Project 21817-15

Pharos Marine Automatic Power

Phalcon-NT

RACON Radar Transponder

Band S Section

Wireless Certification Report

Prepared for:

Pharos Marine Automatic Power Systems
10810 W Little York St. Suite 130
Houston TX 77041

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

25 Sep 2020

Reviewed by	Written by
	
Larry Finn	Eric Lifsey
Chief Technical Officer	EMC Engineer

Revision History

Revision Number	Description	Date
Draft 02	Add emission data above 26 GHz.	25 Sep 2020
Final1		19 Oct 2020
Final2A	Add radiated emission data 18-26.5 GHz. Correct typos & cal date. Add antenna gain for EIRP.	22 Oct 2020

Errata:

Table of Contents

Certificate of Compliance

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

Applicant	Device & Test Identification	
Pharos Marine Automatic Power Systems 10810 W Little York St. Suite 130 Houston TX 77041 Certificate Date: 25 Sep 2020	Model(s): FCC ID: Laboratory Project ID:	Phalcon-NT 2ARGZPHALCON-NT 21817-15

The EUT model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR, FCC, Part 87 and Part 2 Band S Section, FCC Paragraph 80.215(n)(3)	
Section/Clause	**Description**
80.215(n)(3); 2.1046	Power and emissions; conducted output power, limited to 20 W peak.
2.1047	Modulation: P0N
2.1049	Occupied BW Mask
2.1051	Emission limitations; Spurious/harmonic emissions at antenna terminals
2.1053	Emission limitations; radiated emissions 30 MHz - 40 GHz
2.1055(a)(2); 80.209(c)	Frequency stability (Maritime Services Part 80; ±1.5 MHz)

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules 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

Eric Lifsey
EMC 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

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.

1.2 EUT Description

Table 1.2.1 Equipment Under Test		
Manufacturer & Description	**Model(s)**	**Serial #(s)**
Pharos Marine Automatic Power Systems RACON Radar Transponder	Phalcon-NT S-Band Section	Item A: 19384-12 Item E: 19384-11

Table 1.2.2: EUT Essential Specifications	
Power Output to Antenna	~+30 dBm
Frequency Range	S-Band Test Frequencies: 2901, 3000, 3099 MHz
Channel Bandwidths Supported (kHz)	N/A
Modulation Methods Supported	P0N
Antenna	Fixed omni-directional slot array
Operating Voltage and Power Required	10 to 36 VDC, 10 Watts
Environment	Outdoor

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

The EUT utilizes a 2-band RACON radio unit in the same enclosure driving an independent antenna for each band. Bands S and X are supported. The antennas are fixed and omni-directional transmit and receive.

A RACON transmits a very fast simple Morse code character when it detects a signal from a ship radar. The responding transmission appears at a graphical Morse code character on the ship radar display. The decoded Morse character is then matched to navigational maps. This provides a way to mark hazards or similar important items for safe ship navigation.

1.4 Modifications to EUT

None.

1.5 Measurement Correction Methods

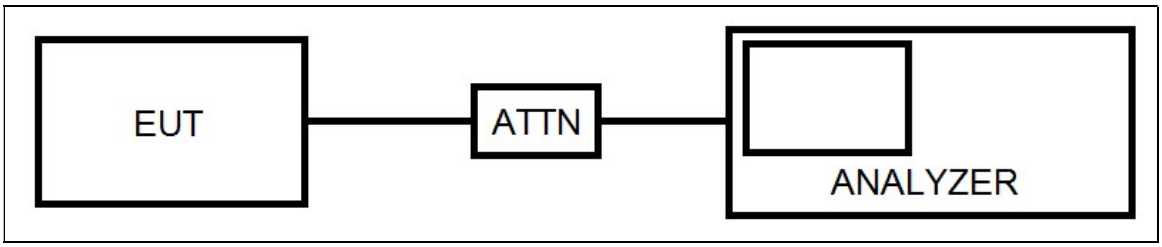
Table 1.6 1 Measurement Corrections	
Parameter	**From Sums Of**
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses
Additionally, measurement distance extrapolation factors (such as 1/d above 30 MHz) are applied and documented where used.	

1.6 Test Site

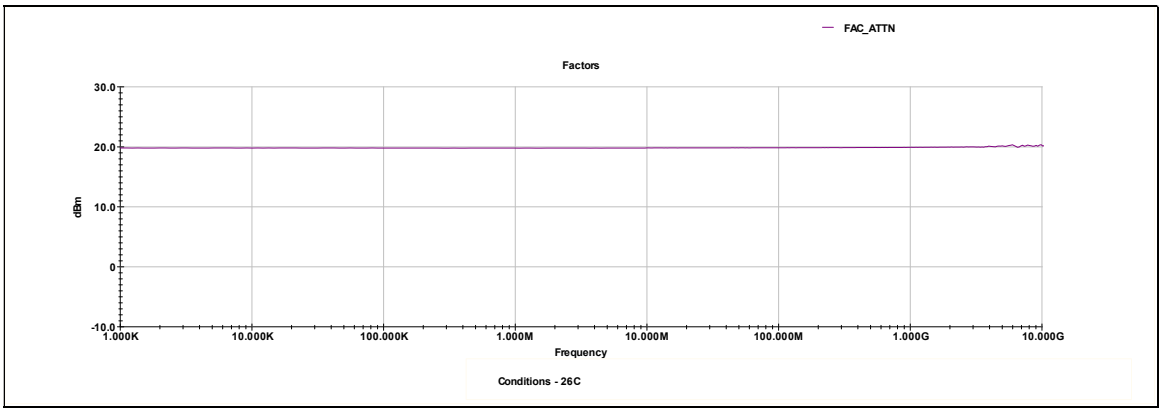
Radiated measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RS-GEN and is subsequently confirmed by laboratory accreditation (NVLAP 200026-0). The test site 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.

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.

1.7 Test Setup Diagram



Setup for Conducted Port Measurements: Power, Mask, Spurious, Bandwidth



Attenuator Factor vs Frequency, Asset Number A105, 20 dB 20 W Narda Attenuator

2.0 Applicable Documents

Table 2.0.1: Applicable Documents	
Document #	**Title/Description**
ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
47 CFR	FCC Part 80 – Subpart E – Technical requirements FCC Part 2 – Subpart J – Equipment authorization procedures

3.0 Conducted Output Power at Antenna Terminal, Clause 80.215(n)(3), 2.1046

3.1 Test Procedure

The output of the EUT was connected by cable and attenuator to a spectrum analyzer. A peak detector was used for the measurement. The transmitter was switched on, and the measurement receiver was tuned to the frequency of the transmitter under test. The loss of the attenuator was compensated by adding an offset to the analyzer amplitude. Power was measured directly with the spectrum analyzer using a resolution bandwidth greater than the occupied bandwidth of the transmitter.

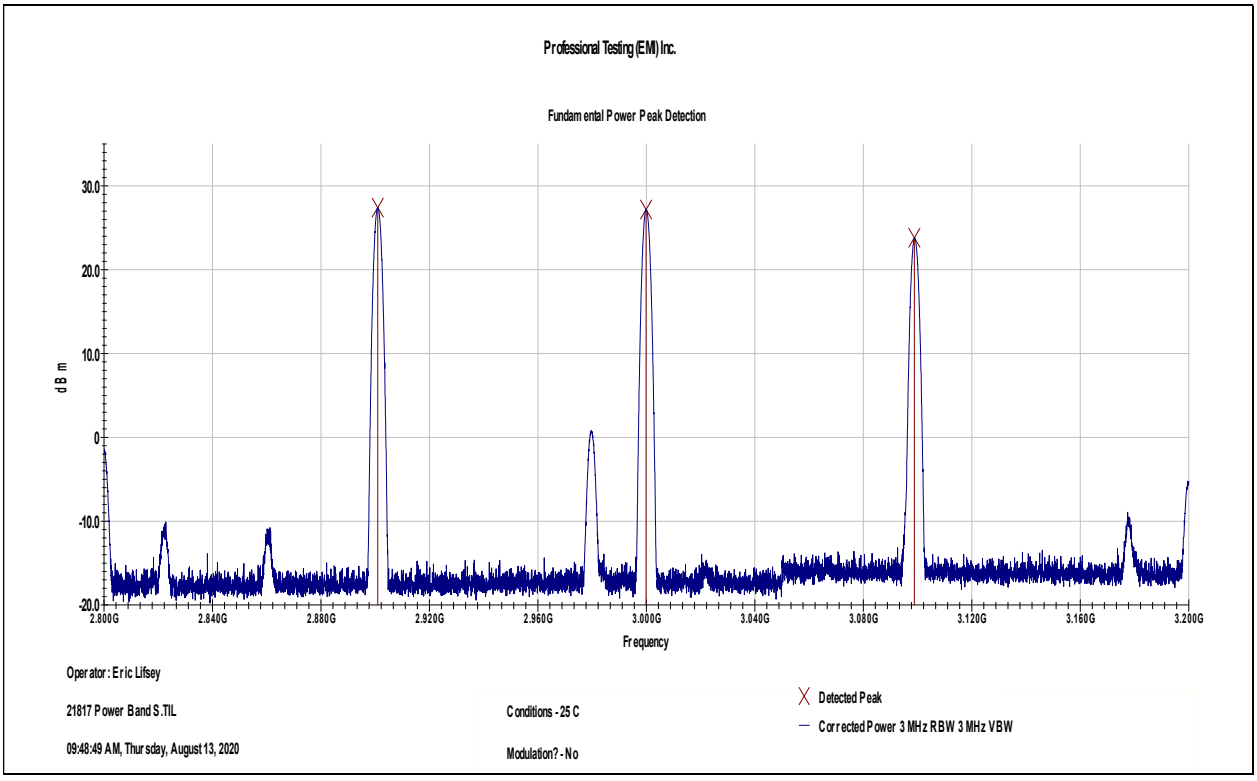
3.2 Test Criteria

Authorized Power
Maximum peak power 20 Watts

3.3 Test Results

Table 3.3.1 Power Measured In 3 MHz RBW/VBW			
Frequency	**Measured Peak Power**	**Antenna Gain**	**EIRP**
2901 MHz	27.4 dBm or 0.550 Watts	1 dBi	28.4 dBm or 0.691 Watts
3000 MHz	27.2 dBm or 0.525 Watts	1 dBi	28.2 dBm or 0.661 Watts
3099 MHz	23.8 dBm or 0.240 Watts	1 dBi	24.8 dBm or 0.302 Watts

The EUT satisfied the requirements.



All Channels

4.0 Occupied Bandwidth, Clause 2.1049

4.1 Test Procedure

The output of the EUT was connected to an attenuator and then to the spectrum analyzer. The spectrum analyzer was tuned to the frequency of the transceiver under test and the EUT activated in continuous transmit mode. Bandwidth is measured relative to the peak power measurement measured separately in full bandwidth.

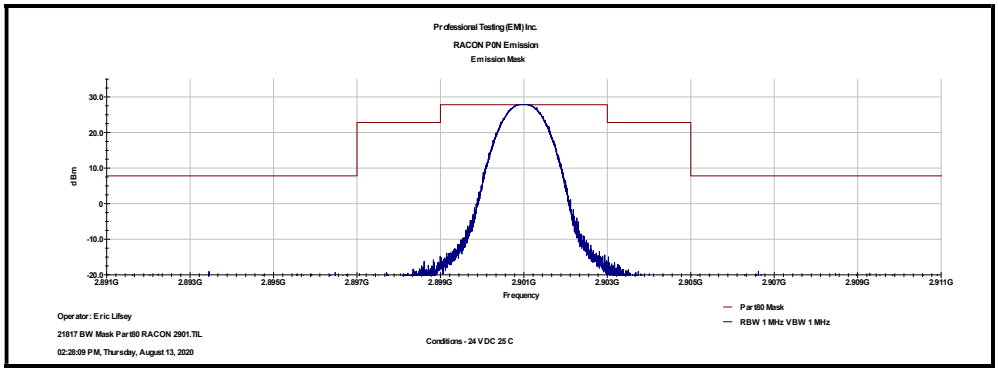
This device is keyed without modulation.

4.2 Test Criteria

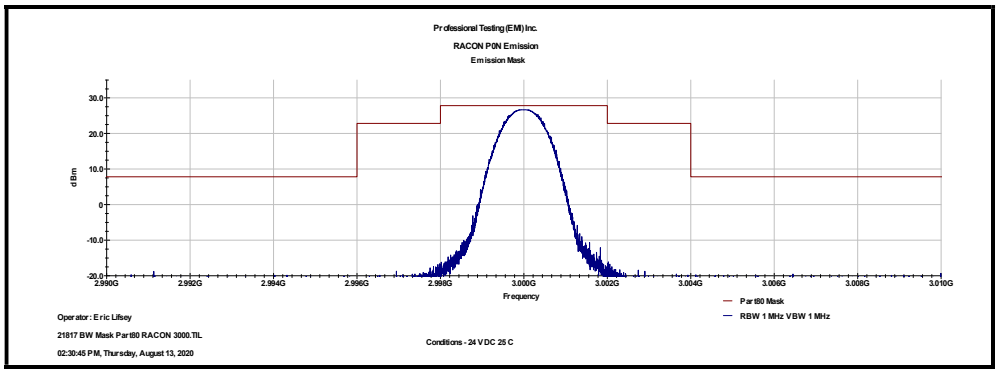
Authorized Bandwidth, 2.1049
< 2 MHz at -5 dBc, < 4 MHz at -20 dBc;

4.3 Test Results

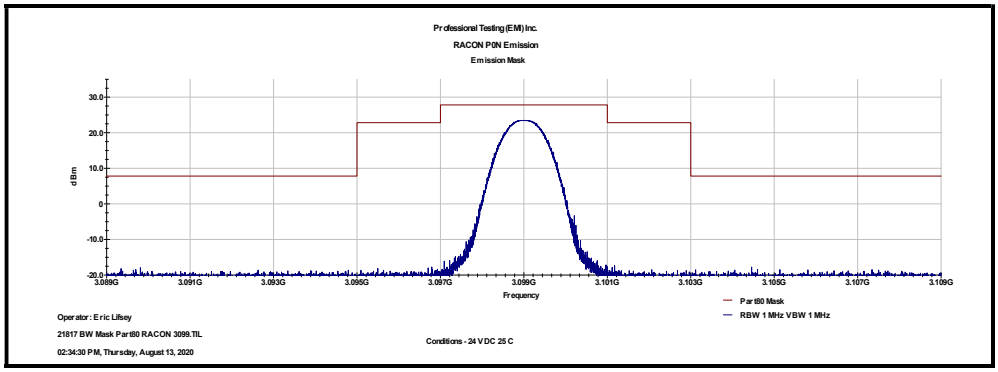
The EUT satisfied the requirements.



Bottom Channel



Middle Channel


Professional Testing (EMI) Inc.
RACON P0N Emission
Emission Mask
30.0
20.0
10.0
0
-10.0
-20.0
dBm
3.089G
3.091G
3.093G
3.095G
3.097G
3.099G
3.101G
3.103G
3.105G
3.107G
3.109G
Frequency
Part80 Mask
RBW 1 MHz VBW 1 MHz
Operator : Eric Lifsey
21817 BW Mask Part80 RACON 3099.TIL
02:34:30 PM, Thursday, August 13, 2020
Conditions - 24 VDC 25 C

Top Channel

5.0 Spurious Emissions at Antenna Terminals, Clause 80.211(f)(1)

5.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the spectrum analyzer. A peak detector was used for the measurement. The transmitter was switched on, and the measurement receiver was tuned to the frequency of the transmitter under test. The loss of the attenuator was compensated by adding an offset to the analyzer amplitude. Spurious power was then measured directly with the spectrum analyzer.

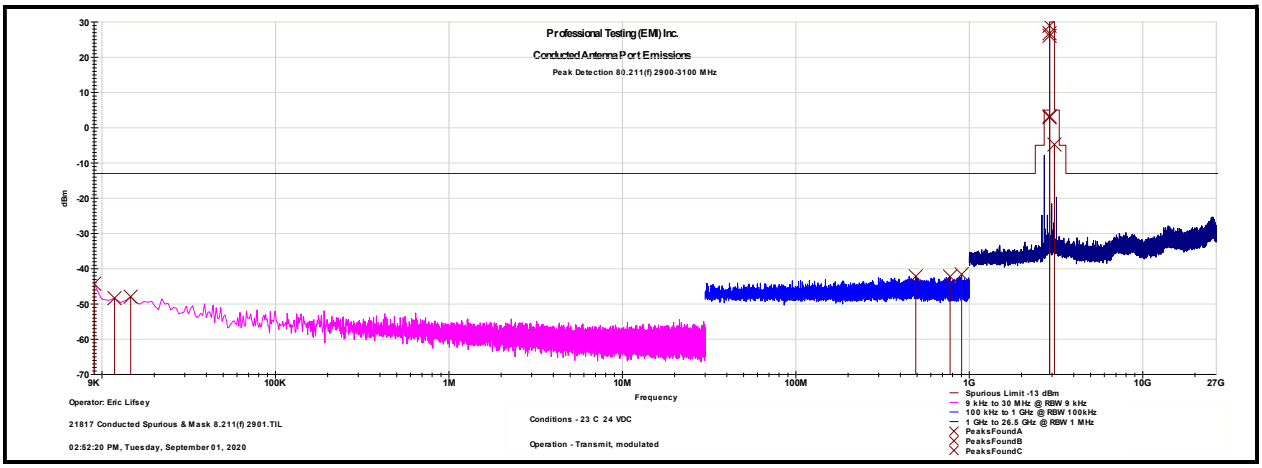
5.2 Test Criteria

Spurious Limit
Authorized BW 2.9 - 3.1 GHz or 200 MHz. (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB; *100 MHz to 200 MHz outside band: 30 dBm - 25 dB = 5 dBm* (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and *200 MHz to 500 MHz outside band: 30 dBm - 35 dB = -5 dBm* (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB. *Use -13 dBm as conservative limit (is closer to -12.6 dBm)* *Beyond 200 * 2.5 = 500 MHz; 43+10log(1W) = 30 dBm - 43 dB = -13 dBm*

5.3 Test Results

The EUT satisfied the requirements.

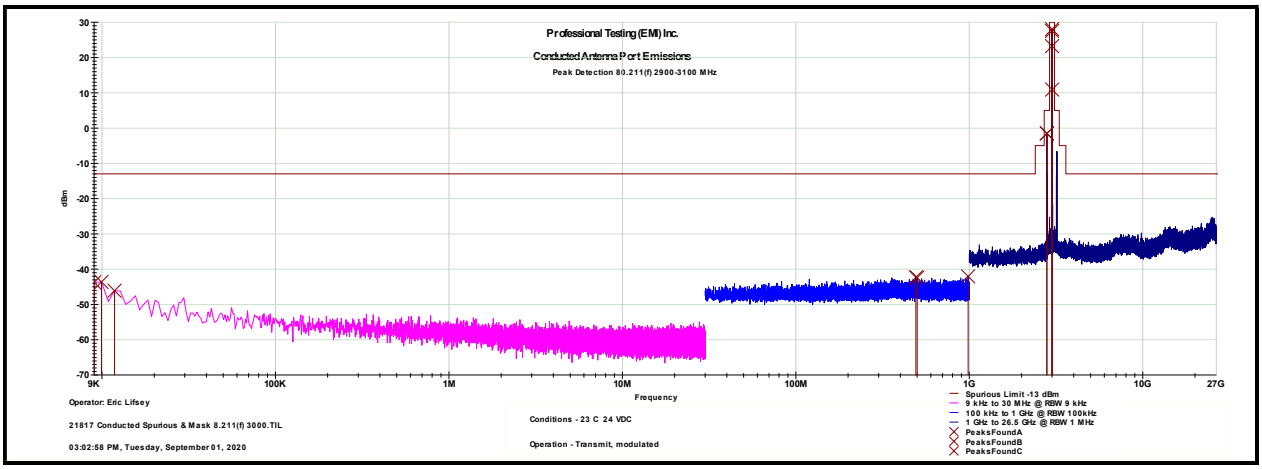
5.3.1 Bottom Channel



Bottom Channel Measured Corrected Levels	
Frequency	dBm
9.0 kHz	-44.2
11.812 kHz	-48.3
14.623 kHz	-47.9
491.28 MHz	-42.2
774.39 MHz	-42.2
902.88 MHz	-41.6

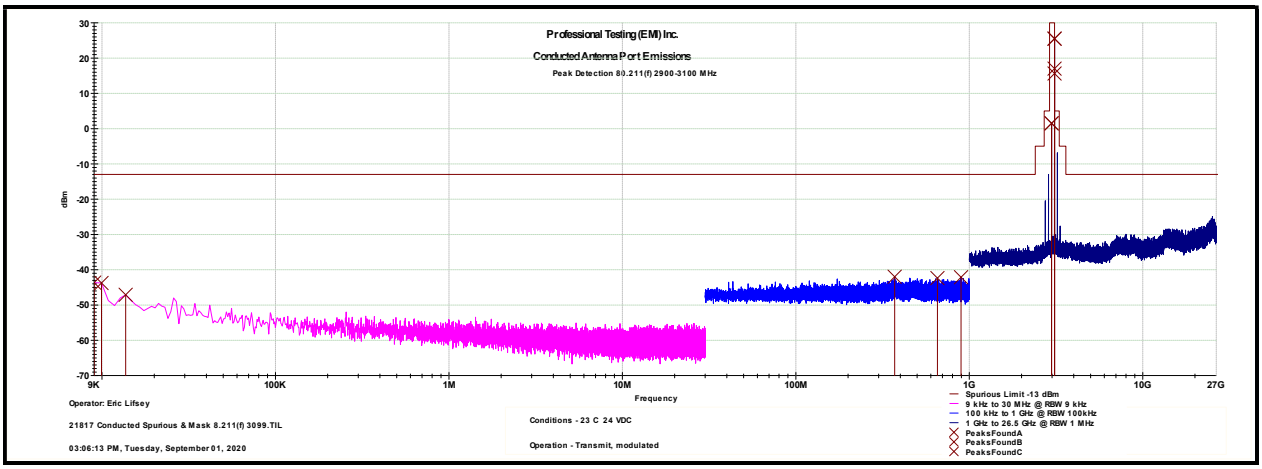
Signals under mask reported elsewhere.

5.3.2 Middle Channel



Bottom Port Measured and Corrected Levels	
Frequency	dBm
9.0 kHz	-43.7
9.9372 kHz	-43.6
11.812 kHz	-46.1
492.0 MHz	-42.3
500.77 MHz	-42.4
984.08 MHz	-42.1

5.3.3 Top Channel



Bottom Port Measured and Corrected Levels	
Frequency	dBm
9.0 kHz	-43.7
9.9372 kHz	-43.8
13.686 kHz	-47.1
371.32 MHz	-42.0
655.04 MHz	-42.4
895.85 MHz	-42.2

6.0 Field Strength of Spurious Emissions, Clause 80.211(f)(1)

6.1 Test Procedure

The EUT was placed on a non-conductive table above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna. The EUT was placed into transmit mode with the antenna removed and a resistive terminator substituted. EUT height was 80 cm below 1 GHz and 150 cm above 1 GHz.

6.2 Test Criteria

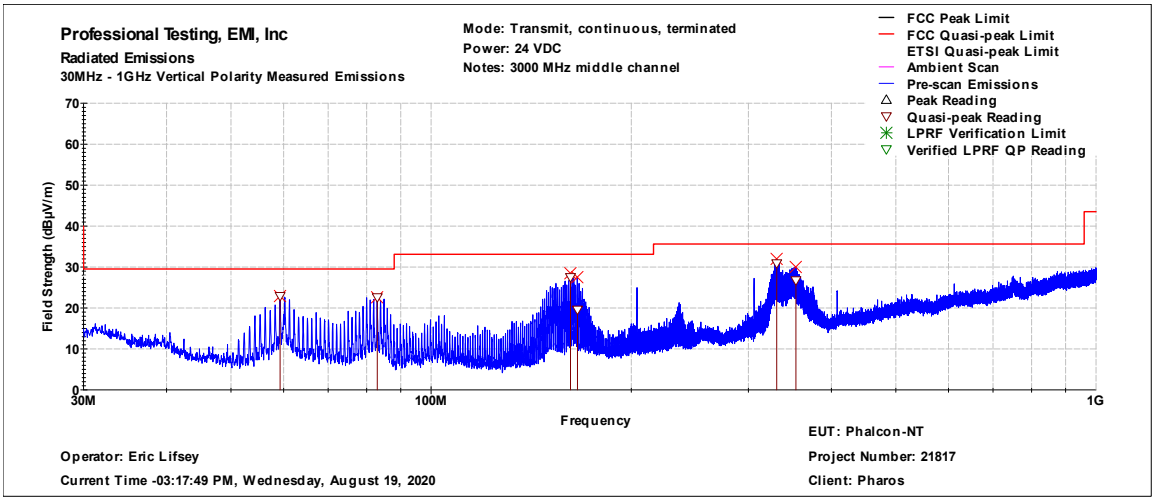
Spurious Limit
Authorized BW 2.9 - 3.1 GHz or 200 MHz. (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB; *100 MHz to 200 MHz outside band: 30 dBm - 25 dB = 5 dBm* (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and *200 MHz to 500 MHz outside band: 30 dBm - 35 dB = -5 dBm* (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB. *Use -13 dBm as conservative limit (is closer to -12.6 dBm)* *Beyond 200 * 2.5 = 500 MHz; 43+10log(1W) = 30 dBm - 43 dB = -13 dBm* ***Radiated limit (avg det.) > 1 GHz is 82.2 dBuV/m @ 3 meters.***

6.3 Test Results

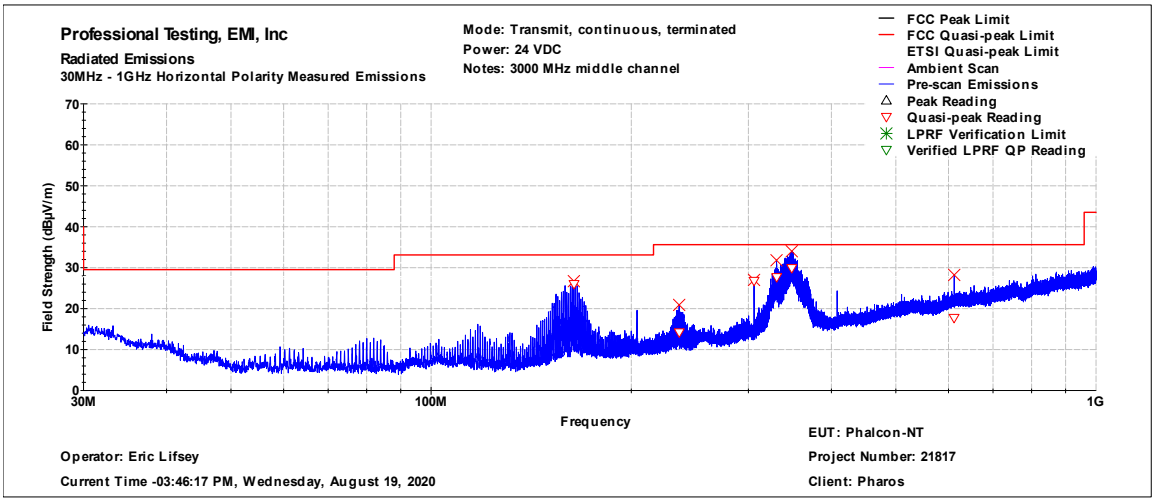
The EUT satisfied the requirements.

While the general emission limits of 15.209 are shown below and largely satisfied, the spurious limit (average detection) is ~18 dB higher.

6.3.1 Middle Channel to 1 GHz

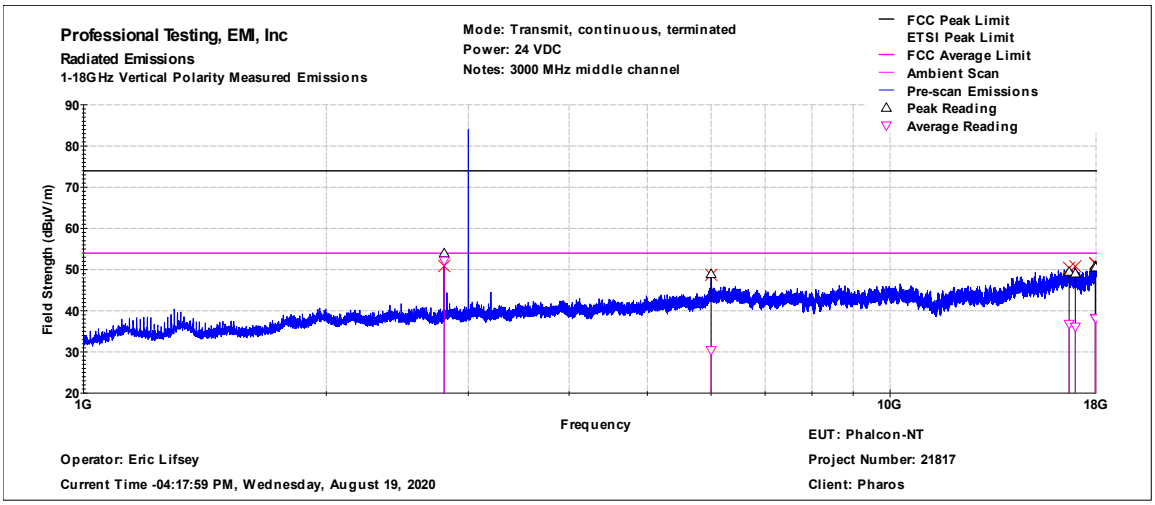


Frequency	Azimuth	Height	QP	QP Limit	QP Margin	QP Results
MHz	(deg)	(cm)	(dBµV)	(dBµV)	(dB)	(P/F)
59.263	18.000	274.000	22.908	29.500	-6.592	PASS
82.985	69.000	171.000	22.605	29.500	-6.895	PASS
162.011	98.000	128.000	27.522	33.100	-5.578	PASS
165.985	5.000	127.000	19.569	33.100	-13.531	PASS
330.971	238.000	127.000	30.887	35.600	-4.713	PASS
353.667	214.000	127.000	26.738	35.600	-8.862	PASS

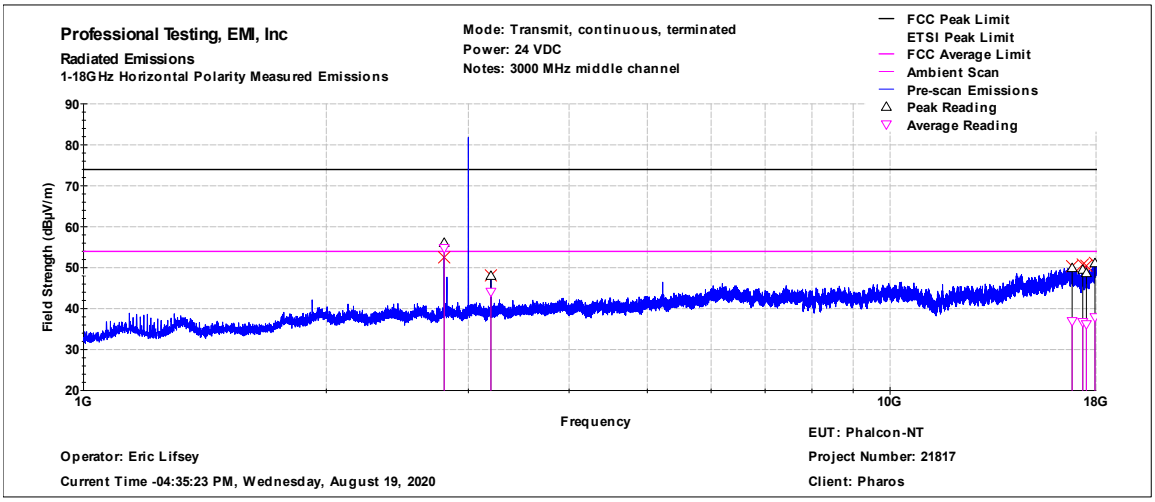


Frequency	Azimuth	Height	QP	QP Limit	QP Margin	QP Results
(MHz)	(deg)	(cm)	(dBµV)	(dBµV)	(dB)	(P/F)
164.015	82.000	379.000	25.979	33.100	-7.121	PASS
236.161	2.000	273.000	14.174	35.600	-21.426	PASS
306.007	254.000	272.000	26.746	35.600	-8.854	PASS
330.966	70.000	329.000	27.669	35.600	-7.931	PASS
348.704	82.000	289.000	29.864	35.600	-5.736	PASS
611.800	2.000	101.000	17.712	35.600	-17.888	PASS

6.3.2 Middle Channel 1 to 18 GHz



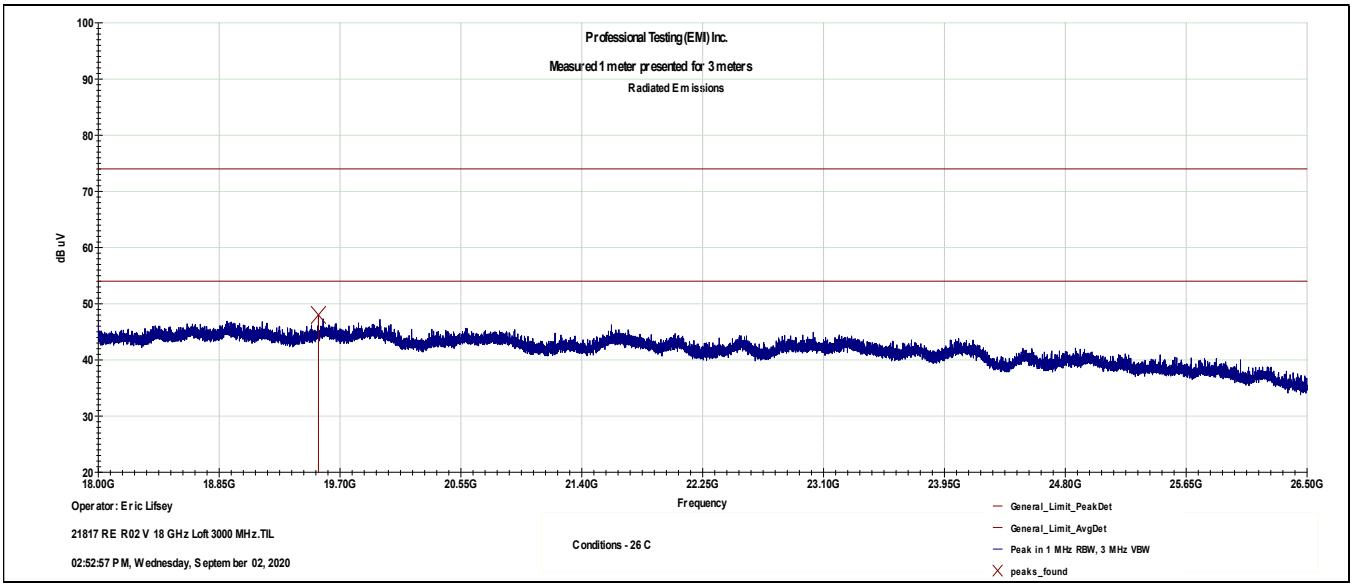
Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)
2800.00	68	104	53.958	73.958	-20.000	PASS	52.139	53.958	-1.819	PASS
5999.99	104	134	48.904	73.958	-25.054	PASS	30.419	53.958	-23.539	PASS
16670.74	256	377	49.453	73.958	-24.505	PASS	36.809	53.958	-17.149	PASS
16969.52	155	260	49.053	73.958	-24.905	PASS	36.126	53.958	-17.832	PASS
17963.39	3	370	50.863	73.958	-23.095	PASS	38.259	53.958	-15.699	PASS
17983.21	120	218	50.524	73.958	-23.434	PASS	38.122	53.958	-15.836	PASS



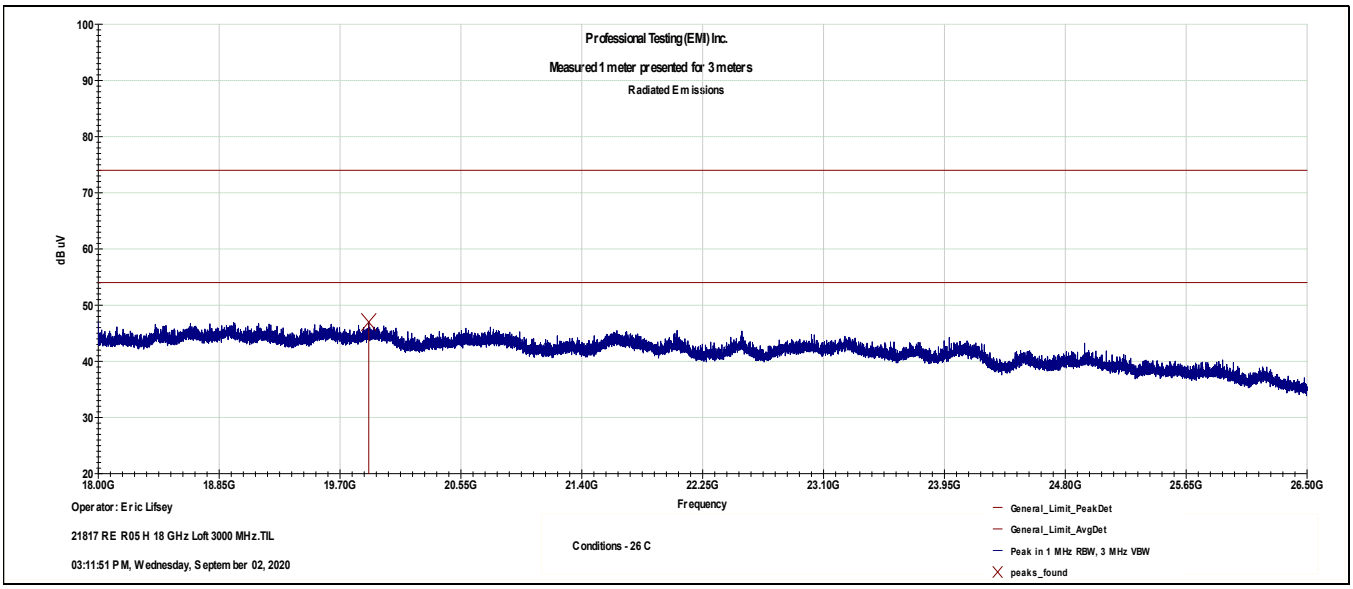
Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)
2799.88	329	126	56.062	73.958	-17.896	PASS	54.792	53.958	0.834	FAIL*
3200.05	18	357	47.990	73.958	-25.968	PASS	44.101	53.958	-9.857	PASS
16817.29	225	102	49.886	73.958	-24.072	PASS	36.932	53.958	-17.026	PASS
17332.02	361	137	49.476	73.958	-24.482	PASS	36.698	53.958	-17.260	PASS
17513.59	187	181	48.657	73.958	-25.301	PASS	36.166	53.958	-17.792	PASS
17948.78	331	168	51.077	73.958	-22.881	PASS	37.892	53.958	-16.066	PASS

*Passes the -13 dBm limit of 82.2.

6.3.3 Middle Channel 18 to 26.5 GHz

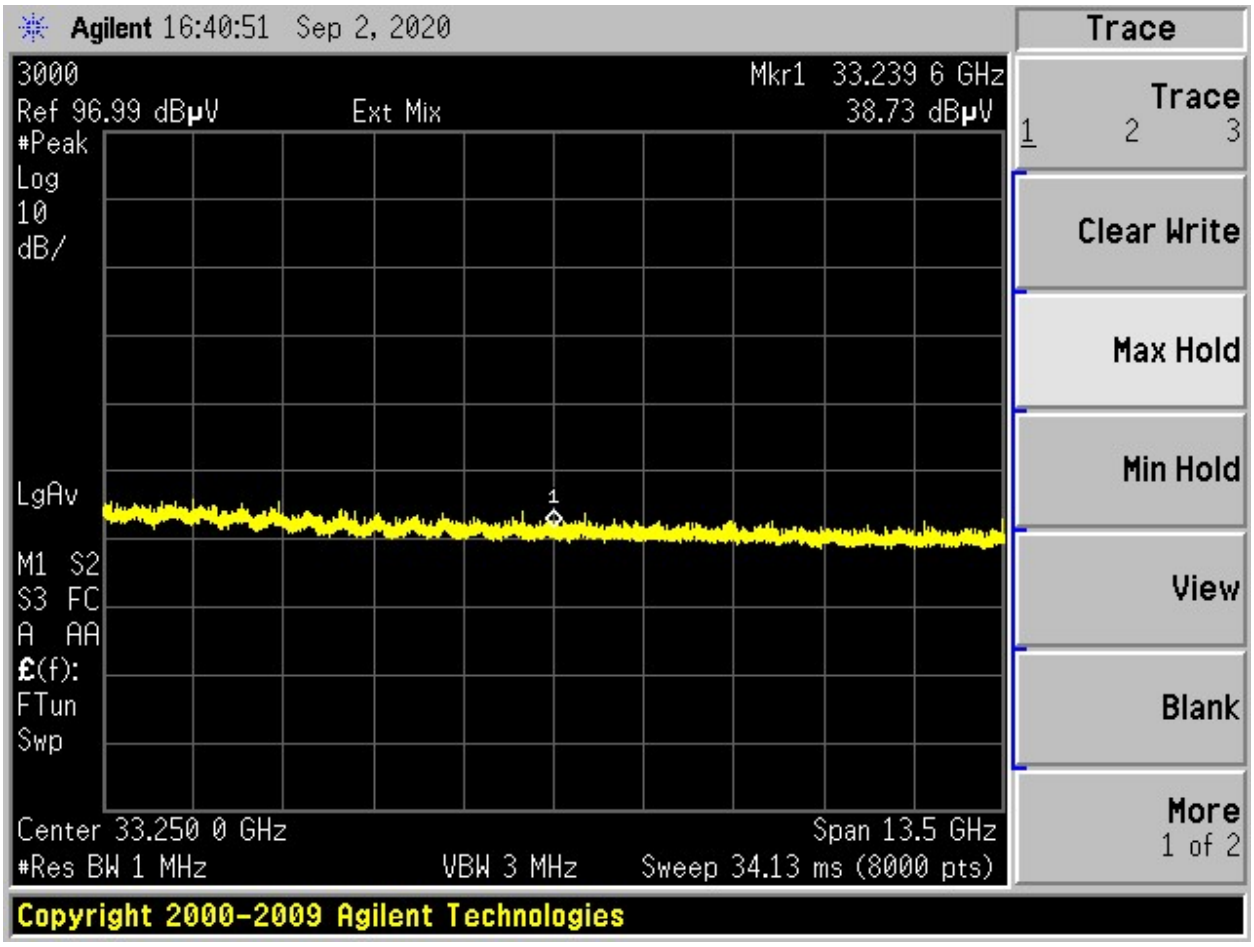


Vertical Polarity; highest recorded: 48.0 dBµV/m, 19.550 GHz



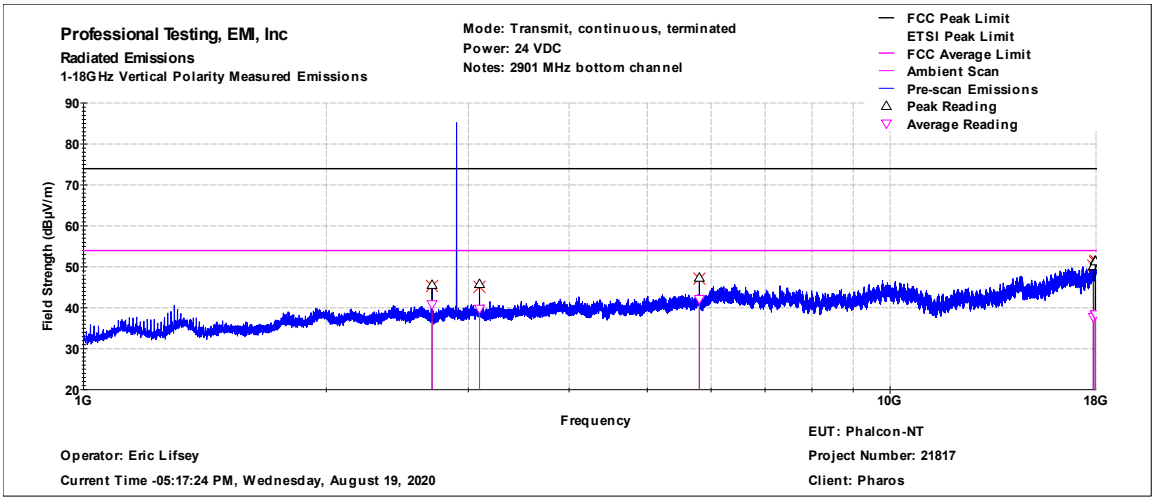
Horizontal Polarity; highest recorded: 47.0 dBµV/m, 19.990 GHz

6.3.4 Middle Channel 26.5 to 40 GHz

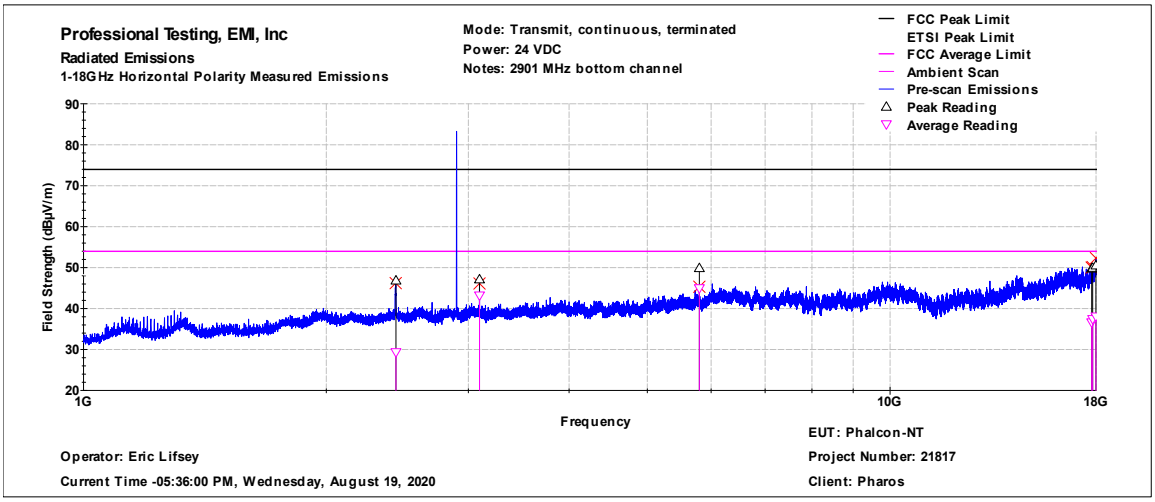


26.5 to 40 GHz
Max-hold of vertical and horizontal emissions.

6.3.5 Bottom Channel 1 to 18 GHz

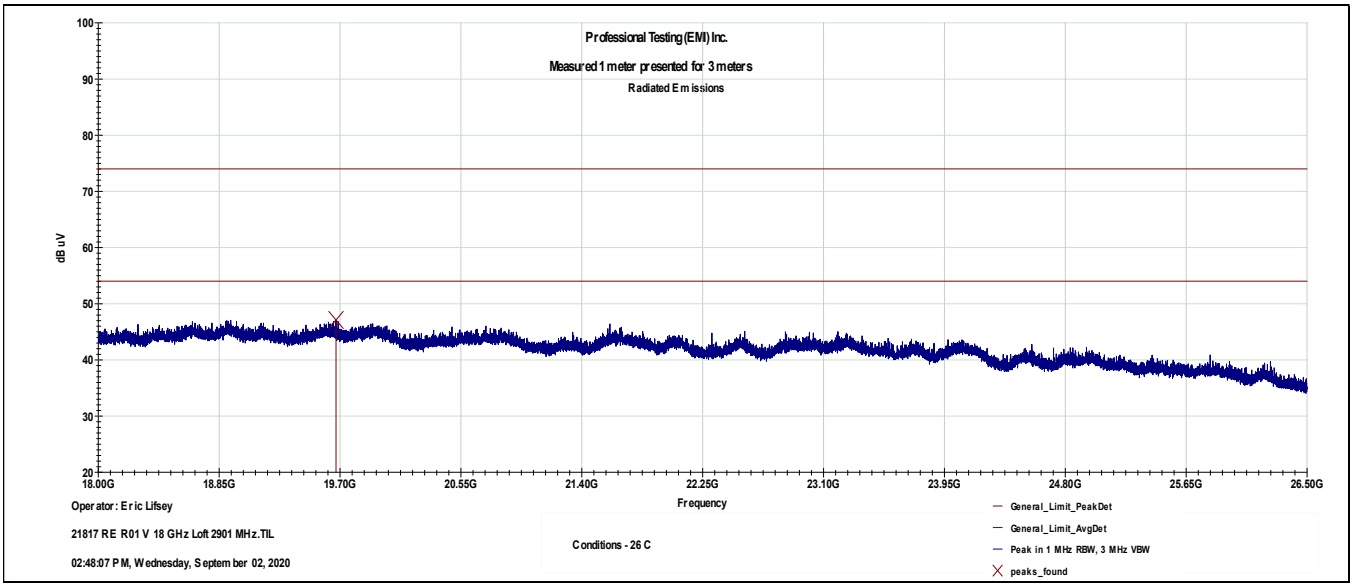


Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)
2705.01	88	213	45.577	73.958	-28.381	PASS	40.843	53.958	-13.115	PASS
3097.33	18	334	45.800	73.958	-28.158	PASS	39.744	53.958	-14.214	PASS
5801.88	2	102	47.333	73.958	-26.625	PASS	42.125	53.958	-11.833	PASS
17860.25	262	290	50.167	73.958	-23.791	PASS	37.730	53.958	-16.228	PASS
17956.88	287	157	51.497	73.958	-22.461	PASS	38.364	53.958	-15.594	PASS
17975.54	184	326	51.333	73.958	-22.625	PASS	38.373	53.958	-15.585	PASS

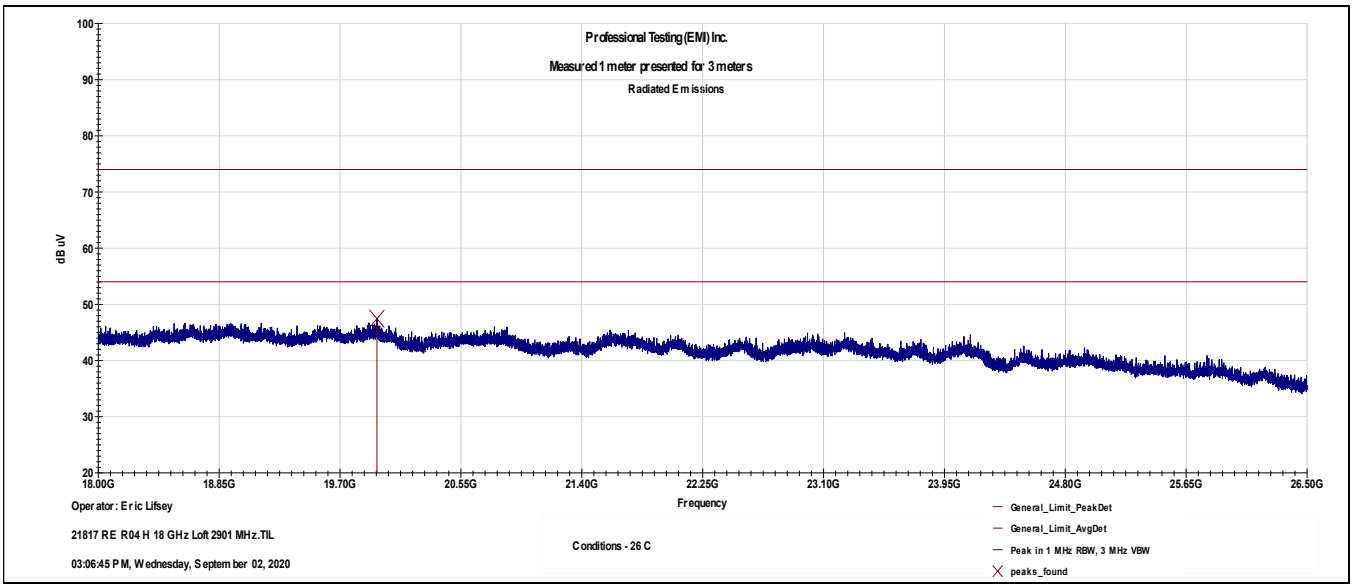


Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results	
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)	
2439.91	359	373	46.844	73.958	-27.114	PASS	29.311	53.958	-24.647	PASS	
3097.21	15	102	47.118	73.958	-26.840	PASS	43.172	53.958	-10.786	PASS	
5802.03	106	137	49.870	73.958	-24.088	PASS	44.948	53.958	-9.010	PASS	
17781.09	2	101	49.759	73.958	-24.199	PASS	36.602	53.958	-17.356	PASS	
17830.88	171	376	49.937	73.958	-24.021	PASS	37.412	53.958	-16.546	PASS	
17998.77	3	126	50.532	73.958	-23.426	PASS	38.041	53.958	-15.917	PASS	

6.3.6 Bottom Channel 18 to 26.5 GHz

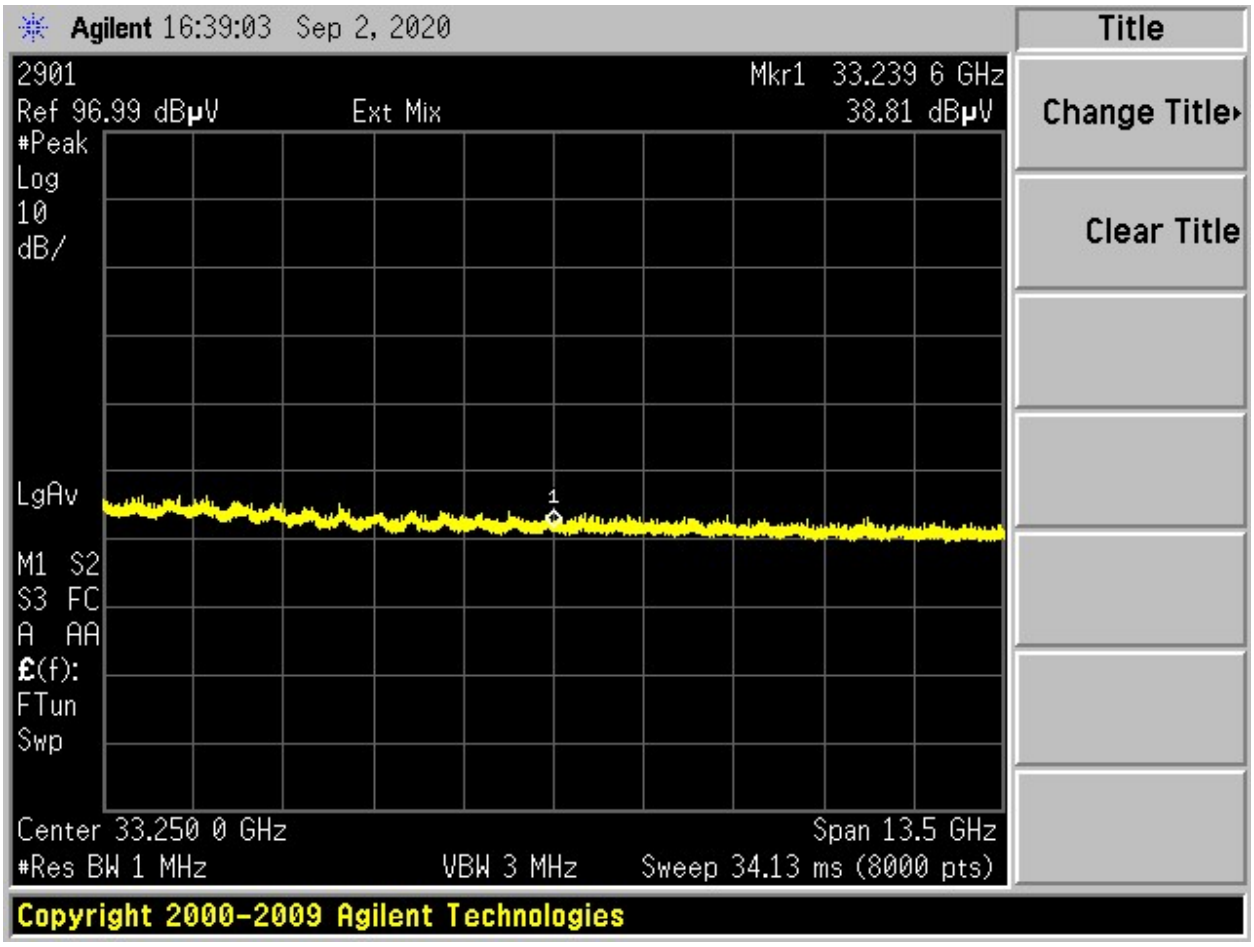


Vertical Polarity; highest recorded: 48.0 dBµV/m, 19.672 GHz



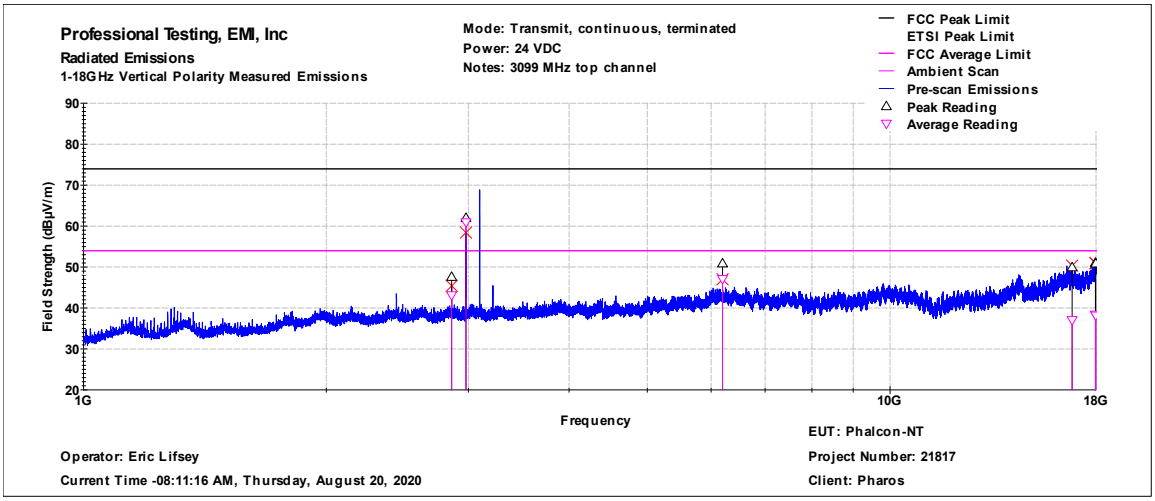
Horizontal Polarity; highest recorded: 47.4 dBµV/m, 19.960 GHz

6.3.7 Bottom Channel 26.5 to 40 GHz



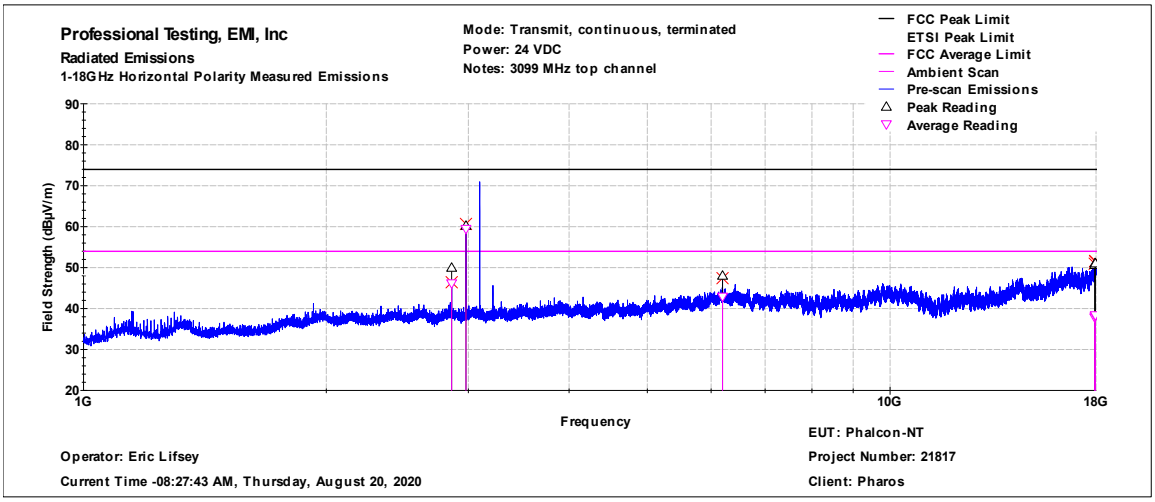
26.5 to 40 GHz
Max-hold of vertical and horizontal emissions.

6.3.8 Top Channel 1 to 18 GHz



Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)
2860.37	21	244	47.597	73.958	-26.361	PASS	43.086	53.958	-10.872	PASS
2979.84	116	102	61.998	73.958	-11.960	PASS	60.880	53.958	6.922	FAIL*
6197.93	107	331	50.899	73.958	-23.059	PASS	47.028	53.958	-6.930	PASS
16816.23	197	126	49.935	73.958	-24.023	PASS	37.011	53.958	-16.947	PASS
17968.99	357	340	51.049	73.958	-22.909	PASS	38.366	53.958	-15.592	PASS
17987.93	295	102	50.872	73.958	-23.086	PASS	38.129	53.958	-15.829	PASS

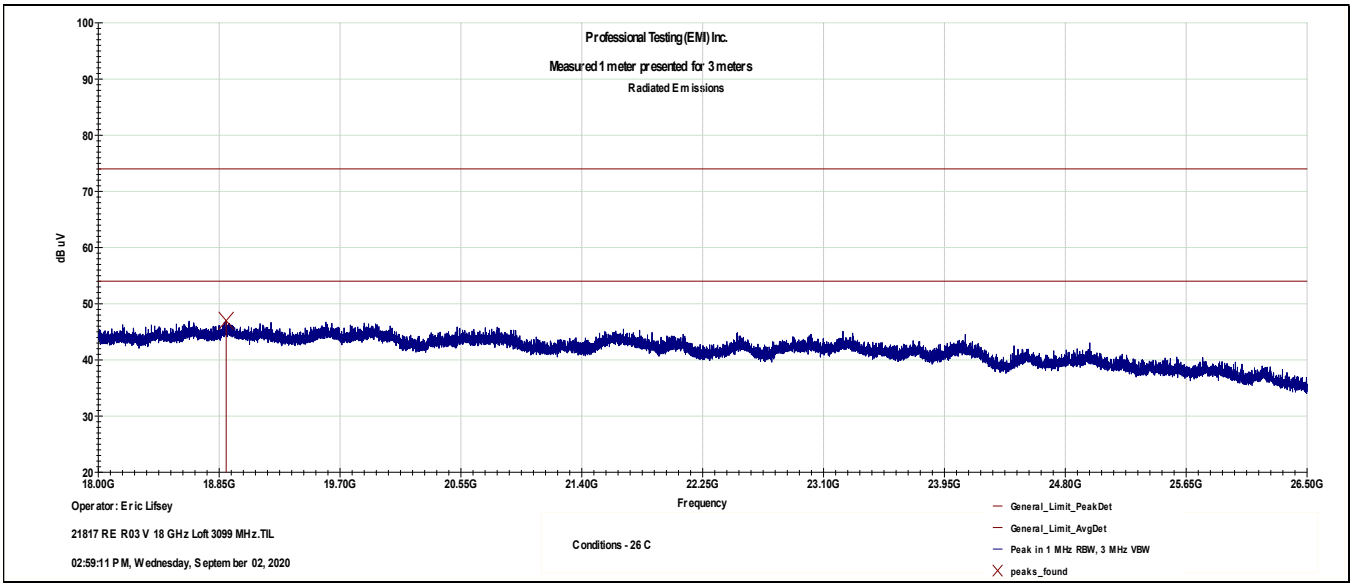
*Passes the -13 dBm limit of 82.2.



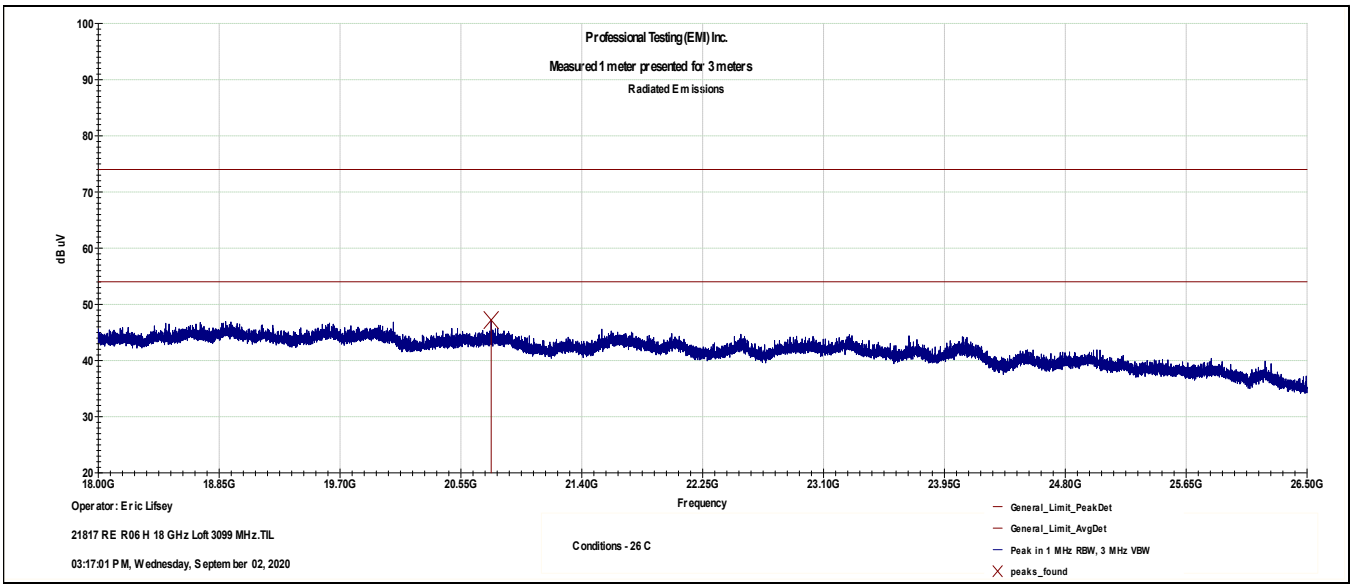
Frequency	Azimuth	Height	Peak	Peak Limit	Peak Margin	Peak Results	Avg	Avg Limit	Avg Margin	Avg Results
(MHz)	(deg)	(cm)	(dBuV)	(dBuV)	(dB)	(P/F)	(dBuV)	(dBuV)	(dB)	(P/F)
2860.42	32	126	49.950	73.958	-24.008	PASS	46.124	53.958	-7.834	PASS
2979.73	103	149	60.222	73.958	-13.736	PASS	59.426	53.958	5.468	FAIL*
6198.00	2	209	48.004	73.958	-25.954	PASS	42.882	53.958	-11.076	PASS
17933.79	180	296	50.635	73.958	-23.323	PASS	37.810	53.958	-16.148	PASS
17952.08	344	359	51.080	73.958	-22.878	PASS	38.241	53.958	-15.717	PASS
17965.73	55	365	51.021	73.958	-22.937	PASS	38.340	53.958	-15.618	PASS

*Passes the -13 dBm limit of 82.2.

6.3.9 Top Channel 18 to 26.5 GHz

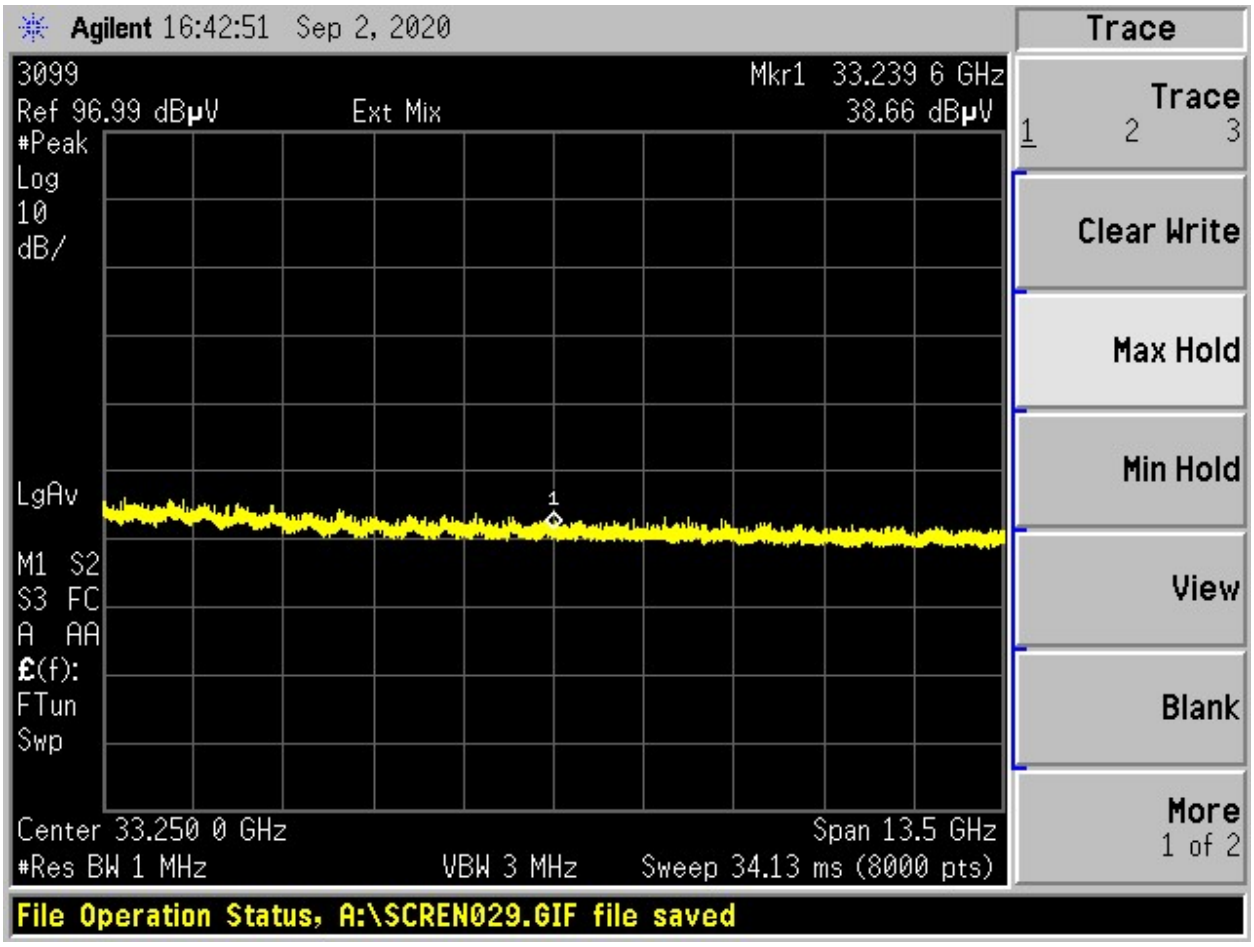


Vertical Polarity; highest recorded: 47.0 dBµV/m, 18.899 GHz



Horizontal Polarity; highest recorded: 47.2 dBµV/m, 20.763 GHz

6.3.10 Top Channel 26.5 to 40 GHz



26.5 to 40 GHz
Max-hold of vertical and horizontal emissions.

7.0 Frequency Stability

7.1 Test Procedure

The EUT is placed into a temperature chamber and connected by cable to a spectrum analyzer; attenuation added if needed. On reaching each set point temperature, the EUT is allowed to soak at least 15 minutes without power applied. After soak time was satisfied, the EUT is powered on in transmit mode and the frequency is observed until it becomes stable; then the measurement of frequency is taken.

Operating voltage stability was also measured for selected extremes based on operating design. This device operates over a wide voltage range greater than the FCC basic requirement.

The EUT is operated in unmodulated mode and continuous transmit.

7.2 Test Criteria

Parameter: Frequency Tolerance

80.209 (c) For stations in the maritime radiodetermination service, other than ship radar stations, the authorized frequency tolerance will be specified on the license when it is not specified in this part.

From Technical Manual:

Frequency performance	
Frequency accuracy (50ns to 200ns pulse widths)	±3.5MHz
Frequency accuracy(>200ns pulse widths)	±1.5MHz

Using ±1.5MHz as criteria.

Test Conditions, Temperatures
-20 C to 50 C and by 10 C steps

Test Conditions, Voltage	
Low Voltage	10 V
Nominal Voltage	28 VDC
High Voltage	40 VDC

7.3 Test Results

The EUT satisfies the requirement.

7.3.1 Temperature

			12-Aug-2020
Condition	**Frequency**		**Deviation**
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-20	2901.000000	2901.010000	10000
-10	2901.000000	2901.020000	20000
0	2901.000000	2901.015000	15000
10	2901.000000	2901.015000	15000
20	2901.000000	2901.020000	20000
30	2901.000000	2901.000000	0
40	2901.000000	2901.015000	15000
50	2901.000000	2901.030000	30000
Max Deviation (Hz)			30000
Min Deviation (Hz)			0

			12-Aug-2020
Condition	**Frequency**		**Deviation**
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-20	3099.000000	3099.020000	20000
-10	3099.000000	3099.020000	20000
0	3099.000000	3099.025000	25000
10	3099.000000	3099.025000	25000
20	3099.000000	3099.005000	5000
30	3099.000000	3099.010000	10000
40	3099.000000	3099.020000	20000
50	3099.000000	3099.020000	20000
Max Deviation (Hz)			25000
Min Deviation (Hz)			5000

7.3.2 Voltage

				12-Aug-2020
Condition	**Voltage**	**Frequency**		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.0	2901.000000	2901.015000	15000
Nominal	24.0	2901.000000	2901.020000	20000
High	36.0	2901.000000	2901.005000	5000

				12-Aug-2020
Condition	**Voltage**	**Frequency**		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	10.0	3099.000000	3099.005000	5000
Nominal	24.0	3099.000000	3099.005000	5000
High	36.0	3099.000000	3099.000000	0

8.0 Equipment Lists

Table 9.1 Equipment List; Power, Bandwidth, and Mask				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
1937	Agilent	E4440A	Spectrum Analyzer	8 Nov 2020
A105	Narda	768A-20	Attenuator, 20 W, 20 dB	23 Sep 2020
0463	Fluke	77A	DMM	13 Jul 2021
1268	HP	6291A	DC Power Supply	CIU

Table 9.2 Equipment List; Frequency Stability				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
1937	Agilent	E4440A	Spectrum Analyzer	8 Nov 2020
A105	Narda	768A-20	Attenuator, 20 W, 20 dB	23 Sep 2020
2134	Tenny	TPC T2C	Temperature Chamber	8 Oct 2020
C247	Pasternack	RG type	Coaxial Cable, double shielded	CNR
0463	Fluke	77A	DMM	13 Jul 2021
1268	HP	6291A	DC Power Supply	CIU

Table 9.3 Equipment List; 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:			**2019_May_Unintentional RE_TILE7_v2.5.til**		
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	9/17/2021
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/9/2022
2295	Keysight	E4440A-AYZ	PSA Spectrum Analyzer	MY46186204	11/6/2020
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/11/2021
C027	none	RG214	Cable Coax, N-N, 25m, 25MHz - 1GHz	None	9/9/2020
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	TDK 10M	TDK 10M Chamber,sVSWR > 1 GHz	DAC-012915-005	9/21/2021
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, 100MHz-18GHz	None	1/9/2022
C030	none	none	Cable Coax, N-N, 30m, 1 - 18GHz	None	9/9/2020
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/11/2021

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

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