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FCC PART 87 TEST REPORT

APPLICANT	SANDIA AEROSPACE CORPORATION
	SANDIA AEROSPACE CORPORATION
	3700 OSUNA RD NE, SUITE 711
	ALBUQUERQUE NEW MEXICO 87109 USA
FCC ID	YJL-DAGEDX
MODEL NUMBER	STX 360
PRODUCT DESCRIPTION	AVIATION TRANSPONDER
DATE SAMPLE RECEIVED	1/3/2017
FINAL TEST DATE	3/01/2017
TESTED BY	Cory Leverett
APPROVED BY	Tim Royer

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**

Report Number	Version Number	Description	Issue Date
9AUT17TestReport	Rev1	Initial Issue	3/1/2017
	Rev2	Added Frequency Stability statement to test data – see Test Report addendum	3/2/2017
	Rev3	Revised 140M1D specs page 7	4/03/2017
	Rev4		4/04/2017



TESTING CERT # 0955-001

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669



TESTING CERT # 0955-001



Tested by:

Name and Title: Cory Leverett, Project Manager/Testing Technician

Date: 4/ 03/ 2017



Reviewed and approved by:

Name and Title: Tim Royer, Project Manager

Date: 4/ 03/ 2017

Applicant: SANDIA AEROSPACE CORPORATION
FCC ID: YJL-DAGEDX
Report: 9AUT17TestReport_Rev4

GENERAL INFORMATION

EUT Description	AVIATION TRANSPONDER
FCC ID	YJL-DAGEDX
Model Number	STX 360
Operating Frequency	978 & 1090MHz
Test Frequencies	978 & 1090MHz
Emission Designator	1M30F1D, 14M0M1D
Type of Emission	1M30F1D: Universal Avionics Transciever 14M0M1D: ATCRBS Mode A/C Transponder
Modulation	1M30F1D: 2FSK 14M0M1D: Pulse
EUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz
	<input checked="" type="checkbox"/> DC Power 11-32 VDC
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input type="checkbox"/> Production
Type of Equipment	<input type="checkbox"/> Fixed
	<input checked="" type="checkbox"/> Mobile
	<input type="checkbox"/> Portable
Test Conditions	The temperature was 26°C with a relative humidity of 50%. Atmospheric Pressure: 30.01"
Revision History to the EUT	None
Test Exercise	The EUT was placed in continuous transmit mode.
Applicable Standards	ANSI/ TIA 603-D:2010 , FCC CFR 47 Part 2, 87 RTCA DO-181E, RTCA DO 282B
Test Facility	Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA.

RESULTS SUMMARY

FCC Rule Part	Requirement	Result
2.201, 87.137	Emission Types	Pass
2.1047, 87.141	Modulation Characteristics	Pass
2.1046, 87.131	RF Power Output	Pass
2.1049, 87.135, 87.139	Occupied Bandwidth	Pass
2.1051, 87.139	Spurious Emissions at Antenna Terminals	Pass
2.1053, 87.139	Field Strength of Spurious Emissions	Pass
2.1055, 87.133	* Frequency Stability	Pass

* The results for this test are issued in a separate test report addendum

EMISSION TYPES

Rule Part No.: Part 2.201, Part 87.137

Requirements: The assignable emissions, corresponding emission designators and authorized bandwidths are as listed in the rule part 87.137(a)

Test Data: 1M30F1D

Universal access transceiver

The emission designator is defined in the referenced aviation standards, and defined in part 87.137(a) is 1M30F1D

Test Data: 14M0M1D Description

Mode A/C, avionics transponder

The emission designator is defined in the referenced aviation standards, and defined in part 87.137(a) is 14M0M1D

MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1047, Part 87.141,

Requirements: A curve or equivalent data shall be submitted

The EUT complies with the following characteristics which are defined in the aviation standards and regulations referenced above in this report. The requirements of 47CFR 2.1047 and applicable paragraphs of Part 87.141 are met. There are no deviations to the specifications.

Test Data: 1M30F1D Specifications

The nominal modulation rate is 1.041667 megabits per second. The data is modulated onto the carrier using binary Continuous Phase Frequency Shift Keying with a modulation index of 0.6. A binary 1 is indicated by a shift up in frequency from the nominal carrier frequency of $\Delta f/2$ 312.5 by a shift of $-\Delta f/2$ (-312.5 kHz). These frequency deviations apply at the optimum sampling points for the bit interval.

Test Data: 14M0M1D Specifications

Pulse Type	Specification	Data	Unit
Mode-A/C	Rise Time (10%/90%)	0.1	us
Mode-A/C	Fall Time (90%/10%)	0.2	us
Mode-A/C	Pulse Width	0.45 ± 0.1	us
Mode-A/C	Pulse spacing	1.45 ± 0.1	us

Results meet requirements

RF POWER OUTPUT

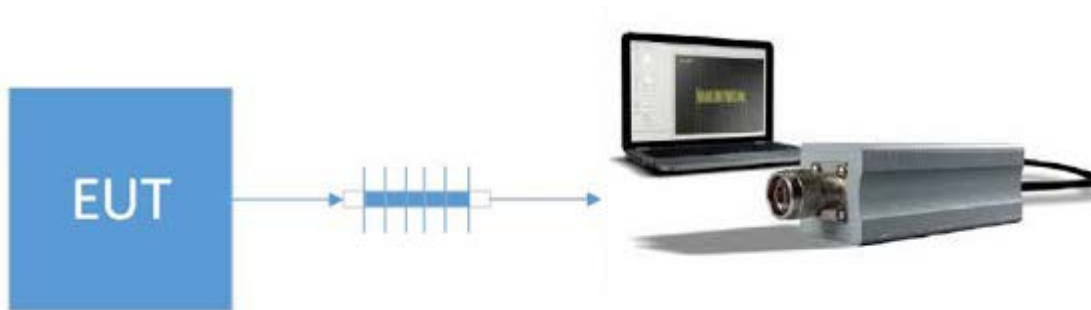
Rule Part No.: Part 2.1046, Part 87.131

Requirements: Manufacturers Specifications

Procedure: RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage and the transmitter properly adjusted the RF output measures:

For the Device has a fixed antenna, RF power is measured as ERP as the antenna is permanently attached. The substitution method was used. With a nominal battery voltage and the transmitter properly adjusted the RF output measures:

Setup Diagram :

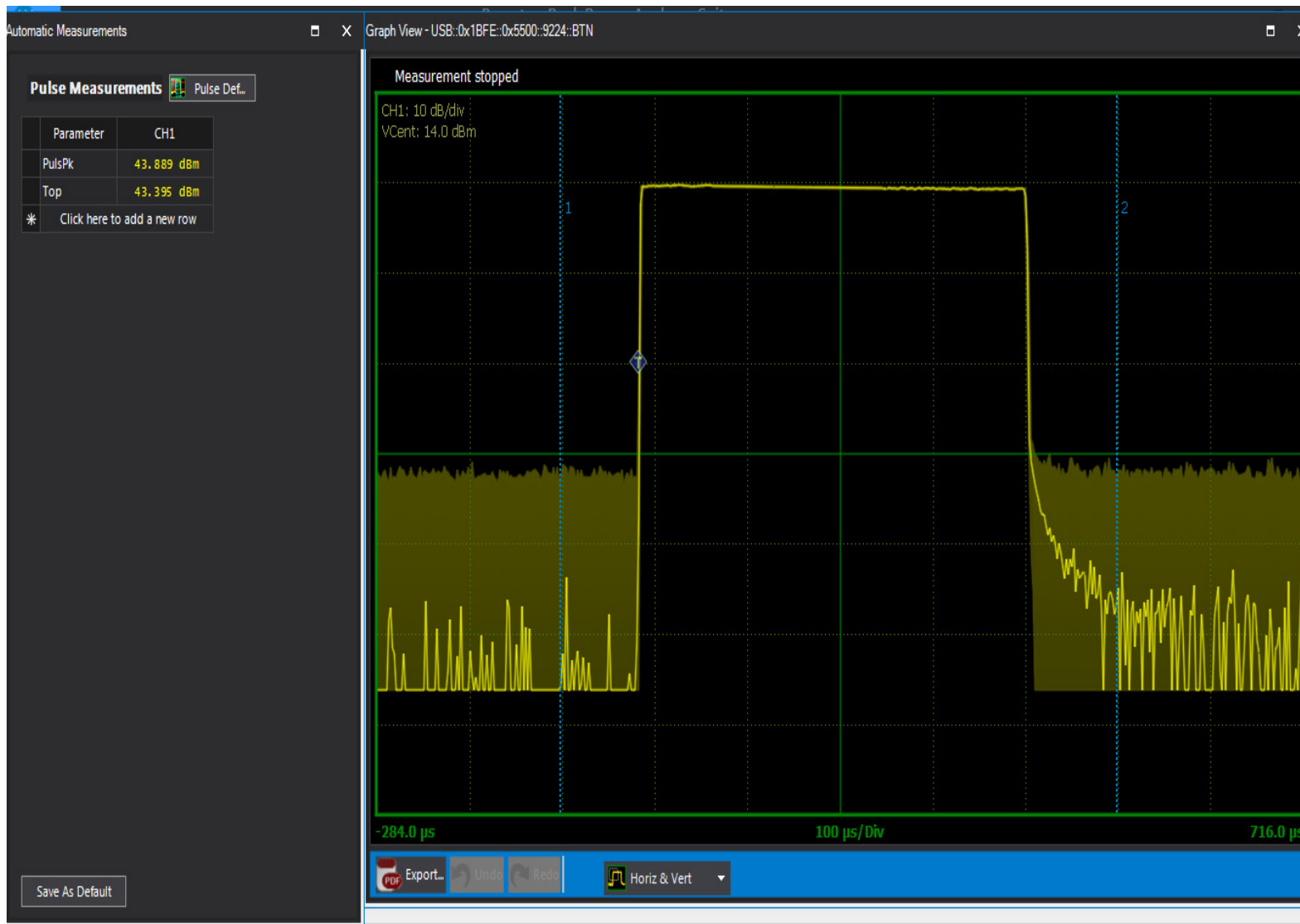


Test Data: Peak Measurement Table

Tuned Freq (MHz)	Pconducted (dBm)	Pconducted (W)
1090	53.02	200.3
978	43.89	24.5

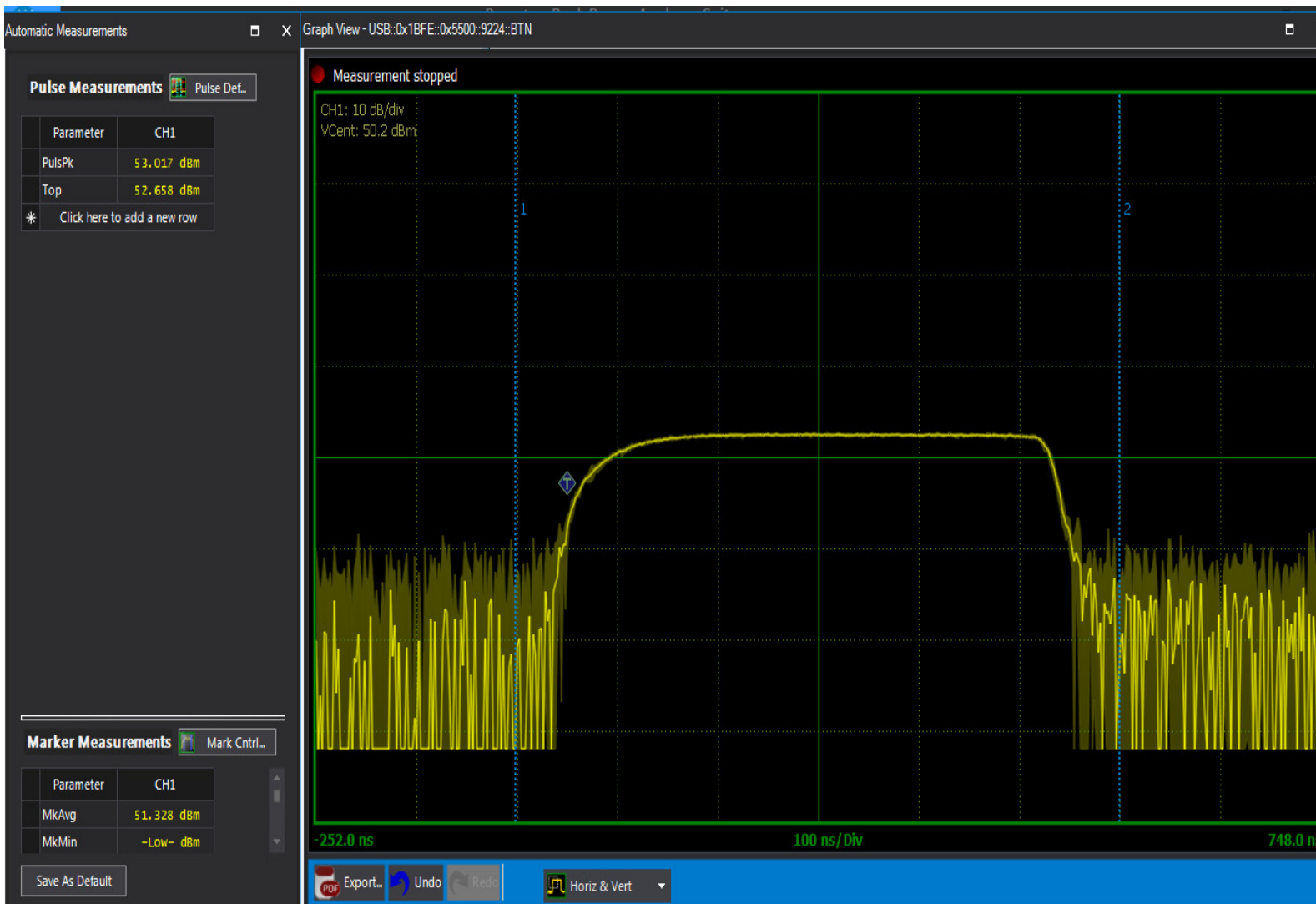
RF OUTPUT POWER

Test Data: 1M30F1D Plot



RF OUTPUT POWER

Test Data: 14M0M1D Plot



OCCUPIED BANDWIDTH

Rule Part No.: 2.1049, 87.135, 87.135, 87.139

Test Requirements: see below

1M30F1D:

For Universal Access Transceiver transmitters, the average emissions measured in a 100 kHz bandwidth must be attenuated below the maximum emission level contained within the authorized bandwidth by at least:

Frequency (MHz)	Attenuation (dB)
±0.5	0
±1.0	18
±2.25	50
±3.25	60

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 average transmitter power measured within the occupied bandwidth in Watts

14M0M1D:

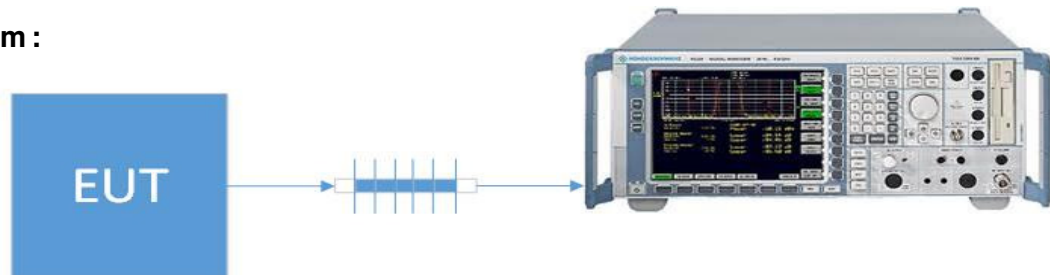
(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10} pY$ dB.

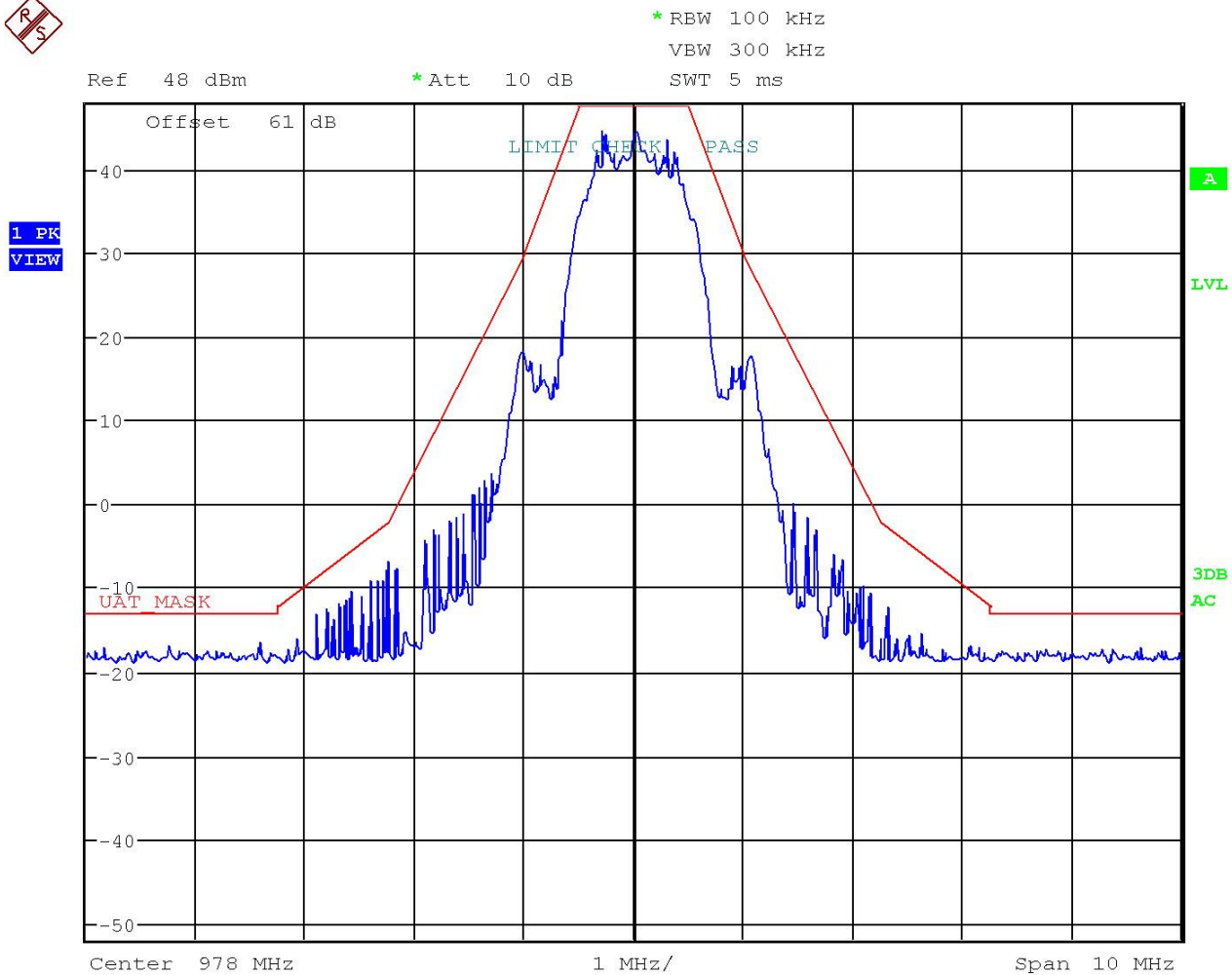
Method of Measurement: as referenced above

Test Setup Diagram:



OCCUPIED BANDWIDTH

Test Data: 1M30F1D Emission Mask Plot



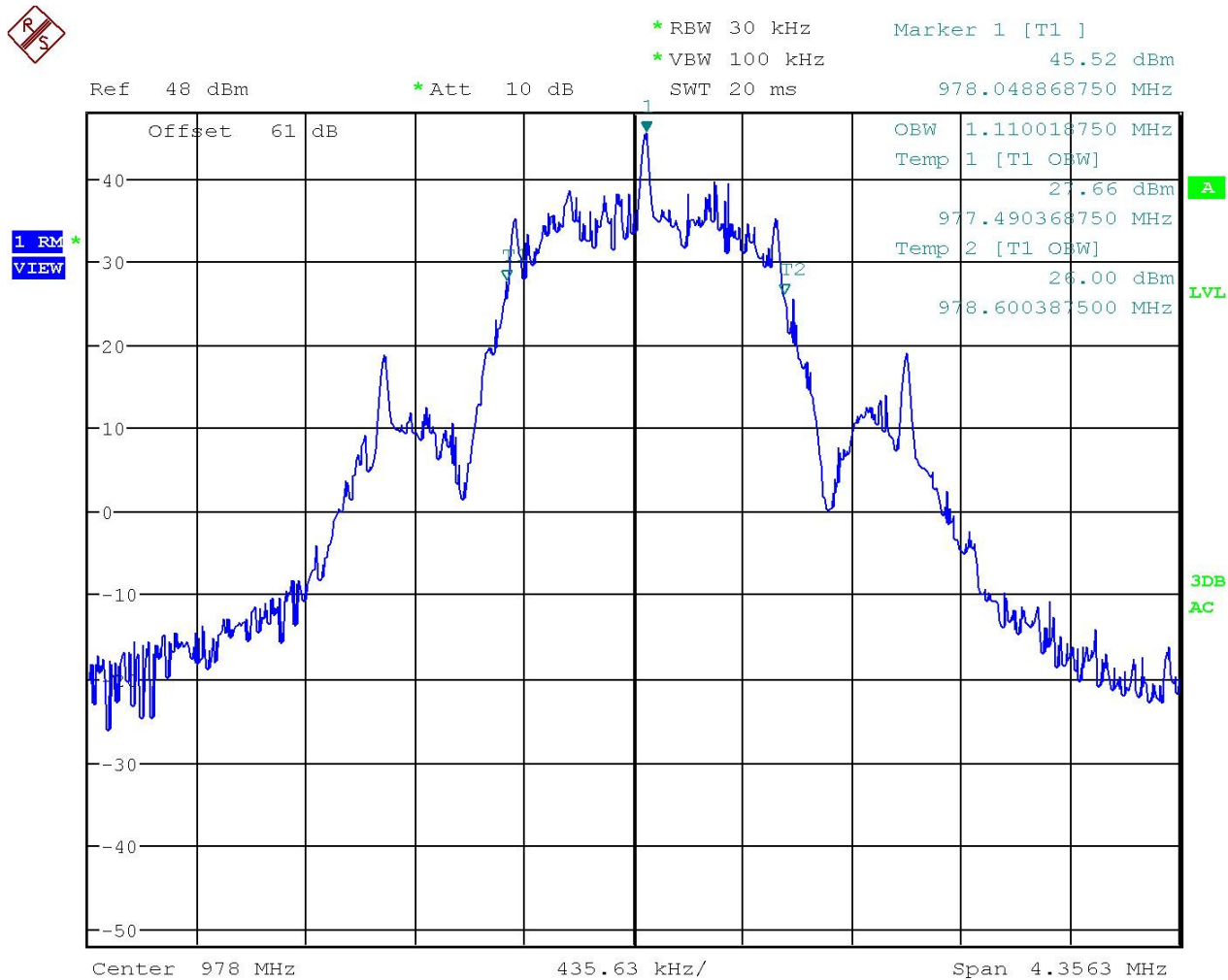
Date: 1.MAR.2017 10:12:01

Results meet requirements

Applicant: SANDIA AEROSPACE CORPORATION
 FCC ID: YJL-DAGEDX
 Report: 9AUT17TestReport_Rev4

OCCUPIED BANDWIDTH

Test Data: 1M30F1D 99% OBW Plot

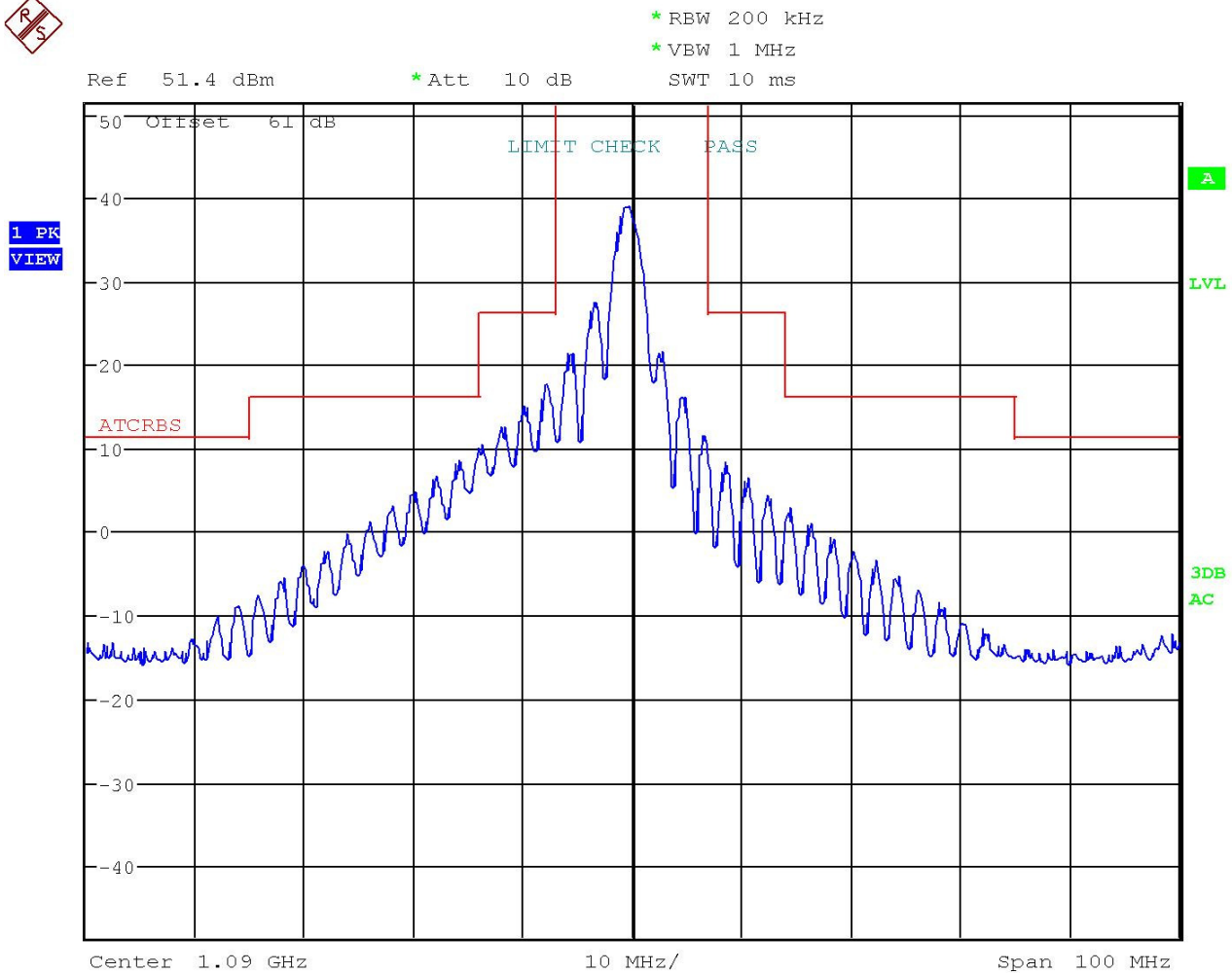


Date: 1.MAR.2017 11:47:29

Results meet requirements

OCCUPIED BANDWIDTH

Test Data: 14M0M1D Emission Mask Plot



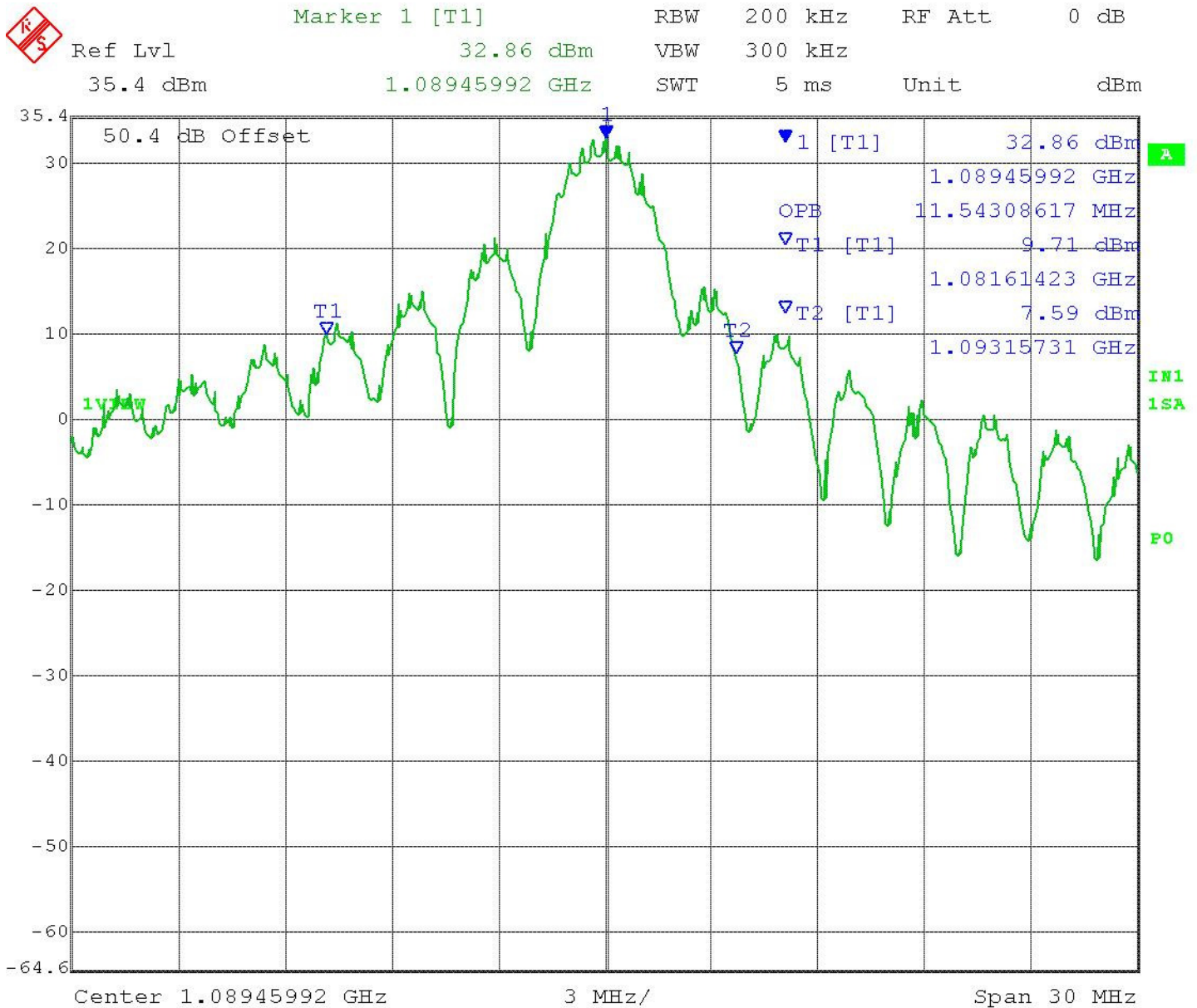
Date: 1.MAR.2017 11:06:32

Results meet requirements

Applicant: SANDIA AEROSPACE CORPORATION
FCC ID: YJL-DAGEDX
Report: 9AUT17TestReport_Rev4

OCCUPIED BANDWIDTH

Test Data: 14M0M1D 99% OBW Plot



Date: 17.FEB.2017 14:13:09

Results meet requirements

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051, 87.139

Requirements: see below

1M30F1D:

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 average transmitter power measured within the occupied bandwidth in Watts

14M0M1D:

When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10} pY$ dB.

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

Test Data: 1M30F1D Measurement Table

	dBm	Watts	Limit dBc
Power Output	43.89	24.49	56.89
	Frequency MHz	Level dBc	Margin dB
	978.00	44	0.0
	1956.00	80.7	16.8
	2934.00	85.1	21.2
	3912.00	82.6	18.7
	4890.00	82.6	18.7
	5868.00	77.8	13.9
	6846.00	76.6	12.7
	7824.00	82.6	18.7
	8802.00	82.6	18.7
	9780.00	82.6	18.7

* Indicates only the noise floor was present

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED) (continued)

Test Data: 14M0M1D Measurement Table

	dBm	Watts	Limit dBc
Power Output	53.02	200.45	66.02
	Frequency MHz	Level dBc	Margin dB
	1090.00	53	0.0
	2180.00	99.3	26.3
	3270.00	102.8	29.8
	4360.00	105.3	32.3
	5450.00	99.3	26.3
	6540.00	96.8	23.8
	7630.00	100.9	27.9
	8720.00	102.5	29.5
	9810.00	102.8	29.8
	10900.00	102.8	29.8

* Indicates only the noise floor was present

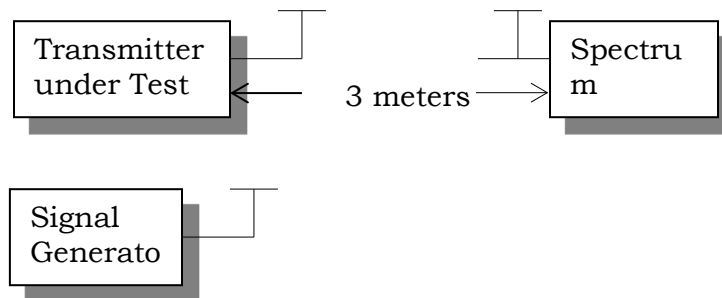
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: Part 2.1053

Test Requirements: The FCC limits for radiated emissions are the same as previously stated for the conducted emissions.

Method of Measurements: The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method.

Test Setup Diagram:



Test Data: 1M30F1D Measurement Table

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
978.00	93.90	H	-127.85	121.31
978.00	147.91	V	-125.15	118.61
978.00	717.12	H	-119.22	112.68
978.00	672.00	V	-119.10	112.56
978.00	1956.00	H	-96.06	89.52
978.00	1956.00	V	-96.41	89.87
978.00	2934.00	H	-106.86	100.32
978.00	2934.00	V	-105.32	98.78
978.00	3912.00	V	-101.37	94.83
978.00	3912.00	H	-92.03	85.49
978.00	4890.00	H	-115.49	108.95
978.00	4890.00	V	-114.70	108.16
978.00	5868.00	V	-114.34	107.80
978.00	5868.00	H	-114.34	107.80
978.00	6846.00	H	-113.53	106.99
978.00	6846.00	V	-114.22	107.68
978.00	7824.00	V	-112.58	106.04
978.00	7824.00	H	-113.51	106.97
978.00	8802.00	H	-114.87	108.33
978.00	8802.00	V	-114.60	108.06
978.00	9780.00	V	-114.35	107.81
978.00	9780.00	H	-113.65	107.11

Field strength of Spurious Emissions (continued)

Test Data: 14M0M1D Measurement Table

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	ERP (dBm)	Margin (dB)
1090.00	2180.00	V	-100.90	93.50
1090.00	3270.00	V	-113.41	106.01
1090.00	4360.00	V	-131.65	124.25
1090.00	5450.00	V	-131.65	124.25
1090.00	6540.00	V	-131.65	124.25
1090.00	7630.00	V	-127.03	119.63
1090.00	8720.00	V	-130.36	122.96
1090.00	10900.00	H	-127.91	120.51
1090.00	174.97	H	-122.98	115.58
1090.00	174.97	V	-122.68	115.28
1090.00	435.52	V	-119.37	111.97
1090.00	305.60	H	-119.03	111.63

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
24 Volt Power Supply	Astron	VLS-25M	9510040	NA	NA
Antenna: Biconical 1096 Chamber	Eaton	94455-1	1096	07/14/15	07/14/17
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/14/15	07/14/17
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
Digital Multimeter	Fluke	77	35053830	10/21/15	10/21/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	02/25/15	05/25/17
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/16/16	08/16/18
Software: Field Strength Program	Timco	N/A	Version 4.0	NA	NA
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
Coaxial Cable - NMNM-0300-00 Yellow	Insulated Wire Inc.		NMNM-0300-00	08/05/15	08/05/17
USB Peak Power Sensor 50 MHz to 18 GHz	Boonton	55318	9224	09/13/16	09/13/18
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Attenuator N 30dB 500W DC-2.5G	Bird	8325	1761	05/18/15	05/18/17
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	NA	NA
Attenuator N 30dB 20W DC-4G	CLASS III	34078	M3933/10-5	05/19/15	05/19/17
Pre-amp	RF-LAMBDA	RLNA00M4 5GA	NA	01/04/16	01/04/18
High Pass Filter 980MHz	Microlab	HA-20N	NA	06/17/15	06/17/17

* EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

MEASUREMENT UNCERTAINTY

State of the measurement uncertainty

TIA 603-D June 2010

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16-4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: “Uncertainty in EMC Measurements” and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	EN 300 Limits	Notes
RF Frequency	$\pm 69.5 \text{ Hz}$	$\pm 1 \times 10^{-7}$	(1)
RF Conducted Power	$\pm 0.93 \text{ dB}$	$\pm 0.750 \text{ dB}$	(1)
Conducted spurious emission of transmitter valid up to 40GHz	$\pm 2.36 \text{ dB}$	$\pm 4.0 \text{ dB}$	
Radiated RF Power	$\pm 1.4 \text{ dB}$	$\pm 6.0 \text{ dB}$	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	$\pm 1.88\%$ $\pm 2.04\%$	$\pm 5.0\%$ $\pm 3.0 \text{ dB}$	
Deviation Limitation	$\pm 1.29\%$	$\pm 5.0\%$	
Adjacent channel power	$\pm 1.47 \text{ dB}$	$\pm 5.0 \text{ dB}$	(1)
Radiated emission of transmitter valid up to 18GHz	$\pm 3.96 \text{ dB}$	$\pm 6.0 \text{ dB}$	
Temperature	$\pm 1.0^\circ \text{C}$	$\pm 1.0^\circ \text{C}$	(1)
Humidity	$\pm 5.0\%$	$\pm 10.0\%$	
Valid up to 1 GHz for the RF parameters unless otherwise stated			

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 1.96$.