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6 REPLACEMENT OF RT-524/246 TRANSMITTER TUBES BY TRANSISTOR INSERTS.

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20. ABSTRACT. (Continued)

In addition to improved reliability, another advantage is that the noisy fan does not operate under normal conditions. Therefore, the position of the radio is not given away in a quiet environment. A further advantage is that a 100% transmit duty cycle is possible.



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REPLACEMENT OF RT/524/246 TRANSMITTER
TUBES BY TRANSISTOR INSERTS

INTRODUCTION:

The RT-524 and RT-246 are vehicular FM radio transceivers used in large quantities by the US Army. These radios provide 920 synthesized radio channels within the range of 30 to 75.95 MHz. The minimum transmitter output power specified is 35W. The RT-246 is similar to the RT-524, but, in addition, it has 10 frequency presets. Except for the receiver front end and the transmitter power amplifier, the radio is fully transistorized.

The objective of the work described in this report was to explore the feasibility of replacing the tubes in the transmitter by transistor inserts.

PREVIOUS WORK:

Previous work, R&D Technical Report ECOM-2836, and ECOM-3209, describe an approach which rather than replacing only the tubes, replaces the entire power amplifier modules A6100 and A6200 by a broadband transistor amplifier module. A similar approach was taken by RF Communications Inc., Contract Number DAAB07-72-C-0153.

In all three cases, the design was not adopted because excessive broadband output noise levels in transmit prevented use of the equipment in radio relay configurations. Typical noise levels 10 MHz off carrier and measured in a 32 kHz bandwidth were in the order of -68 ... -73 dBm. However, for a vehicular radio relay operation, -95 ... -98 dBm are required. These levels were marginally met by the tube version. Another disadvantage was that back intermodulation performance of the transistor model was much worse than that of the tube version. Back intermodulation results when two collocated transmitters are transmitting simultaneously. The signal transmitted by T_1 enters the antenna of T_2 and mixes with the second harmonic of T_2 in the amplifying transistor or tube of T_2 . The resulting mixing product is re-radiated and may jam a nearby receiver which is tuned to that particular frequency. The problems of previous transistor versions were caused by the lack of tuning elements. Tuned circuits are used in the tube version and in the approach described in this report.

NEW APPROACH:

In the new approach, tuning elements were used in the transistor power amplifier train. The question arose whether the same tuning elements now in the tube version could be used for that purpose. As will be shown in this report, this was found possible. The old tube module with its gear trains, tuning elements, and many of the components were reused. As a result, this solution will be very cost effective for retrofit of

equipment now in the field. In addition, the installation of the transistor inserts can be achieved without any machining. Therefore, only simple hand tools are required to perform the modification.

DESCRIPTION:

1. The Driver, Module A6100

a. Concept. The driver tube V6101, type 5686 was replaced by a two stage transistor amplifier, see schematic, Figure 1. This amplifier connects into the socket of V6101 using a nine pin tube socket adapter and is clamped to the former tube heat sink by two brackets. The grid and plate tuned circuits are used as they are, except that choke L6105, which is easily accessible, must be removed. The signal is coupled by a 6 pF capacitor from the tube socket point, where the tube grid had been connected, to the base of transistor Q1(2N23866). The diode D1 prevents peak rectification by the base emitter diode. The 2N3866 was selected according to test setup shown in Figure 2, for a minimum of 160 mA dc collector current. A second transistor Q2(2N3866) forms a cascode configuration with the first one in order to increase the gain and reduce the Miller effect.¹

The output of this cascode amplifier is coupled to the next stage, Q3(2N3632) by transformer T₁. Figure 3 shows the transformer. Resistors R3 and R4 prevent nonlinear instability.

T₁ couples to the second driver stage, which uses a 2N3632 to drive the output tuned circuit. This circuit was formerly connected to the plate of the driver tube. Transformer T₂ couples to this tuned circuit. This transformer must have a low stray factor, proper inductivity, and low winding capacity. Figure 4 shows this transformer. Inductor L2 improves the efficiency and resistors R10 and R8 help prevent nonlinear instability. L2 and R10 are one unit as shown in Figure 5. Capacitors C5 and C6 determine the matching between transistor and tuned circuit.

b. Current limiting. Transistors Q4(2N3791) and Q5(2N3867) act as a current limiter and automatic level control. They limit the current to .75A, such that the driver assembly cannot be damaged by improper operating conditions during tests and repairs. The control current is supplied thru R18 by the ALC circuit. R17 and C8 act as damping circuit for the control loop. Resistors R15 and R16 prevent linear oscillations of the final power amplifier after removal of the drive signal from the driver amplifier. Figure 6 shows the output vs frequency of this driver.

c. Heat Transfer. The thermal resistance between driver insert and module wall (see Figure 7), points A and B, was measured to be 1.1° C/W. With a maximum total power dissipation in the driver assembly of 13W, this will cause a temperature differential of 14°C. This is considered satisfactory. For improvement of heat transfer, Thermal Joint Compound, type Thermacote by Thermalloy Company was used.

1. Miller Effect: Increase of input capacity by $C_{cb} (1 + \text{voltage gain})$ where C_{cb} is the collector-base capacity.

However, with the present construction, the tolerances in the tube socket position do not always allow a perfect match of the heat sinks, with a consequent increase in the heat transfer resistance. Hence, the tube socket connector in the next model should be mounted floating, such that it may move in parallel to the socket surface.

d. Hardware Sketches. (See Figures 8 thru 12) As mentioned above, changes are required in Figure 9 in order to let the tube socket float. Figure 13 shows a photo of this Driver Insert, with the core removed.

2. The Power Amplifier, Module A6200.

a. Concept. The tube socket of lighthouse tube V6201, type 7843 and its BeO heat sink block are removed using a screw driver and cutters. In its place, the transistor power amplifier insert is installed by bolting it into the position where the BeO heat sink block had been. No machining, drilling or thread cutting is required. This power amplifier insert contains:

- (1) Two transistors 2N5643 in push-pull
- (2) Input-output matching and feeding circuits
- (3) Band switch
- (4) Low pass filter for the high band to improve harmonic suppression.
- (5) VSWR detector
- (6) The current limiter transistor and its preamplifier transistor.
- (7) The ALC and high/low power control circuit.

b. Mechanical. The band switch is operated by the switch lever which operates the output tank switch. A new switch lever must be installed which is shaped slightly differently and carries a nose. The nose operates the forked lever of the band switch in the insert. The switch wafer on the printed circuit board of the amplifier is limited in its movement by stops on the printed circuit board; since the wafer is driven by a spring which takes up excess movement. As a result, no high amount of accuracy of the band switch drive is required.

The original plan to add some contacts on existing band switch S6202 was abandoned in favor of placing the switch into the insert. The insert can simply be screwed in and the leads connected. This way the modification is easier to implement in the field.

The High Band Low Pass Filter, the VSWR detector and the ALC circuit are housed in a sheet metal box installed on top of the amplifier. The box is suspended by hinges such that all components are easily accessible for production and service. The potentiometers for level adjustments are accessible with the entire plug-in installed in the radio frame.

c. Heat Transfer. The thermal resistance between the insert and the main heat sink of the power amplifier module A6200 was measured to be $.32^{\circ}\text{C}/\text{W}$. Thermacote was used between the surfaces. At an ambient temperature of 65°C and with a 30V d.c. supply voltage, the fan maintained the main heat sink at 75°C . The following junction temperatures were calculated for the rf transistors and for the current limiter transistor.

RF Transistors

(1) The power supplied to the rf transistors: $2.2\text{A} \times 2 \times 22.5\text{V} = 99\text{W}$.

(2) The rf output power delivered is 45W , hence the transistors dissipate $99 - 45 = 54\text{W}$, ie 27 watts each.

(3) The thermal resistance of the 2N5643 is $\frac{175^{\circ}\text{C}}{60\text{W}} = 2.92^{\circ}\text{C}/\text{W}$. Therefore, the junction temperature is $2.92 \times 27 = 79^{\circ}\text{C}$ above the insert temperature.

(4) The loss in the current limiter will be $6\text{A} \times 7.5\text{V} = 45\text{W}$. Hence the total loss dissipated on the insert will be $45\text{W} + 54\text{W} = 99\text{W}$. Then the temperature difference between the main heat sink and the insert will be: $99\text{W} \times .32^{\circ}\text{C}/\text{W} = .32^{\circ}\text{C}$.

Therefore, at 30V input and 65°C ambient temperature, these temperatures are predicted:

Main Heat Sink:	75°C
Insert:	107°C
Junction:	186°C

Current Limiter Transistor

Thermal resistance of 2N3442: $\frac{175^{\circ}\text{C}}{117\text{W}} = 1.5^{\circ}\text{C}/\text{W}$.

The mica insulator, with Thermacote, will have $.4^{\circ}\text{C}/\text{W}$ adding to a total of $1.9^{\circ}\text{C}/\text{W}$. The temperature differential between junction and insert will then be $1.9^{\circ}\text{C}/\text{W} \times 45\text{W} = 86^{\circ}\text{C}$.

The junction temperature of the current limiter transistor, at 65°C ambient temperature and with 30V supply voltage will then be:

$$T_j = 107 + 86 = 193^{\circ}\text{C}.$$

d. Hardware. Sketches for the hardware of the power amplifier insert are shown in Figures 14 to Figure 22.

e. Electrical

Power amplifier. The two transistors 2N5643 are used in a push-pull configuration in emitter-base switched mode. Two transformers are used to match the input impedance of the transistors to the source and also obtain the 180° phase shift required for push-pull. Figure 23 shows identical construction for transformers T3 and T4. For the transformers, 14 mm dia. ferrite cup cores are used. However, smaller cores will possibly also be usable. Figure 24 shows the input impedance vs. frequency of the transistor under load, on the fundamental. From these measurements, the equivalent circuit shown in figure 24 was derived. It approximates the input impedance of the transistor between 30 and 75 MHz.

Stray and parallel inductance of transformer T3, together with capacitors C31-C37 transform this impedance to a nominal value of 100 ohms (two in parallel yield 50 ohms). The measured values are shown in figure 25.

Resistors R33, R34, R35, R36, and inductors L31, L32 supply d.c. current to the collectors. The arrangement of L31 and R34 or L32 and R36 is shown in figure 26. The resistors prevent nonlinear instability. Resistors R51, R52 and Capacitors C40 .. C43 serve the same purpose.

Switch S1/1-3 is located on the printed circuit board of the insert. It switches the amplifier to the Low or Hi Band Tuned Circuits. Section 3 of switch S1 breaks before S1/1 or S1/2 break. It serves to remove power from the amplifier during band switching.

Transformers T5 and T6 match the transistor output to an unsymmetric load line.

Transformer T5 Construction: Wind 6 turns #22 Formvar Magnet wire on $\frac{1}{4}$ " diameter cylindrical coil form. Apply thin sheet of epoxy and let set. This is the secondary (output) winding. Wind primary tightly on top of secondary in the same winding direction, four turns #20 magnet wire (primary, input). Turn the coils such that primary and secondary leads are offset by 180° . Cement in place. Use cup core #B65541-K-0020-A-012.

Electrical values measured at 50 MHz

Primary Inductance, 254 nH

Primary Inductance, sec. shorted 46 nH

Secondary Inductance, 462 nH

Secondary Inductance, prim. shorted 83 nH

The capacitance between the windings is 21pF. Figure 27 shows the input impedance of transformer T5 when terminated with 50 ohms and with series and parallel capacity added. Since in the actual circuit stray inductance is added, C45 was reduced from 390 pF to 220 pF.

The cup cores of the transformers were filled with Thermacote and mounted on a heat sinking copper plate. Thereby, maximum heat conduction is obtained.

The High Band Low Pass Filter has three poles. The measured filter characteristics are shown in figure 28. In the passband, 30-76 MHz, with a 50 ohm load, the absolute value of the input impedance is within 5 ohms. Figure 29 shows the filter components and figure 30 shows the p.c. board layout.

The filter provides at least 40 dB harmonic suppression. This, together with the second harmonic suppression by the push-pull amplifier, (10...20 dB), and the effect of the tuned tank circuit (15 dB) provides 60 dB of harmonic suppression with ample margin. For filtering in the Low Band, the FL 401 filter now in existence is being retained. This approach provides substantial cost savings for retrofit.

For both bands, one VSWR detector is being used. The trimmers, C54 and C55 shown in Figure 1 can be replaced later by fixed capacitors. Redesign of the mechanical layout of this section is required.

The tuned circuit tank assembly for Band A and B (Low and High Band) is essentially used without change. The tank coils are tapped, and the outputs from the VSWR detector are connected to these taps.

Selection of taps on tank coils: Feed 3 Vrms at 50 MHz to high point of tank coil. Leave J6201 open. Connect a 50 ohm cable, terminated with 50 ohms, at the tapped end of the coil, with the shield connected to the ground end of the coil. Adjust the tap such that .6V rms are measured at the 50 ohm terminal of the cable. Then the 50 ohm load is disconnected from the cable and adjust output coupling and tuning until 50 ohms real are obtained. The High Band tank tapping procedure is analogous.

Figure 31 shows the input impedance of the tank when loaded with 50 ohms. Figure 32 to 35 show measured values of the input impedance of the tank with J6201 being loaded with 50 ohms. For various dial settings, the input impedance was measured for various input frequencies. For the input frequency equal to the dial frequency, the impedance should be close to 50 ohms. Figure 36 and 37 show the measured attenuation characteristics of the tanks, tapped as described.

Inductor L36 (7 H) and capacitor C59 (12 pF) are substituted for the feeding choke L6202 and the plate capacity of the removed power tube V6201.

The ALC circuit, fed by the VSWR detector and the overload current control, regulates the supply voltage for the driver module. It also reduces power when the set is operated in the "Low Power" mode.

The current limiting transistor together with its driver is mounted on the insert heat sink. The current and voltage limiting circuitry is essentially the same as that used in contract DAAB07-72-C-0153. The circuitry is on a printed circuit board located in the space at the rear of the tube socket mounting of former tube V6201. The power zener diode, 1N2988 and the .15 ohms power resistor are mounted below on an aluminum heat sink. The heat sink, shown in Figure 38, is installed in place of R6204. (R6204 is removed.)

Current Limiting. The current limiter maintains the power amplifier supply current in the range of 5 to 6 Amps and regulates the voltage to 23V. However, if some malfunction should occur, the entire current concentrates on one power amplifier transistor, and breakdown may result. Therefore, the circuit should be modified such that dc voltage reduction is initiated if the dc current in any one of the two PA transistors is exceeded. Figure 39 shows the electrical performance of the power amplifier insert. Figures 39A and 39B show the completed laboratory model of the power amplifier assembly.

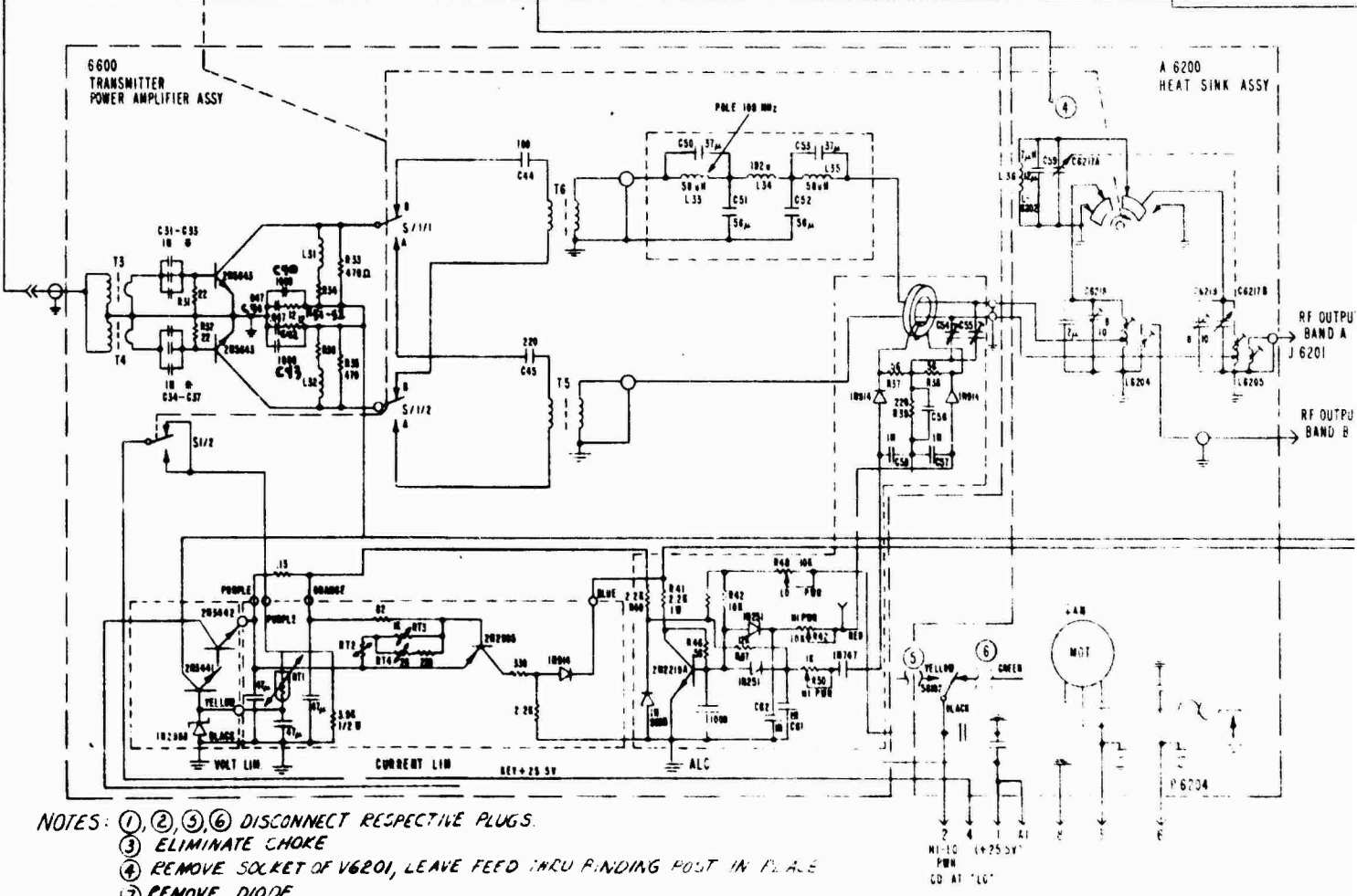
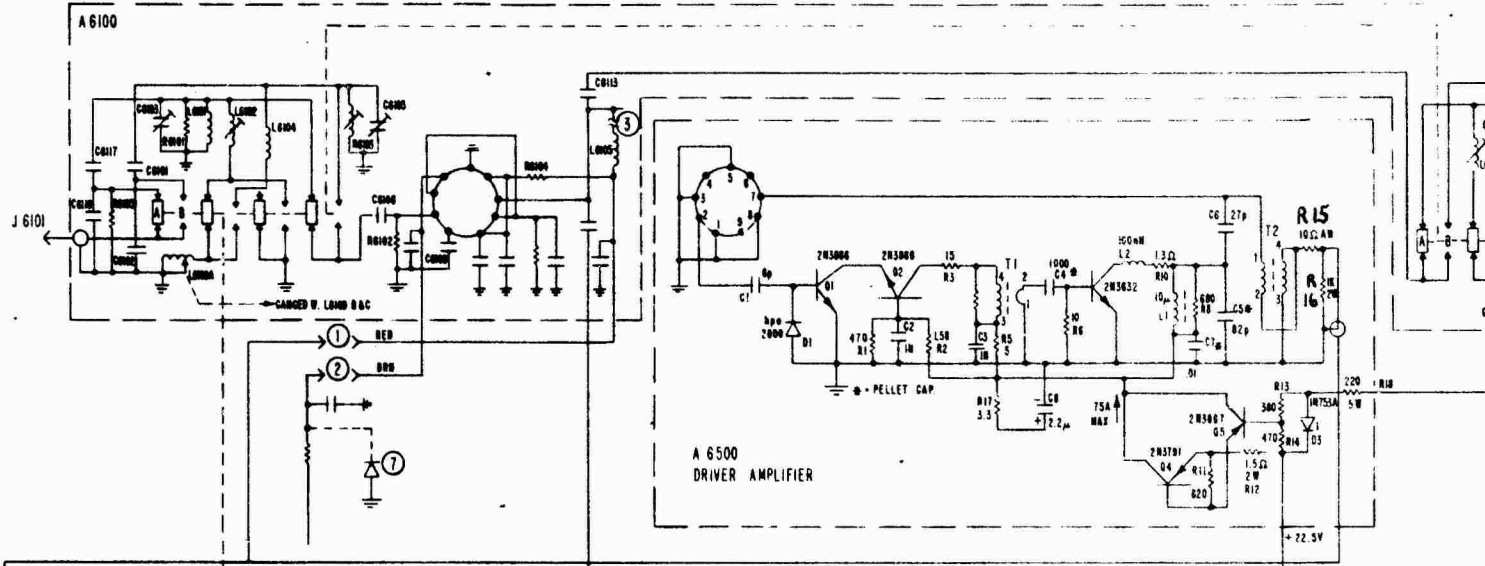
3. Miscellaneous: The fan is turned on only if thermostat S6201 closes. This happens if the temperature on the main heat sink rises above 70°C. The power supply changes (Module A9000) are the same as described in report ECOM 2836. Essentially, the dc to dc converters are disabled. The 400 Hz, 115 Vac power supply is kept as is. However, it is recommended that the Germanium switching transistors, Q9401 and Q9402 be replaced by silicon types on module A9400. Retaining this power supply also allows the modifications to be used in the RT-246 for automatic tuning.

4. Basic Electrical Performance of entire setup. Figure 40 shows output power vs. frequency for the entire radio at 25.5 V.d.c. power supply voltage. As can be seen, the output power falls slightly below the minimum specification at some points. The driver output power and the matching of the final stage need some additional work. The same is true for the ALC circuit.

The noise performance is shown in Figure 41. For a dial setting of 40 MHz, at +10 MHz off carrier, the carrier-to-noise ratio in a 30 kHz bandwidth was measured to be 143 to 145 dB; at 60 MHz dial setting, it was 145 to 147 dB. This shows that the design meets the requirements for retransmission.

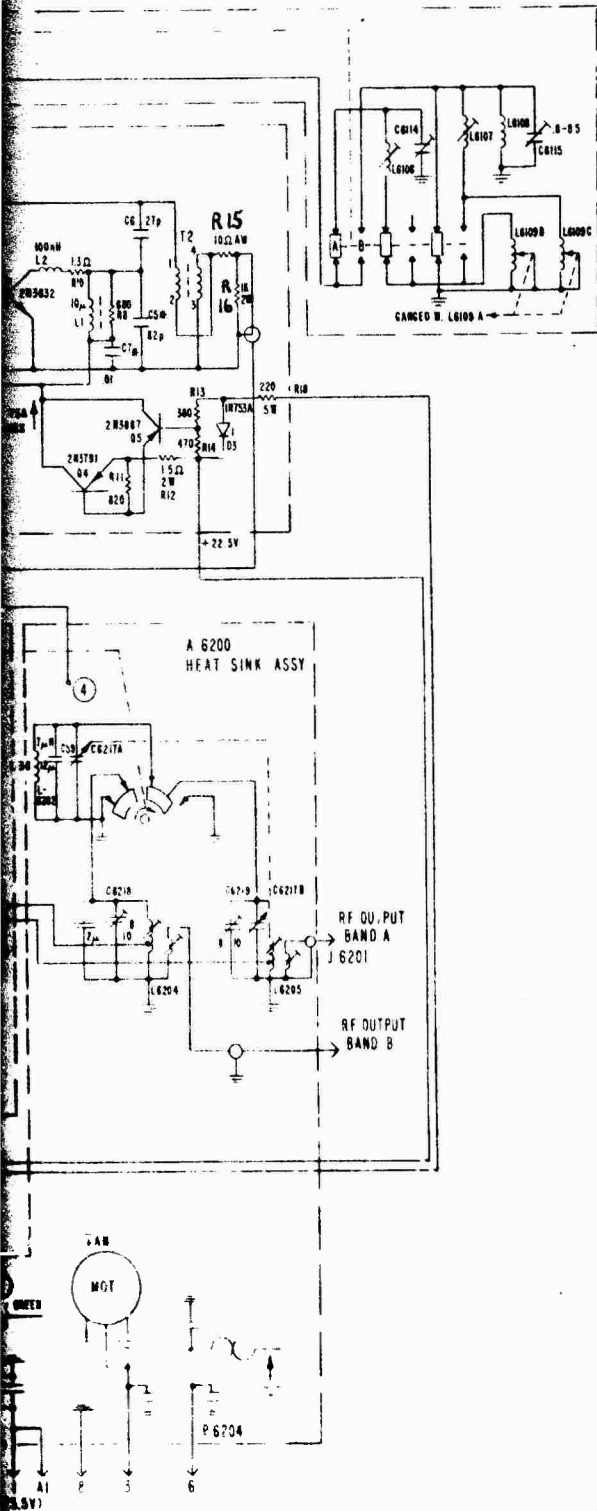
Figure 42 shows a measurement of Back Intermodulation. Significant improvement over broadband designs was obtained. Curves in Figure 43 display harmonic suppression. In the high band, the 60 dB harmonic suppression is not quite met. However, the sum of the attenuations should exceed 60 dB. Improved shielding and grounding may eliminate this problem. Apparently, the fourth harmonic leaks past the filter.

5. Conclusions: The scheme of replacing the transmitter tubes in the RT-524 and RT-246 by transistor inserts appears technically feasible. Due to the minimum of changes required in the rest of the radio, and maximum use of components present in the radio, retrofiting will be economically attractive.



- NOTES: ①, ②, ③, ⑥ DISCONNECT RESPECTIVE PLUGS.
 ③ ELIMINATE CHOKE
 ④ REMOVE SOCKET OF V6201, LEAVE FEED THRU PINDING POST IN PLACE
 ⑦ REMOVE DIODE.

FIG 1



ITEM NO.	QTY REQD.	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION NO.
PARTS LIST				
			<small>U. S. ARMY ELECTRONICS COMMAND RESEARCH AND DEVELOPMENT LABORATORIES FORT MONMOUTH NEW JERSEY 07703</small>	
			DRIVER & POWER AMPLIFIER FOR RT 524/RT 246 TRANSISTOR PLUG-IN MODULES A655C & A6600	
AUTHENTICATION				
DRAWN		PERKINS		
CHECKED				
NEXT ASSY		USED ON		
APPLICATION				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES		APPROVED		DATE
		DATE		17 SEP 75
		SIZE	CODE IDENT NO.	
		D	20309	
		SCALE		
				SHEET

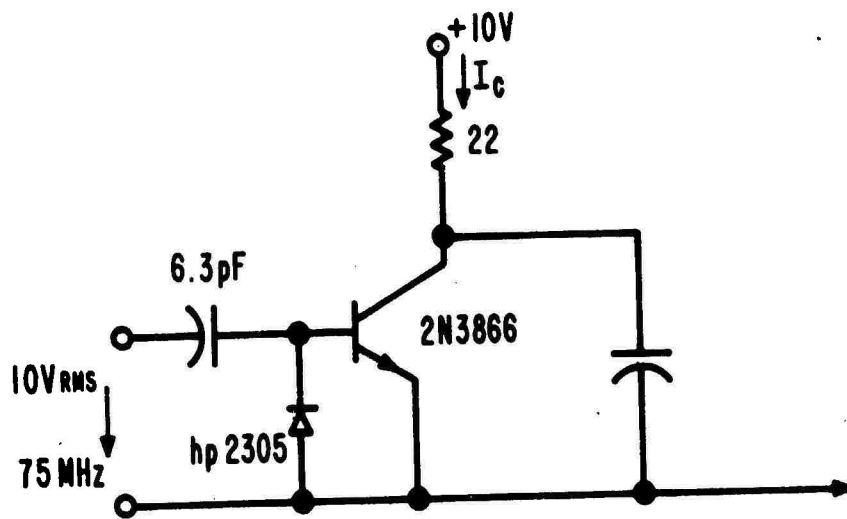
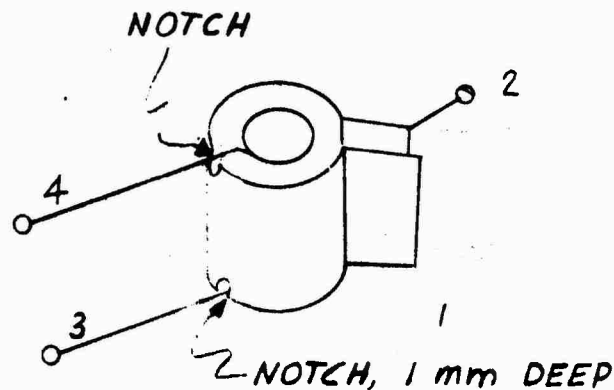


FIG. 2. TEST SETUP



PRIMARY:

6 TURNS #22 mW, FORMVAR. WIND ON $\frac{1}{4}$ " DIA ROD, DIRECTION AS SHOWN, WINDING BESIDE WINDING. PRESENT SPRING-UP, APPLY THIN SHEET OF EASY POXY, LET SET.

SECONDARY:

1 TURN OF COPPER SHEET METAL, 4.5mm WIDE, 5-10MIL THICK. GLUE ONTO PRIMARY WITH EASY POXY.

CORE:

CUP CORE B65541-K-0020-A012

MAT. : 20K12

MEASURE WITH BOONTON RX METER 250A :

$C_p = 15.5 \mu\text{F}$, $R_p = 26 \text{K}\Omega$ @ 50MHz, SEC. OPEN

$C_p = 6.5 \mu\text{F}$, $R_p = 9.4 \text{K}\Omega$ @ 75MHz, SEC. OPEN

$C_p = 65 \mu\text{F}$, $R_p = 2.8 \text{K}\Omega$ @ 50MHz, SEC. SHORT

FIG.3 TRANSFORMER T1 IN DRIVE AMPLIFIER.

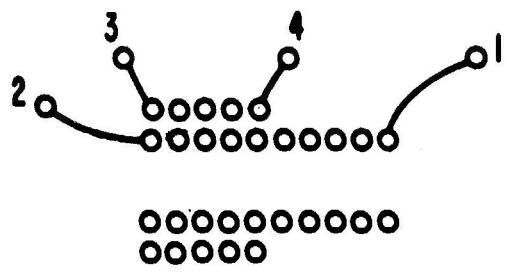
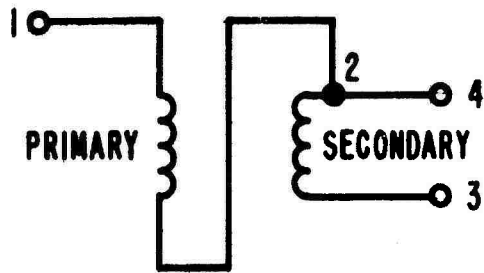


FIG. 4 TRANSFORMER T2 WITH DRIVER

MEASURE WITH BOONTON RX METER 250A

PRIMARY:

f [MHz]	C _p [pF]	R _p [kΩ]	
9	50.3	37	} SEC. OPEN
21	7.3	100	
40	.2	200	
40	24.8	3.4	

SECONDARY:

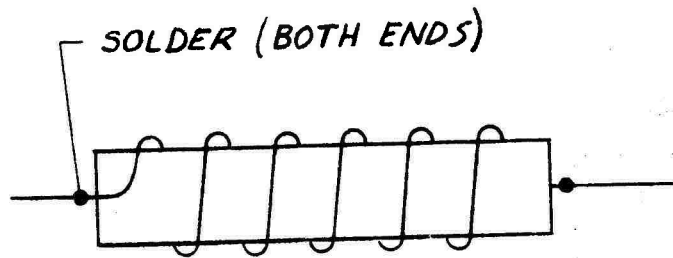
f [MHz]	C _p [pF]	R _p [kΩ]	
21	85	3	PRIM. OPEN
75	72	.52	PRIM. SHORT

TRANSFORMER MATCHED WITH 50Ω AT OUTPUT

INPUT IMPEDANCE:

f [MHz]	C _p [pF]	R _p [Ω]
30	4.7	980
50	1	990
75	0	960

FIG. 4 CONTD.



INDUCTOR { 47K Ω
 FORM { 1/2 WATT

L2 { 5 1/2 TURNS ON 47K Ω
 { 1/2 WATT RESISTOR

WIRE USED - RESISTIVE WIRE 20 Ω /FT
 6 STRANDS IN PARALLEL, EACH 5" LONG
 WOUND ON A HIGH VALUE 1/2 WATT RESISTOR

FIG 5 COMBINATION L2 AND R10

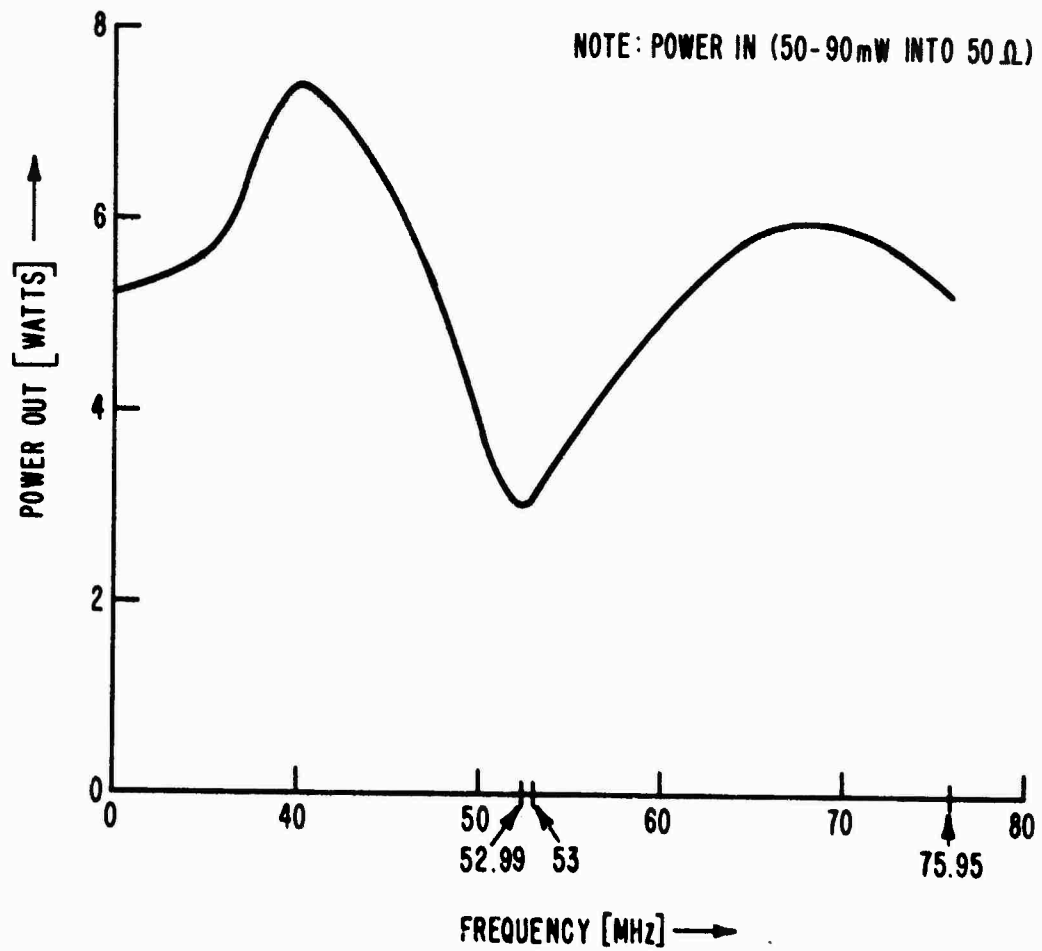


FIG.6 POWER OUT VS FREQUENCY FOR RF DRIVE

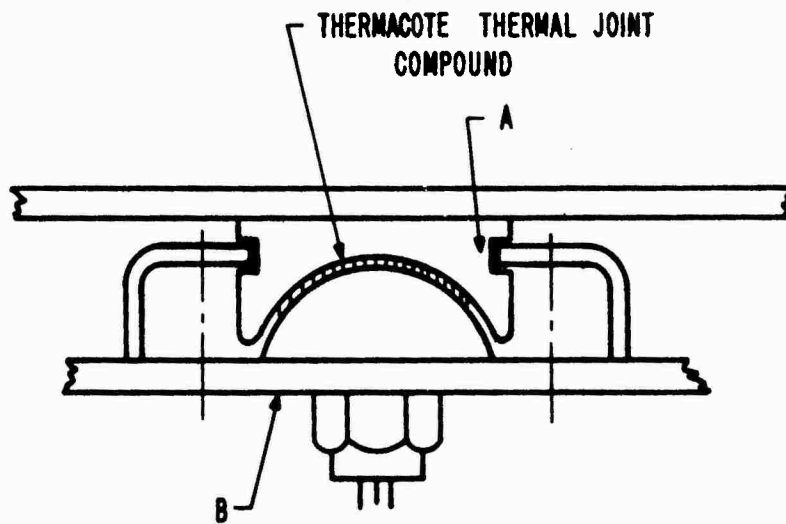
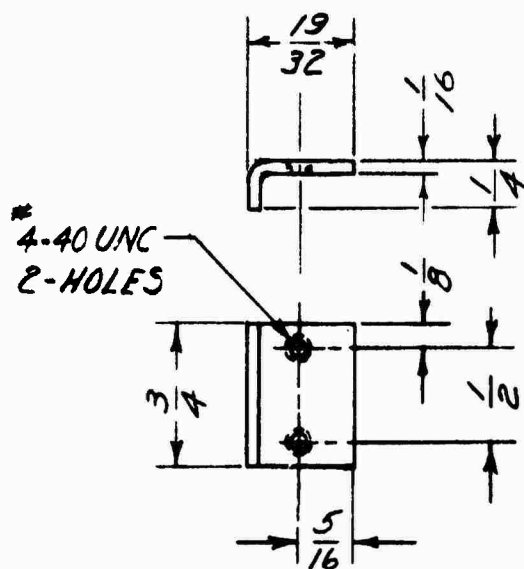
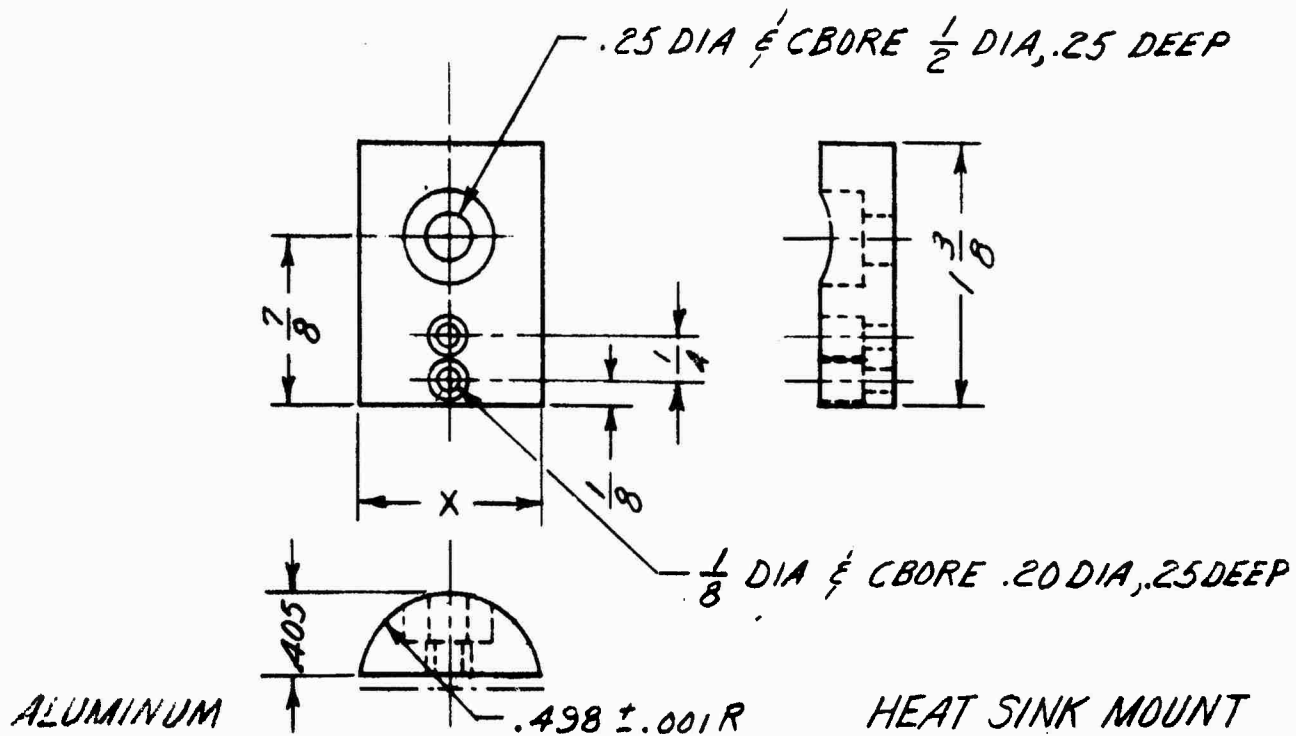
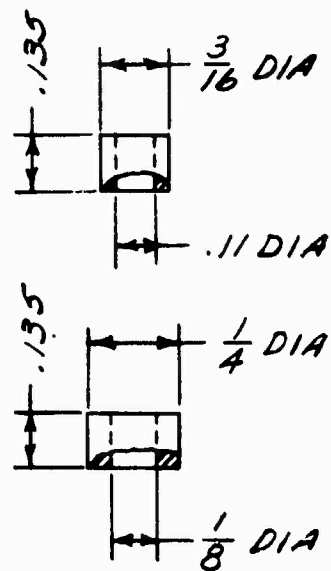


FIG. 7 HEAT TRANSFER OF DRIVER

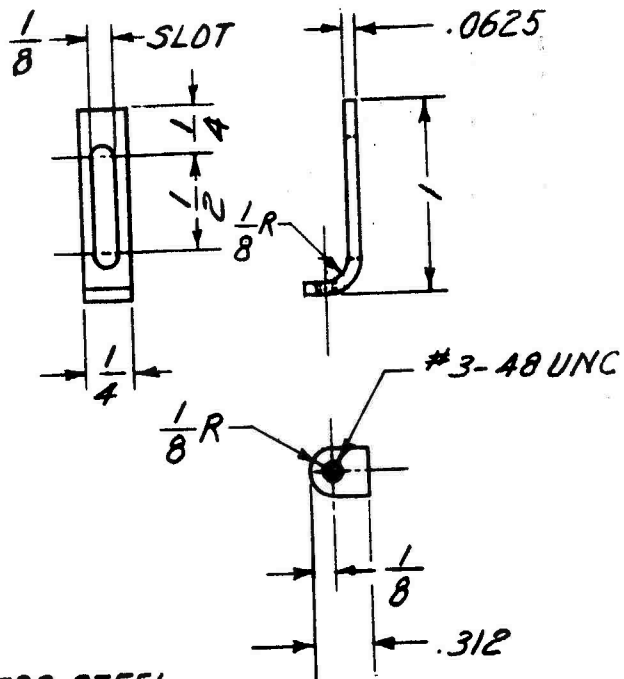


SCALE: 2/1

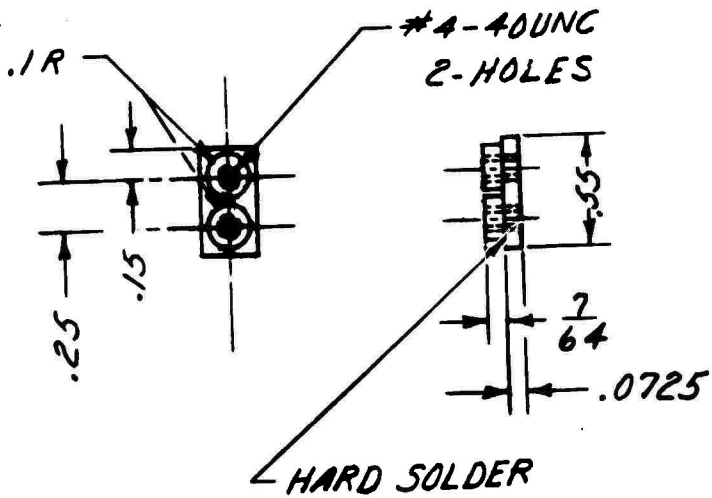


SCALE: 2/1

FIG. 8

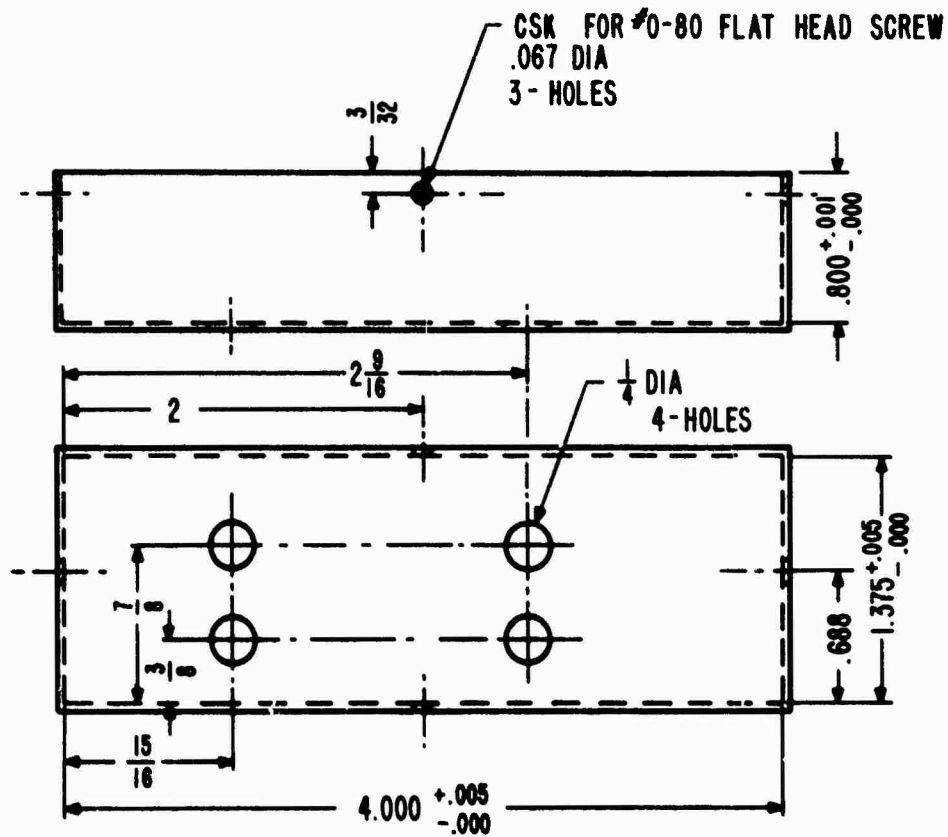


STAINLESS STEEL



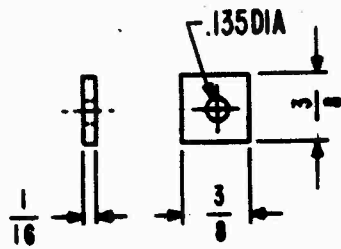
BRASS

FIG. 9. SOCKET ADAPTER

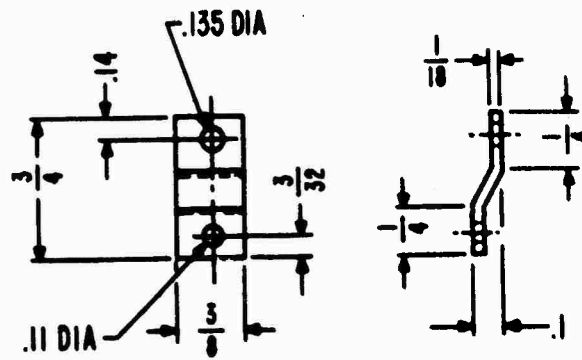


MATL. : ALUMINUM OR BRASS, .0209 THICK, #25 STD GAGE

FIG. 10 COVER, PREDRIVER & DRIVER AMPLIFIER RT/524 A



INSULATOR,
MATERIAL: BeO



MATL: ALUMINUM

FIG. 11 TRANSISTOR HOLDER

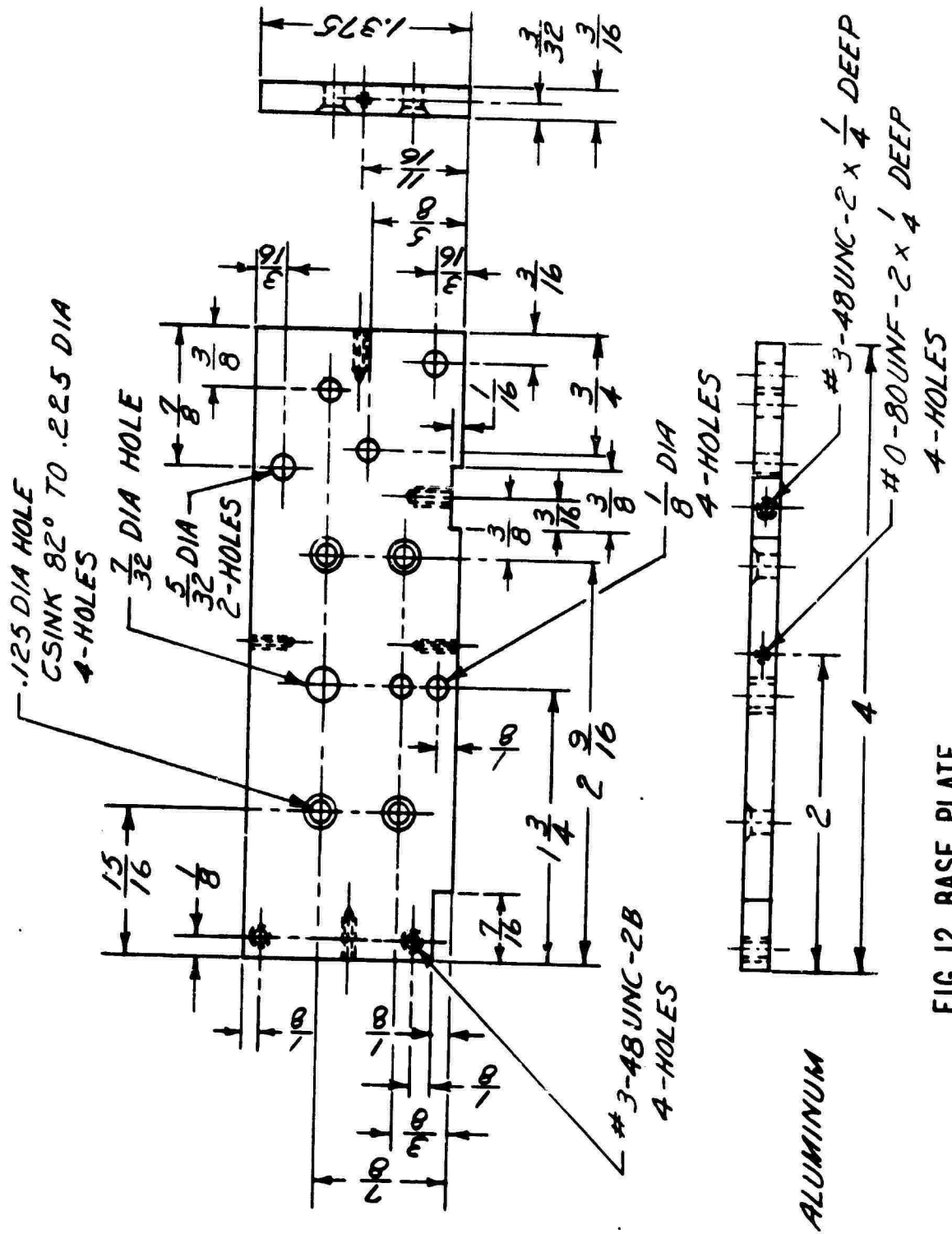


FIG. 12 BASE PLATE

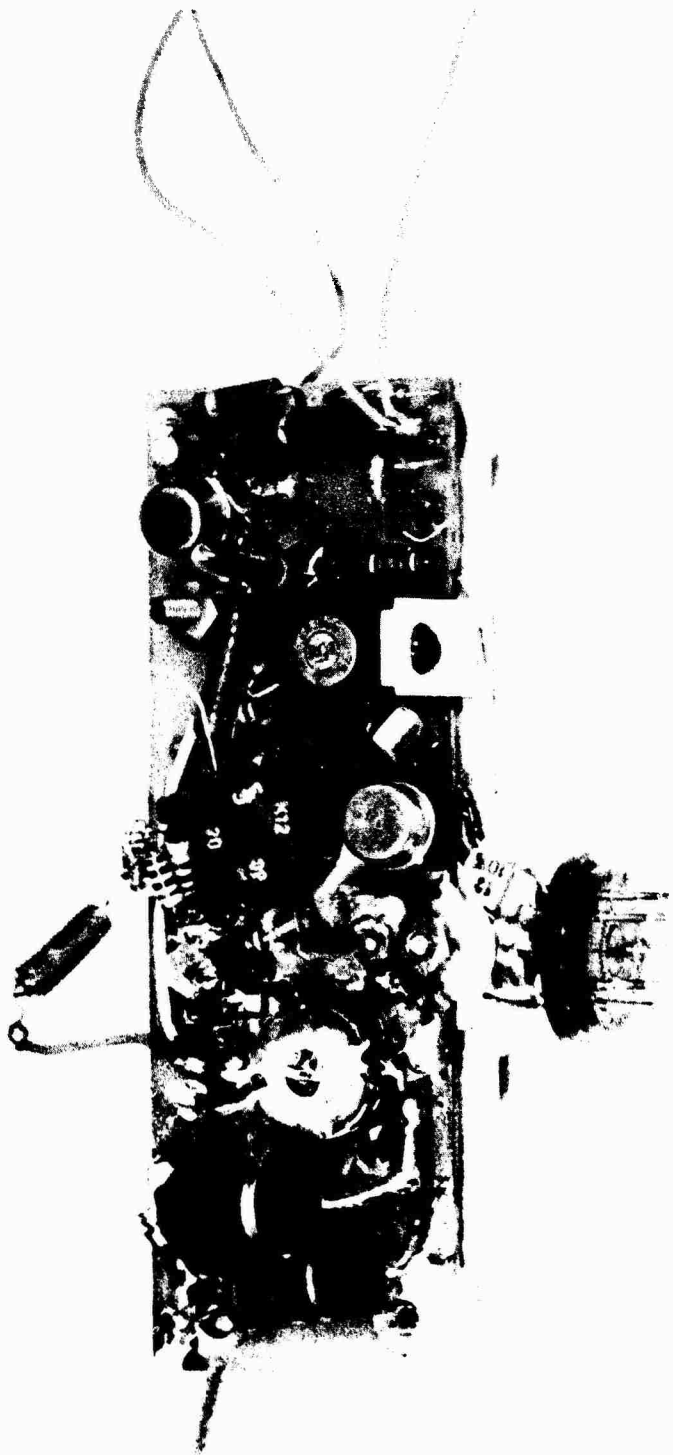


FIG. 13 DRIVER ASSEMBLY

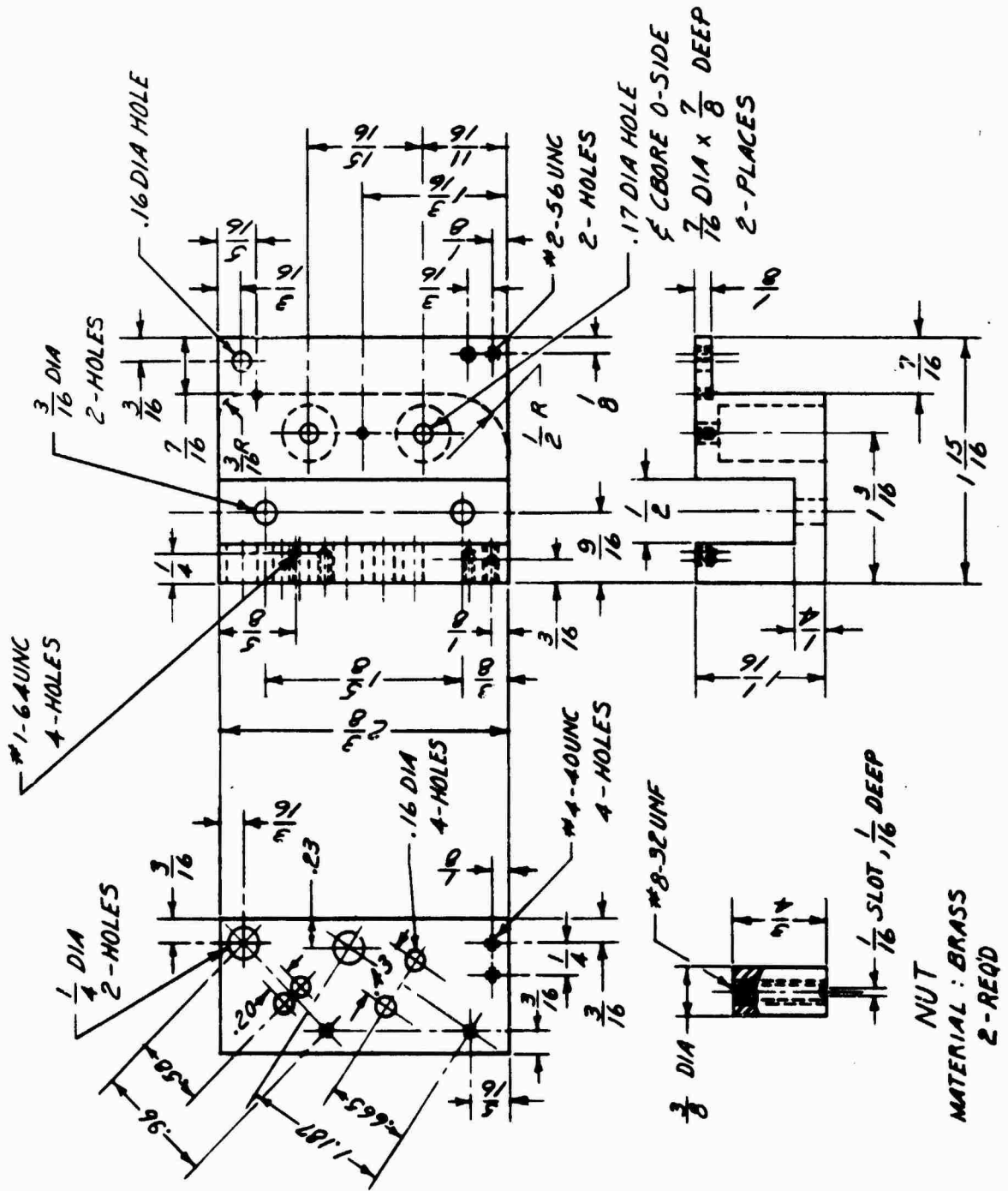


FIG. 14. TRANSISTOR MOUNT FOR P.A. INSERT FOR P.A. RT524/VRC12. MAT.: AL

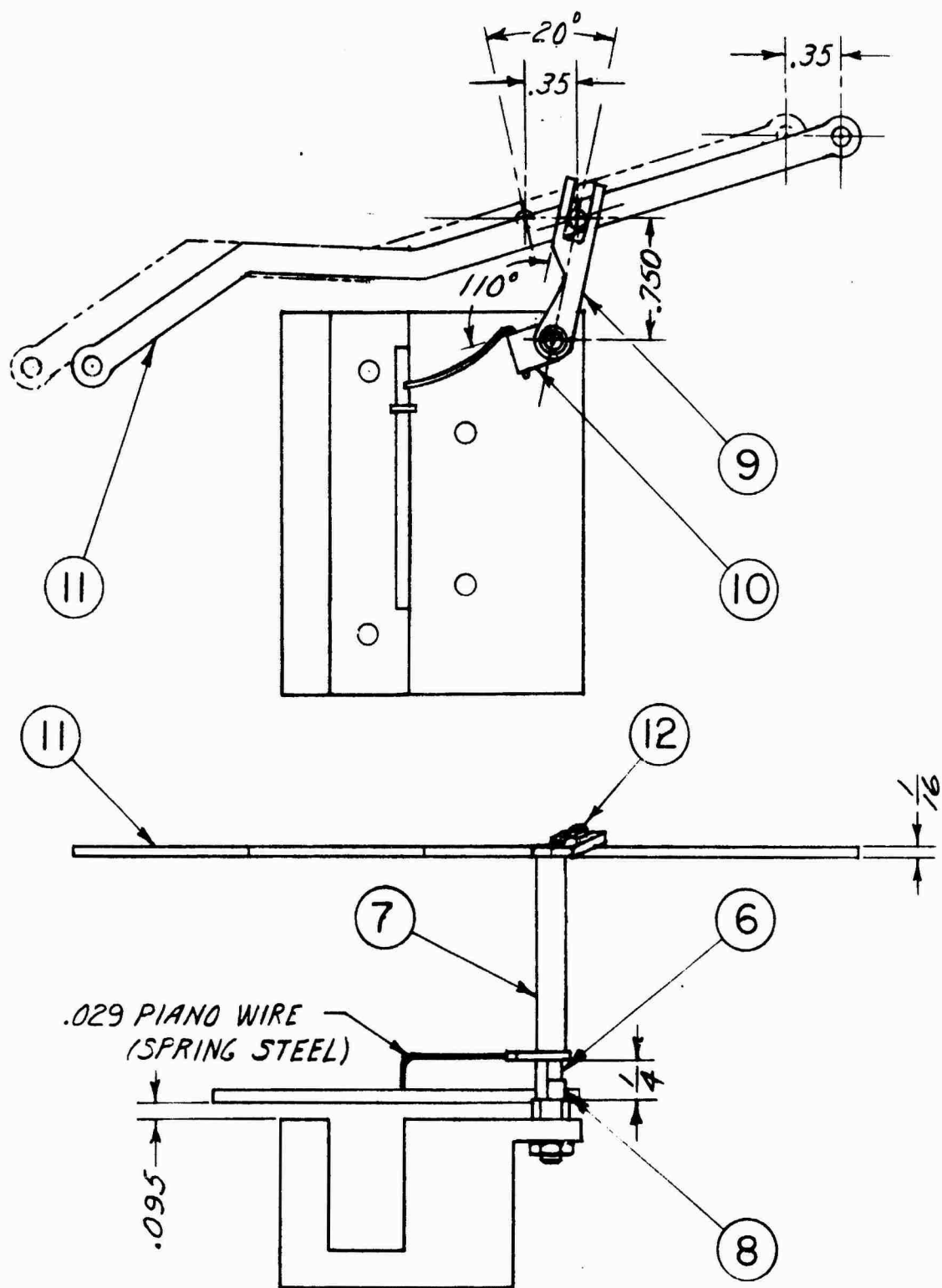
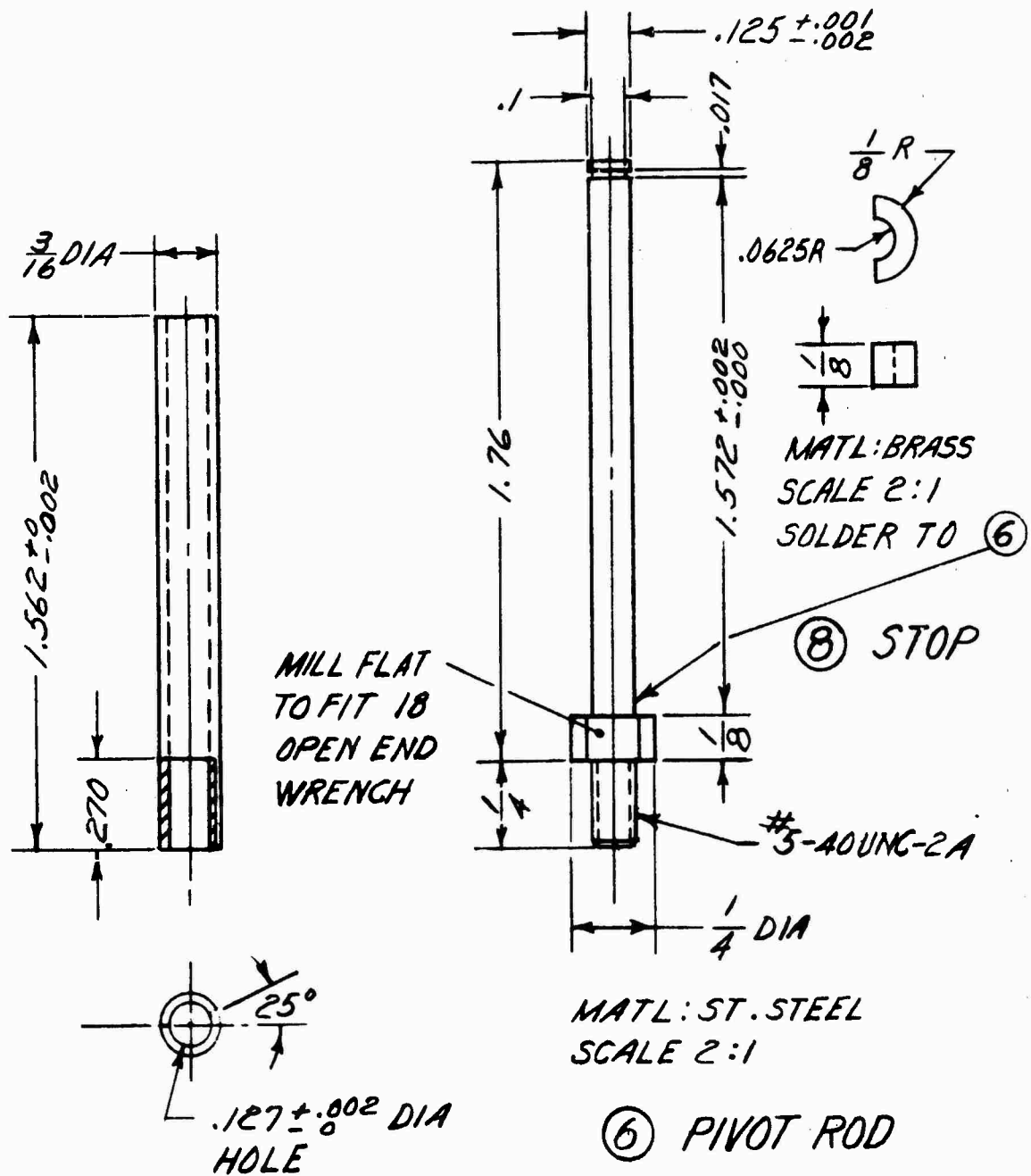


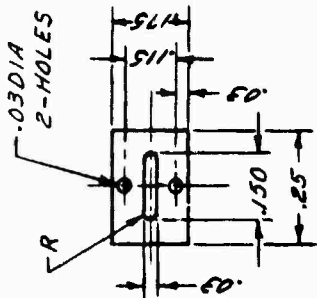
FIG.15. PA RT524 TRANSISTOR VERSION



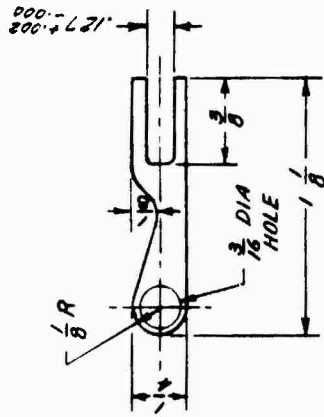
MATL: BRASS
 SCALE 2:1

(7) PIVOT PIPE

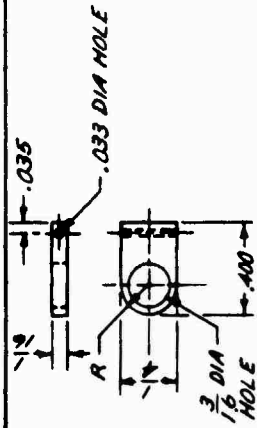
FIG. 16



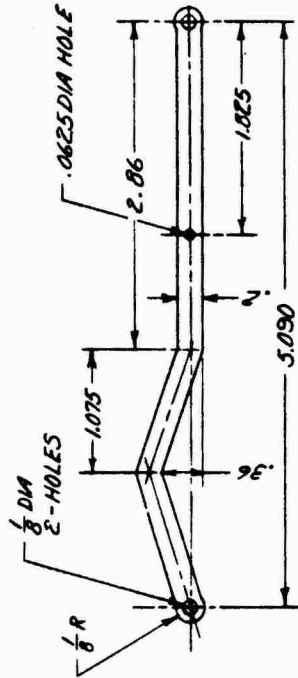
⑤ **ACTIVATOR**
 MATL: DELRIN, .1 THK.
 SCALE 4:1



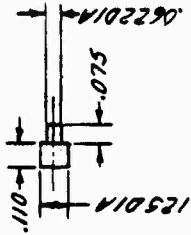
⑨ **TOP LEVER**
 MATL: BRASS, 1/16 THK.
 SOLDER ON TOP OF PIVOT PIPE ⑦
 SCALE 2:1



⑩ **BOTTOM LEVER**
 MATL: BRASS
 SCALE 2:1
 SOLDER ON BOTTOM OF PIVOT PIPE ⑦

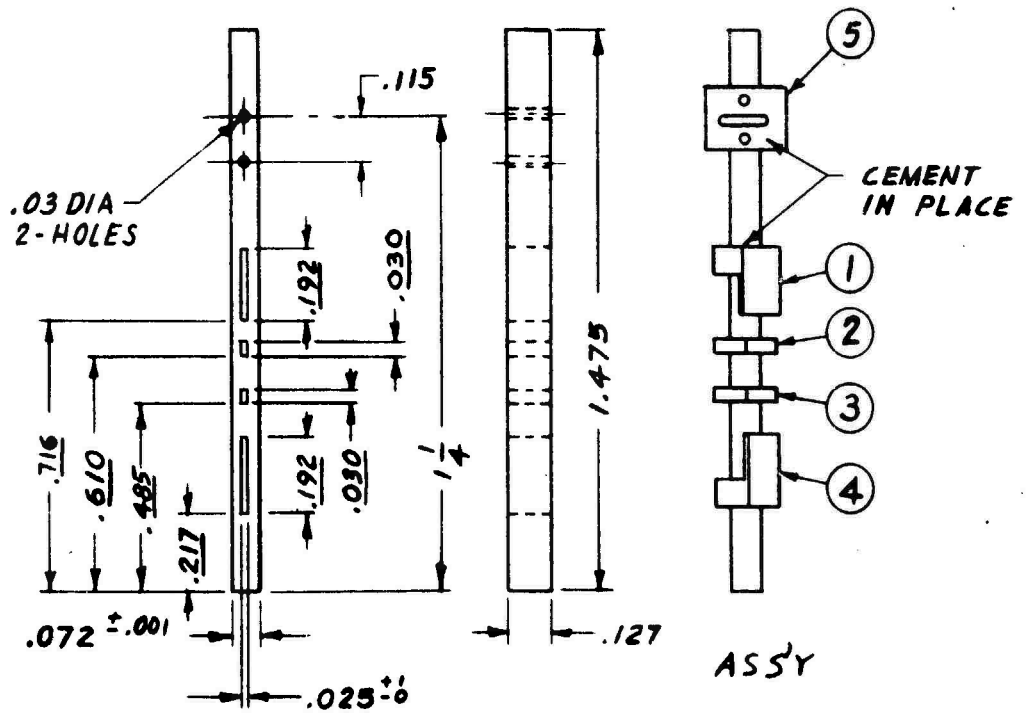
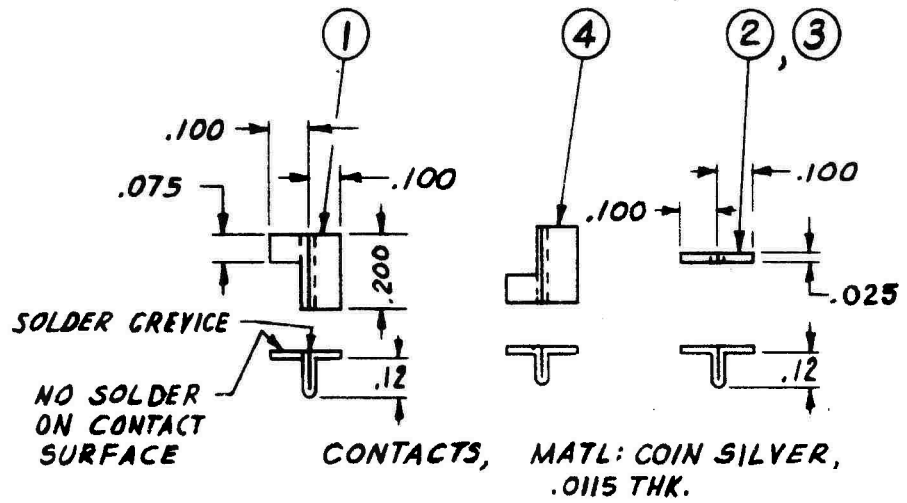


⑪ **SWITCH LEVER**
 MATL: STAINLESS STEEL, 1/16 THK
 SCALE 1:1



⑫ **RIVET ON SWITCH LEVER ⑪**
 MATL: STEEL
 SCALE 4:1

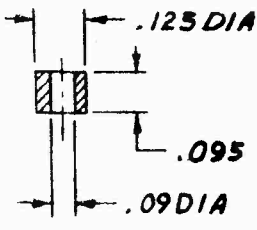
FIG.17



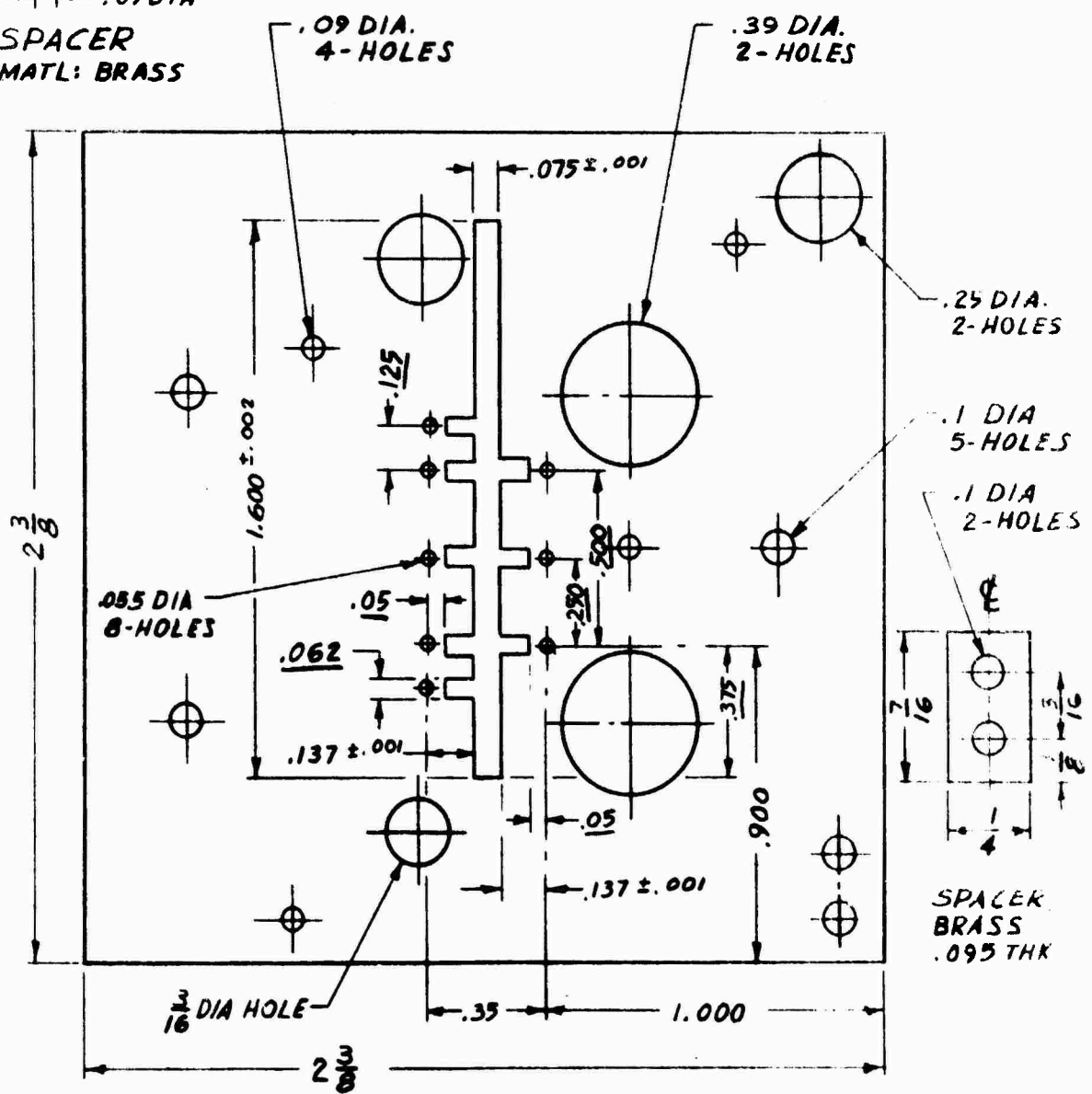
NOTE: ALL UNDERLINED DIMENSIONS ±.002

SWITCH LEVER
MATL: DELRIN

FIG 18

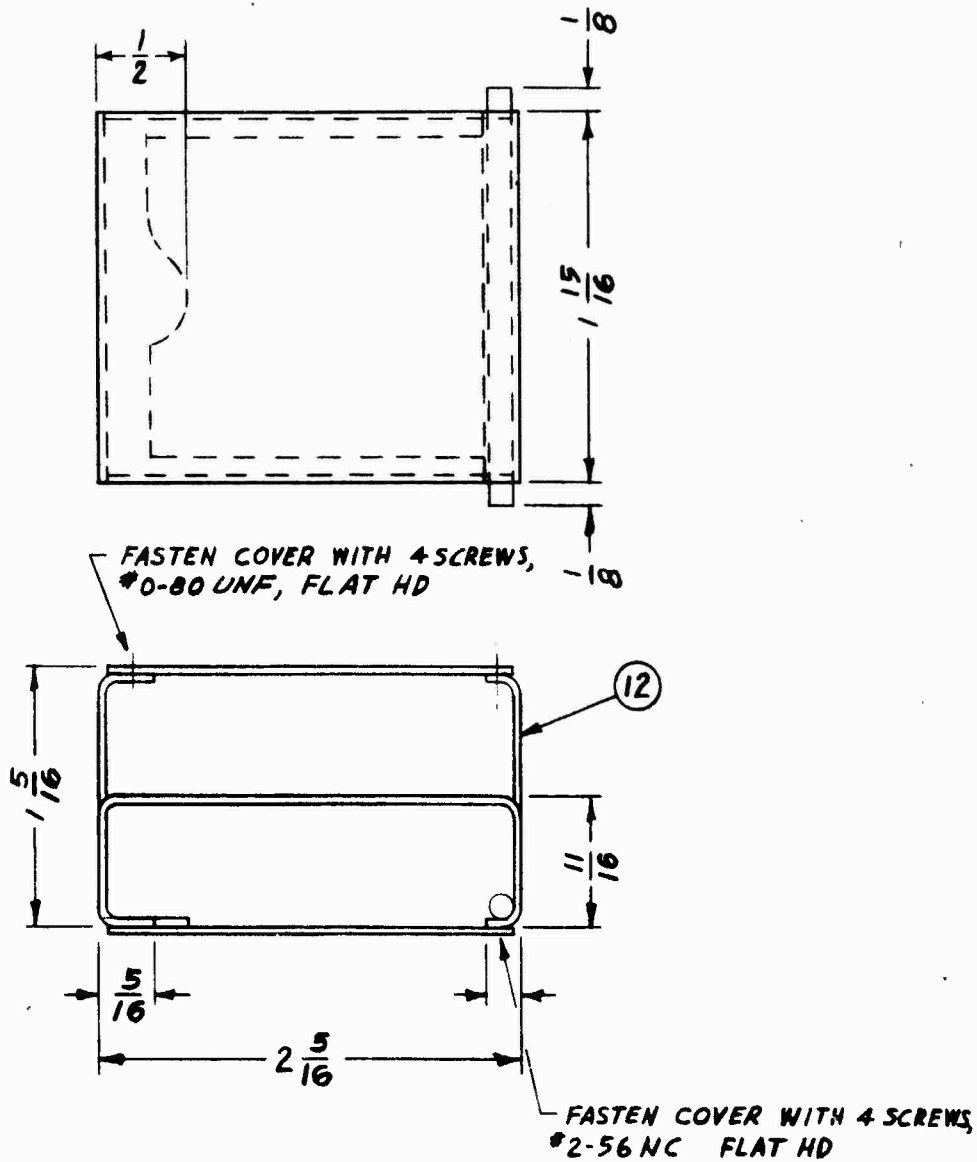


SPACER
MATL: BRASS



NOTE: ALL UNDERLINED DIMENSIONS, ±.002

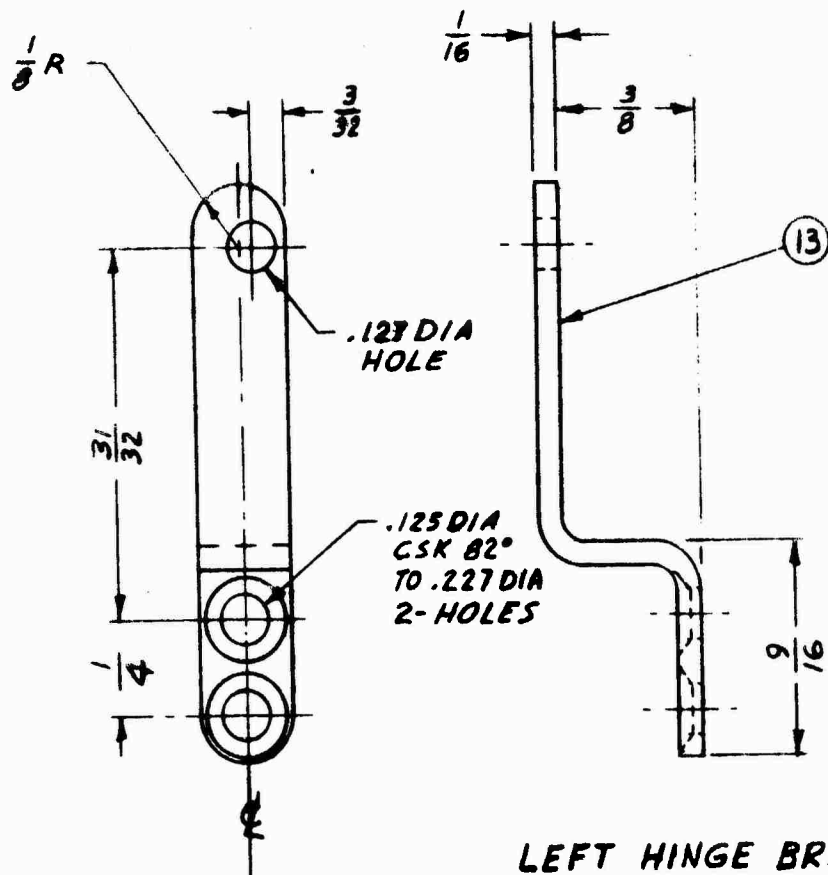
P. C. BOARD, 1/16 THK
P.A. RT524/VRC 12
FIG 19



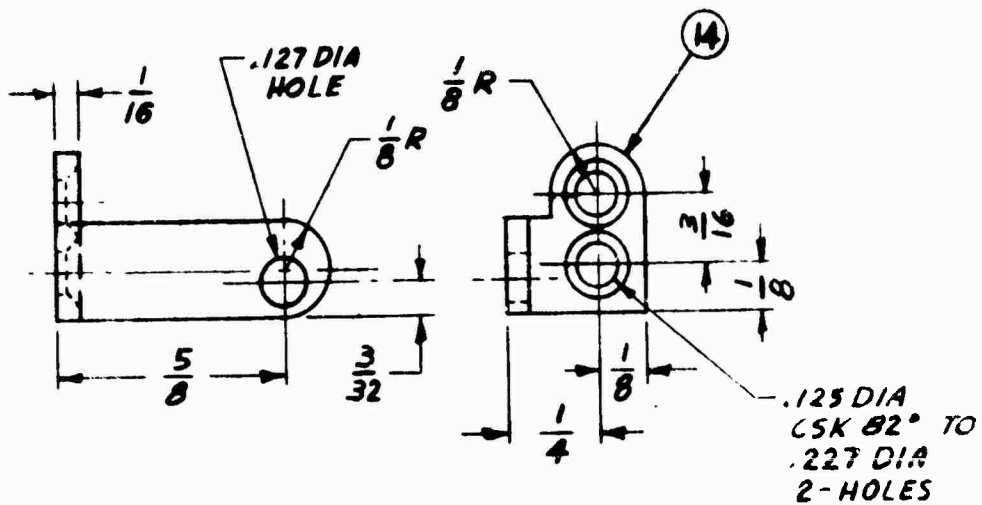
MATL: BRASS, .035 THK.

FILTER, REGULATOR &
VSWR DET. HOUSING

FIG 20

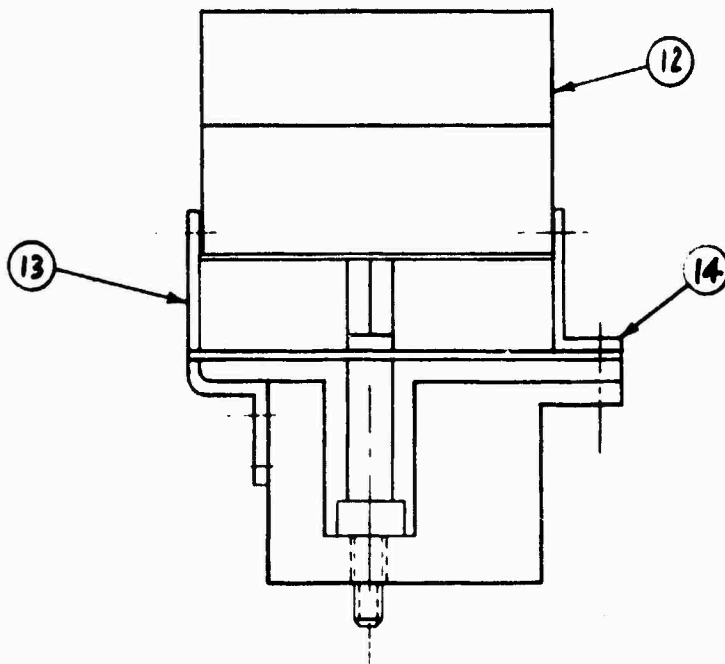
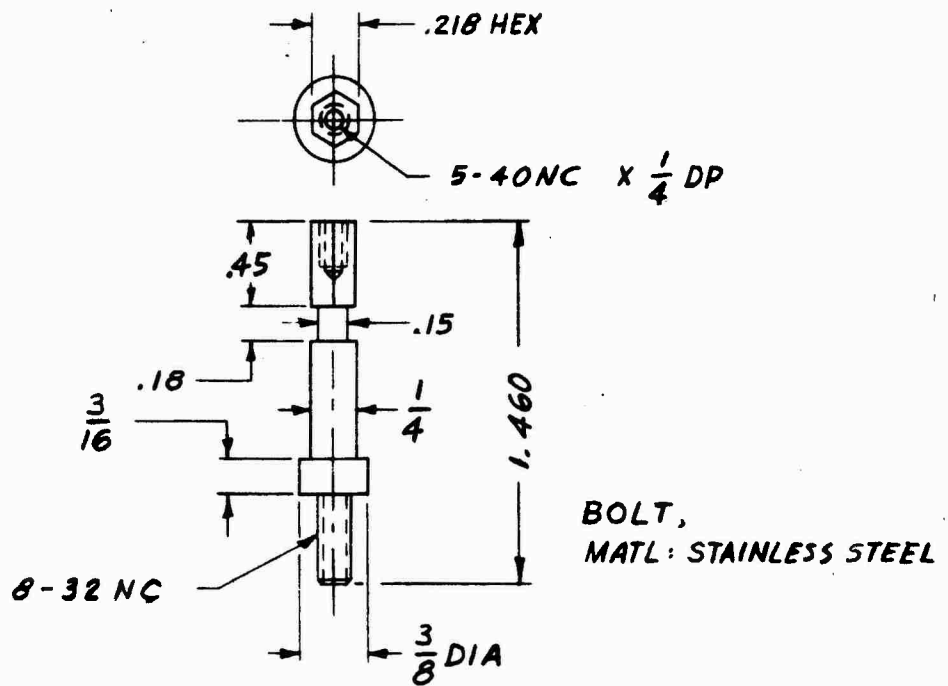


LEFT HINGE BRACKET
MATL: STEEL



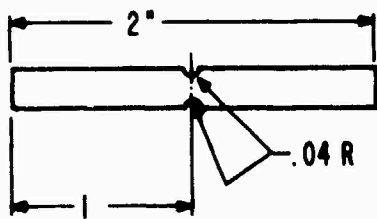
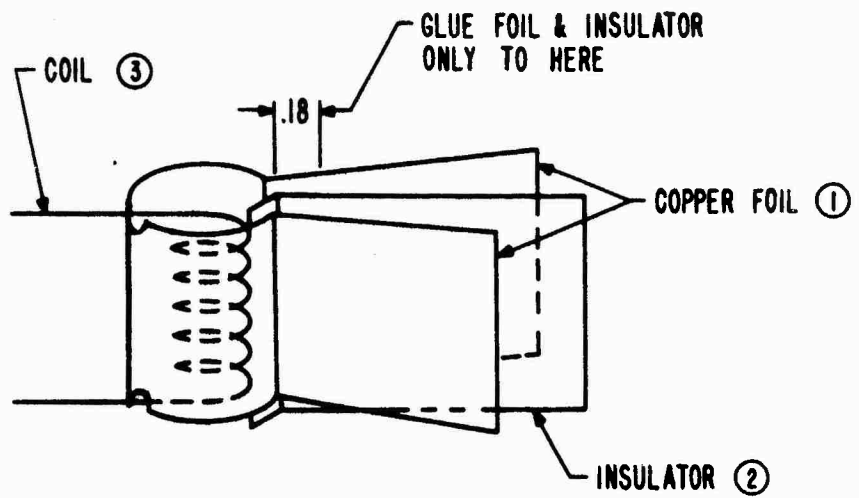
RIGHT HINGE BRACKET
MATL: STEEL

FIG 21

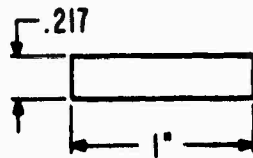


ASSEMBLY

FIG 22



① COPPER FOIL, .005 THICK



② INSULATOR, PAPER .003 THICK

FIG 23 TRANSFORMER T3 OR T4

NAME	TITLE	DWG. NO.
	INPUT IMPEDANCE 2N5643, UNDER LOAD	24
SMITH CHART FORM 5301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

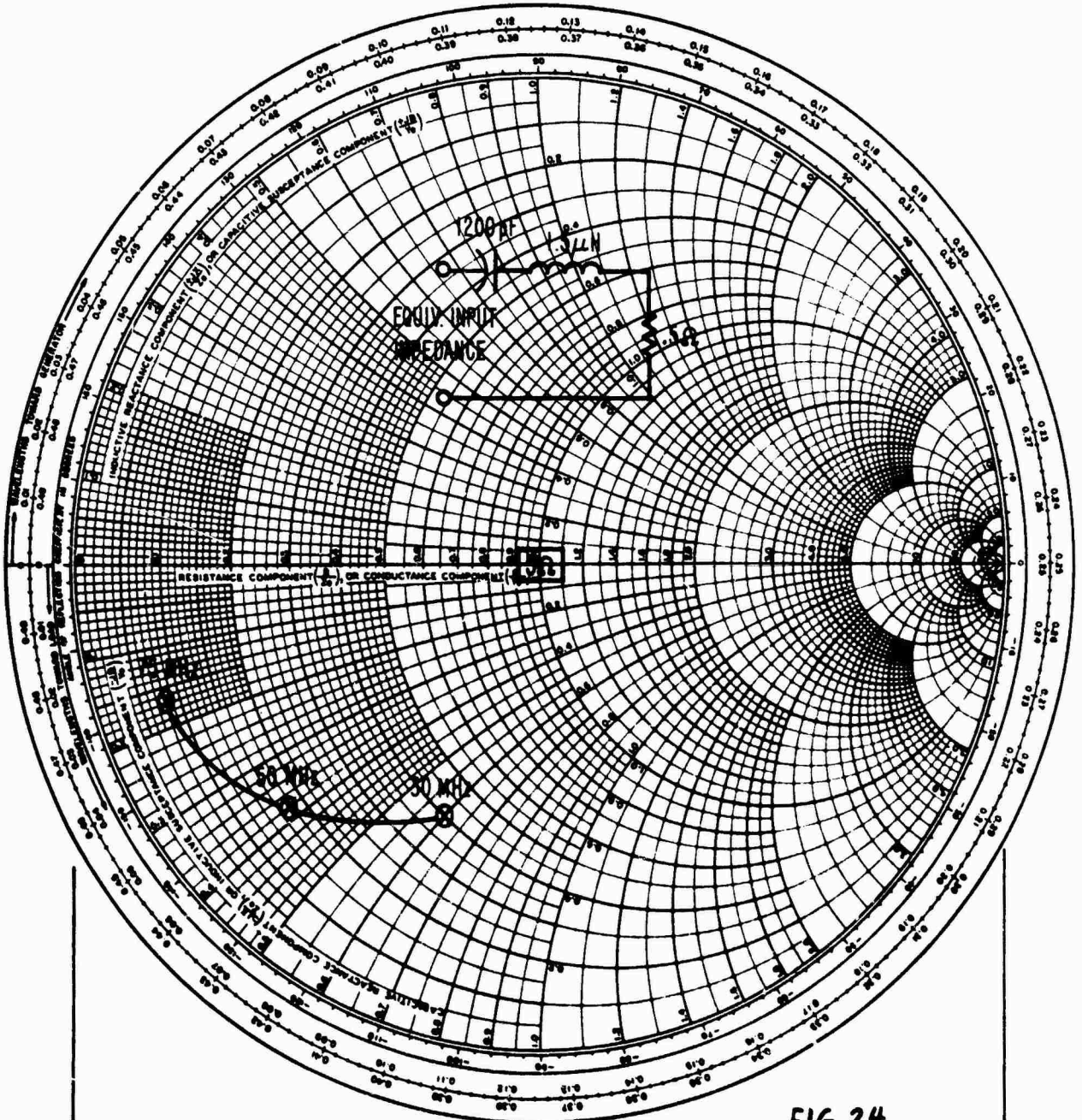
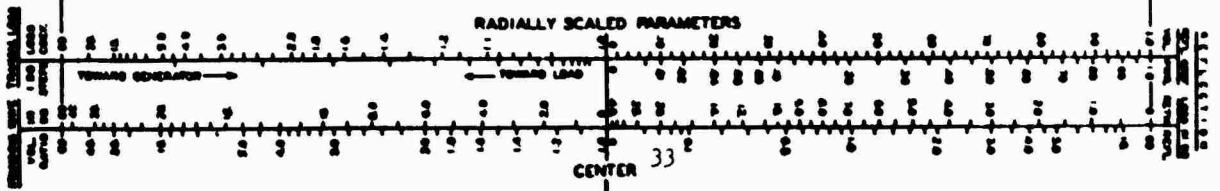


FIG 24



NAME	TITLE	DWG. NO.
	INPUT IMPEDANCE OF P. A., ONE SIDE	25
SMITH CHART FORM 3301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

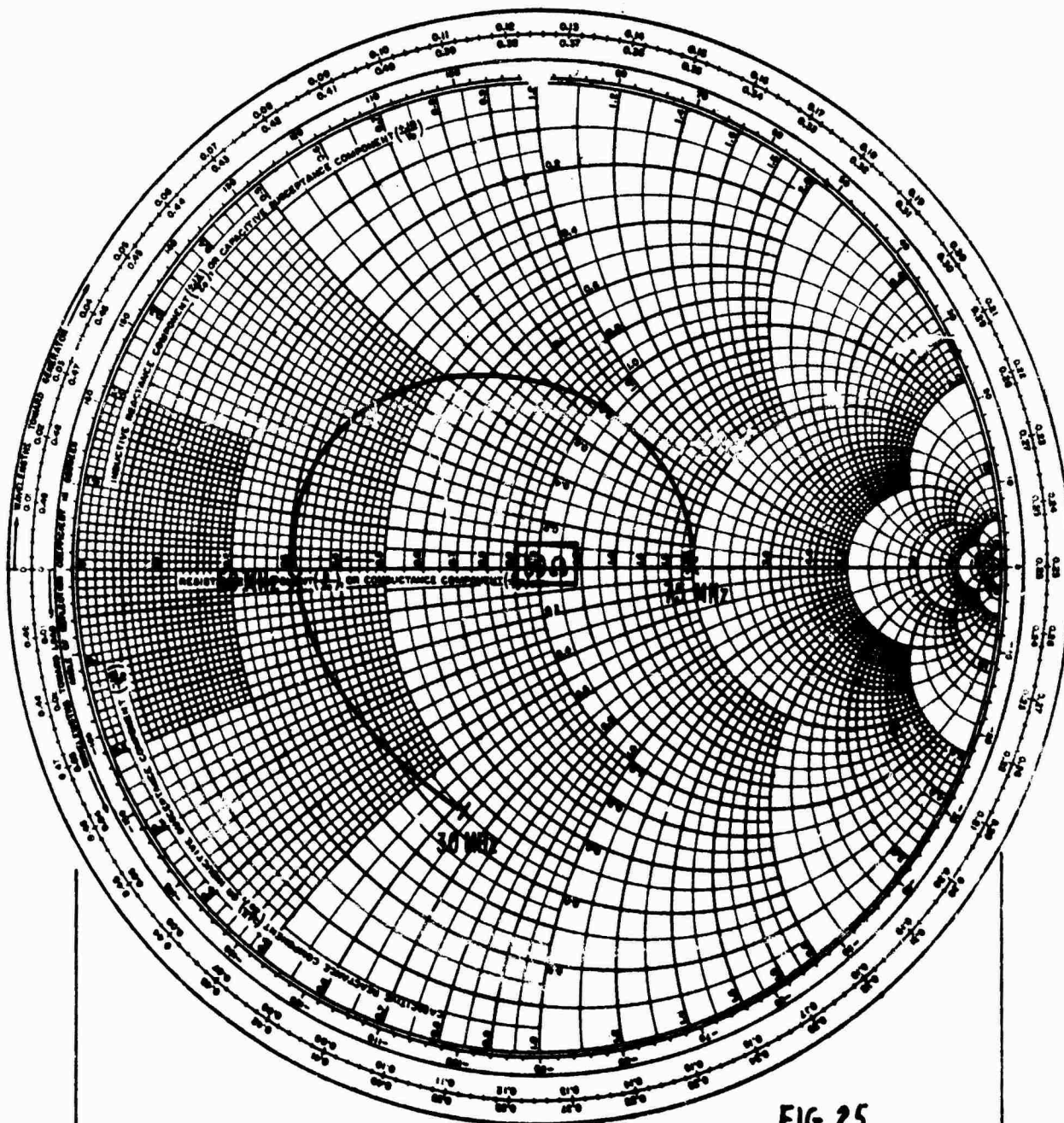
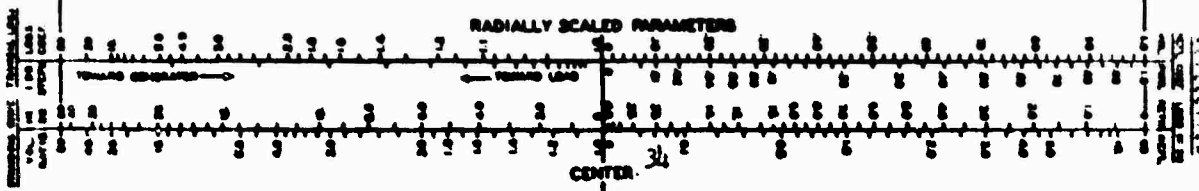
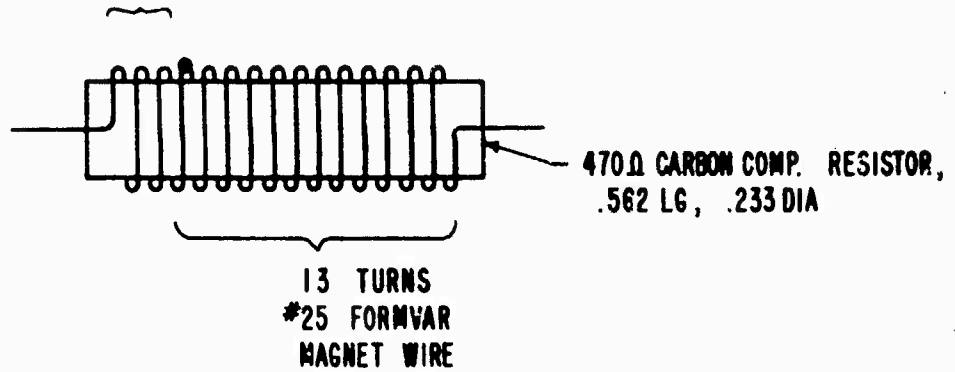


FIG 25



3 TURNS RESISTANCE WIRE, .035 DIA, .5Ω/FT



COMBINATION L31 AND R34
OR L32 AND R36

FIG. 26 FEEDING CHOKE

NAME	TITLE MATCHING OF OUTPUT TRANSF. T5	DWG. NO.
SMITH CHART FORM 5301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

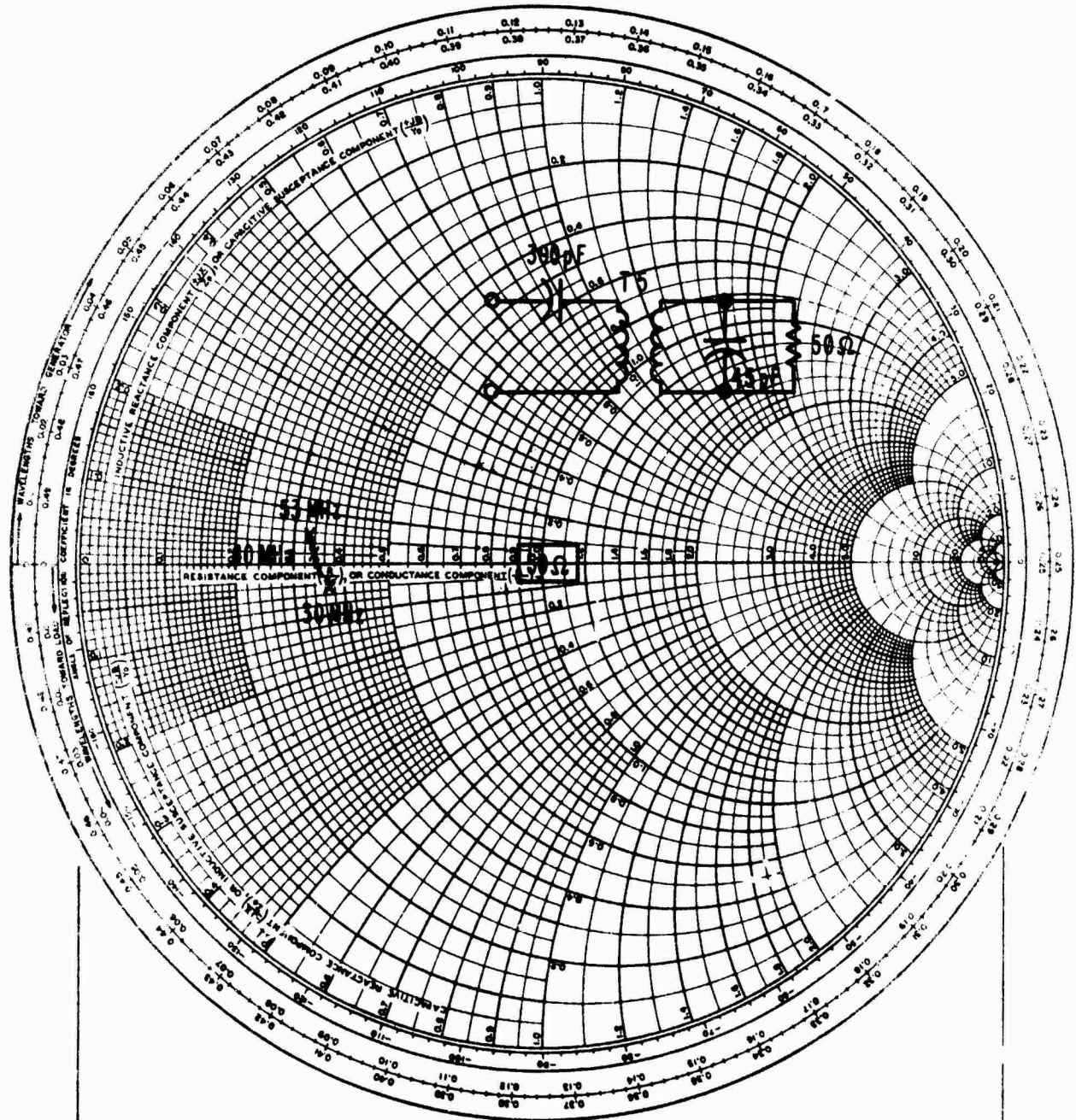
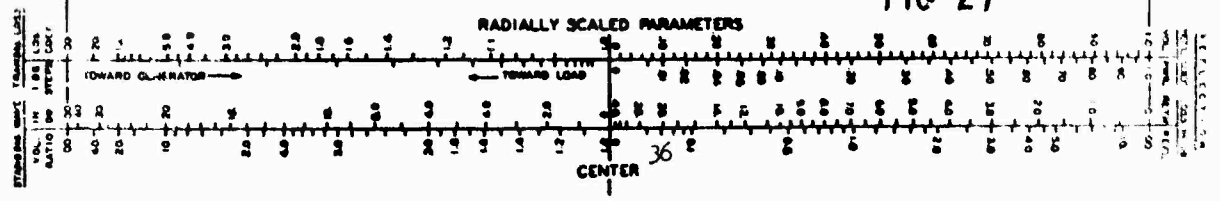
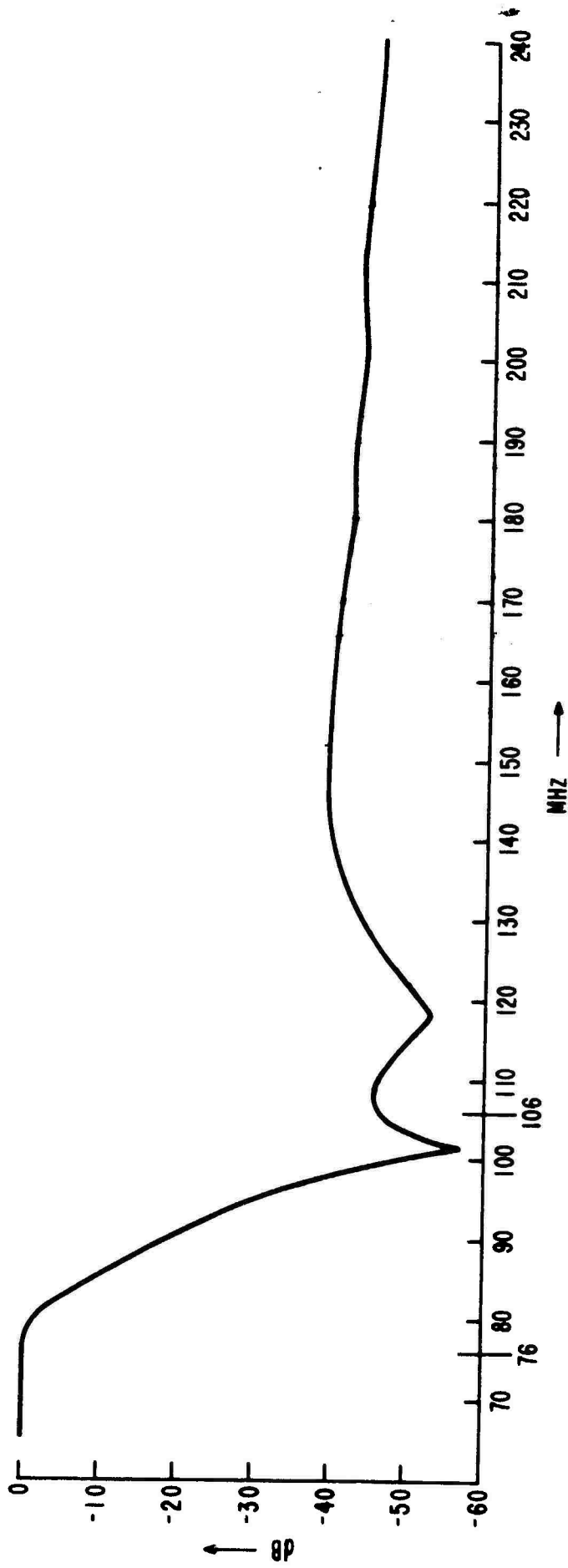


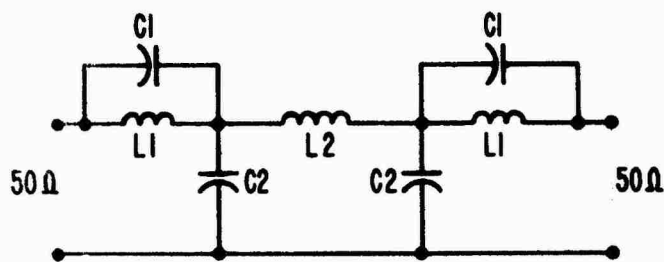
FIG 27





-0.1 dB AT 76 MHZ (REFERENCED AT 65 MHZ); INSERTION LOSS AT 65 MHZ - .3 dB; TOTAL LOSS AT 76 MHZ - .4 dB
 -46 dB AT 106 MHZ

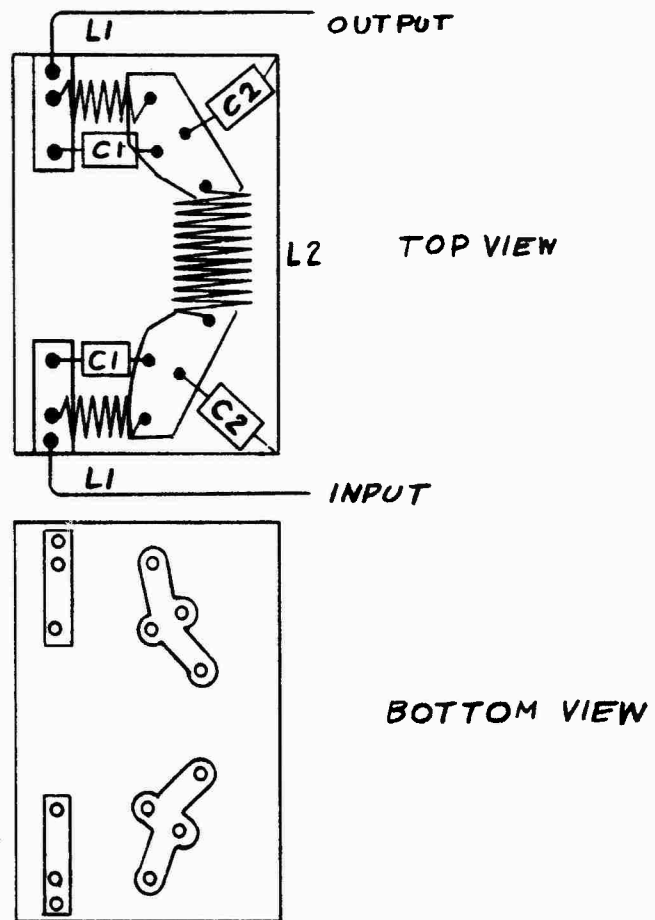
FIG. 28 MEASURED FILTER CHARACTERISTICS



	ACTUAL VALUES
C1	39 pf
C2	56 pf
C3	58nH
C4	192nH

58 nH 4 TURNS, #16 WIRE, INSIDE DIAMETER = 3/16"
 192 nH 8 TURNS, #16 WIRE, INSIDE DIAMETER = 1/4"
 (ALL CAPACITORS ARE MINIATURE GLASS TYPE, RATED AT 300VDC)

FIG. 29 VALUES OF FILTER COMPONENTS



BOARD LAYOUTS

FIG 30

NAME	TITLE	DWG. NO.
SMITH CHART FORM 5301-7560-N	INPUT IMPEDANCE OF TANK, L.B.	31
	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES LOAD SEEN BY P.A. TANK
 MATCHED WITH 50Ω LOAD
 J6201

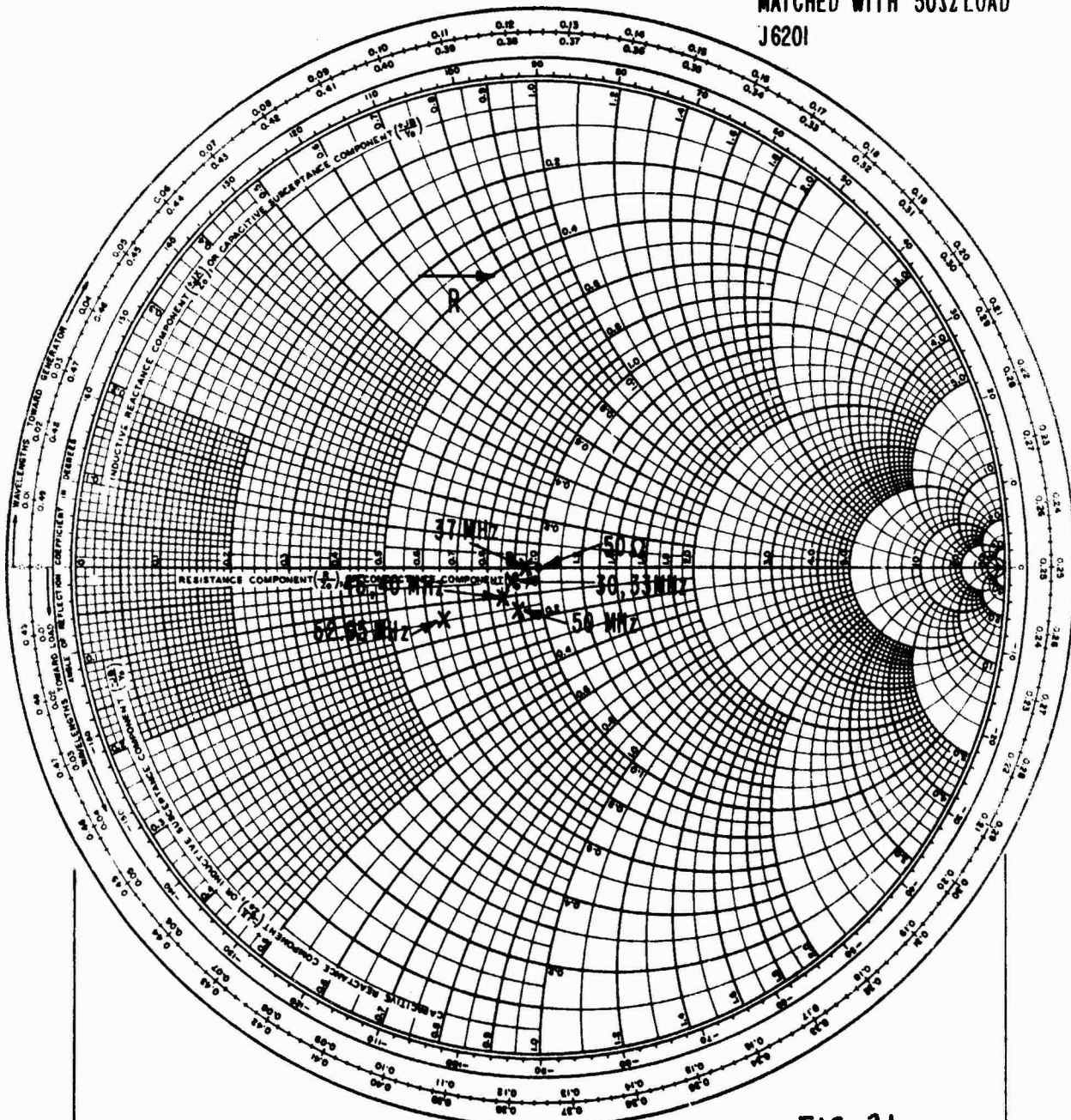
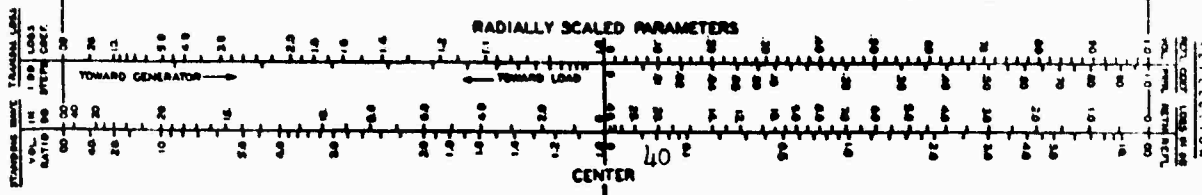


FIG 31



NAME	TITLE TANK INPUT IMPEDANCE VS FREQUENCY	DWG. NO. 33
SMITH CHART FORM 5301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

DIAL { 45 MHz X
37 MHz O
Z₀ = 50Ω

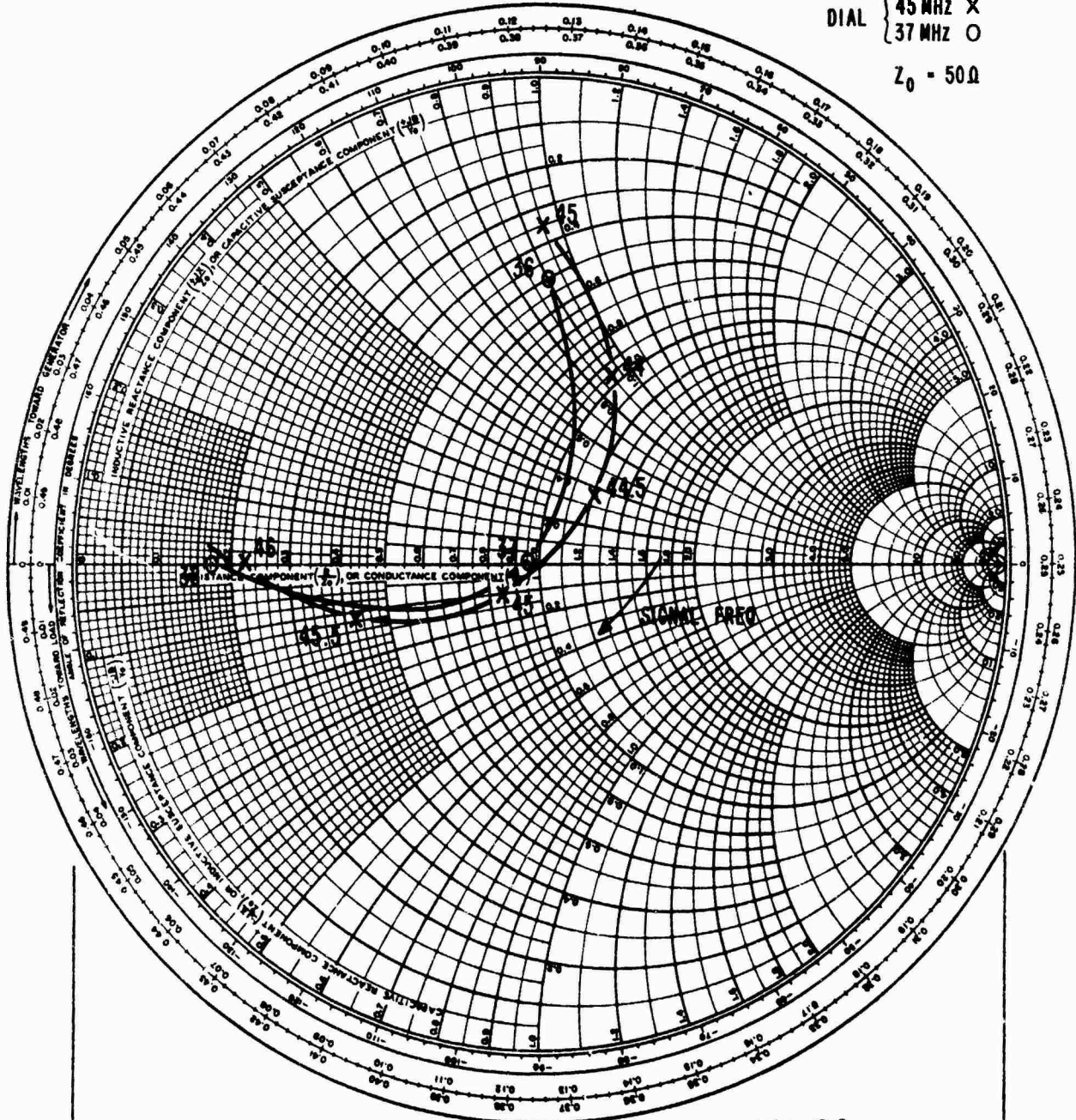
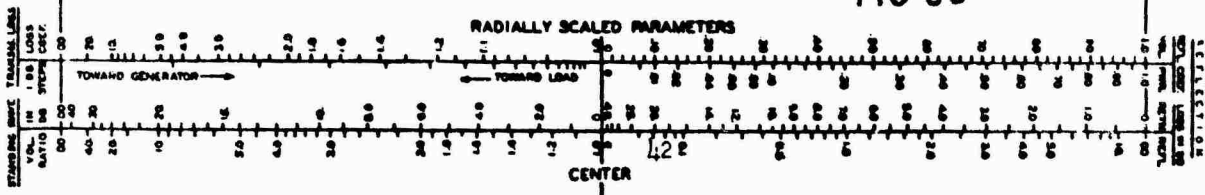


FIG 33



NAME	TITLE TANK INPUT IMPEDANCE VS FREQUENCY	DWG. NO. 34
SMITH CHART Form 5301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

DIAL 50

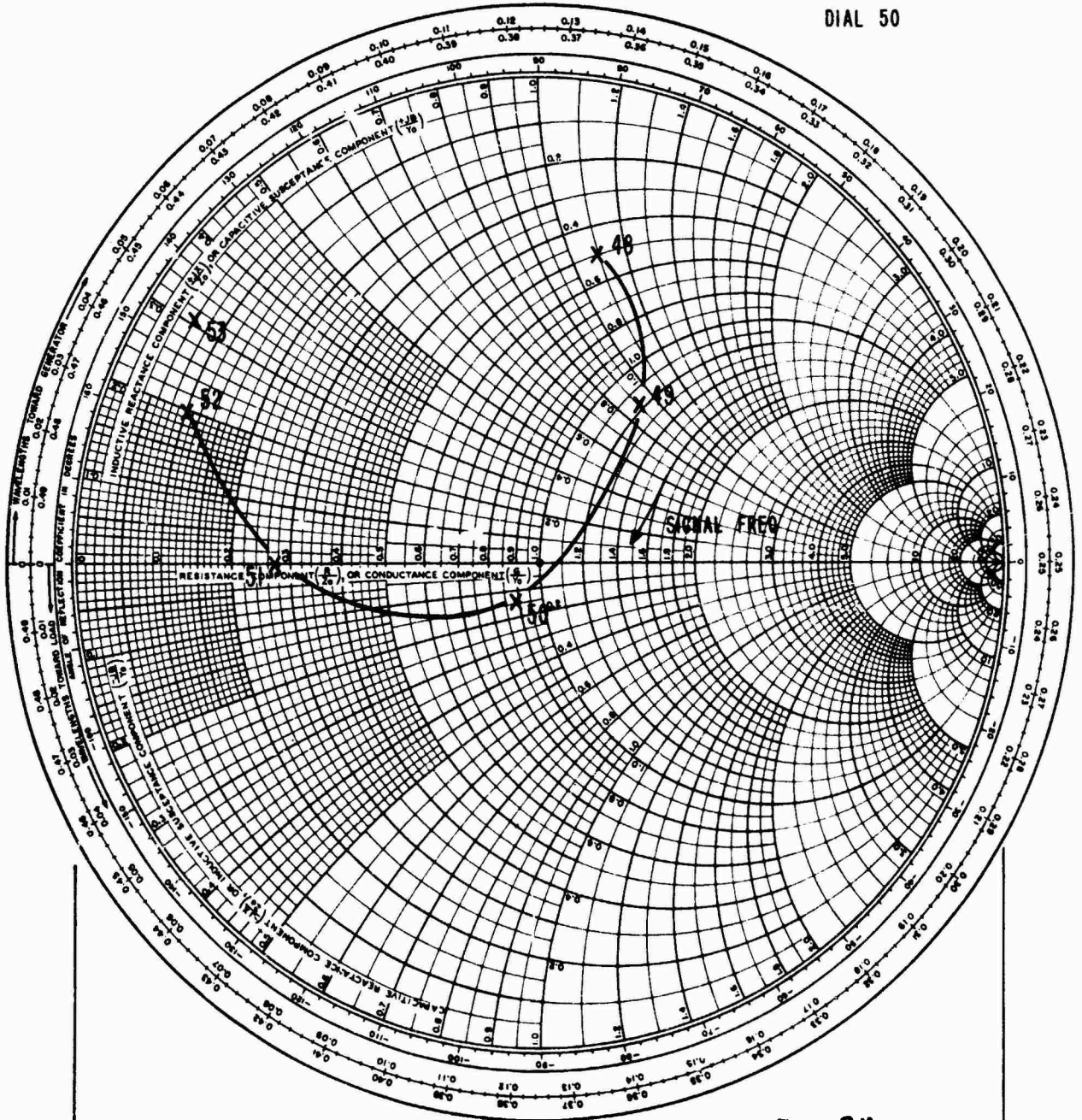
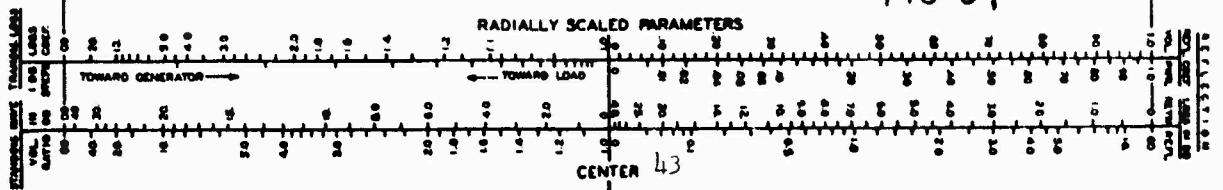


FIG 34



NAME	TITLE TANK INPUT IMPEDANCE VS FREQUENCY	DWG. NO. 35
SMITH CHART Form 5301-7560-N	GENERAL RADIO COMPANY, WEST CONCORD, MASSACHUSETTS	DATE

IMPEDANCE OR ADMITTANCE COORDINATES

DIAL { 52.95 X - CONST.
33 O - CONST.

SIGNAL FREQ IS
VARIED

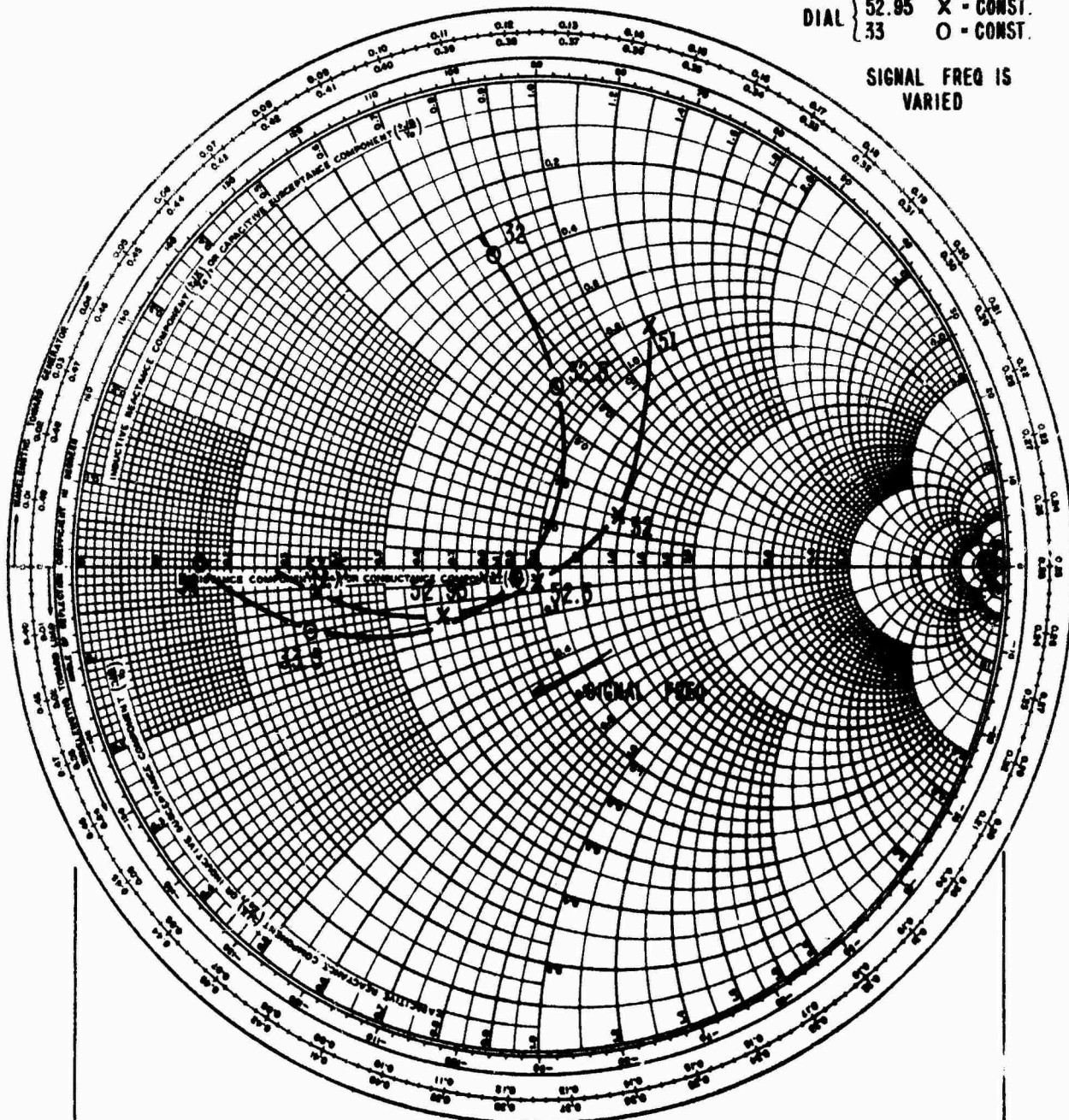
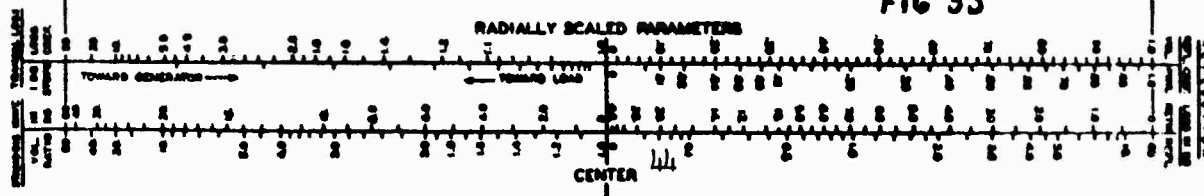


FIG 35



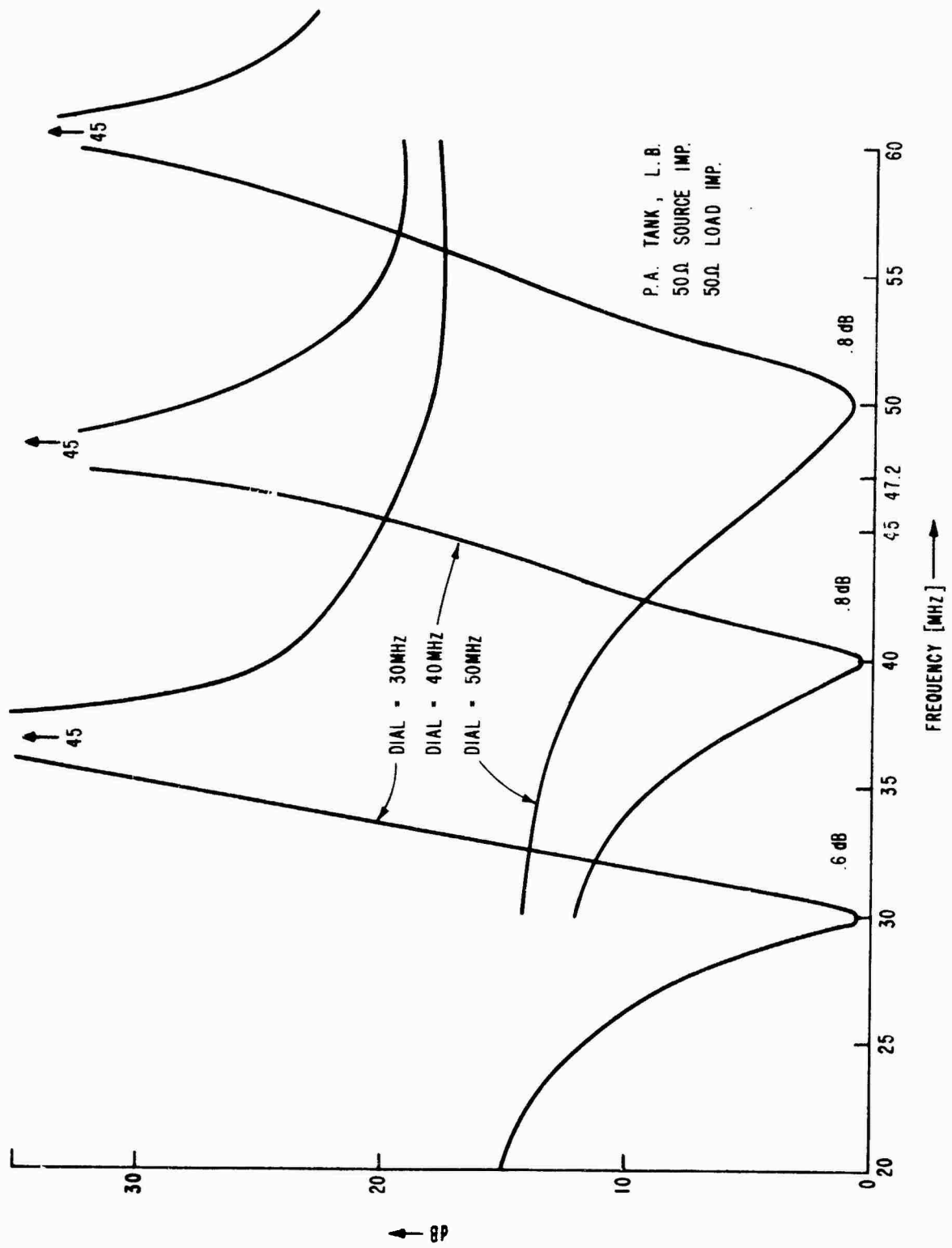


FIG. 36 ATTENUATION OF LOW BAND TANK FOR VARIOUS DIAL SETTINGS

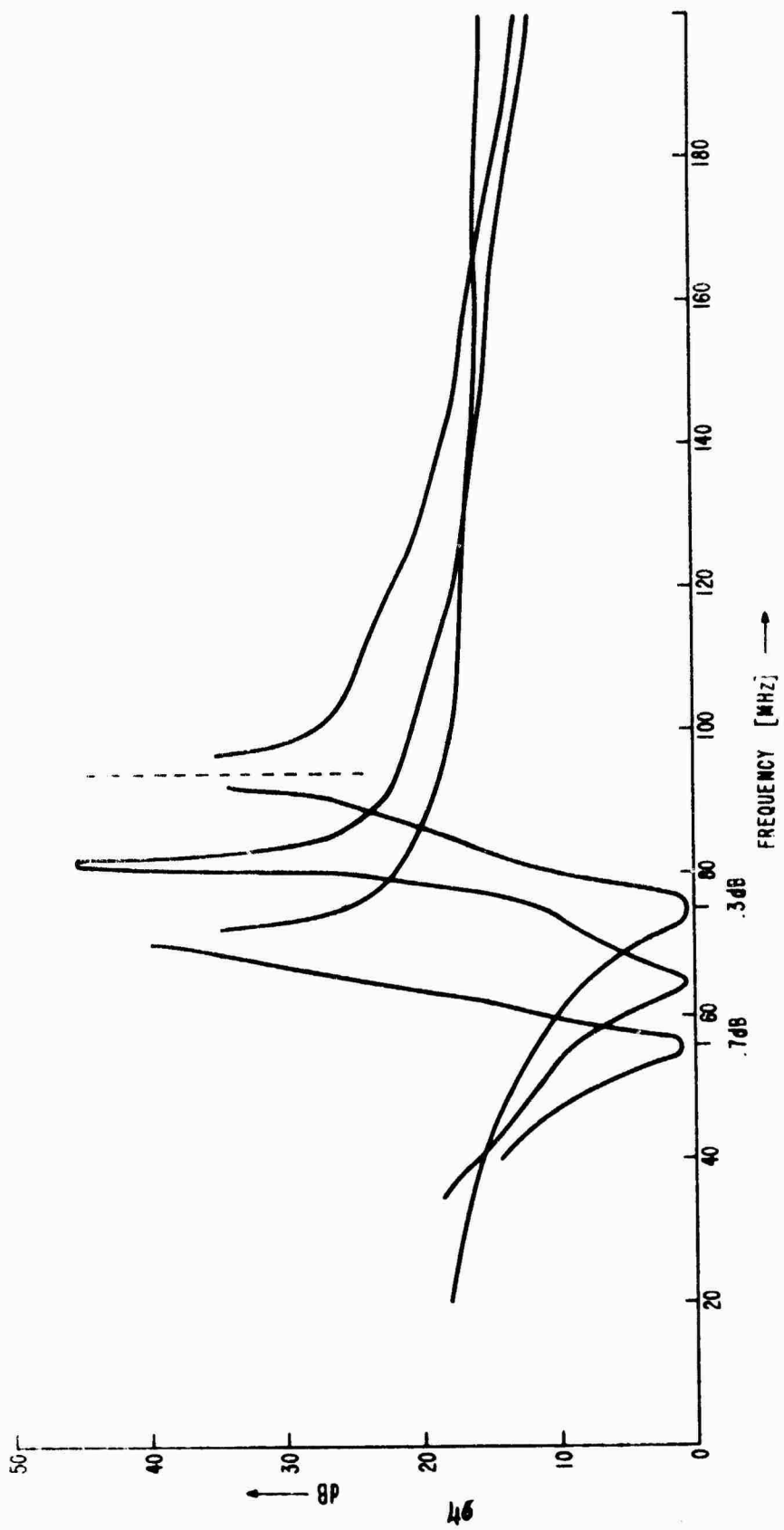
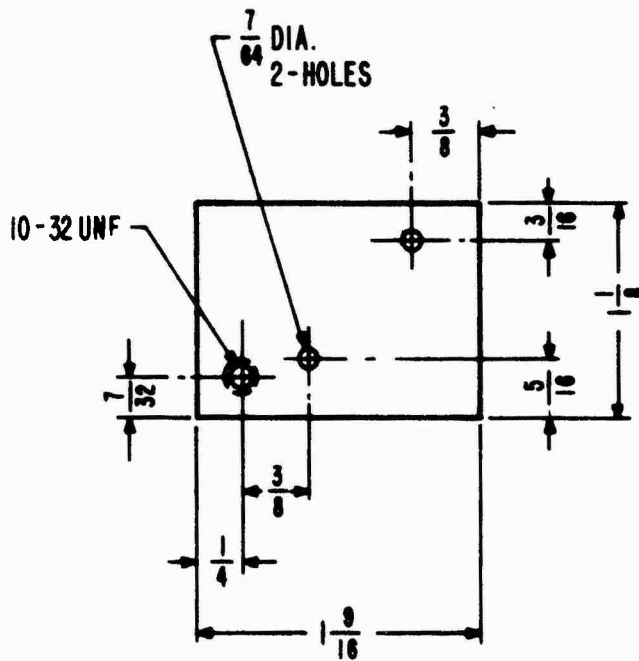


FIG. 37 TANK HI-BAND BETWEEN 50Ω LOAD AND 50Ω SOURCE, ADJ TO .6V DIVISION



MATL : ALUMINUM, $\frac{1}{4}$ " THICK
 ADD 2 MACH. SCREWS 2-56 NC x $\frac{1}{2}$ " LG

FIG. 38 DIODE MOUNT

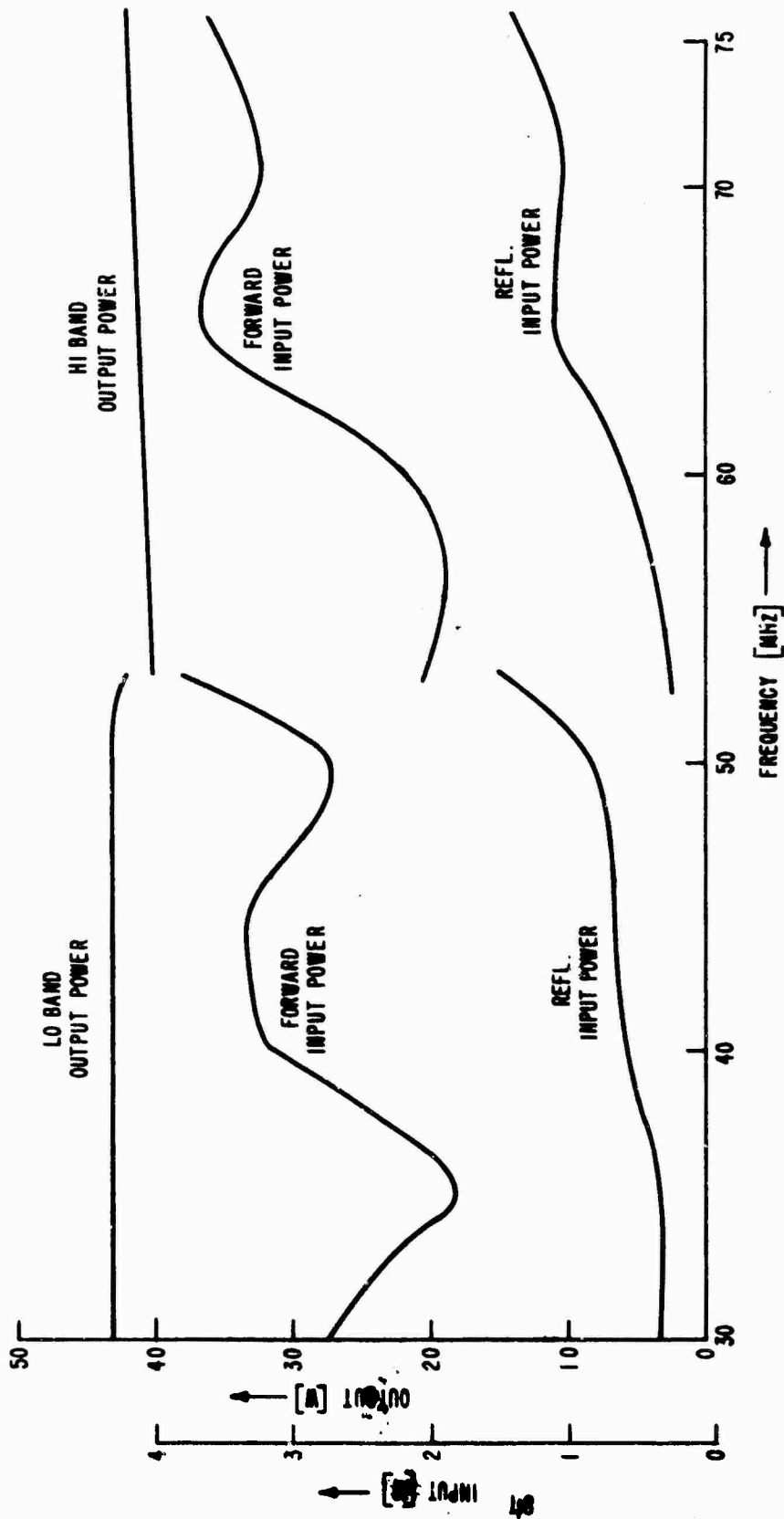


FIG. 39. POWER AMPLIFIER STAGE, 2X 2N5643, OUTPUT BEHIND FILTERS, TUNED CIRCUITS & VSW DETECTOR DRIVEN BY EIN AMPLIFIER THRU 3dB ATTENUATOR.

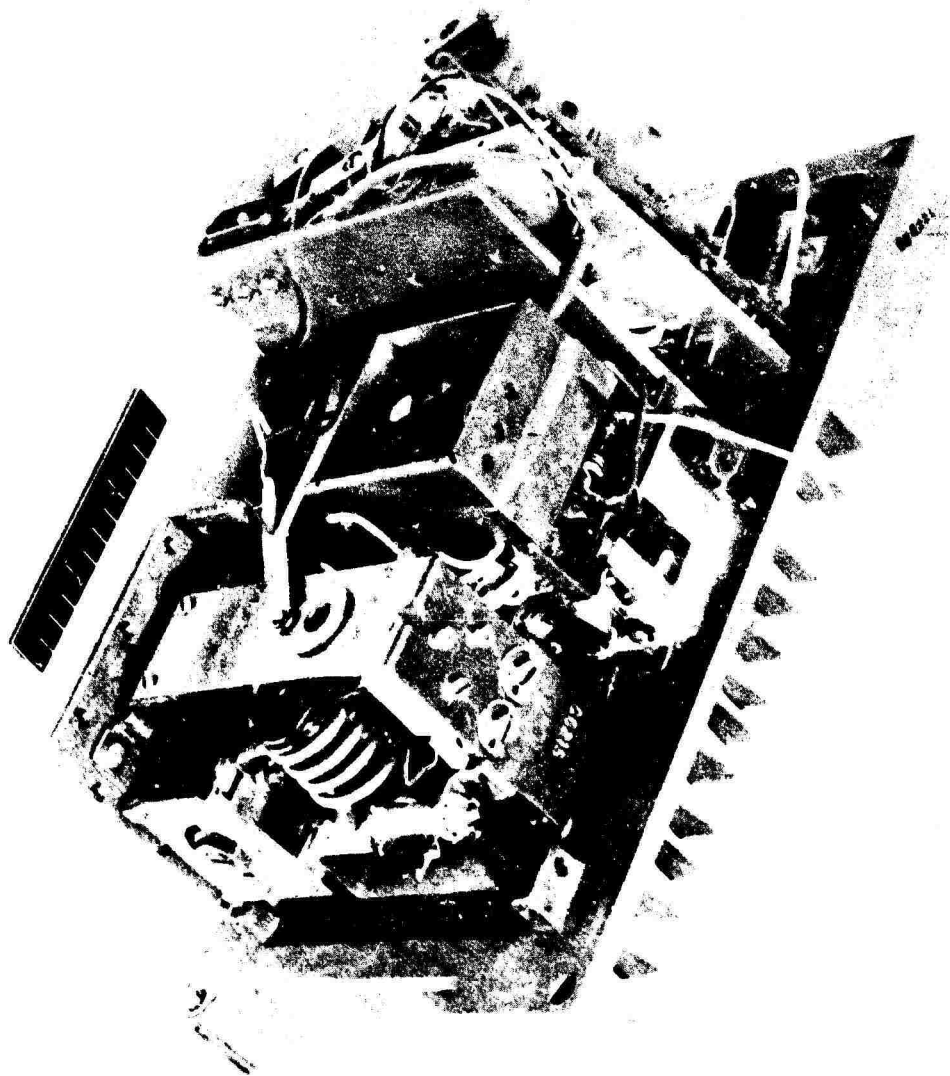


FIG 39 A POWER AMPLIFIER

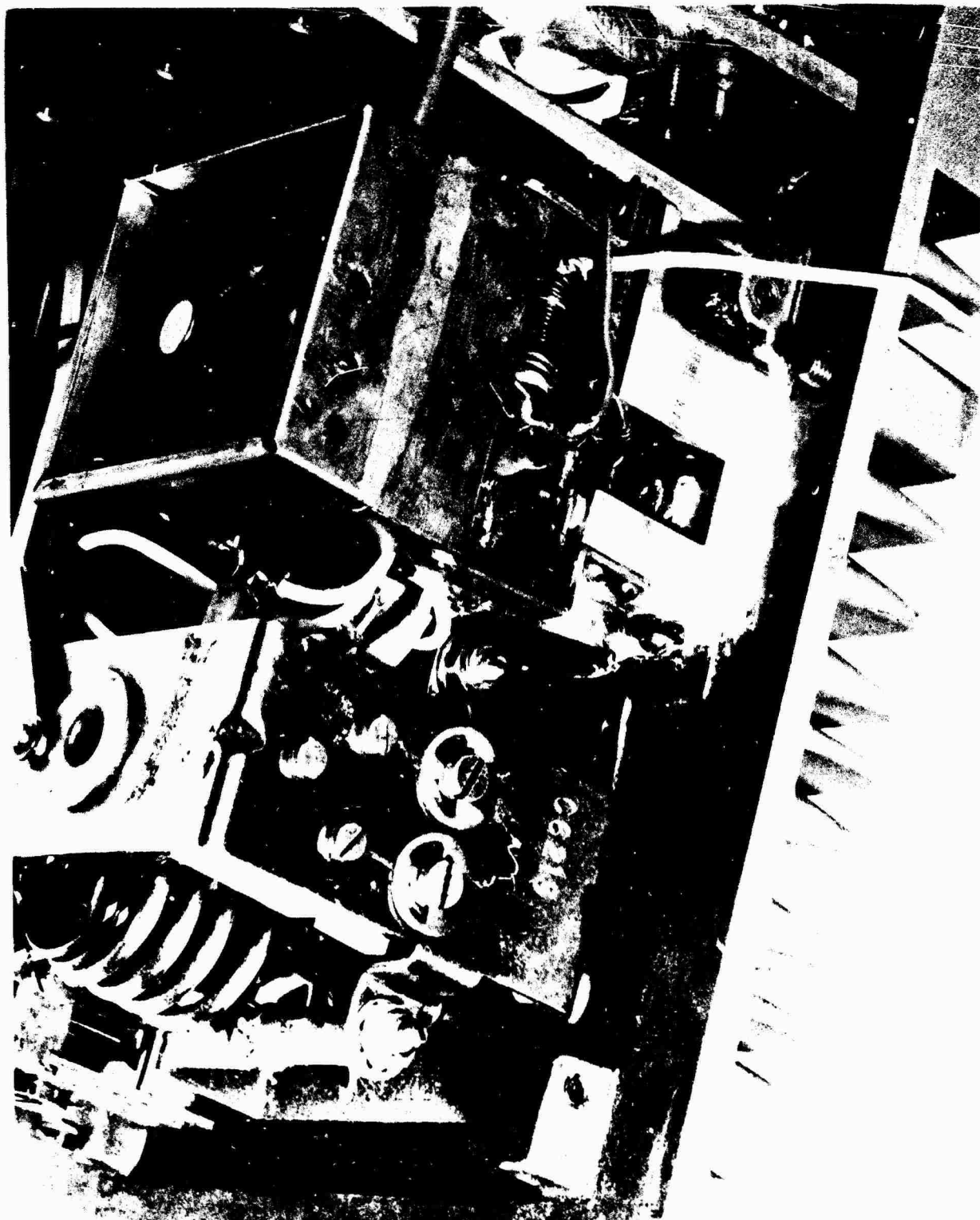


FIG 39 B POWER AMPLIFIER

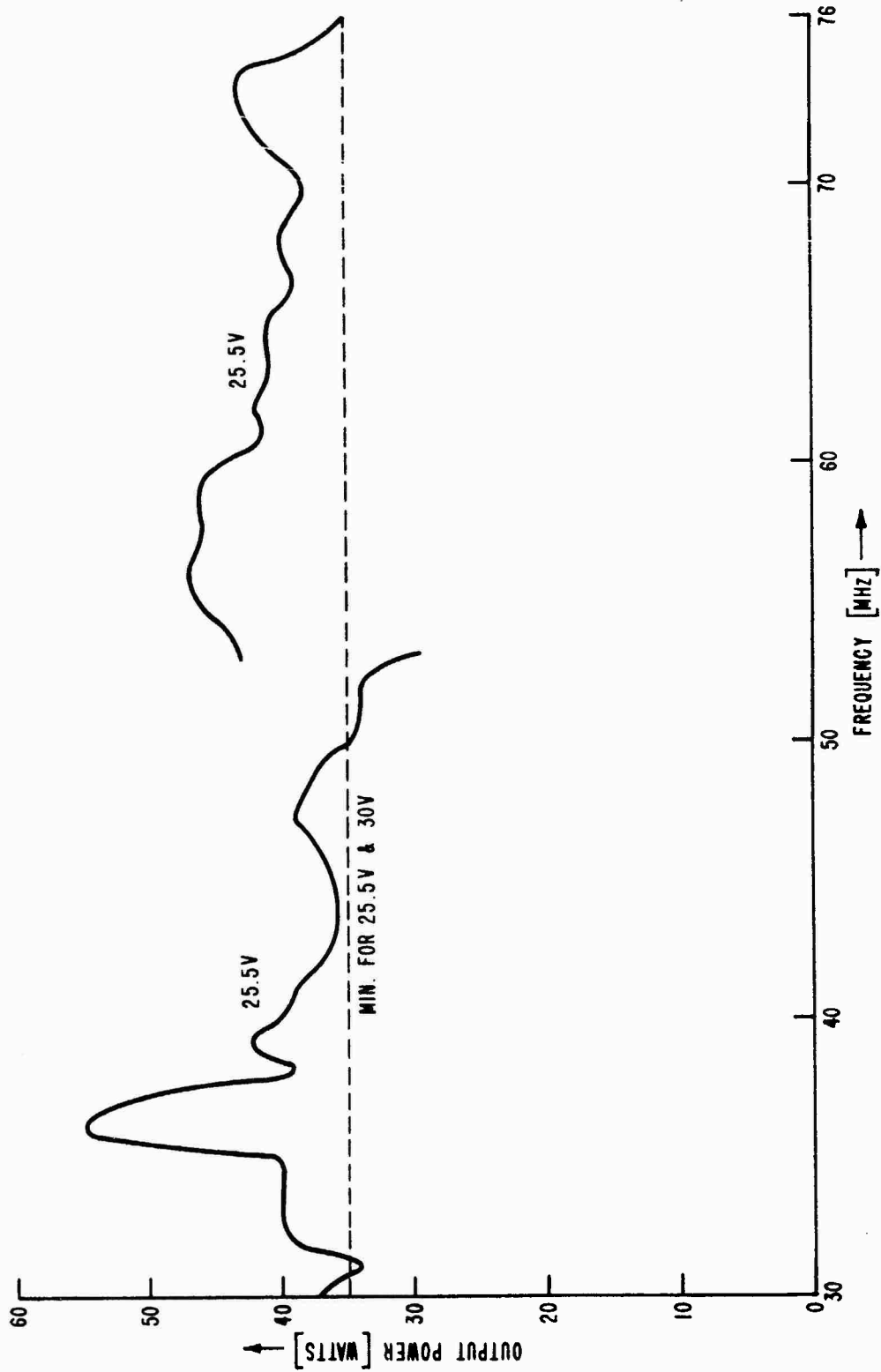


FIG. 40. OUTPUT POWER OF RT524 WITH TRANSISTOR DRIVER & PREAMP. REGULATOR & DRIVER CONNECTED TO P6204/1.

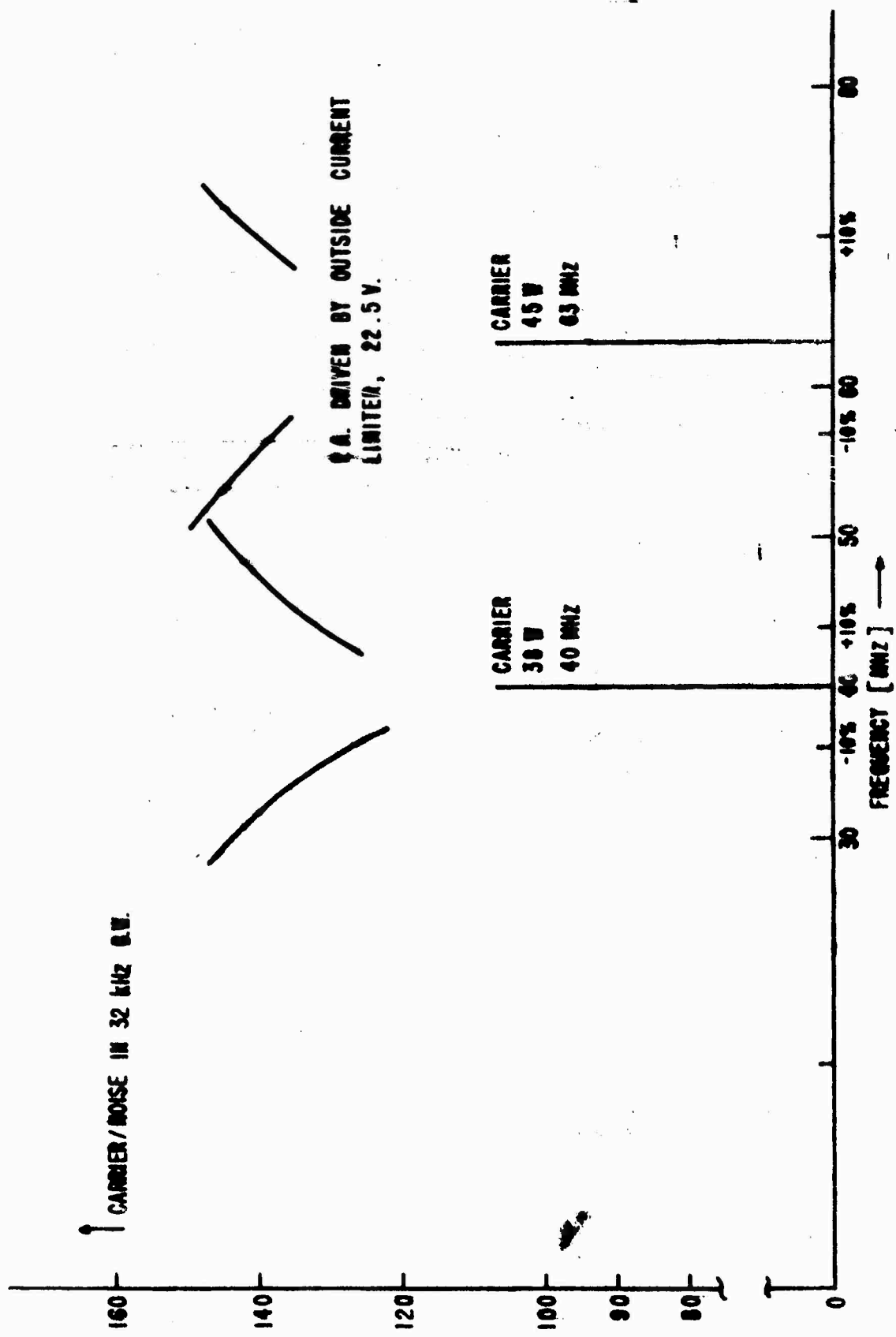


FIG. 4 | RT524 W. TRANSMITTER TUBES REPLACED BY TRANSISTOR MODULES TRANSMITTER OUTPUT NOISE

POWER OF INTERFERING TRANSMISSION OFFERED AT TERMINALS OF AMP. UNDER TEST
THIRD ORDER POWER, OFFERED AT TERMINALS OF AMP. UNDER TEST

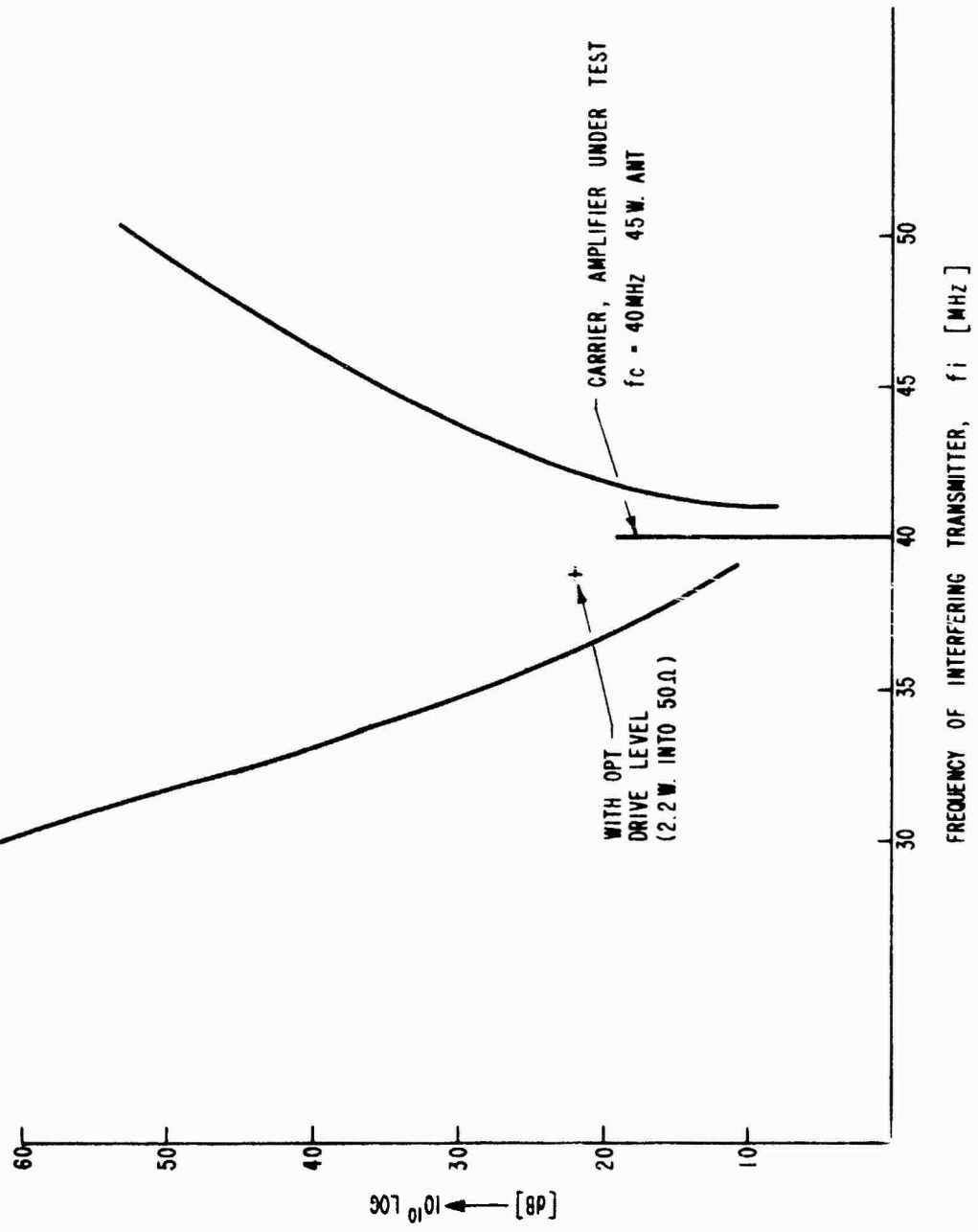


FIG. 42 BACK INTERMODULATION TYPICAL MEASURED WITH CTC 2N6201 IN P.A.

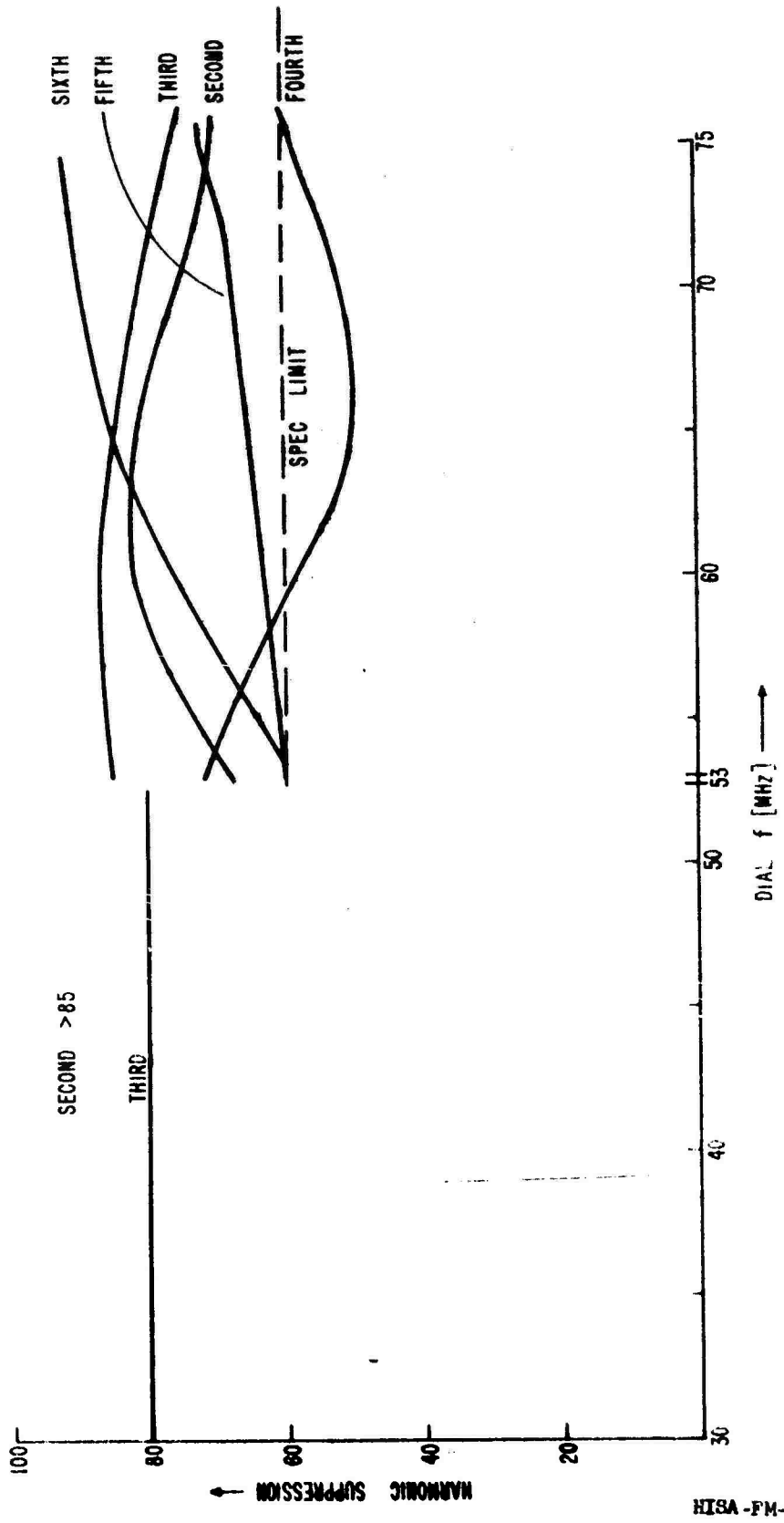


FIG. 4: HARMONIC SUPPRESSION