849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR 352.472.5500
FAX: 352.472.2030
EMAIL: INFO@TIMCOENGR.COM
HTTP://WWW.TIMCOENGR.COM

FCC PART 90
AND IC RSS-119, RSS-GEN
TEST REPORT

APPLICANT	NEPTUNE TECHNOLOGY GROUP INC.
	1600 ALABAMA HIGHWAY 229 TALLASSEE AL 36078 USA
FCC ID	P2SR450M
IC CERTIFICATION	4171B-R450M
MODEL NUMBER	R450M
PRODUCT DESCRIPTION	TRANSMITTER MODULE
DATE SAMPLE RECEIVED	5/3/2012
DATE TESTED	5/10/2012
REVISION	Rev 1.2 - 02/04/2013
TESTED BY	Joe Scoglio
APPROVED BY	Mario R. de Aranzeta
TIMCO REPORT NO.	1134AUT12TestReport.doc
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

GENERAL REMARKS

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

The test results relate only to the items tested.

Summary

The device under test does:
☒ fulfill the general approval requirements as identified in this test report
☐ 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: 2005 requirements.

ACCREDITED

Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

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

Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date: 6/12/2012

GENERAL INFORMATION
DUT Specification

DUT Description	TRANSMITTER MODULE
FCC ID	P2SR450M
IC Certification	4171B-R450M
Model Number	R450M
Serial Number	N/A
Operating Frequency	450-470 MHz
Test Frequencies	451.1, 461.1, 469.0 MHz
Type of Emission	F1D
Modulation	GFSK
DUT Power Source	☐ 110–120Vac/50– 60Hz
	☒ DC Power 3.6V
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☒ Fixed
	☐ Mobile
	☐ Portable
Test Conditions	The temperature was 26ºC Relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90, IC RSS-119, RSS-GEN
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

Revision History: rev 0.0 06/12/2012 original release
Rev1.0 01/07/2013 update as per FCC request.

1. Revised section on occupied BW. Occupied BW plots moved to separate document provided by applicant.
2. RF output power
3. Updated Equipment List

Rev1.1 01/10/2013 added revision history
Rev 1.2 02/04/2013 per FCC request

1. Moved radiated interference statement from page 6 to 14 to better unify general procedure with specific measurement procedures.
2. Updated TOC.
3. Fixed topographic errors on page 14 and 20.

TEST PROCEDURES

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C: 2004 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz
and the span to 50 MHz.

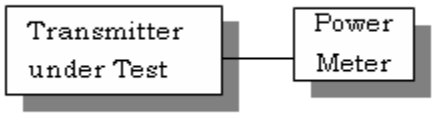
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), IC RSS-119 4.1 and 5.4, RSS-GEN 4.8

Test Requirements:

Method of Measurement: 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:

Test Setup Diagram:



Test Data:

OUTPUT POWER: Measured RF power conducted.

Frequency MHz	Power Watts
450.1	1.1
460	1.2
469.5	1.0

Part 2.1033 (C)(8) DC Input into the final amplifier

FOR HIGH POWER SETTING INPUT POWER: (3.6V)(1.3A) = 4.68 Watts

MODULATION CHARACTERISTICS

Part 2.1033(c)
Part 2.1033(c) (4) Type of Emission: 11K2F1D

FCC Part 90.209, IC RSS-119 5.5
FCC Part 90.207

Type of Emission: 11K2F2D, F1D

Bn = 2M + 2DK
M = B/2 = 9600/2= 4800
D = 800
K=1
Bn = 2(4800) + 2(800) = 11.2k

AUDIO FREQUENCY RESPONSE

Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-119 5.2

Test Requirements:

Method of Measurement:

The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

Not applicable.

Data radio

AUDIO LOW PASS FILTER

VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a) Voice modulated communication equipment: For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Not applicable.

AUDIO INPUT VERSUS MODULATION

Rule Part No.: FCC Part 2.1047(b) & 90, IC RSS-119 5.2

Test Requirements:

Method of Measurement: Modulation cannot exceed 100%, The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C: 2004. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 2500 Hz.

Test data:

Not applicable.

OCCUPIED BANDWIDTH

FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH
FCC Part 90.210(b) RSS-119 4.2 25kHz Channel Spacing

Part 90.210(d) Emission Mask D - 12.5 kHz channel BW equipment.
For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

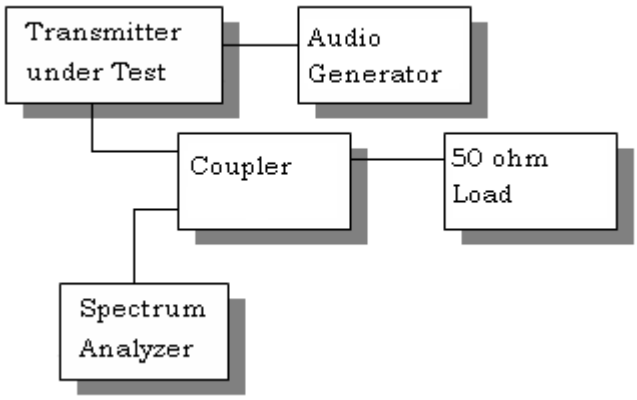
(1).

OCCUPIED BANDWIDTH MEASUREMENT

Test procedure: ANSI/TIA-603-C:2004 para 2.2.11.

Test Setup Diagram:

OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See separate report

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), RSS-GEN 7.1.4

Requirements: 50+10log(1.0) = 50

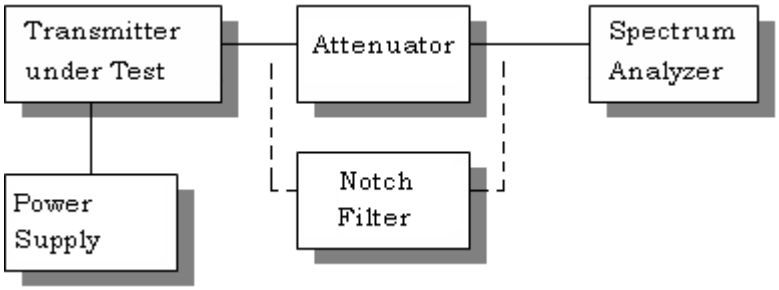
Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from the lowest frequency generated (not going below 9 kHz) to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C: 2004.

Test Data:

TF MHz	EF MHz	dB below carrier		TF MHz	EF MHz	dB below carrier
451.1	451.1	0		461.1	461.1	0
	902.2	64.2			922.2	65.7
	1353.3	91.6			1383.3	82.9
	1804.5	92.5			1844.4	92.7
	2255.7	88.5			2305.5	95.6
	2706.8	82.4			2766.6	83.9
	3157.9	89.1			3227.7	100.5
	3609.1	103			3688.8	102.1
	4060.2	99.7			4149.9	104.4
	4511.4	101.8			4611	100.3

TF MHz	EF MHz	dB below carrier
469	469	0
	938	68
	1407	93.1
	1876	92.8
	2345	73.5
	2814	80.3
	3283	94.3
	3752	102.1
	4221	101.4
	4690	105.4

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

FIELD STRENGTH OF SPURIOUS EMISSIONS

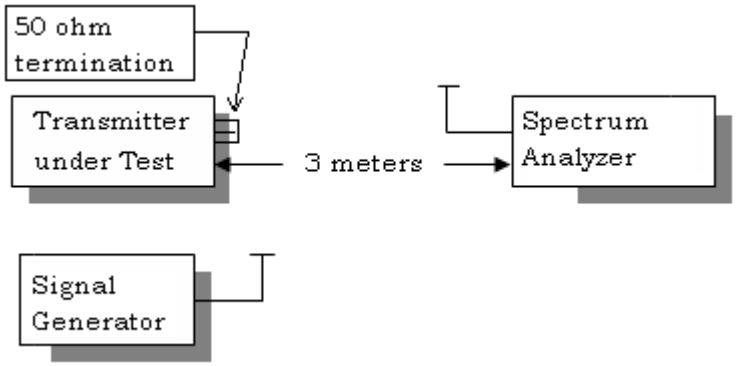
Rule Parts. No.: FCC Part 2.1053, RSS-GEN 4.9

Requirements: 50+10log(1.0) = 50

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-C: 2004 using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

The test procedure used was ANSI/TIA 603-C: 2004 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a micro volt at the output of the antenna.

Test Setup Diagram:



Test Data:

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)		Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
451.10	H	0		461.10	H	0
902.20	H	68.7		922.20	H	74.6
1353.30	H	82.0		1383.30	H	84.9
1804.50	H	80.4		1844.50	H	82.2
2255.60	H	84.5		2305.60	H	88.4
2706.70	H	87.8		2766.70	H	90.1
				3227.90	H	86.2
				4611.30	H	81.9

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
469.00	H	0
938.00	H	78.9
1407.00	H	83.0
1876.00	H	78.9
2345.00	H	86.1
2814.00	H	84.6
4690.00	V	83.9

FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213, RSS-119 5.3, RSS-GEN 7.2.4

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±1.5 PPM

Method of Measurements: ANSI/TIA 603-C: 2004

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		
Temperature (°C)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-30	461.123256	-0.10
-20	461.123360	0.12
-10	461.123492	0.41
0	461.123530	0.49
+10	461.123396	0.20
+20	461.123373	0.15
+30	461.123352	0.10
+40	461.123389	0.18
+50	461.123364	0.13

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	**Frequency (MHz)**	**Frequency Stability (PPM)**
-15%	461.123202	-0.22
+15%	461.123303	0.00

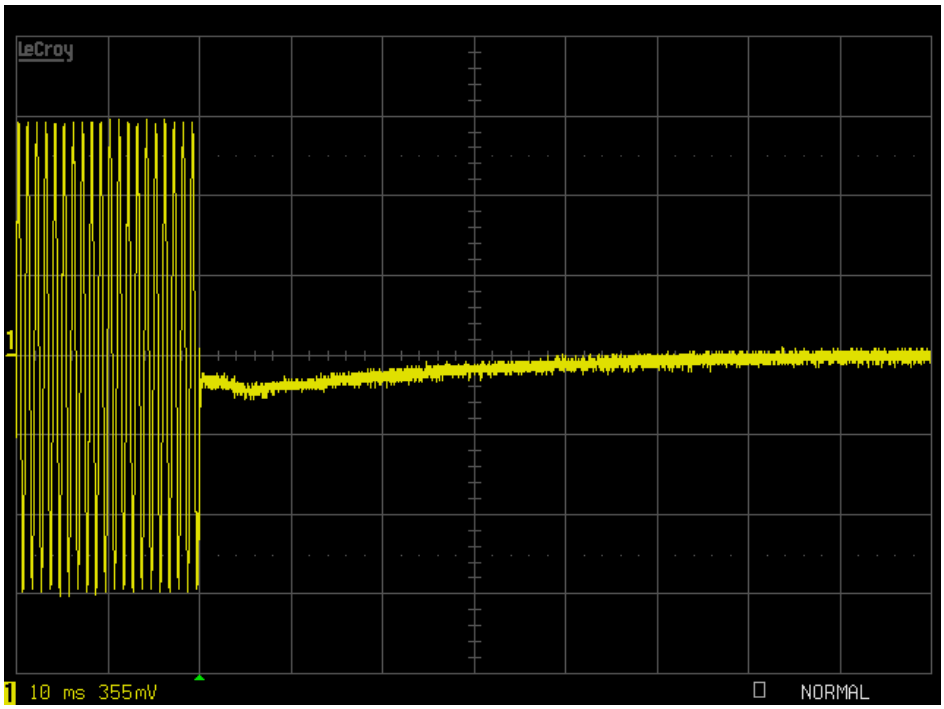
TRANSIENT FREQUENCY BEHAVIOR

FCC Part 2.1055(a)(1)
FCC Part 90.214, IC RSS-119 5.8

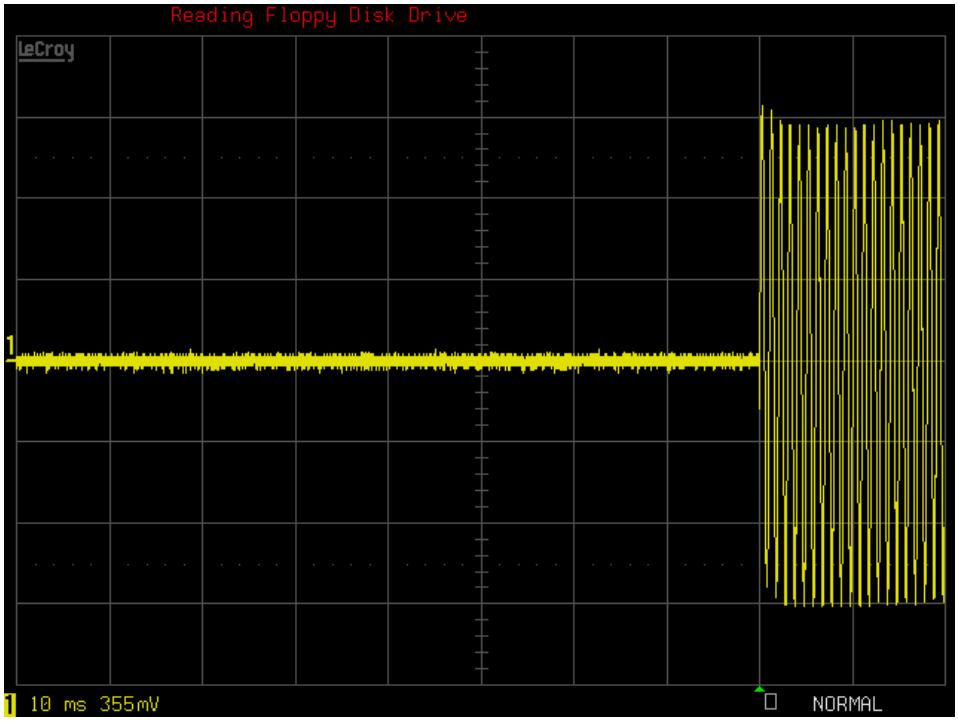
REQUIREMENTS: Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

TX ON
12.5 kHz channel



TX OFF
12.5 kHz channel

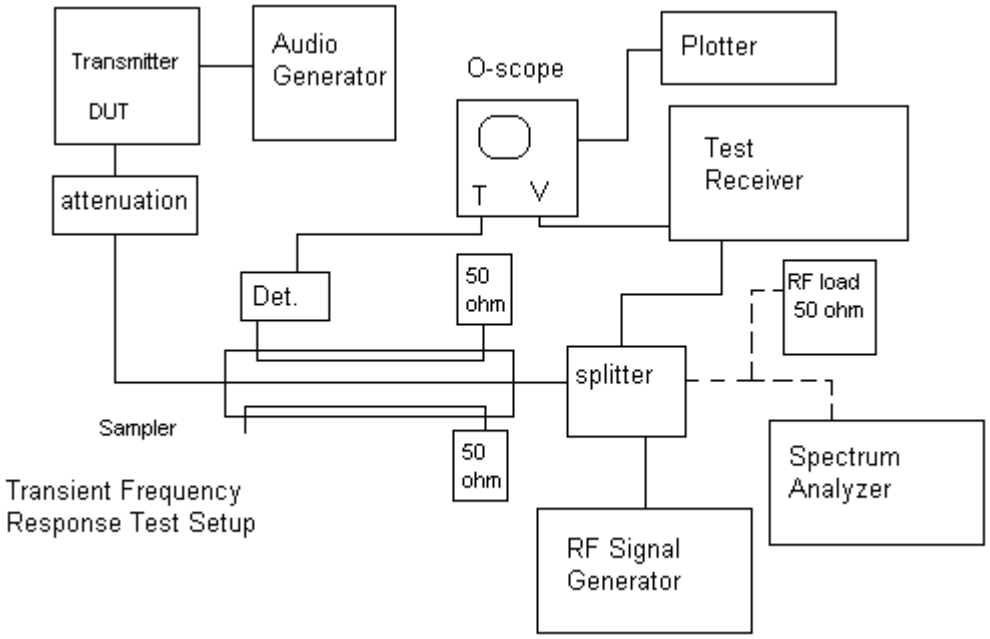


TEST PROCEDURE: ANSI/TIA 603-C: 2004 PARA 2.2.19

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.

2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.

3. Reduce the attenuation between the transmitter and the RF detector by 30 dB. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	10/28/11	10/28/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	10/28/11	10/28/13
Antenna: Biconnical	Eaton	94455-1	1096	05/04/11	05/04/13
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	05/04/11	05/04/13
Frequency Counter	HP	5352B	2632A00165	06/22/11	06/22/13
Frequency Counter	HP	5385A	2730A03025	08/17/11	08/17/13
Signal Generator	HP	8640B	2308A21464	02/23/12	02/23/14
Hygro-Thermometer	Extech	445703	0602	06/15/11	06/15/13
Digital Multimeter	Fluke	77	35053830	09/09/11	09/09/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	10/28/11	10/28/13
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	06/02/09	06/02/12
Modulation Analyzer	HP	8901A	3435A06868	07/18/11	07/18/13
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	06/18/10	06/18/12
Frequency Counter	HP	5385A	3242A07460	06/22/11	06/22/13
3/10-Meter OATS	TEI	N/A	N/A	12/31/2011	12/31/2013
3-Meter OATS	TEI	N/A	N/A	12/31/2011	12/31/2013
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/2011	12/31/2013