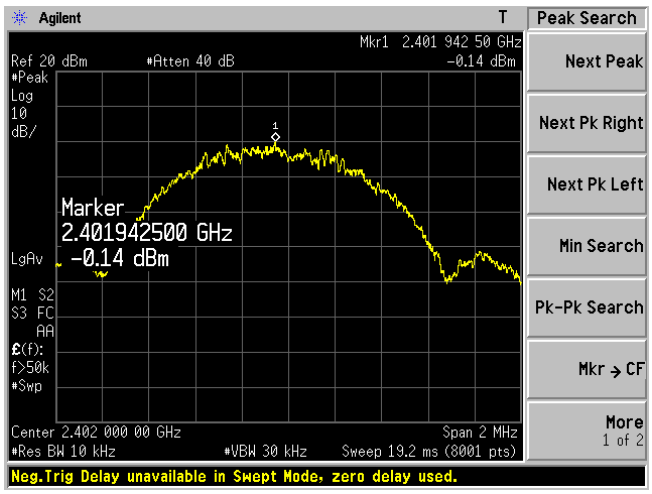
47 CFR (USA) // IC (Canada)	
Section Reference	Power Spectral Density, Conducted Limit
15.247(e) // RSS-247, 5.2	8 dBm / 3 kHz Restated as field strength: 103.23 dBµV/m at 3 m

3.3 Test Results, Tabular

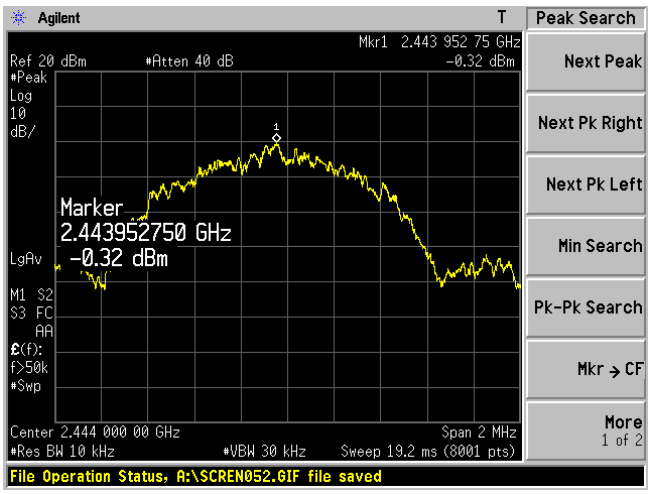
Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
EUT Channel Bandwidth:	0.70	MHz							

Measurement Parameters:	RBW	10	kHz	VBW	30	kHz	Span	2	MHz	Detector	Peak

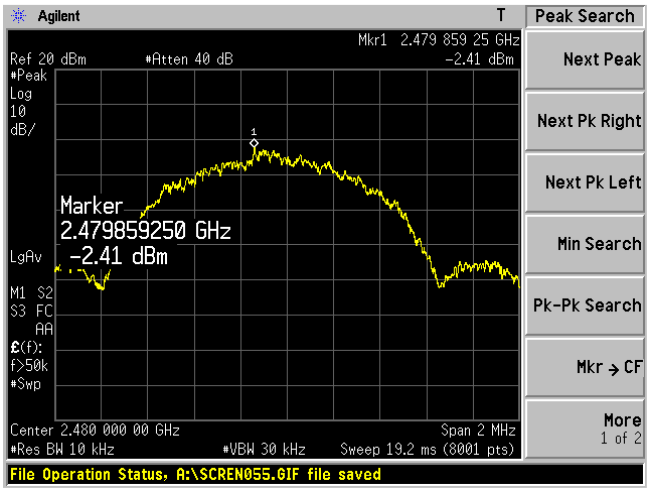
Channel	Frequency (MHz)	Measured Power (dBm)	Attenuator Factor (dB)	Corrected Power (dBm)	Limit (dBm)	Test Result
Low	2402	-0.14	0	-0.14	8	Pass
Mid	2444	-0.32	0	-0.32	8	Pass
High	2480	-2.41	0	-2.41	8	Pass



Low Channel



Mid Channel



High Channel

The requirements were satisfied.

4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured and recorded. The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application. Measurements were performed on 1/14/2022.

4.2 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.

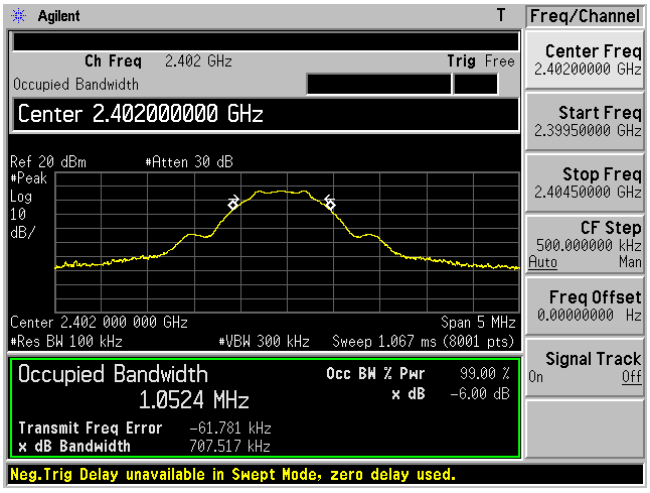
4.3 Test Results, Tabular

Environmental Conditions:	Temperature	24.1	°C	Humidity	32	RH	Barometric Pressure	29.28	in Hg
Measurement Parameters:	RBW	100	kHz	VBW	300	kHz	Span	5	MHz	Detector	Peak
Measurement Bandwidth:	- 6	dB									

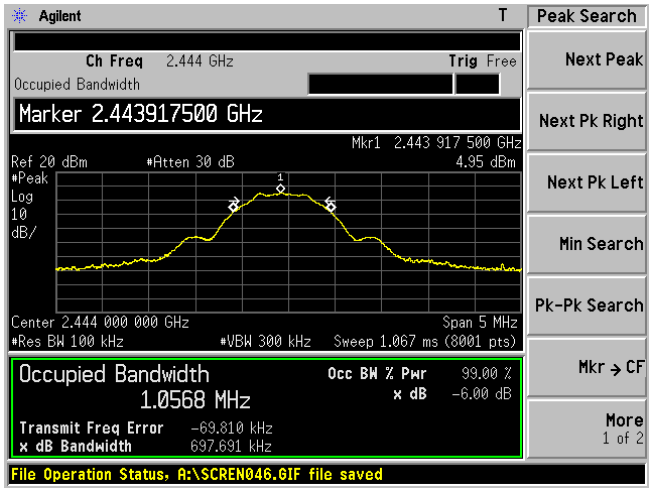
Channel	Frequency (MHz)	Measured Bandwidth (kHz)	Reported Maximum Bandwidth (kHz)
Low	2402	707.517	707.52
Mid	2444	697.691	
High	2480	697.649	

The EUT met the requirements.

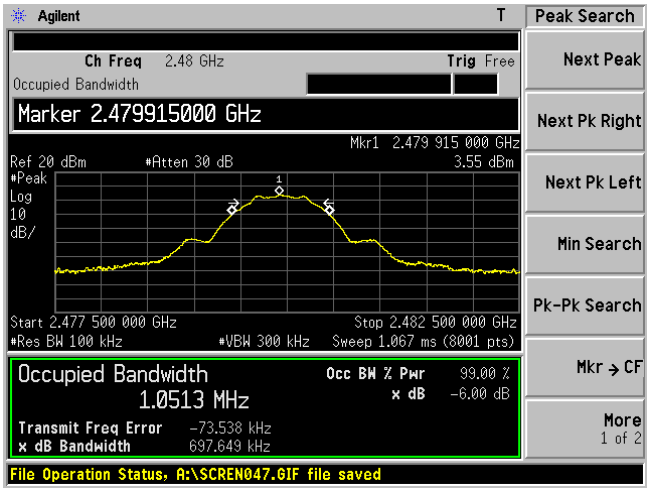
4.4 Test Results, Recorded: 6 dB, 99% BW



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. Measurements were performed on 1/14/2022.

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

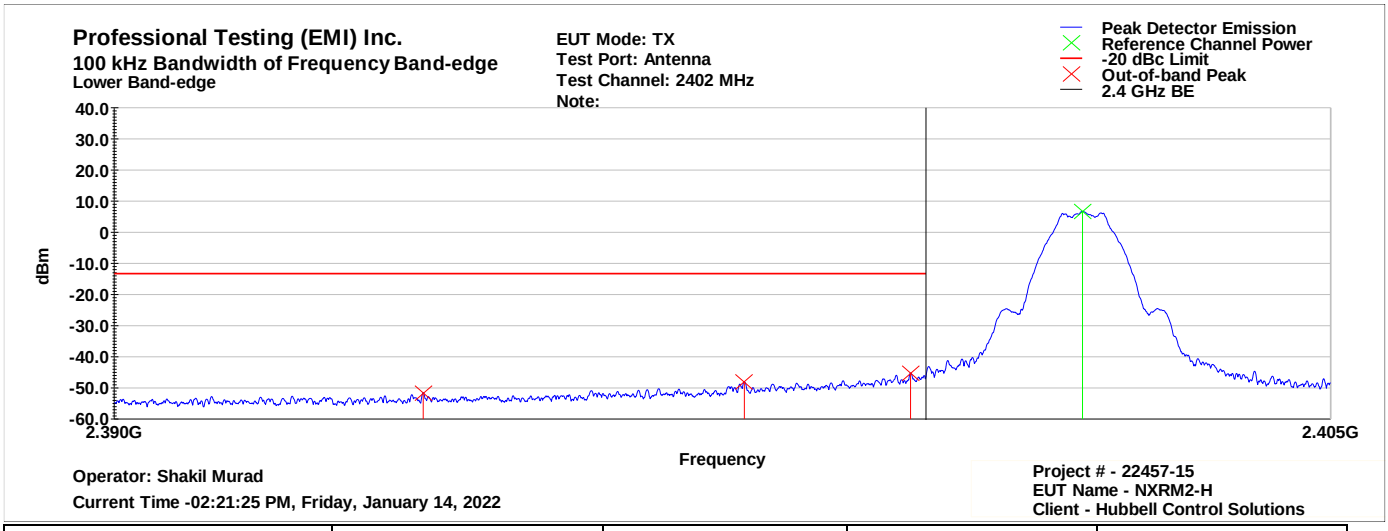
EIRP = 54 dBµV/m + $20Log_{10}$(3 m) – 104.8 dB = -41.25 dBm (commonly -41 dBm is applied)

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.

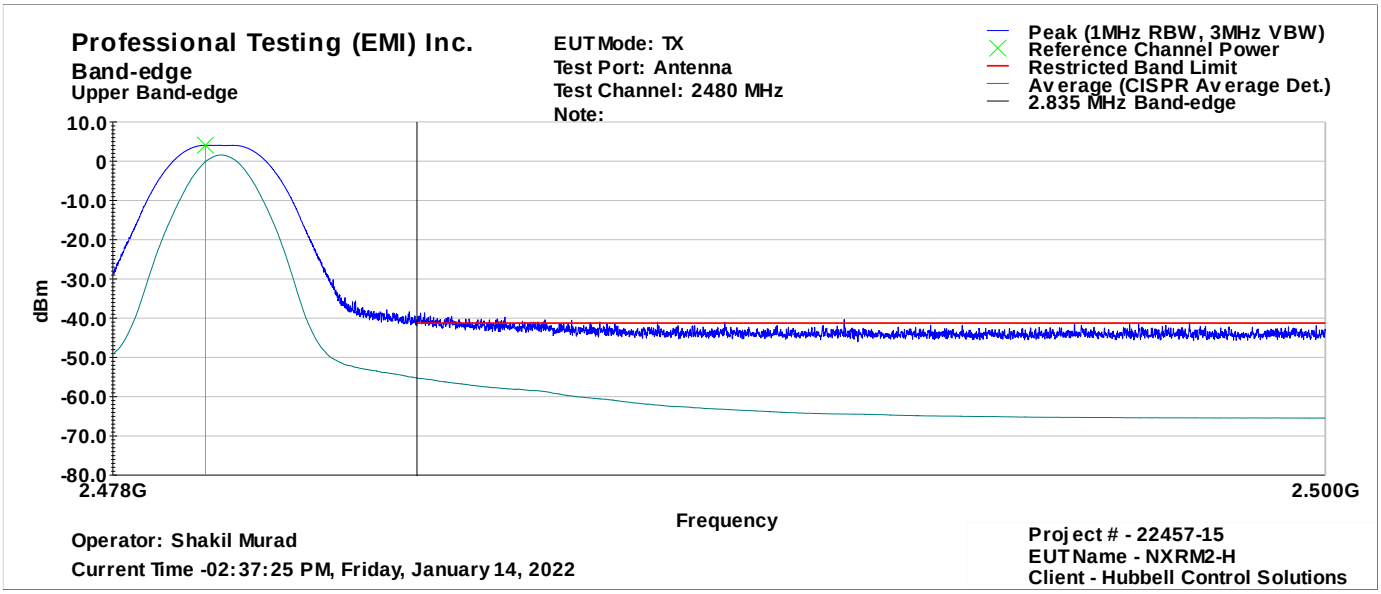
The requirement was satisfied. Plotted results appear on the following page.

Lower Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit -20dBc (dBm)	Margin (dB)	Results
2393.802	-51.569	-13.305	-38.264	PASS
2397.759	-48.052	-13.305	-34.747	PASS
2399.810	-45.255	-13.305	-31.950	PASS

Upper Band-edge



Frequency (MHz)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)	Results
2483.500	-55.233	-41.250	-13.983	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. Measurements were performed on 1/14/2022.

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

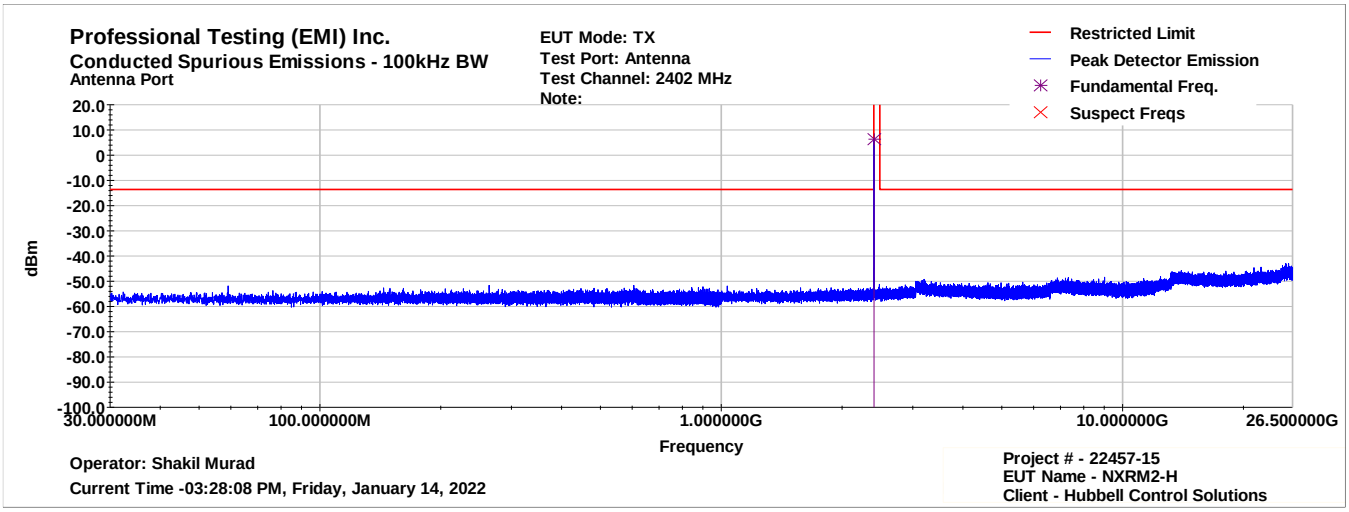
6.3 Test Results

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

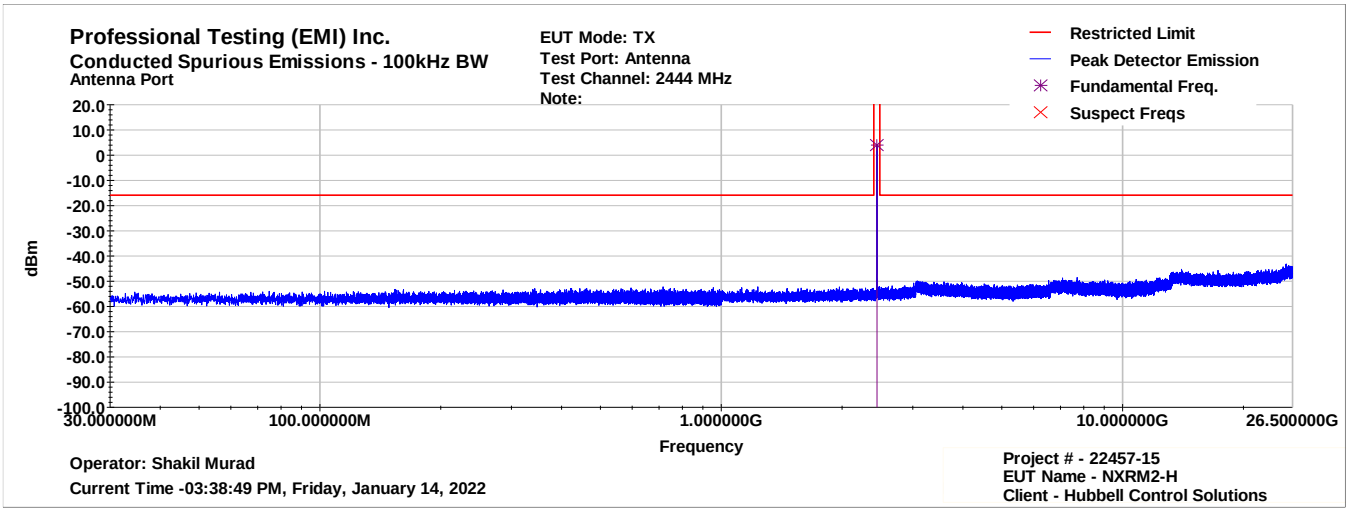
The top, middle and bottom channels were tested. 15.209 limits were applied to entire band for worst-case limits. The EUT satisfied the requirements.

6.3.1 100 kHz Bandwidth Test data

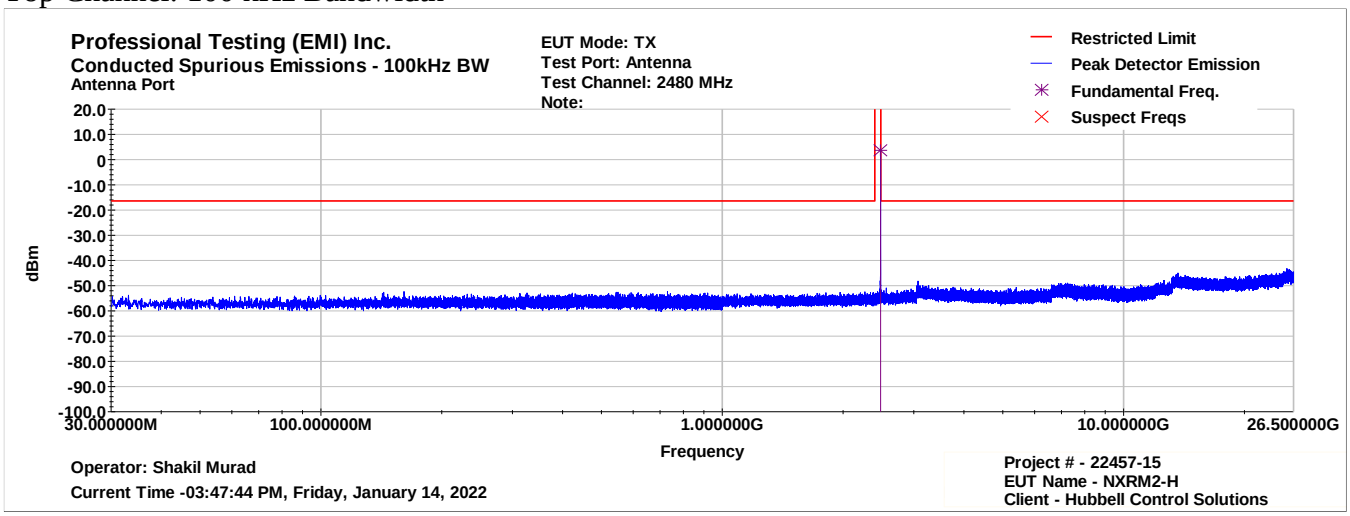
Bottom Channel: 100 kHz Bandwidth



Middle Channel: 100 kHz Bandwidth

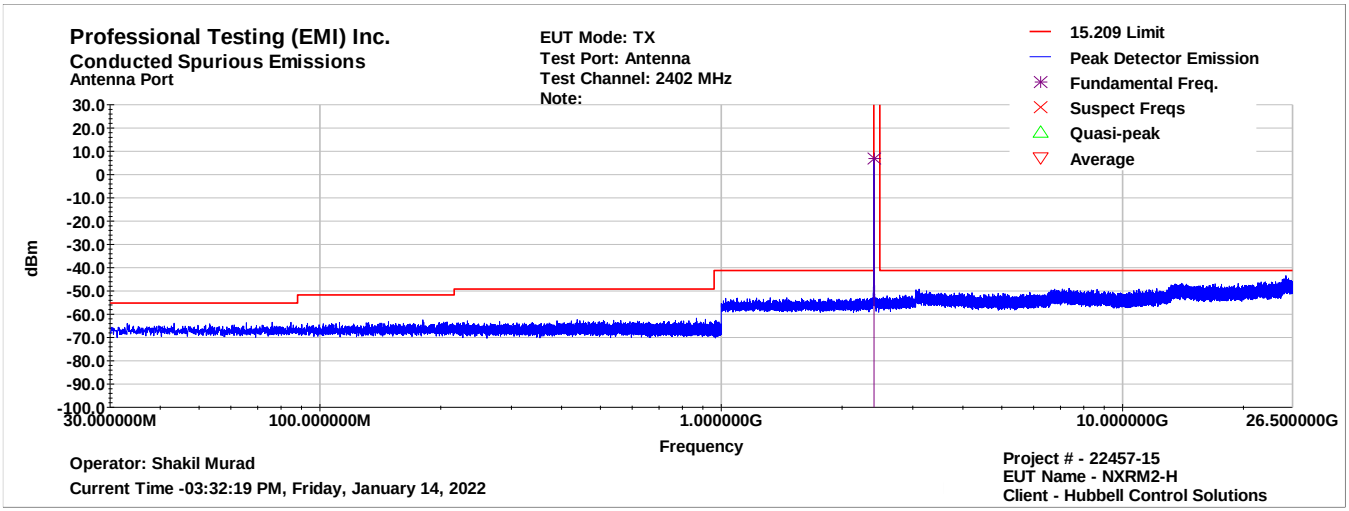


Top Channel: 100 kHz Bandwidth

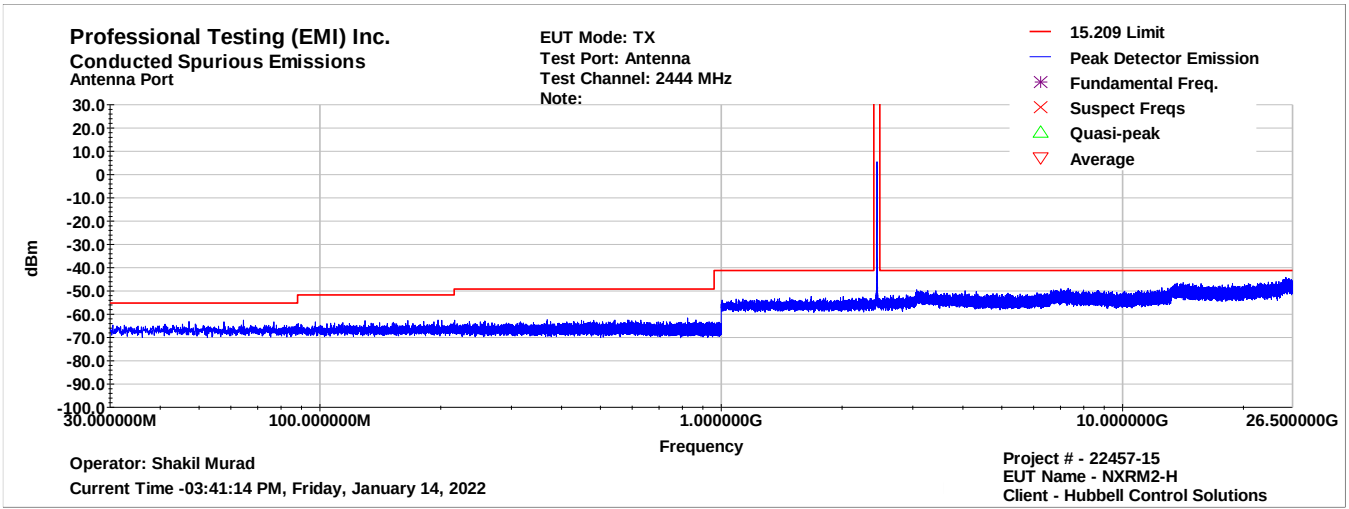


6.3.2 1 MHz Bandwidth Test data

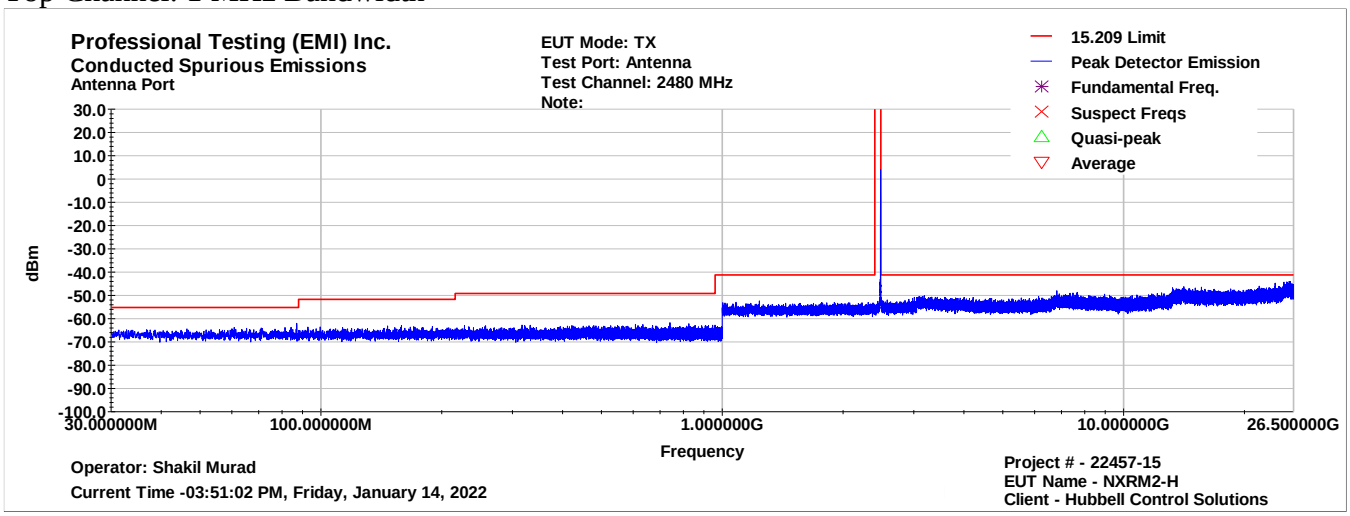
Bottom Channel: 1 MHz Bandwidth



Middle Channel: 1 MHz Bandwidth



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. Measurements were performed on 1/17/2022 – 1/18/2022.

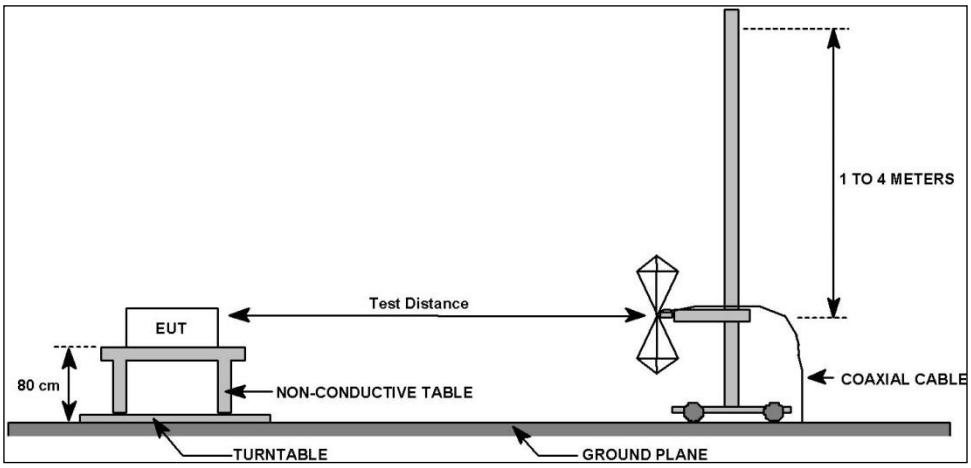


Table 7.1.1: Test Distance, Table Height, and Detection Method

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

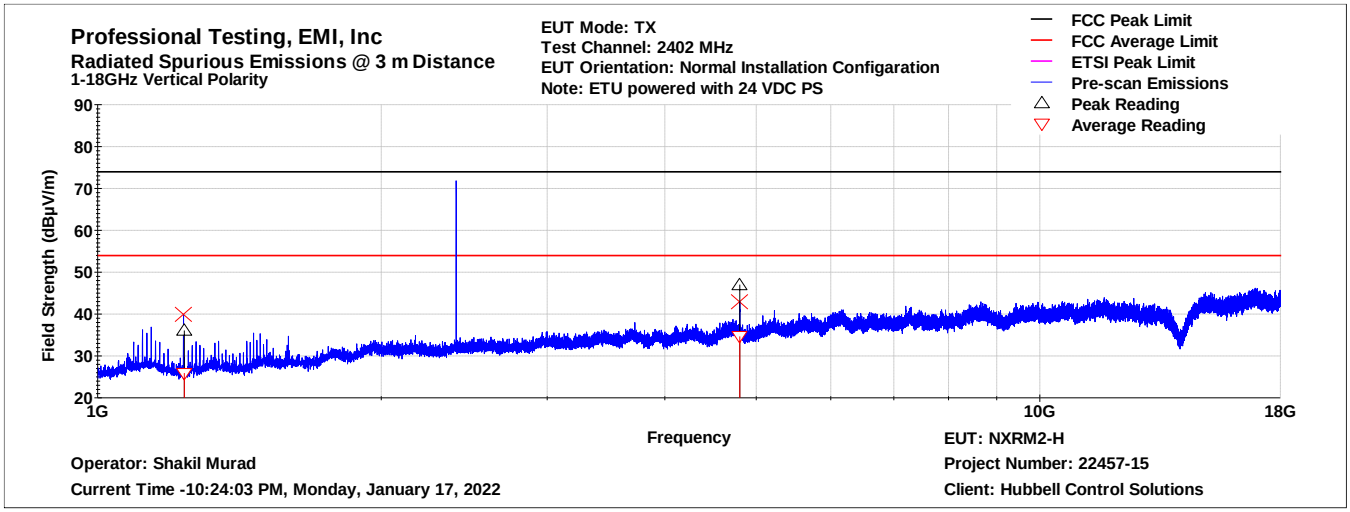
7.3 Test Results

Three channels were tested. EUT was transmitting continuously unmodulated. Device tested in normal operational orientation.

The EUT satisfied the requirement. Graphical and tabular data appears below.

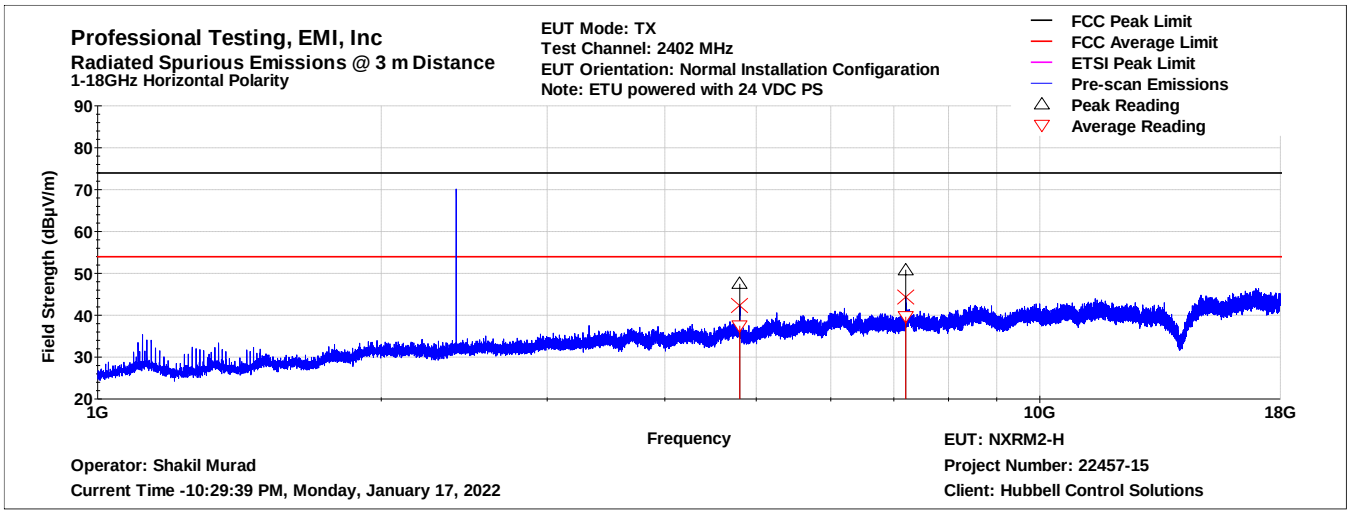
7.3.1 Bottom Channel, 1 GHz to 26.5 GHz

1GHz - 18GHz Vertical Polarity Emissions Data



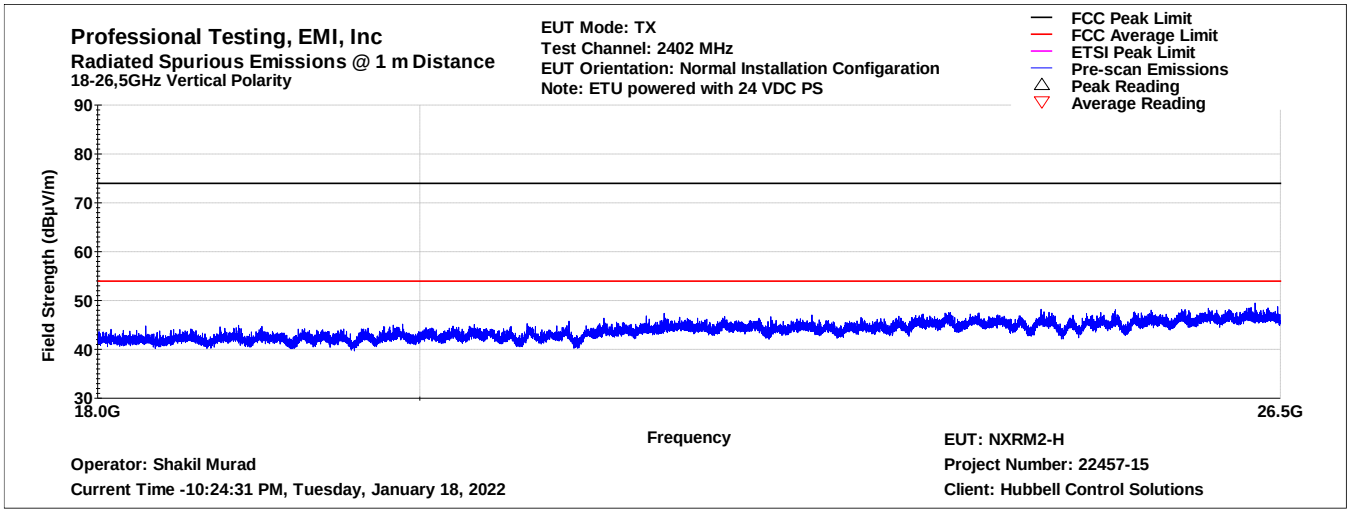
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
1235.99	311	375	36.073	73.958	-37.885	PASS	25.903	53.958	-28.055	PASS
4803.22	361	298	47.020	73.958	-26.938	PASS	34.662	53.958	-19.296	PASS

1GHz - 18GHz Horizontal Polarity Emissions Data

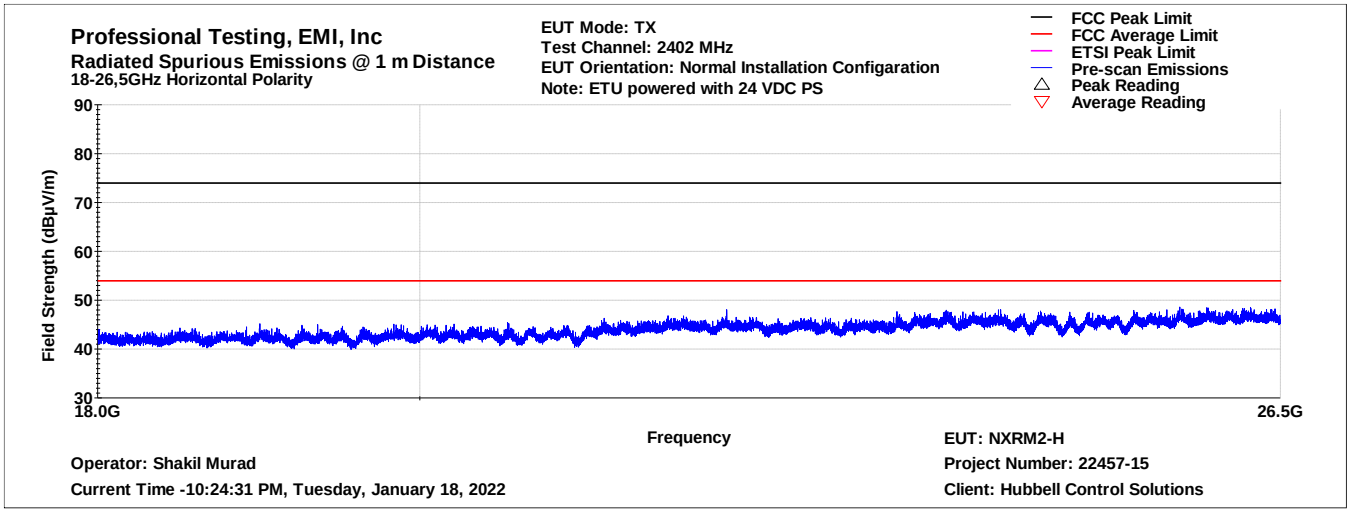


Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results
4803.30	116	167	47.488	73.958	-26.470	PASS	37.473	53.958	-16.485	PASS
7205.84	281	126	50.852	73.958	-23.106	PASS	39.610	53.958	-14.348	PASS

18GHz - 26.5GHz Vertical Polarity Emissions Data

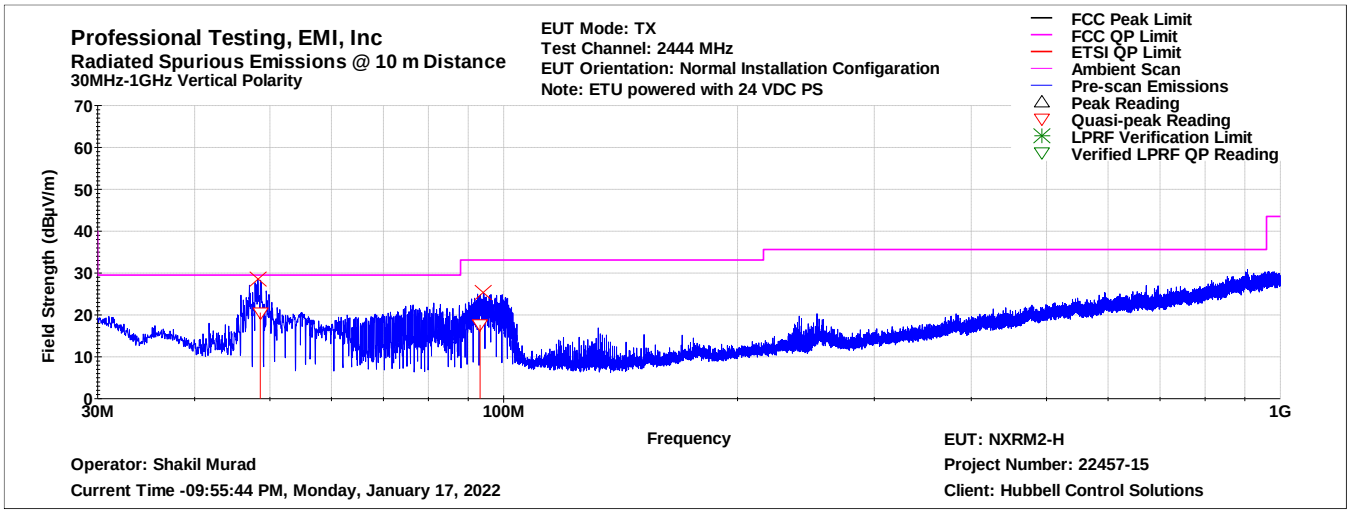


18GHz - 26.5GHz Horizontal Polarity Emissions Data



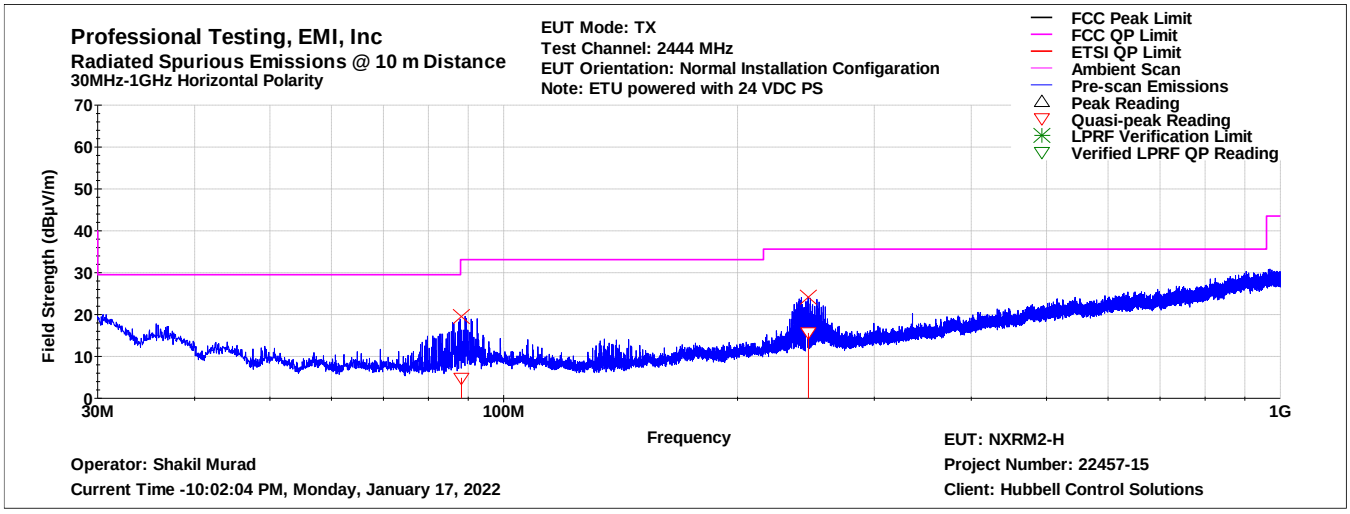
7.3.2 Middle Channel, 30 MHz to 26.5 GHz

30MHz - 1GHz Vertical Polarity Emissions Data



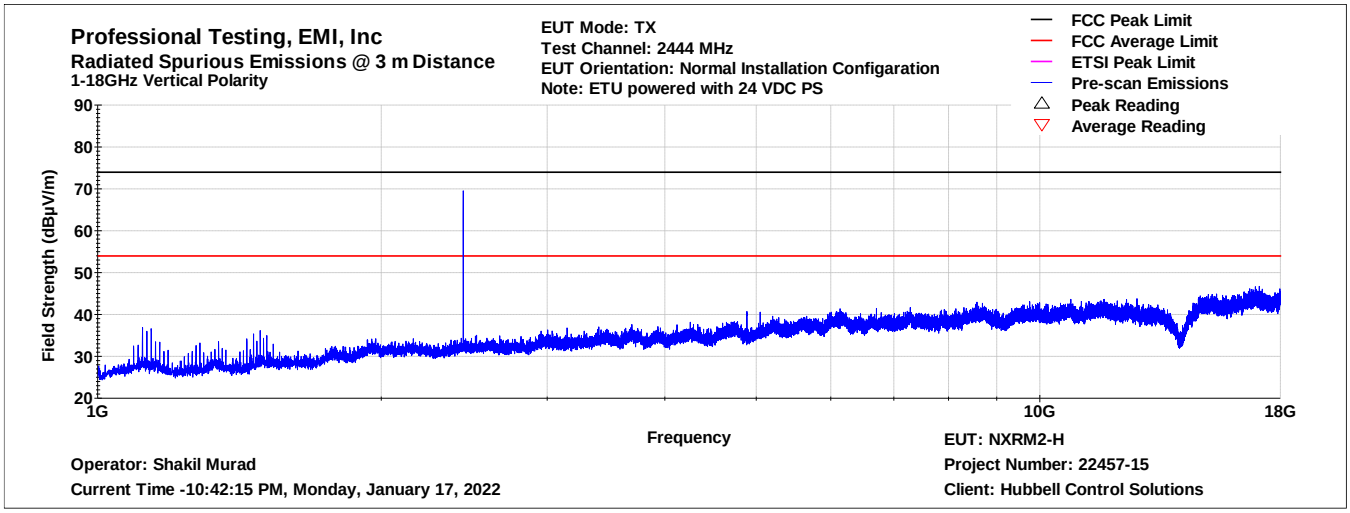
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results
48.587	144.000	118.000	20.550	29.500	-8.950	PASS
93.241	218.000	168.000	17.626	33.100	-15.474	PASS

30MHz - 1GHz Horizontal Polarity Emissions Data

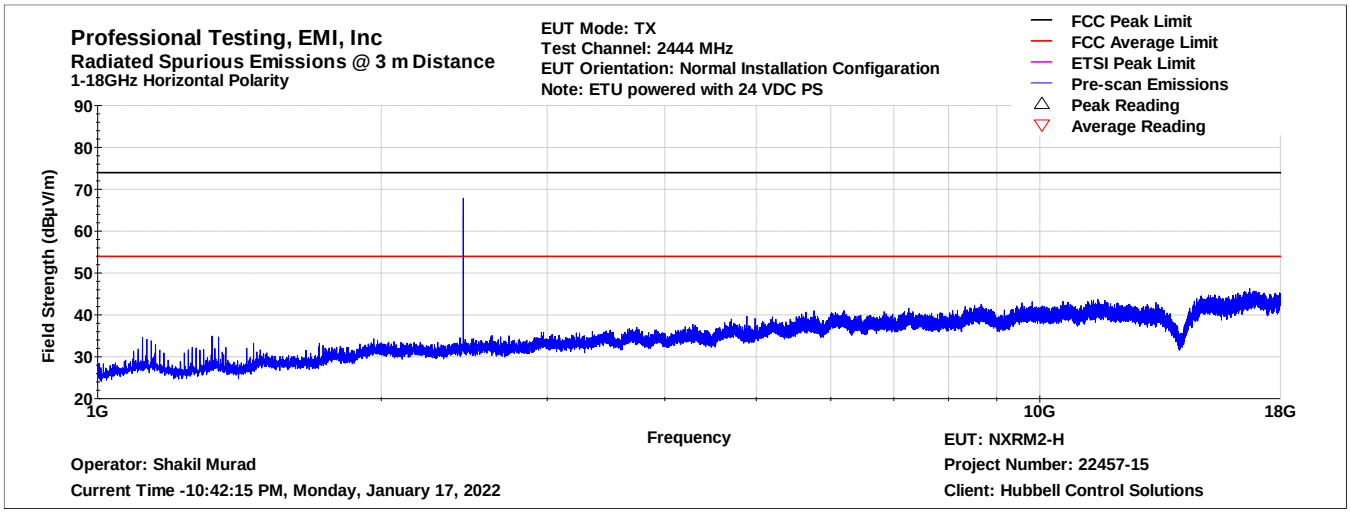


Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results
88.231	346.000	136.000	4.887	33.100	-28.213	PASS
246.789	362.000	379.000	15.592	35.600	-20.008	PASS

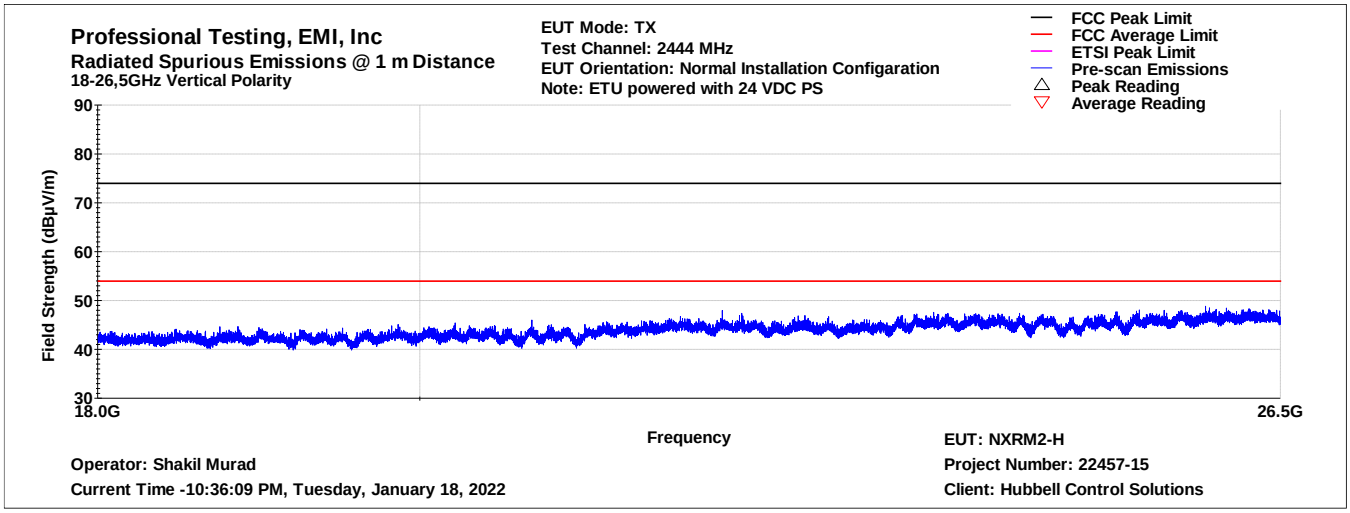
1GHz - 18GHz Vertical Polarity Emissions Data



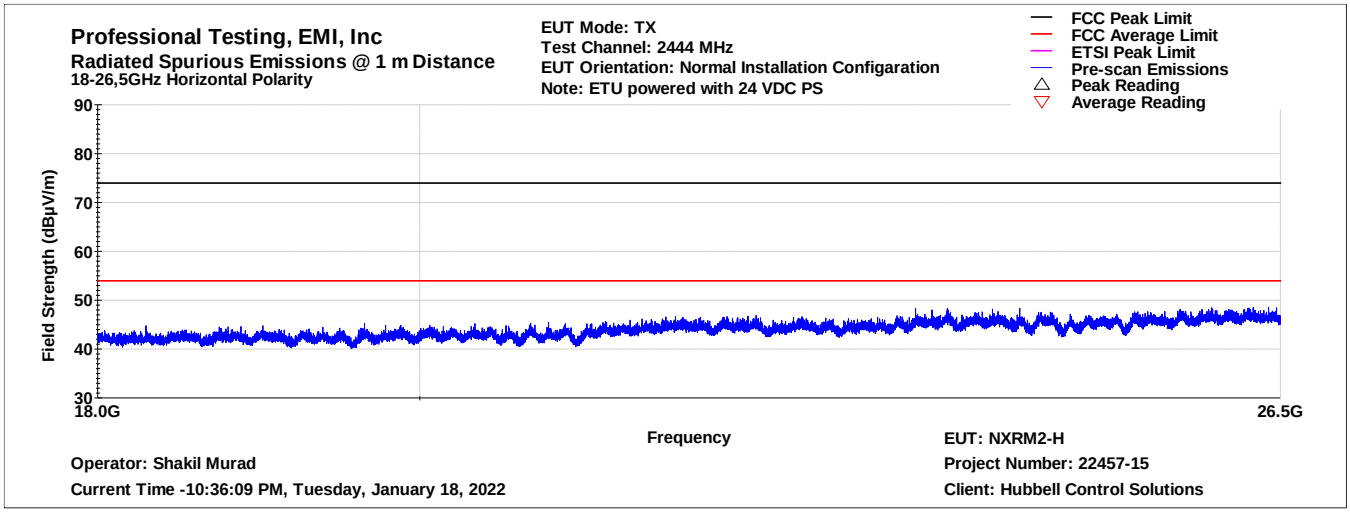
1GHz - 18GHz Horizontal Polarity Emissions Data



18GHz - 26.5GHz Vertical Polarity Emissions Data

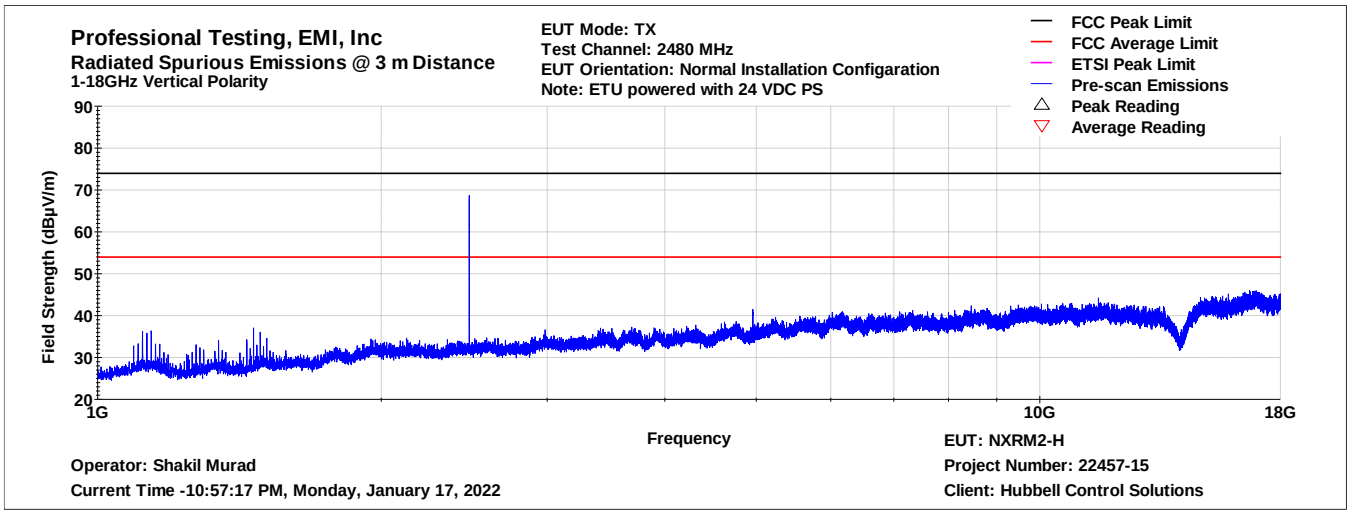


18GHz - 26.5GHz Horizontal Polarity Emissions Data



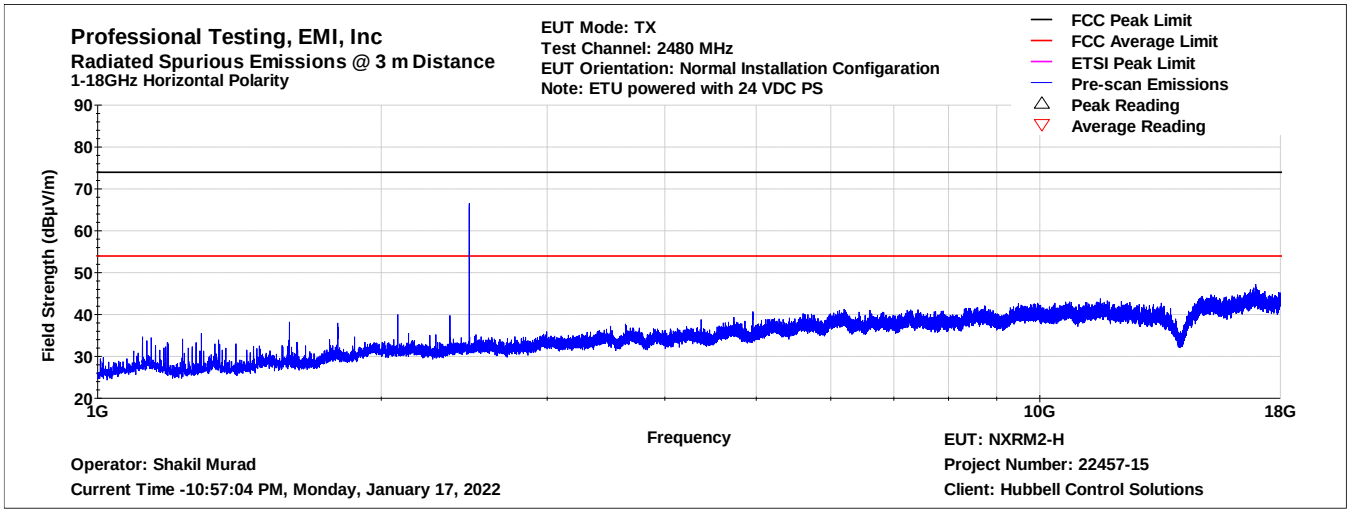
7.3.3 Top Channel, 1GHz to 26.5 GHz

1GHz - 18GHz Vertical Polarity Emissions Data



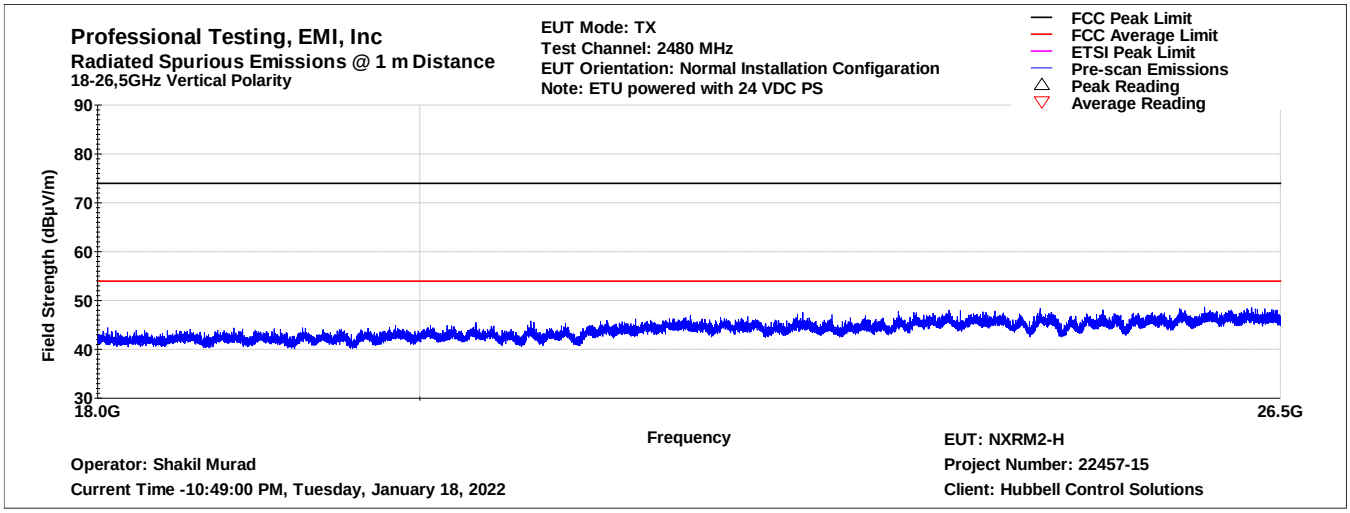
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results

1GHz - 18GHz Horizontal Polarity Emissions Data

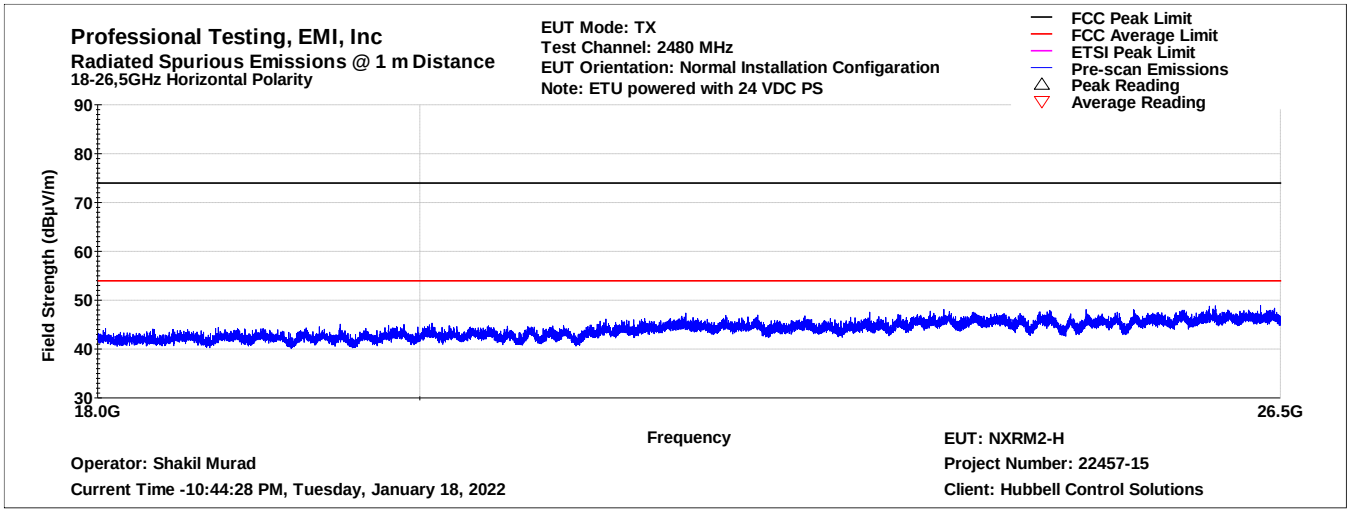


Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Peak Reading (dBµV)	Peak Limit (dBµV)	Peak Margin (dB)	Peak Results	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)	Average Results

18GHz - 26.5GHz Vertical Polarity Emissions Data



18GHz - 26.5GHz Horizontal Polarity Emissions Data



8.0 Radiated Spurious Emissions, Receive Mode

8.1 Test Procedure

The EUT was in normal operation, transmitting and receiving, during this test. A high pass filter was used to attenuate the fundamental frequency above 1 GHz. Measurements were performed on 1/18/2022.

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

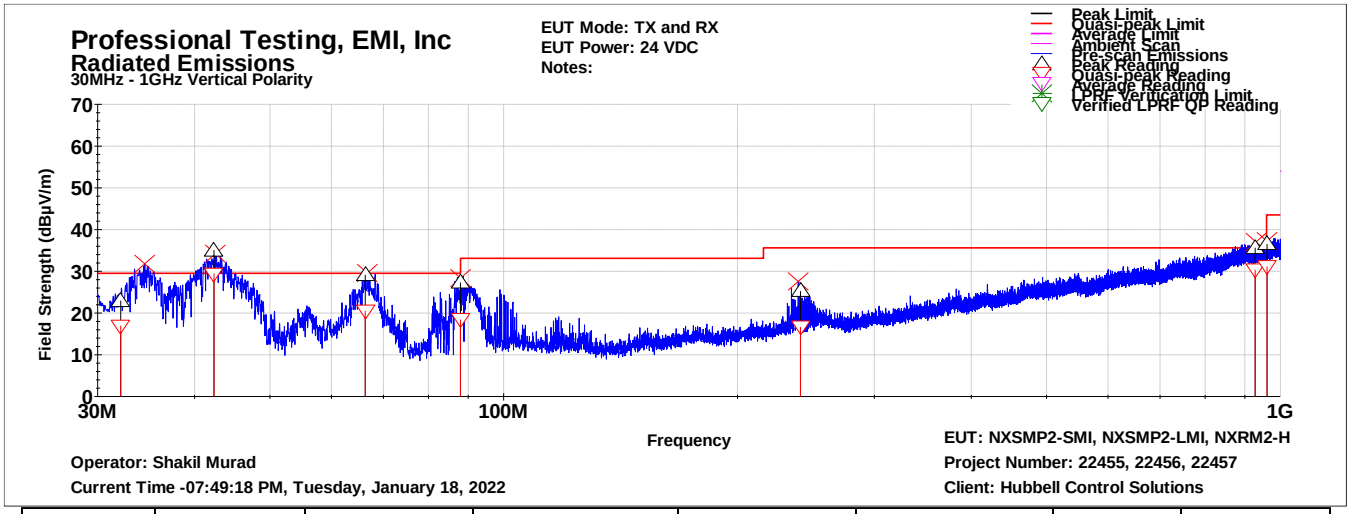
47 CFR (USA) // IC (Canada)	
Section Reference	Parameter
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode

8.3 Test Results

The requirement was satisfied. Graphical and tabular data appears below.

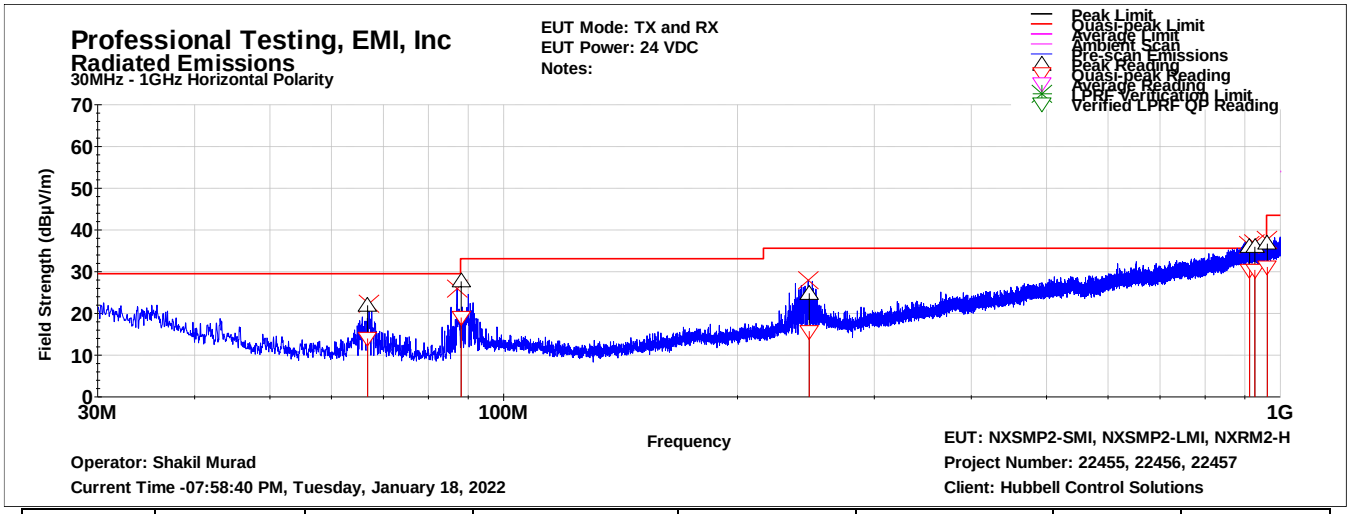
8.3.1 Middle Channel 30 MHz to 14 GHz

30MHz - 1GHz Vertical Polarity Measured Emissions Data



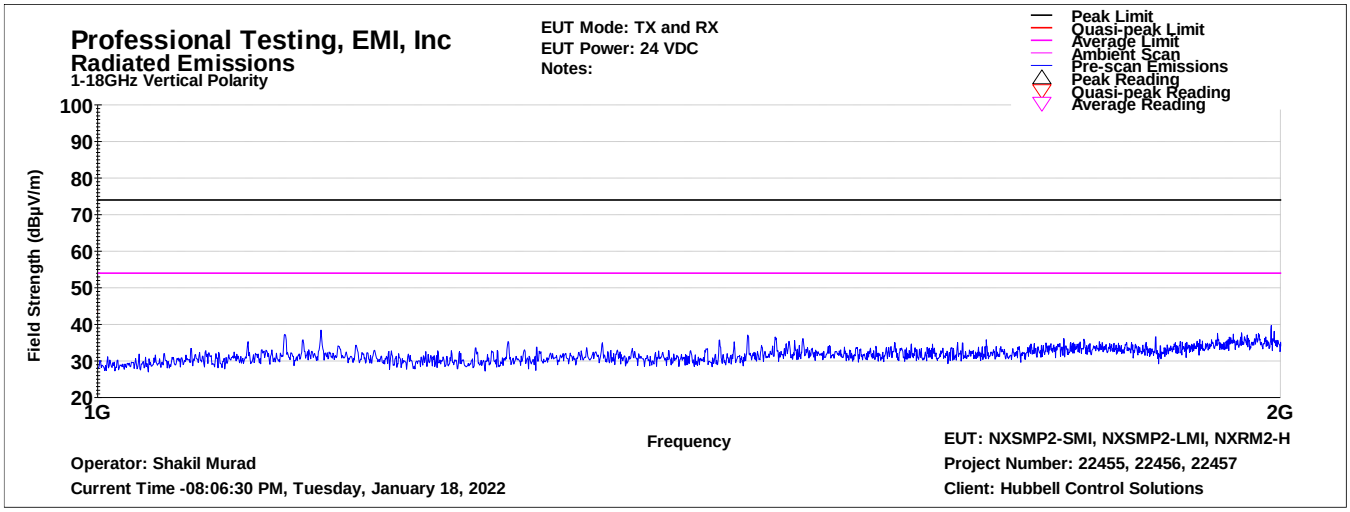
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
32.132	76.000	199.000	16.975	29.500	-12.525	PASS	22.961
42.360	292.000	118.000	29.456	29.500	-0.044	PASS	35.057
66.319	353.000	132.000	20.528	29.500	-8.972	PASS	29.114
87.956	103.000	118.000	18.424	29.500	-11.076	PASS	27.288
241.091	1.000	208.000	16.620	35.600	-18.980	PASS	25.267
928.114	337.000	263.000	30.359	35.600	-5.241	PASS	35.648
961.422	89.000	118.000	31.144	43.500	-12.356	PASS	36.540

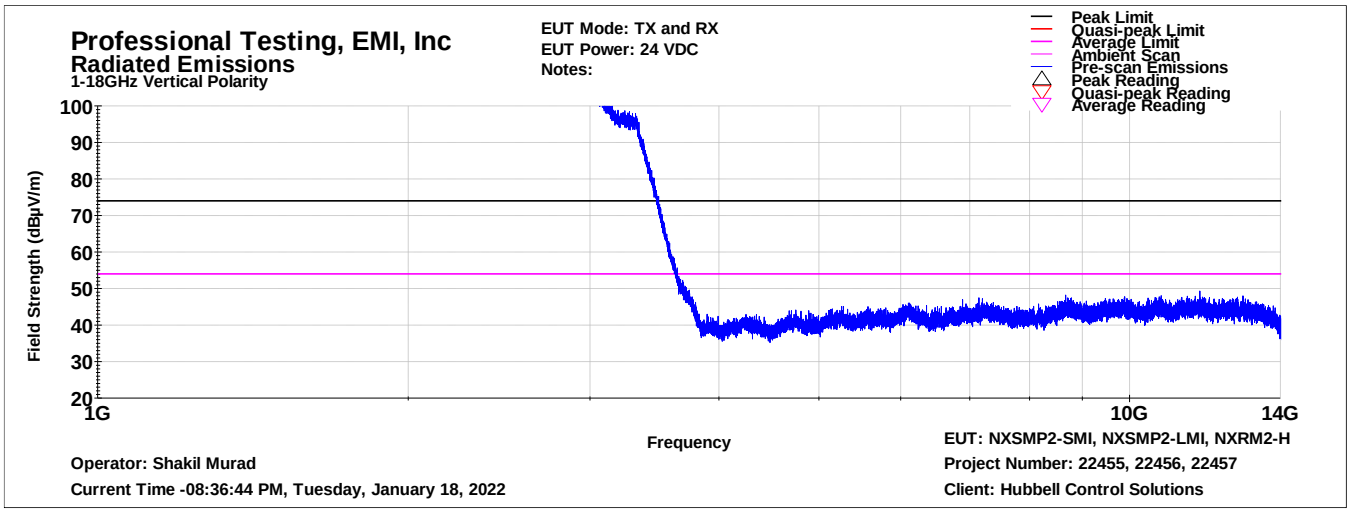
30MHz - 1GHz Horizontal Polarity Measured Emissions Data



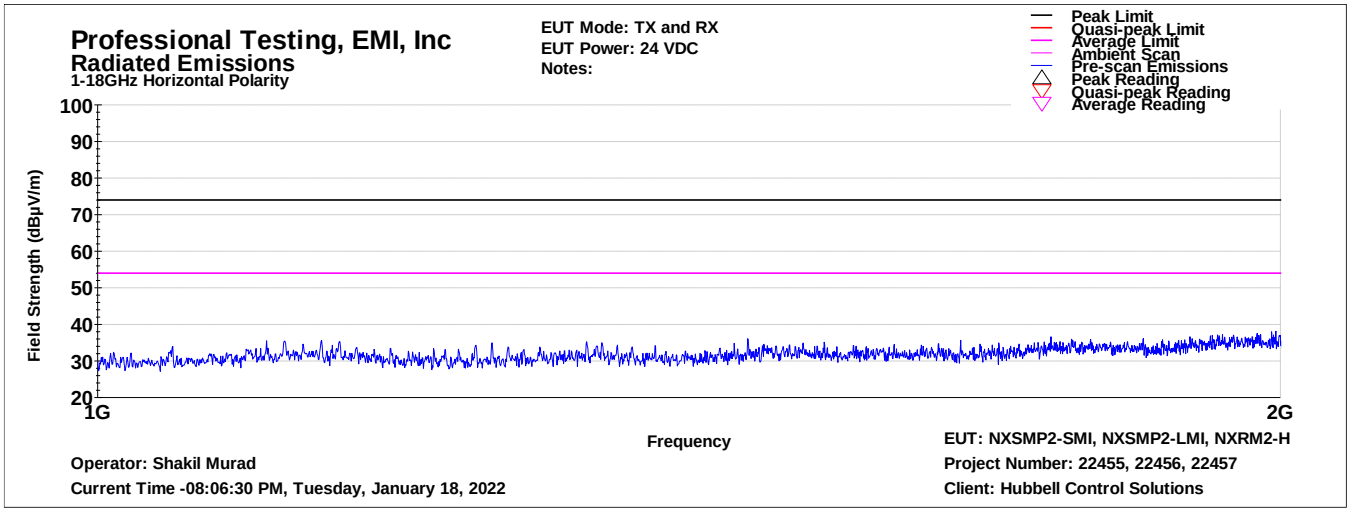
Frequency (MHz)	EUT Direction (Degrees)	Antenna Height (cm)	Quasi-peak Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Quasi-peak Results	Peak Reading (dBµV)
66.806	250.000	351.000	13.995	29.500	-15.505	PASS	21.926
88.164	74.000	398.000	19.010	33.100	-14.090	PASS	27.673
247.398	144.000	101.000	15.732	35.600	-19.868	PASS	24.838
912.780	115.000	232.000	30.350	35.600	-5.250	PASS	36.079
927.189	63.000	397.000	30.415	35.600	-5.185	PASS	35.957
962.309	107.000	310.000	31.130	43.500	-12.370	PASS	36.713

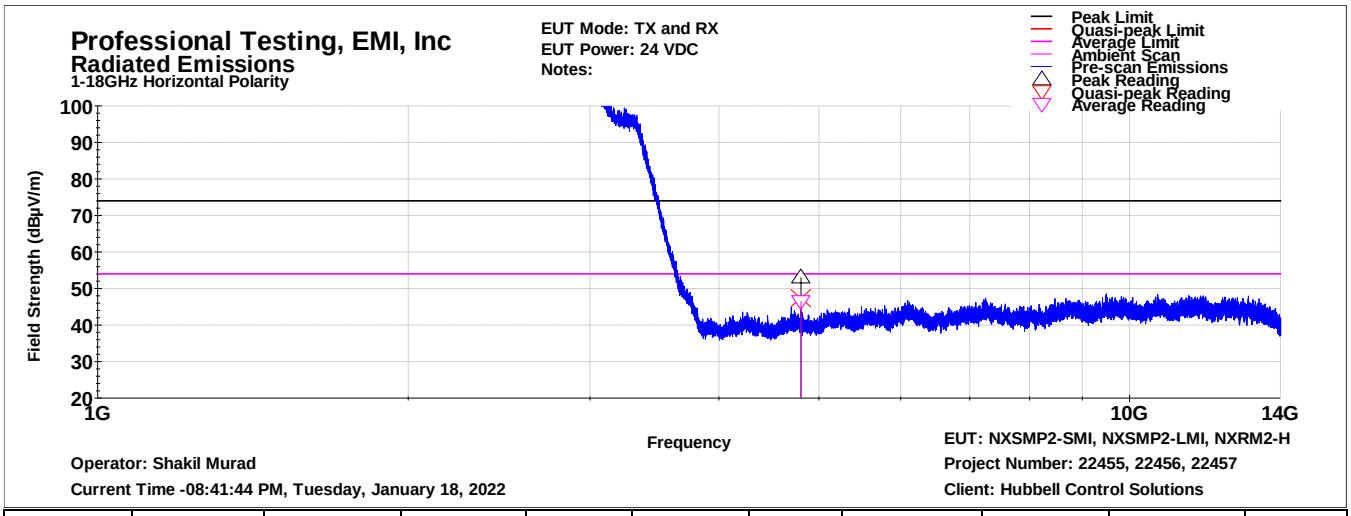
1GHz - 18GHz Vertical Polarity Measured Emissions Data





1GHz - 18GHz 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
4804.27	324	182	53.037	74.000	-20.963	PASS	46.516	54.000	-7.484	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
PCB Antenna
Antenna peak gain: 5.3 dBi max No connector, PCB trace antenna.

User cannot substitute antenna.

Gain is under maximum limit of 6 dBi.

The requirement was satisfied.

10.0 Equipment

10.1 Fundamental Power, Bandwidth, Duty Cycle, 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
1117	HP	6296A	Power Supply, DC, 60V 3A	1552A02489	N/A

10.2 Radiated Spurious Emissions

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
C026A	none	RG-233U	Cable Coax, N-N, 0.914m, 9 kHz - 30 MHz	None	10/21/2022
C026	none	RG214	Cable Coax, N-N, 25m, 9 kHz - 30 MHz	None	9/8/2021
C027A	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/9/2022
1293	EMCO	6502	Antenna, Loop, Active, .01-30MHz	2040	9/14/2022
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
1425	Electro-Metrics	BPA-1000	Preamp, Broadband 10k-1GHz	123	3/13/2022
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
1977	Agilent	87421A	Power Supply	MY44350145	N/A
1937	Agilent	E4440A - AYZ	PSA , 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/12/2022
1268	HP	6291A	Power Supply, DC, 40V 5A	1710A03515	N/A

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 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 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 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