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June 21, 2013

Don Houtz
SkyGuardTWX, LLC
2121 Legends Parkway
Kingsland, Texas 78639

Dear Don:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for SkyGuardTWX, LLC. Enclosed is the Wireless Certification Report for the UAT/ES ADS-B Transceiver. This report can be used to demonstrate compliance with FCC requirements for wireless devices in the United States.

If you have any questions, please contact me.

Sincerely,

Jeffrey A. Lenk
President

Attachment

Project 14393-10

SkyGuardTWX, LLC
UAT/ES ADS-B Transceiver

Wireless Certification Report

Prepared for:

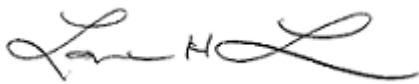
SkyGuardTWX, LLC
2121 Legends Parkway
Kingsland, Texas 78639

By

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

June 21, 2013

Reviewed by



Layne Lueckemeyer
Product Development Engineer

Written by



Tara Duval
Technical Writer

Revised by



Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial Release	January 17, 2013
Final	Final Release	January 18, 2013
02	Revised to address TCB comments	April 24, 2013
03	Revised to address TCB comments	June 14, 2013
04	Revised to address TCB comments	June 21, 2013

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Certificate of Compliance

Applicant: SkyGuardTWX, LLC
Applicant's Address: 2121 Legends Parkway
Kingsland, Texas 78639

FCC ID: R83UAT1000
Model: UAT/ES ADS-B Transceiver
Project Number: 14393-10

The **UAT/ES ADS-B Transceiver** by **SkyGuardTWX, LLC**, was tested utilizing the following documents and found to be in compliance with the required criteria on the indicated test date.

47 CFR, Part 87		
Section 2.1046	Conducted Output Power	11/28/2012
Section 2.1049	Occupied Bandwidth	12/21/2012
Section 2.1051	Conducted Spurious/Harmonic Emissions at Antenna Terminals	1/15/2013
Sections 2.1053, 87.139, 87.143	Field Strength of Radiated Spurious/Harmonic Emissions (30 MHz to 10 GHz)	1/10/2013
Sections 2.1055 and 2.1047	Frequency Stability and Modulation Characteristics	1/13/2013

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures, have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Jeffrey A. Lenk
President

This report has been reviewed and accepted by SkyGuardTWX, LLC. The undersigned is responsible for ensuring that the UAT/ES ADS-B Transceiver by SkyGuardTWX, LLC, will continue to comply with the applicable rules.

Representative of SkyGuardTWX, LLC

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.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

The EUT is the **UAT/ES ADS-B Transceiver** by **SkyGuardTWX, LLC**, an electronic navigation radio used in general aviation aircraft. This radio contains a GPS and transmitters/receivers, which broadcast the aircraft's position to the FAA NextGen tracking system. It also receives weather and traffic reports from the FAA NextGen tracking system. The system tested consisted of the following:

Table 1.2.1: Equipment Under Test

EUT	Manufacturer	Model	Serial #	Description
	SkyGuardTWX, LLC	UAT/ES ADS-B Transceiver	1112-105	Electronic Navigation Radio

1.3 EUT Description

The EUT is a fully integrated 978 MHz UAT and 1,090 MHz ES radio receiver, along with a WAAS GPS and WiFi transceiver.

The unit is powered on by plugging the provided DC charging adapter into any aircraft charging socket that provides either 12 V or 24 V DC. There are four antennas (1 long on 4 ft. coax, 2 long and 1 short) and a GPS receiver that must be installed prior to powering up the transceiver.

The GPS receiver “puck” is plugged into the ADS-B transceiver with the “arrow” on the GPS plug pointing up. The 2 longer black ADS-B receiver antennas are attached to the external SMA1 and SMA2 connectors adjacent to and at same end as the GPS plug.

The 4 ft. coax cable with long external antenna is attached to the center SMA5 connector at the same end as the GPS plug.

The shorter WiFi antenna connector (using reverse-polarized center pin) and the DC power adapter plug are connected to the opposite side of the receiver.

Power is removed at the aircraft operator's position by either removing power from the EUT itself or from the vehicle power plug at the end of the power cable. This satisfies control requirements of FCC 87.143. Transmitter operation is indicated by a green color LED status light on the GPS puck. This satisfies the indicator requirements of FCC 87.143(d)(1).



Photograph 1.3.1: EUT & Attachments



Photograph 1.3.2: EUT Ports Identified – Top View

1.4 EUT Operation

The EUT was exercised in a manner consistent with normal operations. The EUT was visually monitored for anomalies during testing and checked for functionality upon completion of each test.

1.5 Modifications to Equipment

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

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-212, 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.

Measurements using the conducted port method were performed at the main office.

2.0 Applicable Documents, Guidelines, Equipment Used in Testing, and Test Setup Photographs

The following documents were used as reference for the test procedures specified herein:

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	Part 87 – Aviation Services

The following rules apply to the operation of the EUT:

Table 2.0.2: Guidelines for Testing

Guideline	Paragraph Number	Required?	Result
RF Power Output	2.1046/87.131	Yes	Pass
Modulation Characteristics	2.1047	Yes	Pass
Occupied Bandwidth	2.1049(c)/87.135	Yes	Pass
Spurious Emissions at Antenna Terminals	2.1051/87.139(l)	Yes	Pass
Field Strength of Spurious Emissions	2.1053/87.139	Yes	Pass
Frequency Stability	2.1055/87.133/87.147	Yes	Pass
Control*	87.143	Yes	Pass

*See report section 1.3.

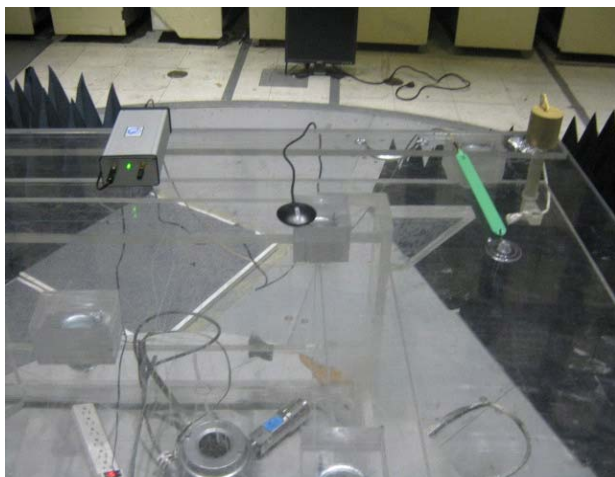
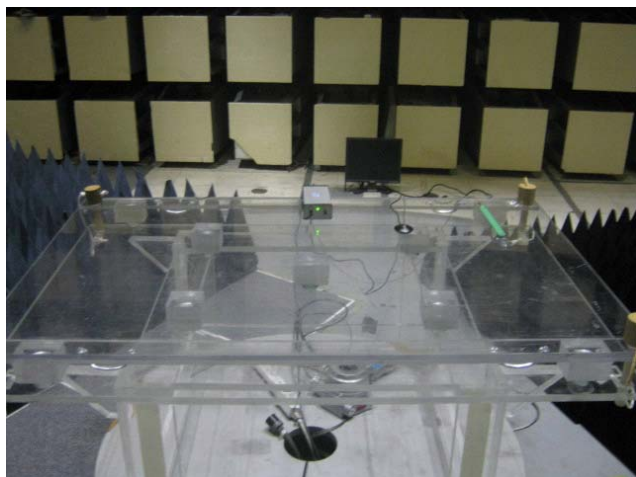
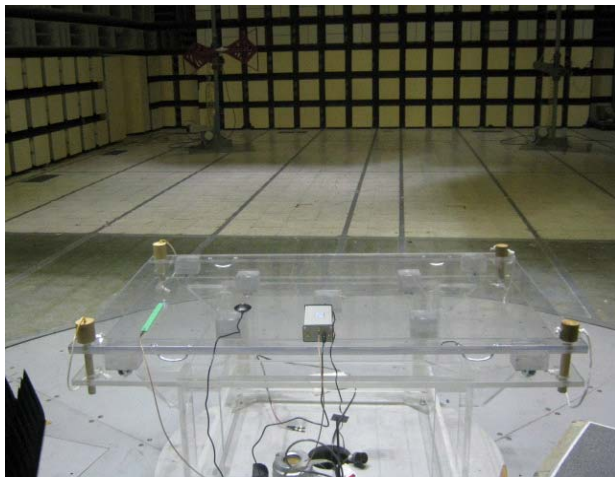
The following equipment was used to test the EUT. Additional equipment for specific tests are listed in the relevant sections:

Table 2.0.3: Test Equipment

Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		Radiated Emissions_Profile Version October 12, 2011			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/27/2013
0586	HP	8447D	Preamp, 0.1-1300MHz, 26dB	1726A01364	1/7/2014
1930	Agilent	E4440A-239	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY45304903	6/19/2013
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/24/2013
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/7/2013
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	4/8/2013
1594	Miteq	AFS44-00102650	Amplifier, 1-26.5GHz, 42dB	none	10/15/2013
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	11/26/2013
C030	N/A	0	Cable Coax, N-N, 30m	none	9/7/2013
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	00110313	1/19/2013
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A

Wireless Certification Report for the UAT/ES ADS-B Transceiver by SkyGuardTWX, LLC
The following photographs were taken of the test setup:

Table 2.0.4: Test Setup Photographs

Test Setup Photographs		Page:	1	of	1
	Closeup		Setup (Front View)		
	Setup (Rear View)				

3.0 Conducted Output Measurements

RF power output measurements were made on the EUT fundamental transmit frequency.

3.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the measuring receiver. 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. If necessary, the input attenuator setting of the measuring receiver was adjusted in order to increase the sensitivity of the measuring receiver. The test setup is diagrammed in Figure 3.1.1.

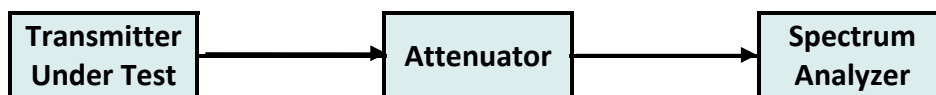


Figure 3.1.1: Conducted Power Output Test Setup

3.2 Output Power Test Results

The conducted output power measurements for the EUT were taken on November 28, 2012, and the EUT was found to be in compliance with the applicable requirements. The specifications of 47 CFR, Part 87, Section 2.1046(a) and other applicable parts of sections 2 and 87.131 were met. There were no deviations to the specifications.

Table 3.2.1: Output Power Test Results

Professional Testing, EMI, Inc.				
Test Method:		TIA/EIA 603C 2004: Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards		
In accordance with:		FCC Part 87 Code of Federal Regulations Part 47		
Section:		87.131 Power and Emissions		
Test Date(s):		1/13/2012	EUT Serial #:	N/A
Customer:		SkyGuard TWX, LLC	EUT Part #:	UAT, ADS-B
Project Number:		14393-10	Test Technician:	Jesse Banda
Purchase Order #:		CC	Supervisor:	Rob McCollough
Equip. Under Test:		UAT/ES ADS-B Transceiver	Witness' Name:	none
Output Power Test Results Data Sheet				Page: 1 of 1
EUT Line Voltage:		14 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:		Horizontal	Frequency Range:	Above 1GHz
EUT Mode of Operation:			Transmitting	
Frequency Measured (MHz)	Measured Power (dBm)	Attenuator Factor (dB)	Output Power (dBm)	Output Power (W)
978	13.34	30.9	44.24	26.56

3.3 Occupied Bandwidth

Occupied bandwidth measurements were performed on the EUT to determine compliance with 47 CFR, Part 87, Sections 87.135 and 2.1049.

3.4 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the measuring receiver. The transceiver was switched on, and the measurement receiver was tuned to the frequency of the transceiver under test. If necessary, the input attenuator setting of the measuring receiver was adjusted in order to increase the sensitivity of the measuring receiver. A diagram showing the test setup is given as Figure 4.4.1.



Figure 4.1.1: Occupied Bandwidth Test Setup

3.5 Test Criteria

According to 47 CFR, Part 87, Section 87.135, the necessary bandwidth for a given class of emissions is the width of the frequency band, which is sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

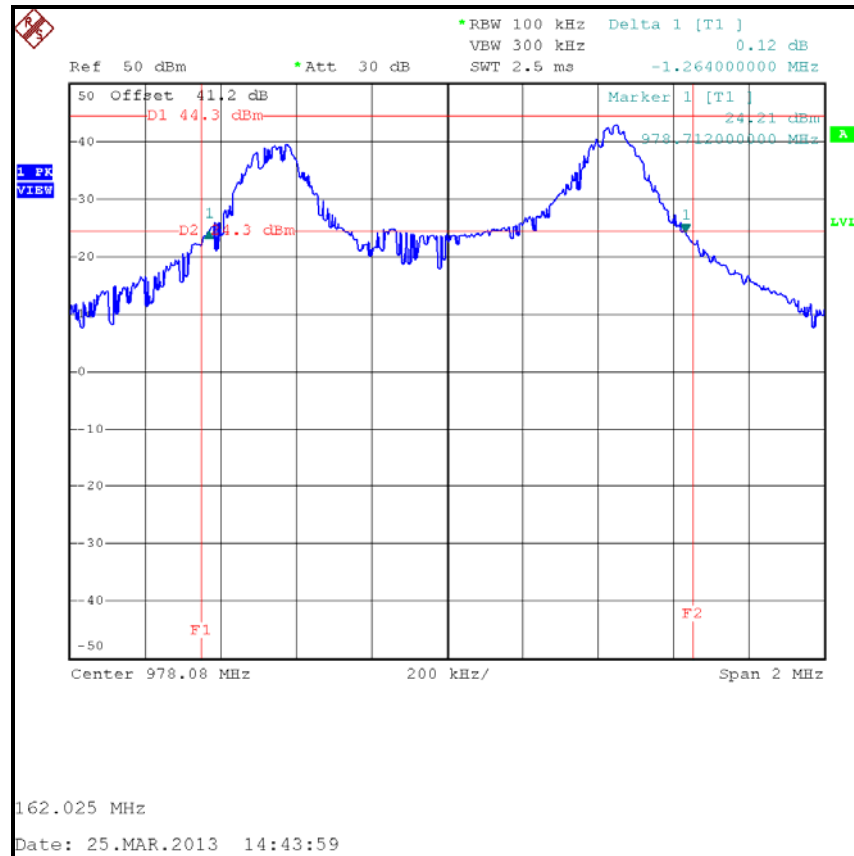
3.6 Test Results

Occupied bandwidth measurements were taken on December 21, 2012, and the EUT was found to be in compliance with applicable requirements.

Table 4.3.1 Occupied Bandwidth Test Results, Page 1

Professional Testing, EMI, Inc.			
Test Method:	FCC Part 87 Occupied Bandwidth, stated as 0.5 % of mean powers above and below stated bandwidth; or commonly 99% bandwidth or 20 dB bandwidth. Authorized bandwidth is 1300 kHz.		
Section:	87.135, 87.137		
Test Date(s):	3/25/2013	EUT Serial #:	DC1112-105
Customer:	SkyGuard TWX	EUT Part #:	None
Project Number:	14393-10	Test Technician:	Eric Lifsey
Purchase Order #:		Supervisor	Rob McCollough
Equipment Under Test:	978 UAT/1090 ES	Witness' Name:	N/A

Bandwidth in 20 dB			
Authorized BW:	1300	kHz	
Measured BW:	1264	kHz	
D1 Reference Power:	44.3	dBm	

**Notes**

Amplitude display line D1 is referenced to power measured at 20 C in RBW 1 MHz.

Amplitude display line D2 is -20 dBc below D1.

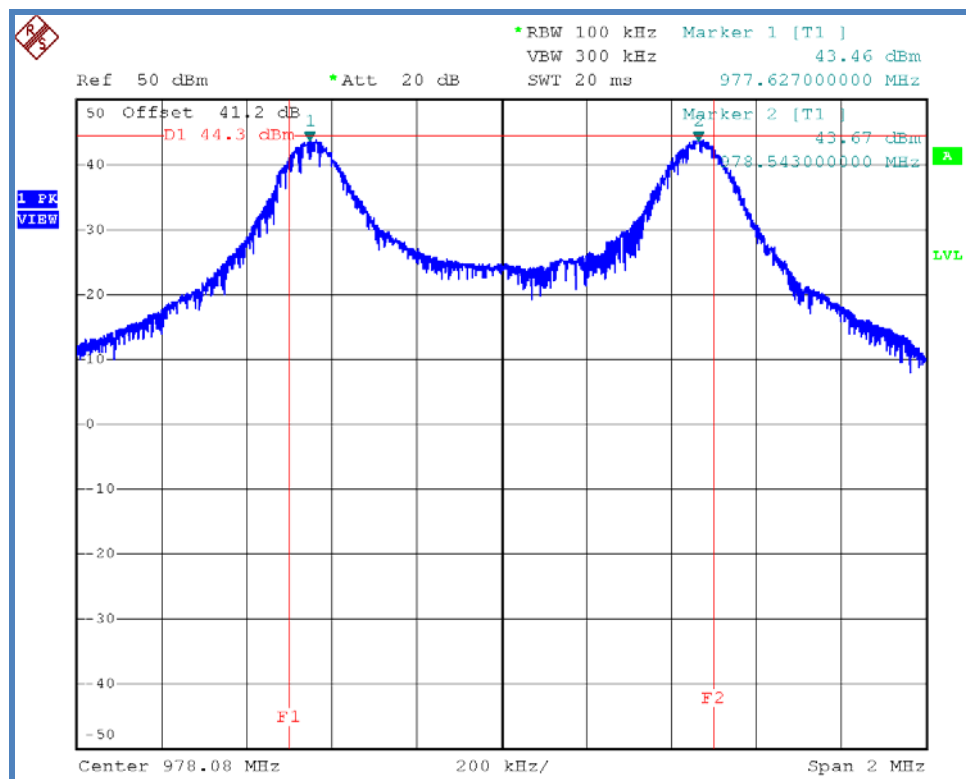
Table 4.3.2 Occupied Bandwidth Test Results, Page 2

Professional Testing, EMI, Inc.			
Test Method:		FCC Part 87.139 Specific emission limits for UAT devices.	
Section:	87.139(1)(1), (2)	EUT Serial #:	DC1112-105
Test Date(s):	3/25/2013, 3/28/2013	EUT Part #:	None
Customer:	SkyGuard TWX	Test Technician:	Eric Lifsey
Project Number:	14393-10	Supervisor	Rob McCollough
Purchase Order #:		Witness' Name:	N/A
Equipment Under Test:	978 UAT/1090 ES		

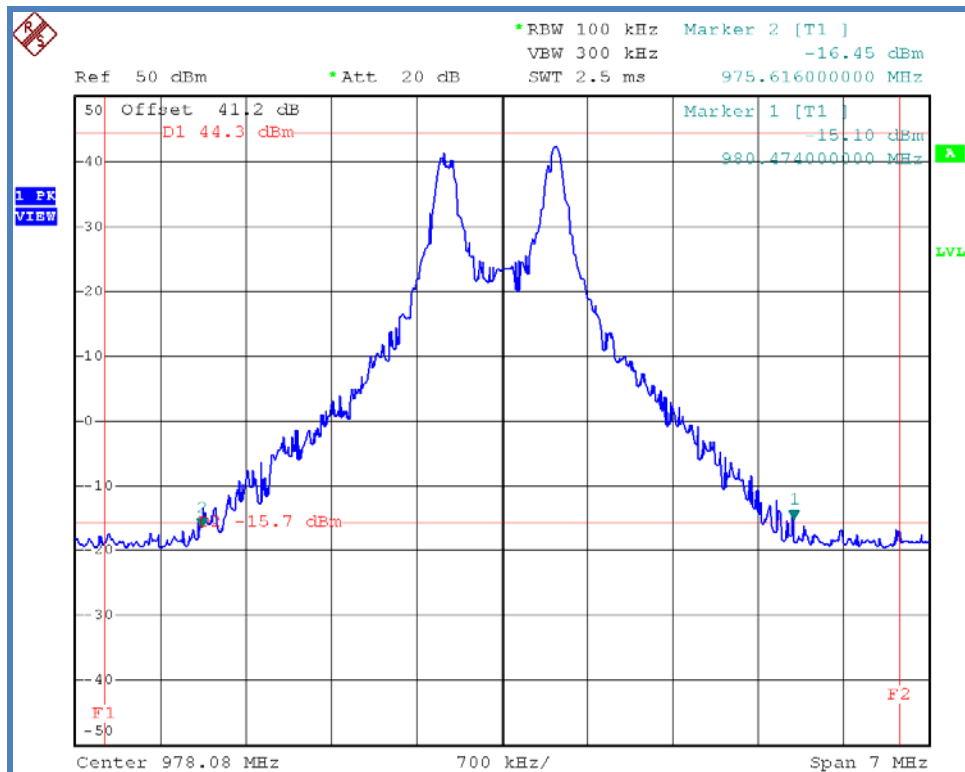
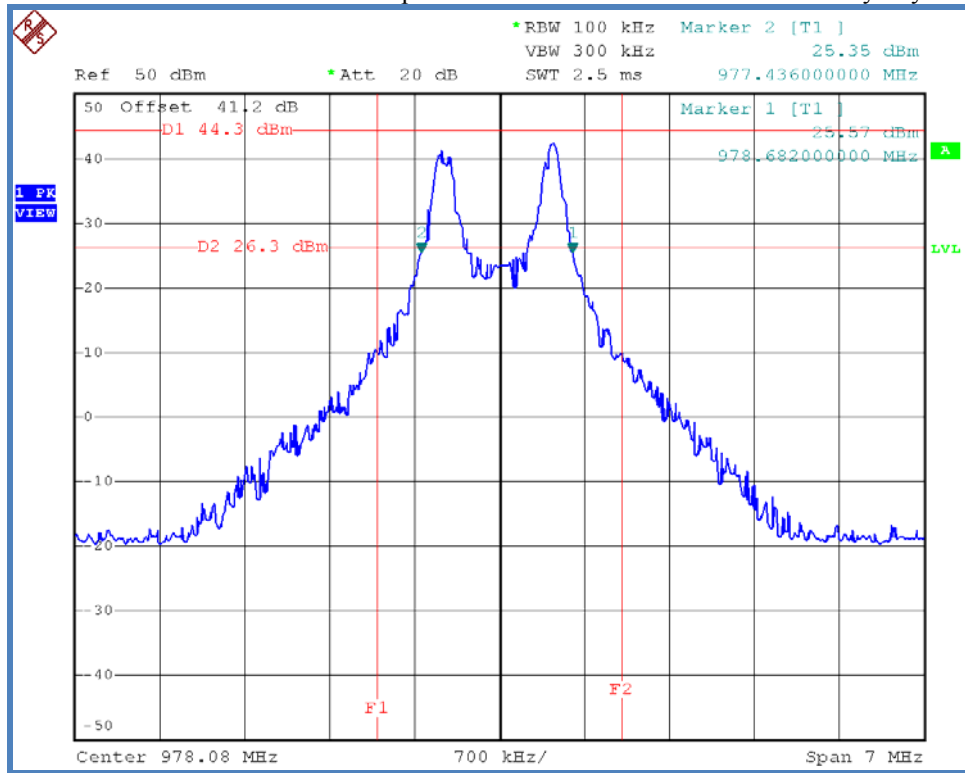
UAT Transmit Shape (Measured in 100 kHz RBW.)			Measured Crossing Point in Shape (MHz)	
Table Citation Line	Attenuation (dB)	Frequency Span (MHz)	To Lower Freq Limit	To Upper Freq Limit
1	0	+/- 0.50	0.453	0.463
2	18	+/- 1.00	0.644	0.602
3	50	+/- 2.25	1.890	1.876
4	60	+/- 3.25	2.464	2.394

*Reference transmit power 44.3 dBm.

Note - setup photos of frequency stability apply.



Wireless Certification Report for the UAT/ES ADS-B Transceiver by SkyGuardTWX, LLC



162.025 MHz

Date: 25.MAR.2013 14:18:01

Table 4.3.3 Occupied Bandwidth Equipment List

Asset #	Manufacturer	Model	Description	Serial Number	Calibration Due
Rental	Rohde & Schwarz	FSP-30	Spectrum Analyzer	1164.4391.30	12/22/2013
0983	Envirotronics	None	Environmental Chamber	None	4/7/2013
0668	AEL	H-1498	Horn Antenna	445	not required
1709	Agilent	34401A	6 1/2 Digit Multimeter	US36112547	6/7/2013
C248	Pasternack	RG58 type low loss	Coaxial Cable	none	not required
A047	Narda	757A-20	20 dB 1 W Attenuator	5082	not required
A106	Narda	768A-20	20 dB 20 W Attenuator	102338	not required
1117	HP	6296A	DC Power Supply	1552A02489	not required

4.0 Spurious Emissions at Antenna Terminals

Measurements of spurious emissions at antenna terminals were taken on the EUT to determine the compliance with 47 CFR, Part 87, Sections 87.139 and 2.1051.

4.1 Test Procedure

The output of the EUT was connected directly to an attenuator and then to the measuring receiver. The transceiver was switched on, and the measurement receiver was tuned to the frequency of the transceiver under test. If necessary, the input attenuator setting of the measuring receiver was adjusted in order to increase the sensitivity of the measuring receiver. A diagram of the test setup is given as Figure 5.1.1.



Figure 5.1.1: Spurious Emissions at Antenna Terminals Test Setup

4.2 Test Criteria

According to 47 CFR, Part 87, Section 87.139, Universal Access Transceiver transmitters with an output power of 5 Watts or more must limit their emissions by at least $43 + 10\log(P)$ dB on any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth. Those emissions shall be measured with a bandwidth of 100 kHz. (P in the above equation is the maximum transmitter power measured within the occupied bandwidth in Watts.)

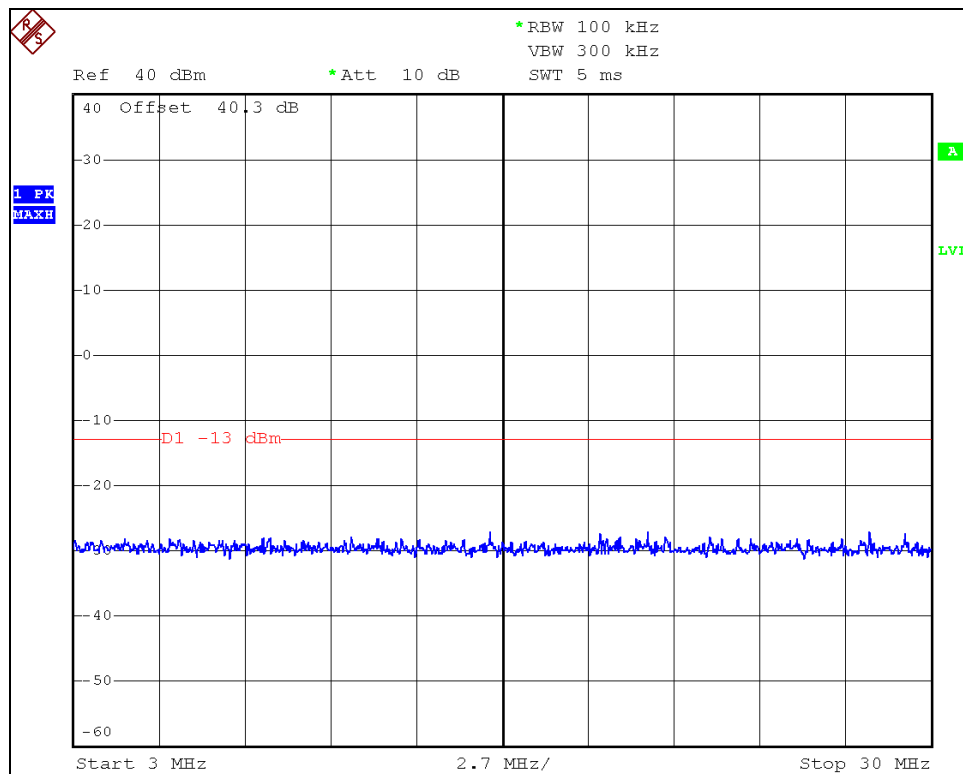
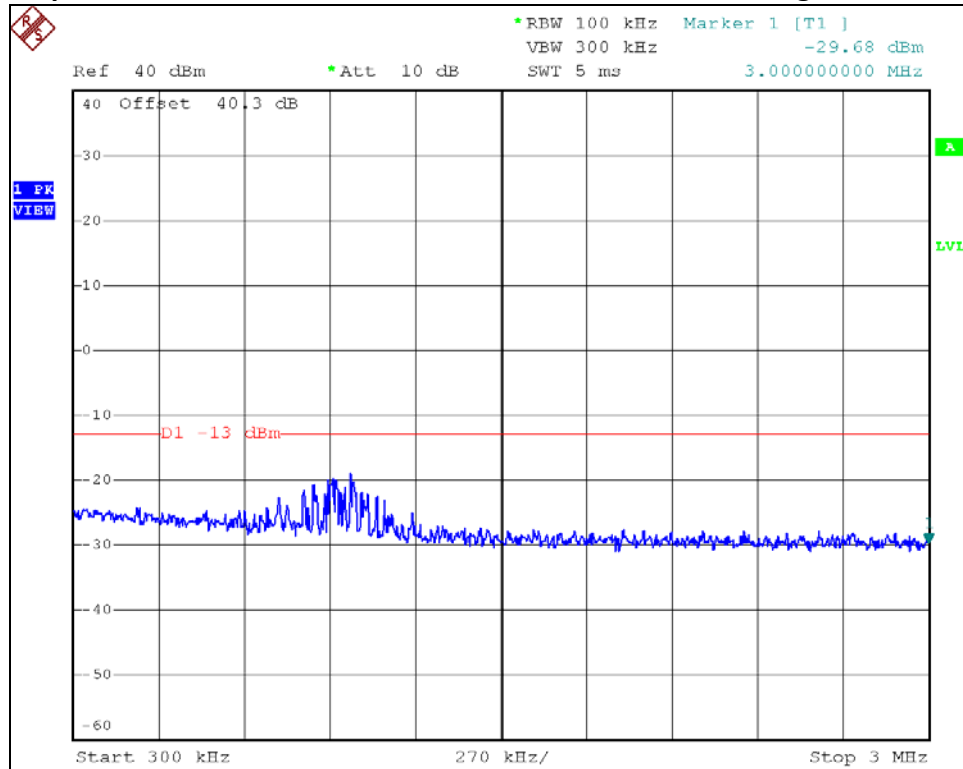
Spurious limit level was determined as follows:

Measured Maximum Transmitter Power:	$P_t = 44.24$ dBm or 26.56 Watts
Method of FCC Part 87.139 for $P_t > 5$ W:	$43 + 10 \log_{10}(P_t)$ dB
Find Required Attenuation:	$43 + 10 \log_{10}(26.56\text{W}) = 57.24$ dB
Apply Attenuation to Power:	44.24 dBm $- 57.24$ dB = -13 dBm
Spurious Limit:	-13 dBm

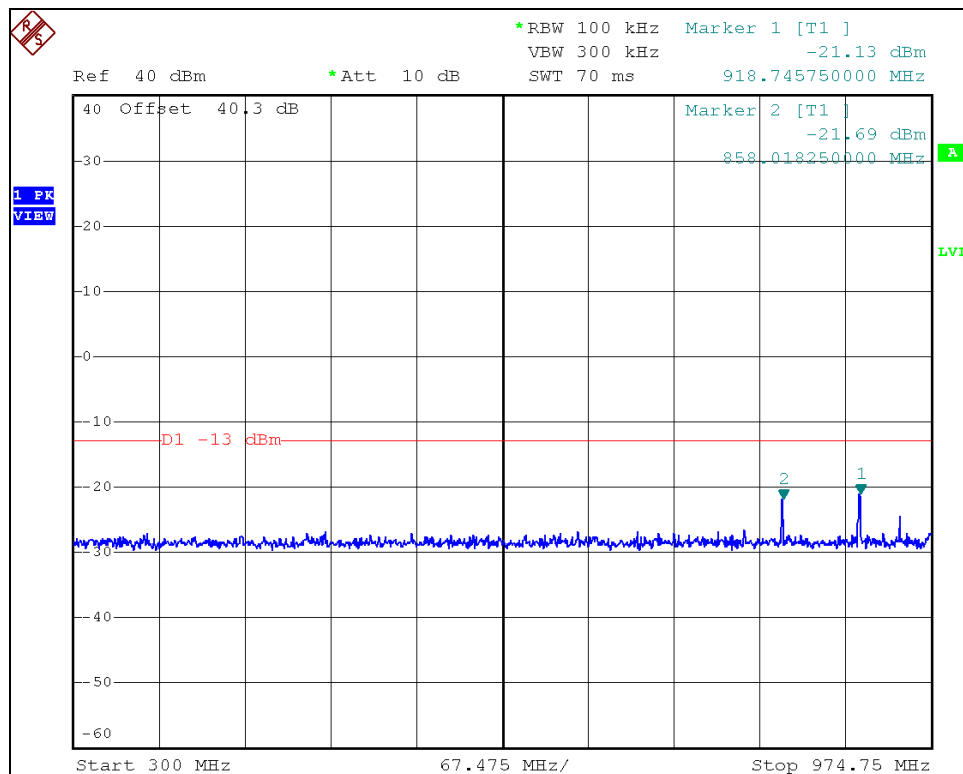
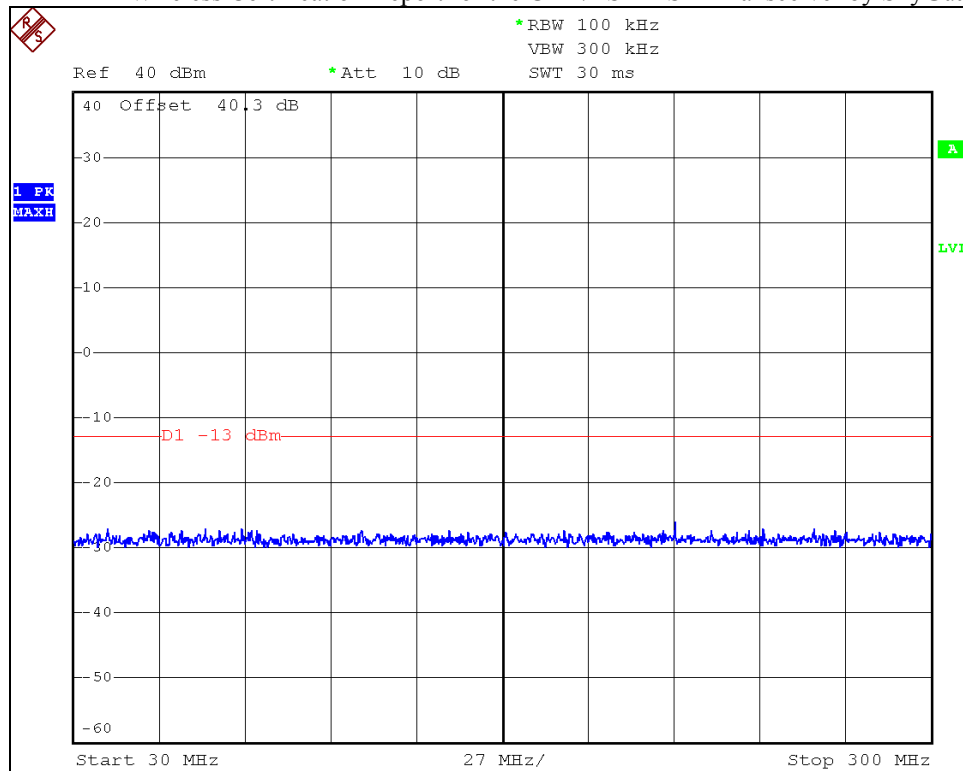
4.3 Test Results

Spurious emissions of the EUT were found to be in compliance with applicable requirements.

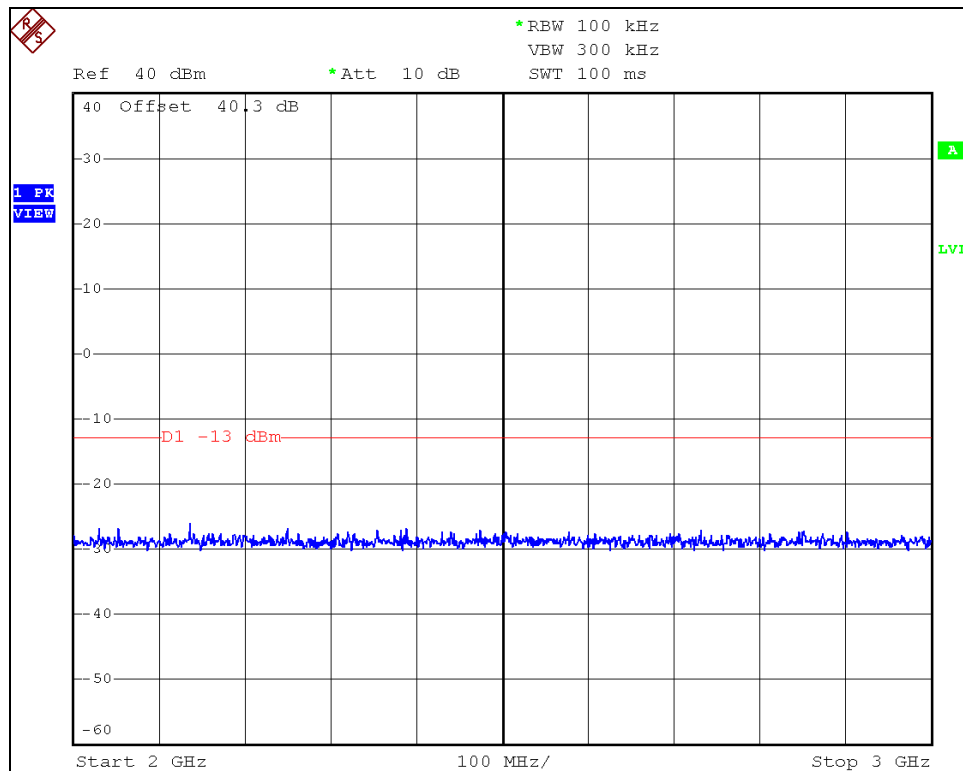
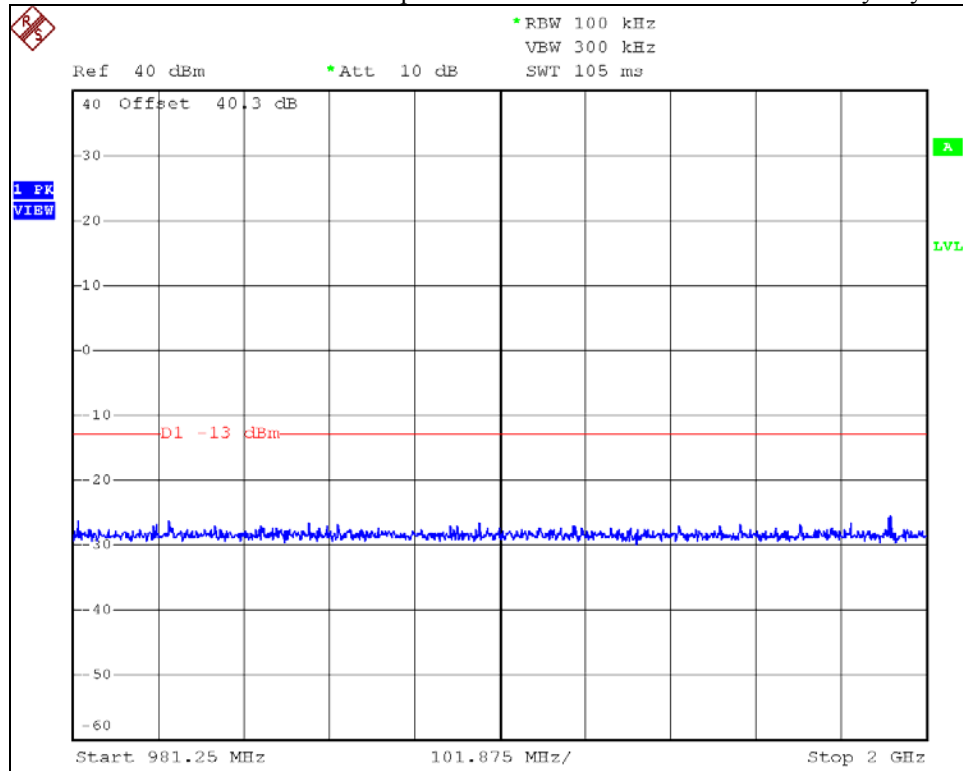
Table 5.3.1: Spurious Emissions at Antenna Terminals Test Results, Page 1



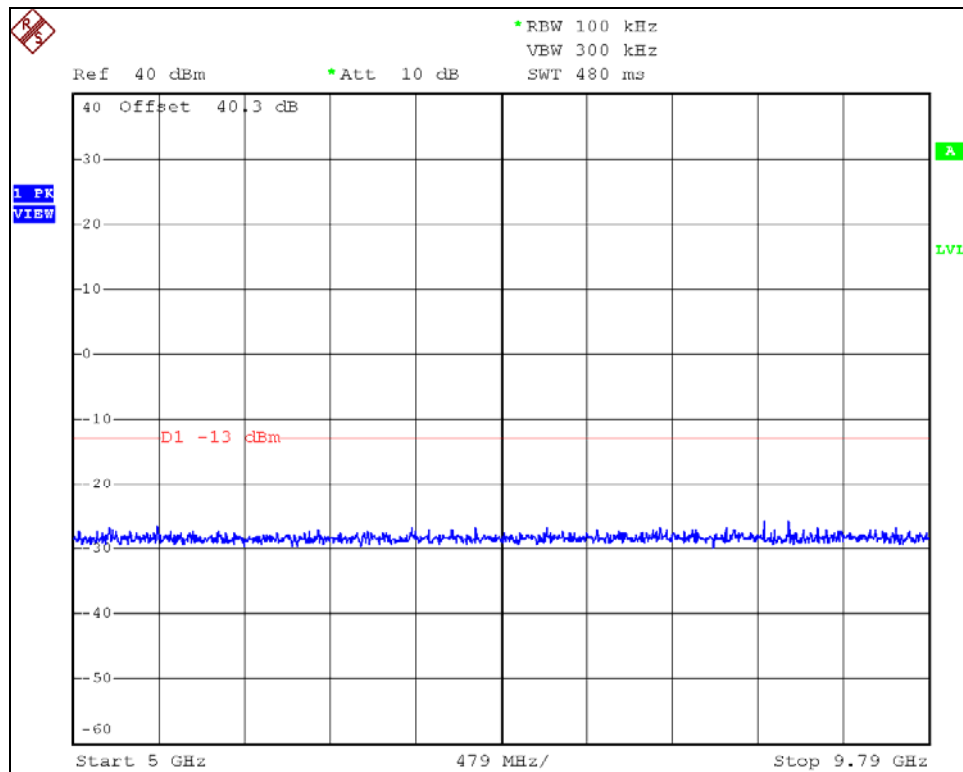
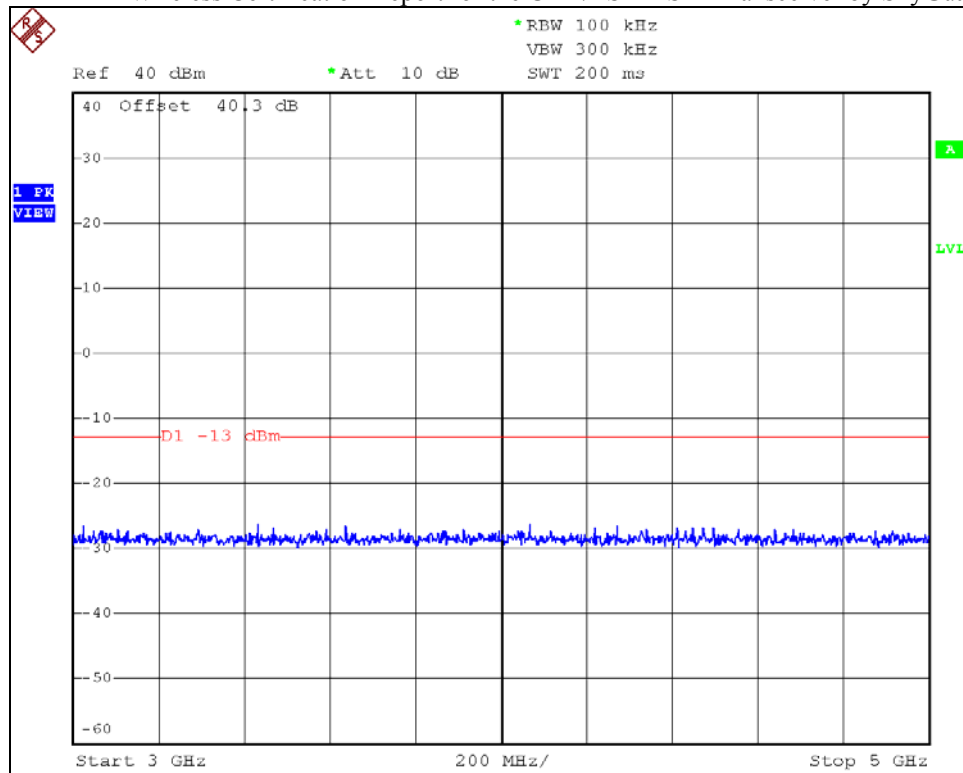
Wireless Certification Report for the UAT/ES ADS-B Transceiver by SkyGuardTWX, LLC



Wireless Certification Report for the UAT/ES ADS-B Transceiver by SkyGuardTWX, LLC



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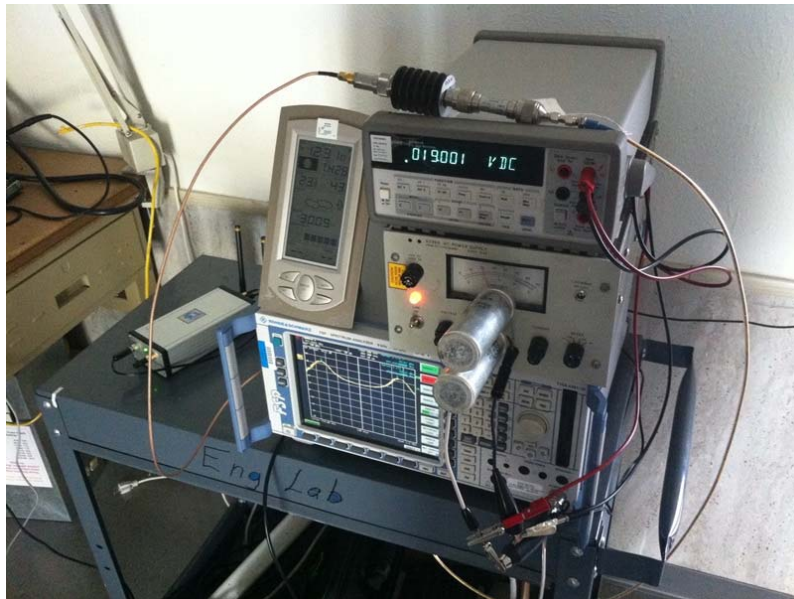


162.025 MHz

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Table 4.3.3 Spurious Emissions at Antenna Terminals Equipment List

Asset #	Manufacturer	Model	Description	Serial Number	Calibration Due
Rental	Rohde & Schwarz	FSP-30	Spectrum Analyzer	1164.4391.30	12/22/2013
1709	Agilent	34401A	6 1/2 Digit Multimeter	US36112547	6/7/2013
C248	Pasternack	RG58 type low loss	Coaxial Cable	none	not required
A047	Narda	757A-20	20 dB 1 W Attenuator	5082	not required
A106	Narda	768A-20	20 dB 20 W Attenuator	102338	not required
1117	HP	6296A	DC Power Supply	1552A02489	not required

**Spurious Emission at Antenna Terminal Setup**

5.0 Field Strength of Spurious Emissions

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 87, Sections 2.1053 and 87.139.

5.1 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 at a distance of 10 meters from the measurement antenna.

For spurious emissions below 1 GHz, peak detection was used with a resolution bandwidth of 120 kHz. All measurements below 1 GHz were normalized to 3 meters using a 20 dB/decade distance extrapolation. The emissions were maximized by rotating the EUT and raising and lowering the measurement antenna from 1 to 4 meters.

Spurious/harmonic emissions above 1 GHz peak were measured with peak detection with a resolution bandwidth of 1 MHz and measured at a distance of 1 meter. Average by duty cycle factor is applied to transmitter products (harmonics) when peaks exceed or approach the average limit. A diagram showing the test setup is given as Figure 6.1.1. Above 1 GHz, testing was completed at the transmit frequency to determine compliance.

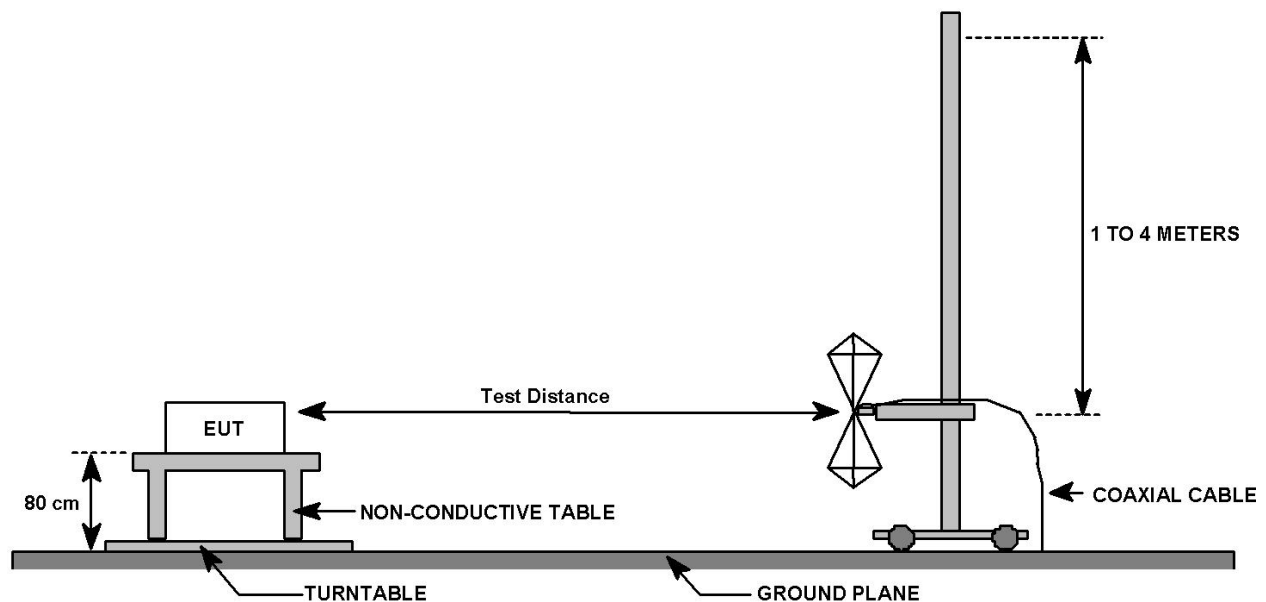


Figure 6.1.1: Field Strength of Spurious Emissions Test Setup

5.2 Test Criteria

According to 47 CFR, Part 87, Section 87.139, Universal Access Transceiver transmitters with an output power of 5 Watts or more must limit their emissions by at least $43 + 10\log(P)$ dB on any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth. Those emissions shall be measured with a bandwidth of 100 kHz. (P in the above equation is the maximum transmitter power measured within the occupied bandwidth in Watts.)

Radiated spurious limit level determined first from application of rule criteria:

Measured Maximum Transmitter Power:	$P_t = 44.24$ dBm or 26.56 Watts
Method of FCC Part 87.139 for $P_t > 5$ W:	$43 + 10 \log_{10}(P_t)$ dB
Find Required Attenuation:	$43 + 10 \log_{10}(26.56\text{W}) = 57.24$ dB
Apply Attenuation to Power:	44.24 dBm $- 57.24$ dB = -13 dBm

Using source power limit (-13 dBm) from above, calculate power P_r at distance R of 10 meters:

Method:	$P_r = P_t + G_t + G_r + 20\log_{10}\left(\frac{\lambda}{4\pi R}\right)$
Path Loss Term:	$20 \log_{10}(\lambda / 4\pi R) = 20 \log_{10}(0.30675 / 4\pi 10) = -52.25$ dB
Power at R:	-13 dBm $+ 0$ dB $+ 0$ dB $+ [-52.25$ dB] = -65.25 dBm

Convert received power P_{meas} to field strength:

Method:	$E(\text{dB}\mu\text{V} / \text{m}) = P_{meas}(\text{dBm}) - P_{gain}(\text{dB}) + 77.2\text{dB} + 20\log(f, \text{MHz}) - G_{ant}(\text{dB})$
Limit:	-65.25 dBm $- 0$ dB $+ 77.2$ dB $+ 20 \log_{10}(978 \text{ MHz}) - 0$ dB = 71.5 dB μ V/m

5.3 Test Results

Out of band radiated spurious emissions measurements were measured on January 10, 2013. High margin in excess of -20 dB was noted for all signals observed below 1 GHz, with worse case margin above 1 GHz of -8.0 dB recorded at one harmonic. Additional measurement with substitution technique was not considered necessary and the EUT was found to be in compliance with applicable requirements.

Table 6.3.1: Field Strength of Spurious Emissions Test Results, 30 MHz to 1 GHz, Horizontal Polarization

Professional Testing, EMI, Inc.									
Test Method: TIA/EIA 603C 2004: Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards									
In accordance with: 47 CFR, Part 87									
Section: 87.139 Emission Limitations									
Test Date(s):	1/10/2013	EUT Serial #:	1112-105						
Customer:	SkyGuard TWX, LLC	EUT Part #:	None						
Project Number:	14393-10	Test Technician:	Jesse Banda						
Purchase Order #:	Not Listed	Supervisor:	Rob McCollough						
Equip. Under Test:	UAT/ES ADS-B Transceiver	Witness' Name:	None						
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
375.001	10	315	2.23	Peak	47.80	38.85	71.50	-32.7	Pass
549.992	10	132	2.11	Peak	40.50	35.50	71.50	-36.0	Pass
574.99	10	320	1.56	Peak	47.50	42.92	71.50	-28.6	Pass
600	10	220	1.6	Peak	40.50	37.42	71.50	-34.1	Pass
625	10	247	1.65	Peak	39.30	36.81	71.50	-34.7	Pass
900.004	10	170	1.39	Peak	26.80	30.15	71.50	-41.4	Pass
924.99	10	128	1.09	Peak	36.50	40.03	71.50	-31.5	Pass

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

Corrected Quasi-peak

Corrected Peak Value

LIMIT_FCC_AT_71.5

Operator: Jesse Banda
14393 Rad Emissions - 71.50 limit.til
10:34:55 AM, Tuesday, April 23, 2013

EUT Power: 14VDC
Frequency

EUT: UAT, ADS-B
Project Number: 14393-10
Client: SkyGuard TWX, LLC

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 6.3.2: Field Strength of Spurious Emissions Test Results, 30 MHz to 1 GHz, Vertical Polarization

Professional Testing, EMI, Inc.									
Test Method:		TIA/EIA 603C 2004: Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards							
In accordance with:		47 CFR, Part 87							
Section:		87.139 Emission Limitations							
Test Date(s):		1/10/2013			EUT Serial #:		1112-105		
Customer:		SkyGuard TWX, LLC			EUT Part #:		None		
Project Number:		14393-10			Test Technician:		Jesse Banda		
Purchase Order #:		Not Listed			Supervisor:		Rob McCollough		
Equip. Under Test:		UAT/ES ADS-B Transceiver			Witness' Name:		None		
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
40.0979	10	73	1.16	Peak	30.60	14.73	71.50	-56.8	Pass
123.508	10	9	1.87	Peak	54.00	34.20	71.50	-37.3	Pass
374.991	10	6	1.2	Peak	44.70	35.75	71.50	-35.7	Pass
524.995	10	74	1.23	Peak	38.60	33.69	71.50	-37.8	Pass
574.996	10	113	1.18	Peak	46.60	42.08	71.50	-29.4	Pass
599.981	10	289	3.1	Peak	31.80	28.73	71.50	-42.8	Pass
624.986	10	249	2.4	Peak	37.80	35.32	71.50	-36.2	Pass
900.002	10	96	3.81	Peak	28.60	31.94	71.50	-39.6	Pass
924.975	10	68	3.78	Peak	35.80	39.33	71.50	-32.2	Pass
949.989	10	75	3.6	Peak	35.30	39.25	71.50	-32.2	Pass

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

Corrected Quasi-peak
Corrected Peak Value
LIMIT FCC AT 71.5

Operator: Jesse Banda
14393 Rad Emissions - 71.50 limit.til
10:34:55 AM, Tuesday, April 23, 2013

EUT Power: 14VDC
Frequency

EUT: UAT, ADS-B
Project Number: 14393-10
Client: SkyGuard TWX, LLC

≤ 1GHz Vertical Antenna Polarity Measured Emissions

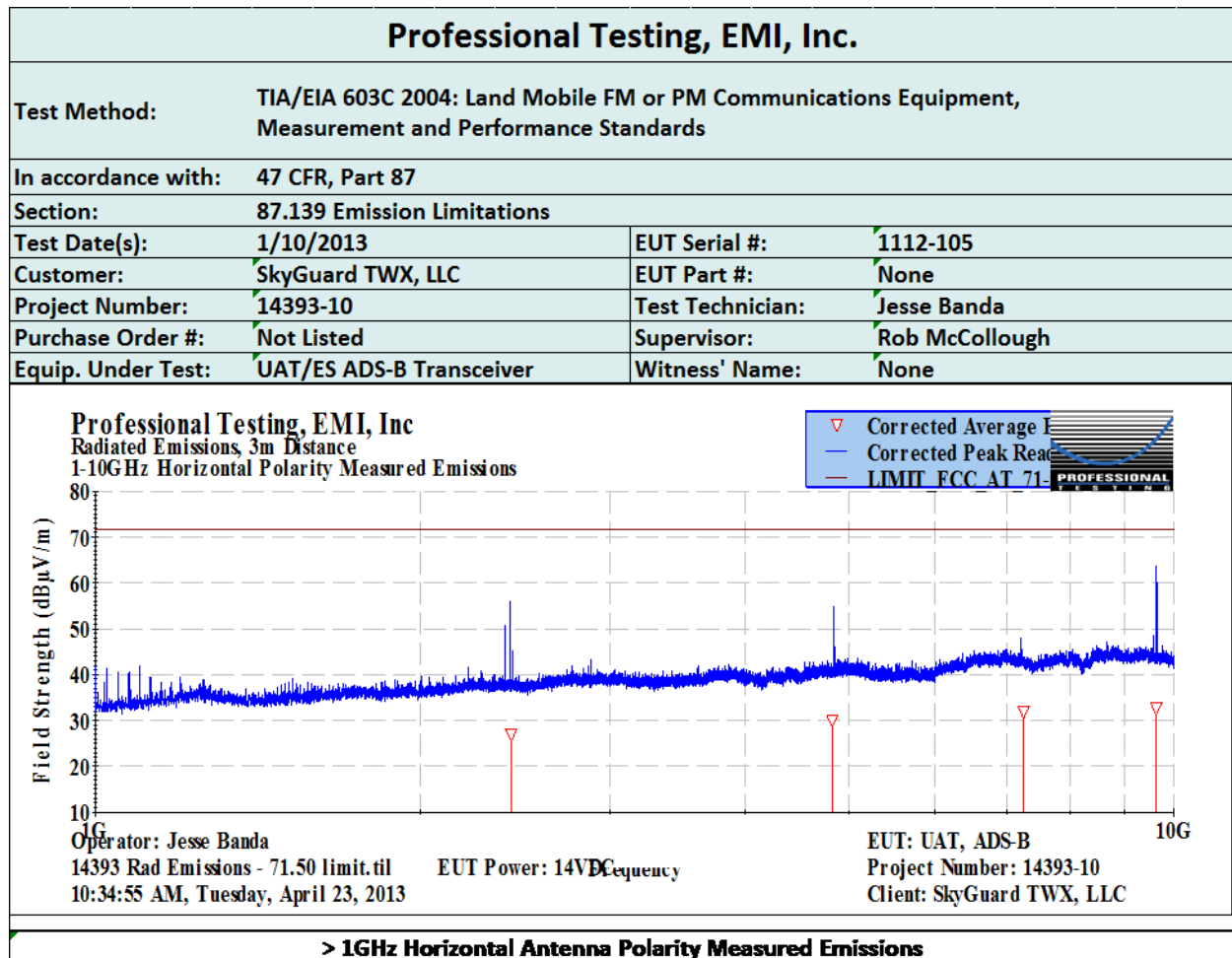
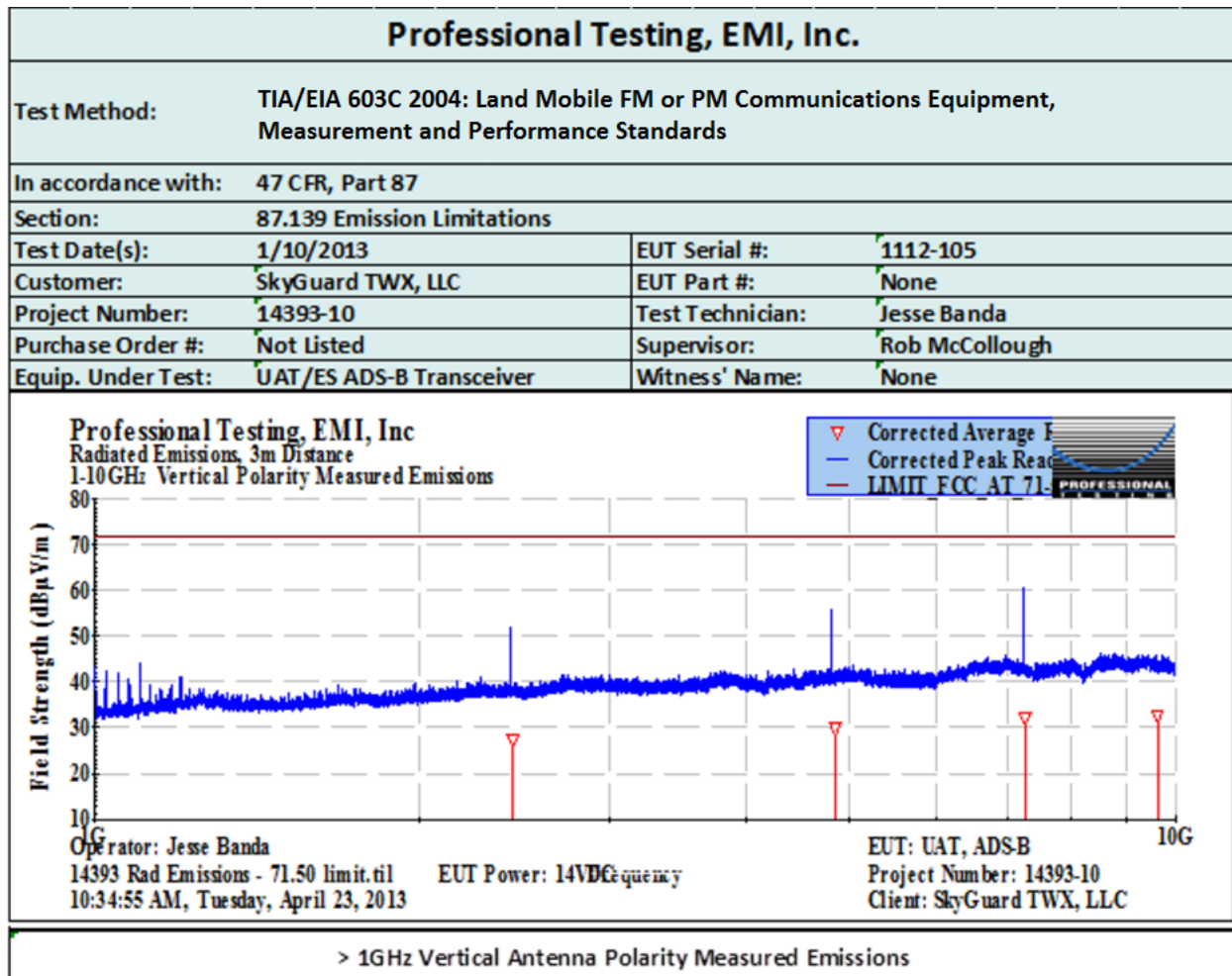
Table 6.3.3: Field Strength of Spurious Emissions Test Results, 1 to 10 GHz, Horizontal Polarization

Table 6.3.4: Field Strength of Spurious Emissions Test Results, 1 to 10 GHz, Vertical Polarization

6.0 Frequency Stability

Frequency stability measurements were performed on the EUT to determine compliance with 47 CFR, Part 87, Section 87.133, 87.147, and 2.1055.

6.1.1 Temperature Test Procedure

The temperature and operating voltage stability of the frequency-generating components of the transceiver were observed.

The transceiver was placed in a temperature chamber with a programming coil that enables a transmission to be requested from outside of the chamber. A receiving antenna inside the chamber picked up the transmittal signal, which was fed to the spectrum analyzer. With the transmitter programmed to transmit at 978 MHz, the chamber temperature was set to 20° C.

After reaching the set temperature, the transceiver was allowed to stabilize. The transmitted signal was captured by the spectrum analyzer, and the frequency was determined. The temperature in the chamber was then increased to 30° C. At each temperature, at least 20 minutes were allowed for stabilization of the transceiver, a transmission was made, and the frequency determined.

The temperature was increased in 10° C intervals to +50° C. The temperature was then returned to 20° C, stabilized, and then decreased to -30° C in 10° C intervals. The temperature was stabilized at each 10° C interval before a reading was made. The frequency at each temperature was recorded, compared to the 978 MHz tuned frequency, and recorded in Table 7.3.1. As evidenced by the data in the table, all readings were within the deviation of ± 20.0 ppm at 978 MHz. A diagram showing the test setup is given as Figure 7.1.1.

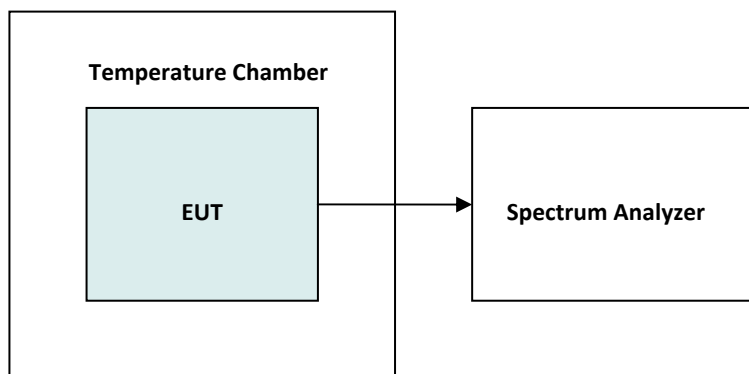


Figure 7.1.1: Frequency Stability Test Setup

6.1.2 Temperature Test Criteria

According to 47 CFR, Part 87, Section 2.1055 (a) (1), the frequency stability shall be measured with variation of ambient temperature from -30° C to +50° C, and input voltage varied $\pm 15\%$.

6.1.3 Temperature Test Results

Frequency stability measurements were taken on January 13, 2013 and March 8, 2013.

The EUT was found to be in compliance with the applicable requirements.

Table 7.3.1: Frequency Stability With Temperature

Professional Testing, EMI, Inc.				
Test Method: FCC Part 2 Frequency Stability. Application of temperatures from -30C to 50C.				
In accordance with: 47 CFR, Part 87				
Section: 87.133 Frequency Stability				
Test Date(s):	1/13/2012	EUT Serial #:	1112-105	
Customer:	SkyGuard TWX, LLC	EUT Part #:	None	
Project Number:	14393-10	Test Technician:	Jesse Banda	
Purchase Order #:	Not Listed	Supervisor:	Rob McCollough	
Equip. Under Test:	UAT/ES ADS-B Transceiver	Witness' Name:	None	
Frequency Stability Test Results Data Sheet				Page: 1 of 1

EUT Mode of Operation:			Transmitting	
Temperature (° C)	Frequency Measured (MHz)	Deviation (Hz)	Deviation (ppm)	Test Result
-30	978.000000	0	0.00	Pass
-20	978.000120	120	0.12	Pass
-10	977.999990	10	0.01	Pass
0	978.000000	0	0.00	Pass
10	978.000090	90	0.09	Pass
20	978.000000	0	0.00	Pass
30	978.000010	10	0.01	Pass
40	978.000010	10	0.01	Pass
50	978.000030	30	0.03	Pass

EUT maximum recorded frequency deviation was +0.12 ppm. The maximum allowed deviation is +/- 20.0 ppm. The EUT satisfies the requirement.

6.1.4 Operating Voltage Test Procedure

EUT is placed into operation at limits of operating voltage and transmit frequency is measured and compared to the nominal starting voltage. The EUT operated with modulation, so the modulation peaks were measured for frequency and the center frequency calculated.

6.1.5 Operating Voltage Test Criteria

For Radionavigation stations in the frequency range of 960 to 1215 MHz, FCC rule clause 87.133, table of frequency bands and tolerance, calls for 20 ppm frequency stability.

6.1.6 Operating Voltage Test Results

This device uses an internal DC-DC converter to regulate input power. It is specified to operate over a voltage range from 6 to 32 VDC to allow operation on two common power systems in aircraft; 12 and 24 VDC. The converter supplies a regulated 12 VDC to the radio and control circuits inside. These voltages were selected for the test levels.

Maximum deviation from nominal was observed as -9.3038 ppm which satisfies the rule requirements.

Table 7.1.6.1: Frequency Stability With Operating Voltage

Professional Testing, EMI, Inc.			
Test Method: FCC Part 2 Frequency Stability. Application of operating voltage limits of +/- 15%.			
Section:	2.1055(a)(2), 2.1055(d)(1)	Ambient Temperature:	23.8 C
Test Date(s):	3/28/2013	EUT Serial #:	DC1112-105
Customer:	SkyGuard TWX	EUT Part #:	None
Project Number:	14393-10	Test Technician:	Eric Lifsey
Purchase Order #:		Supervisor	Rob McCollough
Equipment Under Test:	978 UAT/1090 ES	Witness' Name:	N/A

Conditions	Frequency					
Operating Voltage* (V)	Reference Frequency (MHz)	Lower Measured Frequency (MHz)	Upper Measured Frequency (MHz)	Calculated Center Frequency (MHz)	Deviation From Reference Frequency (MHz)	Deviation From Reference Frequency (ppm)
6	978.090075	977.613625	978.555800	978.084713	-0.0054	-5.4826
19	978.090075	977.626625	978.553525	978.090075	0.0000	0.0000
32	978.090075	977.614925	978.547025	978.080975	-0.0091	-9.3038

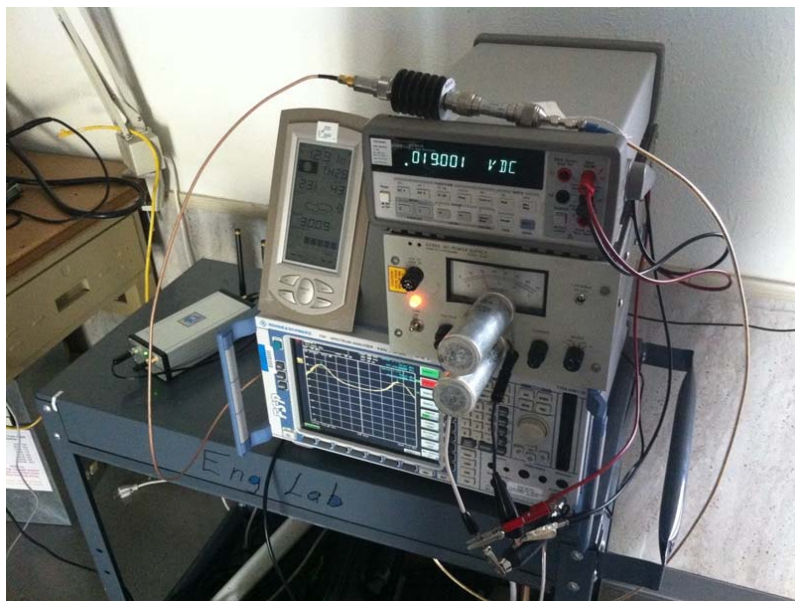
*EUT is rated to operate from 6 to 32 VDC continuously; 19 VDC was selected as mid-point.

EUT maximum recorded frequency deviation was -9.3038 ppm. The maximum allowed deviation is +/- 20.0 ppm. The EUT satisfies the requirement.

Table 7.1.6.2: Frequency Stability With Operating Voltage, Equipment List

Asset #	Manufacturer	Model	Description	Serial Number	Calibration Due
Rental	Rohde & Schwarz	FSP-30	Spectrum Analyzer	1164.4391.30	1/29/2015
0983	Envirotronics	None	Environmental Chamber	None	4/7/2013
0668	AEL	H-1498	Horn Antenna	445	not required
1709	Agilent	34401A	6 1/2 Digit Multimeter	US36112547	6/7/2013
C248	Pasternack	RG58 type low loss	Coaxial Cable	none	not required
A047	Narda	757A-20	20 dB 1 W Attenuator	5082	not required
A106	Narda	768A-20	20 dB 20 W Attenuator	102338	2/15/2014
1117	HP	6296A	DC Power Supply	1552A02489	not required

Note that the spectrum analyzer listed above was employed for the timing measurements of section 3.3.



Frequency Stability with Operating Voltage Setup

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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