

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: sid@timcoengr.com



Test Report

Product Name: HANDHELD MARINE TRANSCEIVER - TRANSMITTER PORTION

FCC ID: PJ5RAY101

Applicant:

RAYMARINE, INC.
22 COTTON ROAD UNIT D
NASHUA, NH 03063-4219

Date Receipt: DECEMBER 1, 2003

Date Tested: DECEMBER 11, 2003

APPLICANT: RAYMARINE, INC.
FCC ID: PJ5RAY101
REPORT #: R\RAYMAR\1594AUT3\1594AUT3TestReport.doc
TITLE PAGE

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GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE

2.1033(c) RAYMARINE, INC. will sell the
FCC ID: PJ5RAY101 VHF Marine transmitter in
quantity, for use under FCC RULES PART 80.

2.1033(c) TECHNICAL DESCRIPTION

(4) Type of Emission: 16K0G3E/16K0F3E
For 20KHz

Bn = 2M + 2DK

M = 3000

D = 4.6KHz (Peak Deviation)

K = 1

Bn = 2(3.0K) + 2(4.6K)(1) = 6.0K + 10.0 = 16.0K

80.205 (A) ALLOWED AUTHORIZED BANDWIDTH = 20.00KHz.

2.1033(c)(5) Frequency Range: 156.025-157.425 MHz

2.1033(c)(6) Power Range and Controls: There is a user Power
switch for High/Low Power.

2.1033(c)(8) DC Voltages and Current into Final Amplifier:

POWER INPUT - FINAL AMPLIFIER ONLY
WITH ALKALINE BATTERIES

High

Low

Vce = 9 VDC

Vce = 9 VDC

Ice = 1.65 A.

Ice = 0.67 A.

Pin = 14.85 Watts

Pin = 6.03 Watts

WITH NiMH BATTERIES

High

Low

Vce = 7.2 VDC

Vce = 7.2 VDC

Ice = 1.65 A.

Ice = 0.67 A.

Pin = 11.88 Watts

Pin = 4.83 Watts

Function of each electron tube or semiconductor
device or other active circuit device: - EXHIBIT #4.

2.1033(c)(10) Complete Circuit Diagrams: The circuit diagram is
included as EXHIBIT 3. The block diagram is
included as EXHIBIT 2.

2.1033(c)(3) Instruction book. The instruction manual is included
as EXHIBIT #5.

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2.1033(c)(9) Tune-up procedure. The tune-up procedure is given in EXHIBIT #9.

Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description in EXHIBIT #10.

2.1033(c)(13) Digital modulation. This unit does NOT use digital modulation.

The data required by 2.1046 through 2.1055 is submitted below.

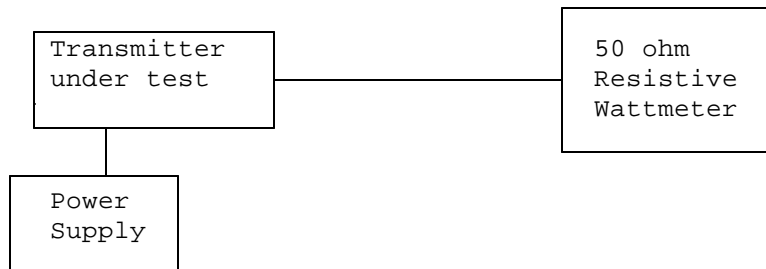
2.1046(a) RF power output.
80.215(e)(1)

RF power is measured by connecting a 50 ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage of 9 V, and the transmitter properly adjusted the RF output measures:

POWER OUTPUT

OUTPUT POWER: HIGH: 5.3 W CONDUCTED
LOW: 1.0 W CONDUCTED

METHOD OF MEASURING RF POWER OUTPUT



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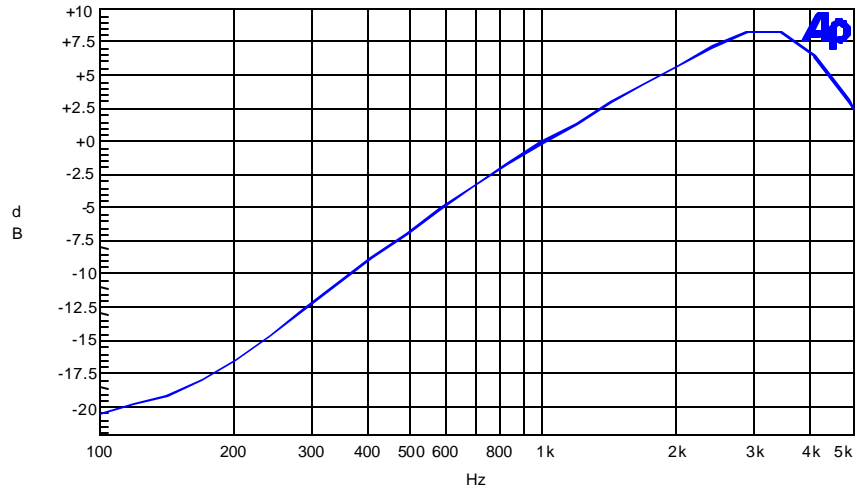
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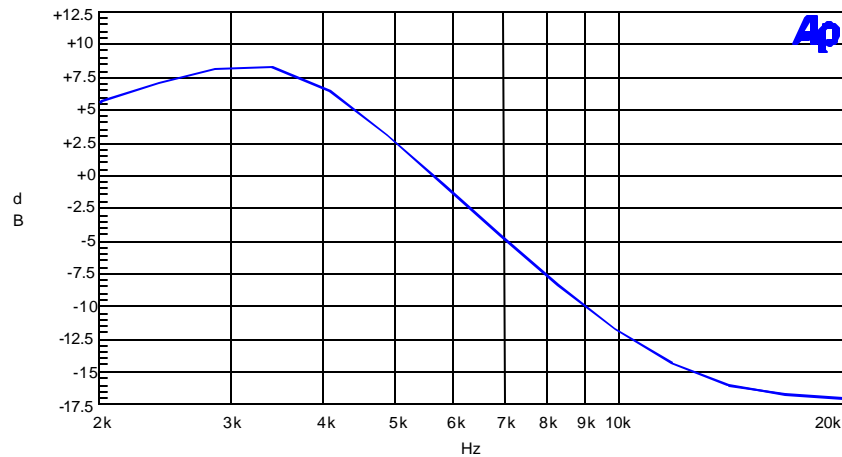
2.1047(a) Voice Modulation characteristics:

Audio Frequency Response



2.1047(a) AUDIO LOW PASS FILTER
The audio low pass filter is included. Rules 80.213(e) for ship stations with a low pass filter.

AUDIO LOWPASS FILTER GRAPH

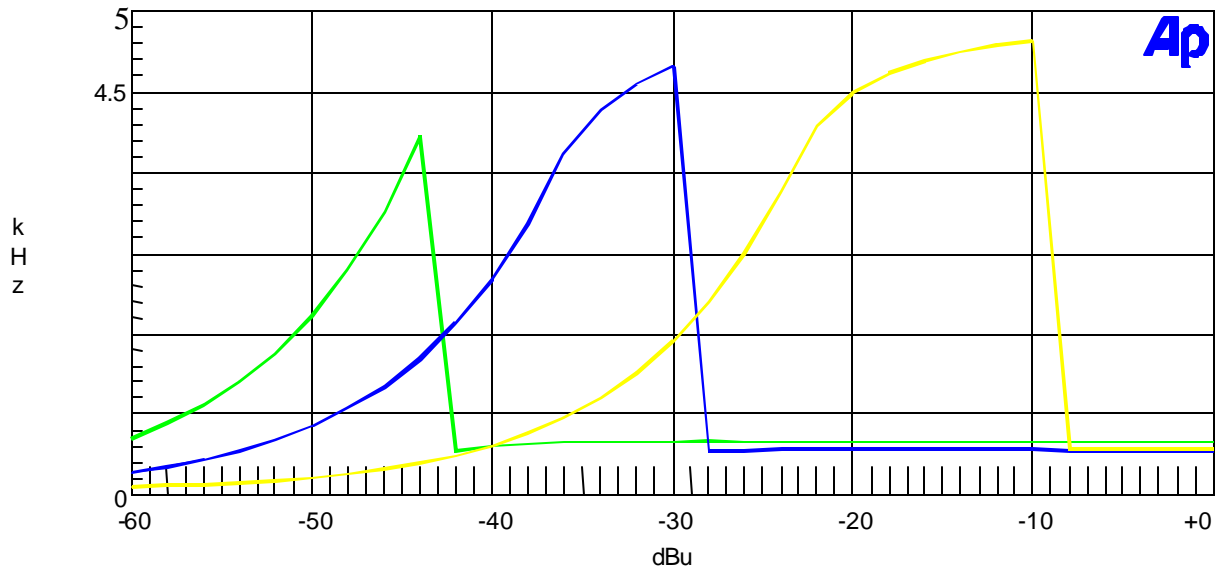


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2.1047(b) Audio_input_versus_modulation
80.213 (d) A plot of the audio input versus
deviation is shown below.

MODULATION LIMITING GRAPH 3.0KHz (Green), 1.0KHz (Blue), and 300Hz (Yellow)



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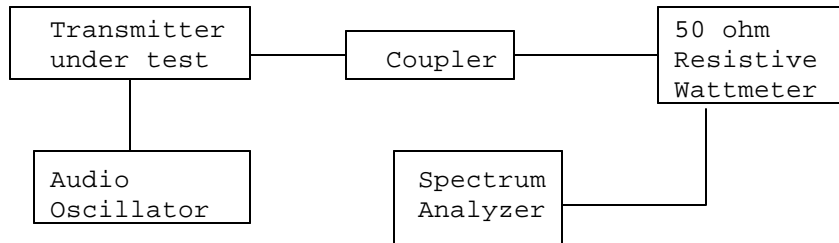
- 2.1049(c) Occupied bandwidth:
- 80.213 (b) Data in the plots shows that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least $43+\log(P)$ dB.

Radiotelephone transmitter with modulation limiter.

Test procedure: TIA/EIA-603 para 2.2.11 , with the exception that various tones were used.

Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT



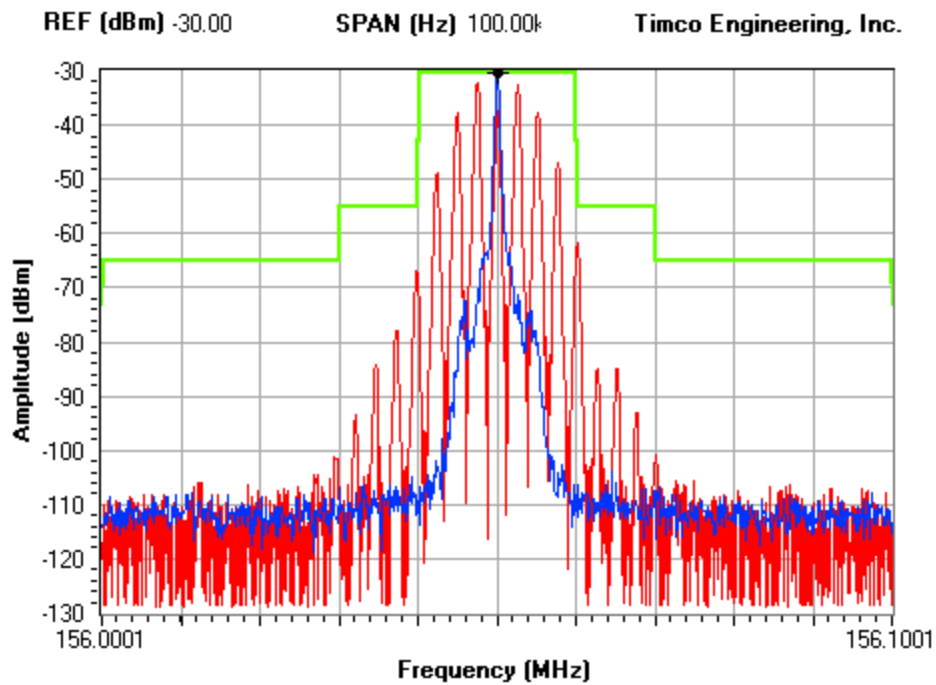
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OCCUPIED BANDWIDTH PLOT

NOTES:

RAYMARINE COMPANY - FCC ID: PJ5RAY101
 OCCUPIED BANDWIDTH PLOT



RBW	VBW	ST (sec)	Peak	156.05	-30.20	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
300 Hz	100 kHz	2	MKR2	156.04	-107.80	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Center Frequency (Hz)	156.050M		MKR3	156.00	-114.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marker Delta (Hz)	0.00		HwMK	23.076	6.27	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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2.1051
 80.211

Spurious emissions at antenna terminals(conducted):
 The data on the following page shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500Hz 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.

REQUIREMENTS: Emissions must be 43 +10log(Po) dB below the mean power output of the transmitter.

43 + 10log(1.0) = 43

43 + 10log(5.3) = 50.24

TF LOW POWER	EF	dB below carrier	TF HIGH POWER	EF	dB below carrier
156.05	156.05	0.0	156.05	156.05	0.0
	312.10	72.9		312.10	83.2
	468.15	89.9		468.15	101.9
	624.20	101.6		624.20	107.7
	780.25	104.8		780.25	103.7
	936.30	79.1		936.30	90.0
	1092.35	100.6		1092.35	99.3
	1248.40	104.4		1248.40	102.5
	1404.45	93.4		1404.45	95.8
	1560.50	84.7		1560.50	85.2

TF LOW POWER	EF	dB below carrier	TF HIGH POWER	EF	dB below carrier
157.03	157.03	0.0	157.03	157.03	0.0
	314.06	74.6		314.06	83.6
	471.09	90.0		471.09	99.6
	628.12	100.8		628.12	107.2
	785.15	103.8		785.15	101.5
	942.18	79.7		942.18	89.4
	1099.21	100.9		1099.21	102.1
	1256.24	101.3		1256.24	101.6
	1413.27	92.9		1413.27	66.8
	1570.30	83.9		1570.30	89.5

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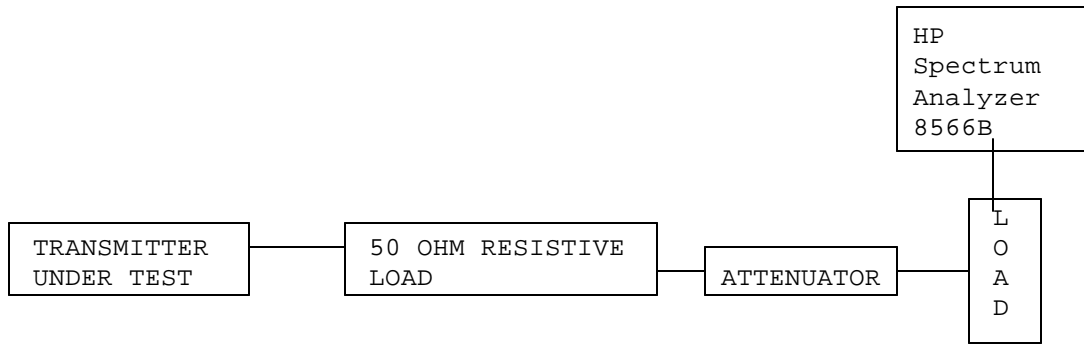
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Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was TIA/EIA-603 STANDARD without any exceptions. An audio generator was connected to the UUT through a dummy microphone circuit and the output of the transmitter connected to a standard load and from the standard load through a pre-selector filter of the spectrum analyzer. The spectrum was scanned from 400kHz to at least the tenth harmonic of the fundamental using a HP model 8566B spectrum analyzer. The measurements were made using the shielded room located at TIMCO ENGINEERING INC. 849 STATE ROAD, NEWBERRY, FLORIDA 32669.

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2.1053(a) Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: Emissions must be 43 +10log(Po) dB below the mean power output of the transmitter.

LOW: 43 + log(1) = 43

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
156.05	H	20.4	0	0.00	0.00
312.10	V	-43.9	0	-1.25	63.05
468.15	H	-53.4	0	-0.52	73.28
624.20	H	-62.7	0	-0.26	82.84
780.25	V	-53.1	0	-1.03	72.47
936.30	V	-49.4	0	-0.99	68.81
1092.35	V	-53.3	1.02	3.32	76.00
1248.40	V	-57.2	1.05	3.94	80.49
1404.45	V	-48.3	1.08	4.57	72.19
1560.50	V	-38.8	1.11	5.00	63.09

HIGH: 43 + log(5.3) = 50.24

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
156.05	H	28.2	0	0.00	0.00
312.10	V	-28.9	0	-1.25	55.85
468.15	V	-52.4	0	-0.52	80.08
624.20	H	-58.6	0	-0.26	86.54
780.25	V	-56.8	0	-1.03	83.97
936.30	V	-44.2	0	-0.99	71.41
1092.35	V	-55.5	1.02	3.32	86.00
1248.40	V	-56.2	1.05	3.94	87.29
1404.45	V	-46.6	1.08	4.57	78.29
1560.50	V	-43.1	1.11	5.00	75.19

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2.1053(a) Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: Emissions must be 43 +10log(Po) dB below the mean power output of the transmitter.

LOW: $43 + \log(1.0) = 43$

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
157.03	H	20.7	0	0.00	0.00
314.06	V	-47.9	0	-1.25	67.35
471.09	H	-54.3	0	-0.53	74.47
628.12	H	-61.2	0	-0.24	81.66
785.15	V	-51.8	0	-1.11	71.39
942.18	H	-51.3	0	-1.06	70.94
1099.21	V	-56.2	1.02	3.35	79.23
1256.24	V	-56.8	1.05	3.97	80.42
1413.27	V	-46.7	1.08	4.60	70.92
1570.30	V	-38.8	1.11	5.01	63.40

HIGH: $43 + \log(5.3) = 50.24$

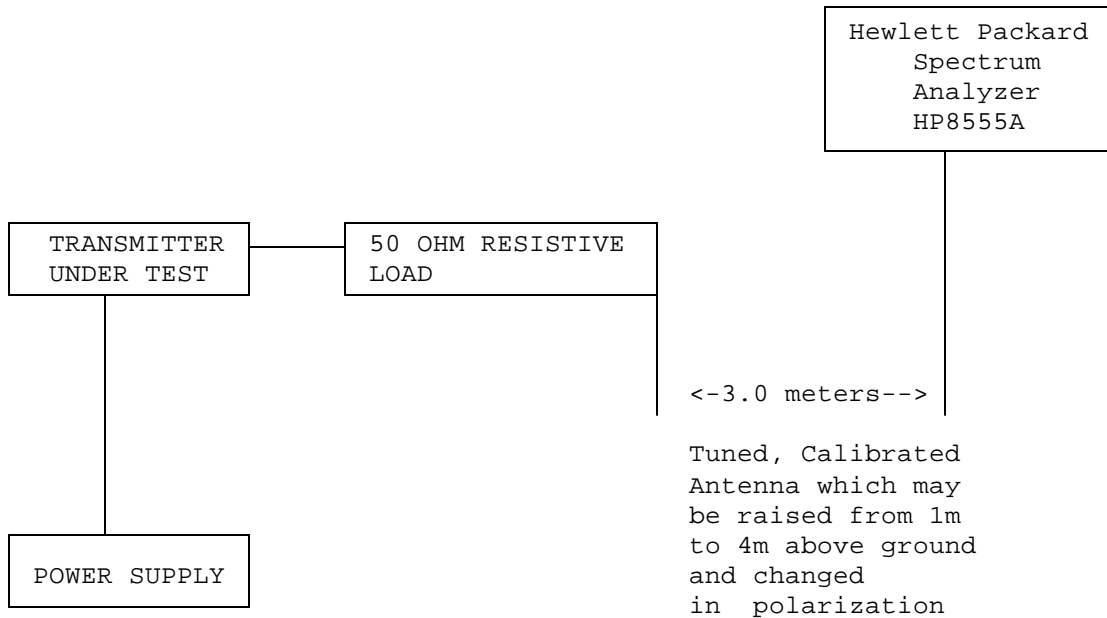
Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
157.03	H	28.8	0	0.00	0.00
314.06	V	-34.1	0	-1.25	61.65
471.09	V	-49.2	0	-0.53	77.47
628.12	H	-58.4	0	-0.24	86.96
785.15	V	-53.9	0	-1.11	81.59
942.18	H	-47.9	0	-1.06	75.64
1099.21	V	-56.2	1.02	3.35	87.33
1256.24	V	-57.8	1.05	3.97	89.52
1413.27	V	-46.7	1.08	4.60	79.02
1570.30	V	-42.0	1.11	5.01	74.70

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2.1053(a) Continued Field_strength_of_spurious_emissions:

Method of Measuring Radiated Spurious Emissions



Equipment placed 80 cm above ground
on a rotatable platform.

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

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Frequency stability:

2.1055(a)(2)

80.209 (a)

Temperature and voltage tests were performed to verify that the frequency remains within the .0010%,10.0 ppm specification limit, for 20kHz spacing. The test was conducted as follows: The transmitter was placed in the temperature chamber at 25° C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -30° C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15sec intervals. The worst-case number was recorded for temperature plotting. This procedure was repeated in 10° increments up to + 50° C.

Readings were also taken at minus 15% of the battery voltage of 9 V, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 156.049 935 MHz

TEMPERATURE_C	FREQUENCY_MHz	PPM
REFERENCE_____	156.049 435	0.00
-30_____	156.049 967	0.21
-20_____	156.049 947	0.08
-10_____	156.049 992	0.37
0_____	156.049 987	0.33
+10_____	156.049 953	0.12
+20_____	156.049 935	0.00
+30_____	156.049 946	0.07
+40_____	156.050 011	0.49
+50_____	156.050 213	1.78

VOLTS.	Batt. Data	Batt. PPM
-15% 9	156.049 97	0.22

RESULTS OF MEASUREMENTS: The test results indicates that the EUT meets the requirements.

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EMC Equipment List

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3/10-Meter OATS	TEI	N/A	N/A	Listed 3/26/01	3/26/04
3-Meter OATS	TEI	N/A	N/A	Listed 1/13/03	1/13/06
Audio Generator	B&K	3010	8739686	CHAR 12/1/02	12/1/04
Audio Oscillator	Precision	653A	832-00260	CHAR 12/1/02	12/1/04
Biconnical Antenna	Eaton	94455-1	1057	CAL 3/18/03	3/18/05
Biconnical Antenna	Eaton	94455-1	1096	CAL 10/1/01	10/1/03
Biconnical Antenna	Electro-Metrics	BIA-25	1171	CAL 4/26/01	4/26/03
Blue Tower Quasi-Peak Adapter	HP	85650A	2811A01279	CAL 4/15/03	4/15/05
Blue Tower RF Preselector	HP	85685A	2926A00983	CAL 4/15/03	4/15/05
Blue Tower Spectrum Analyzer	HP	8568B	2928A04729 2848A18049	CAL 4/15/03	4/15/05
Frequency Counter	HP	5352B	2632A00165	CAL 11/28/01	11/28/03
Frequency Counter	HP	5382A	1620A03535	CHAR 3/2/01	Out of Service
Frequency Counter	HP	5385A	2730A03025	CAL 3/7/03	3/7/05
Frequency Counter	HP	5385A	3242A07460	CAL 3/7/03	3/7/05
LISN	Electro-Metrics	ANS-25/2	2604	CAL 10/9/01	10/9/03
LISN	Electro-Metrics	EM-7820	2682	CAL 3/12/03	3/12/05
Log-Periodic Antenna	Eaton	96005	1243	CAL 5/8/03	5/8/05

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