

AUTOMATED TRANSLATOR CHGR-4

Introduction

The TMC Model CHGR-4 Translator contains all the circuitry covered in the CHG()4 manual, plus automation circuitry. The automation circuitry provides remote frequency selection and preset automatic gain control. Remote frequency selection is performed by supplying a ground (from an external source) to the frequency switch driving Ledex motor, through its coupled notch homing wafer. The automatic gain control circuitry provides a preset automatic unit gain by comparing the CHGR output to a dc referenced 1.75 MHz IF input from the CMRA.

Figures 1A and 2A supply basic functioning of the automated circuits. For more detailed information refer to associated schematic:

FIGURE 3-A	CK-1462	SERVO SENSOR
FIGURE 4-A	CK-1463	SENSING CIRCUIT
FIGURE 5-A	CK-1469	FREQUENCY SELECTOR SWITCHES
FIGURE 6-A	CK 1474	SBGR-4 AUTO GAIN SERVO CONTROL

1. CHGR Remote Ledex Operation. Refer to Figure 1A.

Remote operation of each Ledex motor in the CHGR consists of two steps. First, remotely positioning an external master step switch so that control may be directed to a particular Ledex motor. Second, supplying a remotely controlled ground through the associated Ledex notch homing wafer to determine the frequency position that the Ledex motor will stop.

If control were to be directed to the 10 MHz Ledex motor, external wafers "1" and "2" would be positioned as shown in figure 1A. A positioning ground (0-9) then supplied to S107, the 10 MHz notch homing wafer would keep the 10 MHz Ledex motor energized until the notch on the wafer removed the ground. For example; if a frequency of 15.0000 MHz were programmed, a ground seen on pin "Y" of J119 would place S107 in the position as shown on figure 1A. The positioning of the 1 MHz frequency switch would require rotating the master step switches (1 and 2) one position, then supplying an external ground to pin "C" (position 5) of J119. S106 would keep the 1 MHz Ledex motor energized until position 5 on the notch homing wafer removed the ground. Similar actions for the 100 KHz, 10 KHz, 1 KHz and the 100 Hz frequency switches would follow with the positioning ground for "0" supplied by pin X of J119.

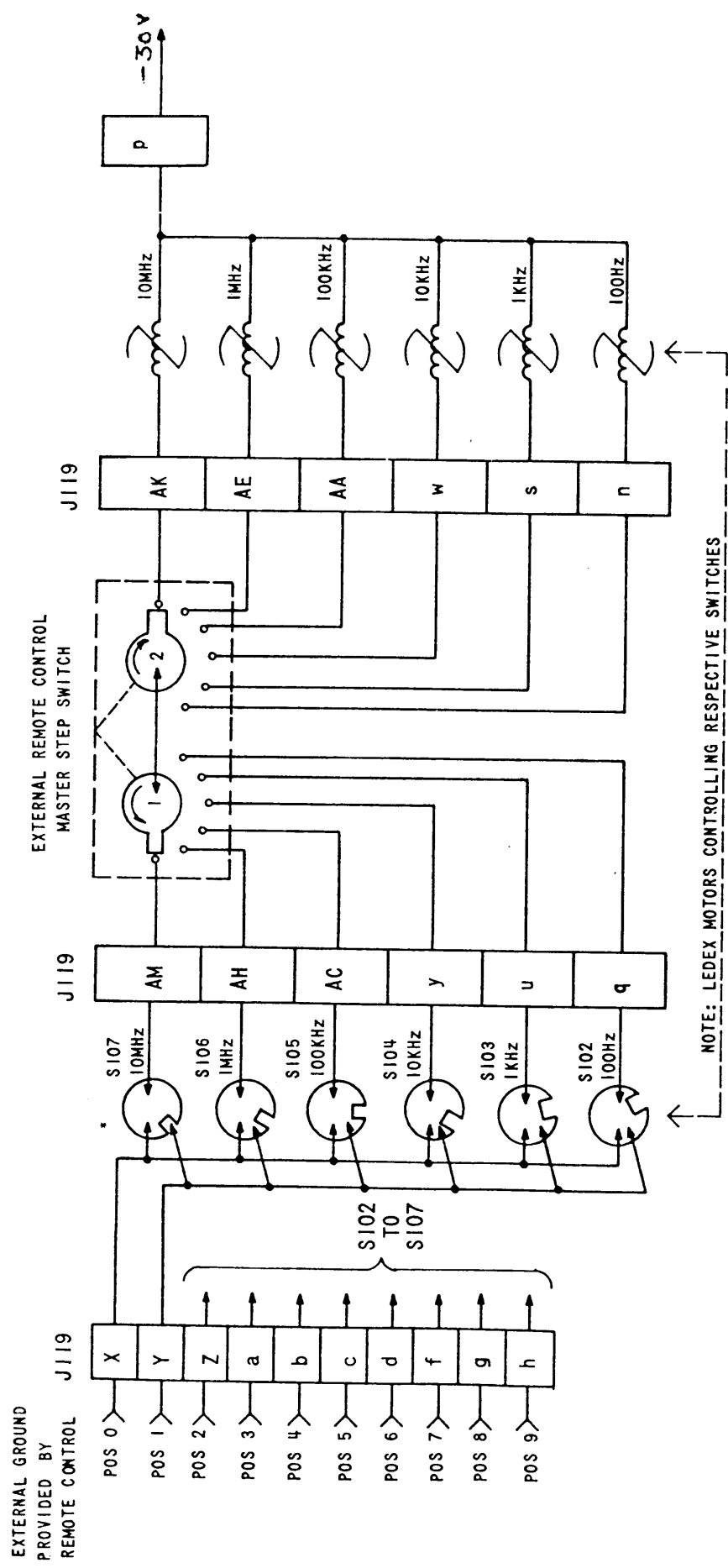
2. CHGR Automatic Gain Control. Refer to Figure 2A.

The automatic gain control circuit in the CHGR automatically adjusts its unit gain to a constant level by comparing a dc referenced 1.75 MHz IF input signal from the CMRA to a sample of the CHGR output. Should the CHGR unit gain tend to change, due to frequency change, AC energizing voltage is routed to the "Up" or "Down" winding of the RF Output motor to maintain the unit gain constant.

Pin 1 of Z117 receives a sample of the 1.75 MHz IF input from J126 on the CHGR. The 1.75 MHz signal is dc amplified and adjusted by R6, the DC Level Adjust before leaving Z117 at pin 4 and entering pin 1 of the Drive Comparator. The DC Level Adjust provides an adjustable dc reference for the Drive Comparator.

A sample of the rf output from J124 of the CHGR is applied to pin 1 of Z116, a rectifying sense circuit. The rectified dc output from Z116 leaves pin 2 and enters pin 6 of Z117, the Servo Sense board. The dc signal is then routed through isolating emitter follower Q3 before application to pin 2 of the Drive Comparator board.

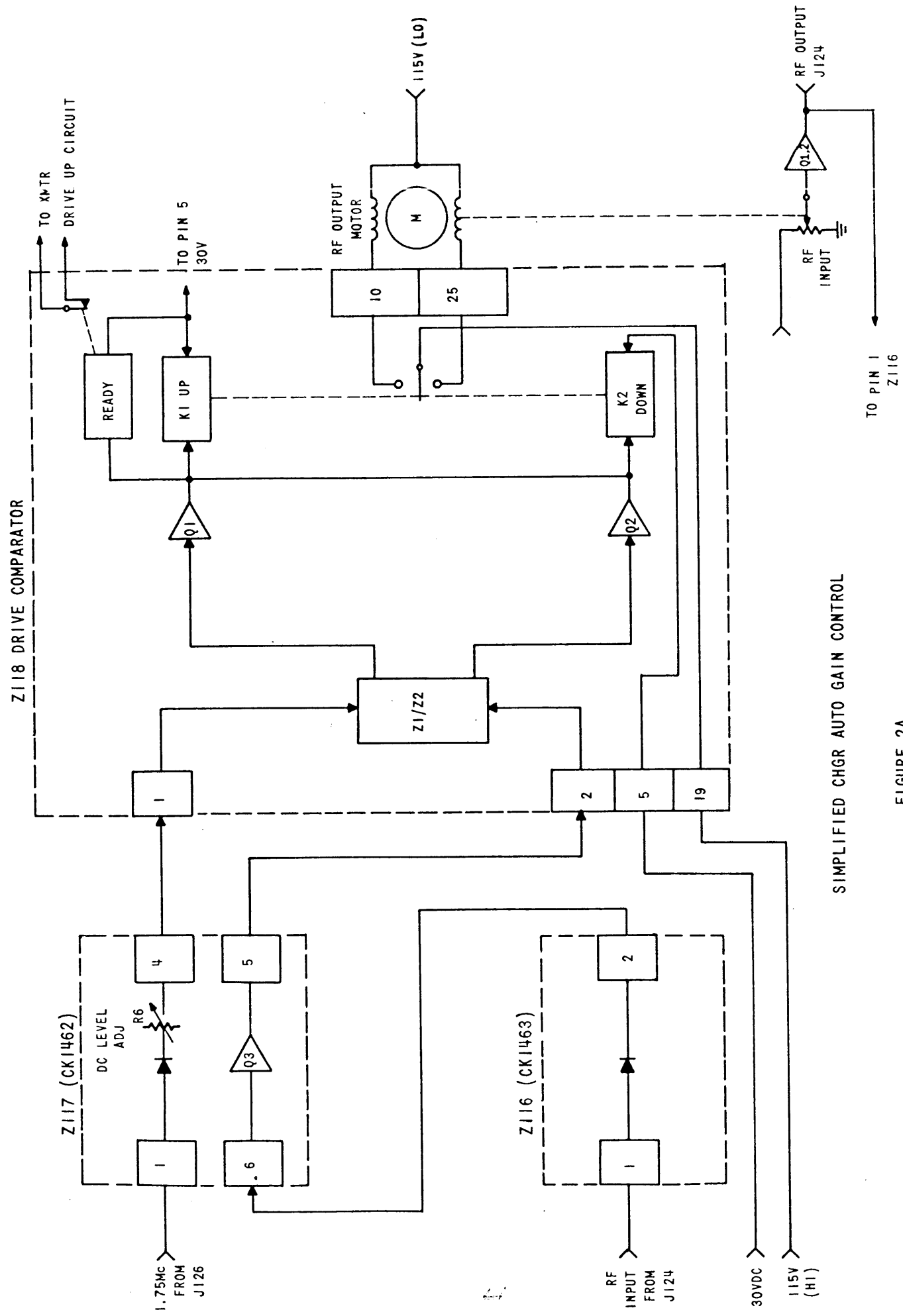
When the CHGR dc input at pin 2 is less than the 1.75 MHz dc reference signal on pin 1, Q1 a relay driver is forward biased sufficiently, to energize K1 the "UP" relay. Contacts of K1 route AC energizing voltage to the motor which will increase drive until the unit gain is restored. When the CHGR input at pin 2 is greater than the voltage at pin 1, Q2 is forward biased causing K2 the "Down" relay to be energized. When K1 or K2 are energized the "Ready" relay also energizes, opening a contact closure supplied to the transmitter automatic drive circuit. This provision prevents erratic automatic drive changes in the transmitter while the CHGR is correcting its unit gain.



* S102 TO S107 SELECT 1 OF 10 POSSIBLE POSITIONS

SIMPLIFIED CHGR REMOTE LEDEX OPERATION
(SHOWN IN 10MHZ POSITION)

FIGURE 1A



SIMPLIFIED CHGR AUTO GAIN CONTROL

FIGURE 2A

★

TECHNICAL MANUAL

for

TRANSLATOR

MODEL CHG ()-4



THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N. Y. OTTAWA, CANADA

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*Electron tubes also include semi-conductor devices.

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4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

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1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

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THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

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Figure 1-1. Translator CHG()-4

SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

This manual presents operating and maintenance instructions for Translator, CHG()-4, designed and manufactured by the Technical Materiel Corporation, Mamaroneck, New York. The manual includes a general description of the equipment; installation and operating procedures; principles of operation; maintenance data; and a parts list.

Translator CHG()-4 (figure 1-1), hereinafter referred to as the CHG()-4, or the Translator, is a solid-state rf generator that provides translation of a 1.75 MHz intermediate input to a selectable rf output range; it functions as an rf frequency exciter in an SSB transmitting system, providing amplitude-modulated (AM), single sideband (SSB) or independent sideband (ISB) intelligence on an rf carrier frequency between 1.6 and 29.9999 MHz, selectable in discrete 100 Hz increments, by means of six frequency selector switches. The Translator also features built-in frequency stability of 1 part in 10^8 /day and provides a continuously adjustable 250 mw rf output from the externally applied 1.75 MHz composite signal.

Optional capabilities of the Translator include provisions for remote-control operation; a choice of internal frequency standards with stabilities of 1 part in 10^6 or 10^7 /day in lieu of the standard oven; or an external frequency standard (CSS-2) with a stability of 1 part in 10^9 /day. A direct-reading front-panel MONITOR meter presents a continuous display of one of three rf output stages or the nominal rf output level, as selected by the METER switch.

NOTE

The terms MHz, kHz and Hz, as used, herein, represent megacycles (Mc), kilocycles (Kc) and cycles (cps), respectively.

1-2. PHYSICAL DESCRIPTION

The majority of electronic components which constitute the Translator are mounted on 16 printed circuit boards which plug into chassis-mounted Cinch connectors. In addition, standard and power supply extender boards are included, and mate with the respective printed circuit boards and chassis connectors, thereby facilitating maintenance, alignment and troubleshooting procedures.

The Translator chassis is designed for installation in a standard 19-inch wide electrical equipment cabinet; removable top and bottom protective covers are provided on the chassis. Operating controls and indicators are situated on the front panel and include six frequency selector switches with direct dial readouts; an RF OUTPUT level control; a METER selector switch; a MONITOR meter; line fuses; an ON-STANDBY switch; and STANDBY and

POWER indicators. A single STD switch is located on the rear panel for selection of the INT or EXT 1 MHz frequency standard.

1-3. TECHNICAL SPECIFICATIONS

Table 1-1 presents a listing of the technical specifications for the CHG()-4.

TABLE 1-1. TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:	1.6 to 29.9999 MHz in 100 Hz steps
FREQUENCY PRESENTATION:	Direct reading digital dials
INPUT:	12 kHz bandwidth centered at 1.75 MHz
OUTPUT POWER:	Continuously adjustable from 0 to 250 mw PEP
OUTPUT IMPEDANCE:	50 ohms, nominal
FREQUENCY STABILITY:	1 part in 10^8 /day for ambient temperature change of 15° C from 0° C to +55° C
FREQUENCY CONTROL:	All frequency determining elements referenced to built-in 1 MHz source
METERING:	Built-in multimeter allows monitoring of rf output circuits and rf output level
TUNING:	Digital frequency selection by front panel control
SIGNAL/DISTORTION RATIO:	Distortion products are at least 40 db below either tone of a two-tone test at 100 mw, which exceeds FCC requirement
HUM AND NOISE LEVEL:	Noise level is at least 60 db down from PEP
ALDC:	Will accept 0 to approximately -11 vdc from ALDC circuit of an associated linear amplifier to improve linearity, limit distortion and deliver a relatively constant output level during high modulation peaks or load changes

TABLE 1-1. TECHNICAL SPECIFICATIONS (cont)

ENVIRONMENTAL CONDITIONS:	Designed to operate in any ambient temperature between 0° C and +55° C and any value of humidity up to 95%
INSTALLATION DATA:	Size: 5-1/4" H x 19" W x 18" D Weight: approximately 30 lbs

TABLE 1-1. TECHNICAL SPECIFICATIONS (cont)

PRIMARY POWER:	115/230V, ±10%, 50/60Hz, single phase, 60 watts
LOOSE ITEMS:	Mating coaxial fittings (BNC) and two instruction manuals
COMPONENTS AND CONSTRUCTION:	All equipment manufactured in accordance with JAN/MIL Specifications wherever practicable

SECTION 2
INSTALLATION

2-1. GENERAL

The Translator is calibrated and tested at the factory prior to shipment. When the Translator is received at the operating site, inspect the packing case and contents for possible damage that might have occurred during transit. Unpack the equipment carefully, and inspect all packaging material for parts that have been shipped as loose items. With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and furnishing of replacement parts.

2-2. POWER REQUIREMENTS

CAUTION

Set ON/STANDBY switch (7, figure 3-1) to STANDBY; when line cord is connected to appropriate power source, the power supply is energized.

The Translator is designed for 115/230 vac, 50/60 Hz, single phase power operation. Unless specifically ordered otherwise, the unit is shipped wired for 115 vac operation. For 230 vac operation, wiring changes must be made, as shown in figure 7-16. For 230 vac operation, replace line protective fuses with fuses having 1/2 the 115 vac fuse rating.

2-3. MECHANICAL INSTALLATION

The Translator is equipped with a standard 19-inch wide front panel. To install the unit in an equipment rack, fasten the front panel to the rack with four screws and four washers (supplied).

When the CHG()-4 is equipped with a tilt-lock slide mechanism, installation is as follows: (See figure 2-1.)

- a. Pull out the center sections of the tracks, located in the equipment rack, until they lock in extended position.
- b. Position the slide mechanisms of the unit in the tracks, and ease the unit into the rack until the release fingers engage the holes in the tracks.
- c. Press the release fingers and slide the unit completely into the rack. Secure the front panel of the unit to the rack with screws and washers.
- d. Make the necessary electrical connections, as described in paragraph 2-4.

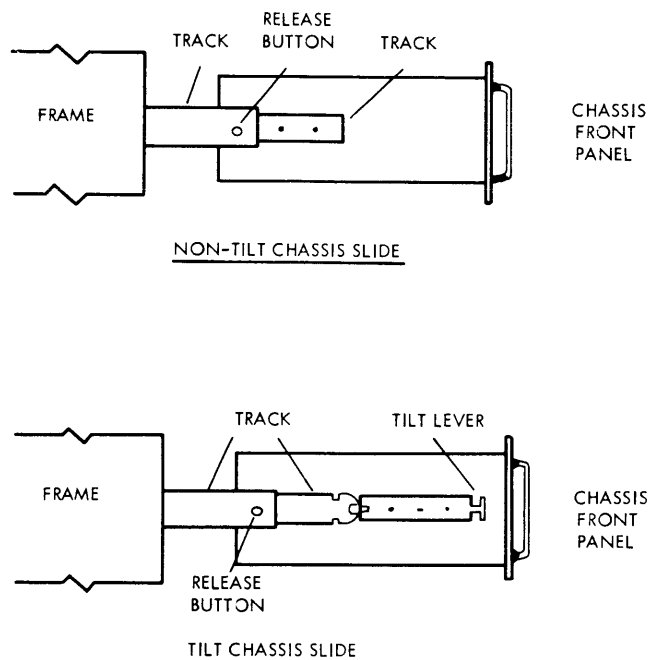


Figure 2-1. Tilt-Lock Slide Mechanism

2-4. ELECTRICAL INSTALLATION

All electrical connections between the CHG()-4 and associated equipment are made at the rear of the unit. Figure 2-2 illustrates all rear panel connections, while table 2-1 lists the panel designation and function of each connection.

TABLE 2-1. REAR PANEL CONNECTIONS

Panel Designation	Function
J116 (POWER)	Power input 115 vac or 230 vac
J119	Used for remote control connections, when desired
J120 (1 MHz OUT)	1 MHz standard output jack
J121 (1 MHz MON)	1 MHz standard monitor jack
J122 (STD)	Input for connection of external 1 MHz standard
J123 (ALDC)	Connection of external ALDC voltage

TABLE 2-1. REAR PANEL CONNECTIONS (cont)

Panel Designation	Function
J124 (RF OUT)	RF output jack
J125 (RF MON)	RF output monitor jack
J126 (IF IN)	Connection of external 1.75 MHz AM, USB, LSB or ISB subcarrier

2-5. INITIAL CHECKOUT PROCEDURE (See figures 2-2 and 2-3.)

Although the CHG()-4 has been aligned and thoroughly checked against the manufacturer's specifications prior to shipment, it is necessary to ensure correct installation and proper Translator operating conditions by performing the following check-out procedures. Refer to Section 3 for location and functions of all operating controls and indicators.

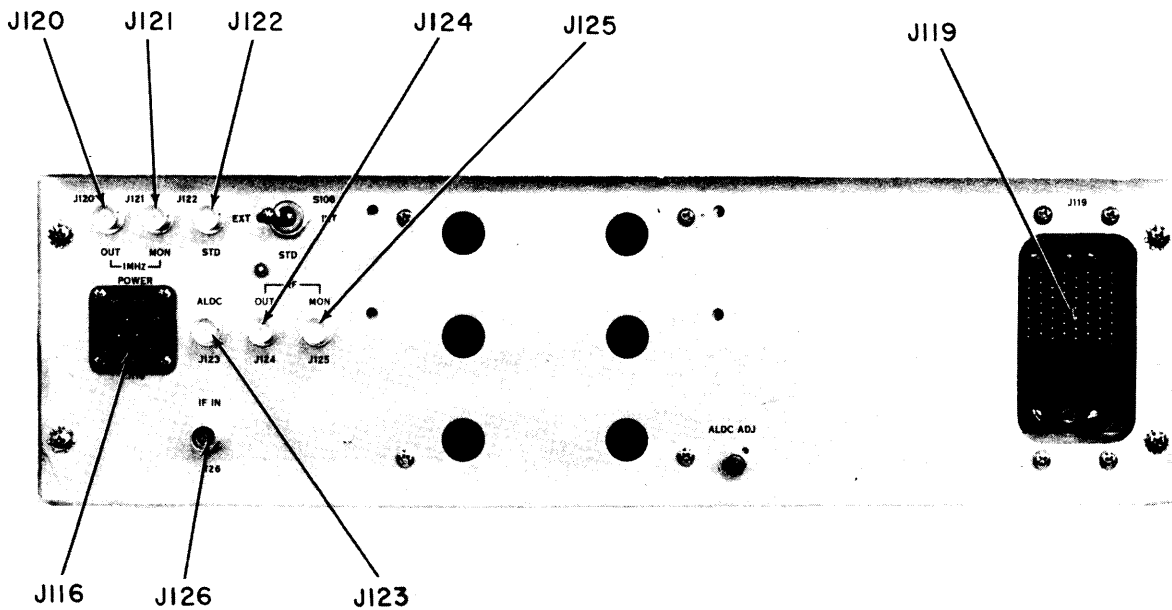


Figure 2-2. Rear Panel Connectors

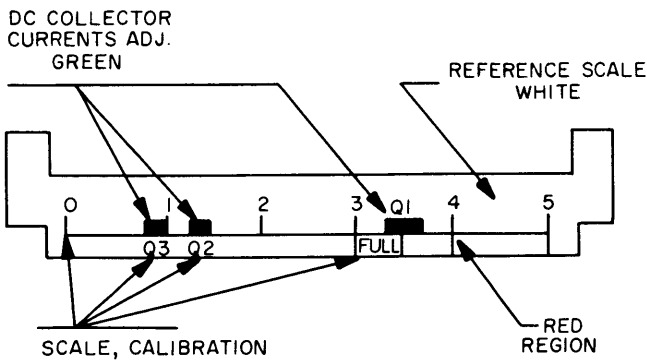


Figure 2-3. Front Panel Monitor Indicator

NOTE

Unless otherwise indicated, item numbers (numbers in parenthesis) are callouts referenced to figure 3-1.

- a. Set ON/STANDBY switch (7) to STANDBY position. STANDBY indicator (5) shall illuminate amber.
- b. Using the six frequency selector switches (8), establish the desired rf.
- c. On rear panel, set STD-INT/EXT switch (9) to INT position.

d. Set ON/STANDBY switch (7) to ON position. STANDBY indicator (5) shall extinguish, and POWER indicator (6) shall illuminate red.

e. Set METER switch (2) to Q1 position. MONITOR meter (3) shall indicate in the green region marked Q1. (See figure 2-3.)

f. Set METER switch (2) to Q2 position. MONITOR meter (3) shall indicate in the green region marked Q2. (See figure 2-3.)

g. Set METER switch (2) to Q3 position. MONITOR meter (3) shall indicate in the green region marked Q3. (See figure 2-3.)

h. Set METER switch (2) to RF position. MONITOR meter (3) shall indicate zero with RF OUTPUT control fully counterclockwise.

i. Connect 1.75 MHz source (or CMR()-4) to IF IN jack on rear panel of Translator. Set amplitude for 10 volts rms.

j. Connect a VTVM (Hewlett-Packard Model 410B, or equivalent) to RF OUT jack J124 (figure 2-2) across a 50-ohm load resistor. Adjust RF OUTPUT control (1) until VTVM indicates 7.0 volts.

k. Remove VTVM and connect oscilloscope (Tektronix Model 545, or equivalent) to RF OUT jack J124 (figure 2-2). Displayed waveform shall be a sharp undistorted sinewave with no modulation signal appearing on any part of the oscilloscope's time/cm scale.

l. Disconnect all test equipment.

SECTION 3
OPERATOR'S SECTION

3-1. GENERAL

The CHG()-4 provides rf frequency translation of amplitude-modulated (AM), upper or lower sideband (USB/LSB), or independent sideband (ISB) intelligence in the 1.75 MHz IF range to a continuously variable 1.6 to 29.9999 MHz output transmission range. Tuning over this frequency range is accomplished manually in incremental tuning steps of 100 Hz using the six front panel frequency-select switches.

3-2. CONTROLS AND INDICATORS

All operator controls and indicators are located on the front and rear panels of the Translator. Figure 3-1 illustrates the front and rear panels, and table 3-1 presents a listing of the controls and indicators and explains the function of each.

TABLE 3-1. FUNCTIONS OF CONTROLS AND INDICATORS

Item Number (Figure 3-1)	Panel Designation	Function
1	RF OUTPUT control	Adjusts rf output level
2	METER switch (four-position: Q1 Q2 Q3 RF	Selects circuit in CHG()-4 to be monitored by MONITOR meter Displays rf output transistor Q1 collector current (350 ma) on MONITOR meter Displays rf output transistor Q2 collector current (130 ma) on MONITOR meter Displays rf output transistor Q3 collector current (65 ma) on MONITOR meter Displays peak rf output on MONITOR meter
3	MONITOR meter	Monitors circuit selected by METER switch
4	LINE (2) fuses	1 ampere line voltage fuses (0.5 ampere for 230 vac operation)
5	STANDBY indicator	Illuminates amber when ON/STANDBY switch is positioned to STANDBY
6	POWER indicator	Illuminates red when ON/STANDBY switch is positioned to ON
7	ON/STANDBY switch	When positioned to ON, applies 12 and 24 vdc to modules. When positioned to STANDBY, removes dc voltages from all modules except 1 MHz frequency standard, and illuminates STANDBY indicator

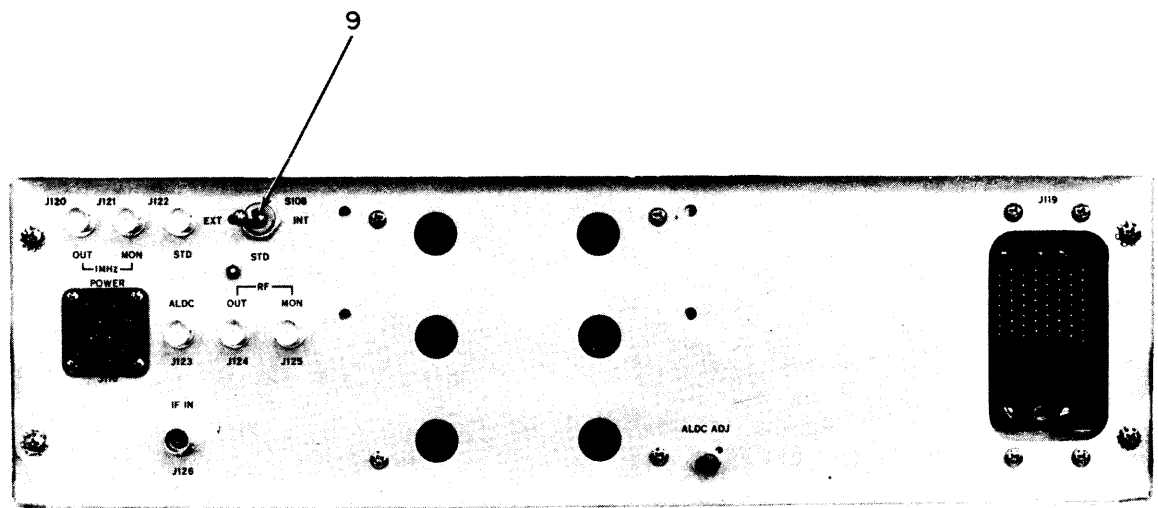
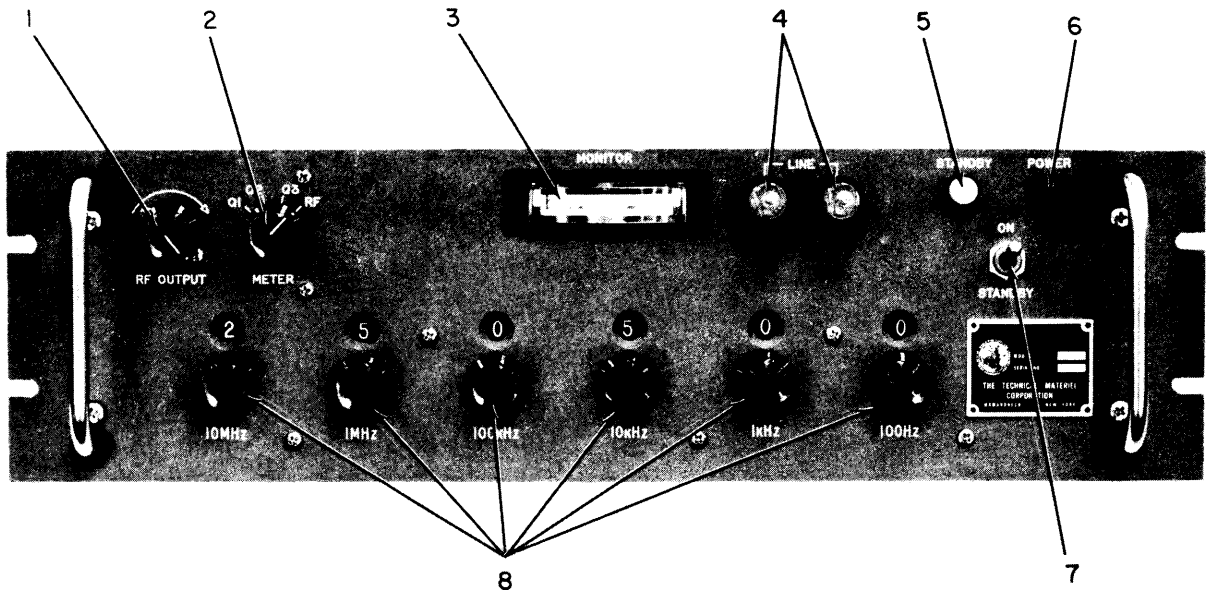


Figure 3-1. Controls and Indicators

TABLE 3-1. FUNCTIONS OF CONTROLS
AND INDICATORS (Continued)

Item Number (Figure 3-1)	Panel Designation	Function
8	100 Hz, 1 kHz, 10 kHz 100 kHz, 1 MHz and 10 MHz switches	Used to select the desired operating frequency
9	STD-INT/EXT switch	Used to select the internal 1 MHz oscillator frequency, or an external 1 MHz standard input frequency

3-3. OPERATING PROCEDURE

Before initially placing the CHG()-4 in operation, perform the initial checkout procedure outlined in Section 2, Installation. To place the unit in operation:

NOTE

Verify that ON/STANDBY switch (7, figure 3-1) is set to STANDBY.

a. Connect source of 115 vac, single phase power to POWER receptacle J116 (figure 2-2). Observe that STANDBY indicator (5, figure 3-1) illuminates amber.

b. Set RF OUTPUT control fully CCW. Make necessary interface connections on rear panel jacks. (See figure 2-2.)

c. Using six frequency selector switches (8), establish the desired rf operating frequency as displayed in the frequency readout windows.

d. Set METER switch (2) to the circuit function to be monitored on MONITOR meter (3).

e. Set ON/STANDBY switch (7) to ON. Observe that STANDBY indicator (5) extinguishes and POWER indicator (6) illuminates red.

f. Use RF OUTPUT control to establish necessary or desired drive to external equipment (CW rotation increases output).

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

The principles of operation for the CHG()-4 is presented in two parts: the first part discusses CHG()-4 operation with reference to an overall functional block diagram, while the second part presents a detailed description of the individual CHG()-4 circuits and is referenced to the interconnection and schematic diagrams contained in Section 7.

4-2. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION (See figure 4-1.)

The CHG()-4 is essentially an rf translator which provides a 1.6 to 29.9999 MHz output signal with AM, USB, LSB or ISB intelligence, in discrete 100 Hz steps, and consists of spectrum generator Z101; comb filters Z102 and Z103; a frequency select switching network; mixer-dividers Z104 and Z105; final mixer Z106; 1.25 MHz generator Z109; 3 MHz balanced mixer Z108; step generators Z110, Z111 and Z113; frequency translator Z112; rf output Z115; output filter Z114; and a power supply assembly, which also contains a stable 1 MHz frequency standard. The following paragraphs present brief descriptions of each of these sections.

a. **SPECTRUM GENERATOR Z101.** The spectrum generator develops seven fundamental output frequencies which are derived from the 1 MHz standard in the power supply assembly. Firstly, the 1 MHz input is amplified and sent both to the mixer-divider circuits, for formulation of four discrete decimal integers to enable frequency selection in 100 Hz steps, and to the 1.25 MHz generator to produce a basic 1.25 MHz subcarrier for translation in the 3 MHz balanced mixer. Secondly, the 1 MHz input is clipped, divided by a factor of 10 and applied to a 100 kHz spectrum generator; this output, containing the 100 kHz fundamental, plus harmonics, is applied to the comb filter circuits. Finally, the 1 MHz input is squared to produce a 1 MHz spectrum containing the required harmonics for generation of five additional output frequencies of 8, 12, 13, 14 and 40 MHz. The 8 Hz output is applied to the mixer-divider section as the fundamental input frequency; the 40 MHz output is coupled to the frequency translator for determination of final output frequency range; and the 12, 13 and 14 MHz outputs are sent to the step generator circuits for derivation of the basic difference frequency range for use in the translator.

b. **COMB FILTERS Z102 AND Z103.** The 100 kHz spectrum output from the spectrum generator is applied to the comb filter sections. These circuits produce 12 discrete output frequencies from 0.8 to 1.9 MHz in 100 kHz steps and apply them to the frequency select switch network. These frequencies are generated by exciting corresponding crystal-controlled filters at the appropriate harmonic of the 100 kHz spectrum input. The 1.0 to 1.9 output range

is applied to the 100 Hz, 1 kHz, 10 kHz, and 100 kHz select switches which control the mixer-divider sections. The complete range of 0.8 to 1.9 MHz is applied to the 1 MHz and 10 MHz select switches, which control the input to the step generator circuits.

c. **FREQUENCY SELECT SWITCHING NETWORKS, AND MIXER-DIVIDERS Z104, Z105 AND Z106.** The mixer-divider sections consist of four frequency channels that can be considered as a cascaded frequency counter; each channel is controlled by a frequency select switch to determine the appropriate 100's, 1000's, 10,000's and 100,000's integers of the desired output frequency. The 8 MHz input from the spectrum generator is applied to each of the four channels; in the 100 Hz channel, this signal is modulated by the 1 MHz input to yield a basic frequency of 9 MHz. This frequency is then mixed with the 1.0 to 1.9 MHz input from the 100 Hz selector switch to produce a sum frequency of 10 to 10.9 MHz, which is divided by 10 to yield a 1.0 to 1.09 MHz input to the next mixer-divider channel. By modulating the 8 MHz input to each successive channel with the net input from the previous channel and the desired frequency from the next higher frequency selector switch, a final output of 10.0 to 10.9999 MHz results, with the last four digits representing the least significant four decimal places in the selected output frequency. The 10.0 to 10.9999 MHz output is applied to the frequency translator section.

d. **STEP GENERATORS Z110, Z111 AND Z113.** The step generators perform the function of first shifting the 12, 13 and 14 MHz inputs to three independent but successive frequency ranges under control of the 1 MHz and 10 MHz frequency select switches, thereby deriving the two most significant digits of the desired frequency. Frequency ranges of 10.4 to 11.2 MHz, 11.3 to 12.2 MHz, and 12.3 to 13.2 MHz are derived in step generators Z113 and Z110 by modulating respective input frequencies of 12, 13 and 14 MHz from the spectrum generator with the 0.8 to 1.7 MHz selected frequency from the 1 and 10 MHz switches and amplifying the difference. These three frequency ranges are then multiplied by 5, filtered and amplified in step generator Z111 to obtain 52 to 56 MHz, 56.5 to 61 MHz, and 61.5 to 66 MHz frequency range inputs to step generator Z113. Finally, each of these three ranges are multiplied by 2, amplified and then summed together to produce an output frequency range of 104 to 132 MHz. This signal is supplied through a high pass filter to the frequency translator.

e. **1.25 MHz GENERATOR Z109.** The 1.25 MHz generator performs the function of producing a 1.25 MHz subcarrier derived from the stable 1 MHz output from spectrum generator Z101. The 1 MHz input is initially divided by 4 to produce 250 kHz, and then multiplied by 5 to yield the 1.25 MHz output.

This subcarrier is applied to 3 MHz balanced mixer Z108 to translate the audio intelligence present on the 1.75 MHz IF input to a 3 MHz carrier for translation to the 1.6 to 29.9999 MHz range in translator Z113.

f. 3 MHz BALANCED MIXER Z108. The 3 MHz balanced mixer produces a 3 MHz intermediate frequency (IF) output, with audio amplitude-modulation (AM), upper or lower sideband (USB, LSB) audio intelligence, or independent sideband (ISB) intelligence. The 3 MHz output is derived by mixing the AM, USB/LSB or ISB 1.75 MHz externally applied input with the 1.25 MHz subcarrier input from 1.25 MHz generator Z109. The resultant sum of these two frequencies is obtained from a balanced modulator circuit and is applied as a 3 MHz IF carrier to translator Z112.

g. TRANSLATOR Z112. The translator performs the function of producing a 1.6 to 29.9999 MHz output signal by successively modulating the 10 to 10.9999 MHz output from final mixer Z106 with the following signals: 3 MHz AM or sideband carrier from the balanced mixer, the 40 MHz signal from the spectrum generator, and the 104 to 132 MHz output range from step generator Z113. The 10.0 to 10.9999 MHz input is amplified and modulated by the 3 MHz input signal to yield a resultant frequency range of 13.0 to 13.9999 MHz; this frequency is then modulated by 120 MHz, which is derived from the 40 MHz input multiplied by a factor of 3. As a result, the modulator yields a sum frequency between 133 and 133.9999 MHz. By subtracting the 104 to 132 MHz signal, representing the two most significant digits of the selected frequency range, a difference output signal results in the range of 1.0 to 29.9999 MHz; this signal is filtered to provide a rolloff below 1.6 MHz, thereby resulting in a 1.6 to 29.9999 MHz frequency range. This signal is amplified and applied through the RF OUTPUT control to rf output section Z115.

h. RF OUTPUT Z115, OUTPUT FILTER Z114 AND METERING CIRCUIT. The 1.6 to 29.9999 MHz output signal from the translator is filtered and amplified in rf output section Z115 and applied to output filter Z114. The rf output circuit also accepts an Automatic Load and Drive Control (ALDC) signal from the external transmitter, which is amplified in translator Z112 and used to limit the translator rf output level to rf output section Z115. Output filter Z114 consists of six independent relay-controlled bandpass output filters; the appropriate filter is inserted in series with the output signal according to the desired frequency set on the frequency selector switches.

A metering circuit is included to monitor the collector currents of the three amplifiers on rf output section Z115 and the rf output level of the selected frequency; display of these parameters is controlled by a METER switch and displayed on the front panel MONITOR meter.

i. POWER SUPPLY ASSEMBLY. The CHG()-4 power supply operates from either 115 or 230 vac, depending on power transformer primary strapping.

(See figure 7-16.) The power supply outputs are regulated dc voltages of +30, +24, and +12 volts for operation of the CHG()-4 frequency generation circuits. The +24 and +12 vdc power supply outputs are applied to the STANDBY position of the STANDBY-ON switch and are applied to the frequency generation circuits when set to the ON position. The 1 MHz standard frequency is produced by an integrated circuit oscillator (also included in the power supply assembly), and provides 1 MHz stable input to spectrum generator Z101, when 115/230 vac power is applied to the Translator.

4-3. DETAILED CIRCUIT ANALYSIS

The following paragraphs present a detailed description of the circuits used to provide rf frequency generation, selection and translation in the CHG()-4. The circuit descriptions are referenced to applicable schematic and interconnection diagrams in Section 7.

a. SPECTRUM GENERATOR Z101. (See figure 7-2.) The spectrum generator performs the function of generating both broad-band and discrete frequencies for use in the frequency translation sections, and consists of the 1 MHz output circuit; the 1 MHz spectrum generator; the 100 kHz spectrum generator; and five discrete frequency generators.

(1) In the 1 MHz output circuit, the 1 MHz frequency standard from Z301 in the power supply subassembly is coupled through capacitors C60 and C5 to 1 MHz output amplifier Q1, whose collector is tuned by the combination of the primary winding of transformer T1 and capacitor C2. The 1 MHz low-impedance output signal from T1 secondary is supplied to 1 MHz OUT jack J120, and through isolation resistor R128 to 1 MHz MON jack J121. (See figure 7-1.) In addition, the 1 MHz output is applied through Level Adjust potentiometer R60 (figure 7-2) to board pin 3, for use by mixer-divider Z104 and by 1.25 MHz generator Z109.

(2) In the 1 MHz spectrum generator circuit, the 1 MHz standard is coupled through capacitors C60 and C8 to the input of 1 MHz squarewave generator Q2. This stage essentially reacts as an overdriven amplifier, with inverse feedback introduced through feedback-divider biasing by resistor R6. The output squarewave is coupled through C9 and is amplified by 1 MHz spectrum output amplifier Q3. This output signal consists of the 1 MHz fundamental frequency plus harmonics, and is applied to the discrete frequency generator circuits.

(3) The 100 kHz spectrum generator consists of 1 MHz clipper Q14, driver amplifier Q17, decade divider Z1, 100 kHz spectrum generator Q15 and emitter follower Q16. The 1 MHz frequency standard is coupled to the input of 1 MHz clipper Q14, an overdriven amplifier similar to squarewave generator Q2; the collector output signal is amplified by driver Q17 and applied to decade divider Z1, a type NW135 integrated circuit (IC). Zener diode CR1 regulates Z1 operating voltage at 12 volts dc. The resultant 100 kHz squarewave output from Z1 is coupled through capacitor C69 to 100 kHz spectrum generator Q15, which amplifies the 100 kHz signal and

sends it to output emitter follower Q16. This last stage provides required low output impedance to board pins E and D for comb filter sections A (Z102) and B (Z103), and effectively isolates the spectrum generator from undesirable load changes.

(4) The discrete frequency generator section consists of four similar frequency determining circuits plus a frequency multiplier network. These circuits produce discrete frequencies of 8 MHz, 12 MHz, 13 MHz, 14 MHz, and 40 MHz. Since the principle of operation for each circuit is the same, only the 8 MHz and subsequent frequency multiplier circuits are discussed.

The output signal from the 1 MHz spectrum generator circuit is applied across the 8 MHz series resonant circuit formed by 8 MHz crystal Y3, trimmer capacitors C64 and C73, capacitor C72, resistor R64 and the base-emitter junction of harmonic select amplifier Q12. Since the 8th harmonic is present in the 1 MHz spectrum, crystal Y3 oscillates at 8 MHz; this input signal is amplified and applied to the tuned collector circuit consisting of transformer T10 and capacitor C75. Being a parallel tuned circuit, this combination is highly selective and rejects all other frequencies; resistor R53 provides the required regenerative feedback to reinforce or sustain oscillations at 8 MHz. The 8 MHz output signal from transformer T10 is coupled through C78 to 8 MHz output amplifier Q13. The tuned collector output is transferred, via the secondary winding of T11, to board pins 5 and 15 for use by mixer-divider Z104, dual mixer-divider Z105 and final mixer Z106. 8 MHz output is also coupled through C83 to the frequency multiplier circuit. Discrete frequencies of 12, 13, and 14 MHz are formulated in a similar manner; the 12 MHz, 13 MHz and 14 MHz outputs are respectively applied to board pins 8 and J, P and R, and 13 and 12, from which they will be routed to the step generator circuits, Z110 and Z113. It should be noted that +12 vdc is applied to the 13 MHz generator (via pin M) only when the selected frequency is above 12 MHz. (See figure 7-1.)

The 40 MHz frequency multiplier circuit consists of emitter follower Q18 and X5 amplifier Q19. The 8 MHz output from Q18 is directly coupled to X5 amplifier Q19, whose collector circuit is L-C tuned to the 5th multiple of 8 MHz, or 40 MHz. The output signal developed across isolation transformer T12 and tuned by C89 to 40 MHz, is coupled through capacitor C90 and supplied to frequency translator Z112, via pins 11 and 10.

b. COMB FILTERS A (Z102) AND B (Z103). (See figures 7-3 and 7-4.) Each of the comb filter boards contain six independent discrete frequency filters; comb filter A, Z102, provides generation of frequencies from 0.8 MHz to 1.8 MHz in 0.2 MHz steps, while comb filter B, Z103, provides generation of frequencies from 0.9 MHz to 1.9 MHz in 0.2 MHz steps. As a result, 12 discrete frequencies are provided, at 100 kHz intervals, from 0.8 MHz to 1.9 MHz.

The circuit configurations and operation of all filter sections of Z102 and Z103 are identical; therefore, discussion of one of these sections should suffice as a model: for example, the 0.8 MHz circuit (figure 7-3) consists of 0.8 MHz crystal Y6, 0.8 MHz amplifier Q11 and 0.8 MHz output amplifier Q12. Upon receipt of the 100 kHz spectrum signal from spectrum generator Z101, the circuit oscillates at the eighth harmonic and thus produces 0.8 MHz in the same manner as discussed for the 8 MHz discrete frequency generator. (Refer to paragraph 4-3a. (4).) Level Adjust potentiometer R42 varies the gain of 0.8 MHz output amplifier Q12, and thus the overall amplitude of the 0.8 MHz output signal at pin S of J102.

c. FREQUENCY SELECT SWITCHING. (See figure 7-1.) Frequency selection in the CHG()-4 is accomplished by six rotary switches S102 through S107, with direct-reading dials, corresponding to selectable frequency increments of 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz, respectively. (See figure 4-2.) The six discrete frequencies, produced on each of the comb filter boards Z102 and Z103, are applied to the selector switch networks through 100-ohm series isolation resistors on respective terminal boards TB101 and TB102. (See figure 7-1.)

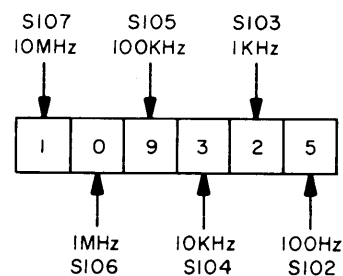


Figure 4-2. Frequency Selector Switch Readouts

Each of the first four selector switches (S102 through S105) receives 10 (1.0 MHz to 1.9 MHz) of the 12 discrete frequencies from terminal boards TB101 and TB102, and distributes them to mixer-divider Z104, dual mixer-divider Z105, and to final mixer Z106, for frequency shift modulation. All 12 discrete frequencies (0.8 MHz to 1.9 MHz) are applied to switch S106 (1 MHz), and are distributed by switch S107 (10 MHz) to step generator A, Z110, for translation. (See figure 7-1.) The remaining decks of switches S105, S106 and S107 enable appropriate circuits in step generator A, Z110, translator Z112, step generator C, Z113, and output filter Z114, such that proper operating voltages and injection frequencies are provided to produce the selected output frequency.

d. MIXER-DIVIDERS Z104 AND Z105, AND FINAL MIXER Z106. (See figures 7-5 through 7-7.) The mixer-dividers and final mixer shift a basic 8 MHz input signal such that a frequency component,

as chosen by the frequency selector switches, is generated having four decimal places and representing hundreds (100 Hz) through one-hundred thousands (100 kHz). The circuits accomplish the task of shifting the fundamental 8 MHz signal through the use of tuned, balanced-modulator and amplifier circuits. Because the circuit configuration and principle of operation for each mixer-divider is similar, only mixer-divider Z104 is discussed. (See figure 7-5.)

The 8 MHz output from spectrum generator Z101 is supplied to the inputs of each mixer-divider (to both halves of Z105) and to the input of the final mixer. In mixer-divider Z104, the 8 MHz input is applied to 8 MHz collector-tuned amplifier Q1; the 8 MHz signal developed across the T1 primary/C6 tank circuit is transferred to a balanced modulator consisting of the T1 secondary, Balance Adjust potentiometer R7 and modulator CR1/CR2, a matched pair of diodes. The balanced modulator receives the standard 1.0 MHz output (also from Z101) and produces sum and difference frequencies while attenuating the two original frequencies; since the tuned primary of coupling transformer T2 is selective at 9 MHz, the sum of the two frequencies is transferred by coupling transformer T3 to the input of the first of two tuned 9 MHz amplifiers, Q2 and Q3. The tuned collector output developed across coupling transformer T6 is applied to the second balanced modulator consisting of the T6 secondary, Balance Adjust potentiometer R23 and CR3/CR4.

The second balanced modulator receives a 1 MHz to 1.9 MHz input signal from 100 Hz selector switch S102, depending upon switch position (0 through 9). As a result, the 9 MHz signal is modulated as explained previously for 8 MHz, thereby resulting in a 10 MHz to 10.9 MHz signal. This output is tuned by transformers T7 through T11 and amplified by transistors Q4 and Q5. The 10 MHz to 10.9 MHz output signal from T11 is applied to Q6, the first of two direct-coupled clipper/driver stages. The output from Q6 is applied to divide-by-ten decade Z1, producing the resultant frequency of 1.0 to 1.09 MHz. This signal is applied to dual mixer-divider Z105.

Each half of dual mixer-divider Z105 (figure 7-6) is similar to Z104 and functions to produce a resultant output signal between 1.0 and 1.9999 MHz, thereby satisfying selector switches S103 (1 kHz) and S104 (10 kHz). Final mixer Z106 (figure 7-7) satisfies selector switch S105 (100 kHz) by modulating the 8 MHz signal with the 1.0 to 1.0999 MHz signal from Z105 to produce 9.0 to 9.0999 MHz; this signal is then modulated by the 1.0 to 1.9 MHz output from 100 kHz selector switch S105 to yield a 10.0 to 10.9999 MHz output to translator Z112. In the 0 to 4 positions of 100 kHz selector switch S105 (figure 7-1), +12 vdc is applied to final mixer Z106 through the tuned output network consisting of capacitors C36 and C48, and diodes CR5 and CR6; this network forms a high pass filter which effectively prevents the higher range of frequencies, 10 through 10.9999 MHz (positions 5 through 9 of switch S105), from appearing at the output. In positions 5 through 9 of switch S105, -12 vdc is applied to the circuit through an alternate

pin (14), thereby making the tuned output filter inoperative.

e. STEP GENERATORS Z110, Z111 AND Z113. (See figures 7-8 through 7-10.) The step generator circuits receive the 12, 13, and 14 MHz frequencies from spectrum generator Z101 and the 0.8 to 1.7 MHz frequency range from 10 MHz selector switch S107. These inputs are amplified, mixed, filtered, and multiplied to obtain a 104 to 132 MHz frequency range which is applied to one input of translator Z112. Step generator Z110 receives 13 MHz and 14 MHz inputs which are applied to respective amplifier and mixer circuits. The 13 MHz frequency is amplified by Q9 and applied to the primary of tuned coupling transformer T17. Input signal amplitude is controlled by Level Adjust potentiometer R61. The 13 MHz output signal is developed across the balanced modulator consisting of the T17 secondary, Balance Adjust potentiometer R67 and matched diodes CR3 and CR4. Similarly, the 14 MHz input signal is amplified by transistor Q1 and applied to the balanced modulator in the collector circuit formed by transformer T1, Balance Adjust potentiometer R7 and matched diodes CR1 and CR2. The 0.8 to 1.7 MHz output from 10 MHz selector switch S107 (figure 7-1) is amplified by transistor Q5 and is coupled via transformer T9 to both the 13 and 14 MHz balanced modulators. At this point, the 13 and 14 MHz channels are each split into two identical sub-channels. Since each pair of subchannels is similar in circuit configuration, only the 13 MHz section is discussed.

As previously mentioned, the balanced modulator produces the sum, difference and two original frequencies; these four signals are coupled to the input tuned transformers, T18 and T25, of the respective 11.8 to 12.2 MHz, and 11.3 to 11.7 MHz sub-channels. Both T18 and T25 are tuned to a portion of the 11.3 MHz to 12.2 MHz frequency range with T25 passing the 11.3 to 11.7 MHz segment and T18 passing the 11.8 to 12.2 MHz segment. The 11.3 to 11.7 MHz range is tuned by transformers T26 through T31 and amplified by Q13 through Q15; the 11.8 to 12.2 MHz range is tuned by transformers T19 through T24 and amplified by Q10 through Q12. The 11.3 to 12.2 MHz frequency range is obtained from the series-connected secondary windings of transformers T24 and T31 and is supplied to step generator B, Z111.

The 14 MHz section is similarly split into sub-channels of 12.3 to 12.7 MHz and 12.8 to 13.2 MHz and supplied to step generator B, Z111. Depending upon the selected frequency, operating voltage of +12 vdc to the 13 MHz and 14 MHz circuits is controlled by 10 MHz frequency selector switch S107 B (front) and 1 MHz selector switch S106 C and E (rear), while a switched ground to the sub-channels is controlled by 1 MHz selector switch S106 C (front). (See figure 7-1.)

(1) Step generator Z113 contains a frequency step circuit for 12 MHz input, similar to the 13 and 14 MHz circuits previously described. (See figure 7-10.) The 12 MHz input is modulated by the 0.8 to 1.7 MHz input from step generator Z110 in

the tuned collector circuit of mixer Q14; the combination of crystal Y1 and trimmer capacitor C101 serves to filter the 12 MHz component of the modulated signal. At this point, the mixer output is split into twin sub-channels of 10.4 to 10.6 MHz and 10.7 to 11.2 MHz by the series of tuned transformers and amplifiers similar to those discussed for step generator Z110. Switched B+ voltage of +12 vdc is applied to either sub-channel, depending upon the range of the selected frequency. The 10.4 to 11.2 MHz output is also applied to step generator B, Z111.

(2) Step generator B, Z111, (figure 7-9), contains three identical multiplier-amplifier circuits for the respective three frequency range inputs from step generator A, Z110. Consider the 52 to 56 MHz multiplier-amplifier, consisting of Q1, Q2, bandpass filter FL1 and output amplifier Q3:

The 10.4 to 11.2 MHz output from Z110 is applied to the input of X5 multiplier Q1, whose tuned collector tank circuit T1/C3 produces the fifth harmonic, or a 52 to 56 MHz signal. This frequency band is amplified in Q2 and the tuned output across collector tank circuit T2/C9 is coupled through C11 to bandpass filter FL1. Filter FL1 effectively rejects all frequencies except the 52 to 56 MHz band, applying this signal to output amplifier Q3. The 52 to 56 MHz signal across tuned collector tank circuit T3/C19 is coupled through C21 to step generator C, Z113.

The 56.5 to 61 MHz multiplier-amplifier circuit operates in the same manner upon receipt of the 11.3 to 12.2 MHz input from step generator A, Z110, while a similar action takes place in the 61.5 to 66 MHz multiplier-amplifier circuit upon receipt of the 12.3 to 13.2 MHz input from Z110. Each of these three output frequency ranges are applied to the frequency translation circuits in step generator C, Z113. Operating voltage of +12 vdc is applied to each of the three multiplier-amplifier sections, depending upon the frequency range value set on the 10 MHz and 1 MHz selector switches. (See figure 7-1.)

(3) Step generator Z113 (figure 7-10) accepts the three frequency ranges produced in Z111 and, using separate multiplier-amplifier circuits, combines and amplifies them to produce a resultant 104 to 132 MHz output frequency range; this output signal is applied to translator Z112. Since the three multiplier-amplifier circuits are identical, only the 52 to 56 MHz circuit need be discussed.

The 52 to 56 MHz input is coupled through a bandpass filter network to the input of X2 multiplier Q1, whose collector tank circuit T1/C10 is tuned to the second harmonic, thereby producing a resultant frequency range from 104 to 112 MHz. This signal is then applied to the first of three cascade-connected amplifiers, Q2 through Q4, whose respective collector outputs are tuned by transformer T2 and T3 and the combination of L8 and C27/C28. The 104 to 112 MHz output signal is applied through summing resistor R127 to the input of 104 to 132 MHz amplifier Q13. The frequency ranges of 113 to 122 MHz and 123 to 132 MHz are produced in a similar manner; the 113 to 122 MHz output is applied through summing resistor

R132 to the input of Q13, while the 123 to 132 MHz output is applied through resistor R133 to the input of Q13. As a result, Q13, a broadband amplifier, effectively sums the three input frequency ranges producing a net output signal of 104 to 132 MHz from T10 in the collector circuit. This frequency band is coupled through capacitor C128 and an FX287 filter (figure 7-1) to translator Z112. Again, switched B+ voltage of +12 vdc is applied to each circuit depending upon the selected frequency.

f. 1.25 MHz GENERATOR Z109. (See figure 7-11.) The 1.25 MHz generator provides translation of the 1 MHz standard to a 1.25 MHz subcarrier for use in the 3 MHz balanced mixer, Z108.

The 1 MHz standard from spectrum generator Z101 is applied to 1 MHz amplifier Q2 in the 1.25 MHz generator; the collector output is coupled to 1 MHz emitter follower Q1 and the 1 MHz emitter output is directly coupled to the first of two cascade-connected divide-by-2 integrated circuits (IC's) Z1/Z2. Therefore, the 1 MHz signal is effectively quartered to yield a 250 kHz input to X5 amplifier Q3. As a result, a 1.25 MHz collector signal is developed across the T1/C8 tank circuit, and the T1 secondary output is coupled through C11 to 1.25 MHz amplifier Q4. The gain of this stage is set by Level Adjust potentiometer R20 in the emitter return; the collector output signal is then coupled through 1.25 MHz bandpass filter FL1 to 1.25 MHz double-tuned collector output amplifier Q5. The output signal developed across the tuned secondary of transformer T2 is applied to board pins R and S, for use by 3 MHz balanced mixer Z108. A press-to-talk (PTT) voltage enable from the junction of R27/R28 is also supplied to remote control connector J119 on the rear panel, via pin N.

g. 3 MHz BALANCED MIXER Z108. (See figure 7-12.) The 3 MHz balanced mixer produces a 3 MHz IF frequency AM, USB, LSB or ISB intelligence, when the 1.75 kHz IF input from the external equipment is mixed with the subcarrier output from 1.25 MHz generator Z109.

The 1.25 MHz subcarrier input at board pin C is coupled through capacitor C2, amplified in 1.25 MHz amplifier Q1, and coupled to emitter follower Q2; this latter stage isolates the 1.25 MHz input circuit from balanced mixer Z1. The 1.25 MHz input to Z1 is then mixed with the externally applied 1.75 MHz signal from IF IN jack J126, via board pin 2. Depending upon the external mode of operation, the 1.75 input may contain AM, SSB or ISB intelligence. As a result, balanced mixer Z1 produces the sum and difference frequency outputs, while attenuating the two original frequencies; the combination of tuned transformer T1 and capacitors C6/C20 provide a further trap for the 1.75 MHz carrier frequency. The 3 MHz sum frequency, with audio intelligence, is applied to 3 MHz amplifier Q3. The collector output of Q3 is coupled through 3 MHz bandpass filter FL1 to 3 MHz output amplifier Q4. The output signal developed across the collector tank circuit consisting of the T2 primary and C12 is transferred to the

secondary winding, developed across Level Adjust potentiometer R22, and coupled through C14 to board pin 7, thence to translator Z112. The CW key time delay circuit consisting of C18, Time Delay Adjust potentiometer R28, diode CR1 and resistor R27, establishes the pull-in time of main chassis keying relay K101 through external key circuit connector J119-F.

h. TRANSLATOR Z112. (See figure 7-13.)

Translator Z112 receives the 3 MHz carrier from 3 MHz balanced mixer Z108; the 40 MHz signal from spectrum generator Z101; the 10 to 10.9999 MHz signal from final mixer Z106; and the 104 to 132 MHz signal from the FX287 filter. These signals are effectively shifted or translated to produce an output frequency range from 1.6 to 29.9999 MHz, depending upon the selected rf output carrier frequency.

The 10 to 10.9999 MHz selectable frequency range input is applied at board pin H to balanced mixer Q12 (through a bandpass filter network), developed across the tuned collector tank circuit, T12/C81, and coupled to the balanced modulator consisting of the T12 secondary, Balance Adjust potentiometer R71 and matched diodes CR4 and CR5. With the 3 MHz input coupled to the balanced modulator via transformer T14 (through a low-pass network) and capacitor C50, diode CR5 of the modulator outputs the sum and difference frequencies, while attenuating the two original frequencies, and applies them to tuned coupling transformer T13 in the 13 to 13.5 MHz circuit, and to tuned coupling transformer T19 in the 13.5 to 14 MHz circuit. With T13 and T15 tuned to the lower half of the sum frequency from 13 to 13.9999 MHz, a 13.0 to 13.5 MHz signal is applied to a series of two amplifiers, Q13 and Q14, tuned by transformers T16 through T18. Similarly, with transformers T19 and T20 tuned to the upper half of the sum frequency, a 13.5 to 13.9999 MHz signal is applied to amplifiers Q18 and Q19, and tuned by transformers T21 through T23. The upper half of the frequency range is then applied to the secondary of transformer T18, combined with the lower half of the frequency range developed across the primary; and applied to balanced modulator transformer T6 in the 40 MHz multiplier-amplifier section. The Automatic Load and Drive Control (ALDC) circuit consisting of Q15, Q16, and Q17 receives a negative bias level from rf output Z115 via board pin 10 when an external ALDC input is present. The gain of this circuit is set by Level Adjust potentiometer R97. The ALDC circuit supplies each half of the 13 to 13.9999 MHz circuits with a control voltage to maintain a relatively constant net output signal at the secondary of T18. The combination of modulator diode CR4 and resistor R77 effectively isolates the ALDC circuit from the input circuit to the 13 to 13.5 MHz and 13.5 to 13.9999 MHz amplifier sections.

The 40 MHz input from spectrum generator Z101 is applied via board pin B to a series of three tuned amplifiers, Q1 through Q3; the tuned collector output from 40 MHz amplifier Q3 is coupled from the secondary of T3 through capacitor C16 to X3 multiplier Q4, thereby resulting in an output frequency of 120 MHz across transformer T4 in the tuned collector

circuit. This signal is amplified and tuned in stages Q5 and Q6 and applied across the tuned collector circuit consisting of the T6 primary and trimmer capacitor C31. The 120 MHz signal is then coupled to the balanced modulator consisting of the T6 secondary, Balance Adjust potentiometer R36 and matched diodes CR1 and CR2. As a result, the 120 MHz signal is modulated by the 13 to 13.9999 MHz signal from the secondary of transformer T18, resulting in the sum and difference frequencies, while attenuating the two original frequencies. With the secondary of transformer T7 tuned to the sum frequency, a signal range of 133 to 133.9999 MHz results; this signal is amplified by four subsequent tuned amplifier stages, Q7 through Q10, and is coupled to the anode of mixer diode CR3.

At this point, the 104 to 132 MHz signal from high pass filter Z116 is coupled (at board pins 13, P and S) through capacitor C10 to the cathode of mixer diode CR3, thereby resulting in a difference frequency range of 1.0 to 29.9999 MHz. This signal is applied to a two-section L-type inductive filter (consisting of inductors L17 and L19, and capacitors C64 and C65) which provides a sharp rolloff below 1.6 MHz; thus, a 1.6 to 29.9999 MHz frequency range results and is coupled through C66 to the 1.6 to 29.9999 output amplifier, Q11. The collector output developed across autotransformer T11 is coupled through C70 and output board pin R to RF OUTPUT control R103 (figure 7-1). Switched +12 vdc inputs are applied to the translator circuits, depending upon the selected range value of rf output frequency.

i. RF OUTPUT Z115 AND METERING

CIRCUIT. (See figures 7-1 and 7-14.) RF output Z115 consists of three rf stages, Q1 through Q3. The 1.6 to 29.9999 MHz input frequency range from the RF OUTPUT control is applied between board pins B and A to cascode amplifier Q3 through a dual LC filter consisting of L7, L24, C20 and C39. Potentiometer R1 establishes the operating bias of the input stage, while RF OUTPUT control R103 sets the desired input signal amplitude. The collector output of Q3 is coupled through C9 and autotransformer T1 to the first of two cascade-connected rf amplifiers Q2/Q1. The 1.6 to 29.9999 MHz signal output from Q1 is coupled through C14 and applied to filter network Z114 and to the rf metering and ALDC circuits. The signal to the metering circuit is coupled through isolation resistor R17 and capacitor C37 to diode CR2 which passes the negative half-cycle to ground; the positive half-cycle is then filtered to produce, between pins 13 and P, a dc level proportional to the amplitude of the rf output. This level is supplied to MONITOR meter M101 when METER switch S115 is in the RF position. In the ALDC circuit, a positive ALDC threshold adjustment level is obtained from ALDC Adjust potentiometer R107, located on the main chassis; this level is filtered and applied to diode CR1, thereby setting the reverse-bias threshold level. The externally applied ALDC signal is a negative level from the transmitting circuits, and occurs whenever the transmitted envelope crest exceeds a preset threshold. This level is coupled through diode CR3; is filtered; and is applied to the ALDC amplifier in translator Z112.

In the metering circuit (figure 7-1), +30 vdc and +24 vdc from the power supply assembly is coupled to METER switch S115B and through dropping resistors R108 through R110 to S115A and to rf output circuit Z115, via pins 9, 11, and N. Therefore, meter M101 is effectively placed in series with the collectors of each rf amplifier and the B+ supply voltage, thereby monitoring respective collector current of each amplifier when METER switch S115 is set to the Q1 (350 ma), Q2 (130 ma) or Q3 (65 ma) position. Potentiometer R106, mounted on the main chassis, provides a means of calibrating meter M101. In the RF position of switch S115, one side of meter M101 is returned to ground through S115A, while S115B connects the other side of the meter to the RF metering circuit, via pin 13. Thus, in the RF position, the MONITOR displays relative amplitude of the output signal.

j. OUTPUT FILTER Z114. (See figure 7-15.) Output filter Z114 contains six relay-controlled bandpass filters, which each relay returned to the appropriate positions on the 10 MHz (S107), 1 MHz (S106) and 100 kHz (S105) switches relative to the selected rf output frequency range. As a result, the range in which the selected frequency falls is filtered by an appropriate L-C network prior to appearing at RF OUT jack J124 and MON jack J125. (See figure 7-1.) The four upper bandpass filters are tuned by trimmer capacitors. Table 4-1 presents a listing of each bandpass filter control relay and the corresponding frequency range it controls.

TABLE 4-1. OUTPUT FILTER PASS BANDS AND CONTROL RELAYS

Control Relay	Filter Bandpass Frequency
K1	1.6 MHz - 2.5 MHz
K2	2.5 MHz - 4.0 MHz
K3	4.0 MHz - 7.0 MHz
K4	7.0 MHz - 12.0 MHz
K5	12.0 MHz - 20.0 MHz
K6	20.0 MHz - 29.9999 MHz

k. POWER SUPPLY ASSEMBLY. (See figures 7-16 through 7-18.) Three subassemblies are incorporated into the power supply: rectifier and filter capacitor board A, Z304, regulator board B, Z303, and heat sink Z305. (See figure 7-16.) Also included is power transformer T301 and 1 MHz standard oscillator Z301. Input power of either 115 or 230 vac is applied to power transformer T301 via

POWER INPUT jack J116 and line fuses F101 and F102. For 115-volt operation, the primaries of T301 are connected in parallel and line fuses of 1.0-ampere value are used; for 230-volt operation, the primaries of T301 are connected in series and fuse value is 0.5-ampere. The secondary output voltage, approximately 60 vac, is applied to the full-wave bridge rectifier on Z304 (figure 7-17). The rectified output voltage of 40 vdc is filtered by C4 and applied to regulator Z303. The centertap voltage from T301, approximately 30 vac, is filtered by capacitor C3 and also applied as +20 volts to regulator Z303.

The +40 volt input to regulator Z303 (figure 7-18) is developed across the combination of voltage reference diode CR5 and 24V Current Adjust potentiometer R12, thus providing a stable positive reference input to over-current amplifier Q6. As a result, Q6 conducts by an amount proportional to the setting of R12, and causes regulator drivers Q2 and Q3 to conduct, which, in turn, respectively cause series regulators Q302 and Q303 to conduct on heat sink Z305. The supply collector current drawn by regulator Q302 is sensed by the R15, R19 and CR2 network in the emitter circuit of over-current amplifier Q6, thereby establishing a current reference in conjunction with the bias applied to the base via R12. Series regulator Q302 furnishes a +30 vdc output, while regulator Q303 supplies +24 vdc.

Fluctuations in the +24 vdc output of Q303 are applied to a resistive divider consisting of R6, +24V Adjust potentiometer R18, and R16; R18 applies this positive voltage to dc amplifier Q7. Since the emitter of Q7 is maintained at a constant +15 vdc potential by zener diode CR7, variations in the output voltage, when compared with this stable reference, cause Q7 to provide more or less drive current to regulator drivers Q2 and Q3. For example, if the +24 vdc output decreases, Q7 conducts less thereby causing the collector voltage to rise and increase the forward bias applied to drivers Q2 and Q3. As a result, Q2 and Q3 conduct more, driving the bases of regulators Q302 and Q303 more positive. Therefore, Q302 and Q303 conduct more, thus causing a decrease in effective series resistance with the output voltage. Consequently the output voltages rise to the normal +24 and +30 vdc levels. The +12 vdc regulator, consisting of Q1, Q4, Q5 and Q301, is similar in operation to the +24 vdc/+30 vdc regulators.

The +30 vdc output from the power supply assembly (figure 7-16) is applied to output filter Z114 and to METER switch S115; the +24 vdc and +12 vdc outputs are applied to STANDBY-ON switch S112. (See figure 7-1.)

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

The following paragraphs describe procedures to inspect, check and clean the components of the CHG()-4. In general, preventive maintenance provides a basis for recognizing future probable causes of equipment malfunction in the early stages of deterioration. Many such causes are apparent to the senses of sight, touch and smell. Therefore, by adhering to a stringent program of preventive maintenance, involving periodic inspection and checks, the most probable causes of equipment malfunction can be avoided, thereby minimizing equipment down-time and the possibility of compromising important schedules. Table 5-3 presents a listing of test equipment required for CHG()-4 maintenance.

a. INSPECTION AND TEST. The following paragraphs describe equipment inspection and power supply checks to be performed on a weekly basis.

(1) General Inspection. A most important and least expensive tool in the preventive maintenance program is the sense of sight; a thorough visual inspection of an assembly or component for tell-tale signs of deterioration prior to failure can save hours of test and troubleshooting time after a complete breakdown. Table 5-1 presents a weekly inspection checklist for the CHG()-4.

TABLE 5-1. WEEKLY INSPECTION ROUTINE

Assembly or Subassembly	Check
Line Power Cord	Check three-wire line power cord for cracks, nicks or fraying
Main Chassis Assemblies	<ol style="list-style-type: none"> 1. Check underside of chassis for dirt and dust. 2. Check all inter-connector wiring for nicks, cracks or fraying. 3. Check all printed circuit boards for cracks; check components for looseness and evidence of deterioration from possible overheating.

TABLE 5-1. WEEKLY INSPECTION ROUTINE
(continued)

Assembly or Subassembly	Check
Main Chassis Assemblies (cont)	<ol style="list-style-type: none"> 4. Check printed circuit board jacks for tightness against chassis. 5. Check ground connections for security.
Front and Rear Panels	<ol style="list-style-type: none"> 1. Check panel for general cleanliness. 2. Check all control knobs for smooth action from limit-to-limit. Check all switches for positive action. 3. Check MONITOR meter face for cracks, scratches, etc. 4. Check indicator faces for cracks. 5. Remove line fuses and check for proper 1-ampere or 0.5-ampere value and condition (0.5-ampere with 230 vac line). 6. Check all input/output jacks for security against panel.

(2) Power Supply checks. Perform the following power supply routine maintenance on a weekly basis as follows:

- (a) Remove line cord from 115 or 230 vac source.
- (b) Unplug power supply regulator board Z303 from its receptacle at the rear center of the chassis; insert the small extender board in the vacated receptacle and mount the regulator board on the extender board.

(c) Check that POWER switch on front panel is in STANDBY position and connect line power cord to 115 or 230 vac source as applicable.

(d) Using an HP410B VTVM, or equivalent, check dc voltage at pin F of Z303; voltage should be +12 vdc \pm 5%.

(e) Check voltage at pin 4 of Z303; voltage should be +24 vdc \pm 5%.

(f) Check voltage at pin 3 of Z303; voltage should be +30 vdc \pm 5%.

(g) Remove line cord from power source, and replace regulator board into mating jack J303 after removing extender board.

(3) Functional Test. Perform the check-out procedure for the CHG()-4 as outlined in Section 2, paragraph 2-5, on a weekly basis, after a check has been made of the power supplies.

b. CLEANING INSTRUCTIONS. In general, the CHG()-4 should be cleaned once a week, using a soft camel's hair brush, forced air pressure of not more than 20 psi and a suitable cleaning agent such as trichlorethylene or methylchloroform.

WARNING

When using toxic solvents, make certain that adequate ventilation is provided; prolonged or repeated breathing of the vapor shall be avoided. Avoid prolonged or repeated contact with the skin. Flammable solvents shall not be used on energized equipment or near other equipment from which a spark may be received.

CAUTION

Trichlorethylene contains a paint removing solvent; avoid contact with painted surfaces.

Remove dirt or grease from wiring and chassis surfaces using cleaning solvent; dry with compressed air. Remove dust from printed circuit boards using a soft camel's hair brush. Blow out accumulated dust from inaccessible areas of chassis using forced air.

5-2. TROUBLESHOOTING

The circuits of the CHG()-4 are contained on 17 PC boards accessible from the top of the chassis. The card Zxxx numbers are the circuit reference designation prefix. Numbers prefixed with an "A" are the PC assembly part numbers by which they are identified and ordered. The "Z" prefix number is silkscreened both on the card and on the chassis adjacent to the PC board receptacle. Some PC boards in the CHG()-4 and in other TMC equipment, although they are assigned different "A" designations, have the same assembly "A" prefix and are thus identical and interchangeable. These PC boards have similar keying at their plug ends and mating receptacles. The power supply assembly heat sink is mounted against the rear wall of the chassis; the smaller power supply boards are mounted forward of the heat sink and are removable.

In general, a malfunction in the CHG()-4 will usually manifest itself by lack of, or improper, readings on the MONITOR meter, and can be quickly localized to a particular printed circuit board by the logical process of elimination. If a second CHG()-4 is obtainable, or a set of spare PC boards is available, troubleshooting can be facilitated by the board substitution method. In some instances, a particular board may require alignment or adjustment as outlined in paragraph 5-3. Table 5-2 presents a troubleshooting chart for the CHG()-4; figures 5-1 and 5-2 show respective top and bottom views of the equipment.

TABLE 5-2. TROUBLESHOOTING CHART

Step	Trouble	Probable Cause	Remedy
1	No rf output at any selected frequency.	Check that POWER indicator is illuminated with POWER switch ON.	If lamp is not illuminated, check fuses; check power supply voltages as outlined in paragraph 5-1 a.(2). If lamp is illuminated, proceed to step 2.
2		Check that STD switch is set to INT.	Set switch at INT. If switch is at INT, proceed to step 3.
3		Check for normal display on MONITOR with METER switch in Q1, Q2 and Q3 position.	If all readings are normal, proceed to step 4. If any reading is abnormal, check Q1, Q2 or Q3 and associated circuitry on rf output Z115 as indicated by meter reading.

TABLE 5-2. TROUBLESHOOTING CHART
(Continued)

Step	Trouble	Probable Cause	Remedy
4		Check for 1 MHz output at 1 MHz MON jack on rear of chassis.	If 1 MHz is present, proceed to step 5. If 1 MHz is not present, check for 1 MHz output at J302 on the power supply assembly. If not present, replace 1 MHz standard Z301.
5		Check for 1 MHz spectrum from 1 MHz spectrum generator on Z101.	If present, proceed to step 6. Otherwise, troubleshoot 1 MHz spectrum generator and 1 MHz squarewave generator on Z101.
6		Check for 100 kHz spectrum output at pin D of Z101.	If present, proceed to step 7. Otherwise, troubleshoot 100 kHz spectrum generator channel on Z101.
7		Check for 3 MHz input to translator Z112.	If not present, proceed to step 8. If present, proceed to step 9.
8		Check for 1.25 MHz input to Z108.	If not present, troubleshoot 1.25 MHz generator Z109. If present, check for 1.75 MHz IF input to Z108 and troubleshoot 3 MHz balanced mixer circuit.
9		Check for 10.0 to 10.9999 MHz, 40 MHz, and 104 to 132 MHz inputs to Z112.	If 10 to 10.9999 MHz input is missing, check mixer-divider circuits Z104, Z105 and Z106. If 40 MHz input is missing, check 40 MHz multiplier circuit on Z101. If 104 to 132 MHz input is missing, check step generators Z110, Z111 and Z113. If all inputs to Z112 are present, check translator Z112; check 1.6 to 29.9999 MHz amplifier Q11.

5-3. ALIGNMENT

a. GENERAL. The following paragraphs present alignment procedures required to maintain the translator in a satisfactory operating condition.

b. TEST EQUIPMENT REQUIRED. Table 5-3 presents a listing of test equipment required for complete alignment of the Translator.

TABLE 5-3. TEST EQUIPMENT REQUIRED

Equipment	Manufacturer
Signal Generator	H.P. Model 606A
Oscilloscope	Tektronix Model 545, or equivalent

TABLE 5-3. TEST EQUIPMENT REQUIRED
(Continued)

Equipment	Manufacturer
Spectrum Analyzer	Lavoie Laboratories Inc., or equivalent
Audio Generator	H.P. 200CD, or equivalent
DC Power Supply	0-10 Volts
Attenuator	Telonic D-550 or equivalent
Millivolt Meter,	Millivac MV-28E, or equivalent
VTVM	H.P. Model 410B, or equivalent
VTVM	Ballantine Model 314, or equivalent

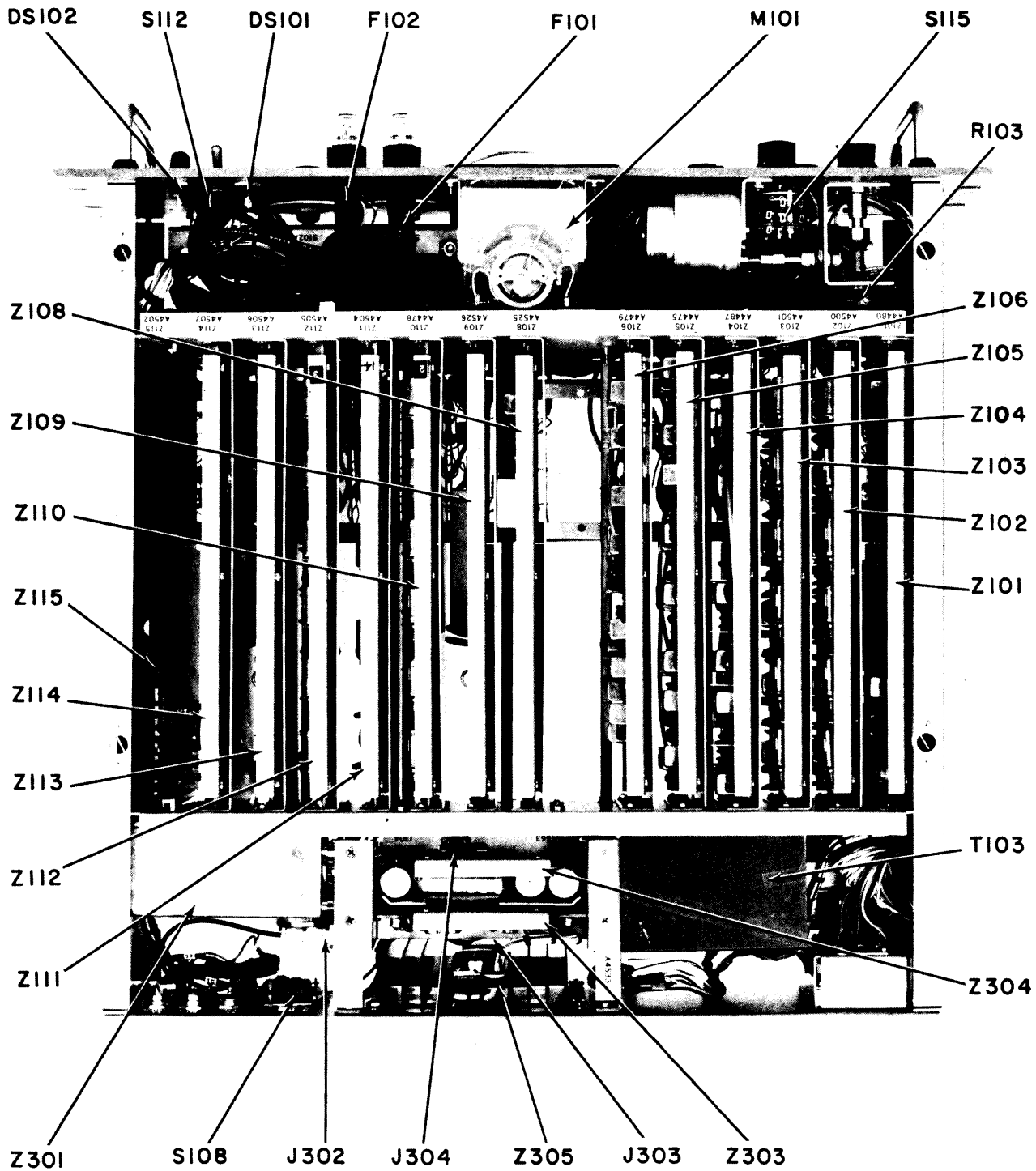


Figure 5-1. CHG()-4 Top View, Location of Major Components

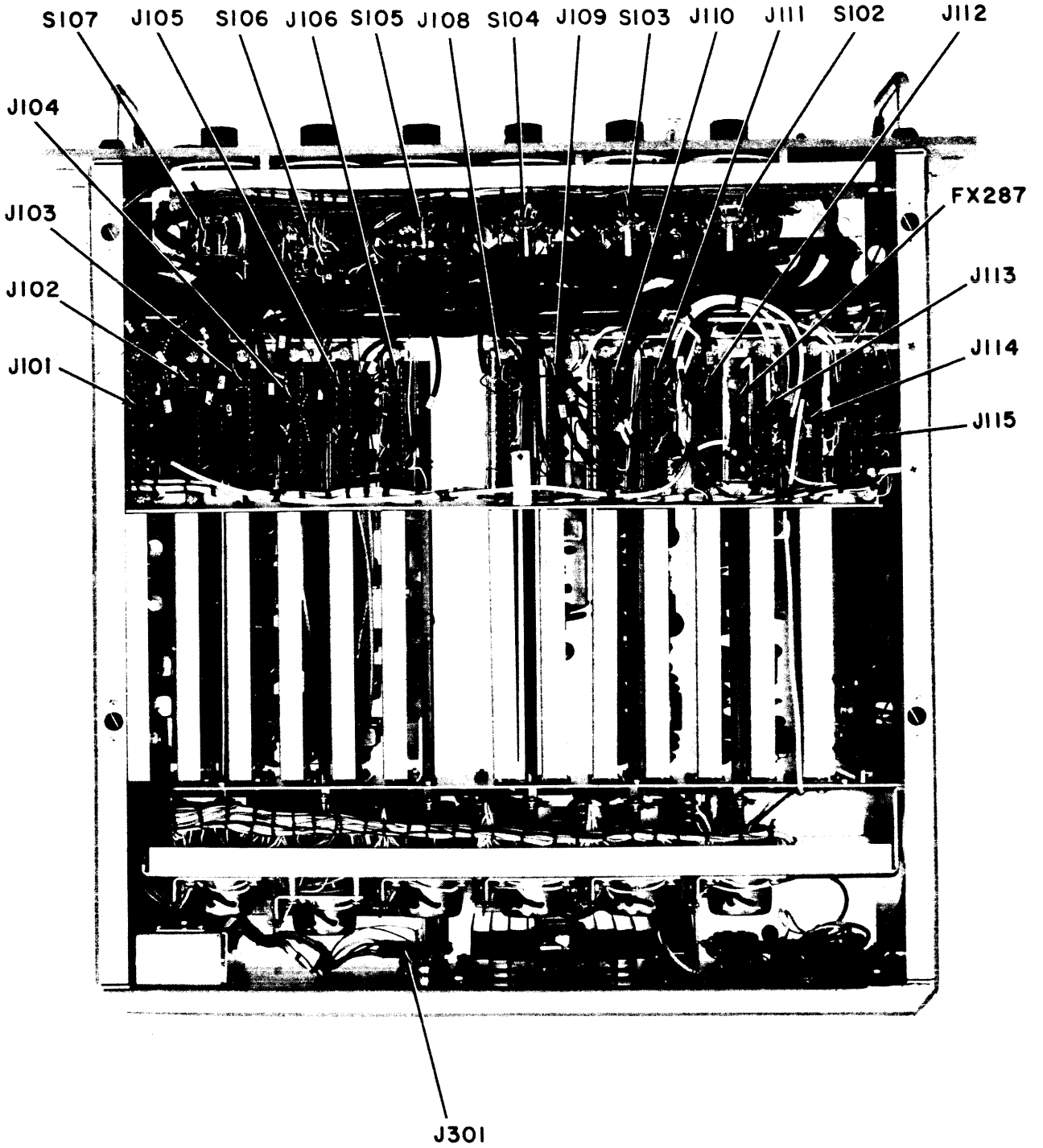


Figure 5-2. CHG()-4, Bottom View, Location of Major Components

TABLE 5-3. TEST EQUIPMENT REQUIRED
(Continued)

Equipment	Manufacturer
Voltmeter	Simpson 260A, or equivalent
Frequency Counter	H.P. Model 5244L, or equivalent
1.75 MHz Source	CMR-4 or equivalent

c. POWER SUPPLY BOARDS Z303 AND Z304. (See figure 5-3.) Align the power supply boards as follows:

- (1) Plug in ac line cord; STANDBY lamp should light.
- (2) Turn POWER switch to ON position; red POWER lamp should light.
- (3) Measure dc voltage at pin 6 of J304 (approximately 45 volts).
- (4) Allow fifteen (15) minutes warm-up.
- (5) Using Simpson 260A, measure dc voltage level at J304 pin A (approximately +40 volts).
- (6) Measure dc voltage level at pin E (approximately +20 volts).
- (7) Measure dc voltage level at J303 pin E (approximately +20 volts).
- (8) Measure dc voltage level at pin A (approximately +40 volts). Turn potentiometers R3 and R12 fully cw.
- (9) Measure dc voltage at pin F. Adjust potentiometer R8 for exactly 12.0 volts (all cards tested and inserted except Z115 (subparagraph o.)). Connect scope to pin F. Maximum ac ripple should be 5 mv. Adjust R3 until voltage level just starts to drop. Back off slightly to full voltage.
- (10) Measure dc voltage at pin 4. Adjust potentiometer R18 for exactly 24.0 volts. Connect scope to pin 4. Maximum ac ripple should be 2 mv. Adjust potentiometer R12 until voltage level just starts to drop. Back off slightly to full voltage.
- (11) Measure dc voltage at J301 pin E (30 volts \pm 1 volt).
- (12) Turn POWER switch to STANDBY position and METER switch to Q1 position. Adjust potentiometer R106 (meter adjust) for equal readings on front panel meter and Simpson Model 260, with set-up shown in figure 5-3.

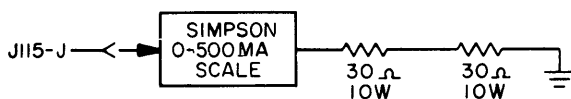


Figure 5-3. Power Supply, Test Setup

d. SPECTRUM GENERATOR Z101. Align the spectrum generator as follows:

NOTE

Insert Z102, Z103, Z105 and Z106 into Translator for 1 MHz load.

(1) Set STD switch (S108) on rear panel to INT position. Place scope between pin A and ground and adjust transformer T1 for maximum output at 1 MHz.

(2) Place scope between pin 3 and ground and adjust potentiometer R60 for 0.6 volt peak-to-peak.

(3) Measure level at collector of transistor Q3 with scope (1 MHz spectrum of 1.5 volts peak-to-peak).

(4) Measure level at pin D of J101 (100 kHz spectrum of 1.0 volt peak-to-peak).

(5) Place scope between TP3 and ground. Adjust transformer T2 and capacitor C12 for maximum output at 12 MHz (Z113 inserted and 10 MHz switch on front panel set to position 3; all other switches on front panel set to 0 position).

(6) Place scope lead to pin 8 and ground lead to pin J. Adjust transformer T3 for maximum output at 12 MHz (approximately 0.4 volt peak-to-peak).

(7) Place scope between TP6 and ground. Adjust capacitor C50 and transformer T8 for maximum signal at 13 MHz.

(8) Place scope lead to pin P with ground lead to pin R. Adjust transformer T9 for maximum output at 13 MHz (approximately .75 volt peak-to-peak).

(9) Place scope between TP9 and ground. Adjust capacitor C73 and transformer T10 for maximum output at 8 MHz.

(10) Place scope lead to pin S, with ground lead to pin 15. Adjust transformer T11 for maximum output at 8 MHz. Output should be approximately 1.5 volts peak-to-peak.

(11) Place scope between TP5 and ground. Adjust capacitor C36 and transformer T6 for maximum output at 14 MHz (Z110 inserted and 10 MHz switch on front panel set to position 0).

(12) Place scope lead to pin 13, with ground lead to pin 12. Adjust transformer T7 for maximum output at 14 MHz. Output level should be approximately .75 volt peak-to-peak.

(13) Place Millivac METER MV-28B to pin 11, with ground lead to pin 10. Set analyzer to read 40 MHz. Adjust capacitors C86 and C89 for maximum output. Output should be approximately 70 mv rms (Z112 inserted).

e. COMB FILTER Z102. Align comb filter A, Z102, as follows:

(1) Set 100 Hz, 1 kHz, 10 kHz and 100 kHz switches to blank position; remove comb filter B, Z103, from Translator.

(2) Place scope between TP11 and ground. Adjust capacitor C54 and transformer T11 for maximum output at 0.8 MHz.

(3) Place scope lead to pin S with ground lead on pin 15. Adjust transformer T12 for maximum output at 0.8 MHz. Adjust potentiometer R42 for 0.7 volt peak-to-peak.

(4) Place scope on TP9. Adjust capacitor C43 and transformer T9 for maximum output at 1.0 MHz.

(5) Place scope on pin J. Adjust transformer T10 for maximum output at 1.0 MHz. Adjust potentiometer R35 for 0.7 volt peak-to-peak.

(6) Place scope on TP7. Adjust capacitor C32 and transformer T7 for maximum output at 1.2 MHz.

(7) Place scope on pin P. Adjust transformer T8 for maximum output at 1.2 MHz. Adjust potentiometer R28 for 0.7 volt peak-to-peak.

(8) Place scope on TP5. Adjust transformer T5 and capacitor C22 for maximum output at 1.4 MHz.

(9) Place scope on pin F. Adjust transformer T6 for maximum output at 1.4 MHz. Adjust potentiometer R21 for 0.7 volt peak-to-peak.

(10) Place scope on TP4. Adjust transformer T3 and capacitor C11 for maximum output at 1.6 MHz.

(11) Place scope on pin L. Adjust transformer T4 for maximum output at 1.6 MHz. Adjust potentiometer R14 for 0.7 volt peak-to-peak.

(12) Place scope on TP1. Adjust capacitor C10 and transformer T2 for maximum output at 1.8 MHz.

(13) Place scope on pin 4. Adjust transformer T1 for maximum output at 1.8 MHz. Adjust potentiometer R3 for 0.7 volt peak-to-peak.

f. COMB FILTER Z103. Align comb filter B, Z103, as follows:

(1) Set 100 Hz, 1 kHz, 10 kHz and 100 kHz switches to blank position; remove comb filter A, Z102, from Translator.

(2) Follow same procedure outlined in subparagraph e, steps (2) and (3); substitute 0.9 MHz.

(3) Follow same procedure outlined in steps (4) and (5) of subparagraph e; substitute 1.1 MHz.

(4) Follow same procedure outlined in steps (6) and (7) of subparagraph e; substitute 1.3 MHz.

(5) Follow same procedure outlined in steps (8) and (9) of subparagraph e; substitute 1.5 MHz.

(6) Follow same procedure outlined in steps (10) and (11) of subparagraph e; substitute 1.7 MHz.

(7) Follow same procedure outlined in steps (12) and (13) of subparagraph e; substitute 1.9 MHz.

g. MIXER-DIVIDER Z104. Align the mixer-divider as follows:

(1) Place scope probe from cathode side of diode CR1 to ground. Adjust transformer T1 for maximum output at 8.0 MHz. Place scope probe on TP1. Jumper pin B of J104 to ground. Adjust potentiometer R7 for minimum output. Level at cathode of CR1 should be 0.5 volt peak-to-peak minimum. Remove spectrum generator Z101 from unit.

(2) Place scope probe from TP5 to ground. Place generator input from TP1 to ground. Adjust generator to 9.05 MHz; terminate generator input with 47 ohms. Adjust transformers T2 through T6 for maximum output. Connect scope to TP6 and adjust potentiometer R23 for minimum output. With generator set to 10 mv rms, the output should be 0.5 volt peak-to-peak minimum at TP5. Remove short from pin B of J104.

(3) Place generator input through a 220-ohm resistor to TP6. Place the ground lead to ground. Adjust generator to 10.4 MHz at a level of 10 mv rms.

(a) Place the scope probe at TP6 and the ground lead to ground. Short TP7 to ground.

Adjust transformer T7 for maximum output. Remove the short from TP7. Adjust transformer T8 for minimum reading at TP6.

(b) Place scope probe from TP8 to ground. Short TP9 to ground. Adjust transformer T9 for maximum output. Remove the short from TP9 and adjust transformer T10 for minimum output at TP8.

(c) Place scope probe at TP10. Adjust transformer T11 for maximum output. With a generator input of 10 mv rms, the output should be 0.2 volt peak-to-peak minimum for the range of 10 MHz to 11 MHz.

(d) Disconnect generator and reinsert Z101 into J101. Place scope probe on pin 15 and the ground lead to pin R. Turn 100 Hz switch from position 0 to position 9. Output should be minimum of 0.6 volt peak-to-peak with frequency variation of 1.0 MHz to 1.09 MHz.

h. DUAL MIXER-DIVIDER Z105. Align the dual mixer-divider as follows:

(1) Place scope probe from cathode side of diode CR1 to ground. Adjust 100 Hz switch to blank position. Adjust transformer T1 for maximum output at 8.0 MHz. Place scope on TP1. Adjust potentiometer R9 for minimum output. Output at cathode of diode CR1 should be 0.5 volt peak-to-peak minimum.

(2) Place the scope probe on cathode side of diode CR3 and ground lead to ground. Set 1 kHz switch to blank position. Adjust 100 Hz switch to position 5. Adjust transformers T2 through T6 for maximum output at 9.0 to 9.09 MHz. Place probe on TP5 and adjust potentiometer R23 for minimum output. Output at cathode of diode CR3 should be 0.5 volt peak-to-peak minimum in 100 Hz switch positions from 0 through 9.

(3) Rotate 100 Hz switch to blank position. Place signal generator through a 220-ohm resistor to TP5. Adjust generator output for 10.4 MHz at a level of 20 mv rms; terminate generator line with 47-ohm resistor.

(a) Place scope probe at TP5. Ground lead to ground. Short TP6 to ground and adjust transformer T8 for minimum output.

(b) Place scope probe at TP7 with a ground lead grounded near this point. Short TP8 to ground. Adjust transformer T9 for maximum output. Remove short from TP8 and adjust transformer T10 for minimum output.

(c) Place scope probe between TP9 and ground. Adjust transformer T11 for maximum indication. With a generator input of 10 mv rms, the output should be 0.2 volt peak-to-peak minimum for the range of 10 MHz to 11 MHz.

(4) Disconnect generator. Place scope probe on the junction of inductor L4 and resistor R46. With the 100 Hz switch in position 5, rotate the 1 kHz switch from position 0 to position 9. The output should be 0.6 volt peak-to-peak from 1.0 to 1.099 MHz.

(5) Rotate the 1 kHz switch to a blank position. Place the scope probe between cathode end of diode CR6 and ground. Adjust transformer T12 for maximum output at 8.0 MHz. Place scope probe at TP10. Adjust potentiometer R54 for minimum output.

Output at cathode of diode CR6 should be 0.5 volt peak-to-peak minimum.

(6) Place scope probe between cathode side of diode CR8 and ground. Rotate the 1 kHz switch to position 5. Adjust transformers T13 through T17 for maximum output from 9.0 to 9.099 MHz. With the 1 kHz switch in position 5, place the scope probe between TP14 and ground. Adjust potentiometer R69 for minimum indication. Output at cathode of diode CR8 should be 0.5 volt peak-to-peak minimum with the 1 kHz switch in positions 0 through 9.

(7) Rotate the 1 kHz switch to the blank position. Connect signal generator through 220-ohm resistor to TP14 and connect ground lead to ground. Make sure signal generator lead is terminated with 47 ohms.

(a) Place scope probe between TP14 and ground. Adjust signal generator for 10.4 MHz at a level of 10 mv rms. Short TP15 to ground. Adjust transformer T18 for maximum output. Remove short from TP15 and adjust transformer T19 for minimum output.

(b) Place scope probe between TP16 and ground. Short TP17 to ground. Adjust transformer T20 for maximum output. Remove short from TP17. Adjust transformer T21 for minimum output.

(c) Place scope probe between TP18 and ground. Adjust transformer T22 for maximum output. With a generator input of 10 mv rms in, the output should be 0.2 volt peak-to-peak for the range of 10 MHz to 11 MHz.

(8) Disconnect generator and rotate 1 kHz switch to position 5. Place scope probe at pin 15 and ground lead to pin R. Rotate 10 kHz switch from position 0 through position 9. Output should be 0.6 volt peak-to-peak over a frequency variation from 1.0 to 1.0999 MHz.

i. FINAL MIXER Z106. Align the final mixer as follows:

(1) Place scope probe from cathode end of diode CR2 to ground. Rotate 10 kHz switch to the blank position. Rotate 100 kHz switch to position 5. Adjust transformer T1 for maximum output at 8.0 MHz. Place short between pin H and pin E. Output at cathode of diode CR2 should be 0.5 volt peak-to-peak.

(2) Rotate 1 kHz and 10 kHz switches to position 5. Place scope probe between the cathode of diode CR3 and ground. Adjust transformers T2 through T6 and T13 for maximum output from 9.0 to 9.0999 MHz. Place scope probe between junction of diodes CR4 and CR3 and ground. Adjust potentiometer R18 for minimum output. Output at cathode of diode CR3 should be 0.5 volt peak-to-peak.

(3) Rotate 10 kHz switch to blank position. Connect generator through a 220-ohm resistor to TP5. Connect ground lead to ground. Adjust signal generator for 10.4 MHz at a level of 10 mv rms. Rotate 100 kHz switch to position 4.

(a) Connect probe to TP5. Short TP7 to ground. Adjust transformer T7 for maximum output. Remove short from TP7 and adjust transformer T8 for minimum output.

(b) Place scope probe between TP8 and ground. Short TP9 to ground. Adjust transformer T9 for maximum output. Remove short from TP9 and

adjust transformer T10 for minimum output.

(c) Remove translator Z112 from unit. Place a 47-ohm resistor between pins 12 and 13 of J106. Place scope probe on TP10. Place short across secondary of transformer T12. Rotate 100 kHz switch to position 5. Adjust generator for a frequency of 10.75 MHz. Adjust transformer T11 for maximum output. Remove short from transformer T12 and adjust T12 for minimum output.

(d) Rotate 100 kHz switch to position 4. Adjust generator frequency for 10.1 MHz. Short secondary of transformer T12. Adjust capacitor C36 for maximum output. Remove short from T12 and adjust capacitor C48 for minimum output.

(e) Place scope across 47-ohm resistor. Set generator for 10.5 MHz 100 mv rms out. With 100 kHz switch in position 4, output should be at least 0.2 volt peak-to-peak with generator frequency of 10 MHz to 10.5 MHz. With the 100 kHz switch in position 5, output should be at least 0.2 volt peak-to-peak with a frequency input of 10.5 MHz to 11 MHz.

(4) Remove generator input and set 10 kHz switch to position 5. Remove short from pins H and E. Rotate 100 kHz switch from position 0 to position 9. Output should be a minimum of 0.2 volt peak-to-peak from 10.0 to 10.9999 MHz. Remove 47-ohm resistor from pins 12 and 13. Replace translator Z112 into J112.

j. 1.25 MHz GENERATOR Z109. (See figure 5-4.) Align the 1.25 MHz generator as follows:

(1) Interconnect an aligned CMR()-4 (or 1.75 MHz source) and the CHG()-4 under test as shown in figure 5-4.

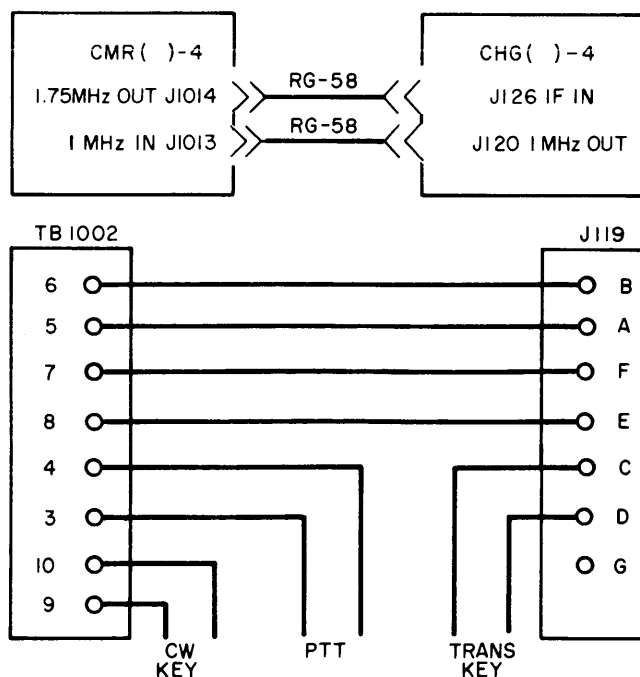


Figure 5-4. 1.25 MHz Generator, Test Setup

(2) Turn MODE switch S1005 on CMR-() 4 to NORM. Set CARRIER SUPPRESSION switch to 0. Turn RF OUTPUT control on CHG()-4 fully ccw.

(3) Monitor TP1 on Z109 with scope probe; voltage should be 10 volts peak-to-peak.

(4) Adjust potentiometer R20 fully cw. Monitor TP2 with scope probe and adjust T1 for maximum level (approximately .66 volt peak-to-peak).

(5) Monitor TP3 with scope probe. Adjust transformer T2 for maximum level. Adjust potentiometer R20 for 70 mv peak-to-peak.

k. 3 MHz BALANCED MIXER Z108. Align the 3 MHz balanced mixer as follows:

(1) Remove Z108 from unit. Adjust potentiometer R20 fully ccw. With card still removed, measure 1.25 MHz at pin C of J208 (70 mv peak-to-peak). Measure 1.75 MHz at pin 2 of J108 (20 mv peak-to-peak). Insert Z108.

(2) Monitor pin 7 of J108 with scope probe. Adjust transformers T1 and T2 for maximum level (approximately .4 volt peak-to-peak).

1. STEP GENERATOR A, Z110. (See figure 5-5.) Align step generator A as follows:

(1) Remove comb filters Z102 and Z103 from unit and set frequency selector switches on front panel to 03.0000 MHz.

(2) Place scope on collector of transistor Q1 and adjust potentiometer R1 for maximum level.

(3) Place scope at junction of diode CR1 and transformer T1. Adjust transformer T1 for maximum level.

(4) Place scope on collector of transistor Q1 and adjust potentiometer R1 for a level of 2 volts peak-to-peak.

(5) Place scope at junction of diodes CR1 and CR2. Adjust potentiometer R7 for minimum level.

(6) Connect Hewlett-Packard Model 606A signal generator to pin N of J110 as shown in figure 5-5. Set frequency to 1.05 MHz and output level to .4 volt peak-to-peak.

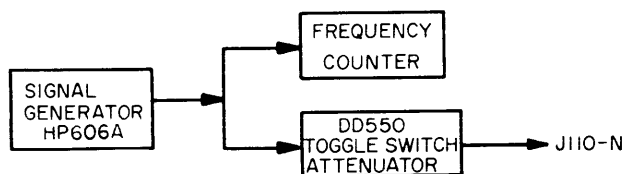


Figure 5-5. Step Generator Z110, Test Setup

(7) Place scope at pin R of J110 and adjust potentiometer R28 for a level of .4 volt peak-to-peak.

(8) Connect short jumper across secondary of transformer T3 and place Millivac Meter, Model MV-28B, at junction of resistor R8 and capacitor C8.

(9) Adjust transformer T2 for maximum level indication on meter.

(10) Remove jumper and adjust transformer T3 for dip, or minimum, indication on meter.

(11) Repeat steps (8) through (10) using transformer T5 and transistor Q2 collector for step (8), transformer T4 for step (9) and transformer T5 for step (10).

(12) Repeat steps (8) through (10) using transformer T7 and transistor Q3 collector for step (8), transformer T6 for step (9) and transformer T7 for step (10).

(13) Place scope at pin 5 of J110 and adjust transformer T8 for maximum level indication.

(14) Vary frequency of 606A generator from .8 MHz to 1.2 MHz. Output level on scope should be .5 volt peak-to-peak minimum at frequency of 13.2 MHz to 12.8 MHz, correspondingly.

(15) Adjust 606A generator to 1.55 MHz and change frequency selector switches on front panel to 07.0000 MHz.

(16) Repeat steps (8) through (10) using transformer T11 and junction of resistor R9 and capacitor C9 for step (8), transformer T10 for step (9) and transformer T11 for step (10).

(17) Repeat steps (8) through (10) using transformer T13 and transistor Q6 collector for step (8), transformer T12 for step (9) and transformer T13 for step (10).

(18) Repeat steps (8) through (10) using transformer T15 and transistor Q7 collector for step (8), transformer T14 for step (9) and transformer T15 for step (10).

(19) Repeat steps (13) and (14) using transformer T16 for step (13) and 1.3 MHz to 1.7 MHz, and 12.7 MHz to 11.3 MHz, for step (14).

(20) Remove 606A generator from pin N of J110 and adjust frequency selector switches on front panel to 13.0000 MHz.

(21) Repeat steps (2) through (5) using potentiometer R61 and transistor Q9 collector for step (2), diode CR3 and transformer T17 for step (3), potentiometer R61 and transistor Q9 collector for step (4) and diodes CR3 and CR4 junction and potentiometer R67 for step (5).

(22) Repeat steps (8) through (10) using transformer T19 and junction of resistor R68 and capacitor C80 for step (8), transformer T18 for step (9) and transformer T19 for step (10).

(23) Repeat steps (8) through (10) using transformer T21 and transistor Q10 collector for step (8), transformer T20 for step (9) and transformer T21 for step (10).

(24) Repeat steps (8) through (10) using transformer T23 and transistor Q11 collector for step (8), transformer T22 for step (9) and transformer T23 for step (10).

(25) Repeat steps (13) and (14) using pin 4 of J110 and transformer T24 for step (13), and .8 MHz to 1.2 MHz and 12.2 MHz to 11.8 MHz for step (14).

(26) Repeat step (15) using 11.0000 MHz.

(27) Repeat steps (8) through (10) using transformer T26 and junction of resistor R69 and capacitor C81 for step (8), transformer T25 for step (9) and transformer T26 for step (10).

(28) Repeat steps (8) through (10) using transformer T28 and transistor Q13 collector for step (8), transformer T27 for step (9) and transformer T28 for step (10).

(29) Repeat steps (8) through (10) using transformer T30 and transistor Q14 collector for step

(8), transformer T29 for step (9), and transformer T30 for step (10).

(30) Repeat steps (13) and (14) using pin 4 of J110 and transformer T31 for step (13) and 1.3 MHz to 1.7 MHz and 11.7 MHz to 11.3 MHz for step (14).

(31) Replace Z102 and Z103 in Translator.

m. STEP GENERATORS B, Z111, AND C, Z113. (See figure 5-5.) Align the step generators as follows:

(1) Remove comb filters Z102 and Z103 from unit and set frequency selector switches on front panel to 28.0000 MHz.

(2) Place scope at collector of Q14 on Z113 and adjust potentiometer R78 for maximum level.

(3) Place scope at junction of transformer T11 and diode CR1 and adjust T11 for maximum level.

(4) Place scope at junction of capacitor C104 and resistor R88 and alternately adjust capacitor C101 and potentiometer R84 until minimum level is obtained.

(5) Place scope at collector of transistor Q14 and adjust potentiometer R78 for 2-volt peak-to-peak level.

(6) Connect Hewlett-Packard Model 606A signal generator to pin N of J110 as shown in figure 5-5. Set frequency to 1.6 MHz and output level to .4 volt peak-to-peak.

(7) Connect short jumper across secondary of transformer T13 and place Millivac Model MV-28B millivolt meter at junction of resistor R88 and capacitor C104.

(8) Adjust transformer T12 for maximum level indication on meter.

(9) Remove jumper and adjust transformer T13 for dip or minimum indication on meter.

(10) Repeat steps (7) through (9) using transformer T15 and transistor Q15 collector for step (7), transformer T14 for step (8) and transformer T15 for step (9).

(11) Repeat steps (7) through (9) using transformer T17 and transistor Q16 collector for step (7), transformer T16 for step (9) and transformer T17 for step (9).

(12) Place scope at pin N of J113 and adjust transformer T18 for maximum level indication.

(13) Vary frequency of 606A generator from 1.4 MHz to 1.8 MHz. Output level on scope should be .5 volt peak-to-peak minimum at frequency of 10.6 MHz to 10.2 MHz correspondingly.

(14) Adjust 606A generator to 1.075 MHz with output level set at .4 volt peak-to-peak and change frequency selector switches on front panel to 23.0000 MHz.

(15) Repeat steps (7) through (9) using transformer T20 and junction of resistor R87 and capacitor C103 for step (7), transformer T19 for step (8) and transformer T20 for step (9).

(16) Repeat steps (7) through (9) using transformer T22 and transistor Q18 collector for step (7), transformer T21 for step (8) and transformer T22 for step (9).

(17) Repeat steps (12) and (13) using transformer T25 for step (12) and .8 MHz to 1.3 MHz and 11.2 MHz to 10.7 MHz for step (13).

(18) Replace Z102 and Z103 in Translator.

(19) Set frequency selector switches on front panel to 25.0000 MHz and place Millivac Model MV-28B millivolt meter on pin 1 of J111.

(20) Adjust capacitors C3, C9 and C19 for maximum level on meter.

(21) Vary frequency selector switches on front panel from 21.0000 MHz to 31.0000 MHz in 1 MHz steps. Minimum level indication on meter should be 0.4 volt rms. If necessary, stagger tune capacitors in step (20).

(22) Repeat steps (19) through (21) using 15.0000 MHz and pin 2 of J111 for step (19), capacitors C25, C30 and C41 for step (20) and 11.0000 MHz to 20.0000 MHz for step (21).

(23) Repeat steps (19) through (21) using 05.0000 MHz and pin 3 of J111 for step (19), capacitors C45, C49 and C62 for step (20) and 01.0000 MHz to 10.0000 MHz for step (21).

(24) Repeat steps (19) and (20) using 25.0000 MHz and pin 1 of J113 for step (19) and capacitors C10, C16, C22 and C28 for step (20).

(25) There should be a minimum of 0.4 volt rms on meter.

(26) Repeat steps (19) and (20) using 15.0000 MHz and pin 1 of J113 for step (19) and capacitors C39, C45, C51 and C56 for step (20).

(27) Repeat step (25).

(28) Repeat steps (19) and (20) using 0.50000 MHz and pin 1 of J113 for step (19) and capacitors C68, C75, C81 and C87 for step (20).

(29) Repeat step (25).

n. TRANSLATOR Z112. (See figure 5-6.) Align the translator as follows:

(1) Remove rf output card Z115 from unit. Set all frequency dials on front panel to blank positions and remove step generator Z113 card from unit (MODE switch on CMR()-4 to VOX).

(2) Connect 606A signal generator between junction of resistors R73 and R75 and ground as shown in figure 5-6.

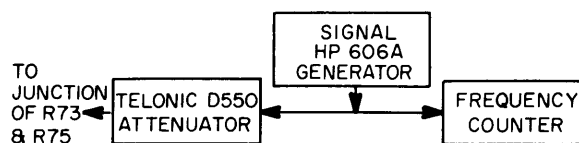


Figure 5-6. Translator, Test Setup

(3) With full attenuation on toggle switch attenuator, adjust generator for 1 volt output at frequency of 13.3000 MHz. Set 100 kHz switch on front panel to position 3.

(4) Connect short jumper across secondary of transformer T15 and connect Millivac meter, MV-28B, across primary of transformer T13, observing proper ground. Set meter to .01-volt range.

(5) Remove attenuation from telonic

attenuator until mid-scale reading is observed on meter.

NOTE

Maintain reading on .01 scale of meter using attenuator for the following steps.

(6) Adjust transformer T13 for peak indication on meter.

(7) Remove jumper from transformer T15 and adjust T15 for dip on meter.

(8) Connect short jumper across secondary of transformer T17 and reconnect Millivac meter across secondary of transformer T16, observing proper ground.

(9) Change attenuation of telonic attenuator for mid-scale reading on meter and adjust transformer T16 for peak reading on meter.

(10) Remove jumper from transformer T17 and adjust T17 for dip on meter.

(11) Reconnect meter to TP7 and adjust for maximum indication on meter.

(12) Repeat steps (3) through (11) using 13.8000 MHz and position 8 for step (3); transformers T20 and T19, respectively, for step (4); transformer T19 for step (6); transformer T20 for step (7); transformers T22 and T21, respectively, for step (8); transformer T21 for step (9); transformer T22 for step (10); and test point TP9 for step (11).

(13) Remove 606A generator and turn MODE switch on CMR()-4 to NORM. Set frequency dials on front panel to 05.0000 MHz.

(14) Using scope, check for 10.5 MHz signal at level of .2 volt peak-to-peak minimum on J112 pin H and for 3 MHz signal of approximately 90 mv peak-to-peak at J112 pin D.

(15) Adjust potentiometer R71 to mid-position; tune transformer T12 for maximum indication on meter (meter still on TP7 or TP9).

(16) Remove 3 MHz Balanced mixer Z108 from unit and connect Millivac meter to junction of resistors R73 and R75, observing proper ground.

(17) Adjust potentiometer R71 for minimum indication on meter; return all frequency dials on front panel to blank position.

(18) Using Millivac meter, check for 40 MHz signal at approximately 50 mv rms level at J112 pin B.

(19) Connect meter to transformer T3 secondary, observing proper ground, and tune transformers T1, T2 and T3 for maximum indication.

(20) Connect Lavoie LA-40 spectrum analyzer to TP7 and adjust potentiometer R36 to one extreme position. Tune capacitors C20, C26 and C31 for maximum 120 MHz indication on analyzer.

(21) Connect Lavoie LA-40 analyzer to TP3 and adjust potentiometer R36 for minimum 120 MHz indication. Plug Z108 into unit and adjust frequency dials on front panel to 05.5000 MHz.

(22) Adjust capacitors C37 and C42 for maximum 133.5 MHz indication on analyzer.

(23) Connect analyzer to TP4 and adjust capacitors C48, C42 and C37 for maximum 133.5 MHz indication. Connect analyzer to TP5 and adjust capacitors C54, C48, C42 and C37 for maximum 133.5

MHz indication. Connect analyzer to TP6 and adjust capacitors C60, C54, C48, C42 and C37 for maximum 133.5 MHz indication.

(24) Replace step generator Z113 and connect scope to J112 pin R. There should be an output level of 0.2 volt minimum at a frequency corresponding to the front panel frequency controls.

(25) Connect a 0-10 volt power supply between J112 pin 10 (+) and ground (-). Increase voltage from 0 to 10 volts. The output level indication on scope should drop to zero as the voltage increases from 6.5 to 8.5 volts.

o. RF OUTPUT Z115. Align the rf output as follows:

NOTE

Do not attempt to adjust RF card without first performing step (12) of subparagraph c.

(1) Before inserting card into unit, adjust potentiometers R1, R2 and R4 for maximum resistance. Turn RF OUTPUT control on front panel fully ccw. Insert Z115 into unit. Re-check power supply voltages and readjust as outlined in subparagraph c.

(2) Turn METER switch to Q1 position. On RF output card, adjust potentiometer R4 until front panel MONITOR reads in the center of the green region marked Q1.

(3) Turn METER switch to Q2 and adjust potentiometer R2 until MONITOR meter reads in the center of the green region marked Q2.

(4) Turn METER switch to Q3 and adjust potentiometer R1 until MONITOR meter on front panel reads in the center of the green region marked Q3.

(5) Connect 50-ohm load to RF OUT connector on rear panel of unit and a Hewlett-Packard Model 410B VTVM across the load. Turn ALDC control on rear panel fully ccw and set frequency of unit to 29.9999 MHz. Place short jumper from pin S of J115 to pin B of J114.

(6) Connect scope to pin B of J115. Turn RF OUTPUT on front panel until scope reads 220 mv peak-to-peak. Hewlett-Packard meter should read 3.55 volts rms. Remove jumper and insert Z114 into J114. Output should not change more than 0.2 volt.

(7) Using Simpson Model 260 meter, measure dc voltage at pin 12 of J115; it should vary from 0-12 vdc with the ALDC adjust control on rear panel of unit. Return ALDC control fully ccw.

p. RF FILTER Z114. The rf filter should not be field-adjusted; it must be returned to the factory when alignment is required.

q. OVERALL ALIGNMENT. Perform an overall alignment of the CHG() 4 as follows, after alignment of the individual PC cards:

(1) Connect CHG()-4 and CMR()-4 (or 1.75MHz source) as shown in figure 5-4.

(2) Make the following preliminary checks and adjustments:

(a) Check power supply voltages and

readjust if necessary as outlined in subparagraph c.

- (b) All cards aligned and inserted.
- (c) RF OUTPUT control (R103) fully

ccw.

(d) Output frequency selector controls set to 29.9999 MHz.

- (e) MODE switch on CMR()-4 to PTT.
- (f) Carrier suppression on CMR()-4

to 0.

(g) All four (4) priority controls on CMR()-4 fully ccw.

(h) Two-tone generator connected to all four (4) channels on rear panel of CMR()-4.

(i) METER switch on front panel of CHG()-4 to Q1.

(j) ALDC control on rear panel of CHG()-4 fully ccw.

With Lavoie Analyzer, neutralize spectrum generator card and comb filter cards as follows:

(3) Place Z101 on extender card and connect Lavoie Model LA-40 spectrum analyzer to J101 pin 8 and ground lead to pin J. Adjust analyzer for 12 MHz display. Adjust capacitor C56 so that 11 MHz and 13 MHz are at least -80 db from 12 MHz level.

(4) Set frequency on front panel to 0.9999 MHz and connect analyzer to J101 pin P and ground lead to pin R. Display 13 MHz. Adjust capacitor C80 so that 12 MHz and 14 MHz are at least -80 db from 13 MHz level. Return frequency to 1.9999 MHz.

(5) Connect analyzer to J101 pin S and ground lead to pin 15. Display 8 MHz. Adjust capacitor C64 so that 7 MHz and 9 MHz are at least -80 db from 8 MHz level.

(6) Place Z101 into unit and place Z102 on extender card. Remove comb filter B, Z103, from unit. Connect analyzer to J102 pin J and ground lead to pin 8. Display 1 MHz. Adjust capacitor C68 so that 100 kHz spurs above and below 1 mc are at least -80 db from 1 MHz level.

(7) Repeat step (6) using 1.2 MHz, pin P and ground lead to pin 13, and capacitor C69.

(8) Repeat step (6) using 1.4 MHz, pin F and ground lead to pin 5, and capacitor C70.

(9) Repeat step (6) using 1.6 MHz, pin L and ground lead to pin 10, and capacitor C71.

(10) Repeat step (6) using 1.8 MHz, pin 4 and ground lead to pin D, and capacitor C72.

(11) Place Z103 on extender card and remove comb filter A, Z102, from unit. Connect analyzer to J103 pin J and ground lead to pin 8. Display 1.1 MHz. Adjust capacitor C68 so that 100 kHz spurs above and below 1.1 MHz are at least -80 db from 1.1 MHz level.

(12) Repeat step (11) using 1.3 MHz, pin P and ground lead to pin 13, and capacitor C69.

(13) Repeat step (11) using 1.5 MHz, pin F and ground lead to pin 5, and capacitor C70.

(14) Repeat step (11) using 1.7 MHz, pin L and ground lead to pin 10, and capacitor C71.

(15) Repeat step (11) using 1.9 MHz, pin 4 and ground lead to pin D, and capacitor C72.

(16) Turn METER switch to Q1 position. Front panel meter should read in the green region marked Q1.

(17) Turn METER switch to Q2 position. Front panel meter should read in the green region marked Q2.

(18) Turn METER switch to Q3 position.

Front panel meter should read in the green region marked Q3.

(19) Connect dummy load to J124 of CHG()-4; monitor with ac VTVM.

(20) Connect spectrum analyzer to J125 of CHG()-4.

(21) Select two-tone on two-tone generator. Increase level until channel activity indicators light on CMR()-4.

(22) Turn carrier suppression on CMR()-4 to full. Set channel A1 priority control to full cw. Adjust analyzer for a two-tone presentation at the frequency selected on CHG()-4. RF OUTPUT control should be set to give 3.5 volts indication on ac VTVM that is monitoring dummy load. Distortion should be -45 db. This method is used to check distortion at all prescribed frequencies. Repeat above for all channels. Return all channel priority controls to full ccw.

(23) Turn RF OUTPUT control on CHG()-4 to fully ccw. Turn carrier suppression switch on CMR()-4 to 0. Turn level control of TTG full ccw. Turn MODE switch of CMR()-4 to PTT. Short PTT terminals on rear of CMR()-4. Adjust RF OUTPUT control on CHG()-4 to give a 3.5 volt indication on ac VTVM monitoring dummy load. Adjust analyzer for a full-scale, single-tone presentation. Unshort PTT terminals. Carrier suppression should be -55 db.

5-4. REPAIR OF PRINTED CIRCUITRY.

a. INTRODUCTION. Repair of the chassis-mounted power supply circuitry follows standard laboratory procedures. Repair of printed circuit cards and card receptacle wiring, however, requires the special tools and techniques as outlined here. Section 6, Parts List, lists all replaceable parts and their circuit symbol numbers. These symbol numbers are shown on the schematic/parts location drawings in Section 7.

NOTE

Replacement of parts on the printed circuit boards requires the special tools and techniques described in paragraph 5-4 d.

b. REPLACEMENT OF PARTS. When replacing a part on a board, it is necessary to remove the old part from the board by melting the solder on all the component pins. Soldering the new part to the board is done pin-by-pin with conventional methods.

c. CHECKING PRINTED CIRCUIT CONDUCTORS. Breaks in the conducting strip (foil) on a printed circuit board can cause permanent or intermittent trouble. In many instances, these breaks will be so small that they cannot be detected by the naked eye. These invisible cracks (breaks) can be located only with the aid of a powerful magnifying glass.

To check out and locate trouble in the conducting strips of a printed circuit board, set up a multimeter (one which does not use a current in excess of 1 ma) for making point-to-point resistance tests,

using needle probes. Insert one point into the conducting strip, close to the end of terminal, and place the other probe on the terminal or opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip (or, if the conducting strip is coated, puncture the coating at intervals) until the multimeter indicates continuity. Mark this area; then use a magnifying glass to locate the fault in the conductor.

CAUTION

Before using an ohmmeter for testing a circuit containing transistors or other voltage-sensitive semiconductors, check the current it passes under test on all ranges. DO NOT use a range that passes more than 1 ma.

d. REPAIR OF PRINTED CONDUCTORS. If the break in the conductor strip is small, lightly scrape away any coating covering the area of the conducting strip to be repaired. Clean the area with a firm-bristly brush and approved solvent. Then repair the cracked or broken area of the conducting strip by flowing solder over the break. Considerable care must be exercised to keep the solder from flowing onto an adjacent strip.

If a strip is burned out, or fused, cut and remove the damaged strip. Connect a length of insulated wire across the breach or from solder-point to solder-point.

After the repairs are completed, clean the repaired area with a stiff brush and solvent. Allow the board to dry thoroughly, and then coat the repaired area with an epoxy resin or similar compound. This coating not only will protect the repaired area, but will also help to strengthen it.

CAUTION

After repairs, check the board for solder drippings; they may cause shorts.

Frequently, a low-resistance leakage path will be created by moisture and/or dirt that has carbonized onto the phenolic board. This leakage can be detected by measuring the suspected circuit with a multimeter. To overcome this condition, thoroughly clean the carbonized area with solvent and a stiff brush. If this does not remove it, use a scraping tool (spade end of a solder-air tool or its equivalent) to remove the carbon or drill a hole through the leakage path to break the continuity of the leakage. When the drilling method is used, be careful not to drill into a part mounted on the other side.

SECTION 6

PARTS LIST

6-1. INTRODUCTION

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

- a. Reference symbol.
- b. Description as indicated in parts list.
- c. TMC part number.
- d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

MIXER DIVIDER, (A-4475)	6-2
STEP GENERATOR A, (A-4487).	6-12
MIXER FINAL, (A-4479)	6-23
SPECTRUM GENERATOR, (A-4480).	6-29
MIXER DIVIDER $\frac{1}{2}$ BD, (A-4487).	6-37
COMB FILTER A, (A-4500)	6-43
COMB FILTER B, (A-4501)	6-49
RF OUTPUT, (A-4502)	6-55
STEP GENERATOR B, (A-4504).	6-58
TRANSLATOR, (A-4505).	6-64
STEP GENERATOR C, (A-4506).	6-76
OUTPUT FILTER (A-4654).	6-89
3 MHz BALANCED MIXER (A-4697)	6-90
1.25 MHz GENERATOR (A-4698)	6-93
120 MHz GENERATOR (A-4600).	6-95
RESISTOR BOARD ASSEMBLY (A-4592).	6-98
RESISTOR BOARD ASSEMBLY (A-4593).	6-99
HEAT SINK ASSEMBLY (BMA-173).	6-100
FILTER (A-4507)	6-101
PC BOARD "A" (A-4512)	6-105
PC BOARD "B" (A-4513)	6-106
POWER SUPPLY (AP-142)	6-108
FILTER, SWITCHABLE (A-4751)	6-109
BRACKET ASSEMBLY, SWITCH (BMA-259).	6-110
CHASSIS ASSEMBLY, MAIN (AX-676)	6-111
CHASSIS COMPONENTS (BMA-256).	6-112

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2201	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C2202 thru C2205	Same as C2201	
C2206	Capacitor, Fixed, Mica, 220 uuf, $\pm 2\%$, 500 WVDC	CM111F221G5S
C2207	Same as C2201	
C2208	Capacitor, Fixed, Mica, 1200 uuf, $\pm 1\frac{1}{2}\%$, 500 WVDC	CM11SF122D5S
C2209	Not used	
C2210	Not used	
C2211	Same as C2206	
C2212	Same as C2206	
C2213	Capacitor, Fixed, Mica, 5 uuf, $\pm 10\%$, 500 WVDC	CM111C050K5S
C2214 thru C2217	Same as C2201	
C2218	Same as C2206	
C2219	Same as C2213	
C2220	Same as C2201	
C2221	Same as C2206	
C2222 thru C2225	Same as C2201	
C2226	Capacitor, Fixed, Mica, 180 uuf, $\pm 2\%$, 500 WVDC	CM111F181G5S
C227	Not used	
C2228	Same as C2201	
C2229	Capacitor, Fixed, Mica, 1500 uuf, $\pm 1\frac{1}{2}\%$, 500 WVDC	CM112F152D5S
C2230	Same as C2229	
C2231	Capacitor, Fixed, Mica, 130 uuf, $\pm 2\%$, 500 WVDC	CM111F131J5S

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2232	Capacitor, Fixed, Mica, 12 uuf, ±5%, 500 WVDC	CM111C120J5S
C2233	Same as C2231	
C2234 thru C2236	Same as C2201	
C2237	Same as C2231	
C2238	Same as C2201	
C2239	Same as C2231	
C2240	Same as C2232	
C2241 thru C2244	Same as C2201	
C2245	Same as C2231	
C2246 thru C2249	Same as C2201	
C2250	Capacitor, Fixed, Mica, .01 uf, ±20%, 500 WVDC	CC100-41
C2251	Same as C2250	
C2252	Same as C2250	
C2253	Same as C2208	
C2254 thru C2262	Not used	
C2263	Same as C2208	
C2264 thru C2269	Same as C2201	
C2270	Same as C2206	
C2271	Same as C2201	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2272	Same as C2206	
C2273	Same as C2213	
C2274	Same as C2206	
C2275 thru C2278	Same as C2201	
C2279	Same as C2206	
C2280	Same as C2206	
C2280	Same as C2213	
C2281	Same as C2201	
C2282	Same as C2206	
C2283 thru C2286	Same as C2201	
C2287	Same as C2226	
C2288	Same as C2201	
C2289	Not used	
C2290	Same as C2229	
C2291	Same as C2229	
C2292	Same as C2231	
C2293	Same as C2232	
C2294	Same as C2231	
C2295 thru C2297	Same as C2201	
C2298	Same as C2231	
C2299	Same as C2201	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2300	Same as C2231	
C2301	Same as C2232	
C2302 thru C2305	Same as C2201	
C2306	Same as C2231	
C2307 thru C2311	Same as C2201	
C2312 thru C2314	Same as C2250	
C2315	Same as C2208	
CR2201	Semiconductor Device Diode	DD139
CR2202 thru CR2204	Same as CR2201	
CR2205	Semiconductor, Device Diode	1N752
CR2210	Same as CR2205	
L1	Coil, Radio Frequency, fixed, 8.2 uh, ±10%, molded case	CL275-8R2
L2	Coil, Radio Frequency, fixed, 120 uh, ±10%, molded case	CL275-121
L3	Coil, Radio Frequency, fixed, 220 uh, ±10%, molded case	CL275221
L4	Coil, Radio Frequency, fixed, 15 uh, ±10%, molded case	CL275-150
L5	Same as L2	
L6	Same as L1	
L7	Same as L2	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L8	Same as L3	
L9	Same as L4	
Q1	Transistor	2N3646
Q2 thru Q14	Same as Q1	
R1	Resistor, Fixed, Composition, 390 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF391J
R2	Resistor, Fixed, Composition, 56 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF560J
R3	Resistor, Fixed, Composition, 1500 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF152J
R4	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R5	Resistor, Fixed, Composition, 680 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF681J
R6	Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R7	Resistor, Fixed, Composition, 15 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF150J
R8	Resistor, Fixed, Composition, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R9	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501
R10	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R11	Same as R1	
R12	Resistor, Fixed, Composition, 27000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF273J
R13	Resistor, Fixed, Composition, 3300 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF332J
R14	Resistor, Fixed, Composition, 470 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF471J
R15	Same as R7	
R16	Same as R6	
R17	Same as R5	
R18	Resistor, Fixed, Composition, 4700 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF472J

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R19	Resistor, Fixed, Composition, 10000 ohms, ±5%, ¼ watt	RC07GF103J
R20	Same as R5	
R21	Same as R6	
R22	Resistor, Fixed, Composition, 47 ohms, ±5%, ¼watt	RC07GF470J
R23	Same as R9	
R24	Resistor, Fixed, Composition, 6800 ohms, ±5%, ¼ watt	RC07GF682J
R25	Same as R13	
R26	Same as R12	
R27	Same as R10	
R28	Same as R7	
R29	Resistor, Fixed, Composition, 560 ohms, ±5%, ¼watt	RC07GF561J
R30	Same as R24	
R31	Resistor, Fixed, Composition, 270 ohms, ±5%, ¼watt	RC07GF271J
R32	Same as R13	
R33	Resistor, Fixed, Composition, 18000 ohms, ±5%, ¼ watt	RC07GF183J
R34	Same as R10	
R35	Same as R7	
R36	Same as R29	
R37	Resistor, Fixed, Composition, 220 ohms, ±5%, ¼watt	RC07GF221J
R38	Resistor, Fixed, Composition, 100000 ohms, ±5%, ¼ watt	RC07GF104J
R39	Same as R38	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R40	Resistor, Fixed, Composition, 2200 ohms, ±5%, ¼ watt	RC07GF222J
R41	Same as R19	
R42	Resistor, Fixed, Composition, 3900 ohms, ±5%, ¼ watt	RC07GF392J
R43	Resistor, Fixed, Composition, 100 ohms, ±5%, ½ watt	RC20GF101J
R44	Same as R40	
R45	Same as R5	
R46	Same as R8	
R47	Same as R1	
R48	Same as R2	
R49	Same as R3	
R50	Same as R4	
R51	Same as R5	
R52	Same as R7	
R53	Same as R6	
R54	Same as R9	
R55	Same as R10	
R56	Same as R1	
R57	Same as R13	
R58	Same as R12	
R59	Same as R10	
R60	Same as R7	
R61	Same as R14	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R62	Same as R6	
R63	Same as R5	
R64	Same as R18	
R65	Same as R19	
R66	Same as R5	
R67	Same as R6	
R68	Same as R22	
R69	Same as R9	
R70	Same as R24	
R71	Same as R13	
R72	Same as R12	
R73	Same as R10	
R74	Same as R7	
R75	Same as R29	
R76	Same as R24	
R77	Same as R31	
R78	Same as R13	
R79	Same as R33	
R80	Same as R10	
R81	Same as R7	
R82	Same as R29	
R83	Resistor, Fixed, Composition, 220 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF221J
R84	Same as R38	
R85	Same as R38	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R86	Same as R40	
R87	Same as R19	
R88	Same as R42	
R89	Same as R43	
R90	Same as R40	
R91	Same as R5	
R92 thru R94	Same as R10	
R95	Resistor, Fixed, Composition, 18 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF180J
R96	Same as R29	
R97	Same as R29	
R98	Same as R10	
R99	Same as R10	
R100	Same as R29	
R101	Same as R29	
R102	Same as R29	
T1	Transformer, Radio Frequency, tuned	TT285-4
T2	Transformer, Radio Frequency, tuned	TT285-2
T3 thru T5	Same as T2	
T6	Transformer, Radio Frequency, tuned	TT285-17
T7	Transformer, Radio Frequency, tuned	TT285-3
T8	Same as T1	
T9	Same as T7	

MIXER DIVIDER
A-4475

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T10 thru T12	Same as T1	
T13 thru T16	Same as T2	
T17	Same as T6	
T18	Same as T7	
T19	Same as T1	
T20	Same as T7	
T21	Same as T1	
T22	Same as T1	
Z	Network, Decade Counter	NW134
Z2	Same as Z1	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 1,000 uuf, GMV, 500 WVDC	CC100-29
C2 thru C5	Same as C1	
C6	Capacitor, Fixed, Mica, 120 uuf, $\pm 2\%$, 500 WVDC	CM111F121G5S
C7 thru C9	Same as C1	
C10	Capacitor, Fixed, Mica, 150 uuf, $\pm 1\%$, 500 WVDC	CM111F151F5S
C11	Capacitor, Fixed, Mica, 5 uuf, $\pm 10\%$, 500 WVDC	CM111C050K5S
C12	Same as C10	
C13	Capacitor, Fixed, Ceramic, 20,000 uuf, $+80-20\%$, 25 WVDC	CC100-40
C14 thru C17	Same as C1	
C18	Same as C10	
C19	Same as C11	
C20	Same as C10	
C21 thru C24	Same as C1	
C25	Same as C10	
C26	Same as C11	
C27	Same as C10	
C28 thru C30	Same as C1	
C31	Capacitor, Fixed, Mica, 47 uuf, $\pm 2\%$, 500 WVDC	CM111E470G5S

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C32	Same as C1	
C33	Same as C1	
C34	Same as C13	
C35	Capacitor, Fixed, Ceramic, .1 uf, +80-20%, 100 WVDC	CC100-28
C36 thru C39	Same as C35	
C40	Capacitor, Fixed, Mica, 620 uuf, $\pm\frac{1}{2}\%$, 500 WVDC	CM111F621D5S
C41 thru C43	Same as C40	
C44	Same as C10	
C45	Same as C11	
C46	Same as C10	
C47	Same as C13	
C48 thru C51	Same as C1	
C52	Same as C10	
C53	Same as C11	
C54	Same as C10	
C55 thru C58	Same as C1	
C59	Same as C10	
C60	Same as C11	
C61	Same as C10	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C62 thru C65	Same as C1	
C66	Same as C31	
C67	Same as C13	
C68	Same as C1	
C69	Same as C35	
C70 thru C72	Not Used	
C73 thru C77	Same as C1	
C78	Same as C10	
C79 thru C81	Same as C1	
C82	Same as C6	
C83	Same as C11	
C84	Same as C6	
C85	Same as C13	
C86 thru C89	Same as C1	
C90	Same as C6	
C91	Same as C11	
C92	Same as C6	
C93 thru C96	Same as C1	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C97	Same as C6	
C98	Same as C11	
C99	Same as C6	
C100 thru C103	Same as C1	
C104	Capacitor, Fixed, Mica, 68 uuf, $\pm 1\%$, 500 WVDC	CM111E680J5S
C105	Same as C1	
C106	Same as C13	
C107	Same as C6	
C108	Same as C11	
C109	Same as C6	
C110	Same as C13	
C111 thru C114	Same as C1	
C115	Same as C6	
C116	Same as C11	
C117	Same as C6	
C118 thru C121	Same as C1	
C122	Same as C6	
C123	Same as C11	
C124	Same as C6	
C125 thru C127	Same as C1	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C128	Same as C104	
C129	Same as C1	
C130	Same as C13	
C131	Same as C1	
C132	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-30
C133	Same as C1	
CR1	Semiconductor, Device, Diode	DD139
CR2 thru CR4	Same as CR1	
CR5	Semiconductor, Device, Diode	IN914
CR6 thru CR12	Same as CR5	
L1	Coil, Radio Frequency, Fixed, 120 uh, $\pm 10\%$, molded case	CL275-121
L2 thru L5	Same as L1	
L6	Coil, Radio Frequency, fixed, 2200 uh, $\pm 10\%$, molded case	CL275-222
L7	Same as L6	
L8	Coil, Radio Frequency, fixed, 12 uh, $\pm 10\%$, molded case	CL275-120
L9	Same as L8	
L10 thru L20	Same as L1	
Q1	Transistor	2N3646

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q2 thru Q15	Same as Q1	
R1	Resistor, Variable, Composition, 100 ohms, $\pm 30\%$, 0.5 watts	RV124-1-101
R2	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R3	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R4	Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R5	Resistor, Fixed, Composition, 47 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
R6	Resistor, Fixed, Composition, 68 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF680J
R7	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501
R8	Resistor, Fixed, Composition, 100 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF101J
R9	Same as R8	
R10	Same as R2	
R11	Same as R3	
R12	Same as R4	
R13	Resistor, Fixed, Composition, 1800 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF182J
R14	Resistor, Fixed, Composition, 15 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF150J
R15	Resistor, Fixed, Composition, 180 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF181J
R16	Same as R2	
R17	Same as R3	
R18	Same as R4	
R19	Same as R13	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R20	Resistor, Fixed, Composition, 22 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF220J
R21	Resistor, Fixed, Composition, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R22	Resistor, Fixed, Composition, 12000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF123J
R23	Same as R13	
R24	Resistor, Fixed, Composition, 820 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF821J
R25	Same as R8	
R26	Resistor, Fixed, Composition, 27 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF270J
R27	Same as R15	
R28	Same as R1	
R29	Same as R4	
R30	Same as R2	
R31	Same as R3	
R32	Same as R6	
R33	Same as R21	
R34	Same as R21	
R35	Same as R2	
R36	Same as R3	
R37	Same as R4	
R38	Same as R13	
R39	Same as R14	
R40	Same as R15	
R41	Same as R2	
R42	Same as R3	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R43	Same as R4	
R44	Same as R13	
R45	Same as R20	
R46	Same as R21	
R47	Same as R22	
R48	Same as R13	
R49	Same as R24	
R50	Same as R8	
R51	Same as R26	
R52	Same as R15	
R53	Resistor, Fixed, Composition, 10 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF100J
R54 thru R60	Not used	
R61	Same as R1	
R62	Same as R2	
R63	Same as R3	
R64	Same as R4	
R65	Same as R5	
R66	Same as R6	
R67	Same as R7	
R68	Same as R8	
R69	Same as R8	
R70	Same as R2	
R71	Same as R3	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R72	Same as R4	
R73	Same as R13	
R74	Same as R14	
R75	Same as R15	
R76	Same as R2	
R77	Same as R3	
R78	Same as R4	
R79	Same as R13	
R80	Same as R20	
R81	Same as R21	
R82	Same as R22	
R83	Same as R13	
R84	Same as R24	
R85	Same as R8	
R86	Same as R26	
R87	Same as R15	
R88	Same as R2	
R89	Same as R3	
R90	Same as R4	
R91	Same as R13	
R92	Same as R14	
R93	Same as R15	
R94	Same as R2	
R95	Same as R3	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R96	Same as R4	
R97	Same as R13	
R98	Same as R20	
R99	Same as R21	
R100	Same as R22	
R101	Same as R13	
R102	Same as R24	
R103	Same as R8	
R104	Same as R26	
R105	Same as R15	
R106 thru R108	Same as R21	
R109 thru R112	Same as R8	
T1	Transformer, Radio Frequency, tuned	TT287-19
T2	Transformer, Radio Frequency, tuned	TT287-5
T3	Transformer, Radio Frequency, tuned	TT287-3
T4	Transformer, Radio Frequency, tuned	TT287-4
T5	Same as T3	
T6	Same as T4	
T7	Same as T3	
T8	Transformer, Radio Frequency, tuned	TT287-20
T9	Transformer, Radio Frequency, fixed	TZ221
T10	Same as T2	

STEP GENERATOR A A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T11	Same as T3	
T12	Same as T4	
T13	Same as T3	
T14	Same as T4	
T15	Same as T3	
T16	Same as T8	
T17	Same as T1	
T18	Transformer, Radio Frequency, tuned,	TT287-15
T19	Transformer, Radio Frequency, tuned	TT287-13
T20	Transformer, Radio Frequency, tuned	TT287-14
T21	Same as T19	
T22	Same as T20	
T23	Same as T19	
T24	Same as T8	
T25	Same as T18	
T26	Same as T19	
T27	Same as T20	
T28	Same as T19	
T29	Same as T20	
T30	Same as T19	
T31	Same as T8	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 1,000 uuf, GMV, 500 WVDC	CC100-29
C2	Same as C1	
C3	Capacitor, Fixed, Mica, 220 uuf, $\pm 2\%$, 500 WVDC	CM111F221G5S
C4 thru C7	Same as C1	
C8	Capacitor, Fixed, Mica, 1,200 uuf, $\pm 5\%$, 500 WVDC	CM112F122J5S
C9	Not used	
C10	Same as C3	
C11	Capacitor, Fixed, Mica, 5 uuf, $\pm 10\%$, 500 WVDC	CM111C050K5S
C12	Same as C3	
C13	Same as C1	
C14	Same as C1	
C15	Capacitor, Fixed, Mica, 270 uuf, $\pm 1\%$, 500 WVDC	CM111F271F5S
C16	Same as C11	
C17	Same as C3	
C18	Same as C1	
C19	Same as C1	
C20	Same as C3	
C21	Same as C1	
C22	Capacitor, Fixed, Mica, 1,500 uuf, $\pm \frac{1}{2}\%$, 500 WVDC	CM112F152DS
C23	Same as C22	
C24	Capacitor, Fixed, Mica, 130 uuf, $\pm 2\%$, 500 WVDC	CM111F131G5S
C25	Capacitor, Fixed, Mica, 12 uuf, $\pm 5\%$, 500 WVDC	CM111C120J5S
C26	Same as C24	
C27	Same as C1	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C28	Same as C24	
C29	Same as C1	
C30	Same as C24	
C31	Same as C25	
C32	Same as C1	
C33	Same as C1	
C34	Not used	
C35	Same as C1	
C36	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C37	Capacitor, Fixed, Ceramic, 20000 uuf, +80-20%, 25 WVDC	CC100-40
C38 thru C44	Same as C37	
C45	Capacitor, Fixed, Mica, 200 uuf, ±5%, 500 WVDC	CM111F201J5S
C46	Same as C1	
C47	Same as C1	
C48	Same as C36	
C49 thru C51	Same as C1	
C52	Same as C45	
C53	Same as C25	
C54	Same as C1	
C55	Same as C1	
C56	Same as C11	
C57	Same as C3	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C58 thru C61	Same as C1	
CR1	Semiconductor, Device, Diode	DD139
CR2 thru CR4	Same as CR1	
CR5	Semiconductor Device, Diode	1N4864
CR6	Same as CR5	
CR7	Same as CR5	
L1	Not used	
L2	Coil, Radio Frequency, fixed, 8.2 uh, $\pm 10\%$, molded case	CL275-8.2
L3	Coil, Radio Frequency, fixed, 120 uh, $\pm 10\%$, molded case	CL275-121
L4 thru L12	Same as L3	
Q1	Transistor	2N3646
Q2 thru Q6	Same as Q1	
R1	Resistor, Fixed, Composition, 390 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF391J
R2	Resistor, Fixed, Composition, 56 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF560J
R3	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R4	Resistor, Fixed, Composition, 2200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF222J
R5	Same as R1	
R6	Resistor, Fixed, Composition, 220 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF221J
R7	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501
R8	Same as R6	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R9	Resistor, Fixed, Composition, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R10	Resistor, Fixed, Composition, 1,800 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF182J
R11	Resistor, Fixed, Composition, 10000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF103J
R12	Resistor, Fixed, Composition, 15 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF150J
R13	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R14	Resistor, Fixed, Composition, 4700 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF472J
R15	Same as R11	
R16	Same as R1	
R17	Resistor, Fixed, Composition, 8.2 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF8R2J
R18	Same as R7	
R19	Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R20	Resistor, Fixed, Composition, 470 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF471J
R21	Resistor, Fixed, Composition, 47 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
R22	Resistor, Fixed, Composition, 6800 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF682J
R23	Resistor, Fixed, Composition, 3300 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF332J
R24	Resistor, Fixed, Composition, 12000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF123J
R25	Resistor, Fixed, Composition, 560 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF561J
R26	Same as R22	
R27	Resistor, Fixed, Composition, 270 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF271J
R28	Same as R22	
R29	Resistor, Fixed, Composition, 33 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF330J
R30	Same as R19	
R31	Resistor, Fixed, Composition, 1 meg ohm, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF105J
R32	Resistor, Fixed, Composition, 47000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF473J
R33	Same as R6	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R34	Same as R31	
R35	Resistor, Fixed, Composition: 680 ohms, ±5%, ¼watt	RC07GF681J
R36	Same as R13	
R37	Same as R14	
R38	Same as R19	
R39	Same as R12	
R40	Resistor, Fixed, Composition, 22 ohms, ±5%, ¼ watt	RC07GF220J
R41	Same as R29	
R42 thru R44	Same as R6	
R45	Same as R27	
R46	Same as R24	
R47	Same as R24	
R48	Resistor, Fixed, Composition, 1200 ohms, ±5%, ¼watt	RC07GF122J
R49	Resistor, Fixed, Composition, 180 ohms, ±5%, ¼ watt	RC07GF181J
T1	Transformer, Radio Frequency, tuned	TT285-4
T2	Transformer, Radio Frequency, tuned	TT285-2
T3	Same as T2	
T4	Same as T2	
T5	Transformer, Radio Frequency, tuned	TT285-6
T6	Same as T2	
T7	Transformer, Radio Frequency, tuned	TT285-3
T8	Same as T1	
T9	Same as T7	
T10	Same as T1	

MIXER FINAL A-4479

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T11	Transformer, Radio Frequency, tuned	TT285-7
T12	Transformer, Radio Frequency, tuned	TT285-18
T13	Same as T1	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 20000 uuf, +60-40%, 150 WVDC	CC100-35
C2	Capacitor, Fixed, Mica, 2700 uuf, $\pm\frac{1}{2}\%$, 500 WVDC	CM112F272D5S
C3	Same as C1	
C4	Same as C1	
C5	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-30
C6	Capacitor, Fixed, Ceramic, 10000 uuf, GMV, 500 WVDC	CC100-16
C7	Same as C6	
C8	Same as C6	
C9	Capacitor Fixed, Mica, 20 uuf, $\pm 2\%$, 500 WVDC	CM111C200J5S
C10	Same as C6	
C11	Same as C6	
C12	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C13	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C14	Same as C6	
C15	Capacitor, Fixed, Mica, 320 uuf, $\pm\frac{1}{2}\%$, 500 WVDC	CM11F321D5S
C16 thru C18	Same as C6	
C19	Same as C15	
C20	Same as C6	
C21	Same as C13	
C22	Same as C6	
C23	Not used	
C24 thru C33	Not used	
C34	Same as C6	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C35	Same as C13	
C36	Same as C12	
C37	Same as C6	
C38	Same as C6	
C39	Capacitor, Fixed, Mica, 220 uuf, $\pm 2\%$, 500 WVDC	CM111F221G5S
C40	Same as C6	
C41	Same as C13	
C42	Same as C6	
C43	Same as C39	
C44 thru C48	Same as C6	
C49	Same as C13	
C50	Same as C12	
C51	Same as C6	
C52	Same as C6	
C53	Capacitor, Fixed Mica, 270 uuf, $\pm 1\%$, 500 WVDC	CM111F271F5S
C54	Same as C13	
C55	Same as C6	
C56	Same as C12	
C57	Same as C53	
C58 thru C62	Same as C6	
C63	Same as C12	
C64	Same as C12	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C65	Same as C6	
C66 thru C68	Capacitor, Fixed, Ceramic, 200,000 uuf, +80-20%, 25 WVDC	CC100-33
C69	Capacitor, Fixed, Mica, 180 uuf, ±2%, 500 WVDC	CM11F181G5S
C70	Same as C6	
C71	Same as C6	
C72	Same as C13	
C73	Same as C12	
C74	Same as C6	
C75	Capacitor, Fixed, Mica, 430 uuf, ±2%, 500 WVDC	CM11F431G5S
C76	Same as C6	
C77	Same as C6	
C78	Same as C13	
C79	Not used	
C80	Same as C12	
C81	Same as C75	
C82 thru C84	Same as C13	
C85	Capacitor, Fixed, Mica, 82 uuf, ±2%, 500 WVDC	CM111E820F5S
C86	Capacitor, Variable, Ceramic, 15-60 uuf, 100 WVDC	CV112-6
C87	Same as C13	
C88	Capacitor, Fixed, Mica, 100 uuf, ±10%, 500 WVDC	CM11F101J5S
C89	Same as C86	
C90	Same as C13	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1	Semiconductor, Device, Diode, Silicon	IN750
Q1 thru Q5	Transistor	2N3646
Q6, Q7	Not used	
Q8 thru Q19	Same as Q1	
R1	Resistor, Fixed, Composition, 330 ohms, 5%, $\frac{1}{4}$ watt	RC07GF331J
R2	Resistor, Fixed, Composition, 8200 ohms, 5%, $\frac{1}{4}$ watt	RC07GF822J
R3	Resistor, Fixed, Composition, 1000 ohms, 5%, $\frac{1}{4}$ watt	RC07GF102J
R4	Resistor, Fixed, Composition, 47 ohms, 5%, $\frac{1}{4}$ watt	RC07GF470J
R5	Same as R3	
R6	Resistor, Fixed, Composition, 33000 ohms, 5%, $\frac{1}{4}$ watt	RC07GF333J
R7	Same as R3	
R8	Resistor, Fixed, Composition, 10000 ohms, 5%, $\frac{1}{4}$ watt	RC07GF103J
R9	Same as R4	
R10	Same as R8	
R11	Resistor, Fixed, Composition, 180 ohms, 5%, $\frac{1}{4}$ watt	RC07GF181J
R12	Same as R3	
R13	Resistor, Fixed, Composition, 560 ohms, 5%, $\frac{1}{4}$ watt	RC07GF561J
R14	Resistor, Fixed, Composition, 470000 ohms, 5%, $\frac{1}{4}$ watt	RC07GF474J
R15	Same as R2	
R16	Same as R3	
R17	Resistor, Fixed, Composition, 15000 ohms, 5%, $\frac{1}{4}$ watt	RC07GF153J

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R18	Resistor, Fixed, Composition, 3300 ohms, 5%, ¼ watt	RC07GF332J
R19	Resistor, Fixed, Composition, 270 ohms, 5%, ¼ watt	RC07GF271J
R20 thru R26	Not used	
R27	Same as R14	
R28	Same as R13	
R29	Same as R3	
R30	Same as R2	
R31	Same as R17	
R32	Same as R18	
R33	Same as R19	
R34	Same as R14	
R35	Same as R3	
R36	Same as R2	
R37	Same as R13	
R38	Same as R17	
R39	Same as R18	
R40	Same as R19	
R41	Resistor, Fixed, Composition, 4700 ohms, 5%, ¼ watt	RC07GF472J
R42	Resistor, Fixed, Composition, 100000 ohms, 5%, ¼ watt	RC07GF104J
R43	Same as R42	
R44	Same as R8	
R45	Resistor, Fixed, Composition, 2200 ohms, 5%, ¼ watt	RC07GF222J
R46	Resistor, Fixed, Composition, 3900 ohms, 5%, ¼ watt	RC07GF392J

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R47	Same as R45	
R48	Resistor, Fixed, Composition, 180 ohms, $\pm 5\%$, 1 watt	RC32GF181J
R49	Same as R8	
R50	Same as R46	
R51 and R52	Same as R3	
R53	Same as R14	
R54	Same as R13	
R55	Same as R3	
R56	Same as R2	
R57	Same as R17	
R58	Same as R18	
R59	Resistor, Fixed, Composition, 390 ohms, 5%, $\frac{1}{4}$ watt	RC07GF391J
R60	Resistor, Variable, Composition, 5000 ohms, $\pm 30\%$, 5 watts	RV124-1-502
R61	Same as R11	
R62 thru R64	Resistor, Fixed, Composition, 100 ohms, 5%, $\frac{1}{4}$ watt	RC07GF101J
R65	Not used	
R66	Same as R62	
R67	Resistor, Fixed, Composition, 27 ohms, 5%, $\frac{1}{4}$ watt	RC07GF270J
R68	Same as R62	
R69	Same as R8	
R70	Same as R8	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R71	Resistor, Fixed, Composition, 2700 ohms, 5%, $\frac{1}{4}$ watt	RC07GF272J
R72	Same as R41	
R73 thru R75	Same as R4	
T1	Transformer, Radio Frequency, tuned	TT286-2
T2	Transformer, Radio Frequency, tuned	TT286-16
T3	Transformer, Radio Frequency , tuned	TT286-15
T4	Not used	
T6	Same as T2	
T7	Same as T3	
T8	Same as T2	
T9	Same as T3	
T10	Transformer, Radio Frequency, tuned	TT286-14
T11	Transformer, Radio Frequency, tuned	TT286-13
T12	Transformer, Radio Frequency, tuned	TZ222
TP3	Terminal Stud.	TE0-127-2
TP5	Same as TP3	
TP6	Same as TP3	
P8	Same as TP3	
TP9	Same as TP3	
L1 thru L3	Coil, Radio Frequency, Fixed, 120 uh, $\pm 10\%$	CL275-121
L4,L5	Not used	

SPECTRUM GENERATOR A-4480

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L6 thru L14	Same as L1	
L15	Coil, Radio Frequency, fixed, 12 uh, ±10%	CL275-120
L16	Same as L1	
L17	Same as L1	
L18	Coil, 40 MC	CL419
L19	Same as L1	
Y1	Crystal, Unit, Quartz, 12 MHZ	CR109-124
Y2	Crystal, Unit, Quartz, 14 MHZ	CR109-138
Y3	Crystal, Unit, Quartz, 8.0 MHZ	CR109-104
Y4	Not used	
Y5	Crystal, Unit, Quartz, 13.0 MHZ	CR109-134
Z1	NW Decade Counter	NW135

MIXER DIVIDER $\frac{1}{2}$ BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-29
C2 thru C5	Same as C1	
C6	Capacitor, Fixed, Mica, 220 uuf, $\pm 5\%$, 500 WVDC	CM111F221J5S
C7	Not used	
C8	Not used	
C9	Capacitor, Fixed, Mica, 1200 uuf, $\pm 1\%$, 500 WVDC	CM112F122F5S
C10	Same as C6	
C11	Capacitor, Fixed, Mica, 5 uuf, $\pm 5\%$, 500 WVDC	CM111C050J5S
C12	Same as C6	
C13 thru C16	Same as C1	
C17	Same as C6	
C18	Same as C11	
C19	Same as C6	
C20 thru C23	Same as C1	
C24	Capacitor, Fixed, Mica, 180 uuf, $\pm 2\%$, 500 WVDC	CM111F181G5S
C25	Capacitor, Fixed, Mica, 1500 uuf, $\pm 1\%$, 500 WVDC	CM112F152F5S
C26	Same as C25	
C27	Capacitor, Fixed, Mica, 130 uuf, $\pm 5\%$, 500 WVDC	CM111F131J5S
C28	Capacitor, Fixed, Mica, 12 uuf, $\pm 10\%$, 500 WVDC	CM111C120K5S
C29 thru C31	Same as C1	

MIXER DIVIDER 1/2 BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C32	Same as C27	
C33	Same as C1	
C34	Same as C28	
C35	Same as C27	
C36	Same as C1	
thru		
C40		
C41	Same as C27	
C42	Same as C1	
thru		
C44		
C45	Capacitor, Fixed, Ceramic, 20,000 uuf, +80-20%, 25 WVDC	CC100-40
C46	Same as C1	
C47	Same as C45	
C48	Same as C9	
C49	Not used	
C50	Same as C1	
C51	Same as C1	
C52	Same as C27	
C53	Not used	
C54	Same as C1	
thru		
C57		
CR1	Semiconductor, Device, Diode	DD139
CR2	Same as CR1	
thru		
CR4		
CR5	Semiconductor, Device, Diode	1N752

MIXER DIVIDER $\frac{1}{2}$ BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L1	Not used	
L2	Coil, Radio Frequency, fixed, 8.2 uh, $\pm 10\%$, molded case	CL275-8R2
L3	Coil, Radio Frequency, fixed, 120 uh, $\pm 10\%$, molded case	CL275-121
L4	Coil, Radio Frequency, fixed, 220 uh, $\pm 10\%$, molded case	CL275-221
L5	Coil, Radio, Frequency, fixed, 15 uh, $\pm 10\%$, molded case	CL275-150
L6	Same as L3	
Q1	Transistor	2N3646
Q2 thru Q7	Same as Q1	
R1	Resistor, Fixed, Composition, 390 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF391J
R2	Resistor, Fixed, Composition, 56 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF560J
R3	Resistor, Fixed, Composition, 1500 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF152J
R4	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R5	Resistor, Fixed, Composition, 680 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF681J
R6	Not used	
R7	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501
R8	Resistor, Fixed, Composition, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R9	Same as R1	
R10	Resistor, Fixed, Composition, 3300 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF332J

MIXER DIVIDER 1/2 BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R11	Resistor, Fixed, Composition, 27000 ohms, ±5%, 1/4 watt	RC07GF273J
R12	Resistor, Fixed, Composition, 1000 ohms, ±5%, 1/4 watt	RC07GF102J
R13	Resistor, Fixed, Composition, 15 ohms, ±5%, 1/4 watt	RC07GF150J
R14	Resistor, Fixed, Composition, 470 ohms, ±5%, 1/4 watt	RC07GF471J
R15	Resistor, Fixed, Composition, 330 ohms, ±5%, 1/4 watt	RC07GF331J
R16	Resistor, Fixed, Composition, 4700 ohms, ±5%, 1/4 watt	RC07GF472J
R17	Resistor, Fixed, Composition, 10000 ohms, ±5%, 1/4 watt	RC07GF103J
R18	Not used	
R19	Same as R5	
R20	Not used	
R21	Not used	
R22	Resistor, Fixed, Composition, 47 ohms, ±5%, 1/4 watt	RC07GF470J
R23	Same as R7	
R24	Resistor, Fixed, Composition, 6800 ohms, ±5%, 1/4 watt	RC07GF682J
R25	Not used	
R26	Same as R10	
R27	Same as R11	
R28	Same as R12	
R29	Same as R13	
R30	Resistor, Fixed, Composition, 560 ohms, ±5%, 1/4 watt	RC07GF561J

MIXER DIVIDER $\frac{1}{2}$ BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R31	Not used	
R32	Same as R24	
R33	Resistor, Fixed, Composition, 270 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF271J
R34	Same as R13	
R35	Same as R11	
R36	Same as R10	
R37	Same as R12	
R38	Same as R15	
R39	Same as R30	
R40	Resistor, Fixed, Composition, 220 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF221J
R41	Resistor, Fixed, Composition, 100,000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF104J
R42	Same as R41	
R43	Same as R17	
R44	Resistor, Fixed, Composition, 2200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF222J
R45	Resistor, Fixed, Composition, 3900 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF392J
R46	Same as R44	
R47	Resistor, Fixed, Composition, 100 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF101J
R48	Same as R5	
R49	Same as R13	
R50	Same as R5	

MIXER DIVIDER $\frac{1}{2}$ BD A-4487

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R51	Same as R15	
R52	Same as R30	
R53	Same as R30	
R54	Same as R12	
R55	Resistor, Fixed, Composition, 18 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF180J
R56	Same as R12	
R57	Same as R12	
T1	Transformer, Radio Frequency, tuned	TT285-4
T2	Transformer, Radio Frequency, tuned	TT285-2
T3 thru T5	Same as T2	
T6	Transformer, Radio Frequency, Tuned	TT285-17
T7	Transformer, Radio Frequency, Tuned	TT285-3
T8	Same as T1	
T9	Same as T7	
T10	Same as T8	
T11	Same as T1	
TP1 thru TP10	Term Stud	TE0127-2
Z1	Network, Frequency Divider	NW134

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 20,000 uuf, +60-40%, 150 WVDC	CC100-35
C2	Capacitor, Fixed, Mica, 1,800 uuf, ±2%, 500 WVDC	CM112F182G
C3	Capacitor, Fixed, Ceramic, 1,000 uuf, GMV, 500 WVDC	CC100-29
C4	Capacitor, Fixed, Ceramic, 10,000 uuf, GMV, 500 WVDC	CC100-16
C5 thru C7	Same as C1	
C8	Same as C2	
C9	Same as C1	
C10	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C11	Same as C10	
C12	Same as C1	
C13	Same as C1	
C14	Same as C2	
C15	Same as C1	
C16	Same as C1	
C17	Same as C2	
C18	Same as C1	
C19	Same as C4	
C20	Same as C3	
C21	Same as C4	
C22	Same as C10	
C23	Same as C1	
C24	Same as C1	
C25	Capacitor, Fixed, Mica, 2400 uuf, ±2%, 500 WVDC	CM112F242G5S

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C26	Same as C1	
C27	Same as C25	
C28	Same as C1	
C29	Same as C3	
C30	Same as C4	
C31	Same as C4	
C32	Same as C10	
C33	Same as C1	
C34	Same as C1	
C35	Capacitor, Fixed, Mica, 2700 uuf, $\pm 1\%$, 500 WVDC	CM112F272F5S
C36 thru C38	Same as C1	
C39	Same as C3	
C40	Same as C35	
C41	Same as C4	
C42	Same as C4	
C43	Same as C10	
C44	Same as C1	
C45	Same as C1	
C46	Same as C35	
C47	Same as C1	
C48	Same as C1	
C49	Same as C35	
C50	Same as C1	
C51	Same as C3	

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C52	Same as C4	
C53	Same as C4	
C54	Same as C10	
C55	Same as C1	
C56	Same as C1	
C57	Capacitor, Fixed, Mica, 3900 uuf, $\pm 2\%$, 300 WVDC	CM112F392G3S
C58	Same as C1	
C59	Same as C1	
C60	Same as C57	
C61	Same as C1	
C62	Same as C3	
C63 thru C65	Same as C4	
C66	Same as C1	
L1	Coil, Radio Frequency, fixed, 120 uh, $\pm 10\%$ molded case	CL275-121
L2 thru L12	Same as L1	
Q1	Transistor	2N3646
Q2 thru Q12	Same as Q1	
R1	Resistor, Fixed, Composition, 15,000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF153J
R2	Resistor, Fixed, Composition, 3,300 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF332J
R3	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R4	Resistor, Fixed, Composition: 1,000 ohms, ±5%, ¼ watt	RC07GF102J
R5	Resistor, Fixed, Composition, 8,200 ohms, ±5%, ¼ watt	RC07GF822J
R6	Resistor, Fixed, Composition, 470000 ohms, ±5%, ¼ watt	RC07GF474J
R7	Resistor, Fixed, Composition, 560 ohms, ±5%, ¼ watt	RC07GF561J
R8	Same as R7	
R9	Same as R6	
R10	Same as R5	
R11	Same as R4	
R12	Same as R1	
R13	Same as R2	
R14	Same as R3	
R15	Same as R7	
R16	Same as R6	
R17	Same as R5	
R18	Same as R4	
R19	Same as R1	
R20	Same as R2	
R21	Same as R3	
R22	Same as R7	
R23	Same as R6	
R24	Same as R5	
R25	Same as R4	
R26	Same as R1	

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R27	Same as R2	
R28	Same as R3	
R29	Same as R7	
R30	Same as R6	
R31	Same as R5	
R32	Same as R4	
R33	Same as R1	
R34	Same as R2	
R35	Same as R3	
R36	Same as R7	
R37	Same as R6	
R38	Same as R5	
R39	Same as R4	
R40	Same as R1	
R41	Same as R2	
R42	Same as R3	
T1	Transformer, Radio Frequency, tuned	TT286-8
T2	Same as T1	
T3	Transformer, Radio Frequency, tuned	TT286-6
T4	Same as T3	
T5	Same as T3	
T6	Same as T3	
T7	Transformer, Radio, Frequency, tuned	TT286-4
T8	Same as T7	
T9	Transformer, Radio, Frequency, tuned	TT286-2

COMB FILTER A A-4500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T10	Same as T9	
T11	Same as T9	
T12	Same as T9	
XY1	Socket, Crystal, clip type, 2 cadmium plated contacts, 3/64" X 5/32" tail slots	TS167-1
XY2 thru XY6	Same as XY1	
Y1	Crystal unit quartz, frequency 1.8 MHZ	CR109-100
Y2	Crystal unit quartz, frequency 1.6 MHZ	CR109-98
Y3	Crystal unit quartz, frequency 1.4 MHZ	CR109-96
Y4	Crystal unit quartz, frequency 1.2 MHZ	CR109-94
Y5	Crystal unit quartz, frequency 1.0 MHZ	CR109-92
Y6	Crystal unit quartz, frequency .8 MHZ	CR109-90

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 20000 uuf, +60-40%, 150 WVDC	CC100-35
C2	Capacitor, Fixed, Mica, 1,600 uuf, ±2%, 500 WVDC	CM112F162G5S
C3	Capacitor, Fixed, Ceramic, 1,000 uuf, GMV, 500 WVDC	CC100-29
C4	Capacitor, Fixed, Ceramic, 10000 uuf, GMV, 500 WVDC	CC100-16
C5 thru C7	Same as C1	
C8	Same as C2	
C9	Same as C1	
C10	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C11	Same as C10	
C12	Same as C1	
C13	Same as C1	
C14	Capacitor, Fixed, Mica, 2000 uuf, ±2%, 500 WVDC	CM112F202G5S
C15	Same as C1	
C16	Same as C1	
C17	Same as C14	
C18	Same as C1	
C19	Same as C4	
C20	Same as C3	
C21	Same as C4	
C22	Same as C10	
C23	Same as C1	
C24	Same as C1	
C25	Capacitor, Fixed, Mica, 2200 uuf, ±1%, 500 WVDC	CM112F222F5S

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C26	Same as C1	
C27	Same as C25	
C28	Same as C1	
C29	Same as C3	
C30	Same as C4	
C31	Same as C4	
C32	Same as C10	
C33	Same as C1	
C34	Same as C1	
C35	Same as C25	
C36 thru C38	Same as C1	
C39	Same as C3	
C40	Same as C25	
C41	Same as C4	
C42	Same as C4	
C43	Same as C10	
C44	Same as C1	
C45	Same as C1	
C46	Capacitor, Fixed, Ceramic, 3300 uuf, ±2%, 500 WVDC	CM112332F5S
C47	Same as C1	
C48	Same as C1	
C49	Same as C46	
C50	Same as C1	
C51	Same as C3	

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C52	Same as C4	
C53	Same as C4	
C54	Same as C10	
C55	Same as C1	
C56	Same as C1	
C57	Same as C46	
C58	Same as C1	
C59	Same as C1	
C60	Same as C46	
C61	Same as C1	
C62	Same as C3	
C63 thru C65	Same as C4	
C66	Same as C1	
L1	Coil, Radio Frequency, fixed, 120 uh, ±10%, molded case	CL275-121
L2 thru L12	Same as L1	
Q1	Transistor	
Q2 thru Q12	Same as Q1	
R1	Resistor, Fixed Composition, 15000 ohms, ±5%, ¼ watt	RC07GF153J
R2	Resistor, Fixed Composition, 3300 ohms, ±5%, ¼ watt	RC07GF332J
R3	Resistor, Variable Composition, 500 ohms, ±30%, 0.5 watts	RV124-1-501
R4	Resistor, Fixed, Composition, 1,000 ohms, ±5%, ¼ watt	RC07GF102J

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R5	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼ watt	RC07GF822J
R6	Resistor, Fixed, Composition, 470000 ohms, ±5%, ¼ watt	RC07GF474J
R7	Resistor, Fixed, Composition, 560 ohms, ±5%, ¼ watt	RC07GF561J
R8	Same as R7	
R9	Same as R6	
R10	Same as R5	
R11	Same as R4	
R12	Same as R1	
R13	Same as R2	
R14	Same as R3	
R15	Same as R7	
R16	Same as R6	
R17	Same as R5	
R18	Same as R4	
R19	Same as R1	
R20	Same as R2	
R21	Same as R3	
R22	Same as R7	
R23	Same as R6	
R24	Same as R5	
R25	Same as R4	
R26	Same as R1	
R27	Same as R2	
R28	Same as R3	

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R29	Same as R7	
R30	Same as R6	
R31	Same as R5	
R32	Same as R4	
R33	Same as R1	
R34	Same as R2	
R35	Same as R3	
R36	Same as R7	
R37	Same as R6	
R38	Same as R5	
R39	Same as R4	
R40	Same as R1	
R41	Same as R2	
R42	Same as R3	
T1	Transformer, Radio Frequency, tuned,	TT286-8
T2	Same as T1	
T3	Same as T1	
T4	Same as T1	
T5	Transformer, Radio Frequency, tuned	TT286-6
T6	Same as T5	
T7	Transformer, Radio Frequency, tuned	TT286-4
T8	Same as T7	
T9	Same as T7	
T10	Same as T7	
T11	Transformer, Radio Frequency, tuned	TT286-1

COMB FILTER B A-4501

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T12	Same as T11	
XY1	Socket, Crystal,	TS167-1
XY2 thru XY6	Same as XY1	
Y1	Crystal, unit quartz, frequency 1.9 MHZ	CR109-101
Y2	Crystal, unit quartz, frequency 1.7 MHZ	CR109-99
Y3	Crystal, unit quartz, frequency 1.5 MHZ	CR109-97
Y4	Crystal, unit quartz, frequency 1.3 MHZ	CR109-95
Y5	Crystal, unit quartz, frequency 1.1 MHZ	CR109-93
Y6	Crystal, unit quartz, frequency .8 MHZ	CR109-91

RF OUTPUT A-4502

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Plastic: 0.82 uf, ±5%, 60 WVDC	CN114R82-5J
C2	Capacitor, Fixed, Ceramic: 10,000 uuf, GMV, 500 WVDC	CC100-16
C3	Same as C2	
C4	Same as C1	
C5 Thru C17	Same as C2	
C18	Capacitor, Fixed, Mica: 620 uuf, ±½%, 500 WVDC 500 WVDC	CM111F621D5S
C19	Capacitor, Fixed, Electrolytic: 50 uf, -10+150% at 120 cps at 25 degrees C; 50 WVDC; polarized.	CE105-50-50
C20	Capacitor, Fixed, Mica, 2200 uuf, ±2%, 500 WVDC	CM112F222G5S
C21 thru C30	Not used	
C31 thru C34	Same as C2	
C35	Capacitor, Fixed, Ceramic: 1,000 uuf, GMV, 500 WVDC	CC100-29
C36	Same as C2	
C37	Same as C35	
C38	Same as C2	
C39	Capacitor, Fixed, Mica, 1100 uuf, ±½%, 500 WVDC	CM112F112D5S
CR1	Semiconductor Device, Diode	IN4864
CR2	Semiconductor Device, Diode	IN100
CR3	Same as CR2	
L1	Coil, Radio Frequency: 120 uh, ±10%, molded case.	CL240-120

RF OUTPUT A-4502

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L2 thru L6	Same as L1	
L7	Coil, Radio Frequency, 2.20 uh, ±20%, molded case	CL240-2R2
L8	Same as L1	
L9 thru L12	Not Used	
L13	Coil, Radio Frequency: fixed, 120 uh, ±10%, molded case	CL275-121
L14 thru L22	Same as L13	
L23	Coil, Radio Frequency: fixed, 212 uh, ±10%, molded case	CL275-2R2
Q1	Transistor	2N5070
Q2	Transistor	2N3375
Q3	Transistor	2N3296
R1	Resistor, Variable, Composition: 10,000 ohms, ±30%, 0.5 watts	RV124-1-103
R2	Same as R1	
R3	Resistor, Fixed, Composition: 22 ohms, ±5%, ½ watt	RC20GF220J
R4	Resistor, Fixed, Composition: 2,000 ohms, ±30%, ½ watt	RV124-1-202
R5	Resistor, Fixed, Composition: 5600 ohms, ±5%, ½ watt	RC20GF562J
R6	Resistor, Fixed, Composition: 3300 ohms, 5%, ½ watt	RC20GF332J
R7	Resistor, Fixed, Composition: 1000 ohms, ±5%, 1 watt	RC32GF102J
R8	Same as R3	

RF OUTPUT A-4502

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R9	Resistor, Fixed, Composition: 1000 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF102J
R10	Not Used	
R11	Resistor, Fixed, Composition: 47 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
R12	Same as R9	
R13	Resistor, Fixed, Composition: 10 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF100J
R14	Same as R10	
R15	Resistor, Fixed, Composition: 2200 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF222J
R16	Not used	
R17	Same as R9	
R18	Resistor, Fixed, Composition: 220 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF221J
R19	Resistor, Fixed, Composition: 47000 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF473J
R20	Not used	
R21	Resistor, Fixed, Composition: 43,000 ohms, $\pm 5\%$, $\frac{1}{2}$ watt	RC20GF433J
T1	Transformer, Radio Frequency: fixed,	TZ220
T2	Transformer, Radio Frequency: fixed,	TZ219

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Mica, 470 uuf, $\pm 5\%$, 500 WVDC	CM111F471J5S
C2	Capacitor, Fixed, Ceramic, 1,000 uuf, GMV, 500 WVDC	CC100-29
C3	Capacitor, Variable, Ceramic, 15 to 60 uuf, 100 WVDC	CV112-5
C4 thru C8	Same as C2	
C9	Same as C3	
C10	Same as C2	
C11	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-30
C12	Same as C2	
C13	Capacitor, Fixed, Ceramic, 470 uuf, $\pm 10\%$, 500 WVDC	CC100-7
C14	Same as C2	
C15	Same as C11	
C16 thru C18	Same as C2	
C19	Same as C3	
C20	Same as C2	
C21	Same as C11	
C22 thru C24	Same as C2	
C26 thru C29	Same as C2	
C30	Same as C3	
C31	Same as C2	
C32	Same as C11	
C33	Same as C2	

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C34	Same as C13	
C35	Same as C2	
C36	Same as C11	
C37 thru C40	Same as C2	
C41	Same as C3	
C42	Same as C11	
C43	Same as C2	
C44	Same as C2	
C45	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C46 thru C48	Same as C2	
C49	Same as C45	
C50 thru C52	Same as C2	
C53	Same as C11	
C54	Same as C2	
C55	Same as C13	
C56	Same as C2	
C57	Same as C11	
C58 thru C61	Same as C2	
C62	Same as C45	
C63 thru C66	Same as C11	

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C67	Capacitor, Fixed, Mica, 82 uuf, $\pm 5\%$, 500 WVDC	CM111F820J5S
C68	Same as C1	
FL1	Filter, Bandpass	FX280
FL2	Filter, Bandpass	FX281
FL3	Filter, Bandpass	FX282
L1	Coil, Radio Frequency, fixed, 120 uh, $\pm 10\%$, molded case	CL275-121
L2	Same as L1	
L3	Same as L1	
L4	Coil, Radio Frequency, fixed, 47 uh, $\pm 10\%$, molded case	CL275-470
L5	Same as L1	
L6	Coil, Radio Frequency, fixed, 10 uh, $\pm 10\%$, molded case	CL275-100
L7 thru L10	Same as L1	
L11	Same as L4	
L12	Same as L1	
L13	Same as L6	
L14 thru L17	Same as L1	
L18	Same as L4	
L19	Same as L1	
L20	Same as L6	
L21	Same as L1	
L22	Coil, Radio Frequency, fixed, 0.47 uh, $\pm 10\%$, molded case	CL275-OR47

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q1	Transistor	2N3646
Q2 thru Q9	Same as Q1	
R1	Resistor, Fixed, Composition, 68 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF680J
R2	Resistor, Fixed, Composition, 3,900 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF392J
R3	Resistor, Fixed, Composition, 39000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF393J
R4	Resistor, Fixed, Composition, 5600 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF562J
R5	Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R6	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R7	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R8	Resistor, Fixed, Composition, 150 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF151J
R9	Resistor, Fixed, Composition, 10 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF100J
R10	Resistor, Fixed, Composition, 47 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
R11	Same as R7	
R12	Same as R6	
R13	Same as R8	
R14	Same as R9	
R15	Same as R5	
R16	Same as R1	
R17	Same as R2	
R18	Same as R3	
R19	Same as R4	
R20	Same as R5	
R21	Same as R6	
R22	Same as R7	

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R23	Same as R8	
R24	Same as R9	
R25	Same as R10	
R26	Same as R7	
R27	Same as R6	
R28	Same as R8	
R29	Same as R9	
R30	Same as R5	
R31	Same as R1	
R32	Same as R2	
R33	Same as R3	
R34	Same as R4	
R35	Same as R5	
R36	Same as R6	
R37	Same as R7	
R38	Same as R8	
R39	Same as R9	
R40	Same as R10	
R41	Same as R7	
R42	Same as R6	
R43	Same as R8	
R44	Same as R9	
R45	Same as R5	
R46 thru R48	Same as R10	

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T1 T2 thru T9	Transformer, Radio Frequency, fixed, Same as T1	TX215-12

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C2	Capacitor, Fixed, Mica, 18 uuf, $\pm 5\%$, 500 WVDC	CM111C180J5S
C3	Same as C1	
C4	Capacitor, Fixed, Ceramic, 100000 uuf, +80-20%, 100 WVDC	CC100-28
C5 thru C7	Same as C1	
C8	Same as C4	
C9	Same as C2	
C10	Capacitor, Fixed, Mica, 22 uuf, $\pm 5\%$, 500 WVDC	CM111C220J5S
C11 thru C13	Same as C1	
C14	Same as C2	
C15	Capacitor, Fixed, Ceramic, 200000 uuf, =80-20%, 25 WVDC	CC100-33
C16 thru C37	See Separate Parts List A-4600	
C38	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-30
C39	Capacitor, Fixed, Mica, 51 uuf, $\pm 2\%$, 500 WVDC	CM111E510G5S
C40	Not used	
C41	Not used	
C42	Capacitor, Variable, Ceramic, 2 to 8 uuf, 200 WVDC	CV112-4
C43	Capacitor, Fixed, Mica, 47 uuf, $\pm 2\%$, 500 WVDC	CM111E470G5S
C44	Same as C38	
C45	Same as C39	

TRANSLATOR A-4505c

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C46	Same as C38	
C47	Same as C43	
C48	Same as C42	
C49	Same as C38	
C50	Same as C1	
C51	Same as C39	
C52	Same as C38	
C53	Same as C43	
C54	Same as C42	
C55	Same as C38	
C56	Same as C38	
C56	Same as C38	
C57	Same as C39	
C58	Same as C38	
C59	Capacitor, Fixed, Mica, 75 uuf, $\pm 5\%$, 500 WVDC	CM111E750J5S
C60	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C61	Same as C38	
C62	Same as C38	
C63	Same as C10	
C64	Capacitor, Fixed, Mica, 68 uuf, $\pm 1\%$, 500 WVDC	CM111E680F5S
C65	Capacitor, Fixed, Mica, 33 uuf, $\pm 2\%$, 500 WVDC	CM111E330G5S
C66	Capacitor, Fixed, Ceramic, 20000 uuf, +80-20%, 25 WVDC	CC100-40
C67	Same as C15	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C68	Capacitor, Fixed, Ceramic, 2200 uuf, GMV, 500 WVDC	CC100-11
C69	Same as C66	
C70	Same as C66	
C71	Same as C4	
C72	Capacitor, Fixed, Mica, 510 uuf, $\pm 2\%$, 500 WVDC	CM111F511G5S
C73	Capacitor, Fixed, Mica, 120 uuf, $\pm 2\%$, 500 WVDC	CM111F121G5S
C74	Capacitor, Fixed, Mica, 560 uuf, $\pm 1\%$, 500 WVDC	CM111F561F5S
C75	Capacitor, Fixed, Mica, 430 uuf, $\pm 2\%$, 500 WVDC	CM111F431G5S
C76	Capacitor, Fixed, Mica, 360 uuf, $\pm 2\%$, 500 WVDC	CM111F361G5S
C77	Same as C4	
C78	Same as C1	
thru		
C80		
C81	Capacitor, Fixed, Mica, 130 uuf, $\pm 2\%$, 500 WVDC	CM111F131G5S
C82	Same as C1	
C83	Capacitor, Fixed, Mica, 390 uuf, $\pm 1\%$, 500 WVDC	CM111F391F5S
C84	Same as C66	
C85	Capacitor, Fixed, Mica, 750 uuf, $\pm 20\%$, 500 WVDC	CM111F751G5S
C86	Same as C83	
C87	Capacitor, Fixed, Mica, 110 uuf, $\pm 5\%$, 500 WVDC	CM111F111J5S
C88	Capacitor, Fixed, Mica, 5 uuf, $\pm 10\%$, 500 WVDC	CM111C050K5S
C89	Same as C87	
C90	Same as C1	
C91	Same as C1	
C92	Same as C87	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C93	Same as C87	
C94	Same as C88	
C95	Same as C1	
C96	Same as C1	
C97	Same as C87	
C98	Same as C87	
C99	Same as C88	
C100	Same as C87	
C101 thru C106	Same as C1	
C107	Same as C87	
C108	Same as C87	
C109	Same as C88	
C110 thru C113	Same as C1	
C114	Same as C87	
C115	Same as C1	
C116	Same as C1	
C117	Same as C38	
C118	Capacitor, Fixed, Electrolytic, 10 MF, -10+150%, 250 WVDC	CE105-10-25
C119	Sam as C38	
CR1	See Seperate Parts List A-4600	
CR2	See Seperate Parts List A-4600	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR3	Semiconductor, Device, Diode	DD137
CR4	Semiconductor, Device, Diode	DD138
CR5	Same as CR4	
CR6	Semiconductor, Device, Diode	IN914
CR7	Same as CR6	
CR8	Semiconductor, Device, Diode	IN4864
CR9	Same as CR8	
CR10	Same as CR6	
L1	Coil, Radio Frequency, fixed, 8.2 uh, $\pm 10\%$, molded case	CL275-8R2
L2	Same as L1	
L3	Same as L1	
L4 thru L9	See Separate Parts List A-4600	
L10	Coil, Radio Frequency, fixed, 1.0 uh, $\pm 10\%$, Molded case	CL275-1R0
L11 thru L13	Same as L10	
L14	Coil, Radio Frequency, fixed, .077 uh, $\pm 4\%$	CL412-23
L15	Coil, Radio Frequency, fixed, 22 uh, $\pm 10\%$, molded case	CL275-220
L16	Same as L10	
L17	Coil, Radio Frequency, fixed, 0.39 uh, $\pm 10\%$, molded	CL2750R39
L18	Same as L10	
L19	Coil, Radio Frequency, fixed, 0.82 uh, $\pm 10\%$, molded case	CL275-0R82

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L20	Coil, Radio Frequency, fixed, 120 uh, ±10%, molded case	CL275-121
L21	Same as L20	
L22	Same as L20	
L23	Coil, Radio Frequency, fixed, .63 uh, ±4%	CL412-24
L24	Coil, Radio Frequency, fixed, .36 uh, ±4%	CL412-25
L25	Same as L20	
L26	Same as L20	
L27	Same as L1	
L28	Same as L1	
L29	Same as L15	
L30	Same as L15	
L131 thru L34	Same as L20	
Q1	Transistor	2N3646
Q2	Same as Q1	
Q3	Same as Q1	
Q4 thru Q6	See Separate Parts List A-4600	
Q7	Transistor	2N3600
Q8 thru Q11	Same as Q7	
Q12 thru Q19	Same as Q1	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1	Resistor, Fixed, Composition, 47 ohms, ±5%, ¼ watt	RC07GF470J
R2	Resistor, Fixed, Composition, 47000 ohms, ±5%, ¼ watt	RC07GF473J
R3	Resistor, Fixed, Composition, 100000 ohms, ±5%, ¼ watt	RC07GF104J
R4	Resistor, Fixed, Composition, 33 ohms, ±5%, ¼ watt	RC07GF330J
R5	Resistor, Fixed, Composition, 100 ohms, ±5%, ¼ watt	RC07GF101J
R6	Same as R1	
R7	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼ watt	RC07GF102J
R8	Same as R2	
R9	Same as R4	
R10	Same as R3	
R11	Same as R5	
R12	Same as R1	
R13	Same as R7	
R14	Same as R2	
R15	Same as R4	
R16	Same as R3	
R17	Same as R5	
R18	Same as R7	
R19 thru R36	See Separate Parts List A-4600	
R37	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼ watt	RC07GF822J
R38	Same as R7	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R39	Same as R5	
R40	See Separate Parts List A-4600	
R41	Resistor, Fixed, Composition, 39 ohms, ±5%, ¼ watt	RC07GF390J
R42	Resistor, Fixed, Composition, 560 ohms, ±5%, ¼ watt	RC07GF561J
R43	Same as R7	
R44	Resistor, Fixed, Composition, 150 ohms, ±5%, ¼ watt	RC07GF151J
R45	Same as R41	
R46	Resistor, Fixed, Composition, 6800 ohms, ±5%, ¼ watt	RC07GF682J
R47	Resistor, Fixed, Composition, 330 ohms, ±5%, ¼ watt	RC07GF331J
R48	Resistor, Fixed, Composition, 5600 ohms, ±5%, ¼ watt	RC07GF562J
R59	Same as R7	
R50	Same as R44	
R51	Same as R41	
R52	Resistor, Fixed, Composition, 220 ohms, ±5%, ¼ watt	RC07GF221J
R53	Resistor, Fixed, Composition, 4700 ohms, ±5%, ¼ watt	RC07GF472J
R54	Same as R7	
R55	Same as R44	
R56	Same as R41	
R57	Resistor, Fixed, Composition, 120 ohms, ±5%, ¼ watt	RC07GF121J
R58	Same as R1	
R59	Same as R1	
R60	Resistor, Fixed, Composition, 3300 ohms, ±5%, ¼ watt	RC07GF332J
R61	Same as R37	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R62	Same as R44	
R63	Resistor, Fixed, Composition, 8.2 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF8R2J
R64	Same as R1	
R65	Same as R1	
R66	Same as R2	
R67	Same as R3	
R68	Same as R7	
R69	Resistor, Fixed, Composition, 10 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF100J
R70	Not used	
R71	Resistor, Variable, Composition, 500 ohms, $\pm 30\%$, 0.5 watts	RV124-1-501
R72	Same as R57	
R73	Same as R52	
R74	Resistor, Fixed, Composition, 390 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF391J
R75	Same as R52	
R76	Resistor, Fixed, Composition, 18000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF183J
R77	Same as R7	
R78	Resistor, Fixed, Composition, 27000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF273J
R79	Resistor, Fixed, Composition, 22 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF220J
R80	Same as R3	
R81	Same as R1	
R82	Same as R7	
R83	Same as R74	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R84	Same as R76	
R85	Resistor, Fixed, Composition, 56000 ohms, ±5%, ¼ watt	RC07GF563J
R86	Resistor, Fixed, Composition, 10000 ohms, ±5%, ¼ watt	RC07GF103J
R87	Same as R2	
R88	Same as R1	
R89	Resistor, Fixed, Composition, 820 ohms, ±5%, ¼ watt	RC07GF821J
R90	Resistor, Fixed, Composition, 68000 ohms, ±5%, ¼ watt	RC07GF683J
R91	Resistor, Fixed, Composition, 820000 ohms, ±5%, ¼ watt	RC07GF824J
R92	Resistor, Fixed, Composition, 330000 ohms, ±5%, ¼ watt	RC07GF334J
R93	Resistor, Fixed, Composition, 220000 ohms, ±5%, ¼ watt	RC07GF224J
R94	Same as R74	
R95	Same as R86	
R96	Same as R53	
R97	Resistor, Fixed, Composition, 470 ohms, ±5%, ¼ watt	RC07GF471J
R98	Same as R76	
R99	Same as R3	
R100	Same as R79	
R101	Same as R78	
R102	Same as R7	
R103	Same as R1	
R104	Same as R74	

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R105	Same as R76	
R106	Same as R85	
R107	Same as R86	
R108	Same as R2	
R109	Same as R1	
R110	Same as R89	
R111	Same as R90	
R112	Same as R1	
R113	Same as R1	
R114	Same as R57	
R115 thru R117	See Separate Parts List A-4600	
R118	Same as R1	
R119	Same as R52	
R120	Resistor, Fixed, Composition, 82 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF820J
T1	Transformer, Radio Frequency, tuned	TT285-10
T2	Same as T1	
T3	Same as R1	
T4 thru T7	See Separate Parts List A-4600	
T8	Transformer, Radio Frequency, fixed	TZ215-1
T9	Same as T8	
T10	Same as T8	
T11	Transformer, Radio Frequency, fixed,	TZ220

TRANSLATOR A-4505

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T12	Transformer, Radio Frequency, Tuned	TT285-4
T13	Transformer, Radio Frequency, tuned	TT285-2
T14	Transformer, Pulse	TF228U13
T15 thru T23	Same as T13	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Mica, 100 uuf, $\pm 1\%$, 500 WVDC	CM111F101F5S
C2	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C3	Capacitor, Fixed, Mica, 18 uuf, $\pm 5\%$, 500 WVDC	CM111C180J5S
C4	Capacitor, Fixed, Mica, 130 uuf, $\pm 5\%$, 500 WVDC	CM111F131J5S
C5	Capacitor, Fixed, Mica, 27 uuf, $\pm 5\%$, 500 WVDC	CM111E270J5S
C6	Capacitor, Fixed, Mica, 91 uuf, $\pm 5\%$, 500 WVDC	CM111F910J5S
C7	Capacitor, Fixed, Ceramic, 100 uuf, GMV, 500 WVDC	CC100-30
C8	Same as C7	
C9	Same as C7	
C10	Capacitor, Variable, Ceramic, 2.5 to 11 uuf, 200 WVDC	CV112-3
C11	Same as C7	
C12	Capacitor, Fixed, Mica, 36 uuf, $\pm 5\%$, 500 WVDC	CM111E360J5S
C13 thru C15	Same as C7	
C16	Same as C10	
C17 thru C21	Same as C7	
C22	Same as C10	
C23 thru C26	Same as C7	
C27	Capacitor, Fixed, Mica, 10 uuf, $\pm 5\%$, 500 WVDC	CM111C100J5S
C28	Capacitor, Variable, Ceramic, 5.5 to 18 uuf 200 WVDC	CV112-1
C29	Same as C7	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C30	Same as C2	
C31	Capacitor, Fixed, Mica, 82 uuf, $\pm 1\%$, 500 WVDC	CM111E820F5S
C32	Same as C27	
C33	Capacitor, Fixed, Mica, 110 uuf, $\pm 5\%$, 500 WVDC	CM111F111J5S
C34	Same as C5	
C35	Capacitor, Fixed, Mica, 75 uuf, $\pm 5\%$, 500 WVDC	CM111E750J5S
C36 thru C38	Same as C7	
C39	Same as C10	
C40	Same as C7	
C41	Same as C12	
C42 thru C44	Same as C7	
C45	Same as C10	
C46 thru C50	Same as C7	
C51	Same as C10	
C52 thru C54	Same as C7	
C55	Same as C27	
C56	Same as C28	
C57	Same as C7	
C58	Same as C7	
C59	Same as C2	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C60	Same as C31	
C61	Same as C27	
C62	Same as C33	
C63	Same as C34	
C64	Same as C35	
C65 thru C67	Same as C7	
C68	Same as C10	
C69	Same as C7	
C70	Same as C12	
C71 thru C73	Same as C7	
C74	Not used	
C75	Same as C10	
C76 thru C80	Same as C7	
C81	Same as C10	
C82 thru C85	Same as C7	
C86	Same as C27	
C87	Same as C28	
C88 thru C91	Same as C7	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C92 thru C96	Same as C2	
C97	Capacitor, Fixed, Mica, 180 uuf, $\pm 2\%$, 500 WVDC	CM111F181G5S
C98	Same as C2	
C99	Capacitor, Fixed, Mica, 620 uuf, $\pm \frac{1}{2}\%$, 500 WVDC	CM111F621D5S
C100	Same as C99	
C101	Capacitor, Variable, Ceramic, 9 to 35 uuf, 100 WVDC	CV112-2
C102 thru C104	Same as C2	
C105	Same as C6	
C106	Capacitor, Fixed, Mica, 5 uuf, $\pm 10\%$, 500 WVDC	CM111C050K5S
C107	Same as C6	
C108 thru C111	Same as C2	
C112	Same as C6	
C113	Same as C2	
C114	Same as C6	
C115	Same as C106	
C116 thru C118	Same as C2	
C119	Same as C6	
C120	Same as C106	
C121	Same as C6	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C122 thru C124	Same as C2	
C125	Same as C12	
C126 thru C128	Same as C2	
C129	Same as C6	
C130	Same as C106	
C131	Same as C6	
C132 thru C135	Same as C2	
C136	Same as C6	
C137	Same as C106	
C138	Same as C6	
C139 thru C142	Same as C2	
C143	Same as C6	
C144	Same as C6	
C145	Same as C106	
C146 thru C148	Same as C2	
C149	Same as C12	
C150	Same as C2	
C151	Same as C2	
CR1	Semiconductor, Device, Diode	DD139

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2	Same as CR1	
CR3	Semiconductor, Device, Diode,	1N627
CR4	Same as CR3	
L1	Coil, Radio Frequency, fixed, .128 uh, $\pm 10\%$	CL412-41
L2	Coil, Radio Frequency, fixed, .11 uh, $\pm 10\%$	CL412-36
L3	Coil, Radio Frequency, fixed, 0.82 uh, $\pm 10\%$, molded case	CL275-0R82
L4 thru L7	Same as L3	
L8	Coil, Radio Frequency, fixed, .205 uh, $\pm 4\%$	CL412-38
L9	Same as L3	
L10	Same as L2	
L11	Coil, Radio Frequency, fixed, .085 uh, $\pm 4\%$	CL412-37
L12 thru L16	Same as L3	
L17	Coil, Radio Frequency, fixed, .205 uh, $\pm 4\%$,	CL412-39
L18	Same as L3	
L19	Same as L2	
L20	Same as L11	
L21 thru L25	Same as L3	
L26	Coil, Radio Frequency, fixed, .155 uh, $\pm 4\%$	CL412-40
L27	Same as L3	
L28	Same as L3	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L29	Coil, Radio Frequency, fixed, 129 uh, $\pm 10\%$, molded case	CL275-121
L30	Same as L29	
L31	Coil, Radio Frequency, fixed, 12 uh, $\pm 10\%$, molded case	CL275-120
L32 thru L40	Same as L29	
Q1	Transistor	2N3600
Q2 thru Q13	Same as Q1	
Q14	Transistor	2N3646
Q15 thru Q20	Same as Q14	
R1	Resistor, Fixed, Composition, 56 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF560J
R2	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R3	Resistor, Fixed, Composition, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R4	Resistor, Fixed, Composition, 2200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF222J
R5	Resistor, Fixed, Composition, 18 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF180J
R6	Resistor, Fixed, Composition, 220 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF221J
R7	Resistor, Fixed, Composition, 12 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF120J
R8	Same as R2	
R11	Resistor, Fixed, Composition, 22 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF220J
R12	Same as R6	
R13	Same as R7	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R14	Same as R2	
R15	Same as R3	
R16	Same as R10	
R17	Resistor, Fixed, Composition, 10 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF100J
R18	Same as R6	
R19	Same as R7	
R20	Resistor, Fixed, Composition, 1500 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF152J
R21	Same as R3	
R22	Same as R10	
R23	Same as R17	
R24	Resistor, Fixed, Composition, 180 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF181J
R25	Same as R1	
R26	Same as R2	
R27	Same as R3	
R28	Same as R4	
R29	Same as R17	
R30	Same as R6	
R31	Resistor, Fixed, Composition, 68 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF680J
R32	Same as R2	
R33	Same as R3	
R34	Same as R10	
R35	Same as R11	
R36	Same as R6	
R37	Resistor, Fixed, Composition, 47 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R38	Same as R2	
R39	Same as R3	
R40	Same as R10	
R41	Same as R17	
R42	Same as R6	
R43	Same as R37	
R44	Same as R20	
R45	Same as R3	
R46	Same as R10	
R47	Same as R17	
R48	Same as R24	
R49	Same as R1	
R50	Same as R2	
R51	Same as R3	
R52	Same as R4	
R53	Same as R17	
R54	Same as R6	
R55	Same as R31	
R56	Same as R2	
R57	Same as R3	
R58	Same as R10	
R59	Same as R11	
R60	Same as R6	
R61	Same as R37	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R62	Same as R2	
R63	Same as R3	
R64	Same as R10	
R65	Same as R17	
R66	Same as R6	
R67	Same as R37	
R68	Same as R2	
R70	Same as R10	
R71	Same as R17	
R72	Same as R24	
R73	Resistor, Fixed, Composition, 3300 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF332J
R74	Same as R20	
R75	Same as R10	
R76	Resistor, Fixed, Composition, 6.8 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF6R8J
R77	Same as R10	
R78	Resistor, Variable, Composition, 100 ohms, $\pm 30\%$,	RV124-1-101
R79	Same as R2	
R80	Same as R3	
R81	Resistor, Fixed, Composition, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R82	Resistor, Fixed, Composition, 4.7 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF4R7J
R83	Same as R24	
R84	Same as R78	
R85	Resistor, Fixed, Composition, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R86	Same as R52	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R87	Resistor, Fixed, Composition, 100 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF101J
R88	Same as R87	
R89	Same as R2	
R90	Same as R3	
R91	Same as R81	
R92	Resistor, Fixed, Composition, 1200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF122J
R93	Resistor, Fixed, Composition, 15 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF150J
R94	Same as R24	
R95	Same as R2	
R96	Same as R3	
R97	Same as R81	
R98	Same as R92	
R99	Same as R11	
R100	Same as R85	
R101	Same as R2	
R102	Resistor, Fixed, Composition, 6800 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF682J
R103	Same as R92	
R104	Resistor, Fixed, Composition, 820 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF821J
R105	Resistor, Fixed, Composition, 27 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF270J
R106	Same as R5	
R107	Same as R2	
R108	Same as R3	
R109	Same as R81	
R110	Same as R93	

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R111	Same as R24	
R112	Same as R2	
R113	Same as R3	
R114	Same as R81	
R115	Same as R92	
R116	Same as R11	
R117	Same as R85	
R118	Same as R2	
R119	Same as R102	
R120	Same as R92	
R121	Same as R104	
R122	Same as R105	
R123	Same as R24	
R124	Same as R92	
T1	Transformer, Radio Frequency, fixed	TZ215-6
T2	Same as T1	
T3	Same as T1	
T4	Transformer, Radio Frequency, fixed	TZ215-8
T5	Same as T4	
T6	Same as T4	
T7	Transformer, Radio Frequency, fixed	TZ215-10
T8	Same as T7	
T9	Same as T7	
T10	Transformer, Radio Frequency, fixed	TZ215-11

STEP GENERATOR C A-4506

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T11	Transformer, Radio Frequency, fixed	TT287-19
T12	Transformer, Radio Frequency, fixed	TT287-9
T13	Transformer, Radio Frequency, fixed	TT287-12
T14	Transformer, Radio Frequency, fixed	TT287-10
T15	Same as T13	
T16	Same as T14	
T17	Same as T13	
T18	Transformer, Radio Frequency, Fixed	TT287-21
T19	Same as T12	
T20	Same as T13	
T21	Same as T14	
T22	Same as T13	
T23	Same as T14	
T24	Same as T13	
T25	Same as T18	
Y1	Crystal, Unit Quartz, 12 MHZ	CR109-124

OUTPUT FILTER

A4654

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC; 130 pf $\pm 5\%$, 500 WVDC	CM111F131J5S
C2	CAPACITOR, FIXED, MICA DIELECTRIC; 180 pf $\pm 20\%$, 500 WVDC	CM11F181G5S
C3	CAPACITOR, FIXED, MICA, DIELECTRIC; 120 pf $\pm 5\%$, 500 WVDC	CM111F121J5S
C4	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 2-8 pf, 200 WVDC	CV112-4
C5	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 15-60 pf, 100 WVDC	CV112-5
L1	COIL, FIXED, RF; .21 uh, min. Q = 55 @ 25 MHz	CL412-16
L2	COIL, FIXED, RF; .19 uh, min. Q = 55 @ 25 MHz	CL412-17

3 MHz BAL. MIXER
A4697

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1001 thru	CAPACITOR, FIXED, CERAMIC DIELECTRIC; .01 uf, +80% -20%, 100 WVDC.	CC100-41
C1005	Same as C1001.	
C1006	CAPACITOR, FIXED, MICA DIELECTRIC: 270 pf \pm 1%, 50C WVDC.	CM11F271F5S
C1007	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.1 uf +80% -20%, 100 WVDC.	CC100-28
C1008 thru	Same as C1001.	
C1011		
C1012	CAPACITOR, FIXED, MICA DIELECTRIC; 360 pf \pm 1%, 500 WVDC.	CM111F361F5S
C1013	Same as C1001.	
C1014	CAPACITOR, FIXED, CERAMIC DIELECTRIC; .02 uf	CC100-40
C1015	Same as C1007.	
C1016	Same as C1001.	
C1017	Same as C1001.	
C1018	CAPACITOR, FIXED, ELECTROLYTIC: 150 uf, 50 WVDC	CE105-150-50
C1019 thru	Same as C1001.	
C1021	Same as C1001.	
CR1001	SEMICONDUCTOR DEVICE, DIODE	1N39A
FL1001	FILTER, BANDPASS; 3 MHz	FX268

3 MHz BAL. MIXER

A4697
(cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q1001 thru Q1004	TRANSISTOR	2N3646
R1001	RESISTOR, FIXED, COMPOSITION: 22,000 ohms $\pm 5\%$, 1/4 watt	RC07GF223J
R1002	RESISTOR, FIXED, COMPOSITION; 3300 ohms $\pm 5\%$, 1/4 watt	RC07GF332J
R1003	RESISTOR, FIXED, COMPOSITION, 1000 ohms $\pm 5\%$, 1/4 watt	RC07GF102J
R1004	RESISTOR, FIXED, COMPOSITION, 33 ohms $\pm 5\%$, 1/4 watt	RC07GF330J
R1005	RESISTOR, FIXED, COMPOSITION; 560 ohms $\pm 5\%$, 1/4 watt	RC07GF561J
R1006	RESISTOR, FIXED, COMPOSITION: 33,000 ohms $\pm 5\%$, 1/4 watt	RC07GF333J
R1007	RESISTOR, FIXED, COMPOSITION; 330 ohms $\pm 5\%$, 1/4 watt	RC07GF331J
R1011	RESISTOR, FIXED, COMPOSITION: 15,000 ohms $\pm 5\%$, 1.4 watt	RC07GF153J
R1012	Same as R1001.	
R1013	RESISTOR, FIXED, COMPOSITION; 470 ohms $\pm 5\%$, 1/4 watt	RC07GF471J
R1014	RESISTOR, FIXED, COMPOSITION: 680 ohms $\pm 5\%$, 1/4 watt	RC07GF681J
R1015	Same as R1003.	
R1016	RESISTOR, FIXED, COMPOSITION; 1500 ohms $\pm 5\%$, 1/4 watt	RC07GF152J
R1017	Same as R1011	
R1018	Same as R1001	
R1019	Same as R1013	
R1020	RESISTOR, FIXED, COMPOSITION; 100 ohms $\pm 5\%$, 1/4 watt	RC07GF101J
R1021	Same as R1003.	
R1022	RESISTOR, VARIABLE, COMPOSITION; 100 ohms $\pm 30\%$, 1/2 watt	RV124-1-101

3 MHz BAL. MIXER

A4697

(cont.)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1027	Same as R1020.	
R1028	RESISTOR, VARIABLE, COMPOSITION; 100,000 ohms $\pm 10\%$, 1/4 watt.	RV111-104A
R1029	Same as R1014	
T1001	TRANSFORMER, RF; ADJUSTABLE, 3 MHz Nominal	TT285-19
T1002	TRANSFORMER, RF, ADJUSTABLE, 3 MHz Nominal	TT285-20
TP1001 thru TP1004	TERMINAL, STUD (Test Points)	TE0127-2
Z1001	MIXER, DOUBLE BALANCED (Packaged circuit)	NW168

1.25 MHz GENERATOR
A4698

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1101	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01uf, +80% -20% 100 WVDC	CC100-41
C1102	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.1 uf, +80% -20%, 100 WVDC	CC100-28
C1103	Same as C11 2.	
C1104	CAPACITOR, FIXED, ELECTROLYTIC: 175 uf, 15 WVDC	CE105-175-15
C1105	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .02 uf	CC100-40
C1106	Same as C1105.	
C1107	Same as C1101.	
C1108	CAPACITOR, FIXED, MICA DIELECTRIC: 250 pf \pm 5%, 100 WVDC.	CM11F251J1S
C1110	Same as C1101.	
C1111	Same as C1101.	
C1113	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .001 uf, 24WVDC	CC100-29
C1114	Same as C1113.	
C1115	Same as C1108.	
C1116	Same as C1101.	
C1118	CAPACITOR, FIXED, ELECTROLYTIC: 25 uf, 25 WVDC	CE105-25-25
C1119	Same as C1102.	
C1120	Same as C1102.	
C1121	Same as C1102.	
C1122	Same as C1101.	
C1123	Same as C1102.	
C1124	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, 15 WVDC	CE105-10-15
C1125	Same as C1102.	
C1126	Same as C1102	

1.25 MHz GENERATOR
A4698
(cont.)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1101	SEMICONDUCTOR, DEVICE, DIODE.	1N746A
FL1101	FILTER, BANDPASS; 1.25 MHz	FX283
L1101	COIL, RF, FIXED; 1.0 uh.	CL275-1R0
L1102	COIL, RF, FIXED; 22 uh.	CL275-221
L1103	COIL, RF, FIXED; 1000 uh.	CL275-102
L1104	Same as L1102	
L1105	Same as L1103.	
Q1101 thru	TRANSISTOR	2N3646
Q1105	Same as Q1101	
T1101	TRANSFORMER, RF, ADJUSTABLE; 1.25 MHz, 63.5 uh. Nominal inductance.	TT285-19
T1102	TRANSFORMER, RF, ADJUSTABLE; 1.25 MHz, 63.5 uh. nominal inductance.	TT285-20
Z1101 and	MULTIVIBRATOR, BISTABLE (flip flop).	NW136
Z1102	Same as Z1101.	

120 MC GENETATOR A-4600

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C16	Cap, Fxd, Mica, 110 uufd, $\pm 5\%$, 500 WVDC	CM111F111J5S
C17	Cap, Fxd, Ceramic, 100 uufd, GMV, 500 WVDC	CC100-30
C18	Same as C17	
C19	Cap, Fxd, Mica, 47 uufd, $\pm 2\%$, 500 WVDC	CM111E470G5S
C20	Cap, Var, Cer, 2-8 uufd, 200 WVDC	CV112-4
C21 thru C24	Same as C17	
C25	Same as C19	
C26	Same as C20	
C27 thru C30	Same as C17	
C31	Same as C20	
C32	Same as C17	
C33	Same as C16	
C34	Cap, Fxd, Cer, 1000 uufd, GMV, 500 WVDC	CC100-29
C35	Same as C34	
C36	Same as C19	
C37	Cap, Var, Cer, 5.5-18 uufd, 200 WVDC	CV112-1
CR1	Scnd Device Diode	DD138
CR2	Same as CR1	
L4	Coil, Rf, Fxd, 1uh, $\pm 10\%$ molded	CL275-1R0
L5	Same as L4	
L6	Same as L4	
L7	Coil, R.F., Fxd, 0.22 uh, $\pm 20\%$, Molded	CL275-OR22
L8	Coil, R.F. Fxd, 120 uh, $\pm 10\%$, molded	CL275-121

120 MC GENERATOR A-4600

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L9	Same as L8	
Q4	Transistor, Silicon	2N3646
Q5	Same as Q4	
Q6	Transistor	2N5179
R19	Res, Fxd, Comp, 1000 Ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R20	Res, Fxd, Comp, 8200 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF822J
R21	Res, Fxd, Comp, 330 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF331J
R22	Res, Fxd, Comp, 180 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF181J
R23	Res, Fxd, Comp, 10 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF100J
R24	Same as R19	
R25	Same as R20	
R26	Same as R21	
R27	Same as R22	
R28	Same as R23	
R29	Res, Fxd, Comp, 47000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF473J
R30	Res, Fxd, Comp, 33 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF330J
R31	Res, Fxd, Comp, 100000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF104J
R32	Same as R19	
R33	Res, Fxd, Comp, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
R34	Same as R23	
R35	Res, Fxd, Comp, 120 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF121J
R36	Res, Var, Comp, 500 ohms, $\pm 30\%$, 200 VDC	RV124-1-501
R40	Same as R33	
R115	Same as R33	
R116	Same as R30	

120 MC GENERATOR A-4600

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R117	Same as R33	
T4	Transformer, Radio Frequency, Fixed	TZ215-4
T5	Same as T4	
T6	Transformer, Radio Frequency, Fixed	TZ215-3
T7	Transformer, Radio Frequency, Fixed	TZ215-2

A-4592

RESISTOR BOARD ASSEMBLY

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R129	Resistor, Fixed, Composition, 100 ohms, ±5%, ¼ Watt	RC07GF101J
R130	Resistor, Fixed, Composition, 470 ohms, ±5%, ¼ Watt	RC07GF471J
R132 thru R135	Same as R130	
R138 thru R142	Same as R130	
R144 thru R148	Same as R130	
R150 thru R154	Same as R130	
R156 thru R160	Same as R130	

A-4593

RESISTOR BOARD ASSEMBLY

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R161	Resistor, Fixed Composition, 100 ohms, $\pm 5\%$, $\frac{1}{4}$ Watt	RC07GF101J
R162	Resistor, Fixed Composition, 470 ohms, $\pm 5\%$, $\frac{1}{4}$ Watt	RC07GF471J
R164 thru R168	Same as R162	
R170 thru R174	Same as R162	
R176 thru R180	Same as R162	
R182 thru R186	Same as R162	
R188 thru R192	Same as R162	

BMA-173

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P306	CONN, RECP, MALE	PL225-8P
Q301	TRANSISTOR, SILICON, NPN	2N1488
Q302	Same as Q301	
Q303	Same as Q301	

FILTER A-4507

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 10,000, GMV, 500 WVDC	CC100-16
C2	Same as C1	
C3	Capacitor, Fixed, Mica, 680 uufd, $\pm 2\%$, 500 WVDC	CM111F681G5S
C4	Capacitor, Fixed, Mica, 430 uufd, $\pm 2\%$, 500 WVDC	CM111F431G5S
C5	Capacitor, Fixed, Mica, 750 uufd, $\pm 2\%$, 500 WVDC	CM111F751G5S
C6	Capacitor, Fixed, Mica, 820 uufd, $\pm 2\%$, 500 WVDC	CM111F821G5S
C7	Capacitor, Fixed, Mica, 910 uufd, $\pm 2\%$, 500 WVDC	CM111F911G5S
C8	Capacitor, Fixed, Mica, 560 uufd, $\pm 1\%$, 500 WVDC	CM111F561F5S
C9	Capacitor, Fixed, Mica, 510 uufd, $\pm 2\%$, 500 WVDC	CM111F511G5S
C10	Capacitor, Fixed, Mica, 1000 uufd, $\pm 1\%$, 500 WVDC	CM111F102F5S
C11	Same as C10	
C12	Capacitor, Fixed, Mica, 200 uufd, $\pm 2\%$, 500 WVDC	CM111F201G5S
C13	Same as C5	
C14	Same as C5	
C15	Same as C1	
C16	Same as C5	
C17	Capacitor, Fixed, Mica, 390 uufd, $\pm 2\%$, 500 WVDC	CM111F391G5S
C18	Capacitor, Fixed, Mica, 1100 uufd, $\pm 1/2\%$, 500 WVDC	CM112F112D5S
C19	Same as C8	
C20	Capacitor, Fixed, Mica, 1300 uufd, $\pm 1\%$, 500 WVDC	CM112F132F5S
C21	Capacitor, Fixed, Mica, 110 uufd, $\pm 5\%$, 500 WVDC	CM111F111J5S
C22	Same as C7	
C23	Same as C1	
C24	Capacitor, Fixed, Mica, 360 uufd, $\pm 2\%$, 500 WVDC	CM111F361G5S

FILTER A-4507

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C25	Capacitor, Fixed, Mica, 330 uufd, $\pm 2\%$, 500 WVDC	CM111F331G5S
C26	Capacitor, Variable, Ceramic, 15-60 uufd, 100 WVDC	CV112-5
C27	Same as C8	
C28	Capacitor, Fixed, Mica, 470 uufd, $\pm 1\%$, 500 WVDC	CM111F471F5S
C29	Same as C26	
C30	Capacitor, Fixed, Mica, 620 uufd, $\pm 1\%$, 500 WVDC	CM111F621F5S
C31	Capacitor, Fixed, Mica, 36 uufd, $\pm 5\%$, 500 WVDC	CM111E360J5S
C32	Same as C26	
C33	Same as C9	
C34	Same as C1	
C35	Capacitor, Fixed, Mica, 220 uufd, $\pm 2\%$, 500 WVDC	CM111F221G5S
C36	Capacitor, Fixed, Mica, 150 uufd, $\pm 1\%$, 500 WVDC	CM111F151F5S
C37	Same as C26	
C38	Same as C25	
C39	Same as C35	
C40	Same as C26	
C41	Same as C17	
C42	Capacitor, Fixed, Mica, 24 uufd, $\pm 5\%$, 500 WVDC	CM111C240J5S
C43	Capacitor, Variable, Ceramic, 9-35 uufd, 100 WVDC	CV112-2
C44	Capacitor, Fixed, Mica, 330 uufd, $\pm 2\%$, 500 WVDC	CM111F301G5S
C45	Same as C1	
C46	Capacitor, Fixed, Mica, 130 uufd, $\pm 2\%$, 500 WVDC	CM111F131G5S
C47	Capacitor, Fixed, Mica, 560 uufd, $\pm 5\%$, 500 WVDC	CM111E560J5S
C48	Same as C26	

FILTER A-4507

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C49	Same as C35	
C50	Capacitor, Fixed, Mica, 100 uufd, ±1%, 500 WVDC	CM111F101F5S
C51	Same as C26	
C52	Capacitor, Fixed, Mica, 240 uufd, ±2%, 500 WVDC	CM111F241G5S
C53	Capacitor, Fixed, Mica	CM111C050K5S
C54	Same as C43	
C55	Capacitor, Fixed, Mica, 180 uufd, ±2%, 500 WVDC	CM111F181G5S
C56	Same as C1	
C57	Same as C46	
C58	Same as C55	
C59	Capacitor, Fixed, Mica 120 uufd, ±2%, 500 WVDC	CM111F121G5S
C60	Capacitor, Variable, Ceramic, 2-8 uufd, 200 WVDC	CV112-4
C61	Same as C26	
K1	Relay, Armature	RL143-4
K2	Same as K1	
K3	Same as K1	
K4	Same as K1	
K5	Same as K1	
K6	Same as K1	
L1	Coil, R.F., Fixed, 2.69 uh, ±4%,	CL412-2
L2	Coil, R.F., Fixed, 2.49 uh, ±4%,	CL412-3
L3	Coil, R.F., Fixed, 3.80 uh, ±4%,	CL412-1
L4	Coil, R.F., Fixed, 1.78 uh, ±4%,	CL412-5
L5	Coil, R.F., Fixed, 1.6° uh, ±4%,	CL412-6
L6	Coil, R.F., Fixed, 2.41 uh, ±4%,	CL412-4

FILTER A-4507

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L7	Coil, R.F., Fixed, .85 uh, $\pm 4\%$,	CL412-8
L8	Coil, R.F., Fixed, .76 uh, $\pm 4\%$,	CL412-10
L9	Coil, R.F., Fixed, 1.32 uh, $\pm 4\%$	CL412-7
L10	Coil, R.F., Fixed, .52 uh, $\pm 4\%$,	CL412-11
L11	Coil, R.F., Fixed, .47 uh, $\pm 4\%$,	CL412-13
L12	Coil, R.F., Fixed, .78 uh, $\pm 4\%$,	CL412-9
L13	Coil, R.F., Fixed, .34 uh, $\pm 4\%$,	CL412-14
L14	Coil, R.F., Fixed, .31 uh, $\pm 4\%$,	CL412-15
L15	Coil, R.F., Fixed, .48 uh, $\pm 4\%$,	CL412-12
L16	Coil, R.F., Fixed, 120 uh, $\pm 10\%$,	CL275-121
L17	Same as L16	
L18	Same as L16	
L19	Same as L16	
L20	Same as L16	
L21	Same as L16	
L22	Same as L16	
L23	Coil, R.F., Fixed, .21 uh, $\pm 4\%$	CL412-16
L24	Coil, R.F., Fixed, .19 uh, $\pm 4\%$	CL412-17

PC BD A POWER SUPPLY A-4512

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Electrolytic, 200 mfd, 50 WVDC	CE105-200-50
C2	Same as C1	
C3	Capacitor, Fixed, Electrolytic, 150 mfd, 75 WVDC	CE105-150-75
C4	Same as C3	
CR1	Rectifier, Semiconductor, Device	DD130-200-40

PC BD B POWER SUPPLY A-4513

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed Electrolytic, 25 mfd, +50-15%, 50 WVDC	CE107-6
C2	Same as C1	
C3	Same as C1	
C4	Same as C1	
C5	Same as C1	
CR1	Semiconductor, Device Diode	1N100
CR2	Same as CR1	
CR3	Semiconductor, Device, Diode	1N4619
CR4	Semiconductor, Device, Diode	1N753A
CR5	Same as CR3	
CR6	Semiconductor, Device, Diode	1N972B
CR7	Same as CR4	
Q1	Transistor	2N1481
Q2	Same as Q1	
Q3	Same as Q1	
Q4	Transistor	2N3638
Q5	Same as Q1	
Q6	Same as Q4	
Q7	Same as Q1	
R1	Resistor, Fixed, Composition, 470 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF471J
R2	Resistor, Fixed, Composition, 1000 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF102J
R3	Resistor, Variable, Composition, 1000 ohms, $\pm 30\%$, $\frac{1}{2}$ watt	RV124-1-102
R4	Same as R2	

PC BD B POWER SUPPLY A-4513

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R6	Resistor, Fixed, Composition, 10000 ohms, ±5%, ¼watt	RC07GF103J
R7	Same as R2	
R8	Same as R3	
R9	Resistor, Fixed, Composition, 4700 ohms, ±5%, ¼watt	RC07GF472J
R10	Resistor, Fixed, Composition, 1500 ohms, ±5%, ¼watt	RC07GF152J
R11	Resistor, Fixed, Wirewound, 10 ohms, ±2%, 5 watt	RR114-10W2
R12	Same as R3	
R13	Resistor, Fixed, Composition, 6800 ohms, ±5%, ¼watt	RC07GF682J
R14	Same as R2	
R15	Same as R11	
R16	Resistor, Fixed, Composition, 4700 ohms, ±5%, ¼watt	RC07GF472J
R17	Resistor, Fixed, Composition, 150 ohms, ±5%, ¼watt	RC07GF151J
R18	Resistor, Variable, Composition	RV124-1-103
R19	Same as R17	

POWER SUPPLY

AP - 142

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C304	CAPACITOR, FIXED, METALLIZED: 0.47 uf, 50 WVDC	CN114R47-5J
C305	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 0.1 uf, +80% -20%, 300 WVDC.	CC100-37
C306		
thru		
C307	Same as C305.	
J301	CONNECTOR, RECEPTACLE, MALE	JJ242-5P
J302	CONNECTOR, RECEPTACLE, RF	JJ211
J303	CONNECTOR, RECEPTACLE, FEMALE	JJ319-6DPE
and		
J304	Same as J303.	
J306	CONNECTOR, RECEPTACLE, FEMALE	JJ242-5S
L301	COIL, RF, FIXED; 120 uh	CL275-121
P301	CONNECTOR, PLUG, FEMALE	PL225-8S
R301	RESISTOR, FIXED, COMPOSITION; 470 ohms, $\pm 5\%$, $\frac{1}{4}$ watt	RC07GF470J
T301	TRANSFORMER, STEPDOWN	TF0352
XZ301	SOCKET, ELECTRON TUBE	TS100-3
Z303	PC BOARD "B"	A4513
Z304	PC BOARD "A"	A4512

FILTER, SWITCHABLE

A4751

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2601	CAPACITOR, FIXED, MICA DIELECTRIC; 160 pf, 300 WVDC	CM111F161J3S
C2602	CAPACITOR, FIXED, MICA DIELECTRIC; 100 pf, 300 WVDC	CM111F101J3S
C2603	CAPACITOR, FIXED, MICA DIELECTRIC; 130 pf, 300 WVDC	CM111F131J3S
C2604	CAPACITOR, FIXED, MICA DIELECTRIC; 620 pf, 300 WVDC	CM111F621J3S
C2605	CAPACITOR, FIXED, MICA DIELECTRIC; 360 pf, 300 WVDC	CM111F361J3S
K2601	RELAY, DPDT	RL143-4
L2601 thru	COIL, RF, FIXED; 0.39 uh	CL275-OR39
L2603	Same as L2601.	

BRACKET ASSEMBLY, SWITCH

BMA - 259

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C150	CAPACITOR, FIXED, CERAMIC; .001 uf GMV, 500 WVDC	CC100-29
C178 thru	Same as C150.	
C181	Same as C150.	
R106	RESISTOR, VARIABLE, COMPOSITION; 10,000 ohms, $\frac{1}{2}$ watt.	RV106UX8B103A
S102 thru	SWITCH, ROTARY	SW443
S104	Same as S102	
S105	SWITCH, ROTARY	SW441
S106	SWITCH, ROTARY	SW440
S107	SWITCH, ROTARY	SW442
S108	SWITCH, ROTARY	SW

AX-676

CHASSIS, ASSEMBLY MAIN

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J101	Connector, Receptacle, Female	JJ319A15DFE
J102	Same as J101	
J103	Same as J101	
J104	Same as J101	
J105	Same as J101	
J106	Same as J101	
J107	Same as J101	
J108	Same as J101	
J109	Same as J101	
J110	Same as J101	
J111	Same as J101	
J112	Same as J101	
J113	Same as J101	
J114	Same as J101	
J115	Same as J101	

CHASSIS COMPONENTS

BMA 256

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C104	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01uf GMV, 500 WVDC.	CC100-16
C105	Same as C104.	
C110	Same as C104.	
C112	Same as C104.	
C115	Same as C104.	
C118	Same as C104.	
C119	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.1uf, +80%-20%, 100 WVDC.	CC100-28
C120	Same as C104.	
C121	Same as C119.	
C124	Same as C104.	
C127	Same as C104.	
C128	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100 uuf \pm 10%, 500 WVDC	CC100-30
C129	Same as C119.	
thru		
C131	Same as C119.	
C132	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .02 uf +80%-20%, 25 WVDC.	CC100-33
C133	Same as C104	
C134	CAPACITOR, FIXED, METALLIZED: 1uf \pm 10%, 50 WVDC	CN114-1R0-5J
C135	Same as C119.	
C137	CAPACITOR, FIXED, CERAMIC DIELECTRIC; 2X .01 uf GMV, 1000 WVDC.	CC100-23
C139	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .001 uf GMV, 500 WVDC	CC100-29
C140	Same as C139	

CHASSIS COMPONENTS

BMA-256

(cont.)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C141	Same as C104.	
C142	Same as C137.	
and		
C143	Same as C137.	
C144	Same as C104.	
C146	Same as C139	
and		
C147	Same as C139	
C154	Same as C104.	
C182	Same as C139	
C183	Same as C119.	
C184	Same as C104.	
C185	Same as C119.	
CR101	SEMICONDUCTOR DEVICE, DIODE.	1N39A
DS101	LAMP, INCANDESCENT: 28v., 40 ma.	BI110-7
and		
DS102	Same as DS101.	
F101	FUSE, CARTRIDGE: 1.0 amp.	FU102-1.00
and		
F102	Same as F101.	
FL101	FILTER, BANDPASS	FX287
J116	CONNECTOR, RECEPTACLE, MALE	MS3102A16S5P
J119	CONNECTOR, RECEPTACLE, MALE	MS3102A16S1S

CHASSIS COMPONENTS
BMA-256
(cont.)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J120	CONNECTOR, RECEPTACLE, RF: BNC type.	UG625/U
thru		
J126	SAME AS J120.	
K101	RELAY, 4PDT; 24 VDC.	RL156-8
L104	COIL, RF, FIXED, 120 uh.	CL275-121
L105	Same as L104.	
L106	Same as L104.	
L110	Same as L104.	
L112	Same as L104.	
L115	Same as L104.	
L118	Same as L104.'	
L119	Same as L104.	
thru		
L122	Same as L104.	
L125	Same as L104.	
L126	Same as L104.	
L128	Same as L104.	
L129	COIL, RF, FIXED: 8.2 uh.	CL275-8R2
M101	METER: 0-50 ua, 1800 ohms.	MR 191-12
R103	RESISTOR, VARIABLE, COMPOSITION: 100 ohms, 5 watts.	RV4NAYSD101A
R107	RESISTOR, VARIABLE, COMPOSITION: 10.000 ohms \pm 20%; 1/2 watt.	RV106UX8B103A
R127	RESISTOR, FIXED, COMPOSITION: 2200 ohms \pm 5%, 1/2 watt	RC20GF222J
R128	RESISTOR, FIXED, COMPOSITION: 2200 ohms \pm 5%, 1/2 watt.	RC20GF102J
R131	RESISTOR, FIXED, COMPOSITION; 68 ohms \pm 5%, 1/4 watt.	RC07GF680J

CHASSIS COMPONENTS

BMA-256

(cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R137	RESISTOR, FIXED, COMPOSITION: 82 ohms $\pm 5\%$, 1/4 watt.	RC07GF820J
R194	RESISTOR, FIXED, COMPOSITION: 39 ohms $\pm 5\%$, 1/4 watt.	RC07GF390J
and		
R195	Same as R194.	
R196	RESISTOR, FIXED, COMPOSITION: 12 Ohms $\pm 5\%$, 1/4 watt.	RC07GF120J
R197	RESISTOR, FIXED, COMPOSITION: 560,000 ohms $\pm 1/4$ watt.	RC07GF564J
S108	SWITCH, TOGGLE, SPDT.	ST103-11-62
S112	SWITCH, TOGGLE, DPDT.	ST22N
XDS101	LIGHT, INDICATOR: RED	TS153-1
XDS102	LIGHT, INDICATOR; RED	TS153-5
XF101	FUSEHOLDER	FH104-3
and		
XF102	Same as XF101.	
XK101	SOCKET, RELAY	TS171-3

SECTION 7

DIAGRAMS

7-1. INTRODUCTION

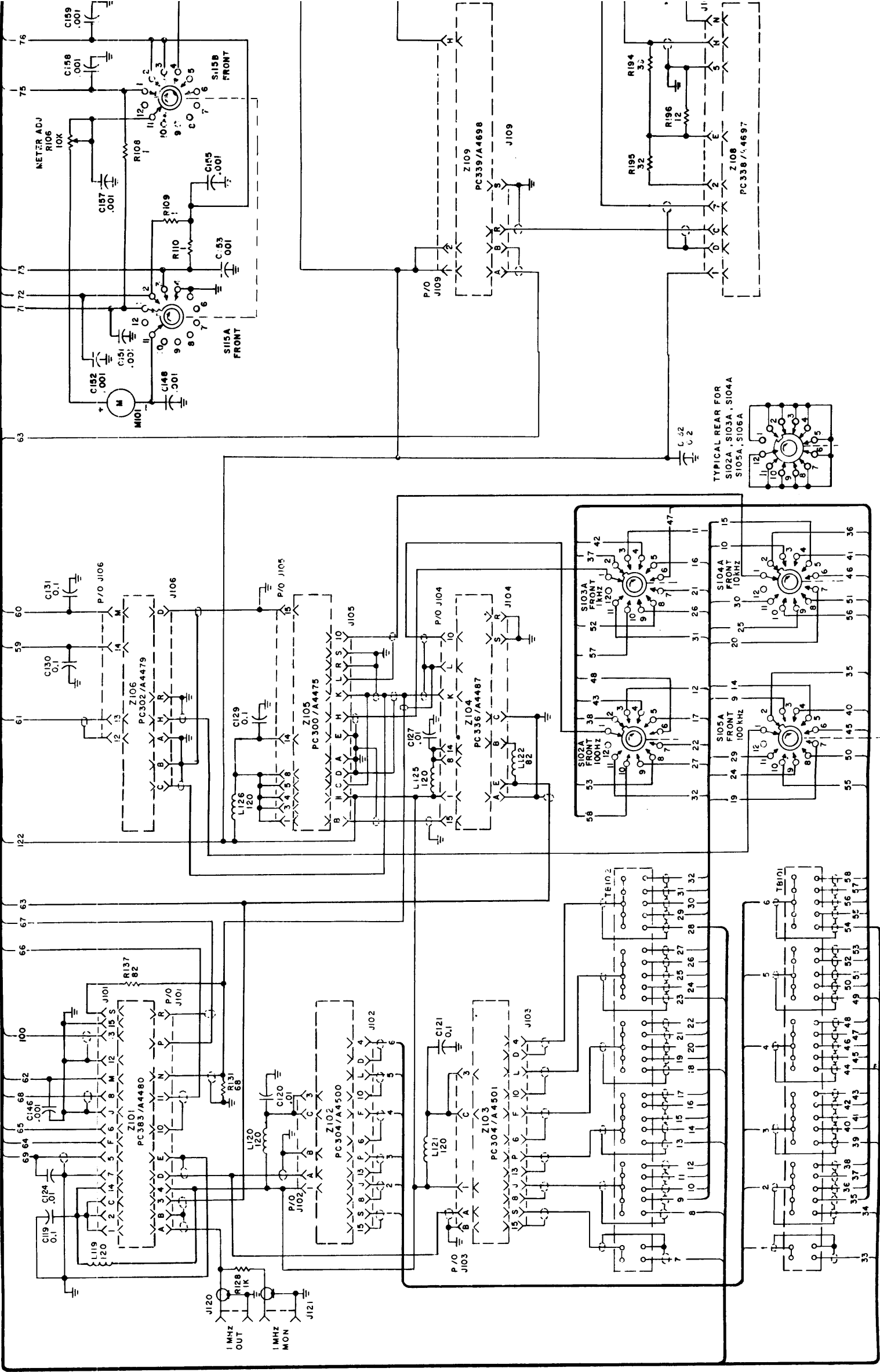
This section contains wiring and schematic diagrams for the CHG()-4. Table 7-1 lists the figure numbers contained herein and the corresponding TMC drawing numbers.

TABLE 7-1. LIST OF DIAGRAMS

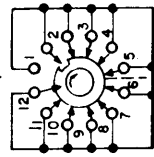
Figure No.	Title	TMC Drawing No.
7-1	CHG()-4, Interconnection Diagram	CK1454O
7-2	Spectrum Generator Z101, Schematic/ Parts Location Diagram	CK1396C
7-3	Comb Filter Z102, Schematic/Parts Location Diagram	CK1313B
7-4	Comb Filter Z103, Schematic/Parts Location Diagram	CK1314A
7-5	Mixer-Divider Z104, Schematic/Parts Location Diagram	CK1318C
7-6	Dual Mixer-Divider Z105, Schematic/Parts Location Diagram	CK1393C
7-7	Final Mixer Z106, Schematic/Parts Location Diagram	CK1319C
7-8	Step Generator Z110, Schematic/Parts Location Diagram	CK1322D
7-9	Step Generator Z111, Schematic/Parts Location Diagram	CK1323C
7-10	Step Generator Z113, Schematic/Parts Location Diagram	CK1325D
7-11	1.25 MHz Generator Z109, Schematic/ Parts Location Diagram	CK1456C
7-12	3 MHz Balanced Mixer Z108, Schematic/ Parts Location Diagram	CK1455C
7-13	Translator Z112, Schematic/Parts Location Diagram	CK1324F
7-14	RF Output Z115, Schematic/Parts Location Diagram	CK1327F
7-15	RF Output Filter Z114, Schematic/Parts Location Diagram	CK1326A
7-16	Power Supply Wiring Diagram	CK1453A
7-17	Rectifier-Filter Z304, Schematic/Parts Location Diagram	CK1328O
7-18	Regulator Z303, Schematic/Parts Loca- tion Diagram	CK1291O

02 03
01 RF

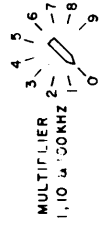
METER (S115)



TYPICAL REAR FOR
S102A, S103A, S104A
S105A, S106A



MULTIPLIER
100 HZ

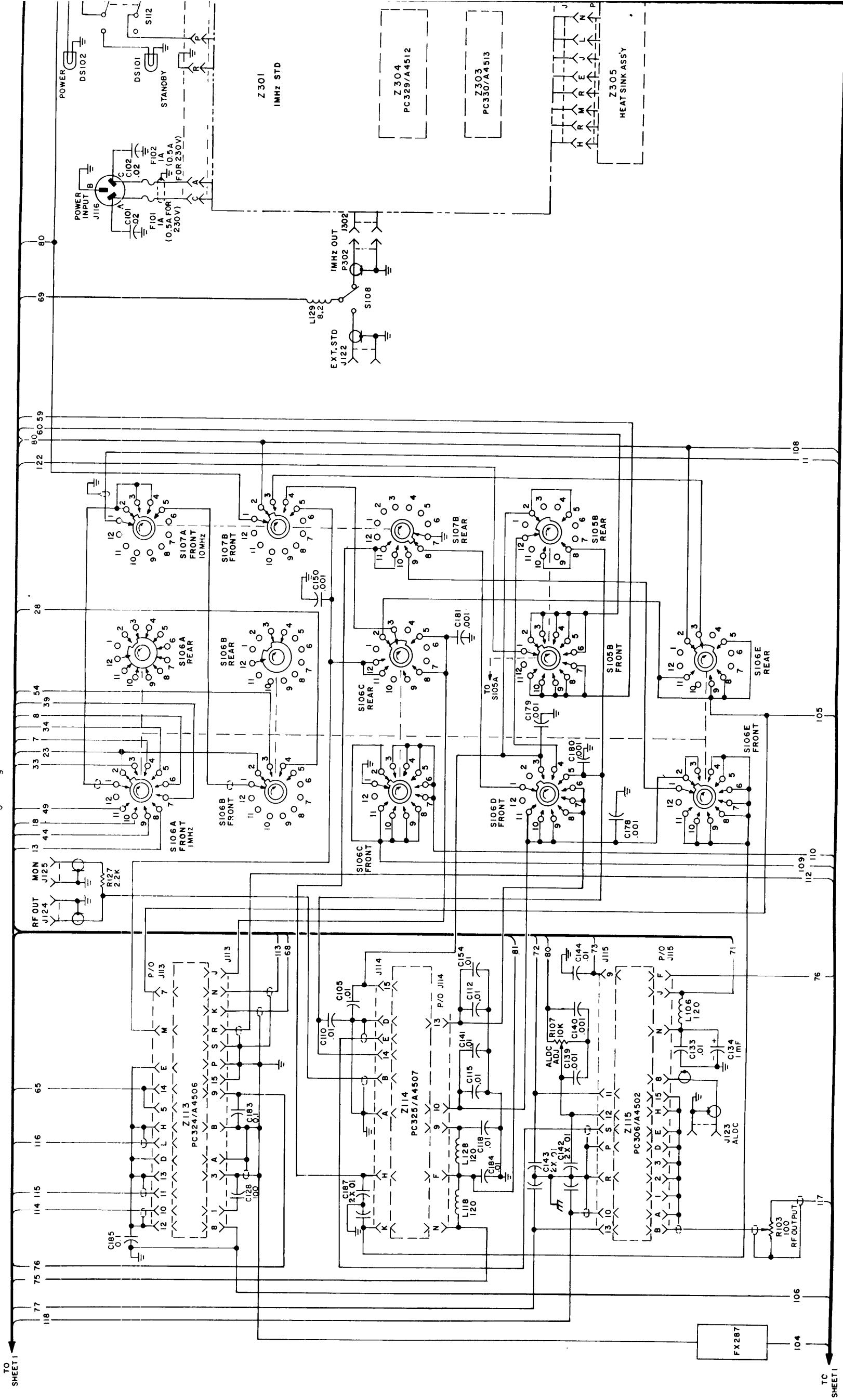


MULTIPLIER
1.10 x 10^4 HZ



TYPICAL FOR
S102A, S103A, S104A
S105A, S106A

MULTIPLIER
1 & 10MHZ
TYPICAL FOR
S106 & S107



TO SHEET 1

TC SHEET 1

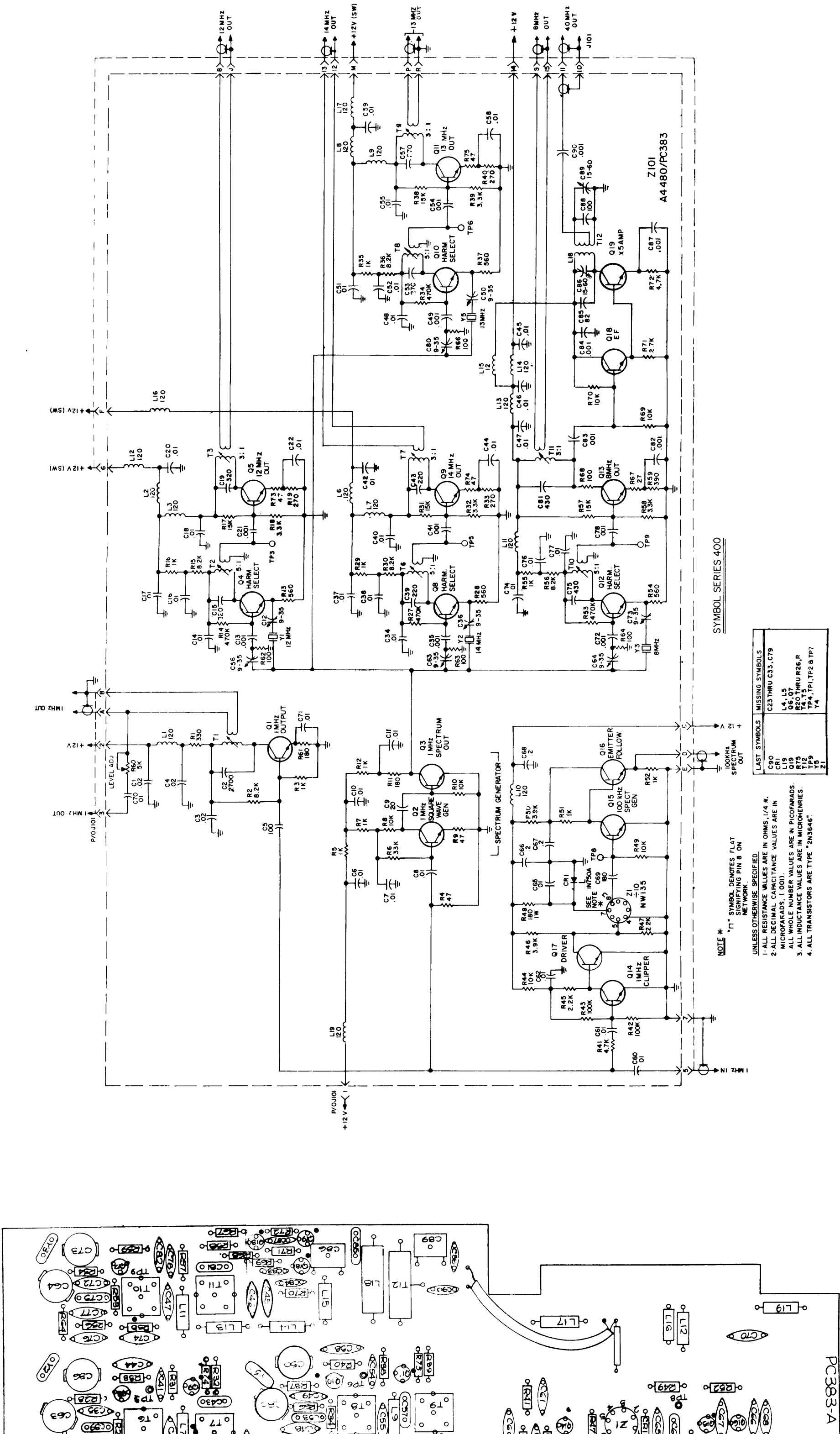


Figure 7-2. Spectrum Generator Z101, Schematic/Parts Location Diagram

006692046

7-7/7-8

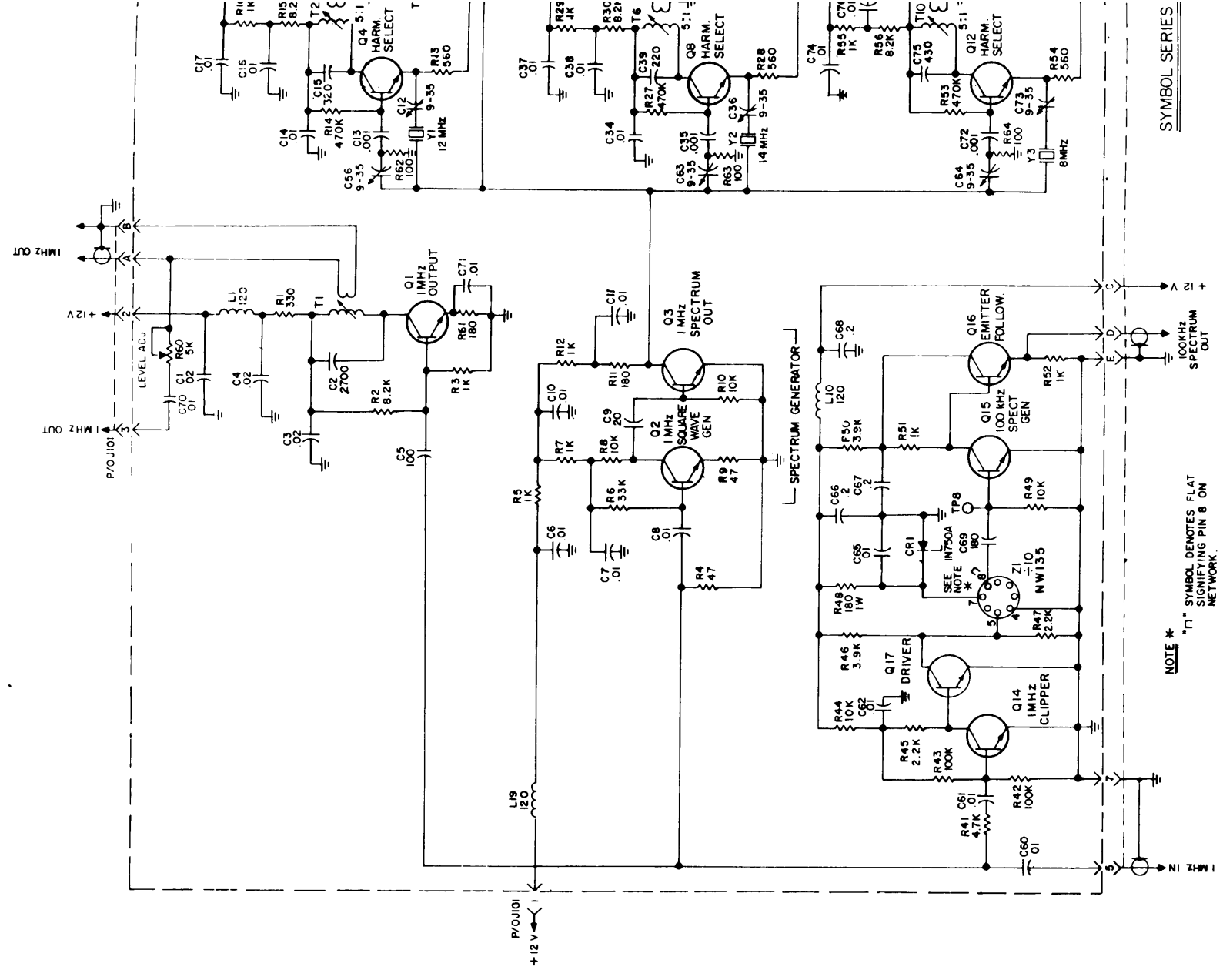
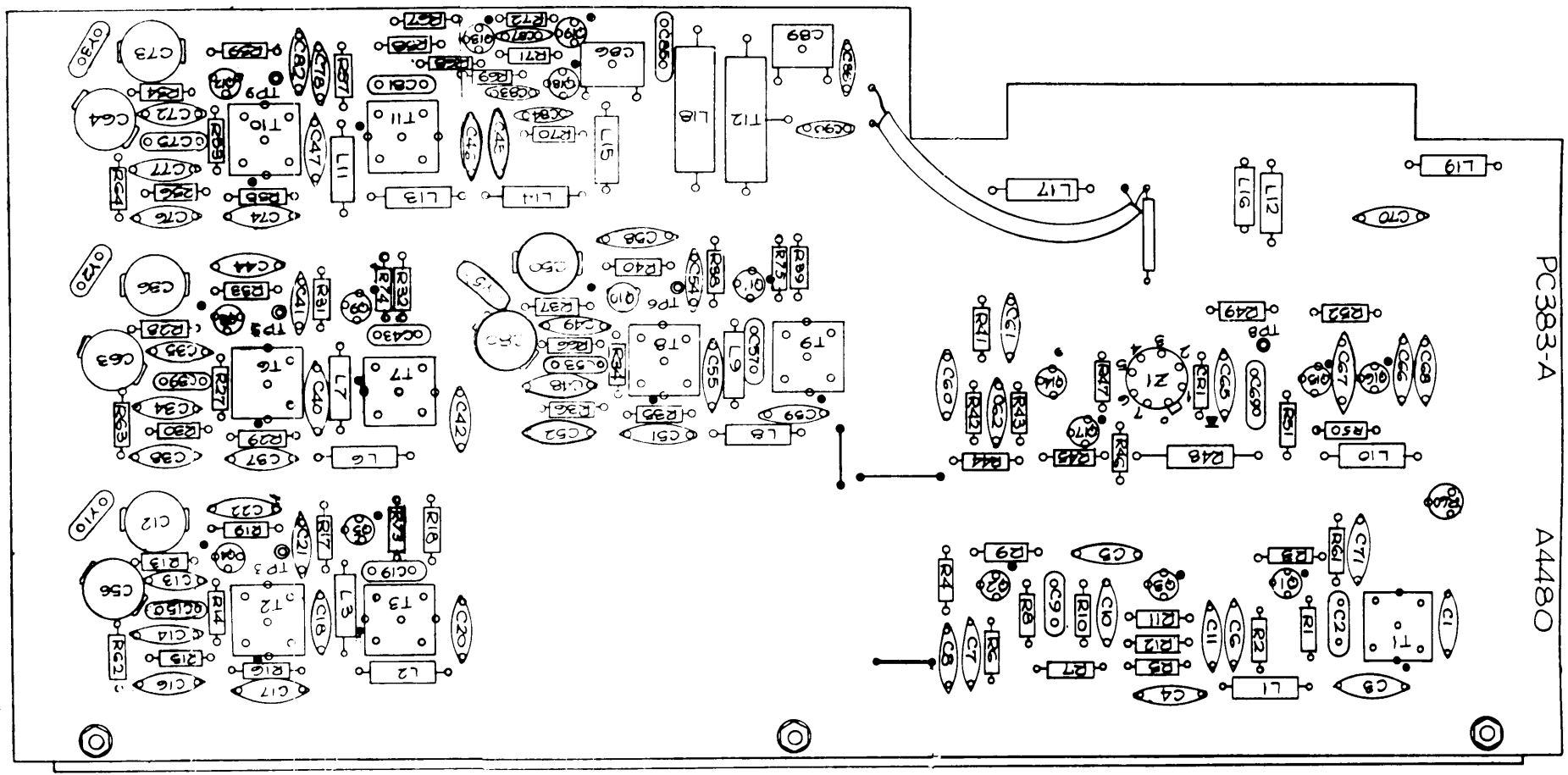
SYMBOL SERIES 400

NOTE * "1" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK.

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 "
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001)
- 3- ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
- 4- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 5- ALL TRANSISTORS ARE TYPE "2N3646"

LAST SYMBOLS	MISSING SYMBOLS
C90	C23 THRU C33, C79
C91	L4, L5
Q19	Q6, Q7
R75	R20 THRU R26, R
T12	T4, T5
TP9	TP4, TP1, TP2 & TP7
Z1	Y4

PC383-A



NOTE *

* "L" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK

- UNLESS OTHERWISE SPECIFIED
- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
 - 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (001).
 - 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
 - 4- ALL TRANSISTORS ARE TYPE *2N3646*

LAST SYMBOLS	MISSING SYMBOLS
C90	C23 THRU C33, C79
C91	L4, L5
L19	Q6, Q7
Q19	R20 THRU R26, R
R75	T1, T2
TP5	TP4, TP1, TP2 & TP7
Y5	Y4
Z1	

SYMBOL SERIES

SYMBOL SERIES 500

UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001)
- ALL WHOLE NUMBER VALUES ARE IN PICO FARADS, (.18000).
- 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4- ALL TRANSISTORS ARE TYPE "2N3646".

LAST SYMBOL	MISSING SYMBOL
C72	
L12	
Q12	
R48	
T12	
TP12	
Y6	

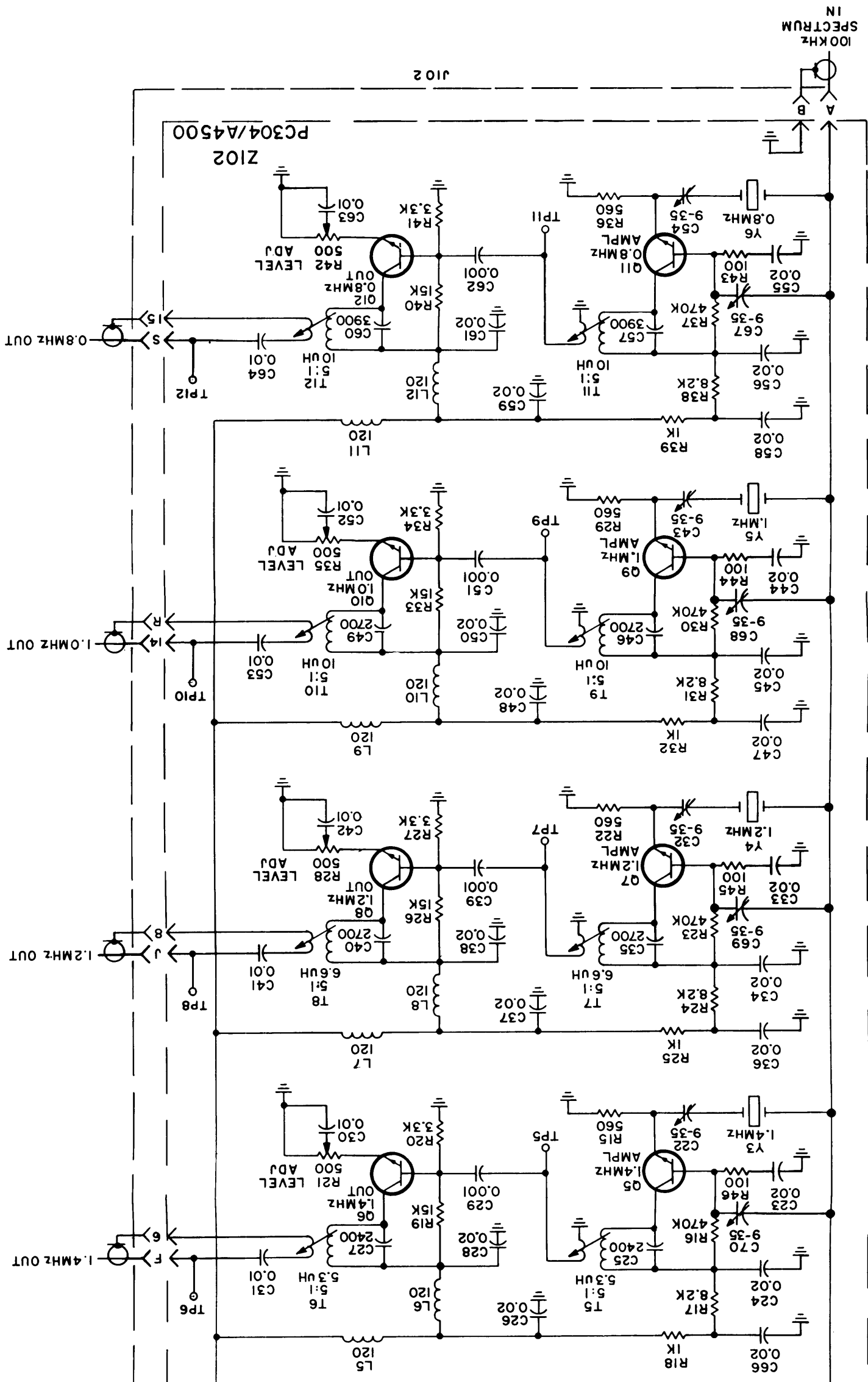
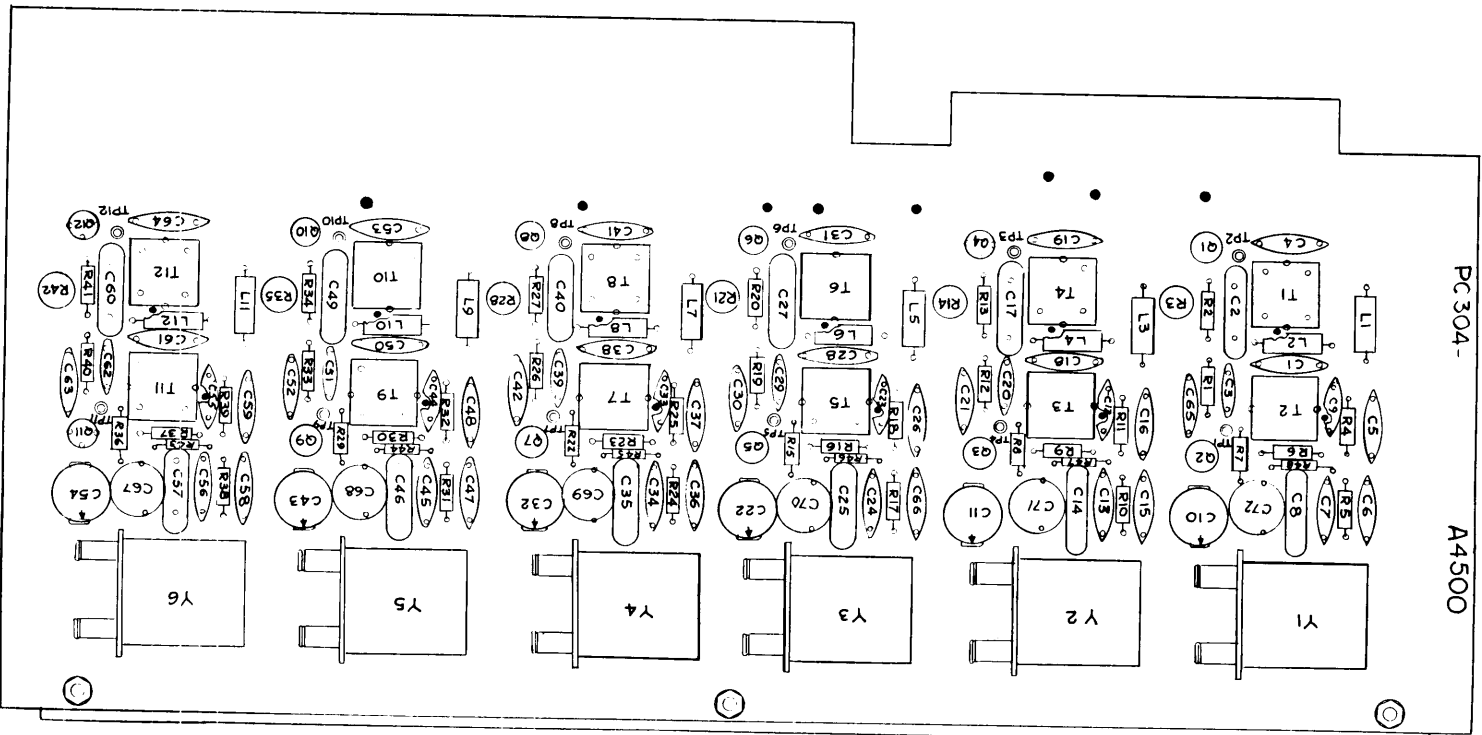
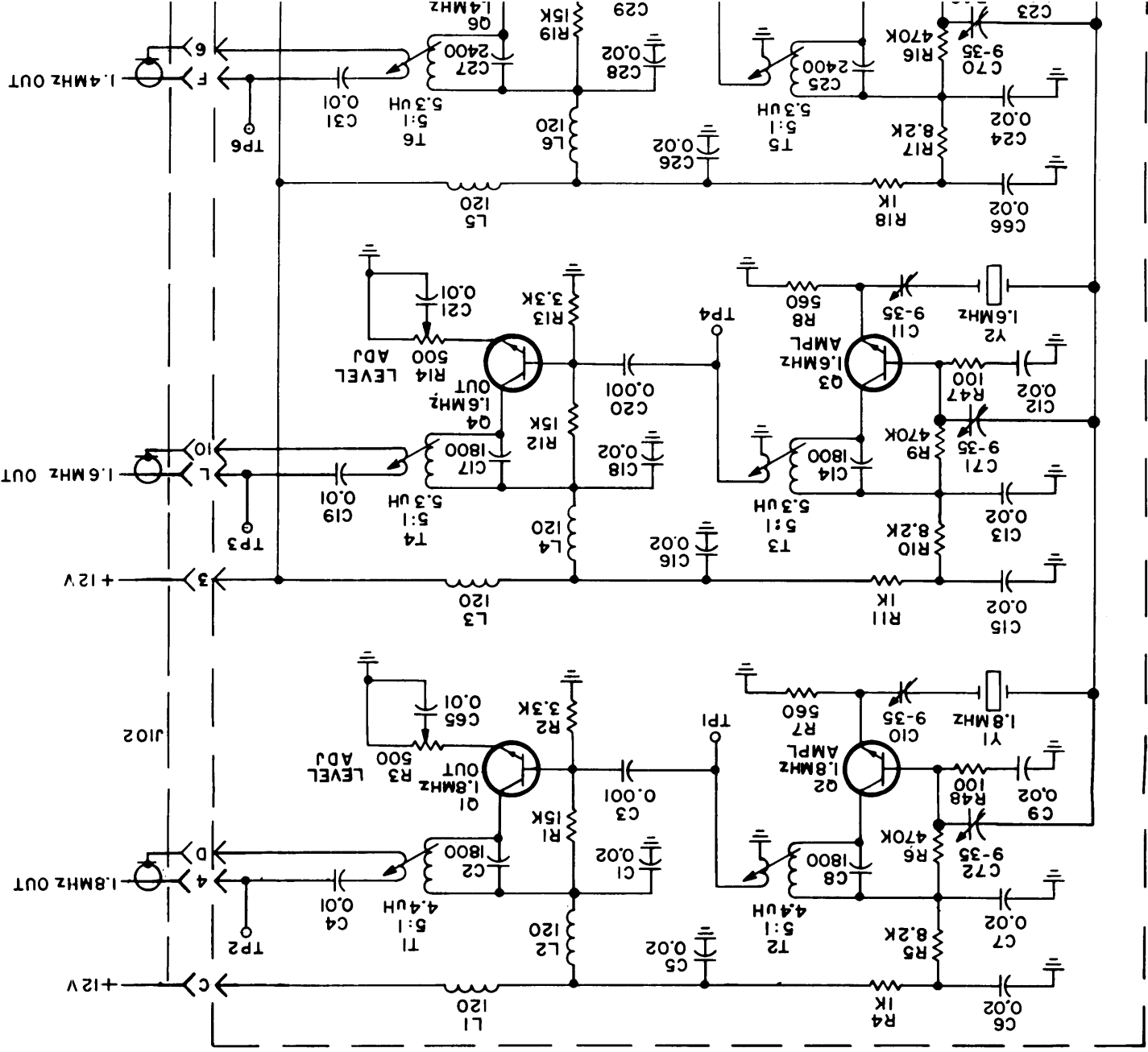


Figure 7-3. Comb Filter Z102, Schematic/Parts Location Diagram

006692046



SYMBOL SERIES 600

UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS (.001).
- ALL WHOLE NUMBER VALUES ARE IN PICOFARADS (.1600).
- 3- ALL TRANSISTORS ARE TYPE "2N3646".
- 4- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

LAST SYMBOL	MISSING SYMBOL
C72	
L12	
Q12	
R48	
T12	
TP12	
Y6	

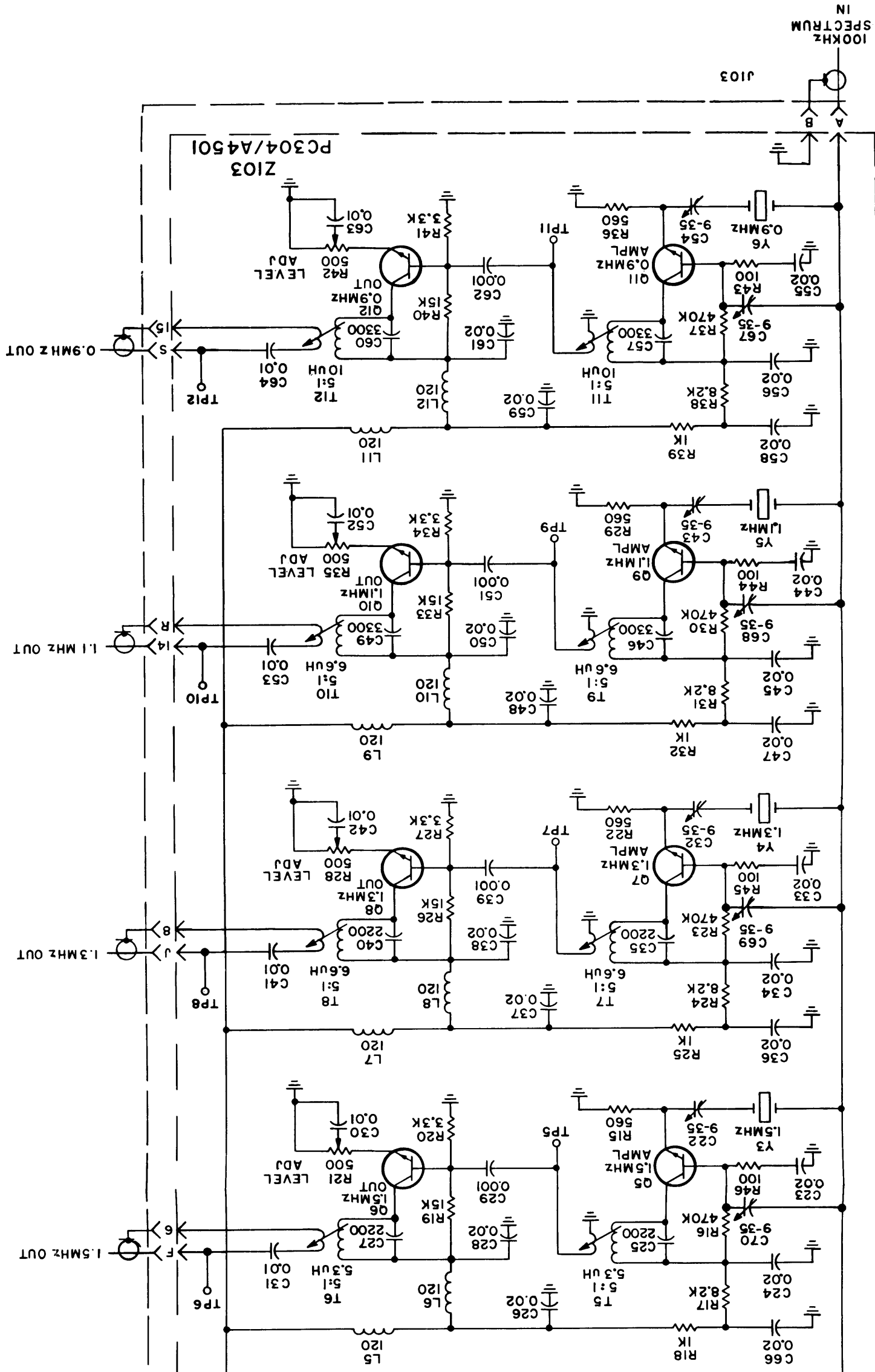
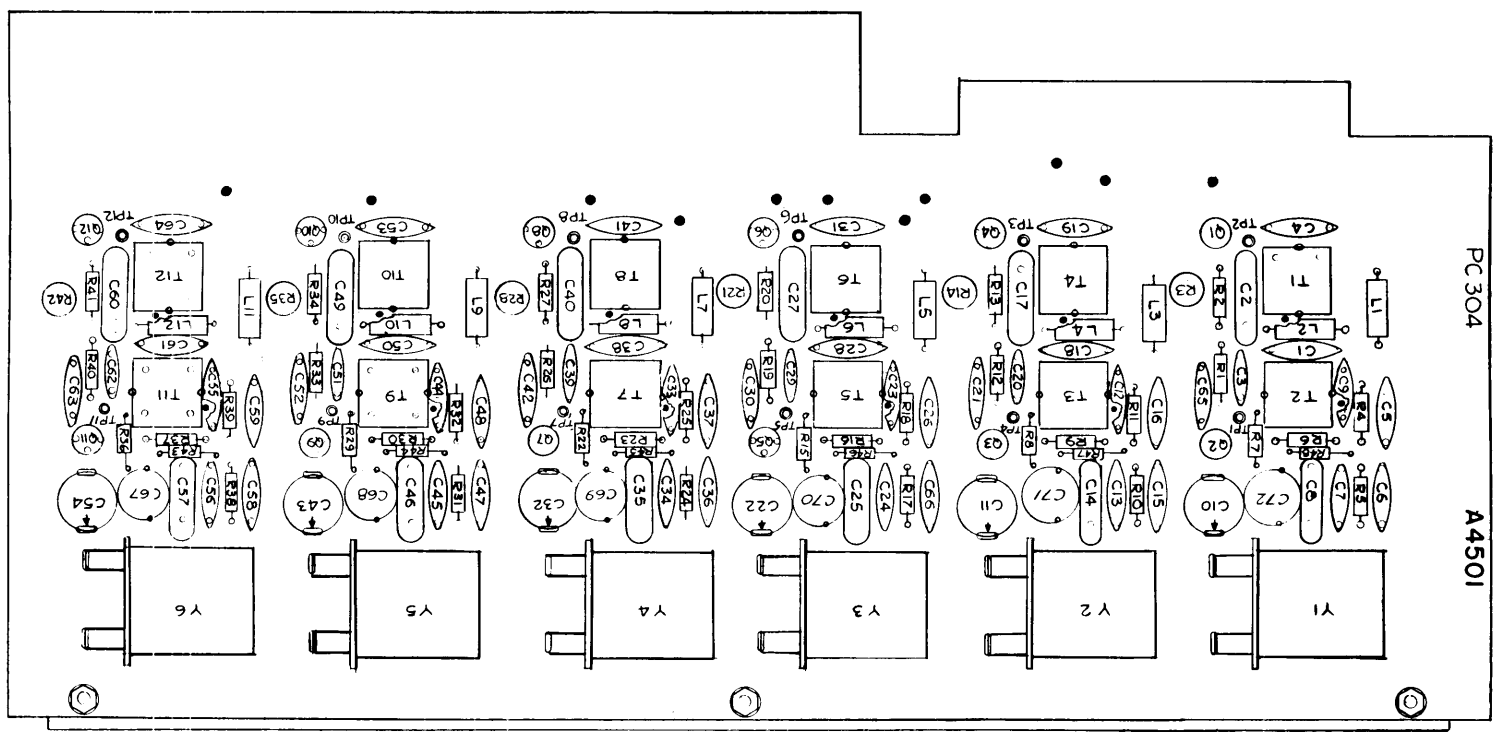
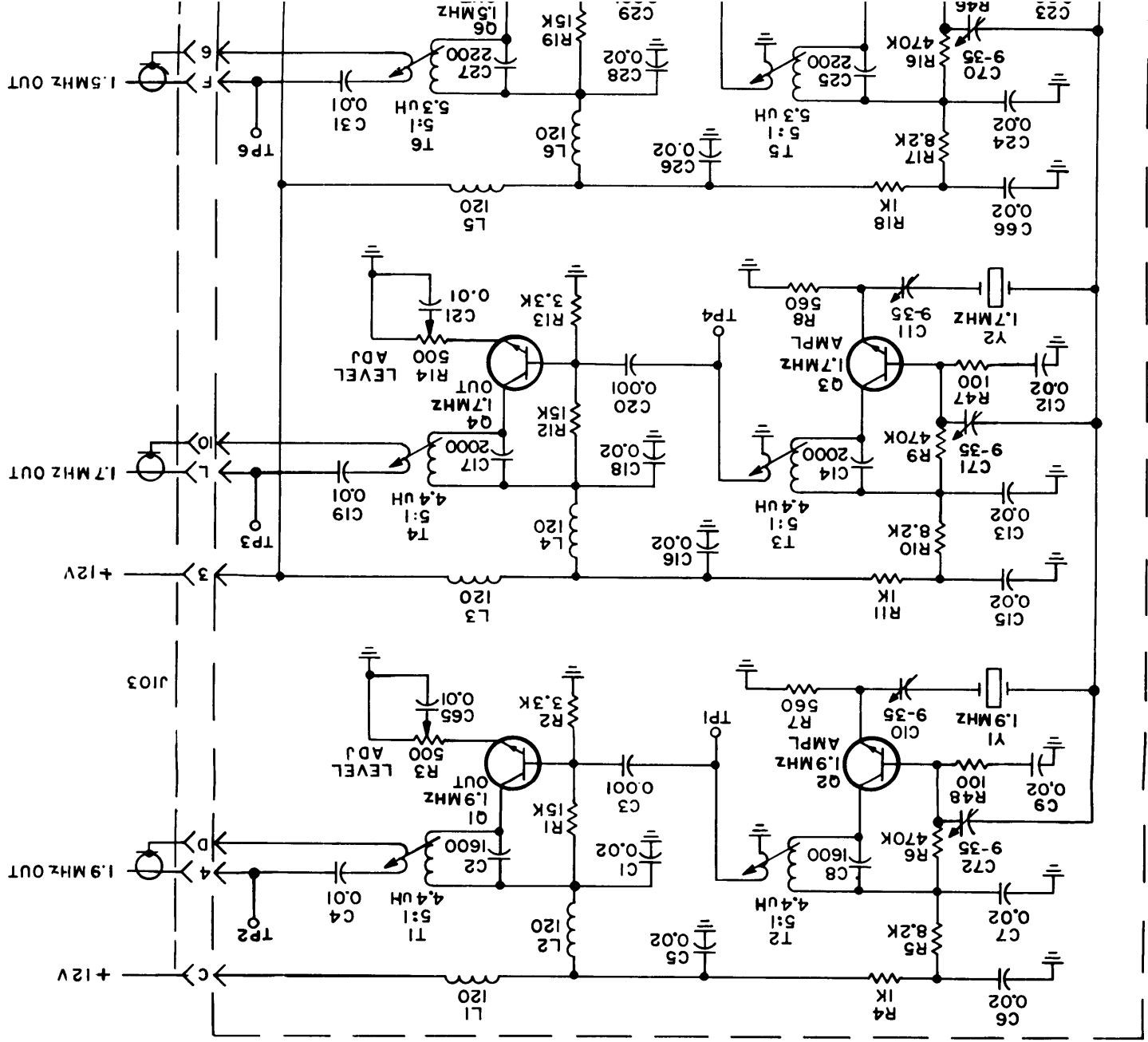
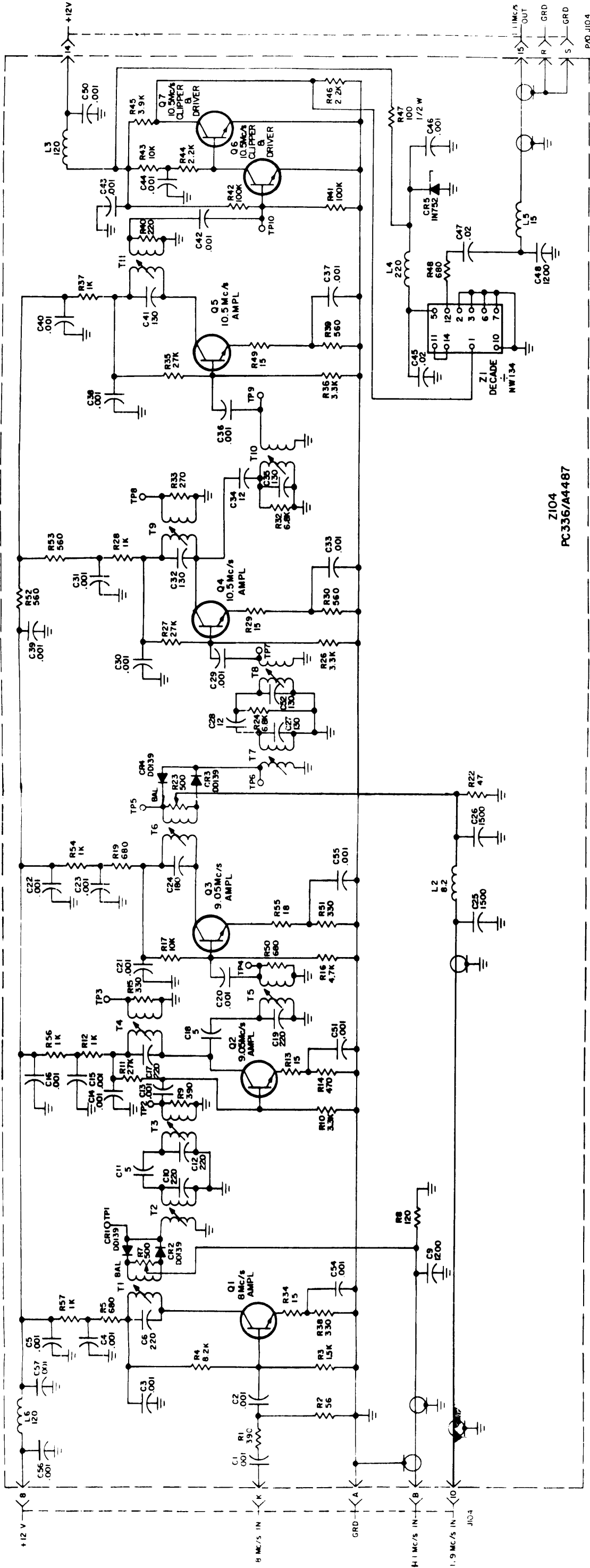
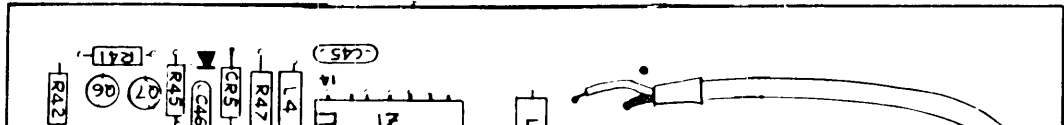


Figure 7-4. Comb Filter Z103, Schematic/Parts Location Diagram

006692046





2039-37

UNLESS OTHERWISE SPECIFIED

- 1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2-ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS (.0001).
- 3-ALL WHOLE NUMBER VALUES ARE IN PICOFARADS (.130).
- 4-ALL TRANSISTORS ARE TYPE 2N3646*

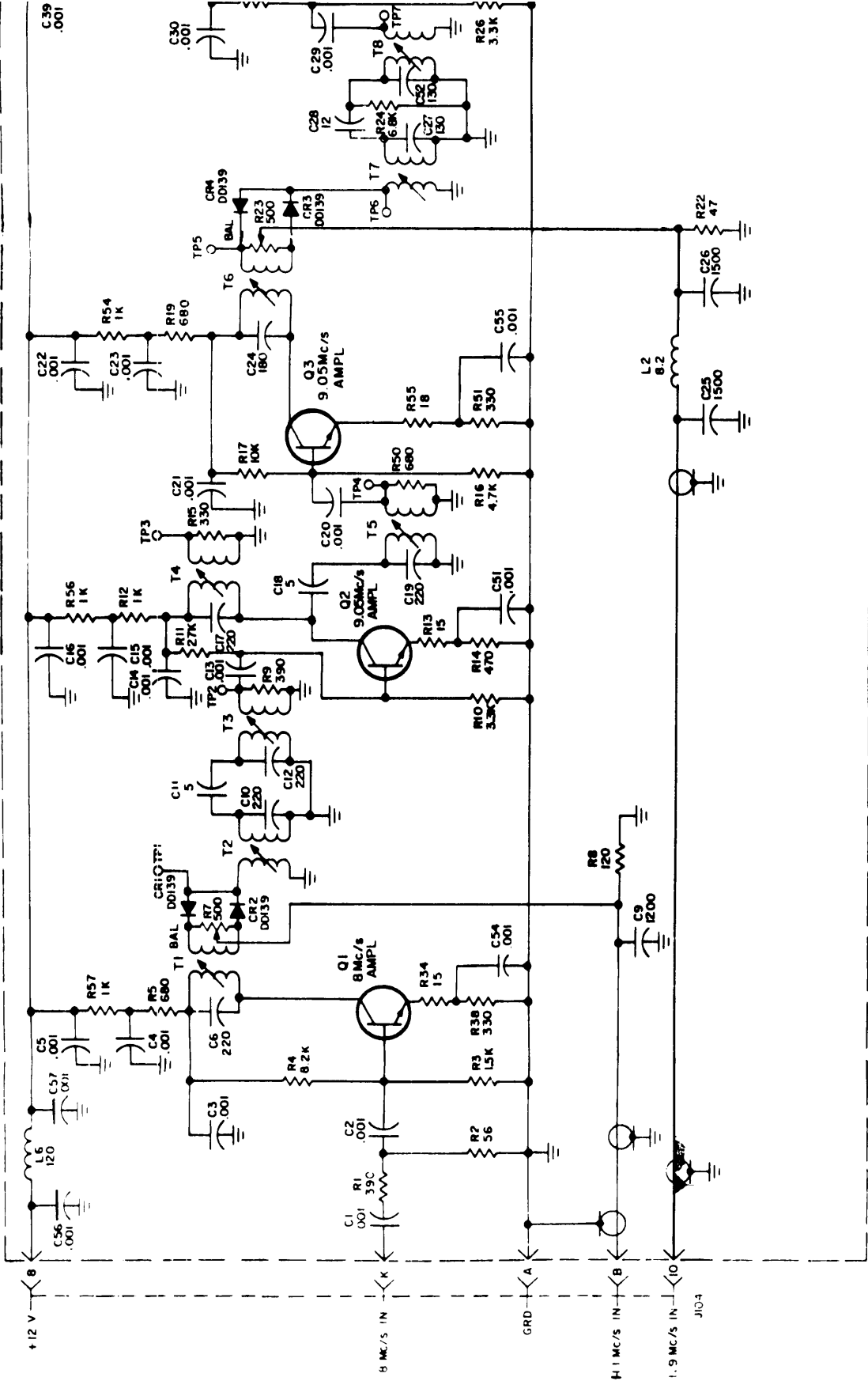
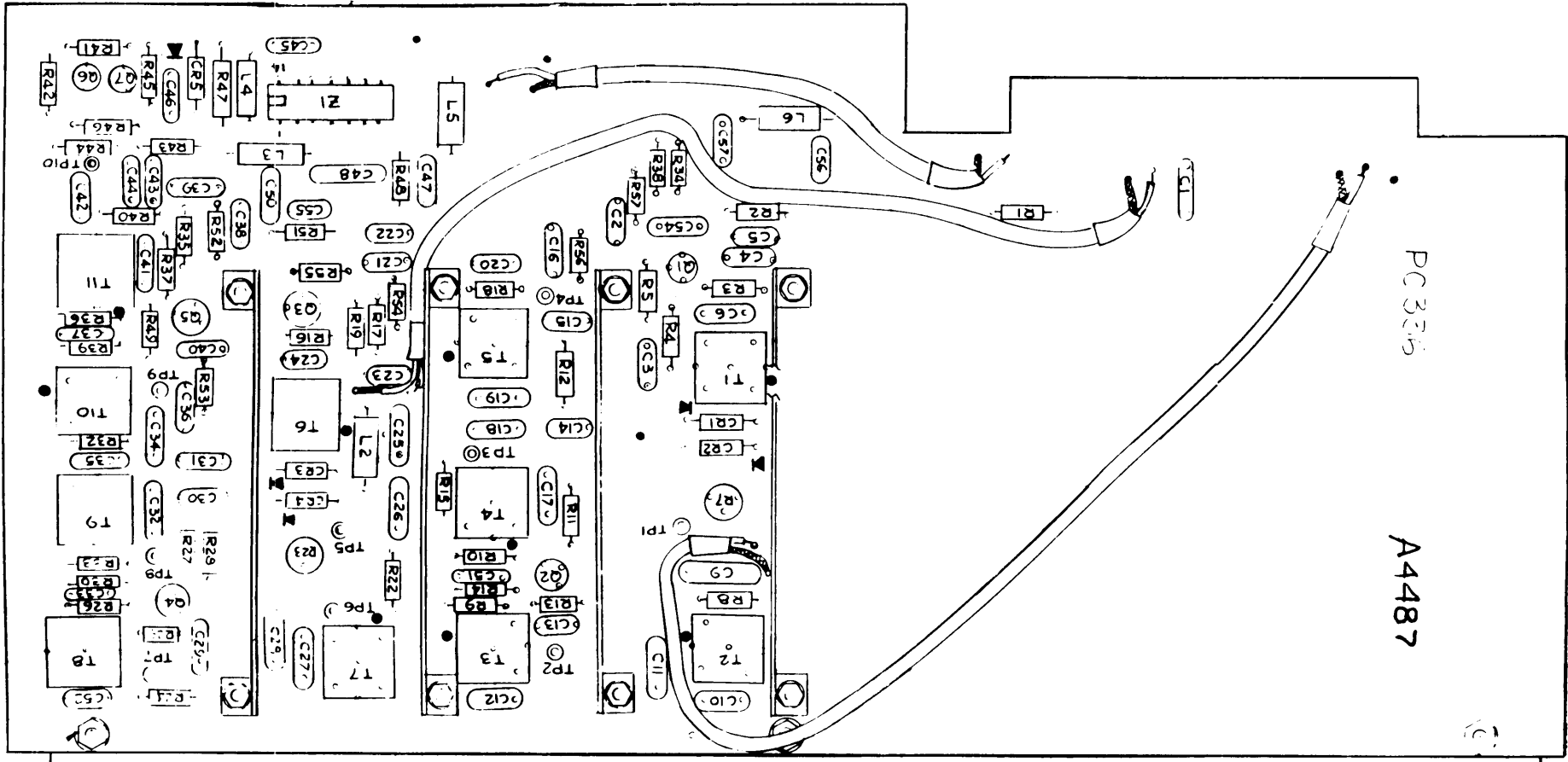
SYMBOL SERIES 700

LAST SYMBOLS	MISSING SYMBOLS
C38	C33, C49, C38, C7, C8
C35	
L6	L1
Q7	Q18, R20, R6
R57	R21, R25, R31
T11	
TP10	
Z1	

Figure 7-5. Mixer-Divider Z104, Schematic/Parts Location Diagram

006692046

7-13/7-14



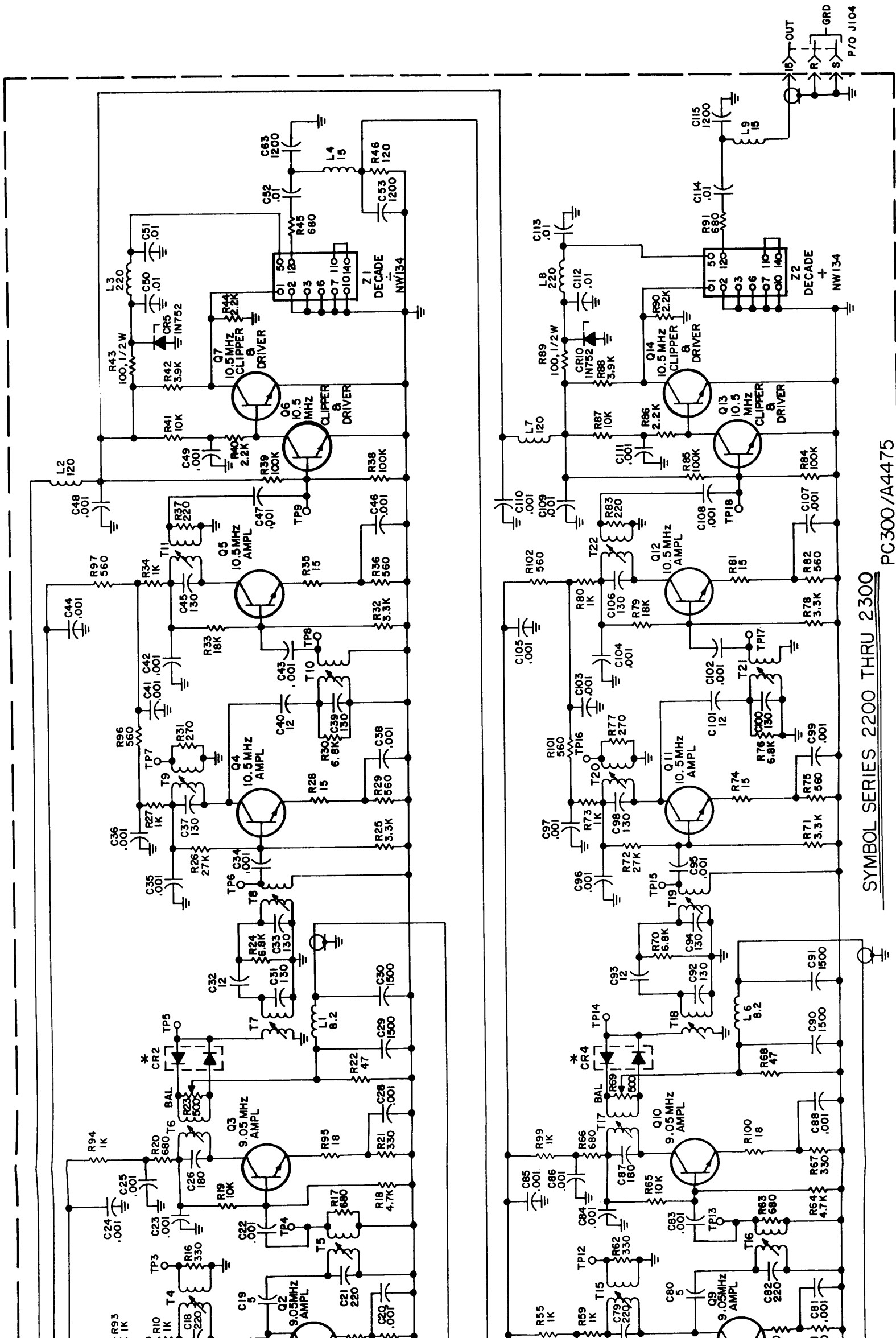
2039-37

UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS (.001).
- 3- ALL WHOLE NUMBER VALUES ARE IN PHOOFARADS, (1.00).
- 4- ALL TRANSISTORS ARE TYPE 2N3646.

SYMBOL SERIES 700

LAST SYMBOLS	MISSING SYMBOLS
C38	C33, C49, C56, C70
C35	L1
L6	R18, R20, R6
G7	R21, R25, R31
T11	
TP10	
Z1	



UNLESS OTHERWISE SPECIFIED

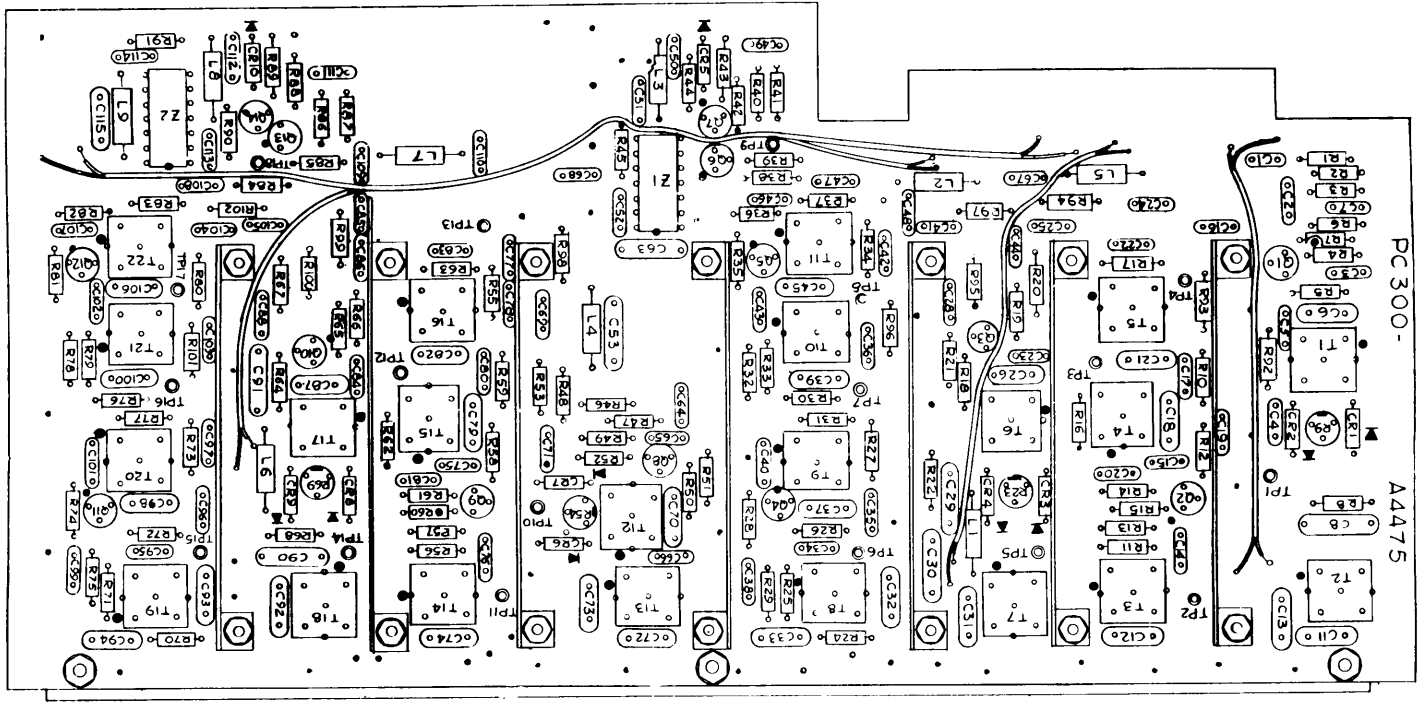
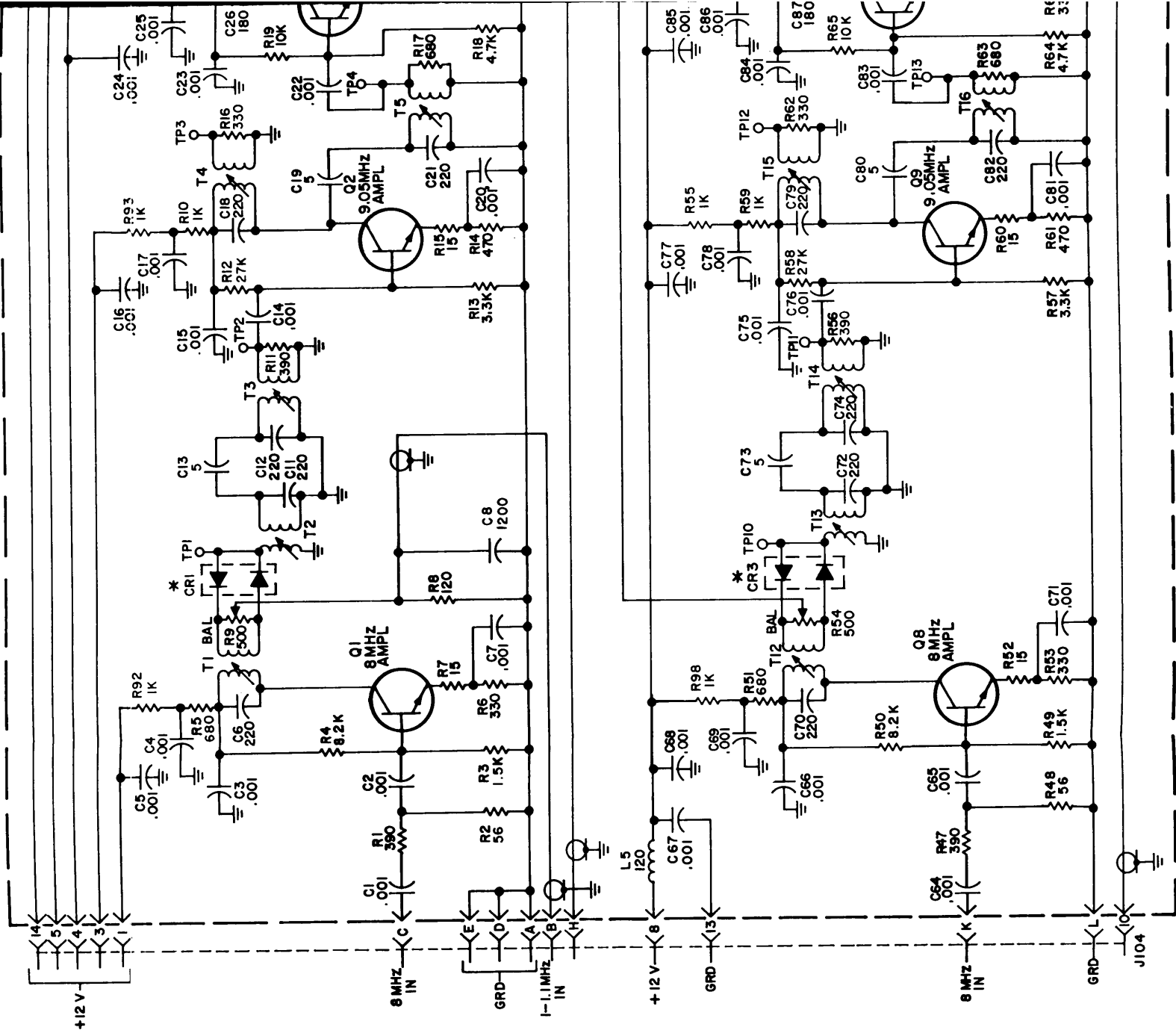
- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
- ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
- 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4- ALL TRANSISTORS ARE TYPE "2N3646".

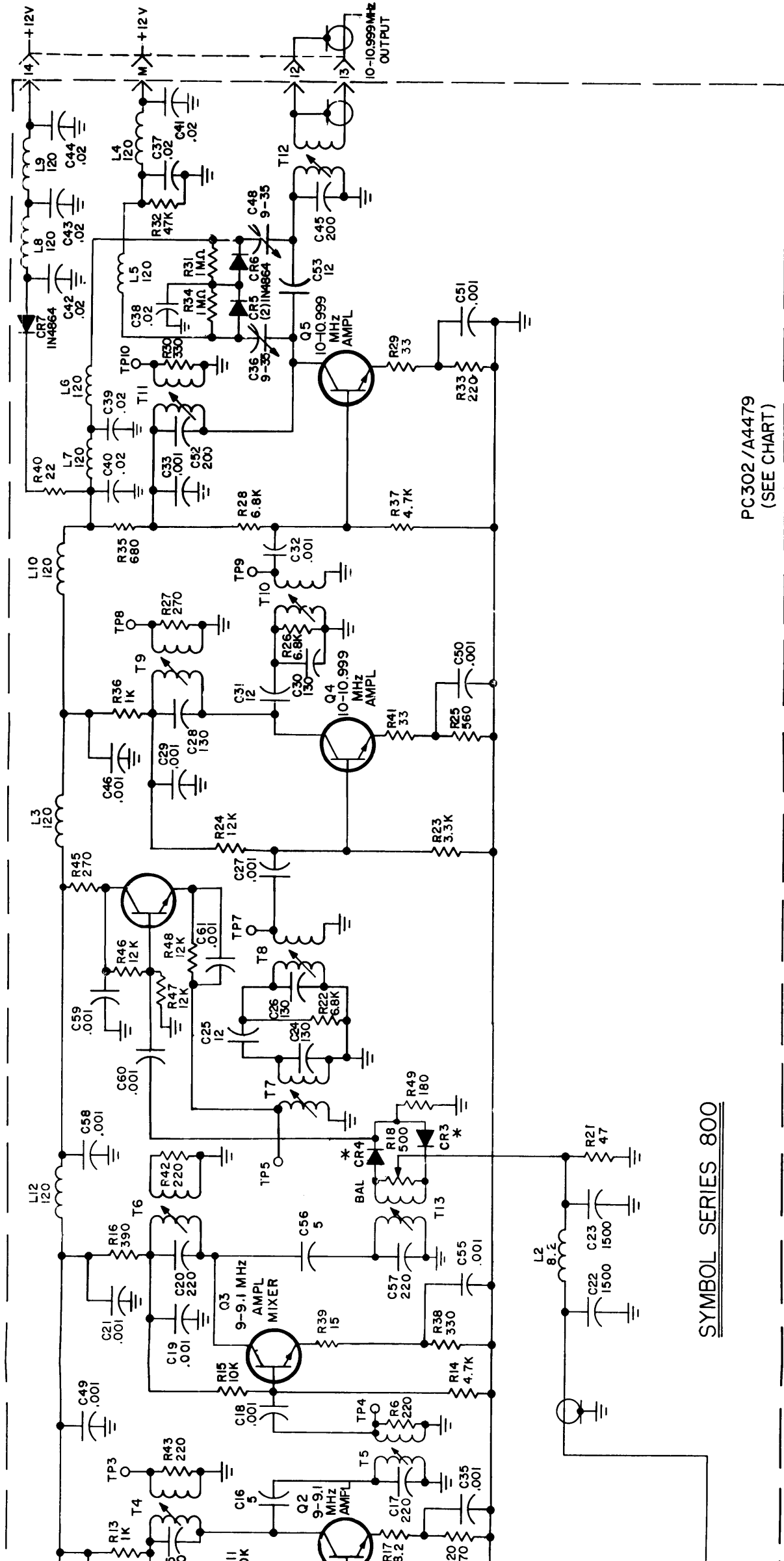
* NOTE CR1 & CR2, CR3 & CR4, CONSIST OF MATCHED PAIRS OF IN995 DIODES

LAST SYMBOLS	MISSING SYMBOLS
C115	C9, C10, C27
CR10	C53 THRU C62, C89
L9	CR6, 7, 8, 9
Q14	
R102	
T22	
TP18	
Z2	

PC300/A4475
 SYMBOL SERIES 2200 THRU 2300

Figure 7-6. Dual Mixer-Divider Z105, Schematic/Parts Location Diagram





SYMBOL SERIES 800

PC302/A4479
(SEE CHART)

UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001).
- ALL WHOLE NUMBER VALUES ARE IN PICO FARADS, (.130).
- 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4- ALL TRANSISTORS ARE TYPE "2N3646".

* NOTE

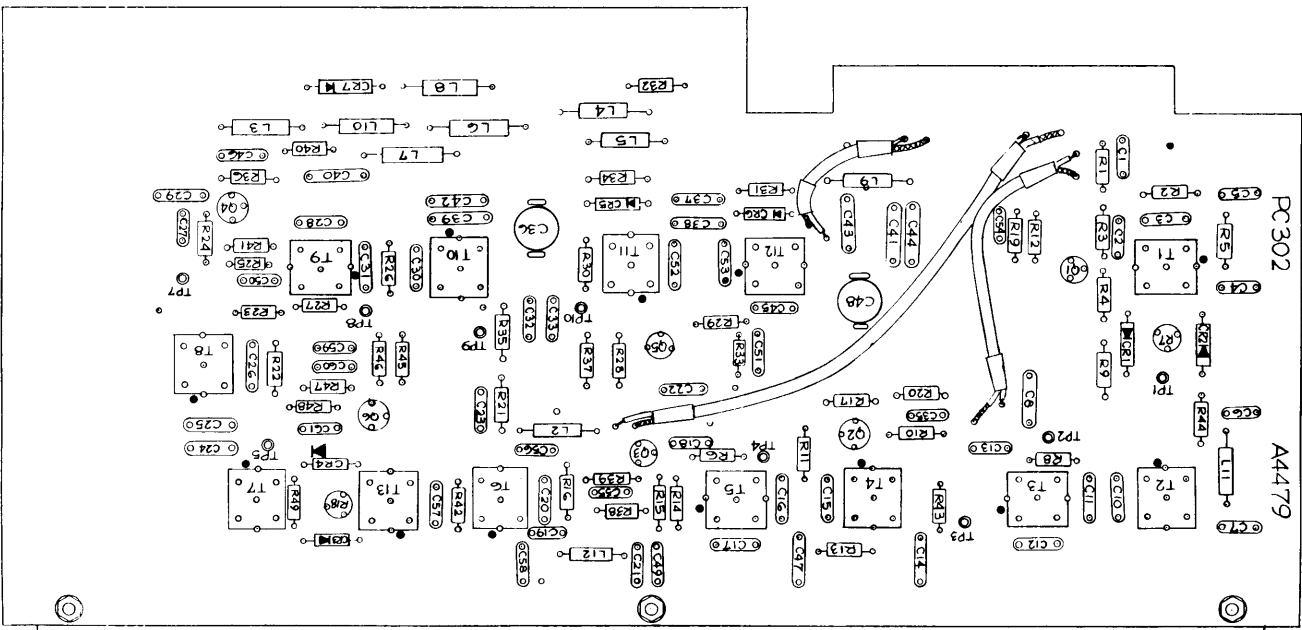
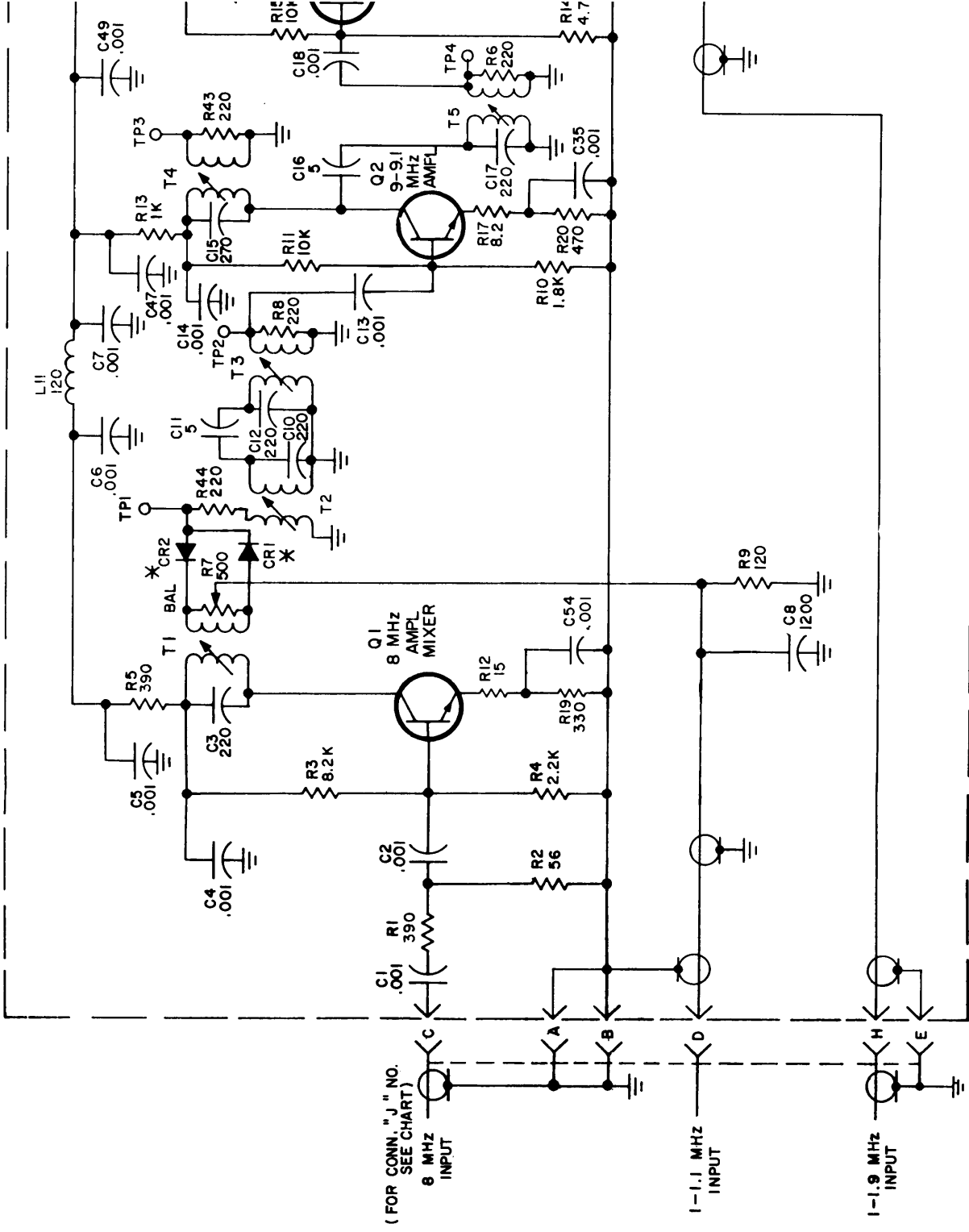
CR1 & CR2, CR3 & CR4 ARE "IN955'S" MATCHED PAIRS.

LAST SYMBOLS	MISSING SYMBOLS
C61	C9, C34
CR7	L1
L12	
Q6	
R49	
T13	
TP.O	TP6

MODEL	"Z" NO.	CONN. "J" NO.
MMX-1	Z106	J106
VOX-7	Z106	J106
LFE-1	Z107	J107

Figure 7-7. Final Mixer Z106, Schematic/Parts Location Diagram

006692046



UNLESS OTHERWISE SPECIFIED

- 1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W
- 2-ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001).
- ALL WHOLE NUMBER VALUES ARE IN PICOFARADS, (130).
- 3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4-ALL TRANSISTORS ARE TYPE 2N3646.

* NOTE

CR1 & CR2, CR3 & CR4 (DD139) MUST BE MATCHED PAIRS.

LAST SYMBOLS	MISSING SYMBOLS
C133	C70 THRU C72
CR12	
L20	
Q15	R54 THRU R60
RI12	
T31	

SYMBOL SERIES 1200 - THRU 1300

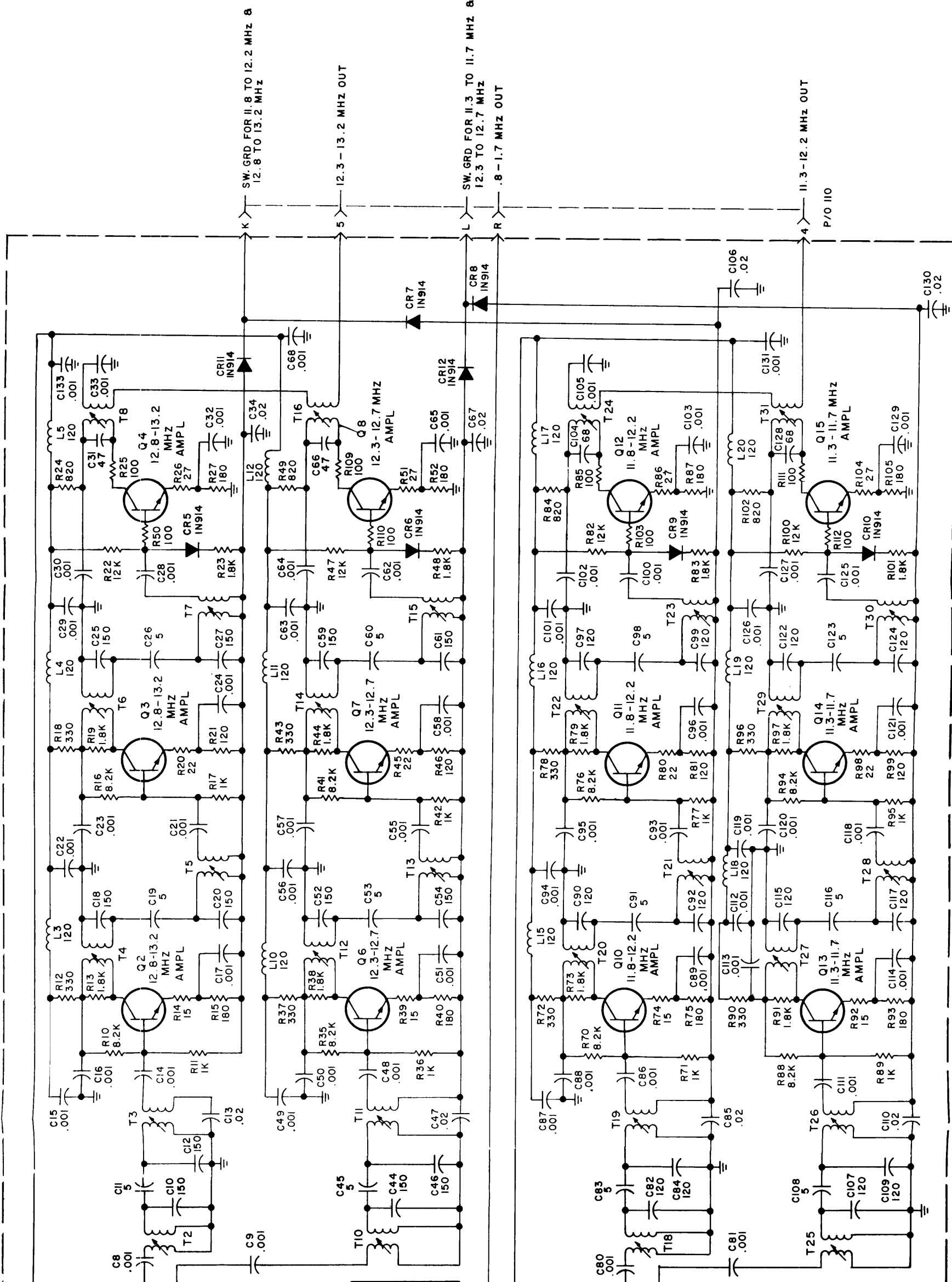
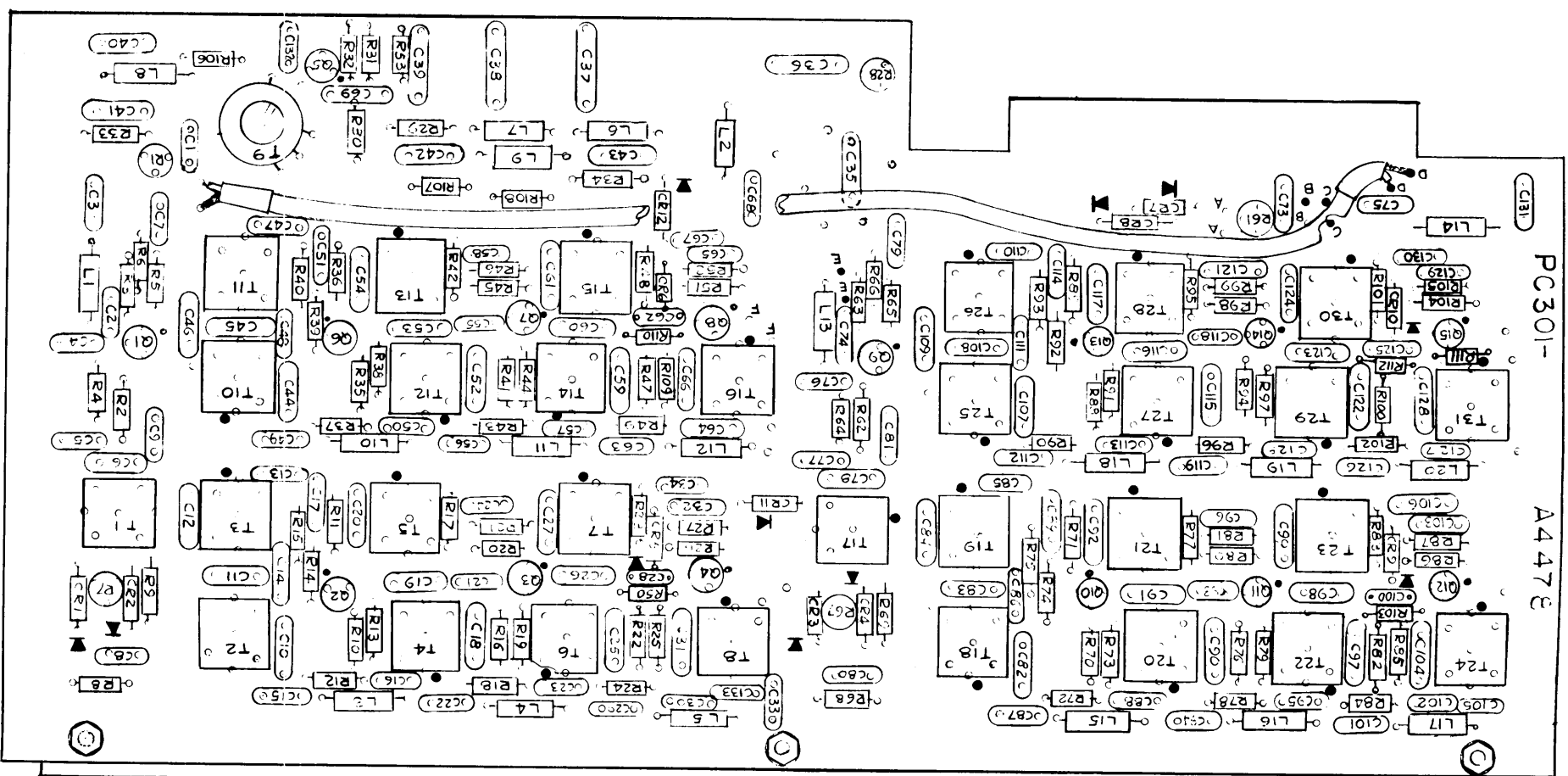
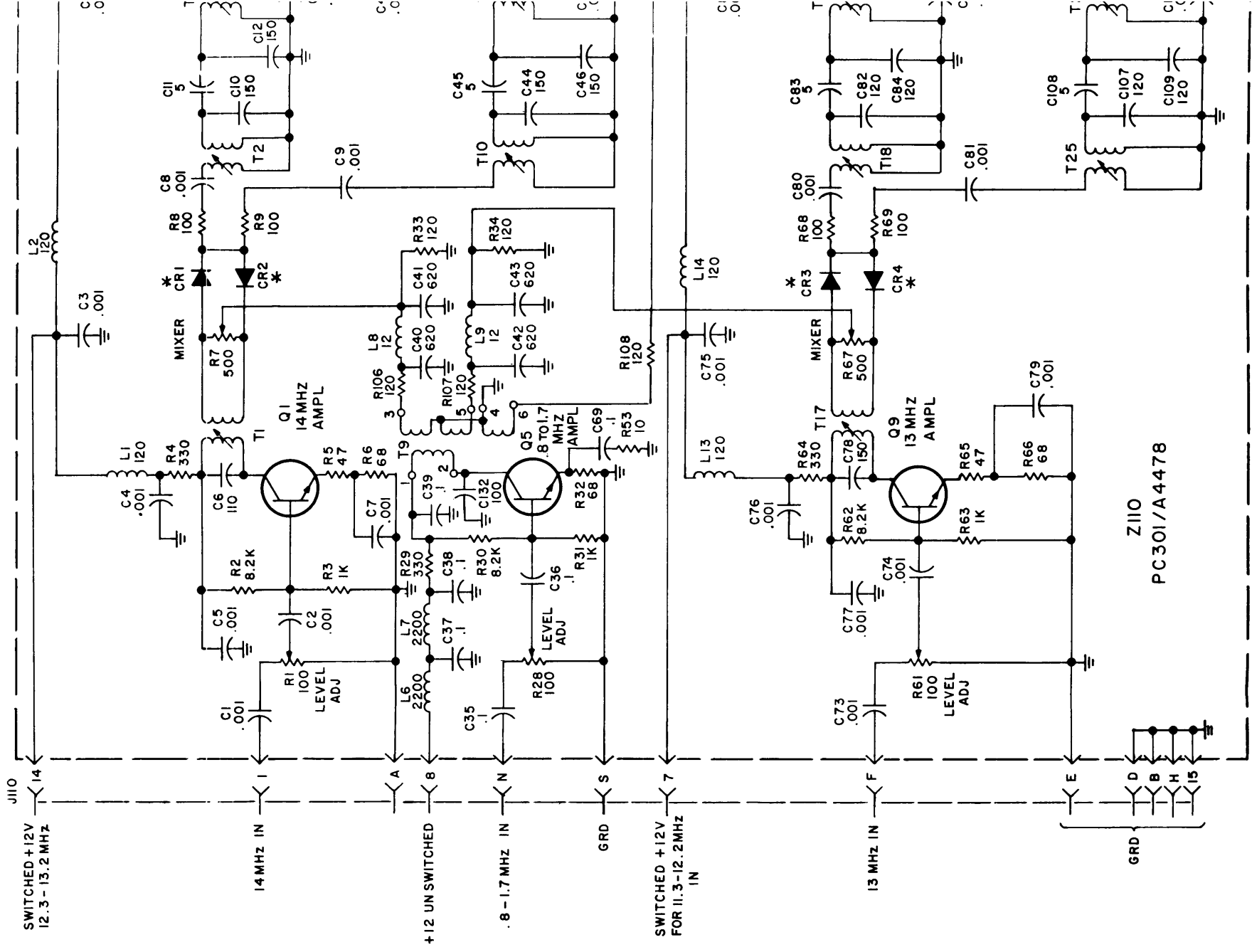


Figure 7-8. Step Generator Z110, Schematic/Parts Location Diagram

006692046

7-19/7-20



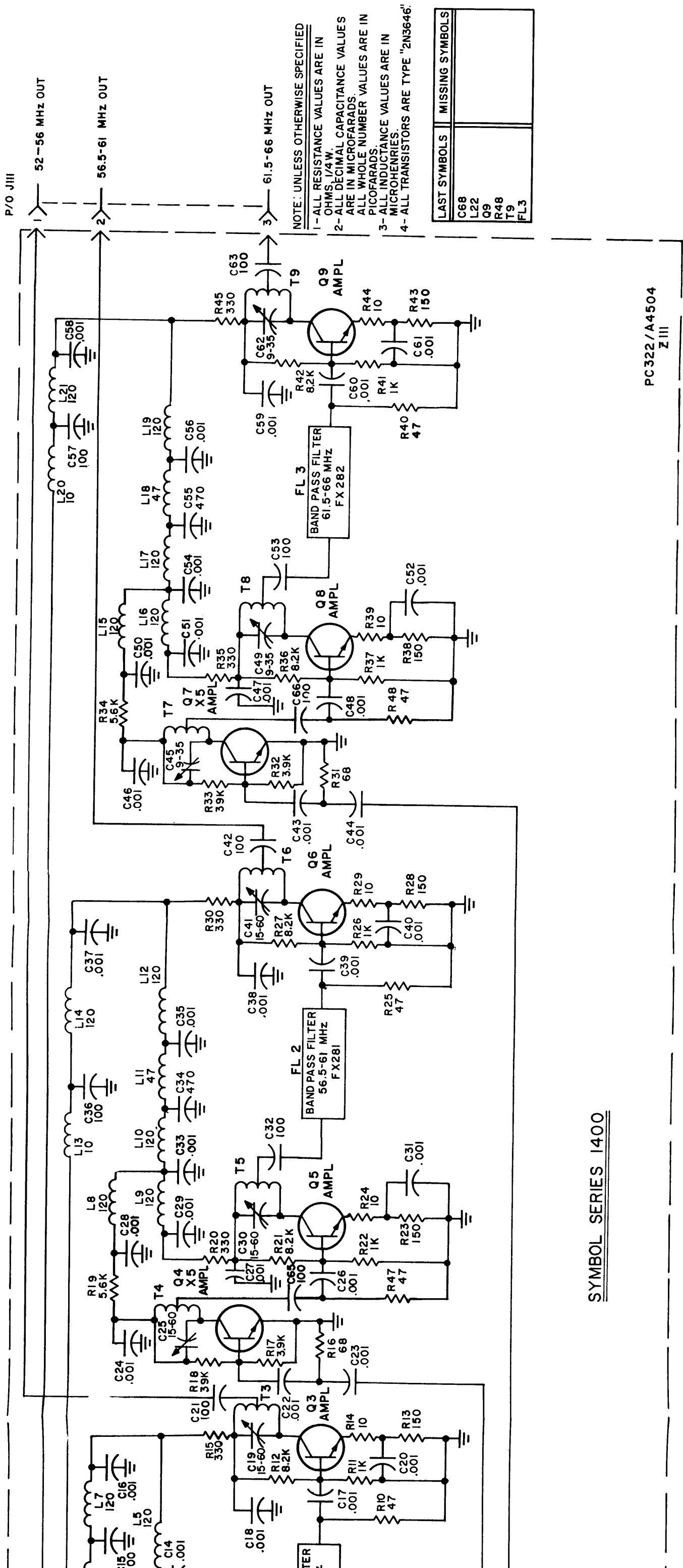


Figure 7-9. Step Generator Z111, Schematic/Parts Location Diagram

006692046

7-21/7-22

UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL NUMBER CAPACITANCE VALUES ARE IN MICROFARADS.
- ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
- 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4- TRANSISTORS Q1 THRU Q13 ARE TYPE 2N5179
- TRANSISTORS Q14 THRU Q20 ARE TYPE 2N3646.

NOTE: CR1 & CR2 MUST BE MATCHED PAIR.

LAST SYMBOLS	MISSING SYMBOLS
C153	C74
CR6	
L40	
Q20	
R133	
T25	
Y1	

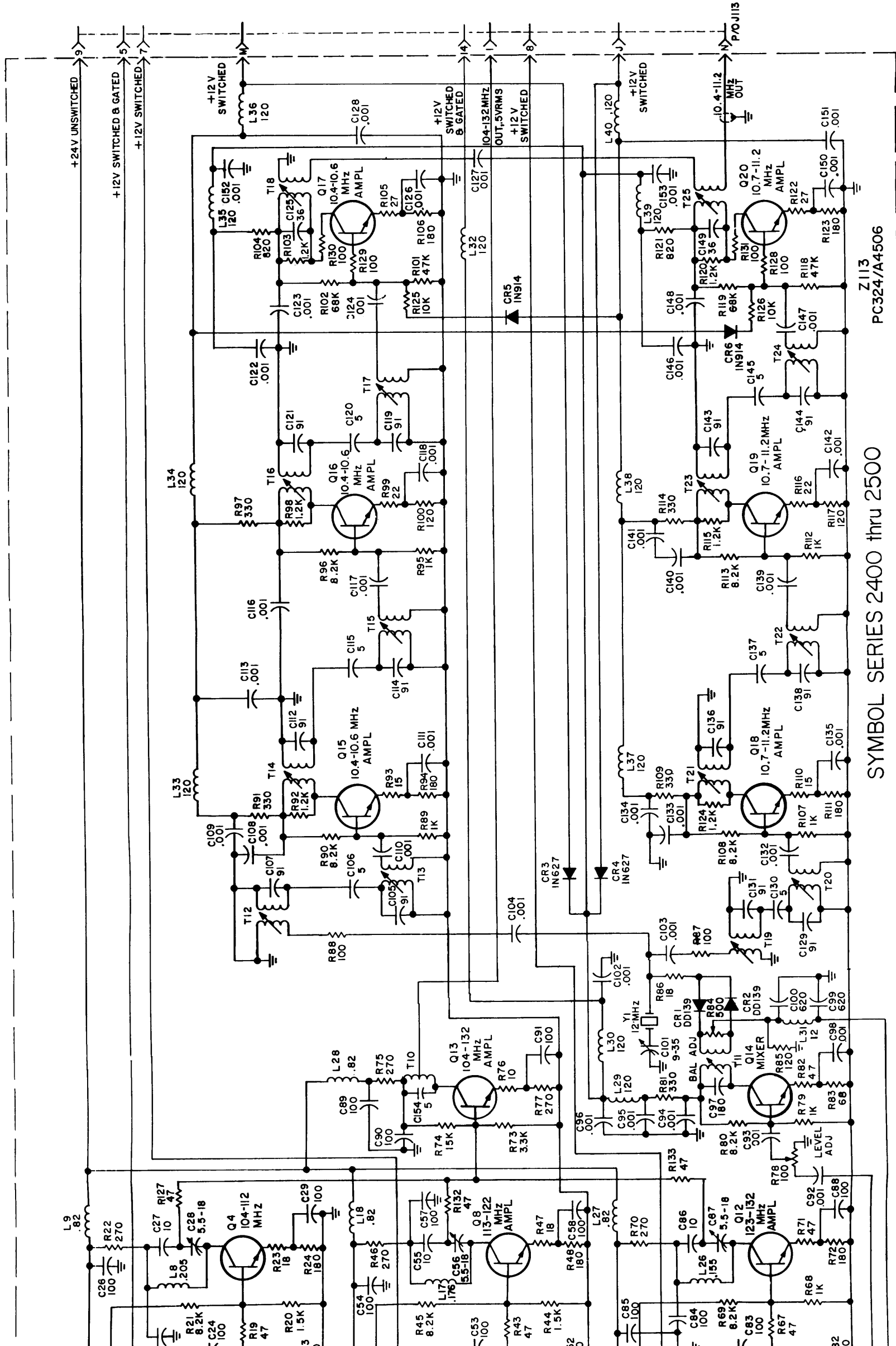
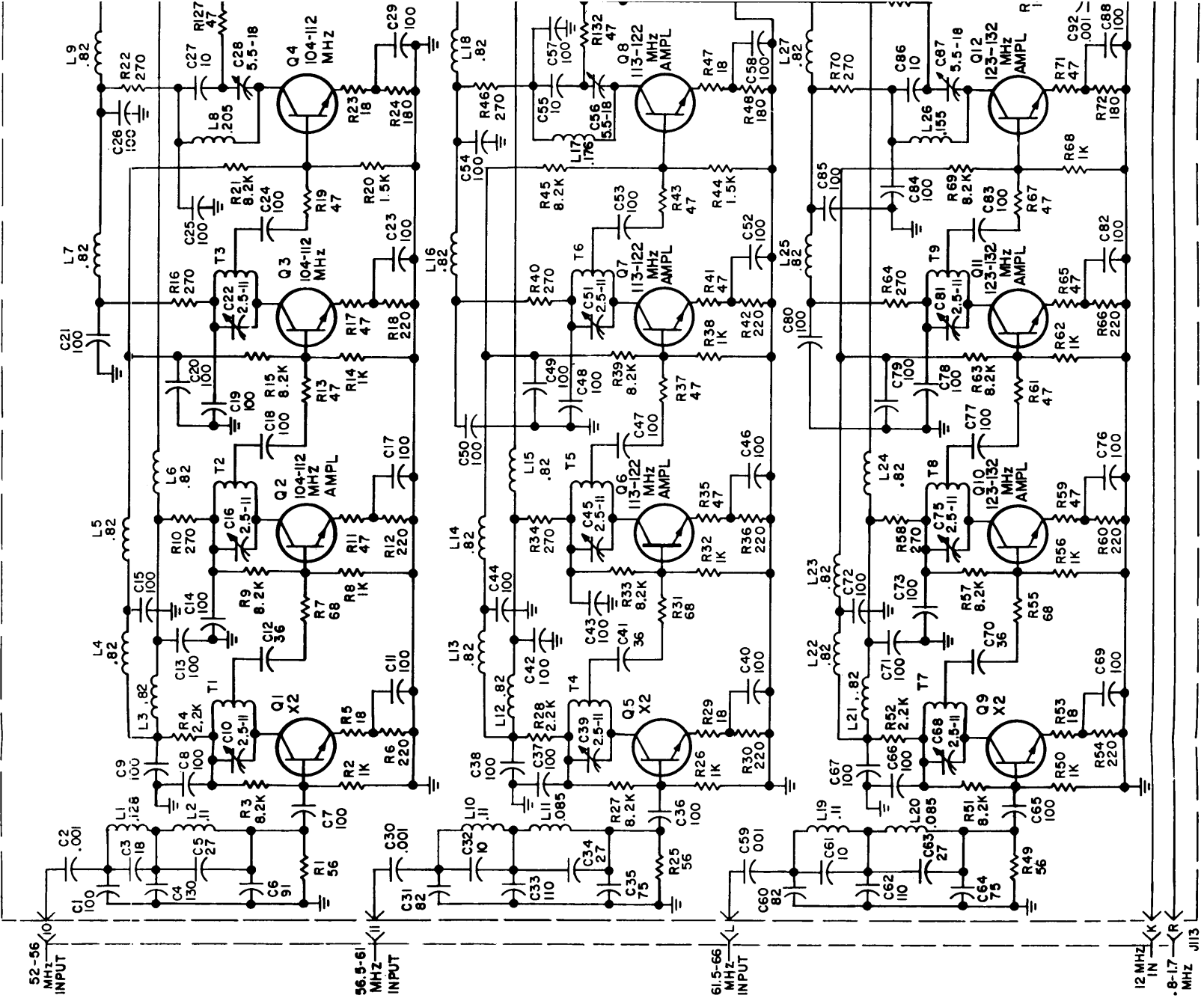
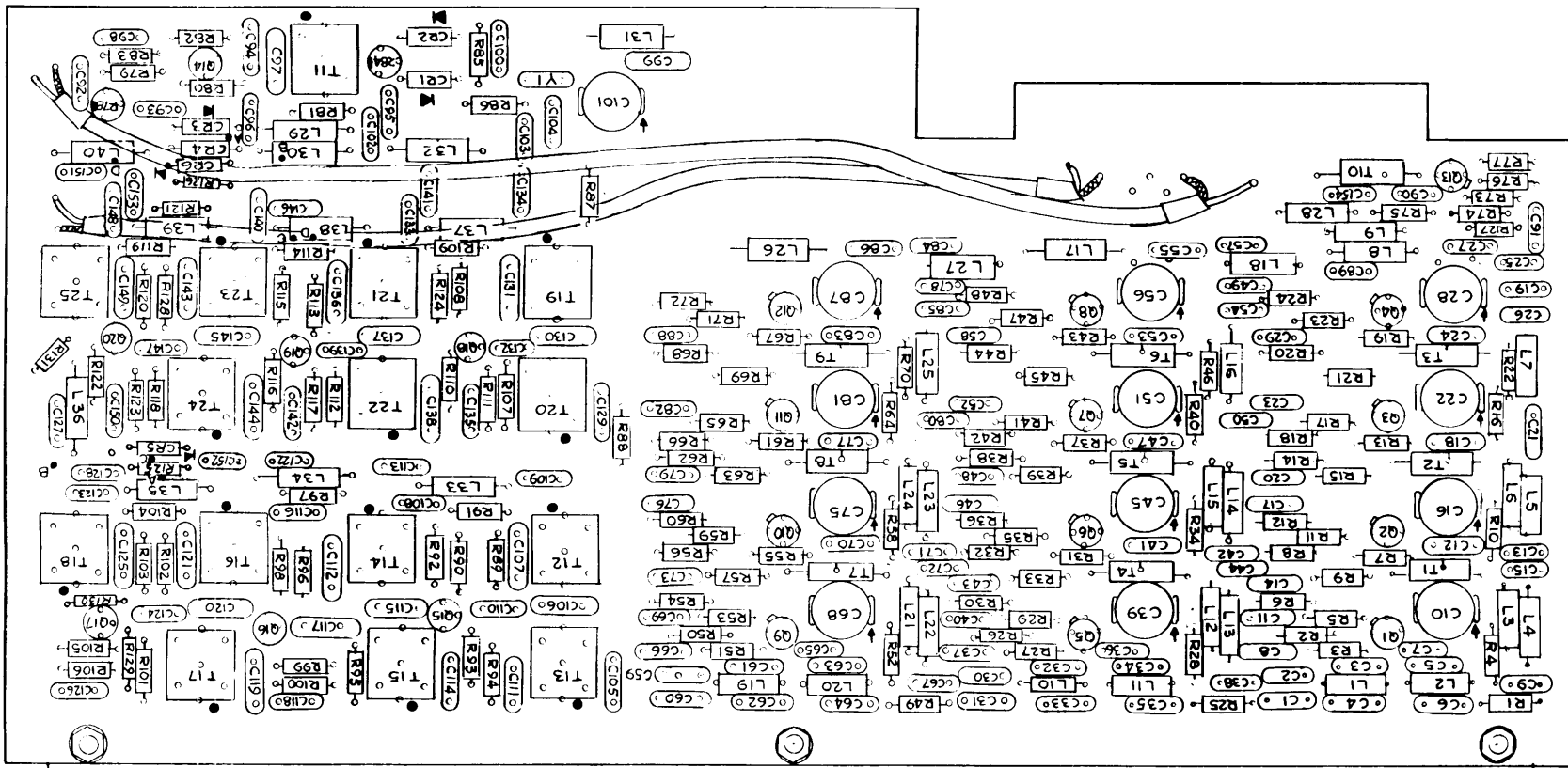
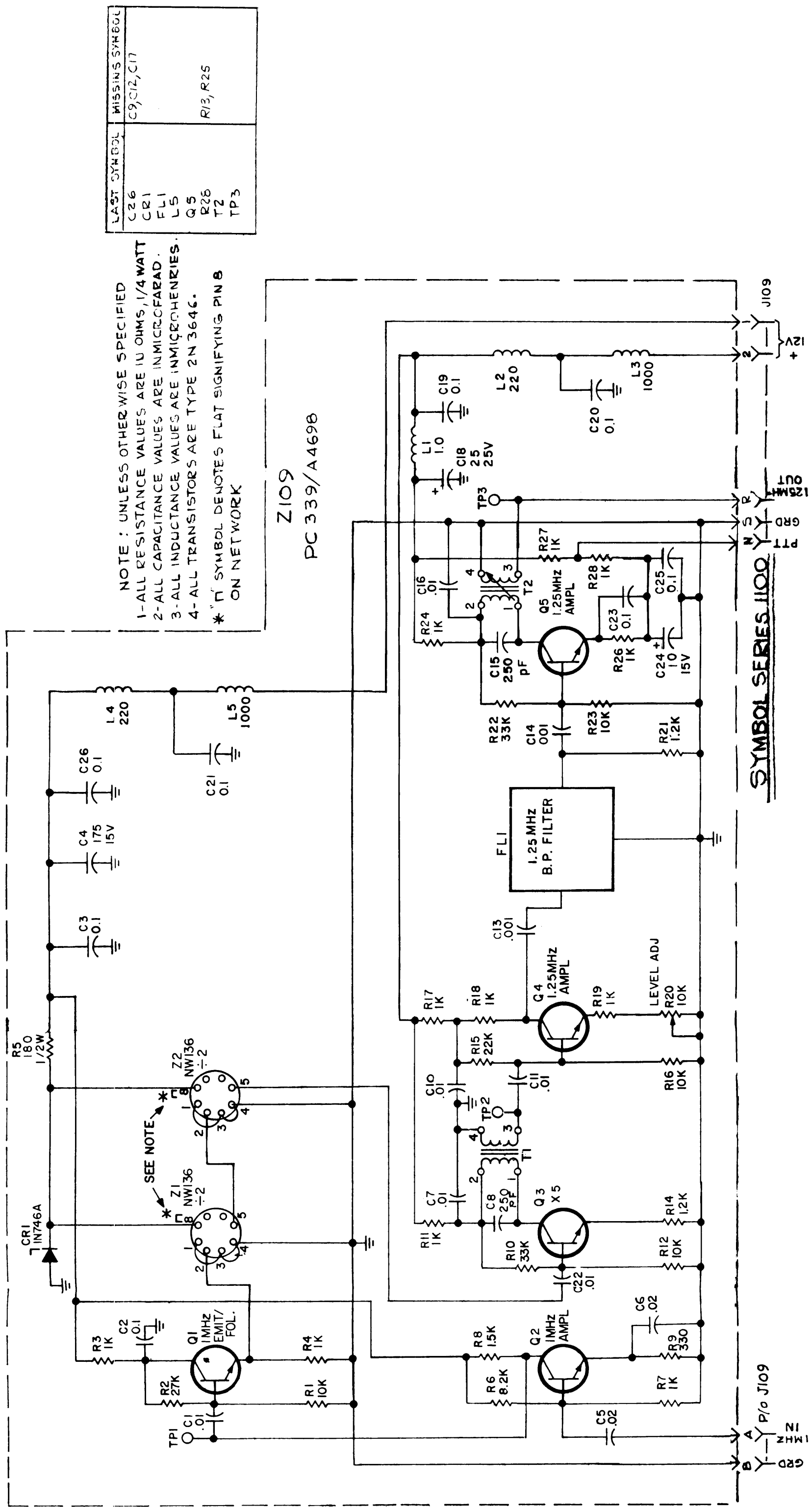


Figure 7-10. Step Generator Z113, Schematic/Parts Location Diagram

006692046





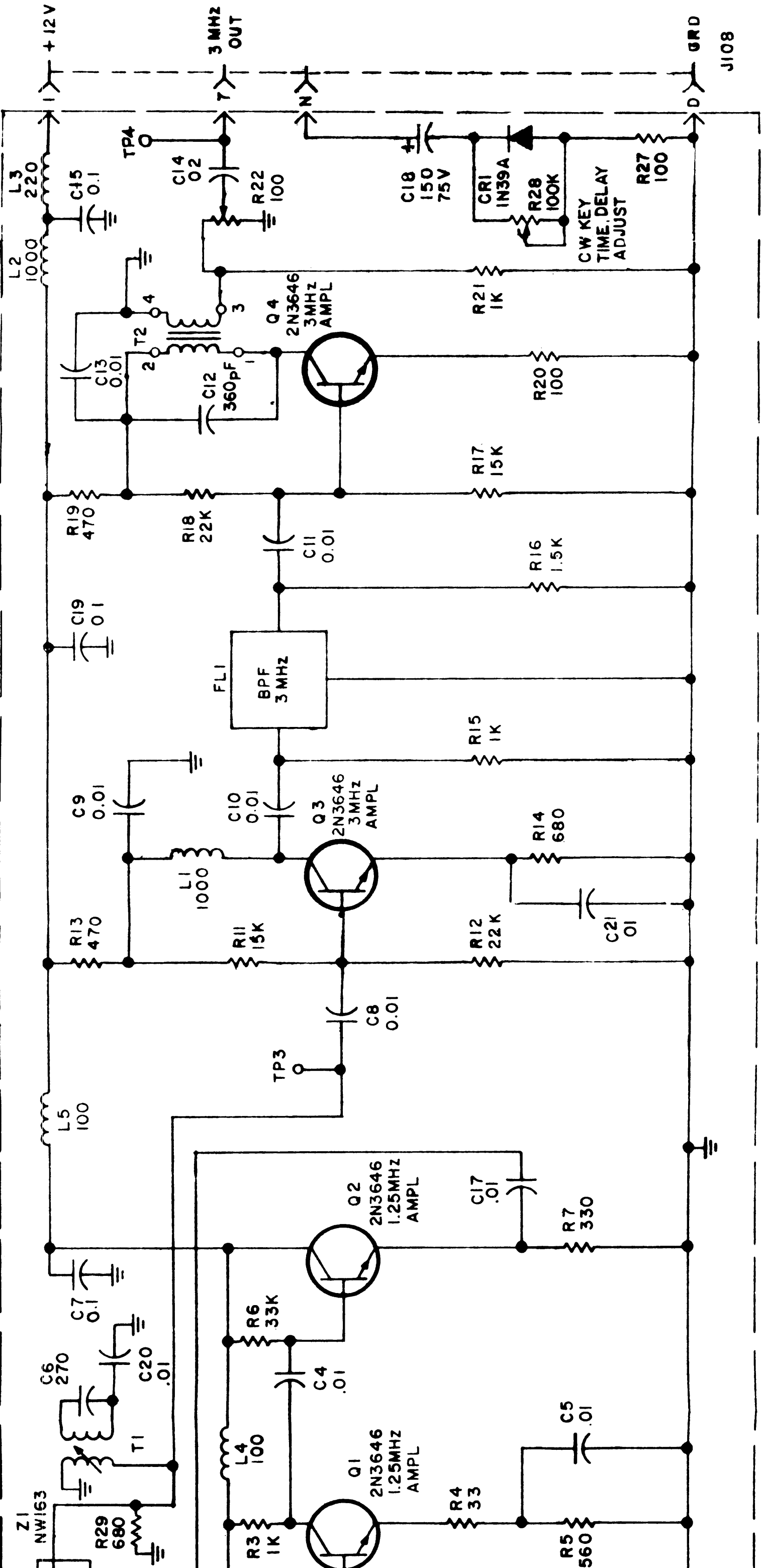
LAST SYMBOL	MISSING SYMBOL
C26	C9, C12, C17
CR1	
FL1	
L5	
Q5	R13, R25
R28	
T2	
TP3	

Figure 7-11. 1.25 MHz Generator Z109, Schematic/Parts Location Diagram

006692046

LAST SYMBOL	MISSING SYMBOL
Q4	C21 TP4
R29	CRI Z1
T2	FL1
	L5

NOTE: UNLESS OTHERWISE SPECIFIED.
 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4W.
 2- ALL CAPACITANCE VALUES ARE IN MICROFARADS.
 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

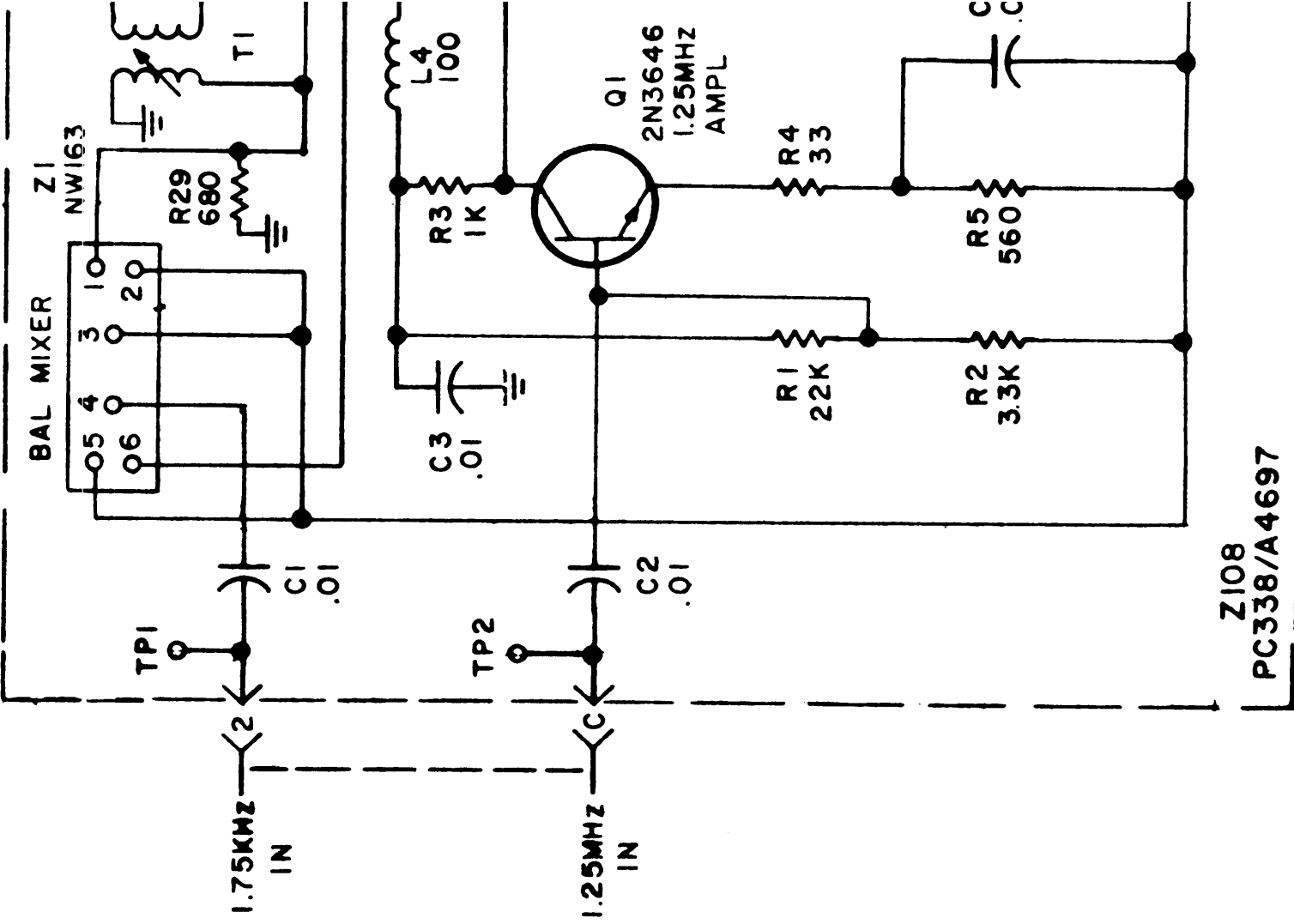


SYMBOL SERIES 1000

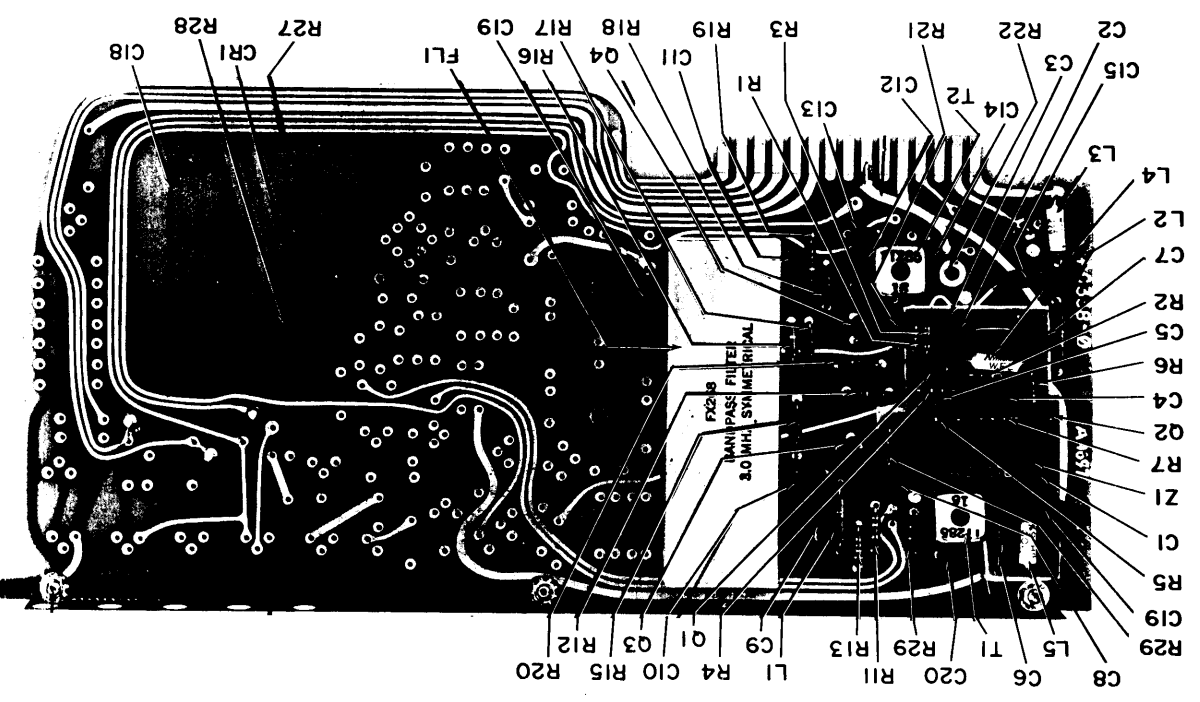
Figure 7-12. 3 MHz Balanced Mixer Z108, Schematic/Parts Location Diagram

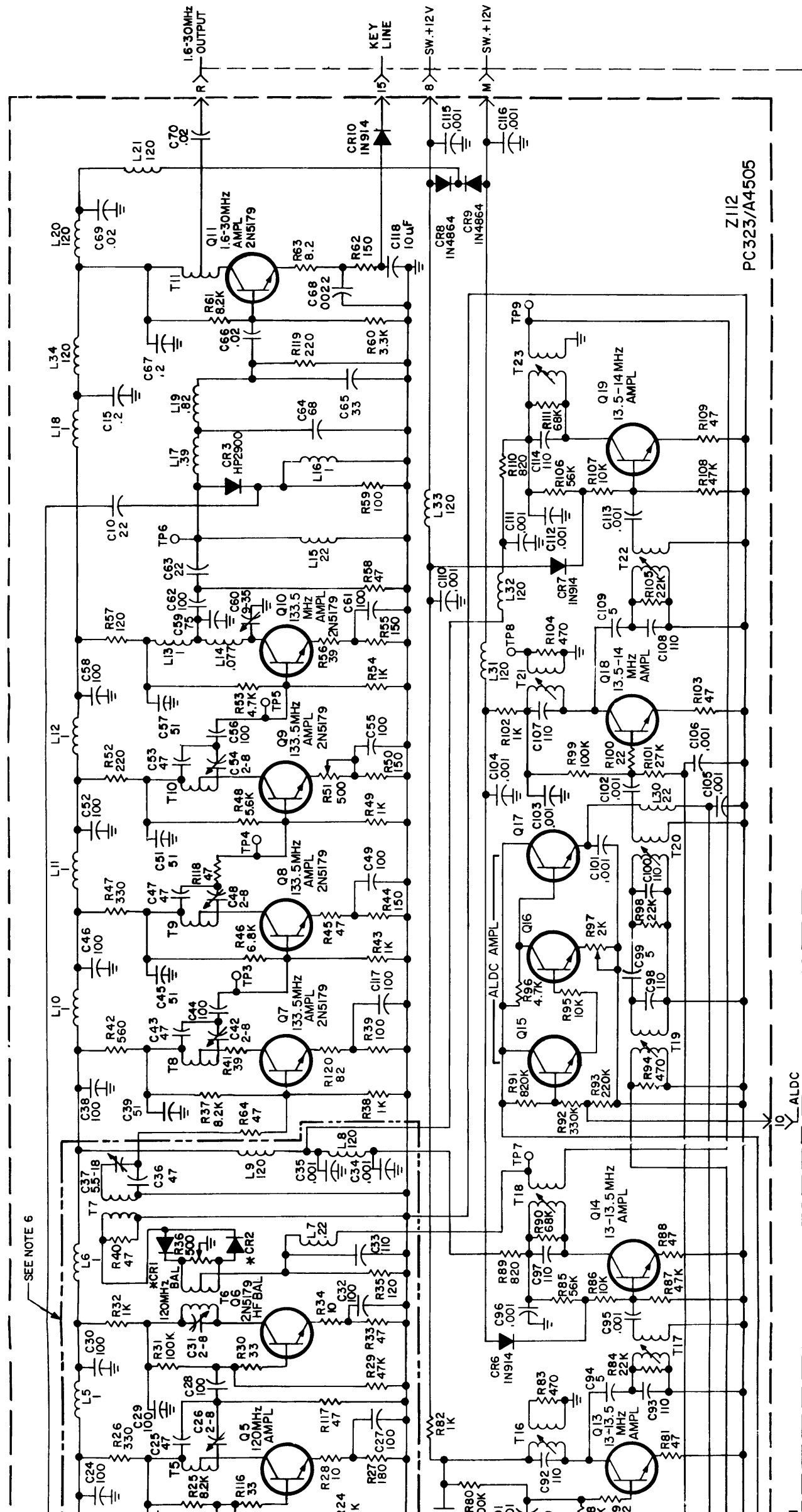
006692046

7-27/7-28



Z108
PC338/A4697





NOTES:
UNLESS OTHERWISE SPECIFIED

- 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
- 2- ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
ALL WHOLE NUMBER CAPACITANCE VALUES (.47) ARE IN PICOFARADS.
- 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
- 4- ALL TRANSISTORS (EXCEPT THOSE INDICATED) ARE "2N3646",
*5- CR1 & CR2, CR4 & CR5 ARE "HP8403'S", MATCHED PAIRS.

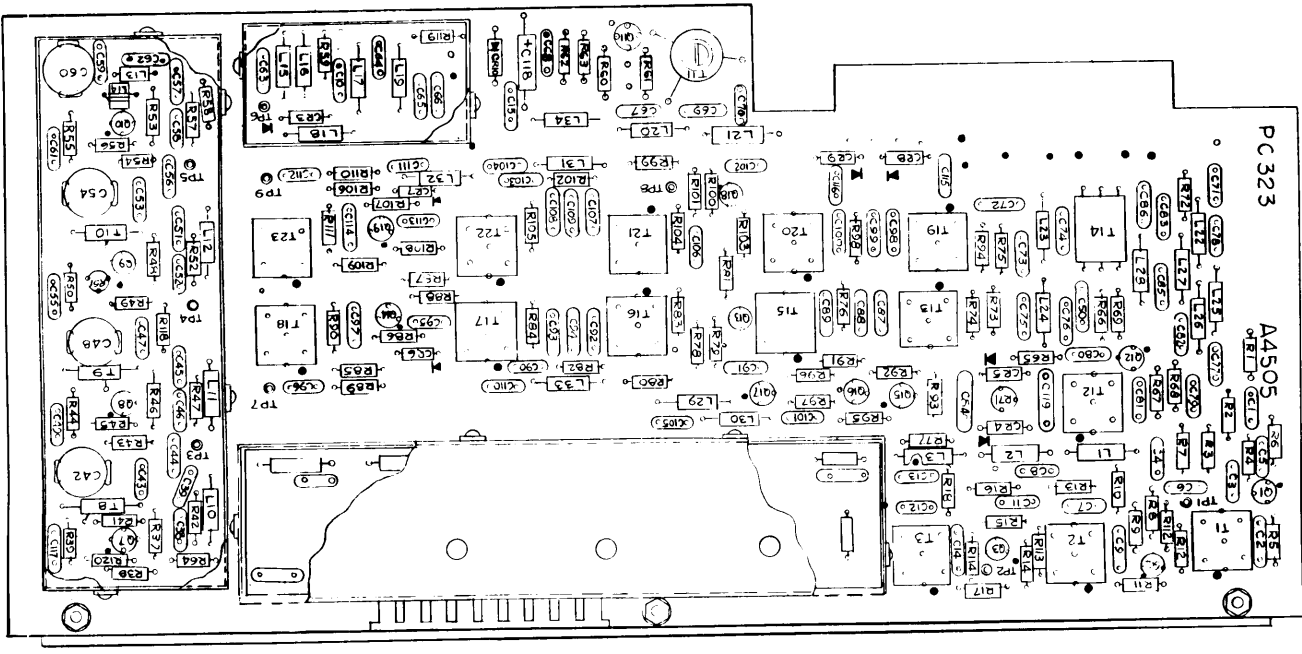
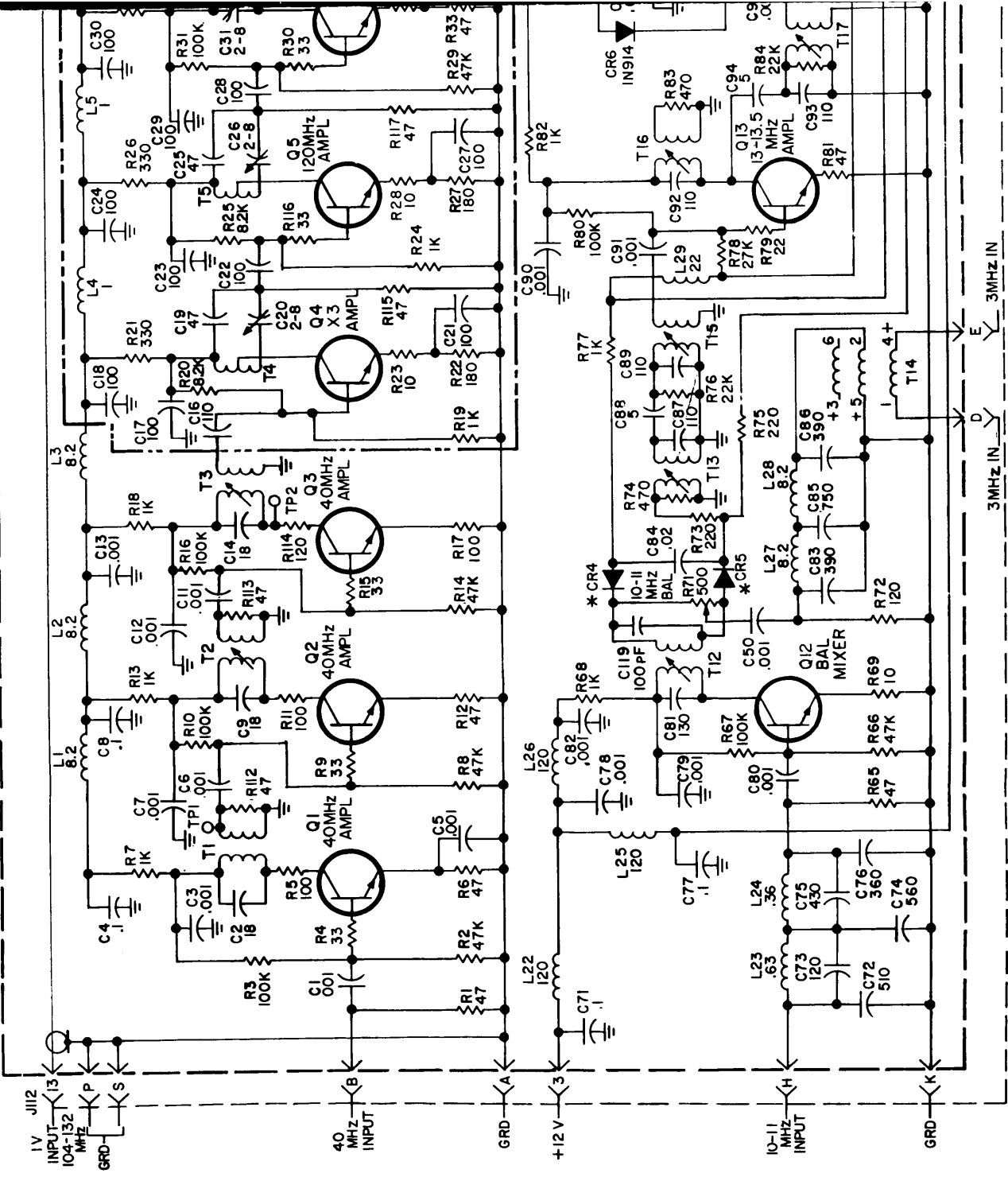
NOTES: (CONT.)

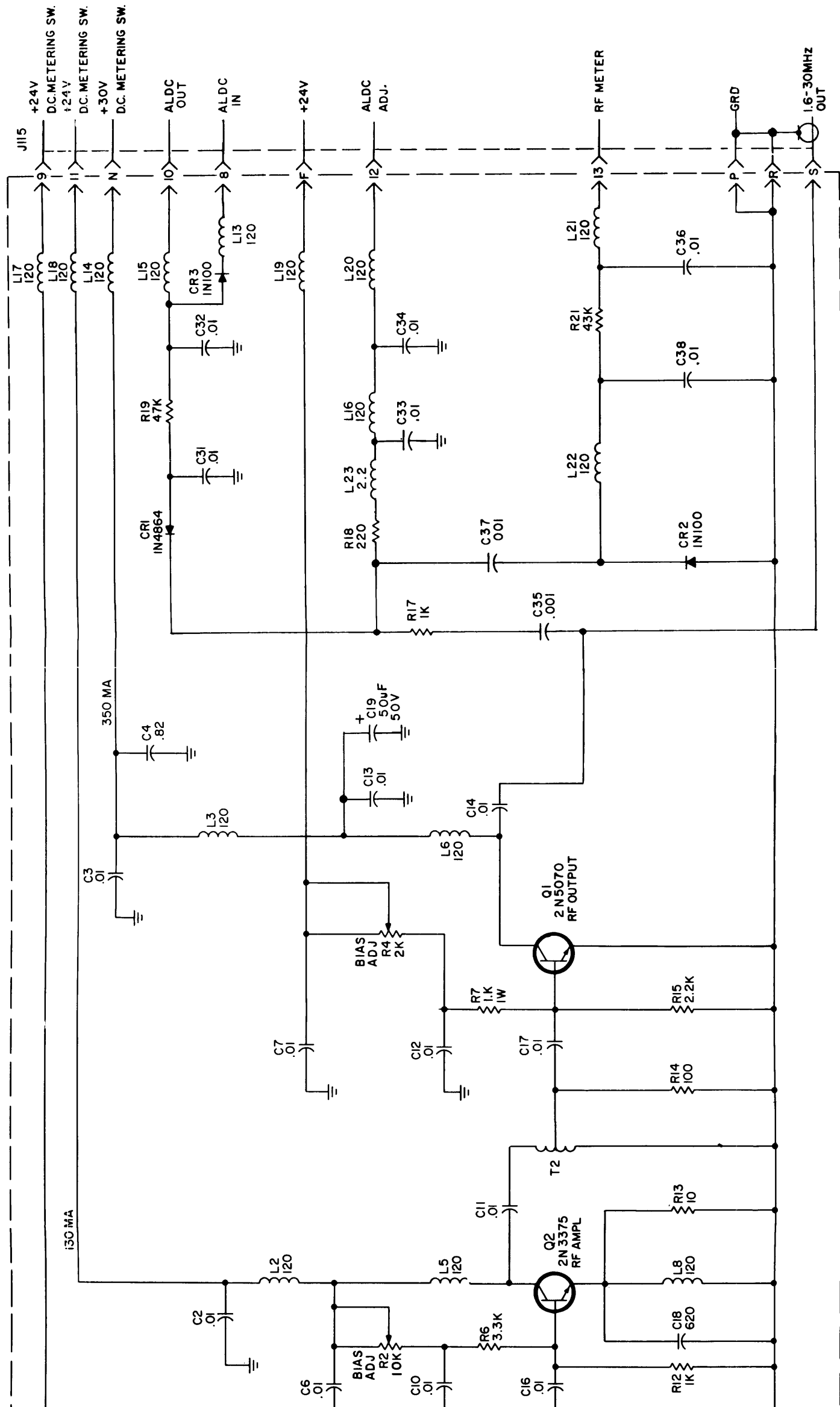
- 6- COMPONENTS CONTAINED IN OUTLINE MARKED -----
ARE MOUNTED ON SEPARATE PC BOARD (REF. PC377/A4600)

LAST SYMBOLS	MISSING SYMBOLS
C119	C40, C41
CR10	
L34	
Q19	R70
R120	
T23	
TP9	

SYMBOL SERIES 2000 & 2100

Figure 7-13. Translator Z112, Schematic/Parts Location Diagram



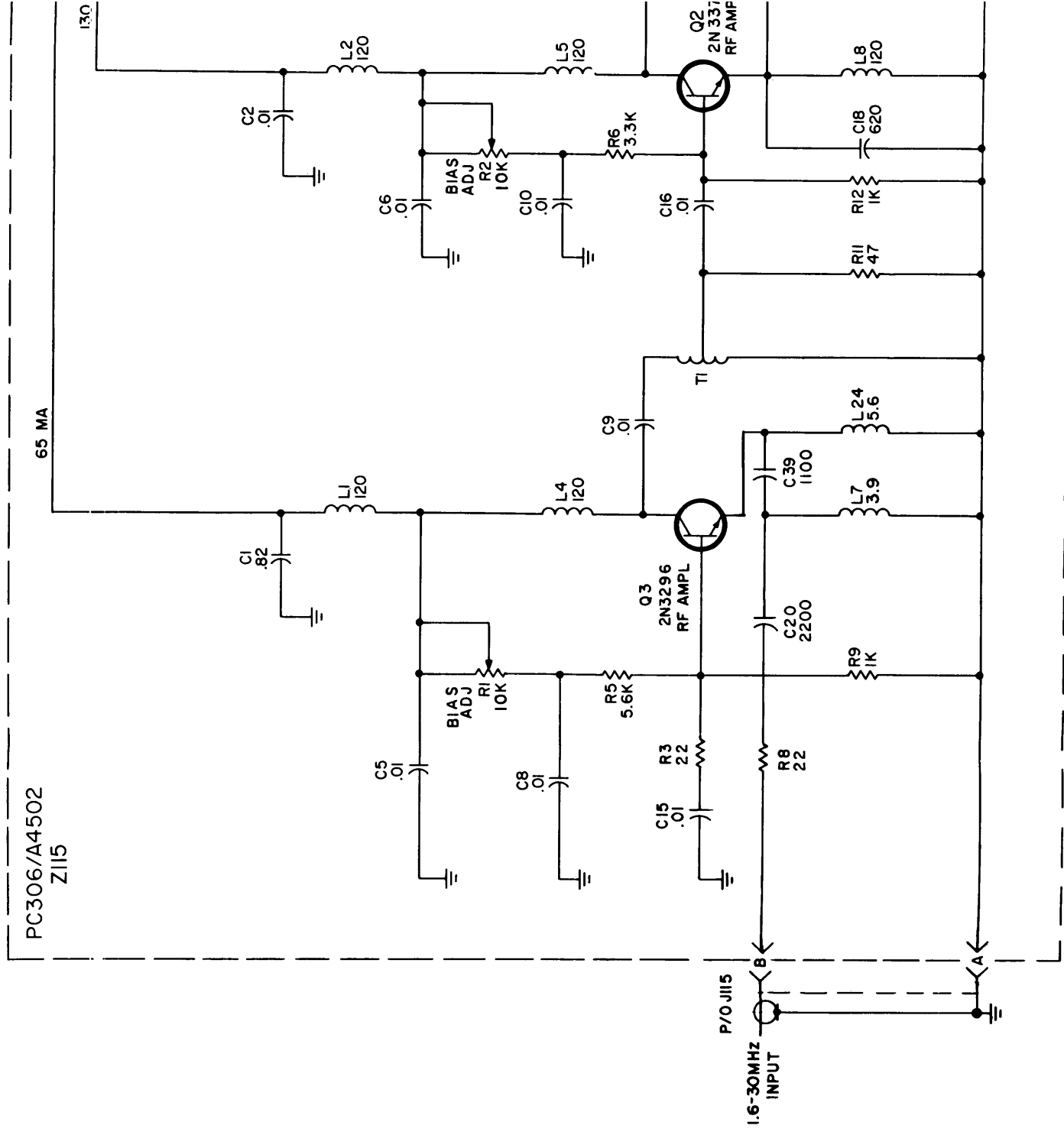
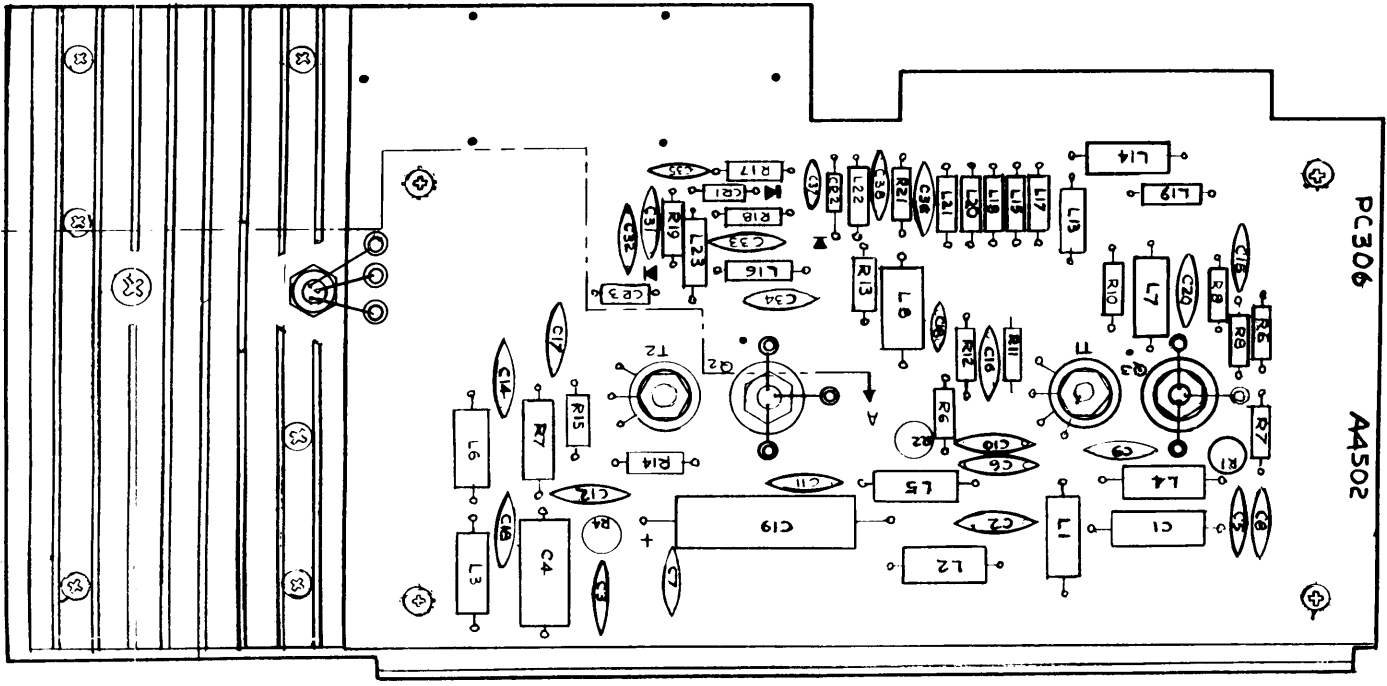


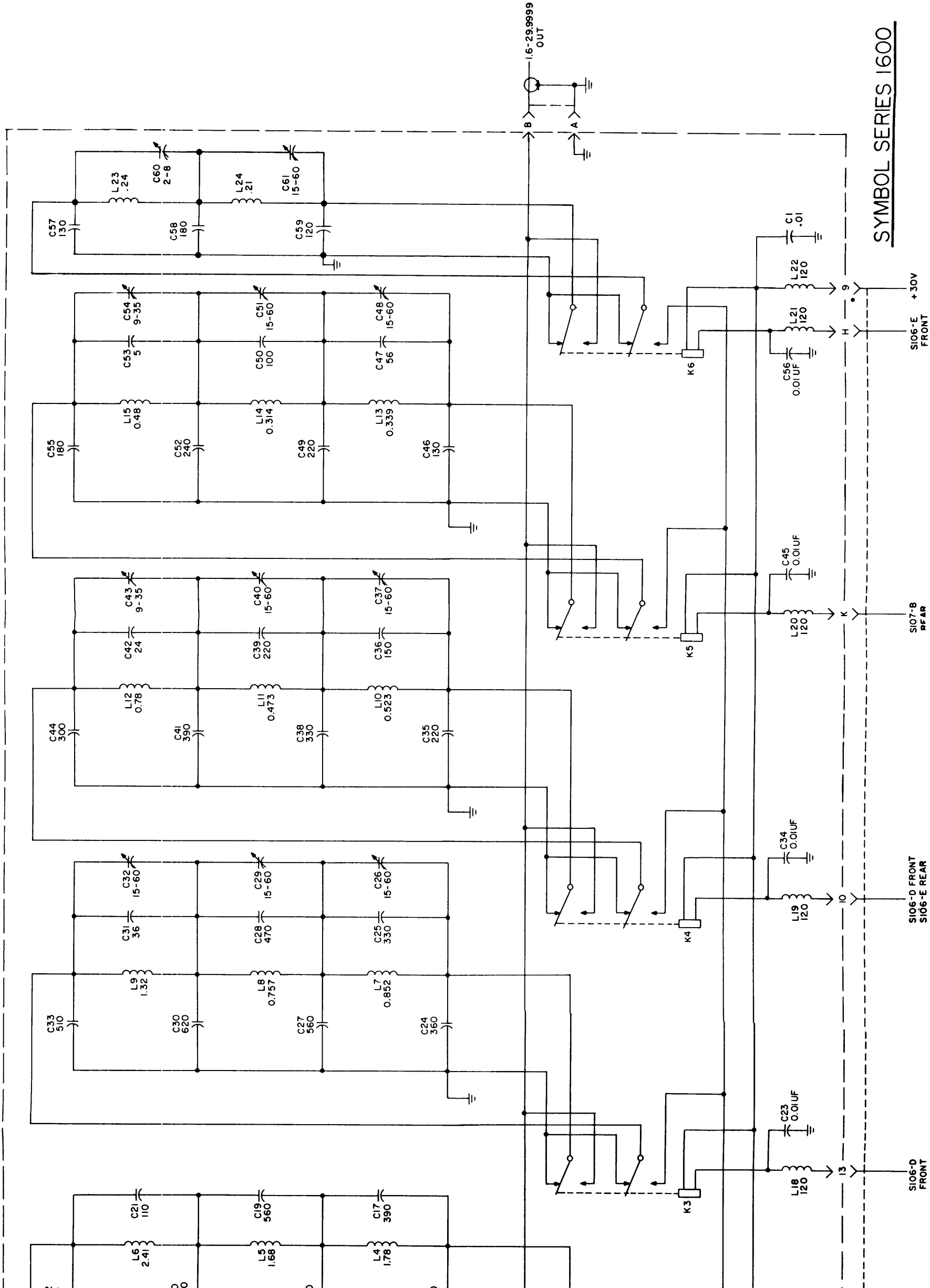
NOTES:
 UNLESS OTHERWISE SPECIFIED
 1- ALL RESISTANCE VALUES ARE IN OHMS, 1/2W.
 2- ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
 ALL WHOLE NUMBER CAPACITANCE VALUES (.47) ARE IN PICOFARADS.
 3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

SYMBOL	SERIES	MISSING SYMBOL
C39		C21 THRU C30
CR3		L9 THRU L12
L24		R16, R20, R10
Q3		
R21		
T2		

Figure 7-14. RF Output Z115, Schematic/Parts Location Diagram

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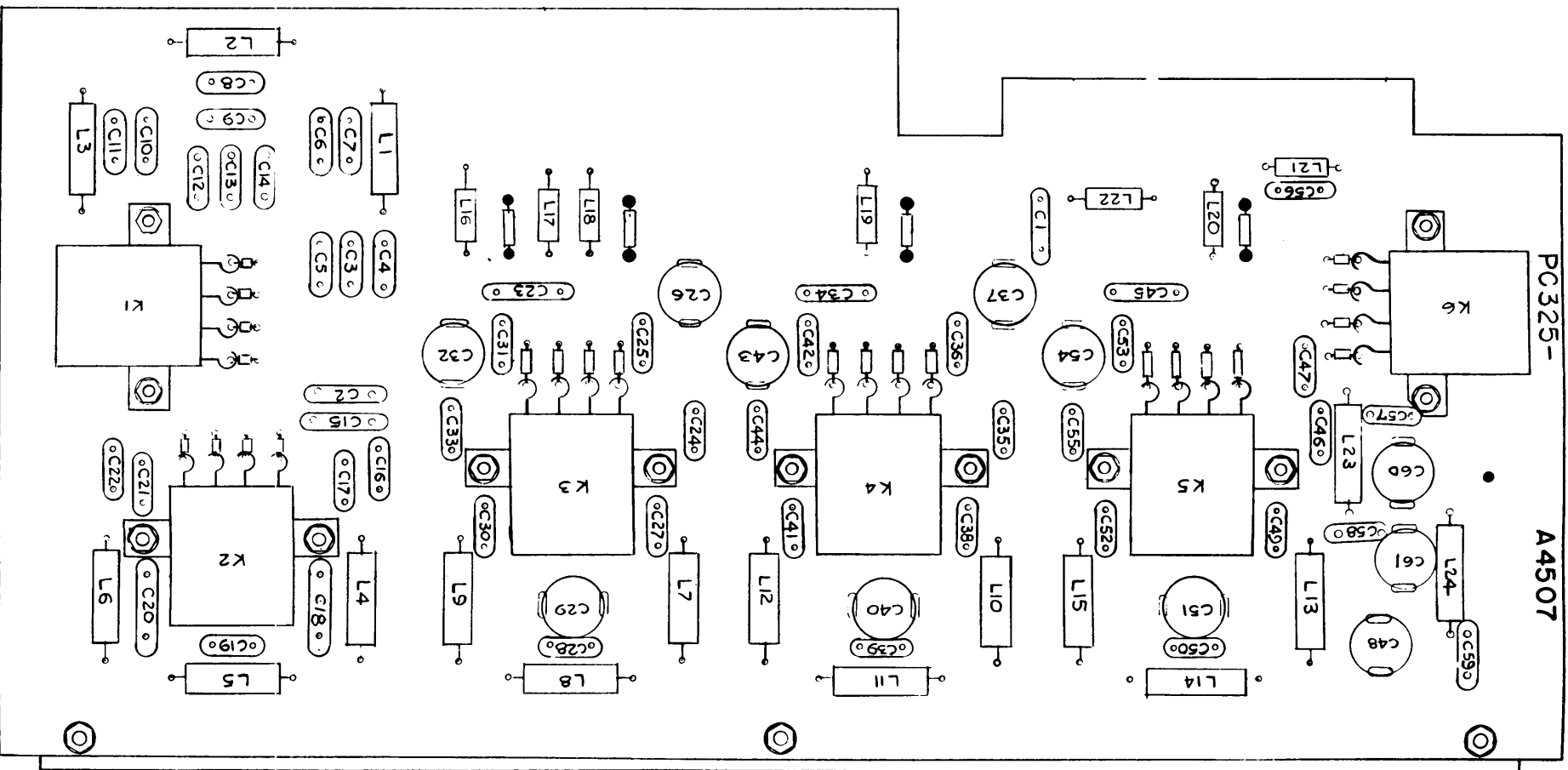
NOTE:
 UNLESS OTHERWISE SPECIFIED
 1- ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
 ALL WHOLE NUMBER CAPACITANCE VALUES (47) ARE IN PICOFARADS.
 2- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

LAST SYMBOL	SYMBOL SERIES 1600	MISSING SYMBOL
C 61		
K 6		
L 24		

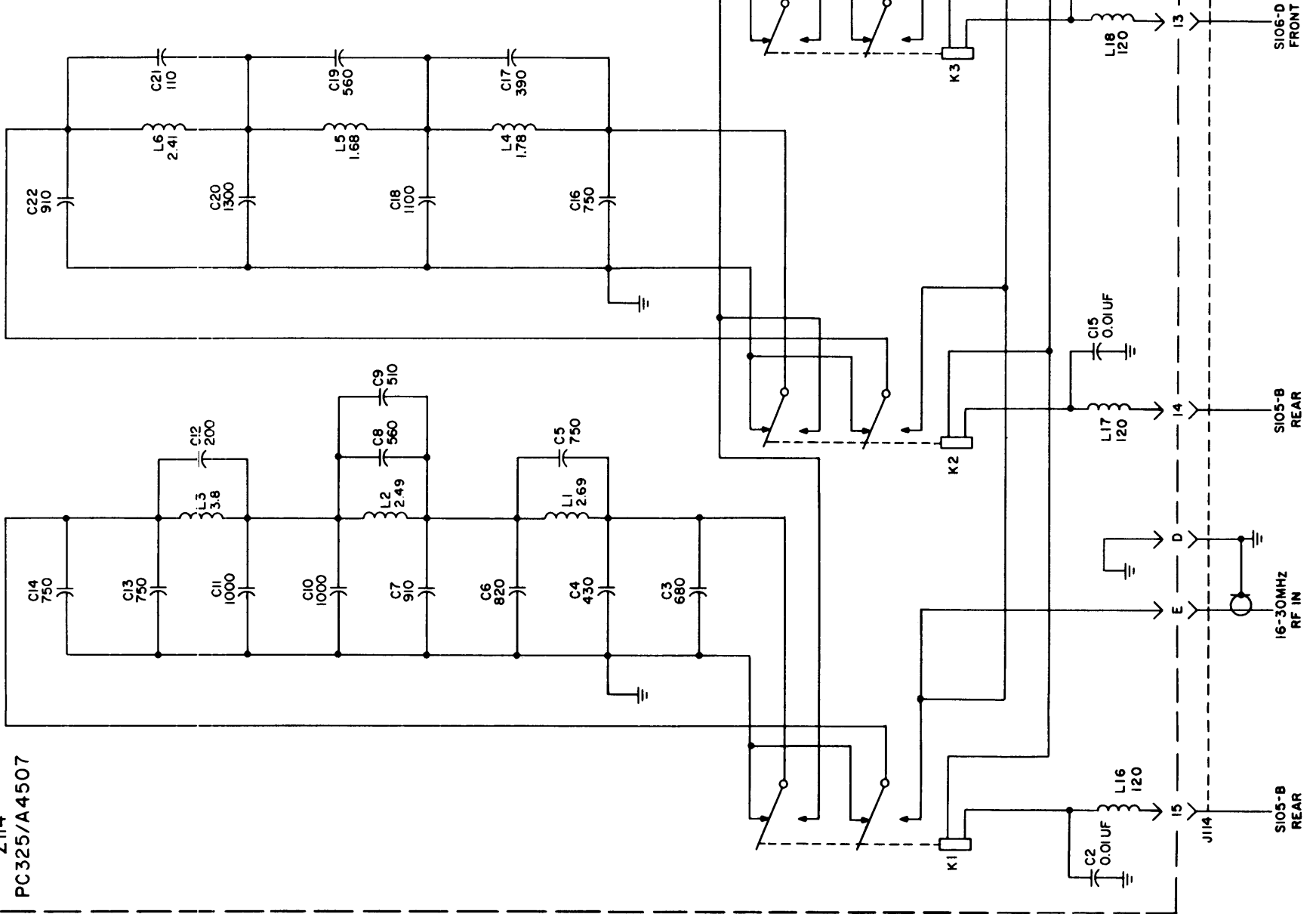
SYMBOL SERIES 1600

Figure 7-15. RF Output Filter Z114, Schematic/Parts Location Diagram

006692046



Z114
PC325/A4507



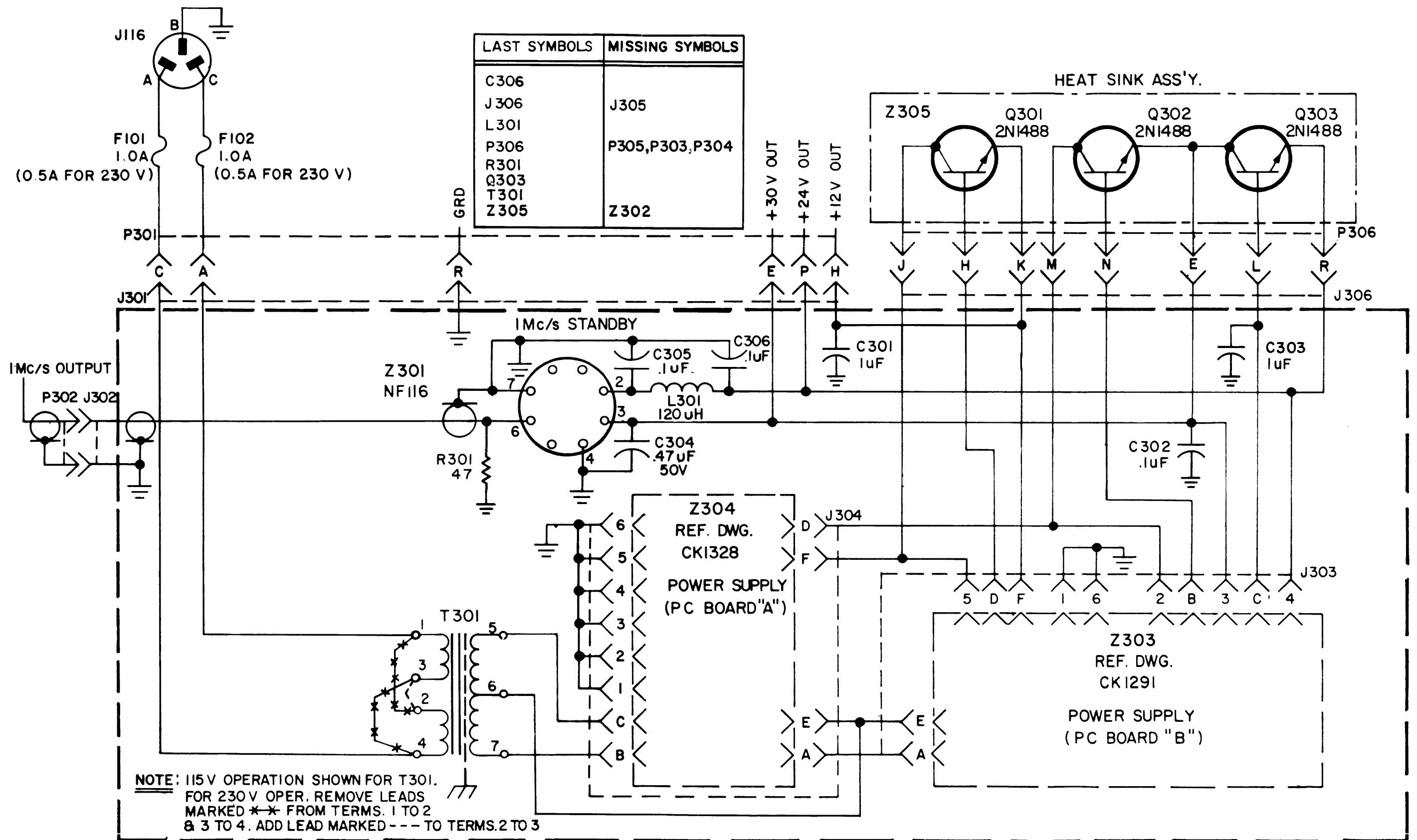


Figure 7-16. Power Supply Wiring Diagram

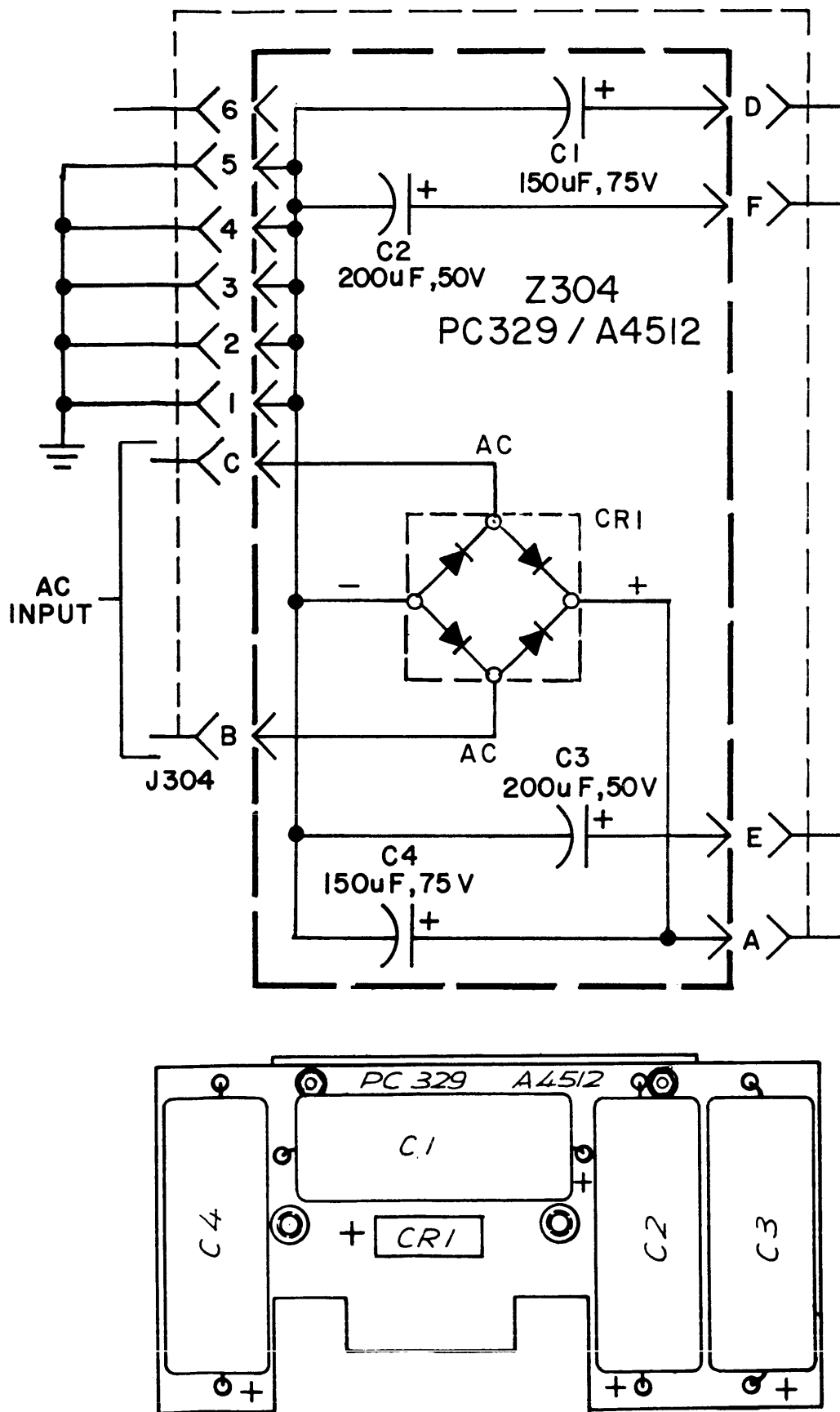


Figure 7-17. Rectifier-Filter Z304, Schematic/Parts Location Diagram

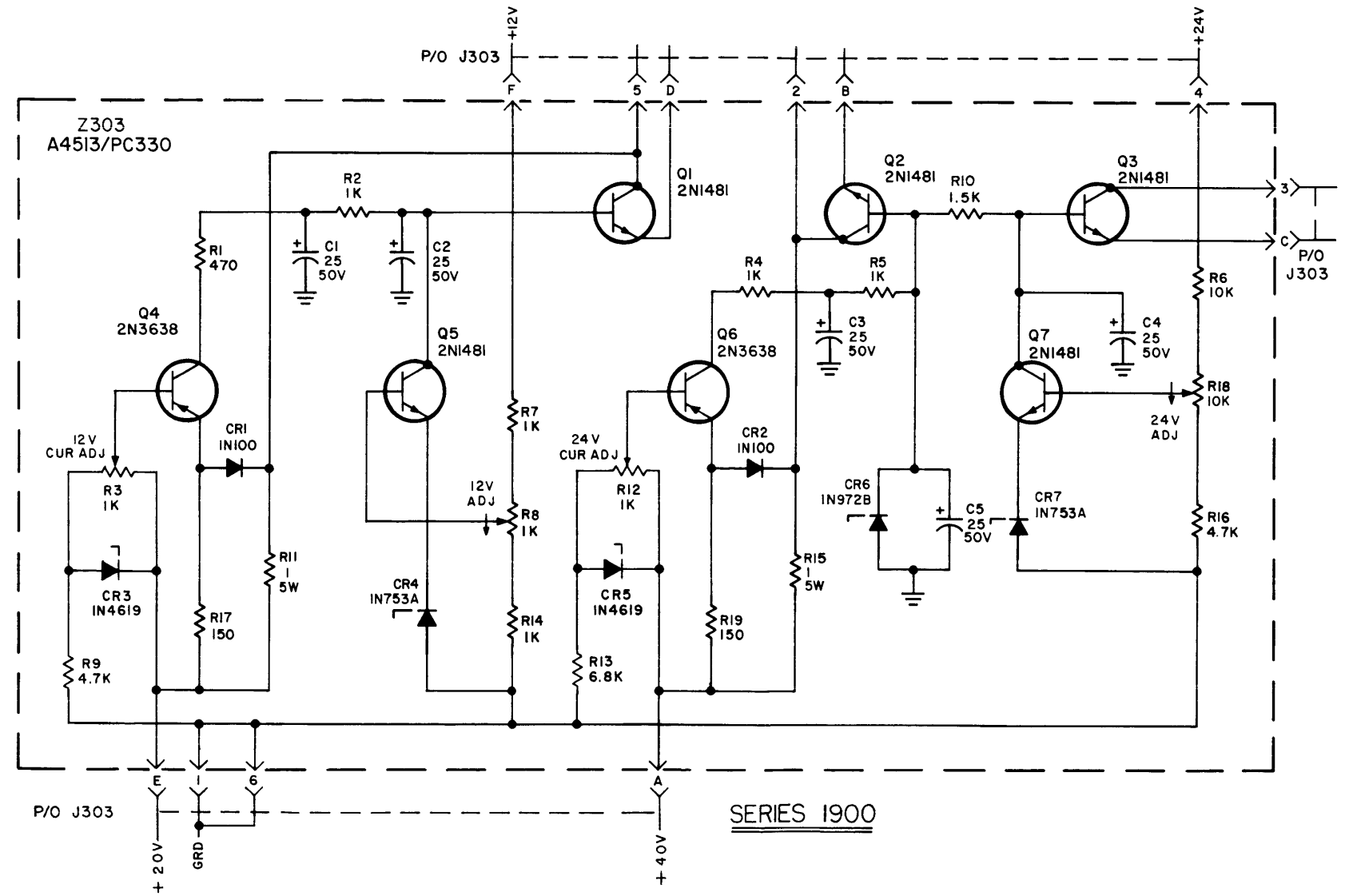
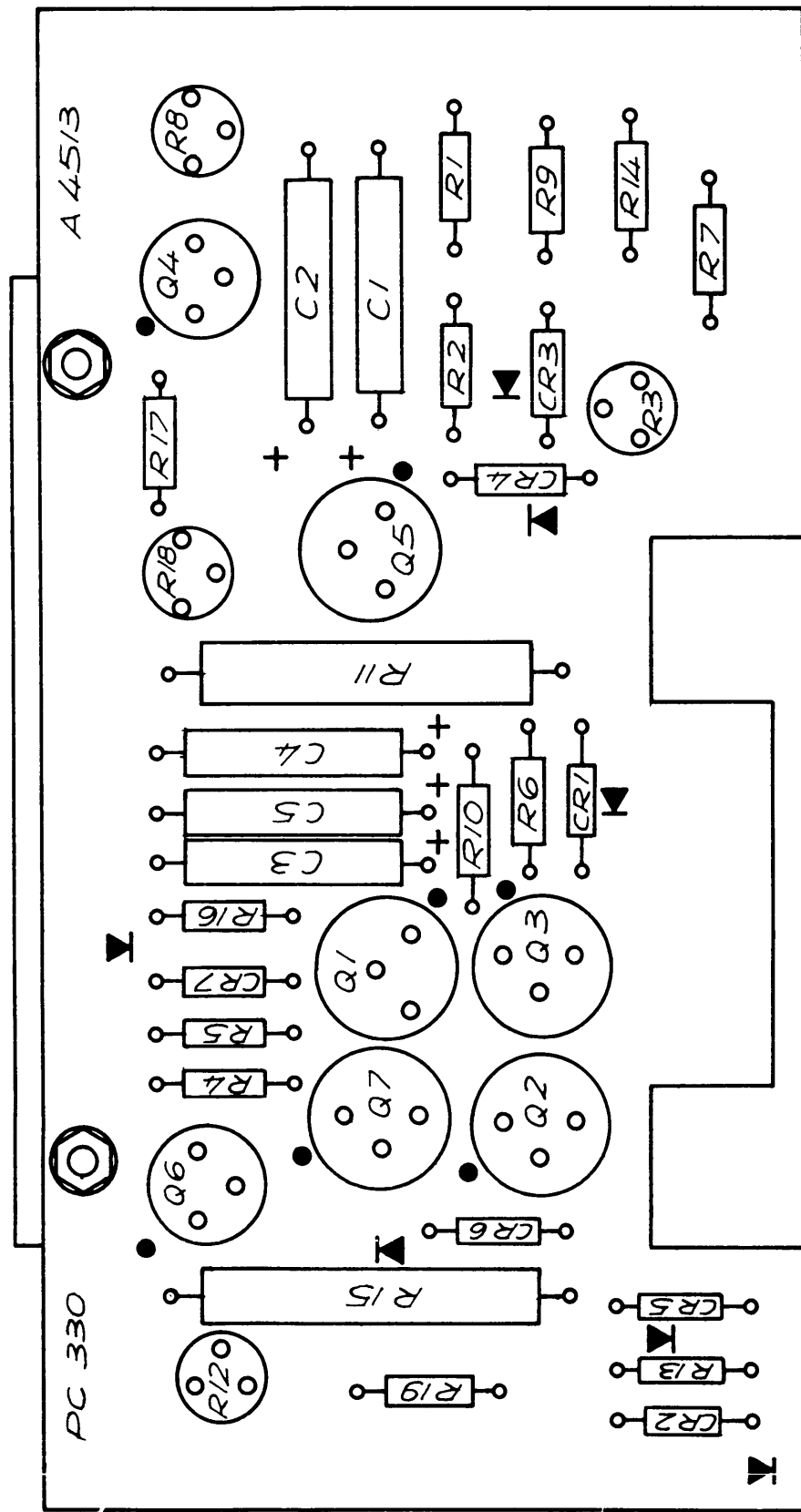


Figure 7-18. Regulator Z303, Schematic/Parts Location Diagram