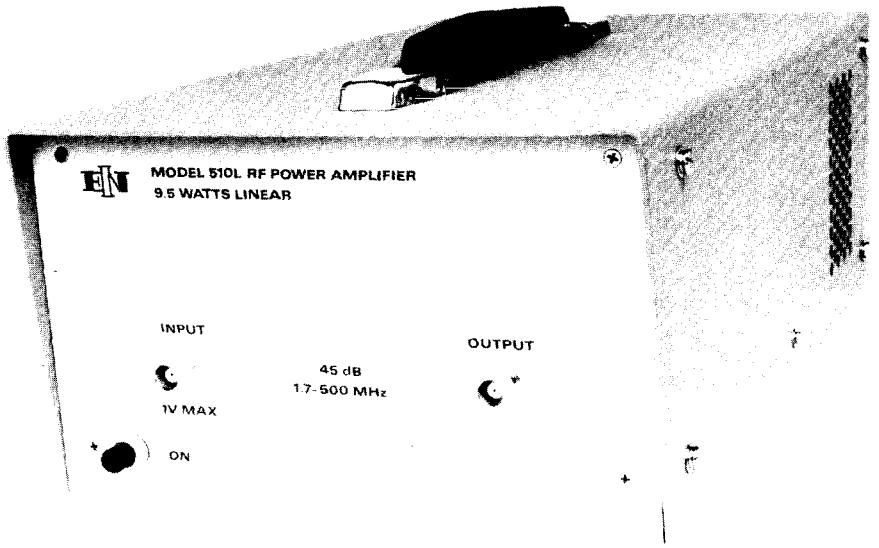
ELECTRONIC NAVIGATION INDUSTRIES, INC.

INSTRUCTION MANUAL

MODEL 510L

BROADBAND POWER AMPLIFIER



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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 work is started.

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

CONTENTS

CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

The Model 510L is a general purpose broadband amplifier capable of more than 9.5 watts of linear power output when driven by any laboratory signal or sweep generator from 1.7 to 500 MHz.

An ultra linear Class A design, the 510L will "boost" the output of any signal source by a flat 45 dB (±1.5 dB) and provide its full forward output power into any load impedance (from an open to a short circuit). Its output is a faithful reproduction of the input waveform for AM, FM, SSB, CATV, pulse and other complex modulations. Although specified only over the 1.7 to 500 MHz frequency range, full power output is typically available from 1.5 to 520 MHz.

The use of microwave transistors on thin film substrates, microstrip circuitry, and plug-in modules make the 510L both reliable and easy to service. An integral power supply and cooling system permit operation over a wide range of temperature and AC line conditions.

1.2 DATA SUMMARY

Frequency Coverage:	1.7 to 500 MHz
Gain:	45 dB nominal
Gain Variation:	±1.5 dB below 1 watt ±2 dB below 9.5 watts
Maximum Linear Power Output:	More than 9.5 watts
Harmonic Distortion:	All harmonics greater than 20 dB below the fundamental at 9.5 watts output. Lower distortion at reduced power.
Input/Output Impedance:	50 ohms
Input VSWR:	1.5 Maximum
Output VSWR:	2.6 Maximum
Stability:	Unconditionally stable

Typical 3rd Order Intermodulation Intercept Point:	+ 49 dBM
Noise Figure:	12 dB
Power Requirements:	115/230V a.c. ±10% 50-60 Hz, at 250 watts
Size and Weight:	5¼ x 8½ x 15 inches 18 pounds 13.3 x 21.6 x 38.1 cm 8.2 kg.
Operating Temperature:	0^{o} to 45^{o}C
Protection:	Unit will withstand a +20 dB overdrive (1 volt RMS) for all output load conditions, including short and open circuits.
Output Connectors:	BNC standard, SMA and type N optional
Rack Mounting:	Adaptors provided

CHAPTER 2 OPERATION

2.1 INTRODUCTION

The ENI 510L RF amplifier is used to increase the r.f. output level of signal sources in the 1.7 to 500 MHz range. No tuning or any other form of adjustment is required other than the selection of the correct power supply input voltage.

The 510L produces rated power output at its output connector, regardless of load impedance. Any power reflected due to output load mismatch is absorbed in the amplifier. Therefore, although the output impedance is 50 ohms (typical VSWR: 2:1), the amplifier will work into any load impedance.

2.2 RACK INSTALLATION

For standard nineteen inch relay 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. Verify left and right brackets by positioning them next to the cover screw holes and noting that the bottom of each bracket is flush with the base of the chassis. Attach the rack mounting brackets firmly using the hardware removed above. The rubber feet may be unscrewed and removed if the minimum vertical usage of the relay rack is necessary.

2.2.1 Mains Voltage Setting

The supply voltage selection switch is located at the rear of the instrument and is normally set for 115 V a.c. operation.

CAUTION

Before connecting the unit to the mains supply, check that the supply voltage selection 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.

2.2.2 Mains Fuse Rating

The mains fuse F1 is located on the rear panel. The replacement part number details are:

4 amp	Slow Blow	ENI Part No. 313004

The 4 amp rating is correct for both 115 and 230 volts a.c.

2.2.3 Mains Lead Connection

For 230 V a.c. operation, a suitable mains supply plug must be fitted to the mains lead attached to the instrument. The three conductors are coded as follows:

BLACK	-	Live
WHITE	-	Neutral
GREEN	-	Earth

2.3 OPERATION

Determine and adjust the voltage setting and fuse rating as described in the previous sections 2.2.1 and 2.2.2 then proceed as follows:

(i) Ensure input voltage is not excessive

The 1 V rms indicated maximum input voltage is 5 times the level of the input signal required to achieve maximum output. Input voltages in excess of 2 volts peak may permanently damage the instrument.

(ii) Connect the input signal via a 50 ohm coaxial lead and BNC plug to the input connector.

(iii) Connect the output via a 50 ohm coaxial lead and BNC plug to the load.

CHAPTER 3 TECHNICAL DESCRIPTION

3.1 GENERAL DESCRIPTION

The ENI 510L is designed to amplify signals by 45 dB in the frequency band 1.7 to 500 MHz. The signal from the front panel BNC connector is fed via a length of 50 ohm coaxial cable to the input of the preamplifier module (510L-3446). The signal from the input of the preamplifier is fed via a length of microstrip transmission line to a π network attenuator R1, R2 and R3 (see figure 5.1).

The output from the attenuator is fed to the input of low noise amplifier stage Q1. The output of Q1 is amplified and amplitude leveled by stage Q2. Capacitor C10 is varied to level the gain vs. frequency response of the overall unit. Transistor Q3 supplies its low distortion output through transformers T1 and T2 to preamplifier output stages Q4 and Q5. The high level output is matched and split into four equal amplitude and phase signals at J3, J4, J5, and J6 by transformers T3, T4, T5, and T6. These signals are distributed by 50 ohm coaxial cables to form the inputs of four identical power amplifier modules (510L-4441) mounted on the side plate heatsinks.

The input signal is matched and attenuated by resistors R1, R2, R3 and R4 and capacitors C1 and C3 and coupled to the base of transistor Q1. The output signal at the collector of Q1 is then split into two equal phase and amplitude signals by transformer T2. Transformer T1 matches the output impedance of Q1 to the input impedance of T2. The two output signals from T2 are fed through attenuators R12, R13, R14 to Q2 and R44, R45, R46, to Q5 respectively. The output signal from Q2 is impedance matched and split into two equal phase and amplitude signals by transformers T3 and T4 where they are fed to the bases of Q3 and Q4 through π attenuators. In a like manner, the output of Q5 is impedance matched and split into two equal phase and amplitude signals by transformer T6 and T7 where they are fed to the bases of Q6 and Q7 through π attenuators.

The outputs of the four power amplifier stages Q3, Q4, Q6 and Q7 are combined by hybrid transformers T5, T8 and T9. Capacitors C68, C69 and transformer T10 match the combined RF output signal to 50 ohms at connectors J11, J12, J13, and J14 respectively. The outputs of the four power amplifier modules are fed via 50 ohm coaxial cable to the output combiner module 510L-4443.

Hybrid transformers T1, T2 and T3 vectorially sum the power outputs of the power amplifier modules. Transformer T4 and capacitors C1 and C2 match the output impedance of the combiner to 50 ohms. Resistors R1, R2, R3, R4 and R5 will dissipate power only if the power amplifiers are unmatched or a failure has occurred. The output of the combiner module is sent to the output BNC connector on the front panel via a length of coaxial cable and connector module 510L-4445.

The amplifier power requirements are 115V or 230V a.c. at 250 watts. The power supply regulator (510L-4444) provides a 15V d.c. 500 ma source and a 22V d.c. 11 ampere source. The 15V d.c. source is regulated by series pass transistor Q1 and integrated circuit IC1. R2 adjusts the supply to 15 volts. The 22V d.c. source is regulated by series pass transistors Q3, Q4, Q5, and Q6 and integrated circuit IC2. Transistor Q2 drives the pass transistors in a Darlington arrangement. Resistor R10 controls the output voltage. Resistor R8 adjusts the short circuit load current to 12 amperes, thereby protecting the power supply from over-dissipation. The front panel light located in the front panel push button assembly is connected to the 22V d.c. supply and will indicate when the power supply is operating.

CHAPTER 4 MAINTENANCE

4.1 INTRODUCTION

The ENI 510L RF amplifier requires no periodic maintenance. The instrument is unconditionally stable and is failsafe under all load conditions. Damage can only be externally caused by the incorrect selection of the supply voltage or by an input signal in excess of the specified 1 volt rms maximum.

This chapter therefore, deals only with certain fundamental procedures for fault location and with the subsequent re-alignment procedures.

Performance limits quoted are for guidance only and should not be taken for guaranteed performance specifications unless they are also quoted in the Data Summary Section 1.2.

4.2 ACCESS AND LAYOUT

The ENI Model 510L RF amplifier is housed in an aluminum chassis. The cover can be removed by releasing the ten screws on the side of the unit and eight screws on the top and lifting by the handle.

The lamp indicator in the on-off switch may be replaced by unscrewing the knurled bezel on the switch and removing the lamp assembly.

The rear panel supports the mains fuse holders, the mains input voltage selector switch (S2) and the cooling fan.

The preamplifier module is mounted to the baseplate with three #4-40 screws. Each of the power amplifier side plates are mounted to the base plate by three #6-32 screws. Before removal of either of these plates it is necessary to first remove the coaxial cables connected to it and the appropriate leads from the terminal block located on the power supply regulator board.

4.3 PERFORMANCE CHECKS

To determine the amplifier's performance carry out the following procedure.

4.3.1 Initial Check

The following check can be made after repair and adjustments or whenever the condition of the unit is in question.

(i) Connect power supply. Switch on power and observe that the supply lamp (DS1) illuminates.

(ii) Connect a sweep generator (Wavetek 2001 or similar) capable of sweeping the frequency range 1.7 to 500 MHz to the input connector.

(iii) Adjust the output level of the sweep generator so that a 50 ohm video detector connected at the output of the unit will not be damaged by excessive power output.

(iv) Observe the gain versus frequency ripple on an oscilloscope calibrated in decib The gain variation must be not more than ± 1.5 dB over the frequency range.

(v) Connect a calorimetric power meter (HP434 or equivalent) through a short length of 50 ohm cable to the output connector. Adjust the input CW signal to any frequency between 1.7 and 500 MHz for 9.5 watts output.

(vi) Observe the harmonic distortion of the output on a spectrum analyzer. The harmonic components contributed by the amplifier should be at least 20 dB down from the fundamental.

If the requirements of this check are not met, verify that:

(a) The mains supply switch and fuse are correctly selected and that DS1 is illuminated.

(b) The preamplifier supply voltage is set at 24 volts by R2.

(c) The power amplifier supply voltage is set at 22 volts by R10.

If the above checks are found to be correct, then normal fault location procedures, with reference to the circuit diagram Figure 5.1 should be followed to determine the correct operatic of the preamplifier and power amplifier modules.

If the ENI 802 module is found to be faulty it will be necessary to obtain a replacement module from our Service Division or return the complete unit for repair. Replacement of the module or any other part of the signal line will require the instrument to be re-aligned.

4.4 RE-ALIGNMENT PROCEDURE

Before any adjustment is made to the unit, first

(i) Ensure that the mains switch and fuse are correctly selected and that DS1 is illuminated.

(ii) Measure the power supply voltages and adjust per section 4.3.1 (b) and 4.3.1 (c).

4.4.1 Measurement of Gain

Equipment required:

(a) Oscilloscope - Telequipment Model S54A
(b) Sweep/Signal Generator - Wavetek 2001
(c) 50 ohm Detector - Wavetek D151
(d) Attenuator, 10 dB, 20 watts - Narda 766-10

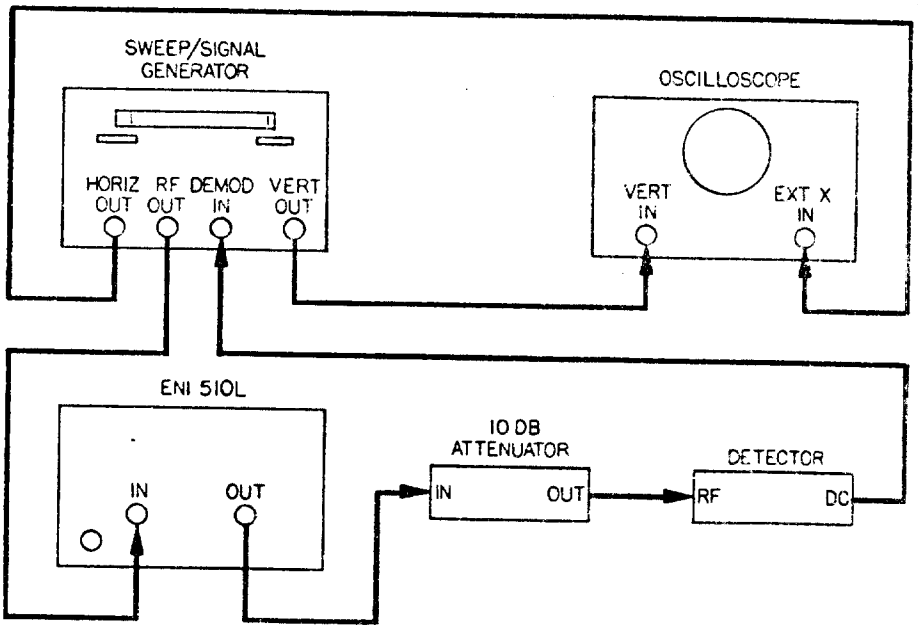

Figure 4-1 Gain Measurement

Connect the equipment as shown in Figure 4.1, then proceed as follows:

(a) Set the oscilloscope to DC, time/CM to Ext. X, and vertical gain to 10MV/CM.

(b) Set the sweep/generator to the S/S mode with the start frequency at 1.7 MHz and the sweep width to 500 MHz.

(c) Disconnect the ENI 510L from the set-up and connect the sweep/generator RF output directly to the 10 dB attenuator.

(d) Adjust the output level of the sweep/generator for full vertical deflection on the oscilloscope face.

(e) Calibrate the scope face to show 3 dB in 1 dB steps by attenuating the sweep/generator in 1 dB steps and marking the traces with a grease pencil.

(f) Return sweep/generator output level to full deflection. Rotate the step attenuator on the sweep/generator (CCW) so that the output is reduced by 45 dB.

(g) Reconnect the 510L into the test set-up of Figure 4.1.

(h) Push the 510L power switch to the "on" position.

(i) Observe the gain versus frequency sweep on the oscilloscope. Adjust the output of sweep/signal generator so that trace is centered.

1. The average gain should be 46 dB (within 1.5 dB).

2. The gain variation should be within the 3 dB markings as shown on the oscilloscope.

(j) If the gain versus frequency sweep is out of specification, adjust C5 (located beneath the snap plug on the pre-amplifier module) using an insulated slotted screwdriver until the sweep observed on the oscilloscope is within the 3 dB markings.

4.4.2 Measurement of Harmonics

Equipment required:

(a) Sweep/Signal generator - Wavetek 2001
(b) Attenuator, 30 dB-Bird 8321
(c) Calorimetric Power Meter - HP434A

(d) Spectrum Analyzer - HP140T Display Unit
HP85541 Spectrum Analyzer
RF Section
HP8552A Spectrum Analyzer
IF Section

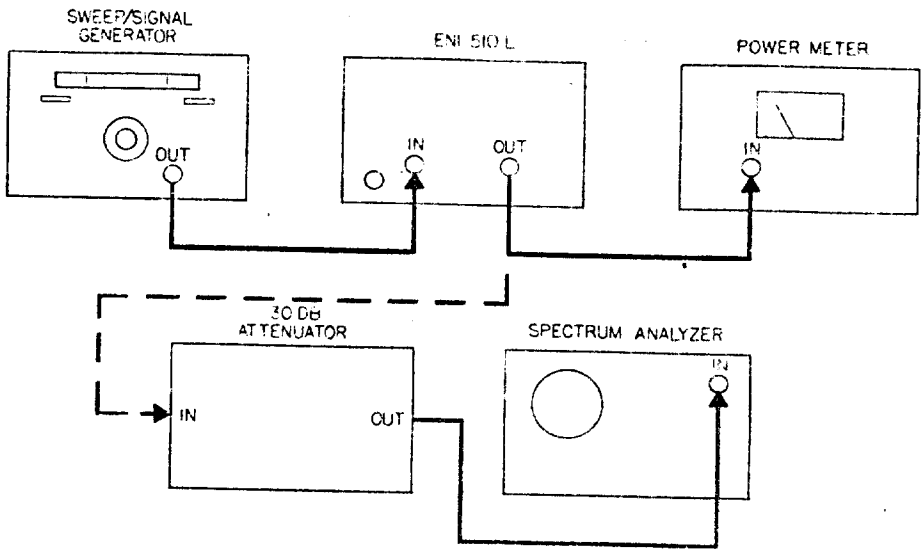

Figure 4-2 Harmonic Measurement

Connect the equipment as shown in Figure 4.2 then proceed as follows:

(a) Adjust the sweep/signal generator at a CW center frequency of 150 MHz for an indicated output of 9.5 watts on the power meter.

(b) Using the spectrum analyzer, check that the level of the carrier harmonics are less than -20 dB with respect to the carrier.

(c) If the above specification is not met, the 22 volt d.c. supply may be varied up to ±.5 V to reduce the harmonic level.

4.5 PACKAGING FOR RESHIPMENT

In the event of the equipment being returned for servicing it should be packed in the original shipping carton and packing material. If this is not available wrap the instrument in heavy paper or plastic and place in a rigid outer box of wood, fiberboard or very strong corrugated cardboard. Use ample soft packing to prevent movement. Provide additional support for projecting parts to relieve these of unnecessary shock. Close the carton securely and seal with durable tape. Mark the shipping container FRAGILE to ensure careful handling.

CHAPTER 5 SCHEMATIC AND PARTS LIST

5.1 SCHEMATIC DIAGRAM

A complete schematic diagram appears in figure 5.1.

5.2 PARTS LIST

Table 5.1 provides a listing of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagrams. Parts list includes a description, part number and manufacturers federal supply code number. Table 5.2 provides a reference glossary of abbreviations used in the parts list.

5.3 LIST OF MANUFACTURERS

Table 5.3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code numb (10226) appears, that part must be obtained directly from Electronic Navigation Industries, In

5.4 ORDERING REPLACEMENT PARTS

To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc. or its authorized service facility. Identify parts by number as listed in the parts list.

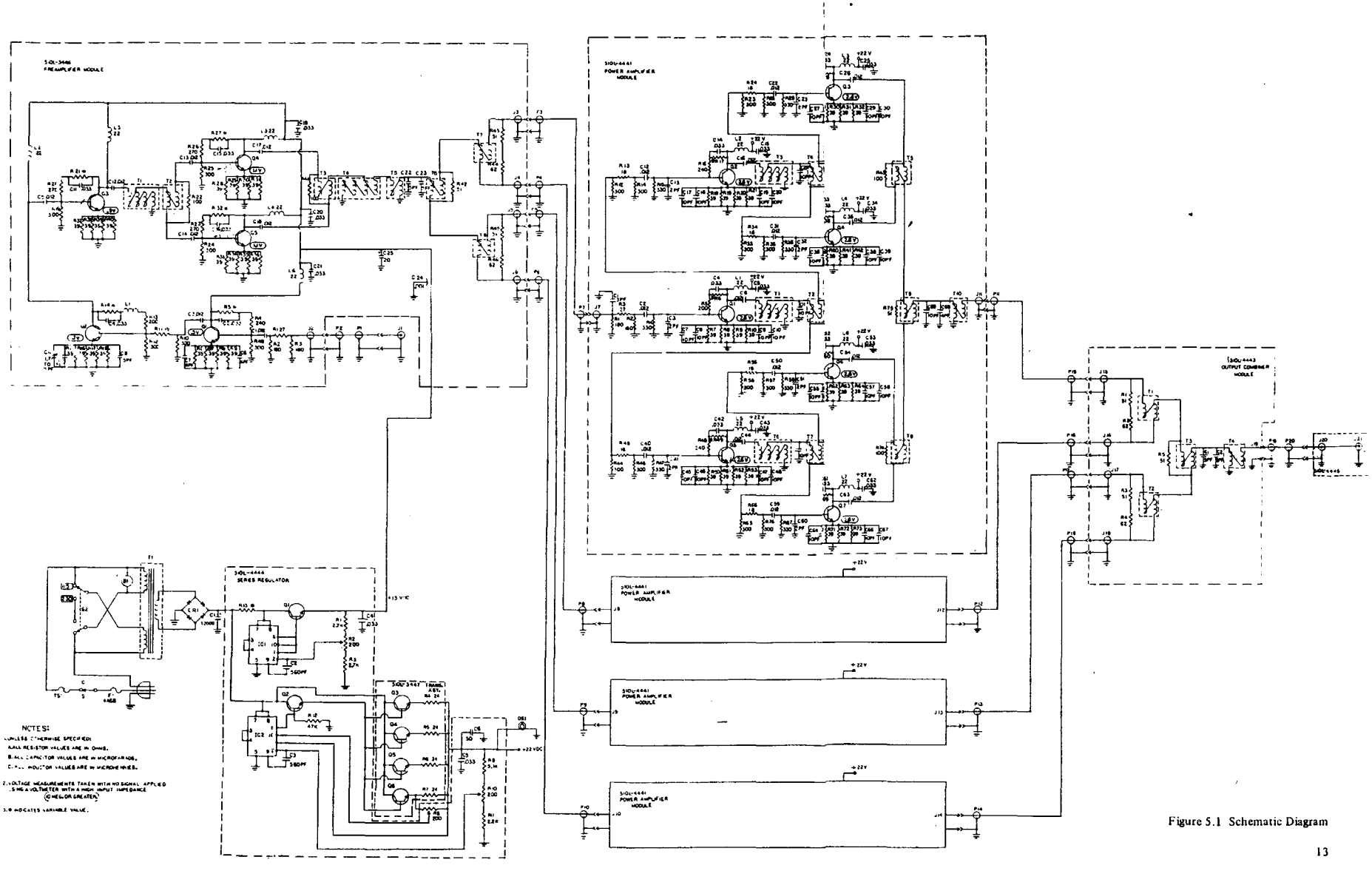

Figure 5.1 Schematic Diagram

TABLE 5-1. REPLACEMENT PARTS LIST

REF. DESIGN.	DESCRIPTION	MFR. CODE	PART NO.
	POWER DISTRIBUTION ASSEMBLY		
B1	Motor, Fan	28875	WS2107F-110
C1	Cap., Elect, 12000UF, 50 VDCW	56289	36D902G050BC2A
CR1	Bridge, Rect.	04713	MDA990-2
F1	Fuse, Type 3AG4ASB	75915	313004
XF1	Fuseholder	75915	342001
J1, J2	Jack, Type BNC	13511	UG625 B/U
S1	Switch	87034	675-6
S2	Switch	22753	622HK-115/230
T1	Transformer	12715	AM-8059
TS1	Thermostat	14604	2450-88-105
A79	Feed Thru Board	10226	510L-4445
	Transistor Assy	10226	510L-3447
Q3-Q6	Transistor, Power	10226	ENI-1
R4-R7	Resistor, Comp., .24 ohm 1% 2W	75042	IRC-BWH
A-63	Power Supply Reg. Board	10226	510L-4444
R1	Resistor, Comp, 2.7K ohm 5%, 1/4W	01121	HC-5
R2	Pot., 200 ohm	32997	3389T-1-201
R3	Resistor, Comp, 2.7K ohm 5%, 1/2W	16299	HC-5
R8	Pot., 200 ohm	32997	3389T-1-201
R9	Resistor, Comp, 5.1K ohm 5%, 1/2W	16299	HC-5
R10	Pot., 200 ohm	32997	3389T-1-201
R11	Resistor, Comp, 2.2K ohm 5%, 1/2W	16299	HC-5
R12	Resistor, Comp, 47K ohm 5%, 1/4W	01121	RC07GF472J
C2, C3	Cap, MICA, 560PF, 5%	09023	CM06FD561J03
C4, C5	Cap, CER, .033UF, 50 VDCW	72982	812-1-050-651333Z
C6	Cap, Elect, 50UF, 50 VDCW	56289	500D506G050DD7
IC1, IC2	Voltage Regulator	49956	RC723T
Q1, Q2	Transistor, Power	79089	40312
	RF PREAMPLIFIER ASSEMBLY		
C24	Capacitor Feed-thru 1000Pf	72982	
A87	Preamplifier Board	10226	510L-4442
R1	Resistor, Comp. 27 ohm 5% 1/8W	01121	RC05GF270J
R2, R3	Resistor, Comp. 180 ohm 5% 1/8W	01121	RC05GF181J
R4	Resistor, Comp. 240 ohm 5% 1/4W	01121	RC07GF241J

REF. DESIGN	DESCRIPTION	MFR. CODE	PART NO.
	RF PREAMPLIFIER ASSEMBLY (Cont.)		
R5	Resistor, Comp. Variable	01121	
R6-R9	Resistor, Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
R10	Resistor, Comp. 300 ohm 5% 1/8W	01121	RC05GF301J
R11	Resistor, Comp. 18 ohm 5% 1/8W	01121	RC05GF180J
R12	Resistor, Comp. 300 ohm 5% 1/8W	01121	RC05GF301J
R13	Resistor, Comp. 200 ohm 5% 1/4W	01121	RC07GF201J
R14	Resistor, Comp. Variable	01121	
R15-R18	Resistor, Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
R19	Resistor, Comp. 300 ohm 5% 1/4W	01121	RC07GF301J
R20	Resistor, Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
R22	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
R23	Resistor, Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
R24, R25	Resistor, Comp. 300 ohm 5% 1/4W	01121	RC07GF301J
R26	Resistor, Comp. 270 ohm 5% 1/4W	01121	RC07GF271J
R27	Resistor, Comp. Variable	01121	
R28-R31	Resistor, Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
R32	Resistor, Comp. Variable	01121	
R33-R40	Resistor, Comp. 39 ohm 5% 1/4W	01121	RC07GF390J
R41	Resistor, Comp. 100 ohm 5% 1/4W	01121	RC07GF101J
R42, R43	Resistor, Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
R44	Resistor, Comp. 62 ohm 5% 1/4W	01121	RC07GF620J
R45	Resistor, Comp. 51 ohm 5% 1/4W	01121	RC07GF510J
R46	Resistor, Comp. 62 ohm 5% 1/4W	01121	RC07GF620J
R48	Resistor, Comp. 300 ohm 5% 1/4W	01121	RC07GF301J
C1	Capacitor, Cer. .012UF, Chip	32159	SC21BX123VS
C2	Capacitor, Cer. .033UF, 50VDCW	72982	8121-050-651-333Z
C3	Capacitor, Cer. .012UF, Chip	32159	SC21BX123VS
C4	Capacitor, Cer. .033UF, 50VDCW	72982	8121-050-651-333Z
C5	Capacitor, Cer. .012UF, Chip	32159	SC21BX123VS
C6, C7	Capacitor, Mica, 4PF, 5%	09023	DM5CC040A
C8, C9	Capacitor, Mica, 5PF, 5%	09023	DM5CC050A
C10	Capacitor, Trimmer, 1.7-10PF	91293	9301
C11	Capacitor, Cer. .033UF, 50VDCW	72982	8121-050-651-333Z
C12-C14	Capacitor, Cer. .012UF, Chip	32159	SC21BX123VS
C15, C16	Capacitor, Cer. .033UF, 50VDCW	72982	8121-050-651-333Z
C17, C18	Capacitor, Cer. .012UF, Chip	32159	SC21BX123VS
C19-C21	Capacitor, Cer. .033UF, 50VDCW	72982	8121-050-651-333Z

REF. DESIGN	DESCRIPTION	MFR. CODE	PART NO.
C22, C23	Capacitor, Mica, 5PF, 5%	09023	DM5CC050A
C25	Capacitor, Lytic, 20MF, 50VDCW	56289	500D206G050
L1	Choke	10226	
L2-L6	Choke, RF, 22UH, 10%	99800	MS18130-24
Q1-Q5	Transistor, Power	10226	LT2001
T1-T8	Transformer	10226	
	RF POWER AMPLIFIER ASSEMBLY		510L-3445
A57	Power Amplifier Board	10226	510L-4441
Q1-7	Transistor, Power	10226	CD2240
R1, R2	Resistor, Comp, 180 ohm 5%, 1/8W	01121	RC05GF181J
R3	Resistor, Comp, 27 ohm 5%, 1/8W	01121	RC05GF270J
R4	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R5	Resistor, Comp, 200 ohm 5%, 1/2W	01121	RC20GF201J
R6	Resistor, Comp, Variable 5%, 1/2W	01121	
R7-10	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R11	Resistor, Comp, 100 ohm 5%, 1/4W	01121	RC07GF101J
R12	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R13	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R14	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R15	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R16	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R17	Resistor, Comp, Variable 5%, 1/2W	01121	
R18-21	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R22	Resistor, Comp, 100 ohm 5%, 1/4W	01121	RC07GF101J
R23	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R24	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R25	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R26	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R27	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R28	Resistor, Comp, Variable 5%, 1/2W	01121	
R29-32	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R33	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R34	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R35	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R36	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R37	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R38	Resistor, Comp, Variable 5%, 1/2W	01121	
R39-42	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J

REF. DESIGN	DESCRIPTION	MFR. CODE	PART NO.
	RF POWER AMPLIFIER ASSEMBLY (Cont.)		
R43	Resistor, Comp, 100 ohm 5%, 1/4W	01121	RC07GF101J
R44	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R45	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R46	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R47	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R48	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R49	Resistor, Comp, Variable 5%, 1/2W	01121	
R50-53	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R54	Resistor, Comp, 100 ohm 5%, 1/4W	01121	RC07GF101J
R55	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R56	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R57	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R58	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC05GF331J
R59	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R60	Resistor, Comp, Variable 5%, 1/2W	01121	
R61-64	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R65	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
R66	Resistor, Comp, 18 ohm 5%, 1/8W	01121	RC05GF180J
R67	Resistor, Comp, 330 ohm 5%, 1/4W	01121	RC07GF331J
R68	Resistor, Comp, 240 ohm 5%, 1/2W	01121	RC20GF241J
R69	Resistor, Comp, Variable 5%, 1/2W	01121	
R70-73	Resistor, Comp, 39 ohm 5%, 1/4W	01121	RC07GF390J
R74	Resistor, Comp, 100 ohm 5%, 1/4W	01121	RC07GF101J
R75	Resistor, Comp, 51 ohm 5%, 1/4W	01121	RC07GF510J
R76	Resistor, Comp, 300 ohm 5%, 1/8W	01121	RC05GF301J
C1	Cap, MICA, 3PF, 5%	09023	DM5CC030A
C2	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C3	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C4, C5	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C6	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C7-11	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C12	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C13	Cap, MICA, 2 PF, 5%	09023	DM5CC020A
C14, C15	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C16	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C17-21	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C22	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C23	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C24, C25	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C25-C26	Cap, Cer, .012UF, Chip	32159	SC21BX123V

REF. DESIGN	DESCRIPTION	MFR. CODE	PART NO.
	RF POWER AMPLIFIER ASSEMBLY (Cont.)		
C27-30	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C31	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C32	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C33, C34	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C35	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C36-39	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C40	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C41	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C42, C43	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C44	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C45-49	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C50	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C51	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C52, C53	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C54	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C55-58	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C59	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C60	Cap, MICA, 2PF, 5%	09023	DM5CC020A
C61, C62	Cap, Cer, .033UF, 50 VDCW	72982	8121-050-651-333Z
C63	Cap, Cer, .012UF, Chip	32159	SC21BX123V
C64-67	Cap, MICA, 10PF, 5%	09023	DM5CC100A
C68	Cap, MICA, 4PF, 5%	09023	DM5CC040B
C69	Cap, MICA, 10PF, 5%	09023	DM5CC100A
L1-7	Choke, RF, 22UH, 10%	99800	MS18130-24
T1	Transformer	10226	
T2	Transformer	10226	
T3	Transformer	10226	
T4	Transformer	10226	
T5	Transformer	10226	
T6	Transformer	10226	
T7	Transformer	10226	
T8	Transformer	10226	
T9	Transformer	10226	
T10	Transformer	10226	
	OUTPUT COMBINER		510L-4443
R1	Resistor, Comp, 51 ohm 5%, 1/4W	01121	RC07GF510J
R2	Resistor, Comp, 62 ohm 5%, 1/4W	01121	RC07GF620J
R3	Resistor, Comp, 51 ohm 5%, 1/4W	01121	RC07GF510J
R4	Resistor, Comp, 62 ohm 5%, 1/4W	01121	RC07GF620J

REF. DESIGN	DESCRIPTION	MFR. CODE	PART NO.
	RF POWER AMPLIFIER ASSEMBLY (Cont.)		
R5	Resistor, Comp, 51 ohm 5%, 1/2W	01121	RC20GF510J
C1, C2	Cap, MICA, 5PF 5%	09023	DM5CC050A
T1, T2	Transformer	10226	
T3	Transformer	10226	
T4	Transformer	10226	

TABLE 5.2. GLOSSARY OF ABBREVIATIONS

AMP	AMPERES	PF	PICOFARAD
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
CER	CERAMIC	SIL	SILICON
COMP	COMPOSITION CARBON	UF	MICROFARADS
DPDT	DOUBLE-POLE THROW	UH	MICROHENRY
ELECT	ELECTROLYTIC	V	VOLTS
IN	INCHES	VAR	VARIABLE
K	KILOHMS	VDCW	DC WORKING VOLTS
MTG	MOUNTING	W	WATTS
MW	MILLIWATTS	WW	WIRE WOUND

TABLE 5.3. LIST OF MANUFACTURERS

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
01121	Allen-Bradley Co.	Milwaukee, WI.
04713	Motorola, Inc. Semiconductor Prod. Div.	Phoenix, AZ.
09023	Cornell-Dubilier Electronics	Sanford, N.C.
10226	ELECTRONIC NAVIGATION INDUSTRIES, INC.	Rochester, N.Y.
12715	American Magnetics Corp.	Carterville, IL.
13511	Amphenol Corp. Inc.	Los Gatos, CA.
14604	Elmwood Sensors, Inc.	Cranton, R.I.
16299	Corning Glass	Raleigh, N.C.
22753	U I D Electronics Corp.	Hollywood, FL.
32997	Bourns, Inc.	Riverside, CA.
49956	Raytheon Co.	Lexington, MA.
56289	Sprague Electric Co.	N. Adams, MA;
72982	Erie Technological Products, Inc.	Erie, PA.
75042	I R C Div. of TRW, Inc.	Philadelphia, PA.
75915	Littlefuse, Inc.	Des Plaines, IL.
79089	RCA	Harrison, N.Y.
99800	Delevan Electronics Corp.	E. Aurora, N.Y.
72619	Dialight Corp.	Brooklyn, N.Y.
28875	IMC Magnetics	Rochester, N.H.
32159	West-Cap Arizona	Tucson, AZ.
71590	Centralab Electronics	Milwaukee, WI.
83003	Varo, Inc.	Garland, TX.
87034	Marco Oak Industries	Anaheim, CA.
91293	Johanson Manufacturing Co.	Boonton, N.J.

ADDENDUM

All Model 510L broadband power amplifiers with serial number 126 or higher use a new Preamplifier Module (510L-3446) design. The newer module is physically interchangeable with the old module and its electrical characteristics are identical with the exception of its required voltage supply level. The new module requires +15 volts d.c. at 500 ma while the old module required +24 volts d.c. at 500 ma.

The changes in the manual text that result from the new circuitry are entered in the following by paragraph and page number:

3.1 GENERAL DESCRIPTION

paragraph 2 and 3 (page 5)

The output from the attenuator is fed to the input of low noise amplifier stage Q1. The output of Q1 is amplified and amplitude leveled by stage Q2. Capacitor C10 is varied to level the gain vs. frequency response of the overall unit. Transistor Q3 supplies its low distortion output through transformers T1 and T2 to preamplifier output stages Q4 and Q5. The high level output is matched and split into four equal amplitude and phase signals at J3, J4, J5, and J6 by transformers T3, T4, T5, and T6. These signals are distributed by 50 ohm coaxial cables to form the inputs of four identical power amplifier modules (510L-4441) mounted on the side plate heatsinks.

paragraph 7 (page 6)

The amplifier power requirements are 115V or 230V a.c. at 250 watts. The power supply regulator (510L-4444) provides a 15 V d.c. 500 ma source and a 22 V d.c. 11 ampere source. The 15 V d.c. source is regulated by series pass transistor Q1 and integrated circuit IC1. R2 adjusts the supply to 15 volts. The 22 V d.c. source is regulated by series pass transistors Q3, Q4, Q5, and Q6 and integrated circuit IC2. Transistor Q2 drives the pass transistors in a Darlington arrangement. Resistor R10 controls the output voltage. Resistor R8 adjusts the short circuit load current to 12 amperes, thereby protecting the power supply from over-dissipation. The front panel light located in the front panel push button assembly is connected to the 22 V d.c. supply and will indicate when the power supply is operating.

4.3.1. INITIAL CHECK

paragraph 10 (page 8)

(b) The preamplifier supply voltage is set at 15 volts by R2.

4.4.1 MEASUREMENT OF GAIN

paragraph 11 (page 10)

(j) If the gain vs. frequency sweep is out of specification, adjust C10 (located beneath the snap plug on the preamplifier module) using an insulated slotted screwdriver until the sweep observed on the oscilloscope is within the 3dB markings.

RF Preamplifier Assembly (Pages 15,16 & 17)

Ref. Design	Description	MFR. Code	Part No.
C24	Capacitor Feed-thru 1000Pf	72982	
A-62	Preamplifier Board	10226	510L-4442
R1	Resistor,Comp.27 ohm 5% 1/8W	01121	RC05GF270J
R2,R3	Resistor,Comp.180 ohm 5% 1/8W	01121	RC05GF181J
R4	Resistor,Comp.240 ohm 5% 1/4W	01121	RC07GF241J
R5	Resistor,Comp. Variable	01121	
R6-R9	Resistor,Comp.39 ohm 5% 1/4W	01121	RC07GF390J
R10	Resistor,Comp.300 ohm 5% 1/8W	01121	RC05GF301J
R11	Resistor,Comp.18 ohm 5% 1/8W	01121	RC05GF180J
R12	Resistor,Comp.300 ohm 5% 1/8W	01121	RC05GF301J
R13	Resistor,Comp.200 ohm 5% 1/4W	01121	RC07GF201J
R14	Resistor,Comp. Variable	01121	
R15-R18	Resistor,Comp.39 ohm 5% 1/4W	01121	RC07GF390J
R19	Resistor,Comp.300 ohm 5% 1/4W	01121	RC07GF301J
R20	Resistor,Comp.270 ohm 5% 1/4W	01121	RC07GF271J
R22	Resistor,Comp.100 ohm 5% 1/4W	01121	RC07GF101J
R23	Resistor,Comp.270 ohm 5% 1/4W	01121	RC07GF271J
R24,R25	Resistor,Comp.300 ohm 5% 1/4W	01121	RC07GF301J
R26	Resistor,Comp.270 ohm 5% 1/4W	01121	RC07GF271J
R27	Resistor,Comp. Variable	01121	
R28-R31	Resistor,Comp.39 ohm 5% 1/4W	01121	RC07GF390J
R32	Resistor,Comp. Variable	01121	
R33-R40	Resistor,Comp.39 ohm 5% 1/4W	01121	RC07GF390J
R41	Resistor,Comp.100 ohm 5% 1/4W	01121	RC07GF101J
R42,R43	Resistor,Comp.51 ohm 5% 1/4W	01121	RC07GF510J
R44	Resistor,Comp.62 ohm 5% 1/4W	01121	RC07GF620J
R45	Resistor,Comp.51 ohm 5% 1/4W	01121	RC07GF510J
R46	Resistor,Comp.62 ohm 5% 1/4W	01121	RC07GF620J
R48	Resistor,Comp.300 ohm 5% 1/4W	01121	RC07GF301J
C1	Capacitor,Cer. .012UF, Chip	32159	SC21BX123VS
C2	Capacitor,Cer. .033UF,50VDCW	72982	8121-050-65 333Z
C3	Capacitor,Cer. .012UF, Chip	32159	SC21BX123VS
C4	Capacitor,Cer. .033UF,50VDCW	72982	8121-050-65 333Z

FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.