

Instruction Manual

300L

BroadBand RF Power Amplifier

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CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

The Model 300L is a broadband solid state power amplifier, covering the frequency range of 250 KHz to 110 MHz.

Three watts of RF power can be produced at the output, with low harmonic and intermodulation distortion. The amplifier will accept inputs of AM, FM, SSB, Pulse and other complex modulations, over its entire frequency range. The 40 dB gain of the unit permits it to be driven to its full power output by any signal or sweep generator capable of supplying a minimum -5 dBm (.13 volts) signal level into its 50 ohm input. Virtually all commercial signal and sweep generators are capable of supplying this signal.

The Model 300L operates over its entire bandwidth without tuning or other adjustments. It is capable of supplying useful power output up to 150 MHz, at reduced gain.

It is unconditionally stable and will not oscillate for any possible combination of source and load impedances. This feature is especially useful where highly reactive loads are encountered. Reflected power due to output load mismatch is absorbed in the amplifier.

The Model 300L is protected against failure due to output load mismatch and/or overdrive. The unit will withstand a +20 dB overdrive (input signal of +15 dBm), for all output load conditions including both short and open circuit loads.

Output RF voltage level as well as power output into 50 ohms, is monitored by a front panel meter. An integral power supply permits operation directly from the AC line.

1.2 SPECIFICATIONS

Frequency Coverage:	250 KHz to 110 MHz without tuning
Maximum Power Output:	3 watts CW and PEP (Peak Envelope Power)
Input Signals:	unit will accept CW, AM, FM, SSB, Pulse, Wideband Sweep and other complex modulations, limited only by their bandwidth and peak input level
Gain:	40 dB nominal
Gain Variation:	less than ± 1 dB over the entire frequency range at power outputs below .5 watts; less than ± 1.5 dB for power outputs between 0.5 and 3 watts.
Harmonic Distortion:	All harmonics more than 23 dB down at full power output, lower at reduced power output
Intermodulation Distortion:	30 dB down (typical) from .25-40 MHz at full power output; 25 dB down (typical) from 40-110 MHz, lower at reduced power output
Input/Output Impedance:	50 ohms
Input VSWR:	less than 1.5
Output VSWR:	less than 2

Noise Figure:	8 dB typical
Output Metering:	Average reading voltmeter, calibrated in RMS volts with an accuracy of $\pm 5\%$ (0-17 volts); also calibrated in watts into 50 ohms (0-5 watts)
Stability:	unconditionally stable; unit will not oscillate for any conditions of load and source impedance
Protection:	unit will withstand a +20 dB overdrive (input signal of +15 dBm) for all output load conditions including short and open circuit loads
Power Requirements:	115-230 VAC $\pm 10\%$ 50-60 Hz, 35 Watts
Operating Temperature Range:	0 to +50° C
Size:	5½ x 8½ x 10 in. 13.3 x 21.6 x 25.4 cm.
Weight:	10 lbs.; 4.5 kg.
Input and Output Connectors:	BNC

1.3 INSTRUMENT IDENTIFICATION

Each amplifier is identified by a serial number tag on the rear panel of the unit. Both the model number and the serial number should be given in any correspondence with the company.

CHAPTER 2

OPERATION

2.1 INTRODUCTION

The ENI Model 300L amplifier will increase the R.F. output level of signal sources in the 250 KHz to 110 MHz range.

The input and output are connected via the front panel BNC connectors to the signal source and load respectively.

2.2 MAINS VOLTAGE SETTING

The supply voltage selection switch is located at the rear of the unit and is normally set for 115 VAC operation. Before connecting the unit to the mains supply, check that the supply voltage switch is correctly set.

EXTENSIVE DAMAGE WILL RESULT IF THE AMPLIFIER IS CONNECTED TO THE WRONG SUPPLY VOLTAGE. UNDER NO CIRCUMSTANCES SHOULD THIS SWITCH BE OPERATED WHILE THE SUPPLY IS CONNECTED.

2.3 MAINS FUSE RATING

The mains fuse F1 is located on the rear panel. The replacement part number is 313001 1ASB.

2.4 RACK INSTALLATION

For standard nineteen inch rack installations, rack mounting brackets are supplied with the unit. Remove the two 8-32 screws on each side of the cover nearest the front panel. Attach the rack mounting brackets firmly using the hardware removed above. The rubber feet may be unscrewed and removed if minimum vertical usage of the rack is necessary.

2.5 OPERATION

Connect the signal source to the input BNC and the load to the output BNC with 50 ohm coaxial leads.

When the Model 300L is connected to a 50 ohm load, the CW power output of the unit may be read directly from the meter scale. The input signal should be increased gradually while observing the output voltage on the output RF voltmeter. Input voltage should not be allowed to exceed 1.4 volts (peak). The red portion of the meter indicates that the amplifier is no longer operating in its linear region and excessive distortion will result. This occurs at 3 watts (PEP or CW) of RF output power into 50 ohms (17.2 volts peak).

When the amplifier is connected to an arbitrary or unknown load impedance, the following procedure will insure low output distortion.

- (1) Disconnect the load from the output BNC connector.
- (2) Adjust CW input signal until meter reads into the red portion of the scale (12.3 volts RMS).
- (3) Connect the output of the amplifier to the unknown load.

If the output of the amplifier is monitored by a high frequency oscilloscope (or spectrum analyzer), the input signal may be increased until the point of maximum undistorted power output of the unit is observed.

CHAPTER 3
PRINCIPLES OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION

The Model 300L RF amplifier consists of four circuit modules. (see figure 3.1)

The RF signal fed to the input BNC is amplified in the RF preamplifier module 300L-4122. The low noise circuit has a gain of approximately 22 dB from 250 KHz to 50 MHz. The trimmer capacitor C8 (externally adjustable) provides varying amounts of overpeaking from 50 MHz to 120 MHz. Output of the preamplifier module is fed to the input connector (UG 1619) of the power amplifier.

The Power Amplifier Module 300L-4121 consists of two identical pushpull hybrid connected transistor circuits. The amplifier chains are balanced at the factory to insure proper operation of the combining transformer networks. Overall gain of the module is 20 dB at the low end of the frequency range, decreasing to 17 dB at 110 MHz.

The Output RF Voltmeter Module 300L-4124 samples the RF output voltage and provides a D.C. voltage proportional to its average value. The D.C. voltage is fed to the front panel meter, which is calibrated in RMS volts for a sine wave. Average CW power into 50 ohms is calibrated on the bottom scale of the meter. The RF sample is isolated from the output connector by a series .003 mfd capacitor. This provides isolation from the effects of any D.C. voltage fed into the output connector from an external source.

The Power Supply Module 403L-4221 is a regulated D.C. power supply adjusted for approximately +25.5 volts and capable of supplying 1.0 amp of current. The output of the supply is fed directly to the other three modules and to the front panel light.

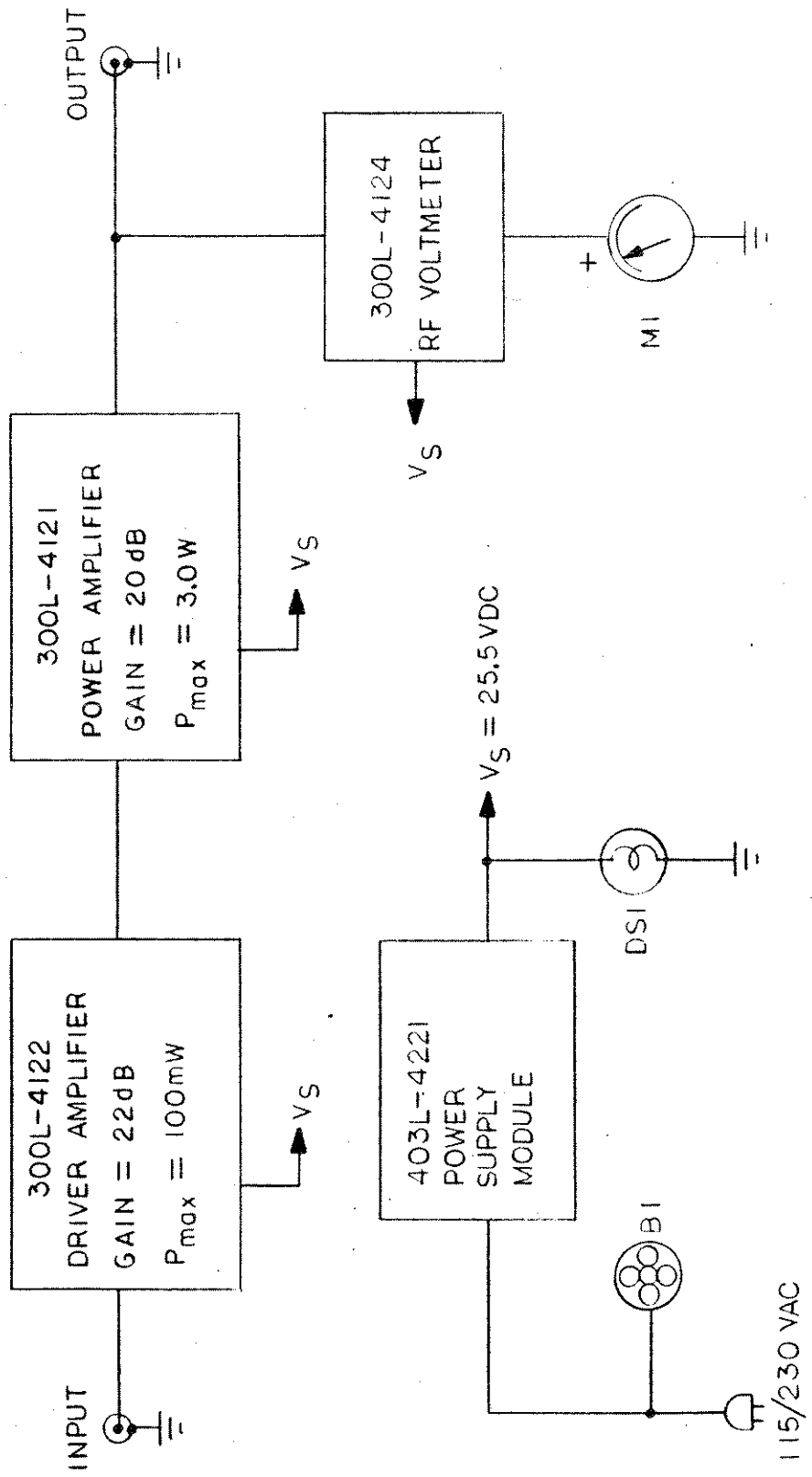


FIGURE 3.1
BLOCK DIAGRAM

CHAPTER 4

MAINTENANCE AND PERFORMANCE TESTS

4.1 INITIAL CHECK

Before connecting the unit to the mains supply, make certain that the supply voltage switch on the rear panel is in the proper position.

EXTENSIVE DAMAGE WILL RESULT IF THE AMPLIFIER IS CONNECTED TO THE WRONG SUPPLY VOLTAGE. UNDER NO CIRCUMSTANCES SHOULD THIS SWITCH BE OPERATED WHILE THE SUPPLY IS CONNECTED.

Connect the unit to the mains supply, switch it on and observe that the indicator lamp illuminates.

4.2 GAIN AND GAIN VS FREQUENCY

Equipment Required:

- a) Oscilloscope (Tektronix T921)
- b) Sweep/Signal Generator (HP8601A)
- c) 50 ohm Video Detector (Wavetek D151)

Procedure:

- a) Set the oscilloscope to DC, triggering source to X-Y (external), and volts/division to 20 MV/CM.
- b) Set the Sweep/Generator to video sweep and the frequency to 110 MHz. Connect the RF Output of the generator to the video detector and then to the vert input of the oscilloscope. Connect the sweep output to the horizontal input of the oscilloscope.
- c) Adjust the output level of the sweep signal generator for full vertical deflection on the oscilloscope face.
- d) Calibrate the scope face to show 2 dB in 1 dB steps and mark the traces with a grease pencil.
- e) Rotate the step attenuator on the sweep/generator until the output is reduced a total of 40 dB from the original full vertical deflection reference point.
- f) Connect the RF output of the sweep/generator to the input of the 300L and the video detector to the output.

- g) Switch the unit on and observe the oscilloscope. The gain should typically be 40 dB and the sweep trace should be within the 2 dB markings.

4.3 CALIBRATION

Generally there are no adjustments necessary on the 300L. However, there is one adjustment to level the gain versus frequency response if needed:

Remove the cover by removing the screws on both sides of the unit. Set up the gain versus frequency test as outlined in section 4.2.

If the gain versus frequency response shows a variation of greater than ± 1 dB, locate the access hole on the RF Heat-sink and adjust the variable capacitor (C8, 300L-4122) with a plastic alignment tool until maximum gain flatness occurs.

4.4 RF POWER OUTPUT

The purpose of this test is to verify that the Model 300L will deliver its rated power output over the frequency range of 0.25 MHz to 110 MHz.

Equipment Required:

- a) Signal generator, HP8601A or equivalent
- b) Calorimetric power meter, HP434A

Procedure:

Connect the output of the signal generator to the input of the 300L. Connect the calorimetric power meter to the output of the unit.

Set the signal generator to CW and the frequency to 110 MHz. Select the appropriate range on the power meter. Switch the unit on and increase the gain of the signal generator until the power meter reads 3.0 watts. Do not overdrive the amplifier. The unit will withstand +15 dBm of drive, however it will saturate before that point.

Scan the range of the amplifier (0.25 MHz - 110 MHz) and verify that the output is 3 watts or greater at all frequencies.

4.5 MEASUREMENT OF HARMONICS

Equipment Required:

- a) Sweep signal generator, HP8601A
- b) Calorimetric power meter, HP434A
- c) Spectrum analyzer
- d) Attenuator, 30 dB

Procedure:

Set the signal generator at 30 MHz CW. Connect the RF output to the input of the 300L. Connect the output of the 300L to the input of the calorimetric power meter. Switch the unit on and adjust the gain for an output of 3 watts. Disconnect the output of the 300L and connect it to the 30 dB attenuator and into the RF input of the spectrum analyzer. The level of the harmonics should be less than -23 dB with respect to the carrier. Repeat the above procedure at other frequencies from 0.25 MHz to 110 MHz.

4.6 TROUBLESHOOTING AND REPAIR

Proper operation of the Model 300L can be determined by inserting a CW (at any frequency between 250 KHz and 110 MHz) signal into the input and connecting a 50 ohm load to the output. Set the input signal level to -5 dBm; power output on the meter should indicate approximately 3 watts on the meter scale.

If the Model 300L should fail to operate, and the panel light does not glow, check the condition of the 1 amp fuse at the rear of the unit.

The Model 300L circuit modules should be serviced only by the factory or its authorized facility. However, ENI will supply pre-aligned and calibrated module boards as replacement items.

DO NOT ATTEMPT TO PROBE THE CIRCUIT MODULES WHILE THEY ARE MOUNTED IN THE AMPLIFIER CASE, AS EXTENSIVE DAMAGE MAY RESULT.

When factory service is required, the following steps should be taken:

- 1) Notify us, giving full details of the difficulty. Include the instrument serial number.
- 2) On receipt of shipping instructions, forward the instrument transportation prepaid, to the factory or to the authorized repair station indicated on the instructions.
- 3) An estimate of the charge will be made before the work begins, provided the instrument is not covered by the warranty.

4.7 MAINTENANCE

There are no periodic electrical adjustments required to maintain the amplifier gain and power output characteristics.

Periodic cleaning and lubrication of the fan filter should be done every six months under ordinary service conditions. To clean the fan filter, remove its four cap nuts and gently pry it off. The filter should be soaked in an industrial cleaner solution such as "Toluene" for two minutes. After drying thoroughly, lubricate it with a few drops of number 10 oil.

4.8 PRECAUTIONS

- (1) The Model 300L output is at DC ground potential through the final combining transformer. Therefore, the output should not be directly connected to a load on which there is a DC potential. If the output load has a DC potential, insert a

series capacitor with the appropriate voltage breakdown rating (.1 mfd is the recommended value) between the load and the output cable.

- (2) The input and output of the Model 300L should not be connected together. This will cause oscillation and may damage the input preamplifier.
- (3) The 300L should not remain connected to an antenna when the unit is not in use. If thunderstorms are likely, it would be prudent to earth ground the unit's case.
- (4) When the input signal voltage of a drive source is unknown, insert an attenuator between it and the Model 300L input.

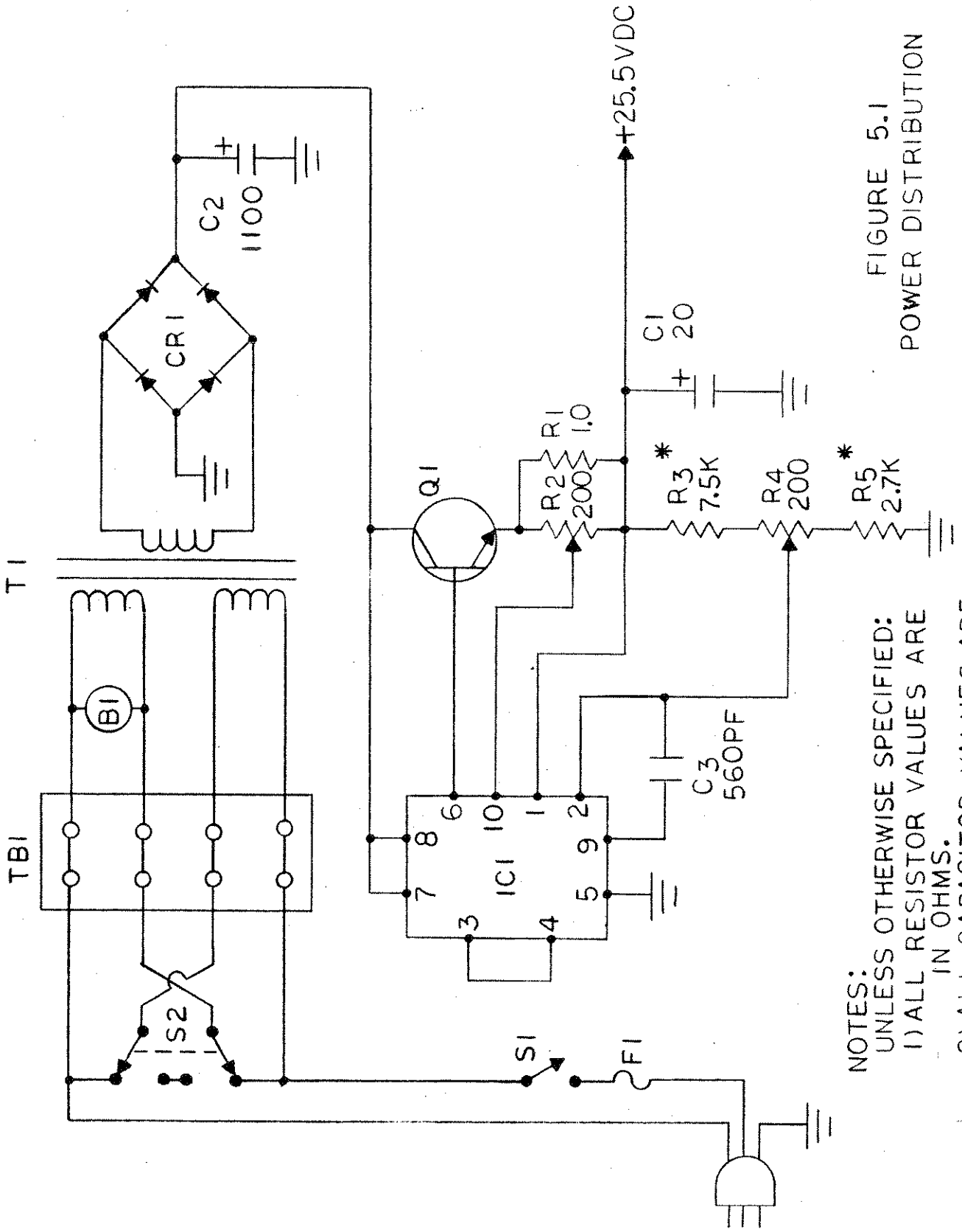


FIGURE 5.1
POWER DISTRIBUTION

NOTES:
UNLESS OTHERWISE SPECIFIED:
1) ALL RESISTOR VALUES ARE IN OHMS.
2) ALL CAPACITOR VALUES ARE IN MICROFARADS.
3) * VARIARI F VAI IIF.

- NOTES:
 UNLESS OTHERWISE NOTED:
 A. ALL RESISTOR VALUES ARE IN OHMS.
 B. ALL CAPACITOR VALUES ARE IN MICRIFARADS.
 C. ALL INDUCTOR VALUES ARE IN MICROHENRIES.
 D. * VARIABLE VALUE.

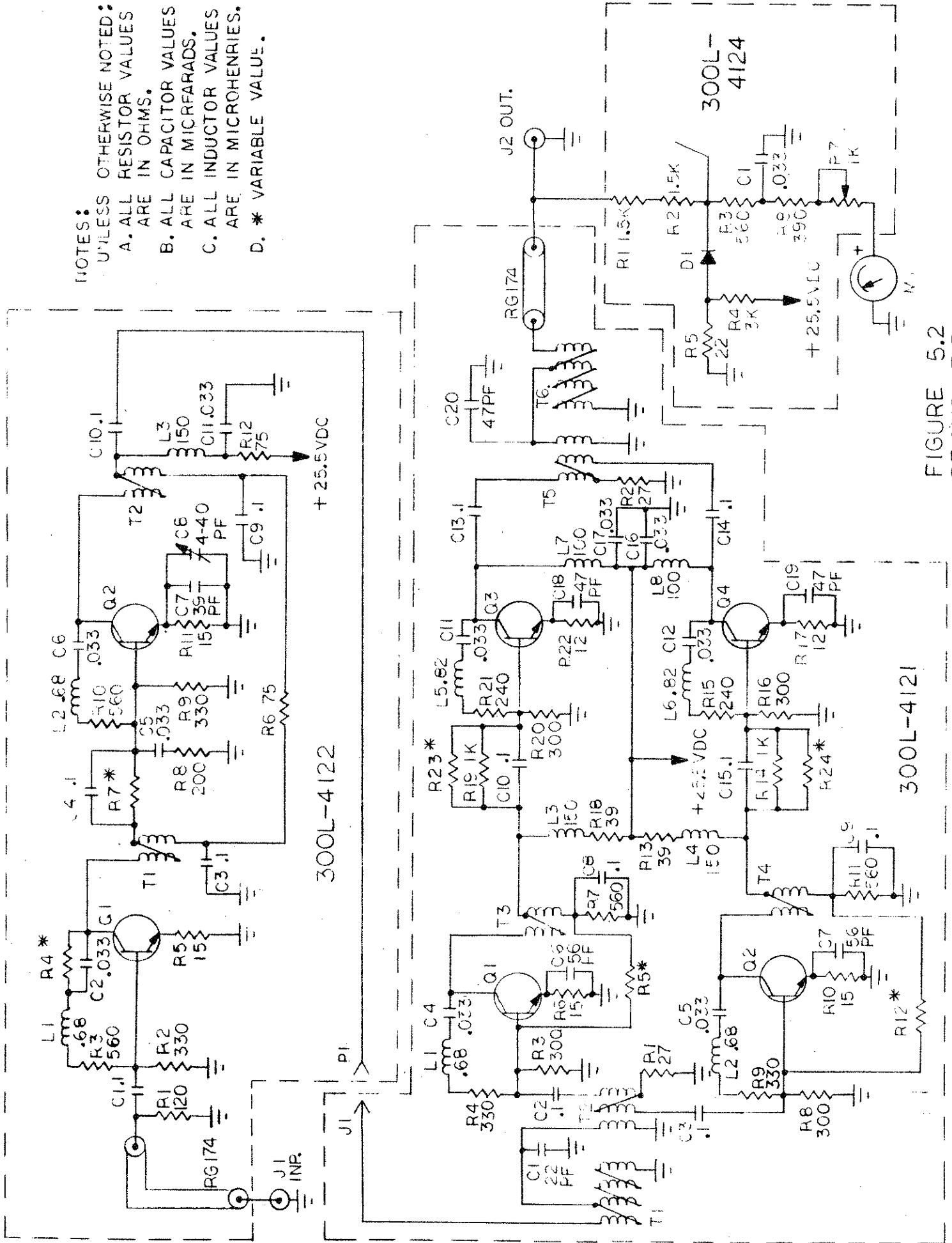


FIGURE 5.2
 RF AMPLIFIER

5.3 REPLACEMENT PARTS LIST

REFERENCE DESIGNATION	DESCRIPTION	MFR. CODE	PART #
	<u>BASEPLATE ASSEMBLY</u>	10226	403L-3221
CR1	2A, 100P1V, FWB	83003	VS148
Q1	Transistor	10226	ENI-1
T1	Transformer, Power	12715	AM5177A
A9	<u>POWER SUPPLY ASSEMBLY</u>	10226	403L-4221
R1	1 ohm, 5W, Res.	44655	4530
R2,R4	200 ohm, Pot.	32997	3389T-1-201
R3	7.5K ohm, Res., 5%, $\frac{1}{2}$ W	16299	HC5-7.5K
R5	2.7K ohm, Res., 5%, $\frac{1}{2}$ W	16299	HC5-2.7K
C1	Cap., 20 ufd, 50V	56289	TE1305
C2	Cap., 1100 ufd, 50V	56289	39D118G050HP4
C3	Cap., 560 pfd	09023	CM05ED561J03
IC1	IC Regulator	49956	RC723CT
	<u>FRONT PANEL ANGLE ASSEMBLY</u>	10226	300L-3125
J1,J2	BNC Connector	13511	UG-625/U
	<u>FRONT PANEL ASSEMBLY</u>	10226	300L-3124
S1	Switch	87034	616-6-1
M1	Meter	10226	820-019B
	Bulb	71744	327
	<u>REAR PANEL ASSEMBLY</u>	10226	403L-3223
B1	Fan	28875	WS2107-FL2
F1	Fuse 1A5B	75915	313001
	<u>DRIVER AMPLIFIER BOARD</u>	10226	300L-4122
A2R1	Res., 120 ohm, $\frac{1}{2}$ W, 5%	10226	carbon film
A2R2,R9	Res., 330 ohm, $\frac{1}{2}$ W, 5%	10226	carbon film
A2R3,R10	Res., 560 ohm, $\frac{1}{2}$ W, 5%	10226	carbon film
A2R4,R7	Res., Variable	10226	carbon film
A2R5,R11	Res., 15 ohm, $\frac{1}{2}$ W, 5%	10226	carbon film
A2R8	Res., 200 ohm, $\frac{1}{2}$ W, 5%	10226	carbon film
A2R6,R12	Res., 75 ohm, 1W, 5%	10226	metal film
A2C8	Capacitor 4-40 pf	02799	422
A2C2,C5,C6,C11	Capacitor .033 mf 50V	36346	C320C333M5U-1CA-C9250
A2C1,C3,C4,C9,C10	Capacitor .1 mf 50V	36346	C330C104M5U-1CA-C9250
A2C7	Capacitor 39 pf	09023	CM05ED390J03
A2L1,L2	Choke .68 mHy	99800	1537-08
A2L3	Choke 150 mHy	99800	3500-12
A2Q1,Q2	Transistor	10226	ENI5744
A2T1,T2	Transformer	10226	

REFERENCE DESIGNATION	DESCRIPTION	MFR. CODE	PART #
<u>POWER AMPLIFIER BOARD</u>			300L-4121
A1R1	Res., 27 ohm, 1/2W, 5%	10226	carbon film
A1R6,R10	Res., 15 ohm, 1/2W, 5%	10226	carbon film
A1R3,R8,R16,R20	Res., 300 ohm, 1/2W, 5%	10226	carbon film
A1R4,R9	Res., 330 ohm, 1/2W, 5%	10226	carbon film
A1R2	Res., 27 ohm, 1/2W, 5%	10226	carbon film
A1R14,R19	Res., 1K ohm, 1/2W, 5%	10226	carbon film
A1R15,R21	Res., 240 ohm, 1W, 5%	10226	metal film
A1R7,R11	Res., 560 ohm, 1W, 5%	10226	metal film
A1R17,R22	Res., 12 ohm, 2W, 5%	10226	metal film
A1R13,R18	Res., 39 ohm, 2W, 5%	10226	metal film
A1R5,R12,R23,R24	Variable Resistor		
A1C4,C5,C11, C12,C16,C17	Capacitor, .033 uf 50V	36346	C320C333M5U- 1CA-C9250
A1C2,C3,C8,C9, C10,C13,C14,C15	Capacitor, .1 mf 50V	36346	C330C474M5U- 1CA-C9250
A1C1	Capacitor 22 pf	09023	CM05ED220J03
A1C18,C19,C20	Capacitor 47 pf	09023	CM05ED470J03
A1C6,C7	Capacitor 56 pf	09023	CM05ED560J03
A1L1,L2	Choke .68 mHy	99800	1537-08
A1L5,L6	Choke .82 mHy	99800	1537-10
A1L7,L8	Choke 100 mHy	99800	2890-42
A1L3,L4	Choke 150 mHy	99800	3500-12
A1Q3,Q4	Transistor	10226	PT3642A
A1Q1,Q2	Transistor	10226	EN15744
A1T1,T2,T3, T4,T5,T6	Transformer	10226	
<u>RF VOLTMETER BOARD</u>			300L-4124
A12R5	Res., 22ohm, 1/2W, 5%	10226	300L-4124
A12R8	Res., 390ohm, 1/2W, 5%	10226	
A12R3	Res., 560 ohm, 1/2W, 5%	10226	
A12R4	Res., 3Kohm, 1/2W, 5%	10226	
A12R1,R2	Res., 1.5K ohm, 1/2W, 5%	10226	
A12R7	POT 1K ohm	32997	3386T-1-102
A12C1	Capacitor .033uFD 50V	36346	C320C333M5U 1CA C9250
A12D1	Diode HP	28480	5082-2800

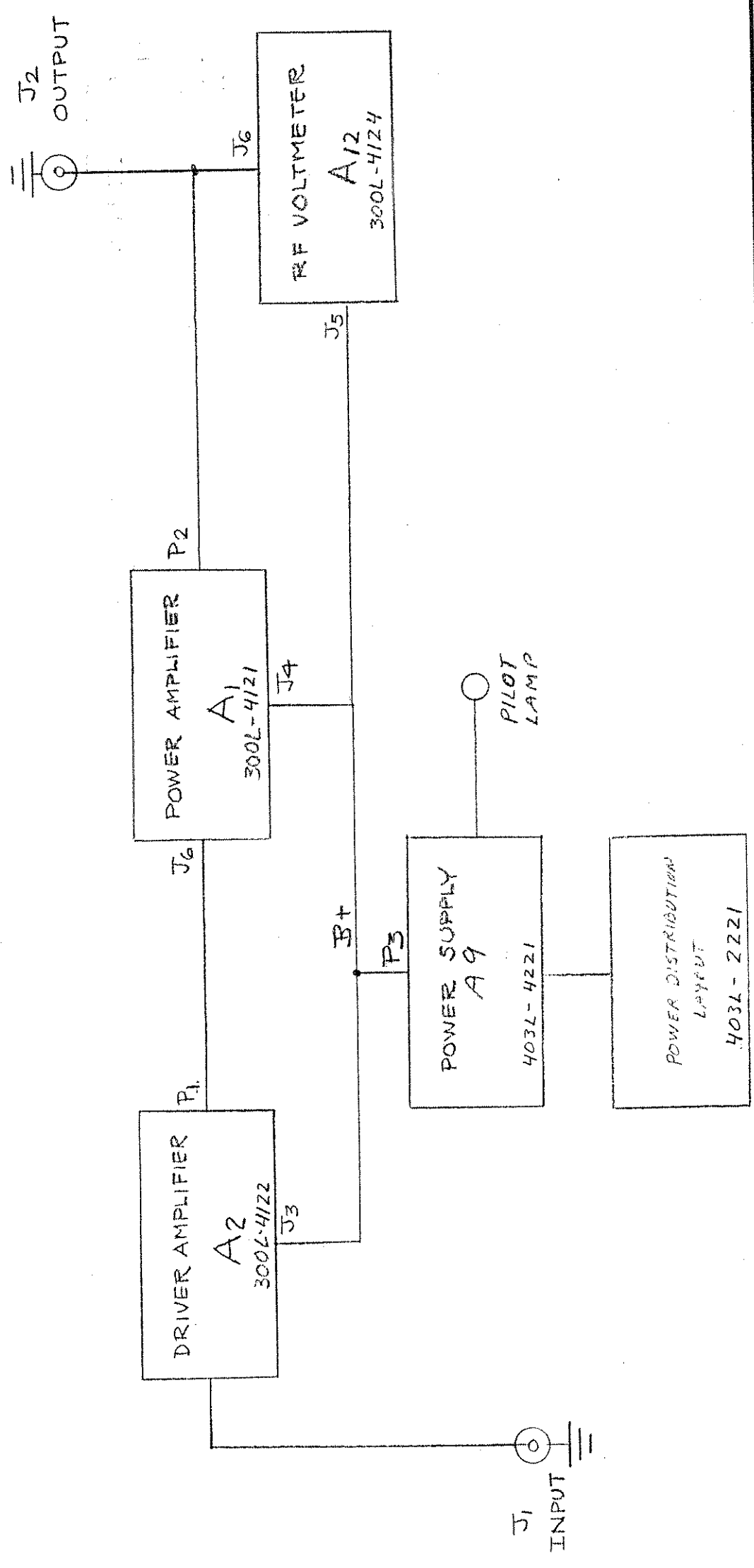
WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

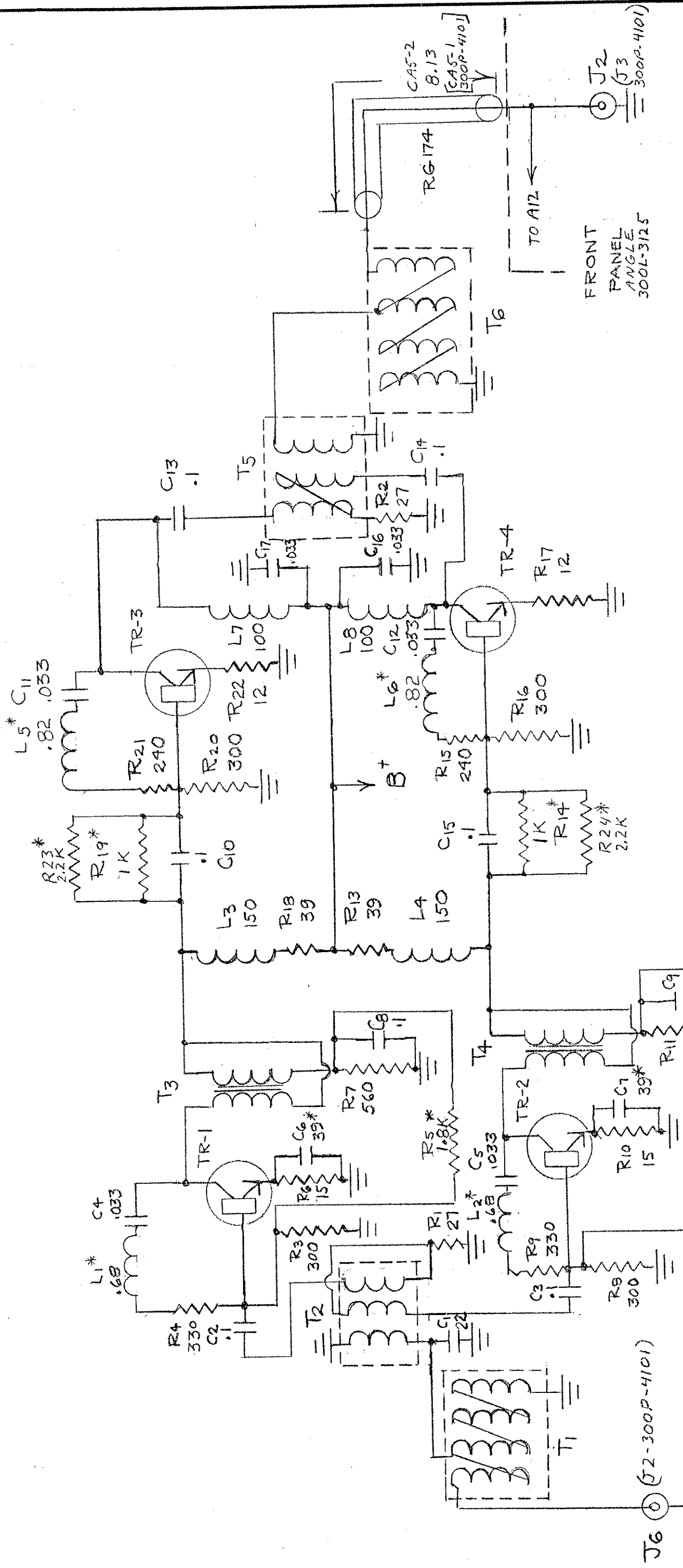
There are no other warranties expressed or implied, including any warranty of merchantability or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
NOV 70	A	AND 300L-055	7C		
4/72	B	UPDATE TO AIR	7C		
7/72	C	UPDATE P.S. TO A9	7C		
9/72	D	UPDATE PIN	7C		
12/72	E	" "	7C		
3/73 F ECN123					7C



ELECTRONIC NAVIGATION INDUSTRIES		DRAWN BY J. N. BROOKS	
TOLERANCES (EXCEPT AS NOTED)	MODEL 300L	SCALE	APPROVED BY
DECIMAL ±	INTERCONNECTION BLOCK DIAGRAM		
FRACTIONAL ±			
ANGULAR ±	DATE	DRAWING NUMBER 300L-1121	

DATE	SYM	REVISION RECORD	AUTH.	DR. CK.
4/13/68	A	310L UNIT MOD		
4/14/68	B	WAS RESISTOR CHANGE		
5/12/68	C	ADD R23, R24		
12/12/68	D	CHANGE OUTPUT		



* VARIABLE VALUE

V_e TR-1, TR-2 1.2V
V_e TR-3, TR-4 3.6V

TOLERANCES (EXCEPT AS NOTED)	ELECTRONIC NAVIGATION IND	
DECIMAL	SCALE	DRAWN BY J.N. BROOKS
±	MODEL 300L	APPROVED BY K
FRACTIONAL	TITLE POWER AMPLIFIER - BOARD A1	
±	DATE Nov 12, 69	DRAWING NUMBER 300L-4121
ANGULAR		
±		