NAVSHIPS 0967-292-9030

VOLUME 3

TECHNICAL MANUAL

for

MODULATOR-SYNTHESIZER MD-777/FRT

Used with:

AN/FRT-83(V) 1 KW HF ISB TRANSMITTER
AN/FRT-84(V) 10 KW HF ISB TRANSMITTER
AN/FRT-85(V) 40 KW HF ISB TRANSMITTER
AN/FRT-86(V) 200 KW HF ISB TRANSMITTER

DEPARTMENT OF THE NAVY
NAVAL ELECTRONIC SYSTEMS COMMAND

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NATIONAL RADIO COMPANY, INC., MELROSE, MASS. CONTRACT N00600-67-C-0589

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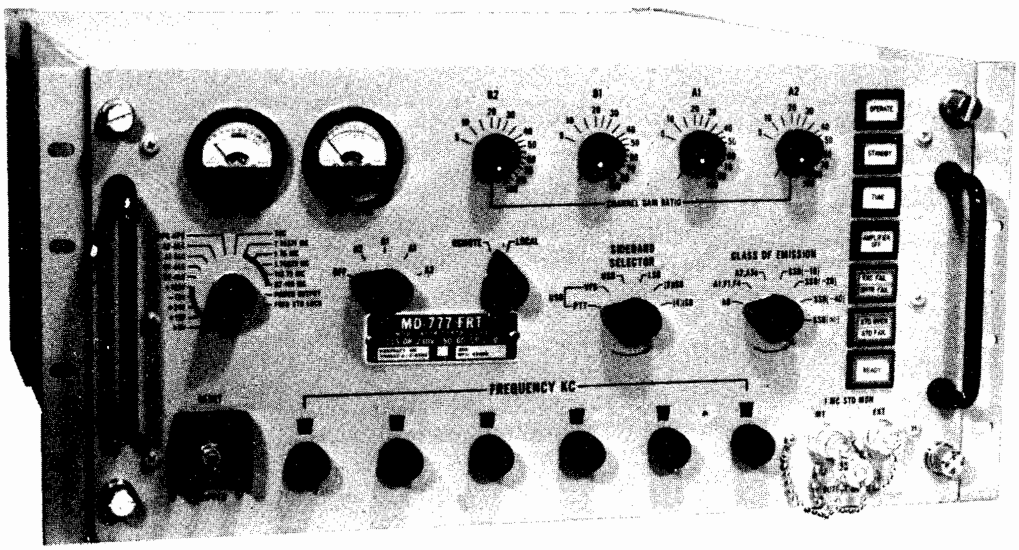

Figure 1-1. Modulator-Synthesizer MD-777/FRT

SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This technical manual, which is in effect upon receipt, provides the information required to install, operate, trouble shoot, and maintain Modulator-Synthesizer MD-777/FRT. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL DESCRIPTION.

Modulator-Synthesizer MD-777/FRT is a part of Radio Transmitting Sets AN/FRT-83(V), AN/FRT-84(V), AN/FRT-85(V), and AN/FRT-86(V). The MD-777/FRT, which is known colloquially as the exciter, is illustrated in figure 1-1. Its function is to provide rf excitation and modulation for the aforementioned transmitting sets.

The exciter operates in the frequency range from 2 to 30 mc (29.9999 mc). It employs a digital synthesizer for frequency selection. Frequency selection, which may be made in increments as low as 100 cps, is accomplished by setting six tuning dials to the desired frequency. The exciter provides the means of modulating the selected frequency in any of the various modes listed in paragraph 1-3b(4). Up to four independent 3 kc-wide channels of intelligence may be transmitted simultaneously.

Rf power output is variable from 25 to 250 mw (PEP). Carrier suppression, for the several single-sideband modes, is selectable in steps of -10 db, -20 db, -40 db, and -60 db. Automatic power control circuits for average power (APC) and for peak power (PPC) control output in response to dc control signals originating in the radio transmitting set power amplifier (LPA). In a similar manner, automatic control of system gain (TGC) is also provided.

The exciter may be controlled locally or remotely. During local operation, the exciter is controlled entirely by its own operating controls. For remote operation, the standby/operate status, operating frequency, class of emission, and sideband selection are controlled by Control-Indicator, Transmitter C-7709/FRT (remote control unit) via Decoder-Encoder KY-656/FRT (local control unit), and all other operational characteristics are determined by the operating controls of the exciter. An internal 1 mc frequency standard, subject to automatic substitution with a 1 mc external frequency standard, is employed for the derivation of all synthesized frequencies and has a stability of one part in 10^8 per day.

The chassis assembly is mounted in the enclosure on a retractable slide mechanism. The mechanism permits extension of the chassis as a drawer, and chassis rotation over a 180° arc to expose all modules for inspection and maintenance. A portion of the functional circuits are contained on a hinged top deck and the remainder are located on the chassis proper. Modular construction containing printed-circuit boards is used extensively in the unit. For operation, the exciter unit requires a primary power source of 115/230 volts ac, 50/60 cycles, single phase. Standby power requirements are approximately 70 watts, and the full power requirements are approximately 130 watts.

1-3. QUICK REFERENCE DATA.

a. GENERAL.

(1) NOMENCLATURE: Modulator-Synthesizer MD-777/FRT.

(2) CONTRACT NUMBER: N00600-67-C-0589.

(3) DATE OF CONTRACT: 7 February 1967.

(4) CONTRACTOR: National Radio Company, Inc., Melrose, Massachusetts, 02176, U.S.A.

(5) COGNIZANT INSPECTOR: DCASR, Boston, Massachusetts.

(6) NUMBER OF PACKAGES: 1.

b. FUNCTIONAL CHARACTERISTICS.

(1) PRIMARY POWER REQUIREMENTS:

(a) Voltage: 115/230 volts ac (±10%); frequency: 50/60 cps (±5%), single phase.

(b) Power: Operating 130 watts, standby 70 watts.

(2) FREQUENCY RANGE. - 2.0 to 30.0 mc (29.9999 mc).

(3) TYPE OF FREQUENCY CONTROL. - Incremental tuning; six digital-type tuning dials. Synthesizer controlled by 1 mc crystal-oscillator frequency standard.

(4) TRANSMITTING MODES:

(a) CLASS OF EMISSION:

1. A0.

2. A2, A3e.

3. A1, F1, F4.

4. SSB (-10 db).

5. SSB (-20 db).

6. SSB (-40 db).

7. SSB (-∞).

(b) SIDEBAND SELECTION:

1. USB.

2. LSB.

3. (2)ISB.

4. (4)ISB.

5. USB with voice frequency gate (VFG).

6. USB with push-to-talk (PTT).

(5) EXCITER OUTPUT:

(a) Cw/fsk: 100 mw, nominal.

(b) Two tone: 200 mw pep, nominal.

(c) White noise: 40 mw average, nominal.

(6) EXCITER STABILITY AND ACCURACY. - 1 part per 10^8 per day.

(7) CARRIER SUPPRESSION:

(a) Maximum: -60 db below output power (rms).

(b) Reinsertion: Selectable, 0 db, -10 db, -20 db, -40 db.

(8) AUDIO CHANNEL RESPONSE:

(a) A1 and B1: 250 to 3040 cps, within 0.5 db of 1000 cps reference.

(b) A2 and B2: 250 to 3040 cps, within 0.5 db of 1000 cps reference.

(9) SIGNAL INPUTS:

(a) Audio (four): 0 dbm.

(b) Input attenuator: Accommodates levels from +10 dbm to -25 dbm.

(c) Input impedance: 600 ohms, balanced.

(10) RF OUTPUT:

(a) Adjustment: 25 to 250 mw, pep.

(b) Impedance: 50 ohms, unbalanced.

1-4. EQUIPMENT LISTS.

a. EQUIPMENT SUPPLIED. - Table 1-1 lists the names, quantities, dimensions, and weights of equipment supplied.

b. EQUIPMENT REQUIRED BUT NOT SUPPLIED. - Table 1-2 lists the equipment required for exciter operation, but not supplied.

c. SHIPPING DATA. - Table 1-3 lists the contents, dimensions, volume, and weight of the exciter prepared for shipment.

TABLE 1-1. EQUIPMENT AND PUBLICATIONS SUPPLIED

QTY PER EQUIP.	NOMENCLATURE		DIMENSIONS (IN.)			VOL	WT
	NAME	DESIG	H	W	D	(CU FT)	(LB)
1	Modulator - Synthesizer	MD-777/FRT	8.72	18.99	22.28	2.14	98
1	Cable Assembly, RF	C45138G1					
1	Cable Assembly, RF	C45148G1					
1	Cable Assembly, RF	C45149G1					
1	Cable Assembly, RF	C45149G2					
1	Card, Extender	D45184G1					
1	Card, Extender	E45170G1					
1	Card, Extender	D46442G1					
1	Card, Extender	D46442G2					
1	Connector	MS3108R14S-7S					
1	Connector	MS3116F20-39SX					
1	Connector	MS3116F14-19S					
1	Extractor, Printed Circuit Board	B43412G1					
1	Extractor, Printed Circuit Board	B45837G1					
2	Technical Manual for Modulator - Synthesizer MD-777/FRT	NAVSHIPS 0967-292-9030	10.75	8.25	2		
2	Maintenance Standards Book for Modulator-Synthesizer MD-777/FRT	NAVSHIPS 0967-293-3010	10.75	8.25	0.4		

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	EQUIPMENT CHARACTERISTICS
	NAME	DESIG		
1	RF Voltmeter	Boonton 91CA	Signal measurements, rms	Range: 50 kc - 125 mc; Voltage, full-scale: 0.001 to 3 volts ac.
1	Signal Generator	H-P 606A	Test signals	Frequency range: 50 kc to 65 mc; output voltage: up to 3 volts; output impedance: 50 ohms.

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TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (Cont)

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	EQUIPMENT CHARACTERISTICS
	NAME	DESIG		
1	Signal Generator	H-P 608D	Test signals	Frequency range: 10 mc - 125 mc; output voltage: up to 0.5 volts; output impedance: 50 ohms.
1	Electronic Frequency Counter	AN/USM-207 (with video amplifier)	Frequency measurement	Frequency display: 10 cps to 125 mc; sensitivity: 0.1 volt; input impedance 50 ohms.
1	Multimeter	AN/PSM-6	Voltage and resistance measurement	Voltage, full scale: 0.5 to 1000 volts ac or dc; resistance: 0 to 100 megohms.
1	Calorimetric Power Meter	H-P 434A	Output power measurement	Frequency range: dc to 30 mc; power range: 10 milliwatts to 10 watts; maximum input power: 1 kw, peak-10 watts, average.
1	Power Supply	Power Designs 4005	Power source	Output voltage: 0 to 40 volts dc; current: 0 to 500 milliamperes.
1	Oscilloscope	Tektronix 585A (with dual-trace plug-in unit, Tektronix Type 82)	Waveform analysis and measurement	Frequency range: dc to 120 mc; input impedance: 1 megohm; rise time: 0.01 microsecond.
1	Spectrum Analyzer	H-P 140S	Output waveform measurement and analysis	Frequency range: 1 kc to 110 mc; input amplitude: +10 dbm to -130 dbm; input bandwidth: 0.05 kc to 300 kc; input impedance: 50 ohms; scan time: 0.1 second/division to 50 milliseconds/division; i-f bandwidth: 10 mc/division to 0.05 kc/division.
1	Dual-Tone Audio Signal Generator	SG-376/U	Audio test signals	Two simultaneous audio tones; frequency range: 5 cps to 3000 cps; output voltage: 0 to 2 volts ac; output impedance: 600 ohms.

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TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (Cont)

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	EQUIPMENT CHARACTERISTICS
	NAME	DESIG		
1	Variable Output Attenuator	HP-355D	Output measurement	Frequency range: dc to 30 mc; input power: 0.5 volts, maximum-350 volts, peak; input impedance: 50 ohms; attenuation: 0 to 120 db in 10 db steps.
1	Standard-Frequency Oscillator	General Radio Type 1115-C	Calibration of Internal Frequency Standard	Any fixed ac potential from 0.3 to 3 vac rms across 50 ohms, 1 mc ±1 pp 10^9.
1	Test Jig	(See figure 2-2)		
1	Alignment Tool	J. F. D. S284		

TABLE 1-3. CRATED DIMENSIONS AND WEIGHT

PACKAGE NO.	CONTENTS	DIMENSIONS (INCHES)			WEIGHT (LBS)
		H	W	D	
1	Modulator-Synthesizer MD-777/FRT (with all equipment supplied as listed in table 1-1)	13-1/2	24-3/8	30-3/8	150

1-5. EQUIPMENT SIMILARITIES.

Modulator-Synthesizer MD-777/FRT is supplied as either a four-channel exciter or a two-channel exciter. In the four-channel unit, all four sideband channels (B2, B1, A1, and A2) are operational; in the two-channel unit, only two sideband channels (B1 and A1) are operational. The only internal difference is that sideband filters FL2 and FL4 are used only in the four-channel exciter. For the two-channel exciter, all front-panel controls associated with channels B2 and A2 are inoperative, and all front-panel indications associated with channels B2 and A2 should be disregarded. Usually, two-channel exciters are employed in Radio Transmitting Sets AN/FRT-83(V) and AN/FRT-84(V), and four-channel exciters are employed in Radio Transmitting Sets AN/FRT-85(V) and AN/FRT-86(V). Throughout this technical manual, the four-channel exciter is discussed. For the two-channel exciter, the aforementioned differences must be taken into account.

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

No special unpacking or handling procedures are required for Modulator-Synthesizer MD-777/FRT. Exercise normal precautions regarding electronic equipment when unpacking and handling this unit.

2-2. POWER REQUIREMENTS AND DISTRIBUTION.

a. REQUIREMENTS. - The exciter is designed to be operated from a primary power source of 115 or 230 volts ac, 50 or 60 cycles, single phase. The voltage tolerance is ±10% and the frequency tolerance is ±5%. These tolerances should not be exceeded.

b. PRIMARY POWER CONNECTIONS. - Primary power connections to the exciter require attachment of a power input cable. Table 2-1 lists the cables and connections for all external cables required.

TABLE 2-1. CONNECTORS SUPPLIED AND EXTERNAL CABLE REQUIREMENTS

CIRCUIT WHERE USED	TYPE CABLE	EQUIPMENT RECEPTACLE	CABLE CONNECTOR
Primary power, 115/230 vac, 50/60 cps, 1 phase, A19FL1J1.	THFA, or equivalent	Sealtron, 8001-14S-7P-FP	MS3108R-14S-7S
Linear power amplifier, signal circuits, A19FL2J1.		MS3114E20-39PX	MS3116F20-39SX
Audio modulation, input A19FL3J1.		MS3114E14-19P	MS3116F14-19S
Rf output to linear power amplifier A19J1.	RG-114	Automatic, 011N3800-85	
Transmitter gain control A19J2.		Amphenol, 17825	
Average and peak power control, A19J3.		Amphenol, 17825	
1 mc, external frequency standard, A19J4.		Amphenol, 17825	
1 mc, internal frequency monitor, A19J5.		Amphenol, 17825	

c. DISTRIBUTION. - The primary power distribution diagram (see figure 5-62) illustrates the distribution of ac power circuits within the exciter. Primary ac power, via the rf input filter A19FL1 at input connector A19J1, passes through overload circuit-breaker A18CB1 and 115/230 volt power selection switch PS1S1 to power supply transformer PS1T1. Circuit breaker A18CB1 opens to remove primary power if the current exceeds 1.0 amperes. It can be reset manually.

2-3. INSTALLATION PLANNING. (See figure 2-1.)

The exciter is intended for installation in a standard relay rack or cabinet together with Keyer, Frequency Shift KY-655/FRT and Decoder-Encoder KY-656/FRT. Facilities are provided for interconnections with these units. In selecting a suitable location for installation, the following factors should be considered:

a. POWER SOURCE. - The power source described in paragraph 2-2a must be available for exciter operation.

b. CABLE LENGTHS. - The length of connecting cables to the exciter is not critical with exception of the RF OUT transmission line. If the length of this connection exceeds approximately 30 feet, a special low-loss transmission line must be employed.

c. SERVICE ACCESS. - The exciter design permits most servicing to be done at the front. The enclosure slide-and-tilt mechanism allows the chassis to be extended and tilted at various angles. Operation of this mechanism is given in detail in paragraph 2-4. There must be at least 23 inches in front of the exciter to permit full extension of the chassis, and a clearance of at least 8 inches above the exciter for chassis indexing.

d. TEMPERATURE AND VENTILATION. - The exciter dissipates heat at a rate of approximately 8 Btu per minute. The use of solid state circuits and forced air cooling, combined with the heat conduction and dissipation ability of the chassis and panel structures, limit the exciter temperature rise to 20°C above the ambient temperature at the location. The normal operating temperature range of the transmitter is from 0°C (32°F) to 57°C (135°F).

e. INTERACTION WITH OTHER EQUIPMENT. - A principal feature of the exciter is its ability to operate in an environment close to other facilities. Internal shielding and effective filtering reduce the possibility of interaction with other communication equipment.

f. OPERATION WITH AUXILIARY EQUIPMENT. - Installation planning should consider the relative locations of auxiliary equipment to be used with the exciter, in addition to the aforementioned keyer and local control units. The source and routing of auxiliary, dc control, monitoring, rf output, and primary power cables, etc., should be considered during the planning stage.

2-4. INSTALLATION REQUIREMENTS.

Installing the exciter consists of securing the chassis enclosure to the standard relay rack or cabinet and completing the necessary external cable connections. Because the exciter is shipped assembled, the chassis assembly must be removed from the enclosure prior to installation. The empty enclosure is then installed and the chassis assembly reassembled following installation.

CAUTION

> The chassis assembly (drawer) is heavy. Two men are required to safely remove and replace it.

a. REMOVING AND REPLACING THE DRAWER. - The following procedures describe the steps for removing and replacing the chassis assembly (drawer) in the enclosure.

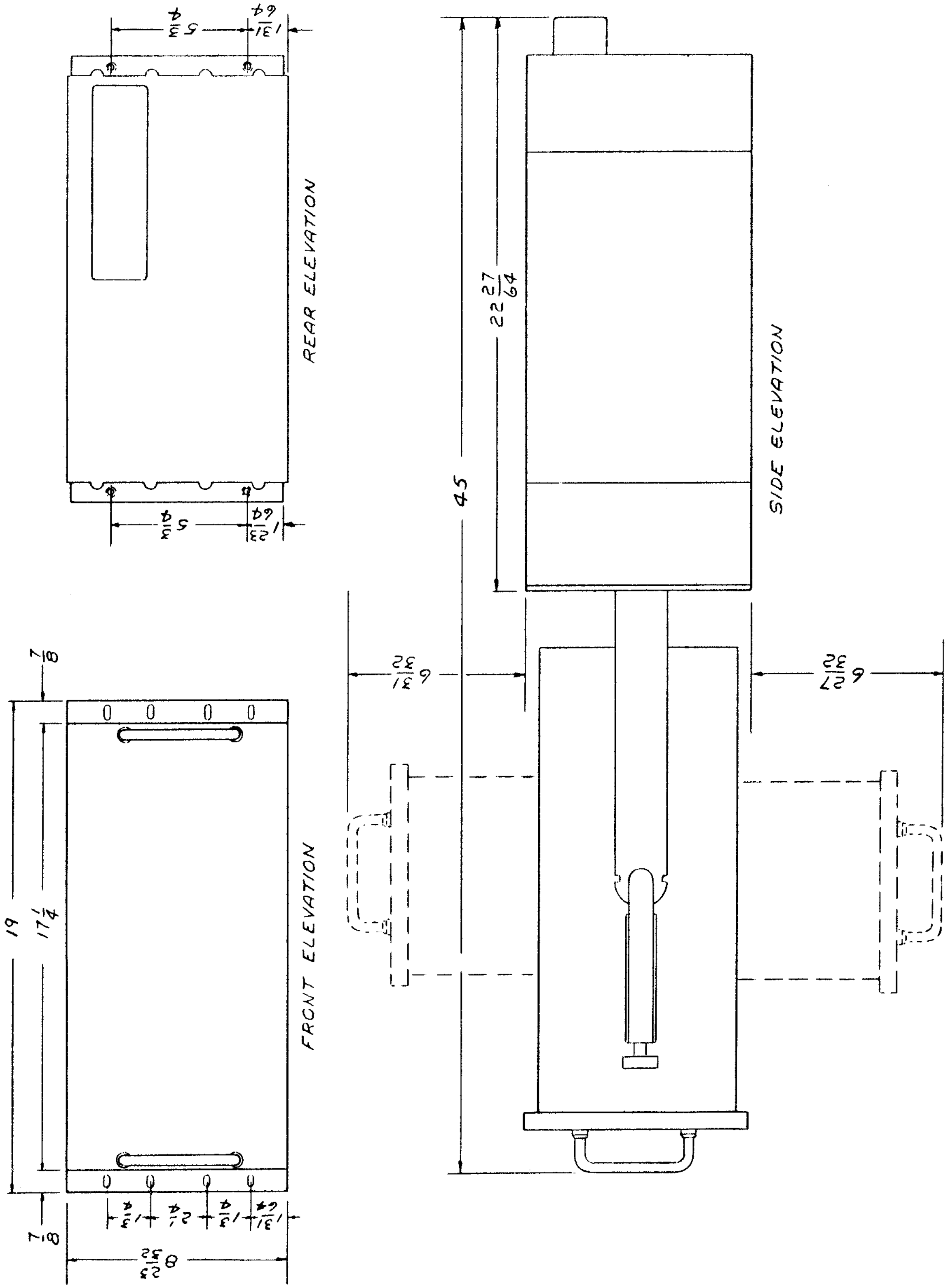

Figure 2-1. Modulator-Synthesizer MD-777/FRT, Outline Drawing

(1) REMOVING THE DRAWER.

(a) Loosen the panel captive screws and open the drawer to its fully extended position.

(b) Remove four retaining screws from cable clamps located above A18J8 and A18J9; remove the cable clamps.

(c) Reach in and disconnect the retractable cable at connectors A18J8 and A18J9 at the chassis rear.

(d) Press the rear latches on both slide mechanisms and pull the drawer forward, supporting it when it separates from the slides.

(2) REPLACING THE DRAWER.

(a) Engage the drawer slides and push-in until the drawer locks in the fully extended position.

(b) Connect the retractable cable at connectors A18J8 and A18J9.

(c) Replace the two cable clamps and four screws.

(d) Press the forward latches at both slides and close the drawer. Tighten the panel captive screws to secure the drawer in the enclosure.

b. RACK OR CABINET INSTALLATION. - The exciter enclosure contains side flanges at front and rear for mounting in a standard rack or cabinet. Preliminary to installation, remove the chassis assembly from the enclosure following the procedure described in paragraph 2-4a(1).

(1) Place the exciter empty enclosure in position and secure, using 1/2 inch, 10-32, fillister-head machine screws. Use four screws in each of the front flanges and two screws in each of the rear flanges. Place a washer beneath each screw head.

(2) Install the drawer in the enclosure following instructions given in paragraph 2-4a(2).

c. OPENING, INDEXING, AND CLOSING THE DRAWER. - The following procedure describes steps to be performed for opening, indexing, and closing the drawer, and also for swinging open the bottom chassis deck.

(1) To open the drawer, loosen the panel captive screws and pull the drawer out on its slides. It will lock in a fully extended position.

(2) To index the drawer on its horizontal axis, pull forward the levers on both slides, simultaneously. Rotate the drawer and release the levers to lock the drawer at the desired position.

CAUTION

Do not force spring with screwdriver or other tool during performance of following step (3). Release spring manually by pressing outward on button within chassis.

(3) To swing open the bottom chassis deck, index the drawer vertically with the front panel upward, loosen the five captive screws that secure the deck, support the deck with the left hand, release the spring at the right-hand side of the chassis with the right hand, and lower the deck to the limit of the two restraining cords.

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(4) To secure the bottom chassis deck, lift it upward until it is engaged by the spring at the right-hand side of the chassis, and secure it with the five captive screws.

(5) To close the drawer, index it to its horizontal position. Press the forward latches on both slides, simultaneously. Close the drawer and secure it with the panel captive screws.

d. EXTERNAL CABLES. - Because of the variations in installation requirements, no external cables are supplied with the exciter. Cable assemblies for interconnection with the Keyer, Frequency Shift KY-655/FRT and Decoder-Encoder KY-656/FRT are supplied with those units. Connectors are furnished for some of the remaining external cables (see table 2-1). Detailed instructions for cable assembly are contained in NAVSHIPS 0967-000-0000.

(1) CABLE ASSEMBLY. - The rear panel interconnection diagram (figure 5-91), when used in conjunction with table 2-1, gives all information needed for properly wiring the cable connectors supplied with the exciter.

(2) CONNECTION TO EXCITER. - Figure 5-4 shows the location of all external cables at the rear of the exciter enclosure. If rear access is limited at the relay rack or cabinet, the external cables can be connected just prior to installation of the enclosure. Otherwise, make all cable connections following enclosure installation.

(3) COMPLETING CABLE CONNECTIONS. - To complete external cabling at the transmitter unit the following connections are to be made.

(a) Connect ac power cable from connector A19FL1J1 to the primary power source at the installation site. (See paragraph 2-2a.)

(b) Connect signal cable from connector A19FL2J1 to the LPA.

(c) Connect audio modulation cable at A19FL3J1 to the patch-panel or modulation source at the installation site.

(d) Connect rf output cable at A19J1 to the LPA.

(e) Connect transmitter gain control cable at A19J2 to the LPA.

(f) Connect the average and peak power control cable at A19J3 to the LPA.

(g) Connect the 1 mc frequency standard cable at A19J4 to the external 1 mc frequency standard at the installation site.

(h) If required, connect the 1 mc frequency standard monitor cable at A19J5 to the external frequency monitor at the installation site.

2-5. INITIAL OPERATING TESTS.

a. GENERAL. - Following installation of the exciter and prior to performance tests, initial operating tests are performed to assure optimum exciter performance. Operational aspects and features of the exciter are checked with particular attention to any condition noted which could lead to abnormal performance.

b. INITIALLY ENERGIZING EXCITER. - The location of each operating control is shown in figure 3-1. Table 3-1 gives a brief description of control functions and indicates their preset positions. To initially energize the exciter, perform the following steps in the order presented.

Note

Exciter is checked out using special test jig to simulate certain interface circuits within LPA. Complete fabrication instructions for test jig are given in figure 2-2.

(1) Make sure all external cable connections are secure.

(2) Verify that transmitter is connected to correct primary power source described in paragraph 2-2a.

CAUTION

Make sure 115V/230V toggle switch PS1S1 (in power supply) is in position which corresponds with primary power source voltage.

(3) Disconnect LPA signal cable from A19FL2J1. Connect test jig to A19FL2J1. Disconnect LPA rf cable from A19J1.

(4) Preset test jig switches as follows:

(a) STANDBY/OPERATE switch to OPERATE.

(b) TUNE ENABLE/READY switch to READY.

(5) Preset all exciter operating controls according to table 3-1. Make sure LOCAL/REMOTE switch is in LOCAL position.

(6) Place external primary power switches <u>on</u> at installation site.

(7) Place exciter RESET/TRIPPED switch in RESET position.

(8) Press exciter STANDBY pushbutton.

(9) Place test jig STANDBY/OPERATE switch in STANDBY position.

(10) Press exciter OPERATE pushbutton.

(11) Place test jig STANDBY/OPERATE switch in OPERATE position.

(12) Press exciter TUNE pushbutton.

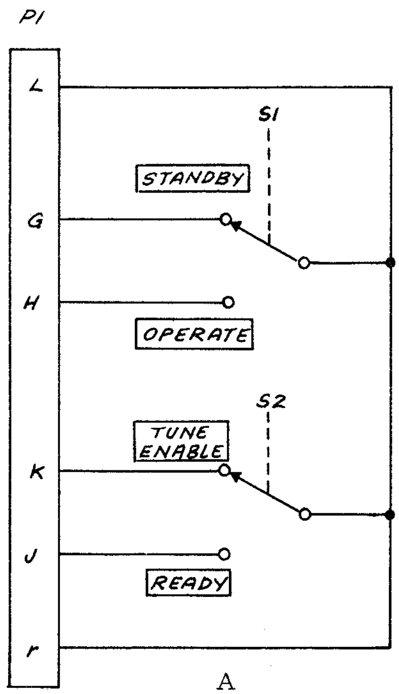
(13) Place test jig TUNE ENABLE/READY switch in TUNE ENABLE position.

(14) After transmitter gain control motor has stopped running (approximately 750 milliseconds), place test jig TUNE ENABLE/READY switch in READY position. This completes exciter energizing procedures.

Note

Each time exciter FREQUENCY KC dial settings are changed, or CLASS OF EMISSION control is rotated out of A0 or A2, A3e position, steps (9) through (14) must be repeated to re-energize exciter.

c. FREQUENCY STANDARD CALIBRATION. - To check calibration of the internal 1 mc frequency standard, a secondary 1 mc standard having a stability of one part in 10^9 is used. The CIRCUIT TEST panel meter serves as a "null" indicator during calibration.



A
SCHEMATIC

REF DES	DESCRIPTION
P1	CONNECTOR, MIL TYPE MS3116E20-39SX
S1	SWITCH, TOGGLE, MIL TYPE ST130
S2	SWITCH, TOGGLE, MIL TYPE ST130
MISC. WIRE, HARDWARE	

B
PARTS LIST

Figure 2-2. Initial Checkout Test Jig, Fabrication Details

Note

For maximum accuracy, allow a 1 hour warm-up period prior to calibration of the internal 1 mc frequency standard.

(1) Connect the external 1 mc frequency standard (standard-frequency oscillator) to the 1 MC STD IN connector (A19J4) on the rear panel.

(2) Set the CIRCUIT TEST switch to the FREQ STD LOCK position.

(3) Observe the period of oscillation (from left to right to left to right or vice versa) for the pointer of the front-panel CIRCUIT TEST meter. This period should be greater than or equal to 100 seconds. If the period is less than 100 seconds, calibrate the internal frequency standard by adjusting the FREQ STD control on the auxiliary panel.

Note

If the range of the FREQ STD control is exceeded, adjust the mechanical FREQ ADJ control on the internal frequency standard to return the FREQ STD control within range, and readjust the FREQ STD control as necessary.

d. CIRCUIT TEST METER USE. - The CIRCUIT TEST selector and panel meter provide a means of checking exciter-circuit operation at selected test points. In this manner, normal operation of major circuits can be verified. A meter reading in the green scale segment indicates normal operation for those selector switch positions also marked with a green segment. The remaining selector switch positions are read directly on the scale as a function of their respective levels.

(1) Check the five dc supply voltages from +5V to +125V. Meter readings should be in the red segment.

(2) Check the five frequencies from 1.74731 mc to 82-110 mc. Meter readings should be in the green segment.

(3) The remaining selector switch positions are checked during performance of other initial tests, with exception of the PPC/APC and the TGC selector positions. These measurements are dependent upon operation of the transmitter LPA and will not be made during initial performance testing.

e. INPUT CHANNEL TESTS. - The four input channels B2, B1, A1, and A2, are tested, using the INPUT LEVEL selector and panel meter, by applying a 0 dbm (level) audio test signal at the individual CHANNEL TEST jacks. Use Audio Signal Generator SG-376/U and a patch plug with PJ-327 jacks, or equivalent.

(1) Connect generator to input channel A1 and adjust output for a 1000 cycle, 0.775 volt (rms) test signal. Set input level selector switch to A1.

(2) Note INPUT LEVEL meter reading. It should be 0 VU. If not, adjust the METER ADJ control to obtain this reading. (This calibration is not repeated for the remaining channels.)

(3) Set A1 INPUT LEVEL control to +10 and note that meter reading drops to approximately -10 VU on the scale. Return INPUT LEVEL -dbm control to zero setting.

(4) Connect generator to channel B1 and set selector to B1. Repeat steps (2) and (3).

(5) Connect generator to channel B2 and set selector to B2. Repeat steps (2) and (3).

(6) Connect generator to channel A2 and set selector to A2. Repeat steps (2) and (3).

f. RF OUTPUT TEST. - The rf output test is performed with the test jig switch in the TUNE ENABLE position. The test frequency is 2.0 mc. Use RF Monitor H-P 434A or equivalent to measure output level.

(1) Connect rf monitor to the rear panel RF OUTPUT connector (A19J1).

(2) Using PWR control, adjust output to 50 mw.

g. MODE TESTS. - The following output level tests verify exciter operation in the various modes. Use RF Monitor H-P 434A, Audio Signal Generator SG-376/U, and a patch plug with PJ-327, or equivalent, jacks.

(1) Set CLASS OF EMISSION selector to A0.

(2) Connect rf monitor to RF OUTPUT connector A19J1.

(3) Note output level. It should be 100 milliwatts ±1 db, or twice the output level set in paragraph 2-5f, step (2).

(4) Connect audio generator to channel A1 at the CHANNEL TEST jacks. Adjust two-tone generator outputs for 1000 cps and 1625 cps at 0.775 volt (rms). Set INPUT LEVEL selector to A1.

(5) Set INPUT LEVEL-dbm control A1 for a zero VU reading on the INPUT LEVEL panel meter.

(6) Set the MOD ON/OFF switch to ON.

(7) Set CLASS OF EMISSION selector to SSB(∞).

(8) Note rf monitor reading. It should be 100 milliwatts ±1 db, or twice the power of paragraph 2.5f, step (2).

h. CARRIER SUPPRESSION TESTS. - These tests are performed using the USB mode to verify carrier suppression in steps of -10 db, -20 db, -40 db, and -60 db for the various signal sideband modes of operation. Use RF Monitor H-P 434A.

(1) Connect rf monitor to the RF OUTPUT panel connector (A19J1). Set CLASS OF EMISSION selector to A2,A3E. Set MOD ON/OFF switch to OFF.

(2) Note rf monitor reading. It should be 250 milliwatts.

(3) Set CLASS OF EMISSION selector to SSB (-10). Rf output level should drop 4 db, from 50 mw reference.

(4) Set CLASS OF EMISSION selector to SSB (-20). Rf output level should drop 14 db from 50 mw reference.

(5) Set CLASS OF EMISSION selector to SSB (-40). Rf output level should drop 34 db from 50 mw reference.

(6) Set CLASS OF EMISSION selector to SSB (-∞). Rf output level should drop to approximately zero (-54 db from 50 mw).

i. CHANNEL GAIN-RATIO TESTS. - The following performance tests verify operation of the four CHANNEL GAIN RATIO controls and also the SIDEBAND SELECTOR positions LSB, (2)ISB, and (4)ISB. Use RF Monitor H-P 434A and Audio Signal Generator SG-376/U or equivalent.

(1) Connect audio generator to all four CHANNEL TEST jacks (in parallel). Adjust generator frequencies to 1000 and 1625 cps, and output level for a 0 VU reading on the INPUT LEVEL panel meter.

(2) Connect rf monitor to the RF OUTPUT panel connector (A19J1).

(3) Set INPUT LEVEL selector to A1, SIDEBAND SELECTOR to USB, and CLASS OF EMISSION selector to SSB (∞). Set rf output to 100 milliwatts.

(4) Set SIDEBAND SELECTOR in turn to LSB, (2)ISB, and (4)ISB. Rf monitor reading should <u>not</u> change.

(5) Disconnect audio from all channels except B2. Ensure audio level is 0 VU. With B2 CHANNEL GAIN RATIO control set to 100, set PWR control for a 50 mw output. Adjust B2 CHANNEL GAIN RATIO control to 50. Output power should be 25 milliwatts.

(6) Repeat step (5) using the B1 CHANNEL GAIN RATIO control.

(7) Repeat step (5) using the A1 CHANNEL GAIN RATIO control.

(8) Repeat step (5) using the A2 CHANNEL GAIN RATIO control.

j. VFG TESTS. - The VFG (voice-frequency gate) function is tested by applying an audio channel test signal and noting the threshold level of VFG operation. The VFG hold time can be estimated by noting the delay interval which occurs when the test signal is removed. Use RF Monitor H-P 434A and Audio Generator SG-376/U.

(1) Connect audio generator to the A1 CHANNEL TEST jack. Adjust generator for -10 VU at 1000 and 1625 cps.

(2) Connect rf monitor to RF OUTPUT connector A19J1.

(3) Set SIDEBAND SELECTOR to USB-VFG and CLASS OF EMISSION to SSB (-∞).

(4) Slowly increase the audio generator output and note the level at which the rf monitor reading appears. This is the VFG threshold level. It should be -6 VU ±1 db.

(5) Reduce the generator output to zero. Note the hold time interval before the rf monitor reading drops to zero. It should be approximately the same as the setting of the VFG HOLD TIME control.

k. SYNTHESIZER TESTS. - These tests verify synthesizer operation for the over-all exciter frequency range. Operation at 2.0 mc was checked during the rf output test described in paragraph 2-5f. To complete operational testing, perform the following tests at 15.0 and 29.0 mc. Use RF Monitor H-P 434A.

(1) Connect rf monitor to RF OUTPUT panel connector A19J1.

(2) Set SIDEBAND SELECTOR to USB and CLASS OF EMISSION to A0.

(3) Set FREQUENCY KC dials to 15000.0 kc.

(4) Note rf monitor reading. It should be adjustable to at least 100 mw.

(5) Repeat steps (3) and (4) with FREQUENCY KC dials set to 29000.0 kc.

l. POWER OUTPUT ADJUSTMENT. - Prior to exciter operation, the rf output level must be set to the requirements of the LPA to be used. Use RF Monitor H-P 434A.

CAUTION

PWR adjustment must be set for maximum drive requirements of LPA. Excess rf drive may cause emergency shut-down of system.

(1) Determine frequency of maximum rf drive requirements for LPA (in milliwatts from a 50-ohm source).

(2) Connect rf monitor to RF OUTPUT panel connector A19J1.

(3) Set SIDEBAND SELECTOR to USB and CLASS OF EMISSION to A0.

(4) Set FREQUENCY KC dials to frequency determined in step (1).

Note

Repeat steps (9) through (14), paragraph 2-5b, to re-energize exciter and to be absolutely sure that transmitter gain control (TGC) servo system is set at a maximum rf output position.

(5) Note rf monitor reading. Set PWR adjustment to 1 db above the level previously determined in step (1). Lock the PWR adjustment.

m. OPERATION WITH OTHER EQUIPMENT. - Modulator-Synthesizer MD-777/FRT is intended for operation with Keyer, Frequency Shift KY-655/FRT and Decoder-Encoder

KY-656/FRT. Final tests should be performed using the LPA as a part of this system before turning equipment over to operating personnel.

2-6. PREPARATION FOR RESHIPMENT.

a. EQUIPMENT DISASSEMBLY. - The following steps form a logical sequence for exciter preparation prior to reshipment.

(1) Place the panel circuit breaker in the TRIPPED position and remove all primary power by opening the power source switches at the installation site.

(2) Disconnect all external cables at the rear panel.

(3) Remove from relay rack or cabinet (reverse of procedure described in paragraph 2-4b).

(4) Collect all reusable mounting hardware, external cables, and connectors, and technical manuals. Spare parts to be returned with the exciter should be inventoried and replaced in their original containers if possible. Provisions should be made for replacement of missing or defective items prior to shipment.

b. REPACKAGING. - Refer to the latest packaging specifications for the instructions and requirements for packaging and packing the exciter. Also observe the following:

(1) Mark the box containing technical manuals "TECHNICAL MANUALS INSIDE".

(2) Check that all plug-in circuit boards and modules are secure and retaining screws tightened.

SECTION 3

OPERATION

3-1. FUNCTIONAL OPERATION.

Modulator-Synthesizer MD-777/FRT is intended for operation with Keyer, Frequency Shift KY-655/FRT, Control-Indicator, Transmitter C-7709/FRT, and Decoder-Encoder KY-656/FRT, to provide rf drive, modulation, and operating controls for Radio Transmitting Sets AN/FRT-83(V), AN/FRT-84(V), AN/FRT-85(V), and AN/FRT-86(V).

The Modulator-Synthesizer (exciter) controls include pushbuttons and indicators which initiate and respond to command signals between the system units. These controls and indicators are duplicated at the Control-Indicator, Transmitter (remote control unit) to permit a control of the transmitting system at either unit. Fault signals, in the event of a system failure, are indicated at both units.

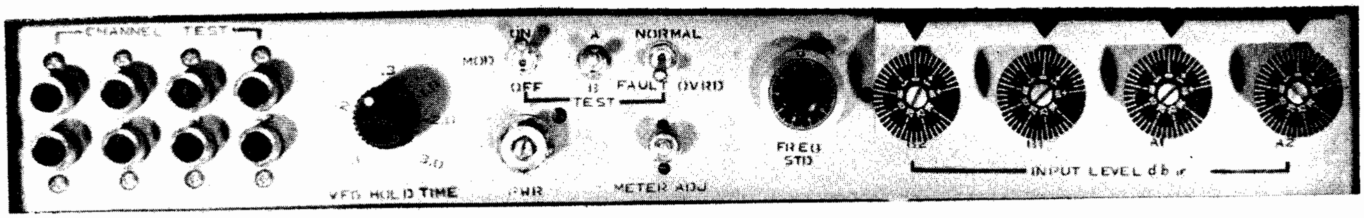
The exciter provides a selection of transmission frequencies from 2.0 to 30.0 mc (29.9999 mc), in 100 cycle increments, by setting six digital tuning dials to the desired frequency. Modulation modes for A0, A1, A2, A3b, A3e, A3j, A9b, F1, and F4 operations are applicable to from one to four independent 3-kc wide sidebands. Frequency selection, mode selection, and sideband selection controls are duplicated at the remote control unit.

Panel controls are provided for selecting the number of sidebands used, selecting the class of emission, and for monitoring the audio levels at each of the sideband channels. In addition, a test circuit is incorporated to measure the exciter power supply voltages, synthesizer injection frequencies, power output, and various transmission control features such as peak power control (PPC), average power control (APC), automatic level control (ALC), and transmitter gain control (TGC). A voice frequency gate (VFG) which operates as a VOX circuit and provisions for push-to-talk operation (PTT) are also incorporated.

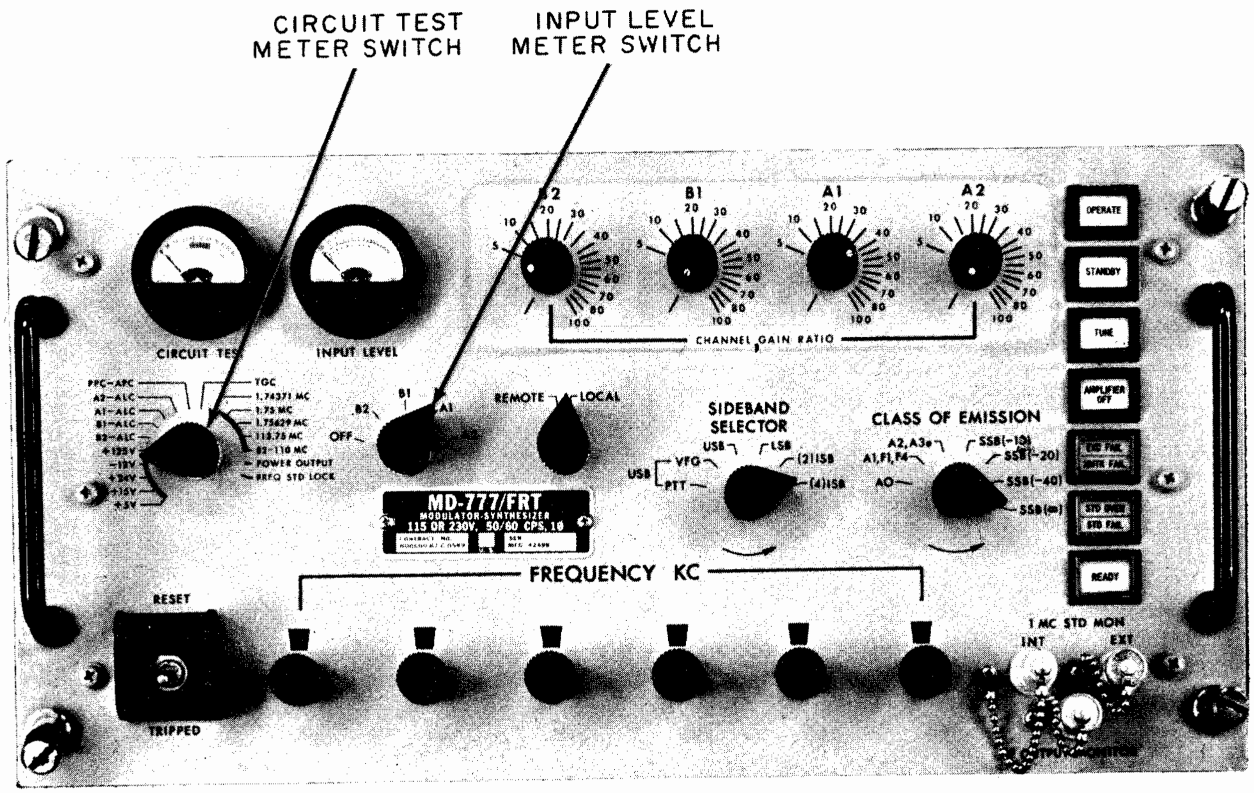
Maximum exciter rf output power is 250 milliwatts and carrier suppression is selectable in steps of -10 db, -20 db, -40 db, and -60 db. An internal 1 mc frequency standard serves as a frequency source for development of all synthesized frequencies and provisions are made for connection of an external frequency standard. A frequency standard comparison circuit automatically selects the output of one standard in the event of a malfunction in the other standard. The exciter operates from a primary power source of 115/230 volts ac, 50/60 cycles, single phase. The power requirement for "standby" operation is 70 watts, and for normal operation is 130 watts.

3-2. OPERATING PROCEDURES.

a. DESCRIPTION OF CONTROLS. - All controls for normal exciter operation are located on the front panel; seldom used controls are located on an auxiliary panel which is exposed when the drawer is opened. Figure 3-1 shows the location of each panel control and indicating device and table 3-1 supplies a functional description of each control and indicator. In addition, table 3-1 gives the "preset" control positions to be used for the initial performance tests contained in Section 2 and for the alignment and adjustment procedures in Section 5.



AUXILIARY PANEL



FRONT PANEL

Figure 3-1. Operating Controls and Indicators

TABLE 3-1. OPERATING CONTROLS AND INDICATORS

CONTROL/INDICATOR NAME	PRESET POSITION	CONTROL FUNCTION
FRONT PANEL		
OPERATE Pushbutton	None	Illuminated pushbutton. Press to initiate group operation. Green lamp lights when operation achieved.
STANDBY Pushbutton	None	Illuminated pushbutton. Press to place group units at standby. White lamp lights when standby achieved.
TUNE Pushbutton	None	Illuminated pushbutton. Press to initiate transmitter tuning cycle. White lamp extinguished when tuning cycle initiated.
AMPLIFIER OFF Pushbutton	None	Illuminated pushbutton. Press to shut down transmitter. White lamp lights when shutdown accomplished. Exciter placed at standby.
EXC FAIL Lamp	N/A	Fault indicator. Red lamp lights if fault occurs in exciter circuits.
XMTR FAIL Lamp	N/A	Fault indicator. Red lamp lights if fault occurs in over-all system.
STD OVEN Lamp	N/A	Fault indicator. Green lamp lights when frequency standard oven operating.
STD FAIL Lamp	N/A	Fault indicator. Red lamp lights when frequency standard fault occurs and external standard is in use.
READY Lamp	N/A	Ready indicator. Green lamp lights when tuning completed and system is ready to transmit.
RESET/TRIPPED	RESET	Primary power circuit breaker. Trips to remove exciter power in event of abnormal primary current.
FREQUENCY KC	02000.0 kc	Six tuning dials. Select transmission frequency from 2.0 to 29.9999 mc in 100-cycle steps. Local operation only.
CIRCUIT TEST	FREQ STD LOCK	Test meter and selector switch. Tests exciter at selected circuit points for monitoring and trouble shooting.
INPUT LEVEL	OFF	VU meter and selector switch. Measures audio signal level at each input channel.

TABLE 3-1. OPERATING CONTROLS AND INDICATORS (Cont)

CONTROL/INDICATOR NAME	PRESET POSITION	CONTROL FUNCTION
REMOTE/LOCAL	LOCAL	Exciter control selector, remote or local operation.
SIDEBAND SELECTOR	USB	Selector, locally or remotely controlled. Selects transmission (sideband) channels.
CLASS OF EMISSION	A0	Selector, transmission modes.
CHANNEL GAIN RATIO	100 (all 4)	Channel gain controls (four). Adjusts transmission power allocated to each individual channel (sideband).
AUXILIARY PANEL		
CHANNEL TEST	N/A	Twin input-channel test jacks. Input lines disconnect when plug inserted.
TEST A/B	Central	Three position toggle switch. Used only for initial exciter installation tests.
PWR	Fully cw	Controls exciter power output. Adjust only during initial installation tests.
NORMAL/FAULT OVRD	NORMAL	Service switch. Overrides fault circuits to determine fault location. Lights the EXC FAIL lamp when in OVRD position.
METER ADJ	N/A	Calibration adjustment for VU panel meter.
FREQ STD	N/A	Calibration adjustment for internal frequency standard. Equipped with "logging" scale to register calibration changes.
INPUT LEVEL -dbm	0 dbm (all 4)	Input level controls (four). Adjusts audio input channel levels (using VU meter). Algebraic sum of control and VU meter readings equals audio line level.
ON/OFF MOD	ON	Service switch. Removes carrier modulation for carrier only adjustments. Lights EXC FAIL lamp in OFF position.
VFG HOLD TIME	N/A	Adjustment for voice frequency gate hold time.

b. MODES OF OPERATION. - Table 3-2 lists the exciter modes of operation and the related sideband selection used.

TABLE 3-2. OPERATING MODES AND SIDEBAND SELECTIONS

<table>
<tr><th>CLASS OF EMISSION</th><th>SIDEBAND SELECTOR</th><th>SIDEBAND CHANNEL IN USE</th></tr>
<tr><td>A0</td><td>(Not applicable)</td><td>(Test purposes)</td></tr>
<tr><td>A1, F1, F4</td><td>USB or ISB</td><td>A1 or B1</td></tr>
<tr><td>A2, A3E</td><td>USB/VFG/PTT</td><td>A1 (Automatically selected)</td></tr>
<tr><td>SSB (-10)</td><td rowspan="4">ALL USB
PTT
VFG
LSB
(2)ISB
(4)ISB</td><td>A1</td></tr>
<tr><td>SSB (-20)</td><td>B1</td></tr>
<tr><td>SSB (-40)</td><td>A1 and B1</td></tr>
<tr><td>SSB ( )</td><td>A1, B1, A2, B2</td></tr>
</table>

c. SEQUENCE OF OPERATION. (See also table 3-5.)

CAUTION

Before starting the exciter for the first time, make sure the primary power source corresponds with the information contained in paragraph 2-2a. Verify that the 115V/230V switch (PS1S1) is set in the correct position for the primary power available.

(1) STARTING.

Note

To perform the following starting, operating, and stopping procedures, the exciter must be operated as a part of the complete Radio Transmitting Set.

(a) Place external power source switches <u>on</u> at the installation site. The FREQUENCY KC dial windows, TUNE lamp, AMPLIFIER OFF lamp, and STD OVEN lamp should light. Press STANDBY pushbutton. After a time delay of approximately three minutes (to allow the LPA filaments to heat up) the STANDBY lamp should light.

(b) When the STANDBY lamp lights, press the OPERATE pushbutton. The OPERATE lamp should light.

(2) TUNING. - Exciter tuning, in increments of 100 cycles, is performed by setting the six FREQUENCY KC tuning dials to the desired transmission frequency in kilocycles. A frequency of 2.5 mc has been selected as an example for the following tuning steps:

Note

> Changing the FREQUENCY KC or CLASS OF EMISSION front panel control positions will automatically place the exciter unit in the TUNE control cycle.

(a) Set the FREQUENCY KC dials to the desired frequency in kilocycles. (This is a setting of 02500.0 kc for the example frequency of 2.5 mc.)

(b) The TUNE pushbutton will light. Press it to initiate system tuning to the new frequency. When tuning is completed, the READY lamp will light to signal an automatic return to "on-the-air" operation.

(3) OTHER OPERATING ADJUSTMENTS.

(a) CLASS OF EMISSION SELECTOR. - This panel control contains a rotary solenoid actuator for joint operation by the remote control unit. Consequently, the control can only be rotated in a counterclockwise direction. The four SSB positions provide for carrier suppression in four successive steps from -10 db to -60 db (labeled ∞). The A2, A3E position provides -6 db of carrier suppression, and the A1, F1, and F4 positions provide -60 db of carrier suppression.

Note

> Each time the CLASS OF EMISSION control is rotated past the A2, A3E position or the A0 position, the transmitting system will automatically switch to the TUNE mode. Press the TUNE pushbutton to return the system to normal operation.

(b) SIDEBAND SELECTOR. - This control, similar to the CLASS OF EMISSION control, contains a rotary solenoid actuator for remote operation and, therefore, cannot be rotated other than in a counterclockwise direction. The USB/PTT position, an auxiliary operation feature, selects sideband channel A1 and has provisions for push-to-talk (PTT) operation. No transmitter system output will occur until the PTT circuit is closed, usually by pressing the "push-to-talk" button on a microphone or handset.

The USB/VFG position selects channel A1 for transmissions and employs a voice-frequency-gate (VFG) circuit. This sideband selection is similar to VOX operation and is operable for all classes of emission with the exception of A0.

The USB position selects channel A1 and the LSB position selects channel B1 for transmissions using any class of emission. The (2)ISB position (two independent sidebands) selects channels A1 and B1 for simultaneous operation, and the (4)ISB position (four independent sidebands) selects all four channels, A1, B1, and A2, B2 for simultaneous transmissions. These selector positions, inclusive, can be used for all modes of operation except A0 and A2, A3E.

(c) REMOTE/LOCAL CONTROL SELECTOR. - The REMOTE/LOCAL control switch permits transfers of the system major operating control functions to the remote control unit. In the LOCAL position, system control is performed at the exciter. In the REMOTE position, frequency selection, class of emission, and sideband selection control functions are performed at the remote control unit. All other operating controls remain a function of the exciter.

(d) CHANNEL GAIN RATIO CONTROLS. - Four channel ratio controls, one for each of the four audio input channels, control distribution of the exciter rf output power for the four independent sideband channels. When the four controls are set at 100, exciter output power is distributed equally in the four channels with 25 per cent of the maximum power in each sideband. Table 3-3 gives the rf power distribution for several control settings as an example and guide for determining the adjustments of the four channel ratio controls, subject to the SIDEBAND SELECTOR control position.

Note

In table 3-3, to serve as an example, maximum exciter rf output power is given as 100 mw. Substitute the exciter power in use and determine channel distribution by interpolation.

TABLE 3-3. EXAMPLES, CHANNEL GAIN RATIO SETTINGS

EXAMPLE NO.	CHANNEL DISTRIBUTION	SIDEBAND CHANNELS			
		B2	B1	A1	A2
	Dial Setting	0	100	100	0
1	Power Ratio	N/A	1/2	1/2	N/A
2 ISB	Output (mw)	0	50	50	0
	Dial Setting	100	100	100	100
2	Power Ratio	1/4	1/4	1/4	1/4
4 ISB	Output (mw)	25	25	25	25
	Dial Setting	100	50	50	100
3	Power Ratio	1/4	1/8	1/8	1/4
4 ISB	Output (mw)	25	12.5	12.5	25

(e) PUSHBUTTON CONTROLS. - Four pushbutton panel controls are provided to control the transmitter system operation. When a button is pushed, the button lamp lights when its operation has been achieved. The following descriptions of the pushbutton controls supplement the functional descriptions given in table 3-1.

1. OPERATE. - The OPERATE pushbutton is pressed to initiate transmitter operation from a "standby" condition. The exciter, keyer, and LPA are placed in an operating condition. The green lamp lights when an "operate" condition is achieved.

2. STANDBY. - The STANDBY pushbutton is pressed to place the transmitter system in a "standby" condition. Operating voltages are removed from the keyer, the LPA, and some exciter circuits. A white lamp lights when the "standby" condition has been achieved.

3. TUNE. - The TUNE pushbutton is pressed to initiate a transmitting system tuning cycle. When the tuning cycle is initiated, a white lamp is extinguished at the pushbutton and a green lamp in the READY indicator lights.

4. AMPLIFIER OFF. - The AMPLIFIER OFF pushbutton is pressed to shut down the LPA. When LPA shutdown has been accomplished, the white AMPLIFIER OFF lamp lights.

(4) STOPPING. - To stop the transmitter system, press the STANDBY pushbutton.

CAUTION

Do not use the RESET/TRIPPED circuit breaker as an exciter on/off switch. To do so removes operating power from the 1 mc frequency standard oven and will affect frequency standard calibration.

(5) AFTER USE. - During a "standby" condition between periods of actual operation, the following steps are suggested by good operating practice.

(a) Log any abnormal performance noted during operation.

(b) Perform maintenance checks for the exciter as described in the Maintenance Standards Book, NAVSHIPS 0967-292-3010.

d. INDICATOR PRESENTATIONS.

(1) FREQUENCY KC DIALS. - The frequency to which the exciter and, therefore, the transmitter system is tuned appears directly in the FREQUENCY KC tuning dial windows. The decimal point is placed between the fifth and sixth window. Each tuning dial selects one digit of a six digit frequency, over the tuning range from 02000.0 to 29999.9 kc (02.0000 to 29.9999 mc), in 100 cycle final steps or increments. The first dial selects tens of megacycles and the second dial units of megacycles. The remaining dials select hundreds, tens, and units of kilocycles, except for the sixth dial which selects hundreds of cycles.

When any tuning dial is reset while the transmitter system is operating, the system automatically switches to an "inhibit" condition, and the TUNE pushbutton lights. Push the TUNE button to initiate a system tuning cycle.

(2) INDICATOR LAMPS. - Five indicating lamps are provided on the front panel to notify the operator in the event a fault occurs in the transmitter system and also to indicate the exciter operating status. The following descriptions supplement the functional descriptions for the indicator lamps given in table 3-1.

Note

If a fault occurs in the transmitter system, the system is automatically placed in the "standby" condition and a fault indicator lamp lights. Request the services of a qualified technician.

(a) EXC FAIL. - The EXC FAIL indicator (red lamp) lights when a fault occurs in the exciter circuits. Absence of a dc operating potential or an rf injection frequency, for example, will light the EXC FAIL indicator. In the event of an EXC FAIL indication, the FAULT OVRD switch must be used to clear the locked-up fault detector before operation can be recommenced.

(b) XMTR FAIL. - The XMTR FAIL indicator (red lamp) lights when a fault occurs in the over-all system. The absence of operating voltages or rf drive at the LPA, or a fault in the keyer (modes A1, F1, and F4 only) for example, will light the XMTR FAIL lamp.

(c) STD OVEN. - The STD OVEN indicator (green lamp) remains lit when the 1 mc frequency standard oven is functioning. If the oven fails, the lamp is extinguished.

(d) STD FAIL. - The STD FAIL indicator (red lamp) lights when a malfunction occurs in the 1 mc frequency standard. In this event, the external 1 mc frequency standard is automatically substituted to maintain system operation.

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(e) READY. - The READY indicator (green lamp) lights following completion of the transmitter system tuning cycle. This action informs the operator that the system is tuned to the frequency established by the setting of the FREQUENCY KC tuning dials.

(3) INPUT LEVEL AND CIRCUIT TEST METERS. - Two front panel meters allow monitoring the signal levels at the four audio input channels and checking exciter operation at selected circuit test points. Each meter circuit has a switch for selecting the function to be monitored.

(a) INPUT LEVEL. - The INPUT LEVEL monitoring circuit contains the panel VU meter and an audio channel selection switch. When the switch is in the OFF position, the meter is disconnected from the input circuits. In the other switch positions, audio levels are monitored at sideband channels B2, B1, A1, and A2, respectively.

(b) CIRCUIT TEST. - The CIRCUIT TEST panel section contains a test meter and selector switch for checking exciter operation at major circuit points. These tests include measurement of various dc power supply voltages and rf injection frequencies, and a check on the operation of control circuits such as the automatic level control (ALC), average and peak power control (APC and PPC), and the transmitter gain control circuit (TGC). A relative measurement is made of the exciter rf power output level. In addition, the panel meter is used as a "null" indicator for calibration of the internal 1 mc frequency standard with the external standard.

To indicate acceptable meter readings for most measurements, a central section of the meter scale is colored green. Those switch positions using this colored section are identified with a green band on the panel. Unmarked switch positions represent measurements which provide acceptable readings outside of the green scale section. Table 3-4 lists the selector switch positions, identifies the particular exciter circuit to be checked, and gives the required meter reading for acceptance.

e. NONOPERATING CONTROLS. - The following controls are not located on the exciter front panel but are accessible on the auxiliary panel, following withdrawal of the exciter drawer from its enclosure. They are intended for use by technicians for adjusting and calibrating the unit and should be adjusted by a qualified technician only. Figure 3-1 shows control locations.

(1) TEST A/B. - A three-position toggle switch used during initial performance tests to override system control circuits and place the exciter in operation independent of the remaining system units.

(2) PWR CONTROL. - A potentiometer adjustment for setting the level of maximum rf power output.

(3) NORMAL/FAULT OVRD. - A toggle switch for overriding the "fault" indicator circuits to determine location of malfunction.

(4) METER ADJ. - A potentiometer adjustment for calibrating the INPUT LEVEL VU meter 0-dbm reading.

(5) FREQ STD. - A potentiometer adjustment for calibrating the 1 mc internal frequency standard. Equipped with a ten-turn dial for logging adjustments made.

(6) INPUT LEVEL -dbm. - Four controls for adjusting audio input levels at the B2, B1, A1, and A2 channels. Dial scales are calibrated from -30 to +10 db. When used with the INPUT LEVEL VU meter reading, the algebraic sum of the control and meter readings equals the audio channel level.

(7) ON/OFF MOD. - Toggle switch to remove modulation from the exciter rf output for test purposes.

TABLE 3-4. CIRCUIT TEST MEASUREMENTS

SWITCH POSITION	CIRCUIT TESTED	METER READING REQUIRED
POWER SUPPLY		
+5 V	+5 volt dc power supply	Within red scale section
+15 V	+15 volt dc power supply	Within red scale section
+24 V	+24 volt dc power supply	Within red scale section
-12 V	-12 volt dc power supply	Within red scale section
+125 V	+125 volt dc power supply	Within red scale section
RF LEVELS		
1.74371 MC	Sidetone, channel B2	Within green scale section
1.75 MC	Sidetone, channels A1, B1	Within green scale section
1.75629 MC	Sidetone, channel A2	Within green scale section
113.75 MC	Up-converter input	Within green scale section
82 - 110 MC	Down-converter injection	Within green scale section
POWER OUTPUT	Exciter rf output	Depends on set level
CONTROL		
PPC/APC	Peak/average power control	Depends on system operation
TGC	Transmitter gain control	Depends on operation
A2-ALC	Level control, channel A2	Depends on operation
A1-ALC	Level control, channel A1	Depends on operation
B1-ALC	Level control, channel B1	Depends on operation
B2-ALC	Level control, channel B2	Depends on operation
"NULL" METER		
FREQ STD LOCK	Calibration, 1 mc standard with external standard	(One beat in 30 seconds is a frequency correlation of 0.3 cps)

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(8) VFG HOLD TIME. - A potentiometer adjustment for setting the voice frequency gate "hold-time".

(9) CHANNEL TEST JACKS. - Four twin-input test jacks for audio input channels B2, B1, A1, and A2. Input lines are disconnected when the plug is inserted. They are used for testing purposes requiring connection of an audio generator to the input channels.

3-3. SUMMARY OF OPERATION.

A summary of the procedures for exciter operation, in the form of step-by-step instructions, is given in table 3-5. These instructions include procedures for starting and stopping the exciter, tuning, mode selection, and sideband selection.

TABLE 3-5. MODULATOR-SYNTHESIZER MD-777/FRT, SUMMARY OF OPERATION

1. STARTING	
Step 1.	Set REMOTE/LOCAL switch to LOCAL.
Step 2.	Press STANDBY pushbutton.
Step 3.	When STANDBY lamp lights, press OPERATE pushbutton.
2. TUNING	
Step 1.	Set FREQUENCY KC dials to transmission frequency in kilocycles.
Step 2.	Press TUNE pushbutton.
3. MODE SELECTION	
Step 1.	Set CLASS OF EMISSION selector to desired mode.
Step 2.	Set SIDEBAND SELECTOR to desired channel(s).
Step 3.	Press TUNE pushbutton.
4. OTHER ADJUSTMENTS	
Step 1.	CHANNEL GAIN RATIO. To set gain ratio for channels selected by SIDEBAND SELECTOR, adjust related CHANNEL GAIN RATIO control. Control scale is marked in per cent of maximum channel power.
Step 2.	REMOTE/LOCAL. To condition exciter for remote operation, set REMOTE/LOCAL switch to REMOTE.
5. STOPPING	
Step 1.	Press STANDBY pushbutton.
Step 2.	Press AMPLIFIER OFF pushbutton to shut down LPA filaments and blowers.

3-4. EMERGENCY OPERATION.

a. PARTIAL FAILURE. - Normally, good maintenance procedures require that electronic equipment be shut down for repairs as soon as a significant defect develops. Under unusual or emergency conditions, however, loss of equipment service for any length of time may not be acceptable, and a substitute method of operation must be found when possible. The substitute method will, in most cases, involve a reduction of equipment capabilities. If alternate equipment is not available, the lower operating capability must be accepted. When the emergency period is over, steps should be taken to restore the equipment to normal operation. Subject to the foregoing, the following emergency procedures are suggested.

(1) SIDEBAND CHANNEL. - In the event of a malfunction in one of the sideband channels, during single channel operation, transmission can be continued by selecting another channel. For example, if the USB channel A1 fails, switch to the LSB channel B1.

(2) OPERATING MODE. - In an emergency, if one mode of operation is faulty, consider the use of another mode to continue transmissions. If the A1, F1, F4 modes fail, transmissions can often be continued or resumed using the A2, A3e, or SSB modes.

(3) PRIMARY POWER. - Interruption of primary power to the exciter can be remedied by an alternate source of 115 or 230 volts ac. The operator should be familiar with the power distribution system at the installation site and the availability of alternate or emergency power sources, and should be able to shift to an alternate source in an emergency.

b. OTHER THAN NORMAL. - In the event of a failure in another part of the transmitting system, transmissions can in some instances be resumed by setting nonoperating controls on the auxiliary panel to override the system fault (see figure 3-1).

(1) FAULT ALARM. - In the event of a system "fault alarm" lighting the EXC FAIL or XMTR FAIL indicators, place the NORMAL/FAULT OVRD switch in the FAULT OVRD position to override the fault indication. If transmission can now be resumed, continue. Otherwise, return the switch to the NORMAL position and notify a qualified technician.

(2) TGC FAILURE. - If the transmitter gain control (TGC) circuit fails when in a maximum exciter output condition causing overdrive at the LPA, transmissions may be resumed by performing the following:

(a) Set the CLASS OF EMISSION selector to SSB ( ).

(b) Reduce rf drive by lowering the setting of the CHANNEL GAIN RATIO controls in use.

Failure of the TGC control circuit when in a minimum exciter output condition cannot be rectified using this procedure, but the emergency steps contained in the next paragraph (paragraph 3-4b(3)) can be successful under some failure conditions.

(3) TUNING COMMAND FAULT. - In the event of a failure in the command circuit between the exciter and the LPA, the following emergency steps can be performed to override the command circuit.

(a) Place the TEST A/B switch in the A position for approximately 3 seconds, then place it in the B position.

(b) Releasing the switch to its center position should place the equipment in operation.

3-5. OPERATOR'S MAINTENANCE.

a. GENERAL. - Electronic technicians are usually responsible for the maintenance and repair of transmitting equipment, although routine items of preventive maintenance which do not require elaborate test set-ups are normally assigned to the operator. Basic trouble shooting and the repair of minor defects may also be required of operating personnel from time to time. In order to meet this responsibility, the operator must have a thorough knowledge of the equipment including a complete familiarity with the function of all controls and the procedures governing their use. A general knowledge of the circuit should be acquired so that a probable cause of minor electrical or mechanical failure may be determined. In this manner, minor troubles can often be corrected before they become serious. Under normal conditions, however, major repairs or precise circuit adjustments should not be attempted by other than qualified technicians.

b. OPERATING CHECKS. - The exciter is intended for long periods of operation without requiring adjustments other than those involved in changing the operating frequency or mode. The following checks should be performed periodically by the operator as preventive maintenance of the equipment.

(1) CIRCUIT TEST. - With the exciter in operation, use the CIRCUIT TEST selector switch and panel meter to check the exciter circuits for normal operation (see table 3-4). Log the measurements obtained for reference and compare them with previous measurements to indicate any deterioration of the exciter performance.

(2) SYSTEM TEST. - At scheduled intervals, perform operating tests with the other transmitting system units to verify normal system operation.

c. PREVENTIVE MAINTENANCE. - A systematic, scheduled, method of checking exciter performance and performing preventive maintenance is contained in the Maintenance Standards Book, NAVSHIPS 0967-293-3010.

d. EMERGENCY MAINTENANCE. - Operating personnel must expect the possibility of exciter unit failure when technician services are not immediately available. In an emergency, the need for keeping the exciter in operation is of utmost importance and the operator must be able to recognize major failure symptoms, determine the particular area of trouble, and make emergency repairs when possible. It is not practical to discuss every type of failure which may possibly occur. Instead, a general outline of trouble shooting techniques will be presented to aid the operator in developing a systematic approach to the problem.

(1) ISOLATING TROUBLE. - The exciter consists of a number of closely related functional circuits, contained in individual plug-in circuit modules, each performing a specific task which contributes to exciter operation. Depending on the particular circuit involved, trouble symptoms can range from a noticeable reduction in modulation or rf drive levels to a complete breakdown in the exciter. A haphazard search for trouble will not accomplish much, except by accident. A more effective approach concerns the identification of the faulty plug-in module based upon observed trouble symptoms such as abnormal measurements when using the CIRCUIT TEST selector. Make the following checks.

(a) Check that all panel controls and auxiliary panel controls are in the intended positions and have not been accidentally moved.

(b) If the exciter unit is completely inoperative (no illumination at the FREQUENCY KC dial windows or indicating lamps), check the primary power sources at the installation site for blown fuses, etc.

(c) Make sure all external cable connections at the exciter and terminal equipment are secure. If a plug-in module is suspect because of abnormal measurements on the CIRCUIT TEST meter, place the exciter at STANDBY and replace the module with one known to be in good condition.

SECTION 4

TROUBLE SHOOTING

4-1. INTRODUCTION.

This section of the technical manual contains information to enable the electronics technician to efficiently locate the cause of equipment malfunction and abnormal performance. Effective trouble shooting of electronic equipment consists of recognizing the fault symptom, identifying the circuit responsible, and isolating the defective component or module in order to repair the equipment and return it to normal operation. To perform these steps quickly and efficiently, the technician should clearly understand the purpose and operation of each functional circuit in the equipment, and follow a systematic, logical trouble shooting procedure. A haphazard search for the faulty circuit can be successful only by accident. Refer to NAVSHIPS 0967-000-0000 for descriptions of conventional electronic circuits.

4-2. LOGICAL TROUBLE SHOOTING.

The following paragraphs describe a general trouble shooting technique based on six logical trouble shooting steps. If adequate field data of equipment faults is not available as a guide, a trouble shooting procedure similar to these steps should be followed.

a. SYMPTOM RECOGNITION. - This is the first step in a logical trouble shooting procedure and requires a complete familiarity with the equipment and its operating characteristics. Some troubles, which are not a direct result of component failure, are only apparent as a condition of less than optimum performance. This type of trouble is usually discovered during performance of the preventive maintenance steps contained in the Maintenance Standards Book (NAVSHIPS 0967-293-3010). It is important to recognize performance deterioration in addition to more apparent symptoms. More obvious troubles such as low output power or a complete equipment breakdown are readily discerned.

b. SYMPTOM INVESTIGATION. - When a trouble symptom occurs and is recognized, the situation should be investigated to elaborate the symptom and further identify the trouble. Equipment controls can be adjusted and panel meter readings noted in an attempt to identify the symptom with a particular equipment function or mode of operation. For example, if the exciter operation is subnormal for one or two modes of operation and normal when using other modes, the trouble can be associated with that section of the exciter employed for the faulty mode or modes.

c. PROBABLE FAULTY CIRCUIT. - The next step in a logical trouble shooting procedure is to make a tentative decision, based on results of the symptom investigation, as to the most likely circuit at fault. The decision should be based upon the trouble symptom and a thorough knowledge of the equipment circuits, and should be limited to those circuits which, if defective, could probably cause the trouble. The exciter functional block diagram (figure 4-2) together with the over-all functional description (paragraph 4-3) should be used to aid in the determination of the possible faulty circuit. For example, using the fault symptom described in the previous paragraph, a number of tentative decisions can be made:

(1) The trouble can be caused by a faulty mode (CLASS OF EMISSION) switch or switch circuit.

(2) The rf carrier and injection circuits are not at fault, because other modes of operation are normal.

(3) The trouble can only be caused by a fault in a circuit which supplies the defective mode signals.

d. LOCALIZING THE FAULTY CIRCUIT. - To localize the trouble to a particular circuit, tests should be made in an order which requires the least testing time. The test sequence should be based on validating the tentative decisions in the order of test difficulty. If the first circuit tested is not at fault, the next circuit must be tested, and so on, until the faulty circuit is located. Refer to the functional circuit descriptions, service block diagrams, and test data for the particular circuit being tested. Perform tests and checks which will either eliminate the circuit or pinpoint the trouble. For example, using the previously discussed fault symptom, the following test sequence and procedures could be employed:

(1) Examine the CLASS OF EMISSION switch contacts and check the circuit continuity using an ohmmeter.

(2) If the cw mode is at fault (A1, F1, F4 modes), check for presence of signal supplied by the external keying circuit.

(3) If a normal keyed signal is being supplied, check the associated keyline circuit output.

e. ISOLATING THE FAULTY COMPONENT. - When the faulty circuit section or module has been identified, the trouble should be pinpointed to the particular parts at fault. For example, using the previously discussed fault symptom the following procedure could be followed to isolate the faulty component.

(1) Continuity at the suspected mode switch circuits can be established by circuit tests.

(2) If the cw mode is at fault and a normal keying signal is being supplied from the external keyer, check for keyline closure.

f. FAULT ANALYSIS. - When the faulty component has been isolated by circuit tests and measurements, review the tentative decisions and the trouble shooting procedure employed, to establish the reason for component failure. Make sure that the defective component is the actual cause of trouble and not just the result of an undiscovered malfunction, perhaps in another circuit. For example, a short-circuited capacitor in a power supply decoupling circuit can cause a resistor, located in another module, to overheat and burn out. A fault analysis of this trouble would consider the following aspects when establishing the reason for the resistor failure; otherwise, replacement of the burned out resistor would not only fail to solve the problem, but would result in another burned out resistor.

(1) Only an abnormally high current flow could have caused the resistor to overheat and burn out.

(2) Current flow of this magnitude could only occur if a short circuit existed at the load terminal and not the supply terminal of the resistor.

(3) Circuit measurements at the resistor would verify this analysis and lead to discovery of the short-circuited capacitor in another module.

g. USE OF CIRCUIT BOARD EXTENSION. - A printed-circuit board extender permits tests and adjustments to be made of the synthesizer (A12) plug-in printed circuit boards while they are in operation. To install the board extension, perform the following:

CAUTION

Always place the exciter in STANDBY condition before removing or replacing any circuit board or module. Otherwise, the making and breaking of live circuits can damage connector terminals and components.

(1) Place the exciter in STANDBY.

(2) Use a board puller and remove the board to be tested.

(3) Insert the board extension into the compartment in place of the board.

(4) Insert the board to be tested into the extension socket.

(5) When tests or adjustments are completed, perform steps (2) through (4) in a reverse order to remove the board extension.

4-3. OVER-ALL FUNCTIONAL DESCRIPTION.

a. GENERAL. - Modulator-Synthesizer MD-777/FRT is a high frequency rf exciter and modulator intended for operation as a driver to a linear high-power rf amplifier (LPA). It tunes a frequency range from 2.0 to 30.0 mc (29.9999 mc) in precise 100-cycle increments. Class of emission is selectable from A0, A1, A2, A3b, A3e, A3j, A9b, F1, and F4. Modulation can be applied to four 3 kc wide independent sideband channels individually or in several channel combinations. Maximum exciter output rf power is 250 milliwatts (PEP). Individual channel gain controls are provided to adjust the rf power allocated to each of the four channels.

Exciter operation in conjunction with the LPA is controlled locally by front-panel controls and pushbutton switches, or remotely by Decoder-Encoder KY-656/FRT. Automatic control circuits provide for the control of peak and average power output (PPC and APC), and transmitter gain control (TGC) for the LPA. Automatic level control (ALC) and voice frequency gate or VOX operation (VFG) is also provided. All rf injection frequencies for exciter circuit operation are developed, using digital circuit techniques, from an internal 1 mc frequency standard. A frequency comparison circuit compares the internal standard frequency with a 1 mc frequency supplied by an external standard and automatically substitutes the external standard in the event of an internal standard malfunction.

A test circuit, located on the control panel, is used to monitor and measure the exciter dc operating voltages and rf injection voltages at selected test points to verify exciter performance and aid in the execution of preventive maintenance steps. Panel lamps monitor the operating status of the exciter and LPA, and alert the operator in the event of equipment failure.

The exciter operates from a primary power source of 115 or 230 volts ac, 50/60 cycles, single phase. All major circuit modules plug-in for ease of maintenance and can be exposed for examination or service by withdrawing the exciter drawer from its enclosure. The exciter chassis contains a secondary deck, or clam-shell, which is hinged to permit inspection of its components and modules.

b. TRANSMITTING SYSTEM BLOCK DIAGRAM. - Figure 4-1 is a basic block diagram showing the functional relationship of Modulator-Synthesizer MD-777/FRT (exciter) to other units of the AN/FRT-( ) transmitter system. Note the command functions which link the exciter to the LPA and to Decoder-Encoder KY-656/FRT. Table 4-1 identifies the command functions and control circuits between the exciter and the LPA. These functions permit direct control of the LPA from the exciter control panel. Table 4-2 lists and identifies the command and control functions between Decoder-Encoder KY-656/FRT (LCU) and the exciter. These functions permit control of the transmitting system from Control-Indicator, Transmitter C-7709/FRT when the exciter REMOTE/LOCAL switch is in the

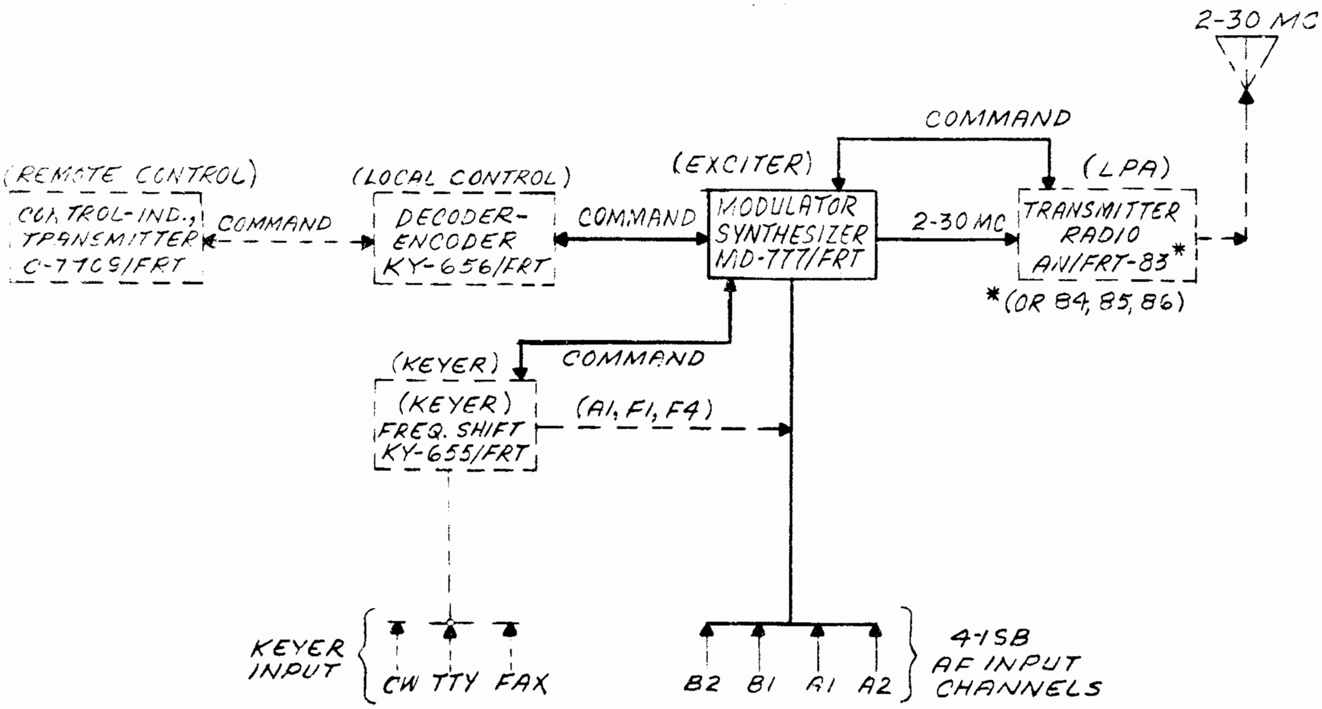

Figure 4-1. Transmitting System Block Diagram

REMOTE position. Although the information contained in tables 4-1 and 4-2 relates to control and operation of the complete transmitting system, the command and control functions listed either originate at or are received by the exciter. The information is included to clarify the exciter circuit descriptions given in this section of the manual.

TABLE 4-1. EXCITER - LPA CONTROL CIRCUITS

COMMAND	FROM	TO	CONTROLLING FUNCTION
Frequency Band Selection	Exciter	LPA	Coarse tune rf amplifier.
Standby	Exciter	LPA	Remove rf amplifier operating power.
Standby Return	LPA	Exciter	Power control interlock.
Operate	Exciter	LPA	Apply rf amplifier operating power.
Operate Return	LPA	Exciter	Power control interlock.
Tune	Exciter	LPA	Initiate rf amplifier tuning cycle.
Ready	LPA	Exciter	Condition exciter for normal operation.
Mode	Exciter	LPA	Condition rf amplifier for single-tone modes.
Tune Enable	LPA	Exciter	Condition exciter to transmit "tune carrier".
Local Override	LPA	LCU (via Exciter)	Indicate transmitter not available for remote operation.

TABLE 4-1. EXCITER - LPA CONTROL CIRCUITS (Cont)

COMMAND	FROM	TO	CONTROLLING FUNCTION
Amplifier Off	Exciter	LPA	Remove standby power.
Inhibit	Exciter	LPA	Readback to LPA. Indicates forthcoming "tune" command.
Keyline	Exciter	LPA	Places rf amplifier on-the-air.
Average Power Control (APC) Peak Power Control (PPC)	LPA	Exciter	DC control voltage. For single-tone signals level is function of average rf power output. For multi-tone signals level is function of peak rf power output.
Transmitter Gain Control (TGC)	LPA	Exciter	DC control voltage. Level is function of rf power output.

TABLE 4-2. LCU - EXCITER CONTROL CIRCUITS

COMMAND	FROM	TO	CONTROLLING FUNCTION
Frequency Selection	LCU	Exciter	Frequency selection by Control-Indicator, Transmitter C-7709/FRT (remote control unit) (RCU).
Class of Emission	LCU	Exciter	Mode selection by remote control unit.
Sideband Selection	LCU	Exciter	Sideband selection by remote control unit.
Operating Power	LCU	Exciter	Standby and operate conditions by remote control unit.
Tune-Activate	LCU	Exciter	Tuning cycle command by remote control unit.
<u>READBACK</u>			
Class of Emission	Exciter	LCU	Return signal, emission selection made.
Standby/Operate	Exciter	LCU	Return signal, standby or operate condition accomplished.
Sideband Selection	Exciter	LCU	Return signal, sideband selection made.
Ready	Exciter	LCU	Return signal, tuning cycle completed.
Fault	Exciter	LCU	Indication, fault condition in transmitter system.
Local Status	Exciter	LCU	Return signal, exciter under local rather than remote control and/or transmitter not available.

For detailed information regarding the origination and use of command and control signals at the LPA and LCU units, refer to the individual technical manuals for these units (NAVSHIPS 0967-292-9010, 0967-293-0010, 0967-293-1010, 0967-293-2010, or 0967-292-9050 as applicable).

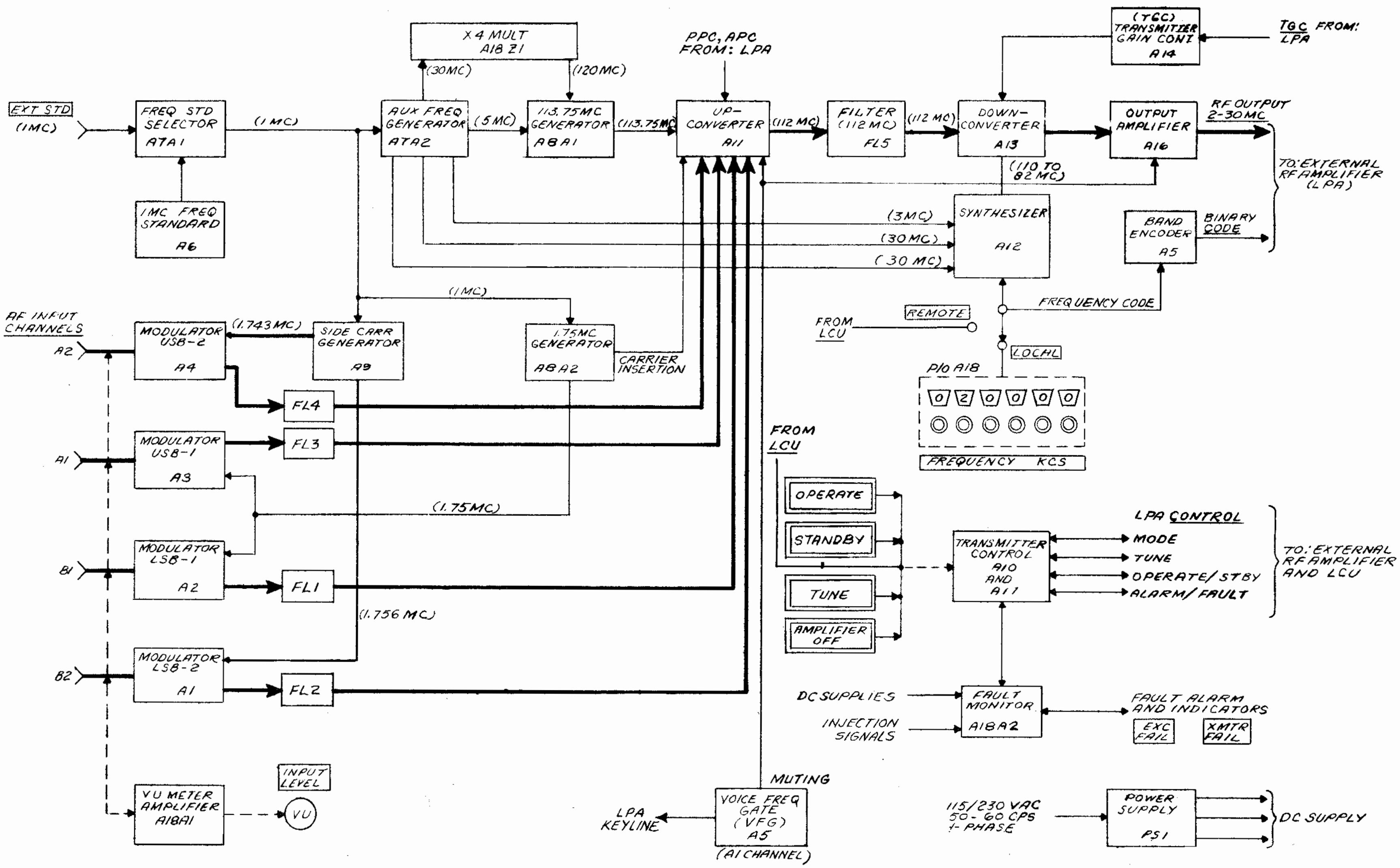

Figure 4-2. **Modulator-Synthesizer** MD-777/FRT, Functional Block Diagram

c. BASIC OVER-ALL FUNCTIONAL DESCRIPTION. - Figure 4-2 is a block diagram of the exciter, showing the functional relationship of the various circuits. The exciter is designed to drive a linear high-power amplifier (LPA). Suitable drive consists of:

(a) Providing proper modulation and carrier signals, consistent with the selected mode of operation.

(b) Control of operating frequency.

(c) Power control.

In addition, the exciter is designed to provide certain auxiliary functions and capabilities. These are:

(a) Control of LPA automatic tuning.

(b) Remote control operation.

(c) Automatic fault monitoring (providing equipment shut-down in case of malfunction).

(d) Built-in metering circuits (to indicate normal equipment operation and to aid in the location of faulty circuits during equipment malfunction).

The functions and capabilities outlined above are to some extent interrelated; they may, however, be considered separately for the purpose of this over-all description.

(1) MODULATION AND CARRIER. - Modulation and carrier signals are combined (in the correct ratio for the selected mode of operation) in up-converter A11. The modulation signals are obtained from modulators A1 through A4, and the carrier signal is obtained from 1.75 mc/113.75 mc generator A8. Table 4-3 gives the characteristics of each mode of operation, together with the settings of the front panel CLASS OF EMISSION and SIDE-BAND SELECTOR switches required to select the mode. Figure 4-3 shows the relationship of the four modulation channels. The outboard channels (A2 and B2) are inverted by a reference carrier (from side-carrier generator A9) for compatibility with existing equipment.

All modulation channels are similar, and function in the following manner: The audio input signal applied to the exciter is set to a nominal -35 dbm level by its associated INPUT LEVEL -dbm control before being applied to the modulator. The modulator converts the audio signal to a first intermediate frequency of approximately 1.75 mc. An automatic level control (ALC) circuit in the modulator limits its peak power output. This helps to control signals with large peak-to-average ratios, and permits the modulator to be overdriven by up to 10 db without affecting LPA power output or performance. Modulator output is passed through a sideband filter to obtain the appropriate sideband and inter-channel cross-talk performance. The outputs of the four modulation channels are combined in the up-converter. The composite signal at the output of the up-converter is centered at 112 mc.

(2) CONTROL OF OPERATING FREQUENCY. - Figure 4-4 shows the plan by which all injection frequencies are derived. The exciter signal path requires five phase locked frequencies. They are: 1.75 mc for inboard channel modulation and carrier insertion, 1.756290 mc for lower sideband outboard channel, 1.743710 mc for upper sideband outboard channel, 113.75 mc for up-conversion of the modulation and carrier to 112 mc, and a variable frequency of from 82 to 110 mc for final conversion of the 112 mc signal to the exciter output frequency range of 2 to 30 mc (nominal). As shown in figure 4-4, all frequencies are phase-related to 1 mc frequency standard A6. The 1.75 mc signal is obtained by direct multiplication and division of the 1 mc signal, and all other frequencies are derived by means of phase-locked oscillators. Figure 4-5 shows the conversions which occur along the signal path.

TABLE 4-3. EXCITER CHARACTERISTICS IN EACH MODE OF OPERATION

MODE	POWER LEVEL	CLASS OF EMISSION	SIDEBAND SELECTOR	CHARACTERISTICS
A0	-3 db PEP	A0	Any	A0 is a continuous carrier (cw) with no modulation. PPC/APC feedback from the LPA functions as an average power control.
A1	-3 db PEP	A1F1F4	USB or LSB	A1 is an interrupted cw signal obtained by keying the usb or lsb modulator with an audio signal. This signal is usually obtained from Keyer KY-655/FRT. The LPA output is thus offset from the assigned carrier frequency by the audio frequency (1000 cps in the KY-655/FRT).
F1	-3 db PEP	A1F1F4	USB or LSB	F1 is an FSK (frequency shift keyed) signal obtained from the KY-655/FRT. It is applied to either the usb or lsb modulator.
F4	-3 db PEP	A1F1F4	USB or LSB	F4 is an FSK signal where the frequency shift is proportional to the amplitude of the modulating signal, and is used for facsimile transmission. It is obtained from the KY-655/FRT. NOTE In the A1, F1, and F4 modes the normal carrier is fully suppressed. LPA keyline control is obtained from the KY-655/FRT. PPC/APC feedback from the LPA functions as an average power control.
A2	Carrier -6 db PEP; modulation -6 db PEP; single-tone total power full PEP.	A2,A3e	Any, but exciter is automatically set to USB. VFG or PTT may be used.	A2 is a modulated cw signal consisting of a continuous carrier 6 db below PEP, with a keyed audio input applied to the usb channel.

TABLE 4-3. EXCITER CHARACTERISTICS IN EACH MODE OF OPERATION (Cont)

MODE	POWER LEVEL	CLASS OF EMISSION	SIDEBAND SELECTOR	CHARACTERISTICS
A3e	Carrier -6 db PEP; modulation -6 db PEP; single-tone total power full PEP.		USB VFG (USB) PTT (USB)	A3e is an amplitude modulated equivalent signal which can be detected by conventional AM receivers. It consists of a continuous carrier 6 db below PEP, with voice modulation applied to the usb channel. In this mode, keyline control is optional depending on the SIDEBAND SELECTOR. In USB the keyline is automatically closed; in VFG the keyline is automatically closed when modulation is applied; in PTT the keyline is closed manually via an external switch. NOTE In the A2, A3e modes the APC/PPC feedback from the LPA functions as a peak power control and affects only the modulation (an AM signal, by definition, has a fixed level carrier).
A3a	-3 db PEP single-tone; full PEP with normal modulation.	SSB -40 SSB -20 SSB -10	LSB USB VFG (USB) PTT (USB)	A3a is a single-sideband signal with reduced carrier. This reduced carrier, selected via the CLASS OF EMISSION switch, is used to operate receiver afc circuits. Modulation is applied to either sideband and, in the case of usb operation, VFG or PTT may be employed. APC/PPC and keyline control is as described for A3e operation.
A3b	Full PEP	SSB -40 SSB -20 SSB -10	2 ISB	A3b is an independent-sideband reduced carrier signal. The reduced carrier is selected via the CLASS OF EMISSION switch. Modulation is applied to

TABLE 4-3. EXCITER CHARACTERISTICS IN EACH MODE OF OPERATION (Cont)

MODE	POWER LEVEL	CLASS OF EMISSION	SIDEBAND SELECTOR	CHARACTERISTICS
A3b Cont				the usb and lsb (A1 and B1) channels. The exciter power output is automatically adjusted by means of a 3 db attenuator to account for two channel operation. Keyline control is automatically closed. APC/PPC functions as a peak power control.
A3j	-3 db single-tone; full PEP with normal modulation.	SSB ∞	LSB USB VFG (USB) PTT (USB)	A3j is a single-sideband signal with no transmitted carrier. Infinite carrier suppression is selected via the CLASS OF EMISSION switch. Modulation is applied to either lsb or usb (A1 or B1). Channel is selected via the SIDEBAND SELECTOR. PTT or VFG operation may be used, as described for A3e.
A9b	Full PEP	SSB ∞ SSB -40 SSB -20 SSB -10	4 ISB	A9b is a composite four channel independent-sideband transmission with reduced or fully suppressed carrier. Carrier level is selected via the CLASS OF EMISSION switch. Modulation is applied to all four channels. Exciter power output is automatically adjusted for four channel operation by inserting a 6 db attenuator. Each channel has one fourth of the transmitter power. NOTE In the A3a, A3b, A3j, and A9b modes APC/PPC feedback functions as a peak power control. Except for VFG and PTT operation in the A3j mode, keyline control is automatic.

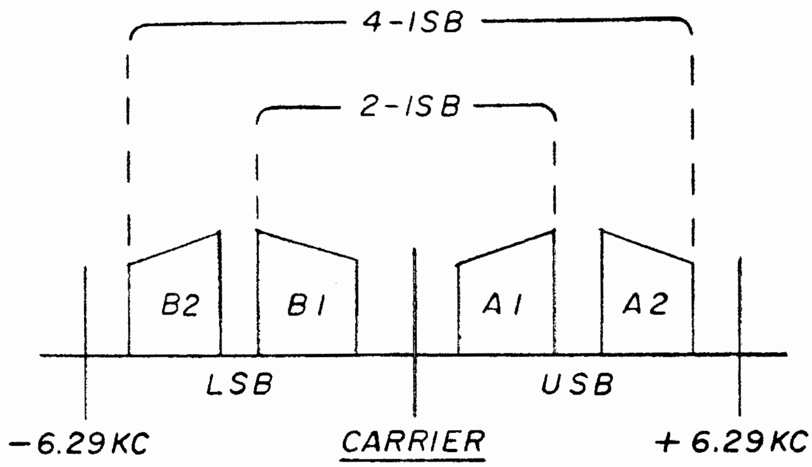

Figure 4-3. AF Channel Distribution

(3) POWER CONTROL. - Automatic power control in the transmitter system is primarily accomplished by transmitter gain control (TGC) module (A14). Adjustment of power by means of this module takes place during the transmitter tune cycle. During the tune cycle, the exciter generates a -6 db PEP carrier signal. Acting upon information returned from a detector in the LPA, the TGC adjusts system gain at the down-converter module (A13) thus eliminating any variation in the over-all system.

After tuning, power control is obtained by use of the APC/PPC feedback from the LPA. The feedback is applied to a variable-gain signal amplifier in the up-converter. As a secondary power control, the ALC network in each modulator helps keep the power correctly adjusted in certain modes of operation.

In addition to the automatic power control just described, manual channel gain ratio controls are provided. These controls may be used to adjust the balance of power between channels in ISB operation, or to manually control power output in any mode of operation which employs the modulators. These controls reduce power relative to the automatic setting.

(4) CONTROL OF LPA AUTOMATIC TUNING. - Transmitter system tuning is a fully automatic function normally accomplished by depressing the TUNE button on the exciter front panel. The following sequence of operations occurs:

(a) An "inhibit" command is sent to the LPA, and the output of the exciter is immediately reduced to zero.

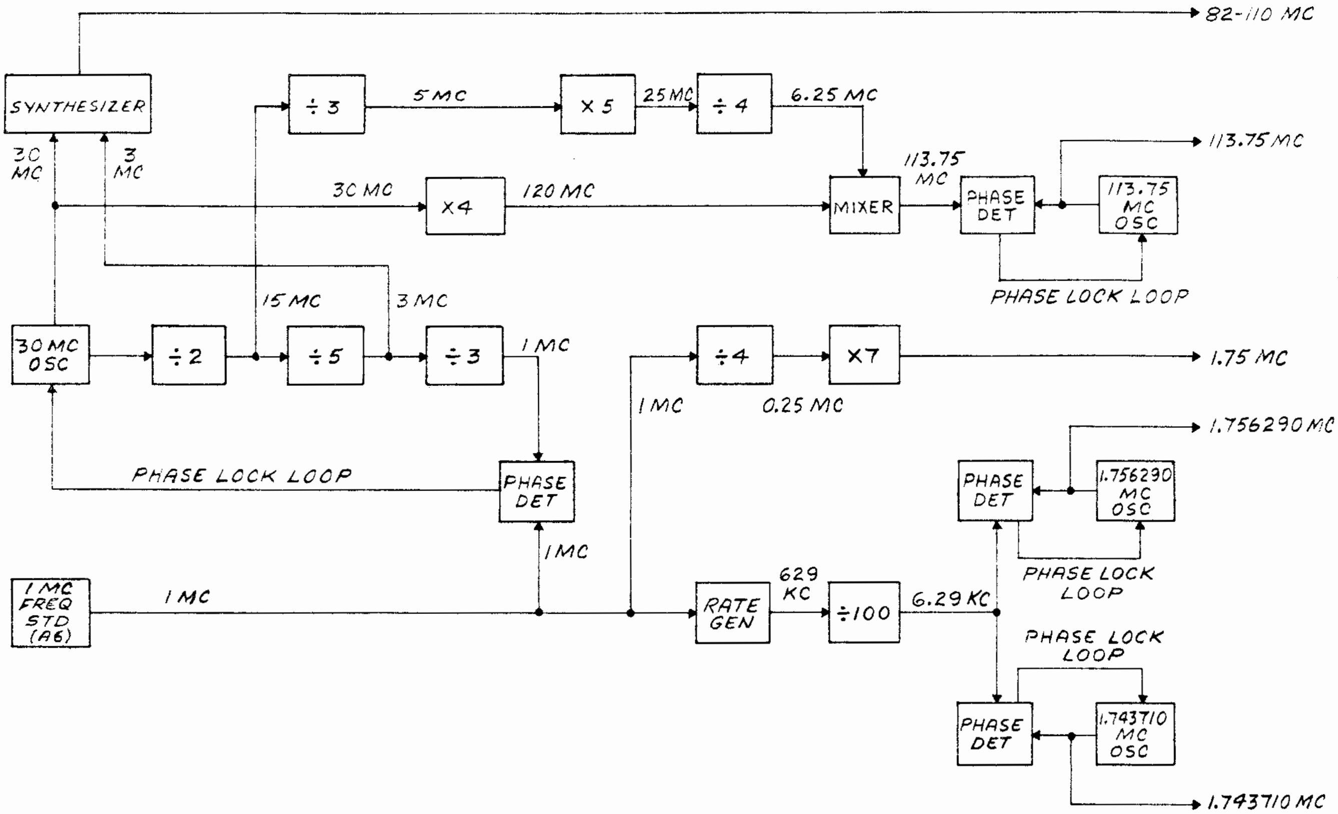

Figure 4-4. Frequency Derivation Plan

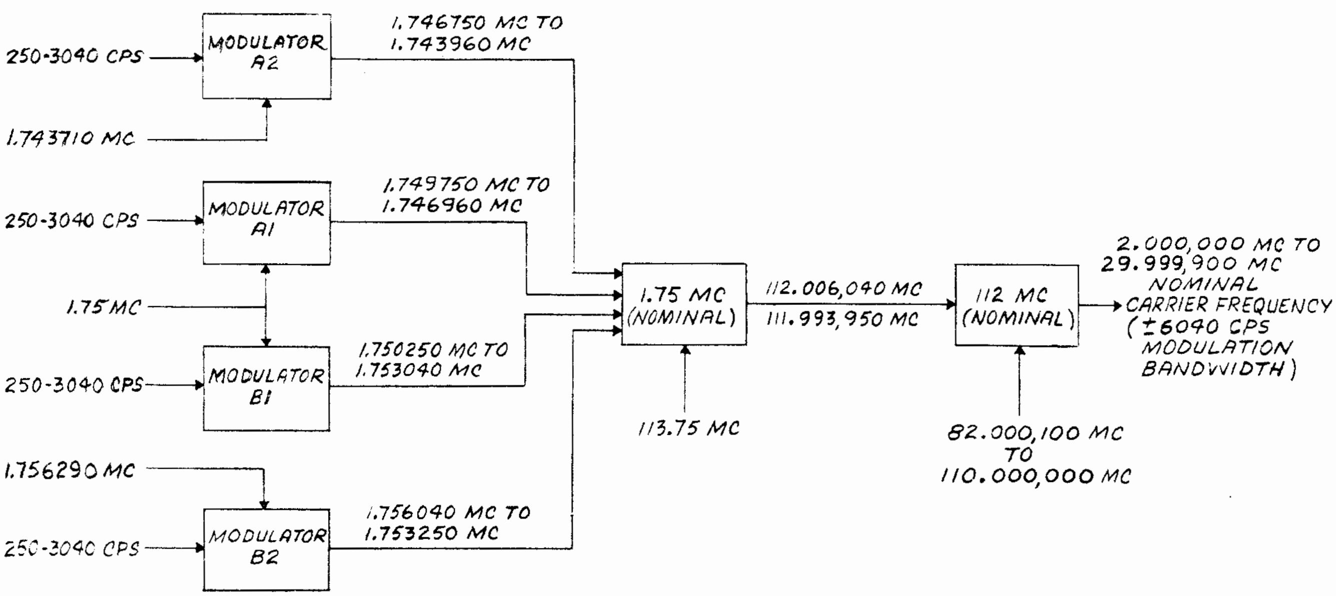

Figure 4-5. Signal Path Frequency Conversions

(b) The TGC motor turns the power control to the minimum gain position and closes the "tune activate" contacts.

(c) The "tune activate" command is sent to the LPA.

(d) When the LPA is ready to tune, it sends a "tune enable" command to the exciter. This command turns on the carrier at a level preset at -6 db PEP. The LPA servos now tune and load the system. A detected output sample from the LPA (TGC feedback) continually adjusts the exciter drive level to the LPA, thus compensating any gain variation due to frequency response.

(e) When the system is correctly tuned and is at the proper drive level, the "tune enable" signal is discontinued and the exciter stops sending the tune carrier signal.

(f) The LPA now sends a "ready" command to the exciter. The exciter then functions in accordance with the settings of the front panel controls.

The transmitter automatic tuning control sequence is governed by exciter module A10, transmitter control no. 1.

(5) REMOTE CONTROL OPERATION. - The exciter can be remotely controlled using Control-Indicator, Transmitter C-7709/FRT (RCU) and Decoder-Encoder KY-656/FRT (LCU). The following functions may be controlled by the RCU.

(a) Mode of operation.

(b) Frequency.

(c) Power (operate or standby condition).

(d) LPA tuning.

The mode of operation, power, and tuning functions are controlled via the remote control circuits of transmitter control module no. 2 (A17). Frequency is controlled by direct digital interface with the frequency synthesizer. All other exciter operational controls such as INPUT LEVEL, CHANNEL GAIN RATIO, etc., must be preset for normal operation before switching the exciter to REMOTE. When the equipment is in the REMOTE condition, adjustments of exciter frequency, mode of operation, operate, standby, and tune controls will not effect the operation of the equipment.

(6) AUTOMATIC FAULT MONITORING. - The exciter contains built-in circuit monitoring facilities which will shut the system down to "standby" status in the event of the failure of a circuit being monitored. Ten monitoring points are used. These encompass all power supply outputs and all signal path injection frequencies. In the event of a failure, the equipment goes to "standby" and a warning light on the front panel shows EXC FAIL. In addition, the system can be shut down by external commands from the LPA, Keyer, or the LCU. In the case of the two latter stimuli, shut down will only occur in those modes of operation employing the particular equipment (A1F1F4 mode for the Keyer or REMOTE for the LCU).

(7) METERING FACILITIES. - Internal metering is provided to help locate problems and provide convenient monitoring of normal operation. The monitoring points used for the automatic circuits previously described are also available on the meter. By using the FAULT OVRD switch, the meter may be used to locate the cause and failure. Other useful monitoring facilities are also provided. A VU meter is used in conjunction with the INPUT LEVEL -dbm controls to set the correct input level to each modulator module.

4-4. FUNCTIONAL CIRCUIT DESCRIPTION AND TROUBLE SHOOTING.

The following paragraphs describe the operation of each circuit in the exciter. Trouble shooting information and test data is provided to assist the maintenance technician in diagnosing the malfunction and locating the cause of trouble.

Simplified schematic diagrams are provided, as applicable, to identify the functional circuits within a module and to supplement the circuit descriptions. Servicing block diagrams are supplied to show the circuit stage arrangements and for use as an aid in trouble shooting. Whenever possible, simplified schematic diagrams are located in the text adjacent to the circuit discussion for quick reference. All servicing block diagrams are located at the end of this section. Refer to Section 5, Maintenance, for module removal and replacement procedures.

Note

> For technical reasons which will become obvious, the exciter is assumed to be operating as a part of the complete transmitting system for all trouble shooting procedures.

a. TROUBLE SHOOTING. - Unless otherwise noted, all trouble shooting procedures are performed with the exciter energized. Major circuit test points equipped with test jacks are exposed for measurements when the exciter chassis is withdrawn from its enclosure and the hinged deck section is opened. Refer to Section 5, Maintenance, for illustrations showing the location of each plug-in module and its circuit components, and for circuit schematic diagrams and module interconnection diagrams. The following trouble shooting information, in the order presented, is supplied for each circuit module.

(1) PRELIMINARY CHECK. - This paragraph describes initial checks to be made before performing the detailed trouble shooting procedure.

(2) TEST EQUIPMENT. - A list of test equipment and special tools (if required) for trouble shooting is contained in this paragraph.

(3) CONTROL SETTINGS. - Table 3-1, Section 3, gives the function of all exciter operating controls. It also lists the initial control settings to be made prior to operating or trouble shooting the equipment. Any change in a control setting from that given in table 3-1 is supplied in this paragraph when required for a particular trouble shooting step.

(4) TEST DATA. - This paragraph contains test information and test data to aid the technician in locating a faulty module or circuit.

b. REFERENCES. - Refer to the Handbook for Electronic Circuits (NAVSHIPS 0967-000-0120) for a description of conventional electronic circuits used in this and similar equipment.

WARNING

> Dc potentials as high as 125 volts are present in the power supply circuits. Avoid contact.

4-5. FREQUENCY STANDARD A6. (See figure 4-6.)

The 1 mc frequency standard (A6) is a sealed module containing a solid state crystal oscillator and amplifier circuit, enclosed in a temperature controlled oven. Faulty operation of this module will cause frequency standard selector circuit A7A1 to select the external 1 mc frequency standard as a substitute signal source. In this event the STD FAIL indicating panel lamp will light.

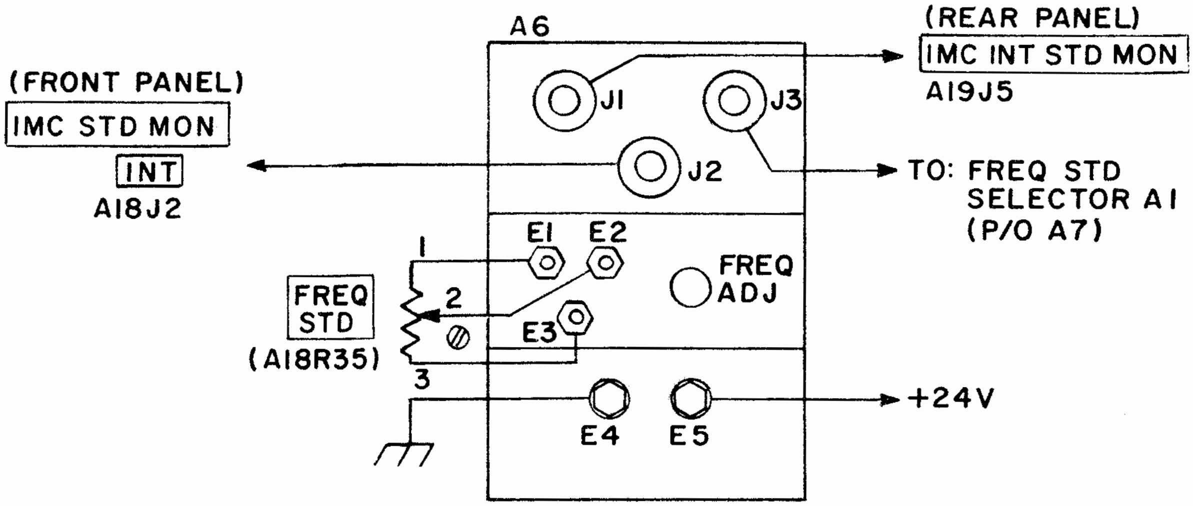

Figure 4-6. Frequency Standard, Simplified Schematic Diagram

a. DESCRIPTION. - The 1 mc frequency standard requires a +24 volt dc operating voltage. Total operating power, when the oven is on, is 15 watts. The standard frequency stability is one part in 10^9 per 24 hours. Nominal 1 mc output level is 1.0 volts rms with a 50 ohm load. The FREQ STD control on the auxiliary control panel serves as a crystal oscillator calibration control; the ten-turn numbered dial permits logging calibration adjustments. A coarse mechanical frequency adjustment is provided on the frame of the standard for use when the range of the electronic control is exceeded.

b. PRELIMINARY CHECK. (See figure 5-90.) - Make a preliminary check of the frequency standard before trouble shooting, with emphasis on the following:

(1) Cable connections at A6J1, A6J2, and A6J3.

(2) Soldered connections at the module terminals.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Frequency Counter AN/USM-207. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1.

e. TEST DATA. (See figure 5-90.) - Trouble shooting the 1 mc frequency standard consists of checking the +24 volts dc operating potential and measuring the standard output frequency.

(1) Connect multimeter to terminal 4 of the frequency standard. Meter should read +24 volts dc ±10%.

(2) Connect frequency counter to the 1 MC STD MON, INT connector (A18J2) on the front panel. Counter should read 1000.0000 kc, ±1 count.

Note

A frequency measurement using the counter is sufficient to verify circuit operation. For maximum accuracy, repeat the calibration procedure in paragraph 2-5c, Section 2. (Most counter frequency standards are less accurate than the exciter frequency standard.)

4-6. AUXILIARY FREQUENCY GENERATOR A7. (See figures 4-40 and 5-66.)

The auxiliary frequency generator module contains the frequency standard selector circuit (A7A1), the 30 mc oscillator buffer circuit (A7A2) and the 30 mc phase lock loop (A7A3). Faulty operation of the selector circuit can prevent automatic selection of the external frequency standard, in the event of a malfunction by the internal frequency standard, or can prevent exciter unit operation completely. Faulty operation of the 30 mc circuits will affect operation of the synthesizer (A12) and the 113.75 mc generator (A8), and can prevent exciter operation completely.

a. DESCRIPTION. - The auxiliary frequency generator (A7) module contains two separate circuits serving independent and unrelated functions. The frequency standard selector (A7A1) continually compares the internal and external 1 mc frequency standard output levels. Normally, the internal standard provides the 1 mc frequency for exciter operation. If the output level drops more than 3 db, the selector circuit automatically substitutes the external standard output and lights the STD FAIL indicator on the front panel. If the internal standard level returns to normal, the selector circuit reverses the switching procedure and extinguishes the STD FAIL indicator lamp.

In addition, the selector circuit contains a phase detector for calibrating the internal standard against the external standard. For this application the CIRCUIT TEST meter on the exciter panel serves as a null indicator at the detector output. The resultant beat indication is a direct function of the frequency correlation between the two standards.

The 3, 5, and 30 mc outputs of auxiliary frequency generator A7 are developed from a 30 mc oscillator (A7A2) which is phase locked to the 1 mc standard. The 30 mc signal is digitally divided by ten and six to produce the 3 and 5 mc signals. The 30 mc output is supplied through three buffer amplifiers in A7A3 to synthesizer module A12 and to chassis-mounted multiply-by-four circuit A18Z1. The 3 mc output is also supplied to synthesizer module A12. The 5 mc output is supplied to 1.75/113.75 mc generator A8.

Note

Refer to paragraph 4-14b(4) for a basic description of NAND gate operation and a discussion of the digital terminology used in the following paragraphs.

(1) FREQUENCY STANDARD SELECTOR A7A1. - The frequency standard selector contains an automatic switching circuit consisting of differential amplifier Q2 and Q4; buffer stages Q1, Q3, and Q5; amplifier Q6; quad NAND gates Z2; and two sections of quad NAND gates Z1 (Z1-3 and Z1-6). The phase detector circuit uses one section of quad gate Z1 (Z1-8); and the failure alarm circuit uses the remaining section of quad gate Z1 (Z1-10), and buffer stage Q7.

(a) STANDARD SELECTOR CIRCUIT. - A 1 mc internal standard signal is applied via transformer T1 to the bases of buffer Q1 and differential amplifier Q2. The base-emitter junction of Q2 rectifies the signal and the resultant dc voltage is compared with a dc voltage at the base of Q4, supplied by voltage divider resistors R8 and R9, and differential trip control R10. Control R10 adjusts the difference amplifier balance or "trip" point at which a drop in the 1 mc internal standard signal will cut off Q2. Prior to a switching cycle, the 1 mc signal level is normal causing Q2 to saturate which in turn saturates Q5 to place a low (ground) condition at gate input Z2-12. Gate output Z2-11 goes high driving gate inputs Z2-2, Z2-10, and Z1-12 high, also.

At the same time, the 1 mc internal standard signal at the base of buffer Q1 appears, via bias diode CR1, at gate input Z1-1. The negative signal alternation at the gate input produces a 1 mc square wave (high) at output Z1-3, and also at gate input Z1-9 and Z2-9. Since input Z2-10 is already high (from output Z2-11), output Z2-8 now produces 1 mc square waves to drive the base of amplifier Q6. The 1 mc output from Q6 is applied to side carrier generator module A9 and 1.75/113.75 mc generator module A8.

If the 1 mc internal standard signal level drops 3 db or more, because of a circuit malfunction, Q2 becomes cut-off and in turn cuts off Q5. This action places a high at gate input Z2-12, driving output Z2-11 low. This low at gate input Z2-10 (and also at gate inputs Z2-2 and Z1-12) opens the 1 mc internal standard circuit to the base of amplifier Q6, effectively disconnecting the internal standard.

The 1 mc external standard signal at the base of buffer Q3 appears at gate input Z1-4, via bias diode CR2. The negative signal alternation at the gate input produces a 1 mc square wave (high) at output Z1-6, driving input Z2-5 high. Since gate input Z2-4 is already high (when the internal standard level dropped, it placed a low at gate input Z2-2 to drive output Z2-3 high), the 1 mc output from gate Z2-6 now drives the base of amplifier Q6. In this manner, a 1 mc standard frequency is maintained at the output of Q6 from either the internal or external frequency standard, to assure a continuation of exciter operation in the event of circuit failure in the internal standard.

When the 1 mc internal standard signal level returns to normal, Q2 and Q5 again become saturated, driving gate outputs Z2-8 and Z2-11 high as before. The internal standard replaces the external standard and the automatic switching cycle is completed. Although a 3 db drop in level is necessary to substitute the internal standard signal with that from the external standard, a resubstitution will not occur until the internal standard level rises to within 1.5 db of normal level. This switching cycle overlap assures reliable circuit operation and immunity from the affects of circuit noise. Resistor R11 at gate input Z2-10 provides the overlap. Prior to initiation of a switching cycle, Q2 and Q5 are saturated and gate output Z2-11 is high. The gate output voltage, via resistor R11, is superimposed on the base bias voltage of differential amplifier Q4 to set the initial 3 db "trip" point. When switching has been accomplished and the external standard is in use, Q2 and Q5 are cut-off and gate output Z2-11 is low. Consequently, the trip point is determined by the adjustment of control R10 only, and the internal standard is resubstituted when its output level is 1.5 db below normal rather than at the 3 db "drop-out" level.

Although not intended for use in this equipment, provisions have been incorporated in the standard selector circuit for manual rather than automatic selection of the frequency standard in use. If terminal 16 at resistor R2 is grounded, thus grounding gate input Z2-13, gate output Z2-11 will go high and select the internal standard. If terminal 4 at resistor R1 is grounded, thus grounding gate input Z1-12, gate output Z2-11 will also be grounded (a low) and select the external standard.

(b) FAILURE ALARM CIRCUIT. - When frequency standard switching is initiated, following a drop of 3 db in the internal standard output level, gate output Z2-11 goes low and effectively grounds gate input Z1-12. Gate output Z1-11 goes high to drive buffer amplifier Q7 and operate the failure alarm circuit at the output of Q7. This action lights the STD FAIL indicating lamp on the exciter front panel, and also other STD FAIL indicators present in the transmitting system. Upon return of the internal standard to operation, accompanied by a high at gate input Z2-11, gate input Z1-12 goes high to drive output Z1-11 low. This extinguishes the STD FAIL lamp and opens the failure alarm output circuit.

(c) PHASE DETECTOR CIRCUIT. - The phase detector circuit receives a portion of the internal standard output at gate input Z1-9 via gate Z1-3, and a portion of the external standard output at gate input Z1-10 via gate Z1-6. This section of quad gate Z1 serves as a digital phase-detector and provides a square wave output voltage at gate output Z1-8 which is a function of the phase relation between the two frequency standard signals. Resistor R12 and capacitor C5 integrate the gate output to obtain a dc voltage level which is proportional to the square wave duty cycle.

The CIRCUIT TEST selector on the front panel, when placed in the FREQ STD LOCK position, connects the associated panel meter to a null indicating circuit. The "beat" meter indications occur at a rate which is relative to the phase coincidence between the two frequency standards, and are used to calibrate the internal standard against the external standard.

(2) 3/5/30 MC GENERATOR CIRCUIT. - The 3, 5 and 30 mc generator circuit contains a 30 mc phase-locked oscillator A7A2, frequency dividers and a phase detector circuit (A7A3) and a frequency divider located on A7A1.

The circuit consists of a voltage-controlled 30 mc oscillator, a three stage digital frequency divider (÷2, ÷5, and ÷3), and a phase detector. These circuits are connected in a conventional phase-locked-loop configuration.

A 1 mc reference signal for the phase detector is supplied from the frequency standard via incidental filter and amplifier circuits in 115/113.75 generator A8A2. The comparison 1 mc signal for the phase detector is developed by dividing the 30 mc output of the oscillator by 2 to obtain 15 mc, by 5 to obtain 3 mc and then by 3 to obtain 1 mc. The dc output of the phase detector is used as the control signal for the voltage-controlled 30 mc oscillator, as is common with phase-locked oscillators.

An output of the divide-by-two circuit of the phase-lock loop is taken as the 15 mc output and is supplied to the divide-by-three circuit in A7A1 to obtain the 5 mc output for 1.75/113.75 generator A8. An output from the divide-by-five circuit is taken as the 3 mc output and is supplied to synthesizer module A12.

Three 30 mc outputs are provided by buffer amplifier circuit A7A3; two as source-frequency signals to synthesizer A12, and one to X4 frequency multiplier A18Z1. The resultant 120 mc output of the X4 multiplier is supplied to the 113.75 mc frequency generating circuits (A8A1) of 1.75/113.75 mc frequency generator A8.

b. PRELIMINARY CHECK. (See figure 5-66.) - Make a preliminary check of the auxiliary frequency generator before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections to socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Frequency Counter H-P 5245L with Frequency Converter H-P 5253A. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place exciter in "operate" condition.)

e. TEST DATA. (See figure 5-66.) - Trouble shooting the auxiliary frequency generator consists of checking the +5 and +15 volt dc operating potentials and measuring the output frequencies at chassis connector A18XA7.

(1) Connect multimeter to XA7 pin K. Meter should read +5 vdc ±5%.

(2) Connect multimeter to XA7 pin P. Meter should read +15 vdc ±5%.

(3) Connect frequency counter to XA7 pin F. Counter should read 1.000000 ±1 count.

(4) Connect frequency counter to XA7 pin U. Counter should read 30.000000 mc ±1 count.

(5) Connect frequency counter to XA7 pin V. Counter should read 30.000000 mc ±1 count.

(6) Connect frequency counter to XA7 pin X. Counter should read 30.000000 mc ±1 count.

(7) Connect frequency counter to XA7 pin B. Counter should read 1.000000 mc ±1 count.

(8) Connect frequency counter to XA7 pin D. Counter should read 5.000000 mc ±1 count.

(9) Connect frequency counter to XA7 pin T. Counter should read 3.000000 mc ±1 count.

4-7. 1.75/113.75 MC FREQUENCY GENERATOR A8. (See figures 4-41 and 5-67.)

The frequency generator module contains the 1 mc filter (p/o A8A2), the 1.75 mc generator (p/o A8A2), and the 113.75 mc generator (A8A1). Faulty operation of these circuits will affect operation of up-converter A11 and/or modulators A2 and A3, and can prevent exciter operation completely.

a. DESCRIPTION. - The 1.75/113.75 frequency generator module contains two separate but functionally related circuits. The 1.75 mc generator (A8A2) develops a 1.75 mc frequency, using both conventional and digital circuit techniques, from a 1 mc standard input frequency. The A1 and B1 audio channel modulators (A2 and A3) receive 1.75 mc generator output for use as an injection frequency. The 113.75 mc generator (A8A1) employs a phase-locked, voltage-controlled oscillator (VCO) to generate a precise 113.75 mc frequency. A 5 mc standard frequency supplied by auxiliary frequency generator A7, and a 120 mc standard frequency from X4 multiplier A18Z1, control and "lock" the oscillator. The 113.75 mc oscillator output is applied to up-converter A11 as the second injection frequency for conversion to a 112 mc signal path (carrier) frequency.

Note

Refer to paragraph 4-14b(4) for a basic description of J-K flip-flop operation and a discussion of the digital terminology used in the following paragraphs.

(1) 1.75 MC FREQUENCY GENERATOR A8A2. (See figures 4-41 and 5-67.) - The 1.75 mc frequency generator contains 1 mc crystal filter Y1 with input and output buffer amplifiers Q1, Q2, and Q3, Q4, respectively. The filtered 1 mc output at Q4 is supplied to auxiliary frequency generator A7 and to the input of the divide-by-two circuit Z1. The output of Z1 (500 kc square wave) is applied to a filter network (L1, L2, C7, C8, C9). The filter selects the seventh harmonic (3-5 mc) and is followed by divide-by-two J-K flip-flop Z2 and its input and output buffer amplifiers, Q5, Q6, and Q7, to provide 1.75 mc.

(a) 1 MC FILTER AND 500 KC HARMONIC GENERATOR. (See figure 4-7.) - A 1 mc square-wave signal from frequency standard selector A7A1 is amplified by input buffer stage Q1 and Q2, and passed through 1 mc crystal filter Y1 to output buffer stage Q3 and Q4. The crystal filter converts the square wave input signal to a 1 mc sine wave. The 1 mc sine wave is also applied, via terminals 5 and 6, to the 3/5/30 mc circuits in auxiliary frequency generator A7. In addition to dividing the 1 mc sine wave by a factor of two, flip-flop Z1 also serves as a harmonic generator. The output at Z1-9 contains a high order of 500 kc harmonics which are applied to the input of the 1.75 mc frequency generator circuit.

(b) 1.75 MC FREQUENCY GENERATOR. (See figure 4-8.) - The 500 kc harmonics at flip-flop Z1-9 are applied to a two-section, 3.5 mc bandpass filter consisting of tuned circuits L2, C7, and L1, C9, coupled by capacitor C8. The 3.5 mc (seventh) harmonic of 500 kc is selected by the filter, amplified by buffer stage Q5 and Q6, and applied to the divide-by-two flip-flop at input Z2-2. Flip-flop output at Z2-9 is a 1.75 mc square wave which is amplified by Q7 and applied to the circuit output termination via output transformer T2. The transformer primary is tuned to 1.75 mc by capacitor C13. Adjustment

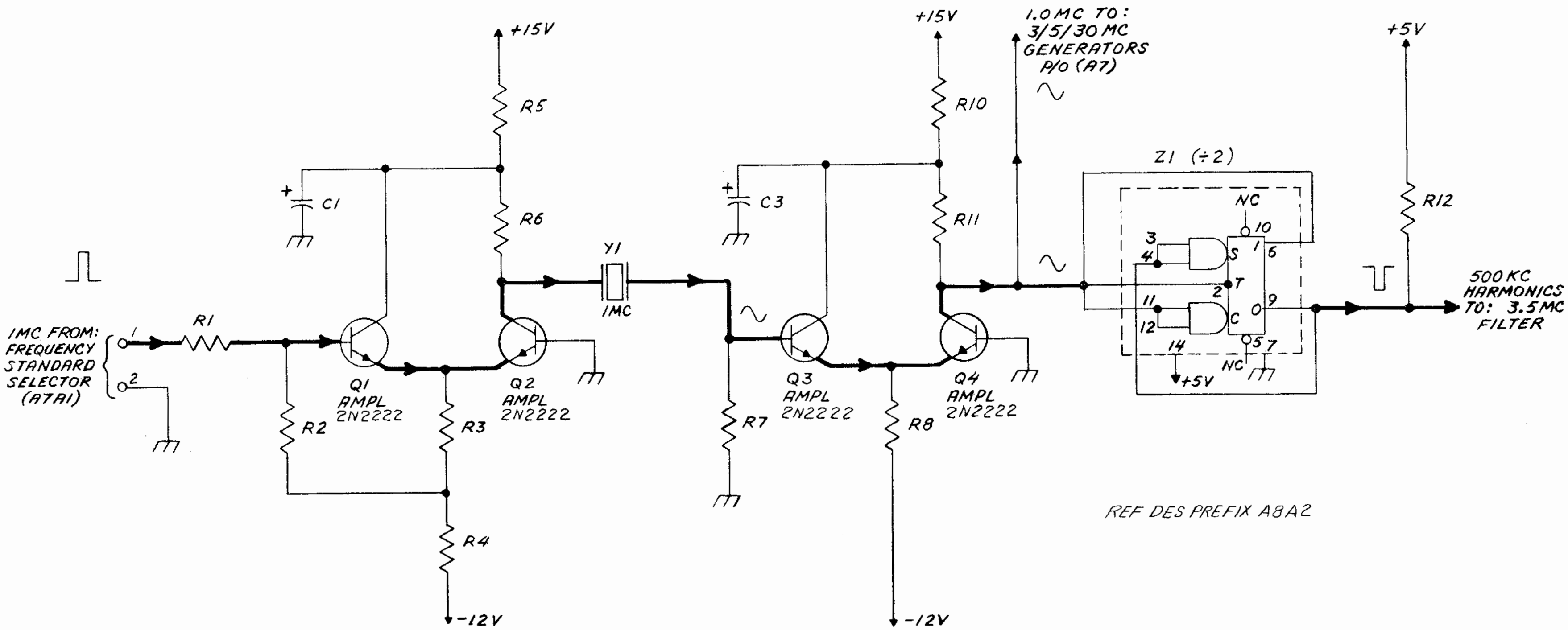

Figure 4-7. 500 Kc Harmonic Generator, Simplified Schematic Diagram

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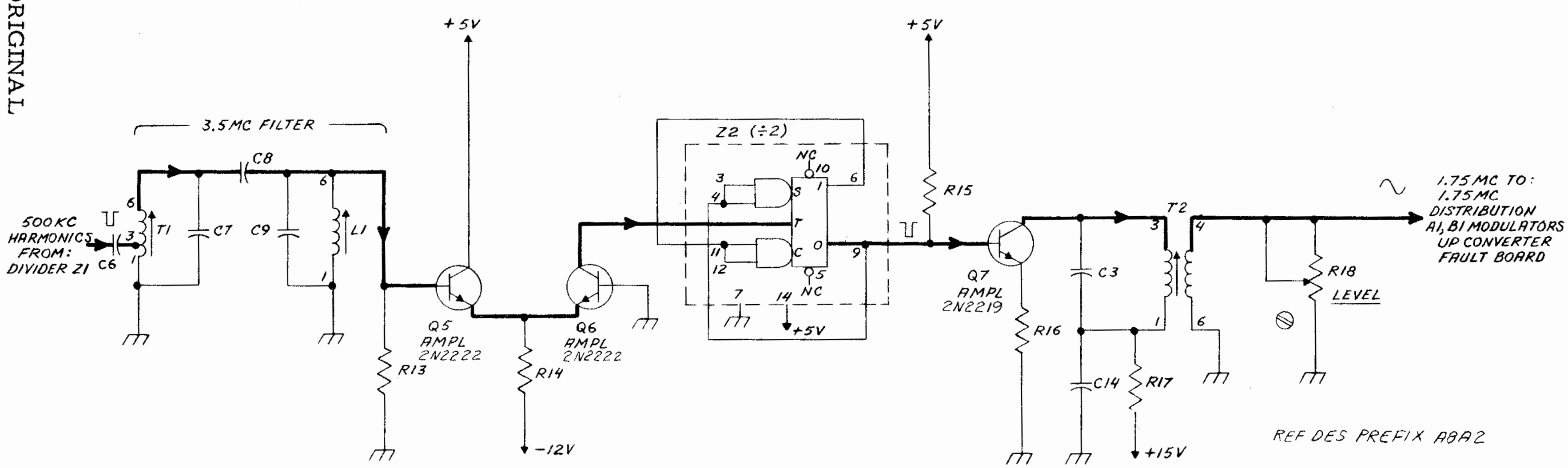

Figure 4-8. 1.75 Mc Frequency Divider, Simplified Schematic Diagram

R17 establishes the level of the 1.75 mc injection frequency applied to the channel A1 and B1 modulators (A2 and A3).

(2) 113.75 MC FREQUENCY GENERATOR A8A2. (See figure 4-9.) - The 113.75 mc frequency generator contains a frequency multiplier-divider circuit (Q1, Q3, Q4, Z1, and Z2) which produces a 6.25 mc output frequency from a 5 mc input frequency. The multiplier-divider is followed by phase detector Z4 and dc amplifier Q10, Q12. The phase detector output is used to control the frequency of 113.75 mc VCO, Q11. The 113.75 mc frequency generator also contains a 120 mc amplifier and mixer circuit (Q2, Q5, and Z3) and the oscillator buffer-amplifier (Q8 and Q9).

(a) 6.25 MC MULTIPLIER AND 120 MC AMPLIFIER. (See figure 4-10.) - A 5 mc square-wave input signal from auxiliary frequency generator (A7) is applied to the base of X5 frequency multiplier Q1 and appears as a 25 mc frequency at transformer T1. The double-tuned circuit consisting of L4 and C3, and the primary of transformer T1, tuned by capacitor C5, selects the 25 mc component at the collector of Q1. Capacitor C4 provides coupling between the two tuned circuits. Output from T1 is passed through a complementary amplifier formed by Q3 and Q4, and is reduced to 6.25 mc by divide-by-four frequency divider Z1 and Z2. The 6.25 mc square-wave output from Z2 is amplified by Q6 and applied to one input of phase detector Z4. Gated flip-flops Z1 and Z2 have an internal J-K connection for operation as digital frequency dividers.

A 120 mc frequency supplied by X4 multiplier A18Z1 is applied to the input of cascode amplifier Q2 and Q5. The primary of transformer T2 at the collector of Q8 is tuned to 120 mc by capacitor C32, and the 120 mc frequency at the transformer secondary is passed through a resistive attenuator to one input of mixer Z4.

(b) 113.75 MC VCO AND PHASE LOCK LOOP. - Voltage controlled oscillator (VCO) Q11 is arranged in a modified Colpitts circuit. Tank inductor L3 is tuned by series capacitors C34 and C35. Varactor CR3, in parallel with tuning capacitor C35, controls the oscillator frequency over a narrow tuning range in response to a dc varactor control voltage applied via resistor R50. Phase detector Z4 develops the control voltage which is amplified by the direct-coupled stages Q10 and Q12. VCO output goes to up-converter A11 via emitter follower Q13. To limit the varactor control voltage range, and therefore the VCO frequency range, a fixed dc voltage is applied to varactor CR3 through resistor R49 which forms a voltage divider with R48. Consequently, the minimum value of control voltage, corresponding to the lowest VCO frequency, is determined by the fixed supply voltage.

A tuned low-pass filter in the output circuit of phase detector Z4 rejects unwanted frequency components of the dc control signal. Inductor L3 is tuned to 120 mc by capacitor C25 to reject this frequency. Capacitors C21 and C26 complete the low-pass filter network.

Ramp generator CR2, in conjunction with the RC circuit R41, R43, and C32, generates a dc ramp voltage at the base of Q12 for effective VCO control. Normally the dc ramp does not repeat during circuit operation but rises when the circuit is initially energized until the VCO locks at an appropriate ramp level. Capacitor C32 is charged at a relatively slow rate from the +15 volt dc supply circuit through resistor R43 via Q10 collector load resistor R41. When the VCO locks, the dc operating level of Q10 stabilizes to hold the charge of C9 at that point of the dc ramp. In the event of nonlocking, the charge at C9 continues to rise until it equals the conduction threshold of CR2, and C9 discharges immediately to ground through CR2. In this instance only, the ramp generation cycle is repeated.

VCO locking is performed by a phase-lock loop consisting of amplifier stages Q8 and Q9, mixer Z3, amplifier Q7 with transformer T3, and phase detector Z4. A sample of the VCO output frequency is amplified by Q8 and Q9, and applied as the second input frequency to mixer Z3. There, the 113.75 mc VCO frequency is mixed with the standard 120 mc frequency (from the 120 mc amplifier circuit) to obtain a 6.25 mc frequency at the mixer output. Amplifier Q7 applies the mixer output frequency to phase detector Z4 via transformer T3, where it is compared with the standard 6.25 mc frequency developed by the 6.25 mc multiplier

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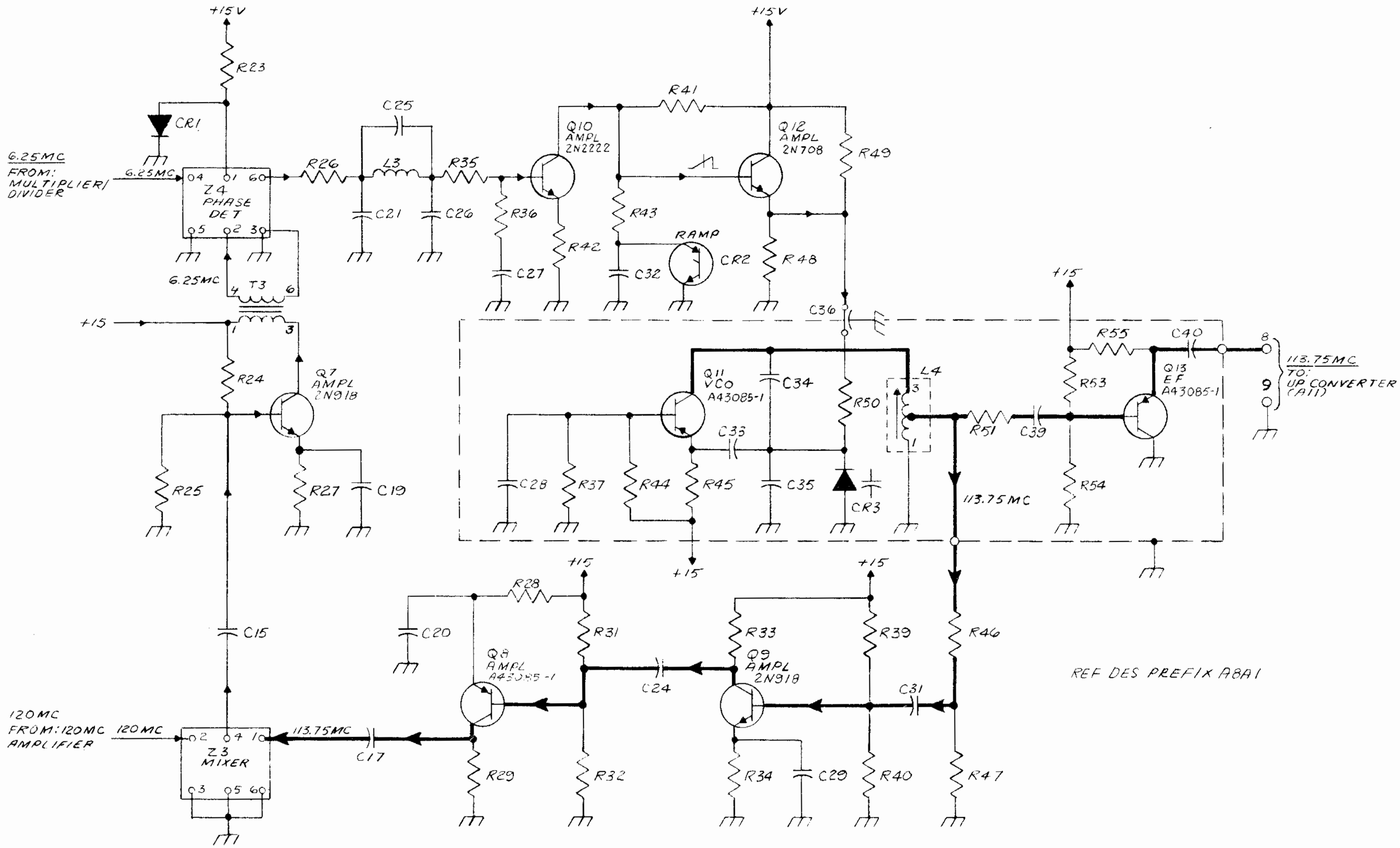

Figure 4-9. 113.75 Mc VCO and Phase-Locked Loop, Simplified Schematic Diagram

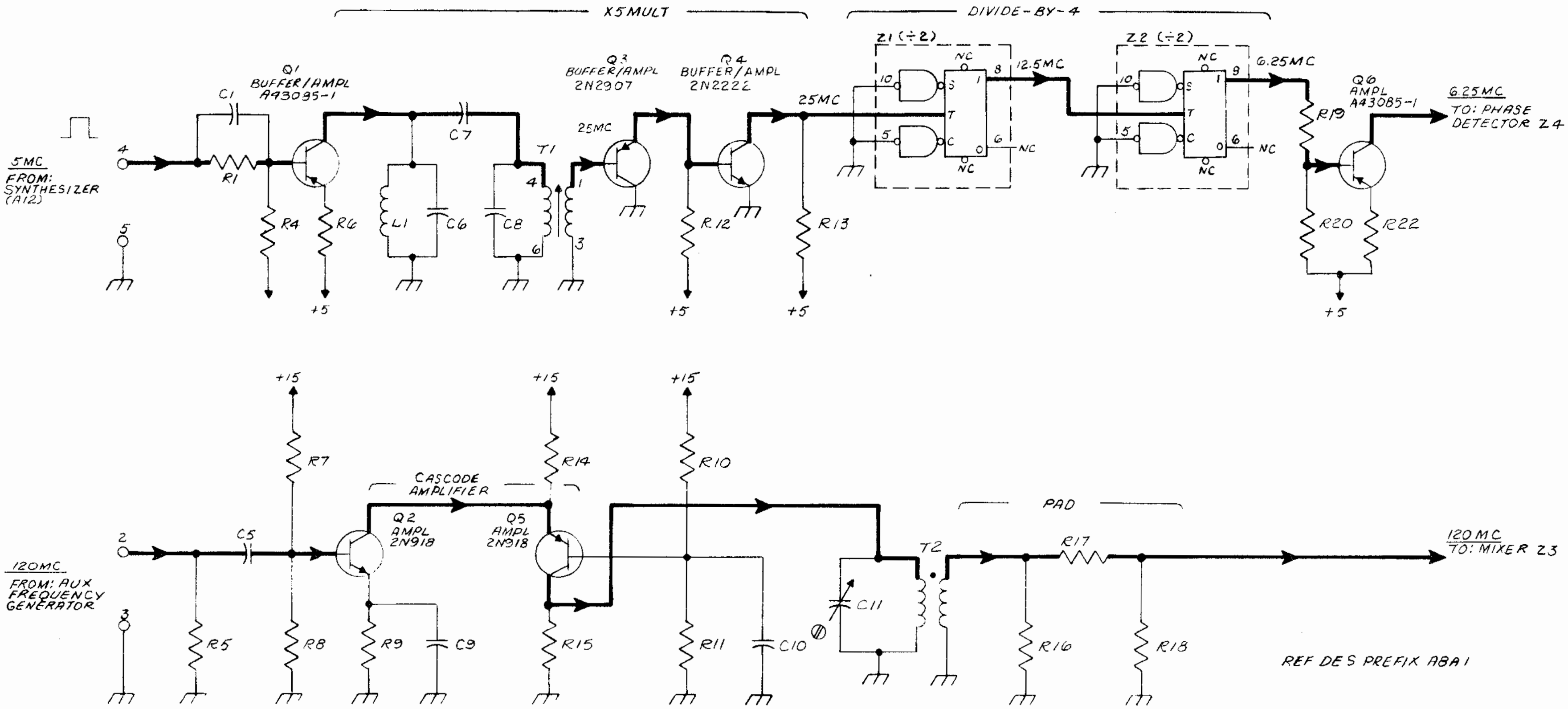

Figure 4-10. 6.25 Mc Multiplier and 120 Mc Amplifier, Simplified Schematic Diagram

circuit. The phase detector output is a function of the phase relation between the two 6.25 mc frequencies, and any change in the VCO output frequency causes a proportional change in the varactor dc control voltage to correct the VCO and maintain a precise 113.75 mc output frequency.

b. PRELIMINARY CHECK. (See figure 5-67.) - Make a preliminary check of the 1.75/113.75 mc frequency generator before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116, and Frequency Counter H-P 5245L with Frequency Converter H-P 5253A. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place exciter in operate condition.)

e. TEST DATA. (See figure 5-67.) - Trouble shooting the 1.75/113.75 mc frequency generator consists of checking the +5, +15, and -12 volt dc operating potentials and measuring the input and output frequencies at chassis connector A18XA8.

(1) Connect multimeter to XA8 pin K. Meter should read +5 vdc ±5%.

(2) Connect multimeter to XA8 pin H. Meter should read +15 vdc ±10%.

(3) Connect multimeter to XA8 pin P. Meter should read -12 vdc ±10%.

(4) Connect frequency counter to XA8 pin V. Counter should read 1.0000000 mc ±1 count. Repeat step (4) at XA8 pin W.

(5) Connect frequency counter to XA8 pin X. Counter should read 1.7500000 mc ±1 count.

(6) Connect frequency counter to XA8 pin C. Counter should read 5.0000000 mc ±1 count.

(7) Connect frequency counter with frequency converter to XA8 pin A. Counter should read 113.75000 mc ±1 count.

4-8. UP-CONVERTER A11. (See figures 4-42 and 5-70.)

The up-converter module contains 113.75 mc buffer A11A2, 1.75 mc carrier insertion circuit A11A3, mixer Z1, and 1.75 mc i-f amplifier A11A1. Faulty operation of these circuits will affect exciter modulation and carrier suppression processes, and can prevent exciter operation completely.

a. DESCRIPTION. - The up-converter employs three functionally related circuits which are combined to perform a number of major functions in the exciter. These functions include a carrier frequency conversion from 1.75 mc to 112.0 mc, a channel combining network for from one to four modulated sidebands, a carrier insertion in selectable steps, an adjustment of signal levels for the voice modes of operation, and automatic control of either the average or peak power levels (APC or PPC) in response to a dc control signal supplied from the associated high-powered rf amplifier in the transmitting system.

Mixer Z1 mixes the 113.75 mc injection frequency from 1.75/113.75 mc frequency generator A8 with the 1.75 mc sideband and carrier insertion frequencies from combining network T11/T12 to obtain a 112.0 mc output frequency which is applied to signal path filter FL5. The 1.75 mc i-f amplifier circuit (A11A1) amplifies the four channel (modulated) sideband signals prior to injection at the mixer. An APC/PPC circuit section in A11A1 controls the i-f amplifier gain in response to an external dc control signal.

Carrier insertion circuit A11A3 performs the major portion of the operative functions. It applies a 1.75 mc carrier and the modulated sideband channels to mixer Z1 via 1.75 mc i-f amplifier A11A1. It contains provisions for disabling or attenuating the 1.75 mc carrier in a series of progressive steps, and for completely disabling or attenuating the modulation input in response to control adjustments at the exciter control panel.

(1) BUFFER A11A2 AND MIXER A11Z1. - The buffer/mixer circuit consists of a 113.75 mc two-stage amplifier followed by a balanced modulator type mixer (Z1). Mixer Z1 is contained in a sealed module and is not subject to adjustment or repair in the field. The buffer amplifier raises the 113.75 mc injection level prior to application to the mixer where the 113.75 mc signal is mixed with a 1.75 mc carrier and modulated sidebands supplied by carrier insertion circuit A11A3. The 112 mc difference frequency at the mixer output is applied to 112 mc bandpass filter FL5.

(2) 1.75 MC I-F AMPLIFIER A11A1. - The 1.75 mc i-f amplifier circuit contains an i-f amplifier employing Q6 and Q7, and a dc differential amplifier formed by Q1 through Q4, followed by dc amplifier Q5. A dc control voltage (+4 to +5 vdc) supplied by the LPA is processed by the differential amplifier and applied to a varactor circuit controlling the i-f amplifier gain. In this manner, the average or peak rf amplifier power output (APC or PPC) is automatically controlled by adjusting the i-f amplifier gain.

(a) I-F AMPLIFIER. - The sideband channels (or the 1.75 mc carrier in the A0 mode) is applied to amplifier Q6 and Q7. Amplifier output is applied to hybrid combiner A11A3T11 and A11A3T12 via a 1.75 mc tuned circuit at the collector of Q7. Inductor L4 is tuned by capacitors C9 and C10 connected in series. Output is taken from the junction of C9 and C10 to reduce circuit loading.

The emitter circuit of Q6 contains a gain control network consisting of varactor CR3, inductor L1, capacitor C1, and potentiometer R17, arranged to control the degree of emitter bypassing and, therefore, the stage gain. Inductor L1 and varactor CR3 form a 1.75 mc tuned circuit between blocking capacitor C1 and ground. The amount of emitter degeneration present is a function of the tuned circuit impedance. This impedance is minimum at resonance and increases rapidly when the circuit is tuned off-resonance by the dc varactor control voltage applied to CR3.

Potentiometer R17 sets the amplifier maximum gain. When the dc voltage from the differential amplifier circuit in A11A1 decreases from its normal level of 100 volts, varactor CR3 detunes the resonant circuit and reduces the amplifier gain. In this manner the i-f amplifier gain is controlled by the dc control voltage at CR3. The controlled gain range is approximately 25 db ±5 db for voltages from +4 volts dc (maximum gain) to +5 volts dc (minimum gain), at the differential amplifier input.

(b) DC DIFFERENTIAL AMPLIFIER. - The differential amplifier consists of a pair of Darlington amplifiers (Q1, Q2) and (Q3, Q4) with common emitter resistor R3. Differential output is obtained at the collector of Q4. A dc control voltage (APC/PPC) supplied by the LPA is applied to the base of Q1. A dc reference voltage, set by potentiometer R6, is applied to the base of Q4. This establishes the threshold at which Q1, Q2 starts to conduct. When the input voltage exceeds +4.0 volts (maximum i-f amplifier gain), Q1 and Q2 start to conduct. When Q1 and Q2 start to conduct, Q3 and Q4 start to cut off. The collector of Q4 is applied to the input of dc amplifier Q5 via resistor R8 and potentiometer R10. Diodes CR1 and CR2 provide temperature compensation for amplifier Q5, and potentiometer R10 adjusts the slope of control to correspond with the minimum gain (+5v input) and maximum gain (+4v input). Dc amplifier Q5 increases the control voltage to the level required for operation of varactor CR3.

An increase in the APC/PPC control voltage at the base of Q1 increases the output at the collector of Q4, thus driving dc amplifier Q5 to a lower output voltage. This decrease in control voltage at varactor CR3 decreases the associated i-f amplifier gain. During the applicable exciter modes of operation, this circuit function automatically controls the exciter rf output and, therefore, the LPA rf drive level to assure that the LPA does not exceed its maximum average or peak power ratings. Although the designation APC/PPC is used in this description to represent average or peak power control functions, only one dc control signal is supplied to the exciter from the LPA. This signal exhibits either average or peak control characteristics depending upon the transmission mode employed. For example, in the A0 mode the continuous unmodulated rf carrier produces a dc control voltage proportional to the average carrier power. In all modulated modes, the dc control voltage is proportional to the peak power of the rf amplifier output.

(3) CARRIER INSERTION CIRCUIT A11A3. - The carrier insertion circuit contains a four-channel balun (sideband combiner) employing rf transformers T1 through T10; a modulation attenuation and disabling circuit using relays K2, K3, and K4; and a carrier insertion and suppression circuit using amplifier Q1, relays K1 and K5, and hybrid combiner T11 and T12.

(a) SIDEBAND COMBINER. - The four-channel balun circuit combines the four sideband channels and provides from 30 to 40 db of isolation between channels.

Essentially a balun transformer or coil couples a balanced (ungrounded) circuit to an unbalanced (grounded) circuit, or the reverse, without upsetting circuit symmetry, and provides efficient power transfer with circuit isolation. The two upper sideband channels, A1 and A2, are applied to baluns T1 and T2 respectively, to obtain a balanced two-channel output which is applied to transformer T5 for phase correction. The two lower sidebands, B1 and B2, are combined in a similar fashion at baluns T3 and T4, and the balanced two-channel output is applied to transformer T6. Baluns T7 and T8 combine the upper and lower sideband channels to obtain a balanced four-channel output which is applied to transformer T9 for impedance correction. Balun T10 prevents the reflection of an unbalanced termination into the network and provides a 50-ohm output. The four-channel output is applied to relay K2 in the modulation attenuation and disabling circuit.

(b) MODULATION ATTENUATION AND DISABLING. - Normally the rf power level at the up-converter output would be determined by the number of individual sideband channels in use. For example, power output using the A1 (usb) channel only will double when the A1 and B1 (2-ISB) channels are used, and quadruple when all four channels (4-ISB) are used. To assure that the average power level remains unchanged and within the transmitter gain control (TGC) circuit operating range, suitable attenuation is inserted into the circuit when the SIDEBAND SELECTOR control is set for a particular sideband selection. The following list identifies the relay selected attenuator circuit for each control setting:

Sideband	Relay Circuit	Attenuation
USB - (VFG / PTT)	None	None
USB	None	None
LSB	None	None
(2) ISB	K2	-3 db
(4) ISB	K2, K3	-6 db
(Mode A2/A3e)	K2	-3 db

When attenuation of the modulation is not required, output from the four-channel balun circuit at relay K2-b2 is applied to combiner T11, T12 via contacts K2-a1, contacts K4-a2, contacts K4-b2, and 1.75 mc amplifier A11A1. With the SIDEBAND SELECTOR set at (2) ISB, a +18 volt dc potential energizes relay K2, and a -3 db pad consisting of resistors R24, R25, and R27 is inserted at contacts K2-b1 and K2-a1. In the (4) ISB position, a +18 volt dc potential is applied to relays K2 and K3, inserting a -6 db pad, formed by resistors R22, R23, and R26, in series with the signal path. The attenuation pads are calibrated using potentiometers R24 and R22 for -3 db and -6 db attenuation, respectively. With the CLASS OF EMISSION switch in the A2A3e position, the -3 db pad is in circuit.

Modulation disable relay K4 removes exciter modulation during the LPA tuning cycle, and for all "key-up" conditions when a keyed transmitting mode is employed. For test purposes, relay K4 can be energized using the MOD ON/OFF switch on the auxiliary control panel.

To insure a low contact resistance for the passage of 1.75 mc rf signals at relays K2, K3, and K4, a dc potential is applied to modulation attenuation and disabling circuits by resistor R15. The resultant small dc current flow to ground, for both energized and de-energized relay conditions, does not adversely affect the passage of rf signals. At relays K2 and K3, the dc current path to ground is via transformer T10 (p/o four-channel balun) when K2 is not energized, and via attenuator pad resistors R25, R26, and R27 when energized. At relay K4, the dc current path to ground occurs at the 1.75 mc i-f amplifier (A11A1) input circuit. When K4 is energized, the dc path includes inductor L7 which also functions as an rf choke to disable application of the 1.75 mc modulation carrier signal. Diode CR6 at relay K4 functions as an arc suppressor.

(c) CARRIER INSERTION AND SUPPRESSION. - The 1.75 mc carrier frequency supplied by 1.75/113.75 mc generator A8 is applied to hybrid combiner T11 and T12, via carrier suppression relay K1, amplifier Q1, and directional relay K5. The four-channel 1.75 mc modulated sidebands from 1.75 mc i-f amplifier circuit A11A1 are also applied to combiner T11 and T12. The resultant 1.75 mc signal at the combiner output contains the four-channel sidebands and the inserted 1.75 mc carrier. Relay K1 and amplifier Q1 are arranged to provide six degrees of unmodulated carrier suppression, selected by the CLASS OF EMISSION control. Relay K5 changes the carrier insertion point from combiner T11 and T12 to the input of 1.75 mc i-f amplifier A11A1, for PPC control of the carrier when using the A0 operating mode.

The 1.75 mc carrier frequency at relay terminal K1-a2 passes through level adjustment potentiometer R3 to the base of amplifier Q1. The collector circuit contains a 1.75 mc tuned circuit consisting of inductor L1 and capacitors C4 and C5. Amplifier output is obtained at the junction of C4 and C5 to limit tuned circuit loading. An attenuator formed by resistors R12, R13, and R16 provides additional load isolation as well as signal attenuation. Amplifier output is applied to combiner T11 and T12 through relay contacts K5-a2 and a3.

Amplifier Q1 functions as a gain-controlled stage to provide five of the six selectable steps of carrier suppression. Relay K1, when energized, supplies the remaining step. Basically, Q1 provides a signal attenuation of -40 db when its emitter circuit is not bypassed. Amplifier gain, and therefore signal attenuation, is then controlled by selecting one of the four emitter decoupling networks via gating diodes CR2 thru CR5, by setting the CLASS OF EMISSION control. For example: a +18 volt dc potential to diode gate CR2 via R11 and L3 causes diode conduction which effectively grounds emitter bypass network C6 and R9, and increases amplifier gain. Signal attenuation, when R11 and L3 are used to bypass the emitter, changes from -40 db to -3 db. The remaining diodes are not conducting and offer a high impedance (open circuit) path to ground for the other decoupling networks. In this manner, amplifier gain and therefore carrier suppression is controlled by selecting the appropriate decoupling network. Potentiometer R9 is used to set the -3 db attenuation level.

The following list identifies the CLASS OF EMISSION control positions with the degree of carrier suppression provided, and gives the connector P1 terminal supplied with the +18 volt dc gating potential. Infinite carrier suppression is obtained by energizing relay K1. Signal leakage past the open contacts increases the basic -40 db attenuation of Q1 to approximately -60 db.

Carrier suppression relay K1 is also selected during "key-up" conditions of the keyed operating modes. Directional relay K5 is energized for the A0 mode of operation to obtain a carrier output subject to PPC control. Amplifier Q1 output, via relay K5, is passed

Class of Emission	Carrier Suppression	+18 VDC To
A0	-3 db	P1-N
A1, F1, F4	Infinite	P1-Y
A2, A3e	-6 db	P1-J
SSB (-10)	-10 db	P1-S
SSB (-20)	-20 db	P1-U
SSB (-40)	-40 db	None
SSB (∞)	Infinite	P1-Y

through an attenuator formed by resistors R29 to R33 to the input of 1.75 mc i-f amplifier A11A1. Potentiometer R29 sets the degree of attenuation.

To insure a low contact resistance for passage of the 1.75 mc rf signals at relays K1 and K5, a dc potential is applied via resistors R2 and R28, respectively. Diodes CR1 and CR7 at relays K1 and K5 perform the following functions: CR1 serves as an arc suppressor at relay K1, and CR7 operates gating diode CR2 to select -3 db of carrier suppression in mode A0.

b. PRELIMINARY CHECK. (See figure 5-70.) - Make a preliminary check of the up-converter before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116, Frequency Counter H-P 5245L with Frequency Converter H-P 5253A, Audio Generator SG-376/U, and RF Monitor H-P 434A. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place the exciter in "operate" condition.)

e. TEST DATA. (See figure 5-70.) - Trouble shooting the up-converter circuits consists of checking the +15 and +125 volt dc operating potentials, checking the +18 volt dc gating and relay operating potential at applicable settings of the SIDEBAND SELECTOR and CLASS OF EMISSION controls, measuring the input and output frequencies, and checking the modulation attenuation and carrier suppression circuits. All measurements are made at chassis connector A18XA11, and the RF OUTPUT MONITOR jack.

(1) Connect multimeter to XA11 pin B. Meter should read +15 vdc ±10%.

(2) Connect multimeter to XA11 pin A. Meter should read +125 vdc ±5%.

The following measurements verify application of a +18 volt dc potential to the diode gates and relay circuits controlled by the CLASS OF EMISSION switch.

(3) Set CLASS OF EMISSION to A0. Connect multimeter to XA11 pin N. Meter should read +18 vdc ±10%.

(4) Set CLASS OF EMISSION to A1, F1, F4. Connect multimeter to XA11 pin Y. Meter should read +18 vdc ±10%.

(5) Set CLASS OF EMISSION to A2, A3e. Connect multimeter to XA11 pin J. Meter should read +18 vdc ±10%.

(6) Set CLASS OF EMISSION to SSB (-10). Connect multimeter to XA11 pin S. Meter should read +18 vdc ±10%.

(7) Set CLASS OF EMISSION to SSB (-20). Connect multimeter to XA11 pin U. Meter should read +18 vdc ±10%.

(8) Set CLASS OF EMISSION to SSB (∞). Connect multimeter to XA11 pin Y. Meter should read +18 vdc ±10%.

The following measurements verify application of a +18 volt dc potential to relay circuits controlled by the SIDEBAND SELECTOR and MOD ON/OFF switches.

(9) Set SIDEBAND SELECTOR to (2)ISB. Connect multimeter to XA11 pin L. Meter should read +18 vdc ±10%.

(10) Set SIDEBAND SELECTOR to (4)ISB. Connect multimeter to XA11 pin M. Meter should read +18 vdc ±10%.

(11) Set MOD ON/OFF switch to OFF. Connect multimeter to XA11 pin F. Meter should read +18 vdc ±10%.

Note

Before continuing the test data measurements; set the CLASS OF EMISSION control to A0, the SIDEBAND SELECTOR control to USB, and the MOD ON/OFF switch to ON.

The following measurements check the rf signal frequencies at the input and output circuits of the up-converter.

(12) Connect frequency counter with converter to XA11 pin V. Counter should read 113.75000 mc ±1 count.

(13) Connect frequency counter (without converter) to XA11 pin W. Counter should read 1750.0000 kc ±1 count.

(14) Connect frequency counter with converter to XA13 pin T. Counter should read 112.00000 mc ±1 count.

The following measurements verify operation of the carrier suppression circuit and are performed without accompanying sidebands. Connect the rf monitor to RF OUTPUT MONITOR panel connector and perform the following steps:

(15) With the CLASS OF EMISSION control set to A0, note the rf monitor reading. Refer to this reading when determining the degree of carrier suppression obtained for other CLASS OF EMISSION control positions.

(16) Set CLASS OF EMISSION to A1, F1, F4. RF monitor reading should drop approximately 57 db, representing infinite carrier suppression.

(17) Set CLASS OF EMISSION to A2, A3e. RF monitor reading should be approximately 3 db below the step (15) reference reading.

(18) Set CLASS OF EMISSION to SSB (-10). RF monitor reading should be approximately 7 db below the step (15) reference reading.

(19) Set CLASS OF EMISSION to SSB (-20). RF monitor reading should be approximately 17 db below the step (15) reference reading.

(20) Set CLASS OF EMISSION to SSB (-40). RF monitor reading should be approximately 37 db below the step (15) reference reading.

(21) Set CLASS OF EMISSION to SSB (∞). RF monitor reading should be the same as the step (16) reading.

The following measurements verify four-channel sideband operation and are performed under conditions of maximum carrier suppression. Set MOD ON/OFF switch to ON, CLASS OF EMISSION to SSB (∞), and connect rf monitor to RF OUTPUT MONITOR connector on the panel.

(22) Connect audio generator to the A1 channel test jack on the auxiliary control panel. Adjust generator for a 1000 cycle, 0 dbm test signal, in the following manner:

(a) Set INPUT LEVEL selector to A1.

(b) Adjust generator output control and INPUT LEVEL-dbm control A1 for a 0 dbm reading on the INPUT LEVEL meter.

(23) Set SIDEBAND SELECTOR to USB and note rf monitor reading for future reference.

(24) Connect audio generator to the B1 channel test jack and repeat step (22) adjustments for channel B1.

(25) Set SIDEBAND SELECTOR to LSB. RF monitor should read same as step (23).

(26) Connect generator to the A1 and B1 channel test jacks (in parallel) and repeat step (22) adjustments for channels A1 and B1.

(27) Set SIDEBAND SELECTOR to (2)ISB. RF monitor reading should be the same as the step (23) reading.

(28) Connect generator to channel A1, B1, A2, and B2 test jacks (all in parallel) and repeat step (22) adjustments for all four channels.

(29) Set SIDEBAND SELECTOR to (4)ISB. RF monitor reading should be the same as the step (23) reading.

The following measurements verify operation of the APC/PPC differential amplifier circuit.

(30) Connect multimeter to XA11 pin D and note reading in dc volts.

(31) Connect multimeter to XA11 pin E. If the measurement in step (30) was between zero and 4 vdc, multimeter reading should be approximately +15 vdc. If the measurement in step (30) was 5 volts dc, multimeter reading should be 0 to +5 vdc.

4-9. 112 MC FILTER FL5. (See figure 4-11.)

The 112 mc bandpass filter, which follows up-converter circuit (A11) in the main signal path, is contained in a sealed module. It consists of seven helical-cavity filter sections and has an over-all bandwidth of 250 kc at 3 db points. Insertion loss is 12 db. The filter bandpass accepts only the 112 mc frequency from up-converter A11, and rejects unwanted sidebands.

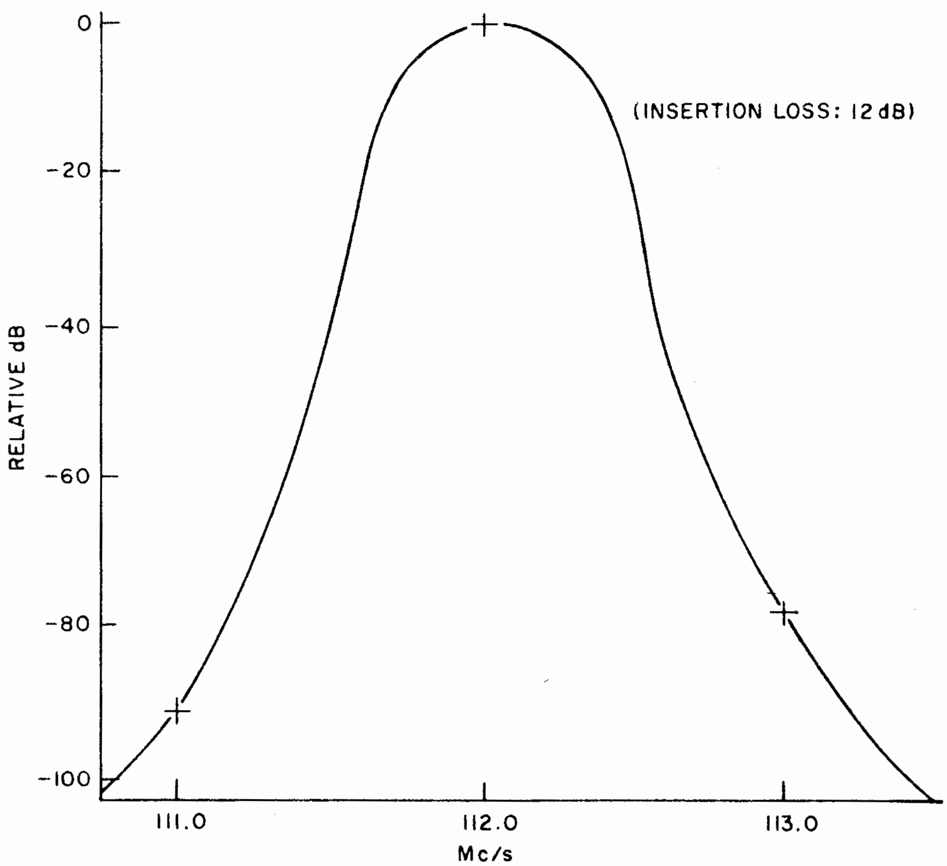

Figure 4-11. 112 Mc Filter FL5, Typical Response

4-10. DOWN-CONVERTER A13. (See figures 4-43 and 5-79.)

The down-converter module contains a 112 mc i-f amplifier (A13A2), a mixer circuit (A13Z1), and an 82 to 110 mc buffer amplifier circuit (A13A2). Faulty operation of these circuits can prevent exciter unit operation completely.

a. DESCRIPTION. - The exciter final frequency conversion to an output frequency range of 2.0 to 30.0 mc (29.9999 mc) is performed by the down-converter. The 112 mc carrier frequency from 112 mc filter FL5 is amplified by 112 mc i-f amplifier A13A2. The frequency is then mixed (in A13Z1) with an 82 to 110 mc injection frequency supplied by synthesizer A12 and amplified in 82 to 110 mc buffer amplifier A13A3. The 112 mc i-f amplifier gain is controlled by a signal from transmitter gain control circuit A14, in response to a dc control signal derived at the LPA. In this manner, a corrected exciter output level is maintained over the entire exciter frequency range to assure constant rf output levels from the rf amplifier unit.

(1) 112 MC I-F AMPLIFIER A13A2. - The 112 mc i-f amplifier circuit consists of gain-controlled cascode amplifier Q1 and Q2, and output amplifier Q3 and Q4 connected in parallel. A 112 mc input signal applied to the base of Q1 is amplified by Q1 and Q2 and appears in a tuned circuit consisting of inductor L3 and capacitors C10 and C11 (in series), at the collector of Q2. The signal is then applied to the bases of Q3 and Q4, in parallel, via coupling capacitor C12. The collector circuit of the parallel amplifier contains a tuned circuit consisting of inductor L4 and capacitors C17 and C18 (in series). The output is taken at the junction of C17 and C18.

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The emitter circuit of Q1 contains a gain control network formed by varactor CR1, capacitor C4, and inductor L1, arranged to control the degree of emitter by-passing and, therefore, the gain of Q1. Inductor L1 and varactor CR1, in series with capacitor C4, form a 112 mc tuned circuit between emitter bypass capacitor C5 and ground. Consequently, the bypass effectiveness of C5 is a function of the tuned circuit impedance. This impedance is maximum with the tuned circuit resonant, dropping rapidly as varactor CR1 detunes the circuit in response to the dc varactor-control (AGC) voltage. At resonance, the high tuned-circuit impedance effectively opens the C5 ground circuit causing emitter circuit degeneration and reducing amplifier gain. Off resonance, the tuned circuit impedance is low and C5 effectively bypasses the emitter circuit to increase the stage gain. Inductor L2 functions as a parasitic suppressor.

(2) MIXER A13Z1. - Down-converter mixer is a sealed component. The 112 mc frequency from 112 mc i-f amplifier A13A2 is mixed with the 82 to 110 mc injection frequency from 82 to 110 mc amplifier A13A3 to obtain a 2.0 to 30.0 mc (actually 29.9999 mc) mixer output frequency range. Essentially, the mixer uses a balanced demodulator circuit with balun transformers in the main input and output circuits for coupling to the unbalanced (grounded) circuits involved.

(3) 82 TO 110 MC AMPLIFIER A13A3. - The 82 to 110 mc buffer amplifier consists of input stage Q1, emitter follower Q2, and output stage Q4. It also includes level detector/amplifier Q3 which is driven from the emitter of amplifier Q4. An 82 to 110 mc range of frequencies supplied by synthesizer A12 is applied to the base of Q1 through a resistive attenuator (R1, R2, and R3) which has approximately a 6 db insertion loss. Output from the collector of Q1 passes through emitter follower Q2 and drives the base of output amplifier Q4. Output at the collector of Q4 is applied to mixer A13Z1 to serve as the injection frequency. The dc level from detector Q3 is applied to fault monitor board A18A2.

b. PRELIMINARY CHECK. (See figure 5-79.) - Make a preliminary check of the down-converter before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Frequency Counter H-P 5245L with Frequency Converter H-P 5253A. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place the exciter in "operate" condition.) Make sure CLASS OF EMISSION switch is in A0 position.

e. TEST DATA. (See figure 5-79.) - Trouble shooting the down-converter circuits consists of checking the +18, and +24 volt dc operating potentials and measuring the input and output frequencies. All measurements are made at chassis connector A18XA13.

(1) Connect multimeter to XA13 pin M. Meter should read 0 to +5 vdc.

(2) Connect multimeter to XA13 pin T. Meter should read +24 vdc ±10%.

(3) Connect frequency counter with converter to XA13 pin S. Counter should read 112.00000 mc ±1 count.

Note

Check that FREQUENCY KC tuning dials are set at 02000.0 kc before performing the measurements in steps (4) and (5).

(4) Connect frequency counter with converter to XA13 pin X. Counter should read 110.00000 mc ±1 count.

(5) Connect frequency counter (only) to XA13 pin P. Counter should read 2000.0000 kc ±1 count.

4-11. OUTPUT AMPLIFIER A16. (See figures 4-44 and 5-82.)

The rf output amplifier module contains preamplifier A16A1 and three-stage push-pull rf amplifier A16A2. An output termination circuit containing muting relay K1 and meter rectifier CR1 is located on A16A1 for level monitoring. Faulty operation of these circuits can adversely affect the exciter power output level or prevent exciter unit operation completely.

a. DESCRIPTION. - The rf output amplifier is a linear broadband amplifier for the frequency range from 2.0 to 30.0 mc. It raises the level of carrier signal from down-converter module A13 to produce 250 milliwatts of rf power (PEP), into a 50-ohm exciter output termination. A muting relay circuit is incorporated to remove exciter output power for system "key up" conditions. A meter rectifier and filter circuit permits measurement of the output amplifier level by the CIRCUIT TEST meter on the exciter control panel.

(1) PREAMPLIFIER A16A1. - A 2.0 to 30.0 mc (29.9999 mc) carrier frequency from down-converter A13 is passed through input filter FL1 to the base of preamplifier Q1. The filter is an 11-pole Chebysheff having a 35 mc cut-off frequency and an attenuation of 66 db-per-octave, to effectively remove 82 to 110 mc injection frequencies present in the down-converter output. Preamplifier Q1 raises the signal level prior to application at the input of rf amplifier A13A2.

(2) RF AMPLIFIER A16A2. - The 2.0 to 30.0 mc signal from preamplifier A13A1Q1 is applied to phase splitter Q1 via coupling capacitor C2. The phase splitter output drives push-pull amplifiers Q2 and Q3 through capacitors C4 and C5. Transformer T1, in turn, drives a second push-pull stage using emitter-followers Q4 and Q5. Emitter follower output is directly connected to the bases of the last push-pull amplifier, Q8 and Q9, and rf output is obtained from output transformer T2. Inductors L2 and L3 serve as the base load impedance for Q2 and Q3, and inductor L7 performs a decoupling function in the -12 volt dc supply circuit to the emitters of Q6 and Q7.

Stages Q6 and Q7 function as dc rather than rf amplifiers and serve as a constant current source for the emitter circuits of Q4 and Q5, respectively, to maintain a constant emitter-current supply during the rf drive excursions at the bases of Q8 and Q9. Capacitors C12 and C17, and C18 and C19, bypass the rf components at the base and emitter circuits of Q6 and Q7. Rf output from transformer T2 is applied to the muting relay and meter rectifier circuit.

(3) MUTING RELAY AND METER RECTIFIER. - The muting relay and meter rectifier are located on module A16A1. Output from rf amplifier A16A2 is applied through balun transformer T1 and a resistive attenuator (R7 through R9) to muting relay K1. Balun T1 provides an unbalanced (grounded) output termination with a 50-ohm impedance. When de-energized, relay K1 supplies rf output power to RF OUT connector A19J1 on the exciter rear panel, via relay contacts b2, b3, and a2, a3. When relay K1 is energized, during a system "key-up" operating condition, rf output is disconnected from the RF OUT connector and terminated at load resistor R12. For normal operation attenuator R7 through R9 inserts a 1 db attenuation. For "key-up" conditions, the attenuator maintains a stable 50-ohm load in conjunction with load resistors R12 and R13. Diode CR2 at relay K1 functions as an arc suppressor.

A portion of the rf output is applied to meter rectifier CR1 via divider resistors R10 and R11. A low pass filter consisting of inductor L5 and resistor R14, with capacitors C12 through C15, removes rf components from the resultant dc voltage which is applied to the CIRCUIT TEST meter when the test switch is set at POWER OUTPUT. A divider formed by resistors R16 and R17 supplies a reduced portion of the rf output to front panel RF OUTPUT MONITOR connector A18J1.

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b. PRELIMINARY CHECK. (See figure 5-82.) - Make a preliminary check of the output amplifier before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116, Frequency Counter H-P 5245L, and RF Monitor H-P 434A. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place the exciter in "operate" condition.) Place CLASS OF EMISSION switch in A0 position.

e. TEST DATA. (See figure 5-82.) - Trouble shooting the output amplifier circuits consists of checking the -12 and +24 volt dc operating potentials, measuring the input and output frequencies and output power level, and checking operation of muting relay A16A1K1. All measurements are made at chassis connector A18XA16.

(1) Connect multimeter to XA16 pin N. Meter should read -12 vdc ±10%.

(2) Connect multimeter to XA16 pin L. Meter should read +24 vdc ±10%.

Note

Check that FREQUENCY KC panel dials are set at 02000.0 kc before performing the measurements in steps (3) through (5).

(3) Connect frequency counter to XA16 pin A. Counter should read 2000.0000 kc ±1 count.

(4) Connect frequency counter to XA16 pin S. Counter should read 2000.0000 kc ±1 count.

(5) Connect rf monitor to XA16 pin X. Rf monitor should read 125 milliwatts.

(6) Place exciter in "standby" condition. Connect multimeter (using ohmmeter range) between XA16 pin X and ground. Meter should read approximately 5 ohms.

(7) Set SIDEBAND SELECTOR at USB/PTT (to energize muting relay). Meter should read approximately 50 ohms.

4-12. SIDECARRIER GENERATOR A9. (See figures 4-12, 4-13, 4-45, and 5-68.)

The side-carrier generator module contains a 1 mc/250 kc and a 1 mc/6.29 kc divider circuit (A9A1) and side-carrier generator circuits (A9A2). Combined operation of these circuits develops the 1.756290 and 1.743710 mc side-carrier injection frequencies for the B2 channel modulator (A1) and the A2 channel modulator (A4), respectively, from a 1 mc standard frequency. Faulty operation of this module can adversely affect channel modulation or prevent operation of the associated channel.

a. DESCRIPTION. - The side-carrier generator module contains two separate but functionally related circuits. The 1 mc/250 kc/6.29 kc frequency divider circuit (A9A1) develops a 6.29 kc frequency and two 250 kc frequencies, using both conventional and digital circuit techniques, from the 1 mc input frequency. These frequencies control the side-carrier generators (A9A2) which contain individual voltage-controlled crystal oscillators for generating the side-carrier frequencies of 1.756290 and 1.743710, respectively.

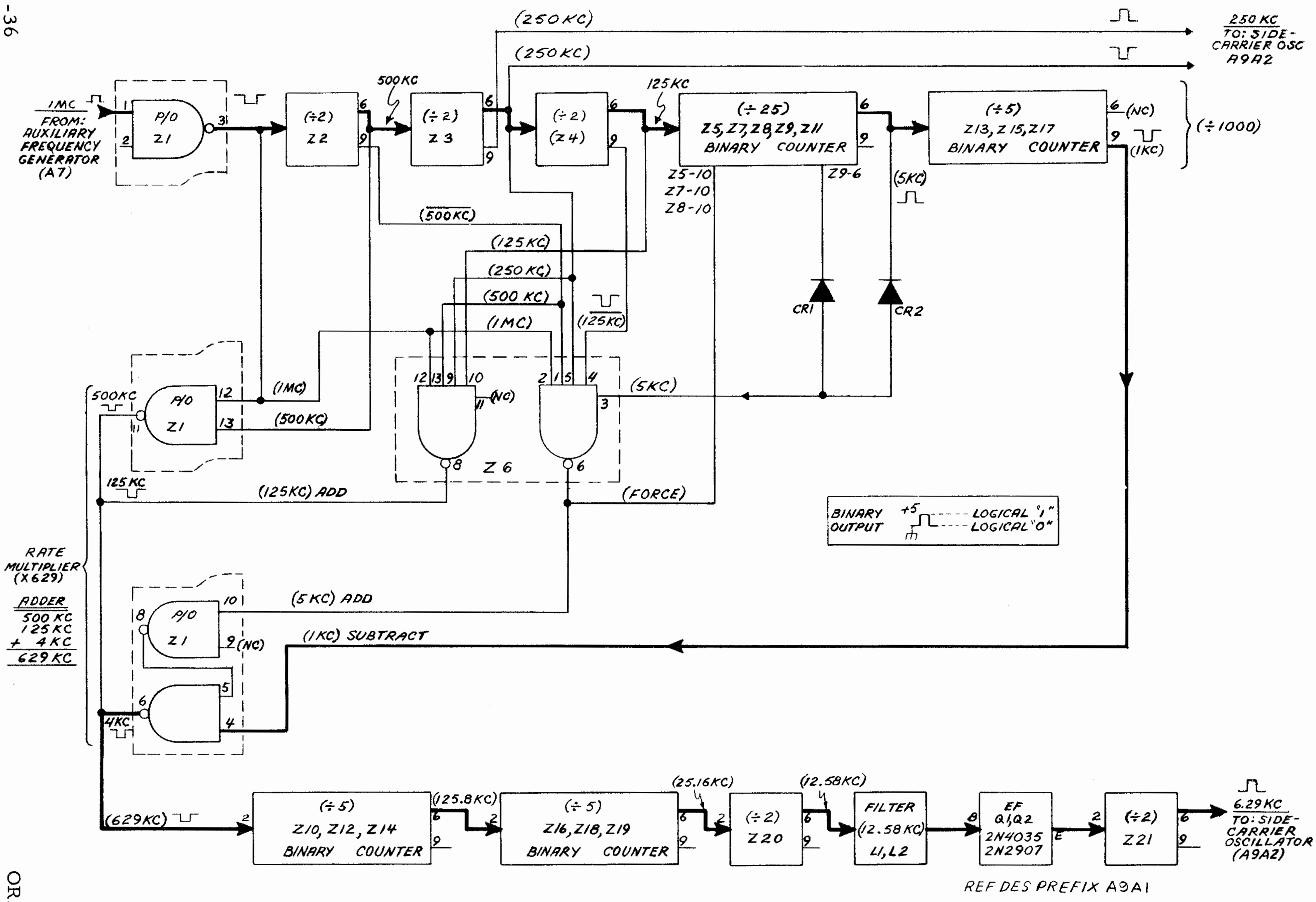


Figure 4-12. 1 Mc/6.29 Kc Divider, Functional Block Diagram

ORIGINAL

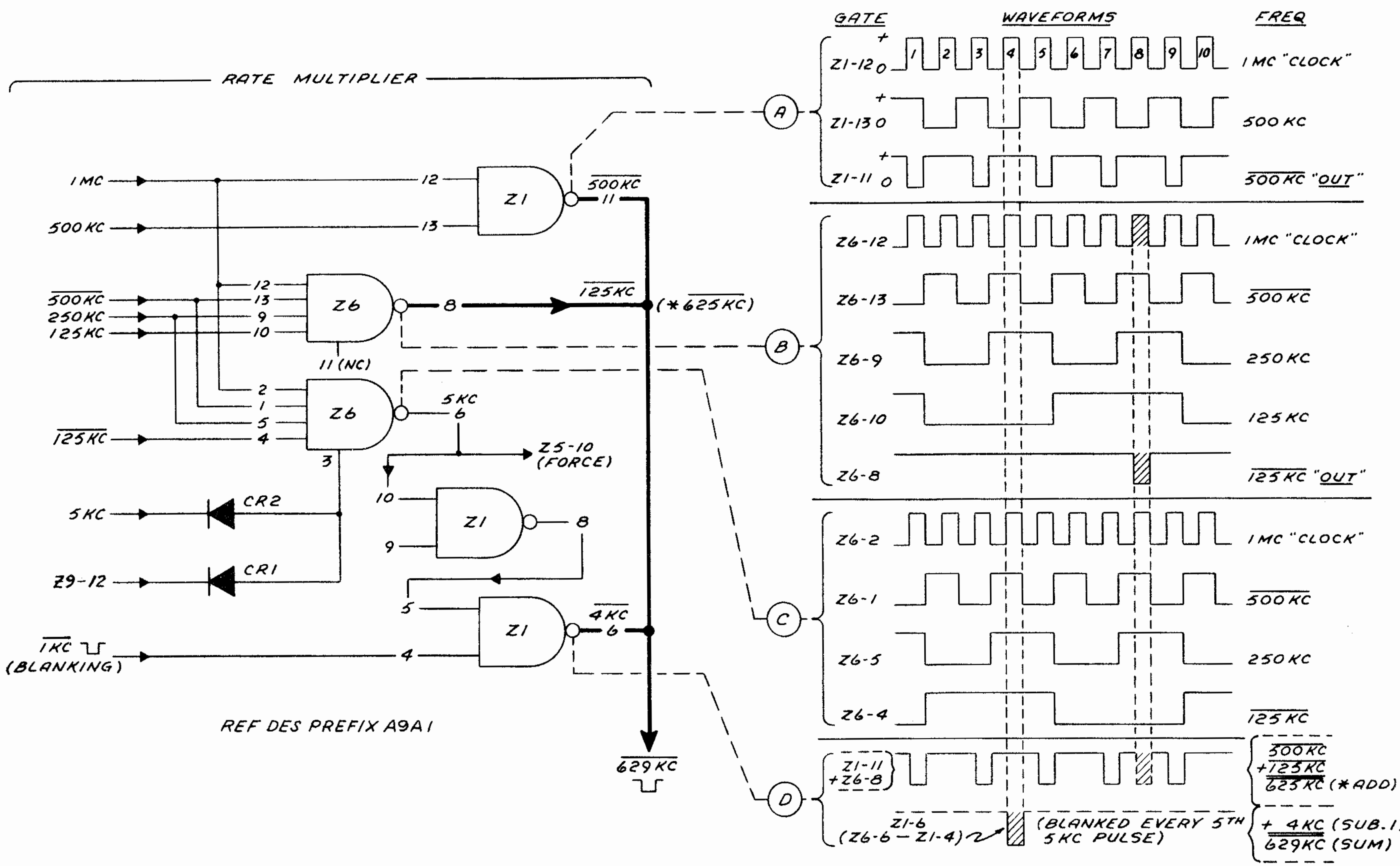


Figure 4-13. Rate Multiplier, Functional Diagram

Note

Refer to paragraph 4-14b(4) for a basic description of J-K flip-flop operation and a discussion of the digital terminology used in the following paragraphs.

(1) 1 MC/6.29 KC DIVIDER A9A1. (See figures 4-12 and 4-13.) - The 1 mc/6.29 kc frequency divider circuit consists of two series of "clocked" binary flip-flops for frequency divisions by factors of 1000 and 100, and a rate multiplier circuit using NAND gates, to obtain a 6.29 kc output frequency from the 1 mc standard input frequency. Because a direct division of 1 mc cannot produce a 6.29 kc frequency, this frequency is developed by "anding" several divisions of the 1 mc "clock" frequency at 500 kc, 125 kc, and at 4 kc. Both the "0" and "1" logic outputs at 500 kc and 125 kc are employed to obtain all logic combinations. In this manner, the 500 kc, 125 kc, and 4 kc frequencies are added (literally) to obtain a 629 kc frequency which is reduced to 6.29 kc by a divide-by-100 circuit. The 4 kc frequency is developed by a subtraction of 1 kc from 5 kc.

(a) DIVIDE-BY-1000 CIRCUIT. (See figure 4-12.) - The divide-by-1000 circuit selection consists of three divide-by-2 J-K flip-flops, Z2, Z3, and Z4; a divide-by-25 binary counter employing short-counted flip-flops Z5, Z7, Z8, Z9, and Z11; and a divide-by-5 binary counter using short-counted flip-flops Z13, Z15, and Z17. Total frequency division from 1 mc to 1 kc is obtained in division steps of 2, 2, 2, 25, and 5. The 250 kc logical "0" and logical "1" outputs from flip-flop Z3 are applied to side-carrier generators A9A2.

The 1 mc square-wave standard frequency at the circuit input is passed through gate Z1-3 to the trigger input of flip-flop Z2. The NAND gate performs a waveform reshaping function and also inverts the input pulses. Flip-flop Z3 reduces the 500 kc output from Z2 to 250 kc, and flip-flop Z4 provides an additional reduction to 125 kc. The divide-by-25 counter provides a 5 kc output which is reduced to 1 kc by the divide-by-5 counter.

The divide-by-25 binary counter is "short-counted" for division by a factor of 25 rather than 32 (the free-running division factor) by a "force" count from NAND gate Z6-6, applied to the "force 1" inputs of Z5, Z7, and Z8. The divide-by-5 binary counter is "short-counted" for division by five rather than eight by the "trigger" input at Z17-2, supplied from the logical "1" output of Z11. During divide-by-1000 divider operation, count progression is sampled and applied to the rate multiplier NAND gates. The 500 kc, 250 kc, 125 kc, and 1 kc frequencies are obtained directly from the logical "0" or "1" flip-flop outputs. The 5 kc sample is taken via isolation diodes CR1 and CR2.

(b) RATE MULTIPLIER CIRCUIT. (See figure 4-13.) - The rate multiplier circuit uses three sections of dual-input quad NAND gate Z1, and five-input dual NAND gate Z6. The sample frequencies obtained from the divide-by-1000 circuit section are processed using the gates, and gate outputs are combined at a parallel (wired OR) summing bus to obtain the desired 629 kc frequency. Figure 4-13 is a functional diagram of the rate multiplier showing the major input and output waveforms. The 5 kc and 2.5 kc waveforms at input Z6-3 are not shown as they are not present during the ten 1 mc "clock" pulses in the diagram. Note that the logical "0" waveforms from the flip-flop binary stages are identified by a solid line just above the frequency in kilocycles. They are 180 degrees out-of-phase with their logical "1" counterparts. Usually, gate output waveforms occur at a rate determined by the lowest input frequency and have a pulse width determined by the highest input frequency. For example: the $\overline{\text{500 kc}}$ output of gate Z1-11, shown in detail A of figure 4-13, has a pulse width contributed by the 1 mc "clock" frequency.

Detail A shows the input and output waveforms related to NAND gate Z1-11 operation. Gate output is a $\overline{\text{500 kc}}$ frequency which is applied to the common summing bus. Detail B shows the waveforms for NAND gate Z6-8 operation. Gate output is $\overline{\text{125 kc}}$, occuring during the pulse period of every eighth 1 mc "clock" pulse only. Theoretically stated, the "wired OR" configuration at this point has produced a 625 kc sum frequency as shown in detail D.

Detail C shows the waveforms associated with NAND gate Z6-6 operation. Note that the gate inputs are a duplicate of the gate Z6-8 inputs, with exception of the $\overline{\text{125 kc}}$ substitution for 125 kc at Z6-4 and the addition of a 5 kc and 2.5 kc input (combined) via diodes CR1 and CR2 at Z6-3. Both phases of the 500 kc and 125 kc input frequencies are employed to obtain all of the combinations required for development of a 4 kc frequency.

Detail D shows the rate multiplier "wired OR" summing process with a $\overline{\text{4 kc}}$ pulse added to the previous $\overline{\text{625 kc}}$ frequency summation to obtain a $\overline{\text{629 kc}}$ frequency. The 5 kc output at gate Z6-6 is buffered by gate Z1-8 and applied to the input of NAND gate Z1-6 together with a $\overline{\text{1 kc}}$ frequency from the divide-by-1000 circuit. Output at gate Z1-6 is a 5 kc frequency "blanked out" every fifth pulse to obtain a 4 kc rate. Blanking is accomplished by the $\overline{\text{1 kc}}$ frequency which inhibits gate Z1-6 after each group of four 5 kc pulses. Output from the rate multiplier circuit is applied to the divide-by-100 circuit section for frequency reduction to 6.29 kc.

(c) DIVIDE-BY-100 CIRCUIT. (See figure 4-12.) - The divide-by-100 circuit consists of two divide-by-5 binary counters using flip-flops Z10, Z12, Z14, and Z16, Z18, Z19, respectively; divide-by-2 J-K flip-flop Z20; a 12.58 kc bandpass filter and amplifier with Q1 and Q2; and divide-by-2 J-K flip-flop Z21. Total frequency division from 629 kc to 6.29 kc is accomplished in division steps of 5, 5, 2, and 2.

A 629 kc frequency from the rate multiplier circuit is reduced to 125.8 kc and then to 25.16 kc by the two divide-by-5 binary counters. J-K flip-flop Z20 performs an additional division-by-2 to obtain a 12.58 kc frequency which is applied to a double-tuned bandpass filter consisting of tuned circuits L1, C4, and L2, C6. The filter rejects spurious frequency components contributed by the rate multiplier circuit and supplies a 12.58 kc sine wave to compound emitter-follower stage Q1 and Q2. This stage offers a high impedance input to the filter circuit and reduces tuned circuit loading. A final frequency reduction to 6.29 kc is performed by J-K flip-flop Z21 which also performs a waveform squaring function to obtain a 6.29 kc square wave signal. Output from Z21 is applied to side-carrier generators A9A2.

(2) SIDE-CARRIER GENERATORS A9A2. (See figures 4-45 and 5-68.) - The side-carrier generator circuit contains two individual voltage-controlled crystal oscillators for the generation of 1.756290 and 1.743710 mc side-carrier frequencies. Each crystal oscillator is indirectly phase locked to the 1 mc standard frequency by comparing their output frequencies with the 250 kc and 6.29 kc frequencies derived from the 1 mc standard frequency. Both frequency generators employ a voltage-controlled crystal oscillator (oscillating at two times the output frequency); buffer amplifiers; a divide-by-two circuit; an output stage with a bandpass filter; and a phase locked loop consisting of a buffer amplifier, a digital mixer, a differential amplifier and a 6.29 kc chopper stage. Because the two oscillator circuits are identical except for the crystal frequency, descriptions in the following paragraphs for the 1.756290 mc circuit also apply to the 1.743710 circuit.

Basically, the frequency of crystal oscillator Y1 (3.512580 mc) is corrected by a dc control voltage applied to the varactor control circuit of CR1. Control voltage is supplied by differential amplifier Q1 and Q2 via chopper Q5 which samples the voltage at a 6.29 kc rate. The differential amplifier is driven by a digital mixer using NAND gates Z1-11 and Z2-11, and a sample of the output frequency is combined with the two out-of-phase 250 kc input frequencies at the mixer. Any change in oscillator frequency is corrected by a change in level of the chopper output.

(a) DIGITAL MIXER. - The digital mixer consists of dual-input NAND gates Z1-11 and Z2-11, and output integrating networks R1, C6 and R9, C9. Gate output pulses drive the base elements of differential amplifier Q1, Q2. A 250 kc (logical "1") frequency at gate input Z2-13, and a $\overline{\text{250 kc}}$ (logical "0") frequency at gate input Z1-13 are combined with a sample of the output frequency (1750 kc, nominal) applied to gate inputs Z1-12 and Z2-12 from buffer gate Z1-3. The (nominal) 1750 kc output frequency is the seventh harmonic of the 250 kc input frequencies, and the digital mixer output contains conventional sum and difference mixer products. Consequently, for the (actual) output frequency 1.756290 mc (1756.290 kc), the gate outputs will contain a 6.29 kc component representing the beat-frequency difference between with the 250 kc seventh harmonic (1750.000 kc - 1756.290 kc = 6.29 kc). Because the two 250 kc input frequencies are 180 degrees out-of-phase, the related gate outputs will also be out of phase.

The 6.29 kc component is applied via integrating networks R1, C6 and R9, C9 to differential amplifier Q1 and Q3. The output of the differential amplifier is a 6.29 kc frequency which is applied to chopper stage Q5. C12 gives additional filtering of higher frequency components. R1 balances the input to the differential amplifier Q1 and Q3 to obtain maximum output swing at Q1 collector.

(b) CHOPPER CIRCUIT. - The chopper circuit consists of dual-emitter chopper Q5 and a pulse shaper using dual-input NAND gates Z2-3 and Z2-8. A 6.29 kc frequency from divider circuit A9A1 is directly applied to gate input Z2-10, and applied via integrating circuit R10 and C10 to gate input Z2-3. Output from gate Z2-8 is a narrow pulse which occurs only during the time overlap period of the two input pulses. The integrating circuit delays the gate input Z2-2 pulse to produce the overlapping. The 6.29 kc "sampling" pulse triggers chopper Q5 via transformer T1.

The chopper functions as a phase detector, and the chopper output level is determined by the phase relation between the 6.29 kc component from differential amplifier Q1, Q2, and the fixed 6.29 kc chopping frequency. A decrease in oscillator frequency will increase chopper output, and the higher charge at capacitor C14 will increase and correct the oscillator frequency. Conversely, an increase in oscillator frequency will reduce the chopper output and decrease the oscillator frequency. In this manner, crystal oscillator Y1 is "locked" to the absolute 6.29 kc "sampling" frequency.

(c) VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR AND DIVIDE-BY-TWO CIRCUITS. - The varactor-controlled crystal oscillator consists of Q7, C16, C17, 3.512580 crystal Y1, and varactor CR1. Oscillator output is applied via buffer amplifier Q8 and Q11 to divide-by-two flip-flop Z4. The output of Z4 (1.756290 mc) is applied to buffer Z1. One output, Z1-6, is applied to buffer Z1-2; the output at Z1-3 is applied to the digital mixer. The second output, Z1-8, is applied to the output amplifier. Dc control voltage from chopper circuit capacitor C14 is applied to the varactor to "pull" the oscillator frequency, over a small frequency range, and thereby control and correct the frequency.

(d) 1.756290 MC OUTPUT AMPLIFIER. - Amplifier Q7 receives the 1.756290 mc output from buffer (NAND) gate Z1-8 and raises the signal level. Potentiometer R42 sets the side-carrier level applied to the B2 channel modulator circuit (A1). The primary of output transformer T3 is tuned to 1.756290 mc by capacitor C22, and the resultant sine-wave signal goes through an attenuator, formed by resistors R26, R28, and R30, which also provides a 50-ohm output termination impedance for the amplifier. The 1.743710 mc side-carrier generator circuit is identical to the 1.756290 generator, with the exception of the frequency of Y2, which is 3.487420 mc.

b. PRELIMINARY CHECK. (See figure 5-68.) - Make a preliminary check of the side-carrier generator before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Frequency Counter H-P 5245L. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1. (Place the exciter in "operate" condition.)

e. TEST DATA. (See figure 5-68.) - Trouble shooting the side-carrier generator consists of checking the +5 and +15 volt dc operating potentials, and measuring the input and output frequencies. All measurements are made at chassis connector A18XA9.

(1) Connect multimeter to XA9 pin J. Meter should read +5 vdc ±5%.

(2) Connect multimeter to XA9 pin F. Meter should read +15 vdc ±10%.

(3) Connect frequency counter to XA9 pin A. Counter should read 1000.0000 kc ±1 count.

(4) Connect frequency counter to XA9 pin K. Counter should read 1756.2900 kc ±1 count.

(5) Connect frequency counter to XA9 pin X. Counter should read 1743.7100 kc ±1 count.

4-13. MODULATORS A1, A2, A3, A4. (See figures 4-46 and 5-64.)

The four modulator modules in the exciter are identical except for the side-carrier frequency employed. Therefore, the following information generally applies to all four modulator modules, although it refers specifically to modulator A3 (sideband A1) which uses a 1.75 mc carrier frequency. Each modulator contains an audio amplifier circuit (board no. 1), and a ring modulator and agc (audio ALC) amplifier circuit (board no. 2). Combined operation of these circuits develops a modulated side-carrier frequency which is applied via a sideband filter (FL1-FL4) to up-converter A11. Faulty operation of a modulator module can adversely affect or prevent operation of the associated sideband channel.

a. DESCRIPTION. - Modulator module A3 receives an audio input from the A1 INPUT LEVEL-dbm control and a 1.75 mc injection frequency from 1.75 mc/113.75 mc generator A8. The carrier is amplitude modulated by a diode "ring" modulator, and the carrier frequency is suppressed. The resultant double-sideband modulation is passed through filter A3A1FL3 for rejection of one sideband, prior to application to up-converter A11. Automatic level control (ALC) for the audio input signal is obtained by using an audio-signal-derived agc-voltage applied to the audio amplifier circuit prior to modulation. The following list identifies the four modulator modules and lists the associated sideband channel and carrier frequency employed, and the related audio input transformer and sideband filter.

Modulator Module	Audio Transformer	Audio Channel	Carrier Freq. (Mc)	Sideband Used	Sideband Filter
A1	A18T1	B2	1.756290	Lower	FL2
A2	A18T2	B1	1.750	Upper	FL1
A3	A18T3	A1	1.750	Lower	FL3
A4	A18T4	A2	1.743710	Upper	FL4

(1) BOARD NO. 1 (A3A1). (See figures 4-46 and 5-64.) - Modulator board no. 1 contains input audio amplifier Q1, cascode amplifier Q3 and Q4, gain control circuit Q2, and audio amplifier Q5 through Q8. The audio signal (250 - 6000 cps) is amplified in these stages and applied to the ring modulator circuit and ALC circuit on board no. 2 (A3A2).

Emitter-follower Q1 applies the audio input signal to Q3 and Q4 which function as a conventional cascode amplifier. Agc voltage from the agc amplifier circuit in board no. 2 is applied to the base of Q2 to control the signal level at the emitter of Q4. In the absence of an agc voltage, Q2 is near cut-off and the cascode amplifier provides maximum amplification of the signal. When agc voltage is applied, Q2 conduction increases and a portion of the signal at the emitter of Q4 is by-passed to ground through capacitor C3 at the collector of Q2. In this manner, audio level at the emitter of Q4 is controlled by the agc voltage applied to Q2. To increase the agc dynamic range and improve amplifier control characteristics, agc voltage is also applied to the base of Q4 through diode CR3 and resistor R10.

Diodes CR1 and CR2 at the base of Q3 provide temperature compensation for the gain-control amplifier circuit.

The main audio amplifier receives the audio signal from the gain-control circuit. Transistors Q5 and Q6 amplify the signal to drive complementary amplifier Q7 and Q8. Diodes CR4 and CR5 provide temperature compensation, and output is obtained via coupling capacitors C21 and C22, in parallel. A feedback network, consisting of capacitor C20 and resistor R21, reduces distortion and stabilizes amplifier gain.

(2) BOARD NO. 2 (A3A2). (See figures 4-46 and 5-64.) - Modulator board no. 2 contains the ring modulator; 1.75 mc carrier amplifier Q1, Q3, and Q4; and audio ALC circuit Q2 and Q5 thru Q9.

A 1.75 mc signal is applied to rf amplifier Q1 which drives complementary rf amplifier Q3 and Q4. Diodes CR1 and CR2 provide temperature compensation. Rf output is applied to transformer T2 via coupling capacitor C10. The transformer contains a balun for driving the balanced ring modulator from the unbalanced amplifier output. The audio signal from modulator board no. 1 is also applied to transformer T2 at a secondary center tap. A low-pass filter, consisting of inductor L3 and capacitors C9 and C11, removes undesirable high audio frequencies and isolates the audio amplifier from the injection frequency. The ring modulator circuit mixes the rf and audio signals, suppressing the 1.75 mc carrier frequency, and produces a double-sideband modulation at the output of transformer T3. This transformer also contains a balun to transfer from balanced to an unbalanced output. A pad formed by resistors R28 through R30 and R32 attenuates the modulator output and provides a 50-ohm impedance termination. Variable resistor R32 provides output level adjustment.

The agc amplifier receives the same audio signal applied to the modulator. Input amplifier Q2 drives a three-stage dc amplifier consisting of Q5, Q6, and emitter follower Q7. R8 adjusts the threshold level. The primary (only) of transformer T1 serves as the base load for Q5 and exhibits a high impedance to the signal, accompanied by a low dc voltage drop. Transistor Q5 is turned on by the positive excursions of the audio signal and operates as a half-wave rectifier. The output positive-going audio frequency is taken from emitter follower Q7 and applied via R21 and CR11 to capacitor C13. The attack time of the ALC is determined by R21 and C13, but the decay time is independent of R21. CR11 blocks any leakage via R21/R20 to ground. This provides a fast attack and a relatively slow release of the ALC. The dc level on C13 is applied to emitter followers Q8 and Q9, and the ALC control voltage is taken from resistor R31. A metering point is also provided at the output of Q9 to monitor ALC action on the front panel CIRCUIT TEST meter.

b. PRELIMINARY CHECK. (See figures 4-46 and 5-64.) - Make a preliminary check of the modulator before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116, RF VTVM ME-286/U, and Audio Generator SG-376/U. A special test cable is required consisting of a Miniature Screw Connector UG-14/61 with a convenient length of RG-196U coaxial cable attached.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place the exciter in "tune" condition.)

e. TEST DATA. (See figures 4-46 and 5-64.) - Trouble shooting any one of the four modulator modules consists of checking the +18 volt dc operating potential, measuring the input and output signal levels, and verifying operation of the audio amplifier ALC system. All measurements are made at chassis connectors for A1, A2, A3, or A4, depending upon the particular channel modulator being tested, with exception of the modulator output level which is measured at the output of the associated sideband filter (FL1, 2, 3, or 4) using the special test cable.

(1) Connect multimeter to pin R of XA1, 2, 3, or 4. Meter should read +18 volts dc ±10%.

(2) Connect RF VTVM to pin E and measure the 1.75 mc injection level. Meter should read 1v rms ±1 db.

(3) Connect audio generator to input channel of modulator being tested. Set generator controls for 1000 cps, 0 dbm test signal. Set INPUT LEVEL-dbm control at 0 dbm.

(4) Connect RF VTVM (using special test cable) to output connector of sideband filter FL1, 2, 3, or 4. Meter should read 35 mv/50 ohms ±1 db.

(5) Increase audio generator output +10 db. Note RF VTVM reading to test ALC operation. Meter reading should not change more than 3 db.

4-14. SYNTHESIZER A12. (See figure 4-14.)

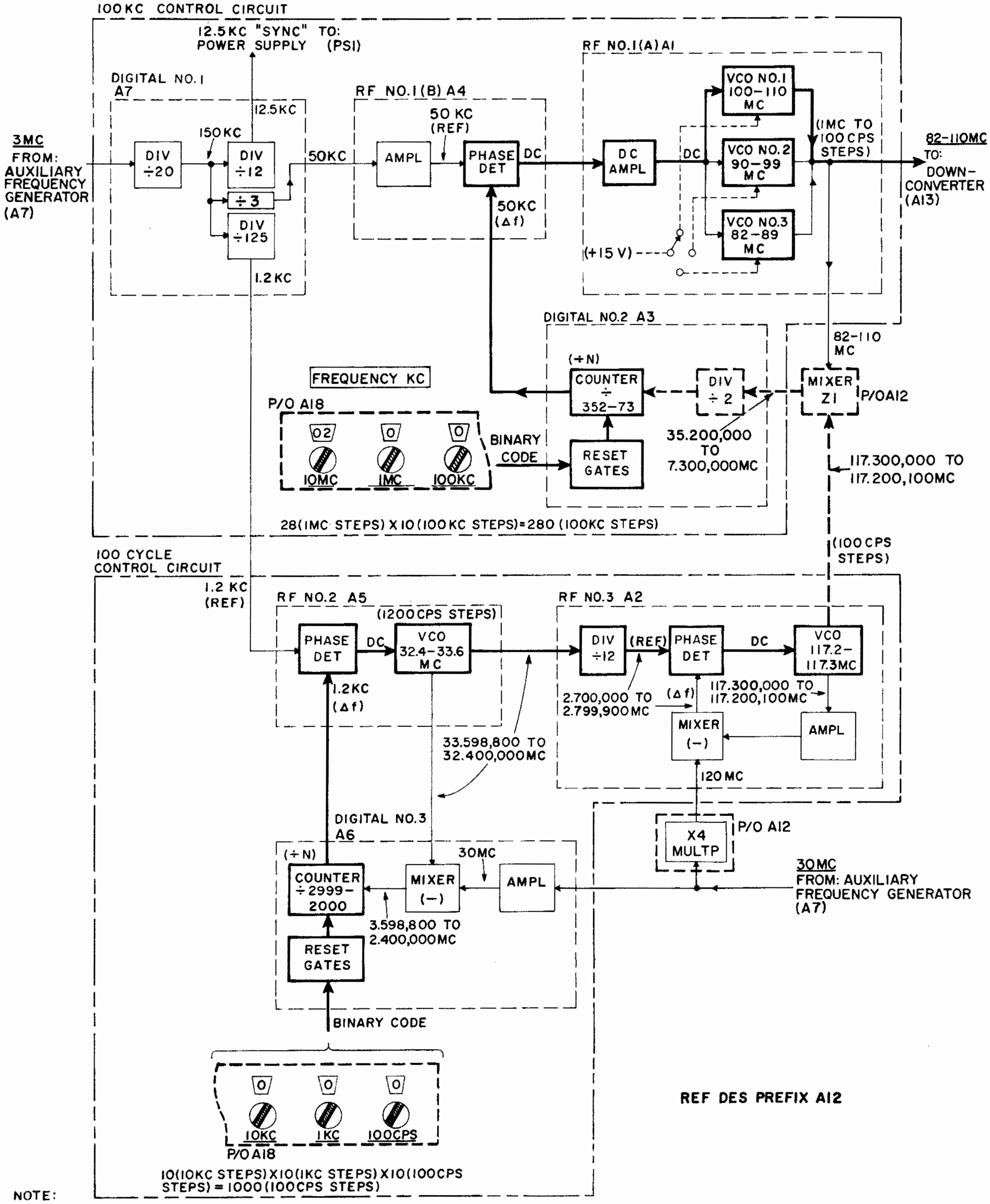
The solid state synthesizer module contains seven plug-in printed-circuit cards. Digital techniques are employed to generate a larger number of precise injection frequencies, over a frequency range from 82 to 110 mc, which are supplied to down-converter A13. In addition, the synthesizer supplies a 12.5 kc "sync" frequency to the solid-state regulator circuits in power supply PS1. The following paragraphs contain a basic description of the synthesizer circuits based on the simplified block diagram shown in figure 4-14. Although the individual circuits are more complex than the block diagram indicates, their basic functions are accurately portrayed. A detailed description of each synthesizer circuit and its operating characteristics is provided in subsequent paragraphs.

a. SYNTHESIZER OUTPUT FREQUENCIES. - The 82 to 110 mc synthesizer output frequencies are generated in three frequency segments by the three voltage-controlled (phase locked) oscillators (vco's) in the rf no. 1 (A) card (A12A1). When selected in 100 cycle increments, a total of 280,000 frequency steps are available for tuning the exciter unit to a desired transmitting frequency. Down-converter A13 mixes the 112 mc carrier frequency with the 82 to 110 mc synthesizer frequencies to obtain the exciter output frequency range from 30 mc (29.9999 mc) to 2.0 mc.

The 12.5 kc "sync" output is supplied by frequency divider circuits in the digital no. 1 card (A12A7). The "sync" pulses are used to control the switching regulator circuits in power supply PS1. All synthesizer output frequencies are derived from the 3 and 30 mc outputs of auxiliary frequency generator A7. Therefore, the synthesizer output frequencies have the same accuracy and stability as the 1 mc frequency standard.

b. SYNTHESIZER CIRCUITS. - In addition to employing conventional frequency dividing, multiplying, and mixing circuits, the synthesizer contains a number of vhf voltage-controlled oscillators, phase-locked loop circuits, and integrated digital-logic (IC) circuits containing J-K flip-flops and NAND gates. A digital pulse counter is arranged, using IC modules, to function as a variable frequency divider in order to synthesize literally thousands of frequencies. To facilitate an understanding of synthesizer circuit operation, the following paragraphs describe briefly the function of each of these circuits.

(1) VOLTAGE-CONTROLLED OSCILLATORS. - Voltage-controlled oscillators are used in the rf no. 1 (A) card (A12A1), the rf no. 2 card (A12A5), and in the rf no. 3 card (A12A2). These oscillators operate in the vhf band, over a relatively narrow frequency, and are varactor controlled. A sample of the vco frequency is compared with a reference frequency by a phase detector, and the resultant error voltage is used to correct the vco frequency. Frequency control of the three vco's in the rf no. 1 (A) card is more involved as



NOTE:
LOW FREQUENCY KCS DIAL SETTINGS PRODUCE LOW ÷N COUNTER RANGES AND HIGH VCO OUTPUT FREQUENCIES, EXCEPT AT THE RF NO. 2 VCO.

Figure 4-14. Synthesizer, Simplified Block Diagram the vco frequency is corrected in two sequential steps. A coarse correction circuit using a digital discriminator performs an initial frequency correction, followed immediately by operation of a fine tuning circuit which "locks" the vco frequency. For comparison, the vco's in the rf no. 2 and rf no. 3 cards employ only a single step frequency correction circuit.

(2) PHASE-LOCKED LOOPS. - Essentially, a phase-locked loop circuit for vco frequency control contains a phase detector, a mixer, and (for some vco circuits) a divide-by-N digital counter which serves as a variable frequency divider. The digital discriminator and phase detector for the three vco's in the rf no. 1 (A) card are located in the rf no. 1 (B) card, and the remaining loop circuit with a divide-by-N counter is located in the digital no. 2 card. The rf no. 3 card contains a fourth vco and includes a complete phase-locked loop. The fifth and last vco and its phase-detector is located in the rf no. 2 card, but the remainder of the loop circuit is in the digital no. 3 card.

During circuit operation, the vco output frequency is sampled and processed by the phase-locked loop circuit and applied to the related phase detector. When the (processed) sample frequency corresponds with the (fixed) reference frequency, the vco is "locked". The phase-locked loop circuits for the rf no. 1 (B) and the rf no. 2 cards are not as simple as the block diagram of figure 4-14 indicates. Actually, a ramp generator is employed which sweeps the vco over its tuning range prior to vco "locking". For the purpose of a basic synthesizer description, it can be assumed that the phase detector performs all necessary vco control functions. Complete circuit descriptions for each synthesizer module are given in subsequent paragraphs.

(3) DIVIDE-BY-N COUNTERS. - A divide-by-N, digital-type pulse counter is used as a variable-rate frequency divider in the digital no. 2 and the digital no. 3 cards. The counter "counts down" the applied input frequency to produce one output pulse for a given number of input pulses. Digital reset gates, programmed by setting the related front panel FREQUENCY KC tuning dials, determine the length of the counting period and, therefore, the frequency division factor "N". The counter automatically repeats the counting sequence until another factor is selected.

Normally, once a vco is "locked" to a reference frequency by the phase-locked loop circuit, vco operation at a different frequency is prohibited. An exception to this situation occurs when the loop circuit contains a divide-by-N counter. The counter permits vco operation and locking at any selected frequency within its range. By changing the counter division factor, the sample vco frequency remains "matched" to the phase detector reference frequency. For example: To increase the vco frequency 1 kc, reduce the loop frequency by 1 kc; to decrease the vco frequency 1 kc, raise the loop frequency by 1 kc.

(4) DIGITAL LOGIC COMPONENTS. - A number of digital logic components are employed in the synthesizer circuits as well as in other modules in the exciter. The following brief descriptions for the operation of J-K flip-flops, gated and clocked flip-flops, and multiple-input NAND gates, are provided as supplemental information to facilitate an understanding of these circuits in relation to their functions as a part of the exciter modules. No attempt will be made to investigate the digital design factors involved for circuit operation. Digital circuit descriptions will be related to their functional aspects at a field maintenance level.

(a) BINARY FLIP-FLOPS. (See figure 4-15.) - The bistable Eccles-Jordan multivibrator circuit is a building block for counters, shift registers, data storage, and control circuits. The flip-flop provides a convenient means of storing logical conditions within a digital system. It has two stable states represented by "0" and "1", and remains in one of these states until a command to change state is received. Three commands may be given: <u>set</u> which puts the flip-flop in the "1" state, <u>clear</u> which puts the flip-flop in the "0" state, and <u>complement</u> (or trigger) which changes the state of the flip-flop regardless of its previous state.

A simple binary flip-flop for frequency division applications may be considered as having a single <u>trigger</u> input and two outputs; the logical "0" and "1". A logical "0" condition,

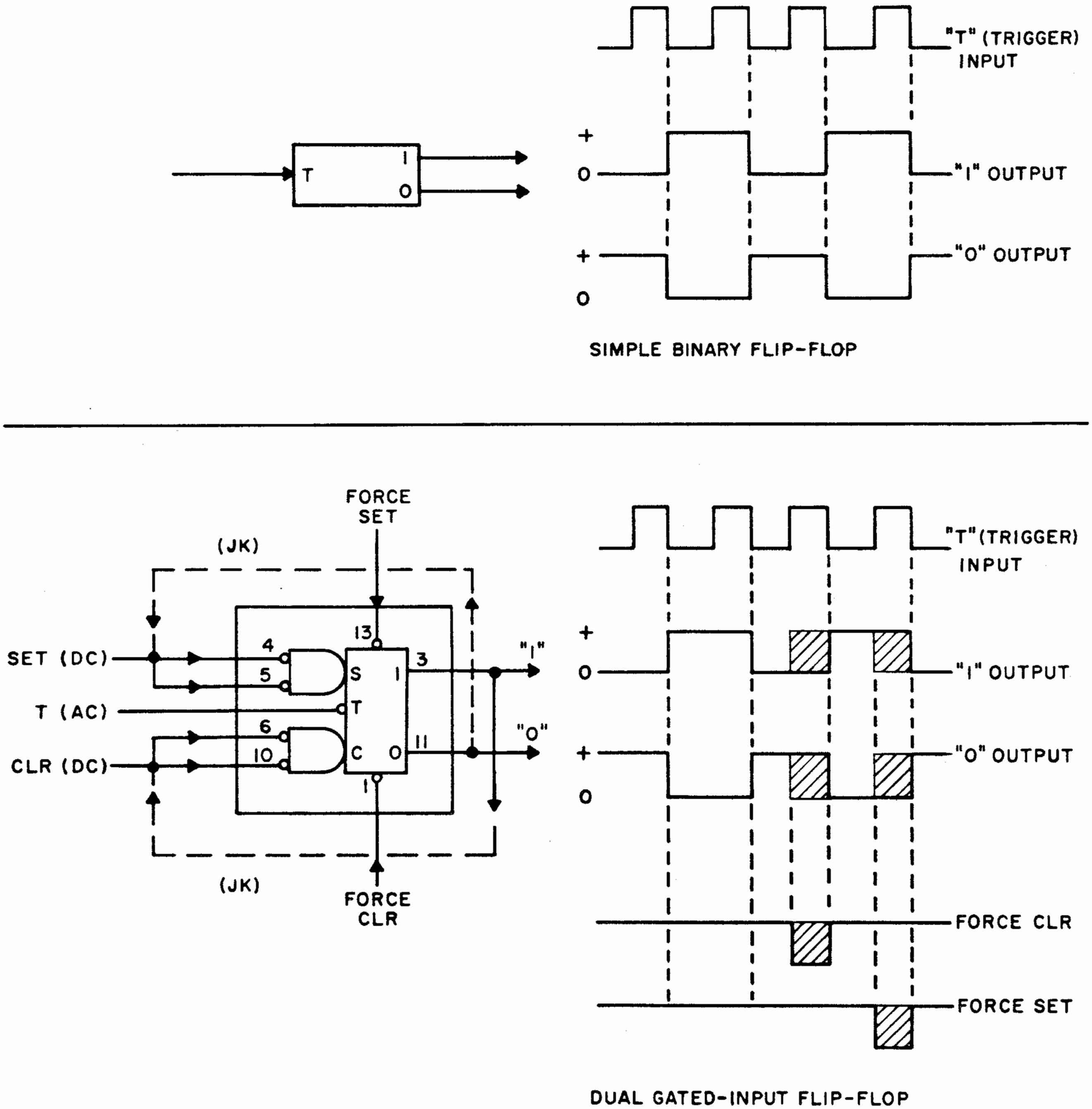


Figure 4-15. Comparison, Triggered Binary Flip-Flops

which ambiguously can appear at either flip-flop output, represents a circuit ground or zero voltage. The logical "1" condition, which also can appear at either output, represents a high and is characterized by a +5 volt dc output termination. Although the terminology may appear confusing, in practice a logical "1" (+5 vdc) output appears at the "1" terminal coincidental with the appearance of a logical "0" (ground) at the "0" terminal. Because a logical "1" output will appear once for every two trigger pulses at the input, the flip-flop performs a frequency division by a factor of 2. For example: a 1 mc trigger input will provide a 500 kc output, at either the "1" or the "0" terminals which are 180 degrees out-of-phase.

A more sophisticated flip-flop is actually employed in the digital circuits in the form of a micro-logic integrated component (IC). It contains dual-input NAND gates at the set and clear inputs, a separate trigger or "clock" input, and clamped output circuits to assure a +5 vdc logical "1" output level. The input gates permit storage of a given logical state until an appropriate command is given to change state. In addition, direct inputs to the flip-flop circuit are provided to "force" a logical "1" or "0" state, regardless of the normal triggered state.

The IC flip-flop circuits are arranged for frequency divisions by a wide range of factors, using the J-K circuit configuration or a "short-counted" circuit. The J-K arrangement consists of a number of flip-flops formed in a series string with the output of one driving the input of the next. Free-running frequency division is obtained by a factor of 2 for each flip-flop employed. For example: three J-K flip-flops will provide frequency division by a factor of 2^3 or eight, and a 1 mc input frequency is reduced to 125 kc at the output. Conversely, division by an odd factor such as 3 or 5 is not obtained unless the circuit is "short-counted" in some way. The previously mentioned divide-by-8 circuit can be "short-counted" to obtain a frequency division by a factor of 5 in several ways. In general, short counting is affected by feeding-back a logical state to "force" a counter output before the free-running division has been completed. For example: the J-K divide-by-8 circuit can be "short-counted" to obtain division-by-5 by feeding-back (or forward) a logical state (pulse) to obtain output from the last flip-flop when the fifth input pulse occurs, instead of at the eight input pulse. In this manner, the counting process is changed and the circuit actually counts 1, 2, 3, 4, 8, or a total of five counts instead of a conventional 1 through eight count.

(b) NAND GATES. (See figure 4-16.) - The synthesizer module and other modules in the exciter employ NAND gates with from two to six input circuits. By definition, a NAND gate is an AND gate with the output pulse inverted (NOT AND). It has more than one input but only one output, and an output occurs only when all input signals are present simultaneously. Actually, this last statement is true only for certain operating conditions. In the sense of positive logic, where a logical "0" is a low or ground termination and a logical "1" is a high or +5 vdc termination, a low (inverted) output can occur only when all inputs are high at the same time. Conversely, any combination of low and high inputs will always produce a high output. For some circuit applications, only one input (of a two input NAND gate) is used and the other input is open circuit (NC). In this manner, the internal gate-amplifier is used as a functional buffer amplifier whose output is an inversion of the input signal. Gating in the logical sense does not occur.

With reference to figure 4-16, note that functionally the NAND gate resemble a series circuit containing switches (an AND gate) followed by an inverter. When all switches are closed, a low output appears. Opening one or more switches, therefore, will produce a high output. Therefore, a closed switch is analogous to a high gate input, and an open switch is similar to a low gate input.

c. SYNTHESIZER OPERATION. (See figure 4-14.) - The 82 to 110 mc synthesizer output frequency range is controlled by setting the six FREQUENCY KC dials on the exciter front panel to the desired transmitting frequency in the tuning range from 02.0000 to 29.9999 mc. The six tuning dials, from left to right, select the exciter output frequency in steps of 10 mc, 1 mc, 100 kc, 10 kc, 1 kc, and 100 cps, for a total of 280,000 frequencies 100 cycles apart. To simplify the basic description of over-all synthesizer operation contained in the

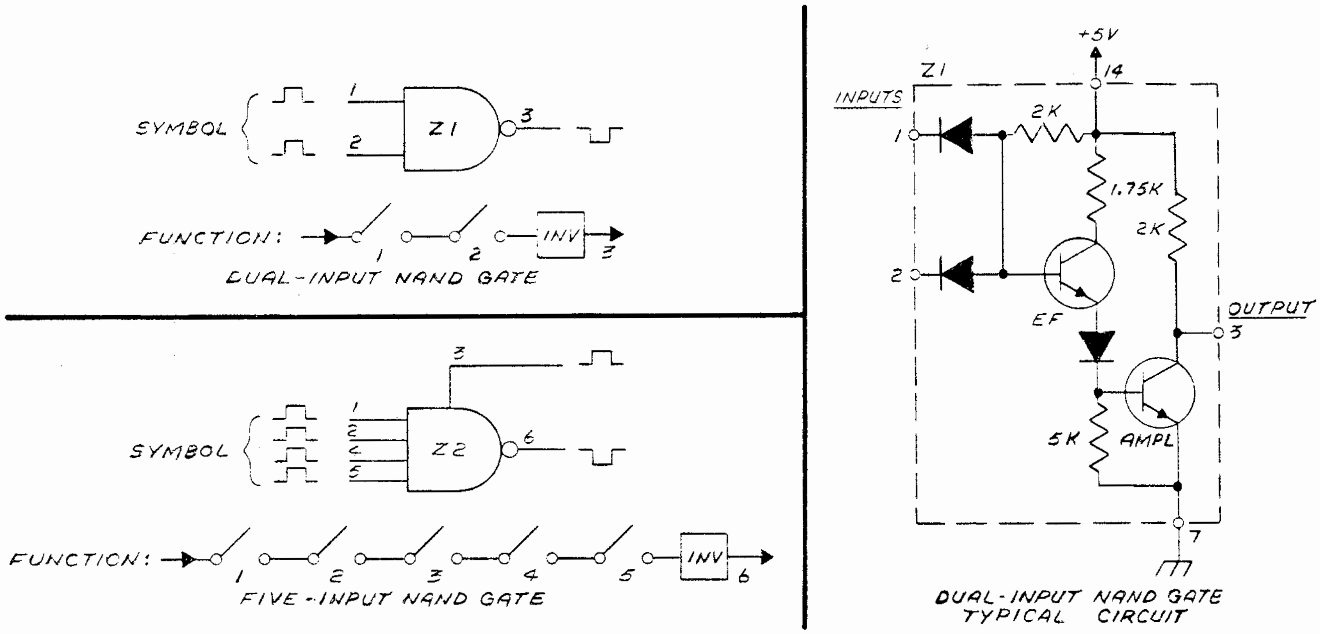


Figure 4-16. Digital NAND Gates, Functional Diagram

following paragraphs, the synthesizer is separated into two functional sections. These are: the 100 kc control circuit, directly controlled by the 10 mc, 1 mc, and 100 kc tuning dials, and the 100 cps control circuit which is directly controlled by the 10 kc, 1 kc, and 100 cps tuning dials. The products of these two control circuits are combined at mixer A12Z1 to obtain complete control of the synthesizer frequencies in six decimally related divisions.

(1) 100-KC CONTROL CIRCUIT. - The 100-kc control circuit consists of the 10 mc, 1 mc, and 100 kc tuning dials, digital no. 2 card (A12A3), and the rf no. 1 (A) and (B) cards (A12A1 and A12A4). The digital no. 1 card (A12A7) is common to both control circuits. When these three tuning dials are set, in digital steps over their range from 02.0 to 29.9 mc, the synthesizer output frequency from the rf no. 1 (A) card is controlled from 110.0 to 82.1 mc in a series of 280 (100-kc) steps. The 10 mc dial selects the output frequency in steps of 10 mc, the 1 mc dial in steps of 1 mc, and the 100 kc in steps of 100 kc. (For the purpose of this description it is assumed that the remaining three tuning dials are set at zero.)

When all six tuning dials are set for a transmitting frequency of 02.0000 mc (02000.0 kc), the rf no. 1 (A) card output frequency is 110.0000 mc (the frequency difference between 2.0 mc and the 112.0 mc down-converter (A13) input frequency). This output frequency is generated by vco no. 1 in the rf no. 1 (A) circuit. Selection of vco no. 1, 2, or 3 is determined by the frequency selected. The selection is controlled via transmitter control no. 2 module A17 by the 10 mc and 1 mc FREQUENCY KC dials (when the LOCAL/REMOTE switch is in the LOCAL position) or by Decoder-Encoder KY-656/FRT (when the switch is in the REMOTE position). The vco is phase-locked by the phase detector (in the rf no. 1 (B) card) to a 50 kc reference frequency supplied by digital no. 1 card A12A7. A sample of the 110.0000 mc frequency applied to mixer A12Z1 is mixed with a 117.3000 mc frequency supplied by the 100 cycle control circuit. The output of mixer A12Z1 is a 7.300000 mc difference frequency, reduced to 3.650,000 mc by the divide-by-2 frequency divider. The divide-by-N counter is programmed for a 73 count by the 10 mc, 1 mc, and 100 kc dial settings, and functions as a divide-by-73 frequency divider to reduce the 3.650,000 mc frequency to the required 50 kc at the phase detector.

If the FREQUENCY KC tuning dials are reset for a 29.9000 mc transmitting frequency, the 10 mc to 100 kc setting limit, an 82.1000 mc frequency is produced by the rf no. 1 (A) card. Vco no. 3 generates the output frequency which is phase-locked by the rf no. 1 (B) card phase detector. Mixer A12Z1 mixes the 82.100 mc sample frequency with the 117.300, 000 mc frequency from the 100 cycle tuning circuit to obtain a 35.200,000 mc difference frequency. The divide-by-2 frequency divider reduces the frequency to 17.600,000 mc for application to the divide-by-N counter. With the 10 mc, 1 mc, and 100 kc dials set at 29.9 mc, the counter is programmed for frequency division by 352, and division by this factor reduces 17,600.000 mc to the required 50 kc frequency for phase-locking vco no. 3.

The divide-by-N counter in the digital no. 2 card can be programmed for a series of 280 different frequency divisions, from divide-by-73 to divide-by-352. Consequently, setting the 10 mc, 1 mc, and 100 kc tuning dials over their complete ranges will phase-lock one of the three vco's in the rf no. 1 (A) card to 280 precise frequencies, and each frequency will exhibit the frequency stability and accuracy of the 1 mc frequency standard source. To subdivide the 100 kc control circuit frequency divisions into smaller frequency segments, the 10 kc, 1 kc, and 100 cps tuning dials in the 100 cycle control circuit are used.

(2) 100-CYCLE CONTROL CIRCUIT. - The 100-cycle control circuit consists of the 10 kc, 1 kc, and 100 cps tuning dials, digital no. 3 card (A12A6), and the rf no. 2 and 3 cards (A12A5 and A12A2). When these tuning dials are set, in digital steps over their range from 000 to 999, the synthesized output from the rf no. 1 (A) card is changed in steps of 10 kc, 1 kc, or 100 cps, for a series of 1000 (total) 100-cycle steps. Mixer A12Z1 combines the product of these steps with the 280 (100 kc) step product contributed by the 100 kc control circuit, for a grand total of 280,000 synthesizer output frequencies, selectable in increments of 100 cycles.

Two separate vco circuits, located in the rf no. 2 card and the rf no. 3 card, are employed to produce a 117.300,000 mc to 117.200,100 mc range of synthesized frequencies for mixer A12Z1 operation. This frequency range contains tuning information in 10 kc, 1 kc, and 100-cps steps, contributed by the 100-cycle control circuit. The rf no. 2 card vco operates from 33.598,800 mc to 32.400,000 mc, and is directly controlled by the divide-by-N counter in the digital no. 3 card. When the three (associated) tuning dials are set to 000, the counter functions as a divide-by-2000 frequency divider. For a 999 tuning dial setting, the counter functions as a divide-by-2999 frequency divider. A mixer stage combines a sample of the vco output frequency with a fixed 30 mc frequency, and the difference frequencies from 3.598,800 to 2.400,000 mc are applied to the counter input. The resultant 1.2 kc counter output locks the vco to a 1.2 kc reference frequency via its phase detector.

The rf no. 3 card vco is phase locked to a reference frequency derived from the rf no. 2 card vco output. The 33.598,800 mc to 32.400,000 mc reference frequency is reduced to a 2.799,900 mc to 2.700,000 mc range by the divide-by-12 frequency divider. A sample of the 117.300,000 mc to 117.200,100 mc vco output is mixed with a fixed 120 mc frequency at the mixer, and the 2.799,900 mc to 2.700,000 mc difference frequency (range) phase-locks the vco. When the 10 kc, 1 kc, and 100 cps tuning dials are set over their range from 000 to 999, the rf no. 2 card vco output appears as a series of 1000 frequency steps, 1200 cycles apart. The divide-by-12 circuit in the rf no. 3 card reduces the step separation to 100 cycles without changing the total number of steps.

(3) SYNTHESIZING PROCESS. - The synthesizing processes described below occur simultaneously, following any change in a tuning dial position. They are presented as a series of occurrances to show the individual circuit functions involved. It should be understood that for each tuning dial (or dials) change, the particular vco circuit in use at the rf no. 1 (A) card will shift frequency accordingly. For an increase in the tuning dial frequency setting, the vco frequency (82 to 110 mc) decreases, and for a decrease in a dial setting the vco frequency increases.

When the six FREQUENCY KC tuning dials are set for a transmission frequency of 02.0000 mc (02000.0 kc), selecting a synthesizer output frequency of 110.0000 mc, the 100 cycle control circuit supplies a 117.300,000 mc frequency to mixer A12Z1. Now, if the 10 kc, 1 kc, and 100 cps dials are reset to 999 for a transmission frequency of 02.0999 mc (02099.9 kc), the following synthesizing process occurs. The divide-by-N counter in the digital no. 3 card is programmed to divide-by-2999, and the rf no. 2 card vco is locked at a frequency of 33.598,800 mc. The divide-by-12 frequency divider in the rf no. 3 card reduces this to a frequency of 2.799,900 mc to lock the related vco at a frequency of 117. 200,100 mc.

Mixer A12Z1 combines this last frequency with the 110.0000 mc output from vco no. 1 at the rf no. 1 (A) card to produce a 7.200,100 mc difference frequency. The divide-by-2 frequency divider at the mixer output, in the digital no. 2 card, produces a 3.600,050 mc frequency which is applied to the divide-by-N counter. The counter, programmed to divide-by-73 (by the 10 mc, 1 mc, and 100 kc tuning dial setting), supplies a 49.315 kc frequency to the phase detector in the rf no. 1 (B) card instead of the required 50 kc vco "locking" frequency. Unlocked, vco no. 1 in the rf no. 1 (A) card sweeps to a frequency of 109.900,100 mc which corresponds with the 02.0999 mc tuning dial setting, and becomes locked. At this point, the output frequency of mixer A12Z1 has changed to 7.300,000 mc, and the divide-by-2 divider with the divide-by-N counter (dividing by a total factor of 146) supplies the 50 kc "locking" frequency.

Note

> The following trouble shooting procedure concerns a complete synthesizer module (A12). Refer to paragraphs 4-16 through 4-23 when trouble shooting the individual synthesizer cards (A12A1 through A12A7).

d. PRELIMINARY CHECK. (See figure 5-71.) - Make a preliminary check of the synthesizer module before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its sockets.

(2) Seating of the individual cards in the module.

(3) Soldered connections to the module sockets.

e. TEST EQUIPMENT. - Use Frequency Counter H-P 5245L with Frequency Converter H-P 5253A, and Electronic Multimeter AN/USM-116. No special tools are required.

f. CONTROL SETTINGS. - Set all controls as indicated in table 3-1. (Place the exciter in "tune" condition.) During tests, set the FREQUENCY KC tuning dials as directed.

g. TEST DATA. (See figure 5-71.) - Trouble shooting the complete synthesizer module consists of checking the +5 and +15 volt dc operating potentials, and measuring the input and output frequencies. Test steps have been selected to verify normal operation of the three vco's in the rf no. 1 (A) card (A12A1) at a central frequency in their ranges. All measurements are made at chassis connectors A18XA12P1 and A1A8XA12P2.

(1) Connect multimeter to XA12P2 pin Z. Meter should read +5 vdc ±5%.

(2) Connect multimeter to XA12P2 pin E. Meter should read +15 vdc ±10%.

(3) Connect frequency counter to XA12P2 pin DD. Counter should read 30000.000 kc ±1 count.

(4) Connect frequency counter to XA12P2 pin BB. Counter should read 3000.0000 kc ±1 count.

(5) Connect frequency counter to XA12P2 pin CC. Counter should read 12.5000 kc ±1 count.

(6) Connect frequency counter to XA12P2 pin B. Counter should read 30000.000 kc ±1 count.

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(7) Connect frequency counter with frequency converter to XA12P1 pin A. Set FREQUENCY KC dials at 07.0000 mc. Counter should read 105.000000 mc ±1 count.

(8) Repeat step (7), with FREQUENCY KC dials set at 17.5000 mc. Counter should read 094.500000 mc ±1 count.

(9) Repeat step (7) with FREQUENCY KC dials set at 26.5000 mc. Counter should read 085.500000 mc ±1 count.

h. TROUBLE SHOOTING SUGGESTIONS. - The following trouble shooting suggestions for synthesizer A12 are provided to aid the technician in tracing faulty synthesizer operation to a particular circuit card. Refer also to the test data provided for the individual synthesizer cards in subsequent paragraphs.

(1) VCO OPERATION. - Normal operation of the three vco's in the rf no. 1 (A) card (A12A1) can be verified by repeating the test steps given in paragraph 4-14g(7) through (9) for other FREQUENCY KC dial positions, over the complete vco ranges. (See frequency list in paragraph 4-15a(2).) The tuning range of vco no. 1 is from 101 to 110 mc, the range for vco no. 2 is 91 to 100 mc, and the range for vco no. 3 is 82 to 90 mc. To determine the vco frequency for a given FREQUENCY KC dial setting, subtract the dial setting in megacycles from 112.0 mc. If a vco frequency does not correspond with the FREQUENCY KC dial setting, or if the frequency does not change with a change in dial setting, a sweep failure is indicated. The vco may also sweep continually without locking. In either event, check the varactor control voltages for the faulty vco at the card test points provided for this purpose.

(2) DIVIDE-BY-N COUNTERS. - For a given FREQUENCY KC tuning dial setting, the two divide-by-N digital counters in the digital no. 2 card (A12A3) and the digital no. 3 card (A12A6) provide a frequency division by a predetermined factor. Although it is impractical to measure the actual counting process during exciter operation, the division factor at either counter can be established by noting the FREQUENCY KC tuning dial setting. To determine the count rate for the digital no. 2 counter, add the digits 053 to the 10 mc, 1 mc, and the 100 kc dial settings, disregarding the decimal point. For example: a dial reading of 02.0 (for the 10 mc, 1 mc, and 100 kc dials) indicates a count factor of 73, and a dial reading of 29.9 a count factor of 352; the lower and upper counter limits. To determine the count rate of the digital no. 3 count, add 2000 to the 10 kc, 1 kc, and 100 cps dial readings. A reading of 000 is a count rate of 2000, and a reading of 999 is a count rate of 2999; the lower and upper counter limits.

(3) STANDARD FREQUENCIES. - Synthesizer operation is dependent upon the 50 kc and the 1.2 kc reference frequencies supplied by the digital no. 1 card (A12A7), and the fixed 3 and 30 mc frequencies supplied by auxiliary frequency generator A7. The absence or degradation of any of these frequencies can prevent synthesizer operation, completely. Because mixer A12Z1 combines products of both the 100 kc and 100 cycle tuning circuits, a malfunction in either tuning circuit will have an effect on the 82 to 110 mc synthesizer output frequency.

4-15. FREQUENCY KC TUNING DIALS (p/o A18). (See figures 4-17 and 5-90.)

The tuning dials on the exciter front panel consist of six control knobs and their associated rotary switches and frequency indicating windows. Faulty operation of the tuning dial circuits can affect a portion of the tuning range or prevent exciter operation completely.

a. DESCRIPTION. - The six FREQUENCY KC tuning dials select exciter output frequencies, from 2.0 to 29.9999 mc in increments of 10 mc, 1 mc, 100 kc, 1 kc, and 100 cycles, by controlling synthesizer module A12 output frequencies from 82 to 110 mc in similar increments. Setting the six dials to the transmission frequency in kilocycles selects the appropriate vco in rf no. 1 (A) card A12A1 and locks the vco frequency. The rotary switches controlled by each dial develop a binary code which is applied to a number of IC reset gates, which in turn control the counting rates of the two IC pulse counters (divide-by-N) in the synthesizer. The counters are located in digital no. 2 card (A12A3) and digital no. 3 card (12A6). To determine the synthesizer output frequency for a given dial setting, subtract the dial setting (in megacycles) from 112.0000 mc.

(1) TUNING DIAL CODE. - The six FREQUENCY KC tuning dials control the positions of rotary switches S5 through S10, respectively. Each dial has ten positions (0 to 9), with exception of the 10 mc dial (S5) which has three positions (0, 1, and 2).

Table 4-4 lists the binary code employed for the six tuning dials and identifies the rotary switch section involved. The reset gates controlling the two divide-by-N counters are positive logic NAND gates. An open rotary switch contact represents a logical "1" at the gate inputs provided by frequency select board A18A3; a closed (grounded) contact is a logical "0". Note that the tuning dial functions relate to the divide-by-N counter division factors. For example: the digital no. 3 card (A12A6) counter has a division range from 2999 to 2000 (counting down). The 100 cycle dial controls counting in "units", the 1 kc dial in "tens", and the 10 kc dial in "hundreds". Similarly, the digital no. 2 card (A12A3) counter covers a division range from 352 to 73 (counting down). The 100 kc dial controls counting in "units", the 1 mc dial controls counting in "tens", and the 10 mc dial controls counting in "hundreds".

(2) VCO SELECTION. - A part of section A at the 10 mc rotary switch S5, and sections C and D of the 1 mc rotary switch S6, control selection of the vco circuit to be used in the rf no. 1 (A) card (A12A1). The vco control circuit from switch S5A-1 and S5A-8 goes to the transmitter control no. 2 module A17 via LOCAL/REMOTE switch S11. The following list identifies the vco used, its frequency range, and indicates the related 10 mc and 1 mc tuning dial positions.

Vco	Range (Mc)	10 Mc and 1 Mc Dials
1	101 to 110	02 to 11
2	91 to 100	12 to 21
3	82 to 90	22 to 29

(3) EXCITER "TUNE" PROVISIONS. - Rotary switch sections S5B, S6E, S7C, S8E, S9C, and S10C, controlled by the 10 mc through 100 cycle tuning dials respectively, form a series of switch circuits to insure "fail-safe" exciter operation. During operation, if any one of the six tuning dials is reset (or if the CLASS OF EMISSION switch position is changed), the system is automatically placed in the "tune" cycle of operation. The switch circuit from S10C-1 goes to transmitter control no. 1 module A10 where the various switching operations are performed.

(4) LOCAL/REMOTE SYNTHESIZER CONTROL. - A multiple section switch S11, LOCAL/REMOTE, permits control of the synthesizer from the (optional) remote control unit, Control Indicator, Transmitter C-7709/FRT together with Decoder-Encoder KY-656/FRT (local control unit). When switch S11 is set at REMOTE, all functions of the six FREQUENCY KC tuning dials (including vco selection) are performed by the remote control unit. Frequency selection controls at the remote control unit develop the required binary code given in table 4-4, and reset gate operation duplicates that provided by the exciter controls.

b. PRELIMINARY CHECK. (See figure 5-90.) - Make a preliminary check of the FREQUENCY KC tuning dials (p/o A18) before trouble shooting, with emphasis on the following:

(1) Mechanical operation of the rotary switches.

(2) Frequency numbers versus dial positions.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools required.

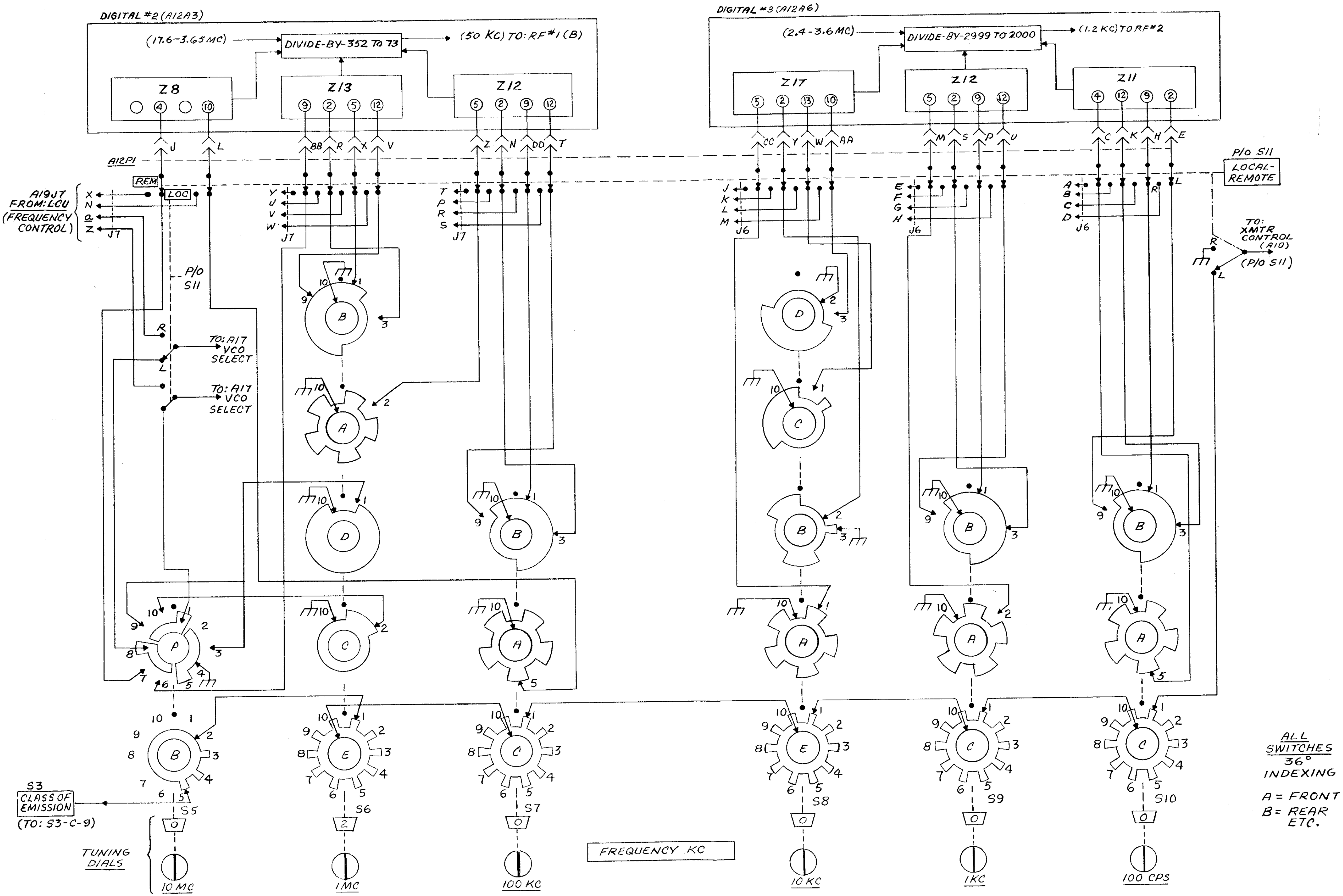

Figure 4-17. Frequency Kc Tuning Dials, Functional Diagram

TABLE 4-4. FREQUENCY KC DIALS, BINARY CODE

100-CPS DIAL (S10)

Dial	Switch Section/Contact A5	B3	B1	B9	÷N
0	0	0	0	1	2000
1	1	0	0	1	2001
2	0	0	1	1	2002
3	1	0	1	1	2003
4	0	1	1	0	2004
5	1	1	1	0	2005
6	0	1	0	0	2006
7	1	1	0	0	2007
8	0	0	0	0	2008
9	1	0	0	0	2009

1-KC DIAL (S9)

Dial	Switch Section/Contact A2	B3	B1	B9	÷N
0	1	0	0	1	2000
1	0	0	0	1	2010
2	1	0	1	1	2020
3	0	0	1	1	2030
4	1	1	1	0	2040
5	0	1	1	0	2050
6	1	1	0	0	2060
7	0	1	0	0	2070
8	1	0	0	0	2080
9	0	0	0	0	2090

10-KC DIAL (S8)

Dial	Switch Section/Contact A1	B2	C1	D3	÷N
0	0	0	1	1	2000
1	1	1	0	1	2100
2	0	1	0	1	2200
3	1	0	0	1	2300
4	0	0	0	1	2400
5	1	1	1	0	2500
6	0	1	1	0	2600
7	1	0	1	0	2700

10-KC DIAL (S8) (Cont)

Dial	Switch Section/Contact A1	B2	C1	D3	÷N
8	0	0	1	0	2800
9	1	1	0	0	2900

100-KC DIAL (S7)

Dial	Switch Section/Contact A5	B3	B1	B9	÷N
0	0	0	0	1	73
1	1	0	0	1	74
2	0	0	1	1	75
3	1	0	1	1	76
4	0	1	1	0	77
5	1	1	1	0	78
6	0	1	0	0	79
7	1	1	0	0	80
8	0	0	0	0	81
9	1	0	0	0	82

1-MC DIAL (S6)

Dial	Switch Section/Contact A2	B3	B1	B9	÷N
0	1	1	0	0	
1	0	1	0	0	
2	1	0	0	0	73
3	0	0	0	0	83
4	1	0	0	1	93
5	0	0	0	1	103
6	1	0	1	1	113
7	0	0	1	1	123
8	1	1	1	0	133
9	0	1	1	0	143

10-MC DIAL (S5)

Dial	Switch Section/Contact A7	A6	÷N
0	1	1	73
1	0	1	173
2	1	0	273

GND = Logical "0", OPEN = Logical "1"

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. Other control settings will be given during performance of the test procedure.

CAUTION

Make sure the exciter is in "standby" condition before performing the following test procedures.

e. TEST DATA. (See figure 5-90.) - Trouble shooting the FREQUENCY KC tuning dials circuit (p/o A18) consists of checking the rotary switch circuits for generation of the binary code listed in table 4-4. Use the test data given in table 4-5 and connect the dc voltmeter between the chassis and the switch terminals noted at connector XA12P1. A ground (zero volts) should occur at those terminals so indicated when the related tuning dial is set to the prescribed positions; all other terminals should indicate an open circuit (+5 volts).

TABLE 4-5. FREQUENCY KC DIALS, TEST DATA

DIAL	SWITCH	CONNECTOR XA12P1 TERM.	DIAL TEST POSITIONS	TEST
10-MC (S5)	A-7	J	2 (only)	GRD
	A-6	BB	1 (only)	GRD
1 MC (S6)	A-2	Z	1, 3, 5, 7, 9	GRD
	B-3	R	2 through 7	GRD
	B-1	X	0 through 5	GRD
	B-9	V	0 through 3, 8, 9	GRD
100 KC (S7)	A-5	L	0, 2, 4, 6, 8	GRD
	B-3	N	0 through 3, 8, 9	GRD
	B-1	DD	0, 1, 6 through 9	GRD
	B-9	T	4 through 9	GRD
10 KC (S8)	A-1	CC	0, 2, 4, 6, 8	GRD
	B-2	Y	0, 3, 4, 7, 8	GRD
	C-1	W	1 through 4, 9	GRD
	D-3	AA	5 through 9	GRD
1 KC (S9)	A-2	M	1, 3, 5, 7, 9	GRD
	B-3	S	0 through 3, 8, 9	GRD
	B-1	P	0, 1, 6 through 9	GRD
	B-9	U	4 through 9	GRD
100-CPS (S10)	A-5	C	0, 2, 4, 6, 8	GRD
	B-3	K	0 through 3, 8, 9	GRD
	B-1	H	0, 1, 6 through 9	GRD
	B-9	E	4 through 9	GRD

4-16. RF NO. 1 (A) CARD A12A1. (See figure 5-72.)

The rf no. 1 (A) card contains a dc amplifier, three voltage-controlled vhf oscillators (vco's), an output amplifier, and a vco supply voltage distribution circuit. Faulty operation of this module can prevent exciter operation completely.

a. DESCRIPTION. - The rf no. 1 (A) card generates the 82 to 110 mc synthesizer output frequencies in response to a dc varactor-control voltage developed in the other synthesizer circuits. A dc amplifier applies the varactor control voltage, supplied by the rf no. 1 (B) card (A12A4), to all three vco circuits, but only one vco circuit operates at a time. The operating vco is selected by a dc supply-voltage distribution circuit (controlled by transmitter control no. 2, A17) which supplies power to one vco, disabling the other two. Vco output frequencies are applied directly to down-converter module A13 and via an output amplifier to mixer A12Z1.

(1) DC AMPLIFIER. - The dc amplifier consists of stages Q1 through Q4. A 50 kc twin-T filter at the amplifier input rejects this frequency component which is contributed by the phase detector circuit located in rf no. 1 (B) card A12A4. The filter network is formed by capacitors C1, C2, C3 and C5, and resistors R2, R3, R4, and R6. Dc output from Q3 is applied to an "active" low-pass filter consisting of emitter-follower Q4, capacitors C7, C8, and resistors R12, R15. Without feedback this network has a 3 kc roll-off point and attenuation of -6 db per octave. Feedback capacitor C7 increases attenuation after roll-off to -12 db per octave. In this manner, 50 kc harmonics present in the dc amplifier are effectively removed.

(2) VCO'S NOS. 1, 2, and 3. - The three voltage-controlled oscillators, with outputs connected in parallel, are identical circuits except for their frequency ranges. Vco no. 1 generates frequencies from 101 to 110 mc, vco no. 2 from 91 to 100 mc, and vco no. 3 from 82 to 90 mc; thus, the synthesizer output range from 82 to 110 mc is covered in three steps. The circuit description which follows for vco no. 1 also applies to the other vco circuits.

Vhf oscillator Q5 employs a modified Colpitts circuit. The tank circuit is formed by inductor L1, tuned by capacitor C15 and varactor CR1 in series, and feedback capacitors C13 and C14. Oscillator output is obtained at the junction of resistors R23 and R24 in the feedback circuit. Dc varactor-control voltage is applied to CR1 via isolation resistor R25. The dc control voltage range is from approximately 4.5 volts dc to 10.5 volts dc, corresponding with an oscillator output frequency range from 101 mc to 110 mc, respectively.

The low end of the tank circuit is grounded, and a +15 volt dc operating potential for PNP transistor Q5 is applied to the emitter circuit via decoupling resistor R22 and capacitor C12. Operating voltage, supplied by the dc voltage distribution circuit, is applied only when the 10 mc and 1 mc tuning dials are set at positions 02 to 11. Vco no. 1 is disabled for all other 10 mc and 1 mc dial positions. (See paragraph 4-15a(2) for a list of vco operating sequences.)

(3) OUTPUT AMPLIFIER. - The vco output amplifier, consisting of Q8 and Q9, supplies synthesizer output frequencies to mixer A12Z1. Self-tuned inductor L4 at the collector of Q9 functions as a tuned circuit for the broadband vhf amplifier. Dc operating voltage is obtained directly from decoupling stage Q10 in the supply-voltage distribution circuit.

(4) SUPPLY-VOLTAGE DISTRIBUTION. - The supply-voltage distribution circuit for the three vco's consists of decoupling stage Q10 and switch stages Q11 through Q13. Gate diodes CR4 through CR6 isolate application of the +15 volt dc supply voltage to the individual vco circuits, while providing an OR gate to supply the output amplifier.

Depending upon the 10 mc and 1 mc tuning dial settings, a +15 volt dc potential is applied to one of the three switch stages (Q11 through Q13) via transmitter control no. 2 circuit A17, to enable the related vco circuit. For example: when the 10 mc and 1 mc tuning dials are set for a reading of 02 to 11, a +15 volt potential is applied to the emitter of switch Q11 and it saturates, providing operating potential for the output amplifier and vco no. 1.

Q10 performs a power supply decoupling function. Capacitor C32 and resistor R50 perform initial supply decoupling. Q10 effectively multiplies the capacitance of C32 (15 uf) by the current gain (beta) factor of the stage to obtain a capacitance effect 50 times larger (75 uf) at the emitter circuit, thus increasing the degree of decoupling.

b. PRELIMINARY CHECK. - Make a preliminary check of the rf no. 1 (A) card A12A1 before trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer module in its sockets.

c. TEST EQUIPMENT. - Use Frequency Counter H-P 5245L with Frequency Converter H-P 5253A, and Electronic Multimeter AN/USM-116. No special tools required.

d. CONTROL SETTINGS. - Set all controls as indicated in table 3-1. (Place the exciter in "tune" condition.) During tests, set the FREQUENCY KC tuning dials as directed.

e. TEST DATA. (See figure 5-72.) - Trouble shooting the rf no. 1 (A) card (A12A1) consists of measuring the synthesizer output frequency and monitoring the dc varactor-control voltage for that frequency. Frequency and voltage measurements are performed at the upper and lower range limits for each of the three vco circuits. With exception of the varactor-control voltage, all measurements are performed at chassis connector A18XA12P1.

(1) Connect VTVM (dc volts) to test point J1(TP) on rf no. 1 (A) card. Connect frequency counter (with converter when required) to XA12P1 pin A.

(2) Set FREQUENCY KC dials to 02000.0 kc. Counter should read 110.0000 mc ±1 count; VTVM should read approximately +10 volts dc.

(3) Set FREQUENCY KC dials to 11000.0 kc. Counter should read 101.0000 mc ±1 count; VTVM should read approximately +4.5 volts dc.

(4) Set FREQUENCY KC dials to 12000.0 kc. Counter should read 100.0000 mc ±1 count; VTVM should read approximately +10 volts dc.

(5) Set FREQUENCY KC dials to 21000.0 kc. Counter should read 091.0000 mc ±1 count; VTVM should read approximately +4.5 volts dc.

(6) Set FREQUENCY KC dials to 22000.0 kc. Counter should read 090.0000 mc ±1 count; VTVM should read approximately +10 volts dc.

(7) Set FREQUENCY KC dials to 29000.0 kc. Counter should read 083.0000 mc ±1 count; VTVM should read approximately +4.5 volts dc.

4-17. RF NO. 1 (B) CARD A12A4. (See figures 4-18, 4-19, and 4-20.)

The rf no. 1 (B) card contains a dc ramp generator, a digital phase detector, and a digital type frequency-discriminator. These circuits develop and process the dc varactor-control voltage applied to the three vco circuits in rf no. 1 (A) card A12A1. Faulty operation of this card can prevent exciter operation completely.

a. DESCRIPTION. - The dc varactor-control voltage is developed as a function of the frequency (and phase) relation between two input frequencies. A fixed 50 kc reference frequency from digital no. 1 card A12A7 is compared with the 50 kc frequency from digital no. 2

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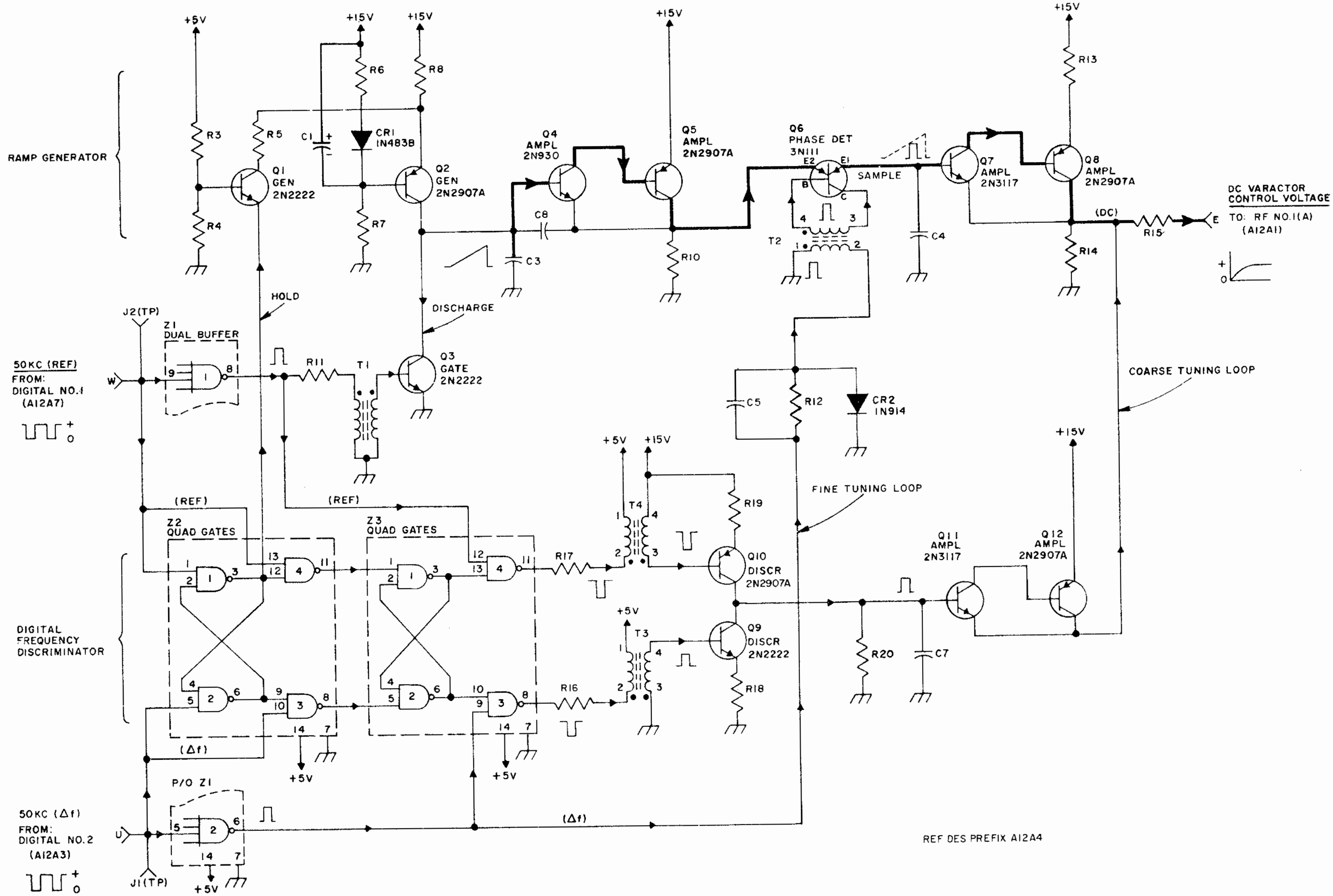

Figure 4-18. RF No. 1(B) Card, Simplified Schematic Diagram

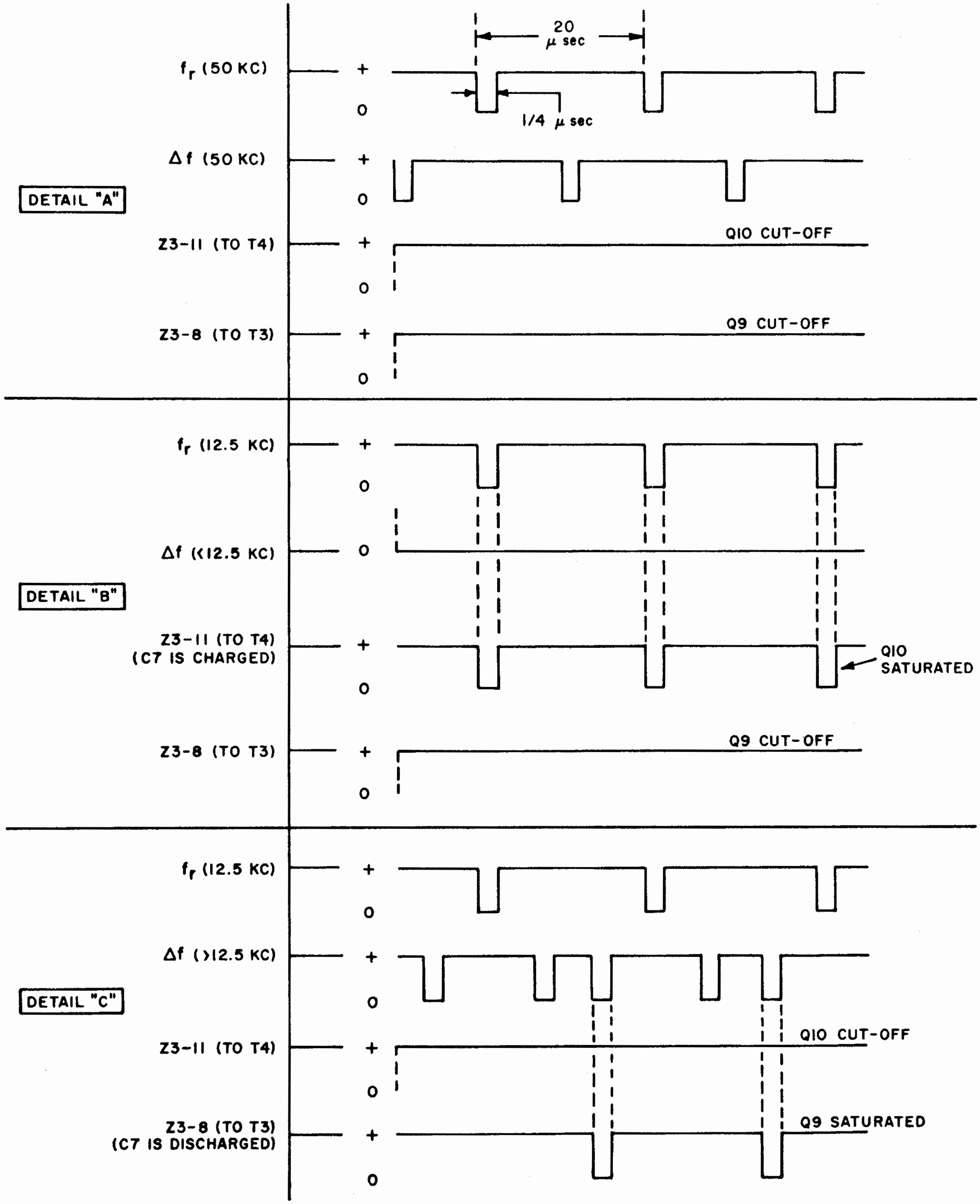

Figure 4-19. Coarse-Tuning Circuit, Timing Diagram

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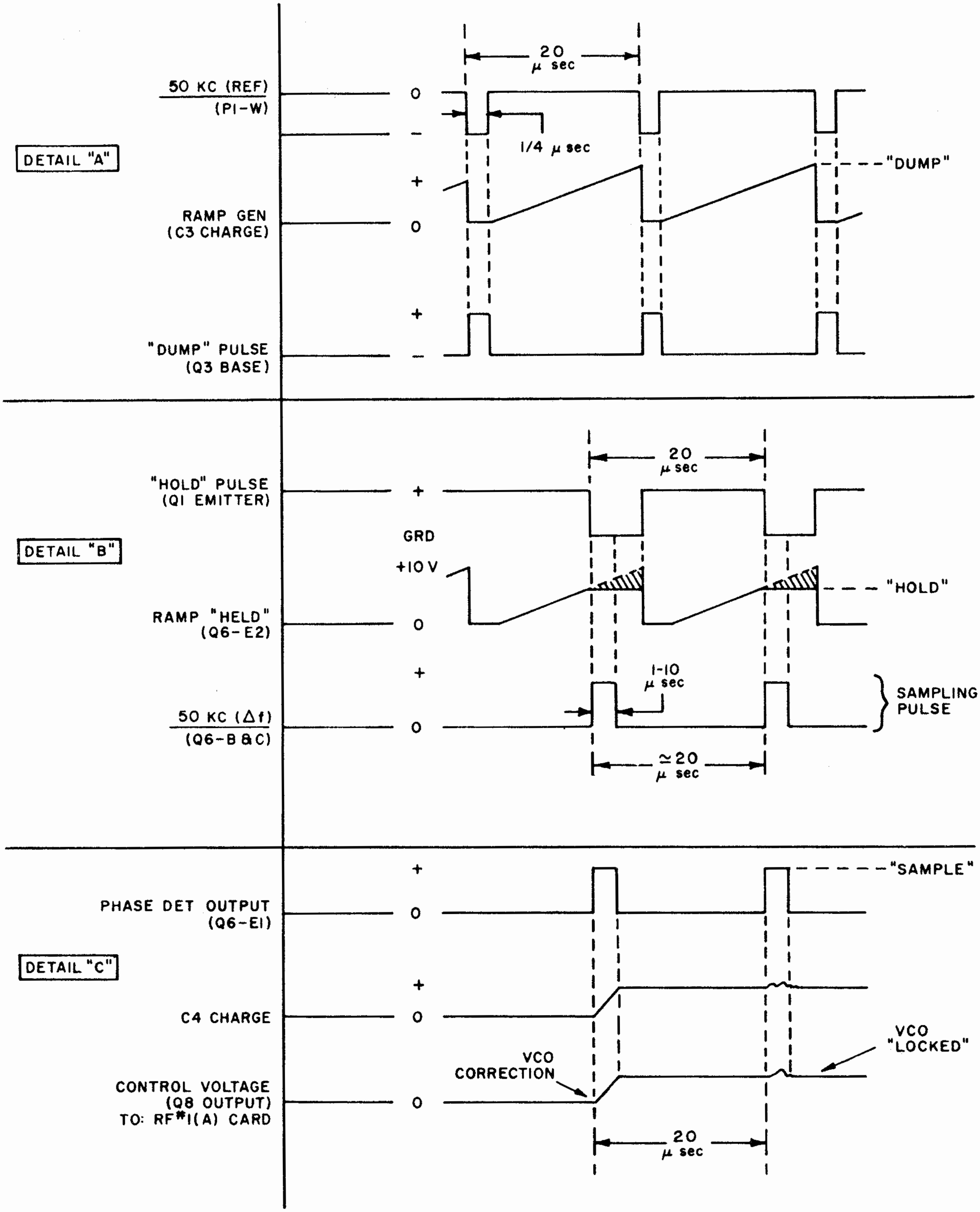

Figure 4-20. Fine-Tuning Circuit, Timing Diagram

card A12A3. Frequency comparison is performed by digital techniques and the resultant dc voltage directly controls the vco circuits in rf no. 1 (A) card A12A1.

Vco frequency control is affected in two steps. A coarse-tuning circuit supplies the dc control voltage when a relatively large frequency difference exists between the two input frequencies; a fine-tuning circuit employing a dc ramp generator supplies the dc control voltage when the two frequencies are in close agreement. When a frequency coincidence is reached, the control voltage "locks" the vco operating frequency.

Because the three vco circuits cover the 82 to 110 mc frequency range in three segments with only one vco circuit operating at a given time, a particular dc varactor-control voltage can represent any one of three synthesizer output frequencies (see paragraph 4-15a (2)). For each vco circuit, the dc control voltages range is approximately from +4.5 volts dc (low frequency limit) to +10 volts dc (high frequency limit).

(1) COARSE-TUNING CIRCUIT. (See figures 4-18 and 4-19.) - The coarse-tuning circuit consists of dual buffer Z1, two dual-input quad NAND gates Z2 and Z3, discriminator stages Q9 and Q10, and complementary dc amplifier Q11, Q12. In addition to development of the coarse-tuning varactor control voltage, this circuit also supplies a timing function for fine-tuning circuit operation.

Dual buffer Z1 provides circuit isolation for the two input pulse trains and also inverts the pulses. Dual-input quad NAND gates Z2 and Z3 operate as a digital frequency discriminator to control operation of discriminator stages Q9 and Q10. The input gates of Z2 and Z3 are cross-coupled to function in a manner similar to a J-K flip-flop. The two output gates perform as NAND gates, an output appearing only when both gate inputs occur simultaneously.

Discriminator stages Q9 and Q10 actually function as switching circuits under control of the Z3 output pulses, via pulse transformers T3 and T4. When Q10 saturates, capacitor C7 is charged from the +15 volt dc supply, and when Q9 saturates C7 is discharged. In this manner, the charge at capacitor C7 is determined by the digital discriminator action of Z3. The charge at C7 is amplified by Q11 and Q12, and appears as a dc varactor-control voltage at the card output. The following paragraphs provide a detailed description of the coarse-tuning circuit operation for three conditions. These are: a "null" condition when the two 50 kc input frequencies coincide, a control condition where the variable frequency (Δf) is greater than the reference frequency (f_r), and a control condition where the reference frequency (f_r) is greater than the variable frequency (Δf).

(a) Coarse Tuning: $\Delta f = fr$. - Detail A of figure 4-19 gives the timing relation at major points in the coarse-tuning circuit when the two input frequencies are near coincidence, and a coarse tuning "null" occurs. A frequency coincidence of approximately 600 cycles, well within the capture range of the fine-tuning circuit, will cut off discriminator Q9 and Q10 to stop production of a coarse tuning dc control voltage by this circuit. At a coarse-tuning "null", the cross-coupled NAND gates in Z2 and Z3 (and the direct coupled NAND gates) produce a logical "1" or positive-going output pulse at terminals Z3-11 and Z3-8, simultaneously. Z3 gate output remains at this operating condition as long as a coarse-tuning "null" exists.

Because the steady dc voltage (logical "1") at the primaries of pulse transformers T3 and T4 does not induce a secondary voltage, discriminator stages Q9 and Q11 are held cut-off. Capacitor C7 retains its previous charge, subject to a slow discharge via resistor R20, and the dc varactor-control voltage level at the card output is maintained until the fine-tuning circuit operates.

(b) Coarse Tuning: $\Delta f < f_r$. - Detail B of figure 4-19 shows the circuit timing when the variable 50 kc frequency is lower than the reference 50 kc frequency. To facilitate a description of tuning circuit operation for this condition, it is assumed that Δf is lower than f_r by several kilocycles. Frequency coincidence, within the previously mentioned 600 cycle range, does not exist. Therefore, gate Z3 produces a differential output. The lower

Δf frequency produces a logical "1" output at Z3-8 and the higher f_r frequency causes simultaneous production of a logical "0" at Z3-11, a direct result of frequency noncoincidence.

Discriminator stage Q9 remains cut-off, but the repeated occurrence of a logical "0" at the primary of pulse transformer T4 induces a similar (in phase) pulse into the secondary to drive Q10 to saturation and charge capacitor C7. The charge is amplified by Q11 and Q12 and the rising dc varactor-control voltage causes an increase in the vco frequency, and a corresponding rise in the Δf frequency until a coarse-tuning circuit "null" occurs. As the "null" condition is approached, the number of logical "0" (negative going pulses) at Z3-11 diminishes, slowing down the rate of charge at capacitor C7.

(c) Coarse Tuning: $\Delta f > f_r$. - Detail C of figure 4-19 shows the circuit timing when the variable 50 kc frequency is higher than the reference 50 kc frequency. Again, it is assumed that a difference of several kilocycles exists between the two input frequencies. NAND gate Z3 produces a differential output, but now terminal Z3-11 has the logical "1" output and terminal Z3-8 the logical "0" output. Discriminator stage Q10 is cut-off and the occurrence of negative going pulses at output Z3-8 drives Q9 to saturation, via pulse transformer T3. With Q10 cut-off, capacitor C7 is no longer charged from the +15 volt supply but discharges to ground through the saturated Q9 stage. Capacitor discharge occurs intermittantly in response to the Z3-8 output pulses, and the gradual reduction in dc varactor-control voltage lowers the vco frequency until a coarse-tuning "null" condition is obtained.

(d) Z2 Timing Function. - In addition to operating as a part of the coarse-tuning circuit digital discriminator, dual-input quad gate Z2 performs a timing function for the fine-tuning circuit. Output pulses from terminal Z2-3 perform a "hold" function at the dc ramp generator and are applied to the emitter of Q1. This action occurs during a coarse-tuning cycle to stop or "hold" the dc ramp voltage at a rise-point determined by the frequency relation of the two input frequencies. The "hold" function is in the form of negative-going pulses which ground the emitter of Q1, each time a Δf pulse appears. Figure 4-19 shows the derivation of these pulses.

(2) FINE-TUNING CIRCUIT. (See figures 4-18 and 4-20.) - The fine-tuning circuit consists of dc ramp generator Q1 and Q2, ramp "dump" gate Q3, dc complementary amplifier Q4 and Q5, digital phase detector (chopper) Q6, and dc complementary amplifier Q7 and Q8. This circuit performs the final vco frequency adjustment, immediately following operation of the coarse-tuning circuit, to lock the vco. The dc ramp voltage is sampled by phase detector Q6 to develop a fine-tuning varactor-control voltage.

(a) Ramp Generator Circuit. - Ramp generator Q1 and Q2, controlled by a "hold" pulse from dual-input quad gate Z2 and a "dump" pulse from buffer Z1-8, charges capacitor C3 at a 50 kc rate to generate the ramp. When the emitter of Q1 receives a logical "1" (positive-going pulse) from quad gate terminal Z2-3, Q1 is cut-off causing Q2 to saturate and charge capacitor C3 from the +15 volt dc supply, via collector resistor R8. When the emitter of Q1 receives a logical "0" (ground) pulse from terminal Z2-3, it saturates cutting off Q2 to stop the charging process. The C3 charge is held at that ramp value until "dumped" by the action of gate Q3.

Normally, gate Q3 is cut-off. When a logical "1" (positive-going pulse) appears at buffer output Z1-8 it is applied to the base of Q3 via pulse transformer T1. Q3 saturates and provides a discharge path to ground for capacitor C3. In this manner, the dc ramp voltage at capacitor C3 is "dumped" by each pulse of the 50 kc f_r input signal, and allowed to rise between pulses, subject to the "hold" action performed when a logical "0" (ground) pulse is supplied from quad gate Z2-3.

(b) Phase Detector (Chopper). - The dc ramp voltage derived at capacitor C3 in the ramp generator circuit is applied to one input of phase detector Q6 via complementary amplifier Q4 and Q5, and a "sampling" pulse is applied to the other input from transformer T2. Detector output occurs only when a dc ramp voltage is present during the "sampling" pulse interval. Diode CR2 functions as a dc restorer to hold the "sampling" pulse at a constant level with respect to ground, and resistor R12 with capacitor C5 removes switching transients. Phase detection is essentially a digital process and the detector output level is determined by the dc ramp level "held" during the sampling. To assure effective vco frequency control, only the upper portion of the dc ramp is sampled, from approximately +4.5 volts to +10 volts dc, corresponding to the lower and upper frequency limits of the three vco circuits in card rf no. 1 (A). Phase detector output charges storage capacitor C4. The charge is applied to Q7 and Q8, and then combined with the coarse-tuning circuit output at the collector of Q8.

(c) Fine-Tuning Circuit Operation. - Figure 4-20, the fine-tuning circuit timing diagram, shows the circuit operation at major circuit points. Detail A shows the dc ramp and the "dump" pulse, with reference to the 50 kc f_r input frequency, in the absence of a "hold" pulse. Dc ramp generation is a continuing function and is entirely independent of the coarse-tuning circuit operation. Note that the "dump" pulse appearance coincides with that of the 50 kc f_r pulse train.

Detail B shows introduction of the "hold" pulse and retention of the dc ramp voltage at that level. Phase detector "sampling" occurs only during the "hold" pulse interval, and this interval is productive when the Δf and f_r input frequencies are brought to near coincidence by the coarse-tuning circuit. The fine-tuning circuit capture range is comparatively narrow, so the coarse-tuning circuit operation must be completed before the fine-tuning circuit will function.

Detail C shows the phase detector "sampling" relative to the charge at capacitor C4. Note that vco frequency correction is performed immediately after initial sampling of the dc ramp level. Repeated sampling, prior to the "dump" function, only serves to re-establish the previously sampled portion of ramp voltage. Complementary amplifier Q7 and Q8 also functions as an isolation stage to separate the coarse and fine tuning circuits.

b. PRELIMINARY CHECK. (See figure 5-73.) - Make a preliminary check of the rf no. 1 (B) card (A12A4) before trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer module in its sockets.

4-18. DIGITAL NO. 2 CARD A12A3. (See figures 4-21 and 5-77.)

The digital no. 2 card contains an input amplifier circuit with a divide-by-2 digital frequency divider, a divide-by-N digital counter having a variable division range from 352 to 73, and NAND control gates to select the division factor via the 10 mc, 1 mc, and 100 kc tuning dials at the FREQUENCY KC selector. These circuits form part of the phase-lock loop for vco circuits in rf no. 1 (A) card A12A1. Faulty operation of this card can prevent exciter unit operation completely.

a. DESCRIPTION. - The digital no. 2 card controls the selection of operating frequency at the vco circuits in the rf no. 1 (A) card, and therefore controls selection of the exciter unit output frequency. A sample of the 82 to 110 mc vco output frequency is mixed with a 117.300,000 to 117.200,100 mc frequency from rf no. 3 card A12A2 by mixer A12Z1. The difference frequency, obtained at the mixer output, ranges from 35.200,000 to 7.300,000 mc, and it is reduced to a frequency range from 17.600,000 to 3.650,000 mc by ÷2 frequency divider Z5. The divide-by-N counter provides a final frequency reduction to 50 kc when set (by control gates Z6, Z11 and Z16) for a frequency division by factors from 352 to 73, respectively. The 50 kc output is applied to rf no. 1 (B) card A12A4 for development of the vco varactor control-voltage. Counter control gates Z6, Z11, and Z16, in response to the 10 mc, 1 mc, and 100 kc tuning dial settings, select the divide-by-N counter division factor.

A 50 kc output frequency from the divide-by-N counter occurs only when the rf no. 1 (A) vco circuits have become phase-locked. When the 10 mc, 1 mc, and 100 kc dials are reset, changing the divide-by-N counter division factor, the immediate output frequency is higher (or lower) than 50 kc until vco "locking" is accomplished by the coarse and fine tuning circuits contained in rf no. 1 (B) card A12A4.

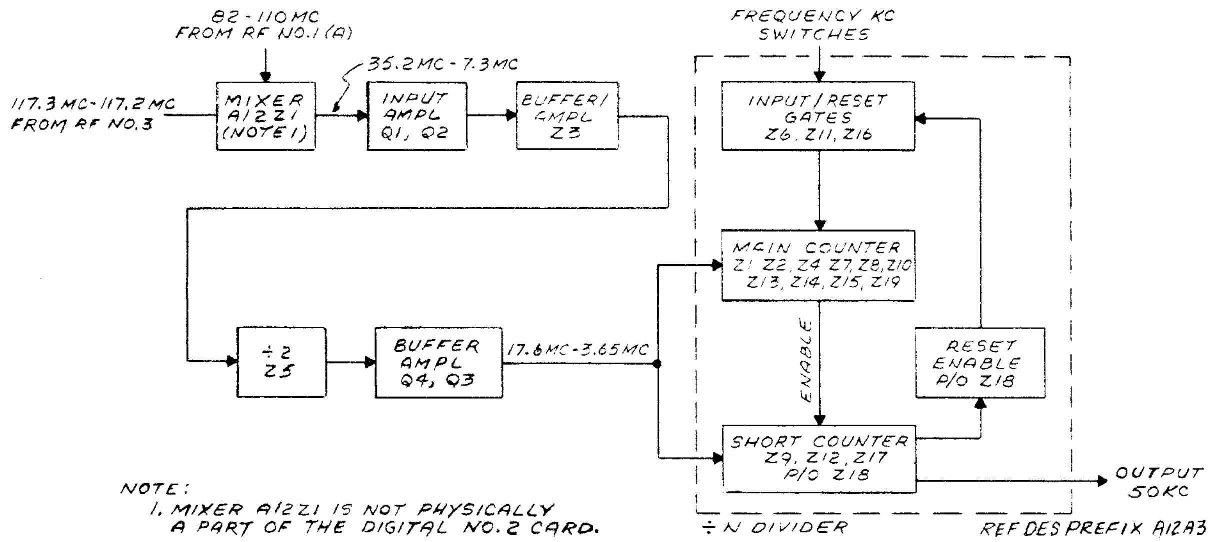

Figure 4-21. Digital No. 2 Card, Simplified Block Diagram

(1) INPUT MIXER A12Z1. - Input mixer A12Z1 mixes an 82 to 110 mc sample frequency from rf no. 1 (A) card A12A1 with a 117.300,000 to 117.200,100 mc range of frequencies from rf no. 3 card A12A2 to obtain a 35.200,000 to 7.300,000 mc difference frequency range. The difference frequency is applied to the input amplifier of the digital no. 2 card.

(2) AMPLIFIER AND DIVIDER (÷2). - Mixer A12Z1 supplies the 35.200,000 to 7.300,000 mc frequency to a video type input amplifier consisting of amplifier Q1 and Q2. Resistor R3 applies negative feedback to the base of Q1. Z3 is a buffer amplifier which drives divide-by-two flip-flop Z5 to produce a frequency in the range of 17.600,000 to 3.650, 000 mc. The output of Z5 is connected via buffer amplifier Q3 and Q4 to the variable divider.

(3) DIVIDE-BY-N VARIABLE FREQUENCY DIVIDER. - The divide-by-N digital counter (frequency divider) has a selectable division range from 352 to 73, in unit steps. It consists of main counter Z14 (÷2), Z1/Z2/Z4 (÷5), Z7 (÷2), Z8/Z10/Z13 (÷5) and Z15/Z19 (÷4); short counter Z9/Z12/Z17; reset enable gate Z18; and input/reset gates Z6/Z11/Z16.

The main counter is able to divide-by up to 400 (÷ (2 x 5 x 2 x 5 x 4) = 400). When a division by 352 is selected (corresponding to a system output frequency of 29.9 mc) the main counter counts to 346. This enables the short counter which continues the count to 352. After the short counter is enabled, the main counter reset is enabled. This provides sufficient time for the main counter to reset before the start of the next counting cycle. The short counter provides the output pulse on the 352 count, and then returns to rest until enabled by the main counter at 346 in the next count cycle. When a division by 73 is selected (corresponding to a system output frequency of 2 mc) the counting cycle is the same except the main counter is reset to 299 (352 - 73).

b. PRELIMINARY CHECK. (See figure 5-77.) - Make a preliminary check of digital no. 2 card A12A3 before beginning trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer in its sockets.

c. TEST DATA. - No external test points are provided on the digital no. 2 card. Therefore, trouble shooting is performed by repeating the test data steps for rf no. 1 (A) card A12A1. Satisfactory completion of these tests verifies normal performance of the digital no. 2 card (see paragraph 4-15e).

4-19. RF NO. 3 CARD A12A2. (See figure 5-75.)

The rf no. 3 card contains a divide-by-twelve digital frequency divider, a 120 mc amplifier circuit, and a 117.300,000 to 117.200,100 mc voltage-controlled oscillator (vco) with its phase-locked loop circuit. Faulty operation of this card can prevent exciter unit operation completely.

a. DESCRIPTION. - The rf no. 3 card, a part of the 100-cycle control circuit, supplies the 100-cycle tuning frequency increments to digital no. 2 card A12A3 via mixer A12Z1. The vhf output frequency is determined by the frequency-phase relation between two input frequencies. These are a variable frequency range of 32.400,000 to 33.598,800 mc from rf no. 2 card A12A5, and a fixed 120 mc frequency from X4 multiplier A12Z2. The variable frequency is reduced to a 2.799,900 to 2.700,000 mc range by a divide-by-twelve frequency divider consisting of flip-flops Z1 through Z4, and interstage amplifier Q1 and Q2. This frequency is applied via Q3 to phase detector Z5 followed by dc amplifier Q5 and Q4. The amplified dc signal controls the frequency of 117.300,000 to 117.200,100 mc vco, Q7. The fixed 120 mc input frequency is amplified by Q11 and Q10, and mixed with a sample of the vco output frequency at mixer Z6. Mixer output (difference frequency) is amplified by Q6 and applied to phase detector Z5 for a comparison with the 2.799,900 to 2.700,000 mc frequency from the divide-by-twelve frequency divider circuit.

(1) FREQUENCY DIVIDER (÷12) AND 120 MC AMPLIFIER. - A 32.400,000 to 33.598,800 mc frequency from rf no. 2 card A12A5 is reduced to a 16.200,000 to 16.799,400 mc range by divide-by-two high speed flip-flop Z1, amplified by direct-coupled amplifier stage Q1 and Q2, and applied to divide-by-two flip-flop Z2. Output from Z2, a frequency range of 8.100,000 to 8.399,700 mc, is applied to a "short-counted" divide-by-three circuit consisting of flip-flops Z3 and Z4. The resultant 2.700,000 to 2.799,900 mc frequency range, following a total input frequency division by a factor of twelve, is amplified by Q3 and applied to one input of phase detector Z5.

A 120 mc square-wave frequency, supplied by X4 multiplier A12Z2, is applied to amplifier Q10 and Q11. The primary of the transformer at the collector of Q10 is tuned to 120 mc by capacitor C32, and the sine-wave 120 mc frequency at the transformer secondary is passed through a resistive attenuator to one input of mixer Z6. The "pi" attenuator formed by resistors R44 through R46 inserts approximately 10 db of signal attenuation at the input of mixer Z6.

(2) 117.2 to 117.3 MC VCO AND PHASE-LOCK LOOP. - Voltage controlled oscillator (vco) Q7 is arranged in a modified Colpitts circuit. Tank inductor L3 is tuned by capacitors C22 and C23, in series. Varactor CR3, in parallel with tuning capacitor C23, controls the oscillator frequency over a narrow tuning range in response to a dc varactor control voltage applied via resistor R29. Vco output is applied to digital no. 2 card A12A3 via emitter follower Q12. Phase detector Z5 develops the control voltage which is amplified by Q5 and Q4. A fixed dc voltage is applied to varactor CR3 by the (quiescent) voltage drop at emitter resistor R14 to limit the varactor control voltage range. Consequently, the minimum value of control voltage, corresponding to the lowest vco frequency, is established in the absence of a phase detector output.

A tuned, low-pass filter, in the output circuit of phase detector Z5 rejects unwanted frequency components of the dc control signal. Inductor L1 is tuned to 120 mc by capacitor C12 to reject this frequency, and capacitors C11 and C13 complete the low-pass filter network.

Vco "locking" is performed by the phase-lock loop circuit consisting of amplifier stages Q9 and Q8, mixer Z6, amplifier Q6 with transformer T1, and phase detector Z5. A sample of the vco output frequency is amplified by Q9 and Q8, and applied as the second input to mixer Z6. There the 117.300,000 to 117.200,100 mc vco frequency is combined with the standard 120 mc frequency (from the 120 mc amplifier circuit) to obtain a 2.700,000 to 2.799,900 mc (difference) frequency range at the mixer output. Amplifier Q6 applies the mixer output frequency to phase detector Z5, via transformer T1, where it is compared with a selected frequency (in the 2.700,000 to 2.799,900 mc range) supplied by the divide-by-twelve circuit. The dc phase detector output is a function of the phase relation between the two input frequencies, and the varactor-control voltage obtained tunes vco Q7 to precise correspondence with the divide-by-twelve circuit output frequency.

Ramp generator CR1, in conjunction with RC circuit R15 and C9, generates a dc ramp voltage at the base of Q6 for effective vco control. Normally, the dc ramp does not repeat during circuit operation, but rises when the circuit is initially energized until the vco "locks" at an appropriate ramp level. Capacitor C9 is charged at a relatively slow rate from the +15 volt dc supply circuit through resistor R15, via the Q5 collector load resistor R16. When the vco "locks", the dc operating level of Q5 stabilizes to hold the charge of C9 at that point on the dc ramp. In the event of nonlocking, the charge at C9 continues to rise until it equals the conduction threshold of CR1, and C9 discharges immediately to ground through CR1. In this instance only, the ramp generation cycle is repeated.

b. PRELIMINARY CHECK. (See figure 5-75.) - Make a preliminary check of the rf no. 3 card (A12A2) before trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesize module in its sockets.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools are required.

d. CONTROL SETTINGS. - Set all controls as indicated in table 3-1. (Place the exciter in "tune" condition. During tests, set the 10 kc tuning dial as directed.

e. TEST DATA. (See figure 5-75.) - Trouble shooting the rf no. 3 card (A12A2) consists of measuring the dc varactor-control voltage at a test point provided, for several settings of the 10 kc tuning dial.

(1) Connect VTVM to test point J1(TP) on the rf no. 3 card.

(2) Set the 10 kc tuning dial at 0 and note VTVM reading. It should be approximately 4.5 volts dc.

(3) Set the 10 kc tuning dial at 9 and note the VTVM reading. It should be approximately 4.8 volts dc.

(4) Note the change in VTVM reading when the 10 kc tuning dial setting is changed. (The measurement change of approximately 0.3 volts, using the 10 volt meter scale, will be a small needle movement.)

4-20. RF NO. 2 CARD A12A5. (See figures 4-22 and 4-23.)

The rf no. 2 card contains a dc ramp generator, a digital phase-detector, a digital frequency discriminator, and a voltage-controlled vhf oscillator generating a frequency range from 32.400,000 to 33.598,800 mc. These circuits control the vhf signals supplied to rf no. 3 card A12A2. Faulty operation of this card can prevent exciter operation completely.

a. DESCRIPTION. - A selected frequency, in the range from 32.400,000 to 33.598,800 mc, at the output of rf no. 2 card is determined by the frequency and phase relation between two input frequencies. These are: a fixed 1.2 kc reference frequency from digital no. 1 card A12A7, and a variable 1.2 kc frequency from digital no. 3 card A12A6. The voltage-controlled oscillator (vco) output frequency is selected by a dc varactor-control voltage developed at the digital phase-detector as a function of the frequency relation between the two 1.2 kc frequencies. When the two frequencies coincide, the control voltage "locks" the vco circuit.

A dc ramp generator, Q1 and Q2, develops a dc ramp which is applied to digital phase-detector (chopper) Q6, following amplification by dc amplifier Q3 and Q4. The digital frequency discriminator, consisting of the dual and triple input gates Z2 through Z6, controls phase detector operation via transformer T2. The resultant dc control voltage is amplified by Q7 and Q8, passed through a 1.2 kc twin-T filter, and applied to the varactor circuit of vco Q12 via emitter follower Q9. Two regulator circuits are incorporated for the supply voltages. Current regulator Q5 supplies amplifier stages Q3 and Q4, and voltage regulator Q10 and Q11 supplies operating voltage to stages Q12, Q13, and Q14.

(1) DIGITAL DISCRIMINATOR. (See figure 4-22.) - The digital discriminator circuit consists of dual-input quad NAND gates Z2, Z3 and Z6, and triple-input NAND gates Z4 and Z5. The discriminator supplies the "hold", "sample", and "dump" pulses to the ramp generator and phase detector circuits to obtain a dc varactor-control voltage derived from the frequency and phase relation between the fixed and variable 1.2 kc input frequencies. The "hold" pulse is applied to the emitter of ramp generator Q2. The "sample" pulse is applied to phase detector Q6, via pulse transformer T2 and buffer gate Z1-6, to operate the detector and sample the ramp voltage at the "hold" portion of the ramp. The "dump" pulse is applied to ramp generator Q1 via pulse transformer T1 and buffer gate Z1-8, to saturate Q1 and dump the charge present at capacitor C2 onto capacitor C3.

The digital discriminator NAND gates are arranged to function as flip-flops, with the frequency coincidence between the fixed and variable 1.2 kc frequencies determining the sequence of "hold", "sample", and "dump" output pulses applied to the ramp generator and phase detector circuits.

(2) CIRCUIT OPERATION. (See figure 4-22.) - When the rf no. 2 circuit is energized, ramp generator Q1 is saturated and Q2 is cut-off. Capacitor C2 is charged from the +15 volt dc supply through resistor R2.

A "hold" pulse is applied at the emitter of Q2, driving Q2 to cut-off. Capacitor C3 is charged via resistor R6. When a "dump" pulse is applied to the base-emitter junction of Q1 via transformer T1, Q1 saturates to form a low impedance discharge path for C2 across R6. Capacitor C3 is charged from C2 during the "dump" pulse interval. When the "hold" pulse is removed, capacitor C3 discharges via R3 and Q2.

The dc level at capacitor C3 is amplified by Q3 and Q4, and applied to one input of phase detector Q6. When a "sample" pulse from digital discriminator Z2 through Z6 is applied to the other detector input via transformer T2, detector output occurs at a dc level determined by the charge at capacitor C3. Phase detector output is amplified by Q7 and Q8, and passed through a 1.2 kc twin-T filter formed by resistors R37, R39, and R40, with capacitors C22, C23, and C25. The filter removes 1.2 kc frequency components of the phase detector output.

(3) VCO AND OUTPUT AMPLIFIER. (See figure 4-23.) - This circuit consists of vco Q12, output amplifier Q13 and Q14, and dc voltage regulator Q10 and Q11. The dc varactor-control voltage derived in the ramp generator circuit governs the frequency of vco Q12.

Voltage controlled oscillator Q12 is arranged in a Colpitts circuit with the primary of transformer T3 serving as the tank. Capacitors C15 and C12, in series with varactor CR2, tune the transformer primary. The dc varactor control voltage is applied to CR2 via resistor R24, to tune the vco over a frequency range from 32.400,000 to 33.598,800 mc. Transformer T3 couples the oscillator output to cascode output amplifier Q13 and Q14. Transformer T4 couples the amplifier output to digital no. 3 card A12A6.

Dc voltage regulator Q10 and Q11 supplies operating power to vco Q12 and to cascode amplifier Q10 and Q11. The +15 volt supply voltage is reduced to +12 volts during the regulating process.

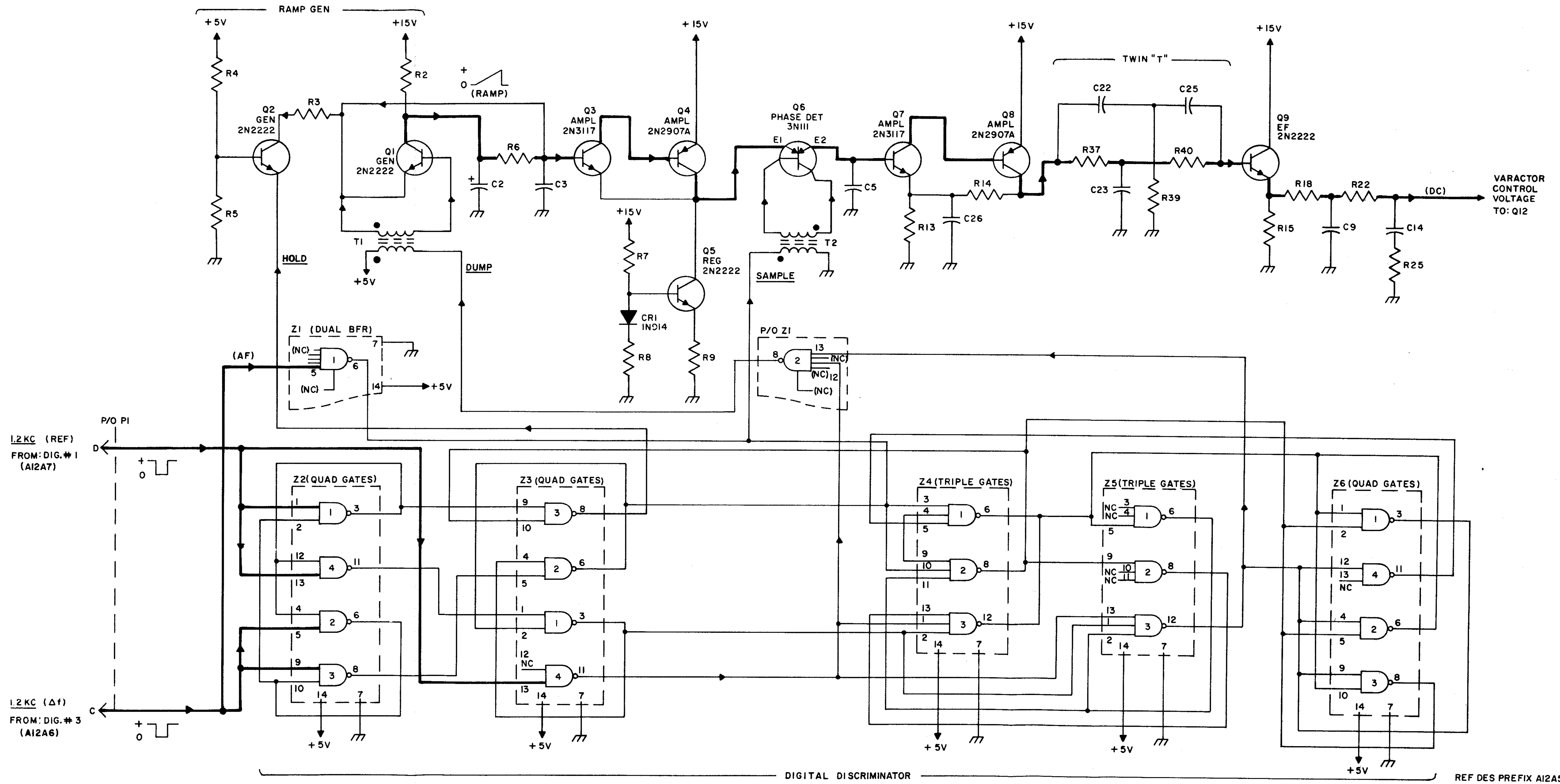

Figure 4-22. Ramp Generator, Phase Detector, and Discriminator, Simplified Schematic Diagram

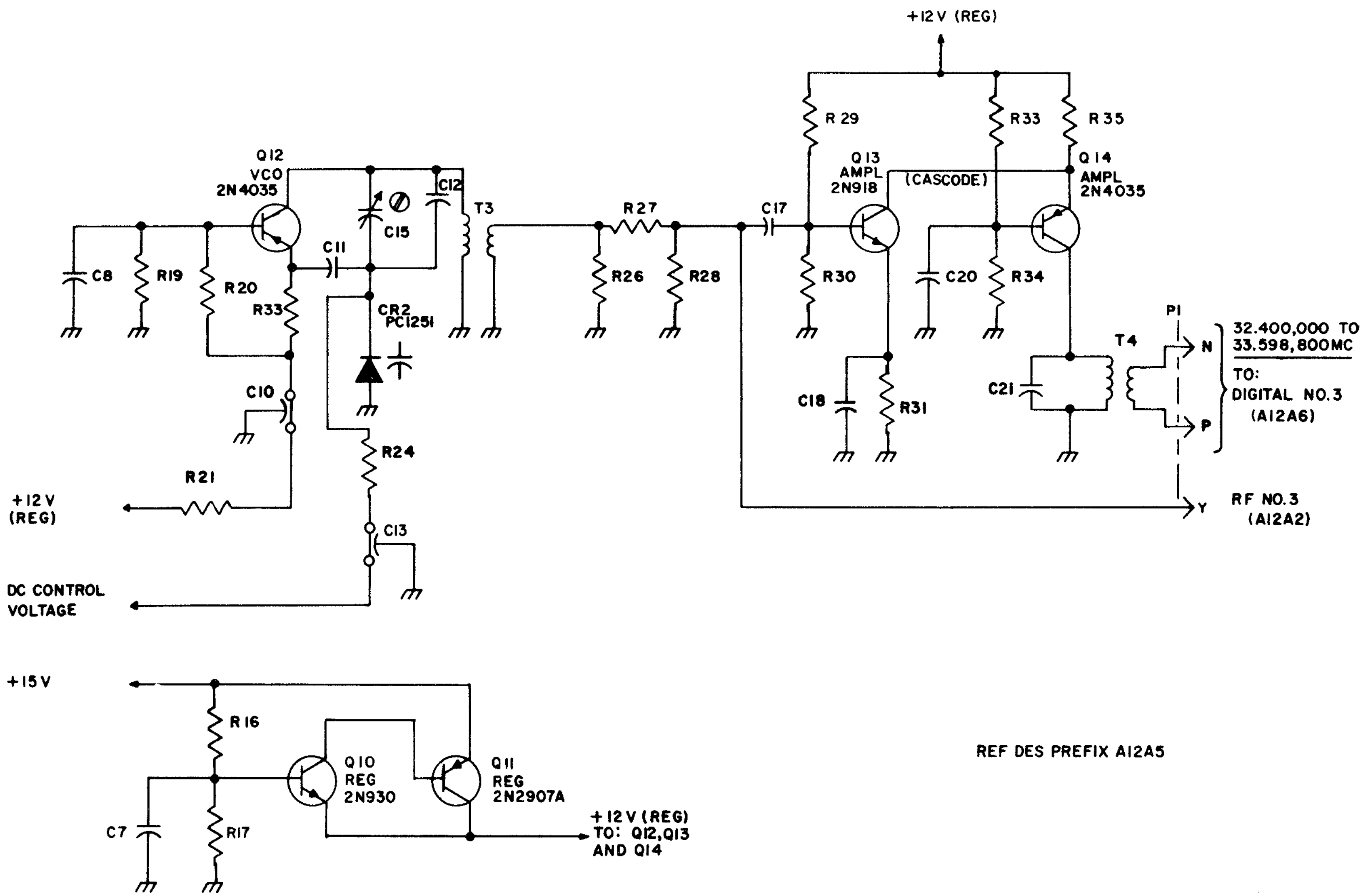

Figure 4-23. 32.4 to 33.6 Mc VCO and Output Amplifier, Simplified Schematic Diagram

b. PRELIMINARY CHECK. (See figure 5-74.) - Make a preliminary check of rf no. 2 card A12A5 before trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer module in its sockets.

c. TEST EQUIPMENT. - Not applicable.

d. CONTROL SETTINGS. - Not applicable.

e. TEST DATA. (See figure 5-74.) - No external test points are provided on the rf no. 2 card. Therefore, trouble shooting is performed by repeating the test data steps for rf no. 1 (A) card A12A1. Satisfactory completion of these tests verifies normal performance of the rf no. 2 card (see paragraph 4-15e).

4-21. DIGITAL NO. 3 CARD A12A6. (See figures 4-24 and 4-25.)

The digital no. 3 card contains an input amplifier circuit, a digital mixer employing three NAND gates, a divide-by-N digital counter having a variable division range from 2999 to 2000, and NAND control gates to select the division factor via the 10 kc, 1 kc, and 100 cycle tuning dials at the FREQUENCY KC selector. These circuits form the phase-lock loop for the vco circuit in rf no. 2 card A12A5. Faulty operation of this card can prevent exciter unit operation completely.

a. DESCRIPTION. - The digital no. 3 card controls the selection of operating frequency of the vco circuit in the rf no. 2 card and, therefore, controls selection of the 100-cycle control circuit frequency.

The digital mixer circuit NAND gates (p/o Z2) receive a 32.400,000 to 33.598,800 mc range of frequencies supplied by rf no. 2 card A12A5, and a 30 mc standard frequency from input amplifier Q2. The resultant difference frequency, 2.400,000 to 3.598,800 mc, at the mixer output is applied to the divide-by-N counter circuit at Z4. The variable frequency counter (Z4, Z8 through Z10, Z13 through Z16, and Z18 through Z22) provides a frequency reduction to 1.2 kc when set (by control gates Z1, Z12, and Z17) for a frequency division by factors from 2000 to 2999, respectively. The 1.2 kc counter output is applied to rf no. 2 card A12A5 for development of a vco varactor-control voltage for the 32.4 to 33.6 mc vco. Counter control gates Z11, Z12, and Z17, in response to the 10 kc, 1 kc, and 100-cycle tuning dial settings, select the divide-by-N counter division factor. The 10 kc dial controls the "thousands" and "hundreds" selection, the 1 kc dial the "tens" selection, and the 100-cps dial the "units" selection, in a decimal sequence.

When a 1.2 kc output from the divide-by-N counter occurs, the vco in rf no. 2 card A12A5 becomes phase-locked. Resetting the three tuning dials changes the counter division factor, and the counter output frequency will be higher (or lower) than 1.2 kc prior to vco locking.

Note

Refer to paragraph 4-14b(4) for a basic description of J-K flip-flop operation and a discussion of the digital terminology used in the following paragraphs.

(1) DIGITAL MIXER. (See figures 4-24 and 5-78.) - The digital mixer consists of three of the four sections of the dual-input NAND quad gate Z2. The 32.400,000 to 33.598,800 mc frequency range supplied from rf no. 2 card A12A5 is applied to gate input Z2-4, and a fixed 30 mc frequency from the emitter of input amplifier Q2 is applied at the other gate input, Z2-5. Gate output at Z2-6 occurs whenever the two input frequencies coincide over the difference frequency range from 2.400,000 to 3.598,800 mc. Gate sections Z2-3 and Z2-11 function as buffer amplifiers, and output from gate Z2-11 is applied to the divide-by-N counter input at Z4, and to control circuit Z1 and Z2.

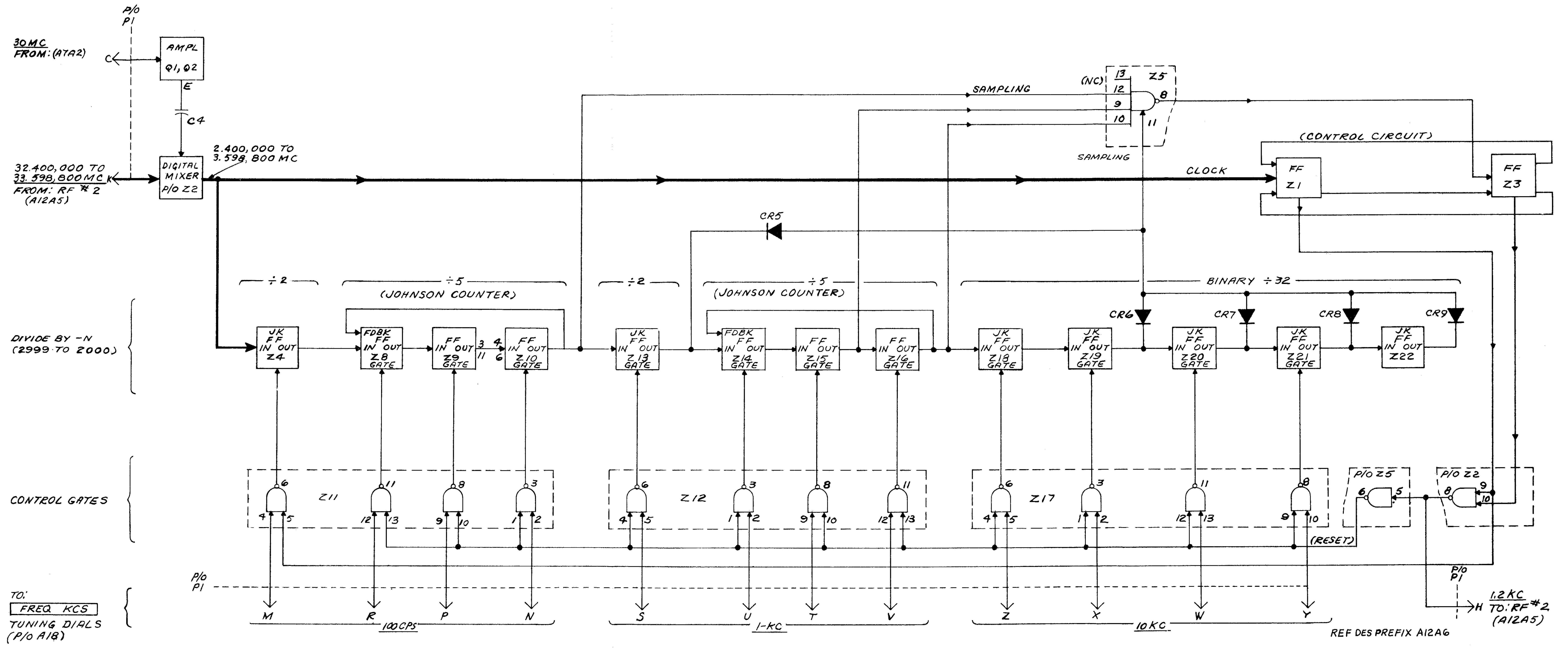

Figure 4-24. Digital No. 3 Card, Simplified Block Diagram

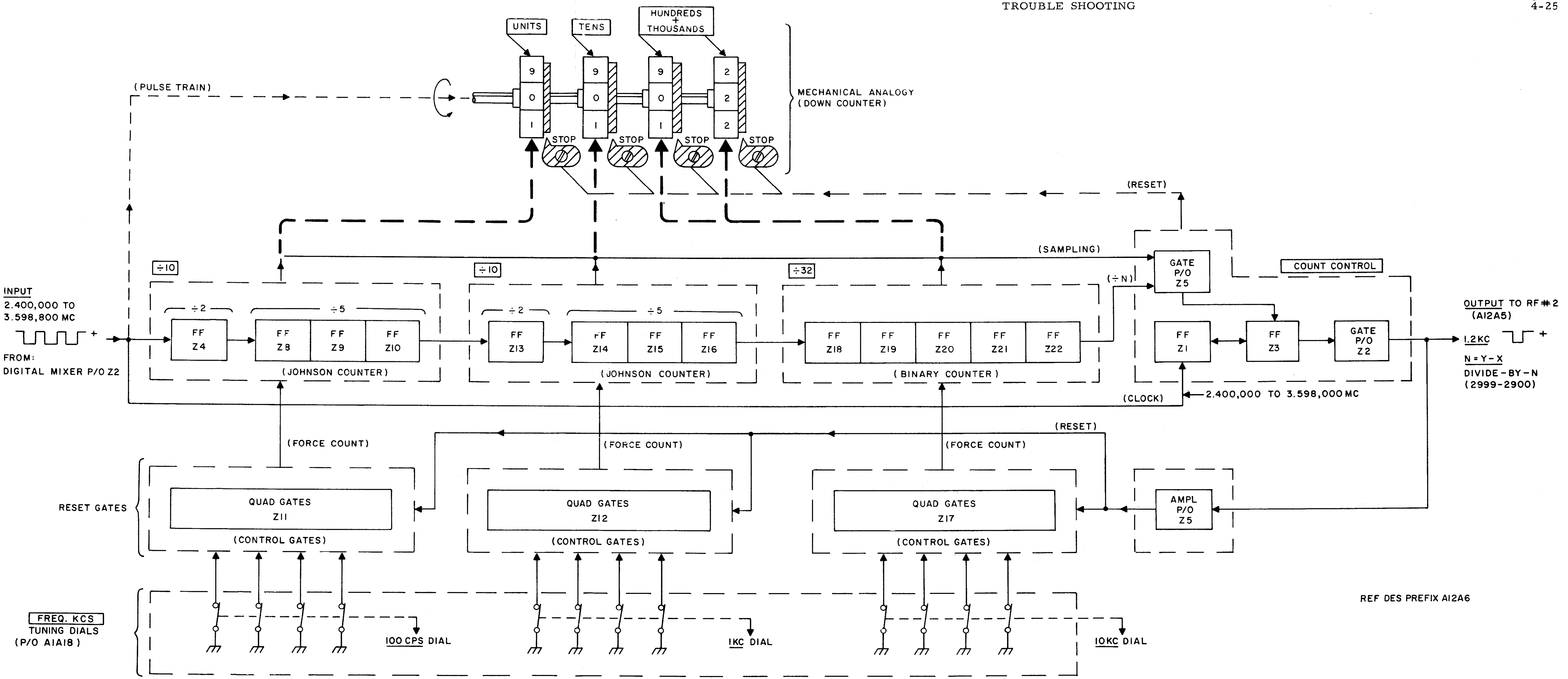

Figure 4-25. Digital No. 3 Divide-by-N Counter Mechanical Analogy

(2) DIVIDE-BY-N VARIABLE FREQUENCY DIVIDER. (See figures 4-24 and 5-78.) - The divide-by-N digital counter (frequency divider) has a selectable division range from 2999 to 2000, in unit steps. It consists of thirteen gated flip-flop modules (Z4, Z8 through Z10, Z13 through Z16, and Z18 through Z22, inclusive); dual-input quad NAND gates Z11, Z12, and Z17; and five-input dual NAND gate Z5. The digital counter is programmed by setting the 10 kc, 1 kc, and 100 cycle FREQUENCY KC tuning dials on the exciter front panel. During counter operation, each pulse of the 2.400,000 to 3.598,800 mc input pulse train to Z4 decreases the preset division factor by one count, until a 1.2 kc output pulse is produced from gate Z2-8 to reset the counter and repeat the countdown. For example, when the input frequency is 2.400,000 mc, a 1.2 kc output frequency represents division by a factor of 2000; and when the input frequency is 3.598,800 mc, a 1.2 kc output appears following division by a factor of 2999.

(a) Terminology. - If the divide-by-N counter circuit employed a conventional binary register circuit using a BCD (binary-coded-decimal) code, the circuit description which follows could directly relate to the FREQUENCY KC tuning dials binary code given in table 4-1. Because the divide-by-ten variable counter circuit uses a J-K flip-flop followed by a divide-by-five "Johnson" counter (2 x 5 = 10), the binary code employed is not conventional and cannot be readily converted to meaningful decimal numbers. Therefore, this circuit description will be concerned with functional operation rather than digital-circuit design factors.

(b) Mechanical Analogy. - Figure 4-25 is a block diagram of the divide-by-N counter circuit. It includes a mechanical analogy which, although not identical in every respect, resembles the digital counting functions performed by the divide-by-N counter circuits. The two divide-by-ten circuits, followed by the divide-by-32 circuits, perform in a manner very similar to the units, tens, hundreds, and thousands drums of the mechanical counter pictured. To continue the mechanical analogy, the 3.598,800 to 2.400,000 mc input pulse train is depicted as a motive force, spinning the counter drums, each input pulse causing the units drum to "count-down" one digit. Although the thousands drum remains permanently at the digit 2 position and does not change during counter operation, it is included to represent the thousands digit of the division factors.

Whereas the control gates, Z11, Z12, and Z17, are governed by setting the 10 kc, 1 kc, and 100-cycle tuning dials, the stop-and-reset pawls of the mechanical counter perform a similar function for the counter drums. When the control gates reset the digital counter for another counting cycle, the stop pawls similarly reset the mechanical counter drums. Because the digital divide-by-N counter is a "count-down" device, the mechanical counter drums also "count-down", from the reset reading. For example, if the digital counter is set for its maximum division factor of 2999, to complete the analogy the mechanical counter drums are set to read 2999. Count termination for the digital counter occurs when a 1.2 kc pulse appears at the output of NAND gate Z2-8. The mechanical counter drums will read 0002 to denote the end of the counting cycle. (Note that the division factor digits appear in a reversed order at the mechanical counter drums. This is necessary to comply with the digital circuit count sequence in units, tens, hundreds, and thousands, from left to right.)

(c) Counting Cycle. - The divide-by-N counter is a variable length digital "down-counter" with a counting cycle which follows the mathematical expression "N = y - x", where N is the count length or division factor, y is the preset or start count determined by the tuning dial settings, and x is the end or stop count producing a 1.2 kc frequency at the output of NAND gate Z2-8. The first divide-by-ten circuit, controlled by the 100-cycle tuning dial, counts in units. The second divide-by-ten circuit counts in tens and is controlled by the 1 kc tuning dial. The divide-by-32 circuit, controlled by the 10 kc tuning dial, counts in hundreds (and thousands), but for division factors from 20 to 29, only. The maximum division range is not used.

For every group of ten pulses at the "units" divide-by-ten circuit input, a single output pulse is obtained and applied to the "tens" divide-by-ten circuit. This circuit also produces a single output pulse for each group of ten input pulses. Therefore, one hundred input pulses at the "units" circuit provide a single output pulse from the "tens" circuit for a division factor of one hundred. The hundreds (and thousands) divide-by-32 circuit increases this factor for a total division capability of 3200. Actually, the divide-by-N counter is used over the division range of 2999 to 2000; the full range is not employed.

The required division factor is programmed by setting the 10 kc, 1 kc, and 100-cycle tuning dials. For example, a dial setting of 000 (complete dial setting of 02000.0 kc) corresponds with a division factor of 2000, and a dial setting of 999 (complete dial setting 02099.9 kc) corresponds with a division factor of 2999, the digital counter low and high counting limits used. This is analogous with setting the mechanical counter drums for a reading of 0002 and 9992, reading from left to right (see figure 4-25).

The count cycle starts when a reset signal from the count control circuit enables the control gates, inserting the programmed division factor. Counting down proceeds from the preset number (division factor) until a 1.2 kc output pulse is produced. Then, the count-control circuit again resets the counter and the counting cycle is repeated unless the tuning dials are reset for a different division factor. This action is analogous to operation of the mechanical counter in the following manner: Mechanical counting starts when the reset signal from the count-control circuit releases the stop pawls, allowing the counter drums to rotate. Down counting continues until the drums register 0002. At this point, the count-control circuit activates the stop pawls, stopping the drums and the counting process, and resetting the drums to the division factor to repeat the counting cycle.

Although the mechanical counter can be described as "counting-down" to a 0002 reading, the digital counter "zero reading" occurs when the 1.2 kc output pulse is obtained. A literally "zero" count state does not occur as the gated flip-flops always contain an arrangement of logical "0" and "1" states, even at the end count.

(d) Count Control. - The count control circuit consists of gated flip-flops Z1 and Z3, and a five-input NAND gate (p/o Z5). This circuit directly monitors the logical state of the counting process at flip-flops Z10, Z15, and Z16; and monitors the state of flip-flops Z13, Z19, Z20, Z21, and Z22 via diodes CR5, CR6, CR7, CR8, and CR9. When a "zero-count" condition appears at the end of the count cycle, the count-control circuit performs the stop, reset, and start functions, accompanied by production of the 1.2 kc pulse at the output of quad gate Z2-8.

b. PRELIMINARY CHECK. (See figure 5-78.) - Make a preliminary check of digital no. 3 card A12A6 before beginning trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer in its sockets.

c. TEST EQUIPMENT. - Not applicable.

d. CONTROL SETTINGS. - Not applicable.

e. TEST DATA. (See figure 5-78.) - No external test points are provided on the digital no. 3 card. Therefore, trouble shooting is performed by repeating the test data steps for rf no. 1 (A) card A12A1. Satisfactory completion of these tests verifies normal performance of the digital no. 3 card (see paragraph 4-15e).

4-22. DIGITAL NO. 1 CARD A12A7. (See figures 4-26 and 5-76.)

The digital no. 1 card contains a series of binary frequency dividers, for frequency divisions by factors of 60, 240, and 2500, to obtain output frequencies of 50 kc, 12.5 kc, and 1.2 kc from a standard 3 mc input frequency. The divider circuits supply a 50 kc pulse train to rf no. 1 (B) card A12A4, a 12.5 kc "sync" pulse to power supply PS1, and a 1.2 kc pulse train to rf no. 2 card A12A5. Because these frequencies are derived from 1 mc frequency standard A6, via 3/30 mc multiplier A7A2, they exhibit the same degree of accuracy

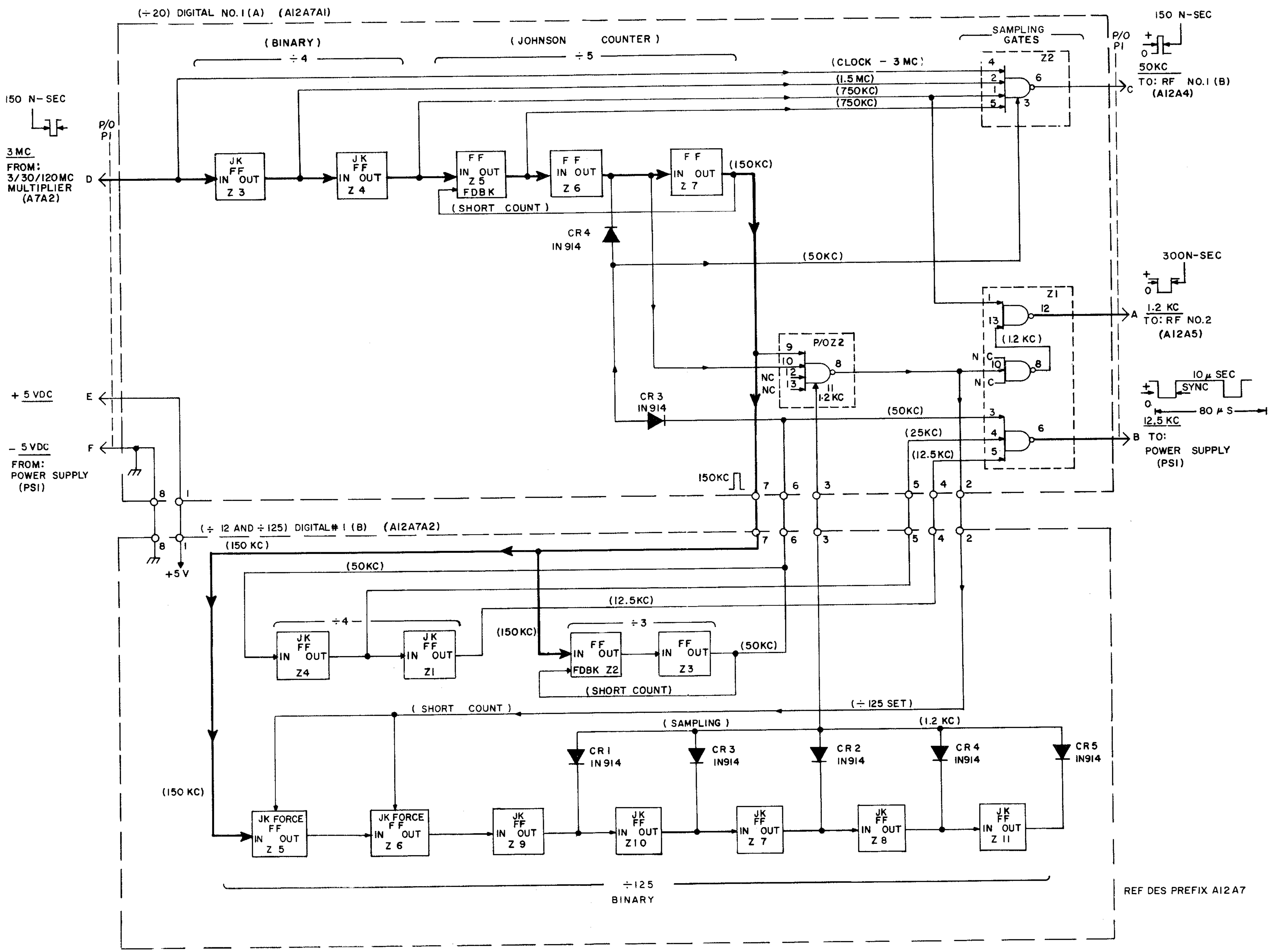

Figure 4-26. Digital No. 1 Card, Simplified Block Diagram

and stability as the frequency standard. Faulty operation of this module can prevent exciter unit operation completely.

a. DESCRIPTION. - The digital no. 1 card consists of two printed-circuit sections: Digital no. 1 (A) A12A7A1, and digital no. 1 (B) A12A7A2. The digital no. 1 (A) circuit contains divide-by-four frequency divider Z3 and Z4; divide-by-five frequency divider Z5, Z6, and Z7; five-input dual NAND gate Z2; and three-input triple NAND gate Z1. The digital no. 1 (B) circuit contains divide-by-four frequency divider Z4 and Z1, divide-by-three frequency divider Z2 and Z3, and divide-by-125 frequency divider Z5 through Z11. The NAND gates are employed to sample the binary counting process at various flip-flops to obtain the 50 kc, 12.5 kc, and 1.2 kc output frequencies, and to assure output pulse widths suitable for the intended applications.

Note

Refer to paragraph 4-14b(4) for a basic description of J-K flip-flop operation and a discussion of the digital terminology used in the following paragraphs.

(1) 50 KC DIVIDERS (÷60). - The 50 kc output frequency supplied to the rf no. 1 (B) card is derived from a 3 mc input frequency by three frequency dividing circuits employing division factors of four, five, and three (4 x 5 x 3 = 60). The 3 mc input frequency from 3/30 mc multiplier A7A2 is applied to the digital no. 1 (A) circuit and reduced to 750 kc by divide-by-four divider A12A7A1Z1 and A12A7A1Z4. The "Johnson" counter which follows (flip-flops A12A7A1Z5 through A12A7A1Z7) provides a frequency division by a factor of five to obtain a 150 kc frequency. The 150 kc divider output is applied to a divide-by-three divider ("short-counted" flip-flops A12A7A2Z2 and A12A7A2Z3) located in the digital no. 1 (B) section, to obtain the final frequency reduction to 50 kc. Output from flip-flop A12A7A2Z3 is applied to the 50 kc NAND gate A12A7A1Z2-3 via gating diode A12A7A1CR3.

The "Johnson" counter circuit consisting of A12A7A1Z5 through Z12A7A1Z7 is similar to the gated "Johnson" counter described in paragraph 4-17a(1) except for the fixed mode of operation. "Short-count" connections from A12A7A1Z7 to A12A7A1Z5 permit operation as a divide-by-five counter only.

(2) 12.5 KC DIVIDERS (÷240). - The 12.5 kc "sync pulse" output frequency supplied to power supply PS1 is derived from the 3 mc input frequency using four frequency divider circuits with division factors of four, five, three, and four, respectively (4 x 5 x 3 x 4 = 240). The first three divisions are performed by the 50 kc dividing circuits described in the previous paragraph, and the 50 kc frequency from "short counted" flip-flops A12A7A2Z2 and A12A7A2Z3 is applied to a divide-by-four circuit using flip-flops A12A7A1Z4 and A12A7A1Z1. The 12.5 kc output frequency obtained goes to 12.5 kc NAND gate A12A7A1Z1-6.

(3) 1.2 KC DIVIDERS (÷2500). - The 1.2 kc output frequency supplied to rf no. 2 card A12A5 is derived from the 3 mc input frequency using three frequency dividing circuits with division factors of four, five, and 125 (4 x 5 x 125 = 2500). The first two divisions are performed by the 50 kc dividing circuits described in a previous paragraph, and the 150 kc frequency from the "Johnson" counter in A12A7A1 is applied to a divide-by-125 circuit consisting of flip-flops A12A7A1Z5 through A12A7A2Z11.

As a free-running binary counter, the seven flip-flops in the divide-by-125 frequency divider have a maximum count capability of 128 (2^7). For division by a factor of 125, the total count is reduced three digits by a "short count" connection from the output of 1.2 kc NAND gate A12A7A1Z2-8 to the "force" inputs of flip-flops A12A7A2Z5 and A12A7A2Z6 at terminal 13. The forced logical "1" state at the first two flip-flops limits counting to a digital sequence from 3 to 128, a net count of 125.

The 150 kc input frequency at flip-flop A12A7A2Z5 is reduced to 1.2 kc at the output of A12A7A2Z11. The count states of flip-flops A12A7A2Z9, 10, 7, 8, and 11 are sampled via diode gates A12A7A2CR1 through A12A7A2CR5 and applied to one input of NAND gate A12A7A1Z2-8. In this manner, the logical state of the divide-by-125 circuit is decoded because a logical "0" occurs at the sampled circuit points only when a division-by-125 has occurred.

(4) DIVIDER OUTPUT GATES. - The five-input dual NAND gate (A12A7A1Z2) and the three-input triple NAND gate (A12A7A1Z1) perform a sampling and decoding function for the frequency dividing circuits to obtain 50 kc, 12.5 kc, and 1.2 kc output frequencies having various pulse widths, suitable for the intended applications.

The 50 kc output from NAND gate A12A7A1Z2-6 has a relatively narrow pulse width, determined by the 3 mc "clock" pulse applied at input A12A7A1Z2-4. Terminals 2, 1, and 5 sample the logical "1" outputs from flip-flops A12A7A1Z3, 4, and 5, respectively. Terminal 3 receives the 50 kc output from divide-by-three divider A12A7A2Z2 and A12A7A2Z3 via diode gate A2A7A1CR3. Output from NAND gate A12A7A1Z2-6 occurs only when all inputs are present, simultaneously. Therefore, the output frequency is determined by the lowest input frequency (50 kc), and the output pulse width or duration is governed by the narrowest pulse present (3 mc).

The 12.5 kc "sync" frequency from NAND gate A12A7A1Z1-6 is obtained by sampling the logical state at the divide-by-four divider (A12A7A2Z4 and A12A7A2Z1), and at the output of the divide-by-three divider (A12A7A2Z2 and A12A7A2Z3). Gate output occurs only when all three inputs are present, simultaneously. The 12.5 kc frequency is obtained at the output of A12A7A2Z1 and applied to gate input A12A7A1Z1-5. Input terminals 3 and 4 receive sample pulses of a shorter duration (higher frequency). Consequently, the 12.5 kc output pulse width is determined by the narrower of the sampled pulses (50 kc).

The 1.2 kc output frequency from NAND gate A12A7A1Z1-12 is a function of buffer gate A12A7A1Z1-8 and NAND gate A12A7A1Z2-8 operation. Gate input terminals A12A7A1Z2-9 and 10 receive a 150 kc logical "1" from "Johnson" counter flip-flops A12A7A1Z6 and A12A7A1Z7. Terminal A12A7A1Z2-11 receives a decoded 1.2 kc sample of logical states from the divide-by-125 divider via diode gates A12A7A2CR1 through A12A7A2CR5. When these three inputs occur simultaneously, a 1.2 kc output frequency from A12A7A1Z2-8 is applied to buffer gate input A12A7A1Z1-10, where the pulse is inverted and applied to gate input 13. Output at A12A7A1Z1-12 occurs at a 1.2 kc frequency, and the pulse width is determined by the 750 kc sample applied to gate input A12A7A1Z1-1.

b. PRELIMINARY CHECK. (See figure 5-76.) - Make a preliminary check of digital no. 1 card A12A7 before beginning trouble shooting, with emphasis on the following:

(1) Seating of plug-in card in its compartment.

(2) Seating of plug-in synthesizer module in its sockets.

c. TEST EQUIPMENT. - Use Frequency Counter H-P 5245L or equivalent. No special tools required.

d. CONTROL SETTINGS. - Not applicable.

e. TEST DATA. (See figures 5-71 and 5-76.) - Trouble shooting the digital no. 1 card consists of measuring the output frequencies at test points provided within synthesizer module A12.

(1) Connect frequency counter to test point J2(TP) on rf no. 1(B) card A12A4. The counter should read 0050.0000 kc ±1 count.

(2) Connect frequency counter to XA12P2 pin CC. The counter should read 0012.5000 kc ±1 count.

4-23. VOICE FREQUENCY GATE A5. (See figures 4-48 and 5-65.)

The voice frequency gate module contains the transmitting system keyline switch circuits for control of system operation in response to PTT (push-to-talk) microphone operation, voice operation VFG (voice frequency gate), or selected positions of CLASS OF EMISSION switch A18S3 and SIDEBAND SELECTOR switch A18S2. The module contains an audio amplifier/detector circuit and the keyline switching and distribution circuits.

a. DESCRIPTION. - The VFG amplifier detector circuit consists of audio amplifier stages Q1, Q3, and Q5, detector Q7, amplifier Q9, SCR stage Q2, timing circuit Q4, and bistable flip-flop Q6 and Q8. Keyline switching circuit distribution to the various keyline system circuits is performed by relay K1 and Q11 via diode gates CR7, CR8, and Q10.

(1) VFG AMPLIFIER-DETECTOR. - An audio frequency signal from sideband channel A1, at the INPUT LEVEL-dbm control is amplified by Darlington stages Q1 and Q3, and by amplifier stage Q5 before being applied to transistor switch Q7. Diode CR2 removes the negative peaks. Potentiometer R9 sets the level at the detector input. The detected audio voltage, amplified by Q9, is applied to steering diode CR4 to turn on flip-flop stage Q8, and to SCR Q2 via capacitor C2 to discharge timing capacitor C5. When Q8 is saturated and VFG is selected by the SIDEBAND SELECTOR the keyline is closed; when Q6 saturates, switching Q8 to an off condition, the keyline is an open circuit.

The timing circuit formed by unijunction transistor Q4, capacitor C5, and charging resistor A18R33 (HOLD TIME control), fires at an adjustable rate of from 100 milliseconds to 3.0 seconds, depending on the HOLD TIME control setting.

When no audio signal is available from sideband channel A1, the detector output is zero; Q2 is off and capacitor C5 charges from the +18 volt supply via A18R33. Q4 fires holding flip-flop Q8 in a "high" condition and the keyline open. When an audio signal is present in sideband channel A1, the switching voltage from the amplifier-detector circuit is applied to flip-flop Q8 through diode CR4 to place Q8 in a "low" condition and close the keyline circuit. At the same time, the switching voltage fires SCR Q2 which discharges capacitor C5. The continuing switching voltage holds Q2 on and C5 discharged. When the audio signal is removed, C5 charges, Q4 fires, and the keyline opens.

(2) KEYLINE SWITCHING.

(a) Switch Positions. - The keyline switching input is grounded for most positions of the CLASS OF EMISSION switch together with the SIDEBAND SELECTOR switch. It is opened, however, for the PTT and VFG positions of the SIDEBAND SELECTOR switch if the CLASS OF EMISSION switch is in any position other than A0. When the CLASS OF EMISSION selected is A1F1F4 and the SIDEBAND SELECTOR is LSB or USB, the keyline switch is controlled from the "transition" relay in Keyer KY-655/FRT. Keyline switch circuit operation for the VFG position has been described in a previous paragraph. Keyline switch circuit operation for the PTT position is accomplished by using the "push-to-talk" switch on the microphone or handset. In any case, the operation of the keyline distribution circuit is essentially unchanged.

(b) LPA Keying. - When the keyline circuit is closed (grounded), stage Q12 saturates to close relay K1. Contacts K1-6 and K1-4 close to key the LPA. Contacts K1-3 and K1-5 close to provide a "keyline closed" indication for other system units.

(c) Output Amplifier Muting. - When stage Q12 saturates to close relay K1, stage Q10 is turned off and relay A16K1 (in output amplifier A16) opens to remove amplifier muting and to supply rf output power. Switch stage Q11, in the absence of a base ground circuit via CR5 and Q10, is also turned off.

(d) Carrier and Modulation Disabling. - When switch Q11 is turned off, power is removed from relays A11K1 and A11K4 (in up-converter A11) to enable the carrier and modulation circuits. Diodes CR7 and CR8 provide circuit isolation for the two relays.

b. PRELIMINARY CHECK. - Make a preliminary check of the voice frequency gate module before trouble shooting with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116, RF VTVM ME-286/U, and Audio Generator H-P 206A. No special tools required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place the exciter in "operate" condition.) See table 4-6 for test settings.

e. TEST DATA. - Trouble shooting the voice frequency gate module consists of checking the +18 volt dc operating potential, checking operation of the keying circuit, and verifying operation of the keyline distribution circuit. All measurements are made at chassis connector A18XA5.

(1) Connect VTVM to XA5 pin Z. Meter should read +18 vdc ±10%.

(2) Connect audio generator to CHANNEL A1 input. Set generator controls for a 400 cycle, zero output, test signal. Set A1 INPUT LEVEL-dbm control to 0 dbm.

(3) Connect VTVM to XA5 pin R. Adjust audio generator output level and note meter reading. At zero output, meter should read +18 vdc ±10%. At 15 mv output level, meter should read approximately 0 vdc.

(4) Set HOLD TIME control to 3.0 seconds. Reduce audio generator level to zero. Note meter reading. After approximately a three second time lag, meter reading should change to approximately +18 vdc.

(5) Repeat step (4) with HOLD TIME control set at 100 milliseconds. Note almost immediate change in meter reading to +18 vdc when audio generator output is reduced to zero level.

(6) Set SIDEBAND SELECTOR switch to VFG. Set CLASS OF EMISSION switch to SSB-20. Connect VTVM between XA5 pins W and V. With a 15 mv test signal from the audio generator, meter should read zero vdc.

(7) Repeat step (6) at XA5 pins X and Y of socket XA5. With a 15 mv test signal, meter should read zero vdc.

TABLE 4-6. KEYLINE CIRCUIT CLOSURE

SIDEBAND SELECTOR (S2)	CLASS OF EMISSION (S3)	KEYLINE CLOSED BY
PTT	Any, except A0 mode	"Push-to-talk" switch
VFG	Any, except A0 mode	Voice frequency gate
USB, LSB	A1, F1, F4	Keyer transition relay
USB, LSB, 2-ISB, 4-ISB	Any, except A1, F1, F4	CLASS OF EMISSION switch and SIDEBAND SELECTOR switch
Any position	Any position	TUNE cycle
Any position	A0, only	CLASS OF EMISSION switch

(8) Connect VTVM between XA5 pin S ground. Note meter reading while adjusting audio generator output level. With a zero test signal, meter should read 0 vdc. With a 15 mv test signal, meter should read 24 vdc.

(9) Connect VTVM between XA5 pin T and ground. Note meter reading while adjusting audio generator output level. With a zero test signal, the meter should read 24 vdc. With a 15 mv test signal, meter should read 0 vdc.

(10) Repeat step (9) with VTVM connected at XA5 pin T. Meter readings should be similar to those obtained for step (9).

4-24. TRANSMITTER GAIN CONTROL A14. (See figures 4-27 and 4-28.)

The transmitter gain control module contains a motor-driven potentiometer circuit which supplies an agc voltage to down-converter module A13 to control the exciter rf output level. Output is maintained at a selected level, over the entire frequency range from 2 to 30 mc, in response to a dc control signal from the LPA. The transmitter gain control module contains an amplifier circuit (A14A1) and a motor control circuit (A14A2).

a. DESCRIPTION. - The amplifier circuit (A14A1) consists of minimum gain relay K1; voltage reference stage Q7, CR2; IC input amplifier Z1; and amplifier stages Q1 through Q6. The motor control circuit (A14A2) consists of motor control relays K1, K3 and K4; minimum gain detector Q1 and K2; and preset gain potentiometers R2 and R4. Motor B1, potentiometer R1, and limit switches S1 and S2, are mounted on the transmitter gain control module proper.

(1) AMPLIFIER A14A1. (See figure 4-27.) - When minimum gain relay K1 is de-energized, a dc voltage obtained by combining the LPA control voltage with a dc reference voltage supplied by stage Q7 is applied to the input of high-gain IC amplifier Z1. Null adjust control R18 sets the "zero input" level for Z1 (the LPA voltage equals the reference voltage) and Zener diode CR2 provides a stable dc reference voltage. R18 is adjusted to accommodate the LPA circuit characteristics (usually 3 to 4 vdc). Output from Z1 is applied to amplifiers Q1 through Q6, three complementary amplifier stages. Detail "A" shows the amplifier output range from Q5-Q6 for an input voltage having a negative polarity and changing through zero to a positive polarity. The "null" occurs within a ±50 millivolt output level bracket. Feedback circuits at Z1 (C3, C2/R4, and R3/R5) stabilize the gain and frequency response. Zener diode CR1 regulates the -28 volt supply for amplifier stages Q2, Q4, and Q6.

When relay K1 is energized, in response to a TUNE command or tuning fault at transmitter control module no. 1 (A10), a +5 vdc potential from resistive divider R1 and R2 is applied to Z1 to drive the output from differential amplifier Q5-Q6 fully positive. This operation assures minimum exciter rf output.

(2) MOTOR CONTROL A14A2. (See figure 4-28.) - Motor B1 is controlled in direct response to the dc control signal from amplifier A14A1Q5, Q6, via relay A10K15 or A10K16, and motor travel limit switches S1 and S2. When a positive dc potential is supplied and motor brake relay K1 is not energized, B1 will drive in a clockwise direction, setting potentiometer R1 for minimum exciter rf output. A negative dc potential drives B1 in a counterclockwise direction. Limit switch S1 (cw) or S2 (ccw), when tripped by the motor shaft cams, energizes relays K3 or K4, respectively. This opens the motor circuit in the direction of current flow, but a path is provided for reverse current flow through associated diodes CR2 or CR3. Relay K1 momentarily reverses the motor connections for a reversal of rotation when C1 discharges in response to the closing of either relay K4 or K3. This reversal provides braking action. Transistor Q1 functions when a minimum rf output condition occurs (fully cw motor drive), energizing relay K2. This completes the TUNE (ACTIVATE) command from transmitter control no. 1 module A10 to the LPA. Capacitor C2 prevents relay K2 from chattering each time reversal relay K1 closes.

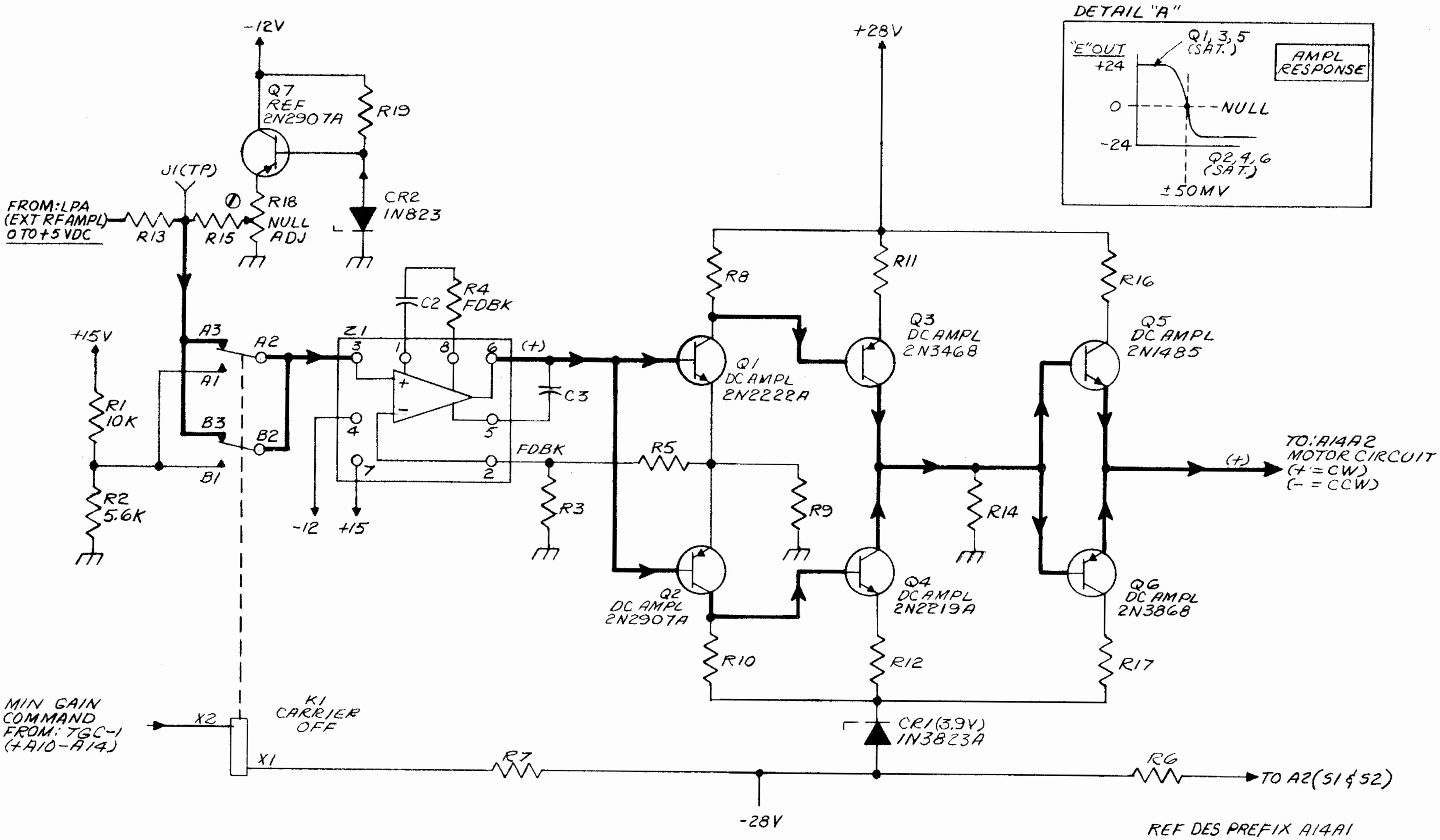

Figure 4-27. Amplifier A14A1, Simplified Schematic Diagram

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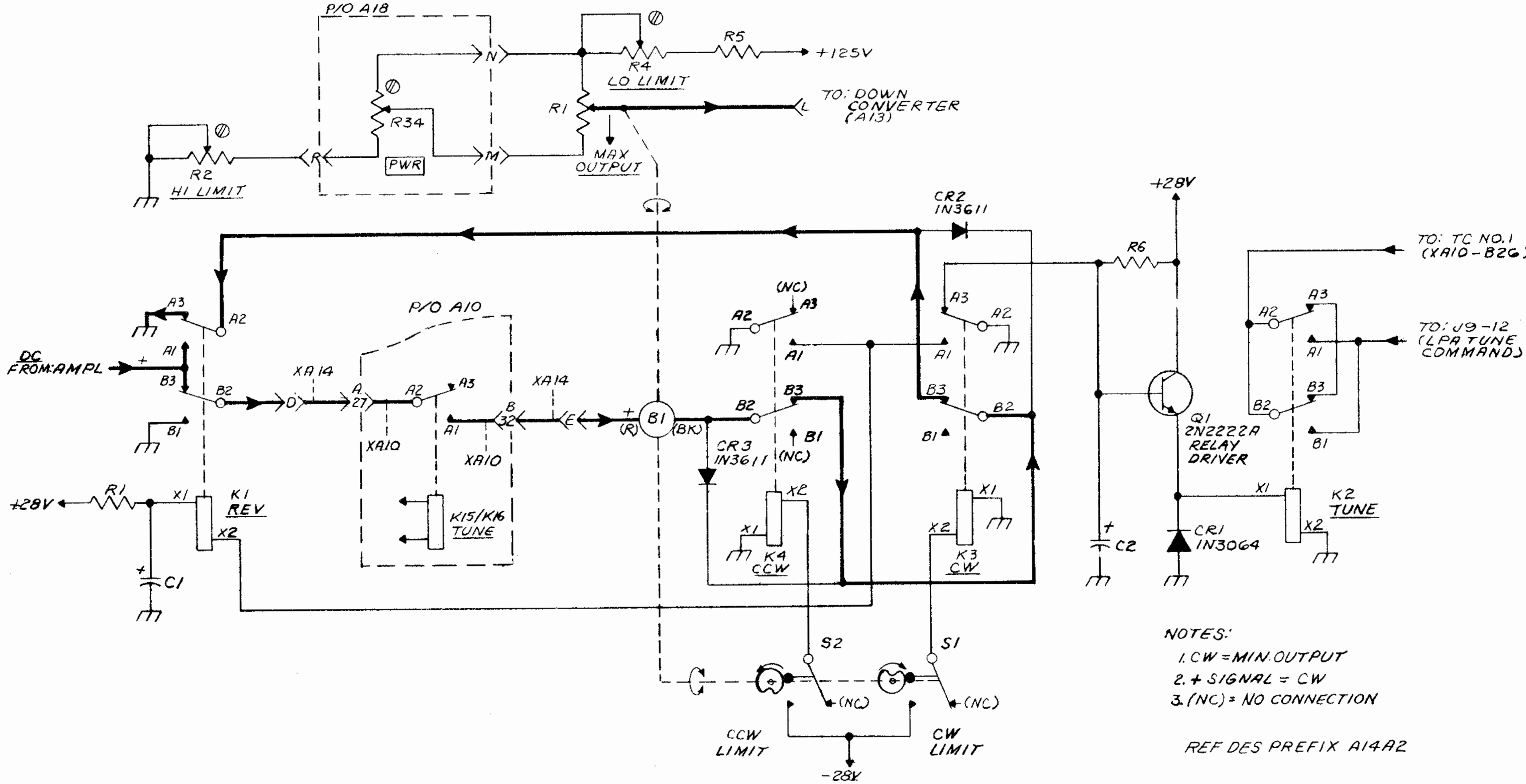

Figure 4-28. Motor Control A14A2, Simplified Schematic Diagram

(a) Ccw Limit. - Limit switch S2 is held open by the operating cam until the ccw extreme of motor rotation is reached. Then S2 closes to energize relay K4. Relay K4, in turn, energizes motor brake relay K1 via contacts K4-a1.

(b) TGC Operation. - During operation the transmitter gain control (TGC) module operates in response to directions from the transmitting system. When a TUNE cycle is initiated, a minimum gain command from transmitter control no. 1 module A10 energizes minimum gain relay K1 (see figure 4-27) driving motor B1 clockwise for minimum rf output conditions.

When coarse tuning of the external rf amplifier (LPA) has been accomplished, an ENABLE signal from the LPA releases the minimum gain relay, and motor B1 drives counterclockwise, responding to the TGC control voltage from the LPA and increasing the rf output level from the exciter until a "null" is reached at the input to A14A1Z1. When a READY signal is issued by the LPA motor B1 is turned off and remains off until a new TUNE cycle is initiated. Test point A14A1J1 provides a convenient point for measuring the required null voltage. Test point A14A2J1 provides a monitoring point to check the TUNE (activate) command. These commands are issued via transmitter control no. 1 module A10.

b. PRELIMINARY CHECK. (See figure 5-80.) - Make a preliminary check of transmitter gain control module A14 before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place exciter in the conditions specified during the test data steps.)

e. TEST DATA. (See figure 5-80.) - Trouble shooting the transmitter gain control module consists of checking the -12, +15, -28, +28, and +125 volts dc operating potentials. All measurements are made at chassis connector A18XA14. Initially, place exciter in the "operate" condition.

(1) Connect VTVM to XA14 pin K. Meter should read -12 vdc ±10%.

(2) Connect VTVM to XA14 pin H. Meter should read +15 vdc ±10%.

(3) Connect VTVM to XA14 pin A. Meter should read -28 vdc ±20%.

(4) Connect VTVM to XA14 pin F. Meter should read +28 vdc ±10%.

(5) Connect multimeter to XA14 pin C. Meter should read +125 vdc ±10%.

(6) Rotate any FREQUENCY KC control. Relay A14A1K1 should close. Motor should run clockwise to limit switch. Relay A14A2K2 should close.

(7) On receipt of TUNE ENABLE command from LPA, motor should run counterclockwise until "null" voltage is reached.

4-25. BAND ENCODER A15. (See figures 4-29, 4-30, 4-50, and 5-81.)

This module contains band encoder A15A2, and -12v and +15v regulator circuit A15A1. The band encoder samples the 10 mc, 1 mc, and 100 kc frequency select logic at the input to synthesizer A12, and encodes this information in the form of a five-wire binary code which is supplied to the LPA for tuning purposes. The voltage regulator circuits receive

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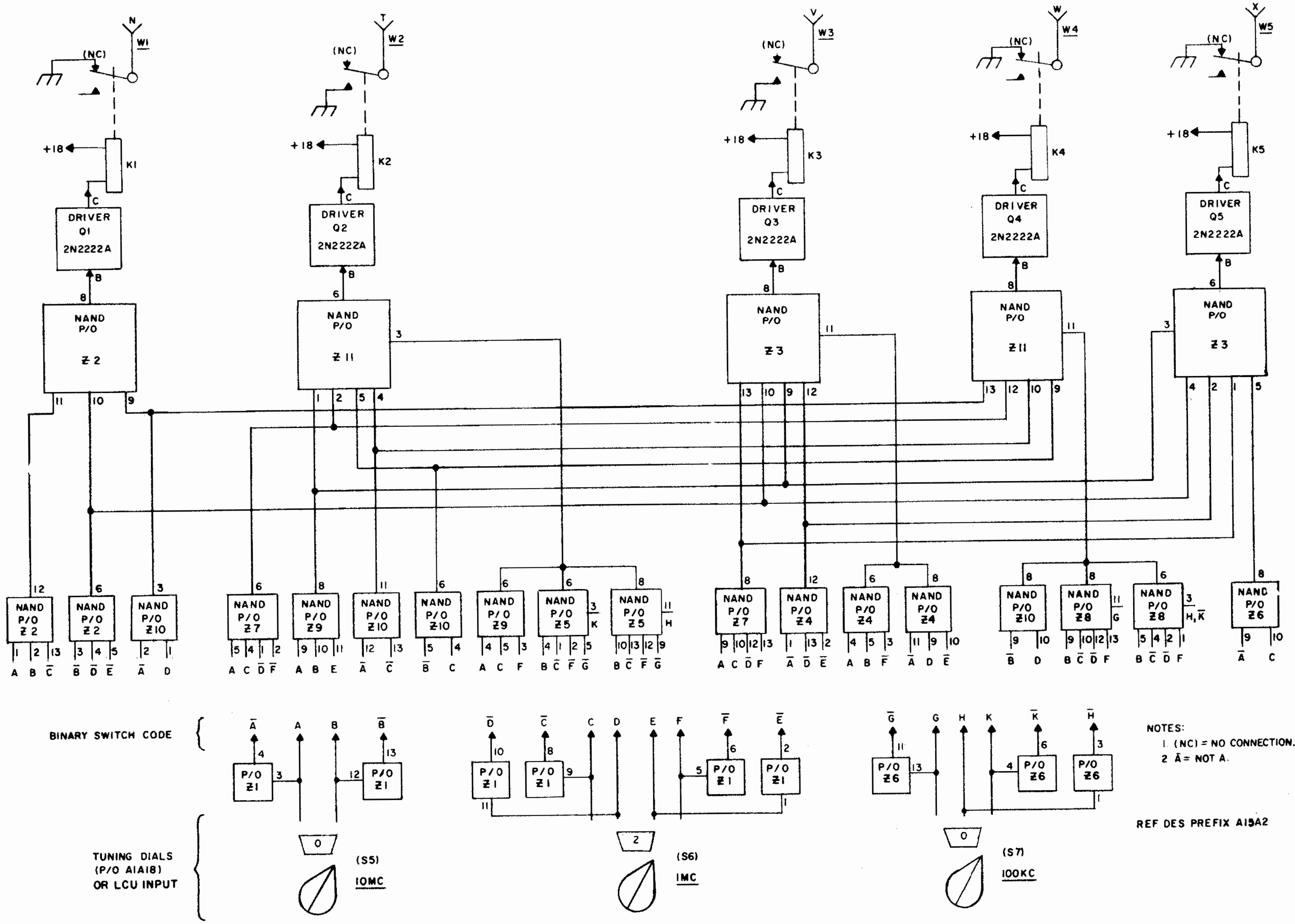
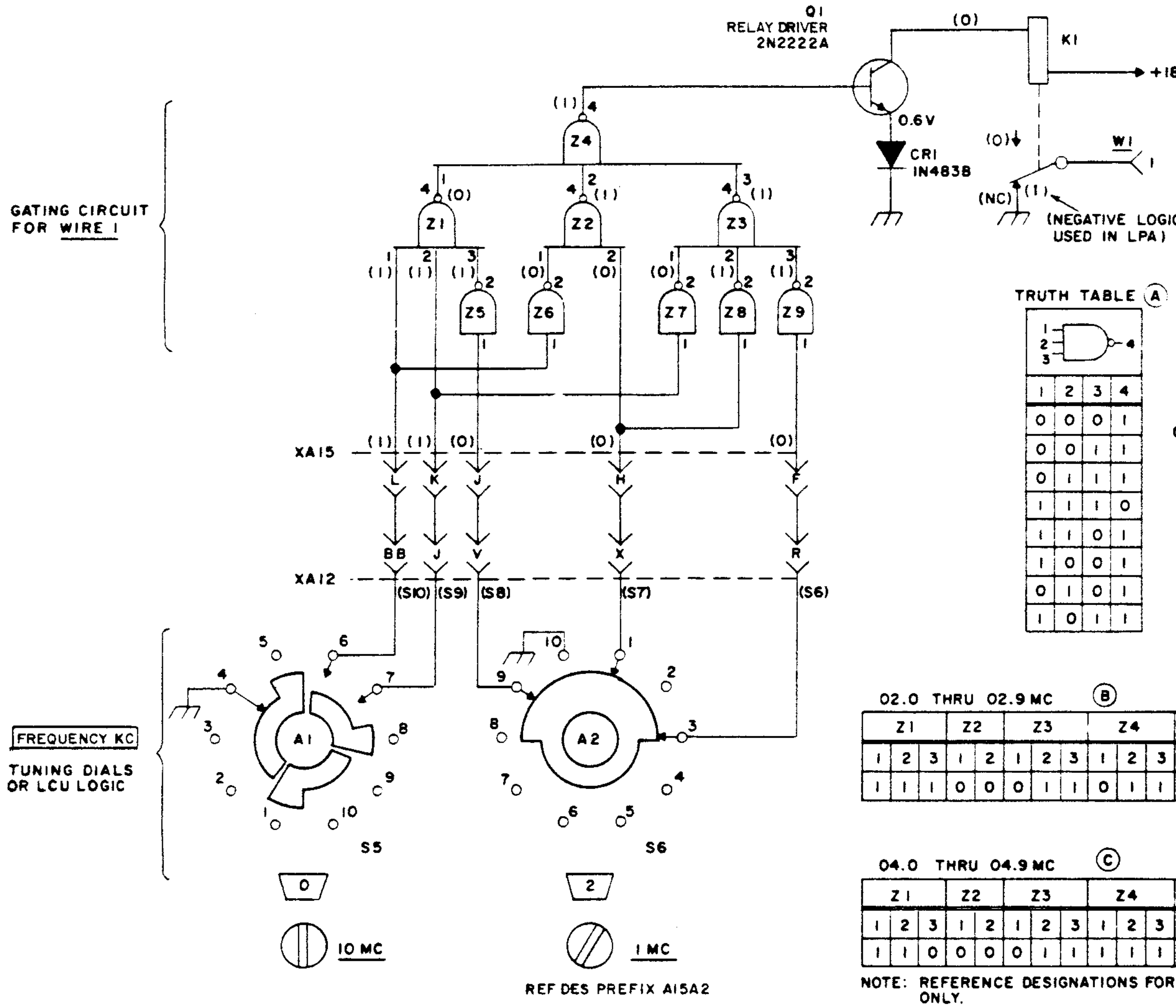


Figure 4-29. Band Encoder, Functional Block Diagram



1	2	3	4
0	0	0	1
0	0	1	1
0	1	1	1
1	1	1	0
1	1	0	1
1	0	0	1
0	1	0	1
1	0	1	1

02.0 THRU 02.9 MC (B)

Z1			Z2		Z3			Z4			Z4 OUT	K1	W1
1	2	3	1	2	1	2	3	1	2	3		K1	W1
1	1	1	0	0	0	1	1	0	1	1	1	OPEN	0

04.0 THRU 04.9 MC (C)

Z1			Z2		Z3			Z4			Z4 OUT	K1	W1
1	2	3	1	2	1	2	3	1	2	3		K1	W1
1	1	0	0	0	0	1	1	1	1	1	0	SHUT	1

NOTE: REFERENCE DESIGNATIONS FOR EXAMPLE USE ONLY.

Figure 4-30. W1 Encoder, Functional Diagram

+18 volt and -18 volt potentials from power supply PS1, and supply regulated -12 and +15 volt potentials to various exciter modules.

a. DESCRIPTION.

(1) BAND ENCODER A15A2. (See figure 4-29.) - The band encoder receives samples of the binary switching code developed by the 10 mc, 1 mc, and 100 kc tuning logic for control of the output frequency of synthesizer A12. These inputs control 280 tuning increments in 100 kc steps over the frequency range from 02.0 to 29.9 mc. The band encoder integrates the 280 frequency increments to obtain a total of 19 frequency segments ranging from 400 kc to 1.9 mc in width for tuning the LPA. Consequently, the band encoder receives the binary position code for the frequency selected and develops a 5-wire binary code containing the 19 LPA tuning segments. Table 4-7 lists the segments and identifies the frequency settings for the 19 LPA tuning segments.

The 9-bit binary code developed by the frequency selector is converted to a 5-wire binary code representing the 19 tuning segments in the sequence listed in table 4-7. The basic block diagram of band encoder A15A2 is shown in figure 4-29. Note the relation of the IC module NAND gates with respect to the tuning dials, the five switch stages (Q1 thru

TABLE 4-7. LPA TUNING CODE

CHAN. NO.	SEGMENT FREQUENCY (MC)	STEP	TUNING DIALS			5-WIRE CODE	RELAYS ENERG.
			10 MC	1 MC	100 KC		
1	02.0 - 02.4	400 KC	11	1000	001 to 010	00001	K2, 4, 5
2	02.5 - 02.9	400 KC	11	1000	110 to 100	00011	K2, 5
3	03.0 - 03.4	400 KC	11	0000	001 to 010	00111	K2, 3
4	03.5 - 03.9	400 KC	11	0000	110 to 100	01111	K3, 5
5	04.0 - 04.9	900 KC	11	1001	001 to 100	11110	K1, 3
6	05.0 - 05.9	900 KC	11	0001	001 to 100	11101	K1, 3, 4, 5
7	06.0 - 06.9	900 KC	11	1011	001 to 100	11011	K1, 5
8	07.0 - 07.9	900 KC	11	0011	001 to 100	10111	K1, 2, 3, 5
9	08.0 - 09.9	1.9 MC	11	1110 to 0110	001 to 100	01110	K3
10	10.0 - 11.9	1.9 MC	01	1100 to 0100	001 to 100	11100	K1, 3, 4
11	12.0 - 13.9	1.9 MC	01	1000 to 0000	001 to 100	11001	K1, 4, 5
12	14.0 - 15.9	1.9 MC	01	1001 to 0001	001 to 100	10010	K1, 2
13	16.0 - 17.9	1.9 MC	01	1011 to 0011	001 to 100	00100	K2, 3, 4
14	18.0 - 19.9	1.9 MC	01	1110 to 0110	001 to 100	01001	K4, 5
15	20.0 - 21.9	1.9 MC	01	1100 to 0100	001 to 100	10011	K1, 2, 5
16	22.0 - 23.9	1.9 MC	10	1000 to 0000	001 to 100	00110	K2, 3
17	24.0 - 25.9	1.9 MC	10	1001 to 0001	001 to 100	01100	K3, 4
18	26.0 - 27.9	1.9 MC	10	1011 to 0011	001 to 100	11000	K1, 4
19	28.0 - 29.9	1.9 MC	10	1110 to 0110	001 to 100	10000	K1, 2, 4

"0" = Low, "1" = High

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Q5), and the five logic relays (K1 thru K5). When de-energized, relays K1, K4, and K5 produce a logical "1" (ground) while the remaining relays provide a logical "0" (open), a negative logic sequence.

The bits from the 10 mc, 1 mc, and 100 kc tuning dials are applied to the NAND gate integrating circuits directly, or following inversion gates Z1 and Z2. Bit inversion of a logical "1", for example, produces a "$\overline{1}$" (not "1", or "0"). In this manner, the total number of bits applied is doubled to facilitate gate operation. With reference to table 4-7, the 9-bit code for channel 1 (11, 1000, 001 to 010) from the three tuning dials, is converted to the 5-wire code 00001 when relays K2, K3, and K4 are energized. Consequently, the frequency segment from 02.0 to 02.4 mc (encompassing 400 kc) is integrated to form a single tuning channel for the LPA. The remaining 18 channels or segments cover the rest of the tuning range and differ only in the segment width expressed in kilocycles or megacycles. No attempt will be made to present a detailed description of the entire band encoder operations; however, the following paragraph contains a description of the W1 circuit which is similar in operation to the other 5-wire circuits, W2 through W5.

(a) W1 ENCODER CIRCUIT. (See figure 4-30.) - The band encoder circuit for wire 1 (W1) of the five-wire output code is shown in figure 4-30. Although NAND gates Z1, Z2, Z6, and part of Z10 are actually used (see figure 4-29), in the functional diagram designations Z1 through Z9 are used for simplicity and to clarify the tables in details A, B, and C.

Detail A is a truth table for the 3-input NAND gates, using positive logic terminology. Output at gate terminal 4 is a "1" for all input states except the coincidental "1" inputs (all "1", simultaneously) which produces a "0" output in typical NAND gate fashion. Gates Z1 through Z4 function in this manner and their output terms follow the truth table listing. Single input gates Z5 through Z9 offer circuit buffering and invert the input signal applied. For example, a logical "1" at the Z5 input is inverted by the gating action and appears as a "0" at the Z5 output terminal. Note that for positive logic operation a logical "0" is a <u>low</u> or ground condition and a logical "1" is a <u>high</u> or open circuit condition.

Detail B lists the logic states at the inputs of gates Z1 through Z4 for tuning dial settings of 02.0 to 02.9, at the 10 mc and 1 mc dials only. These dials determine the first digit of the LPA 5-wire code at the W1 position. The resultant 011 condition at the inputs of gate Z4 produces a logical "1" output, saturating switching stage Q1 and energizing relay K1. The LPA binary code is negative logic to the extent that the open circuit at relay K1 contacts is considered as a logical "0". Consequently, when relay K1 is energized the band encoder output for the W1 line is a "0".

Detail C lists the logic states of gates Z1 through Z4 for tuning dial settings of 04.0 to 04.9, at the 10 mc and 1 mc dials only, to illustrate gate operation when the W1 output line is a logical "1" and relay K1 is <u>not</u> energized. Now, the 111 condition at the gate Z4 inputs produces a logical "0" at the gate output. Switch stage Q1 is cut-off and relay K1 de-energized. The W1 line is in a ground state ("1" state for the LPA code).

(b) ENCODER OPERATION. (See figures 4-29 and 4-30.) - The description of NAND gate operation given in the previous paragraph also applies in general to the operation of the W2 through W5 gate circuits and energizing of relays K2 through K5, all in response to the setting of the 10 mc, 1 mc, and 100 kc tuning dials. For a selected frequency segment (channel) listed in table 4-7, there is a corresponding tuning dial binary code, the energizing of selected 5-wire relays, and a resultant 5-wire binary LPA code.

(2) -12/+15 VOLT REGULATOR A15A1. (See figure 5-81.) - The voltage regulator section contains two similar regulating circuits. The following description of the -12 volt regulator also applies to the +15 volt regulator except for the assigned reference designations. A -18 volt potential from power supply PS1 is applied to a conventional regulating circuit at terminals 1 and 2. Q1 functions as a series regulator controlled by dc amplifier Q2. Zener diode CR1 is the voltage reference in the emitter circuit of Q2. The +18 volt potential for operation of the +15 volt regulator is also supplied by power supply PS1.

b. PRELIMINARY CHECK. (See figure 5-81.) - Make a preliminary check of band encoder module A15 before trouble shooting, with emphasis on the following:

(1) Seating of plug-in module in its socket.

(2) Soldered connections at socket.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools are necessary.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1 and follow instructions for test data steps. (Place exciter unit in operating condition.)

e. TEST DATA. (See figure 5-81.) - Trouble shooting the band encoder and -12/+15 volt regulator module consists of checking the +5, -12, +15, -18, and +18 dc operating potentials, and verifying operation of the band encoder gate circuits for selected tuning dial settings. All measurements are made at chassis connector A18XA15.

(1) Connect VTVM to XA15 pin P. Meter should read +5 vdc ±10%.

(2) Connect VTVM to XA15 pin M. Meter should read -12 vdc ±5%.

(3) Connect VTVM to XA15 pin B. Meter should read +15 vdc ±5%.

(4) Connect VTVM to XA15 pin R. Meter should read -18 vdc ±5%.

(5) Connect VTVM to XA15 pin S. Meter should read +18 vdc ±10%.

(6) Set tuning dials to read 04.0000 mc. Connect ohmmeter to XA15 pins N, T, V, W, and X (in turn). Meter should read (in ohms) 0, 0, 0, 0, and inf. (infinity), respectively.

(7) Set tuning dials to read 02.0000 mc and repeat step (6). Meter should read inf, inf, inf, inf, and 0 ohms, respectively.

4-26. TRANSMITTER CONTROL CENTER, A10/A17. (See figures 4-51, 5-69, 5-83, and 5-87.)

a. INTRODUCTION. - The transmitter control center consists of transmitter control no. 1 (TC1 module, A10) and transmitter control no. 2 (TC2 module, A17) and their associated circuitry. This control center is discussed as a single functional entity in the following subparagraphs of this paragraph (4-26). The TC1 and TC2 modules are discussed individually in paragraph 4-27.

b. DESCRIPTION. - The transmitter control center provides for both local and remote control and monitoring of its associated radio transmitting set. Mode of operation (local or remote) is determined by the setting of the REMOTE/LOCAL control on the front panel of the exciter.

Note

> Certain control and monitoring functions are performed external to the transmitter control center.

During local operation, all transmitter parameters are controlled by the transmitter itself. Under remote operating conditions, the standby/operate status, operating frequency, class of emission, and sideband selection for the transmitter are determined by the remote control system, and all other transmitter parameters are controlled by the transmitter itself.

With the single exception of operating frequency, the transmitter monitors the same parameters during both local and remote operation. Under local operating conditions, the exciter displays the transmitter operating frequency, and the frequency display at the optional local control unit (LCU) of the remote control system is inhibited. During remote operation, the LCU displays the operating frequency assigned to the transmitter by the remote control system; in this case, the exciter frequency display is inhibited. (Note that there is no actual readback of transmitter operating frequency from exciter to LCU.) Under both local and remote operating conditions, the same transmitter parameters are read back from exciter to LCU for monitoring by the remote control system. The remotely monitored transmitter parameters are standby/operate status, availability (local/remote) status, ready status, fault status, class of emission, and sideband selection.

The transmitter control center of the exciter controls operation of the exciter itself and of its associated keyer and linear power amplifier (LPA). In response to its inputs from the exciter itself, from the LCU (an optional unit), and from the LPA, this control center produces outputs for the exciter itself, the keyer, the optional LCU, and the LPA, as well as for auxiliary equipment. Control-center input and output functions are as follows:

(1) FUNCTIONS OF INPUTS FROM EXCITER.

(a) Local Standby Command

(b) Local Operate Command

(c) Local Tune Command

(d) Amplifier-Off Command

(e) Simulated LPA Tune-Enable Return (TEST A/B switch on auxiliary panel of exciter held in A position)

(f) Simulated LPA Ready Return (TEST A/B switch on auxiliary panel of exciter held in B position)

(g) Fault Signal

(h) Tuning-Fault Signal

(i) Local VCO-Select Command

(j) Local Class-of-Emission Command (Manual Switch Positioning)

(k) Local Sideband-Selection Command (Manual Switch Positioning)

(2) FUNCTIONS OF INPUTS FROM OPTIONAL LCU.

(a) Remote Standby Command

(b) Remote Operate Command

(c) Remote Tune Command

(d) Remote VCO-Select Command

(e) Remote Class-of-Emission Command

(f) Remote Sideband-Selection Command

(3) FUNCTIONS OF INPUTS FROM LPA.

(a) Standby Return

(b) Operate Return

(c) Tune-Enable Return

(d) Ready Return

(4) FUNCTIONS OF OUTPUTS TO EXCITER.

(a) Standby-Lamp Signal

(b) Operate-Lamp Signal

(c) Tune-Lamp Signal

(d) Ready-Lamp Signal

(e) Amplifier-Off-Lamp Signal

(f) Fault-Lamps Signal

(g) Modulation-Off Command

(h) Modulation-Normal Command

(i) TGC-Minimum-Gain Command

(j) TGC-Enable Command

(k) Carrier-Disable Command

(l) Tune-Carrier Command

(m) Standby Command

(n) Operate Command

(o) Fault/Standby Override Command

(p) VCO-Select Synthesizer Command

(q) Class-of-Emission Switch Command

(r) Sideband-Selection Switch Command

(5) FUNCTION OF OUTPUT TO OPTIONAL KEYER.

(a) Operate Command

(6) FUNCTIONS OF OUTPUTS TO OPTIONAL LCU.

(a) Standby Readback

(b) Operate Readback

(c) Ready Readback

(d) Fault Readback

(7) FUNCTIONS OF OUTPUTS TO LPA.

(a) Standby Command

(b) Operate Command

(c) Tune-Activate Command

(d) Inhibit Command

(e) Keyline Command

(8) FUNCTIONS OF OUTPUTS TO AUXILIARY EQUIPMENT.

(a) Operate Readback

(b) RF-On Readback

The control status of the radio transmitting set is determined largely by the inputs and outputs of the transmitter control center. Certain combinations of signals constitute valid system conditions, which are of two basic types (normal and fault). The more significant system conditions are indicated by means of lamps located on the front panel of the exciter. Under normal system conditions, the EXC FAIL, XMTR FAIL, and STD FAIL lamps are always extinguished, and the STD OVEN lamp is always illuminated. If these four lamps exhibit any other illumination pattern, a fault system condition is present. Valid system conditions (both normal and fault), as indicated by illuminated exciter lamps, are as follows:

(1) NORMAL SYSTEM CONDITIONS.

(a) TUNE (White)

(b) TUNE (White), STANDBY (White)

(c) TUNE (White), OPERATE (Green)

(d) OPERATE (Green)

(e) OPERATE (Green), READY (Green)

(f) AMPLIFIER OFF (White)

(g) AMPLIFIER OFF (White), TUNE (White)

(h) STANDBY (White), READY (Green)

(2) FAULT SYSTEM CONDITIONS.

(a) EXC FAIL (Red), TUNE (White), STANDBY (White)

(b) XMTR FAIL (Red), TUNE (White), STANDBY (White)

(c) EXC FAIL (Red), STD FAIL (Red), TUNE (White), STANDBY (White)

Note

When the radio transmitting set is under local control, an existing EXC FAIL condition can be overridden by setting the NORMAL/FAULT OVRD switch on the auxiliary panel of the exciter to the FAULT OVRD position. In the fault-override condition, the exciter can be operated "normally" (per preceding items (1)(a) through (1)(h)), except that the EXC FAIL lamp will be illuminated. During remote operation, no fault override is possible. An XMTR FAIL condition can never be overridden, regardless of the type of operation (local or remote).

A discussion of each of the preceding system conditions (both normal and fault) is given in the following paragraphs. At the conclusion of each discussion, the input and output signals present under the particular system condition are tabulated. Unless otherwise specified, input and output signals are from and to the exciter, respectively.

(1) TUNE SYSTEM CONDITION. - When only the TUNE lamp is illuminated, a tuning fault has occurred, and the LPA is not prepared to begin a tune cycle (since the STANDBY lamp is not illuminated). During the warm-up period of the LPA, this is a normal system condition. Presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Tuning-Fault Signal*

(b) OUTPUT SIGNALS.

1. Ready Readback to LCU
2. Standby Command to LPA
3. Inhibit Command to LPA
4. Tune-Lamp Signal
5. Modulation-Off Command
6. Standby Command
7. Fault/Standby Override Command

Note

Regardless of the status of other indicator lamps on the front panel of the exciter, illumination of the TUNE lamp indicates that a tuning fault has occurred and that a tune cycle is required. A tuning fault occurs each time the toggle switch on the RESET/TRIPPED circuit breaker is set to the RESET position. Thereafter, a tuning fault occurs whenever the setting of the REMOTE/LOCAL control is changed, whenever the CLASS OF EMISSION control is rotated out of the A0 or A2, A3e position, and whenever the FREQUENCY KC setting is changed.

* After initiation, presence of tuning-fault signal is maintained until tune cycle is started.

(2) TUNE/STANDBY SYSTEM CONDITION. - When both the TUNE and STANDBY lamps are illuminated, the radio transmitting set is partially energized, and is prepared for full power application, tuning, and normal operation. The TUNE lamp indicates that a tune cycle is required, and the STANDBY lamp indicates that the LPA is prepared to begin a tune cycle. Presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Standby Return from LPA
2. Tuning-Fault Signal*
3. Standby Initiation Command**

(b) OUTPUT SIGNALS.

1. Standby Readback to LCU
2. Ready Readback to LCU
3. Standby Command to LPA
4. Inhibit Command to LPA
5. Standby-Lamp Signal
6. Tune-Lamp Signal
7. Modulation-Off Command
8. Carrier-Disable Command
9. TGC-Minimum-Gain Command
10. TGC-Enable Command
11. Standby Command
12. Fault/Standby Override Command

Note

When the radio transmitting set is in the tune/standby system condition, the keyline command output from the transmitter control center is present. This output is gated through the VFG module (A5) of the exciter to the LPA. Under the tune/standby system condition, the keyline command output to the LPA is inhibited by the VFG module (because the exciter is in the standby condition).

(3) TUNE/OPERATE SYSTEM CONDITION. - When both the TUNE and OPERATE lamps are illuminated, the radio transmitting set is fully energized, and is prepared for tuning and normal operation. The TUNE lamp indicates that a tune cycle is required, and

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* After initiation, presence of tuning-fault signal is maintained until tune cycle is begun.
** During local operation, standby initiation command is present when indicating STANDBY pushbutton is held depressed; during remote operation, standby initiation command is present whenever remote control system is commanding standby status.

the OPERATE lamp indicates that the LPA is prepared to begin a tune cycle. Presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Operate Return from LPA

2. Tuning-Fault Signal*

3. Operate Initiation Command**

(b) OUTPUT SIGNALS.

1. Operate Command to Keyer

2. Operate Readback to LCU

3. Standby Command to LPA

4. Operate Command to LPA

5. Inhibit Command to LPA

6. Keyline Command to LPA

7. Operate Readback to Auxiliary Equipment

8. RF-On Readback to Auxiliary Equipment

9. Operate-Lamp Signal

10. Tune-Lamp Signal

11. Modulation-Off Command

12. Carrier-Disable Command

13. TGC-Minimum-Gain Command

14. TGC-Enable Command

15. Operate Command

Note

When radio transmitting set is in operate condition, both standby and operate commands to LPA are present.

(4) OPERATE SYSTEM CONDITION. - When only the OPERATE lamp is illuminated, a tune cycle is in progress. Each tune cycle is initiated by the presence of a tune-command input (either local or remote) and terminated by the presence of a ready return from the LPA. The tune cycle is subdivided into three periods, those which occur before, during, and after presence of the tune-enable return from the LPA. Duration of a complete tune cycle is always less than 15 seconds.

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* After initiation, presence of tuning-fault signal is maintained until tune cycle is begun.

** During local operation, operate initiation command is present when indicating OPERATE pushbutton is held depressed; during remote operation, operate initiation command is present whenever remote control system is commanding operate status.

The radio transmitting set can be transferred to the operate system condition from either the tune/standby system condition or the tune/operate system condition. (Both local and remote tune command inputs automatically transfer the transmitter to its operate mode if it is in the standby mode.) After completion of each tune cycle, the transmitter is transferred to the operate/ready system condition, which is discussed in a following paragraph.

During the tune cycle, presence of input and output signals prior to presence of the tune-enable return from the LPA is as follows:

(a) INPUT SIGNALS.

1. Operate Return from LPA
2. Tune Initiation Command*
3. Operate Initiation Command**

(b) OUTPUT SIGNALS.

1. Operate Command to Keyer
2. Operate Readback to LCU
3. Standby Command to LPA
4. Operate Command to LPA
5. Tune-Activate Command to LPA
6. Inhibit Command to LPA
7. Keyline Command to LPA
8. Operate Readback to Auxiliary Equipment
9. RF-On Readback to Auxiliary Equipment
10. Operate-Lamp Signal
11. Modulation-Off Command
12. Carrier-Disable Command
13. TGC-Minimum-Gain Command
14. TGC-Enable Command
15. Operate Command

During the tune cycle, presence of input and output signals in the presence of the tune-enable return from the LPA is as follows:

* During local operation, tune initiation command is present when indicating TUNE pushbutton is held depressed; during remote operation, tune initiation command is present for approximately 1/4 second each time RCU addresses control command word of tuning type to LCU.
** Operate initiation command is present when tune initiation command is present.

(a) INPUT SIGNALS.

1. Operate Return from LPA
2. Tune-Enable Return from LPA

(b) OUTPUT SIGNALS.

1. Operate Command to Keyer
2. Operate Readback to LCU
3. Standby Command to LPA
4. Operate Command to LPA
5. Tune-Activate Command to LPA*
6. Keyline Command to LPA
7. Operate Readback to Auxiliary Equipment
8. RF-On Readback to Auxiliary Equipment
9. Operate-Lamp Signal
10. Modulation-Off Command
11. TGC-Enable Command
12. Tune-Carrier Command
13. Operate Command

During the tune cycle, presence of input and output signals after presence of the tune-enable return from the LPA is as follows:

(a) INPUT SIGNALS.

1. Operate Return from LPA

(b) OUTPUT SIGNALS.

1. Operate Command to Keyer
2. Operate Readback to LCU
3. Standby Command to LPA
4. Operate Command to LPA
5. Keyline Command to LPA
6. Operate Readback to Auxiliary Equipment
7. RF-On Readback to Auxiliary Equipment

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* Present only during initial portion of period, when transmitter gain control (TGC) module (A14) is set for minimum gain.

8. Operate-Lamp Signal

9. Modulation-Off Signal

10. Operate Command

(5) OPERATE/READY SYSTEM CONDITION. - When both the OPERATE and READY lamps are illuminated, the radio transmitting set is fully operational. If no fault condition is present, the transmitter is transferred to the operate/ready system condition at the completion of each tune cycle. For the operate/ready system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Operate Return from LPA

2. Ready Return from LPA

(b) OUTPUT SIGNALS.

1. Operate Command to Keyer

2. Operate Readback to LCU

3. Ready Readback to LCU

4. Standby Command to LPA

5. Operate Command to LPA

6. Keyline Command to LPA (as required)

7. Operate Readback to Auxiliary Equipment

8. RF-On Readback to Auxiliary Equipment*

9. Operate-Lamp Signal

10. Ready-Lamp Signal

11. Modulation-Normal Command

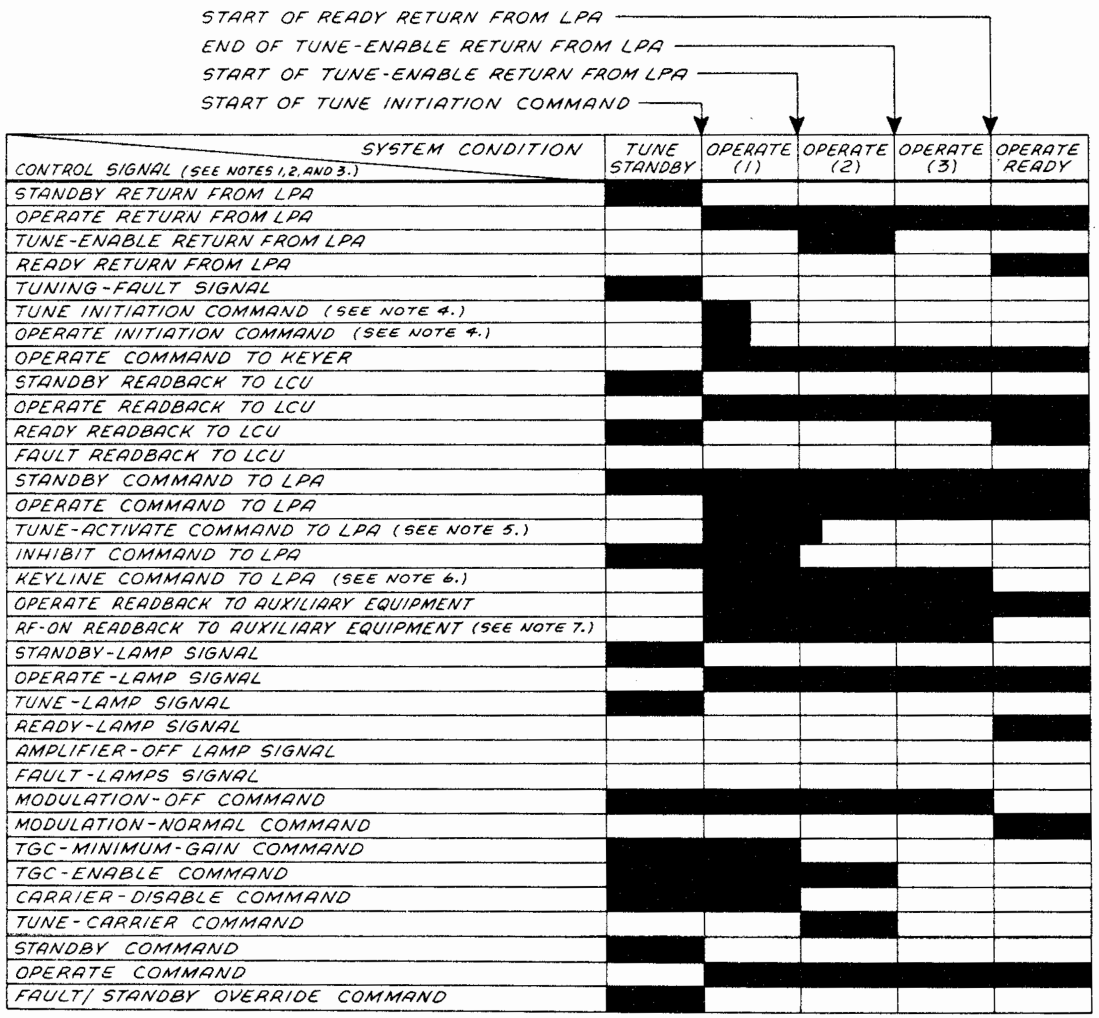
12. Operate Command

Note

When the radio transmitting set is in the operate/ready system condition, the keyline command output from the transmitter control center is absent. Under the operate/ready system condition, the VFG module (A5) of the exciter provides the keyline command output to the LPA as required.

The presence of control signals as the radio transmitting set is transferred from the tune/standby system condition to the operate system condition to the operate/ready system condition is illustrated in figure 4-31.

* Present when keyline command to LPA is present.



NOTES:

1. TIMING IS NOT TO SCALE.
2. ▬ DENOTES PRESENCE OF CONTROL SIGNAL.
3. ▭ DENOTES ABSENCE OF CONTROL SIGNAL.
4. DURING LOCAL OPERATION, CONTROL SIGNAL IS PRESENT WHEN INDICATING TUNE PUSHBUTTON IS HELD DEPRESSED; DURING REMOTE OPERATION, CONTROL SIGNAL IS PRESENT FOR APPROXIMATELY 1/4 SECOND EACH TIME RCU ADDRESSES CONTROL COMMAND WORD OF TUNING TYPE TO LCU.
5. DURING BOTH LOCAL AND REMOTE OPERATION, CONTROL SIGNAL IS PRESENT ONLY FOR INITIAL PORTION OF OPERATE (2) PERIOD, WHEN TRANSMITTER GAIN CONTROL (TGC) MODULE (A14) IS SET FOR MINIMUM GAIN.
6. DURING BOTH LOCAL AND REMOTE OPERATION, CONTROL SIGNAL OUTPUT FROM TRANSMITTER CONTROL CENTER IS PRESENT FOR TUNE/STANDBY PERIOD; HOWEVER, CONTROL SIGNAL OUTPUT TO LPA IS INHIBITED BY VFG MODULE (A5) DURING THIS TIME INTERVAL. DURING BOTH LOCAL AND REMOTE OPERATION, CONTROL SIGNAL OUTPUT FROM TRANSMITTER CONTROL CENTER IS ABSENT FOR OPERATE/READY PERIOD; HOWEVER, VFG MODULE (A5) PROVIDES CONTROL SIGNAL AS REQUIRED DURING THIS TIME INTERVAL.
7. DURING BOTH LOCAL AND REMOTE OPERATION, CONTROL SIGNAL IS PRESENT WHEN KEYLINE COMMAND TO LPA IS PRESENT.

Figure 4-31. Transmitter Tuning Sequence

Note

When the radio transmitting set is under remote control, it cannot be transferred to the amplifier-off status, either locally or remotely.

(6) AMPLIFIER-OFF SYSTEM CONDITION. - When only the AMPLIFIER OFF lamp is illuminated, the exciter is essentially in the standby mode, and all power-supply voltages (including filament voltages) are disconnected from the rf stages of the LPA. The radio transmitting set is transferred to the amplifier-off system condition by depression of the indicating AMPLIFIER OFF pushbutton (of which the AMPLIFIER OFF lamp is a part) or by loss of power. Transfer out of the amplifier-off system condition is accomplished by depression of the indicating STANDBY pushbutton (of which the STANDBY lamp is a part). During the amplifier-off system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Amplifier-Off Command*

(b) OUTPUT SIGNALS.

1. Ready Readback to LCU

2. Operate Command to LPA**

3. Tune-Activate Command to LPA***

4. Amplifier-Off-Lamp Signal

5. Modulation-Normal Command

6. Standby Command

7. Fault/Standby Override Command

(7) AMPLIFIER-OFF/TUNE SYSTEM CONDITION. - When both the AMPLIFIER OFF and TUNE lamps are illuminated, the exciter is essentially in the standby mode, all power-supply voltages (including filament voltages) are disconnected from the rf stages of the LPA, and a tune cycle is required. During the amplifier-off/tune system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Amplifier-Off Command*

2. Tuning-Fault Signal****

(b) OUTPUT SIGNALS.

1. Ready Readback to LCU

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* Present only while indicating AMPLIFIER OFF pushbutton is held depressed.

** Present only when radio transmitting set has transferred from operate system condition to amplifier-off system condition because of loss of power. Depression of indicating AMPLIFIER OFF pushbutton on front panel of exciter removes both standby and operate commands to LPA.

*** Present only when transmitter gain control module (A14) is set for minimum gain.

**** After initiation, presence of tuning-fault signal is maintained until tune cycle is begun.

2. Operate Command to LPA*
3. Inhibit Command to LPA
4. Tune-Lamp Signal
5. Amplifier-Off-Lamp Signal
6. Modulation-Off Command
7. Standby Command
8. Fault/Standby Override Command

(8) STANDBY/READY SYSTEM CONDITION. - When both the STANDBY and READY lamps are illuminated, the radio transmitting set is partially energized, and is prepared for full power application and normal operation. In this case, no tune cycle is required. During the standby/ready system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Standby Return from LPA
2. Ready Return from LPA

(b) OUTPUT SIGNALS.

1. Standby Readback to LCU
2. Ready Readback to LCU
3. Standby Command to LPA
4. Standby-Lamp Signal
5. Ready-Lamp Signal
6. Modulation-Normal Command
7. Standby Command
8. Fault/Standby Override Command

Note

Whenever a transmitter failure occurs, the transmitter control center transfers the transmitter to the standby mode and specifies that a tune cycle is required.

(9) EXC-FAIL/TUNE/STANDBY SYSTEM CONDITION. - When the EXC FAIL, TUNE, and STANDBY lamps are all illuminated, an exciter failure has occurred, the radio transmitting set is in the standby mode, and a tune cycle is required. If an exciter failure occurs when the radio transmitting set is fully operational, the transmitter is transferred

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* Present only when radio transmitting set has transferred from operate system condition to amplifier-off/tune system condition because of loss of power. Depression of indicating AMPLIFIER OFF pushbutton on front panel of exciter removes both standby and operate commands to LPA.

to the exc-fail/tune/standby system condition. Under local operating conditions, an exciter failure can be overridden by setting the NORMAL/FAULT OVRD switch on the auxiliary panel of the exciter to the FAULT OVRD position. No fault override is possible during remote operation.

In the fault-override condition, the exciter can be operated "normally"; however, the EXC FAIL lamp remains illuminated. After an exciter failure has been overridden, the required tune cycle can be initiated by depression of the indicating TUNE pushbutton (of which the TUNE lamp is a part) on the front panel of the exciter. When the tune cycle has been completed, the CIRCUIT TEST switch on the front panel of the exciter can be used as an aid to fault location. During the exc-fail/tune/standby system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Standby Return from LPA
2. Fault Signal

(b) OUTPUT SIGNALS.

1. Standby Readback to LCU
2. Ready Readback to LCU
3. Fault Readback to LCU
4. Standby Command to LPA
5. Inhibit Command to LPA
6. Standby-Lamp Signal
7. Tune-Lamp Signal
8. Fault-Lamps Signal
9. Modulation-Off Command
10. Carrier-Disable Command
11. TGC-Minimum-Gain Command
12. TGC-Enable Command
13. Standby Command
14. Fault/Standby Override Command

Note

When the radio transmitting set is in the exc-fail/tune/standby system condition, the keyline command output from the transmitter control center is present. This output is gated through the VFG module (A5) of the exciter to the LPA. Under the exc-fail/tune/standby system condition, the keyline command output to the LPA is inhibited by the VFG module (because the exciter is in the standby condition).

(10) XMTR-FAIL/TUNE/STANDBY SYSTEM CONDITION. - When the XMTR FAIL, TUNE, and STANDBY lamps are all illuminated, a keyer or LPA failure has occurred, the radio transmitting set is in the standby mode, and a tune cycle is required. If a keyer or LPA failure occurs when the radio transmitting set is fully operational, the transmitter is transferred to the xmtr-fail/tune/standby system condition. A keyer or LPA failure can never be overridden, regardless of the type of operation (local or remote). During the xmtr-fail/tune/standby system condition, presence of input and output signals is as follows:

Note

Keyer failures are sensed only when the CLASS OF EMISSION control on the front panel of the exciter is in the A1, F1, F4 position.

(a) INPUT SIGNALS.

1. Standby Return from LPA
2. Fault Signal

(b) OUTPUT SIGNALS.

1. Standby Readback to LCU
2. Ready Readback to LCU
3. Fault Readback to LCU
4. Standby Command to LPA
5. Inhibit Command to LPA
6. Standby-Lamp Signal
7. Tune-Lamp Signal
8. Fault-Lamps Signal
9. Modulation-Off Command
10. Carrier-Disable Command
11. TGC-Minimum-Gain Command
12. TGC-Enable Command
13. Standby Command
14. Fault/Standby Override Command

Note

When the radio transmitting set is in the xmtr-fail/tune/standby system condition, the keyline command output from the transmitter control center is present. This output is gated through the VFG module (A5) of the exciter to the LPA. Under the xmtr-fail/tune/standby system condition, the keyline command output to the LPA is inhibited by the VFG module (because the exciter is in the standby condition).

(11) EXC-FAIL/STD-FAIL/TUNE/STANDBY SYSTEM CONDITION. - When the EXC FAIL, STD FAIL, TUNE, and STANDBY lamps are all illuminated, a failure has occurred in the 1-mc internal frequency standard of the exciter, the radio transmitting set is in the standby mode, and a tune cycle is required. This type of failure occurs whenever the output from the exciter frequency standard decreases 3 db or more below 1 vac, rms, and no external frequency standard is connected to the exciter. (If the internal frequency standard fails when an external frequency standard is connected to the exciter, the STD FAIL lamp becomes illuminated, but neither an exciter failure nor a transmitter failure is registered.) During the exc-fail/std-fail/tune/standby system condition, presence of input and output signals is as follows:

(a) INPUT SIGNALS.

1. Standby Return from LPA
2. Fault Signal

(b) OUTPUT SIGNALS.

1. Standby Readback to LCU
2. Ready Readback to LCU
3. Fault Readback to LCU
4. Standby Command to LPA
5. Inhibit Command to LPA
6. Standby-Lamp Signal
7. Tune-Lamp Signal
8. Fault-Lamps Signal
9. Modulation-Off Command
10. Carrier-Disable Command
11. TGC-Minimum-Gain Command
12. TGC-Enable Command
13. Standby Command
14. Fault/Standby Override Command

Note

When the radio transmitting set is in the exc-fail/std-fail/tune/standby system condition, the keyline command output from the transmitter control center is present. This output is gated through the VFG module (A5) of the exciter to the LPA. Under the exc-fail/std-fail/tune/standby system condition, the keyline command output to the LPA is inhibited by the VFG module (because the exciter is in the standby condition).

c. PRELIMINARY CHECK. - Refer to paragraphs 4-27b(2) and 4-27c(2).

d. TEST EQUIPMENT. - Refer to paragraphs 4-27b(3) and 4-27c(3).

e. CONTROL SETTINGS. - Refer to paragraphs 4-27b(4) and 4-27c(4).

f. TEST DATA. - Refer to paragraphs 4-27b(5) and 4-27c(5).

4-27. TRANSMITTER CONTROL NO. 1, A10, AND TRANSMITTER CONTROL NO. 2, A17. (See figures 4-51, 5-69, 5-83, and 5-87.)

a. INTRODUCTION. - The transmitter control center consists of transmitter control no. 1 (TC1 module, A10) and transmitter control no. 2 (TC2 module, A17) and their associated circuitry. This control center is discussed as a single functional entity in paragraph 4-26. The TC1 and TC2 modules are discussed individually in the following subparagraphs of this paragraph (4-27).

b. TRANSMITTER CONTROL NO. 1, A10 (See figures 4-51 and 5-69.)

(1) DESCRIPTION. - Transmitter control no. 1 (TC1 module, A10) incorporates the relay/diode logic that controls to a considerable degree the functioning of the radio transmitting set. The system condition of the transmitter is determined primarily by the inputs to and outputs from the TC1 module (A10).

(2) PRELIMINARY CHECK. - Prior to trouble shooting, turn the power off and make a preliminary check of the following items:

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(a) Seating of the TC1 module (A10) in its socket.

(b) Component connections. (Inspect for loose or cold solder joints, etc.)

(3) TEST EQUIPMENT.

(a) Multimeter AN/USM-116 or equivalent.

(b) Oscilloscope AN/USM-140A or equivalent.

(4) CONTROL SETTINGS. - As applicable.

(5) TEST DATA. - The control inputs to the TC1 module (A10) are obtained from both the LPA and the exciter itself. In each case, the presence of a control input is signaled by applying a ground to the applicable A10 terminal. The absence of each control input is signaled by effectively open-circuiting the applicable A10 input external to the TC1 module (A10); in this case, the potential at the applicable A10 terminal rises to approximately +18 vdc. Control inputs to the TC1 module (A10) and the associated A10 terminals are as follows:

Control Input	A10 Terminal
Standby Return from LPA	B17
Operate Return from LPA	A19
Tune-Enable Return from LPA	A23
Ready Return from LPA	A24
Standby Initiation Command	B3
Operate Initiation Command	A17
Tune Initiation Command	A8
Amplifier-Off-Lamp Signal from Exciter	B28
Fault Signal from Exciter	B25
Tuning-Fault Signal from Exciter	B13

Presence of control outputs from the TC1 module (A10) is signaled by relay contact closures. The closure may be to ground, to +18 vdc, or between two A10 terminals. Absence of control outputs from the TC1 module (A10) is signaled by open-circuited relay contacts. The control outputs from the TC1 module (A10), the A10 relays from which they are obtained, the state of each relay when the particular control output is present, the associated A10 terminal or terminals, and the type of control output are itemized in table 4-8.

c. TRANSMITTER CONTROL NO. 2, A17, AND ASSOCIATED CIRCUITRY (See figures 4-51 and 5-83.)

(1) DESCRIPTION. - Transmitter control no. 2 (TC2 module, A17) and its associated circuitry perform four basic functions, which are as follows:

(a) Conversion of either local or remote VCO-select commands from two-wire, 5-volt (or equivalent) commands to three-wire, 15-volt commands. (The latter commands select the correct VCO (voltage controlled oscillator) within the frequency synthesizer (A12).)

(b) Amplification and inversion of remote class-of-emission and sideband-selection commands from 5-volt, positive-logic commands to 28-volt, negative-logic commands. (The latter commands drive the rotary stepping switches that control class of emission and sideband selection automatically under remote operating conditions. During local operation, these switches are positioned manually.)

(c) Amplification and inversion of remote standby, operate, and tune commands from 5-volt, positive-logic commands to 18-volt, negative-logic commands.

(d) Storage and signaling of standby/operate status of radio transmitting set.

(2) PRELIMINARY CHECK. - Prior to trouble shooting, turn the power off and make a preliminary check of the following items:

(a) Seating of the TC2 module (A17) in its socket.

(b) Component connections. (Inspect for loose or cold solder joints, etc.)

(3) TEST EQUIPMENT.

(a) Multimeter AN/USM-116 or equivalent.

(b) Oscilloscope AN/USM-140A or equivalent.

(4) CONTROL SETTINGS. - As applicable.

(5) TEST DATA. - The control inputs to the TC2 module (A17) are obtained from both the LCU and the exciter itself. In the case of the inputs from the LCU, the presence of a control input is signaled by applying +5 vdc to the applicable A17 terminal, and the absence of a control input is signaled by applying a ground to the applicable A17 terminal. For the inputs from the exciter, the applicable A17 terminal is open-circuited (external to the A17 module) to signal the presence of a control input, and short-circuited to ground (external to the A17 module) to signal the absence of a control input. (When an A17 exciter

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TABLE 4-8. CONTROL OUTPUT DATA FOR TC1 MODULE

CONTROL OUTPUT	RELAY	RELAY STATE(S)	A10 TERMINAL(S)	SIGNAL TYPE
Standby Readback to LCU	K3	Energized	B18	Ground Closure
Operate Readback to LCU	K4	Energized	B20	Ground Closure
Ready Readback to LCU	K2	Energized	A18	Ground Closure
Fault Readback to LCU	K13	Energized	A29 and B27	"Floated" Closure
Tune-Activate Command to LPA	K10	Not Energized	B12 and B26	"Floated" Closure
Inhibit Command to LPA	K11	Energized	B5	Ground Closure
Keyline Command to LPA	K8	Energized	B4	Ground Closure
RF-On Readback to Auxiliary Equipment	K8	Energized	B4	Ground Closure
Standby-Lamp Signal to Exciter	K3	Energized	A15	+18 VDC Closure
Operate-Lamp Signal to Exciter	K4	Energized	B21	+18 VDC Closure
Tune-Lamp Signal to Exciter	K10	Energized	B11	Ground Closure
Ready-Lamp Signal to Exciter	K2	Energized	A21	+18 VDC Closure
Fault-Lamp Signal to Exciter	K13	Energized	B34	+18 VDC Closure
Modulation-Off Command to Exciter	K1	Energized	A16	+18 VDC Closure
Modulation-Normal Command to Exciter	K1	Not Energized	A12	+18 VDC Closure
TGC-Minimum-Gain Command to Exciter	K7	Energized	A14	Ground Closure
TGC-Enable Command to Exciter	K15, K16	Either Energized	A27 and B32	"Floated" Closure
Carrier Disable Command to Exciter	K7	Energized	A10	+18 VDC Closure
Tune-Carrier Command to Exciter	K16	Energized	A26	+18 VDC Closure

input terminal is open-circuited, the potential at this terminal increases to approximately +5 vdc.) Control inputs to the TC2 module (A17) and the associated A17 terminals are as follows:

Control Input	A17 Terminal
Standby Command from LCU	B1
Operate Command from LCU	B12
Tune Command from LCU	B14
Class-of-Emission Command from LCU (via rotary stepping switch)	B18
Sideband-Selection Command from LCU (via rotary stepping switch)	B5
VCO-Select Commands from LCU	B3, B20
VCO-Select Commands from Exciter	B3, B20

The amplifier-off-command control input is applied to terminal A18A6-40. Whenever the indicating AMPLIFIER OFF pushbutton on the front panel of the exciter is released (not held depressed), a potential of +18 vdc is applied to terminal A18A6-40. Depression of the indicating AMPLIFIER OFF pushbutton removes the +18 vdc potential from terminal A18A6-40.

With the two exceptions of the class-of-emission and sideband-selection control outputs, presence of control outputs from the TC2 module (A17) and its associated circuitry is signaled by relay contact closures. The closure(s) may be to ground, to +15 vdc, or between two terminals; absence of control outputs is signaled by open-circuited relay contacts. The class-of-emission and sideband-selection switch commands are 28-volt signals, pulsed by the interruptor contacts of the applicable rotary stepping switch. The control outputs from the TC2 module (A17) and its associated circuitry, the relay(s) or transistor from which they are obtained, the state of each relay or transistor when the particular control output is present, the state of each transistor when the particular control output is absent, the associated terminal or terminals, and the type of control output are itemized in table 4-9.

Note

In the following tabulation complete reference designations are employed, because two different modules (A17 and A18) are of interest. A terminal designation such as A17-A40 refers to terminal A40 of module A17, and not to two different terminals.

TABLE 4-9. CONTROL OUTPUT DATA FOR TC2 MODULE AND ASSOCIATED CIRCUITRY

CONTROL OUTPUT	RELAY OR TRANSISTOR	RELAY OR TRANSISTOR STATE	TERMINAL(S)	SIGNAL TYPE
Operate Command to Keyer	A17K3	Operate	A17-A40	Ground Closure
Ready Readback to LCU	A17K3	Standby	A17-B34	Ground Closure
Standby Command to LPA	A18A6K1	Energized	A18A6-31 and A18A6-34	"Floated" Closure
Operate Command to LPA	A17K3	Operate	A17-B24 and A17-B30	"Floated" Closure
Operate Readback to Auxiliary Equipment	A17K3	Operate	A17-A24 and A17-B28	"Floated" Closure
Fault/Standby Override Command to Exciter	A17K3	Standby	A17-A32	Ground Closure
Operate Command to Exciter	A17K3	Operate	A17-A38	Ground Closure
Class-of-Emission Switch Command	A18Q2	Presence*: Cutoff Absence*: Saturation	A18Q2 (Collector)	Presence*: -28 VDC Absence*: Ground
Sideband-Selection Switch Command	A18Q1	Presence*: Cutoff Absence*: Saturation	A18Q1 (Collector)	Presence*: -28 VDC Absence*: Ground
VCO-Select Synthesizer Command VCO 1	A17K1 A17K2	Energized Energized	A17-B17	+15 VDC Closure
VCO-Select Synthesizer Command VCO 2	A17K1 A17K2	Energized Not Energized	A17-B13	+15 VDC Closure
VCO-Select Synthesizer Command VCO 3	A17K1 A17K2	Not Energized Not Energized	A17-B7	+15 VDC Closure

*Presence of signal stops rotation of stepping switch; absence of signal steps rotary switch to next position.

4-28. MAIN CHASSIS AND FRONT PANEL ASSEMBLY A18.

The main chassis and front panel assembly contains all exciter operating controls and indicators, and includes a number of wired-in circuit boards containing the following functional circuits:

a. VU Meter Amplifier A18A1.

b. Fault Board A18A2.

c. Frequency Select Board A18A3.

d. Transmitter Control Board A18A4.

e. Power Distribution Board A18A5.

f. Motor Control Board A18A6.

g. X4 Frequency Multiplier A18Z1.

The following paragraphs provide circuit descriptions, operating information, and trouble shooting test data for each circuit board.

4-29. VU METER AMPLIFIER A18A1. (See figure 4-32.)

The VU meter amplifier board contains a three-stage audio amplifier for operating INPUT LEVEL panel meter A18M1.

a. DESCRIPTION. - The amplifier circuit consists of direct coupled stages Q1 and Q2 followed by output amplifier Q3. A negative feedback loop consisting of potentiometer A18R13, resistor R8, and capacitor C5, applies a portion of the amplifier output from Q3 to the emitter of Q2. Potentiometer R13 functions as a meter calibration control by adjusting the degree of feedback and, therefore, the amplifier gain. An input signal, selected by INPUT LEVEL switch A18S1, is amplified and applied to VU meter A18M1. When the input signal level is -35 dbm, a zero reading appears on the VU meter.

b. PRELIMINARY CHECK. (See figure 5-84.) - Make a preliminary check of VU meter amplifier board A18A1 before trouble shooting, to verify that all connections at the board terminals are secure.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Audio Generator SG-376/U. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place the exciter in "tune" condition.) Adjust controls as instructed in test steps.

e. TEST DATA. (See figure 5-84.) - Trouble shooting the VU meter amplifier consists of checking the +18 volt dc operating potential and verifying operation of the amplifier and meter circuit using a test signal from the audio generator.

(1) Connect VTVM to terminal 2 on board. Meter should read +18 vdc ±5%.

(2) Connect audio generator (using plug PJ-327) to B1 TEST channel jack A18B5. Set INPUT LEVEL selector switch to B1.

(3) Adjust generator output for a 14 millivolt, 1000 cycle, test signal.

(4) VU meter on panel should read approximately "zero" VU.

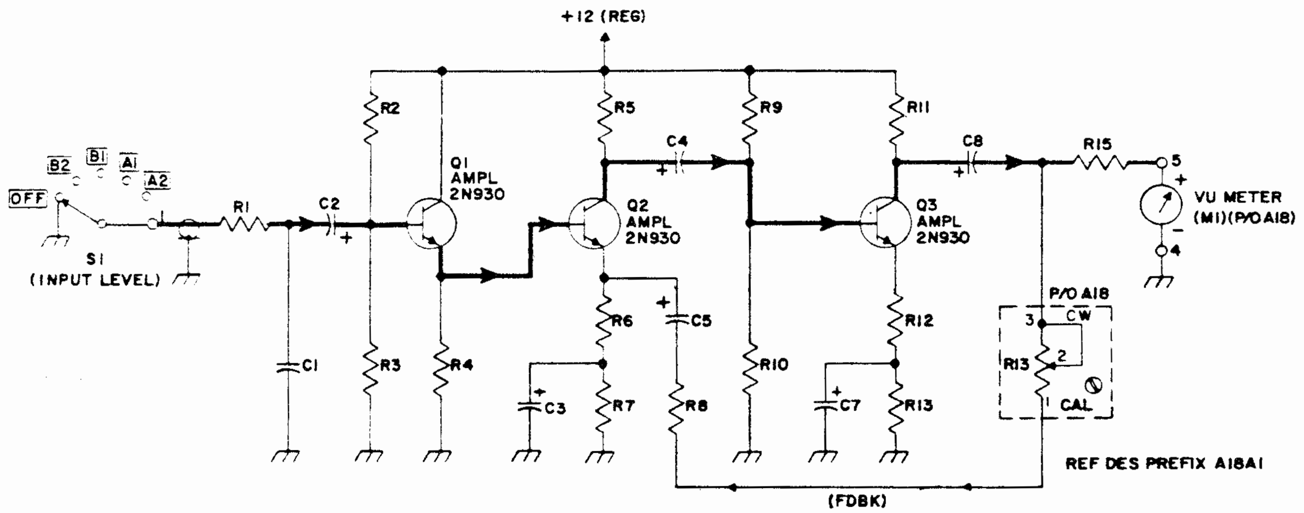


Figure 4-32. VU Meter Amplifier, Simplified Schematic Diagram

4-30. FAULT BOARD A18A2. (See figures 4-33 and 4-34.)

The fault board contains a number of sensitive detecting circuits arranged to monitor selected dc supply voltages, rf signal levels, and external "fault" circuits in the other system units. In the event of a "fault" occurring at one or more of the detecting circuits the over-all transmitting system will be placed in a "standby" condition and the related "fault" indicator illuminated to inform the operator of a "fault" condition. In the case of a STD FAIL fault, where an external standard is available, the transmitting system is not affected. A STD FAIL fault line is supplied for an external fault indicator (STD FAIL).

a. DESCRIPTION. - Table 4-10 lists the fault detection circuits, describes the fault, and identifies the detector components used. The fault board contains fault detection circuits which respond to four categories of circuit faults:

(1) TRANSMITTER FAULT.

(a) KEYER FAULT. - A keyer fault appears as a ground at terminal 36. This provides a dc path, via CR10 and the FAULT OVRD switch, to fault relay K13 on transmitter control module no. 1 (A10). It also provides a dc path to the XMTR FAIL lamp via CR13.

(b) LPA FAULT. - An LPA fault appears as an open circuit at terminal 33. This turns on Q12 which provides a dc path, via CR19, to fault relay A10K13. A dc path to the XMTR FAIL lamp (via CR15) and a dc path (via CR16 and terminal 31) to the tune activate circuits in transmitter control module no. 1 (A10) prevents fault override when the fault is in the LPA.

(c) TRANSMITTER FAIL. - The transmitter fail signal is actuated by the LCU when the exciter is in remote operation and either of the following remote system faults occur:

1. No "class of emission" command.

2. No "sideband" command when "class of emission" command is other than A0 or A2, A3E. The transmitter fail signal appears as a ground closure at terminal 34 of the fault board. The ground closure is applied to the fault circuit as shown in figure 4-33, and acts as described in paragraph (b) above.

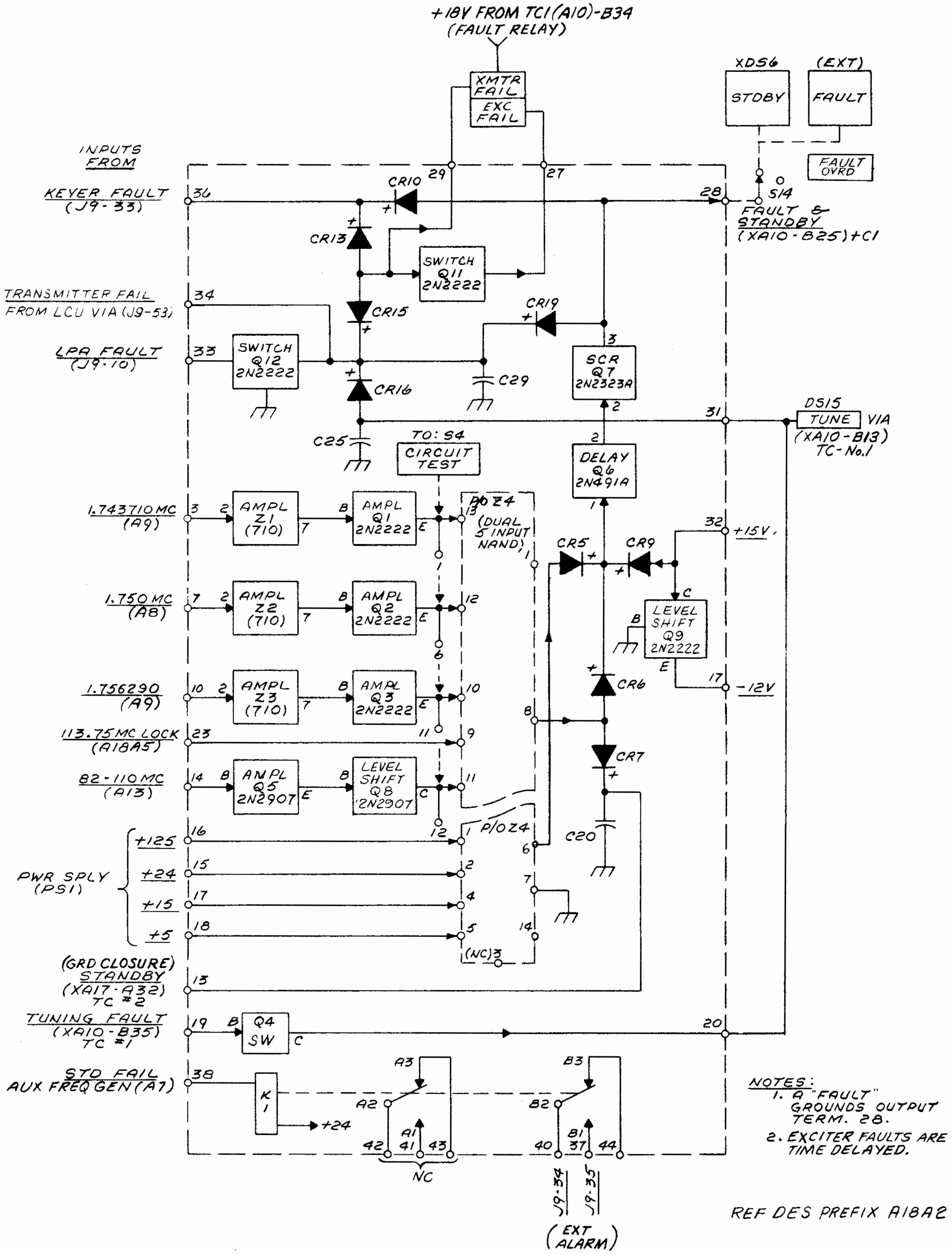
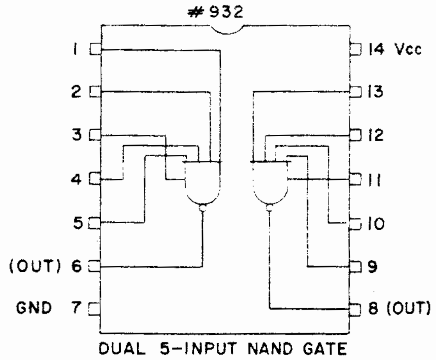


Figure 4-33. Fault Board, Functional Block Diagram



LOGICAL "1" = HI (7VDC)
LOGICAL "0" = GND

PARTIAL TRUTH TABLE

1	2	3	4	5	6
0	0	0	1	1	1
0	0	1	1	1	1
0	1	1	1	1	1
1	1	1	1	1	0 ← LOGICAL "0" OUT
1	1	1	1	0	1
1	1	1	0	0	1
1	1	0	0	0	1
1	0	0	0	0	1

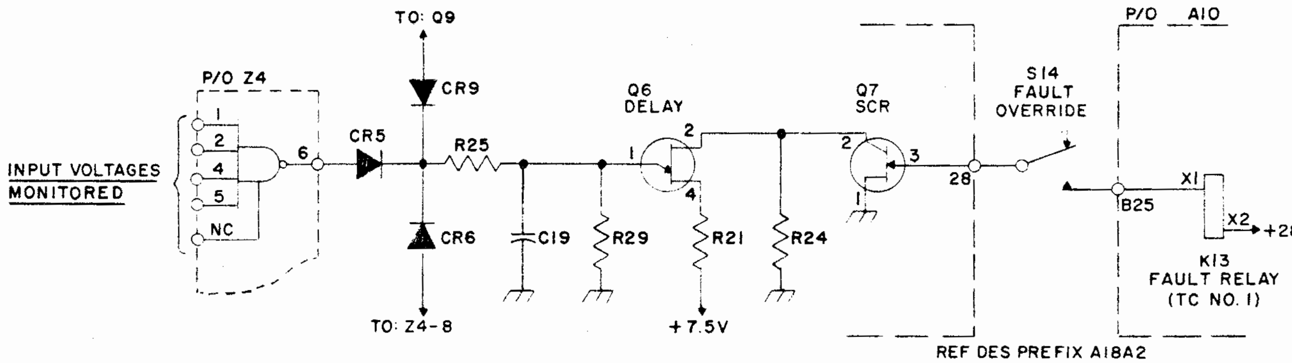


Figure 4-34. Fault Circuit NAND Gates, Truth Table, and Sweep Circuit; Simplified Schematic Diagram

(2) SIGNAL AND DC LEVEL CIRCUITS.

(a) SIGNAL LEVEL CIRCUITS. - Inputs at terminals 3, 7, and 10 are applied via signal level detectors Z1/Q1, Z2/Q2 and Z3/Q3, respectively to three inputs of Z4 (a dual 5-input NAND gate). The input to terminal 14 is a dc level, obtained from down-converter A13, which is inverted and level shifted by Q5 and Q8 and applied to the fourth input of Z4. The fifth input to Z4 is obtained from the output of the 113.75 mc lock detector on motor control board A18A5 via terminal 23. The inputs to the first four gates are also used for circuit test metering. The output of this section of Z4 is pin 8 which is connected to OR gate diode CR6 and to CR7. A logic 1 (high) output indicates the loss of one or more of the input levels. Diode CR7 is provided so that when the exciter is in STANDBY condition the loss of signal levels will not actuate the fault circuit.

(b) DC LEVEL CIRCUITS. - The dc voltages (+125, +24, +15, and +5 volts) are applied via voltage dividers to four inputs of the second section of Z4 (the fifth input is not connected). The output of this section of Z4 is pin 6 which is connected to OR gate diode CR5. A logic 1 (high) output indicates the loss of one or more of the input levels. The -12 volt line is applied to Q9. A high output at Q9 indicates loss of the -12 volt level.

The output of OR gate CR5, CR6, CR9 is applied to delay circuit R25, C19, Q6. Q6 fires after a time delay of approximately 500 msec. This, in turn, fires SCR Q7 and grounds terminal Z8 (fault relay).

(3) STD FAIL. - The fault detector circuit in auxiliary frequency generator A7 grounds K1 which provides a set of relay contacts to an external alarm circuit.

(4) TUNING FAULT. - A momentary open (change of frequency or class of emission) turns on Q4, thus grounding terminals 20 and 31 and energizing the tune activate relays in transmitter control no. 1 module A10.

TABLE 4-10. FAULT DETECTORS

TERM.	FAULT CIRCUIT	FAULT OCCURS WHEN	DETECTION CIRCUIT
36	Keyer, KY-655/FRT	CB-1 opens in keyer or +28 vdc supply fails.	Diode CR10
33	LPA fault	Relay opens in external LPA.	Diode CR19 via Q12
34	Transmitter fail	Remote system sends no "class of emission" command or no "sideband" command when "class of emission" command is other than A0 or A2, A3E. (Remote operation only.)	Diode CR19 via Q12
3	1.743710 mc side-carrier	Sidecarrier level drops.	NAND gate Z4-8
4	1.750 mc carrier	Carrier level drops.	NAND gate Z4-8
9	1.765290 mc side-carrier	Sidecarrier level drops.	NAND gate Z4-8
23	113.75 mc lock	113.75 vco (p/o A8) unlocked.	NAND gate Z4-8
14	82 - 110 mc injection	82 - 110 mc injection level drops.	NAND gate Z4-8
16	+125 vdc supply	+125 volt dc supply level drops.	NAND gate Z4-6
15	+24 vdc supply	+24 volt dc supply level drops.	NAND gate Z4-6
17	+15 vdc supply	+15 volt dc supply level drops.	NAND gate Z4-6
18	+5 vdc supply	+5 volt dc supply level drops.	NAND gate Z4-6
19	Tuning fault	FREQUENCY KC dial, CLASS OF EMISSION switch, or LOCAL/REMOTE switch is reset.	Inverter Q4
38	STD FAIL fault	Internal frequency standard fails.	Freq. Std. Selec. (p/o A7)

b. PRELIMINARY CHECK. (See figure 5-85.) - Make a preliminary check of the fault board before trouble shooting to verify that all connections at the board terminals are secure.

c. TEST EQUIPMENT. - Use CIRCUIT TEST selector switch and meter on front panel of exciter. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. Adjust controls as instructed in test steps.

e. TEST DATA. (See figure 5-85.) - Trouble shooting the fault board circuit consists of monitoring the fault board input circuits using the CIRCUIT TEST panel meter and verifying board operation for those faults which can be readily simulated. In addition, faults not monitored by the CIRCUIT TEST meter are simulated by making external equipment adjustments.

(1) To test keyer fault circuit (terminal 36 circuit), open the panel circuit breaker on Keyer KY-655/FRT. A transmitter fault condition should occur.

(2) To test the STD FAIL external alarm circuit, connect the external frequency standard to rear panel (A19J4). Disconnect J3 at frequency standard A6. INT STD FAIL circuit should indicate failure.

(3) To test operation of the sidecarrier circuits (terminals 3, 7, and 10) place the exciter in "standby" and remove sidecarrier module A9. Return the unit to "operate". A fault condition should occur.

(4) To test the 82-110 mc circuit (terminal 14) disconnect the cable at connector J1 on rf no. 1 (A) card A12A1. A fault should occur.

(5) To test operation of the tuning fault circuit (terminal 19) reset any one of the six FREQUENCY KC tuning dials. A TUNE fault should occur.

(6) The CIRCUIT TEST panel meter monitors the sidecarrier levels and the dc supply voltages. Verify presence of fault signals for each of the fault circuits tested in the preceding paragraphs.

4-31. FREQUENCY SELECT A18A3. (See figure 4-35.)

The frequency select board contains a number of 3300 ohm resistors and two diodes. These components perform unrelated functions for the frequency select circuits and for up-converter A11.

a. DESCRIPTION. - Figure 4-35 is a functional diagram showing the connections of the 3300 ohm resistors R1 through R22 to the FREQUENCY KC tuning dial circuits. Note that a +5 volt dc potential is applied to each frequency selection gate via a 3300 ohm resistor when the circuit is a logical "1" (high impedance). This potential assures that a logical "1" gate input condition is maintained, especially when the LOCAL/REMOTE switch position is changed. When a logical "0" (ground) is selected by a tuning dial, that particular circuit potential becomes grounded through the 3300 ohm isolation resistor without affecting the +5 volt dc potential at other circuits.

Diodes CR1 and CR2 provide isolation between the external switching circuits which control the modulation and directional relays K4 and K5 in up-converter A11. Mod disable relay K4 is controlled by relay K1 in the transmitter control no. 1 module A10 via diode CR1. Directional relay K5 and modulation relay K4 are controlled together by the CLASS OF EMISSION switch A18S3-e and diode CR2. Terminals A, B, C and D provide a convenient point for the optional wiring of the tune power level.

With A connected to B tune power level is -3 db.

With A connected to D tune power level is -6 db.

With A connected to C tune power level is -10 db.

b. PRELIMINARY CHECK. (See figure 5-86.) - Make a preliminary check of the frequency select board before trouble shooting to verify that all board connections are secure.

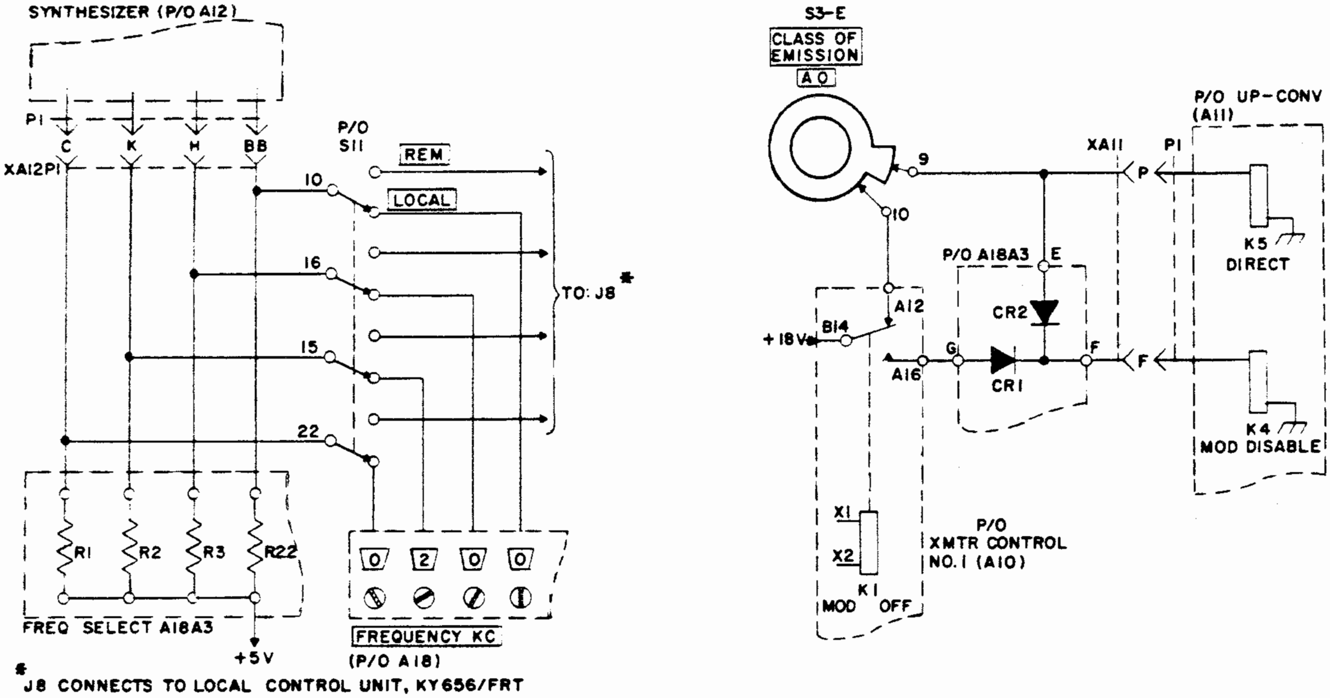


Figure 4-35. Frequency Selector Board, Functional Diagram

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place the exciter in the "tune" condition.)

e. TEST DATA. (See figure 5-86.) - Trouble shooting the frequency select board consists of checking the continuity of the 3300 ohm isolation resistors.

(1) Connect VTVM between chassis and terminal 1. Meter should read +5 volts dc. If not, reset positions of the FREQUENCY KC tuning dials to remove logical "0" (ground) at the board terminal.

(2) Repeat step (1) for remaining 21 terminals.

4-32. TRANSMITTER CONTROL BOARD A18A4. (See figure 5-87.)

Essentially, the transmitter control board contains module sockets XA10 and XA17 for transmitter control modules nos. 1 and 2, A10 and A17, and all interconnecting circuit leads and terminals between the two modules and other exciter modules. Consequently, trouble shooting tests are limited to the inspection of connections at each board terminal.

4-33. MOTOR CONTROL BOARD A18A5. (See figure 4-36.)

The motor control board contains two independent circuits: the TGC (transmitter gain control) monitor stage (Q1), and the 113.75 mc lock detector (Q3 and Q4).

a. DESCRIPTION. - The following paragraphs describe the function of each motor control board circuit; refer to figure 4-36 for circuit details.

(1) TGC MONITOR. - The TGC monitor circuit consists of emitter-follower Q1. A sample of the dc control potential at transmitter gain control potentiometer A14R1 is applied to the base of Q1. The emitter of Q1 drives CIRCUIT TEST panel meter A18M1 when the test circuit selector switch is in the TGC position, thereby monitoring the TGC dc control signal applied as an agc voltage to the 112 mc amplifier in down-converter A13.

(2) 113.75 MC LOCK DETECTOR. - The 113.75 mc lock detector consists of direct-coupled amplifier stages Q3 and Q4. The base of Q3 monitors the ramp developed in 1.75/113.75 mc frequency generator A8 when it is not locked. The output from the collector of Q4 is applied to fault board A18A2 terminal 23, and also to CIRCUIT TEST panel meter A18M2 via multiplier resistor R7. When the 113.75 mc generator circuit is functioning and locked, the fault board receives a logical "1" and the CIRCUIT TEST meter reads in the "normal" green scale segment.

If the 113.75 mc generator circuit malfunctions the ramp is developed and applied to Q3 via C2. The lock detector output stage saturates to apply a logical "0" or fault signal to the fault board and remove the green segment meter reading.

b. PRELIMINARY CHECK. (See figure 5-88.) - Make a preliminary check of the motor control board before trouble shooting to verify that all connections at the board terminals are secure.

c. TEST EQUIPMENT. - Use CIRCUIT TEST selector switch and meter on front panel of exciter. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. Adjust controls as instructed in test steps.

e. TEST DATA. (See figure 5-88.) - Trouble shooting the motor control board consists of checking the TGC monitor circuit and the 113.75 mc lock-detector circuit operation using the CIRCUIT TEST panel meter. For these tests it is assumed that the exciter is operated as a part of a complete transmitting system.

(1) Set the CIRCUIT TEST switch to TGC and note the panel meter reading (approximately 1/2 scale). Reset a FREQUENCY KC switch and note a full scale reading on the panel meter. Press TUNE button and note a return to approximately half scale meter reading.

(2) Set the CIRCUIT TEST switch to 113.75 MC and note a panel meter reading of approximately 1/2 scale.

4-34. POWER DISTRIBUTION BOARD A18A6. (See figure 5-89.)

The power distribution board contains relays K2 through K5 which control the application of dc operating voltages to the circuit modules in compliance with the system "standby" and "operate" conditions, and relay K1 which provides "amplifier off" and "standby" commands to the LPA. It also contains the +5, -12, +15, +24, and +125 volt dc range calibration controls for CIRCUIT TEST meter A18M2.

a. DESCRIPTION. - The power distribution board contains five dpdt relays and five meter calibration controls. Table 4-11 identifies the relays and controls, and lists the related circuits.

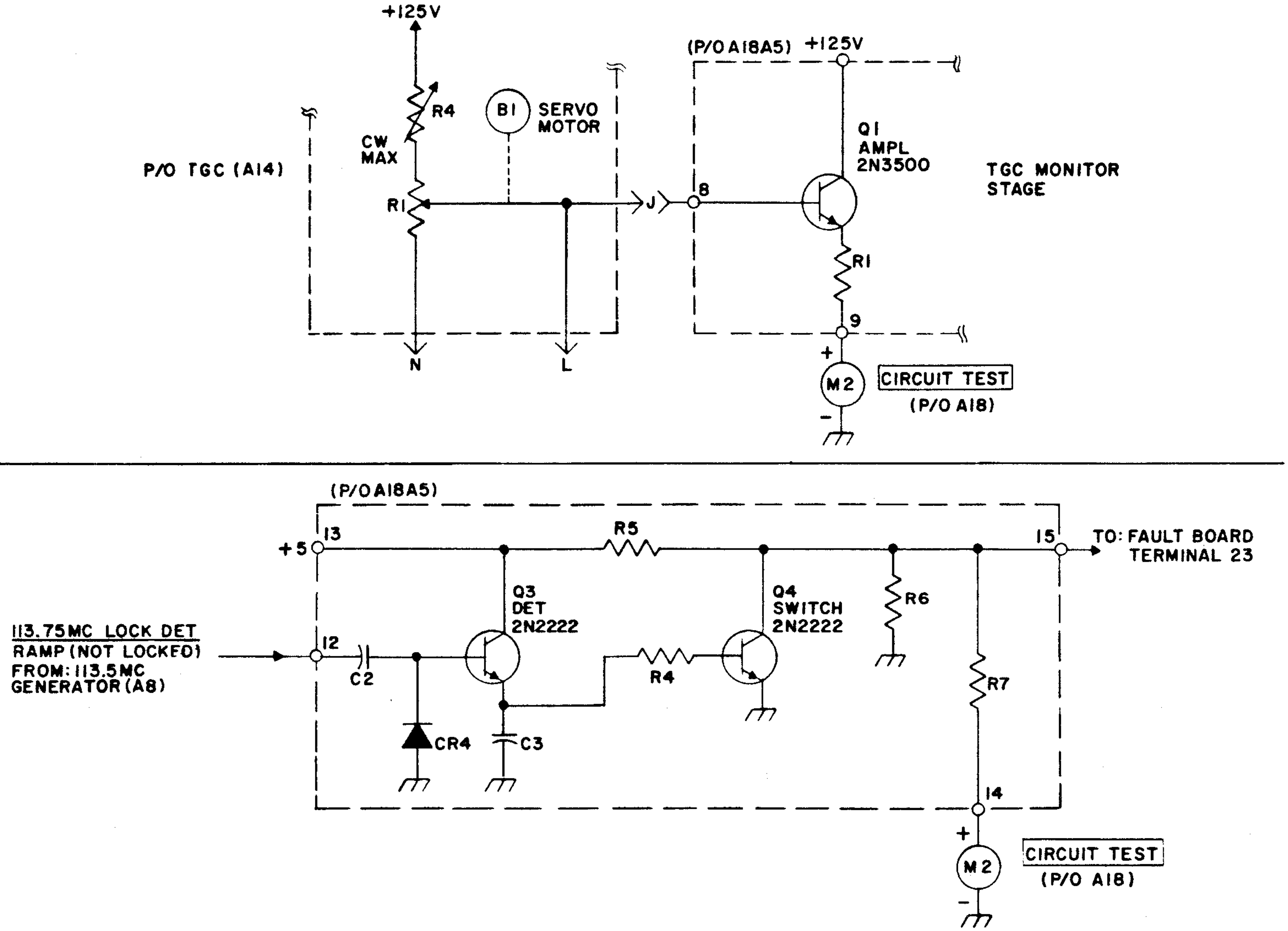


Figure 4-36. Motor Control Board A18A5, Simplified Schematic Diagram

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TABLE 4-11. POWER DISTRIBUTION BOARD CIRCUITS

RELAY	"A" CONTACTS CONTROL	"B" CONTACTS CONTROL	METER CAL.	FOR DC SUPPLY
K1	Standby/amplifier off the commands to the LPA.	Electrical latch and AMPL OFF lamp.	None	None
K2	-28 volts dc to TGC module A14.	+28 volts dc to TGC module A14.	None	None
K3	-12 volts dc to TGC module A14 and output amplifier A16.	+125 volts dc to TGC module A14, down-converter A13, and up-converter A11.	R3 R2	-12V +125V
K4	+18 volts dc to output amplifier A16, down-converter A13, up-converter A11, VFG A5, modulator A4 and SIDE-BAND SELECTOR switch.	+24 volts dc to output amplifier A16, and down-converter A13.	R4	+24V
K5	+5 volts dc to synthesizer A12, side-carrier generator A9, 1.75/113.75 mc generator A8, and auxiliary frequency generator A7.	+15 volts dc to synthesizer A12, TGC A14, side-carrier generator A9, and auxiliary frequency generator A7.	R7 R6	+5V +15V

Relay K1 is energized by a "standby" command (ground) at terminal 22 from transmitter control no. 1 module A10, and is latched in via contacts b2 and b1. The removal of ground from contact b3 (terminal 27) extinguishes the AMPL OFF lamp. The closure of contacts a2 and a1 provide a "standby" command to the LPA. Relay K1 is de-energized by an "amplifier off" command from the AMPL OFF front panel control or by a loss of power. When K1 is de-energized the opening of contacts a2 and a1 provide an "amplifier off" command to the LPA, and the closure of contacts b2 and b3 lights the AMPL OFF lamp on the exciter front panel.

Relays K2 through K5 apply dc operating potentials to the various modules when the OPERATE pushbutton is pressed, grounding terminal 16. Note that for "standby" conditions the dc supply voltages for critical circuits such as 1 mc frequency standard A6 and transmitter control modules A10 and A17 are not removed. This is because the frequency standard operating voltage cannot be interrupted without observing a warm-up and recalibration period, and the transmitter control circuits must be in constant operation for command functions.

The five meter calibration adjustments R2, R3, R4, R6, and R7, are used to calibrate the CIRCUIT TEST panel meter M2 for the +125, -12, +24, +15, and +5 volt dc positions of the meter switch, respectively. In this manner, the meter will indicate in the colored scale segment for each correct supply voltage monitored. Because these dc supply voltages are from regulated power supplies, calibration adjustments are required as the supply voltage accuracy exceeds that of the meter; especially the meter scale linearity at a midscale point.

Resistor R5 reduces the 28 volt relay operating voltage to limit the relay coil heat dissipation for long energized periods. Jumpers at terminals E1 through E12 permit disconnection of any power supply voltage in the event of a short circuit in the load. (This is for use by repair technicians only.)

b. PRELIMINARY CHECK. (See figure 5-89.) - Make a preliminary check of the power distribution board to verify that all terminal connections are secure.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116. No special tools are required.

d. CONTROL SETTINGS. - Preset controls as indicated in table 3-1. (Place exciter in "standby" condition.)

e. TEST DATA. (See figure 5-89.) - Trouble shooting the power distribution board consists of checking relay operation by measuring the dc supply voltage at a load terminal and then placing the exciter in "standby" condition to remove the voltage by opening the voltage supply relays.

(1) Connect multimeter to terminal 19. Meter should read 0 volts. Press OPERATE button. Meter should read -28 volts dc. Press STANDBY button.

(2) Repeat step (1) at terminals 8, 3, 10, 20, 14, 32, and 26 for dc supply voltages of +28, -12, +125, +18, +24, +5, and +15 volts, respectively.

4-35. POWER SUPPLY PS1. (See figures 4-37, 4-38, 4-52, and 5-63.)

The power supply module contains an ac power supply and rectifier circuits providing outputs of -28 volts and +40 volts dc, and a 70 volt (rms) output. This supply is followed by voltage regulating circuits which supply -18, +18 and +5, +24 and +15, +125, and +28 volts dc. The complete power supply operates from a primary power source of 115/230 volts ac, 50-60 cycles, single phase. Primary operating voltage is selected by switch PS1S1. In the event of abnormal current drain from any of the regulating circuits, circuit breaker A18CB1 on the exciter front panel will "trip" to remove primary power from the supply.

a. DESCRIPTION. - Table 4-12 lists the power supply regulating circuits and gives the input and output voltages for each circuit.

(1) POWER SUPPLY TRANSFORMER/RECTIFIER. - The power supply transformer/rectifier section consists of transformer T1 with primary voltage switch S1, full-wave rectifier CR1 and CR2, and bridge rectifier CR3 through CR6. Switch S1 connects the two primary transformer windings in parallel for 115 volt operation or in series for 230 volt operation.

Bridge rectifier CR3-CR6 supplies -28 vdc to -18V regulator PS1A1 and also as a power supply output voltage. Input capacitor C1 functions as a filter capacitor, and Zener diode CR8 and resistor R2 provide a fixed voltage drop prior to series regulator stage Q7. Full-wave rectifier CR1 and CR2 delivers +40 volts dc to the input of +28 volt regulator PS1A5. The 70 volts (rms) from transformer winding terminals 10 and 11 goes to the input of +125 volt regulator PS1A4.

(2) -18 VOLT REGULATOR PS1A1. - The -18 volt dc regulator consists of series regulator stage PS1Q7, complementary pair Q2 and Q3, and emitter follower Q1; diodes CR2, CR3, and CR4, and Zener diode CR5. Circuit operation is conventional, but it should be noted that this is a "negative" voltage regulator and consequently some functions are inverted. A sample of regulated output voltage from the junction of resistors R6 and R7 is applied to the base of Q3 and compared with a reference voltage from Zener diode CR5 at the emitter of Q3. Any voltage difference is amplified by Q2 and applied to the base of regulator Q7 as a dc control voltage, via amplifier stage Q1. Diodes CR2, CR3, and CR4 protect the regulation circuit if the output becomes shorted. In this event, the large IR drop across resistor R4 causes diode conduction and cuts off the base of Q1 (via PS1Q7) reducing the regulator output voltage to zero.

(69)

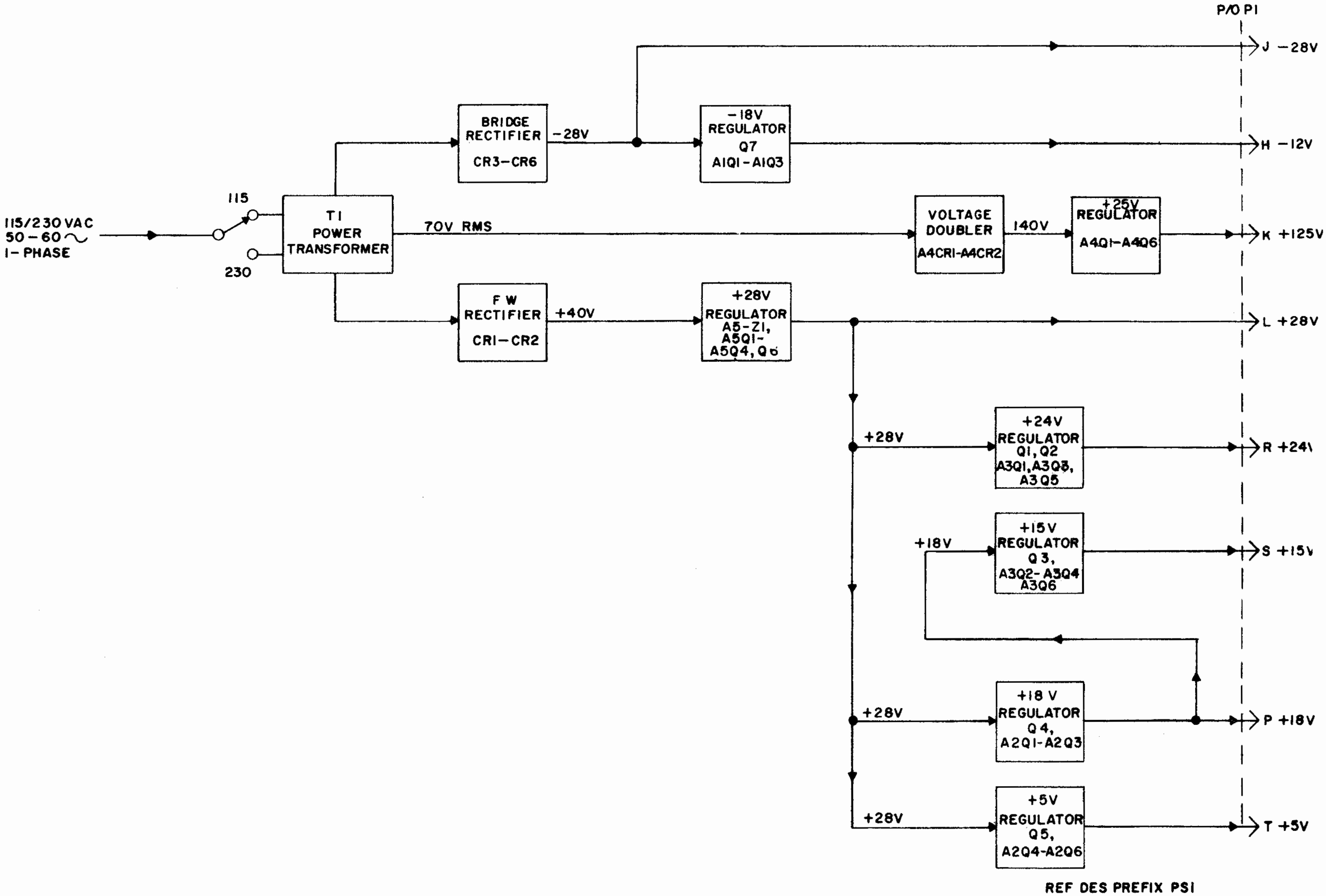

Figure 4-37. Power Supply, Functional Block Diagram

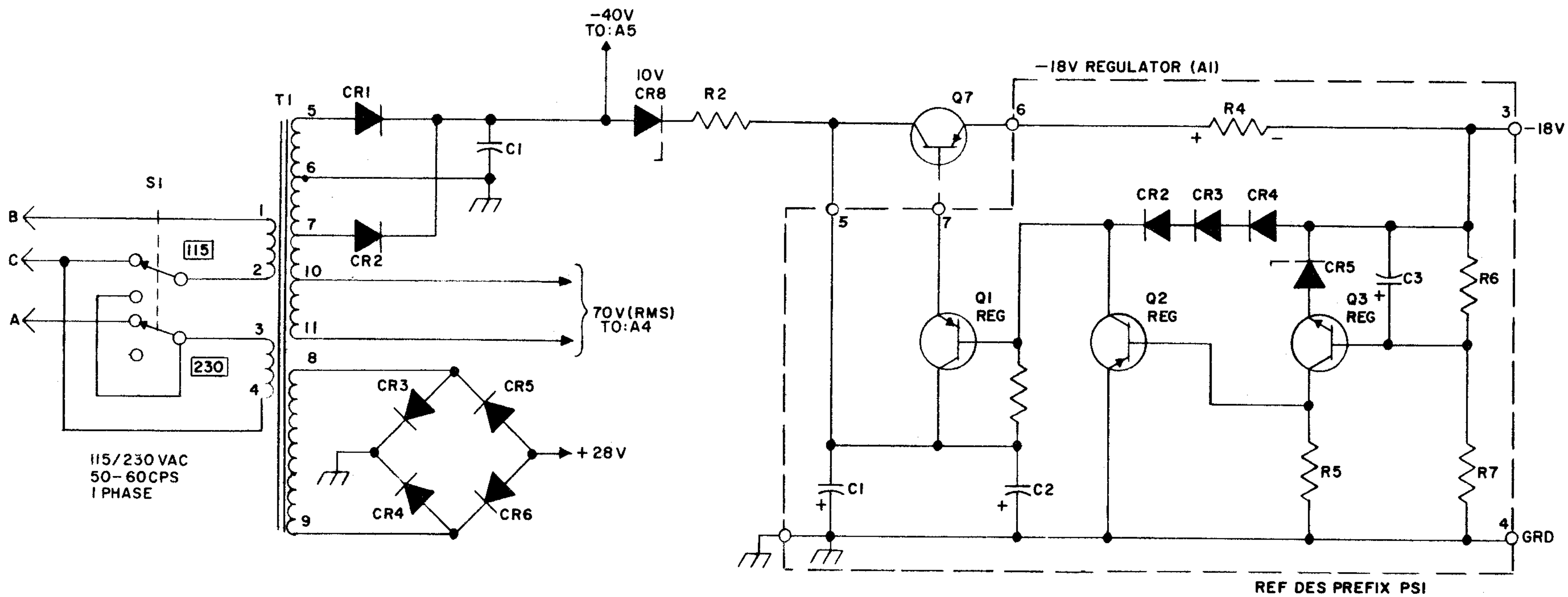

Figure 4-38. Power Transformer and -12 Volt Regulator, Simplified Schematic Diagram

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TABLE 4-12. POWER SUPPLY REGULATORS

REF. DES.	CIRCUIT NAME	INPUT VOLTAGE	OUTPUT VOLTAGE	LOAD "I"
PS1 (p/o)	Power supply (transformer and rectifiers)	115/230 vac	-28 vdc +40 vdc 70V rms	6A.* 3A.
A1	-18 volt regulator	-28V	-18V	0.6A.
A2	+18 volt and +5 volt regulator	+28V	+18V +5V	1.5A. 1.2A.
A3	+24 volt and +15 volt regulator	+28V	+24V +15V	2A. .6A.
A4	+125 volt regulator	70V (rms)	+125V	.01A.
A5	+28 volt regulator	+40V	+28V	3A.

* Intermittent duty

(3) +18 AND +5 VOLT REGULATORS PS1A2. - The +18 and +5 volt regulators are contained on a common circuit board. The +18 volt circuit consists of series regulator stage PS1Q4; dc amplifiers Q1, Q2, and Q3; and IC differential comparator Z1. The +5 volt circuit is similar and consists of series regulator stage PS1Q5; dc amplifiers Q4, Q5, and Q6; and IC differential comparator Z2. Both regulating circuits are of the switching type employing a series inductor (L1 and L2) and a commutating diode (CR4 and CR6). Regulator switching is triggered by the externally supplied 12.5 kc "sync" pulse. Although the following description is of the +18 volt regulator circuit it also applied to the +5 volt regulator circuit.

A +28 volt dc supply voltage from the output of +28 volt regulator A5 is applied to the emitter of switching regulator PS1Q4 and also as the operating voltage for switch driver stages Q1 and Q2. Q2 is switched on and off by current amplifier Q1, in response to drive pulses from differential comparator Z1. The comparator output is approximately 6 volts above ground. To assure a "turn-off" by switch Q2, Zener diode CR3 inserts a "bucking" potential in series with the emitter of Q1, restoring the pulse to a ground reference level. Differential comparator Z1 compares a sample of the +18 volt regulator output, via amplifier Q3, with a fixed reference voltage from Zener diode CR2. When the regulated output level exceeds the reference voltage, the pulse width from Z1 is decreased to lower the switch stage (PS1Q4) "on" time and, thereby lower the regulator output voltage. When regulator output is less than the reference voltage, the switch stage "on" time is increased by an increase in the switching pulse width from Z1, thereby raising the regulator output voltage. In this manner the switch regulator is controlled in a step sequence to regulate the output voltage and hold it constant.

To stabilize the switching regulator and improve operation, a 12.5 kc "sync" pulse is applied to the base of Q3 via capacitor C7, and is then applied to differential comparator Z1 through a low pass filter consisting of resistors R12 and R13, and capacitors C4 and C5. The "sync" pulse times the comparator operation and governs the switching rate of PS1Q4.

Regulation is also a function of inductor L1 and commutating diode CR4. Dc pulses at the output of switch stage PS1Q4 are applied through a low pass filter consisting of inductor L1 and capacitors C3, C8, and C9. During PS1Q4 "off" intervals, the collapsing field at inductor L1 charges capacitors C8 and C9, with commutating diode CR4 providing a return path. (Back-emf of L1 has a reversed polarity causing CR4 to conduct.) In this manner a charge at capacitor C8 (and C9) is maintained during "off" switch periods to assure output current to the load.

It is apparent that Zener reference diode CR2 supplies a reference voltage to both the +18 and +5 volt regulating circuits at Z1 and Z2, and that Zener diode CR1 supplies a regulated operating voltage to both comparators at terminal 8. With the exception of the reference designations employed, the operation of the +18 and +5 regulators is identical.

(4) +24 AND +15 VOLT REGULATORS (A3). - The +24 and +15 volt regulators are contained on a common circuit board. The +24 volt regulator consists of a Darlington series regulator formed by PS1Q1 and PS1Q2, differential amplifier Q3 and Q5, and dc amplifier Q1. The +15 volt regulator is similar, and uses series regulator stage PS1Q3, differential amplifier Q4 and Q6, and dc amplifier Q2. Both circuits employ conventional voltage regulating techniques. Although the following circuit description applies specifically to the +24 volt regulator it also describes the +15 volt regulator circuit except for a different set of reference designations.

Series regulator stage Q1 and Q2 receives a +28 volt dc potential from +28 volt regulator PS1A5. This stage is conducting at all times, the amount of conduction being controlled by dc amplifier Q1. A sample of the +24 volt output voltage is obtained from the junction of resistors R15 and R16, and compared with a fixed dc reference voltage from Zener diode CR7 at difference amplifier Q3 and Q5. The voltage difference is amplified by Q1 and applied to the base of series regulator PS1Q1. When the sampled voltage exceeds the reference voltage, the differential amplifier drives Q1 to increase the voltage drop across the series regulator. When the sampled voltage is less than the reference voltage, the series regulator voltage drop is decreased. In this manner, the series regulator conduction is controlled to correct the regulator output voltage and maintain a constant level. Zener diode CR1 biases amplifier Q1 to raise the dc signal level at its base to a corresponding level with the collector of Q3 (dc restoration).

Capacitors C7 and C9 at board terminals 1 and 8 are externally connected to PS1A2-3, and provide output filtering for the +5 volt regulated supply voltage.

(5) +125 VOLT REGULATOR PS1A4. - The +125 volt regulator circuit consists of a voltage-doubler rectifier CR1 and CR2; three cascaded series regulator stages Q1, Q2, and Q6; and a dc control amplifier consisting of difference amplifier Q4 and Q5, and dc amplifier Q3.

Voltage-doubler rectifiers CR1 and CR2 receive a 70 volt rms potential from power transformer PS1T1. The rectified (and doubled) potential is filtered by an RC low-pass filter consisting of resistor R1 and capacitors C3 and C4. Resistors R2 and R3 assure an even distribution of dc voltage across capacitors C3 and C4. Filter output is applied to cascaded series regulators Q1, Q2, and Q6. A sample of the +125 volt output potential is obtained from the junction of resistors R16 and R17, and compared with a fixed dc reference voltage from Zener diode CR10 at difference amplifier Q4 and Q5. Any voltage difference is amplified by Q3 and applied to the base of series regulators Q1 and Q2 via dc level stabilizing Zener diode CR6. When the sampled voltage exceeds the reference voltage, the difference amplifier drives Q3 to increase the voltage drop across regulators Q1 and Q2. When the sampled voltage is less than the reference voltage, the series regulator drops are decreased. In this manner, series regulator conduction is controlled to correct and maintain the +125 volt dc output level. Zener diode CR7 biases amplifier Q3 to raise the dc signal level at its base to a level corresponding with the collector of Q4. Operating potentials for stages Q3, Q4, and Q5 are obtained from the +24 volt output of regulator PS1A3. Zener CR3 regulates this potential with resistor R4.

Diodes CR4 and CR5 in shunt to the emitter-base circuit of Q1 protect this stage in the event of abnormal supply current drain. The IR drop across resistor R8 increases causing diodes CR4 and CR5 to conduct, limiting the conduction of series regulator Q1. Diodes CR8 and CR9 function in a similar manner for series regulator Q2.

Series stage Q6 functions as an active ripple filter. The base of Q6 is driven from the +125 volt regulator output via resistor divider R18 and R19. Any ripple frequency across capacitor C9 is applied between the emitter and base via capacitor C8, and removed by the Q6 self-regulating action. Capacitors C5 and C6 serve to bypass ripple components from the base of series regulators Q1 and Q2.

(6) +28 VOLT REGULATOR PS1A5. - The +28 volt regulator circuit consists of series switching regulator PS1Q6; dc amplifiers Q2, Q3, and Q4; IC differential comparator Z1; and overload protection stage Q1. This is a switching-type regulator and is similar in operation to the +5 and +18 volt regulators (PS1A2) previously described.

A +40 volt dc potential from full-wave rectifier PS1CR1 and PS1CR2 is applied to series regulator PS1Q6 (via overload sensing resistor PS1R1) and also as the operating voltage for switch driver stages Q2 and Q3. Q2 is switched on and off by current amplifier Q3 in response to drive pulses from differential comparator Z1. Z1 compares a sample of the +28 volt regulator output voltage, via amplifier Q4 and isolation diode CR6, with a fixed reference voltage from Zener diode CR2. When the regulated output level exceeds the reference voltage, the pulse width from Z1 is decreased to reduce the switch stage Q2 "on" time and thereby lower the regulator output voltage. When regulator output is less than the reference voltage, the switch stage "on" time is increased by an increase in the switching pulse width from Z1, thereby raising the regulator output voltage. In this manner the switch regulator is controlled in step sequence to regulate the output voltage and hold it constant.

To stabilize the switching regulator and improve operation, a 12.5 kc "sync" pulse is applied to the base of Q4 via capacitor C9, and is then applied to differential comparator Z1 through a low pass filter consisting of resistors R11, R12, and R13; and capacitors C6 and C8. The "sync" pulse times the comparator operation and governs the switching rate of PS1Q6.

Regulation is also a function of inductor L1 and commutating diode CR7. Dc pulses at the output of switch stage PS1Q6 are applied through a low pass filter consisting of inductor L1 and capacitors C5 and C7. During the switch stage "off" intervals, the collapsing field at inductor L1 charges capacitors C5 and C7, with commutating diode CR7 providing a return path. (Back-emf of L1 has a reversed polarity causing CR7 to conduct.) In this manner a charge at capacitor C5 (and C7) is maintained during "off" switch periods to assure output current to the load.

Stage Q1 is biased by the IR drop across resistor PS1R1. In the event of an abnormally high current drain from the regulator, the IR drop across R1 drives Q1 to saturation, driving differential comparator Z1 to reduce the regulator output via isolation diode CR4. Zener diode CR5 establishes a fixed level of comparator input (error) voltage for the output of both amplifier Q4 and stage Q1. Zener diode CR3 regulates the operating potential applied to differential comparator Z1 at terminal 8 (the Vcc terminal). Capacitor C2 introduces a time lag in the overload (Q1, R1) circuit.

WARNING

Deadly voltages are present at the power supply terminals.
Use extreme caution when trouble shooting.

b. PRELIMINARY CHECK. (See figure 5-63.) - Make a preliminary check of the power supply before trouble shooting, with emphasis on the following:

(1) Seating of connector PS1P1 in its socket.

(2) Seating of connectors PS1J1 and PS1P2.

(3) Soldered connections to socket XPS1.

c. TEST EQUIPMENT. - Use Electronic Multimeter AN/USM-116 and Frequency Counter H-P 5245L. No special tools required.

d. CONTROL SETTINGS. - Preset all controls as indicated in table 3-1.

e. TEST DATA. (See figure 5-63.) - Checking the power supply consists of checking the input sync signal and measuring the power supply output voltages at the appropriate terminals.

(1) Connect frequency counter to XA12P2 pin CC. Counter should read 12.500 kc ±1 count.

(2) Connect multimeter to A18A4 terminal 18. Meter should read -18 vdc ±5%.

(3) Connect multimeter to A18A6 terminal 15. Meter should read +125 vdc ±5%.

(4) Connect multimeter to A18A6 terminal 5. Meter should read +18 vdc ±5%.

(5) Connect multimeter to A18A6 terminal 11. Meter should read +24 vdc ±5%.

(6) Connect multimeter to A18A6 terminal 18. Meter should read +15 vdc ±5%.

(7) Connect multimeter to A18A6 terminal 6. Meter should read +5 vdc ±10%.

(8) Connect multimeter to A18A6 terminal 7. Meter should read +28 vdc ±10%.

4-36. REAR FILTER-PANEL A19. (See figures 4-39 and 5-91.)

The rear filter-panel contains cable connectors and rf interference filters for external exciter connections to the primary ac power source and to the LPA and LCU system units (the external rf power amplifier and the Decoder-Encoder KY-656/FRT). Table 4-13 lists the retractable cable connection between the exciter chassis and the rear filter-panel attached to the exciter enclosure, identifies the cable connectors, and gives the type and number of conductors employed. The 51-conductor flat ribbon is color coded in groups of ten leads and employs the RMA resistor color code for lead identification. The RG-196 coaxial cables and the twisted shielded pair cables are white in color. In addition, connectors J2 and J3 have IC low-pass filters in series with the rf cable connections. These connectors are in dc control voltage circuits, and the low-pass filters reject any spurious rf signals present.

Retractable cables are arranged within the enclosure so that the exciter drawer can be opened and closed; the flat cables accommodating this motion.

4-37. SERVICING BLOCK DIAGRAMS.

Figures 4-40 through 4-52 are servicing block diagrams for the applicable exciter modules. These illustrations provide maintenance technicians with a pictorial guide for use in trouble shooting. Main signal flow or data paths are represented by heavy lines and light lines are used for secondary paths. Arrow heads, placed on the flow lines, indicate the direction of signal flow. Waveforms, where applicable, are placed at appropriate test points on the service block diagrams.

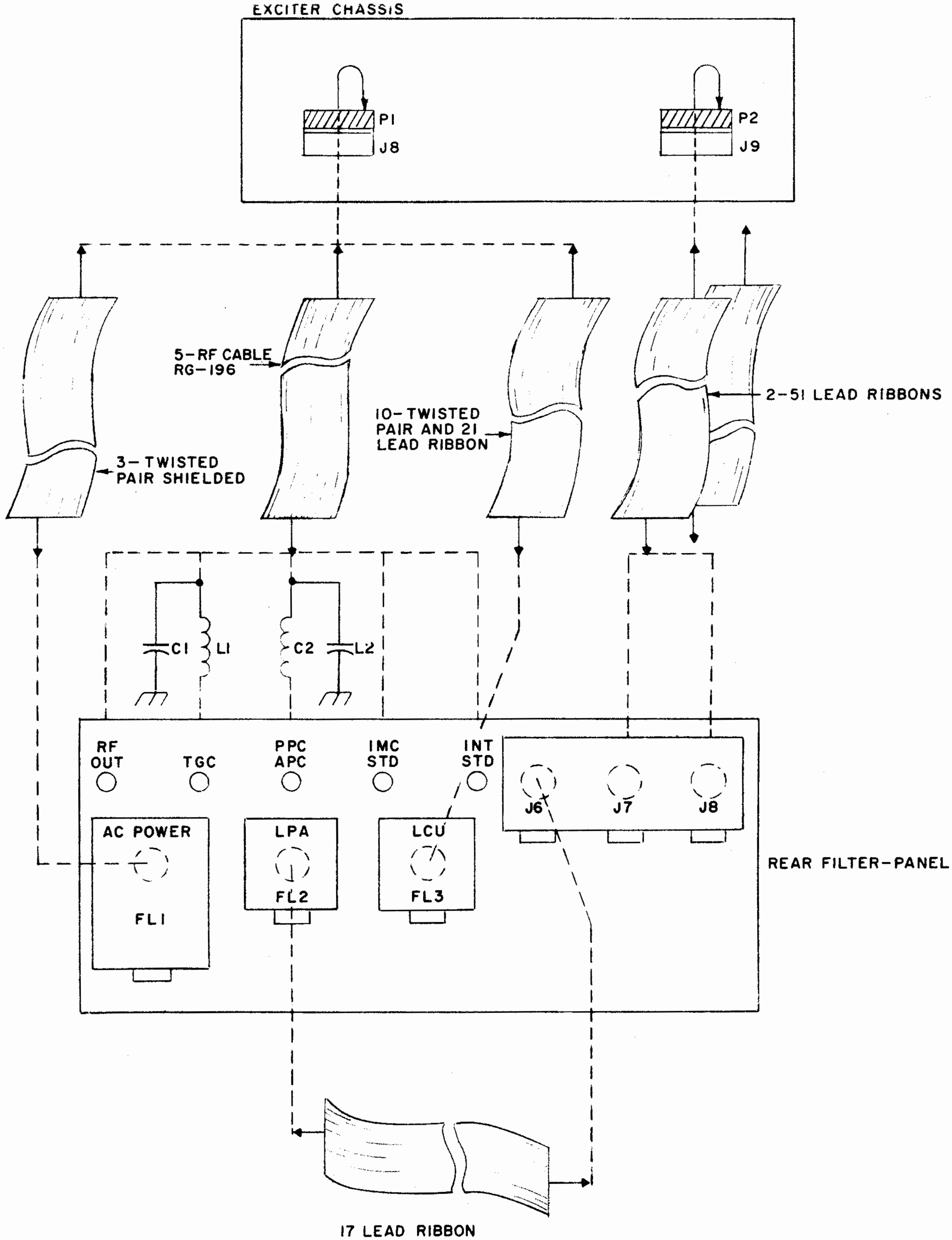

Figure 4-39. Rear Filter Panel Functional Diagram
Showing Retractable Cables

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TABLE 4-13. RETRACTABLE CABLES

CHASSIS CONNECTOR	CABLE TYPE	TO	CONNECTOR NAME
P1	RG-196 coaxial cable	J1	RF OUT
	RG-196	J2	TGC IN
	RG-196	J3	APC/PPC
	RG-196	J4	1 MC STD IN
	RG-196	J5	1 MC INT STD MON
	Twisted-pair, shielded (3)		FL-1
	17-lead ribbon	J6	FL-2
	Twisted-pair, shielded (10)		FL-3
	21-lead ribbon		FL-3
P2	51-lead ribbon (2)	J7 J8	

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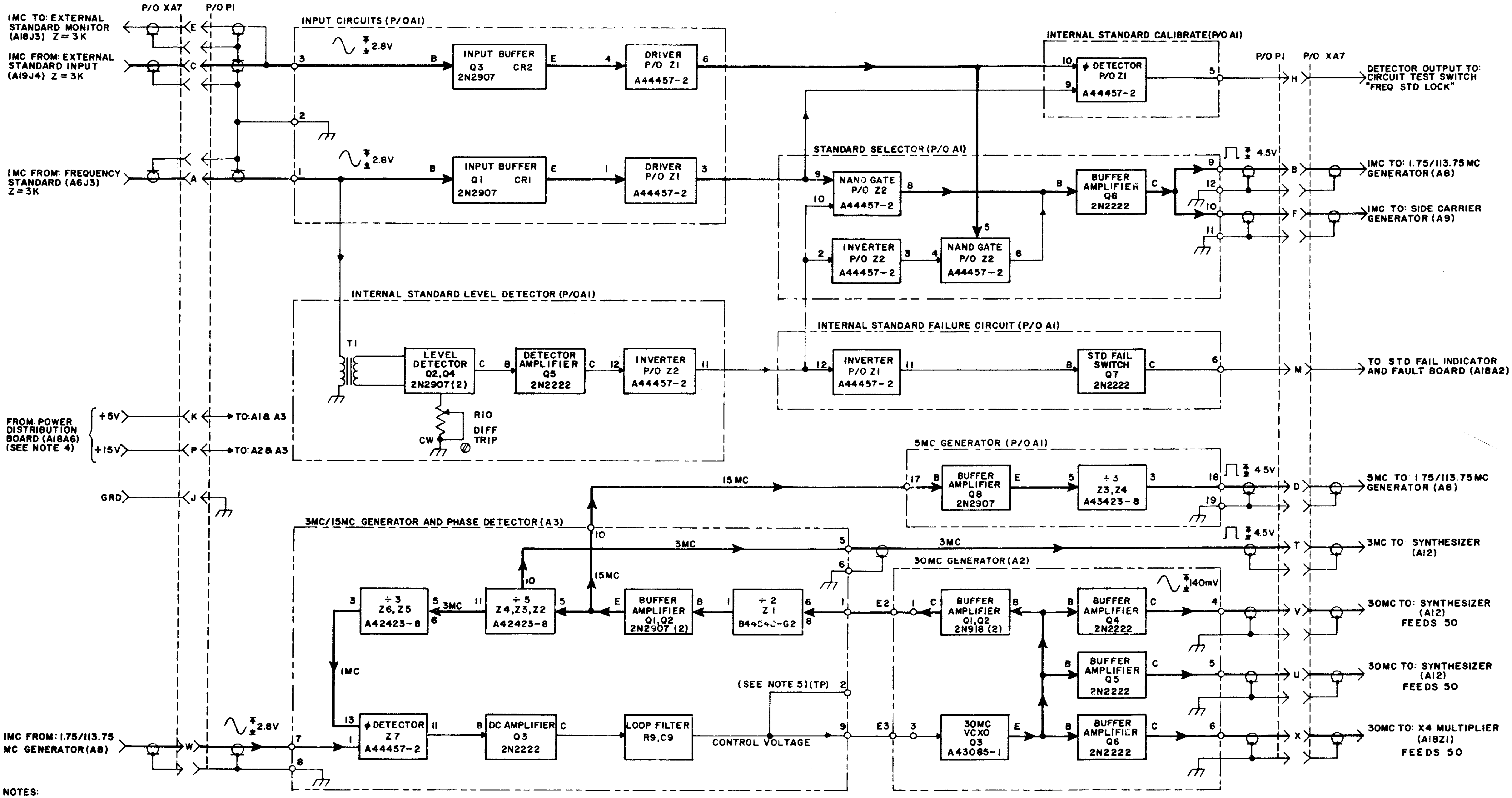
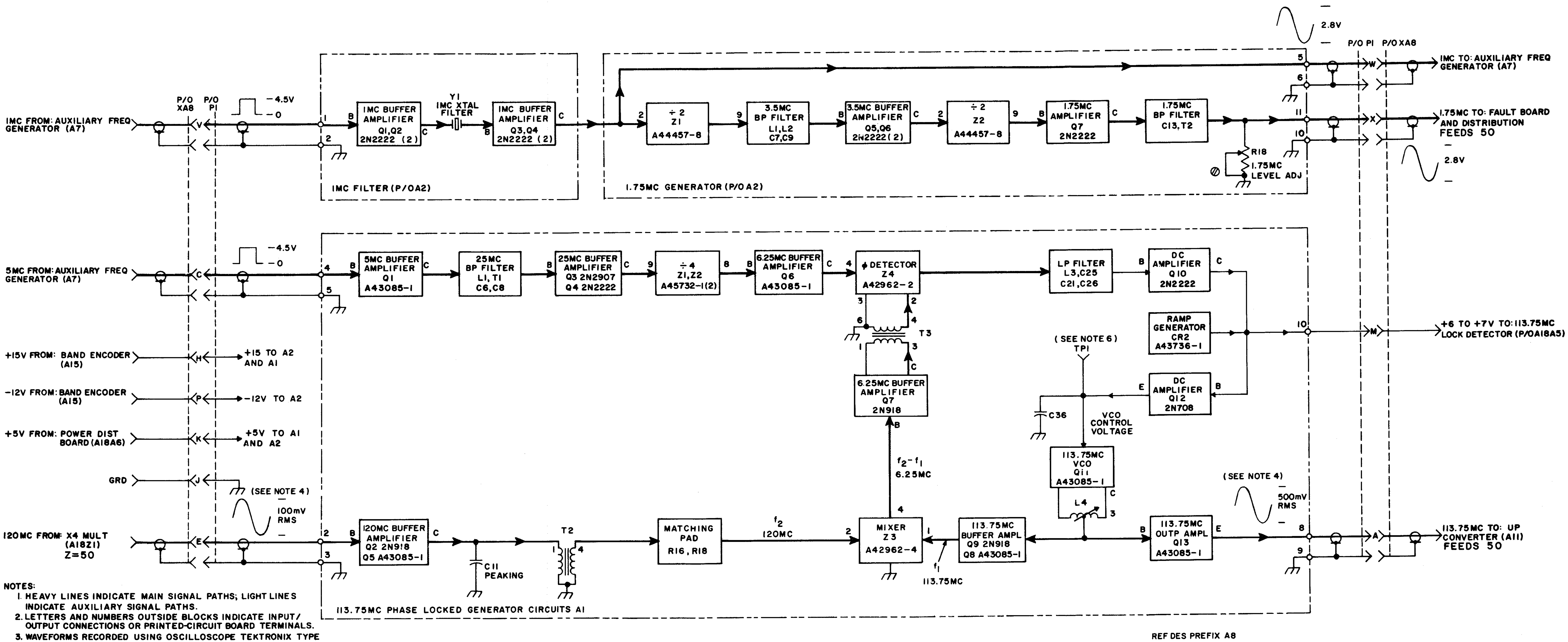


NOTES:

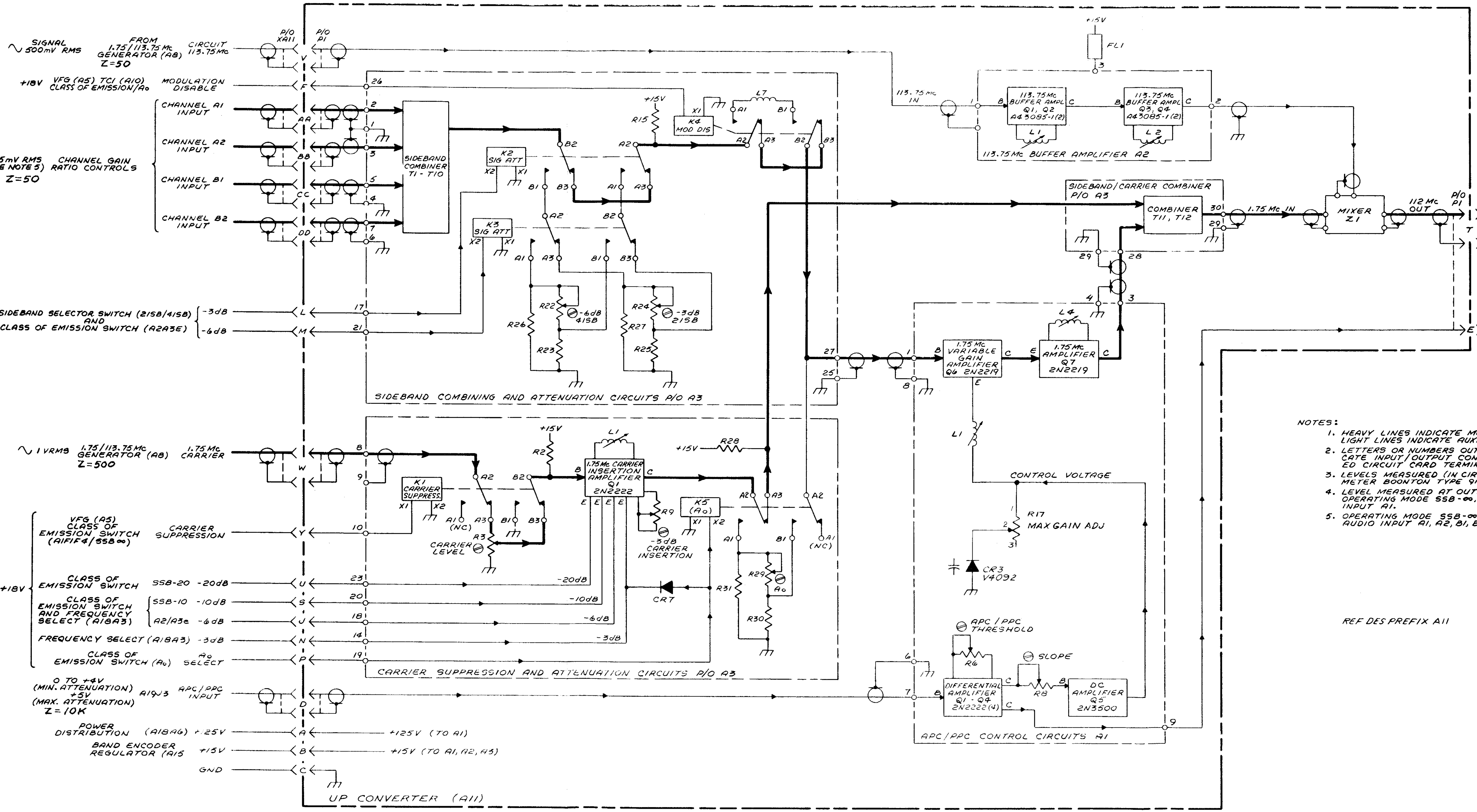
1. HEAVY LINES INDICATE MAIN SIGNAL PATH; LIGHT LINES INDICATE AUXILIARY OR SECONDARY SIGNAL PATHS.
2. LETTERS AND NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED-CIRCUIT BOARD TERMINALS.
3. WAVEFORMS RECORDED USING OSCILLOSCOPE TEKTRONIX TYPE 585A WITH PLUG IN UNIT TYPE 82.
4. VOLTAGES AVAILABLE IN OPERATE CONDITION ONLY.
5. A POSITIVE VOLTAGE OF APPROX +3V TO +10V WITH THE ABSENCE OF A LOW FREQUENCY COMPONENT INDICATES A PHASE LOCKED CONDITION
6. REF DES PREFIX: A7

Figure 4-40. Auxiliary Frequency Generator, Servicing Block Diagram



NOTES:
1. HEAVY LINES INDICATE MAIN SIGNAL PATHS; LIGHT LINES INDICATE AUXILIARY SIGNAL PATHS.
2. LETTERS AND NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED-CIRCUIT BOARD TERMINALS.
3. WAVEFORMS RECORDED USING OSCILLOSCOPE TEKTRONIX TYPE 585A WITH PLUG IN UNIT TYPE 82.
4. 113.75MC AND 120MC LEVELS MEASURED WITH RF VOLTMETER BOONTON TYPE 91CA.
5. VOLTAGES AVAILABLE IN OPERATE CONDITION ONLY.
6. A POSITIVE VOLTAGE OF APPROX 6V INDICATES A PHASE LOCKED CONDITION.

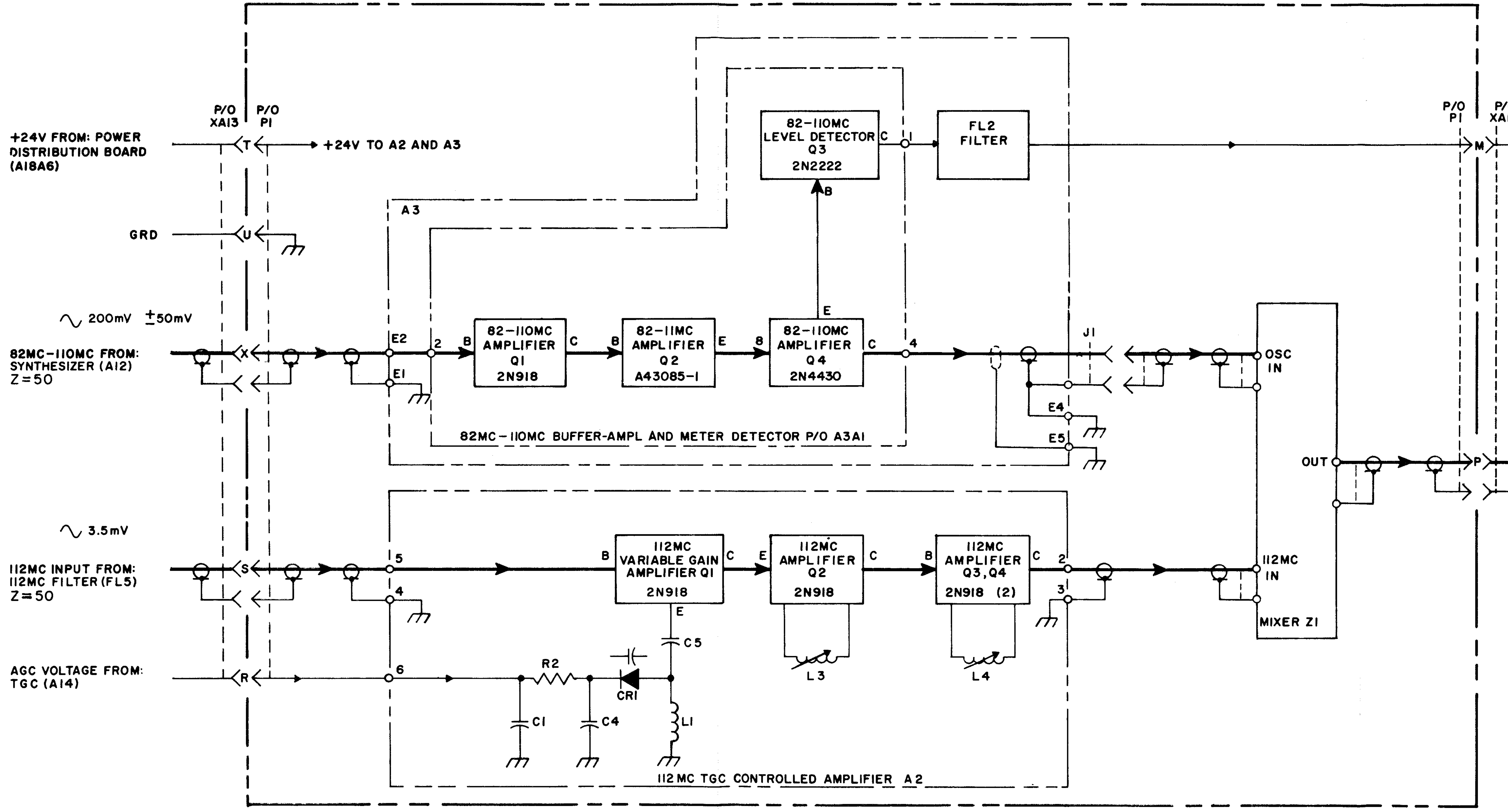
Figure 4-41. 1.75/113.75 Mc Frequency Generator, Servicing Block Diagram



NOTES:
1. HEAVY LINES INDICATE MAIN SIGNAL PATHS. LIGHT LINES INDICATE AUXILIARY SIGNAL PATHS.
2. LETTERS OR NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED CIRCUIT CARD TERMINATIONS.
3. LEVELS MEASURED (IN CIRCUIT) WITH VOLTMETER BOONTON TYPE 91CA.
4. LEVEL MEASURED AT OUTPUT OF 112Mc FILTER. OPERATING MODE SSB-∞, USB, 1Kc 0dBm AUDIO INPUT A1.
5. OPERATING MODE SSB-∞ 4ISB 1Kc 0dBm AUDIO INPUT A1, A2, B1, B2.

REF DES PREFIX A11

Figure 4-42. Up-Converter, Servicing Block Diagram



NOTES:

1. HEAVY LINES INDICATE MAIN SIGNAL PATH, LIGHT LINES INDICATE AUXILIARY OR SECONDARY SIGNAL PATHS.
2. LETTERS AND NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED-CIRCUIT BOARD TERMINALS.
3. SIGNAL LEVELS MEASURED USING RF VOLTMETER, BOONTON MODEL 91CA CLASS OF EMISSION-AO.
4. OUTPUT LEVEL DEPENDENT ON "PWR" OUTPUT CONTROL SETTING.

REF DES PREFIX A13

Figure 4-43. Down-Converter, Servicing Block Diagram

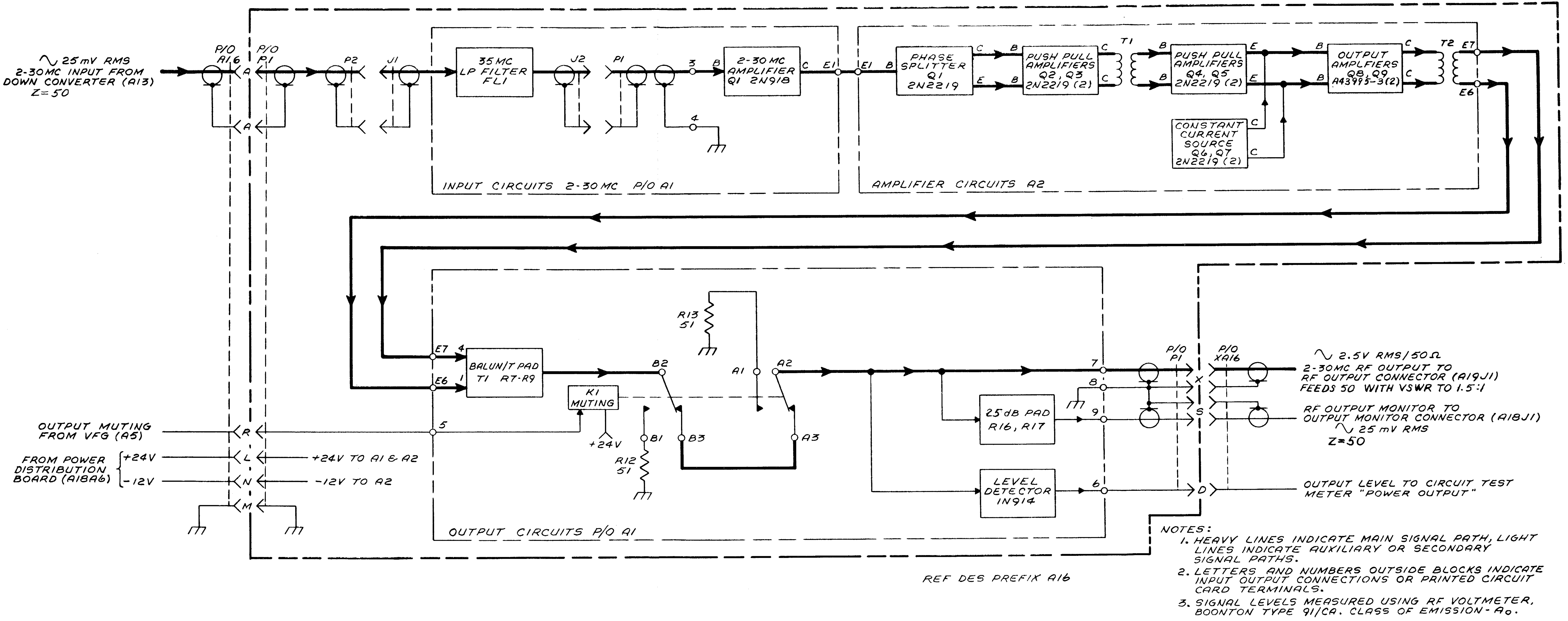


Figure 4-44. Output Amplifier, Servicing Block Diagram

Figure 4-45. Side-Carrier Generator, Servicing Block Diagram

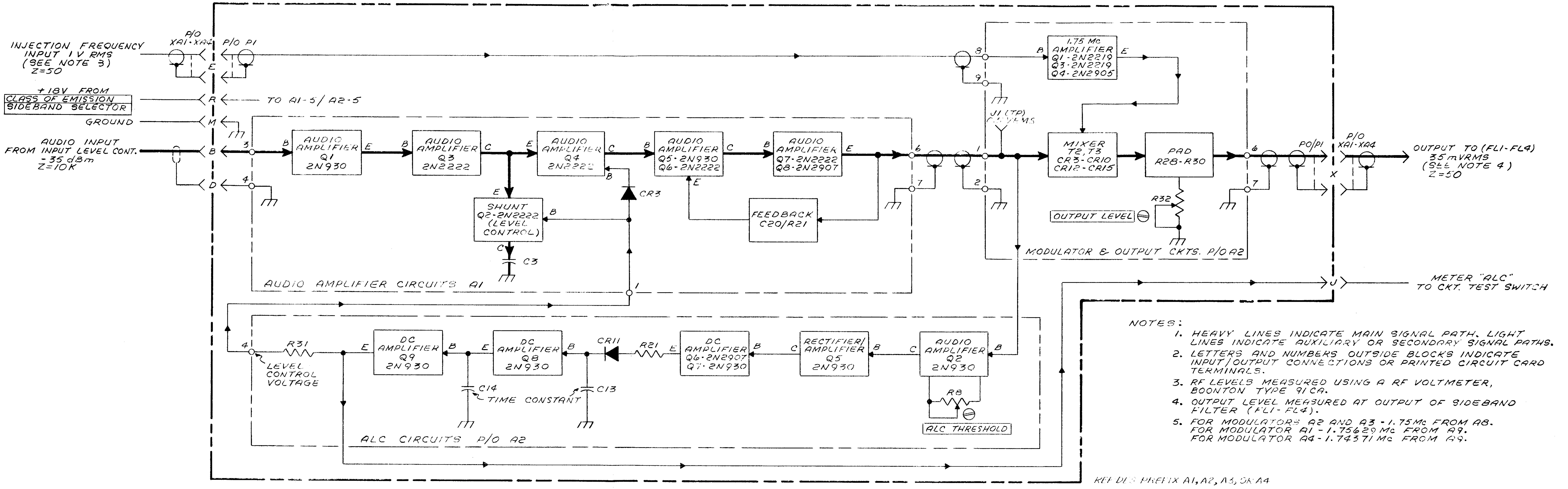
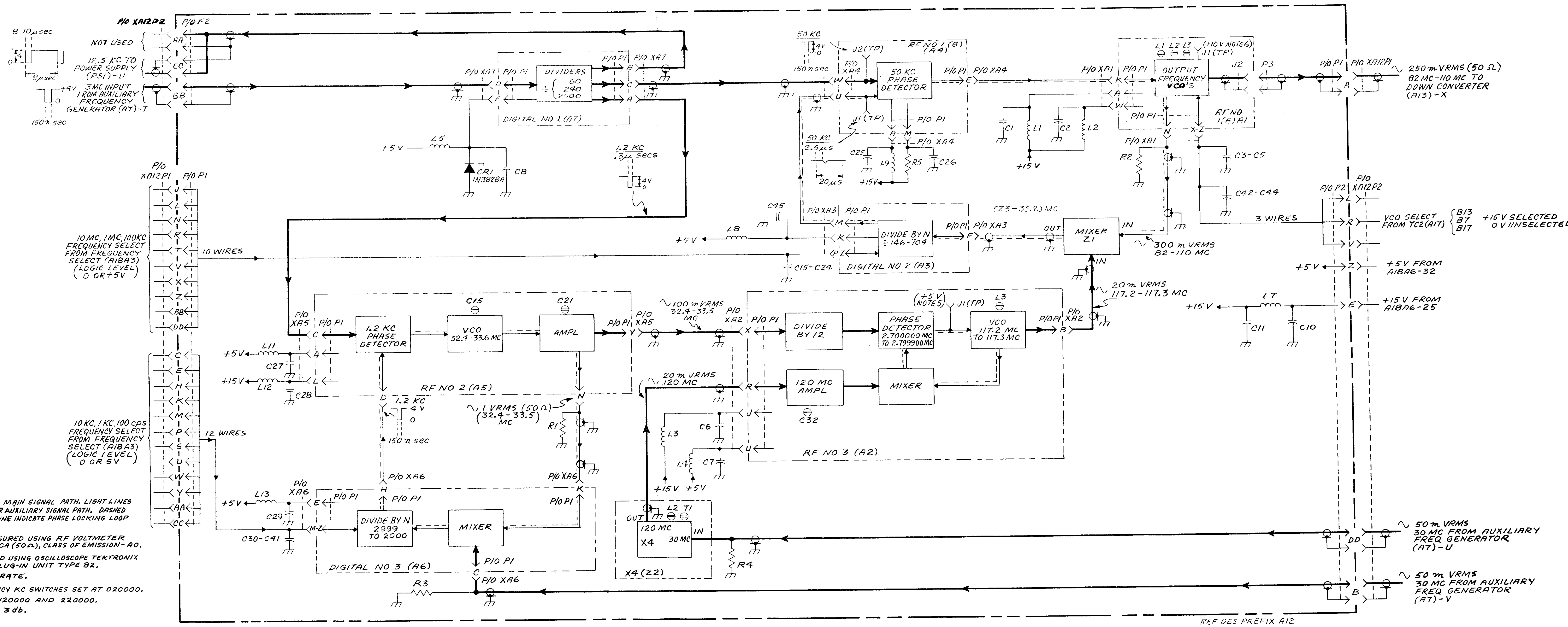


Figure 4-46. Modulator, Servicing Block Diagram



NOTES:
1. HEAVY LINES INDICATE MAIN SIGNAL PATH. LIGHT LINES INDICATE SECONDARY OR AUXILIARY SIGNAL PATH. DASHED LINES BESIDE SIGNAL LINE INDICATE PHASE LOCKING LOOP SIGNAL PATH.
2. SIGNAL LEVELS MEASURED USING RF VOLTMETER BOONTON MODEL 91CA (50 Ω), CLASS OF EMISSION - A0.
3. WAVEFORMS RECORDED USING OSCILLOSCOPE TEKTRONIX TYPE 585A WITH PLUG-IN UNIT TYPE 82.
4. EQUIPMENT IN OPERATE.
5. +5 V WHEN FREQUENCY KC SWITCHES SET AT 020000.
6. +10 V AT 020000, 120000 AND 220000.
7. SIGNAL LEVELS ± 3 db.

Figure 4-47. Synthesizer, Servicing Block Diagram

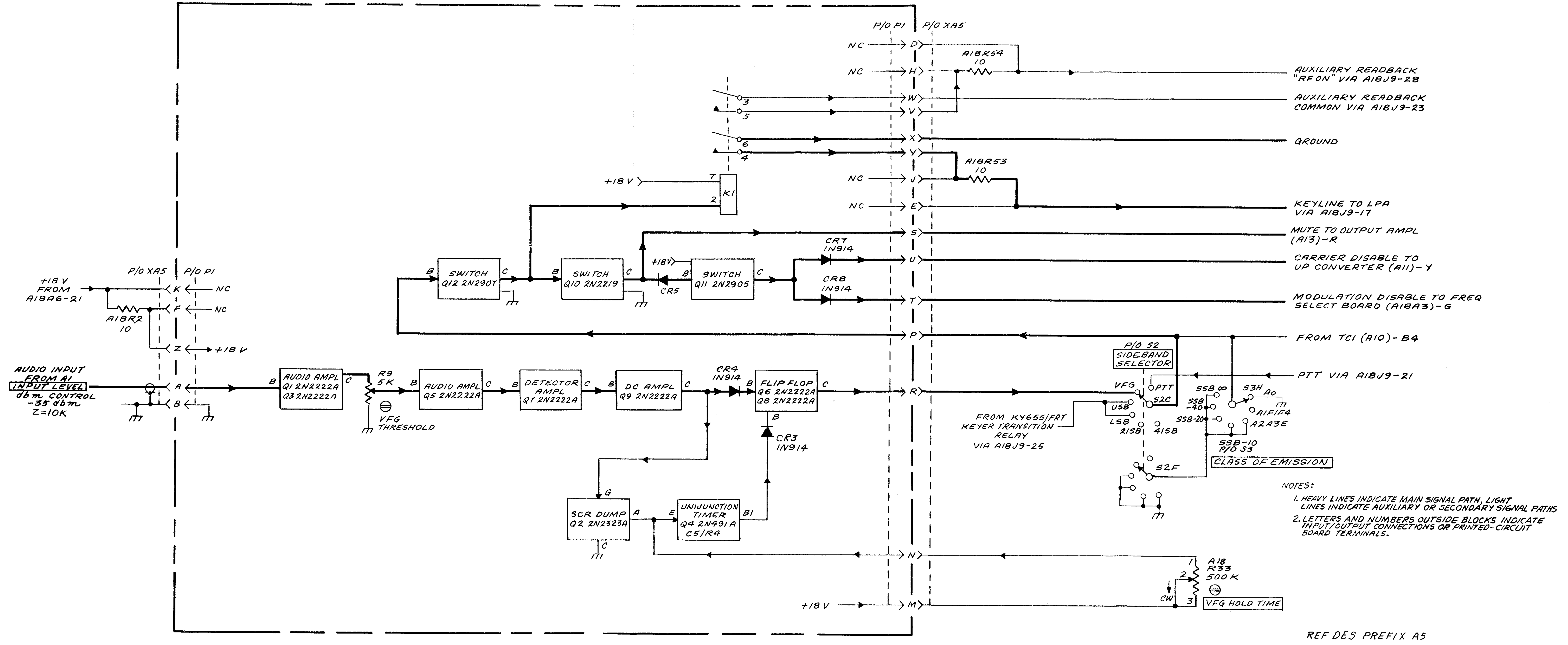


Figure 4-48. Voice Frequency Gate, Servicing Block Diagram

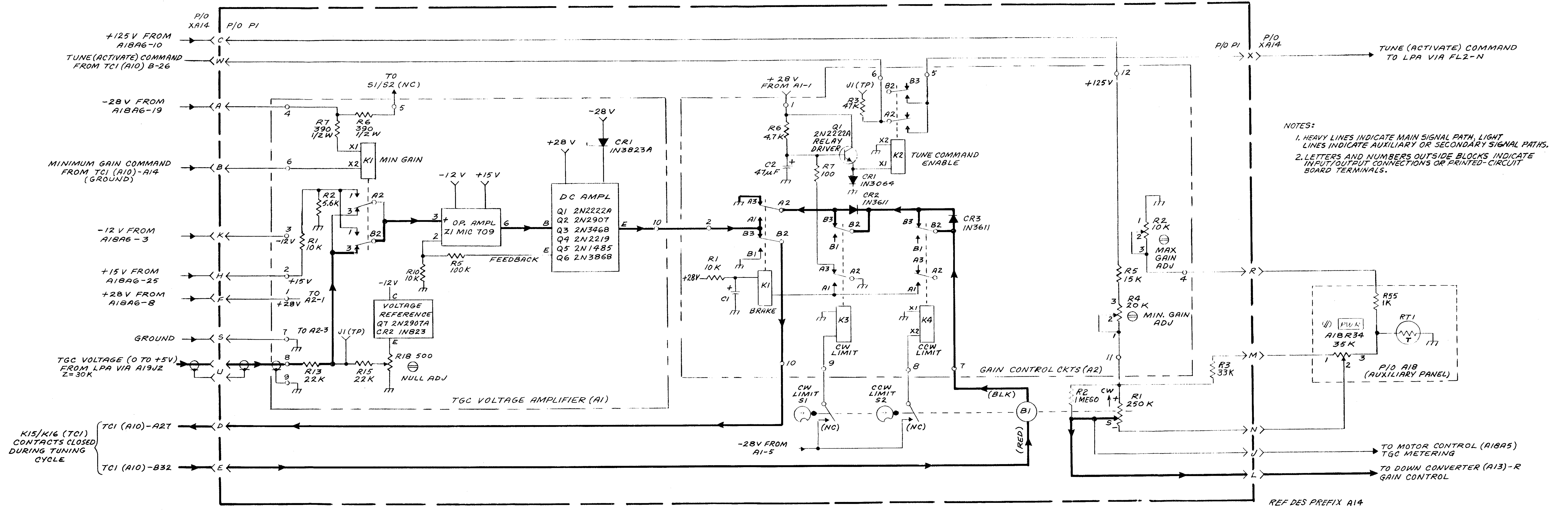
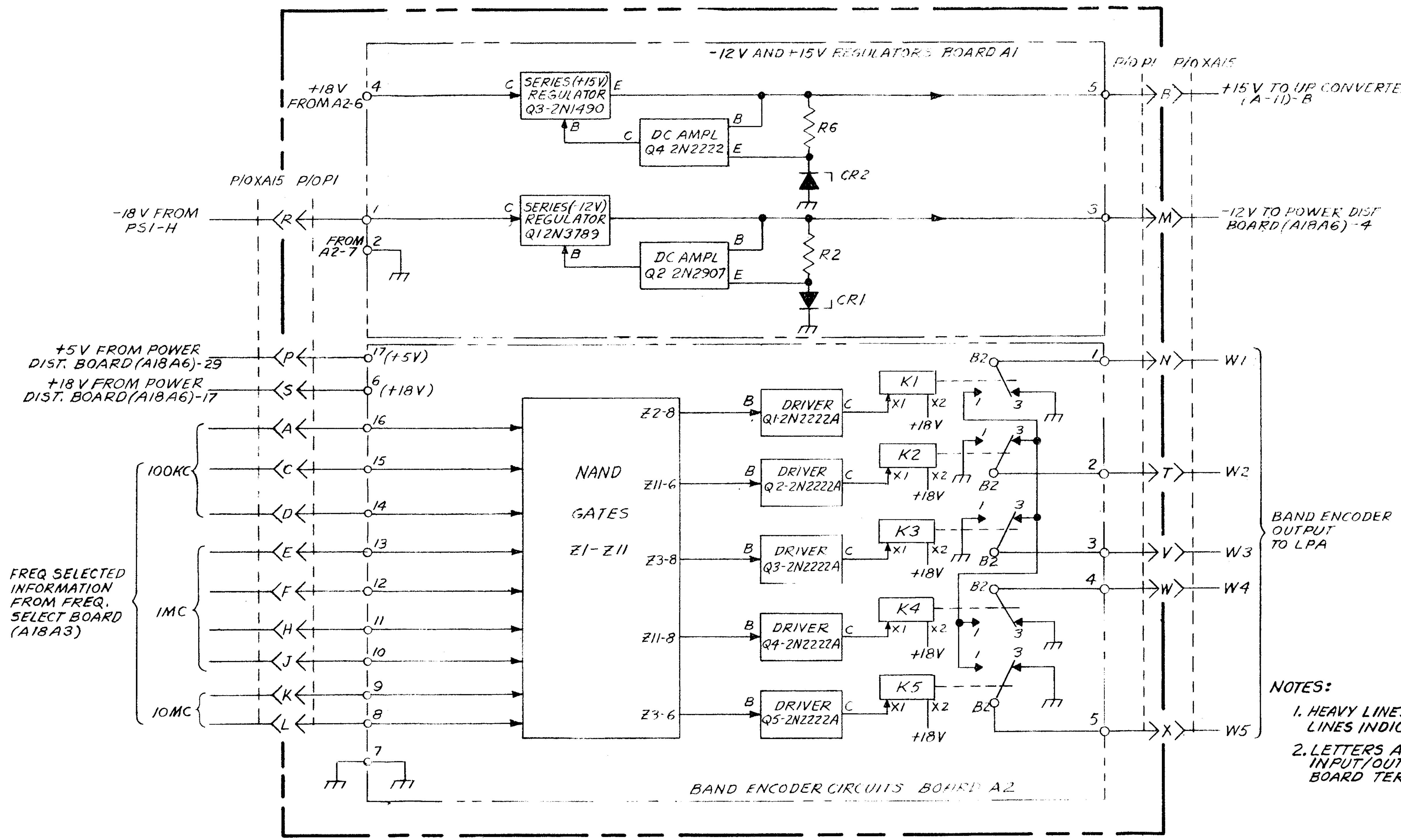


Figure 4-49. Transmitter Gain Control, Servicing Block Diagram



NOTES:

1. HEAVY LINES INDICATE MAIN SIGNAL PATH, LIGHT LINES INDICATE AUXILIARY OR SECONDARY SIGNAL PATHS.
2. LETTERS AND NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED-CIRCUIT BOARD TERMINALS.

Figure 4-50. Band Encoder, Servicing Block Diagram

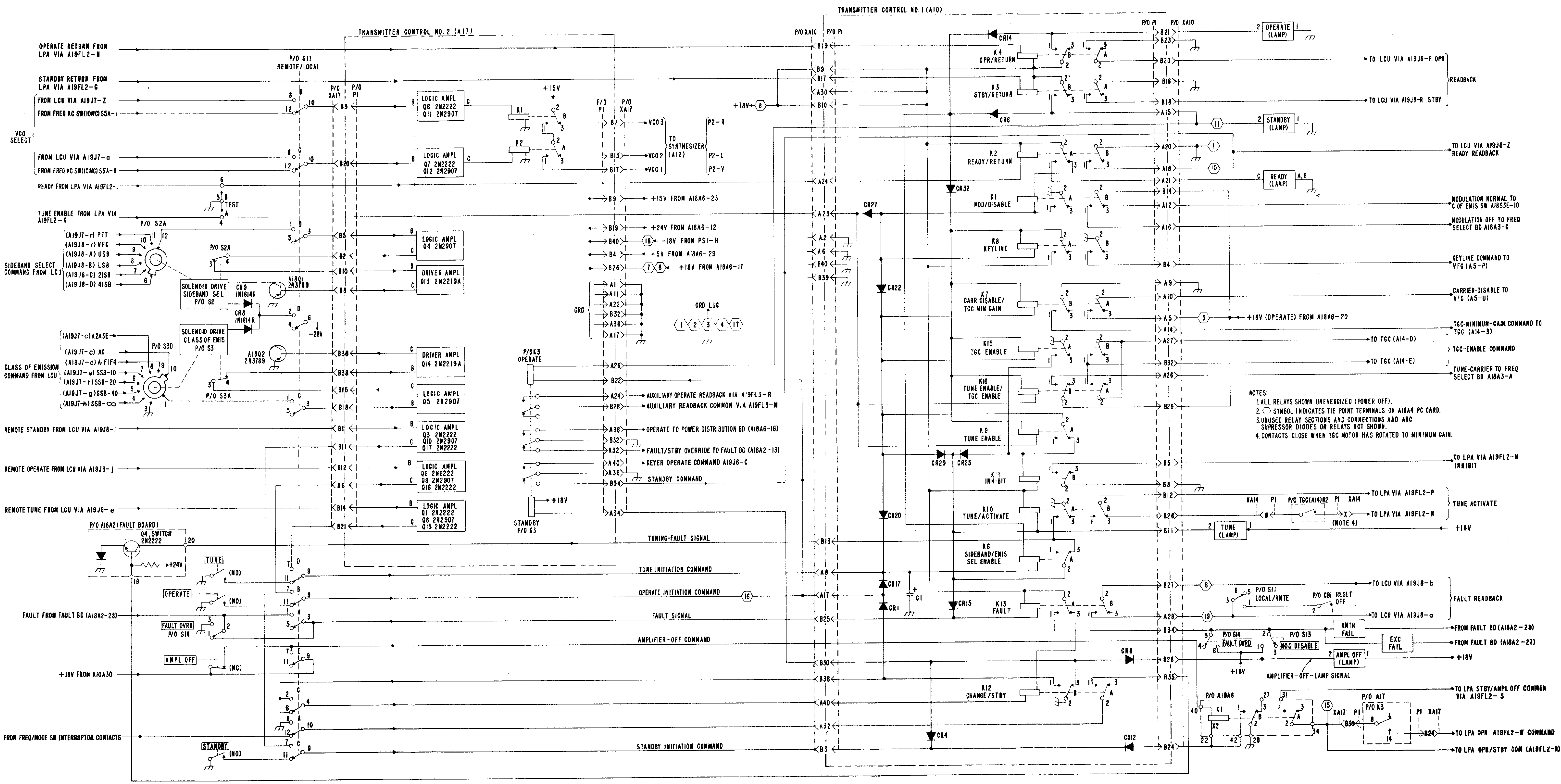
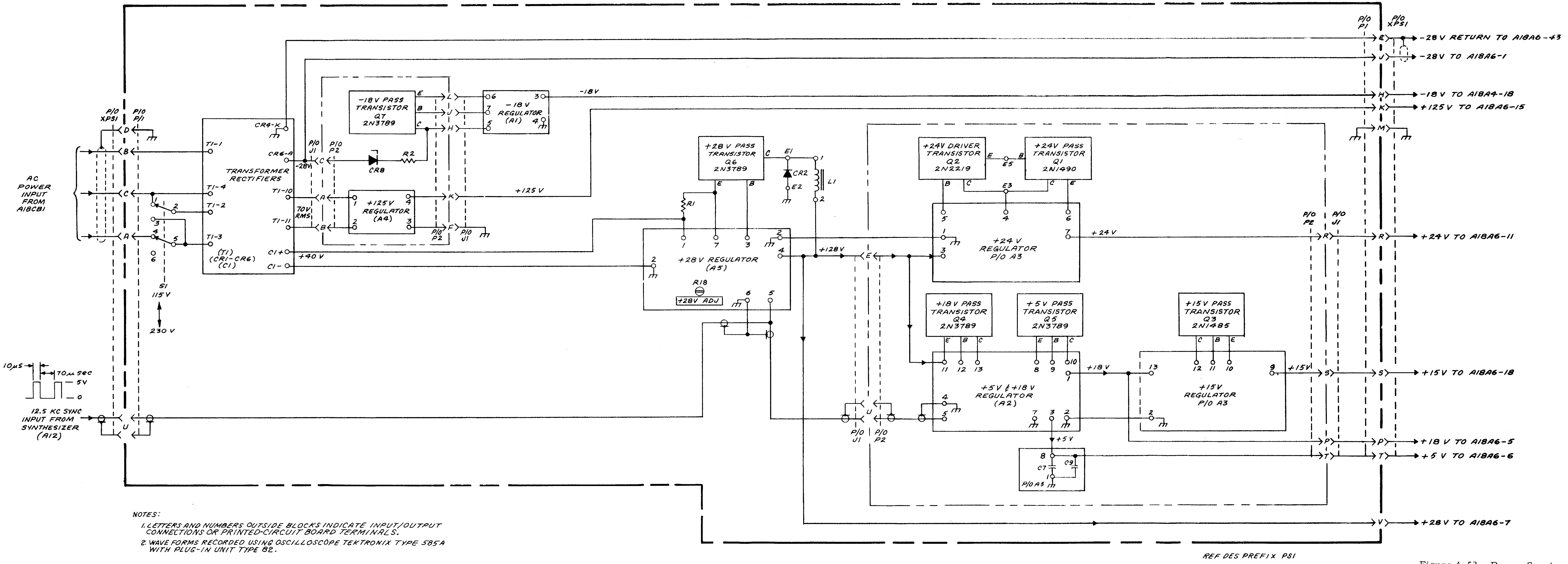


Figure 4-51. Transmitter Control Numbers 1 and 2, Servicing Block Diagram



NOTES:

1. LETTERS AND NUMBERS OUTSIDE BLOCKS INDICATE INPUT/OUTPUT CONNECTIONS OR PRINTED-CIRCUIT BOARD TERMINALS.
2. WAVE FORMS RECORDED USING OSCILLOSCOPE TEKTRONIX TYPE 585A WITH PLUG-IN UNIT TYPE 82.

Figure 4-52. Power Supply, Servicing Block Diagram

SECTION 5

MAINTENANCE

5-1. INTRODUCTION.

This section provides removal, repair, replacement, and adjustment procedures for Modulator-Synthesizer MD-777/FRT, together with complete schematic diagrams, interconnection diagrams, and parts location illustrations. Refer to the Maintenance Standards Book (NAVSHIPS 0967-293-3010) for complete preventive maintenance and reference standards procedures.

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Note

> The Naval Electronic Systems Command no longer requires the submission of failure reports for all equipments. Failure reports and performance and operational reports are to be accomplished for designated equipments (refer to Electronics Installation and Maintenance Book, NAVSHIPS 0967-000-0000) only to the extent required by existing directives. All failures shall be reported for those equipments requiring the use of failure reports.

5-2. TUNING AND ADJUSTMENT.

a. GENERAL. - The following paragraphs contain information for the tuning and adjustment procedures required for the exciter. Special tools, test equipment, and step-by-step procedures are given for all applicable circuit modules.

b. TEST EQUIPMENT AND SPECIAL TOOLS. - Table 5-1 lists the test equipment, test cables, and special tools required for tuning and adjustment procedures.

c. TEST CABLES. - A number of test cables are provided for the operation and testing of plug-in modules when removed from the exciter chassis.

d. CARD EXTRACTOR. - A card extractor is provided to facilitate removal of the printed circuit cards from the synthesizer module enclosure A12.

e. CARD EXTENSION. - Card extensions are provided to elevate printed circuit cards from their modules and expose test points and adjustments on the card faces.

f. CIRCUIT TEST PROVISIONS. - The CIRCUIT TEST meter and selector switch on the exciter front panel are available for use during the tuning and adjustment procedures. Acceptable meter readings are within the colored scale segment as indicated at the panel markings.

g. ALIGNMENT SEQUENCE. - Complete alignment of the exciter should be performed following the order of alignment presented in this section, and starting with power supply PS1.

TABLE 5-1. TEST EQUIPMENT AND SPECIAL TOOLS

TYPE	MODEL (OR EQUIVALENT)	APPLICATION
RF Voltmeter	Boonton 91CA	Signal measurements, rms.
Signal Generator	H-P 606A	Test signals.
Signal Generator	H-P 608D	Test signals.
Electronic Frequency Counter	AN/USM-207 (with video amplifier)	Frequency measurement.
Multimeter	AN/PSM-6	Voltage and resistance measurement.
Calorimetric Power Meter	H-P 434A	Output power measurement.
Power Supply	Power Designs 4005	Power source.
Oscilloscope	Tektronix 585A (with plug-in unit, type 82)	Waveform analysis and measurement.
Spectrum Analyzer	H-P 140S	Output waveform measurement and analysis.
Dual-Tone Audio Signal Generator	SG-376/U	Audio test signals.
Variable Output Attenuator	H-P 355D	Output measurement.
Standard-Frequency Oscillator	General Radio type 1115-C	Internal-frequency-standard calibration.
Test Jig	See figure 2-2	Allows energizing equipment independent of power amplifier.
Test Cable	NRCI C45138G1*	Extension cable for 20-pin plug-in modules.
Test Cable	NRCI C45148G1*	Extension cable for 26-pin plug-in modules.
Test Cable	NRCI C45149G1*	Extension cable for 66-pin plug-in modules.
Test Cable	NRCI C45149G2*	Extension cable for plug-in modules.
Card Extender	NRCI D45184G1*	Extender for card A5.
Card Extender	NRCI E45170G1*	Extender for printed-circuit boards of modules A10 and A17.
Card Extender	NRCI D46442G1*	Extender for card A12A7A1.
Card Extender	NRCI D46442G2*	Extender for cards A12A1 to A12A6.
Printed-Circuit Board Extractor	NRCI B43412G1* NRCI B45837G1*	Allows extraction of printed-circuit boards.
Alignment Tool	J. F. D. S284	Tuning and adjustment.

*Supplied with exciter. See page 6-108.

5-3. TUNING AND ADJUSTMENT PROCEDURES.

The following paragraphs provide alignment and adjustment information for each applicable module and circuit board. Control settings, when they differ from the settings of table 3-1, are given in the applicable paragraph.

CAUTION

> Place exciter at "standby" before removing or replacing a plug-in module. Voltage surges when live contacts are broken can damage the circuit components.

a. POWER SUPPLY PS1. (See figures 5-49 through 5-54.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Volt-ohmmeter AN/PSM-6.

(b) Alignment tool, J. F. D. S284.

(c) Test jig (see figure 2-2).

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-63, sheet 1.

(a) Turn off exciter and remove power supply cover.

(b) Connect voltmeter (+) lead to PS1A5 terminal 4, and (-) lead to ground.

(c) Energize exciter as instructed in paragraph 2-5b.

(d) Adjust PS1A5R18 for +28 vdc.

(e) Turn off exciter and replace power supply cover.

b. FREQUENCY STANDARD A6. (See figure 5-9.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Standard-frequency oscillator, General Radio type 1115-C.

(b) Test jig (see figure 2-2).

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - To check calibration of the internal 1 mc frequency standard, a secondary 1 mc standard having a stability of one part in 10^9 is used. The CIRCUIT TEST panel meter serves as a "null" indicator during calibration.

(a) Energize exciter as instructed in paragraph 2-5b; energize secondary 1 mc standard as instructed in applicable technical documentation.

Note

For maximum accuracy, allow a 1 hour warm-up period prior to calibration of the internal 1 mc frequency standard.

(b) Connect the external 1 mc frequency standard (standard-frequency oscillator) to the 1 MC STD IN connector (A19J4) on the rear panel. The amplitude should be from 0.3 to 3 vac rms.

(c) Set the CIRCUIT TEST switch to the FREQ STD LOCK position.

(d) Observe the period of oscillation (from left to right to left to right or vice versa) for the pointer of the front-panel CIRCUIT TEST meter. This period should be greater than or equal to 100 seconds. If the period is less than 100 seconds, calibrate the internal frequency standard by adjusting the FREQ STD control on the auxiliary panel.

Note

If the range of the FREQ STD control is exceeded, adjust the mechanical FREQ ADJ control on the internal frequency standard to return the FREQ STD control within range, and readjust the FREQ STD control as necessary.

c. 1.75/113.75 MC GENERATOR A8. (See figures 5-14 through 5-16.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) RF Voltmeter, Boonton Model 91CA.

(b) Oscilloscope, Tektronix 585A.

(c) Insulated alignment tool.

(d) Test jig (see figure 2-2).

(e) 1.75/113.75 mc generator module extender cable.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-67.

(a) Turn off exciter and remove 1.75/113.75 mc generator module A8.

(b) Connect the 1.75/113.75 mc generator to its chassis socket using the module extender cable. Remove module cover.

(c) Energize exciter as instructed in paragraph 2-5b. Place exciter in USB/A0 mode.

(d) Connect oscilloscope leads to A8A2 terminals 1 and 2. Observe a 1 mc square wave signal of approximately 4 volts ±0.5 volt.

(e) Connect oscilloscope to A8A2 terminals 5 and 6. Observe a 1 mc signal of approximately 1 volt.

(f) Connect the oscilloscope to the collector of A8A2Q6. Adjust A8A2L2 and A8A2L1 for maximum amplitude.

Note

This is a 3.5 mc signal. L1 and L2 are tuned for the seventh harmonic of the 500 kc output of A8A2Z1.

(g) Connect oscilloscope to A8A2 terminals 10 and 11. Adjust A8A2R18 for maximum. This is a 1.75 mc signal and should be at least 3 volts peak-to-peak.

(h) Connect oscilloscope to A8A1 terminals 4 and 5. Observe a 5 mc signal of 4 volts ±0.5 volt.

(i) Connect oscilloscope to collector of A8A1Q4. Adjust A8A1L1 and A8A1T1 for maximum.

(j) Connect oscilloscope to collector of Q8A1Q6. Observe a 6.25 mc signal of approximately 1 volt peak-to-peak.

(k) Connect rf voltmeter between A8A1 terminals 2 and 3. Voltmeter should read approximately 20 millivolts.

(l) Connect oscilloscope to collector of A8A1Q7. Adjust A8A1C11 for maximum. This is a 6.25 mc signal of approximately 1.5 volts peak-to-peak.

(m) Connect oscilloscope to A8A1TP1. Adjust A8A1L4 for 5 volts dc. Make sure the signal is pure dc (with no ac component).

Note

A8A1L4 should be adjustable between +3 and +8 volts without unlocking the 113.75 mc generator.

(n) Connect rf voltmeter to A8A1 terminals 8 and 9. Observe a 113.75 mc signal of approximately 0.5 volts.

(o) Disconnect oscilloscope, turn off exciter, remove module extender cable, fasten module cover, and reinstall module.

d. SIDE CARRIER GENERATOR A9. (See figures 5-17, 5-18, and 5-19.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Oscilloscope, Tektronix 585A.

(b) Alignment tool.

(c) Test jig (see figure 2-2).

(d) Side carrier generator module extender cable.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-68.

(a) Turn off exciter and remove side carrier generator A9.

(b) Connect the side carrier generator to its chassis socket using the module extender cable. Remove module cover.

(c) Energize exciter as instructed in paragraph 2-5b.

(d) Connect oscilloscope across A9A1 terminals 1 and 2. Observe a 1 mc signal of approximately 4 volts.

(e) Connect oscilloscope across A9A2 terminals 3 and 4. Observe 250 kc pulses going from zero to +4.5 volts ±0.5 volt.

(f) Connect oscilloscope across A9A2 terminals 7 and 8. Observe same pulses as in step (e) above.

(g) Connect oscilloscope between A9A1R3 and ground. Adjust A9A1L1 and A9A1L2 to obtain the sharpest rise time on pulses observed on oscilloscope.

(h) Connect oscilloscope to A9A1 terminals 8 and 9. Observe a 6.29 kc signal of 4.5 volts ±0.5 volt.

(i) Connect oscilloscope to A9A2 terminals 5 and 6. Observe same frequency and amplitude as in step (h). Connect oscilloscope to A2Q1 collector. Adjust R1 for maximum voltage swing (typically +3V to +13V).

(j) Connect oscilloscope between A9A2J1(TP) and ground. A dc level between +3V and +10V assures that the phase lock loop is locked. Connect oscilloscope to A2Q2 collector. Adjust R2 for maximum voltage swing (+3V to +13V). 208

(k) Connect oscilloscope between A9A2J2(TP) and ground. Observe the same oscilloscope display as in step (j).

(l) Connect oscilloscope between A9A2 terminals 1 and 2. Adjust A9A2R42 and A9A2T3 for maximum signal; amplitude should be approximately 3 volts peak-to-peak.

(m) Disconnect oscilloscope and set exciter CIRCUIT TEST meter to the 1.75629 MC position. Adjust A9A2R42 until meter reads in middle of green scale.

(n) Connect oscilloscope between A9A2 terminals 9 and 10. Adjust A9A2R45 and A9A2T4 for maximum signal; amplitude should be approximately 3 volts peak-to-peak.

(o) Disconnect oscilloscope and set exciter CIRCUIT TEST meter to the 1.74370 MC position. Adjust A9A2R45 until meter reads in middle of green scale.

(p) Turn off exciter, disconnect side carrier module extender cable, replace cover, and reinstall side carrier generator module.

e. RF NO. 2 CARD A12A5. (See figures 5-25 and 5-28.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Oscilloscope, Tektronix 585A.

(b) RF Voltmeter, H-P 411D.

(c) Alignment tool, J. F. D. S284.

(d) Test jig (see figure 2-2).

(e) Synthesizer card extender.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES.

(a) Turn off exciter. Remove synthesizer cover and rf no. 2 card A12A5. Reinsert card using card extender.

(b) Energize exciter as instructed in paragraph 2-5b up to and including step (13).

(c) Connect oscilloscope to A12A5 pin D (and ground). Observe a logic pattern from 0 to +4 volts at 1.2 kc.

(d) Connect oscilloscope to A12A5 pin C. Observe the same logic pattern noted above.

(e) Set FREQUENCY KC dials to 2999.9 kc. Connect rf voltmeter between A12A5R26 and ground.

(f) Adjust A12A5C15 for +10 volts.

(g) Connect oscilloscope across A12A5 pins N and P. Adjust A12A5C21 for maximum signal (approximately 0.5V rms).

(h) Turn off exciter, remove card extender, and reinstall card A12A5.

f. RF NO. 1 (A) CARD A12A1. (See figures 5-25 and 5-26.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Oscilloscope, Tektronix 585A.

(b) Multimeter, AN/PSM-6.

(c) Alignment tool, J. F. D. S284.

(d) Test jig (see figure 2-2).

(e) Synthesizer card extender.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES.

(a) Turn off exciter. Remove synthesizer cover and rf no. 1 (A) card A12A1. Reinsert card using card extender.

(b) Set FREQUENCY KC dials to 22000.0 kc.

(c) Energize exciter as instructed in paragraph 2-5b up to and including step (13).

(d) Connect multimeter between A12A1J1(TP) and ground. Adjust A12A1L3 for +10 volts dc. See figure 5-72.

(e) Connect oscilloscope between A12A4J2(TP) and ground. Observe locked pulse on scope. See figure 5-73.

(f) Change FREQUENCY KC setting to 12000.0 kc. Adjust A12A1L2 for +10 volts dc (read on multimeter at A12A1J1(TP).

(g) Observe same oscilloscope presentation as in step (e) (oscilloscope connected to A12A4J2(TP).

(h) With oscilloscope and multimeter connected to A12A4J2(TP) and A12A1J1(TP), respectively, change FREQUENCY KC setting to 02000.0 kc. Adjust A12A1L1 for +10 volts dc. Observe same oscilloscope presentation as in steps (e) and (g).

g. RF NO. 3 CARD A12A2. (See figures 5-25 and 5-29.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Oscilloscope, Tektronix 585A.

(b) RF Voltmeter, Boonton 91CA.

(c) Alignment tool, J. F. D. S284.

(d) Test jig (see figure 2-2).

(e) Synthesizer card extender.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-75.

(a) Turn off exciter. Remove synthesizer exciter and rf no. 3 card A12A2. Reinsert card using card extender.

(b) Energize exciter as instructed in paragraph 2-5b.

(c) Connect rf voltmeter between ground and junction of A12A2R54 and A12A2C35. Voltmeter should read approximately 20 millivolts rms.

(d) Connect rf voltmeter between A12A2C2 and ground. Voltmeter should read approximately 0.5 millivolts, rms.

(e) Connect oscilloscope between collector of A12A2Q3 and ground. Observe a 2.7 mc to 2.8 mc signal of approximately 1 volt peak-to-peak. Frequency will depend on front panel FREQUENCY KC setting.

(f) Connect oscilloscope to collector of A12A2Q6. Adjust A12A2C32 for maximum amplitude. Observe a 2.7 mc to 2.8 mc signal (depending on FREQUENCY KC setting) of approximately 1.5 volts peak-to-peak.

(g) Connect oscilloscope between A12A2J1(TP) and ground. Adjust A12A2L3 for 5 volts dc. Assure that the pattern observed on the scope is pure dc with no ac component.

Note

This is a locked condition; a sawtooth pattern indicates an unlocked loop. Inductor A12A2L3 should be adjustable between +3 and +8 volts without unlocking the loop.

(h) Connect oscilloscope between A12A2 terminal B and ground. Observe a 0.5 volt rms, 117.2 mc to 117.3 mc signal.

Note

Frequency depends on FREQUENCY KC setting.

h. MODULATORS A1 THROUGH A4. (See figures 5-5, 5-6, and 5-7.)

Note

The following procedures are applicable to modulators A1 through A4. The following is a list of modulators and their associated audio channel designations:

Modulator	Channel
A1	B2
A2	B1
A3	A1
A4	A2

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Calorimetric power meter, H-P 434A.

(b) Dual-tone audio signal generator, SG-376/U.

(c) Alignment tool, J. F. D. S284.

(d) Modulator extender cable.

(e) Test jig (see figure 2-2).

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1 except set following controls as indicated below:

CLASS OF EMISSION	-	SSB -∞
SIDEBAND SELECTOR	-	(4) ISB
CHANNEL GAIN RATIO	-	Channel under test - 85; all others, fully ccw
INPUT LEVEL switch	-	Channel under test

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-64.

(a) Turn off exciter and remove modulator module.

(b) Connect modulator to its chassis socket using the appropriate extender cable.

(c) Connect calorimetric power meter to exciter rear panel RF OUTPUT connector.

(d) Disconnect cables from rear panel TGC and PPC connectors.

(e) Connect dual-tone audio signal generator to appropriate CHANNEL TEST jack for channel under test.

(f) Set frequency of the two tones for 1000 cps and 1625 cps. Adjust both signal levels to 0 db across 600 ohms (0.775 volt rms).

(g) Energize exciter as instructed in paragraph 2-5b (through step (13)).

(h) Adjust appropriate INPUT LEVEL -dbm control for a reading of 0 dbm on the INPUT LEVEL meter.

(i) On the auxiliary panel, adjust PWR control R34 fully counterclockwise; then adjust PWR control for an output of 50 milliwatts on the power meter. 212

(j) Place test jig TUNE ENABLE/READY switch in the READY position.

(k) On modulator board no. 2, adjust R8 first for a maximum reading on the power meter. Then adjust R8 counterclockwise to a point where the power indication decreases slightly.

(l) On modulator board no. 2, adjust R32 for a reading of 25 milliwatts on the power meter.

(m) Adjust the appropriate INPUT LEVEL -dbm control for a 0.5 dbm increase on the INPUT LEVEL meter.

Note

The power meter reading should decrease slightly.

(n) Disconnect test equipment and reinstall modulator in its socket.

(o) Set all four CHANNEL GAIN RATIO controls to 85.

(p) Reconnect TGC and PPC cables removed in step (d).

i. UP-CONVERTER A11. (See figures 5-21 through 5-24.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Calorimetric power meter, H-P 434A.

(b) RF Voltmeter, H-P 411B.

(c) Multimeter, AN/PSM-6.

(d) Dual-tone audio signal generator, SG-376/U.

(e) Dc power supply, Power Design 4005 (0-40 vdc, 0-500 ma).

(f) Test jig (see figure 2-2).

(g) Up-converter extender cable.

(h) Alignment tool, J. F. D. S284.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1 except set following controls as indicated below:

NORMAL/FAULT OVRD	FAULT OVRD
CLASS OF EMISSION	USB
SIDEBAND SELECTOR	A0
CIRCUIT TEST switch	POWER OUTPUT
PWR potentiometer	Center

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figures 5-70 and 5-90, sheet 4.

(a) Turn off exciter. Remove up-converter and down-converter modules. Connect up-converter to its chassis socket using the up-converter extender cable.

(b) Disconnect cables from rear panel TGC and PPC connectors.

(c) Connect calorimetric power meter to exciter rear panel RF OUTPUT connector.

(d) Connect rf voltmeter to pin S of down-converter socket A18XA13.

(e) Energize exciter as instructed in paragraph 2-5b (through step (13)).

(f) Adjust potentiometer A11A3R3 for a 2 millivolt reading on the rf voltmeter.

(g) Place test jig TUNE ENABLE/READY switch in READY position.

(h) Adjust A11A1L1, A11A1L4, and A11A3L1 for maximum reading on rf voltmeter. (Level should be between 2 and 20 millivolts.)

(i) Turn off exciter. Disconnect rf voltmeter and reinstall down-converter in its socket. Re-energize exciter as instructed in paragraph 2-5b (up to and including step (13)).

(j) Adjust PWR control for a reading of 50 milliwatts on the power meter.

(k) Place test jig TUNE ENABLE/READY switch in READY position.

(l) Adjust A11A3R29 for a reading of 100 milliwatts on the power meter. If adjustment of A11A3R29 will not provide required output, adjust A11A3R9 for the required 100 milliwatt reading.

(m) Set CLASS OF EMISSION switch to SSB -∞. Press exciter TUNE push-button. Set test jig TUNE ENABLE/READY switch to TUNE ENABLE. After transmitter gain control has stopped running, set test jig switch to READY.

(n) Connect dual-tone audio signal generator to CHANNEL TEST A1 jack. Adjust signal generator outputs to 1000 cps and 1625 cps (each at 0 db).

(o) Adjust A11A1R17 for a reading of 100 milliwatts on the power meter.

(p) Set CLASS OF EMISSION switch to A0. Set test jig switch to READY. Press exciter TUNE pushbutton. Set test jig switch to TUNE ENABLE.

(q) Adjust A11A3R29 for 100 milliwatts.

(r) Set CLASS OF EMISSION switch to SSB -∞. Set test jig switch to READY. Press exciter TUNE pushbutton. Set test jig switch to TUNE ENABLE.

(s) Set SIDEBAND SELECTOR to (4)ISB. Adjust A11A3R22 for 25 milliwatts on power meter.

(t) Set SIDEBAND SELECTOR to (2)ISB. Adjust A11A3R24 for 50 milliwatts.

(u) Set SIDEBAND SELECTOR to LSB. Power meter should read 100 milliwatts.

(v) Set SIDEBAND SELECTOR to (4)ISB. Power meter should read 25 milliwatts.

(w) Disconnect signal from channel A1 and connect it to channel A2. Power meter should read 25 milliwatts.

(x) Set SIDEBAND SELECTOR to USB and CLASS OF EMISSION switch to A2, A3e. Set test jig switch to READY. Press exciter TUNE button. Set test jig switch to TUNE ENABLE. After transmitter gain control motor stops running, set test jig switch to READY.

(y) Power meter should read 100 milliwatts.

(z) Remove test signal from channel A2. Power meter should read 50 milliwatts.

(aa) Set dc power supply output to zero volts. Connect power supply output terminals (via a BNC/alligator adapter) to exciter rear panel PPC connector.

(bb) Set CLASS OF EMISSION switch to SSB -∞. Press exciter TUNE button. Set test jig switch to TUNE ENABLE. After transmitter gain control motor stops running, set test jig switch to READY.

(cc) Increase power supply output to +4 volts dc. Adjust A11A1R10 for a reading of +5 volts dc on the collector of A11A1Q4.

(dd) Adjust A11A1R6 for maximum reading on power meter.

(ee) Increase power supply output to 4.1 volts dc. Adjust A11A1R6 to the point where the power meter reading just starts to decrease.

Note

This adjustment sets the PPC threshold at +4 volts dc, and ensures PPC action when a slight increase in PPC voltage is supplied to the exciter.

(ff) Disconnect test equipment, reconnect cables removed in step (b), and reinstall up-converter in its chassis socket.

j. 112 MC FILTER FL5. (See figure 5-2 and 5-90, sheet 5.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Signal generator, H-P 608D.

(b) RF Voltmeter, Boonton 91CA.

(c) 50-ohm load adapters (2).

(d) Alignment tool, J. F. D. S284.

(2) CONTROL SETTINGS. - Not applicable.

(3) TEST SETUP. - See procedures below.

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES.

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(a) Turn off exciter. Remove two coaxial cables connected to 112 mc filter FL5.

(b) Remove screws securing filter to exciter chassis. Remove filter.

(c) Connect signal generator to filter input connector, and rf voltmeter to filter output connector.

Note

Terminate input and output in 50 ohms.

(d) Remove seven variable capacitor covers from filter.

(e) Adjust signal generator output to 112 mc at 0 db.

(f) Tune all seven capacitors for a maximum reading on the rf voltmeter.

Note

The filter output should not be more than 13 db down from the input.

(g) Replace capacitor covers, disconnect test equipment, and reinstall filter in exciter chassis.

k. TRANSMITTER GAIN CONTROL A14 (MECHANICAL ADJUSTMENT). (See figures 5-39 through 5-41.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Multimeter, AN/PSM-6.

(b) Transmitter gain control module extender cable.

(c) Test jig (see figure 2-2).

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-80.

(a) Turn off exciter. Carefully remove transmitter gain control module A14.

(b) Unlock cover fasteners and remove module cover.

(c) Loosen (but do not remove) two setscrews fastened to coupling cam connecting motor drive shaft to potentiometer R1.

(d) Loosen three screws which secure potentiometer R1 to module frame.

(e) Connect ohmmeter between R1 terminals S and (+).

(f) Manually turn cam coupling until cam slot activates limit switch S1. Limit switch S1 will be closed when it is actuated. If limit switch does not actuate, loosen hardware securing switch to the module frame and gently move switch until it actuates. Secure hardware.

(g) Manually rotate potentiometer R1 until ohmmeter reads minimum resistance. Minimum resistance may be anywhere between zero and 25K ohms. Secure the three screws.

(h) Turn cam coupling until cam slot activates limit switch S2.

(i) Connect ohmmeter to R1 terminals S and (-). Ohmmeter should read between zero and 25K ohms. If a higher resistance is read, repeat steps (f), (g), and (h).

(j) Secure two setscrews on the coupling shaft.

(k) Connect the transmitter gain control module to the exciter using the extender cable.

CAUTION

Do not attempt to use brute force when connecting extender cable to either the module or chassis connector; this could result in bent or pushed connectors.

(l) Energize exciter as instructed in paragraph 2-5b.

Note

Make sure no input cable is attached to the rear panel TGC coaxial BNC connector.

(m) Ensure that the cam coupling slot activates limit switch S1 in an exciter tune fault condition and actuates the limit switch S2 in an exciter tune enable condition. At no time should both S1 and S2 be simultaneously actuated. If S1 and S2 should activate simultaneously, repeat complete alignment procedure.

(n) Turn off exciter, remove cable extender from exciter and module, replace module cover, and reinstall transmitter gain control module.

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l. TRANSMITTER GAIN CONTROL A14 (ELECTRICAL ADJUSTMENT). (See figures 5-39 through 5-41.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) Multimeter, AN/PSM-6.

(b) Dc power supply (0-40 vdc, 0-500 ma), Power Design 4005.

(c) Transmitter gain control module extender cable.

(d) Test jig (see figure 2-2).

(e) Six-foot cable, RG-58/U. Alligator clips on one end; BNC connector on the other.

(f) Alignment tool, J. F. D. S284.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1, except set CIRCUIT TEST switch to TGC.

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(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figures 5-80 and 5-90, sheet 4.

(a) Turn off exciter. Carefully remove transmitter gain control module A14, down-converter module A13, and output amplifier module A16. Disconnect cable from rear panel TGC connector.

(b) Unlock transmitter gain control module cover fasteners and remove cover.

(c) Connect transmitter gain control module to its chassis socket using extender cable.

(d) Rotate PWR potentiometer fully clockwise. Set NORMAL/FAULT OVRD switch to OVRD.

Note

The switch must be in the OVRD position, because the exciter will indicate a fault. The fault will occur because the down-converter has been removed from the exciter.

(e) Energize exciter as instructed in paragraph 2-5b.

(f) Inhibit the exciter by changing the setting of one of the FREQUENCY KC dials. TGC should now be at its minimum gain point and CIRCUIT TEST meter should read approximately 100. The cam slot should be actuating limit switch S1.

(g) Connect voltmeter to the wiper arm of A14A1R18. Adjust R18 for a reading of -5 volts dc. This adjustment sets the threshold of the TGC closed circuit.

(h) Place exciter in a tune enable condition. TGC should now be at its maximum gain point and CIRCUIT TEST meter should read 20 or less. The cam slot should be actuating limit switch S2.

(i) Attach dc power supply (0 volt output) to exciter rear panel TGC BNC connector using the special RG-58/U coaxial cable (BNC/alligator clips).

(j) Inhibit the exciter as in step (f). TGC will move to its minimum gain point and CIRCUIT TEST meter will read approximately 100.

(k) Increase power supply output to +5 volts. No change should be observed on CIRCUIT TEST meter. Decrease power supply output to zero volts.

(l) Place exciter in a tune enable condition. TGC should not be at its maximum gain point and CIRCUIT TEST meter should read 20 or less.

(m) Connect voltmeter to pin U of down-converter chassis connector A18XA13. Adjust A14A2R4 for a maximum reading on voltmeter. Reading should not be more than +20 volts.

(n) Turn PWR potentiometer fully counterclockwise. Voltmeter reading should increase to not less than +85 volts. Rotate PWR potentiometer to its fully clockwise position. Voltmeter reading should return to not more than +20 volts.

(o) Increase power supply output to +5 volts. Voltmeter reading should increase to +85 volts or more.

(p) Connect voltmeter between A14A1J1(TP) and ground. Voltmeter reading should be zero.

(q) Disconnect power supply from exciter.

(r) Turn off exciter and remove the extender cable from both the exciter and the transmitter gain control module. Replace module cover.

(s) Reinstall output amplifier, down-converter, and transmitter gain control modules in their respective chassis sockets. Set NORMAL/FAULT OVRD switch to NORMAL. Set PWR potentiometer to its fully counterclockwise position.

(t) Energize exciter as instructed in paragraph 2-5b, up to and including step (13). (This places exciter in "tune enable" condition.) Reading on CIRCUIT TEST meter should read 90 or more. Slowly rotate PWR potentiometer to its fully clockwise position, noticing change on CIRCUIT TEST meter from 90 or more towards 20 or less. Return PWR potentiometer to its fully counterclockwise position.

CAUTION

Do not keep PWR potentiometer in its fully clockwise position for an extended period of time, as damage to the output amplifier module might result.

(u) Turn off exciter.

m. DOWN-CONVERTER A13. (See figures 5-35 through 5-38.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) RF Voltmeter, Boonton 91CA.

(b) Multimeter, AN/PSM-6.

(c) 50-ohm load adapter.

(d) Calorimetric power meter, H-P 434A.

(e) Output amplifier module extender cable.

(f) Down-converter module extender cable.

(g) Test jig (see figure 2-2).

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-79.

(a) Turn off exciter. Remove down-converter module A13 and output amplifier module A16. Disconnect cables from rear panel TGC and PPC connectors.

(b) Remove module covers. Connect down-converter and output amplifier to their respective chassis sockets using appropriate extender cables. Connect rf power meter to rear panel RF OUTPUT connector.

(c) Energize exciter as instructed in paragraph 2-5b ("ready" mode of operation).

(d) Connect rf voltmeter to junction of A13A3A1R1 and A13A3A1R2. Voltmeter reading should be 200 millivolts ±50 millivolts. (Exact reading depends upon FREQUENCY KC setting.)

(e) Connect rf voltmeter to junction of A13A2R1 and A13A2C3. Voltmeter reading should be approximately 3.5 millivolts.

(f) Set test jig TUNE ENABLE/READY switch to TUNE ENABLE. Connect dc voltmeter between A13A2 terminal 6 and ground.

(g) Rotate PWR control fully clockwise. Voltmeter reading should be less than +20 volts dc.

(h) Rotate PWR control fully counterclockwise. Voltmeter reading should be greater than +85 volts dc.

(i) Set test jig switch to READY. Connect rf voltmeter between A13A3A1 terminal 4 and ground. Voltmeter reading (82-110 mc amplifier output) should be 3 volts ±2 db. (Exact reading depends upon FREQUENCY KC setting.)

(j) Connect rf voltmeter between terminals 2 and 3 of A13A2. Set PWR control to mid-range. Adjust A13A2L3 and A13A2L4 for maximum reading on voltmeter.

(k) Adjust PWR control for a reading of 125 milliwatts on power meter. Voltmeter (at terminal 2 of A13A2) should read at least 125 millivolts.

(l) Connect rf voltmeter between output amplifier card A16A1 terminals 3 and 4. Measured signal should be approximately 12 millivolts. See figures 5-45 and 5-82.

(m) Turn off exciter. Disconnect test equipment. Reconnect operational cables to rear panel connectors. Reinstall down-converter and output amplifier in their respective chassis sockets.

n. AUXILIARY FREQUENCY GENERATOR A7. (See figures 5-10 through 5-13.)

(1) TEST EQUIPMENT AND SPECIAL TOOLS.

(a) RF Signal generator, H-P 608D.

(b) Auxiliary frequency generator extender cable.

(c) Test jig (see figure 2-2).

(d) Alignment tool, J. F. D. S284.

(2) CONTROL SETTINGS. - Preset exciter controls in accordance with table 3-1, except set NORMAL/FAULT OVRD switch to FAULT OVRD.

(3) TEST SETUP. - Exciter connected to test jig as instructed in paragraph 2-5b (through step (4)).

(4) CONNECTIONS. - See procedures below.

(5) PROCEDURES. - See figure 5-66.

(a) Turn off exciter and remove auxiliary frequency generator module A7.

(b) Connect auxiliary frequency generator to its chassis socket using module extender cable. Remove module cover. 220

(c) Disconnect coaxial cable from frequency standard. Connect signal generator in its place.

(d) Adjust signal generator output to 1 mc at 1 volt.

(e) Energize exciter as instructed in paragraph 2-5b.

(f) Decrease signal generator output by 3 db.

(g) If the STD FAIL lamp is on, adjust A7A1R10 until lamp extinguishes; then adjust A7A1R10 to the point where the lamp lights.

(h) Disconnect signal generator and reconnect frequency standard cable. STD FAIL lamp should extinguish.

(i) Turn off exciter. Replace module cover and reinstall module in its chassis socket.

5-4. REPAIR.

a. GENERAL. - The exciter is designed to require a minimum repair effort. It is composed of readily accessible and replaceable plug-in subassemblies and circuit boards. Access to most circuits is obtained by removing module covers and extracting printed circuit cards or by unplugging the module from the chassis. Paragraph 5-5 contains complete instructions for removal and replacement of circuit boards and modules.

CAUTION

Place exciter unit at "standby" before attempting to remove or replace modules.

b. MODULE REPAIR TECHNIQUES. - Module repair, at a field maintenance level, will consist of identifying, removing, and replacing the faulty module or plug-in printed circuit card.

c. USE OF PARTS LOCATION AND SCHEMATIC DIAGRAMS. - When repairing any plug-in module or printed circuit card, refer to the applicable parts location diagram and schematic. The parts location diagrams in this section identify and locate all replaceable electric parts.

d. PRINTED CIRCUIT REPAIR TECHNIQUES. - When modules or printed-circuit cards must be repaired in the field, observe all precautions applicable for soldering small parts on printed-circuit boards. To protect board and part from damage, use a heat sink such as long-nose pliers or metal clips at the part to be soldered. Solder as rapidly as possible using as low a wattage soldering iron as practical. The "siphon" type iron especially made for removing molten solder is recommended.

5-5. MODULE REMOVAL AND REPLACEMENT.

a. GENERAL. - This paragraph contains instructions for the removal and subsequent replacement of plug-in modules, printed-circuit boards, and terminal boards from the exciter. The procedures given should be carefully followed to prevent damaging equipment. In no case should any module be forced into place.

b. PROCEDURES. - The exciter contains a number of plug-in modules and circuit boards having similar mounting arrangements. Removal and replacement instructions where identical will not be repeated for each module or circuit board, but will be described for general applications. Instructions for circuit modules which differ in removal and replacement instructions will be given separately.

(1) PLUG-IN MODULES. - All plug-in modules are secured to the chassis with from three to six captive screws, depending upon the module size.

(a) REMOVAL.

1. Loosen captive mounting screws which secure plug-in module to chassis assembly.

2. Remove plug-in module from its chassis connector, using a rocking motion.

3. Loosen captive cover screws and remove cover.

4. Remove individual printed-circuit boards by unsoldering board terminal connections.

(b) REPLACEMENT.

1. Place printed-circuit board in position on module.

2. Resolder terminal leads.

3. Secure module cover to module.

4. Plug module into its socket on the chassis. Make sure plug locating pins are centered in socket receptacles. Secure module using captive screws.

(2) CIRCUIT BOARDS. - Chassis located circuit boards, such as fault board A18A2 and power distribution board A18A6, do not plug in and require removal of all leads at the soldered terminals prior to board removal.

(a) REMOVAL.

1. Unsolder terminal leads noting lead numbers to facilitate replacement.

2. Remove securing screws and remove circuit board.

(b) REPLACEMENT.

1. Position board on chassis and secure with screws.

2. Resolder terminal leads using information noted during lead removal.

(3) PLUG-IN PRINTED-CIRCUIT BOARDS. - Transmitter control boards nos. 1 and 2 (A10 and A17) plug into transmitter control board A18A4. Unsoldering and resoldering of terminal leads is unnecessary for these circuit boards. See figures 5-1 and 5-2.

(a) REMOVAL.

1. Remove retaining clamp at top of circuit boards.

2. Pull board upwards along slides.

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(b) REPLACEMENT.

1. Locate board at top of slides. Note board orientation relative to the socket guide pins.

2. Plug in board, pressing downwards. Secure with clamp.

(4) SYNTHESIZER MODULE A12 PRINTED-CIRCUIT BOARDS. - The synthesizer module contains six plug-in circuit boards. These are removed using the card extractor supplied. See figures 5-25, 5-71, and 5-72.

(a) REMOVAL.

1. Loosen captive screws and remove module cover.

2. Using card extractor, unplug card from socket and withdraw along the module slides from the pocket.

CAUTION

Be sure to remove rf cable at connector A12J2 before attempting to remove rf no. 1 (A) card A12A1.

(b) REPLACEMENT.

1. Locate card at top of pocket slides. Note orientation relative to the socket guide pins.

2. Attach rf cable at connector A12J2 (card A12A1, only).

3. Plug in card, pressing downward.

4. Replace synthesizer module cover and secure with the captive screws provided.

5-6. REAR FILTER-PANEL REMOVAL AND REPLACEMENT.

To remove rear filter-panel on exciter case, first remove exciter from system relay rack or cabinet. Case mounting brackets at rear prevent filter-panel removal when unit is installed in cabinet.

a. REMOVAL.

(1) Remove rear mounting brackets at each side of case.

(2) Withdraw chassis assembly from case to expose retractable cables.

(3) Remove cable clamping blocks; one at each cable.

(4) Unplug cable connectors A19P1 and A19P2 from A18J8 and A18J9.

(5) Loosen captive screws securing panel to case and remove panel complete with retractable cables.

b. REPLACEMENT.

(1) Position filter panel at rear of exciter case. Secure with screws.

(2) Connect cables at A19P1 and A19P2 to connectors A18J8 and A18J9.

(3) Install cable clamping blocks; one for each cable.

(4) Close chassis assembly in case.

(5) Install rear mounting brackets at each side of case.

5-7. MAINTENANCE ILLUSTRATIONS.

Illustrations contained in this section of the manual are for use by the technician to maintain, trouble shoot, and repair the exciter. They consist of parts location illustrations, module schematic diagrams, interconnection diagrams, and an ac power distribution diagram.

a. PART LOCATION ILLUSTRATIONS. - Figures 5-1 through 5-61 are the part location illustrations. They identify the relative location of all parts, circuit elements, and test points within the equipment.

b. PRIMARY POWER DISTRIBUTION DIAGRAM. - Figure 5-62 shows the distribution of primary power in the exciter. It is an across-the-line type of diagram showing the circuit elements directly related to the distribution of ac power.

c. SCHEMATIC DIAGRAMS. - Schematic diagrams of each module and circuit board in the exciter, together with interconnection diagrams, are provided in figures 5-63 to 5-91. Primary signal path flow is indicated by heavy lines with arrowheads affixed indicating direction of flow. Light lines indicate secondary paths. The following information applies to all schematic diagrams in this section of the manual.

(1) All part values are given in ohms, picofarads, and microhenries unless otherwise indicated.

(2) The dc resistance of inductors and transformers is omitted when less than one ohm.

(3) All resistors are rated 1/4 watt unless otherwise indicated.

(4) All dc voltages measured at card terminals are made using a 20,000 ohm-per-voltmeter, unless otherwise stated. All ac voltage measurements with exception of the rf signal measurements are made with a 1000 ohm-per-voltmeter, unless otherwise indicated. All measurements are with respect to ground.

(5) The letters cw or ccw placed adjacent to the appropriate terminal of a potentiometer indicates the direction of rotation when viewed from the shaft end.

(6) For all relays, dc coil resistance is 600 ohms ±10%; pickup voltage is 18 vdc, max; dropout voltage is 14 vdc max, 1.5 vdc, min. Exception: dc coil resistance of relay A18A5K1 is 400 ohms ±10%.

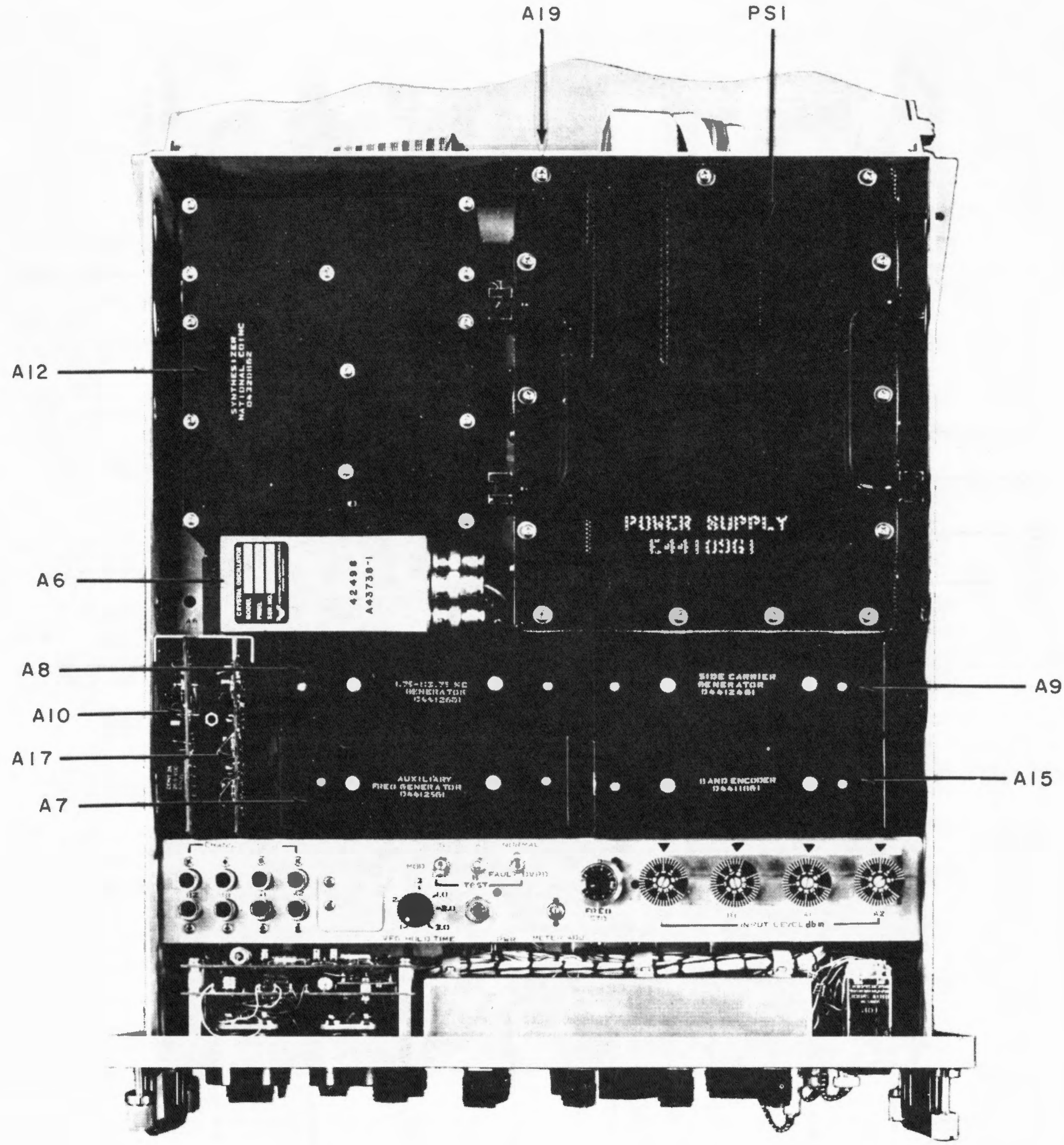

Figure 5-1. Modulator-Synthesizer MD-777/FRT, Top View Case Removed

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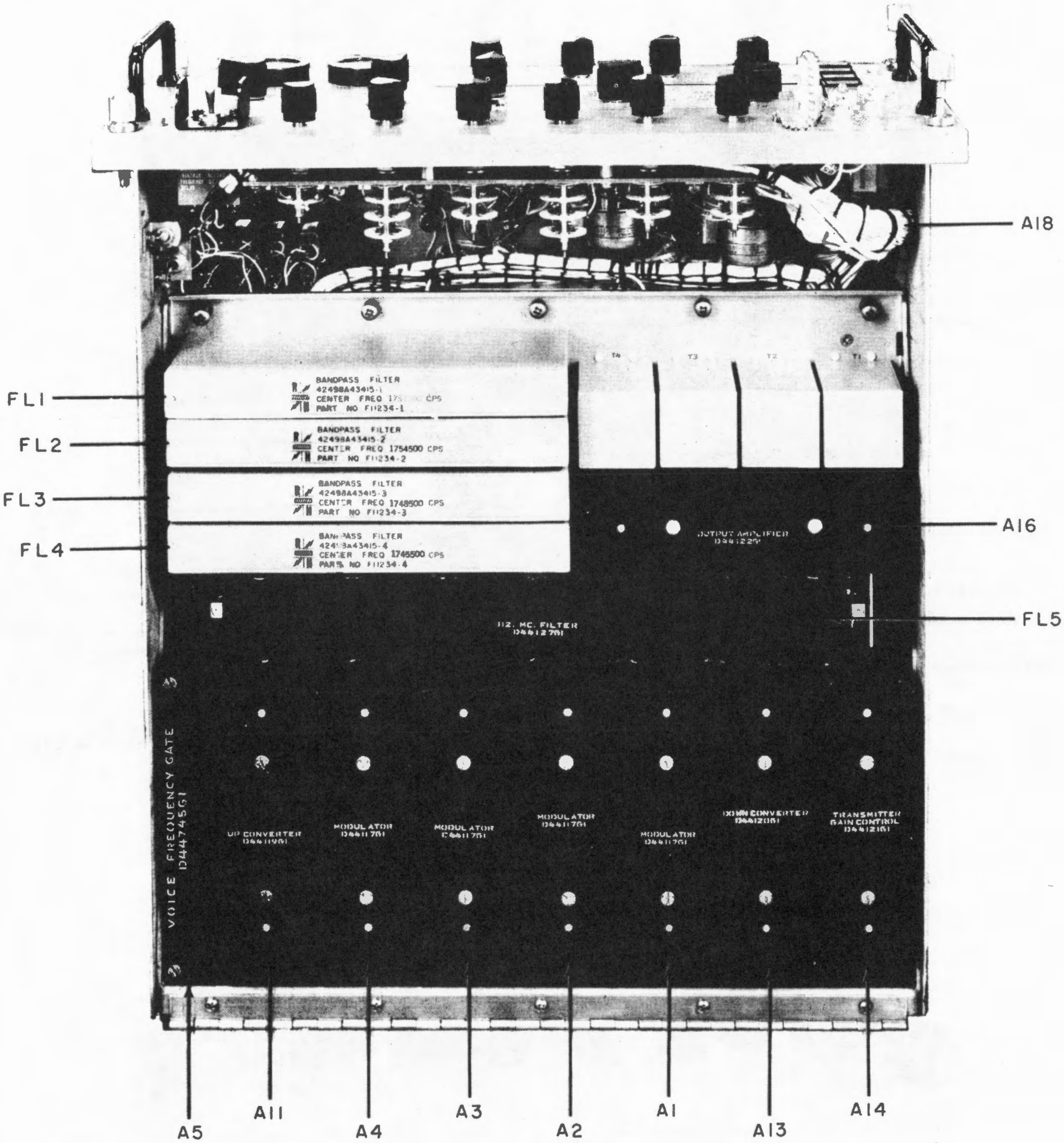

Figure 5-2. Modulator-Synthesizer MD-777/FRT, Bottom View Case Removed

226

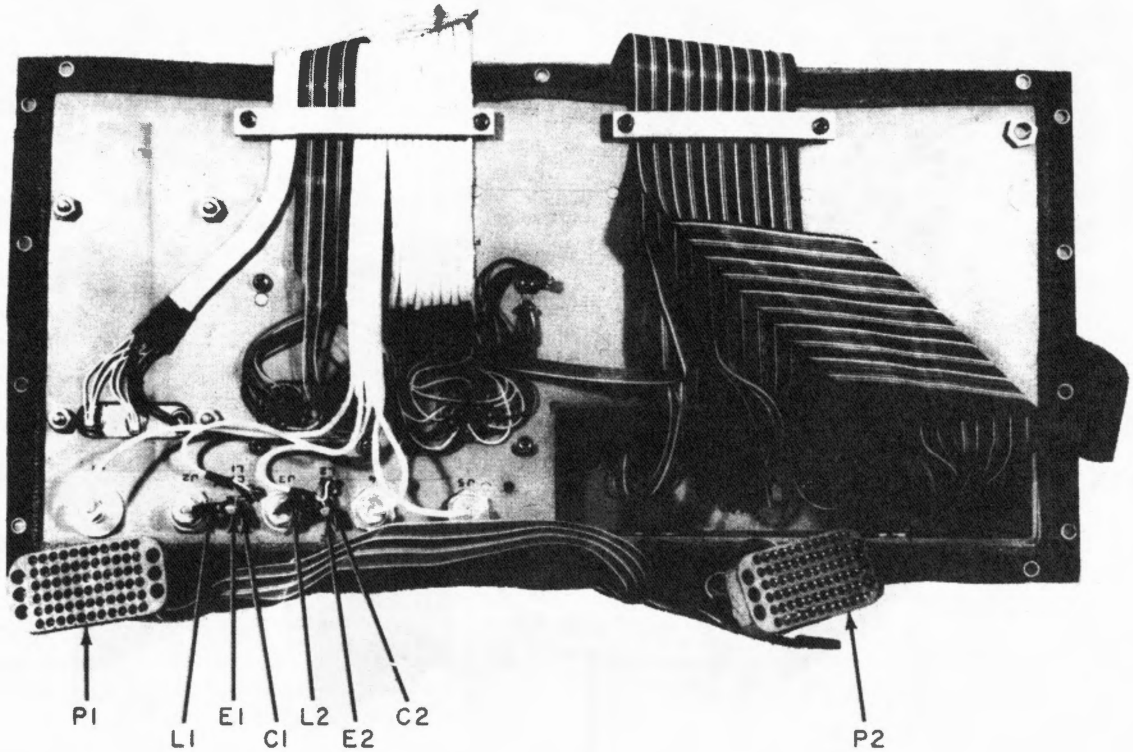

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Figure 5-3. Modulator-Synthesizer MD-777/FRT, A19, Rear Filter-Panel, Front View

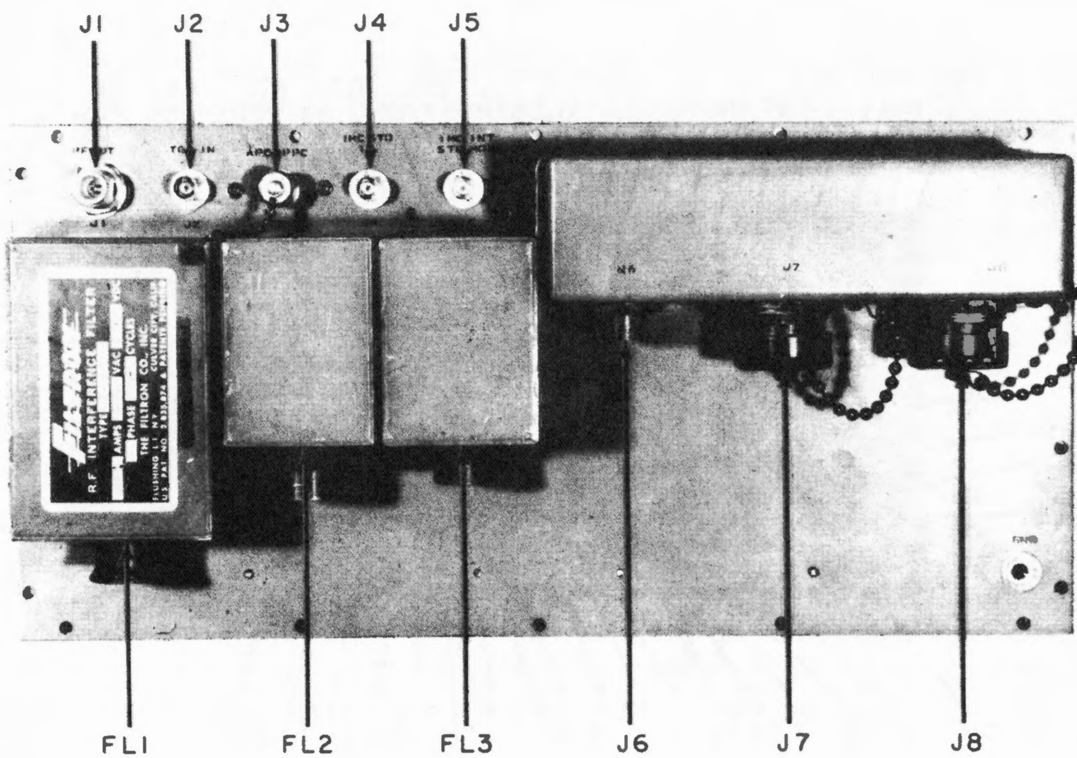


Figure 5-4. Modulator-Synthesizer MD-777/FRT, A19, Rear Filter-Panel, Rear View

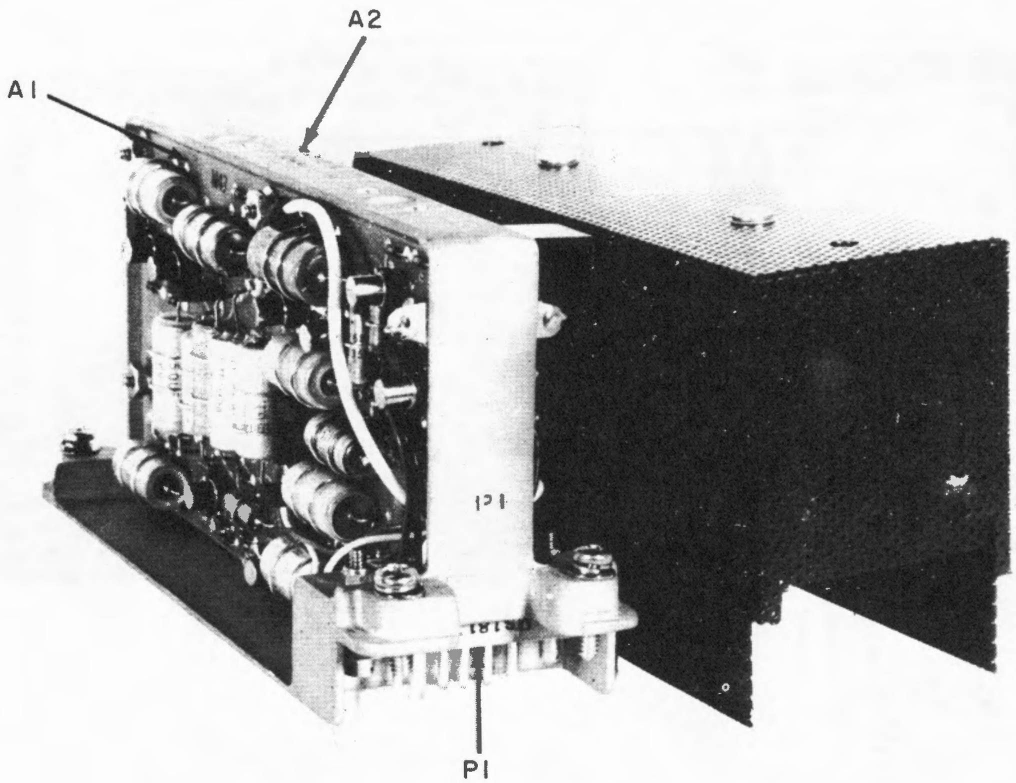


Figure 5-5. Modulator Assembly A1, A2, A3, A4

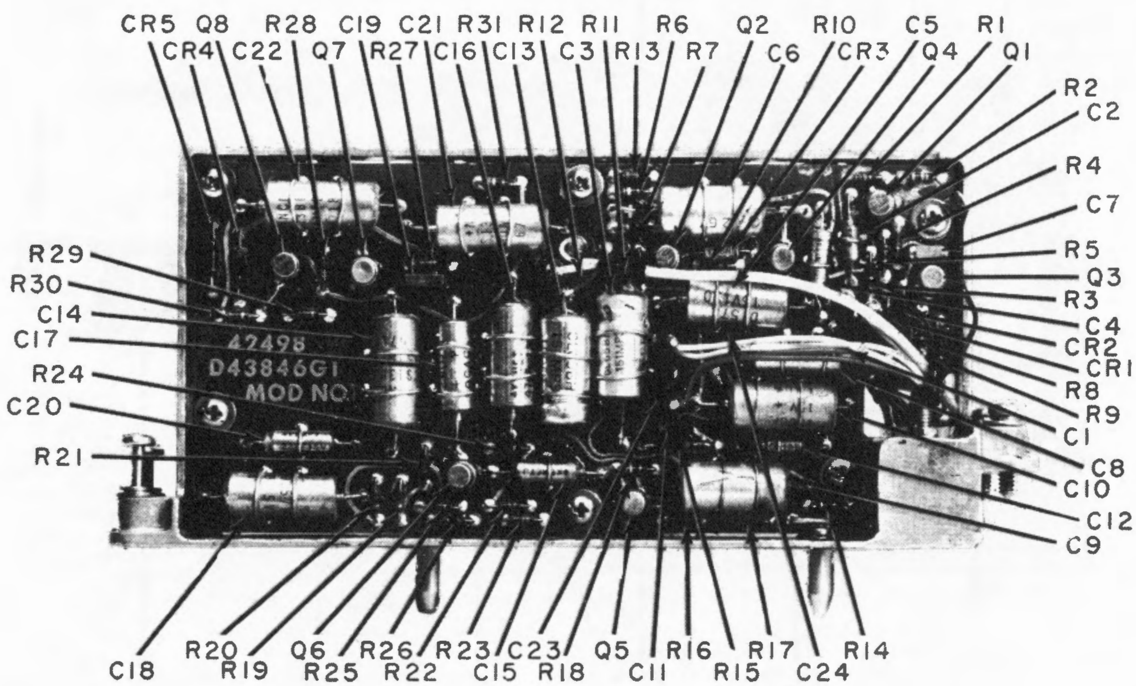
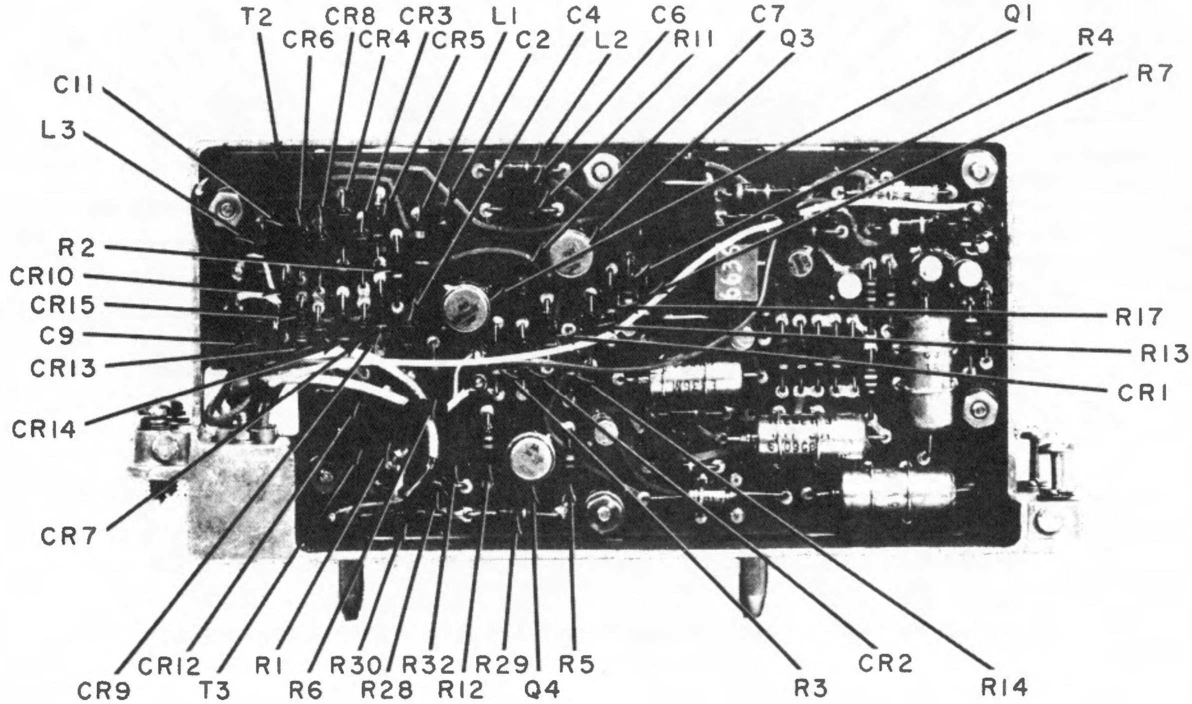


Figure 5-6. Modulator Board No. 1 (A1A1, A2A1, A3A1, A4A1), Parts Location



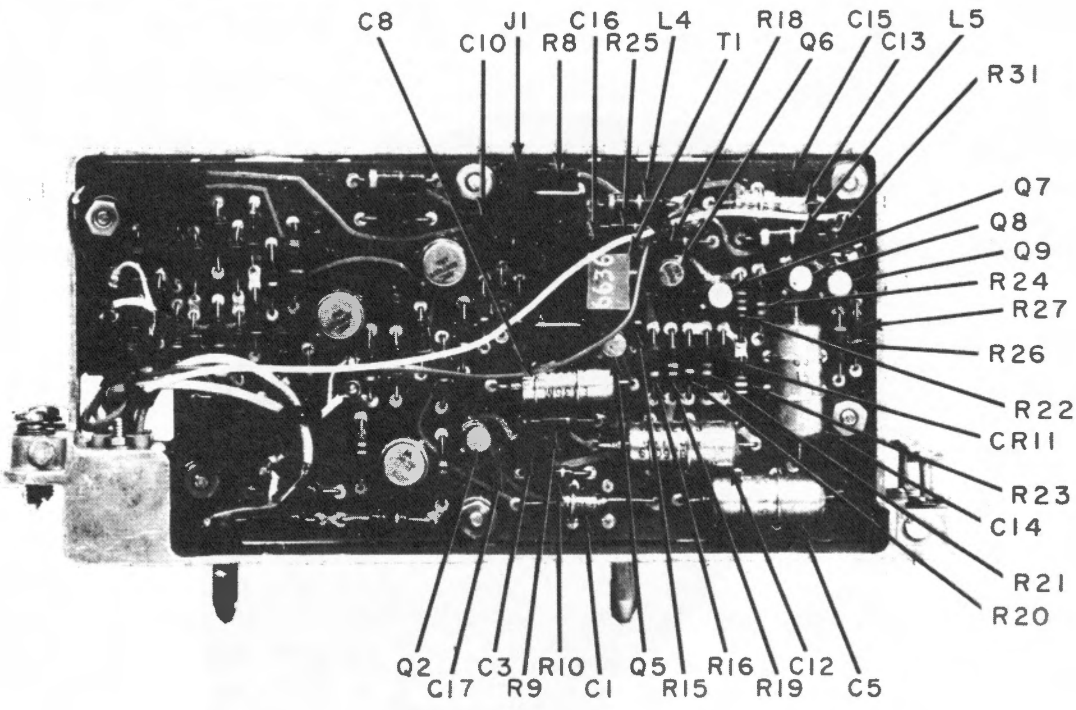


Figure 5-7. Modulator Board No. 2 (A1A2, A2A2, A3A2, A4A2), Parts Location

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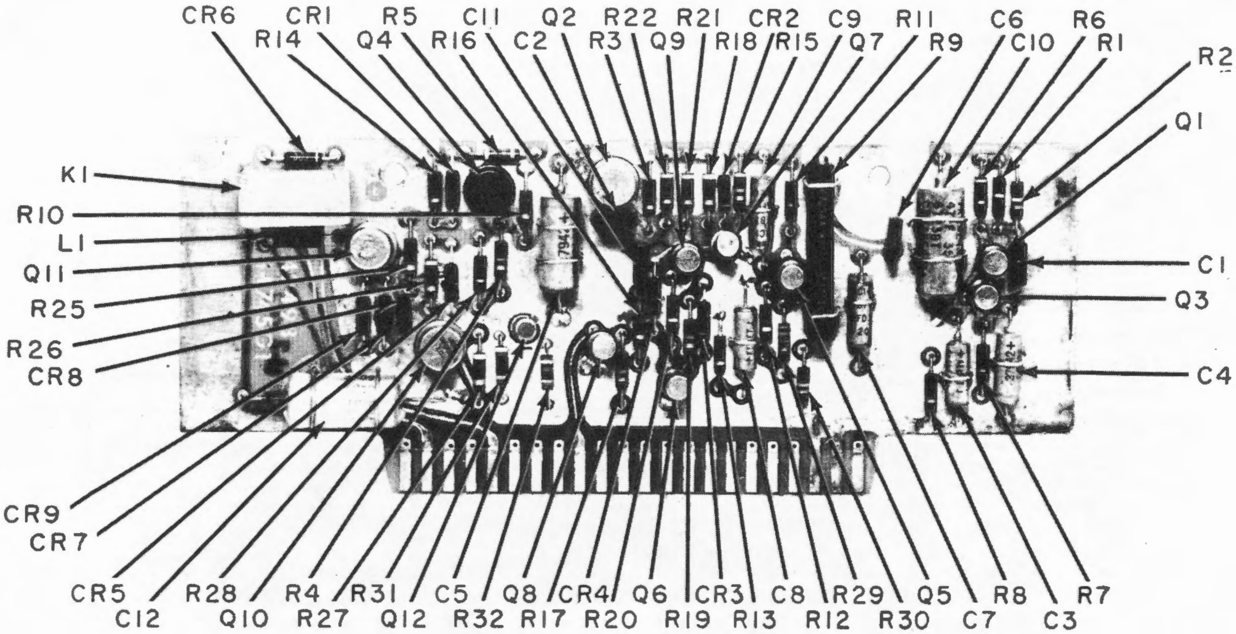

Figure 5-8. Voice Frequency Gate A5, Parts Location

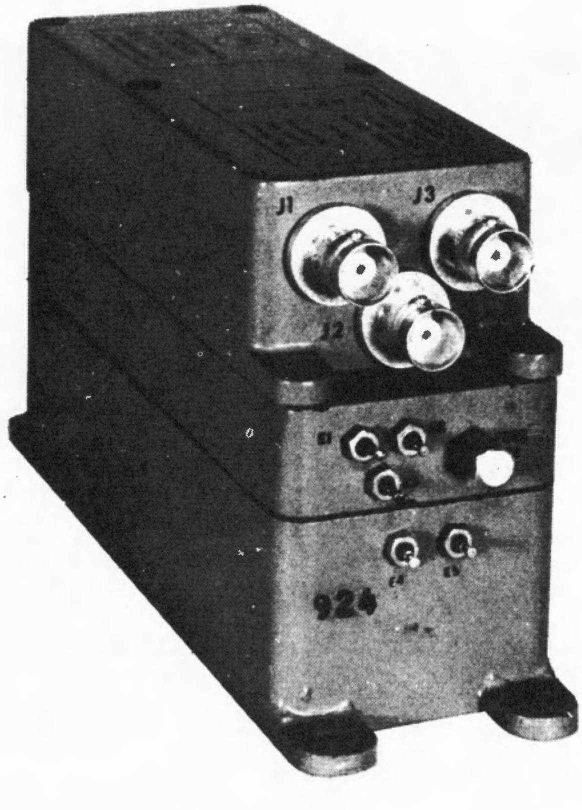

Figure 5-9. Frequency Standard A6, Nonrepairable Assembly

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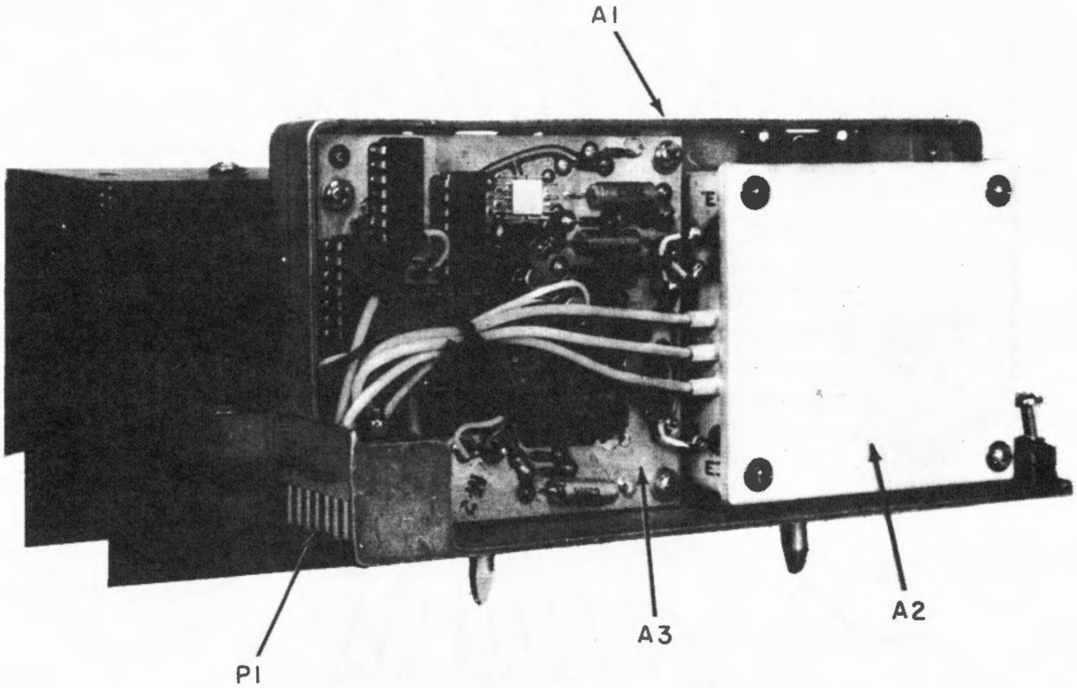

Figure 5-10. Auxiliary Frequency Generator Assembly A7, Parts Location

231

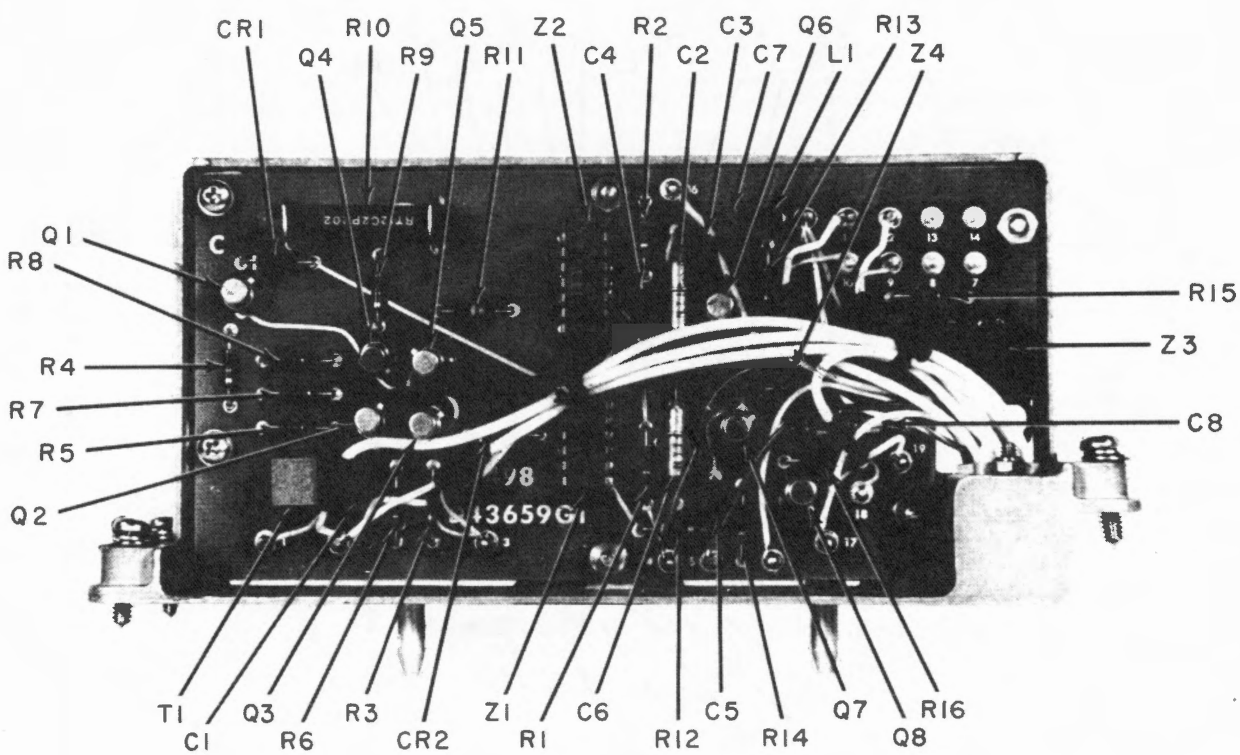

Figure 5-11. Frequency Standard Selector A7A1, Part of Auxiliary Frequency Generator A7, Parts Location

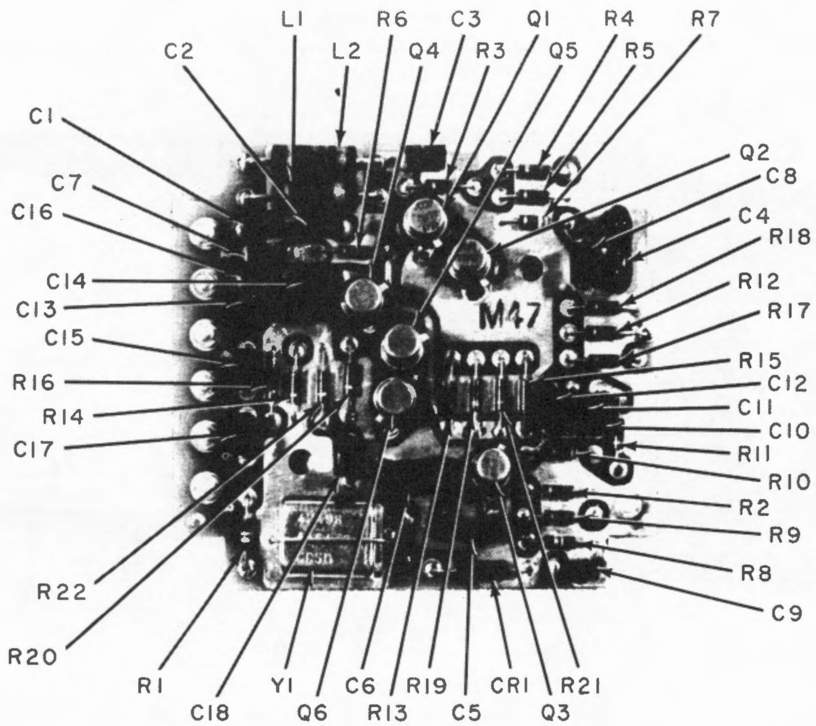

Figure 5-12. 30 Mc Oscillator A7A2, Parts Location

232

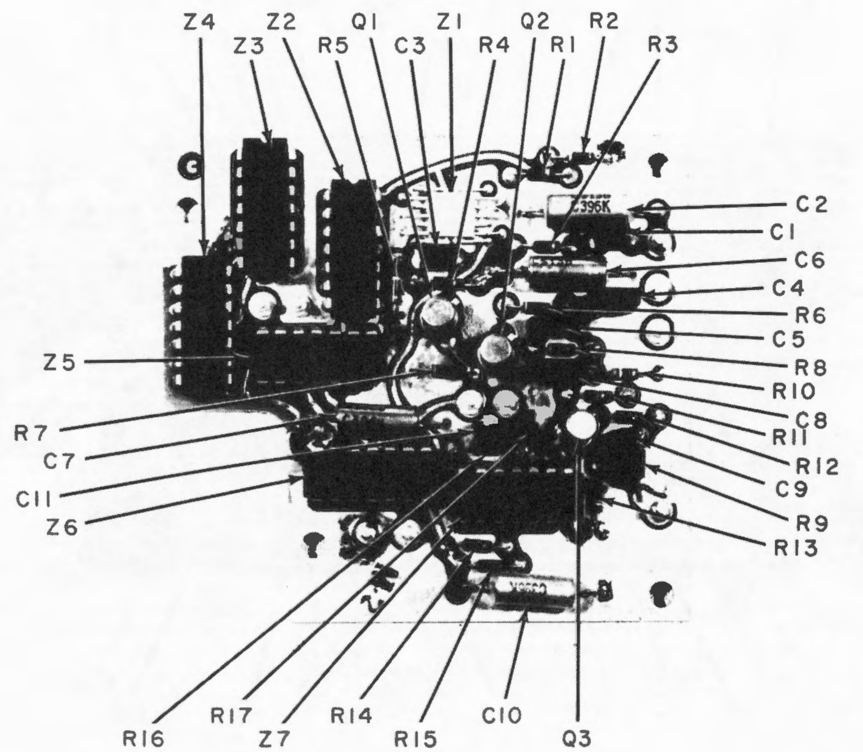

Figure 5-13. 30 Mc Phase-Locked Loop A7A3, Parts Location

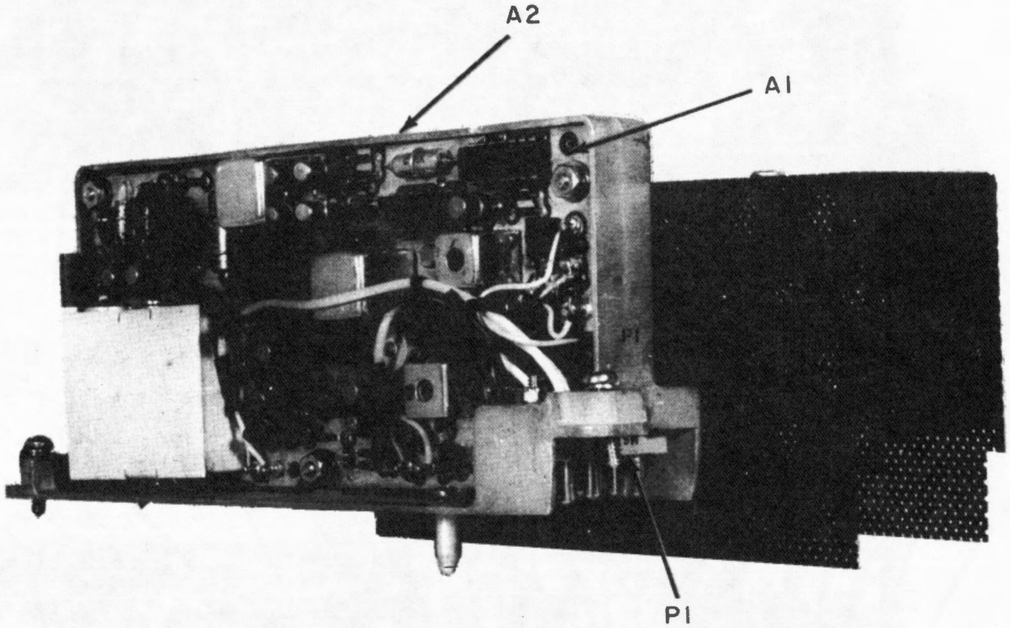

Figure 5-14. 1.75 MHz - 113.75 MHz Generator Assembly, A8

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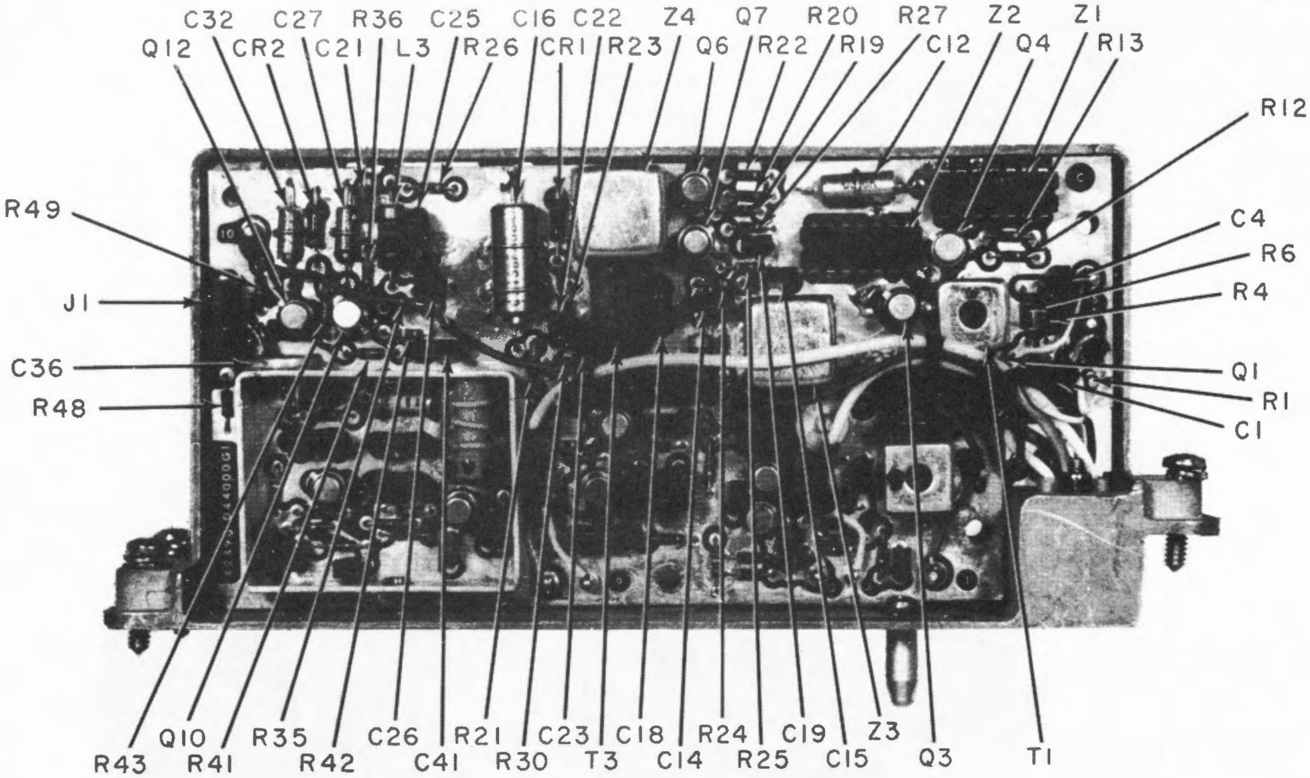

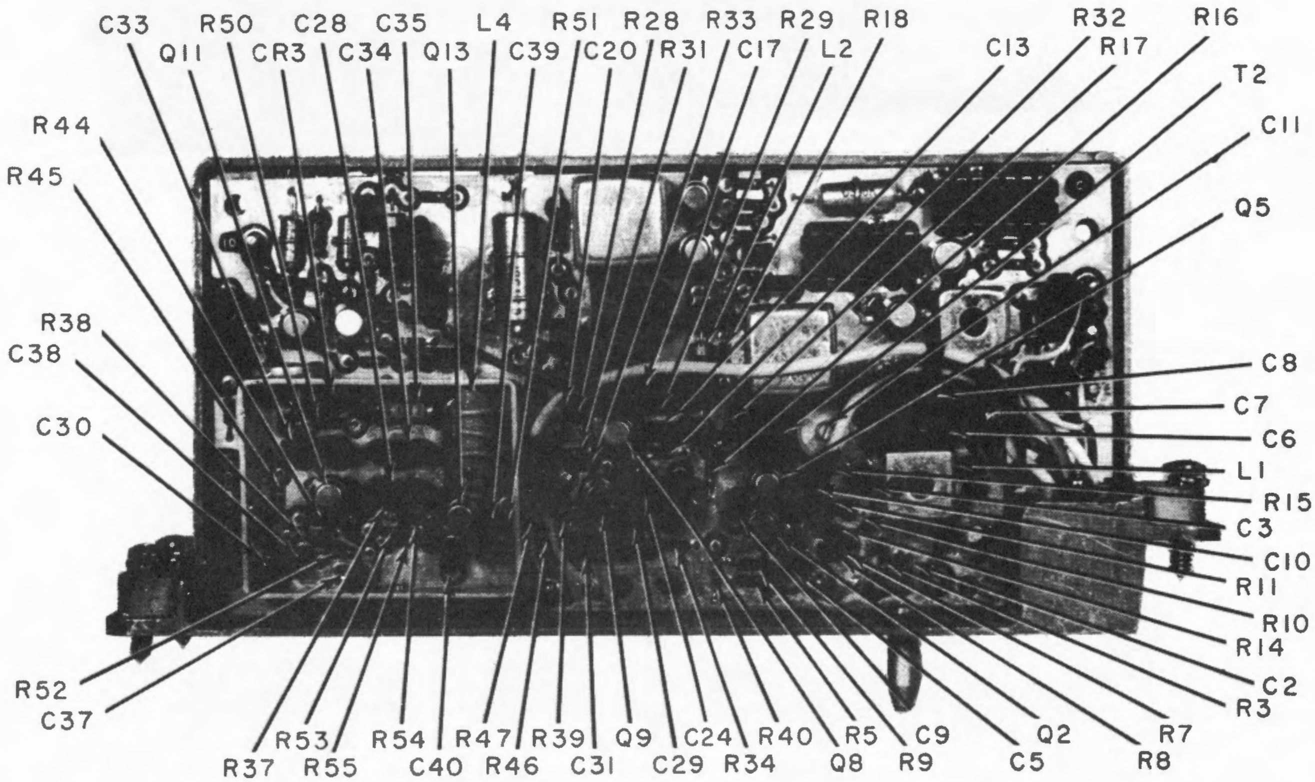

Figure 5-15. 113.75 Mc Generator A8A1, Part of 1.75/113.75 Mc Frequency Generator A8, Parts Location

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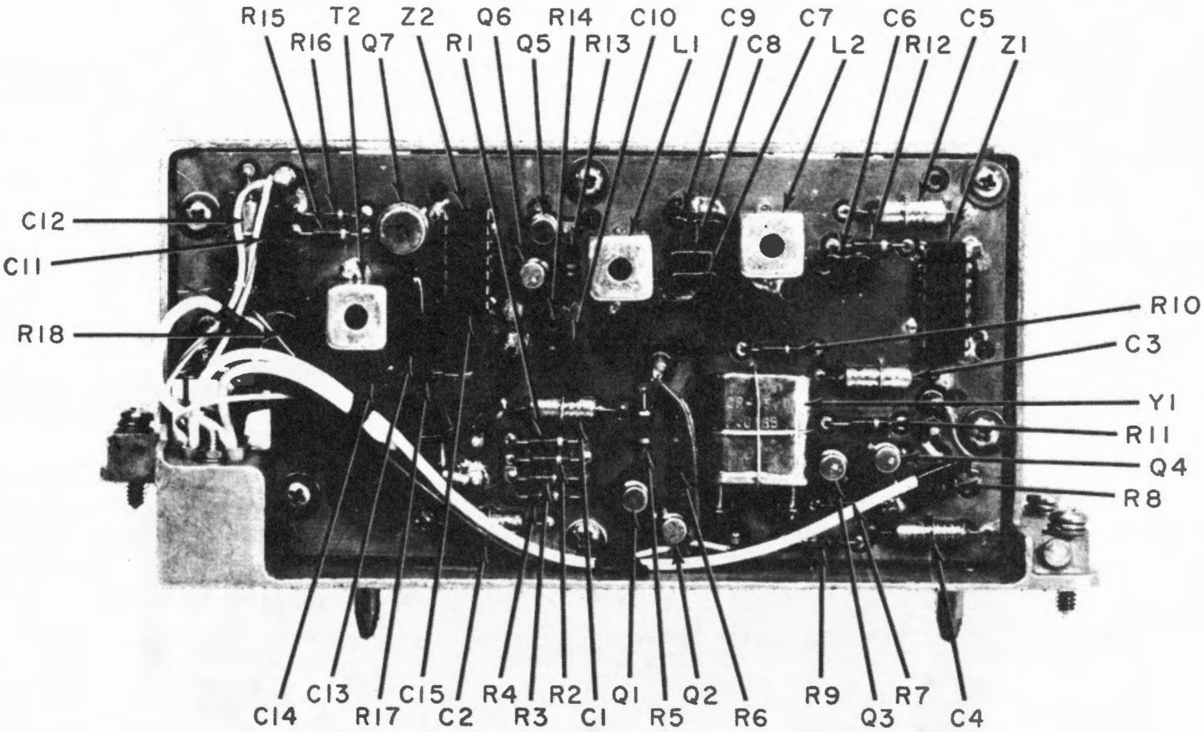

Figure 5-16. 1.75 Mc Generator A8A2, Part of 1.75/113.75 Mc Frequency Generator A8, Parts Location

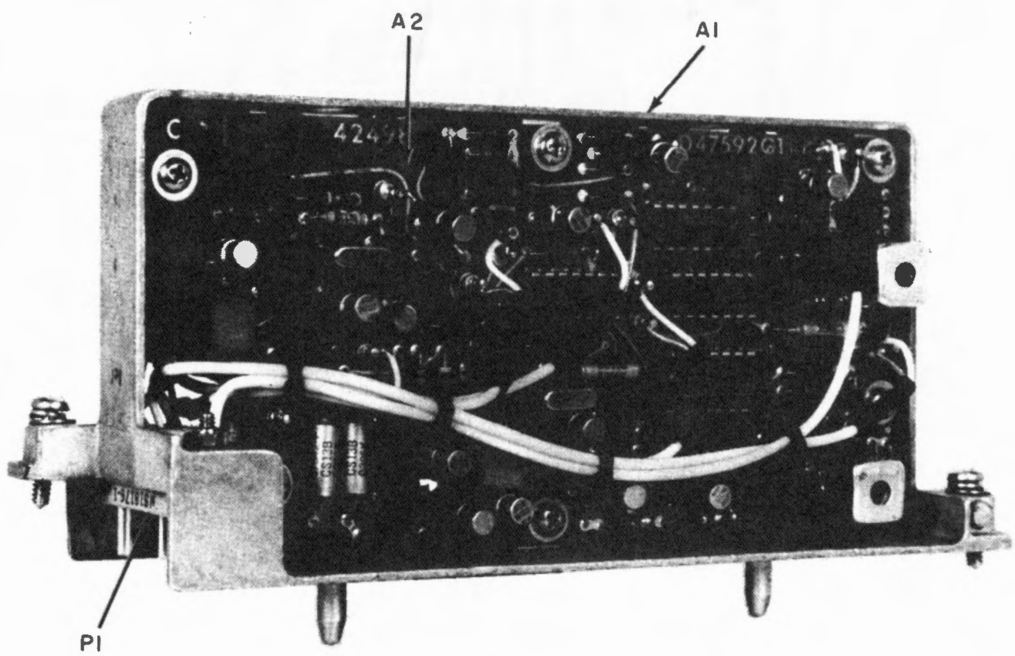

Figure 5-17. Side Carrier Generator Assembly, A9

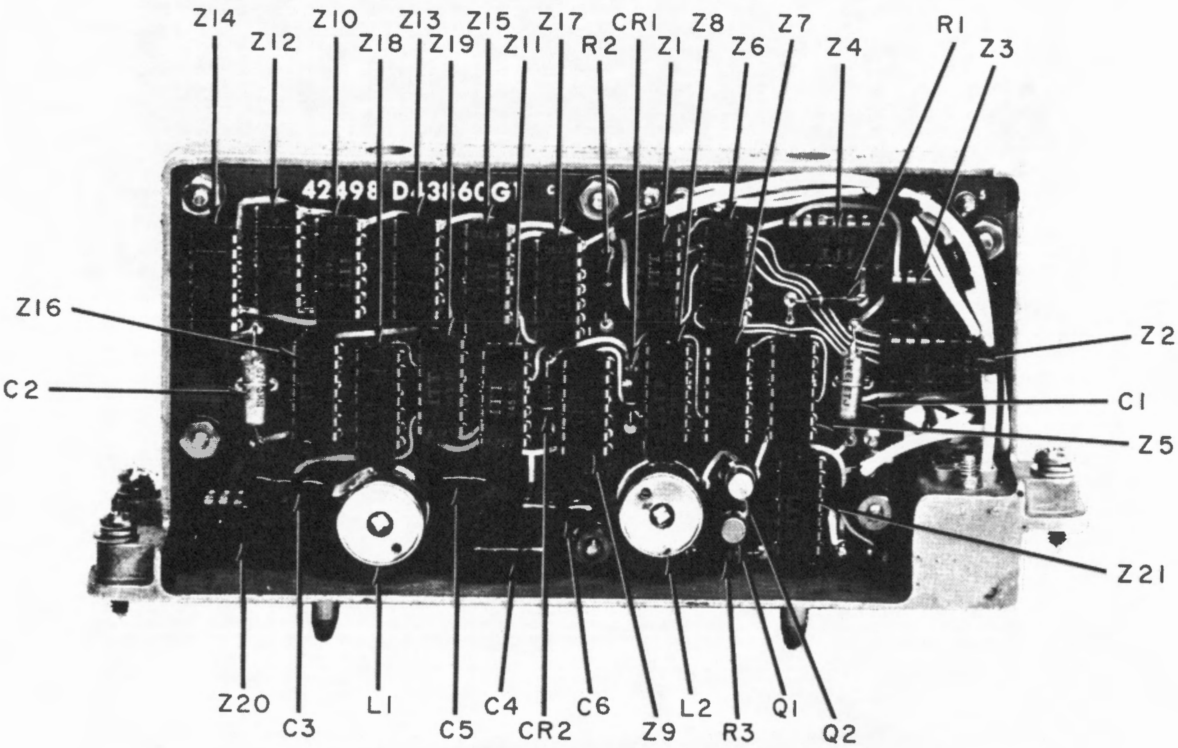

Figure 5-18. 1 Mc - 6.29 Kc Divider A9A1, Part of Side-Carrier Generator A9, Parts Location

236

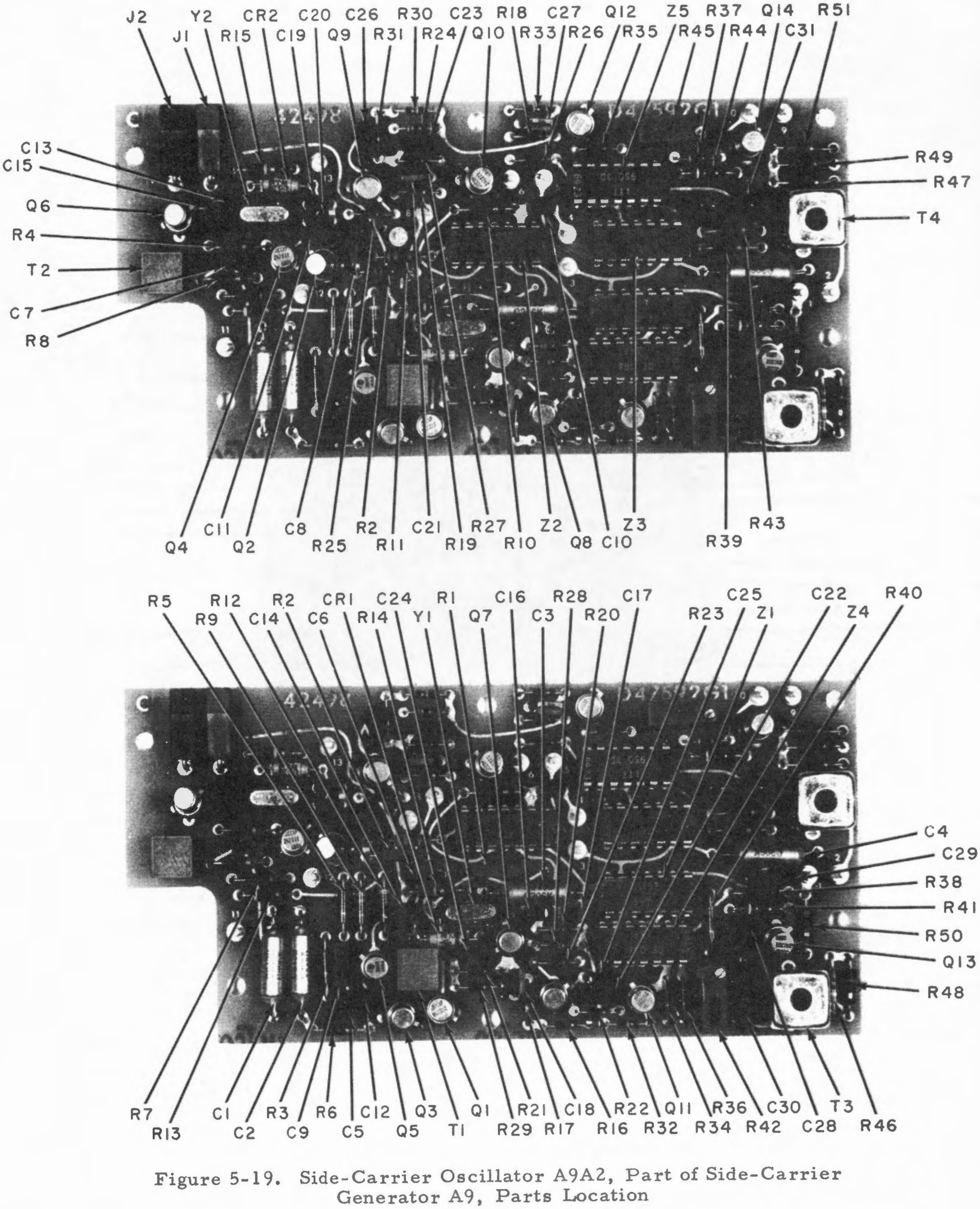

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Figure 5-19. Side-Carrier Oscillator A9A2, Part of Side-Carrier Generator A9, Parts Location

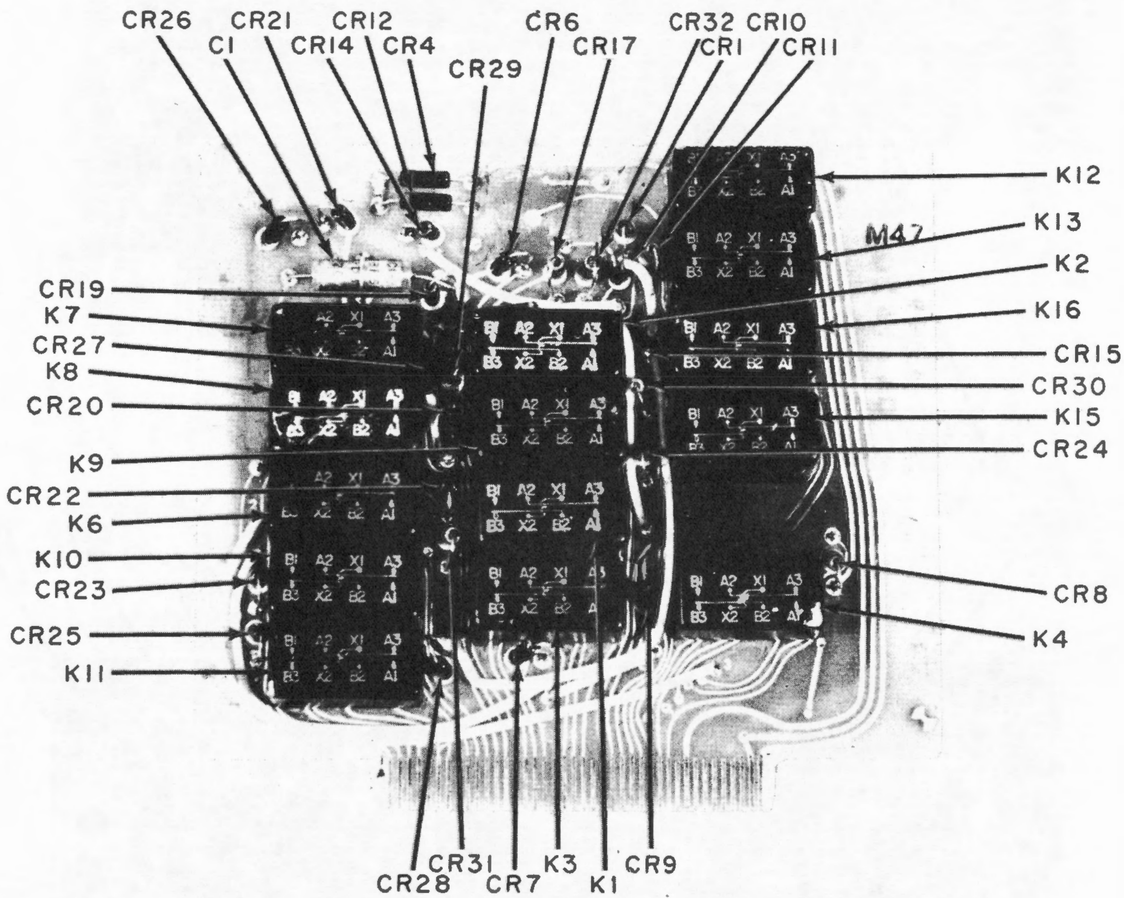

Figure 5-20. Transmitter Control No. 1 A10, Parts Location

239

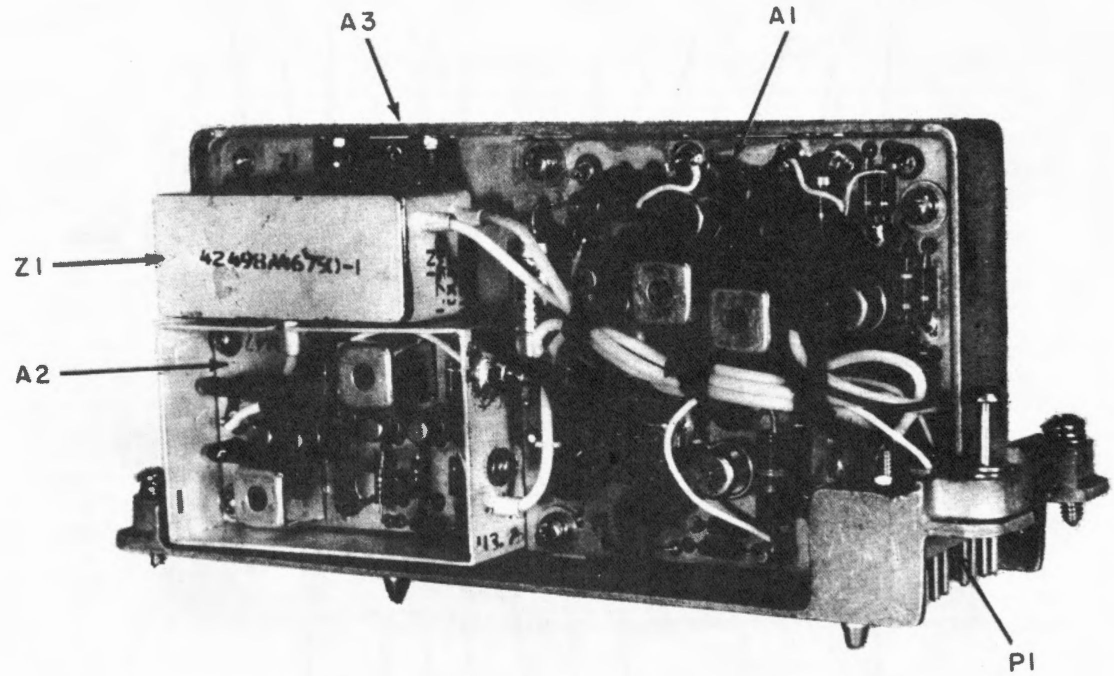

Figure 5-21. Up-Converter Assembly, A11, Parts Location

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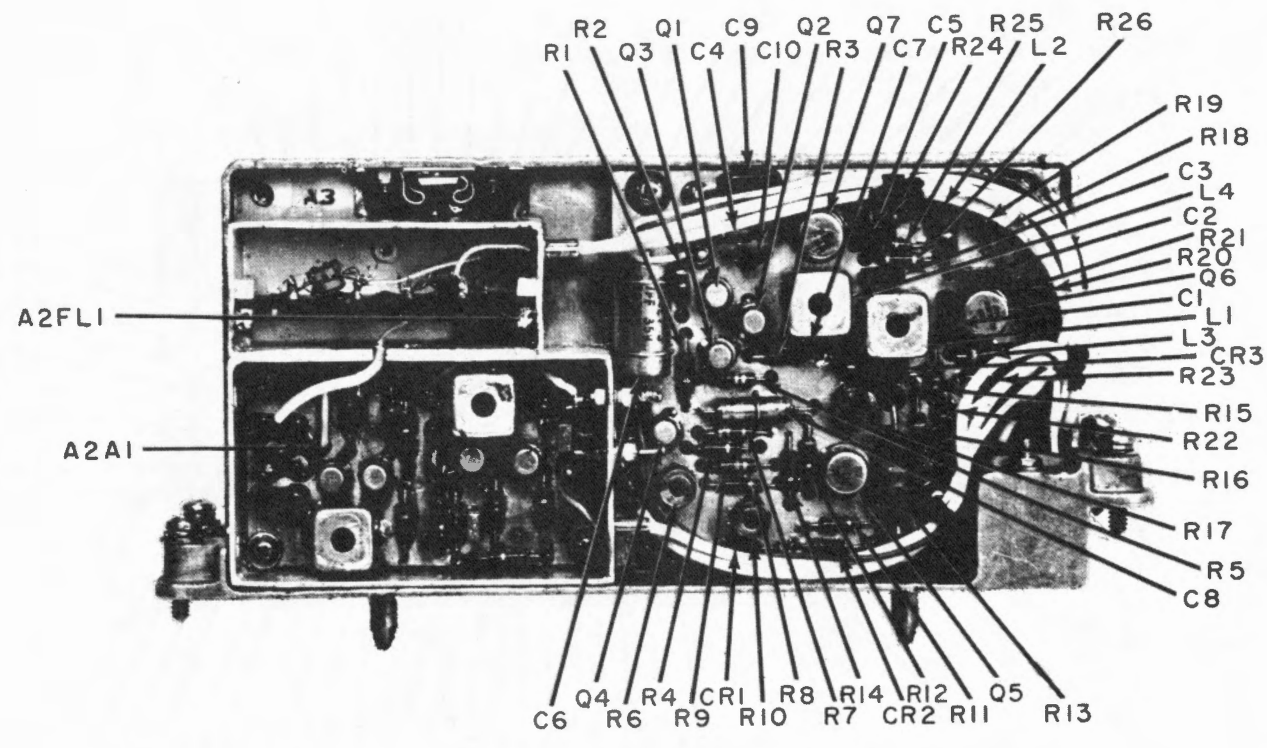


Figure 5-22. 113.75 Mc Amplifier A11A1, A11A2,
Part of Up-Converter A11, Parts Location

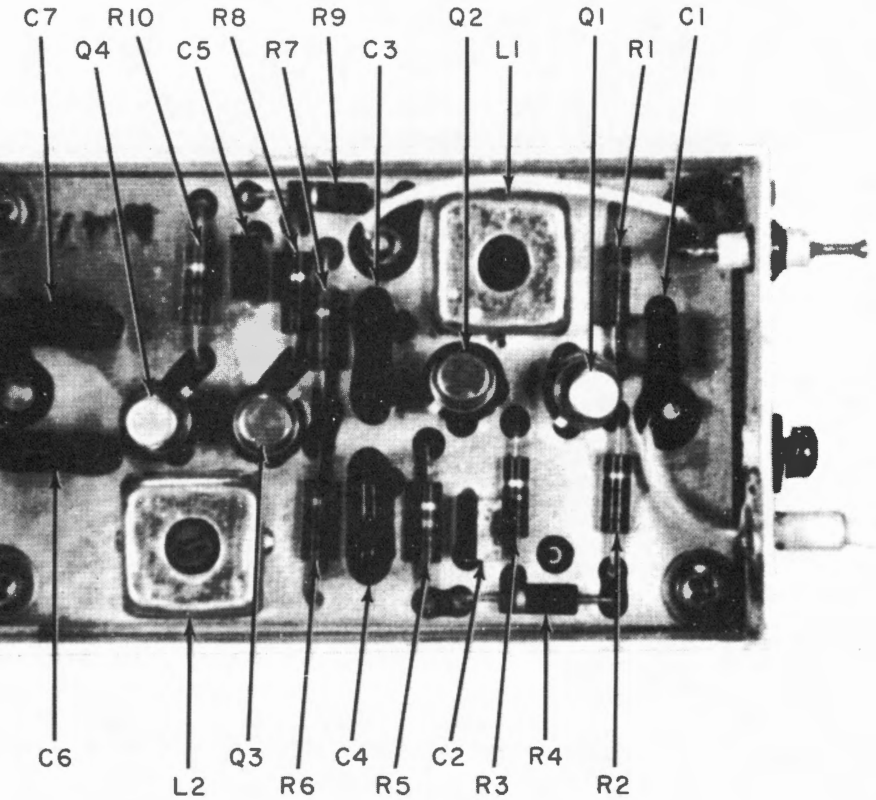


Figure 5-23. Mixer, Up-Converter A11A2A1

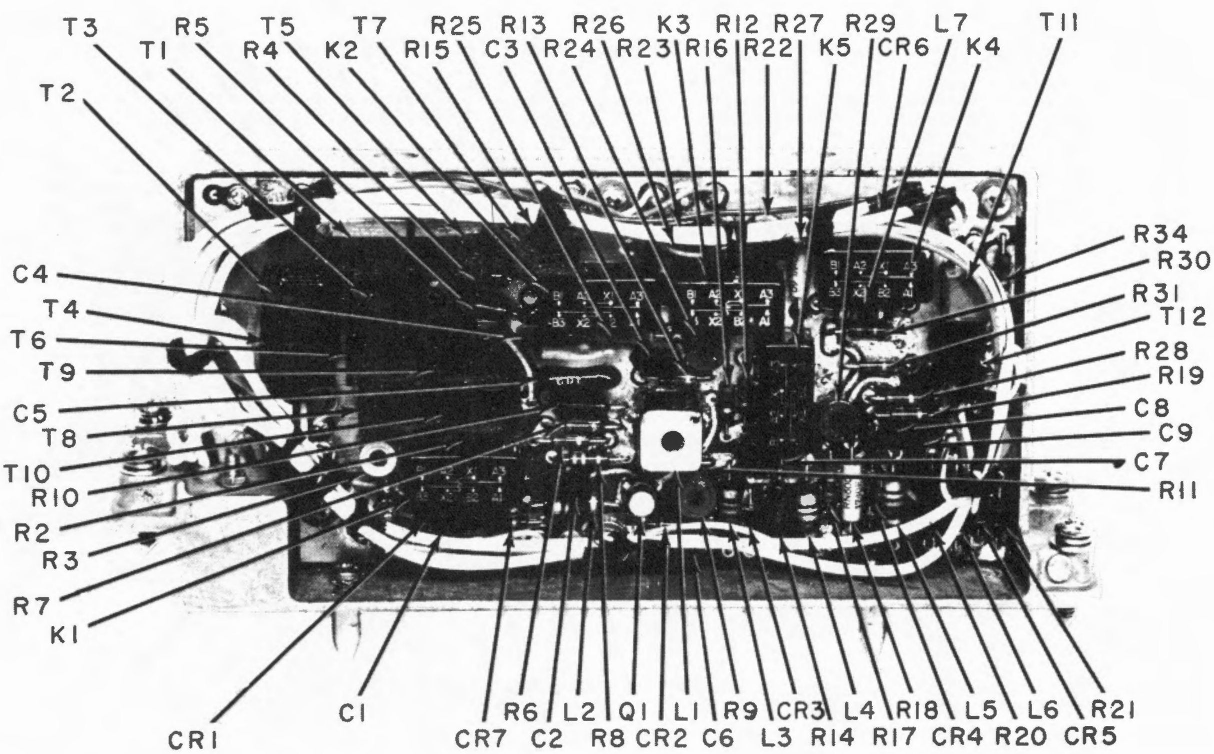
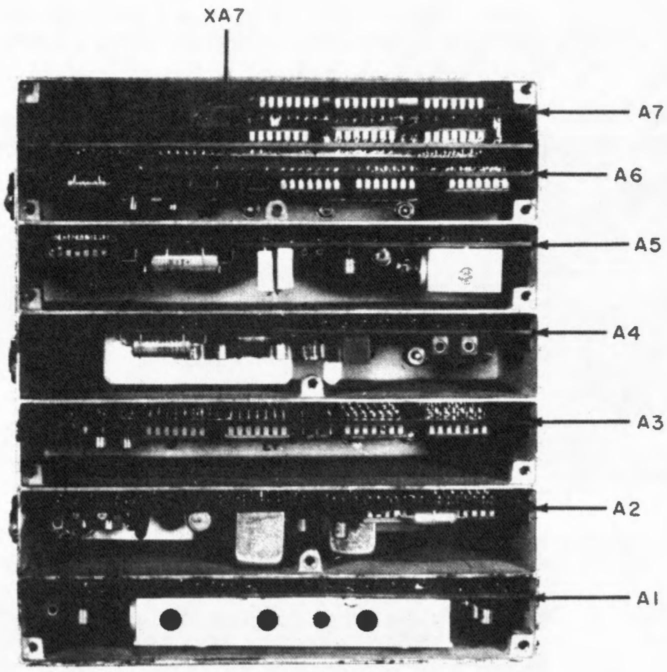
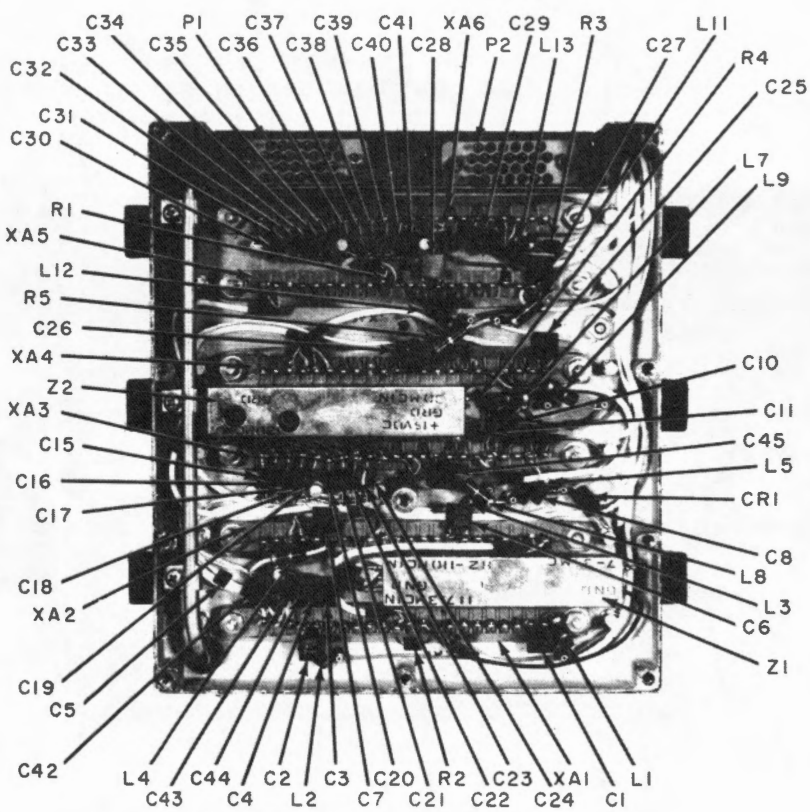


Figure 5-24. Carrier Insertion Amplifier A11A3, Part of Up-Converter A11, Parts Location

240

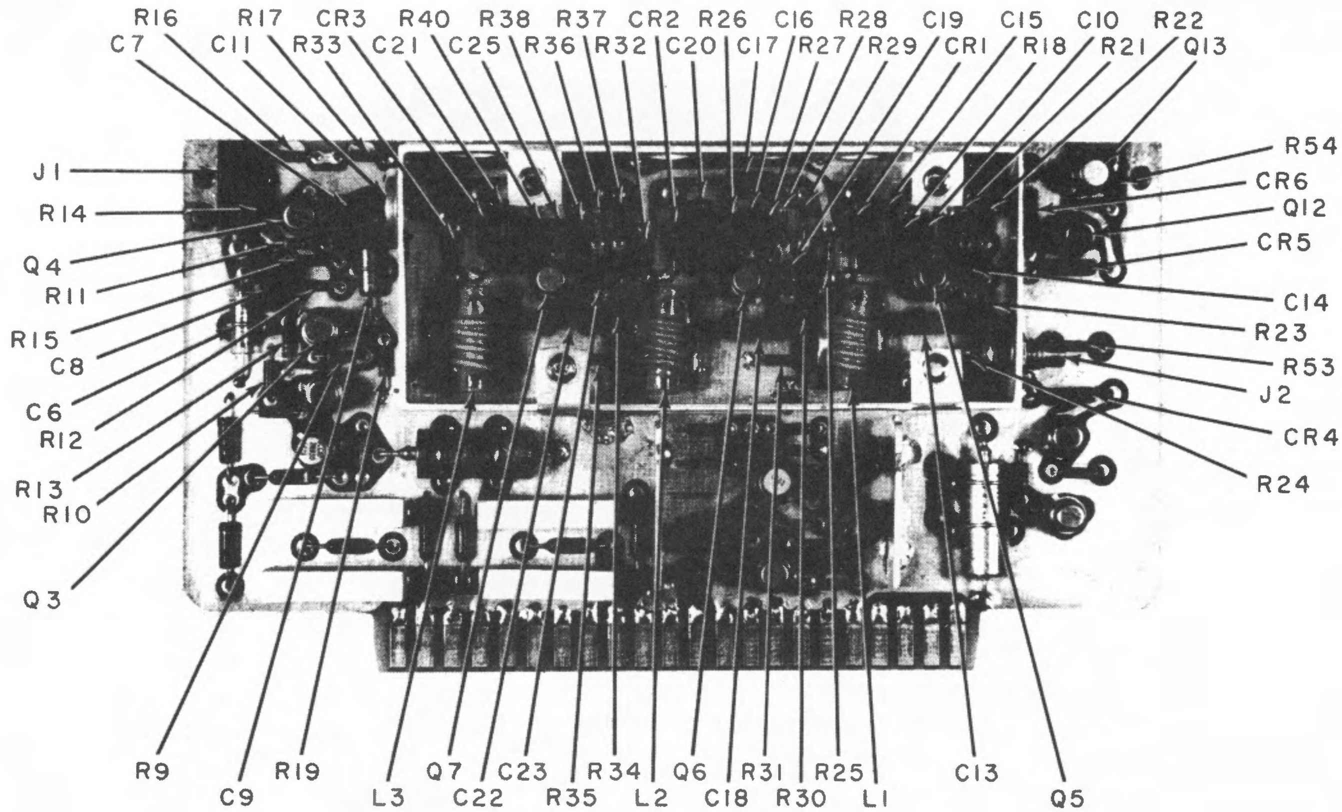


Top View, Synthesizer



Bottom View, Synthesizer

Figure 5-25. Synthesizer Assembly, A12



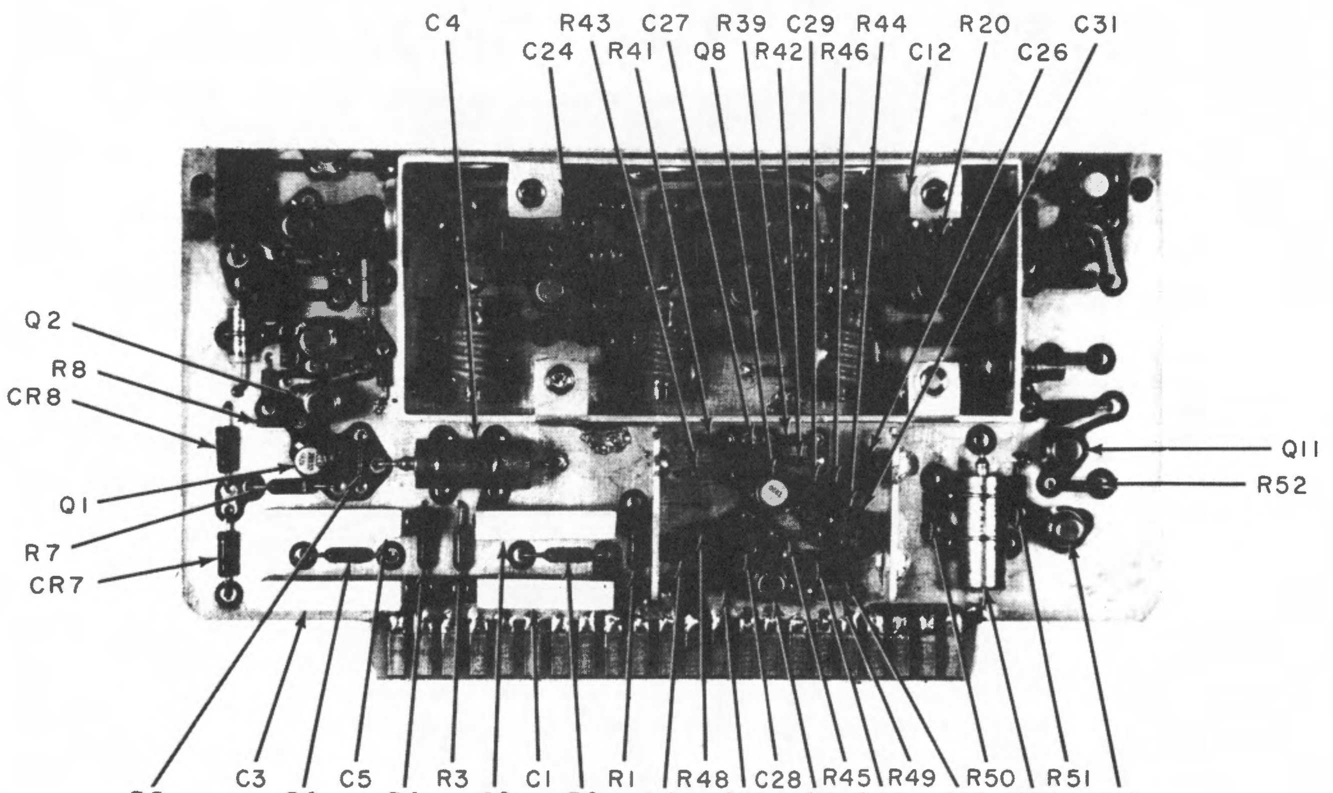


Figure 5-26. Card RF No. 1(A), A1, Part of Synthesizer A12, Parts Location

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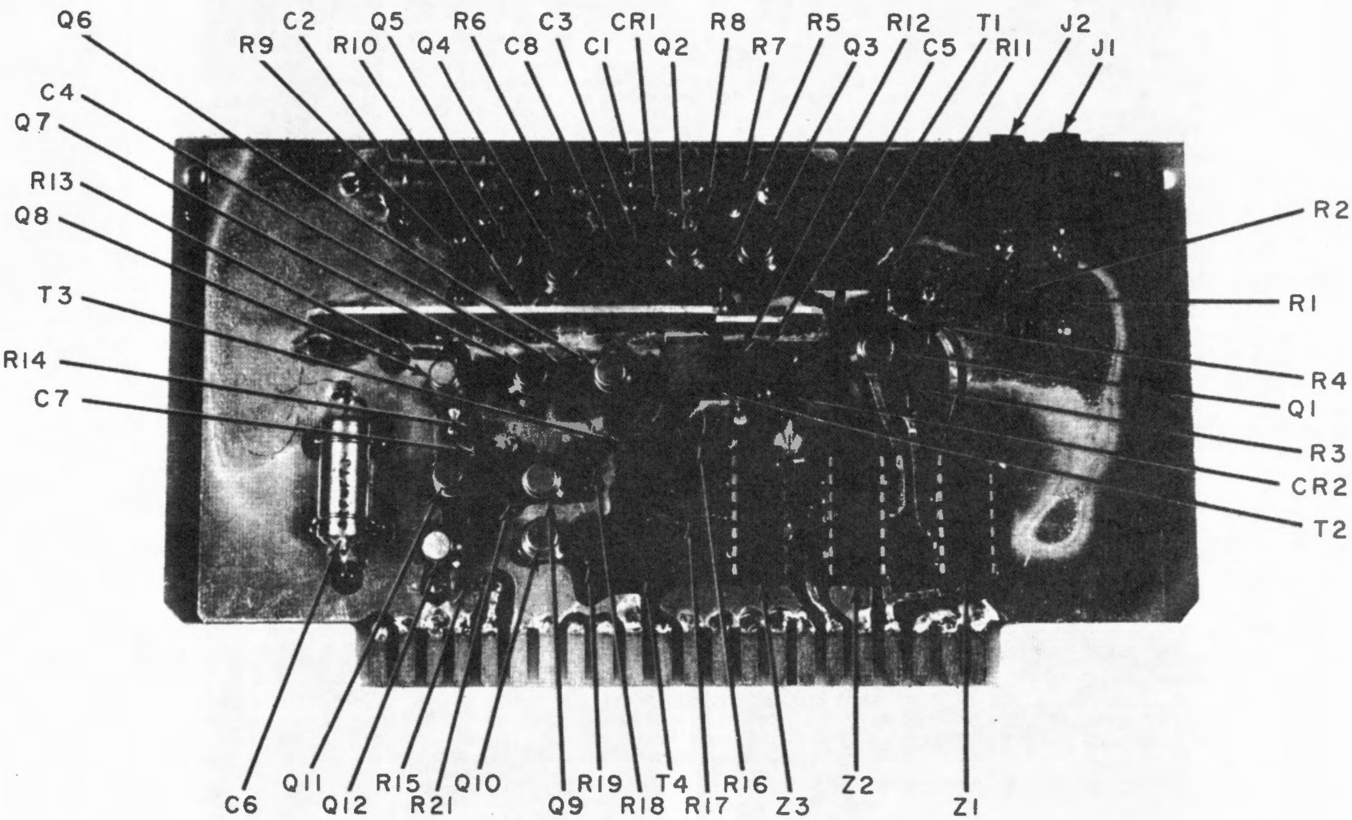
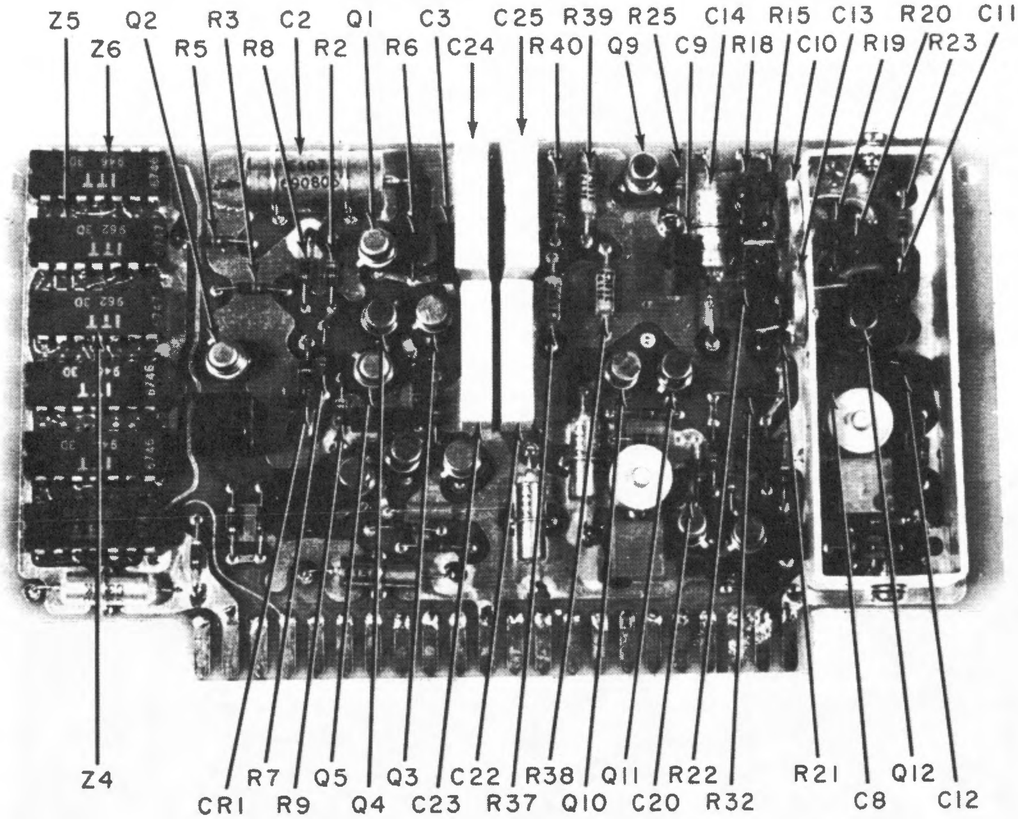


Figure 5-27. Card RF No. 1(B), A4, Part of Synthesizer A12, Parts Location



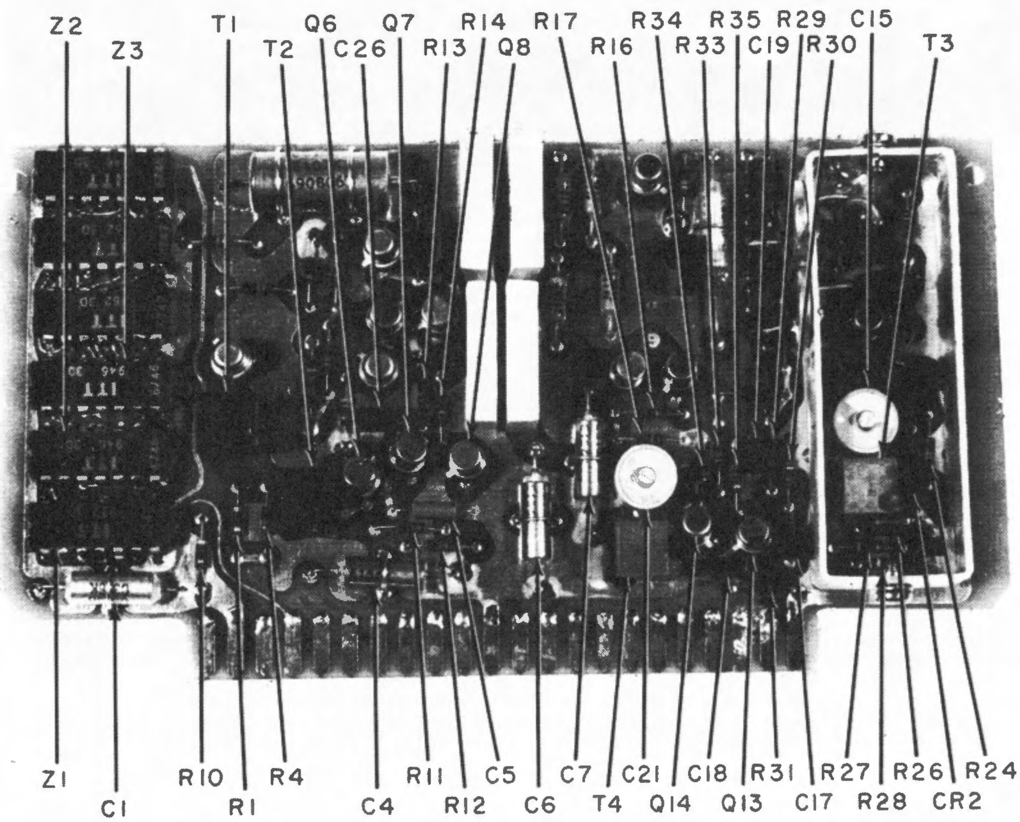
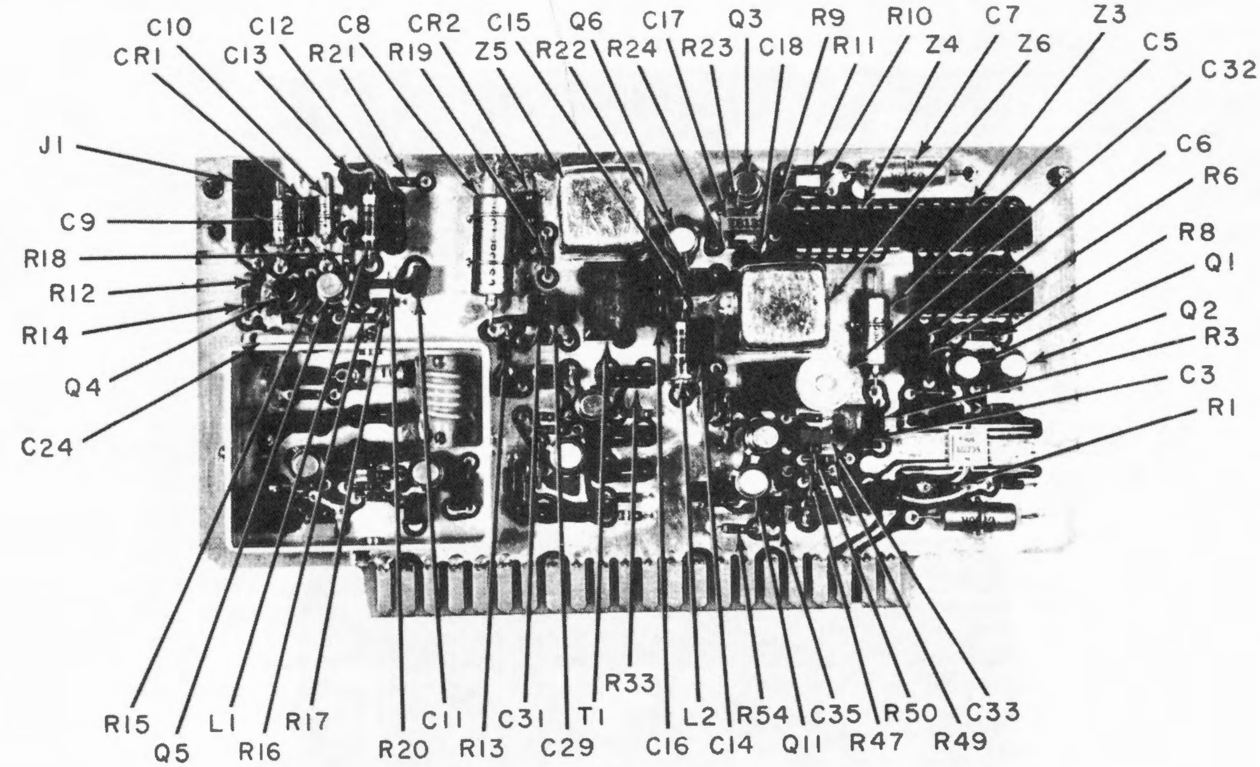


Figure 5-28. Card RF No. 2, A5, Part of Synthesizer A12, Parts Location

244



245

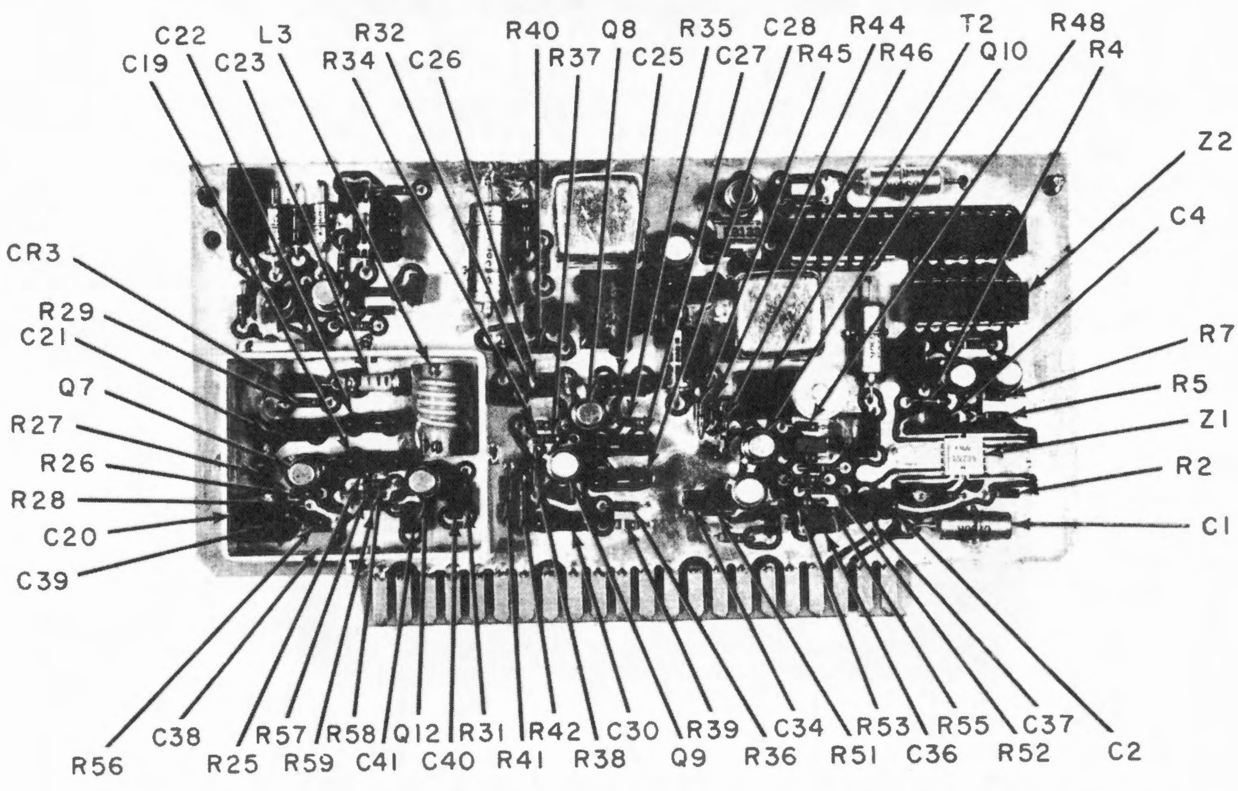


Figure 5-29. Card RF No. 3, A2, Part of Synthesizer A12, Parts Location

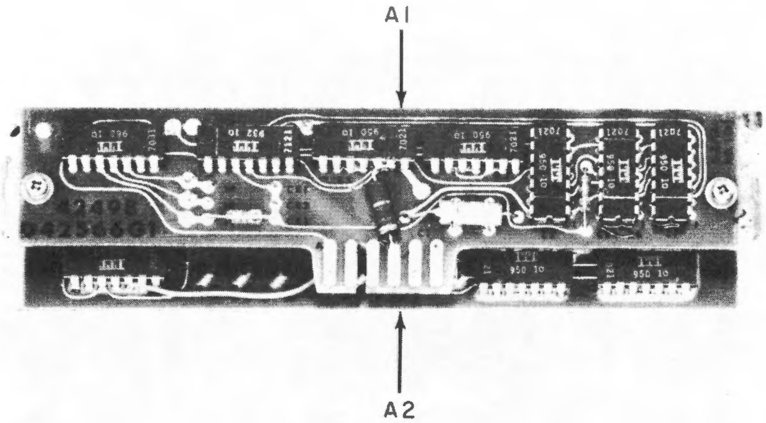


Figure 5-30. Card Digital No. 1, A7, Part of Synthesizer A12, Parts Location

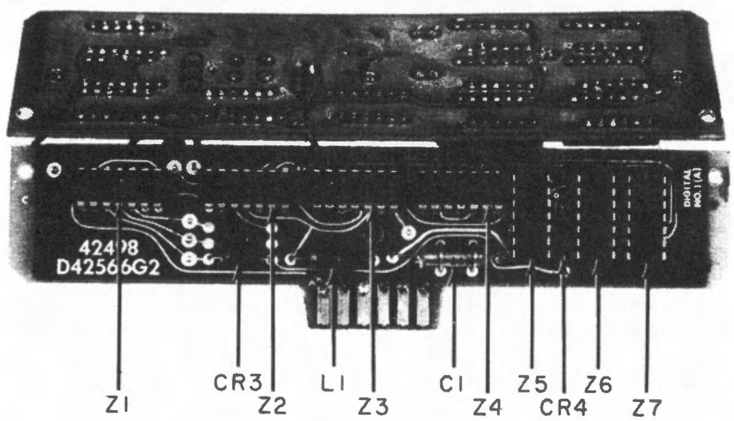


Figure 5-31. Digital No. 1A, A12A7A1

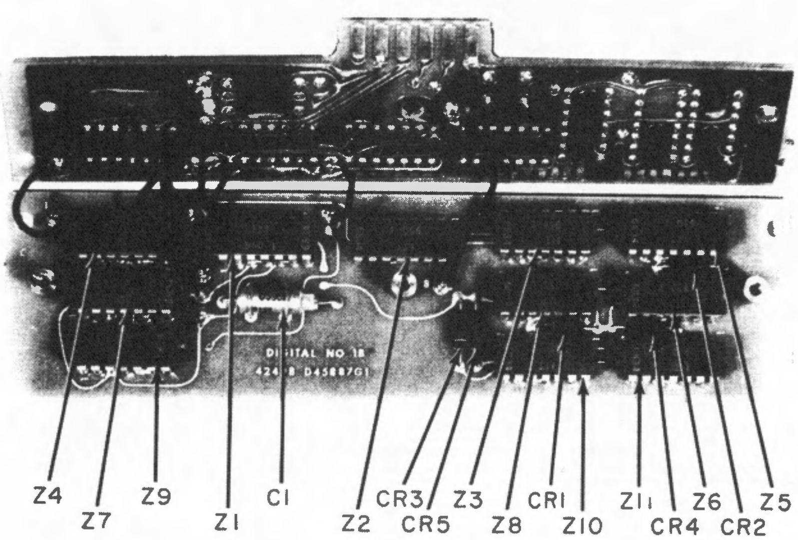


Figure 5-32. Digital No. 1B, A12A7A2

247

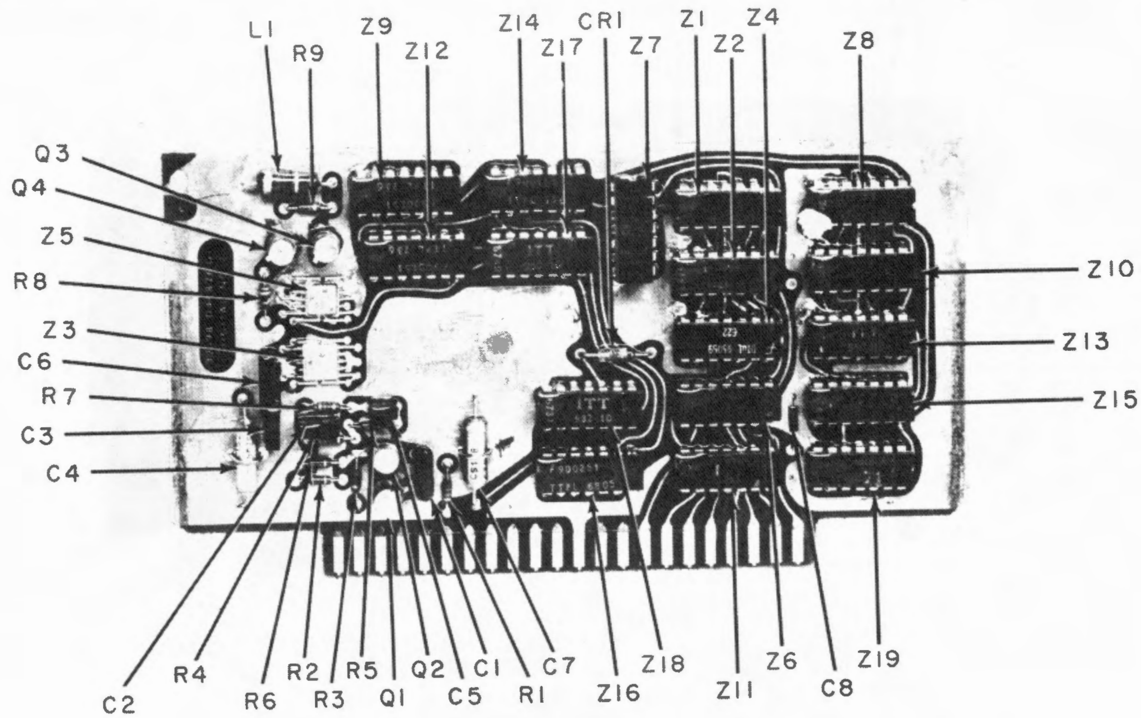


Figure 5-33. Card Digital No. 2, A3, Part of Synthesizer A12, Parts Location

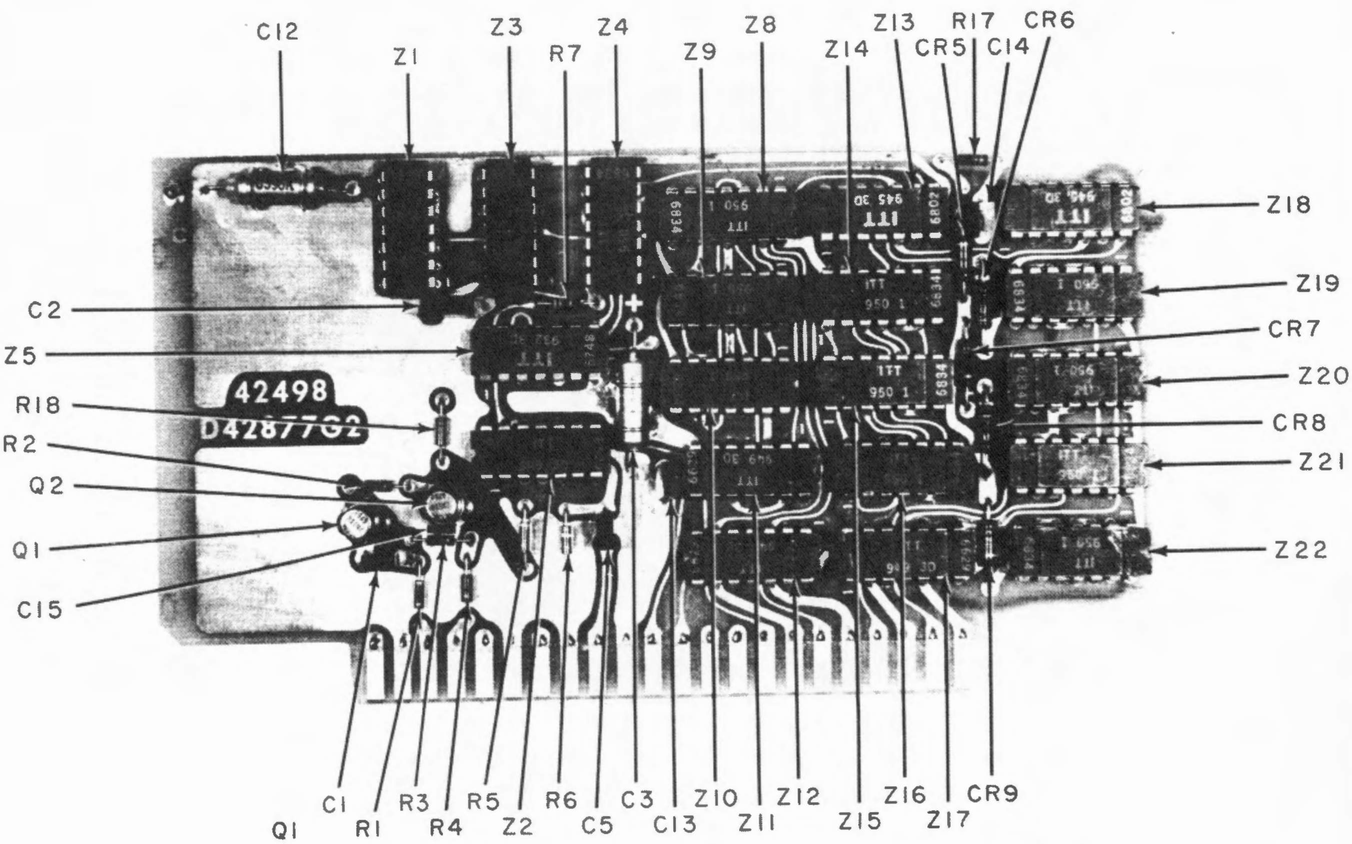


Figure 5-34. Card Digital No. 3, A6, Part of Synthesizer A12, Parts Location

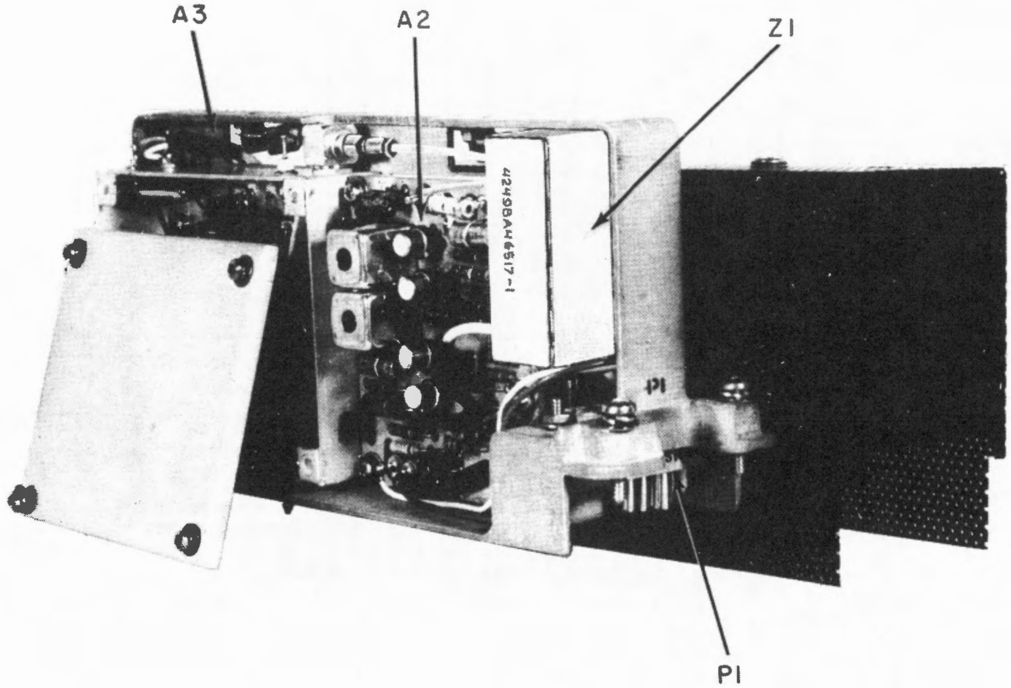


Figure 5-35. Down-Converter A13, Parts Location

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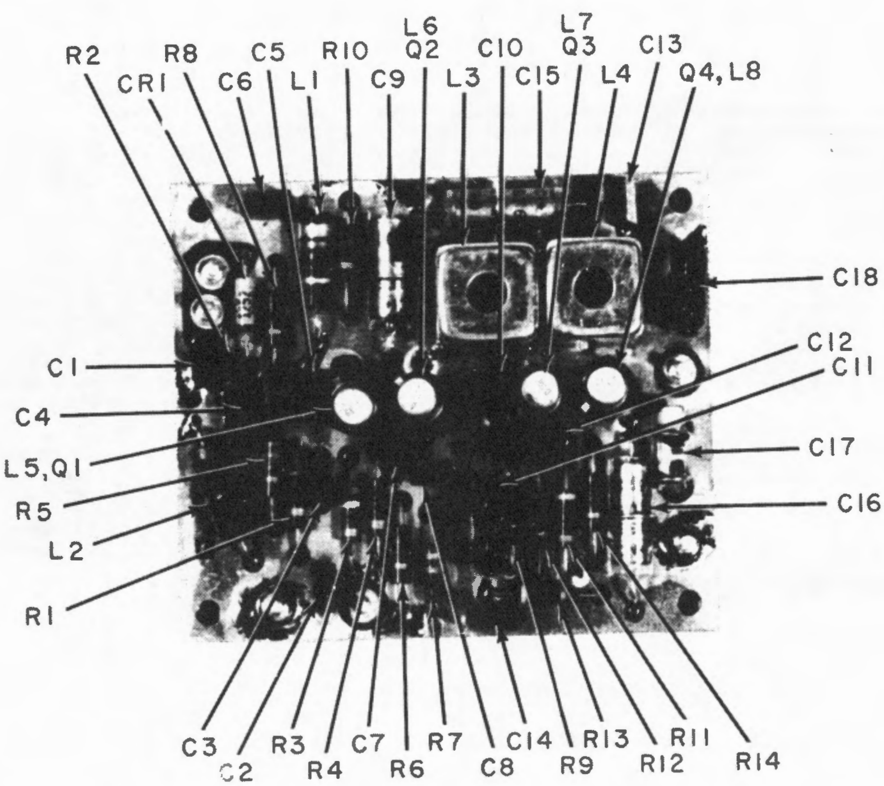

Figure 5-36. A13A2 Down-Converter 112 MHz IF Amplifier

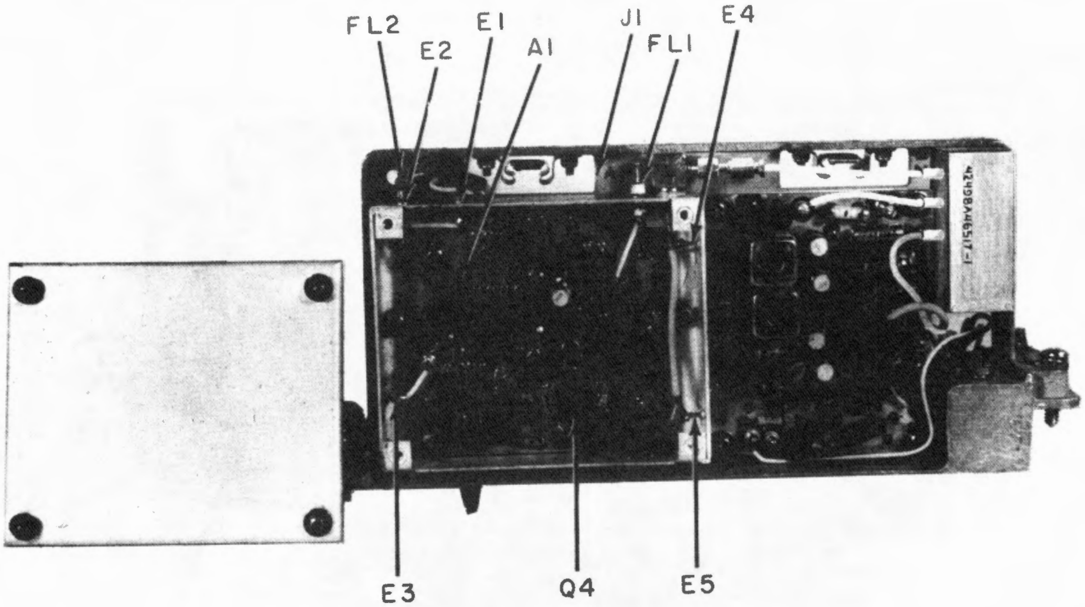

Figure 5-37. A13A3 82-110 MHz Amplifier

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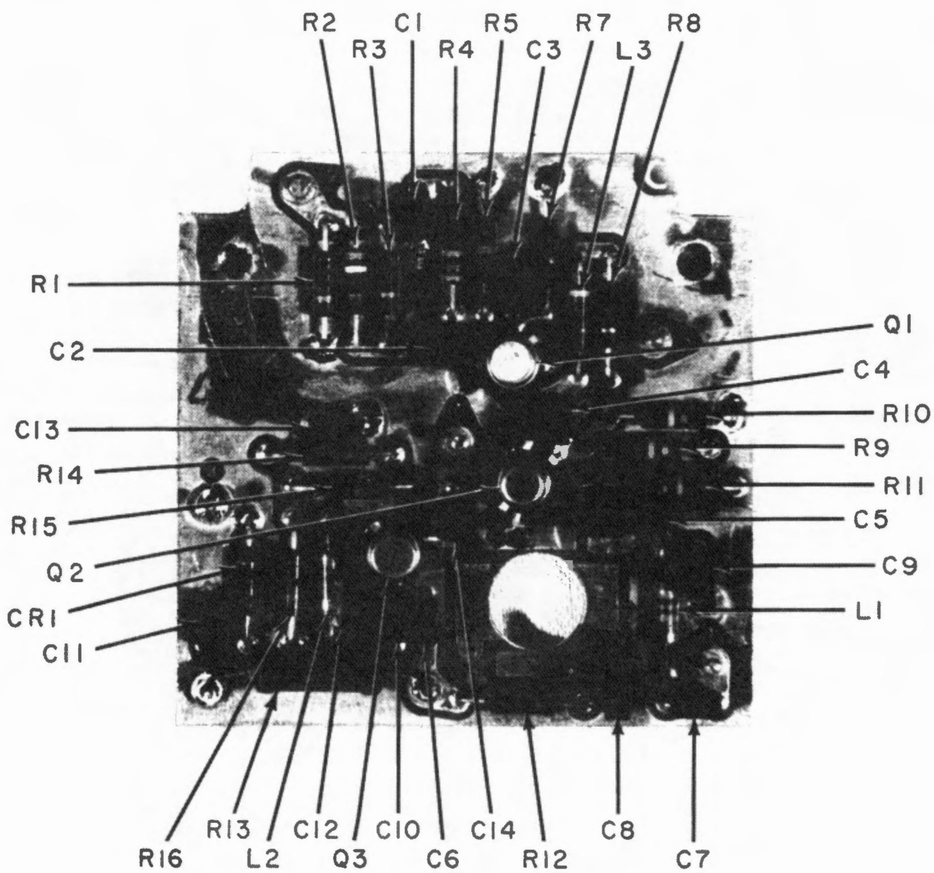


Figure 5-38. A13A3A1 82-110 MHz Amplifier Subassembly

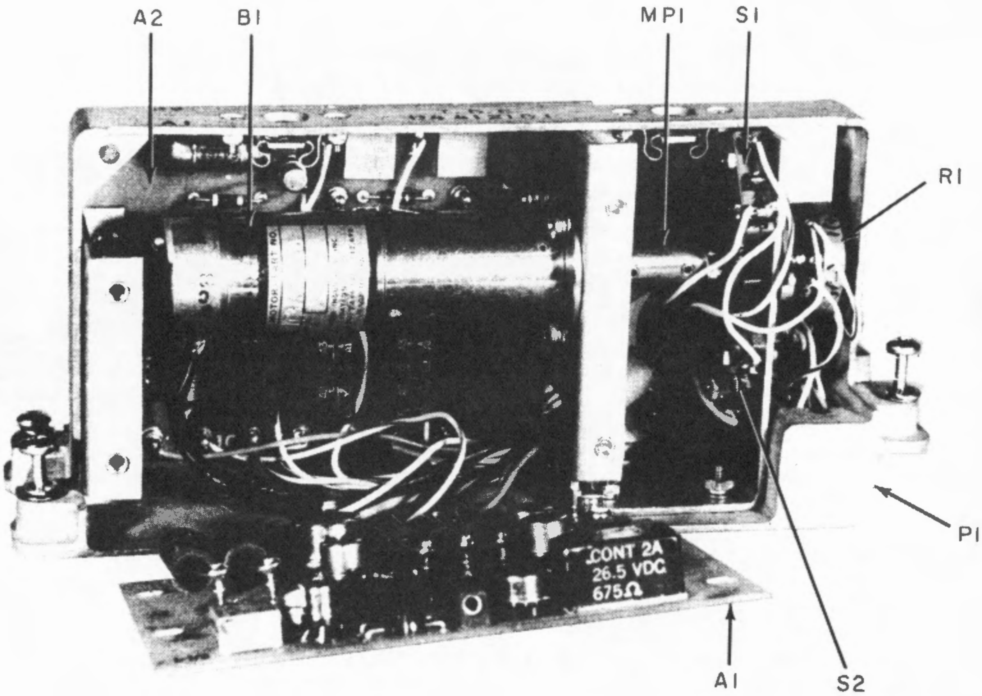


Figure 5-39. Transmitter Gain Control A14, Parts Location

250

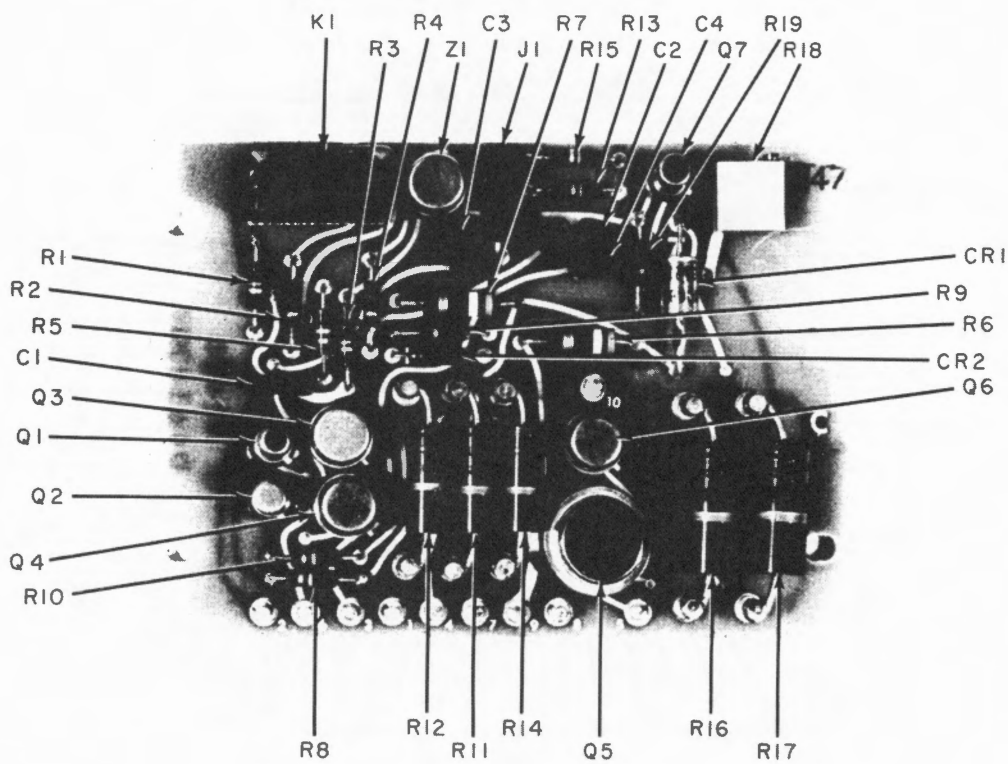


Figure 5-40. A14A1 TGC No. 1

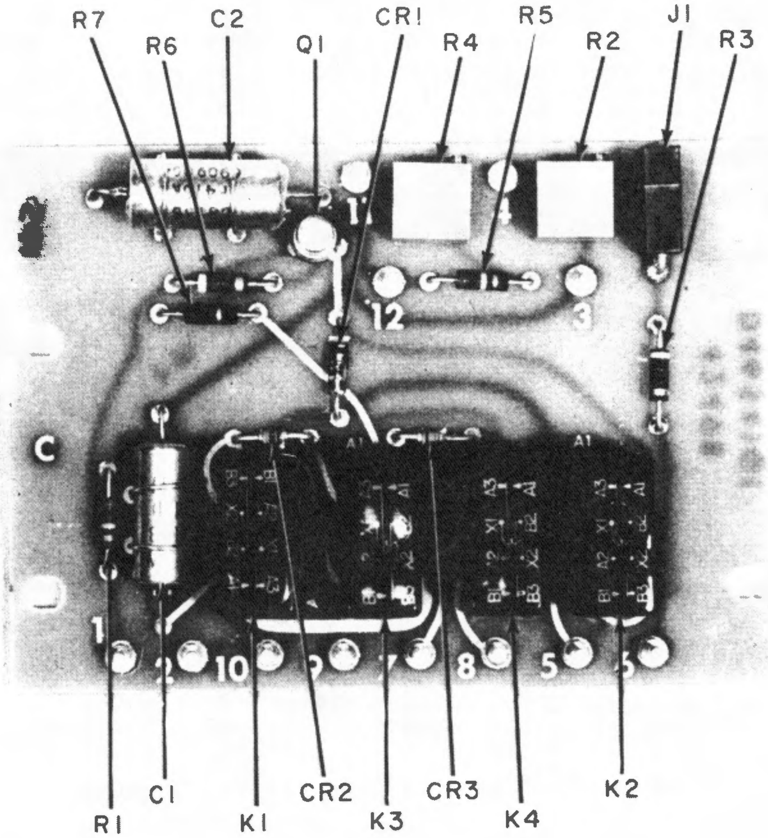


Figure 5-41. A14A2 TGC No. 2

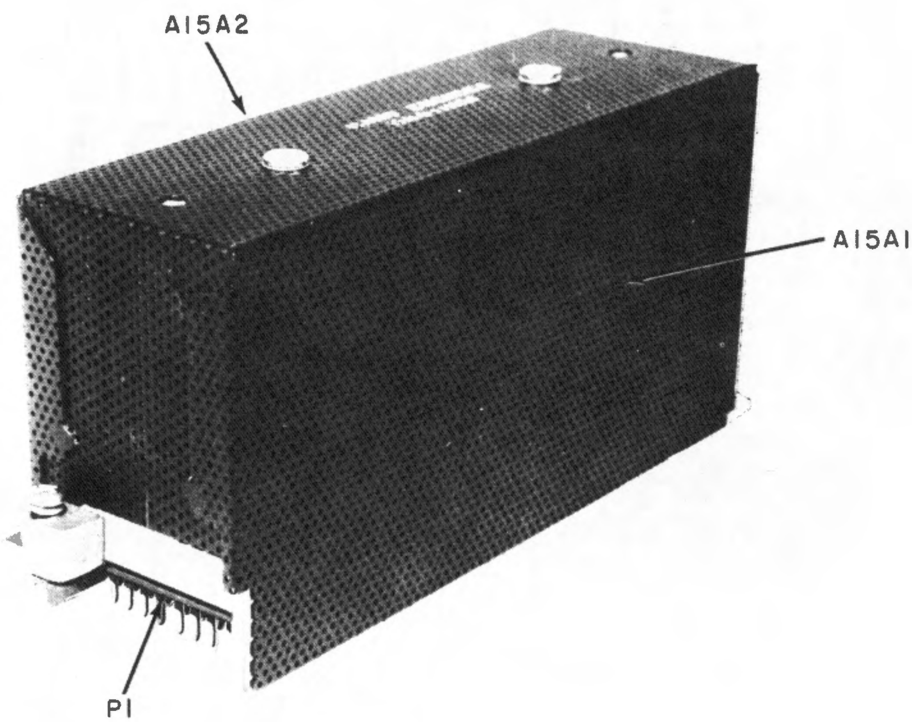


Figure 5-42. Band Encoder A15, Parts Location

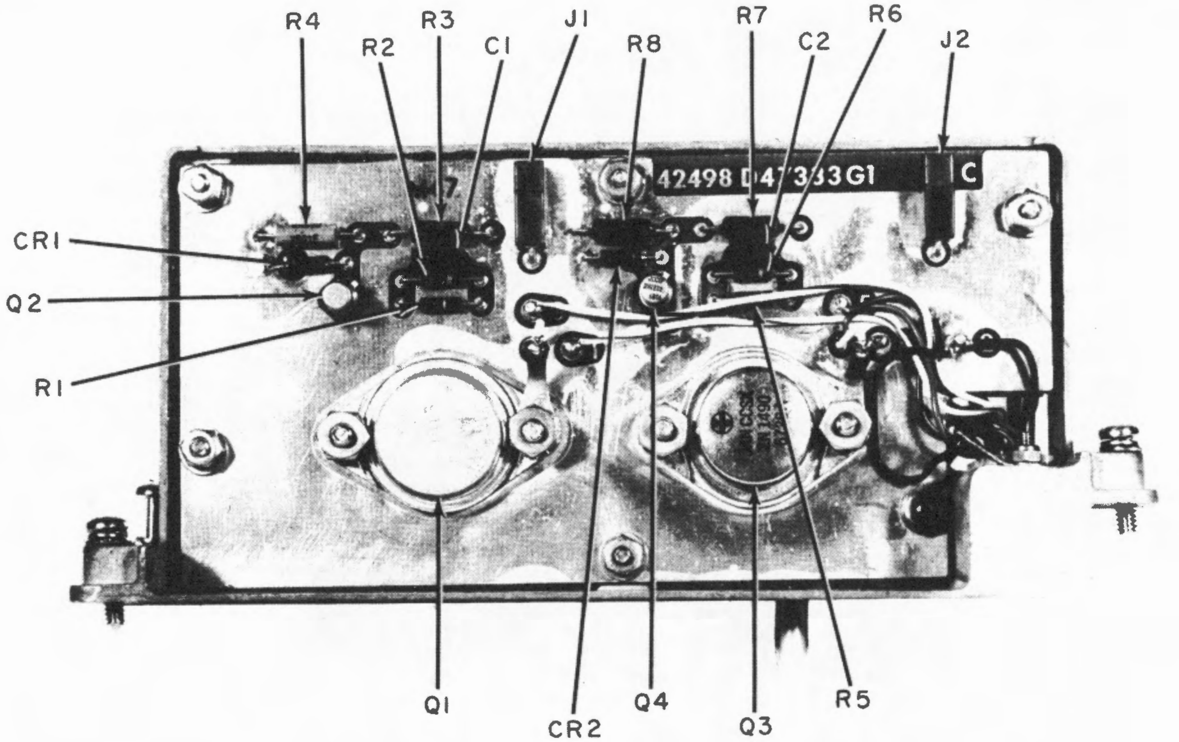


Figure 5-43. A15A1 -12 and +15 Volt Regulator

252

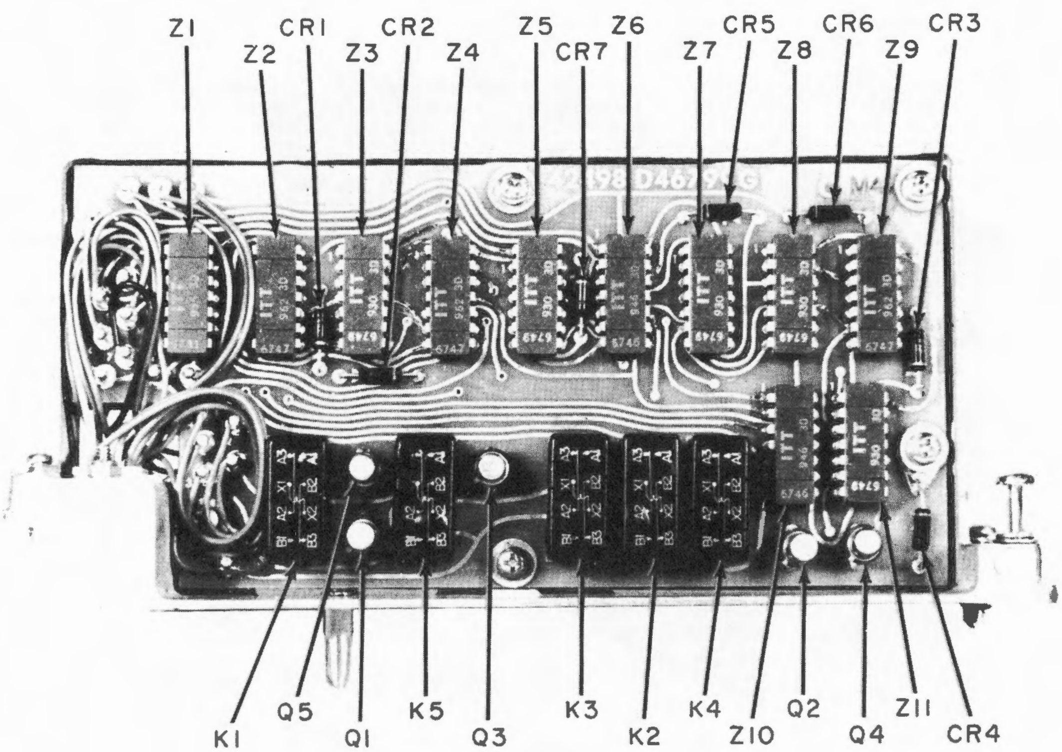


Figure 5-44. A15A2 Band Encoder Board No. 1

253

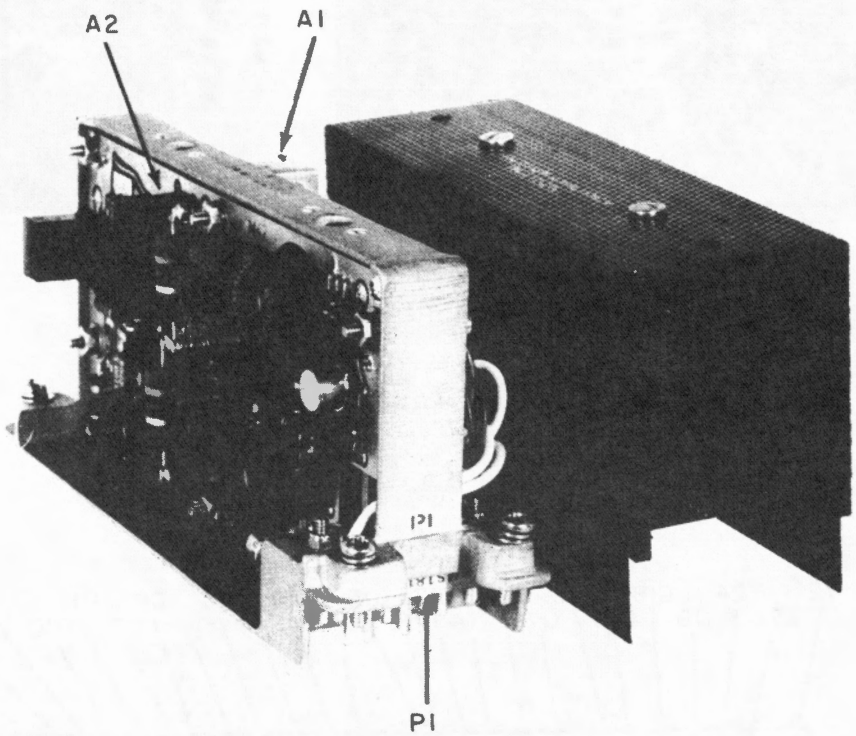


Figure 5-45. Output Amplifier A16, Parts Location

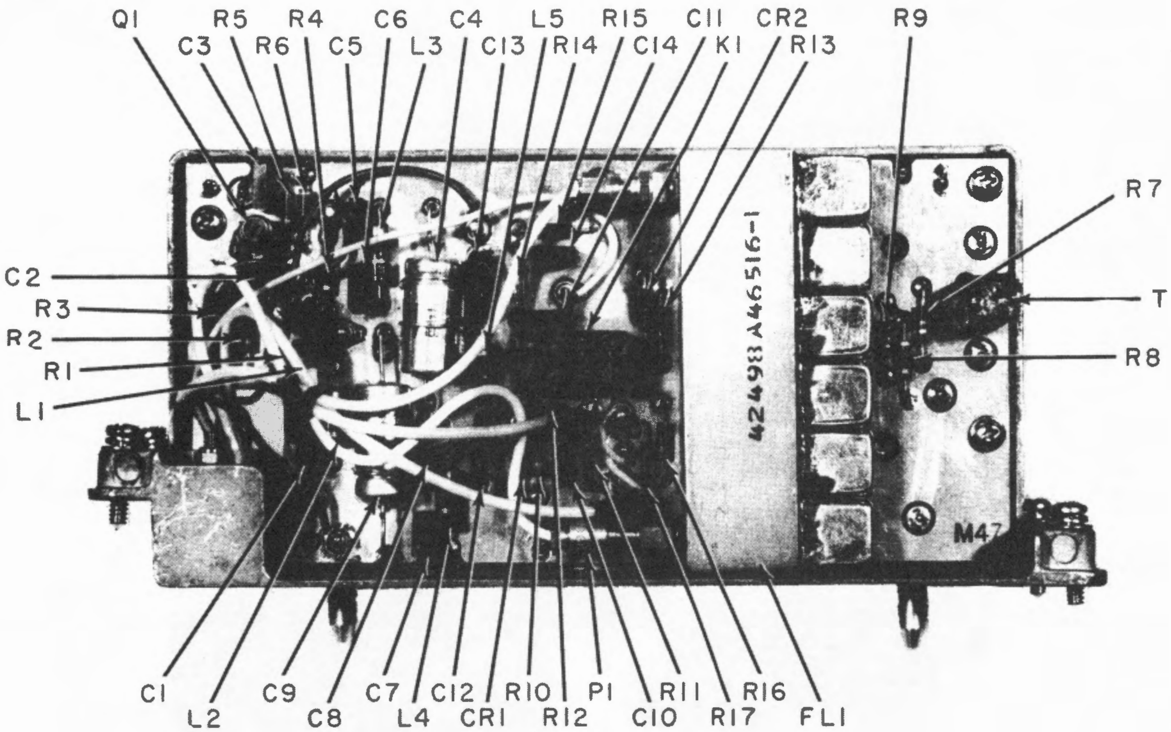


Figure 5-46. A16A1 Output Amplifier No. 1

254

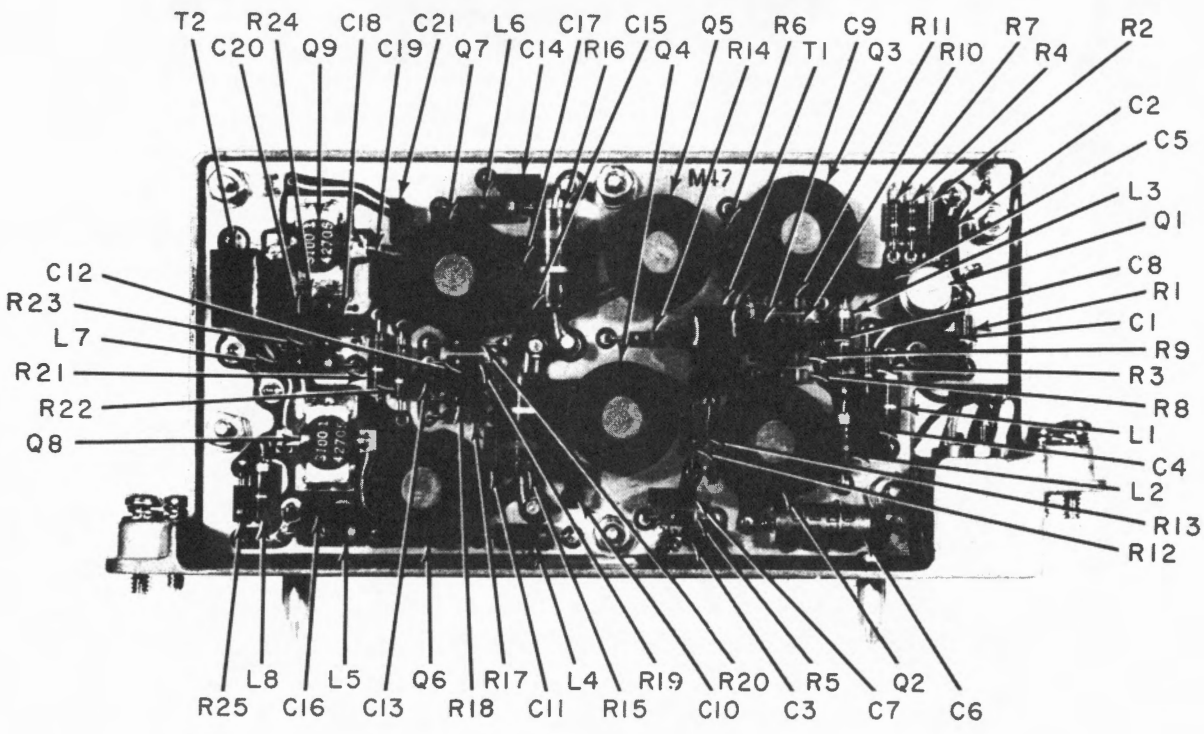
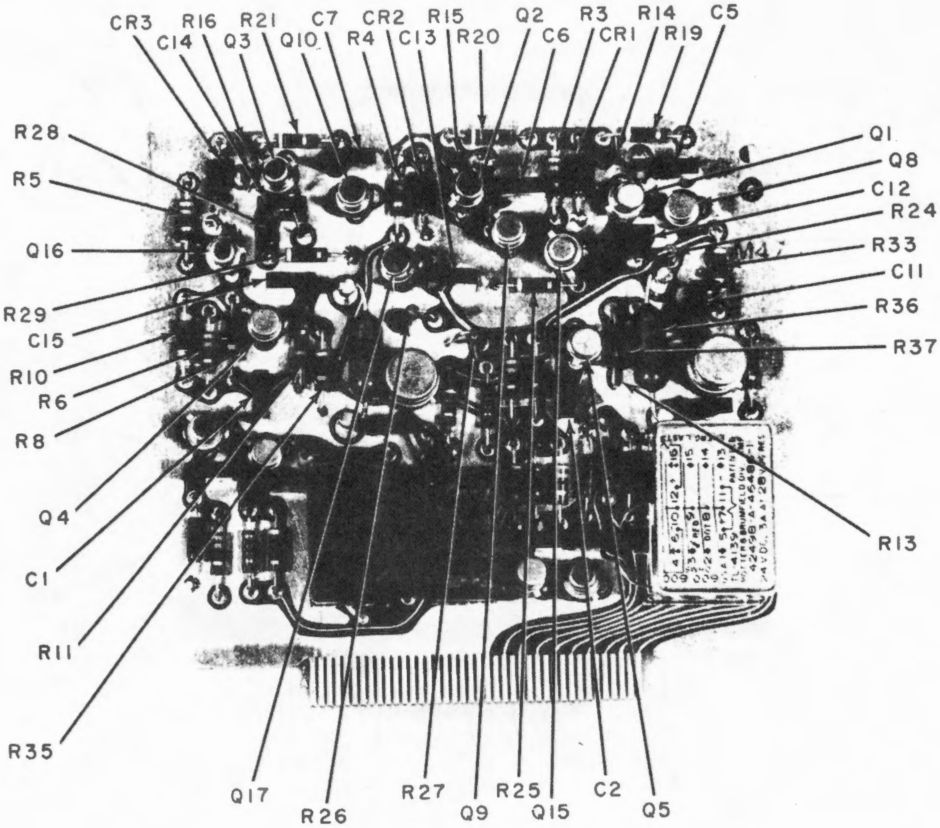


Figure 5-47. A16A2 Output Amplifier No. 2



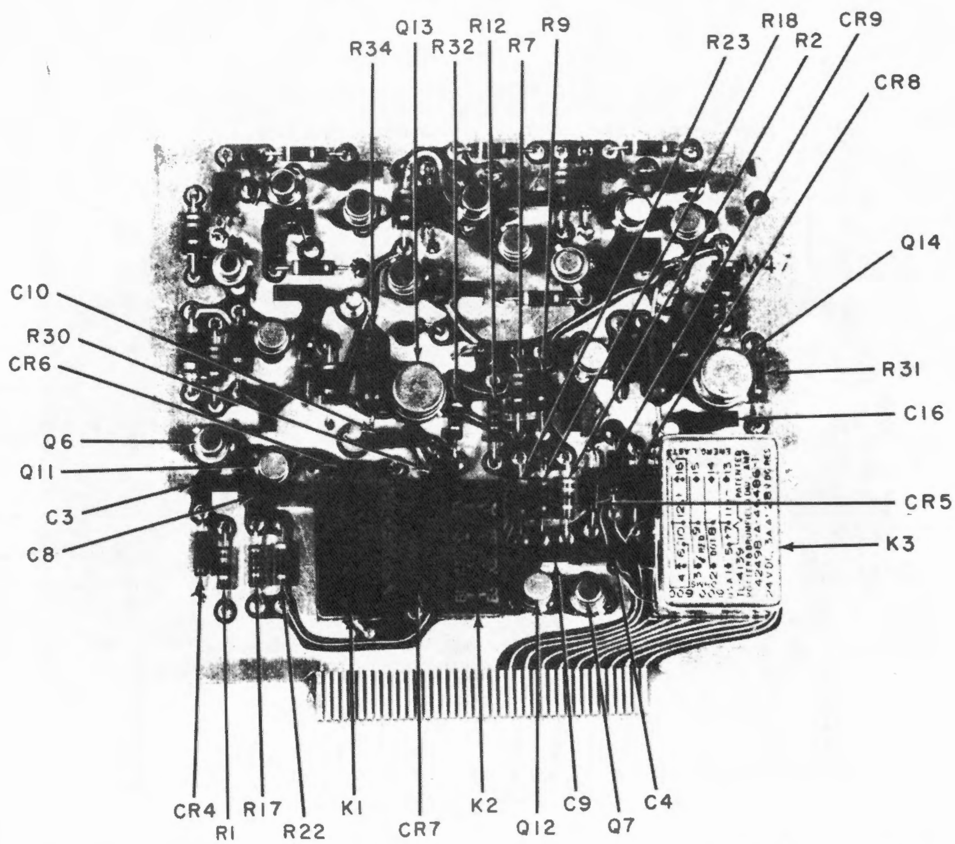


Figure 5-48. Transmitter Control No. 2, A17, Parts Location

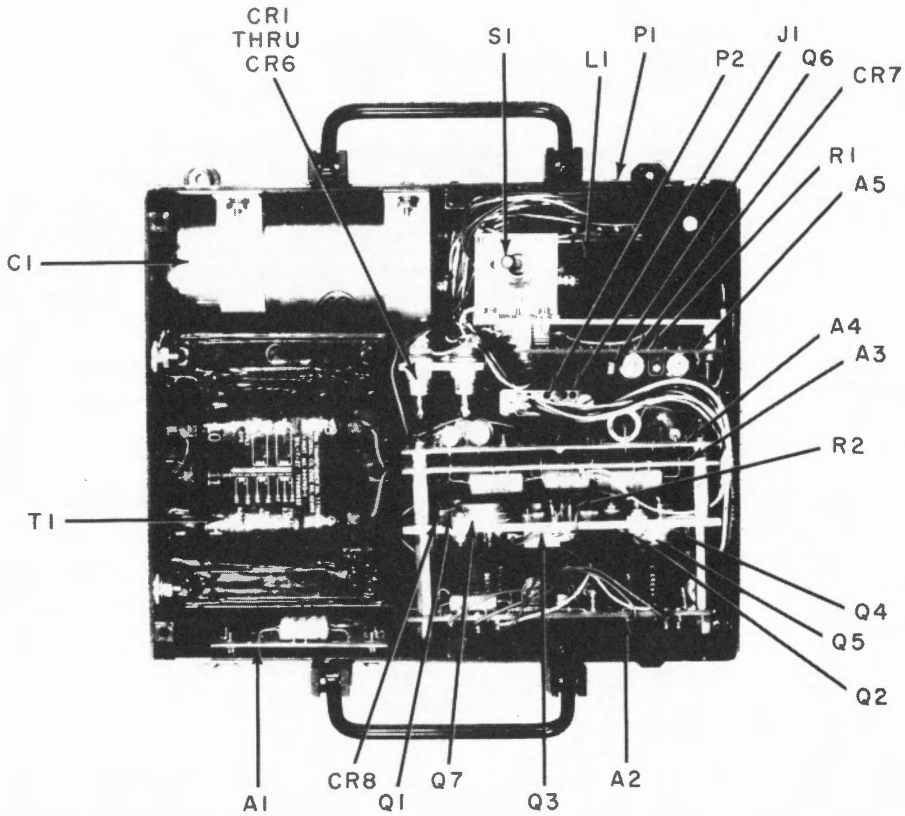


Figure 5-49. Power Supply Module PS1

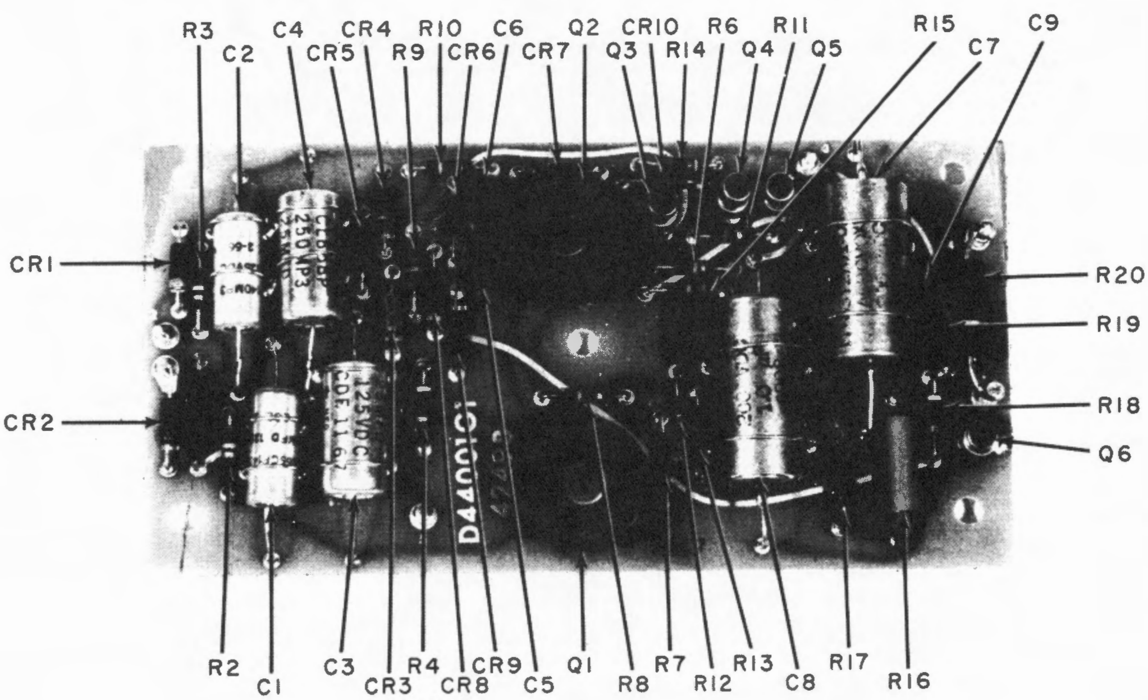


Figure 5-50. +125 Volt Regulator, PS1A4, Part of Power Supply PS1, Parts Location

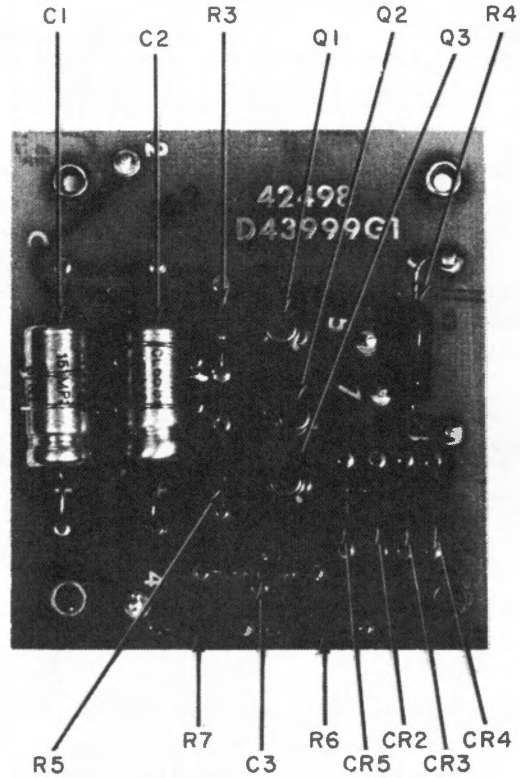


Figure 5-51. -12 Volt Regulator A1, Part of Power Supply PS1, Parts Location

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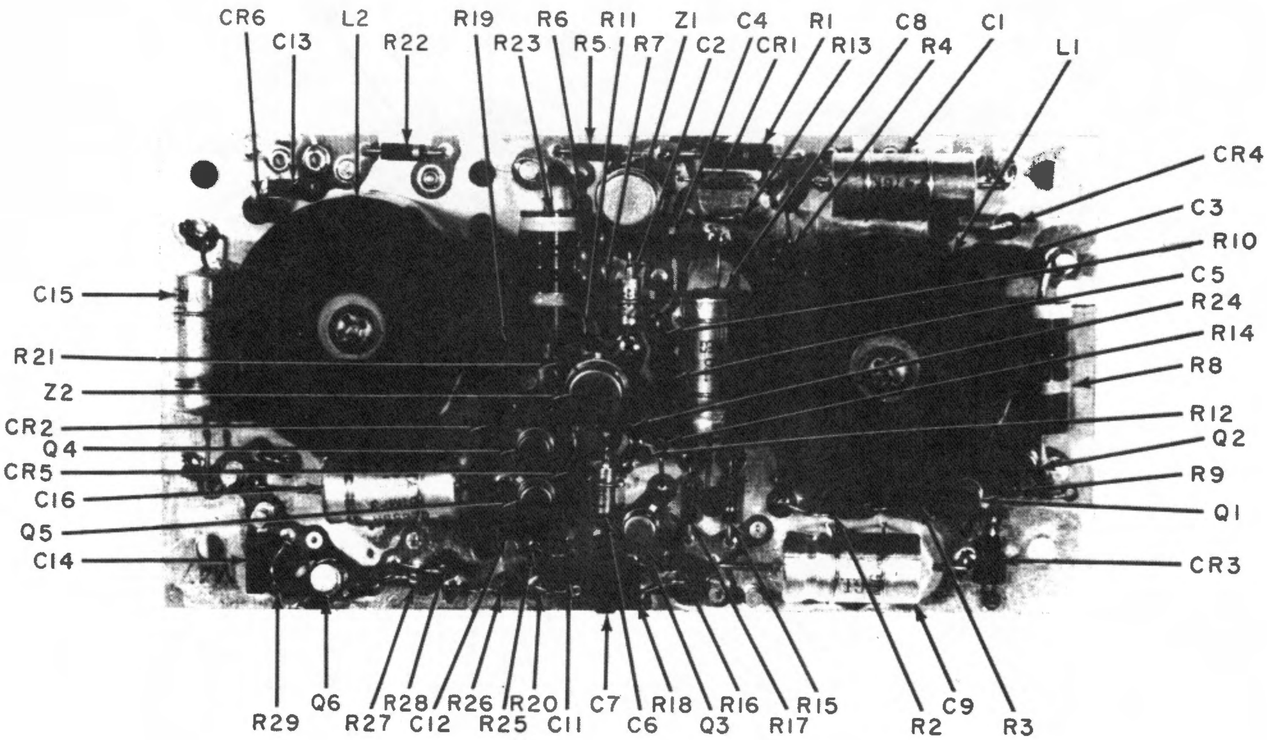


Figure 5-52. +5 and +18 Volt Regulator A2, Part of Power Supply PS1, Parts Location

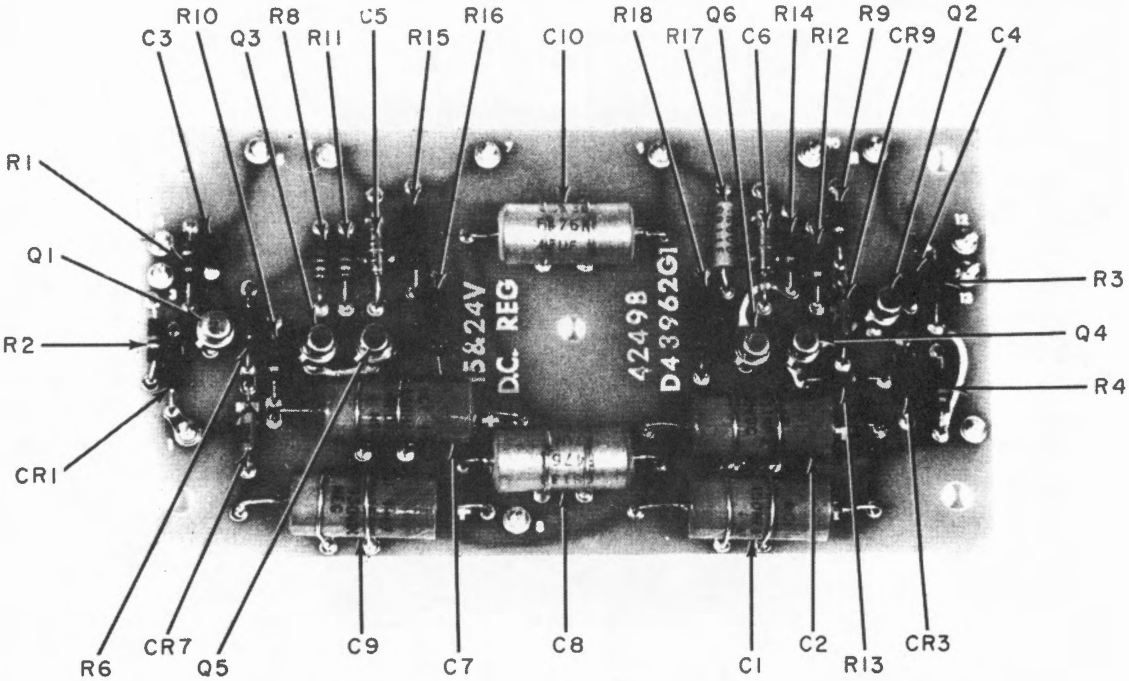


Figure 5-53. +15 and +24 Volt Regulator A3, Part of Power Supply PS1, Parts Location

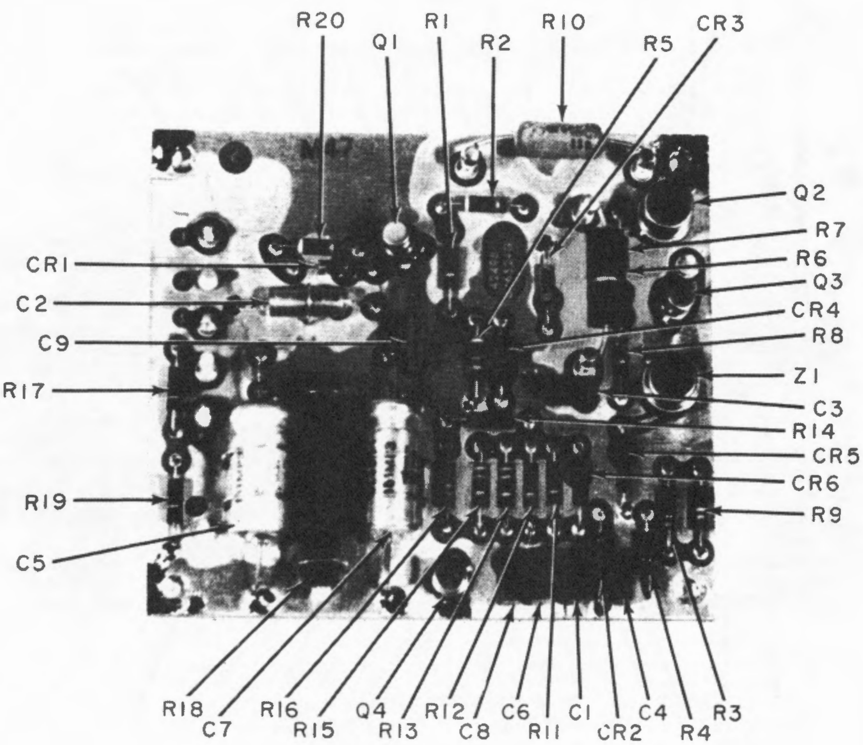
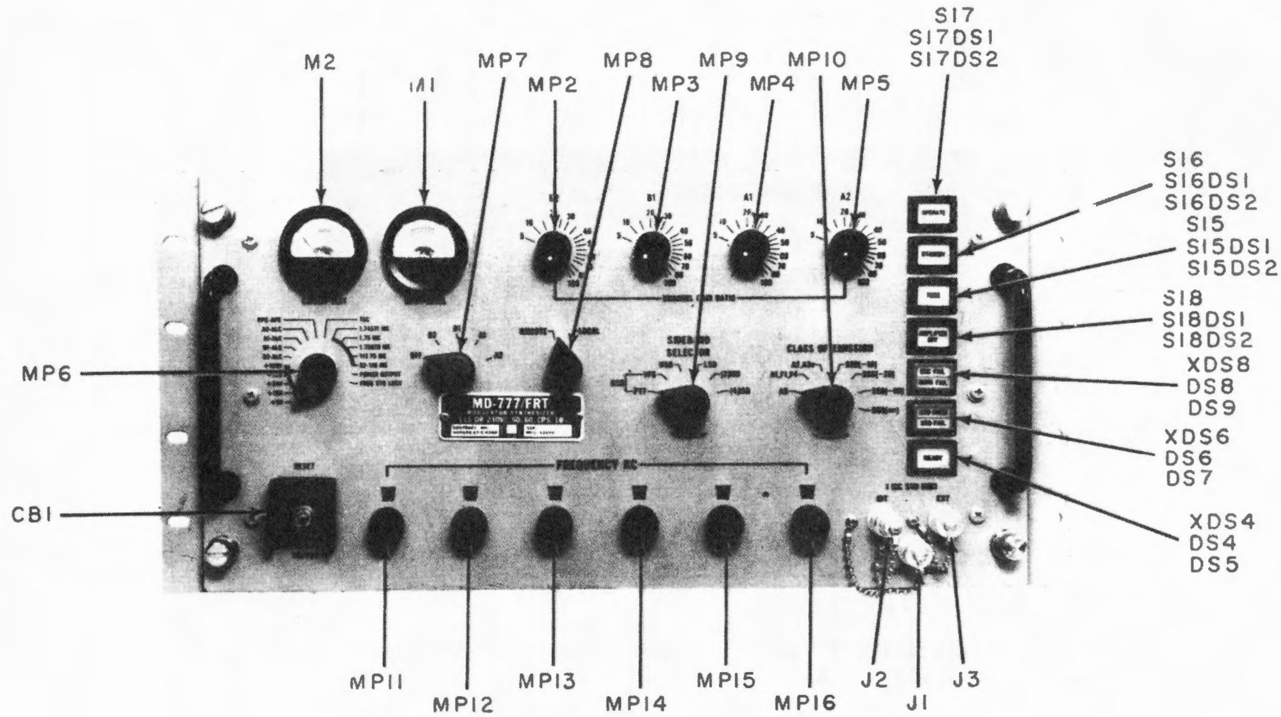
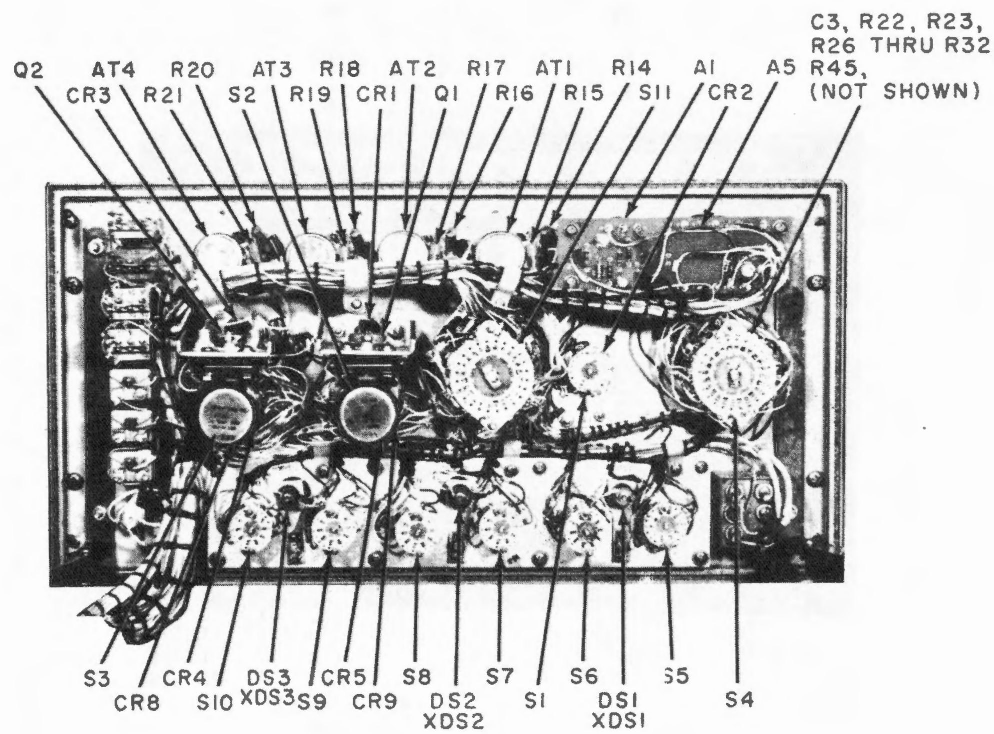


Figure 5-54. PS1A5 Switching Regulator

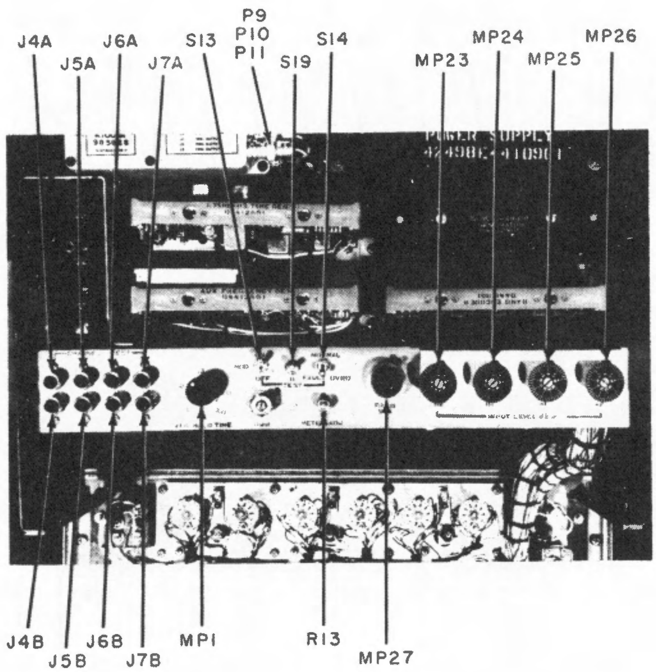


Front Panel Assembly



Front Panel, Rear Assembly

Figure 5-55. Modulator-Synthesizer Assembly, A18 (Sheet 1 of 4)



Chassis Assembly, Front View

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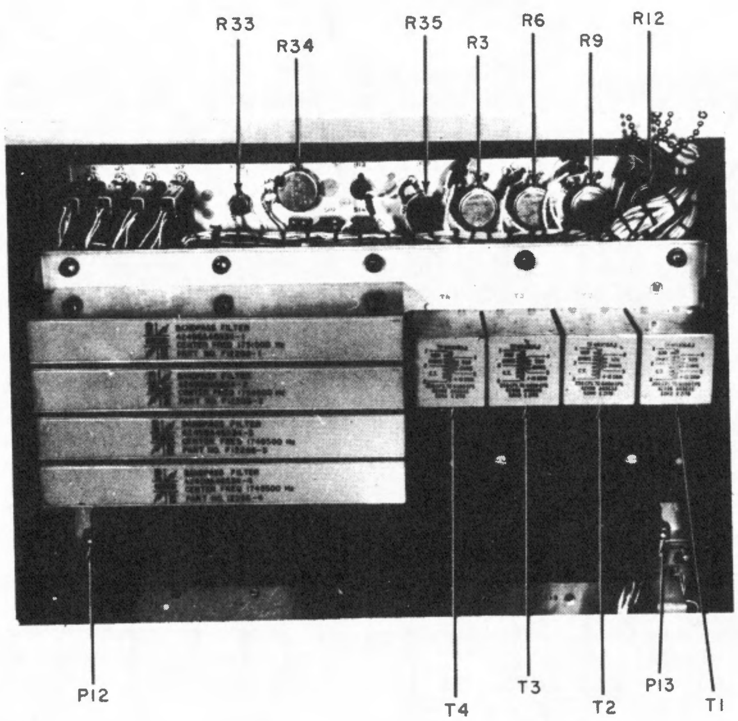
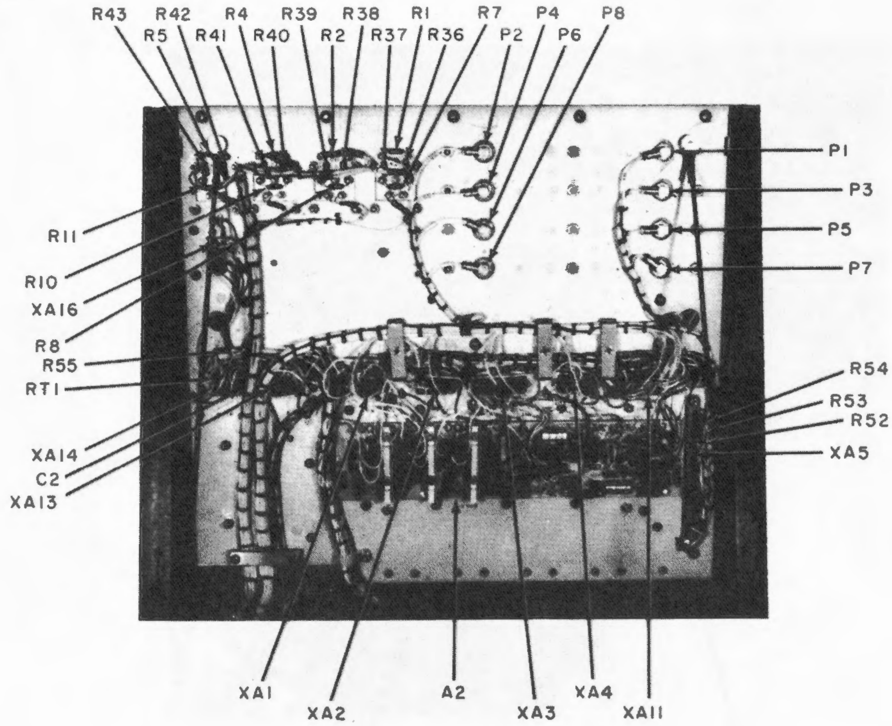
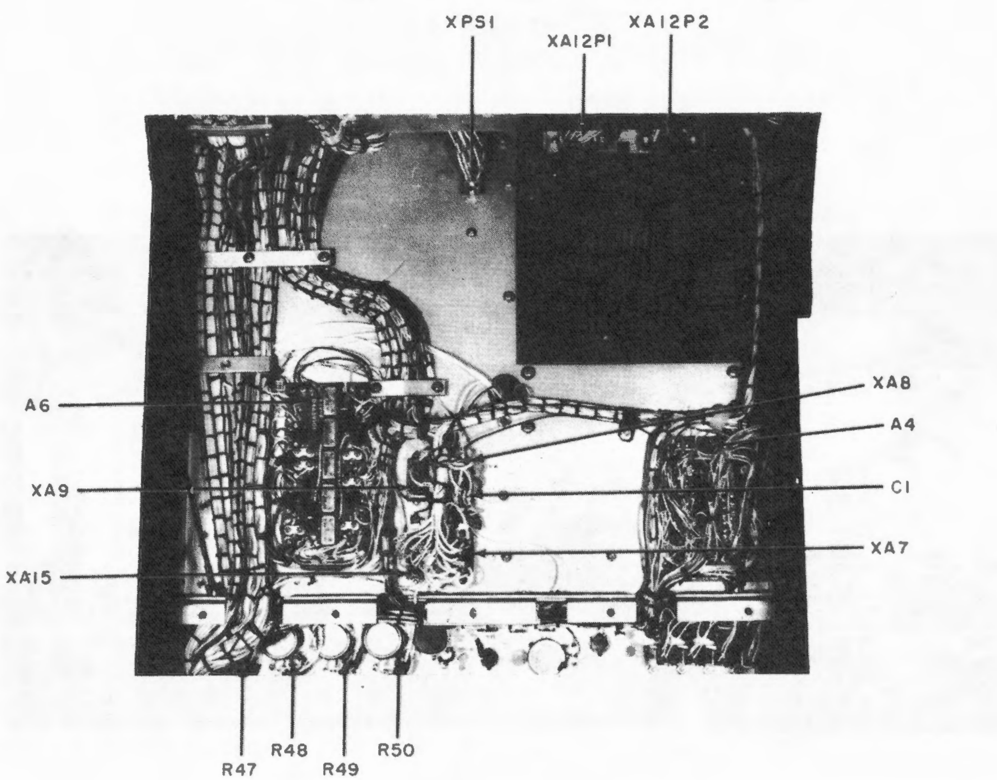


Chassis Assembly, Rear View

Figure 5-55. Modulator-Synthesizer Assembly, A18 (Sheet 2 of 4)



Chassis Assembly, Bottom View



Chassis Subassembly, Bottom View

Figure 5-55. Modulator-Synthesizer Assembly, A18 (Sheet 3 of 4)

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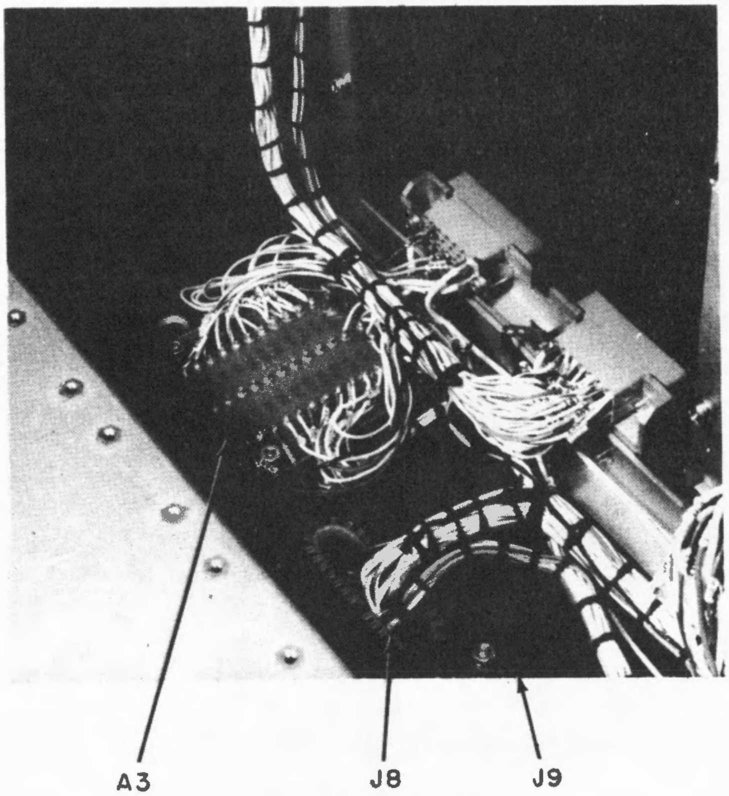

Interior View

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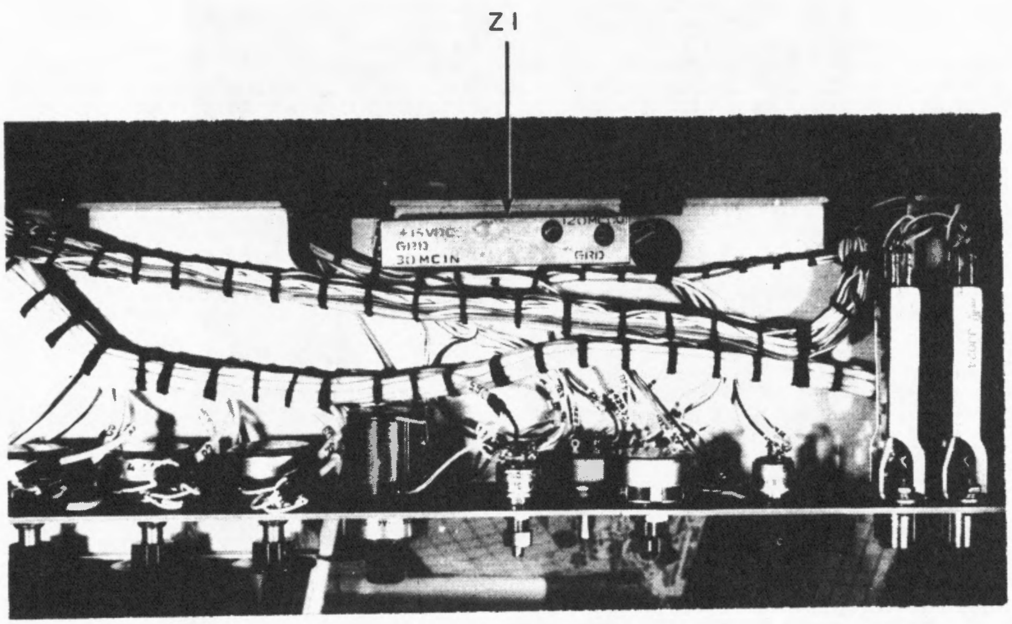

Interior View

Figure 5-55. Modulator-Synthesizer Assembly, A18 (Sheet 4 of 4)

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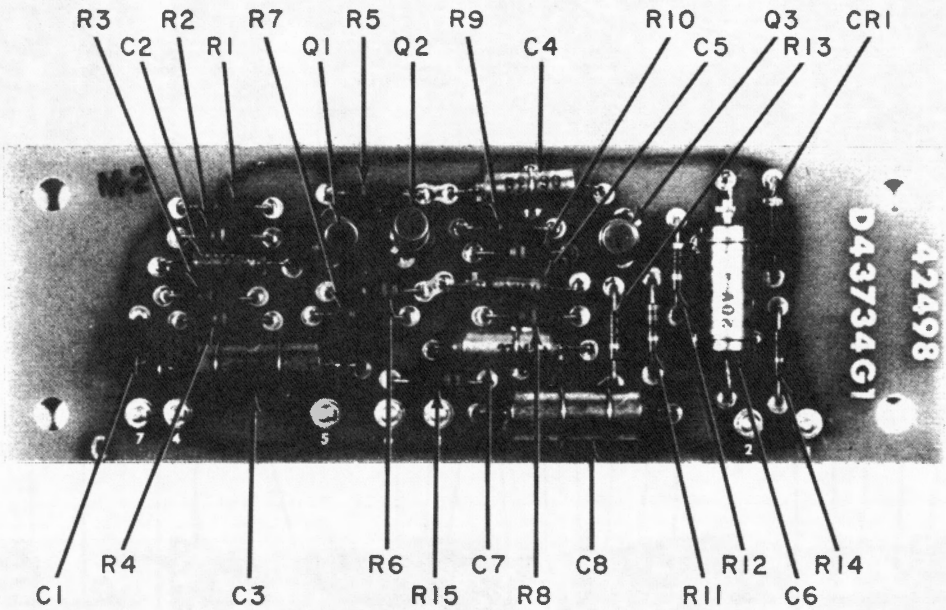


Figure 5-56. VU Meter Amplifier A1, Part of Panel and Chassis Assembly A18, Parts Location

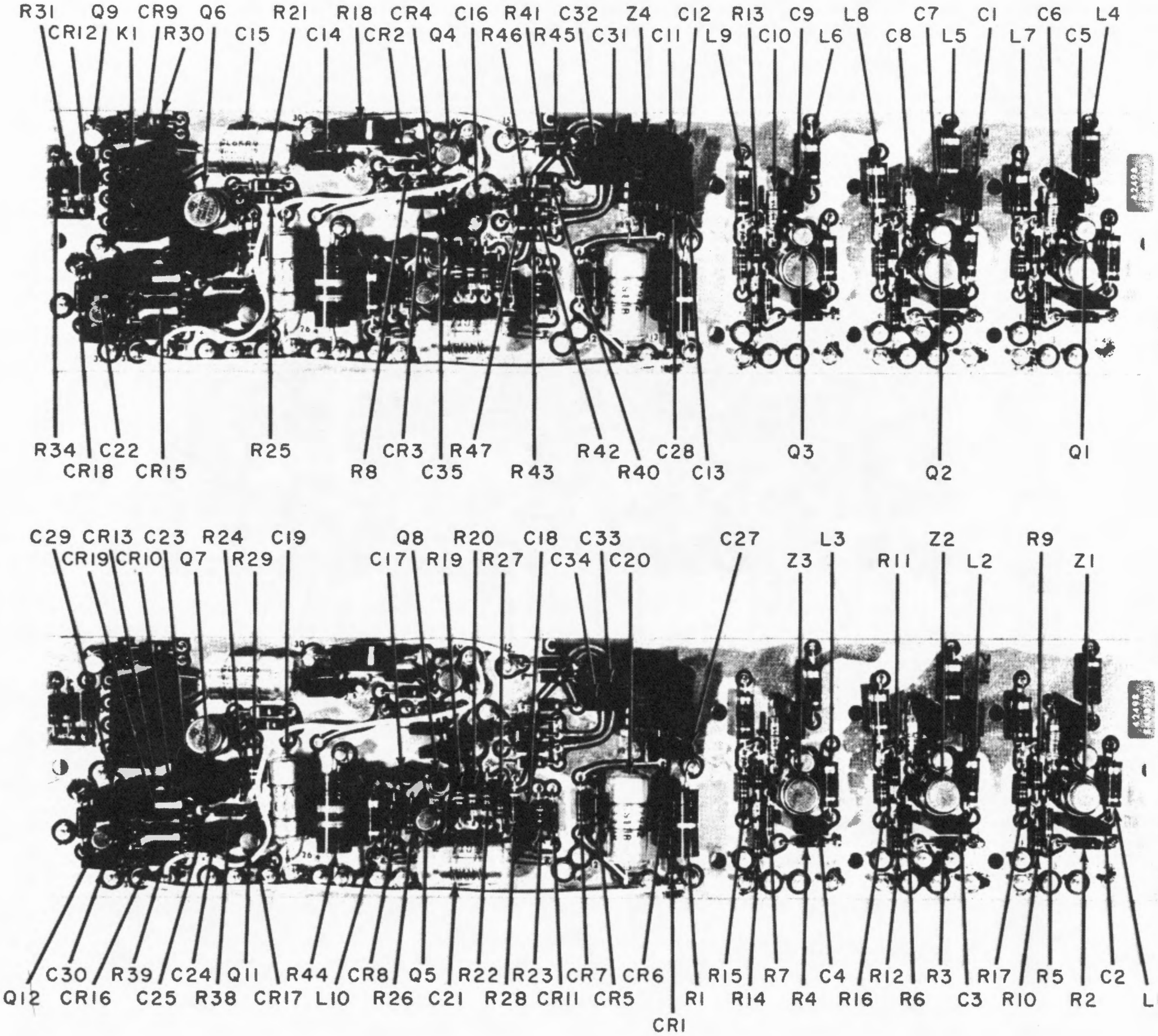


Figure 5-57. Fault Board A2, Part of Panel and Chassis Assembly A18, Parts Location

264

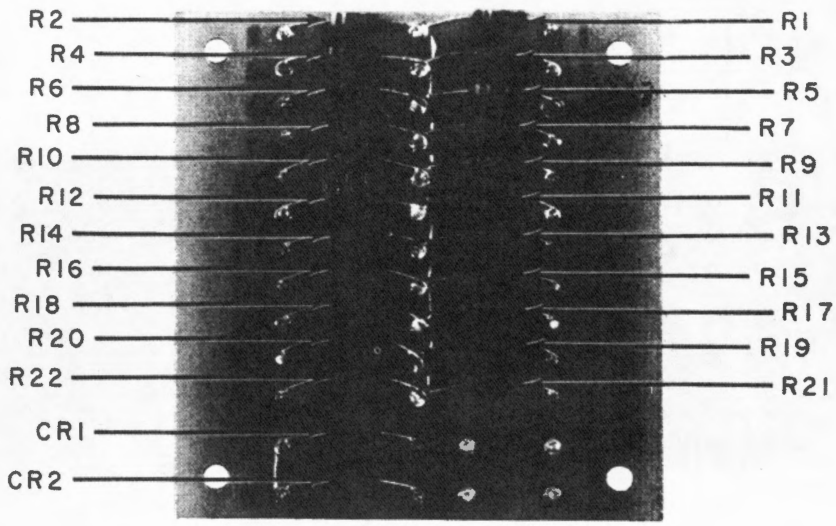


Figure 5-58. Frequency Selector Board A3, Part of Panel and Chassis Assembly A18, Parts Location

265

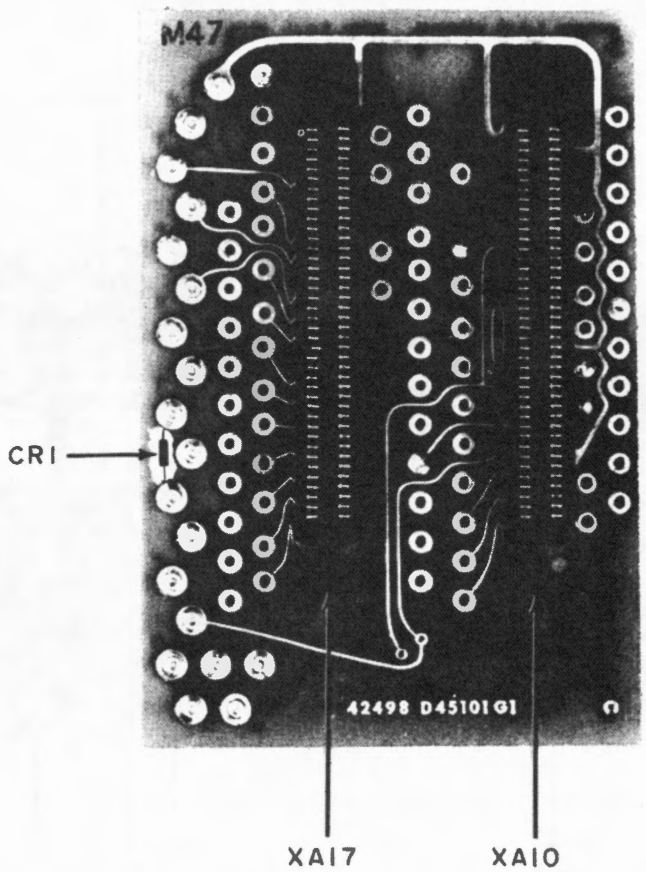


Figure 5-59. Transmitter Control Board A4, Part of Panel and Chassis Assembly A18, Parts Location

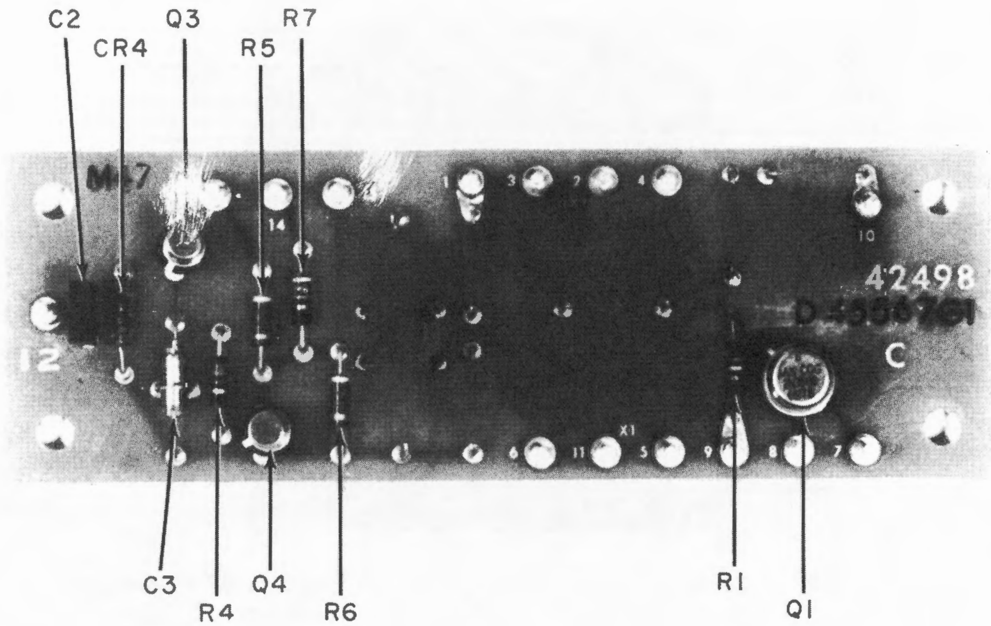


Figure 5-60. Motor Control Board A5, Part of Panel and Chassis Assembly A18, Parts Location

266

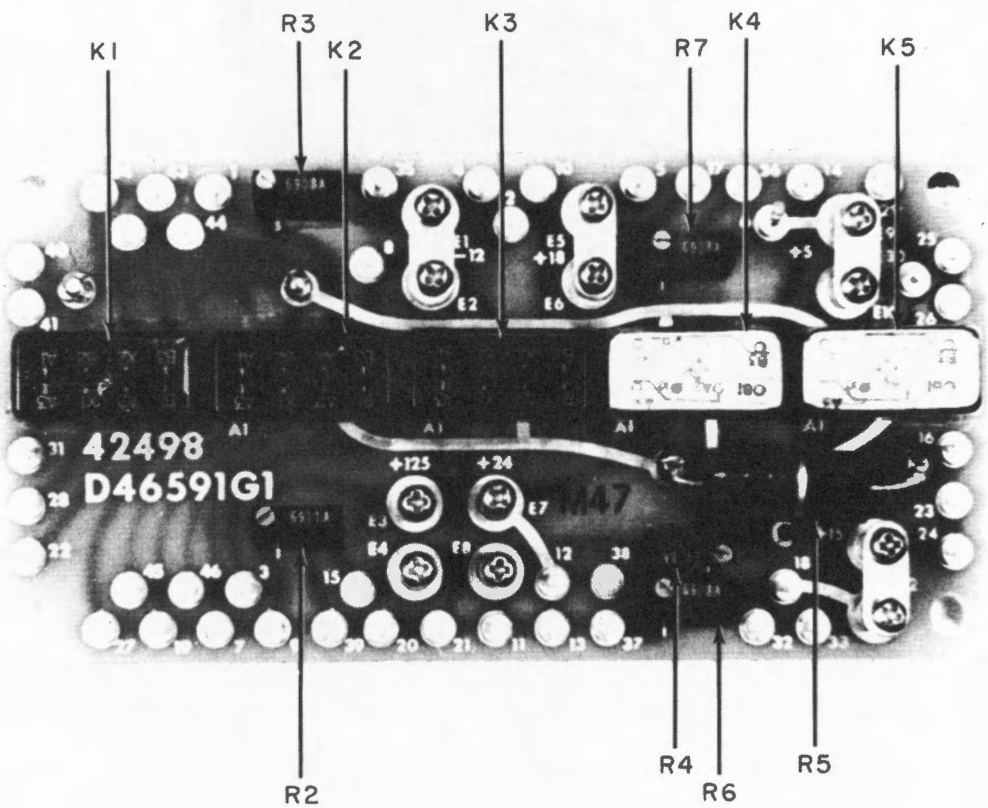


Figure 5-61. Power Distribution Board A6, Part of Panel and Chassis Assembly A18, Parts Location

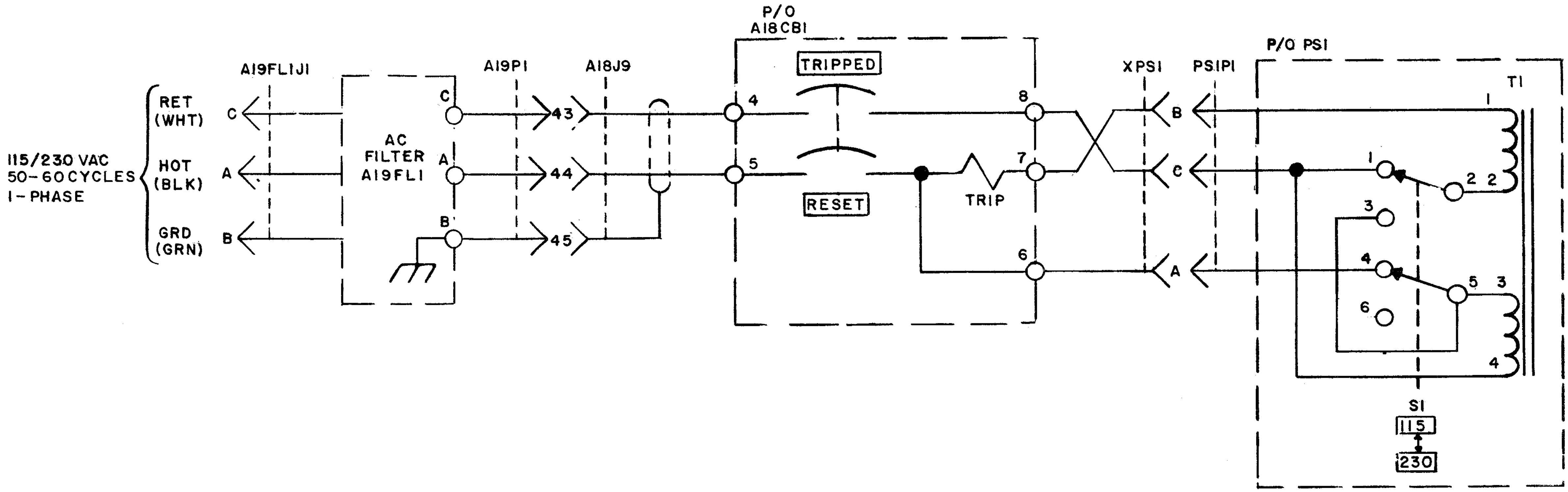


Figure 5-62. Modulator-Synthesizer MD-777/FRT, AC Power Distribution, Schematic Diagram

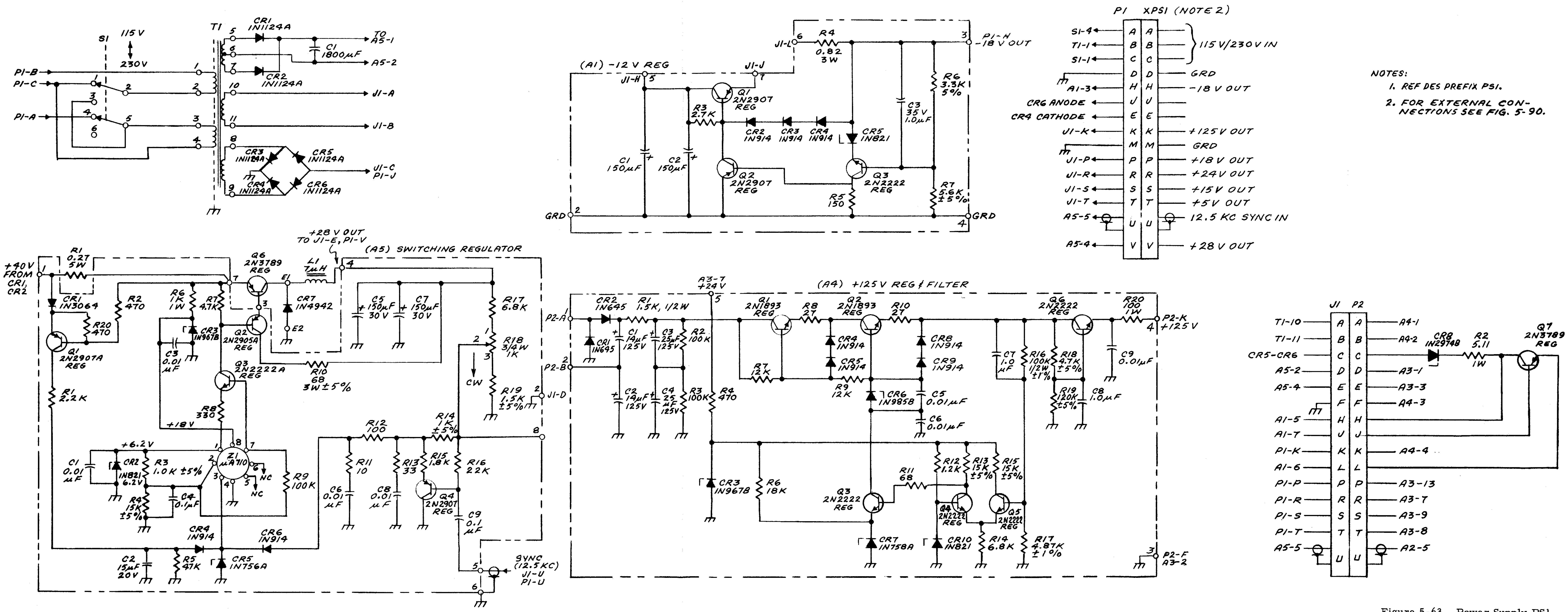
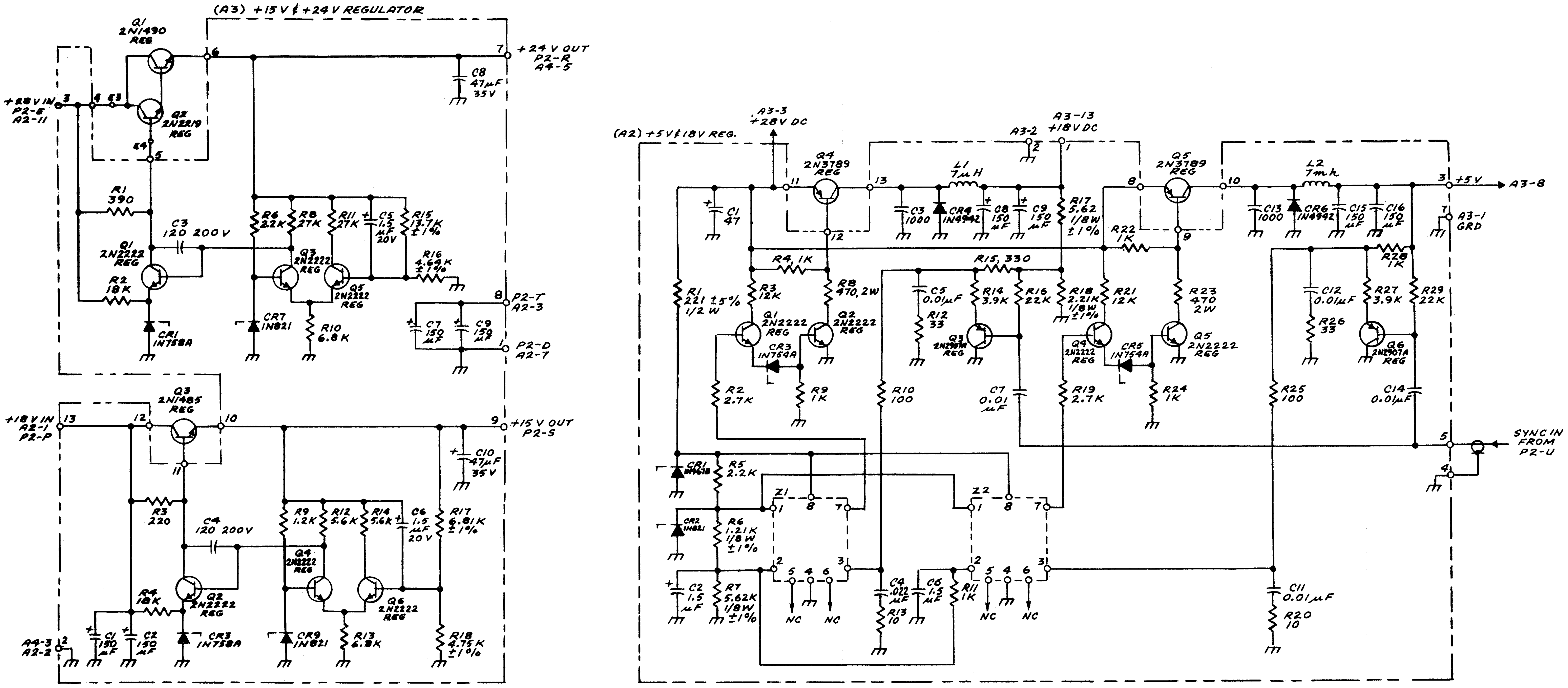


Figure 5-63. Power Supply PS1, Schematic Diagram (Sheet 1 of 2)



NOTES:

1. REF DES PREFIX: PS1.
2. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.

Figure 5-63. Power Supply PS1, Schematic Diagram (Sheet 2 of 2)

PARTS LOCATION INDEX

Modulator Board No. 1 (A1)				Modulator Board No. 2 (A2)					
REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	F3	Q6	E11	C1	F17	CR12	B23	R9	H18
C2	E3	Q7	D13	C2	A17	CR13	C23	R10	I18
C3	C5	Q8	F13	C3	F17	CR14	D23	R11	A19
C4	E4	R1	F4	C4	C17	CR15	D23	R12	D19
C5	D5	R2	E4	C5	I18	J1	D17	R13	B20
C6	D6	R3	F4	C6	A19	L1	B18	R14	C20
C7	F6	R4	E4	C7	B19	L2	A19	R15	F20
C8	G6	R5	F5	C8	F19	L3	E20	R16	G20
C9	C6	R6	C5	C9	E20	L4	D25	R17	B20
C10	F6	R7	D5	C10	B21	L5	D25	R18	F21
C11	C8	R8	F5	C11	E21	Q1	C18	R19	G21
C12	E8	R9	G5	C12	F23	Q2	G18	R20	G22
C13	C8	R10	D6	C13	G23	Q3	B20	R21	G22
C14	G9	R11	D7	C14	G24	Q4	C20	R22	F23
C15	E10	R12	F7	C15	D25	Q5	G20	R23	G23
C16	C12	R13	D7	C16	E25	Q6	G21	R24	G24
C17	E12	R14	B8	CR1	B19	Q7	G21	R25	E25
C18	G13	R15	B8	CR2	C19	Q8	G24	R26	G25
C19	E13	R16	F9	CR3	C22	Q9	G25	R27	H25
C20	G14	R17	D9	CR4	D22	R1	C17	R28	B25
C21	D14	R18	D10	CR5	B22	R2	B18	R29	C25
C22	E14	R19	F10	CR6	D22	R3	C18	R30	B26
C23	B3	R20	G10	CR7	C22	R4	F18	R31	H26
C24	D3	R21	G10	CR8	C22	R5	G18	R32	C26
CR1	F5	R22	D11	CR9	B22	R6	C18	T1	I20
CR2	G5	R23	F11	CR10	D22	R7	F18	T2	B22
CR3	C6	R24	D11	CR11	G22	R8	G18	T3	C24
CR4	D12	R25	F11						
CR5	E12	R26	G11						
Q1	E4	R27	C12						
Q2	D5	R28	F12						
Q3	E5	R29	D13						
Q4	E7	R30	E13						
Q5	E10	R31	F15						

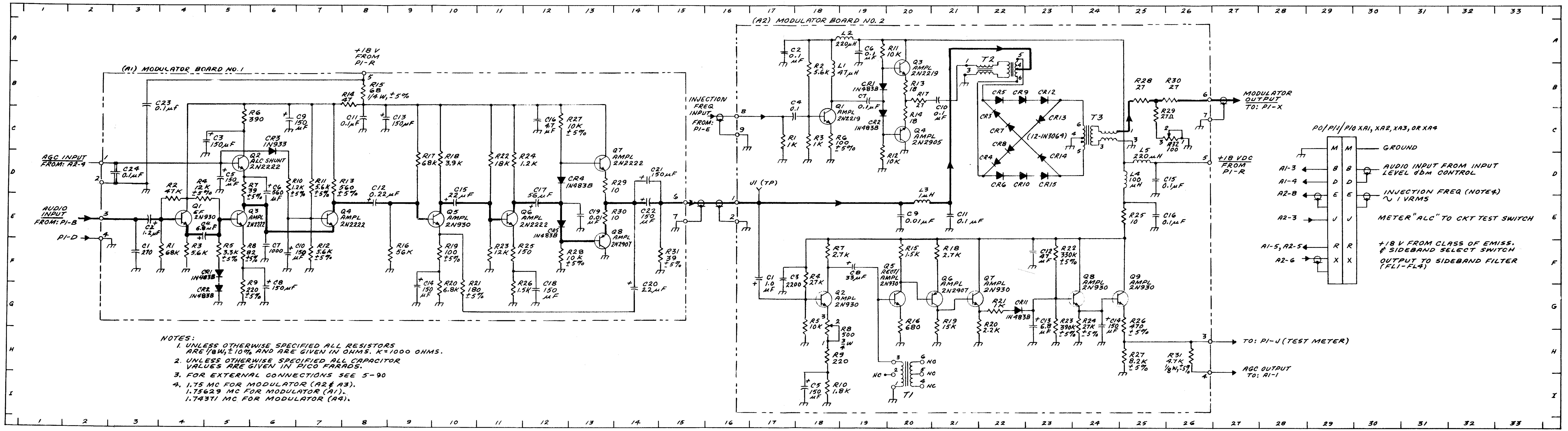


Figure 5-64. Modulator A1, A2, A3, A4, Schematic Diagram

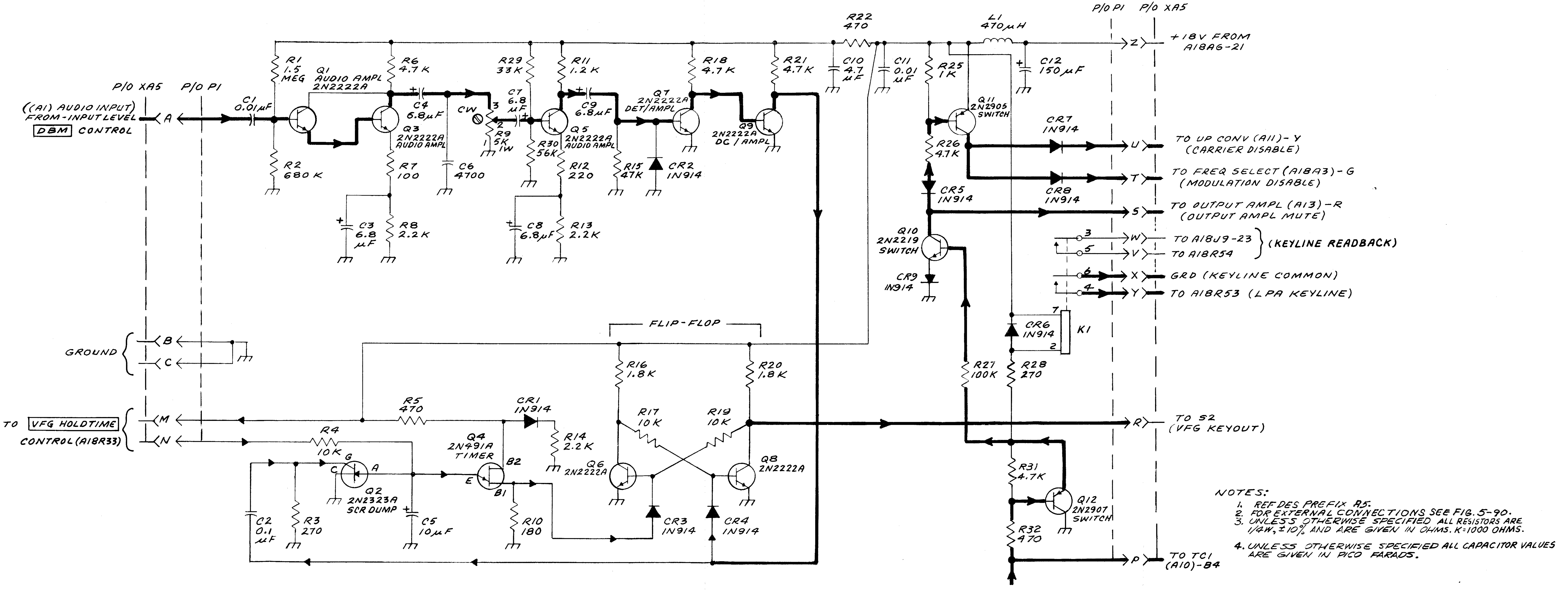
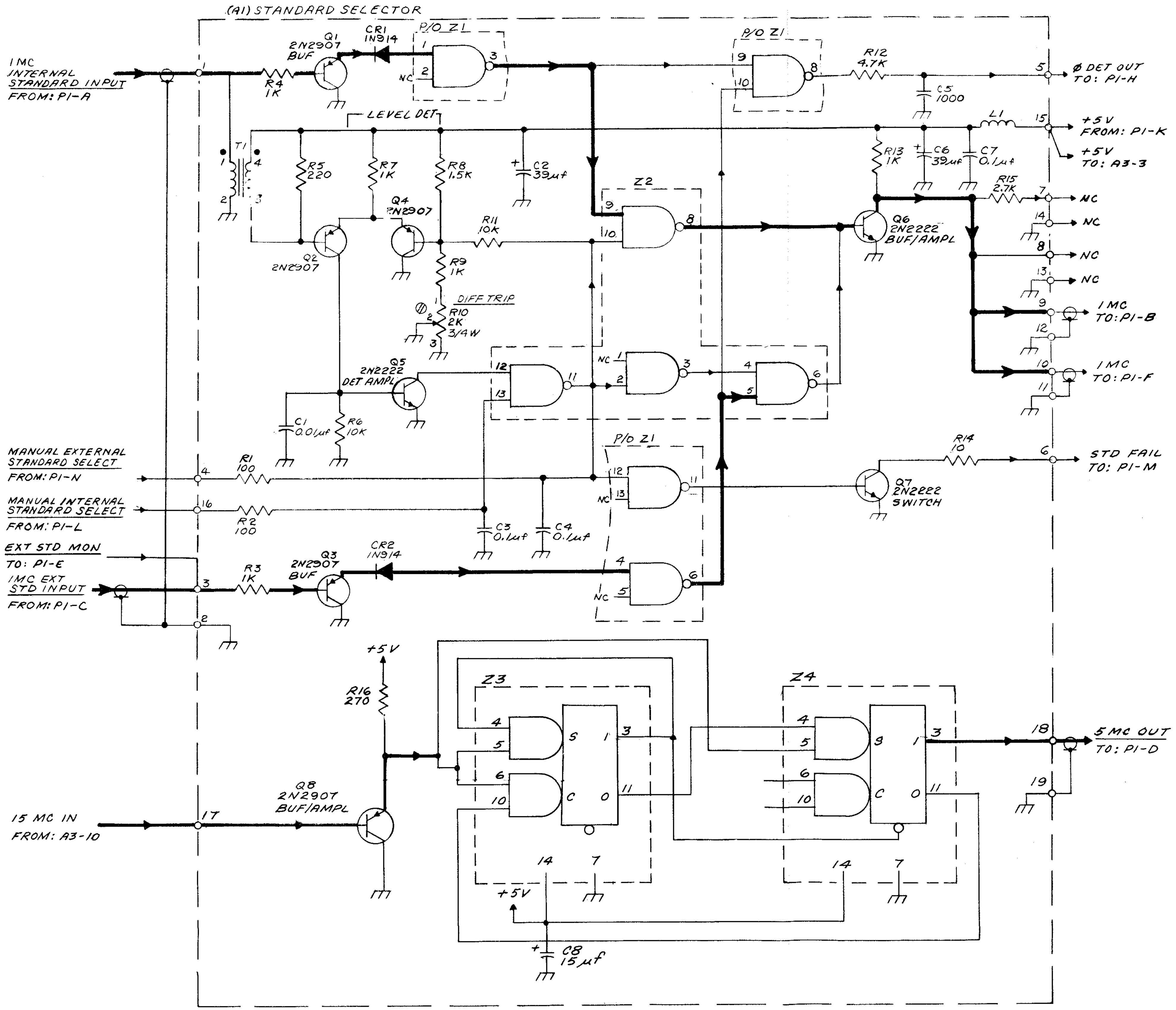
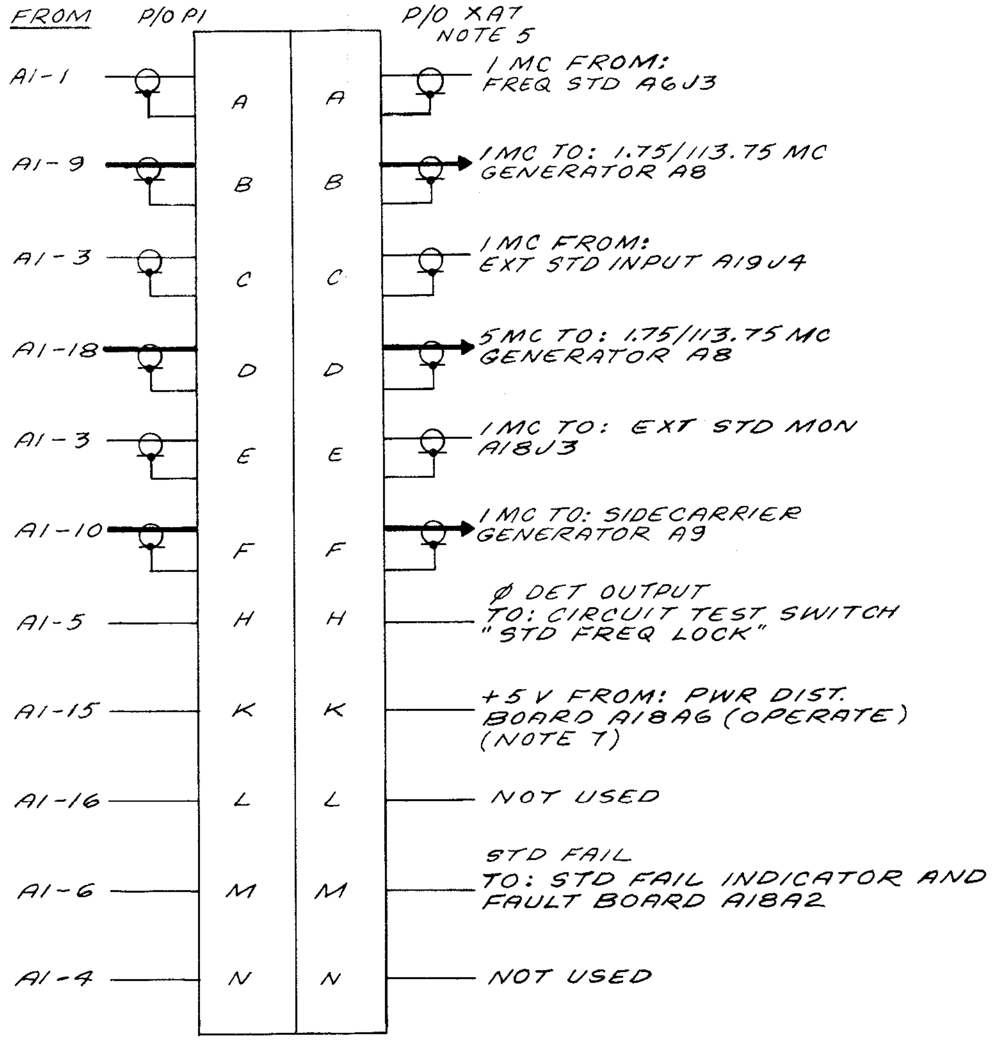


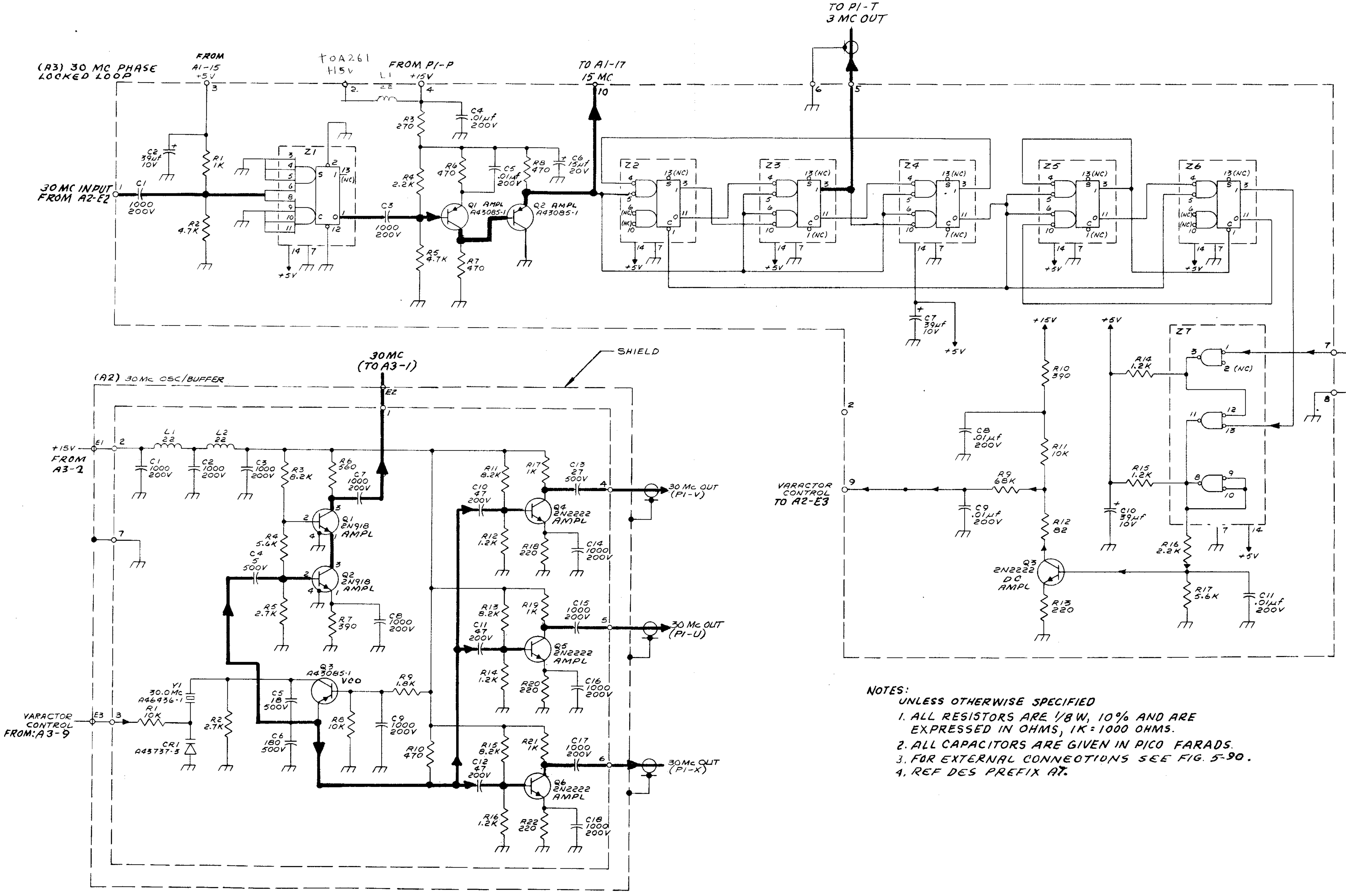
Figure 5-65. Voice Frequency Gate A5, Schematic Diagram





NOTES:
1. UNLESS OTHERWISE SPECIFIED; ALL RESISTORS ARE IN OHMS, 1/4 W ± 5%. K = 1000 OHMS.
2. UNLESS OTHERWISE SPECIFIED; ALL CAPACITOR VALUES ARE GIVEN IN PICO FARADS.
3. PIN 7 ON Z1 AND Z2 ARE GROUNDED.
4. PIN 14 ON Z1 AND Z2 ARE CONNECTED TO +5 VDC.
5. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
6. REF DESIG PREFIX A7.
7. VOLTAGE AVAILABLE ONLY IN OPERATE CONDITION.

Figure 5-66. Auxiliary Frequency Generator A7, Schematic Diagram (Sheet 1 of 2)



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/8 W, 10% AND ARE EXPRESSED IN OHMS, 1K = 1000 OHMS.
2. ALL CAPACITORS ARE GIVEN IN PICO FARADS.
3. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
4. REF DES PREFIX A7.

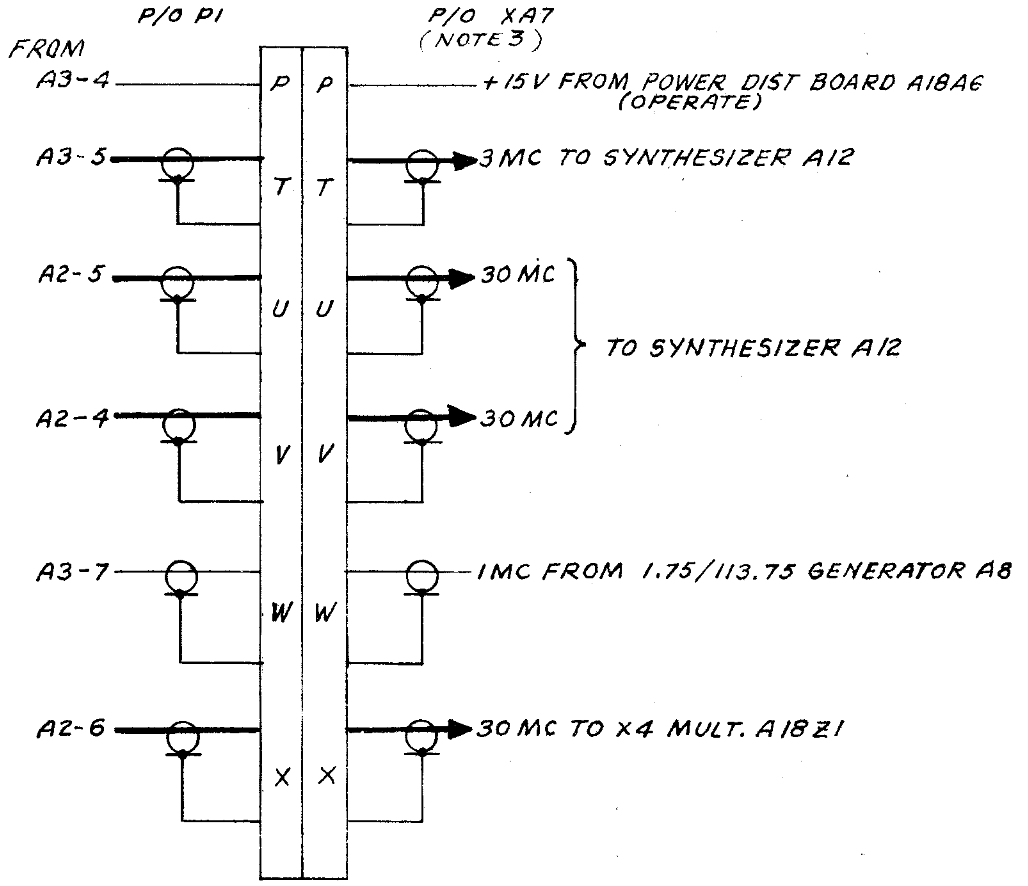


Figure 5-66. Auxiliary Frequency Generator A7, Schematic Diagram (Sheet 2 of 2)

PARTS LOCATION INDEX

113.75 Mc (MHz) (Generator) (A8A1)								1.75 Mc Gen. (A8A2)	
REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	F2	C32	F11	R1	F2	R32	I10	C1	B2
C2	H2	C33	H14	R2	Not used	R33	H11	C2	C3
C3	H2	C34	G14	R3	H2	R34	I11	C3	B4
C4	G3	C35	H14	R4	F2	R35	F10	C4	C5
C5	H2	C36	F12	R5	I2	R36	F10	C5	A8
C6	F3	C37	E14	R6	F3	R37	G13	C6	B8
C7	E4	C38	E14	R7	H2	R38	H13	C7	B9
C8	F4	C39	E15	R8	I2	R39	H11	C8	B9
C9	I3	C40	E15	R9	I3	R40	I11	C9	B9
C10	I4	C41	F11	R10	H3	R41	E10	C10	C11
C11	I4	CR1	E9	R11	I3	R42	F10	C11	A13
C12	F7	CR2	F11	R12	F5	R43	F11	C12	A14
C13	H7	CR3	H15	R13	F6	R44	G13	C13	B14
C14	H8	J1	D12	R14	H4	R45	H14	C14	C14
C15	H8	L1	F3	R15	I4	R46	H12	C15	C14
C16	E8	L2	H7	R16	I6	R47	I11	L1	B10
C17	I8	L3	F9	R17	I6	R48	F12	L2	B8
C18	H8	L4	G14	R18	I6	R49	E12	Q1	B3
C19	I9	Q1	F3	R19	E8	R50	G15	Q2	B3
C20	H9	Q2	H3	R20	F8	R51	F15	Q3	B5
C21	F9	Q3	F5	R21	E8	R52	E14	Q4	B5
C22	H12	Q4	F6	R22	F8	R53	E15	Q5	B10
C23	H11	Q5	H4	R23	E8	R54	E14	Q6	B11
C24	H10	Q6	F8	R24	H8	R55	E15	Q7	B13
C25	E9	Q7	H9	R25	I8	T1	F4	R1	B2
C26	F9	Q8	H10	R26	F9	T2	I5	R2	C2
C27	F10	Q9	H11	R27	I9	T3	G8	R3	C3
C28	G13	Q10	F10	R28	H10	Z1	E6	R4	C2
C29	I10	Q11	G14	R29	I10	Z2	E7	R5	A3
C30	H13	Q12	F12	R30	H11	Z3	I7	R6	B3
C31	H11	Q13	E15	R31	H10	Z4	F8	R7	C4
								R8	C5
								R9	C5
								R10	A5
								R11	B5
								R12	A8
								R13	C10
								R14	C11
								R15	A13
								R16	C13
								R17	C14
								R18	B15
								T1	Not used
								T2	B14
								Y1	B4
								Z1	B7
								Z2	B12

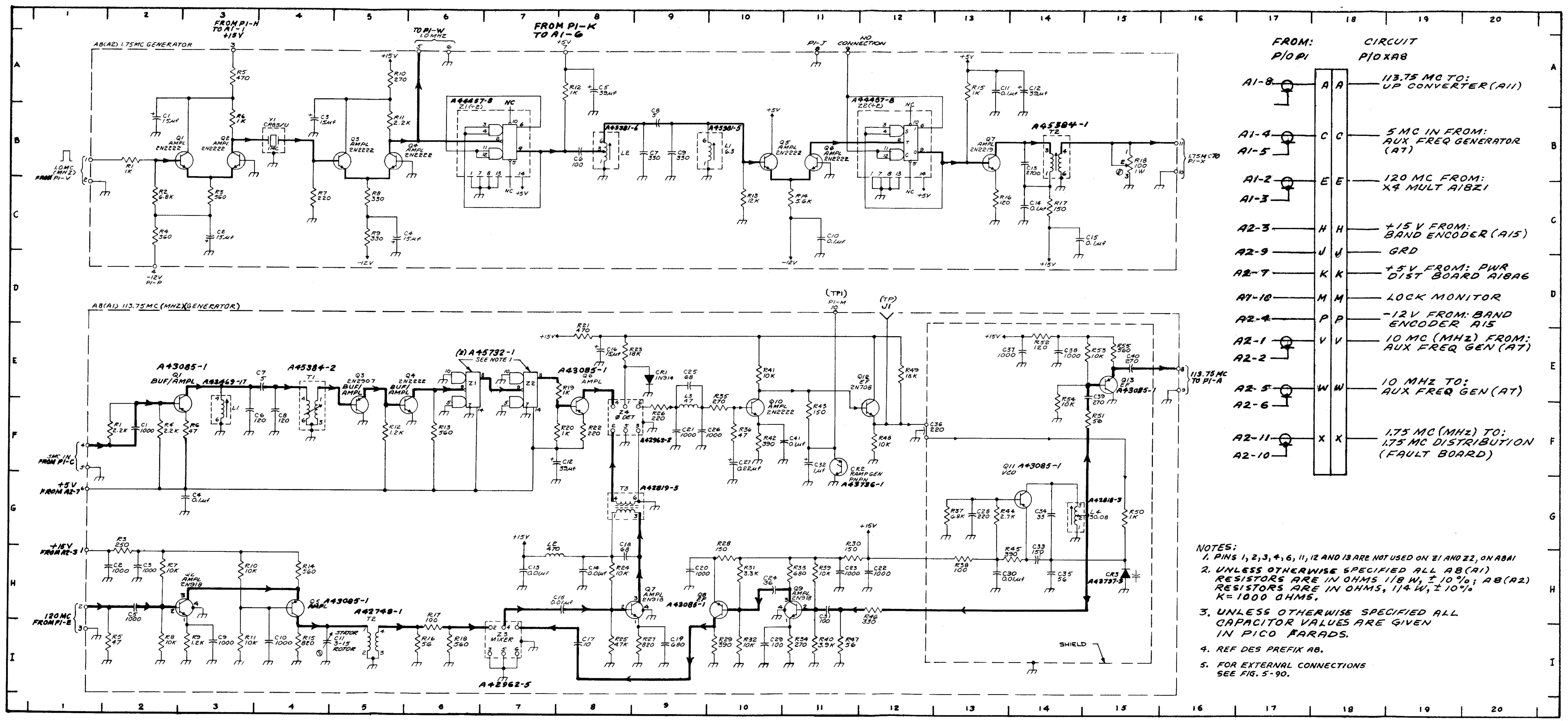


Figure 5-67. 1.75/113.75 MC Frequency Generator A8, Schematic Diagram

PARTS LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC
C1	C26	Z4	C8
C2	C26	Z5	C11
C3	H21	Z6	H5
C4	H22	Z7	C13
C5	G22	Z8	C15
C6	H22	Z9	C17
CR1	D16	Z10	H8
CR2	D19	Z11	C19
L1	H21	Z12	H10
L2	H23	Z13	C21
Q1	H24	Z14	H12
Q2	H24	Z15	C23
R1	C10	Z16	H14
R2	H7	Z17	C25
P/O Z1	C3	Z18	H16
P/O Z1	G6	Z19	H18
P/O Z1	I5	Z20	H20
Z2	C5	Z21	G26
Z3	C6		

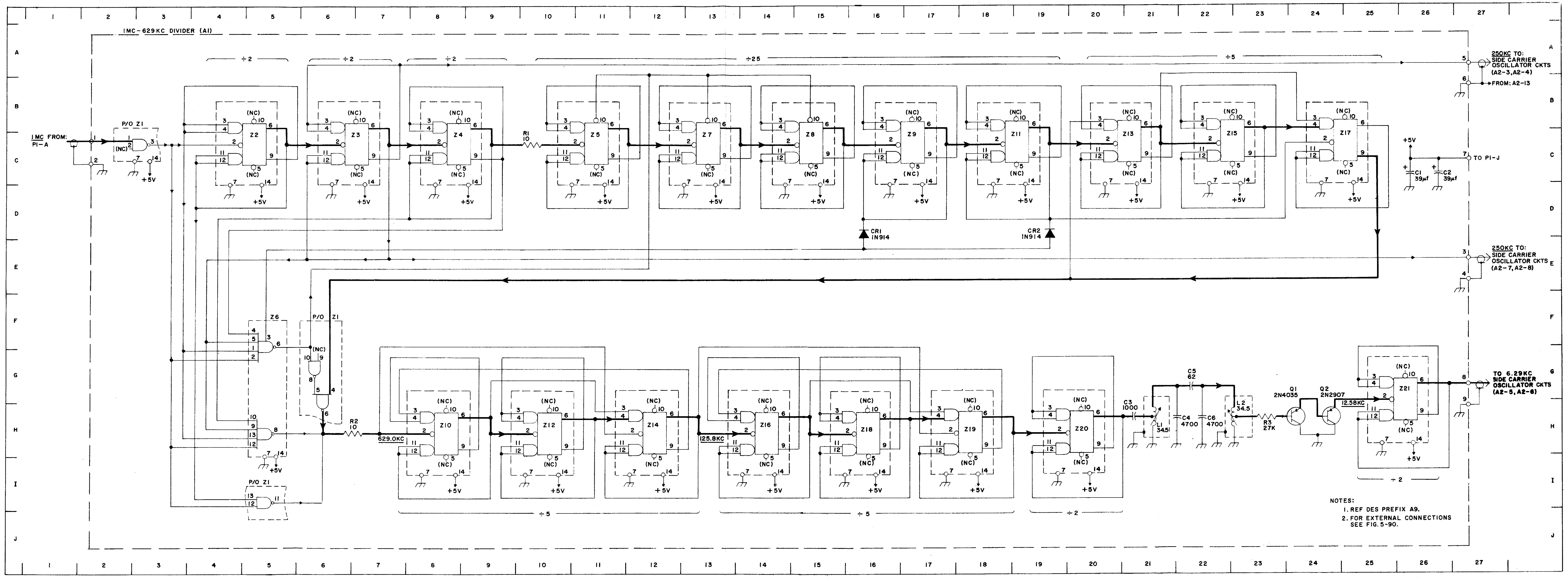


Figure 5-68. Side-Carrier Generator A9, Schematic Diagram (Sheet 1 of 2)

PARTS LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	B29	Q4	H35	R28	C41
C2	B30	Q5	C38	R29	D41
C3	B30	Q6	H38	R30	G31
C4	B30	Q7	D40	R31	H41
C5	C36	Q8	D42	R32	D43
C6	D34	Q9	H40	R33	I43
C7	G36	Q10	H42	R34	C44
C8	H34	Q11	D44	R35	G44
C9	D36	Q12	H44	R36	C45
C10	F30	Q13	D49	R37	H45
C11	H36	Q14	H49	R38	D38
C12	C37	R1	D33	R39	H48
C13	H37	R2	H33	R40	B49
C14	C38	R3	C34	R41	D49
C15	H38	R4	G34	R42	E49
C16	C40	R5	C34	R43	F49
C17	E40	R6	D35	R44	H49
C18	D41	R7	G33	R45	I49
C19	H40	R8	I35	R46	B50
C20	I40	R9	D36	R47	G50
C21	I41	R10	F30	R48	C50
C22	D43	R11	G36	R49	G50
C23	I43	R12	E37	R50	B51
C24	D41	R13	F37	R51	G51
C25	C43	R14	C39	T1	D38
C26	H41	R15	H39	T2	G38
C27	H43	R16	C42	T3	C49
C28	C45	R17	E42	T4	G49
C29	G45	R18	G42	Y1	C39
C30	C49	R19	I42	Y2	H39
C31	G49	R20	C40	P/O Z1	C32
CR1	C39	R21	E40	P/O Z1	B47
CR2	H39	R22	C42	Z2	F32
J1	C38	R23	D42	P/O Z3	H32
J2	G38	R24	G40	P/O Z3	I47
Q1	D34	R25	I40	Z4	C46
Q2	H34	R26	G42	Z5	H46
Q3	D35	R27	I42		

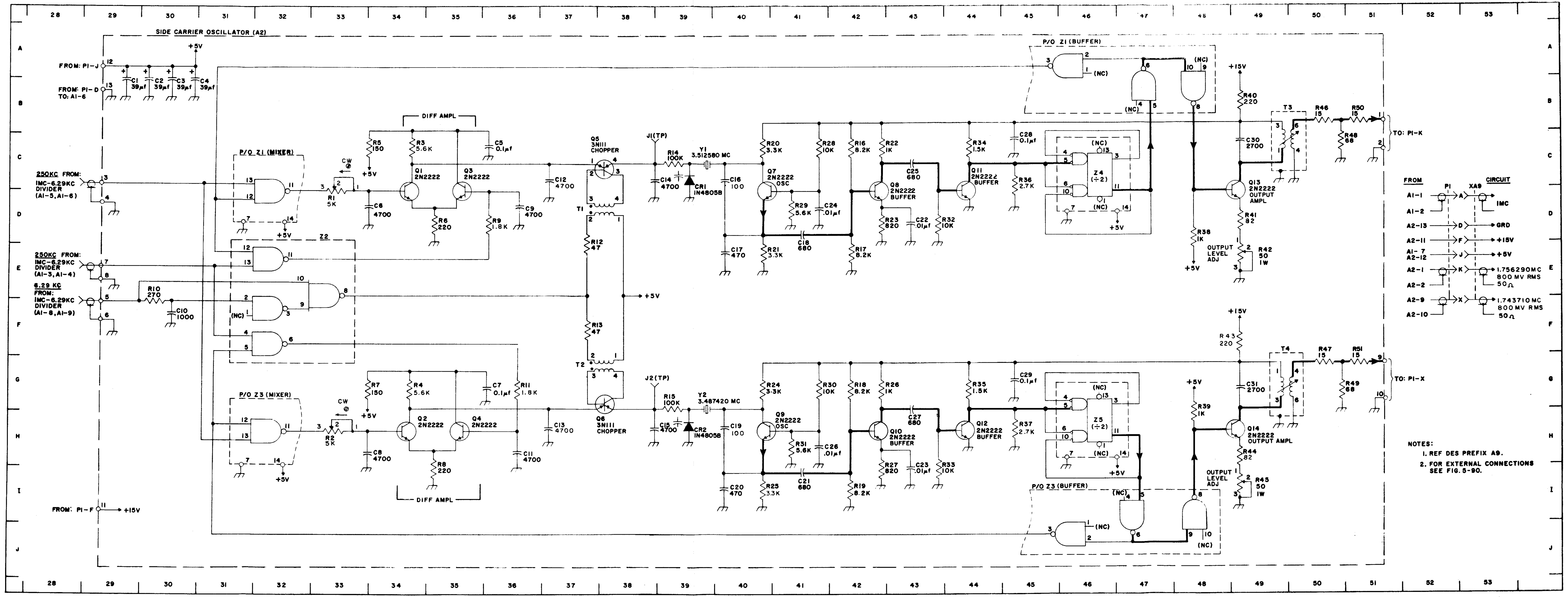
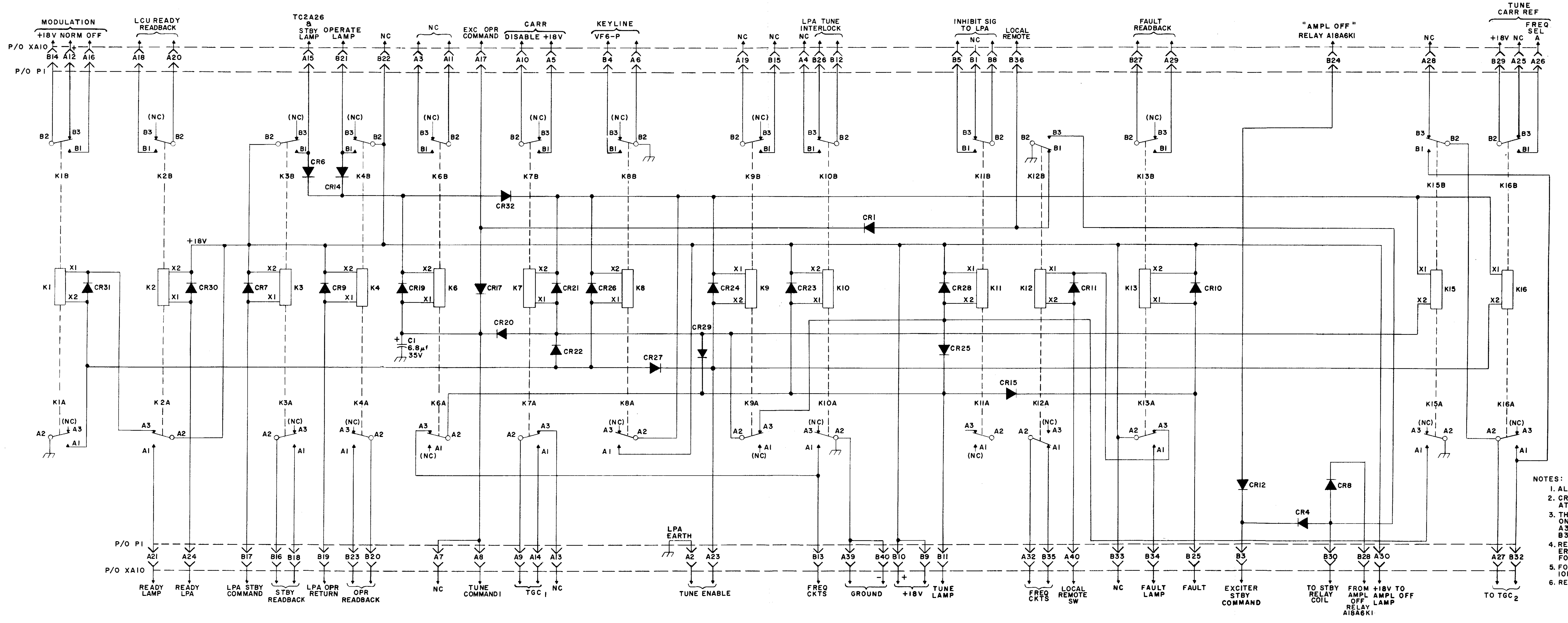


Figure 5-68. Side-Carrier Generator A9, Schematic Diagram (Sheet 2 of 2)

LEGEND

RELAY SYMBOL	FUNCTION
K1	MODULATION
K2	READY RETURN
K3	STANDBY RETURN
K4	OPERATE RETURN
K5	NOT USED
K6	ACTIVATE COMMAND
K7, K8, K15	TGC & CARR CONTROLS
K9, K16	TUNE ENABLE RETURN
K10	FREQ & MODE CONTROLS
K11	LPA INHIBIT
K12	FAULT/STBY INTERLOCK
K13	FAULT



NOTES:

1. ALL DIODES ARE IN483B.
2. CR2 & CR3 REF DESIGNATIONS ARE NOT USED.
3. THE FOLLOWING CONTACTS ON CARD ARE SPARES; A22, A31, A33 THRU A38, B1, B2, B37, B38 & B39.
4. RELAY CONTACTS IN UNENERGIZED POSITION EXCEPT FOR K12.
5. FOR EXTERNAL CONNECTIONS SEE FIG. 5-87.
6. REF DES PREFIX A10.

Figure 5-69. Transmitter Control No. 1 A10, Schematic Diagram

PARTS LOCATION INDEX

1.75 (MHz) IF Amplifier (A1)

REF DESIG	LOC	REF DESIG	LOC
C1	J16	R2	G19
C2	I12	R3	J19
C3	I13	R4	G19
C4	J17	R5	G21
C5	J16	R6	G22
C6	H16	R7	J22
C7	H15	R8	H21
C8	H16	R9	H22
C9	H14	R10	H21
C10	I14	R11	J21
CR1	I21	R12	H22
CR2	I21	R13	K22
CR3	K19	R14	J23
L1	J18	R15	J21
L2	H18	R16	K22
L3	J13	R17	K20
L4	H14	R18	I11
Q1	I18	R19	J11
Q2	I19	R20	J12
Q3	I20	R21	H12
Q4	I20	R22	J12
Q5	I22	R23	J13
Q6	I13	R24	H17
Q7	H14	R25	J16
R1	J17	R26	J14

Up Converter Buffer (A2)

REF DESIG	LOC	REF DESIG	LOC
C1	B17	Q3	B21
C2	B19	Q4	B22
C3	B20	R1	C18
C4	C20	R2	B18
C5	B22	R3	B18
C6	B23	R4	B18
C7	C23	R5	B19
FL1	A20	R6	C20
L1	C20	R7	B20
L2	C22	R8	B21
Q1	B18	R9	B21
Q2	B19	R10	B22

Carrier Insertion (A3)

REF DESIG	LOC	REF DESIG	LOC
C1	J3	R11	K7
C2	H5	R12	F9
C3	F6	R13	G8
C4	F7	R14	I7
C5	G7	R15	E8
C6	H6	R16	G9
C7	H7	R17	K8
C8	H8	R18	I8
C9	H9	R19	K8
CR1	H3	R20	I9
CR2	J6	R21	K10
CR3	J7	R22	D9
CR4	J8	R23	E10
CR5	J9	R24	E10
CR6	C14	R25	E10
CR7	D15	R26	D10
K1	G4	R27	E10
K2	C8	R28	F12
K3	C9	R29	D12
K4	B12	R30	E12
K5	D12	R31	D13
L1	G6	R32	Not used
L2	I6	R33	Not used
L3	J7	R34	F13
L4	J8	T1	B4
L5	J9	T2	C4
L6	J10	T3	D4
L7	C12	T4	E4
R1	Not used	T5	B5
R2	G5	T6	D5
R3	J4	T7	C5
R4	C5	T8	D5
R5	E5	T9	D6
R6	G5	T10	D7
R7	I5	T11	E14
R8	J6	T12	E15
R9	I6		
R10	D6	Z1	E23

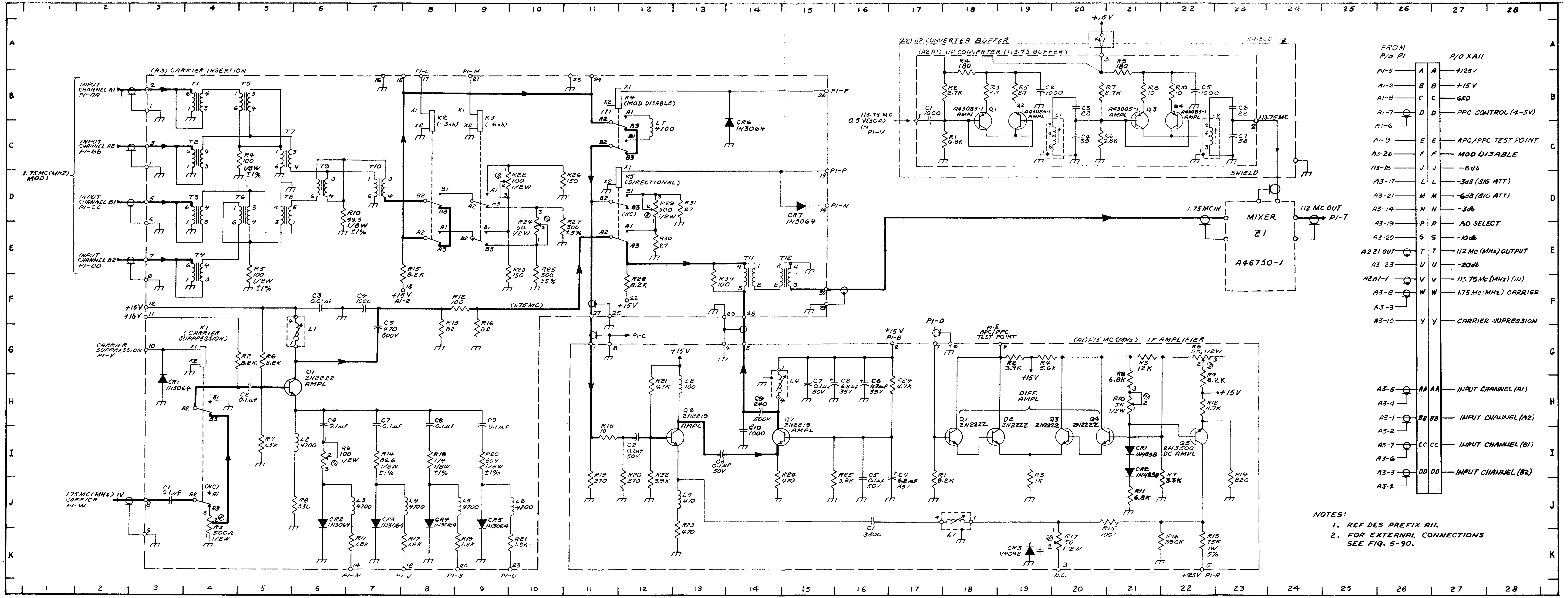
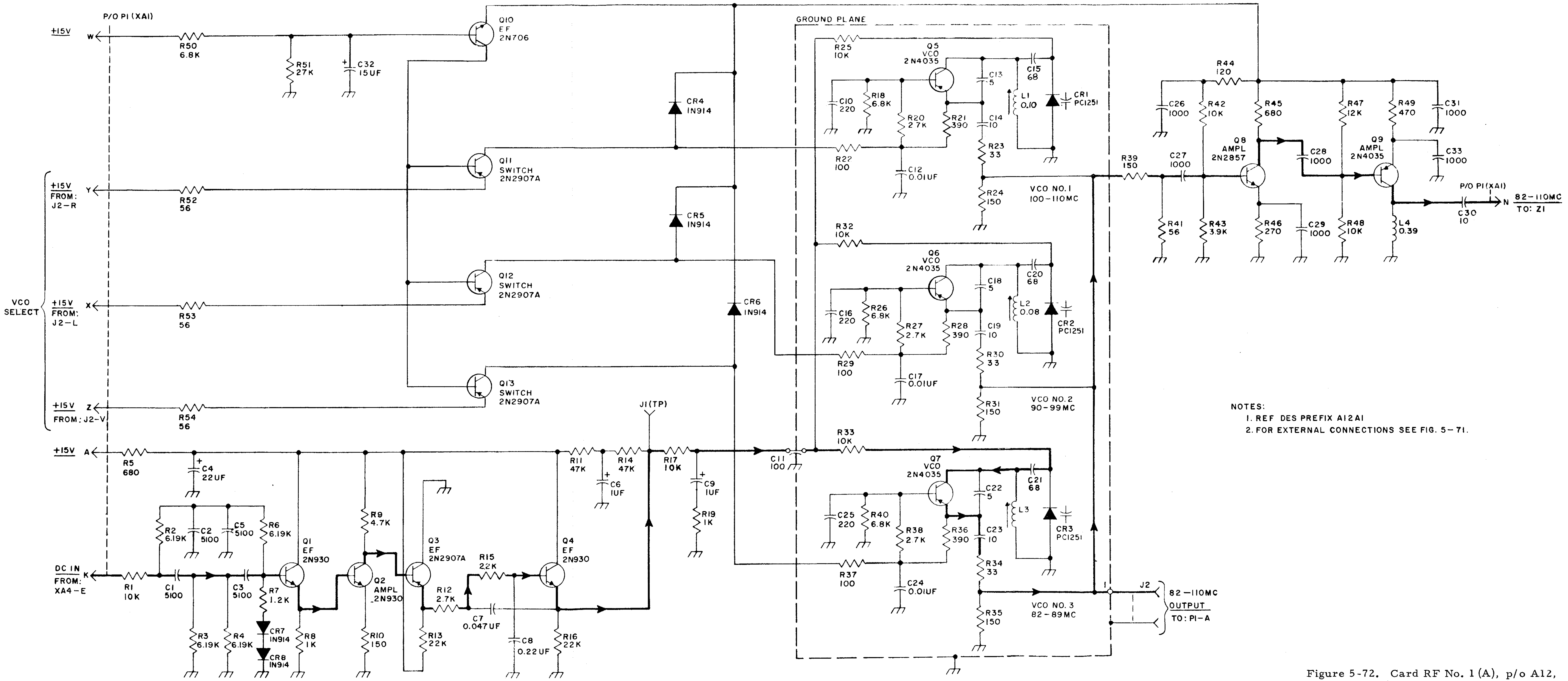


Figure 5-70. Up-Converter A11, Schematic Diagram

Figure 5-71. Synthesizer A12, Interconnection Diagram



NOTES:
1. REF DES PREFIX A12A1
2. FOR EXTERNAL CONNECTIONS SEE FIG. 5-71.

Figure 5-72. Card RF No. 1 (A), p/o A12, Schematic Diagram

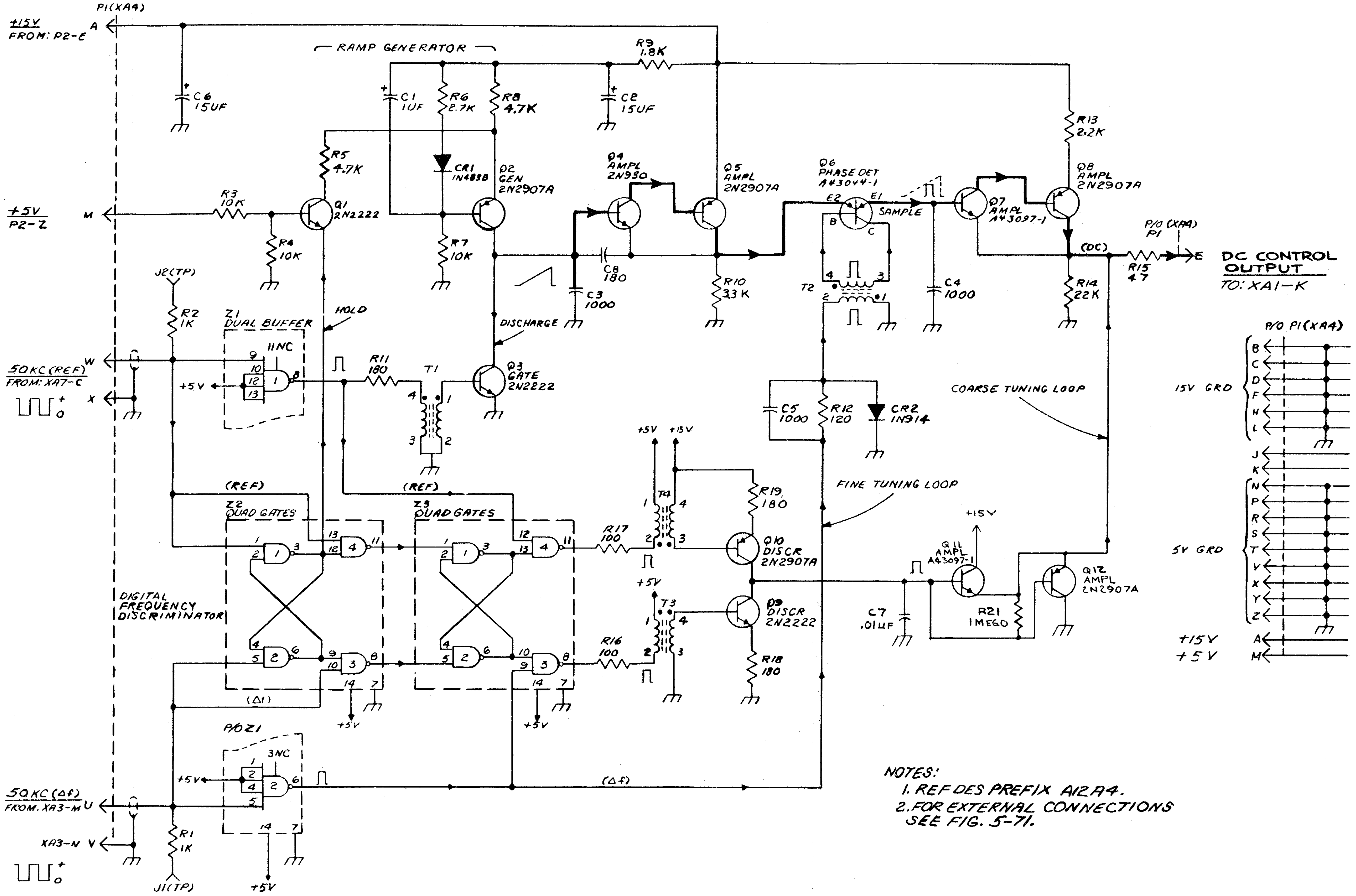
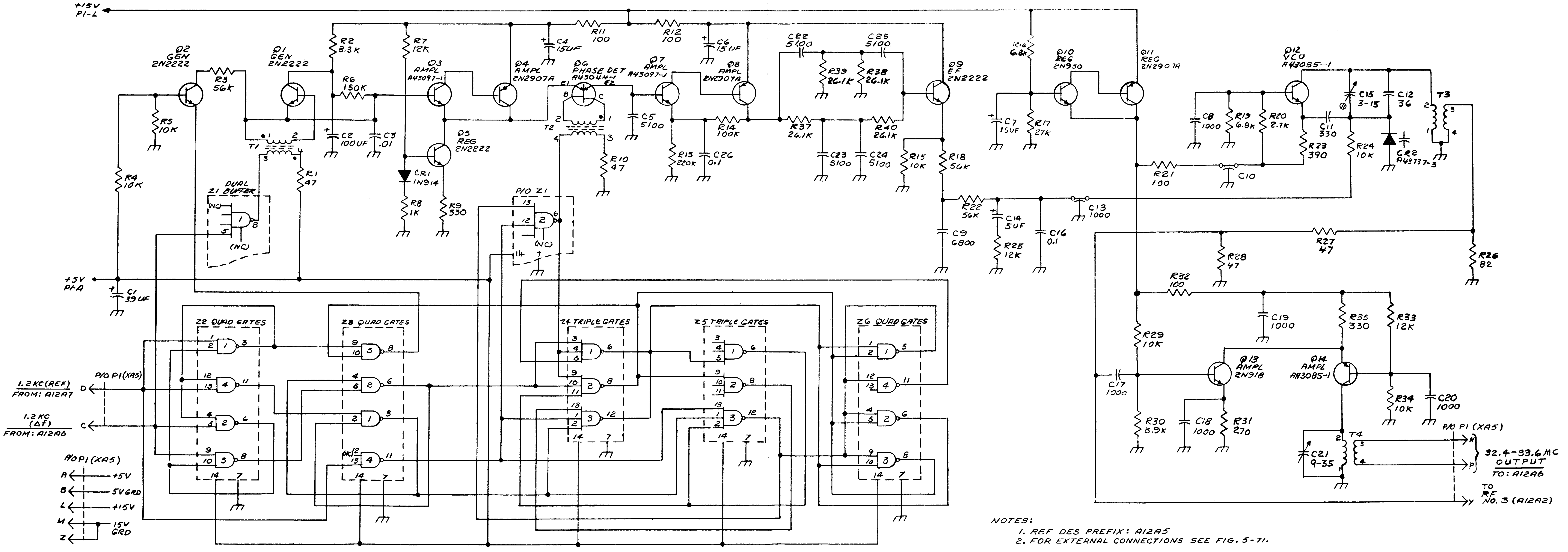


Figure 5-73. Card RF No. 1 (B), p/o A12, Schematic Diagram



NOTES:
1. REF DES PREFIX: A12A5
2. FOR EXTERNAL CONNECTIONS SEE FIG. 5-71.

Figure 5-74. Card RF No. 2, p/o A12, Schematic Diagram

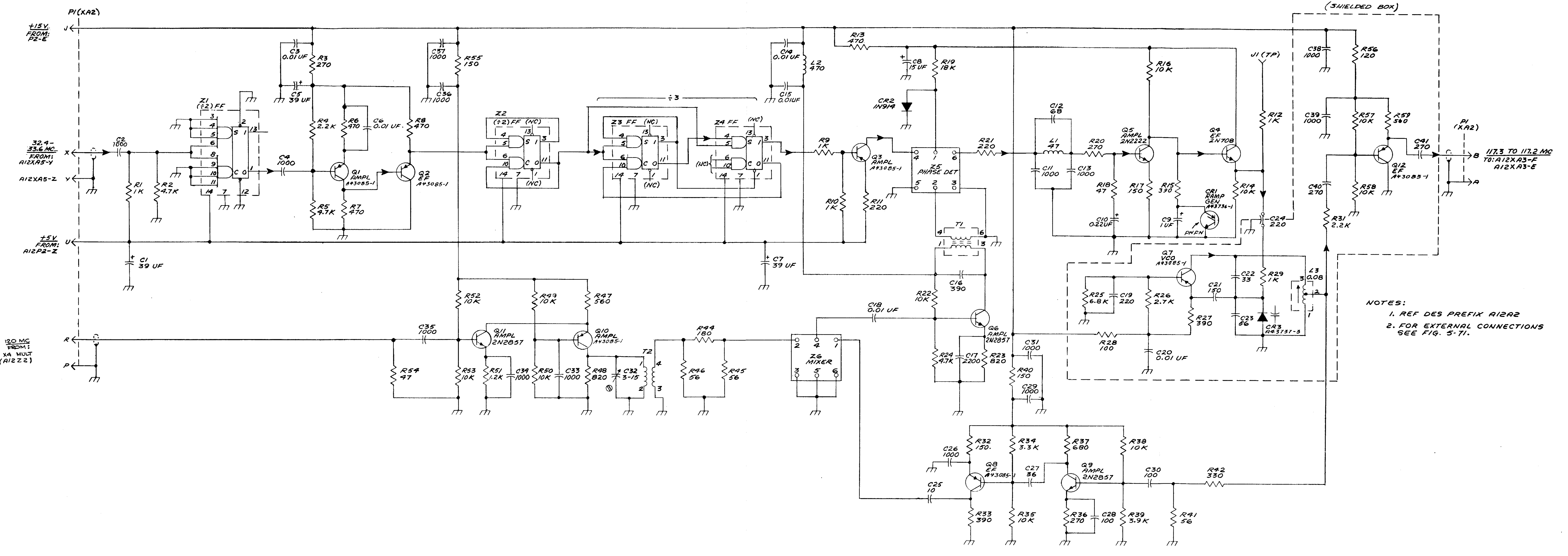


Figure 5-75. Card RF No. 3, p/o A12, Schematic Diagram

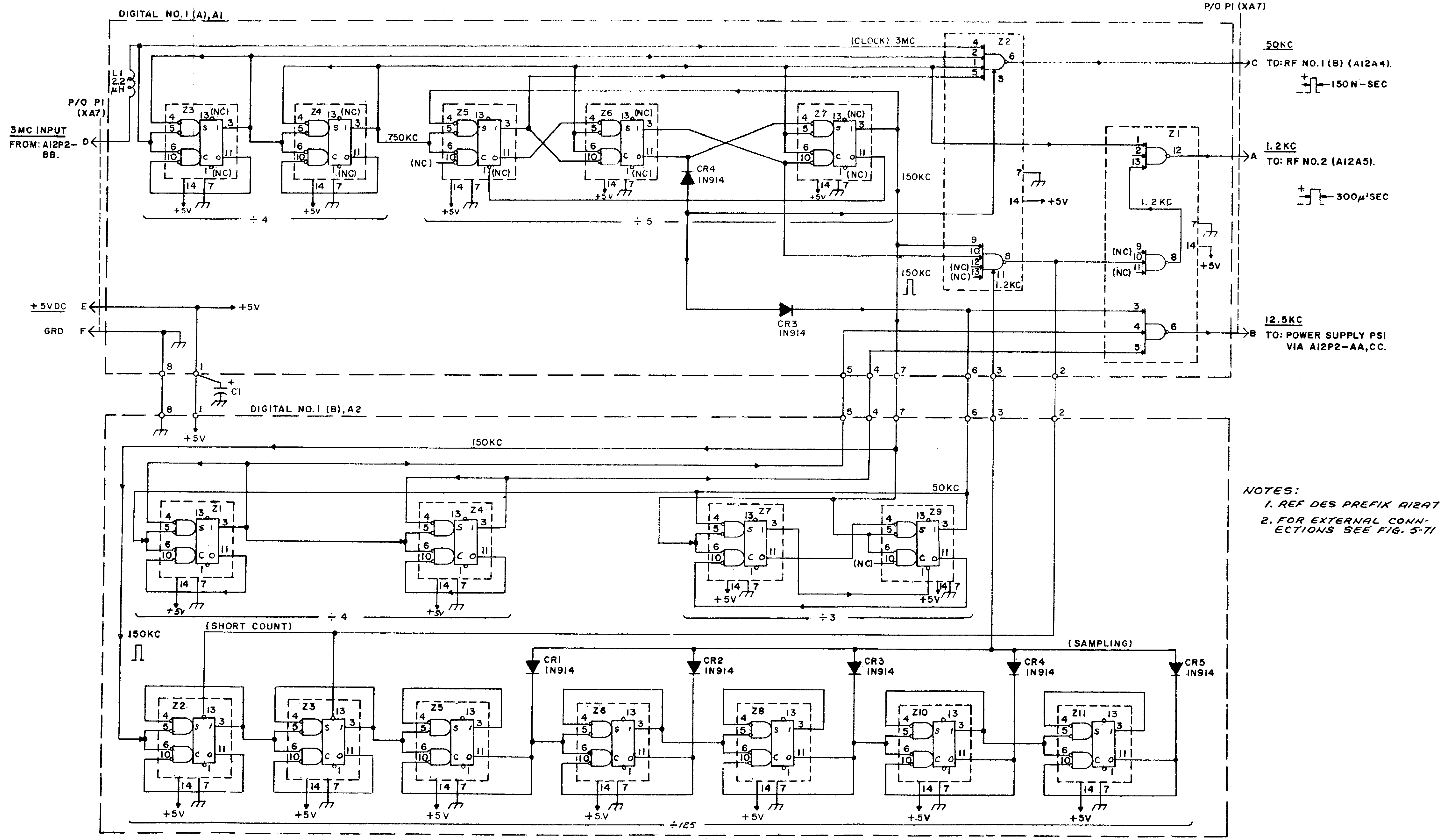
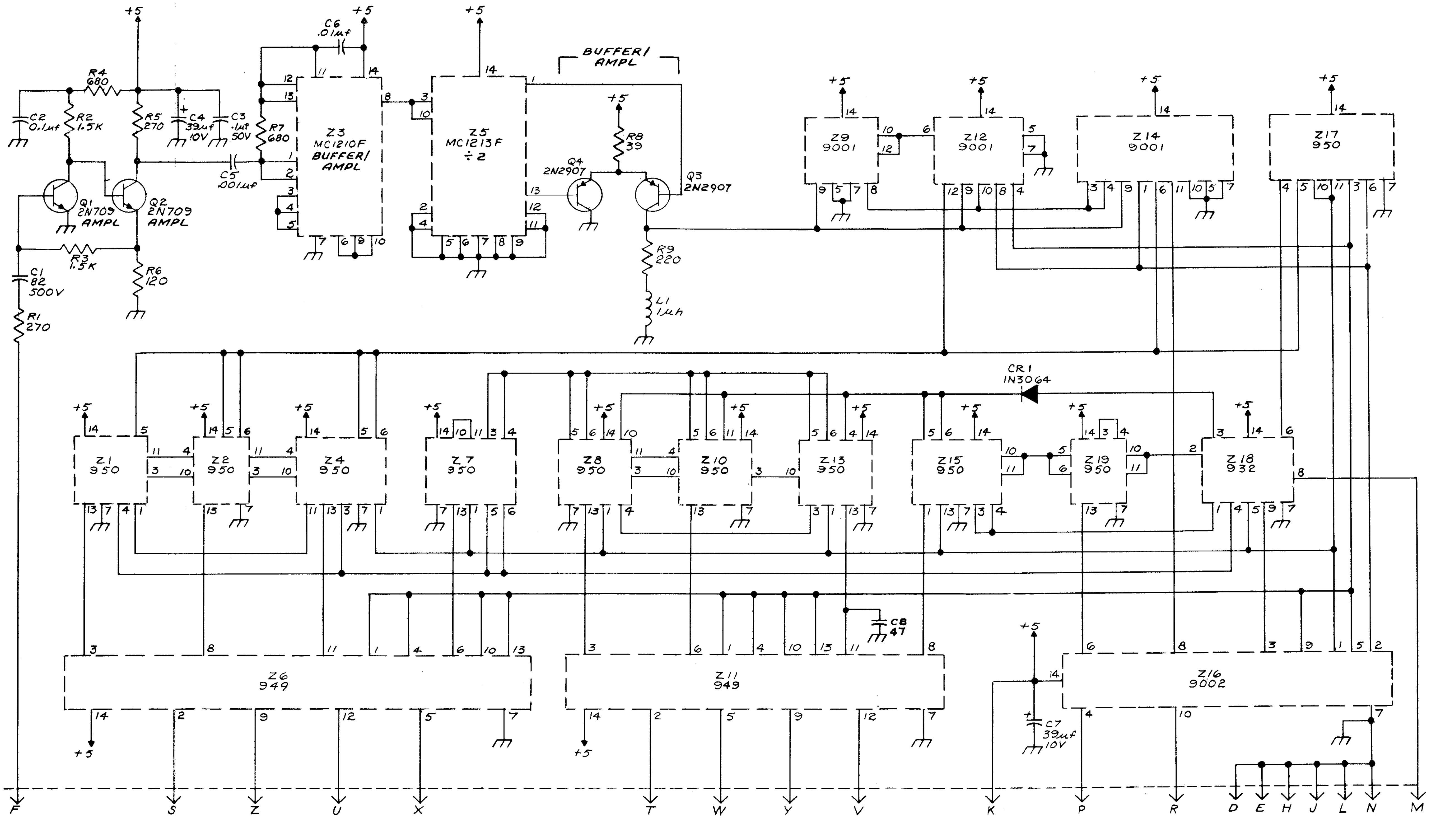


Figure 5-76. Card Digital No. 1, p/o A12, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, 1/8W ± 10%. K=1000 OHMS.
2. UNLESS OTHERWISE SPECIFIED, ALL CAPACITORS ARE GIVEN IN PICOFARADS, 200V ± 10%.
3. REF DES PREFIX A12A3.
4. FOR EXTERNAL CONNECTIONS SEE FIG. 5-71.

Figure 5-77. Card Digital No. 2, p/o A12, Schematic Diagram

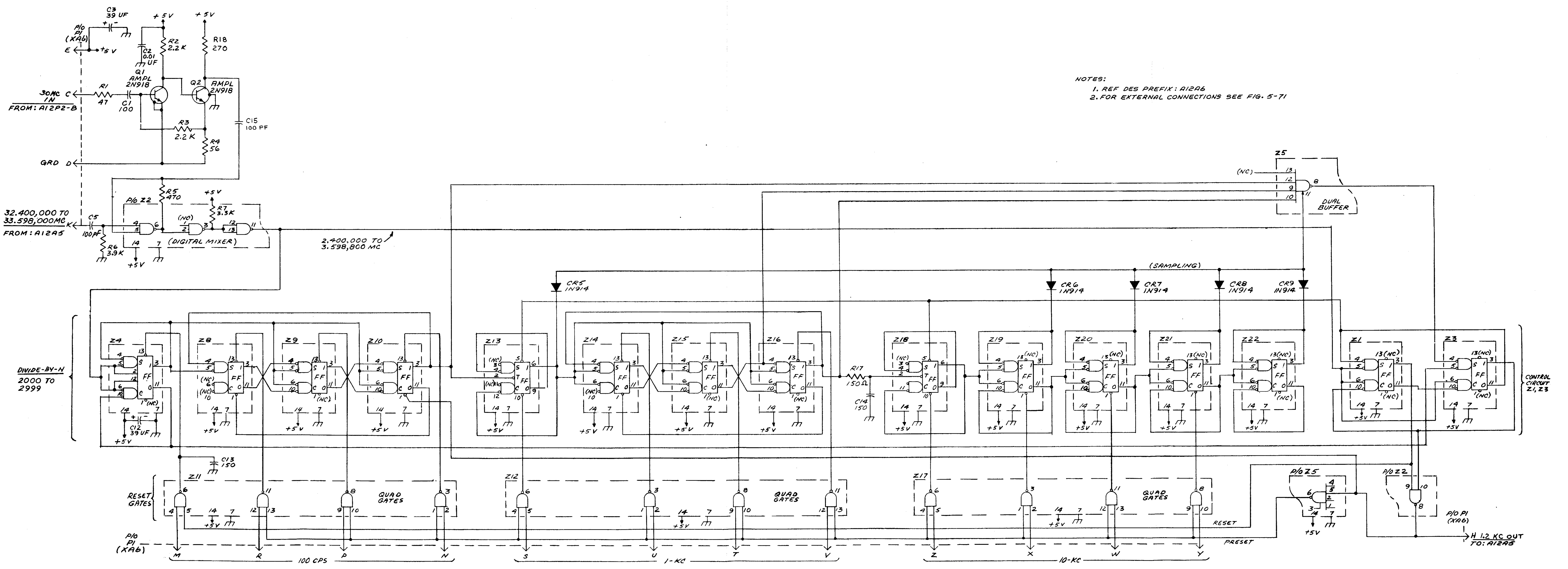
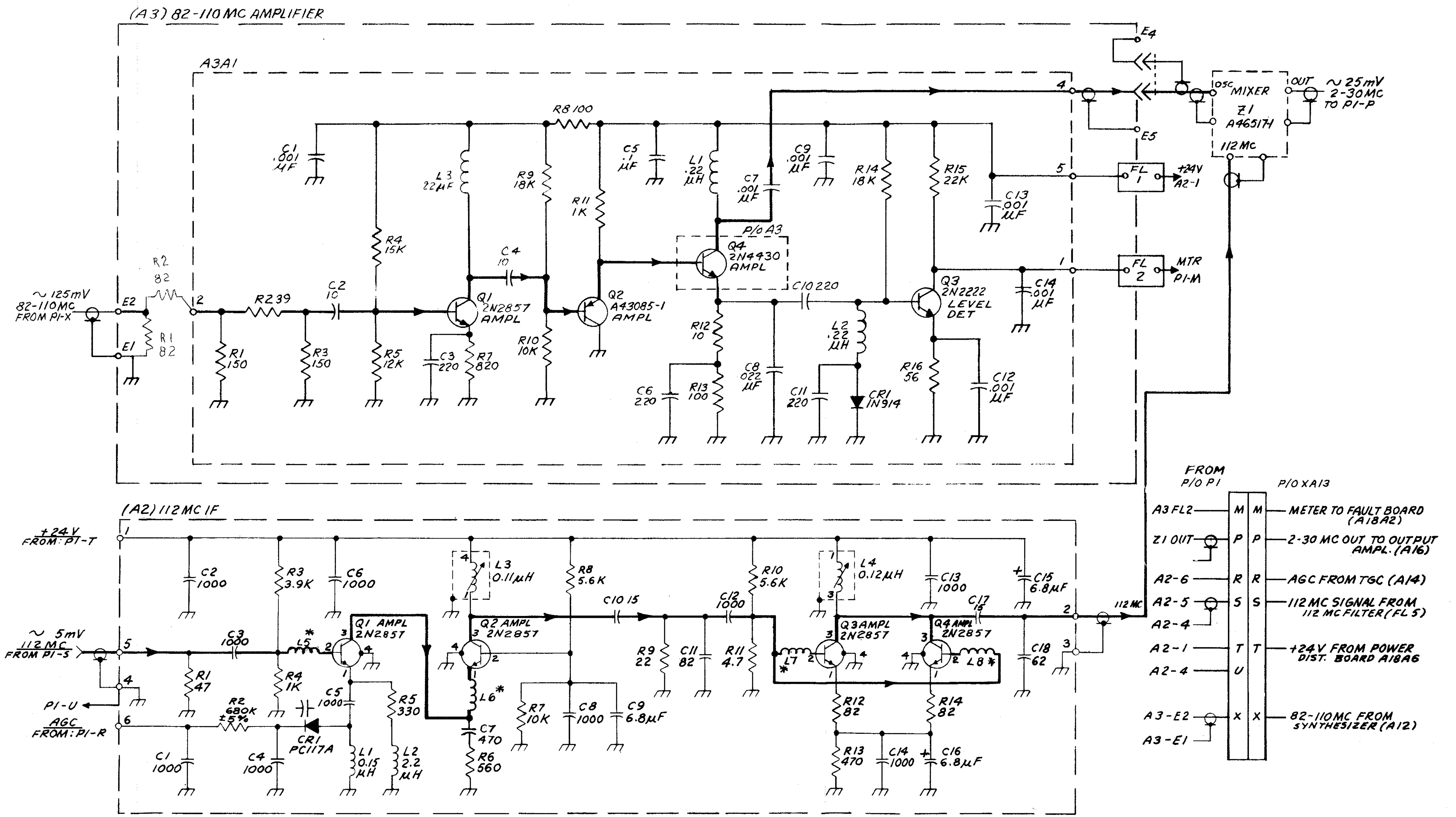


Figure 5-78. Card Digital No. 3, p/o A12, Schematic Diagram

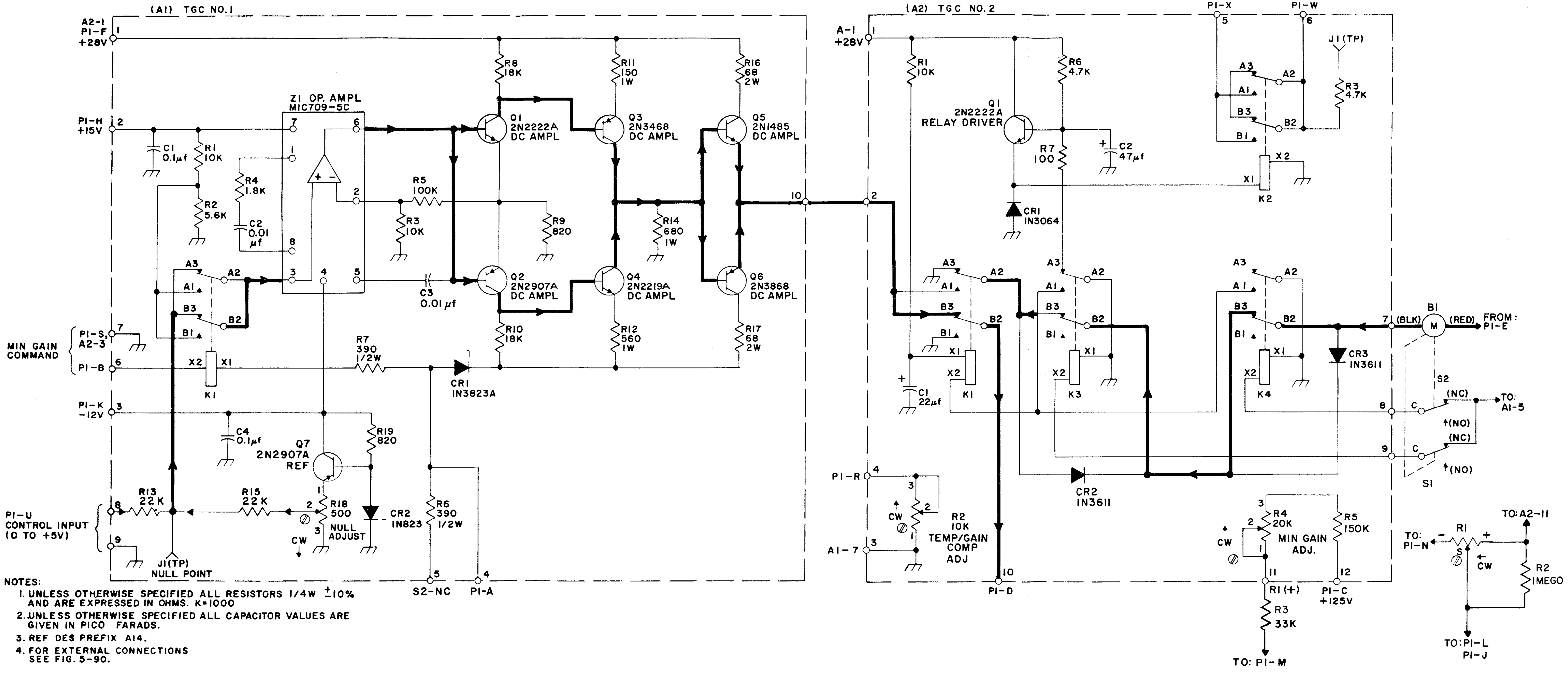


NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4W, ±10% AND ARE GIVEN IN OHMS. K=1000 OHMS.
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE GIVEN IN PICO FARADS.
3. REF DES PREFIX A13.
4. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.

* FERRITE BEAD CHOKES

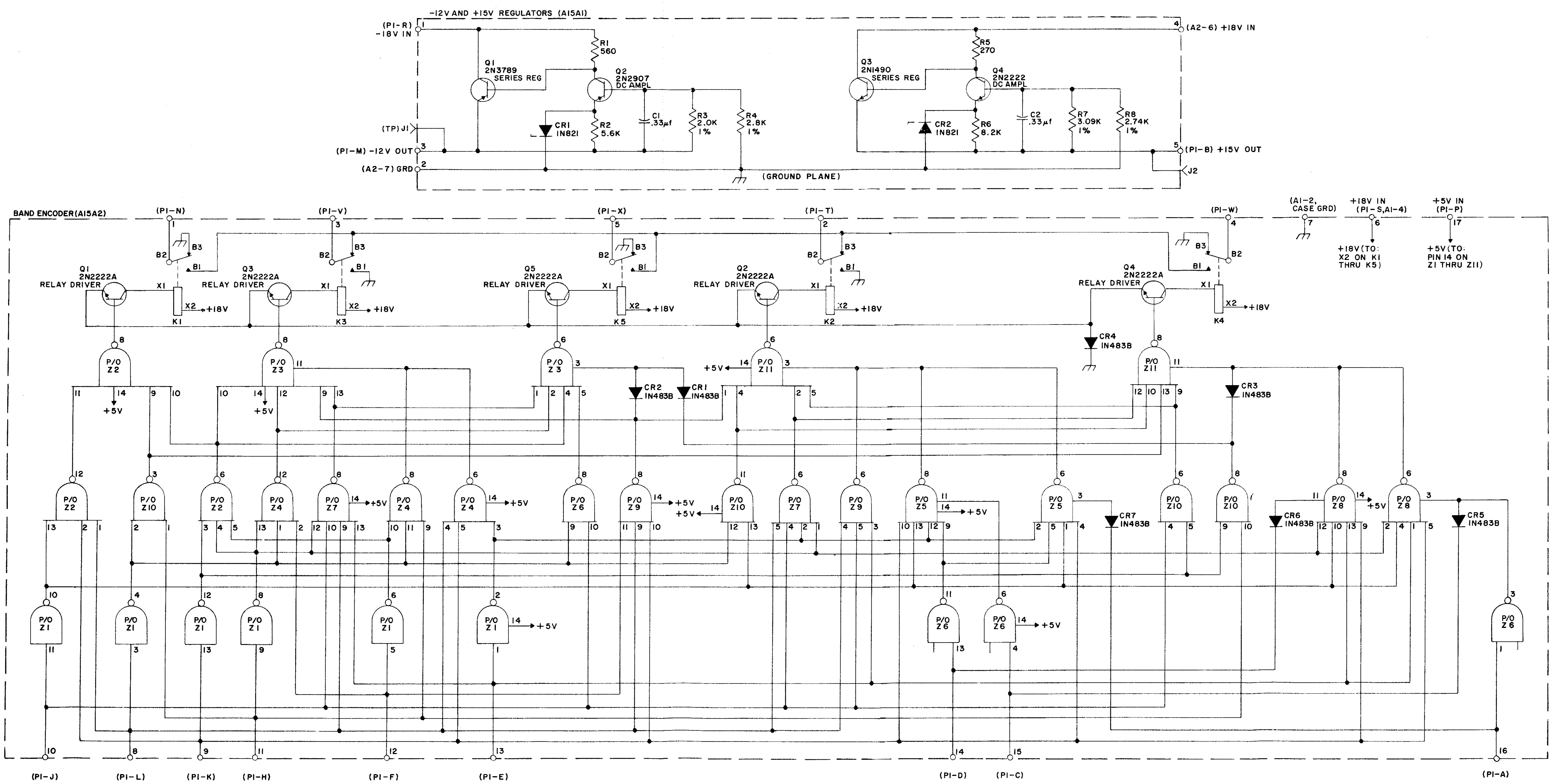
Figure 5-79. Down-Converter A13, Schematic Diagram



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS 1/4W ±10% AND ARE EXPRESSED IN OHMS. K=1000
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE GIVEN IN PICO FARADS.
3. REF DES PREFIX A14.
4. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.

FROM			CIRCUIT
A1-4	A	A	-28 V FROM A18A6-19
A1-6	B	B	MIN GAIN COMMAND FROM TC1 (A10)
A2-12	C	C	+125 V FROM A18A6-10
A2-10	D	D	TC1 (A10)-A27 } K15/K16 CONTACTS CLOSED DURING TUNING CYCLE
B1 (RED)	E	E	TC1 (A10)-B32
A1-1	F	F	+28 V FROM A18A6-8
1-2	H	H	+15 V FROM A18A6-25
R1 (S)	J	J	TO MOTOR CONTROL (A18A5) TGC MON
A1-3	K	K	-12 V FROM A18A6-3
R1 (S)	L	L	XA13-R
R3	M	M	A18R34-1
R1 (-)	N	N	A18R34-2
	P	P	
A2-4	R	R	A18R34-3
A1-7	S	S	GRD
	T	T	
A1-8	U	U	CONTROL INPUT (0 TO +5 V)
A1-9			
A2-6	W	W	TUNE COMMAND FROM TC1 (A10) B26
A2-5	X	X	TUNE COMMAND TO LPA VIA FL2-N

Figure 5-80. Transmitter Gain Control A14, Schematic Diagram



FROM	P1	XA15	NOTE 1
A2-16	A	A	S1
A1-5	B	B	+15V OUT
A2-15	C	C	S3
A2-14	D	D	S4
A2-13	E	E	S5
A2-12	F	F	S6
A2-11	H	H	S7
A2-10	J	J	S8
A2-9	K	K	S9
A2-8	L	L	S10
A1-3	M	M	-12 V OUT
A2-1	N	N	W1
A2-17	P	P	+5V IN
A1-1	R	R	-18 V IN
A2-6	S	S	+18 V IN
A2-2	T	T	W2
A2-3	V	V	W3
A2-4	W	W	W4
A2-5	X	X	W5

NOTES:
1. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
2. REF DES PREFIX A15.

Figure 5-81. Band Encoder A15, Schematic Diagram

NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4 W, ± 10% AND ARE GIVEN IN OHMS. K = 1000 OHMS.
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE GIVEN IN PICO FARADS.
3. REF DES PREFIX A16.
4. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.

Figure 5-82. Output Amplifier A16, Schematic Diagram

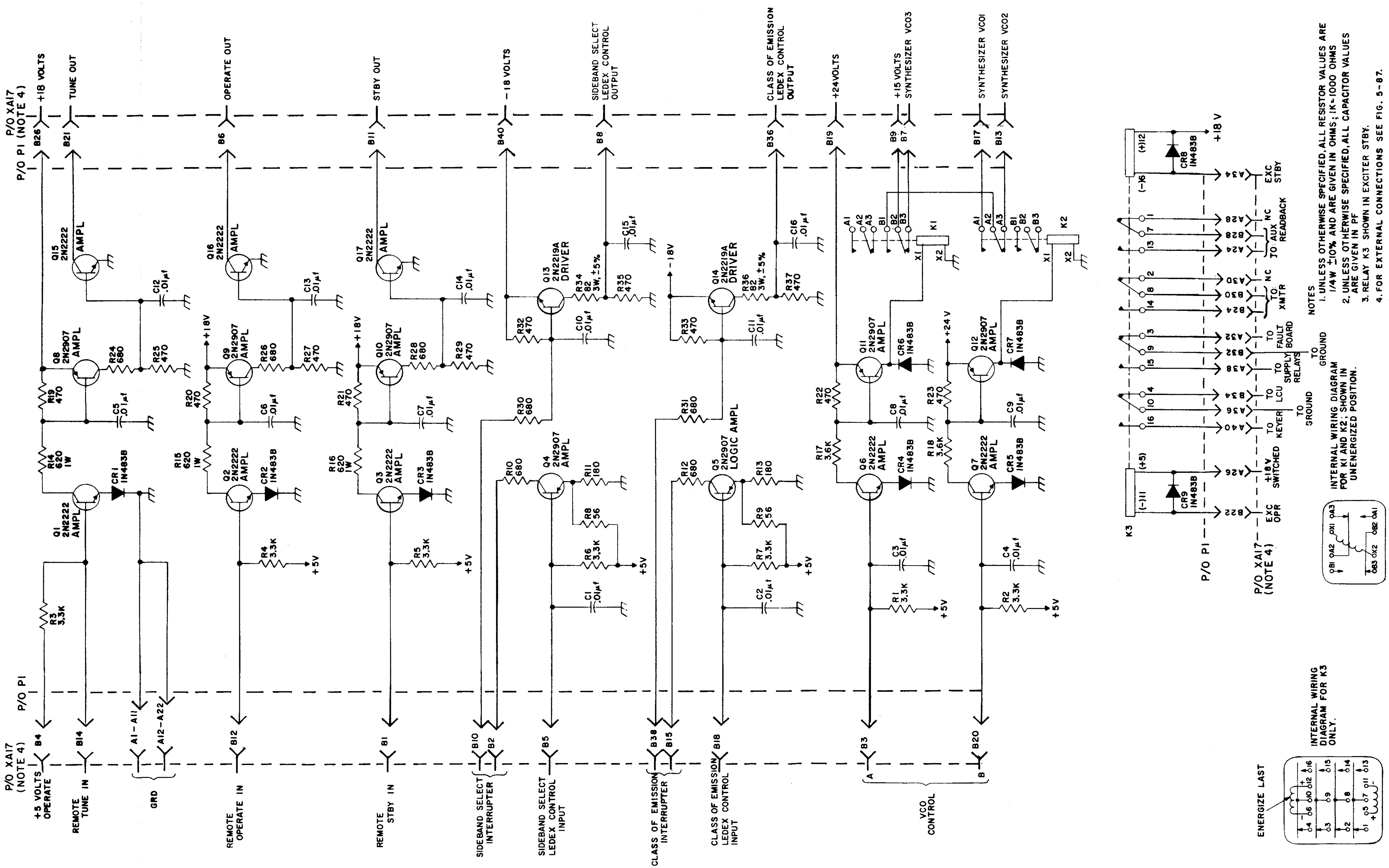
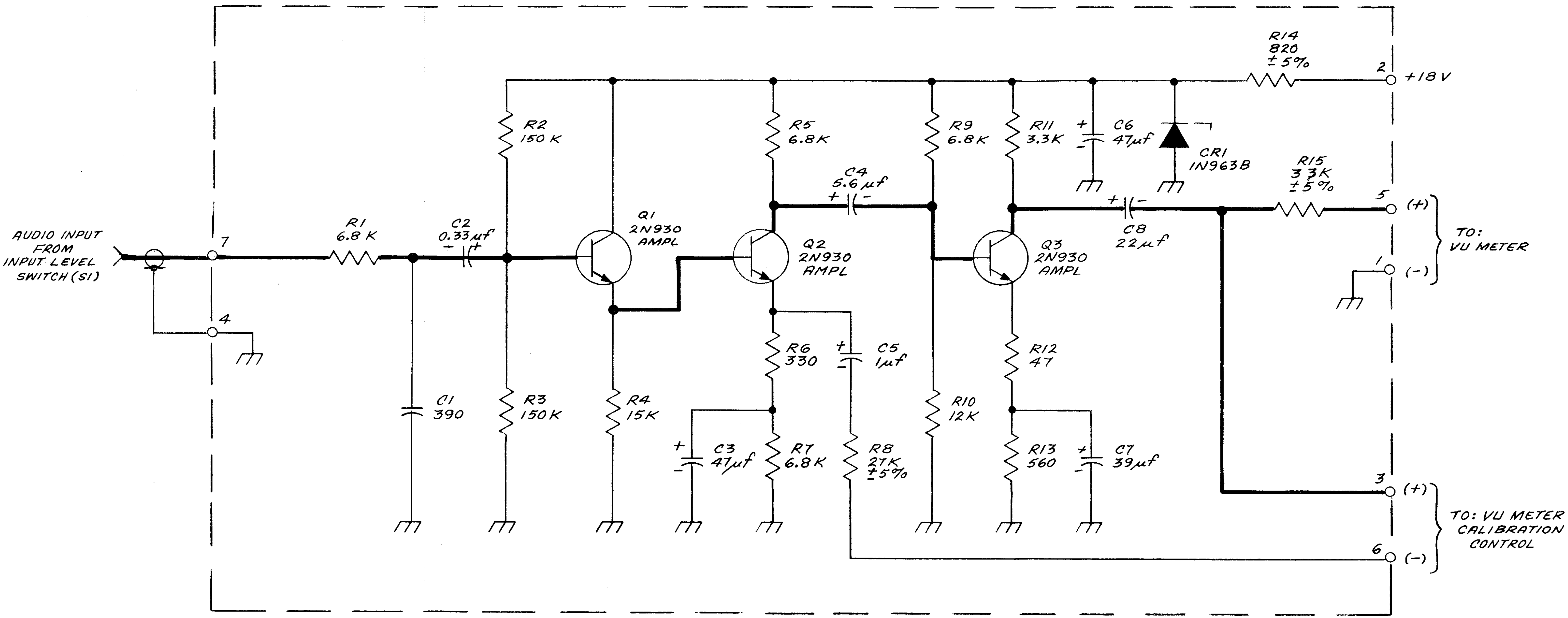


Figure 5-83. Transmitter Control No. 2, A17, Schematic Diagram



NOTES:
1. ALL RESISTORS ARE 1/4 W, ± 10% AND ARE EXPRESSED IN OHMS.
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE EXPRESSED IN PICO FARADS.
3. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
4. REF DES PREFIX A18A1.

Figure 5-84. VU Meter Amplifier A1, Part of Panel and Chassis Assembly A18, Schematic Diagram

PARTS LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	H4	CR9	D13	R10	D6
C2	C4	CR10	B13	R11	E6
C3	E4	CR11	I13	R12	F6
C4	H5	CR12	E14	R13	H6
C5	B7	CR13	B14	R14	H6
C6	C7	CR14	Not used	R15	I7
C7	E7	CR15	C15	R16	I8
C8	E7	CR16	E15	R17	I8
C9	G7	CR17	C16	R18	B11
C10	H7	CR18	E17	R19	H11
C11	D9	CR19	C17	R20	J11
C12	E9	K1	I3	R21	C11
C13	H9	L1	C4	R22	I11
C14	B10	L2	E4	R23	J11
C15	B11	L3	G4	R24	C12
C16	D16	L4	B7	R25	D12
C17	G12	L5	D7	R26	H12
C18	J12	L6	G7	R27	I12
C19	C12	L7	C9	R28	J12
C20	G12	L8	E9	R29	C13
C21	G13	L9	G9	R30	D14
C22	C14	L10	G13	R31	E14
C23	C14	Q1	C6	R32	Not used
C24	C15	Q2	E6	R33	Not used
C25	F15	Q3	G6	R34	E14
C26	Not used	Q4	I6	R35	Not used
C27	I15	Q5	H11	R36	Not used
C28	J15	Q6	C12	R37	Not used
C29	C17	Q7	B13	R38	B16
C30	E18	Q8	H12	R39	D18
C31	H18	Q9	D14	R40	H19
C32	I18	Q10	Not used	R41	I19
C33	I18	Q11	B16	R42	I19
C34	J18	Q12	D17	R43	J19
C35	I5	R1	G2	R44	H19
CR1	H3	R2	B3	R45	H19
CR2	I6	R3	E3	R46	I19
CR3	D10	R4	G3	R47	J19
CR4	B11	R5	B4	Z1	C5
CR5	D12	R6	D4	Z2	E5
CR6	E12	R7	G4	Z3	G5
CR7	F12	R8	I6	P/O Z4	E11
CR8	G12	R9	C6	P/O Z4	H17

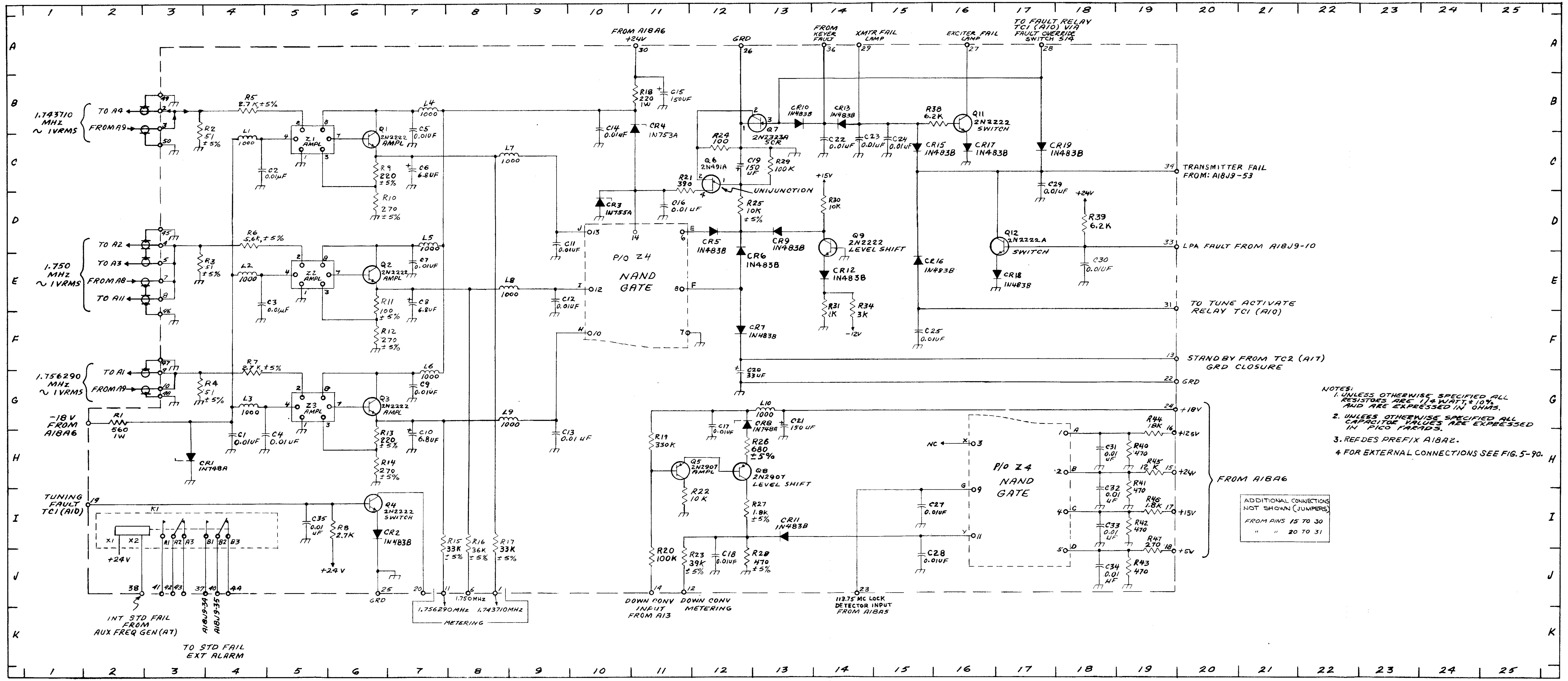
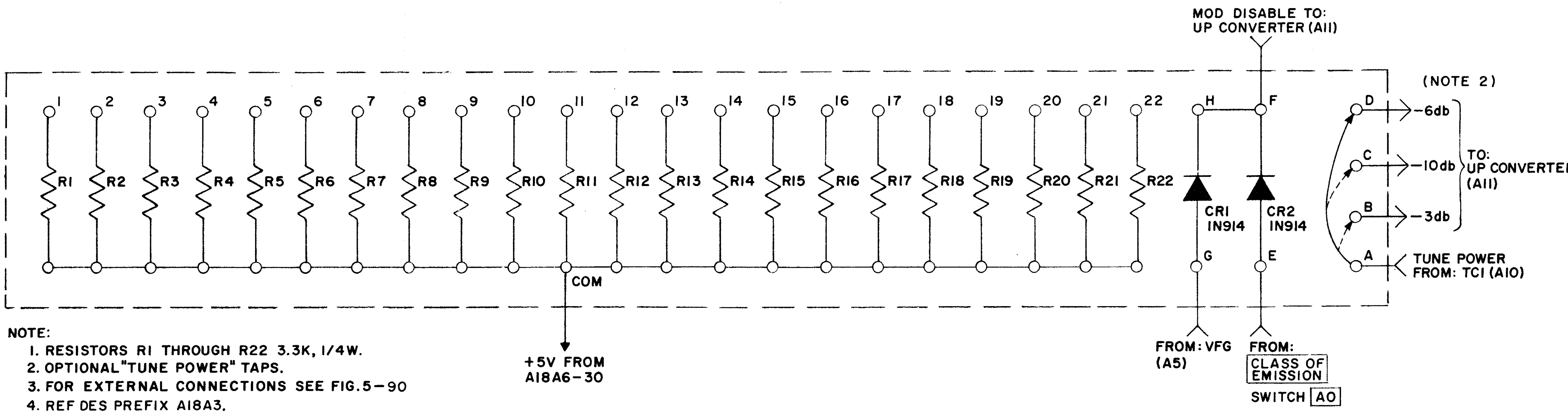


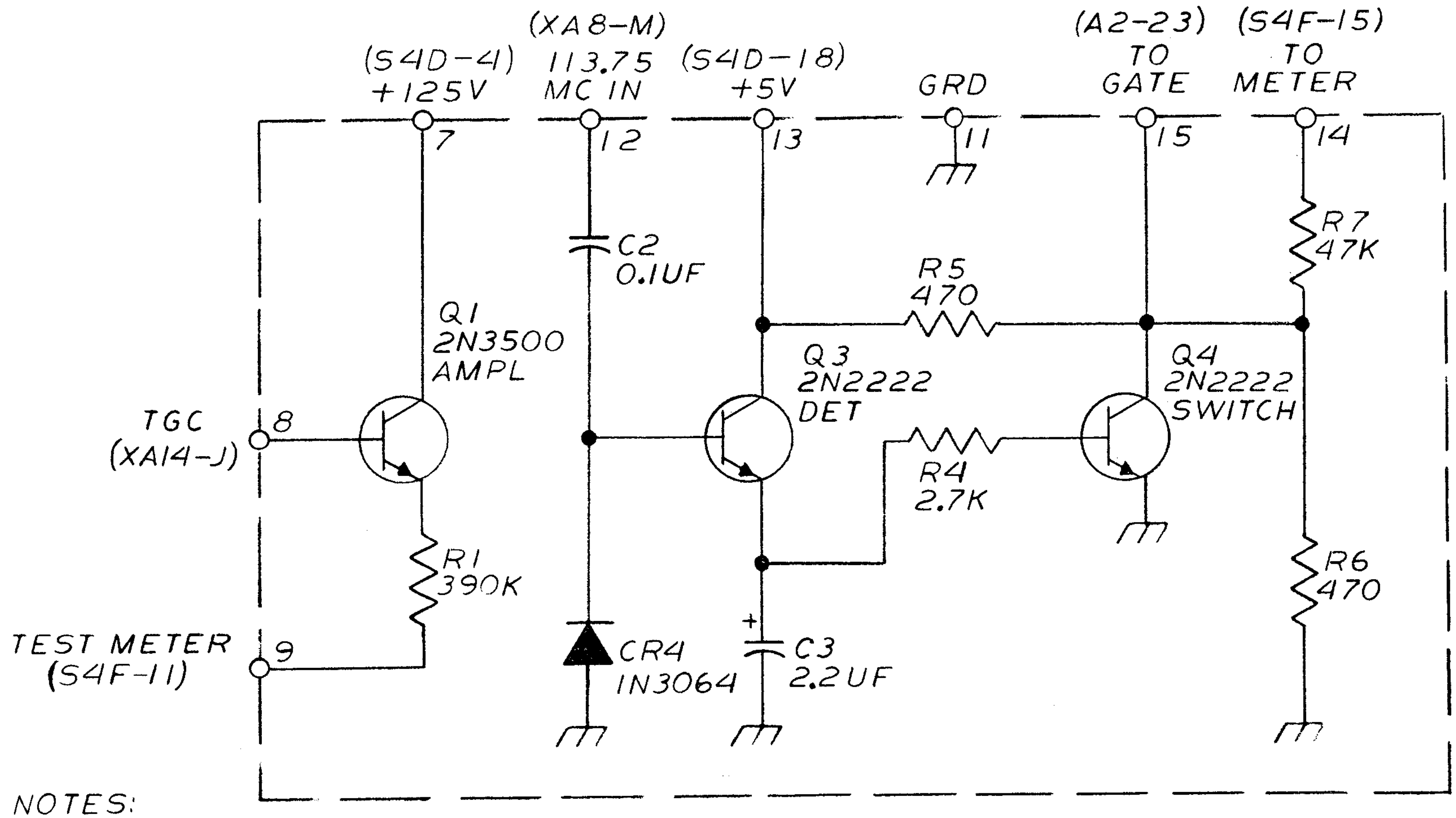
Figure 5-85. Fault Board A2, Part of Panel and Chassis Assembly A18, Schematic Diagram



NOTE:
1. RESISTORS R1 THROUGH R22 3.3K, 1/4W.
2. OPTIONAL "TUNE POWER" TAPS.
3. FOR EXTERNAL CONNECTIONS SEE FIG.5-90
4. REF DES PREFIX A18A3.

Figure 5-86. Frequency Selector Board A3, Part of Panel and Chassis Assembly A18, Schematic Diagram

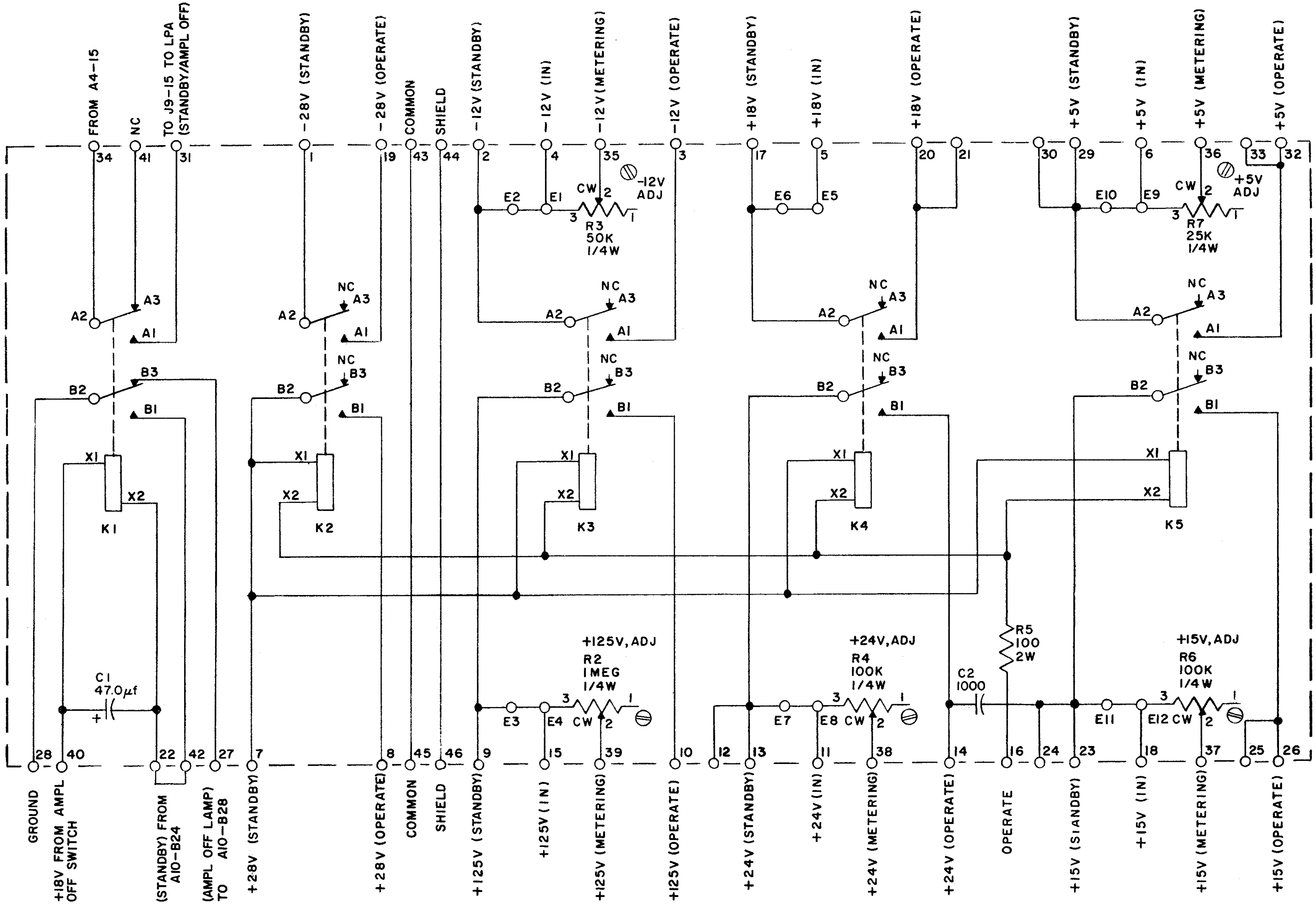
Figure 5-87. Transmitter Control Board A4, Part of Panel Chassis Assembly A18, Interconnection Diagram



NOTES:

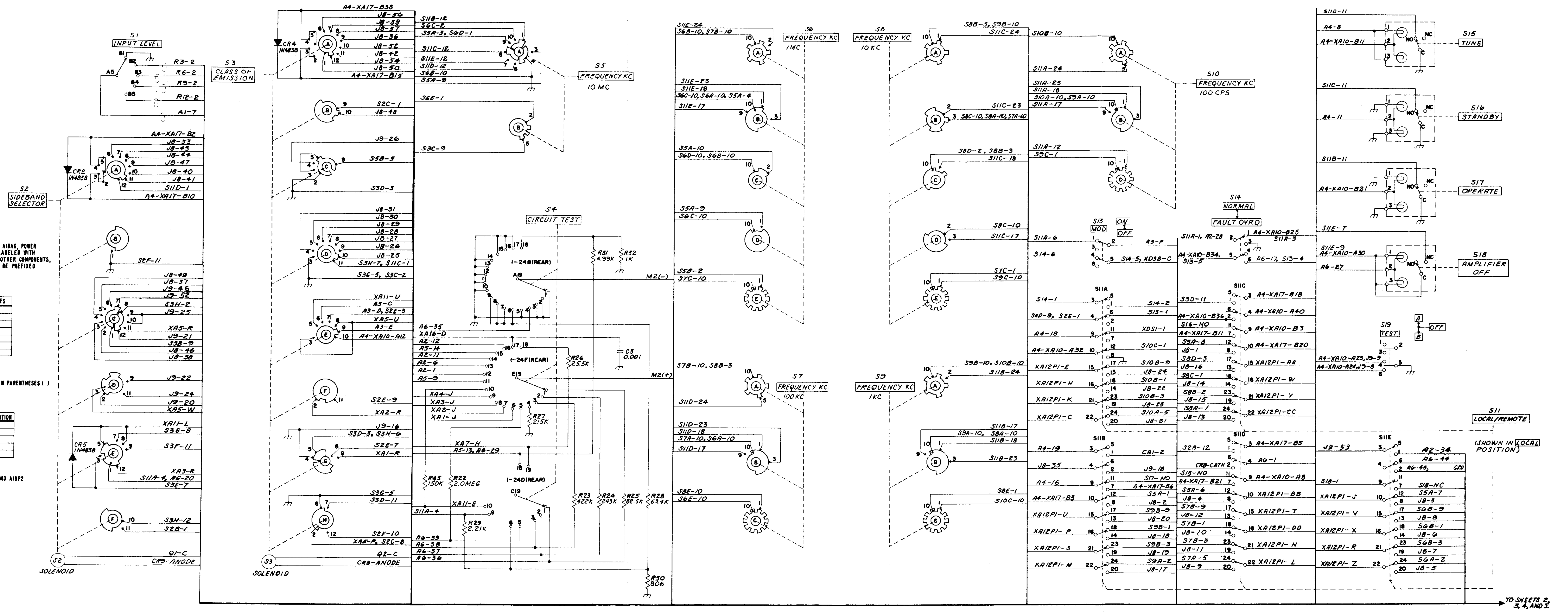
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE GIVEN IN OHMS, 1/4W ±10%, K=1000 OHMS.
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE GIVEN IN PICO FARADS.
3. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
4. REF DES PREFIX A18A5.

Figure 5-88. Motor Control Board A5, Part of Panel and Chassis Assembly A18, Schematic Diagram



NOTES:
1. FOR EXTERNAL CONNECTIONS SEE FIG. 5-90.
2. REF DES PREFIX A18A6.

Figure 5-89. Power Distribution Board A6, Part of Panel and Chassis Assembly A18, Schematic Diagram



NOTES:

1. MODULES A1 THROUGH A17, MODULES A18A1 THROUGH A18A6, POWER SUPPLY PS1, AND FILTERS FL1 THROUGH FL5 ARE LABELED WITH THEIR COMPLETE REFERENCE DESIGNATIONS. ALL OTHER COMPONENTS, INCLUDING SOCKETS XA1 THROUGH XA17, SHOULD BE PREFIXED BY A18.

EXAMPLES:

LABELED REF DES	COMPLETE REF DES
A1	A1
XA1	A18XA1
A18A1	A18A1
FL3	FL3
Z1	A18Z1
R34	A18R34
J8	A18J8

2. ALL WIRING DESTINATIONS EXCEPT THOSE SHOWN IN PARENTHESES ( ) SHOULD BE PREFIXED BY A18.

EXAMPLES:

LABELED DESTINATION	COMPLETE DESTINATION
XA1	A18XA1
A6-1	A18A6-1
(A6-1)	A6-1
R34-2	A18R34-2
J8-C	A18J8-C

3. CONNECTORS J8 AND J9 (SHEET 5) MATE WITH A19P1 AND A19P2 (SEE FIGURE 5-91).

Figure 5-90. Modulator-Synthesizer MD-777/FRT, Front Panel and Chassis Assembly, Interconnection Diagram (Sheet 1 of 5)

Figure 5-90. Modulator-Synthesizer MD-777/FRT, Front Panel and Chassis Assembly, Interconnection Diagram (Sheet 2 of 5)

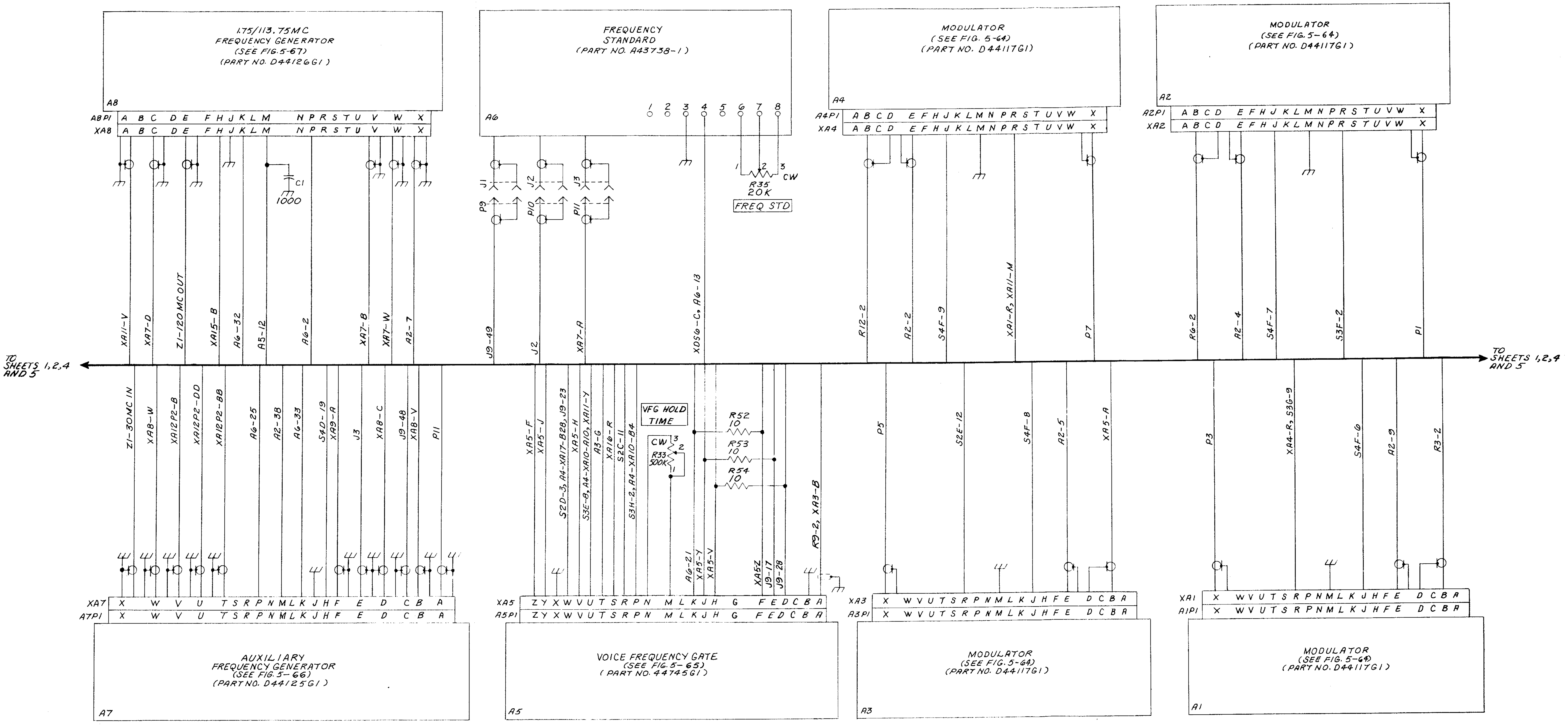


Figure 5-90. Modulator-Synthesizer MD-777/FRT, Front Panel and Chassis Assembly, Interconnection Diagram (Sheet 3 of 5)

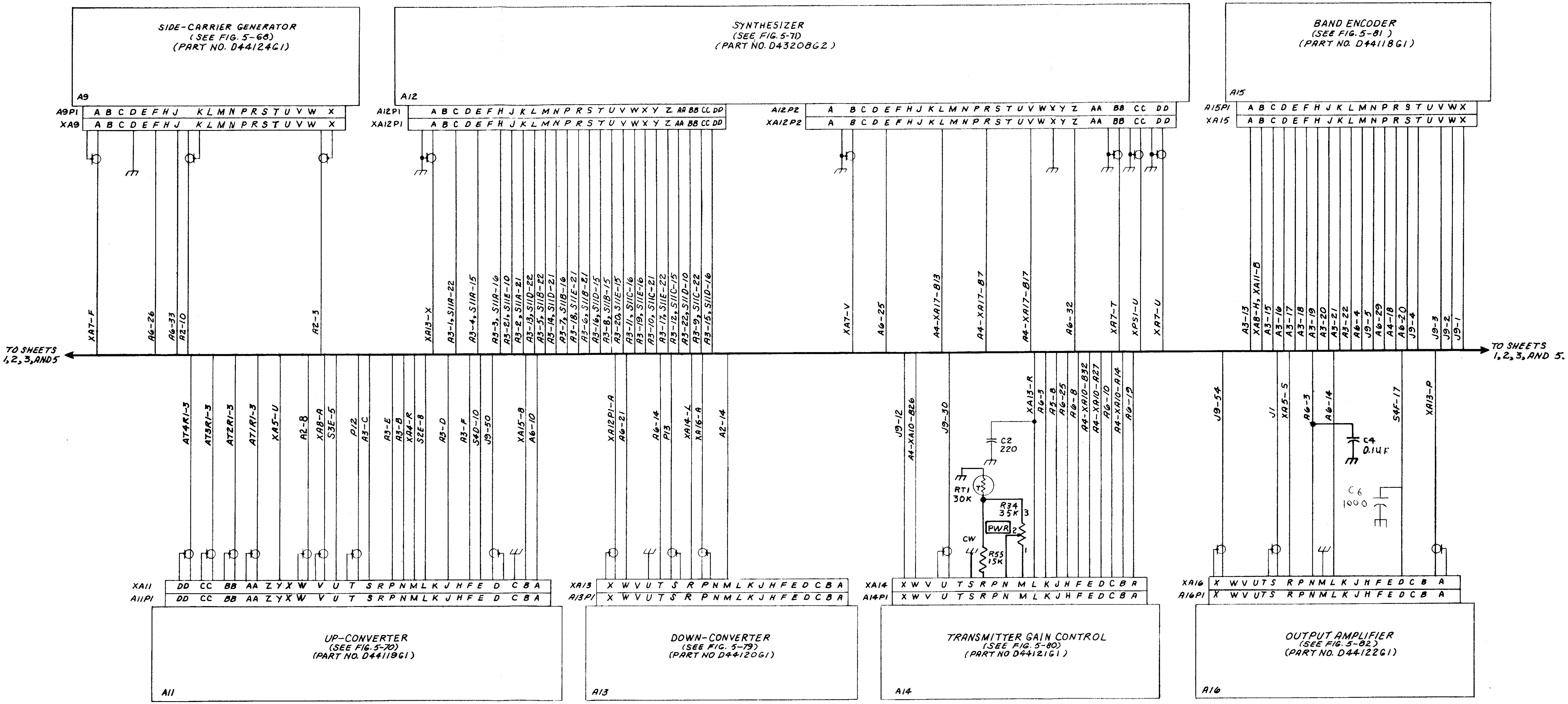


Figure 5-90. Modulator-Synthesizer MD-777/FRT, Front Panel and Chassis Assembly, Interconnection Diagram (Sheet 4 of 5)

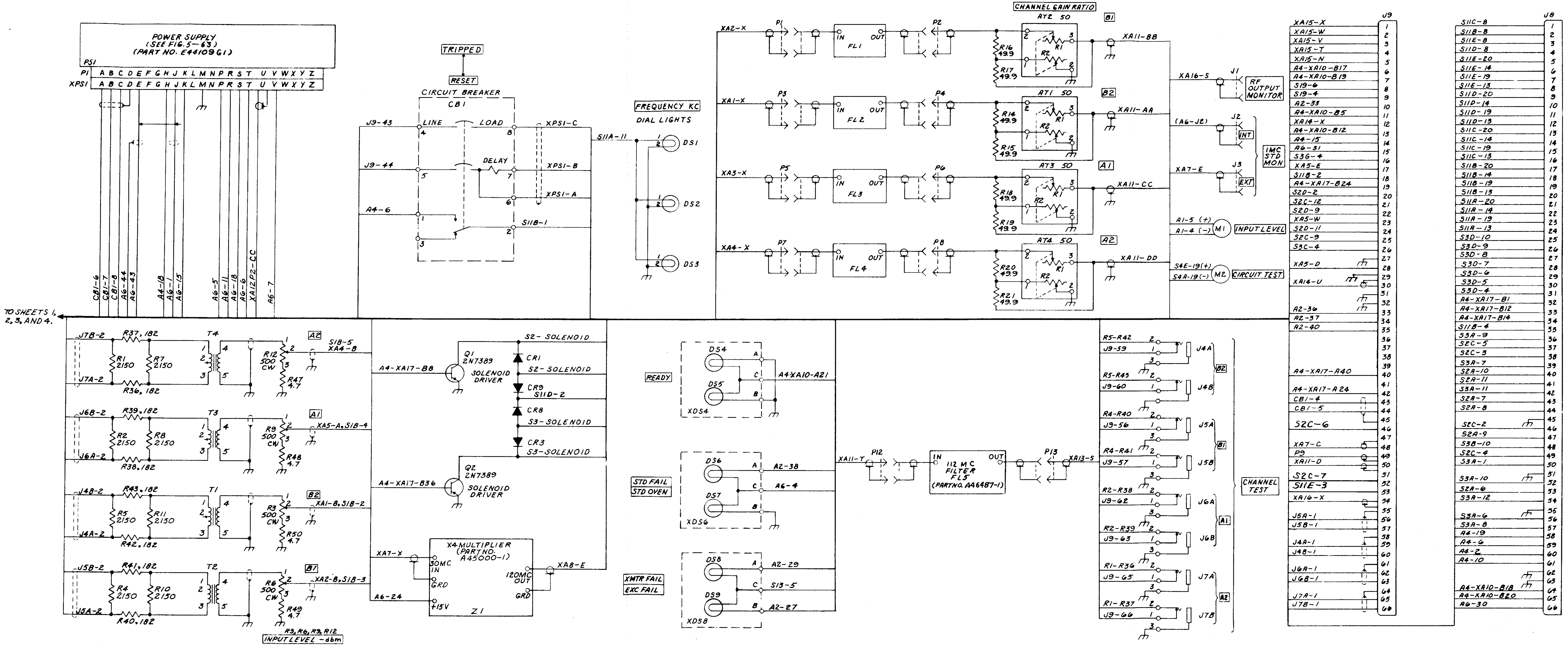


Figure 5-90. Modulator-Synthesizer MD-777/FRT, Front Panel and Chassis Assembly, Interconnection Diagram (Sheet 5 of 5)

CONNECTOR NO. (MATES WITH KEYER)

J6-A	Keyer Keyline
B	Keyer Keyline Common
C	Keyer Standby Operate
D	Operate/Standby Common
E	Keyer Fault Return
F	Keyer Fault

CONNECTOR NO. (MATES WITH LCU)

J7-A	100 CPS	FREQUENCY SELECTION
B	100 CPS	FREQUENCY SELECTION
C	100 CPS	FREQUENCY SELECTION
D	100 CPS	FREQUENCY SELECTION
E	1 KC	FREQUENCY SELECTION
F	1 KC	FREQUENCY SELECTION
G	1 KC	FREQUENCY SELECTION
H	1 KC	FREQUENCY SELECTION
J	10 KC	FREQUENCY SELECTION
K	10 KC	FREQUENCY SELECTION
L	10 KC	FREQUENCY SELECTION
M	10 KC	FREQUENCY SELECTION
N	100 KC	FREQUENCY SELECTION
P	100 KC	FREQUENCY SELECTION
R	100 KC	FREQUENCY SELECTION
S	100 KC	FREQUENCY SELECTION
T	1 MC	FREQUENCY SELECTION
U	1 MC	FREQUENCY SELECTION
V	1 MC	FREQUENCY SELECTION
W	1 MC	FREQUENCY SELECTION
X	10 MC	FREQUENCY SELECTION
Y	10 MC	FREQUENCY SELECTION
Z	VCO-A	VCO SELECTION
a	VCO-B	VCO SELECTION
b	A0	CLASS OF EMISSION SELECTION
c	A2, A3E	CLASS OF EMISSION SELECTION
d	A1, F1, F4	CLASS OF EMISSION SELECTION
e	SSB -10 db	CLASS OF EMISSION SELECTION
f	SSB -20 db	CLASS OF EMISSION SELECTION
g	SSB -40 db	CLASS OF EMISSION SELECTION
h	SSB -∞	CLASS OF EMISSION SELECTION
i	Standby Command	
j	Operate Command	
k	Ground	
m	Ground	
r	PTT Command	

CONNECTOR NO. (MATES WITH LCU)

J8-A	USB Sideband Select Control
B	LSB Sideband Select Control
C	2ISB Sideband Select Control
D	4ISB Sideband Select Control
G	A0 Class of Emission Readback
H	A2, A3E Class of Emission Readback
J	A1, F1, F4 Class of Emission Readback
K	SSB-10 Class of Emission Readback
L	SSB-20 Class of Emission Readback
M	SSB-40 Class of Emission Readback
N	SSB- ∞ Class of Emission Readback
P	Operate Readback
R	Standby Readback
S	USB Sideband Readback
T	LSB Sideband Readback
U	2ISB Sideband Readback
V	4ISB Sideband Readback
Y	Ready Readback Common
Z	Ready Readback
a	Fault Readback
b	Fault Readback Common
c	Local Status
d	Transmitter Not Available Readback Common
e	Tune Command
f	Tune Activate Common (ground)
g	+5 VDC
h	PTT Readback
i	Transmitter Fail
j	VFG Readback
k	Standby-Operate Readback Common
m	Sideband Select Common
n	Sideband Readback Common
q	Class of Emission Readback Common
r	VFG Command

CONNECTOR NO. (AC POWER)

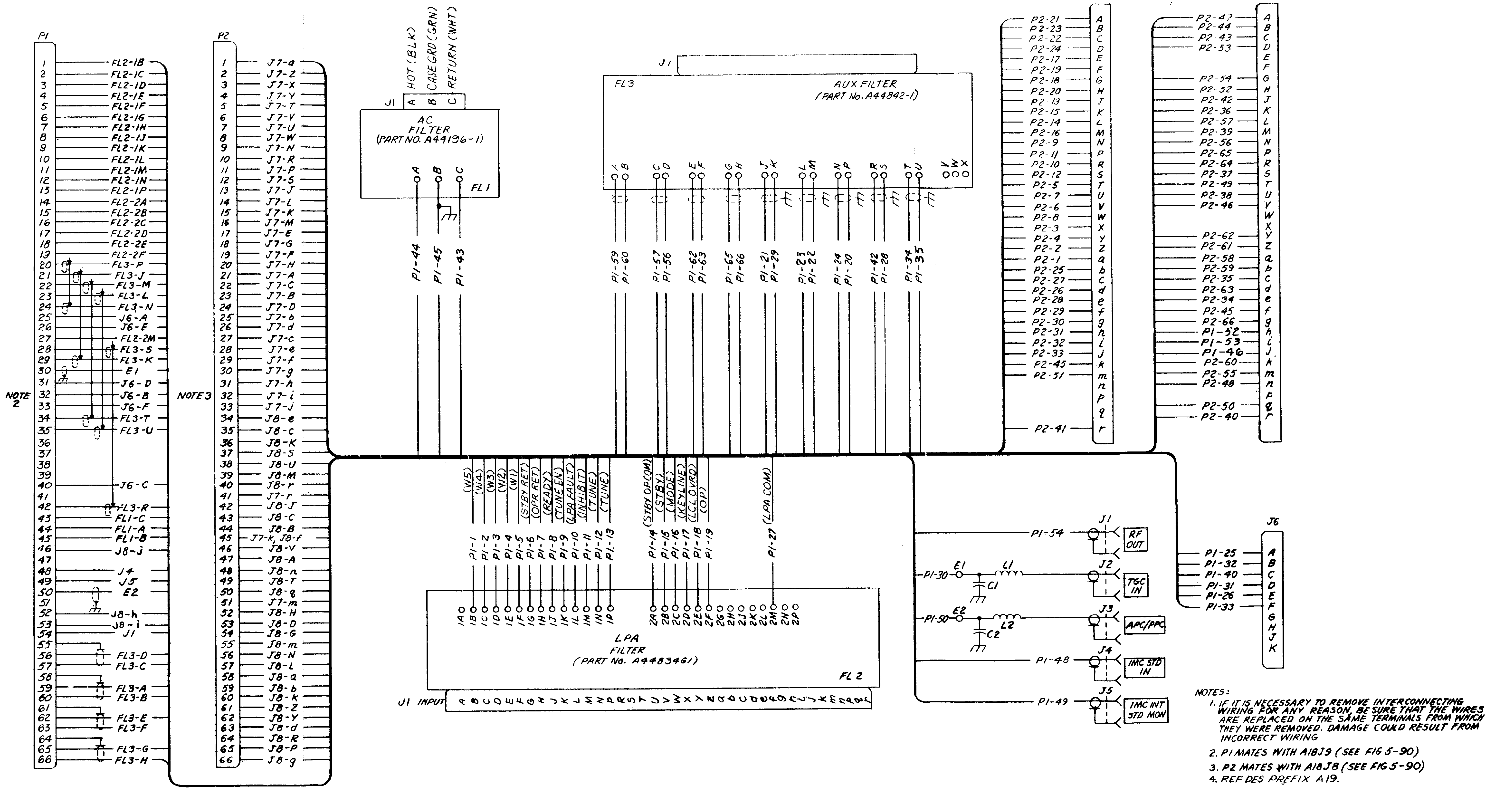
FL1J1-A	Hot	1 Phase 115/230 VAC ±10%, 50-60 cps ±5%
B	Case Ground	1 Phase 115/230 VAC ±10%, 50-60 cps ±5%
C	Return	1 Phase 115/230 VAC ±10%, 50-60 cps ±5%

CONNECTOR NO. (MATES WITH LPA)

FL2J1-A		
B	W5	Band Encoder Output (to LPA)
C	W4	Band Encoder Output (to LPA)
D	W3	Band Encoder Output (to LPA)
E	W2	Band Encoder Output (to LPA)
F	W1	Band Encoder Output (to LPA)
G	Standby Return	(from LPA)
H	Operate Return	(from LPA)
J	Ready	(from LPA)
K	Tune Enable	(from LPA)
L	LPA Fault	(from LPA)
M	Inhibit	(to LPA)
N	Tune	(to LPA)
P	Tune	(to LPA)
R	Stdby Oper. Com.	(to LPA)
S	Standby	(to LPA)
T	Mode	(to LPA)
U	Keyline	(to LPA)
V	Local Override	(from LPA)
W	Operate	(to LPA)
r	LPA Common	

CONNECTOR NO. (AUXILIARY)

FL3J1-A	Channel B2 Audio Input
B	Channel B2 Audio Input
C	Channel B1 Audio Input
D	Channel B1 Audio Input
E	Channel A1 Audio Input
F	Channel A1 Audio Input
G	Channel A2 Audio Input
H	Channel A2 Audio Input
J	Push-to-Talk
K	Push-to-Talk Common
L	Auxiliary Common
M	Channel A2, B2 Auxiliary Readback
N	Channel B1 Auxiliary Readback
P	Channel A1 Auxiliary Readback
R	B+ ON Auxiliary Readback
S	RF ON Readback
T	Int. Std. Fail
U	Int. Std. Fail



NOTES:

1. IF IT IS NECESSARY TO REMOVE INTERCONNECTING WIRING FOR ANY REASON, BE SURE THAT THE WIRES ARE REPLACED ON THE SAME TERMINALS FROM WHICH THEY WERE REMOVED. DAMAGE COULD RESULT FROM INCORRECT WIRING
2. P1 MATES WITH A18J9 (SEE FIG 5-90)
3. P2 MATES WITH A18J8 (SEE FIG 5-90)
4. REF DES PREFIX A19.

Figure 5-91. Modulator-Synthesizer MD-777/FRT, Rear Filter-Panel, Interconnection Diagram

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

This parts list identifies all replaceable assemblies, subassemblies and detail parts of maintenance significance for Modulator-Synthesizer MD-777/FRT, Part No. E43966G1, manufactured by National Radio Company, Inc., Melrose, Mass. The list is used to facilitate ready identification of components for replacement and ordering purposes. It makes reference to the parts-location Illustrations in Section 5 of this technical manual.

6-2. REFERENCE DESIGNATIONS.

The unit numbering method of assigning reference designations has been used to identify assemblies, subassemblies and parts. This method has been expanded as much as necessary to adequately cover the various degrees of subdivision of the equipment. Partial reference designations have been used to identify piece parts listed within an assembly, subassembly and in Illustrations in Section 5. Complete reference designation may be obtained by prefixing the assembly or subassembly reference designator listed at the top of each page and on Illustrations to the partial reference designation of the piece part. Examples of this unit numbering method and typical expansions of the same are illustrated by the following:

Example 1:

A 1

Class of item — Item No. within class

Read as: A1 First (1) assembly of end item. Typical of prefix used at top of page.

Example 2:

A1 R1

Prefix at top of page — Class and No. of item

Read as: First (1) resistor (R) of first (1) assembly (A). Top of page prefix A1 added to class and number of Item R1.

Example 3:

A1 A1

Prefix at top of page — Subassembly designation

Read as: First (1) subassembly (A) of first (1) assembly (A). Top of page prefix A1 added to subassembly designation A1.

Example 4: A1 A1 R1

Prefix at top of page — Class and No. of item

Read as: First (1) resistor (R) of first (1) subassembly (A) of first (1) assembly (A). Top of page prefix A1A1 added to class and number of Item R1.

6-3. LIST OF UNITS.

Table 6-1 is a listing of the units comprising the equipment. The units are listed by their complete reference designation. Table 6-1 contains the following information for each unit listed: (1) reference designation, (2) name and (3) location of the first page of its parts listing in Table 6-2.

6-4. MAINTENANCE PARTS LIST.

Table 6-2 lists all assemblies and their maintenance parts. Table 6-2 provides the following information: (1) the complete reference designation by adding the top of the page prefix to the piece part reference designation, (2) name and brief description, and (3) identification of the illustration which pictorially locates the part and (4) the Usable on Code, if any.

6-5. USABLE ON CODE.

Parts variations within each article are identified by a Letter Symbol in the Notes Column. The absence of a Letter Symbol in the Notes Column indicates that the part is used on all articles covered by this manual. The codes are assigned as follows:

MASTER USABLE ON CODING LIST

PART NUMBER	USABLE ON CODE
E43966G1	A
E43966G2	B

Items used on Part No. E43966G1 only will have the symbol "A" in the Notes Column. Items used on G2 only will have the symbol "B". Parts which do not have any letter in the Notes Column are used in both Part No. E43966G1 and E43966G2.

6-6. SPECIAL TOOLS AND EQUIPMENT.

Special tools and equipment supplied with but not part of the equipment are listed at the end of the MAINTENANCE PARTS LIST.

6-7. LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The Table includes the manufacturers' code used in Table 6-2 to identify the manufacturers. These codes were taken from the Federal Supply Code for Manufacturers, H4-1.

6-8. STOCK NUMBER IDENTIFICATION.

Stock Number Identifications Tables (SNIT) and Allowance Parts Lists (APL) issued by Electronics Supply Office (ESO) include Federal Stock Numbers and Source Maintenance and Recoverability Codes. Therefore, reference should be made to the SNIT and APL prepared for this equipment for stock numbering information.

TABLE 6-1. LIST OF UNITS

REF DESIG	NAME	PAGE
	Modulator-Synthesizer MD-777/FRT	6-5
A1	Modulator Assembly No. 1	6-6
A1A1	Printed Circuit Board, Modulator Subassembly No. 1	6-7
A1A2	Printed Circuit Board, Modulator Subassembly No. 2	6-9
A2	Modulator Assembly No. 2 Same as A1	6-11
A2A1	Printed Circuit Board, Modulator Subassembly No. 1 Same as A1A1	6-12
A2A2	Printed Circuit Board, Modulator Subassembly No. 2 Same as A1A2	6-14
A3	Modulator Assembly No. 3 Same as A1	6-16
A3A1	Printed Circuit Board, Modulator Subassembly No. 1 Same as A1A1	6-17
A3A2	Printed Circuit Board, Modulator Subassembly No. 2 Same as A1A2	6-19
A4	Modulator Assembly No. 4 Same as A1	6-21
A4A1	Printed Circuit Board, Modulator Subassembly No. 1 Same as A1A1	6-22
A4A2	Printed Circuit Board, Modulator Subassembly No. 2 Same as A1A2	6-24
A5	Printed Circuit Board Subassembly, Voice Frequency Gate and Keyline Switch	6-26
A6	Frequency Standard	6-28
A7	Auxiliary Frequency Generator Assembly	6-29
A7A1	Printed Circuit Board Subassembly, Standard Selector	6-30
A7A2	Printed Circuit Board Subassembly, 30 MHz Oscillator/Buffer	6-31
A7A3	Printed Circuit Board Subassembly, 30 MHz Phase Locked Loop	6-32
A8	1.75 MHz-113.75 MHz Generator Assembly	6-33
A8A1	Printed Circuit Board Subassembly, 113.75 MHz Generator	6-34
A8A2	Printed Circuit Board Subassembly, 1.75 MHz Generator	6-37
A9	Side Carrier Generator Assembly	6-38
A9A1	Printed Circuit Board Subassembly, 1 MHz-6.29 kHz Divider	6-39
A9A2	Printed Circuit Board Subassembly, Side Carrier Oscillator	6-40
A10	Printed Circuit Board Subassembly, Transmitter Control No. 1	6-43
A11	Up Converter Assembly	6-44
A11A1	Printed Circuit Board Subassembly, Up-Converter 1.75 MHz IF	6-45
A11A2	Mixer, Up-Converter Subassembly	6-47
A11A2A1	Printed Circuit Board Subassembly, Up-Converter 113.75 MHz Buffer	6-48
A11A3	Printed Circuit Board Subassembly, Up-Converter Carrier Insertion	6-49
A12	Synthesizer Assembly	6-51
A12A1	Printed Circuit Board Subassembly, RF1A	6-53
A12A2	Printed Circuit Board Subassembly, RF3	6-56

TABLE 6-1. LIST OF UNITS (Cont)

REF DESIG	NAME	PAGE
A12A3	Printed Circuit Board Subassembly, Digital No. 2	6-59
A12A4	Printed Circuit Board Subassembly, RF1B	6-61
A12A5	Printed Circuit Board Subassembly, RF2	6-63
A12A6	Printed Circuit Board Subassembly, Digital No. 3	6-66
A12A7	Digital 1A and 1B Assembly	6-68
A12A7A1	Printed Circuit Board Subassembly, Digital No. 1A	6-69
A12A7A2	Printed Circuit Board Subassembly, Digital No. 1B	6-70
A13	Down Converter Assembly	6-71
A13A1	Not Used	6-72
A13A2	Printed Circuit Board Subassembly, Down-Converter 112 MHz IF Amplifier	6-73
A13A3	82-110 MHz Amplifier Subassembly	6-74
A13A3A1	Printed Circuit Board Subassembly, 82-110 MHz Amplifier	6-75
A14	Transmitter Gain Control Assembly	6-76
A14A1	Printed Circuit Board Assembly, TGC No. 1	6-77
A14A2	Printed Circuit Board Assembly, TGC No. 2	6-78
A15	Band Encoder Assembly	6-79
A15A1	Printed Circuit Board Subassembly, -12 and +15 Volt Regulator	6-80
A15A2	Printed Circuit Board Subassembly, Band Encoder Board No. 1	6-81
A16	Output Amplifier Assembly	6-82
A16A1	Printed Circuit Board Subassembly, Output Amplifier No. 1	6-83
A16A2	Printed Circuit Board Subassembly, Output Amplifier No. 2	6-84
A17	Printed Circuit Board Subassembly, Transmitter Control No. 2	6-86
A18	Modulator-Synthesizer Assembly	6-88
A18A1	Printed Circuit Board Subassembly, Volume Units Meter Amplifier	6-93
A18A2	Printed Circuit Board Subassembly, Fault Board	6-94
A18A3	Frequency Select Board Subassembly	6-96
A18A4	Printed Circuit Board Subassembly, Transmitter Control	6-97
A18A5	Printed Circuit Board Subassembly, Motor Control	6-98
A18A6	Power Distribution Board Subassembly	6-99
A19	Filter Panel Assembly, Modulator-Synthesizer	6-100
PS1	Power Supply Assembly	6-101
PS1A1	Printed Circuit Board, Subassembly, -12V Regulator	6-102
PS1A2	Printed Circuit Board, Subassembly, +5 and +18 Volt Regulator	6-103
PS1A3	Printed Circuit Board Subassembly, 15 and 24 Volt DC Regulator	6-105
PS1A4	Printed Circuit Board Subassembly, +125 Volt Rectifier, Regulator and Filter	6-106
PS1A5	Printed Circuit Board, Subassembly, Switching Regulator	6-107

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TABLE 6-2. MAINTENANCE PARTS LIST

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
		MODULATOR-SYNTHESIZER MD-777/FRT: Capable of processing up to 4 independent audio inputs simultaneously; each input is handled by 1 of 4 identical audio frequency modules; provides the terminations for the audio input lines and furnishes Linear Amplifier-Power Supply Group a modulated RF excitation signal adjustable between 0 and 250 milliwatts over the frequency range of 2 to 30 MHz; 42498 dwg E43966G1.	5-1
FL1		FILTER, BANDPASS: 1,751,500 MHz; 50 ohms impedance porm 5 pct in parallel with 0 to 25 pf; 250 MV RMS input level; 42498 dwg A46534-1.	5-2
FL2		FILTER, BANDPASS: 1,754,500 MHz; 50 ohms impedance porm 5 pct in parallel with 0 to 25 pf; 250 MV RMS input level; 42498 dwg A46534-2.	5-2
FL3		FILTER, BANDPASS: 1,748,500 MHz; 50 ohms impedance porm 5 pct in parallel with 0 to 25 pf; 25 MV RMS input level; 42498 dwg A46534-3.	5-2
FL4		FILTER, BANDPASS: 1,745,500 MHz; 50 ohms impedance porm 5 pct in parallel with 0 to 25 pf; 250 MV RMS input level; 42498 dwg A46534-4.	5-2
FL5		FILTER ASSEMBLY: 112 MHz; 1.836 in. w by 2.875 in. h by 12.508 in. lg o/a; 42498 dwg A46487-1.	5-2

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1		MODULATOR ASSEMBLY: Contains two printed circuit boards with all components; audio amplifier board A1 and modulator/agc amplifier board A2; 42498 dwg D44117G1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-5

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1A1		MODULATOR SUBASSEMBLY NO. 1: Printed circuit board with all components assembled for operation; 42498 dwg D43846G1.	5-5
C1		CAPACITOR: MIL type CK06CW271K.	5-6
C2		CAPACITOR: MIL type CS13BE125K.	5-6
C3		CAPACITOR: MIL type CL65BH151MP3.	5-6
C4		CAPACITOR: MIL type CS13BF685K.	5-6
C5		CAPACITOR: MIL type CS13BD157K.	5-6
C6		CAPACITOR: MIL type CL65BB561MP3.	5-6
C7		CAPACITOR: MIL type CK05CW102K.	5-6
C8		CAPACITOR: MIL type CS13BB157K.	5-6
C9		Same as C3.	5-6
C10		Same as C5.	5-6
C11		CAPACITOR: MIL type CK06BX104K.	5-6
C12		CAPACITOR: MIL type CS13BH224K.	5-6
C13		Same as C3.	5-6
C14		Same as C5.	5-6
C15		CAPACITOR: MIL type CS13BD226K.	5-6
C16		CAPACITOR: MIL type CS13BF476K.	5-6
C17		CAPACITOR: MIL type CS13BD566K.	5-6
C18		Same as C5.	5-6
C19		CAPACITOR: MIL type CK06CW103K.	5-6
C20		Same as C15.	5-6
C21		Same as C5.	5-6
C22		Same as C5.	5-6
C23		Same as C11.	5-6
C24		Same as C11.	5-6
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-6
CR2		Same as CR1.	5-6
CR3		SEMICONDUCTOR: MIL type 1N933.	5-6
CR4		Same as CR1.	5-6
CR5		Same as CR1.	5-6
Q1		TRANSISTOR: MIL type 2N930.	5-6
Q2		TRANSISTOR: MIL type 2N2222.	5-6
Q3		Same as Q2.	5-6
Q4		Same as Q2.	5-6
Q5		Same as Q1.	5-6
Q6		Same as Q2.	5-6
Q7		Same as Q2.	5-6
Q8		TRANSISTOR: MIL type 2N2907.	5-6
R1		RESISTOR: MIL type RC05GF683K.	5-6
R2		RESISTOR: MIL type RC05GF473K.	5-6
R3		RESISTOR: MIL type RC05GF562K.	5-6
R4		RESISTOR: MIL type RC05GF123J.	5-6
R5		RESISTOR: MIL type RC05GF332J.	5-6
R6		RESISTOR: MIL type RC05GF391K.	5-6
R7		RESISTOR: MIL type RC05GF390J.	5-6
R8		RESISTOR: MIL type RC05GF820J.	5-6
R9		RESISTOR: MIL type RC05GF221J.	5-6
R10		RESISTOR: MIL type RC05GF122J.	5-6
R11		RESISTOR: MIL type RC05GF562J.	5-6
R12		Same as R11.	5-6
R13		RESISTOR: MIL type RC05GF561J.	5-6
R14		RESISTOR: MIL type RC05GF470K.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1A1 (cont)			
R15		RESISTOR: MIL type RC07GF680J.	5-6
R16		RESISTOR: MIL type RC05GF563K.	5-6
R17		Same as R1.	5-6
R18		RESISTOR: MIL type RC05GF392K.	5-6
R19		RESISTOR: MIL type RC05GF101J.	5-6
R20		RESISTOR: MIL type RC05GF682K.	5-6
R21		RESISTOR: MIL type RC05GF181J.	5-6
R22		RESISTOR: MIL type RC05GF183K.	5-6
R23		RESISTOR: MIL type RC05GF123K.	5-6
R24		RESISTOR: MIL type RC05GF122K.	5-6
R25		RESISTOR: MIL type RC05GF151K.	5-6
R26		RESISTOR: MIL type RC05GF152K.	5-6
R27		RESISTOR: MIL type RC05GF103J.	5-6
R28		Same as R27.	5-6
R29		RESISTOR: MIL type RC05GF100K.	5-6
R30		Same as R29.	5-6
R31		Same as R7.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1A2		MODULATOR SUBASSEMBLY NO. 2: Printed circuit board with all components assembled for operation; 42498 dwg D43847G1.	5-5
C1		CAPACITOR: MIL type CS13BF105K.	5-7
C2		CAPACITOR: MIL type CK06BX104K.	5-7
C3		CAPACITOR: MIL type CK06CW222K.	5-7
C4		Same as C2.	5-7
C5		CAPACITOR: MIL type CS13BD157K.	5-7
C6		Same as C2.	5-7
C7		Same as C2.	5-7
C8		CAPACITOR: MIL type CS13BE336K.	5-7
C9		CAPACITOR: MIL type CK05CW103K.	5-7
C10		Same as C2.	5-7
C11		Same as C2.	5-7
C12		CAPACITOR: MIL type CS13BF476K.	5-7
C13		CAPACITOR: MIL type CS13BF685K.	5-7
C14		Same as C5.	5-7
C15		Same as C2.	5-7
C16		Same as C2.	5-7
C17		CAPACITOR: MIL type CK05BX102K.	5-7
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-7
CR2		Same as CR1.	5-7
CR3		SEMICONDUCTOR: MIL type 1N3064.	5-7
CR4 thru CR10		Same as CR3.	5-7
CR11		Same as CR1.	5-7
CR12		Same as CR3.	5-7
CR13		Same as CR3.	5-7
CR14		Same as CR3.	5-7
CR15		Same as CR3.	5-7
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-7
L1		COIL, RF: MIL type MS90537-33.	5-7
L2		COIL, RF: MIL type MS90537-41.	5-7
L3		COIL, RF: MIL type MS90537-13.	5-7
L4		COIL, RF: MIL type MS90537-37.	5-7
L5		Same as L2.	5-7
Q1		TRANSISTOR: MIL type 2N2219.	5-7
Q2		TRANSISTOR: MIL type 2N930.	5-7
Q3		Same as Q1.	5-7
Q4		TRANSISTOR: MIL type 2N2905.	5-7
Q5		Same as Q2.	5-7
Q6		TRANSISTOR: MIL type 2N2907.	5-7
Q7		Same as Q2.	5-7
Q8		Same as Q2.	5-7
Q9		Same as Q2.	5-7
R1		RESISTOR: MIL type RC07GF102K.	5-7
R2		RESISTOR: MIL type RC07GF562K.	5-7
R3		Same as R1.	5-7
R4		RESISTOR: MIL type RC07GF273K.	5-7
R5		RESISTOR: MIL type RC07GF103K.	5-7
R6		RESISTOR: MIL type RC07GF101J.	5-7
R7		RESISTOR: MIL type RC07GF272K.	5-7
R8		RESISTOR: MIL type RJ11BP501.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A1A2 (cont)			
R9		RESISTOR: MIL type RC07GF221K.	5-7
R10		RESISTOR: MIL type RC07GF182K.	5-7
R11		Same as R5.	5-7
R12		Same as R5.	5-7
R13		RESISTOR: MIL type RC07GF180K.	5-7
R14		Same as R13.	5-7
R15		RESISTOR: MIL type RC07GF152K.	5-7
R16		RESISTOR: MIL type RC07GF681K.	5-7
R17		RESISTOR: MIL type RC07GF270K.	5-7
R18		Same as R7.	5-7
R19		RESISTOR: MIL type RC07GF153K.	5-7
R20		RESISTOR: MIL type RC07GF222K.	5-7
R21		Same as R1.	5-7
R22		RESISTOR: MIL type RC07GF334J.	5-7
R23		RESISTOR: MIL type RC07GF394J.	5-7
R24		RESISTOR: MIL type RC07GF273J.	5-7
R25		RESISTOR: MIL type RC07GF100K.	5-7
R26		RESISTOR: MIL type RC07GF471J.	5-7
R27		RESISTOR: MIL type RC07GF822J.	5-7
R28		RESISTOR: MIL type RC07GF270K.	5-7
R29		Same as R28.	5-7
R30		Same as R28.	5-7
R31		RESISTOR: MIL type RC05GF472J.	5-7
R32		RESISTOR: MIL type RJ24CX101.	5-7
T1		TRANSFORMER, AF: 2 windings; 50 MW primary input; primary and secondary windings 10,000 ohms porm 10 pct impedance and center tapped; 42498 dwg A43450-1.	5-7
T2		TRANSFORMER, RF: 2 windings, primary winding 20 uh porm 20 pct at 25 deg C, 50 ohms impedance, 0 ma, 0.3 ohm dc resistance; secondary winding 200 ohms impedance, 0 ma, 0.2 ohm dc resistance; 42498 dwg A45391-1.	5-7
T3		Same as T2.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A2		MODULATOR ASSEMBLY: Same as A1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-5

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A2A1		MODULATOR SUBASSEMBLY NO. 1: Same as A1A1.	5-5
C1		CAPACITOR: MIL type CK06CW271K.	5-6
C2		CAPACITOR: MIL type CS13BE125K.	5-6
C3		CAPACITOR: MIL type CL65BH151MP3.	5-6
C4		CAPACITOR: MIL type CS13BF685K.	5-6
C5		CAPACITOR: MIL type CS13BD157K.	5-6
C6		CAPACITOR: MIL type CL65BB561MP3.	5-6
C7		CAPACITOR: MIL type CK05CW102K.	5-6
C8		CAPACITOR: MIL type CS13BB157K.	5-6
C9		Same as C3.	5-6
C10		Same as C5.	5-6
C11		CAPACITOR: MIL type CK06BX104K.	5-6
C12		CAPACITOR: MIL type CS13BH224K.	5-6
C13		Same as C3.	5-6
C14		Same as C5.	5-6
C15		CAPACITOR: MIL type CS13BD226K.	5-6
C16		CAPACITOR: MIL type CS13BF476K.	5-6
C17		CAPACITOR: MIL type CS13BD566K.	5-6
C18		Same as C5.	5-6
C19		CAPACITOR: MIL type CK06CW103K.	5-6
C20		Same as C15.	5-6
C21		Same as C5.	5-6
C22		Same as C5.	5-6
C23		Same as C11.	5-6
C24		Same as C11.	5-6
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-6
CR2		Same as CR1.	5-6
CR3		SEMICONDUCTOR: MIL type 1N933.	5-6
CR4		Same as CR1.	5-6
CR5		Same as CR1.	5-6
Q1		TRANSISTOR: MIL type 2N930.	5-6
Q2		TRANSISTOR: MIL type 2N2222.	5-6
Q3		Same as Q2.	5-6
Q4		Same as Q2.	5-6
Q5		Same as Q1.	5-6
Q6		Same as Q2.	5-6
Q7		Same as Q2.	5-6
Q8		TRANSISTOR: MIL type 2N2907.	5-6
R1		RESISTOR: MIL type RC05GF683K.	5-6
R2		RESISTOR: MIL type RC05GF473K.	5-6
R3		RESISTOR: MIL type RC05GF562K.	5-6
R4		RESISTOR: MIL type RC05GF123J.	5-6
R5		RESISTOR: MIL type RC05GF332J.	5-6
R6		RESISTOR: MIL type RC05GF391K.	5-6
R7		RESISTOR: MIL type RC05GF390J.	5-6
R8		RESISTOR: MIL type RC05GF820J.	5-6
R9		RESISTOR: MIL type RC05GF221J.	5-6
R10		RESISTOR: MIL type RC05GF122J.	5-6
R11		RESISTOR: MIL type RC05GF562J.	5-6
R12		Same as R11.	5-6
R13		RESISTOR: MIL type RC05GF561J.	5-6
R14		RESISTOR: MIL type RC05GF470K.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A2A1 (cont)			
R15		RESISTOR: MIL type RC07GF680J.	5-6
R16		RESISTOR: MIL type RC05GF563K.	5-6
R17		Same as R1.	5-6
R18		RESISTOR: MIL type RC05GF392K.	5-6
R19		RESISTOR: MIL type RC05GF101J.	5-6
R20		RESISTOR: MIL type RC05GF682K.	5-6
R21		RESISTOR: MIL type RC05GF181J.	5-6
R22		RESISTOR: MIL type RC05GF183K.	5-6
R23		RESISTOR: MIL type RC05GF123K.	5-6
R24		RESISTOR: MIL type RC05GF122K.	5-6
R25		RESISTOR: MIL type RC05GF151K.	5-6
R26		RESISTOR: MIL type RC05GF152K.	5-6
R27		RESISTOR: MIL type RC05GF103J.	5-6
R28		Same as R27.	5-6
R29		RESISTOR: MIL type RC05GF100K.	5-6
R30		Same as R29.	5-6
R31		Same as R7.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A2A2		MODULATOR SUBASSEMBLY NO. 2: Same as A1A2.	5-5
C1		CAPACITOR: MIL type CS13BF105K.	5-7
C2		CAPACITOR: MIL type CK06BX104K.	5-7
C3		CAPACITOR: MIL type CK06CW222K.	5-7
C4		Same as C2.	5-7
C5		CAPACITOR: MIL type CS13BD157K.	5-7
C6		Same as C2.	5-7
C7		Same as C2.	5-7
C8		CAPACITOR: MIL type CS13BE336K.	5-7
C9		CAPACITOR: MIL type CK05CW103K.	5-7
C10		Same as C2.	5-7
C11		Same as C2.	5-7
C12		CAPACITOR: MIL type CS13BF476K.	5-7
C13		CAPACITOR: MIL type CS13BF685K.	5-7
C14		Same as C5.	5-7
C15		Same as C2.	5-7
C16		Same as C2.	5-7
C17		CAPACITOR: MIL type CK05BX102K.	5-7
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-7
CR2		Same as CR1.	5-7
CR3		SEMICONDUCTOR: MIL type 1N3064.	5-7
CR4 thru CR10		Same as CR3.	5-7
CR11		Same as CR1.	5-7
CR12		Same as CR3.	5-7
CR13		Same as CR3.	5-7
CR14		Same as CR3.	5-7
CR15		Same as CR3.	5-7
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-7
L1		COIL, RF: MIL type MS90537-33.	5-7
L2		COIL, RF: MIL type MS90537-41.	5-7
L3		COIL, RF: MIL type MS90537-13.	5-7
L4		COIL, RF: MIL type MS90537-37.	5-7
L5		Same as L2.	5-7
Q1		TRANSISTOR: MIL type 2N2219.	5-7
Q2		TRANSISTOR: MIL type 2N930.	5-7
Q3		Same as Q1.	5-7
Q4		TRANSISTOR: MIL type 2N2905.	5-7
Q5		Same as Q2	5-7
Q6		TRANSISTOR: MIL type 2N2907.	5-7
Q7		Same as Q2.	5-7
Q8		Same as Q2.	5-7
Q9		Same as Q2.	5-7
R1		RESISTOR: MIL type RC07GF102K.	5-7
R2		RESISTOR: MIL type RC07GF562K.	5-7
R3		Same as R1.	5-7
R4		RESISTOR: MIL type RC07GF273K.	5-7
R5		RESISTOR: MIL type RC07GF103K.	5-7
R6		RESISTOR: MIL type RC07GF101J.	5-7
R7		RESISTOR: MIL type RC07GF272K.	5-7
R8		RESISTOR: MIL type RJ11BP501.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A2A2 (cont)			
R9		RESISTOR: MIL type RC07GF221K.	5-7
R10		RESISTOR: MIL type RC07GF182K.	5-7
R11		Same as R5.	5-7
R12		Same as R5.	5-7
R13		RESISTOR: MIL type RC07GF180K.	5-7
R14		Same as R13.	5-7
R15		RESISTOR: MIL type RC07GF152K.	5-7
R16		RESISTOR: MIL type RC07GF681K.	5-7
R17		RESISTOR: MIL type RC07GF270K.	5-7
R18		Same as R7.	5-7
R19		RESISTOR: MIL type RC07GF153K.	5-7
R20		RESISTOR: MIL type RC07GF222K.	5-7
R21		Same as R1.	5-7
R22		RESISTOR: MIL type RC07GF334J.	5-7
R23		RESISTOR: MIL type RC07GF394J.	5-7
R24		RESISTOR: MIL type RC07GF273J.	5-7
R25		RESISTOR: MIL type RC07GF100K.	5-7
R26		RESISTOR: MIL type RC07GF471J.	5-7
R27		RESISTOR: MIL type RC07GF822J.	5-7
R28		RESISTOR: MIL type RC07GF270K.	5-7
R29		Same as R28.	5-7
R30		Same as R28.	5-7
R31		RESISTOR: MIL type RC05GF472J.	5-7
R32		RESISTOR: MIL type RJ24CX101.	5-7
T1		TRANSFORMER, AF: 2 windings; 50 MW primary input; primary and secondary windings 10,000 ohms porm 10 pct impedance and center tapped; 42498 dwg A43450-1.	5-7
T2		TRANSFORMER, RF: 2 windings, primary winding 20 uh porm 20 pct at 25 deg C, 50 ohms impedance, 0 ma, 0.3 ohm dc resistance; secondary winding 200 ohms impedance, 0 ma, 0.2 ohm dc resistance; 42498 dwg A45391-1.	5-7
T3		Same as T2.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A3		MODULATOR ASSEMBLY: Same as A1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-5

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A3A1		MODULATOR SUBASSEMBLY NO. 1: Same as A1A1.	5-5
C1		CAPACITOR: MIL type CK06CW271K.	5-6
C2		CAPACITOR: MIL type CS13BE125K.	5-6
C3		CAPACITOR: MIL type CL65BH151MP3.	5-6
C4		CAPACITOR: MIL type CS13BF685K.	5-6
C5		CAPACITOR: MIL type CS13BD157K.	5-6
C6		CAPACITOR: MIL type CL65BB561MP3.	5-6
C7		CAPACITOR: MIL type CK05CW102K.	5-6
C8		CAPACITOR: MIL type CS13BB157K.	5-6
C9		Same as C3.	5-6
C10		Same as C5.	5-6
C11		CAPACITOR: MIL type CK06BX104K.	5-6
C12		CAPACITOR: MIL type CS13BH224K.	5-6
C13		Same as C3.	5-6
C14		Same as C5.	5-6
C15		CAPACITOR: MIL type CS13BD226K.	5-6
C16		CAPACITOR: MIL type CS13BF476K.	5-6
C17		CAPACITOR: MIL type CS13BD566K.	5-6
C18		Same as C5.	5-6
C19		CAPACITOR: MIL type CK06CW103K.	5-6
C20		Same as C15.	5-6
C21		Same as C5.	5-6
C22		Same as C5.	5-6
C23		Same as C11.	5-6
C24		Same as C11.	5-6
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-6
CR2		Same as CR1.	5-6
CR3		SEMICONDUCTOR: MIL type 1N933.	5-6
CR4		Same as CR1.	5-6
CR5		Same as CR1.	5-6
Q1		TRANSISTOR: MIL type 2N930.	5-6
Q2		TRANSISTOR: MIL type 2N2222.	5-6
Q3		Same as Q2.	5-6
Q4		Same as Q2.	5-6
Q5		Same as Q1.	5-6
Q6		Same as Q2.	5-6
Q7		Same as Q2.	5-6
Q8		TRANSISTOR: MIL type 2N2907.	5-6
R1		RESISTOR: MIL type RC05GF683K.	5-6
R2		RESISTOR: MIL type RC05GF473K.	5-6
R3		RESISTOR: MIL type RC05GF562K.	5-6
R4		RESISTOR: MIL type RC05GF123J.	5-6
R5		RESISTOR: MIL type RC05GF332J.	5-6
R6		RESISTOR: MIL type RC05GF391K.	5-6
R7		RESISTOR: MIL type RC05GF390J.	5-6
R8		RESISTOR: MIL type RC05GF820J.	5-6
R9		RESISTOR: MIL type RC05GF221J.	5-6
R10		RESISTOR: MIL type RC05GF122J.	5-6
R11		RESISTOR: MIL type RC05GF562J.	5-6
R12		Same as R11.	5-6
R13		RESISTOR: MIL type RC05GF561J.	5-6
R14		RESISTOR: MIL type RC05GF470K.	5-6
R15		RESISTOR: MIL type RC07GF680J.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A3A1 (cont)			
R16		RESISTOR: MIL type RC05GF563K.	5-6
R17		Same as R1.	5-6
R18		RESISTOR: MIL type RC05GF392K.	5-6
R19		RESISTOR: MIL type RC05GF101J.	5-6
R20		RESISTOR: MIL type RC05GF682K.	5-6
R21		RESISTOR: MIL type RC05GF181J.	5-6
R22		RESISTOR: MIL type RC05GF183K.	5-6
R23		RESISTOR: MIL type RC05GF123K.	5-6
R24		RESISTOR: MIL type RC05GF122K.	5-6
R25		RESISTOR: MIL type RC05GF151K.	5-6
R26		RESISTOR: MIL type RC05GF152K.	5-6
R27		RESISTOR: MIL type RC05GF103J.	5-6
R28		Same as R27.	5-6
R29		RESISTOR: MIL type RC05GF100K.	5-6
R30		Same as R29	5-6
R31		Same as R7.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A3A2		MODULATOR SUBASSEMBLY NO. 2: Same as A1A2.	5-5
C1		CAPACITOR: MIL type CS13BF105K.	5-7
C2		CAPACITOR: MIL type CK06BX104K.	5-7
C3		CAPACITOR: MIL type CK06CW222K.	5-7
C4		Same as C2.	5-7
C5		CAPACITOR: MIL type CS13BD157K.	5-7
C6		Same as C2.	5-7
C7		Same as C2.	5-7
C8		CAPACITOR: MIL type CS13BE336K.	5-7
C9		CAPACITOR: MIL type CK05CW103K.	5-7
C10		Same as C2.	5-7
C11		Same as C2.	5-7
C12		CAPACITOR: MIL type CS13BF476K.	5-7
C13		CAPACITOR: MIL type CS13BF685K.	5-7
C14		Same as C5.	5-7
C15		Same as C2.	5-7
C16		Same as C2.	5-7
C17		CAPACITOR: MIL type CK05BX102K.	5-7
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-7
CR2		Same as CR1.	5-7
CR3		SEMICONDUCTOR: MIL type 1N3064.	5-7
CR4 thru CR10		Same as CR3.	5-7
CR11		Same as CR1.	5-7
CR12		Same as CR3.	5-7
CR13		Same as CR3.	5-7
CR14		Same as CR3.	5-7
CR15		Same as CR3.	5-7
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-7
L1		COIL, RF: MIL type MS90537-33.	5-7
L2		COIL, RF: MIL type MS90537-41.	5-7
L3		COIL, RF: MIL type MS90537-13.	5-7
L4		COIL, RF: MIL type MS90537-37.	5-7
L5		Same as L2.	5-7
Q1		TRANSISTOR: MIL type 2N2219.	5-7
Q2		TRANSISTOR: MIL type 2N930.	5-7
Q3		Same as Q1.	5-7
Q4		TRANSISTOR: MIL type 2N2905.	5-7
Q5		Same as Q2.	5-7
Q6		TRANSISTOR: MIL type 2N2907.	5-7
Q7		Same as Q2.	5-7
Q8		Same as Q2.	5-7
Q9		Same as Q2.	5-7
R1		RESISTOR: MIL type RC07GF102K.	5-7
R2		RESISTOR: MIL type RC07GF562K.	5-7
R3		Same as R1.	5-7
R4		RESISTOR: MIL type RC07GF273K.	5-7
R5		RESISTOR: MIL type RC07GF103K.	5-7
R6		RESISTOR: MIL type RC07GF101J.	5-7
R7		RESISTOR: MIL type RC07GF272K.	5-7
R8		RESISTOR: MIL type RJ11BP501.	5-7

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A3A2 (cont)			
R9		RESISTOR: MIL type RC07GF221K.	5-7
R10		RESISTOR: MIL type RC07GF182K.	5-7
R11		Same as R5.	5-7
R12		Same as R5.	5-7
R13		RESISTOR: MIL type RC07GF180K.	5-7
R14		Same as R13.	5-7
R15		RESISTOR: MIL type RC07GF152K.	5-7
R16		RESISTOR: MIL type RC07GF681K.	5-7
R17		RESISTOR: MIL type RC07GF270K.	5-7
R18		Same as R7.	5-7
R19		RESISTOR: MIL type RC07GF153K.	5-7
R20		RESISTOR: MIL type RC07GF222K.	5-7
R21		Same as R1.	5-7
R22		RESISTOR: MIL type RC07GF334J.	5-7
R23		RESISTOR: MIL type RC07GF394J.	5-7
R24		RESISTOR: MIL type RC07GF273J.	5-7
R25		RESISTOR: MIL type RC07GF100K.	5-7
R26		RESISTOR: MIL type RC07GF471J.	5-7
R27		RESISTOR: MIL type RC07GF822J.	5-7
R28		RESISTOR: MIL type RC07GF270K.	5-7
R29		Same as R28.	5-7
R30		Same as R28.	5-7
R31		RESISTOR: MIL type RC05GF472J.	5-7
R32		RESISTOR: MIL type RJ24CX101.	5-7
T1		TRANSFORMER, AF: 2 windings; 50 MW primary input; primary and secondary windings 10,000 ohms porm 10 pct impedance and center tapped; 42498 dwg A43450-1.	5-7
T2		TRANSFORMER, RF: 2 windings, primary winding 20 uh porm 20 pct at 25 deg C, 50 ohms impedance, 0 ma, 0.3 ohm dc resistance; secondary winding 200 ohms impedance, 0 ma, 0.2 ohm dc resistance; 42498 dwg A45391-1.	5-7
T3		Same as T2.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A4		MODULATOR ASSEMBLY: Same as A1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-5

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A4A1		MODULATOR SUBASSEMBLY NO. 1: Same as A1A1.	5-5
C1		CAPACITOR: MIL type CK06CW271K.	5-6
C2		CAPACITOR: MIL type CS13BE125K.	5-6
C3		CAPACITOR: MIL type CL65BH151MP3.	5-6
C4		CAPACITOR: MIL type CS13BF685K.	5-6
C5		CAPACITOR: MIL type CS13BD157K.	5-6
C6		CAPACITOR: MIL type CL65BB561MP3.	5-6
C7		CAPACITOR: MIL type CK05CW102K.	5-6
C8		CAPACITOR: MIL type CS13BB157K.	5-6
C9		Same as C3.	5-6
C10		Same as C5.	5-6
C11		CAPACITOR: MIL type CK06BX104K.	5-6
C12		CAPACITOR: MIL type CS13BH224K.	5-6
C13		Same as C3.	5-6
C14		Same as C5.	5-6
C15		CAPACITOR: MIL type CS13BD226K.	5-6
C16		CAPACITOR: MIL type CS13BF476K.	5-6
C17		CAPACITOR: MIL type CS13BD566K.	5-6
C18		Same as C5.	5-6
C19		CAPACITOR: MIL type CK06CW103K.	5-6
C20		Same as C15.	5-6
C21		Same as C5.	5-6
C22		Same as C5.	5-6
C23		Same as C11.	5-6
C24		Same as C11.	5-6
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-6
CR2		Same as CR1.	5-6
CR3		SEMICONDUCTOR: MIL type 1N933.	5-6
CR4		Same as CR1.	5-6
CR5		Same as CR1.	5-6
Q1		TRANSISTOR: MIL type 2N930.	5-6
Q2		TRANSISTOR: MIL type 2N2222.	5-6
Q3		Same as Q2.	5-6
Q4		Same as Q2.	5-6
Q5		Same as Q1.	5-6
Q6		Same as Q2.	5-6
Q7		Same as Q2.	5-6
Q8		TRANSISTOR: MIL type 2N2907.	5-6
R1		RESISTOR: MIL type RC05GF683K.	5-6
R2		RESISTOR: MIL type RC05GF473K.	5-6
R3		RESISTOR: MIL type RC05GF562K.	5-6
R4		RESISTOR: MIL type RC05GF123J.	5-6
R5		RESISTOR: MIL type RC05GF332J.	5-6
R6		RESISTOR: MIL type RC05GF391K.	5-6
R7		RESISTOR: MIL type RC05GF390J.	5-6
R8		RESISTOR: MIL type RC05GF820J.	5-6
R9		RESISTOR: MIL type RC05GF221J.	5-6
R10		RESISTOR: MIL type RC05GF122J.	5-6
R11		RESISTOR: MIL type RC05GF562J.	5-6
R12		Same as R11.	5-6
R13		RESISTOR: MIL type RC05GF561J.	5-6
R14		RESISTOR: MIL type RC05GF470K.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A4A1 (cont)			
R15		RESISTOR: MIL type RC07GF680J.	5-6
R16		RESISTOR: MIL type RC05GF563K.	5-6
R17		Same as R1.	5-6
R18		RESISTOR: MIL type RC05GF392K.	5-6
R19		RESISTOR: MIL type RC05GF101J.	5-6
R20		RESISTOR: MIL type RC05GF682K.	5-6
R21		RESISTOR: MIL type RC05GF181J.	5-6
R22		RESISTOR: MIL type RC05GF183K.	5-6
R23		RESISTOR: MIL type RC05GF123K.	5-6
R24		RESISTOR: MIL type RC05GF122K.	5-6
R25		RESISTOR: MIL type RC05GF151K.	5-6
R26		RESISTOR: MIL type RC05GF152K.	5-6
R27		RESISTOR: MIL type RC05GF103J.	5-6
R28		Same as R27.	5-6
R29		RESISTOR: MIL type RC05GF100K.	5-6
R30		Same as R29.	5-6
R31		Same as R7.	5-6

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A4A2		MODULATOR SUBASSEMBLY NO. 2: Same as A1A2.	5-5
C1		CAPACITOR: MIL type CS13BF105K.	5-7
C2		CAPACITOR: MIL type CK06BX104K.	5-7
C3		CAPACITOR: MIL type CK06CW222K.	5-7
C4		Same as C2.	5-7
C5		CAPACITOR: MIL type CS13BD157K.	5-7
C6		Same as C2.	5-7
C7		Same as C2.	5-7
C8		CAPACITOR: MIL type CS13BE336K.	5-7
C9		CAPACITOR: MIL type CK05CW103K.	5-7
C10		Same as C2.	5-7
C11		Same as C2.	5-7
C12		CAPACITOR: MIL type CS13BF476K.	5-7
C13		CAPACITOR: MIL type CS13BF685K.	5-7
C14		Same as C5.	5-7
C15		Same as C2.	5-7
C16		Same as C2.	5-7
C17		CAPACITOR: MIL type CK05BX102K.	5-7
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-7
CR2		Same as CR1.	5-7
CR3		SEMICONDUCTOR: MIL type 1N3064.	5-7
CR4 thru CR10		Same as CR3.	5-7
CR11		Same as CR1.	5-7
CR12		Same as CR3.	5-7
CR13		Same as CR3.	5-7
CR14		Same as CR3.	5-7
CR15		Same as CR3.	5-7
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-7
L1		COIL, RF: MIL type MS90537-33.	5-7
L2		COIL, RF: MIL type MS90537-41.	5-7
L3		COIL, RF: MIL type MS90537-13.	5-7
L4		COIL, RF: MIL type MS90537-37.	5-7
L5		Same as L2.	5-7
Q1		TRANSISTOR: MIL type 2N2219.	5-7
Q2		TRANSISTOR: MIL type 2N930.	5-7
Q3		Same as Q1.	5-7
Q4		TRANSISTOR: MIL type 2N2905.	5-7
Q5		Same as Q2.	5-7
Q6		TRANSISTOR: MIL type 2N2907.	5-7
Q7		Same as Q2.	5-7
Q8		Same as Q2.	5-7
Q9		Same as Q2.	5-7
R1		RESISTOR: MIL type RC07GF102K.	5-7
R2		RESISTOR: MIL type RC07GF562K.	5-7
R3		Same as R1.	5-7
R4		RESISTOR: MIL type RC07GF273K.	5-7
R5		RESISTOR: MIL type RC07GF103K.	5-7
R6		RESISTOR: MIL type RC07GF101J.	5-7
R7		RESISTOR: MIL type RC07GF272K.	5-7
R8		RESISTOR: MIL type RJ11BP501.	5-7

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A4A2 (cont)			
R9		RESISTOR: MIL type RC07GF221K.	5-7
R10		RESISTOR: MIL type RC07GF182K.	5-7
R11		Same as R5.	5-7
R12		Same as R5.	5-7
R13		RESISTOR: MIL type RC07GF180K.	5-7
R14		Same as R13.	5-7
R15		RESISTOR: MIL type RC07GF152K.	5-7
R16		RESISTOR: MIL type RC07GF681K.	5-7
R17		RESISTOR: MIL type RC07GF270K.	5-7
R18		Same as R7.	5-7
R19		RESISTOR: MIL type RC07GF153K.	5-7
R20		RESISTOR: MIL type RC07GF222K.	5-7
R21		Same as R1.	5-7
R22		RESISTOR: MIL type RC07GF334J.	5-7
R23		RESISTOR: MIL type RC07GF394J.	5-7
R24		RESISTOR: MIL type RC07GF273J.	5-7
R25		RESISTOR: MIL type RC07GF100K.	5-7
R26		RESISTOR: MIL type RC07GF471J.	5-7
R27		RESISTOR: MIL type RC07GF822J.	5-7
R28		RESISTOR: MIL type RC07GF270K.	5-7
R29		Same as R28.	5-7
R30		Same as R28.	5-7
R31		RESISTOR: MIL type RC05GF472J.	5-7
R32		RESISTOR: MIL type RJ24CX101.	5-7
T1		TRANSFORMER, AF: 2 windings; 50 MW primary input; primary and secondary windings 10,000 ohms porm 10 pct impedance and center tapped; 42498 dwg A43450-1.	5-7
T2		TRANSFORMER, RF: 2 windings, primary winding 20 uh porm 20 pct at 25 deg C, 50 ohms impedance, 0 ma, 0.3 ohm dc resistance; secondary winding 200 ohms impedance, 0 ma, 0.2 ohm dc resistance; 42498 dwg A45391-1.	5-7
T3		Same as T2.	5-7

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A5		VOICE FREQUENCY GATE AND KEYLINE SWITCH SUBASSEMBLY: Contained on one printed circuit card; VFG circuit provides voice controlled transmission (VOX) by disabling the carrier and modulator circuits; muting the RF (external) power amplifier, and opening and closing the keyline circuit in response to the presence or absence of voice modulation; an adjustable delay (100 microseconds to 3 seconds) prevents the carrier from being turned off during speech pauses; 42498 dwg D44745G1.	5-2
C1		CAPACITOR: MIL type CK06CW103K.	5-8
C2		CAPACITOR: MIL type CK06BX104K.	5-8
C3		CAPACITOR: MIL type CS13BF685K.	5-8
C4		Same as C3.	5-8
C5		CAPACITOR: MIL type CS13BF106K.	5-8
C6		CAPACITOR: MIL type CK06CW472K.	5-8
C7		Same as C3.	5-8
C8		Same as C3.	5-8
C9		Same as C3.	5-8
C10		CAPACITOR: MIL type CS13BF476K.	5-8
C11		Same as C1.	5-8
C12		CAPACITOR: MIL type CL65BH151MP3.	5-8
CR1		SEMICONDUCTOR: MIL type 1N914.	5-8
CR2 thru CR9		Same as CR1.	5-8
K1		RELAY, RESONANT REED: 3.0 kHz resonant frequency; DP normally open; 0.5 amp, 250 vdc; 42498 dwg A44195-1; 12965 type MG-2A.	5-8
L1		COIL, RF: MIL type MS90537-45.	5-8
Q1		TRANSISTOR: MIL type 2N2222A.	5-8
Q2		TRANSISTOR: MIL type 2N2323A.	5-8
Q3		Same as Q1.	5-8
Q4		TRANSISTOR: MIL type 2N491A.	5-8
Q5 thru Q9		Same as Q1.	5-8
Q10		TRANSISTOR: MIL type 2N2219.	5-8
Q11		TRANSISTOR: MIL type 2N2905.	5-8
Q12		TRANSISTOR: MIL type 2N2907.	5-8
R1		RESISTOR: MIL type RC07GF155K.	5-8
R2		RESISTOR: MIL type RC07GF684K.	5-8
R3		RESISTOR: MIL type RC07GF271K.	5-8
R4		RESISTOR: MIL type RC07GF103K.	5-8
R5		RESISTOR: MIL type RC07GF471K.	5-8
R6		RESISTOR: MIL type RC07GF472K.	5-8
R7		RESISTOR: MIL type RC07GF101K.	5-8
R8		RESISTOR: MIL type RC07GF222K.	5-8
R9		RESISTOR: MIL type RT12C2P502.	5-8
R10		RESISTOR: MIL type RC07GF181K.	5-8
R11		RESISTOR: MIL type RC07GF122K.	5-8
R12		RESISTOR: MIL type RC07GF221K.	5-8
R13		Same as R8.	5-8
R14		Same as R8.	5-8
R15		RESISTOR: MIL type RC07GF473K.	5-8
R16		RESISTOR: MIL type RC07GF182K.	5-8
R17		Same as R4.	5-8

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A5 (cont)			
R18		Same as R6.	5-8
R19		Same as R4.	5-8
R20		RESISTOR: MIL type RC07GF182K.	5-8
R21		Same as R6.	5-8
R22		Same as R5.	5-8
R23		Not used.	
R24		Not used.	
R25		RESISTOR: MIL type RC07GF102K.	5-8
R26		Same as R6.	5-8
R27		RESISTOR: MIL type RC07GF104K.	5-8
R28		RESISTOR: MIL type RC20GF271K.	5-8
R29		RESISTOR: MIL type RC07GF333K.	5-8
R30		RESISTOR: MIL type RC07GF563K.	5-8
R31		Same as R6.	5-8
R32		Same as R3.	5-8

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A6		FREQUENCY STANDARD: 1 MHz frequency standard is a sealed module containing a solid state, high stability crystal oscillator and amplifier circuit, enclosed in a temperature controlled oven; the standard frequency stability is one part in 10^9 per 24 hours; non-repairable assembly; 42498 dwg A43738-1.	5-1

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A7		AUXILIARY FREQUENCY GENERATOR ASSEMBLY: Contains circuitry for selection of the operative (internal or external) frequency standard, and the 30 MHz oscillator-buffer and phase lock loop circuitry which provides a frequency source of one -3 MHz output and three -30 MHz outputs locked to the stability and accuracy of the frequency standard in use, for use by the synthesizer and the X4 multiplier; 42498 dwg D44125G1.	5-1
P1		CONNECTOR: MIL type MS18176-1.	5-10

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A7A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, STANDARD SELECTOR: 42498 dwg D43659G1.	5-10
C1		CAPACITOR: MIL type CK06CW103K.	5-11
C2		CAPACITOR: MIL type CS13BC396K.	5-11
C3		CAPACITOR: MIL type CK06BX104K.	5-11
C4		Same as C3.	5-11
C5		CAPACITOR: MIL type CK05CW102K.	5-11
C6		Same as C2.	5-11
C7		Same as C3.	5-11
C8		CAPACITOR: MIL type CS13BE156K.	5-11
CR1		SEMICONDUCTOR: MIL type 1N914.	5-11
CR2		Same as CR1.	5-11
L1		BEAD, SHIELDING: Ferrite; single through hole; 0.047 in. ID by 0.118 in. lg by 0.138 in. OD; 42498 dwg A20406-1; 02114 type 255T118A205.	5-11
Q1		TRANSISTOR: MIL type 2N2907.	5-11
Q2 thru Q4		Same as Q1.	5-11
Q5		TRANSISTOR: MIL type 2N2222.	5-11
Q6		Same as Q5.	5-11
Q7		Same as Q5.	5-11
Q8		Same as Q1.	5-11
R1		RESISTOR: MIL type RC07GF101J.	5-11
R2		Same as R1.	5-11
R3		RESISTOR: MIL type RC07GF102J.	5-11
R4		Same as R3.	5-11
R5		RESISTOR: MIL type RC07GF221J.	5-11
R6		RESISTOR: MIL type RC07GF103J.	5-11
R7		Same as R3.	5-11
R8		RESISTOR: MIL type RC07GF152J.	5-11
R9		Same as R3.	5-11
R10		RESISTOR: MIL type RT12C2P202.	5-11
R11		Same as R6.	5-11
R12		RESISTOR: MIL type RC07GF472J.	5-11
R13		Same as R3.	5-11
R14		RESISTOR: MIL type RC07GF100J.	5-11
R15		RESISTOR: MIL type RC07GF272J.	5-11
R16		RESISTOR: MIL type RC07GF271K.	5-11
T1		TRANSFORMER, RF: 2 windings; primary winding 20 uh porm 20 pct at 25 deg C at 1 MHz, 50 ohms impedance, 44 ma, 0.1 ohm dc resistance; secondary winding 200 ohms impedance, 22 ma, 0.2 ohm dc resistance; 42498 dwg A42745-1.	5-11
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-11
Z2		Same as Z1.	5-11
Z3		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-11
Z4		Same as Z3.	5-11

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A7A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, 30 MHz OSC/BUFFER: 42498 dwg D46236G1.	5-10
C1		CAPACITOR: MIL type CK05CW102K.	5-12
C2		Same as C1.	5-12
C3		Same as C1.	5-12
C4		CAPACITOR: MIL type CM05CD050D03.	5-12
C5		CAPACITOR: MIL type CM05ED240J03.	5-12
C6		CAPACITOR: MIL type CM05FD181J03.	5-12
C7 thru C9		Same as C1.	5-12
C10		CAPACITOR: MIL type CK05CW470K.	5-12
C11		Same as C10.	5-12
C12		Same as C10.	5-12
C13		CAPACITOR: MIL type CM05ED270J03.	5-12
C14		Same as C1.	5-12
C15 thru C18		Same as C1.	5-12
CR1		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-12
L1		COIL, RF: MIL type MS90537-29.	5-12
L2		Same as L1.	5-12
Q1		TRANSISTOR: MIL type 2N918.	5-12
Q2		Same as Q1.	5-12
Q3		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-12
Q4		TRANSISTOR: MIL type 2N2222.	5-12
Q5		Same as Q4.	5-12
Q6		Same as Q4.	5-12
R1		RESISTOR: MIL type RC05GF103K.	5-12
R2		RESISTOR: MIL type RC05GF272K.	5-12
R3		RESISTOR: MIL type RC05GF822K.	5-12
R4		RESISTOR: MIL type RC05GF562K.	5-12
R5		Same as R2.	5-12
R6		RESISTOR: MIL type RC05GF561K.	5-12
R7		RESISTOR: MIL type RC05GF391K.	5-12
R8		Same as R1.	5-12
R9		RESISTOR: MIL type RC05GF182K.	5-12
R10		RESISTOR: MIL type RC05GF471K.	5-12
R11		Same as R3.	5-12
R12		RESISTOR: MIL type RC05GF122K.	5-12
R13		Same as R3.	5-12
R14		Same as R12.	5-12
R15		Same as R3.	5-12
R16		Same as R12.	5-12
R17		RESISTOR: MIL type RC05GF102K.	5-12
R18		RESISTOR: MIL type RC05GF221K.	5-12
R19		Same as R17.	5-12
R20		Same as R18.	5-12
R21		Same as R17	5-12
R22		Same as R18	5-12
Y1		CRYSTAL UNIT, QUARTZ: 30.000000 MHz, porm .005 pct frequency stability, 20 pf load capacitance, 30 ohms max resistance, fundamental, parallel mode of oscillation; 42498 dwg A46436-1.	5-12

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A7A3		PRINTED CIRCUIT BOARD SUBASSEMBLY, 30 MHz PHASE LOCKED LOOP: 42498 dwg D46231G1.	5-10
C1		CAPACITOR: MIL type CK05CW102K.	5-13
C2		CAPACITOR: MIL type CS13BC396K.	5-13
C3		Same as C1.	5-13
C4		CAPACITOR: MIL type CK06CW103K.	5-13
C5		Same as C4.	5-13
C6		CAPACITOR: MIL type CS13BE156K.	5-13
C7		Same as C2.	5-13
C8		Same as C4.	5-13
C9		Same as C4.	5-13
C10		Same as C2.	5-13
C11		Same as C4.	5-13
L1		COIL: MIL type MS91537-29. (Not shown)	
Q1		TRANSISTOR: MIL type 2N2907.	5-13
Q2		Same as Q1.	5-13
Q3		TRANSISTOR: MIL type 2N2222.	5-13
R1		RESISTOR: MIL type RC05GF102K.	5-13
R2		RESISTOR: MIL type RC05GF472K.	5-13
R3		RESISTOR: MIL type RC05GF271K.	5-13
R4		RESISTOR: MIL type RC05GF222K.	5-13
R5		Same as R2.	5-13
R6		RESISTOR: MIL type RC05GF471K.	5-13
R7		Same as R6.	5-13
R8		Same as R6.	5-13
R9		RESISTOR: MIL type RC05GF683K.	5-13
R10		RESISTOR: MIL type RC05GF391K.	5-13
R11		RESISTOR: MIL type RC05GF103K.	5-13
R12		RESISTOR: MIL type RC05GF820K.	5-13
R13		RESISTOR: MIL type RC05GF221K.	5-13
R14		RESISTOR: MIL type RC05GF122K.	5-13
R15		Same as R14.	5-13
R16		Same as R4.	5-13
R17		RESISTOR: MIL type RC05GF562K.	5-13
Z1		INTEGRATED CIRCUIT, FLIP FLOP: 70 MHz, ac coupled JK flip flop, minus 10 vdc, 20 ma; 42498 dwg B44548G2.	5-13
Z2		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-13
Z3 thru Z6		Same as Z2.	5-13
Z7		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-13

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A8		1.75 MHz-113.75 MHz GENERATOR ASSEMBLY: Contains two separate but functionally related circuits; develops the 1.75 MHz frequency for use by the channel A1 and B1 modulators, and the 113.75 MHz generator circuitry; the 113.75 generator develops the 113.75 MHz frequency used by the up-converter from the 1.75 MHz signal delivered by the 1.75 MHz generator; 42498 dwg D44126G1.	5-1
P1		CONNECTOR: MIL type MS18176-1.	5-14

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A8A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, 113.75 MHz GENERATOR: 42498 dwg D44000G1.	5-14
C1		CAPACITOR: MIL type CK05CW102K.	5-15
C2		Same as C1.	5-15
C3		Same as C1.	5-15
C4		CAPACITOR: MIL type CK06BX104K.	5-15
C5		Same as C1.	5-15
C6		CAPACITOR: MIL type CM05FC121J03.	5-15
C7		CAPACITOR: MIL type CM05FC050J03.	5-15
C8		Same as C6.	5-15
C9		Same as C1.	5-15
C10		Same as C1.	5-15
C11		CAPACITOR, VARIABLE, CERAMIC: 3.0-15.0 pf, 200 vdc;42498 dwg A42545-9; 72982 type 538-016-E2P0-110R.	5-15
C12		CAPACITOR: MIL type CS13BC396K.	5-15
C13		CAPACITOR: MIL type CK06CW103K.	5-15
C14		Same as C13.	5-15
C15		Same as C13.	5-15
C16		CAPACITOR: MIL type CS13BF156K.	5-15
C17		CAPACITOR: MIL type CM05C100K03.	5-15
C18		CAPACITOR: MIL type CM05F680J03.	5-15
C19		CAPACITOR: MIL type CK05CW681K.	5-15
C20 thru C23		Same as C1.	5-15
C24		CAPACITOR: MIL type CM05E360J03.	5-15
C25		CAPACITOR: MIL type CM05E680J03.	5-15
C26		Same as C1.	5-15
C27		CAPACITOR: MIL type CS13BH224K.	5-15
C28		CAPACITOR: MIL type CM05E221J03.	5-15
C29		CAPACITOR: MIL type CM05E101J03.	5-15
C30		Same as C13.	5-15
C31		Same as C29.	5-15
C32		CAPACITOR: MIL type CS13BF105K.	5-15
C33		CAPACITOR: MIL type CM05E151J03.	5-15
C34		CAPACITOR: MIL type CM05E330J03.	5-15
C35		CAPACITOR: MIL type CC20UJ560G.	5-15
C36		CAPACITOR: MIL type CB11RD221K.	5-15
C37		Same as C1.	5-15
C38		Same as C1.	5-15
C39		CAPACITOR: MIL type CK05CW271K.	5-15
C40		Same as C39.	5-15
C41		Same as C4.	5-15
CR1		SEMICONDUCTOR: MIL type 1N914.	5-15
CR2		SEMICONDUCTOR: P-N-P-N 4 layer polarity; 42498 dwg A43736-1; 04713 type M4L3053.	5-15
CR3		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-15
J1		JACK, TIP: 1,000V RMS; nylon body; gold plated contacts; color red; 42498 dwg A47778-2; 00779 type 3-582340-2.	5-15
L1		COIL, RF: 0.31 uh, Q 50 at 8.1 MHz, 150 ma, 185 MHz min self resonant frequency, 0.46 ohm dc resistance; 42498 dwg A43469-17.	5-15

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A8A1 (cont)			
L2		COIL, RF: MIL type MS90537-45.	5-15
L3		COIL, RF: MIL type MS90537-33.	5-15
L4		COIL, RF: 117 MHz, 1,000 ma, 0.01 ohm dc resistance 400 MHz min self resonant frequency; 42498 dwg A42818-3.	5-15
Q1		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-15
Q2		TRANSISTOR: MIL type 2N2857.	5-15
Q3		TRANSISTOR: MIL type 2N2907.	5-15
Q4		TRANSISTOR: MIL type 2N2222.	5-15
Q5		Same as Q1.	5-15
Q6		Same as Q1.	5-15
Q7		Same as Q2.	5-15
Q8		Same as Q1.	5-15
Q9		Same as Q2.	5-15
Q10		Same as Q4.	5-15
Q11		Same as Q1.	5-15
Q12		TRANSISTOR: MIL type 2N708.	5-15
Q13		Same as Q1.	5-15
R1		RESISTOR: MIL type RC05GF222K.	5-15
R2		RESISTOR: MIL type RC05GF470K.	5-15
R3		RESISTOR: MIL type RC05GF151K.	5-15
R4		Same as R1.	5-15
R5		Same as R2.	5-15
R6		Same as R2.	5-15
R7		RESISTOR: MIL type RC05GF103K.	5-15
R8		Same as R7.	5-15
R9		RESISTOR: MIL type RC05GF122K.	5-15
R10		Same as R7.	5-15
R11		Same as R7.	5-15
R12		Same as R9.	5-15
R13		RESISTOR: MIL type RC05GF561K.	5-15
R14		Same as R13.	5-15
R15		RESISTOR: MIL type RC05GF821K.	5-15
R16		RESISTOR: MIL type RC05GF560K.	5-15
R17		RESISTOR: MIL type RC05GF101K.	5-15
R18		Same as R13.	5-15
R19		RESISTOR: MIL type RC05GF102K.	5-15
R20		Same as R19.	5-15
R21		RESISTOR: MIL type RC05GF471K.	5-15
R22		RESISTOR: MIL type RC05GF221K.	5-15
R23		RESISTOR: MIL type RC05GF183K.	5-15
R24		Same as R7.	5-15
R25		RESISTOR: MIL type RC05GF472K.	5-15
R26		Same as R22.	5-15
R27		Same as R15.	5-15
R28		Same as R3.	5-15
R29		RESISTOR: MIL type RC05GF391K.	5-15
R30		Same as R3.	5-15
R31		RESISTOR: MIL type RC05GF332K.	5-15
R32		Same as R7.	5-15
R33		RESISTOR: MIL type RC05GF681K.	5-15

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A8A1 (cont)			
R34		RESISTOR: MIL type RC05GF271K.	5-15
R35		Same as R34.	5-15
R36		Same as R5.	5-15
R37		RESISTOR: MIL type RC05GF682K.	5-15
R38		Same as R17.	5-15
R39		Same as R7.	5-15
R40		RESISTOR: MIL type RC05GF392K.	5-15
R41		Same as R7.	5-15
R42		Same as R29.	5-15
R43		Same as R3.	5-15
R44		RESISTOR: MIL type RC05GF272K.	5-15
R45		Same as R29.	5-15
R46		RESISTOR: MIL type RC05GF331K.	5-15
R47		Same as R16.	5-15
R48		Same as R7.	5-15
R49		RESISTOR: MIL type RC05GF393K.	5-15
R50		Same as R19.	5-15
R51		Same as R16.	5-15
R52		RESISTOR: MIL type RC05GF121K.	5-15
R53		Same as R7.	5-15
R54		Same as R7.	5-15
R55		Same as R13.	5-15
T1		TRANSFORMER, RF: 2 windings; primary winding 0.31 uh, Q 95 at 25 MHz, 160 MHz min self resonant frequency, 150 ma, 0.16 ohm dc resistance; secondary winding 0.46 ohm dc resistance; 42498 dwg A45384-2.	5-15
T2		TRANSFORMER, RF: 2 windings; primary winding 0.12 uh, 250 MHz min self resonant frequency, 22 ma, 0.1 ohm dc resistance; secondary winding 0.03 ohm dc resistance; 42498 dwg A42748-1.	5-15
T3		TRANSFORMER, RF: 2 windings; primary winding 9 uh, 28 MHz min self-resonant frequency, 100 ma, 0.4 ohm dc resistance; secondary winding 0.2 ohm dc resistance; 42498 dwg A42819-5.	5-15
Z1		INTEGRATED CIRCUIT, FLIP FLOP: 2.7v output high voltage, 0.4v output low voltage, 1.7v input high voltage, 0.9v input low voltage; 42498 dwg A45732-1; 14433 type TTUL9001.	5-15
Z2		Same as Z1.	5-15
Z3		MIXER, RF: F1 input 112 MHz, F2 input 117 MHz, F3 output 5 MHz, 50 ohms dc resistance; 42498 dwg A42962-5.	5-15
Z4		MIXER, RF: F1 input 15 MHz, F2 input 10 MHz, F3 output 5 MHz, 50 ohms dc resistance; 42498 dwg A42962-2.	5-15

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A8A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, 1.75 MHz GENERATOR: 42498 dwg D43919G1.	5-14
C1		CAPACITOR: MIL type CS13BE156K.	5-16
C2 thru C4		Same as C1.	5-16
C5		CAPACITOR: MIL type CS13BC396K.	5-16
C6		CAPACITOR: MIL type CM05FC101J03.	5-16
C7		CAPACITOR: MIL type CM05FC331J03.	5-16
C8		CAPACITOR: MIL type CM05FC050J03.	5-16
C9		Same as C7.	5-16
C10		CAPACITOR: MIL type CK06BX104K.	5-16
C11		CAPACITOR: MIL type CK06CW103K.	5-16
C12		Same as C5.	5-16
C13		CAPACITOR: MIL type CM06FC272J03.	5-16
C14		Same as C10.	5-16
C15		Same as C10.	5-16
L1		COIL, RF: 6.3 uh, Q 50 at 7.9 MHz, 18 MHz min self resonant frequency, 40 ma, 0.5 ohm dc resistance; 42498 dwg A45381-5.	5-16
L2		COIL, RF: 6.3 uh, Q 50 at 7.9 MHz, 18 MHz min self resonant frequency, 40 ma, 0.5 ohm dc resistance; tapped; 42498 dwg A45381-6.	5-16
Q1		TRANSISTOR: MIL type 2N2222.	5-16
Q2 thru Q6		Same as Q1.	5-16
Q7		TRANSISTOR: MIL type 2N2219.	5-16
R1		RESISTOR: MIL type RC07GF102K.	5-16
R2		RESISTOR: MIL type RC07GF682K.	5-16
R3		RESISTOR: MIL type RC07GF561K.	5-16
R4		Same as R3.	5-16
R5		RESISTOR: MIL type RC07GF471K.	5-16
R6		Same as R1.	5-16
R7		RESISTOR: MIL type RC07GF221K.	5-16
R8		RESISTOR: MIL type RC07GF331K.	5-16
R9		Same as R8.	5-16
R10		RESISTOR: MIL type RC07GF271K.	5-16
R11		RESISTOR: MIL type RC07GF222K.	5-16
R12		Same as R1.	5-16
R13		RESISTOR: MIL type RC07GF123K.	5-16
R14		RESISTOR: MIL type RC07GF562K.	5-16
R15		Same as R1.	5-16
R16		RESISTOR: MIL type RC07GF121K.	5-16
R17		RESISTOR: MIL type RC07GF151K.	5-16
R18		RESISTOR: MIL type RT22C2P101.	5-16
T1		Not used.	5-16
T2		TRANSFORMER, RF: 2 windings; primary winding 3.0 uh, Q 70 at 7.9 MHz, 50 MHz min self resonant frequency, 40 ma, 0.7 ohm dc resistance; secondary winding 0.3 ohm dc resistance; 42498 dwg A45384-1.	5-16
Y1		CRYSTAL: MIL type CR85U.	5-16
Z1		INTEGRATED CIRCUIT, FLIP FLOP: R-S or J-K flip flop; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 9 fanout; 42 MW/gate power dissipation; 42498 dwg A44457-8; 14433 type MIC945-3D.	5-16
Z2		Same as Z1.	5-16

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A9		SIDE CARRIER GENERATOR ASSEMBLY: Develops injection frequencies for the A2 and B2 channel modulators through the combined operation of a divider circuit and an oscillator circuit from a 1 MHz standard frequency; 42498 dwg D44124G1.	5-1
P1		CONNECTOR: MIL type MS18176-1.	5-17

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A9A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, 1 MHz -6.29 kHz DIVIDER: 42498 dwg D43860G1.	5-17
C1		CAPACITOR: MIL type CS13BC396K.	5-18
C2		Same as C1.	5-18
C3		CAPACITOR: MIL type CM06E102J03.	5-18
C4		CAPACITOR: MIL type CM06E472J03.	5-18
C5		CAPACITOR: MIL type CM05E620J03.	5-18
C6		Same as C4.	5-18
CR1		SEMICONDUCTOR: MIL type 1N914.	5-18
CR2		Same as CR1.	5-18
L1		COIL, RF: 34.5 MHz, Q 160 at 79 kHz, 200 kHz min self resonant frequency, 16 ma, 35 ohms dc resistance;42498 dwg A45382-1.	5-18
L2		Same as L1.	5-18
Q1		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-18
Q2		TRANSISTOR: MIL type 2N2907.	5-18
R1		RESISTOR: MIL type RC07GF100J.	5-18
R2		Same as R1.	5-18
R3		RESISTOR: MIL type RC07GF273J.	5-18
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-18
Z2		INTEGRATED CIRCUIT, FLIP FLOP: R-S or J-K flip flop; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 9 fanout; 42 MW/gate power dissipation; 42498 dwg A44457-8; 14433 type MIC945-3D.	5-18
Z3		Same as Z2.	5-18
Z4		Same as Z2.	5-18
Z5		Same as Z2.	5-18
Z6		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input exclusive or gate; 3.0-4.0v operating voltage; 40 nsec propagation delay; 1.0v noise margin; 27/gate fanout; 20 MW/gate power dissipation; 42498 dwg A44457-6; 14433 type MIC944-3D.	5-18
Z7 thru Z21		Same as Z2.	5-18

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A9A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, SIDE CARRIER OSCILLATOR: 42498 dwg D47592G1.	5-17
C1		CAPACITOR: MIL type CS13BC396K.	5-19
C2 thru C4		Same as C1.	5-19
C5		CAPACITOR: MIL type CK06BX104K.	5-19
C6		CAPACITOR: MIL type CK06BX472K.	5-19
C7 thru C9		Same as C6.	5-19
C10		CAPACITOR: MIL type CK06BX102K.	5-19
C11		Same as C6.	5-19
C12		Same as C6.	5-19
C13		Same as C6.	5-19
C14		Same as C6.	5-19
C15		Same as C6.	5-19
C16		CAPACITOR: MIL type CK05BX101K.	5-19
C17		CAPACITOR: MIL type CK05BX471K.	5-19
C18		CAPACITOR: MIL type CK05BX681K.	5-19
C19		Same as C16.	5-19
C20		Same as C17.	5-19
C21		Same as C18.	5-19
C22 thru C24		Same as C12.	5-19
C25		Same as C18.	5-19
C26		Same as C12.	5-19
C27		Same as C18.	5-19
C28		Same as C5.	5-19
C29		Same as C5.	5-19
C30		CAPACITOR: MIL type CM06FD272J03.	5-19
C31		Same as C30.	5-19
CR1		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-19
CR2		Same as CR1.	5-19
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-19
J2		Same as J1.	5-19
Q1		TRANSISTOR: MIL type 2N2222.	5-19
Q2 thru Q4		Same as Q1.	5-19
Q5		TRANSISTOR: Silicon P-N-P polarity; JEDEC case style VVV (TO-72); 42498 dwg A43044-1; 01295 type 3N111.	5-19
Q6		Same as Q5.	5-19
Q7 thru Q14		Same as Q1.	5-19
R1		RESISTOR: MIL type RJ26CW502.	5-19
R2		Same as R1.	5-19
R3		RESISTOR: MIL type RC07GF562J.	5-19
R4		Same as R3.	5-19
R5		RESISTOR: MIL type RC07GF151J.	5-19
R6		RESISTOR: MIL type RC07GF221J.	5-19
R7		Same as R5.	5-19
R8		Same as R6.	5-19
R9		RESISTOR: MIL type RC07GF182J.	5-19
R10		RESISTOR: MIL type RC07GF271J.	5-19
R11		Same as R9.	5-19
R12		RESISTOR: MIL type RC07GF470J.	5-19
R13		Same as R12.	5-19

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A9A2 (cont)			
R14		RESISTOR: MIL type RC07GF104J.	5-19
R15		Same as R14.	5-19
R16		RESISTOR: MIL type RC07GF822J.	5-19
R17 thru R19		Same as R16.	5-19
R20		Same as R1.	5-19
R21		RESISTOR: MIL type RC05GF332J.	5-19
R22		RESISTOR: MIL type RC05GF102J.	5-19
R23		RESISTOR: MIL type RC05GF821J.	5-19
R24		Same as R21.	5-19
R25		Same as R21.	5-19
R26		Same as R22.	5-19
R27		Same as R23.	5-19
R28		RESISTOR: MIL type RC05GF103J.	5-19
R29		RESISTOR: MIL type RC05GF562J.	5-19
R30		Same as R28.	5-19
R31		Same as R29.	5-19
R32		Same as R28.	5-19
R33		Same as R28.	5-19
R34		Same as R21.	5-19
R35		Same as R21.	5-19
R36		RESISTOR: MIL type RC05GF272J.	5-19
R37		Same as R36.	5-19
R38		RESISTOR: MIL type RC07GF102J.	5-19
R39		Same as R38.	5-19
R40		Same as R6.	5-19
R41		RESISTOR: MIL type RC07GF820J.	5-19
R42		RESISTOR: MIL type RT22C2W101.	5-19
R43		Same as R6.	5-19
R44		Same as R41.	5-19
R45		Same as R42.	5-19
R46		RESISTOR: MIL type RC07GF150J.	5-19
R47		Same as R46.	5-19
R48		RESISTOR: MIL type RC07GF680J.	5-19
R49		Same as R48.	5-19
R50		Same as R46.	5-19
R51		Same as R46.	5-19
T1		TRANSFORMER, RF: 2 windings; primary winding 20 uh porm 20 pct at 25 deg C at 1 MHz, 50 ohms impedance, 44 ma, 0.1 ohm dc resistance; secondary winding 200 ohms impedance, 22 ma, 0.2 ohm dc resistance; 42498 dwg A42745-1.	5-19
T2		Same as T1.	5-19
T3		TRANSFORMER, RF: 2 windings; primary winding 3.0 uh, Q 70 at 7.9 MHz, 50 MHz min self resonant frequency 40 ma, 0.7 ohm dc resistance; secondary winding 0.3 ohm dc resistance; 42498 dwg A45384-1.	5-19
T4		Same as T3.	5-19
Y1		CRYSTAL: MIL type CR69AU 3.512580 MHz.	5-19
Y2		CRYSTAL: MIL type CR69AU 3.487420 MHz.	5-19
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2 input gate; 4.5-5.0v operating voltage; 45 nsec propagation delay; 1.0v noise margin; 7 gate fanout; 8 MW/gate power dissipation; 42498 dwg A44457-10; 14433 type MIC949-3D.	5-19

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A9A2 (cont)			
Z2		Same as Z1.	5-19
Z3		Same as Z1.	5-19
Z4		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop plus 8.0v continuous supply voltage; plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-19
Z5		Same as Z4.	5-19

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A10		PRINTED CIRCUIT BOARD SUBASSEMBLY, TRANSMITTER CONTROL NO. 1: Performs system command functions between the exciter, external control, and RF amplifier units; the functions include frequency and mode selection, tuning cycle initiation, fault indication, and operate and standby commands between the external units; the transmitter control circuits also process function and command signals originating with the external Decoder-Encoder KY-656/FRT via the Control Indicator Transmitter C-7709/FRT; 42498 dwg D44262G1.	5-1
C1		CAPACITOR: MIL type CS13BF685K.	5-20
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-20
CR2		Not used.	
CR3		Not used.	
CR4		Same as CR1.	5-20
CR5		Not used.	
CR6 thru CR12		Same as CR1.	5-20
CR13		Not used.	
CR14		Same as CR1.	5-20
CR15		Same as CR1.	5-20
CR16		Not used.	
CR17		Same as CR1.	5-20
CR18		Not used.	
CR19 thru CR29		Same as CR1.	5-20
K1		RELAY: MIL type M5757-9-003.	5-20
K2 thru K4		Same as K1.	5-20
K5		Not used.	
K6 thru K13		Same as K1.	5-20
K14		Not used.	
K15		Same as K1.	5-20
K16		Same as K1.	5-20

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11		UP CONVERTER ASSEMBLY: Consists of three functionally related circuits performing the following major operative functions in the exciter unit; frequency conversion from 1.75 MHz to 112.0 MHz; multiplexing of from one to four modulated side-bands; carrier suppression in selectable steps; preset adjustment of signal levels for all modes; automatic control of either the average or peak power levels (APC or PPC) in response to a dc control signal supplied from the associated high powered RF amplifier used in the transmitting system; 42498 dwg D44119G1.	5-2
P1		CONNECTOR, PLUG, ELECTRICAL: 26 male contacts, 13 amps, phospher bronze, gold plated finish; rectangular, plastic; 42498 dwg A42559-3; 81312 type MRAC26PG7.	5-21
Z1		MIXER ASSEMBLY: Non-repairable assembly; 1.75 MHz 113.75 MHz input, 112 MHz output; 42498 dwg D46756G1.	5-21

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, UP CONVERTER 1.75 MHz IF: 42498 dwg D44087G1.	5-21
C1		CAPACITOR: MIL type CK06CW332K.	5-22
C2		CAPACITOR: MIL type CK06BX104K.	5-22
C3		Same as C2.	5-22
C4		CAPACITOR: MIL type CS13BF685K.	5-22
C5		Same as C2.	5-22
C6		CAPACITOR: MIL type CS13BF476K.	5-22
C7		Same as C2.	5-22
C8		Same as C4.	5-22
C9		CAPACITOR: MIL type CM05F241J03.	5-22
C10		CAPACITOR: MIL type CK05CW102K.	5-22
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-22
CR2		Same as CR1.	5-22
CR3		SEMICONDUCTOR: 250 pf porm 20 pct at minus 8 vdc bias and 1 MHz, Q 160 at 25 MHz; 42498 dwg A45712-2; 46859 type V4092.	5-22
L1		COIL, RF: 100 uh, Q 80 at 790 kHz, 5.0 MHz min self resonant frequency 20 ma, 4.0 ohms dc resistance; 42498 dwg A45381-1.	5-22
L2		COIL, RF: MIL type MS90537-37.	5-22
L3		COIL, RF: MIL type MS90537-45.	5-22
L4		COIL, RF: 30 uh, Q 75 at 2.5 MHz, 8.0 MHz min self resonant frequency, 40 ma, 2.0 ohms dc resistance; 42498 dwg A45381-2.	5-22
Q1		TRANSISTOR: MIL type 2N2222.	5-22
Q2 thru Q4		Same as Q1.	5-22
Q5		TRANSISTOR: MIL type 2N3500.	5-22
Q6		TRANSISTOR: MIL type 2N2219.	5-22
Q7		Same as Q6.	5-22
R1		RESISTOR: MIL type RC07GF822K.	5-22
R2		RESISTOR: MIL type RC07GF392K.	5-22
R3		RESISTOR: MIL type RC07GF102K.	5-22
R4		RESISTOR: MIL type RC07GF562K.	5-22
R5		RESISTOR: MIL type RC07GF123K.	5-22
R6		RESISTOR, VARIABLE: 5,000 ohms, porm 5 pct, 0.5w; 42498 dwg A46445-7; 80294 type 3300P-1-502.	5-22
R7		RESISTOR: MIL type RC07GF332K.	5-22
R8		RESISTOR: MIL type RC07GF682K.	5-22
R9		Same as R1.	5-22
R10		Same as R6.	5-22
R11		Same as R8.	5-22
R12		RESISTOR: MIL type RC07GF472K.	5-22
R13		RESISTOR: MIL type RC32GF753J.	5-22
R14		RESISTOR: MIL type RC07GF821K.	5-22
R15		RESISTOR: MIL type RC07GF104K.	5-22
R16		RESISTOR: MIL type RC07GF394K.	5-22
R17		RESISTOR, VARIABLE: 50 ohms, porm 5 pct, 0.5w; 42498 dwg A46445-1; 80294 type 3300P-1-500.	5-22
R18		RESISTOR: MIL type RC07GF180K.	5-22
R19		RESISTOR: MIL type RC07GF271K.	5-22
R20		Same as R19.	5-22
R21		Same as R12.	5-22

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A1 (cont)			
R22		Same as R2.	5-22
R23		RESISTOR: MIL type RC07GF471K.	5-22
R24		Same as R12.	5-22
R25		Same as R2.	5-22
R26		Same as R23.	5-22

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A2		BUFFER ASSEMBLY, UP CONVERTER: 42498 dwg D44267G1.	5-21
FL1		FILTER: 1750 pf, 10 amps, 125 vdc; 42498 dwg A43292-1; 72982 type 1214-001.	5-22

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A2A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, UP CONVERTER 113.75 MHz BUFFER: 42498 dwg D44086G1.	5-22
C1		CAPACITOR: MIL type CK05CW102K.	5-23
C2		Same as C1.	5-23
C3		CAPACITOR: MIL type CM05F220J03.	5-23
C4		CAPACITOR: MIL type CM05F390J03.	5-23
C5		Same as C1.	5-23
C6		Same as C3.	5-23
C7		CAPACITOR: MIL type CM05F560J03.	5-23
L1		COIL, RF: 0.065 uh, Q 60 at 115 MHz, 200 ma, 0.01 ohm dc resistance, 250 MHz min self resonant frequency; 42498 dwg A45381-3.	5-23
L2		Same as L1.	5-23
Q1		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-23
Q2 thru Q4		Same as Q1.	5-23
R1		RESISTOR: MIL type RC07GF682K.	5-23
R2		RESISTOR: MIL type RC07GF272K.	5-23
R3		RESISTOR: MIL type RC07GF2R7K.	5-23
R4		RESISTOR: MIL type RC07GF181K.	5-23
R5		Same as R3.	5-23
R6		Same as R1.	5-23
R7		Same as R2.	5-23
R8		RESISTOR: MIL type RC07GF100K.	5-23
R9		Same as R4.	5-23
R10		Same as R8.	5-23

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A3		PRINTED CIRCUIT BOARD SUBASSEMBLY, UP CONVERTER CARRIER INSERTION: 42498 dwg D44091G1.	5-21
C1		CAPACITOR: MIL type CK06CW104K.	5-24
C2		Same as C1.	5-24
C3		CAPACITOR: MIL type CK06CW103K.	5-24
C4		CAPACITOR: MIL type CK05CW102K.	5-24
C5		CAPACITOR: MIL type CM06F471J03.	5-24
C6 thru C9		Same as C1.	5-24
CR1		SEMICONDUCTOR: MIL type 1N3064.	5-24
CR2 thru CR7		Same as CR1.	5-24
K1		RELAY: MIL type M5757-9-003.	5-24
K2 thru K5		Same as K1.	5-24
L1		COIL, RF: 20 uh, Q 20 at 2.5 MHz, 10 MHz min self resonant frequency, 60 ma, 0.8 ohm dc resistance; 42498 dwg A45381-4.	5-24
L2		COIL, RF: MIL type MS90537-57.	5-24
L3 thru L7		Same as L2.	5-24
Q1		TRANSISTOR: MIL type 2N2222.	5-24
R1		Not used.	
R2		RESISTOR: MIL type RC07GF822K.	5-24
R3		RESISTOR, VARIABLE: 500 ohms, porm 5 pct, 0.5w; 42498 dwg A46445-4; 80294 type 3300P-1-501.	5-24
R4		RESISTOR: MIL type RN60C1000F.	5-24
R5		Same as R4.	5-24
R6		Same as R2.	5-24
R7		RESISTOR: MIL type RC07GF152K.	5-24
R8		RESISTOR: MIL type RC07GF331K.	5-24
R9		RESISTOR, VARIABLE: 100 ohms, porm 5 pct, 0.5w; 42498 dwg A46445-2; 80294 type 3300P-1-101.	5-24
R10		RESISTOR: MIL type RN60C49R9F.	5-24
R11		RESISTOR: MIL type RC07GF182K.	5-24
R12		RESISTOR: MIL type RC07GF101K.	5-24
R13		RESISTOR: MIL type RC07GF820K.	5-24
R14		RESISTOR: MIL type RN60C86R6F.	5-24
R15		Same as R2.	5-24
R16		Same as R13.	5-24
R17		Same as R11.	5-24
R18		RESISTOR: MIL type RN60C1740F.	5-24
R19		Same as R11.	5-24
R20		RESISTOR: MIL type RN60C6040F.	5-24
R21		Same as R11.	5-24
R22		Same as R9.	5-24
R23		RESISTOR: MIL type RC07GF151K.	5-24
R24		RESISTOR, VARIABLE: 50 ohms, porm 5 pct, 0.5w; 42498 dwg A46445-1; 80294 type 3300P-1-500.	5-24
R25		RESISTOR: MIL type RC07GF301J.	5-24
R26		Same as R23.	5-24
R27		Same as R25.	5-24
R28		Same as R2.	5-24
R29		Same as R3.	5-24
R30		RESISTOR: MIL type RC07GF270K.	5-24
R31		Same as R30.	5-24

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A11A3 (cont)			
R32		Not used.	
R33		Not used.	
R34		Same as R12.	5-24
T1		TRANSFORMER, RF: 2 windings; primary winding 420 uh, 0 ma, 0.18 ohm dc resistance; secondary winding 0 ma, 0.18 ohm dc resistance; 42498 dwg A45481-1.	5-24
T2 thru T10		Same as T1.	5-24
T11		TRANSFORMER, RF: 2 windings; primary windings; primary winding 20 uh, porm 20 pct at 25 deg C at 1 MHz, 50 ohms impedance, 44 ma, 0.1 ohm dc resistance; secondary winding 200 ohms impedance, 22 ma, 0.2 ohm dc resistance; 42498 dwg A42745-1.	5-24
T12		TRANSFORMER, RF: 2 windings; primary winding 28 uh porm 20 pct at 25 deg C, 0 ma, 0.15 ohm dc resistance; secondary winding 0.20 ohm dc resistance; 42498 dwg A45387-1.	5-24

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12		SYNTHESIZER ASSEMBLY: Solid state module contains seven plug-in printed circuit cards, a total of 280,000 accurate injection frequencies, over a frequency range of 82 MHz to 110 MHz are generated by digital techniques; each frequency is derived from the 1 MHz frequency standard and exhibits the same degree of accuracy and stability as that of the standard; the module also supplies a 12.5 kHz synchronizing pulse to the power supply; 42498 dwg D43208G2.	5-1
C1		CAPACITOR: MIL type CK06BX104K.	5-25
C2		Same as C1.	5-25
C3		CAPACITOR: MIL type CK06CW103K.	5-25
C4		Same as C3.	5-25
C5		Same as C3.	5-25
C6		Same as C1.	5-25
C7		Same as C1.	5-25
C8		CAPACITOR: MIL type CK05CW102K.	5-25
C9		Not used.	
C10		Same as C1.	5-25
C11		Same as C8.	5-25
C12 thru C14		Not used.	
C15 thru C24		Same as C8.	5-25
C25 thru C29		Same as C1.	5-25
C30 thru C44		Same as C8.	5-25
C45		Same as C1.	5-25
CR1		SEMICONDUCTOR: MIL type 1N3828A.	5-25
L1		COIL, RF: MIL type MS90537-37.	5-25
L2 thru L4		Same as L1.	5-25
L5		COIL, RF: MIL type MS90537-17.	5-25
L6		Not used.	
L7		Same as L1.	5-25
L8		COIL, RF: MIL type MS90537-25	5-25
L9 thru L13		Same as L1.	5-25
P1		CONNECTOR, PLUG, ELECTRICAL: 26 male contacts, 13 amps, phosphor bronze, gold plated finish; rectangular, plastic; 42498 dwg A42559-3; 81312 type MRAC26PG7.	5-25
P2		Same as P1.	5-25
R1		RESISTOR: MIL type RC05GF560J.	5-25
R2		Not used.	
R3		RESISTOR: MIL type RC05GF470K.	5-25
R4		Same as R3.	5-25
R5		RESISTOR: MIL type RC32GF271K.	5-25
XA1		CONNECTOR, RECEPTACLE, ELECTRICAL: 22 female contacts, 5 amps, phospher bronze, gold plated finish; rectangular, plastic; 42498 dwg A42548-8; 81312 type HB22SOC.	5-25
XA2 thru XA6		Same as XA1.	5-25
XA7		CONNECTOR, RECEPTACLE, ELECTRICAL: 6 male contacts, 7.5 amps, phospher bronze, gold plated finish; rectangular, plastic; 42498 dwg A42548-1; 81312 type HB6SOC-POLA-B-C.	5-25
Z1		FILTER, MIXER: Nonrepairable assembly, 42498 dwg A44861-1.	5-25

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12 (cont)			
Z2		X4 MULTIPLIER: Provides a 120 MHz output for the 1.75/-113.75 MHz frequency generator from a 30 MHz input signal generated by the auxiliary frequency generator; 42498 dwg A45000-1.	5-25

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, RF1A: 42498 dwg D46594G1.	5-25
C1		CAPACITOR, FIXED, GLASS: 5,100 pf, porm 1 pct, 50 vdc; 42498 dwg A42975-1; 95275 type VY20CA512FE+.	5-26
C2		Same as C1.	5-26
C3		CAPACITOR, FIXED, GLASS: 5,100 pf, porm 1 pct, 50 vdc; 42498 dwg A42975-2; 95275 type VY20CA512FE-.	5-26
C4		CAPACITOR: MIL type CS13BF226K.	5-26
C5		Same as C3.	5-26
C6		CAPACITOR: MIL type CS13BF105K.	5-26
C7		CAPACITOR: MIL type CK06BX472K.	5-26
C8		CAPACITOR: MIL type CK06BX222K.	5-26
C9		CAPACITOR: MIL type CS13BD335K.	5-26
C10		CAPACITOR: MIL type CK05CW221K.	5-26
C11		CAPACITOR: MIL type CB11ND101K.	5-26
C12		CAPACITOR: MIL type CK06CW103K.	5-26
C13		CAPACITOR: MIL type CM05CD050D03.	5-26
C14		CAPACITOR: MIL type CK05CW100K.	5-26
C15		CAPACITOR: MIL type CM05ED680J03.	5-26
C16		Same as C10.	5-26
C17		Same as C12.	5-26
C18		Same as C13.	5-26
C19		Same as C14.	5-26
C20		Same as C15.	5-26
C21		Same as C15.	5-26
C22		Same as C13.	5-26
C23		Same as C14.	5-26
C24		Same as C12.	5-26
C25		Same as C10.	5-26
C26		CAPACITOR: MIL type CK05CW102K.	5-26
C27 thru C29		Same as C26.	5-26
C30		CAPACITOR: MIL type CM05CD100D03.	5-26
C31		Same as C26.	5-26
C32		CAPACITOR: MIL type CS13BF156K.	5-26
C33		Same as C26.	5-26
CR1		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-26
CR2		Same as CR1.	5-26
CR3		Same as CR1.	5-26
CR4		SEMICONDUCTOR: MIL type 1N914.	5-26
CR5 thru CR8		Same as CR4.	5-26
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color red; 42498 dwg A42494-1-2; 17117 type 4879-125-2.	5-26
J2		CONNECTOR: MIL type UG1464U.	5-26
L1		COIL, RF: 0.10 uh, Q 100 at 25 MHz, 350 MHz min self resonant frequency, 1,000 ma, 0.01 ohm dc resistance; 42498 dwg A42818-2.	5-26
L2		COIL, RF: 0.07 uh, Q 95 at 50 MHz, 400 MHz min self resonant frequency, 1,000 ma, 0.01 ohm dc resistance;42498 dwg A42818-1.	5-26

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A1 (cont)			
L3		Same as L2.	5-26
L4		COIL, RF: 0.39 uh, Q 100 at 25 MHz, 250 MHz min self resonant frequency, 100 ma, 0.15 ohm dc resistance; 42498 dwg A42820-1.	5-26
Q1		TRANSISTOR: MIL type 2N930.	5-26
Q2		Same as Q1.	5-26
Q3		TRANSISTOR: MIL type 2N2907.	5-26
Q4		Same as Q1.	5-26
Q5		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-26
Q6		Same as Q5.	5-26
Q7		Same as Q5.	5-26
Q8		TRANSISTOR: MIL type 2N2857.	5-26
Q9		Same as Q5.	5-26
Q10		TRANSISTOR: MIL type 2N706.	5-26
Q11		TRANSISTOR: MIL type 2N2907A.	5-26
Q12		Same as Q11.	5-26
Q13		Same as Q11.	5-26
R1		RESISTOR: MIL type M22684/01-0111.	5-26
R2		RESISTOR: MIL type RN55C6190F.	5-26
R3		Same as R2.	5-26
R4		Same as R2.	5-26
R5		RESISTOR: MIL type RC05GF681J.	5-26
R6		Same as R2.	5-26
R7		RESISTOR: MIL type M22684/01-0067.	5-26
R8		RESISTOR: MIL type RC05GF102J.	5-26
R9		RESISTOR: MIL type RC05GF472J.	5-26
R10		RESISTOR: MIL type RC05GF151J.	5-26
R11		RESISTOR: MIL type RC05GF473J.	5-26
R12		RESISTOR: MIL type RC05GF272J.	5-26
R13		RESISTOR: MIL type RC05GF223J.	5-26
R14		Same as R11.	5-26
R15		RESISTOR: MIL type RC05GF222J.	5-26
R16		Same as R13.	5-26
R17		RESISTOR: MIL type RC05GF103J.	5-26
R18		RESISTOR: MIL type RC05GF682J.	5-26
R19		Same as R8.	5-26
R20		Same as R12.	5-26
R21		RESISTOR: MIL type RC05GF391J.	5-26
R22		RESISTOR: MIL type RC05GF101J.	5-26
R23		RESISTOR: MIL type RC05GF330J.	5-26
R24		Same as R10.	5-26
R25		Same as R17.	5-26
R26		Same as R18.	5-26
R27		Same as R12.	5-26
R28		Same as R21.	5-26
R29		Same as R22.	5-26
R30		Same as R23.	5-26
R31		Same as R10.	5-26
R32		Same as R17.	5-26
R33		Same as R17.	5-26
R34		Same as R23.	5-26

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A1 (cont)			
R35		Same as R10.	5-26
R36		Same as R21.	5-26
R37		Same as R22.	5-26
R38		Same as R12.	5-26
R39		Same as R10.	5-26
R40		Same as R18.	5-26
R41		RESISTOR: MIL type RC05GF560J.	5-26
R42		Same as R17.	5-26
R43		RESISTOR: MIL type RC05GF392J.	5-26
R44		RESISTOR: MIL type RC05GF121J.	5-26
R45		Same as R5.	5-26
R46		RESISTOR: MIL type RC05GF271J.	5-26
R47		RESISTOR: MIL type RC05GF123J.	5-26
R48		Same as R17.	5-26
R49		RESISTOR: MIL type RC05GF471J.	5-26
R50		Same as R18.	5-26
R51		RESISTOR: MIL type RC05GF273J.	5-26
R52 thru R54		Same as R41.	5-26

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, RF3: 42498 dwg D42681G2.	5-25
C1		CAPACITOR: MIL type CS13BC396K.	5-29
C2		CAPACITOR: MIL type CK05CW102K.	5-29
C3		CAPACITOR: MIL type CK06CW103K.	5-29
C4		Same as C2.	5-29
C5		Same as C1.	5-29
C6		Same as C3.	5-29
C7		Same as C1.	5-29
C8		CAPACITOR: MIL type CS13BF156K.	5-29
C9		CAPACITOR: MIL type CS13BF105K.	5-29
C10		CAPACITOR: MIL type CS13BH224K.	5-29
C11		Same as C2.	5-29
C12		CAPACITOR: MIL type CM05E680J03.	5-29
C13		Same as C2.	5-29
C14		Same as C3.	5-29
C15		Same as C3.	5-29
C16		CAPACITOR: MIL type CM05F391J03.	5-29
C17		CAPACITOR, FIXED, CERAMIC: 2200 pf, porm 10 pct, 50 vdc; 42498 dwg A43748-1; 72982 type 8133-000W5R0222K.	5-29
C18		Same as C3.	5-29
C19		CAPACITOR: MIL type CM05E221J03.	5-29
C20		Same as C3.	5-29
C21		CAPACITOR: MIL type CM05E151J03.	5-29
C22		CAPACITOR: MIL type CM05E330J03.	5-29
C23		CAPACITOR: MIL type CC20UJ560G.	5-29
C24		CAPACITOR: MIL type CB11RD221K.	5-29
C25		CAPACITOR: MIL type CM05C100K03.	5-29
C26		Same as C2.	5-29
C27		CAPACITOR: MIL type CM05E360J03.	5-29
C28		CAPACITOR: MIL type CM05E101J03.	5-29
C29		Same as C2.	5-29
C30		Same as C28.	5-29
C31		Same as C2.	5-29
C32		CAPACITOR, VARIABLE, CERAMIC: 3.0-15.0 pf, 200 vdc; 42498 dwg A42545-9; 72982 type 538-016-E2P0-110R.	5-29
C33 thru C39		Same as C2.	5-29
C40		CAPACITOR: MIL type CK05CW271K.	5-29
C41		Same as C40.	5-29
CR1		SEMICONDUCTOR: P-N-P-N polarity; 0.104 in. dia by 0.300 in. lg excl wire leads; 42498 dwg A43736-1; 04713 type M4L3053.	5-29
CR2		SEMICONDUCTOR: MIL type 1N914.	5-29
CR3		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-29
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color red; 42498 dwg A42494-1-2; 17117 type 4879-125-2.	5-29
L1		COIL, RF: MIL type MS90537-33.	5-29
L2		COIL, RF: MIL type MS90537-45.	5-29

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A2 (cont)			
L3		COIL, RF: 117 MHz, 400 MHz min self resonant frequency, 1,000 ma, 0.01 ohm dc resistance; tapped; 42498 dwg A42818-3.	5-29
Q1		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-29
Q2		Same as Q1.	5-29
Q3		Same as Q1.	5-29
Q4		TRANSISTOR: MIL type 2N708.	5-29
Q5		TRANSISTOR: MIL type 2N2222.	5-29
Q6		TRANSISTOR: MIL type 2N2857.	5-29
Q7		Same as Q1.	5-29
Q8		Same as Q1.	5-29
Q9		Same as Q6.	5-29
Q10		Same as Q1.	5-29
Q11		Same as Q6.	5-29
Q12		Same as Q1.	5-29
R1		RESISTOR: MIL type RC05GF102J.	5-29
R2		RESISTOR: MIL type RC05GF472J.	5-29
R3		RESISTOR: MIL type RC05GF271J.	5-29
R4		RESISTOR: MIL type RC05GF222J.	5-29
R5		Same as R2.	5-29
R6		RESISTOR: MIL type RC05GF471J.	5-29
R7		Same as R6.	5-29
R8		Same as R6.	5-29
R9		Same as R1.	5-29
R10		Same as R1.	5-29
R11		RESISTOR: MIL type RC05GF221J.	5-29
R12		Same as R1.	5-29
R13		Same as R6.	5-29
R14		RESISTOR: MIL type RC05GF103J.	5-29
R15		RESISTOR: MIL type RC05GF391J.	5-29
R16		Same as R14.	5-29
R17		RESISTOR: MIL type RC05GF151J.	5-29
R18		RESISTOR: MIL type RC05GF470J.	5-29
R19		RESISTOR: MIL type RC05GF183J.	5-29
R20		Same as R3.	5-29
R21		Same as R11.	5-29
R22		Same as R14.	5-29
R23		RESISTOR: MIL type RC05GF821J.	5-29
R24		Same as R2.	5-29
R25		RESISTOR: MIL type RC05GF682J.	5-29
R26		RESISTOR: MIL type RC05GF272J.	5-29
R27		Same as R15.	5-29
R28		RESISTOR: MIL type RC05GF101J.	5-29
R29		Same as R1.	5-29
R30		Not used.	
R31		Same as R4.	5-29
R32		Same as R17.	5-29
R33		Same as R15.	5-29
R34		RESISTOR: MIL type RC05GF332J.	5-29
R35		Same as R14.	5-29
R36		Same as R3.	5-29

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A2 (cont)			
R37		RESISTOR: MIL type RC05GF681J.	5-29
R38		Same as R14.	5-29
R39		RESISTOR: MIL type RC05GF392J.	5-29
R40		Same as R17.	5-29
R41		Same as R31.	5-29
R42		RESISTOR: MIL type RC05GF331J.	5-29
R43		Not used.	
R44		RESISTOR: MIL type RC05GF181J.	5-29
R45		Same as R31.	5-29
R46		Same as R31.	5-29
R47		RESISTOR: MIL type RC05GF561J.	5-29
R48		Same as R23.	5-29
R49		Same as R14.	5-29
R50		Same as R14.	5-29
R51		RESISTOR: MIL type RC05GF122J.	5-29
R52		Same as R14.	5-29
R53		Same as R14.	5-29
R54		Same as R18.	5-29
R55		Same as R17.	5-29
R56		RESISTOR: MIL type RC05GF121J.	5-29
R57		Same as R14.	5-29
R58		Same as R14.	5-29
R59		Same as R47.	5-29
T1		TRANSFORMER, RF: 2 windings; primary winding 9 uh, 28 MHz min self resonant frequency, 100 ma, 0.4 ohm dc resistance; secondary winding 0.2 ohm dc resistance; 42498 dwg A42819-5.	5-29
T2		TRANSFORMER, RF: 2 windings; primary winding 0.12 uh, 250 MHz min self resonant frequency, 22 ma, 0.1 ohm dc resistance; secondary winding 0.03 ohm dc resistance; 42498 dwg A42748-1.	5-29
Z1		INTEGRATED CIRCUIT, FLIP FLOP: Minus 10 vdc supply voltage; 20 ma output source current; 42498 dwg A43915-1; 04713 type SC2721.	5-29
Z2		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop, plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-29
Z3		Same as Z2.	5-29
Z4		Same as Z2.	5-29
Z5		MIXER, RF: F1 input 15 MHz, F2 input 10 MHz, F3 output 5 MHz, 50 ohms dc resistance; 42498 dwg A42962-2.	5-29
Z6		MIXER, RF: F1 input 112 MHz, F2 input 117 MHz, F3 output 5 MHz, 50 ohms dc resistance; 42498 dwg A42962-5.	5-29

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A3		PRINTED CIRCUIT BOARD SUBASSEMBLY, DIGITAL NO. 2: 42498 dwg D45826G1.	5-25
C1		CAPACITOR: MIL type CM05CD820J03.	5-33
C2		CAPACITOR: MIL type CK06CW103K.	5-33
C3		CAPACITOR: MIL type CK06BX104K.	5-33
C4		CAPACITOR: MIL type CS13BC396K.	5-33
C5		CAPACITOR: MIL type CK05CW102K.	5-33
C6		Same as C2.	5-33
C7		Same as C4.	5-33
C8		CAPACITOR: MIL type CK05BX470K.	5-33
CR1		SEMICONDUCTOR: MIL type 1N3064.	5-33
L1		COIL, RF: MIL type MS90537-13.	5-33
Q1		TRANSISTOR: Silicon; N-P-N polarity; JEDEC case style TO-18; 42498 dwg A43098-1; 14936 type 2N907.	5-33
Q2		Same as Q1.	5-33
Q3		TRANSISTOR: MIL type 2N2907.	5-33
Q4		Same as Q3.	5-33
R1		RESISTOR: MIL type RC05GF271K.	5-33
R2		RESISTOR: MIL type RC05GF152K.	5-33
R3		Same as R2.	5-33
R4		RESISTOR: MIL type RC05GF681K.	5-33
R5		Same as R1.	5-33
R6		RESISTOR: MIL type RC05GF121K.	5-33
R7		Same as R4.	5-33
R8		RESISTOR: MIL type RC05GF390K.	5-33
R9		RESISTOR: MIL type RC05GF221K.	5-33
Z1		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop, plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-33
Z2		Same as Z1.	5-33
Z3		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input logic gate; minus 10 vdc, 20 ma, 115 MW/gate power dissipation; 42498 dwg B44548G1.	5-33
Z4		Same as Z1.	5-33
Z5		INTEGRATED CIRCUIT, FLIP FLOP: 70 MHz, ac coupled J-K flip flop, minus 10 vdc, 20 ma; 42498 dwg B44548G2.	5-33
Z6		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; 3.0-4.0v operating voltage; 45 nsec propagation delay 1.0v noise margin; 7/gate fanout; 8 MW/gate dissipation; 42498 dwg A44457-10, 14433 type MIC949-3D.	5-33
Z7		Same as Z1.	5-33
Z8		Same as Z1.	5-33
Z9		INTEGRATED CIRCUIT, FLIP FLOP: J-K flip flop; 1v noise immunity; 25 nsec propagation delay; 75 MW power dissipation; 10 fanout; 42498 dwg A45732-1; 13715 type TTUL9001.	5-33
Z10		Same as Z1.	5-33
Z11		Same as Z6.	5-33

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A3 (cont)			
Z12		Same as Z9.	5-33
Z13		Same as Z1.	5-33
Z14		Same as Z9.	5-33
Z15		Same as Z1.	5-33
Z16		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; minus 1.5v to plus 5.5v input voltage, 50 ma; 42498 dwg A46082-1; 14433 type TTUL9002.	5-33
Z17		Same as Z1.	5-33
Z18		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input buffer; 3.0-4.0v operating voltage; 35 nsec propagation delay; 1.0v noise margin; 25/gate fanout; 25 MW/gate power dissipation; 42498 dwg A44457-5; 14433 type MIC932-3D.	5-33
Z19		Same as Z1.	5-33

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A4		PRINTED CIRCUIT BOARD SUBASSEMBLY, RF1B: 42498 dwg D43071G2.	5-25
C1		CAPACITOR: MIL type CS13BF105K.	5-27
C2		CAPACITOR: MIL type CS13BF156K.	5-27
C3		CAPACITOR, FIXED, GLASS: 1,000 pf, porm 5 pct, 300 vdc; 42498 dwg A42875-2; 14674 type TY07102J.	5-27
C4		Same as C3.	5-27
C5		CAPACITOR: MIL type CK05CW102K.	5-27
C6		Same as C2.	5-27
C7		CAPACITOR: MIL type CK06BX103K.	5-27
C8		CAPACITOR: MIL type CM05E181J03.	5-27
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-27
CR2		SEMICONDUCTOR: MIL type 1N914.	5-27
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color red; 42498 dwg A42494-1-2; 17117 type 4879-125-2.	5-27
J2		Same as J1.	5-27
Q1		TRANSISTOR: MIL type 2N2222.	5-27
Q2		TRANSISTOR: MIL type 2N2907A.	5-27
Q3		Same as Q1.	5-27
Q4		TRANSISTOR: MIL type 2N930.	5-27
Q5		Same as Q2.	5-27
Q6		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style VVV (TO-72); 42498 dwg A43044-1; 01295 type 3N111.	5-27
Q7		TRANSISTOR: Silicon; N-P-N polarity; JEDEC case style TO-18; 42498 dwg A43097-1; 07263 type 2N3117.	5-27
Q8		Same as Q2.	5-27
Q9		Same as Q1.	5-27
Q10		Same as Q2.	5-27
Q11		Same as Q7.	5-27
Q12		Same as Q2.	5-27
R1		RESISTOR: MIL type RC05GF102J.	5-27
R2		Same as R1.	5-27
R3		RESISTOR: MIL type RC05GF103J.	5-27
R4		Same as R3.	5-27
R5		RESISTOR: MIL type RC05GF472J.	5-27
R6		RESISTOR: MIL type RC05GF272J.	5-27
R7		Same as R3.	5-27
R8		Same as R5.	5-27
R9		RESISTOR: MIL type RC05GF182J.	5-27
R10		RESISTOR: MIL type RC05GF332J.	5-27
R11		RESISTOR: MIL type RC05GF181J.	5-27
R12		RESISTOR: MIL type RC05GF121J.	5-27
R13		RESISTOR: MIL type RC05GF222J.	5-27
R14		RESISTOR: MIL type RC05GF223J.	5-27
R15		RESISTOR: MIL type RC05GF470J.	5-27
R16		RESISTOR: MIL type RC05GF101J.	5-27
R17		Same as R16.	5-27
R18		Same as R11.	5-27
R19		Same as R11.	5-27
R20		Not used.	
R21		RESISTOR: MIL type RC05GF105J.	5-27

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A4 (cont)			
T1		TRANSFORMER, RF: 2 windings; primary winding 7 uh porm 20 pct at 25 deg C at 1 MHz, 50 ohms impedance, 78 ma, 0.06 ohm dc resistance; secondary winding 200 ohms impedance, 39 ma, 0.12 ohm dc resistance; 42498 dwg A42745-4.	5-27
T2		Same as T1.	5-27
T3		TRANSFORMER, RF: 2 windings; primary winding 20 uh at 25 deg C at 1 MHz, 50 ohms impedance; 44 ma, 0.1 ohm dc resistance; secondary winding 200 ohms impedance, 22 ma, 0.2 ohm dc resistance; 42498 dwg A42745-1.	5-27
T4		Same as T3.	5-27
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input buffer; 3.0-4.0v operating voltage; 35 nsec propagation delay; 1.0v noise margin; 25/gate fanout; 25 MW/gate power dissipation; 42498 dwg A44457-5; 14433 type MIC932-3D.	5-27
Z2		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2-input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-27
Z3		Same as Z2.	5-27

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A5		PRINTED CIRCUIT BOARD SUBASSEMBLY, RF2: 42498 dwg D43080G2.	5-25
C1		CAPACITOR: MIL type CS13BC396K.	5-28
C2		CAPACITOR: MIL type CS13BE107K.	5-28
C3		CAPACITOR: MIL type CK06BX104K.	5-28
C4		CAPACITOR: MIL type CS13BE156K.	5-28
C5		CAPACITOR, FIXED, GLASS: 10,000 pf, porm 10 pct, 50 vdc; 42498 dwg A42960-1; 14674 type CYK01BT103K.	5-28
C6		Same as C4.	5-28
C7		Same as C4.	5-28
C8		CAPACITOR: MIL type CK05CW102K.	5-28
C9		CAPACITOR: MIL type CK06CW682K.	5-28
C10		CAPACITOR: MIL type CB11RD102K.	5-28
C11		CAPACITOR: MIL type CM05F331J03.	5-28
C12		CAPACITOR: MIL type CM05F360J03.	5-28
C13		Same as C10.	5-28
C14		CAPACITOR: MIL type CL65CJ050JP3.	5-28
C15		CAPACITOR, VARIABLE, CERAMIC: 3.0-15.0 pf, 200 vdc; 42498 dwg A42545-9; 72982 type 538-016-E2P0-110R.	5-28
C16		Not used.	
C17 thru C20		Same as C8.	5-28
C21		CAPACITOR, VARIABLE, CERAMIC: 9.0-35.0 pf, 200 vdc; 42498 dwg A42545-1; 72982 type 538-016-E2P0-94R.	5-28
C22		CAPACITOR, FIXED, GLASS: 5,100 pf, porm 2 pct, 50 vdc; 42498 dwg A42975-4; 95275 type VY20CA512GE-.	5-28
C23		Same as C22.	5-28
C24		CAPACITOR, FIXED, GLASS: 5,100 pf, porm 2 pct, 50 vdc; 42498 dwg A42975-3; 95275 type VY20CA512GE+.	5-28
C25		Same as C24.	5-28
C26		CAPACITOR: MIL type CK06BX104K.	5-28
CR1		SEMICONDUCTOR: MIL type 1N914.	5-28
CR2		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-3; 01281 type PC1251.	5-28
Q1		TRANSISTOR: MIL type 2N2222.	5-28
Q2		Same as Q1.	5-28
Q3		TRANSISTOR: Silicon; N-P-N polarity; JEDEC case style TO-18; 42498 dwg A43097-1; 07263 type 2N3117.	5-28
Q4		TRANSISTOR: MIL type 2N2907A.	5-28
Q5		Same as Q1.	5-28
Q6		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style VVV (TO-72); 42498 dwg A43044-1; 01295 type 3N111.	5-28
Q7		Same as Q3.	5-28
Q8		Same as Q4.	5-28
Q9		Same as Q1.	5-28
Q10		TRANSISTOR: MIL type 2N930.	5-28
Q11		Same as Q4.	5-28

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A5 (cont)			
Q12		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-28
Q13		TRANSISTOR: MIL type 2N918.	5-28
Q14		Same as Q12.	5-28
R1		RESISTOR: MIL type RC05GF470J.	5-28
R2		RESISTOR: MIL type RC05GF332J.	5-28
R3		RESISTOR: MIL type RC05GF563J.	5-28
R4		RESISTOR: MIL type RC05GF103J.	5-28
R5		Same as R4.	5-28
R6		RESISTOR: MIL type RC05GF334J.	5-28
R7		RESISTOR: MIL type RC05GF123J.	5-28
R8		RESISTOR: MIL type RC05GF102J.	5-28
R9		RESISTOR: MIL type RC05GF331J.	5-28
R10		Same as R1.	5-28
R11		RESISTOR: MIL type RC05GF101J.	5-28
R12		Same as R11.	5-28
R13		RESISTOR: MIL type RC05GF224J.	5-28
R14		RESISTOR: MIL type RC05GF104J.	5-28
R15		Same as R4.	5-28
R16		RESISTOR: MIL type RC05GF682J.	5-28
R17		RESISTOR: MIL type RC05GF273J.	5-28
R18		Same as R3.	5-28
R19		Same as R16.	5-28
R20		RESISTOR: MIL type RC05GF272J.	5-28
R21		Same as R11.	5-28
R22		Same as R3.	5-28
R23		RESISTOR: MIL type RC05GF391J.	5-28
R24		Same as R4.	5-28
R25		Same as R7.	5-28
R26		RESISTOR: MIL type RC05GF820J.	5-28
R27		Same as R1.	5-28
R28		Same as R1.	5-28
R29		Same as R4.	5-28
R30		RESISTOR: MIL type RC05GF392J.	5-28
R31		RESISTOR: MIL type RC05GF271J.	5-28
R32		Same as R11.	5-28
R33		Same as R7.	5-28
R34		Same as R4.	5-28
R35		Same as R9.	5-28
R36		Not used.	
R37		RESISTOR: MIL type RN55E2612F	5-28
R38 thru R40		Same as R37.	5-28
T1		TRANSFORMER, RF: 2 windings; primary winding 7 uh porm 20 pct at 25 deg C at 1 MHz, 50 ohms impedance, 78 ma, 0.06 ohm dc resistance; secondary winding 200 ohms impedance, 39 ma, 0.12 ohm dc resistance; 42498 dwg A42745-4.	5-28
T2		Same as T1.	5-28
T3		TRANSFORMER, RF: 2 windings; primary winding 0.09 uh, 100 MHz, min self resonant frequency, 20 ma, 0.2 ohm dc resistance; secondary winding 0.7 ohm dc resistance; 42498 dwg A42748-3.	5-28

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

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REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A5 (cont)			
T4		TRANSFORMER, RF: 2 windings; primary winding 1.4 uh, 100 MHz min self resonant frequency, 20 ma, 0.2 ohm dc resistance; secondary winding 0.7 ohm dc resistance; 42498 dwg A42748-2.	5-28
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input buffer, 3.0-4.0v operating voltage; 35 nsec propagation delay; 1.0v noise margin; 25/gate fanout; 25 MW/gate power dissipation; 42498 dwg A44457-5; 14433 type MIC932-3D.	5-28
Z2		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2 input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-28
Z3		Same as Z2.	5-28
Z4		INTEGRATED CIRCUIT, LOGIC GATE: Triple 3 input NAND/NOR gate; 3.0-4.0v operating voltage; 1.0v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-3; 14433 type MIC962-3D.	5-28
Z5		Same as Z4.	5-28
Z6		Same as Z2.	5-28

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A6		PRINTED CIRCUIT BOARD SUBASSEMBLY, DIGITAL NO. 3: 42498 dwg D42877G2.	5-25
C1		CAPACITOR: MIL type CK05CW101K.	5-34
C2		CAPACITOR: MIL type CK06CW103K.	5-34
C3		CAPACITOR: MIL type CS13BC396K.	5-34
C4		Not used.	
C5		Same as C1.	5-34
C6 thru C11		Not used.	
C12		Same as C3.	5-34
C13		CAPACITOR: MIL type CK05CW151K.	5-34
C14		Same as C13.	5-34
C15		CAPACITOR: MIL type CK05BX101K.	5-34
CR1 thru CR4		Not used.	
CR5 thru CR9		SEMICONDUCTOR: MIL type 1N914.	5-34
Q1		TRANSISTOR: MIL type 2N918.	5-34
Q2		Same as Q1.	5-34
R1		Not used.	
R2		RESISTOR: MIL type RC05GF222J.	5-34
R3		Same as R2.	5-34
R4		RESISTOR: MIL type RC05GF560J.	5-34
R5		RESISTOR: MIL type RC05GF471J.	5-34
R6		RESISTOR: MIL type RC05GF392J.	5-34
R7		RESISTOR: MIL type RC05GF332J.	5-34
R8 thru R16		Not used.	
R17		RESISTOR: MIL type RC05GF151J.	5-34
R18		RESISTOR: MIL type RC05GF271J.	5-34
Z1		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop; plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-34
Z2		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2 input gate; 3.0-4.0v operating voltage; 45 nsec propagation delay; 1.0v noise margin; 7/gate fanout; 8 MW/gate power dissipation; 42498 dwg A44457-10; 14433 type MIC949-3D.	5-34
Z3		Same as Z1.	5-34
Z4		Same as Z1.	5-34
Z5		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input buffer; 3.0-4.0v operating voltage; 35 nsec propagation delay; 1.0v noise margin; 25/gate fanout; 25 MW/gate power dissipation; 42498 dwg A44457-5; 14433 type MIC932-3D.	5-34
Z6		Not used.	
Z7		Not used.	
Z8 thru Z10		Same as Z1.	5-34
Z11		Same as Z2.	5-34
Z12		Same as Z2.	5-34
Z13		INTEGRATED CIRCUIT, FLIP FLOP: R-S or J-K flip flop; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 9 fanout; 42 MW/gate power dissipation; 42498 dwg A44457-8; 14433 type MIC945-3D.	5-34

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A6 (cont)			
Z14 thru Z16		Same as Z1.	5-34
Z17		Same as Z2.	5-34
Z18		Same as Z13.	5-34
Z19 thru Z22		Same as Z1.	5-34

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A7		DIGITAL 1A AND 1B SUBASSEMBLY: 42498 dwg C43382G2.	5-25

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A7A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, DIGITAL NO. 1A: 42498 dwg D42566G2.	5-30
C1		CAPACITOR: MIL type CS13BC396K.	5-31
CR1		Not used.	
CR2		Not used.	
CR3		SEMICONDUCTOR: MIL type 1N914.	5-31
CR4		Same as CR3.	5-31
L1		COIL, RF: MIL type MS90537-17.	5-31
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Triple 3 input NAND/NOR gate; 3.0-4.0v operating voltage; 1.0v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-3; 14433 type MIC962-3D.	5-31
Z2		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input buffer; 3.0-4.0v operating voltage; 35 nsec propagation delay; 1.0v noise margin; 25/gate fanout; 25 MW/gate power dissipation; 42498 dwg A44457-5; 14433 type MIC932-3D.	5-31
Z3		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop; plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-31
Z4 thru Z7		Same as Z3.	5-31

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A12A7A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, DIGITAL NO. 1B: 42498 dwg D45887G1.	5-30
C1		CAPACITOR: MIL type CS13BC396K.	5-32
CR1		SEMICONDUCTOR: MIL type 1N914.	5-32
CR2 thru CR5		Same as CR1.	5-32
Z1		INTEGRATED CIRCUIT, FLIP FLOP: High speed flip flop; plus 8.0v continuous supply voltage, plus 12v pulsed supply voltage, minus 10 ma forward input current, 5.0 ma reverse input current, minus 1.0v or plus 8.0v input voltage; 42498 dwg A47728-1; 14433 type MIC950-3D.	5-32
Z2 thru Z11		Same as Z1.	5-32

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A13		DOWN CONVERTER ASSEMBLY: Consists of three functionally related circuits performing the final frequency conversion of the exciter to a range of 2 MHz to 30 MHz (29.999 MHz); the three circuits consist of 112 MHz amplifier; 82-110 MHz amplifier; and a mixer assembly; the output level of a portion of the down converter is adjusted by the circuitry of the transmitter gain control in accordance with dc control signals developed by the external RF amplifier; 42498 dwg D44120G1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-35
Z1		MIXER ASSEMBLY: Non-repairable assy; 42498 dwg A46517-1.	5-35

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A13A1		Not used.	

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A13A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, DOWN CONVERTER 112 MHz IF AMPL: 42498 dwg D44032G1.	5-35
C1		CAPACITOR: MIL type CK05CW102K.	5-36
C2 thru C6		Same as C1.	5-36
C7		CAPACITOR: MIL type CK05CW471K.	5-36
C8		Same as C1.	5-36
C9		CAPACITOR: MIL type CS13BF685K.	5-36
C10		CAPACITOR: MIL type CM05F150K03.	5-36
C11		CAPACITOR: MIL type CM05F820J03.	5-36
C12 thru C14		Same as C1.	5-36
C15		Same as C9.	5-36
C16		Same as C9.	5-36
C17		CAPACITOR: MIL type CC20UJ150K.	5-36
C18		CAPACITOR: MIL type CM05F620J03.	5-36
CR1		SEMICONDUCTOR: Silicon; JEDEC case style DO-14; 42498 dwg A43737-1; 01281 type VS684.	5-36
L1		COIL, RF: MIL type MS90537-1.	5-36
L2		COIL, RF: MIL type MS90537-17.	5-36
L3		COIL, RF: 0.11 uh, Q 100 at 25 MHz, 250 MHz min self resonant frequency, 200 ma, 0.01 dc resistance; 42498 dwg A45381-7.	5-36
L4		COIL, RF: 0.12 uh, Q 80 at 25 MHz, 250 MHz min self resonant frequency, 200 ma, 0.01 dc resistance; 42498 dwg A42816-4.	5-36
L5		BEAD, SHIELDING: Ferrite; 0.047 in. id by 0.118 in. lg by 0.198 in. od; 42498 dwg A20406-1; 02114 type 255T118A205.	5-36
L6 thru L8		Same as L5.	5-36
Q1		TRANSISTOR: MIL type 2N2857.	5-36
Q2 thru Q4		Same as Q1.	5-36
R1		RESISTOR: MIL type RC07GF470K.	5-36
R2		RESISTOR: MIL type RC07GF684J.	5-36
R3		RESISTOR: MIL type RC07GF392K.	5-36
R4		RESISTOR: MIL type RC07GF102K.	5-36
R5		RESISTOR: MIL type RC07GF331K.	5-36
R6		RESISTOR: MIL type RC07GF561K.	5-36
R7		RESISTOR: MIL type RC07GF103K.	5-36
R8		RESISTOR: MIL type RC07GF562K.	5-36
R9		RESISTOR: MIL type RC07GF220K.	5-36
R10		Same as R8.	5-36
R11		RESISTOR: MIL type RC07GF472K.	5-36
R12		RESISTOR: MIL type RC07GF820K.	5-36
R13		RESISTOR: MIL type RC07GF471K.	5-36
R14		Same as R12.	5-36

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A13A3		82-110 MHz AMPLIFIER SUBASSEMBLY: 42498 dwg D46443G1.	5-35
E1		INSULATOR, STANDOFF: Brass, silver plated finish; through panel mounting; 0.051 in mounting dim; 0.093 in dia by 0.237 in lg incl mtg dim o/a dim; 42498 dwg A40473-1; 71279 type 2043-1.	5-37
E2		TERMINAL, FEED THRU INSULATED: Rated for 1000v RMS, 3 amps current; 0.175 in dia by 0.468 in lg o/a dim; panel mounting; looped on one end and lug with hole on the other end; 42498 dwg A43990-1; 20093 type AAA30WHP.	5-37
E3 thru E5		Same as E1.	5-37
FL1		FILTER: 1750 pf, 10 amps, 125 vdc; 42498 dwg A43292-1; 72982 type 1214-001.	5-37
FL2		Same as FL1.	5-37
J1		CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact, 50 ohms impedance; right angle shaped; 42498 dwg A44108-1; 98291 type 50-047-0000.	5-37
Q1 thru Q3		Not used.	
Q4		TRANSISTOR: Silicon; N-P-N polarity; 0.375 in dia by 0.558 in lg excl wire leads; one no. 8-32 UNC-2A thd mtg stud; 42498 dwg A43995-3; 13923 type S-1001 MOD.	5-37
R1		RESISTOR: MIL type RC07GF820K. (Not shown)	
R2		Same as R1. (Not shown)	

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A13A3A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, 82-110 MHz AMPL: 42498 dwg D47599G1.	5-37
C1		CAPACITOR: MIL type CK05BX102K.	5-38
C2		CAPACITOR: MIL type CK05BX100K.	5-38
C3		CAPACITOR: MIL type CK05BX221K.	5-38
C4		Same as C2.	5-38
C5		CAPACITOR: MIL type CK06BX104K.	5-38
C6		Same as C3.	5-38
C7		Same as C1.	5-38
C8		CAPACITOR: MIL type CK06BX223K.	5-38
C9		Same as C1.	5-38
C10		Same as C3.	5-38
C11		Same as C3.	5-38
C12 thru C14		Same as C1.	5-38
CR1		SEMICONDUCTOR: MIL type 1N914.	5-38
L1		COIL, RF: 0.22 uh, Q 33 at 25 MHz, 510 MHz min self-resonant frequency, 935 ma, 0.14 ohm dc resistance; 42498 dwg A43286-3; 76493 type 9230-04.	5-38
L2		Same as L1.	5-38
L3		Same as L1.	5-38
Q1		TRANSISTOR: MIL type 2N918.	5-38
Q2		TRANSISTOR: P-N-P polarity; JEDEC case style TO-18; 42498 dwg A43085-1; 14433 type TS1847.	5-38
Q3		TRANSISTOR: MIL type 2N2222.	5-38
R1		RESISTOR: MIL type RC07GF151J.	5-38
R2		RESISTOR: MIL type RC07GF390J.	5-38
R3		Same as R1.	5-38
R4		RESISTOR: MIL type RC07GF153J.	5-38
R5		RESISTOR: MIL type RC07GF123J.	5-38
R6		Not used.	
R7		RESISTOR: MIL type RC07GF821J.	5-38
R8		RESISTOR: MIL type RC07GF101J.	5-38
R9		RESISTOR: MIL type RC07GF183J.	5-38
R10		RESISTOR: MIL type RC07GF103J.	5-38
R11		RESISTOR: MIL type RC20GF102J.	5-38
R12		RESISTOR: MIL type RC07GF100J.	5-38
R13		RESISTOR: MIL type RW79U1000F.	5-38
R14		RESISTOR: MIL type RC07GF183J.	5-38
R15		RESISTOR: MIL type RC07GF223J.	5-38
R16		RESISTOR: MIL type RC07GF560J.	5-38

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A14		TRANSMITTER GAIN CONTROL ASSEMBLY: Adjusts the gain of a portion of the Down Converter Assembly in accordance with dc control signals developed by the external RF amplifier; the dc control signals are translated into a mechanical function by an electromechanical servo system driving a potentiometer; 42498 dwg D44121G1.	5-2
B1		MOTOR, DIRECT CURRENT: 27 vdc; 10,000 to 13,000 rpm, 0.23 amp rated load current, 84.11 to 1 speed reduction ratio, 14 oz-in max continuous torque; 42498 dwg A46066-1; 25140 type 43A1306.	5-39
MP1		CAM, COUPLING: Cres, passivated finish; 0.375 in. dia by 1.187 in lg o/a; adapted for use with four setscrews; 42498 dwg B44697-1.	5-39
P1		CONNECTOR: MIL type MS18176-1.	5-39
R1		RESISTOR, VARIABLE: Carbon film element; 250,000 ohms porm 10 pct, 2.0 pct linearity; 42498 dwg A46065-1; 08815 type 78FL1.	
R2		RESISTOR: MIL type RC07GF105K. (Not shown)	
R3		RESISTOR: MIL type RC07GF333K. (Not shown)	
S1		SWITCH, SENSITIVE: SPDT, contact rating 0.5 amp at 28 vdc; 42498 dwg A42826-1; 80207 type USM500W.	5-39
S2		Same as S1.	5-39

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A14A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, TGC NO. 1: 42498 dwg D46542G1.	5-39
C1		CAPACITOR: MIL type CK06BX104K.	5-40
C2		CAPACITOR: MIL type CK06BX103K.	5-40
C3		Same as C2.	5-40
C4		Same as C1.	5-40
CR1		SEMICONDUCTOR: MIL type 3823A.	5-40
CR2		SEMICONDUCTOR: MIL type 1N823	5-40
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-40
K1		RELAY: MIL type M5757/9-003.	5-40
Q1		TRANSISTOR: MIL type 2N2222A.	5-40
Q2		TRANSISTOR: MIL type 2N2907A.	5-40
Q3		TRANSISTOR: MIL type 2N3468.	5-40
Q4		TRANSISTOR: MIL type 2N2219A.	5-40
Q5		TRANSISTOR: MIL type 2N1485.	5-40
Q6		TRANSISTOR: MIL type 2N3868.	5-40
Q7		Same as Q2.	5-40
R1		RESISTOR: MIL type RC07GF103K.	5-40
R2		RESISTOR: MIL type RC07GF562K.	5-40
R3		Same as R1.	5-40
R4		RESISTOR: MIL type RC07GF182K.	5-40
R5		RESISTOR: MIL type RC07GF104K.	5-40
R6		RESISTOR: MIL type RC20GF391K.	5-40
R7		Same as R6.	5-40
R8		RESISTOR: MIL type RC07GF183K.	5-40
R9		RESISTOR: MIL type RC07GF821K.	5-40
R10		Same as R8.	5-40
R11		RESISTOR: MIL type RC32GF151K.	5-40
R12		RESISTOR: MIL type RC32GF561K.	5-40
R13		RESISTOR: MIL type RC07GF223K.	5-40
R14		RESISTOR: MIL type RC32GF681K.	5-40
R15		Same as R13.	5-40
R16		RESISTOR: MIL type RC42GF680K.	5-40
R17		Same as R16.	5-40
R18		RESISTOR: MIL type RJ24CP501.	5-40
R19		Same as R9.	5-40
Z1		INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER: 7.5 MV input offset voltage, 500 ma input offset current, 1.5 ua input bias current, 250,000 ohms input resistance, 150 ohms output resistance; 42498 dwg A45717-1; 14433 type MIC709-5C.	5-40

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A14A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, TGC NO. 2: 42498 dwg A46541G1.	5-39
C1		CAPACITOR: MIL type CS13BF226K.	5-41
C2		CAPACITOR: MIL type CS13BF470K.	5-41
CR1		SEMICONDUCTOR: MIL type 1N3064.	5-41
CR2		SEMICONDUCTOR: MIL type 1N3611.	5-41
CR3		Same as CR2.	5-41
J1		JACK, TIP: Plastic body; beryllium copper spring contact, gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-41
K1		RELAY: MIL type M5757/9-003.	5-41
K2 thru K4		Same as K1.	5-41
Q1		TRANSISTOR: MIL type 2N2222A.	5-41
R1		RESISTOR: MIL type RC07GF103K.	5-41
R2		RESISTOR: MIL type RJ24CP103.	5-41
R3		RESISTOR: MIL type RC07GF472K.	5-41
R4		RESISTOR: MIL type RJ24CP203.	5-41
R5		RESISTOR: MIL type RC07GF154K.	5-41
R6		Same as R3.	5-41
R7		RESISTOR: MIL type RC07GF101K.	5-41

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A15		BAND ENCODER ASSEMBLY: Develops a code, representative of each tuning dial setting to course tune the external RF amplifier unit to the exciter carrier frequency; when the system is under remote control, the unit develops the tuning code from the frequency selected by the remote control unit; the tuning code enables the external RF amplifier to tune to one of 19 broad frequency segments of the system output frequency spectrum; 42498 dwg D44118G1.	5-1
P1		CONNECTOR: MIL type MS18176-1.	5-42

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A15A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, -12 AND 15 VOLT REGULATOR: 42498 dwg D47333G1.	5-42
C1		CAPACITOR: MIL type CK06BX334K.	5-43
C2		Same as C1.	5-43
CR1		SEMICONDUCTOR: MIL type 1N821.	5-43
CR2		Same as CR1.	5-43
J1		JACK, TIP: Plastic body; beryllium copper spring contact; gold plated finish; brass terminal; color green; 42498 dwg A42494-1-5; 17117 type 4879-125-5.	5-43
J2		Same as J1.	5-43
Q1		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style TO-3; 42498 dwg A43788-1; 04713 type 2N3789.	5-43
Q2		TRANSISTOR: MIL type 2N2907.	5-43
Q3		TRANSISTOR: MIL type 2N1490.	5-43
Q4		TRANSISTOR: MIL type 2N2222.	5-43
R1		RESISTOR: MIL type RC07GF561K.	5-43
R2		RESISTOR: MIL type RC07GF562K.	5-43
R3		RESISTOR: MIL type RN60D2001F.	5-43
R4		RESISTOR: MIL type RN60D2801F.	5-43
R5		RESISTOR: MIL type RC07GF271K.	5-43
R6		RESISTOR: MIL type RC07GF822K.	5-43
R7		RESISTOR: MIL type RN60D3091F.	5-43
R8		RESISTOR: MIL type RN60D2741F.	5-43

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A15A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, BAND ENCODER BOARD: 42498 dwg D46799G1.	5-42
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-44
CR2 thru CR7		Same as CR1.	5-44
K1		RELAY: MIL type M5757/9-003.	5-44
K2 thru K5		Same as K1.	5-44
Q1		TRANSISTOR: MIL type 2N2222A.	5-44
Q2 thru Q5		Same as Q1.	5-44
Z1		INTEGRATED CIRCUIT, LOGIC GATE: Hex single-input gate; 42498 dwg A44457-4; 14433 type MIC946-3D.	5-44
Z2		INTEGRATED CIRCUIT, LOGIC GATE: Triple 3-input NAND/NOR gate; 3.0-4.0v operating voltage; 1.0v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-3; 14433 type MIC962-3D.	5-44
Z3		INTEGRATED CIRCUIT, LOGIC GATE: Dual 4-input NAND/NOR gate; 3.0-4.0v operating voltage; 25 nsec propagation delay; 1.0v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-1; 14433 type MIC930-3D.	5-44
Z4		Same as Z2.	5-44
Z5		Same as Z3.	5-44
Z6		INTEGRATED CIRCUIT, LOGIC GATE: Quadruple 2 input gate; 3.0-4.0v operating voltage; 50 nsec propagation delay; 0.6v noise margin; 8/gate fanout; 5 MW/gate power dissipation; 42498 dwg A44457-2; 14433 type MIC946-3D.	5-44
Z7		Same as Z3.	5-44
Z8		Same as Z3.	5-44
Z9		Same as Z2.	5-44
Z10		Same as Z6.	5-44
Z11		Same as Z3.	5-44

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A16		OUTPUT AMPLIFIER ASSEMBLY: A linear broad band amplifier mounted on two printed circuit boards; the unit raises the level of the carrier signal from the Down Converter Module to 250 milliwatts of RF power (PEP) over a frequency range of 2 MHz to 30 MHz, in addition to providing a 50 ohm output termination; a muting delay is incorporated to remove output power when the system is in a key-up condition; 42498 dwg D44122G1.	5-2
P1		CONNECTOR: MIL type MS18176-1.	5-45

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A16A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, OUTPUT AMPLIFIER NO. 1: 42498 dwg D44411G1.	5-45
C1		CAPACITOR: MIL type CK06CW103K.	5-46
C2		Same as C1.	5-46
C3		Same as C1.	5-46
C4		CAPACITOR: MIL type CL65BH151MP3.	5-46
C5 thru C8		Same as C1.	5-46
C9		Same as C4	5-46
C10		CAPACITOR: MIL type CM05FC100J03.	5-46
C11		Same as C1.	5-46
C12		CAPACITOR: MIL type CM05FC101J03.	5-46
C13		CAPACITOR: MIL type CM05FC470J03.	5-46
C14		Same as C1.	5-46
CR1		SEMICONDUCTOR: MIL type 1N914.	5-46
CR2		Same as CR1.	5-46
FL1		FILTER ASSEMBLY: Non-repairable assembly; 35 MHz; 42498 dwg A46516-1.	5-46
K1		RELAY: MIL type M5757/9-003.	5-46
L1		COIL, RF: MIL type MS90537-1.	5-46
L2		COIL, RF: MIL type MS90537-41.	5-46
L3		COIL, RF: MIL type MS90537-50.	5-46
L4		COIL, RF: MIL type MS90537-5.	5-46
L5		COIL, RF: MIL type MS90537-43.	5-46
P1		CONNECTOR: MIL type UG1460U.	5-46
Q1		TRANSISTOR: MIL type 2N918.	5-46
R1		RESISTOR: MIL type RC07GF510K.	5-46
R2		RESISTOR: MIL type RC07GF123K.	5-46
R3		RESISTOR: MIL type RC07GF822K.	5-46
R4		RESISTOR: MIL type RC07GF181K.	5-46
R5		RESISTOR: MIL type RC07GF150K.	5-46
R6		RESISTOR: MIL type RC07GF471K.	5-46
R7		RESISTOR: MIL type RC07GF2R7K.	5-46
R8		Same as R6.	5-46
R9		Same as R7.	5-46
R10		Same as R6.	5-46
R11		Same as R6.	5-46
R12		Same as R1.	5-46
R13		Same as R1.	5-46
R14		RESISTOR: MIL type RC07GF103K.	5-46
R15		RESISTOR: MIL type RC07GF102K.	5-46
R16		RESISTOR: MIL type RC07GF561K.	5-46
R17		Same as R1.	5-46
T1		TRANSFORMER, RF: 2 windings; primary winding 9.2 uh porm 20 pct at 25 deg C, 50 ohms impedance, 0 ma, 0.08 ohm dc resistance; secondary winding 50 ohms impedance, 0 ma, 0.08 ohm dc resistance; 42498 dwg A45387-2.	5-46

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A16A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, OUTPUT AMPLIFIER NO. 2: 42498 dwg D44179G1.	5-45
C1		CAPACITOR: MIL type CK06CW103K.	5-47
C2 thru C5		Same as C1.	5-47
C6		CAPACITOR: MIL type CS13BF226K.	5-47
C7 thru C21		Same as C1.	5-47
L1		COIL, RF: MIL type MS90537-41.	5-47
L2		COIL, RF: MIL type MS90537-31.	5-47
L3		Same as L2.	5-47
L4		COIL, RF: MIL type MS90537-29.	5-47
L5		Same as L1.	5-47
L6		Same as L1.	5-47
L7		COIL, RF: MIL type MS90537-35.	5-47
L8		Same as L7.	5-47
Q1		TRANSISTOR: MIL type 2N2219.	5-47
Q2 thru Q7		Same as Q1.	5-47
Q8		TRANSISTOR: Silicon, N-P-N polarity; 0.375 in dia by 0.558 in lg excl terminals; 42498 dwg A43995-3; 13923 type S-1001.	5-47
Q9		Same as Q8.	5-47
R1		RESISTOR: MIL type RC07GF182K.	5-47
R2		RESISTOR: MIL type RC07GF681K.	5-47
R3		RESISTOR: MIL type RC07GF181K.	5-47
R4		Same as R3.	5-47
R5		RESISTOR: MIL type RC07GF470K.	5-47
R6		RESISTOR: MIL type RC07GF152K.	5-47
R7		RESISTOR: MIL type RC07GF122K.	5-47
R8		RESISTOR: MIL type RC07GF180K.	5-47
R9		RESISTOR: MIL type RC07GF331K.	5-47
R10		Same as R9.	5-47
R11		Same as R8.	5-47
R12		RESISTOR: MIL type RC07GF222K.	5-47
R13		Same as R9.	5-47
R14		RESISTOR: MIL type RC07GF391K.	5-47
R15		RESISTOR: MIL type RC42GF181K.	5-47
R16		Same as R15.	5-47
R17		Same as R1.	5-47
R18		Same as R7.	5-47
R19		Same as R7.	5-47
R20		Same as R1.	5-47
R21		RESISTOR: MIL type RC20GF820K.	5-47
R22		Same as R21.	5-47
R23		Same as R8.	5-47
R24		Same as R8.	5-47
R25		RESISTOR: MIL type RC07GF151K.	5-47
T1		TRANSFORMER, RF: 2 windings; primary winding 47 uh porm 20 pct at 25 deg C, 200 ohms impedance, 0 ma unbalanced dc, 200 ma balanced dc, 0.04 ohm dc resistance; secondary winding 200 ohms impedance, 0 ma, 0.04 ohm dc resistance; 42498 dwg A45388-2.	5-47

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A16A2 (cont)			
T2		TRANSFORMER, RF: 107 uh porm 20 pct at 25 deg C, 450 ohms impedance, 0 ma unbalanced dc, 200 ma balanced dc, 0.10 ohm dc resistance; secondary winding 50 ohms impedance, 0 ma, 0.01 ohm dc resistance; 42498 dwg A45388-1.	5-47

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A17		PRINTED CIRCUIT BOARD SUBASSEMBLY, TRANSMITTER CONTROL NO. 2: Performs system command functions between the exciter, external control, and RF amplifier units; the functions include frequency and mode selection, tuning initiation, fault indication, and operate and standby commands between the external units; the transmitter control circuits also process function and command signals originating with the external Decoder-Encoder KY-656/FRT via the Control Indicator, Transmitter C-7709/FRT; 42498 dwg D44762G1.	5-1
C1		CAPACITOR: MIL type CK06CW103K.	5-48
C2 thru C16		Same as C1.	5-48
CR1		SEMICONDUCTOR: MIL type 1N483B.	5-48
CR2 thru CR9		Same as CR1.	5-48
K1		RELAY: MIL type M5757/9-003.	5-48
K2		Same as K1.	5-48
K3		RELAY, ARMATURE: 4PDT, 3 amps at 28 vdc resistive contact rating; 42498 dwg A46486-1; 77342 type TL-4139.	5-48
Q1		TRANSISTOR: MIL type 2N2222.	5-48
Q2		Same as Q1.	5-48
Q3		Same as Q1.	5-48
Q4		TRANSISTOR: MIL type 2N2907.	5-48
Q5		Same as Q4.	5-48
Q6		Same as Q1.	5-48
Q7		Same as Q1.	5-48
Q8 thru Q12		Same as Q4.	5-48
Q13		TRANSISTOR: MIL type 2N2219A.	5-48
Q14		Same as Q13.	5-48
Q15 thru Q17		Same as Q1.	5-48
R1		RESISTOR: MIL type RC07GF332K.	5-48
R2 thru R7		Same as R1.	5-48
R8		RESISTOR: MIL type RC07GF560K.	5-48
R9		Same as R8.	5-48
R10		RESISTOR: MIL type RC07GF681K.	5-48
R11		RESISTOR: MIL type RC07GF181K.	5-48
R12		Same as R10.	5-48
R13		Same as R11.	5-48
R14		RESISTOR: MIL type RW70U6200F.	5-48
R15		Same as R14.	5-48
R16		Same as R14.	5-48
R17		RESISTOR: MIL type RC07GF362K.	5-48
R18		Same as R17.	5-48
R19		RESISTOR: MIL type RC07GF471K.	5-48
R20 thru R23		Same as R19.	5-48
R24		RESISTOR: MIL type RW70U6800F.	5-48
R25		Same as R19.	5-48
R26		Same as R24.	5-48
R27		Same as R19.	5-48
R28		Same as R24.	5-48
R29		Same as R19.	5-48
R30		Same as R10.	5-48

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A17 (cont)			
R31		Same as R10.	5-48
R32		Same as R19.	5-48
R33		Same as R19.	5-48
R34		RESISTOR: MIL type RW69V820.	5-48
R35		Same as R19.	5-48
R36		Same as R34.	5-48
R37		Same as R19.	5-48

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18		MODULATOR-SYNTHESIZER ASSEMBLY: The main chassis consists of two decks hinged at the rear where all modules, filters, and transformers are mounted for the operation of the exciter; all interconnecting cables are mounted between the decks and two multi-pin connectors are mounted on the rear panel for interface with the filter assembly; the majority of the operating controls, indicators, meters, and frequency setting switches are mounted on the front panel assembly; a sub-panel mounted behind the front panel contains auxiliary controls used for test and maintenance purposes; the front panel is connected to the chassis with a cable sufficiently long to permit the front panel to be removed for maintenance purposes; 42498 dwg E44203G1.	5-2
AT1		ATTENUATOR, VARIABLE: 50 ohms, porm 10 pct, 5w; 42498 dwg A44194-1; 01121 type JJ.	5-55
AT2 thru AT4		Same as AT1.	5-55
C1		CAPACITOR: MIL type CK05CW102K.	5-55
C2		CAPACITOR: MIL type CK05CW221K.	5-55
C3		Same as C1.	5-55
C4		CAPACITOR: MIL type CK05BX102K. (Not shown)	
C5		Not used.	
C6		CAPACITOR: MIL type CK05BX102K.	
C7		Not used.	
CB1		CIRCUIT BREAKER: SPDT; 1.0 amp, 240 vac, 60 kHz; 42498 dwg A44733-1; 81541 type AP13-SR199-1.	5-55
CR1		ABSORBER, OVERVOLTAGE: 33 vdc operating voltage, 1 vdc max reverse voltage; 42498 dwg A46062-1; 81840 type 126911-001.	5-55
CR2		SEMICONDUCTOR: MIL type 1N483B.	5-55
CR3		Same as CR1.	5-55
CR4		Same as CR2.	5-55
CR5		Same as CR2.	5-55
CR6		Not used.	
CR7		Not used.	
CR8		SEMICONDUCTOR: MIL type 1N1614R.	5-55
CR9		Same as CR8.	5-55
CR10		Not used.	
DS1		LAMP, INCANDESCENT: 18 vdc, 0.04 amp; T-1-3/4 bulb; 42498 dwg A46155-2; 92966 type 370.	5-55
DS2		Same as DS1.	5-55
DS3		Same as DS1.	5-55
DS4		Same as DS1.	5-55
DS5		Same as DS1.	5-55
DS6		LAMP: MIL type MS25237-327.	5-55
DS7		Same as DS6.	5-55
DS8		Same as DS1.	5-55
DS9		Same as DS1.	5-55
J1		CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact bronze; 1 amp, 50 ohms impedance, 50 vdc; phosphor brass body, silver plated finish, straight shape; 42498 dwg A44259-1; 74868 type 17825.	5-55
J2		Same as J1.	5-55
J3		Same as J1.	5-55

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18 (cont)			
J4A		JACK, TELEPHONE: MIL type JJ024.	5-55
J4B		Same as J4A.	5-55
J5A		Same as J4A.	5-55
J5B		Same as J4A.	5-55
J6A		Same as J4A.	5-55
J6B		Same as J4A.	5-55
J7A		Same as J4A.	5-55
J7B		Same as J4A.	5-55
J8		CONNECTOR: MIL type MS18185-1.	5-55
J9		CONNECTOR: MIL type MS18184-1. (Not shown)	5-55
M1		METER, ELECTRICAL FREQUENCY: Minus 20 to plus 3 VU range of inscription; porm 0.5 pct accuracy at full scale deflection; white background w/black and red markings; 42498 dwg A44022-1.	5-55
M2		AMMETER: 0 to 100 ua range of inscription; porm 3 pct accuracy at full scale deflection; white background w/black and green markings; 42498 dwg A44050-1.	5-55
MP1		KNOB: MIL type MS91528-1E1B.	5-55
MP2		KNOB: MIL type MS91528-1E2B.	5-55
MP3 thru MP5		Same as MP2.	5-55
MP6		KNOB: MIL type MS91528-1K2B.	5-55
MP7 thru MP10		Same as MP6.	5-55
MP11		KNOB: MIL type MS91528-1D2B.	5-55
MP12 thru MP16		Same as MP11.	5-55
MP17		DIAL, CONTROL: Round plastic; 0 to 9 CCW range of inscription; setscrew mtd; 42498 dwg B44389G1.	5-55
MP18 thru MP22		Same as MP17.	5-55
MP23		DIAL, CONTROL: Round aluminum; 0 to minus 30, plus 10 and plus 5 CCW range of inscription; setscrew mtd; 42498 dwg C44553G1.	5-55
MP24 thru MP26		Same as MP23.	5-55
MP27		DIAL, COUNTING: Round, clear finish; 0 to 30 turns w/mechanical brake; 100 dial divisions per turn; white markings with black background; 42498 dwg A46059-1; 80294 type H492-3.	5-55
P1		CONNECTOR, PLUG, ELECTRICAL: 1 male contact; plastic insulation right angle shape; 42498 dwg A47741-1; 98291 type 51-011-7848.	5-55
P2 thru P8		Same as P1.	5-55
P9		CONNECTOR, PLUG, ELECTRICAL: 1 male contact; plastic insulation; straight shape; 42498 dwg A46060-1; 94375 type 801-B-1800W.	5-55
P10		Same as P9.	5-55
P11		Same as P9.	5-55
P12		CONNECTOR: MIL type UG1460U.	5-55
P13		Same as P12.	5-55
Q1		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style TO-3; 42498 dwg A43788-1; 04713 type 2N3789.	5-55
Q2		Same as Q1.	5-55
R1		RESISTOR: MIL type RN60D2151F.	5-55
R2		Same as R1.	5-55
R3		RESISTOR, VARIABLE: 500 ohms, porm 10 pct, lw; 42498 dwg A45111-1; 01121 type JAIN056S501DA.	5-55
R4		Same as R1.	5-55

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18 (cont)			
R5		Same as R1.	5-55
R6		Same as R3.	5-55
R7		Same as R1.	5-55
R8		Same as R1.	5-55
R9		Same as R3.	5-55
R10		Same as R1.	5-55
R11		Same as R1.	5-55
R12		Same as R3.	5-55
R13		RESISTOR: MIL type RV6LAYSA503A.	5-55
R14		RESISTOR: MIL type RN70D49R9B.	5-55
R15 thru R21		Same as R14.	5-55
R22		RESISTOR: MIL type RC07GF205J.	5-55
R23		RESISTOR: MIL type RN60D4223F.	5-55
R24		RESISTOR: MIL type RN60D2433F.	5-55
R25		RESISTOR: MIL type RN60D8252F.	5-55
R26		RESISTOR: MIL type RN60D2552F.	5-55
R27		RESISTOR: MIL type RN60D2153F.	5-55
R28		RESISTOR: MIL type RN60D6342F.	5-55
R29		RESISTOR: MIL type RN60D2211F.	5-55
R30		RESISTOR: MIL type RN60D8060F.	5-55
R31		RESISTOR: MIL type RN60D4991F.	5-55
R32		RESISTOR: MIL type RN60D1001F.	5-55
R33		RESISTOR: MIL type RV6NAYSD504C.	5-55
R34		RESISTOR: MIL type RV4LAYSA353A.	5-55
R35		RESISTOR, VARIABLE: 20 ohms porm 0.2 pct linearity; 0 to 30 turns; 42498 dwg A46058-1; 80294 type 3500S-2-203.	5-55
R36		RESISTOR: MIL type RN60D1820F.	5-55
R37 thru R43		Same as R36.	5-55
R44		Not used.	
R45		RESISTOR: MIL type RC07GF154J.	5-55
R46		Not used.	
R47		RESISTOR: MIL type RC07GF4R7J.	5-55
R48 thru R50		Same as R47.	5-55
R51		Not used.	
R52		RESISTOR: MIL type RC07GF100K.	5-55
R53		Same as R52.	5-55
R54		Same as R52.	5-55
R55		RESISTOR: MIL type RC07GF153K. (Not shown)	
S1		SWITCH, ROTARY: 1 section, 2 poles and 5 positions; nonshorting contacts; 36 deg positioning increment; 42498 dwg A44379-1; 76854 type 267625-BA1.	5-55
S2		SWITCH, ROTARY: Solenoid actuated; 28 vdc, 8.02 ohms coil resistance, 15 to 25 steps per second solenoid CW speed; contact rating 2 amps at 28 vdc resistive and 1 amp at 110 vac resistive; 3 sections, 6 positions each section; 42498 dwg A45452-1; 81840 type 172495-001.	5-55
S3		SWITCH, ROTARY: Solenoid actuated; 28 vdc, 8.02 ohms coil resistance, 15 to 25 steps per second solenoid CW speed; contact rating 2 amps at 28 vdc resistive and 1 amp at 110 vac resistive; 4 sections with 7 positions for each section; 30 deg positioning increment; 42498 dwg A45453-1; 81840 type 172494-001.	5-55

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18 (cont)			
S4		SWITCH, ROTARY: 3 sections; 1 pole on section one, 24 dummy lugs on section two, 1 pole on section three with 24 positions for each section; non-shorting contacts; 15 deg positioning increment; 42498 dwg A44377-1; 76854 type 267623-MF3E.	5-55
S5		SWITCH, ROTARY: One section; 4 poles with 3 positions, non-shorting contacts, 36 deg positioning increment; 42498 dwg A44615-1; 76854 type 267629-BA1.	5-55
S6		SWITCH, ROTARY: 3 sections; 2 poles on sections one and two, 1 pole on section three with 10 positions for each section; non-shorting contacts; 36 deg positioning increment; 42498 dwg A44610-1; 76854 type 267628-BA3.	5-55
S7		SWITCH, ROTARY: 2 sections; 2 poles on section one, 1 pole on section two with 10 positions for each section; non-shorting contacts; 36 deg positioning increment; 42498 dwg A44592-1; 76854 type 267626-BA2.	5-55
S8		SWITCH, ROTARY: 3 sections; 2 poles on sections one and two, 1 pole on section three with 10 positions for each section; non-shorting contacts; 36 deg positioning increment; 42498 dwg A44601-1; 76854 type 267627-BA3.	5-55
S9		Same as S7.	5-55
S10		Same as S7.	5-55
S11		SWITCH, ROTARY: 5 sections; 8 poles and 2 positions for each section; non-shorting contacts; 36 deg positioning increment; 42498 dwg A44378-1; 76854 type 267624-MF6E.	5-55
S12		Not used.	
S13		SWITCH: MIL type MS75029-23.	5-55
S14		Same as S13.	5-55
S15		SWITCH, PUSH: 2PDT; 3 amps at 28 vdc resistive and 1.5 amps at 28 vdc inductive; 42498 dwg A44044-28; 96182 type 90E10A1C2J1(W)H1L10N1R12 TUNE.	5-55
S15DS1		LAMP, INCANDESCENT: 18 vdc, 0.04 amp; T-1 3/4 bulb; 42498 dwg A46155-2; 92966 type 370.	5-55
S15DS2		Same as S15DS1.	5-55
S16		SWITCH, PUSH: 2PDT; 3 amps at 28 vdc resistive and 1.5 amps at 28 vdc inductive; 42498 dwg A44044-27; 96182 type 90E10A1C2J1(W)H1L10N1R12 STANDBY.	5-55
S16DS1		Same as S15DS1.	5-55
S16DS2		Same as S15DS1.	5-55
S17		SWITCH, PUSH: 2PDT; 3 amps at 28 vdc resistive and 1.5 amps at 28 vdc inductive; 42498 dwg A44044-26; 96182 type 90E10A1C2J1(G)H1L10N1R12 OPERATE.	5-55
S17DS1		Same as S15DS1.	5-55
S17DS2		Same as S15DS1.	5-55

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18 (cont)			
S18		SWITCH, PUSH: 2PDT; 3 amps at 28 vdc resistive and 1.5 amps at 28 vdc inductive; 42498 dwg A44044-29; 96182 type 90E10A1C2J1(W)H1L10N1R13 AMPLIFIER, OFF.	5-55
S18DS1		Same as S15DS1.	5-55
S18DS2		Same as S15DS1.	5-55
S19		SWITCH: MIL type MS75029-27.	5-55
T1		TRANSFORMER, AF: Minus 250 to 6000 cps operating frequency range, minus 600 ohms primary impedance; no dc current in windings; 42498 dwg A43633-1.	5-55
T2 thru T4		Same as T1.	5-55
XA1		CONNECTOR: MIL type MS18177-1.	5-55
XA2 thru XA4		Same as XA1.	5-55
XA5		CONNECTOR: MIL type M21097/1-145.	5-55
XA6		Not used.	
XA7 thru XA9		Same as XA1.	5-55
XA10		Not used.	
XA11		CONNECTOR, RECEPTACLE, ELECTRICAL: 26 female contacts, 13 amps, phospher bronze, gold plated finish; rectangular shape, plastic; 42498 dwg A42560-1; 81312 type MRAC26SG7.	5-55
XA12P1		Same as XA11.	5-55
XA12P2		Same as XA11.	5-55
XA13 thru XA16		Same as XA1.	5-55
XDS1		LIGHT: MIL type LH73LC12CN2.	5-55
XDS2		Same as XDS1.	5-55
XDS3		Same as XDS1.	5-55
XDS4		LIGHT, INDICATOR: 1 amp; accommodates two incandescent T-1 3/4 midget flange base lamps; marked "Ready"; filter color green; 42498 dwg A44045-21; 96182 type 80E10A1F1(G)H1J1L1N12 READY.	5-55
XDS5		Not used.	
XDS6		LIGHT, INDICATOR: 1 amp; accommodates two incandescent T-1 3/4 midget flange base lamps; marked "STD OVEN/STD FAIL"; filter color amber; 42498 dwg A44045-20; 96182 type 80E10A1F2(YR) H2J2L1N16 STD OVEN/STD FAIL.	5-55
XDS7		Not used.	
XDS8		LIGHT, INDICATOR: 1 amp; accommodates two incandescent T-1 3/4 midget flange base lamps; marked "EXC FAIL/XMTR FAIL"; filter color red/red; 42498 dwg A44045-23; 96182 type 80E10A1F2(RR) H2J2L1N16 EXC FAIL/XMTR FAIL.	5-55
XPS1		CONNECTOR: MIL type MS18177-1.	5-55
Z1		X4 MULTIPLIER: Provides a 120 MHz output for the 1.75/-113.75 MHz frequency generator from a 30 MHz input signal generated by the auxiliary frequency generator; 42498 dwg A45000-1.	5-55

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, VOLUME UNITS METER AMPL: Drives the VU meter which indicates the audio input level to the individual modulators; the amplifier input is switched to read the individual channel levels as required; 42498 dwg D43734G1.	5-55
C1		CAPACITOR: MIL type CK05CW391K.	5-56
C2		CAPACITOR: MIL type CS13BF334K.	5-56
C3		CAPACITOR: MIL type CS13BE476K.	5-56
C4		CAPACITOR: MIL type CS13BF565K.	5-56
C5		CAPACITOR: MIL type CS13BF105K.	5-56
C6		Same as C3.	5-56
C7		CAPACITOR: MIL type CS13BC396K.	5-56
C8		CAPACITOR: MIL type CS13BF226K.	5-56
CR1		SEMICONDUCTOR: MIL type 1N963B.	5-56
Q1		TRANSISTOR: MIL type 2N930.	5-56
Q2		Same as Q1.	5-56
Q3		Same as Q1.	5-56
R1		RESISTOR: MIL type RC07GF682K.	5-56
R2		RESISTOR: MIL type RC07GF154K.	5-56
R3		Same as R2.	5-56
R4		RESISTOR: MIL type RC07GF153K.	5-56
R5		Same as R1.	5-56
R6		RESISTOR: MIL type RC07GF331K.	5-56
R7		Same as R1.	5-56
R8		RESISTOR: MIL type RC07GF273J.	5-56
R9		RESISTOR: MIL type RC07GF683K.	5-56
R10		RESISTOR: MIL type RC07GF123K.	5-56
R11		RESISTOR: MIL type RC07GF332K.	5-56
R12		RESISTOR: MIL type RC07GF470K.	5-56
R13		RESISTOR: MIL type RC07GF561K.	5-56
R14		RESISTOR: MIL type RC07GF821J.	5-56
R15		RESISTOR: MIL type RC07GF332J.	5-56

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, FAULT BOARD: Monitors major operating functions in the Exciter and external RF Amplifier; when a circuit malfunction occurs, the fault board circuitry will switch the transmitting system off and light an indicator on the exciter unit panel. "EXC FAIL", "XMTR FAIL", and "STD FAIL" indicators are used for this purpose; a "fault override" switch on the exciter auxiliary panel permits overriding the fault indication to locate the circuit malfunction; 42498 dwg E44857G1.	5-55
C1		CAPACITOR: MIL type CK06CW103K.	5-57
C2 thru C5		Same as C1.	5-57
C6		CAPACITOR: MIL type CS13BB685K.	5-57
C7		Same as C1.	5-57
C8		Same as C6.	5-57
C9		Same as C1.	5-57
C10		Same as C6.	5-57
C11 thru C14		Same as C1.	5-57
C15		CAPACITOR: MIL type CL65BH151MP3.	5-57
C16 thru C18		Same as C1.	5-57
C19		CAPACITOR: MIL type CS13BB157K.	5-57
C20		CAPACITOR: MIL type CS13BF336K.	5-57
C21		Same as C15.	5-57
C22 thru C25		Same as C1.	5-57
C26		Not used.	
C27 thru C35		Same as C1.	5-57
CR1		SEMICONDUCTOR: MIL type 1N748A.	5-57
CR2		SEMICONDUCTOR: MIL type 1N483B.	5-57
CR3		SEMICONDUCTOR: MIL type 1N755A.	5-57
CR4		SEMICONDUCTOR: MIL type 1N753A.	5-57
CR5 thru CR7		Same as CR2.	5-57
CR8		Same as CR1.	5-57
CR9 thru CR13		Same as CR2.	5-57
CR14		Not used.	
CR15 thru CR19		Same as CR2.	5-57
K1		RELAY: MIL type M5757/9-003.	5-57
L1		COIL, RF: MIL type MS90537-49.	5-57
L2 thru L10		Same as L1.	5-57
Q1		TRANSISTOR: MIL type 2N2222.	5-57
Q2 thru Q4		Same as Q1.	5-57
Q5		TRANSISTOR: MIL type 2N2907.	5-57
Q6		TRANSISTOR: MIL type 2N491A.	5-57
Q7		TRANSISTOR: MIL type 2N2323A.	5-57
Q8		Same as Q5.	5-57
Q9		Same as Q1.	5-57
Q10		Not used.	
Q11		Same as Q1.	5-57
Q12		TRANSISTOR: MIL type 2N2222A.	5-57
R1		RESISTOR: MIL type RC32GF561K.	5-57
R2		RESISTOR: MIL type RC07GF510J.	5-57
R3		Same as R2.	5-57
R4		Same as R2.	5-57
R5		RESISTOR: MIL type RC07GF272J.	5-57

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A2 (cont)			
R6		Same as R5.	5-57
R7		Same as R5.	5-57
R8		RESISTOR: MIL type RC07GF272K.	5-57
R9		RESISTOR: MIL type RC07GF221J.	5-57
R10		RESISTOR: MIL type RC07GF271J.	5-57
R11		Same as R9.	5-57
R12		Same as R10.	5-57
R13		Same as R9.	5-57
R14		Same as R10.	5-57
R15		RESISTOR: MIL type RC07GF333J.	5-57
R16		Same as R15.	5-57
R17		Same as R15.	5-57
R18		RESISTOR: MIL type RC32GF221K.	5-57
R19		RESISTOR: MIL type RC07GF334K.	5-57
R20		RESISTOR: MIL type RC07GF104K.	5-57
R21		RESISTOR: MIL type RC07GF391K.	5-57
R22		RESISTOR: MIL type RC07GF103K.	5-57
R23		RESISTOR: MIL type RC07GF393J.	5-57
R24		RESISTOR: MIL type RC07GF101K.	5-57
R25		RESISTOR: MIL type RC07GF103J.	5-57
R26		RESISTOR: MIL type RC07GF681J.	5-57
R27		RESISTOR: MIL type RC07GF182J.	5-57
R28		RESISTOR: MIL type RC07GF471J.	5-57
R29		Same as R20.	5-57
R30		Same as R22.	5-57
R31		RESISTOR: MIL type RC07GF102K.	5-57
R32		Not used.	
R33		Not used.	
R34		RESISTOR: MIL type RC07GF302K.	5-57
R35 thru R37		Not used.	
R38		RESISTOR: MIL type RC07GF622K.	5-57
R39		Same as R38.	5-57
R40		RESISTOR: MIL type RC07GF471K.	5-57
R41 thru R43		Same as R40.	5-57
R44		RESISTOR: MIL type RC42GF183K.	5-57
R45		RESISTOR: MIL type RC07GF123K.	5-57
R46		RESISTOR: MIL type RC07GF182K.	5-57
R47		RESISTOR: MIL type RC07GF271K.	5-57
Z1		INTEGRATED CIRCUIT, LOGIC GATE: High speed differential comparator; plus 14v positive supply voltage, minus 7v negative supply voltage, 10 ma, 300 MV internal power dissipation; 42498 dwg A42423-10; 14433 type UA710.	5-57
Z1 to Z4		Same as Z1.	5-57

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A3		FREQUENCY SELECT BOARD SUBASSEMBLY: Located in close proximity to the Synthesizer Assembly, is a diode-biasing network for the frequency selection circuitry and a diode-gate circuit for control of the up-converter assembly during frequency selection; 42498 dwg C44958G1.	5-55
CR1		SEMICONDUCTOR: MIL type 1N914.	5-58
CR2		Same as CR1.	5-58
R1		RESISTOR: MIL type RC07GF332J.	5-58
R2 thru R22		Same as R1.	5-58

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A4		PRINTED CIRCUIT BOARD SUBASSEMBLY, TRANSMITTER CONTROL: 42498 dwg D45101G1.	5-55
CR1		SEMICONDUCTOR: MIL type 1N4148.	5-59
XA1 thru XA9		Not used.	
XA10		CONNECTOR, PLUG, ELECTRICAL: 40 dual male contacts, 1 amp, beryllium copper, gold plated finish; rectangular shape, plastic; 42498 dwg A46483-1; 95238 type 600-6PC40.	5-59
XA11 thru XA16		Not used.	
XA17		Same as XA10.	5-59

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A5		PRINTED CIRCUIT BOARD SUBASSEMBLY, MOTOR CONTROL: Provides protection for the solenoids used in the "Sideband Selector" and "Class of Emission" switches on the front panel; 42498 dwg D45567G1.	5-55
C1		Not used.	
C2		CAPACITOR: MIL type CK06BX104K.	5-60
C3		CAPACITOR: MIL type CS13BE225K.	5-60
CR1 thru CR3		Not used.	
CR4		SEMICONDUCTOR: MIL type 1N3064.	5-60
Q1		TRANSISTOR: MIL type 2N3500.	5-60
Q2		Not used.	
Q3		TRANSISTOR: MIL type 2N2222.	5-60
Q4		Same as Q3.	5-60
R1		RESISTOR: MIL type RC07GF394J.	5-60
R2		Not used.	
R3		Not used.	
R4		RESISTOR: MIL type RC07GF272K.	5-60
R5		RESISTOR: MIL type RC07GF471K.	5-60
R6		Same as R5.	5-60
R7		RESISTOR: MIL type RC07GF473K.	5-60

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A18A6		POWER DISTRIBUTION BOARD SUBASSEMBLY: 42498 dwg D46591G1.	5-55
C1		CAPACITOR: MIL type CS13BF476M. (Not shown)	
C2		CAPACITOR: MIL type CK05BX102K. (Not shown)	
K1		RELAY: MIL type M5757/9-003.	5-61
K2 thru K5		Same as K1.	5-61
R1		Not used.	
R2		RESISTOR: MIL type RJ24CW105.	5-61
R3		RESISTOR: MIL type RJ24CW503.	5-61
R4		RESISTOR: MIL type RJ24CW104.	5-61
R5		RESISTOR: MIL type RC42GF101K.	5-61
R6		Same as R4.	5-61
R7		RESISTOR: MIL type RJ24CW253.	5-61

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
A19		FILTER PANEL ASSEMBLY, MODULATOR-SYNTHESIZER: Comprised of RFI filters and interconnecting cables used for signal and input power connections; interfacing with the external RF amplifier and auxiliary equipment; they are mounted on the rear panel which in turn is fastened to the outer case with machine screws through the RFI gasket; 42498 dwg E44634G1.	5-1
C1		CAPACITOR: MIL type CK06CW103K.	5-4
C2		Same as C1.	5-4
E1		TERMINAL: MIL type SE199D01.	5-4
E2		Same as E1.	5-4
FL1		FILTER, RADIO INTERFERENCE: 250 vac or minus 600 vdc; 2 x 1.5 amps, 47 to 63 cps at rated voltage; 42498 dwg A44196-1.	5-3
FL2		FILTER, RADIO INTERFERENCE: 24 sections; 100 vdc for all sections, 0.10 amp at 25 deg C for all sections; 42498 dwg A44834-1.	5-3
FL3		FILTER, RADIO INTERFERENCE: 19 sections; 100 vdc for all sections, 0.1 amp at 25 deg C for 11 sections; 42498 dwg A44842-1.	5-3
J1		CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact, 50 ohms impedance, straight shape; 42498 dwg A43520-1; 94375 type 011-N3805-85.	5-3
J2		CONNECTOR: MIL type MS35182-911A.	5-3
J3		Same as J2.	5-3
J4		CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact, 50 ohms impedance, 1 amp, 500 vdc, phospher bronze; straight shape, brass, silver plated finish; 42498 dwg A44259-1; 74868 type 17825.	5-3
J5		Same as J4.	5-3
J6		CONNECTOR: MIL type MS3114E12-10P.	5-3
J7		CONNECTOR: MIL type MS3114E20-39P.	5-3
J8		CONNECTOR: MIL type MS3114E20-39PW.	5-3
L1		INDUCTOR: MIL type MS90537-25.	5-4
L2		Same as L1.	5-4
P1		CONNECTOR: MIL type MS18185-1.	5-4
P2		CONNECTOR: MIL type MS18184-1.	5-4

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1		POWER SUPPLY ASSEMBLY: The power supply used by the exciter contains four individual voltage regulating circuits fed from a common power transformer and full-wave rectifier circuit; the regulator circuits consist of a minus 12 volt regulator; plus 5 and plus 18 volt regulator; plus 15 and plus 24 volt regulator; plus 125 watt regulator and a switching regulator; the 12.5 MHz pulse supplied by the synthesizer synchronizes the plus 5 and plus 18 volt solid-state switching circuits; 42498 dwg E44109G1.	5-1
C1		CAPACITOR: MIL type CE71C182H.	5-49
CR1		SEMICONDUCTOR: MIL type 1N1124A.	5-49
CR2 thru CR6		Same as CR1.	5-49
CR7		SEMICONDUCTOR: MIL type 1N4942.	5-49
CR8		SEMICONDUCTOR: MIL type 1N2974B.	5-49
J1		CONNECTOR: MIL type MS18177-1.	5-49
L1		REACTOR: 6 mh porm 10 pct at 0.1v RMS; 1 kHz and 0 amp dc, incremental inductance 3.2 mh min at 1 kHz and 4 amps dc, Q 150 min at 1 kHz and 0.1v RMS, 0.25 ohm dc resistance, 55v peak operating voltage; 42498 dwg A45393-1.	5-49
P1		CONNECTOR: MIL type MS18176-1.	5-49
P2		Same as P1.	5-49
Q1		TRANSISTOR: MIL type 2N1490.	5-49
Q2		TRANSISTOR: MIL type 2N2219.	5-49
Q3		TRANSISTOR: MIL type 2N1485.	5-49
Q4		TRANSISTOR: Silicon; P-N-P polarity; JEDEC case style TO-3; 42498 dwg A43788-1; 04713 type 2N3789.	5-49
Q5 thru Q7		Same as Q4.	5-49
R1		RESISTOR: MIL type RE60GR250.	5-49
R2		RESISTOR: MIL type RE60GR511.	5-49
S1		SWITCH: MIL type MS35059-23.	5-49
T1		TRANSFORMER, POWER, STEP-UP: Primary winding 115 and 230v RMS, 47 to 63 cps, single phase; secondary winding no. one 72v RMS center tapped, 2.5 amps dc continuous duty; secondary winding no. two 34v RMS, 4.0 amps dc porm 10 pct duty cycle; secondary winding no. three 70v RMS, 0.04 amp dc continuous duty; 42498 dwg A44703-1.	5-49

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A1		PRINTED CIRCUIT BOARD SUBASSEMBLY, -12V REGULATOR: 42498 dwg D43999G1.	5-49
C1		CAPACITOR: MIL type CL65BH151MP3.	5-51
C2		Same as C1.	5-51
C3		CAPACITOR: MIL type CS13BF105K.	5-51
CR1		Not used.	
CR2		SEMICONDUCTOR: MIL type 1N914.	5-51
CR3		Same as CR2.	5-51
CR4		Same as CR2.	5-51
CR5		SEMICONDUCTOR: MIL type 1N821.	5-51
Q1		TRANSISTOR: MIL type 2N2907.	5-51
Q2		Same as Q1.	5-51
Q3		TRANSISTOR: MIL type 2N2222.	5-51
R1		Not used.	
R2		Not used.	
R3		RESISTOR: MIL type RC07GF272K.	5-51
R4		RESISTOR: MIL type RW69VR82.	5-51
R5		RESISTOR: MIL type RC07GF151K.	5-51
R6		RESISTOR: MIL type RC07GF332J.	5-51
R7		RESISTOR: MIL type RC07GF562J.	5-51

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A2		PRINTED CIRCUIT BOARD SUBASSEMBLY, +5 AND +18 VOLT REGULATOR: 42498 dwg D42577G2.	5-49
C1		CAPACITOR: MIL type CS13BF476K.	5-52
C2		CAPACITOR: MIL type CS13BE155K.	5-52
C3		CAPACITOR: MIL type CK05CW102K.	5-52
C4		CAPACITOR: MIL type CK06BX223K.	5-52
C5		CAPACITOR: MIL type CK06CW103K.	5-52
C6		Same as C2.	5-52
C7		Same as C5.	5-52
C8		CAPACITOR: MIL type CL65BH151MP3.	5-52
C9		Same as C8.	5-52
C10		Not used.	
C11		Same as C5.	5-52
C12		Same as C5.	5-52
C13		Same as C3.	5-52
C14		Same as C5.	5-52
C15		Same as C8.	5-52
C16		Same as C8.	5-52
CR1		SEMICONDUCTOR: MIL type 1N967B.	5-52
CR2		SEMICONDUCTOR: MIL type 1N821.	5-52
CR3		SEMICONDUCTOR: MIL type 1N754A.	5-52
CR4		SEMICONDUCTOR: MIL type 1N4942.	5-52
CR5		Same as CR3.	5-52
CR6		Same as CR4.	5-52
L1		REACTOR: 7 mh at porm 10 pct at 1v RMS; 1.0 amp dc, Q 80 min at 1 kHz and 1v RMS, 0.38 ohm dc resistance; 42498 dwg A43531-1.	5-52
L2		Same as L1.	5-52
Q1		TRANSISTOR: MIL type 2N2222.	5-52
Q2		Same as Q1.	5-52
Q3		TRANSISTOR: MIL type 2N2907A.	5-52
Q4		Same as Q1.	5-52
Q5		Same as Q1.	5-52
Q6		Same as Q3.	5-52
R1		RESISTOR: MIL type RC20GF221J.	5-52
R2		RESISTOR: MIL type RC07GF272K.	5-52
R3		RESISTOR: MIL type RC07GF123K.	5-52
R4		RESISTOR: MIL type RC07GF102K.	5-52
R5		RESISTOR: MIL type RC07GF222K.	5-52
R6		RESISTOR: MIL type RN55C1211F.	5-52
R7		RESISTOR: MIL type RN55C5621F.	5-52
R8		RESISTOR: MIL type RC42GF471K.	5-52
R9		Same as R4.	5-52
R10		RESISTOR: MIL type RC07GF101K.	5-52
R11		Same as R4.	5-52
R12		RESISTOR: MIL type RC07GF330K.	5-52
R13		RESISTOR: MIL type RC07GF100K.	5-52
R14		RESISTOR: MIL type RC07GF392K.	5-52
R15		RESISTOR: MIL type RC07GF331K.	5-52
R16		RESISTOR: MIL type RC07GF223K.	5-52
R17		Same as R7.	5-52
R18		RESISTOR: MIL type RN55C2211F.	5-52
R19		Same as R2.	5-52

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A2 (cont)			
R20		Same as R13.	5-52
R21		Same as R3.	5-52
R22		Same as R4.	5-52
R23		Same as R8.	5-52
R24		Same as R4.	5-52
R25		Same as R10.	5-52
R26		Same as R12.	5-52
R27		Same as R14.	5-52
R28		Same as R4.	5-52
R29		Same as R16.	5-52
Z1		INTEGRATED CIRCUIT, LOGIC GATE: High speed differential comparator; plus 14v positive supply voltage, minus 7v negative supply voltage, 10 ma, 300 MW internal power dissipation; 42498 dwg A42423-10; 14433 type UA710.	5-52
Z2		Same as Z1.	5-52

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A3		PRINTED CIRCUIT BOARD SUBASSEMBLY, 15 AND 25 VOLT DC REGULATOR: 42498 dwg D43962G1.	5-49
C1		CAPACITOR: MIL type CL65BH151MP3.	5-53
C2		Same as C1.	5-53
C3		CAPACITOR: MIL type CK05CW121K.	5-53
C4		Same as C3.	5-53
C5		CAPACITOR: MIL type CS13BE155K.	5-53
C6		Same as C5.	5-53
C7		Same as C1.	5-53
C8		CAPACITOR: MIL type CS13BF476K.	5-53
C9		Same as C1.	5-53
C10		Same as C8.	5-53
CR1		SEMICONDUCTOR: MIL type 1N758A.	5-53
CR2		Not used.	
CR3		Same as CR1.	5-53
CR4 thru CR6		Not used.	
CR7		SEMICONDUCTOR: MIL type 1N821.	5-53
CR8		Not used.	
CR9		Same as CR7.	5-53
Q1		TRANSISTOR: MIL type 2N2222.	5-53
Q2 thru Q6		Same as Q1.	5-53
R1		RESISTOR: MIL type RC07GF391K.	5-53
R2		RESISTOR: MIL type RC07GF183K.	5-53
R3		RESISTOR: MIL type RC07GF221K.	5-53
R4		Same as R2.	5-53
R5		Not used.	
R6		RESISTOR: MIL type RC07GF222K.	5-53
R7		Not used.	
R8		RESISTOR: MIL type RC07GF273K.	5-53
R9		Same as R6.	5-53
R10		RESISTOR: MIL type RC07GF682K.	5-53
R11		Same as R8.	5-53
R12		RESISTOR: MIL type RC07GF562K.	5-53
R13		Same as R10.	5-53
R14		Same as R12.	5-53
R15		RESISTOR: MIL type RN60D1372F.	5-53
R16		RESISTOR: MIL type RN60D4641F.	5-53
R17		RESISTOR: MIL type RN60D6811F.	5-53
R18		RESISTOR: MIL type RN60D4751F.	5-53

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A4		PRINTED CIRCUIT BOARD SUBASSEMBLY, 125V RECTIFIER, REGULATOR AND FILTER: 42498 dwg D44001G1.	5-49
C1		CAPACITOR: MIL type CL65BP140MP3.	5-50
C2		Same as C1.	5-50
C3		CAPACITOR: MIL type CL65BP250MP3.	5-50
C4		Same as C3.	5-50
C5		CAPACITOR: MIL type CK06CW103K.	5-50
C6		Same as C5.	5-50
C7		CAPACITOR: MIL type M18312/01-0436.	5-50
C8		Same as C7.	5-50
C9		Same as C5.	5-50
CR1		SEMICONDUCTOR: MIL type 1N645.	5-50
CR2		Same as CR1.	5-50
CR3		SEMICONDUCTOR: MIL type 1N967B.	5-50
CR4		SEMICONDUCTOR: MIL type 1N914.	5-50
CR5		Same as CR4.	5-50
CR6		SEMICONDUCTOR: MIL type 1N985B.	5-50
CR7		SEMICONDUCTOR: MIL type 1N758A.	5-50
CR8		Same as CR4.	5-50
CR9		Same as CR4.	5-50
CR10		SEMICONDUCTOR: MIL type 1N821.	5-50
Q1		TRANSISTOR: MIL type 2N1893.	5-50
Q2		Same as Q1.	5-50
Q3		TRANSISTOR: MIL type 2N2222.	5-50
Q4 thru Q6		Same as Q3.	5-50
R1		RESISTOR: MIL type RC20GF152K.	5-50
R2		RESISTOR: MIL type RC07GF104K.	5-50
R3		Same as R2.	5-50
R4		RESISTOR: MIL type RC07GF471K.	5-50
R5		Not used.	
R6		RESISTOR: MIL type RC07GF183K.	5-50
R7		RESISTOR: MIL type RC07GF332K.	5-50
R8		RESISTOR: MIL type RC07GF270K.	5-50
R9		RESISTOR: MIL type RC07GF472K.	5-50
R10		Same as R8.	5-50
R11		RESISTOR: MIL type RC07GF680K.	5-50
R12		RESISTOR: MIL type RC07GF122K.	5-50
R13		RESISTOR: MIL type RC07GF153J.	5-50
R14		RESISTOR: MIL type RC07GF682K.	5-50
R15		Same as R13.	5-50
R16		RESISTOR: MIL type RN65C1003F.	5-50
R17		RESISTOR: MIL type RN60C4871F.	5-50
R18		RESISTOR: MIL type RC07GF472J.	5-50
R19		RESISTOR: MIL type RC07GF124J.	5-50
R20		RESISTOR: MIL type RC32GF101K.	5-50

TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
PS1A5		PRINTED CIRCUIT BOARD SUBASSEMBLY, SWITCHING REGULATORS: 42498 dwg D46524G1.	5-49
C1		CAPACITOR: MIL type CK06CW103K.	5-54
C2		CAPACITOR: MIL type CS13BE156K.	5-54
C3		Same as C1.	5-54
C4		CAPACITOR: MIL type CK06BX104K.	5-54
C5		CAPACITOR: MIL type CL65BH151MP3.	5-54
C6		Same as C1.	5-54
C7		Same as C5.	5-54
C8		Same as C1.	5-54
C9		Same as C4.	5-54
CR1		SEMICONDUCTOR: MIL type 1N3064.	5-54
CR2		SEMICONDUCTOR: MIL type 1N821.	5-54
CR3		SEMICONDUCTOR: MIL type 1N967B.	5-54
CR4		SEMICONDUCTOR: MIL type 1N914.	5-54
CR5		SEMICONDUCTOR: MIL type 1N756A.	5-54
CR6		Same as CR4.	5-54
Q1		TRANSISTOR: MIL type 2N2907A.	5-54
Q2		TRANSISTOR: MIL type 2N2905A.	5-54
Q3		TRANSISTOR: MIL type 2N2222.	5-54
Q4		Same as Q1.	5-54
R1		RESISTOR: MIL type RC07GF222K.	5-54
R2		RESISTOR: MIL type RC07GF471K.	5-54
R3		RESISTOR: MIL type RC07GF102J.	5-54
R4		RESISTOR: MIL type RC07GF153J.	5-54
R5		RESISTOR: MIL type RC07GF473K.	5-54
R6		RESISTOR: MIL type RC32GF102K.	5-54
R7		RESISTOR: MIL type RC07GF472K.	5-54
R8		RESISTOR: MIL type RC07GF331K.	5-54
R9		RESISTOR: MIL type RC07GF104K.	5-54
R10		RESISTOR: MIL type RW69V680.	5-54
R11		RESISTOR: MIL type RC07GF100K.	5-54
R12		RESISTOR: MIL type RC07GF101K.	5-54
R13		RESISTOR: MIL type RC07GF330K.	5-54
R14		RESISTOR: MIL type RC07GF102J.	5-54
R15		RESISTOR: MIL type RC07GF182K.	5-54
R16		RESISTOR: MIL type RC07GF223K.	5-54
R17		RESISTOR: MIL type RC07GF682K.	5-54
R18		RESISTOR: MIL type RT12C2P102.	5-54
R19		RESISTOR: MIL type RC07GF152J.	5-54
R20		Same as R2.	5-54
Z1		INTEGRATED CIRCUIT, LOGIC GATE: High speed differential comparator; plus 14v positive supply voltage, minus 7v negative supply voltage, 10 ma, 300 MW internal power dissipation; 42498 dwg A42423-10; 14433 type UA710.	5-54

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TABLE 6-2. MAINTENANCE PARTS LIST (Cont)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
		SUPPLIED WITH BUT NOT PART OF EQUIPMENT	
		SPECIAL TOOLS AND EQUIPMENT	
		CABLE ASSEMBLY, RF: C/o one connector plug MIL type MS18176-1 on one end and one connector plug MIL type MS18177-1 on the other end; one strand of cable MIL type RG196U, 10 in lg; 42498 dwg C45138G1.	
		CABLE ASSEMBLY, RF: C/o one connector plug 42498 dwg A42559-3; 81312 type MRAC26PG7 on one end and one connector plug 42498 dwg A42560-3, 81312 type MRAC26SG7 on the other end; 10 strands of cable MIL type RG196U, 10 in lg; 42498 dwg C45148G1.	
		CABLE ASSEMBLY, RF: C/o one connector plug MIL type MS18176-1 on one end and one connector plug MIL type MS18177-1 on the other end; 7 strands of cable MIL type RG196U, 10 in lg; 42498 dwg C45149G1.	
		CABLE ASSEMBLY, RF: C/o one connector plug MIL type MS18176-1 on one end and one connector plug MIL type MS18177-1 on the other end; 12 strands of cable MIL type RG196U, 10 in lg; 42498 dwg C45149G2.	
		CARD, EXTENDER: For use with printed circuit board A5; 42498 dwg D45184G1.	
		CARD, EXTENDER: For use with printed circuit boards A10 and A17; 42498 dwg E45170G1.	
		CARD, EXTENDER: For use with printed circuit board A12A7A1, 42498 dwg D46442G1.	
		CARD, EXTENDER: For use with printed circuit boards A12A1 to A6; 42498 dwg D46442G2.	
		CONNECTOR: MIL type MS3108R14S-7S.	
		CONNECTOR: MIL type MS3116F20-39SX.	
		CONNECTOR: MIL type MS3116F14-19S.	
		EXTRACTOR, PRINTED CIRCUIT BOARD: 42498 dwg B43412G1.	
		EXTRACTOR, PRINTED CIRCUIT BOARD: 42498 dwg B45837G1.	

TABLE 6-3. LIST OF MANUFACTURERS

MFR CODE	NAME	ADDRESS
01121	Allen-Bradley Co.	1201 South 2nd Street Milwaukee, Wis. 53204
01281	TRW Semiconductors, Inc.	14520 Aviation Blvd Lawndale, Calif. 90260
01295	Texas Instruments, Inc. Semi-conductor-Components Division	13500 North Central Express Way, Dallas, Texas 75231
02114	Ferroxcube Corp. of America	Mt. Marion Rd. Saugerties, N.Y. 12477
04713	Motorola Semiconductor Products, Inc.	5005 East McDowell Rd. Phoenix, Ariz. 85008
07263	Fairchild Camera and Instrument Corp. Semiconductor Division	313 Frontage Rd. Mountain View, Calif.
08815	New England Instrument Co.	H. F. Brown Way Natick, Mass. 01760
12965	Computer Components, Inc.	88-06 Van Wyck Express Way Jamaica, N.Y. 1418
13327	Solitron Devices, Inc.	256 Oak Tree Rd. Tappan, N.Y. 10983
13715	Fairchild Camera and Instrument Corp. Semiconductor Division Diode Plant	4300 Redwood Highway San Rafael, Calif. 94902
13923	Communications Products Department of the Norden Division of United Air-craft Corp.	Trevose, Pa. 19047
14433	ITT Semiconductors A Division of International Telephone and Telegraph Corp.	3301 Electronics Way West Palm Beach, Fla 33401
14674	Corning Glass Works	Houghton Park Corning, N.Y. 14830
14936	General Instrument Corp. Semi-conductor Products Group	P.O. Box 600 6000 W. John Street Hicksville, N.Y. 11802
17117	Electronic Molding Corp.	40 Church Street Pawtucket, R.I. 02860
25140	Globe Industries, Division of TRW Inc.	2275 Stanley Ave. Dayton, Ohio 45404
42498	National Radio Company, Inc.	111 Washington Street Melrose, Mass. 02176
46859	Philco-Ford Corp.	C and Tioga Streets Philadelphia, Pa. 19134
72982	Erie Technological Products, Inc.	644 W. 12th Street Erie, Pa. 16512

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TABLE 6-3. LIST OF MANUFACTURERS (Cont)

MFR CODE	NAME	ADDRESS
74868	Amphenol Corp., Amphenol RF Div.	33 E. Franklin Street Danbury, Conn. 06810
76493	Miller, J.W. Co.	5915 S. Main Street Los Angeles, Calif. 90003
76854	Oak Mfg Co., Division of Oak Electro/Netics Corp.	South Main Street Crystal Lake, Ill. 60014
77342	American Machine and Foundry Co. Potter and Brumfield Division	1200 E. Broadway P.O. Box 522 Princeton, Ind. 47570
80207	Unimax Switch, Division of Maxson Electronics Corp.	Ives Road Wallingford, Conn. 06493
80294	Bourns, Inc.	1200 Columbia Ave Riverside, Calif. 92507
81312	Winchester Electronics Division Litton Industries, Inc.	Main Street and Hillside Ave. Oakville, Conn.
81541	Airpax Electronics, Inc.	Woods Road Cambridge, Md. 21613
81840	Ledex, Inc.	123 Webster Street Dayton, Ohio 45402
92966	Hudson Lamp Co.	526 Elm Street Kearny, N. J.
94375	Automatic Metal Products Corp.	315-323 Berry Street Brooklyn, N.Y. 11211
95238	Continental Connector Corp.	34-63 56th Street Woodside, N.Y.
95275	Vitramon, Inc.	Box 544 Bridgeport, Conn. 06601
96095	Aerovox Corp.	Seneca Avenue Olean, N.Y. 14760
96182	Master Specialties Co.	1640 Monrovia Costa Mesa, Calif. 92627
98291	Sealectro Corp.	225 Hoyt Mamaroneck, N.Y. 10544

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