REV A	APPROVALS	DATE
1	DRAWN R. DeLona	6/14/99
	CHECKED	
	ENGINEER R. DeLona	06/14/99
	ISSUED	

DOC NO. 150-040214

REV	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE Per DCN W627		

NEXT ASSEMBLY	FINAL ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

FRACTIONS	DECIMALS	ANGLES
±	.XX ± .XXX ±	±

DRAWING TITLE

TYPE ACCEPTANCE REPORT MODEL RT-9600 AND RT-9600F, FCC ID: FRW4WJRT-96000

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

SIZE	CAGE CODE	DWG . NO.	REV
A	1B7G3	150-040214	A

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1 INTRODUCTION

This Engineering Report details the changes made to the Wulfsberg RT-9600 and RT-9600F transceiver to improve frequency stability and 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.

Previously the RT-9600 and RT-9600F were type accepted under separate FCC ID numbers. The upgrade to this equipment makes these radios identical. New equipment will bear only one FCC ID number and the RT-9600 and RT-9600F will be considered trade name differences only as per chapter 2.924.

This change would be considered a Class I change, as per part 2.1001, in regards to the initial Grant of Equipment Authorization. However, additional lab measurements have been made to characterize the narrow-band operation for extension of the Grant of Equipment Authorization to include narrow-band emission designators.

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-9600 is intended for mobile aircraft use for communications primarily with land mobile, portable, aircraft, marine, and base station radios. Intended frequency coverage is:

150-174 MHz

Associated equipment is the C-962 Communication Management Controller which provides frequency selection, indication, and audio routing.

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 NBS.

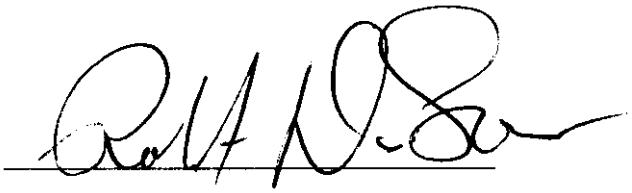
Radiated emissions measurements were conducted by contract to M. Flom Associates, Inc. in Chandler, Arizona. See Exhibit B for their statements of site and test facilities.

3 CERTIFICATION OF DATA

CERTIFICATION OF DATA CONCERNING TYPE ACCEPTANCE APPLICATION FOR FCC ID:

FRW4JRT-9600

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	FR4WJRT-9600
DATE:	May 26, 1999

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):

Models:	RT-9600, RT-9600F
Serial number:	E101
FCC ID:	FRW4WJRT-9600, FRW4WJRT-9600F

4.3 Production Quantity; Paragraph 2.983 (c):

Quantity production of the Model RT-9600, and RT-9600F is planned.

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

16K0F3E
11K2F3E

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

150-174 MHz

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

1 Watt / 10 Watts

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

10 Watts

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

Collector voltage:	13.7 VDC
Supply voltage:	28.7 VDC
Collector Current:	1.37 Amps.

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

Please refer to Exhibit A for the Theory of Operation and schematics of the modified circuits and Exhibit D for the unmodified portion of the radio.

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

Complete Schematic diagrams for the circuit modifications are in Exhibit A and the unmodified circuit diagrams are located in the repair manual located in Exhibit D.

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

The instruction book is located in Exhibit C.

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

The tune-up procedure is in the repair manual located in Exhibit D.

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

The main VCO is phase locked to a temperature compensated crystal oscillator. The TCXO frequency is 12.8 MHz. Exact operation is detailed in Exhibit A.

4.14 Circuits for Suppression of Surious 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 Exhibit D.

(ii) Limiting of modulation:
The audio input is limited by the supply rails of audio amplifier I1A which is follow by a low pass filter to remove induced harmonics. The schematic of this circuit is located in the repair manual in Exhibit D.

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

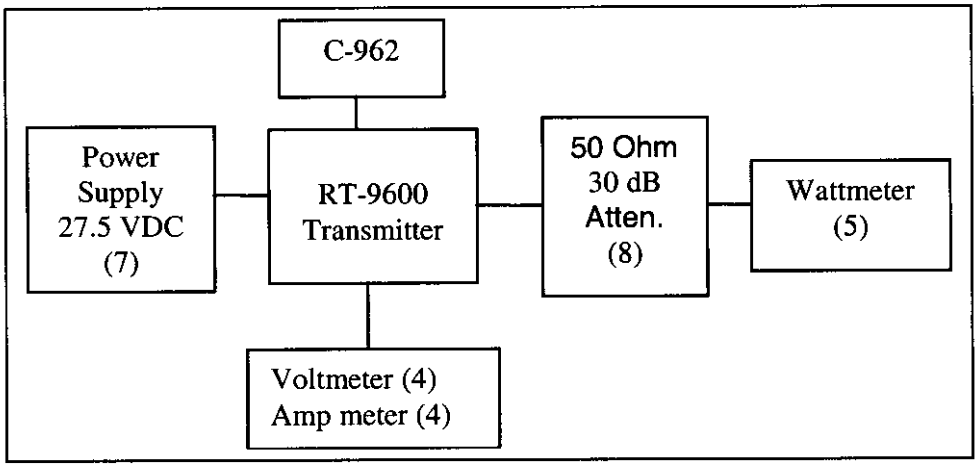
Supply Voltage: 27.5 VDC (nominal aircraft battery)

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 Exhibit D.

6.1.1 Test Set-up:

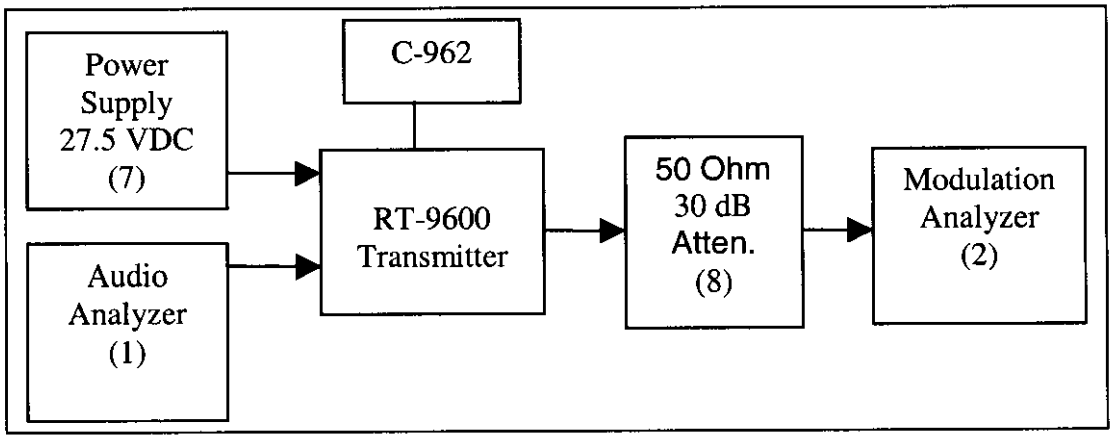


6.1.2 Power Measurements:

Frequency	High Power	High Current	Low Power	Low Current
150.0 MHz	11.1 Watts	1.95 A	1.0	.61 A
156.0	10.0 Watts	1.37 A	1.0	.46 A
173.99 MHz	9.5 Watts	2.27 A	0.9	.52 A

6.2 Modulation Characteristics; Paragraph 2.987:

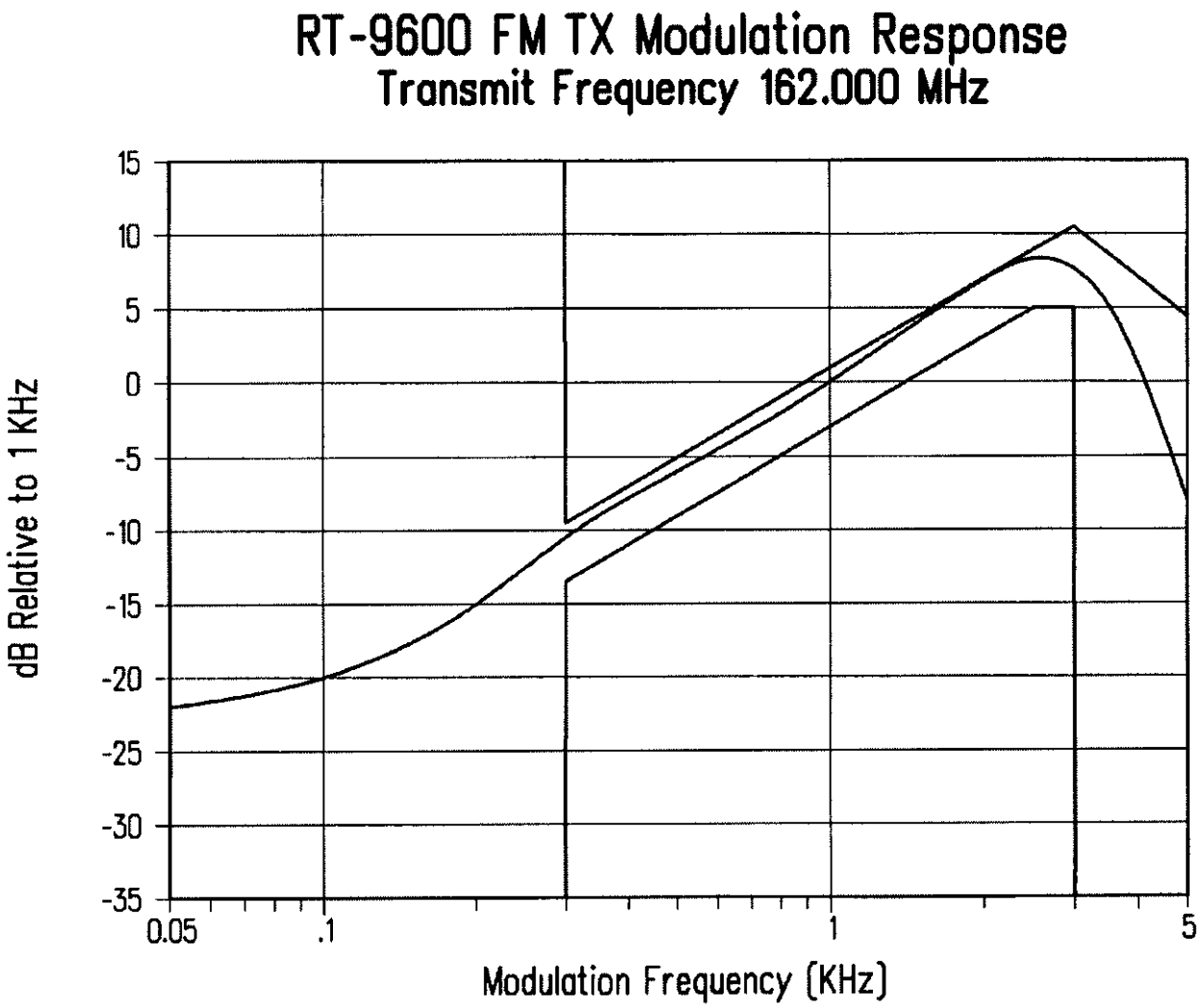
6.2.1 Test setup for Frequency Response and Limiting:



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.

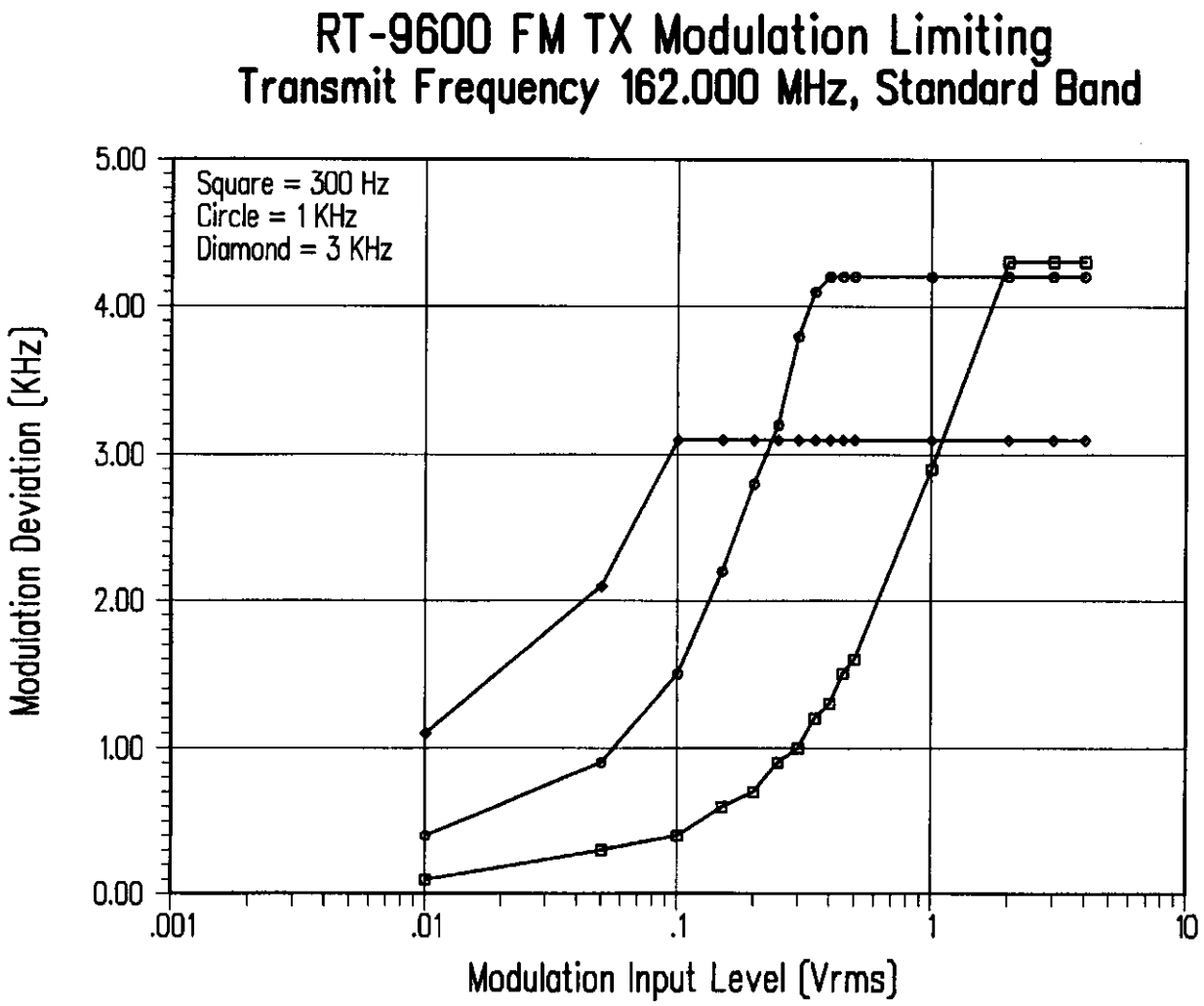
6.2.3 Measured Frequency Response:



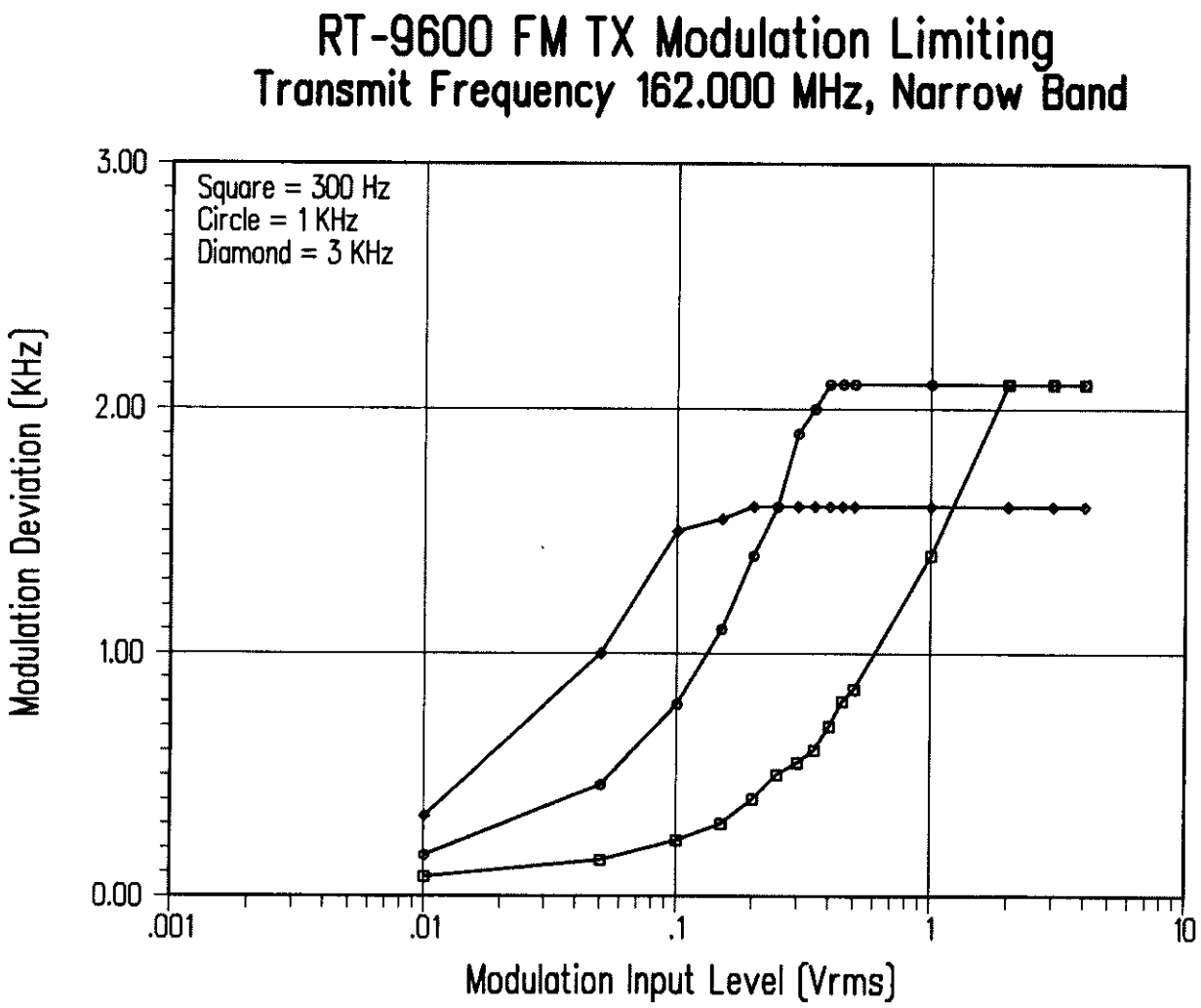
6.2.4 Modulation Limiting Characteristics; Paragraph 2.987 (b)

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.

6.2.5 Measured Standard Band Limiting



6.2.6 Measured Narrow Band Limiting



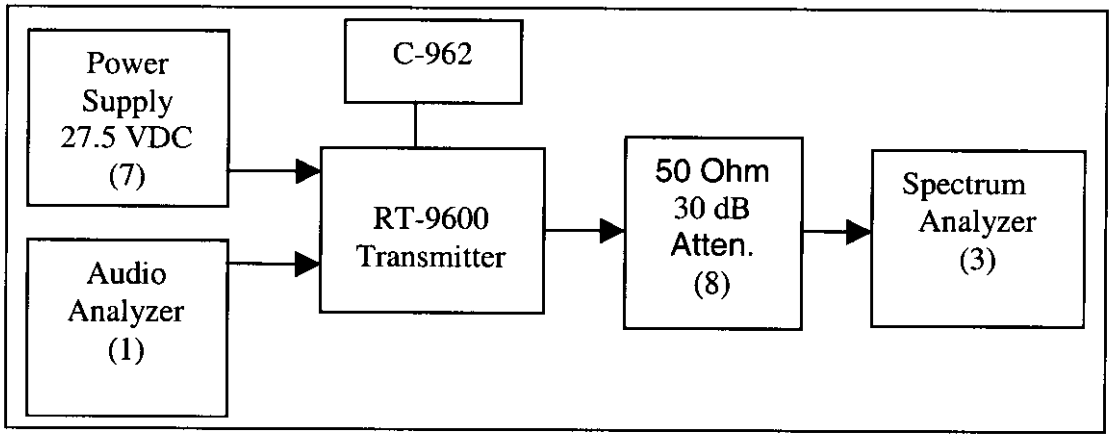
6.3 Occupied Bandwidth; Paragraph 2.989:

Occupied bandwidth was measured at 162 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

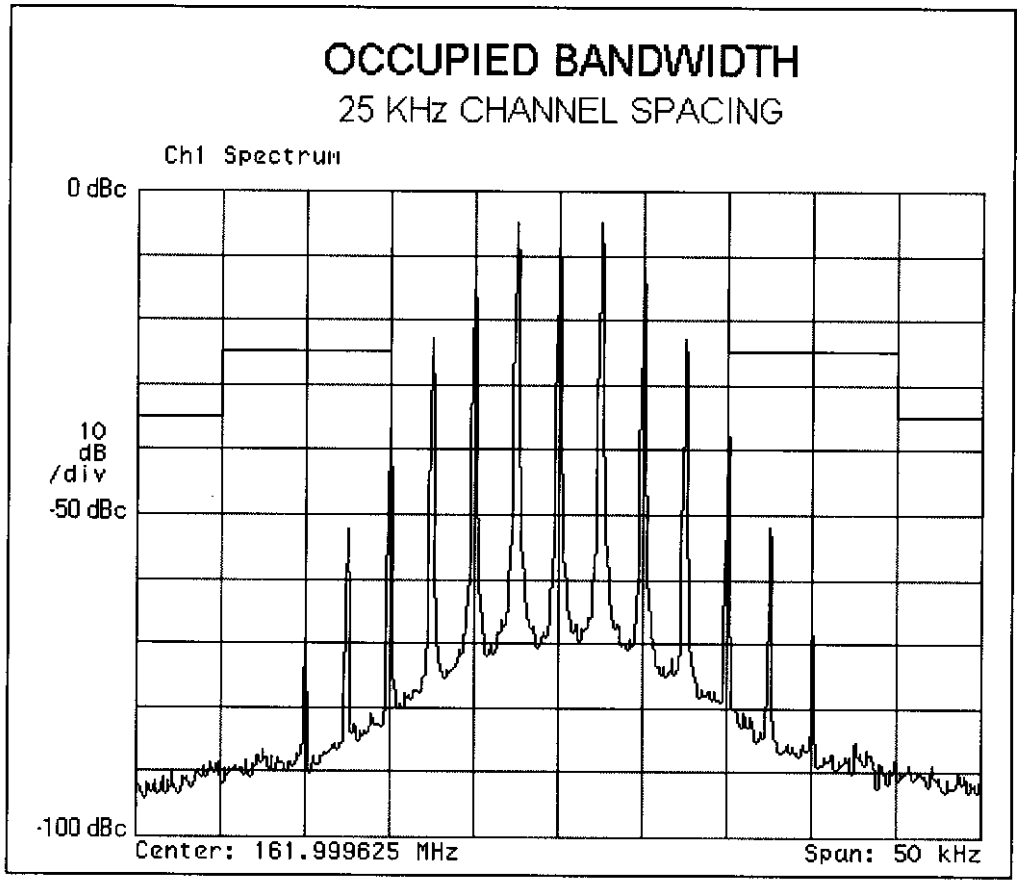
6.3.1 Occupied Bandwidth Test Procedure; Paragraph 2.989

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. No difference in occupied bandwidth was noted at the low power setting

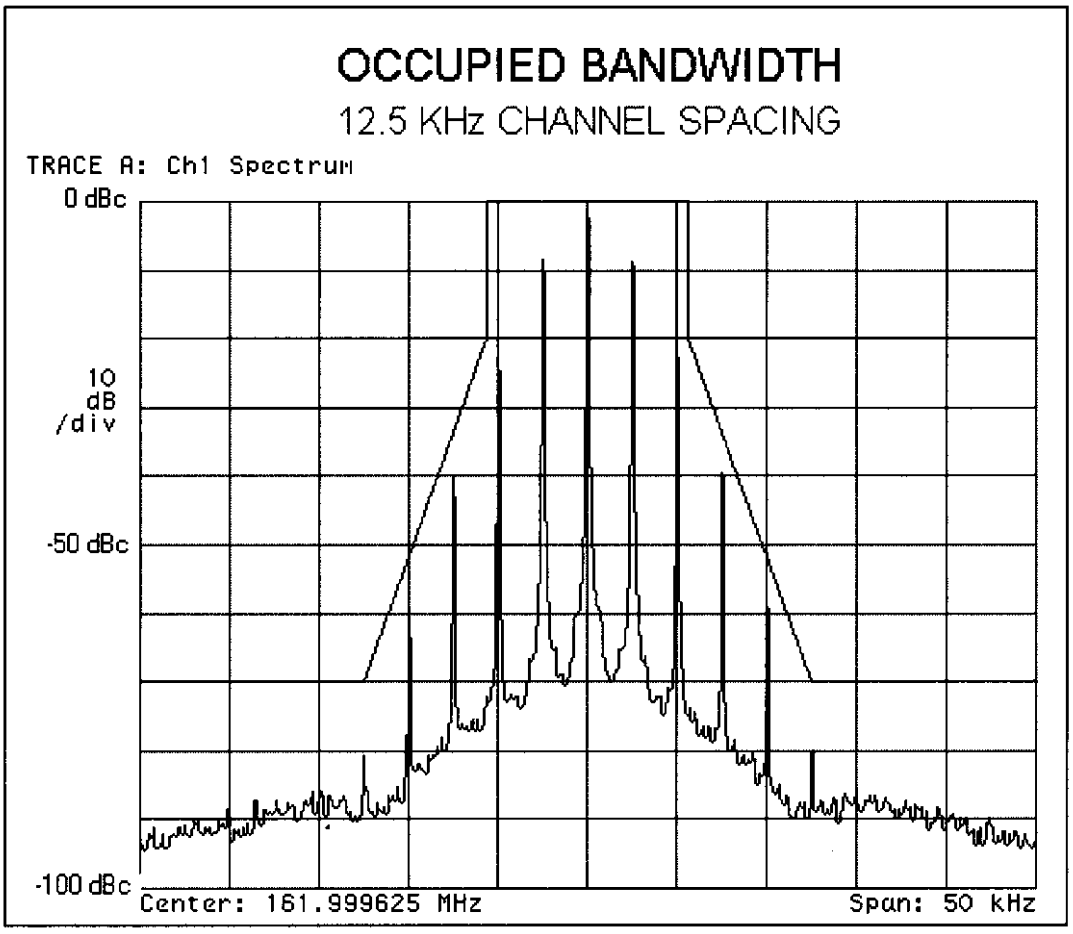
6.3.2 Occupied Bandwidth Test Setup:



6.3.3 Measured Standard Band Occupied Bandwidth:



6.3.4 Measured Narrow Band Occupied Bandwidth:



6.4 Spurious Emissions; Paragraph 2.991, 2.993:

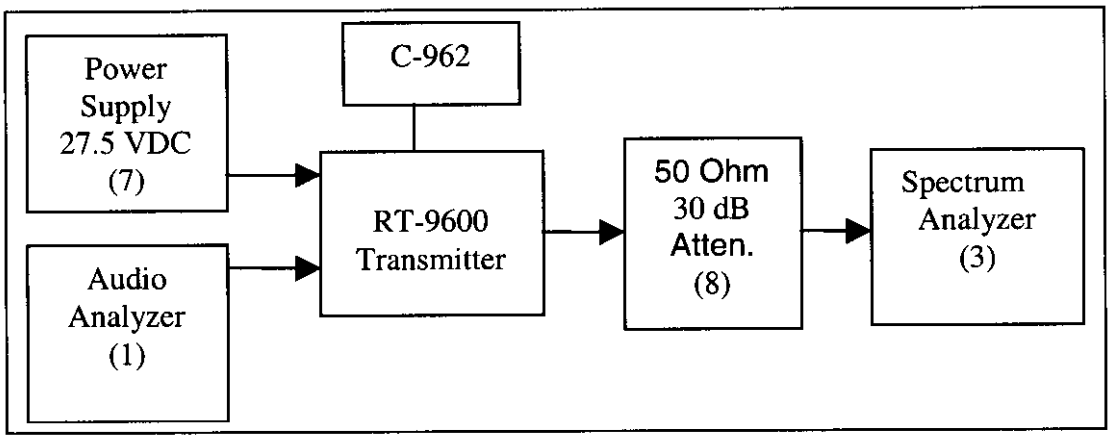
The permitted maximum level of spurious emissions, as per paragraph 90.209 (g) of the FCR is:

= 43 + 10 Log (Mean Power Output) dBc

6.4.1 Spurious Emissions at the Antenna Terminals; Paragraph 2.991:

Spurious emissions were measured at the band center of 162 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 greater than –75 dBc.

6.4.2 Spurious Emission Test Setup:



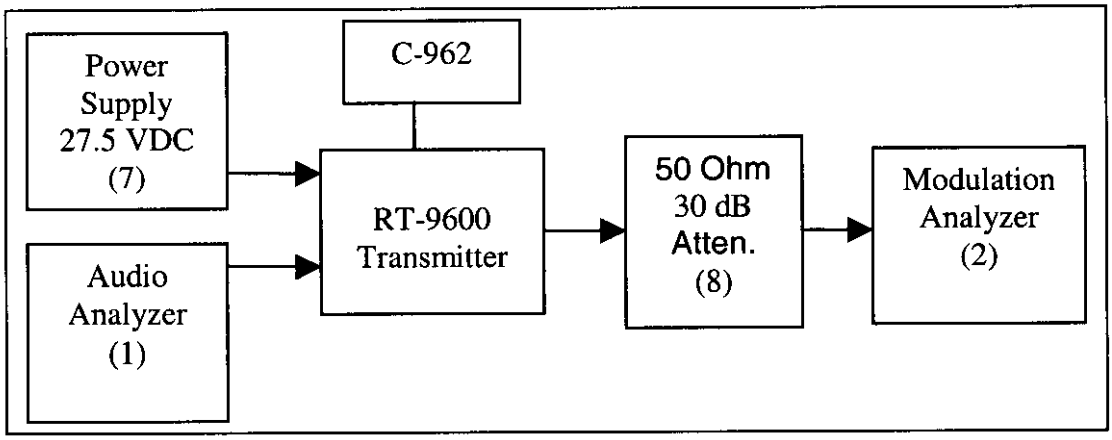
6.4.3 Field Strength Measurement of Spurious Radiation; Paragraph 2.993

Radiated Field strength measurements were conducted on the original equipment by M. Flom Associates, Inc., Chandler, AZ. The original report is attached in Exhibit B. The transmitter and shielding of this radio has not been altered from the original design. The FAA required DO-160 radiation testing has been performed on this unit with no significant changes relative to the original unit.

6.5 Frequency Stability; Paragraph 2.995:

The transceiver reference TCXO was adjusted at 25º C per the tune up instructions. The TCXO in this unit does not require a warm up period and data was taken immediately upon reaching the test temperature.

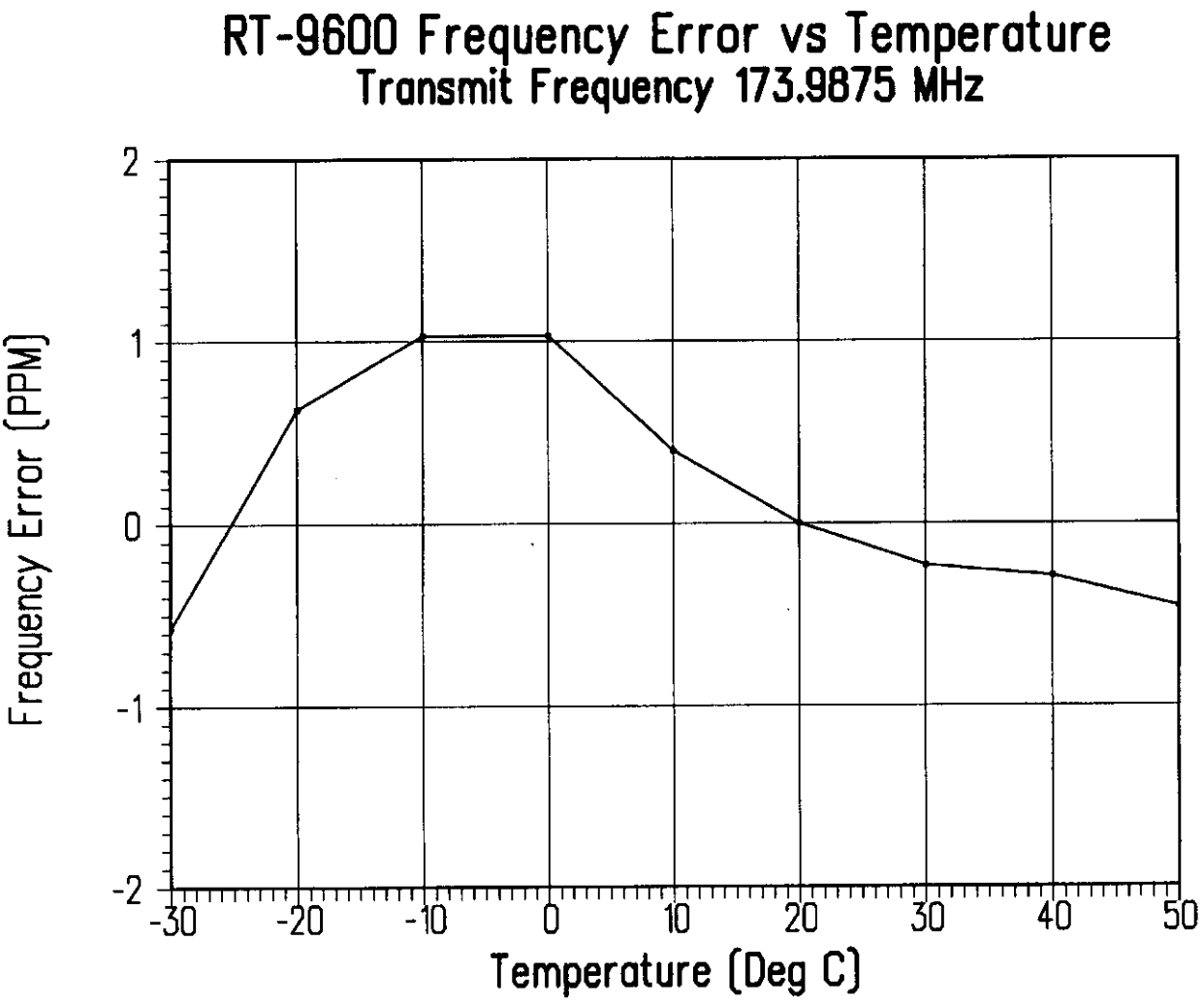
6.5.1 Test Setup for Frequency Stability:



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

The RT-9600 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 +50º 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 and the transmitter was keyed for at least 5 seconds and the frequency was measured at the end of the period.

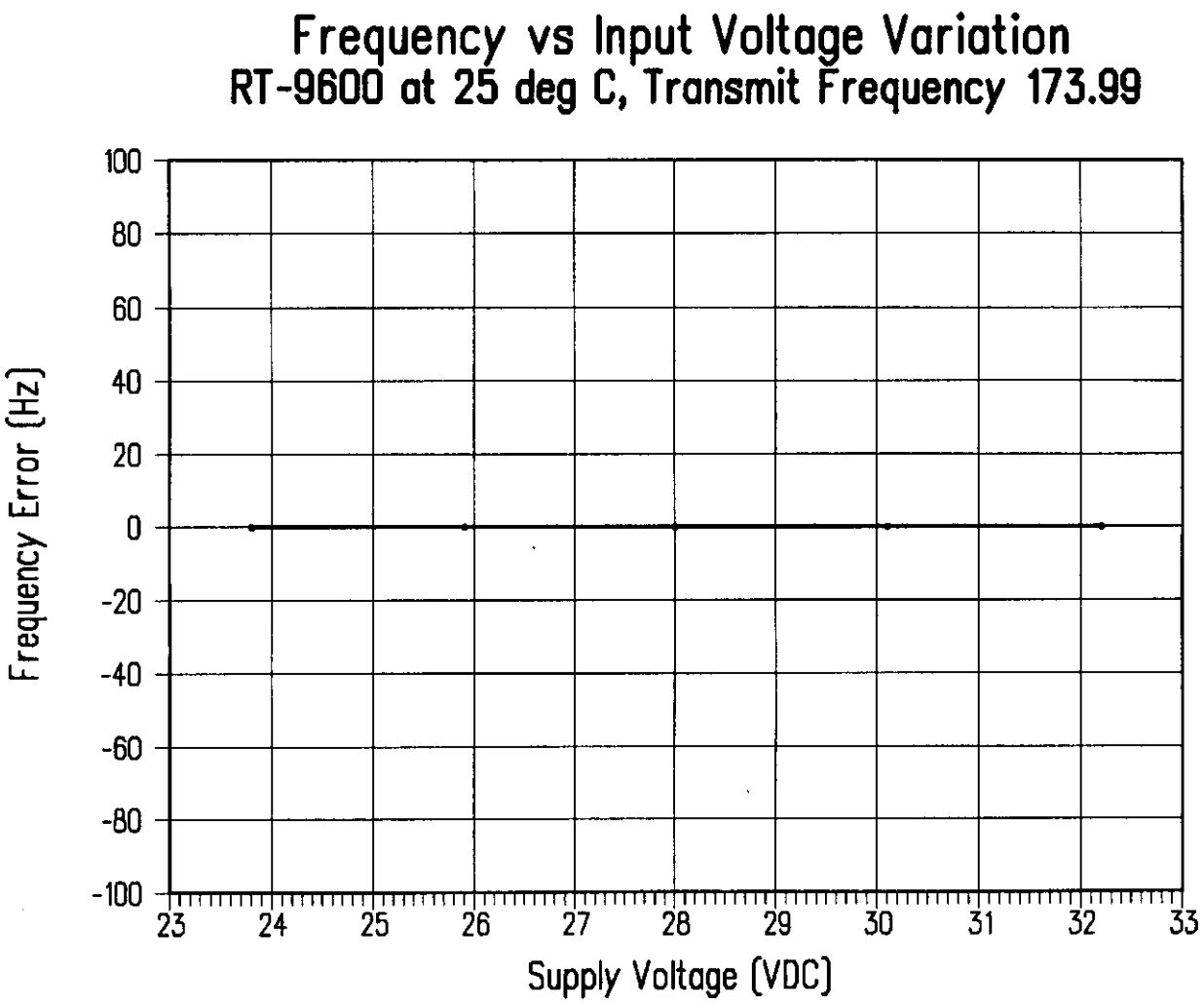
6.5.3 Measured Temperature Data:



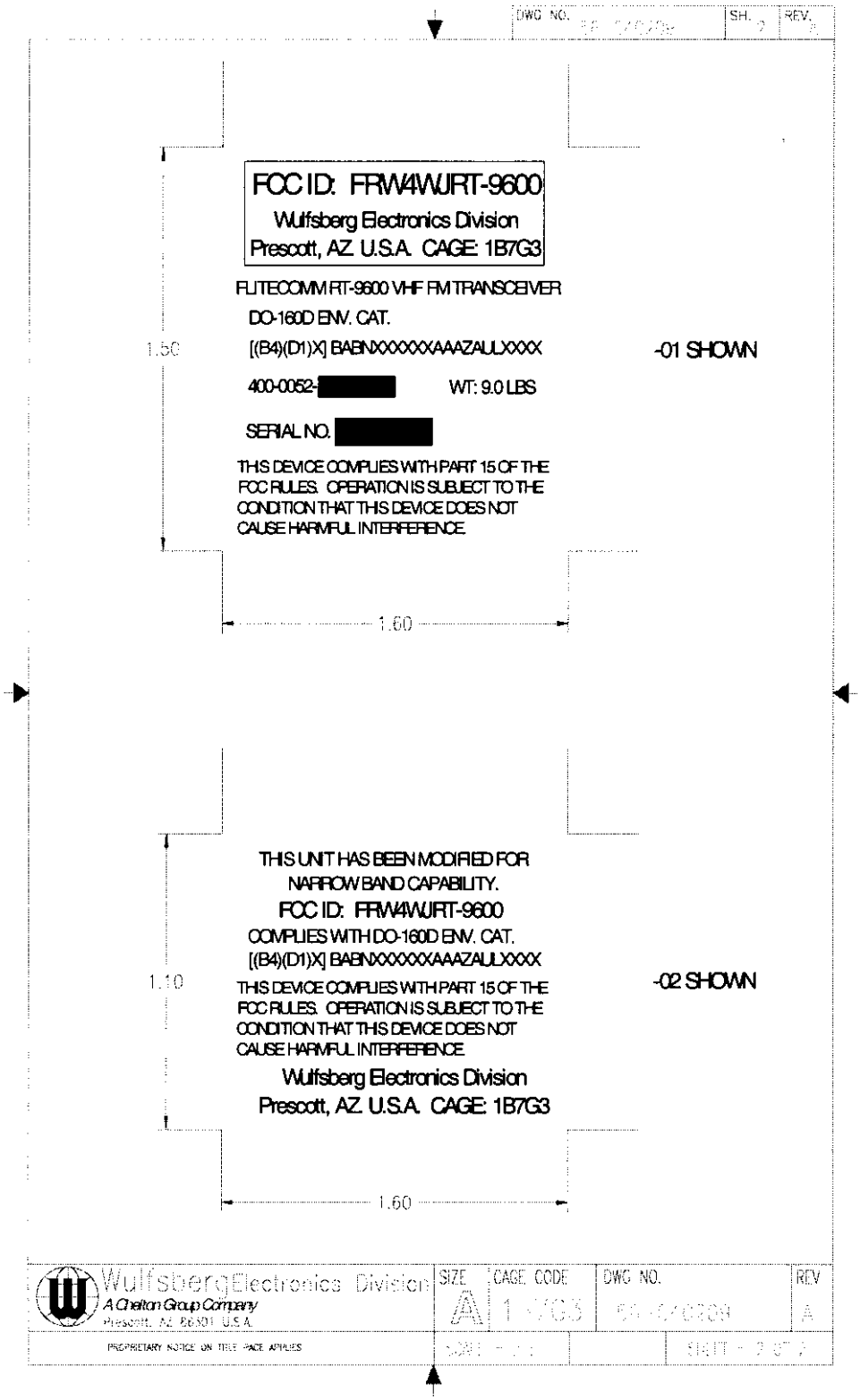
6.5.4 Frequency Stability Under Voltage Variation; Paragraph 2.995 (d)

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.

6.5.5 Measured Frequency Stability Under Voltage Variation Data:



7 EQUIPMENT IDENTIFICATION LABEL:



RT-9600F NARROW-BAND SYNTHESIZER MODULE
MAINTENANCE MANUAL ADDENDUM

Record of Revisions

Revision Number	Issue Date	Date Inserted	By	Revision Number	Issue Date	Date Inserted	By
A	06/15/99						

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RT-9600F NARROW-BAND SYNTHESIZER MODULE MAINTENANCE MANUAL ADDENDUM

Section 1 Introduction

1.1 Overview

This Addendum contains information pertaining to the Narrow-band Synthesizer Module for the Wulfsberg RT-9600F Transceiver.

1.2 Audience

This manual is intended for qualified aircraft avionics technicians in authorized maintenance and repair facilities.

1.3 References

Wulfsberg Electronics RT-9600 Maintenance Manual, PN 150-0058-000

Section 2 Theory of Operation

2.1 General

The RT-9600F and RT-9600 transceiver have identical boards and operation except for the synthesizer board. The RT-9600F contained an improved synthesizer board which allowed faster channel switching. The Narrow-band upgrade replaces the synthesizer board and makes minor chassis wiring changes. After the modification, the RT-9600 and RT-9600F are equivalent radios. The Theory of Operation contained in this document covers only the new synthesizer board. The board's remaining operations are covered in the original Theory of Operation in the maintenance manual.

2.2 Operational Block Diagram

Figure 2-1 through 2-4 shows a block diagram that illustrates the operation of the RT-9600/RT-9600F Synthesizer Module.

2.3 Synthesizer Module Circuit Theory

The new Synthesizer Module (A102) is one board which replaces the Synthesizer PC Board (A109), the TCVCXO Assembly (A103), the VCO Assembly (A110), and the Buffer Assembly (A111).

The Synthesizer Board contains a microprocessor controller which scans the frequency input lines for channel changes, generates the Receiver Board preselector filter tuning voltage, and adjusts the modulation amplifiers for constant modulation sensitivity across the RF frequency band. This board also contains the Phase-Locked Loop (PLL) Synthesizer IC and loop filter, which together with the Voltage Controlled Oscillator (VCO) and the Buffer Amplifier form the frequency-determining loop.

2.3.1 Controller Operation

The microprocessor controller U1 performs the following functions:

- Monitors the frequency input lines, which are multiplexed by latches U14, U15, and U16, the Narrow Band line, and PTT line for channel and radio state changes.
- Monitors the $\overline{\text{Lock Det}}$ line from the Programmed Logic Device (PLD) IC U3 to determine if the Phase-Locked Loops are on frequency.
- Generates the Receiver Board preselector filter tuning voltage using the digital-to-analog (DAC) formed by buffer U17, CR1, and Op Amp U2-C. The diode CR1 provides temperature compensation for the DAC to adjust for the varactor diodes in the input filter.
- Calculates the PLL frequency counters divide ratios and loads the PLL chips through serial bus lines SDTA and SCLK.
- Calculates the required gains for DACs U300 and U302 and loads via the serial bus.

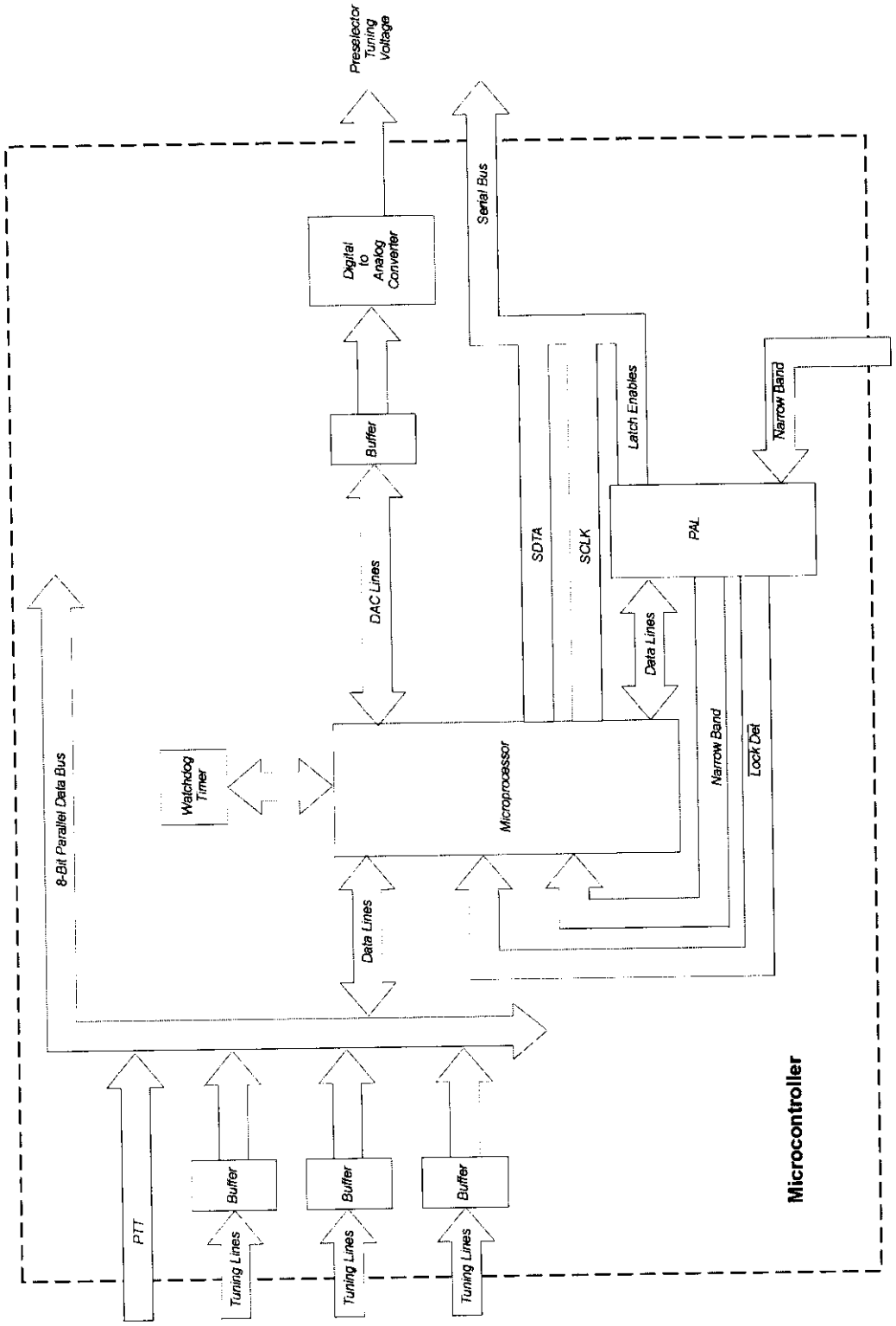

Figure 2-1. RT-9600 Synthesizer Module Block Diagram (1 of 4)

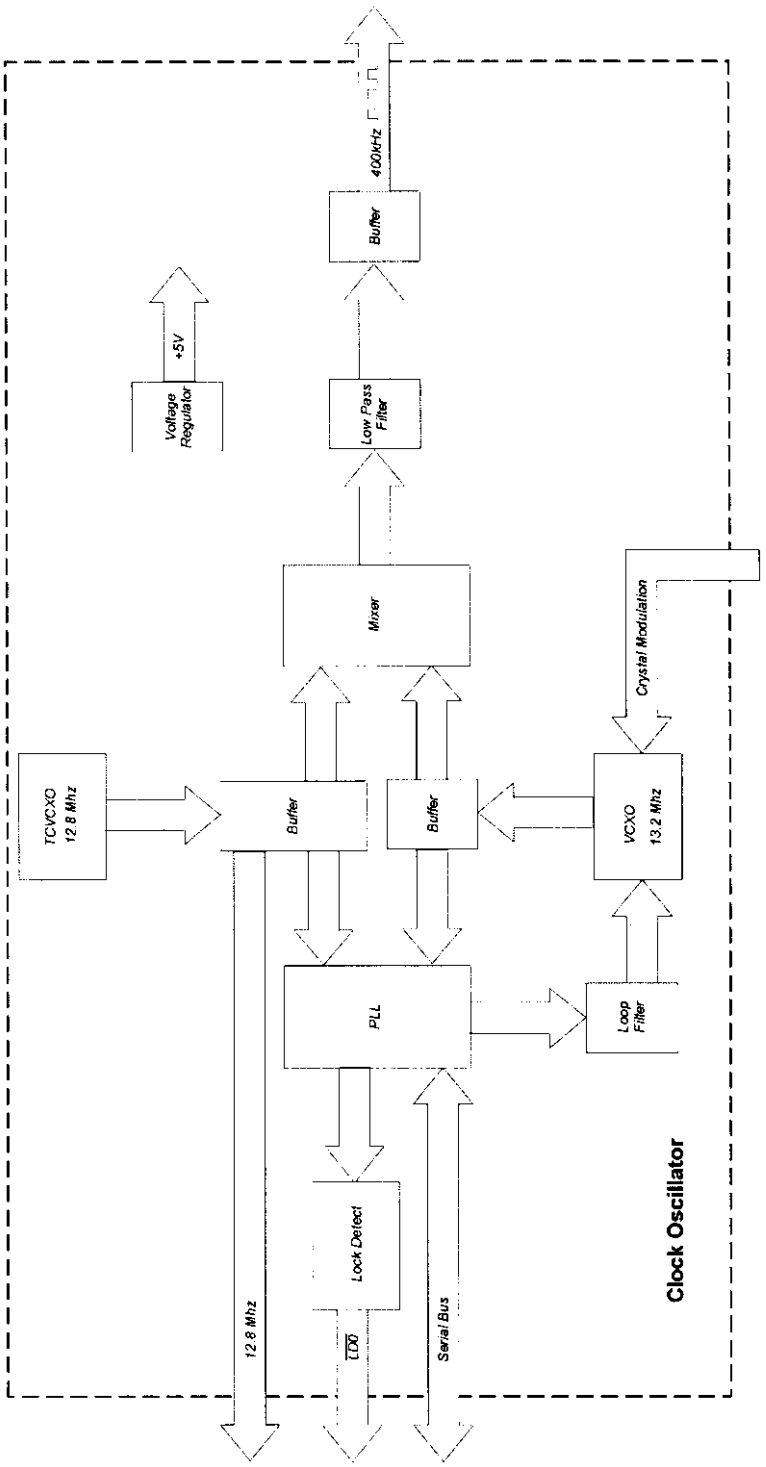

Figure 2-2. RT-9600 Synthesizer Module Block Diagram (2 of 4)

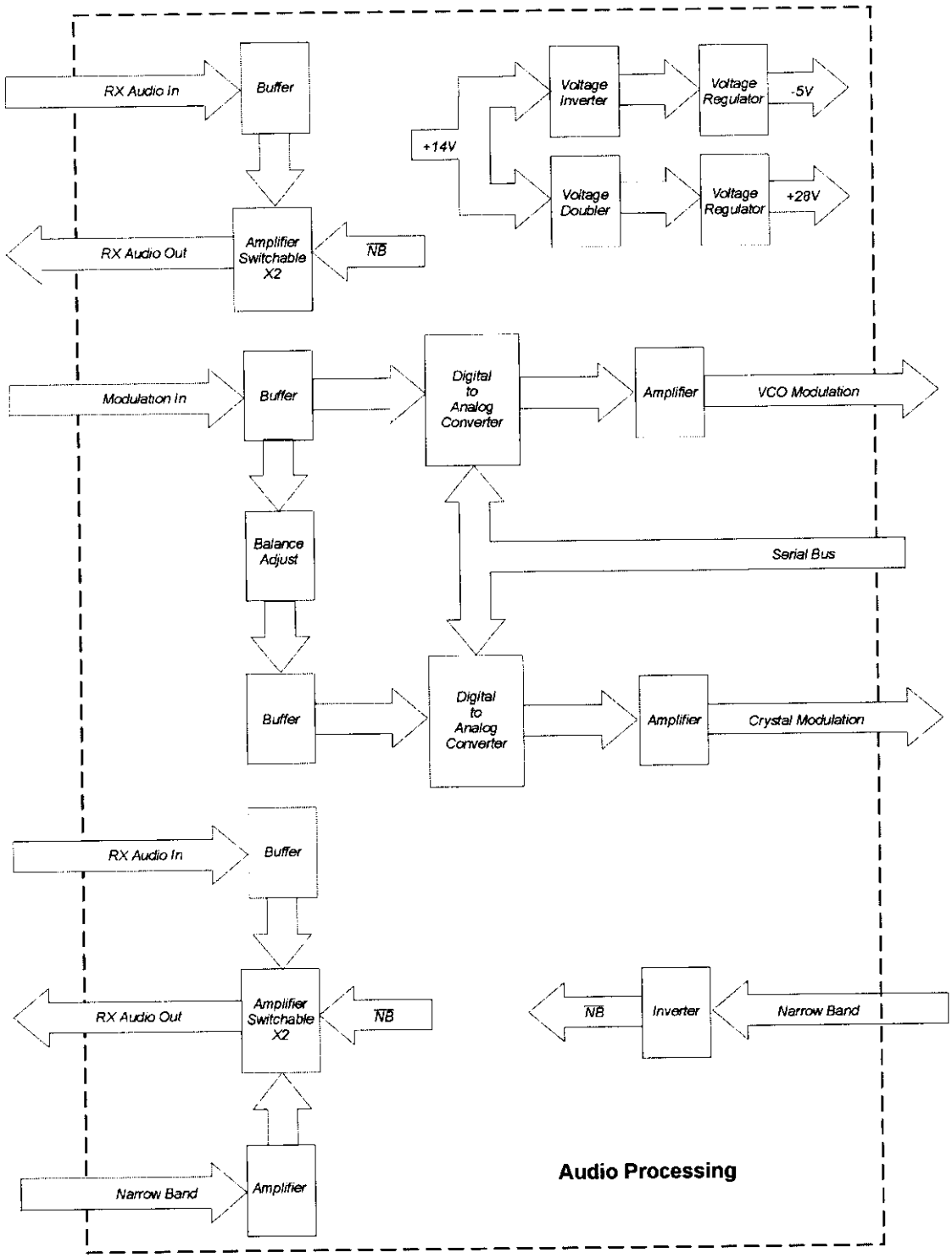

Figure 2-3. RT-9600 Synthesizer Module Block Diagram (3 of 4)

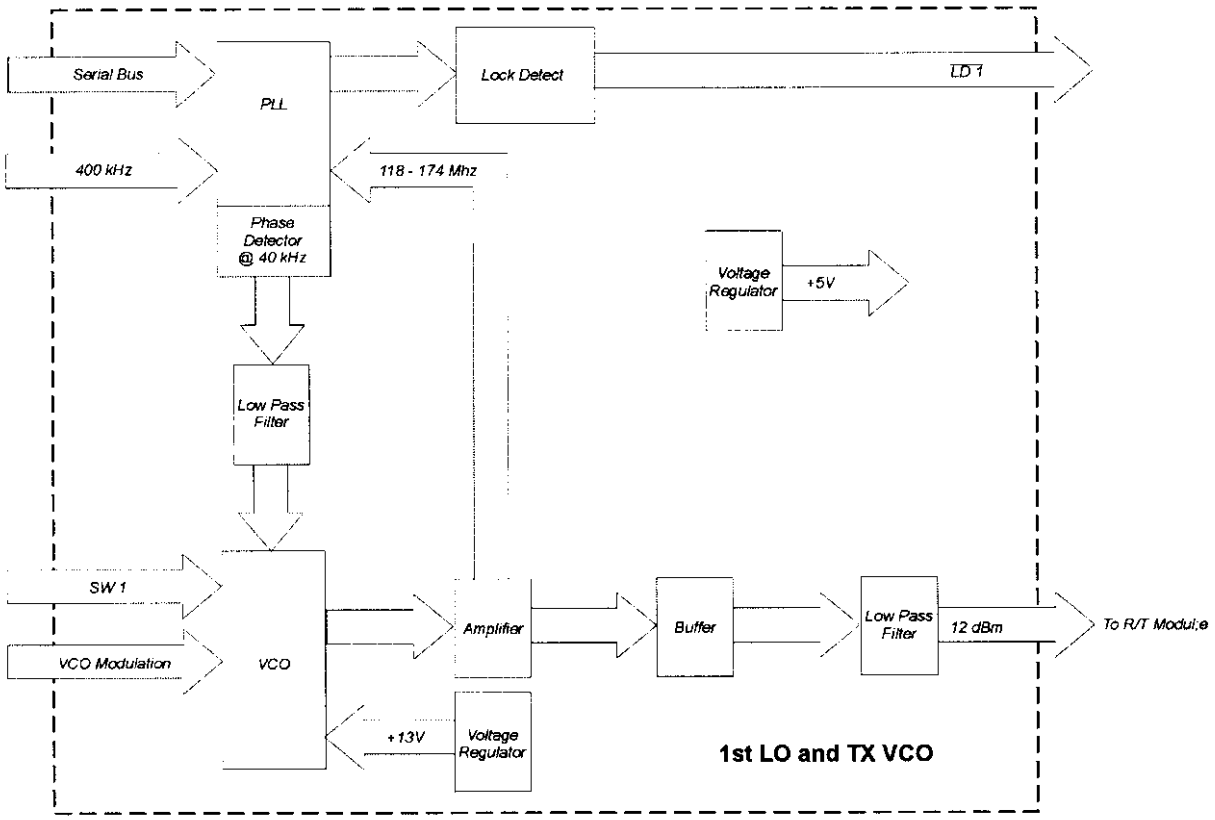

Figure 2-4. RT-9600 Synthesizer Module Block Diagram (4 of 4)

Static electric discharge protection is provided by diodes CR2 and CR3. U6 provides a watchdog timer and power on reset function for the µP controller.

2.3.1.1 Frequency Selection

Sixteen BCD weighted control lines and the PTT line accomplish determination of the VCO frequency. These lines are active low. The µP controller reads these BCD frequency inputs by means of three octal latches U14, U15, and U16.

When a change in the frequency control lines occurs or if the PTT line goes low, the µP controller calculates and outputs clocked serial data to PLL IC U100 and U202. This programs the chip for the proper divide ratios. At completion of this serial data transfer, the µP controller latches the data into the PLL counter registers by generating a positive pulse on the ENABLE line, pin 16 U100 and pin 11 U202. If the PTT line indicates receive operation, the µP controller calculates and outputs the proper digital word to the receiver preselector tuning DAC. If the PTT line indicates transmit operation, the transmitter is enabled within 5 ms after $\overline{\text{Lock Det}}$ goes low.

An OUT OF LOCK condition is treated essentially the same as a channel change. If an OUT OF LOCK condition occurs, indicated by a low on U1, Pin 14, the controller will immediately disable the transmitter and re-program the counters within the PLL ICs.

2.3.2 Receiver Preselector Tuning Voltage Generation

Based on the frequency control lines, the synthesizer generates a voltage, which is used to tune the receiver preselector. µP controller U1 outputs a seven bit binary number, which represents this voltage. A DAC composed of operational amplifier U2-C, buffer U17, resistors R61 through R67 and CR1 converts this binary number to a voltage, which typically ranges between 5 VDC and 15 VDC. Potentiometer R72 sets the starting point (i.e., voltage at 150 MHz) at nominally 5 VDC. Potentiometer R68 sets the slope of the preselector tuning curve without moving the 5 VDC starting point. These adjustments allow additional freedom in matching the variations to be expected within the receiver preselector. Diode CR1 causes the preselector tuning curve to shift in voltage with temperature variations. This shift matches the temperature characteristics of the preselector filter.

2.3.3 Reference Frequency Generation

The reference frequency for the main VCO PLL is 400 kHz. This frequency is generated by mixing a 12.8 MHz TCVCXO, Y200 and a phase locked 13.2 MHz crystal oscillator.

The 12.8 MHz is buffered by amplifier, Q201 and feeds the mixer, PLL U202, and the micro controller U1. The mixer consists of Q206, Q207, and Q208, which form a Gilbert cell. The 400 kHz output of the mixer is filtered by the low pass filter formed by C228, L207, C230 and L209. This output is shaped and buffered by amplifier Q204.

The 13.2 MHz VCXO consists of CR204, CR203, Y201 and Q203. The varactors, CR204 and CR203, allow the frequency of the oscillator to be pulled by 230 PPM for phase locking to the 12.8 MHz TCVCXO. The output of the oscillator is buffered by amplifier Q202 and feeds the mixer and the PLL IC U202, pin 1. Inside of U202 the 12.8MHz and 13.2 MHz signals are divide to a 40 kHz frequency for phase comparison. A signal proportional to the phase difference is generated at pin 5 of U202. The loop filter formed by U200, R220, C245, R221, and R232 filters this signal that is applied to the varactors to form a phase-locked loop.

The 13.2 MHz loop is modulated by audio when applied to R233 and CR204 when in transmit mode.

The outputs of pin 7, U202 are pulses proportional to the phase difference at the phase detector. The signal at pin 7 is integrated by CR201, C217, and Q200 and produces a logic level lock detection signal. This signal is applied to LED CR202 to produce a visual lock indicator and feeds U3 to provide lock indication to the micro controller.

2.3.4 Reference and VCO Modulation Amplifiers

To extend the transmitter modulation frequency response at low audio frequencies, modulation audio is applied to both the VCO and the 13.2 MHz VCXO. In this architecture, the VCO is responsible for modulation of the higher audio frequencies, the VCXO for the lower audio frequencies, and the two combine at frequencies in the neighborhood of the loop bandwidth.

The gain of the audio modulation path is adjusted as a function of the VCO frequency to provide flat modulation. This adjustment is accomplished by DACs U300 and U302 which, in combination with U303-C and U303-A, form a digitally controlled variable gain stage. The proper gain is loaded by the μP controller from a lookup table stored in ROM. Amplifiers U303-B and U303-D are used to inject a DC offset to the audio signal. Amplifiers U305-A and C act as a buffer stages and R300 is used to balance the gains between the two audio paths.

2.3.5 Narrow Band Gain Boost

When the radio incorporates a narrow-band system, the received audio is reduced by a factor of two due to the reduced modulation deviation. To compensate for this reduction, a times-two audio boost circuit is supplied for the main and guard receive audio paths and is controlled by the narrow-band control signal.

The Main Receiver audio is buffered by amplifier U302-D and fed to the two-state amplifier formed by U302-B and U309-A. A low signal on pin 16 of U309-A will produce a gain of two. A high signal (+5 VDC) will produce a gain of one.

The Guard Receiver audio is buffered by amplifier U306-B and inverted by amplifier U306-A. The output is fed to the two-state inverting amplifier formed by U306-C, U309-C, and U309-B. A low signal on pin 9 of U309-B will produce a gain of two. A high signal (+5 VDC) will produce a gain of one.

The extra audio gate U309-D is used to invert the logic signal Narrow Band to produce $\overline{NB}$.

2.3.6 Voltage Generation and Regulation

A negative voltage is required for operation of the new synthesizer board. This voltage is generated by voltage inverter U304 and is regulated by U301.

A voltage doubler consisting of U307, C310, C309 and CR301 produces a 28 VDC supply. This voltage is regulated and filtered by U308 to 22 VDC.

Voltage regulator U102 supplies filtered 13 volts to the VCO. Voltage regulators U203 and U101 supply regulated 5 VDC.

2.3.7 Main VCO and Buffer

The main VCO covers the frequency range of 130 to 174 MHz. This provides the transmitter exciter frequency of 150 to 174 MHz and the receiver LO of 130 to 154 MHz. The VCO consists of Q101, C100, C101, C102, L103, CR104, CR100, CR103, L106, and C146. The VCO is band switched by the logic signal SW 1. SW 1 activates the drivers Q100 and Q104 to turn on or off the pin diode CR100. Turning on CR100 adds the reactance of L106 to the tuned circuit of the VCO to shift the VCO higher in frequency.

Frequency control of the VCO is obtained by applying a feedback control voltage to varactor CR104. Audio modulation is injected onto the oscillator by applying audio voltage to varactor diode CR103.

Amplifier Q102 and Q103 buffer the output of the VCO. Diode CR102 provides temperature compensation of the DC biases for Q102 and Q103. The output of Q102 is fed to the PLL IC U100, pin 6. The output of Q103 feeds the low pass filter formed by C110, L104, and C111. The output of this filter provides a 12 dBm output to the R/T module.

The VCO frequency applied to pin 6 is divided to produce 40 kHz signal that is phase compared to a 40 kHz reference. The frequency step size of 2.5 kHz is obtained by utilizing fractional division in the PLL IC. The output of the phase detector on U100 drives a charge pump output on pin 4. This current is integrated by the loop filter formed by U105, C122, and R132. The output of the loop filter is restricted from going below two volts by a clamp formed by CR109 and Q105. This output voltage is applied to CR104 to form a phase locked loop.

The outputs of pin 11, U100 are pulses proportional to the phase difference at the phase detector. The signal at pin 11 is integrated by CR107, C118, and Q118 and produces a logic level lock detection signal. This signal is applied to LED CR108 to produce a visual lock indicator and feeds U3 to provide lock indication to the micro controller.

Section 3 Maintenance

3.1 Disassembly

See the RT-9600 Maintenance Manual, Section 4.1, with the following exceptions for new synthesizer module.

3.1.1 Synthesizer Module

VCO

1. Remove the synthesizer cover by removal of ten flat-head Phillips screws.
2. Remove nine hex posts holding down the synthesizer board.
3. Remove VCO.

3.2 Test Equipment

See the RT-9600 Maintenance Manual.

3.3 RT-9600F Overall Performance Tests

See the RT-9600 Maintenance Manual for wide band tests. All tests are performed with a C-962 control head that has been upgraded for narrow band operation. For narrow band mode operation the following changes should be noted:

3.3.1 Transmitter Deviation Capability

In the narrow band mode with an input of 0.25 VRMS at 1000 Hz, the transmitter shall produce a deviation greater than 1.5 kHz.

3.3.2 Transmitter Deviation Limiter

A 2.5 VRMS audio input signal shall produce no greater than 2.5 kHz deviation.

3.4 Troubleshooting

3.4.1 General

The RT-9600 Synthesizer Module (A102) now has only one board which replaced the: the Synthesizer P.C. Board (A109), the VCO Assembly (A110), and the Buffer Assembly (A111). For a description of the function of this module see the Theory of Operation. Reference to the block diagram and the synthesizer schematic may also be helpful.

3.4.2 Synthesizer Module Inputs for Proper Operation

The synthesizer module must have seven supporting inputs or groups of input lines for proper operation. They are as follows:

Synthesizer Inputs	Source of Input
BCD TUNING (17 lines)	CONTROL HEAD
PTT	CONTROL HEAD
MODULATION	AUDIO MODULE
$\overline{\text{NARROW BAND}}$	CONTROL HEAD
+5 VDC	POWER SUPPLY
+8.5 VDC	POWER SUPPLY
+14 VDC	POWER SUPPLY

The BCD TUNING lines are used to select the frequency of operation of the synthesizer. They can be at one of only two voltage levels: a HI voltage level (about 10 VDC) or a LOW voltage level (0-2 VDC). These lines are LOW when selected. The frequency of operation selected can easily be calculated by adding up the BCD-weighted lines selected. As an example, for 156.957 MHz, the lines selected would be:

1	$\overline{100\ \text{MHz}}$ line is assumed selected
5	$\overline{40}$ and $\overline{10\ \text{MHz}}$ lines selected
6	$\overline{4}$ and $\overline{2\ \text{MHz}}$ lines selected
9	$\overline{.8}$ and $\overline{.1\ \text{MHz}}$ lines selected
5	$\overline{.04}$ and $\overline{.01\ \text{MHz}}$ lines selected
7	$\overline{.005}$ and $\overline{.0025}$ MHz lines selected

The input voltage levels are internally converted to levels that can be multiplexed onto the microprocessor controller data bus.

$\overline{\text{PTT}}$ is an active low input. $\overline{\text{PTT}}$ selection causes the microprocessor to load different loop divide ratios into the PLL IC (U100), shifting the synthesizer operating frequency from 20 MHz below the selected frequency (for receiver low-side injection) to directly on the selected frequency (for transmitter operation).

Audio at the MODULATION input is level-adjusted and filtered before being sent to both the XMT VCO and the TCVCXO. Typically, 0.55 VRMS input at P102 Pin M will produce ±5 kHz deviation for wide band operation and ±2.5 kHz narrow band operation.

The +5 VDC input supplies power to all of the digital circuitry on the synthesizer board. It should be 5.0 VDC ± 0.5 VDC under all conditions.

The +14 VDC input supplies power to much of the audio circuitry on the board. It should be 14 VDC ±0.5 VDC under all conditions.

The +24 VDC should be 24 VDC ±1 VDC under all conditions.

3.4.3 Synthesizer Module Outputs for Proper Operation

The synthesizer module has the following three outputs:

Synthesizer Output	Output Termination
$\overline{\text{TX DISABLE}}$	R/T MODULE
TUNING VOLTAGE	R/T MODULE
RX/TX INJECTION	R/T MODULE

The $\overline{\text{TX DISABLE}}$ line must be in one of only two states: HI (+ 5.0 VDC) or LOW (0.1 VDC). If this line is LOW, the transmitter will be disabled. This line is LOW when the transceiver is in the receive mode, or when the synthesizer is in an out-of-lock condition. The transmitter will be enabled only after the synthesizer locks on frequency when the $\overline{\text{PTT}}$ line is actuated.

The TUNING VOLTAGE output is a voltage that is generated to tune the preselector in the receiver. It ranges from 5.0 VDC at 150 MHz to approximately 14.8 VDC at 173.9975 MHz for a typical receiver.

The RX/TX INJECTION output is the RF drive to the first mixer in the receive mode or to the power amplifier chain in the transmit mode. The frequency of this output varies from 130 to 153.9975 MHz in the receive mode, and from 150 to 173.9975 MHz in the transmit mode. The typical power level at this port is +12 dBm.

3.4.4 Synthesizer Module Troubleshooting Sequence

The synthesizer has two phase locked loops (PLLs). Each loop has an LED for a visual lock indicator, which aids in trouble shooting. The LO PLL indicator is CR202 and the Clock Oscillator PLL indicator is CR104.

Failure to achieve frequency lock, as indicated by an unstable or incorrect output frequency, may be due to a number of different things. The following levels or waveforms are some key points to check if an out of lock condition persists.

1. Verify the DATA, CLOCK, and ENABLE signals from the microprocessor controller are reaching the PLL ICs (U202, Pins 10, 9, and 11 and U100, Pins 15 14 and 16 respectively). The sequence of the high and low bits on the DATA line should be a function of the frequency selected. The CLOCK line should show a series of pulses, followed by a single + 5 VDC pulse on the ENABLE line. The entire sequence should repeat itself approximately every 200ms, when the PLL is out of lock.

2. If these signals are not present, either the PLD, U3 or μP controller, U1 has failed. Verify that U1 Pin 10 is low (RESET), and a 12.8 MHz clock signal is present at U1 Pin 21.

3. If the DATA, CLOCK, and ENABLE signals are present, but the 1st LO loop does not lock up, verify the presence of 400 kHz signal at U100 Pin 10 and the VCO signal at Pin 6. If the latter signal is not present, work backwards through the RF chain to discover where the break occurs.

4. If there is no RF signal (130 to 174 MHz) at the output of the VCO, trace backwards through the two buffers to find where the circuit failed.

5. If the loop achieves lock, but on an incorrect frequency, one or more of the input lines may have failed. Verify that the proper inputs to input latches U16, U15, and U14 are selected according to the frequency selected on the control head.

6. If the Clock Oscillator PLL is out of lock check for 12.8 MHz signal at U202 Pin 8 and 13.2 MHz on Pin 1. If these signals are not present, trace back thought the circuitry to find the failure.

A failure in the modulation amplifier chains (U305, U303, and associated digital switching stages) will generally result in loss of modulation or modulation flatness across the RF and audio frequency bands. If this happens, check the following points:

1. If the synthesizer will modulate at high audio frequencies (> 100 Hz) but not at low audio frequencies, the failure is most likely in the XTAL MOD amplifier chain. The total audio gain from modulation input (P102 Pin M) to amplifier output (U303-D Pin 14) varies across the radio frequency band, controlled by the switching in and out of various resistors in the feedback network of U303. The actual gain will be a function of the setting or R300. The micro controller controls this gain.

2. If the synthesizer will modulate at extremely low audio frequencies (< 30 Hz) but not at high audio frequencies, the failure is most likely in the VCO MOD amplifier chain. The total audio gain from modulation input (P102 Pin M) to amplifier output (U303-B Pin 7) also varies across the radio frequency band controlled by the switching in and out of various resistors in the feedback network of U300. The micro controller controls this gain.

3.5 Alignment Procedures

3.5.1 General

The following is a brief alignment procedure to follow in order to align the Synthesizer Module. It is assumed that the synthesizer module is installed in a known good RT-9600F or RT-9600 transceiver. Reference to the synthesizer schematic or the synthesizer assembly component locator may be helpful in locating the various test points or adjustment locations.

3.5.2 Power Supply Voltages

With a DC voltmeter, measure the power supply voltages at the following test points. All voltage measurements should be made with respect to chassis ground. There are no adjustments to make.

1. Verify +14 VDC ±0.5 VDC at P102 Pin N.

2. Verify +8.5 VDC ±1.0 VDC at P102 Pin F.

3. Verify +5 VDC ±0.5 VDC at P102 Pin K.

3.5.3 Frequency Alignment

1. Verify that the frequency at TP3 is 12.8 MHz ± 10 Hz. If the frequency is out of specification adjust R228 to bring into the limits.

3.5.4 Preselector Tuning Voltage Alignment

1. With a DC voltmeter, monitor the tuning voltage at P102 Pin H.
2. Channel the transceiver to 150.000 MHz. Adjust R72 for a tuning voltage of 5.00 VDC ±0.0 1 VDC.
3. Channel the transceiver to 173.997 MHz. Adjust R68or a tuning voltage of 14.8 VDC ± 0.05 VDC.
4. Repeat Steps 2 and 3 as there may be a slight interaction between the setting of the potentiometers.

3.5.5 Modulation Balance Adjust

1. Channel the transceiver to 162.100 MHz, and input a 3 Vpp, 50 Hz square wave to the DVP MOD input line of the transceiver (P102, p).
2. Key the transmitter, feeding a portion of the output signal to the input of the modulation meter. Observe the waveform at the audio output port of the modulation meter.

NOTE: It is important that the modulation meter used for this test has an audio frequency response extending to 10 Hz or below.

3. The recovered waveform should be a square wave with a visible amount of distortion (i.e., overshoot or undershoot on the edge transitions). Adjust R300 for the least distorted (squarest) waveform possible.

Section 4 Schematic Diagrams

4.1 Assembly and Component Numbers

Schematic components are shown in this section according to assembly for the RT-9600-F.

ASSEMBLY NUMBER	COMPONENT
A102	Narrow-Band Synthesizer Module

Parts are numbered according to the assembly within the RT-9600F.

Section 5 Parts Listing

5.1 General

The purpose of this parts list is for the identification, requisition, and issuance of parts for the RT-9600F. Refer to Figure 4-1. Part numbers included in this parts list meet critical equipment design specification requirements. Use only the part number specified in the parts list for replacement of parts.

5.2 Parts list, RT-9600 Narrow-Band Fast Lock Synthesizer

Item	Qty	UM	Part	Title	Reference
1	2	EA	007-00542-0000	XSTR PNP MMBTA64	Q118 Q200
2	2	EA	007-04056-0000	DIODE MMBV109 V	CR203 CR204
3	1	EA	007-04057-0000	DIODE MMBV105G	CR103
4	2	EA	007-06424-0001	LED SURFACE MOUNT	CR108 CR202
5	3	EA	019-02723-0036	INDUCTOR 10.0UH 10% 118MA 1210	L1 06 L204 205
6	3	EA	019-02723-0044	INDUCTOR 4.72UH 10% 51.7MA 1210	L2 L3 L100
7	3	EA	019-02723-0049	INDUCTOR 120UH 5% 35MA 1210	L206 L207 209
8	9	EA	096-01186-0019	CAP 22UF 20V 10%	C137 C141 C240 C246 C247 C312 C313 C322 C341
9	6	EA	096-01186-0024	CAP 0.1UF 35V 10% CHIP TANT	C106 C124 C126 C128 C221 C241
10	1	EA	096-01186-0029	CAP 0.68UF 35V CHIP TANT	C245
11	3	EA	096-01186-0080	CAP 1.0UF 35V 20%	C132 C219 C307
12	4	EA	096-01186-0087	CAP 15UF 35V 10% CHIP TANT	C309 C31 0 C326 C339
13	9	EA	106-014270-01	XSTR MMBT3904 NPN SMD	Q104 Q105 0201 Q202 Q203 Q204 Q206 Q207 Q208
14	1	EA	106-014814-01	XSTR, SMD PNP	Q100
15	3	EA	106-016393-01	XSTR MMBR951L PNP RF SMD	Q101 Q102 Q103
16	1	EA	106-04101-0016	CAP 100PF 5% 50V NPO 1206	C210
17	3	EA	106-04102-0016	CAP 100OPF 5% 50V NPO 1206	C144 C145 C228
18	1	EA	106-04103-0047	CAP .01UF 10% 50V X7R 1206	C43
19	17	EA	106-04104-0047	CAP 0.1UF 10% 50V X7R 1206	C45 C119 C121 C125 C136 C213 C215 C224 C226 C229 C231 C232 C233 C237 C239 C244 C323
20	1	EA	106-04109-0011	CAP 1.0PF +-.25PF 50V NPO 1206	C113

Item	Qty	UM	Part	Title	Reference
21	2	EA	106-04120-0016	CAP 12PF 5% 50V NPO 1206	C102 C146
22	1	EA	106-04182-0016	CAP 180OPF 5% 50V NPO 1206	C230
23	3	EA	106-04221-0016	CAP 220PF 5% 50V NPO 1206	C103 C133 C211
24	1	EA	106-04249-0011	CAP 2.4PF +-.25PF 50V NPO 1206	C105
25	1	EA	106-04273-0047	CAP .027uF 50V CHIP 1206	C118
26	2	EA	106-04331-0016	CAP 330PF 5% 50V NPO 1206	C302 C305
27	2	EA	106-04334-0047	CAP .33UF 20% 50V Z5U l2O6	C338 C343
28	1	EA	106-04470-0016	CAP 47PF 5% 50V NPO 1206	C212
29	3	EA	106-04471-0016	CAP 470PF 5% 50V NPO 1206	C127 C318 C319
30	2	EA	106-04560-0016	CAP 56PF 5% 50V NPO 1206	C100 C101
31	1	EA	106-04569-0011	CAP 5.6PF +-.25PF 50V NPO 1206	C242
32	2	EA	106-04680-0016	CAP 68PF 5% 50V NPO 1206	C123 C243
33	4	EA	106-514278-01	DIODE BAV99 SWITCHING SMD	CR1 CR2 CR3 CR301
34	4	EA	106-516396-01	DIODE BAV70L DUAL SW SMD	CR102 CR107 CR109 CR201
35	1	EA	106-540031-01	DIODE, VARACTOR SMV1207-004 (SOT23)	CR104
36	1	EA	106-617885-01	DIODE HSMP3822L31 DUAL PIN SMD	CR100
37	1	EA	106-714803-03	IC DG201 A QUAD ANLG SW SMD	U309
38	4	EA	106-714804-02	IC TL074 QUAD OP MAP SMD	U2 U303 U305 U306
39	1	EA	106-715998-02	IC MC145158DW2 PLL SMD	U202
40	1	EA	106-716451-01	IC MC79MO5CDT -5 VOLT REG SMD	U301
41	2	EA	106-716621-03	I.C., LM317MDT ADJ VOLT REGULATOR (SMD)	U102 U308
42	2	EA	106-716704-02	IC MP7543KS 12 BIT DAC	U300 U302
43	4	EA	106-716737-02	I.C., 74HC541DW BCTL/BFFR LN DRVR	U14 U15 U16 U17
44	1	EA	106-740015-02	IC DS1232LP 5V MICRO-MONITOR	U6
45	1	EA	106-740016-02	IC LMX2352 DUAL N FREQ SYNTHESIZER	U100
46	2	EA	106-740090-02	SWITCHED CAPACITOR VOLTAGE CONVERTER	U304 U307
47	2	EA	106-740124-02	LOW NOISE HIGH SPEED OP AMP	U105 U200
48	1	EA	106-840153-01	I.C., PROGRAM. MICROCONTROL.SYNTH.	U1
49	1	EA	106-840154-01	I.C. PROGRAMMED GAL RT-9600 SYNTHESIZER	U3
50	0	EA	108-640049	PWB, RT-9600 FAST LOCK SYNTHESIZER	
51	3	EA	118-114276-220	INDUCTOR CHIP 22UH	L201 L202 L203
52	1	EA	118-115978-100	INDUCTOR, 10UH CHIP	L107
53	1	EA	118-115978-1RO	INDUCTOR 1.OUH	L102
54	1	EA	118-140032-0028	INDUCTOR, 28.0nH 2% 1.8 GHz	L103

Item	Qty	UM	Part	Title	Reference
55	1	EA	118-140033-047	IND 47NH 5% 35Q@.65GHZ 0.90 OHM 500MA 0603	L104
56	1	EA	118-140134-068	INDUCTOR, SPRING 1812SMD	L105
57	2	EA	120-03026-0080	IC 78M05 DPAK VLT REG	U101 U203
58	1	EA	129-040122-01	CONNECTOR, COAXIAL (RT ANGLE PCB JACK)	P103
59	1	EA	129-2060-008	HEADER, STRAIGHT 8 PIN	P1
60	1	EA	139-016955-01	CRYSTAL 13.2 MHZ HC-35/U	Y201
61	1	EA	139-316654-01	OSCILLATOR, TCXO 12.8 MHZ	Y200
62	2	EA	146-040116-01	SHIELD FENCE & LID	FNC100 FNC200
63	1	EA	204-016669-474	CAP CHIP .47 UF POLY FILM 10%	C122
64	6	EA	210-040018-101	CAP 100PF 5% 50V COG 0603	C308 C316 C320 C324 C325 C340
65	2	EA	210-040018-150	CAP 15PF 5% 50V COG 0603	C110 C111
66	2	EA	210-040018-221	CAP 220PF 5% 50V COG 0603	C109 C321
67	25	EA	210-040018-471	CAP 470PF 5% 50V COG 0603	C2 C3 C6 C9 C10 C13 C14 C17 C18 C21 C22 C25 C26 C29 C30 C34 C41 C46 C49 C50 C201 C205 C207 C315 C344
68	1	EA	210-040018-510	CAPACITOR, 51PF 5% COG 0603	C217
69	1	EA	210-040018-820	CAP 82PF 5% 50V COG 0603	C330
70	16	EA	210-040019-103	CAP 10000PF 10% 50V X7R 0603	C5 C7 C8 C11 C12 C15 C16 C19 C20 C23 C24 C27 C28 C31 C32 C36
71	58	EA	210-040021-104	CAP 0.1uF 10% 50V X7R 0805	C33 C35 C37 C38 C39 C40 C42 C44 C47 C48 C51 C52 C104 C107 C108 C112 C114 C115 C116 C117 C120 C129 C130 C139 C135 C138 C139 C140 C142 C143 C203 C204 C206 C208 C214 C218 C222 C223 C225 C227 C234 C235 C236 C238 C300 C301 C303 C304 C306 C311 C314 C317 C327
72	1	EA	210-040136-183	CAP XXXuF 10% 50V LOW DISTORTION 1206	C134
73	4	EA	233-040075-102	TRIMPOT 5 TURN 1K SMD	R68 R72 R228 R300
74	1	EA	234-040024-0000	RES 0.0 OHM JUMPER 0603	R59

Item	Qty	UM	Part	Title	Reference
75	3	EA	234-040024-1001	RES 1000 OHM 1 % 100PPM 1/16W 0603	R100 R201 R217 R74 R51
76	46	EA	234-040024-1002	RES 10.0K OHM 1% 100PPM 1/16W 0603	R22 R23 R25 R27 R29 R31 R32 R35 R36 R39 R40 R43 R44 R47 R48 R53 R111 R115 RR118 R124 R129 R131 R135 R203 R204 R205 R213 R223 R225 R301 R302 R306 R307 R308 R31 0 R315 R316 R320 R321 R323 R325 R326 R328 R332
77	2	EA	234-040024-1003	RES 100K OHM 1% 100PPM 1/16W 0603	R311 R312
78	3	EA	234-040024-1004	RES 1.00M OHM 1% 10OPPM 1/16W 0603	R60 R116 R214
79	1	EA	234-040024-10R0	RES 10.0 OHM 1% 200PPM 1/16W 0603	R226
80	1	EA	234-040024-1211	RES 1210 OHM 1% 100PPM 1/16W 0603	R17
81	18	EA	234-040024-1212	RES 12.1K OHM 1% 100PPM 1/16W 0603	R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R52 R73
82	1	EA	234-040024-1273	RES 127K OHM 1% 100PPM 1/16W 0603	R64
83	1	EA	234-040024-1472	RES 114.7K OHM 1% 10OPPM 1/16W 0603	R109
84	1	EA	234-040024-1500	RES 150 OHM 1% 10OPPM 1/16W 0603	R1
85	1	EA	234-040024-1503	RES 150K OHM 1% 100PPM 1/16W 0603	R221
86	1	EA	234-040024-1622	RES 16.2K OHM 1% 100PPM 1/16W 0603	R66
87	1	EA	234-040024-1650	RES 165 OHM 1% 10OPPM 1/16W 0603	R127
88	2	EA	234-040024-1821	RES 1820 OHM 1% 10OPPM 1/16W 0603	R200 R227 R58
89	2	EA	234-040024-2000	RES 200 OHM 1% 100PPM 1/16W 0603	R105 R209
90	1	EA	234-040024-2001	RES 2000 OHM 1% 100PPM 1/16W 0603	R123
91	3	EA	234-040024-2002	RES 20.OK OHM 1% 100PPM 1/16W 0603	R202 R233 R327
92	2	EA	234-040024-2211	RES 2210 OHM 1% 100PPM 1/16W 0603	R113 R234
93	2	EA	234-040024-23R2	RES 23.2 OHM 1% 20PPM 1/16W 0603	R110 R119
94	2	EA	234-040024-2430	RES 243 OHM 1% 100PPM 1/16W 0603	R112 R305
95	1	EA	234-040024-2433	RES 243K OHM 1% 100PPM 1/16W 0603	R114
96	2	EA	234-040024-2551	RES 2.55K OHM 1% 100PM 1/16W 0603	R103 R120
97	7	EA	234-040024-2553	RES 255K OHM 1% 100PM 1/16W 0603	R63 R133 R134 R218 R219 R313 RR318
98	3	EA	234-040024-2801	RES 2.80K OHM 1% 100PPM 1/16W 0603	R70 R104 R132
99	1	EA	234-040024-2941	RES 2.94K OHM 1% 100PPM 1/16W 0603	R130
100	2	EA	234-040024-3012	RES 30.1K OHM 1% 100PPM 1/16W 0603	R21 0 R230
101	1	EA	234-040024-3013	RES 301K OHM 1% 100PPM 1/16W 0603	R215
102	3	EA	234-040024-3242	RES 32.4K OHM 1% 100PPM 1/16W 0603	R65 R101 R102
103	2	EA	234-040024-3320	RES 332 OHM 1% 10OPPM 1/16W 0603	R212 R231

Item	Qty	UM	Part	Title	Reference
104	1	EA	234-040024-3571	RES 3570 OHM 1% 10OPPM 1/16W 0603	R69
105	2	EA	234-040024-3572	RES 35.7K OHM 1% 100PPM 1/16W 0603	R222 R232
106	3	EA	234-040024-4021	RES 4.02K OHM 1% 100PPM 1/16W 0603	R62 R304 R314
107	2	EA	234-040024-4752	RES 47.5K OHM 1% 100PPM 1/16W 0603	R211 R229
108	3	EA	234-040024-5110	RES 511 OHM 1% 100PPM 1/16W 0603	R117 R128 R216
109	3	EA	234-040024-5111	RES 5110 OHM 1% 100PPM 1/16W 0603	R107 R208 R224
110	1	EA	234-040024-6343	RES 634K OHM 1% 100PPM 1/16W 0603	R220
111	1	EA	234-040024-6492	RES 64.9K OHM 1% 100PPM 1/16W 0603	R61
112	1	EA	234-040024-6810	RES 681 OHM 1% 100PPM 1/16W 0603	R50
113	17	EA	234-040024-6811	RES 6810 OHM 1% 100PPM 1/16W 0603	R19 R20 R24 R26 R28 R30 R33 R34 37 R38 R41 R42 R45 R46 R49 R54
114	5	EA	234-040024-68R1	RES 68.1 OHM 1% 200PPM 1/16W 0603	R106 R121 R122 R125 R126
115	3	EA	234-040024-7871	RES 7.87K OHM 1% 100PPM 1/16W 0603	R206 R207 R330
116	1	EA	234-040024-8061	RES 8.06K OHM 1% 100PPM 1/16W 0603	R67
117	1	EA	234-040024-8250	RES 825 OHM 1% 100PPM 1/16W 0603	R108
118	1	EA	234-040024-9091	RES 9090 OHM 1% 100PPM 1/16W 0603	R71
119	1	A/R	600-0021-000	PROCESS CTRL SPEC PROTECTIVE COATING	

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Notification

Wulfsberg Electronics Division
6400 Wilkinson Drive

Prescott,AZ 86301

Date of Grant: 12/02/1986

Application Dated: 09/16/1986

Attention: Robert DeLong

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER FRW4WJRT-9600
Name of Grantee Wulfsberg Electronics Division

Equipment Class: **Communications Rcvr for use w/ licensed Tx and CBs**

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15	150 - 174		%	
74	15	-		%	

74: **Type Acceptance and Notification under the same FCC Identifier.**

Mail To:

9211028315736001

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Notification

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6400 Wilkinson Drive

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Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15	150 - 174		%	
74	15	-		%	

74: **Type Acceptance and Notification under the same FCC Identifier.**

Mail To:

9211028315736001

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Wulfsberg Electronics Division
6400 Wilkinson Drive

Prescott,AZ 86301

Date of Grant: 05/25/1988

Application Dated: 04/13/1988

Attention: Robert DeLong

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER FRW4WJRT-9600
Name of Grantee Wulfsberg Electronics Division

Equipment Class: **Licensed Non-Broadcast Station Transmitter**

Notes: **Then used under Part 90 in conjunction with an operator programmable frequency agile control unit, the subject equipment is limited to aircraft installation and operation pursuant to Section 90.423 of the Commissions Rules.**

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
BM	74,80,90	150 - 174	10	0.0005 %	16K0F3E
BM	74,80,90	150 - 174	1	0.0005 %	16K0F3E

BM: **The output power is continuously variable from the value listed in this entry to 50%-55% of the value listed.**

Mail To:

9211028315736001

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Notification

Wulfsberg Electronics Division
6400 Wilkinson Drive

Prescott,AZ 86301

Date of Grant: 03/13/1987

Application Dated: 01/27/1987

Attention: Robert DeLong

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER FRW4WJRT-9600F
Name of Grantee Wulfsberg Electronics Division

Equipment Class: **Communications Rcvr for use w/ licensed Tx and CBs**

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15	150 - 174		%	
74	15	-		%	

74: **Type Acceptance and Notification under the same FCC Identifier.**

Mail To:
Morton Flom,
M Flom Associates, Inc.
3356 N San Marcos Pl #107
Chandler, AZ 85224

9211028315736001

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION
Type Acceptance

Wulfsberg Electronics Division
6400 Wilkinson Drive

Prescott,AZ 86301

Date of Grant: 05/27/1988

Application Dated: 04/13/1988

Attention: Robert DeLong

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER FRW4WJRT-9600F
Name of Grantee Wulfsberg Electronics Division

Equipment Class: **Licensed Non-Broadcast Station Transmitter**

Notes:

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	74,80,90	150 - 174	10	0.0005 %	16K0G3E

Not acceptable for ship station use. When used under Part 90 in conjunction with an operator programmable frequency agile control unit, the subject equipment is limited to aircraft installation and operation pursuant to Section 90.423 of the Commission's Rules.

Mail To:
Morton Flom,
M Flom Associates, Inc.
3356 N San Marcos Pl #107
Chandler, AZ 85224

9211028315736001

M. Flom Associates, Inc.

☐ 3356 North San Marcos Place, #107, Chandler, Arizona 85224: 602: 926-3100
☐ c-o 51 Mount Royal Ave. West, Montreal, Canada H2 T2 S5: 514: 288-3121

January 23rd, 1987.

Federal Communications Commission,
Authorization and Standards Division,
P. O. Box 429,
Columbia, MD. 21045.

Attention: Equipment Authorization Branch-TX. TYPE ACCEPTANE
Applicant: Global-Wulfsberg Systems, Div. of Sundstrand Data Control Inc.
Equipment: FCC ID: FRW4WJRT-9600F
FCC Rules: Parts 74, 80, 90

Gentlemen:

On behalf of the Applicant, enclosed please find Application Form 731, Test Data Report and all pertinent documentation, the whole for type acceptance of the referenced equipment as indicated.

We trust the same is in order. Should you require any further information, please contact the writer.

Sincerely yours,

MF:mgf
encs.

MORTON FLOM, P. Eng.

CERTIFIED MAIL, R.R.R.

FCC FORM 731

Washington, DC 20554

Approved by OMB 3060-0057 Expires 3/31/85

APPLICATION FOR EQUIPMENT AUTHORIZATION

1.(a) Grantee Code assigned by FCC: F R W

(b) Manufacturer Code assigned by FCC: 4 W J

FOR FCC STAFF USE

(a) Applicant's FULL business name: GLOBAL-WULFSBERG SYSTEMS DIVISION OF SUNDSTRAND DATA CONTROL, INC.

(b) Applicant's COMPLETE address (Number, street, city, state, ZIP code): 6400 WILKINSON DRIVE PRESCOTT, AZ 86301

(c) Name and title of person at above address to receive grant (SEE INSTRUCTIONS): Walter L. Crawford Director of RF Engineering

3.(a) Instead of applicant, FCC is authorized to mail original grant to (Firm name, number, street, city, state, ZIP code): M. FLOM ASSOCIATES, INC. #107, 3356 N. San Marcos Pl., Chandler, ARIZONA 85224.

(b) Name and title of person at above address to receive grant: 602: 926-3100. MORTON FLOM, P. Eng..

File No.: EQU

Application dated

Data entered _____ by

Examiner _____

4.(a) FULL name of equipment manufacturer, if different from Item 2(a) above: N/A

(b) Address of equipment manufacturer, if different from Item 2(b) above (Number, street, city, state, ZIP code): N/A

Reviewer(s)

Equipment Code:

Print _____ authorization(s)

Microfiched _____ by _____ date

5. Has a request for confidentiality been filed for any portion(s) of the data contained in this application pursuant to Section 0.459 of the Commission's rules, or has a waiver of any sections of the Commission's rules been filed? YES: ☐ NO: ☒ X

6. Kind of equipment authorization requested (Check ONE box only) ☐ Certification ☒ Type Acceptance ☐ Type Approval ☐ Notification (See Instructions)

7.(a) Kind of equipment: TRANSCEIVER

(b) Equipment will be operated under FCC Rules Part(s): 4, 80, 90

8. Application is for (Check ONE box only)

☒ 1 Original Equipment — List FCC ID in Item 9(a) and trade name, if any in Item 9(b).

☐ 2 Change in identification of presently authorized equipment — List FCC ID in Item 9(a) and trade name, if any in Item 9(b). Complete Items 10(a), (c), (d), and (e).

☐ 3 Change in manufacturer of presently authorized equipment — List FCC ID in Item 9(a) and trade name, if any in Item 9(b). Complete Items 10(b), (c), (d), and (e).

☐ 4 Modification of presently authorized equipment — List FCC ID in Item 9(a) and trade name, if any in Item 9(b). Give date of original grant _____ If no FCC ID assigned, complete Items 11(a)-11(d).

9.(a) FCC ID (grantee and manufacturer codes listed in Item 1(a) and 1(b), plus number assigned by applicant. SEE INSTRUCTIONS: F R W 4 W J R T - 9 6 Ø Ø F

(b) Trade Name(s), if any (maximum of 30 characters each - see Instructions): Global-Wulfsberg

10.(a) Name of present grantee, if different from Item 2(a) above: N/A

(b) Name of present manufacturer, if different from Item 4(a) above: N/A

(c) FCC ID, if assigned/Model or Type No., and Trade name, if any: N/A

(d) FCC Type Approval No., if assigned: N/A

(e) Date of original grant: N/A

11.(a) Complete ONLY if no FCC ID assigned to equipment to be modified (Model or type No.): N/A

(b) Trade Name, if any: N/A

(c) FCC Type Approval No., if assigned: N/A

(d) Date of original grant: N/A

12.(a) Is the equipment, or section(s) thereof, subject to more than one equipment authorization? ☒ Yes ☐ No If yes, complete Item 12(b), and 12(c), 12(d), or 12(e), as appropriate.

(b) Additional equipment authorization(s) required for equipment ☒ Notification ☐ Type Acceptance ☐ Type Approval

(c) FCC ID listed on simultaneously filed RCVR or RCVR section application: FRW4WJRT-9600F

(d) FCC ID listed on simultaneously filed XMTR or XMTR section application: N/A

(e) FCC ID listed on other simultaneously filed application: N/A

FOR FCC STAFF USE ONLY

FOR FCC STAFF USE ONLY

NOTES:

1. MATERIAL-0.008 THK. AL'
   (GRAPHTEC
2. LETTERS
3. BACKGROUND
4. BORDER-
5. CORNF
6. S

REVISIONS		
DESCRIPTION	DATE	APPROVED
RELEASE	10-20-86	ST

UCTION RELEASE 10-20-86

M. Flom Associates, Inc.

3356 North San Marcos Place, #107, Chandler, Arizona 85224: 602: 926-3100
c-o 51 Mount Royal Ave. West, Montreal, Canada H2 T2 S5: 514: 288-3121

Sub-part
2.903 (f):

EQUIPMENT IDENTIFICATION

FCC ID: FRW4WJRT-9600F

NAMEPLATE DRAWING

ATTACHED EXHIBIT

LOCATION OF LABEL

AS PER PHOTOGRAPHS

DATE OF REPORT: JANUARY 23rd, 1987.

SUPERVISED BY:

MORTON FLOM, P. Eng.

MF:mgf

M. Flom Associates, Inc.

☒ 6694 South Rockford Drive, Tempe, Arizona 85283, U.S.A. 602: 838-2862
☐ c-o 51 Mount Royal Ave. West, Montreal, Canada H2T2S5: 514: 288-3121

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LIST OF GENERAL INFORMATION
REQUIRED FORTYPE ACCEPTANCE

IN ACCORDANCE WITH FCC RULES AND REGULATIONS, VOLUME II, PART 2 AND TO

PARTS 74, 80, 90

Sub-part 2.983 (a): NAME AND ADDRESS OF APPLICANT:

Global-Wulfsberg Systems,
A Div. of Sundstrand Data Control, Inc.,
6400 Wilkinson Drive,
Prescott, Arizona 86301.

2.983 (b): VENDOR: AS ABOVE

MANUFACTURER:

AS ABOVE

FCC ID: FRW4WJRT-9600F

2.983 (c): PRODUCTION:

QUANTITY PRODUCTION PLANNED.

2.983 (d): TECHNICAL DESCRIPTION:

SEE MAINTENANCE MANUAL

2.983 (d)(1): TYPE OF EMISSION: 16KOF3E

2.983 (d)(2): FREQUENCY RANGE: 150 to 174 MHz

2.983 (d)(3): POWER RATING: 1/10 Watts

2.983 (d)(4): MAXIMUM POWER RATING: 1/25 Watts

2.983

(d)(5): VOLTAGES & CURRENTS IN ALL ELEMENTS IN FINAL R. F. STAGE, INCLUDING FINAL TRANSISTOR OR SOLID STATE DEVICE:

COLLECTOR VOLTAGE = 13.7 Vdc
SUPPLY VOLTAGE = 14 Vdc
COLLECTOR CURRENT = 1.1 amps.

(d)(6): FUNCTION OF ACTIVE CIRCUIT DEVICES:

MAINTENANCE MANUAL

(d)(7): CIRCUIT DIAGRAM:

PLEASE SEE MAINTENANCE MANUAL

(d)(8): MANUAL:

MAINTENANCE MANUAL - ATTACHED EXHIBITS
OPERATOR'S MANUAL - ATTACHED EXHIBITS

(d)(9): TUNE-UP PROCEDURE:

PLEASE SEE MAINTENANCE MANUAL

(d)(10): DESCRIPTION OF CIRCUITRY & DEVICES PROVIDED FOR DETERMINING AND STABILIZING FREQUENCY:

PLEASE SEE "THEORY OF OPERATION" MAINTENANCE MANUAL.

(d)(11): DESCRIPTION OF CIRCUITS OR DEVICES EMPLOYED

(a) FOR SUPPRESSION OF SPURIOUS RADIATION

(b) FOR LIMITING MODULATION

(c) FOR LIMITING POWER

PLEASE SEE "THEORY OF OPERATION"

(g): PHOTOGRAPHS: (5 views)

Sub-part
2.983 (e):

TEST AND MEASUREMENT DATA

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II, Part 2, Sub-part J, Sections 2.981, 2.983, 2.985, 2.987, 2.989, 2.991, 2.993, 2.995, 2.997, 2.999 and the following individual Parts, i.e.

PART 21.	DOMESTIC PUBLIC RADIO SERVICES	___
PART 22.	PUBLIC MOBILE SERVICE	___
PART 22K.	DOMESTIC PUBLIC CELLULAR RADIO TELECOMMUNICATION SERVICE	___
PART 23.	INTERNATIONAL FIXED PUBLIC RADIO COMMUNICATIONS SERVICE	___
PART 74.	EXPERIMENTAL, AUXILIARY & SPECIAL BROADCAST AND OTHER PROGRAM DISTRIBUTION SERVICES	✓
PART 80.	STATIONS IN THE MARITIME SERVICE	✓
PART 80T.	RADIO TELEGRAPH INSTALLATION REQUIRED FOR VESSELS ON THE GREAT LAKES	___
PART 80U.	RADIO TELEGRAPH INSTALLATION REQUIRED BY THE BRIDGE-to-BRIDGE ACT	___
PART 87.	AVIATION SERVICES	___
PART 90.	PRIVATE LAND MOBILE RADIO SERVICES	✓
PART 94.	PRIVATE OPERATIONAL-FIXED MICROWAVE SERVICES	___
PART 95.	GENERAL MOBILE RADIO SERVICE	___

STANDARD TEST CONDITIONS and ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were observed during the testing :

ROOM TEMPERATURE	= 25±5°C
ROOM HUMIDITY	= 20-50%
D.C. SUPPLY VOLTAGE	= 14 Vdc
A.C. SUPPLY VOLTAGE	=
A.C. SUPPLY FREQUENCY	=

Prior to testing, the E.U.T. was tuned up in accordance with the manufacturer's alignment procedures. all external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

MEASUREMENT DATA, unless otherwise noted, are WORST CASE measurements.

Subsection:
80.215 (c)(d)(i):

Subsection
2.985 (a):

R. F. POWER OUTPUT

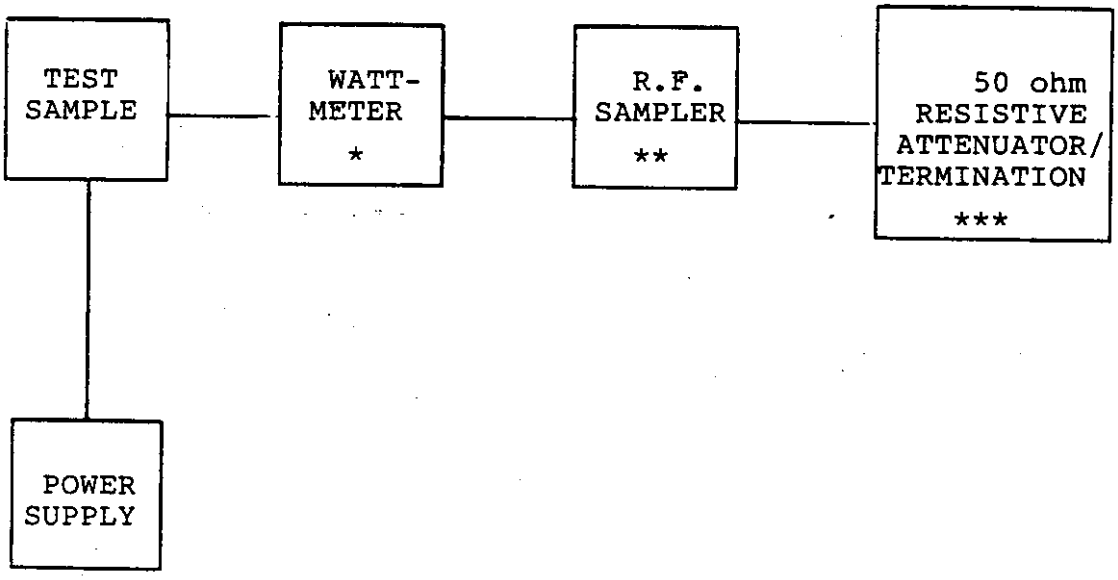
MEASUREMENT PROCEDURE: REFERENCE: EIA STANDARD RS152B, Para. 3.3.

1. The E.U.T. was connected to a resistive coaxial attenuator of normal load impedance, and the unmodulated output power was measured by means of an R. F. Power Meter.

2. TEST SETUP: PLEASE SEE PAGE 8.

3. TEST RESULTS: PLEASE SEE PAGE 9.

R. F. POWER OUTPUT
A.M. or F.M.



* BIRD 43 or
H.P. 435A POWER METER
8901A MODULATION ANALYZER CALIBRATED TO ±3% ACCURAC

** BIRD 4275, BIRD 4273

*** NARDA 766

TLW-25 (Term.)

BIRD 8329 COAX ATTENUATOR (Hi Power)
SIERRA 661A-30 (Lo Power)

TEST RESULTS

SUPPLY VOLTAGE = 14 Vdc

CHANNEL NO.	NOMINAL, MHz.	R. F. POWER OUTPUT Lo Watts Hi
16	156.800	1 10

* AS MEASURED WITH H.P. 8901A MODULATION ANALYZER (POWER MODE). ACCURACY, ±3%.

JANUARY 23rd, 1987.
SUPERVISED BY:

MORTON FLOM, P. Eng.

Subsection
2.987 (a):

FREQUENCY RESPONSE OF AUDIO MODULATING CIRCUIT

MEASUREMENT PROCEDURE:

REFERENCE: EIA STANDARD RS 152B, Paragraph 6.

1. The E.U.T. and test equipment were set up as shown on Page 11.

2. The audio signal generator was connected to the audio input circuit/mic. of the E.U.T.

3. The audio signal input was adjusted to obtain 50% modulation @ 1000 Hz., and this point was taken as the 0db reference level.

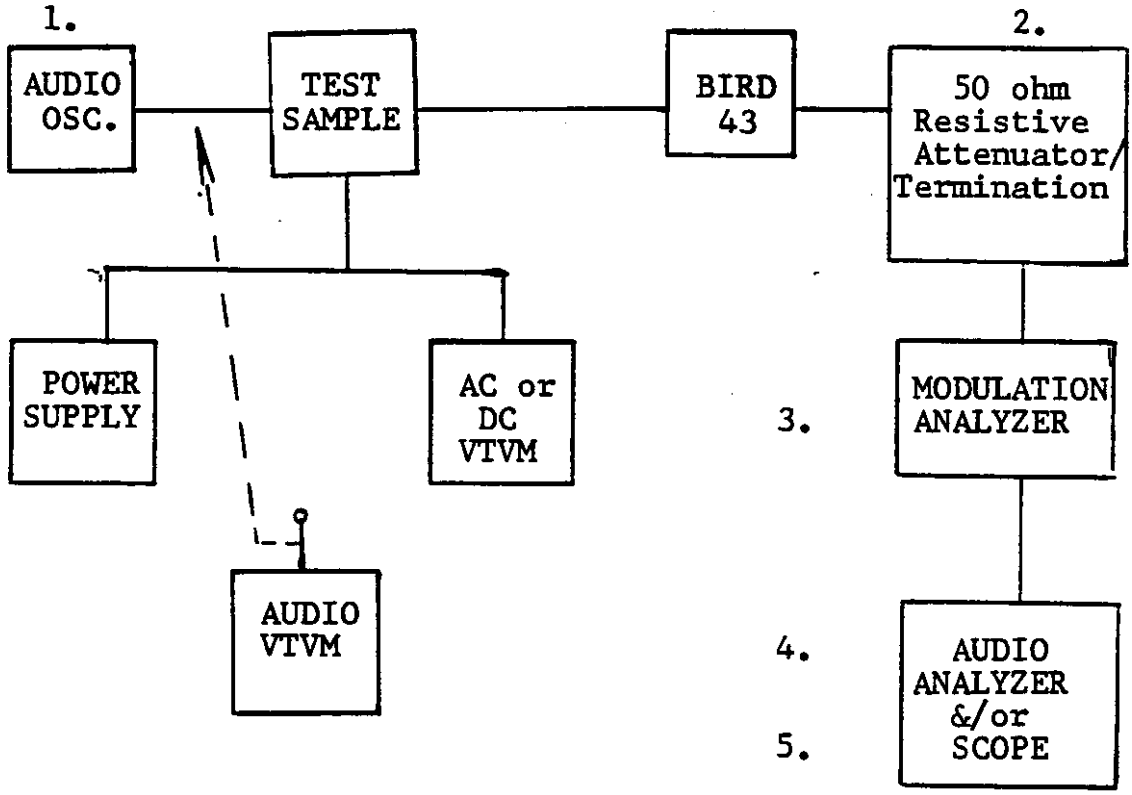
4. With input levels held constant and below limiting at all frequencies, the audio signal generator was varied from 100 to 50,000 Hz.

5. The response in db relative to 1 KHz was then measured, using the HP 8901A Modulation Analyzer.

6. TEST RESULTS: PLEASE SEE PAGE 12.

TRANSMITTER
TEST SET-UP

A. MODULATION CAPABILITY/DISTORTION
B. AUDIO FREQUENCY RESPONSE
C. HUM AND NOISE LEVEL
D. RESPONSE OF LOW PASS FILTER
E. MODULATION LIMITING



1. MOTOROLA S-1333B; AIEC DTC-1; H.P.204D
2. SIERRA 661A-30; TLW-25; CO-AX ATTENUATOR
   NARDA 766-10; BIRD 8329.
3. MOTOROLA R-1007A.; H.P. 8901A.
4. H.P. 334A.; H.P. 8903A.
5. H.P. 181T; TEK T-935, H.P.1741A

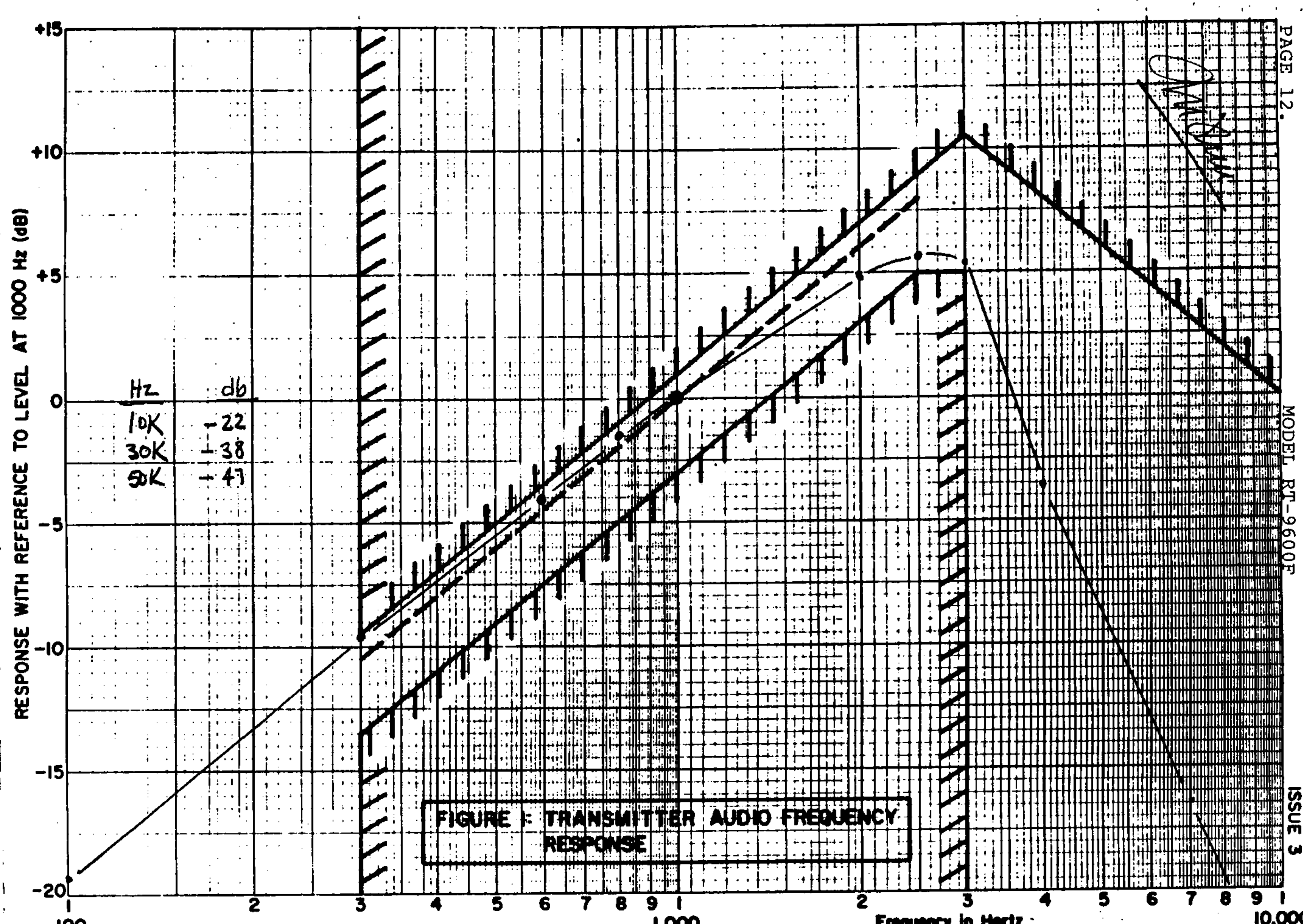


FIGURE 1: TRANSMITTER AUDIO FREQUENCY RESPONSE

Subsection
2.987 (a):

FREQUENCY RESPONSE OF AUDIO LOW PASS FILTER

MEASUREMENT
PROCEDURE: REFERENCE: EIA STD. RS152B, Para. 6 (GUIDE):

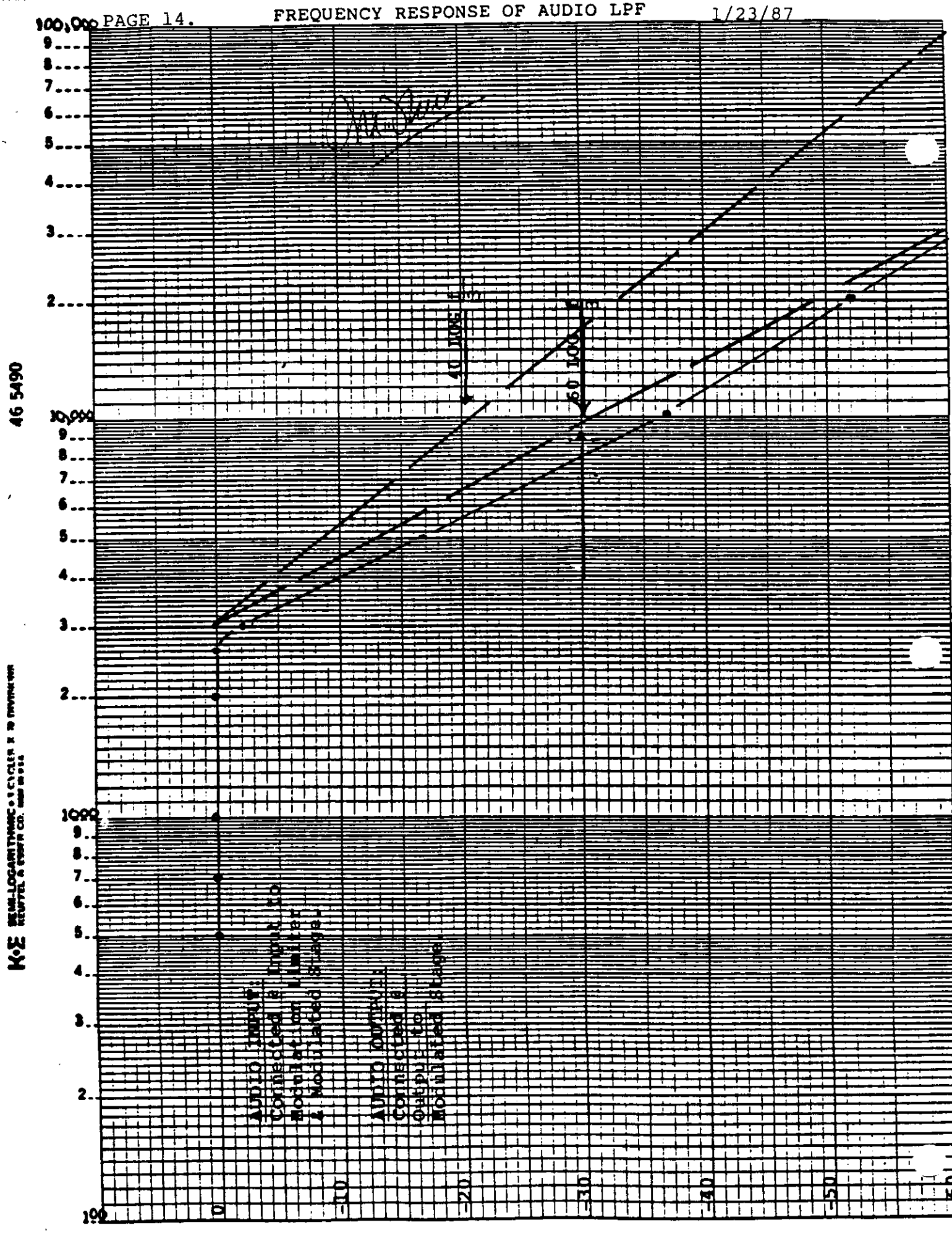
1. The E.U.T. and test equipment were set up such that the audio input was connected at the input to the modulation limiter, and the modulated stage.

2. The audio output was connected at the output to the modulated stage.

3. TEST RESULTS: PLEASE SEE PAGE 14.

FREQUENCY RESPONSE OF AUDIO LPF

1/23/87



RESPONSE LEVEL, db.

Subsection
2.987 (b):

MODULATION LIMITING

MEASUREMENT PROCEDURE: REFERENCE: EIA STANDARD RS152B, Paragraph 9.

1. The audio signal generator was connected to the audio input cct/mic/ of the E.U.T. as for "Frequency Response of the Audio Modulating Circuit".

2. The modulation response was measured for each of three tones (one of which was the frequency of maximum response), and the input voltage was varied and was observed on an H.P. 8901A Modulation Analyzer.

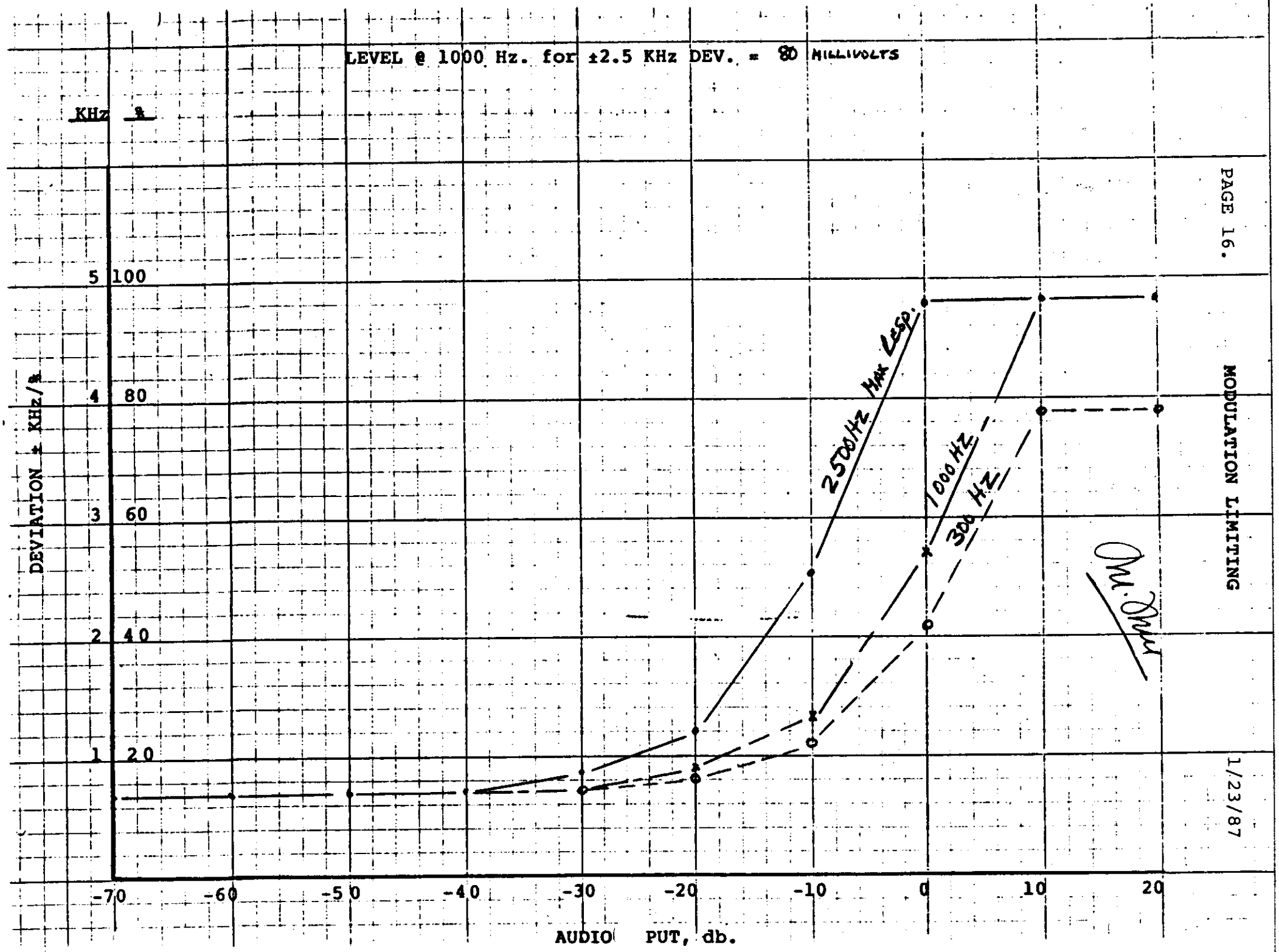
3. The audio input level was varied from 30% modulation (±1.5 KHz. Dev.) to at least 20db higher than the saturation point.

4. Measurements were performed for both negative and positive modulation and the respective results were recorded.

5. TEST RESULTS: PLEASE SEE PAGE 16.

MODULATION LIMITING

LEVEL @ 1000 Hz. for ±2.5 KHz DEV. = 80 MILLIVOLTS



1/23/87

Subsection
2.989 (c)(1):
80.205:

OCCUPIED BANDWIDTH

MEASUREMENT PROCEDURE:

REFERENCE: EIA STANDARD RS152B, Paragraph 17.

1. The E.U.T. and test equipment were set up as shown on attached Page 18, with the Spectrum Analyzer connected.

2. The audio signal generator was adjusted to the frequency of maximum response and with output level set for ±2.5 KHz deviation (or 50% modulation).

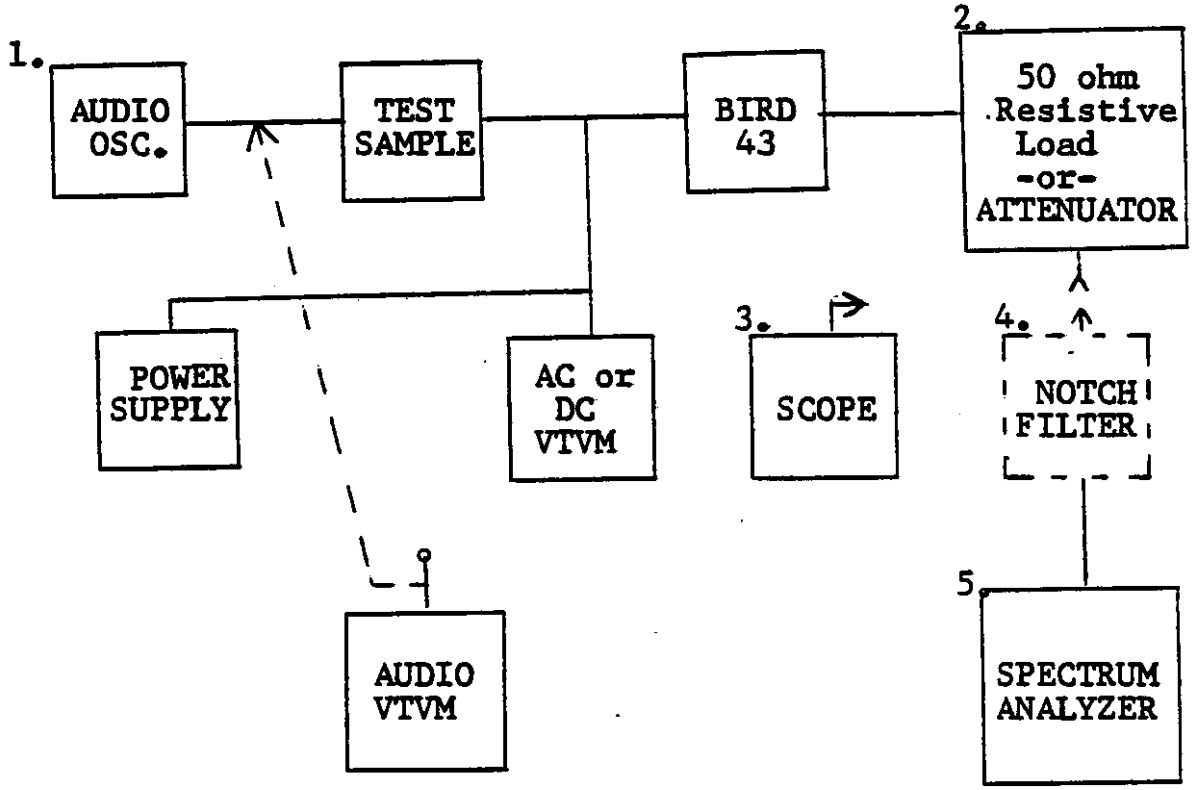
3. With level constant, the frequency was set @ 2500 Hz., then the signal level was increased 16db.

4. The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

5. TEST RESULTS: PLEASE SEE PAGE 19.

TRANSMITTER SPURIOUS EMISSION

TEST A. OCCUPIED BANDWIDTH (IN-BAND SPURIOUS)
TEST B. OUT-OF-BAND SPURIOUS



1. MOTOROLA S-1333B; AIEC DTC-1; H.P. 204D.
2. SIERRA 661A-30; TLW-25; Co-AX ATTENUATOR BIRD 8329.
3. H.P. 181T; TEK 935, H.P.1741A
4. JERROLD THB-1; JERROLD TLB-1; CIRQTEL FHT., EAGLE TNF-1 SERIES *
5. H.P. 181T/8558B; TEK.492.H.P.8557 * PHELPS-DODGE PD-495-8.
   H.P. 8566B, H.P. 8568B.

Subsection
2.991:

SPURIOUS EMISSIONS @ ANTENNA TERMINALS

MEASUREMENT PROCEDURE: REFERENCE: EIA STANDARD RS152B, Paragraph 17.

1. The emissions were measured for the worst case as follows:

(a): within a band of frequencies defined by the carrier frequency plus and minus one channel.

(b): from the lowest frequency generated in the E.U.T. and to at least the 10th Harmonic of the carrier frequency, or40 GHz, whichever is lower.

2. The magnitude of spurious emissins which are attenuated more than 20db below the permissible value need not be specified.

3. TEST RESULTS: PLEASE SEE PAGE 21.

TEST RESULTS

FREQUENCY OF CARRIER = 156.80 MHz

SPECTRUM SEARCHED = 0 to 2 GHz

FREQUENCY OF MAXIMUM RESPONSE = 2500 Hz.

L I M I T: -(43 + 10 LOG W) = -43 dbc (1 Watt)
= -53 dbc (10 Watts)

EMISSION MHz/HARM.	SPURIOUS LEVEL BELOW CARRIER	
	Lo	Hi
3rd	<-81½	81½
2nd, 4th to 10th	<-85	<-85

ALL OTHER SPURIOUS READINGS WERE 20db OR MORE BELOW LIMIT

JANUARY 23rd, 1987.
SUPERVISED BY:

MORTON FLOM, P. Eng.

Subsection
2.993 (a):

FIELD STRENGTH OF SPURIOUS RADIATION

1. SITE DESCRIPTIONS as previously filed with the F.C.C. per Subsection 15.38(b), or at a correlatable site.

2. At first, in order to locate all spurious frequencies and approximate amplitudes, and to determine proper equipment functioning, the test sample was set up at a distance of three meters from the test instrument. Valid spurious signals were determined by switching the power ON and OFF.

3. In the field, the test sample was placed on a wooden turntable above ground and three (or thirty) meters away from the search antenna. The test sample was connected to an RF Wattmeter and a 50 ohm dummy load, and adjusted to its rated output.

In order to obtain the maximum response at each spurious frequency, the turntable was rotated. Also, the Search Antennas were raised and lowered vertically, and all cables were oriented. Excess power lead was coiled near the power supply.

4. A signal generator, connected with a

(non-...)

non-radiating cable to a vertically polarized half-wave antenna (for each frequency involved) was substituted for the transmitter. The Search Antenna was raised and lowered to obtain maximum indicated.

5. The signal generator output was adjusted until a signal level indication equal to that from the transmitter was obtained.

6. Steps 4 and 5 were repeated, using a horizontally polarized half-wave antenna. The higher of the two observations was noted.

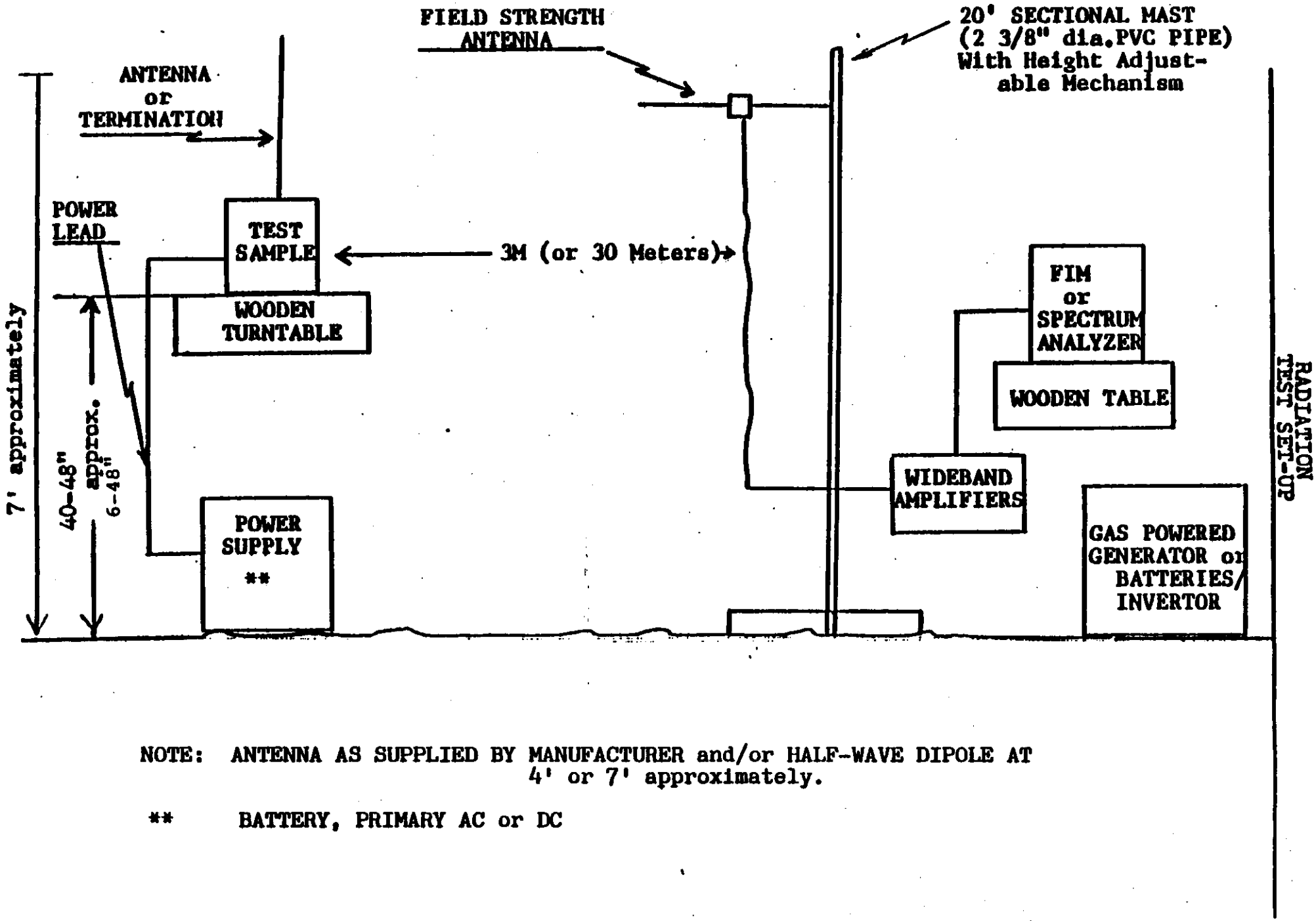
7. Power into the half-wave antenna was calculated from the characteristic impedance of the line, and the voltage output from the signal generator.

8. The level of each spurious radiation with reference to the transmitter power in db, was calculated from:

$$\text{SPURIOUS LEVEL, db.} = 10 \text{ LOG } \frac{\text{(Calculated Spurious Power) [from Para. 7].}}{\text{Tx Power (Wattmeter)}}$$

9. The worst case for all channels is shown.

10. TEST SET-UP AND TEST RESULTS FOLLOW.



NOTE: ANTENNA AS SUPPLIED BY MANUFACTURER and/or HALF-WAVE DIPOLE AT 4' or 7' approximately.

** BATTERY, PRIMARY AC or DC

TEST RESULTS

FREQUENCY TUNED = 156.80 MHz

SPECTRUM SEARCHED = 0 to 2 GHz

L I M I T S: -(43 + 10 LOG W) = -43 dbc (1 Watt)
= -53 dbc (10 Watts)

EMISSION MHz/HARM.	SPURIOUS LEVEL BELOW CARRIER Lo	Hi
3rd	<-90	<-90
2nd 4th to 10th	<-90	<-90

ALL OTHER SPURIOUS READINGS WERE 20db OR MORE BELOW LIMIT

JANUARY 23rd, 1987.
SUPERVISED BY:

MORTON FLOM, P. Eng.

Subsection 2.995 (a): 80.209:

FREQUENCY STABILITY

2.995 (a)(1):

VARIATION OF AMBIENT TEMPERATURE

MEASUREMENT PROCEDURE: REFERENCE EIA STANDARD RS152B, Paragraph 10.

1. The E.U.T. and test equipment were set up as shown on Page 27.

2. With all power removed, the temperature was decreased to -30°C and permitted to stabilize for three hou rs. Power was applied and the maximum change in frequency was noted within one minute.

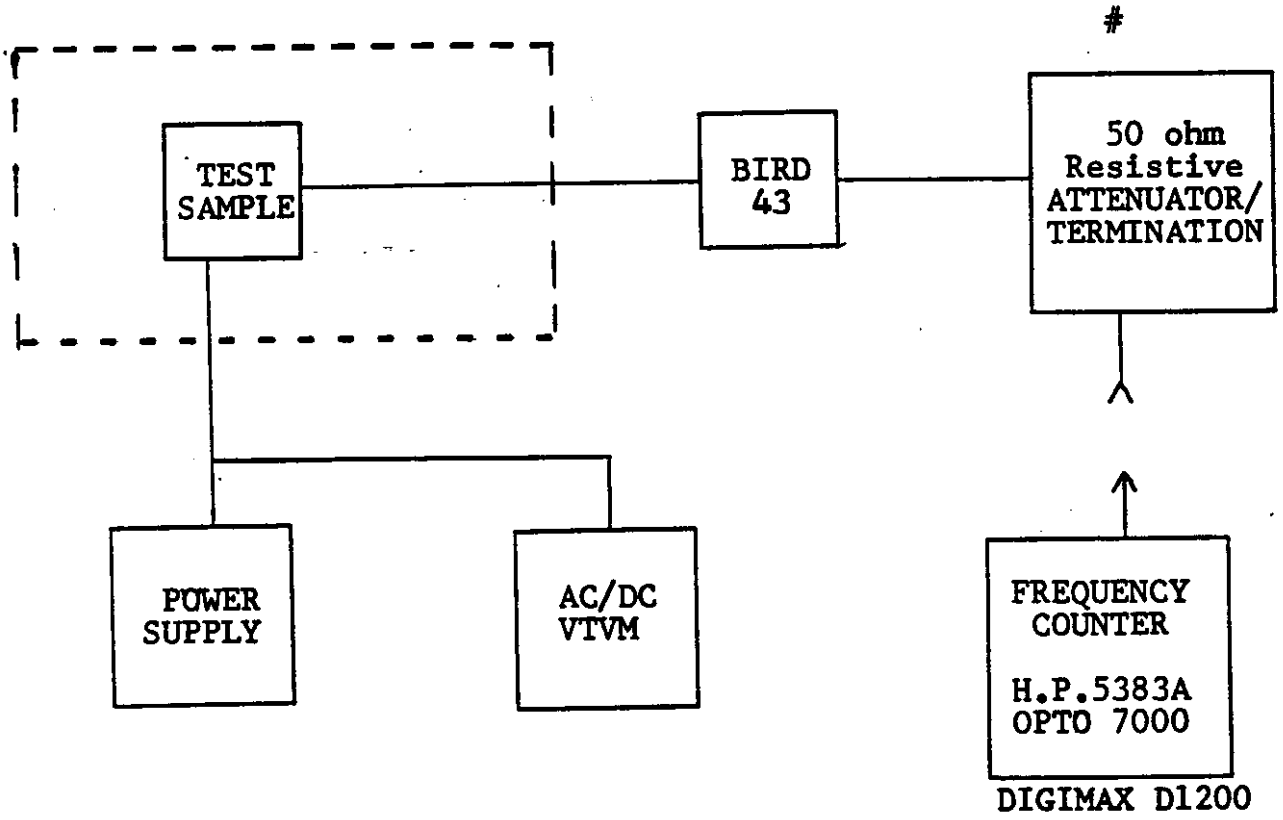
3. With power OFF, the temperature was raised in 10°C steps. The sample was permitted to stabilize at each step for at least one-half hour. Power was applied and the maximum frequency change was noted within one minute.

4. The temperature tests were performed for the WORST CASE.

5. TEST RESULTS: PLEASE SEE PAGE 28.

TRANSMITTER
TEST SET-UP

A. OPERATIONAL STABILITY
B. CARRIER FREQUENCY STABILITY
C. OPERATIONAL PERFORMANCE STABILITY
D. HUMIDITY *
E. VIBRATION **
F. ENVIRONMENTAL TEMPERATURE ***
G. FREQUENCY STABILITY: TEMPERATURE VARIATION
H. FREQUENCY STABILITY: VOLTAGE VARIATION



#

NARDA 766-10
TLW-25
SIERRA 661A-30
CO-AX ATTENUATOR BIRD 8329.

* WEBER HUMIDITY CHAMBER
** L.A.B. CORP. RVH 18-100
*** TENNEY

Subsection
2.995 (d)(1):
80.209:

FREQUENCY STABILITY - VOLTAGE VARIATION

MEASUREMENT PROCEDURE:

1. The E.U.T. was placed in a temperature chamber @ 25±5°C and connected as for "Frequency Stability - Variation with Temperature" test.

2. The power supply voltage to the E.U.T. was varied from 85% to 115% of the nominal value measured at the input to the E.U.T.

3. The variation in frequency was measured for the worst case.

4. TEST RESULTS: PLEASE SEE PAGE 30.

Subsection
2.995 (d)(1):

FREQUENCY STABILITY - VOLTAGE VARIATION

STV %	Vdc	CHANGE IN FREQUENCY FROM NOMINAL, MHz.
85	11.9	156,799,730
100	14	156,799,730
115	16.1	156,799,760

LIMIT = ±5 PPM

JANUARY 23rd, 1987.
SUPERVISED BY:

MORTON FLOM, P. Eng.

LIST OF EXHIBITS

APPLICANT: GLOBAL-WULFSBERG SYSTEMS

EQUIPMENT: FCC ID: FRW4WJRT-9600F

BY APPLICANT:

EXHIBIT:

1. IDENTIFICATION LABEL DRAWING
2. MAINTENANCE MANUAL
3. OPERATOR'S MANUAL
4. PHOTOGRAPHS

BY M.F.A. INC.

A. TESTIMONIAL & STATEMENT
B. STATEMENT OF QUALIFICATIONS
C. LIST OF TEST INSTRUMENTATION

T E S T I M O N I A L

AND

STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY:

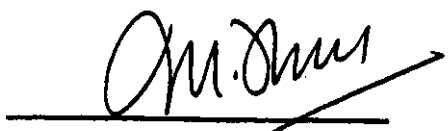
1. THAT the application was prepared either by, or under the direct supervision of, the undersigned.

2. THAT the technical data supplied with the application was taken under my direction and supervision.

3. THAT the data was obtained on representative production units, randomly selected.

4. THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.

CERTIFYING ENGINEER



MORTON FLOM, P. Eng.

STATEMENT OF QUALIFICATIONS

EDUCATION:

1. B. ENG. in ENGINEERING PHYSICS, 1949, McGill University, Montreal, Canada.

2. Post Graduate Studies, McGill University & Sir George Williams University, Montreal.

PROFESSIONAL AFFILIATIONS:

1. ARIZONA SOCIETY OF PROFESSIONAL ENGINEERS (NSPE), #026 031 821.

2. ORDER OF ENGINEERS (QUEBEC) 1949. #4534.

3. ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOPHYSICISTS & GEOLOGISTS OF ALBERTA #5916.

4. REGISTERED ENGINEERING CONSULTANT - GOVERNMENT OF CANADA, DEPARTMENT OF COMMUNICATIONS. Radio Equipment Approvals.

5. IEEE, Member No. 0417204 since 1947.

EXPERIENCE:

1. Research/Development/Senior Project Engineer, R.C.A. LIMITED (4 years).

2. Owner/Chief Engineer of Electronics. Design/Manufacturing & Cable TV Companies (10 years).

3. **CONSULTING ENGINEER** (over 20 years).

Type Acceptance/Approval on Radio & Electronic Equipment. RFI, EMI to FCC, VDE, FCC PART 15J, CLASS A & B Computers and Peripherals.

SSB & VHF Marine, Radar, Loran, Radio Buoys, EPIRBs. Energy Management Transmitters and Receivers. CELLULAR RADIOS.

Base & Land Mobile, Radio Location, Aircraft Radio (RTCA).

Pagers, Paging Transmitters, Portable Phones, Radio Remote Control, Security Alarms, Garage Door Openers, Transmitters & Receivers.

Low-Power Communication Devices. Power Amplifiers. Telephone Inter-connect, Satellite Receivers, Video Games.

1987.

MORTON FLOM, P. Eng.

LIST OF TEST INSTRUMENTATION

ALL EQUIPMENT CALIBRATED WITHIN LAST 90 DAYS.

ADAPTERS:	H.P.x281 (COAXIAL WAVEGUIDE): H.P. S281. H.P. 85650A (QUASI PEAK):
AMPLIFIERS:	Pre-amp. H.P. 10885A (2-1300 MHz); H.P. 8447D, H.P. 8447E.
ANTENNAS:	SINGER, DM-105A; 92197-2 (41"); 93049-1 (9'); 94593-1 (LOOP) & 90794-2 (DISCONE, 1-10 GHz).
ATTENUATORS:	KAY 432D; Power, SIERRA 661A-30; NARDA 76610; NARDA 4779-3, -6, -10db.
AUDIO OSCILLATORS:	H.P. 204D; AIEC DTC-1; MOTOROLA S-1333B;HP.331
BATTERIES:	SEARS DIEHARD, STOCK #4341.
CAMERA:	OSCILLOSCOPE, TEKTRONIX C5A.
CONVERTOR, Down:	H.P. 117 10B
COUPLER:	NARDA 1080, WAVEGUIDE. HP S750E (CROSS GUIDE). WAVELINE 274/40.
DETECTOR:	H.P. 8470B
DIGITAL MULTIMETER:	H.P. 3476A w/H.F. PROBE: FLUKE 8030A-01.
DIP METER:	HEATH HD 1250.
DISTORTION ANALYZER:	H.P. 334A; H.P. 8903A
ELECTRONIC COUNTER:	H.P. 5383A; OPTO-7000; DIGIMAX D1200.
FILTERS:	CIRQTEL FHT/7-50-57/50-1A/1B (H.P.); JERROLD TLB-1; THB-1, PIEZO 5064; EAGLE TNF-I SERIES, KROHN-HITE 3202; See Page 2.
FREQ. DEV. METERS:	MOTOROLA R-1007A; H.P. 8901A.
FREQUENCY METER:	H.P. 537A ; H.P.536A;
LIMITERS, R.F.:	H.P. 11867A; H.P. 11693A; H.P. 10509A .
LISN:	SINGER 91221-1; AILTECH 94641-1 (50uH).
LOAD, POWER:	TELEWAVE TLW-25; BIRD 8329.
MILLIAMETER:	H.P. 428B
MIXER:	H.P. 10514A; MINI-CIRCUITS TAK-1H.

LIST OF TEST INSTRUMENTATION: PAGE 2.

OPEN FIELD SITE: AS FILED WITH FCC &DOC AND KEPT UP-DATED.

TURNTABLES: UP TO 2000# CAPACITY
GROUND SCREEN: COMPLIES WITHDOCKET 80-284
ANTENNA MAST: COMPLIES AS ABOVE

OSCILLOSCOPES: H.P. 1741A; H.P. 181T; TEKTRONIX T935.

POWER METER: AF GR 1840A; H.P. 435A with 8481A & 8482H POWER SENSORS.

POWER SUPPLY: H.P. 6286A; HEATHKIT 1P 2711; 1P 5220; HONDA EM400 (PORTABLE GAS GEN.); H.P. 6012.

SIGNAL GENERATORS: H.P.8640B; GAW 1012 (Calibration Frequencies 50, 100, 300, 500, 700, 1000 MHz); H.P. 8656A.

SIGNAL LEVEL METER: JERROLD 704B

SIGNAL SAMPLER: R. F. BIRD 4273-030, 4275-030.

SINAD/VOLTMETER: HELPER SINADDER 3/S-103.

SPECTRUM ANALYZERS: H.P. 8558B, 8557; TEKTRONIX 492; H.P.853A: H.P. 8566B/8568B:

TEMPERATURE CHAMBERS: TENNEY, Jr.

TEMPERATURE PROBE: FLUKE 80T-150C

TERMINATION: NARDA 320B WAVEGUIDE. WAVELINE #281.

TEST SET: SEMI-AUTOMATIC: H.P. 8953A; H.P. 8954A INTERFACE: FREQUENCY DOUBLER H.P. 11721A; COMPUTER/ CONTROLLER H.P. 85; P.S. PROGRAMMER H.P.59501A.

TRANSFORMER: IMPEDANCE H.P. 11694A

WATTMETERS: BIRD 43, SIERRA 174A-2.

TRANSMISSION & NOISE MEASURING SET H.P.3555B

VOLTMETER: H.P.410C

PLOTTER: H.P.7470

FILTERS: PHELPS-DODGE #PD-495-8; NEWTONE #PD6000 Line Protector; 870-890 MHz (LAB DESIGN) 900 MHz (Lab Design)

RF PRESELECTOR: H.P.85685A:

Wulfsberg Electronics Division
A Chelton Group Company

RT-9600F TRANSCEIVER

NARROW-BAND SYNTHESIZER MODULE

Maintenance Manual Addendum

Manual Number 150-040219

Revision A

June 15, 1999