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Research and Development Technical Report
ECOM-75-0146-F

TRANSISTORIZED RF POWER AMPLIFIER AND DRIVER for RECEIVER-TRANSMITTERS RT-246/VRC and RT-524/VRC

FINAL REPORT

by
B. WILLIAMS

JUNE 1976

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CONTRACT DAAB07-75-C-0146
HARRIS CORPORATION
RF COMMUNICATIONS DIVISION
ROCHESTER, NEW YORK

Research and Development Technical Report

ECOM-75-0146-F

TRANSISTORIZED RF POWER AMPLIFIER AND DRIVER FOR RECEIVER TRANSMITTERS RT-246/VRC and RT-524/VRC

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JUNE 1976

Final Report for Period September 1975 to March 1976

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This final report describes development work on the transistorized RF Power Amplifier and Tuner/Driver Assembly for the Receiver Transmitter RT-524 and RT-246.

During this reporting period, a prototype power amplifier and tuner/driver were constructed and bench tested. Three → over

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deliverable units were then constructed and tested. Complete performance and temperature tests were run before the three deliverable units were shipped to ECOM for further evaluation.

Data covering the major operating parameters measured during testing is presented in this report.

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LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

The purpose of this contract was to develop a design modification to the transmitter/power supply for the Receiver-Transmitter Radio, RT-246/VRC and RT-524/VRC. The objective of this modification was to:

1) Increase Reliability

2) Minimize broadband noise and harmonic emissions

3) Eliminate the high-voltage power supply and vacuum tubes in the Power Amplifier and Driver Assembly.

4) Design a low cost conversion kit suitable for retrofit by low-skilled personnel.

This final report will discuss the design and development results achieved during the last reporting period of this contract. This includes a discussion of the Tuner/Driver Assembly, power amplifier, power supply and automatic level control.

2.0 REQUIREMENTS

The technical approach is directed toward meeting Specification EL-CP0108-0001A, SCN001 and SCN002 in accordance with the work statement in section F.2 of the contract DAAB07-75-C-0146. Maximum utilization of existing parts is desirable to minimize conversion costs. These include:

a) Power Amplifier Heat Exchanger

b) Fan

c) Fan power supply

d) Power Amplifier output tank circuit and tuning mechanism

e) Transmitter driver assembly tuned circuits

f) Low band low pass antenna filter (FL 401)

g) All transmitter circuitry up to and including the buffer amplifier assembly

The transmitter output tank circuit and driver assembly tuned circuits are retained to achieve the required selectivity necessary to limit the transmitter noise to -140 dB below the carrier. Retention of these three tuned circuits is based on worst case noise measurements at ECOM of -95 dBm in a 30 kHz bandwidth at the output of the existing RT-524/VRC Transmitter Buffer.

3.0 DESIGN ACCOMPLISHMENTS

3.1 Tuner/Driver Assembly

The Tuner Driver Assembly mounts on a tube socket plug which fits directly into the socket that is presently used by the driver vacuum tube. The solid state amplifier mounts to the heat sink partition where the removed tube shield presently clips. Deletion of tube associated parts were accomplished as shown in the enclosed original schematic Figure 3.1-1. The inductuner has been retained to preserve selectivity. Retaining the tuned circuits was essential to meet the transmitter noise specifications as shown in the gain distribution data contained in the last quarterly report.

The basic Tuner/Driver circuitry (Figure 3.1-2) has been altered to include a few additions. A forward biased hot carrier diode, CR1, has been added at the base of the input stage to compensate for cold environmental conditions. The addition of the diode allows the transistor to operate somewhere between Class B and Class C rather than hard Class C. Inductor L1, which is in series with CR1, is a broadband ferrite choke which furnishes an RF impedance of 750 ohms to the signal path. Capacitor C1 was also changed from 5 pF to 7 pF. This value was optimized to furnish greater drive power to the input stage without compromising the loading to the inductuner.

Another addition to the circuitry was a feedback path between the collector and base of the driver stage Q3. L4, C13 and R9 was added to stabilize the operation of Q3 at the upper end of band "B".

The minor changes outlined in this paragraph did not

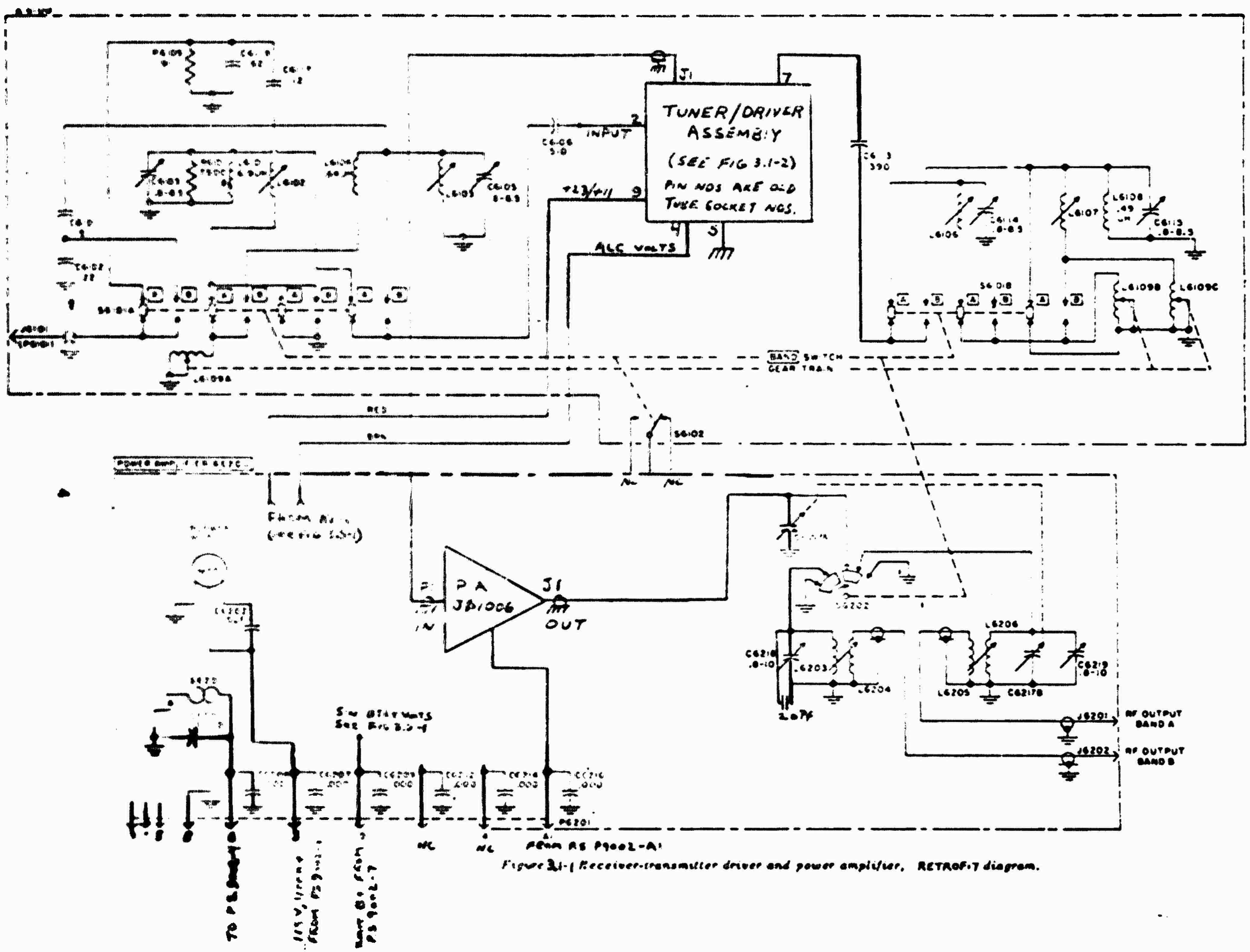


Figure 3.1-1 Receiver-transmitter driver and power amplifier, RETROFIT diagram.

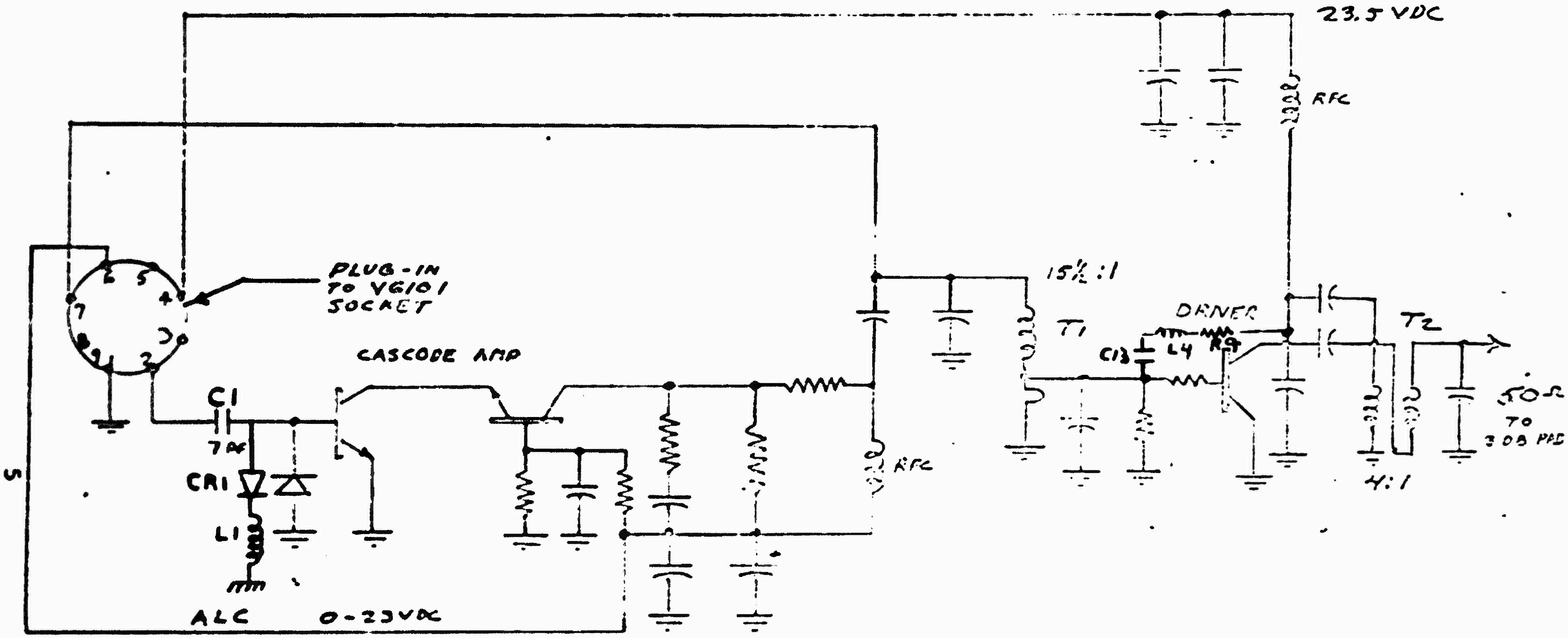


FIGURE 3.1-2

SOLID STATE AMPLIFIER
TUNNER / DRIVER ASSEMBLY

alter the operating characteristics of the Tuner/Driver Assembly to any noticeable degree. The data furnished in the last quarterly report concerning this assembly remains valid.

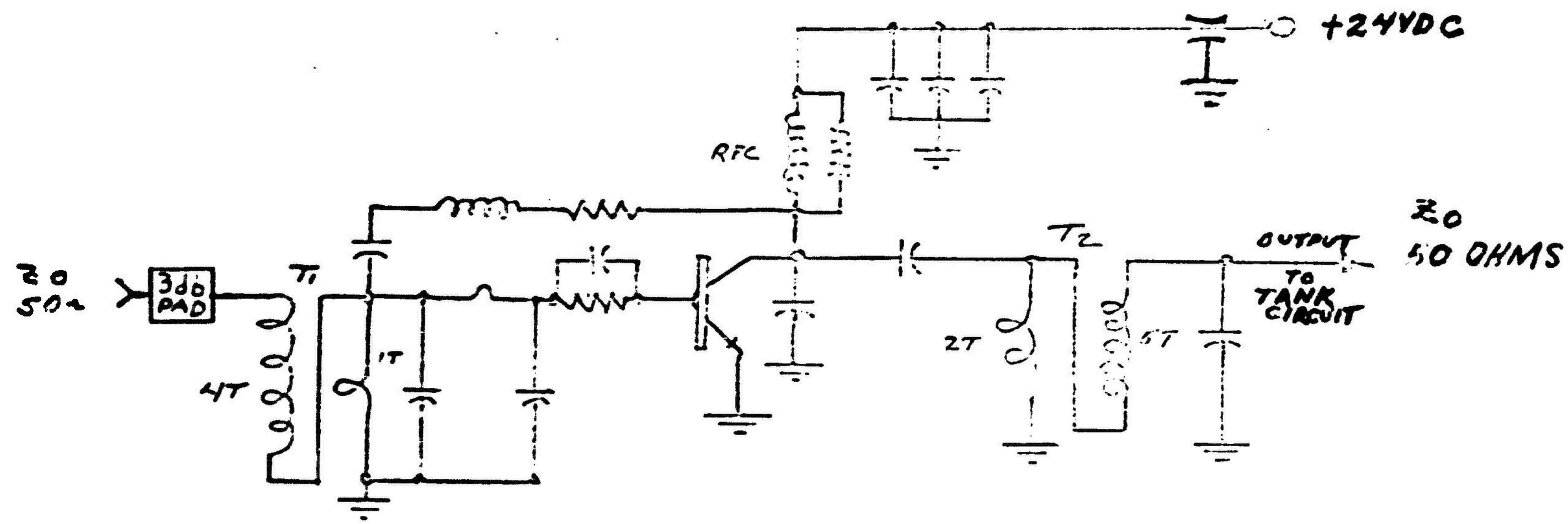
3.2 Power Amplifier

The single ended power amplifier approach has been maintained and successfully implemented in the system. The TRW JØ1006 transistor has been retained and has proven to be a reliable device for the required design. The circuitry described in the last quarterly report has been modified only slightly (Figure 3.2-1).

Previously a resistor divider at the output of the driver stage was used to isolate the driver output from the power amplifier input. The divider has now been placed in the power amplifier assembly in the form of a 3 dB thick film pad. The pad is heat sunk to the power amplifier chassis. To compensate for gain at the higher frequencies where the PA gain is less, a 150 pF capacitor is shunted across the pad to provide sufficient drive level at the higher frequencies.

The output tank circuit was modified to improve selectivity, reverse IM, and reduce output noise. The pickup coil for each band was made smaller and an extra turn added. The form of the coil was also altered to allow the coil position to be varied inside the tank coil.

The tap on the tank coil was maintained at the same point as before. The resulting performance showing the output power, IM and noise data are shown in Section 4.



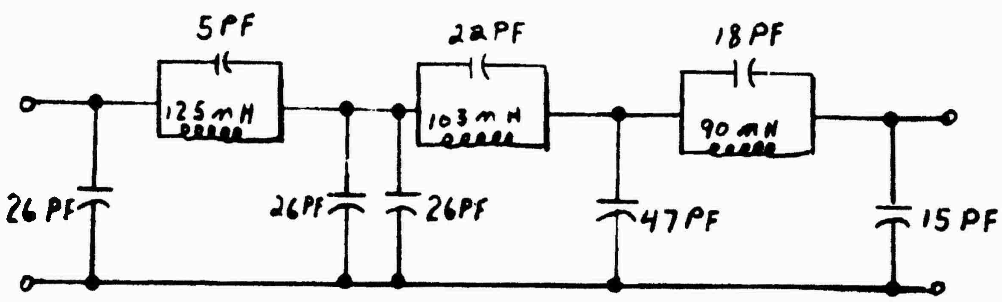
POWER AMPLIFIER
SCHEMATIC

Figure 3.2-1

3.3 High Band Low Pass Filter

The high band low pass filter, supplied by ECOM, has been installed on the A9000 module. This filter was necessary to meet the harmonic specification during High Band (Band "B") operation. The schematic and response of the filter is shown in Figure 3.3-1 and Figure 3.3-2.

HIGH BAND OUTPUT FILTER



REQUIREMENTS

$Z_{in} = Z_{out} = 50$ OHMS

3dB CUT OFF FREQ = 78 MHZ

ATTENUATION = { LESS Than 1dB BELOW 76 MHZ; 50 dB OR GREATER (106 – 500) MHZ }

FIG. 3.3-1

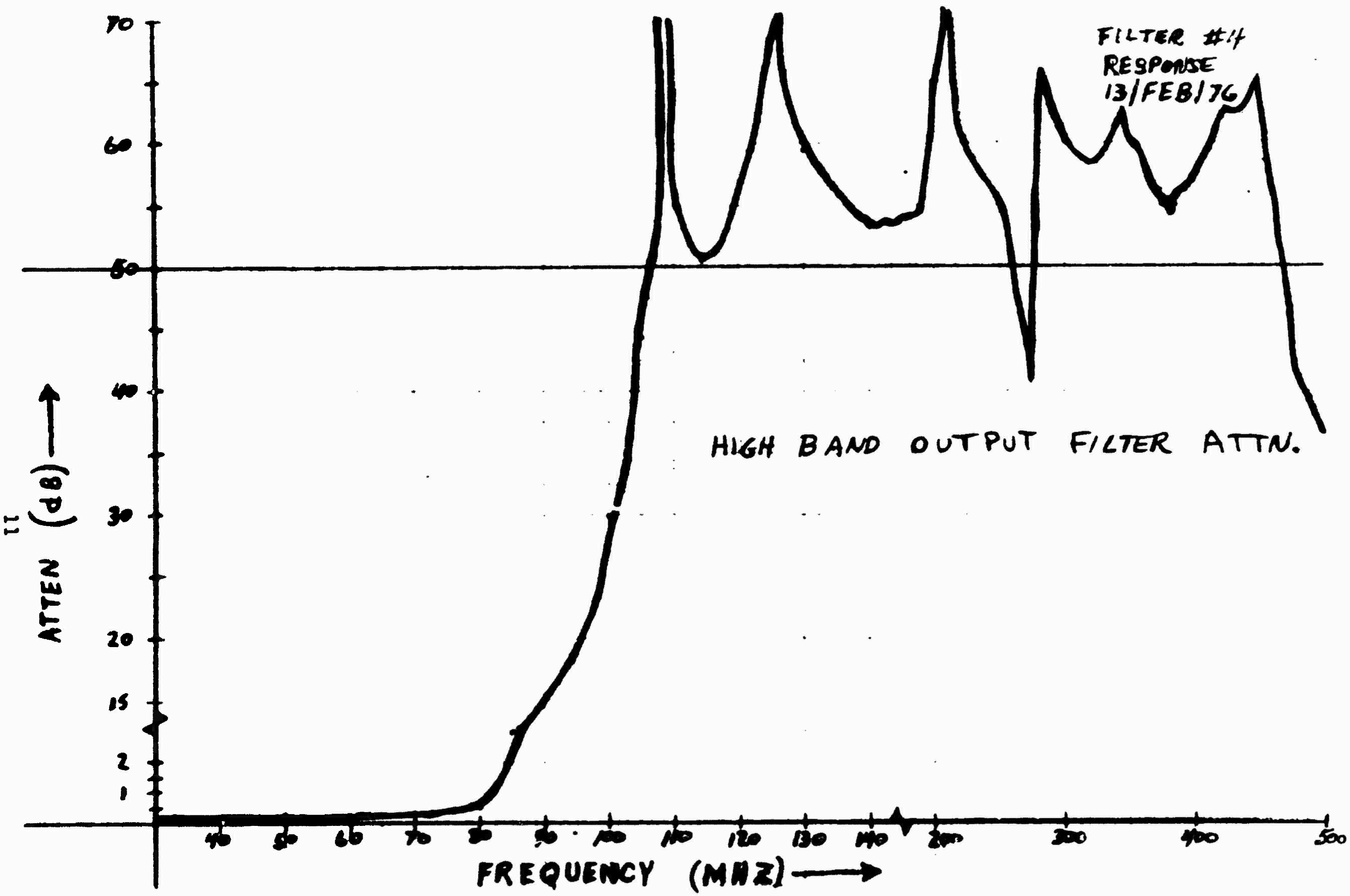

FILTER #4
RESPONSE
13/FEB/76
HIGH BAND OUTPUT FILTER ATTN.
ATTEN (dB)
70
60
50
40
30
20
15
2
1
40
50
60
70
80
90
100
110
120
130
140
200
300
400
500
FREQUENCY (MHZ)

FIG 3.3-2

3.4 Power Supply

The power supply for the power amplifier provides voltage regulation at 24 volts and current limits to protect the power amplifier transistor. The power supply, as described in the last quarterly report, has remained the same mechanically and electrically except for the setting of the current limiting. The previous current limiting which was set at 4.5 amps is now set for 5.5 amps. The voltage to the power amplifier reduces rapidly from 24 volts to approximately 4 volts as the current exceeds 5.5 amps.

The power supply is shown in Figure 3.4-1. The output voltage is nominally at 24 volts in high power operation. A 27 volt zener diode (1N2988B) on the regulator board serves as a reference. The .17 ohm, 10 watt resistor in the collector circuit of regulator transistor Q1 (2N5302) serves to sample the output current. Once the voltage drop accross the 0.17 ohm resistor approaches 0.6 volts, it is fed to E7 of the regulator board. through the temperature compensating thermistor network. turning on the 2N2905 transistor. This action causes Q3 to conduct which lowers the voltage on the bases of Q2 and regulator transistor Q1. The emitter of Q1 follows and reduces the output voltage to the power amplifier.

During low power operation, the 24 volt reference to the base of Q1 transistor is reduced when the low power ground is introduced through pin 15 of P9002. This furnished ground causes the 1N2975B zener diode to conduct applying an 11 volt reference to the voltage regulator when it shunts out the higher voltage 27 volt zener diode.

The other power transistors on the power supply heat

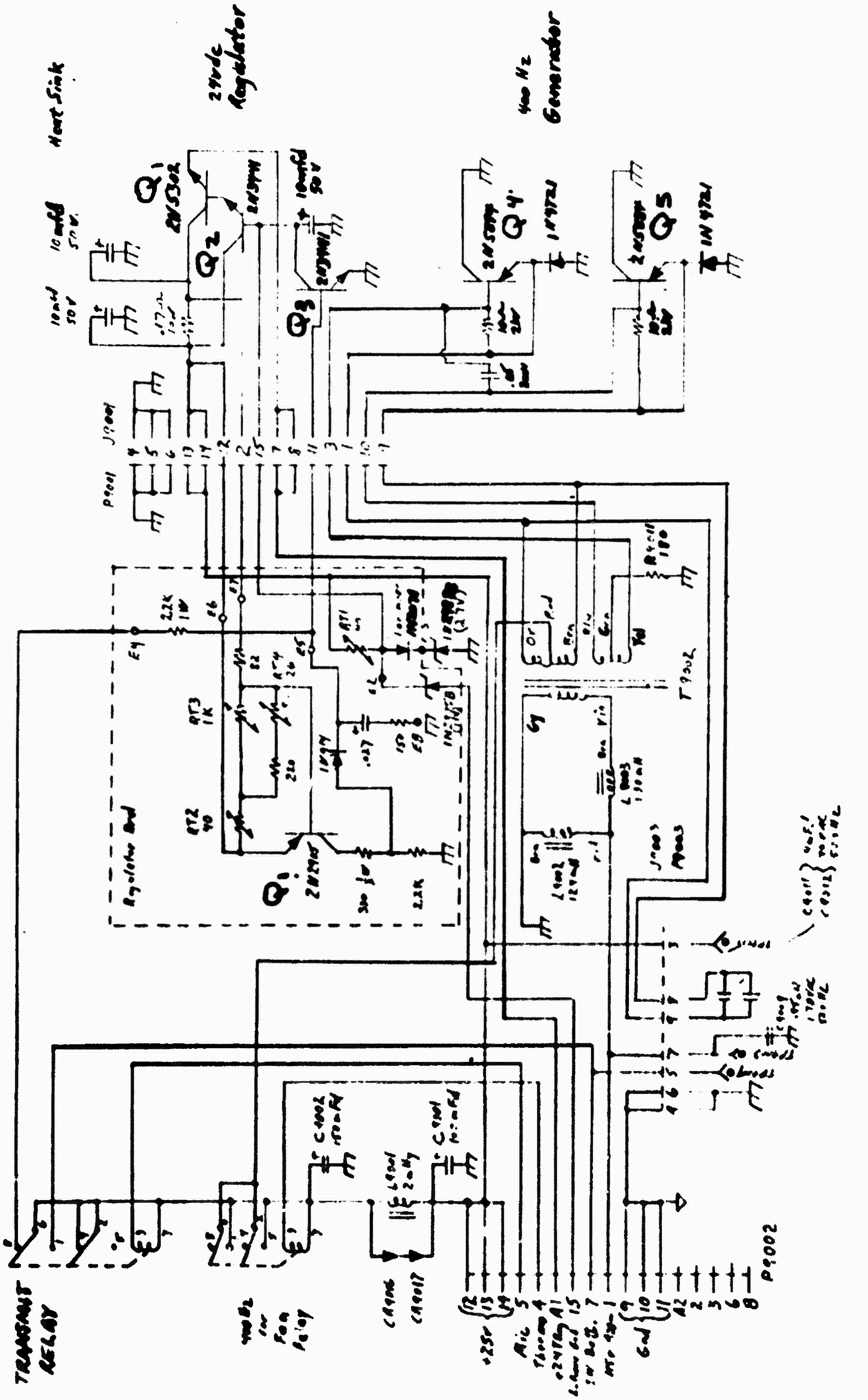


FIG. 3.4-1
POWER SUPPLY SCHEMATIC

sink are Q4 and Q5. This circuit is the 400 Hz power oscillator which supplies the power for the fan located on the power amplifier heat sink. This circuit retains its original form with the exception of the change in transistors. The germanium devices have been replaced with silicon transistors. Diodes were added in the emitters to clamp the negative swings from the transformer to ground.

Also shown on the schematic are the transmit and fan relays which are an integral part of the present radio, but shown here to illustrate the system integration of the power supply.

The fan is thermostatically controlled to operate at +150°F. (Note that this feature is presently available in the existing VRC-12.) In a hostile environment it may be desirable in some instances to disconnect the fan operation to avoid detection. For this purpose, a disconnect is provided. It is tagged and clearly visible after removal of the top cover.

3.5 Control Circuits

The Automatic Level Control (ALC) circuitry is used to level the power from 30 MHz to 76 MHz. This portion of the development program was modified somewhat since the last quarterly report. The concept is basically the same, however a second loop has been added. This new loop controls the RF drive level for optimum efficiency.

Refer to Figure 3.5-1 for a schematic diagram of the ALC and its associated circuitry.

The regulator mounted on a heat sink is comprised of two 2N3441 transistors. Transistor Q1 furnishes either +23 volts in the high power mode or +11 volts in the low power mode. The voltage is selected for high power at +24 volts when the +24 volt zener diode 1N2986 is used. During low power selection, the anode of the 11 volt zener is grounded through the Hi/Low power relay which causes the zener to conduct and shunts out the 24 volt reference with an 11 volt reference. The output from Q1 provides the collector voltage of the driver transistor on the Tuner/Driver Assembly. Another output from Q1 is used as a reference voltage on the ALC board at E2.

The power bridge is similar to the one described in the last quarterly report. The only difference is that the diode is forward biased from E6 of ALC board. This is necessary because the detected output is fed to an operational amplifier using a single polarity voltage thereby requiring operation above ground. The power bridge is located after the tank circuit to provide a relatively harmonic free signal to be power sampled. The power bridge is the conventional type using the current and voltage

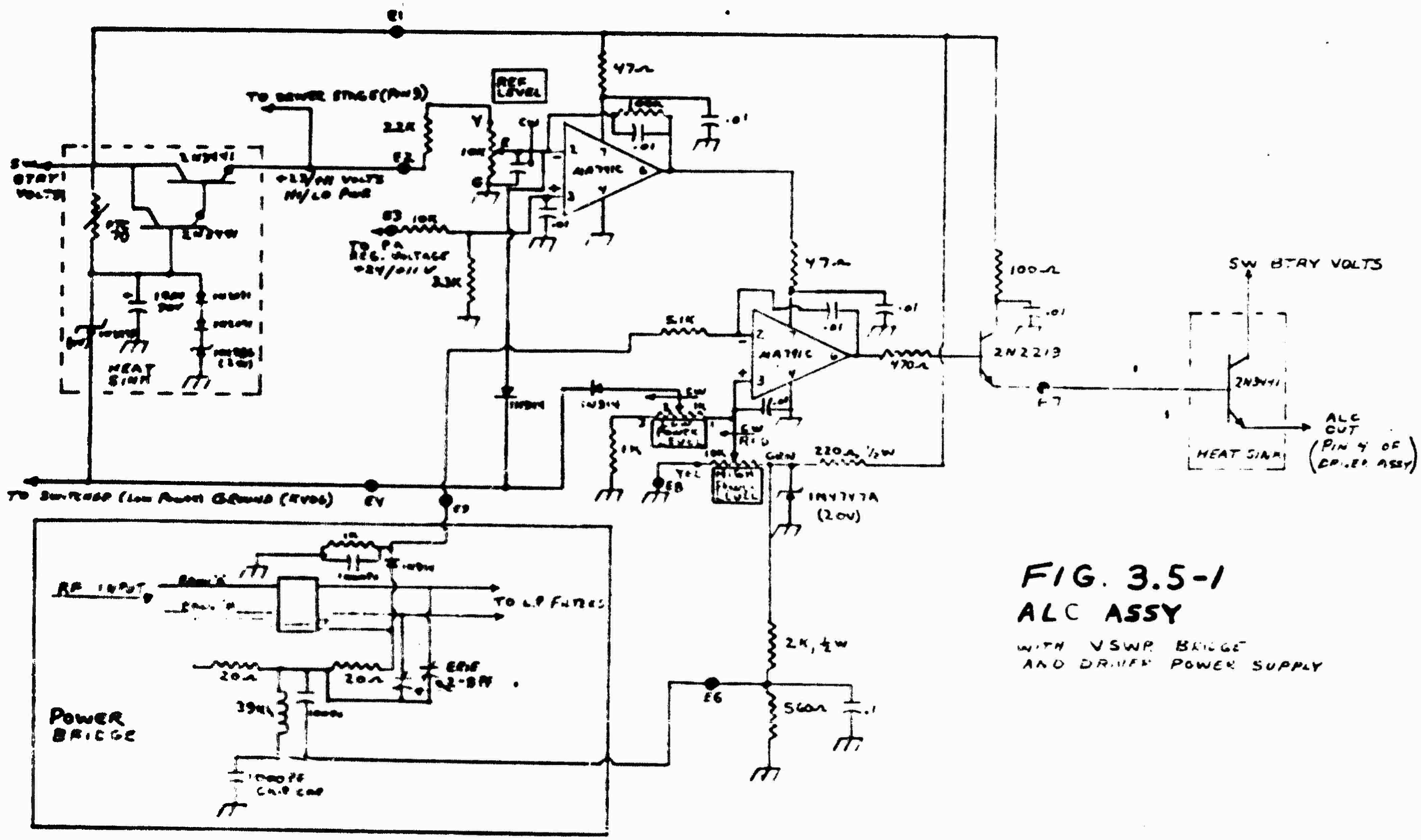


FIG. 3.5-1
ALC ASSY
WITH VSWR BRIDGE AND DRIVER POWER SUPPLY

relationship of the signal and rectifying the resultant which is proportional to the forward power when the sense of the windings is correct. The output of the power bridge is filtered and becomes an input to the ALC board at E5.

The ALC board contains two μA741C operational amplifiers, A1 and A2. Two controls are excercised in this circuitry. Amplifier A1 controls the B+ to amplifier A2. Amplifier A2 controls the ALC voltage to the cascode amplifier which varies the gain of the driver amplifier.

Assume the B+ to A2 is fixed and High Power operation is selected. The input to pin 3 of A2 is set by the HIGH POWER LEVEL pot whose reference is derived from a 20 volt zener diode. The other input to A2 is from the power bridge and is to pin 2, the inverting input. As long as the voltage from the power bridge is below that of the reference level set at pin 3, A2, which is acting as a threshold detector, will be latched in a positive direction thereby applying full B+ to the output at E7. This output drives an emitter follower, a heatsunk 2N3441, to furnish the ALC voltage to the cascode amplifier stage. When the voltage from the power bridge exceeds the level set at pin 3 of A2, the amplifier tends to switch toward ground to lower the voltage supplied to the cascode amplifier and thereby lowers the gain. The high gain loop acts instantaneously to lower the power which lowers the voltage at pin 2 since the voltage is a function of the output power level.

During LOW POWER operation, the wiper of the LOW POWER LEVEL pot is grounded by the Hi/Low power relay. This reduces the reference level at pin 3 by shunting less resistance across the wiper of the HIGH POWER LEVEL pot. This causes A2 to supply a lower voltage in accordance with the LOW POWER LEVEL setting.

The operation of A2 discussed to this point assumes the B+ supplied from A1 to be fixed which is not always the case. The output of A1 is controlled in a similar manner discussed for A2. The REF LEVEL pot is set at a level to be compared against a divided output voltage supplied to the power amplifier from its power supply. When excessive current is drawn, this voltage drops as a function of overload current. The function of A1 then is to lower the drive voltage to the cascode amplifier by dropping the B+ to A1. This is necessary since A2 would continue to furnish maximum ALC voltage if the preset level was not reached. But, the PA would be unable to deliver the power since a foldback condition of the power supply would only allow 3 or 4 volts on the collector of the PA. A stalemate condition with maximum current would result. Therefore a compromise condition had to be reached. The REFERENCE LEVEL is set to allow the power supply to drop to a minimum of 22 volts. The power obtained under this condition will be the maximum without increased transistor dissipation. This control of A1 also serves to protect the PA transistor under short or open circuit loads. The gain of A1 is controlled by a feedback resistor set for a nominal gain of 10. This circuit arrangement prevents an unstable condition should A1 and A2 both exercise control simultaneously.

3.6 Mechanical Packaging

The modifications described in this report are of such a design as to be implemented as a retrofit kit into the present equipment by low skilled personnel. All controls and operation of the equipment remain unchanged.

The replacement circuitry has been designed to directly interchange with the present radio by replacing the power supply module and associated heat sink assembly and the transmitter-driver and power amplifier module. The present mechanical configurations have been maintained, eliminating the necessity of drilling new holes. The only wiring changes that are required involve two wires on relay K406, and the removal of R401.

A major design accomplishment allows integration of the present controls in the new design. Tracking the amplifier tuning through the present gear assemblies proved to be adequate when the backlash adjustment in the gears are properly set.

4.0 PERFORMANCE AND DATA

4.1 Discussion

An RT-246/VRC and two RT-524/VRC units were modified with the modules outlined in Section 3. All three were built using the engineering prototype information gained during the research and development stage of the program. Little difficulty was experienced in incorporating this new design into the original units. Tracking the driver and power amplifier tuning with the original front panel controls required some altering of the capacitor plates of the final tank circuit. The greatest problem encountered was in the backlash play of the connecting gear assemblies in the final tank circuit. A hysteresis was noted in this gear assembly that yielded different power readings depending on the direction of rotation when tuning. This problem, which still could occur from over torque at the end points, was minimized through rework of the couplings. The only other problem encountered was the sometimes erratic performance of the synthesizer which failed to properly lock to the programmed frequency.

An acceptance test for conformance to the specifications was run during the week of March 7, 1976. The units were tested to the outlined specifications except for temperature. Only one unit (Unit #3) was tested for temperature at that time due to the cycling time involved in reaching the required stabilized temperatures; however, all three units have been successfully tested over the temperature range prior to the acceptance test. The data taken during the acceptance test is included as part of this report.

4.2 RF Power Output Test

This test was performed using a calibrated 50 dB pad and an HP-435A Power Meter. All equipments met the 35 watts minimum power requirement.

4.3 Reverse IM Test

This test was run as shown in the diagram on the data sheet. With the forward power set at 40 watts on the RT-524, the interfering power was set for 4 mW delivered to the output jack of the RT-524. Note that Unit #3 did not have the 6 dB pad between the coupler and the transmitter. The 6 dB pad was used to provide a 50 ohm impedance at the transmitter. All units when connected through the 6 dB pad met the 15 dB reverse IM requirement.

4.4 Transmitter Noise Level

This test was performed as shown in the diagram on the data sheet. With 40 watts forward power at 62 MHz being delivered from the transmitter under test, attenuation was added in series with the signal to permit use of a sensitive receiver located in a screen room. Additional attenuation was also used in the screen room. After a reference level was determined, a low pass filter with a cutoff of 53 MHz was inserted in the path and attenuation removed. The receiver was tuned to 52 MHz and the signal measured at that frequency. Corrections were made for a 30 kHz bandwidth since the receiver has a 20 kHz bandwidth, and a 1 dB insertion loss at 52 MHz was taken into account as shown on the data sheet. All three equipments met the -140 dB noise requirement.

4.5 Spurious and Harmonics

The transmitter was checked for spurious and harmonics in the screen room. A notch filter was used to attenuate the carrier into the analyzer to prevent generation of harmonics in the mixer of the spectrum analyzer. All equipments far exceeded the 60 dB requirement for 2nd and 80 dB requirement for all other harmonics.

RT- 524/VRC

Ser. No. 1

Figure 4.2-1

RF POWER OUTPUT TEST
(Power in Watts)

Frequency (MHz)	I@25V	Room Temperature 25.5 V High	25.5 V Low	22 V High	22 V Low	30 V High	30 V Low	+150°F 25.5 V High	-40°F 25.5 V High
30	7.2A	44	3.2	41		49			
32	6.5	44.5	3.2	42		49			
34	6.0	44	3.1	42		49			
36	6.0	46	3.2	43		50			
38	6.6	50	3.4	38		55			
40	6.1	46	2.9	36.5		49			
42	5.8	45	2.9	40		49			
44	6.4	44	2.8	38		48			
46	7.9	45	2.7	32.5		47.5			
48	7.0	42	2.8	30		47			
50	6.8	40	2.7	32		44.5			
52	6.2	39.5	2.5	37		44			
52.95	6.3	39	2.4	35		42			
53	7.65	43	3.1	31		53			
54	7.5	41	3.1	31		52			
56	7.2	42.5	3.0	30		54			
58	6.6	42	3.1	29		53			
60	5.9	42.5	3.1	29		54			
62	6.0	40.5	3.1	33		54			
64	5.9	44	3.0	33		54			
66	6.0	44	3.0	31		54			
68	6.4	46.5	2.9	32		53			
70	6.4	47.0	2.9	32		54			
72	6.5	47.5	3.0	33		54.5			
75	6.5	46.0	3.0	33		53.5			
75.95	6.4	42	2.9	27		53			

RT-246/VRC

Ser. No. 2

Figure 4.2-2

RF POWER OUTPUT TEST
(Power in Watts)

Frequency (MHz)	I@25V	Room Temperature 25.5 V High	25.5 V Low	22 V High	22 V Low	30 V High	30 V Low	+150°F 25.5 V High	-40°F 25.5 V High
30	7.0A	44	2.9	40	3.3	50	2.8		
32	7.0	47	3.1	42	3.4	50	3.0		
34	6.4	48	3	43	3.5	52	3.0		
36	6.8	50	3	45	3.5	53	3.0		
38	6.8	45	2.7	41	3.2	50	2.8		
40	6.5	43	2.6	38	3.1	49	2.7		
42	6.1	43	2.45	41	3.0	50	2.6		
44	6.0	44	2.6	39.5	3.0	48	2.6		
46	6.2	44	2.5	38	3.0	47.5	2.6		
48	7.0	42.5	2.3	34	2.6	43.5	2.3		
50	7.7	39	2.2	31	2.65	43	2.3		
52	6.4	38	2.1	34	2.5	42	2.2		
52.95	6.2	38	2.0	33	2.4	41	2.1		
53	5.9	42	2.1	37	2.7	45.5	2.3		
54	6.0	42	2.3	36	2.7	46	2.3		
56	6.0	41	2.2	35	2.7	45	2.3		
58	6.0	41	2.3	34	2.7	45	2.3		
60	6.0	41	2.2	33	2.7	46	2.3		
62	6.0	41.5	2.3	33	2.8	46.5	2.3		
64	6.0	42	2.2	32	2.8	47	2.4		
66	5.9	42	2.3	30	2.7	47	2.4		
68	5.8	41	2.2	30	2.6	45	2.4		
70	5.5	39.5	2.1	33	2.5	44.5	2.3		
72	5.4	40	2.1	36	2.5	44	2.2		
75	5.5	40	2.1	32	2.5	43	2.1		
75.95	5.8	40	2.1	26.5	2.5	43	2.1		

RT- 524/VRC

Ser. No. 3

Figure 4.2-3

RF POWER OUTPUT TEST
(Power in Watts)

Frequency (MHz)		Room Temperature 25.5 V		22 V		30 V		+150°F 25.5 V	-40°F 25.5 V
	I@25V	High	Low	High	Low	High	Low	High	High
30	7.5A	46	3.4	40	3.7	47	3.4	45	40
32	6.5	44.5	3.5	42	3.75	48	3.5	52	39
34	6.5	45	3.4	41.5	3.7	48	3.4	51	39
36	7.6	56	5.3	45	5.7	60.5	5.2	52	57
38	7.5	49	3.6	41	3.8	52	3.6	51	44
40	7.0	47	3.2	40.5	3.5	50	3.2	50	41
42	6.8	46	3.2	41	3.5	48	3.2	50	40
44	7.2	44	3.2	41	3.5	48	3.2	43	41
46	8.2	43	3.1	36	3.2	47	3.1	38	39
48	8.2	42	2.9	34	3.0	45	2.9	37	36.5
50	6.3	38	2.6	34	2.9	40.5	2.7	42	34.5
52	6.8	38	2.6	35	2.95	41	2.6	43	35.5
52.95	7.3	40	2.7	31	2.95	44	2.6	39	37
53	7.3	43	3.2	34	3.4	42	3.1	43	40
54	7.0	44	3.2	33	3.4	47	3.1	40	40
56	6.2	42	3.1	32	3.3	48	3.0	43	39
58	5.6	40.5	3.1	30	3.3	42.3	3.0	42	39
60	5.5	40	3.0	30	3.2	44	2.95	41	39
62	5.6	41.5	2.8	30	3.2	44	2.9	41	39
64	5.6	41.0	2.9	30	3.1	43	2.85	39	38
66	6.0	41.0	2.8	31	3.0	44	2.8	39	37.5
68	6.3	41.5	2.1	33	3.0	44	2.8	41	37.5
70	6.2	41	2.6	35	3.1	45	2.8	43	38
72	6.0	43	2.9	33.5	3.2	46	2.9	42	39
75	5.8	43	2.9	33	3.1	46	2.5	41	39
75.95	5.7	41	2.9	29	3.1	46.5	2.85	37.5	39

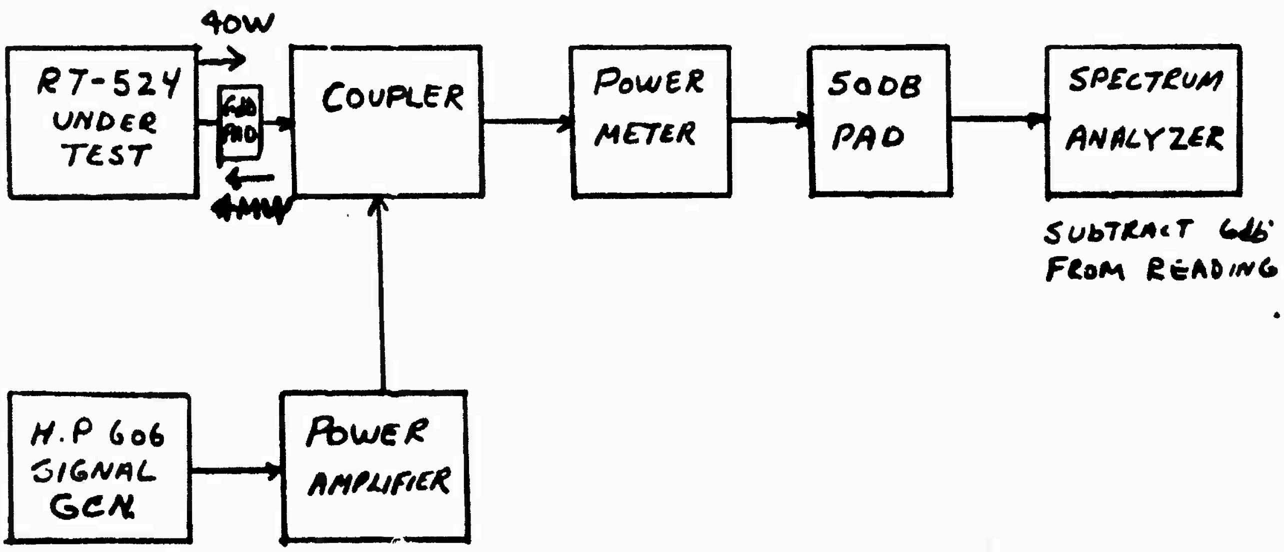
RT-524/VRC

Ser. No. 1

Figure 4.3-1

REVERSE IM TEST

Frequency	F_{INT} (-2 MHz)	F_{INT} (+2 MHz)
30	>30 db	>30 db
35	24	22
40	20	20
45	24	22
50	>30	25
52.95	>30	>30
53	23	>30
55	>30	[illegible]
60	21	22
65	19	19
70	22	20
75	23	>30
75.95	>30	24



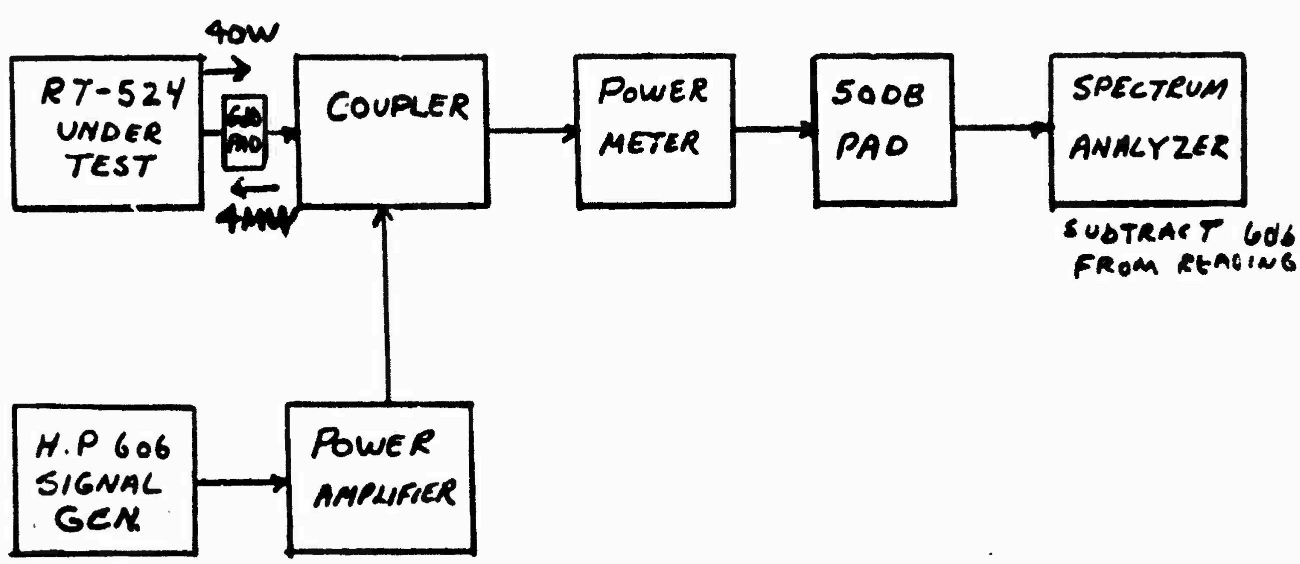
RT- 246/URC

Ser. No. 2

Figure 4.3-2

REVERSE IM TEST

Frequency	F_{INT} (-2 MHz)	F_{INT} (+2 MHz)
30	>30 db	>30 db
35	25	22
40	19	19
45	22	24
50	>30	27
52.95	27	>30
53	>30	24
55	25	22
60	23	21
65	21	22
70	21	21
75	24	25
75.95	25	>30



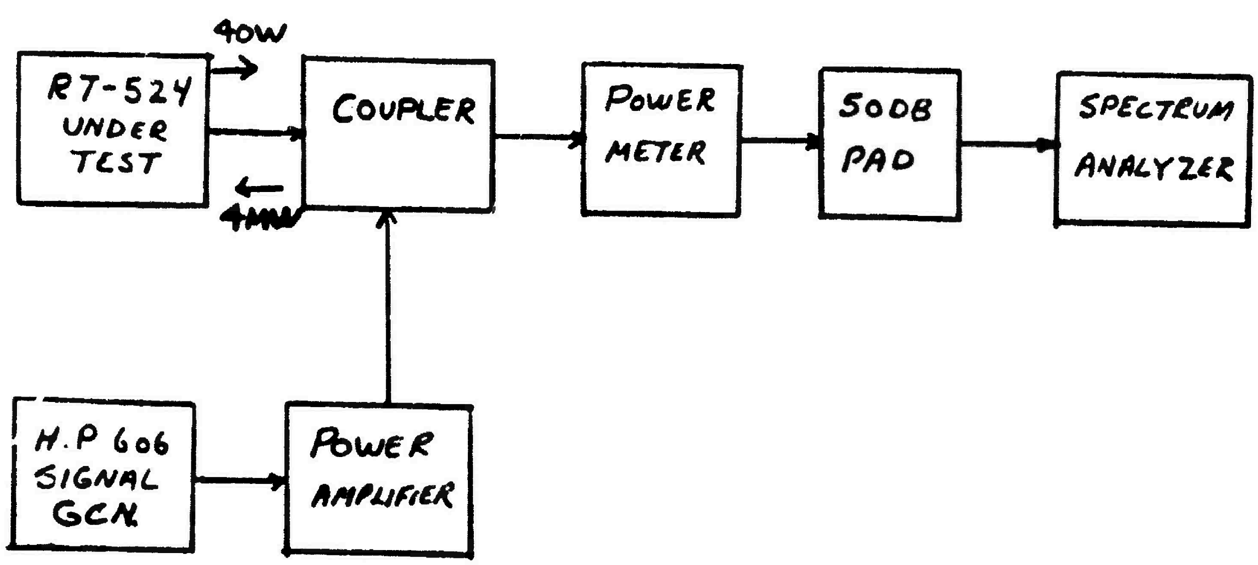
RT-524/VRC

Ser. No. 3

Figure 4.3-3

REVERSE IM TEST

Frequency	F_{INT} (-2 MHz)	F_{INT} (+2 MHz)
30	32db	32db
35	32	26
40	20	18
45	14	23
50	39	21
52.95	20	20
53	34	24
55	36	26
60	16	20
65	17	17
70	26	22
75	25	30
75.95	23	21

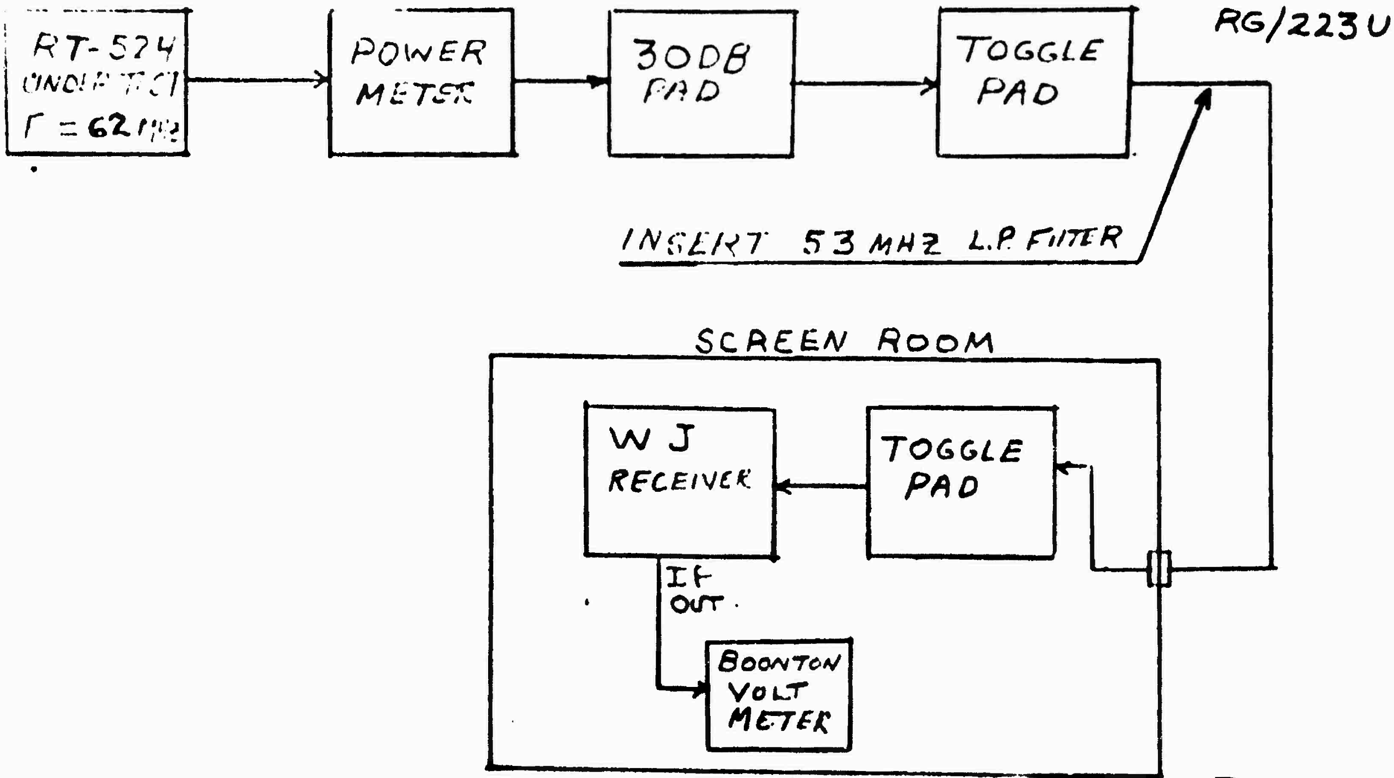


RT- 524/VRC

Ser. No. 1

Figure 4.4-1

TRANSMITTER NOISE LEVEL



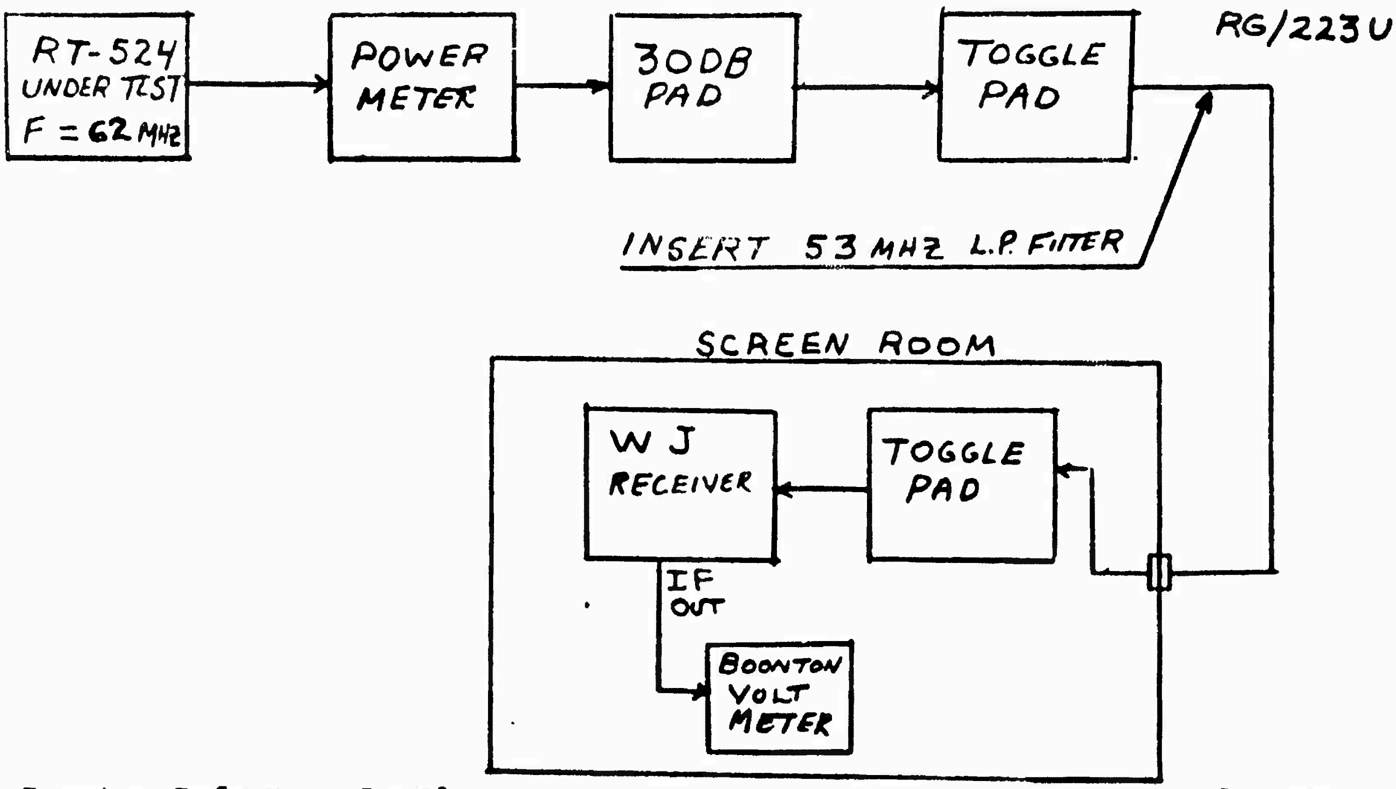
Boonton Reference Level	-7 dBm
External Pad Total	-80 dB
Internal Pad Total	-70 dB
Total	-150 dB
Insert Low Pass Filter External Pad Removed	-50 dB
Internal Pad Removed	-70 dB
Boonton Reference Level Difference (dB)	-23.5 dB
Total Attenuation Removed	-143.5 dB
Insertion Loss of Filter at 53 MHz	+1 dB
Revised Reading	-142.5 dB
30 kHz/20 kHz BW Correction Factor	+1.8 dB
Noise Level Below Carrier	-140.7 dB

RT- 246/VRC

Ser. No. 2

Figure 4.4-2

TRANSMITTER NOISE LEVEL



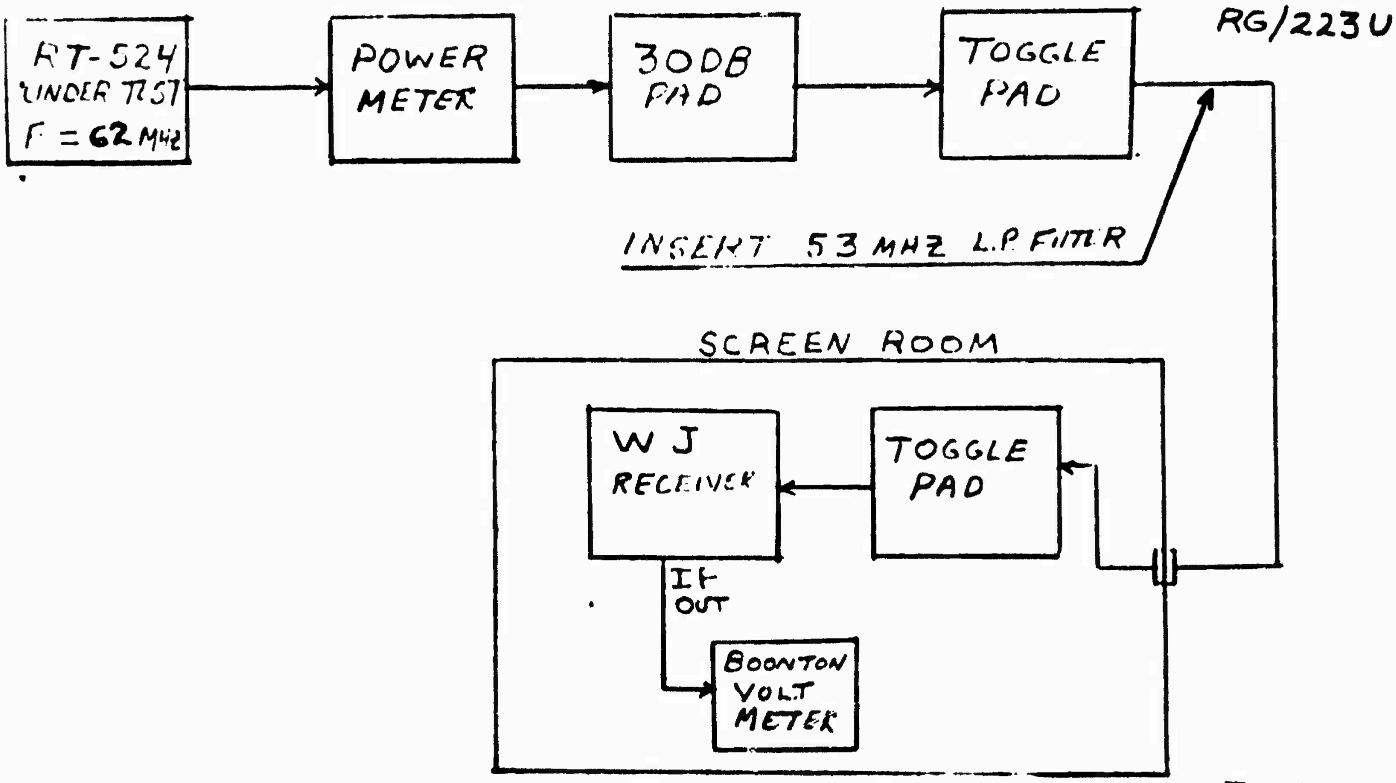
Boonton Reference Level	-7	dBm
External Pad Total	-80	dB
Internal Pad Total	-70	dB
Total	-150	dB
Insert Low Pass Filter External Pad Removed	-50	dB
Internal Pad Removed	-70	dB
Boonton Reference Level Difference (dB)	-23	dB
Total Attenuation Removed	-143	dB
Insertion Loss of Filter at 53 MHz	+1	dB
Revised Reading	-142	dB
30 kHz/20 kHz BW Correction Factor	+1.8	dB
Noise Level Below Carrier	-140.2	dB

RT- 524/VRC

Ser. No. 3

Figure 4.4-3

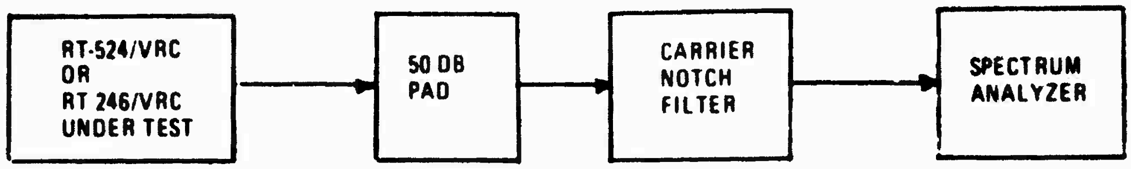
TRANSMITTER NOISE LEVEL



Boonton Reference Level	-7	dBm
External Pad Total	80	dB
Internal Pad Total	70	dB
Total	150	dB
Insert Low Pass Filter External Pad Removed	-50	dB
Internal Pad Removed	-70	dB
Boonton Reference Level Difference (dB)	-23	dB
Total Attenuation Removed	-143	dB
Insertion Loss of Filter at 53 MHz	+1	dB
Revised Reading	-142	dB
30 kHz/20 kHz BW Correction Factor	+1.8	dB
Noise Level Below Carrier	-140.2	dB

Figure 4.5-1

SPURIOUS AND HARMONIC TEST



HARMONIC TEST SET-UP

Set #1 RT-524/VRC

SPURIOUS: None visible

HARMONICS: Transmitter Frequency = 30 MHz
- 2nd Harmonic > -90 dB from carrier
- 3rd Harmonic ≈ -85 dB from carrier

Transmitter Frequency - 55 MHz
- 2nd Harmonic > -80 dB from carrier
- 3rd Harmonic -90 dB from carrier

Set #2 RT-246/VRC

SPURIOUS: None visible

HARMONICS: Transmitter Frequency = 30 MHz
- 2nd Harmonic > -90 dB from carrier
- 3rd Harmonic -86 dB from carrier

Set #3 RT-524/VRC

SPURIOUS: None visible

HARMONICS: Transmitter Frequency = 30 MHz
- 2nd Harmonic > -90 dB from carrier
- 3rd Harmonic -90 dB from carrier

Transmitter Frequency = 55 MHz
- 2nd Harmonic -90 dB from carrier
- 3rd Harmonic -90 dB from carrier

5.0 CONCLUSIONS

The feasibility of retrofitting the power stages of the RT-524/VRC and RT-246/VRC with a solid state design has proven to be practical and desirable from the standpoint of reliability and efficiency. The power amplifier in its present form has withstood countless hours of operation during development and testing without a failure. The current drain of the modified unit at 7.5 amperes compares favorably to the typical 13 to 14 amperes drain of the unmodified unit.

There are three areas of investigation that are desirable before production of this unit is undertaken. The first would be the addition of an amplifier stage in the Tuner/Driver Assembly. The addition of a stage between the cascode amplifier and the driver would relax the performance requirements for ease in production.

A second area of improvement lies in a resonance condition at about 36 MHz which appears at the output of the Power Bridge. This resonance tends to cause a peak in the power output beyond the level control setting. This resonance would be moved out of band where it would have no effect.

The third is an evaluation of the interchangeability between manufacturers of the PA transistor. Only the TRW J01006 has been tried. It is recommended that the CTC device also be evaluated.

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