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.

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Certificate of Compliance

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

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

uAvionix LLC Mode S Transponder for 1090 MHz P200S none	Table 1.2.1 Equipm Manufacturer & Description	Model	Serial #	Photo
	Mode S Transponder for	P200S	none	ping

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: Applicabl	e Documents
Document #	Title/Description
TIA/EIA 603C 2004	Land Mobile FM or PM Communications Equipment, Measurement and
11A/EIA 603C 2004	Performance Standards
47 CED	FCC Part 87 – Subpart D – Technical requirements
47 CFR	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

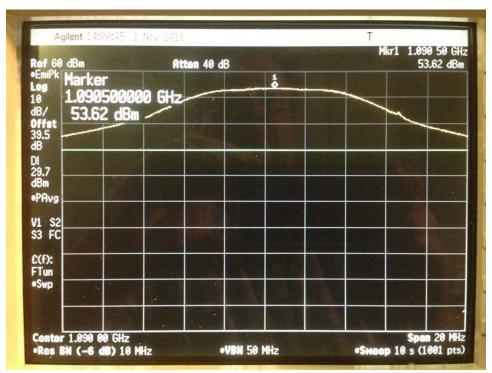
Table 3.2.1 Authorized Power, 87.131 (Radionavigation Unspecified), 2.1046
Minimum 125 Watts per RTCA/DO-181D

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.



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.

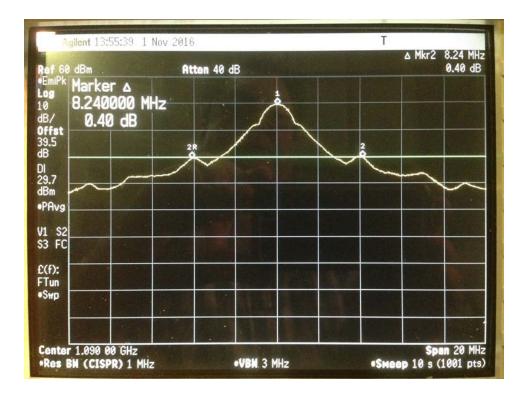
4.2 Test Criteria

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				

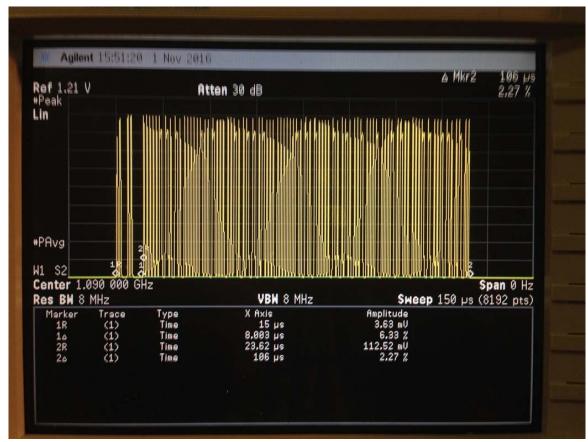
The EUT satisfied the requirements. Results appear below.



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					

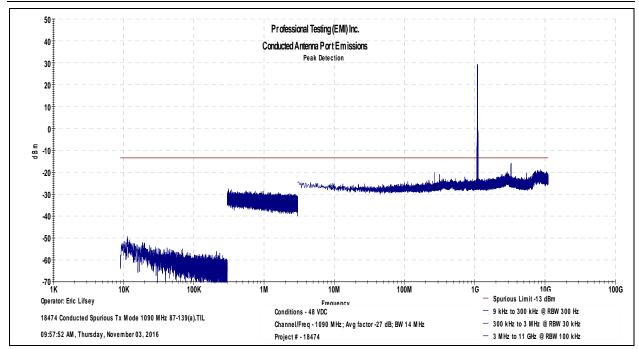
Table 5.2.3 Spurious Limit, FCC 87.139(a)(2)							
Attenuation & Frequency Range:	35 dB from ±7 to ±14 MHz (100% of BW)						
Deduct Attenuation from Measured Power:	26.6 dBm – 35 dB = -8.4 dBm						

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					

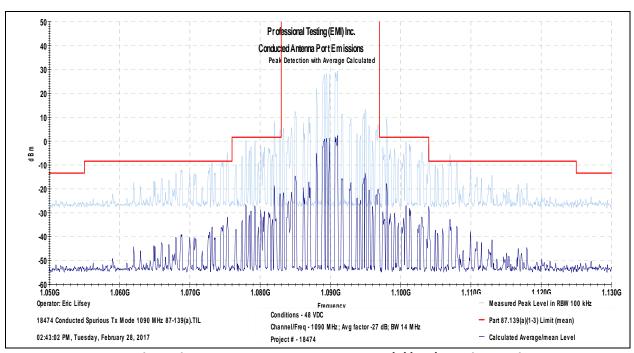
5.3 Test Results

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

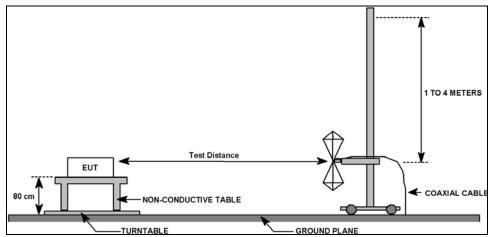


Conducted Antenna Port Spurious; 87.139(a)(1-3) Mask Detail Measured Peak and Calculated Average Presented

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: $20 \log_{10} (\lambda / 4\pi R) = 20 \log_{10} (0.30675 / 4\pi 10) = -52.25 dB$					
Patil Loss Termi.	3 m: $20 \log_{10} (\lambda / 4\pi R) = 20 \log_{10} (0.30675 / 4\pi 3) = -41.79 dB$					
Power at R:	10 m: -13.4 dBm + 0 dB + 0 dB + [-52.25 dB] = -65.65 dBm					
Power at A.	3 m: -13.4 dBm + 0 dB + 0 dB + [-41.79 dB] = -55.19 dBm					
Field Strength Limit	$E(dB\mu V/m) = P_{meas}(dBm) - P_{gain}(dB) + 77.2dB + 20\log(f, MHz) - G_{ant}(dB)$					
Conversion Formula:	$E(aB\mu\nu + m) = I_{meas}(aBm) = I_{gain}(aB) + 77.2aB + 2010g(f, NIII2) = G_{ant}(aB)$					
Field Strength Limit	[-65.65 dBm] – 0 dB + 77.2 dB + 20 log ₁₀ (1090 MHz) - 0 dB					
Calculation, 10 m:	= 72.3 dBμV/m					
Field Strength Limit	[-55.19 dBm] – 0 dB + 77.2 dB + 20 log ₁₀ (1090 MHz) - 0 dB					
Calculation, 3 m:	= 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 Metho	d:	TIA/EIA 603-	С									
In accordan	ice with:	FCC 15.209 a	nd 87.139									
Section:		15.209, 87.1	39									
Test Date(s):	11/1/2016			EUT Serial	#:		none				
Customer:		uAvionix			EUT Part #:			none				
Project Nur		18474			Test Techn			Eric Lifs	ey			
Purchase O	rder #:	NA			Supervisor:			Lisa Arn	ndt			
Equip. Und	er Test:	P200C			Witness' N	ame:		Matt Le	e			
	F	Radiated Em	issions Test	t Results Data	a Sheet				Page	: 1	of	1
EUT Li	ne Voltage	: 4	8 VDC		EUT Pow	ver Fr	equen	су:	0	N/A		
Antenna	Orientatio	n:	Vertic	al	Frequ	ency I	Range		3	OMHz to	1GHz	
	EUT N	/lode of Ope	eration:			Trai	nsmit;	5 packe	ts per	second		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Le	ected vel .V/m)	Limit Le		Margin (dB)	Test R	esults
99.8731	10	54	2.34	Quasi-peak	33.2	16.	704	33.1		-16.4	Pa	ISS
101.812	10	292	3.86	Quasi-peak	34.8		336	33.1		-14.8		SS
164.831	10	111	1.44	Quasi-peak	30.9	14.	901	33.1		-18.2	Pa	SS
169.601	10	137	1.52	Quasi-peak	37.3	21.	784	33.1		-11.3	Pa	ISS
179.392	10	341	1.54	Quasi-peak	39.5	24.	431	33.1		-8.7	Pa	SS
215.235	10	130	1.29	Quasi-peak	37.5	23.	161	33.1		-9.9	Pa	ISS
275.229	10	93	1.59	Quasi-peak	32.2	21.	586	35.6		-14.0	Pa	ISS
Profess Radiated 30MHz-10				✓ Corre— Corre✓ Verific× LPRF	i-peak Limit Lev ected Quasi-peal ected Peak Value ed Low-PRF QI Verification Lin -13 dBm at 10 n	k Reading e P Reading nit		PROFESS T E S T	SIONAL IN 6			
Field Strength (d B µ V m) 10 10	man allenga	www.marahawamanahahahahahahahahahahahahahahahahahah	×	× ×	× × ×	× ×	AND THE PARTY OF T				and served to	
0± 30M	+	• • •	100M	r		-		,	•		1G	;
Operator: Eric Lifsey Transmitting modulated. 50 VDC 10:58:09 AM, Tuesday, November 01, 2016 Transmitting modulated. Antenna port terminated.					quency		F	UT: Ping 200S				

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

			Profes	sional Te	sting, El	VII, Inc.			
Test Metho	d:	TIA/EIA 603-	C						
In accordan	ce with:	FCC 15.209 a							
Section:		15.209, 87.1	39		I				
Test Date(s):	11/1/2016			EUT Serial :		none		
Customer: Project Nur	nhor:	uAvionix 18474			Test Techn		none Eric Lifsey		
Purchase O		NA			Supervisor		Lisa Arndt		
Equip. Und		P200C			Witness' N		Matt Lee		
		Radiated Em	issions Test	t Results Data			Pa	ge: 1	of 1
EUT Li	ne Voltage:	: 4	8 VDC		EUT Pow	ver Frequen	cy:	0 N/A	
Antenna	Orientatio	n:	Horizor	ntal	Frequ	ency Range:		30MHz to	1GHz
	EUT N	Node of Ope	eration:		-	Transmit;	5 packets p	er 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
192.963 236.389	10	222	2.73	Quasi-peak	31	15.953	33.1	-17.1	Pass
271.599	10 10	3 334	2.84 1.23	Quasi-peak Quasi-peak	26.9 28.3	14.466 17.77	35.6 35.6	-21.1 -17.8	Pass Pass
324.156	10	350	1.47	Quasi-peak	26.8	17.329	35.6	-18.3	Pass
Radiated 30MHz-10	ional Testing, Emissions, 10m Di GHz Horizontal Polar		S			✓ Corre — Corre ✓ Verifi × LPRF	i-peak Limit Level octed Quasi-peak Read octed Peak Value ed Low-PRF QP Read Verification Limit -13 dBm @ 10 m		PROFESSIONAL TESTINE
600	Manager of least again, and a control of the contro		100M	Freq	X	×××	UT: Ping 200S		16
18474'110	116 RE'Spurious.til M, Tuesday, Novemb	per 01,2016	50 VDC	ing modulated.		P	roject Number: 1847-	4	

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

			Profess	sional Te	sting, El	VII, Inc.			
Test Metho	d:	TIA/EIA 603-	С						
In accordan	ice with:	FCC 15.209 a	nd 87.139						
Section:		15.209, 87.1	39						
Test Date(s):	11/1/2016			EUT Serial	#:	none		
Customer:		uAvionix			EUT Part #:		none		
Project Nur	nber:	18474			Test Techn	ician:	Eric Lifsey		
Purchase O		NA			Supervisor		Lisa Arndt		
Equip. Und	er Test:	P200C			Witness' N	ame:	Matt Lee		
	F	Radiated Em	issions Test	Results Data	a Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage:	: 4	8 VDC		EUT Pow	ver Frequen	icy:	0 N/A	
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range	:	Above 1	GHz
	EUT N	lode of Ope	eration:			Transmit;	5 packets p	er 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
Radiated	cional Testing, Emissions, 3m Dis ertical Polarity Measu	tance				 ∇ Corre — Peak — Corre 	age Limit Level ected Average Readin Limit Level ected Peak Reading -13 dBm at 3m	3	PROFESSIONAL TESTING
Field Strength (dBµV/m) 09 40 40 40 40 40 40 40 40 40 40 40 40 40					7				
30			7 7		Y	7	7		-
$20^{\frac{1}{6}}$									10G 11G
					quency	P	CUT: Ping 2008 Project Number: 1847 Client: uAvionix	4	

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

			Profess	sional Te	esting, El	VII, Inc.			
Test Metho	od:	TIA/EIA 603	-с						
In accorda	nce with:	FCC 15.209	and 87.139						
Section:		15.209, 87.1	139						
Test Date(s	s):	11/1/2016	i		EUT Serial	#:	none		
Customer:		uAvionix			EUT Part #:		none		
Project Nu		18474			Test Techn		Eric Lifsey		
Purchase C		NA			Supervisor		Lisa Arndt		
Equip. Und	er Test:	P200C			Witness' N	ame:	Matt Lee		
	F	Radiated Er	nissions Test	Results Dat	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage:	:	48 VDC		EUT Pow	ver Frequen	cy: (N/A	
Antenna	orientation of the contraction o	n:	Horizor	ntal	Frequ	ency Range	:	Above 1	GHz
	EUT N	lode of Op	eration:			Transmit;	5 packets p	er 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
Radiated	sional Testing, Emissions, 3m Dis Iorizontal Polarity Me	tance				∇ Corre— Peak I— Corre	ge Limit Level cted A verage Reading Limit Level cted Peak Reading 13 dBm at 3 m		PROFESSIONAL TESTING
Field Strength (dBµV/m) 20 40 40									
30	lating the base of	and the state of the last of t	Y	and the second s		<u> </u>		7	Y
20 TG Operator: Eric Lifsey 18474'110116'RE'Spurious.til 11:59:43 AM, Tuesday, November 01, 2016 Antenna port terminated.					equency	P	UT: Ping 200S roject Number: 18474 lient: uA vionix		10G 11G

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

			Profes	sional Te	sting, EN	VII, 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). FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated										
In accordance with: Emissions Limits										
Section:	,	15.109			· · ·		<u>, </u>			
Test Date(s Customer:	<u>):</u>	11/3/2016 uAvionix L			EUT Serial # EUT Part #:		None None			
Project Nur	mher:	18474-10	<u></u>		Test Techni		Bob Redou	tev		
Purchase O		N/A			Supervisor:		Lisa Arndt	tcy		
Equip. Und		Ping200s			Witness' Na		Matt Lee			
		Radiated En	nissions Test	t Results Data			Pa	ge: 1	of 1	
EUT Li	ne Voltage	: 4	8 VDC		EUT Pow	er Frequen		- N/A		
	Orientation		Vertic	al	Freque	ency Range:	1	30MHz to	1GHz	
	EUT N	/lode of Op	eration:			R	eceive Mod	le		
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 10	62 17	2.31 1.54	Quasi-peak	34.5 34.9	18.645	33.1	-14.5 -15.0	Pass	
221.209 270.721	10	281	1.54	Quasi-peak Quasi-peak	31.5	20.581 20.943	35.6 35.6	-13.0	Pass Pass	
351.755	10	74	2.44	Quasi-peak	30.3	20.54	35.6	-15.1	Pass	
Radiated	cional Testing, Emissions, 10m D GHz Vertical Polarity	istance				▽ Corre ─ Corre ▽ Verifi	-peak Limit Level cted Quasi-peak Read cted Peak Value ed Low-PRF QP Read Verification Limit		PROFESSIONAL TESTING	
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	Bob Redoutey 16 RE_ClassB-10031	6.17	EUTMod		luency		UT: Ping 200s roject Number: 1847			

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

			Profes	sional Te	sting, El	ΜI,	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								iated			
Section:		15.109			1			,			
Test Date(s	s):	11/3/2016	1		EUT Serial	#:		None			
Customer:		uAvionix L	LC		EUT Part #:			None			
Project Nui	mber:	18474-10			Test Techn	ician	<u> </u>	Bob Redou	itey		
Purchase C		N/A			Supervisor			Lisa Arndt			
Equip. Und	er Test:	Ping200s			Witness' N	ame:		Matt Lee			
	ſ	Radiated En	nissions Test	t Results Data	a Sheet			Pa	ge: 1	of 1	
EUT L	ine Voltage	: 4	18 VDC		EUT Pow	ver Fi	requen	су:	- N/A		
Antenna	orientation	on:	Horizoi	ntal	Frequ	ency	Range:		30MHz to	OMHz to 1GHz	
	EUT N	Node of Op	eration:				R	eceive Mod	le		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Le	rected evel uV/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	2	1.5	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	
Radiated	sional Testing, Emissions, 10m D GHz Horizontal Polar		18				▽ Corre	-peak Limit Level cted Quasi-peak Read cted Peak Value ed Low-PRF QP Read		DDDEESSIONAL	
50							× LPRF	V erifica tio n Limit		PROFESSIONAL TESTING	
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	Bob Redoutey			Freq	luency		E	UT: Ping 200s			

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

			Profess	sional Te	sting, EN	VII, Inc.			
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 accordan	ce with:	FCC Part 15.1 Emissions Lin		ederal Regulat	ions Part 47, S	Subpart B - Ur	intentional Ra	adiators, Radi	ated
Section:		15.109							
Test Date(s)	:	11/3/2016			EUT Serial	#:	None		
Customer:		uAvionix LL	.C		EUT Part #:		None		
Project Nun		18474-10			Test Techni	ician:	Bob Redou	tey	
Purchase O		N/A			Supervisor:		Lisa Arndt		
Equip. Unde	er Test:	Ping200s			Witness' N	ame:	Matt Lee		
	F	Radiated Em	issions Test	Results Data	Sheet		Pa	ge: 1	of 1
EUT Lin	ne Voltage:	: 4	8 VDC		EUT Pow	er Frequen	cy:	- N/A	
Antenna	Orientatio	n:	Vertic	al	Freque	ency Range:	:	Above 1	GHz
	EUT N	lode of Ope	eration:			R	eceive Mod	e	
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
Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-12GHz Vertkal Polarity Measured Emissions 90				▽ Corre — Peak I	ge Limit Level cted A verage Reading .imit Level cted Peak Reading		PROFESSIONAL TESTING		
Field Strength (dBH Vm) 909 909 909 909 909 909 909 909 909 90		من العلم من من العلم من							1
30 20 1G	Y	PT	Y Y		quency	7		10G	12G

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

			Profess	sional Te	sting, EN	VII, Inc.				
Test Metho	od:		2003: "Metho	ds of Measure e Range of 9 kl	ment of Radio-	Noise Emission		_		d
In accorda	nce with:		FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109								
Test Date(s	s):	11/3/2016			EUT Serial	# :	None			
Customer:		uAvionix LL	.C		EUT Part #:		None			
Project Nu		18474-10			Test Techni		Bob Redou	tey		
Purchase C		N/A			Supervisor:		Lisa Arndt			
Equip. Und	ler Test:	Ping200s			Witness' N	ame:	Matt Lee			
	F	Radiated Em	issions Test	Results Dat	a Sheet		Pa	ge: 1	of	1
	ine Voltage		8 VDC			er Frequen		- N/A		
Antenn	a Orientatio	n:	Horizor	ntal	Frequ	ency Range		Above 1	GHz	
	EUT N	/lode of Ope	eration:			R	eceive Mod	le		
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 R	tesults
1131.75	3	83	1.84	Average	36.5	24.71	54.0	-29.2	Pa	ass
1483.9	3	147	1.31	Average	35.6	24.493	54.0	-29.5	Pa	ass
1947.7	3	81	3.74	Average	36.3	27.488	54.0	-26.5	Pa	ass
2915.6	3	32	1.94	Average	34.3	27.51	54.0	-26.4	Pa	ass
3502.88	3	185	2.64	Average	34.9	29.178	54.0	-24.8	Pa	ass
4530.88	3	219	3.84	Average	33.4	29.911	54.0	-24.0	Pa	ass
8849.74	3	9	2.91	Average	27.2	34.618	54.0	-19.3	Pa	ass
10352.5	3	147	3.75	Average	26.6	36.723	54.0	-17.2	Pa	ass
11256.7	3	78	2.51	Average	27.2	37.443	54.0	-16.5	Pa	ass
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	sional Testing, Emissions, 3m Dis									≢
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Field Strength (dBµVm) 09 000			_							
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	Bob Redoutey			Fre	quency	TC.	UT: Ping 200s			
Operator:						15	U 1. 1 mg 2005			

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	Freq	uency	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 #	Asset # Manufacturer Model # Description						
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.

TIA/EIA 603-C Test Method:

FCC 15.209 and 87.139 In accordance with:

15.209, 87.139

Section: Test Date(s): 11/1/2016 EUT Serial #: none **Customer:** uAvionix EUT Part #: none Project Number: 18474 Test Technician: **Eric Lifsey** NA Purchase Order #: 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

2016 RE_ClassA - Boresite+Mast_LowPRF_072616.til or **Test Profile:** 2016 RE_ClassB - 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	НР	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	НР	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
Radiated Ellissions	1 to 18 GHz	3 m	5.7

End of Report

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