DWG. NO. 150-040684 | SH 1 | REV A

APPLICATION		REVISIONS			
NEXT ASSEMBLY	**FINAL ASSEMBLY**	**REV**	**DESCRIPTION**	**DATE**	**APPROVED**
		A	INITIAL RELEASE PER DCN W		Vern Wallace

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TITLE: **TYPE ACEPTANCE REPORT**
MODEL RT-138
FCC ID: FRWRT-138N

SIZE	CAGE CODE	DWG. NO.	REV
A	**1B7G3**	**150-040684**	**A**

SCALE NONE

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1 INTRODUCTION

This Engineering Report details the changes made to the Wulfsberg RT-138 transceiver to incorporate switchable modulation limiting. 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-138 was originally granted Type Acceptance under FCC ID number FRW4WJRT-138 in 1986. The intent of this application is to Type Accept changes to the RT-138 to enable narrow band operation. The intent is to remanufacture existing customer's radios 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-138 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), is controllable via a hardware frequency-control lockout.

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.

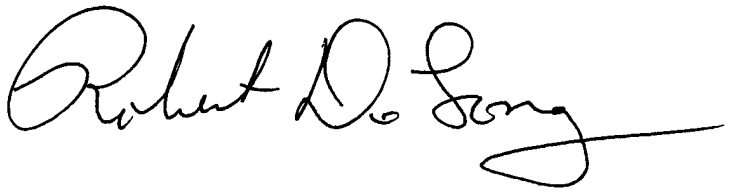
The original radiated emissions measurements on the RT-138 were conducted by Rogers Consulting. See Attachment B for their statements of site and test facilities. The design changes to allow narrow band operation involve only addition of a switchable audio gain stage and replacement of the IF filter. 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-138N

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-138N
DATE:	April 26, 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-138N
Serial number:	X865
FCC ID:	FRWRT-138N

4.3 Production Quantity; Paragraph 2.983 (c):

Quantity production of the remanufactured RT-138N 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 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. 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 ± 5º C

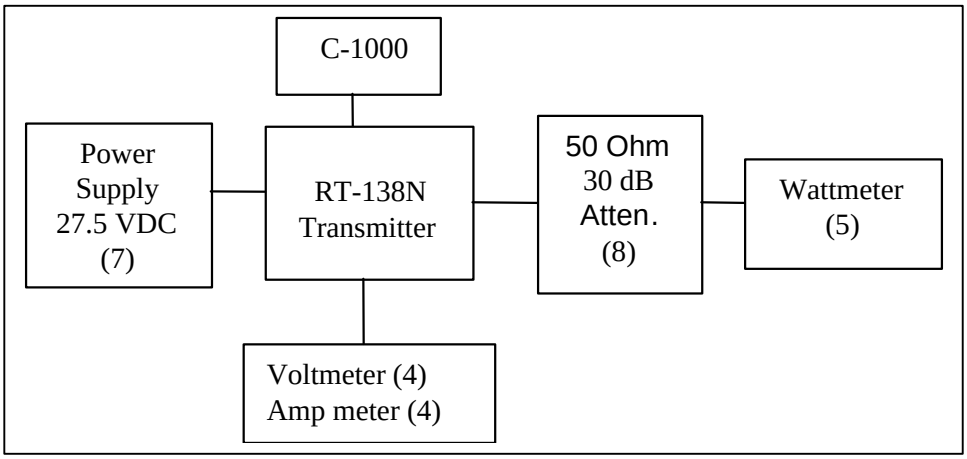
Supply Voltage: 27.5 VDC (nominal aircraft battery)

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:

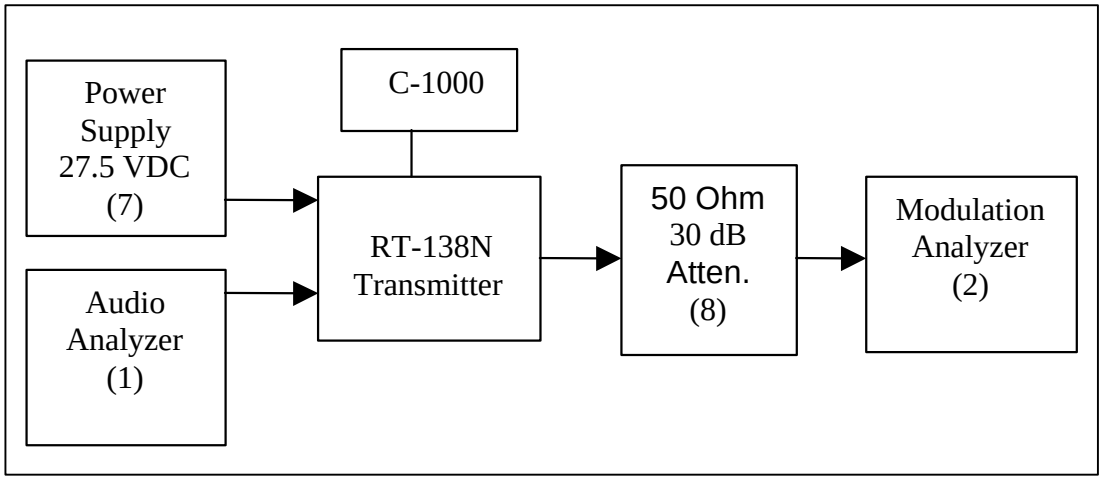


6.1.2 Power Measurements:

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:

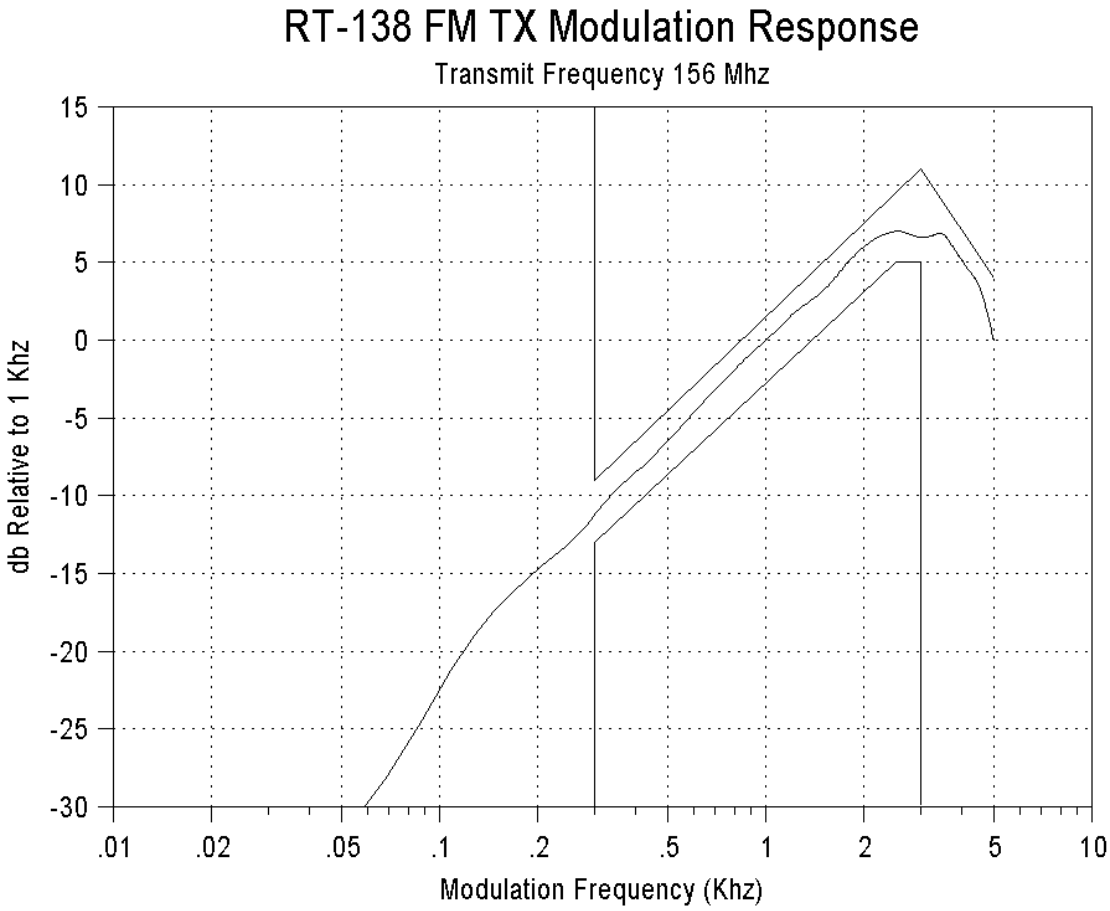
6.2.1 Test setup for Frequency Response and Limiting:



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.

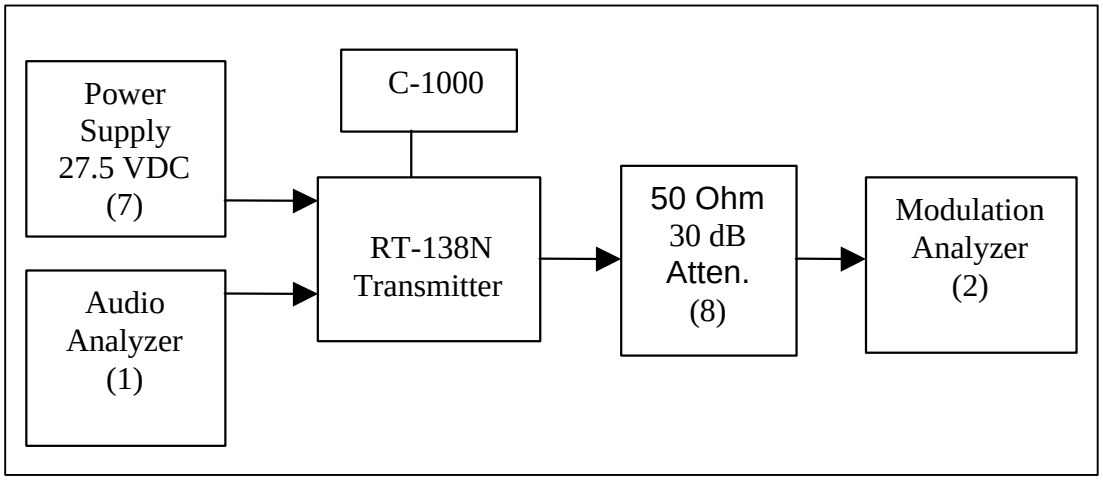
6.2.3 Measured Frequency Response:



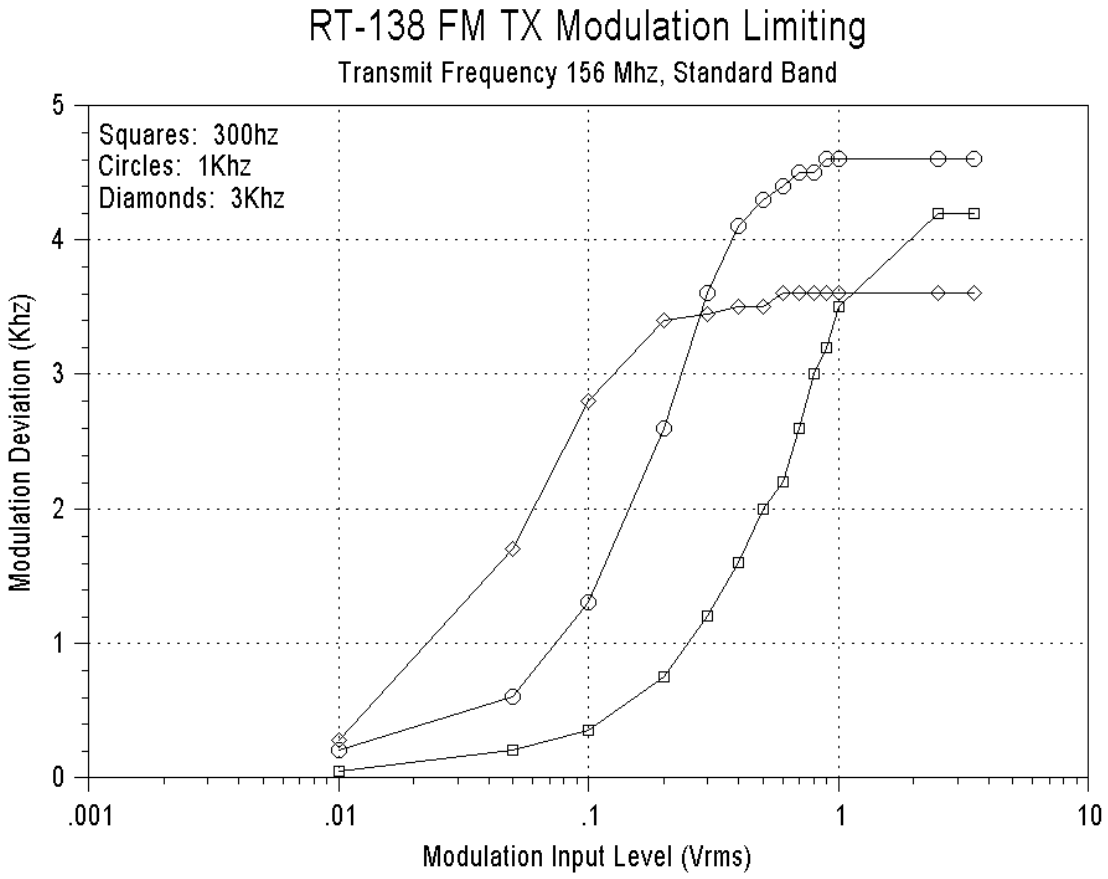
6.3 Modulation Limiting Characteristics; Paragraph 2.987 (b)

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.

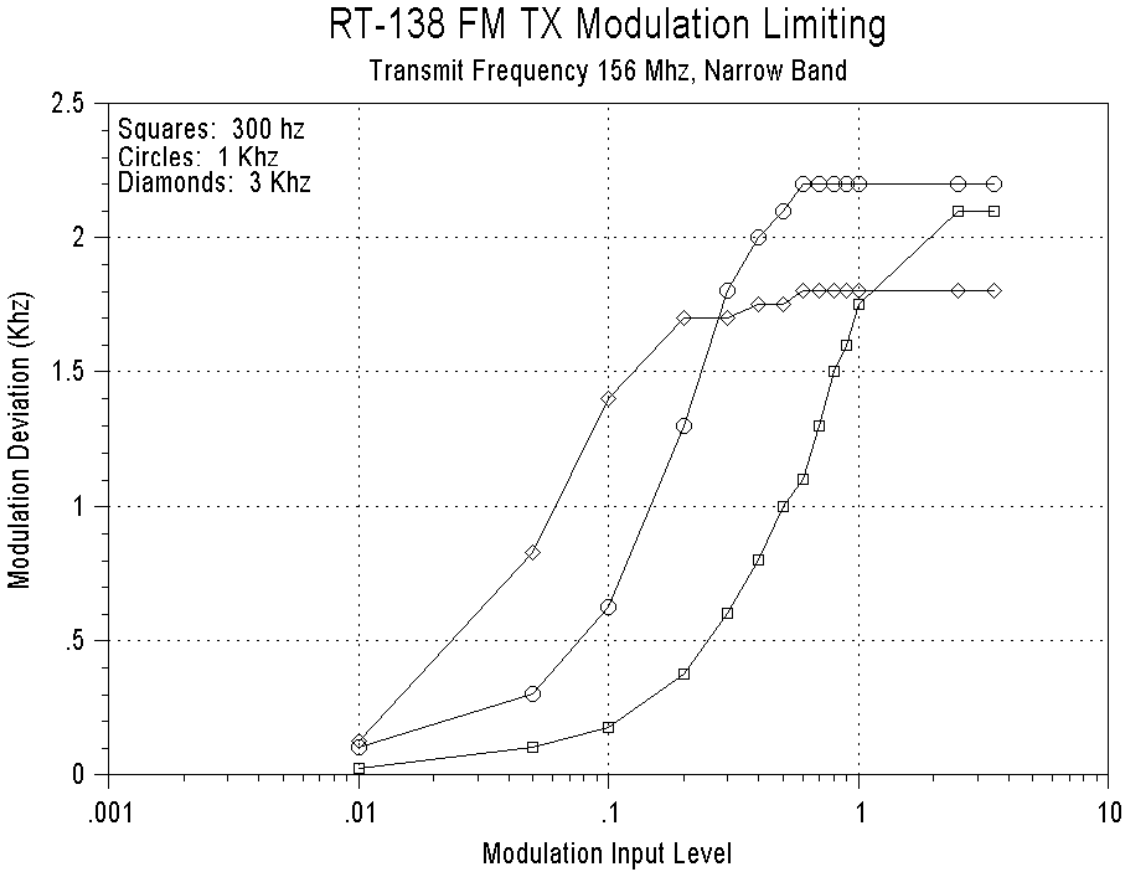
6.3.1 Modulation Limiting Test Setup



6.3.2 Measured Standard Band Limiting



6.3.3 Measured Narrow Band Limiting



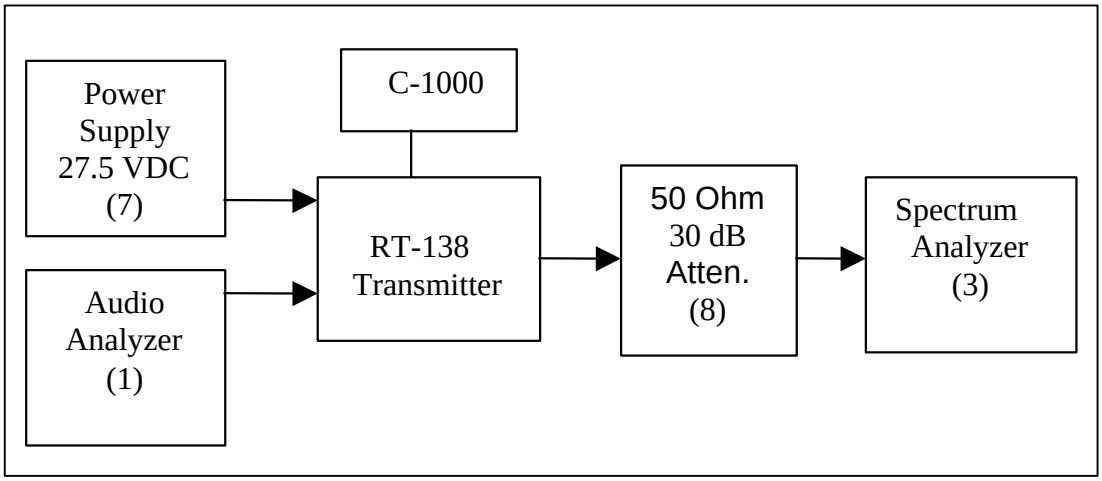
6.4 Occupied Bandwidth; Paragraph 2.989:

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

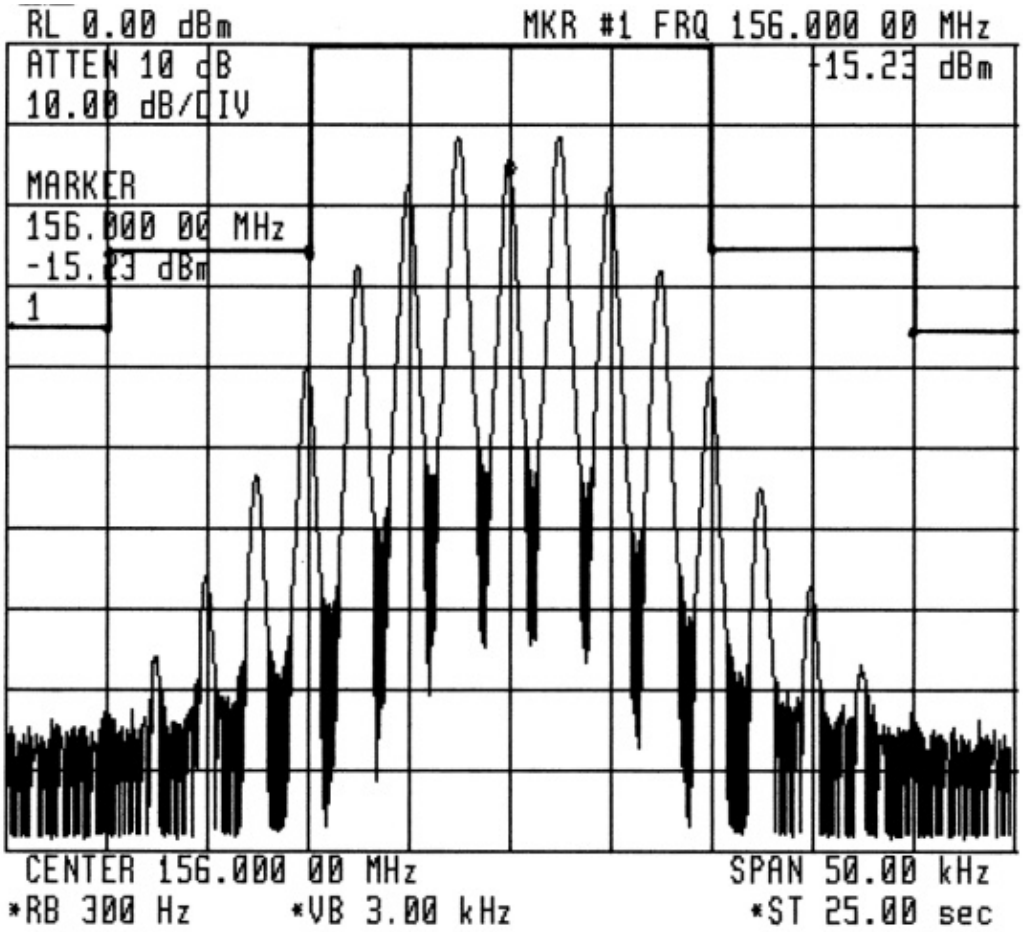
6.4.1 Occupied Bandwidth Test Procedure; Paragraph 2.989

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.

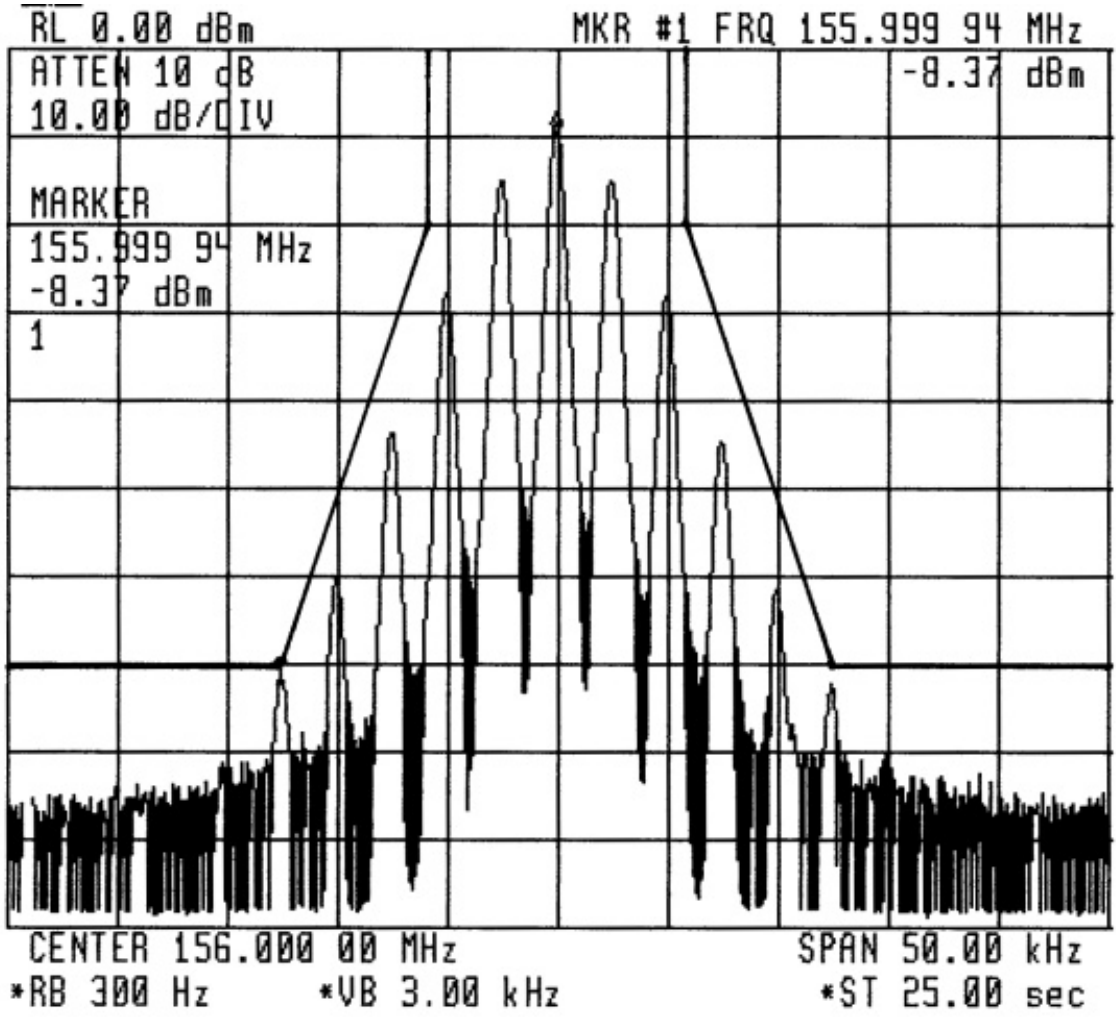
6.4.2 Occupied Bandwidth Test Setup:



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:

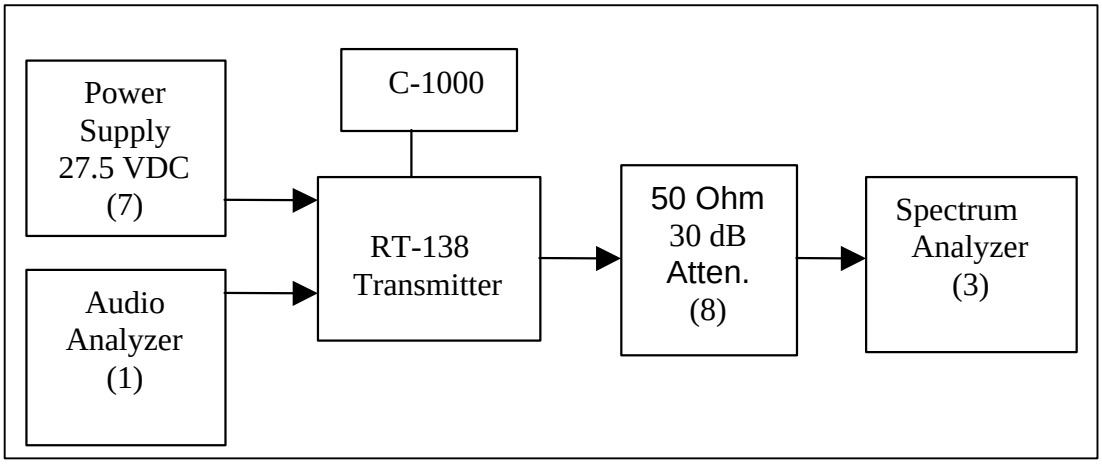
The permitted maximum level of spurious emissions, as per paragraph 90.209 (g) of the FCR is:

= 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:



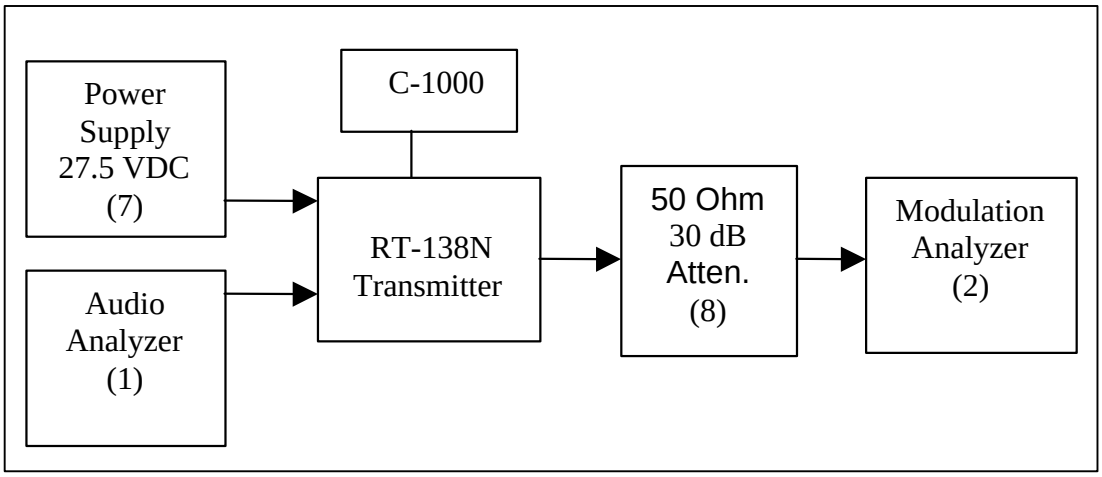
6.5.3 Field Strength Measurement of Spurious Radiation; Paragraph 2.993

Radiated Field strength measurements were conducted on the original equipment Rogers Consulting of Shawnee Mission, Kansas. 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 25º 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.

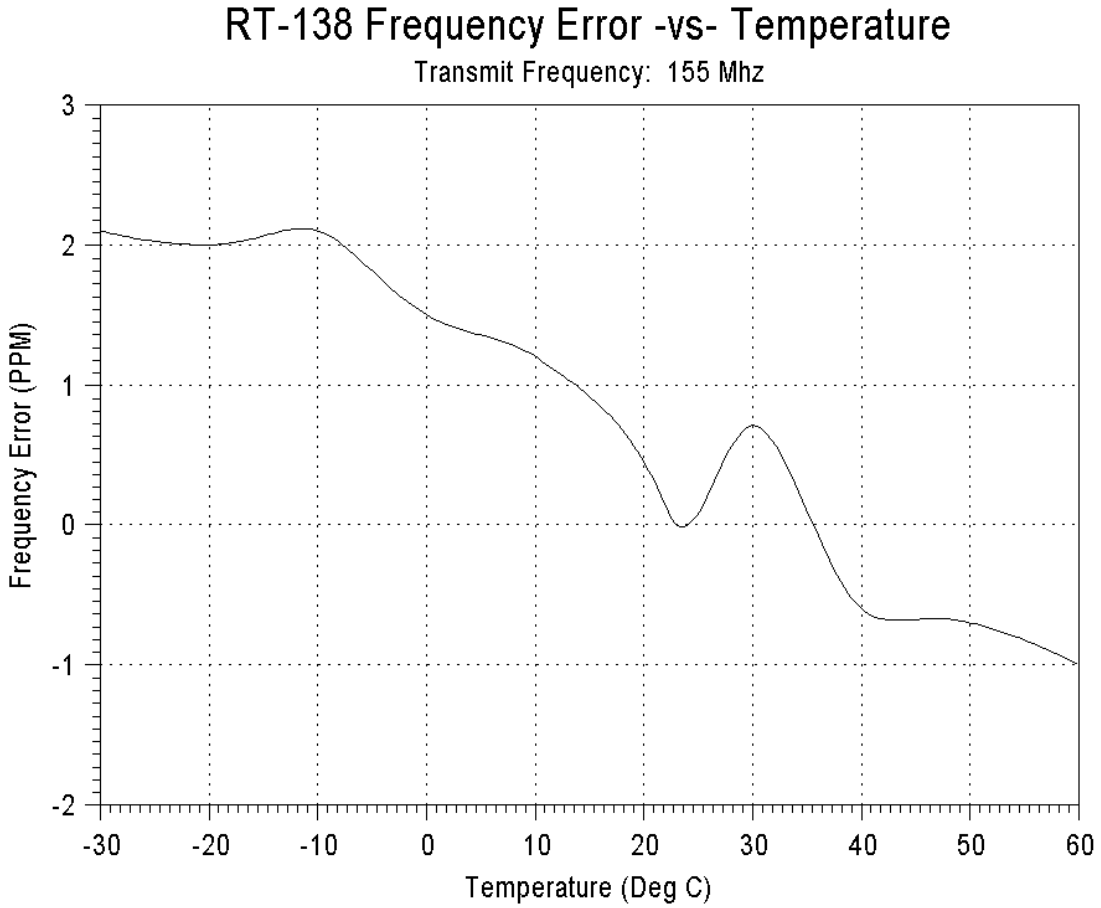
6.6.1 Test Setup for Frequency Stability:



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

The RT-138N was placed in an environmental chamber with the power to the UUT turned off. The temperature was varied over the range of -30º C to +60º 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.

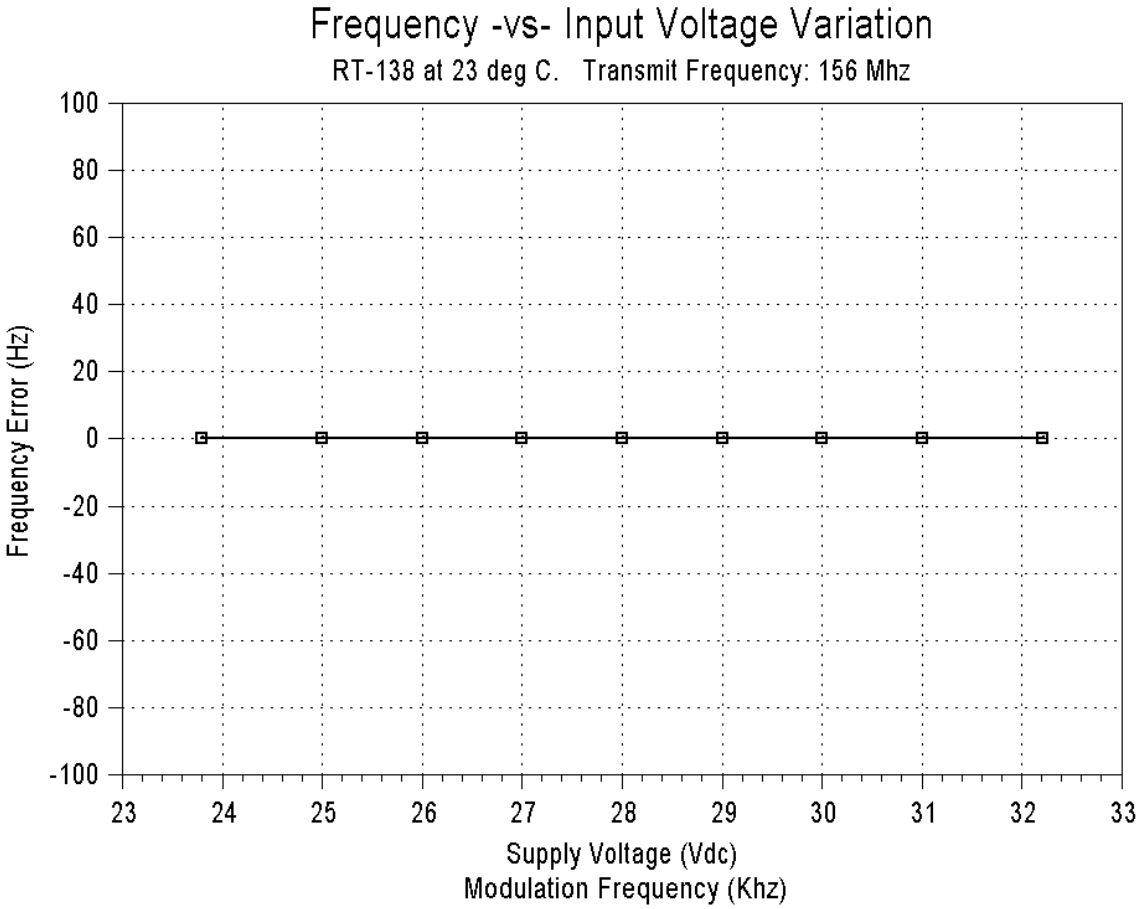
6.6.3 Measured Temperature Data:



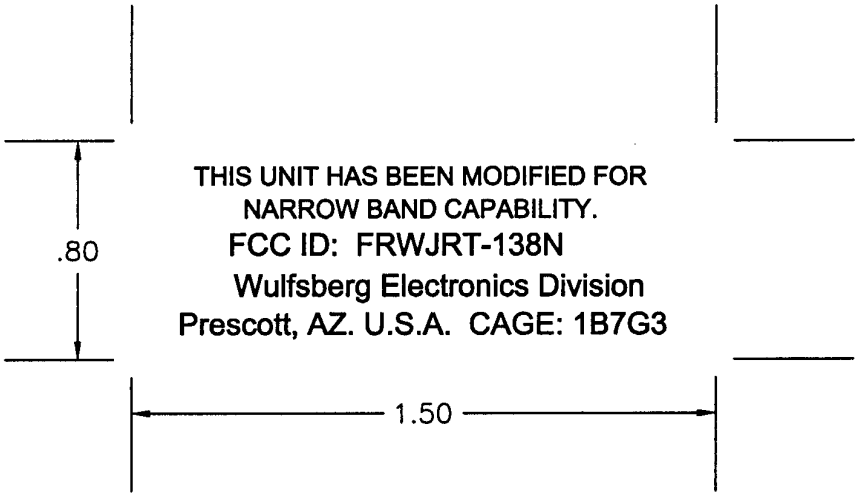
6.6.4 Frequency Stability Under Voltage Variation; Paragraph 2.995 (d)

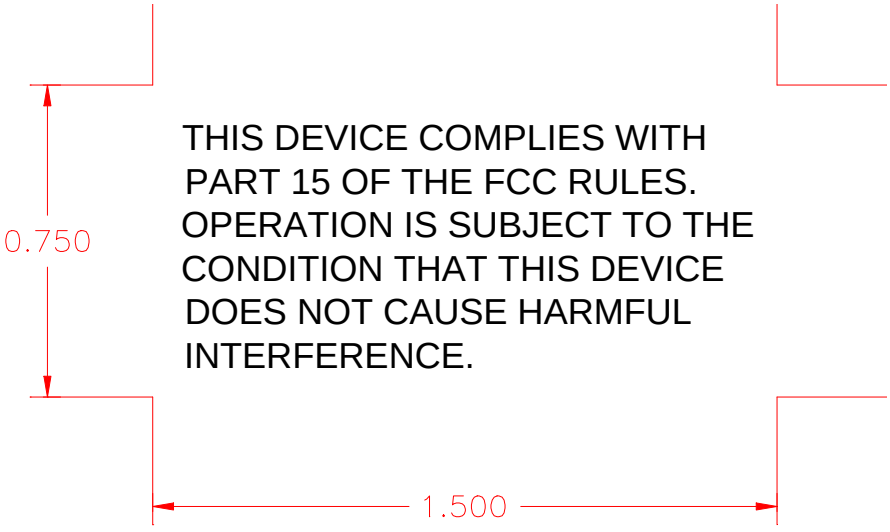
The variation of frequency with supply voltage was measured at room temperature. The voltage was varied from 85% to 115 % of the nominal input value. The radio was set to transmit and the output frequency was measured.

6.6.5 Measured Frequency Stability Under Voltage Variation Data:



7 EQUIPMENT IDENTIFICATION LABEL:





8 PHOTOGRAPHS OF EQUIPMENT: