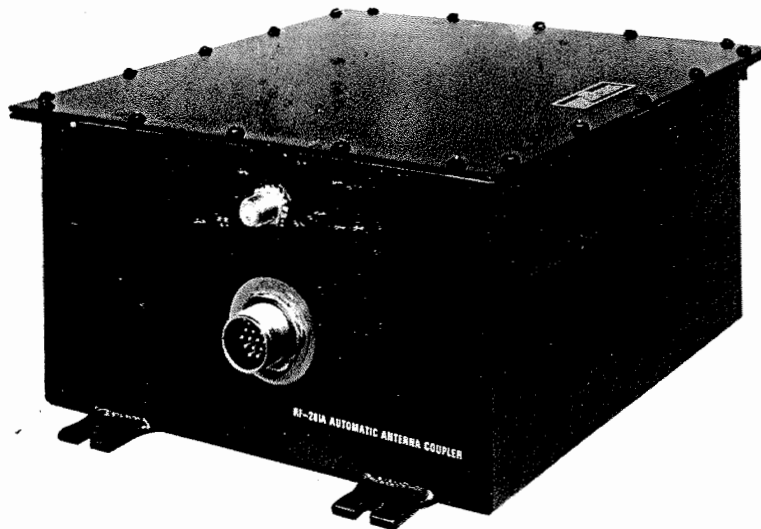


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RF-339
RF-339A
COUPLER CONTROL



RF-281
RF-281A
AUTOMATIC ANTENNA COUPLER



WARRANTY

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PUBLICATION NUMBER: 1960-0009F
DECEMBER 1981

RF-281 RF-281A

AUTOMATIC ANTENNA COUPLER

and

RF-339 RF-339A

COUPLER CONTROL

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COMMUNICATION AND
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HARRIS CORPORATION RF COMMUNICATIONS DIVISION
1680 University Avenue Rochester, New York 14610 U.S.A.
Ph 716-244-5830 Cable RFCOM Rochester, NY TELEX 978464

OPTIONAL EQUIPMENT AND SPARE PARTS

Listed below are optional accessories and spare parts kits available from Harris Corporation for use with the equipment described in this manual. To order any of these items, or to obtain more information concerning them, write to:

HARRIS CORPORATION
RF Communications Division
Rochester, New York
14610 U.S.A.

ATTN: MARKETING DEPARTMENT

or call: (716) 244-5830, and ask for Marketing Department.

When placing an order, please specify the model number.

We will be happy to answer any questions you may have regarding these or any other items we manufacture. We also welcome your evaluation of our equipment and suggestions for other accessory items or spare parts.



HARRIS CORPORATION
RF Communications Division

RF-281/RF-339 SPARES KITS

UNIT	COMPONENT	DESCRIPTION
RF-339	Running Spares Kit (RSK) Part number 1001-0170	RF-339 Fuses
	Site Spares Kit (SSK) Part number 1001-0171	Resistor, switches, LEDs, relays, diodes, etc.
RF-281	Assembly Repair Kit (ARK) Part number 1001-0163	Integrated circuits, capacitors, resistors, etc.
	Maintenance Repair Kit (MRK) Part number 1001-0164	RF-616 Test Set, grease, extender board, test cable, long-wire adapter, control cables (W1, W2), leak test kit, etc.
	Operational Spares Kit (OSK) Part number 1001-0165	Complete system spares
	Running Spares Kit (RSK) Part number 1001-0169	Cover gaskets
	Site Spares Kit (SSK) Part Number 1001-0162	Seals, discriminator assembly, control logic pc board and cover, hardware kit, etc.

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SECTION 1

INTRODUCTION

1.1 SCOPE

1.1.1 Organization of Material

This manual provides information for the installation, operation, and maintenance of the RF-281/281A Automatic Antenna Coupler and the RF-339/339A Coupler Control as follows:

- Section 1: Introduction to the manual and component assemblies or options
- Section 2: Installation information and procedures
- Section 3: Operation
- Section 4: Theory of operation
- Section 5: Maintenance information and procedures
- Section 6: Maintenance Parts List and Component Location Drawings
- Section 7: Schematic Diagrams

1.1.2 Obtaining Additional Information

Contact Harris Corporation, RF Communications Division, 1680 University Avenue, Rochester, New York 14610, for specific information requests. Include detailed identification information for all units and/or components involved in the inquiry.

1.2 GENERAL INFORMATION

The RF-281 and the RF-281A are electrically identical; the "A" suffix designates a standard olive drab case as opposed to a gray case. The RF-339 and the RF-339A are also electrically identical; however, the "A" suffix also denotes the mechanical characteristics described in paragraph 2.4.2 in addition to the color difference. RF-281 or RF-339 will be used in this manual with the "A" suffix understood if appropriate.

The RF-281 automatically matches the output of various 150 watt transceivers and transmitters to a variety of whip and long wire antennas over the frequency range of 1.5 to 30 MHz. Operation, including network tuning and monitoring, is fully automatic. Tuning time is typically seven to eight seconds.

The RF-281 is designed for direct interface with the RF-280, AN/URC-35, AN/WRC-1, and AN/URT-24 Transceivers. The RF-281 may be operated with HF transceivers such as the AN/URC-58, RF-301, AN/GRC-165, RF-301A, AN/FRC-93, KWM-2, and other 100 to 150 watt transmitters, by using the RF-339 to provide the necessary control and logic circuitry.

The RF-281 is designed for continuous operation under the most severe environmental conditions. It is intended for vehicular, transportable, shipboard, and fixed station applications. Automatic sensing circuitry protects the RF-281 from defective antennas or any internal malfunctions.

The RF-281 provides tactical security by permitting remote location of the antenna up to 250 feet from the associated radio transceiver or transmitter. Since a radiating antenna is a potential target under combat conditions, the radio set and operator can be protected at a safe distance from the antenna.

1.3 FUNCTIONAL DESCRIPTION

Tuning of the antenna coupler is fully automatic. Upon receipt of a rechannel pulse from the RF-280 Radio Set or upon an initial primary power-on condition, the antenna coupler tuning elements proceed to the "home" positions. During this portion of the cycle, the transmitter is inhibited from transmitting. Also during this portion of the cycle, after the tuning elements have reached the home positions in an unkeyed condition, the tuning elements are bypassed. If, after receiving a rechannel pulse, the antenna coupler receives a momentary Key (Gnd) signal from the RF-280 Radio Set, the coupler will lock the keyline to ground. This places a continuous signal on the Keyhold/Fault indication line, enabling a tune tone in the RF-280 Radio Set.

After the tuning elements have reached the "Homed" position, the transmit inhibit signal is released. After receipt of a Key (Gnd), the antenna coupler disables the bypass function and enables the tune power circuits of the RF-280 Radio Set. When RF tune power is received, the antenna coupler automatically tunes the antennas to a VSWR of 1.5:1 or less within 15 seconds, maximum (typical time is 8 seconds).

When tuning is completed, the antenna coupler releases the Key (Gnd) line and disables the signal on the Keyhold/Fault indication line. Normal transmissions from the transmitter are then allowed and VSWR protection circuitry is enabled. In the event of high reflected power, the transmitter is inhibited from transmitting and an intermittent signal on the Keyhold/Fault indication line is produced to cause an intermittent tone in the RF-280 Radio Set. Upon receipt of a rechannel pulse from the RF-280 Radio Set, the intermittent tone is removed and the tuning elements proceed to the home positions to start a new sequence.

1.4 QUICK REFERENCE DATA

Table I-1 provides quick reference data for the RF-281 and the RF-339.

1.5 OPTIONS

1.5.1 Mounting Tray RF-285-4

The RF-285-4 Mounting Tray is an optional mount which RF Communications recommends using when mounting the RF-281 in vehicular (jeep) or shipboard installations.

The RF-285-4 acts as a structurally sound mounting surface where the frame on which the RF-281 is to be attached does not meet these requirements (i.e., jeep installations). The RF-285-4 also allows for ease of unit removal for maintenance, etc.

1.5.2 Test Set RF-616

The optional RF-616 Test Set simplifies the troubleshooting process because it provides a constant visual indication of all major logic functions used to control the system. Status lights indicate the presence of the following functions: Key Enable (+), Bypass, Coupler Ready, Keyline, Key Enable (Gnd), Rechannel, B+, Tune/Fault Indication, and Tune Power Request.

The RF-616 provides remote RECHANNEL and KEY switching operations. Test points located on the test set allow the FORWARD and REFLECTED power to be remotely monitored.

Table 1-1. Unit Specifications

RF-281 Automatic Antenna Coupler	
Frequency Range and Tuning Capability	1.5 to 30 MHz – 25 to 35 ft. (7.62 to 10.67m) whips, 75 to 150 ft. (22.86 to 45.72m) long wires, doublets; 2 to 30 MHz – 15 ft. (4.57m) whip; 2.5 to 30 MHz – 9 ft. (2.74m) whip.
Rated RF Input Power	Up to 150 watts PEP and average
Tuning Mode	Fully Automatic
Tuning Accuracy	1.5:1 VSWR or less referenced to 50 ohms
RF Efficiency	Typically 50 to 90% depending on antenna type and frequency
Tuning or Homing Time	Typically 7 to 8 seconds, 15 seconds maximum
Features	VSWR overload fault; Automatic receive capability in untuned state; Tuning and Homing time excess fault
RF Antenna Voltage	Up to 7000 volts peak at 150 watts input
Primary Power Requirements	22 to 36 Vdc at: 5 watts, receive (untuned) 3 watts, receive (tuned) 10 watts, keyed (tuned) 180 watts, tuning (short duration peak) 25 watts, tuning (average)
Tune Power Requirements	10 watts carrier minimum forward power throughout the tuning cycle (20 watts with 250 ft. (76.2m) separation)
Remote Capability	Up to 250 ft. (76.2m) separation between transmitter and RF-281
Operating Environment	Waterproof (sealed), designed for exposed installations
Weight	25 pounds (11.34 Kg), maximum
Size	13.25 x 11.75 x 7.45 inches, excluding projections and flanges (33.65 x 29.84 x 18.92 cm) 17.25 x 12.85 x 7.45 inches, including projections and flanges (43.81 x 32.63 x 18.92 cm)
Operating Temperature Range	-28°C to +65°C
Control Lines	Keyline : ground when system is keyed; RF-281 holds key during tuning cycle Key Enable (GND): ground from RF-281 enables transmitter Key Enable (+) : B+ from RF-281 enables transmitter Tune Power Request : ground places transmitter at tune power level; mutes audio Tune/Fault Indication : +22 Vdc indicates tuning; intermittent indicates fault Rechannel: 30 ms or greater pulse for 10, 1, .1 and .01 MHz transmitter frequency changes homes RF-281, resets fault (if there was one) and enables the receive function until keyed. Forward/Reflected Power Metering Lines : for RF-339 metering; not required for RF-280 Transceiver. Coupler Ready : ground indicates RF-281 ready for RF-339 Interface Control; not required for RF-280 Transceiver

Table 1-1. Unit Specifications (Cont)

RF-339 Coupler Control	
Use	For use with any transmitter not designed with automatic RF-281 control lines and capable of at least 20 watts rf carrier for tuning (40 watts with 250 ft. separation). Designed for direct replacement of RF-302, RF-302A, RF-302R and RF-302RA manual Antenna Couplers.
Transmitter Interface	RF coaxial line only
Primary Power Requirements	115 or 230 Vac, 50/60 Hz or 22 to 36 Vdc
Dummy Load	Self-contained 50 ohm load to facilitate transmitter tuning
Tune Power Requirements	20 to 100 watts carrier – self-contained 3 dB attenuator limits transmitter to VSWR of 3:1 during coupler tuning
Operating Environment	Splashproof – designed for installation with transmitter
Operating Temperature Range	-28°C to +65°C
Size	13.125 x 7.625 x 4.875 inches, excluding projections (33.33 x 19.36 x 12.38 cm) 14.750 x 9.125 x 4.875 inches, including projections (37.46 x 23.17 x 12.38 cm)
Weight	9 pounds (4.08 Kg)
Accessories Supplied	One control cable connector, one six foot coaxial cable with UHF connector, 115 Vac line cord, and a primary power connector kit for 230 Vac or 22 to 36 Vdc power input.

1.5.3 RF-281/RF-339 Repair Kits

Table 1-2 lists various optional repair kits available from RF Communications for the RF-281 and the RF-339. Test Set RF-616 is now part of the Maintenance Repair Kit, part number 1001-0164.

1.5.4 RF-340 DC/DC Converter

The converter provides 24 Vdc when only a 12 Vdc power source is available. The RF-340 mounts directly inside the RF-339 and allows the coupler to operate on either 12 Vdc or 24 Vdc without manual switching.

1.6 COMPONENT ASSEMBLIES

1.6.1 RF-281 Major Component Assemblies

Table 1-3 lists the major assemblies of the RF-281 (see figure 1-1).

1.6.2 RF-339 Major Component Assemblies

Table 1-4 lists the major assemblies of the RF-339 (see figure 1-2).

Table 1-2. RF-281/RF-339 Spares Kits

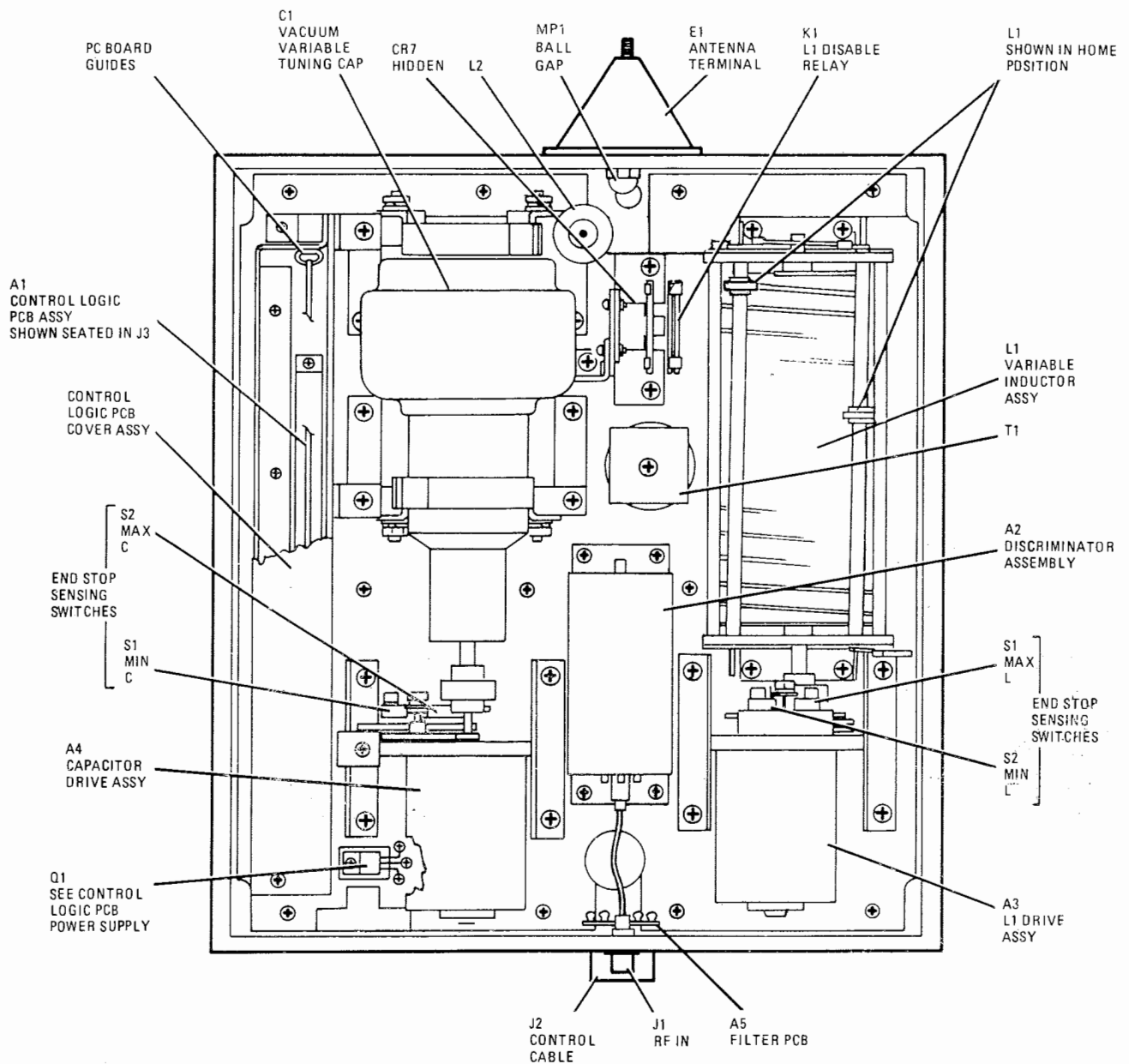
Unit	Component	Description
RF-339	Running Spares Kit (RSK) Part number 1001-0170	RF-339 Fuses
	Site Spares Kit (SSK) Part number 1001-0171	Resistor, switches, LEDs, relays, diodes, etc.
RF-281	Assembly Repair Kit (ARK) Part number 1001-0163	Integrated circuits, capacitors, resistors, etc.
	Maintenance Repair Kit (MRK) Part number 1001-0164	RF-616 Test Set, grease, extender board, test cable, long-wire adapter, control cables (W1, W2), leak test kit, etc.
	Operational Spares Kit (OSK) Part number 1001-0165	Complete system spares
	Running Spares Kit (RSK) Part number 1001-0169	Cover gaskets
	Site Spares Kit (SSK) Part number 1001-0162	Seals, discriminator assembly, control logic pc board and cover, hardware kit, etc.

Table 1-3. RF-281 Major Component Assemblies

Reference Designator	Description
	RF-281 Automatic Antenna Coupler
1A1	Control Logic PC Board
1A2	Discriminator Assembly
1A3	Coil Drive Assembly
1A4	Capacitor Drive Assembly
1A5	Filter PC Board Assembly
1A6	Long Wire Adapter

Table 1-4. RF-339 Major Component Assemblies

Reference Designator	Description
	RF-339 Coupler Control
2A1	Filter PC Board Assembly
2A2	Main PC Board Assembly



REFERENCE DESIGNATOR PREFIX: 1

Figure 1-1. RF-281 Major Component Assemblies

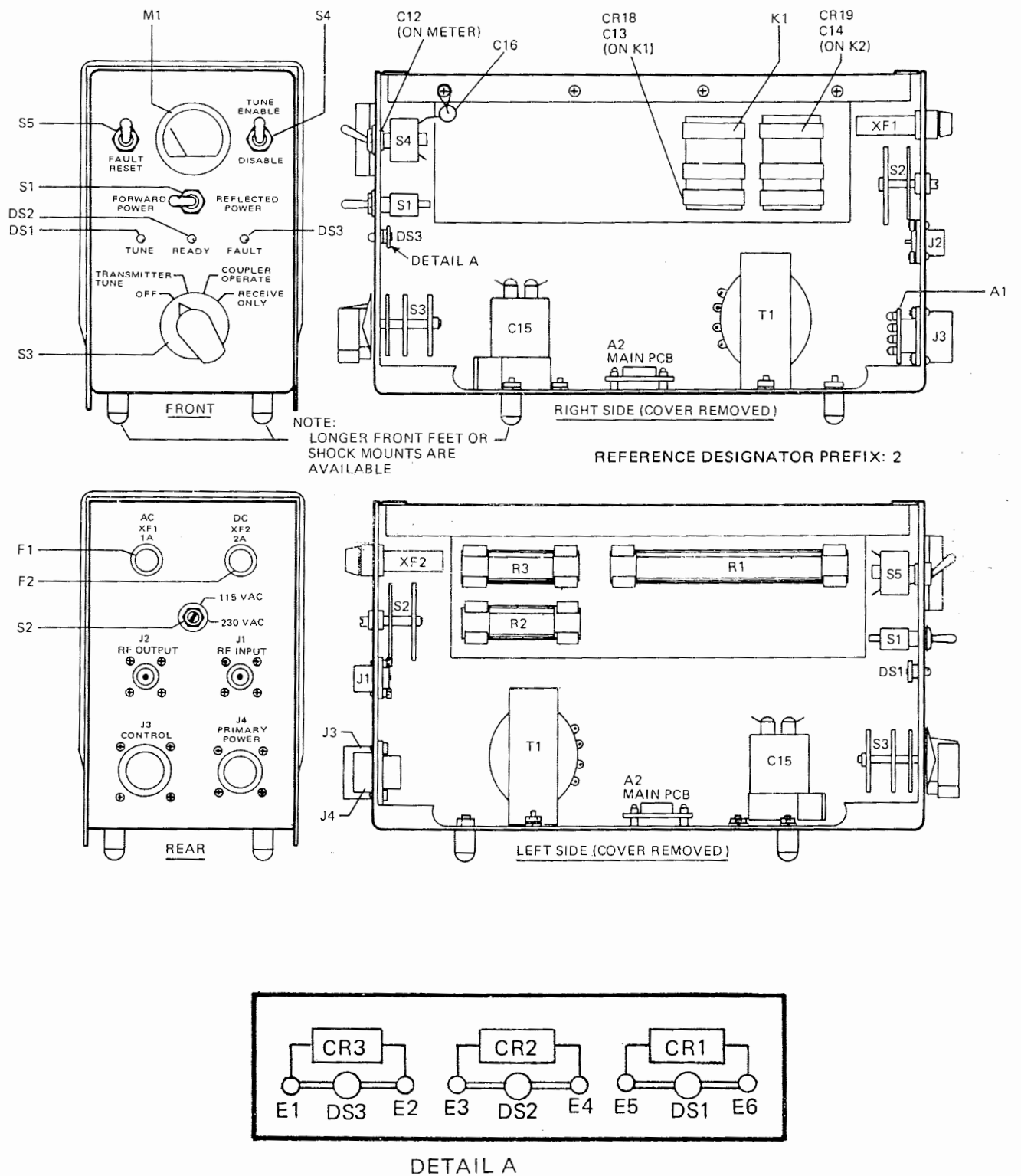


Figure 1-2. RF-339 Major Component Assemblies

SECTION 2

INSTALLATION

2.1 GENERAL

This section contains the information necessary for installation and initial adjustment of the RF-281 and the RF-339.

2.2 UNPACKING AND INSPECTION

Care must be taken when unpacking the RF-281 or the RF-339 to prevent damage to the external components (i.e., connectors, knobs, insulator etc.).

Note

Read all instructions in this manual prior to installation and turn-on.

After unpacking, make a thorough visual inspection of the units. The following check list will serve as a guide for inspection:

- Check external connectors for damage and security.
- Check front panel controls and indicators (RF-339).
- Check antenna terminal insulator (RF-281 only).
- Check for shipping damage.

Caution

Check the threaded hole to the left of control connector J2. If the hole is empty, install the MS51958-76 screw and 600-015-1/4 seal washer provided with the accessory kit.

If any missing or damaged parts are found during inspection they should be referred to Harris Corporation, RF Communications Division, 1680 University Avenue, Rochester, New York 14610 per the warranty page at the front of this manual.

2.3 POWER REQUIREMENTS

2.3.1 RF-339 Primary Power

The RF-339 may be operated with a primary power source of 115 Vac, 230 Vac, or 22 to 36 Vdc. In the 115 or 230 Vac configuration, primary power input connector J4 should be connected as shown in figure 2-1. The applicable ac input voltage must be selected with switch S2 on the RF-339 back panel. In the dc configuration, connector J4 is connected as shown in figure 2-1. Note that switch S2 is bypassed. See figure 2-8 for interface information. The ac line cord assembly (P/N 423-0050, supplied with the RF-339) is wired for 115 Vac operation. A separate connector type MS3106A-16S-1S with an MS-3057-8B clamp and an AN-3420-6A sleeve (P/N 423-0053, cable assembly, if required. See figure 2-1 for connections. Alternatively, disassemble the 115 Vac cable assembly and resolder the connections according to figure 2-1. Cut off the three-prong plug and connect it to the proper connector or terminals.

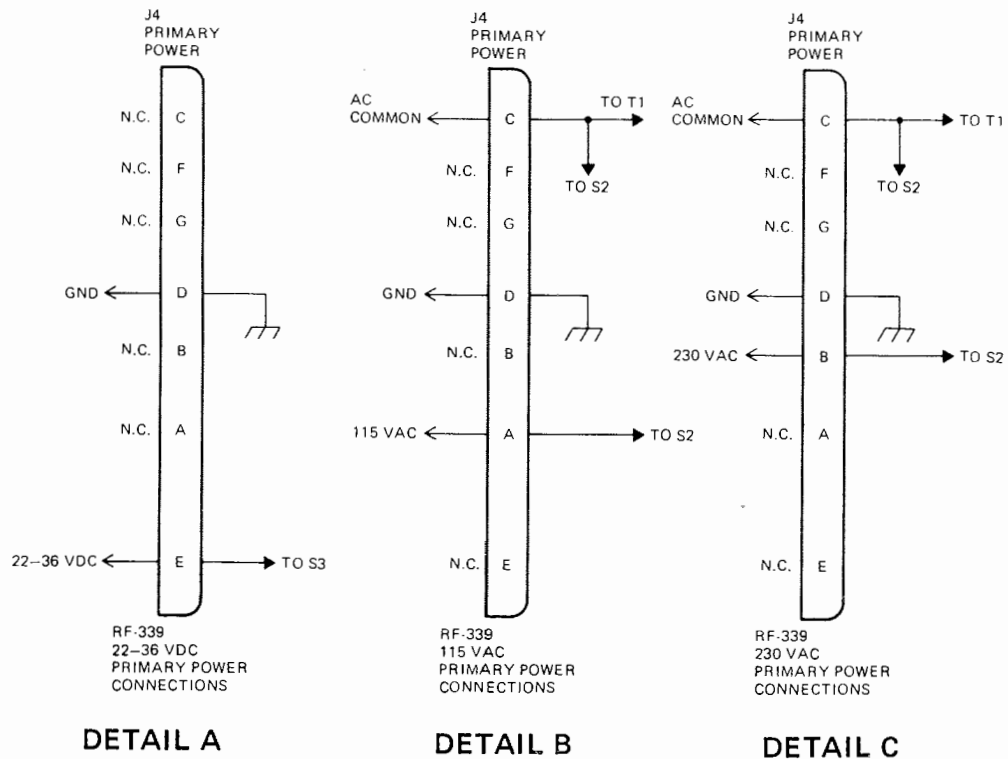


Figure 2-1. RF-339 Primary Power Connections

2.3.2 RF-281 Primary Power

The RF-281 requires a 22 to 36 Vdc primary power source. This voltage may be supplied either through the RF-339 or from a compatible transceiver (i.e., the RF-280).

2.4 MOUNTING

2.4.1 RF-281 Mounting Detail

The RF-281 may be mounted directly to a ships bulkhead, an antenna mast, a vehicle frame, etc. It may also be mounted on the RF-285-4 (optional) for increased mounting stability (see paragraph 1.4.1).

Figure 2-2 shows the mounting dimensions and hardware necessary for the RF-281 and the RF-285-4. Figures 2-5, 2-8 and 2-9 give interfacing information.

There are no installation differences between the RF-281 (gray color) and the RF-281A (olive drab color).

2.4.2 RF-339 Mounting Detail

The RF-339 may be mounted either "free-standing" on four legs or stationary using various configurations of the RF-305 shock mount. (The RF-305 shock mount is used with RF-301 Transceiver).

There are installation differences between the RF-339 and the RF-339A. These differences are as shown in table 2-1, and figure 2-3.

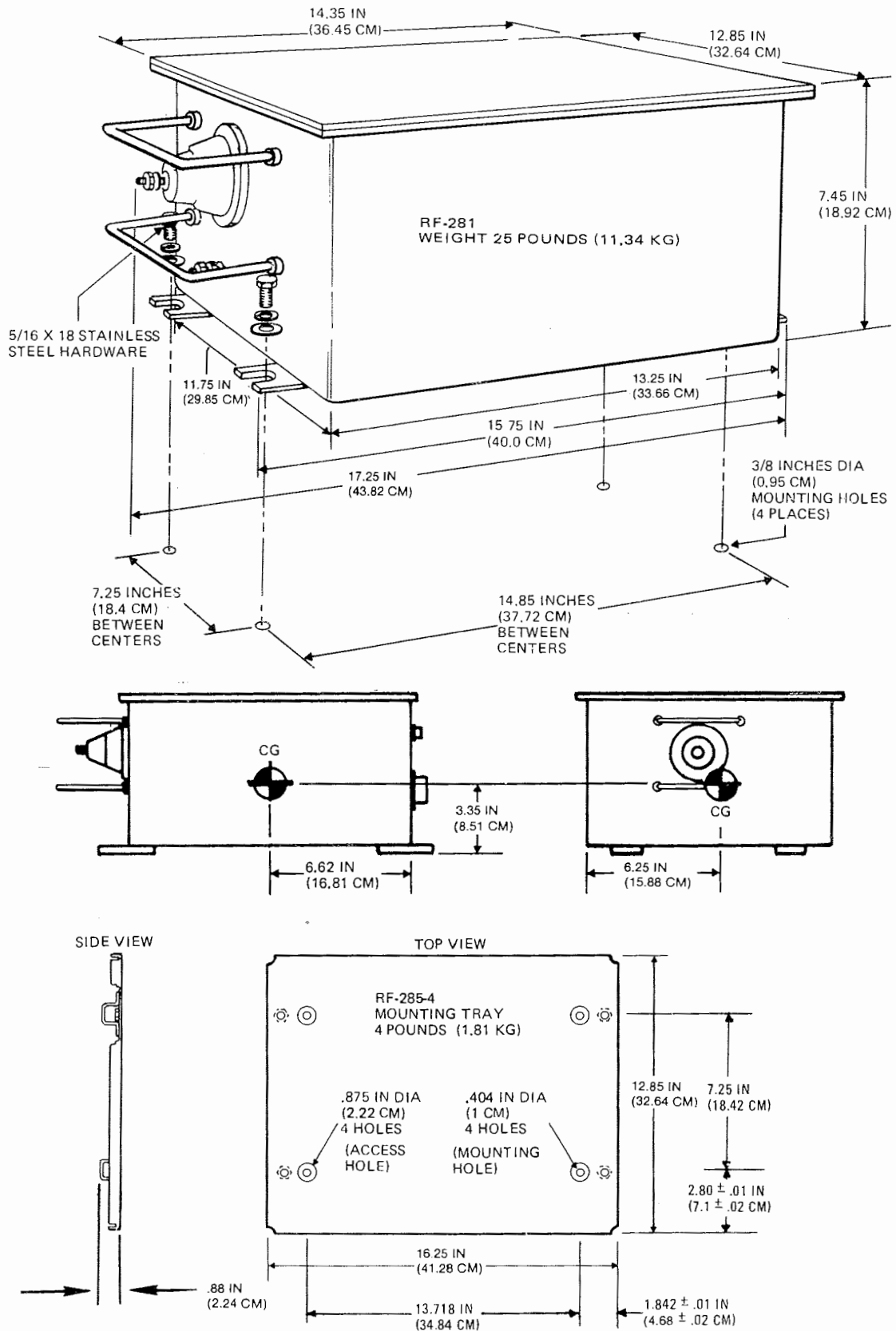


Figure 2-2. RF-281 and RF-285-4 Dimension Drawing

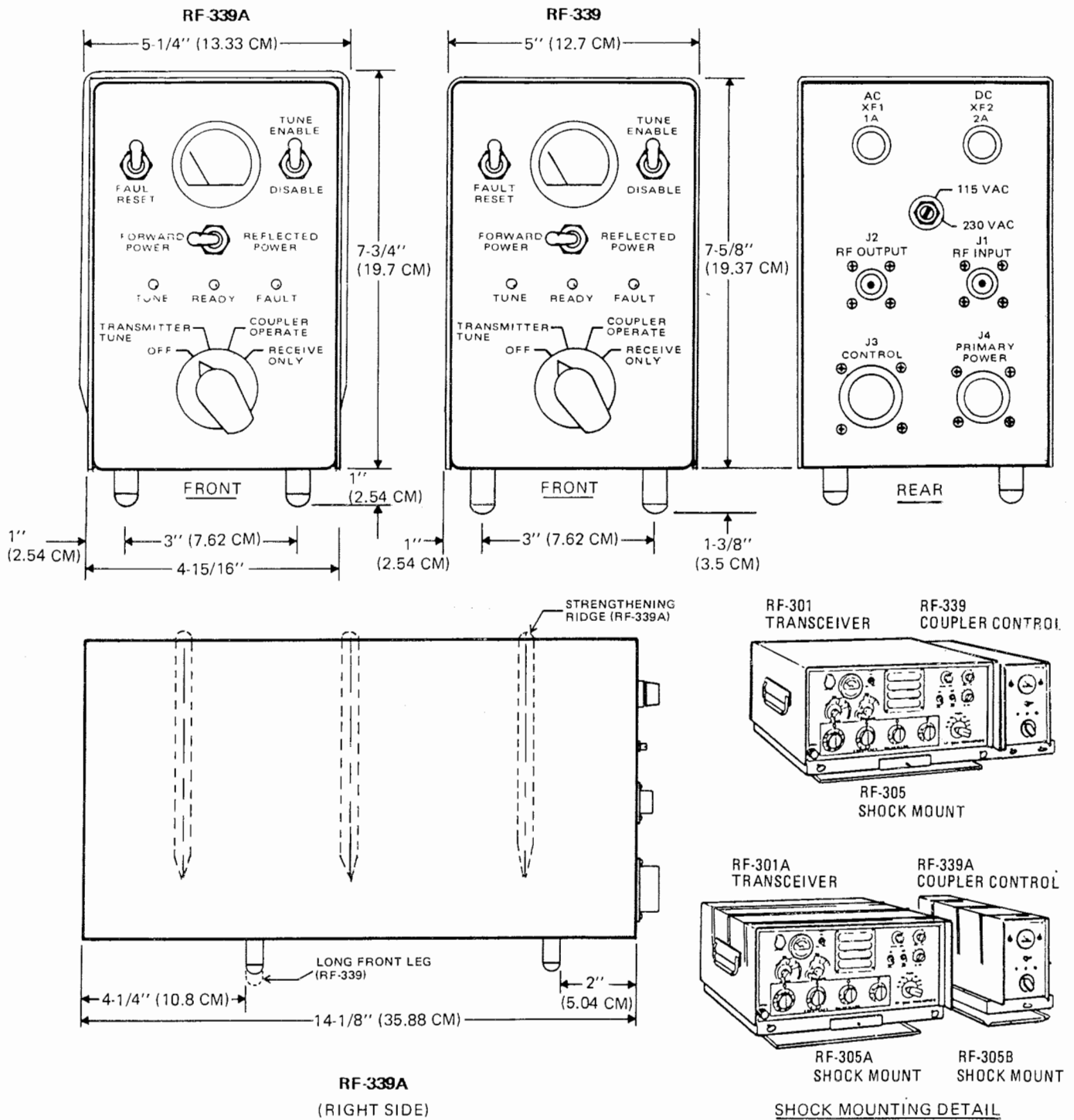


Figure 2-3. RF-339/339A Dimension Drawing

Table 2-1. RF-339/339A Mounting Configurations

<p>RF-339 (gray color)</p>	<p>“Free-standing” unit has two short back legs and two long front legs. Stationary mounting uses RF-305 shock mount.</p>
<p>RF-339A (olive drab color) with strengthening ridges</p>	<p>“Free-standing” unit has four legs of the same length. Stationary mounting uses RF-305A shock mount for the RF-301 and RF-305B shock mount for the RF-339A. (Separate mounts are necessary in this configuration because of unit separation caused by the strengthening ridges.)</p>

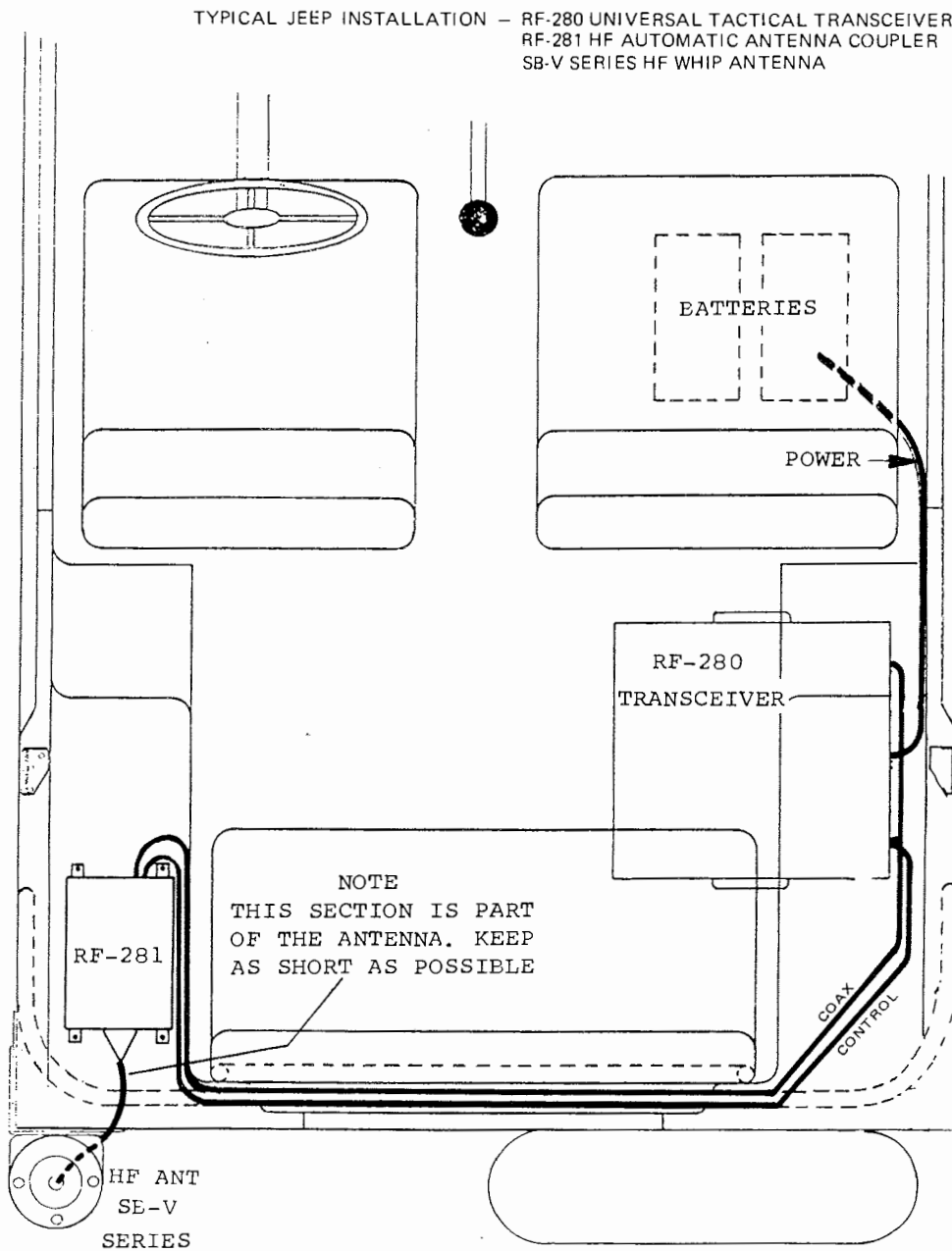


Figure 2-4. Typical Jeep Installation

2.5 TYPICAL INSTALLATIONS

2.5.1 Typical Jeep Installations

Figure 2-4 shows a typical jeep installation using the RF-281, the RF-280, and an SB-V Series HF Whip Antenna. Any compatible transmitter/transceiver or antenna may be substituted, dependent upon customer requirements.

2.5.2 Fixed Installations

There are two basic configurations used for the RF-281 in fixed installations: One uses a transceiver/transmitter, such as the RF-301, and the RF-339; the other uses a compatible transceiver/transmitter, such as the RF-280 without the RF-339. Whip, Long-Wire or Resonant type antennas may be used with either configuration. Separation between the RF-281 and the transceiver or RF-339 should not normally exceed 250 feet (76.2m). Up to 500 feet (152m) may be used if the considerations outlined in paragraph 4.1.1 are provided for. Figure 2-5 is a simplified block diagram of the two configurations. The subsequent paragraphs and figures cover the different types of antennas which may be used with the RF-281.

2.5.3 Whip Antenna Installations

When antennas less than $1/8$ wavelength are used, the antenna reactance present develops very high rf voltages with relatively small antenna currents. These small currents flowing in the radiation resistance yield low radiated power output. As an example, a 16 foot antenna at 2 MHz has an X_C of about 1125 ohms. In this instance, a current of 4 amps would produce peak voltages of 6345 kV ($1.41 \times 1125 \times 4$) and yet yield a radiated power of only 4.8 watts in a radiation resistance of 0.3 ohms (I^2R). At the same frequency, 4 amps in a 35 foot (10.67m) antenna having a radiation resistance of 2.8 ohms, and an X_C of 465 ohms, would radiate 45 watts and develop only about 2623 volts at the antenna terminal. This illustrates the desirability of selecting the longest antenna option possible. Longer antennas permit greater effective radiation of transmitter power and avoids excessively high voltages at the coupler. FSK operation at low frequencies and into short antennas should also be avoided to prevent exceeding the power dissipating capability of the unit.

Whip antennas may be used for fixed installations when necessary, they have omni-directional radiation characteristics and may be desirable for restricted space installations. Whip-type antenna kits SB-V9 (B-C) through SB-V35 (B-C), or their equivalents, are recommended for these installations. The longest antenna possible should be used to gain maximum efficiency.

The antenna insulator on the RF-281 should be connected to the antenna base with a heavy flexible insulated cable, such as the insulated inner conductor from a length of RG-8/U. This cable should be kept as short as possible, not to exceed 2.5 feet (.762m) in length.

Installation instructions are furnished with the previously mentioned kits. A typical Fixed Whip Antenna Installation is shown in figure 2-6. Note that the ground system is an integral and very important part of any such installation. See paragraph 2.7 for detailed information on ground systems. Paragraph 4.1 in the theory section gives additional information on ground systems.

2.5.4 Long-Wire Antenna Installations

For optimum operation between base stations, long-wire antennas, such as SB-A75 or SB-A150, are recommended. These are standard long-wire kits available from Harris Corp., R.F. Communications Division.

When using 75 or 150 foot (22.86 or 45.72m) long-wire-type antennas, it is advisable to mount the RF-281 as close to the antenna base as possible. Cable type and installation precautions for this type antenna are basically the same as for whip-type antennas. Use the long-wire adapter supplied for this type installation. A typical long-wire-type antenna installation is shown in figure 2-7.

2.5.5 Resonant Antenna Installations

Broad-band resonant antennas, such as log periodic antennas that cover the full range of the system, may be used effectively with the RF-281 (using the long wire adapter). Resonant antennas constructed for operation at one frequency, or a narrow band of frequencies, should not be used because of their inherent frequency range limitations.

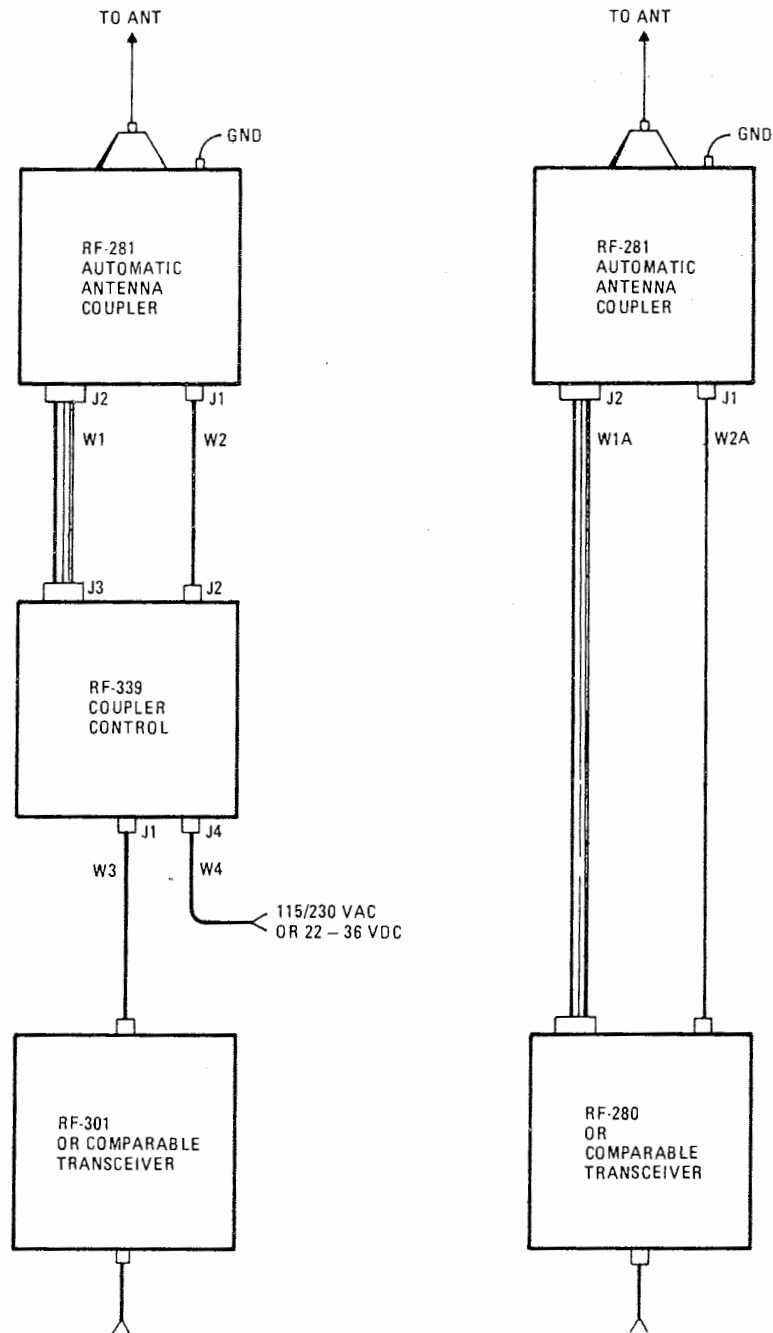


Figure 2-5. RF-281 System Configurations

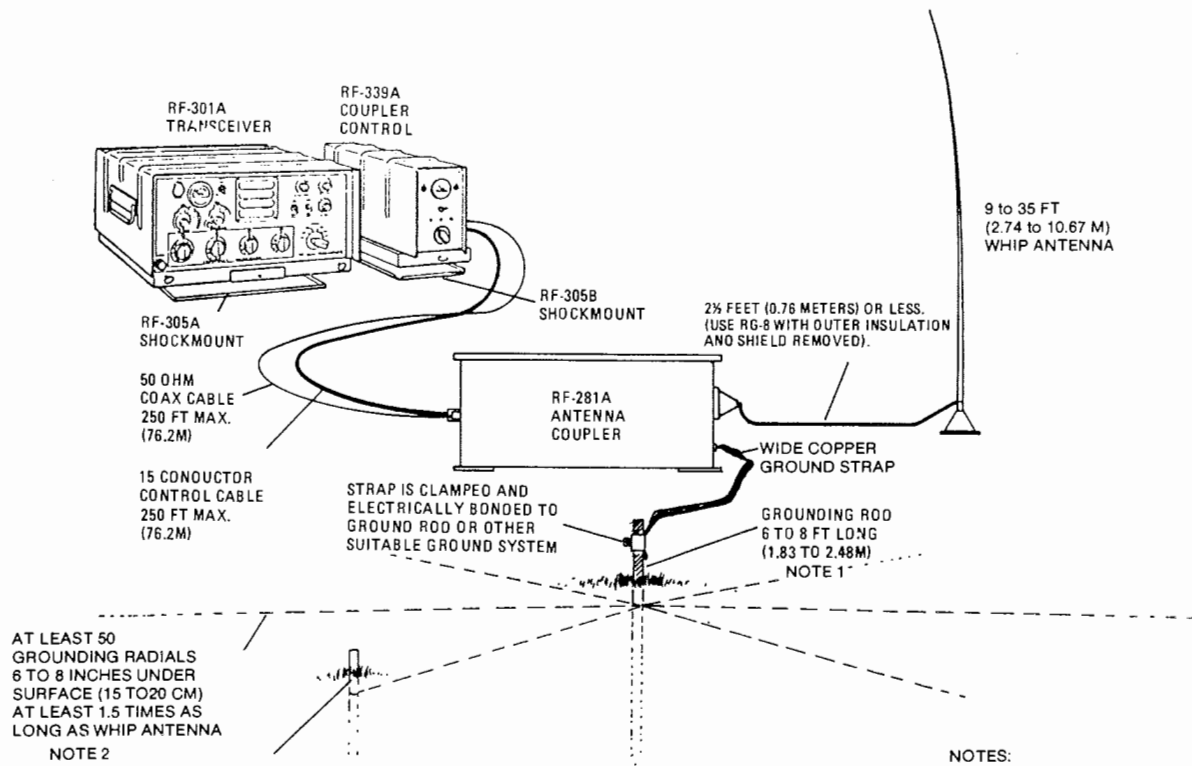


Figure 2-6. Typical Whip Antenna Installation

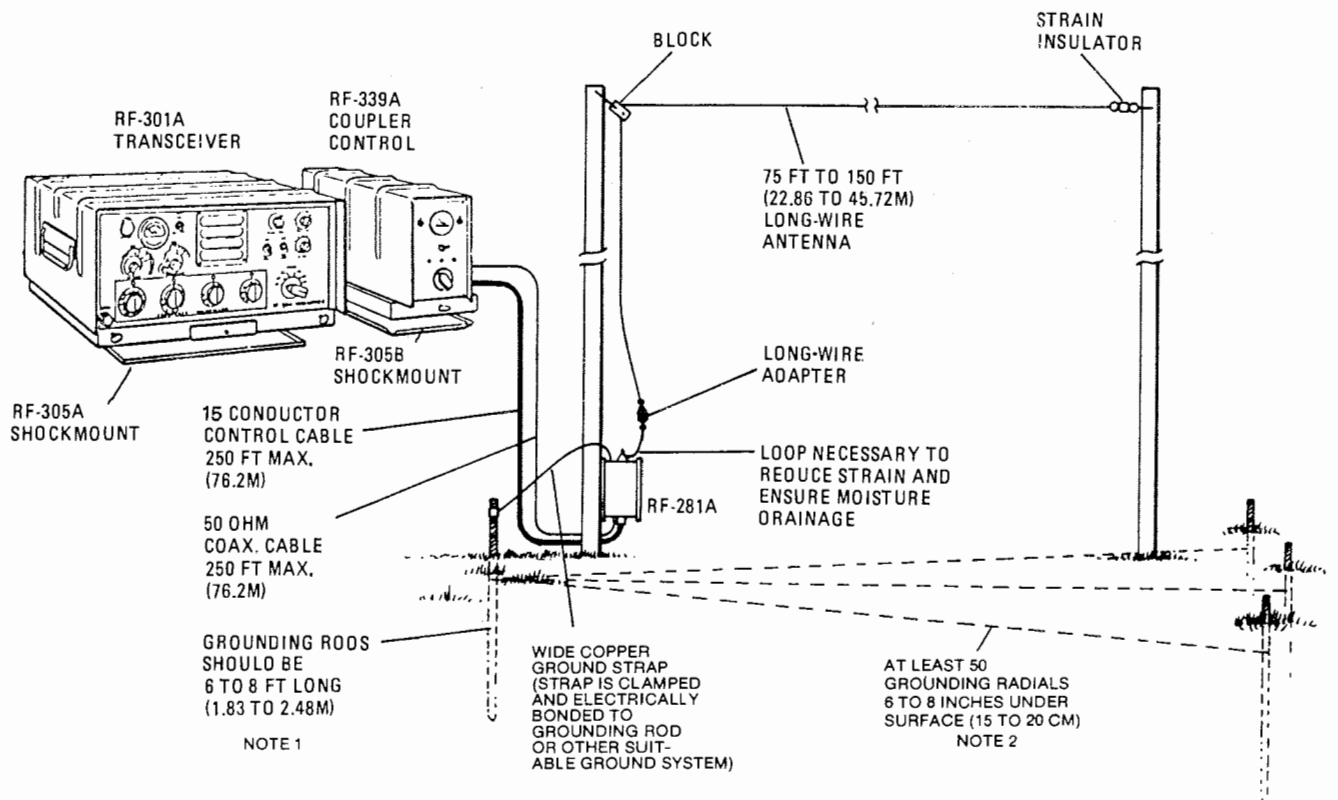


Figure 2-7. Typical Long-Wire Antenna Installation

2.6 CABLE INFORMATION

2.6.1 Cable Identification

Table 2-2 gives a listing of all cables necessary for interfacing the RF-281 with either the RF-280 or the RF-339. Further interfacing information will be found in figures 2-5, 2-8, 2-9, and 2-12 thru 2-15.

Table 2-2. RF-281 Interfacing Cables

Cable No.	Use	Mating Connector	Cable Type	Mating Connector	Remarks
RF-281 with RF-339					
W1	Control Multiconductor	MS3106A-20-27P (P/O 423-0056 connector kit)	RF-322 (15 conductor) purchased separately	MS3106A-20-27S (P/O 423-0057 connector kit)	Mating connectors supplied as part of RF-339 and RF-281
W2	RF Coaxial	PL-259	RG-8/U purchased separately	UG-21D/U	Mating connectors supplied as part of RF-339 and RF-281
W3	RF Coaxial	PL-259	RG-58/U (6 ft, 1.83m)	PL-259	Cable assembly, P/N 1960-6002 supplied with RF-339
W4 115 Vac	Primary Power (Note)	3 prong plug	Line cord	MS3106A-16S-1S	Cable assembly, P/N 423-0050, supplied as part of RF-339
W4 22 to 36 Vdc or 230 Vac	Primary Cable (Note)	Various purchased separately	Line cord, 3 cond. No. 18 AWG, 10 ft. supplied as part of RF-339.	MS3106A-16S-1S (P/O 423-0053 connector kit)	Mating connector supplied as part of RF-339
RF-281 with RF-280					
W1A	Control Multiconductor	MS3108B-24-28P	RF-614 (10 conductor) purchased separately	MS3106A-20-27S	Mating connectors supplied as part of RF-280 and RF-281
W2A	RF Coaxial	PL-259	RG-8/U purchased separately	UG-21D/U	Mating connectors supplied as part of RF-280 and RF-281

Note: See paragraph 2.3.1 for RF-339 primary power configuration

2.6.2 Interfacing

See interface connections as shown in the following figures:

Figure 2-8. RF-281/RF-339

Figure 2-9. RF-281/RF-280

Figure 2-12. RF-281/RF-230/RF-230-08

Figure 2-13. RF-281/RF-230/RF-236

Figure 2-14. RF-281/RF-2301/RF-2302/RF-2360

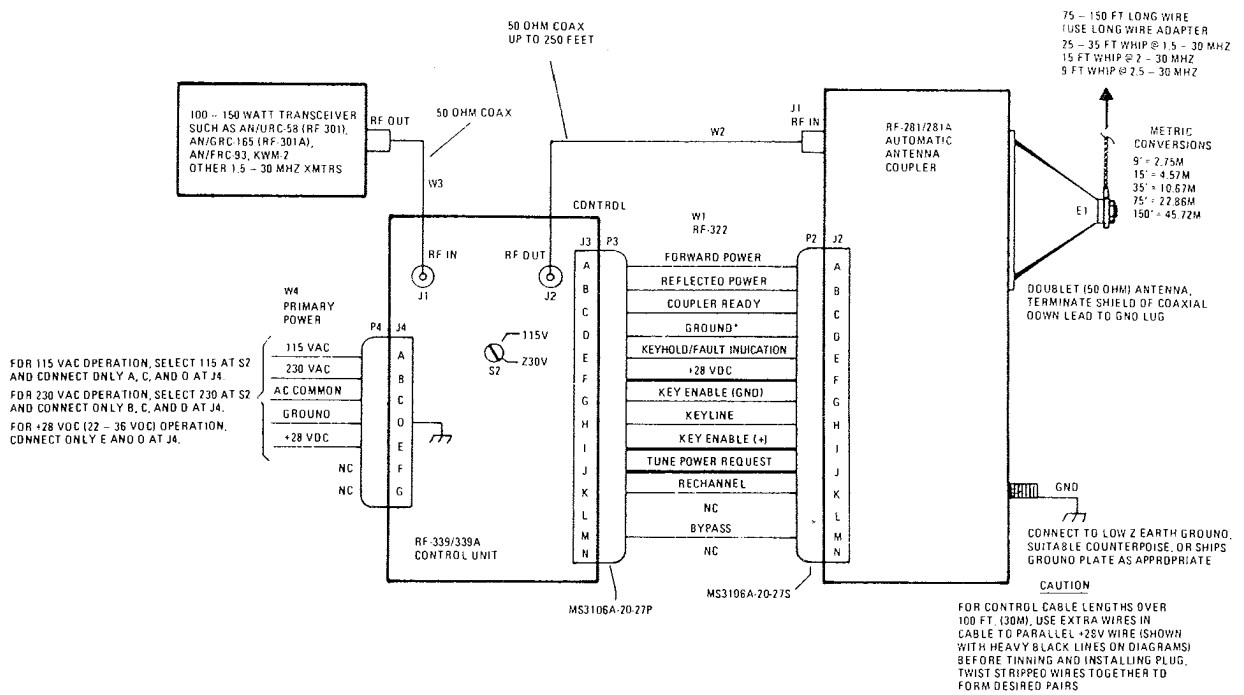
Figure 2-15. RF-281/RF-2301/RF-2302 with 10007-0900 Installed.

2.6.3 Coaxial Cable Fabrication

Figure 2-10 gives a step by step breakdown for installing the UG-21D/U and PL-259 connectors on the RG-8/U coaxial cable.

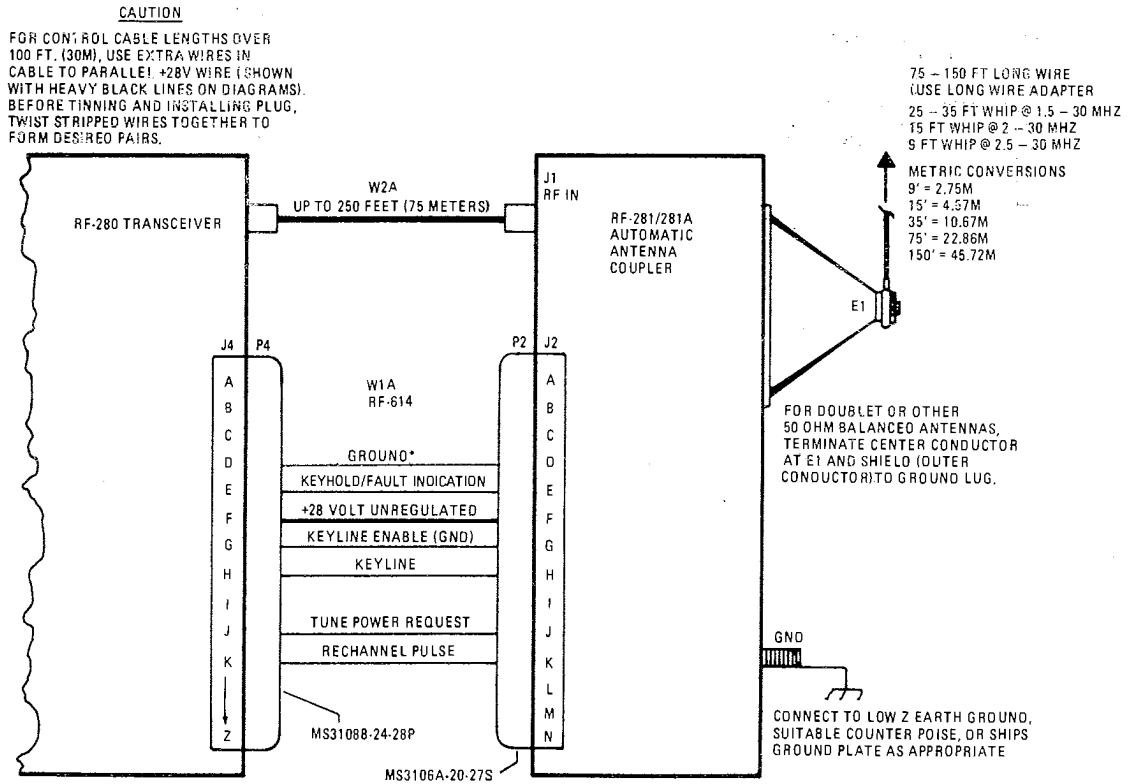
2.6.4 Control Cable Fabrication

Figure 2-11 gives a step by step breakdown for installing the MS3106A-20-27S connector on control cable W1 or W1A. These procedures are applicable to all Multi-conductor cables and connectors in this systems. Included in this figure is information about waterproofing the connectors.



*GROUND CONSISTS OF SHIELD AND ONE WIRE. SEE FIGURE 2-11

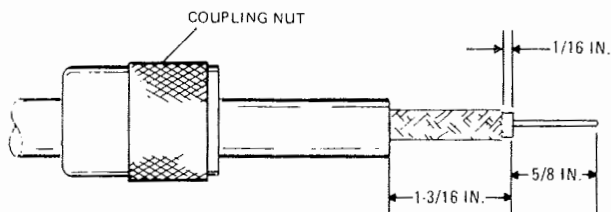
Figure 2-8. RF-281/RF-339 Interfacing Connections



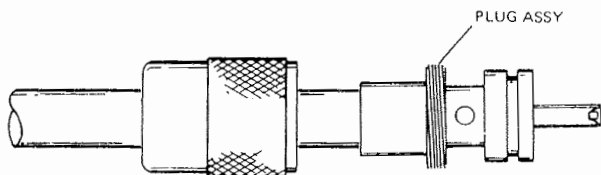
*GROUND CONSISTS OF SHIELD AND ONE WIRE. SEE FIGURE 2-11.

Figure 2-9. RF-281/RF-280 Interfacing Connections

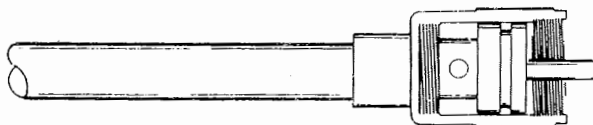
PL-259 Connector Assembly



Cut cable end square. Slide coupling nut on cable. Trim cable to dimensions shown. Tin braid and center conductor.



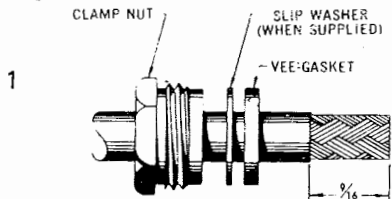
Screw plug assembly on cable. Solder braid through holes. To avoid deforming dielectric, use minimum heat required to produce good bond. Solder center conductor.



Complete assembly by screwing coupling nut over plug assembly. Check assembly by checking for shorts and continuity to other end of cable using ohmmeter.

STEP

UG-21D/U Connector Assembly



Cut cable end square, place clamp-nut, slip washer (when supplied), and gasket over jacket. Remove 9/16" of vinyl jacket.



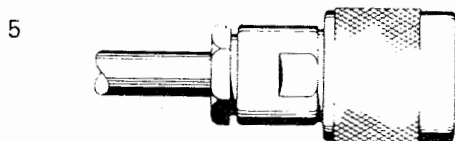
Place braid clamp over braid against jacket cut. Comb out copper braid as shown.



Fold braid back over braid clamp and trim as shown. Cut off dielectric 7/32" from end. Tin center conductor.



Solder contact to center conductor. Avoid use of excessive heat. See that end of dielectric is clean. Contact must be flush against dielectric. Outside of contact must be free of solder.



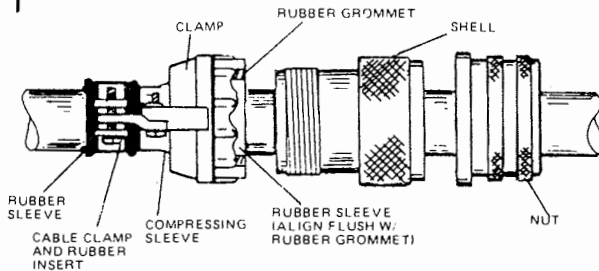
Thread assembly into connector, and lock securely. Vee gasket must be split by braid clamp.

After connector has been threaded onto RF-281 Coupler (J1), wrap connector with several layers of plastic electrical tape (supplied with RF-281 accessory kit) as close to the coupler case as possible. This protects against corrosion of mating threads in wet or humid environments.

Figure 2-10. Coaxial Cable Connector Fabrication

STEP

1



Install cable clamp and rubber insert, rubber sleeve clamp, compressing sleeve, rubber grommet, shell, and nut over cable. Assemble as shown. Leave cable clamp loose. Align rubber sleeve flush with rubber grommet inside clamp. Push assembly back out of the way to perform the steps shown below.

2



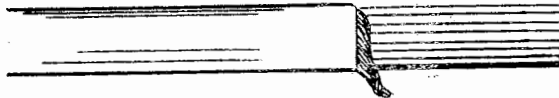
Remove 2" of vinyl jacket from cable as shown. Do not cut into shielding. Remove 1" of shielding as shown. Take care not to damage insulation on wires in cable bundle.

3



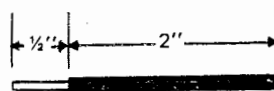
Carefully comb out shield wires as shown.

4



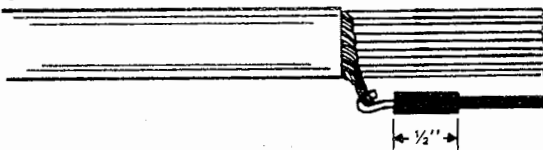
Make a part in the combed shield wires opposite the black wire in the cable. Pull the shield wires around both sides of the cable and twist together to make a pigtail as shown.

5



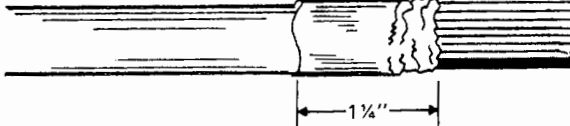
Remove 1/2" of insulation from a 2-1/2" length of No. 22 black stranded wire (supplied in RF-281 Accessory Kit) and tin.

6



Twist the stripped end of black wire with the pigtail and solder. Cut 1/2" black shrink sleeving (supplied with the RF-281 Accessory Kit) and install over soldered connection. Use a heat gun (an alternative is an open flame) to shrink sleeving exercising caution to avoid getting heat onto cable jacket.

7



Install shrink sleeving (supplied in RF-281 Accessory Kit) over cable as shown — apply heat and "shrink" in place. Use heat gun. If no heat gun is available use open flame. Avoid getting heat on cable jacket. Rotate cable for an even shrinkage.

8

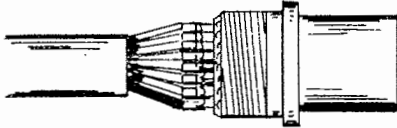


Remove 1/4" insulation from wires to be used.

Figure 2-11. Control Cable Fabrication (Sheet 1 of 2)

STEP

9.



Refer to figure 2-8 or 2-9 for proper interface connections. Twist and tin stripped wires together to form pairs as shown for cable lengths over 100 feet (30 meters). Twist and tin remaining stripped wires. Cut sleeving supplied in connector kits into 1/2 inch (1 1/4 cm) lengths and slide over each wire. Keep wires parallel as they come out of the cable bundle to the connector pins. Ensure the black wire installed in step 6 and the black wire in the cable are lined up with and soldered to pin D. Solder wires to the solder cups using Figure 2-8 or 2-9. Slide sleeving over solder cups. Write down wire colors assigned to each pin number for reference when assembling the connector on the other end of the cable.

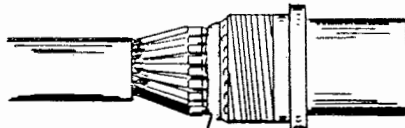
10.

Repeat assembly and soldering procedures for the other end of the cable.

11.

Check both ends of the cable for continuity, shorts between wires and shorts to the connector shell.

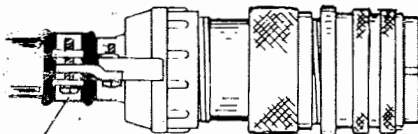
12.



RTV TYPE SILASTIC RUBBER

Apply RTV type silastic rubber (supplied in RF-281 Accessory Kit) to a thickness of approximately 1/8 inch. Use small opening of nozzle to insure getting rubber between all solder cups. Use small, slender object such as a piece of wire or toothpick to insure a smooth, continuous waterseal.

13.



CABLE CLAMP AND RUBBER INSERT

Assemble the plug as shown. Assemble clamp as tightly as possible onto the shell to assure a watertight connection around the cable. Repeat watersealing and assembling of connector on other end of cable. After connector has been threaded on RF-281 Coupler case connector J2, wrap both connectors with several layers of plastic electrical tape (supplied in RF-281 Accessory Kit) as close to the RF-281 Coupler case as possible. (For protection against corrosion of mating threads in wet or humid environments.)

NOTE: To convert inches to centimeters, multiply by 2.540.

Figure 2-11. Control Cable Fabrication (Sheet 2 of 2)

2.7 GROUNDING

Proper grounding of the RF-281 cannot be over emphasized. Inadequate grounding will degrade operation of the system, and cause rf voltage to be present on the chassis. This could cause equipment malfunction and a possibly serious personnel hazard.

The ground straps should be constructed of wide, copper straps, and should be as short as possible. Ground straps should be clamped and bonded to at least two ground stakes or rods. The stakes, or rods, should be at least 6 to 8 feet (1.83 to 2.44 meters) long, and should be spaced 4 to 5 feet (1.22 to 1.52 meters) apart around the coupler ground terminal. If ground stakes, or rods, cannot be used (e.g., installation is on a roof, soil is not sufficiently conductive, etc.), a system of at least 50 ground radials, at least 1.5 times longer than the antenna, should be installed 6 to 8 inches (15.24 to 20.32 cm) underground, per figures 2-6 and 2-7.

The RF-339 and transceiver shock mounts must also have good ground connections. These should be made with heavy braid ground straps connected to a suitable ground system.

2.8 ENVIRONMENTAL PROTECTION

If the RF-281 is exposed to wet or humid environmental conditions, the following protective measures should be taken. After the RF-281 has been installed and all connections have been made:

1. Wrap coaxial connectors J1 and J2 (with mating connectors installed) with several layers of weather resistant, plastic electrical tape (such as 3M Company 33+, or Permacel 29R). A roll of the

appropriate type of tape is supplied with the RF-281 accessory kit. Wrap the tape as close to the coupler case as possible, and up the cable far enough to prevent moisture from contacting the connector threads and internal pin connections.

2. Coat the coupler insulator and all ground connections with Dow Corning DC-5, General Electric G-635, or an equivalent compound (supplied with RF-281 accessory kit). Apply a coating approximately 1/8 inch (.32 cm) thick. This coating will prevent deterioration of the ground connections, and protect the insulator from dirt, dust, and salt accumulation.

NOTE

The coated insulator may leak rf current to ground if it is subjected to excessively wet environmental conditions (e.g., spray, squalls, rain, etc.); however, the rf leakage will stop immediately when the water path is broken.

2.9 INITIAL ADJUSTMENTS

Prior to energizing the RF-281 or RF-339, check the primary power and ground connections to ensure proper configuration.

The RF-281 and RF-339 have been set-up, tested, and completely adjusted prior to shipping. If adjustments are necessary, due to rough handling during shipment, etc., proceed as outlined in the maintenance section of this manual.

Energize the equipment, and exercise by operating at all desired frequencies.

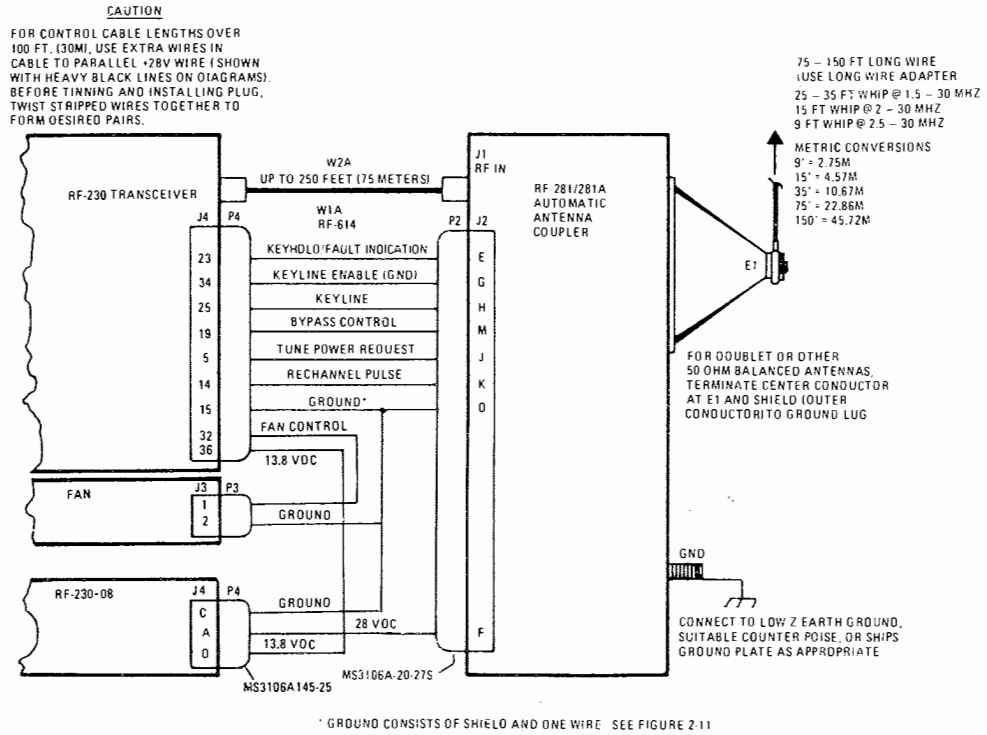


Figure 2-12. RF-281/RF-230/RF-230-08 Interfacing Connections

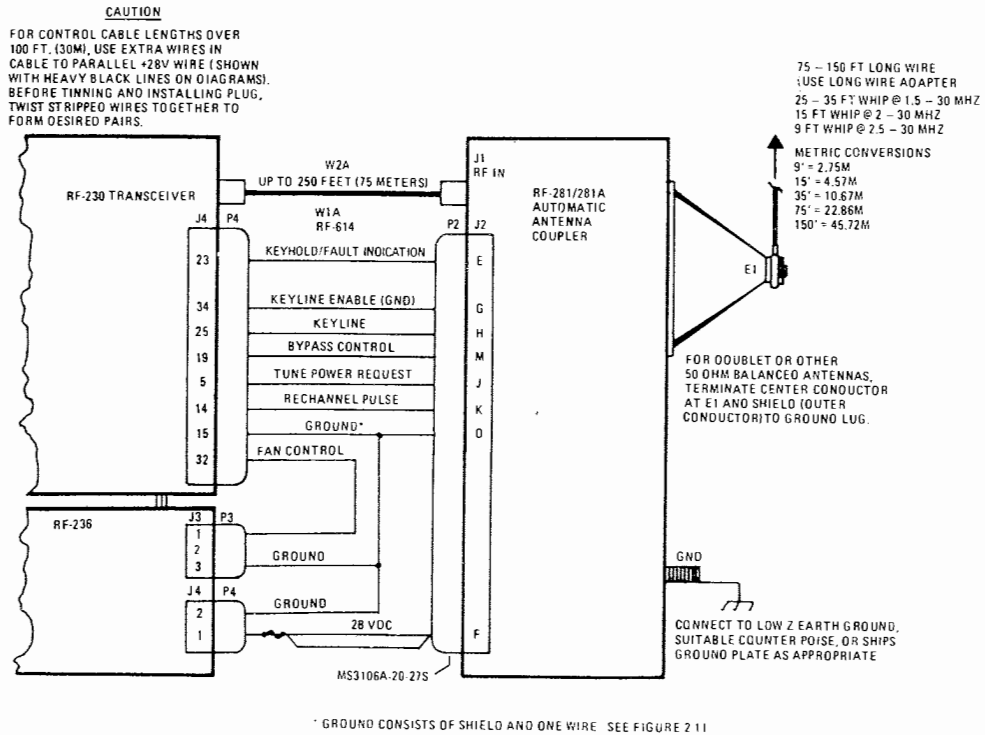


Figure 2-13. RF-281/RF-230/RF-236 Interfacing Connections

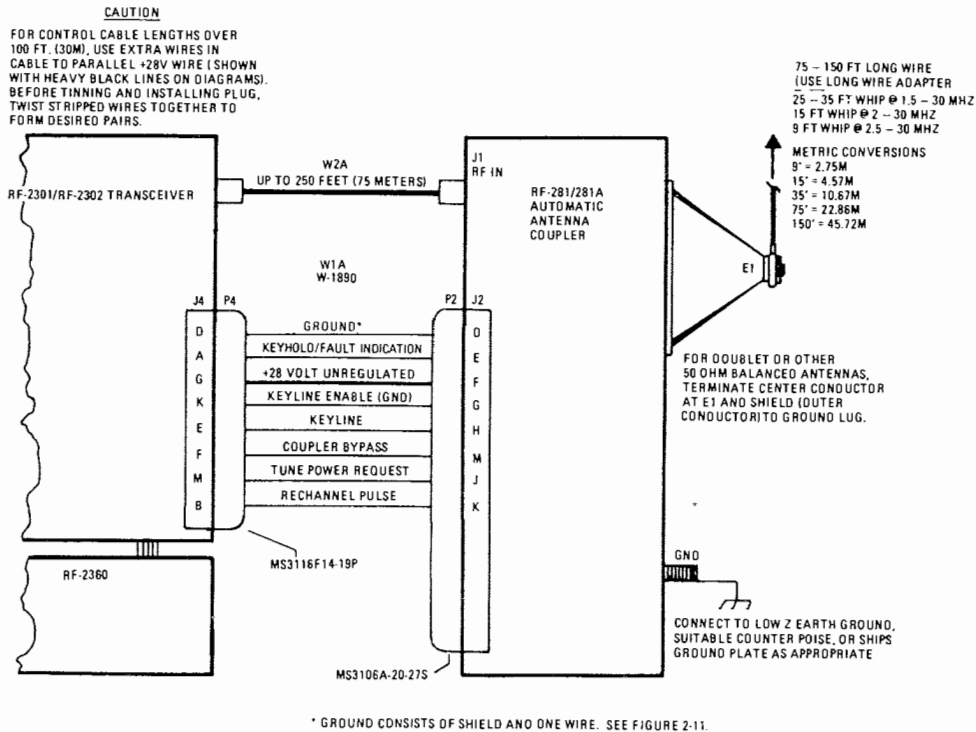


Figure 2-14. RF-281/RF-2301/RF-2302/RF-2360 Interfacing Connections

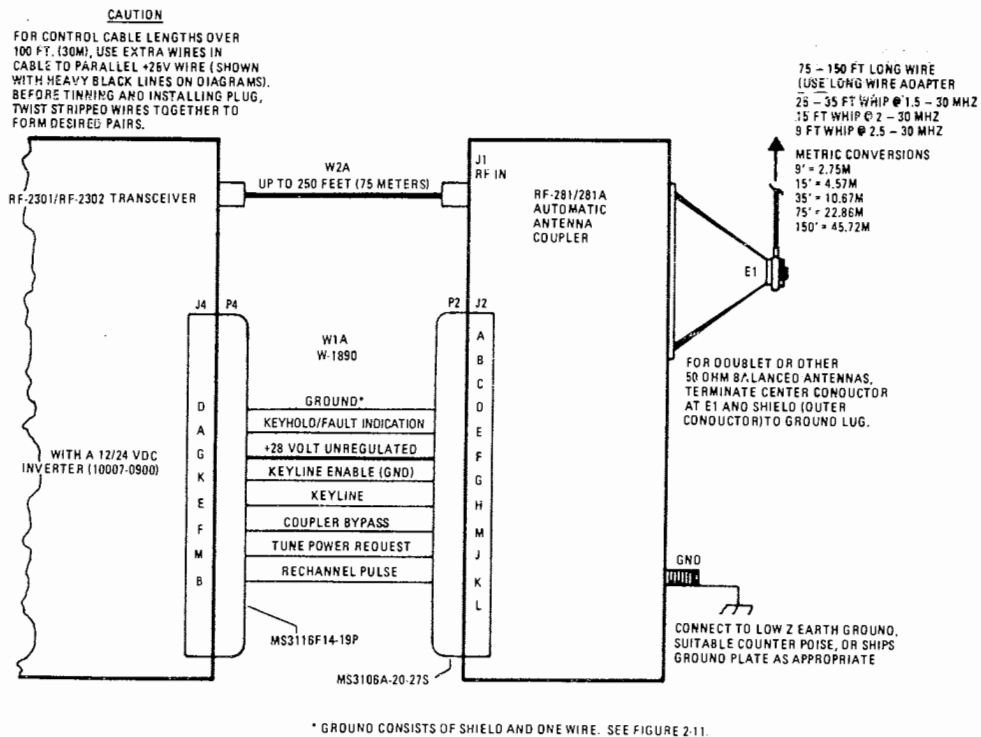


Figure 2-15. RF-281/RF-2301/RF-2302 With 10007-0900 Inverter Installed Interfacing Connections

SECTION 3

OPERATION

3.1 GENERAL

This section covers operation of the RF-281 with and without the RF-339. The information is divided to cover operation in two basic system configurations.

The first system to be covered includes the RF-281, the RF-339, and a transceiver/transmitter, such as the RF-301. The second system to be covered includes the RF-281 and a compatible transceiver, such as the RF-280. The RF-301 and RF-280 are referenced for ease of explanation only, and any equivalent unit which meets customer requirements may be substituted.

3.2 OPERATION WITH THE RF-339/301

3.2.1 RF-339 Operating Controls and Indicators

Figure 3-1 shows all RF-339 controls and indicators. Table 3-1 gives a brief description of these controls and their functions.

Note

For detailed information on the RF-301 or equivalent transceiver/transmitter controls and indicators, refer to the applicable instruction manual. There are no operator controls on the RF-281.

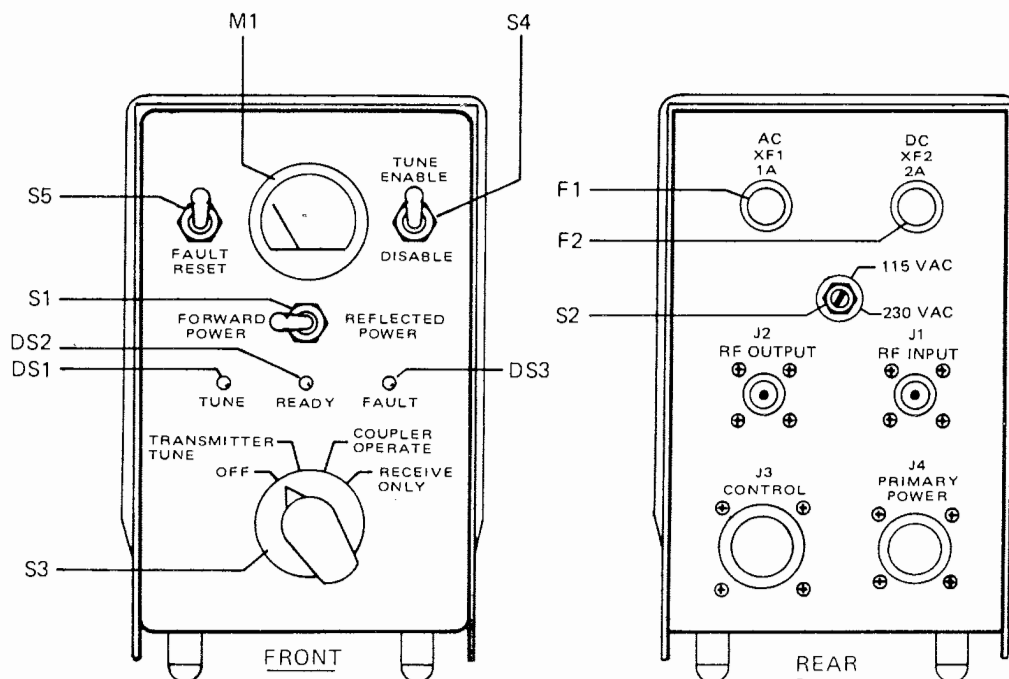


Figure 3-1. RF-339 Controls and Indicators

Table 3-1. RF-339 Controls and Indicators

Control or Indicator	Function
FORWARD/REFLECTED POWER switch S1	Two position switch; selects FORWARD POWER or REFLECTED POWER meter function at M1.
115/230 VAC PRIMARY POWER switch S2	Two position switch; selects 115 Vac or 230 Vac primary input power to transformer T1 in the RF-339 28 Vdc power supply.
Function switch S3	<p>Four position switch; selects the following function:</p> <p>OFF – All power off and no 22 to 36 Vdc supplied to the RF-281.</p> <p>TRANSMITTER TUNE – This position is used for transmitter tuning only. The RF input at J1 is terminated in a 50 ohm dummy load within the RF-339, and a rechannel ground appears on the control line to the RF-281.</p> <p>COUPLER OPERATE – Normal operating position. Configures the system for normal automatic operation.</p> <p>RECEIVE ONLY – Provides for general receiver surveillance operation without disturbing RF-281 tune.</p>
TUNE ENABLE/DISABLE switch S4	<p>Two position switch; selects the following:</p> <p>TUNE ENABLE – Key circuit is enabled.</p> <p>DISABLE – Key circuit is interrupted. Prevents RF-281 from tuning to a nearby signal when the KEY ENABLE logic function is present. VSWR overload protection is also disabled.</p>
FAULT RESET switch S5	Grounds rechannel control line and resets fault logic circuitry.
TUNE indicator DS1	Illuminates to indicate RF-281 ready for rf tune power.
READY indicator DS2	Illuminates to indicate RF-281 is tuned.
FAULT indicator DS3	Illuminates (intermittent) to indicate FAULT.
Power M1	Indicates FORWARD POWER or REFLECTED POWER as selected by FORWARD/REFLECTED POWER switch S1.
AC fuse F1	Fuses primary side of 115/230 Vac power transformer T1.
DC fuse F2	Fuses 22 to 36 Vdc circuits.

3.2.2 Pre-Power On Operations

Special pre-power on operations should be not normally required. Elements built into the system protect against operator error; however, good operating procedures normally require the following pre-power on precautions:

- Visual inspection for personnel hazards and general equipment condition.
- Preposition controls for specific operation anticipated. Note that there are no operator controls on the RF-281.

3.2.3 Standard Operating Procedures

The following procedures are for operating the RF-281 with the RF-339 and a transceiver/transmitter, such as the RF-301.

- a. After completion of pre-power-on operations, energize the system by selecting TRANSMITTER TUNE at the RF-339.
- b. Warm up transceiver per operating procedures in applicable instruction manual.
- c. Select an unmodulated carrier mode, (CW or AM) at the transceiver. Reduce the transmit audio gain control as necessary to avoid any modulation of the carrier through the microphone or through any remote audio units. Note any modulation on the carrier during tuning can prevent the proper execution of the RF-281 automatic tune cycle.
- d. Tune transceiver per applicable instruction manual.
- e. Select COUPLER OPERATE, and TUNE ENABLE at RF-339. Yellow TUNING light will illuminate when RF-281 has homed.

Note

To monitor the intended operating frequency prior to tune operations (RF-339 systems), proceed as follows: Switch to RECEIVE ONLY and push the FAULT RESET switch. This procedure minimizes the impedance through the RF-281 for the receive signal. Switch back to COUPLER OPERATE when satisfied that the frequency is clear.

- f. Key transceiver. Yellow TUNING light on RF-339 will illuminate during tuning. Green READY light will illuminate after RF-281 is tuned.

Note

The transceiver must be held in the keyed position until the yellow TUNING light goes out, and the green READY light illuminates. If the transceiver is unkeyed before the operator receives a READY indication, the red FAULT light on the RF-339 will illuminate (after a 30 second delay).

- g. When a READY indication is received at the RF-339, desired mode may be selected at transceiver and the system is ready for operation.

Note

To monitor another frequency without detuning the RF-281, switch to RECEIVE ONLY and change the transceiver to the desired frequency. DO NOT KEY THE TRANSMITTER. When monitor operations are complete, switch back to COUPLER OPERATE. The RF-281 will still be tuned to the original frequency.

- h. To change operating frequency, send RF-281 to home position by selecting TRANSMITTER TUNE with the RF-339 function switch. Repeat steps c through g.

- i. If the RF-281 tries to respond to transmitted signals from close by high level energy sources, switch the TUNE ENABLE/DISABLE switch to DISABLE. This will disable the servo amplifiers and prevent any attempt to try and tune to this external frequency. To retune the RF-281 on a new frequency, switch back to TUNE ENABLE.

3.3 OPERATION WITH RF-280 OR OTHER COMPATIBLE TRANSCEIVER

Use the following procedure to operate the RF-281 with a compatible transceiver, such as the RF-280.

- a. Complete the pre-power-on operations per paragraph 3.2.2.
- b. Energize system, and tune transceiver per applicable instruction manual.
- c. Select desired mode of operation (SSB, AM, FSK, etc.).

Note

Perform frequency monitoring requirements (if required), prior to key down and coupler tune. Operation in this mode, prior to RF-281 tune, insures maximum receive signal strength.

- d. Momentarily key transmitter, (RF-281 will hold key condition).
- e. To rechannel RF-281, make desired frequency change and repeat steps c and d.

SECTION 4

THEORY OF OPERATION

4.1 GENERAL

The RF-281 Automatic Antenna Coupler matches the output of 100 – 150 watt Transmitters or Transceivers to a wide variety of whip or long wire antennas. As the name suggests, operation of the RF-281 is completely automatic and includes all network tuning and monitoring functions. Figure 4-1A is a functional diagram of the active matching elements in the RF-281, and of the major control logic blocks. Introductory and detailed explanations are included for all elements.

The 100 – 150 watt rf input at J1 is routed directly to the A2 Discriminator Assembly. The discriminator incorporates three functional elements: (1) a forward and reflected power detector; (2) a phase detector; (3) and an "R" detector. All three discriminator functions have a characteristic impedance of 50 ohms.

The RF-281 is designed for use with transmitters that have a standard 50 ohm output impedance. There are advantages, however, in operating automatic antenna coupler systems at a characteristic impedance lower than 50 ohms. This system uses an R_0 , or operating impedance, of 12.5 ohms. Transformer T1 has a turns ratio of 2:1, or an impedance ratio of 4:1, and thus serves to match the optimum 12.5 ohm antenna system to the standard 50 ohm transmitter output.

Vacuum variable capacitor C1 and variable inductor L1 are driven by separate servo systems such that the RF-281 will automatically tune the antenna impedances. A Phase Discriminator output drives the C1 servo system, and an R Discriminator drives the L1 servo system. Figure 4-2 includes a graphic demonstration of the function of these circuit elements. A typical impedance (Z_A) at 1.5 MHz is about $2 - j640$ ohms. When the RF-281 is tuned, the variable coil will have an inductive reactance to shunt the antenna impedance, Z_A , in a circular manner to $Z_B = 12.5 + jX_B$. The variable capacitor will have a capacitive reactance to resonate Z_B to $R_0 = 12.5 + j0$. T1 will transform R_0 to $50 + j0$ ohms.

The control logic circuitry monitors keyline, transmitter rechanneling, rf power level and antenna conditions, and makes the appropriate sequence of responses required to provide automatic operation. The simplified functional diagrams included in figure 4-1A summarize the logic elements required to generate the functions indicated. The "AND" symbol indicates that all inputs must be present to achieve the desired output. The "OR" symbol indicates that any single input, or any combination of inputs, will produce the indicated output. As an example, to generate the "Elements Home" function, both the "C1 at maximum" and the "L1 at minimum" conditions must be met, whereas the "Recycle" signal will be generated in response to either a rechannel pulse or the initial application of a +10 Vdc signal.

Detailed circuit descriptions are included for all of these functions. Note that low logic levels are frequently used to derive a desired output, as in the case of the "Elements Home" function, and as a consequence, the actual logic element used to perform this "AND" function is a NOR gate. Recalling the NOR truth table, the high output will be present only when all inputs are low and the device thus performs an "AND" function.

Figure 4-1B shows the sequence of events from initial application of primary power through transmitter keying, the final step that indicates successful tuning of the coupler. The normal sequence of events is indicated by unbroken lines; incorrect responses or malfunctions are indicated by broken lines. At each stage of the sequence, references are made to related detailed circuit descriptions and illustrations contained in this section.

4.1.1 RF Power

The RF-281 requires a minimum of 5 to 10 watts of forward power at its rf input jack during the complete tuning cycle. Note that reflected power can be as high as forward power during much of the tuning cycle.

Consideration must be given to the amount of tune power that should be available at the transmitter output. For example, at 30 MHz 250 feet of RG-8 coaxial cable has about 3 dB insertion loss. This means that for 250 feet of separation between the transmitter and RF-281, the transmitter should deliver a minimum of 10 to 20 watts of unmodulated carrier at its output to assure a proper tune at 30 MHz. Note that the maximum recommended separation is 250 feet. This recommended limitation is because of losses in the coaxial and control cables.

The RF-339 incorporates a 3 dB pad that is automatically selected during the tune function. This attenuation must also be considered, in addition to attenuation in the coaxial cable used, in systems using an RF-339. As an example, the 3 dB attenuation in 250 feet of RG-8 at 30 MHz, plus the 3 dB attenuation within the RF-339 during tune, equals a total of 6 dB attenuation. This means that the transmitter would have to put out 40 watts at 30 MHz to provide 10 watts at the RF-281 in the tune mode.

Cable lengths up to 500 feet (152m), may be used between the transmitter (or transmitter/RF-339), and the RF-281 as long as the additional attenuation introduced by the cable is accounted for. Low loss cable, such as RG-17, should be used in systems requiring over 250 feet (76m) of cable.

4.1.2 Ground Resistance

The resistive component of the antenna impedance consists of two principle elements: the radiation resistance (that value of resistance which, if driven by the antenna current, would dissipate power equal to the power actually radiated by the antenna); and the ground resistance. Ground resistance is that value of resistance which, if driven by the antenna current, would dissipate power equal to the power lost in the ground system against which the antenna is driven. Ground resistance losses do not contribute to radiated power, but must be considered as part of the system. As a consequence, any reduction in ground resistance that can be effected by an efficient counterpoise system, and low resistance ground connections, make a direct contribution to performance.

4.1.3 Receive Only

The RF-339 contains a receive-only feature that allows the Transceiver to receive when the RF-281 is in the tuned condition and in "RECEIVE ONLY" on the RF-339. A relay minimizes impedance through the RF-281 to allow the operator to receive in a radio-silence condition and be able to listen for traffic after tuning the RF-281. The relay automatically reverts the RF-281 back to the "Tuned" mode after the RF-339 is switched back to "COUPLER OPERATE".

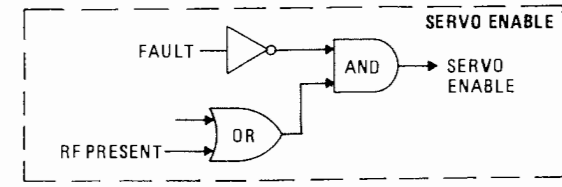
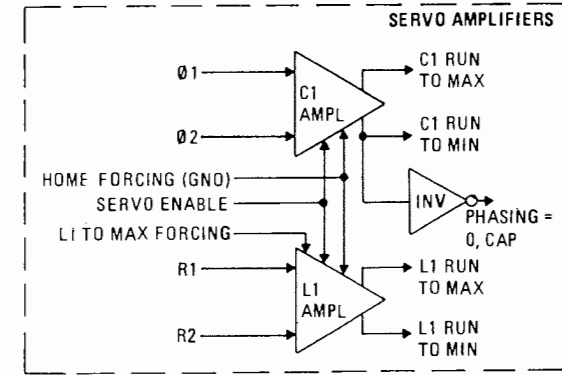
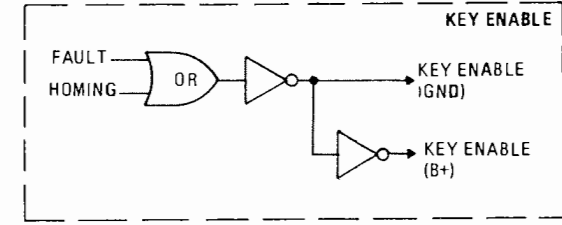
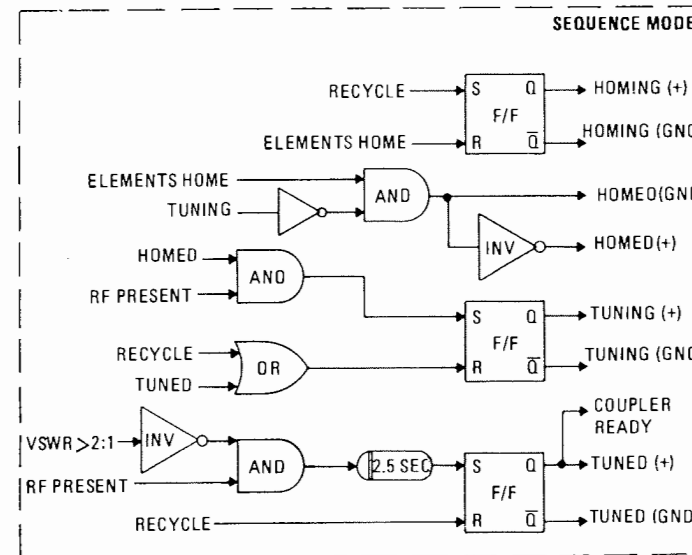
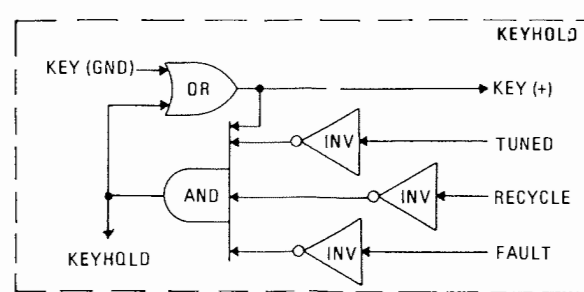
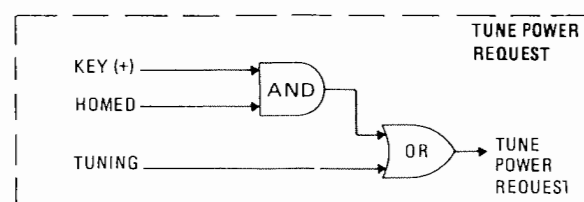
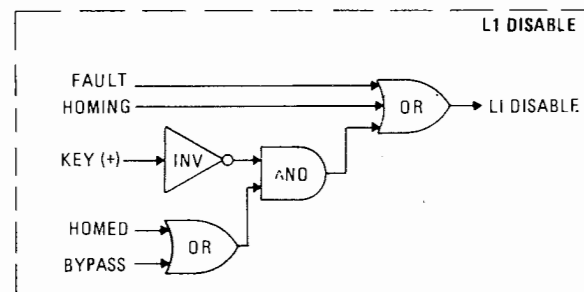
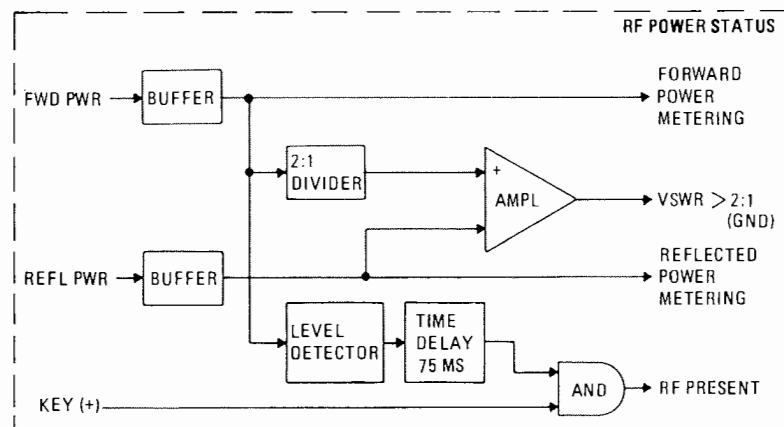
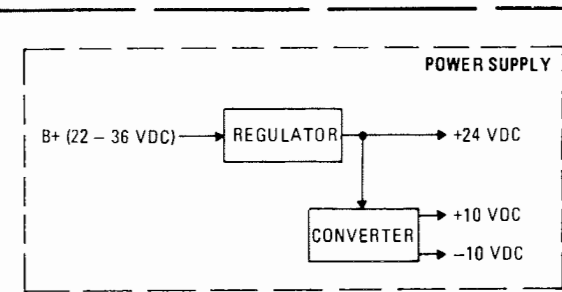
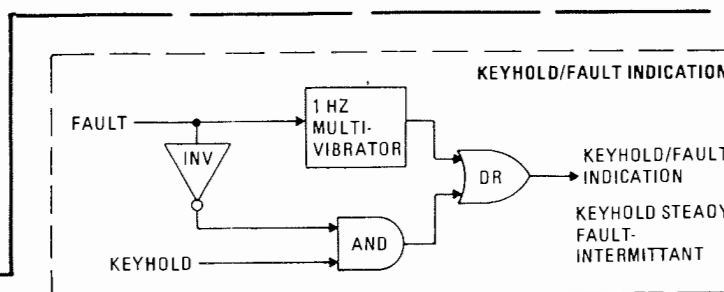
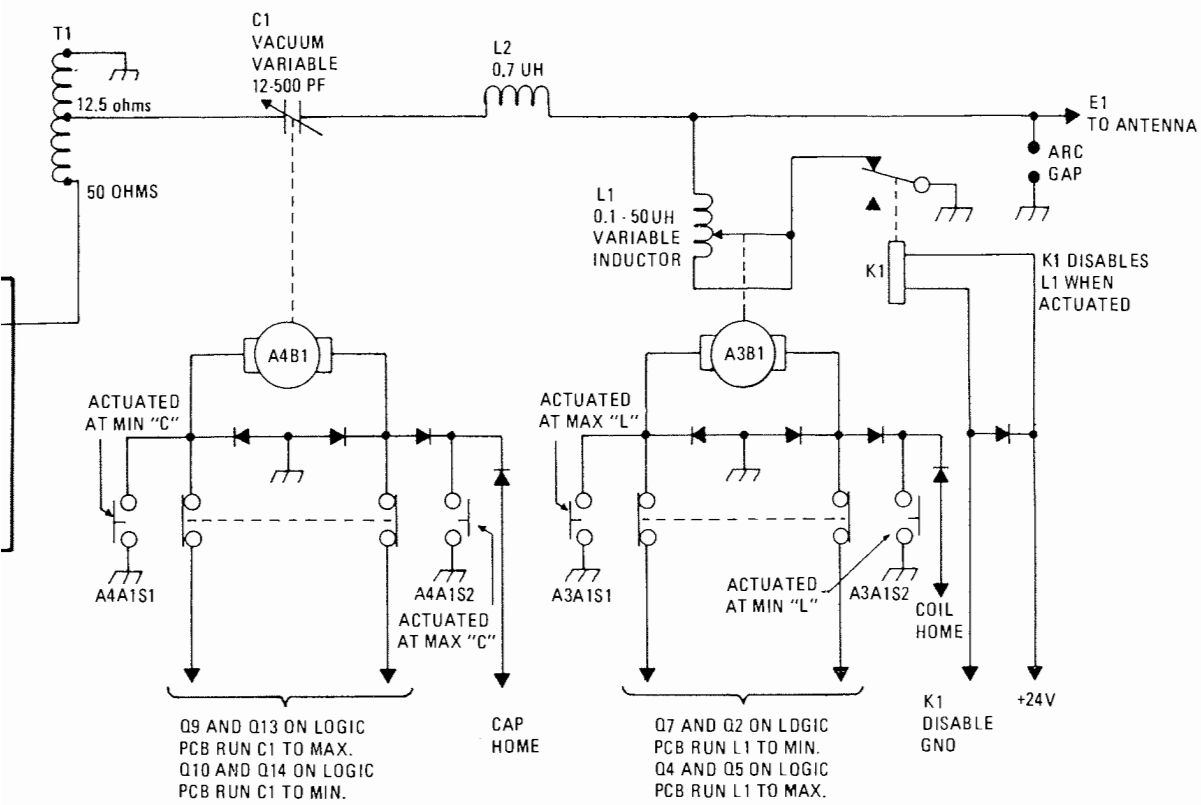
4.2 DISCRIMINATOR ASSEMBLY

4.2.1 Phase Discriminator

When the antenna has been properly tuned or matched by the reactive elements in the RF-281, the RF-281 will present a purely resistive 50 ohm load to the transmitter. If the antenna is not properly tuned, the impedance at this point will be something other than 50 ohms and either inductive or capacitive.

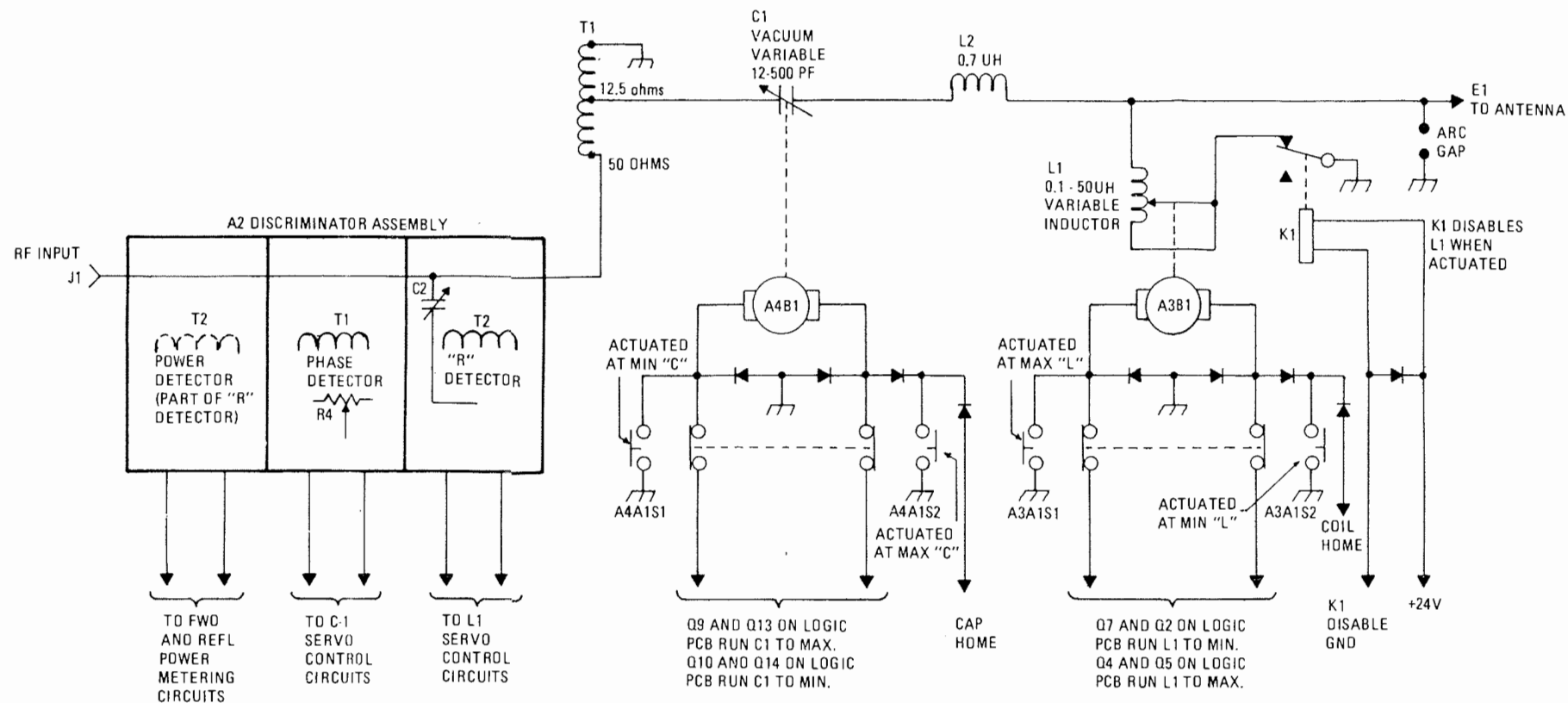
The function of the phase detector is to sense the reactive component and to provide a proportional dc output to the servo system that will drive the variable capacitor such that the condition is corrected.

Refer to figure 4-3 for the following discussion. The discriminator assembly is constructed such that the antenna current induces a voltage in transformer T1. A2T1 and A2T2 function as step up transformers to provide additional sensitivity. A2T2 is constructed with a center tap so that its two outputs, as referenced

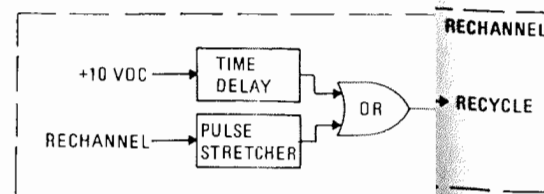
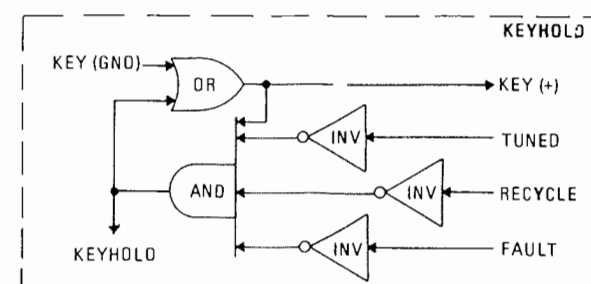
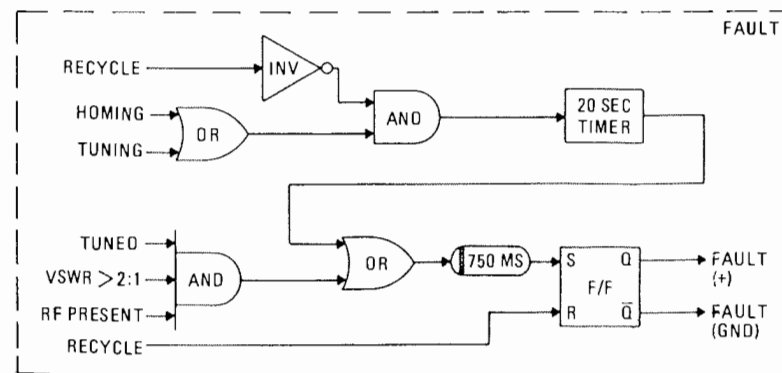
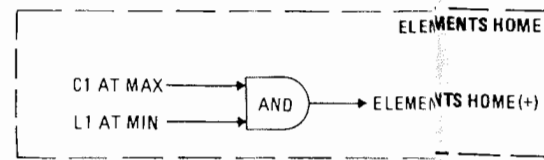
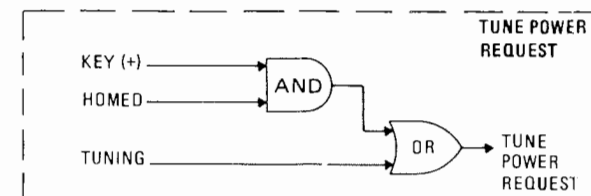
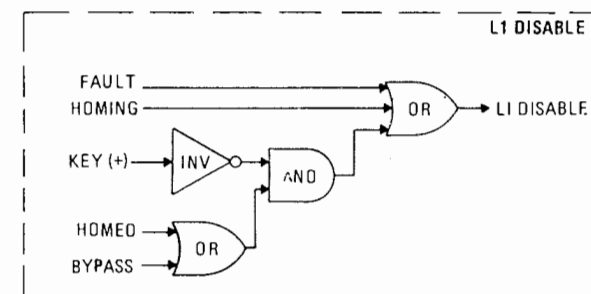
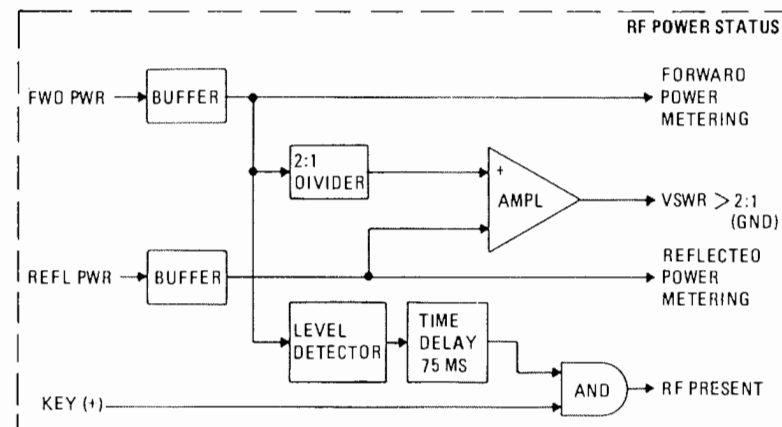


NTS HOME
 S HOME(+)
 ECHANNEL
 RECYCLE

Figure 4-1A. Antenna Coupler, Functional Diagram



- ↔ KEY (GND)
- ← KEY ENABLE (GND)
- ← TUNE POWER REQUEST
- ← KEYHOLD/FAULT INDICATION
- RECHANNEL
- ← FORWARD POWER METERING
- ← REFLECTED POWER METERING
- ← COUPLER READY
- GROUND
- B+ (22 - 36 VDC)
- ← KEY ENABLE (B+)
- BYPASS



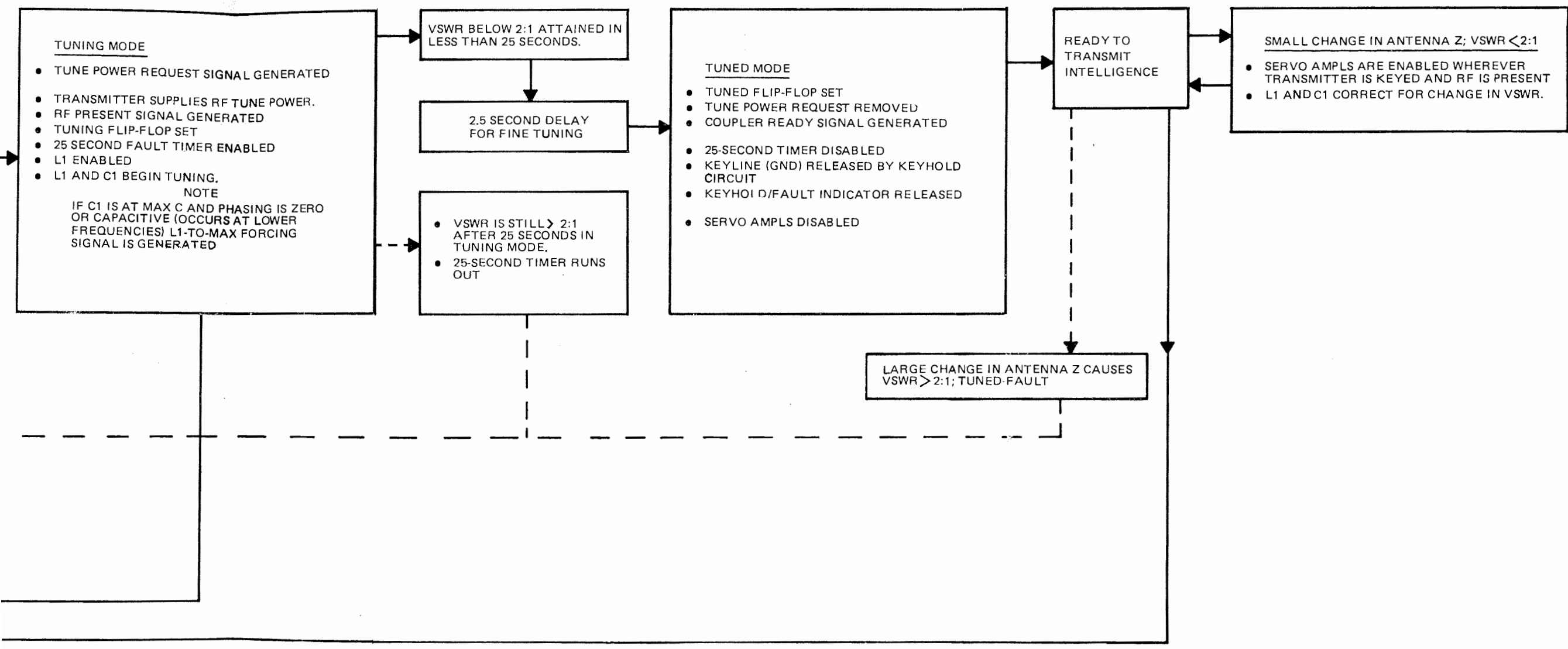
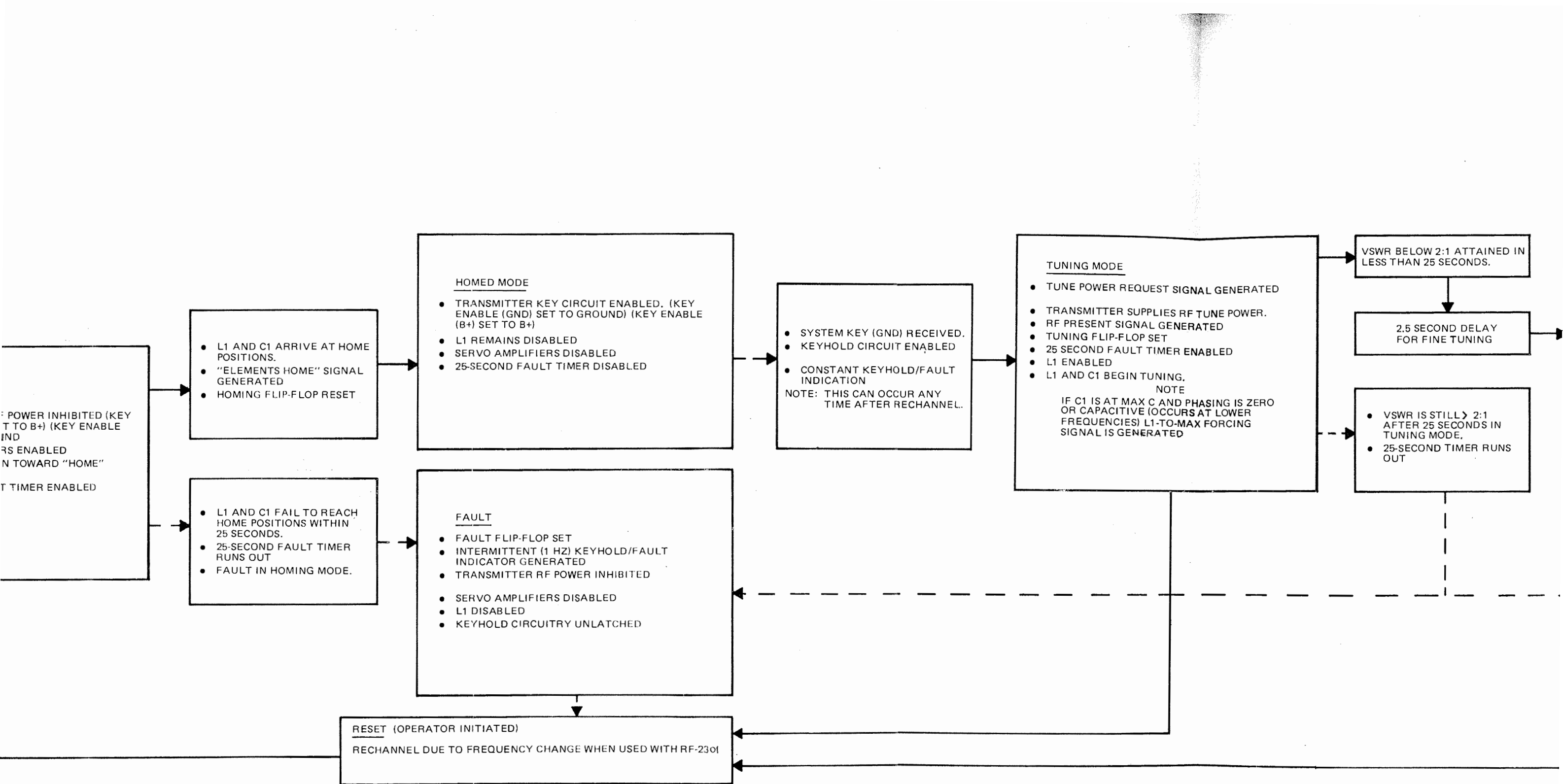


Figure 4-1B. Sequence of Events Functional Block Diagram



INITIAL PRIMARY POWER ON

RECHANNEL

- GENERATES RECYCLE SIGNALS
- RESETS FAULT FLIP-FLOP
- KEYHOLD FAULT INDICATOR SIGNAL REMOVED
- RESETS SEQUENCE MODE CIRCUITRY TO HOMING MODE
- UNLATCHES KEYHOLD CIRCUITRY
- RESETS 25-SECOND HOMING/TUNING FAULT TIMER
- RESETS TUNING MODE FLIP-FLOPS

HOMING MODE

- TRANSMITTER RF POWER INHIBITED (KEY ENABLE (GND) SET TO B+) (KEY ENABLE (B+) SET TO GROUND)
- SERVO AMPLIFIERS ENABLED
- L1 AND C1 DRIVEN TOWARD "HOME" POSITIONS.
- 25-SECOND FAULT TIMER ENABLED
- L1 DISABLED

- L1 AND C1 ARRIVE AT HOME POSITIONS.
- "ELEMENTS HOME" SIGNAL GENERATED
- HOMING FLIP-FLOP RESET

- L1 AND C1 FAIL TO REACH HOME POSITIONS WITHIN 25 SECONDS.
- 25-SECOND FAULT TIMER RUNS OUT
- FAULT IN HOMING MODE.

HOMED MODE

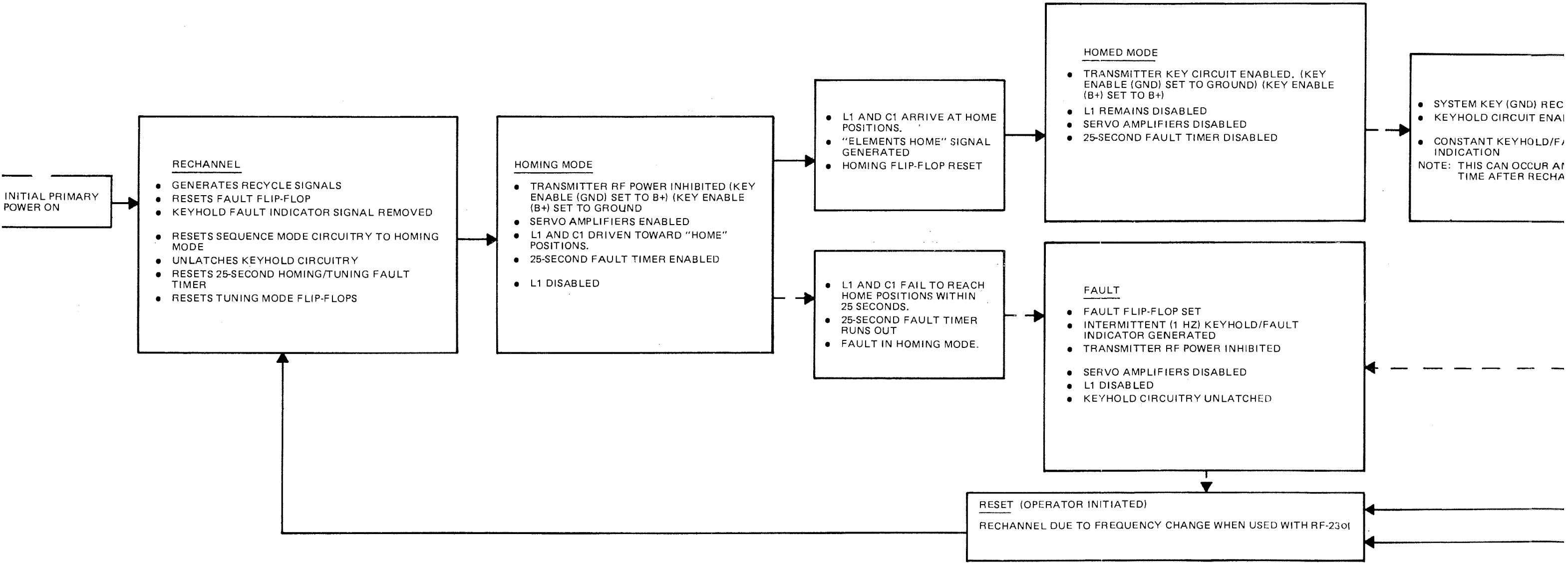
- TRANSMITTER KEY CIRCUIT ENABLED. (KEY ENABLE (GND) SET TO GROUND) (KEY ENABLE (B+) SET TO B+)
- L1 REMAINS DISABLED
- SERVO AMPLIFIERS DISABLED
- 25-SECOND FAULT TIMER DISABLED

FAULT

- FAULT FLIP-FLOP SET
- INTERMITTENT (1 HZ) KEYHOLD/FAULT INDICATOR GENERATED
- TRANSMITTER RF POWER INHIBITED
- SERVO AMPLIFIERS DISABLED
- L1 DISABLED
- KEYHOLD CIRCUITRY UNLATCHED

- SYSTEM KEY (GND) REC
- KEYHOLD CIRCUIT ENAI
- CONSTANT KEYHOLD/F/ INDICATION
- NOTE: THIS CAN OCCUR AT TIME AFTER RECHA

RESET (OPERATOR INITIATED)
RECHANNEL DUE TO FREQUENCY CHANGE WHEN USED WITH RF-2301



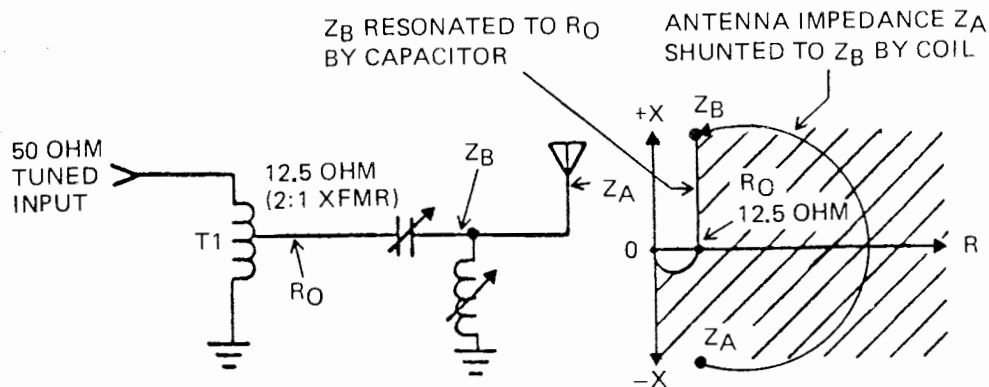


Figure 4-2. Coupler Tune Characteristics

to the center tap, are equal in voltage and 180° out of phase with each other. C1 and the combination of A2R1 and A2R2 form a divider which produces a reference voltage at the center tap of A2T2 that will be 90° out of phase with the line voltage at this point. The vector sum of this reference voltage and the induced voltages in the windings of A2T2 are detected by A2CR1 and A2CR2, respectively, and summed by R4. R4 is adjusted such that the circuit is perfectly symmetrical.

Because of this symmetry, the phase detector output at the wiper of A2R4 will be at a null (zero volts) when the antenna impedance presents a purely resistive load, as in the "tuned" condition. Any other antenna condition would cause vector sum voltages to produce either a positive or a negative voltage output as a function of this phase difference. With a greater vector sum voltage through A2CR1, a positive voltage would be present at the wiper of A2R4 and would cause the servo system to drive A2C1 toward maximum capacitance. With a greater vector sum voltage through A2CR2, a negative voltage would be present at the wiper of A2R4 and would cause the servo system to drive A2C1 toward minimum capacitance.

4.2.2 R Discriminator

Figure 4-4 is a simplified diagram of the R Discriminator circuit. Figure 4-3 includes the complete R discriminator. The function of the R Discriminator is to provide a dc output to the L servo amplifier that is indicative of the resistive component of the line impedance. The dc output will be zero when the resistive component is the desired 50 ohms, negative when the resistive component is less than 50 ohms, and positive when the resistive component is greater than 50 ohms.

Capacitors C2 and A1C1 form a capacitive voltage divider. The voltage across A1C1, shown as E_1 on the diagram, is in phase with and proportional to the line voltage. This voltage is detected by A1CR2, peak filtered by A1C3, and will produce a positive voltage across A1R4 at the output. Transformers T2, A1T1, and A1T2 are shown combined for simplicity. The voltage induced in this transformer combination by the line current will be twice the voltage of E_1 and of opposite polarity. This voltage is shown as E_2 in the diagram. The vector sum of the outputs from the transformer (E_2), and the divider (E_1), is detected by diode A1CR4, peak filtered by A1C5, and appears as a negative voltage across A1R5. The algebraic sum of the positive voltage across A1R4, and the negative voltage across A1R5, will produce an appropriate output as follows: A coupler input impedance of less than 50 ohms would cause a higher rf line current, and therefore increase the value of E_2 . This condition would cause a negative output at A2E2 and would cause the servo to drive the variable inductor toward maximum inductance to force the resistance component of the RF-281 input impedance toward 50 ohms. A higher RF-281 input impedance would cause a lower antenna current, reduce the value of E_2 , cause a positive R Discriminator output to the servo, and drive the variable inductor toward minimum "L" such that the condition is corrected.

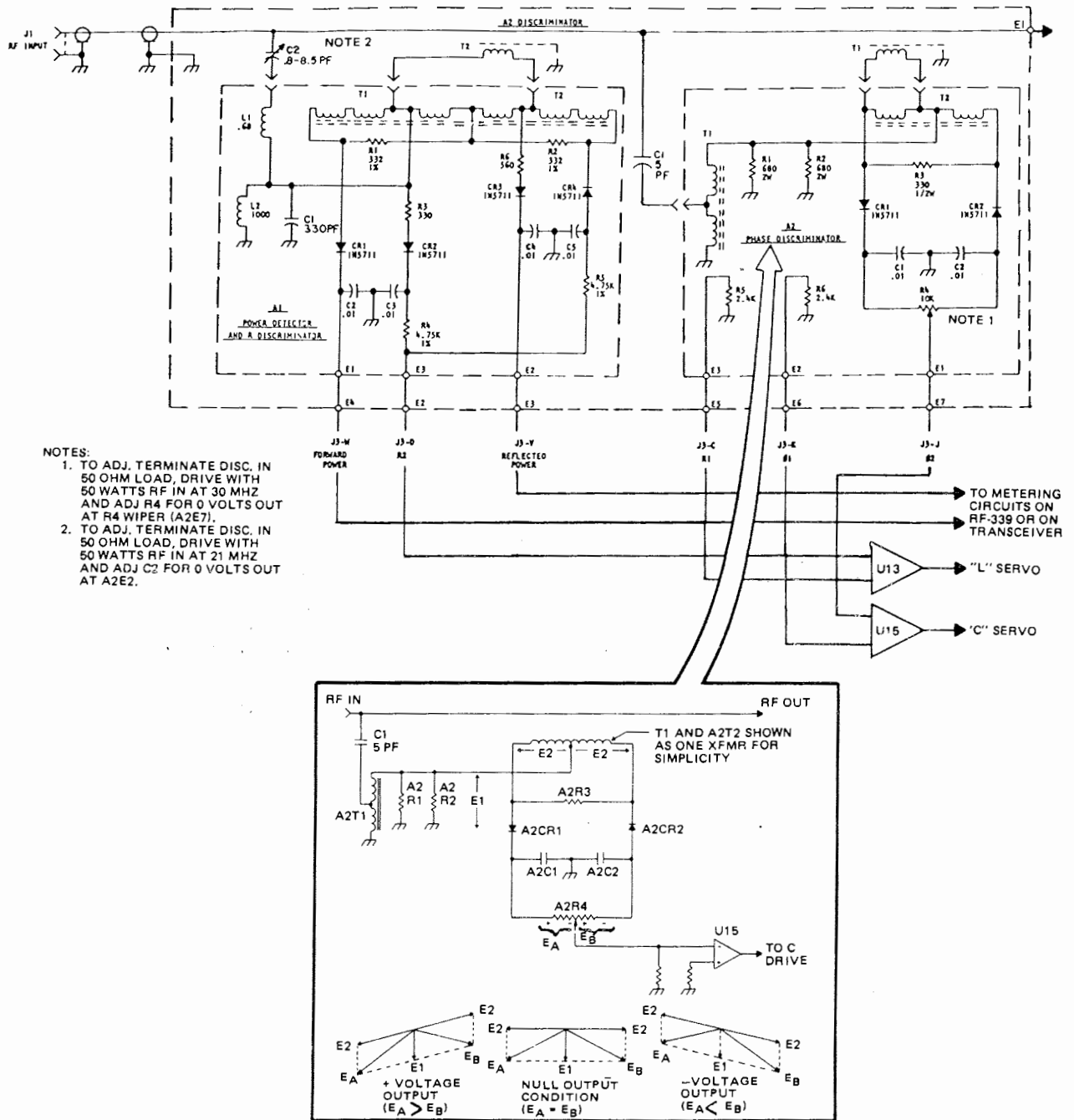


Figure 4-3. A2 Discriminator Assembly, Simplified Schematic

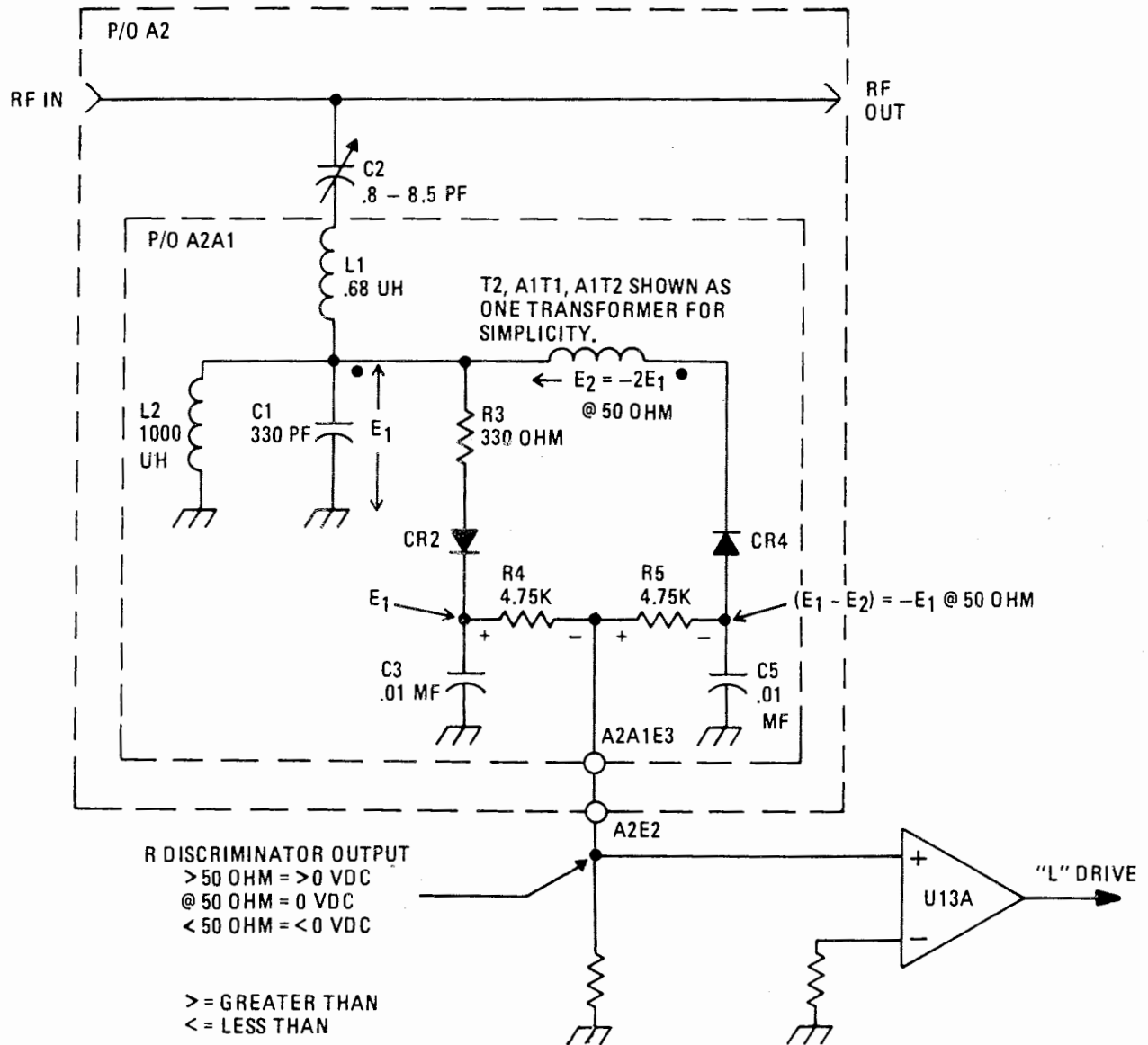


Figure 4-4. R Discriminator, Simplified Schematic

4.2.3 Power Detectors

Refer to figure 4-3 for the following discussion. CR1 and CR3 on the A2A1 Power Detector and R Discriminator Assembly detect representative samples of the forward and reflected power, respectively.

The forward power voltage is developed as follows: C2 and A1C1 form a capacitive voltage divider. The voltage across A1C1 is in phase and equal in magnitude at $50 +j0$ (the tune point) to the voltage developed across the first two sections of A1T1. These voltages are added vectorially, rectified by A1CR1, peak filtered by A1C2, and appear as a voltage proportional to the forward output power at E4. The voltage at this point will cause a full scale indication on the 100 uA FORWARD POWER Meter in the RF-339 at a forward power level of 150 watts.

The reflected power metering voltage is developed as follows: The voltage across A1C1 is 180° out of phase and equal in magnitude to the voltage developed in the last section of A1T1 and the adjacent section of A1T2. These voltages are also added vectorially, and because they are 180° out of phase, at $50 +j0$ (the tune point), the vectorial sum would be zero volts. Any mis-match, or condition other than $50 +j0$, would cause a proportional phase shift, or change in magnitude, and be detected by A1CR3 as a reflected power voltage. This voltage is peak filtered by A1C4 and will appear as a positive voltage output at E3 on the discriminator assembly.

4.3 SERVO CONTROL

4.3.1 Variable Inductor Control Servo

Refer to figure 4-5, a simplified diagram of the servo control system, for this discussion. Control information for the variable inductor servo originates in the "R" Discriminator as previously described. The control voltage at the non-inverting (+) input to U13A can vary between a negative and a positive voltage as a function of the R Discriminator output. The output of U13A is applied to the non-inverting input of U13B and to the inverting input of U14A such that U13B and U14B will have equal but opposite voltages.

Assuming the U13B output voltage to be negative and the U14B output voltage to be positive, the variable inductor would be driven toward maximum as follows: The negative output voltage from U13B would bias on PNP Transistors Q3 and Q4, and the positive output voltage from U14B would bias on NPN Transistors Q6 and Q5. With this polarity voltage on the "L" servo drive motor, the variable inductor will be driven toward maximum. Note that L1 to Maximum forcing logic (ground through CR1 and [+] through CR11), would also drive the inductor toward maximum by similarly biasing Q3, Q4, Q5, and Q6. These same conditions would bias off Q1, Q2, Q7, and Q8, the "L1 Run to Minimum" drive transistors.

An "R" Discriminator output that would cause the U13B output to be positive, and the U14B output to be negative, would bias on Q1, Q2, Q7, and Q8, and cause the variable inductor to be driven toward minimum. Note that minimum "L" is the "Home" position, and that the "Home" logic levels introduced through CR5 and CR3 would also cause drive transistor bias conditions that would drive the variable inductor in this direction.

4.3.2 Variable Capacitor Drive Servo

Refer to figure 4-5, the Servo Control Simplified Diagram. The capacitor drive servo operates just like the variable inductor servo described in the previous paragraph with the notable exception that the Phase Discriminator is used as the sensor and drive voltage source. The Phase Discriminator output will also vary between a negative and a positive voltage as a function of the detune condition. This voltage will cause the capacitor drive servo to run either clockwise or counterclockwise until a tune condition is effected as evidenced by zero volts or a null in the Phase Discriminator output.

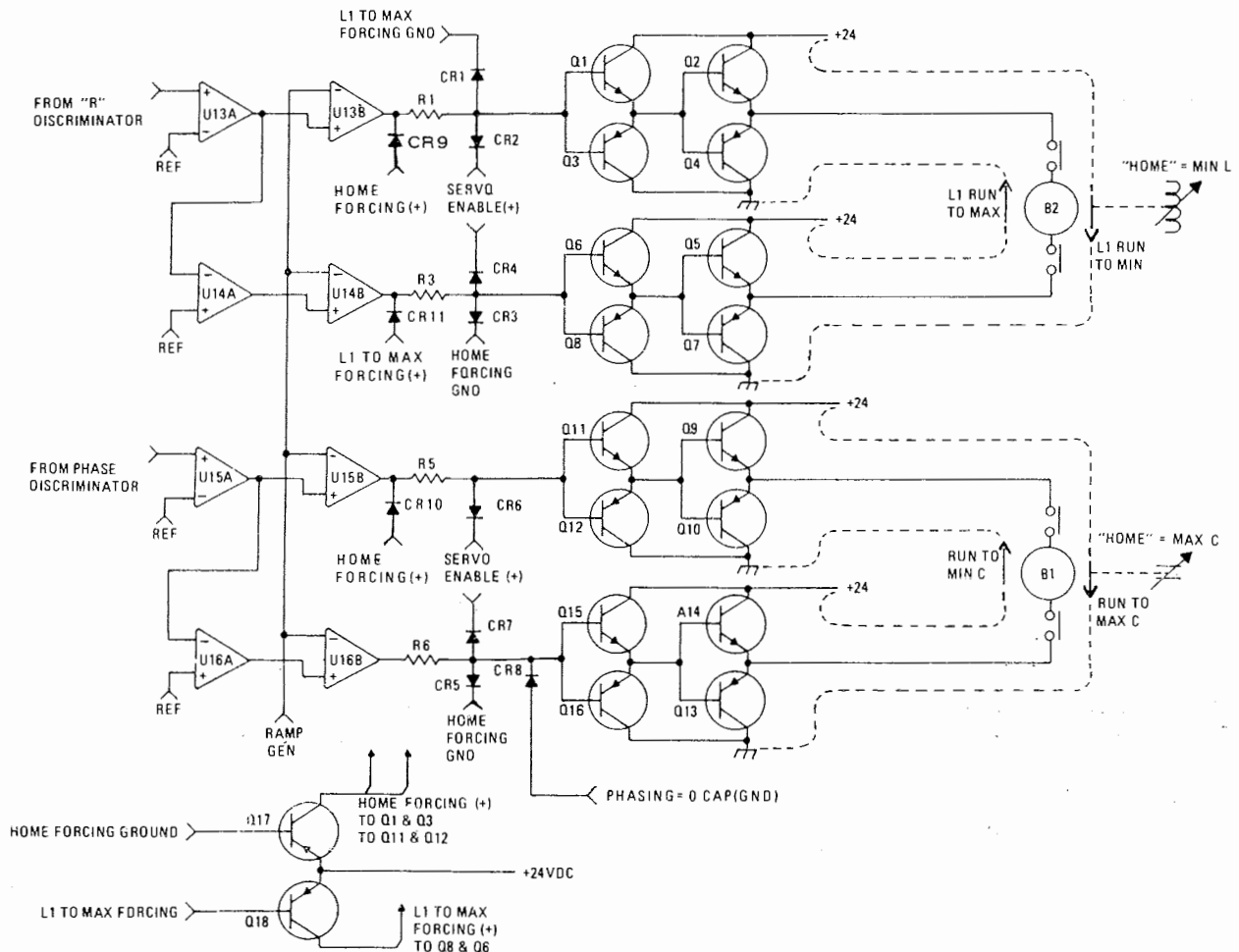


Figure 4-5. Servo Control, Simplified Diagram

4.3.3 Ramp Generator

See figure 4-6 for the following discussion. The ramp oscillator functions in combination with the servo control signal from the respective discriminator to produce time modulated servo motor drive voltages as shown. By pulsing the 24 Vdc motor drive voltage at a pulse width proportional to the error signal, maximum motor efficiency and proportional control are maintained, even at low error voltage levels.

Recall that the phase or R Discriminator outputs can be either positive or negative and will drive the servo motors either clockwise or counterclockwise. We will consider both directions, but only for the variable inductor because both systems operate in the same manner. Referring to figure 4-5, notice that U13 and U14 are both dual operational amplifiers. The R Discriminator output is connected to the non-inverting (+) input of U13A. The inverting input of U13A is tied to a fixed reference voltage.

Let us consider a positive input from the R Discriminator. The output of U13A would, in this instance, be some finite positive value as a function of the gain of U13A and the specific input level. This positive level is applied directly to the non-inverting (+) input of U13B, and also to the inverting input of U14A. At this point there would be equal but opposite signal levels at the non-inverting input of U13B and U14B. Note that the ramp generator output is fed to the inverting input of U13B and U14B. The ramp voltage is a 400 Hz voltage (approximately) that varies between -0.2 and $+5$ Vdc.

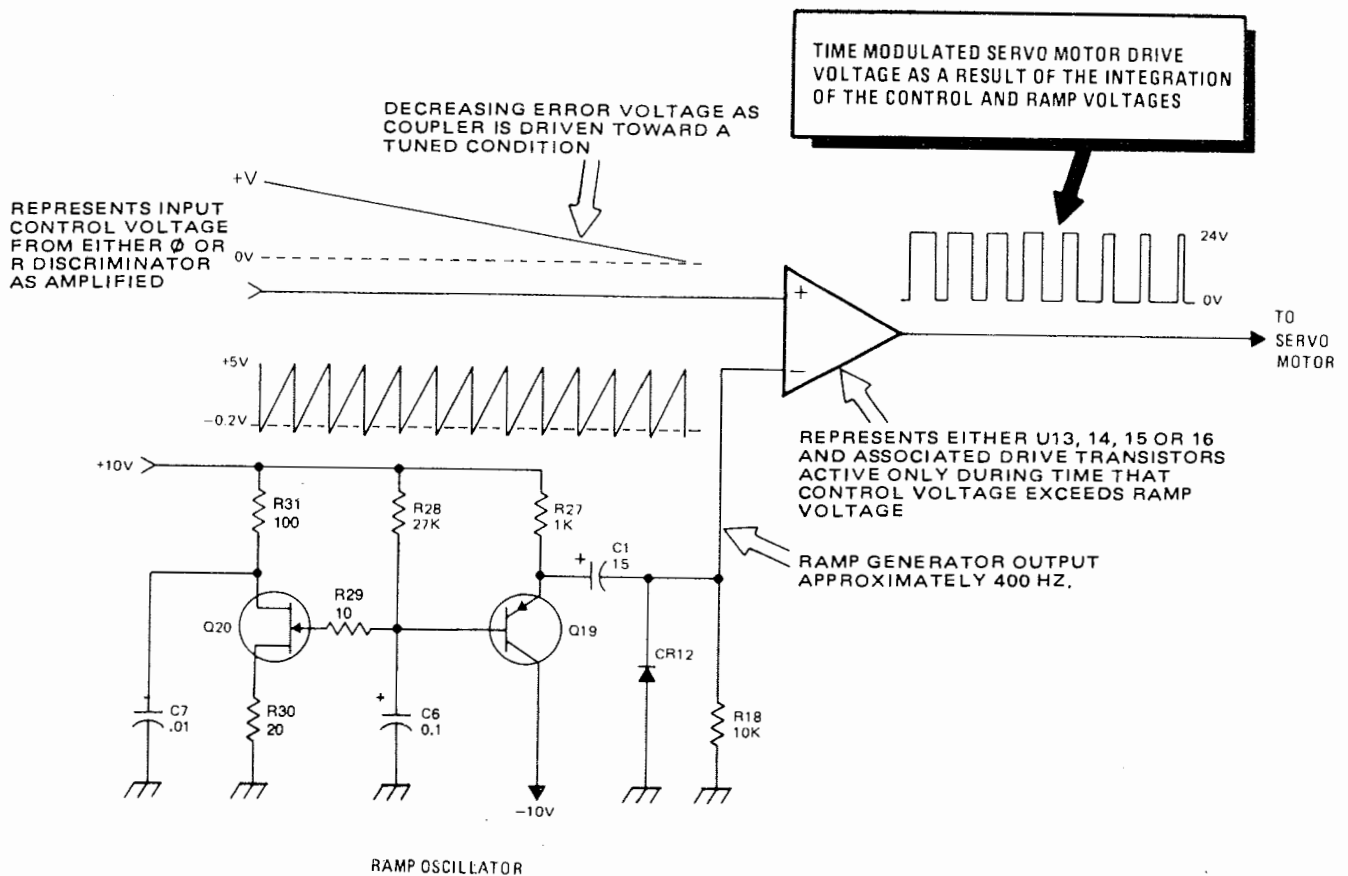


Figure 4-6. Ramp Oscillator Functions

With this ramp voltage applied to the inverting input of U13B, and the positive voltage (in this instance) at the non-inverting input, U13B would produce a positive output, but only during the period of time that the signal voltage exceeds the ramp voltage. A high signal voltage would exceed the ramp voltage for a greater period than would a small signal voltage. During the period that the U13A output is positive, Q1 and Q2 would be biased on and apply +24V to the servo motor as shown in figure 4-5, note that the ground path must also be completed through Q7 and Q8.

Q7 and Q8 will, in this instance, be on continuously – as opposed to the pulsing action on the positive side. This is accomplished as follows: The positive output of U13A is inverted by U14A and compared with the ramp voltage at U14B. In this instance, the negative signal voltage would always be more negative than the positive ramp voltage, and as a consequence, the U14 output would be negative as long as the signal voltage is negative. This condition would provide a continuous ground path for the pulsating +24 Vdc run-to-minimum polarity voltage applied through Q1 and Q2.

A negative input at U13A would control the motor circuit in a similar manner for operation in the opposite direction. In this instance, however, Q3 and Q4 would provide a continuous ground, and Q5 and Q6 would pulse the +24 Vdc side.

4.3.4 L1 Drive Assembly

The heart of the variable inductor drive assembly is a 24 Vdc motor that will run in either direction, dependent on the polarity of the drive voltage previously discussed. There are two microswitches, S1 and S2, mechanically coupled to the assembly. S1 is positioned and adjusted such that it will be opened as the variable inductor reaches the maximum "L" position. When S1 opens, +24 Vdc driving the motor is

removed, and at the same time this side of the motor is grounded so that 24V on the other side of the motor can run the inductor out of this position and toward minimum "L". S2 serves a similar function at the minimum "L" end of the inductor. CR3 provides an "L1 at minimum" signal to the "elements-home" logic on the control logic assembly pc board.

4.3.5 C1 Drive Assembly

The variable capacitor drive assembly operates similar to the L1 drive assembly and includes similar end stop switches. CR3 on the switch assembly also feeds an "elements-home" signal to the same NOR gate fed by the L1 at minimum signal. Note, however, that the C1 "Home" position is maximum capacitance.

4.4 CONTROL LOGIC PC BOARD

The Control Logic Assembly PC Board contains most of the active coupler logic circuits, servo amplifiers, and the related power supply elements. Q1, the series regulator for the power supply, is mounted external to the pc board to provide the heat dissipation requirements. Figure 4-7 shows the power supply functions contained on the Control Logic Assembly PC Board. Note that Q1 is shown with the pc board mounted circuit elements for clarity.

The 22 through 36 Vdc RF-281 input voltage can originate through the RF-339 or from the compatible transmitter/transceiver, dependent upon the system involved. The +24 Vdc regulated output is used primarily with the servo drive system. The plus and minus 10 Vdc voltages are used for the logic functions. All voltages are referenced to chassis ground and can be checked at test points on the pc board.

TP3 = +24 Vdc

TP4 = -10 Vdc

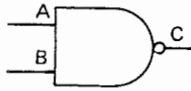
TP7 = +10 Vdc

Circuit explanations include logic symbols and, in some instances, boolean expressions. The following summary is included to define the meaning of these terms.


● BOOLEAN EXPRESSIONS

- (1) $A + B = C$ The plus sign should be read "OR" in a boolean expression. This expression should be read "A OR B = C".
- (2) $A \bullet B = C$ The black dot should be read "AND" in a boolean expression. This expression should be read "A AND B = C".
- (3) $\bar{A} \bullet \bar{B} = C$ The superscript bar is the symbol for negation in a boolean expression. This expression should be read, "NOT A AND NOT B = C".

● LOGIC

- (1)  This NAND gate performs an "AND" function with high level inputs and an "OR" function with low level inputs. The symbols used include an indication of the circuit function performed to produce the desired output.

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

- (2)  This NOR gate performs an "AND" function with two low level inputs and an "OR" function with any high level input. The symbols used include an indication of the circuit function performed to produce the desired output.

A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

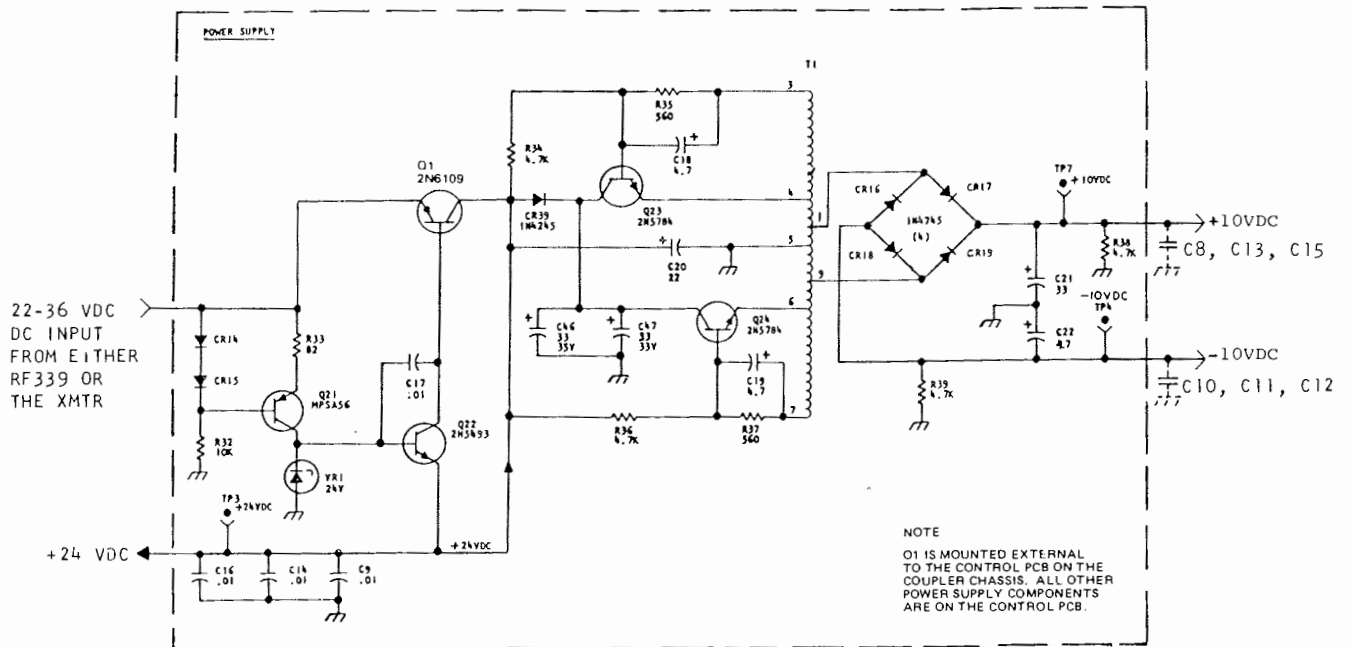


Figure 4-7. Power Supply Schematic

4.4.1 Rechannel Logic

Refer to figure 4-8 and to the related simplified diagram on figure 4-1A. "Recycle" (gnd), and "Recycle" (+) signals are generated by U7C and U3D in response to a rechannel ground signal or at initial power on. The rechannel ground signal could originate at a compatible transceiver or in the RF-339. A rechannel ground will be generated by the RF-339 whenever FAULT RESET switch S5 is activated, or whenever TRANSMITTER TUNE is selected at S3. The RF-280 will generate a ground pulse signal whenever a new frequency is selected. C30 charges through R69 to stretch the "Recycle" output when the rechannel ground input is removed. C30 discharges through CR24 to provide fast response to rechannel ground inputs. C29 provides a low impedance path to ground at power on to cause a momentary low at U7C and generate a "Recycle" signal at initial power on. The time constant of C29 and R68 prevents recycling as a result of momentary power interruptions.

The recycle (gnd) signal resets fault circuitry, resets sequence mode circuitry to "Homing" mode, and unlatches keyhold circuitry. The "Recycle" (+) signal is generated simultaneously and is used to reset the 25 second fault timer, and tuning mode flip-flop.

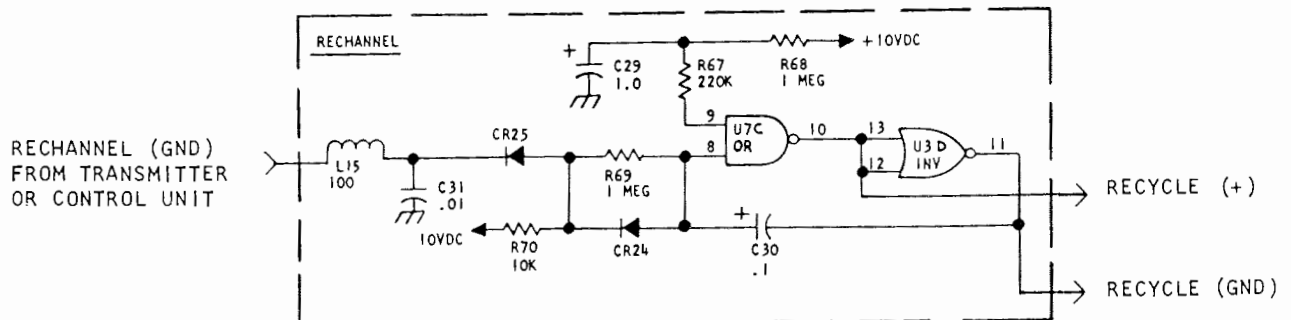


Figure 4-8. Rechannel Pulse Generation

4.4.2 Elements Home Logic

Refer to figure 4-9 and to the related simplified diagram on figure 4-1A. The "Elements Home" signal is generated by NOR gate U12A. This device uses low level inputs to perform an "AND" function such that the "Elements Home" (+) signal will be present only when C1 and L1 are at the "Home" position. When C1 reaches the "Home" (maximum C) position, S2 will be closed and complete the biasing circuit, that includes R78 and R79, to ground. This reduces the bias at U12-1 from +10 Vdc to a ground logic level. S2 on the L1 assembly provides a similar function. S2 on both assemblies must be closed to generate the "Elements Home" (+) logic signal. This signal is fed to the sequence mode logic and will switch the sequence mode logic from the "Homing" mode to the "Homed" mode.

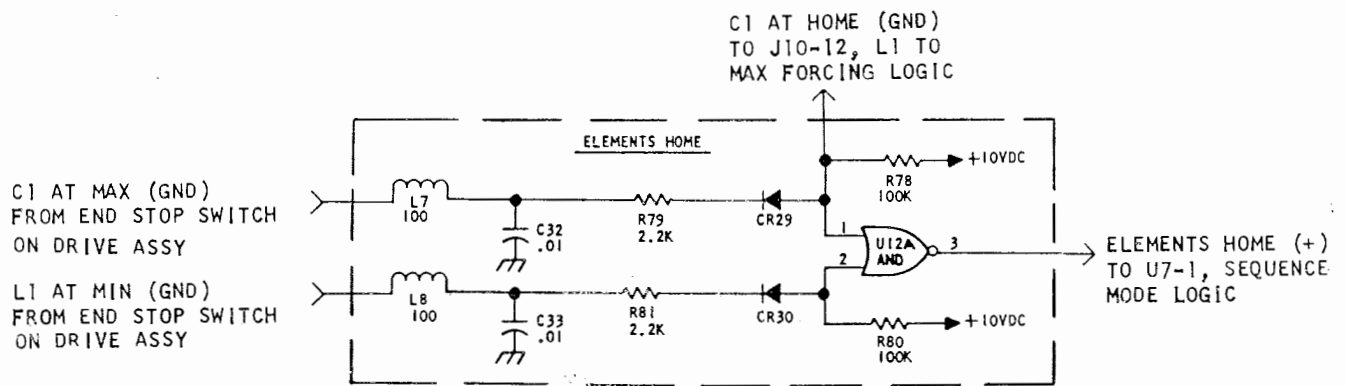


Figure 4-9. Elements Home Logic

4.4.3 Sequence Mode Logic and Control

Refer to figure 4-10 and to the related simplified diagram on figure 4-1A. The Sequence Mode Logic consists of the following functions: Homing, Homed, Tuning, and Tuned. The Homing, Tuning, and Tuned functions are generated through NAND gates configured as RS Type flip-flops. The Homed function is generated by "ANDING" the "Elements Home" (+) signal and the tuning (gnd) signal in part of U6.

$$\text{RECYCLE (GND)} \bullet \overline{\text{ELEMENTS HOME}} = \text{HOMING}$$

The "Homing" signal will be generated whenever a "Recycle" (gnd) signal is received. The "Homing" (+) output biases on Q44 and Q45 and will drive both the variable inductor and capacitor servos to the "Home" position. When the tuning elements have reached their "Home" positions an "Elements Home" (+) signal will be produced (see paragraph 4.4.2) at U7A. Note that U7A has both inputs tied together such that it functions as an inverter. This signal resets the "Homing" RS flip-flop (U7B & D) and switches the "Sequence" mode to Homed.

$$\text{HOMED} \bullet \text{RF PRESENT} = \text{TUNING}$$

The "Tuning" signal will be generated when the "Homed" and "RF Present" functions are present. This signal is used in the generation of the "Tune Power Request" signal and in the fault logic. The "Tuning" mode flip-flop is reset such that it is out of the "Tuning" mode when the "Sequence" mode switches to the "Tuned" mode or when the coupler is rechanneled.

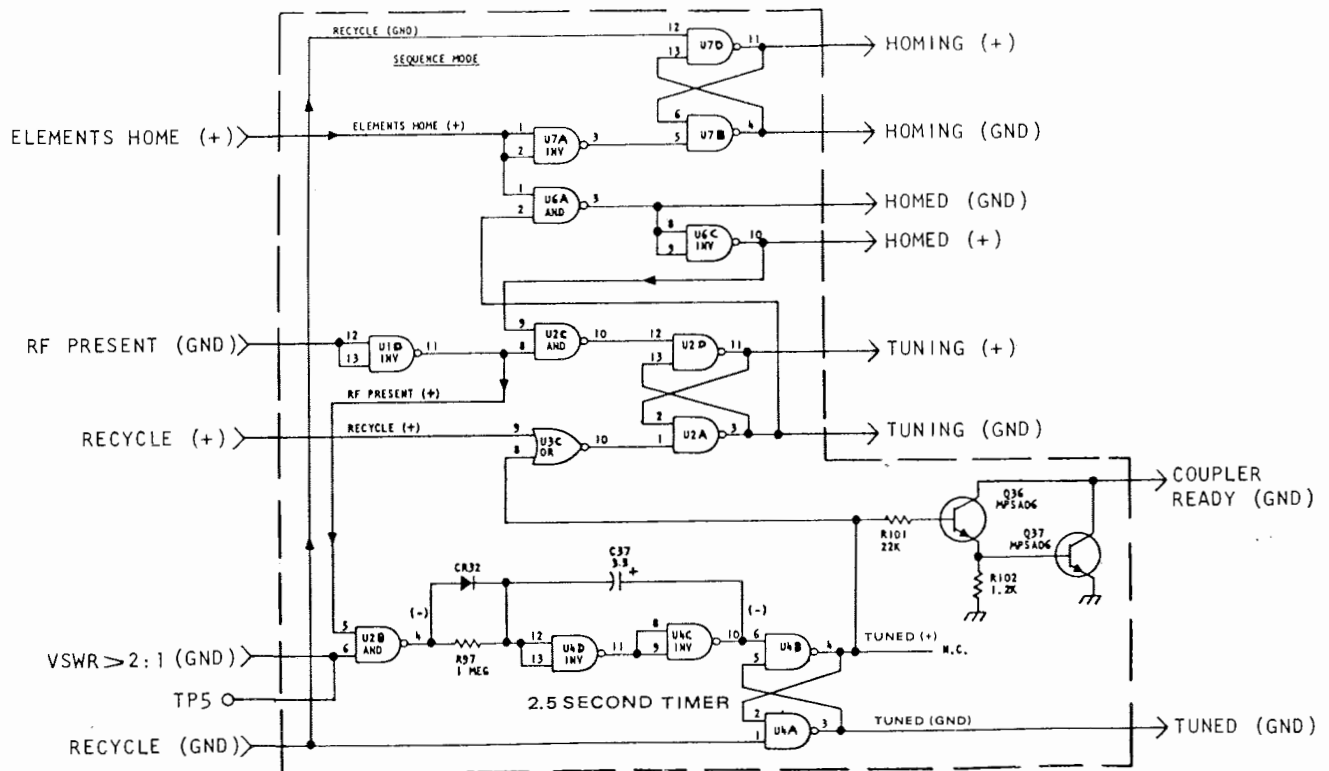


Figure 4-10. Sequence Mode Logic and Control

$$\text{RF PRESENT (+)} \bullet \overline{\text{VSWR} > 2:1} = \text{TUNED (+)}$$

The "Tuned" signal will be present when the RS flip-flop composed of U4A and B is "set" to this condition by an "RF Present" condition in coincidence with a VSWR of less than 2:1 (when VSWR > 2:1 signal goes positive). Note that a delay has been provided in series with the U2B "ANDING" function. This delay provides additional time for fine tuning after a VSWR < 2:1 condition has been achieved. The "Tuned" (+) signal turns on Q36 and Q37 to provide a "Coupler Ready" (gnd). The "Tuned" flip-flop will be reset by a "Recycle" (gnd) signal.

4.4.4 Servo Enable and Control Logic

Refer to figure 4-11 and to the related simplified diagram on figure 4-1A. The "Servo Enable" (+) signal will be generated whenever rf is present or a "Homed" condition exists and there is no fault condition. When the "Servo Enable" (+) condition is not present, the outputs from the servo amplifiers, U13B, U14B, U15B, and U16B, will be shorted to ground through CR2, CR4, CR6 and CR7 respectively and Q43. With a "Servo Enable" (+) condition, these diodes are biased off and the servo amplifier outputs will control the drive transistors. This allows the coupler to perform "surveillance tuning". This means that variable inductor L1 and variable capacitor C1 will automatically be adjusted to a new tune point to compensate for small changes in antenna impedance or operating frequency. This occurs in the "Tuned" mode, without the necessity for recycling through the complete tuning sequence.

4.4.5 L1 Disable and Control Logic

Refer to figure 4-12 and to the related simplified diagram on figure 4-1A. The L1 disable and control logic group controls K1 on variable inductor L1 by controlling its path to ground through Q49. Energizing K1 disables L1 by opening the ground side of the coil. This effectively bypasses the RF-281 tuning network for monitoring receive signals at frequencies other than that to which the coupler is tuned.

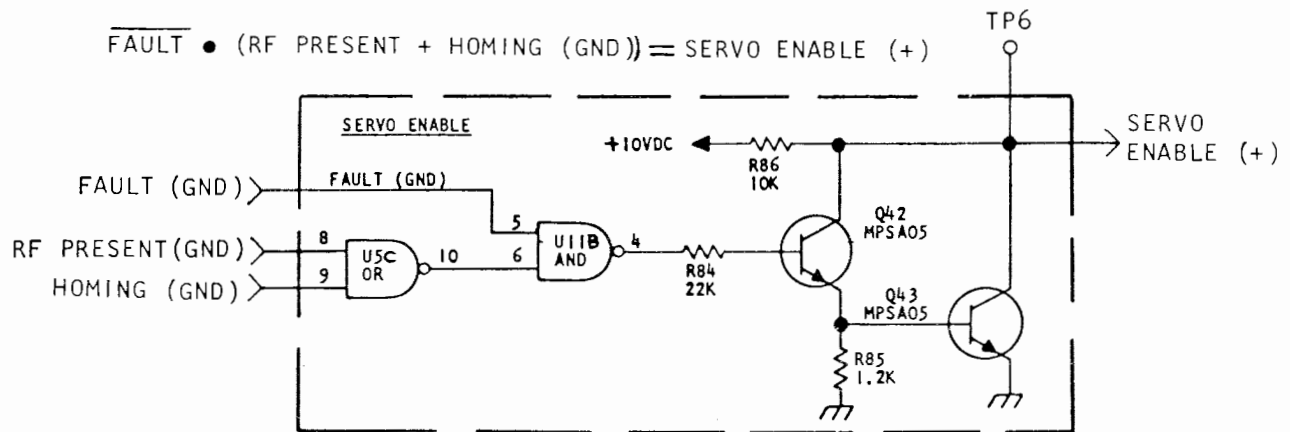


Figure 4-11. Servo Enable and Control Logic

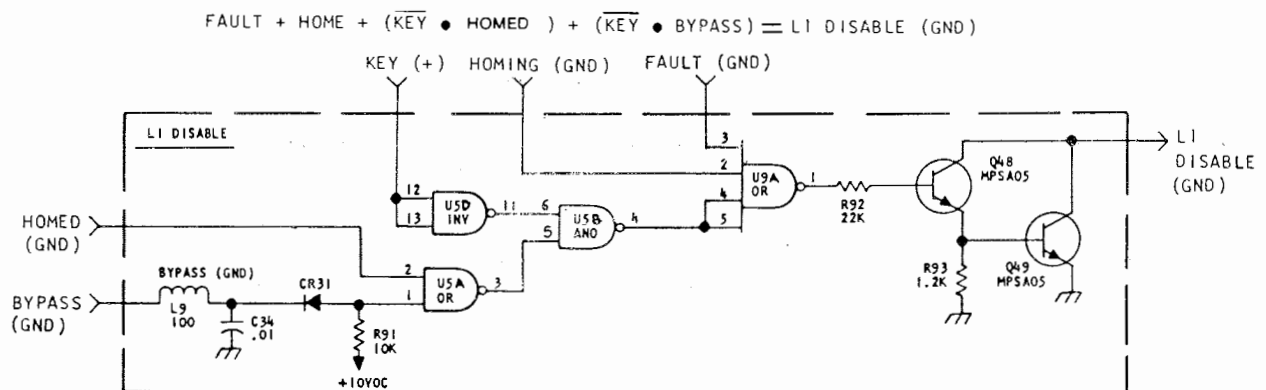


Figure 4-12. L1 Disable and Control Logic

Variable inductor L1 is disabled as follows. Q48 and Q49 are turned on whenever the base of Q48 goes high, as would be the case with a plus output from U9. L1 will be disabled under the following conditions: A "Fault" (gnd) at U9-3, or a "Homing" (gnd) at U9-2, or no "Key" (+) and a "Homed" (gnd), or a "Key" (+) and a "Bypass" (gnd) through U5.

4.4.6 Tune Power Request and Control Logic

Refer to figure 4-13 and to the related simplified diagram on figure 4-1A. A "Tune Power Request" ground signal will be placed on the control line whenever Q35 is turned on. Q35 and Q50 will be turned on when the base of Q50 goes high in response to a plus output from U6B. Tune power will be requested whenever a "Tuning" (gnd) signal is present at U6-B or when "Key" (+), and "Homed" (+) signals are present from U6D. These conditions should occur after the tuning elements have reached the home position and the system is keyed. The "Tune Power Request" signal is removed after the tuning elements have reached the "Tuned" position.

The "Tune Power Request" condition functions to automatically force a compatible transmitter to produce an unmodulated carrier when the transmitter is keyed. This line is used in the RF-280 SSB/FM Tactical Radio to mute audio circuits and select the FM mode. This produces a 25 to 30 watt unmodulated carrier when the RF-280 is keyed. Q35 can sink up to 100 ma dc and can withstand up to 36 Vdc open circuit voltage (uncommitted collector) when not requesting tune power.

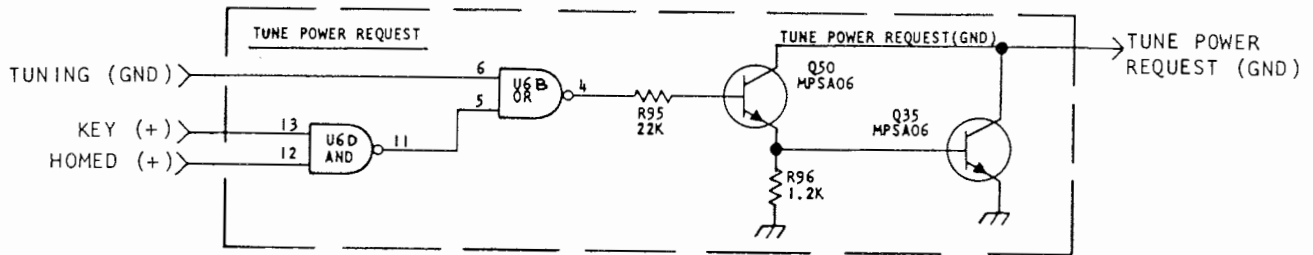
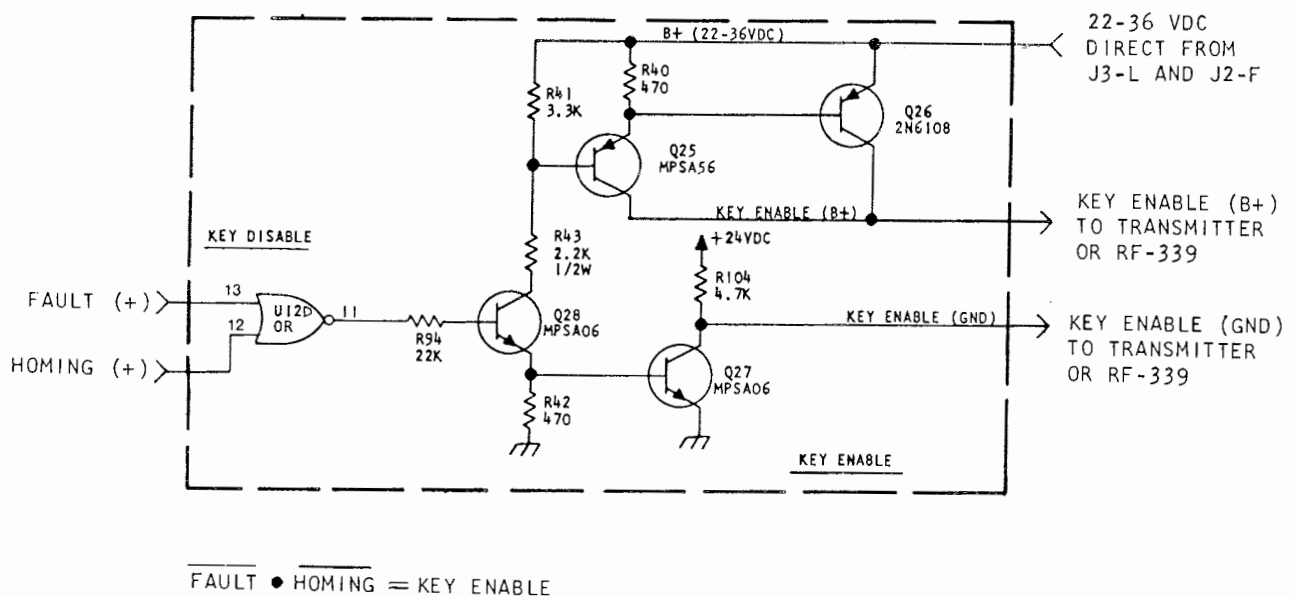


Figure 4-13. Tune Power Request Logic and Control

In systems using the RF-339, this signal activates TUNING indicator DS1, and also closes both K1 and K2 in the RF-339. Closing K1 and K2 reduces power to the RF-281 by placing a 3 dB pad in series with the transmitter rf output to the RF-281.

4.4.7 Key Enable and Disable Control Logic

Refer to figure 4-14 and to the related simplified diagram on figure 4-1A. The "Key Enable" signal from the RF-281 and the keyline are both required to enable the power amplifier to produce rf power output. The "Key Enable" logic actually functions to automatically disable the rf output until all pre-requisite conditions are met. NOR gate U12D will disable the key enable function in the presence of a "Fault" condition or a "Homing" condition. The "Key Enable" function is available as both a ground and as B+. The "Key Enable" (B+) is capable of driving a 250 mA dc load. When disabled, the line is open (uncommitted collector). The "Key Enable" (gnd) is capable of sinking 250 mA dc. Both outputs are available at the control cable output. Note that the "Key Enable" (gnd) is in series with the ENABLE/DISABLE switch on the RF-339, and also the Keyline.



FAULT • HOMING = KEY ENABLE

Figure 4-14. Key Enable and Disable

4.4.8 Key Hold Logic and Control

Refer to figure 4-15 and to the related simplified diagram on figure 4-1A. U9B is part of a dual 4 input NAND gate and performs an "AND" function to control the "Key Hold" ground. This means that all of the inputs must be high before the output will go low. If we assume that the system is not tuned and that we do not have "Fault" or "Recycle" logic levels present, then a momentary key (gnd) condition from the transmitter would bias Q34 off and cause U9-12 to go high. With these input conditions, the U9B output would go low and generate a "Keyhold" (gnd). This ground signal will be inverted by U12B and bias on Q38 and Q39, which will hold the transmitter keyline at ground until any of the logic levels at the input of U9B change to a ground level. Recall that the "Tuned" flip-flop will be reset one second after the $VSWR < 2:1$ and "RF Present" conditions are met. As a consequence, a momentary key by the operator will latch the system in a keyed condition until the RF-281 has either tuned, faulted, or receives a rechannel signal. The keyline through Q39 can sink up to 100 mA, dc, and withstand up to 36 Vdc open circuit (unkeyed).

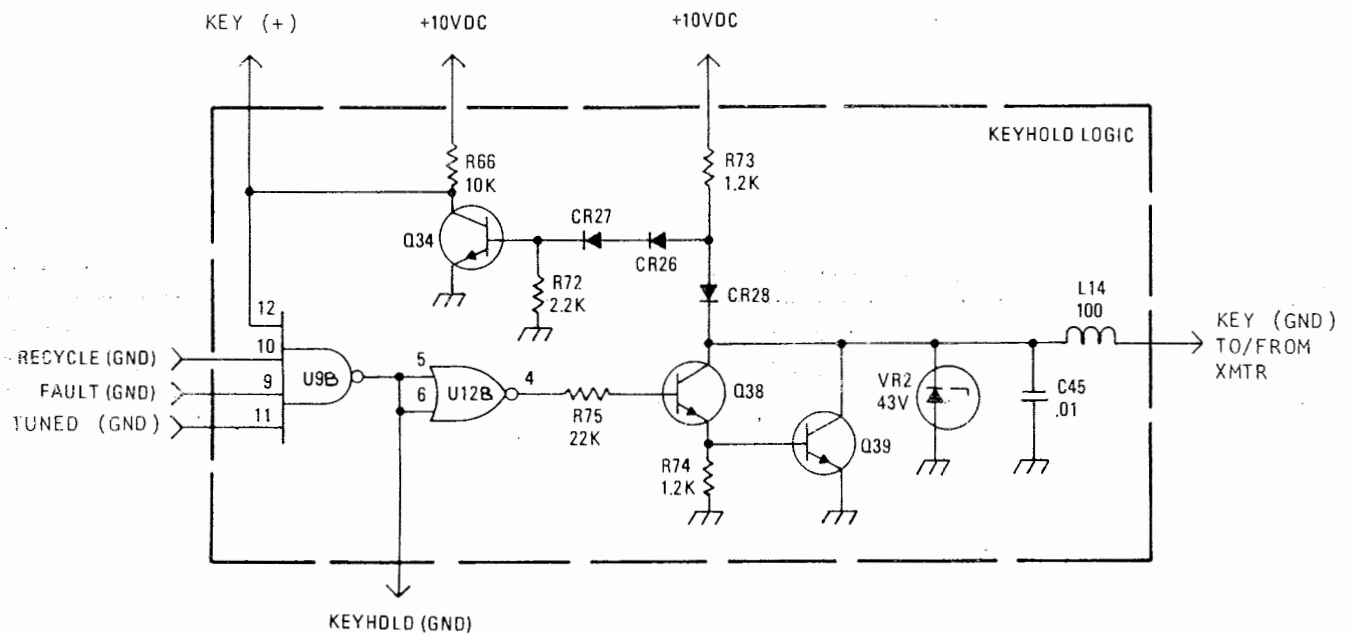


Figure 4-15. Key Hold Logic and Control

4.4.9 Keyhold/Fault Indicator Logic and Control

Refer to figure 4-16 and to the related simplified diagram on figure 4-1A. This signal indicates "Keyhold" or "Fault" status of the RF-281. A constant +24 Vdc on this line indicates that the RF-281 has the system key grounded. A 24 Vdc pulse at 1 Hz indicates that the coupler has faulted. The system keyline is held grounded when the elements are either homing or homed after the system has been momentarily keyed, or when the tuning elements are tuning under rf power. When the RF-281 is not tuning or is not faulted the line is open, (no +24V supplied to the indicator line). This signal operates the FAULT indicator on the RF-339. In RF-280 systems, this signal activates a tone in the headset or speaker.

4.4.10 Fault Logic and Control

Refer to figure 4-17 and to the related simplified diagram on figure 4-1A. U8A and U8B are configured as an RS flip-flop. A "Recycle" (gnd) signal at U8B will reset the latch and a ground at U8A will set the latch to the fault condition. Note that the "Fault" (+) output will drive the 1 Hz multivibrator, U11A and U11D, (figure 4-16) to indicate a "Fault" condition. The 750 ms delay built into this circuit by U8C and U8D, and the combination of C41, R100, and CR33, functions to delay fault action just long enough to accommodate minor VSWR excursions during the final tune phase. The Homing/Tuning Fault (+) input is from the 25 second timer.

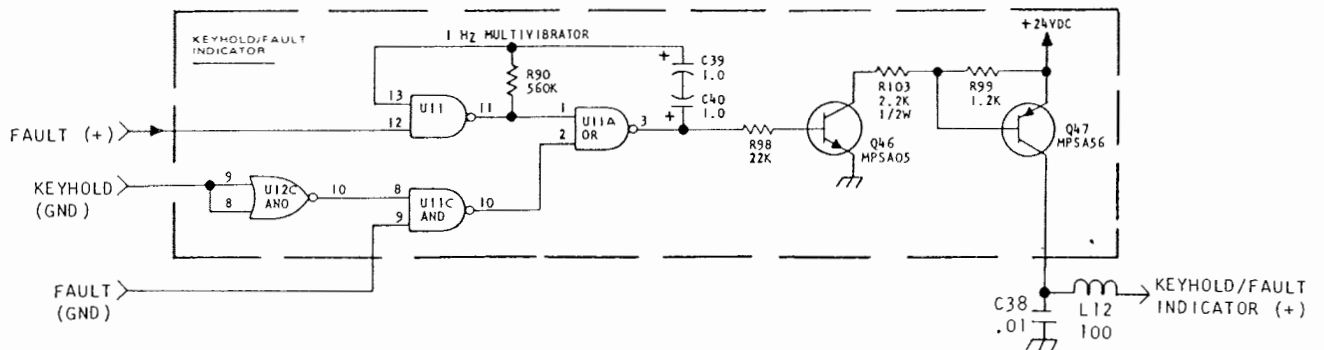


Figure 4-16. Keyhold Fault Indicator Logic and Control

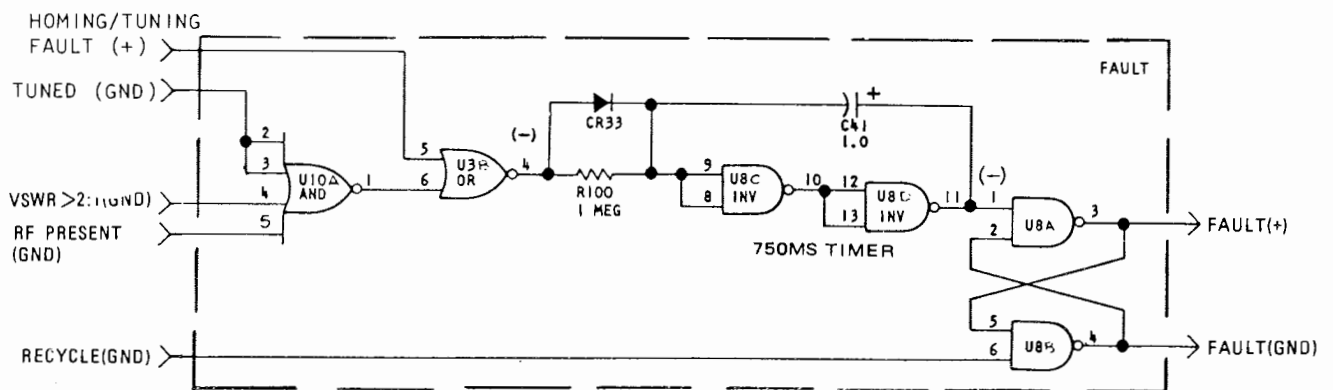


Figure 4-17. Fault Logic

4.4.11 25 Second Timer, Homing/Tuning Fault Control

Refer to figure 4-18 and to the related simplified diagram on figure 4-1A. This circuit will generate a Homing/Tuning Fault signal if the RF-281 has not completed the instructed operation within 25 seconds. Q33 will be switched off and start the tuning action with a ground logic level at its base. U3A will produce a ground logic level output in the presence of either a "Tuning" (+) or a "Homing" (+) logic level at its input. When Q33 is switched off C23 starts to charge towards B+ through R46. The time constant of C23 and R46 provides an approximate 25 second delay in the generation of this function. If the RF-281 does not home or tune within this time frame, the Homing/Tuning Fault signal will be generated and applied to the fault logic. The timer will be reset by a "Recycle" (+) signal at Q33 or when both the "Tuning" (+) NOT and the "Homing" (+) NOT conditions are satisfied.

4.4.12 RF Power Status

Refer to figure 4-19 and to the related simplified diagram on figure 4-1A. This circuit monitors both the forward and the reflected power levels as sampled and detected by the A2A1 Discriminator, and provides four outputs: two metering outputs, and two logic levels. Q31 and Q32 buffer the forward and reflected samples respectively. The output levels to the metering lines are calibrated to indicate 150 watts full scale on a 0 – 100 microamp dc meter, and 40 watts at 1/2 scale (50 microamps). These outputs drive the front panel meter on the RF-339.

The forward and the reflected power levels are compared in U17A. The value of R55, R58, and R59 have been chosen such that VSWR levels less than 2:1 will produce a positive logic level, and VSWR levels greater than 2:1 will produce a ground logic level at the output of U17A.

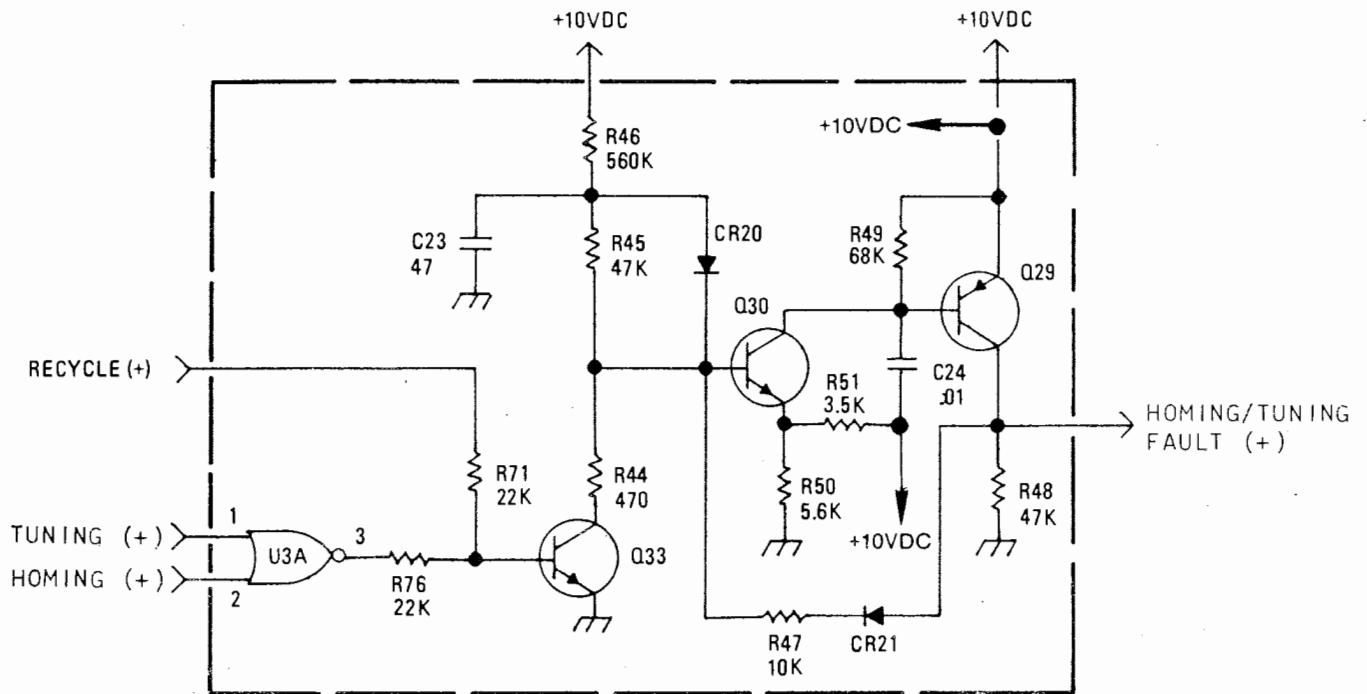


Figure 4-18. 25 Second Timer, Homing/Tuning Fault Control

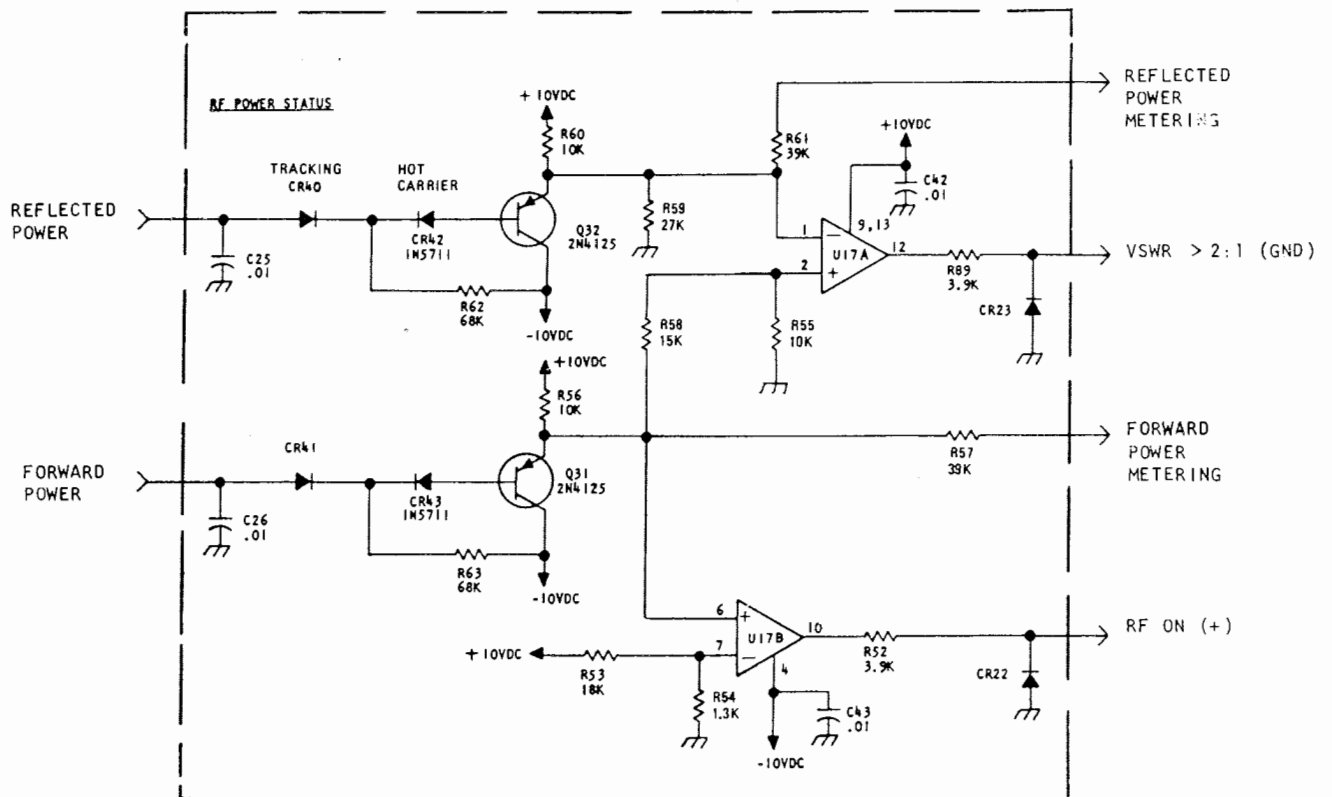


Figure 4-19. RF Power Status

The "RF ON" (+) threshold is established by R53 and R54 at the reference input to U17B. U17B compares the forward power output of Q31 with the reference established by voltage divider R53 and R54. Increasing the value of R54 will increase the amount of rf input power required at J1 to produce an "RF ON" (+) signal. A 1.3K resistor produces a 5 watt threshold and a 2.2K resistor produces a 15 watt threshold. R54 may be changed to generate this function at a higher power level if desired. This may be desirable to decrease the effects of a near-field transmitting antenna.

4.4.13 RF Present Logic and Control

Refer to figure 4-20 and to the related simplified diagram on figure 4-1A. The "RF Present" (gnd) logic level is produced by "ANDING" the delayed "RF ON" (+), and the "Key" (+) logic levels. This output is used with the Sequence and Servo Enable Logic, and it is also used in combination with the VSWR > 2:1 output at the "L1 to Max Forcing" logic and at the "Fault" logic.

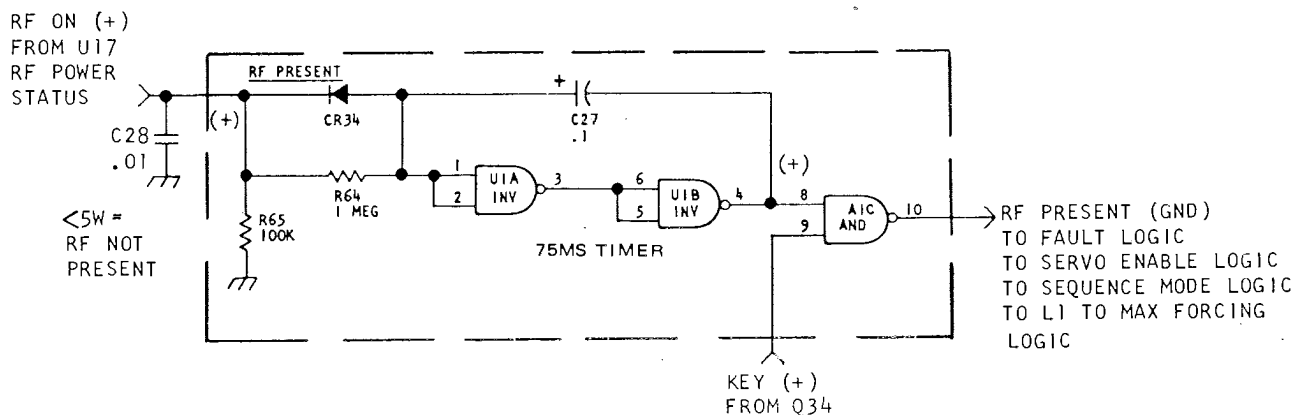


Figure 4-20. RF Present Logic and Control

Combining the "Key" (+) and the "RF ON" (+) assures the various logic circuits requiring the "RF Present" (gnd) will respond only when the transmitting system is keyed. This prevents response to an unkeyed system that is susceptible to near-field interference from another close-by transmitting system.

The 75 ms timer allows time for an initially keyed transmitter carrier to stabilize before being used by the RF-281 circuits.

4.4.14 L1-To-Max Forcing Logic and Control

Refer to figure 4-21 and to the related simplified diagram on figure 4-1A. U10B has four inputs and functions as an AND gate in that all logic levels must be low for the output to go high. When the U10B output is high, Q40 and Q41 are turned on and place a forcing ground on the L1 Servo Control system that will force L1 to run toward the maximum "L" position.

The conditions required to generate this function will normally occur only during the initial tuning operation in the low frequency range from 1.5 MHz to approximately 3 MHz. As an example, if the servo motor for variable capacitor C1 was energized by the Phasing Discriminator to drive toward maximum capacitance, and if the capacitor was already at maximum capacitance, the capacitor could not move. With these conditions a capacitive phasing signal to the coupler would be so far from the tune point that the R Discriminator output would be insufficient to drive the variable inductor toward the tune point. The L1 to maximum forcing logic would sense this condition and generate an L1-to-maximum forcing ground. As variable inductor L1 is driven toward maximum, the Phasing Discriminator will eventually change to

indicate an inductive phasing output and the forcing ground will automatically be removed. At this point the capacitor and the inductor will be actively driven in response to signals from the appropriate discriminator.

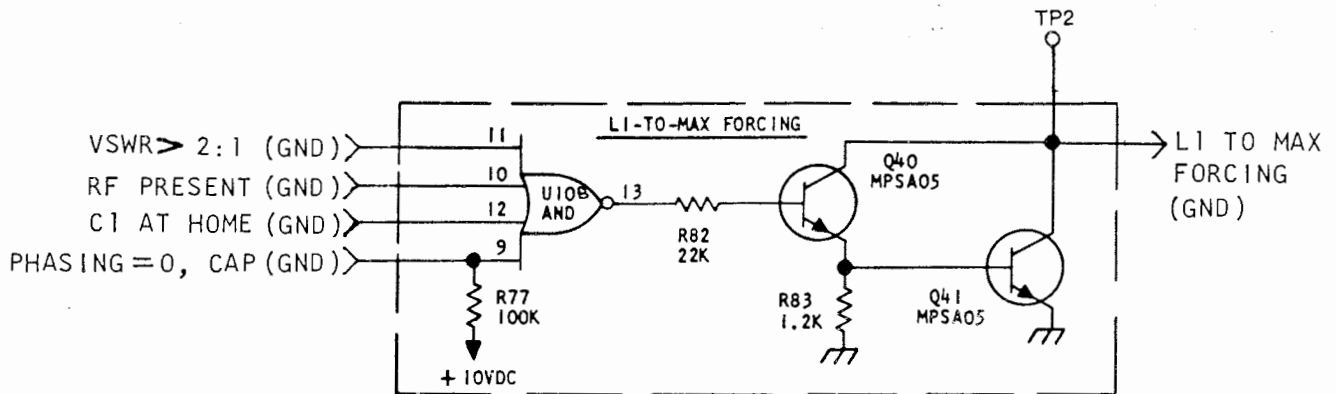


Figure 4-21. L1 to Max Forcing Logic and Control

4.5 RF-339 COUPLER CONTROL

Refer to figure 7-2 for this discussion. The RF-339 contains power supply, metering, monitor, and control circuits that function with the RF-281 to provide automatic antenna coupler operation when the system is used with transceivers that do not provide this functions.

4.5.1 Power Supply Circuits

Input power to the RF-339 can be either 115/230 Vac or from a 22 – 36 Vdc source as described in the installation section of this manual. The appropriate input is selectable by S2 at the rear of the unit. The +28 Vdc full wave bridge rectifier circuit is comprised of T1, CR6, CR7, CR8, CR9, and C15. This source provides all power for the RF-281 and for the RF-339 in systems using the RF-339. In vehicular or other applications where a suitable 22 to 36 Vdc source is available, the power supply and S2 are not used.

4.5.2 Metering

FORWARD and REFLECTED POWER Meter M1 is a 100 uA meter that can be switched by S1 to indicate either forward or reflected power. Power detector circuit elements in the RF-281 have been chosen such that M1 is calibrated to read 150 watts full scale.

4.5.3 Monitor Circuits

The RF-339 provides a direct monitoring capability for the most significant parameters relating to system operation. M1 can be switched at the front panel to monitor either FORWARD or REFLECTED POWER. LED indicators monitor the TUNING, FAULT, and READY (operate) functions. The TUNING and READY indicators are connected to the +28 Vdc power supply such that when the associated control line is grounded, the indicator will light.

4.5.4 Control Circuits

Transmitter rf power to the RF-281 is routed through the RF-339 in systems using this control unit. Relays K1 and K2 in the RF-339 will automatically alter the rf path through the RF-339 in response to control line conditions. With K1 energized and K2 de-energized, rf power is routed directly through the RF-339.

With both K1 and K2 energized, the rf signal is attenuated 3 dB by R2. With K1 de-energized, the transmitter output is terminated in a 50 ohm dummy load. This feature insures safe transmitter termination when the RF-339 is off. K2 is grounded by the "Tune Power" Request signal. K1 will be grounded by any of the following conditions: Coupler Ready (gnd), Tune Power Request (gnd) or Bypass (gnd). Note that B+ for both K1 and K2 is routed through the function switch on the RF-339, and that B+ is applied only in the COUPLER OPERATE and RECEIVE ONLY positions.

SECTION 5

MAINTENANCE

5.1 GENERAL

This section covers instructions and procedures necessary for maintaining the RF-281 and the RF-339. Maintenance includes periodic inspection, cleaning and lubrication, troubleshooting, repair, and adjustments.

5.2 PERIODIC MAINTENANCE

Caution

Drive from the transmitter can cause lethal RF voltages within the RF-281. Always disconnect the RF input and control cable before attempting any cleaning or inspection procedure.

5.2.1 Inspection of RF-281/RF-339

Frequency of inspection will depend on environmental conditions, equipment utilization, and operational schedules. The inspection should cover the following points as a minimum: Check electrical connections for tightness and evidence of arcing; check the ball gap; check CI and LI drive assemblies for signs of wear; check relays for damage to contacts and freedom of operation.

5.2.2 Cleaning and Lubrication

The RF-281 and RF-339 should be cleaned as required to keep the units free of foreign particles. The units can be cleaned using low pressure air or with a soft cloth moistened in a mild detergent for stubborn particles. The units should remain clean for long periods unless exposed to extreme environmental conditions. The RF-281 antenna insulator should be wiped clean more frequently because it is exposed to the elements.

Caution

Use alcohol for cleaning variable inductor LI. Commercial solvents may damage the inductor form.

Variable inductor LI and variable capacitor CI should be lubricated in accordance with the following procedure whenever inspection shows a requirement.

5.2.2.1 Variable Inductor Lubrication

Clean LI coil turns, coil shafts, and electrical contacts on coil shafts with alcohol (see figure 5-9). Apply a light coating of Dow Corning DC 33 silicone lubricant to the inductor turns using a soft lint free cloth. The lubricant should be invisible to the naked eye but sufficient to make the turns feel slippery. Apply a heavier, slightly visible coating to each of the electrical contact shafts and to the spring contact shafts. Some lubricant build-up on these surfaces, after running the inductor is acceptable. Apply one drop of Anderol 401D instrument oil (or equivalent silicone oil), to each of the oilite bushings in the inductor end plates. Note, it is not necessary to apply lubrication to nylon gears.

5.2.2.2 Variable Capacitor Lubrication

Position C1 to the "Home" position by rechanneling the coupler. Insert lubricant into the 3/16 in (0.48 cm) lubrication hole in the side of the lead screw housing (see figure 5-11), and apply a very small amount of Aero Lubriplate grease (or equivalent) to the capacitor lead screw. Tune the coupler at any frequency to expose the capacitor shaft. Apply two drops of Anderol 401D instrument oil (or equivalent silicone oil) to the capacitor shaft.

5.3 TROUBLESHOOTING

Troubleshooting an RF-281 system is relatively simple and straight-forward. The actual troubleshooting method will depend upon the type system involved, and whether or not an RF-616 Test Set is available. Figure 5-1 shows operating setups for both standard system configurations using an RF-616 Test Set.

5.3.1 Troubleshooting, Using The RF-616

The RF-616 Test Set simplifies the troubleshooting process because it provides a constant visual indication of all major logic functions used to control the system. Further, because of all these functions are monitored simultaneously (as opposed to individual measurements), the sequencing, and expected performance are readily "learned". The RF-616 also provides "Rechannel" and "Keyline" control from the test set as well as convenient test jacks for measuring forward and reflected power levels detected by the discriminator in the coupler. These levels may be measured with a voltmeter when used with the RF-339, but are not present when the test set is used with the RF-280.

Table 5-1 shows the levels of the control functions monitored by the RF-616 during a normal tuning sequence and under fault conditions. These functions are indicated by the nine light-emitting-diodes (LEDs) on the front panel. These indicators will light to indicate the presence of each function or condition. The BYPASS indicator will only light when the RF-616 is used with the RF-339 control unit in RECEIVE ONLY mode. When the RF-616 is used with the RF-280, the KEY ENABLE (+) and COUPLER READY indicators will not light. These functions are not used by the RF-280.

5.3.2 Standard Troubleshooting Procedure

Troubleshooting this equipment can normally be accomplished by a logical analysis of the equipment response to any given set of input parameters, and a few subsequent voltage checks to prove or disprove the theory. The troubleshooting information presented in table 5-1 should be helpful in solving most problems. Note that all of the logic elements are contained on the Control Logic PC Board. Figure 5-2 is a diagram designed to help locate these functions.

Some of the logic devices employed perform as many as four separate functions. U12 is a quad 2-input NOR gate, and is a case in point in that it performs four discrete functions: U12A performs an "AND" function in the Elements Home Logic, U12B functions as an inverter in the keyhold logic, U12C functions as an inverter in the Tuning/Fault indicator logic, and U12D performs an "OR" function in the Key Disable Logic. Figure 5-3 gives schematic, functional, and related information on this device, and includes a truth table that demonstrates how "AND", "OR", and "inverter" functions can be performed by this one device. Figures 5-4, 5-5, 5-6, and 5-7 give similar information on the other devices used.

For each mode of the antenna coupler, table 5-2 shows the normal operating voltages at each of the seven test points inside the RF-281 and the condition of the RF-339 indicators. The test points are accessible from the top of the RF-281 on the Control Logic PC Board without removing it from its enclosure. The test points are color coded for ease of identification. The pc board can also be operated on an extender card to facilitate testing.

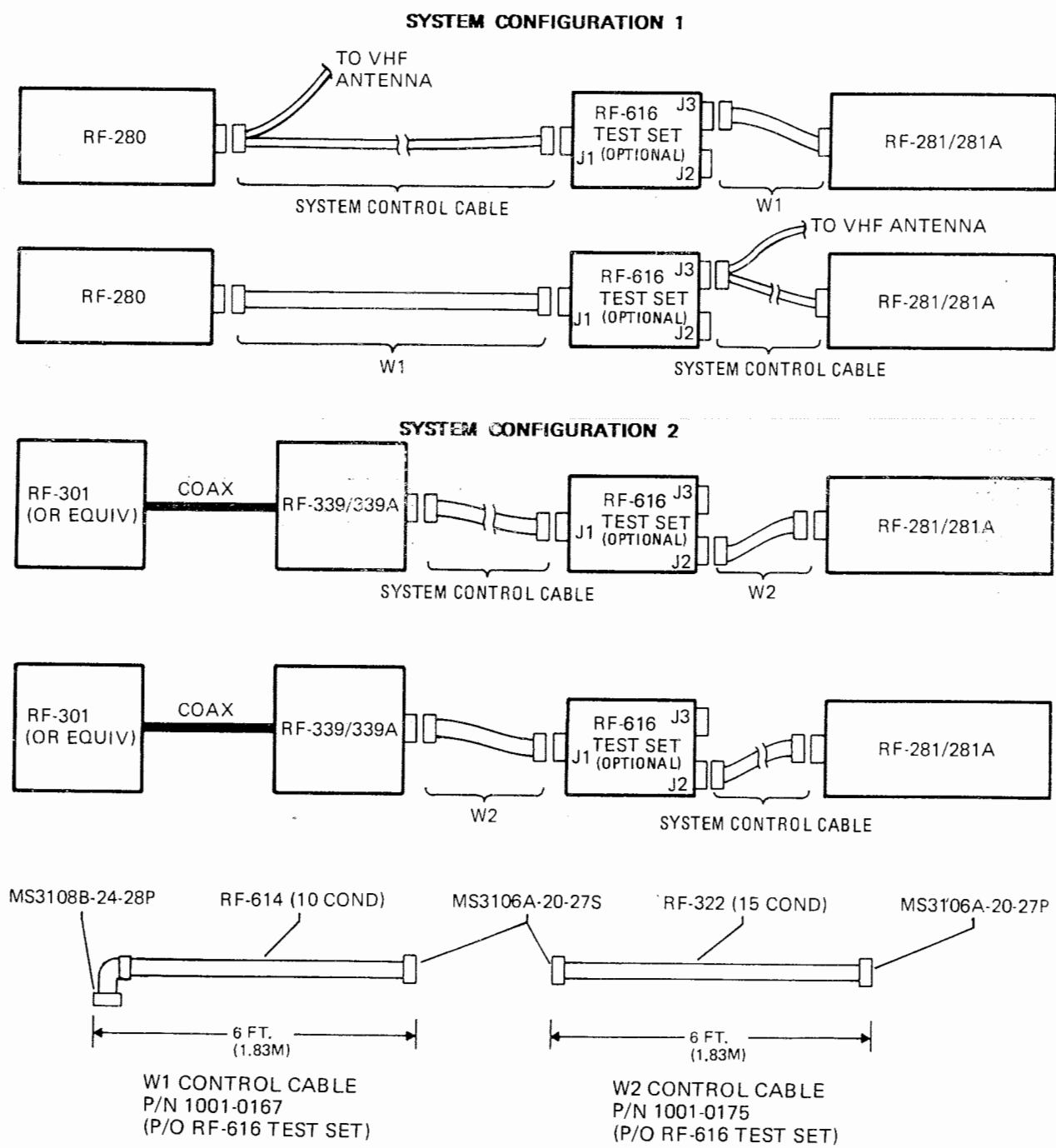


Figure 5-1. Test or Operating Configurations Using RF-616

Table 5-1. Control Function Levels

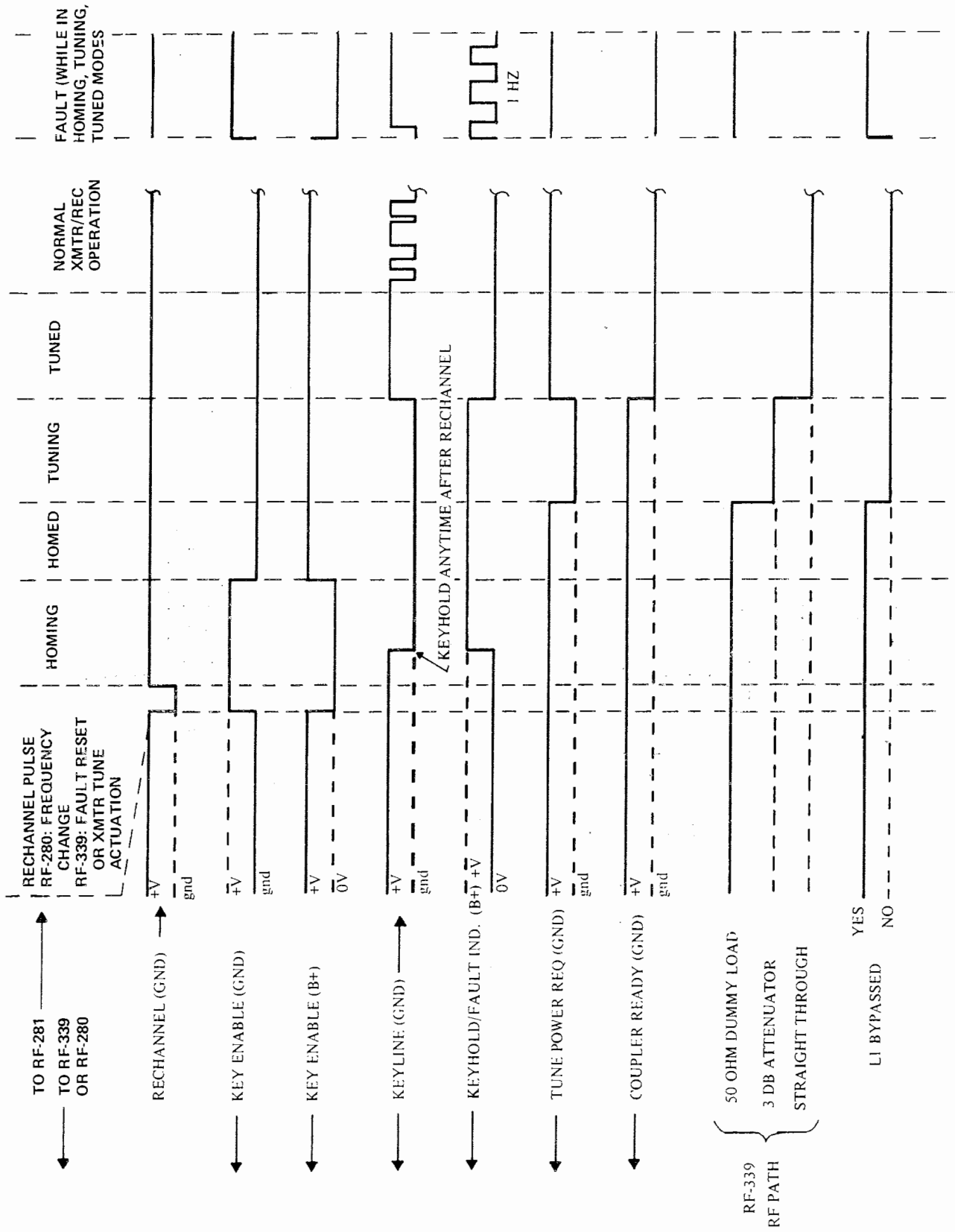


Table 5-2. Troubleshooting Chart

ON CONTROL LOGIC PC BOARD						
INDICATOR	TOLERANCE	HOMING	HOMED	TUNING	TUNING FAULT	TUNED
Ramp from -0.2 to +5.0V. Period 3 msec. - measured with oscilloscope						
TP1 - BROWN (RAMP)	±1 Vdc	24 Vdc	24 Vdc	0.7 Vdc while L1 is forced	24 Vdc	24 Vdc
TP2 - RED (L1 TO MAX FORCING)	±1 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc
TP3 - ORANGE (REGULATED B+)	±1 Vdc	-10 Vdc	-10 Vdc	-10 Vdc	-10 Vdc	-10 Vdc
TP4 - YELLOW (-10 VDC)	±0.5 Vdc	+8.5 Vdc	+8.5 Vdc	-0.7 Vdc while VSWR > 2:1	+8.5 Vdc	+8.5 Vdc
TP5 - GREEN (VSWR > 2:1)	±2 Vdc	22 Vdc	0.7 Vdc	22 Vdc	0.7 Vdc	12 Vdc
TP6 - BLUE (SERVO ENABLE)	±1 Vdc	+10 Vdc	+10 Vdc	+10 Vdc	+10 Vdc	+10 Vdc
TP7 - VIOLET (+10 VDC)						
ON RF-339 FRONT PANEL						
"READY" LED		OFF	OFF	OFF	OFF	ON
"TUNING" LED		OFF	ON	ON	OFF	OFF
"FAULT" LED		OFF	OFF	OFF	ON	ON
METER MI: FORWARD		0	0	1/2 Transmitter tune power	0	Full Transmitter power
REFLECTED		0	0	Decreasing	0	0 to 4% of Forward power (may be higher momentarily).

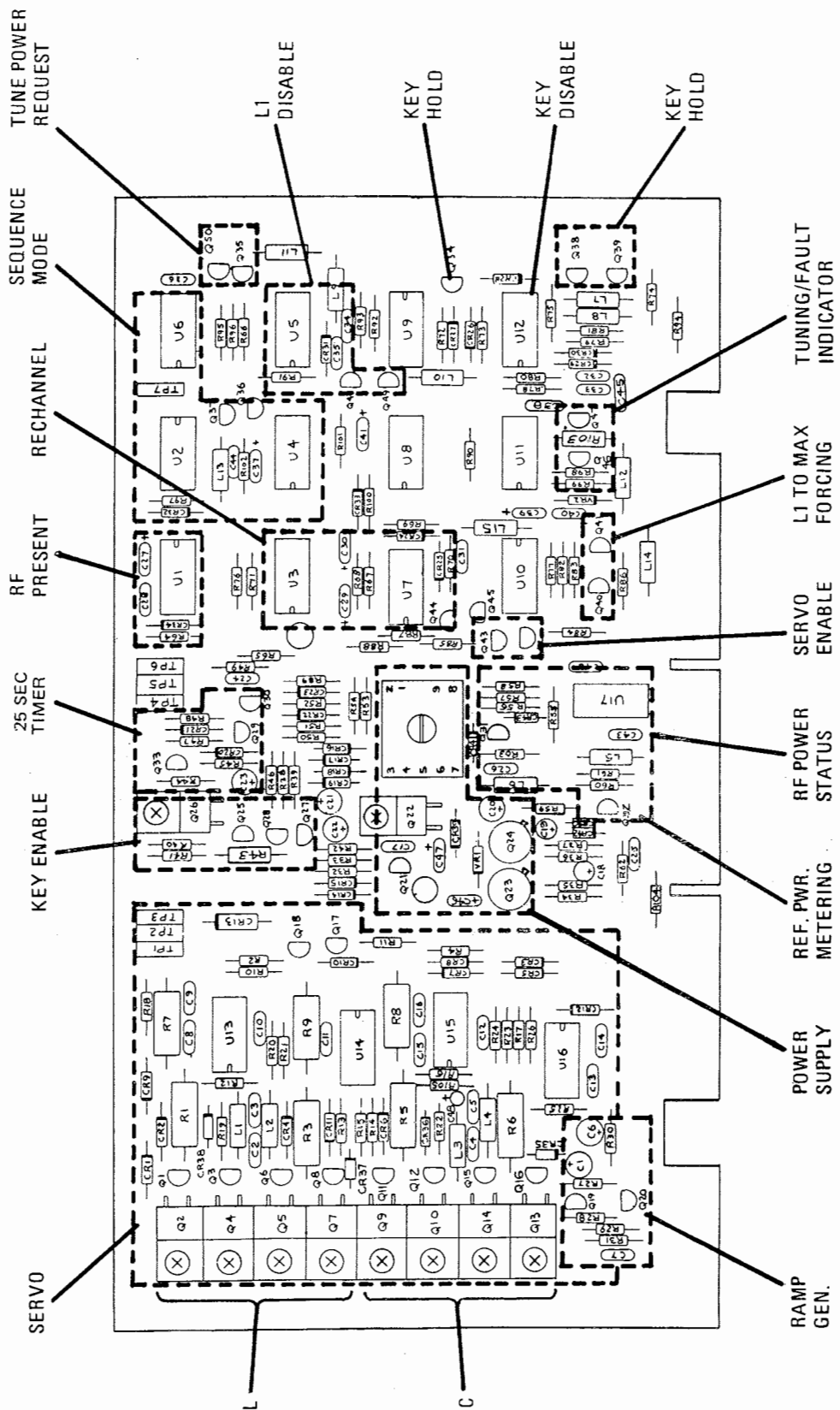


Figure 5-2. Control Logic PC Board Function Locations

5.4 DISASSEMBLY/REASSEMBLY PROCEDURES

The following table provides torque requirements for various screws referred to in the disassembly and reassembly procedures.

Torque Requirements For Screws

Screw Size	Torque Required in-lbs (kg-cm)
4-40	5 (5.8) $\pm 5\%$
6-32	9 (10.4) $\pm 5\%$
8-32	19 (21.9) $\pm 5\%$
10-32	30 (34.6) $\pm 5\%$
5/16-18	125 (144) $\pm 5\%$

5.4.1 RF-339 Disassembly/Reassembly Procedures

The RF-339 can be completely disassembled with common hand tools, a low wattage soldering iron, and a de-soldering aid, such as Solder Wik or other comparable material. Solder-Wik has an affinity for solder and will completely remove solder from the area on a pc board where it is placed in contact and heated so that the solder will flow. The filter pc board, or any of the capacitors mounted on it, can be removed from the base of the input connector using this process. All components should be removed from pc boards using this, or a comparable process, to prevent separation of the conductive foil from the board material. Section 1 and Section 6 contain detailed drawings of this unit.

5.4.2 RF-281 Disassembly/Reassembly Procedures

Detailed procedures are included for the following assemblies: Main Chassis Assembly, 1A2 Discriminator Assembly, 1L1 Variable Inductor Assembly, 1A3 Coil Drive Assembly, 1C1 Variable Capacitor Assembly, 1A4 Capacitor Drive Assembly, 1A5 Filter PC Board Assembly, and 1Q1 (the series regulator transistor).

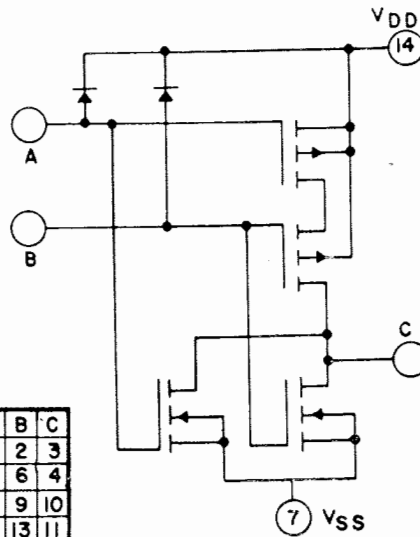
5.4.2.1 Main Chassis Assembly Removal and Installation

Removal of the main chassis is not normally necessary for routine maintenance. When necessary, proceed as follows:

- a. Remove 20 phillips head screws securing cover to case; remove cover and gasket.
- b. Remove nut securing control cable connector to case. Remove wire and ground lug from A5 Filter PC Board Assembly by removing screw securing chassis to case. Pull connector through case.

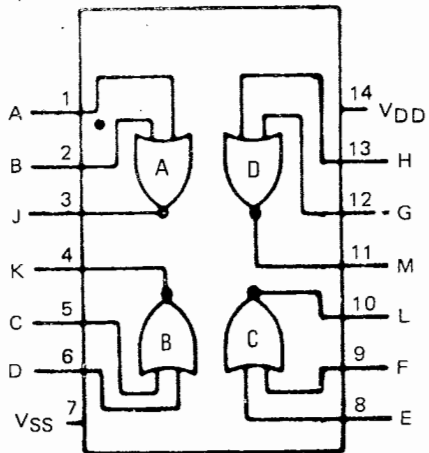
CD 4001AE QUAD 2 INPUT NOR GATE COS/MOS POSITIVE LOGIC

SCHEMATIC DIAGRAM

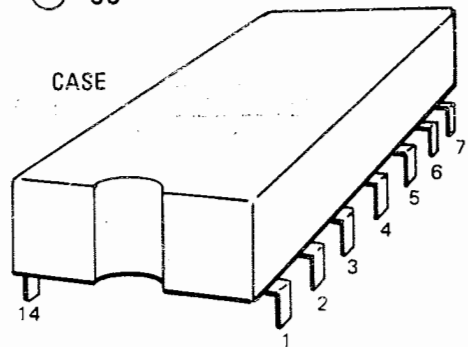


CKT. NO.	A	B	C
1	1	2	3
2	5	6	4
3	8	9	10
4	12	13	11

FUNCTIONAL DIAGRAM



CASE



TRUTH TABLE

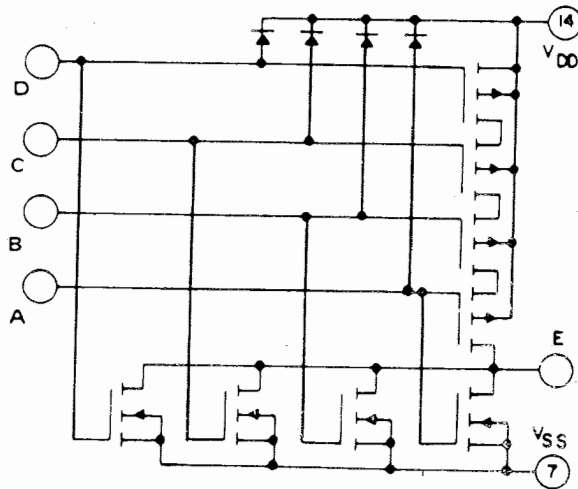
A	B	C
0	0	1
0	1	0
1	0	0
1	1	0



Figure 5-3. CD4001AE Information

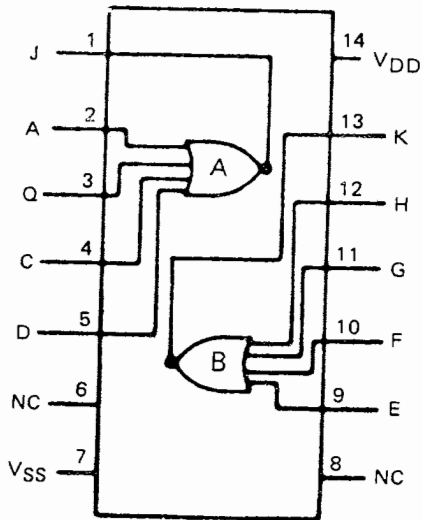
CD4002 DUAL 4 INPUT NOR GATE

SCHEMATIC DIAGRAM



CKT. NO.	A	B	C	D	E
1	2	3	4	5	1
2	9	10	11	12	13

FUNCTIONAL DIAGRAM



TRUTH TABLE

A	B	C	D	E
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

CASE

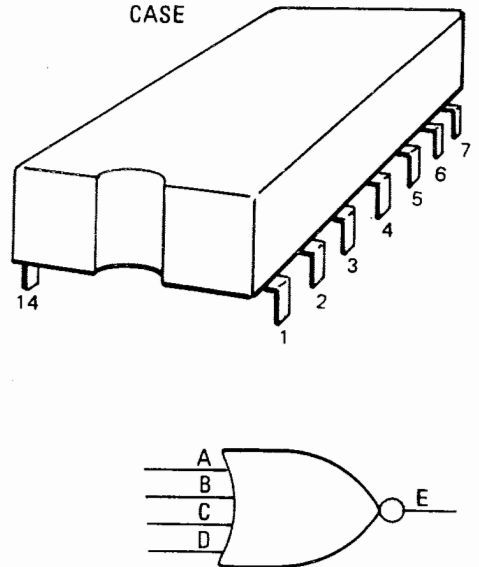
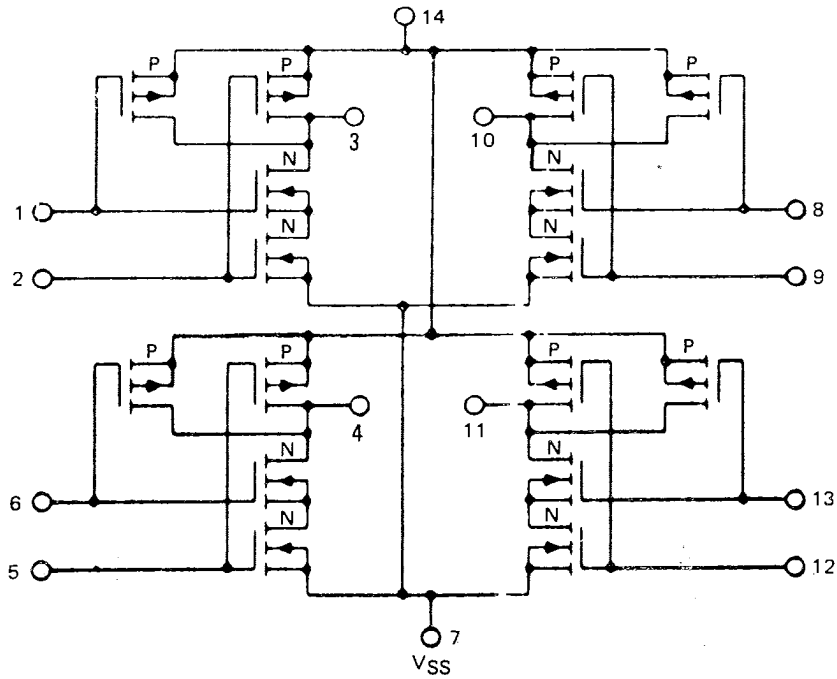


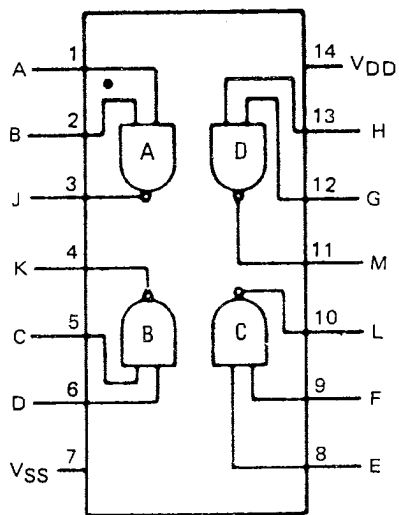
Figure 5-4. CD4002AE Information

CD 4011AE QUAD 2 INPUT NAND GATE COS/MOS POSITIVE LOGIC

SCHEMATIC DIAGRAM



FUNCTIONAL DIAGRAM



TRUTH TABLE

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

CASE

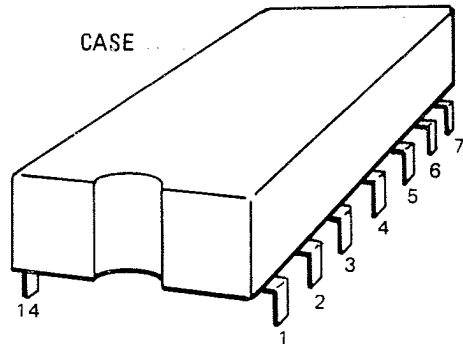
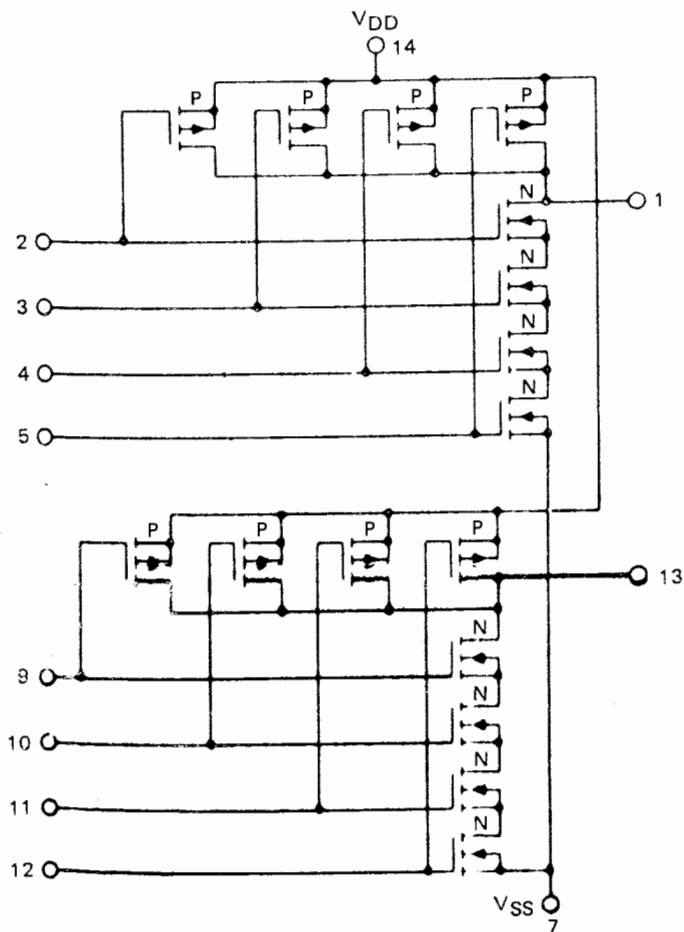


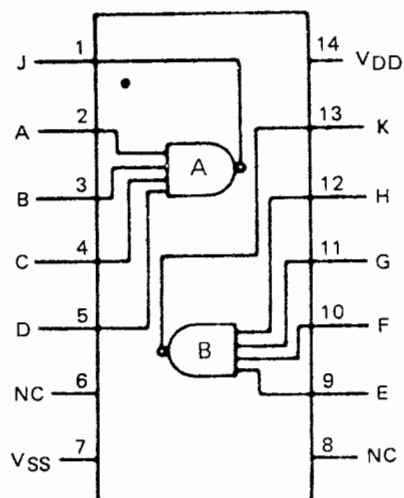
Figure 5-5. CD4011AE Information

CD 4012AE DUAL 4 INPUT NAND GATE

SCHEMATIC DIAGRAM



FUNCTIONAL DIAGRAM



TRUTH TABLE

A	B	C	D	E
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

CASE

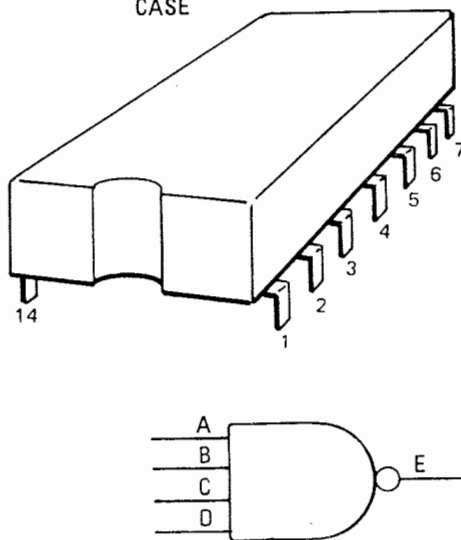
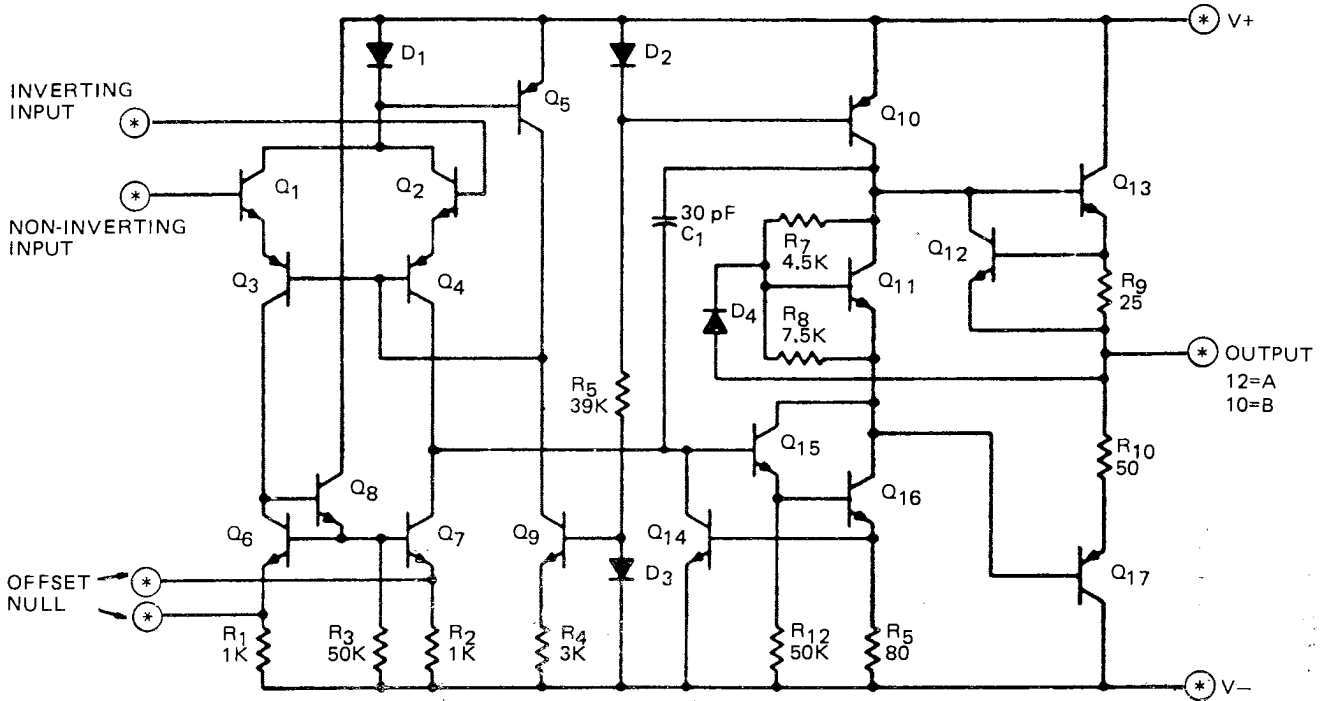


Figure 5-6. CD4012AE Information

CA747E DUAL OPERATIONAL AMPLIFIER

SCHMATIC



* SEE FUNCTIONAL DIAGRAM FOR TERMINAL NUMBERS OF RESPECTIVE TYPE NUMBERS

ALL RESISTANCE VALUES ARE IN OHMS

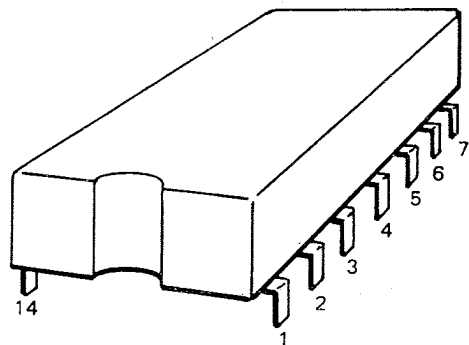
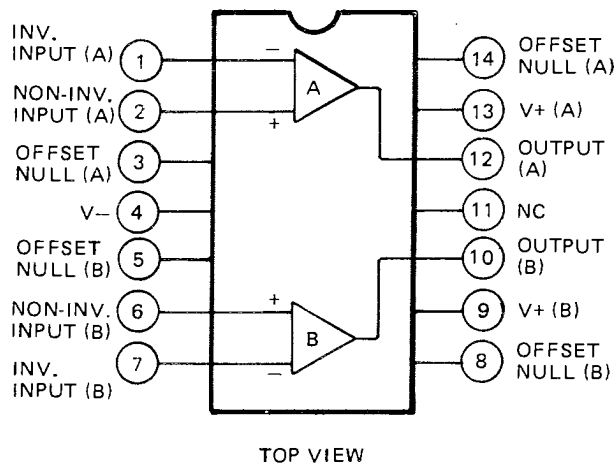


Figure 5-7. CA747E Dual Operational Amplifier

- c. Remove nut securing rf input cable (coax) connector J1 to case: Pull connector through case.
- d. Disconnect the two antenna output wires from antenna insulator E1.
- e. Remove the remaining 10 phillips head screws securing the chassis to case.
- f. Carefully lift chassis straight up. The pressure test sealing screw and washer may have to be removed to clear the chassis.
- g. To reinstall chassis reverse the above procedures. Ensure that 1J1 and 1J2 seal rings are in place before tightening. Check the ball gap assembly for proper adjustment per paragraph 5.5.4.
- h. Replace cover and gasket and tighten screws until the edge of the gasket rounds out. Overtightening may damage the gasket or cover.
- i. Pressure test RF-281 per paragraph 5.8.

5.4.2.2 Discriminator Assembly 1A2 Removal

Refer to figure 5-8 for the following procedure:

- a. Remove RF-281 top cover.
- b. Mark and tag wires connected to Discriminator Assembly, unsolder and remove.
- c. Disconnect nut securing rf input cable (coax) connector J1 to case. Pull connector through case.
- d. Remove four phillips head screws securing Discriminator Assembly to chassis.
- e. Lift assembly out from case.
- f. Remove four phillips head screws securing cover to assembly, and remove cover.
- g. The "R" discriminator and phase discriminator pc boards may now be removed. Tag wires connected to the chassis terminals, remove the mounting screws and remove from the assembly.
- h. To reassemble Discriminator Assembly reverse the above procedure. Adjust the assembly (per paragraph 5.5.1) prior to installing it on the chassis.

5.4.2.3 Variable Inductor L1 Removal

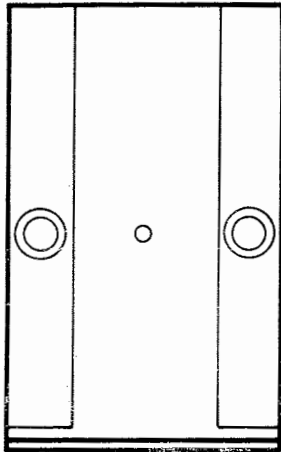
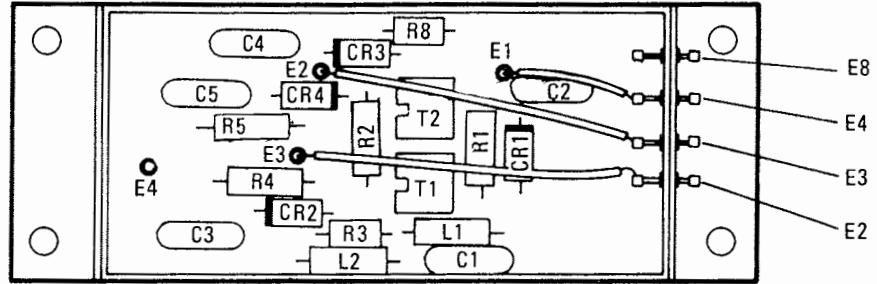
Refer to figures 5-9 and 5-10 for the following procedures.

Note

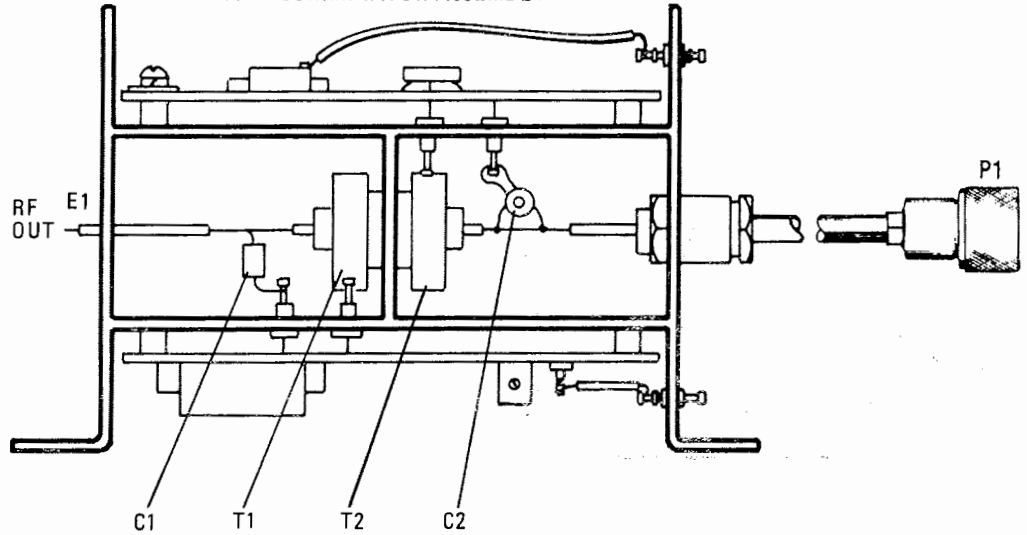
Remove the chassis assembly from the case per paragraph 5.4.2.1 prior to disassembling this unit.

- a. Loosen set screws on the L1 end of the coupling.
- b. Locate wire connected between K1 and L1. Carefully remove upper end of tension spring on L1 stud. Disconnect wire to K1 by removing the hardware and lug at L1.
- c. Remove the four phillips head screws securing the inductor assembly L1 to the chassis. Remove the inductor assembly by carefully sliding L1 shaft out of coupling.

A2A1
"R"
DISCRIMINATOR
PC BOARD



A2 DISCRIMINATOR ASSEMBLY



A2A2
PHASE
DISCRIMINATOR
PC BOARD

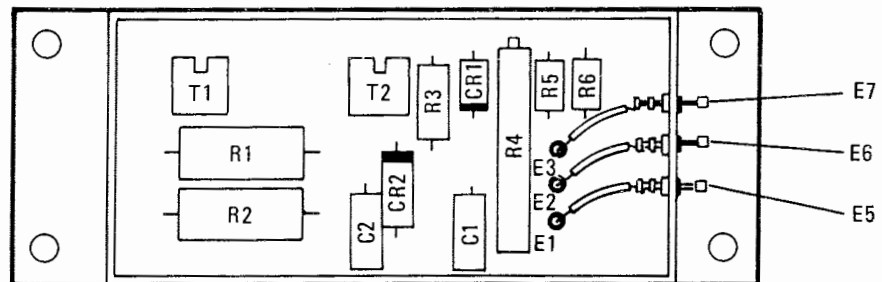


Figure 5-8. Discriminator Assembly 1A2

5.4.2.4 Variable Inductor L1 Reassembly

Refer to figures 5-9 and 5-10 for the following procedures:

- a. Check, and adjust if necessary, the L1 shaft contacts for 25 to 50 grams of contact pressure by loosening and retightening the shaft contact hardware.
- b. Carefully place inductor shaft into coupling hub.
- c. Position variable inductor L1 on the chassis.
- d. Install four phillips head screws securing inductor to chassis and tighten.
- e. Connect output wire between variable inductor and K1.
- f. Adjust rollers for 20 turns spacing.
- g. Manually rotate inductor to its maximum cw position (facing drive shaft). This positions the drive assembly to minimum inductance.
- h. Make final adjustments per paragraph 5.5.2.

5.4.2.5 Inductor Drive Assembly 1A3 Removal and Reassembly

Refer to figure 5-10 for the following procedures:

- a. Remove the chassis assembly from the case per paragraph 5.4.2.1.
- b. Loosen set screws on L1 end of drive coupling.
- c. Mark and tag the connecting wires to the chassis, unsolder at microswitches and remove.
- d. Remove four phillips head screws securing the 1A3 Drive Assembly to the chassis. Remove drive assembly.
- e. Note position on motorshaft if coupling is to be removed.
- f. For re-assembly, install coupling in the same position on motor shaft and tighten set screws.
- g. Secure assembly to chassis with four phillips head screws removed in step d.
- h. Resolder wires removed in step c.
- i. Pre-align variable inductor as in paragraph 5.4.2.4.
- j. Tighten set screws and check position of coupling hub pins as follows: Side-to-side and top-to-bottom hub pin alignment should be within 1/32 inch (0.08 cm) of being flush. If not within this tolerance, loosen the four phillips head screws securing the inductor drive assembly and re-position such that in-tolerance alignment is achieved. It may also be necessary to loosen the inductor assembly to achieve alignment. This unit is also secured with four phillips head screws.
- k. Tighten all hardware and make final adjustments per paragraph 5.5.2.

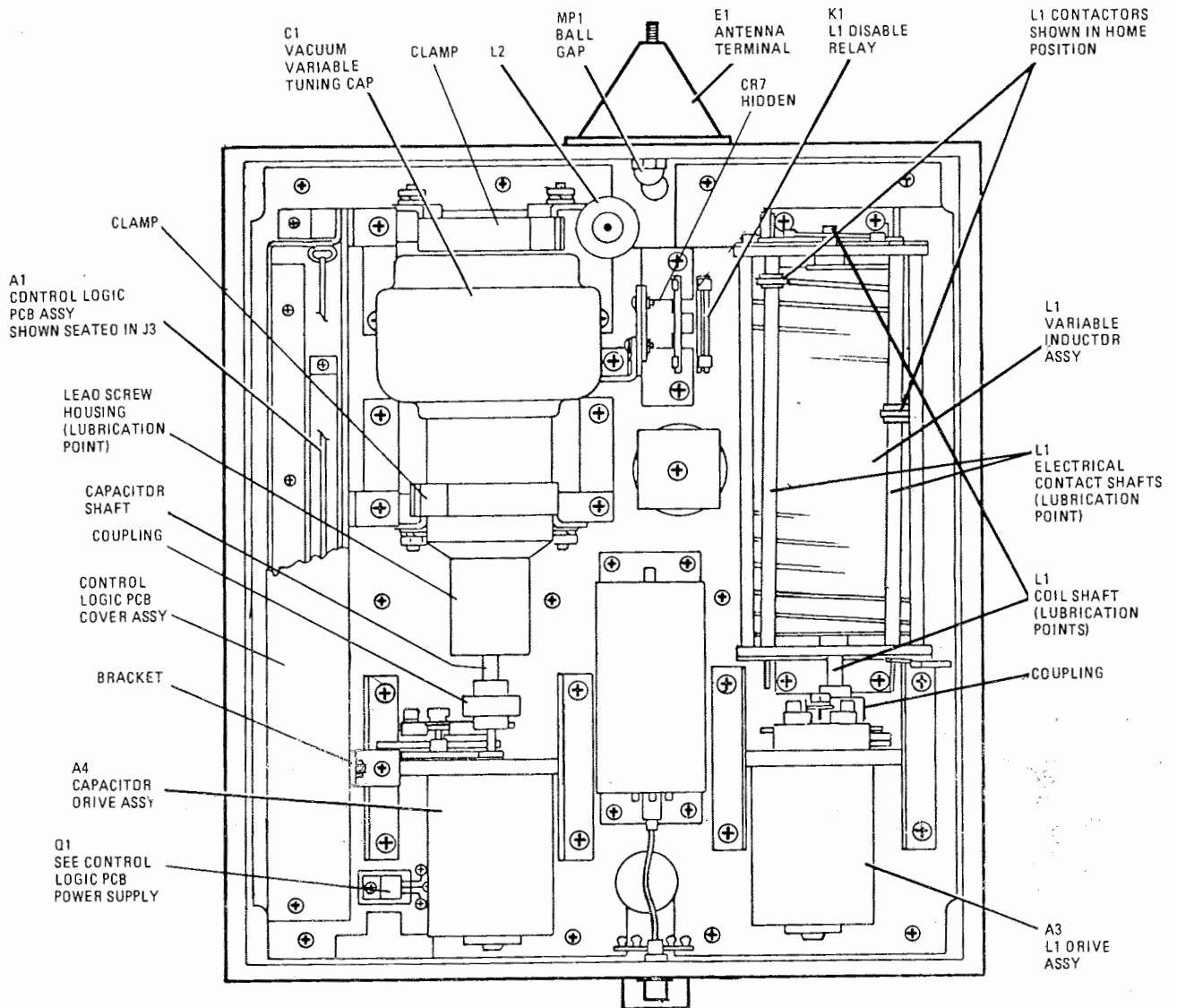
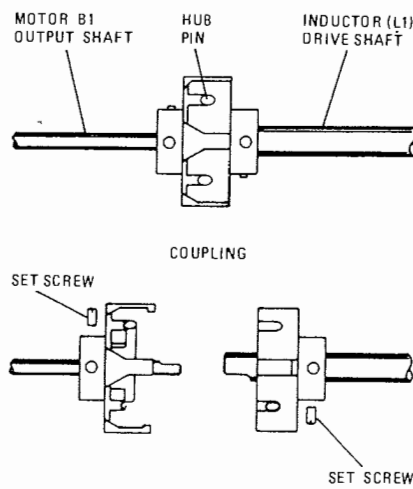
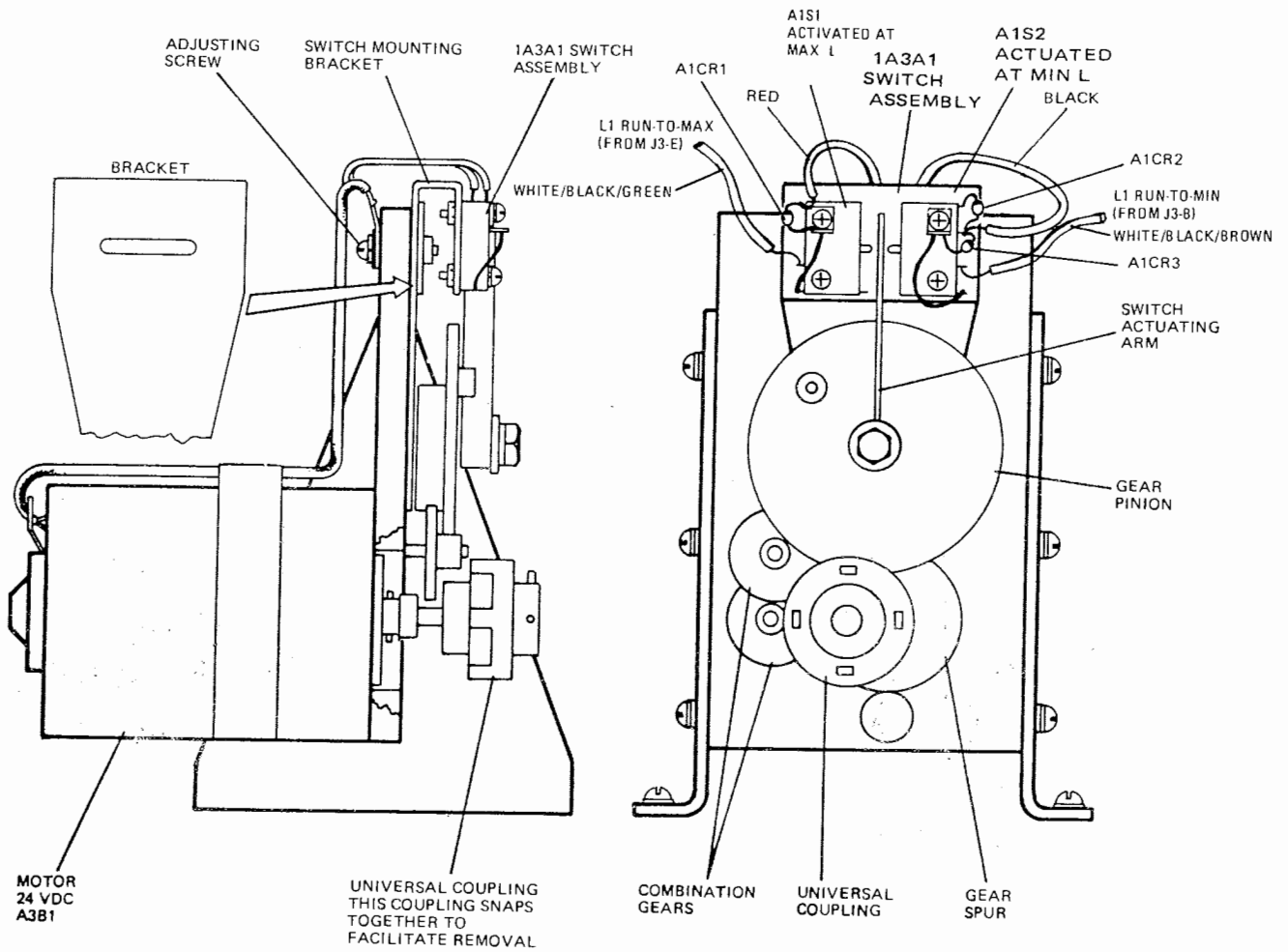


Figure 5-9. C1/L1 Component Drawing

5.4.2.6 Variable Inductor End Stop Sensing Switch Replacement

Refer to figure 5-10 for the following procedures:

- Mark, tag and unsolder wires to applicable switches.
- Remove phillips head screws securing applicable switches to mounting plate. Remove switches.
- Position new switches on mounting plate, insert screws and tighten.
- Connect wires to switches as marked, and solder.
- Adjustment should not be necessary unless other parts have been moved. Adjust per paragraph 5.5.2 if necessary.



NOTE: TO DISASSEMBLE COUPLING, LIFT FOUR CLIPS AND PULL APART.

Figure 5-10. Variable Inductor Drive Assembly 1A3

5.4.2.7 Variable Capacitor C1 Removal

Refer to figures 5-9 and 5-11 for the following procedures:

- a. Remove chassis from case per paragraph 5.4.2.1.
- b. Separate the coupling halves as shown in figure 5-11 and loosen (but do not remove) the phillips head screw in capacitor clamp on antenna end of C1.
- c. Remove two phillips head screws and nuts securing the capacitor clamp nearest the capacitor shaft. Carefully pull T1 output wire away from support. If necessary, loosen coupling half.
- d. Tilting capacitor slightly, pull it out from the antenna end adjusting clamp.
- e. Remove capacitor from the unit, taking care not to damage glass bulb. Remove coupling half.
- f. Loosen (but do not remove) phillips head screw in the capacitor clamp and remove clamp.

5.4.2.8 Variable Capacitor C1 Reassembly

Refer to figures 5-9 and 5-11 for the following procedures:

- a. Place clamp over drive end of capacitor. Tighten phillips head screw finger tight.
- b. Slide capacitor coupling half onto lead screw. Tighten one of the set screws so that coupling can be used as a knob.
- c. Turn capacitor lead screw ccw until lead screw housing becomes loose.
- d. Turn capacitor lead screw cw until housing just becomes tight. This places the capacitor in "Homed" or maximum capacitance position.
- e. Tilt capacitor slightly and slide into antenna end adjusting clamp. Position capacitor with glass nipple pointing down.
- f. Position drive end capacitor clamp on capacitor support. Replace two phillips head screws and nuts and tighten. Ensure that T1 output wire is secured to clamp by innermost screw.
- g. Align drive assembly coupling half on B1 motor shaft.
- h. Snap coupling halves together.
- i. Check position of coupling hub pins per paragraph 5.4.2.10.
- j. Make final adjustments per paragraph 5.5.3.

5.4.2.9 Variable Capacitor Drive Assembly 1A4 Removal

Refer to figure 5-11 for the following procedures:

- a. Remove chassis from case per paragraph 5.4.2.1.
- b. Remove phillips head screw securing drive assembly support bracket to the motor support.
- c. Remove nut securing the bracket to the pc board housing. Remove bracket.

- d. Loosen set screws in coupling connecting C1 to drive assembly (or unsnap coupling).
- e. Mark and tag wires for motor B1. Unsolder wires at chassis terminals.
- f. Remove four phillips head screws securing drive assembly to chassis.
- g. Remove drive assembly.

5.4.2.10 Variable Capacitor Drive Assembly 1A4 Reassembly

Refer to figure 5-11 for the following procedure. To reassemble Variable Capacitor Drive Assembly A4, refer to applicable steps in paragraphs 5.4.2.8 and 5.4.2.9, check position at coupling hub pins as follows:

- a. Side-to-side and top-to-bottom coupling hub pin alignment should be within 1/32 inch (0.08 cm) of being flush. If not within this tolerance, continue as follows.
- b. Loosen four phillips head screws securing the capacitor drive assembly and the 4-40 screw holding the drive assembly bracket to the motor mount plate.
- c. If horizontal misalignment can not be corrected, the capacitor mounting bracket, secured by eight phillips head screws, can be loosened along with the two brass screws securing capacitor brackets to printed circuit board case.
- d. If vertical misalignment can not be corrected, loosen the capacitor end clamp (near antenna), and the two brass screws holding the front capacitor clamp to the mounting bracket. Capacitor can be raised or lowered slightly to achieve alignment.
- e. Tighten all hardware, recheck alignment and reinstall in case.

5.4.2.11 Variable Capacitor End Stop Sensing Switch Replacement

Refer to figure 5-11 for the following procedures:

- a. Remove chassis from case per paragraph 5.4.2.1, and mark, tag and unsolder wires to applicable switches.
- b. Remove phillips head screws securing applicable switches to mounting plate. Remove switches.
- c. Position new switches on mounting plate, insert screws and tighten.
- d. Connect wires to switches as marked, and solder.
- e. Adjust switches per paragraph 5.5.2.
- f. Replace chassis in case and pressure test RF-281 per paragraph 5.8.

5.4.2.12 Filter PC Board Assembly 1A5 Removal

Refer to applicable directions in paragraph 5.4.1 for removal of Filter PC Board Assembly 1A5.

5.4.2.13 Transistor Q1 Replacement

Refer to figure 5-12 for the following procedures.

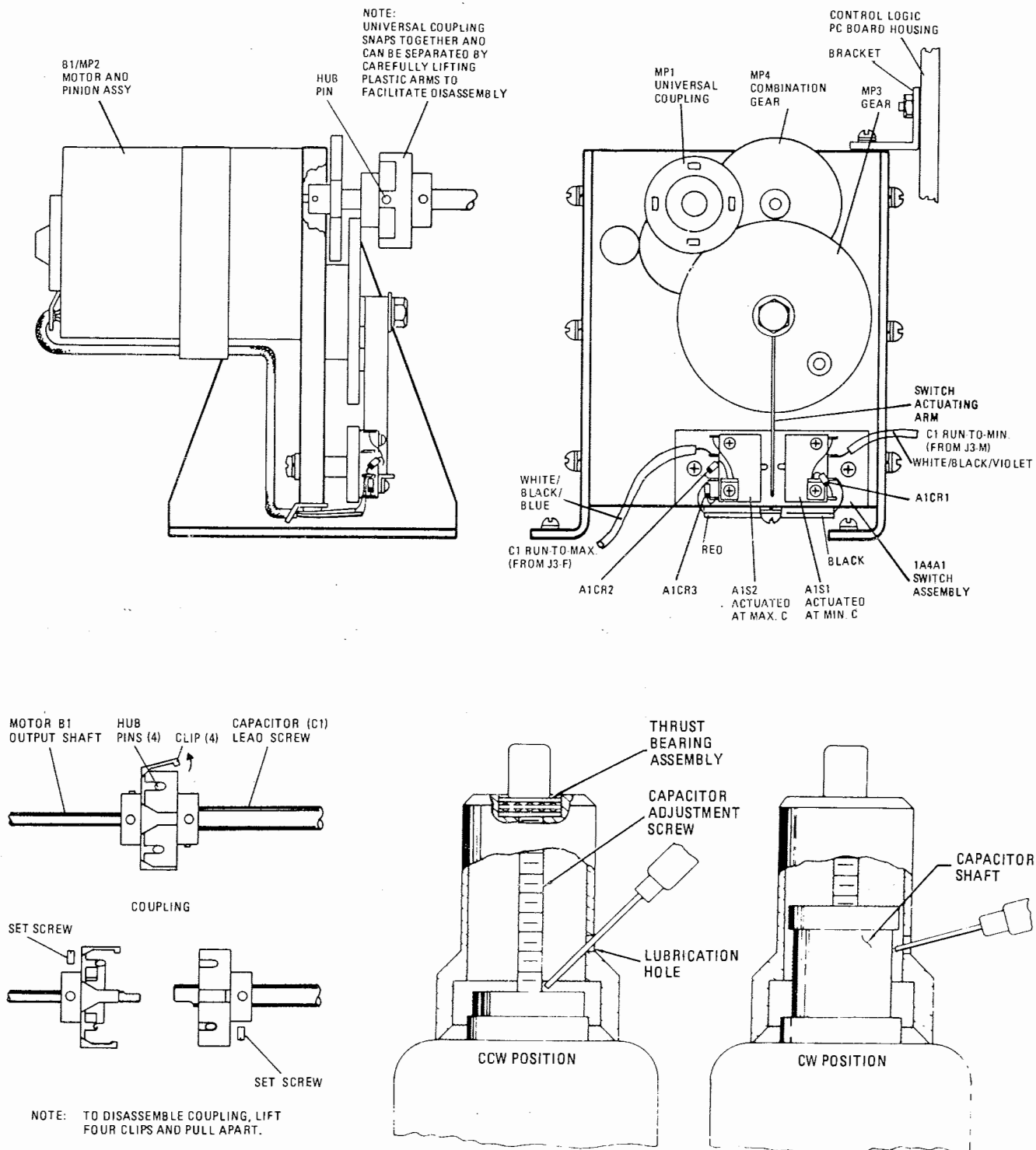


Figure 5-11. Variable Capacitor Drive Assembly 1A4, and Lubrication Detail

Note

Chassis assembly must be removed per paragraph 5.4.2.1.

- a. Remove screw, metal tab, nylon bushing, flat washer, lock washer, and nut securing Q1 to chassis.
- b. Unsolder leads from Q1 to chassis terminals.
- c. Lift Q1 out from unit.

Note

If mica washer must be replaced it may be necessary to loosen 1A4 Drive Assembly hold down screws.

- d. Position new Q1 on chassis, and reverse steps a through c.
- e. Reassemble chassis in case per paragraph 5.4.2.1.
- f. Pressure test unit per paragraph 5.8.

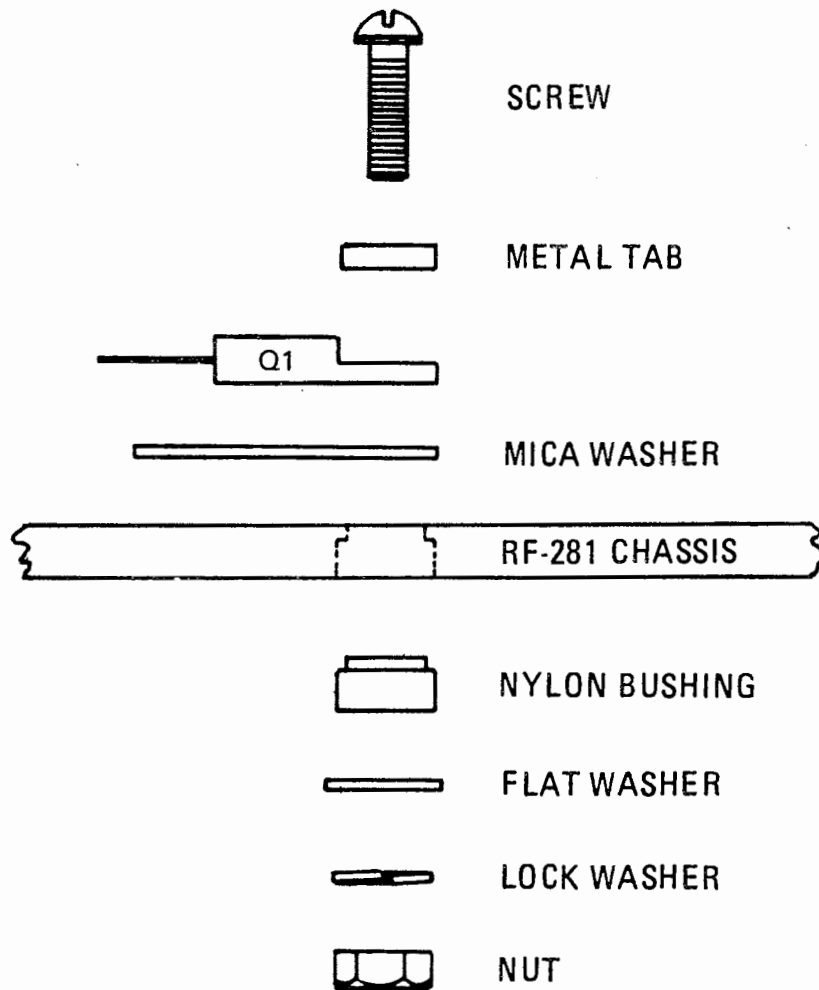


Figure 5-12. Transistor Q1

5.5 ADJUSTMENTS

5.5.1 Discriminator Assembly 1A2 Adjustment

Use the following procedure after discriminator repairs or when testing indicates that the assembly requires adjustment.

The Discriminator Assembly must be removed from the unit per paragraph 5.4.2.2 for adjustment. Clamp or attach the assembly to an aluminum plate to enclose the open bottom for proper shielding and ground current distribution.

Solder the center conductor of the Discriminator Test Cable (see paragraph 5.6) to Discriminator rf output E1, and connect the shield to the nearest ground point on the discriminator chassis. Connect the other end of the cable to a 50 ohm, 100 watt dummy load. Connect an rf output cable from a transmitter to Discriminator rf input at J1. Terminate E7 through a 10K resistor to ground as shown in figure 5-13. Connect a wattmeter (Bird Model 43, or equivalent) in line with the discriminator rf input. Connect a high impedance voltmeter between A2E7 and ground (see figure 5-13). Set the transmitter frequency at 29.999 MHz. Key the transmitter and adjust input level to 50 watts (nominal). Adjust A2A2R4 so that the voltage on the voltmeter is 0 ± 10 millivolts. (If only an RF-301 Transceiver is available, make all measurements at 14.99 MHz.)

Disconnect voltmeter and resistor from A2E7 and connect to A2E2 (see figure 5-13). Set transmitter frequency to 21 MHz and input level to 50 watts (nominal). Adjust A2A1C2 so that the voltage indicated on the voltmeter is 0 ± 10 millivolts. Disconnect voltmeter and resistor from A2E2. Connect voltmeter and a 68K resistor between A2E3 and ground (see figure 5-13). Reflected power voltage indicated on the voltmeter should not exceed +200 millivolts maximum. Disconnect voltmeter and resistor from A2E3 and connect to A2E4 (see figure 5-13). Forward power voltage indicated on the voltmeter should be between 2.0 and 2.5 Vdc. If a high impedance voltmeter is not available use a voltmeter with a known input resistance such as 20K ohms per volt. Allow for a lower measured voltage due to the loading of the voltmeter. De-energize the transmitter and disconnect adjustment setup. Reinstall discriminator assembly in unit per paragraph 5.4.2.2.

5.5.2 Variable Inductor L1 Adjustment

Pre-position variable inductor L1 per paragraph 5.4.2.4 or drive assembly per paragraph 5.4.2.5. Loosen the adjusting screw securing the end stop sensing switch mounting bracket to motor B1 mounting plate (see figure 5-10). The switch mounting bracket screw hole is elongated to allow switch position adjustment. Position the switch mounting bracket in the center of its adjustment range (bracket positioned straight up). Snug the adjusting screw to maintain switch position.

a. Remove Control Logic PC Board 1A1 by removing two phillips head screws that secure the pc board assembly in housing. Lift assembly clear and set aside.

b. Install card extender in place of control logic pc board and note position of pins B and E on exposed portion of extender card.

Note

Maintenance Repair Kit, P/N 1001-0164 contains a card extender that is recommended for this procedure. If not available, the control voltage can be connected to the end stop switches (white/black/green and white/black/brown wires shown in Figure 5-10) after removing the Control Logic PC Board 1A1.

c. Connect negative terminal of an external 0 to 30 Vdc power supply capable of delivering 2 amps to chassis ground on RF-281.

Note

The power supply would normally be set to +24 Vdc, however, for initial settings, +24 Vdc should be used to reduce motor speed to a level that is easier to control and thus prevent possible gear damage because of over travel.

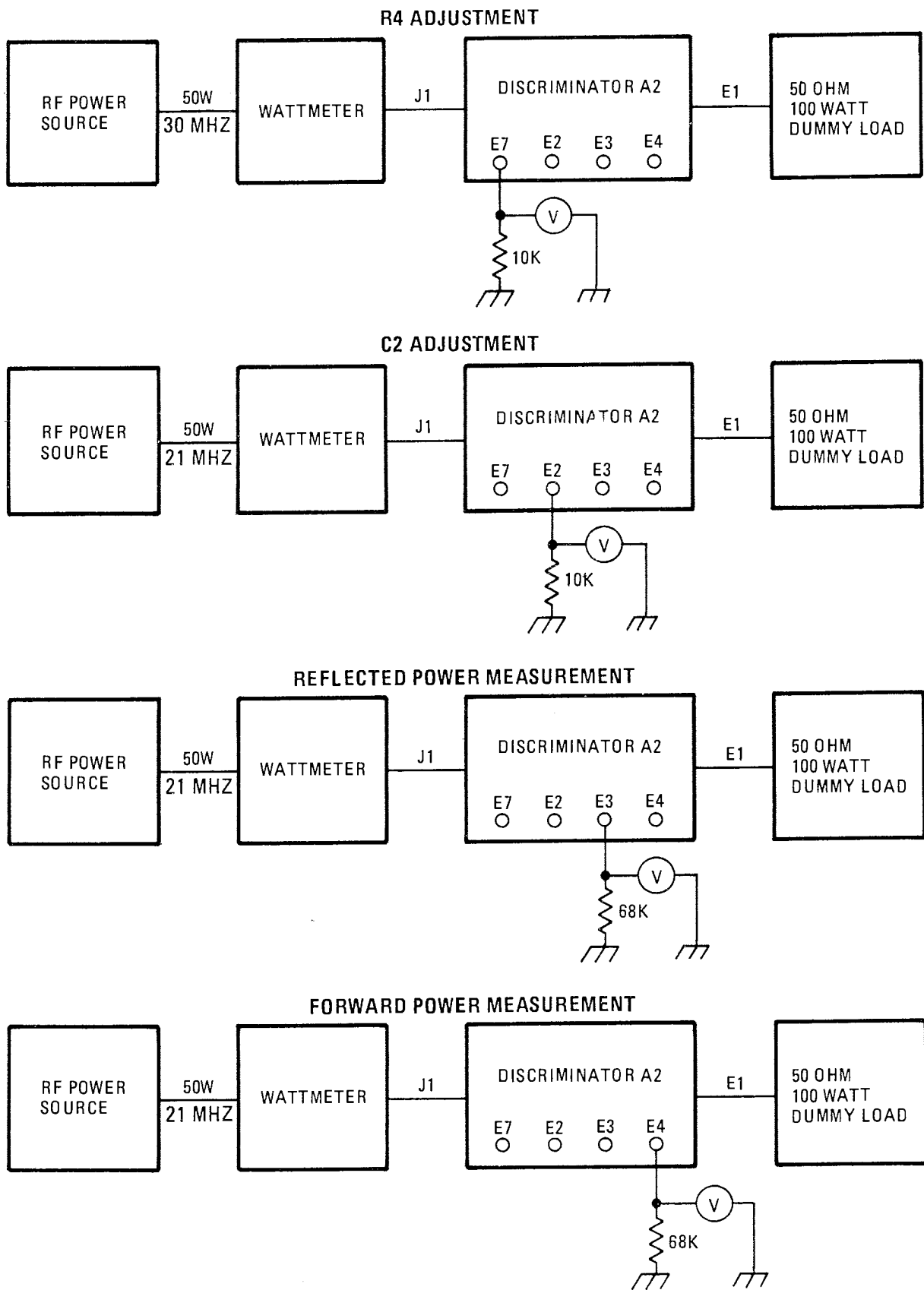


Figure 5-13. Discriminator Assembly Adjustment Drawing

d. Install two test leads on the power supply to make connections to the card extender. Test lead connections will result in motor travel as follows:

- | | |
|------------|-----------------|
| RUN TOWARD | + LEAD TO PIN B |
| ● MINIMUM | AND |
| INDUCTANCE | - LEAD TO PIN E |
| RUN TOWARD | + LEAD TO PIN E |
| ● MAXIMUM | AND |
| INDUCTANCE | - LEAD TO PIN B |

e. Connect the test leads to run the coil toward minimum inductance (+ to B and - to E).

Note

If the drive assembly was already at minimum, reverse leads to run coil out of minimum and then reverse leads and run back into minimum. This insures that motor over travel is included in the adjustment.

f. Manually turn the coil away from minimum inductance, if necessary, to place the coil shaft "flat" under the nearest set screw.

Note

On some low serial number units it may be necessary to remove a set screw to locate the "flat".

g. Run the coil assembly away from minimum to the approximate mid point of the coil.

h. With the power supply set at 12 Vdc, run the inductor to minimum. Microswitch A4A1S1 should stop the drive such that the coil is within 1/4 to 1/2 turn of the minimum inductance mechanical end stop.

i. Adjust the power supply for +24 Vdc. Run the inductor several turns away from minimum and then drive the inductor into minimum several times at this speed to assure that A4A1S1 is adjusted such that the coil stops within 1/16 to 1/8 of a turn of the end stop. Adjust A4A1S1 if necessary.

j. Run the coil to maximum. The roller nearest the antenna terminal should be within the last 1/2 turn of the 40 silver plated turns of the coil.

Note

On some early units there are only 39 silver plated turns and at maximum inductance the roller nearest the antenna terminal will be on the first turn of the 21 plastic turns.

k. Check position of coupling hub pins per paragraph 5.4.2.5 j.

l. The minimum voltage necessary to run the coil smoothly is, in part, a function of the hub pins positioning. Run the coil to maximum and back to minimum by starting with zero volts on the external power supply and varying the voltage until the coil just starts to run smoothly. The voltage necessary to run the coil smoothly in either direction should not exceed 9 volts. Check for other problems that could cause motor loading if this value is exceeded.

m. A commercial locking compound such as "Locktite" grade C or D should be applied to all set screws, especially in high vibration environments.

5.5.3 Variable Capacitor C1 Adjustment

Pre-position C1 per paragraph 5.4.2.8 or drive assembly per paragraph 5.4.2.10. Remove Control Logic PC Board 1A1 from housing by removing two phillips head screws. Secure pc board and cover in housing

a. Insert card extender in control logic pc board connector at base of housing and note position of pins H and F on exposed portion of extender card.

Note

Maintenance Repair Kit, P/N 1001-0164, contains a card extender that is recommended for this procedure. If not available, a convenient point to connect this voltage is at the chassis terminals near the motor, after removing Control Logic PC Board 1A1. The lead from pin H is white/black/violet; the lead from pin F is white/black/blue.

b. Connect ground terminal of an external 0 to 30 Vdc power supply capable of delivering 2 amps to chassis ground on RF-281.

Note

The power supply is nominally set to +24 Vdc, however, +12 Vdc is used to check initial settings to reduce motor speeds and prevent possible damage.

c. Install two test leads on the power supply. Test lead connections to card extender will result in motor travel as follows:

RUN TOWARD	+ LEAD TO PIN H
● MINIMUM	AND
CAPACITANCE	- LEAD TO PIN F
RUN TOWARD	+ LEAD TO PIN F
● MAXIMUM	AND
CAPACITANCE	- LEAD TO PIN H

d. Loosen four set screws on capacitor coupling.

e. Connect power supply leads for capacitor, "run to maximum", (+ lead to pin F and - lead to pin H).

f. Run the capacitor drive assembly to maximum.

Note

If the drive assembly was already at maximum run it off maximum and then back to maximum to assure that the motor overtravel is included in the adjustment.

g. Adjust the coupling so that one of the two set screws is on the motor shaft flat and one of the other two set screws is as close as possible to the capacitor shaft flat. Manually turn the capacitor clockwise, if necessary to place the capacitor shaft flat under a set screw. No more than 1/4 turn should be necessary.

h. Adjust the coupling back or forth axially to center over both shafts. Tighten all set screws. A commercial locking compound, such as "Loctite" grade C or D, should be applied to set screws to prevent loosening in high vibration environments.

i. Run the drive toward minimum capacitance. Minimum end stop sensing switch A4A1S1 should stop the capacitor before it runs into the mechanical end stops. (Built into the capacitor).

j. Run drive toward maximum capacitance. Maximum end stop sensing switch A4A1 S2 should stop capacitor travel at mechanical limits without allowing the capacitor bell housing to loosen.

Note

There are no adjustments for these switches. If they do not function correctly, they must be replaced as per paragraph 5.4.2.10.

k. At a reduced voltage run the capacitor from maximum to minimum and count the turns. The microswitch should stop the rotation after rotating 23 to 23-1/2 turns.

l. Check coupling hub pin alignment as per paragraph 5.4.2.10.

Note

The minimum voltage necessary to run the capacitor smoothly is a function of hub pin positioning.

m. Gradually increase the power supply voltage from 0 volts to determine the minimum running voltage for both directions. The voltage necessary for smooth operation should not exceed 9 volts. If this value is exceeded by more than 10%, check for other problems that may be causing motor loading.

5.5.4 Ball Gap Assembly Adjustment

Refer to figure 5-14 for this adjustment. The gap between the ball assembly and the acorn nut on the antenna terminal stud should be adjusted to .065 to .070 inch (0.16 to 0.17 cm). This gap must be between the ball assembly and the round portion of the acorn nut. Do not set gap to hex portion of nut as this may damage Ball Gap Assembly. The gap clearance may be adjusted by either raising or lowering the ball assembly, or by screwing the acorn nut toward or away from the antenna terminal.

5.6 DISCRIMINATOR ASSEMBLY TEST CABLE FABRICATION

Construct the discriminator test cable from a three foot length of RG-58/U coaxial cable. Assemble a UG-536/U connector to one end, and strip the other end back one inch. Separate the center conductor and shield. Strip insulation from center conductor, and tin the center conductor and shield.

Note

A prefabricated test cable (1001-0046) is provided with Maintenance Repair Kit 1001-0164.

5.7 RF-281/RF-339 REPAIR KITS

Table 1-2 lists various repair kits available from RF Communications for the RF-281 and the RF-339.

5.8 RF-281 PRESSURE TEST

The RF-281 is an air-tight unit and must be leak tested after any internal maintenance. To test, remove the 1/4-28 screw and seal washer from the antenna end of the case. Connect a test adapter and hand pump as shown in figure 5-15 (this adapter may be fabricated by the customer, or may be purchased as part of MRK 1001-0164. The hand pump is included in MRK). Pressurize the RF-281 to 3 psig. Brush a soap and water solution on all portions of the case where leakage might occur (i.e., top cover, Antenna Terminal (E1), cable connectors, etc.). Check for bubbling. If bubbling occurs, check component for tightness and/or replace the applicable seal or gasket. If there is no apparent leakage, bleed off the 3 psig, remove the test adapter, and replace the 1/4-28 screw and seal washer on the case. Clean insulator after leak testing.

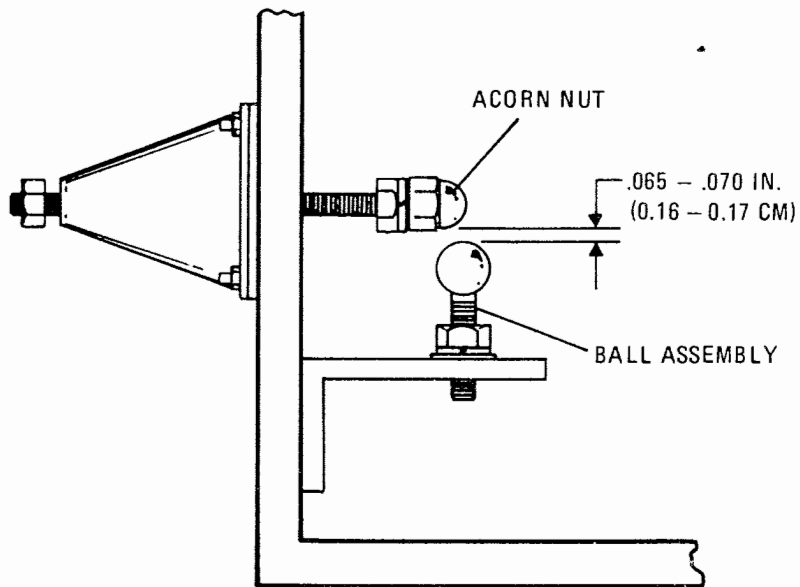


Figure 5-14. Ball Gap Assembly Adjustment Drawing

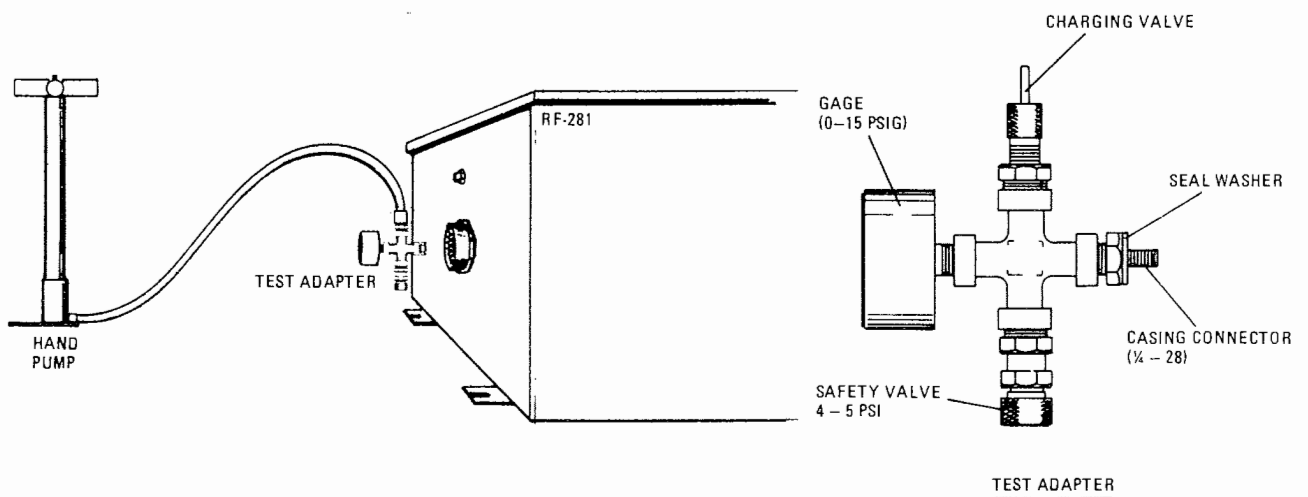


Figure 5-15. RF-281 Pressure Test Setup

SECTION 6

MAINTENANCE PARTS LISTS

6.1 GENERAL

This section contains information for ordering replacement parts for the RF-281/281A Automatic Antenna Coupler (part number 1960-0000/0001), and the RF-339/339A Coupler Control (part number 1960-6000/6001) manufactured by Harris Corporation, RF Communications Division, 1680 University Avenue, Rochester, New York 14610.

6.2 PARTS LISTS

Tables 6-1 and 6-2 list all assemblies and their maintenance parts. Reference designators are used to identify units, assemblies, and subassemblies. The parts are listed in alpha-numeric order by reference designator and include the part name, description, and part number. Table 6-3 lists manufacturers by vendor code. RF Communications and MIL parts do not have vendor codes.

Note

The part number on some integrated circuits actually found in the equipment may not agree with the part number shown. This is due to vendor part number differences and does not indicate differences in the part. Any equivalent IC's may be substituted for those listed.

6.3 COMPONENT LOCATION DRAWINGS

The figure number shown in the parts list relates to the associated component location drawing. These drawings are included in this section to facilitate identification.

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>Unit 1</u>	1-1	Antenna Coupler, RF-281 Antenna Coupler, RF-281A	1960-1000 1960-1001
C1		Capacitor, Variable, 12-500 pF, 7.5KV	C95-0001-001
CR1 thru CR6		Not Used	
CR7		Diode, Silicon, MIL Type	D15-0914-000
E1		Antenna Terminal Assembly	1960-4000
J1		Connector, Receptacle, Type N: MIL Type	UG-30D/U
J2		Connector Assy, Control	1960-4009
J3		Connector, PC Board	J10-0007-008
K1		Relay, DPDT:	K30-0002-005
L1		Inductor Assembly, Variable, .1-50 uH	1960-3002
L2		Inductor Assembly, 0.7 uH	1960-3007
MP1		Ball Assembly	1960-4001
MP2		Gasket, Cover	1960-1104
MP3 thru MP5		Not Used	
MP6		Seal, Ground Stud: MFR 45722	H05-0001-004
MP7		Seal, Pressure Test Connection: MFR 45722	H05-0002-005
P1		Connector, Plug, Type N: MIL Type	UG-21D/U
P2		Connector, Plug, 14 Pin: MIL Type	MS3106A- 20-27S
Q1		Transistor, PNP: MIL Type	Q02-6109-000
T1		Transformer Assembly, Toroidal	1960-3005
<u>1A1</u>	6-1	Control Logic, PC Board Assembly	1960-4006
C1		Capacitor, Fixed, Tantalum, 15 uF, $\pm 10\%$, 20V	C6549
C2 thru C5		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C6		Capacitor, Fixed, Tantalum, 0.1 uF, $\pm 20\%$, 35V	C6415
C7 thru C17		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C18, C19		Capacitor, Fixed, Tantalum, 4.7 uF, $\pm 20\%$, 20V	C6446
C20		Capacitor, Fixed, Tantalum, 22 uF, $\pm 20\%$, 35V	C6429
C21		Capacitor, Fixed, Tantalum, 33 uF, $\pm 20\%$, 25V	C6440

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
1A1		(Cont'd.)	
C22		Capacitor, Fixed, Tantalum, 4.7 uF, $\pm 20\%$, 20V	C6446
C23		Capacitor, Fixed, Tantalum, 47 uF, $\pm 20\%$, 25V	C6441
C24 thru C26		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C27		Capacitor, Fixed, Tantalum, 0.1 uF, $\pm 20\%$, 35V	C6415
C28		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C29		Capacitor, Fixed, Tantalum, 1.0 uF, $\pm 20\%$, 35V	C6421
C30		Capacitor, Fixed, Tantalum, 0.1 uF, $\pm 20\%$, 35V	C6415
C31 thru C36		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C37		Capacitor, Fixed, Tantalum, 3.3 uF, $\pm 20\%$, 20V	C6445
C38		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C39 thru C41		Capacitor, Fixed, Tantalum, 1.0 uF, $\pm 20\%$, 35V	C6421
C42 thru C44		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
C45		Capacitor, Fixed, Tantalum, 0.1 uF, $\pm 20\%$, 50V	C3202
C46, C47		Capacitor, Fixed, Tantalum, 33 uF, $\pm 20\%$, 35V	C6430
C48		Capacitor, Fixed, Tantalum, 1.0 uF, $\pm 20\%$, 35V	C6421
CR1 thru CR12		Diode, Silicon: MIL Type	D15-0914-000
CR13		Diode, Silicon: MIL Type	D22-0004-001
CR14, CR15		Diode, Silicon: MIL Type	D15-0914-000
CR16 thru CR19		Diode, Silicon: MIL Type	D22-4245-000
CR20 thru CR38		Diode, Silicon: MIL Type	D15-0914-000
CR39		Diode, Silicon: MIL Type	D22-4245-000
CR40, CR41		Diode, Silicon: MIL Type	D15-0914-000
CR42, CR43		Diode, Hot Carrier: MIL Type	D35-5711-000
CR44		Diode, Silicon: MIL Type	D15-0914-000
L1 thru L13		Inductor, RF, 100 uH: MIL Type	MS90538-12
L14		Inductor, RF, 1000 uH: MIL Type	MS90539-15
L15		Inductor, RF, 100 uH: MIL Type	MS90538-12

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont'd.)	
Q1		Transistor, NPN: MFR 04713	Q25-0001-000
Q2		Transistor, NPN: MIL Type	Q02-5493-000
Q3		Transistor, PNP: MFR 04713	Q25-0008-000
Q4		Transistor, PNP: MIL Type	Q02-6108-000
Q5		Transistor, NPN: MIL Type	Q02-5493-000
Q6		Transistor, NPN: MFR 04713	Q25-0001-000
Q7		Transistor, PNP: MIL Type	Q02-6108-000
Q8		Transistor, PNP: MFR 04713	Q25-0008-000
Q9		Transistor, NPN: MIL Type	Q02-5493-000
Q10		Transistor, PNP: MIL Type	Q02-6108-000
Q11		Transistor, NPN: MFR 04713	Q25-0001-000
Q12		Transistor, PNP: MFR 04713	Q25-0008-000
Q13		Transistor, PNP: MIL Type	Q02-6108-000
Q14		Transistor, NPN: MIL Type	Q02-5493-000
Q15		Transistor, NPN: MFR 04713	Q25-0001-000
Q16 thru Q18		Transistor, PNP: MFR 04713	Q25-0008-000
Q19		Transistor, PNP: MIL Type	Q02-4125-000
Q20		Transistor, UNIJUNCTION:	1960-1178
Q21		Transistor, PNP: MFR 04713	Q25-0009-000
Q22		Transistor, NPN: MIL Type	Q02-5493-000
Q23, Q24		Transistor, PNP: MFR 02735	Q02-5784-002
Q25		Transistor, PNP: MFR 04713	Q02-0009-000
Q26		Transistor, PNP: MIL Type	Q02-6108-000
Q27, Q28		Transistor, NPN: MFR 04713	Q25-0007-000
Q29		Transistor, PNP: MIL Type	Q02-4125-000
Q30		Transistor, NPN: MIL Type	Q02-4123-000
Q31, Q32		Transistor, PNP: MIL Type	Q02-4125-000
Q33, Q34		Transistor, NPN: MIL Type	Q02-4123-000
Q35 thru Q39		Transistor, NPN: MFR 04713	Q25-0007-000
Q40 thru Q46		Transistor, NPN: MFR 04713	Q25-0001-000
Q47		Transistor, PNP: MFR 04713	Q25-0009-000
Q48, Q49		Transistor, NPN: MFR 04713	Q25-0001-000
Q50		Transistor, NPN: MFR 04713	Q25-0007-000
R1		Resistor, Fixed, Composition, 1K, ±10%, 1W: MIL Type	R-1649
R2		Resistor, Fixed, Composition, 10K, ±10%, 1/4W: MIL Type	R-1273
R3		Resistor, Fixed, Composition, 1K, ±10%, 1W: MIL Type	R-1649

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont'd.)	
R4		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R5		Resistor, Fixed, Composition, 1K, $\pm 10\%$, 1W: MIL Type	R-1649
R6 thru R9		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1W: MIL Type	R-1657
R10, R11		Resistor, Fixed, Composition, 3.3K, $\pm 10\%$, 1/4W: MIL Type	R-1261
R12		Resistor, Fixed, Composition, 180K, $\pm 5\%$, 1/4W: MIL Type	R-1303
R13, R14		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R15		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R16		Resistor, Fixed, Composition, 390K, $\pm 5\%$, 1/4W: MIL Type	R-1311
R17		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R18 thru R25		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R26		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R27		Resistor, Fixed, Composition, 1K, $\pm 10\%$, 1/4W: MIL Type	R-1249
R28		Resistor, Fixed, Composition, 27K, $\pm 10\%$, 1/4W: MIL Type	R-1283
R29		Resistor, Fixed, Composition, 10 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1201
R30		Resistor, Fixed, Composition, 20 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1208
R31		Resistor, Fixed Composition, 100 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1225
R32		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R33		Resistor, Fixed, Composition, 82 ohms, $\pm 5\%$, 1/4W: MIL Type	R-1223
R34		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/2W: MIL Type	R-1465
R35		Resistor, Fixed, Composition, 560 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1243

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont'd.)	
R36		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/2W: MIL Type	R-1465
R37		Resistor, Fixed, Composition, 560 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1243
R38, R39		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/4W: MIL Type	R-1265
R40		Resistor, Fixed, Composition, 470 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1241
R41		Resistor, Fixed, Composition, 3.3K, $\pm 10\%$, 1/4W: MIL Type	R-1261
R42		Resistor, Fixed, Composition, 470 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1241
R43		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1/2W: MIL Type	R-1457
R44		Resistor, Fixed, Composition, 470 ohms, $\pm 10\%$, 1/4W: MIL Type	R-1241
R45		Resistor, Fixed, Composition, 47K, $\pm 10\%$, 1/4W: MIL Type	R-1289
R46		Resistor, Fixed, Composition, 560K, $\pm 5\%$, 1/4W: MIL Type (SN001 to 800)	R-1315
R46		Resistor, Fixed, Composition, 510K, $\pm 5\%$, 1/4W: MIL Type (SN801 and up)	R-1314
R47		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R48		Resistor, Fixed, Composition, 47K, $\pm 10\%$, 1/4W: MIL Type	R-1289
R49		Resistor, Fixed, Composition, 68K, $\pm 10\%$, 1/4W: MIL Type	R-1293
R50		Resistor, Fixed, Composition, 5.6K, $\pm 10\%$, 1/4W: MIL Type	R-1267
R51, R52		Resistor, Fixed, Composition, 3.9K, $\pm 10\%$, 1/4W: MIL Type	R-1263
R53		Resistor, Fixed, Composition, 18K, $\pm 5\%$, 1/4W: MIL Type	R-1279
R54		Resistor, Fixed, Composition, 1.3K, $\pm 5\%$, 1/4W: MIL Type	R-1252
R55		Resistor, Fixed, Composition, 10K, $\pm 5\%$, 1/4W: MIL Type	R-1273
R56		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R57		Resistor, Fixed, Composition, 39.2K, $\pm 1\%$, 1/10W: MIL Type	RN5503922F

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont' d.)	
R58		Resistor, Fixed, Composition, 15K, $\pm 5\%$, 1/4W: MIL Type	R-1277
R59		Resistor, Fixed, Composition, 27K, $\pm 10\%$, 1/4W: MIL Type	R-1283
R60		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R61		Resistor, Fixed, Composition, 39K, $\pm 5\%$, 1/4W: MIL Type	R-1287
R62, R63		Resistor, Fixed, Composition, 68K, $\pm 10\%$, 1/4W: MIL Type	R-1293
R64		Resistor, Fixed, Composition, 1M, $\pm 10\%$, 1/4W: MIL Type	R-1321
R65		Resistor, Fixed, Composition, 100K, $\pm 10\%$, 1/4W: MIL Type	R-1297
R66		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R67		Resistor, Fixed, Composition, 220K, $\pm 10\%$, 1/4W: MIL Type	R-1305
R68, R69		Resistor, Fixed, Composition, 1M, $\pm 10\%$, 1/4W: MIL Type	R-1321
R70		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R71		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R72		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1/4W: MIL Type	R-1257
R73, R74		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R75, R76		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R77, R78		Resistor, Fixed, Composition, 100K, $\pm 10\%$, 1/4W: MIL Type	R-1297
R79		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1/4W: MIL Type	R-1257
R80		Resistor, Fixed, Composition, 100K, $\pm 10\%$, 1/4W: MIL Type	R-1297
R81		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1/4W: MIL Type	R-1257
R82		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont'd.)	
R83		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R84		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R85		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R86		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R87		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R88		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R89		Resistor, Fixed, Composition, 3.9K, $\pm 10\%$, 1/4W: MIL Type	R-1263
R90		Resistor, Fixed, Composition, 560K, $\pm 10\%$, 1/4W: MIL Type	R-1315
R91		Resistor, Fixed, Composition, 10K, $\pm 10\%$, 1/4W: MIL Type	R-1273
R92		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R93		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R94, R95		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R96		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R97		Resistor, Fixed, Composition, 1M, $\pm 10\%$, 1/4W: MIL Type	R-1321
R98		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R99		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R100		Resistor, Fixed, Composition, 1M, $\pm 10\%$, 1/4W: MIL Type	R-1321
R101		Resistor, Fixed, Composition, 22K, $\pm 10\%$, 1/4W: MIL Type	R-1281
R102		Resistor, Fixed, Composition, 1.2K, $\pm 10\%$, 1/4W: MIL Type	R-1251
R103		Resistor, Fixed, Composition, 2.2K, $\pm 10\%$, 1/2W: MIL Type	R-1457

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A1</u>		(Cont'd.)	
R104		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/4W: MIL Type	R-1265
R105		Resistor, Fixed, Composition, 3.9K, $\pm 10\%$, 1/4W: MIL Type	R-1263
R106 thru R110		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/4W: MIL Type	R-1265
R111		Resistor, Fixed, Composition, 10 ohm, $\pm 10\%$, 1/4W; MIL Type	R-1201
R112		Resistor, Fixed, Composition, 4.7K, $\pm 10\%$, 1/4W; MIL Type	R-1265
T1		Transformer, DC Converter	1960-4012
TP1		Test Point, PCB, Brown	J60-0001-008
TP2		Test Point, PCB, Red	J60-0001-002
TP3		Test Point, PCB, Orange	J60-0001-006
TP4		Test Point, PCB, Yellow	J60-0001-007
TP5		Test Point, PCB, Green	J60-0001-004
TP6		Test Point, PCB, Blue	J60-0001-010
TP7		Test Point, PCB, Violet	J60-0001-012
U1, U2		Integrated Circuit, Quad 2 input NAND: MFR 02735	I01-0035-000
U3		Integrated Circuit, Quad 2 input NOR: MFR 02735	I01-0030-000
U4 thru U8		Integrated Circuit, Quad 2 input NAND: MFR 02735	I01-0035-000
U9		Integrated Circuit, Dual 4 input NAND: MFR 02735	I01-0011-000
U10		Integrated Circuit, Dual 4 input NOR: MFR 02735	I01-0049-000
U11		Integrated Circuit, Quad 2 input NAND: MFR 02735	I01-0035-000
U12		Integrated Circuit, Quad 2 input NOR: MFR 02735	I01-0030-000
U13 thru U17		Integrated Circuit, Dual Op Amp: MFR 02735	I30-0021-000
VR1		Diode, Zener, 24V: MIL Type	D30-0047-024
VR2		Diode, Zener, 43V: MIL Type	D30-0047-043
<u>1A2</u>	6-2	Discriminator Assembly	1960-3001
C1		Capacitor, Fixed, Glass, $5.1 \pm .25$ pF, 500V: MIL Type	CY13C5R1C
C2		Capacitor, Variable, .8-8.5 pF, 750V: MIL Type	PC41J8R5
T1, T2		Transformer, RF, Toroidal	T10-0001-000
P1		Connector, Plug, Type N, MIL Type	UG-536B/U

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A2A1</u>	6-3	R Discriminator PC Board Assembly	1960-5000
C1		Capacitor, Fixed, Mica, 330 pF, $\pm 5\%$, 500V: MIL Type	CM05FD331J03
C2 thru C5		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
CR1 thru CR4		Diode, Hot Carrier: MIL Type	D35-5711-000
L1		Inductor, RF, 0.68 uH: MIL Type	MS18130-6
L2		Inductor, RF, 1000 uH: MIL Type	MS90539-15
R1, R2		Resistor, Fixed, Film, 332 ohms, $\pm 1\%$, 1/8W: MIL Type	RN60D3320F
R3		Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, 1/4W: MIL Type	R-1237
R4, R5		Resistor, Fixed, Film, 4.75K, $\pm 1\%$, 1/8W: MIL Type	RN60D4751F
R6, R7		Not Used	
R8		Resistor, Fixed, Composition, 560 ohms, $\pm 5\%$, 1/4W: MIL Type	R-1243
T1, T2		Transformer, RF	1960-4011
<u>1A2A2</u>	6-4	Phase Discriminator PC Board Assembly	1960-5001
C1, C2		Capacitor, Fixed, Ceramic, 0.01 uF, $+60/-40\%$, 150V	C0065
CR1, CR2		Diode, Hot Carrier: MIL Type	D35-5711-000
R1, R2		Resistor, Fixed, Composition, 680 ohms, $\pm 5\%$, 2W: MIL Type	R-1845
R3		Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, 1/2W: MIL Type	R-1437
R4		Resistor, Variable, 10K, $\pm 10\%$: MFR 80294	3059P-1-103
R5, R6		Resistor, Fixed, Composition, 2.4K, $\pm 5\%$, 1/4W: MIL Type	R-1258
T1, T2		Transformer, RF	1960-4013
<u>1A3</u>	6-5	Coil Drive Assembly	1960-3004
B1/MP2		Motor and Pinion Assembly	1960-4014
MP1		Coupling, Universal	Z06-0009-002
MP2		Part of B1	
MP3		Gear, Modified	1960-1147
MP4		Gear, Modified	1960-1168
MP5		Gear, Modified	1960-1169

Table 6-1. Parts List for the RF-281/RF-281A Antenna Coupler(Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>1A3A1</u>		Switch Assembly	1960-4005
CR1 thru CR3 S1, S2		Diode, Silicon: MIL Type Switch, Sensitive: MFR 04426	D22-4245-000 S80-0002-001
<u>1A4</u>	6-6	Capacitor Drive Assembly	1960-3003
B1/MP2 MP1 MP2 MP3 MP4		Motor and Pinion Assembly Coupling, Universal Part of B1 Gear, Modified Gear, Modified	1960-4014 Z06-0011-006 1960-1146 1960-1170
<u>1A4A1</u>		Switch Assembly	1960-4004
CR1 thru CR3 S1, S2		Diode, Silicon: MIL Type Switch, Sensitive: MFR 04426	D22-4245-000 S80-0002-001
<u>1A5</u>	6-7	Filter PC Board Assembly	1960-5003
C1 thru C11		Capacitor, Fixed, Ceramic, 0.01 uF, +60/-40%, 150V	C0065
<u>1A6</u>	6-8	Long Wire Adapter	1960-3006
C1		Capacitor, Fixed, Ceramic, 100 pF, ±10%, 5KV	C15-0001-003

Table 6-2. Parts List for the RF-339/RF-339A Interface Control Unit

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>Unit 2</u>	1-2	Coupler Control Unit, RF-339 Coupler Control Unit, RF-339A	1960-6000 1960-6001
C1 thru C11 C12 thru C14		Not Used Capacitor, Fixed, Ceramic, 0.01 uF, +60/-40%, 150V	C0065
C15		Capacitor, Fixed, Electrolytic, 1300 uF, 50V: MFR 56289	C23-0004-001
C16		Capacitor, Fixed, Ceramic, 0.01 uF, +60/-40%, 150V	C0065
CR1 thru CR17 CR18, CR19		Not Used Diode, Silicon: MIL Type	D15-0914-000
F1		Fuse, Cartridge, 1 Amp, 250V: MIL Type	F02A250V1A
F2		Fuse, Cartridge, 2 Amp, 250V: MIL Type	F02A250V2A
J1, J2		Connector, Receptacle, UHF: MFR 02660	J90-0005-000
J3		Connector, Control	1960-8051
J4		Connector, Receptacle, 7 Pin: MIL Type	MS3102A16S- 1P
K1, K2		Relay, DPDT:	K30-0002-005
M1		Meter, DC, 150W	1960-1409
R1		Resistor, Fixed, Ceramic Silicon, 52 ohms, $\pm 10\%$, 100W	R90-0001-000
R2		Resistor, Fixed, Ceramic Silicon, 15 ohms, $\pm 10\%$, 30W: MFR 10646	R90-0003-029
R3		Resistor, Fixed, Ceramic Silicon, 75 ohms, $\pm 10\%$, 30W: MFR 10646	R90-0003-030
S1		Switch, Toggle; FORWARD/REFLECTED POWER: MIL Type	MS35058-26
S2		Switch, Rotary, 2 position; 115/230 VAC	1960-1407
S3		Switch, Rotary, 4 position; FUNCTION SELECTOR	1960-1408
S4		Switch, Toggle; TUNE ENABLE: MIL Type	MS35058-22
S5		Switch, Toggle; FAULT RESET: MIL Type	MS35058-30
T1		Transformer, Step-down	423-0038
XF1, XF2		Fuseholder: MFR 71400	F01-0001-002

Table 6-2. Parts List for the RF-339/RF-339A Interface Control Unit (Cont)

REFERENCE DESIGNATION	FIGURE NO.	DESCRIPTION	PART NO.
<u>2A1</u>	6-7	Filter PC Board Assembly	1960-9000
C1 thru C11		Capacitor, Fixed, Ceramic, 0.01 uF, +60/-40%, 150V	C0065
<u>2A2</u>	6-9	Main PC Board Assembly	1960-9001
<u>C1</u>		Capacitor, Fixed, Tantalum, 1.0 uF, +20%, 35V	C6421
CR1 thru CR5		Not Used	
CR6 thru CR9		Diode, Silicon: MIL Type	D22-4245-000
CR10		Not Used	
CR11 thru CR14		Diode, Silicon: MIL Type	D15-0914-000
CR15		Not Used	
CR16, CR17		Diode, Silicon: MIL Type	D15-0914-000
CR18		Diode, Silicon: MIL Type	D22-0004-001
R1 thru R6		Not Used	
R7, R8		Resistor, Fixed, Composition, 1.8K, +10%, 2W: MIL Type	R-1855
R9		Resistor, Fixed, Composition, 10K, +10%, 1/4W: MIL Type	R-1273
R10		Resistor, Fixed, Composition, 1.8K, +10%, 2W: MIL Type	R-1855
R11		Resistor, Fixed, Composition, 180K, +10%, 1/4W: MIL Type	R-1303
<u>2A3</u>	1-2	LED Assembly	1960-9002
CR1 thru CR3		Diode, Silicon: MIL Type	D15-0914-000
DS1		Indicator, LED, Yellow; TUNING: MFR 53184	N21-0009-003
DS2		Indicator, LED, Green; READY: MFR 53184	N21-0009-001
DS3		Indicator, LED, Red; FAULT: MFR 53184	N21-0009-002

Table 6-3. Manufacturers and Vendor Codes

Vendor Code	Name and Address
02735	RCA Corp., Solid State Division Somerville, N.J. 08876
02660	Bunker Ramo Corp., Amphenol Connector Division 2801 South 25th Ave., Broadview, Ill. 60153
04426	Illinois Tool Works Inc., Licon Division 6615 W. Irving Park Rd., Chicago, Ill. 60634
04713	Motorola Inc., Semiconductor Products Division 5005 E. McDowell Rd., Pheonix, Az. 85008
08863	Nylomatic Division of Wehco Plastics Inc. 300 N. Lexington Ave., Pittsburgh, Pa. 15208
10646	Carborundum Co. P.O. Box 337, Niagra Falls, N.Y. 14302
45722	Parker-Kalon Corp Clifton, N.J.
53184	Xciton Corp. 5 Hemlock St., Latham, N.Y. 12110
56289	Sprague Electronics Co. North Adams, Ma. 01247
71400	Bussman Mfg., Division of McGraw Edison Co. 2536 W. University St., St. Louis, Mo. 63107
80294	Bourns Inc. Riverside, Ca.

NOTES:
 1. INSTALL ITEM 2 TO T1 AFTER
 INSTALLING T1 TO PROVIDE DOUBLE
 NUT LOCKING.

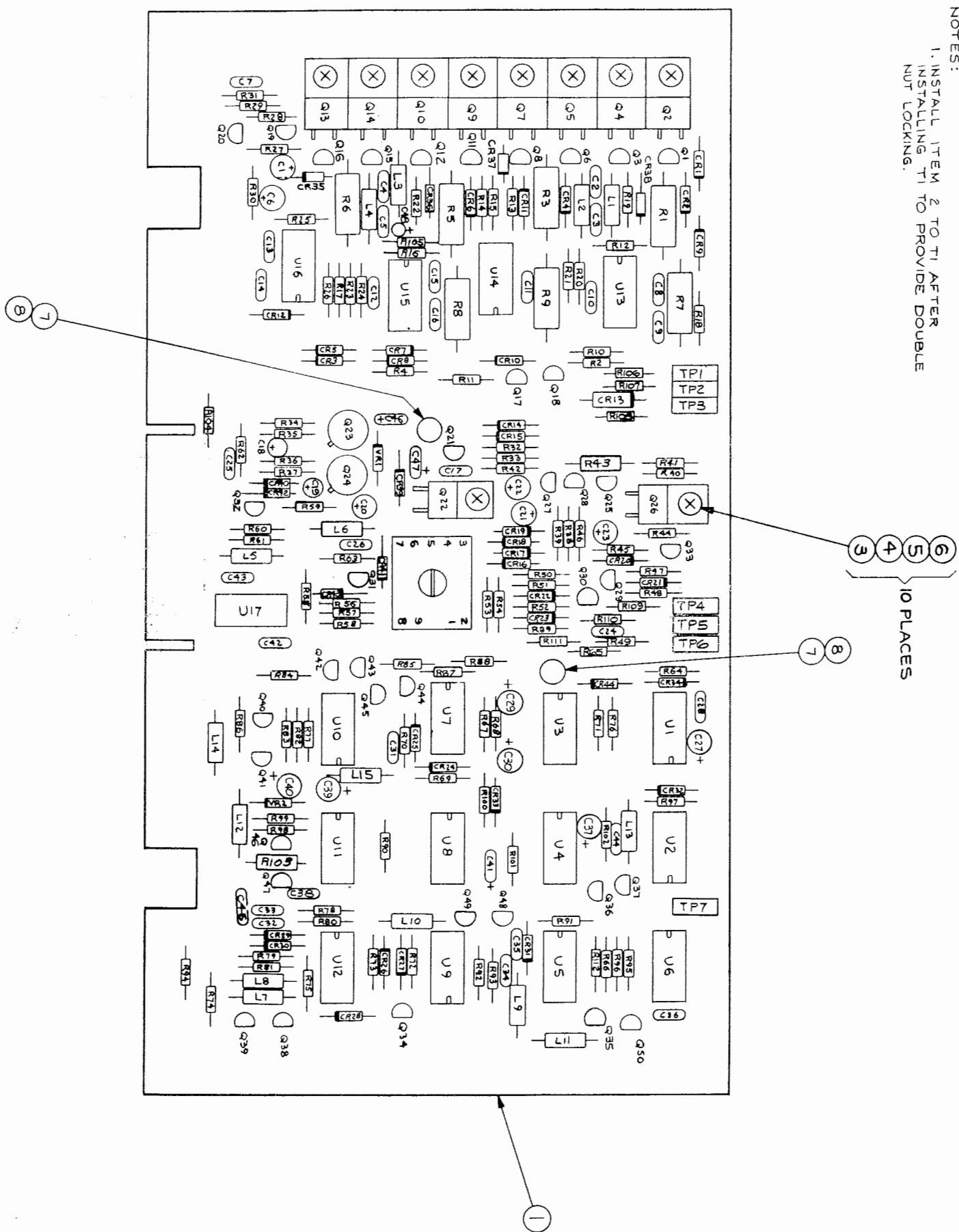


Figure 6-1. Control Logic PC Board Assembly 1A1, Component Location Drawing

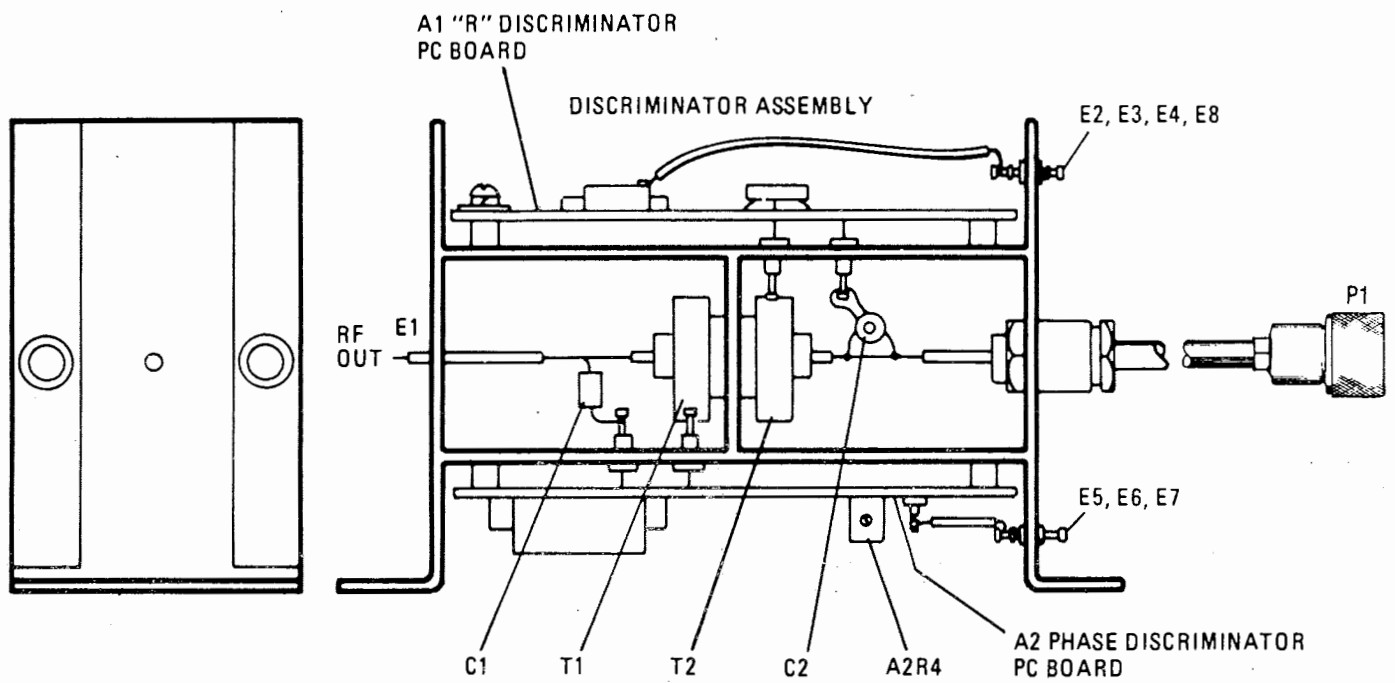


Figure 6-2. Discriminator Assembly 1A2, Component Location Drawing

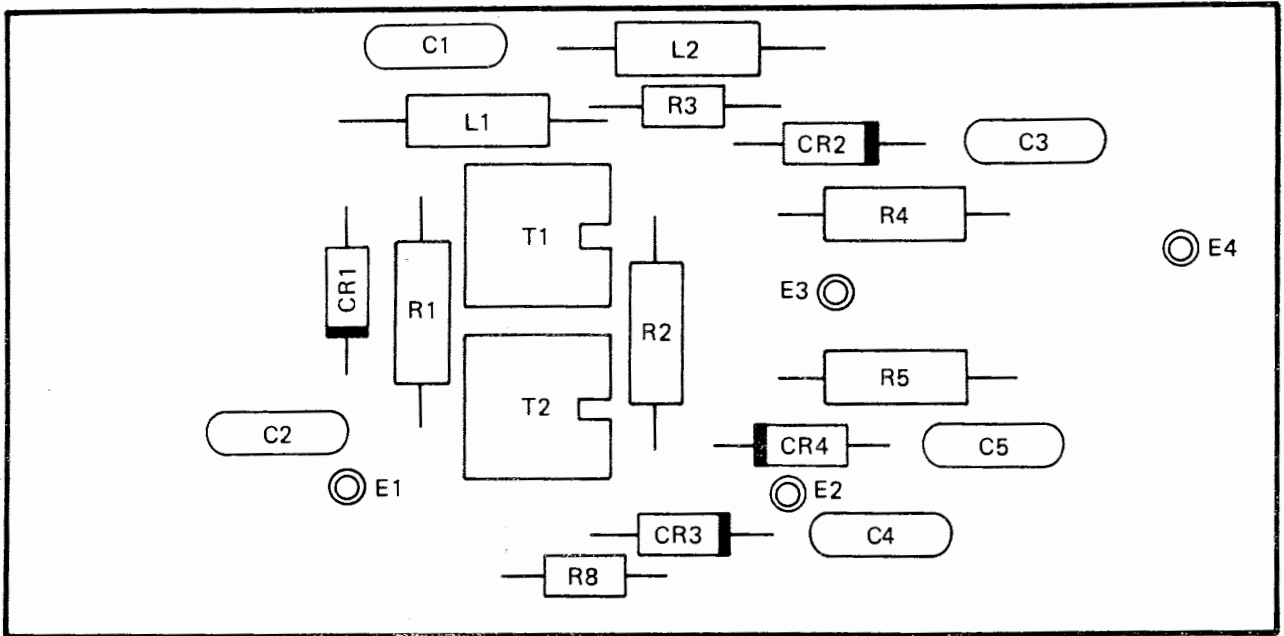


Figure 6-3. "R" Discriminator PC Board Assembly 1A2A1, Component Location Drawing

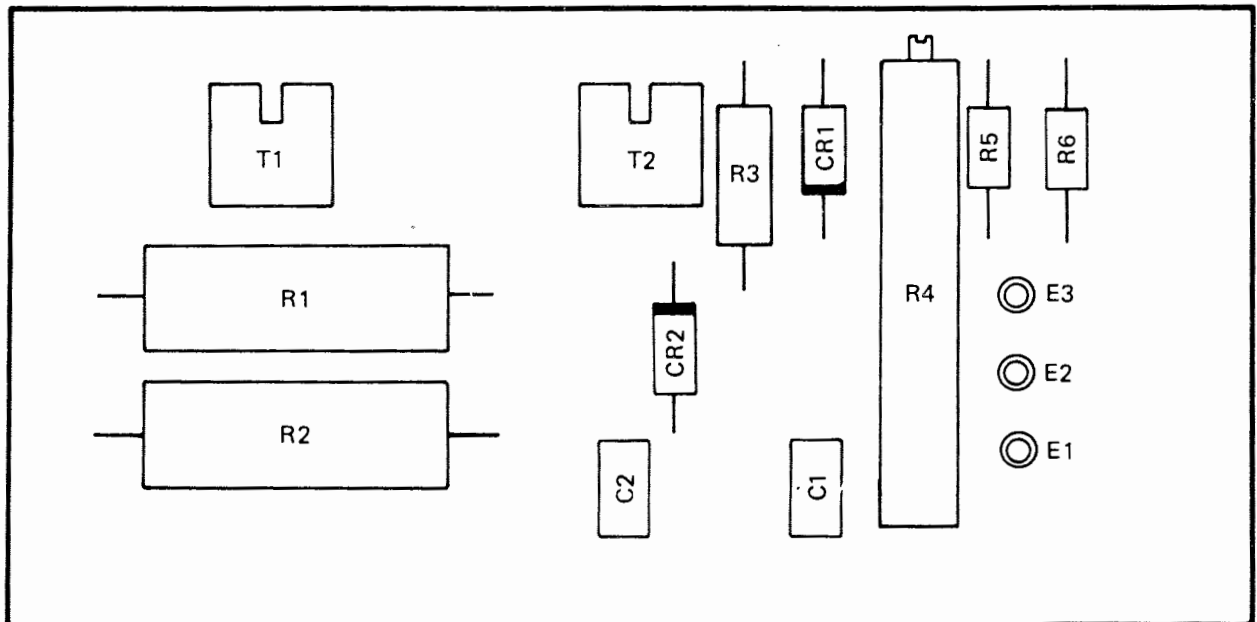


Figure 6-4. Phase Discriminator PC Board Assembly 1A2A2, Component Location Drawing

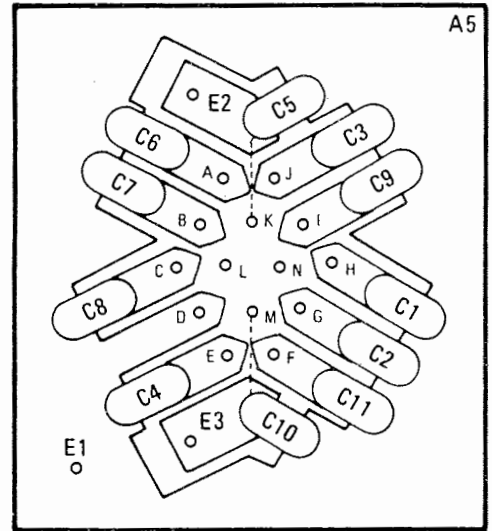
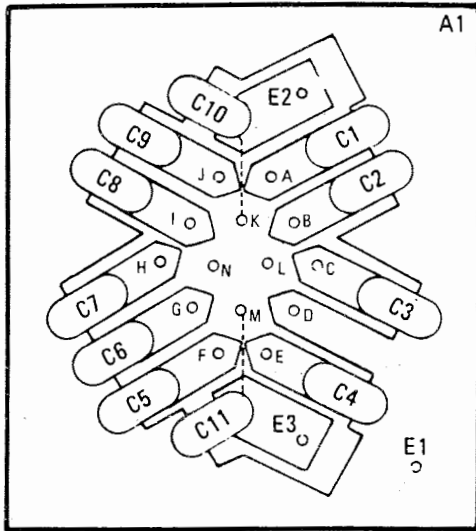


Figure 6-7. Filter PC Board Assembly 1A5/2A1, Component Location Drawing

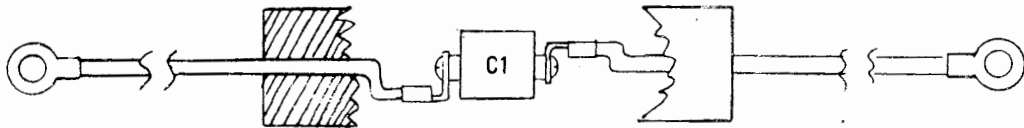


Figure 6-8. Long-Wire Adapter 1A6, Component Location Drawing

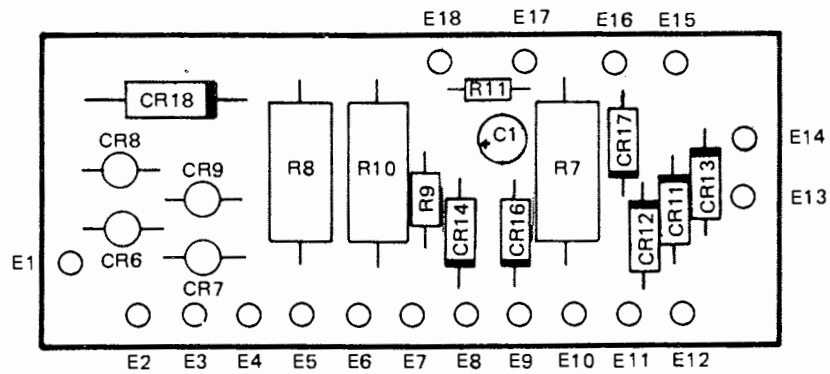


Figure 6-9. Main PC Board Assembly 2A2, Component Location Drawing

SECTION 7

SCHEMATICS

7-1 GENERAL

Figure 7-1 (sheets 1, 2, and 3) and Figure 7-2 are schematic diagrams of the RF-281 and the RF-339 respectively.

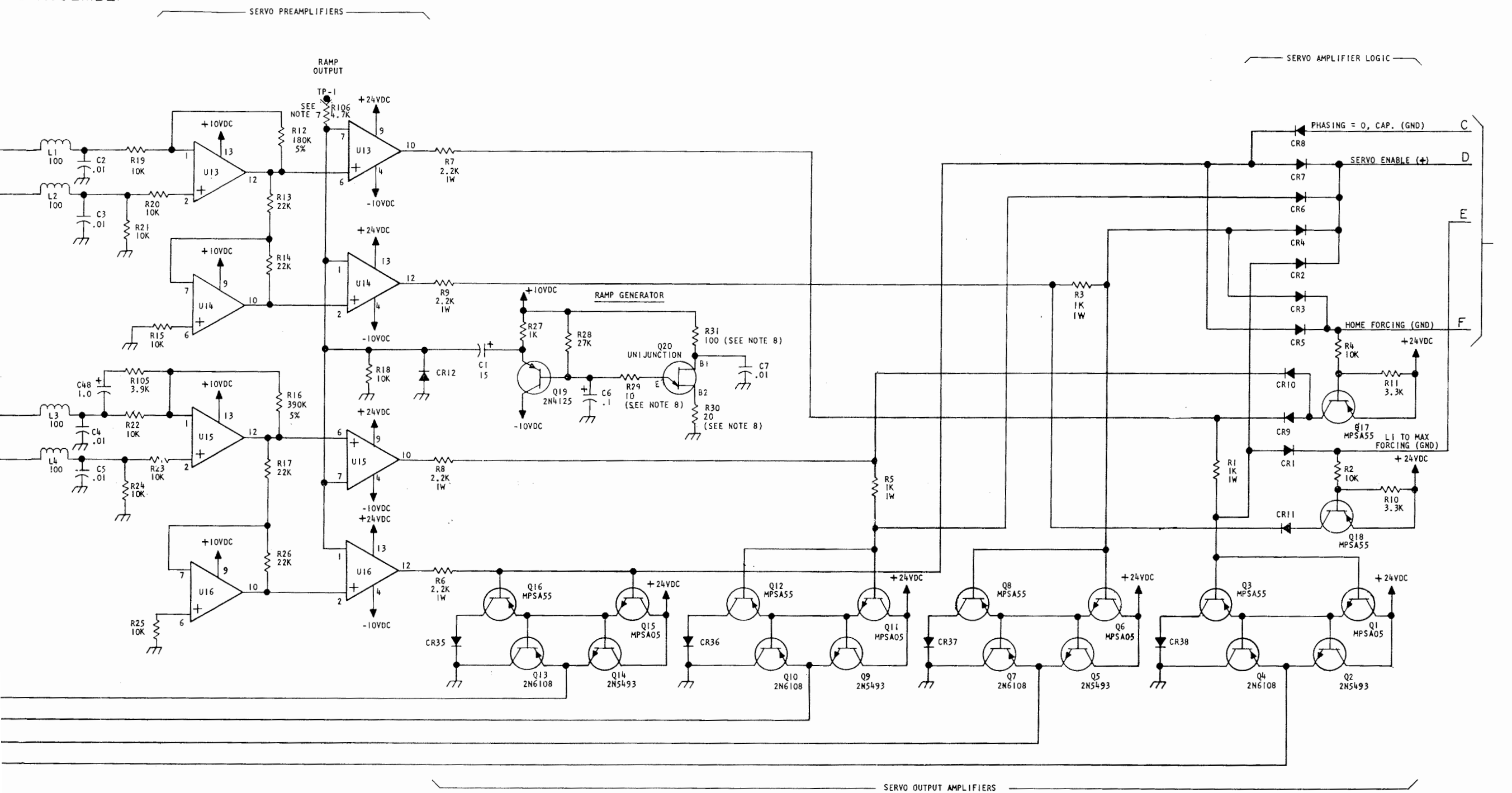
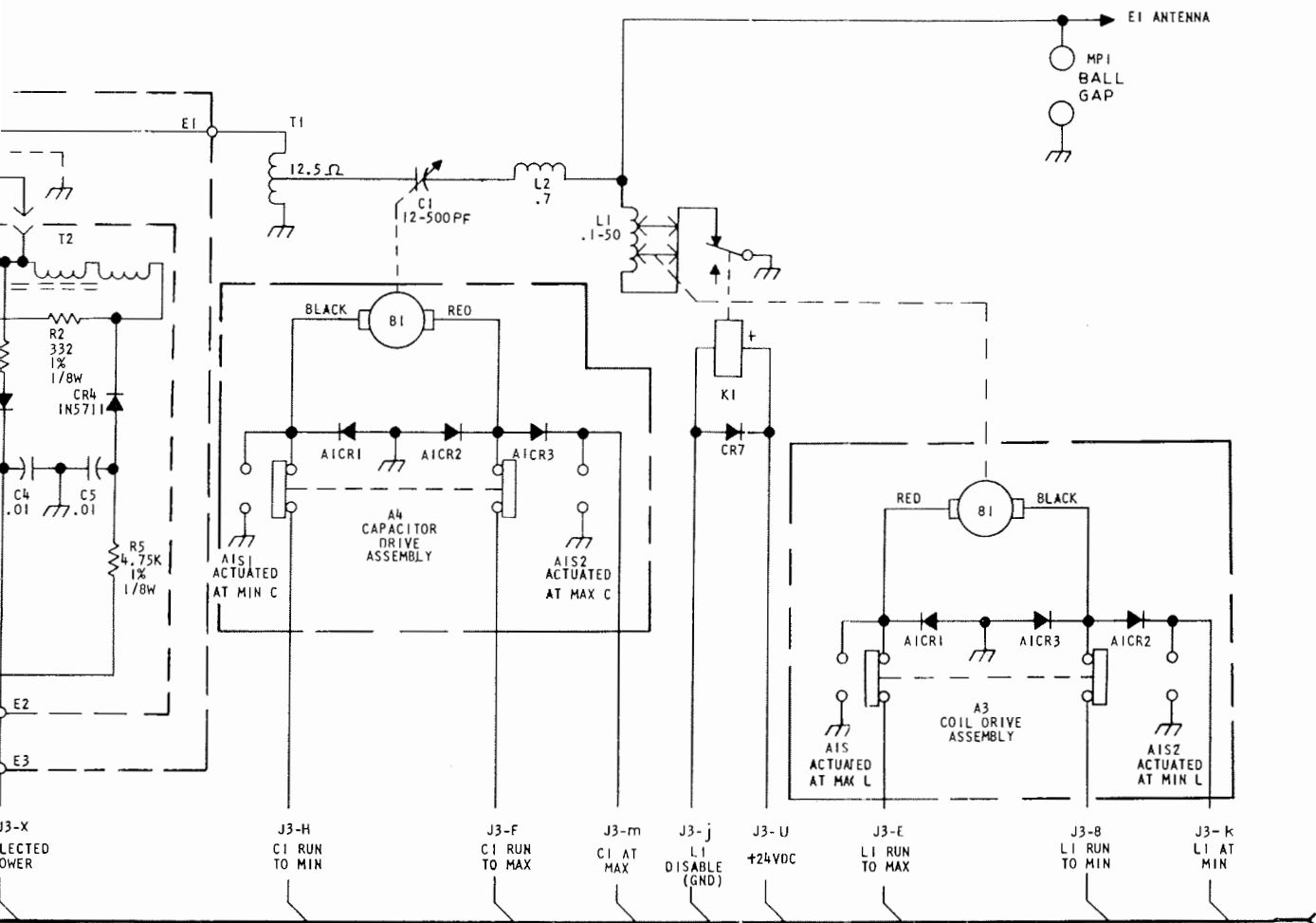
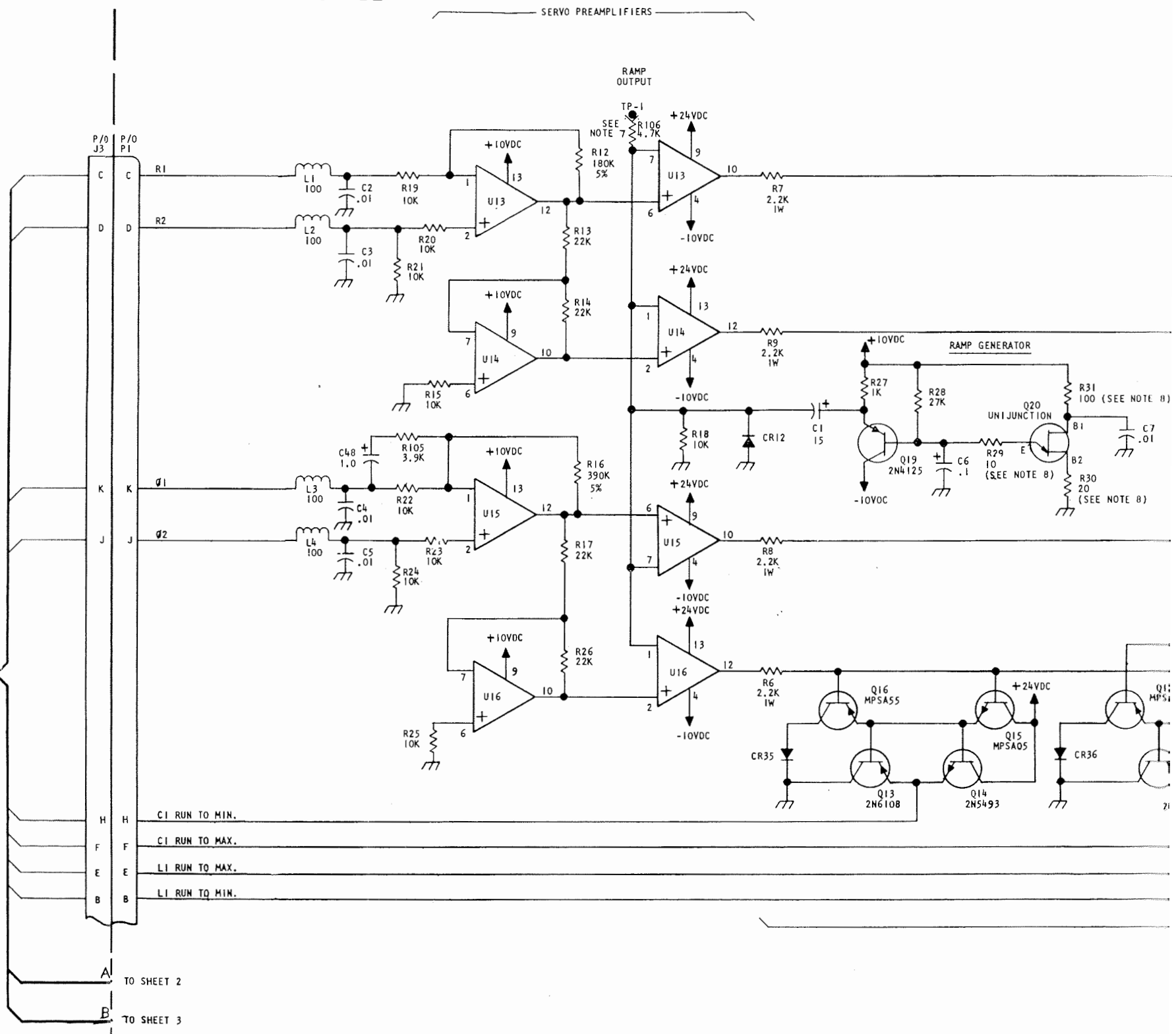


Figure 7-1. RF-281 Schematic Diagram (Sheet 1 of 3)



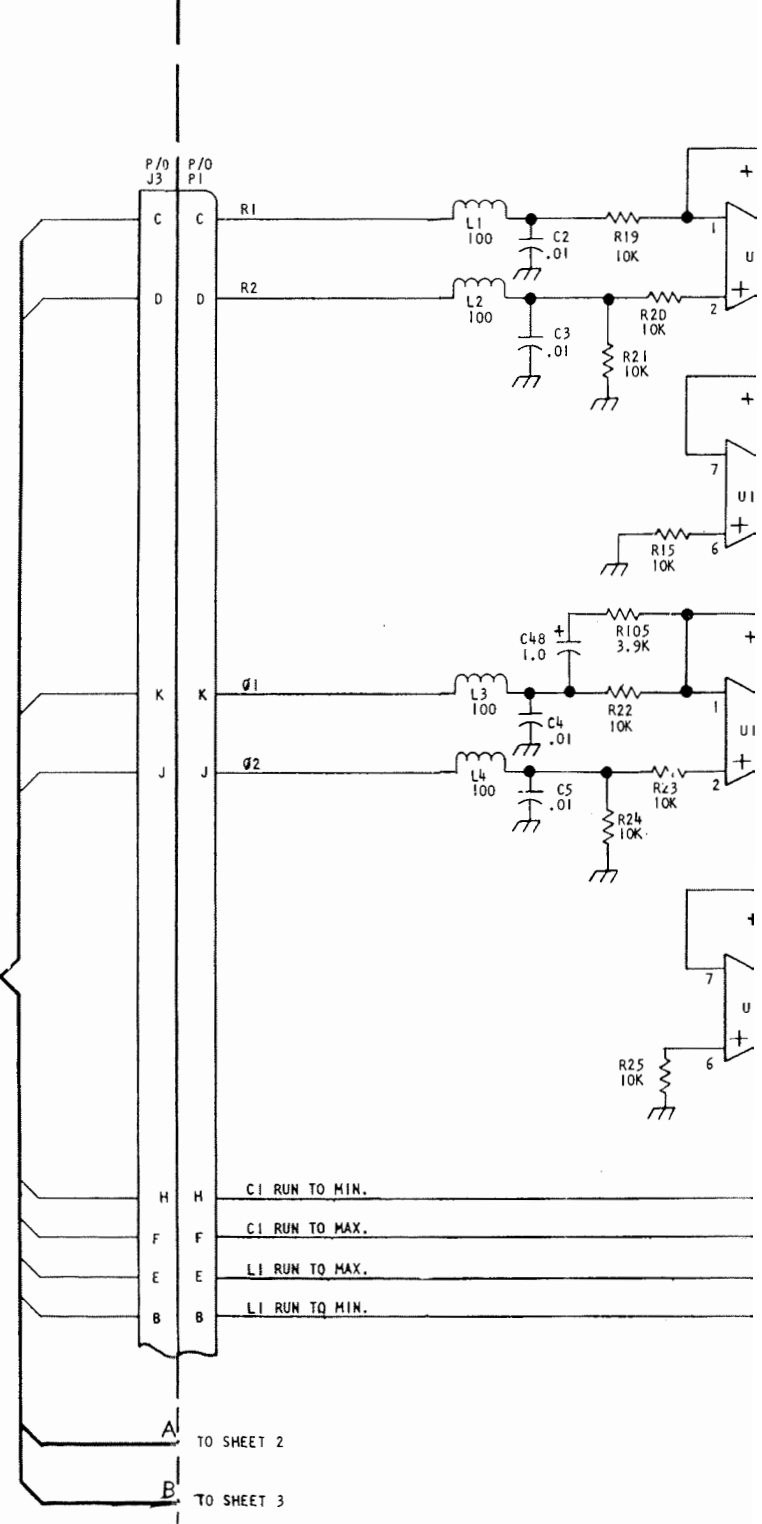
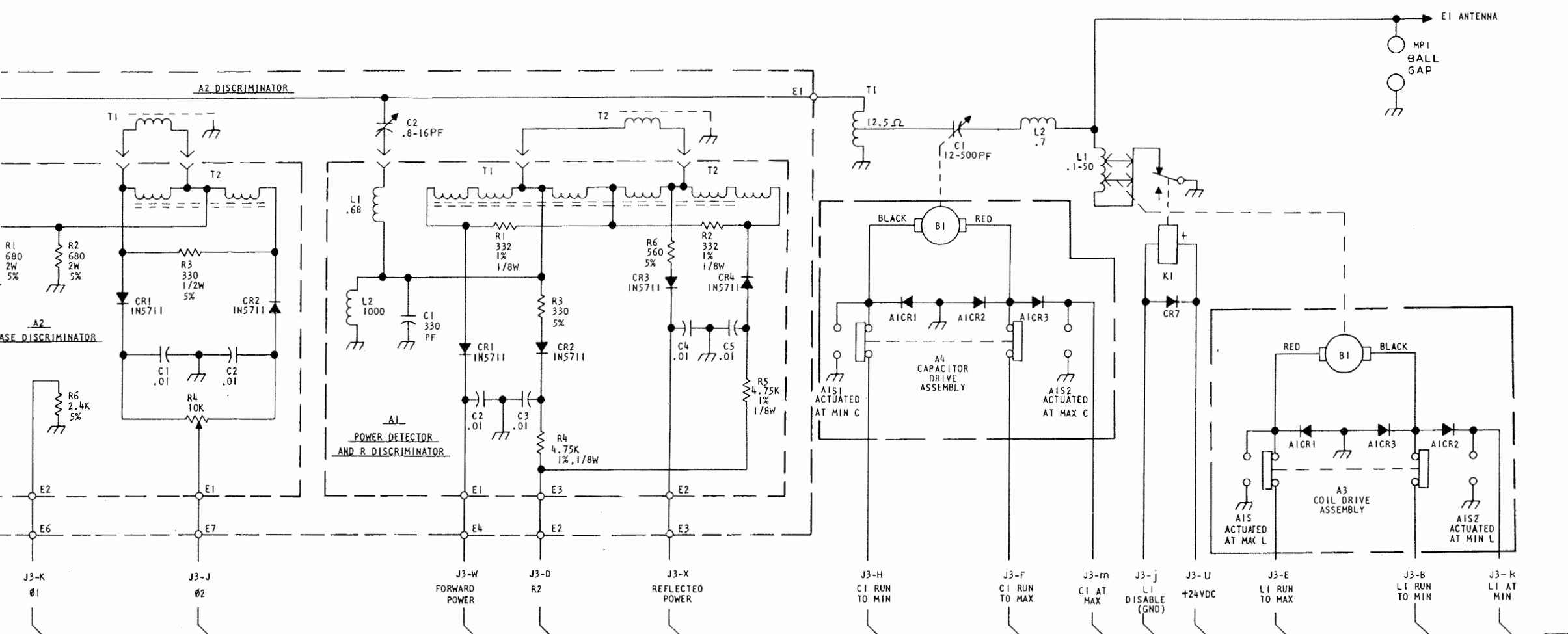
- NOTES:
- UNLESS OTHERWISE SPECIFIED:
 - ALL RESISTORS ARE 1/4W, 10%.
 - ALL CAPACITORS ARE IN MICROFARADS.
 - ALL COILS ARE IN MICROHENRIES.
 - ALL DIODES ARE IN914.
 - ALL FEEDTHRU'S ARE .01 (ASCII THRU ASCII1).
 - A1L14 WAS 100UH FROM RF-281 SER. NO. 1 THRU 23.
 - A1C45 WAS .01UF FROM RF-281 SER. NO. 1 THRU 60.
 - A1R46 WAS 560K FROM RF-281 SER. NO. 1 THRU 400, AND C401 THRU C800.
 - PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 1.
 - R106 THRU R112 AND CR44 ADDED STARTING WITH RF-281 SER. NO. F2401.
 - R29 WAS 220 OHMS, R30 WAS 47 OHMS; AND R31 WAS 220 OHMS UP THRU CONTROL LOGIC PCB ASSEMBLY SER. NO. C318.

P/O AI CONTROL LOGIC
PC BOARD ASSEMBLY

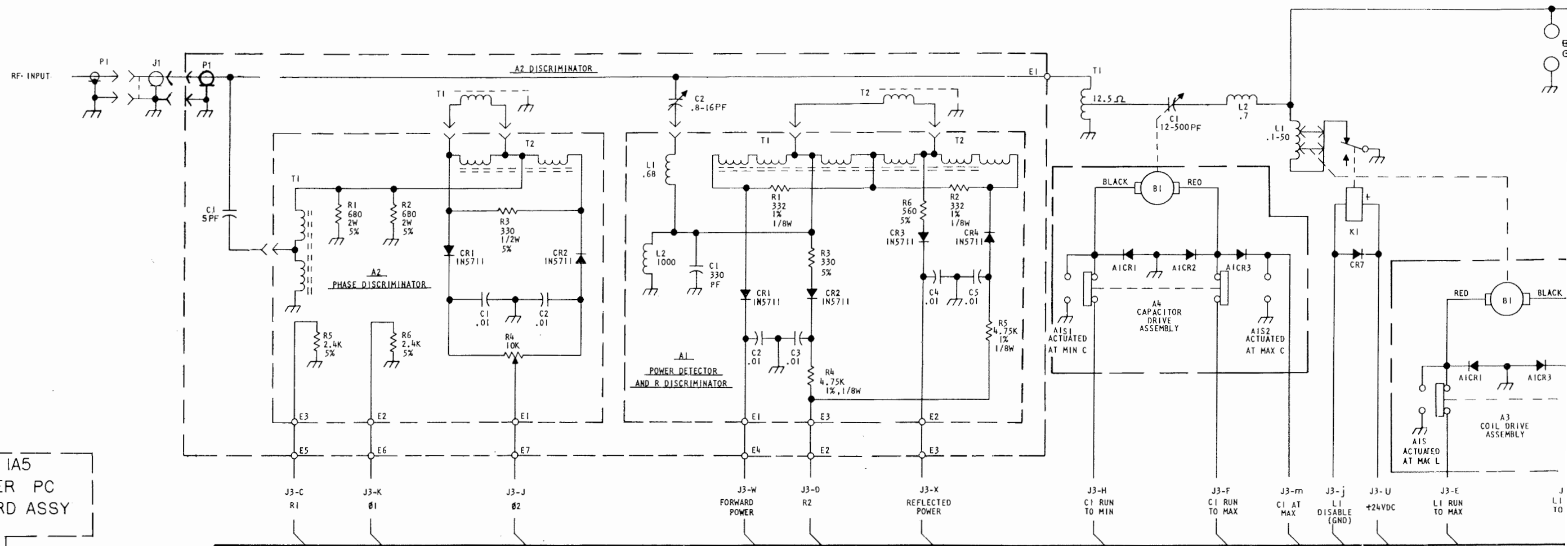


A TO SHEET 2
B TO SHEET 3

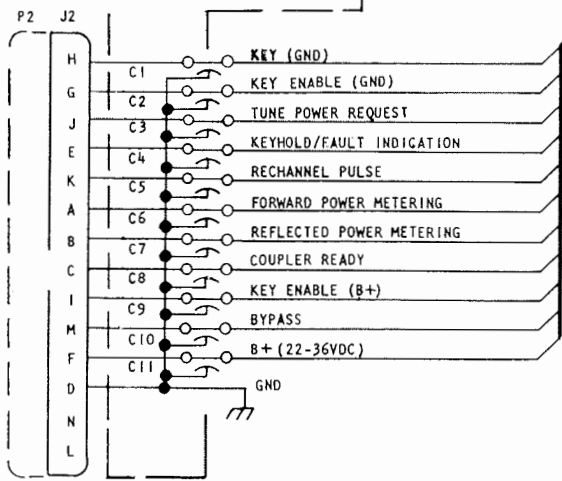
P/O AI CONTROL LOGIC
PC BOARD ASSEMBLY



- NOTES:
- UNLESS OTHERWISE SPECIFIED:
 - A. ALL RESISTORS ARE 1/4W, 10%.
 - B. ALL CAPACITORS ARE IN MICROFARADS.
 - C. ALL COILS ARE IN MICROHENRIES.
 - D. ALL DIODES ARE IN914.
 - ALL FEEDTHRU'S ARE .01 (ASC1 THRU ASC11).
 - A1L14 WAS 100UH FROM RF-281 SER. NO. 1 THRU 23.
 - A1C45 WAS .01UF FROM RF-281 SER. NO. 1 THRU 60.
 - A1R46 WAS 560K FROM RF-281 SER. NO. 1 THRU 400, AND C401 THRU C800.
 - PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH I.
 - R106 THRU R112 AND CR44 ADDED STARTING WITH RF-281 SER. NO. F2401.
 - R29 WAS 220 OHMS; R30 WAS 47 OHMS; AND R31 WAS 220 OHMS UP THRU CONTROL LOGIC PCB ASSEMBLY SER. NO. C318.



IA5
FILTER PC
BOARD ASSY



- NOTES:
- UNLESS OTHERWISE SPECIFIED:
 - ALL RESISTORS ARE 1/4W, 10%.
 - ALL CAPACITORS ARE IN MICROFARADS.
 - ALL COILS ARE IN MICROHENRIES.
 - ALL DIODES ARE IN914.
 - ALL FEEDTHRU'S ARE .01 (ASC1 THRU ASC11).
 - A1L14 WAS 100UH FROM RF-281 SER. NO. 1 THRU 23.
 - A1C45 WAS .01UF FROM RF-281 SER. NO. 1 THRU 60.
 - A1R46 WAS 560K FROM RF-281 SER. NO. 1 THRU 400, AND C1 THRU C800.
 - PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH I.
 - R106 THRU R112 AND CR44 ADDED STARTING WITH RF-281 SER. NO. F2401.
 - R29 WAS 220 OHMS, R30 WAS 47 OHMS, AND R31 WAS 220 OHMS UP THRU CONTROL LOGIC PCB ASSEMBLY SER. NO. C318.

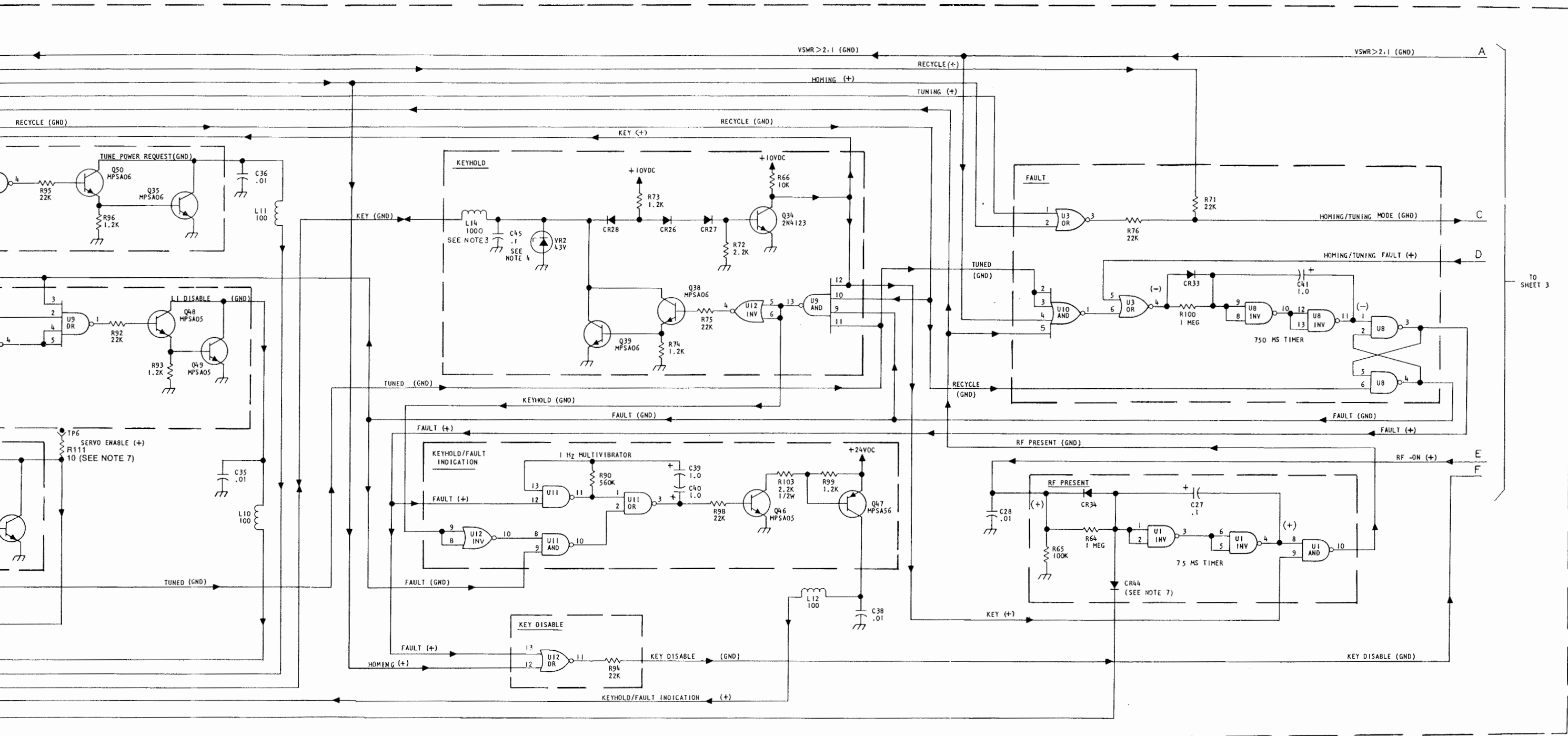
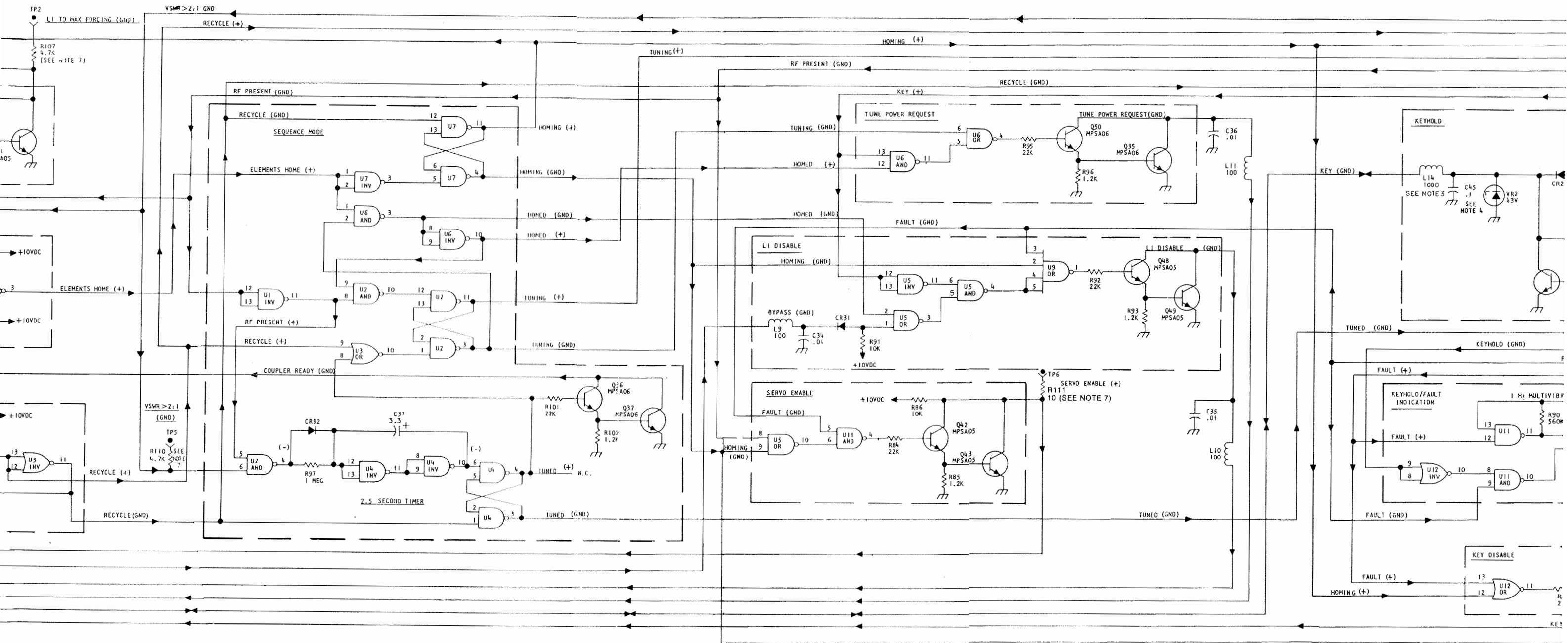
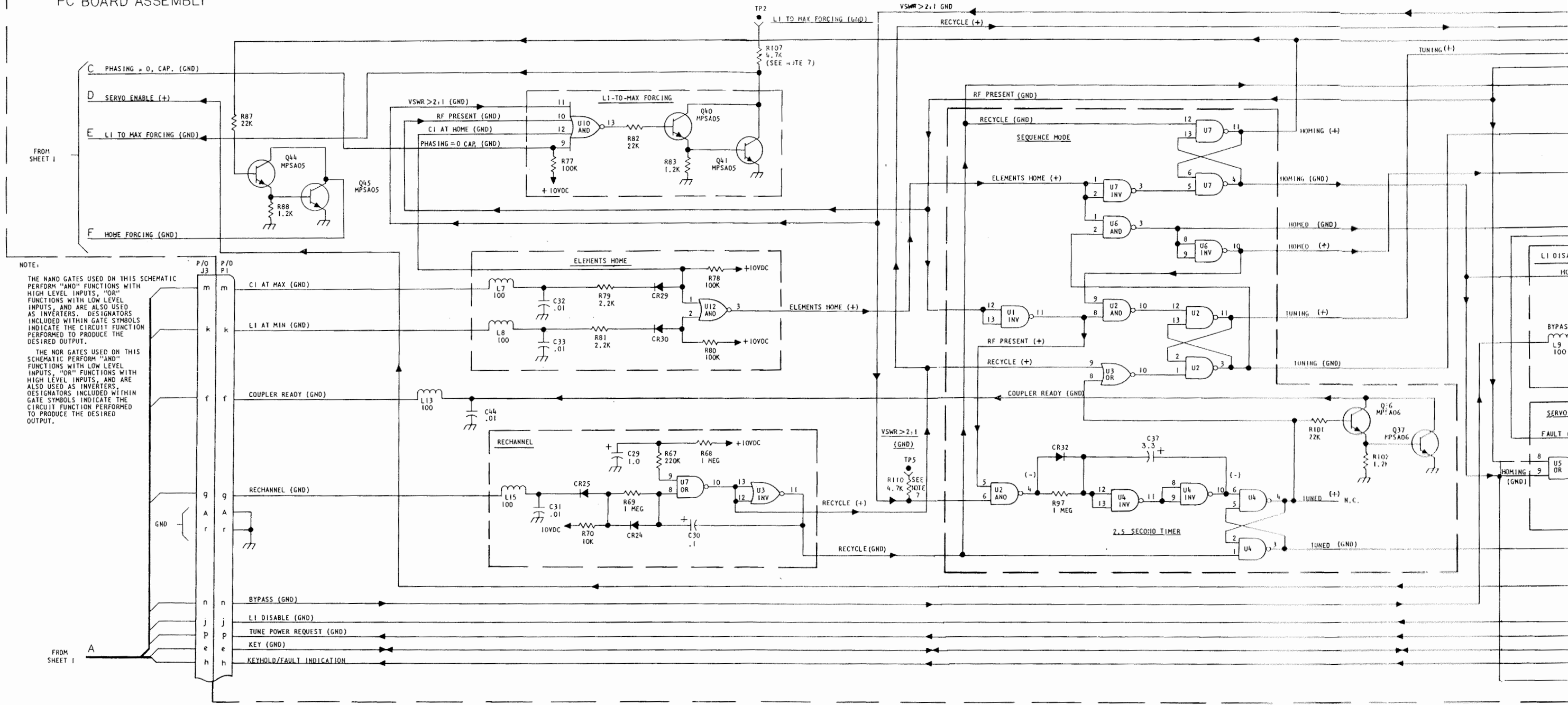


Figure 7-1. RF-281 Schematic Diagram (Sheet 2 of 3)



P/O AI CONTROL LOGIC
PC BOARD ASSEMBLY



NOTE:
THE NAND GATES USED ON THIS SCHEMATIC PERFORM "AND" FUNCTIONS WITH HIGH LEVEL INPUTS, "OR" FUNCTIONS WITH LOW LEVEL INPUTS, AND ARE ALSO USED AS INVERTERS. DESIGNATORS INCLUDED WITHIN GATE SYMBOLS INDICATE THE CIRCUIT FUNCTION PERFORMED TO PRODUCE THE DESIRED OUTPUT.
THE NOR GATES USED ON THIS SCHEMATIC PERFORM "AND" FUNCTIONS WITH LOW LEVEL INPUTS, "OR" FUNCTIONS WITH HIGH LEVEL INPUTS, AND ARE ALSO USED AS INVERTERS. DESIGNATORS INCLUDED WITHIN GATE SYMBOLS INDICATE THE CIRCUIT FUNCTION PERFORMED TO PRODUCE THE DESIRED OUTPUT.

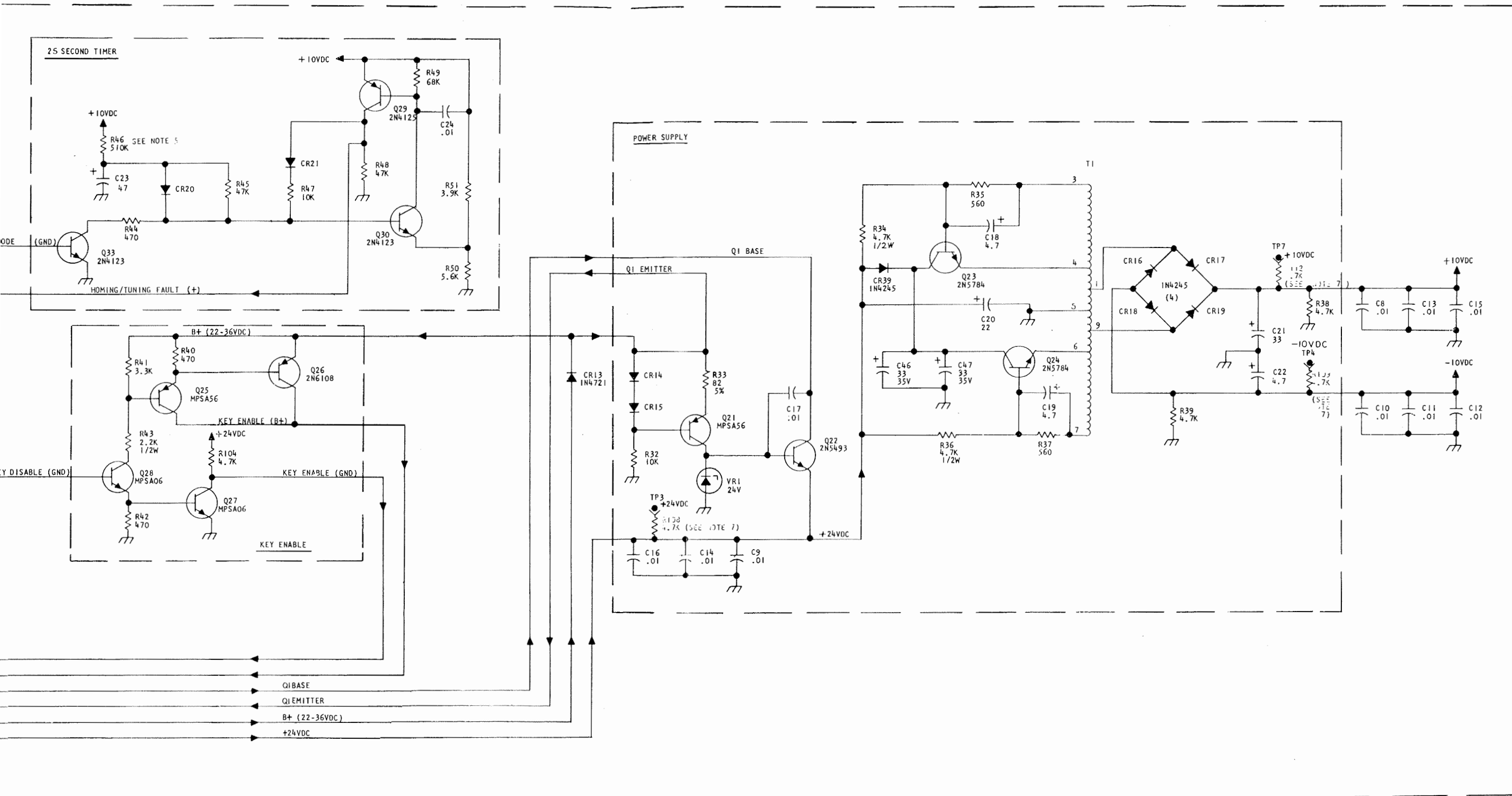
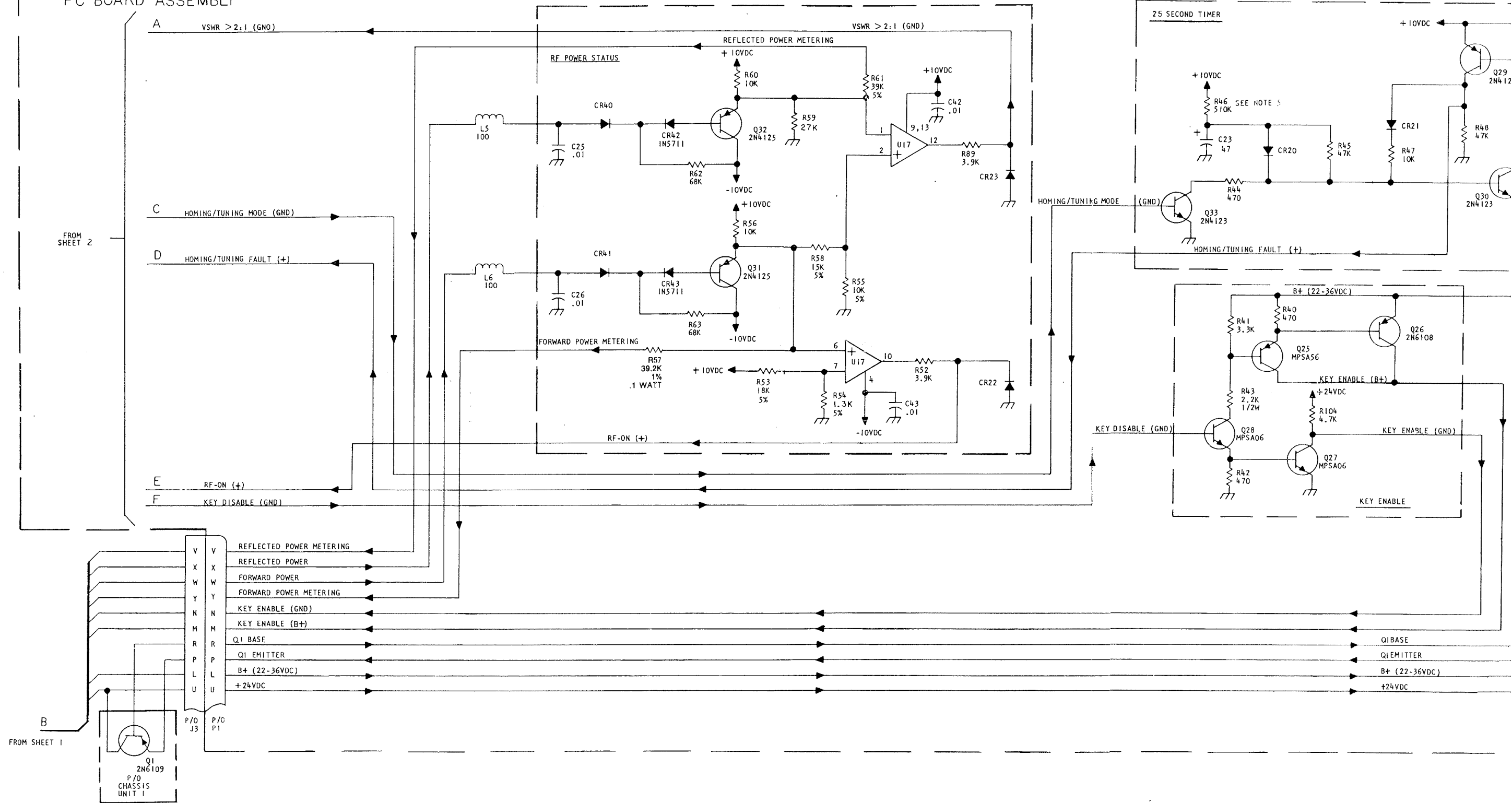


Figure 7-1. RF-281 Schematic Diagram (Sheet 3 of 3)

P/O AI CONTROL LOGIC
PC BOARD ASSEMBLY



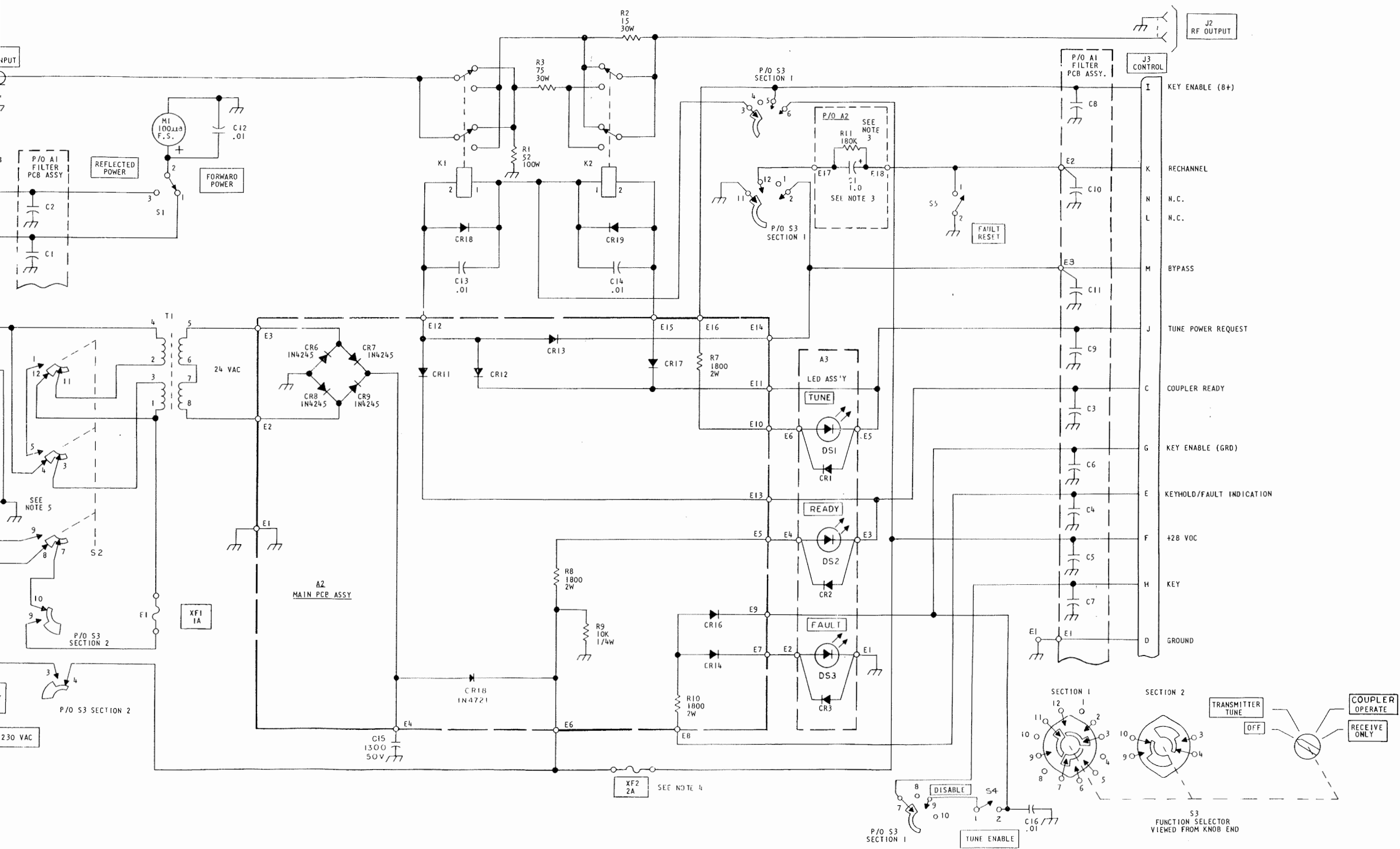


Figure 7-2. RF-339 Schematic Diagram

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
 - A. ALL DIODES ARE 1N914.
 - B. ALL CAPACITORS ARE .01 MFD, 100V.
 - C. ALL RESISTORS ARE IN OHMS, 1/4W, 10%.
 - D. ALL CAPACITORS ARE IN MICROFARADS.
2. PREFIX ALL PARTIAL REFERENCE DESIGNATORS WITH 2.
3. A2R11 AND A2C1 ADDED TO SERIAL NO. 601 AND UP.
4. EARLIER MODELS WITH SERIAL NUMBERS 1 THROUGH 600 HAD F2 LOCATED BETWEEN S3-4 SECTION 2 AND A2E6.
5. GROUND ON J4-F ADDED TO SERIAL NO. 601 AND UP.

