Project 18474-15

uAvionix

P200S

Mode S Transponder
1090 MHz Transceiver

Wireless Certification Report

FCC Part 87

Prepared for:

uAvionix LLC
300 Pine Needle Lane
Big Fork, MT 59911

By

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

1 Mar 2017

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft for review.	17 Nov 2016
01	Revised per reviewer comments.	22 Nov 2016
02	Revised to apply 87.139(a)(1-3) limits.	1 Mar 2017

Errata:

References to a model Ping200S or P200C applies to the P200S in every case.

Table of Contents

Certificate of Compliance

Applicant	Device & Test Identification
uAvionix LLC 300 Pine Needle Lane Big Fork, MT 59911 Certificate Date: 1 Mar 2017	Model(s): P200S FCC ID: 2AFFTP200S Laboratory Project ID: 18474-15

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	
Section	**Description**
87.131; 2.1046	Power and emissions; conducted output power
87.135; 87.137; 2.1049	Bandwidth of & type of emission; occupied bandwidth: 14M0M1D
2.1047	Modulation characteristics
87.139(a); 2.1051	Emission limitations; Spurious/harmonic emissions at antenna terminals
87.139(a); 2.1053	Emission limitations; radiated emissions 30 MHz - 10 GHz
87.133; 2.1055(a)(1)	Frequency stability (Aeronautical utility mobile stations on 1090 MHz; 1000 ppm.)
87.143	Transmitter control requirements

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.

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**	**Serial #**	**Photo**
uAvionix LLC Mode S Transponder for 1090 MHz	P200S	none	
Operating Voltage: 48 VDC nominal.			

Table 1.2.2 EUT Options		
Description	**Gain**	**Notes**
¼ wave SMA whip antenna	2 dBi	For use with surface mounted antenna on airframe.

1.3 EUT User Control Requirement

Power is removed at the aircraft operator's position by the user either removing power from the EUT itself, pulling the circuit breaker or removing the vehicle power plug at the end of the power cable. This satisfies control requirements of FCC 87.143.

1.4 EUT Operation

The EUT was exercised in a manner consistent with normal operations. To insure accurate measurement, the EUT was placed into higher than normal duty cycle modes.

1.5 Modifications to EUT

Transmitter output matching network components were adjusted to better suppress harmonic spurious emissions.

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). 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.

2.0 Applicable Documents

Table 2.0.1: Applicable Documents	
Document #	**Title/Description**
TIA/EIA 603C 2004	Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards
47 CFR	FCC Part 87 – Subpart D – Technical requirements FCC Part 2 – Subpart J – Equipment authorization procedures

3.0 Conducted Output Power at Antenna Terminal

3.1 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. Power was measured directly with the spectrum analyzer using a resolution bandwidth greater than the occupied bandwidth of the transmitter.

3.2 Test Criteria

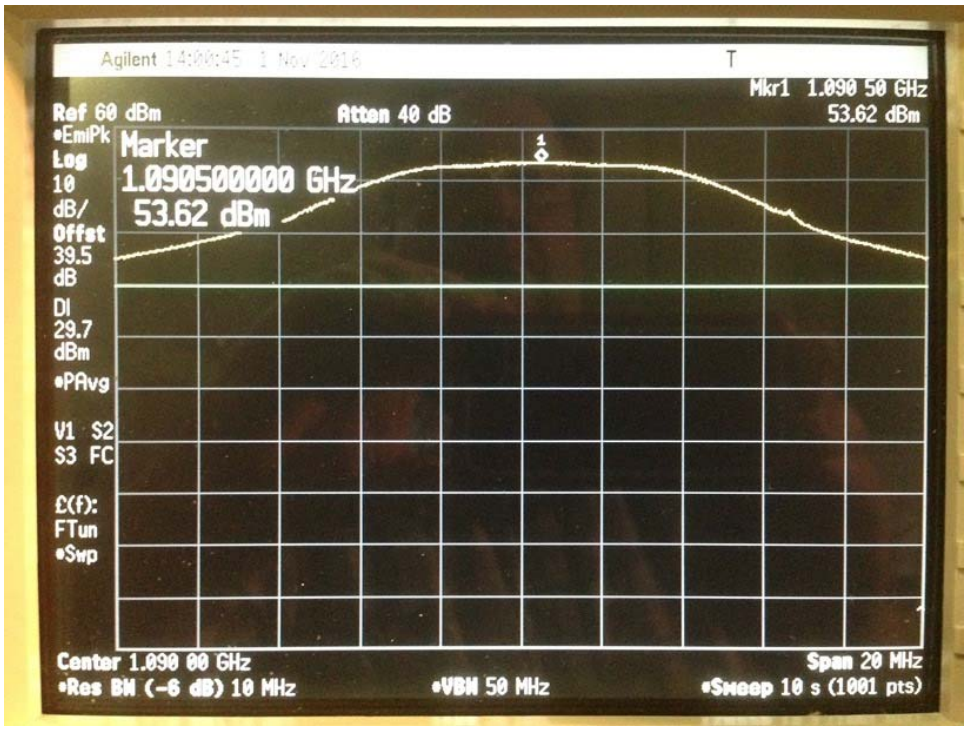
Table 3.2.1 Authorized Power, 87.131 (Radionavigation Unspecified), 2.1046
Minimum 125 Watts per RTCA/DO-181D

3.3 Test Results

Table 3.3.1 Peak Power Measured In 10 MHz RBW, 50 MHz VBW	
Measured Power (peak)	53.6 dBm or 229 Watts

Table 3.3.2 Calculated Duty Cycle and Average Power	
Measured Power (peak)	53.6 dBm or 229 Watts
Transmit Times (µs)	Per TSO-C199: 100 Mode A/C, 19 Short Mode S, 10 Long Mode S, 1 Short Squitter, 3.7 Long Squitters
Total Transmit Time	2011.584 **µs**
Maximum Duty Cycle	0.2012 %
Averaging Factor	$10 \log_{10} (0.002012\%) = -27$ dB
Average Power	$P_{peak} + Factor_{avg} = 53.6 - 27 = 26.6$ dBm or 457 mW

The EUT satisfied the requirements. Plotted results included below.


Agilent 14:00:45 1 Nov 2016
T
Mkr1 1.090 50 GHz
53.62 dBm
Ref 60 dBm
Atten 40 dB
#EmiPk
Log
10
dB/
Offst
39.5
dB
Marker
1.090500000 GHz
53.62 dBm
Dl
29.7
dBm
#PAvg
V1 S2
S3 FC
£(f):
FTun
#Swp
Center 1.090 00 GHz
#Res BW (-6 dB) 10 MHz
#VBW 50 MHz
Span 20 MHz
#Sweep 10 s (1001 pts)

Peak Power

4.0 Occupied Bandwidth and Modulation Characteristics

4.1 Test Procedure

The output of the EUT was connected directly 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. Modulation is a pulse train; to verify a time-domain capture of the pulse train was recorded and compared to expected timings.

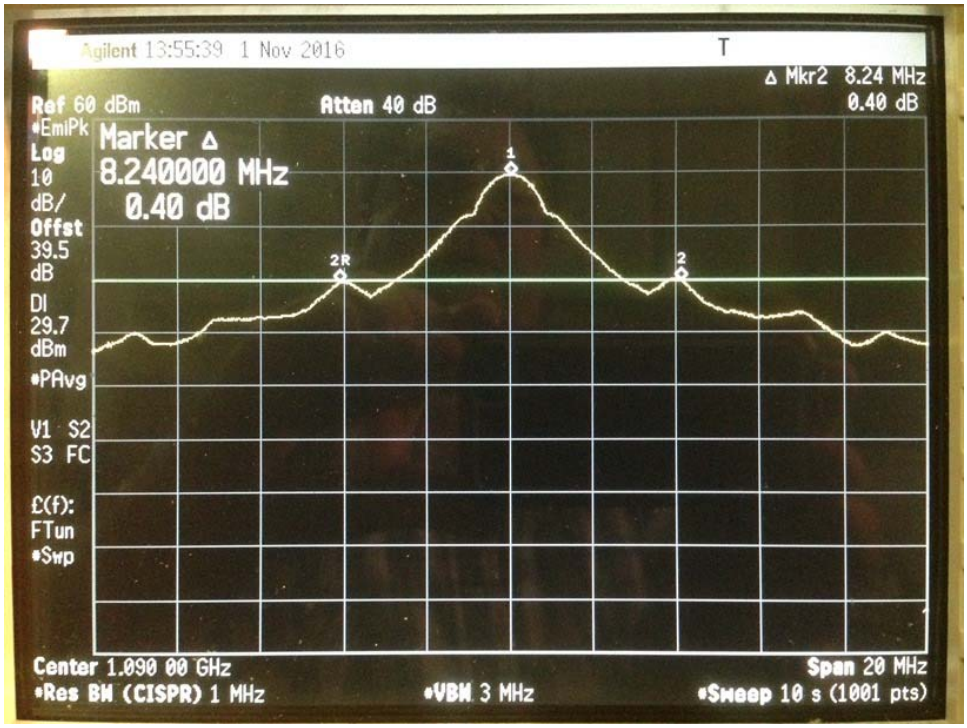
4.2 Test Criteria

Table 4.2.1 Authorized Bandwidth, 87.135; 87.137; 2.1049
14 MHz per 87.137 table; emission designator 14M0M1D

4.3 Test Results, Bandwidth

Table 4.3.1 Bandwidth In 20 dB (1 MHz RBW 3 MHz VBW)	
Reference Power Level	53.6 dBm
Measured 20 dB Bandwidth	8240 kHz
Emission Designator	8M24M1D

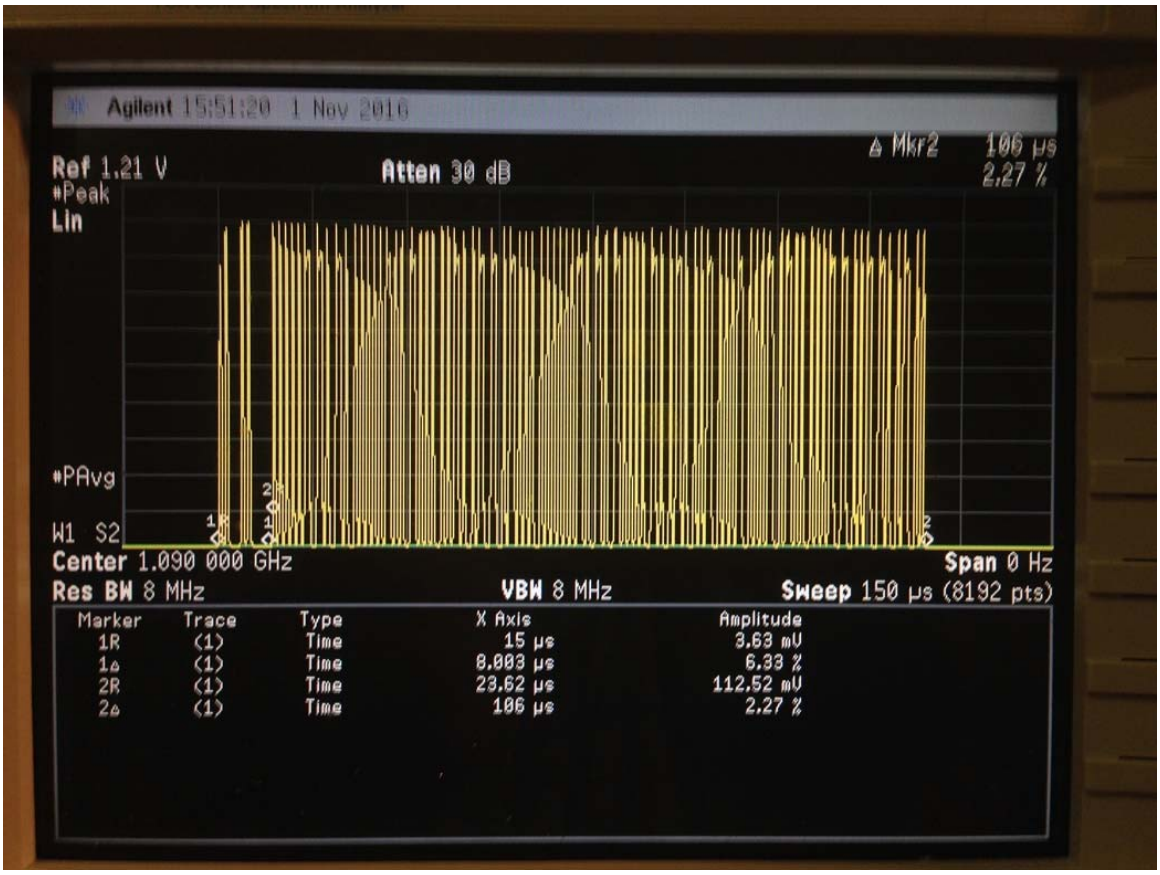
The EUT satisfied the requirements. Results appear below.



4.4 Test Results, Modulation Characteristics

The pulse train was captured in time domain and observed for basic parameters listed below. These were within expected limits and are confirmed through other testing.

Table 4.4.1 Basic Modulation Characteristics Measured	
Flatness	< 2 dB
Preamble Time	8.003 µsec (Marker 1 delta)
Payload Time	106 µsec (Marker 2 delta)



Captured Modulated Data Stream (with trigger delayed 15 µsec)

5.0 Spurious Emissions at Antenna Terminals

5.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to a spectrum analyzer. The transmitter was switched on, and the measurement receiver was swept with TILE V4 software up to the 10th harmonic. EUT could not operate in continuous transmit mode but was adjusted to a higher rate that the transmitter could sustain. Software was adjusted to maximize capture of emissions using maximum point capability (8192 points), running 50 sweeps of 500 ms each, and 20 sweep ranges dividing up 3 MHz to 11 GHz.

5.2 Test Criteria

Table 5.2.1 Spurious Limit, FCC 87.139(a) Basis for limit calculations.	
Measured Peak Transmitter Power:	53.6 dBm or 229 Watts
Average Power Calculated P_t:	P_t = 0.457 Watts or 26.6 dBm

Table 5.2.2 Spurious Limit, FCC 87.139(a)(1)	
Attenuation & Frequency Range:	25 dB out to ±7 MHz (50% of BW)
Deduct Attenuation from Measured Power:	26.6 dBm – 25 dB **=** 1.6 dBm

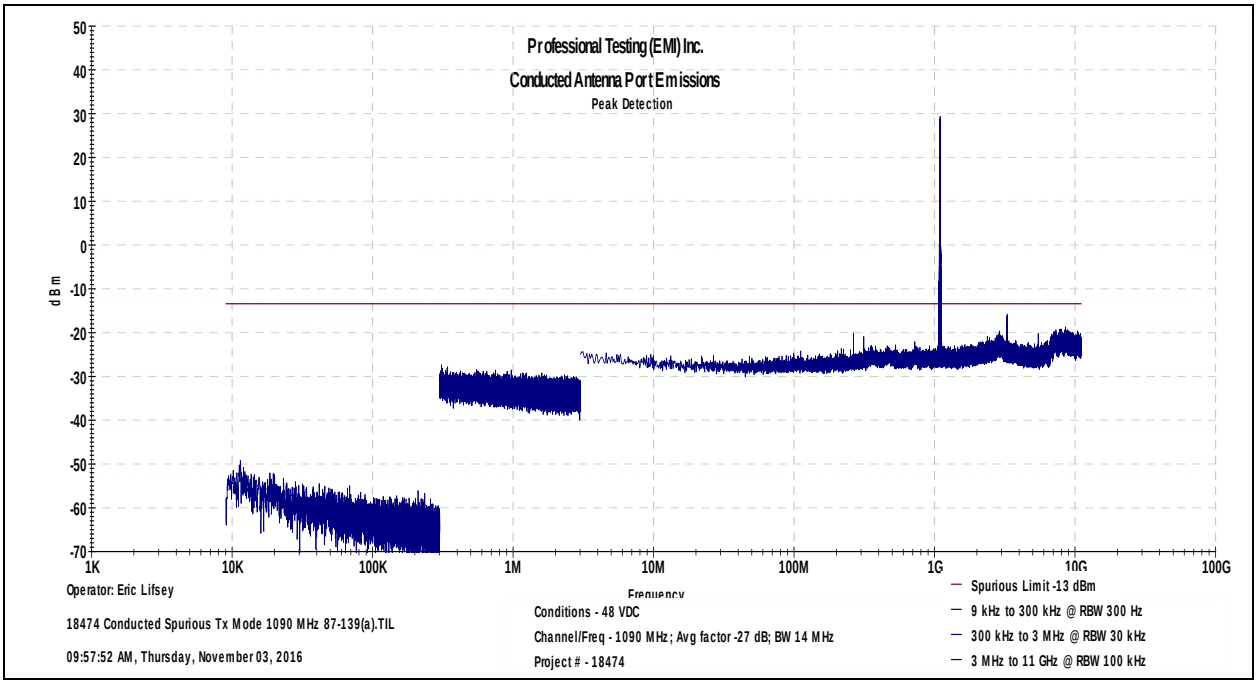
Table 5.2.3 Spurious Limit, FCC 87.139(a)(2)	
Attenuation & Frequency Range:	35 dB from ±7 to ±14 MHz (100% of BW)
Deduct Attenuation from Measured Power:	26.6 dBm – 35 dB **=** -8.4 dBm

Table 5.2.4 Spurious Limit, FCC 87.139(a)(3)	
Attenuation & Frequency Range:	40 dB beyond ±35 MHz (250% of BW)
Deduct Attenuation from Measured Power:	26.6 dBm – 40 dB **=** -13.4 dBm

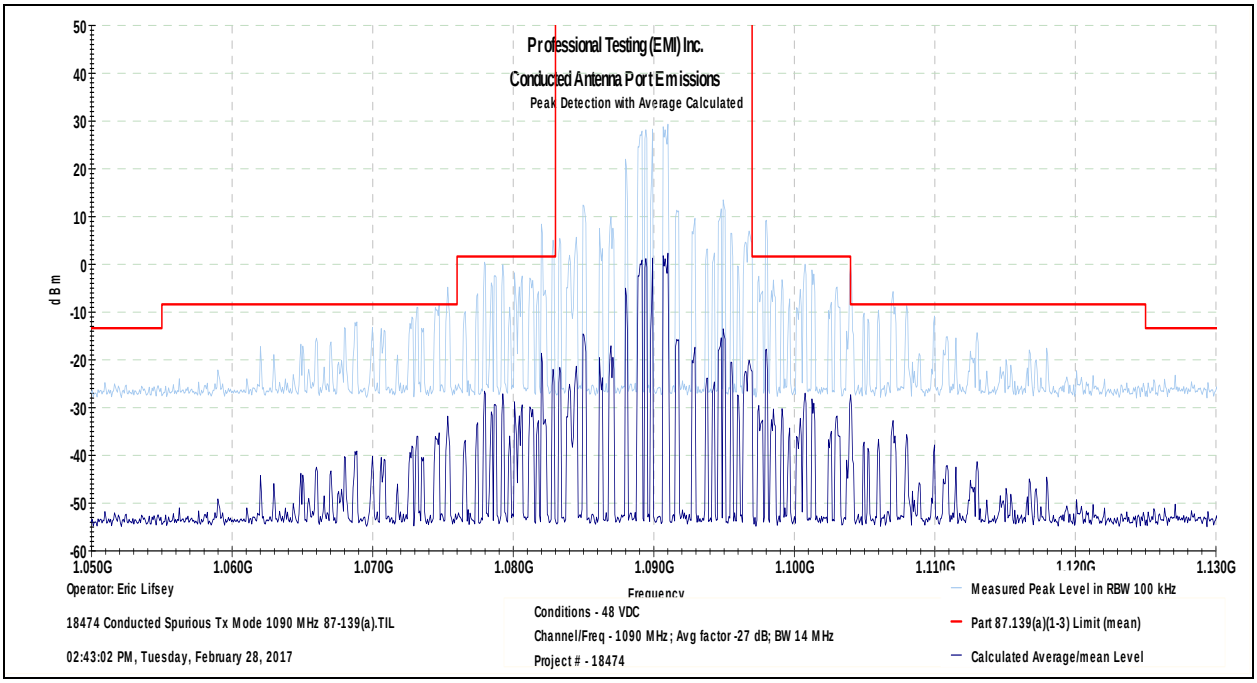
5.3 Test Results

Limits are based on mean or average levels. The overall graph is peak levels which remained below the limit. The averaging factor is applied to the mask plot (-27 dB) with peak and average levels displayed.

The EUT satisfied the requirements. Plotted measurements appear below.



Conducted Antenna Port Spurious; Full Range 9 kHz to 11 GHz
Measured Peak Levels Presented

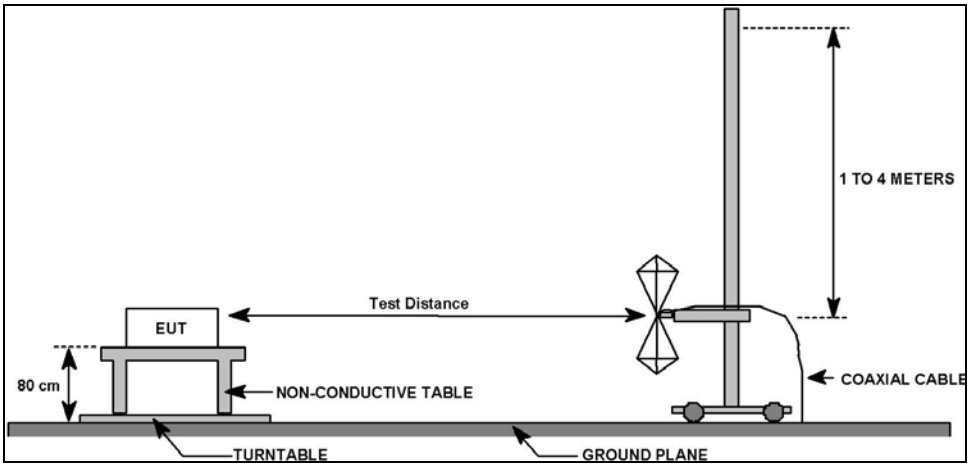


Conducted Antenna Port Spurious; 87.139(a)(1-3) Mask Detail
Measured Peak and Calculated Average Presented

6.0 Field Strength of Spurious Emissions

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable. Antennas were located from the EUT at distances of 10 meters for below 1 GHz and 3 meters for above 1 GHz. The EUT was placed into transmit mode with the antenna removed and a resistive terminator substituted. EUT duty cycle was raised to a safe maximum and the measurement software sweep count raised to capture the signals.



Field Strength of Radiated Emissions Test Setup

6.2 Test Criteria

Table 6.2.1 Radiated Spurious Limit, 87.139(a)(3) *(Calculated limit -13.4 dBm.)*	
Method:	$P_r = P_t + G_t + G_r + 20\log_{10}\left(\frac{\lambda}{4\pi R}\right)$
Path Loss Term:	10 m: 20 $\log_{10}$ (λ/ 4πR) = 20 $\log_{10}$ (0.30675 / 4π10) = -52.25 dB 3 m: 20 $\log_{10}$ (λ/ 4πR) = 20 $\log_{10}$ (0.30675 / 4π3) = -41.79 dB
Power at *R*:	10 m: -13.4 dBm + 0 dB + 0 dB + [-52.25 dB] = -65.65 dBm 3 m: -13.4 dBm + 0 dB + 0 dB + [-41.79 dB] = -55.19 dBm
Field Strength Limit Conversion Formula:	$E(dB\mu V/m) = P_{meas}(dBm) - P_{gain}(dB) + 77.2dB + 20\log(f, MHz) - G_{ant}(dB)$
Field Strength Limit Calculation, 10 m:	[-65.65 dBm] – 0 dB + 77.2 dB + 20 $\log_{10}$ (1090 MHz) - 0 dB = 72.3 dBµV/m
Field Strength Limit Calculation, 3 m:	[-55.19 dBm] – 0 dB + 77.2 dB + 20 $\log_{10}$ (1090 MHz) - 0 dB = 82.8 dBµV/m

6.3 Test Results

The EUT satisfied the requirements. Plotted measurements appear below.

Emissions were below the peak/QP limits of Part 15 and are reflected in the tabular data. The 87.139 field limits calculated above are included as the uppermost limit line in the plotted results.

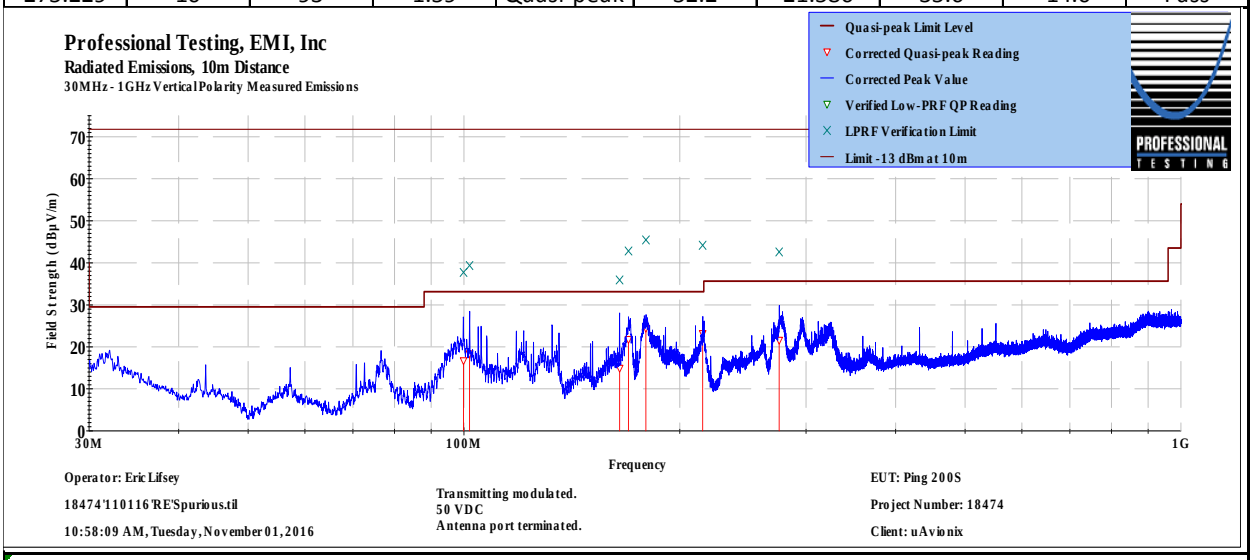
6.3.1 Transmit Mode; Radiated Emissions, 30 MHz to 1 GHz, Vertical Polarization

Test Method:	TIA/EIA 603-C		
In accordance with:	FCC 15.209 and 87.139		
Section:	15.209, 87.139		
Test Date(s):	11/1/2016	**EUT Serial #:**	none
Customer:	uAvionix	**EUT Part #:**	none
Project Number:	18474	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	P200C	**Witness' Name:**	Matt Lee

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	48 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Vertical	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit; 5 packets per second	

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
99.8731	10	54	2.34	Quasi-peak	33.2	16.704	33.1	-16.4	Pass
101.812	10	292	3.86	Quasi-peak	34.8	18.336	33.1	-14.8	Pass
164.831	10	111	1.44	Quasi-peak	30.9	14.901	33.1	-18.2	Pass
169.601	10	137	1.52	Quasi-peak	37.3	21.784	33.1	-11.3	Pass
179.392	10	341	1.54	Quasi-peak	39.5	24.431	33.1	-8.7	Pass
215.235	10	130	1.29	Quasi-peak	37.5	23.161	33.1	-9.9	Pass
275.229	10	93	1.59	Quasi-peak	32.2	21.586	35.6	-14.0	Pass



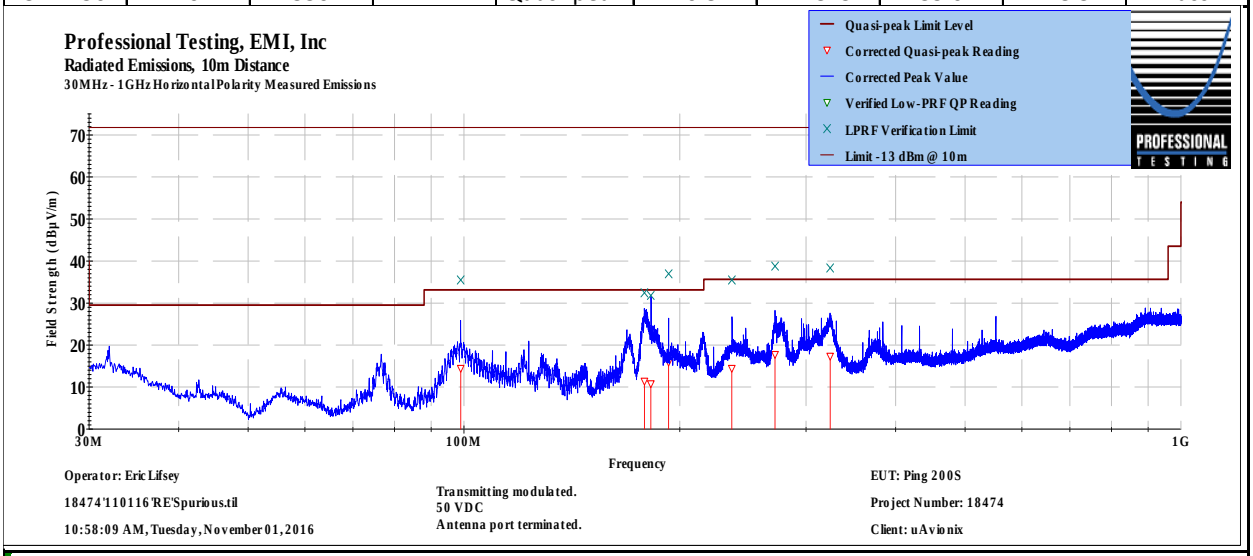
≤ 1GHz Vertical Antenna Polarity Measured Emissions

6.3.2 Transmit Mode; Radiated Emissions, 30 MHz to 1 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	TIA/EIA 603-C		
In accordance with:	FCC 15.209 and 87.139		
Section:	15.209, 87.139		
Test Date(s):	11/1/2016	EUT Serial #:	none
Customer:	uAvionix	EUT Part #:	none
Project Number:	18474	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	P200C	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet				Page:	1	of	1
EUT Line Voltage:	48	VDC	EUT Power Frequency:	0	N/A		
Antenna Orientation:	Horizontal		Frequency Range:	30MHz to 1GHz			
EUT Mode of Operation:			Transmit; 5 packets per second				

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
98.9481	10	48	2.59	Quasi-peak	31.4	14.47	33.1	-18.6	Pass
178.505	10	357	1.44	Quasi-peak	26.5	11.421	33.1	-21.7	Pass
182.192	10	351	1.19	Quasi-peak	25.9	10.79	33.1	-22.3	Pass
192.963	10	222	2.73	Quasi-peak	31	15.953	33.1	-17.1	Pass
236.389	10	3	2.84	Quasi-peak	26.9	14.466	35.6	-21.1	Pass
271.599	10	334	1.23	Quasi-peak	28.3	17.77	35.6	-17.8	Pass
324.156	10	350	1.47	Quasi-peak	26.8	17.329	35.6	-18.3	Pass



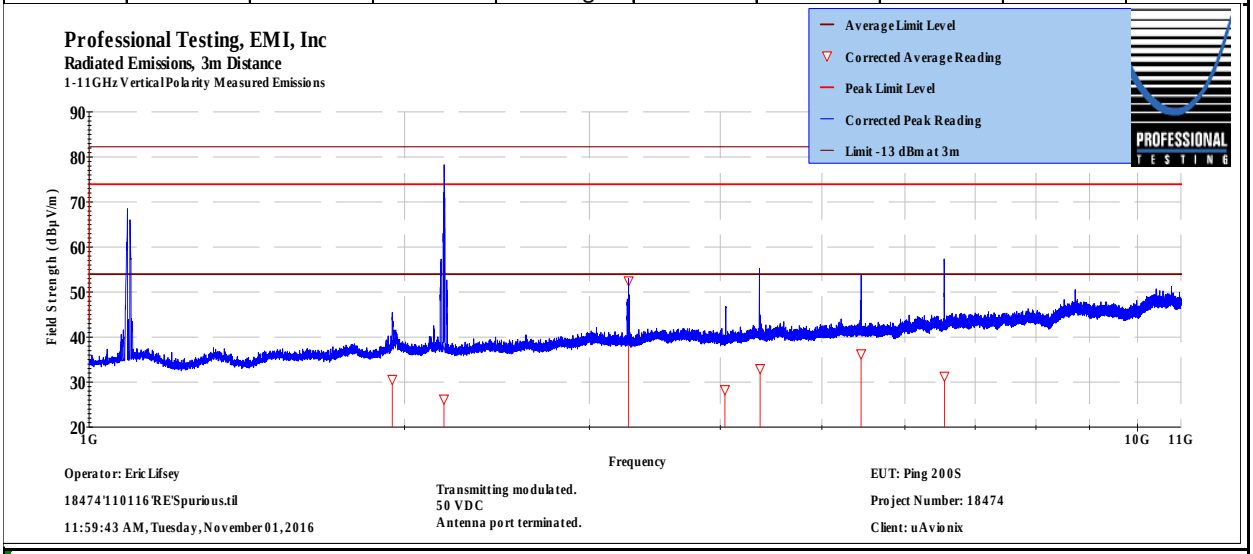
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.3 Transmit Mode; Radiated Emissions, 1 to 11 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	TIA/EIA 603-C		
In accordance with:	FCC 15.209 and 87.139		
Section:	15.209, 87.139		
Test Date(s):	11/1/2016	EUT Serial #:	none
Customer:	uAvionix	EUT Part #:	none
Project Number:	18474	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	P200C	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet				Page:	1	of	1
EUT Line Voltage:	48	VDC	EUT Power Frequency:	0	N/A		
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz			
EUT Mode of Operation:			Transmit; 5 packets per second				

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
1945.94	3	70	2.09	Average	39.4	30.603	54.0	-23.4	Pass
2180.07	3	21	2.96	Average	35.1	26.223	54.0	-27.7	Pass
3270	3	311	3.96	Average	59.4	52.494	54.0	-1.5	Pass
4040.05	3	88	2.92	Average	33.5	28.312	54.0	-25.6	Pass
4365.02	3	87	3.82	Average	37.2	33.03	54.0	-20.9	Pass
5449.66	3	75	1.18	Average	38.3	36.275	54.0	-17.7	Pass
6544.86	3	257	2	Average	29.9	31.293	54.0	-22.7	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

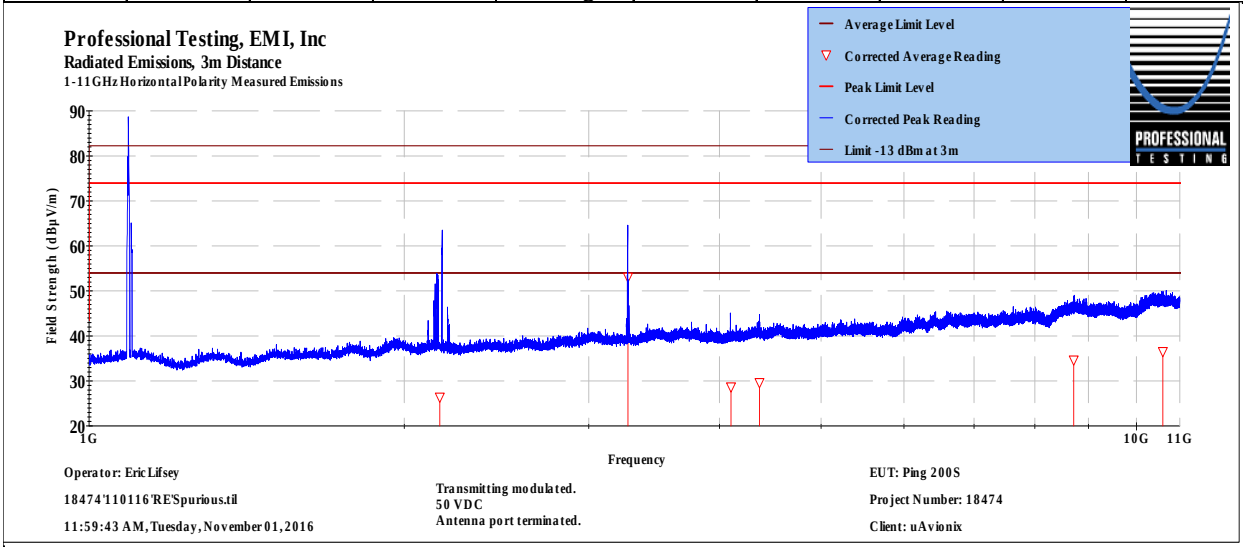
6.3.4 Transmit Mode; Radiated Emissions, 1 to 11 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	TIA/EIA 603-C		
In accordance with:	FCC 15.209 and 87.139		
Section:	15.209, 87.139		
Test Date(s):	11/1/2016	**EUT Serial #:**	none
Customer:	uAvionix	**EUT Part #:**	none
Project Number:	18474	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	P200C	**Witness' Name:**	Matt Lee

Radiated Emissions Test Results Data Sheet — Page: 1 of 1

EUT Line Voltage:	48 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit; 5 packets per second	

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
2162.6	3	134	3.85	Average	35.2	26.425	54.0	-27.5	Pass
3269.99	3	15	3.96	Average	60	53.071	54.0	-0.9	Pass
4102.36	3	90	2.87	Average	33.8	28.69	54.0	-25.3	Pass
4366.71	3	216	1.28	Average	33.8	29.656	54.0	-24.3	Pass
8714.5	3	264	2.55	Average	27.1	34.647	54.0	-19.3	Pass
10600.8	3	221	1.28	Average	26.6	36.534	54.0	-17.4	Pass



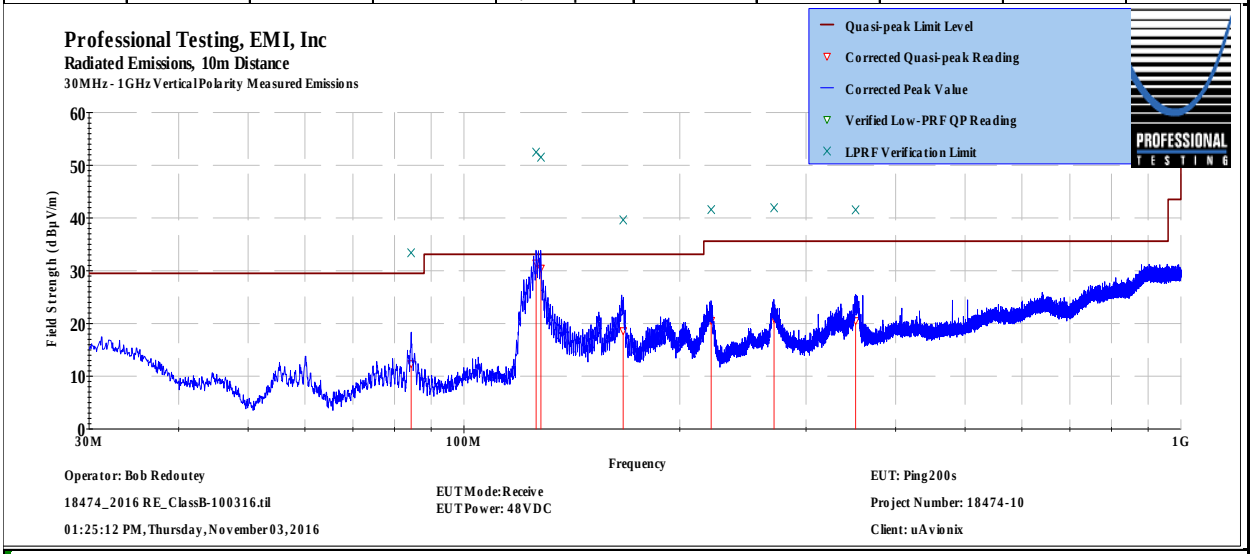
> 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.5 Receive Mode; Radiated Emissions, 30 MHz to 1 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/3/2016	EUT Serial #:	None
Customer:	uAvionix LLC	EUT Part #:	None
Project Number:	18474-10	Test Technician:	Bob Redoutey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	Ping200s	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	48 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

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
84.3922	10	115	3.69	Quasi-peak	32.5	12.397	29.5	-17.1	Pass
126.056	10	200	1.39	Quasi-peak	48.8	31.483	33.1	-1.6	Pass
128.056	10	10	1.65	Quasi-peak	47.8	30.518	33.1	-2.6	Pass
166.788	10	62	2.31	Quasi-peak	34.5	18.645	33.1	-14.5	Pass
221.209	10	17	1.54	Quasi-peak	34.9	20.581	35.6	-15.0	Pass
270.721	10	281	1.51	Quasi-peak	31.5	20.943	35.6	-14.7	Pass
351.755	10	74	2.44	Quasi-peak	30.3	20.54	35.6	-15.1	Pass



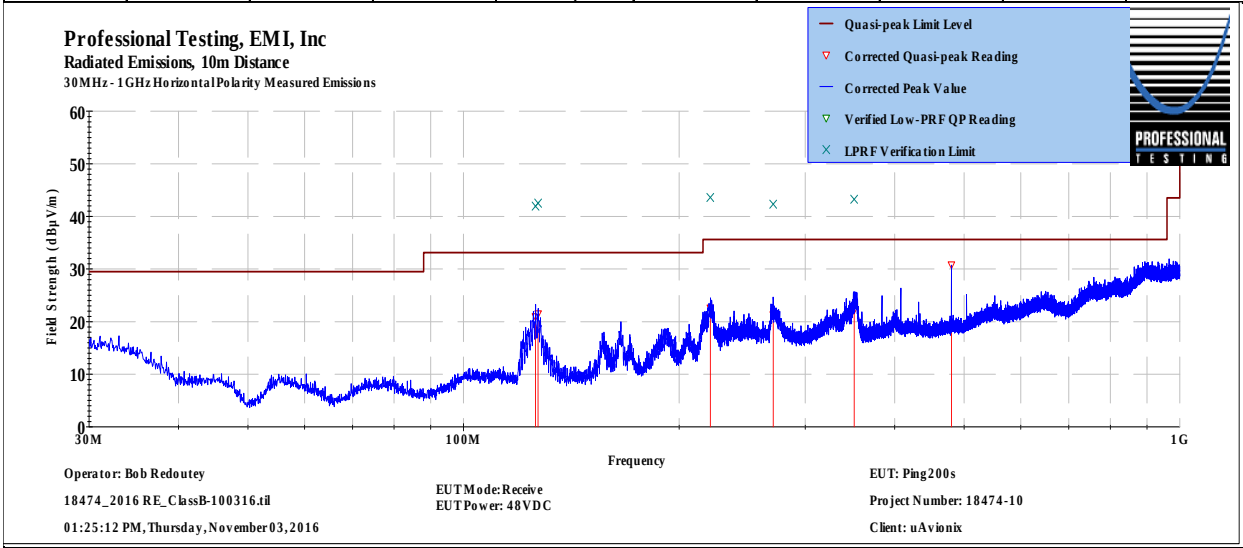
≤ 1GHz Vertical Antenna Polarity Measured Emissions

6.3.6 Receive Mode; Radiated Emissions, 30 MHz to 1 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/3/2016	EUT Serial #:	None
Customer:	uAvionix LLC	EUT Part #:	None
Project Number:	18474-10	Test Technician:	Bob Redoutey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	Ping200s	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	48 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive Mode	

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
126.071	10	79	3.83	Quasi-peak	38.2	20.927	33.1	-12.2	Pass
127.11	10	64	3.89	Quasi-peak	38.8	21.5	33.1	-11.6	Pass
221.11	10	42	3.27	Quasi-peak	36.9	22.592	35.6	-13.0	Pass
270.651	10	187	3.41	Quasi-peak	31.8	21.315	35.6	-14.3	Pass
351.162	10	135	3.41	Quasi-peak	32	22.248	35.6	-13.4	Pass
479.994	10	197	2.4	Quasi-peak	37.4	30.801	35.6	-4.8	Pass



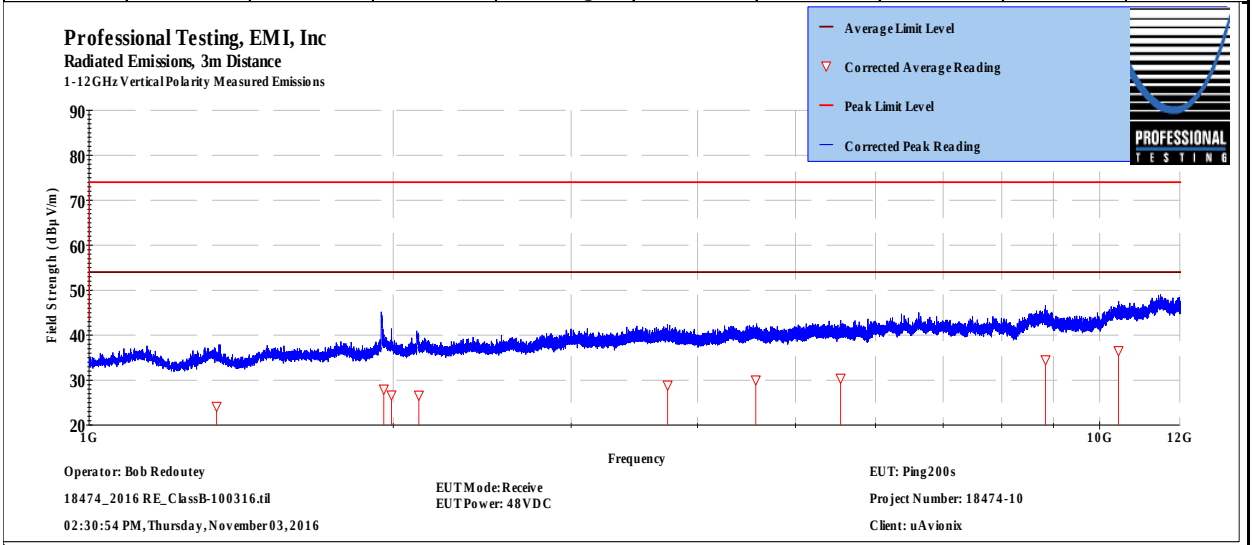
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.7 Receive Mode; Radiated Emissions, 1 to 11 GHz, Vertical Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/3/2016	EUT Serial #:	None
Customer:	uAvionix LLC	EUT Part #:	None
Project Number:	18474-10	Test Technician:	Bob Redoutey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	Ping200s	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	48 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive Mode	

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
1337.42	3	200	1.4	Average	35.9	24.182	54.0	-29.8	Pass
1957.37	3	14	1.04	Average	36.8	28.033	54.0	-25.9	Pass
1991.91	3	149	2.67	Average	35.3	26.722	54.0	-27.2	Pass
2119.96	3	126	1.74	Average	35.4	26.689	54.0	-27.3	Pass
3736.97	3	47	3.73	Average	34.7	28.92	54.0	-25.0	Pass
4569.2	3	274	2.58	Average	33.7	30.081	54.0	-23.9	Pass
5542.74	3	335	2.3	Average	32.3	30.447	54.0	-23.5	Pass
8838.26	3	39	1.7	Average	27.1	34.568	54.0	-19.4	Pass
10439.8	3	300	3.18	Average	26.4	36.559	54.0	-17.4	Pass



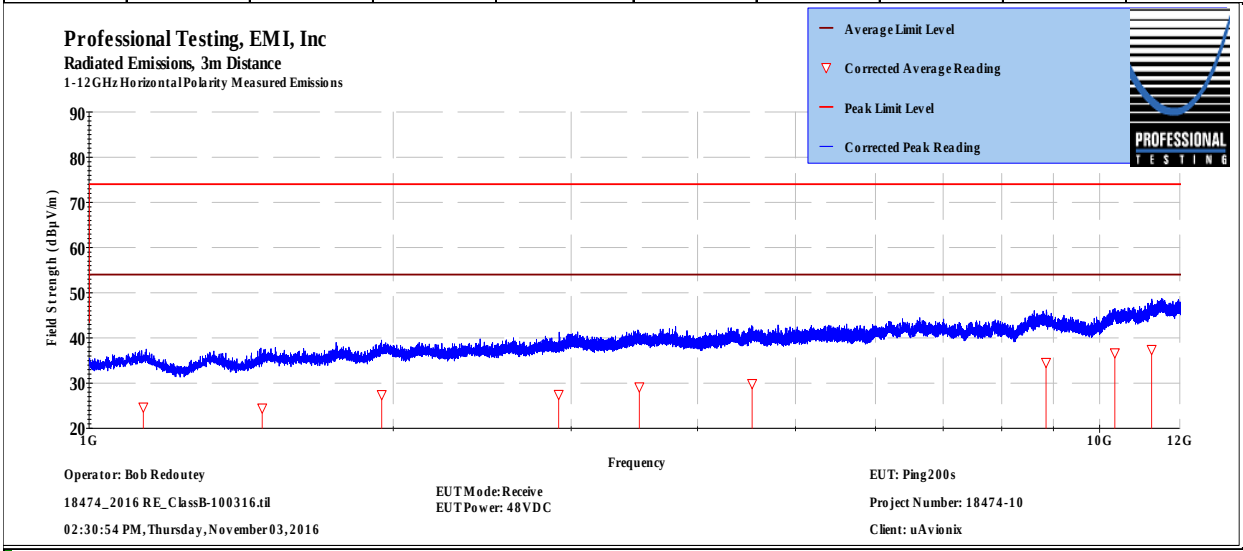
> 1GHz Vertical Antenna Polarity Measured Emissions

6.3.8 Receive Mode; Radiated Emissions, 1 to 11 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits		
Section:	15.109		
Test Date(s):	11/3/2016	EUT Serial #:	None
Customer:	uAvionix LLC	EUT Part #:	None
Project Number:	18474-10	Test Technician:	Bob Redoutey
Purchase Order #:	N/A	Supervisor:	Lisa Arndt
Equip. Under Test:	Ping200s	Witness' Name:	Matt Lee

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	48 VDC	EUT Power Frequency:	- N/A
Antenna Orientation:	Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive Mode	

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
1131.75	3	83	1.84	Average	36.5	24.71	54.0	-29.2	Pass
1483.9	3	147	1.31	Average	35.6	24.493	54.0	-29.5	Pass
1947.7	3	81	3.74	Average	36.3	27.488	54.0	-26.5	Pass
2915.6	3	32	1.94	Average	34.3	27.51	54.0	-26.4	Pass
3502.88	3	185	2.64	Average	34.9	29.178	54.0	-24.8	Pass
4530.88	3	219	3.84	Average	33.4	29.911	54.0	-24.0	Pass
8849.74	3	9	2.91	Average	27.2	34.618	54.0	-19.3	Pass
10352.5	3	147	3.75	Average	26.6	36.723	54.0	-17.2	Pass
11256.7	3	78	2.51	Average	27.2	37.443	54.0	-16.5	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Frequency Stability

7.1 Test Procedure

The EUT was 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 was allowed to soak at least 20 minutes without power applied. After soak time was satisfied, the EUT is powered on in transmit mode and the frequency is observed until it became stable; then the measurement of frequency was taken.

Operating voltage stability was also measured for selected extremes based on operating design.

The EUT was operated in unmodulated mode.

7.2 Test Criteria

Table 7.2.1 Frequency Stability Criteria, 87.133; 2.1055(a)(1)
Parameter: Frequency Tolerance
1000 ppm or ±1,090,000 Hz for 1090 MHz Operating Frequency

Table 7.2.2 Test Conditions, Temperatures
-30 C to 50 C and by 10 C steps

Table 7.2.3 Test Conditions, Voltage (From manufacturers specifications.)	
Low Voltage	46 VDC
Nominal Voltage	49 VDC
High Voltage	52 VDC

7.3 Test Results

The EUT satisfies the requirement. Tabular results appear below.

7.3.1 Temperature

Condition	Frequency		Deviation
Temperature (C)	Reference Center Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
-30	1090.000000	1089.999699	-301
-20	1090.000000	1089.998850	-1150
-10	1090.000000	1089.999180	-820
0	1090.000000	1090.000160	160
10	1090.000000	1089.999730	-270
20	1090.000000	1089.999290	-710
30	1090.000000	1089.998300	-1700
40	1090.000000	1089.997980	-2020
50	1090.000000	1089.998200	-1800
Max Deviation (Hz)			160
Min Deviation (Hz)			-2020

7.3.2 Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	46.00	1090.000000	1089.998592	-1408
Nominal	49.00	1090.000000	1089.998505	-1495
High	52.00	1090.000000	1089.998723	-1277

8.0 Equipment Lists

Table 8.1 Equipment List; Power, Bandwidth, Spurious Conducted, and Mask				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
A113	Narda	776-40	Attenuator, 50 W, 40 dB	12 Sep 2018
0472	Tektronix	THS730A	Scope/DMM	7 Dec 2016
Client Supplied	Agilent	6654A	Adjustable DC Power Supply	CIU

Table 8.2 Equipment List; Frequency Stability				
Asset #	**Manufacturer**	**Model #**	**Description**	**Calibration Due**
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017
A113	Narda	776-40	Attenuator, 50 W, 40 dB	12 Sep 2018
2134	Tenny	TPC T2C	Temperature Chamber	13 Oct 2016
C247	Pasternack	RG type	Coaxial Cable, double shielded	CNR
0472	Tektronix	THS730A	Scope/DMM	7 Dec 2016
Client Supplied	Agilent	6654A	Adjustable DC Power Supply	CIU

Table 8.3 Equipment List; Radiated Emissions

Professional Testing, EMI, Inc.

Test Method:	**TIA/EIA 603-C**		
In accordance with:	**FCC 15.209 and 87.139**		
Section:	**15.209, 87.139**		
Test Date(s):	**11/1/2016**	**EUT Serial #:**	**none**
Customer:	**uAvionix**	**EUT Part #:**	**none**
Project Number:	**18474**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**NA**	**Supervisor:**	**Lisa Arndt**
Equip. Under Test:	**P200C**	**Witness' Name:**	**Matt Lee**

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_072616.til or 2016 RE_Class**B **- Boresite+Mast_LowPRF_072616.til**

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2017
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	12/15/2016
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
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	3/14/2017
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	2/25/2017

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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