
Project 19183-15

Urban Canyon Flight Inc.

UC10x

**Mode A, C, and S Transponder w/ADS-B Out
1090 MHz Transceiver**

Wireless Certification Report

FCC Part 87

Prepared for:

Urban Canyon Flight Inc.
548 Cochran Lane
White Salmon, WA 98672

By

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

15 Sep 2017

Reviewed by



Larry Finn
Chief Technical Officer

Written by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Final 01	Final.	15 Sep 2017

Errata:

None.

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Certificate of Compliance

Applicant	Device & Test Identification
Urban Canyon Flight Inc. 548 Cochran Lane White Salmon, WA 98672 Certificate Date: 15 Sep 2017	Model(s): UC100, UC101, UC102, UC103 FCC ID: 2ANAE-UC10X Laboratory Project ID: 19183-15

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; <i>Aeronautical utility mobile stations on 1090 MHz; 1000 ppm.</i>
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
Urban Canyon Flight Inc. Mode A, C, and S Transponder for 1090 MHz	UC-10x	25	
Model(s) Represented By Above:		UC100, UC101, UC102, UC103	
Operating Voltage:		28 VDC nominal; 9 – 39 VDC overall	

Table 1.2.2 Compliance Statements	
Requirement	Compliance Statement
FCC 87.143	Power 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 power plug at the end of the power cable.

1.3 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 by interrogation commands from an external protocol tester attached via the antenna port. Measurements were made possible by using a forward power coupler.

1.4 Modifications to EUT

None.

1.5 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.

1.6 Measurement Correction Methods

Table 1.6 1 Measurement Corrections	
Parameter	From Sums Of
Radiated Field Strength	Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain
Conducted Antenna Port	Raw Measured Level + Attenuator Factor + Cable Losses
Conducted Mains Port	Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses

Additionally, measurement distance extrapolation factors (such as $1/d$ above 30 MHz) are applied and documented where used.

2.0 Applicable Documents

Table 2.0.1: Applicable Documents	
Document #	Title/Description
TIA/EIA 603 D	Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards
ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
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 RTCA/DO-181E, RTCA/DO-144A, RTCA/DO-260B

3.3 Test Results

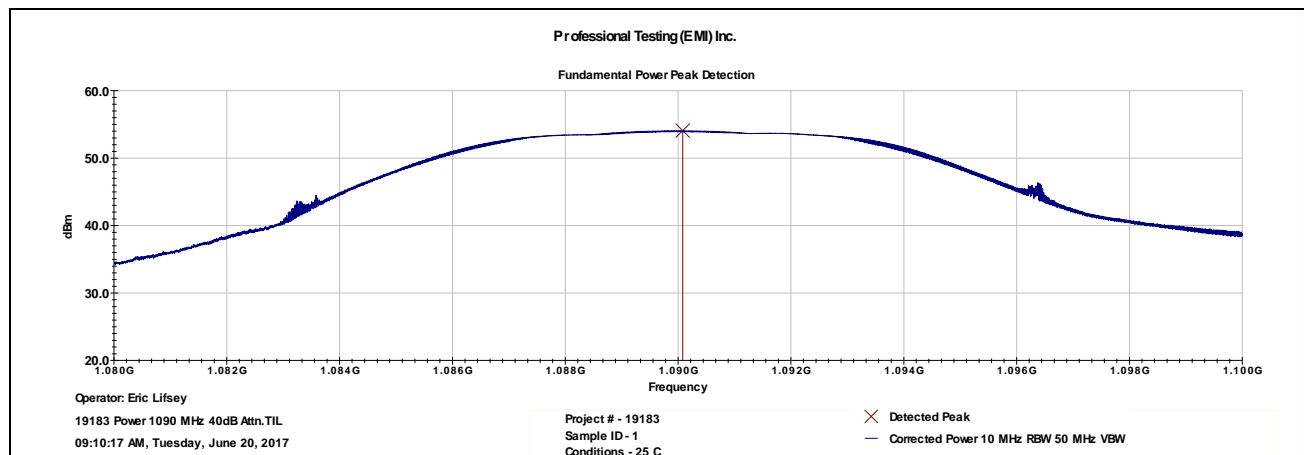
Table 3.3.1 Peak Power Measured In 10 MHz RBW, 50 MHz VBW

Measured Power (peak)	54.1 dBm or 257 Watts
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Table 3.3.2 Calculated Duty Cycle and Average Power

Measured Power (peak)	54.1 dBm or 257 Watts
Transmit Times (μ s)	Per DO-181E: 500 Mode A/C, 60 Mode S replies, 6.6 Squitters/second
Total Transmit Time	10000 μ s
Maximum Duty Cycle	1.00 %
Averaging Factor	$10\log_{10}(1.00\%) = -20.0$ dB
Average Power	$P_{\text{peak}} + \text{Factor}_{\text{avg}} = 54.1 - 20.0 = 34.1$ dBm or 2570 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

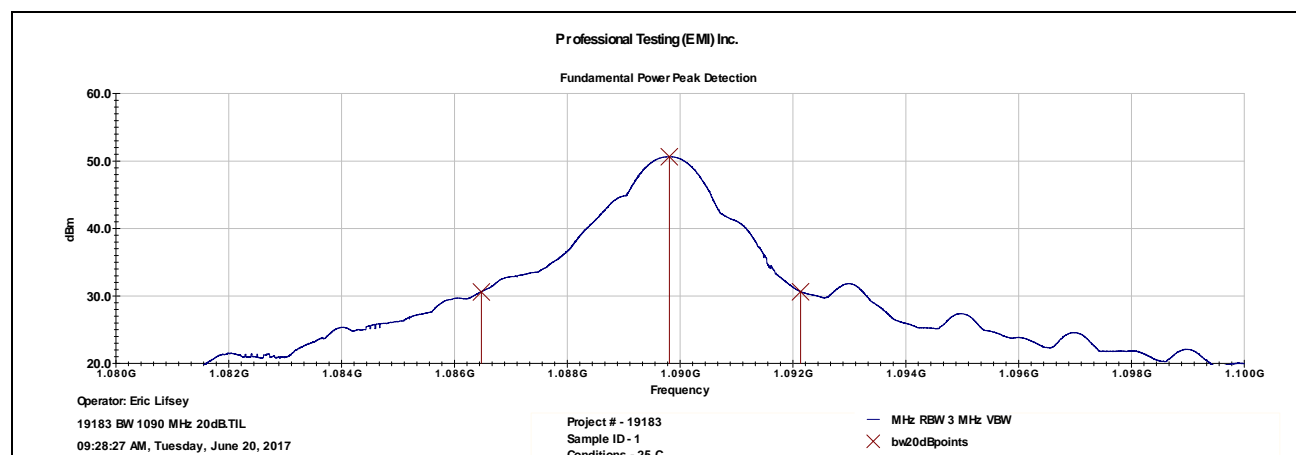
14 MHz per 87.137 table; emission designator 14M0M1D

4.3 Test Results, Bandwidth

Table 4.3.1 Bandwidth In 20 dB (1 MHz RBW 3 MHz VBW)

Reference Power Level	54.1 dBm
Measured 20 dB Bandwidth	5658 kHz
Emission Designator	5M65M1D

The EUT satisfied the requirements. Results appear below.



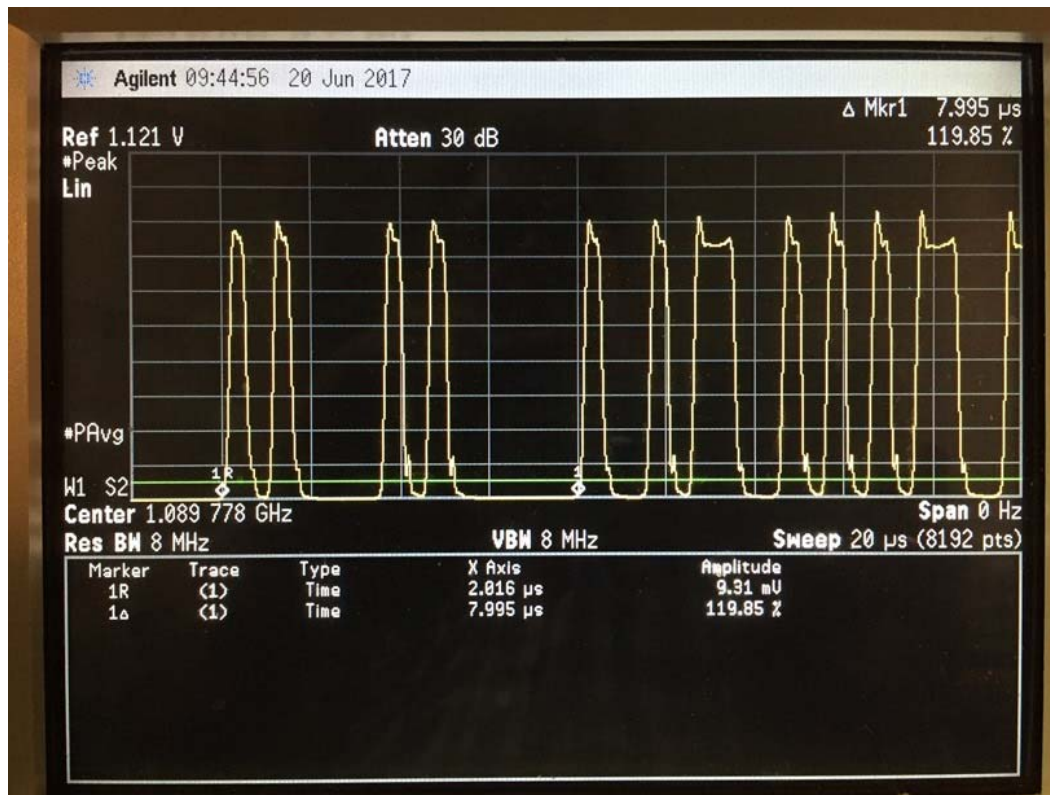
Bandwidth Measured

4.4 Test Results, Modulation Characteristics

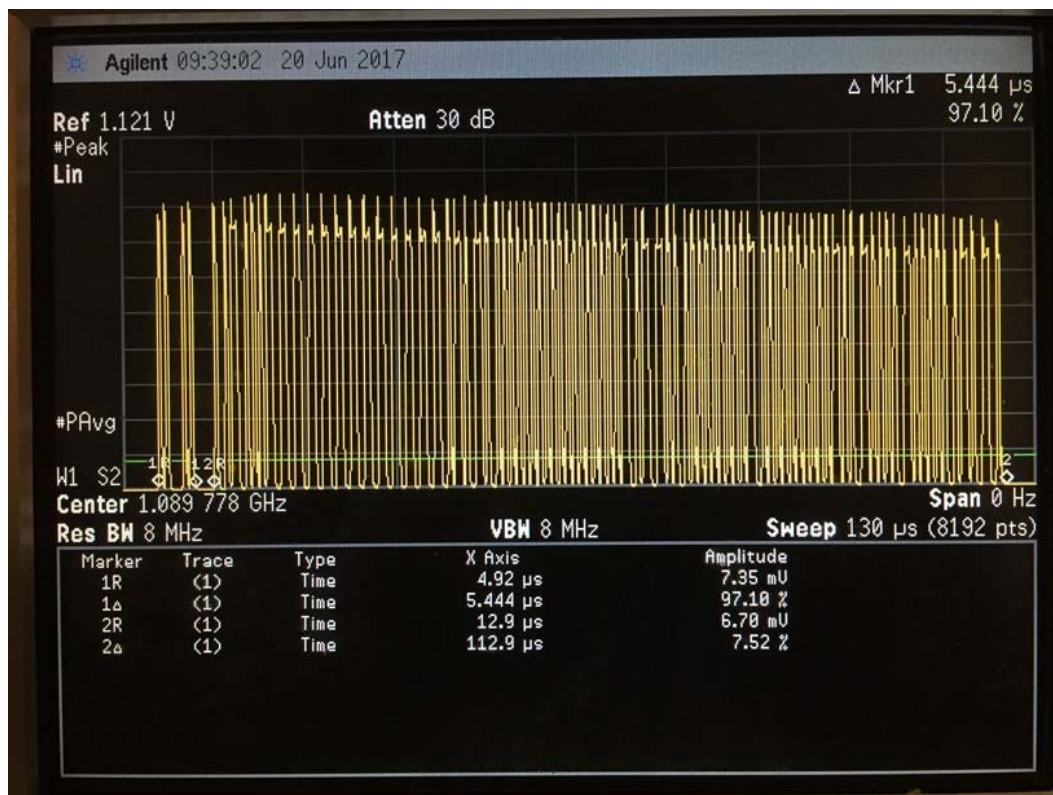
The pulse train was captured in time domain and observed for basic parameters listed below. These were found to be within the expected limits.

Table 4.4.1 Modulation Characteristics Measured

Preamble Time	8.0 μ sec (Preamble, Marker 1 delta)
Payload Time	112.9 μ sec (Full Payload, Marker 2 delta)



Preamble



Full Payload

5.0 Spurious Emissions at Antenna Terminals

5.1 Test Procedure

The output of the EUT was connected directly to a power 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.

5.2 Test Criteria

Table 5.2.1 Spurious Limit, FCC 87.139(a) Basis for limit calculations.

Measured Peak Transmitter Power:	54.1 dBm or 257 Watts
Average Power Calculated P_t:	$P_t = 34.1$ dBm or 2570 mW

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:	34.1 dBm – 25 dB = 9.1 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:	34.1 dBm – 35 dB = -0.9 dBm

Table 5.2.4 Spurious Limit, FCC 87.139(a)(3)

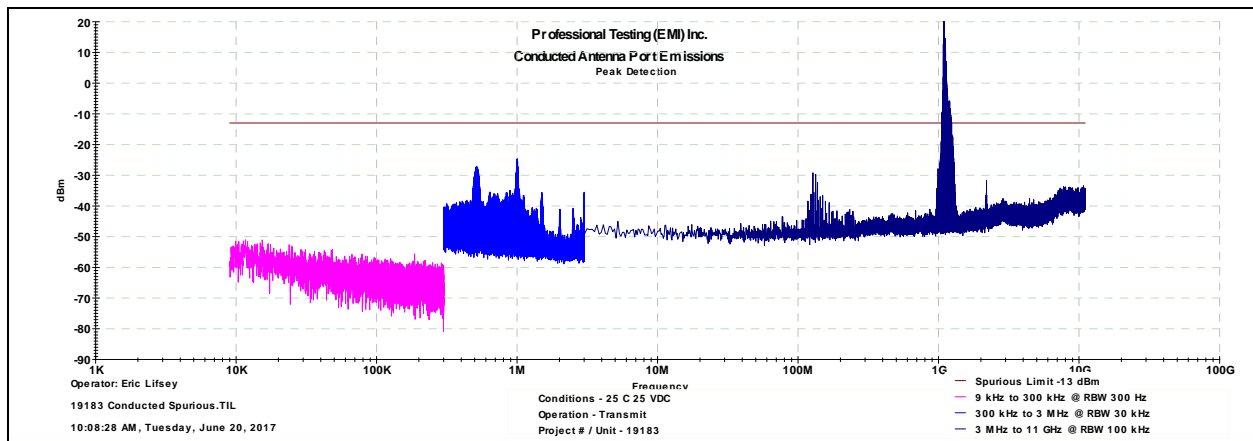
Attenuation & Frequency Range:	40 dB beyond ± 35 MHz (250% of BW)
Deduct Attenuation from Measured Power:	34.1 dBm – 40 dB = -5.9 dBm

5.3 Test Results

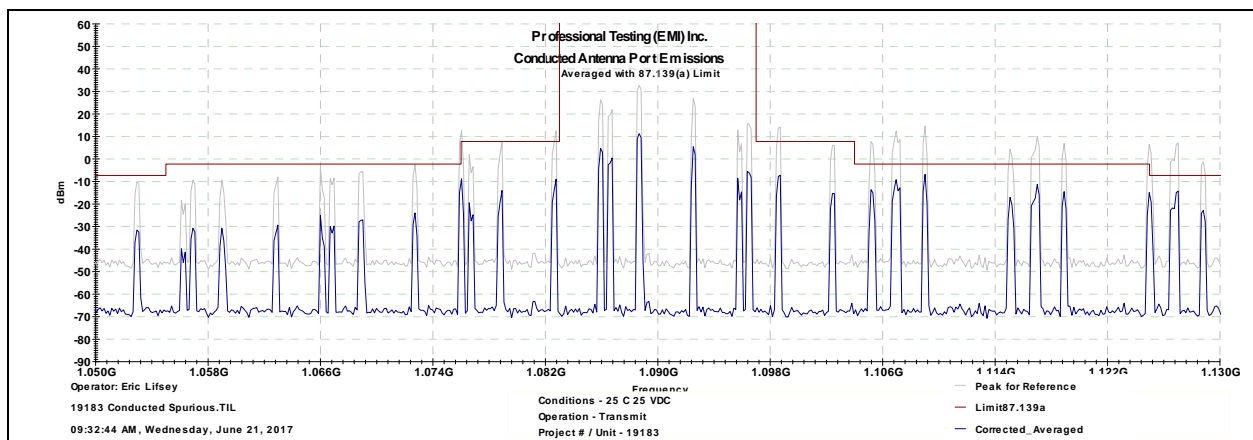
Limits are based on mean or average levels. The overall graph is peak levels. Where applicable the averaging factor is numerically applied with peak and average levels displayed.

The common -13 dBm limit as marked on the plotted data was satisfied. Therefore the -5.9 dBm limit is also satisfied.

The EUT satisfied the requirements. Plotted measurements appear below.



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

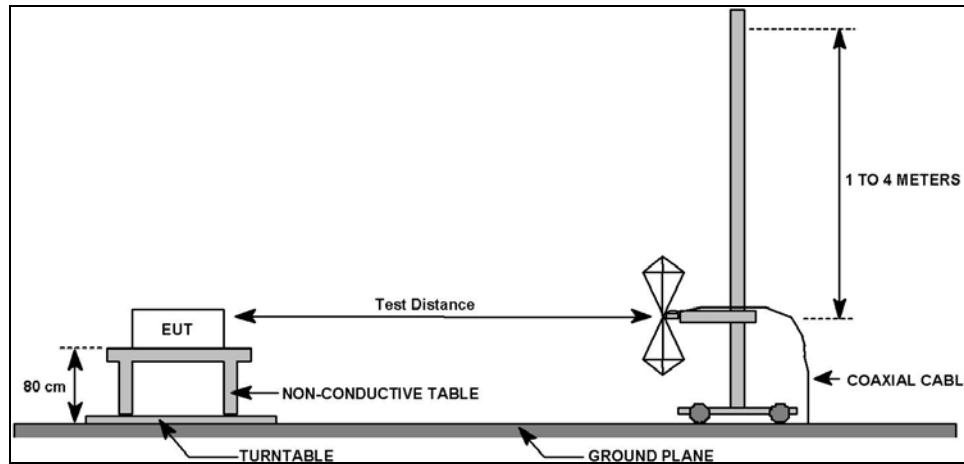


**Conducted Antenna Port Spurious; 87.139(a)(1-3) Mask Detail
Measured Peak and Calculated Average Presented**

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 increased 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 -5.9 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: $20 \log_{10} (\lambda / 4\pi R) = 20 \log_{10} (0.30675 / 4\pi 10) = -52.25 \text{ dB}$ 3 m: $20 \log_{10} (\lambda / 4\pi R) = 20 \log_{10} (0.30675 / 4\pi 3) = -41.79 \text{ dB}$
Power at R:	10 m: $-5.9 \text{ dBm} + 0 \text{ dB} + 0 \text{ dB} + [-52.25 \text{ dB}] = -58.15 \text{ dBm}$ 3 m: $-5.9 \text{ dBm} + 0 \text{ dB} + 0 \text{ dB} + [-41.79 \text{ dB}] = -47.69 \text{ dBm}$
Field Strength Limit Conversion Formula:	$E(\text{dB}\mu\text{V}/\text{m}) = P_{\text{meas}}(\text{dBm}) - P_{\text{gain}}(\text{dB}) + 77.2 \text{ dB} + 20 \log(f, \text{MHz}) - G_{\text{ant}}(\text{dB})$
Field Strength Limit Calculation, 10 m:	$[-58.15 \text{ dBm}] - 0 \text{ dB} + 77.2 \text{ dB} + 20 \log_{10} (1090 \text{ MHz}) - 0 \text{ dB}$ $= 79.8 \text{ dB}\mu\text{V}/\text{m}$
Field Strength Limit Calculation, 3 m:	$[-47.69 \text{ dBm}] - 0 \text{ dB} + 77.2 \text{ dB} + 20 \log_{10} (1090 \text{ MHz}) - 0 \text{ dB}$ $= 90.3 \text{ dB}\mu\text{V}/\text{m}$

6.3 Test Results

The EUT satisfied the requirements. Plotted measurements appear below.

The 87.139 field limits calculated above are just above the scale of the plotted results; the Part-15 limits would only apply to non-intentional emissions.

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

Professional Testing, EMI, Inc.									
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):		6/21/2017			EUT Serial #:		25		
Customer:		Urban Canyon Flight Inc.			EUT Part #:		None		
Project Number:		19183-10			Test Technician:		Bob Redoutey		
Purchase Order #:		N/A			Supervisor:		Lisa Arndt		
Equip. Under Test:		UC 10x Transponder			Witness' Name:		Jeremy Ziegler		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		14 VDC			EUT Power Frequency:		- N/A		
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit				
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
34.1005	10	133	3.94	Quasi-peak	23.1	11.243	29.5	-18.3	Pass
74.9686	10	6	1.88	Quasi-peak	28.1	10.355	29.5	-19.1	Pass
138.109	10	297	2.12	Quasi-peak	22.7	5.528	33.1	-27.6	Pass
257.824	10	127	1.98	Quasi-peak	22.1	11.912	35.6	-23.7	Pass
425.754	10	29	2.04	Quasi-peak	22.3	15.794	35.6	-19.8	Pass
547.882	10	43	4.03	Quasi-peak	22.1	18.274	35.6	-17.3	Pass
903.705	10	78	2.48	Quasi-peak	21.2	26.047	35.6	-9.6	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Vertical Polarity Measured Emissions

Operator: Bob Redoutey
19183_TX_2016 RE_ClassB-041417.ttl
10:54:24 AM, Wednesday, June 21, 2017

EUT Mode: Transmit
EUT Power: 14VDC

EUT: UC 10x Transponder
Project Number: 19183-15
Client: Urban Canyon Flight Inc.

≤ 1GHz Vertical Antenna Polarity Measured Emissions

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

Professional Testing, EMI, Inc.									
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):		6/21/2017			EUT Serial #:		25		
Customer:		Urban Canyon Flight Inc.			EUT Part #:		None		
Project Number:		19183-10			Test Technician:		Bob Redoutey		
Purchase Order #:		N/A			Supervisor:		Lisa Arndt		
Equip. Under Test:		UC 10x Transponder			Witness' Name:		Jeremy Ziegler		
Radiated Emissions Test Results Data Sheet									
Page: 1 of 1									
EUT Line Voltage:		14 VDC			EUT Power Frequency:		- N/A		
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Transmit				
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
34.2436	10	268	1.72	Quasi-peak	23.1	11.23	29.5	-18.3	Pass
107.538	10	86	3.56	Quasi-peak	22.7	6.013	33.1	-27.1	Pass
254.134	10	138	3.65	Quasi-peak	22.2	12.124	35.6	-23.5	Pass
299.718	10	34	3.53	Quasi-peak	22.1	11.648	35.6	-24.0	Pass
398.045	10	149	2.77	Quasi-peak	22.3	15.101	35.6	-20.5	Pass
925.533	10	295	2.65	Quasi-peak	21.2	25.968	35.6	-9.6	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions

Operator: Bob Redoutey
19183_TX_2016 RE_ClassB-041417.ttl
10:54:24 AM, Wednesday, June 21, 2017

EUT Mode: Transmit
EUT Power: 14VDC

EUT: UC 10x Transponder
Project Number: 19183-15
Client: Urban Canyon Flight Inc.

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

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

Professional Testing, EMI, Inc.									
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):		6/21/2017			EUT Serial #:		25		
Customer:		Urban Canyon Flight Inc.			EUT Part #:		None		
Project Number:		19183-10			Test Technician:		Bob Redoutey		
Purchase Order #:		N/A			Supervisor:		Lisa Arndt		
Equip. Under Test:		UC 10x Transponder			Witness' Name:		Jeremy Ziegler		
Radiated Emissions Test Results Data Sheet							Page: 1 of 1		
EUT Line Voltage:		14 VDC			EUT Power Frequency:		- N/A		
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit				
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
1919.99	3	272	2.18	Average	35.1	25.673	54.0	-28.3	Pass
2978.78	3	274	2.16	Average	34.6	27.513	54.0	-26.4	Pass
3756.62	3	192	3.78	Average	34.5	27.864	54.0	-26.1	Pass
4773.4	3	351	2.86	Average	32.7	28.695	54.0	-25.3	Pass
6928.85	3	231	2.07	Average	29.6	31.647	54.0	-22.3	Pass
7858.85	3	38	1.3	Average	28.5	33.117	54.0	-20.8	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-11GHz Vertical Polarity Measured Emissions

Operator: Bob Redoutey
19183_TX_2016 RE_ClassB-041417.ttl
11:46:08 AM, Wednesday, June 21, 2017

EUT Mode: Transmit
EUT Power: 14VDC

EUT: UC 10x Transponder
Project Number: 19183-15
Client: Urban Canyon Flight Inc.

> 1GHz Vertical Antenna Polarity Measured Emissions

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

Professional Testing, EMI, Inc.									
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):		6/21/2017			EUT Serial #:		25		
Customer:		Urban Canyon Flight Inc.			EUT Part #:		None		
Project Number:		19183-10			Test Technician:		Bob Redoutey		
Purchase Order #:		N/A			Supervisor:		Lisa Arndt		
Equip. Under Test:		UC 10x Transponder			Witness' Name:		Jeremy Ziegler		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		14 VDC			EUT Power Frequency:		- N/A		
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit				
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
1775.73	3	245	2.28	Average	35.7	25.863	54.0	-28.1	Pass
2603.36	3	169	2.61	Average	35	26.457	54.0	-27.5	Pass
3796.67	3	241	2.21	Average	34.4	27.802	54.0	-26.2	Pass
5727.16	3	63	2.53	Average	31.6	30.201	54.0	-23.8	Pass
6585.84	3	119	2.57	Average	30.2	31.523	54.0	-22.4	Pass
8786.97	3	15	2.59	Average	27.3	34.669	54.0	-19.3	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-11GHz Horizontal Polarity Measured Emissions

Operator: Bob Redoutey
19183_TX_2016 RE_ClassB-041417.11
11:46:08 AM, Wednesday, June 21, 2017

EUT Mode: Transmit
EUT Power: 14VDC

EUT: UC 10x Transponder
Project Number: 19183-15
Client: Urban Canyon Flight Inc.

> 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: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz								
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):	6/21/2017	EUT Serial #:	25						
Customer:	Urban Canyon Flight Inc.	EUT Part #:	None						
Project Number:	19183-10	Test Technician:	Bob Redoutey						
Purchase Order #:	N/A	Supervisor:	Lisa Arndt						
Equip. Under Test:	UC 10x Transponder	Witness' Name:	Jeremy Ziegler						
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:	14	VDC	EUT Power Frequency:	- N/A					
Antenna Orientation:	Vertical			Frequency Range:	30MHz to 1GHz				
EUT Mode of Operation:				Receive					
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
31.4091	10	334	3.71	Quasi-peak	24.2	12.18	29.5	-17.3	Pass
71	10	78	1.38	Quasi-peak	23.5	4.237	29.5	-25.3	Pass
74.984	10	32	1.29	Quasi-peak	29.1	11.363	29.5	-18.1	Pass
424.459	10	75	3.71	Quasi-peak	22.3	15.781	35.6	-19.8	Pass
652.675	10	221	3.85	Quasi-peak	21.9	20.145	35.6	-15.5	Pass
878.6	10	243	2.98	Quasi-peak	21.4	25.215	35.6	-10.4	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions</p> <p>Operator: Bob Redoutey 19183_2016 RE_ClassB-041417dfl 09:09:01 AM, Wednesday, June 21, 2017</p> </div> <div style="width: 35%;"> <p>EUT Mode: Receive EUT Power: 14VDC</p> <p>EUT: UC 10x Transponder Project Number: 19183-10-15 Client: Urban Canyon Flight Inc.</p> </div> </div>									
≤ 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: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz								
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):	6/21/2017	EUT Serial #:	25						
Customer:	Urban Canyon Flight Inc.	EUT Part #:	None						
Project Number:	19183-10	Test Technician:	Bob Redoutey						
Purchase Order #:	N/A	Supervisor:	Lisa Arndt						
Equip. Under Test:	UC 10x Transponder	Witness' Name:	Jeremy Ziegler						
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		14 VDC		EUT Power Frequency:		- N/A			
Antenna Orientation:		Horizontal		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Receive					
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
32.2945	10	148	3.72	Quasi-peak	23.8	11.848	29.5	-17.7	Pass
103.3	10	223	1.08	Quasi-peak	23.2	6.651	33.1	-26.4	Pass
252.185	10	229	1.29	Quasi-peak	22.1	12.072	35.6	-23.5	Pass
369.432	10	185	1.34	Quasi-peak	22.2	13.124	35.6	-22.5	Pass
563.951	10	211	2.91	Quasi-peak	22.1	18.156	35.6	-17.4	Pass
935.26	10	320	3.81	Quasi-peak	21.1	25.951	35.6	-9.6	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Horizontal Polarity Measured Emissions</p> <p>Operator: Bob Redoutey 19183_2016 RE_ClassB-041417.ttl 09:09:01 AM, Wednesday, June 21, 2017</p> </div> <div style="width: 35%;"> <p>EUT Mode: Receive EUT Power: 14VDC</p> <p>EUT: UC 10x Transponder Project Number: 19183-10-15 Client: Urban Canyon Flight Inc.</p> </div> </div>									
≤ 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: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz								
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):	6/21/2017	EUT Serial #:	25						
Customer:	Urban Canyon Flight Inc.	EUT Part #:	None						
Project Number:	19183-10	Test Technician:	Bob Redoutey						
Purchase Order #:	N/A	Supervisor:	Lisa Arndt						
Equip. Under Test:	UC 10x Transponder	Witness' Name:	Jeremy Ziegler						
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:	14	VDC	EUT Power Frequency:	- N/A					
Antenna Orientation:	Vertical			Frequency Range:	Above 1GHz				
EUT Mode of Operation:				Receive					
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
1090.1	3	70	2.6	Average	44.6	31.696	54.0	-22.3	Pass
1310.26	3	163	3.34	Average	35.9	23.994	54.0	-30.0	Pass
1920.09	3	249	1.66	Average	35.1	25.711	54.0	-28.2	Pass
2967.33	3	284	2.37	Average	34.4	27.295	54.0	-26.7	Pass
3137.62	3	336	2.56	Average	34.6	27.155	54.0	-26.8	Pass
3885.96	3	307	2.5	Average	34.3	27.711	54.0	-26.2	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Vertical Polarity Measured Emissions</p> <p>The graph displays the measured field strength in dBμV/m across a frequency range from 1 GHz to 6 GHz. The y-axis ranges from 20 to 90 dBμV/m. Two horizontal red lines represent the limit levels at approximately 54 dBμV/m. A blue line shows the corrected average reading, which remains consistently below the limit levels. Red triangles indicate the corrected peak readings at specific frequencies.</p> </div> <div style="width: 35%; border: 1px solid black; padding: 5px;"> <p>— Average Limit Level</p> <p>▽ Corrected Average Reading</p> <p>— Peak Limit Level</p> <p>— Corrected Peak Reading</p> <p style="text-align: right; font-weight: bold;">PROFESSIONAL TESTING</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 30%;"> <p>Operator: Bob Redoutey 19183_2016 RE_ClassB-041417.dil 09:44:36 AM, Wednesday, June 21, 2017</p> </div> <div style="width: 30%; text-align: center;"> <p>EUT Mode: Receive EUT Power: 14VDC</p> </div> <div style="width: 30%; text-align: right;"> <p>EUT: UC 10x Transponder Project Number: 19183-10-15 Client: Urban Canyon Flight Inc.</p> </div> </div>									
> 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: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz								
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):	6/21/2017	EUT Serial #:	25						
Customer:	Urban Canyon Flight Inc.	EUT Part #:	None						
Project Number:	19183-10	Test Technician:	Bob Redoutey						
Purchase Order #:	N/A	Supervisor:	Lisa Arndt						
Equip. Under Test:	UC 10x Transponder	Witness' Name:	Jeremy Ziegler						
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:	14	VDC	EUT Power Frequency:	- N/A					
Antenna Orientation:	Horizontal			Frequency Range:	Above 1GHz				
EUT Mode of Operation:				Receive					
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
1090.22	3	33	1.31	Average	40.5	27.634	54.0	-26.3	Pass
1297.18	3	326	1.22	Average	36	24.06	54.0	-29.9	Pass
1919.71	3	140	3.71	Average	41.1	31.717	54.0	-22.2	Pass
2421.01	3	97	1.61	Average	35	25.905	54.0	-28.1	Pass
3755.74	3	209	2.57	Average	34.7	28.064	54.0	-25.9	Pass
4337.11	3	98	1.36	Average	33.6	28.676	54.0	-25.3	Pass
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Professional Testing, EMI, Inc Radiated Emissions, 3m Distance 1-6GHz Horizontal Polarity Measured Emissions</p> </div> <div style="width: 35%; text-align: right;"> <p>Operator: Bob Redoutey 19183_2016 RE_ClassB-041417.4il 09:44:36 AM, Wednesday, June 21, 2017</p> <p>EUT Mode: Receive EUT Power: 14VDC</p> <p>EUT: UC 10x Transponder Project Number: 19183-10-15 Client: Urban Canyon Flight Inc.</p> </div> </div>									
> 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 until the internal temperature sensor stabilized. After soak time was satisfied, the EUT transmitter was powered on in transmit mode and the frequency was 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 a modulated mode.

7.2 Test Criteria

Table 7.2.1 Frequency Stability Criteria, 87.133; 2.1055(a)(1)	
Parameter: Frequency Tolerance	
1000 ppm or $\pm 1,090,000$ 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	9 VDC
Nominal Voltage	28 VDC
High Voltage	39 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	1089.994500	-5500
-20	1090.000000	1089.994500	-5500
-10	1090.000000	1089.994500	-5500
0	1090.000000	1089.992400	-7600
10	1090.000000	1089.988000	-12000
20	1090.000000	1089.990200	-9800
30	1090.000000	1089.985800	-14200
40	1090.000000	1089.988000	-12000
50	1090.000000	1089.992400	-7600
Max Deviation (Hz)			-5500
Min Deviation (Hz)			-14200

7.3.2 Voltage

Condition	Voltage	Frequency		
Voltage Extreme	Voltage (V DC)	Reference Frequency (MHz)	Measured Frequency (MHz)	Calculated Deviation (Hz)
Low	9.00	1090.000000	1089.990200	-9800
Nominal	28.00	1090.000000	1089.990200	-9800
High	39.00	1090.000000	1089.990200	-9800

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	21 Sep 2018
C247	Pasternack	Unspecified	Coaxial cable, RG-223 Type	21 Jan 2018
0472	Tektronix	THS730A	Scope/DMM	15 Nov 2017
1831	HP	6622A	Adjustable DC Power Supply	CIU

Table 8.2 Equipment List; Frequency Stability (In addition to equipment listed in 8.1.)				
Asset #	Manufacturer	Model #	Description	Calibration Due
2134	Tenny	TPC T2C	Temperature Chamber	12 Oct 2017

Table 8.3 Equipment List; Radiated Emissions					
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

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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