converter is keyed). This will supply enough current through the base-emitter junction of switch A7Q1 to keep switch A7Q1 conducting in saturation. Since the coil of relay A3K2 is in the conduction path for switch A7Q1, when switch A7Q1 is saturated, relay A3K2 is energized. This condition will continue as long as the operation of the dc-to-dc converter assembly is normal.

c. When the radio set is keyed and the dc-to-dc converter assembly is turned on (para 1-35*b*), the ground at the junction of resistors A7R1 and A7R2 is removed (contacts 6 and 8 of relay A2K2 opened). The 20-volt output from regulator A3VR1 is then applied to the rc combination of resistors A7R1 and A7R2 and capacitor A7C10. The time constant for this rc combination is such that after 130 MHz, the charge on capacitor A7C10 will reach 10 volts. However, as long as relay A3K2 is energized (*b* above), there is no conduction path for Zener diode A7VR1.

d. If the output voltage from the dc-to-dc converter assembly should decrease, the feedback voltage will also decrease. If the voltage at capacitor A7C3 drops below approximately 10 volts, Zener diode A7VR2 will stop conducting. Therefore, the base-to-emitter junction of switch A7Q1 will be reverse-biased and stop conducting. Diode A7CR1 in the emitter circuit of switch A7Q1 provides reverse biasing to hold switch A7Q1 nonconducting when Zener diode A7VR2 is not conducting. At this time, relay A3K2 is deenergized, and a conduction path is provided for Zener diode A7VR1 (*c* above) through feedthrough capacitor A7C4, inductor A7L1, and resistor A7J8. This fires scr A7Q2 and the dc-to-dc converter assembly is turned off as described in paragraph 1-35*b* Normal operation can be resumed, after the faulty condition is repaired, by resetting the AN/GRC-106(*) as described in paragraph 1-36c.

Section X. OPERATIONAL CONTROL FUNCTIONAL CIRCUIT ANALYSIS OF AMPLIFIER, RADIO FREQUENCY AM-3349/GRC-106

1-38. General

a. The operational control circuits of Amplifier, Radio Frequency AM-3349/GRC-106 provide the following control functions: detection of phase difference between the rf output voltage and current for fine tuning; detection of magnitude difference between the rf output voltage and current for fine tuning; generation of the operate automatic level control signal; generation of the tune automatic level control signal; coding required to rough-tune the impedance-matching networks in antenna coupler assembly 2A3; and metering to monitor the important parameters of the circuits. Paragraphs 1-39 through 1-44 provide a detailed description of these circuits.

b. The two discriminator circuits enable the AM-3349/GRC-106 to be fine-tuned to provide a 50 ohm pure resistive load for the output transformers of power amplifier 2A1A1V1, 2A1A1V2. This provides maximum rf power and maximum efficiency to prevent overdissipation.

1-39. Tune Discriminator 2A4A1 (Meter 2A5M2)

a. When the AM-3349/GRC-106 is correctly tuned (50 ohm resistive load), the rf output voltage and current are in phase with each other. When the output load is reactive, tune discriminator 2A4A1 (fig. 4-52) detects the resulting phase angle between the rf output voltage and current and produces a dc voltage proportional to the phase difference. This dc voltage is applied to meter 2A5M2 (fig. 4-53) on the front panel to provide a relative indication of the magnitude of phase difference for fine tuning.

NOTE

Prefix all reference designators in the following subparagraphs with phase discriminator reference designator 2A4A1, unless otherwise specified.

b. The rf output from power amplifier 2A1A1V1, 2A1A1V2 is applied to connector 2A1P1 (para 1-31), from which is is applied through connectors 2A4J1 and 2A4P1 to connector J1 (fig. 4-52). This cable passes through toroidal transformer T1. Since toroidal transformer T1 is center-tapped, the rf output current will induce a voltage in each half of the winding. These voltages, designated E1 and E2, will be of equal magnitude, 90° out of phase with the rf output current, and 180° out of phase with each other. The rf output voltage is sampled across a capacitance voltage divider consisting of capacitors C4 and C1. This voltage, which is vectorially in phase with the rf output voltage, is applied to the center tap of toroidal transformer T1. The vectoral summation of the sampled voltave (Es) and induced voltage E1 is detected by diode CR1, producing a dc voltage E1' at the cathode of diode CR1. Similarly, the vectoral summation of Es and E2 is detected by diode CR2, producing a dc voltage E2' at the cathode of diode CR2. Voltage E1' is applied 2A1P2, pin 28 of connectors 2A1XA5 and 2A5J1, and resistor 2A5A5R8 to one side of ANT. TUNE meter 2A5M2. Voltage E2' is applied through pin 7 of connectors 2A4J2 and 2A1P2 and pin 29 of connectors 2A2SA5 and 2A5J1 to the other side of ANT. TUNE meter 2A4M2.

c. If the impedance of the rf output line is resistive, the rf output voltage and current will be in phase. Therefore, the two vectoral summations will result in E1' and E2' being equal ((*a*), Fig. 1-11), and there will be no difference in voltage across ANT. TUNE meter 2A5M2. The meter will then indicate center scale, 0° phase difference between the rf output voltage and current. If the impedance of the rf output line is inductive, the rf output current will lag the rf output voltage by some angle Ø. Therefore, as shown in (*b*), figure 1-11, E1' will be greater than E2', causing ANT. TUNE meter 2A5M2 to deflect to the left of center. The degree of deflection will be proportional to the phase difference between the rf output current and voltage. If the impedance of the rf output line is capacitive, the rf output current will lead the rf output voltage by some angle Ø. Therefore, as shown in (*c*), figure 1-11 E1' will be less than E2', causing ANT. TUNE meter 2A5M2 to deflect to the right of center. The degree of deflection will be proportional to the phase difference between the rf output voltage and current. The phase angle is corrected by varying the value of capacitor 2A3C26 (para 1-37), when TUNE-OPERATE switch 2A5S6 is set at TUNE. When TUNE-OPERATE switch 2A5S6 is set at TUNE, E1' is applied through contacts C2 and 4 of switch 2A5S6. This path changes the sensitivity of meter 2A5M2 by bypassing resistor 2A5A5R8.

d. Inductor L1 provides a dc return for capacitors C1 and C4. The values of these components are such that they are not frequency-sensitive within the operating passband of the AM-3349/GRC-106. Capacitors C2 and C3 are rf bypasses. Resistors R1 and R2 provide a dc path for diodes CR1 and CR2, respectively. Resistor R3 is an equalizing resistor to make the dc output from the phase discriminator the same as the output from the load discriminator (para 1-40). Capacitor 2A5C5 bypasses any rf present in the meter voltage around meter 2A5M2.

1-40. Load Discriminator 2A4A2 (fig. 4-52)

a. When Amplifier, Radio Frequency AM-3349/GRC-106 is correctly loaded (50 ohm impedance), the rf output voltage and current are of the correct magnitude to produce an output of 400 watts pep. If the load for the AM-3349/GRC-106 is greater or less than 50 ohms, the rf output voltage and current will no longer be of the correct magnitude to produce a 400-watt pep. output. This difference in magnitude is detected by the load discriminator, which produces a dc output proportional to the difference. The resulting dc voltage is applied to ANT. LOAD meter 2A5M3 on the front panel to provide a relative indication of this difference in magnitude for fine tuning.

NOTE

Prefix all reference designators in this paragraph with load discriminator reference designator 2A4A2, unless otherwise specified.

b. The rf output from power amplifier 2A1A1V2, 2A1A1V2 is applied through tune discriminator 2A4A1 (para 1-39) to connector 2A4A1J4. From this point, the power output is connected through connector P1 and the load discriminator to connector J1. The current flow in this line induces a voltage in toroidal transformer T1. This induced voltage is detected by diode CR2, producing a dc voltage, which is applied through pin 2 of connectors 2A4J2 and 2A1P2, pin 30 of connectors 2A1XA5 and 2A5J1, to one side of ANT. LOAD meter 2A5M3. The rf output voltage is sampled by capacitive divider C1, C2 and detected by diode CR1 to produce a dc voltage, which is applied through pin 8 of connectors 2A4J2 and 2A1P2, pin 31 of connectors 2A1XA5 and 2A5J1, and resistor 2A5A5R7 to the other side of ANT. LOAD meter 2A5M3. When the impedance of the rf output line equals 50 ohms, capacitor C1 is adjusted so that the voltage at pin 8 of connector 2A4J2 is equal in magnitude to the voltage at pin 2 of connector 2A4J2. If the load impedance differs

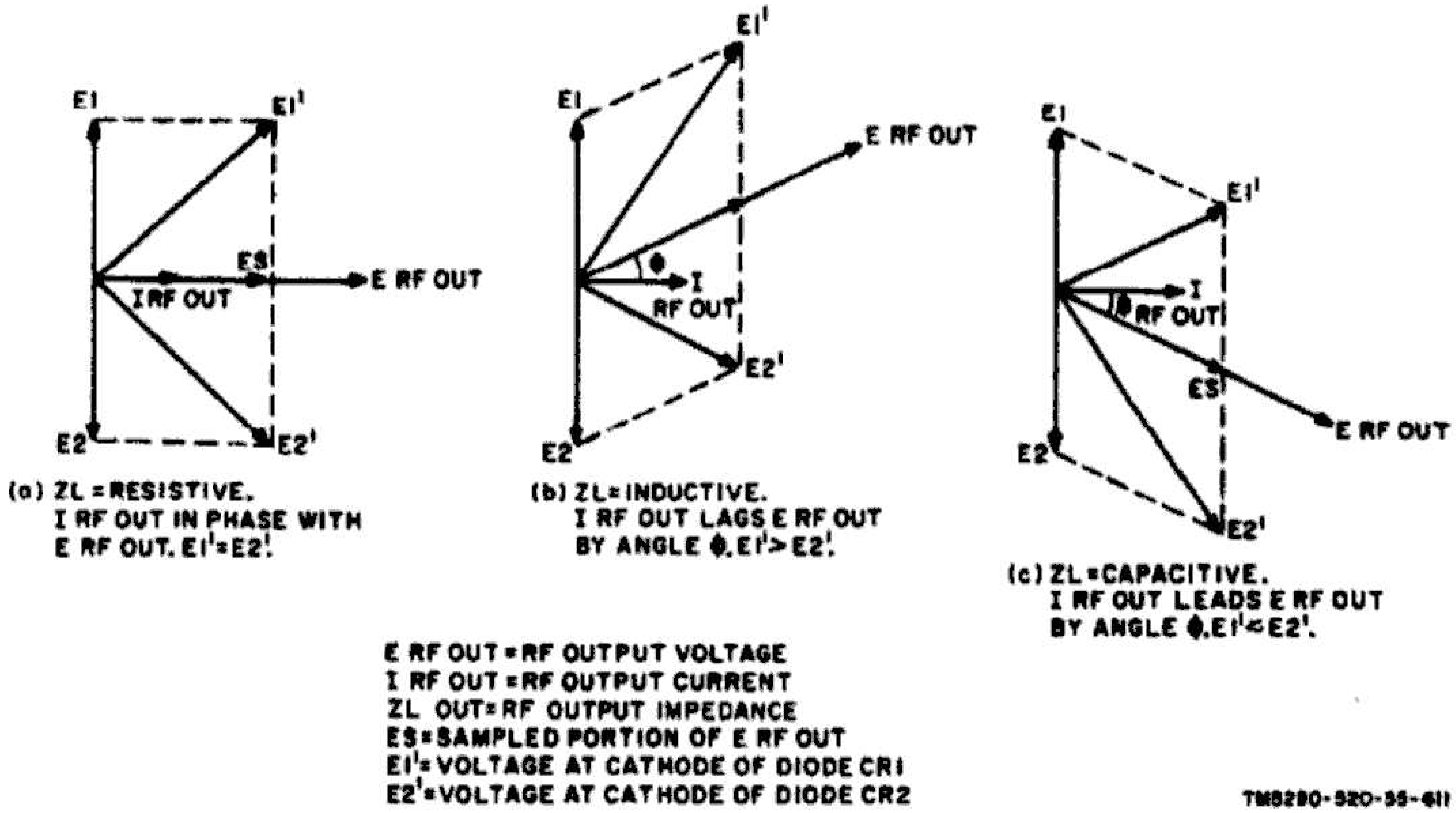


Figure 1-11. Phase discriminator 2A4A1, vector diagram.

from the desired 50 ohms, the voltages at pins 8 and 2 of connector 2A4J2 will differ. The amount of difference will be proportional to the degree of variation from 50 ohms. These two voltages will cause ANT. LOAD meter 2A5M3 to deflect either right or left from center scale, indicating that the load must be decreased or increased to reach the 50 ohm balance point. The load is varied by varying the value of inductor 2A3L1, when TUNE-OPERATE switch 2A5S6 is set at TUNE. When TUNE-OPERATE switch 2A5S6 is set at TUNE, the voltage at pin 2 of connector 2A4J2 is applied through contacts C3 and 6 of switch 2A5S6. This new path changes the sensitivity of ANT. LOAD meter 2A5M3 by bypassing resistor 2A5A5R7.

c. Resistor R1 provides a dc return for capacitors C1 and C2. Resistor R3 is a swamping resistor for toroidal transformer T1 to minimize the effects of frequency variations. Capacitors C3 and C4 are rf bypasses. Resistors R2 and R4 provide a dc path for diodes CR1 and CR2, respectively. Capacitor 2A5C6 bypasses any rf present in the voltage applied to meter 2A5M3.

1-41. Operate Automatic Level Control Signal Generation (fig. 4-52)

a. The output from the AM-3349/GRC-106 is sampled and detected to provide a dc signal to the receiver-transmitter, to control the output from the receiver-transmitter (para 1-6 and 1-46). The output from power amplifier 2A1A1V1, 2A1A1V2 is applied through the tune discriminator (para 1-39) and load discriminator (para 1-40) to connector 2A4A3P1, from which it is applied through connectors 2A4A3J1, 2A4P3, and 2A3J2 to the impedance matching networks in antenna coupler assembly 2A3 (para 1-32).

NOTE

Prefix all reference designators in this paragraph with operate alc circuit reference designator 2A4A3, unless otherwise specified.

b. The power on the 50 ohm line is sampled across capacitive divider C1, C2. This sampled voltage is detected by diode CR1, filtered by capacitor C3, and used to drive emitter follower Q1. The output from emitter follower Q1 is applied through connectors 2A4J2-A1, 2A1P2-A1, 2A1XA5-A3, 2A5J1-A3, feedthrough capacitor 2A5A1C13, and pi-section filter 2A5A1A2C8, 2A5A1A2L6, 2A5A1A2C6, to pin C of CONTROL connector 2A5J2 for connection to the receiver-transmitter (para 1-6 and 1-46). The output from emitter follower Q1 is also sampled across resistive divider R3, R6, and applied to pin 10 of connector 2A4J2, from which it is applied to TEST METER 2A5M1 (when TEST METER switch is set at POWER OUT) to provide a relative indication of the power output from the AM-3349/GRC-106 (para 1-44).

c. Resistor R1 provides a discharge path for capacitors C1 and C2. Resistor R2 provides a dc path to ground for detector CR1. Capacitors C4 and C5 are rf bypasses. Capacitor C6 is an audio bypass to remove all ac from the dc voltage applied to the TEST METER. Emitter follower Q1 is used to isolate the detector from the circuits in the receiver-transmitter.

1-42. Tune Automatic Level Control Signal Generation

(fig. 4-52)

a. The input to power amplifier 2A1A1V1, 2A1A1V2 is detected and applied to the receiver-transmitter, when the TUNE OPERATE switch is set at TUNE. This voltage is used in addition to the operate alc signal to provide the additional control over the receiver-transmitter required for tuning.

NOTE

Prefix all reference designators in this paragraph with reference designator 2A1A1A1, unless otherwise noted.

b. The input to the grids of power amplifier 2A1A1V1, 2A2A2V2 is applied to a shunt detector circuit. When the signal goes positive capacitor C1 will charge to nearly the peak value of the applied signal through the low impedance of diode CR1. On the positive portion of the signal, diode CR1 will be reverse-biased, causing capacitor C1 to discharge through resistors R10 and R11 and thermistor RT1 (fig. 4-49). The discharge time constant is such that a modulated dc signal is applied to the base of emitter follower Q2. Emitter followers Q1 and Q2 are used to provide a high-impedance load for the shunt detector circuit and a low-impedance output to the receiver-transmitter. The output from emitter follower Q1 is applied through pin 25 of connectors 2A1XA5 and 2A5J1 and contacts 8 and 4 of TUNE-OPERATE switch 2A5S6 (TUNE position) to pin B of CONTROL connector 2A5J2 for application to the receiver-transmitter (para 1-46).

c. Thermistor RT1 provides temperature compensation for the drive to emitter follower Q2. Capacitor C2 is an rf bypass Resistor 2A1A1R7 provides a dc return for the tune alc circuit.

1-43. Tuning of Antenna Coupler Assembly 2A3

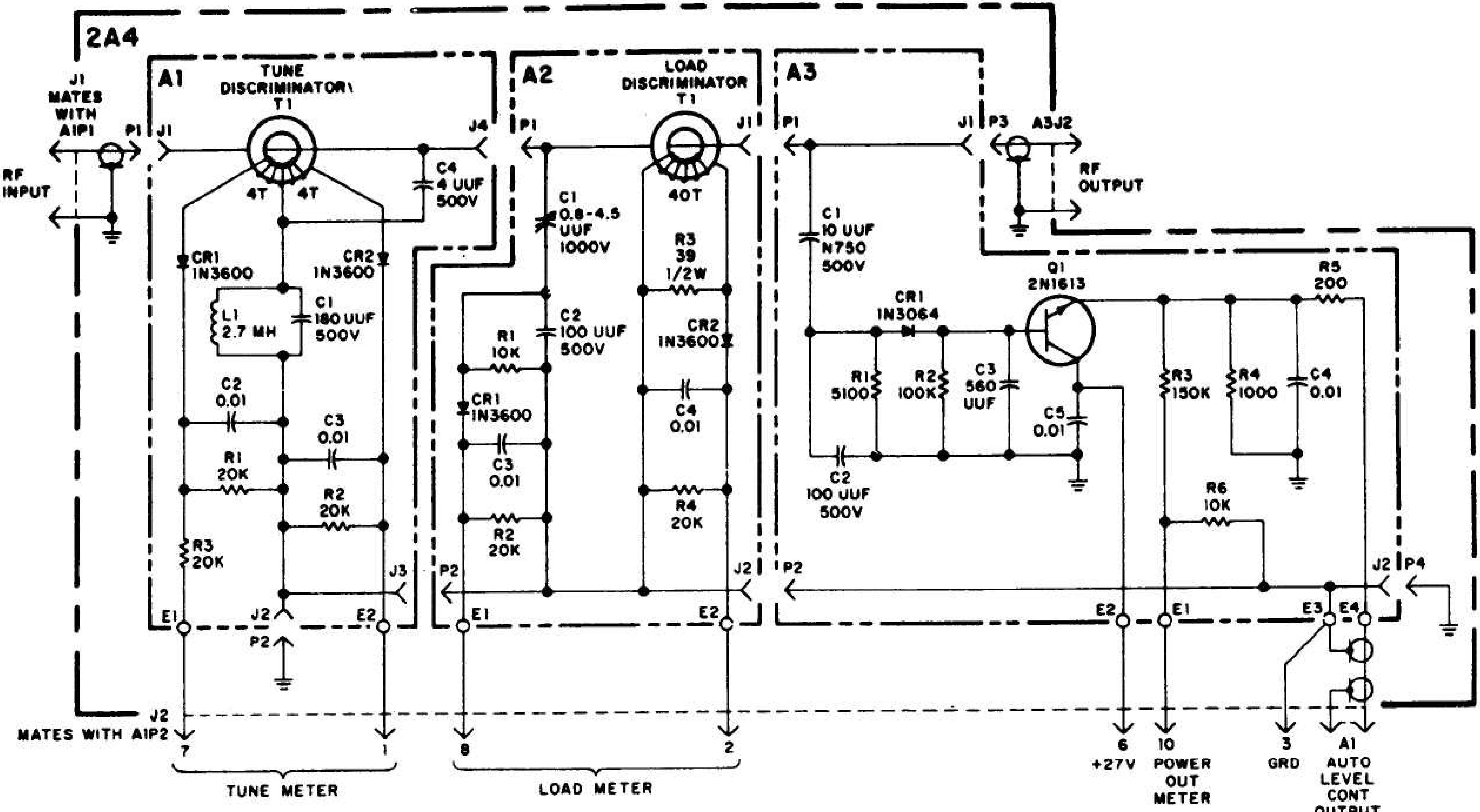
(fig. 4-22)

NOTE

Prefix all reference designations used in *a* through *d* below with unit reference number 2.

a. General. When the interunit tuning cycle is completed (para 1-49), switches A2S4 and A2S5 will be positioned according to the MHz frequency setting for which the units are to be tuned. These switches provide coding information for programming the antenna coupler assembly for the frequency band in use. The chart in figure 4-22 provides a listing of the 30 tuning positions of these switches and their corresponding MHz passband. Whip coding switch A2S4 generates the coding information to position capacitor A3C27 and bandswitch A3S1 when a whip antenna is being used. The 50 ohm line coding switch, A2S5, generates the coding information to position capacitor A3C27 and bandswitch A3S1, when a doublet antenna (50 ohm line) is being used. As shown, the unit is tuned for position 1 (2.0 to 2.5 MHz). Assume that the operating frequency is changed (at the receiver-transmitter), to 26.xxx MHz. The interunit tuning will be accomplished and will set switches A2S4 and A2S5 at 13. These switches will then function to program the antenna coupler assembly for this new frequency. The programing provides the configuration according to the operating frequency as shown on figure 1-10. The following subparagraphs provide a detailed description of the programing necessary to obtain the configuration for the operating frequency for various types of antennas.

b. Whip Antenna Programing. When using a 15-foot whip antenna, whip coding switch A2S4 will program bandswitch A3S1 and capacitor A3C27. A detailed description of how this program is accomplished is given in (1) and (2) below.



NOTE:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATIONS.
2. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS ±5% 1/4W.
   ALL CAPACITOR VALUES ARE IN MICROFARADS, 200V.