TABLE OF CONTENTS LIST

APPLICANT: RAYMARINE INC.

FCC ID: PJ5RAY215

TEST REPORT:


PAGE 1.....COVER SHEET - GENERAL INFORMATION & TECHNICAL DESCR.
PAGE 2.....TECHNICAL DESCRIPTION CONTINUED
PAGE 3.....MODULATION CHARACTERISTICS & RF POWER OUTPUT
PAGE 4.....AUDIO FREQUENCY RESPONSE PLOT
PAGE 5.....MODULATION LIMITING PLOTS – 300 Hz, 1000 Hz
PAGE 6.....MODULATION LIMITING PLOT – 3000 Hz
PAGE 7.....AUDIO LOW PASS FILTER
PAGE 8.....OCCUPIED BANDWIDTH
PAGE 9.....OCCUPIED BANDWIDTH PLOT – CW
PAGE 10.....OCCUPIED BANDWIDTH PLOT
PAGE 11-13...SPURIOUS EMISSIONS AT ANTENNA TERMINALS
PAGE 14.....FIELD STRENGTH OF SPURIOUS EMISSIONS
PAGE 15.....METHOD OF MEASURING RADIATED SPURIOUS EMISSIONS
PAGE 16.....FREQUENCY STABILITY
PAGE 17.....LIST OF TEST EQUIPMENT


EXHIBIT CONTAINING:


EXHIBIT 1.....FCC ID LABEL SAMPLE
EXHIBIT 2.....SKETCH OF FCC ID LOCATION
EXHIBIT 3A.....EXTERNAL PHOTOGRAPH - FRONT VIEW
EXHIBIT 3B.....EXTERNAL PHOTOGRAPH - REAR VIEW
EXHIBIT 3C.....EXTERNAL PHOTOGRAPH – TOP VIEW
EXHIBIT 3D.....EXTERNAL PHOTOGRAPH – BOTTOM VIEW
EXHIBIT 3E-3F.....EXTERNAL PHOTOGRAPH – SIDE VIEWS
EXHIBIT 3G-3H.....INTERNAL CHASSIS VIEW PHOTOGRAPHS
EXHIBIT 3I.....EXTERNAL PHOTOGRAPH – RF BOARD - COMPONENT
EXHIBIT 3J.....INTERNAL PHOTOGRAPH – RF BOARD - SOLDER
EXHIBIT 3K.....INTERNAL PHOTOGRAPH – CONTROL BOARD – COMPONENT
EXHIBIT 3L.....INTERNAL PHOTOGRAPH – CONTROL BOARD – SOLDER
EXHIBIT 3M.....INTERNAL PHOTOGRAPH – FRONT – SOLDER CHASSIS VIEW
EXHIBIT 3N.....INTERNAL PHOTOGRAPH – FRONT – COMPONENT
EXHIBIT 30.....INTERNAL PHOTOGRAPH – FRONT - SOLDER
EXHIBIT 4A-4B.....TEST SETUP PHTOGRAPHS
EXHIBIT 5A-5C.....BLOCK DIAGRAMS
EXHIBIT 6A-6C.....SCHEMATICS
EXHIBIT 7.....USER'S MANUAL
EXHIBIT 8.....TECHNICAL MANUAL

## GENERAL_INFORMATION_REQUIRED FOR_TYPE_ACCEPTANCE

2.1033 (c) (1,2) RAYMARINE INC. will sell the FCC ID: PJ5RAY215 VHF Marine transmitter in quantity, for use under FCC RULES PART 80.

2.202 (c) TECHNICAL_DESCRIPTION
2.1033 (c) (4)

(1) Type of Emission: 13K6G3E/13K6F3E For 20 kHz
For 25kHz
Bn = 2M + 2DK
M = 3000
D = 3.8 kHz (Peak Deviation)
K = 1
Bn = 2(3.0k) + 2(3.8k)(1) = 6.0 + 7.6 = 13.6 k

80.205(A) ALLOWED AUTHORIZED BANDWIDTH = 20.00 kHz.

2.1033 (c) (5)

(2) Frequency Range: 156.025-157.425 MHz

80.215 (e)

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

2.1033 (c) (6,7)

(4) Maximum Output Power Rating:

High 25.0 Watts,
Low 1.0Watt
into a 50 ohm resistive load.

(5) DC Voltages and Current into Final Amplifier:

POWER INPUT
FINAL AMPLIFIER ONLY

| High | Low |
|---|---|
| Vce = 13.2 Volts | Vce = 13.2 VDC |
| Ice = 3.9 A. | Ice = 1.4 A. |
| Pin = 51.48 Watts | Pin = 18.48 Watts |
| Efficiency = 48 % | = 00.05 % |

2.1033(c)(10) (7) Complete Circuit Diagrams: The circuit diagram is included as EXHIBIT 6A-6C. The block diagram is included as EXHIBIT 5A-5C.

2.1033 (c) (3)(8) Instruction book. The instruction manual is included as EXHIBIT #7.

2.1033(c)(9) (9) Tune-up procedure. The tune-up procedure is given in EXHIBIT #7.

2.1033(c)(10) (10) Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description in the instruction manual.

2.1033(c)(13) (11) Digital modulation. This unit does NOT use digital modulation.

The data required by 2.1046 through 2.1047 is submitted below.

2.1033(c)(6) 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 13.2V, and the transmitter properly adjusted the RF output measures:

POWER OUTPUT

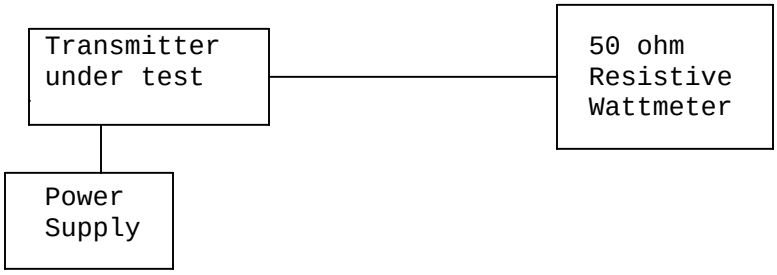
HIGH POWER:

OUTPUT POWER: 25.0 Watts

LOW POWER:

OUTPUT POWER: 1.0 Watt

METHOD OF MEASURING RF POWER OUTPUT

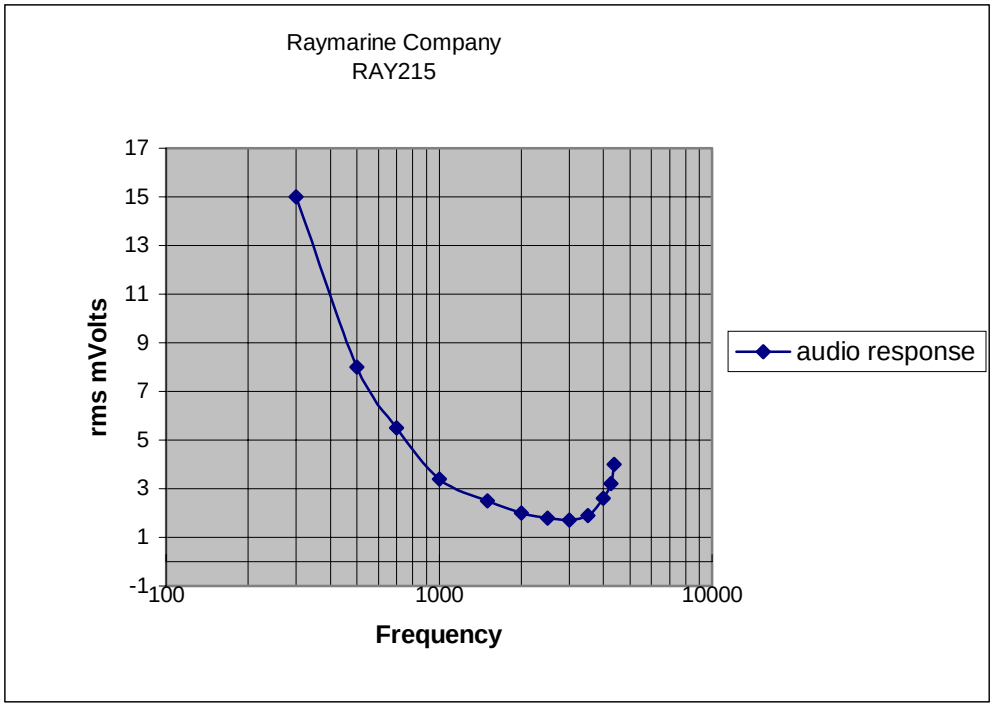


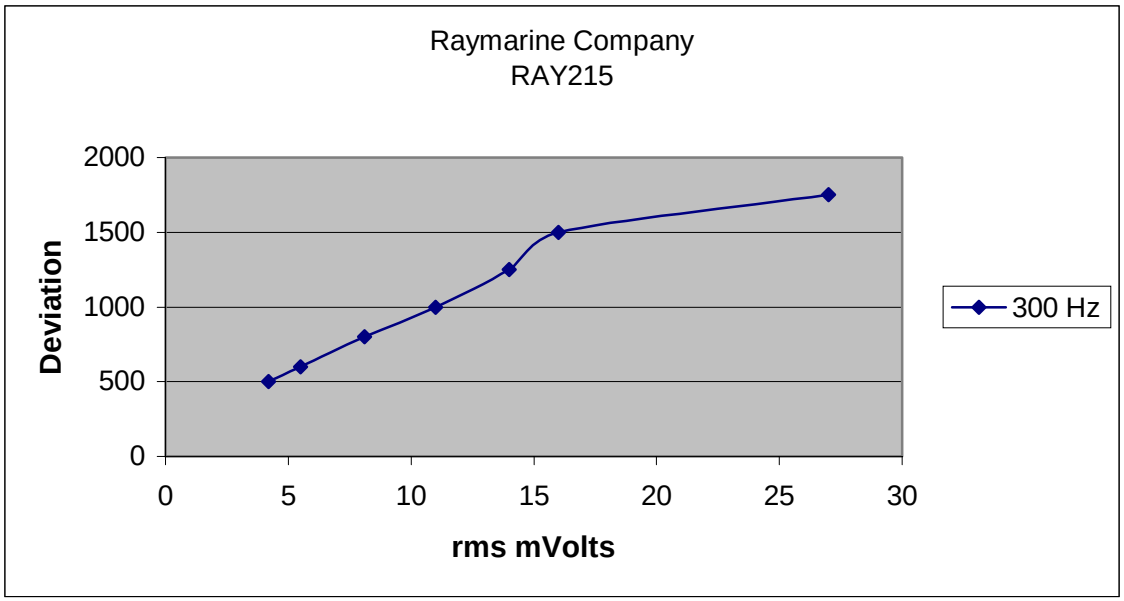

2.1047(a) Voice Modulation_characteristics:

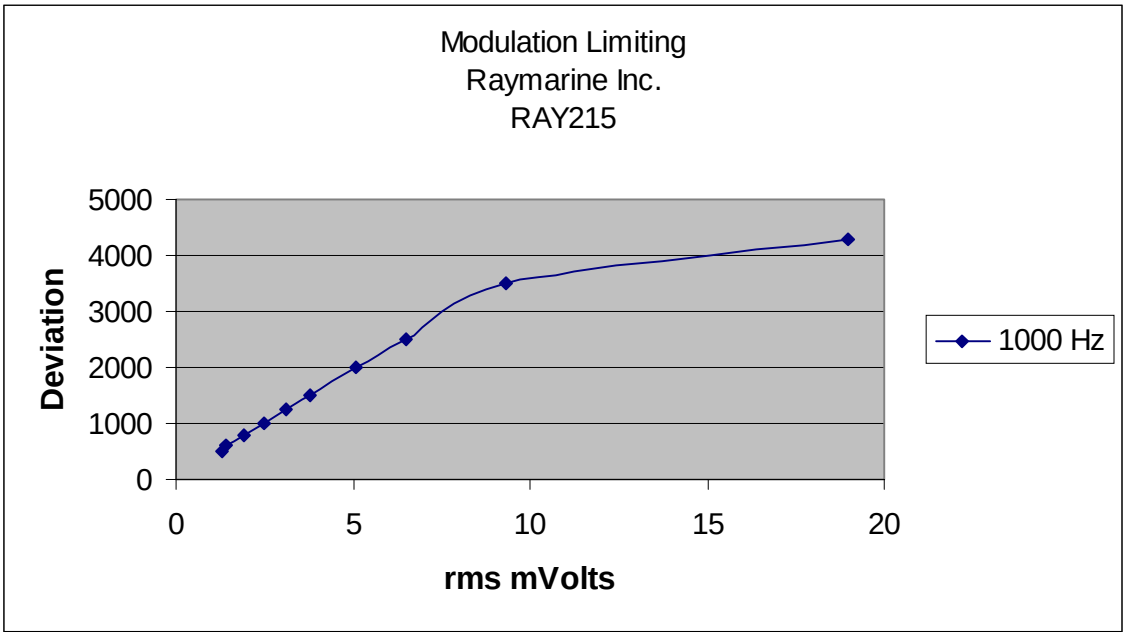
(a) AUDIO_FREQUENCY_RESPONSE See next page.

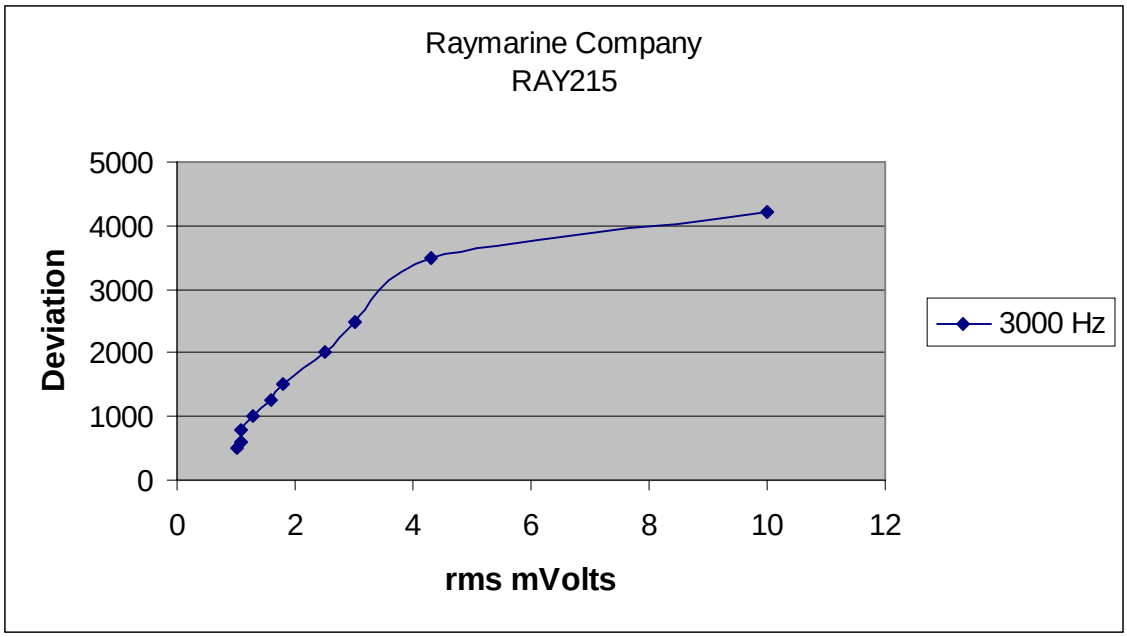
80.213 (e) AUDIO_LOW_PASS_FILTER
The audio low pass filter is included and the plot is shown in page 7. Rules 80.213(e) for ship stations with a low pass filter.

80.213(d) Audio_input_versus_modulation A plot of the audio input versus deviation is shown in in Pages 5-6.

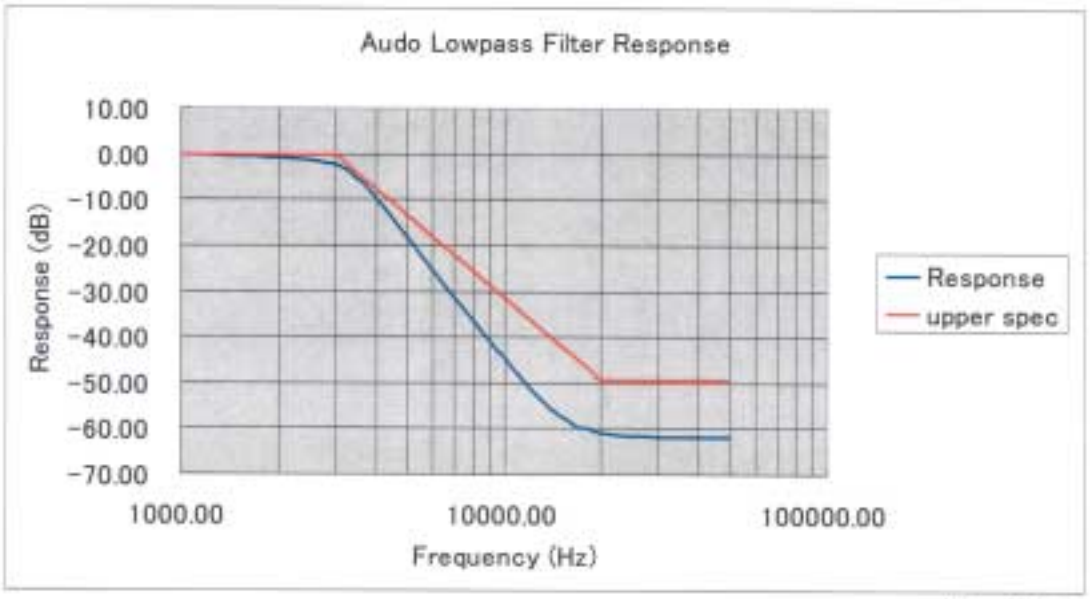

Raymarine Company
RAY215
17
15
13
11
9
7
5
3
1
-1
rms mVolts
100
1000
10000
Frequency
audio response


Raymarine Company
RAY215
2000
1500
1000
500
0
Deviation
0
5
10
15
20
25
30
rms mVolts
300 Hz


Modulation Limiting
Raymarine Inc.
RAY215
5000
4000
3000
2000
1000
0
Deviation
0
5
10
15
20
rms mVolts
1000 Hz


Raymarine Company
RAY215
5000
4000
3000
2000
1000
0
Deviation
0
2
4
6
8
10
12
rms mVolts
3000 Hz

Audio Low-Pass Filter Response Paragraph 2.297a




-60log(f/3k)

2.2049(c) Occupied_bandwidth:

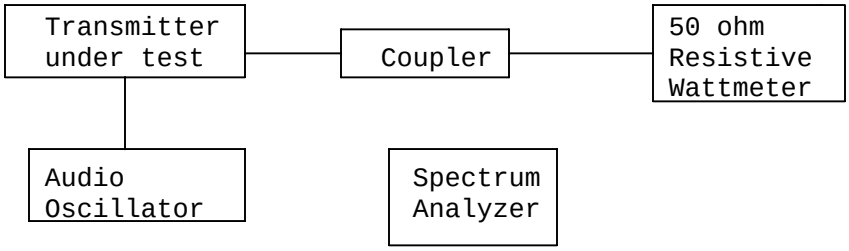
80.205(a)
Data in the plots shows that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35dB. On any frequency removed from the assigned 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.

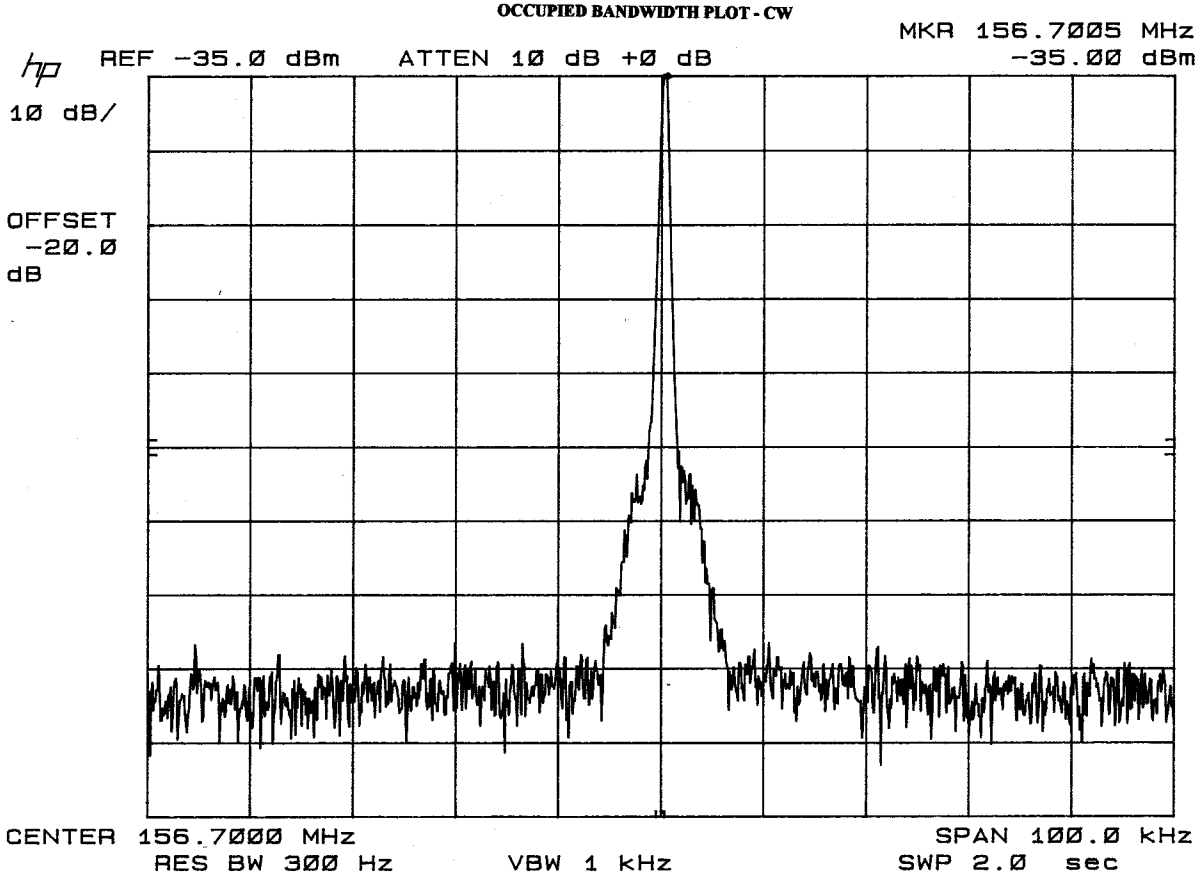
Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT



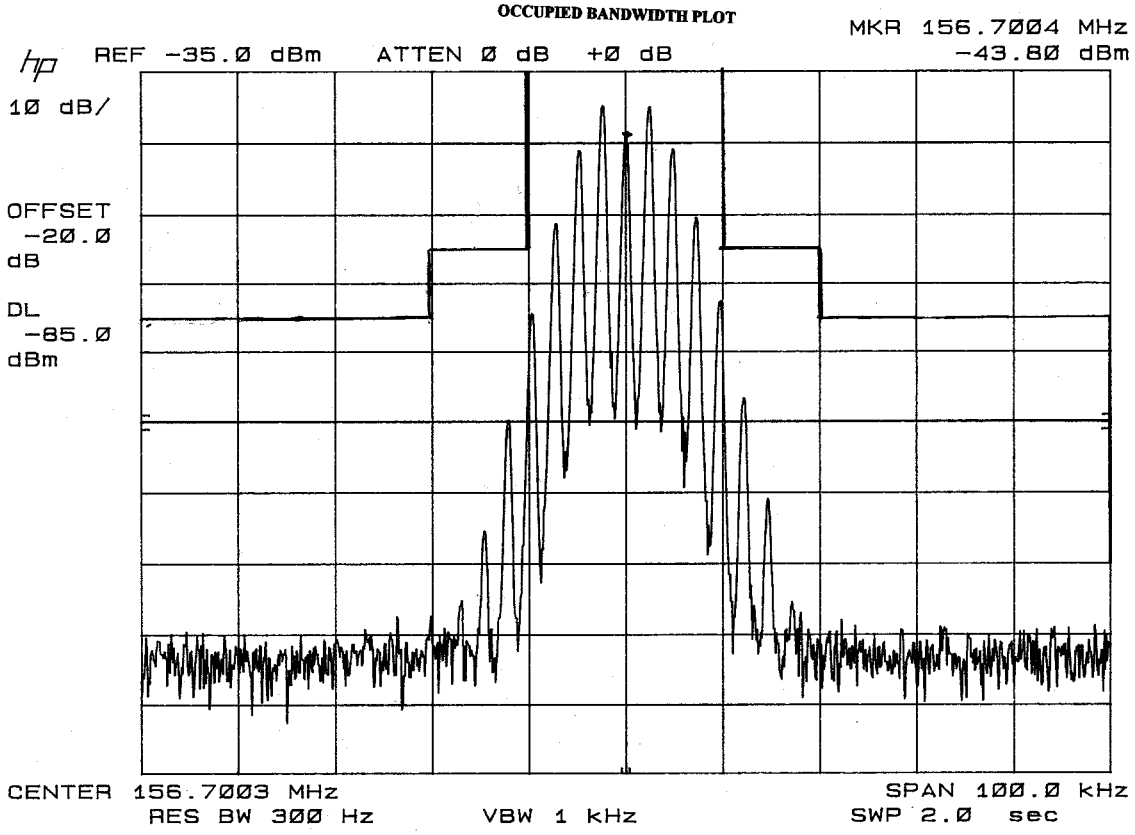
**RAYMARINE, INC.**
**FCC ID: PJ5RAY215**

**OCCUPIED BANDWIDTH PLOT - CW**



RAYMARINE, INC.
FCC ID: PJ5RAY215

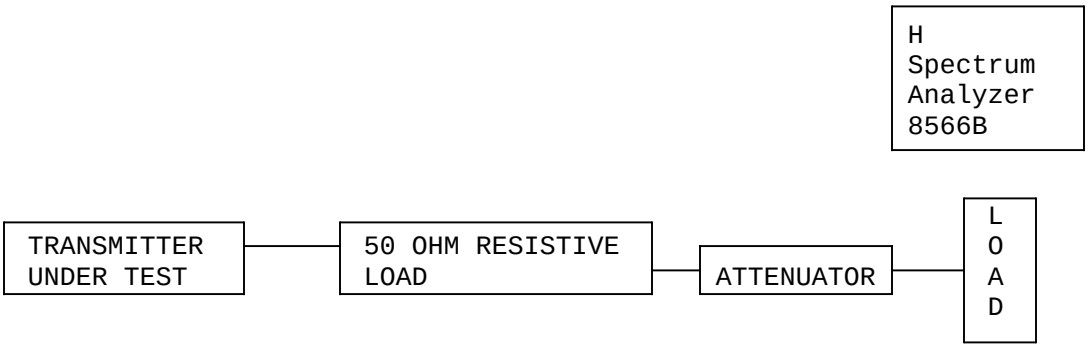
OCCUPIED BANDWIDTH PLOT



2.1051 Spurious_emissions_at_antenna_terminals(conducted):

80.213 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.

Method of Measuring Conducted Spurious Emissions



2.1051 Continued  Spurious_Emissions_at_the_Antenna_Terminals:

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

For 20kHz HIGH POWER  43 + 10log(25) = 43+ 13.98 = 57.0dB
LOW POWER  43 + 10log(1.0) = 43 + 0 = 43dB

**HIGH POWER**

| EMISSION FREQUENCY | dB below carrier |
|---|---|
| 156.6 | 0 |
| 313.2 | 86.2 |
| 469.8 | 81.4 |
| 626.4 | 90.3 |
| 783 | 89.9 |
| 939.6 | 96.6 |
| 1096.2 | 98.3 |
| 1252.8 | 84.1 |
| 1409.4 | 88.9 |
| 1566 | 86.7 |

**LOW POWER**

| EMISSION FREQUENCY | dB below carrier |
|---|---|
| 156.38 | 0 |
| 313 | 44.5 |
| 469 | 42.4 |
| 625 | 56.1 |
| 782 | 53.2 |
| 938 | 98.3 |
| 1095 | 95.8 |
| 1251 | 76.7 |
| 1407 | 88.7 |
| 1564 | 98.7 |

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 400 kHz 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 NW STATE ROAD 45, NEWBERRY FLORIDA 32669.

2.1053(a)(b) 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.

HIGH POWER 43 + 10log(25.0) = 56.98 dB
LOW POWER 43 + 10 LOG(1.0) = 43.00 dB

**HIGH POWER**

| Emission Frequency MHz | Ant. Polarity | Attn. dBc | Margin dB |
|---|---|---|---|
| 156.00 | H | 00.00 | 00.0 |
| 313.30 | H | 57.47 | 0.49 |
| 470.00 | H | 61.41 | 4.43 |
| 626.70 | H | 82.43 | 25.45 |
| 783.40 | H | 78.58 | 21.60 |
| 940.00 | H | 77.10 | 20.12 |
| 1,096.70 | V | 75.62 | 18.64 |
| 1,253.40 | V | 67.04 | 10.06 |
| 1,410.10 | V | 61.18 | 4.20 |
| 1,566.80 | V | 71.62 | 14.64 |

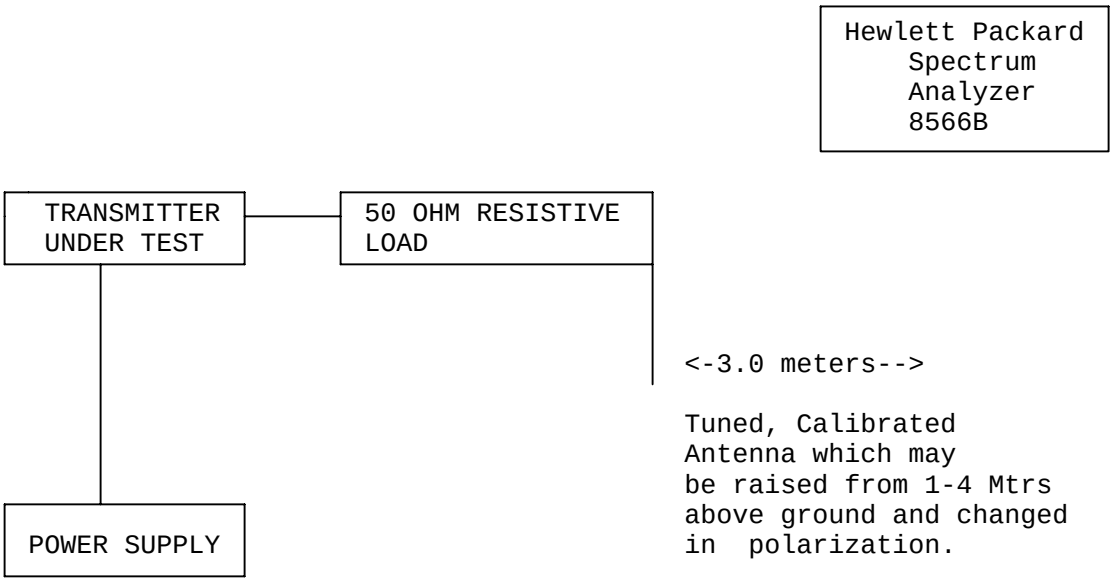
**LOW POWER**

| Emission Frequency MHz | Ant. Polarity | Attn. dBc | Margin dB |
|---|---|---|---|
| 156.38 | H | 00.00 | 00.0 |
| 313.00 | H | 52.01 | 9.01 |
| 469.00 | H | 45.02 | 2.02 |
| 625.00 | H | 52.32 | 9.32 |
| 782.00 | H | 57.12 | 14.12 |
| 938.00 | H | 78.04 | 35.04 |
| 1,095.00 | V | 63.26 | 20.26 |
| 1,251.00 | V | 54.70 | 11.70 |
| 1,407.00 | V | 67.63 | 24.63 |
| 1,564.00 | V | 76.38 | 33.38 |

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.

2.1053(a)(b) Continued Field_strength_of_spurious_emissions:

Method of Measuring Radiated Spurious Emissions




Equipment placed 80 cm above ground
on a rotatable platform.

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 degrees 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 -20 degrees 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 15 second intervals. The worst case number was recorded for temperature plotting. This procedure was repeated in 10 degree increments up to + 50 degrees C.

Readings were also taken at minus 25% of the battery voltage of 13.2VDC, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 156.375 000

| TEMPERATURE_C | FREQUENCY_MHz | PPM |
|---|---|---|
| REFERENCE | 156.375 000 | 00.0 |
| -30 | 156.375 007 | +0.04 |
| -20 | 156.375 081 | +0.52 |
| -10 | 156.375 257 | +1.65 |
| 0 | 156.375 306 | +1.96 |
| +10 | 156.375 219 | +1.40 |
| +20 | 156.375 151 | +0.97 |
| +30 | 156.375 122 | +0.78 |
| +40 | 156.375 269 | +1.72 |
| +50 | 156.375 618 | +3.96 |
| 15% Battery Voltage 15.18 VDC | 156.375 211 | +1.35 |
| -15% Battery Voltage 11.22 VDC | 156.375 159 | +1.02 |

RESULTS OF MEASUREMENTS: The maximum frequency variation over the temperature range was 3.96 ppm. The maximum frequency variation over the voltage range was 1.35 ppm.

TEST EQUIPMENT LIST

1. Spectrum Analyzer: HP 8566B-Opt 462, S/N 3138A07786, w/ preselector HP 85685A, S/N 3221A01400, Quasi-Peak Adapter HP 8565OA, S/N 3303A01690 & Preamplifier HP 8449B-OPT H02, S/N 3008A00372
2. Biconnical Antenna: Eaton Model 94455-1, S/N 1057
3. Biconnical Antenna: Electro-Metrics Model BIA-25, S/N 1171
4. Log-Periodic Antenna: Electro-Metrics Model EM-6950, S/N 632
5. Log-Periodic Antenna: Electro-Metrics Model LPA-30, S/N 409
6. Double-Ridged Horn Antenna: Electro-Metrics Model RGA-180, 1-18 GHz, S/N 2319
7. 18-26.3GHz Systron Donner Standard Gain Horn #DBE-520-20
8. Horn 40-60GHz: ATM Part #19-443-6R
9. Line Impedance Stabilization Network: Electro-Metrics Model EM-7820, w/NEMA Adapter S/N 2682
10. Temperature Chamber: Tenney Engineering Model TTRC, S/N 11717-7
11. Frequency Counter: HP Model 5385A, S/N 3242A07460
12. Peak Power Meter: HP Model 8900C, S/N 2131A00545
13. Open Area Test Site #1-3meters
14. Signal Generator: HP 8640B, S/N 2308A21464
15. Signal Generator: HP 8614A, S/N 2015A07428
16. Passive Loop Antenna: EMCO Model 6512, 9KHz to 30MHz, S/N 9706-1211
17. Dipole Antenna Kit: Electro-Metrics Model TDA-30/1-4, S/N 153
18. AC Voltmeter: HP Model 400FL, S/N 2213A14499
19. Digital Multimeter: Fluke Model 8012A, S/N 4810047
20. Digital Multimeter: Fluke Model 77, S/N 43850817
21. Oscilloscope: Tektronix Model 2230, S/N 300572