Project 19021-15

Houston Radar
PD420

Wireless Certification Report

Prepared for:

Houston Radar
13814 Sherburn Manor Dr.
Cypress, TX 77429

By

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

3 Aug 2017

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
02 DRAFT	For review and comment.	3 Aug 2017
01 Final		10 Aug 2017
02 Final	Added missing 40-50 GHz measurements. Reduced PDF size.	1 Sep 2017

Errata: None

Table of Contents

Compliance Certificate

Applicant	Device & Test Identification	
Houston Radar 13814 Sherburn Manor Dr. Cypress, TX 77429 Certificate Date: 3 Aug 2017	FCC ID: IC ID: Model(s): Laboratory Project ID:	TIAPD420 Label as: **Canada 310** PD420 19021-15

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

Standard	Reference	Detail
FCC 47 CFR Part 15 C	15.249, 15.209, 15.205, 15.212(a)(1)	Radiated Power Bandwidth Spurious Emissions Modular Construction
IC RSS-310 Issue 4 (RSS-Gen Issue 4)	Clause 3.10 24 GHz	Radiated Power Bandwidth Spurious Emissions
IC RSP-100 Issue 11	Section 5	Modular Construction

I, Eric Lifsey, 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.

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 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

Table 1.2.1: EUT Essential Information		
Manufacturer & Model	**Description**	**Power**
Houston Radar PD420	24 GHz FMCW Doppler Radar Module	12 VDC

1.3 EUT Operation

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

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

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 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.

1.6 Radiated Measurements

Radiated levels are determined as follows:

Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level

Conducted RF levels, if applicable, are determined as follows:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

Conducted mains levels are determined as follows:

Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = Corrected Level

Additionally, measurement distance extrapolation factors are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents	
Document	**Title**
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-310 Issue 4	Licence-exempt Radio Apparatus (All Frequency Bands): Category II Equipment
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10 2013	ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

Table 1.7.2: Applicable Clauses		
Parameter	**FCC Part 15 Rule Paragraphs**	**IC RSS References**
Transmitter Characteristics	15.249	RSS 310 3.10, RSS-Gen
Spurious Radiated Power	15.249, 15.209, 15.205	RSS 310 3.10
Antenna Requirement	15.203	RSS-Gen
Modular Construction*	15.212(a)(1)	RSS-Gen 3.2.2

*A separate letter addresses the modular construction details.

2.0 Fundamental Power

2.1 Test Procedure

Power is measured using radiated means and with modulation.

2.2 Test Criteria

Section Reference	Parameter	Date(s)
15.249 RSS-310 3.10	**Average or Peak Detection Per:** **14.249:** Radiated Field Strength, 250 mV/m @ 3 m Restated as 108 dBµV/m @ 3 m **RSS-310:** Radiated Field Strength, 250 mV/m @ 3 m Restated as 108 dBµV/m @ 3 m	8 Jun 2017

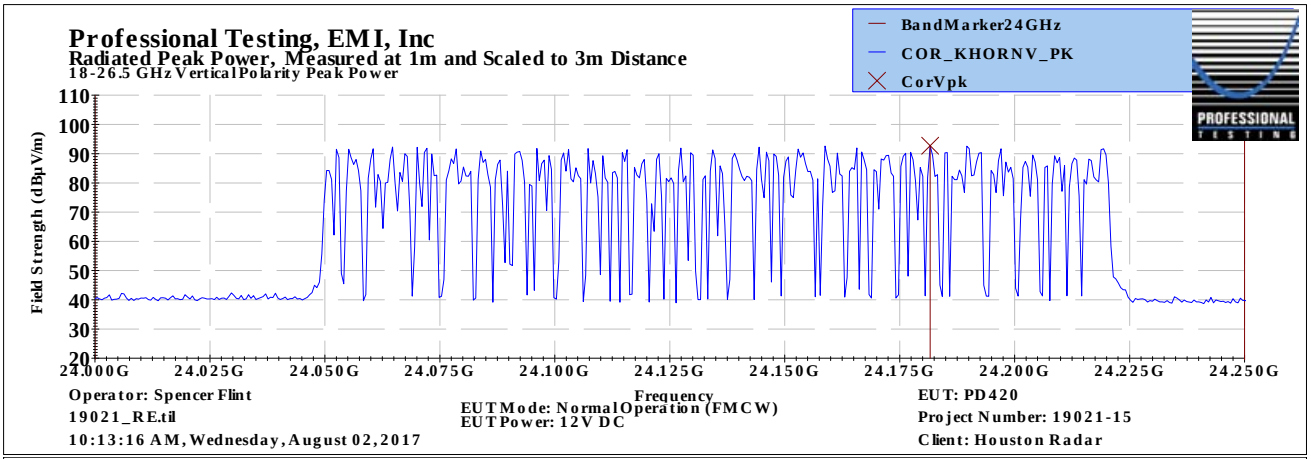
2.3 Test Results, Peak Power

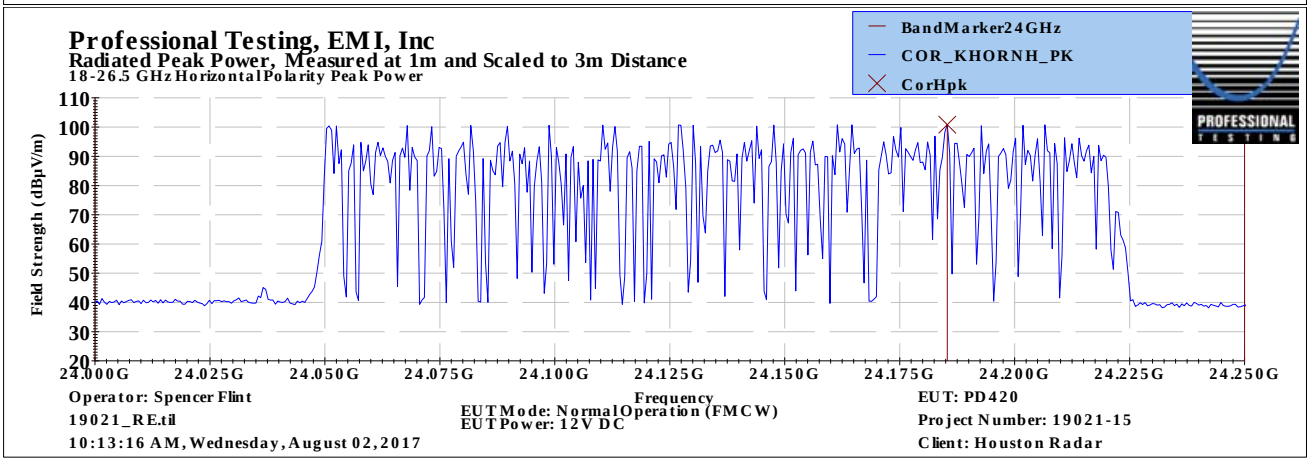
Table 2.3.1: Field Strength of Fundamental; 1 Meter Measurement Distance Corrected to 3 meters

Frequency GHz	Antenna Polarity	Antenna Height meters	Corrected Level* (Measured Peak Level) dBµV/m
24.185	H	1	100.8
24.182	V	1	92.7

*Resolution bandwidth 1 MHz, video bandwidth 3 MHz, using peak detection.

The EUT satisfies the criteria. The EUT operates at 100 % duty cycle.





3.0 Occupied Bandwidth

3.1 Test Procedure

Bandwidth is measured by relative radiated means.

3.2 Test Criteria

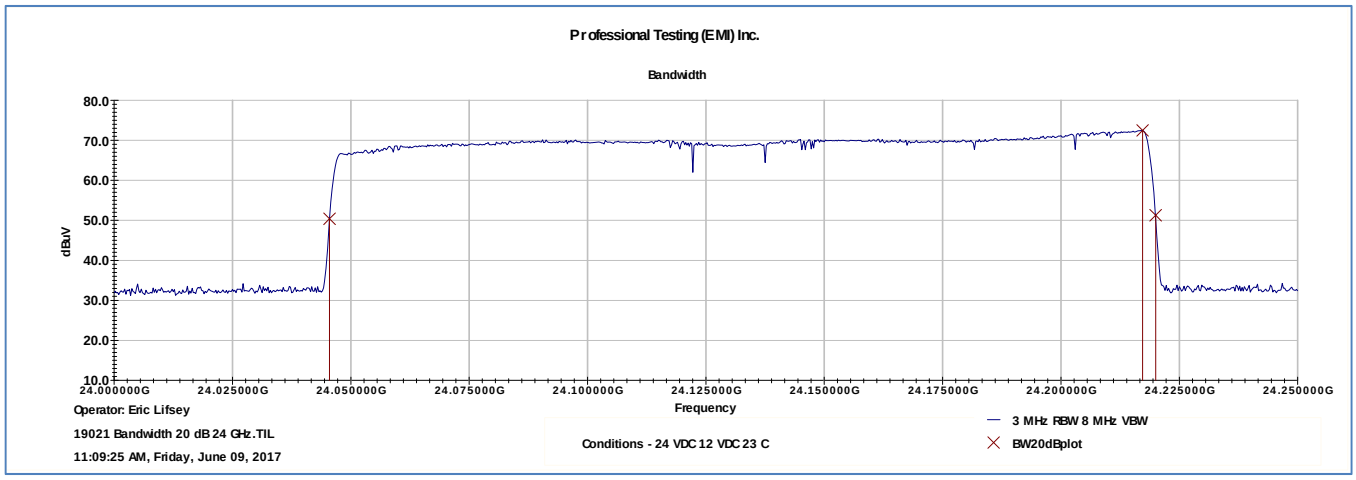
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
2.1049, KDB 558074 D01 // RSS-Gen 4.6	Bandwidth, 20 dB	9 Jun 2017

3.3 Test Results

The bandwidth measurement is used for general reporting for agency application and serves to confirm the emission is confined to the designated band.

The EUT satisfied the requirements.

Table 3.3.1 Bandwidth 20 dB, Measure and Report
Measured BW (MHz)
174.5

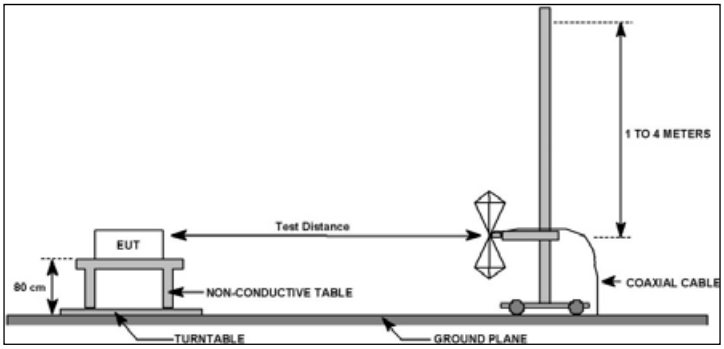


4.0 Radiated Spurious Emissions, Transmit Mode

4.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters or less as needed to overcome path loss and inherent equipment noise.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate and 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



4.2 Test Criteria

Table 4.2.1 Emission Limits Extrapolated as Shown			
Frequency MHz	**Test Distance (Meters)**	**Field Strength Limit (µV/m @ 3m)**	**(dBµV/m @ Test Distance)**
30 to 88	10	100	29.5
88 to 216	10	150	33.0
216 to 960	10	200	35.5
960 to 1000	10	500	43.5
1000 to 18000	3	500	54.0
18000 to 26500	1	500	63.6
26500 to 100000	.1	500	83.5

Table 4.2.2 IC RSS-310 Clause 3.10 Emission Limits
Emissions radiated outside the specified frequency band shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is the less stringent.

4.3 Test Results

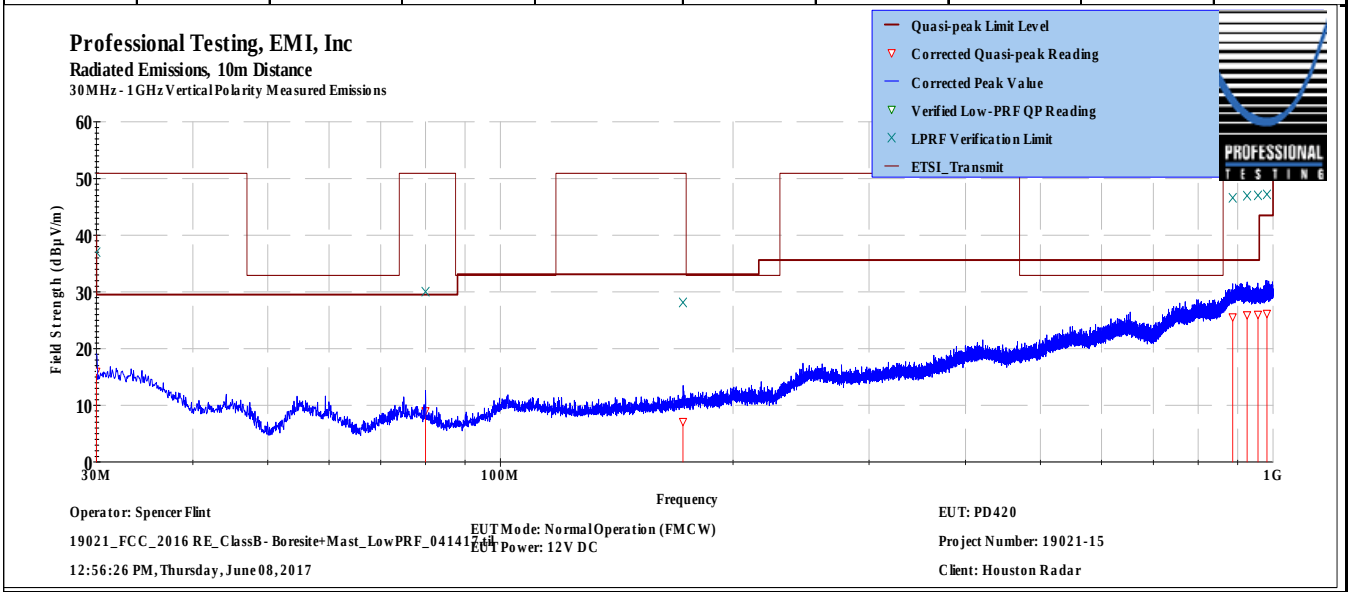
The EUT is a Doppler device, it must transmit to be able to receive. The EUT satisfied the criteria.

4.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
30	10	297	2.46	Quasi-peak	28.1	16.013	29.5	-13.5	Pass
79.9846	10	68	1.3	Quasi-peak	27.6	9.033	29.5	-20.5	Pass
172.348	10	88	1.6	Quasi-peak	22.8	7.14	33.1	-26.0	Pass
886.943	10	67	1.56	Quasi-peak	21.3	25.585	35.6	-10.0	Pass
925.877	10	342	3.65	Quasi-peak	21.1	25.955	35.6	-9.6	Pass
956.286	10	75	3.72	Quasi-peak	21	26.031	35.6	-9.6	Pass
982.363	10	134	3.7	Quasi-peak	21	26.194	43.5	-17.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

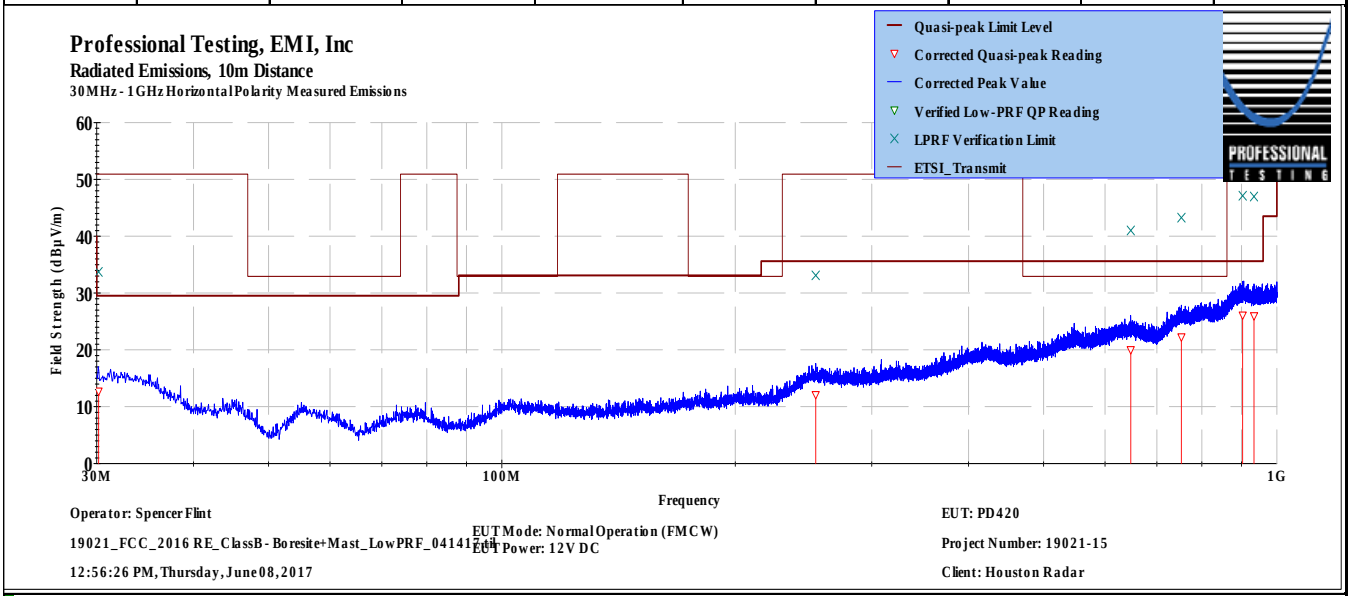
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	**EUT Serial #:**	E2BD85574E7E
Customer:	Houston Radar	**EUT Part #:**	0
Project Number:	19021-15	**Test Technician:**	Spencer Flint
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	PD420	**Witness' Name:**	Jake Bailey

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	N/A N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
30.174	10	282	2.8	Quasi-peak	24.8	12.707	29.5	-16.8	Pass
254.053	10	66	3.77	Quasi-peak	22.2	12.098	35.6	-23.5	Pass
647.708	10	305	2.81	Quasi-peak	21.8	20.015	35.6	-15.6	Pass
752.92	10	81	2.87	Quasi-peak	21.7	22.261	35.6	-13.3	Pass
903.292	10	101	2.17	Quasi-peak	21.3	26.117	35.6	-9.5	Pass
934.252	10	13	1.14	Quasi-peak	21.1	25.982	35.6	-9.6	Pass



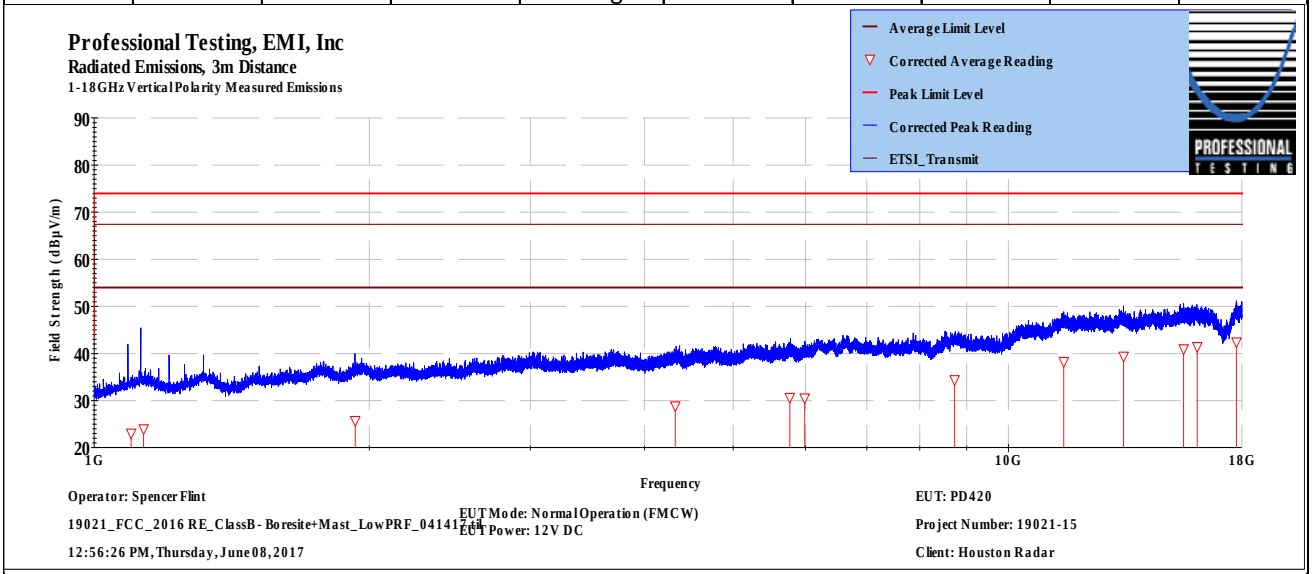
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.2 Up to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1097.76	3	94	3.99	Average	35.9	23.062	54.0	-30.9	Pass
1132.82	3	111	2.79	Average	36.6	23.988	54.0	-30.0	Pass
1930.04	3	51	2.46	Average	35.1	25.74	54.0	-28.2	Pass
4321.68	3	49	3.84	Average	33.7	28.845	54.0	-25.1	Pass
5765.76	3	336	1.3	Average	31.9	30.647	54.0	-23.3	Pass
5986.52	3	282	3.3	Average	31.6	30.542	54.0	-23.4	Pass
8733.36	3	60	1.94	Average	27	34.4	54.0	-19.6	Pass
11497.6	3	160	2.72	Average	27.2	38.251	54.0	-15.7	Pass
13367.4	3	209	1.42	Average	28.7	39.387	54.0	-14.6	Pass
15548.2	3	53	2.75	Average	27.7	40.968	54.0	-13.0	Pass
16086.8	3	138	3.78	Average	27.2	41.42	54.0	-12.5	Pass
17757	3	248	2.73	Average	26.6	42.397	54.0	-11.6	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

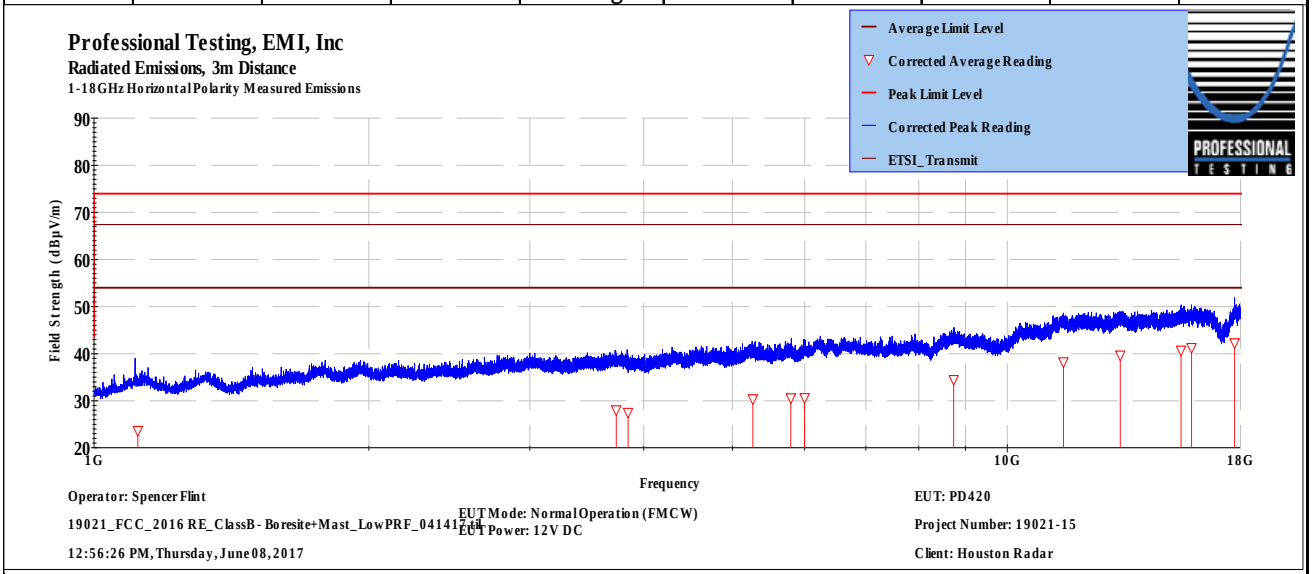
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	**EUT Serial #:**	E2BD85574E7E
Customer:	Houston Radar	**EUT Part #:**	0
Project Number:	19021-15	**Test Technician:**	Spencer Flint
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	PD420	**Witness' Name:**	Jake Bailey

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	N/A N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1116.7	3	245	2.88	Average	36.4	23.658	54.0	-30.3	Pass
3729.94	3	71	2.38	Average	34.8	28.05	54.0	-25.9	Pass
3842.59	3	120	1.62	Average	34.1	27.513	54.0	-26.4	Pass
5264.88	3	92	2.19	Average	33	30.378	54.0	-23.6	Pass
5794.38	3	40	3.74	Average	31.9	30.597	54.0	-23.4	Pass
5998.62	3	198	2.92	Average	31.6	30.634	54.0	-23.3	Pass
8735.33	3	348	1.71	Average	27	34.475	54.0	-19.5	Pass
11521.1	3	49	3.06	Average	27.3	38.232	54.0	-15.7	Pass
13293.5	3	305	2.44	Average	28.6	39.66	54.0	-14.3	Pass
15492.9	3	74	1.2	Average	27.5	40.724	54.0	-13.2	Pass
15913.4	3	136	3.6	Average	27.3	41.268	54.0	-12.7	Pass
17737.4	3	210	3.2	Average	26.6	42.291	54.0	-11.7	Pass



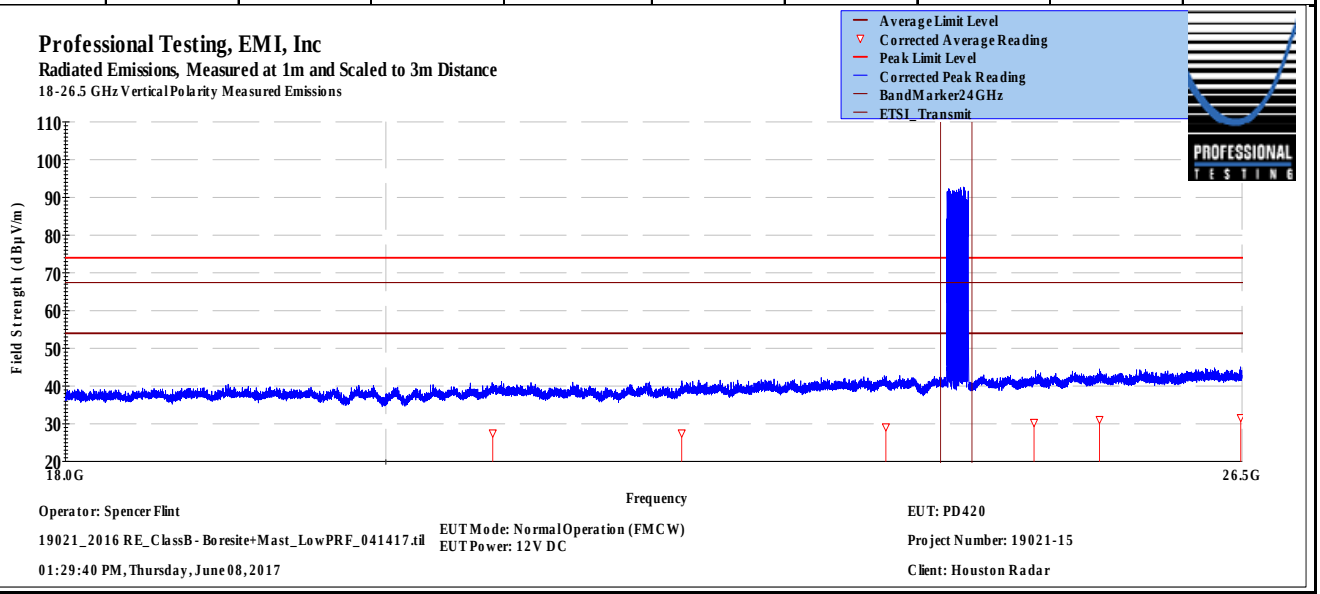
> 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.3 Up to 26.5 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
20715.4	3	175	1	Average	33.2	27.549	54.0	-26.4	Pass
22042.4	3	195	1	Average	32.9	27.552	54.0	-26.4	Pass
23572.2	3	149	1	Average	33.7	29.186	54.0	-24.8	Pass
24749.7	3	83	1	Average	34.2	30.325	54.0	-23.6	Pass
25288.3	3	347	1	Average	34.8	31.13	54.0	-22.8	Pass
26489.5	3	75	1	Average	34.1	31.626	54.0	-22.3	Pass
	3								



> 1GHz Vertical Antenna Polarity Measured Emissions

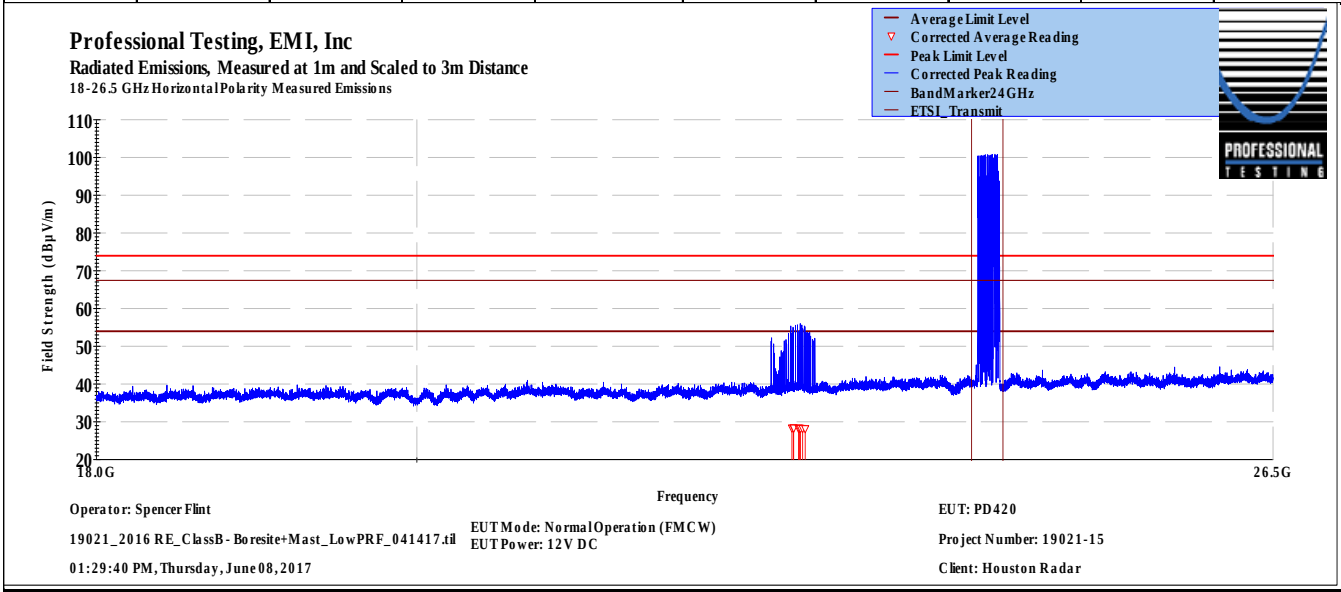
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	**EUT Serial #:**	E2BD85574E7E
Customer:	Houston Radar	**EUT Part #:**	0
Project Number:	19021-15	**Test Technician:**	Spencer Flint
Purchase Order #:	0	**Supervisor:**	Lisa Arndt
Equip. Under Test:	PD420	**Witness' Name:**	Jake Bailey

Radiated Emissions Test Results Data Sheet

EUT Line Voltage:	12 VDC	**EUT Power Frequency:**	N/A N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
22623.7	3	342	1	Average	33.4	28.346	54.0	-25.6	Pass
22635.3	3	168	1	Average	33.4	28.338	54.0	-25.6	Pass
22637.9	3	267	1	Average	33.4	28.309	54.0	-25.6	Pass
22673.2	3	317	1	Average	33.4	28.278	54.0	-25.7	Pass
22679.4	3	164	1	Average	33.4	28.287	54.0	-25.7	Pass
22688.9	3	162	1	Average	33.3	28.239	54.0	-25.7	Pass
22704.1	3	338	1	Average	33.3	28.206	54.0	-25.8	Pass
22723	3	244	1	Average	33.3	28.159	54.0	-25.8	Pass
	3								

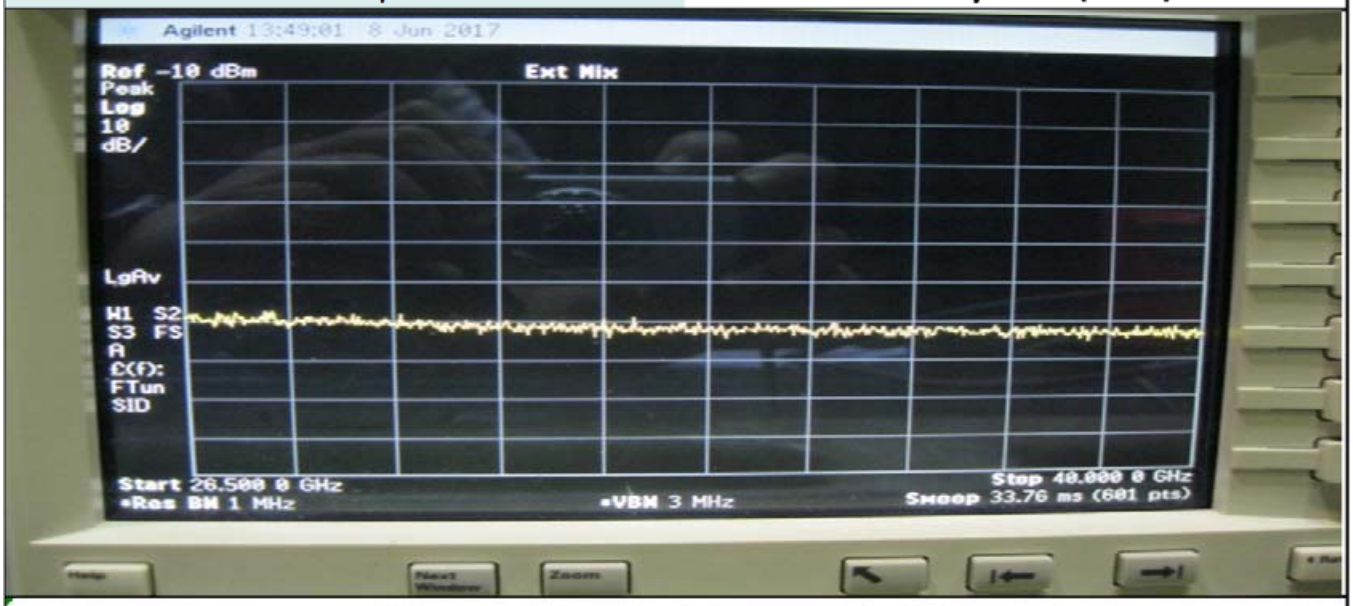


> 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.4 Up to 40 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
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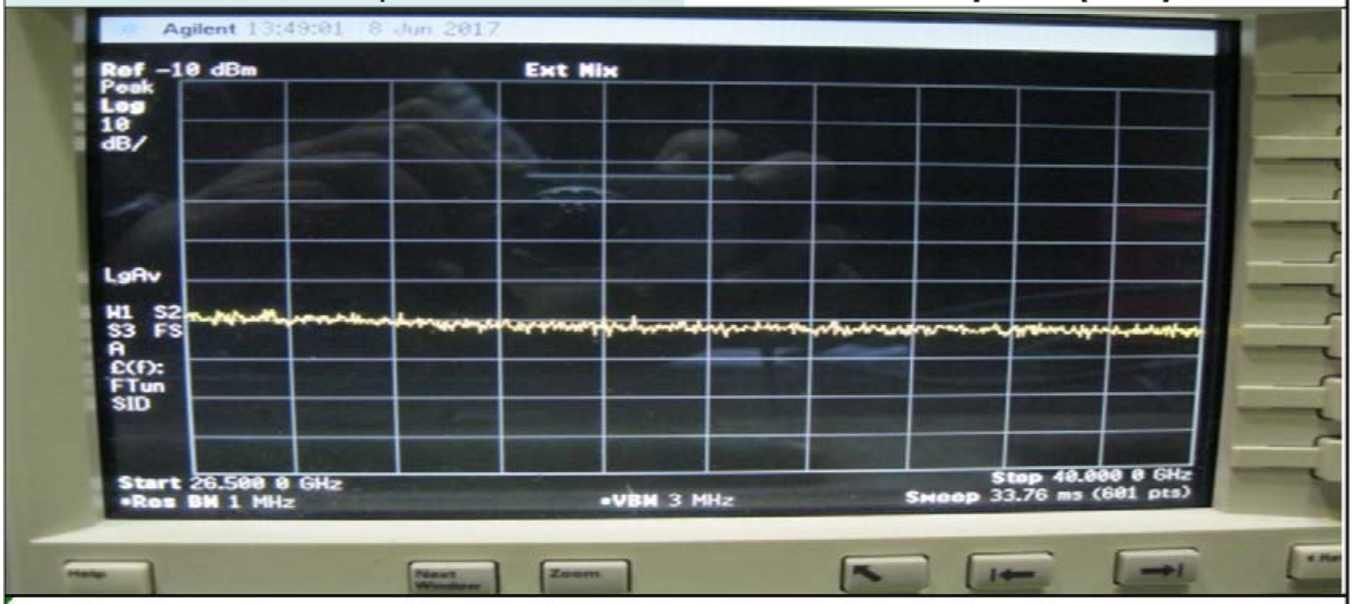
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

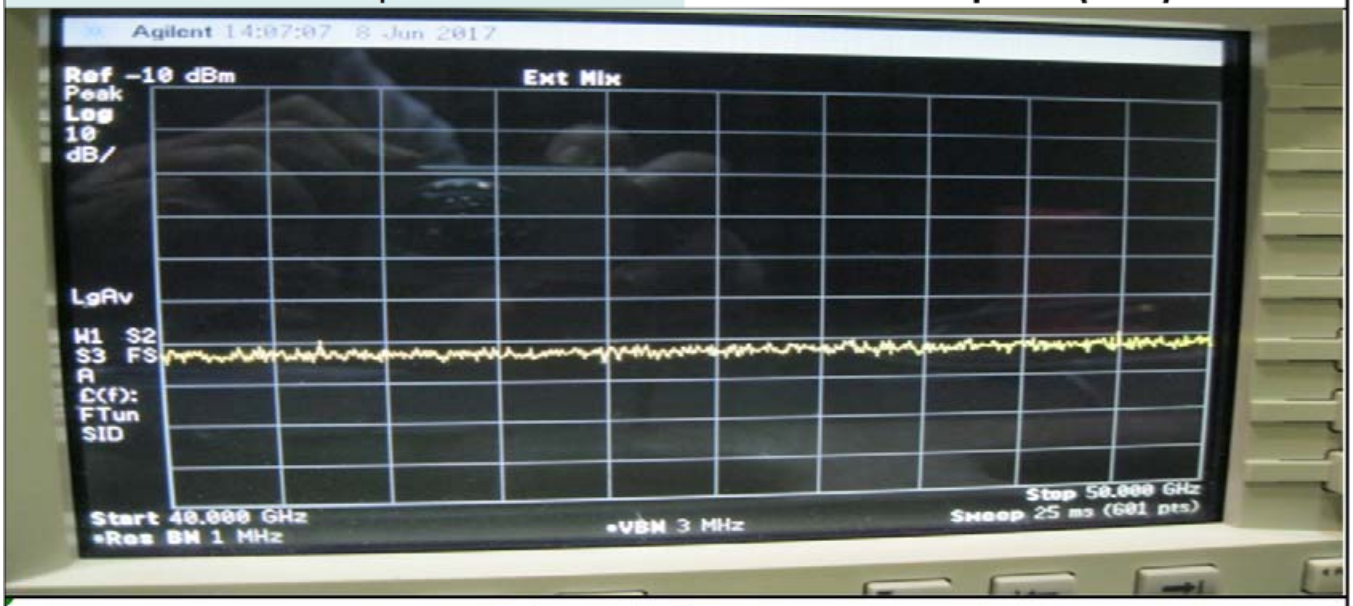


> 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.1 Up to 50 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

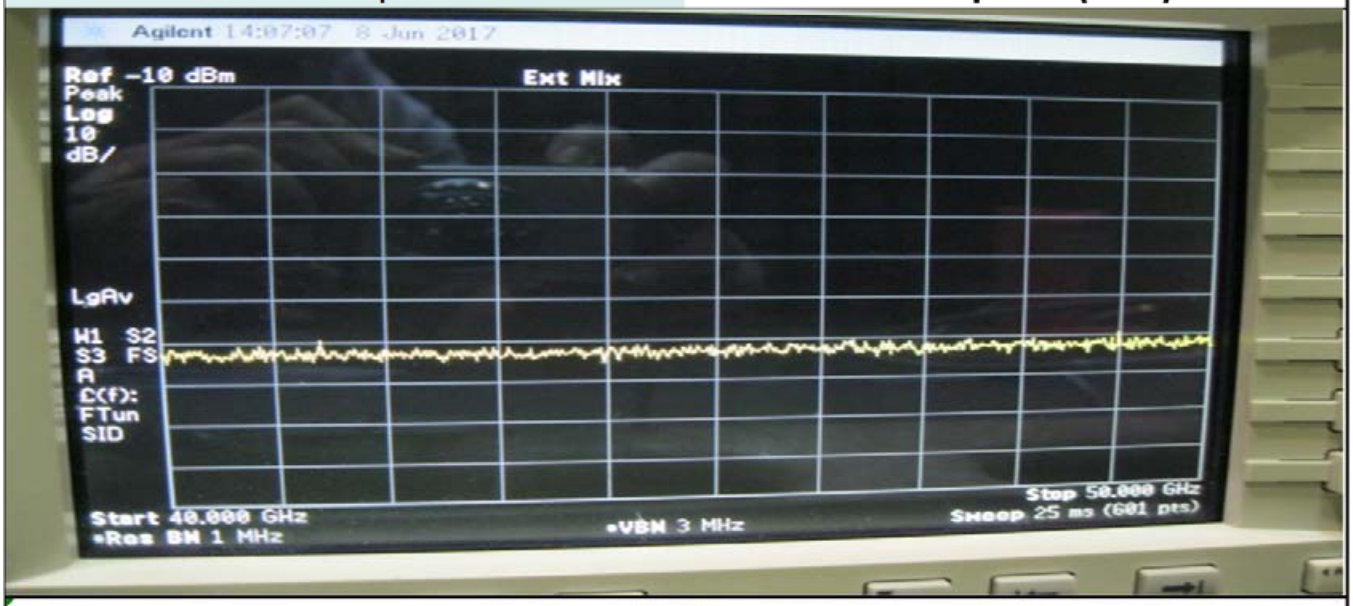
Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

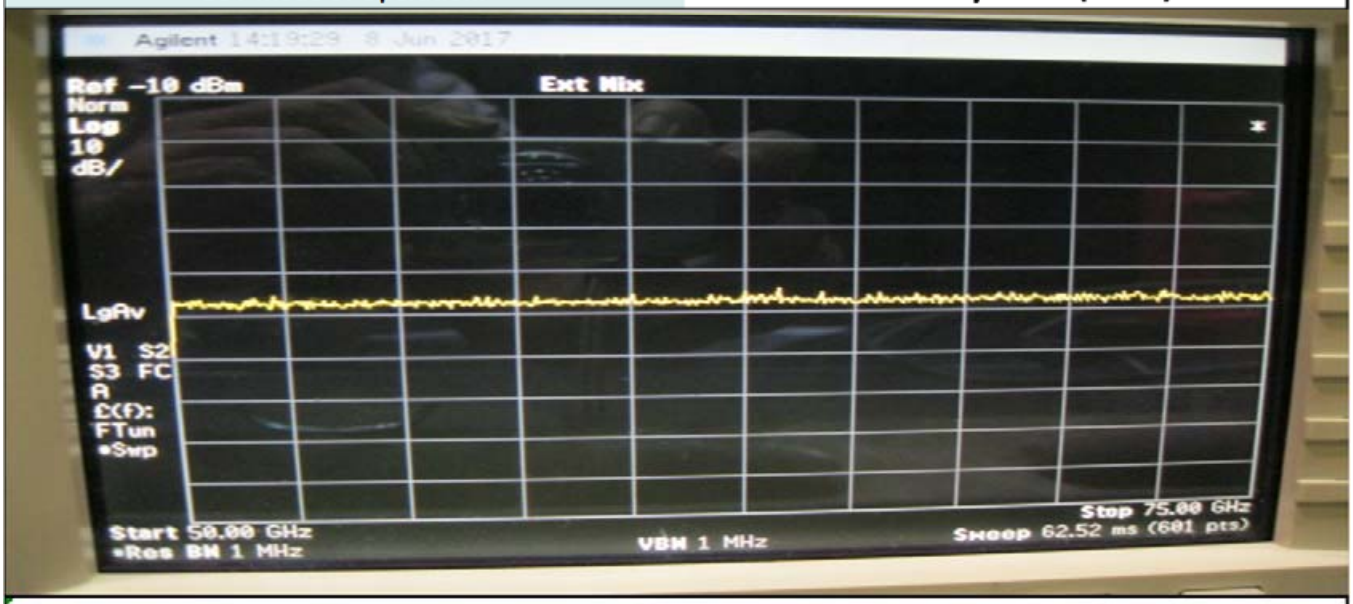


> 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.2 Up to 75 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

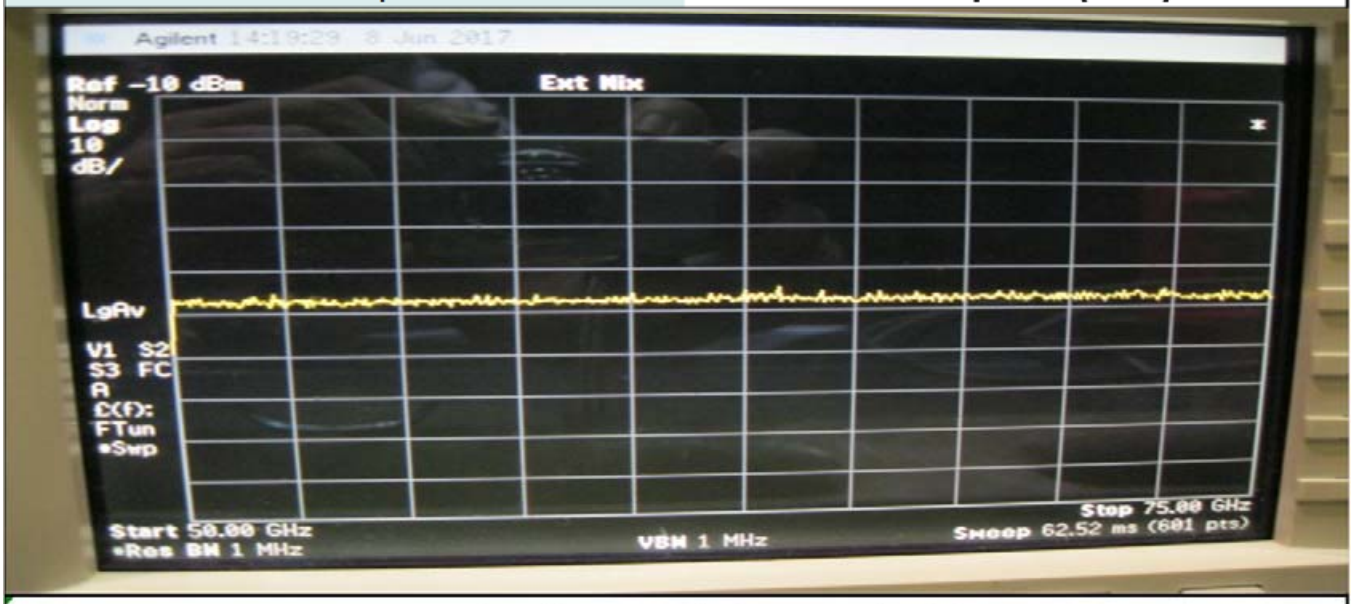
Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	

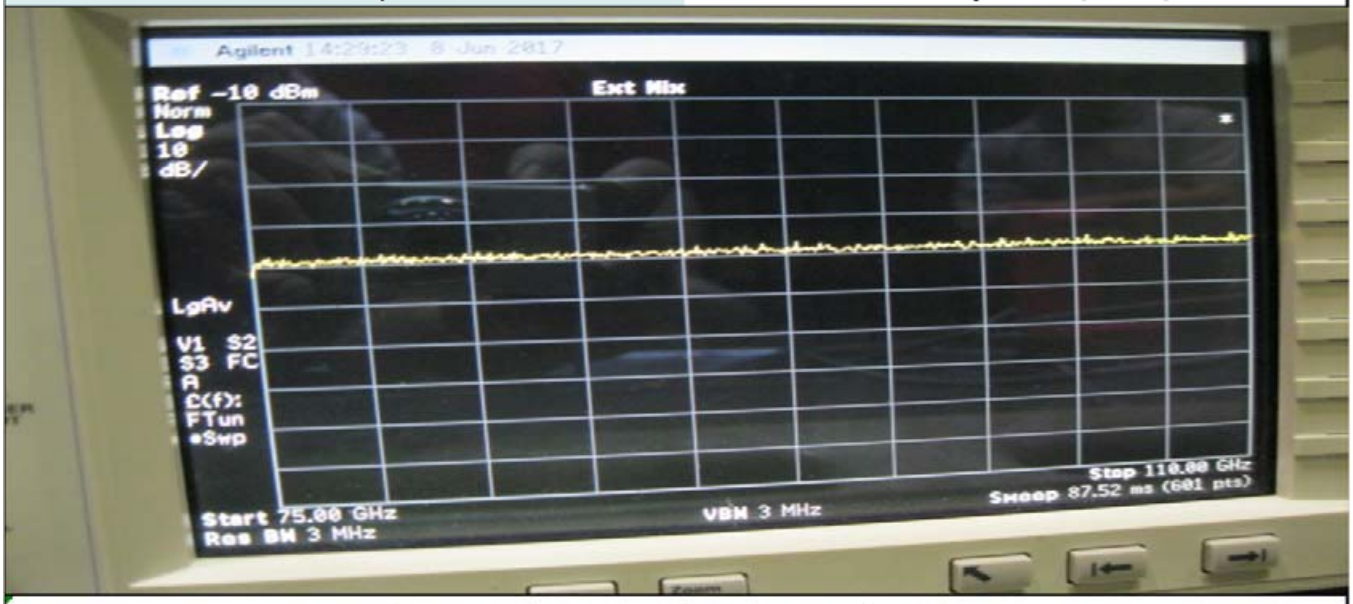


> 1GHz Horizontal Antenna Polarity Measured Emissions

4.3.3 Up to 100 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

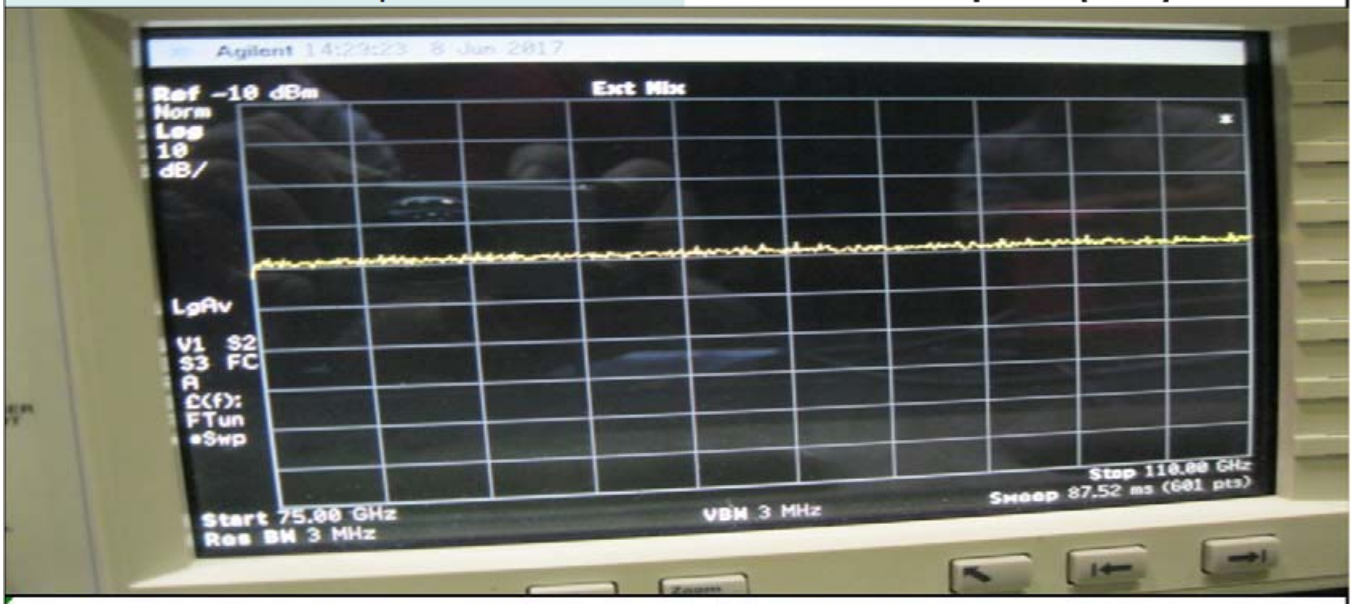
Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	6/8/2017	EUT Serial #:	E2BD85574E7E
Customer:	Houston Radar	EUT Part #:	0
Project Number:	19021-15	Test Technician:	Spencer Flint
Purchase Order #:	0	Supervisor:	Lisa Arndt
Equip. Under Test:	PD420	Witness' Name:	Jake Bailey

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	12 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Normal Operation (FMCW)	



> 1GHz Horizontal Antenna Polarity Measured Emissions

5.0 Antenna Construction Requirements

5.1 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.

5.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	2 Aug 2017

5.3 Results

Table 5.3.1: Modular Construction Results

Criteria	Evaluation	Pass/Fail
Antenna must be permanently attached to the unit.	The antenna is a permanent integral antenna (a printed circuit patch array).	Pass
Antenna must use a unique type of connector to attach to the EUT.	There is no antenna connector.	Pass
Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.	The antenna is not subject to replacement or modification by the user; there is no auxiliary antenna connector.	Pass
Optional criteria for confidentiality of user manual.	The circuitry is potted which prevents field repair or tampering. Only the printed antenna surface is exposed.	Pass

The EUT and antenna satisfied the requirements.

6.0 Equipment

Table 6.0.1 – Radiated Emissions 30 MHz to 26.5 GHz

Radiated Emissions Test Equipment List					
Tile! Software Version:		**4.2.A, May 23, 2010, 08:38:52 AM**			
Test Profile:		**2016 RE_ClassA - Boresite+Mast_LowPRF_030617.til or 2016 RE_ClassB - Boresite+Mast_LowPRF_030617.til**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2017
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/1/2018
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
C027D	PTI	None	Relay	none	N/A
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	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/19/2017
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2017
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019
1735	Pasternack	PE9850-20	Antenna, horn, WR28	N/A	N/A
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/17/2018

Table 6.0.2 – Radiated Emissions 26.5 GHz to 100 GHz				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
1937	Agilent	E4440A	Spectrum Analyzer SN MY44303298	15 Nov 2017
None	Agilent	5061-5458	Agilent harmonic mixer cable 1: IF/LO SN none	NCR
None	Agilent	5061-5458	Agilent harmonic mixer cable 2: IF/LO SN none	NCR
2063	Agilent	11970A	Mixer, Harmonic, 26.5 - 40 GHz SN 3003A08717	NCR
2062	Agilent	11970Q	Mixer, Harmonic, 33 - 50 GHz SN 3003A03234	NCR
2064	Agilent	11970V	Mixer, Harmonic, 50 - 75 GHz SN MY30033017	NCR
2061	Agilent	11970W	Mixer, Harmonic, 75 - 110 GHz SN 2521A00784	NCR
0730	Millitech	SGH-19	Standard Gain Horn (no mixer) SN B020598	NCR
0730	Millitech	SGH-12	Standard Gain Horn (no mixer) SN 035-8344	NCR
0730	Millitech	SGH-10	Standard Gain Horn (no mixer) SN 085-8344	NCR
0730	Millitech	SGH-08	Standard Gain Horn (no mixer) SN 012-8344	NCR

7.0 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	100000	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

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