DWG. NO. 150-040887 | SH 1 | REV A

APPLICATION		REVISIONS			
NEXT ASSEMBLY	FINAL ASSEMBLY	REV	DESCRIPTION	DATE	APPROVED
		A	INITIAL RELEASE PER DCN W1573	7/3/01	W Wallace

Wulfsberg Electronics Division
A Chelton Group Company
Prescott, AZ 86301 U.S.A.

APPROVALS	DATE
DRAWN R D S	7/3/01
CHECKED D. Ellis	7/3/01
ENGINEER Ralph D S	7/3/01
ISSUED W Wallace	7/3/01

TITLE: **TYPE ACCEPTANCE REPORT**
MODEL RT-138FN
FCC ID: FRWRT-138FN

SIZE	CAGE CODE	DWG. NO.	REV
A	1B7G3	150-040887	A

SCALE NONE

TABLE OF CONTENTS

1 INTRODUCTION

This Engineering Report detail the changes made to the Wulfsberg RT-138F transceiver to incorporate switchable modulation limiting. New production radios with these changes will be labeled the RT-138FN. These changes were made to allow operation in either narrow band (12.5 kHz, 90.210 (d)) or wide-band (25 kHz, 90.210(b)) communication systems.

The RT-138F was originally granted Type Acceptance under FCC ID number FRW4WJRT-138 in 1989. The intent of this application is to Type Accept changes to the RT-138F to enable narrow band operation. The intent is to remanufacture existing customer's radios and change new production to allow narrow band operation.

The measurements detailed in this report were done in accordance with Parts 2, 74, 80 and 90 of the FCC Rules and Regulations.

The RT-138F is intended for mobile aircraft use for communications primarily with land mobile, portable, aircraft, marine, and base station radios. Intended frequency coverage is:

138-174 MHz

Associated equipment is the C-1000 Communication Management Controller which provides frequency selection and indication.

Non-frequency agile operation, as required by section 80.203 (b) or 90.203 (e), is controllable via a hardware frequency-control lockout. The C-1000 control head for the RT-138F is designed with an internal switch to disable channel programming or manual transmitter tuning. The switch is activated by the service technician to allow channel programming for system setup. Once programming has been completed, the switch should be deactivated. At that time, transmission is only possible on the preprogrammed channels.

For operation in aircraft installations, under 90.203 (h) and 90.423, the internal switch may be left in the enable position to allow programming by the pilot.

To comply with FAR 80.871 the RT-138F covers the frequency range of 138.00 to 173.9975 MHz. It is tunable in 12.5 or 25 kHz steps, is capable of semi-duplex or simplex operation, and meets the requirements of FAR 80.143.

Paragraph references throughout this report are referenced to CFR, Title 47 revised 1987.

2 TEST FACILITIES

Bench test measurements listed in chapter were completed at the Wulfsberg Electronics Division engineering facilities located in Prescott, Arizona. All test equipment used was in current calibration, traceable to NIST.

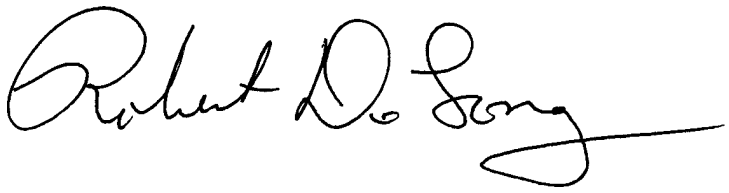
The original radiated emissions measurements on the RT-138F were conducted by Tele-Radio Systems Limited. See Attachment B for their statements of site and test facilities. The design changes to allow narrow band operation involve only addition of a switchable audio gain stage and replacement of the IF filter. Since these changes do not involve the transmitter, the original open field measurements should remain valid. Near field testing in our lab per DO-160 indicates no change after the modification was installed.

3 CERTIFICATION OF DATA

CERTIFICATION OF DATA CONCERNING TYPE ACCEPTANCE APPLICATION FOR FCC ID:

FRWRT-138FN

I certify that all bench tests in Type Acceptance application and Test Report were performed under my supervision. To the best of my knowledge and belief, the facts set forth in the accompanying technical data are true and correct.



_____

Robert DeLong
Vice President Engineering Wulfsberg Electronics Division.

APPLICANT:	Wulfsberg Electronics Division Chelton Avionics, Inc.
FCC ID:	FRWRT-138FN
DATE:	November 17, 2000

4 EXPOSITORY STATEMENTS; Paragraph 2.983 (a) - (d):

4.1 Name of Applicant; Paragraph 2.983 (a):

The applicant and manufacture is: Wulfsberg Electronics Division

4.2 Identification of Equipment; Paragraph 2.983 (b):

Model: RT-138FN
Serial number: 1723
FCC ID: FRWRT-138FN

4.3 Production Quantity; Paragraph 2.983 (c):

Quantity production of the RT-138FN is planned.

4.4 Types of Emission; Paragraph 2.983 (d) (1):

16K0F3E
11K2F3E

4.5 Frequency Range; Paragraph 2.983 (d) (2):

138.0000-174.9975 MHz

4.6 Power Rating; Paragraph 2.983 (d) (3):

10 Watts

4.7 Maximum Power Rating; Paragraph 2.983 (d) (4):

12 Watts

4.8 DC Voltage and Current into final Amplifier; Paragraph 2.983 (d) (5):

Collector voltage: 28.7 VDC
Supply voltage: 28.7 VDC
Collector Current: 0.91 Amps. @ 156 MHz

4.9 Function of Semiconductors and other active devices; Paragraph 2.983 (d) (6):

Please refer to Attachment A for the Theory of Operation and schematics of the radio.

4.10 Complete Circuit Diagrams; Paragraph 2.983 (d) (7):

Complete Schematic diagrams for the radio are in Attachment A.

4.11 Instruction Book; Paragraph 2.983 (d) (8):

The instruction book is located in Attachment C.

4.12 Tune-up Procedure at Nominal Power; 2.983 (d) (9):

The tune-up procedure is in the repair manual located in Attachment A.

4.13 Circuitry and Devices for Determining and Stabilizing Frequency; Paragraph 2.983 (d) (10):

The main VCO is phase locked to an ovenized crystal oscillator (OCXO). The oscillator frequency is 12.8 MHz. Exact operation is detailed in Attachment A.

4.14 Circuits for Suppression of Spurious Radiation, Limiting of Modulation and Limiting of Power; Paragraph 2.983 (d) (11):

(i) Suppression of Spurious Radiation:
A low pass filter follows the Class C power amplifier to attenuate harmonic energy. The schematic of this circuit is located in the repair manual in Attachment A.

(ii) Limiting of modulation:
The audio input is limited by a dual diode clipper, which is follow by a low pass filter to remove induced harmonics. This is followed by a switchable x2 gain stage to allow 2.5 kHz or 5 kHz limiting operation. The schematic of this circuit is located in the repair manual in Attachment A.

5 TEST PROCEDURES AND CONDITIONS

5.1 Measurement Procedures; Paragraph 2.947 (a), (b), (c):

The measurement procedures used to produce the data submitted in this report followed good engineering practice and were in accordance with accepted procedure, as specified in the applicable sections of the FCC rules. The measurement set-up for each set of data is detailed in Section 6 of this report in accordance with FCR 2.947 (b), (c).

5.2 Test Equipment; Paragraph 2.947 (d):

Following is a list of equipment used for the tests detailed herein. Item numbers will be used to refer to equipment in block diagrams. Each piece of equipment is in current calibration traceable to NBS.

Item Number	Equipment	Manufacturer / Model
1	Audio Analyzer	HP 8903B
2	Modulation Analyzer	HP 8901B
3	Spectrum Analyzer	HP 89441A
4	Multimeter	Fluke 77
5	Wattmeter	HP 438A
6	Power Supply	Xantrex XHR 40-25
7	Temperature Chamber	Tenney Mite 5
8	30 dB Power Attenuator	Weinschell 49-30-33

5.3 Test Conditions for Transmitter Type Acceptance Test:

The following conditions applied during room temperature testing.

Temperature: 23 ± 5° C

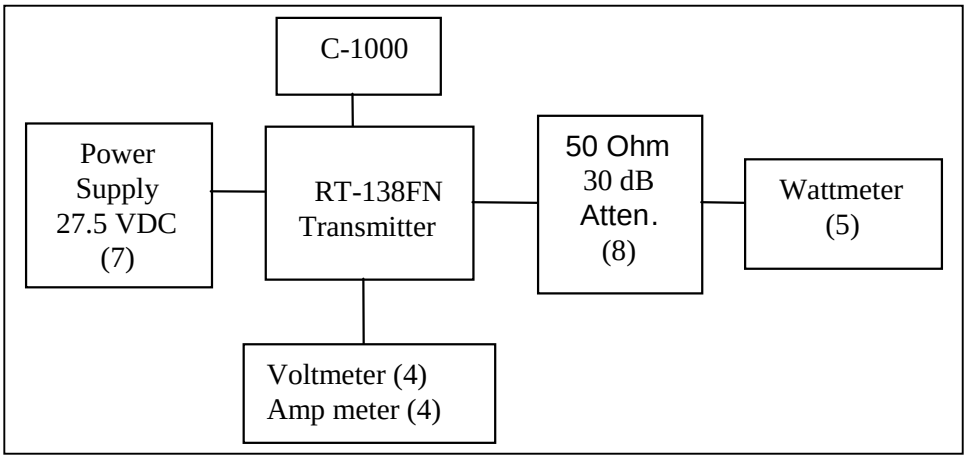
Supply Voltage: 27.5 Vdc (nominal aircraft battery)

6 MEASUREMENT DATA FOR TYPE ACCEPTANCE

6.1 RF Power Output; Paragraph 2.985 (a):

RF power output was measured after alignment of the transmitter per the manufacture's instructions as detailed in the repair manual listed in Attachment A.

6.1.1 Test Set-up:

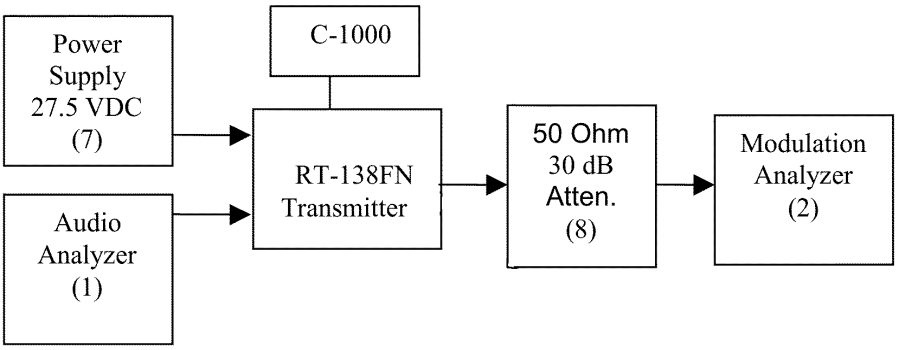


6.1.2 Power Measurements:

Frequency	High Power	High Current
138.0 MHz	11.1 Watts	1.32 A
156.0	10.0 Watts	0.91 A
174 MHz	9.5 Watts	0.99 A

6.2 Modulation Characteristics; Paragraph 2.987:

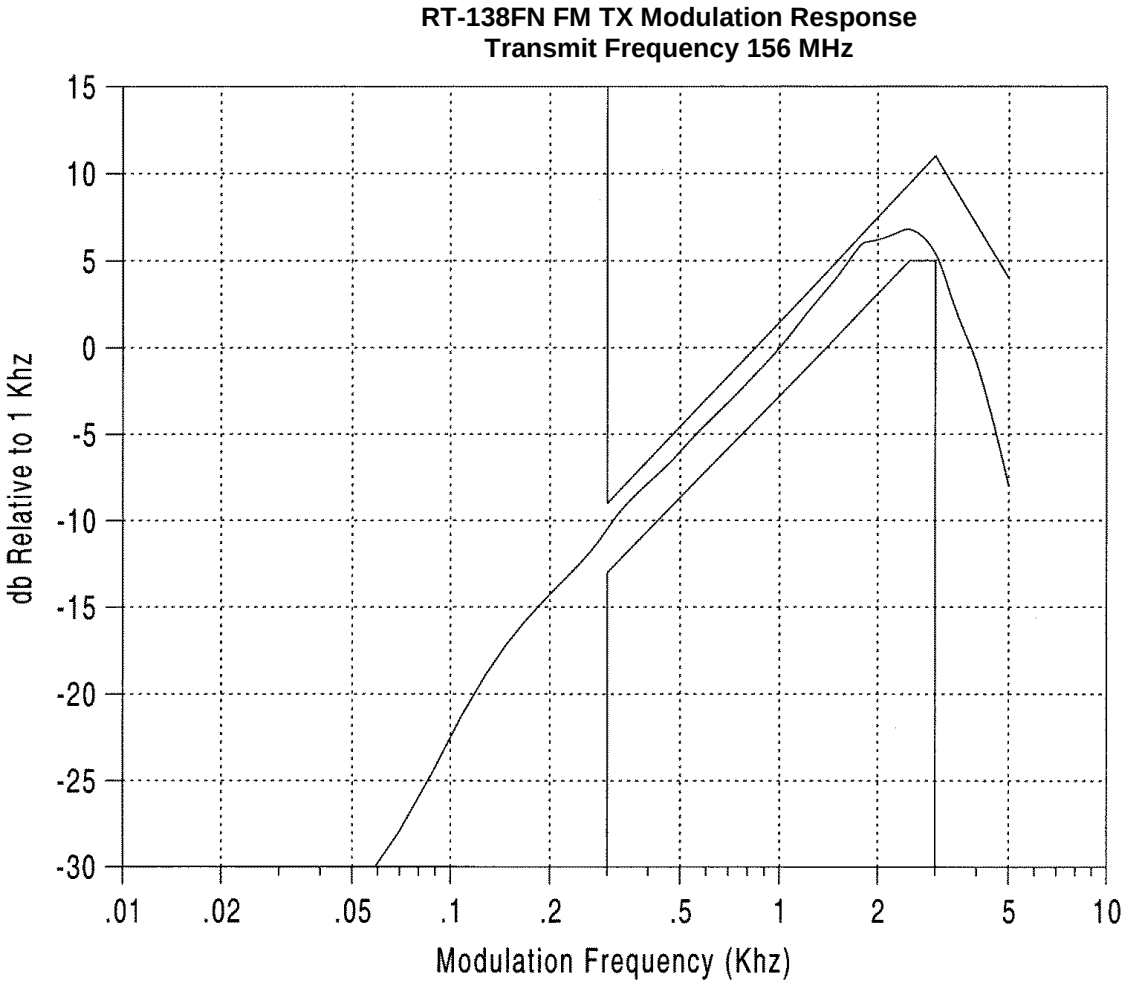
6.2.1 Test setup for Frequency Response and Limiting:



6.2.2 Frequency Response; Paragraph 2.987 (a)

Measurement of transmitter audio frequency response was made with the setup shown in section 6.2.1 of this report. Deviation was reduced to assure that clipping was not occurring at 3 kHz due to the modulation limiting circuit. A zero Decibel reference was established at a 1 kHz tone. The audio input frequency was varied over the range of 50 Hz to 5 kHz with the audio input level held constant. Demodulated audio was measured on the modulation analyzer.

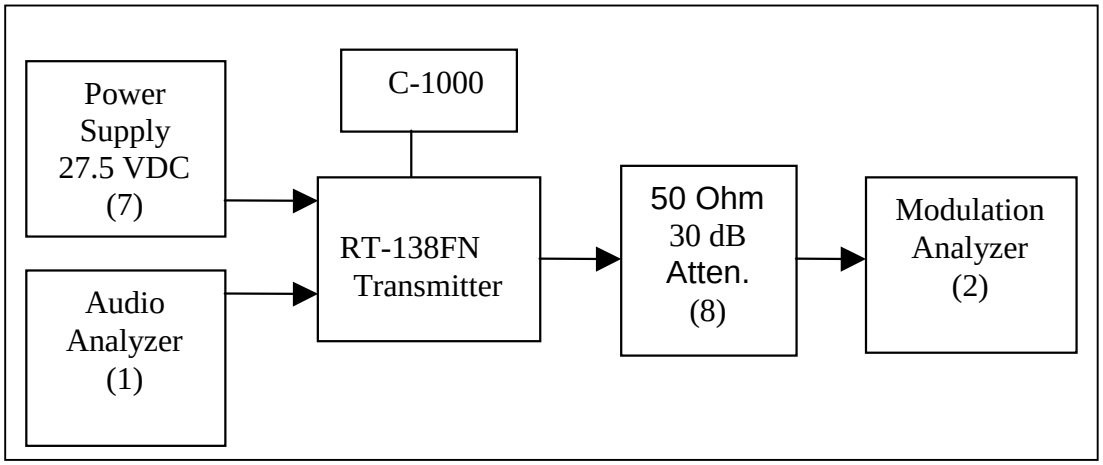
6.2.3 Measured Frequency Response:



6.3 Modulation Limiting Characteristics; Paragraph 2.987 (b)

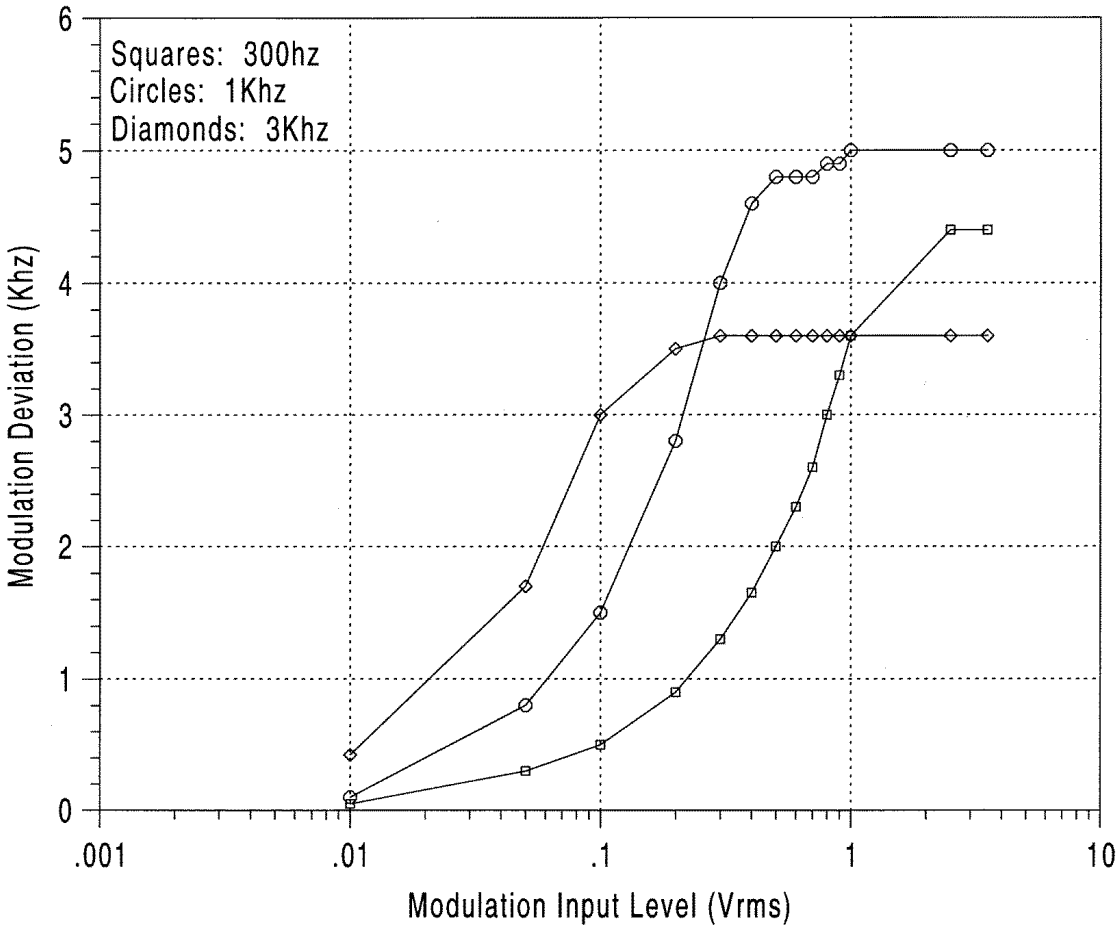
To measure modulation limiting characteristics, the audio input was varied from 10 mV up to a level exceeding 20 dB above that giving 50% modulation at 1 kHz. Modulation deviation was measured for various input levels. The limiting audio responses at frequencies of 300, 1000, and 3000 Hz were measured for narrow and wide band operation.

6.3.1 Modulation Limiting Test Setup



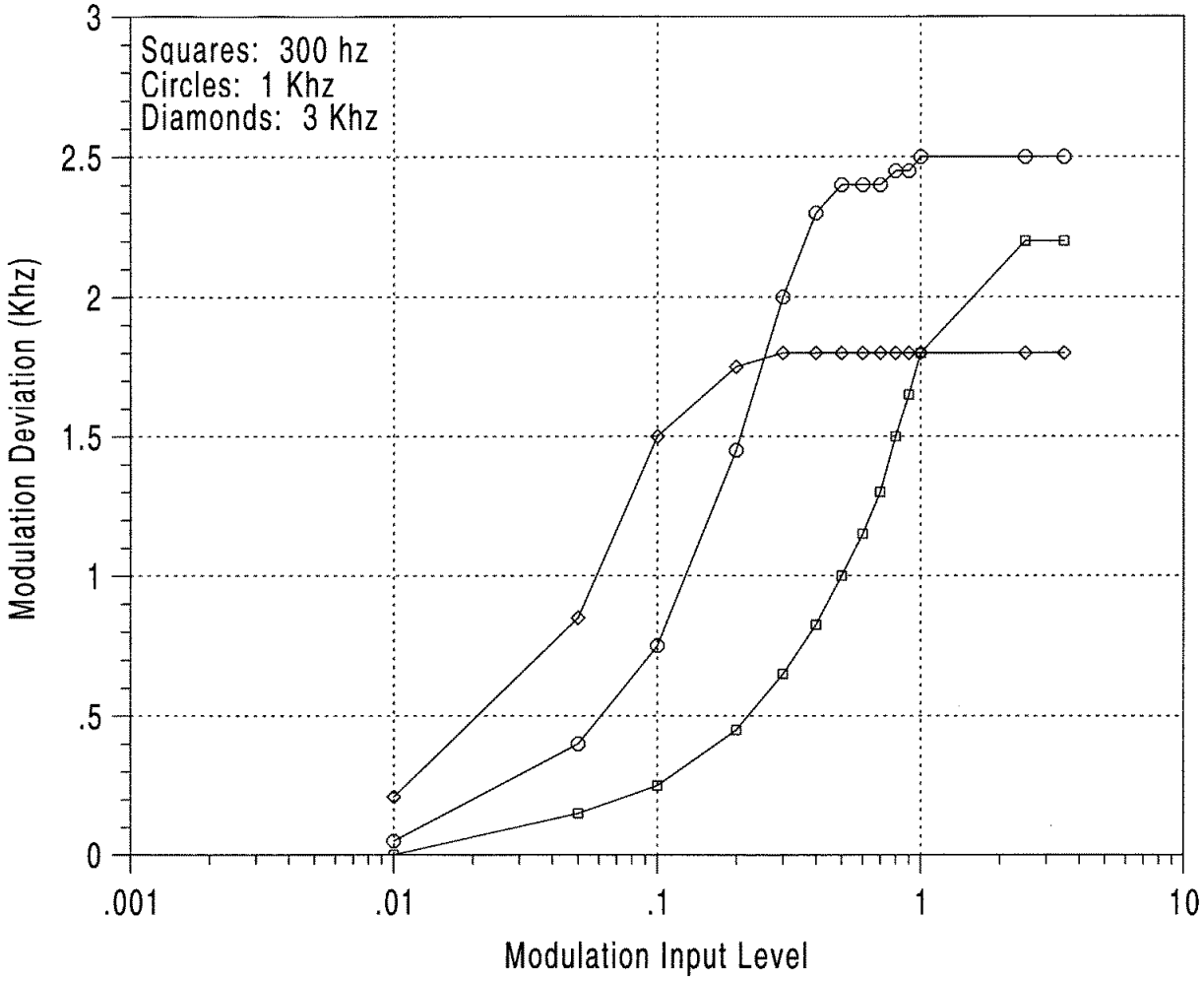
6.3.2 Measured Standard Band Limiting

RT-138FN FM TX Modulation Limiting
Transmit Frequency 156 MHz, Standard Band



6.3.3 Measured Narrow Band Limiting

RT-138FN FM TX Modulation Limiting
Transmit Frequency 156 MHz, Narrow Band



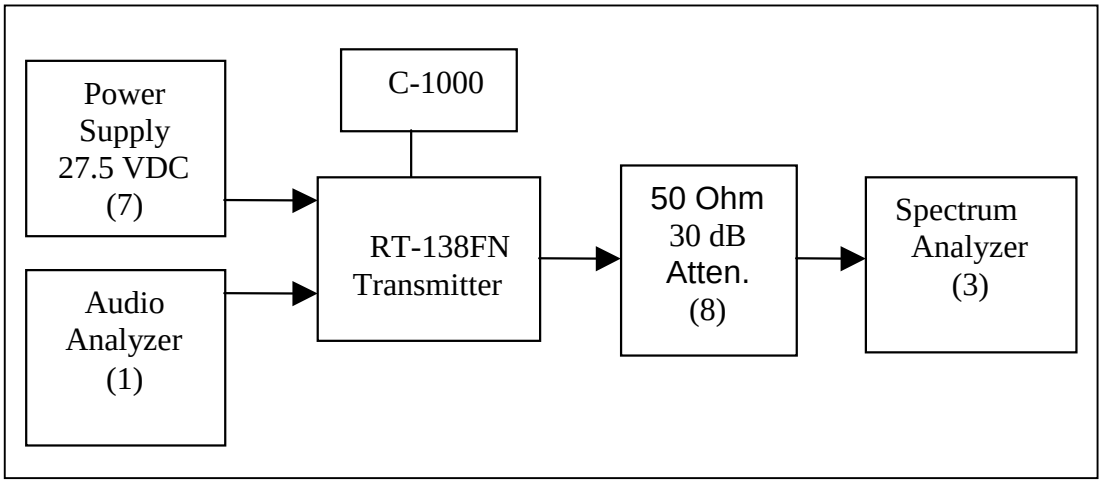
6.4 Occupied Bandwidth; Paragraph 2.989:

Occupied bandwidth was measured at 156 MHz, which is the center of the band of the frequency range. Narrow (±2.5 kHz max deviation) and standard (±5 kHz max deviation) band operation was measured

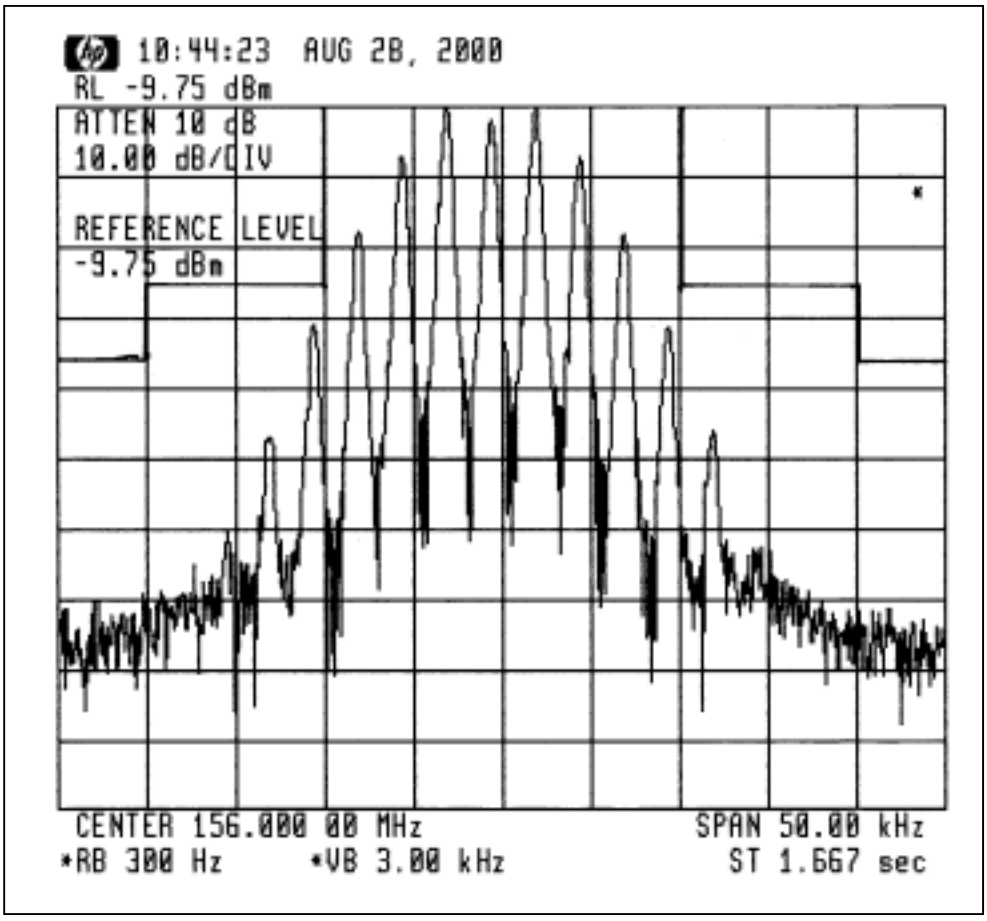
6.4.1 Occupied Bandwidth Test Procedure; Paragraph 2.989

An audio input frequency of 2.5 kHz with a level 16 dB greater than that required to produce 50% modulation was applied to the radio under test. The transmitter spectrum was measured with a 10-Watt output on a spectrum analyzer with a 50 kHz span.

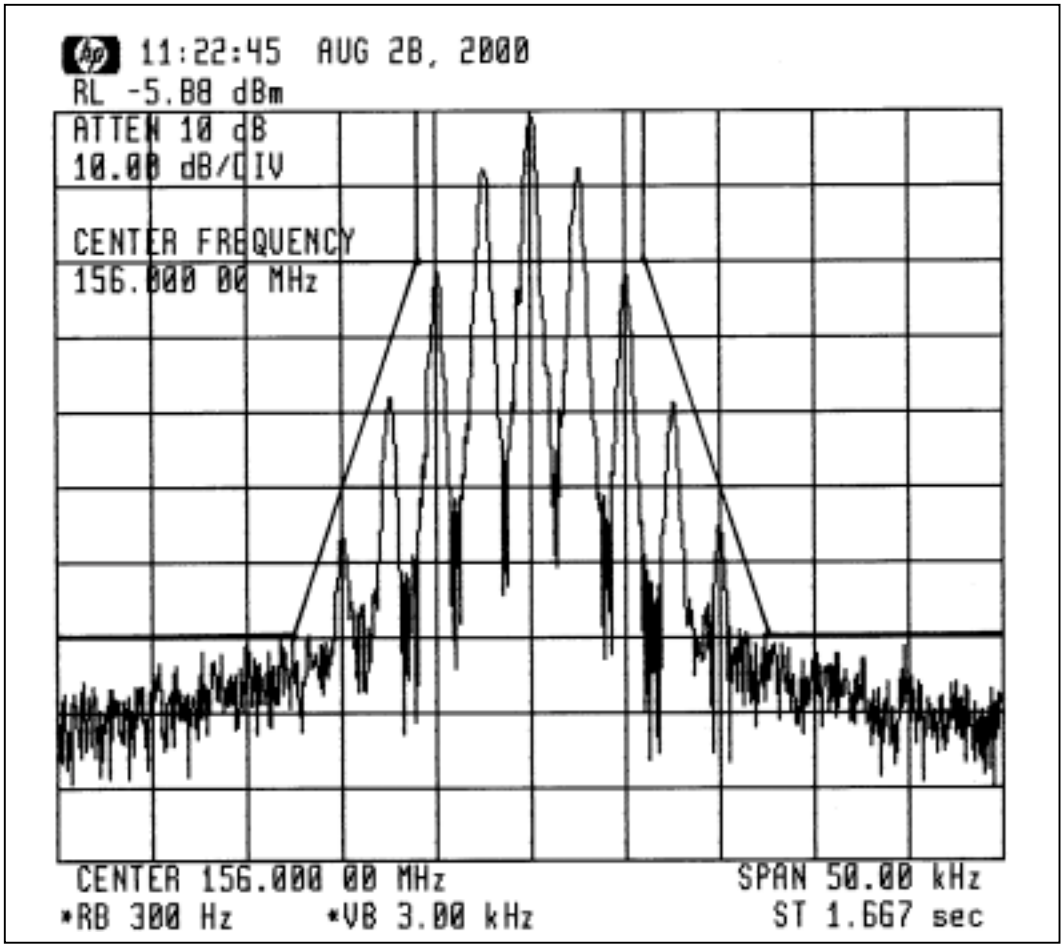
6.4.2 Occupied Bandwidth Test Setup:



6.4.3 Measured Standard Band Occupied Bandwidth:



6.4.4 Measured Narrow Band Occupied Bandwidth:



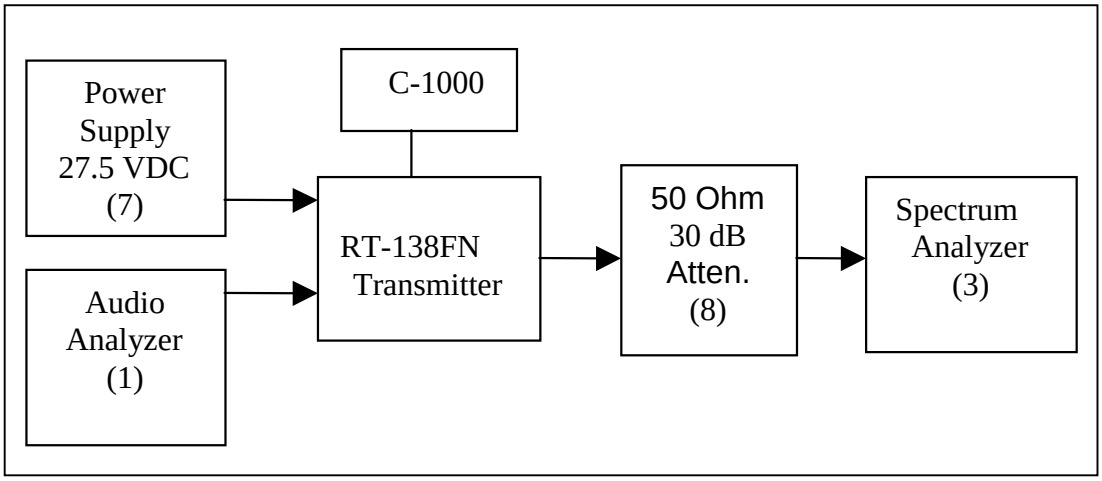
6.5 Spurious Emissions; Paragraph 2.991, 2.993:

The permitted maximum level of spurious emissions, as per paragraph 90.209 (g) of the FCR is:
= 43 + 10 Log (Mean Power Output) dBc

6.5.1 Spurious Emissions at the Antenna Terminals; Paragraph 2.991:

Spurious emissions were measured at the band center of 156 MHz while terminated into a 50 Ohm load. The transmitter was modulated with a 2500 Hz audio signal 16 dB above the level required for 50 % modulation. Spurious emissions were measured from 0.162 to 1.8 GHz. All signals noted were below –75 dBc.

6.5.2 Spurious Emission Test Setup:



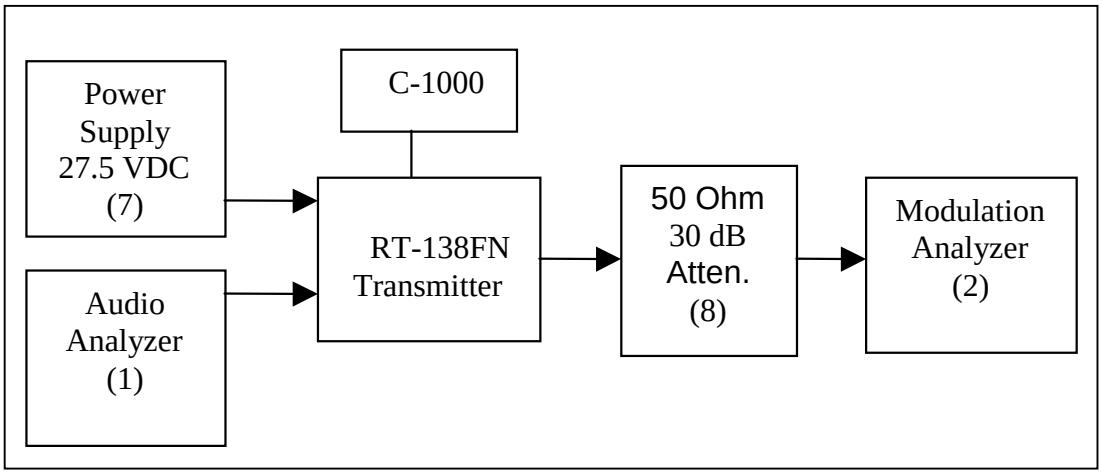
6.5.3 Field Strength Measurement of Spurious Radiation; Paragraph 2.993

Radiated Field strength measurements were conducted on the original equipment byTele-Radio Systems Limited of Vancouver, B.C. The original report is attached in Attachment B. The transmitter and shielding of this radio has not been altered from the original design.

6.6 Frequency Stability; Paragraph 2.995:

The transceiver reference Oscillator was adjusted at 25° C per the tune up instructions. The unit was allowed a 2.5-minute warm up period before the data was taken at each temperature.

6.6.1 Test Setup for Frequency Stability:

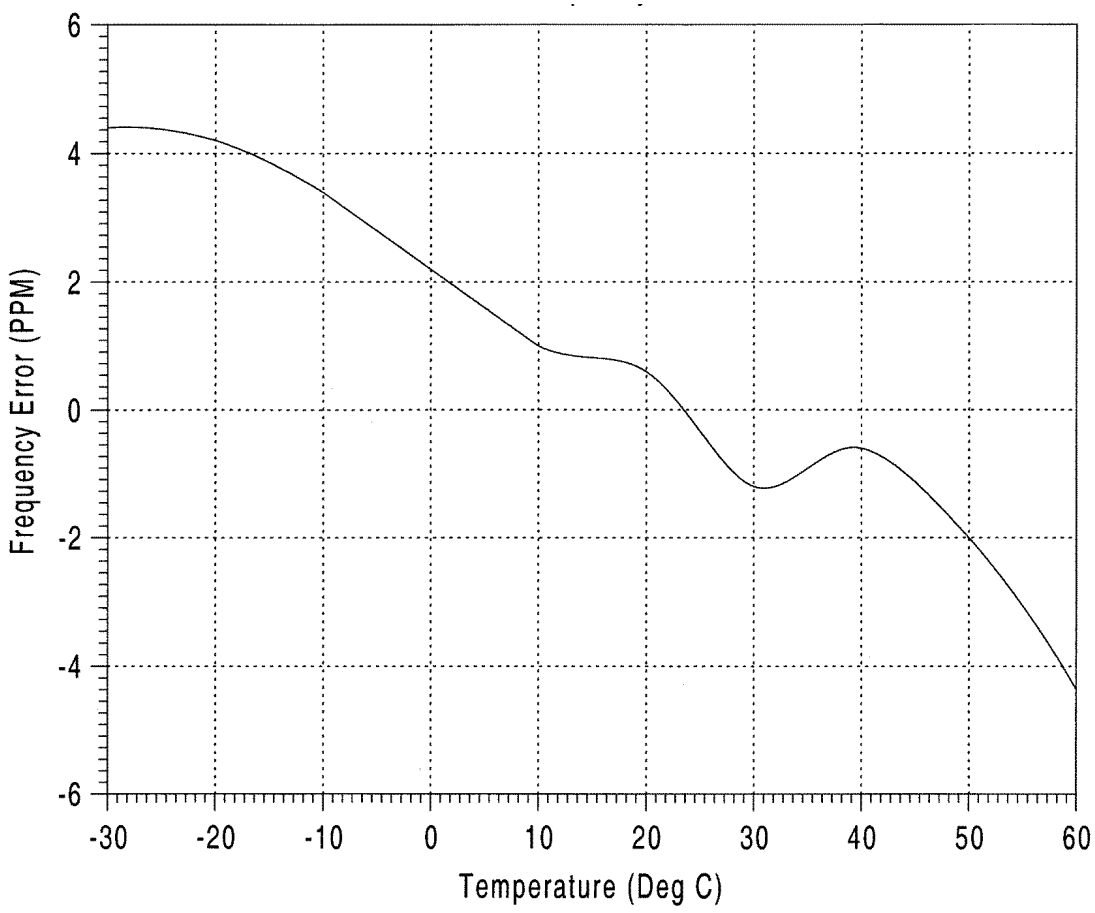


6.6.2 Temperature; Paragraph 2.995 (a) and (b):

The RT-138FN was placed in an environmental chamber with the power to the UUT turned off. The temperature was varied over the range of -30° C to +60° C in ten-degree steps. Temperature of the radio was allowed to stabilize at each step. When stabilization was verified the unit power was applied 2.5 minutes. The transmitter was keyed for at least 5 seconds and the frequency was measured at the end of the period.

6.6.3 Measured Temperature Data:

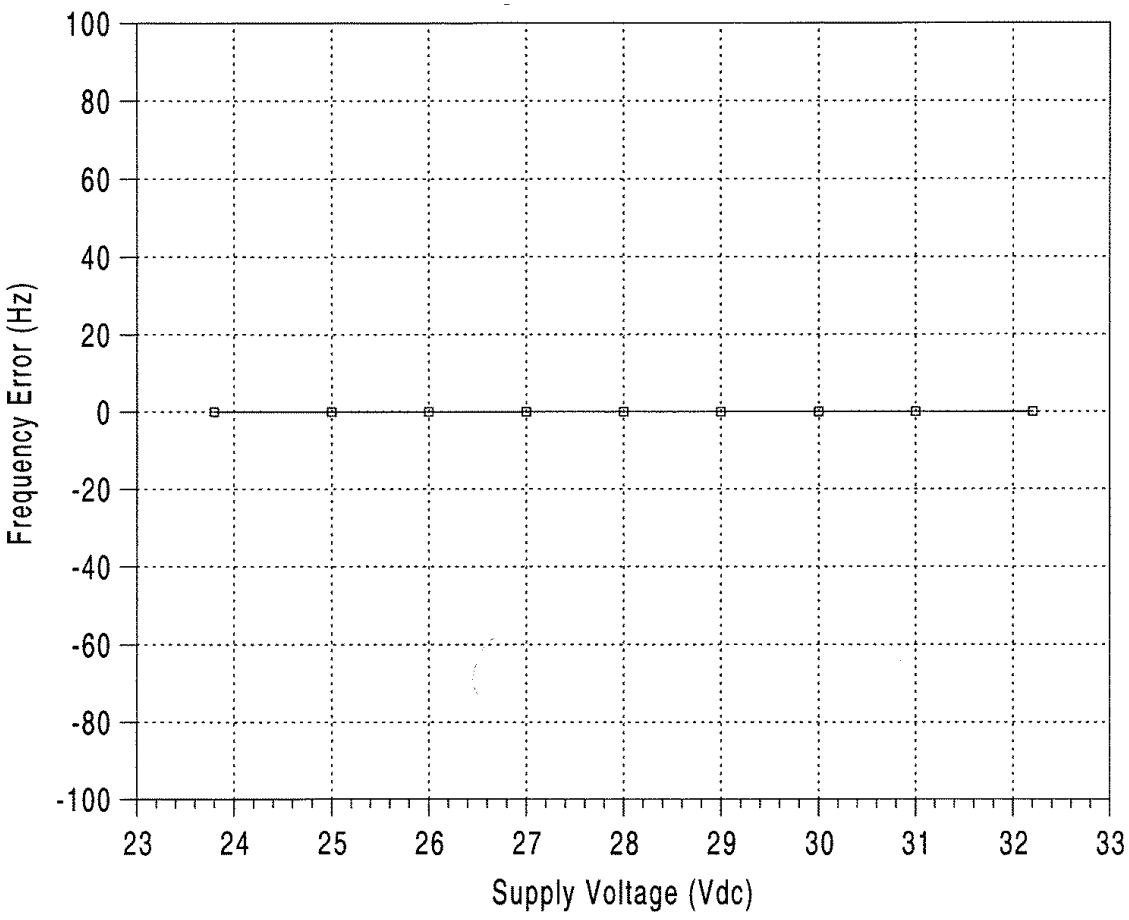
RT-138FN Frequency Error –vs- Temperature
Transmit Frequency: 156 MHz



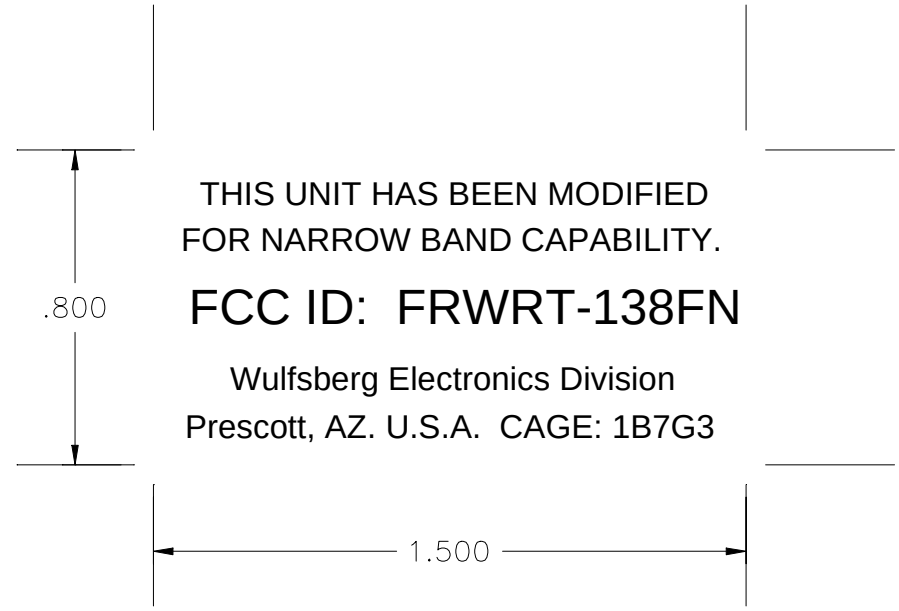
6.6.4 Frequency Stability Under Voltage Variation; Paragraph 2.995 (d)

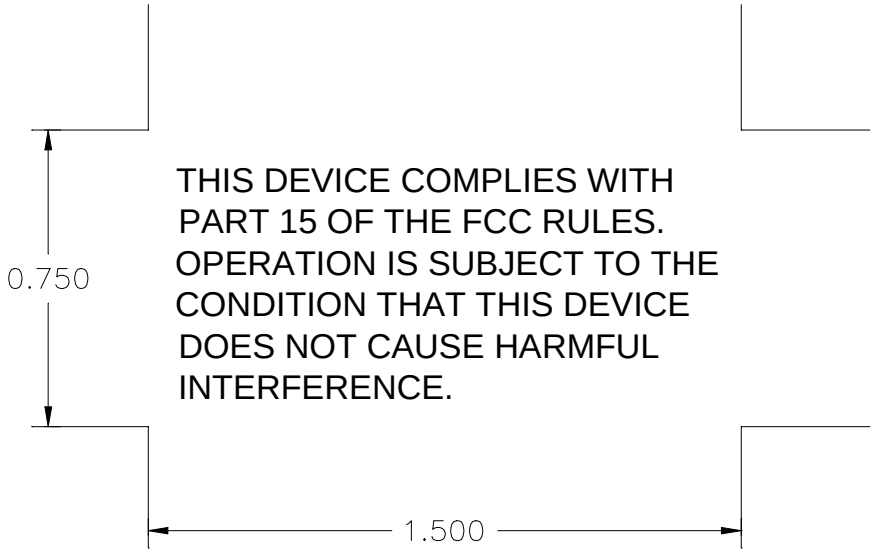
The variation of frequency with supply voltage was measured at room temperature. The voltage was varied from 85% to 115 % of the nominal input value. The radio was set to transmit and the output frequency was measured.

6.6.5 Measured Frequency Stability Under Voltage Variation Data:



7 EQUIPMENT IDENTIFICATION LABEL:





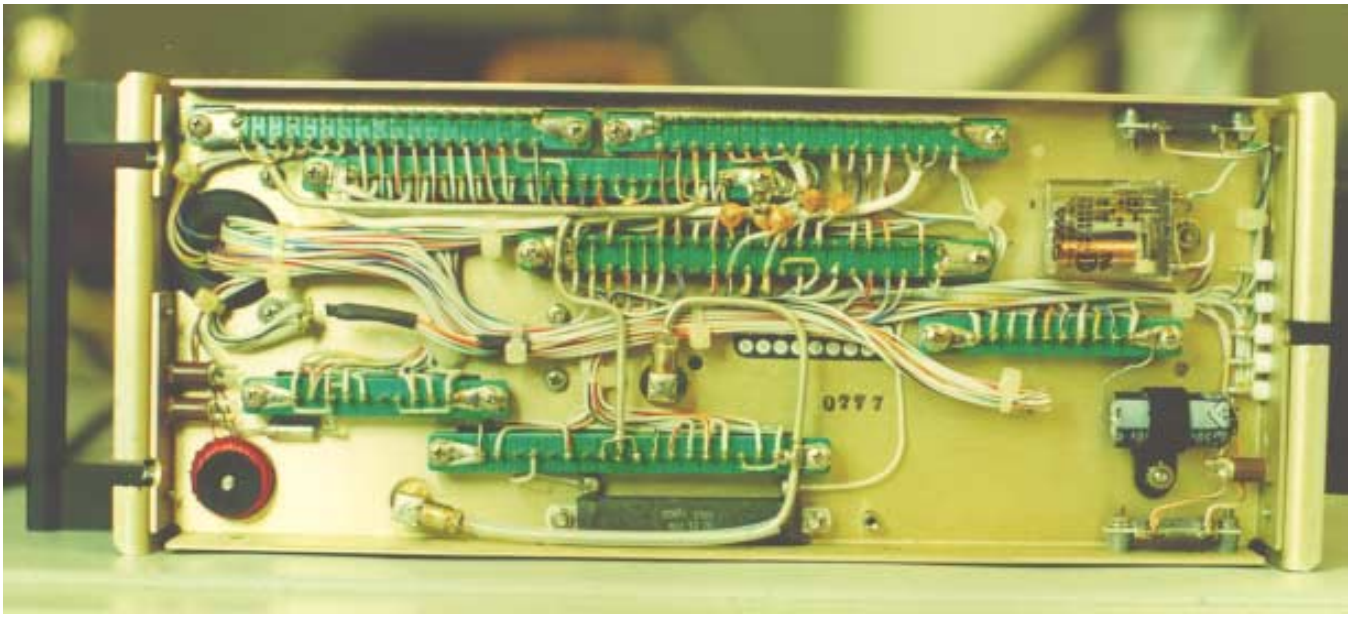
8 PHOTOGRAPHS OF EQUIPMENT:

8.1 Typical RT-138FN Front Panel.

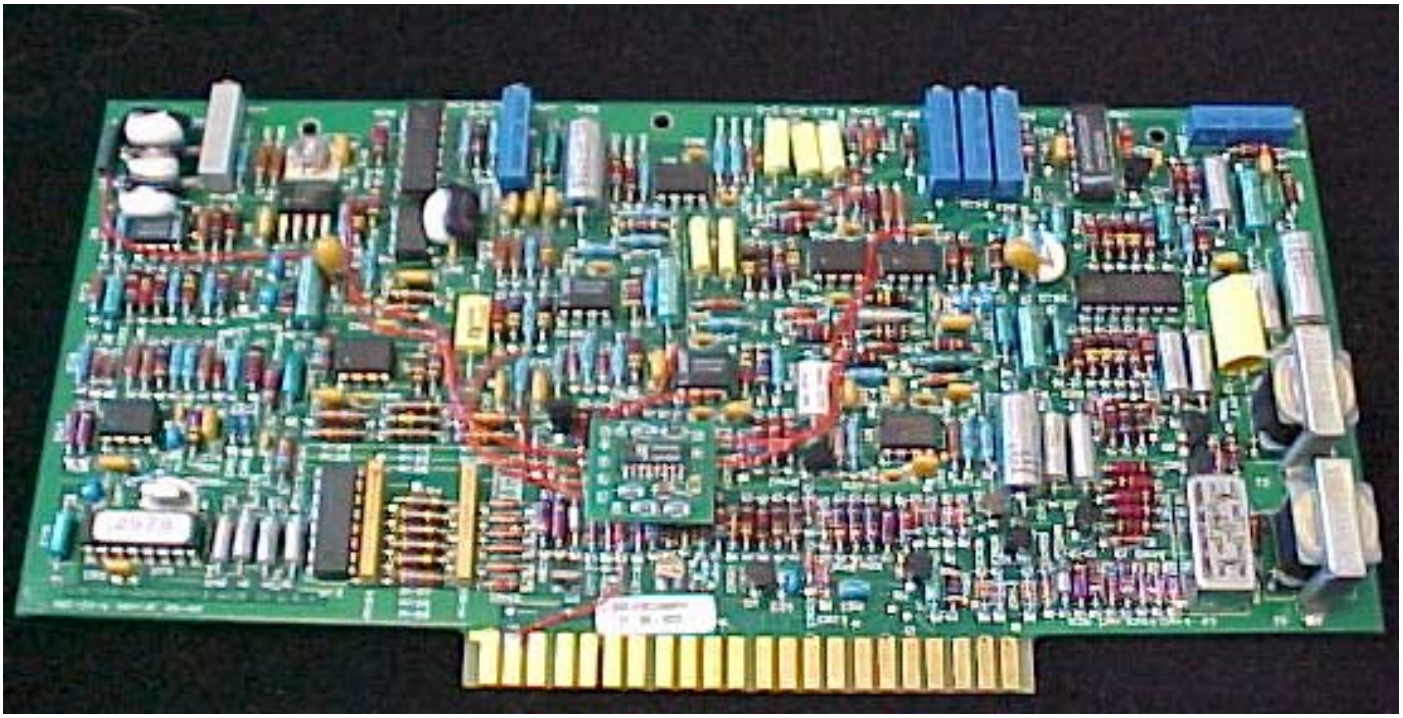
8.2 C-1000 Control Head for RT-138FN.

8.3 Side View of RT-138FN Transceiver.

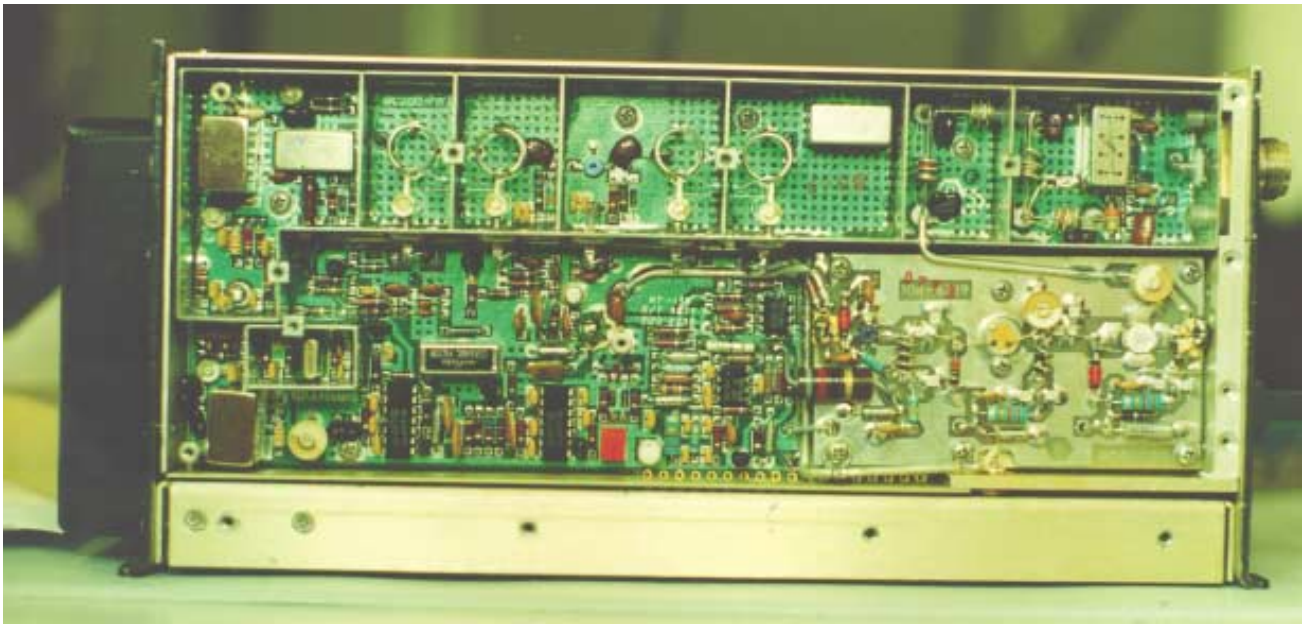
8.4 Chassis Wiring.



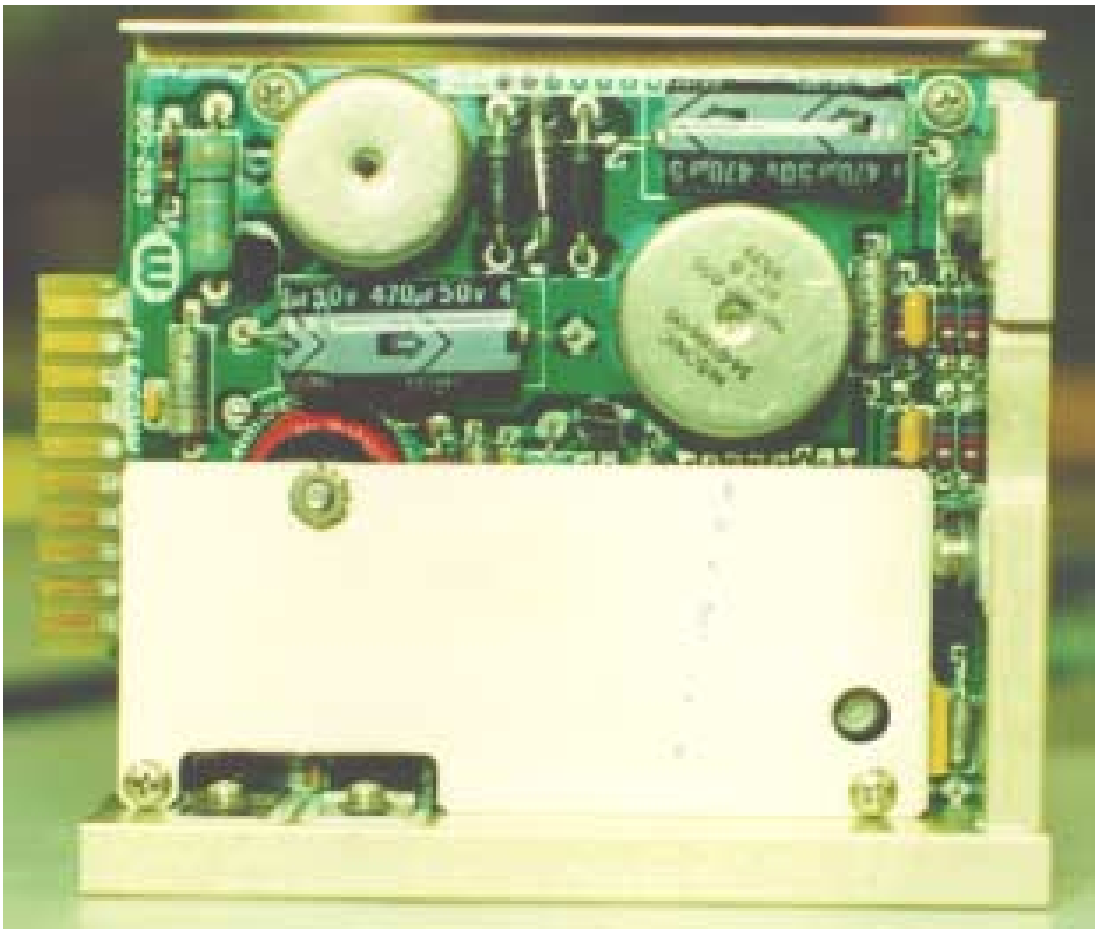
8.5 Audio Board.



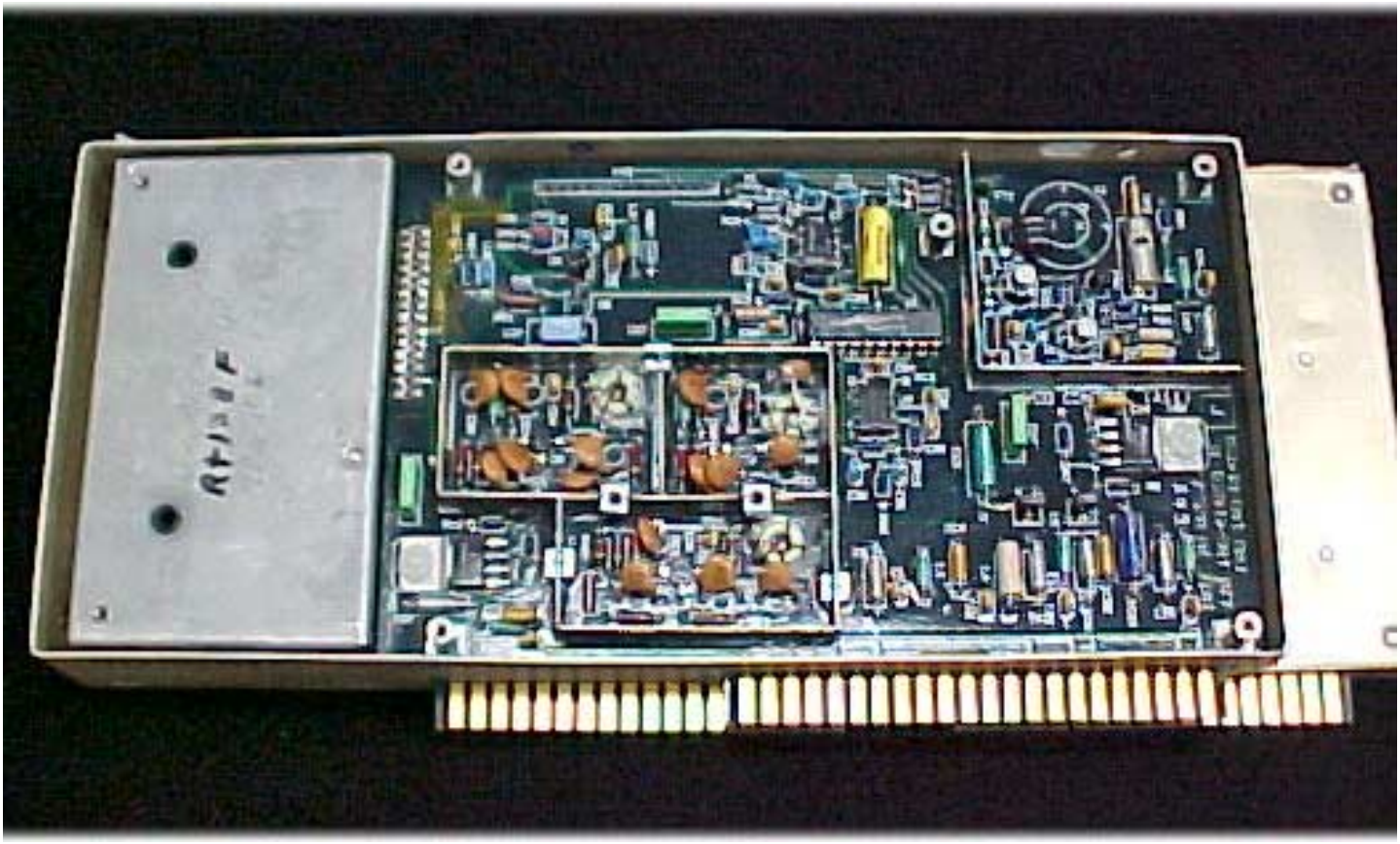
8.6 R/T Module.



8.7 Power Supply.



8.8 Synthesizer Board.



8.9 Logic Board.

8.10 Guard Receiver.