

ENGINEERING STATEMENT

In Connection With
NorCross Marine Products, Inc.

Model No. DF20

FCC ID: PSTDF1000T

Hyak Laboratories, Inc. has been retained to perform radiated and conducted spurious measurements on the DF20 wireless depth sounder in accordance with Section 15.249 of FCC rules.

I am an Electronics Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communications Commission, having submitted numerous applications for equipment authorization.

All tests were made by me or under my supervision in accordance with the rules and regulations of the Federal Communications Commission.

Rowland S. Johnson

Dated: July 20, 2001

INTRODUCTION

Procedures of ANSI 63.4 (1992) were used.

The DF20 is a frequency modulation, 900 MHz band system operating between 903 - 927 MHz.

DF20 is a wireless depth sounder which sends depth reading to remote readers, either DF2D or DF2R. The micro-controller sounds ultrasonic pulses to the transducer connected to DF20, measures the time elapsed for the echoes and computes the depth. Depth readings are sent via radio link to remote units (DF2D or DF2R) to display the readings.

Depth data is a low speed serial bursts of 22 kHz digital signal which FM modulates the 900 MHz RF carrier. There are two frequency channels to be selected.

The heart of the transmitter is a RF2512 transmitter IC by RF Micro Devices. Built inside the RF2512 is a PLL, the division ratio of which can be externally selected. In this application, a division ratio of 64 has been selected. The transmitter frequency is determined by the frequency of the crystal selected. That is transmitter frequency is determined by $64 \times$ crystal frequency.

There are two crystals which can be selected by the micro-controller. The "Chan Select" line selects which crystal. X2 is selected when "Chan Select" is high. The trimmer capacitors are used to trim the crystal to a desired 900 MHz frequency.

FM modulation is done by directly modulating the VCO (formed by L1-3, D1 and C6) via pin 16. R1 and R2 determine the frequency deviation.

Transmitter power is adjustable. The control pin is at pin 7. R5 and R6 set the output power.

RF out is at pin 8. C19, C20 and L4 form a pi filter which filters out the higher order of harmonics.

The antenna is an internally mounted printed circuit whip. Inductor L5 is used to compensate for the antenna's high capacitive reactance.

COMPLIANCE WITH SECTION 15.249 OF PART 15

- 15.249(a,b) The field strength of the radiation emission was measured and found to comply with the limits established by 15.249(a) and 15.209. (See data of Tables 1a, 1b and 1c.)
- 15.249(c) Emissions radiated outside of the specified frequency bands, except for harmonics, were attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, (whichever is the lesser attenuation). See Figures 1a, 1b and 1c.

Operating channels are limited to the 903 - 927 MHz band in order to provide 1 MHz band-edge compliance with any close-in spectra less than 50 dB below carrier.

For typical modulating waveform see Figure 1d.

- 15.207(a) No AC power line conducted measurements are required; the device operates only from a vessel's dc supply.

DATA

Tables and Figures referenced above follow immediately after this page. Description of measurement procedures and test equipment used in the measurements follow the data pages.

TABLE 1a

RADIATED SPURIOUS EMISSIONS
Measured at 3 meters
PART 15(B) PARA. 15.249

<u>Frequency of Emission (MHz)</u>	<u>Meter Reading (dBm)</u>	<u>Antenna Factor (dB)</u>	<u>Field¹ Intensity uV/m @ 3m</u>	<u>FCC Limit uV/m @ 3m</u>	<u>dB to Limit</u>
903.69	-47.2	32.1	39355.0	50000	-2.1V
1807.38	-88.0	27.3	206.5	500	-7.7V
2711.07	-86.0	30.1	358.9	500	-2.9V
3614.76	-86.9	32.6	431.5	500	-1.3V
4518.45	-88.8*	32.8	354.8	500	-3.0V
5422.14	-92.8*	34.9	285.1	500	-4.9V
6325.83	-90.0*	35.6	426.6	500	-1.4H
7229.52	-92.2*	36.9	384.6	500	-2.3V

8133.21	-93.3*	38.2	393.6	500	-2.1V
9036.90	-95.2*	38.5	327.3	500	-3.7V

Note 1: $\mu\text{V/m} = \text{Log}^{\frac{-\text{dBu/m}}{20}}$

dBu = dBm + antenna factor + 107

*Measured at 1 meter, extrapolated to 3 meters.

RBW 100 kHz to 1 GHz; 1 MHz > 1 GHz. Reduced if CW signal.

H,V: Worst-case test antenna polarization.

RADIATED SPURIOUS
EMISSIONS
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TABLE 1a

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TABLE 1b

RADIATED SPURIOUS EMISSIONS
Measured at 3 meters
PART 15(B) PARA. 15.249

Frequency of Emission (MHz)	Meter Reading (dBm)	Antenna Factor (dB)	Field ¹ Intensity $\mu\text{V/m}$ @ 3m	FCC Limit $\mu\text{V/m}$ @ 3m	dB to Limit
912.91	-47.7	32.3	38018.9	50000	-2.4V
1825.82	-86.9	27.4	237.1	500	-6.5V
2738.73	-88.1	30.2	285.1	500	-4.9V
3651.64	-87.2	32.7	421.7	500	-1.5V
4564.55	-88.9*	32.9	354.8	500	-3.0V
5477.46	-91.3*	35.0	342.8	500	-3.3V
6390.37	-90.1*	35.6	421.7	500	-1.5V
7303.28	-91.4*	37.2	436.5	500	-1.2V
8216.19	-93.1*	38.2	402.7	500	-1.9V
9129.10	-94.6*	38.5	350.8	500	-3.1V

Note 1: $\mu\text{V/m} = \text{Log}^{\frac{-1\text{dBu/m}}{20}}$

$$\text{dBu} = \text{dBm} + \text{antenna factor} + 107$$

*Measured at 1 meter, extrapolated to 3 meters.

RBW 100 kHz to 1 GHz; 1 MHz > 1 GHz. Reduced if CW signal.

H,V: Worst-case test antenna polarization.

RADIATED SPURIOUS
EMISSIONS
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TABLE 1b

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TABLE 1c

RADIATED SPURIOUS EMISSIONS
Measured at 3 meters
PART 15(B) PARA. 15.249

<u>Frequency of Emission (MHz)</u>	<u>Meter Reading (dBm)</u>	<u>Antenna Factor (dB)</u>	<u>Field¹ Intensity uV/m @ 3m</u>	<u>FCC Limit uV/m @ 3m</u>	<u>dB to Limit</u>
926.04	-47.9	32.4	37583.7	50000	-2.5V
1852.08	-83.2	27.5	367.3	500	-2.7V
2778.12	-88.4	30.2	275.4	500	-5.2V
3704.16	-89.2	32.8	338.8	500	-3.4V
4630.20	-90.1*	33.2	319.9	500	-3.9V
5556.24	-90.3*	35.0	384.6	500	-2.3V
6482.28	-90.2*	35.8	426.6	500	-1.4H
7408.32	-93.2*	37.4	363.1	500	-2.8V
8334.36	-93.5*	38.1	380.2	500	-2.4V
9260.40	-93.4*	38.5	402.7	500	-1.9V

Note 1: $\text{uV/m} = \text{Log}^{-1} \frac{\text{dBu/m}}{20}$

$$\text{dBu} = \text{dBm} + \text{antenna factor} + 107$$

*Measured at 1 meter, extrapolated to 3 meters.

RBW 100 kHz to 1 GHz; 1 MHz > 1 GHz. Reduced if CW signal.

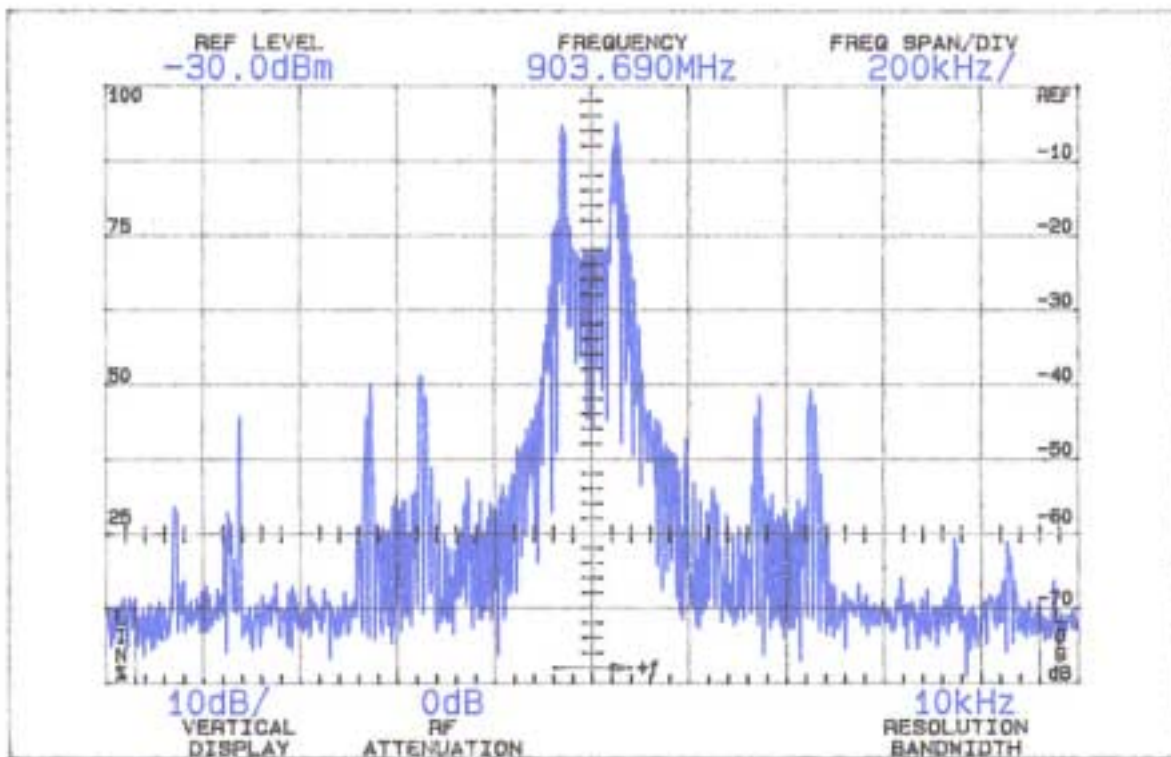
H,V: Worst-case test antenna polarization.

RADIATED SPURIOUS
EMISSIONS
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TABLE 1c

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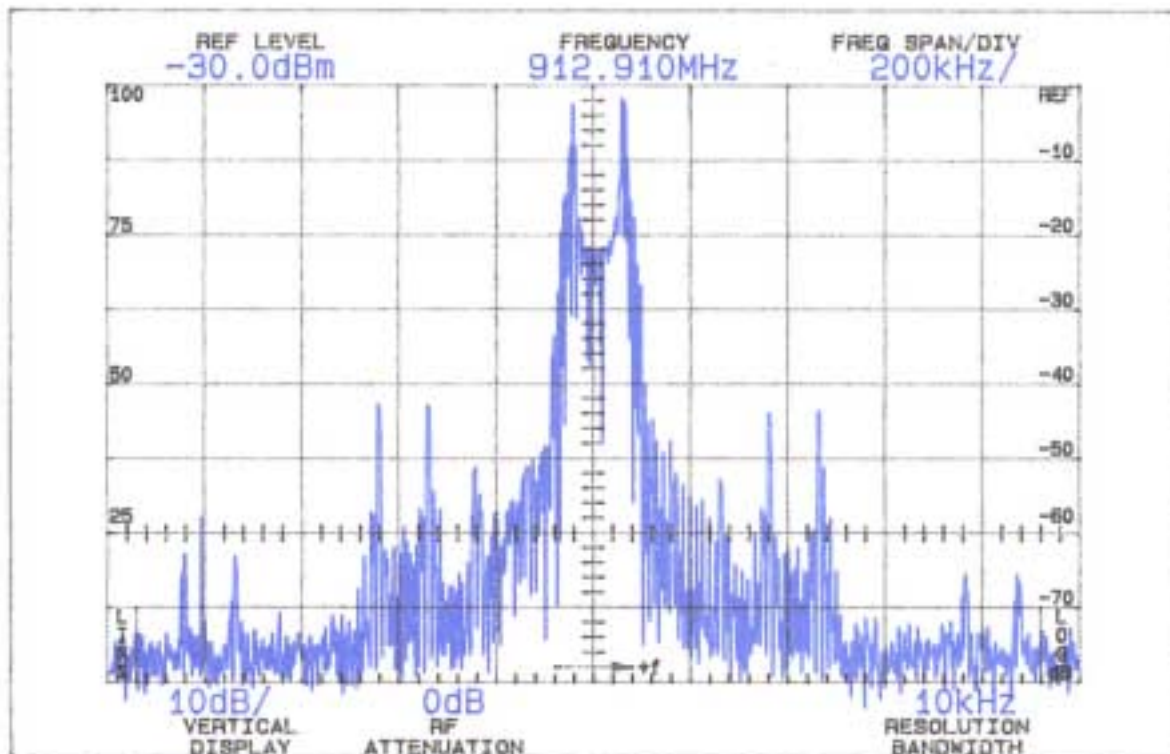
FIGURE 1a



OCCUPIED BANDWIDTH
MODEL DF20

FIGURE 1a (903.69 MHz)

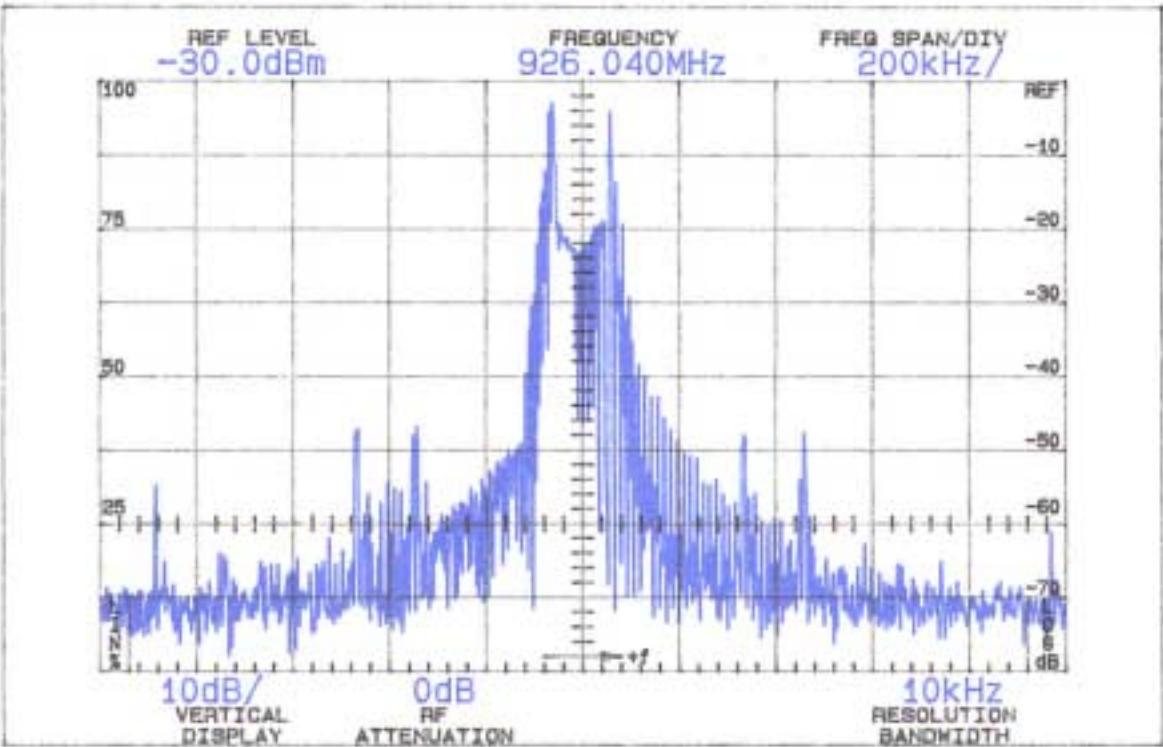
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FIGURE 1b



OCCUPIED BANDWIDTH
MODEL DF20

FIGURE 1b (912.91 MHz)

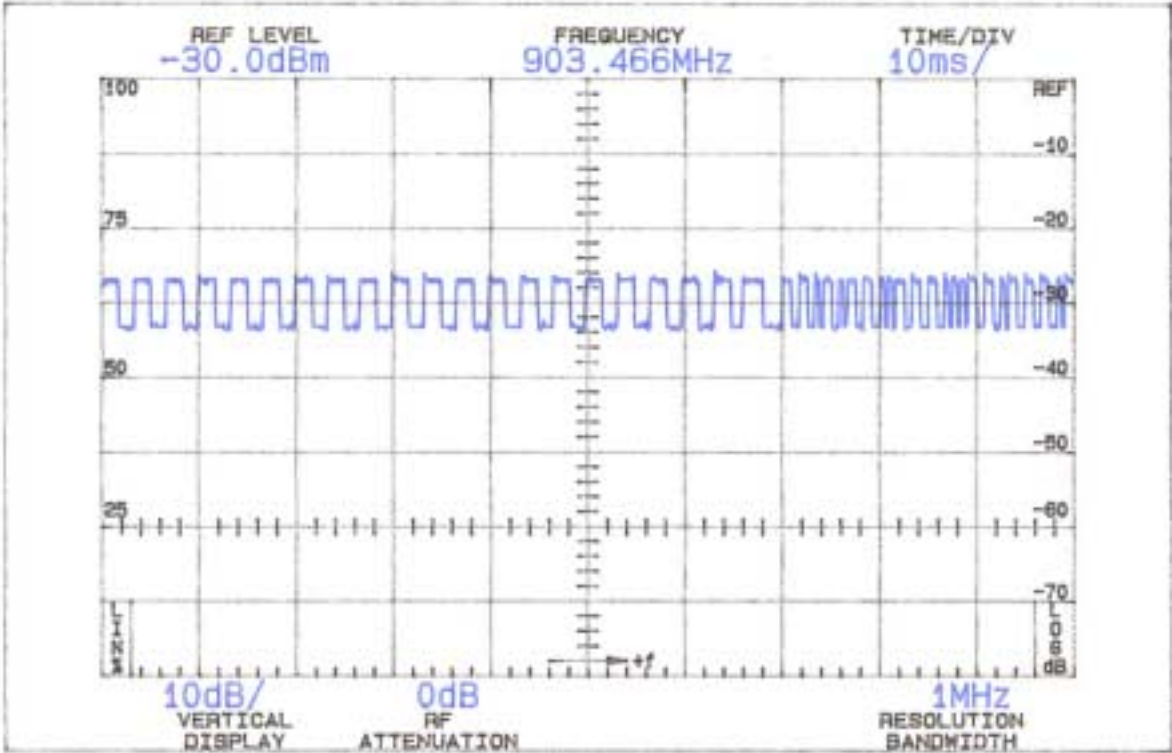
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FIGURE 1c



OCCUPIED BANDWIDTH
MODEL DF20

FIGURE 1c (926.04 MHz)

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FIGURE 1d



MODULATING WAVEFORM
MODEL DF20

FIGURE 1d

PROCEDURES, RADIATED SPURIOUS EMISSIONS

The field strength of the radiated emissions from the DF20 was measured following ANSI 63.4 (1992) at a distance of 3 meters to the third harmonic at which time the horn antennas were moved to 1 meter. The spectrum was scanned from 30 MHz to the tenth harmonic using a Tektronix 494P spectrum analyzer.

Measurement procedure included recording the worst-case field strength for receiving test antenna polarization, test antenna height variation from 1 meter to 3 meters and test sample rotation, and test sample antenna in both vertical and horizontal plane.

The test sample was placed on a rotatable 80 cm high wooden stand. The receiving antenna, placed 3 meters from the test sample, was a Singer DM-105A dipole, or Polarad CA-L, CA-S, or EMC0 3115 Horns. RBW used on the TEK 494P was 100 kHz to 1 GHz; 1 MHz > 1 GHz. Measurements above the 2nd harmonic were made at 1 meter extrapolated to 3 m; peak responding detector, VBW = > than RBW.

The device was operated from a 12 V dc supply enclosed in the EUT.

The spectrum was checked from 30 to the tenth harmonic. All emissions not reported were less than 50 uV/m @ 3m or in system noise. Tabulation of the measurements are shown in Tables 1, 1b and 1c for low, mid and high channels.