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FCC ID: PJ5RAY230

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GENERAL_INFORMATION_REQUIRED
FOR_TYPE_ACCEPTANCE

2.983 (a,b,c) RAYMARINE, INC. will sell the
MODEL NO. PJ5RAY230 VHF Marine transmitter in
quantity, for use under FCC RULES PART 80.

80.203(n) DSC - The statement regarding DSC can be found in Page
7 of the manual.

2.983 (d) TECHNICAL_DESCRIPTION

(1) Type of Emission: 16K0G3E/16K0F3E For 20KHz
For 25KHz

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 4.6\text{KHz (Peak Deviation)}$$

$$K = 1$$

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

80.205(A) ALLOWED AUTHORIZED BANDWIDTH = 20.00KHz.

(2) Frequency Range: 156.025-157.425 MHz

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

(4) Maximum Output Power Rating:

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

(5) DC Voltages and Current into Final Amplifier:

POWER INPUT

FINAL AMPLIFIER ONLY

High	Low
------	-----

$V_{ce} = 13.6$ Volts	$V_{ce} = 13.6$ VDC
-----------------------	---------------------

$I_{ce} = 5.66$ A.	$I_{ce} = 1.51$
--------------------	-----------------

$P_{in} = 76.97$ Watts $P_{in} = 20.53$ Watts

(6) Function of each electron tube or semiconductor
device or other active circuit device: - SEE EXHIBIT# 7

2.983(d) (7) Complete Circuit Diagrams: The circuit diagram is
included as EXHIBIT 6A-6I. The block diagram is
included as EXHIBIT 5A-5E.

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

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

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

2.983 (11) Description of any circuits or devices employed for suppression of spurious radiation, for limiting modulation, and for limiting power.

In addition to the interstage filtering the multi-section low pass filter made up of L12, L11, C40, C47, C95, C46, C94, C45, & C26.

Limiting Modulation:

The transmitter audio limiting circuitry is contained in the loop filter IC01.

Limiting Power: There is no provision for limiting power.

(12) Digital modulation. This unit does NOT use digital modulation.

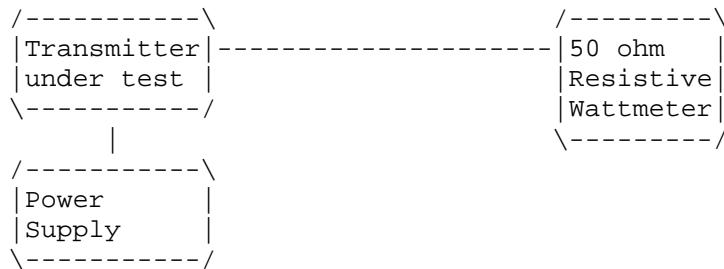
2.983(e) The data required by 2.985 through 2.997 is submitted below.

2.985(a)
80.215(e)(1) RF_power_output.

RF power is measured by connecting a 50 ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage of 13.6V, and the transmitter properly adjusted the RF output measures:

POWER OUTPUT
INPUT POWER: $(13.6V)(5.66A) = 75.97$ Watts
OUTPUT POWER: 25.0 Watts Efficiency: 32.5

METHOD OF MEASURING RF POWER OUTPUT



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2.987(a) Voice Modulation_characteristics:
(a) AUDIO_FREQUENCY_RESPONSE See the EXHIBIT #8.

2.987(a) AUDIO_LOW_PASS_FILTER
The audio low pass filter is included and the plot is shown as EXHIBIT #9. Rules 80.213(e) for ship stations with a low pass filter.

2.987(b) 80.213(d) Audio_input_versus_modulation A plot of the audio input versus deviation is shown in EXHIBITS 10A-10C.

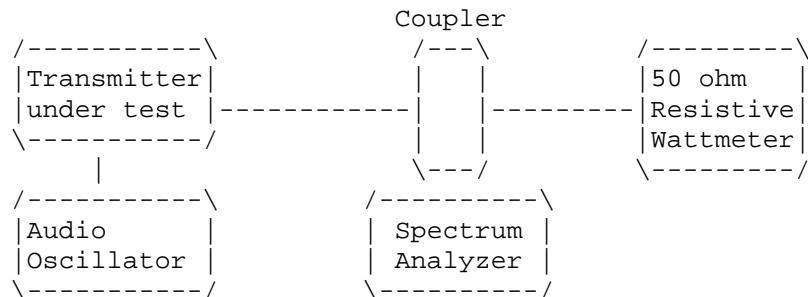
2.989(c) Occupied_bandwidth:
80.210(b,)
Data in the plots shows that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35dB. On any frequency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

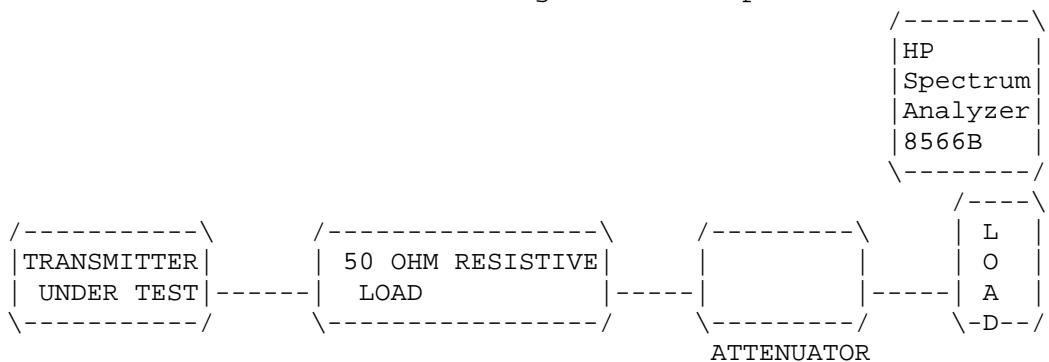
OCCUPIED BANDWIDTH MEASUREMENT



2.991
80.213

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.

Method of Measuring Conducted Spurious Emissions



2.991 Continued Spurious_Emissions_at_the_Antenna_Terminals:

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

For 20KHz HIGH POWER $43 + 10\log(25) = 43 + 13.98 = 57.0$ dB
LOW POWER $43 + 10\log(1) = 43 + 0 = 43$ dB

EMISSION FREQUENCY	HIGH POWER		LOW POWER	
	dB BELOW CARRIER	MHz	EMISSION FREQUENCY	dB BELOW CARRIER
156.80	00.0	156.80	0.0	
313.60	-91.50	313.60	-75.00	
470.40	-93.30	470.40	-83.20	
627.20	-90.20	627.20	-92.10	

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.

2.993(a)(b) Field_strength_of_spurious_emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

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

HIGH POWER $43 + 10\log(25.0) = 56.98$ dB
LOW POWER $43 + 10 \log(1.0) = 43.0$ dB

EMISSION

FREQUENCY ATT.

MHz dB

HIGH POWER

156.00	0.0
312.10	-68.20
468.10	-80.57
624.20	-80.53
780.20	-65.88
936.30	-69.79
1092.30	-72.97
1248.40	-76.69
1404.40	-72.42
1560.50R	-73.84

LOW POWER

156.05	0.00
312.10	-65.66
468.10	-70.30
624.20	-76.93
780.20	-66.28
936.30	-64.59
1092.30	-67.97
1248.40	-72.39
1404.40	-65.72
1560.50	-74.34

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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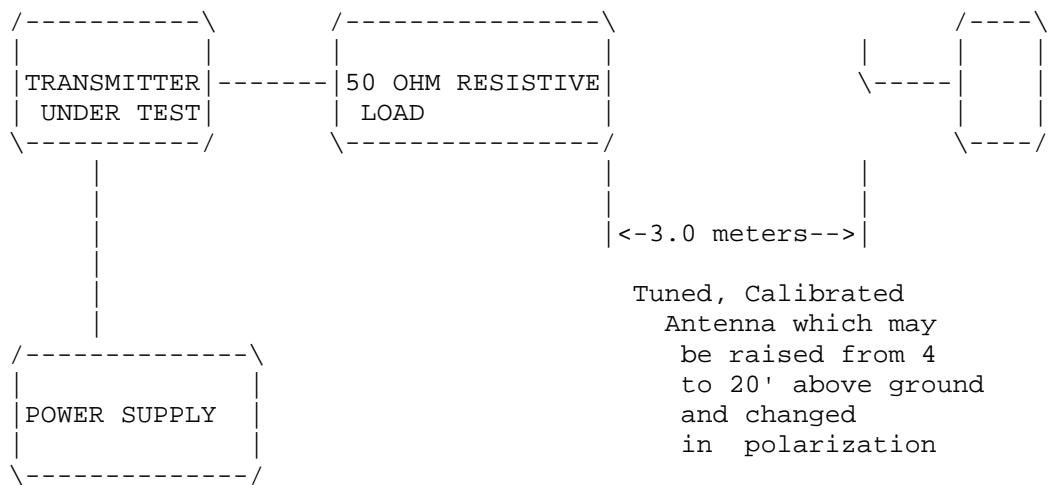
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2.993(a)(b)

2.993(a)(b) Continued Field_strength_of_spurious_emissions:

Method of Measuring Radiated Spurious Emissions

Hewlett Packard
Spectrum
Analyzer
HP8555A



Equipment placed 4' above ground
on a rotatable platform.

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Frequency_stability:

2.1055(a)(2)

90.213(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 5.4VDC, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 156.800 000MHz

TEMPERATURE_C	FREQUENCY_MHz	PPM
REFERENCE_____	156.800 000	00.0
-30_____	156.800 135	+0.87
-20_____	156.800 142	+0.91
-10_____	156.800 342	+2.19
0_____	156.800 338	+2.17
+10_____	156.800 213	1.37
+20_____	156.800 027	0.17
+30_____	156.799 861	-0.89
+40_____	156.799 827	-1.11
+50_____	156.799 993	-0.04
20oC 0.85% Battery Voltage	156.799 984	-0.10
1.15% Battery Voltage	156.799 984	-0.10

RESULTS OF MEASUREMENTS: The maximum frequency variation over the temperature range was -0.89 to 2.19 ppm. The maximum frequency variation over the voltage range was -0.10 ppm.

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2.983(f) Photo_or_Drawing_of_Label:
See Exhibit 2.

2.983(g) Photos_of_Equipment:
See Exhibits 3A-3D.

2.999 Measurement_Procedures_for_Type_Acceptance:
Measurement techniques have been in accordance with EIA specifications and the FCC requirements.

2.909 Certification_of_Technical_Data_by_Engineers
We, the undersigned, certify that the enclosed measurements and enclosed data are true and correct.

S.S. Sanders
Engineer

TEST EQUIPMENT LIST

1. Spectrum Analyzer: HP 8566B-Opt 462, S/N 3138A07786, w/ preselector HP 85685A, S/N 3221A01400, Quasi-Peak Adapter HP 85650A, S/N 3303A01690 & Preamplifier HP 8449B-OPT H02, S/N 3008A00372 Cal. 1/19/01
2. Biconnical Antenna: Eaton Model 94455-1, S/N 1057, Cal 3/15/00
3. Biconnical Antenna: Electro-Metrics Model BIA-25, S/N 1171 Cal. 3/16/01
4. Log-Periodic Antenna: Electro-Metrics Model EM-6950, S/N 632 Cal. 3/15/00
5. Log-Periodic Antenna: Electro-Metrics Model LPA-30, S/N 409 Cal. 3/15/00
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 Cal. 3/16/01
10. Temperature Chamber: Tenney Engineering Model TTRC, S/N 11717-7 Cal. 1/21/01
11. Frequency Counter: HP Model 5385A, S/N 3242A07460 Cal 11/20/00
12. Peak Power Meter: HP Model 8900C, S/N 2131A00545, Cal. 1/26/01
13. Open Area Test Site #1-3meters Cal. 12/22/99
14. Signal Generator: HP 8640B, S/N 2308A21464 Cal. 11/21/00
15. Signal Generator: HP 8614A, S/N 2015A07428
16. Passive Loop Antenna: EMC Model 6512, 9KHz to 30MHz, S/N 9706-1211 Cal. 6/10/00
17. Dipole Antenna Kit: Electro-Metrics Model TDA-30/1-4, S/N 153 Cal. 11/24/00
18. AC Voltmeter: HP Model 400FL, S/N 2213A14499 Cal. 2/1/01
19. Digital Multimeter: Fluke Model 8012A, S/N 4810047 Cal 9/21/99
20. Digital Multimeter: Fluke Model 77, S/N 43850817 Cal 11/16/00
21. Oscilloscope: Tektronix Model 2230, S/N 300572 Cal 2/1/01