



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

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August 15, 2017

Elecraft
125 Westridge Dr.
Watsonville, CA 95076

Dear Bob Wolbert,

Enclosed is the EMC test report for compliance testing of the Elecraft, KPA1500, tested to the requirements of FCC Part 97.307 (d) and (e).

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\Elecraft\EMCS94106-FCC 97 Rev. 2)



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**Electromagnetic Compatibility
Test Report**

for the

**Elecraft
KPA1500**

Tested under

FCC Part 97. 307 (d) and (e)

**MET Report: EMCS94106-FCC 97 Rev. 2
August 15, 2017**

**Prepared for:
Elecraft
125 Westridge Dr.
Watsonville, CA 95076**

**Prepared by:
MET Laboratories, Inc.
3162 Belick Street
Santa Clara, CA 95054**



Electromagnetic Compatibility Test Report

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KPA1500**

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MET Report: EMCS94106-FCC 97 Rev. 2

Ajaz Khan
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements per Test Summary (Section 1.0).

John Mason
Director, Electromagnetic Compatibility Lab



Elecraft
KPA1500

Report Status
Electromagnetic Compatibility
FCC 97 Test Report

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	July 28, 2017	Initial Issue.
1	August 11, 2017	Customer Corrections.
2	August 15, 2017	Typo Correction.



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List of Terms and Abbreviations

AC	Alternating Current	kPa	kilopascal
ACF	Antenna Correction Factor	kV	kilovolt
AV	Average	LISN	Line Impedance Stabilization Network
Cal	Calibration	MHz	Megahertz
d	Measurement Distance	μH	microhenry
dB	Decibels	μF	microfarad
dBμA	Decibels above one microamp	μs	microseconds
dBμV	Decibels above one microvolt	PRF	Pulse Repetition Frequency
dBμA/m	Decibels above one microamp per meter	RF	Radio Frequency
dBμV/m	Decibels above one microvolt per meter	RMS	Root-Mean-Square
DC	Direct Current	V/m	Volts per meter
E	Electric Field	VCP	Vertical Coupling Plane
ESD	Electrostatic Discharge	CE	Conducted Emissions
EUT	Equipment Under Test	RE	Radiated Emissions
f	Frequency	VF	Voltage Fluctuations
CISPR	Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference)	ESD	Electrostatic Discharge
GRP	Ground Reference Plane	QP	Quasi Peak
H	Magnetic Field	RI	Radiated Immunity
HCP	Horizontal Coupling Plane	EFT/B	Electrical Fast Transient/Burst
Hz	Hertz	CI	Conducted Immunity
IEC	International Electrotechnical Commission	MI	Magnetic Immunity
kHz	kilohertz	VDI	Voltage Dips Interruptions



1.0 Testing Summary

1.1 Emissions Test Summary

The emissions tests specified below were performed with the following results:

Radiated Emissions			
Transmitting Frequency	Specification	Margin (dBc)	Compliance
Below 30 MHz	FCC Part 97.307 (d)	>43	Compliant
30-225 MHz	FCC Part 19.307 (e)	>60	Compliant



2.0 Equipment Configuration

2.1. Overview

MET Laboratories, Inc. was contracted by Elecraft to perform testing on the KPA1500, under Elecraft, purchase order number 23533.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Elecraft, KPA1500.

In accordance with §2.955(a) (3), the following data is presented in support of the verification of the Elecraft, KPA1500. Elecraft should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the KPA1500 has been **permanently** discontinued, as per §2.955(b).

The results obtained relate only to the item(s) tested.

Model(s) Tested:	KPA1500
Model(s) Covered:	KPA1500
Primary Power as Tested:	Voltage: 240VAC/60Hz
Equipment Emissions Class:	B
Highest frequency generated or used by the EUT:	48 MHz
Evaluated by:	Ajaz Khan
Report Date:	August 15, 2017

2.1.1. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

MET Laboratories is an ISO/IEC 17025 accredited site by A2LA, (California #0591.02).

Radiated Emissions measurements were performed in a semi anechoic chamber. In accordance with §2.948(a) (3), a complete site description is contained at MET Laboratories.

2.1.2. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty (dB)	K	Confidence Level
Radiated Emissions, (30 MHz – 1 GHz)	± 3.45	2	95%

Table 1: Uncertainty Calculations Summary

2.2. Detailed EUT Description and Test Setup

2.2.1. Description of Test Sample

The KPA1500, Equipment Under Test (EUT), is an External 1500W RF Power Amplifier for Amateur Radio Service, 1.8 to 54 MHz.



Photograph 1. DUT External Photo, 1



Photograph 2. DUT External Photo, 2



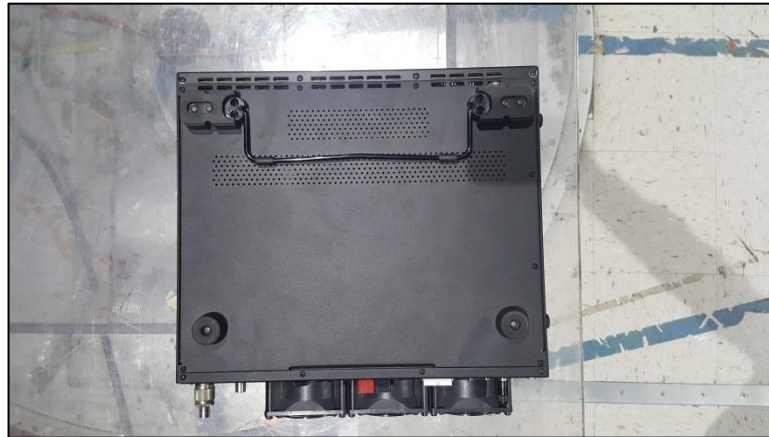
Photograph 3. DUT External Photo, 3



Photograph 4. DUT External Photo, 4



Photograph 5. DUT External Photo, 5



Photograph 6. DUT External Photo, 6



Photograph 7. DUT External Photo, 7



Photograph 8. DUT External Photo, 8



Photograph 9. DUT External Photo, 9



Photograph 10. DUT External Photo, 10

2.2.2. Block Diagram

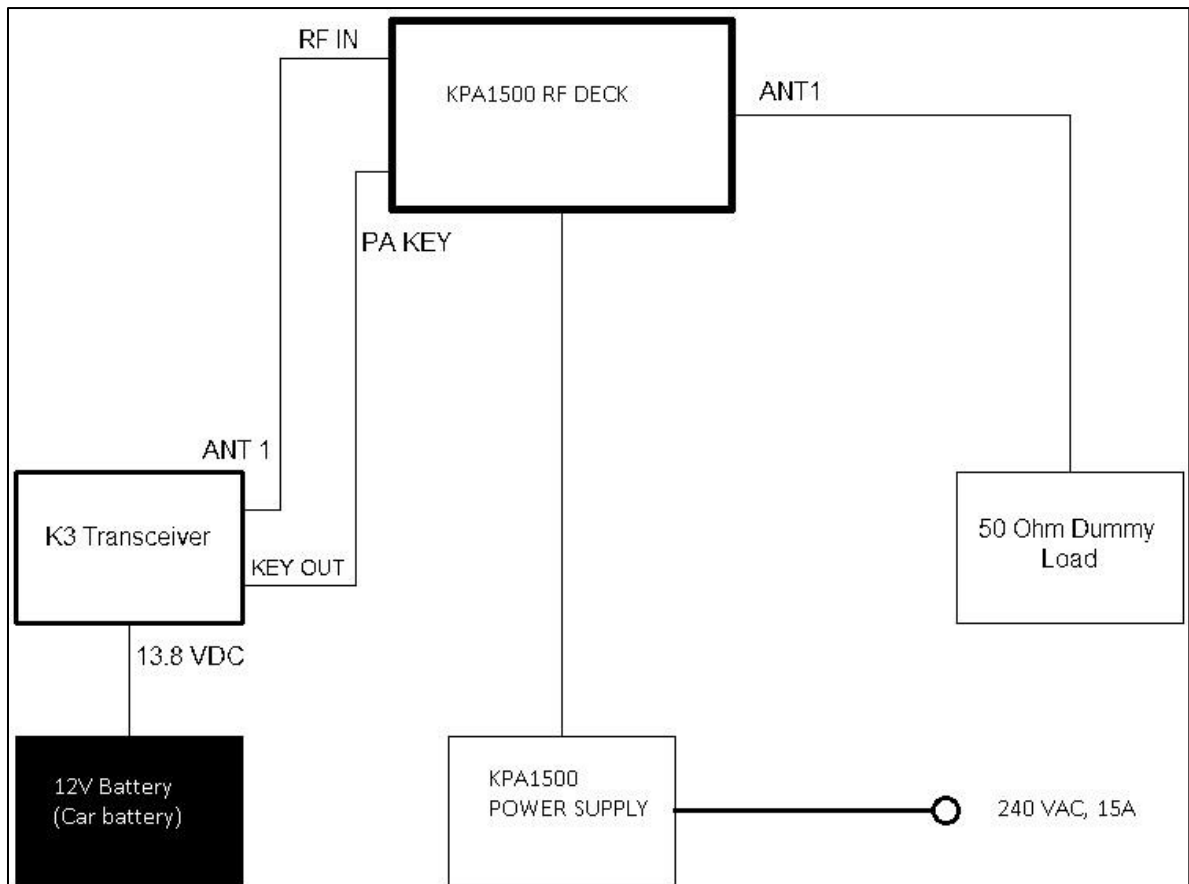


Figure 1. Block Diagram of Test Configuration



2.2.3. Equipment Configuration

The EUT was setup as outlined in Figure 1. All equipment incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
1		RF Deck	KPA1500	RF Deck	22	
2		Power Supply	KPA1500	PS Unit	N/A	

Table 2. Equipment Configuration

2.2.4. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
3,4		50 ohm Coaxial Cable with PL-259 connectors [note]	LMR400	N/A
5		Elecraft K3S/100 Transceiver	K3S/100	Driver
Note:	Cables must be rated for 1500W at 52MHz. RG-58 or equivalent will not work! Elecraft will supply test cables.			
The ‘Customer Supplied Calibration Data’ column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Table 3. Support Equipment



2.2.5. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	INPUT	50 ohm Coax to transceiver	1	1	N/A	Y	
2	ANT 1	50 ohm coax to load	1	1	N/A	Y	
	ANT 2	None. Secondary output, not used in normal operation					
	TX SAMPLE	None. Not used in normal operation.					
	HV SUPPLY	Power Supply Input	1	1.5		N	
	CONTROL	Power Supply Control line	1	1.5		N	
	USB	None. Not used in normal operation.					
	ETHERNET	None. Not used in normal operation.					
	PC DATA	None. Not used in normal operation.					
	TUNE	None. Not used in normal operation.					
	AUX	None. Not used in normal operation.					
	KEY IN	Transmit Key Line	1	1	N/A	Y	
	ALC OUT	None. Not used in normal operation.					
	REM	None. Not used in normal operation.					

Table 4. Ports and Cabling Information

2.2.6. Mode of Operation & Method of Monitoring EUT Operation

The EUT was operated in the following manner:

The KPA1500 is an External Power Amplifier per FCC regulations. It is a communications system device that accepts RF drive of approximately 50W and amplifies it linearly to 1500W. It has two modes: Operate and Standby. It bi-directionally passes the input signal through without modification when in Standby mode.

In operate mode, the KPA1500 has two sub-modes: Receive and Transmit. In receive mode, the signal from the antenna passes through the device in the reverse direction to the input, without amplification. When the KEY IN jack is shorted to ground, the KPA1500 is placed in transmit mode, where it amplifies the (approx) 50W drive signal from the "XCVR" jack and outputs the 1500W amplified signal to the ANT jack.

Performance of the EUT was monitored in the following manner:

RF output dropping from its nominal 1500W to a low value (less than 800W) is considered a failure. Power output is displayed on the RF deck front panel in two places: an LED bargraph and a digital (numeric) LCD display.

Note that the amplifier is not intended for continuous operation. If its duty cycle is exceeded, thermal protection will shut down the amplifier. This is NOT considered a failure as operation will resume after the heat sink cools. Please keep test transmissions to 10 minutes of power output at a time, with a 50% nominal duty cycle.

2.2.7. Modifications to EUT

No modifications were made to the EUT.

2.2.8. Disposition of EUT

The test sample including all support equipment (if any), submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Elecraft upon completion of testing.



3.0 Electromagnetic Compatibility Emission Criteria

3.1. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz

3.1.1. Test Method, Test Requirements, and Test Procedures

3.1.1.1. Test Method

TIA/EIA-603 and TIA/EIA-603-E

3.1.1.2. Test Requirements

For transmitters installed after January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency a 30 MHz must be at least 43 dB below the mean power of the fundamental emission. For transmitters installed on or before January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must not exceed 50 mW and must be at least 40 dB below the mean power of the fundamental emission. For a transmitter of mean power less than 5 W installed on or before January 1, 2003, the attenuation must be at least 30 dB. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

3.1.1.3. Test Procedure

The EUT was placed on top of an 80 centimeter high table inside a semi-anechoic chamber. A transceiver was connected to the input of the EUT and a 50 Ohm load was connected to the output. Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed inside a semi-anechoic chamber, and located 10 meters from the antenna mast.



3.1.2. Test Results, Test Data, and Test Setup

3.1.2.1. Test Results

The EUT was **compliant** with the requirement(s) of this section. Measured emissions were below applicable limits.

97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz	
Ambient Temperature:	21.2°C
Relative Humidity:	34%
Atmospheric Pressure:	101.9kPa

Test Engineer(s): Ajaz Khan

Test Date(s): July 6, 2017

3.1.2.2. Test Data

Frequency	Harmonic	dB below Fundamental	>43dB
1.9	1.9	-	-
	3.8	>43dB	yes
	5.7	>43dB	yes
	7.6	>43dB	yes
	9.5	>43dB	yes
	11.4	>43dB	yes
	13.3	>43dB	yes
	15.2	>43dB	yes
	17.1	>43dB	yes
	19	>43dB	yes

Table 5. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 1.9 MHz, Test Results



Frequency	Harmonic	dB below Fundamental	>43dB
3.75	3.75	-	-
	7.5	>43dB	yes
	11.25	>43dB	yes
	15	>43dB	yes
	18.75	>43dB	yes
	22.5	>43dB	yes
	26.25	>43dB	yes
	30	>43dB	yes
	33.75	>43dB	yes
	37.5	>43dB	yes

Table 6. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 3.75 MHz, Test Results

Frequency	Harmonic	dB below Fundamental	>43dB
5.357	5.357	-	-
	10.714	>43dB	yes
	16.071	>43dB	yes
	21.428	>43dB	yes
	26.785	>43dB	yes
	32.142	>43dB	yes
	37.499	>43dB	yes
	42.856	>43dB	yes
	48.213	>43dB	yes
	53.57	>43dB	yes

Table 7. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 5.357 MHz, Test Results



Frequency	Harmonic	dB below Fundamental	>43dB
7.15	7.15	-	-
	14.3	>43dB	yes
	21.45	>43dB	yes
	28.6	>43dB	yes
	35.75	>43dB	yes
	42.9	>43dB	yes
	50.05	>43dB	yes
	57.2	>43dB	yes
	64.35	>43dB	yes
	71.5	>43dB	yes

Table 8. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 7.15 MHz, Test Results

Frequency	Harmonic	dB below Fundamental	>43dB
10.125	10.125	-	-
	20.25	>43dB	yes
	30.375	>43dB	yes
	40.5	>43dB	yes
	50.625	>43dB	yes
	60.75	>43dB	yes
	70.875	>43dB	yes
	81	>43dB	yes
	91.125	>43dB	yes
	101.25	>43dB	yes

Table 9. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 10.125 MHz, Test Results



Frequency	Harmonic	dB below Fundamental	>43dB
14.175	14.175	-	-
	28.35	>43dB	yes
	42.525	>43dB	yes
	56.7	>43dB	yes
	70.875	>43dB	yes
	85.05	>43dB	yes
	99.225	>43dB	yes
	113.4	>43dB	yes
	127.575	>43dB	yes
	141.75	>43dB	yes

Table 10. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 14.175 MHz, Test Results

Frequency	Harmonic	dB below Fundamental	>43dB
18.118	18.118	-	-
	36.236	>43dB	yes
	54.354	>43dB	yes
	72.472	>43dB	yes
	90.59	>43dB	yes
	108.708	>43dB	yes
	126.826	>43dB	yes
	144.944	>43dB	yes
	163.062	>43dB	yes
	181.18	>43dB	yes

Table 11. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 18.118 MHz, Test Results



Frequency	Harmonic	dB below Fundamental	>43dB
21.225	21.225	-	-
	42.45	>43dB	yes
	63.675	>43dB	yes
	84.9	>43dB	yes
	106.125	>43dB	yes
	127.35	>43dB	yes
	148.575	>43dB	yes
	169.8	>43dB	yes
	191.025	>43dB	yes
	212.25	>43dB	yes

Table 12. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 21.225 MHz, Test Results

Frequency	Harmonic	dB below Fundamental	>43dB
24.94	24.94	-	-
	49.88	>43dB	yes
	74.82	>43dB	yes
	99.76	>43dB	yes
	124.7	>43dB	yes
	149.64	>43dB	yes
	174.58	>43dB	yes
	199.52	>43dB	yes
	224.46	>43dB	yes
	249.4	>43dB	yes

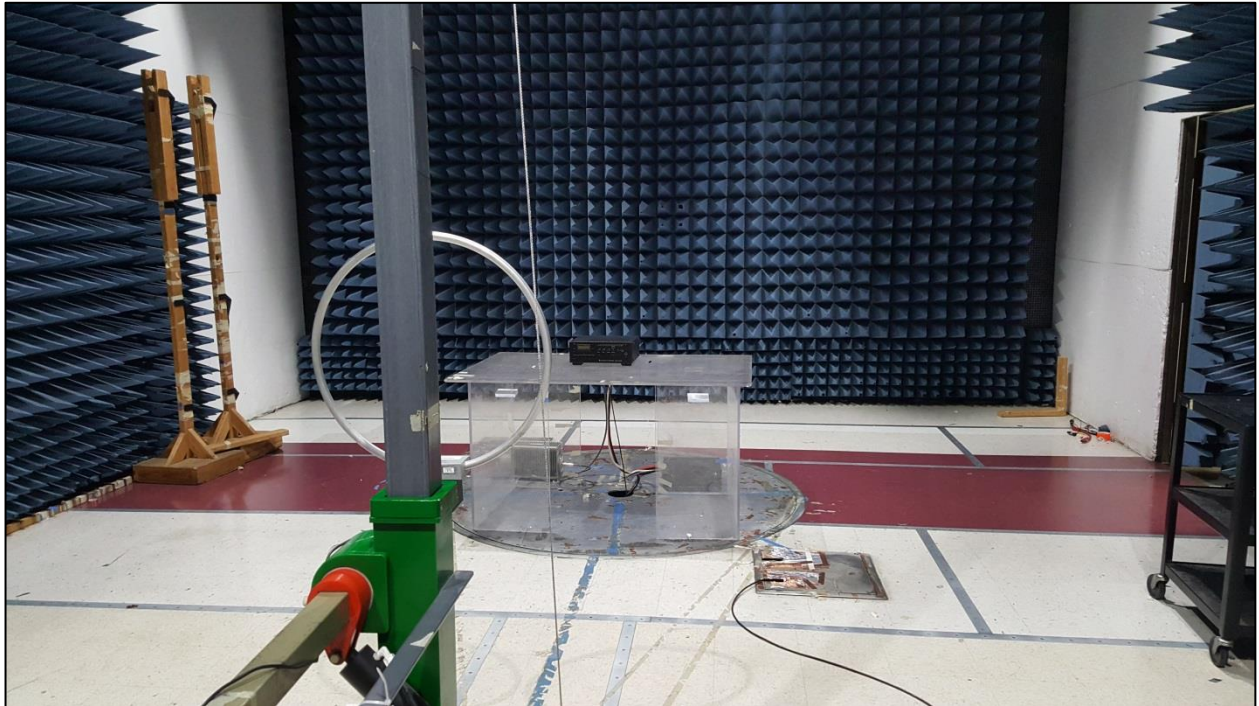
Table 13. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 24.94 MHz, Test Results



Frequency	Harmonic	dB below Fundamental	>43dB
28.85	28.85	-	-
	57.7	>43dB	yes
	86.55	>43dB	yes
	115.4	>43dB	yes
	144.25	>43dB	yes
	173.1	>43dB	yes
	201.95	>43dB	yes
	230.8	>43dB	yes
	259.65	>43dB	yes
	288.5	>43dB	yes

Table 14. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz, 28.85 MHz, Test Results

3.1.2.3. Test Setup Photograph



Photograph 11. 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz Test Setup (Front View)



3.2. 97.307(e) Radiated Spurious Emissions for TX Operating Above 30 MHz

3.2.1. Test Method, Test Requirements, and Test Procedures

3.2.1.1. Test Method

TIA/EIA-603 and TIA/EIA-603-E

3.2.1.2. Test Requirements

The mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency between 30-225 MHz must be at least 60 dB below the mean power of the fundamental. For a transmitter having a mean power of 25 W or less, the mean power of any spurious emission supplied to the antenna transmission line must not exceed 25 μ W and must be at least 40 dB below the mean power of the fundamental emission, but need not be reduced below the power of 10 μ W. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

3.2.1.3. Test Procedure

The EUT was placed on top of an 80 centimeter high table inside a semi-anechoic chamber. A transceiver was connected to the input of the EUT and a 50 Ohm load was connected to the output. Various antennas were placed near the EUT and measurements were taken of the field strengths and frequencies. For final radiated measurements, the EUT was placed inside a semi-anechoic chamber, and located 10 meters from the antenna mast.

3.2.2. Test Results, Test Data, and Test Setup

3.2.2.1. Test Results

The EUT was **compliant** with the requirement(s) of this section. Measured emissions were below applicable limits.

97.307(e) Radiated Spurious Emissions for TX Operating Below 30 MHz	
Ambient Temperature:	21.2°C
Relative Humidity:	34%
Atmospheric Pressure:	101.9kPa

Test Engineer(s): Ajaz Khan

Test Date(s): July 6, 2017

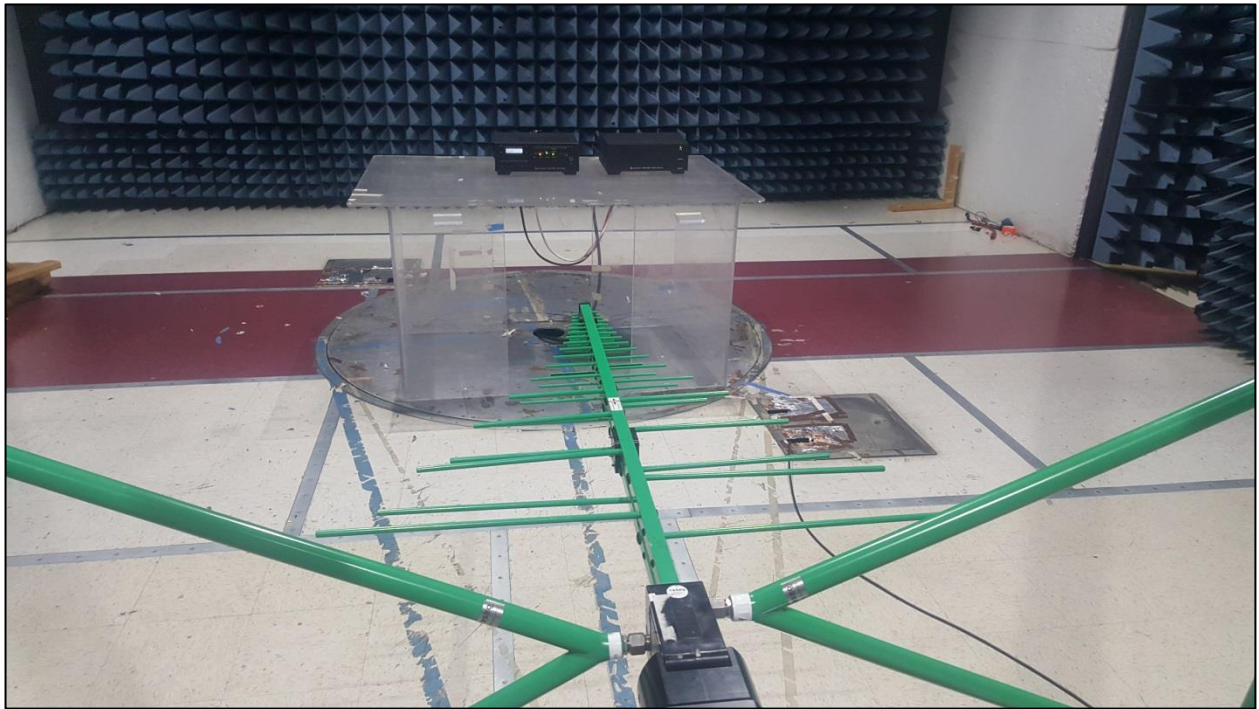


3.2.2.2. Test Data

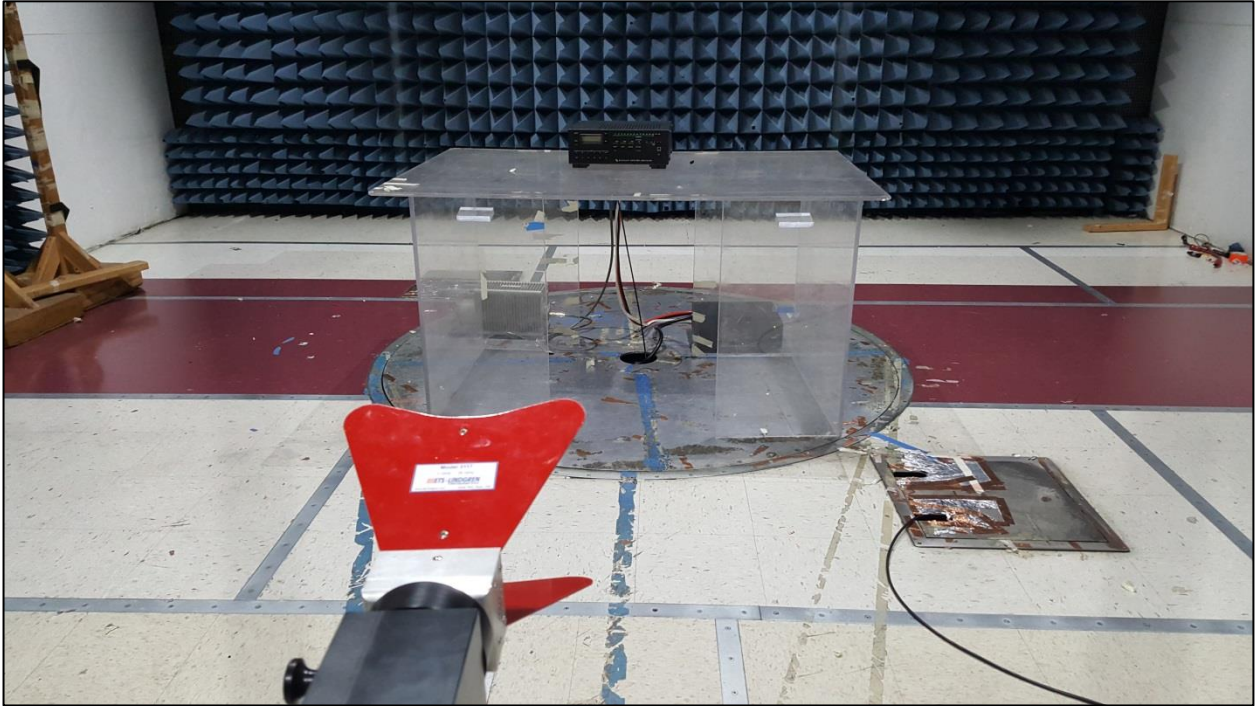
Frequency	Harmonic	dB below Fundamental	>60dB
52	52	-	-
	104	>60dB	yes
	156	>60dB	yes
	208	>60dB	yes
	260	>60dB	yes
	312	>60dB	yes
	364	>60dB	yes
	416	>60dB	yes
	468	>60dB	yes
	520	>60dB	yes

Table 15. 97.307(e) Radiated Spurious Emissions for TX Operating Between 30-225 MHz, 52 MHz, Test Results

3.2.2.3. Test Setup Photograph



Photograph 12. 97.307(e) Radiated Spurious Emissions for TX Operating Above 30 MHz Test Setup



Photograph 13. 97.307(e) Radiated Spurious Emissions for TX Operating Between 30-225 Test Setup (Front View)



4.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

Test Name: 97.307(d) Radiated Spurious Emissions for TX Operating Below 30 MHz			Test Date(s): July 6, 2017		
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2404	Passive Loop Antenna	EMCO	6512	08/11/2016	08/11/2018
1S3928	EMI Tester Receiver	Rohde & Schwarz	ESR26	10/28/2016	10/28/2017
1S2600	Bilog Antenna	Teseq	CBL6112D	11/28/2016	11/28/2017
1S2482A	5 Meter Chamber (FCC)	Panashield	5 Meter Semi-Anechoic Chamber	Not Required	
1S2164	Load Resistor, Termaline Coaxial	BIRD	18201	Functional Verification	
Test Name: 97.307(e) Radiated Spurious Emissions for TX Operating Below 30 MHz			Test Date(s): July 6, 2017		
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2404	Passive Loop Antenna	EMCO	6512	08/11/2016	08/11/2018
1S3928	EMI Tester Receiver	Rohde & Schwarz	ESR26	10/28/2016	10/28/2017
1S2600	Bilog Antenna	Teseq	CBL6112D	11/28/2016	11/28/2017
1S2482A	5 Meter Chamber (FCC)	Panashield	5 Meter Semi-Anechoic Chamber	Not Required	
1S2164	Load Resistor, Termaline Coaxial	BIRD	18201	Functional Verification	

Table 16. Emissions Test Equipment List